SCHOOL LAUNCH · GEOGRAPHY K–12

Geography and History: Why Borders Fall Where They Do

A full-year high-school course that reads world history through the land: the Rhine and the Rio Grande, the Pyrenees and the Andes, the Sahara and the steppe, the Channel and the Bosporus, the open plain that carried Napoleon and Hitler toward Moscow, and the treaty lines and survey chains that cut borders where nature drew none, each one studied on the map, worked with real numbers and asked the same question: what changed when the bridge, the railway, the road or the airplane crossed the barrier?

First edition

> *"And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;" (Acts 17:26, KJV)*

Course guide

This is a full-year elective for students in grades 9–10: 50 lessons in ten units of five, finished in about 34 weeks. Unit 1 teaches the student to think geographically about history: natural and artificial borders, how to read a historical atlas, and how states grow from a core and defend a frontier. Then the course moves across the land itself: rivers (the Rhine, the Danube, the Rio Grande, the Amur), mountains (the Pyrenees, the Alps, the Himalaya, the Andes, the Caucasus), deserts and steppes, seas and islands, harbors and choke points, the North European Plain and the American continent. The last two units turn to the lines people drew: Tordesillas, the Berlin Conference, the Middle East after 1918, the Radcliffe Line and the 38th parallel, and the surveyors who marked the Mason–Dixon line, the Public Land Survey, the Great Arc of India and the 49th parallel. Every lesson has a historic map or painting, worked examples, a practice set with answers and a written response. Each unit ends with a 100-point test and a unit project, there is a midterm after Unit 5, and the course closes with a final exam.

Every lesson begins with **the story**: a real person at a real place on a real date. Hannibal brings his army and his elephants over the Alps in 218 BC; Spanish and French envoys meet on Pheasant Island in the Bidassoa to sign the Treaty of the Pyrenees in 1659; the Grande Armée crosses the Niemen in June 1812 and a fraction of it comes back; Charles Mason and Jeremiah Dixon sight the stars night after night to run a line west from Pennsylvania in the 1760s. Then comes **the land**: the river, the ridge, the pass, the desert or the open plain, and why it mattered. Then **the line**: where the border actually fell, who drew it and why. Then **the numbers** that make it real (distances, widths, rainfall, march rates, degrees of latitude, acres in a section), and finally **what changed** when people crossed the barrier or redrew the line.

Geography is not destiny in the sense of a cage, but it sets the terms, and much of the world's map still follows the rivers, ridgelines and coasts God made. Running through the course is a second question, marked ⚙ in the lessons: what happened when technology crossed the barrier? The Yam relay riders bound the Mongol Empire together; the Georgian Military Road pushed through the Caucasus; Russia's broad rail gauge became part of the story of the plain; the transcontinental railroad bound the American Union from sea to sea; and the theodolites of the Great Trigonometrical Survey measured a subcontinent. Each time, the student asks what the land made hard, how people overcame it and what the land still decided.

The faith thread runs underneath. Scripture says that "When the most High divided to the nations their inheritance, when he separated the sons of Adam, he set the bounds of the people according to the number of the children of Israel" (Deuteronomy 32:8), and the series verse says it again for all the nations: "And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;" (Acts 17:26). The course takes both halves seriously. God orders the lands and the times, and nations are still responsible for what they do with them: for treaties kept or broken, for conquest and partition, for peace made and peace lost. History is

told candidly, with real achievements given their due and real wrongs named plainly, and every people on the map is seen as of one blood.

WHO IT IS FOR

Written for students in grades 9–10. No earlier geography course is required, though students who have done the School Launch Geography grades will recognize many of the places, and the course is a good companion to a world history or Western civilization course. The math is high-school arithmetic: map scale, distance, rate and time, percentages, averages and degrees of latitude and longitude, with every method shown in a worked example first. Students work fairly independently, reading the lesson, studying the map or painting and working the examples themselves; a parent or mentor checks the practice sets against the answers, discusses the written responses and helps with the projects. A globe, a good world atlas, a historical atlas and household materials are all that is needed; the historic maps used in the lessons are free to view online.

HOW TO USE THIS COURSE

The weekly rhythm. Each lesson takes three sessions of about 50 minutes. Session 1: the warm-up, the story, the picture study and discussion. Session 2: map work in the map notebook and the worked examples. Session 3: the practice set, checked against the answers, and a written response of one or two paragraphs. Each unit ends with a test day and time to finish the unit project; the midterm after Unit 5 and the final each have a review day. At five sessions a week (about one and a half lessons a week) the 50 lessons, ten unit tests, midterm and final fill a school year of about 34 weeks.

The ⚙ thread. In the School Launch Geography series, the ⚙ mark flags the lessons where technology overcomes geography. In this course nearly every unit has one, and every unit asks about it. Ask the same three questions each time: What barrier did the land put in the way? What crossed it (a relay road, a mountain highway, a railway, a survey instrument)? And what did the land still decide afterward? Borders that once followed a river or a ridge often stayed there long after bridges and tunnels made the barrier easy to cross, and that is worth noticing.

The map notebook. Use one bound notebook, ideally with graph paper, for the whole year. Each unit has a main map: the world's borders color-coded by type, five river borders, the great mountain borders, the steppe and the empires that crossed it, the Mediterranean world of Rome, the great harbors and choke points, invasions across the plain, the growth of the United States, treaty borders of the world and, at the end, the student's own survey map. Draw them by hand, with a title, a scale, a north arrow and a key, and add a short note on what the map shows.

Worked examples and practice. Most lessons have three worked examples: how wide Chile is on average, how far a degree of latitude runs on the ground, how many men Minard's map shows leaving and returning and what percentage that is, how many acres lie in a section of the Public Land Survey, how far a meandering river can move a border in a

century. Cover the solution, try it yourself, then compare line by line. The practice set of twelve problems has answers; check them the same day and rework every miss.

Unit tests and unit projects. Each unit test is worth 100 points and mixes map questions, short calculations, identification and one short essay. Each unit also has a hands-on project: a border-type field guide, a moving-river border model, a salt-dough relief of a mountain border with its passes, a rainfall-line overlay on the Great Wall, an island-defense board game, a harbor-defense model, Minard's map redrawn with your own data, a watershed map of the Mississippi, a straight-line borders study, and a survey of a field or yard with a homemade sighting instrument and a tape. Record each project in the map notebook with a sketch, measurements and what you learned.

Where it fits. This is Course A of the School Launch high-school Geography electives, and it is the natural first course. Course B, *Geography and Commerce*, follows the trade that moved across these same seas and straits; Course C, *Technology Overcoming Geography*, takes the ⚙ thread and makes it the whole story; Course D, *Geopolitics*, weighs the big theories of Mahan, Mackinder and Spykman that grew out of these maps. It also sits beside the School Launch Engineering and Business high-school courses: Engineering explains how the bridge, the railway and the survey instrument work, Business explains why the harbor and the river mattered to trade, and this course shows where on the map the borders fell and why.

SCOPE AND SEQUENCE

Unit 1: Thinking Geographically About History (Weeks 1–3)

Is geography destiny? Herodotus and Strabo, natural and artificial borders, reading a historical atlas, how states grow from a core and guard a frontier, and Acts 17:26 on providence and the responsibility of nations.

Unit 2: Rivers as Borders and Highways (Weeks 4–6)

Rome's frontiers on the Rhine and the Danube, the Rio Grande and a border that moves with the river, the Amur and the Ussuri between Russia and China, and the great rivers that bind a nation together instead of dividing it.

Unit 3: Mountains as Walls (Weeks 7–10)

The Pyrenees between France and Spain, Hannibal and the Swiss in the Alps, the Himalaya, long and narrow Chile behind the Andes, and the Caucasus wall crossed by the Georgian Military Road.

Unit 4: Deserts and Steppes (Weeks 11–13)

Caravans across the Sahara, tribes and oases in Arabia, the grass road of the steppe from the Scythians to the Mongols, the Yam relay system that held the Mongol Empire together, and the Great Wall built where steppe meets farmland.

Unit 5: Seas and Islands (Weeks 14–17)

Britain behind its moat, Japan the island nation, the Mediterranean as Rome's "our sea," the islands and city-states of the Aegean, and Sicily and Malta at the crossroads. The midterm follows this unit.

Unit 6: Harbors and Choke Points in History (Weeks 18–20)

Constantinople on the Bosporus, Gibraltar, Raffles's Singapore, Gallipoli and the Dardanelles, and the great natural harbors of Sydney, Halifax, Pearl Harbor and San Francisco Bay.

Unit 7: The North European Plain (Weeks 21–24)

The open road from France to the Urals, Poland partitioned and moved, Napoleon's march of 1812 and Operation Barbarossa in 1941, and Russia's broad rail gauge and the debate over why it was chosen.

Unit 8: The American Continent (Weeks 25–27)

The Appalachian barrier and the Cumberland Gap, the Mississippi system and the Louisiana Purchase, the Oregon Treaty and the 49th parallel, the transcontinental railroad, and two oceans as a shield.

Unit 9: Lines Drawn by Treaties (Weeks 28–30)

Lines drawn on maps by diplomats: Tordesillas, the Berlin Conference, the Middle East after 1918, the Radcliffe Line, the 38th parallel in Korea and the Antarctic Treaty, each presented factually with its causes and results.

Unit 10: The Surveyors (Weeks 31–34)

Mason and Dixon surveying by the stars, townships and sections across the West, Lambton and Everest measuring India, and the boundary commissions that marked the 49th parallel, ending with the final review and exam.

MATERIALS

- **A globe**: Any size, as long as it turns freely. Used for latitude lines, the treaty lines and the size of empires.
- **A good world atlas**: A current atlas with physical and political maps. A library copy is fine.
- **A historical atlas**: William R. Shepherd's Historical Atlas is digitized and free to view online; any good historical atlas from the library also works.
- **Map notebook**: One bound notebook, ideally graph paper, for every map, worked example, project record and written response.
- **Colored pencils, tracing paper, a ruler and a protractor**: For border maps, overlays such as the rainfall line and the redrawn Minard map, scale bars and

bearings.
- **A calculator**: Any scientific or phone calculator, for distances, averages, percentages and survey problems.
- **Salt dough and a tray**: Flour, salt and water for the mountain-border relief map; a baking tray, sand or soil for the moving-river model.
- **A tape measure, string, a drinking straw and a washer**: With the protractor, these make the homemade sighting instrument for the survey project in Unit 10. A 100-foot tape is ideal.
- **Optional reading**: John Keay, The Great Arc (2000); Edwin Danson, Drawing the Line (2001); Tim Marshall, Prisoners of Geography (2015). Good background for older students; not required.

GRADING

Grades come from the practice sets and written responses, the map notebook, the ten unit projects, the ten unit tests, the midterm and the final. A calculation earns full credit when the setup, the numbers with their units and the answer are all shown. A written response earns full credit when it explains what the land did, where the line fell and why, with specific places, dates and evidence.

- Practice sets and written responses (completed and corrected): 15%
- Map notebook (accuracy, neatness, notes): 15%
- Unit projects: 10%
- Unit tests: 35%
- Midterm exam: 10%
- Final exam: 15%

A 90–100, B 80–89, C 70–79, D 60–69, F below 60.

- Practice sets are graded for completion and correction, not first-try accuracy: a problem done, checked and correctly reworked earns full credit.
- A map earns full marks when it has a title, a scale, a north arrow, a key and a short note on what it shows, and when the rivers, ranges, borders and cities on it are in the right places.
- On tests, give partial credit for a correct setup even if the arithmetic slips. An essay earns full credit for a clear claim backed by at least two specific facts from the lessons, with contested questions presented fairly from more than one side.
- A unit project earns full marks when it is finished, labeled, recorded in the map notebook with a sketch and measurements, and explained in a short paragraph.
- For a high-school transcript this course is one full credit of social studies (world geography). Keep the map notebook, the unit projects and the tests as the record of the year.

A NOTE TO PARENTS

This course is built to make a teenager see history on the map. After a year of asking why France and Spain meet at the Pyrenees, why Rome stopped at the Rhine, why Russia was invaded across the same plain twice and why so many borders in Africa and the American West are straight lines, most students start reading the news and their history books differently. You do not need to be an expert. The lessons carry the content and the answers are provided; your part is to ask what the land did and where the line fell, read the written responses and help with the projects. History here is told candidly: conquest, partition, slavery and massacre are named plainly where they happened, people are judged by the truth and by the standards and knowledge of their own time, and real achievements, from Roman engineering to the Great Arc, are given their due. Contested and recent questions, such as the Middle East after 1918 or the Partition of India, are presented factually and from more than one side.

A word about time. This course is written from a Christian view of creation (Genesis 1:1) and treats the Flood (Genesis 6–9) as history. It gives no ages of the earth or its rocks in the millions of years. Students will meet deep-time names such as “Ice Age” or “Neolithic” in museums, atlases and textbooks, so the course teaches them as museum words: vocabulary to recognize and read, not claims the course makes. Where a long age unavoidably comes up, a “Thinking About Time” box separates what is actually measured from what is assumed and explains how Christians who read Genesis as history understand it. Recorded history, with dates from written sources, is given normally. Students should be able to read any sign or textbook with understanding and still say with confidence, “in the beginning God created the heaven and the earth” (Genesis 1:1).

Above all, we want students to see the nations as Scripture sees them: made “of one blood,” placed by a God who “hath determined the times before appointed, and the bounds of their habitation,” and still responsible for what they do within those bounds. A student who finishes this course should know where the world’s borders lie and why, be able to read a historical atlas with skill, and be humble before a history that is both ordered by Providence and full of human choices.

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★ quarter path · ⚙ technology overcoming geography

UNIT 1

Thinking Geographically About History

Why is the border between France and Spain where it is? Why did Rome stop at a wall across northern England? Why did Moscow, a small town in the forest, end up ruling to the Pacific? This course reads world history through the land: rivers, mountains, deserts, seas, plains, harbors and choke points, and the surveyors who drew lines where nature drew none. Unit 1 gives you the tools for the whole year. You will weigh the old claim that "geography is destiny," learn to classify borders as natural or artificial, read a historical atlas like a detective, and see how states grow from a core, defend a frontier and sometimes keep a buffer between themselves and their rivals.

You will travel with Herodotus up the Nile and along the Persian Royal Road, measure the earth with Eratosthenes, sit with the American and British negotiators in Paris in 1783 as they drew a nation's borders with rivers, highlands and parallels, open Ortelius's first atlas and Shepherd's *Historical Atlas*, walk Hadrian's Wall, and stand with Paul on the Areopagus in Athens. You will work with real numbers throughout: map scales, latitude and longitude, great-circle distances, areas and perimeters, and dates that cross from BC to AD.

The Bible teaches that God made the earth and set the bounds of the nations: "And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;" (Acts 17:26). The unit ends by asking how that truth fits with geography and with the real freedom and responsibility of nations. Geography sets the stage, God governs the whole story, and people and nations make real choices for which they answer.

BEFORE YOU BEGIN

- Can read latitude and longitude on a globe or atlas and find places by their coordinates
- Can use a map scale (bar or ratio) and convert between kilometers and miles
- Can work with percentages, areas and perimeters, and use sine and cosine on a calculator
- Knows the basic outline of ancient, medieval and modern history (Greece, Rome, the Middle Ages, the age of exploration, the American founding)

MASTERY CHECKLIST

- I can state the claim that "geography is destiny," give its strengths and limits with real examples, and describe what Herodotus, Eratosthenes and Strabo contributed to geography.
- I can classify borders by form (river, mountain, geometric) and by origin (antecedent, subsequent, superimposed, relic), and explain the problems of each kind.
- I can read a historical map critically, measure distances with its scale, and compare plates of different dates to find what lasted and what changed.

- I can identify a state’s core, its frontier and any buffer state, and use area, perimeter and great-circle distance to reason about frontiers.
- I can quote Acts 17:26 exactly and explain how God’s providence, the land and human choice work together in history.

OPTIONAL BOOKS AND RESOURCES

- **Perry-Castañeda Library Map Collection, University of Texas at Austin** (https://maps.lib.utexas.edu/maps/): Free. Its historical maps section includes many plates from William R. Shepherd’s *Historical Atlas*, used in Lesson 1.3 and for the flip-atlas project.
- **Hereford Cathedral** (https://www.herefordcathedral.org/): The home of the Hereford Mappa Mundi (Lesson 1.5), displayed with the cathedral’s chained library. The website describes the map and the exhibition.
- **Project Gutenberg** (https://www.gutenberg.org/): Free. Search for Herodotus’s *Histories* (Book 2 on Egypt and the Nile; Book 5 on the Royal Road) and Augustine’s *The City of God*. A parent may choose the passages.

1.1 Geography Is Destiny?

OBJECTIVES

- State the claim that “geography is destiny,” and give two cases where it explains history well and two where it falls short.
- Describe what Herodotus, Eratosthenes and Strabo contributed to geography, and repeat Eratosthenes’ measurement of the earth with real numbers.
- Use distance, rate and time and population density to test a geographic explanation of history.

Warm-up. On a sheet of paper, list five facts about the land where you live: a river, hills or flat ground, the distance to the sea, the length of winter, the main road or railway. Next to each, write one way that fact shaped your town or county (where it was founded, what people grew or built, how they traveled). Then circle one thing in your town that people did *in spite of* the land: a bridge, a dam, a tunnel, a drained marsh. Keep the list. By the end of the lesson you will have a name for both columns.

Watch. *Geography as Destiny - Full Video* (izzitEDU, 14:54).
https://www.youtube.com/watch?v=hzaJ4np7khI
With the big idea: watch how Dr. Thomas Sowell uses the Spanish and the Aztec to argue that geography, especially how easily a people can reach other cultures, shapes what a civilization can do, and then compare his view with the Greek writers in the story.
Note: Captions were not available to check; preview it first. It deals with the Spanish conquest of Tenochtitlan in 1519, so expect some talk of war and conquest. The video uses the Spanish and Aztec as its example, not Herodotus, Eratosthenes or Strabo; it covers the lesson's big idea rather than the story.

KEY TERMS

geography
From Greek *gē* (earth) and *graphein* (to write or draw): the study of places, the land and seas, and how people live on them. Eratosthenes of Alexandria is credited with first using the word.

environmental determinism
The idea that the physical environment (climate, landforms, soils, location) largely decides how a people live, what they become and what their history will be. In short: “geography is destiny.”

possibilism
The answer to determinism associated with the French geographer Paul Vidal de la Blache (1845–1918): nature sets limits and offers possibilities, but people choose among them.

site

The physical features of the exact spot where a place stands: a hill, a ford, a harbor, an island, a marsh.

situation
A place's position relative to other places: on a trade route, between two powers, at the mouth of a river, near a strait.

stadion (plural stadia)
A Greek unit of distance, originally the length of a race course, about 600 Greek feet. Its exact length varied from place to place, roughly 157 to 185 meters (515 to 607 feet).

CORE IDEAS

The story. In the middle of the 400s BC, a Greek traveler from Halicarnassus, a city on the southwest coast of what is now Turkey, sailed up the Nile. His name was **Herodotus**, and he called his book a *historiē*, an "inquiry," the word from which we get *history*. In Egypt he questioned priests, measured what he could and compared what he was told with what he saw. He noticed seashells on the hills and the black mud the river carried down every year, and he concluded that the lower land of Egypt had been built up by the Nile itself. The Egypt that Greek ships sailed to, he wrote, was land won by the Egyptians, the gift of the river. Then he asked a harder question: why does the Nile rise in summer, when every Greek river runs low? He weighed three explanations offered by other Greeks, rejected all three, and proposed one of his own, which was also wrong. The real cause, heavy summer rains on the highlands of Ethiopia, was not firmly established by Europeans for many centuries. But his method was sound: look at the land, ask why, and test the answer against what you can see.

The first geographers. Herodotus ends his whole history with a story about geography. After the Persians had conquered a great empire, some of them urged King Cyrus to let them leave their rough, mountainous homeland for richer country. Cyrus told them to go if they wished, but to expect to become subjects instead of rulers, because soft lands tend to breed soft men. The Persians, Herodotus says, chose to live in a hard land and rule rather than till rich plains and serve others. Two centuries later **Eratosthenes** (about 276–194 BC), the head of the great library at Alexandria, gave the subject its name, *geographia*, and measured the size of the earth with a shadow and a known distance (see the figure). Then came **Strabo** of Amaseia (about 64 BC to about AD 24), who lived under Augustus and Tiberius and wrote a *Geography* in seventeen books that survives almost entire, the largest description of the known world we have from antiquity. Strabo argued that geography is useful above all to rulers and commanders, who must know the lands, seas and peoples they govern. He praised Italy for being guarded by the sea on most sides and by the Alps on the north, for its harbors and its range of climates, and for its central place among the peoples of the Mediterranean. These advantages, he thought, help explain why Rome came to rule.

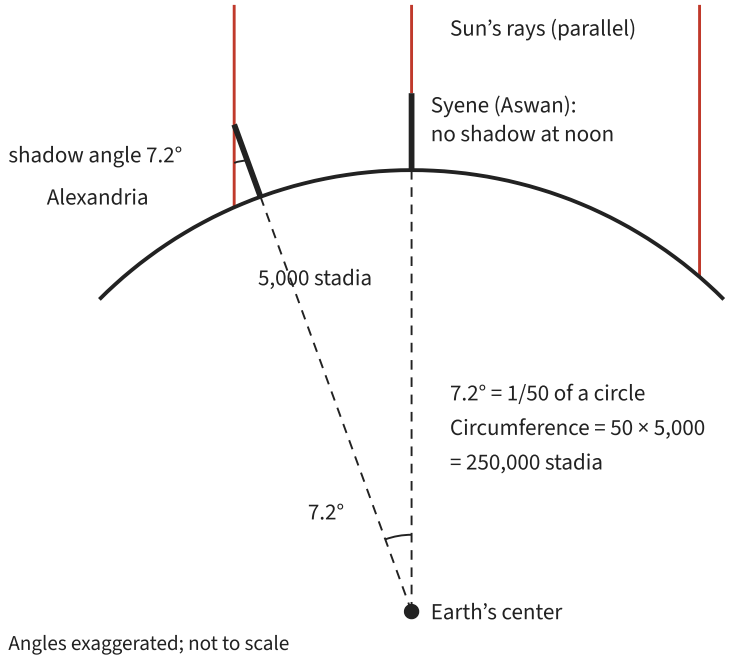
The big idea: the claim. Strabo's argument is an early form of **environmental determinism**, the view that the land decides the history of the people on it. In 1748 the French writer Montesquieu argued in *The Spirit of the Laws* that climate shapes temperament and therefore laws. In 1911 the American geographer Ellen Churchill Semple taught that human history grows out of the earth's surface. Napoleon is often credited with

saying that the policy of a state lies in its geography. The claim is powerful because it is often half true. About 95 percent of Egyptians still live on roughly 5 percent of their country's land, along the Nile and in its delta. Water has always been the cheapest highway, so river valleys and coasts grew rich first. Mountains raise the cost of conquest, deserts the cost of supply, and open plains invite invasion. Britain's Channel, Russia's plain and Switzerland's Alps will appear again and again in this course.

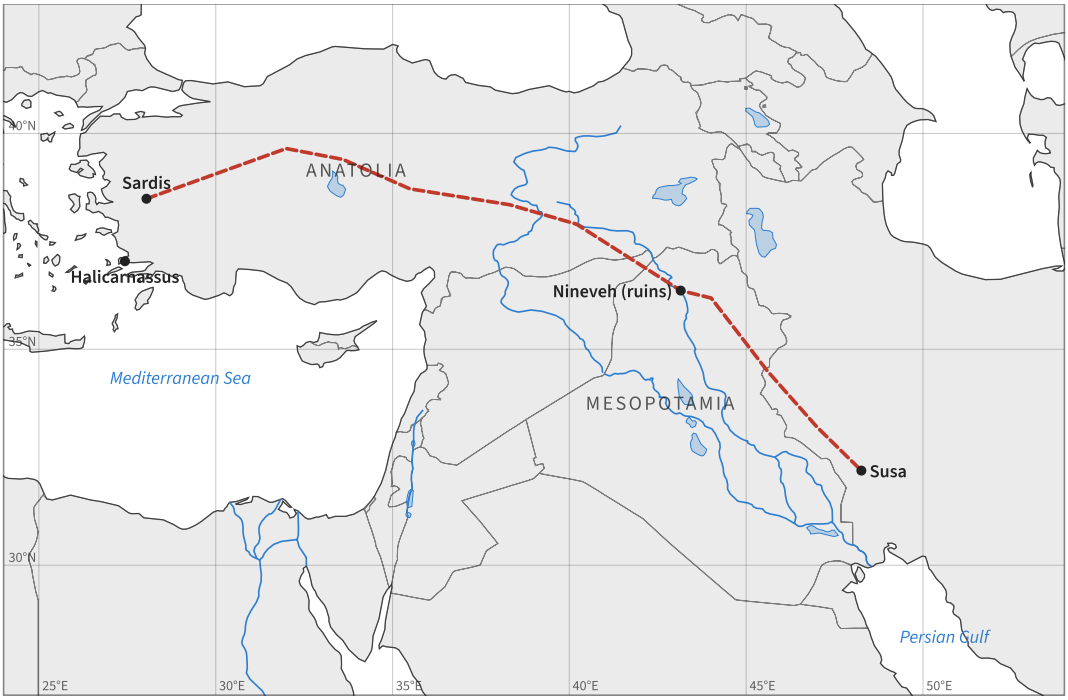
The limits. Yet the same land has carried very different histories. The mountains and harbors of Greece did not change between the age of Pericles and the centuries of Ottoman rule, but the Greek world of those two ages was very different. The Mongolian steppe was herding country for many centuries before 1206, when the chief Temüjin was proclaimed Genghis Khan and his people began to build an empire. The Korean peninsula shares one set of rivers and soils, a broadly similar climate, and until 1945 one people under one government; divided at the end of the Second World War, it became two states in 1948. As of 2026, South Korea is one of the world's leading industrial and trading nations, while North Korea remains poor and closed, with repeated food shortages. Geography did not make that difference; choices of government and economy did. Technology also changes what a barrier means. The Alps were a wall to Hannibal, but since 2016 trains have run beneath them through the Gotthard Base Tunnel, about 57 km (35 miles) long. The French geographer Paul Vidal de la Blache answered the determinists with **possibilism**: nature sets limits and offers possibilities, and people choose among them. A fair way to put it is that geography deals the cards, but people play the hand.

Technology overcoming geography. Herodotus himself recorded one of the first great victories over distance. He describes the Persian Royal Road from Sardis, near the Aegean, to Susa, the royal city near the head of the Persian Gulf: 111 stations, 450 parasangs, which at 30 stadia to the parasang comes to 13,500 stadia. An ordinary traveler covering 150 stadia a day, he says, would need ninety days. But the king's couriers rode in relays, a fresh man and horse at each station, and Herodotus says that nothing mortal traveled faster. A road, inns and fresh horses turned an empire too large to govern into one that could hear its king's commands in days rather than months.

On the map: how this course thinks. In every unit you will ask four questions. *What does the land offer?* (rivers, harbors, plains, passes). *What does it forbid or make costly?* (mountains, deserts, seas, distance). *What did people choose?* (where to settle, where to fight, where to draw the line). *What changed when technology crossed the barrier?* (the bridge, the railway, the tunnel, the airplane). Look for both **site**, the ground a place stands on, and **situation**, its position among other places. Alexandria is a good example: its site was a narrow strip of land between a lake and the sea at the western edge of the Nile Delta; its situation, where the trade of the Nile met the sea lanes of the Mediterranean, made it one of the great cities of the ancient world. And as Christians we remember that the earth is the Lord's. God made the land (Genesis 1:1), and geography is one of the means of His providence, not a rival to it. Lesson 1.5 returns to that question.



Eratosthenes' method (not to scale). Because the sun's rays are parallel, the shadow angle at Alexandria equals the angle at the earth's center between Alexandria and Syene.



The Persian Royal Road as Herodotus described it, from Sardis to Susa. The exact course is reconstructed by historians; the line is approximate.

PICTURE STUDY

World Map from Ptolemy's Geography (Ulm edition), After Claudius Ptolemy (about AD 150); woodcut signed by Johannes Schnitzer of Armsheim, 1482 · Hand-colored woodcut, printed in Ulm, Germany · Printed by Lienhart Holle in Ulm; copies survive in several libraries

Claudius Ptolemy was a Greek scholar who worked in Alexandria about AD 150, more than a century after Strabo. His *Geography* did something new: it listed thousands of places by latitude and longitude and explained how to draw the round earth on a flat sheet. The book was preserved by Byzantine scholars, translated into Latin in Florence in the early 1400s, and then printed with maps. This world map comes from the edition printed at Ulm in 1482, cut in wood and colored by hand.

The map shows the world Herodotus, Eratosthenes and Strabo knew: the Mediterranean in the middle, Europe, North Africa and Asia as far as China, and no Americas at all. Ten years after it was printed, Columbus sailed.

Look closely

- Find the Mediterranean Sea. Compare its shape and length with a modern map. Ptolemy made it far too long from west to east. Why might a mapmaker who relied on travelers' reports of distance overstate it?
- Look at the Indian Ocean. What closes it off to the south? What does that tell you about what Ptolemy did and did not know?
- Find the grid of curved lines. What are they, and why did Ptolemy bend them instead of drawing a simple square grid?
- Look at the faces around the border. They are the winds. Why would winds matter so much to people who traveled by sea?

Talk about it

1. What parts of the world does this map draw most accurately? What does that suggest about where Greek and Roman travelers and traders actually went?
2. Strabo thought Italy's central position helped Rome to rule. Find Italy on the map. Does its position look central to you? Central to what?
3. This map was a best guess built from reports, measurements and reasoning. How is that like the way Herodotus worked?

> **Safety first.** Never look directly at the sun, even briefly. In the project you look only at the stick and its shadow on the ground.

PROJECT: MEASURE THE EARTH LIKE ERATOSTHENES

Eratosthenes never left Egypt, yet he measured the whole earth with a shadow, a distance and a little geometry. You will repeat his experiment with a partner family who lives at least 400 km (250 miles) due north or south of you, or as close to due north or south as you can find. Measure your shadows at local noon on the same day and compute the size of the earth.

You will need

- A straight stick or dowel about 1 m (3 ft) long, or a broom handle
- A carpenter's level or a plumb line (a string with a weight), to make the stick exactly vertical
- A tape measure, chalk or small stones to mark the shadow, a notebook and a calculator with tangent and inverse tangent
- A partner family or co-op at a distant latitude, and an online map tool to find the north–south distance between you

Steps

1. Choose a flat, sunny spot. Stand the stick upright and check it with the level or plumb line on two sides. Measure its height above the ground exactly.
2. Find your local solar noon for the chosen date from an online solar calculator or an almanac. It is when the sun is highest and the shadow is shortest, and it is usually not 12:00 on the clock.
3. From about 15 minutes before solar noon until 15 minutes after, mark the tip of the shadow every three minutes. The shortest mark is your noon shadow. Measure its length.
4. Compute the sun's angle from the vertical: angle = inverse tangent (shadow length ÷ stick height). Your partner does the same on the same day.
5. Subtract the two angles. This difference is the angle at the earth's center between your two places.
6. Find the north–south distance between your two towns (the difference in latitude in degrees × 111 km, or use a map tool and take only the north–south part).
7. Compute the circumference: (360 ÷ angle difference) × north–south distance. Compare it with the accepted value of about 40,000 km (24,900 miles) and find your percent

error.

8. Write a paragraph: which measurement was hardest to make precisely, and how much would an error of half a degree have changed your answer?

Tips

- Measure several days in a row if clouds interfere; the method works on any day both places have sun at noon.
- If no partner is available, many schools join shared Eratosthenes measurements posted online around the March and September equinoxes; compare your shadow with a published one from a distant school on the same date.
- Eratosthenes' hardest problem was the distance, not the angle. Notice that yours is easy because of modern maps.

Check your work

- My stick was truly vertical and I measured the shortest noon shadow.
- I computed both shadow angles correctly with the inverse tangent.
- I computed a circumference and its percent error.
- I can explain why parallel sun rays make the method work.

MAP NOTEBOOK

1. Copy the Eratosthenes diagram, labeling the parallel sun rays, the two sticks, the shadow angle, the angle at the center and the distance along the surface.
2. Draw a two-column chart titled "Destiny or Choice?" List four facts of geography on the left and, on the right, a human choice that used or overcame each one.
3. Sketch the Royal Road from Sardis to Susa from the lesson map. Mark a few stations along it with dots and add a note on how the relay riders beat distance.

> **From history.** Herodotus admired the Persian relay couriers so much that his description of them was carved, in an English adaptation, across the front of the main post office in New York City, opened in 1914: "Neither snow nor rain nor heat nor gloom of night stays these couriers from the swift completion of their appointed rounds." The building, now called the James A. Farley Building, stands across from Pennsylvania Station. The line is not an official motto of the U.S. Postal Service, but many Americans think it is, and few know it began with a Greek historian describing a Persian road.

WORKED EXAMPLES

Example 1. Eratosthenes learned that at noon on the summer solstice the sun shone straight down a well at Syene (Aswan), but at Alexandria a vertical stick cast a shadow at an angle of 1/50 of a circle. He took the distance from Syene to Alexandria as 5,000 stadia. (a) What is 1/50 of a circle in degrees? (b) What circumference did he find? (c) Express it in kilometers if a stadion was 157.5 m, and if it was 185 m. Compare with the modern value of about 40,000 km (24,900 miles).

(Use the map or drawing "Parallel rays: the shadow angle at Alexandria equals the angle at the center." shown earlier in this lesson.)

1. (a) 360° ÷ 50 = 7.2°.
2. (b) The 7.2° angle at the center cuts off 5,000 stadia of the surface. The whole circle is 360° ÷ 7.2° = 50 times as long: 50 × 5,000 = 250,000 stadia.
3. (c) At 157.5 m: 250,000 × 157.5 m = 39,375,000 m = 39,375 km (24,470 miles), about 1.6 percent below 40,000 km.
4. At 185 m: 250,000 × 185 m = 46,250,000 m = 46,250 km (28,740 miles), about 16 percent too large.
5. Historians still debate which stadion Eratosthenes used, so the accuracy of his answer is uncertain, but the method was entirely sound.

Answer: (a) 7.2°. (b) 250,000 stadia. (c) 39,375 km (24,470 mi) with a 157.5 m stadion, or 46,250 km (28,740 mi) with a 185 m stadion; the true value is about 40,000 km (24,900 mi).

Example 2. Herodotus says the Royal Road from Sardis to Susa had 111 stations and measured 450 parasangs, with 30 stadia to the parasang, and that a traveler covering 150 stadia a day would need 90 days. (a) Check his arithmetic. (b) Using a stadion of 185 m, find the length of the road in kilometers and miles and the ordinary traveler's daily distance. (c) If relay couriers covered the road in about a tenth of that time, about how far did the message travel each day?

(Use the map or drawing "The Royal Road crossed Anatolia and ran down the Tigris valley to Susa." shown earlier in this lesson.)

1. (a) 450 parasangs × 30 stadia = 13,500 stadia. 13,500 ÷ 150 stadia per day = 90 days. His arithmetic is correct.
2. (b) 13,500 × 0.185 km = 2,497.5 km, about 2,500 km. In miles: 2,500 ÷ 1.609 = about 1,550 miles. Daily distance: 150 × 0.185 = 27.75 km, about 28 km (17 miles) a day, a steady walking pace.
3. (c) A tenth of 90 days is 9 days. 2,500 km ÷ 9 = about 280 km (170 miles) a day, possible only because riders and horses were changed at each station and the message never stopped.

Answer: (a) 13,500 stadia and 90 days, as Herodotus said. (b) About 2,500 km (1,550 mi); about 28 km (17 mi) a day. (c) About 280 km (170 mi) a day.

Example 3. Egypt has an area of about 1,000,000 km² (386,000 sq mi). About 95 percent of its people live on about 5 percent of the land, in the Nile valley, the delta and a few oases. Using a round figure of 100 million people, find the population density (a) of the inhabited 5 percent and (b) of the other 95 percent, in people per km² and per square mile. (c) How many times denser is the river land?

1. Inhabited land: 5% of 1,000,000 km² = 50,000 km². People there: 95% of 100 million = 95,000,000.
2. (a) 95,000,000 ÷ 50,000 = 1,900 people per km². Per square mile: 1,900 × 2.59 = about 4,900.
3. Remaining land: 950,000 km² with 5,000,000 people.
4. (b) 5,000,000 ÷ 950,000 = about 5.3 people per km² (about 14 per square mile).
5. (c) 1,900 ÷ 5.3 = about 360 times denser.

Answer: (a) About 1,900 per km² (4,900 per sq mi). (b) About 5.3 per km² (14 per sq mi). (c) About 360 times denser. Herodotus's "gift of the river" still shapes where Egyptians live.

PRACTICE

1. EASY What Greek word did Herodotus use to describe his book, and what does it mean?

2. EASY Match each person with a contribution: Herodotus, Eratosthenes, Strabo. (a) named the subject and measured the earth; (b) wrote a 17-book *Geography* under Augustus and Tiberius; (c) traveled in Egypt and called its land the gift of the river.
3. EASY Define environmental determinism and possibilism in one sentence each.
4. EASY Label each statement about Alexandria as SITE or SITUATION: (a) It stands on a narrow strip of land between a lake and the sea. (b) It lies where the trade of the Nile meets the sea lanes of the Mediterranean. (c) It is at the western edge of the Nile Delta, away from the river mouths where silt builds up.
5. MEDIUM Suppose Eratosthenes had measured the shadow angle at Alexandria as 7.0° instead of 7.2°, with the same distance of 5,000 stadia. What circumference would he have found, and by what percent would it differ from 250,000 stadia?
6. MEDIUM Alexandria lies at about 31.20° N and Aswan at about 24.09° N. Using a modern earth circumference of 40,000 km, find the north–south distance between them in kilometers and miles.
7. MEDIUM Assume (for this problem only) that each of the 111 stages of the Royal Road took a relay courier 4 hours, riding day and night. How many hours and days would a message take from Sardis to Susa?
8. MEDIUM Suppose instead that 97 percent of Egypt's 100 million people lived on 4 percent of its 1,000,000 km^2. Find the density of the inhabited land in people per km^2 and per square mile.
9. HARD Before tunnels, a mule train crossing a high Alpine pass might cover 30 km of steep road at about 3 km/h. A passenger train in the Gotthard Base Tunnel (57 km) runs at about 200 km/h. How long does each take? How many times faster is the train over a distance nearly twice as long?
10. HARD Explain why the history of Korea since 1945 is a strong test case against "geography is destiny."
11. HARD Give three features Strabo praised in Italy's geography, and name one way later technology changed the value of one of them.
12. CHALLENGE Write a paragraph evaluating the claim "geography is destiny." Use at least two examples where it explains history well and two where it does not, and end with your own one-sentence judgment.

COMMON MISTAKES

- Treating "geography is destiny" as either simply true or simply false. It is a strong tendency, not a law: the land sets costs and limits, and people decide.
- Confusing site and situation. Site is the ground under the place; situation is where it lies among other places and routes.
- Assuming the ancients thought the earth was flat. Educated Greeks knew it was round; Eratosthenes measured how large it was in the 200s BC.

> **Make it a game · Destiny or Choice?.** Write twelve historical facts on cards, such as "Egypt grew along the Nile," "Venice was built in a lagoon," "South Korea became an industrial power," "Persia built the Royal Road," "Napoleon never crossed the Channel."

Players draw a card and must say whether geography, human choice or technology was the main cause, then argue for it in thirty seconds. The other players vote. A player who convincingly argues that two causes worked together scores two points instead of one. First to ten points wins.

Scripture. “The earth is the LORD’S, and the fulness thereof; the world, and they that dwell therein.” (Psalm 24:1, KJV)

Herodotus and Strabo saw that the land shapes the people. The psalmist goes deeper: both the land and the people belong to the Lord who made them. Studying geography is studying part of His world, and it never replaces Him as the One who governs history.

Practice answers

1. *Historiē*, meaning “inquiry” or “investigation.” It is the root of our word *history*.
2. Herodotus (c); Eratosthenes (a); Strabo (b).
3. Environmental determinism: the physical environment largely decides how a people live and what their history will be. Possibilism: the environment sets limits and offers possibilities, but people choose among them.
4. (a) Site. (b) Situation. (c) Site (the physical ground and its relation to the delta’s silt).
5. 360 ÷ 7.0 = 51.43; 51.43 × 5,000 = 257,143 stadia, about 2.9% larger than 250,000. A small error in the angle makes a noticeable error in the result.
6. Difference 7.11°. Distance = 7.11 ÷ 360 × 40,000 = 790 km, about 491 miles. (Eratosthenes’ 7.2° was very close to the true 7.11°.)
7. 111 × 4 = 444 hours. 444 ÷ 24 = 18.5 days.
8. 4% of 1,000,000 = 40,000 km^2. 97,000,000 ÷ 40,000 = 2,425 per km^2. × 2.59 = about 6,280 per square mile.
9. Mule train: 30 ÷ 3 = 10 hours. Train: 57 ÷ 200 = 0.285 h = about 17 minutes. 600 minutes ÷ 17 minutes = about 35 times faster, while covering almost twice the distance. Technology changed what the Alps mean for travel, though not what they mean for weather or farming.
10. North and South Korea share one peninsula, a similar climate, rivers, soils and a common people, language and history before 1945. If geography decided destiny, they should have similar outcomes. Instead, as of 2026 the South is a leading industrial and trading nation and the North is poor and closed with repeated food shortages. The difference comes from choices of government and economy, not from the land.
11. The sea guarding most of its coasts; the Alps guarding the north; many harbors; a range of climates; a central place among the Mediterranean peoples (any three). Example of change: railway tunnels such as the Gotthard Base Tunnel (2016) cut through the Alps, so they are less of a barrier to travel and trade; or aircraft and long-range weapons reduced the protection of the sea.
12. A strong answer grants the claim real force (for example, Egypt’s dependence on the Nile, Britain’s protection by the Channel, Russia’s open plain, mountains raising the cost of conquest) and then shows its limits (for example, the same Greek land in different ages, the Mongols before and after 1206, divided Korea, technology turning barriers into routes). A good closing judgment is possibilist: geography sets limits and costs and makes some outcomes more likely, but people’s choices, beliefs and inventions decide what is done with the land.

1.2 Natural and Artificial Borders

OBJECTIVES

- Classify borders by form (physical, geometric, cultural) and by origin (antecedent, subsequent, superimposed, relic), with real examples of each.
- Explain the practical problems of each kind of border: rivers that move, ridges that do not match the water divide, and parallels that cannot be seen on the ground.
- Compute the size of a geometric border from latitude and longitude and the division of a river under the median-line and thalweg rules.

Warm-up. Lay a towel on a table and push it into a rough ridge with a few hills on top. Pour a spoonful of water slowly along the top. Watch where it runs. Is the line where the water splits the same as the line along the highest bumps? Now imagine two neighbors agreed to divide the towel "along the mountains." Which line would each want, and why?

Video. Coming soon. Natural and artificial borders, the Treaty of Paris of 1783 and the Mitchell Map, the thalweg principle, Bir Tawil and the straight-line state borders of the American West: search Library of Congress (Mitchell Map, Treaty of Paris), The History Guy and Drive Thru History; UsefulCharts (flagged, use selectively) for border maps; Jay Foreman (Map Men) and RealLifeLore are candidates (need vetting).

KEY TERMS

physical (natural) boundary
A border that follows a feature of the land or water, such as a river, the crest of a mountain range, a lake or a strait.

geometric (artificial) boundary
A border drawn as a straight line or along a parallel of latitude or a meridian of longitude, without regard to the land beneath it.

thalweg
From German *Talweg*, "valley way": the line of the deepest channel of a river. Many treaties place a river border on the thalweg rather than halfway between the banks (the median line).

drainage divide (watershed)
The line on high ground that separates water flowing to one river system from water flowing to another. It does not always pass over the highest peaks.

antecedent, subsequent, superimposed, relic
A way of classifying borders by when they were drawn: before most people settled (antecedent), after settlement, following divisions among peoples (subsequent), by an outside power over existing peoples (superimposed), or a line that no longer works as a border but still shows on the land (relic).

delimitation and demarcation

Delimitation is describing a border in words or on a map, usually in a treaty. Demarcation is marking it on the ground with posts, stones, cleared lines or buoys.

CORE IDEAS

The story. On September 3, 1783, in a room at the Hôtel d'York in Paris, John Adams, Benjamin Franklin and John Jay for the United States and David Hartley for Great Britain signed the treaty that ended the War of Independence. Its second article drew the borders of the new nation, in words. During the negotiations both sides had worked from the best map then available, John Mitchell's map of North America of 1755. Read Article 2 closely and you find every kind of border at once. Rivers: the St. Croix in the east, the Connecticut, the St. Lawrence, the Mississippi and the St. Marys. A ridgeline: "the highlands" dividing the rivers that empty into the St. Lawrence from those that fall into the Atlantic. Lines of latitude: the 45th parallel between the Connecticut River and the St. Lawrence, and the 31st parallel in the south, along the border of Spanish Florida. It took well over half a century to turn those words into a line on the ground.

How it worked out: every kind of border has its problem. Several rivers flow into Passamaquoddy Bay, and no one was sure which one the treaty meant by the St. Croix. In 1798 a joint commission settled it after the ruins of Samuel de Champlain's settlement of 1604 were found on an island near the mouth of the Schoodic River; Champlain had named that river the St. Croix, so the Schoodic it was. The "highlands" were worse: in the Maine forest there was no obvious ridge, and Britain and the United States both claimed about 12,000 square miles of timberland. Rival lumbermen and militia faced each other in the bloodless Aroostook War of 1838–1839, and the Webster–Ashburton Treaty of 1842 finally split the land, giving the United States somewhat more than half. The parallel had a different problem. Colonial surveyors had marked the 45th parallel in the early 1770s, but their line ran a little north of the true parallel in places. After the War of 1812 the United States began a fort at Rouses Point on Lake Champlain, only to learn from a new survey in 1818 that it stood on the British side of the true line. Americans called it "Fort Blunder." The 1842 treaty kept the old surveyed line, and the site became American again. Finally, the treaty ran a line due west from the northwest point of the Lake of the Woods to the Mississippi. The river actually rises far to the south, at Lake Itasca, so the line could never reach it. A later agreement in 1818 replaced it with the 49th parallel.

The big idea: physical borders. A **river** is easy to see and name and was often easy to defend. But where exactly is the line: halfway between the banks (the **median line**), or on the deepest channel, the **thalweg**, which keeps the main shipping lane open to both nations? Rivers also move. By long-standing practice, when a river shifts gradually by wearing away one bank and building up the other (accretion), the border moves with it; when it jumps suddenly to a new bed in a flood (avulsion), the border stays in the old bed. And a river joins as much as it divides: people on both banks of a valley often share one language and one trade. **Mountains** are true barriers, thinly settled and hard to cross, but a treaty that says "along the mountains" must choose between the **crest line** of highest peaks and the **drainage divide**. Chile and Argentina agreed in 1881 on a line along the highest crests that divide the waters. In southern Patagonia the highest peaks and the water divide do not

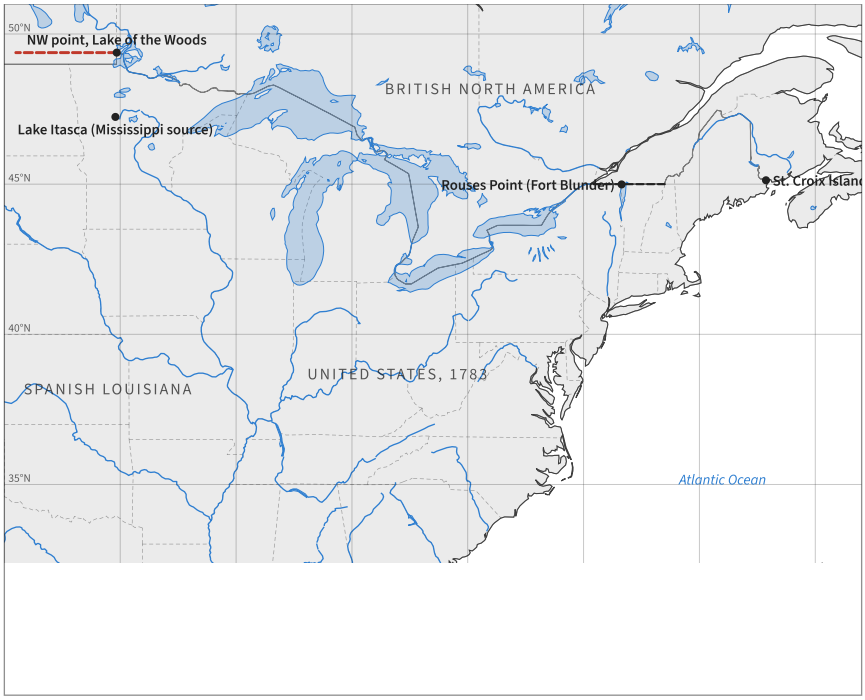
coincide, and the two nations nearly went to war before King Edward VII of Britain gave an arbitration award in 1902 that drew a compromise line.

Geometric borders. A parallel of latitude is the easiest border to write in a treaty and the hardest to find on the ground. Before good astronomical instruments and accurate clocks, surveyors could miss it by hundreds of feet or more, as Fort Blunder shows. Geometric borders ignore rivers, ridges and people, which can be a strength or a weakness. Drawn across nearly empty land before settlement, they can be peaceful and simple: Colorado and Wyoming are rectangles on a map, bounded by parallels and meridians. Drawn across settled lands, they can cut through peoples, pastures and water sources. In 1899 Britain and Egypt set the border between Egypt and Sudan along the 22nd parallel; a separate administrative line drawn in 1902 bent away from it. The result is the strange case of Bir Tawil, a tract of about 2,060 km^2 (795 sq mi) that lies between the two lines and is claimed by neither country, because each claims a different line that would give it a more valuable area elsewhere.

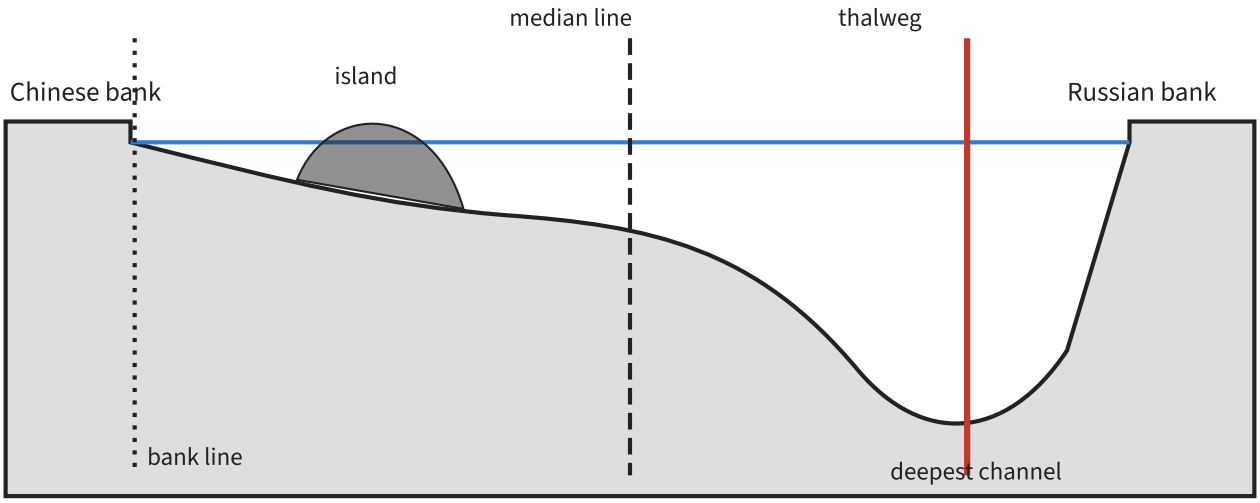
Classifying borders. The American geographer Richard Hartshorne, writing in the 1930s, proposed classifying borders by when they were drawn. An **antecedent** border was drawn before most people lived there, like the 49th parallel across the northern prairies. A **subsequent** border was drawn after settlement and tends to follow divisions that already existed among peoples, as many old European borders do. A **superimposed** border was laid down by outside powers over peoples already living there, as with many colonial borders in Africa (Unit 9). A **relic** border no longer divides anything but can still be seen, like Hadrian's Wall in England (Lesson 1.4). The same border can be described both ways: the 49th parallel is geometric in form and antecedent in origin.

On the map. No border is "natural" until people agree to it. During the French Revolution, French leaders spoke of France's natural frontiers, the Rhine, the Alps and the Pyrenees, and used the phrase to justify expanding to the Rhine. A natural border can be an argument for conquest as easily as a guarantee of peace. As you color the world's borders by type in this unit, keep asking three questions: What feature, if any, does this line follow? Who drew it, and when? And does it still match how people live on either side?

Technology overcoming geography. Every geometric border depends on the instruments that can find it. The colonial surveyors of the early 1770s had only the stars, simple instruments and patience; later boundary commissions added better telescopes, the telegraph to fix longitude, and finally satellite positioning, which can place a boundary marker within centimeters. The parallel never moved, but our power to find it did.

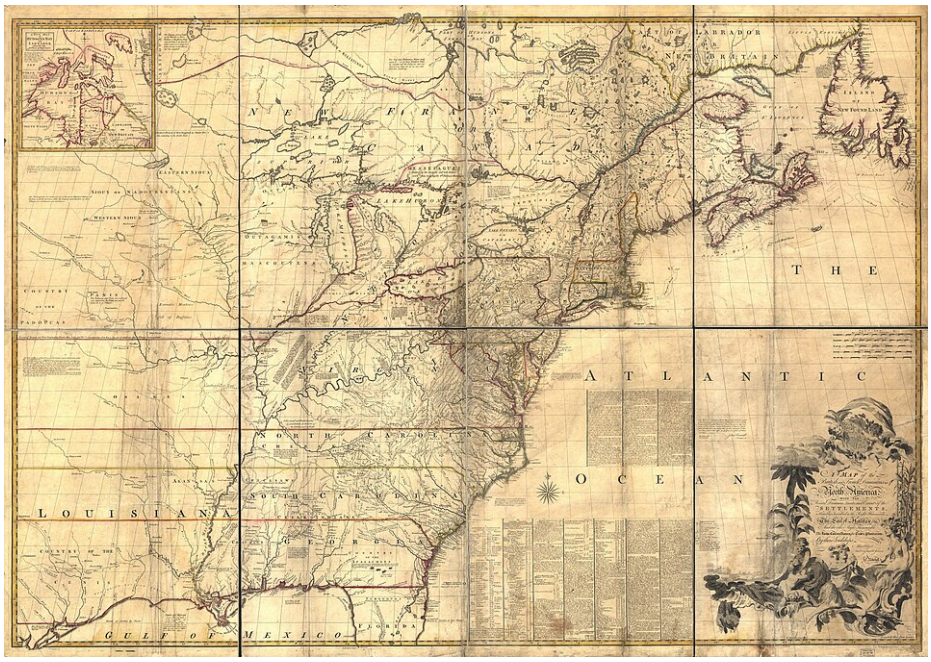


The 1783 boundary used rivers, a ridgeline of "highlands" and lines of latitude. The line due west from the Lake of the Woods could never meet the Mississippi, which rises at Lake Itasca, about 238 km (148 miles) farther south.



Median line or thalweg? The same river divides very differently under the two rules.

PICTURE STUDY



A Map of the British and French Dominions in North America (the Mitchell Map), John Mitchell; engraved by Thomas Kitchin, 1755 · Engraved map in eight sheets, hand-colored · Copies at the Library of Congress, the British Library and elsewhere

John Mitchell was a Virginia physician and botanist who moved to London and, with the support of the Board of Trade, compiled the most detailed map of eastern North America of his day. It was published in 1755, just as Britain and France went to war over the Ohio country, and it was drawn to support British claims.

Nearly thirty years later the negotiators in Paris used Mitchell's map to describe the borders of the United States. A copy marked in red with the boundary, once belonging to King George III, is in the British Library. For more than a century afterward, the Mitchell Map was brought out again and again in boundary disputes, because it showed what the treaty's makers had in front of them.

Look closely

- Find the Mississippi River. How far north does Mitchell show it running? Where does he put its source?
- Find the coast of Maine and the rivers flowing into Passamaquoddy Bay. Can you tell from the map which is the St. Croix?
- Look for the Appalachian ranges. Do they appear as one clear line of "highlands" or as many ridges?
- Read one of the long notes printed in the empty spaces. What kind of information did Mitchell think a statesman needed?

Talk about it

1. The 1783 treaty was only as good as the map behind it. What errors on the Mitchell Map caused later disputes?
2. Mitchell drew the map to support Britain's claims against France. How might a mapmaker's purpose affect what a map shows?
3. Why would diplomats still use an old map decades later, even after better maps existed?

PROJECT: CREST OR DIVIDE? A MOUNTAIN-BORDER MODEL

Build a small mountain range in a baking pan, rain on it, and find out for yourself why "along the mountains" is not a clear border. You will mark the crest line and the drainage divide, see where they part, and then draw a river border by both the median-line and thalweg rules.

You will need

- A large baking pan or plastic storage tub
- Aluminum foil and crumpled newspaper (or modeling clay) to build terrain
- A spray bottle of water with a few drops of blue food coloring
- Two colors of yarn or string, toothpicks, small paper flags, a ruler and a notebook

Steps

1. Crumple newspaper into a long ridge across the middle of the pan. Make it uneven: put the two or three highest peaks a little to one side of the ridge, not exactly on top of the main line of high ground.
2. Cover the ridge with one sheet of foil, pressing it into valleys and around the peaks. Leave the edges of the foil turned up so water collects at the two sides of the pan, which represent two different seas.
3. Lay the first color of yarn along the line of highest peaks and pin it with toothpicks. This is the crest line.
4. Spray water slowly along the high ground, a little at a time. Watch which side each drop runs to. Place toothpicks where the water splits, then lay the second color of yarn along them. This is the drainage divide.
5. Measure the greatest distance between the two yarns. Label with paper flags any peak that lies on one side of the divide but drains to the other sea.
6. Press a winding channel into the foil on one side for a river. Make one bank steep and the other gentle so the deepest water lies near the steep side. Mark the median line with a ruler and the thalweg where the water runs deepest.
7. In your notebook, write a short treaty sentence that would describe each border so clearly that a surveyor could not misread it.

Tips

- If the water pools instead of running, give the ridge steeper sides.
- Photograph the model from above before you take it apart; the photo goes into your border field guide for the unit portfolio.

Check your work

- I marked both a crest line and a drainage divide, and found where they differ.
- I marked both a median line and a thalweg on my river.
- I wrote treaty language for each border and can explain why exact wording matters.

MAP NOTEBOOK

1. Copy the thalweg cross-section and add a third line showing where the border would be if it ran along Country B's bank. Label which country would want each of the three lines.
2. Draw a simple outline map of the United States' borders of 1783, coloring river borders blue, the highland border brown and the parallels red.
3. Make a four-box chart for antecedent, subsequent, superimposed and relic borders, with a one-line definition and a small sketch of an example in each box.

> **From history.** When the Webster–Ashburton Treaty of 1842 kept the old 45th-parallel survey line, the United States finally completed a large masonry fort at Rouses Point, begun in 1844 and named Fort Montgomery. It never saw battle. Today its ruins stand on the shore of Lake Champlain, a short distance from the Canadian border, a quiet reminder that a few hundred feet of surveying error once put a nation's fort in the wrong country.

WORKED EXAMPLES

Example 1. Colorado is bounded by the parallels 37° N and 41° N and the meridians 102°03′ W and 109°03′ W. (a) How far is it from north to south? (b) How wide is it from east to west, measured along its middle parallel, 39° N? Use 1° of latitude = 69.0 mi (111.1 km), and 1° of longitude = 69.17 mi (111.32 km) × cos(latitude).

1. (a) North to south: 41° − 37° = 4°. 4 × 69.0 = 276 mi; 4 × 111.1 = 444 km.
2. (b) East to west: 109°03′ − 102°03′ = 7° of longitude.
3. At 39° N, cos 39° = 0.7771. One degree of longitude = 69.17 × 0.7771 = 53.75 mi (111.32 × 0.7771 = 86.51 km).
4. Width = 7 × 53.75 = 376 mi; 7 × 86.51 = 606 km.

Answer: About 276 mi (444 km) north to south and 376 mi (606 km) east to west at 39° N. (The real borders, surveyed in the 1800s, follow these lines closely but not perfectly.)

Example 2. A border river is 400 m wide. Its deepest channel lies 280 m from Country A's bank and 120 m from Country B's bank. For each kilometer of river, how much water surface does each country receive (a) under the median-line rule and (b) under the thalweg rule? (c) Why might a treaty prefer the thalweg even though it divides the surface unequally?

(Use the map or drawing "Median line at 200 m; thalweg at 280 m from Country A's bank." shown earlier in this lesson.)

1. (a) Median line: 400 ÷ 2 = 200 m to each country. Per kilometer of river: 0.200 km × 1 km = 0.20 km^2 each.
2. (b) Thalweg: Country A receives 280 m × 1,000 m = 280,000 m^2 = 0.28 km^2; Country B receives 120 m × 1,000 m = 0.12 km^2.
3. (c) Ships follow the deepest channel. If the border ran down the median line while the channel hugged one bank, all the navigable water might belong to one country. The thalweg rule gives both countries a share of the shipping lane itself.

Answer: (a) 0.20 km^2 each. (b) A: 0.28 km^2; B: 0.12 km^2. (c) The thalweg keeps the navigable channel shared between the two countries.

Example 3. The 1783 treaty ran the boundary due west from the northwest point of the Lake of the Woods, at about 49.38° N, to the Mississippi. The Mississippi actually rises at Lake Itasca, at about 47.24° N. How far north of the river's source does the line pass, in miles and kilometers? What does this tell you about the map the negotiators used?

(Use the map or drawing "The dashed line due west from the Lake of the Woods passes far north of Lake Ita" shown earlier in this lesson.)

1. Difference in latitude: 49.38° − 47.24° = 2.14°.
2. 2.14 × 69.0 = 148 mi. 2.14 × 111.1 = 238 km.
3. A line running due west stays on the same parallel, so it passes about 148 miles north of the source and can never meet the river.

Answer: About 148 mi (238 km). The negotiators' map did not show the true source of the Mississippi; the source was not identified until Henry Schoolcraft reached Lake Itasca in 1832.

PRACTICE

1. EASY Classify each border as physical (river or mountain) or geometric: (a) Egypt–Sudan along 22° N; (b) Chile–Argentina in the Andes; (c) United States–Mexico from El Paso to the Gulf of Mexico; (d) Colorado–Wyoming; (e) France–Spain.
2. EASY What is the thalweg, and which border rule (median line or thalweg) better protects both countries' use of a river for shipping?

3. EASY Name the three kinds of border used in Article 2 of the 1783 Treaty of Paris, with one example of each.
4. EASY Match: antecedent, subsequent, superimposed, relic. (a) Hadrian's Wall today; (b) the 49th parallel across the northern prairies; (c) a colonial border drawn in Europe across African peoples; (d) an old European border that follows a long-settled division between peoples.
5. MEDIUM Wyoming lies between 41° N and 45° N. How far is it from north to south, in miles and kilometers?
6. MEDIUM Bir Tawil covers about 2,060 km^2. Convert to square miles (1 sq mi = 2.59 km^2). Why does neither Egypt nor Sudan claim it?
7. MEDIUM A border river is 600 m wide, and its thalweg lies 150 m from Country A's bank. For a 1 km stretch, find each country's water area under the median-line rule and under the thalweg rule.
8. MEDIUM Explain how "Fort Blunder" happened and how it was resolved.
9. HARD Wyoming's eastern and western borders are 7° of longitude apart (104°03′ W to 111°03′ W). Find the length of its southern border along 41° N and its northern border along 45° N, in miles and kilometers. What shape is Wyoming really?
10. HARD Chile and Argentina agreed in 1881 on a border along "the highest crests which divide the waters." Explain why this caused a crisis in southern Patagonia and how it was settled.
11. HARD Why did the ruins of Champlain's 1604 settlement settle the question of which river was the St. Croix?
12. CHALLENGE Write a paragraph answering: Are natural borders better than geometric ones? Use at least three examples from this lesson.

COMMON MISTAKES

- Assuming the line along a mountain range is obvious. The crest line and the drainage divide can be miles apart.
- Thinking a river border is always the middle of the river. Many treaties use the thalweg, and a border can stay in an old riverbed after a sudden change of course.
- Thinking geometric borders are always newer or worse. The 45th and 49th parallels have been among the most peaceful borders in the world; their problem was finding them, not living with them.

Make it a game · Border Detective. Open an atlas or an online map to any continent. One player points to a border; the others race to classify it by form (river, mountain, lake, geometric, other) and, if they can, by origin (antecedent, subsequent, superimposed, relic). One point for a correct form, two for a correct origin with a reason. Zoom to satellite view to check: does the line follow a river or ridge you can see? Play until each player has called five borders.

Scripture. "Remove not the ancient landmark, which thy fathers have set." (Proverbs 22:28, KJV)

In Israel a landmark was a boundary stone marking a family's inheritance. Moving it in secret was theft. Borders between nations are larger landmarks, and the same principle applies: an agreed line, honestly marked, protects peace, and moving it by stealth or force is a wrong.

Practice answers

1. (a) Geometric. (b) Physical (mountain). (c) Physical (the Rio Grande). (d) Geometric (41° N). (e) Physical (the Pyrenees).
2. The line of the deepest channel. The thalweg rule, because it gives each country access to the navigable channel.
3. Rivers (the St. Croix, Connecticut, St. Lawrence, Mississippi or St. Marys); a ridgeline (the "highlands" dividing rivers flowing to the St. Lawrence from those flowing to the Atlantic); parallels of latitude (the 45th or the 31st). Lines through the middle of the Great Lakes are also acceptable as an additional kind.
4. Antecedent (b); subsequent (d); superimposed (c); relic (a).
5. 4° × 69.0 = 276 mi; 4° × 111.1 = 444 km.
6. 2,060 ÷ 2.59 = about 795 sq mi. Egypt claims the 1899 line along the 22nd parallel and Sudan the 1902 administrative line. Each country's preferred line gives it the more valuable Hala'ib area and leaves Bir Tawil to the other, so claiming Bir Tawil would weaken its larger claim.
7. Median: 300 m each, so 0.30 km^2 each. Thalweg: A gets 150 m × 1,000 m = 0.15 km^2; B gets 450 m × 1,000 m = 0.45 km^2.
8. Colonial surveyors marked the 45th parallel in the early 1770s, but their line ran slightly north of the true parallel. The United States began a fort at Rouses Point on Lake Champlain after the War of 1812; a new survey in 1818 found the fort lay north of the true 45th parallel, on the British side. The Webster–Ashburton Treaty of 1842 kept the old surveyed line, which put the site back in the United States.
9. South (41° N): 69.17 × cos 41° = 69.17 × 0.7547 = 52.20 mi per degree; × 7 = 365 mi (111.32 × 0.7547 × 7 = 588 km). North (45° N): 69.17 × 0.7071 = 48.91; × 7 = 342 mi (551 km). Meridians converge toward the pole, so Wyoming is not a rectangle on the globe but a shape with its northern edge about 23 mi (37 km) shorter than its southern edge.
10. The treaty assumed that the highest peaks and the water divide were the same line. In southern Patagonia they are not: some rivers rise east of the high peaks and cut through the range to the Pacific. Chile argued for the divide and Argentina for the line of highest peaks. The two nations came close to war, and King Edward VII of Britain gave an arbitration award in 1902 that drew a compromise line between the two claims.
11. Champlain had wintered on an island near the mouth of a river he named the St. Croix. Finding the ruins identified which river he meant, and so which river the treaty makers, following the traditional name, intended. In 1798 the commission accepted the Schoodic as the St. Croix.
12. A strong answer weighs both sides. Natural borders are visible and often defensible, and mountains in particular separate peoples who really live apart (the Pyrenees). But rivers move and unite valleys, and mountain borders must choose between crest and divide (Patagonia, 1902; the Maine highlands, 1842). Geometric borders are simple to write and can be peaceful when drawn before settlement (Colorado, the 49th parallel), but they are hard to find on the ground before good instruments (Fort Blunder) and can cut through peoples or create oddities (Bir Tawil). The best border is one the neighbors agree on, describe precisely and

mark carefully; the phrase “natural frontier” has sometimes been used to justify expansion, as in revolutionary France’s claim to the Rhine.

1.3 Reading a Historical Atlas

OBJECTIVES

- Read a historical map critically: its date, key, scale, boundary symbols, and the time and purpose of the mapmaker.
- Compare a sequence of maps of the same region to find which borders lasted, which changed, and how fast.
- Convert between map scales and measure real distances on a historical atlas plate, and do date arithmetic for changes of sovereignty.

Warm-up. Find two maps of the same place made at different times: an old road map and a phone map of your town, or a printed atlas and an online map of your state. Lay them side by side. List three things that appear on one and not the other (a road, a town, a county line, a reservoir). For each, guess whether the land changed or only the mapmaker’s choices changed. Keep your list for the lesson.

Watch. *Reading Historic Maps* (Portsmouth Historical Society, 7:02).
https://www.youtube.com/watch?v=eL4BReYmUeg
Before the project: watch how the guide reads old city maps, decoding the map symbols and following streets whose names changed over time, then use the same habits on the historical atlas maps in the lesson.
Note: Captions were not available to check; preview it first. It is a short local-history talk about maps of Portsmouth, New Hampshire, so it teaches map-reading skills but says nothing about Ortelius or Europe's changing borders. It covers Sanborn fire insurance maps and city maps from 1813 on, not printed historical atlases or the 1570 Theatrum Orbis Terrarum.

KEY TERMS

historical atlas
A bound collection of maps showing places as they were at past dates, usually arranged so that changes over time can be compared.

map key (legend)
The table on a map that explains its colors, lines and symbols. On historical maps colors often stand for rulers or dynasties, not modern nations.

representative fraction (RF)
A map scale written as a ratio, such as 1:10,000,000, meaning one unit on the map equals ten million of the same units on the ground.

anachronism
Placing something in a time where it does not belong, such as labeling a map of AD 1500 with a country that did not yet exist.

sovereignty

Supreme authority over a territory: the right to make and enforce its laws and to deal with other states. Historical atlases mostly map sovereignty and its changes.

CORE IDEAS

The story. In May 1570 a map dealer in Antwerp named **Abraham Ortelius** published a book unlike any before it: the *Theatrum Orbis Terrarum*, the "Theater of the World." Earlier mapmakers had sold maps one sheet at a time, in every size and style. Ortelius gathered 53 maps, redrawn to a uniform size and style, bound them in one volume and named the makers whose work he had used. It is usually called the first modern atlas. It sold so well that it went through dozens of editions in several languages. Then, from 1579, Ortelius added something new, a supplement he called the *Parergon*, made of maps of the ancient and biblical world: the Roman Empire, ancient Greece, the Holy Land, and among them a map of the journeys of the apostle Paul. He understood that to read history you must be able to see where it happened, and that the world of Paul or Alexander did not look like the world of 1570.

Shepherd's atlas. Three and a half centuries later, in 1911, **William R. Shepherd**, a professor of history at Columbia University in New York, published his *Historical Atlas* (Henry Holt). Page after page of colored maps traced the world from ancient Egypt and Mesopotamia to the early twentieth century, with the greatest detail for Europe. His book became the standard historical atlas in English-speaking schools for half a century; revised editions were still printed in the 1960s. Because the early editions are now in the public domain, many of Shepherd's plates have been scanned and placed online free by the Perry-Castañeda Library of the University of Texas. You can open Shepherd's maps of Europe at dates such as 1648, 1789 and 1815 and lay them side by side, exactly what this lesson asks you to do.

How to read a plate. Before you trust a historical map, question it like a witness. First, the **title and date**: a map shows one moment, and Europe "about 1560" is not Europe in 1600. Second, the **key**. On historical maps colors usually stand for rulers or dynasties, not for nations in the modern sense. On a map of Europe about 1550 the same color may cover Spain, the Netherlands, Milan, Naples and lands in the Americas, because they all belonged to one ruler, the emperor Charles V, not because they were one country. Third, the **boundary symbols**. A solid line may mean a surveyed, agreed border; a dotted or dashed line may mean a disputed, unmarked or merely approximate one; a band of color fading at the edge may mean a frontier zone where no one ruled firmly. Fourth, the **scale**, usually given as a bar or a **representative fraction**. Fifth, the **mapmaker's own time**. Shepherd drew in 1911, when Austria-Hungary was one of Europe's great powers and the Ottoman Empire still held land in the Balkans, and like most atlases of his day he gave far more space to Europe than to Africa or Asia. A map always answers the questions its maker thought important.

The big idea: comparing plates. A single historical map is a snapshot; a sequence is a film. Lay maps of the same region at several dates side by side and ask three questions. *What lasted?* Some borders are astonishingly old. Most of the border between Portugal and Spain was fixed by the Treaty of Alcañices in 1297 and has changed little since. *What changed, and how much?* In 1648 the Holy Roman Empire contained more than three

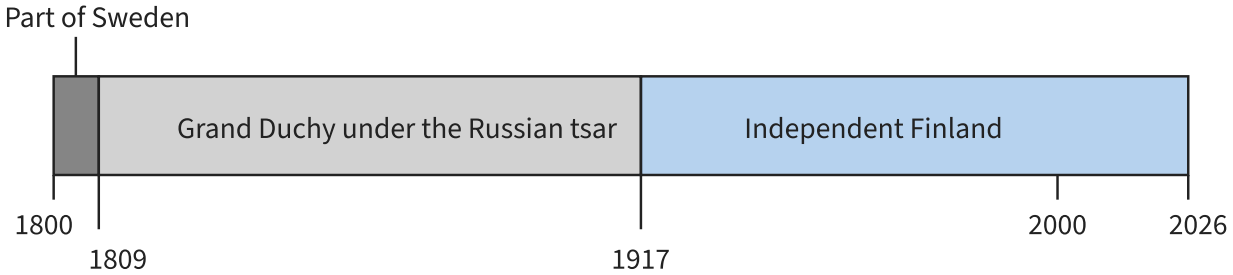
hundred separate principalities, bishoprics and free cities; after the Congress of Vienna in 1815 the German Confederation that replaced it had thirty-nine member states. *When and how did each change happen?* Finland was part of Sweden for centuries; after the war of 1808–1809 it became a grand duchy under the Russian tsar; on December 6, 1917, during the Russian Revolution, it declared its independence. Each date marks a war, a treaty or a revolution, and each one sends you back to the physical map to ask why the line fell where it did: across the Gulf of Bothnia, along a river, at a mountain pass.

Pitfalls. Historical maps tempt us into three errors. The first is **anachronism**: reading modern countries back into the past, as if “Germany” or “Italy” existed as states in 1500, when each was a patchwork of separate states and would not be united until 1871 and 1861 (with Rome added in 1870). The second is mistaking **claims for control**. A colored area means a ruler claimed it, not that his officials governed every valley; vast stretches of Siberia or the Sahara on old maps were claimed far more than they were ruled. The third is mistaking **lines for walls**. Many old frontiers were zones, but a map must draw something, so it draws a sharp line where reality was blurred.

On the map. The best way to read a historical atlas is with a physical map open beside it. Lay a sheet of tracing paper over a plate, trace the borders, then lay the tracing over a relief map of the same scale. You will see at once which borders follow rivers and ridges, which follow nothing visible, and which cut across a natural region. Do this for several dates and the region’s history becomes a story of lines moving across real ground: advancing along open plains and river valleys, and stopping at mountains, marshes and seas. That is the method of this whole course.

Technology overcoming geography. Ortelius’s atlas depended on the printing press and on copper engraving, which allowed the same map to be printed in thousands of identical copies for the first time. Shepherd’s depended on color lithography. Today digital scans and mapping software let anyone overlay a plate of 1815 on a satellite image in minutes. The tools changed; the questions a careful reader asks did not.

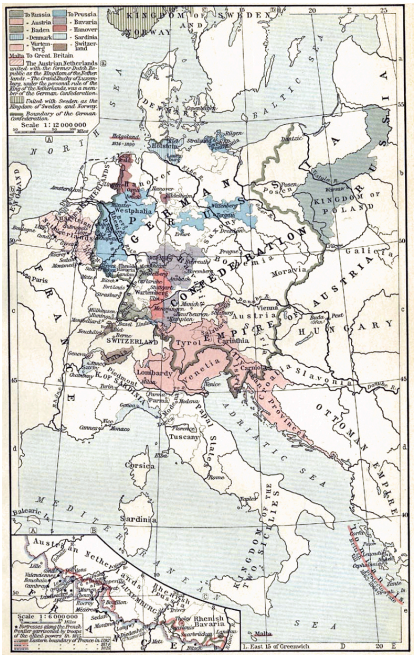
Reference map for this lesson's scale problems and for the story of Finland, with present-day borders for orientation.



1809: Treaty of Fredrikshamn (Hamina). 1917: independence, December 6.

A sequence of atlas plates turned into a timeline: who held sovereignty over Finland, 1800–2026.

PICTURE STUDY



Treaty Adjustments, 1814–15 (plate from Shepherd's Historical Atlas), William R. Shepherd, 1911 (first edition) · Color-printed map in a bound atlas · Published in New York by Henry Holt; early editions scanned by the Perry-Castañeda Library, University of Texas at Austin

As Napoleon's empire collapsed, the great powers of Europe met at the Congress of Vienna (1814–1815) and redrew the map of the continent. They tried to restore old dynasties, to reward the victors and to build a balance of power so that no single state could dominate Europe again. The Final Act was signed on June 9, 1815, a few days before the Battle of Waterloo.

Shepherd's plate shows the changes the peacemakers made in 1814 and 1815. It is a good plate to practice on because it is full of changes from the map of 1789, and many of them lasted only a few decades.

Look closely

- Find the line around the German Confederation. How many separate colors can you count inside it? Compare with the hundreds of territories in the Holy Roman Empire of 1648.
- Find Prussia. Its lands are in two separate pieces, one in the east and one on the Rhine. Why might that be a problem for a state, and an opportunity?
- Find the Kingdom of the Netherlands. It includes what is today Belgium. Why might the peacemakers have wanted one strong kingdom on France's northern border?
- Find the Kingdom of Sardinia. It includes Savoy and Nice on the French side of the Alps. Look ahead: France acquired both in 1860.

Talk about it

1. Which borders on this plate follow rivers, mountains or seas, and which seem to follow nothing on the land?
2. The peacemakers drew lines to balance the powers, not to follow language or nationality. Find one border that you would expect to change later, and explain why.
3. What would you need beside this map (a relief map, a map of 1789, a map of 1871) to understand it fully?

PROJECT: A FLIP-ATLAS OF ONE REGION

Make your own small historical atlas of one region by tracing its borders at four dates on separate sheets of tracing paper over a single base map. Flip the sheets down one at a time and you will watch history move across the land.

You will need

- Four sheets of tracing paper or clear page protectors, and one plain sheet for the base map
- Fine markers or colored pencils, a ruler, paper clips or a binder clip
- Shepherd's *Historical Atlas* plates online (Perry-Castañeda Library) or another historical atlas, and a physical (relief) map of the same region

Steps

1. Choose a region and four dates. Good choices: Central Europe in 1648, 1789, 1815 and 1871; the Baltic in 1700, 1809, 1920 and 2026; or Italy in 1494, 1815, 1861 and 1871.
2. On the plain sheet, draw the base map from the physical map: coasts, major rivers, mountain ranges shaded lightly. Add a scale bar and north arrow. Mark four or five cities as reference points.
3. Clip the first tracing sheet over the base map, lined up on the reference cities. Copy the borders from your first historical plate. Title the sheet with its date and color each state, writing the ruler or dynasty in the key.
4. Repeat for the other three dates, keeping the reference cities lined up on every sheet.
5. Clip all four sheets to the top of the base map. Flip them down one at a time. On a notebook page, list each border that (a) lasted through all four dates, (b) changed once, (c) changed more than once.
6. For each lasting border, write which physical feature it follows, if any. For each changing border, write the war, treaty or revolution that moved it.

Tips

- Use the same color for the same state on every sheet so changes jump out.
- Historical plates are often drawn at different scales. If needed, enlarge or reduce them on a copier to match your base map before tracing.
- This flip-atlas becomes a page of evidence in your unit field guide.

Check your work

- My four sheets line up on the same reference cities and carry their dates and keys.
- I sorted the borders into lasting, changed once and changed more than once.
- I linked at least two lasting borders to physical features and at least two changes to specific events.

MAP NOTEBOOK

1. Draw a mock historical-map key with five symbols: an agreed border, a disputed border, a frontier zone, a capital and a fortress. Explain each in a few words.
2. Copy the Finland timeline and draw a second one below it for another place whose sovereignty changed at least twice (for example Nice, Alsace or Hong Kong).
3. Write the five questions to ask of any historical map (date, key, boundary symbols, scale, mapmaker's time) on an index card to keep in your atlas.

> **From history.** Ortelius's *Parergon* map of the journeys of Paul traced the apostle's travels from Jerusalem through Asia Minor and Greece to Rome, using the place names of the book of Acts. It made the New Testament visible as real geography: real ports, real roads and real distances across a real sea. Families in the 1500s and 1600s who owned the atlas could follow Paul from Troas across to Neapolis and Philippi with a finger on the page, exactly as you will in Lesson 1.5.

WORKED EXAMPLES

Example 1. A Shepherd plate of Europe has a scale of 1:10,000,000. On it, the distance from Paris to Vienna measures 10.3 cm. How far apart are the cities in kilometers and miles?

(Use the map or drawing "Paris to Vienna, the distance measured in this example." shown earlier in this lesson.)

1. 1 cm on the map = 10,000,000 cm on the ground.
2. 10,000,000 cm = 100,000 m = 100 km. So 1 cm = 100 km.
3. 10.3 cm × 100 km = 1,030 km.
4. 1,030 ÷ 1.609 = 640 miles.

Answer: About 1,030 km (640 miles), close to the true straight-line distance of about 1,035 km.

Example 2. In 1648 the Holy Roman Empire held more than 300 separate territories. In 1815 the German Confederation had 39 member states. Taking 300 as the earlier figure, by what percent did the number of separate states fall? What does a reader need to remember about the word “state” in each case?

1. Decrease: 300 − 39 = 261.
2. Percent decrease: 261 ÷ 300 = 0.87 = 87%.
3. Caution: the territories of 1648 ranged from large kingdoms to tiny abbeys and free cities, and their independence was limited by the Empire. The 39 states of 1815 were larger and more truly sovereign. Counting colors on a map is a start, not the whole story.

Answer: A fall of about 87 percent. The units being counted were very different in size and independence, so the count alone understates how much the political map changed.

Example 3. Using the timeline, how many years of the period 1800 to 2000 did Finland spend under each sovereignty, and what percent of the two hundred years was each?

(Use the map or drawing “Read the change-points from the timeline: 1809 and 1917.” shown earlier in this lesson.)

1. Part of Sweden: 1800 to 1809 = 9 years.
2. Grand Duchy under the Russian tsar: 1809 to 1917 = 108 years.
3. Independent: 1917 to 2000 = 83 years.
4. Check: 9 + 108 + 83 = 200 years.
5. Percents: 9 ÷ 200 = 4.5%; 108 ÷ 200 = 54%; 83 ÷ 200 = 41.5%.

Answer: Sweden 9 years (4.5%), Russian grand duchy 108 years (54%), independent 83 years (41.5%).

PRACTICE

1. EASY What did Abraham Ortelius publish in 1570, and what did he add from 1579 that makes him a founder of the historical atlas?
2. EASY Who was William R. Shepherd, and when was the first edition of his *Historical Atlas* published?
3. EASY List the five things to check before trusting a historical map.
4. EASY Write the verbal scale “1 inch = 100 miles” as a representative fraction. (1 mile = 63,360 inches.)
5. MEDIUM On a plate at 1:10,000,000, Berlin to Vienna measures 5.2 cm. Find the distance in kilometers and miles.
6. MEDIUM A plate’s scale bar shows that 1 cm = 50 km. Write this as a representative fraction, and find the ground distance for 7.4 cm.

7. MEDIUM Hong Kong Island was ceded to Britain in 1842, and all of Hong Kong was transferred to China on July 1, 1997. The New Territories had been leased in 1898 for 99 years. (a) How many years was Hong Kong Island under British rule? (b) In what year did the lease run out?
8. MEDIUM A student labels a map of Europe in AD 1500 with the countries “Germany” and “Italy.” What error is this, and how should the map be labeled?
9. HARD Most of the border between Portugal and Spain was fixed by the Treaty of Alcañices in 1297. As of 2026, how old is it? Why might a historical atlas reader treat such a border differently from one that changed four times in a century?
10. HARD On one plate, the western boundary of a European state is a solid line and its eastern boundary, in the steppe, is a dotted line fading into a band of color. Interpret what the mapmaker is telling you about each.
11. HARD On a Mercator projection, the scale at latitude φ is enlarged by a factor of 1 ÷ cos φ compared with the equator, and areas by the square of that factor. By how much are lengths and areas enlarged at 60° N, the latitude of Helsinki? Why does this matter when comparing the sizes of states on a world plate?
12. CHALLENGE Explain in a paragraph why a historical atlas is both a source of evidence and an interpretation, using Shepherd’s 1911 atlas as your example.

COMMON MISTAKES

- Reading colors as nations. On historical maps a single color often marks the lands of one ruler or dynasty, scattered across many peoples.
- Ignoring the date of the map and the date of the mapmaker. A map of 1648 drawn in 1911 tells you about 1648 and also about how people saw it in 1911.
- Mixing scales. Distances measured on two plates drawn at different scales cannot be compared until both are converted to the ground.

Make it a game · Atlas Detective. One player opens a historical atlas or Shepherd’s plates online and covers the title and date with a sticky note. The others ask yes-or-no questions (“Is there a united Germany?” “Is Finland its own color?” “Does Sardinia include Savoy?”) and try to name the date within twenty-five years in as few questions as possible. Score ten points minus one for each question asked. Rotate until everyone has hidden a plate.

Scripture. “Remember the days of old, consider the years of many generations: ask thy father, and he will shew thee; thy elders, and they will tell thee.” (Deuteronomy 32:7, KJV)

Moses told Israel to remember and consider the past. A historical atlas is a tool for that kind of remembering: it lays the years of many generations side by side so that we can consider what changed, what lasted and why.

Practice answers

1. The *Theatrum Orbis Terrarum*, usually called the first modern atlas (maps of uniform size and style, bound together, with their sources named). From 1579 he added the *Parergon*, maps of the ancient and biblical world.
2. A professor of history at Columbia University; the first edition appeared in 1911 (New York, Henry Holt).
3. Its title and date; its key (what colors stand for); its boundary symbols (solid, dotted, zones); its scale; and the mapmaker's own time and purpose.
4. 100 × 63,360 = 6,336,000, so 1:6,336,000.
5. 1 cm = 100 km, so 5.2 × 100 = 520 km; 520 ÷ 1.609 = about 323 miles. (The true straight-line distance is about 525 km.)
6. 50 km = 5,000,000 cm, so 1:5,000,000. 7.4 × 50 = 370 km (about 230 miles).
7. (a) 1997 − 1842 = 155 years. (b) 1898 + 99 = 1997.
8. Anachronism. Neither was a single state in 1500; each was a patchwork of separate states (Italy united in 1861, with Rome in 1870; Germany in 1871). The map should label the actual states, such as the Holy Roman Empire and its principalities, Venice, Milan, the Papal States and the Kingdom of Naples, or use "Germany" and "Italy" only as regional names, clearly marked as such.
9. 2026 − 1297 = 729 years. A border that has lasted for centuries usually rests on settled agreement, long habit and often physical features, so it is part of the deep structure of a region; a border that changed often marks a contested zone where the land offered no clear line or where powers were evenly matched, and it calls for explanation of each change.
10. The solid line marks an agreed, probably surveyed and treaty-defined border. The dotted line and fading band show a frontier zone, where the boundary was undefined or disputed and the state's control thinned out gradually rather than stopping at a line.
11. cos 60° = 0.5, so lengths are enlarged 2 times and areas 4 times. Northern states such as Sweden, Finland and Russia look far larger relative to tropical states than they really are, so area comparisons on a Mercator world map mislead.
12. A good answer notes that the atlas gathers real evidence (treaties, dates, the extent of states) and arranges it so that change over time can be seen, which makes it a valuable source. But every plate reflects choices: which dates to show, what colors mean (often dynasties rather than peoples), where to draw sharp lines across blurred frontiers, and how much space to give each region. Shepherd wrote in 1911, before the First World War broke up Austria-Hungary and the Ottoman Empire, and he gave Europe most of his pages. Readers should use the atlas as evidence while asking what the mapmaker knew, believed and chose.

1.4 Core, Frontier and Buffer

OBJECTIVES

- Define core area, frontier, boundary, march and buffer state, and identify each on real historical maps.
- Explain how states grow outward from a core along easy routes and why they often fortify a frontier at a narrow neck of land.
- Use length, area, perimeter and great-circle distance to compare frontier lines and to measure how far a frontier lay from its core.

Warm-up. Pour a cup of dry rice or sand into the middle of a baking sheet that has a few obstacles on it (a book, a mug, a ruler laid on edge). Gently tap the sheet and watch the pile spread. Where does it spread easily? Where does it stop? Where does it pile up against an obstacle? Sketch the result. You have just made a rough model of how a state grows from its core.

Watch. *Frontiers of the Roman Empire: Hadrian's Wall - UNESCO World Heritage Site* (World Heritage Journey, 3:50). https://www.youtube.com/watch?v=LjjSSyj-hcI
With On the map: walk along Hadrian's Wall coast to coast and look at the forts of Vercovicium (Housesteads) and Vindolanda, the line where Rome decided its frontier would stop.
Note: Captions were not available to check; preview it first. It looks like a short travel tour set to music, so it should be gentle viewing.

KEY TERMS

core area
The region where a state began and where its population, wealth, capital and power are concentrated, usually a fertile, well-watered lowland with easy communications.

frontier
A zone, often wide, at the edge of a state’s control where its power thins out, settlement is sparse or contested, and peoples mix. A frontier is an area; a boundary is a line.

boundary
A line, agreed or claimed, that marks exactly where one state’s sovereignty ends and another’s begins.

march
In medieval Europe, a borderland province organized for defense under a military governor, a margrave (“march count”) or marquis, such as the Spanish March or the March of Brandenburg.

buffer state
A smaller, independent state lying between two larger rival powers, which keeps them from sharing a border and so reduces the risk of war between them.

limes

Latin for a path or boundary; historians use it for the fortified frontiers of the Roman Empire, with their roads, forts, watchtowers and walls.

CORE IDEAS

The story. In AD 122 the emperor Hadrian came to Britain. He had spent much of his reign touring the frontiers, and he had decided that Rome had grown as large as it could safely hold. In the north of the province he chose a narrow neck of land between the North Sea and the Irish Sea, from the mouth of the Tyne to the Solway Firth, and ordered a wall built across it. His Roman biographer says that Hadrian was the first to build a wall, eighty miles long, to divide the Romans from the barbarians. Soldiers of three legions built it in a few years: about 80 Roman miles, some 117 km (73 miles), stone in the east and at first turf in the west, with a small fort called a milecastle at every Roman mile and two turrets between each pair. Each milecastle had a gate. The wall was not meant to seal Britain off but to control who crossed it, where and with what goods. Twenty years later Hadrian's successor, Antoninus Pius, pushed north and built a turf wall across the next narrow neck, between the Firths of Forth and Clyde, only about 63 km (39 miles) long. Within about twenty years the Romans pulled back to Hadrian's line, and it remained the frontier of Roman Britain for most of the next two and a half centuries.

The big idea: the core. Hadrian's Wall was the edge of something, and every edge implies a center. Political geographers call the center a state's **core area**: the region where it began and where its people, food, wealth and government are concentrated. Rome's core was the plain of Latium and the Tiber valley; China's was the valleys of the Wei and Yellow rivers; England's was the fertile southeast lowland around London. France grew from a strikingly small core. When Hugh Capet became king in 987, the land he ruled directly was a modest domain around Paris and Orléans. But that domain sat in the middle of the **Paris Basin**, where the Seine, Marne and Oise converge, with rich soils and rivers leading in every direction. Ring after ring of low escarpments, their steep faces turned toward the east, also gave Paris a series of natural defensive lines against invasion from that direction. Over eight centuries French kings extended their rule outward from this core until it reached the Channel, the Atlantic, the Pyrenees, the Alps and the Rhine.

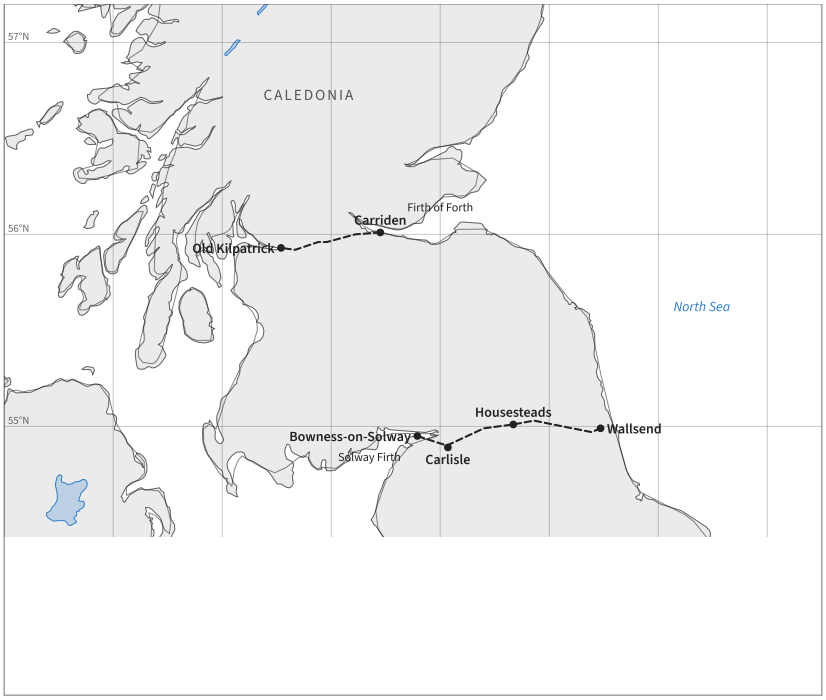
How states grow. States usually grow outward from the core along the easiest routes: river valleys, open plains, coasts. They slow or stop at barriers (mountains, deserts, marshes, seas) or where they meet another strong state. Moscow is the classic case. In the 1300s it was one small principality among many in the forests of the upper Volga, under the overlordship of the Mongol Golden Horde. It stood near the headwaters of rivers flowing to the Baltic, the Black Sea and the Caspian, linked by short portages. Its princes added neighbor after neighbor, a policy Russians called "the gathering of the Russian lands." Ivan III annexed Novgorod in 1478 and ended the Horde's overlordship in 1480, when a Tatar army turned back at the Ugra River without a battle. With no mountains to stop them on the plain, Russian traders and Cossacks crossed the low Urals and reached the Pacific at the Sea of Okhotsk in 1639.

Frontier and boundary. A **boundary** is a line; a **frontier** is a zone. For most of history, states ended not at a surveyed line but in a broad belt where their power faded, settlers were few, raiders came and went, and trade crossed in both directions. Rulers organized these belts for defense as **marches**. Charlemagne's Franks created the Spanish March south of the Pyrenees in the 790s and 800s, taking Barcelona in 801. German kings set up marches on their eastern frontier; one of them, the March of Brandenburg, grew into the core of Prussia. Frontier defense took several forms: a wall or earthwork, like Hadrian's Wall or the Roman **limes** of Germany, a line of forts and towers about 550 km (340 miles) long; a river line such as the Rhine or the Danube (Unit 2); or a chain of fortresses at mountain passes. Notice where Rome chose to build: across the narrowest necks of land, where the shortest line could be held with the fewest soldiers.

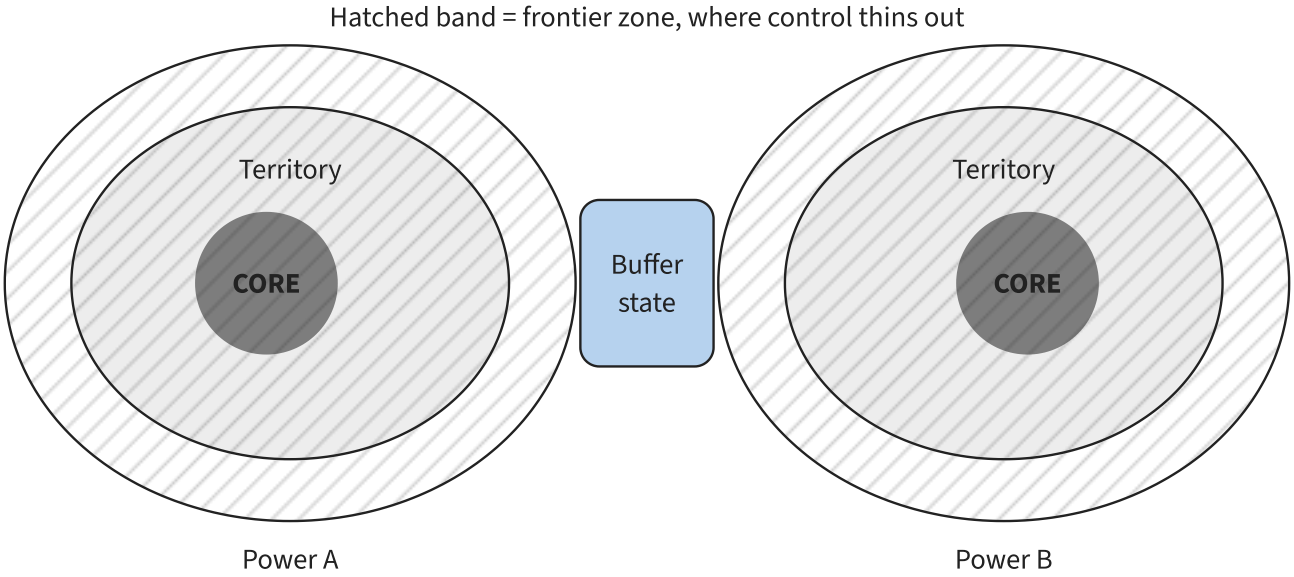
Buffers. When two great powers grow toward each other, they sometimes prefer not to touch. A **buffer state** keeps them apart. In the 1800s the British in India and the Russians in Central Asia advanced toward each other across the mountains in what was called the Great Game. Afghanistan became the buffer between them, and in 1895 Britain and Russia agreed to give Afghanistan the Wakhan Corridor, a mountain strip roughly 350 km (220 miles) long and in places only about 13 km (8 miles) wide, so that Russian and British territory would never meet. In Southeast Asia, Britain in Burma and France in Indochina agreed in 1896 to respect the independence of the heart of Siam (Thailand). Siam's own kings, Mongkut and Chulalongkorn, earned much of the credit by modernizing their government and ceding outlying lands to keep the core free. In South America, Uruguay became independent in 1828 as a buffer between Brazil and Argentina. A buffer's safety depends on the great powers keeping their word: the powers guaranteed Belgium's neutrality in 1839, and Germany invaded it in 1914.

On the map. Look for three things on any historical map. Find the **core**: the densest cities, the capital, the old heartland. Find the **frontier**: where the state's lines are drawn along walls, rivers or mountains, or fade out on the map. Find any **buffer** lying between rivals. Then measure. A compact state, close to a circle or square, has less border to guard for each square mile of land than a long, thin one, and its frontiers are closer to its core.

Technology overcoming geography. Distance from the core has always been a frontier's greatest weakness. A message from Rome to Hadrian's Wall took weeks; a legion took months. Roman roads, Russia's rivers and later its railways, and finally the telegraph shrank those distances and let a capital defend frontiers ever farther away.



Rome's two walls in Britain, each built across a narrow neck of land. Hadrian's Wall is about 117 km (73 miles) long; the Antonine Wall about 63 km (39 miles).



Core, territory, frontier zone and buffer state: a model, not a map.

PICTURE STUDY

The Romans Cause a Wall to Be Built for the Protection of the South, William Bell Scott, 1857 · Oil on canvas · Wallington Hall, Northumberland (National Trust)

William Bell Scott was a Scottish painter and poet who taught art in Newcastle upon Tyne. In the 1850s Sir Walter and Lady Pauline Trevelyan asked him to paint the story of Northumberland on the walls of the central hall of their house at Wallington. He painted a series of large scenes, beginning with the Romans building the Wall and ending with the coal and iron works of Victorian Tyneside.

Scott could not know exactly what the builders looked like, so this is a picture of the Victorian imagination as well as of Roman Britain. But he walked the Wall and knew its landscape, and he understood that for Northumberland the story began at a frontier.

Look closely

- Find the person in charge. How does the painter show who gives orders and who does the work?
- Look at the land behind the wall. How does Scott show that the builders chose high, rough ground for the line?
- Look at the stones and tools. What does the painting suggest about how much labor the frontier cost?
- Look for anything that tells you which side of the wall is “inside” and which is “outside.”

Talk about it

1. Scott called the wall a protection for the south. Who was being protected, and from whom? How might the people living north of it have seen it?

2. Hadrian’s Wall had gates at every milecastle. How does that change your idea of what the wall was for?
3. Why might a Victorian Englishman painting in 1857 have been proud of a Roman frontier?

PROJECT: GROW A STATE: A TERRAIN-COST SIMULATION

Using graph paper, colored pencils and dice, you will grow two rival states outward from their cores across a landscape of plains, forest, hills, mountains and rivers. Terrain makes some squares costly to take. Watch where your states’ frontiers settle, whether a buffer forms between them, and which state ends up more compact.

You will need

- A sheet of graph paper with at least 20 × 20 squares, a pencil and colored pencils (two colors for the states, others for terrain)
- Two six-sided dice
- A ruler and a notebook for recording turns

Steps

1. Draw a landscape: color most squares as plains, add a band of mountains, a few patches of hills and forest, and one river running across the sheet. Make a key.
2. Give terrain costs: plains 1, river valley squares 1, forest 2, hills 3, mountains 6. Crossing the river itself costs 2 extra.
3. Mark each state’s core as a 2 × 2 block of four squares, far apart, on plains. Label the cores.
4. Each turn, each state rolls two dice. The total is its growth points for that turn. It may spend them to add squares that touch its existing territory, paying each square’s cost.
5. A square already held by the other state cannot be taken unless you roll doubles; then you may take one enemy square at twice its cost.
6. Play twelve turns. After every third turn, record each state’s area (number of squares) and border length (number of square edges on its outer boundary).
7. At the end, mark the frontier between the states, any unclaimed squares left between them (a natural buffer), and where the mountains stopped growth.
8. Compute each state’s ratio of border length to area. Which state is more compact? Which is easier to defend? Write a paragraph comparing your result with Rome in Britain or France in the Paris Basin.

Tips

- Grow toward cheap squares first, as real states did: along the river and across the plains.
- If the states never meet, add a turn limit or move the cores closer; if they meet too soon, add more mountains.

- Save your final sheet for your unit field guide as an example of core, frontier and buffer.

Check your work

- I recorded area and border length for both states at least four times.
- I marked the cores, the frontier, any buffer and the barriers that stopped growth.
- I calculated border-to-area ratios and explained which state was more compact and why.

MAP NOTEBOOK

1. Draw a simple map of northern Britain with both Roman walls, label the two narrow necks of land and their lengths, and shade the zone between the walls.
2. Draw three small sketches: a frontier zone, a boundary line and a buffer state between two powers, with a one-sentence caption for each.
3. Sketch the Paris Basin as a set of rings opening toward Paris, mark the Seine, Marne and Oise, and add arrows showing the direction an invader from the east would have to climb.

> **From history.** Just south of Hadrian’s Wall, at the fort of Vindolanda, archaeologists since the 1970s have recovered hundreds of thin wooden writing tablets from the decades just before the Wall was built. They include supply lists, duty rosters and an invitation from one officer’s wife to another to come to her birthday party. One Roman report notes that the Britons have no armor and that their many cavalry do not use swords, and it calls them by a scornful diminutive, “little Britons.” They are the voices of the frontier, written by the soldiers and families who lived on it.

WORKED EXAMPLES

Example 1. Hadrian's Wall is about 117 km (73 miles) long; the Antonine Wall about 63 km (39 miles). Suppose (for comparison only) a commander had 9,000 soldiers to man either line. (a) How many soldiers per kilometer and per mile would each line have? (b) How many times longer is Hadrian's line? (c) Give one reason why Rome nevertheless returned to the longer line.

(Use the map or drawing "Two narrow necks, two walls." shown earlier in this lesson.)

1. (a) Hadrian: 9,000 ÷ 117 = about 77 per km; 9,000 ÷ 73 = about 123 per mile.
2. Antonine: 9,000 ÷ 63 = about 143 per km; 9,000 ÷ 39 = about 231 per mile.
3. (b) 117 ÷ 63 = 1.86, so Hadrian's line is nearly twice as long.
4. (c) The Antonine line was farther from Rome's bases and the settled lands of the province, with hostile peoples on both sides of it. Historians do not know all the reasons for the withdrawal, but distance from supply and the cost of holding the territory between the walls are likely ones.

Answer: (a) Hadrian: about 77 per km (123 per mile); Antonine: about 143 per km (231 per mile). (b) About 1.86 times. (c) The shorter line lay farther from the core of the province and its supplies, and the land between the walls had to be held too.

Example 2. Compare two square states. State A is 200 km on a side; State B is 400 km on a side. For each, find the area, the length of border, and the kilometers of border per 1,000 km² of territory. What does this show about large compact states?

(Use the map or drawing "Compact states keep their frontiers closer to their cores." shown earlier in this lesson.)

1. State A: area = 200 × 200 = 40,000 km²; border = 4 × 200 = 800 km.
2. Border per 1,000 km²: 800 ÷ 40 = 20 km.
3. State B: area = 400 × 400 = 160,000 km²; border = 4 × 400 = 1,600 km.
4. Border per 1,000 km²: 1,600 ÷ 160 = 10 km.
5. Doubling the side doubles the border but quadruples the area.

Answer: A: 40,000 km², 800 km of border, 20 km per 1,000 km². B: 160,000 km², 1,600 km of border, 10 km per 1,000 km². As a compact state grows, it has less border to guard for each square kilometer, which is one reason large, compact states have been hard to conquer.

Example 3. Find the great-circle distance from Rome (41.90° N, 12.50° E) to Carlisle on Hadrian's Wall (54.89° N, 2.93° W). Use $\cos d = \sin \varphi_1 \sin \varphi_2 + \cos \varphi_1 \cos \varphi_2 \cos \Delta\lambda$, and 1° of arc = 111.2 km. Then estimate how many days an official courier at 75 km a day and a legion marching 30 km a day would need to cover that distance (ignore the Channel crossing and the bends of the roads).

1. $\Delta\lambda = 12.50° - (-2.93°) = 15.43°$.
2. $\sin 41.90° \times \sin 54.89° = 0.6678 \times 0.8182 = 0.5464$.
3. $\cos 41.90° \times \cos 54.89° \times \cos 15.43° = 0.7443 \times 0.5750 \times 0.9640 = 0.4126$.
4. $\cos d = 0.5464 + 0.4126 = 0.9590$, so $d = 16.47°$.
5. Distance = 16.47 × 111.2 = 1,831 km, about 1,830 km (1,140 miles).
6. Courier: 1,830 ÷ 75 = about 24 days. Legion: 1,830 ÷ 30 = 61 days.

Answer: About 1,830 km (1,140 miles) in a straight line: roughly 24 days for a courier and 61 days for a marching legion, and more in practice. The frontier lay weeks from the empire's core.

PRACTICE

1. EASY Define core area, and name the core areas from which France and Russia grew.
2. EASY What is the difference between a frontier and a boundary?
3. EASY What was a march, and what does the title margrave mean? Give one example.
4. EASY Name two buffer states from this lesson and the powers each separated.
5. MEDIUM A Roman mile was about 1,480 m. Convert Hadrian's Wall's 80 Roman miles to kilometers and statute miles.
6. MEDIUM Hadrian's Wall had a milecastle every Roman mile and two turrets evenly spaced between each pair of milecastles. About how many turrets were there along 80 Roman miles, and about how far apart were neighboring towers (milecastles and turrets together), in meters and yards?
7. MEDIUM With 6,000 soldiers, how many would there be per kilometer on Hadrian's Wall (117 km) and on the Antonine Wall (63 km)?
8. MEDIUM A hypothetical state shaped like Chile is a rectangle 4,300 km long and 177 km wide. Find its area and perimeter. Then find the perimeter of a square state with the same area. How many times more border does the long state have?
9. HARD The Wakhan Corridor is in places only about 13 km (8 miles) wide. Walking at 5 km/h, how long would it take to cross it at its narrowest? Why would two empires accept such a thin buffer?
10. HARD Explain why Russia's growth from Moscow differed from France's growth from Paris, using geography.
11. HARD Give two reasons a buffer state may fail to keep the peace, with an example.
12. CHALLENGE Write a paragraph analyzing Roman Britain with the ideas of this lesson: core, frontier, boundary, march-like zones and distance from the core.

COMMON MISTAKES

- Thinking of all historical borders as sharp lines. Most were frontier zones until modern surveying and treaties turned them into lines.
- Assuming Hadrian's Wall was built to keep everyone out. It had a gate at every milecastle; it controlled and taxed movement and slowed raiders.
- Thinking a bigger state is always harder to defend. A large compact state has less border per square mile than a small one, though its frontiers may be farther from its core.

Make it a game · Core or Frontier?. A leader names a place and a date, such as "Paris, 1100," "Barcelona, 801," "Carlisle, AD 130," "Moscow, 1480," "the Wakhan, 1900." Players hold up one of three cards: CORE, FRONTIER or BUFFER, and must give a one-sentence reason. Correct answers with a good reason score two points; a correct card without a reason scores one. Players may challenge each other's answers using an atlas. First to twelve points wins.

Scripture. "He increaseth the nations, and destroyeth them: he enlargeth the nations, and straiteneth them again." (Job 12:23, KJV)

Job saw the rise and fall of nations as part of God's rule over the world. Rome enlarged its borders to the Tyne and the Forth and then was straitened again to Hadrian's line, and in time lost Britain altogether. Frontiers advance and retreat, but none of them is beyond the government of God.

Practice answers

1. The region where a state began and where its people, wealth and government are concentrated. France: the Paris Basin around Paris and Orléans (the Île-de-France). Russia: the principality of Moscow in the upper Volga forests.
2. A frontier is a zone at the edge of a state's control where its power fades; a boundary is a line marking exactly where one state's sovereignty ends and another's begins.
3. A borderland province organized for defense. A margrave was a "march count," its military governor. Examples: the Spanish March, the March of Brandenburg.
4. Afghanistan (with the Wakhan Corridor): British India and Russia. Siam: British Burma and French Indochina. Uruguay: Brazil and Argentina. Belgium: France and the German states (any two).
5. 80 × 1.48 = 118.4 km; 118.4 ÷ 1.609 = about 73.6 miles.
6. Two turrets in each of about 80 spaces: about 160 turrets. Each Roman mile is divided into three equal parts: 1,480 ÷ 3 = about 493 m, or about 540 yards.
7. Hadrian: 6,000 ÷ 117 = about 51 per km. Antonine: 6,000 ÷ 63 = about 95 per km.
8. Area = 4,300 × 177 = 761,100 km². Perimeter = 2 × (4,300 + 177) = 8,954 km. Square side = √761,100 = about 872 km; perimeter = 4 × 872 = 3,490 km. 8,954 ÷ 3,490 = about 2.6 times as much border.
9. 13 ÷ 5 = 2.6 hours. The buffer did not need to be wide, because its purpose was political, not military: as long as both powers recognized it as Afghan territory, their own borders never

touched, and no border incident between them could happen there. The high mountains on both sides also made it a poor invasion route.

10. France grew outward until it reached strong barriers on most sides (the Channel, the Atlantic, the Pyrenees, the Alps), and its eastern side, toward the Rhine, stayed contested. Moscow stood on an open plain laced with rivers and portages, with no high mountains in any direction; the low Urals did not stop expansion, so Russian power spread across Siberia to the Pacific by 1639. Few barriers meant both easy growth and long, exposed frontiers.
11. The great powers may break their guarantee when war comes (Germany invaded neutral Belgium in 1914 despite the 1839 guarantee). A weak buffer may be partitioned or absorbed by its neighbors, or one power may take control of its government. A buffer survives best when it is strong and well governed itself, as Siam was.
12. A strong answer identifies the core of the empire as Italy and the core of the province as the fertile southeast lowlands; explains that the north was a frontier zone of hills and moorland, harder to farm and to control; notes that Hadrian chose a boundary line across a narrow neck (Tyne to Solway, about 117 km), with gates to control movement rather than stop it; explains the brief advance to the shorter Antonine line and the return to Hadrian’s; and uses the distance from Rome (about 1,830 km, weeks of travel) to explain why a fixed, defensible line made sense for a frontier so far from the empire’s core.

1.5 Providence and Human Choice

OBJECTIVES

- Explain what Acts 17:26 and Deuteronomy 32:8 teach about the nations, their times and their bounds, and quote Acts 17:26 exactly.
- Show from Scripture and history that God's providence works through geography and does not cancel the freedom and responsibility of nations.
- Sort the causes of a historical event into what was given by the land, what people chose and what technology changed, and support the analysis with distances and dates.

Warm-up. Take a board game you own and set it up. Write three lists: what the board and rules give every player (the same map, the same dice), what each player chooses (moves, trades, risks), and what could change the game (a new rule, a new piece). Now think of your own family's story: where you live, why you moved there or stayed, what you could not choose and what you did. Write two sentences on which column mattered most.

Watch. *Did Paul really Visit Ancient Athens?* (Drive Thru History with Dave Stotts, 5:56).
https://www.youtube.com/watch?v=WeohDhepxOM
After the story: watch Dave Stotts in Athens and look for the Areopagus (Mars Hill) beside the Acropolis, where Paul spoke about the 'unknown god.'
Note: Captions were not available to check; preview it first. Drive Thru History is a trusted Christian channel, so problems are unlikely.

KEY TERMS

providence
God's ongoing care and government of all His creatures and all events, by which He directs history to His purposes, usually working through ordinary means such as land, weather and human decisions.

responsibility
Being answerable for one's choices. Scripture holds both persons and nations responsible for how they act, including how they treat their neighbors and their borders.

fatalism
The belief that everything is fixed in advance by impersonal fate (or by geography alone), so human choices make no real difference. It is not the biblical teaching of providence.

mappa mundi
Latin, "cloth (or sheet) of the world": a medieval world map, usually round, meant to show the history and meaning of the world as well as its places.

T-O map
A simple medieval world plan: an O (the encircling ocean) divided by a T of waters into three continents, Asia above, Europe lower left and Africa lower right, with east at the top.

CORE IDEAS

The story. About AD 50, the apostle Paul arrived in Athens while waiting for his companions Silas and Timothy. Walking through the city he saw temples and statues everywhere, and among them an altar inscribed "TO THE UNKNOWN GOD." He reasoned with Jews in the synagogue and with anyone he met in the marketplace, until philosophers brought him to the Areopagus, the hill of Ares northwest of the Acropolis where Athens' old council met, to explain his teaching. There, before men who prided themselves on knowing everything, Paul gave a short speech about geography and history. He told them that the God "that made the world and all things therein" does not live in temples made with hands (Acts 17:24), and then said this: "And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26). It is the verse that runs through this whole series.

What the verse claims. Paul makes three claims. First, **one blood**: all nations descend from one ancestor, so every people on every continent is part of one human family. That was a startling thing to say to Athenians, who were proud to think themselves born from their own soil and called all foreigners barbarians. Second, **the times**: God has set the seasons of the nations, when they rise and when they fall. Third, **the bounds**: God has determined where peoples live. Paul was echoing the song of Moses: "When the most High divided to the nations their inheritance, when he separated the sons of Adam, he set the bounds of the people according to the number of the children of Israel" (Deuteronomy 32:8). Genesis tells the same story: after the Flood, the families of Noah's sons spread out by their nations (Genesis 10:32), and at Babel God scattered the proud builders over the face of the earth (Genesis 11:8–9). And Paul gives the reason in the next verse: "That they should seek the Lord, if haply they might feel after him, and find him, though he be not far from every one of us" (Acts 17:27). The nations' places on the map have a purpose beyond themselves.

How providence works. Providence is not a rival to geography; it is the deeper explanation behind it. God usually governs through ordinary means: rivers, mountains, winds, harvests and human decisions. Paul's own journey to Athens shows this. The book of Acts says that he and his companions were forbidden to preach in the province of Asia and prevented from entering Bithynia, and that at Troas, on the coast near ancient Troy, Paul saw a vision of a man of Macedonia saying, "Come over into Macedonia, and help us" (Acts 16:9). So the gospel crossed the narrow northern Aegean to Neapolis and Philippi, from Asia into Europe. On that crossing they made the voyage in two days with a straight course; on a later trip the same crossing in the other direction took five (Acts 16:11; 20:6). The sea and the winds were God's means, but Paul still had to choose to get into the boat.

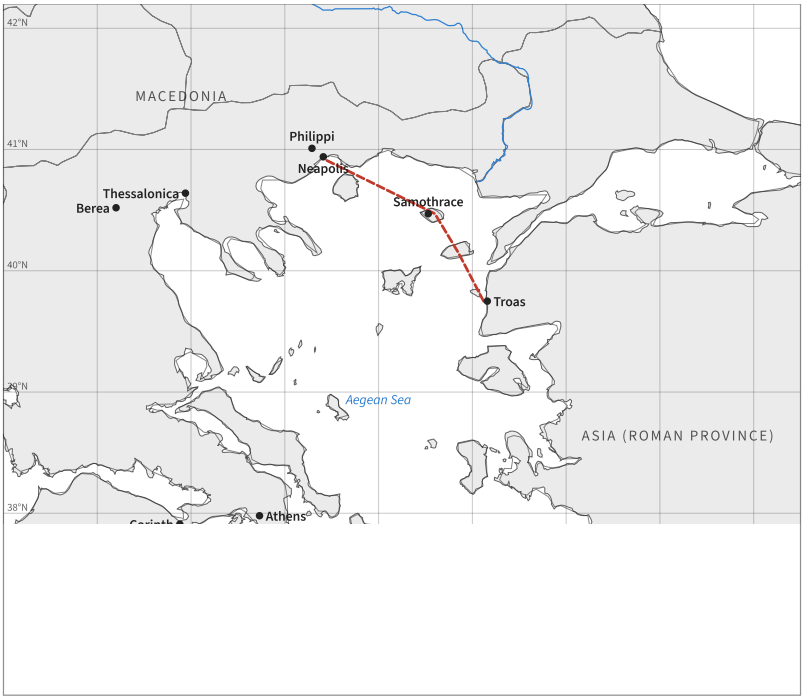
The freedom and responsibility of nations. Scripture never treats providence as fatalism. Through Jeremiah, God said that if He announced judgment on a nation and "that nation, against whom I have pronounced, turn from their evil," He would relent (Jeremiah 18:7–8). Nineveh did exactly that when Jonah preached (Jonah 3), and it was spared; generations later, having returned to cruelty, it fell in 612 BC. Amos condemned the Ammonites for atrocities committed in war "that they might enlarge their border" (Amos 1:13). God holds nations accountable for how they gain and keep their land. "Righteousness exalteth a nation:

but sin is a reproach to any people” (Proverbs 14:34). Geography sets the stage, God governs the whole drama, and nations and their rulers really choose, and really answer for their choices.

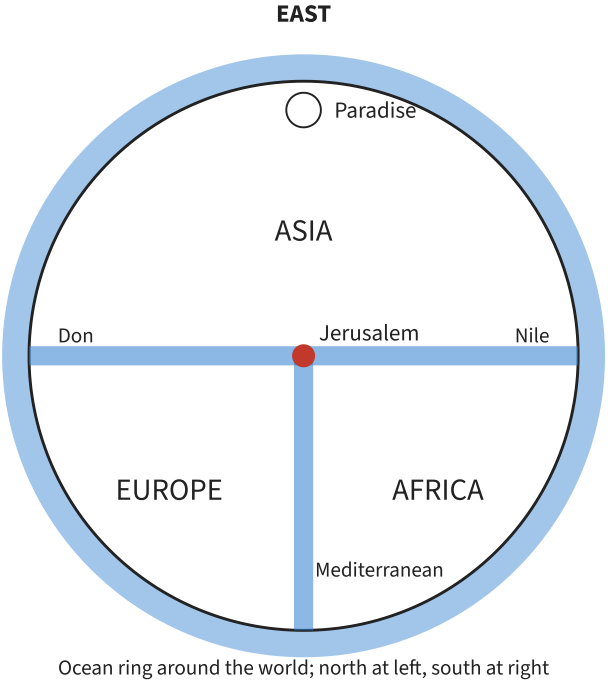
The big idea: two errors to avoid. When Alaric’s Goths sacked Rome in 410, many Romans blamed the Christians for abandoning the old gods. Augustine, bishop of Hippo in North Africa, answered in *The City of God*, written between 413 and 426. He argued that God gives earthly kingdoms to whom He wills, that every earthly city rises and falls, and that no empire, Rome included, is the Kingdom of God. His answer guards against two errors. The first is **fatalism**: “geography (or fate) decides everything, so our choices do not matter.” The second is **pride**: claiming that a nation made itself, or that its land is owed to it by destiny. The builders of Babel made that error, and so did twentieth-century ideologies. Nazi Germany claimed the German people needed “living space” in Eastern Europe and used geography and race to justify a war of conquest and the murder of millions. Good geography is humble: it studies what God has given and what people have done with it.

On the map: given, chosen, changed. In every case study in this course, sort the causes into three columns. *Given*: the land, sea, climate and position. *Chosen*: what people decided to do with them. *Changed*: what technology later altered. The Dutch saying that God created the world but the Dutch created the Netherlands is half a joke; in 1932 they finished the Afsluitdijk, a dam about 32 km (20 miles) long that closed off the Zuiderzee from the North Sea. The low land was given; the dikes were chosen; the engineering changed what the land could be. Venice, built on islands in a lagoon, and Switzerland, holding together several languages behind its mountains, show the same pattern.

Technology overcoming geography. Medieval Christians drew the world as they understood it in Scripture: the Hereford Mappa Mundi places Jerusalem in the center and Christ in judgment above the whole earth. Modern maps measure the earth with satellites. Christians need both kinds of map: one that measures where things are, and one that remembers what the world is for.



From Asia into Europe: Paul's crossing from Troas by way of Samothrace to Neapolis (Acts 16:11), and the cities of his later journey to Athens.



The T-O plan behind the Hereford Mappa Mundi: east at the top, Jerusalem at the center.

PICTURE STUDY

The Hereford Mappa Mundi, Attributed to “Richard of Haldingham and Lafford,” named on the map, about 1300 · Ink, paint and gold leaf on a single sheet of vellum (calfskin), about 1.6 m by 1.3 m (5 ft 2 in by 4 ft 4 in) · Hereford Cathedral, Hereford, England

The Hereford Mappa Mundi is the largest medieval world map that survives. It was made around 1300, probably in England, and an inscription in one corner asks prayers for a man named Richard of Haldingham and Lafford, who made or designed it. It is drawn on one calfskin, its neck still visible at the top.

It is not a road map. It is a picture of the world as history and as Scripture: hundreds of drawings and more than a thousand inscriptions of cities, rivers, animals, peoples and Bible events, arranged on a T-O plan with east at the top. Jerusalem is at the center, echoing Ezekiel 5:5: “This is Jerusalem: I have set it in the midst of the nations and countries that are round about her.” Above the circle of the world, Christ sits in judgment.

Look closely

- Find Jerusalem at the center and the Garden of Eden, a round island at the top. What does putting them in those places say about the mapmaker’s view of the world?
- Find Noah’s Ark in the mountains of Armenia, the Tower of Babel and the Red Sea, painted red, with the route of the Exodus. Why would a world map show these?
- Find the British Isles squeezed along the bottom left edge. Can you find Hereford? Why would a map made there show its own home so small?
- Look at the labels for Europe and Africa. The maker accidentally swapped them, writing “Europa” on Africa and “Affrica” on Europe. Even a careful mapmaker makes mistakes.

Talk about it

1. This map is very poor for finding your way but very rich in meaning. What questions was its maker trying to answer?
2. How does the map show Acts 17:26, that God made the nations and set their times and bounds?
3. A modern atlas measures carefully but rarely says what the world is for. What does each kind of map do well, and what does each leave out?

PROJECT: A MAPPA MUNDI IN MINIATURE

Make your own round world map in the medieval manner, with a T-O plan, the events of Scripture and history in their places, and your own home marked on it. Then compare it with a modern map of the same world and write what each one teaches.

You will need

- A large circle of heavy paper or poster board about 45 cm (18 in) across, or a paper charger plate
- A compass (drawing tool) or string and pencil, a ruler, colored pencils or paints, a fine black pen and gold or yellow marker
- A Bible, a modern world map or atlas, and an image of the Hereford Mappa Mundi to study

Steps

1. Draw a circle and a second circle just inside it for the encircling ocean. Mark east at the top.
2. Draw the T: a vertical band of blue from the bottom edge to the center for the Mediterranean, and a horizontal band across the center for the waters dividing Asia from Europe and Africa. Label Asia (top half), Europe (lower left) and Africa (lower right).
3. Place Jerusalem at the center. Place Eden at the top edge.
4. Draw and label at least six scenes from Scripture in their regions: Noah’s Ark (Armenia), Babel, the Red Sea crossing, Nineveh, Athens with Paul on the Areopagus, Rome.
5. Add at least six places from this unit: the Nile and Egypt, Alexandria, the Royal Road from Sardis to Susa, Hadrian’s Wall, Paris, Moscow.
6. Mark your own home on the map, in the medieval manner, wherever it would fall (Americans will need to add land beyond the ocean ring).
7. Lay your map beside a modern world map. In your notebook, list three things your mappa mundi shows that the modern map does not, and three things the modern map shows that yours does not.

Tips

- Medieval mapmakers squeezed and stretched places to fit their plan. Do the same, and do not worry about exact shapes.

- Use gold or yellow for the most important places, as the Hereford mapmaker did.
- Photograph your finished map for your unit field guide.

Check your work

- My map follows the T-O plan with east at the top and Jerusalem at the center.
- I placed at least six Bible scenes and six places from this unit correctly by region.
- I wrote a comparison of what my mappa mundi and a modern map each show and leave out.

MAP NOTEBOOK

1. Write Acts 17:26 from memory at the top of a page, then underline the three claims (one blood, the times, the bounds) and write one example of each from this unit.
2. Draw a three-column chart titled “Given, Chosen, Changed” and fill it in for the Netherlands, Venice and the Persian Royal Road.
3. Trace Paul’s route from Troas to Neapolis and Philippi on the lesson map, and note the two travel times from Acts 16:11 and 20:6 beside the route.

> **From history.** Augustine finished *The City of God* in 426. Four years later, in 430, the Vandals, who had crossed from Spain into Africa, laid siege to Hippo, and Augustine died in the besieged city at the age of seventy-five. The Vandals took Carthage in 439. The bishop who had explained to the Romans that every earthly city falls lived to see his own city surrounded, and the book he left behind outlasted the Vandal kingdom by more than fourteen centuries.

WORKED EXAMPLES

Example 1. From Troas to Neapolis is about 200 km (125 miles) in a straight line. Acts 16:11 says Paul’s ship made the crossing with a straight course, by way of Samothrace, in two days. Acts 20:6 says a later crossing between the same coasts, in the opposite direction, took five days. Find the average distance covered per day on each voyage in kilometers and miles. What does the difference show?

(Use the map or drawing “Troas to Neapolis by way of Samothrace.” shown earlier in this lesson.)

1. First voyage: 200 km ÷ 2 days = 100 km a day; 125 ÷ 2 = about 62 miles a day.
2. Second voyage: 200 km ÷ 5 days = 40 km a day; 125 ÷ 5 = 25 miles a day.
3. Ratio: 5 ÷ 2 = 2.5 times as long for the same distance (the real track by way of islands was somewhat longer than the straight line in both cases).

Answer: About 100 km (62 mi) a day on the first voyage and 40 km (25 mi) a day on the second. In the age of sail, wind and weather, not distance alone, set the travel time.

Example 2. After the sack of Rome in 410, refugees from Italy reached North Africa, where Augustine was bishop of Hippo Regius (modern Annaba, Algeria). Find the great-circle distance from Rome (41.90° N, 12.50° E) to Hippo (36.90° N, 7.77° E). Use $\cos d = \sin \varphi_1 \sin \varphi_2 + \cos \varphi_1 \cos \varphi_2 \cos \Delta\lambda$ and 1° = 111.2 km.

1. $\Delta\lambda = 12.50° - 7.77° = 4.73°$.
2. $\sin 41.90° \times \sin 36.90° = 0.6678 \times 0.6004 = 0.4009$.
3. $\cos 41.90° \times \cos 36.90° \times \cos 4.73° = 0.7443 \times 0.7997 \times 0.9966 = 0.5932$.
4. $\cos d = 0.4009 + 0.5932 = 0.9941$, so d = about 6.2°.
5. Distance = 6.2 × 111.2 = about 690 km (430 miles).

Answer: About 690 km (430 miles), mostly across open sea: close enough that news and refugees from Rome reached Augustine quickly, which is part of why he took up the question of Rome's fall.

Example 3. Jonah sailed from Joppa (32.05° N, 34.75° E) instead of going to Nineveh (36.36° N, 43.15° E). (a) Find the straight-line distance from Joppa to Nineveh. (b) If Jonah preached in Nineveh about 760 BC, in the reign of Jeroboam II (2 Kings 14:25), how many years passed before the city fell in 612 BC?

1. (a) $\Delta\lambda = 43.15° - 34.75° = 8.40°$.
2. $\sin 32.05° \times \sin 36.36° = 0.5306 \times 0.5928 = 0.3145$.
3. $\cos 32.05° \times \cos 36.36° \times \cos 8.40° = 0.8476 \times 0.8054 \times 0.9893 = 0.6754$.
4. $\cos d = 0.3145 + 0.6754 = 0.9899$, so d = about 8.15°. Distance = 8.15 × 111.2 = about 906 km (563 miles).
5. (b) Both dates are BC, so subtract: 760 − 612 = 148 years. (Jonah's date is approximate; the fall of Nineveh in 612 BC is well documented.)

Answer: (a) About 906 km (563 miles) in a straight line; the real caravan route around the desert was longer. (b) About 148 years. Nineveh's repentance spared it for a time; its later return to cruelty did not go unjudged.

PRACTICE

1. EASY Write Acts 17:26 exactly as it appears in the King James Version.
2. EASY Name the three claims Paul makes in Acts 17:26, and the purpose he gives in verse 27.
3. EASY Which Old Testament verse does Acts 17:26 echo, and what does it say God did?
4. EASY Define providence and fatalism, and explain the difference in one sentence.
5. MEDIUM Babylon's armies destroyed Jerusalem in 586 BC, and Babylon fell to Cyrus of Persia in 539 BC. How many years apart were these events?

6. MEDIUM By tradition Rome was founded in 753 BC; the last emperor in the West was deposed in AD 476. How many years is that? (There is no year 0.)
7. MEDIUM On one voyage across the same stretch of sea, a ship covers 200 km in 2 days; on another, 200 km in 5 days. If a third voyage averaged 65 km a day, how long would it take?
8. MEDIUM Classify each fact about the Netherlands as GIVEN, CHOSEN or CHANGED (by technology): (a) much of the land lies low beside the North Sea; (b) the Dutch decided to close off the Zuiderzee; (c) the 32 km Afsluitdijk, finished in 1932, turned a salt bay into a freshwater lake.
9. HARD Use the formula $\cos d = \sin \varphi_1 \sin \varphi_2 + \cos \varphi_1 \cos \varphi_2 \cos \Delta\lambda$ to find the distance from Athens (37.98° N, 23.73° E) to Jerusalem (31.78° N, 35.22° E). Use 1° = 111.2 km.
10. HARD Amos condemned the Ammonites for atrocities “that they might enlarge their border” (Amos 1:13). What does this verse teach about borders, providence and responsibility?
11. HARD The Hereford Mappa Mundi places Jerusalem at the center and Christ in judgment above the world. Explain what the mapmaker was trying to teach, and why it is not fair to judge it simply as a bad map.
12. CHALLENGE Write a paragraph explaining how geography, God’s providence and human choice all worked together in one event from this unit (for example, Paul’s crossing into Macedonia, Hadrian’s Wall, or Finland’s independence).

COMMON MISTAKES

- Treating providence as fatalism. Scripture teaches that God governs all things and that people and nations are free and responsible for their choices.
- Using Acts 17:26 to claim that any present border is permanent or that one nation is destined to take another’s land. The verse teaches God’s sovereignty, not anyone’s right to conquer.
- Dismissing medieval maps as ignorant. Their makers knew the earth was round and had practical travel guides; a mappa mundi had a different purpose.

Make it a game · Given, Chosen, Changed. Make three labeled baskets or boxes: GIVEN, CHOSEN, CHANGED. Write twenty short facts from this unit on slips of paper (“the Nile floods each summer,” “Hadrian ordered a wall,” “the Afsluitdijk was finished in 1932,” “Paul sailed from Troas,” “the Alps divide Italy from the north,” “trains run through the Gotthard Base Tunnel”). Players take turns drawing a slip, dropping it into a basket and giving a reason. A player who argues persuasively that a slip belongs in two baskets may tear it in half and score two points. Highest score after all slips are sorted wins.

Scripture. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their

> habitation; That they should seek the Lord, if haply they might feel after him, and find him, though he be not far from every one of us:” (Acts 17:26–27, KJV)

This is the series verse. God made the nations one family, set their times and their bounds, and did it for a purpose: that people everywhere would seek Him. Every border you study in this course lies within that purpose, and every nation you meet is answerable to the God who set its bounds.

Practice answers

1. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;”
2. One blood (all nations are one human family); God has determined the times of the nations; God has determined the bounds of their habitation. Purpose: that they should seek the Lord and find Him, though He is not far from any of us.
3. Deuteronomy 32:8: when the most High divided to the nations their inheritance and separated the sons of Adam, He set the bounds of the people.
4. Providence: God’s personal care and government of all things, usually through ordinary means. Fatalism: the belief that impersonal fate fixes everything, so choices do not matter. Providence is the rule of a personal, wise God who works through real human choices and holds people responsible; fatalism denies both the Person and the responsibility.
5. Both are BC, so subtract: 586 − 539 = 47 years.
6. From the start of 753 BC to the start of AD 1 is 753 years (753 BC down through 1 BC); from the start of AD 1 to the start of AD 476 is 475 years. Total: 753 + 475 = 1,228 years. Rule for spans that cross from BC to AD: add the two numbers and subtract 1, because there is no year 0: 753 + 476 − 1 = 1,228.
7. 200 ÷ 65 = about 3.1 days, a little over three days.
8. (a) Given. (b) Chosen. (c) Changed (the engineering made the choice possible and altered the geography).
9. $\Delta\lambda = 11.49°$. $\sin 37.98° \times \sin 31.78° = 0.6152 \times 0.5266 = 0.3240$. $\cos 37.98° \times \cos 31.78° \times \cos 11.49° = 0.7884 \times 0.8501 \times 0.9800 = 0.6568$. $\cos d = 0.9807$, d = about 11.28°. Distance = 11.28 × 111.2 = about 1,254 km (779 miles).
10. Even though God sets the bounds of the nations, nations are responsible for how they seek to change them. Expanding a border by cruelty is a wrong that God judges. Providence does not excuse conquest; it makes rulers answerable to God for how they gain and hold land.
11. The mapmaker was teaching the meaning of the world: that its history centers on God’s work in Jerusalem (Ezekiel 5:5), that all nations and events from Eden to the Last Judgment are under Christ, and that the world is a place of pilgrimage. It was never meant for finding one’s way; judged by its own purpose and by the knowledge of about 1300, it is a learned and careful work, and people of its age also had practical itineraries for travel.
12. A strong answer names the geographic facts (for Paul: the narrow northern Aegean, the island route by Samothrace, the winds), the providential direction recorded in Scripture or seen in the outcome (the closed doors in Asia and Bithynia and the Macedonian vision), and the real human choices (Paul chose to sail, Lydia chose to believe, the magistrates of Philippi chose to beat and jail him). It concludes that providence works through the land and through human choices without canceling human responsibility, and that geography alone does not explain the event.

Unit 1 test

Answer each question. Show your work for every calculation and give distances in both kilometers and miles where asked. Use complete sentences for explanations. A calculator is allowed. The test is worth 100 points.

1. (6 pts) Give one contribution to geography made by each of these men: Herodotus, Eratosthenes, Strabo.
2. (6 pts) Suppose a shadow angle of 7.5° were measured at one city when the sun was overhead at another city 5,000 stadia due south. What circumference would that give?
3. (7 pts) Define environmental determinism and possibilism. Give one historical example that supports determinism and one that challenges it.
4. (7 pts) Classify each border by form (river, mountain or geometric): (a) Egypt–Sudan along 22° N; (b) France–Spain; (c) United States–Canada west of the Lake of the Woods; (d) Texas–Mexico; (e) Chile–Argentina. Then classify (c) by origin.
5. (7 pts) Kansas extends from 37° N to 40° N. How far is it from south to north in miles and kilometers? (1° of latitude = 69.0 mi = 111.1 km.)
6. (8 pts) A border river is 500 m wide, and its deepest channel lies 350 m from Country A's bank. For a 10 km stretch of river, how much water surface does each country receive under (a) the median-line rule and (b) the thalweg rule? (c) Why do many treaties use the thalweg?
7. (7 pts) The 1783 Treaty of Paris used three kinds of border. Name them with one example each, and describe one problem that arose in turning the treaty's words into a line on the ground.
8. (7 pts) A historical atlas plate has a scale of 1:4,000,000. Two cities are 12.5 cm apart on it. How far apart are they in kilometers and miles?
9. (7 pts) List four questions to ask of any historical map, and explain why coloring a map of 1550 with the modern borders of Germany and Italy would be an error.
10. (8 pts) Finland became a grand duchy under the Russian tsar in 1809 and declared independence on December 6, 1917. (a) For how many years was it a Russian grand duchy? (b) On December 6, 2026, how many years of independence will Finland mark? (c) What sequence of atlas plates would show these changes, and what physical features separate Finland from Sweden at sea and on land?
11. (7 pts) Define core area, frontier and buffer state, and give one historical example of each.
12. (7 pts) Two states each cover 90,000 km². One is a square; the other is a rectangle 900 km by 100 km. Find each one's border length and the kilometers of border per 1,000 km² of land. Which is easier to defend, and why?
13. (8 pts) Hadrian's Wall was 80 Roman miles long (1 Roman mile ≈ 1,480 m). (a) Convert to kilometers and statute miles. (b) With a milecastle every Roman mile and two turrets between each pair, about how many turrets were there? (c) Why did Rome build its frontier walls across narrow necks of land?

14. (8 pts) Quote Acts 17:26 exactly. Then explain in a paragraph how the verse, Jeremiah 18:7–8 or Amos 1:13, and the history of Nineveh show that God's providence does not cancel the responsibility of nations.

UNIT PROJECT: A FIELD GUIDE TO THE WORLD'S BORDERS

Make an illustrated field guide to borders, like a bird guide, with one page for each type: river (median line and thalweg), mountain crest and drainage divide, lake and sea, geometric (parallel, meridian, straight line), cultural, and frontier zone or buffer. On each page give a definition, a small sketch map, at least two real examples with their dates and how they came to be drawn, and the strengths and problems of that type. Include your photos or pages from the lesson projects (the crest-or-divide model, the flip-atlas, the grow-a-state simulation and your mappa mundi).

Finish with a world map of borders color-coded by type: blue for river borders, brown for mountain borders, red for geometric borders, and another color for all others. Mark at least twenty borders across every inhabited continent. Write a closing page answering the question of this course: why do borders fall where they do? Use the ideas of determinism, possibilism, core and frontier, and providence and human choice.

- **Accuracy**: Border types are classified correctly; examples, dates and locations are correct; the world map shows at least twenty borders, colored by type and placed accurately.
- **Evidence and measurement**: Each page includes real examples with how and when they were drawn, and at least three pages include a measurement or calculation (a length, a latitude span, a scale distance or an area).
- **Reasoning**: The guide weighs the strengths and problems of each border type, and the closing page explains, with examples, how land, human choice, technology and providence together shape where borders fall.
- **Craft**: Pages are neat, clearly labeled and illustrated, with a key on every map and a consistent color scheme throughout.

Answer key

1. Herodotus: traveled and inquired, explained Egypt as the gift of the Nile and described lands such as the Royal Road (any one). Eratosthenes: named the subject geography and measured the earth's circumference. Strabo: wrote a 17-book *Geography* of the known world, arguing that geography serves rulers and that Italy's position helped Rome to rule.
2. 360 ÷ 7.5 = 48; 48 × 5,000 = 240,000 stadia.
3. Determinism: the environment largely decides a people's way of life and history. Possibilism: the environment sets limits and possibilities, and people choose. Support (any): Egypt's population concentrated along the Nile; Britain protected by the Channel; Russia's exposed plain. Challenge (any): divided Korea with one geography and very different outcomes; the Mongols before and after 1206; Greece in different ages; tunnels and railways overcoming the Alps.
4. (a) Geometric. (b) Mountain (the Pyrenees). (c) Geometric (the 49th parallel). (d) River (the Rio Grande). (e) Mountain (the Andes). By origin, (c) is antecedent: drawn across the prairies

before most settlement.

5. 3° × 69.0 = 207 mi; 3° × 111.1 = 333 km.
6. (a) Median: 250 m each; 0.25 km × 10 km = 2.5 km^2 each. (b) Thalweg: A gets 0.35 × 10 = 3.5 km^2; B gets 0.15 × 10 = 1.5 km^2. (c) The thalweg is the navigable channel; placing the border on it gives both countries access to the shipping lane.
7. Rivers (the St. Croix, Connecticut, Mississippi or St. Marys); a ridgeline (the “highlands” dividing rivers flowing to the St. Lawrence from those flowing to the Atlantic); parallels (the 45th or the 31st). Problems (any one): no one knew which river was the St. Croix until Champlain’s 1604 ruins were found (settled 1798); the highlands could not be found on the ground, leading to the Aroostook War and the Webster–Ashburton Treaty of 1842; the 45th parallel was surveyed slightly wrong, so “Fort Blunder” stood in British territory; the line due west from the Lake of the Woods could never meet the Mississippi.
8. 1 cm = 4,000,000 cm = 40 km. 12.5 × 40 = 500 km; 500 ÷ 1.609 = about 311 miles.
9. What date does it show? What do its colors and symbols mean? What do its boundary lines mean (agreed, disputed, frontier zone)? What is its scale? When, by whom and for what purpose was it made? (any four). Coloring 1550 with modern Germany and Italy is anachronism: neither was a single state until 1871 and 1861, and in 1550 the regions were divided among many states and dynasties.
10. (a) 1917 − 1809 = 108 years. (b) 2026 − 1917 = 109 years. (c) Plates of the Baltic before 1809, between 1809 and 1917, and after 1917 (for example 1789, 1815 and 1920). At sea the Gulf of Bothnia separates them; on land the border follows the Torne (Tornio) River and its tributary the Muonio for most of its length.
11. Core area: the region where a state began and its people and power are concentrated (the Paris Basin for France; Moscow for Russia; Latium for Rome). Frontier: a zone at the edge of a state’s control where its power thins out (northern Roman Britain; the Spanish March). Buffer state: a smaller independent state between rival powers (Afghanistan with the Wakhan Corridor; Siam; Uruguay; Belgium).
12. Square: side 300 km, border 1,200 km, 1,200 ÷ 90 = 13.3 km per 1,000 km^2. Rectangle: border 2 × (900 + 100) = 2,000 km, 2,000 ÷ 90 = 22.2 km per 1,000 km^2. The square is easier to defend: less border to guard, and every frontier is closer to its center.
13. (a) 80 × 1.48 = 118.4 km, about 73.6 miles. (b) About 2 × 80 = 160 turrets. (c) A short line between two seas could be held with the fewest soldiers and could not easily be outflanked by land; the sea guarded both ends.
14. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;” A strong paragraph explains that God sets the times and bounds of the nations, yet Scripture holds nations responsible: through Jeremiah God said He would relent if a nation turned from its evil; Nineveh repented at Jonah’s preaching and was spared, and later fell in 612 BC after returning to cruelty; Amos condemned Ammon for atrocities committed to enlarge its border. Providence works through real choices; it is not fatalism, and it gives no nation a right to conquer.

UNIT 2

Rivers as Borders and Highways

Rivers are the oldest borders on earth and the oldest highways. A river is easy to see, hard to cross with an army and simple to describe in a treaty, so empires and nations have drawn their lines along rivers for more than two thousand years. But a river also joins the people on its banks, carries their trade and, in winter, may freeze into a bridge. Worst of all for a treaty-maker, a river moves. In this unit you will ask of five great rivers the same questions: Was this river a wall or a road? Who drew the border here, and why? What happened when the river moved, or when engineers bridged, straightened or dammed it?

You will stand with Julius Caesar at his ten-day bridge over the Rhine and follow the long contest between France and Germany for the Rhine lands. You will cross the Danube on Trajan's bridge and watch Huns, Magyars, Ottomans and Habsburgs use the river as a road of empires. You will sign the Treaty of Guadalupe Hidalgo in 1848 and see how the wandering Rio Grande caused a century-long quarrel over the Chamizal. You will float down the Amur with Muravyov in 1858 and stand on the ice of the Ussuri in 1969. Finally you will see how the Mississippi and the Nile, flowing through the heart of their lands, became the spines of nations, and how steam, steel and concrete changed them.

Behind every border in this unit stands the truth Moses sang: "When the most High divided to the nations their inheritance, when he separated the sons of Adam, he set the bounds of the people according to the number of the children of Israel" (Deuteronomy 32:8). God made the rivers and set the bounds of the nations; men and women must still draw their lines with honesty and settle their quarrels in peace.

BEFORE YOU BEGIN

- Can read latitude and longitude and estimate distances using 111 km (69 miles) per degree of latitude (Unit 1)
- Knows the difference between natural and artificial borders (Lesson 1.2)
- Can use speed = distance ÷ time and convert between kilometers and miles
- Can read a historical atlas map with changing borders (Lesson 1.3)

MASTERY CHECKLIST

- I can explain why rivers make attractive borders and why they are so often disputed.
- I can tell the story of the Rhine and the Danube as Roman frontiers and later as contested borders and roads of empires.
- I can explain the Treaty of Guadalupe Hidalgo and apply the rules for gradual river change and avulsion, using the Chamizal as an example.
- I can compare a bank line, a median line and a thalweg, and explain the 1969 Zhenbao Island clash and its settlement.
- I can explain how the Mississippi and the Nile united their lands and how technology changed both rivers.

- I can calculate river distances, travel times with and against a current, sinuosity and land areas.

OPTIONAL BOOKS AND RESOURCES

- **Chamizal National Memorial (National Park Service)** (https://www.nps.gov/cham/): Free. The park's pages tell the story of the Chamizal dispute and its peaceful settlement in 1963–1967, with maps and photographs for Lesson 2.3.
- **Treaty of Guadalupe Hidalgo (U.S. National Archives, Milestone Documents)** (https://www.archives.gov/milestone-documents/treaty-of-guadalupe-hidalgo): Free. Images and a transcript of the 1848 treaty. Read Article V, which describes the boundary along the Rio Grande, before Lesson 2.3.
- **Julius Caesar, *The Gallic War* (free at Project Gutenberg)** (https://www.gutenberg.org/ebooks/search/?query=caesar+gallic+war): Free. Book 4 contains Caesar's own description of building the Rhine bridge in 55 BC (Lesson 2.1). Students can read the bridge chapters and sketch the trestle from his words.

2.1 The Rhine: Rome's Frontier and a Thousand Years of Contest

OBJECTIVES

- Explain how the Rhine became Rome's northern frontier after Caesar's bridge (55 BC) and the Teutoburg disaster (AD 9), and why Rome built the Upper German–Raetian Limes across the land between the Rhine and the Danube.
- Trace the contest over the Rhine lands from the Treaty of Verdun (843) through Louis XIV, the French Revolution, 1871, 1919 and 1945, and explain why a river valley that is one region makes a disputed border.
- Use river kilometers, latitude and percentages to measure the Rhine border and the effect of Tulla's straightening of the Upper Rhine.

Warm-up. Lay a piece of string across a table to stand for a river. Put a few coins on each side for villages and a spoon across the string for a bridge. Now answer quickly: Is the string a good place for a border? What makes it good (easy to see, hard to cross)? What makes it poor (the villages on both banks fish, trade and marry across it)? Move the spoon. What happens to the "wall" once anyone can cross?

Watch. *Why and How the Battle of Teutoburg Happened - Who Was Varus?* (Kings and Generals, 18:35). https://www.youtube.com/watch?v=U4-1zmyyoVM
After the story: follow the animated maps from Caesar's Rhine crossing to Varus's march into Germania, and notice why Rome stopped at the Rhine after AD 9.
Note: Captions were not available to check; preview it first. It is an 18-minute battle documentary with animated violence, and Kings and Generals videos sometimes include a sponsor message.

Backup video. *Life in Alsace Lorraine (Short Animated Documentary)* (History Matters, 3:03). https://www.youtube.com/watch?v=5g-j-ayW-ZE
As review: see what changed for families in Alsace-Lorraine when the border along the Rhine moved after 1871. Note: Captions were not available to check; preview it first. History Matters sometimes uses light, sarcastic humor.

KEY TERMS

frontier (Latin limes)
The edge zone of a state or empire, often guarded by forts and roads. Rome's fortified frontier was called the limes.

natural frontier
The idea that a nation's proper border is a feature of nature such as a river, mountain range or sea. French writers applied it to the Rhine.

left bank and right bank

The banks of a river named as you face downstream. The Rhine flows north, so its left bank is the west bank.

thalweg
The line of the deepest channel of a river. Many treaties since the Treaty of Lunéville (1801) put the border on the thalweg.

Lotharingia (the Middle Kingdom)
The long strip of land between West and East Francia given to Lothair I in 843, from the North Sea toward Italy, including the Rhine lands.

Rhineland
The German lands along the middle and lower Rhine, especially the left bank, around Cologne, Bonn, Koblenz and Mainz.

CORE IDEAS

The story. In the summer of 55 BC, Julius Caesar stood on the west bank of the Rhine. Germanic warriors had been crossing into Gaul, and Caesar wanted them to know that Rome could cross too. A friendly tribe, the Ubii, offered boats, but Caesar judged that crossing by boat was neither safe enough nor fitting for the dignity of the Roman people. So his engineers drove pairs of heavy timber piles into the riverbed, slanting them with the current, tied them together with cross-beams and laid a road of planks on top. By his own account in *The Gallic War*, the whole bridge was finished within ten days of the start of gathering timber. Caesar marched across, burned the villages and fields of the Sugambri, spent eighteen days in all on the far bank, came back and broke the bridge down behind him. The lesson was plain: the river was a wall Rome chose to keep, not one Rome could not pass.

How the frontier was made. Caesar's heir Augustus tried to push the border east to the Elbe. In AD 9, in the Teutoburg Forest, the German chief Arminius, who had served Rome, led the governor Varus and three legions into an ambush and destroyed them. The historian Suetonius says Augustus would beat his head against a door, crying, "Quintilius Varus, give me back my legions!" After that the Rhine became Rome's frontier for about four hundred years. Legionary fortresses lined the west bank at Xanten, Neuss, Bonn, Mainz and Strasbourg, and many are cities today; Cologne began as a Roman colony in AD 50. A Rhine fleet patrolled the water. Where the upper Rhine and the upper Danube bend away from each other, Rome cut off the corner with the Upper German–Raetian Limes, about 550 km (340 miles) of ditch, palisade, wall, watchtowers and forts from near Koblenz to the Danube near Regensburg. A shorter line needed fewer soldiers. Yet a river is also a road, and in a hard winter, a bridge of ice. By the traditional date, on the last day of AD 406, Vandals, Alans and Suebi crossed the Rhine near Mainz, and the western frontier never recovered. The Franks settled on both banks.

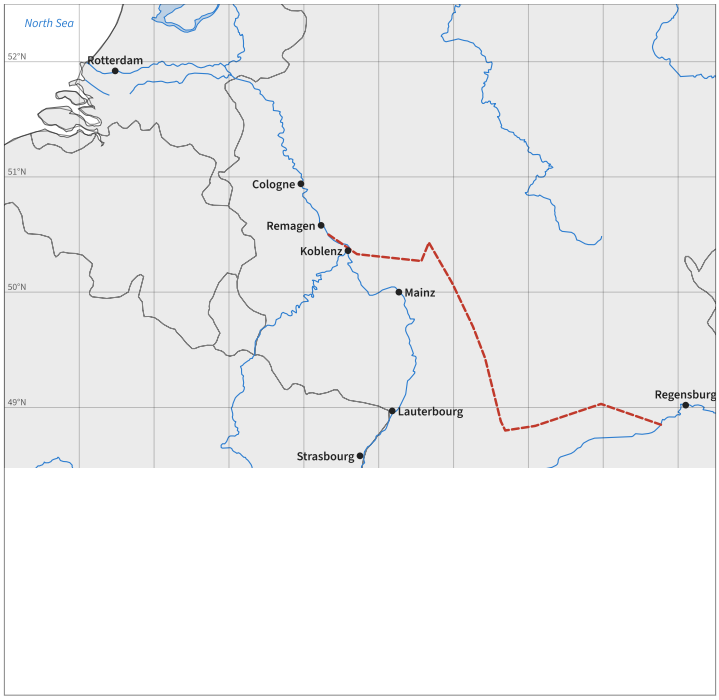
The big idea. A river is both a barrier and a highway. It divides the land but joins the water. People on both banks often speak the same tongue, buy and sell in the same markets and marry across the stream. In Alsace, on the French left bank, most country people spoke a German dialect for centuries. That is why river borders are so often fought over: the valley is one region, but the river is an easy line to draw. In 843 the Treaty of Verdun split

Charlemagne’s empire among his three grandsons. Charles the Bald took West Francia, the seed of France. Louis the German took East Francia, the seed of Germany. Lothair took the Middle Kingdom, a long strip from the North Sea toward Italy that included the Rhine lands. The strip had no natural walls and soon broke apart, and for a thousand years France and the German states fought over its pieces: Alsace, Lorraine, the Palatinate and the Rhineland.

Centuries of contest. The Peace of Westphalia (1648) gave France Habsburg rights in Alsace, and Louis XIV seized Strasbourg in 1681. His armies laid waste to the Palatinate in 1688–1689, burning towns and the castle at Heidelberg. The French revolutionaries spoke of “natural frontiers”: in 1793 Georges Danton told the National Convention that nature had marked the limits of France at the Rhine, the ocean, the Alps and the Pyrenees. France took the whole left bank, which the Treaty of Lunéville confirmed in 1801. In 1815 the Congress of Vienna gave most of the Rhineland to Prussia. When French politicians talked of the Rhine again in 1840, Germans answered with songs, among them Max Schneckenburger’s “Die Wacht am Rhein” (“The Watch on the Rhine”). After the Franco-Prussian War, the Treaty of Frankfurt (1871) gave Alsace and part of Lorraine to the new German Empire. The Treaty of Versailles (1919) returned them to France and demilitarized the Rhineland; in March 1936 Hitler sent troops into the Rhineland in defiance of the treaties, and in 1940 Nazi Germany annexed Alsace in all but name and forced thousands of young Alsatians into its army. On March 7, 1945, American soldiers captured the railway bridge at Remagen before it could be destroyed and crossed the last great barrier into Germany. After the war, France and West Germany chose reconciliation, sealed by the Élysée Treaty of 1963 between Charles de Gaulle and Konrad Adenauer. Strasbourg, once the prize of every war, now hosts the Council of Europe and the European Parliament.

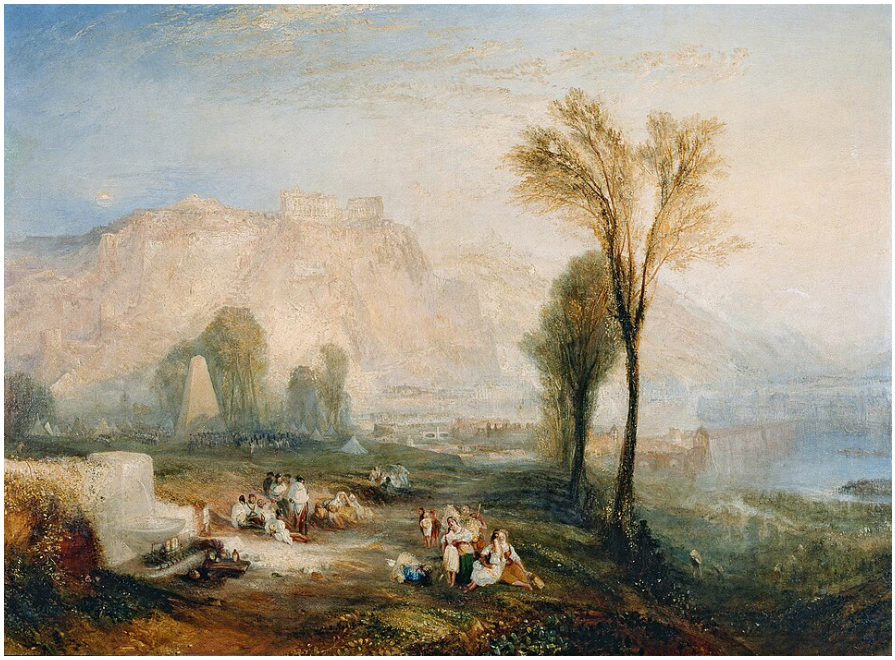
On the map. The Rhine runs about 1,230 km (765 miles) from the Swiss Alps to the North Sea (see the map). It flows through Lake Constance and over the Rhine Falls, turns north at Basel, crosses the flat Upper Rhine Plain between the Vosges and the Black Forest, cuts the narrow Middle Rhine gorge of castles and vineyards between Bingen and Bonn, and spreads into a delta in the Netherlands. Along the way it forms borders between Switzerland and Liechtenstein, Switzerland and Austria, Switzerland and Germany, and, for about 184 km (114 miles) from Basel to Lauterbourg, France and Germany. As of 2026 that border is open to travelers under the Schengen agreement.

Technology overcoming geography. The Congress of Vienna in 1815 created the Central Commission for the Navigation of the Rhine, now seated in Strasbourg and the oldest international organization still at work; the Mannheim Act of 1868 opened the river to free navigation. From 1817 the engineer Johann Gottfried Tulla began straightening the wandering Upper Rhine, cutting through its loops and shortening the stretch from Basel to Worms from about 354 km to about 273 km. The work fixed a border that had shifted with every flood, drained malarial marshes and opened the river to steamboats, though the faster current cut its bed deeper and lowered the water table. Today barges carry coal, grain, containers and chemicals between Rotterdam and Basel, and Duisburg is one of the largest inland ports in the world. Caesar’s ten-day bridge and the captured bridge at Remagen bracket the story: once a river can be bridged at will, it stops being a wall and becomes a line on a map.



The Rhine frontier. The Romans held the river line and cut off the corner between the Rhine and the Danube with the limes. Today the Rhine forms the France–Germany border from Basel to Lauterbourg.

PICTURE STUDY



The Bright Stone of Honour (Ehrenbreitstein) and the Tomb of Marceau, from Byron's Childe Harold, J. M. W. Turner, exhibited 1835 · Oil on canvas · Private collection (sold at Sotheby's, London, in 2017). An engraving of it by John Pye (1845) is in the National Gallery of Art, Washington.

Joseph Mallord William Turner (1775–1851) was the greatest English painter of light and weather. In August 1817, two years after Waterloo, he traveled up the Rhine from Cologne to Mainz and back, filling small sketchbooks with quick pencil notes. He returned to the river

again and again, and in 1835 he exhibited this large painting of Ehrenbreitstein, the fortress on a crag across the Rhine from Coblenz, where the Moselle flows in. The Romans had called the place Confluentes, “the meeting of the rivers.”

Turner took his subject from Lord Byron’s poem *Childe Harold’s Pilgrimage* (Canto III, 1816). Byron wrote of the simple tomb near Coblenz of Marceau, a young French general killed fighting the Austrians in 1796, and of Ehrenbreitstein itself, “with her shattered wall / Black with the miner’s blast.” French armies had starved the fortress into surrender in 1799 and blown it up in 1801; when Turner first saw it, Prussia was rebuilding it as a guard on its new Rhine frontier. The quiet golden river in this picture had been fought over for two thousand years.

Look closely

- Find the fortress. Why would a ruler build on a high rock where two rivers meet?
- Find the boats on the river. Which way would the current carry them, and what might they be carrying?
- Look at how the rock rises straight from the water. Where is there room for a road, a town or a field?
- Look at the light. Where is it brightest, and how does Turner make the fortress feel both strong and far away?

Talk about it

1. In this picture, does the Rhine look more like a wall or a highway? Point to evidence for each.
2. Byron asked his readers to honor Marceau even though he was “our enemy.” Why might Turner, an Englishman, paint a French general’s tomb on a German river?
3. Turner painted a calm, golden scene of a place that had been besieged and blown up. What does the painting show about the river’s history, and what does it leave out?

PROJECT: A THOUSAND YEARS OF BORDERS: RHINE OVERLAY ATLAS

You will build a stack of see-through overlays on one base map of the Rhine lands. Each sheet shows the border at a different date. Flipped one at a time, they show the border swinging back and forth across the river like a door on a hinge.

You will need

- A printed or hand-traced outline map of the Rhine from Basel to the North Sea, about letter size (trace it from an atlas or from the lesson map)
- Six sheets of tracing paper, baking parchment or clear page protectors
- Colored pencils or fine markers (wet-erase markers if you use page protectors)
- Tape, a ruler and a historical atlas or the lesson text

Steps

1. Base map: draw the Rhine, the Moselle, the Main and the Neckar. Mark Basel, Strasbourg, Mainz, Koblenz, Bonn, Cologne and Rotterdam. Shade Alsace and Lorraine lightly. Tape the base map to the table along its top edge.
2. Overlay 1, about AD 100: trace the Rhine as Rome's frontier in red and the limes from near Koblenz to the Danube. Mark three legionary fortresses (Xanten, Bonn, Mainz or Strasbourg).
3. Overlay 2, AD 843: draw the three kingdoms of the Treaty of Verdun. Color the Middle Kingdom of Lothair as a long strip including the Rhine lands.
4. Overlay 3, 1681: show Alsace and Strasbourg as French and the Rhine as the edge of France in the south; the lands north of Alsace remain German.
5. Overlay 4, 1801: show France reaching the Rhine along the whole left bank, from Basel to the Netherlands border.
6. Overlay 5, 1871: show Alsace and northern Lorraine as part of the German Empire; the border now runs along the Vosges, not the Rhine.
7. Overlay 6, 1919 and again after 1945: show the modern line, with the Rhine as the border from Basel to Lauterbourg only.
8. Flip through the overlays and write a caption on each: the date, the treaty or war, and whether the border followed the river, the mountains or neither.

Tips

- Line up two corner marks on every sheet so the overlays register exactly with the base map.
- Use one color for French control and one for German control on every sheet so the change is easy to see.

Check your work

- I can show at least six border positions in the Rhine lands in the right order.
- I can name the treaty or war behind each change.
- I can explain why the Rhine was a border in some periods and not in others.

MAP NOTEBOOK

1. Sketch Caesar's bridge trestle from his description: two slanting piles, the cross-beam between them and the deck on top. Label which way the current flows.
2. Draw a cross-section of the Upper Rhine Plain from the Vosges to the Black Forest, with the river in the middle. Label France, Germany, Alsace and the Rhine.
3. Make a two-column chart, "Rhine as wall" and "Rhine as highway," with at least four examples in each column from this lesson.

> **From history.** The bridge at Remagen did not last long. The Ludendorff Bridge, damaged by the German demolition charges and by the weight of traffic and shelling, collapsed into the Rhine on March 17, 1945, ten days after its capture, killing American engineers who

were repairing it. By then the U.S. Army had built pontoon bridges nearby, and the crossing held. The bridge was never rebuilt; its stone towers still stand on both banks.

WORKED EXAMPLES

Example 1. Distances along the Rhine are marked by Rhine-kilometers, counted from km 0 at the Rhine bridge in Konstanz. The France–Germany river border begins near Basel at about km 168 and ends at the mouth of the Lauter near Lauterbourg at about km 352. How long is the border, in kilometers and miles?

(Use the map or drawing "The France–Germany Rhine border runs from Basel north to Lauterbourg." shown earlier in this lesson.)

1. Subtract the markers: 352 − 168 = 184 km.
2. Convert to miles (1 km ≈ 0.621 mile): 184 × 0.621 ≈ 114 miles.
3. Check the sense: Basel (47.56° N) and Lauterbourg (48.97° N) are 1.41° of latitude apart, so they are at least 1.41 × 111 ≈ 157 km apart. The canalized river is a little longer than the straight line, so 184 km is reasonable.

Answer: About 184 km (about 114 miles).

Example 2. Before Tulla's work began in 1817, the Upper Rhine from Basel to Worms wandered through loops and side channels for about 354 km. After the straightening it measured about 273 km. By how many kilometers, and by what percentage, was the river shortened? Why did this help settle the border between France and Baden?

1. Shortening: 354 − 273 = 81 km (about 50 miles).
2. Percentage: 81 ÷ 354 ≈ 0.229, or about 23 percent.
3. Border: a border on a wandering river moves with every flood or argues over which channel is the real river. One fixed channel gives one clear line.

Answer: About 81 km shorter, roughly 23 percent. A single fixed channel gave the border one clear, stable line instead of many shifting branches.

Example 3. The Upper German–Raetian Limes ran about 550 km. Archaeologists have found about 900 watchtower sites along it. What was the average spacing between towers? How long would a soldier walking at 5 km/h take to cover one gap?

1. Spacing: 550 km ÷ 900 ≈ 0.61 km, or about 610 m (about 0.4 mile).
2. Time: 0.61 km ÷ 5 km/h ≈ 0.12 h; 0.12 × 60 ≈ 7 minutes.
3. Meaning: towers were close enough to see one another and pass signals, so a raid could be reported quickly to the forts behind the line.

Answer: About 610 m (0.4 mile) between towers on average; about 7 minutes' walk.

PRACTICE

1. EASY In which general direction does the Rhine flow between Basel and Mainz?
2. EASY Who bridged the Rhine in 55 BC, how long did the bridge take to build by his own account, and how long did he stay on the far side?
3. EASY What happened in the Teutoburg Forest in AD 9, and what did it mean for Rome's border?
4. EASY Strasbourg and Cologne both stand on the west side of the Rhine. Using the rule for naming banks, which bank is that?
5. MEDIUM Name the three kingdoms created by the Treaty of Verdun (843) and their rulers. Which one included the Rhine lands, and why did it not last?
6. MEDIUM Put these events in order: Treaty of Frankfurt; Louis XIV takes Strasbourg; capture of the bridge at Remagen; Treaty of Verdun; Teutoburg Forest; Treaty of Lunéville.
7. MEDIUM Basel is at 47.56° N and Cologne is at 50.94° N. About how far apart are they north to south, in km and miles? (Use 111 km or 69 miles per degree of latitude.)
8. MEDIUM Mainz is at about Rhine-km 498 and Cologne at about Rhine-km 688. A barge travels downstream at 18 km/h and upstream at 10 km/h. How long does each trip take?
9. MEDIUM Look at the map of the Rhine frontier. The limes leaves the Rhine near which city, and on which river does it end?
   (Use the map or drawing "Trace the limes from end to end." shown earlier in this lesson.)
10. HARD Why did the Romans build the Upper German–Raetian Limes across open country instead of simply holding the Rhine and the Danube all the way around? Give two reasons.
11. HARD In 1801 the Treaty of Lunéville set the border between France and the Holy Roman Empire on the thalweg of the Rhine. Why would the deepest channel be a better line than either bank or the exact middle of the water?
12. CHALLENGE In a paragraph, weigh Danton's claim that nature marked the Rhine as France's frontier. Use at least three facts from the lesson, and say what the claim gets right and what it leaves out.

COMMON MISTAKES

- Naming the banks by the map instead of by the current. Left and right bank are always named facing downstream, so the Rhine's left bank is its west bank.
- Thinking a "natural" border is permanent. The Rhine has been the French border, an inner German river and a Roman frontier at different times; people and treaties decided which.
- Thinking the Romans never crossed the Rhine. They bridged it, campaigned beyond it, and held land east of it behind the limes for about two centuries.

Make it a game · Left Bank, Right Bank. One player names a river city (Strasbourg, Cologne, Bonn, Mainz, Koblenz, Basel, Düsseldorf, Mannheim) and a date. The other must say which bank it stands on (left or right, named facing downstream) and, for the date given, whether it was French, German or Roman. Check with the map and the overlay atlas. One point for the bank, one for the ruler; play to ten.

Scripture. "There is a river, the streams whereof shall make glad the city of God, the holy place of the tabernacles of the most High." (Psalm 46:4, KJV)

The Rhine has been fought over for two thousand years. The psalmist sings of a river that brings gladness rather than war. Earthly rivers divide nations; God's peace is the river that does not.

Practice answers

1. North (very slightly east of north).
2. Julius Caesar; about ten days from the start of gathering timber; eighteen days in all.
3. Arminius ambushed and destroyed three legions under Varus. Rome gave up pushing to the Elbe and kept the Rhine as its frontier.
4. The left bank. Facing downstream (north), the west is on your left.
5. West Francia (Charles the Bald), East Francia (Louis the German) and the Middle Kingdom (Lothair). The Middle Kingdom included the Rhine lands. It was a long, narrow strip with no natural walls, squeezed between two larger kingdoms, and it broke apart.
6. Teutoburg Forest (AD 9); Treaty of Verdun (843); Louis XIV takes Strasbourg (1681); Treaty of Lunéville (1801); Treaty of Frankfurt (1871); Remagen (1945).
7. $50.94 - 47.56 = 3.38°$. $3.38 \times 111 \approx 375$ km; $3.38 \times 69 \approx 233$ miles.
8. Distance $688 - 498 = 190$ km. Downstream $190 \div 18 \approx 10.6$ h (about 10 h 33 min). Upstream $190 \div 10 = 19$ h.
9. It leaves the Rhine just north of Koblenz (near Rheinbrohl) and ends on the Danube near Regensburg (at Eining).
10. The two rivers bend away from each other, leaving a large corner; a straight land line across it was much shorter than the river line, so it needed fewer troops. It also brought the fertile land inside the corner under Roman control and shortened the roads between the Rhine and Danube armies.
11. The deepest channel is where boats travel, so putting the border there gives both countries access to the navigable water. A bank line would hand the whole river to one side, and the

middle of the water can lie over shallows no boat can use.

12. A strong answer notes that the Rhine is a clear, defensible line and was Rome’s frontier for centuries, so the idea has some geographic force. But the claim ignores that the people of Alsace and the Rhineland mostly spoke German dialects; that the valley is one economic region joined by the river; that the Middle Kingdom of 843 showed the Rhine lands had their own history; and that the river is a highway as much as a wall, as the Rhine Commission (1815) and the shipping of today show. The answer should conclude that nature offers a line, but people and treaties decide whether it becomes a border.

2.2 The Danube: Rome's Other Frontier and the Road of Empires

OBJECTIVES

- Explain how the Danube served as Rome's northern frontier from Raetia to the Black Sea, and why Trajan bridged it to conquer Dacia (101–106).
- Describe the Danube as a corridor of chains of basins and gates (the Vienna gap, the Pannonian Plain, the Iron Gates) and trace the empires that moved along it, from the Huns to the Ottomans and Habsburgs.
- Use river kilometers, gradients and march rates to compare travel up and down the Danube.

> **Warm-up.** Take a long strip of paper (two sheets taped end to end). Without looking anything up, draw the Danube from left to right and mark every city or country you think it passes. Then fold the strip into "rooms" at the narrow places where you think the river might squeeze through hills. Keep the strip; you will correct it at the end of the lesson.

> **Watch.** *11th August 106: Roman Emperor Trajan declares Dacia (modern Romania) a Roman province* (HistoryPod, 2:35). https://www.youtube.com/watch?v=iKrOSnn7ReY
> After the story: see how Trajan's Dacian Wars ended in AD 106 and how Dacia became a Roman province on the far side of the Danube.
> **Note:** Captions were not available to check; preview it first. It mentions that King Decebalus killed himself to avoid capture. Uses 'CE' rather than 'AD'. The province was declared in 106; the lesson dates the bridge to about 105.

KEY TERMS

basin
A broad, low area of land surrounded by higher ground, such as the Pannonian (Great Hungarian) Plain.

gorge
A narrow, steep-sided valley cut by a river through hills or mountains. The Iron Gates gorge is the Danube's greatest.

gate (gap)
A narrow passage between basins, such as the gap near Vienna and Bratislava. Whoever holds a gate controls movement through it.

confluence
The place where two rivers join. Belgrade stands at the confluence of the Sava and the Danube.

Military Frontier

The Habsburg border zone facing the Ottoman Empire, settled by soldier-farmers who held land in return for military service.

delta
The fan of channels and marshes where a river drops its silt and meets the sea. The Danube delta lies in Romania and Ukraine.

CORE IDEAS

The story. In about AD 105, at Drobeta, in what is now Romania, Roman soldiers finished one of the wonders of the ancient world: a bridge across the Danube more than 1,100 m (about 3,700 feet) long. It was designed by Apollodorus of Damascus, Trajan's architect. Twenty great stone piers rose from the riverbed and carried wooden arches. Upstream, in the narrow gorge called the Iron Gates, Roman engineers had already cut a road into the cliffs, held out over the water on beams, and a stone tablet carved in the rock face, the Tabula Traiana, dated AD 100, still records the work. The road and the bridge served one purpose: to carry legions north against Decebalus, king of the Dacians. Trajan's second war ended in 106 with Decebalus dead and Dacia, with its gold mines, a Roman province. The bridge stayed the longest arch bridge in the world for more than a thousand years. In AD 113 Trajan's Column rose in Rome with the campaigns carved around it like a scroll.

Rome's other frontier. The Danube runs about 2,850 km (1,770 miles) from the Black Forest in Germany to the Black Sea. With the Rhine it formed one long northern frontier across Europe. Along its south bank lay the Roman provinces of Raetia, Noricum, Pannonia and Moesia, and along it stood fortresses whose names hide under modern cities: Castra Regina (Regensburg), Vindobona (Vienna), Carnuntum, Aquincum (Budapest) and Singidunum (Belgrade). River fleets patrolled the water. Dacia was the one great province north of the river, and about 271 the emperor Aurelian gave it up and pulled the frontier back to the Danube, a shorter line to hold. Marcus Aurelius spent years fighting the Marcomanni and Quadi across the middle Danube; headings in his *Meditations* place parts of the book among the Quadi on the Gran and at Carnuntum. In 376 a people called the Goths, fleeing the Huns, begged to cross the Danube. The emperor Valens let them in, Roman officials mistreated them, and in 378 the Goths destroyed his army at Adrianople and killed him. The frontier had failed from the inside.

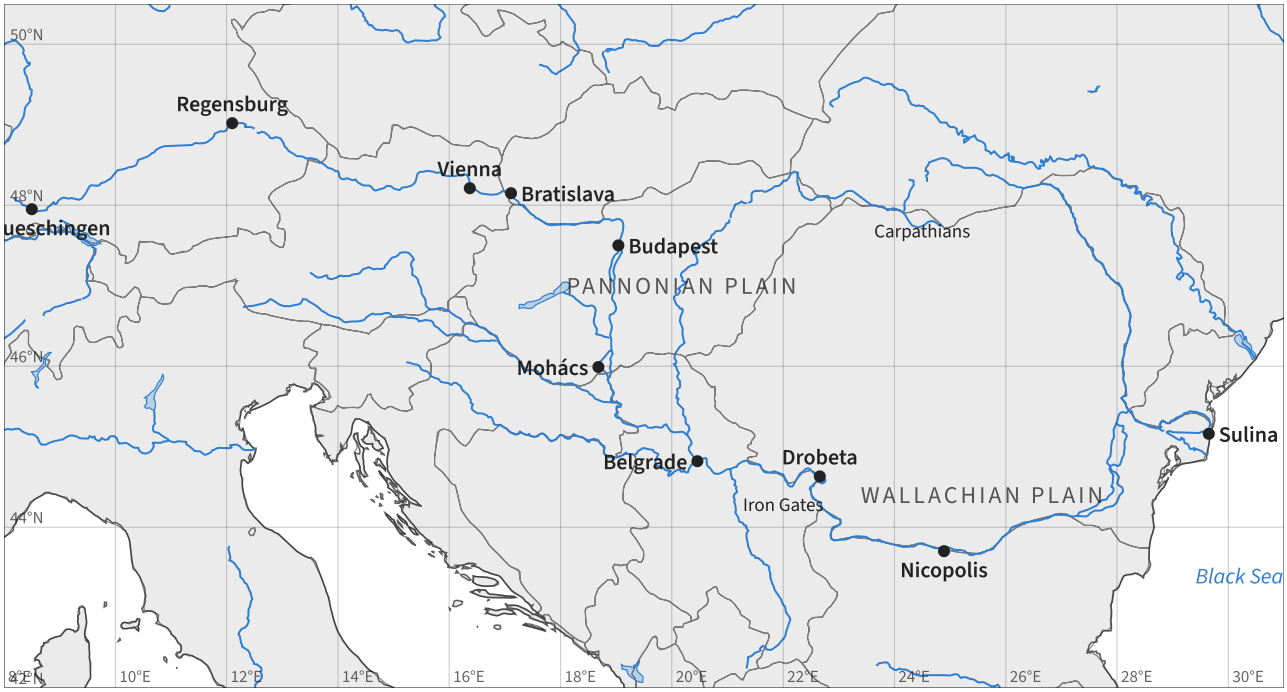
The big idea. The Rhine flows along a frontier; the Danube flows through one. Its valley is a chain of basins joined by narrow gates: the upper Danube in Bavaria and Austria, the Vienna basin, the gate near Vienna and Bratislava, the wide Pannonian Plain of Hungary, the Iron Gates gorge between the Carpathians and the Balkan Mountains, the flat Wallachian Plain, and the delta. Because the river points from Central Europe toward the Black Sea and the steppe, it was a road in both directions. Up it came the Huns under Attila, the Avars, and the Magyars, who settled the Pannonian Plain in the 890s and became the Hungarians. Down it went crusaders: the People's Crusade of 1096 and Frederick Barbarossa's army in 1189. Whoever held the gates held the road.

The road of empires. The Ottoman Turks came up the Danube from the southeast. In 1396 they crushed a crusading army at Nicopolis on the lower river. In 1456 John Hunyadi broke

Sultan Mehmed II’s siege of Belgrade, where the Sava meets the Danube. In 1526, on the river plain at Mohács, Suleiman the Magnificent destroyed the Hungarian army; King Louis II drowned in his flight, and Hungary was split for a century and a half. Suleiman besieged Vienna in 1529, and in 1683 the grand vizier Kara Mustafa besieged it again until King Jan III Sobieski of Poland led the relieving army down the hills on September 12 and broke the siege. The river was the Ottoman supply line: barges carried guns, grain and powder upstream. After 1683 the Habsburg armies rolled the frontier back down the river, and the Treaty of Karlowitz (1699) returned most of Hungary to them. Belgrade, at its confluence, changed hands again and again. Along the new line the Habsburgs settled soldier-farmers in the Military Frontier, a living wall facing the Ottomans for nearly two centuries.

On the map. The Danube passes through or along ten countries, more than any other river, and four capitals: Vienna, Bratislava, Budapest and Belgrade (see the map). Today it forms borders between Slovakia and Hungary, Croatia and Serbia, Serbia and Romania, Romania and Bulgaria (for about 470 km, the longest stretch), and Romania and Ukraine. Rivers that move make trouble here too: Croatia holds that its border follows old land-survey lines drawn when the river ran elsewhere, while Serbia holds that it follows the river as it runs now, and as of 2026 the dispute over pockets of land along the river remained unresolved.

Technology overcoming geography. For centuries the rapids of the Iron Gates stopped through traffic. In 1829 the Danube Steamship Company began service from Vienna, and the Hungarian reformer Count István Széchenyi pushed for steam navigation and for the Chain Bridge, opened in 1849, the first permanent bridge between Buda and Pest. After the Crimean War, the Treaty of Paris (1856) set up a European Commission of the Danube to deepen the Sulina mouth. Austria-Hungary blasted a ship canal through the worst rocks of the Iron Gates, opened in 1896, and in 1972 Romania and Yugoslavia completed the Iron Gate I dam, which drowned the rapids (and the island town of Ada Kaleh) under a deep lake and made electricity. In 1992 the Rhine–Main–Danube Canal opened: 171 km with 16 locks, climbing to about 406 m above sea level over the divide between the two great rivers, so a barge can now travel from the North Sea to the Black Sea. The road Trajan cut into the cliffs has become a highway for the whole continent.



The Danube: a chain of basins and gates from Germany to the Black Sea. Note the gate near Vienna and Bratislava and the Iron Gates gorge near Drobeta.

PICTURE STUDY

Trajan's Column (scenes of the Danube crossing and Trajan's bridge), Unknown Roman sculptors; the design is often attributed to Apollodorus of Damascus, Dedicated AD 113 · Marble column about 30 m (100 Roman feet) tall, wrapped by a spiral relief frieze about 190 m long · Trajan's Forum, Rome. Full-size casts are in the Victoria and Albert Museum, London, and the National History Museum of Romania, Bucharest (the photograph here shows the Bucharest cast).

Trajan's Column tells the story of the two Dacian Wars in more than 150 scenes that wind 23 times around the shaft from bottom to top. It is one of the best records we have of how

Roman soldiers looked, marched, built and fought. Near the beginning, a huge bearded river god, the Danube himself, rises from the water to watch the legions cross on a bridge of boats.

Later in the frieze, in the second war, Trajan stands at an altar before a great bridge on stone piers with wooden arches: Apollodorus's bridge at Drobeta. The column turns a river crossing into a picture of power: Rome could put a road across the largest river in its empire.

Look closely

- Find the river god. How does the sculptor show that he is part of the water?
- Find the bridge of boats. How are the boats tied together, and what are the soldiers carrying?
- Find the stone piers of Trajan's bridge. How many can you count in the scene, and what sits on top of them?
- Look at the soldiers working (digging, building, carrying timber). What does that tell you about how Rome won wars?

Talk about it

1. Why would Trajan want the river god shown welcoming the army?
2. The frieze winds high above the ground where no one could see the top clearly. Who do you think it was made for?
3. What does the column suggest about whether a river can stop an empire that has engineers?

PROJECT: THE DANUBE RIBBON: A RIVER-KILOMETER STRIP MAP AND PROFILE

Rivermen measure the Danube in kilometers counted upstream from its mouth at Sulina. You will build a long ribbon map of the river, marked like a navigation chart, with an elevation profile beneath it, and use it to see why the gates and gorges mattered so much.

You will need

- A strip of paper about 3 m (10 feet) long (adding-machine tape, a roll of craft paper, or taped sheets)
- Meter stick or tape measure, pencil and colored markers
- Atlas or the lesson map
- Small sticky notes or paper flags

Steps

1. Choose a scale of 1 m of paper = 1,000 river km. Mark the right end "km 0, Sulina, Black Sea" and the left end "km 2,850, Donaueschingen (source)."
2. Mark these places at their river kilometers (approximate): Regensburg km 2,380; Vienna km 1,930; Bratislava km 1,870; Budapest km 1,650; Mohács km 1,450; Belgrade km 1,170; Iron Gate I dam km 943; Nicopolis km 600; Sulina km 0.

3. Shade the gates and gorges: the gap near Vienna and Bratislava, and the Iron Gates (roughly km 1,040 to 943).
4. Below the ribbon, draw an elevation profile: about 680 m at the source, about 160 m at Vienna, about 100 m at Budapest, about 70 m at Belgrade, near sea level at the mouth. Use a vertical scale of 1 cm = 50 m.
5. Add colored flags for empires and battles: Roman fortresses (red), Ottoman battles and sieges (green), crusades (blue), Habsburg gains (yellow).
6. Mark which stretches are borders today, with the two countries named on each bank.
7. Write a caption: Where is the river steepest? Where was it hardest to pass? Where were the most battles?

Tips

- Measure every mark from the right end (km 0) so errors do not add up.
- River kilometers are counted along the channel, so they are longer than straight-line distances on a map.

Check your work

- I can place the major Danube cities and gates in the right order and at about the right river kilometer.
- I can read the profile and say where the river falls fastest.
- I can point to the stretches where the Danube is a border today.

MAP NOTEBOOK

1. Sketch one pier and arch of Trajan’s bridge, using the column relief as your guide. Label stone pier, wooden arch and deck.
2. Draw the Danube as a chain of “rooms” (basins) joined by “doors” (gates). Label each room and door.
3. Make a timeline of the Ottoman advance and retreat on the Danube: Nicopolis 1396, Belgrade 1456, Mohács 1526, Vienna 1529, Vienna 1683, Karlowitz 1699.

> **From history.** When Count István Széchenyi’s father died in 1820, ice and floods on the Danube kept the young count from crossing from Pest to Buda for about a week, too late for the funeral. Széchenyi later championed a permanent bridge. The Chain Bridge, designed by the English engineer William Tierney Clark and built under the Scottish engineer Adam Clark (no relation), opened in 1849 and became the symbol of a united Budapest.

WORKED EXAMPLES

Example 1. The Danube falls from about 680 m above sea level at its source near Donaueschingen to sea level at the Black Sea, over about 2,850 km. What is its average gradient in meters per kilometer and centimeters per kilometer? Why would a river with this gradient be a good highway?

1. Gradient = drop ÷ distance = 680 m ÷ 2,850 km ≈ 0.24 m/km.
2. In centimeters: 0.24 m × 100 = 24 cm per km (about 1.3 feet per mile).
3. A gentle fall means a slow current most of the way, so boats can go upstream as well as down, except where the drop is bunched up in rapids such as the Iron Gates.

Answer: About 0.24 m/km, or 24 cm per km. The gentle average slope makes most of the river navigable both ways; the trouble spots are where the fall is concentrated in gorges.

Example 2. Vienna is at about Danube-km 1,930 and Budapest at about km 1,650 (river kilometers are counted from the mouth). A boat makes 20 km/h downstream and 10 km/h upstream. Find the river distance and the time each way.

(Use the map or drawing "Vienna and Budapest on the middle Danube." shown earlier in this lesson.)

1. Distance: 1,930 − 1,650 = 280 km (about 174 miles).
2. Downstream (Vienna to Budapest): 280 ÷ 20 = 14 hours.
3. Upstream (Budapest to Vienna): 280 ÷ 10 = 28 hours.
4. The upstream trip takes twice as long, which is why armies going up the Danube moved more slowly than traders floating down.

Answer: 280 km; 14 hours downstream and 28 hours upstream.

Example 3. Suleiman's army left Istanbul (41.01° N, 28.98° E) on May 10, 1529, and began the siege of Vienna (48.21° N, 16.37° E) on September 27. Estimate the straight-line distance, the number of days, and the average progress per day.

1. North–south: 48.21 − 41.01 = 7.20°; 7.20 × 111 ≈ 799 km.
2. East–west: 28.98 − 16.37 = 12.61°. At the middle latitude (about 44.6°), cos 44.6° ≈ 0.712, so 12.61 × 111 × 0.712 ≈ 997 km.
3. Straight line ≈ $\sqrt{(799^2 + 997^2)}$ ≈ √1,632,000 ≈ 1,280 km (about 795 miles).
4. Days: May 11–31 = 21, June 30, July 31, August 31, September 1–27 = 27; total 140 days.
5. Rate: 1,280 ÷ 140 ≈ 9 km (about 6 miles) per day in a straight line. The real road was longer, and heavy rains that summer slowed the army so much that much of the heavy artillery was left behind.

Answer: About 1,280 km in a straight line over 140 days, roughly 9 km per day. The army reached Vienna so late in the year that the coming of winter helped end the siege by mid-October.

PRACTICE

1. EASY Where does the Danube begin, and where does it end?
2. EASY Name the four capital cities on the Danube.
3. EASY Who designed the bridge at Drobeta, for which emperor, and for what war?
4. EASY Convert the length of the Danube, about 2,850 km, to miles.
5. MEDIUM Put in order: Treaty of Karlowitz; Battle of Adrianople; Battle of Mohács; Magyars settle the Pannonian Plain; siege of Vienna relieved by Sobieski; Battle of Nicopolis.
6. MEDIUM Belgrade is at about Danube-km 1,170 and the Iron Gate I dam at about km 943. How far is it by river, and how long would a barge take at 15 km/h downstream?
7. MEDIUM Using the map, name in order the pairs of countries the Danube separates from Belgrade to the Black Sea.
   (Use the map or drawing "Follow the lower Danube to the sea." shown earlier in this lesson.)
8. MEDIUM The Rhine–Main–Danube Canal is 171 km long with 16 locks. What is the average distance between locks? What geographic obstacle do the locks overcome?
9. HARD Explain why the gate near Vienna and the Iron Gates were so important in war. Use the words basin and gate.
10. HARD Why did Aurelian abandon Dacia about 271, and how does that decision show a river's value as a frontier?
11. HARD Vienna is at 48.21° N, 16.37° E and Belgrade at 44.82° N, 20.46° E. Estimate the straight-line distance. The river distance is about 1,930 − 1,170 = 760 km. What is the ratio of river distance to straight-line distance?
12. CHALLENGE In a paragraph, compare the Rhine and the Danube as Roman frontiers and as roads for later empires. Which river flows along a frontier and which flows through

one? Use at least three examples.

COMMON MISTAKES

- Confusing the Danube's river kilometers with the Rhine's. Danube kilometers are counted upstream from the mouth (km 0 at Sulina); Rhine kilometers are counted downstream from Konstanz.
- Thinking the Danube flows only through Germany and Austria. It crosses or borders ten countries before reaching the Black Sea.
- Assuming a river frontier keeps people out. Rome's Danube line failed when the Goths were allowed across in 376 and then mistreated; frontiers depend on armies and policy as well as water.

Make it a game · Gatekeeper. Lay your Danube ribbon on the floor. One player is the Gatekeeper and stands at a gate (Vienna or the Iron Gates). The other is a traveler (a Roman legion, a Magyar band, a crusader army, an Ottoman supply fleet or a modern barge) and must name the date and goal of the journey. The Gatekeeper asks one question about that journey from the lesson; a correct answer lets the traveler pass. Reach the other end of the river to win, then switch roles.

Scripture. "And he changeth the times and the seasons: he removeth kings, and setteth up kings: he giveth wisdom unto the wise, and knowledge to them that know understanding:" (Daniel 2:21, KJV)

Romans, Huns, Magyars, Ottomans and Habsburgs all held the Danube for a time, and all passed. Daniel reminds us that empires rise and fall under the hand of God, who gives wisdom to those who seek it.

Practice answers

1. It begins in the Black Forest of southwestern Germany (at Donaueschingen) and ends in a delta on the Black Sea, in Romania and Ukraine.
2. Vienna, Bratislava, Budapest and Belgrade.
3. Apollodorus of Damascus, for Trajan, to carry the army across the Danube in the war against the Dacians under Decebalus.
4. 2,850 × 0.621 ≈ 1,770 miles.
5. Adrianople (378); Magyars settle (890s); Nicopolis (1396); Mohács (1526); Vienna relieved (1683); Karlowitz (1699).
6. 1,170 − 943 = 227 km. 227 ÷ 15 ≈ 15.1 hours (about 15 hours).
7. Serbia and Romania (through the Iron Gates), then Romania and Bulgaria, then (after a stretch inside Romania) a few hundred meters of Romania and Moldova at Giurgiulești, and finally Romania and Ukraine near the delta.
8. 171 ÷ 16 ≈ 10.7 km between locks on average. The locks lift barges up and over the watershed (divide) between the Rhine and Danube basins, about 406 m above sea level at the summit.

9. The Danube valley is a chain of basins joined by narrow gates. An army or trader moving along the river had to pass through the gates, so a fortress or army at a gate could block or control all traffic between two basins. Vienna guards the gate between the Pannonian Plain and the Alpine and Central European lands; the Iron Gates guard the passage between the Pannonian and Wallachian plains.
10. Dacia stuck out north of the Danube and was hard to defend on three sides while the empire was under pressure. Pulling back to the Danube gave a shorter, clearer line with a moat in front and a river road behind it for moving troops and supplies.
11. North–south: $3.39° \times 111 \approx 376$ km. East–west: $4.09° \times 111 \times \cos 46.5°$ (≈ 0.688) ≈ 312 km. Straight line $\approx \sqrt{(376^2 + 312^2)} \approx 489$ km (about 304 miles). Ratio $760 \div 489 \approx 1.55$: the river is about one and a half times as long as the straight line.
12. A strong answer says both rivers formed Rome's northern frontier, with fortresses and fleets (Mainz, Cologne; Vienna, Budapest, Belgrade). The Rhine runs north along the edge between the French and German lands, so later it was mostly a line to fight over. The Danube runs east toward the Black Sea and the steppe, so it became a road for invaders and armies in both directions: Huns, Avars, Magyars, crusaders in 1096 and 1189, the Ottomans at Nicopolis, Mohács and Vienna, and the Habsburgs pushing back after 1683. Engineers eventually tamed both: the Rhine Commission and Tulla, the Iron Gates canal and dam, and the Rhine–Main–Danube Canal joining them.

2.3 The Rio Grande: The Treaty of Guadalupe Hidalgo and a River That Moves

OBJECTIVES

- Explain the causes and terms of the Treaty of Guadalupe Hidalgo (February 2, 1848), including the Texas boundary dispute and how Americans of the time judged the war.
- Distinguish gradual erosion and accretion from sudden avulsion, and apply the rules of the 1884 and 1905 conventions to river changes, using the Chamizal dispute as the main case.
- Compute land prices, areas and river sinuosity for the Rio Grande border.

Warm-up. Fill a baking pan with damp sand and draw a wiggly river channel with your finger. Push a toothpick "border post" into each bank. Slowly pour a cup of water down the channel, then pour a second cup fast. Did the channel move? Did it move a little at a time, or jump? If the border was "the middle of the river," where is the border now?

Watch. *Treaty of Guadalupe Hidalgo* (Pritzker Military Museum & Library, 2:29).
https://www.youtube.com/watch?v=IgvVBR4Pt1k
After the story: this short museum segment covers how the Mexican–American War started along the Rio Grande and ended with the treaty signed on February 2, 1848; listen for how the treaty set the river as the border.
Note: Captions were not available to check; preview it first. It is a short military-history piece about how the war started and ended, with mentions of battles.

KEY TERMS

cession
Land given up by one country to another by treaty. The Mexican Cession of 1848 included California and New Mexico.

meander
A loop in a river. Water flows faster on the outside of a bend, eating that bank, and drops sand on the inside, so meanders slowly migrate.

accretion and erosion
The gradual adding of land to one bank and wearing away of the other. Under U.S.–Mexico treaties, the border moves with the river when the change is gradual.

avulsion
A sudden change of a river's course, as when a flood cuts across the neck of a meander. Under the 1884 convention the border stays in the old bed.

banco
A piece of land cut off by a river's sudden change of course and left on the "wrong" side of the new channel.

International Boundary and Water Commission (IBWC)
The joint U.S.–Mexico body, created in 1889 as the International Boundary Commission, that marks the border and manages the shared rivers.

CORE IDEAS

The story. On February 2, 1848, in the village of Guadalupe Hidalgo, near the shrine of Our Lady of Guadalupe just north of Mexico City, an American diplomat named Nicholas Trist signed a treaty he no longer had the authority to sign. President James K. Polk had recalled him months before. Trist stayed anyway, judging that if he went home, no Mexican government willing to make peace might be found again. Polk was furious, but the treaty gave him what he wanted, and the Senate ratified it on March 10, 1848, by a vote of 38 to 14. Mexico accepted the Rio Grande as the border of Texas and gave up California and New Mexico: the lands that became California, Nevada and Utah, most of Arizona, and parts of New Mexico, Colorado and Wyoming, about 525,000 square miles (1.36 million km²). The United States paid $15 million and took on up to $3.25 million in claims American citizens held against Mexico. Mexicans living in the ceded lands could stay and become American citizens, and their property was to be respected; in practice, many lost their land in the years that followed, especially through long and costly title cases in California.

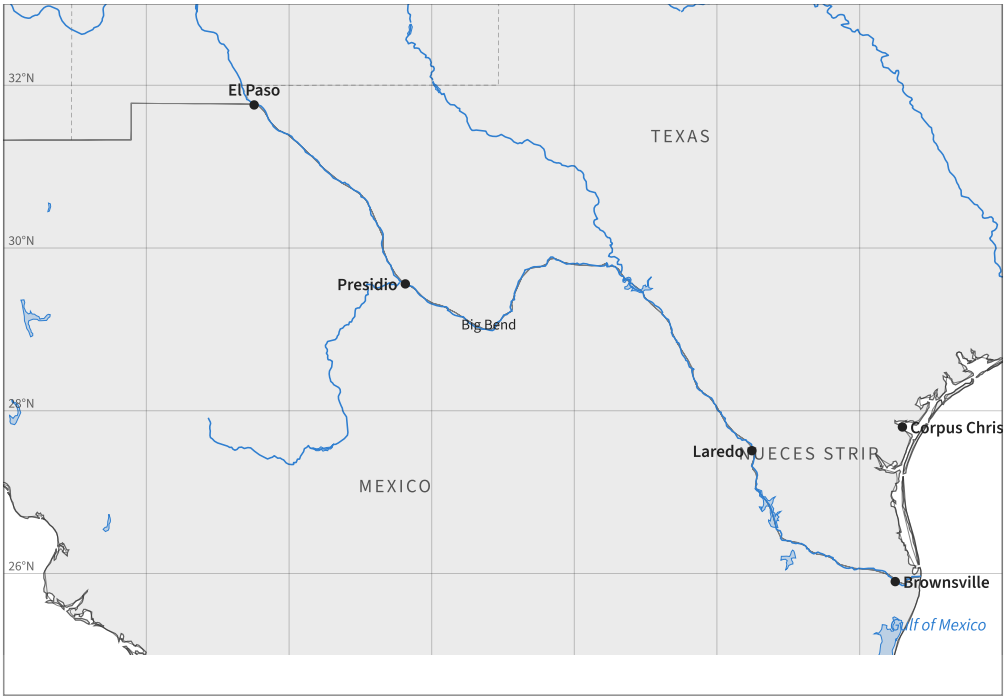
The war behind the line. Texas had won its independence from Mexico in 1836 and claimed the Rio Grande as its border. Mexico never recognized Texas, and in any case held that the province of Texas had ended at the Nueces River, more than 100 miles to the north. When the United States annexed Texas in 1845, it took up the Texas claim. Polk sent General Zachary Taylor to the Rio Grande, and in April 1846 Mexican cavalry attacked an American patrol in the disputed strip. Polk told Congress that Mexico had “shed American blood upon the American soil,” and Congress declared war on May 13, 1846. Many Americans backed the war as a defense of Texas; others doubted it. In December 1847 a young congressman, Abraham Lincoln, demanded to know the exact “spot” where the blood was shed, since he believed it was Mexican soil. Ulysses S. Grant, who fought bravely in the war as a young lieutenant, later wrote that he regarded it “as one of the most unjust ever waged by a stronger against a weaker nation.” Soldiers on both sides showed real courage: Winfield Scott’s march from Veracruz to Mexico City in 1847 was a brilliant campaign, and Mexico still honors the young cadets who died defending Chapultepec Castle on September 13, 1847. A student should understand how men of that day argued the question, and why the border was drawn where it was.

The big idea: rivers move. A river makes a tempting border. It is easy to see, surveyors need not plant a line of stone markers, and both sides can patrol it. But rivers move. Water runs fastest on the outside of a bend, cutting that bank away, and drops sand on the inside, so a meander creeps sideways year after year. Sometimes a flood cuts straight across the neck of a loop in a single night. In 1884 the United States and Mexico agreed on a rule: when the river shifts by slow erosion and accretion, the border moves with it; when it jumps by avulsion, the border stays in the old bed, even if the old bed is dry. That left bancos, pockets of one country’s land stranded on the other side of the river, so a convention of 1905 provided that most bancos would simply pass to the country on whose side they now lay.

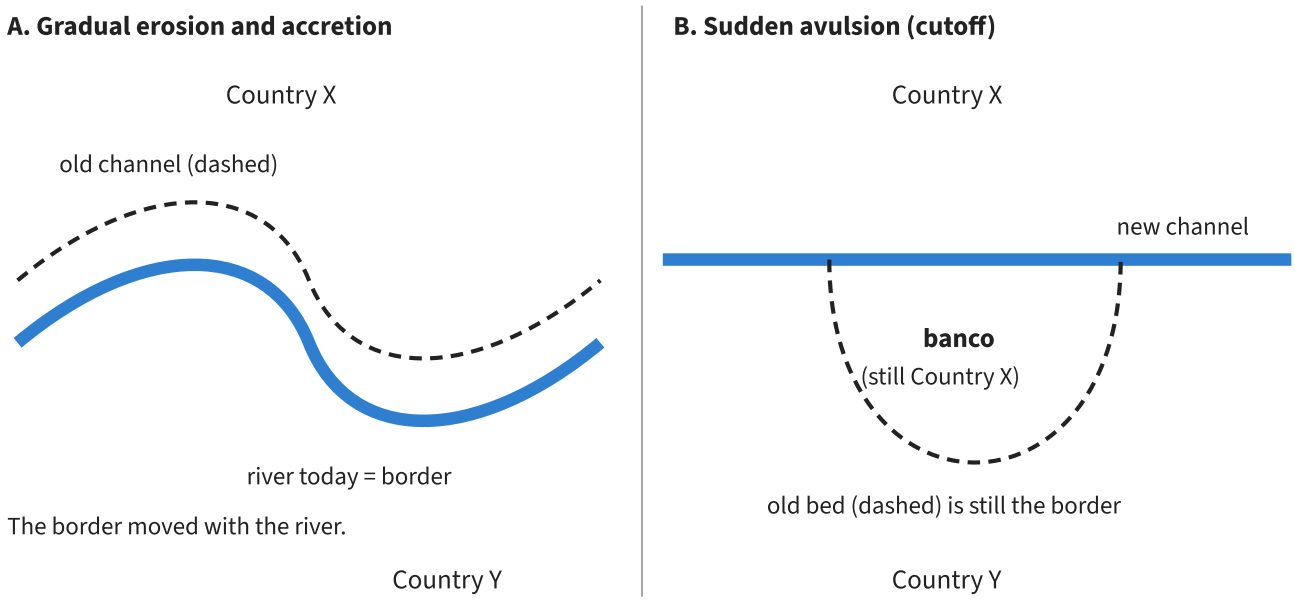
The Chamizal. At El Paso and Ciudad Juárez the rule was tested. Surveys in 1852 had fixed the river's course, but floods, especially in 1864, pushed the Rio Grande south, and a tract called El Chamizal ended up on the El Paso side. El Paso grew onto it. Mexico said the change had been sudden, so the land was still Mexican; the United States said it had been gradual, so the land was American. A 1911 arbitration commission, led by the Canadian jurist Eugène Lafleur, divided the tract, but the United States refused the award, arguing that the commission had gone beyond its instructions. The quarrel lasted another half century. In 1963 the two countries signed the Chamizal Convention: a new concrete-lined channel would carry the river, Mexico would receive 366 acres of the Chamizal and 71 acres east of Cordova Island, and the United States would receive 193 acres of Cordova Island. Several thousand residents of south El Paso had to move. Presidents Lyndon Johnson and Gustavo Díaz Ordaz met to mark the transfer in October 1967, and parks now stand on both banks, including Chamizal National Memorial.

On the map. The Rio Grande, which Mexicans call the Río Bravo del Norte, rises in the San Juan Mountains of Colorado and runs about 1,900 miles (3,060 km) to the Gulf of Mexico (called the Gulf of America by the U.S. government since 2025). From El Paso to the Gulf it forms the border for about 1,250 miles (2,000 km), through the canyons of the Big Bend and past Laredo to Brownsville and Matamoros (see the map). West of El Paso the border runs over dry land along surveyed lines, set after the Gadsden Purchase of 1853, when the United States paid $10 million for about 29,670 square miles south of the Gila River, partly for a southern railroad route.

Technology overcoming geography. Engineering has pinned the moving river down. Under a 1933 convention, the two countries straightened the river through the El Paso–Juárez valley, shortening roughly 155 miles of loops to about 86 miles of fixed channel. The Water Treaty of 1944 divided the waters of the Rio Grande and the Colorado, and the two nations built Falcon Dam (1954) and Amistad Dam (1969) together to store water and stop floods. A treaty of 1970 settled the remaining border questions and kept the line in the middle of the channel. Concrete, levees and dams have made the Rio Grande behave more like a line on a map, but every big flood reminds both countries that a river is a living thing.



The Rio Grande border and the Nueces Strip. Texas, and then the United States, claimed the Rio Grande; Mexico held that Texas ended at the Nueces.



The 1884 rules. Gradual change moves the border; sudden avulsion leaves it in the old bed.

PICTURE STUDY

Mapa de los Estados Unidos de Méjico (the treaty map), Published by John Disturnell, New York, reprinted from the 1828 plates of White, Gallaher & White, which copied Henry S. Tanner's 1826 map, 1847 · Engraved map, hand colored · A copy is bound with the treaty in the U.S. National Archives (this image); other copies are in the Library of Congress.

The negotiators at Guadalupe Hidalgo needed a map to describe the new border, and they used the best one commonly available: a map of Mexico published in 1847 by John Disturnell, a New York publisher, copied largely from Henry S. Tanner's earlier map. The treaty names it, and a copy was attached to the treaty itself.

The map was wrong in an important place. It placed El Paso and the Rio Grande about half a degree too far north and some two degrees too far east. When American and Mexican surveyors went out to mark the line, they quarreled over whether to follow the words of the treaty or the false positions on the map. The quarrel over the Mesilla Valley was one reason for the Gadsden Purchase of 1853.

Look closely

- Find the Rio Grande and follow it from the Gulf up to El Paso. Where does the treaty line leave the river?
- Find the Gila River. Why would a river be chosen for the next stretch of the border?
- Look for the grid of latitude and longitude. How could a mistake in this grid move a border by many miles?
- Look at the title and decorations. Who was this map made to sell to?

Talk about it

1. If a treaty's words and its map disagree, which should rule? Give a reason.

2. Half a degree of latitude is about 35 miles. Why would that error matter to a farmer or a railroad?
3. What does this map show about how much people in 1847 actually knew of the land they were dividing?

PROJECT: THE MOVING RIVER: A BORDER MODEL IN SAND

This is the unit's main model. You will build a meandering river in a sand tray, mark a border down its middle, run water through it, and watch the river move. Then you will apply the 1884 rules to decide where the border goes after each change.

You will need

- A shallow plastic storage bin, paint tray or large baking pan (at least 40 × 60 cm, about 16 × 24 inches)
- Play sand or fine builder's sand, slightly damp
- A pitcher or a hose with gentle flow, and a bucket to catch runoff
- A block of wood or books to tilt one end about 3 to 5 cm
- Toothpicks with paper flags in two colors (two countries), string or yarn for the border, and a ruler
- A phone or camera for before-and-after photos

Steps

1. Fill the bin with damp sand about 5 cm deep. Tilt it slightly and cut a hole or lower the far end so water can drain into the bucket.
2. With your finger, carve a river with at least three meander loops from the high end to the low end.
3. Plant flags of Country X along one bank and Country Y along the other. Lay yarn down the middle of the channel as the border and photograph it from above.
4. Gentle flow (erosion and accretion): pour water slowly for two or three minutes. Watch the outside of each bend wear away and sand build on the inside. Photograph it. Move the yarn to the new middle of the channel, as the 1884 rule says.
5. Flood (avulsion): pour fast or make a small cut across the narrowest neck of one loop, so the river jumps across. Photograph it. Leave the yarn in the old bed, as the 1884 rule says, and mark the cut-off land with a third flag: a banco.
6. Measure each loop: the length along the channel (lay a string along it) and the straight distance across. Compute the sinuosity (channel length ÷ straight length) before and after the flood.
7. Decide the banco's fate under the 1905 convention and write it on a card.
8. Finish with a photo sequence or drawing on poster board showing four stages: original, gradual change, flood, settlement.

Tips

- Damp, not wet, sand holds channel walls best. Mix in a little clay or flour if the banks collapse.
- The outside of a bend is called the cut bank and the inside the point bar. Watch for both.
- Work outside or on a towel; the runoff will be muddy.

Check your work

- I can show where a river erodes and where it deposits in a meander.
- I can apply the 1884 rules to a gradual change and to an avulsion.
- I can explain what a banco is and how the 1905 convention handled it.
- I can compute sinuosity from my own measurements.

MAP NOTEBOOK

1. Draw a single meander from above. Label the cut bank, the point bar, the fastest current and the direction the loop is moving.
2. Draw the two-panel “1884 rules” diagram from memory: gradual change and avulsion, with the border marked in each.
3. Sketch the outline of the Mexican Cession and the Gadsden Purchase on a small map of the United States, with the Rio Grande and the Gila River labeled.

> **From history.** When the Chamizal was finally transferred in 1967, the two governments built a new channel about 4.4 miles long, lined with concrete, so the river could no longer wander there. A new bridge, the Bridge of the Americas, was built over the new channel. On the American side, Chamizal National Memorial, run by the National Park Service, was set aside to honor the peaceful settlement of the dispute by diplomacy.

WORKED EXAMPLES

Example 1. The United States paid $15 million for the Mexican Cession (about 525,000 square miles) in 1848, and $10 million for the Gadsden Purchase (about 29,670 square miles) in 1853. Find the price per square mile and per acre for each. (1 square mile = 640 acres.)

1. Cession per square mile: $15,000,000 ÷ 525,000 ≈ $28.57.
2. Cession per acre: $28.57 ÷ 640 ≈ $0.045, about 4½ cents.
3. Gadsden per square mile: $10,000,000 ÷ 29,670 ≈ $337.
4. Gadsden per acre: $337 ÷ 640 ≈ $0.53, about 53 cents.
5. The Gadsden land cost about twelve times as much per acre, because the United States wanted a specific strip for a railroad route and to settle the Mesilla dispute. (The Cession figure leaves out the $3.25 million in claims and the cost of the war.)

Answer: Cession: about $28.57 per square mile (about 4½¢ an acre). Gadsden: about $337 per square mile (about 53¢ an acre).

Example 2. Under the Chamizal Convention of 1963, Mexico received 366 acres of the Chamizal plus 71 acres east of Cordova Island, and the United States received 193 acres of Cordova Island. How many acres did each side receive, what was Mexico's net gain, and what is that net gain in km² and square miles? (1 acre ≈ 0.004047 km²; 640 acres = 1 square mile.)

(Use the map or drawing "The Chamizal turned on which of these two kinds of change had happened." shown earlier in this lesson.)

1. Mexico received 366 + 71 = 437 acres.
2. The United States received 193 acres.
3. Net gain to Mexico: 437 − 193 = 244 acres.
4. In km²: 244 × 0.004047 ≈ 0.99 km², almost exactly 1 km².
5. In square miles: 244 ÷ 640 ≈ 0.38 square mile.

Answer: Mexico 437 acres, United States 193 acres; net gain to Mexico 244 acres, about 1 km² (0.38 square mile).

Example 3. El Paso is at 31.76° N, 106.49° W and Brownsville at 25.90° N, 97.50° W. The Rio Grande border between them is about 1,250 miles long. Estimate the straight-line distance and the sinuosity (river length ÷ straight-line length).

(Use the map or drawing "Compare the winding river with a straight line from El Paso to Brownsville." shown earlier in this lesson.)

1. North–south: 31.76 − 25.90 = 5.86°; 5.86 × 69 ≈ 404 miles.
2. East–west: 106.49 − 97.50 = 8.99°. At the middle latitude (about 28.8°), cos 28.8° ≈ 0.876, so 8.99 × 69 × 0.876 ≈ 543 miles.
3. Straight line ≈ $\sqrt{(404^2 + 543^2)}$ ≈ $\sqrt{458{,}000}$ ≈ 677 miles (about 1,090 km).
4. Sinuosity = 1,250 ÷ 677 ≈ 1.85.

Answer: About 677 miles in a straight line; sinuosity about 1.85, so the river border is nearly twice as long as a straight line.

PRACTICE

1. EASY When and where was the Treaty of Guadalupe Hidalgo signed, and who signed for the United States?
2. EASY What did the United States pay under the treaty?
3. EASY What do Mexicans call the Rio Grande, and where does the river begin?
4. EASY Define a banco.
5. MEDIUM Apply the 1884 rules. (a) Over twenty years the river slowly eats 300 feet into the Mexican bank. (b) In one night's flood the river cuts across the neck of a loop, leaving 40 acres of U.S. land south of the new channel. Where is the border in each case?
6. MEDIUM Convert the 1,250-mile Rio Grande border to kilometers.
7. MEDIUM The 1933 rectification shortened about 155 miles of river to about 86 miles. By how many miles and what percentage was it shortened?
8. MEDIUM On the map, find the Nueces Strip. Which city stands at the mouth of the Nueces, and which at the mouth of the Rio Grande? Why did the strip matter in 1846? *(Use the map or drawing "The disputed strip lies between the two rivers." shown earlier in this lesson.)*
9. MEDIUM Why did both Mexico and the United States care whether the Chamizal changes of the 1860s were sudden or gradual?
10. HARD A model meander in your sand tray measures 48 cm along the channel and 20 cm in a straight line. After a flood cuts the neck, the channel measures 26 cm. Find the sinuosity before and after.
11. HARD Summarize how Polk, Lincoln and Grant each judged the start of the war, and explain how the Nueces Strip was at the heart of the disagreement.
12. CHALLENGE You are drafting a treaty for two countries divided by a meandering river. In a paragraph, propose the rules your treaty should use for (a) gradual change, (b) sudden

avulsion, (c) bancos, and (d) keeping the river in place. Defend each choice with a lesson from the Rio Grande.

COMMON MISTAKES

- Thinking the border always follows the river wherever it goes. Under the 1884 rules, it follows only gradual change; after an avulsion it stays in the old bed.
- Confusing the Mexican Cession (1848) with the Gadsden Purchase (1853). The Cession was the treaty land; Gadsden was a later purchase of a strip south of the Gila.
- Assuming everyone in 1846 agreed about the war. Americans argued sharply about it at the time, and the dispute over the Nueces Strip was real.

Make it a game · Accretion or Avulsion?. One player reads a river event (a bank slowly eaten over years; a loop cut off in one flood; a sandbar slowly building; a dam break that sends the river down a new valley). The other must call “Accretion!” or “Avulsion!” and say where the border goes under the 1884 rules. A correct call and border earns two points; a correct call alone earns one. After six rounds, the loser must explain the Chamizal story in one minute.

Scripture. “Remove not the ancient landmark, which thy fathers have set.” (Proverbs 22:28, KJV)

In Israel, boundary stones protected each family’s inheritance, and moving them was theft. When a river moves a border, honest neighbors need agreed rules and patient diplomacy, as the Chamizal settlement finally showed.

Practice answers

1. February 2, 1848, at Guadalupe Hidalgo, just north of Mexico City; Nicholas Trist signed for the United States.
2. $15 million, plus assuming up to $3.25 million in claims of American citizens against Mexico.
3. The Río Bravo (del Norte). It begins in the San Juan Mountains of Colorado.
4. A piece of land cut off by a sudden change in the river’s course and left on the other side of the new channel.
5. (a) Gradual erosion: the border moves with the river, about 300 feet south into what had been Mexico, and the land that builds up on the U.S. bank becomes American. (b) Avulsion: the border stays in the old bed, so the 40 acres remain U.S. land, a banco south of the river (under the 1905 convention it would usually pass to Mexico).
6. $1{,}250 \times 1.609 \approx 2{,}010$ km.
7. $155 - 86 = 69$ miles; $69 \div 155 \approx 0.445$, about 45 percent.
8. Corpus Christi is at the mouth of the Nueces; Brownsville (with Matamoros across the river) is near the mouth of the Rio Grande. Texas and the United States claimed the land to the Rio Grande, while Mexico held that Texas ended at the Nueces, so the April 1846 clash took place on land both sides claimed.
9. Under the 1884 rules, gradual change would make the tract American (the border moves with the river), while sudden change would leave it Mexican (the border stays in the old bed). The kind of change decided who owned land on which part of El Paso had been built.

10. Before: 48 ÷ 20 = 2.4. After: 26 ÷ 20 = 1.3. The cutoff nearly halved the sinuosity.
11. Polk said Mexico had shed American blood on American soil, treating the land to the Rio Grande as part of Texas and so of the United States. Lincoln's "spot" resolutions challenged him to show the exact spot, implying the clash was on Mexican soil. Grant later called the war one of the most unjust ever waged by a stronger nation against a weaker one. The disagreement turned on whether the strip between the Nueces and the Rio Grande belonged to Texas or to Mexico.
12. A strong answer might: (a) let the border follow the river for gradual change, because it keeps the line in the water both sides can see (1884); (b) keep the border in the old bed for avulsion so a single flood cannot take a farm or town from a country, while requiring a joint survey after any flood; (c) transfer bancos to the country on whose side they now lie, perhaps with limits on size and population, as the 1905 convention did, to avoid stranded pockets; and (d) create a joint commission like the IBWC with power to fix and maintain the channel, since the Chamizal shows how a quarrel can last a century and the 1933 rectification and 1963 concrete channel show that engineering can settle it.

2.4 The Amur and the Ussuri: The Treaty of Aigun and the 1969 Border Clash

OBJECTIVES

- Explain how the Russia–China border moved from the mountain watershed of the Treaty of Nerchinsk (1689) to the Amur and Ussuri rivers by the Treaty of Aigun (1858) and the Convention of Peking (1860).
- Compare three ways to draw a border in a river (bank, median line, thalweg) and use them to explain the 1969 clash on Zhenbao (Damansky) Island and its settlement in 1991 and 2004–2008.
- Compute areas, distances and seasonal limits for the Amur frontier.

Warm-up. Fill a clear loaf pan or plastic box with water. Lay a ruler across the top as the "surface" and press a ball of clay against one side of the bottom so the water is deep on one side and shallow on the other. Drop a small cork or bottle cap "island" near the shallow side. Now ask: if the border runs down the middle of the water, whose is the island? If it runs along the deepest water, whose is it? If it runs along one bank, whose is it?

Watch. *Why did China give up so much of Siberia to Russia?* (History Matters, 4:21).
https://www.youtube.com/watch?v=UNT90coKeZI
After the story: watch how Russia gained land from China north of the Amur and east of the Ussuri, and listen for the Treaties of Nerchinsk and Aigun.
Note: Captions were not available to check; preview it first. History Matters sometimes uses light, sarcastic humor. The description says 'hundreds of thousands of miles' of territory, which is a loose figure; the lesson's numbers should take priority.

Backup video. *The Sino Soviet Split: Explained* (History Matters, 3:42).
https://www.youtube.com/watch?v=M24mK3o8Qzw
As review: see why Communist China and the Soviet Union split, which set the stage for the 1969 fighting on the Ussuri River. Note: Captions were not available to check; preview it first. The description is flippant in tone, and the video may say little about the 1969 Zhenbao Island clash itself.

KEY TERMS

watershed (divide)
The high ground separating two river basins. The Treaty of Nerchinsk used mountain watersheds north of the Amur as the border.

median line
A border drawn down the exact middle of a river, halfway between the two banks.

thalweg

The line of the deepest channel of a river, where boats travel. Most modern river treaties put the border there.

unequal treaties
The name Chinese governments and historians give to nineteenth-century treaties forced on Qing China by stronger powers, including Aigun (1858) and Peking (1860).

Sino-Soviet split
The break between Communist China and the Soviet Union that grew from the late 1950s into open hostility in the 1960s.

demarcation
Marking a border on the ground (or in the water) with posts, buoys and surveyed points, after a treaty has described it in words.

CORE IDEAS

The story. On May 28, 1858, in the town of Aigun on the right bank of the Amur River, two men signed a treaty that moved a border hundreds of kilometers south. One was Nikolay Muravyov, Russia's governor-general of Eastern Siberia. Since 1854, while Russia fought Britain and France in the Crimean War, he had floated soldiers and settlers down the Amur on rafts and barges and built posts along the north bank, daring the Qing Empire to stop him. The other was the Qing general Yishan. China was in no position to resist: the Taiping Rebellion was tearing apart its heartland, and British and French forces were fighting it on the coast. By the treaty, the whole left (north) bank of the Amur, from the Argun River to the sea, became Russian, about 600,000 km² (230,000 square miles). The land between the Ussuri River and the Pacific was to be held in common for the time being, and only Russian and Chinese ships could sail the Amur, the Ussuri and the Sungari. The tsar made Muravyov a count with the title "Amursky."

How the line moved. The border had once stood far to the north. In the 1680s, Cossacks built a fort at Albazin on the Amur, and Qing armies besieged it. The two empires then signed the Treaty of Nerchinsk in 1689, China's first treaty with a European power. Two Jesuit missionaries at the Qing court, the Frenchman Jean-François Gerbillon and the Portuguese Tomás Pereira, served as interpreters, and the official text was in Latin. Nerchinsk drew the line along the Argun and then along the mountains of the Stanovoy (Outer Khingan) range: a watershed border, giving the whole Amur basin to China for 170 years. Aigun moved the line from the mountain crest down to the river. Two years later, in November 1860, just after British and French troops captured Beijing and burned the Old Summer Palace, the Russian envoy Nikolay Ignatyev offered to mediate and won the Convention of Peking, which gave Russia the land east of the Ussuri down to Korea, about 400,000 km² more. That year Russia founded Vladivostok, "Ruler of the East," on a fine harbor at the southern tip. Chinese governments have long called these the unequal treaties, signed under pressure by a weakened empire.

The big idea. A river border is only as clear as its words. The 1858 and 1860 treaties named the rivers but did not say where in the river the line ran. The Amur and Ussuri are wide, braided rivers with hundreds of islands. There are three common answers. A *bank line* gives

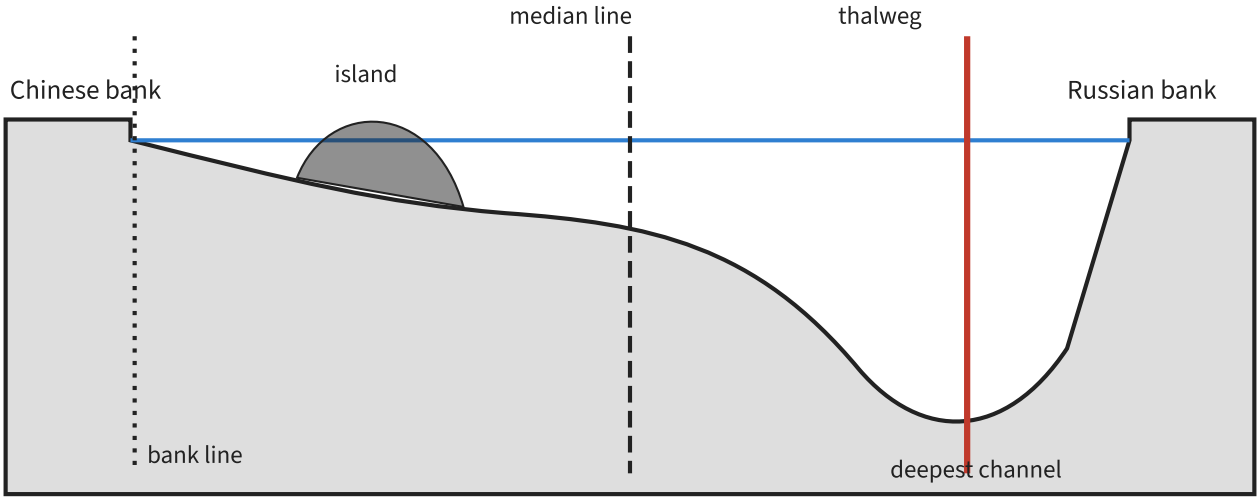
the whole river and every island to one side. A *median line* runs halfway between the banks. A *thalweg* follows the deepest navigable channel, which gives each side the islands on its side of the shipping lane; it became the usual rule for navigable rivers after the Treaty of Lunéville used it for the Rhine in 1801. A map attached to the 1860 treaty showed a red line that Soviet officials read as running along the Chinese bank, which would make nearly every island Soviet. China insisted on the thalweg. For a century the difference hardly mattered. Then the two great Communist powers fell out.

The 1969 clash. By the 1960s Mao Zedong's China and the Soviet Union had broken over ideology and power, and the Soviets had massed troops along the border. Zhenbao Island, which the Russians call Damansky, is a low, flat island of less than 1 km² in the Ussuri, lying closer to the Chinese bank. In winter the river freezes solid and patrols could walk to it; through 1968 the guards of both sides shoved and fought with clubs on the ice. On March 2, 1969, Chinese troops who had dug in on the island at night ambushed a Soviet patrol, killing 31 Soviet border guards; most historians now judge that the Chinese side planned the attack, though Beijing blamed the Soviets. On March 15 a larger battle followed, with tanks, artillery and Soviet BM-21 rocket launchers. A Soviet T-62 tank was knocked out on the ice and later recovered by the Chinese, who still display it in Beijing. Soviet losses totaled about 58 dead; Chinese losses are disputed. More clashes broke out that summer, in August on the Xinjiang border, and both nuclear powers feared a wider war. On September 11, 1969, Soviet Premier Alexei Kosygin met Zhou Enlai at the Beijing airport, and talks began. The fear of the Soviet Union was one reason China opened to the United States, leading to President Nixon's visit in 1972.

On the map. The Amur, which the Chinese call Heilong Jiang, the Black Dragon River, forms from the Shilka and the Argun and runs about 2,800 km (1,750 miles) to the Strait of Tartary (see the map). Blagoveshchensk faces the Chinese city of Heihe across it, and at Khabarovsk the Ussuri flows in from the south. The river carried a dark chapter as well: in July 1900, during the Boxer crisis, Russian authorities at Blagoveshchensk drove the city's Chinese residents into the Amur, and thousands drowned. A settlement finally came. A 1991 agreement fixed most of the border on the thalweg, and Zhenbao went to China. A 2004 agreement divided the last disputed islands near Khabarovsk, giving China Tarabarov Island and about half of Bolshoy Ussuriysky Island, roughly 170 km² in all, transferred in 2008. As of 2026, the whole Russia–China border, about 4,200 km long, is agreed and marked.

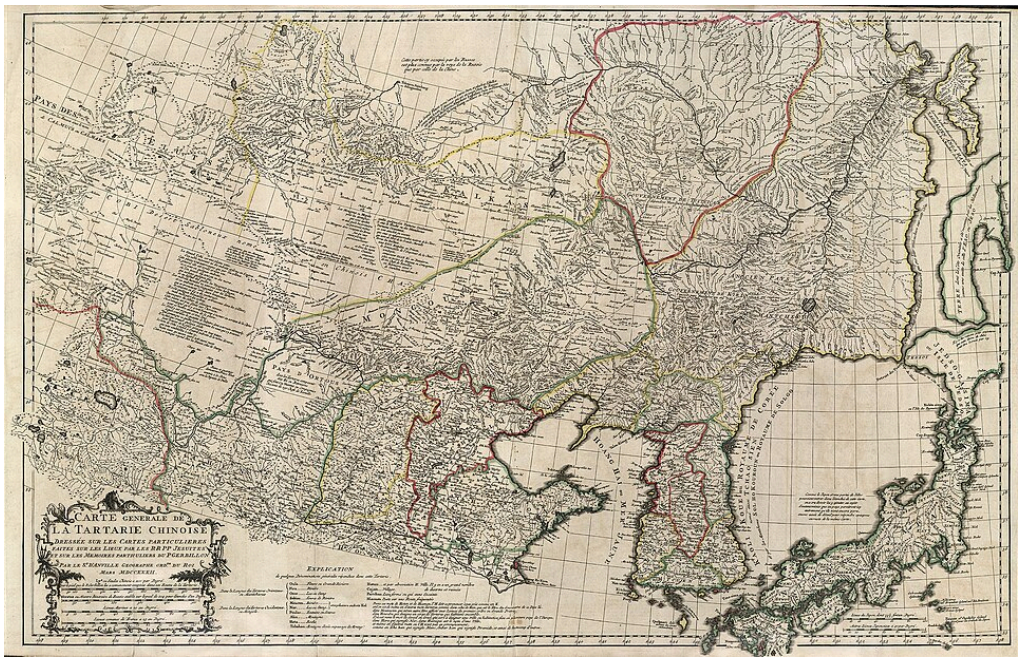
Technology overcoming geography. The Amur freezes for about five months a year, so in winter the river border becomes a road of ice, and in summer it is a highway for steamers. Russia built the Trans-Siberian Railway between 1891 and 1916; the Ussuri line from Vladivostok to Khabarovsk was finished in 1897, and the great Khabarovsk railway bridge over the Amur opened in 1916, completing an all-Russian route to the Pacific. For more than a century no bridge joined the two banks across the border itself. Then a rail bridge between Nizhneleninskoye and Tongjiang and a road bridge between Blagoveshchensk and Heihe both opened to traffic in 2022. A river that once divided rival empires now carries their trade across it.

The Amur and the Ussuri. Nerchinsk (1689) put the border on the mountains to the north; Aigun (1858) and Peking (1860) moved it to the rivers.



Three ways to draw a border in a river. The island's owner depends on which line the treaty uses.

PICTURE STUDY



General Map of Chinese Tartary, from the Nouvel atlas de la Chine, Jean-Baptiste Bourguignon d'Anville, from surveys by Jesuit missionaries for the Kangxi Emperor, 1737 (surveys of 1708–1718) · Copperplate engraving · Published at The Hague in 1737 to accompany Jean-Baptiste Du Halde's description of China (1735); this scan is from the Göttingen State and University Library, and copies are in the Library of Congress and many other map libraries.

Between 1708 and 1718 the Kangxi Emperor of China had Jesuit missionaries, trained in European surveying and astronomy, measure his empire using latitude observations and triangulation. Their survey covered Manchuria and the Amur, the homeland of the Qing dynasty. The French mapmaker Jean-Baptiste Bourguignon d'Anville, who never visited China, turned their results into the finest maps of East Asia Europeans had yet seen, published in Paris and in an atlas at The Hague in 1737.

The map shows the Amur country as it stood under the Treaty of Nerchinsk, a century before Muravyov's barges came downriver. It is a reminder that the border between Russia and China was first fixed with the help of Jesuit missionaries, as interpreters at Nerchinsk and as surveyors for the emperor.

Look closely

- Find the Amur and follow it to the sea. Which large rivers join it from the south?
- Find the mountains drawn north of the Amur. What did the Treaty of Nerchinsk do with them?
- Look at how much detail the map shows near rivers compared with the land between them. Why would surveyors follow rivers?
- Look for lines of latitude. How would accurate latitudes help settle a border?

Talk about it

1. If you were a Qing official in 1737 and saw this map, what would you say was the border of the empire?
2. Why might a ruler pay for an accurate map of his own frontier?
3. How did the work of missionaries at the Qing court help shape a border that still exists?

PROJECT: WHOSE ISLAND? A RIVER CROSS-SECTION MODEL

You will build a cross-section of a river with an uneven bed and an island, sound its depths like a surveyor, and test three border rules. Then you will apply them to a sketch of the Ussuri at Zhenbao Island.

You will need

- A clear plastic box or glass loaf pan at least 25 cm long
- Modeling clay or play dough for the riverbed and an island
- Water with a drop of blue food coloring
- A ruler, a skewer or pencil marked in centimeters (your sounding pole), and a strip of masking tape
- Graph paper and colored pencils

Steps

1. Shape a clay riverbed across the bottom of the box: shallow on one side, a deep channel nearer the other bank, and a small island rising above the water on the shallow side. Label the banks “Country A” and “Country B.”
2. Pour in water until the island just shows. Lay masking tape along the top edge and mark it every 2 cm from bank A to bank B.
3. At each mark, lower the sounding pole straight down and record the depth to the nearest half centimeter. Make a table.
4. Plot the depths on graph paper to draw the riverbed profile (distance across on the horizontal axis, depth downward on the vertical axis).
5. Draw three border lines on your profile in three colors: the bank line along bank B, the median line at half the width, and the thalweg through the deepest sounding.
6. Decide who owns the island under each rule and write it beside the line.
7. Now apply the same reasoning to a sketch of the Ussuri: Zhenbao lies nearer the Chinese bank, and the main channel runs between the island and the Russian bank. Write who owns Zhenbao under each rule.

Tips

- Take every sounding with the pole straight up and down; a slanted pole reads too deep.
- Real rivers are sounded the same way, by lead line in the past and by echo sounder today.

Check your work

- I can sound and graph a river cross-section.
- I can draw the bank line, median line and thalweg on the profile.
- I can explain why Zhenbao was disputed and why the thalweg rule gave it to China.

MAP NOTEBOOK

1. Draw a simple map showing the border under Nerchinsk (1689) in one color and under Aigun and Peking (1858–1860) in another. Shade the land that changed hands.
2. Sketch the thalweg cross-section diagram from memory with all three lines labeled.
3. Make a timeline from 1689 to 2022 with at least eight events from the lesson.

> **From history.** The Treaty of Nerchinsk was signed in Latin, Russian and Manchu, and the Latin text was the one both sides could read through their interpreters. Gerbillon kept a journal of the journey to Nerchinsk and the hard bargaining there, and Du Halde printed his account in the description of China that d'Anville's maps accompanied. Through these Jesuits, Europeans first learned the geography of the Amur borderland.

WORKED EXAMPLES

Example 1. The Treaty of Aigun gave Russia about 600,000 km² and the Convention of Peking about 400,000 km². Find the total in km² and square miles, and compare it with Texas (about 696,000 km²). (1 square mile ≈ 2.59 km².)

1. Total: 600,000 + 400,000 = 1,000,000 km².
2. In square miles: 1,000,000 ÷ 2.59 ≈ 386,000 square miles.
3. Compared with Texas: 1,000,000 ÷ 696,000 ≈ 1.44.

Answer: About 1,000,000 km² (about 386,000 square miles), nearly one and a half times the size of Texas.

Example 2. A river is 600 m wide. Soundings show the deepest channel 450 m from the Chinese bank (150 m from the Russian bank). An island lies 100 m from the Chinese bank. Where is the border, and who owns the island, under (a) a line along the Chinese bank, (b) the median line, (c) the thalweg?

(Use the map or drawing "Compare the three lines with the island's position." shown earlier in this lesson.)

1. (a) Chinese-bank line: the border is at 0 m from the Chinese bank, so all the water and the island (at 100 m) are on the Russian side. Island: Russia.
2. (b) Median line: the border is at 600 ÷ 2 = 300 m from either bank. The island at 100 m lies on the Chinese side. Island: China.
3. (c) Thalweg: the border is at 450 m from the Chinese bank. The island at 100 m lies on the Chinese side. Island: China.
4. This is the Zhenbao problem: the Soviet reading of the 1860 map was close to (a); China argued for (c).

Answer: (a) border on the Chinese bank, island Russian; (b) border 300 m out, island Chinese; (c) border 450 m out, island Chinese.

Example 3. Khabarovsk is at 48.48° N, 135.07° E and Vladivostok at 43.12° N, 131.89° E. Estimate the straight-line distance in km and miles. The Ussuri Railway between them was finished in 1897; if a train of that era averaged 25 km/h over a route about 1.2 times the straight line, how long was the trip?

(Use the map or drawing "The Ussuri valley links Khabarovsk with Vladivostok." shown earlier in this lesson.)

1. North–south: 48.48 − 43.12 = 5.36°; 5.36 × 111 ≈ 595 km.
2. East–west: 135.07 − 131.89 = 3.18°. At the middle latitude (about 45.8°), cos 45.8° ≈ 0.697, so 3.18 × 111 × 0.697 ≈ 246 km.
3. Straight line ≈ $\sqrt{(595^2 + 246^2)}$ ≈ $\sqrt{414{,}500}$ ≈ 644 km (about 400 miles).
4. Route ≈ 1.2 × 644 ≈ 773 km. Time ≈ 773 ÷ 25 ≈ 31 hours.

Answer: About 644 km (400 miles) in a straight line; a route of about 773 km at 25 km/h takes about 31 hours.

PRACTICE

1. EASY Who signed the Treaty of Aigun, and when?
2. EASY What did the Treaty of Nerchinsk (1689) use as the border, and who interpreted at the talks?
3. EASY What does the Chinese name for the Amur, Heilong Jiang, mean?
4. EASY Define thalweg and median line.

5. MEDIUM Why was Qing China unable to resist Russia's demands in 1858 and 1860? Give two reasons.
6. MEDIUM Convert the Amur's length, about 2,800 km, and the Russia–China border, about 4,200 km, to miles.
7. MEDIUM On the map, what city stands where the Ussuri joins the Amur, and what Chinese city faces Blagoveshchensk?
   (Use the map or drawing "Find the confluence and the twin cities on the Amur." shown earlier in this lesson.)
8. MEDIUM The Amur is frozen about five months a year. What fraction of the year is that, and how did the ice affect the 1969 clash?
9. MEDIUM Russia founded Vladivostok in 1860 after the Convention of Peking. Why was this harbor so valuable to Russia?
10. HARD Explain why the 1858 and 1860 treaties caused the 1969 clash more than a century later. Use the words bank line and thalweg.
11. HARD The Treaty of Aigun gave Russia the left bank of the Amur. Past Blagoveshchensk the Amur flows generally southeast and east, and later turns northeast to the sea. Is the left bank the north or the south bank? Explain using the rule for naming banks, and say what this means for the cities of Blagoveshchensk and Heihe.
12. CHALLENGE In a paragraph, explain how the Russia–China border moved from mountains (1689) to rivers (1858–1860) to a surveyed thalweg (1991–2008). What does this story show about natural borders, power and agreement?

COMMON MISTAKES

- Thinking a treaty that names a river settles the border. It must also say where in the river the line runs and must be demarcated.
- Confusing Aigun (1858, the north bank of the Amur) with Peking (1860, the land east of the Ussuri).
- Assuming the Russia–China border is still disputed. As of 2026, the whole border has been agreed and marked since the 2004 agreement was carried out in 2008.

Make it a game · Draw the Line. Draw a river with islands on a large sheet. One player names a rule (bank line on the north bank, bank line on the south bank, median line or thalweg), and the other has thirty seconds to draw the border and award each island to a country. Then switch. Score one point per island correctly awarded. Bonus point: name the treaty or event in the lesson where that rule mattered.

Scripture. "And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;" (Acts 17:26, KJV)

Russian and Chinese soldiers who fought on the ice in 1969 were made of one blood. God sets the times and bounds of nations, and He also calls nations to settle their bounds in peace, as Russia and China finally did by patient agreement.

Practice answers

1. Nikolay Muravyov for Russia and the Qing general Yishan for China, on May 28, 1858.
2. The Argun River and the Stanovoy (Outer Khingan) mountains, a watershed line that left the Amur basin to China. The Jesuits Jean-François Gerbillon and Tomás Pereira interpreted, using Latin.
3. Black Dragon River.
4. The thalweg is the line of the deepest, navigable channel. The median line runs exactly halfway between the two banks.
5. The Taiping Rebellion was devastating China's heartland, and Britain and France were at war with China (the Second Opium War), capturing Beijing in 1860. Russia also already had soldiers and settlers on the Amur.
6. 2,800 × 0.621 ≈ 1,740 miles (about 1,750). 4,200 × 0.621 ≈ 2,610 miles.
7. Khabarovsk stands at the confluence; Heihe faces Blagoveshchensk across the Amur.
8. 5 ÷ 12 ≈ 0.42, about two fifths of the year. In winter patrols could walk across the frozen Ussuri to Zhenbao Island, so the island was easy for both sides to reach; the March 1969 fighting took place on the ice.
9. It gave Russia a port on the Pacific (Sea of Japan) far south of its earlier Pacific ports, closer to the trade of East Asia; its name, "Ruler of the East," shows its purpose as a base for Russian power in the Pacific.
10. The treaties named the rivers but did not say where in the river the border ran. The Soviet side read the 1860 map as putting the line along the Chinese bank (a bank line), making nearly every island Soviet. China insisted on the thalweg, which would give it islands on its side of the main channel, including Zhenbao. When relations collapsed in the 1960s, patrols contested the islands, leading to the March 1969 fighting.
11. Banks are named facing downstream. Facing east or southeast (downstream), your left hand points north or northeast, so the left bank is the north bank. Blagoveshchensk, on the north bank, is Russian; Heihe, on the south (right) bank, is Chinese.
12. A strong answer explains that Nerchinsk used a watershed line when the Qing were strong; Aigun and Peking moved the border to the rivers when China was weak and Russia had settlers and soldiers on the spot; the treaties' vague wording about where in the river the line ran led to the 1969 clash; and only patient negotiation produced a precise, demarcated thalweg border in 1991 and 2004–2008. It concludes that nature offers lines (crests, rivers), but power decides which line is chosen, and only exact, agreed demarcation makes a border stable.

2.5 Rivers That Unite: The Mississippi and the Nile as Spines of a Nation

OBJECTIVES

- Explain why a river that runs through the heart of a land tends to unite it, using the Nile in ancient Egypt and the Mississippi in the Civil War (Vicksburg, 1863).
- Describe how technology (the steamboat, the bridge, locks, jetties, levees and the Aswan High Dam) changed what the Mississippi and the Nile could do, with the trade-offs each brought.
- Compute travel times with and against a current, cargo capacities and drainage-basin shares.

Warm-up. Lay a long scarf or rope across the floor. First lay it along the edge of the room between two “countries” of chairs. Then lay it straight through the middle of one country. Ask: in which position does the rope keep people apart, and in which does it tie places together? Now imagine the rope is a river with boats on it. What changes?

Watch. *Why Engineers Can't Control Rivers* (Practical Engineering, 15:52).
https://www.youtube.com/watch?v=vLZElIYHmAI
Before the project: watch the river-table demonstrations and look for why engineers have to work so hard to keep a big river like the Mississippi in its channel.
Note: Captions were not available to check; preview it first. Practical Engineering videos usually include a short sponsor message, which you can skip.

Backup video. *How Do Flood Control Structures Work?* (Practical Engineering, 11:18).
https://www.youtube.com/watch?v=5mCJh5SJEis
With the big idea: see how levees, floodwalls, dams and spillways protect the towns along a great river. Note: Captions were not available to check; preview it first. The description says it is sponsored by Nebula, so expect a sponsor message you can skip.

KEY TERMS

drainage basin
All the land drained by a river and its tributaries. The Mississippi basin covers about 1.2 million square miles.

tributary
A river that flows into a larger river, such as the Ohio and the Missouri into the Mississippi.

cataract
A stretch of rapids over rock. The First Cataract at Aswan was ancient Egypt’s southern gateway.

spine (core river)
A river that runs through the heart of a country and ties its regions together, as opposed to one that runs along its edge.

levee
A bank of earth built along a river to hold back floods.

towboat and barge tow
A powerful riverboat that pushes a group of barges lashed together, the main way bulk cargo moves on the Mississippi today.

CORE IDEAS

The story. On July 4, 1863, after a siege of about seven weeks, the Confederate army at Vicksburg, Mississippi, surrendered to General Ulysses S. Grant. Five days later Port Hudson, Louisiana, the last Confederate fort on the river, gave up too. In mid-July the steamboat *Imperial* tied up at New Orleans, the first boat to come down from St. Louis since the war had closed the river. On August 26, 1863, President Abraham Lincoln wrote in a public letter, “The Father of Waters again goes unvexed to the sea.” He knew why it mattered. The farmers of Ohio, Indiana, Illinois and the upper Midwest had always sent their corn, pork and flour down the river to New Orleans, and Union control of the whole river now split the Confederacy in two, cutting Texas, Arkansas and western Louisiana off from the east. A river that ran through the middle of the country could not be divided between two nations for long.

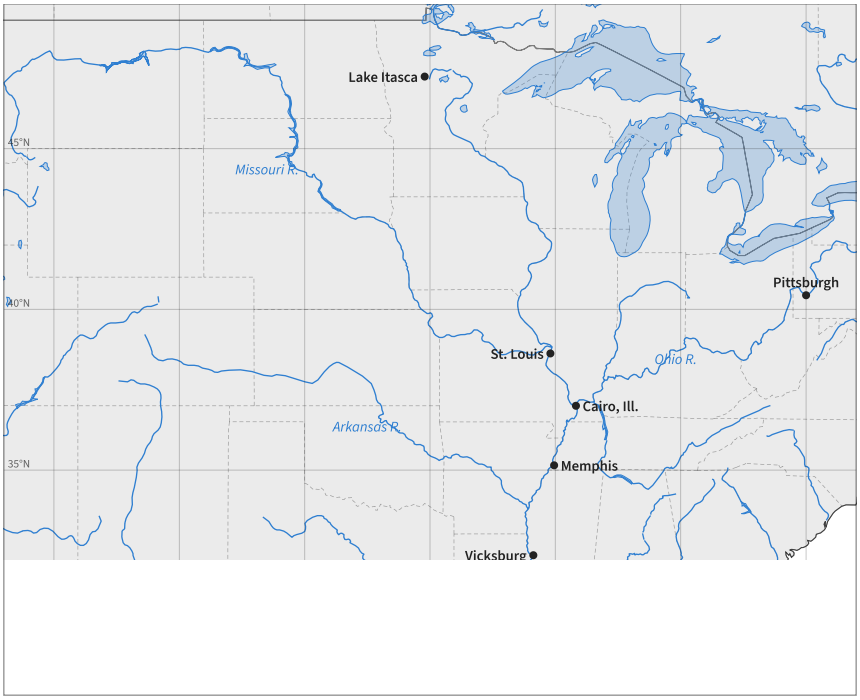
How a river unites. The Mississippi runs about 2,340 miles (3,770 km) from Lake Itasca in Minnesota to the Gulf. With the Missouri, the Ohio, the Arkansas, the Red and the Tennessee, it drains about 1.2 million square miles from the Rockies to the Appalachians, roughly two fifths of the lower 48 states. Before railroads, water was the cheapest way to move anything heavy, and the whole basin funneled toward one outlet. Flatboats floated produce down to New Orleans and were broken up for lumber; keelboat crews poled and hauled cargo back upstream for months. In 1811 the steamboat *New Orleans* left Pittsburgh for the city it was named for, and by the 1850s hundreds of steamboats worked the western rivers, carrying goods and passengers upstream as easily as down. Steam had a terrible cost too: boilers exploded and boats burned. In April 1865 the overloaded *Sultana*, carrying Union soldiers just released from Confederate prison camps, blew up near Memphis and more than a thousand people died, the worst disaster in American river history.

The Nile. The Greek historian Herodotus, who visited Egypt about 450 BC, called its land the gift of the river. Almost no rain falls in most of Egypt. The water comes from far to the south: the White Nile from the lake country around Lake Victoria, and the Blue Nile from Lake Tana and the Ethiopian highlands, whose summer rains sent most of the yearly flood. Every summer the Nile rose, spread over the valley and left a layer of black silt; the Egyptians called their land Kemet, “the black land,” and the desert beyond it the red land. Deserts walled the valley on both sides, the First Cataract at Aswan guarded the south, and the marshy delta opened to the sea in the north. Best of all, the river flows north while the steady wind blows from the north, so a boat could drift downstream with the current and sail

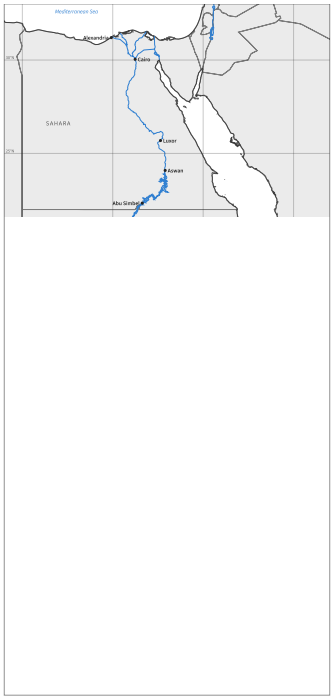
back upstream with the wind. That two-way highway let the kings who united Upper and Lower Egypt, about 3100 BC by the usual textbook date (a figure historians build from king lists and still debate), govern a land more than 600 miles long. Granite from Aswan floated to the pyramids and temples, grain flowed to royal storehouses, and officials traveled the length of the kingdom. The Bible's story of Joseph begins with Pharaoh dreaming that he stood by the river (Genesis 41). For some three thousand years, the Nile made Egypt one country.

The big idea. A river along the edge of a country divides; a river through its heart unites. The Rhine divides France from Germany for a stretch but then runs through the heart of western Germany. The Mississippi began as a border: the Treaty of Paris of 1783 made it the western boundary of the United States, and Spain and then France held its mouth. Once the United States held both banks and the mouth, the river became the nation's spine, and war in 1861–1863 showed that no one could split the spine without crippling the body. The Nile is Egypt's spine, but it is also shared by eleven countries in its basin, and as of 2026, Egypt, Sudan and Ethiopia had still not reached a binding agreement on the operation of the Grand Ethiopian Renaissance Dam on the Blue Nile, which Ethiopia formally inaugurated in 2025. A river that unites one nation can divide its neighbors.

Technology overcoming geography. On the Mississippi, the steamboat was only the start. James Eads's bridge at St. Louis (1874), the first major bridge built largely of steel, carried railroads across the river. Eads then built jetties at the mouth of the river's South Pass (finished 1879), which made the current scour a channel deep enough for ocean ships. After the great flood of 1927, the federal government built a vast system of levees, and on the upper river the Army Corps of Engineers built locks and dams in the 1930s to hold a 9-foot channel. The river also tries to move, like the Rio Grande: since 1963 the Old River Control Structure in Louisiana has kept the Mississippi from shifting its main course into the shorter, steeper Atchafalaya River. Today towboats push tows of 15 barges on the upper river and far more below, each barge holding about 1,500 tons. On the Nile, the British built the first Aswan Dam in 1902, and Egypt built the Aswan High Dam between 1960 and 1970 with Soviet help. It ended the yearly flood, stored water in Lake Nasser for dry years, made electricity, and let farmers grow crops all year; but the silt that once renewed the fields now settles in the lake, and farmers must use fertilizer instead. To save the temples of Abu Simbel from the rising lake, an international team cut them into blocks and rebuilt them on higher ground between 1964 and 1968. Engineers have made both rivers safer and more useful, but neither has stopped being the backbone of its land.



The Mississippi system. The river and its tributaries funnel the whole interior toward one outlet at New Orleans.



The Nile flows north for thousands of miles through desert. The Blue Nile from Ethiopia brought most of the yearly flood.

PICTURE STUDY

The "Champions of the Mississippi": A Race for the Buckhorns, Frances Flora Bond Palmer, for Currier & Ives, 1866 · Hand-colored lithograph · The Metropolitan Museum of Art, New York (this impression); other impressions are in the Library of Congress, Prints and Photographs Division

Currier & Ives of New York sold cheap, handsome prints "for the people," and their pictures of steamboats hung in homes across America. This one was drawn by Fanny Palmer, an English-born artist who became one of the firm's best lithographers. It shows two great Mississippi steamboats racing at night, as river captains loved to do, with the winner earning the right to hang a set of deer antlers, the "buckhorns," as a trophy.

The print was made just after the Civil War, when the reopened river was busy again. It celebrates the speed and power that steam brought to the river, and it quietly shows the danger too: racing boats pushed their boilers hard, and boilers sometimes exploded.

Look closely

- Find the paddle wheels. Are they at the sides or the stern? What drives them?
- Look at the smoke and sparks from the stacks. What fuel do you think the boats burned, and where would they get it along the river?
- Find the light on the water. How does the artist make the night scene feel exciting?
- Look at how many decks the boats have. What do you think the passengers and cargo were doing on each?

Talk about it

1. How would a fast steamboat change the life of a farmer in Ohio or a merchant in New Orleans?
2. What risks does the picture hint at? Why would captains race anyway?

3. Compare this picture with Turner's Rhine. Which river looks more like a highway, and why?

PROJECT: AGAINST THE CURRENT: A PADDLE-WHEEL BOAT TEST

Build a rubber-band paddle-wheel boat and race it with and against a current in a rain-gutter river. From your times you can calculate both the boat's own speed and the speed of the current, exactly the problem every river captain faced.

You will need

- A clean half-gallon milk or juice carton (or a foam block) for the hull
- Two pencils or wooden craft sticks for the frame
- Rubber bands and a piece of stiff plastic (from a lid or a gift card) cut to about 5 × 4 cm for the paddle
- Waterproof tape or hot glue (with a parent's help)
- A 10-foot (3 m) vinyl rain gutter with end caps, or a bathtub
- A garden hose or pitcher to make a gentle current, a stopwatch and a tape measure

Steps

1. Cut the carton in half lengthwise to make a hull. Tape the two pencils so they stick out past the stern about 8 cm.
2. Stretch a rubber band between the pencil ends, slip the plastic paddle through the middle, and tape it in place.
3. Wind the paddle backward about 20 turns and test it in still water. Adjust until the boat runs straight.
4. Mark a 2 m course in the gutter. Time three runs in still water and average them.
5. Make a gentle, steady current with the hose at one end (prop the other end slightly lower so water drains). Time three runs downstream and three upstream, always winding the same number of turns.
6. Compute speeds (distance ÷ time). Then current speed = (downstream speed − upstream speed) ÷ 2, and boat speed in still water = (downstream speed + upstream speed) ÷ 2. Compare with your still-water test.
7. Write a paragraph: How much harder was the upstream trip? What would a keelboat crew without an engine have felt on the Mississippi?

Tips

- Keep the current gentle; if the boat cannot go upstream at all, you have discovered why flatboats were broken up at New Orleans.
- Wind the paddle the same number of turns every run so only the current changes.

Check your work

- I built a working paddle-wheel boat and timed it fairly.

- I can calculate current speed and boat speed from upstream and downstream times.
- I can explain why steam power changed travel on the Mississippi.

MAP NOTEBOOK

1. Draw the Nile valley in cross-section: desert, cliffs, black land, river, black land, cliffs, desert. Label Kemet and the red land.
2. Sketch a side view of a Nile boat going north (sail down, drifting with the current) and going south (sail up, pushed by the north wind). Add arrows for current and wind.
3. Draw the Mississippi as a tree: the trunk to the Gulf and the branches (Missouri, Ohio, Arkansas, Red, Tennessee). Mark St. Louis, Cairo, Vicksburg and New Orleans.

> **From history.** When the steamboat *New Orleans* made its first trip down the Ohio and Mississippi in 1811–1812, the great New Madrid earthquakes struck while it was on the river. Passengers saw riverbanks collapse and trees fall into the water, and the river itself changed course in places. The boat reached New Orleans in January 1812 and began regular service between New Orleans and Natchez.

WORKED EXAMPLES

Example 1. Aswan is at 24.09° N, 32.90° E and Cairo at 30.04° N, 31.24° E. Estimate the straight-line distance. Take the river distance as 1.3 times the straight line. An ancient boat drifting north with the current covers 48 km a day; sailing south against the current with the north wind, it covers 72 km a day. How long is each trip?

(Use the map or drawing "From Aswan to Cairo, the Nile flows north through the desert." shown earlier in this lesson.)

1. North–south: 30.04 − 24.09 = 5.95°; 5.95 × 111 ≈ 660 km.
2. East–west: 32.90 − 31.24 = 1.66°. At about 27° N, cos 27° ≈ 0.891, so 1.66 × 111 × 0.891 ≈ 164 km.
3. Straight line ≈ $\sqrt{(660^2 + 164^2)}$ ≈ √462,500 ≈ 680 km (about 423 miles).
4. River distance ≈ 1.3 × 680 ≈ 884 km.
5. North (downstream): 884 ÷ 48 ≈ 18.4 days. South (upstream, sailing): 884 ÷ 72 ≈ 12.3 days.

Answer: About 680 km straight, about 884 km by river; about 18 days drifting north and about 12 days sailing south. With a steady north wind, the trip upstream could even be faster than the trip down.

Example 2. Before steam, a keelboat crew needed about four months (120 days) to work a cargo upstream from New Orleans to Louisville, about 1,400 river miles. In 1853 the steamboat *Eclipse* made the run in about 4 days and 9 hours. Compare the average speeds.

1. Keelboat: 1,400 ÷ 120 ≈ 11.7 miles per day (less than half a mile an hour).
2. Eclipse time: 4 days 9 hours = 4 × 24 + 9 = 105 hours.
3. Eclipse speed: 1,400 ÷ 105 ≈ 13.3 miles per hour, or about 320 miles per day.
4. Ratio: 120 days ÷ 4.375 days ≈ 27.

Answer: About 11.7 miles per day by keelboat versus about 13.3 miles per hour (about 320 miles a day) by steamboat: roughly 27 times faster.

Example 3. The Mississippi basin covers about 1.2 million square miles, and the lower 48 states cover about 3.1 million square miles. What fraction of the lower 48 drains to the Mississippi (ignoring the small Canadian part of the basin)? Express the basin in km². (1 square mile ≈ 2.59 km².)

(Use the map or drawing "The tributaries gather water from the Rockies to the Appalachians." shown earlier in this lesson.)

1. Fraction: 1.2 ÷ 3.1 ≈ 0.39, or about 39 percent (roughly two fifths).
2. In km²: 1.2 million × 2.59 ≈ 3.1 million km².
3. Meaning: rain falling on about two fifths of the country ends up passing New Orleans, which is why whoever held the river's mouth held the trade of the interior.

Answer: About 39 percent, roughly two fifths; about 3.1 million km².

PRACTICE

1. EASY What did Lincoln mean by "The Father of Waters again goes unvexed to the sea," and what events led to it?
2. EASY Which way does the Nile flow, and which way does the usual wind blow in Egypt? How did Egyptian boats use both?
3. EASY What did the Egyptians call their land, and what does the name mean?
4. EASY Name four tributaries of the Mississippi.
5. MEDIUM Convert the length of the Nile, about 6,650 km, and the Mississippi, about 2,340 miles, into the other unit.
6. MEDIUM A towboat pushes 15 barges, each carrying 1,500 tons. How many tons is that? How many rail hopper cars of 100 tons, or trucks of 25 tons, would carry the same load?
7. MEDIUM On the Nile map, at which city do the White Nile and the Blue Nile meet? Which branch brought most of the floodwater, and from where?

(Use the map or drawing "Find where the two Niles join." shown earlier in this lesson.)

8. MEDIUM In the paddle-boat test, a boat covers 2 m downstream in 4 s and 2 m upstream in 10 s. Find the current speed and the boat's still-water speed.
9. MEDIUM What did the Old River Control Structure (1963) do, and how does it connect to the Rio Grande lesson?
10. HARD List two benefits and two costs of the Aswan High Dam.
11. HARD Classify each river as a wall (along a border) or a spine (through the heart of a country), and explain: the Rhine for France; the Rhine for Germany; the Mississippi in 1783; the Mississippi after 1803; the Nile in Egypt; the Rio Grande today.
12. CHALLENGE In a paragraph, explain why railroads reduced but did not end the importance of the Mississippi. Use at least one number from the lesson.

COMMON MISTAKES

- Thinking the Nile flows south because it is at the "bottom" of the map. It flows north, from the heart of Africa to the Mediterranean.
- Thinking every river is either a border or a highway. The same river can be both, and can change from one to the other, as the Mississippi did between 1783 and 1803.
- Treating dams and levees as pure gains. Every big river project brings real benefits and real costs, and both must be weighed.

Make it a game · Spine or Wall?. Call out a river and a date (the Rhine in AD 100, the Danube in 1526, the Rio Grande in 1848, the Amur in 1858, the Mississippi in 1783 and 1863, the Nile in 1500 BC). The other player answers "Spine!" or "Wall!" and gives one fact from the unit to prove it. If the river is both, the player must say why for a double point. Play through all five lessons of the unit.

Scripture. "All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again." (Ecclesiastes 1:7, KJV)

The Preacher saw the great cycle of water that God set in motion. The same cycle carries the Ethiopian rains to the Egyptian delta and the snows of the Rockies to the Gulf, binding whole nations together along the way.

Practice answers

1. The Mississippi was open again from source to sea under Union control, after the fall of Vicksburg (July 4, 1863) and Port Hudson (July 9, 1863).
2. The Nile flows north; the wind usually blows from the north. Boats drifted north with the current and raised sail to go south with the wind.
3. Kemet, "the black land," after the dark silt left by the flood.
4. Any four of: the Missouri, Ohio, Arkansas, Red, Tennessee (via the Ohio), Illinois, Wisconsin and others.
5. Nile: 6,650 × 0.621 ≈ 4,130 miles. Mississippi: 2,340 × 1.609 ≈ 3,770 km.
6. 15 × 1,500 = 22,500 tons. 22,500 ÷ 100 = 225 rail cars; 22,500 ÷ 25 = 900 trucks.

7. Khartoum. The Blue Nile, from Lake Tana and the Ethiopian highlands, where heavy summer rains fall.
8. Downstream 2 ÷ 4 = 0.5 m/s; upstream 2 ÷ 10 = 0.2 m/s. Current = (0.5 − 0.2) ÷ 2 = 0.15 m/s. Boat = (0.5 + 0.2) ÷ 2 = 0.35 m/s.
9. It keeps the Mississippi from shifting its main flow into the shorter, steeper Atchafalaya River. Like the Rio Grande, the Mississippi is a moving river, and engineers hold it in place to protect the towns, ports and borders built along its present course.
10. Benefits (any two): flood control, water stored for dry years, hydroelectric power, year-round irrigation and more crops. Costs (any two): the yearly silt no longer reaches the fields, so farmers need fertilizer; silt is trapped in Lake Nasser; the delta coast lost new sediment; Nubian villages and ancient sites were flooded, and Abu Simbel had to be moved.
11. Rhine for France: wall (border). Rhine for Germany: mostly spine (it runs through western Germany's heart). Mississippi in 1783: wall (western boundary of the United States). Mississippi after 1803: spine (both banks and the mouth American). Nile in Egypt: spine. Rio Grande today: wall (U.S.–Mexico border).
12. A strong answer explains that railroads, often running east–west, carried goods directly to eastern cities and ended the river's near-monopoly, so St. Louis and New Orleans lost some of their importance after the Civil War. But for heavy bulk goods such as grain, coal and gravel, water is still the cheapest way to move cargo: one 15-barge tow carries about 22,500 tons, the load of about 225 rail cars or 900 trucks. Locks, dams, levees and jetties keep the channel deep, so the river remains a working spine of the country.

Unit 2 test

Answer each question. Show your work for every calculation, give units (km and miles where asked), and use complete sentences for explanations. Use 111 km (69 miles) per degree of latitude and 1 km ≈ 0.621 mile. The test is worth 100 points.

1. (6 pts) Explain how Caesar's bridge (55 BC) and the Teutoburg Forest (AD 9) together made the Rhine Rome's frontier.
2. (6 pts) The Rhine flows north from Basel. Is Strasbourg on the left or right bank? State the rule you used. Which country holds the right bank opposite Strasbourg?
3. (8 pts) A meandering stretch of a river measures 60 km along its channel. After engineers straighten it, it measures 45 km. By how many kilometers and what percentage was it shortened? Give one benefit for the border and one cost of such straightening, using Tulla's Rhine work as your example.
4. (8 pts) Give the date and the cause (treaty or event) for each change in the control of Alsace: (a) Strasbourg becomes French; (b) Alsace becomes German; (c) Alsace returns to France; (d) Alsace is annexed in practice by Germany; (e) Alsace returns to France for good.
5. (6 pts) Name, in order from upstream to the sea, the main basins and gates of the Danube from Vienna onward, and explain why the gates mattered in war.
6. (8 pts) Budapest is at about Danube-km 1,650 and Belgrade at about km 1,170. A barge makes 16 km/h downstream and 8 km/h upstream. Find the distance (in km and miles) and the time each way.
7. (6 pts) Explain the importance of two of these for the Danube as a road of empires: Trajan's bridge (105); Adrianople (378); Mohács (1526); the relief of Vienna (1683).
8. (8 pts) State three terms of the Treaty of Guadalupe Hidalgo (1848), and explain the dispute over the Nueces Strip that helped start the war.
9. (8 pts) Apply the 1884 and 1905 rules. (a) The Rio Grande slowly shifts 500 feet north over thirty years. (b) A flood cuts across a meander neck in one night, leaving 60 acres of Mexican land north of the new channel. Where is the border in each case, and what happens to the 60 acres under the 1905 convention?
10. (6 pts) A stretch of a border river measures 90 km along its channel, and the straight distance between its ends is 50 km. Find its sinuosity and explain what the number tells you.
11. (8 pts) Compare the Treaty of Nerchinsk (1689), the Treaty of Aigun (1858) and the Convention of Peking (1860): what border did each set, and why was China in a stronger or weaker position each time?
12. (8 pts) A border river is 800 m wide. The deepest channel lies 200 m from the Russian bank. An island lies 300 m from the Chinese bank. Where is the border, and who owns the island, under (a) a line along the Chinese bank, (b) the median line, (c) the thalweg? Which rule did the 1991 agreement use, and what happened to Zhenbao Island?

13. (6 pts) Explain in a paragraph why the Nile united ancient Egypt. Include the direction of the current and the wind.
14. (8 pts) A steamboat makes 15 mph downstream and 9 mph upstream on the Mississippi. Find the speed of the current and the boat's speed in still water. How long does a 300-mile trip take each way?

UNIT PROJECT: FIVE RIVERS, FIVE BORDERS: AN ATLAS AND A MOVING-RIVER MODEL

Make a hand-drawn atlas of five river maps: the Rhine, the Danube, the Rio Grande, the Amur and Ussuri, and the Mississippi or the Nile. On each map, mark the river, its source and mouth, at least four cities, the border (if it is one) and the key dates from the lesson, and add a short caption answering: Wall, road or spine? Who drew this line, and why?

Present your moving-river sand model (Lesson 2.3) with its photo sequence, your sinuosity measurements and a one-page explanation of the 1884 rules, the Chamizal settlement and the thalweg rule from the Amur. Finish with a paragraph on what changed when technology (bridges, straightening, canals, dams) crossed or tamed each river.

- **Accuracy**: Rivers, cities, borders and dates are placed correctly on all five maps, with km and miles where distances are given.
- **Model and measurement**: The sand model shows gradual change and avulsion clearly; photos are in order; sinuosity is measured and computed correctly.
- **Explanation**: Captions and the written page explain why each river is a wall, a road or a spine, and apply the rules for moving rivers and the thalweg correctly.
- **Care and judgment**: The atlas is neat and readable, and the history is told candidly and fairly, judging people by the standards of their own time.

Answer key

1. Caesar's bridge showed Rome could cross the Rhine at will, but he returned and destroyed it, treating the river as the edge of Roman Gaul. Augustus later tried to push to the Elbe, but after Arminius destroyed three legions under Varus in the Teutoburg Forest, Rome gave up the plan and held the Rhine as its frontier for about four centuries.
2. Left bank. Banks are named facing downstream; facing north, the west bank is on your left. Germany holds the right (east) bank opposite Strasbourg.
3. 60 − 45 = 15 km; 15 ÷ 60 = 25 percent. Benefit: one fixed channel gives a clear, stable border (as on the Upper Rhine between France and Baden), and it opened the river to steam navigation and drained malarial marshes. Cost: the faster current cut the bed deeper and lowered the water table (and can increase erosion and flooding downstream).
4. (a) 1681, seized by Louis XIV (after the Peace of Westphalia, 1648, gave France rights in Alsace). (b) 1871, Treaty of Frankfurt after the Franco-Prussian War. (c) 1919, Treaty of Versailles after World War I. (d) 1940, annexed in practice by Nazi Germany after the fall of France. (e) 1944–1945, liberated by the Allies (Strasbourg on November 23, 1944; the Colmar Pocket cleared in February 1945) and returned to France for good. (For (c), accept 1918–1919: French troops entered Alsace in November 1918, and Versailles confirmed it in 1919.)
5. Vienna basin; the gate near Vienna and Bratislava; the Pannonian (Great Hungarian) Plain; the Iron Gates gorge; the Wallachian Plain; the delta. Armies and boats had to pass through

the narrow gates, so whoever held a gate could block or control movement between basins.

6. 1,650 − 1,170 = 480 km ≈ 298 miles. Downstream 480 ÷ 16 = 30 hours; upstream 480 ÷ 8 = 60 hours.
7. Any two, for example: Trajan's bridge let Rome conquer Dacia north of the river. At Adrianople, the Goths whom Rome had allowed across the Danube destroyed a Roman army and killed Emperor Valens. At Mohács, Suleiman the Magnificent destroyed the Hungarian army on the Danube plain and split Hungary. In 1683 Jan III Sobieski broke the Ottoman siege of Vienna, after which the Habsburgs drove the Ottomans back down the Danube (Treaty of Karlowitz, 1699).
8. Terms (any three): the Rio Grande became the border of Texas; Mexico ceded California and New Mexico (about 525,000 square miles); the United States paid $15 million; the United States assumed up to $3.25 million in claims; Mexicans in the ceded lands could stay and become citizens with their property protected. Dispute: Texas and then the United States claimed land to the Rio Grande, while Mexico held that Texas ended at the Nueces; the April 1846 clash took place in the strip between the two rivers.
9. (a) Gradual change: the border moves with the river, so it moves 500 feet north. (b) Avulsion: the border stays in the old bed, so the 60 acres are still Mexican, a banco north of the river. Under the 1905 convention, most bancos pass to the country on whose side of the river they now lie, so the 60 acres would normally become American.
10. 90 ÷ 50 = 1.8. The river is 1.8 times as long as a straight line, so it winds strongly, which means its meanders are likely to migrate and cause border changes.
11. Nerchinsk set the border along the Argun and the Stanovoy mountains (a watershed), leaving the Amur basin to China; the Qing were strong and had besieged Albazin. Aigun gave Russia the north bank of the Amur, with the land east of the Ussuri held in common; China was weakened by the Taiping Rebellion and war with Britain and France, and Muravyov had men on the river. Peking gave Russia the land east of the Ussuri to Korea, where Vladivostok was founded; it was signed just after British and French troops took Beijing.
12. (a) Border on the Chinese bank; the island is Russian. (b) Median line 400 m from each bank; the island (300 m from the Chinese bank) is Chinese. (c) Thalweg 800 − 200 = 600 m from the Chinese bank; the island is Chinese. The 1991 agreement used the thalweg, and Zhenbao Island went to China.
13. The Nile runs through the middle of Egypt, walled by deserts, so nearly all the people lived along one river. Its yearly flood left black silt that fed the land. The current flows north and the usual wind blows from the north, so boats could drift north and sail south, making the river a two-way highway for officials, grain and stone. This let one king govern the whole valley from the First Cataract to the delta.
14. Current = (15 − 9) ÷ 2 = 3 mph. Boat = (15 + 9) ÷ 2 = 12 mph. Downstream 300 ÷ 15 = 20 hours; upstream 300 ÷ 9 ≈ 33.3 hours (about 33 hours 20 minutes).

UNIT 3

Mountains as Walls

Rivers move, but mountains stay put. Of all the lines on the map of the world, borders that follow great mountain ranges are among the oldest and most stable. In this unit you will climb five of them. You will watch Cardinal Mazarin and Don Luis de Haro make the Pyrenees the line between France and Spain in 1659, follow Hannibal's army and its elephants over the Alps in 218 BC, and see how a few mountain valleys around the Gotthard Pass became Switzerland. You will stand on the roof of the world, where the borders of India, China and Nepal were drawn on maps by men who had never walked them, and travel the length of Chile, a country about 2,670 miles long and on average only about 110 miles wide. You will end in the Caucasus, the wall between the steppe and the old kingdoms of the south, where Byzantines, Persians, Ottomans and Russians fought for two narrow gates.

In every range you will ask the same questions: Where are the passes? Who held them? Does the border follow the highest peaks or the watershed, and what happens where the two disagree? And, as in every unit, what changed when technology crossed the barrier: the Gotthard Base Tunnel, the Transandine Railway, the Georgian Military Road. You will find that mountains do not stop armies, traders or refugees; they channel them through a few gates, make them pay in time and lives, and give the people who hold the gates a power out of all proportion to their numbers. "When the most High divided to the nations their inheritance... he set the bounds of the people" (Deuteronomy 32:8). The mountains are some of the plainest of those bounds.

BEFORE YOU BEGIN

- Can use a map scale and convert between miles and kilometers
- Can read latitude and longitude on a map grid
- Knows the difference between natural and artificial borders (Unit 1) and how river borders can move (Unit 2)
- Can compute a percent and a ratio

MASTERY CHECKLIST

- I can explain why mountain borders tend to be stable and why passes, not peaks, decide how a range is crossed.
- I can tell the difference between the highest-crest and watershed rules and give a real case where they disagree (Val d'Aran, Patagonia).
- I can tell the stories of the Treaty of the Pyrenees, Hannibal's crossing, the founding of Switzerland, the McMahon Line, the Andes boundary settlement and the Russian conquest of the Caucasus, with correct dates.
- I can compute grades, temperature drop with altitude, route lengths and travel times for mountain crossings.
- I can explain what tunnels, roads and railways have and have not done to mountain walls.

- I can describe disputed mountain borders (India–China, Abkhazia and South Ossetia) neutrally and as of 2026.

OPTIONAL BOOKS AND RESOURCES

- **Polybius, *Histories*, Book 3 (free online at LacusCurtius)** (https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Polybius/home.html): Free. The classic Loeb translation of Polybius. Read Book 3, chapters 47 to 56, his own account of Hannibal's crossing of the Alps, for Lesson 3.2.
- **NASA Earth Observatory** (https://earthobservatory.nasa.gov/): Free. Search for satellite images of the Himalaya, the Atacama, the Patagonian ice fields, the Alps and the Caucasus to compare with your salt-dough models.
- **Library of Congress, Map Collections** (https://www.loc.gov/maps/): Free. Search for historical maps of the Pyrenees, Switzerland, the Caucasus and Chile to see how mapmakers drew these borders over time.

3.1 The Pyrenees

OBJECTIVES

- Explain how the Treaty of the Pyrenees (1659) made the mountain range the border between France and Spain, and why the treaty still left odd pieces such as Llívia and the Val d'Aran.
- Distinguish the watershed (water-parting) principle from the highest-crest principle and apply both to a real mountain border.
- Use map scale, elevation and route distance to explain why a few passes controlled travel across the Pyrenees for centuries.

Warm-up. Crumple a sheet of paper into a long ridge and lay it across the middle of a table. Drip a few drops of water along the top with a spoon. Watch which way each drop runs. Now put a pencil along the line where the water splits. That pencil is a *watershed*. Ask: if two kings agreed that "the mountains" are the border, would they mean the pencil line, the highest bumps, or the foot of the hills on each side?

Video. Coming soon. Search Kings and Generals and The History Guy for the Franco-Spanish War and the Peace of the Pyrenees (1659); Drive Thru History or UsefulCharts (flagged, preview) for a historical map of the French–Spanish border, Andorra and Llívia.

KEY TERMS

watershed (water-parting)
The line along a ridge that separates water flowing to one side from water flowing to the other. Many treaties use it to define a mountain border.

pass
A low point or gap in a mountain range that people, animals and later roads and railways use to cross it.

exclave
A piece of a country cut off from the main part of that country and surrounded by another country. Llívia is a Spanish exclave inside France.

condominium
A territory ruled jointly by two states. Pheasant Island in the Bidasoa River is shared by France and Spain.

delimitation and demarcation
Delimitation is describing a border in a treaty; demarcation is marking it on the ground with stones or posts. The Pyrenees border was delimited in 1659 but fully demarcated only in the 1860s.

co-principality
A state with two princes. Andorra's co-princes are the Bishop of Urgell in Spain and the President of France.

CORE IDEAS

The story. On 7 November 1659, two tired statesmen sat down in a wooden pavilion built on a small island in the middle of the Bidasoa River, where it runs into the Bay of Biscay. On one side of the island was France; on the other was Spain. The island had been chosen so that neither minister had to step onto the other king's soil. Cardinal Mazarin, who governed France for the young Louis XIV, and Don Luis de Haro, chief minister of Philip IV of Spain, had met there again and again over three months. They were ending a war between their countries that had begun in 1635. The result was the **Treaty of the Pyrenees**. One of its articles declared that the Pyrenees mountains, which in ancient times had divided the Gauls from the Spains, should from now on be the division between the two kingdoms. The next summer, on the same island, Philip IV handed over his daughter Maria Theresa to be Louis XIV's bride, and the peace was sealed by a marriage.

What the treaty did. Before 1659, the Spanish crown held land north of the mountains. The county of **Roussillon**, around Perpignan, had been part of Catalonia for centuries and spoke Catalan. The treaty gave Roussillon, along with Conflent, Vallespir, Capcir and the northern part of Cerdanya (French Cerdagne), to France. France also gained Artois and a string of fortress towns on its northern frontier, but in the south the important point was simple: the crest of the mountains would now be the line. A range that had once sat in the middle of Catalan lands became a wall between two states. Families, parishes and grazing lands that had looked across the passes for centuries were now in different kingdoms. People on both sides kept speaking Catalan, and many still do, but their taxes, laws and soldiers came from different capitals.

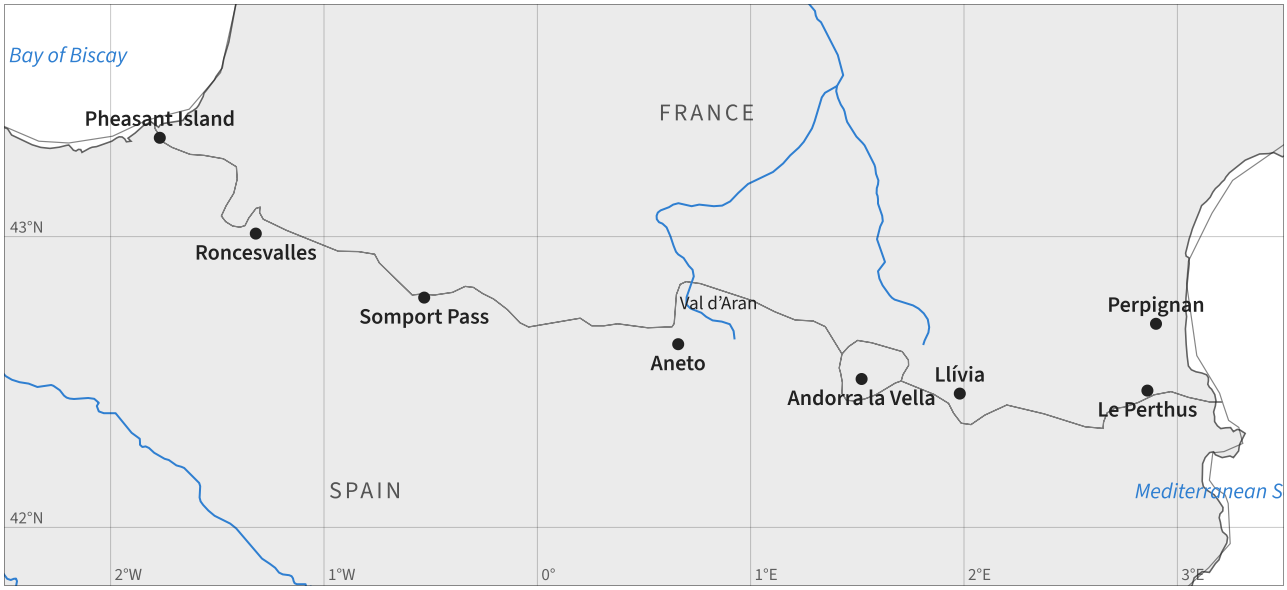
How they figured it out. Saying "the mountains are the border" is easy. Drawing the line is hard. Mountains are wide, often 50 to 90 miles (80 to 150 km) across in the Pyrenees, and a treaty must say exactly where in that width the line runs. Two common rules exist. The **highest-crest rule** joins the highest peaks. The **watershed rule** follows the ridge that splits the rain: water on one side flows to France, on the other to Spain. In the Pyrenees the two rules mostly agree, but not everywhere. The **Val d'Aran** lies on the north side of the main water-parting; its river is the Garonne, which flows through France to Bordeaux. Yet the valley was not part of the lands handed over and has stayed Spanish. In Cerdanya the treaty gave France 33 villages. The town of **Llívia** argued that it was a town, not a village, and so it stayed Spanish. Today Llívia is an island of Spain about 5 square miles (about 13 km^2) in size, surrounded by France and joined to Spain by a short neutral road. The full border was not marked on the ground until the Treaties of Bayonne in the 1850s and 1860s, which set hundreds of numbered boundary stones from the Bay of Biscay to the Mediterranean.

The big idea. A mountain range makes a strong border for three reasons. First, it is hard to cross: armies, carts and trade must squeeze through a handful of **passes**. Second, it is easy to describe: a crest or watershed is a line that both sides can see. Third, it is easy to defend: a few forts at the passes guard the whole frontier. The Pyrenees run about 270 miles (430 km) from the Bay of Biscay to the Mediterranean, and their highest peak, Aneto, rises to 11,168 feet (3,404 m). For most of their length there is no low gap at all. The easy routes are at the two ends, where the mountains drop to the sea: the Basque coast near Irun and

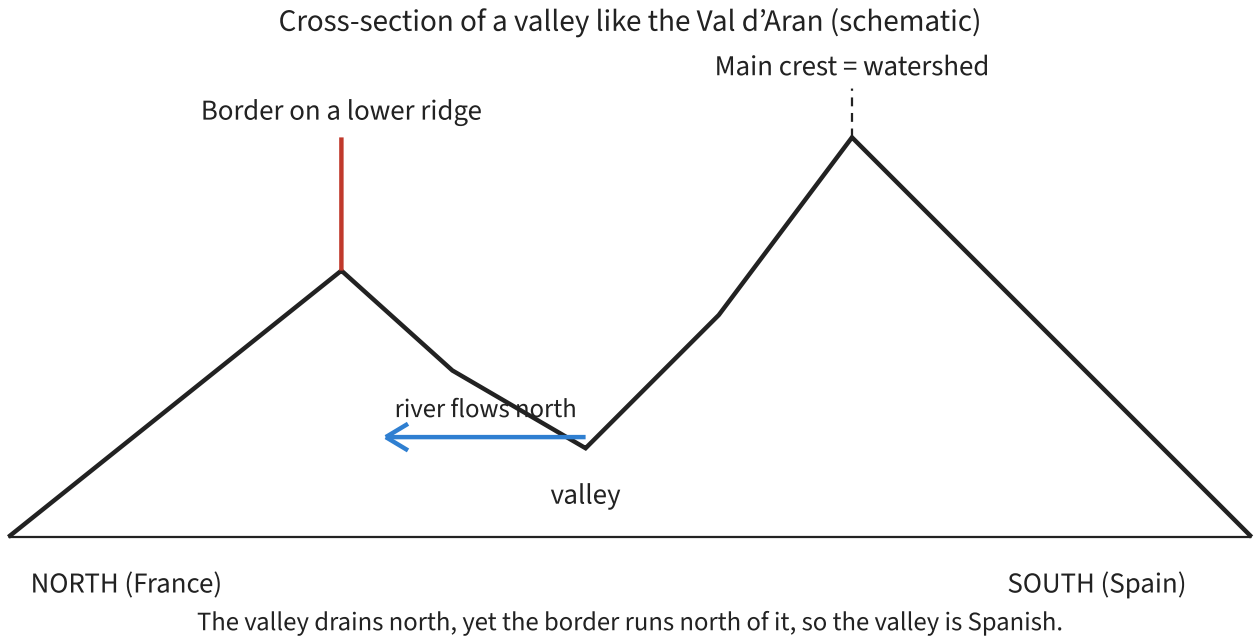
Hendaye in the west, and the Col du Perthus and the coast road in the east. In between are high passes such as Roncesvalles and Somport, closed or dangerous in winter. Charlemagne learned the danger in 778, when Basques ambushed his rear guard in the pass of Roncesvalles, the event later sung in the *Song of Roland*. Wellington's army fought its way across the western Pyrenees in 1813 to drive Napoleon's forces out of Spain. The same passes served people fleeing for their lives: about 450,000 refugees crossed into France at the end of the Spanish Civil War in early 1939, and during the Second World War guides led Allied airmen and escapers south over the mountains to Spain.

On the map. Look at the border on a map of Europe and you will see that it is one of the oldest and most stable lines on the continent. It has hardly moved since 1659, while borders on the open plains of Europe moved again and again. Two leftovers from older times remain. **Andorra**, a tiny state of about 181 square miles (468 km^2) high in the eastern Pyrenees, has been a co-principality since an agreement of 1278 between the Bishop of Urgell and the Count of Foix; the French head of state inherited the count's role. And **Pheasant Island**, where the treaty was signed, is still a condominium: the Treaty of Bayonne of 1856 made it the joint property of both countries, and under a convention of 1901 France and Spain take turns governing it for six months at a time. When Louis XIV's grandson became King Philip V of Spain in 1700, a saying was put in Louis's mouth that there were no more Pyrenees. The saying may not be his, and in any case the mountains outlasted the family alliance. They stayed the border through every war that followed.

Technology overcoming geography. For most of history, the Pyrenees forced trade around their ends. In 1928 a railway reached the grand station of Canfranc on the Spanish side and passed through a tunnel under the Somport pass into France. Yet traffic stayed light, the two countries used different track gauges, and after a French bridge was destroyed in a 1970 accident the line through the mountains was not reopened. In 2003 a road tunnel under the Somport opened, and a high-speed rail tunnel near the Col du Perthus, opened in 2010 and carrying passenger trains from 2013, joined the French and Spanish networks near the Mediterranean end, the old easy route. Technology has softened the wall, but it has done so mainly at the places nature already made easiest. As Proverbs warns, "Remove not the ancient landmark": a line that both sides have accepted for centuries is a treasure of peace.



The Pyrenees border fixed by the Treaty of the Pyrenees, 1659. Easy crossings lie at the two ends; the high passes lie between.



In the Val d'Aran the border and the main watershed part ways: the valley drains to France but belongs to Spain.

PICTURE STUDY

The Meeting of Louis XIV and Philip IV on the Isle of Pheasants (from the History of the King tapestries), Designed by Charles Le Brun, woven at the Gobelins Manufactory, Paris, designed in the 1660s; sets woven from 1665 onward · Wool and silk tapestry · French national collections; the series was made to hang in royal residences including the Palace of Versailles. The weaving shown here hangs in the French Embassy in Madrid.

Louis XIV wanted the great events of his reign remembered in a form that would last. His first painter, Charles Le Brun, designed a series of huge tapestries called the *History of the King*, each about 18 by 12 feet, woven at the royal Gobelins workshop in Paris. One shows 7 June 1660, when Louis XIV and his uncle Philip IV of Spain met in the pavilion on Pheasant Island to confirm the Peace of the Pyrenees, and Philip gave his daughter Maria Theresa in marriage.

The meeting place itself is the lesson. The pavilion was built so that the room straddled the border: each king could enter from his own side without leaving his own kingdom. Look for how Le Brun shows the two courts as two separate groups facing each other across an invisible line.

Look closely

- Find the two kings. How does the artist show that they are equals?
- Look at the two crowds of courtiers. Can you tell which side is French and which is Spanish by their clothes or position?
- Where would the border line run through this room? Trace it with your finger.
- Find Maria Theresa. Where is she placed, and why might that matter for the meaning of the scene?

Talk about it

1. Why would two kings meet on an island in a border river rather than in one of their capitals?
2. This tapestry was made for Louis XIV’s own palaces. How might that affect the way the event is shown?
3. What does this meeting tell you about how peace was made between kingdoms in the 1600s?

PROJECT: SALT-DOUGH PYRENEES: BUILDING THE UNIT RELIEF MAP (PART 1)

Across this unit you will build a salt-dough relief of a mountain border with its passes marked. Start with the Pyrenees: they are long, narrow and simple, a perfect first range. You will see with your own hands why the easy crossings lie at the two ends and why the 1659 border could follow the crest.

You will need

- 2 cups flour, 1 cup salt, about 3/4 cup water (makes one board)
- A piece of stiff cardboard or plywood about 12 by 18 inches
- A printed outline map of the Pyrenees region (or trace the lesson map)
- Toothpicks, small paper flags and glue
- Poster paints: green, brown, white, blue
- A ruler and a fine marker

Steps

1. Tape or glue your outline map to the board. Mark the Bay of Biscay and the Mediterranean in blue.
2. Mix the dough until it is stiff, like modeling clay. Add flour if sticky.
3. Build the range as a long ridge from the Basque coast to Cap de Creus. Make it highest in the center (Aneto, 11,168 feet) and let it fall to low hills at both ends.
4. Choose a vertical scale: 1/4 inch of dough for every 2,000 feet works well. Write your scale in the corner.
5. Press in the passes with your thumb: Roncesvalles, Somport and the Col du Perthus. Make the ends near Irun and Le Perthus clearly lower than the center.
6. Drag a pencil tip along the watershed and mark it. Then mark the border with a thin line of marker or yarn. Show where the Val d’Aran lies north of the watershed but inside Spain.
7. Let the dough dry for two or three days (or bake at 200°F for a few hours, with an adult’s help). Paint lowlands green, slopes brown and the high crest white.
8. Add flags for Pheasant Island, Andorra, Llívia and Perpignan, and label each pass with its elevation.

Tips

- Keep the ridge narrow compared with its length; the Pyrenees are about five times as long as they are wide.

- Dough shrinks and can crack as it dries. Build on a board, not loose paper, and keep layers under an inch thick.

Check your work

- My relief shows the Pyrenees highest in the middle and lowest at the two ends.
- My passes, border and watershed are marked and labeled.
- I can point to Llívia and the Val d'Aran and explain why each is unusual.

MAP NOTEBOOK

1. Draw a cross-section of the Pyrenees from Toulouse to Zaragoza. Mark France, the crest, the border and Spain, and shade where snow lies in winter.
2. Sketch the watershed diagram in your own words, labeling a highest-crest border and a watershed border that differ.
3. Make a two-column table: "Easy crossings" and "Hard crossings," listing at least three of each and one historical event at each.

> **From history.** The pilgrim road to Santiago de Compostela, one of the most traveled routes of medieval Europe, crossed the Pyrenees at Roncesvalles. A twelfth-century pilgrims' guide, often called the *Codex Calixtinus*, describes the climb over the pass and warns of the hardships of the Basque country. The monastery hospital at Roncesvalles was founded in the 1100s to shelter pilgrims caught by bad weather in the mountains, and pilgrims still begin the Spanish part of the Way there today.

WORKED EXAMPLES

Example 1. On a wall map at a scale of 1 inch to 40 miles, the straight-line distance from Pheasant Island to Cap de Creus measures about 6.6 inches. How long is the Pyrenees frontier in a straight line, in miles and kilometers? Compare it with the actual border length of about 400 miles (650 km) and explain the difference.

(Use the map or drawing "Measure straight-line and border distances on this map." shown earlier in this lesson.)

1. Multiply map distance by the scale: 6.6 in × 40 mi/in = 264 miles.
2. Convert: 264 mi × 1.609 km/mi ≈ 425 km.
3. Compare: the real border is about 400 mi, so it is about 400 ÷ 264 ≈ 1.5 times the straight-line distance.
4. Explain: the border follows the twisting crest and watershed, bending around valleys and peaks, so it is much longer than a straight line between its ends.

Answer: About 264 miles (about 425 km) in a straight line. The actual border is about 1.5 times longer because it winds along the crest.

Example 2. A mule train in the 1600s carrying wool from Zaragoza to Toulouse could take the high Somport route or go around by the Basque coast. Somport route: 190 miles, including a climb to 5,354 feet (1,632 m). Coast route: 290 miles, never above about 1,000 feet. On level ground the mules make 20 miles a day; on the 40 miles of steep mountain road they make only 10 miles a day. Which route is faster, and by how many days?

1. Somport route: level part = 190 − 40 = 150 miles at 20 mi/day = 7.5 days.
2. Mountain part = 40 miles at 10 mi/day = 4 days. Total = 7.5 + 4 = 11.5 days.
3. Coast route: 290 miles at 20 mi/day = 14.5 days.
4. Difference: 14.5 − 11.5 = 3 days.

Answer: The Somport route is faster by about 3 days in good weather. In winter, when snow can close the pass, the longer coast route may be the only choice. This is why the ends of the range carried so much trade.

Example 3. Llívia covers about 12.8 km². Convert this to square miles. If France had insisted that Llívia was a village, how would the map of the border have changed?

1. 1 square mile = 2.59 km².
2. 12.8 ÷ 2.59 ≈ 4.9 square miles.
3. If Llívia had counted as a village, it would have passed to France with the 33 villages of northern Cerdanya, and there would be no Spanish exclave inside France.

Answer: About 4.9 square miles. Llívia would be French, and the border in Cerdanya would be a single line with no island of Spanish land.

PRACTICE

1. EASY In what year was the Treaty of the Pyrenees signed, which two countries signed it, and where?
2. EASY Name the two chief ministers who negotiated the treaty and the king each served.
3. EASY Name the county around Perpignan that passed from Spain to France in 1659.
4. MEDIUM Define a watershed. Why is the Val d'Aran an exception to the watershed rule on the French–Spanish border?
5. MEDIUM Aneto is 3,404 m high. Convert to feet (1 m = 3.281 ft).
6. MEDIUM The Pyrenees are about 270 miles long and on average about 60 miles wide. What is the ratio of length to width, and what does it tell you about the shape of the range?
7. MEDIUM Pheasant Island is governed by France for six months and by Spain for six months each year. Since the convention of 1901, about how many times has control

changed hands by 2026?

8. MEDIUM Why did Llívia remain Spanish when the rest of northern Cerdanya passed to France?
9. HARD A road climbs from Saint-Jean-Pied-de-Port (about 170 m) to the Roncesvalles pass area (about 1,060 m at Ibañeta) over about 25 km. What is the average grade in percent?
10. HARD Give three events, from three different centuries, in which people crossed the Pyrenees through its passes, and say why each crossing mattered.
11. HARD Explain the difference between delimitation and demarcation, using the Pyrenees border as your example.
12. CHALLENGE In a paragraph, argue whether the Pyrenees are a “natural” border. Consider the Catalan-speaking people of Roussillon, the Val d’Aran, and the fact that the border has barely moved since 1659.

COMMON MISTAKES

- Thinking the border must follow the highest peaks. Many treaties use the watershed instead, and the two can differ.
- Assuming mountains stopped all movement. Armies, traders, pilgrims and refugees crossed the Pyrenees for centuries through a few passes.
- Confusing Andorra (an independent co-principality) with Llívia (a Spanish town surrounded by France).

Make it a game · Pass or Wall?. One player calls out a place along the Pyrenees (Irun, Roncesvalles, Somport, Aneto, Andorra, Le Perthus). The other must answer “pass” or “wall,” give its rough elevation, and say whether a mule train could cross there in January. A correct answer scores a point; naming a historical event at that place scores a bonus point. Play to ten.

Scripture. “Remove not the ancient landmark, which thy fathers have set.” (Proverbs 22:28, KJV)

In Israel, boundary stones marked a family’s inheritance, and moving them was theft. Between nations too, a border both sides have long accepted is a gift of peace. The Pyrenees line, kept since 1659, has spared France and Spain many quarrels.

Practice answers

1. 1659 (7 November), France and Spain, on Pheasant Island in the Bidasoa River.
2. Cardinal Mazarin for Louis XIV of France, and Don Luis de Haro for Philip IV of Spain.
3. Roussillon (with Conflent, Vallespir, Capcir and northern Cerdanya).
4. A watershed is the line separating water that drains to one side from water that drains to the other. The Val d’Aran drains north through the Garonne into France, yet it belongs to Spain.
5. 3,404 × 3.281 ≈ 11,168 feet.

6. 270 ÷ 60 = 4.5, so the range is about four and a half times as long as it is wide: a long, narrow wall, which makes a clear border line.
7. 2026 − 1901 = 125 years × 2 changes per year = about 250 changes.
8. The treaty gave France the villages of northern Cerdanya. Llívia was counted as a town, not a village, so it stayed Spanish, leaving it surrounded by French land.
9. Rise = 1,060 − 170 = 890 m. Grade = 890 ÷ 25,000 = 0.0356, about 3.6 percent on average (with much steeper stretches).
10. Sample: 778, Charlemagne’s rear guard ambushed at Roncesvalles, remembered in the Song of Roland; 1813, Wellington’s army fought across the western Pyrenees to drive the French out of Spain; 1939, about 450,000 refugees fled into France at the end of the Spanish Civil War. (Allied airmen escaping over the mountains in the 1940s also counts.)
11. Delimitation is describing the line in words in a treaty, as the 1659 treaty did by naming the mountains. Demarcation is marking it on the ground; that happened under the Treaties of Bayonne (1856–1868), which placed numbered boundary stones along the line.
12. A strong answer notes that the range is a clear physical wall with few passes, which made the line easy to describe, defend and keep stable for over 350 years. It also notes that the border cut a Catalan-speaking people in two and does not follow the watershed everywhere, so the exact line was a political choice laid over a physical feature. A good conclusion: the mountains made a border likely; kings and treaties decided exactly where.

3.2 The Alps

OBJECTIVES

- Retell Hannibal’s crossing of the Alps in 218 BC from the ancient sources, Polybius and Livy, and measure its cost in men, animals and time.
- Explain how the Alpine passes, especially the Gotthard, gave the Swiss both a reason to win their independence and the means to keep it.
- Calculate distances, daily marches, temperature drop with altitude and grades to compare crossing the Alps on foot, by pass road and by base tunnel.

Warm-up. Put an ice cube on a plate and another in a glass of warm water. While they melt, list everything an army of about 45,000 men, thousands of horses and 37 elephants would need to carry over a mountain pass at 8,000 feet in late October. Circle the items that would be hardest to find once they were above the tree line.

Watch. *Ancient History: Rome If You Want To, Hannibal (EP3) - Drive Thru History* (Drive Thru History with Dave Stotts, 5:31). https://www.youtube.com/watch?v=OnlTLfwbgPY
After the story: watch Dave Stotts follow Hannibal, his mercenaries and his war elephants on the long march from Spain toward the Alps, and look for why Rome never expected an attack over land.
Note: Captions were not available to check; preview it first. The description says Hannibal's name means "Joy of Baal" and mentions an oath sworn over an animal sacrifice, which is a good opening to talk about Carthage's false gods.

Backup video. *Why Switzerland drilled the Alps like cheese?* (Railways Explained, 19:00). https://www.youtube.com/watch?v=6F7EGkN3UYQ
With On the map: watch how Switzerland cut railway tunnels such as the Gotthard straight through the Alps, and compare them with the high passes Hannibal had to climb on foot. Note: Captions were not available to check; preview it first. A company called HARTING sponsors the video, so expect a sponsor message you can skip. At 19 minutes it is long, so you could stop after the Gotthard section.

KEY TERMS

Second Punic War
The war between Rome and Carthage from 218 to 201 BC, which began with Hannibal’s march from Spain over the Alps into Italy.

lapse rate
The rate at which air grows colder as you climb; on average about 3.6°F per 1,000 feet (6.5°C per 1,000 m).

Forest Cantons

Uri, Schwyz and Unterwalden, the mountain communities around Lake Lucerne whose 1291 alliance became the seed of Switzerland.

neutrality
A state's policy of taking no side in other nations' wars. The great powers recognized Swiss neutrality in 1815.

base tunnel
A tunnel bored near the level of the valleys at the foot of a range rather than high up near a pass, so trains need hardly climb at all.

grade
The steepness of a road or railway: rise divided by horizontal distance, often given as a percent.

CORE IDEAS

The story. In the late spring of 218 BC, Hannibal Barca, a 29-year-old Carthaginian general, marched north out of New Carthage (modern Cartagena) in Spain. Rome expected him to fight in Spain or to come by sea, because Rome ruled the waves. Instead he did what no one thought an army could do: he marched overland, across the Pyrenees, across southern Gaul and the Rhône, and then over the Alps into Italy. The Greek historian **Polybius**, who wrote within living memory and says he walked part of the route himself to see it, tells us that Hannibal crossed the Ebro with about 90,000 foot soldiers and 12,000 cavalry. Many were left behind as garrisons or sent home, and many more died or deserted. When he came down into the plain of the Po, Polybius says, he had about 20,000 foot and 6,000 horse left. The whole march from New Carthage took about five months; the crossing of the Alps took fifteen days.

How it worked. The Alps fought Hannibal with height, cold and narrow paths. Mountain tribes rolled rocks down on his columns in the gorges. It was late in the season; Polybius dates the arrival at the summit to the setting of the Pleiades, about early November, and snow already lay on the pass. On the way down, the path had been carried away by a landslide, and men and animals slid to their deaths on fresh snow lying over old ice. The Roman historian **Livy**, writing about two centuries later, adds that Hannibal's men cleared a great rock by heating it with fire and pouring vinegar on it, then breaking it with tools; Polybius does not mention this, so we treat it with care. Hannibal's 37 elephants, which had crossed the Rhône on rafts covered with earth, suffered terribly from hunger. Which pass he used is still argued: the Col de la Traversette, the Col du Clapier, the Mont Cenis and the Little St Bernard all have defenders. What is not argued is the result. Within weeks Hannibal defeated the Romans at the Trebia (December 218 BC), then at Lake Trasimene (217 BC) and at Cannae (216 BC). The mountains Rome trusted as a wall had become a road.

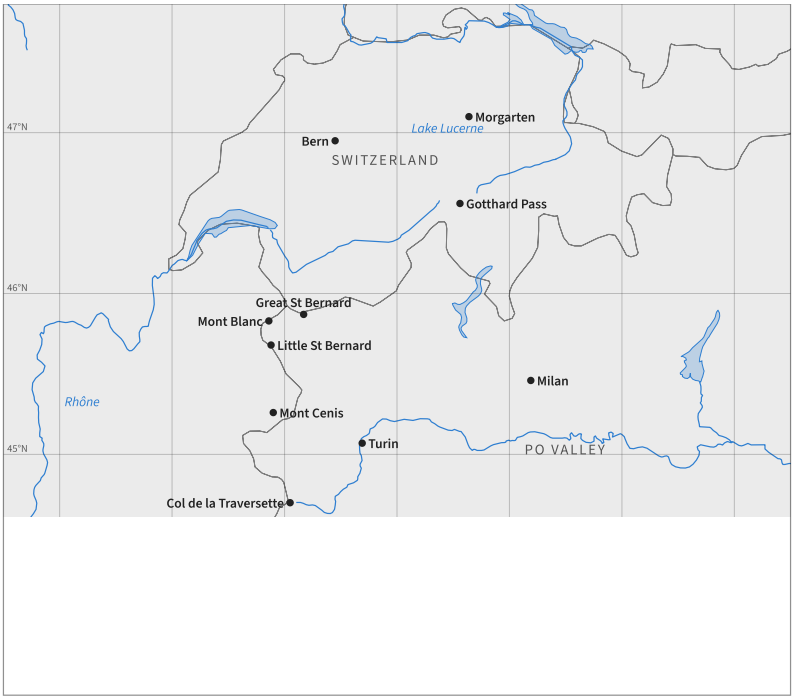
The big idea. A mountain wall is only as strong as its passes. The Alps form an arc about 750 miles (1,200 km) long from near Nice to near Vienna, with Mont Blanc rising to about 15,770 feet (4,806 m). Climb 1,000 feet and the air cools by about 3.6°F (6.5°C per 1,000 m); at a pass at 8,000 feet it is roughly 28°F colder than on the plain below at 300 feet. Above the tree line there is no firewood and no grass, so an army must carry its food and fodder or

starve. The passes are open only a few months a year. That is why great Alpine crossings by armies, Hannibal in 218 BC, Suvorov in 1799, Napoleon over the Great St Bernard in May 1800, were remembered as wonders. The wall did not stop determined armies, but it made them pay a heavy price, and it shaped where they could go.

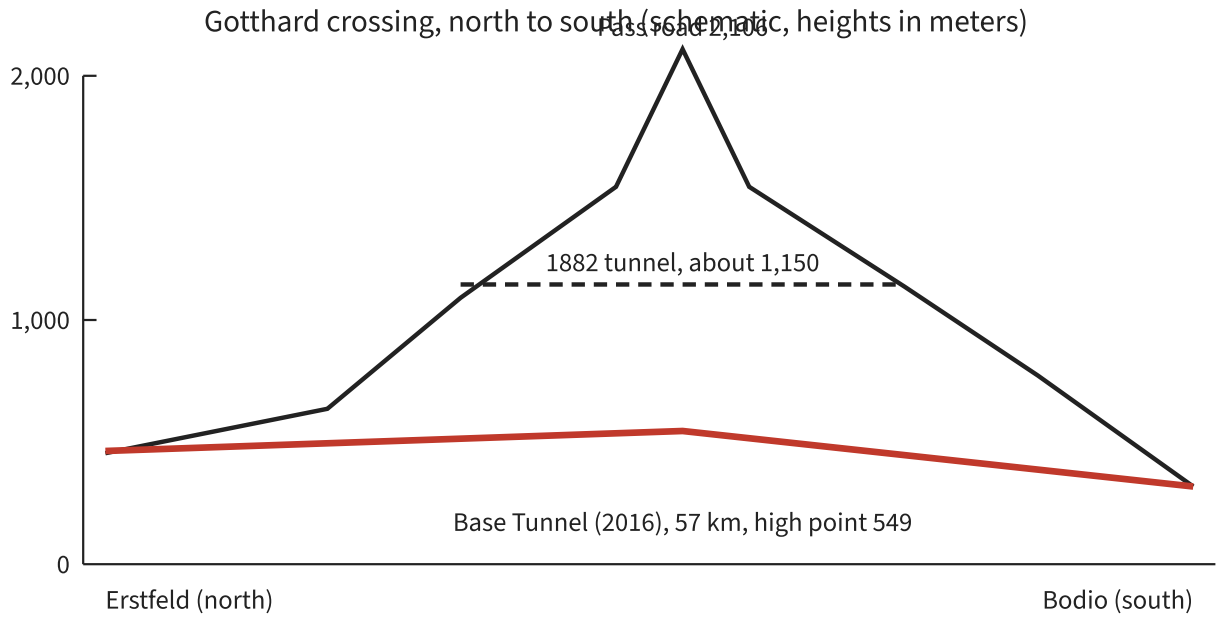
Mountain independence. The same passes made the Swiss. Early in the 1200s a road was opened through the Schöllenen gorge, with a bridge over the Reuss that legend calls the Devil's Bridge, and the **Gotthard Pass** became the shortest route between the Rhine lands and Milan. The valley of Uri controlled the northern approach. In early August 1291, the men of Uri, Schwyz and Unterwalden swore a **Federal Charter** of mutual help, promising to defend one another and to settle their quarrels by arbitration. When a Habsburg army marched against Schwyz in 1315, the confederates ambushed it at **Morgarten**, where the road ran between a steep slope and a lake, and destroyed it. At Sempach in 1386 they beat the Habsburgs again. (The story of William Tell belongs to this age as a legend; it is not recorded in sources from the time.) The confederation grew to include rich towns such as Lucerne, Zurich and Bern. Its independence from the Holy Roman Empire was recognized at the Peace of Westphalia in 1648, and the great powers recognized Swiss neutrality in 1815. Geography did not make the Swiss free by itself: their own oaths, discipline and courage did. But steep valleys, narrow roads and passes that could be held by a few men gave free peasants a fighting chance against princes with larger armies.

On the map. Find Lake Lucerne in the middle of Switzerland and you have found the old heart of the country, right on the road to the Gotthard. Switzerland grew outward from that core into a country of about 15,940 square miles (41,285 km^2), with four national languages: German, French, Italian and Romansh. Notice that most of its borders do not follow the main Alpine crest. Ticino, the Italian-speaking canton, lies south of the Gotthard and drains to the Po; the confederates won it in the 1400s and early 1500s to hold both sides of their pass. A state built around a pass wants to own the whole pass, not just one side. Elsewhere, the crest does mark borders: much of the line between Italy and France, Italy and Switzerland, and Italy and Austria runs along high ridges and glaciers. In the Second World War, General Henri Guisan planned a **National Redoubt** in the high Alps, ready to blow up the Gotthard and Simplon tunnels if Switzerland were invaded; the mountains were still the shield.

Technology overcoming geography. Each age has attacked the Alps with better tools: Roman roads, the Schöllenen bridge, the Napoleonic road over the Simplon, and in 1882 the Gotthard railway tunnel, about 9 miles (15 km) long, cut by thousands of workers, about 200 of whom died in its construction. In 2016 Switzerland opened the **Gotthard Base Tunnel**, about 35 miles (57 km) long, the longest railway tunnel in the world. Its highest point is only about 1,800 feet (549 m) above sea level, while the old pass road tops out at 6,909 feet (2,106 m). Freight trains that once needed extra engines to haul up the long climbs now run nearly level under the mountains. Yet even now, snow, avalanches and the cost of tunneling decide where crossings can go. The wall has been pierced in a few places; it has not been removed.



The Alps: Hannibal's candidate passes in the west and the Gotthard, the pass that made Switzerland.



Over the top or straight through: the Gotthard Pass and the Gotthard Base Tunnel.

PICTURE STUDY

Snow Storm: Hannibal and his Army Crossing the Alps, Joseph Mallord William Turner, exhibited 1812 · Oil on canvas · Tate Britain, London

J. M. W. Turner was the great English painter of light, weather and the power of nature. A friend later recalled that Turner watched a thunderstorm sweep across the Yorkshire hills in 1810, sketched it on the back of a letter, and said that in two years it would appear as Hannibal crossing the Alps. It did: Turner exhibited this painting at the Royal Academy in 1812, while Britain was at war with Napoleon, another general who had crossed the Alps.

Look at what Turner chose to make big and what he made small. The storm fills most of the canvas. Hannibal himself is almost impossible to find, and his famous elephants are tiny shapes in the distance. Turner printed lines from his own poem, *Fallacies of Hope*, in the exhibition catalog alongside the painting.

Look closely

- Trace the great curve of the storm cloud with your finger. Where does it lead your eye?
- Find the sun. Is it bright and warm, or pale and weak? What mood does it create?
- Search the bottom of the painting for soldiers, people being attacked by mountain tribesmen and an elephant in the distance.
- Compare the size of the army with the size of the mountains and sky.

Talk about it

1. Turner made the storm the hero of the picture, not Hannibal. What is he saying about mountains and armies?
2. Polybius tells us Hannibal lost tens of thousands of men on his march. How does the painting help you feel that cost?

3. Painted while Napoleon ruled most of Europe, could this picture be a warning? To whom?

PROJECT: SALT-DOUGH ALPS: PASSES AND THE SWISS CORE (PART 2)

Add the Alps to your unit relief, or build a separate board of the western and central Alps. Your goal is to show why the passes matter more than the peaks: mark Hannibal's candidate passes, the Gotthard and the old Swiss core around Lake Lucerne.

You will need

- Salt dough (2 cups flour, 1 cup salt, about 3/4 cup water) or your Pyrenees board
- Outline map of the Alps from Lyon to Vienna
- Blue paint or blue modeling clay for lakes
- Toothpicks and paper flags
- A piece of yarn or a thin wire to show a tunnel

Steps

1. Trace the Alpine arc on your board, from near Nice through Mont Blanc and Switzerland to near Vienna.
2. Build the main ridges with dough using the same vertical scale as your Pyrenees (1/4 inch for every 2,000 feet). Make Mont Blanc the highest point.
3. Press deep valleys for the Rhône, the Rhine, the Reuss and the Ticino.
4. Pinch notches for the passes and flag them with elevations: Little St Bernard (7,178 ft), Mont Cenis (6,834 ft), Traversette (about 9,680 ft), Great St Bernard (8,100 ft) and Gotthard (6,909 ft).
5. Press in Lake Lucerne and Lake Geneva and paint them blue. Flag Uri, Schwyz and Unterwalden around Lake Lucerne.
6. Push a wire or yarn straight through the base of the dough under the Gotthard to show the Base Tunnel at valley level.
7. When dry, paint and add a legend: passes, tunnel, Swiss core, Hannibal's candidate routes.

Tips

- Keep valleys deep and passes clearly lower than peaks; that contrast is the lesson.
- If you are adding to the Pyrenees board, a scale of 1 inch to 40 miles will keep both ranges on a large poster board.

Check your work

- My model shows at least four passes with elevations.
- I can point to the Swiss core and explain why it lies on the Gotthard road.
- I can show how a base tunnel avoids the climb to the pass.

MAP NOTEBOOK

1. Draw a timeline of Hannibal's march: New Carthage (spring 218 BC), the Ebro, the Pyrenees, the Rhône, the Alps (15 days), the Trebia (December 218 BC).
2. Sketch the Gotthard profile from the figure and label the pass, the 1882 tunnel and the 2016 Base Tunnel.
3. Draw the Morgarten battlefield as a simple map: steep slope, narrow road, lake. Explain in two sentences why the ground favored the Swiss.

> **From history.** In 1799 the Russian general Alexander Suvorov, aged nearly seventy, led his army over the Gotthard Pass and then across the high Panix Pass in autumn snow to escape a French trap in the Swiss valleys. Thousands of men and most of his pack animals were lost, but the army got through. A large memorial cut into the rock of the Schöllenen gorge near the Devil's Bridge, unveiled in 1898, still marks the place where his men fought their way up the Reuss valley.

WORKED EXAMPLES

Example 1. Polybius says the Alpine part of Hannibal's march was about 1,200 stades and took 15 days. A Greek stade was about 185 m (the exact length is debated). How long was the crossing in kilometers and miles, and what was the average daily march?

1. Distance: 1,200 × 185 m = 222,000 m = 222 km.
2. Convert: 222 km ÷ 1.609 ≈ 138 miles.
3. Daily march: 222 km ÷ 15 days ≈ 14.8 km/day, or 138 ÷ 15 ≈ 9.2 miles/day.
4. Compare: a Roman army on a good road could march about 20 miles a day, so Hannibal's pace was less than half of that.

Answer: About 222 km (138 miles), roughly 15 km (9 miles) a day: slow, because of steep paths, attacks, snow and the baggage train.

Example 2. The Po plain near Turin lies at about 250 m. A pass is at 2,500 m. If it is 10°C (50°F) in Turin, about how cold is it at the pass? Use a lapse rate of 6.5°C per 1,000 m.

1. Climb: 2,500 − 250 = 2,250 m = 2.25 thousand meters.
2. Cooling: 2.25 × 6.5°C = 14.6°C.
3. Temperature at the pass: 10 − 14.6 = −4.6°C.
4. Convert: −4.6 × 9/5 + 32 ≈ 23.7°F.

Answer: About −5°C (about 24°F), below freezing, so snow that fell on the pass would stay. This fits Polybius's account of snow on the summit in late autumn.

Example 3. A freight train goes from Erstfeld (about 460 m) to the south side of the Gotthard. Over the old line it must climb to the 1882 tunnel at about 1,150 m; through the Base Tunnel it climbs only to 549 m. How much less climbing does the Base Tunnel require, and by what percent is the climb reduced?

(Use the map or drawing "Compare the heights of the pass, the 1882 tunnel and the Base Tunnel." shown earlier in this lesson.)

1. Old line climb: 1,150 − 460 = 690 m.
2. Base Tunnel climb: 549 − 460 = 89 m.
3. Savings: 690 − 89 = 601 m.
4. Percent reduction: 601 ÷ 690 ≈ 0.87, so about 87 percent.

Answer: About 600 m (about 1,970 feet) less climbing, an 87 percent reduction. That is why heavy trains no longer need extra locomotives.

PRACTICE

1. EASY In what year did Hannibal cross the Alps, and from which city in Spain did he begin his march?
2. EASY Name the two ancient historians who are our main sources for Hannibal's crossing. Which wrote closer to the event?
3. EASY Name the three communities that swore the Federal Charter of 1291.
4. MEDIUM Polybius says Hannibal crossed the Ebro with about 102,000 men (90,000 foot, 12,000 horse) and reached Italy with about 26,000. What percent arrived? Why does this number overstate deaths?
5. MEDIUM Mont Blanc is about 4,806 m high. Convert to feet.
6. MEDIUM Why did control of the Gotthard Pass matter to the people of Uri?
7. MEDIUM The Gotthard Base Tunnel is 57 km long. A train averages 200 km/h inside it. How long does the passage take, in minutes?
8. MEDIUM Explain how the ground at Morgarten (1315) helped the confederates defeat a larger Habsburg army.
9. HARD A road climbs from Airolo (about 1,140 m) to the Gotthard Pass (2,106 m) along about 13 km of road. Find the average grade. Why did the old road need so many hairpin bends?
10. HARD Why is Ticino, on the south side of the Gotthard, part of Switzerland even though it drains to the Po and speaks Italian?
11. HARD List three dates that mark the growth of Swiss independence after 1291 and say what each one meant.
12. CHALLENGE Write a paragraph answering: Did the Alps protect Rome or endanger it in 218 BC? Use evidence from the lesson.

COMMON MISTAKES

- Thinking we know exactly which pass Hannibal used. Several passes are argued for, and none is proven.
- Treating the William Tell story as recorded history. It is a later legend about the founding age.
- Assuming the Swiss borders follow the Alpine crest. Switzerland straddles the Alps, including Ticino on the southern side.

Make it a game · Hannibal's Supply Wagon. Start with 100 counters (beans) as your army. Roll a die for each of the 15 days of the crossing: 1 = rockfall, lose 5; 2 = tribal ambush, lose 4; 3 = snow, lose 3; 4 or 5 = steady march, lose 1; 6 = good camp, lose 0. On days 9 to 15 (the descent on ice) double every loss. Record your survivors and compare with Polybius's figures. Play twice and discuss which dangers mattered most.

Scripture. "As the mountains are round about Jerusalem, so the LORD is round about his people from henceforth even for ever." (Psalm 125:2, KJV)

The psalmist knew how mountains protect a city. The Swiss knew it too. Yet Hannibal's march shows that mountains can fail; the psalm points past them to the One whose protection does not fail.

Practice answers

1. 218 BC, from New Carthage (modern Cartagena).
2. Polybius and Livy. Polybius, a Greek writing in the 100s BC, was much closer to the event than Livy, a Roman writing around the time of Augustus.
3. Uri, Schwyz and Unterwalden.
4. 26,000 ÷ 102,000 ≈ 25 percent arrived. Many of the missing were not dead: some were left as garrisons in Spain and some were sent home before the march over the Pyrenees, though thousands did die in battle, cold and accidents.
5. 4,806 × 3.281 ≈ 15,770 feet.
6. After the Schöllenen gorge was opened in the early 1200s, the Gotthard became the shortest route between the Rhine lands and Milan. Uri controlled the northern approach, so trade, tolls and the attention of powerful rulers all passed through its valley.
7. 57 ÷ 200 = 0.285 hours × 60 ≈ 17 minutes.
8. The road ran in a narrow strip between a steep slope and a lake. The Swiss attacked from the slope, the Habsburg knights could not spread out or maneuver, and many were driven into the lake or killed on the road.
9. Rise 966 m ÷ 13,000 m ≈ 0.074, about 7.4 percent. A straight route up the valley side would be far steeper, so the road zigzags to keep the grade low enough for carts, coaches and later cars.
10. The confederates conquered it in the 1400s and early 1500s to control both sides of the Gotthard route. A state built around a pass wants to hold both approaches, so the border does not follow the watershed there.
11. 1315, Morgarten: the first great victory over the Habsburgs. 1648, Peace of Westphalia: independence from the Holy Roman Empire recognized. 1815, Congress of Vienna settlement:

the great powers recognized Swiss neutrality. (1386, Sempach, and 1848, the federal constitution, are also acceptable.)

12. A strong answer says the Alps protected Rome in that they cost Hannibal a great part of his army, his animals and time, so he arrived with only about 26,000 men. But they endangered Rome because the Romans trusted them too much and did not expect an overland invasion, so Hannibal arrived in the north of Italy by surprise and won at the Trebia, Trasimene and Cannae. The wall slowed the enemy but did not stop him.

3.3 The Himalaya

OBJECTIVES

- Describe the Himalaya as a physical barrier (height, length, passes, climate) and explain the rain shadow that makes Tibet dry.
- Trace how the borders of Nepal, India and China were set: the Treaty of Sugauli (1816), the McMahon Line (1914), the Nepal–China boundary treaty (1961) and the war of 1962, and explain neutrally why parts remain disputed as of 2026.
- Use map scale, gradient and rainfall data to reason about why a high, empty mountain border is hard to define and defend.

Warm-up. Take a thick marker and draw a line across a road map whose scale you know (or a printed map from the internet). Measure the width of your marker line with a ruler. Using the scale, work out how wide a strip of real ground your line covers. Would you want your family's land to depend on which edge of that line a surveyor meant?

Watch. *Why did China Invade India in 1962? (Short Animated Documentary)* (History Matters, 3:43). https://www.youtube.com/watch?v=v97TzqGzbM4
After the story: watch this short animation on the 1962 war between China and India, and look for how the McMahon Line drawn at Simla in 1914 became the border the two countries fought over high in the Himalaya.
Note: Captions were not available to check; preview it first. It is about a war, so it mentions fighting and casualties.

KEY TERMS

rain shadow
The dry side of a mountain range. Moist air rising over the mountains cools and drops its rain on the windward side, leaving little for the far side.

monsoon
A seasonal wind that reverses direction. South Asia's summer monsoon blows moist air from the Indian Ocean against the Himalaya.

McMahon Line
The boundary between British India and Tibet in the eastern Himalaya agreed by British and Tibetan representatives in 1914. India treats it as the border; China has never accepted it.

Line of Actual Control (LAC)
The line separating areas actually held by India and China, which in many places differs from what each side claims.

buffer state
A smaller country lying between two larger powers, which keeps them apart. Nepal and Bhutan lie between India and China.

Treaty of Sugauli
The treaty (signed 1815, ratified 1816) that ended the Anglo-Nepalese War and fixed much of Nepal's border with British India.

CORE IDEAS

The story. In the spring of 1914, at a conference held in the British hill station of Simla, the British foreign secretary for India, Sir Henry McMahon, spread out a map of the eastern Himalaya drawn at a scale of eight miles to the inch. With the Tibetan representative, Lonchen Shatra, he agreed on a red line running along the high crest from the eastern edge of Bhutan to the bend of the Brahmaputra river. The two sides confirmed it by an exchange of letters in March 1914. A Chinese delegate, Ivan Chen, took part in the wider conference and initialed a draft agreement, but the Chinese government refused to accept it. That line, drawn by a few officials in a mountain town, became the **McMahon Line**. Nearly fifty years later, Indian and Chinese armies fought over it at more than 14,000 feet, and as of 2026 its meaning is still disputed.

The big idea. The Himalaya is the highest wall on earth. It runs about 1,500 miles (2,400 km) in a great curve from the bend of the Indus in the west to the bend of the Brahmaputra in the east. Ten of the world's fourteen peaks above 8,000 m (26,250 ft) stand in the Himalaya, among them Mount Everest, measured in a joint Chinese–Nepalese survey announced in 2020 at 8,848.86 m (29,031.7 ft). North of the range lies the **Tibetan Plateau**, averaging over 14,000 feet (about 4,500 m), the land often called the roof of the world. (The phrase first belonged to the Pamir mountains farther west; the Persian name Bam-i-Dunya means the same.) The range also makes a climate wall. Each summer the **monsoon** drives moist air from the Indian Ocean north against the mountains. As the air rises, it cools and drops its water, so hill towns such as Darjeeling receive about 100 inches (2,500 mm) of rain a year. Beyond the crest lies the **rain shadow**: Lhasa gets only about 17 inches (430 mm). On one side are rice paddies, tea gardens and dense forest; on the other, cold, dry grassland and yak herds. Language, food, faith and empire have followed the same divide.

How they figured it out. For most of history no one needed a precise line in the high Himalaya. Few people lived there, and the passes, such as Nathu La at 14,140 feet (4,310 m) between Sikkim and Tibet, were used by traders and pilgrims only in summer. Lines were drawn when empires met. The kingdom of Nepal, united by the conquests of Prithvi Narayan Shah, who took the Kathmandu valley in 1768, expanded east and west along the hills until it collided with the British East India Company. The **Anglo-Nepalese War** (1814–1816) ended with the **Treaty of Sugauli**: Nepal lost its western conquests of Kumaon and Garhwal and lands in the east, and the Kali (Mahakali) River became its western border. The British had been so impressed by Nepal's soldiers that they began recruiting Gurkhas, a tradition that continues in the British and Indian armies. In the north, Nepal and the People's Republic of China signed a boundary treaty in 1961 that ran the line along the high crest; it places the summit of Everest on the border itself, so climbers stand in two countries at once. Between India and China, however, two great disputes remain. In the west, the **Aksai Chin**, a high, nearly empty plateau, was claimed by India from old British maps, but China built a road

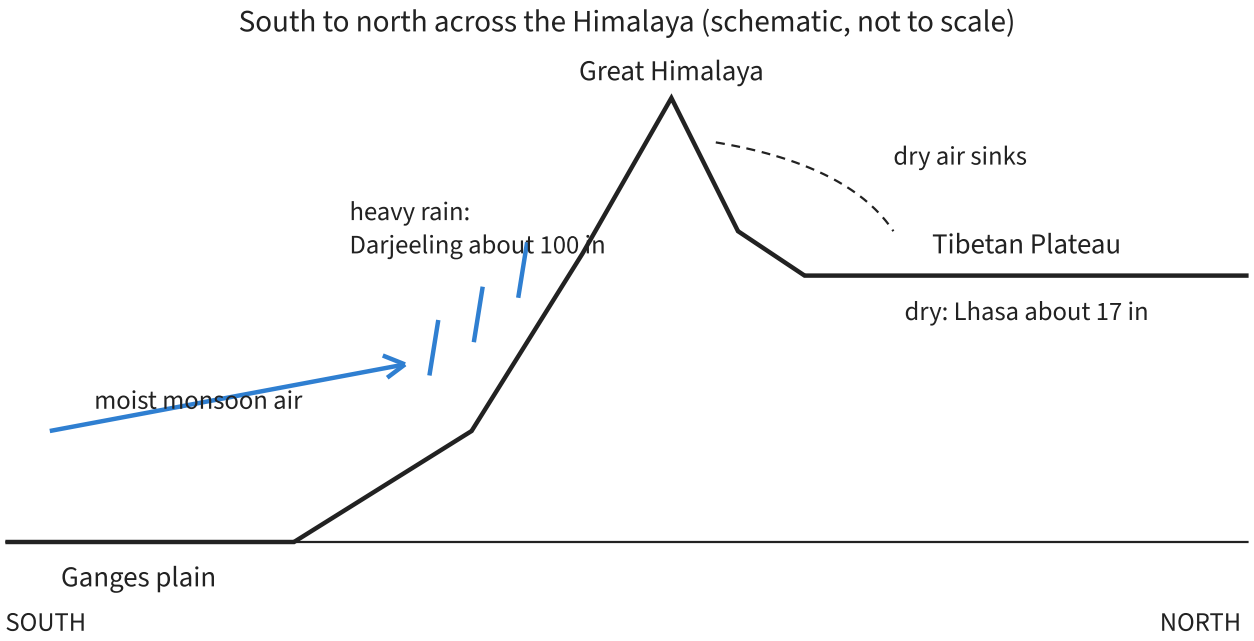
across it in the 1950s to join Xinjiang and Tibet and holds it. In the east, India holds the land south of the McMahon Line, now the state of Arunachal Pradesh, which China claims.

The war of 1962. On 20 October 1962, Chinese forces attacked Indian positions at both ends of the disputed frontier. The Indian army, sent to hold posts high in the mountains with poor roads, thin supplies and men not used to the altitude, was badly beaten. On 21 November China declared a ceasefire and pulled back in the east to roughly the McMahon Line, while keeping Aksai Chin. Each side lost thousands of men killed, wounded or captured. The war showed that in the high Himalaya the side with better roads to the front holds a great advantage, and the Chinese road across the Tibetan Plateau had given China that advantage. Since then the two countries have managed the **Line of Actual Control** by agreements between their armies. Clashes still occur; in June 2020 a fight in the Galwan Valley in Ladakh left soldiers dead on both sides (India reported 20; China reported 4). As of 2026 large stretches of the boundary remain undefined, and both governments continue to talk.

On the map. Find Nepal: a rectangle about 500 miles (800 km) long and 90 to 150 miles wide, stepping from the hot plain of the Terai, less than 300 feet above sea level, to Everest in a distance of under 125 miles. Find Sikkim, a small kingdom that became a state of India in 1975, and Bhutan, which remains independent. Notice how Nepal and Bhutan sit between India and China like stones between two millwheels. Their position has shaped their history. Nepal was never a colony, and for long periods it kept foreigners out. In 1903–1904 a British expedition under Francis Younghusband marched over the passes from Sikkim into Tibet and fought its way to Lhasa; at Chumik Shenko in March 1904, several hundred poorly armed Tibetans were killed in minutes by British rifles and machine guns. The pass that let Younghusband in was the same kind of narrow door that makes the Himalaya so hard to defend for whoever must hold it.

Technology overcoming geography. Roads, airstrips and helicopters have changed the Himalaya more in seventy years than in all the centuries before. Both India and China have built roads, tunnels and airfields toward the frontier, and Nathu La was reopened to border trade in 2006. China completed a railway to Lhasa in 2006, climbing over the Tanggula Pass at about 16,640 feet (5,072 m). Yet the mountains still rule. Winter closes passes, the thin air weakens men and engines, and avalanches and landslides cut roads every year. On the summit of Everest the air pressure is about one-third of that at sea level. The Psalmist, who never saw these peaks, could still say that before the mountains were brought forth, God was God; the highest wall on earth stands under His hand.

The Himalayan borders. Aksai Chin is held by China and claimed by India; Arunachal Pradesh is held by India and claimed by China (as of 2026).



The Himalaya as a climate wall: wet on the windward side, dry in the rain shadow.

Thinking About Time

What the sign says. Fossils of sea creatures, such as shellfish and crinoids, are found in the limestone near the summit of Everest, and textbooks give that limestone an age in many millions of years.

What we observe. What is measured is the rock, its fossils and how it is folded today. The long age comes from assuming that the slow rates of uplift seen now have always held.

How Christians read it. Christians who read Genesis as history see in these marine fossils on the roof of the world a witness to the Flood, when “all the high hills, that were under the whole heaven, were covered” (Genesis 7:19), and to great movements of the earth during and after it.

PICTURE STUDY

Kangchenjunga from Darjeeling, Edward Lear, 1879 · Oil on canvas · Yale Center for British Art, Paul Mellon Collection, New Haven, Connecticut

Edward Lear is best remembered for his nonsense rhymes, such as *The Owl and the Pussy-cat*, but he earned his living as a landscape painter and traveler. In 1873 he set out on a long journey through India and Ceylon, and in January 1874 he came to Darjeeling, the hill town in the foothills of the eastern Himalaya, to see Kangchenjunga, the third-highest mountain in the world. Back in Europe he painted the view in large oils; this one, finished in 1879, is about 4 by 6 feet.

Kangchenjunga stands on the border between Nepal and Sikkim, which is now part of India. Lear’s painting shows the whole lesson in one frame: the wet, green, forested foothills of the monsoon side in front, and beyond them, far above, the snowy wall that divides South Asia from Tibet.

Look closely

- Divide the painting into three bands: foreground plants, middle ridges, distant snow. How does Lear make the mountain look far away and very high?
- Look closely at the foreground. What does the vegetation tell you about the rainfall on this side of the range?
- Find the line where the snow begins. Why might a border be drawn along the snowy crest rather than in the green valleys?

Talk about it

1. Lear chose to paint a mountain that marks a border, but no border is visible. What makes a border real if you cannot see it?
2. How does this painting help you understand why few people lived on the high crest, and why that made drawing a border there difficult?

PROJECT: SALT-DOUGH HIMALAYA: RAIN, SHADOW AND PASSES (PART 3)

Add a section of the Himalaya to your relief, or build a cross-section model from the Ganges plain to the Tibetan Plateau. Show the climb, the passes and the difference between the wet south side and the dry north side.

You will need

- Salt dough
- A board about 6 by 18 inches for a cross-section, or space on your unit board
- Green, brown, white and tan paint
- Cotton balls (clouds) and blue yarn (rain)
- Toothpicks and paper flags

Steps

1. Lay out the cross-section from south to north: Ganges plain, Terai, foothills, Great Himalaya, Tibetan Plateau.
2. Keep the same vertical scale as your other ranges (1/4 inch for every 2,000 feet). The Himalaya crest will stand about 7 inches high and the plateau about 2 inches.
3. Notch two passes into the crest and flag them: Nathu La (14,140 ft) and a pass of your choice from an atlas.
4. Paint the south slopes deep green and the plateau tan. Paint the highest peaks white.
5. Glue cotton clouds on the south side with blue yarn falling as rain. Leave the north side cloudless.
6. Flag Everest, Kathmandu, Darjeeling and Lhasa. Mark the border on the crest with a thin red line.

Tips

- The plateau is high but flat; make it a broad shelf, not a second range.

- If you are building a map instead of a section, keep Nepal's border on the crest and use a dashed line for the disputed India–China sectors.

Check your work

- My model shows the south side wet and the north side dry, and I can explain why.
- My passes and the border are labeled.
- I can explain why a border along the crest is easy to name but hard to mark.

MAP NOTEBOOK

1. Copy the Himalaya cross-section and add arrows for the monsoon winds, the rain and the dry descending air.
2. Draw a simple map of Nepal's borders and label the Kali River, the Mechi River, Kathmandu, Everest and the Terai.
3. Make a timeline: 1768, 1816, 1914, 1961, 1962, 1975, 2020. Write one line for each.

> **From history.** The Gurkha regiments that the British began recruiting after the Anglo-Nepalese War served in both world wars and won many of the highest awards for gallantry. When India became independent in 1947, an agreement among Britain, India and Nepal divided the Gurkha regiments between the British and Indian armies, and young men from the hills of Nepal still compete for places in both.

WORKED EXAMPLES

Example 1. The McMahon Line was drawn on a map at a scale of 8 miles to 1 inch. Suppose the red line drawn on it was about 1/16 inch thick. How wide a strip of real ground does the line cover, in miles, feet and meters?

1. Ground width = map width × scale = (1/16 in) × 8 mi/in = 0.5 mile.
2. Convert to feet: 0.5 × 5,280 = 2,640 feet.
3. Convert to meters: 0.5 × 1,609 ≈ 805 m.
4. Meaning: a single pen stroke covers a strip nearly half a mile wide. In flat, crowded land that strip would hold farms and houses; in the high Himalaya it could put a whole ridge or pass on one side or the other.

Answer: About 0.5 mile (2,640 feet, about 800 m). This is one reason why lines drawn on small-scale maps in empty country lead to disputes later.

Example 2. From the plain on Nepal's southern border (about 100 m) to the summit of Everest (8,849 m) is roughly 155 km in a straight north–south line. What is the average gradient, in meters per kilometer and as a percent? Compare it with the Mississippi valley, which drops about 450 m from Lake Itasca to the Gulf over roughly 3,700 km of river.

1. Rise: 8,849 − 100 = 8,749 m.
2. Gradient: 8,749 m ÷ 155 km ≈ 56 m per km.
3. Percent: 56 m ÷ 1,000 m = 5.6 percent.
4. Mississippi: 450 m ÷ 3,700 km ≈ 0.12 m per km.
5. Ratio: 56 ÷ 0.12 ≈ 470.

Answer: About 56 m per km (5.6 percent) on average, roughly 470 times steeper than the Mississippi's fall. Nepal climbs from tropical plain to the highest point on earth in less than 100 miles.

Example 3. Darjeeling, on the monsoon side, averages about 2,500 mm (about 100 in) of precipitation a year; Lhasa, in the rain shadow, about 430 mm (about 17 in). How many times wetter is Darjeeling? Rice grown on rain alone needs roughly 1,000 mm or more a year. Which place could grow rice without irrigation?

(Use the map or drawing "The monsoon drops its rain on the south side." shown earlier in this lesson.)

1. Ratio: 2,500 ÷ 430 ≈ 5.8.
2. Lhasa: 430 mm is less than half of 1,000 mm, so it could not.
3. Darjeeling: 2,500 mm is two and a half times the need, so rain is plenty (its problem is steep slopes, which is why hill farmers build terraces).

Answer: Darjeeling is nearly six times wetter. Only the monsoon side could grow rice from rain alone; Tibet's farmers grow barley, a hardy grain, and depend on herds and irrigation.

PRACTICE

1. EASY What is the official height of Mount Everest announced in 2020, in meters and feet? On which border does its summit lie?
2. EASY Who drew the McMahon Line, when, and with which other party did he agree it?
3. EASY Define rain shadow and name the dry region north of the Himalaya.
4. MEDIUM Which war ended with the Treaty of Sugauli, and what river became Nepal's western border?
5. MEDIUM Nathu La is at 4,310 m. Convert to feet. Using a lapse rate of 6.5°C per 1,000 m, how much colder is it there than at Siliguri on the plain (about 120 m)?

6. MEDIUM Name the two main India–China disputed areas and say which side holds each as of 2026.
7. MEDIUM Why did China's road across the Aksai Chin matter so much in 1962?
8. MEDIUM On a map at 1:1,000,000, the straight-line distance from Kathmandu to Everest measures 16 cm. How far apart are they in kilometers and miles?
9. HARD Air pressure on Everest's summit is about one-third of sea-level pressure. If one breath at sea level brings in 100 units of oxygen, about how many units does the same breath bring in on the summit? What does this mean for armies on high passes?
10. HARD Explain why Nepal and Bhutan are called buffer states, and give one way Nepal's geography helped it avoid becoming a colony.
11. HARD The Himalaya is about 2,400 km long. If it averages 250 km wide, estimate its area in km^2 and square miles.
12. CHALLENGE Write a paragraph explaining why a border along the highest crest of the Himalaya, which seems the most "natural" border in the world, is still disputed in places.

COMMON MISTAKES

- Thinking the whole Himalayan border was fixed long ago. Nepal's northern line dates from 1961, and long stretches of the India–China line remain undefined as of 2026.
- Assuming the side of the mountains closest to a country must belong to it. Roads, supply and treaties decided who held Aksai Chin and Arunachal Pradesh.
- Mixing up Sikkim (part of India since 1975) and Bhutan (an independent kingdom).

Make it a game · Who Holds the Pass?. Draw a simple map of a high ridge with three passes. Each player has 10 supply counters per turn. Moving supplies to a pass costs 1 counter per step on your side's road and 3 per step on a mountain track; one player has a road, the other only tracks. Whoever has more supplies at a pass after five turns holds it. Switch sides and play again, then explain what 1962 teaches about roads in the mountains.

Scripture. "Before the mountains were brought forth, or ever thou hadst formed the earth and the world, even from everlasting to everlasting, thou art God." (Psalm 90:2, KJV)

Everest is called the roof of the world, yet it was brought forth by the Creator who was before it. Borders drawn across it by men in 1816, 1914 or 1961 are recent; His rule over the mountains is from everlasting.

Practice answers

1. 8,848.86 m (29,031.7 ft, often rounded to 29,032 ft). The summit lies on the border between Nepal and China (Tibet).
2. Sir Henry McMahon of British India, in 1914, with the Tibetan representative Lonchen Shatra.

3. A rain shadow is the dry side of a mountain range, where descending air has already lost its moisture on the windward side. The Tibetan Plateau lies in the Himalaya's rain shadow.
4. The Anglo-Nepalese War (1814–1816); the Kali (Mahakali) River.
5. 4,310 × 3.281 ≈ 14,140 ft. Difference in height: 4,190 m × 6.5°C per 1,000 m ≈ 27°C colder (about 49°F colder).
6. Aksai Chin in the west, held by China and claimed by India; Arunachal Pradesh in the east (south of the McMahon Line), held by India and claimed by China.
7. It let China move troops and supplies easily over the plateau to the front, while Indian forces had to climb from the plains on poor tracks. In high mountains the side with roads to the front has the advantage.
8. 16 cm × 1,000,000 = 16,000,000 cm = 160 km, about 99 miles.
9. About 100 ÷ 3 ≈ 33 units, one-third as much. Soldiers at altitude tire quickly, sicken and need time to acclimatize; this weakened Indian troops rushed to high posts in 1962.
10. They lie between the two great powers, India and China, keeping them apart. Nepal's steep hills and narrow valleys made conquest costly; after the war of 1814–1816 the British chose a treaty, Gurkha recruitment and influence rather than direct rule.
11. 2,400 × 250 = 600,000 km². Divide by 2.59: about 232,000 square miles, a little smaller than Texas (about 269,000 square miles).
12. A strong answer explains that the crest is clear in principle but the actual ridges branch, rivers cut through them, and there was no survey or settlement on the ground when lines were drawn. The McMahon Line was drawn on a small-scale map by two parties while the third (China) refused it, and the Aksai Chin was claimed from old maps by one side while the other built a road and held it. Empty, high country left no villages, taxes or local loyalties to settle the question, so it was decided by treaties some did not accept and by force in 1962.

3.4 The Andes

OBJECTIVES

- Explain how the Andes, the Pacific, the Atacama Desert and the southern ice fields together shaped Chile into a country about 2,670 miles (4,300 km) long and on average only about 110 miles (177 km) wide.
- Describe how Chile and Argentina turned a mountain border into peace: the treaty of 1881, the arbitration of 1902, the Christ of the Andes (1904) and the papal mediation of 1978–1984.
- Compute a country's length from latitude, estimate area from length and width, and read a cross-section to explain where Chileans live.

Warm-up. Cut a strip of paper 1 inch wide and 24 inches long. That strip has the same shape as Chile. Lay it on a table and walk your fingers from one end to the other. Now cut a square of the same area (about 5 by 5 inches). Which shape would be easier to govern, defend and connect with roads? Which would have more coastline?

Video. Coming soon. Search Kings and Generals for San Martín's crossing of the Andes (1817) and the War of the Pacific; The History Guy for the Christ of the Andes and the Beagle Channel crisis of 1978; NASA Earth Observatory for satellite images of the Atacama and the Patagonian ice fields; Geography Now (candidate, needs vetting) for a Chile overview.

KEY TERMS

cordillera
Spanish for a mountain chain. The Andes are often called simply "the Cordillera" in Chile and Argentina.

Central Valley
The long, fertile valley in central Chile between the Coastal Range and the Andes, where Santiago lies and most Chileans live.

arbitration
Settling a dispute by asking a neutral judge to decide, with both sides promising to accept the result. Britain's King Edward VII arbitrated the Andes boundary in 1902.

mediation
Help from a neutral party who brings two sides to agree, without imposing a ruling. Pope John Paul II mediated the Beagle Channel dispute.

elongated state
A country much longer than it is wide, such as Chile, Norway or Vietnam.

coastal desert
A desert along an ocean shore, kept dry by cold currents and sinking air. The Atacama is one of the driest places on earth.

CORE IDEAS

The story. In January 1817, an army of about 5,000 men marched west out of Mendoza, on the dry eastern foot of the Andes. Its general, José de San Martín, meant to free Chile from Spanish rule by doing what Spanish officers believed impossible: crossing the high Cordillera with a whole army. He split his force into columns to confuse the enemy. The main body crossed by the Los Patos route and another by the Uspallata route, climbing over passes more than 12,000 feet high, where men suffered from cold and from the altitude sickness known in the Andes as *puna*. They carried dried beef, onions and garlic, and they lost a large share of their mules and horses on the way. In about three weeks they came down into the valley of the Aconcagua, and on 12 February 1817 San Martín and the Chilean leader Bernardo O'Higgins defeated the royalists at **Chacabuco**. Chile declared its independence one year later. The Andes had been crossed as Hannibal crossed the Alps: not because the wall was weak, but because careful planning paid its price.

The big idea. The Andes are the longest mountain chain on any continent, running about 4,300 miles (7,000 km) down the western edge of South America. Their highest peak, Aconcagua, rises to 22,838 feet (6,961 m), the highest point outside Asia. In the middle latitudes the range is a nearly unbroken wall, and Chile is the country squeezed between that wall and the Pacific. From its northern border near 17.5° south to Cape Horn at about 56° south, mainland Chile stretches about 2,670 miles (4,300 km), roughly the distance from New York to Los Angeles. Yet it averages only about 110 miles (177 km) wide. Laid on a map of Europe, Chile would reach from northern Norway to North Africa. On a cross-section you see why the land is so narrow: a Coastal Range rises from the sea; behind it lies the **Central Valley**; and then the Andes climb in a few dozen miles to the Argentine border. Most of Chile's people live in a few hundred miles of that valley, around Santiago, Valparaíso and Concepción.

How it worked. Chile is walled on four sides. On the east stand the Andes. On the west lies the Pacific. In the north is the **Atacama Desert**, where the cold Humboldt Current and sinking air keep the coast almost rainless; Arica averages less than a millimeter of rain a year. In the south, the land breaks into fjords, islands and the great Patagonian ice fields. The Spanish founded Santiago in 1541 under Pedro de Valdivia, and for most of three centuries the colony of Chile was a long, isolated pocket reached by sea or by mule over the passes. In the south it faced another wall: the **Mapuche** people, who resisted conquest fiercely, killed Valdivia in 1553, and destroyed the Spanish towns south of the Biobío River after a victory at Curalaba in 1598. In 1641 the Spanish recognized the Biobío as a frontier at the parliament of Quilín. Independent Chile finally occupied the Mapuche lands by military campaigns between 1861 and 1883, taking most of their land and confining them to small reserves, a real loss that is part of the country's history. In the north, Chile won the War of the Pacific (1879–1884) against Peru and Bolivia and took the nitrate-rich desert provinces of Antofagasta and Tarapacá. Bolivia lost its whole coast and has been landlocked ever since.

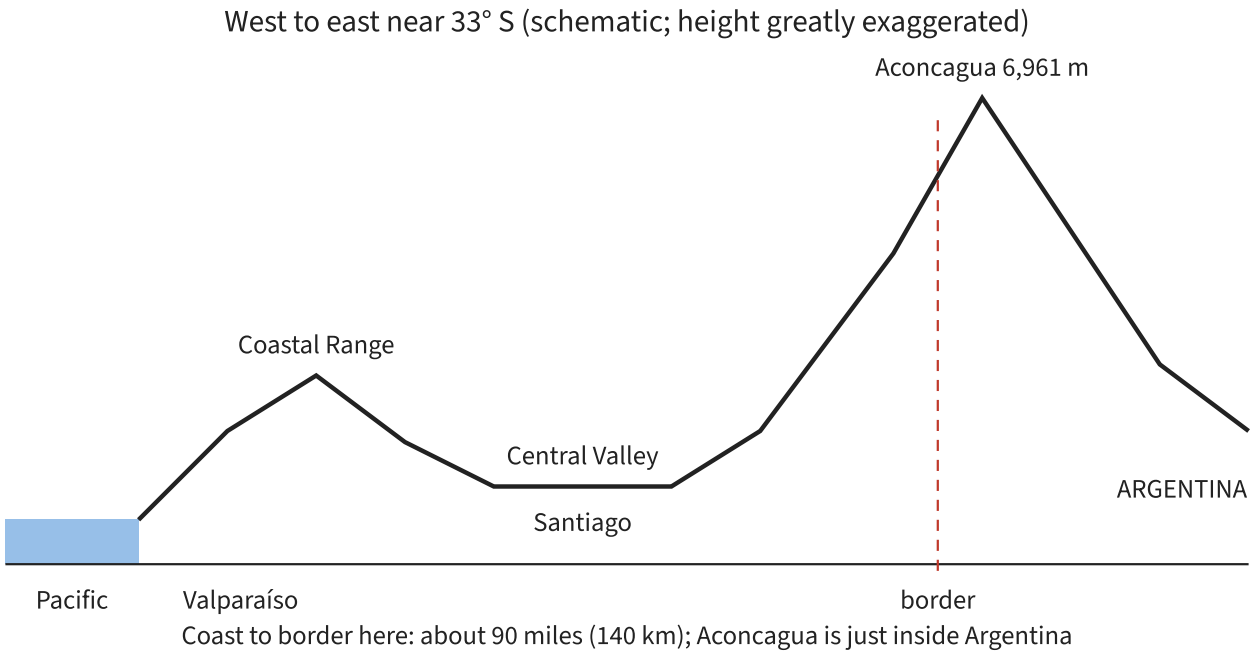
On the map. The border with Argentina runs about 3,300 miles (5,300 km), one of the longest in the world. In 1881 the two countries signed a treaty saying the line would follow

the highest peaks of the Cordillera that divide the waters. In the north and center, the highest peaks and the water-parting are the same ridge. In Patagonia they are not: some rivers rise on the dry eastern side, cut west through the range and reach the Pacific. Argentina argued for the highest peaks; Chile argued for the water-parting. By the late 1890s both countries were buying warships, and war seemed close. Instead, in 1902 they signed the Pacts of May, limiting their navies, and accepted the award of King Edward VII of Britain, whose surveyors, led by Sir Thomas Holdich, walked the disputed valleys and split the difference between the two principles. To celebrate, a bronze statue of Christ, the **Christ the Redeemer of the Andes**, was dedicated on 13 March 1904 on the border at the La Cumbre (Bermejo) pass, at about 12,570 feet (3,832 m), on the old route above the Uspallata road. Its plaque, added later, says in effect that the mountains would sooner crumble to dust than Argentines and Chileans break the peace they swore at Christ's feet.

The peace tested. The peace was tested again in 1978 over three small islands at the mouth of the Beagle Channel, near Cape Horn. Both armies moved to the border, and Argentina had planned an attack for December. At the last moment both governments accepted the mediation of Pope John Paul II, whose envoy, Cardinal Antonio Samorè, worked for years on a settlement. In 1984 the two countries signed a Treaty of Peace and Friendship that gave the islands to Chile and most of the surrounding sea rights to Argentina. As of 2026 only a short stretch of the border, across the Southern Patagonian Ice Field, still waits to be fully marked on the ground. The Andes border shows that a mountain wall can make a clear line, but peace along it was made by people who chose arbitration over war.

Technology overcoming geography. In 1910 the Transandine Railway joined Los Andes in Chile with Mendoza in Argentina, using rack sections to climb the steep grades and a tunnel near the Cristo Redentor pass. Snow and avalanches closed it for weeks at a time, and it carried its last train in 1984. Since 1980 a road tunnel under the same pass has carried most of the truck traffic between the two countries, yet it, too, closes in winter storms. Along Chile's length, the Pan-American Highway and coastal shipping tie the long ribbon together, and many Chileans fly rather than drive between Arica and Punta Arenas. The wall still stands; the country has learned to live along it.

Chile: about 2,670 miles long and on average about 110 miles wide, between the Andes and the Pacific.



Why Chile is narrow: coast, Coastal Range, Central Valley and Andes in under 100 miles at this latitude.

PICTURE STUDY

The Heart of the Andes, Frederic Edwin Church, 1859 · Oil on canvas · The Metropolitan Museum of Art, New York

Frederic Edwin Church was an American painter who traveled to Colombia and Ecuador in 1853 and 1857, following the path of the German explorer and scientist Alexander von Humboldt. Back in New York, he combined his sketches into one enormous painting, about 5 1/2 by 10 feet. When it was shown alone in a darkened room in 1859, framed like a window, thousands of people paid admission to stand before it, some with opera glasses to study the details.

The scene is not one real view but a composite of the Ecuadorian Andes, from steamy forest to eternal snow. It shows the tropical, wet side of the range, very different from Chile's desert north and icy south. Church painted the zones of life, one above another, just as Humboldt had described them.

Look closely

- Start at the bottom and climb with your eyes: forest, plain, ridges, snow. How many climate zones can you count?
- Find the small village and church in the middle distance and the tiny figures near a cross by the path. How big are the people compared with the mountains?
- Look for water. Where does it come from, and where is it going?
- Where is the snow line? What does it tell you about how high the far peak must be, so close to the equator?

Talk about it

1. Church painted the Andes of Ecuador. How would a painting of the Andes from Chile's Atacama look different, and why?
2. Why might Church have included a cross along the path? What does it say about how he saw God and creation?
3. How could a painting like this have shaped what Americans in 1859 thought about South America?

PROJECT: SALT-DOUGH ANDES: THE RIBBON COUNTRY (PART 4)

Build a long, narrow relief of Chile and the Andes, or add the central Andes around Santiago and Mendoza to your unit board. Your model should make the shape of Chile obvious and show the passes that join it to Argentina.

You will need

- Salt dough
- A strip of cardboard about 4 inches wide and 30 inches long (for the full country) or a 12-by-12-inch board (for the central section)
- Paint: blue, tan, green, brown, white
- Flags, toothpicks, and a ruler
- An atlas map of Chile

Steps

1. Choose a horizontal scale. For the full country, 1 inch to 100 miles makes the model about 27 inches long and about 1 to 2 inches wide.
2. Along the east edge, build the Andes as a continuous ridge, highest near Aconcagua, lower and broken in Patagonia.
3. Along the west, build a low Coastal Range, and leave a groove between them for the Central Valley.
4. Paint the north tan (Atacama), the center green, the south dark green and white (forests and ice), and the ocean blue.
5. Notch and flag passes: Cristo Redentor/La Cumbre (12,570 ft), and one more pass of your choice from the atlas.
6. Flag Arica, Antofagasta, Santiago, Valparaíso, Concepción, Puerto Montt, Punta Arenas and Cape Horn. Mark the Biobío River.
7. Write the length, average width and area of Chile on a label card.

Tips

- The width is the hardest part. Use a ruler and keep the land strip true to scale; it should look almost too thin.
- Exaggerate height more than length (for example, 1/4 inch for every 2,000 feet), and say so on your label.

Check your work

- My model shows Chile’s length and narrow width to scale.
- I have shown the four walls: Andes, Pacific, desert and ice.
- I can explain the 1881 rule and why it caused a dispute in Patagonia.

MAP NOTEBOOK

1. Draw the Chile cross-section at the latitude of Santiago and label the Pacific, Coastal Range, Central Valley, Andes and Argentina.
2. Trace an outline of Chile and, at the same scale, an outline of the eastern United States from Maine to Florida. Compare the lengths.
3. Draw a small diagram of a river that rises east of the highest peaks and flows west to the Pacific. Mark where the line would go under the highest-peaks rule and under the water-parting rule.

> **From history.** When the Christ of the Andes was dedicated in 1904, bishops from both countries led the ceremony on the pass, and soldiers of both armies stood together beside the statue. It was cast in Buenos Aires, carried by rail to the end of the line at Mendoza, and then hauled up the mountain in pieces by mules and by soldiers pulling on ropes, because no road or railway yet reached the top.

WORKED EXAMPLES

Example 1. Mainland Chile runs from about 17.5° S to Cape Horn at about 56.0° S, almost exactly north–south. One degree of latitude is about 111 km (69 miles). How long is Chile?

(Use the map or drawing “Read the latitudes of Chile’s north and south ends from the grid.” shown earlier in this lesson.)

1. Degrees of latitude: 56.0 − 17.5 = 38.5°.
2. Kilometers: 38.5 × 111 ≈ 4,270 km.
3. Miles: 38.5 × 69 ≈ 2,660 miles.
4. This is a straight north–south distance; the coastline itself, with all its fjords, is many times longer.

Answer: About 4,270 km (about 2,660 miles), in line with the usual figure of about 4,300 km (2,670 miles).

Example 2. Estimate Chile's area from its length (4,300 km) and average width (177 km). Compare with the official figure of about 756,000 km², and convert your estimate to square miles.

1. Area ≈ length × average width = 4,300 × 177 = 761,100 km².
2. Compare: 761,100 − 756,000 = 5,100 km², an error of about 5,100 ÷ 756,000 ≈ 0.7 percent.
3. Convert: 761,100 ÷ 2.59 ≈ 294,000 square miles.

Answer: About 761,000 km² (about 294,000 sq mi), within 1 percent of the official figure. Chile is a little larger than Texas but shaped like a ribbon.

Example 3. Before the War of the Pacific, Chile's northern border was near 24° S. After the war it ran near 18.3° S (just north of Arica). How far north did Chile's territory extend, in km and miles? What resource made this desert worth a war?

1. Change in latitude: 24.0 − 18.3 = 5.7°.
2. Distance: 5.7 × 111 ≈ 633 km.
3. Miles: 5.7 × 69 ≈ 393 miles.

Answer: About 630 km (about 390 miles). The prize was nitrate (saltpeter), mined in the Atacama and sold worldwide as fertilizer and for explosives; later the same region became a great copper producer.

PRACTICE

1. EASY Who led the Army of the Andes across the mountains in 1817, and what battle did it win?
2. EASY Name the highest mountain in the Andes, its height in feet and meters, and the country it stands in.
3. EASY Name the four "walls" that surround Chile.
4. MEDIUM Chile is about 4,300 km long and averages 177 km wide. What is the ratio of length to width?
5. MEDIUM State the rule of the 1881 boundary treaty and explain why it caused a dispute in Patagonia.
6. MEDIUM Who settled the 1902 dispute, and how? What else did the Pacts of May agree?
7. MEDIUM The Christ the Redeemer of the Andes stands at 3,832 m. Convert to feet. Using 6.5°C per 1,000 m, how much colder is it there than in Mendoza (about 750 m)?
8. MEDIUM Which river marked the frontier between Spanish Chile and Mapuche lands, and when did Chile finally occupy the Mapuche lands?
9. HARD Valparaíso is at about 33.0° S and Punta Arenas at about 53.2° S. Both lie near 71° W. A ship sails between them in a straight line at 15 knots (1 knot = 1.852 km/h). How

long is the trip, ignoring the fjords?

10. HARD Explain why the Atacama is so dry even though it lies beside the ocean.
11. HARD What happened in the Beagle Channel crisis, and how was it resolved?
12. CHALLENGE Write a paragraph: Is Chile's shape a disadvantage or an advantage? Consider defense, transport, government, climate variety and access to the sea.

COMMON MISTAKES

- Saying Aconcagua is in Chile. It is in Argentina, though close to the border.
- Assuming "highest peaks" and "water-parting" always mean the same line. In Patagonia they differ, which caused the 1902 arbitration.
- Forgetting that the north of Chile was won in the War of the Pacific (1879–1884); before it, Bolivia had a seacoast.

Make it a game · Ribbon Country Relay. Write Chile's cities and places on cards (Arica, Atacama, Antofagasta, Santiago, Valparaíso, Biobío, Puerto Montt, Punta Arenas, Cape Horn). Shuffle them. Players race to lay them in order from north to south on a long strip of paper, then must give one fact for each card: climate, history or resource. Score a point for each correct fact; the fastest correct strip wins a bonus.

Scripture. "Blessed are the peacemakers: for they shall be called the children of God." (Matthew 5:9, KJV)

Chile and Argentina came close to war more than once over lines in the mountains. Twice they chose a neutral judge or mediator and accepted the result. The statue on the pass is a public reminder that peace is a blessing worth working for.

Practice answers

1. José de San Martín (with Bernardo O'Higgins); the Battle of Chacabuco, 12 February 1817.
2. Aconcagua, 22,838 feet (6,961 m), in Argentina.
3. The Andes (east), the Pacific Ocean (west), the Atacama Desert (north) and the Patagonian ice fields and fjords (south).
4. 4,300 ÷ 177 ≈ 24, so Chile is about 24 times as long as it is wide.
5. The border was to follow the highest peaks that divide the waters. In Patagonia some rivers rise east of the highest peaks and flow west to the Pacific, so the highest peaks and the water-parting are different lines. Argentina chose the peaks, Chile the water-parting.
6. King Edward VII of Britain, as arbitrator, after surveys led by Sir Thomas Holdich; the award divided the disputed land between the two principles. The Pacts of May also limited the two countries' navies.
7. 3,832 × 3.281 ≈ 12,570 ft. Difference: 3,082 m × 6.5 ÷ 1,000 ≈ 20°C colder (about 36°F colder).
8. The Biobío River; Chile occupied the lands south of it by military campaigns between 1861 and 1883.
9. 20.2° × 111 ≈ 2,240 km. Speed 15 × 1.852 ≈ 27.8 km/h. Time ≈ 2,240 ÷ 27.8 ≈ 81 hours, about 3.4 days (real ships take longer, winding through the channels).

10. The cold Humboldt Current cools the air above it, so it cannot rise and form rain clouds; the region also lies under sinking, dry air of the subtropics; and the Andes block moist air from the Amazon side. The result is one of the driest deserts on earth.
11. In 1978 Argentina and Chile nearly went to war over three islands at the mouth of the Beagle Channel. Both accepted mediation by Pope John Paul II (through Cardinal Antonio Samorè), and the Treaty of Peace and Friendship of 1984 gave the islands to Chile and most maritime rights in the area to Argentina.
12. A strong answer weighs both sides. Disadvantages: long internal distances, hard to defend a long border, regions far from the capital, costly roads and many bridges. Advantages: every region is near the sea, so shipping is easy; the Andes protect the eastern border; the great range of latitude gives deserts with copper and nitrates, a Mediterranean center for farming and wine, and forests and fisheries in the south. A good conclusion links the shape to the walls that made it.

3.5 The Caucasus

OBJECTIVES

- Explain why the Greater Caucasus forms a wall between the steppe and the lands to the south, and why its two gates, the Darial Gorge and the Derbent passage, mattered to Byzantines, Persians, Ottomans and Russians.
- Trace how the Georgian Military Road carried Russian power over the mountains after 1801, and what the road, later tunnels and the lack of a railway show about technology and mountains.
- Compare route lengths, grades and travel times through and around the range, and explain neutrally the borders of the Caucasus as of 2026.

Warm-up. Lay a long book across a table to stand for a mountain range. Its two ends touch two “seas” (bowls of water). Using only a pencil, find every way an ant could get from one side of the table to the other: over the top, through a gap you cut with a paper “gorge,” or around the ends beside the water. Which route would a king fortify first?

Watch. *World War I: Fate of Armenians, Georgians, Azerbaijanis, Kurds and Assyrians* (Kings and Generals, 22:28). https://www.youtube.com/watch?v=kN2yEEMeIFA
As review: for older students, this animated map documentary shows how the mountains, passes, railways and Baku's oil made the Caucasus a battleground again in 1918; watch the maps for the peoples squeezed between Russia, the Ottomans and Persia.
Note: Captions were not available to check; preview it first. It is a 22-minute war documentary that likely describes massacres and the suffering of Armenians and Assyrians, and the description opens with a membership/Patreon promotion. It covers the 1917–1918 collapse of Russian rule and the short-lived republics, not Pushkin's 1829 journey or the earlier Russian conquest and Imam Shamil.

KEY TERMS

Greater Caucasus
The main range of the Caucasus, running about 750 miles (1,200 km) from the Black Sea to the Caspian Sea.

Darial Gorge
The deep gorge of the Terek River through the center of the Greater Caucasus, the main inland gateway; its name comes from Persian words meaning “Gate of the Alans.”

Derbent
An ancient fortress city on the narrow strip of land between the Caucasus and the Caspian Sea, the eastern gateway around the range.

Georgian Military Road
The road of about 130 miles (208 km) from Vladikavkaz over the Jvari (Cross) Pass to Tbilisi, rebuilt by the Russian army in the 1800s to hold Georgia.

imperial frontier
The edge of an empire, where its power meets another empire or peoples it does not yet rule.

frozen conflict
A war that has stopped fighting without a peace treaty, leaving borders unsettled, as in Abkhazia and South Ossetia.

CORE IDEAS

The story. In May 1829 the poet Alexander Pushkin rode south from Vladikavkaz, a Russian fortress at the northern foot of the Caucasus, on his way to the Russian army fighting the Ottoman Turks. The road took him into the **Darial Gorge**, where the Terek River roars between cliffs so high and close that, as he later wrote, a traveler seems not only to see the narrowness of the gorge but to feel it. He passed under the snowy cone of Mount Kazbek, crossed the high pass and came down to Tiflis (Tbilisi). He described the journey in his *Journey to Arzrum*. A few years later Mikhail Lermontov, exiled to the Caucasus as an officer, set the opening of his novel *A Hero of Our Time* (1840) on the same road, with a traveler's cart being hauled up the steep mountain road by oxen, and a snowstorm on the Cross Pass soon after. For Russians the road was romance and adventure. For Georgians, Ossetians and the mountain peoples it was something more serious: the line along which an empire came to stay.

The big idea. The **Greater Caucasus** runs about 750 miles (1,200 km) from the Black Sea to the Caspian. It is high, with Elbrus at 18,510 feet (5,642 m) and Kazbek at about 16,550 feet (5,047 m), and it is a continuous wall with very few low gaps. North of it stretch the grasslands of the steppe, the road of nomad horsemen; south of it lie the valleys of Georgia, Armenia and Azerbaijan, old Christian kingdoms and Muslim khanates, vineyards and cities. Only two routes lead through or around the wall without climbing high snowfields. In the middle is the **Darial Gorge**, the Gate of the Alans. In the east is **Derbent**, where the mountains come down to within about 2 miles (3 km) of the Caspian shore. Whoever held those two gates could keep the steppe peoples out of the south, or let them in. Ancient writers called them the Caucasian Gates and the Caspian Gates and wove legends around them, including the story that Alexander the Great had shut the northern nations behind iron gates.

Empires at the gates. For a thousand years the great powers of the south contested the Caucasus. Armenia adopted Christianity as its state faith by tradition in 301, and Georgia's king Mirian III was converted in the 330s through the witness of a woman remembered as Saint Nino. Both stood between the Christian Roman (Byzantine) Empire and Persia. In the 500s the Persian king Khosrow I built massive stone walls at Derbent, running from the sea up into the mountains, to stop raiders from the steppe, and the Byzantine emperors sometimes paid gold toward guarding the passes, because nomad raids threatened both empires. In the 620s the emperor Heraclius did the opposite: he allied with Turkic horsemen from the north and brought them through the gates to attack Persia, besieging Tiflis in 627. Later the Arabs, the Seljuk Turks and the Mongols all came through. In the 1500s the

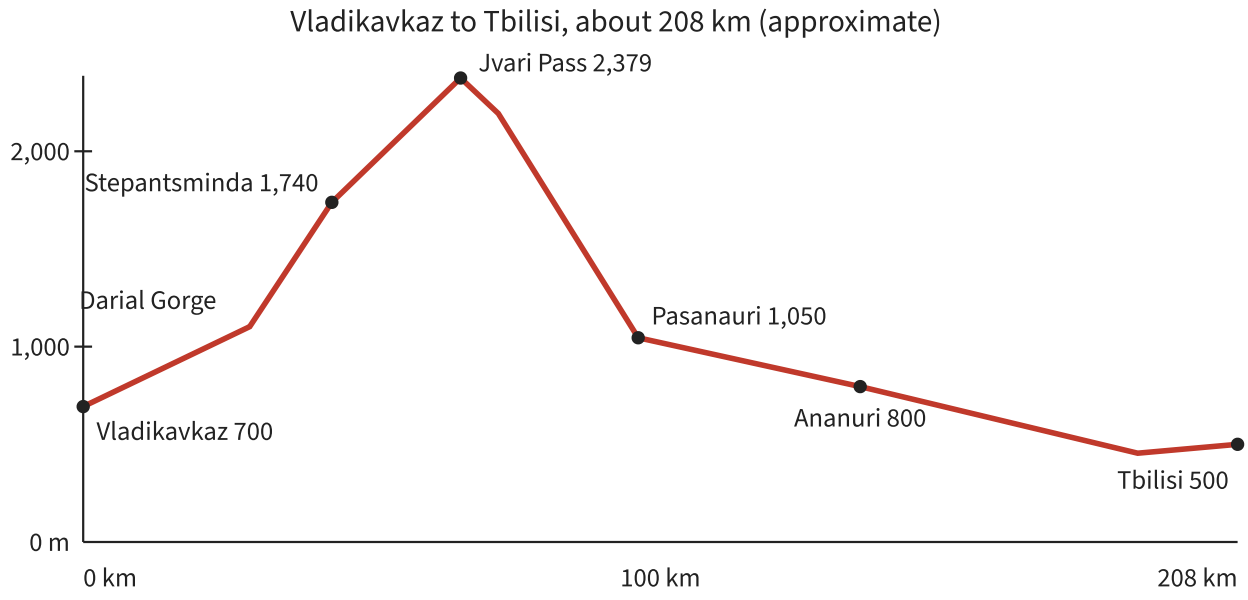
Ottoman Turks and the Safavid Persians fought over the region; at the Peace of Amasya in 1555 they split it, the west to the Ottomans and the east to Persia. The mountains did not decide who won, but they decided where the armies marched.

How it worked. Russia came last and stayed. In 1783, by the Treaty of Georgievsk, the Georgian king Erekle II placed his kingdom under Russian protection, and in 1784 the Russians founded Vladikavkaz, whose name means “ruler of the Caucasus,” at the north end of the Darial route. When the Persian ruler Agha Mohammad Khan sacked Tbilisi in 1795, Russian help did not come in time. In 1801 Russia annexed the eastern Georgian kingdom outright. To hold a province on the far side of a mountain wall, Russia needed a road. Army engineers widened the old track up the Terek, through the Darial Gorge, over the **Jvari (Cross) Pass** at about 7,805 feet (2,379 m) and down the Aragvi valley to Tbilisi, a distance of about 130 miles (208 km). They rebuilt it in stages through the 1800s, with posting stations where travelers changed horses, until it was a highway fit for coaches and artillery. Along it marched the armies that defeated Persia (Treaty of Turkmenchay, 1828, which fixed the Aras River as the border) and fought the Ottomans. The road also carried war to the mountain peoples. In the long Caucasian War, the Muslim highlanders of Chechnya and Dagestan resisted under Imam Shamil until he surrendered at Gunib in 1859. In the west, the Circassians fought until 1864; then hundreds of thousands of them were driven from their homeland to the Ottoman Empire, and many died of hunger and disease on the way. That expulsion was one of the great sorrows of the century.

On the map. Today the crest of the Greater Caucasus forms most of the border between Russia and Georgia and part of the border between Russia and Azerbaijan. Some geographers draw the boundary of Europe and Asia along the same crest, which makes Elbrus the highest mountain in Europe; others draw it farther north along the Kuma–Manych Depression. In August 2008 Russia and Georgia fought a short war; Russia then recognized the Georgian regions of Abkhazia and South Ossetia as independent states, while Georgia and most other countries regard them as part of Georgia. As of 2026 the main road crossing between Russia and Georgia is the Upper Lars checkpoint, on the Georgian Military Road in the Darial Gorge, the same gate Pushkin rode through.

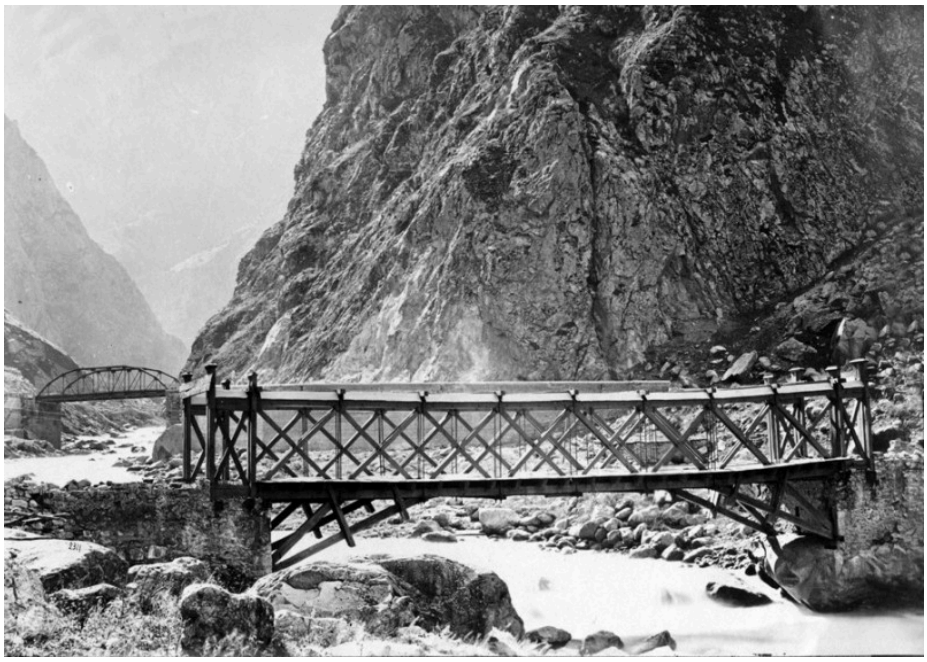
Technology overcoming geography. Look at what technology has and has not done here. Railways reached Tiflis from the Black Sea in 1872 and joined it to Baku in 1883, but no railway has ever crossed the central Greater Caucasus. Trains from Russia go around the ends: along the Caspian shore through Derbent, or along the Black Sea coast. The Roki road tunnel, opened in 1984, cut under the range between North and South Ossetia, and the Georgian Military Road is now paved and open most of the year, though avalanches and rockfalls still close it, and trucks can wait for days at the border in winter. Oil and gas pipelines from the Caspian were laid south of the range rather than across it. Isaiah foretold a day when “every mountain and hill shall be made low”; road builders have lowered a few. The Caucasus still teaches the lesson of this unit: a mountain wall is crossed at its gates, and whoever holds the gates shapes the border.

The Caucasus wall and its two gates: the Darial Gorge (Georgian Military Road) and Derbent on the Caspian.



The Georgian Military Road from north to south, about 208 km.

PICTURE STUDY



The Darial Gorge on the Georgian Military Road, Dmitri Ermakov (Dmitry Yermakov), late 1800s (Ermakov photographed the road from the 1870s to the 1890s) · Albumen print photograph · Georgian National Museum, Tbilisi (Ermakov collection)

Dmitri Ermakov trained at the military topographical school in Tiflis and opened his own photography studio there in 1870. Over the next forty years he traveled all over the Caucasus with his heavy glass-plate camera, photographing mountains, churches, towns, roads and the many peoples of the region. His thousands of pictures are one of the best records of the Caucasus in the 1800s, and the Georgian National Museum keeps a large collection of them.

Among his favorite subjects was the Georgian Military Road, especially the Darial Gorge, where the road was cut into the cliffs beside the Terek. Albums of his views were sold to travelers who had made the journey Pushkin and Lermontov wrote about.

Look closely

- Find the road. How did the engineers fit it between the cliff and the river?
- Look for people, horses or a carriage. How do they help you judge the size of the gorge?
- Where would a small force of soldiers stand to block this road? Why would a few be enough?
- What dangers can you see or imagine for travelers here: rockfall, flood, ice?

Talk about it

1. Why would the Russian army care so much about keeping this one road open?

2. A photograph is a record, but the photographer still chooses what to show. What did Ermakov want viewers to feel about the gorge?
3. Compare this photograph with Turner's painting of Hannibal in the Alps (Lesson 3.2). How do the two pictures show mountains differently?

PROJECT: SALT-DOUGH CAUCASUS AND THE FINISHED MOUNTAIN BORDER RELIEF (PART 5)

Finish your unit relief with the Caucasus, the most "gated" of the five ranges. Then add the final touches that turn your boards into a portfolio: a legend of passes and tunnels, and a short label for each range.

You will need

- Salt dough and paint
- Board space or a new board about 12 by 18 inches
- Red yarn (road), black yarn (railway), a wire (tunnel)
- Flags and index cards

Steps

1. Outline the Black Sea and the Caspian Sea and paint them blue.
2. Build the Greater Caucasus as a long, high wall between them, with Elbrus near the west and Kazbek in the center.
3. Cut a deep, narrow notch for the Darial Gorge and lay red yarn along the Georgian Military Road from Vladikavkaz to Tbilisi.
4. Leave a thin coastal strip at Derbent and lay black yarn along it for the railway around the eastern end. Lay another black yarn along the Black Sea coast.
5. Push a wire through the base for the Roki Tunnel.
6. Flag Vladikavkaz, Tbilisi, Derbent, Baku and Mount Ararat (to the south).
7. Write a legend card covering all five ranges: pass, tunnel, road, railway, border, watershed.

Tips

- Show that no railway crosses the central range; this is one of the key lessons.
- If all five ranges are on separate boards, use the same vertical scale on each so they can be compared.

Check your work

- My model shows both gates (Darial and Derbent) and the routes around the ends.
- Road, railway and tunnel are shown and labeled in my legend.
- I can explain why holding the gates mattered to every empire that came here.

MAP NOTEBOOK

1. Draw the Georgian Military Road profile and label Vladikavkaz, the Darial Gorge, Kazbek, the Jvari Pass, Ananuri and Tbilisi.
2. Make a timeline of the empires at the Caucasus gates: 500s Persians at Derbent, 627 Heraclius at Tiflis, 1555 Amasya, 1783 Georgievsk, 1801 annexation, 1828 Turkmenchay, 1859 Gunib, 1864, 2008.
3. Sketch the two ways around the range (Black Sea coast, Caspian coast) and the way through (Darial), and write the approximate length of each route between Vladikavkaz and Tbilisi.

> **From history.** Halfway along the Georgian Military Road stands the fortress of Ananuri, built by the lords of the Aragvi valley, with two churches inside its walls, the larger dating from the 1600s. From its towers the defenders could watch the road in both directions. Farther north, the Gergeti Trinity Church, built in the 1300s, stands alone on a ridge at about 7,120 feet (2,170 m) beneath Mount Kazbek, and in times of danger treasures from Mtskheta, including, by tradition, the cross of Saint Nino, were carried there for safekeeping.

WORKED EXAMPLES

Example 1. From Vladikavkaz to Tbilisi is about 208 km by the Georgian Military Road. Going around the eastern end of the range by road (through Makhachkala, Derbent and Baku) is about 1,300 km. How many times longer is the detour? If a truck averages 40 km/h on the mountain road and 60 km/h on the detour, how many hours does each route take?

(Use the map or drawing "Compare the road through the gorge with the route around the Caspian end." shown earlier in this lesson.)

1. Ratio: 1,300 ÷ 208 ≈ 6.25, about six times longer.
2. Mountain road time: 208 ÷ 40 = 5.2 hours.
3. Detour time: 1,300 ÷ 60 ≈ 21.7 hours.
4. Difference: about 16.5 hours, or roughly two full days of driving for a trucker who stops at night.

Answer: The detour is about six times longer and takes roughly 22 hours of driving against about 5. This is why the Darial gate matters so much, and why its closing in winter storms is costly.

Example 2. Southbound travelers from Vladikavkaz climb from Stepantsminda (about 1,740 m) to the Jvari Pass (2,379 m) in about 25 km of road. Beyond the pass, the road drops to Pasanauri (about 1,050 m) in about 35 km. Find the average grade of each side.

(Use the map or drawing "Read the elevations from the profile." shown earlier in this lesson.)

1. North side: rise 2,379 − 1,740 = 639 m over 25,000 m = 0.026, about 2.6 percent.
2. South side: drop 2,379 − 1,050 = 1,329 m over 35,000 m = 0.038, about 3.8 percent.
3. The south side is steeper on average, which is why the road there winds down in hairpin bends near Gudauri.

Answer: About 2.6 percent on the north (Stepantsminda) side and about 3.8 percent on the south (Pasanauri) side.

Example 3. If the Europe–Asia boundary follows the crest of the Caucasus, Elbrus (5,642 m) is the highest mountain in Europe; if not, Mont Blanc (about 4,806 m) is. How much higher is Elbrus, in meters and feet? Using a lapse rate of 6.5°C per 1,000 m, how much colder is the summit of Elbrus than the summit of Mont Blanc in the same air?

1. Difference: 5,642 − 4,806 = 836 m.
2. Feet: 836 × 3.281 ≈ 2,743 feet.
3. Temperature: 0.836 × 6.5 ≈ 5.4°C (about 9.8°F) colder.

Answer: Elbrus is about 836 m (about 2,740 ft) higher and about 5°C (about 10°F) colder at the top. Which is "Europe's highest" depends on a human convention about where Europe ends.

PRACTICE

1. EASY Name the two seas at the ends of the Greater Caucasus and the range's approximate length.
2. EASY Name the two great gates through or around the Caucasus.
3. EASY Which two cities does the Georgian Military Road join, and over which pass?
4. MEDIUM Convert the height of the Jvari Pass (2,379 m) to feet. Is it higher or lower than the Gotthard Pass (2,106 m)?
5. MEDIUM What did the Persian king Khosrow I build at Derbent, and why did the Byzantines sometimes help pay for guarding the passes?
6. MEDIUM What did the Peace of Amasya (1555) do in the Caucasus?
7. MEDIUM What does the name Vladikavkaz mean, and why was it founded where it was in 1784?
8. MEDIUM A post coach in the 1840s changed horses at stations about every 20 km along the 208 km road. About how many stations did it use? If it averaged 8 km/h moving and

spent 20 minutes at each change, how long was the trip?

9. HARD Explain why no railway crosses the central Greater Caucasus, while railways run around both ends of the range.
10. HARD Describe the Caucasian War's two endings: in the east in 1859 and in the west in 1864.
11. HARD As of 2026, what is the status of Abkhazia and South Ossetia? State the positions neutrally.
12. CHALLENGE Write a paragraph comparing the Caucasus with the Pyrenees as borders. Consider the number of gates, how stable the border has been, and the role of technology.

COMMON MISTAKES

- Thinking the mountains stopped invasions. They channeled them through two gates, which made the gates the prize.
- Assuming the boundary between Europe and Asia is fixed by nature. It is a convention; the Caucasus crest is one choice, the Kuma–Manych Depression another.
- Confusing the Greater Caucasus (the main wall) with the Lesser Caucasus to the south in Armenia and Azerbaijan.

Make it a game · Hold the Gate. Draw the Caucasus on paper with three routes: the Black Sea coast, the Darial Gorge and Derbent. One player (the northern army) secretly chooses a route and rolls a die for each of 4 turns of marching; the other (the defender) has 6 guard counters to place on the routes before the game. Each guard on the chosen route subtracts 1 from every roll. The attacker needs a total of 12 to break through. Then switch roles. Afterward, discuss why every empire in the region fortified Derbent and Darial.

Scripture. "Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight, and the rough places plain:" (Isaiah 40:4, KJV)

Ancient kings sent workers ahead to level a road for a royal visit, and Isaiah uses that picture for preparing the way of the LORD. Road builders on the Darial have made a few crooked places straight; but only God can bring every mountain low.

Practice answers

1. The Black Sea (west) and the Caspian Sea (east); about 750 miles (1,200 km).
2. The Darial Gorge in the center (the Gate of the Alans) and the Derbent passage beside the Caspian.
3. Vladikavkaz (Russia) and Tbilisi (Georgia), over the Jvari (Cross) Pass.
4. 2,379 × 3.281 ≈ 7,805 feet. It is 273 m higher than the Gotthard Pass.
5. Massive stone walls running from the Caspian shore up into the mountains. Raids by nomads from the northern steppe threatened both empires, so both had an interest in keeping the gates shut.

6. It divided the region between the Ottoman Empire (the west) and Safavid Persia (the east).
7. “Ruler of the Caucasus.” It was founded at the northern entrance to the Darial route, so Russia could control the road over the mountains to Georgia.
8. 208 ÷ 20 ≈ 10 stages, so about 9 or 10 changes. Moving time 208 ÷ 8 = 26 hours; changes 10 × 20 min ≈ 3.3 hours; total about 29 hours, plus time for meals and rest.
9. The central range is high and steep with few gaps; the Darial Gorge is narrow and prone to avalanches, rockfall and floods, and a railway needs much gentler grades than a road. A tunnel long enough would be very costly. The coastal strips at Derbent and along the Black Sea are low and nearly level, so railways follow them.
10. In the east, Imam Shamil, leader of the highlanders of Dagestan and Chechnya, surrendered to the Russians at Gunib in 1859. In the west, the Circassians were defeated in 1864, and hundreds of thousands were driven from their homeland to the Ottoman Empire; many died of hunger and disease.
11. Since the war of August 2008, Russia recognizes them as independent states and has forces there; Georgia and most other countries regard them as parts of Georgia. The dispute is unresolved (a frozen conflict).
12. A strong answer notes that both are long walls between seas with easy routes mainly at the ends (Pyrenees: Basque coast and Le Perthus; Caucasus: Black Sea coast and Derbent) and few central passes (Somport, Roncesvalles; Darial). The Pyrenees border has been stable since 1659 between two settled kingdoms, while the Caucasus was an imperial frontier fought over by Byzantines, Persians, Arabs, Mongols, Ottomans and Russians, and parts remain disputed today. In both, technology (tunnels, roads, railways) mostly improved the routes nature already favored, and neither wall has been removed.

Unit 3 test

Answer each question. Show your work for every calculation, give units, and use complete sentences for explanations. Use 1 mile = 1.609 km, 1 m = 3.281 ft, 1 degree of latitude = 111 km (69 miles), and a lapse rate of 6.5°C per 1,000 m where needed. The test is worth 100 points.

1. (6 pts) Give the year, place and two negotiators of the Treaty of the Pyrenees, and state what it said about the border.
2. (6 pts) Explain why Llívia is Spanish and why the Val d'Aran is an exception to the watershed rule.
3. (6 pts) A wool caravan can cross the Pyrenees by a pass route of 180 miles (40 of them steep, at 10 miles a day; the rest at 20 miles a day) or by a coast route of 280 miles at 20 miles a day. Which is faster and by how much? Give one reason a merchant might choose the slower route.
4. (7 pts) According to Polybius, how long did Hannibal's crossing of the Alps take, and with about how many men did he arrive in Italy? Name the three great victories that followed.
5. (6 pts) On a day when it is 12°C on the plain at 300 m, what is the temperature at a pass at 2,500 m? Is the pass above or below freezing? Convert your answer to °F.
6. (7 pts) Explain how the Gotthard Pass helped create Switzerland. Include the Federal Charter of 1291 and the battle of Morgarten.
7. (6 pts) The old Gotthard Pass road reaches 2,106 m; the Gotthard Base Tunnel's highest point is 549 m. How much less must a train climb through the tunnel? Give your answer in meters and feet.
8. (7 pts) Explain the rain shadow of the Himalaya using Darjeeling (about 2,500 mm a year) and Lhasa (about 430 mm). How many times wetter is Darjeeling?
9. (8 pts) What is the McMahon Line? Explain neutrally why it is disputed and what happened in 1962.
10. (6 pts) On a map at a scale of 8 miles to 1 inch, a border is drawn with a line 1/20 inch thick. How wide a strip of ground does the line cover, in feet and meters? Why does this matter in high mountains?
11. (8 pts) Chile runs from about 17.5° S to about 56° S. Compute its north–south length in km and miles. Then, with an average width of 177 km, estimate its area in km^2.
12. (7 pts) Why did the 1881 rule for the Chile–Argentina border cause a dispute in Patagonia, and how was it settled? What does the Christ of the Andes commemorate?
13. (8 pts) Name the two gates of the Caucasus and give one empire that fortified or used each. Why did every empire in the region care about them?
14. (8 pts) The Georgian Military Road is about 208 km; the road route around the Caspian end is about 1,300 km. At 40 km/h on the mountain road and 60 km/h on the detour, find each driving time. Then explain why there is still no railway across the central Greater Caucasus.

15. (4 pts) In a short paragraph, compare any two of this unit's mountain borders and explain why one has been more stable than the other.

UNIT PROJECT: THE GREAT MOUNTAIN BORDERS: RELIEF AND MAP

Complete your salt-dough relief of at least one mountain border, with its passes, tunnels and border line marked, built over the five lessons of this unit. Alongside it, draw a world map of the great mountain borders: the Pyrenees, the Alps, the Himalaya, the Andes and the Caucasus, with the countries each separates, at least two passes for each range and one tunnel or road that crosses it.

Add a one-page written comparison: which of the five ranges makes the strongest border, and why? Use at least three numbers from the unit (heights, lengths, grades, travel times or widths) and at least two historical events as evidence.

- **Accuracy**: Ranges, passes, borders and cities are placed correctly; heights and lengths are correct and labeled with units.
- **Relief craftsmanship**: The salt-dough relief uses a stated vertical scale, shows passes clearly lower than peaks, and has a clear legend for border, watershed, road, railway and tunnel.
- **Reasoning**: The written comparison uses numbers and historical events as evidence, explains the role of passes, and states disputed borders neutrally.
- **Care and clarity**: Map and relief are neat, readable and titled; sources (atlas, Polybius, NASA images) are noted.

Answer key

1. 1659 (7 November), Pheasant Island in the Bidasoa River; Cardinal Mazarin (France) and Don Luis de Haro (Spain). It made the Pyrenees mountains, which had anciently divided Gaul from Spain, the division between the two kingdoms.
2. The treaty gave France the villages of northern Cerdanya; Llívia was counted a town, so it stayed Spanish and became an exclave inside France. The Val d'Aran drains north through the Garonne into France but belongs to Spain, so the border there does not follow the main watershed.
3. Pass route: 140 ÷ 20 = 7 days + 40 ÷ 10 = 4 days = 11 days. Coast route: 280 ÷ 20 = 14 days. The pass is faster by 3 days. A merchant might choose the coast in winter, when snow closes the pass, or to avoid danger, tolls or exhausted animals.
4. Fifteen days; about 20,000 foot and 6,000 horse (about 26,000 men). The Trebia (218 BC), Lake Trasimene (217 BC) and Cannae (216 BC).
5. Climb 2,200 m × 6.5°C per 1,000 m = 14.3°C. 12 − 14.3 = −2.3°C, below freezing. In °F: −2.3 × 9/5 + 32 ≈ 27.9°F.
6. Once the Schöllenen gorge was opened in the early 1200s, the Gotthard became the shortest route from the Rhine lands to Milan, and the valley communities of Uri and its neighbors controlled its northern approach. In 1291 Uri, Schwyz and Unterwalden swore a Federal Charter of mutual defense. In 1315 they ambushed a Habsburg army at Morgarten on a narrow road between a slope and a lake. Steep ground and narrow roads let free peasants defend themselves; their alliance grew into the Swiss Confederation.

7. 2,106 − 549 = 1,557 m, about 5,108 feet less.
8. Moist monsoon air from the Indian Ocean rises against the south face of the Himalaya, cools and drops heavy rain, as at Darjeeling. By the time it passes the crest it has lost its moisture, so the Tibetan Plateau, including Lhasa, lies in a dry rain shadow. 2,500 ÷ 430 ≈ 5.8 times wetter.
9. The boundary in the eastern Himalaya agreed in 1914 by Britain's Sir Henry McMahon and Tibet's representative Lonchen Shatra at Simla. China's government never accepted it. India treats it as the border (Arunachal Pradesh lies south of it); China claims the area. In October–November 1962 China attacked Indian positions in both the east and the Aksai Chin; after defeating Indian forces it declared a ceasefire, withdrew in the east to about the McMahon Line and kept the Aksai Chin.
10. (1/20) × 8 = 0.4 mile = 2,112 feet ≈ 644 m. In mountains, a strip that wide can place a ridge, pass or valley on either side, so a thick line on a small-scale map can become a dispute on the ground.
11. 38.5° × 111 ≈ 4,270 km; 38.5 × 69 ≈ 2,660 miles. Area ≈ 4,270 × 177 ≈ 756,000 km² (close to the official figure of about 756,000 km²).
12. The rule said the line should follow the highest peaks that divide the waters, but in Patagonia some rivers rise east of the highest peaks and flow to the Pacific, so the two principles gave different lines. The dispute was settled by the arbitration of King Edward VII in 1902, after British surveys, together with the Pacts of May limiting armaments. The Christ of the Andes, dedicated on the pass in 1904, commemorates that peaceful settlement.
13. The Darial Gorge (used by Russia for the Georgian Military Road after 1801; earlier known as the Gate of the Alans) and the Derbent passage (walled by the Persian king Khosrow I in the 500s). Because the range is a near-continuous wall, these were the only easy routes between the steppe and the lands to the south; holding them meant keeping nomads or rival armies out, or being able to march through.
14. 208 ÷ 40 = 5.2 hours; 1,300 ÷ 60 ≈ 21.7 hours. Railways need gentle grades; the central range is high, steep and narrow-gated, with avalanches and rockfall, and a long base tunnel would be very costly, so railways go around the ends along the Black Sea and Caspian coasts.
15. Sample: The Pyrenees border has barely moved since 1659 because it lies between two settled kingdoms that agreed on a clear crest and later marked it with stones. The Himalayan border between India and China is still disputed because it was drawn on small-scale maps in empty country, one side never accepted the McMahon Line, and roads, not treaties, decided who held the Aksai Chin. Answers should name a physical reason and a human reason.

UNIT 4

Deserts and Steppes

Rivers and mountains make borders you can see. Deserts and grasslands make borders of a different kind, drawn by rainfall. Where the rain fails, farmers cannot follow, and the land belongs to those who can cross it: caravans with camels, herders with horses. In this unit you will study the two great dry belts of the Old World, the desert belt from the Sahara through Arabia and the grassland belt of the Eurasian Steppe, and you will see that each was both a wall and a highway, depending on who was looking at it. “When the most High divided to the nations their inheritance, when he separated the sons of Adam, he set the bounds of the people” (Deuteronomy 32:8), and in these lands the bounds were written in water and grass.

You will cross the Sahara with Ibn Battuta in 1352 and see salt traded for gold, follow Muhammad from Mecca to the oasis of Medina in 622 and the Arab armies that came out of the desert, watch Darius chase the Scythians across a steppe that would not fight, and stand at the kurultai of 1206 where Temüjin became Chinggis Khan. You will learn how the Mongols’ Yam relay conquered distance, and you will end at the Great Wall, where the Ming tried to fix in stone the line where the 15-inch rain line divides the fields from the pasture.

In every lesson you will ask the course’s question, **why does the border fall here?**, and the technology question, **what crossed the barrier?** The camel, the horse, the composite bow, the relay station, gunpowder, the ship and the railway each changed what a desert or a steppe meant. You will name the real wrongs that crossed these lands, the slave caravans, the conquests and the massacres, and give real achievements their due.

BEFORE YOU BEGIN

- Can read latitude and longitude and find a place from its coordinates (Units 1–3)
- Can convert between miles and kilometers and between inches and millimeters
- Knows the ideas of core, frontier and buffer from Unit 1
- Can use speed = distance ÷ time to find travel times

MASTERY CHECKLIST

- I can explain why the Sahara and Arabia are dry and why the steppe is grassland, using rainfall figures and the belt of sinking air near the tropics.
- I can describe how the camel and the caravan made the Sahara and Arabia crossable, and explain the salt and gold trade and the empires of Ghana, Mali and Songhai.
- I can explain, factually, how Islam arose in the oasis towns of the Hejaz and how Arab armies came out of the desert in the 600s and 700s.
- I can trace the Scythians, Huns and Mongols along the steppe highway and explain why nomad armies were fast and where they were stopped.
- I can explain how the Mongol Yam relay worked and calculate relay times and speeds.

- I can show on a map that the Great Wall lies near the 15-inch rain line and weigh that explanation with its exceptions.

OPTIONAL BOOKS AND RESOURCES

- **Project Gutenberg (free classic texts)** (https://www.gutenberg.org/): Free. Search for Herodotus's *Histories* (Book 4 tells the Scythian campaign of Darius) and for Henry Yule's translation of *The Book of Ser Marco Polo* (Book 2 describes the Yam post stations). A parent may choose the passages.
- **Library of Congress Geography and Map Division** (https://www.loc.gov/maps/): Free. Search for historic maps of Africa, Arabia, Central Asia and China, including early European maps that show the Great Wall, to compare with the maps in this unit.

4.1 The Sahara

OBJECTIVES

- Describe the Sahara’s size, surfaces and climate, and explain why it worked both as a barrier to armies and farmers and as a “sea” with its own shores and ports.
- Explain how the camel, the caravan and the exchange of salt for gold tied North Africa to the West African empires of Ghana, Mali and Songhai, and name the real wrongs, such as the slave trade, that traveled the same roads.
- Measure caravan distances by latitude and calculate travel times, water loads and price changes along a trans-Saharan route.

Warm-up. Put a spoonful of coarse salt on one saucer and a gold-colored coin or button on another. Imagine you live in a hot land where people and cattle sweat all day, and the nearest salt mine is a two-month walk away across a waterless desert. Which saucer would you trade for? Write down three things that make a good valuable (how much there is, how badly people need it, how far it must travel) and decide which of the three matters most for salt.

Watch. *The Sahara: Earth’s Greatest Desert* (Geographics, 22:35).
https://www.youtube.com/watch?v=gUtw4I5el1s
With On the map: watch for how big the Sahara is, its different landscapes (sand seas, rocky plateaus, oases) and the old camel caravan routes, then trace them on the lesson map from Sijilmasa to Taghaza and Mali.
Note: Captions were not available to check; preview it first. The video has a sponsor message (Blinkist) to skip, and its sources suggest it gives the Sahara's age in millions of years and describes the desert swinging between green and dry periods. It may give deep-time ages for the Sahara that the lesson does not use.

KEY TERMS

erg
A sand sea: a large area of wind-blown sand dunes. Ergs cover only about a fifth to a quarter of the Sahara.

reg and hamada
The Sahara’s commonest surfaces: reg is a flat plain of gravel and pebbles; hamada is a bare, rocky plateau swept clean of sand by the wind.

Sahel
From the Arabic *sahil*, “shore” or “coast”: the band of dry grassland and thorn scrub along the southern edge of the Sahara, where the desert’s “sea” meets its southern shore.

caravan
A company of merchants, guides and pack animals (in the Sahara, camels) traveling together for safety, water and mutual help.

oasis
A place in a desert where underground water comes near the surface or rises in springs, so that wells can be dug and date palms and gardens can grow.

entrepôt
A trading town where goods from one route are unloaded, sold and reloaded for another, such as Timbuktu between the camel road and the Niger River boats.

CORE IDEAS

The story. In February 1352 the Moroccan traveler Ibn Battuta set out from Sijilmasa, the caravan town on the northern edge of the Sahara, bound for the kingdom of Mali. After about twenty-five days his caravan reached Taghaza, and he found a village unlike any he had ever seen. Its houses and its mosque were built of blocks of rock salt and roofed with camel skins. No trees grew there; the water was brackish; the only people who lived there year-round were slaves of the Masufa tribe who dug the salt, and lived on dates from the north and millet from the south. Yet great sums of gold changed hands in that miserable place, because every slab of salt cut there would be sold in the lands of the Niger for many times its price. On the last and driest stretch the caravan hired a scout, a *takshif*, who rode ahead alone so that people in Walata would come out with water. About two months after leaving Sijilmasa, Ibn Battuta reached Walata, a town of the empire of Mali. He had crossed one of the great barriers of the earth the way merchants had for centuries: by treating the desert like a sea.

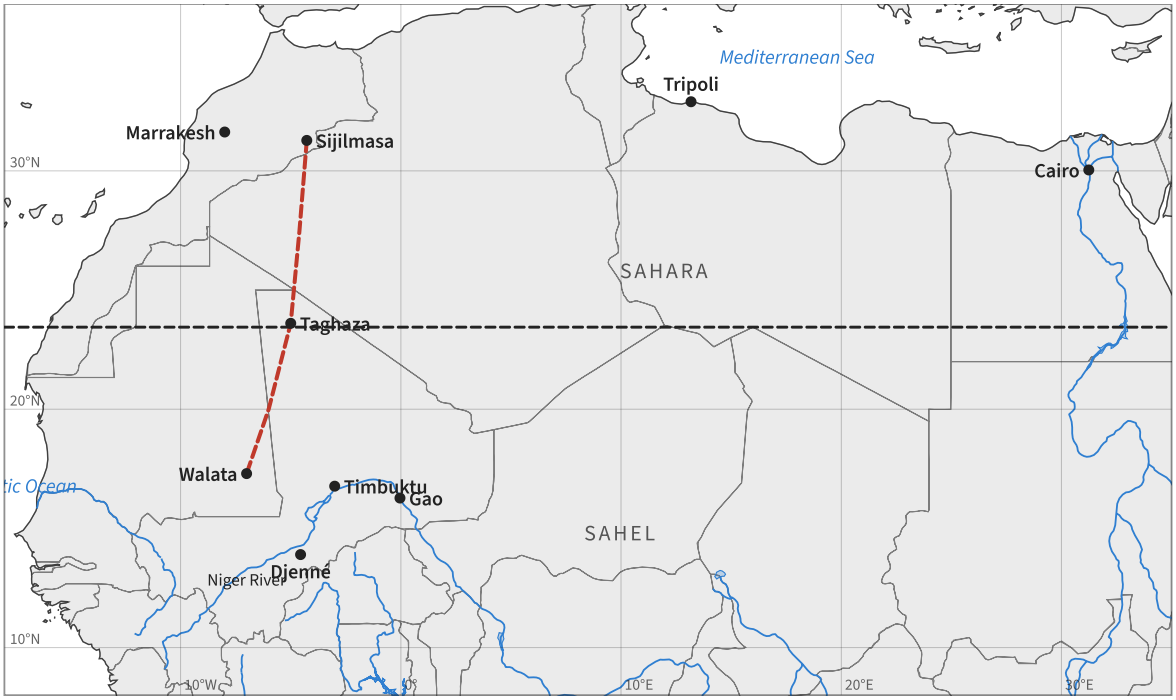
On the map. The Sahara covers about 3.6 million square miles (9.2 million km^2), nearly the size of the whole United States. It runs about 3,000 miles (4,800 km) from the Atlantic to the Red Sea and 800 to 1,200 miles (1,300 to 1,900 km) from north to south. Most of it is not sand dunes at all. Ergs, the sand seas, cover perhaps a fifth to a quarter of it; the rest is gravel plain (reg), bare rock plateau (hamada) and mountains such as the Ahaggar of Algeria and the Tibesti of Chad, whose highest peak, Emi Koussi, rises above 11,000 feet (3,400 m). Most of the Sahara receives less than 4 inches (100 mm) of rain a year. The reason is physical geography: the Tropic of Cancer runs through the middle of the desert, and near the tropics air that rose over the equator sinks back toward the ground, warming and drying as it falls. Clouds rarely form in sinking air. Rock paintings in the Tassili n’Ajjer of southern Algeria show cattle, giraffes and even hippopotamuses where none could live today, so the Sahara has not always been this dry (see “Thinking About Time”). Arab geographers saw the desert as an empty sea with two shores. On the north shore stood Sijilmasa, Tlemcen and the cities of the Maghreb below the Atlas Mountains; on the south shore stood Walata, Timbuktu and Gao, where the grass began and the Niger River bent north to meet the sand.

How it worked. The ship of this sea was the dromedary, the one-humped camel. Camels came into wide use in North Africa in the later centuries of the Roman Empire. A pack camel can carry about 300 to 400 pounds, walk 20 to 25 miles (30 to 40 km) a day, and go a week or more without drinking in the cool season. Caravans of hundreds and sometimes thousands of camels moved from well to well with guides who could read the stars and the shape of dunes. What they carried south was salt, along with copper, cloth, horses and books. Salt

mattered because people and cattle in the hot lands of the south lose salt through sweat every day and need it to live, and the savanna had few salt deposits of its own. What they carried north was gold from the fields of Bambuk and Bure near the upper Senegal and Niger rivers, and later from the forest lands farther south. For centuries West Africa was one of the chief sources of the gold used in the Mediterranean world and in Europe. The caravans also carried people. A trans-Saharan slave trade sent captives from the south across the desert to North Africa and beyond for more than a thousand years, and many died of thirst and exhaustion on the crossing. The road that carried learning and wealth also carried that great wrong.

The big idea. Deserts make borders, but they also make ports. Because the Sahara kept northern armies away for centuries, strong states could grow on its southern shore and grow rich by controlling where the caravans landed. Arab writers knew of Ghana (its people called it Wagadu) by the 700s. The geographer al-Bakri, writing in Córdoba in 1068, described its king's court and reported that the king kept every gold nugget found in his land and let the people trade only the gold dust, a way of keeping the price high. Mali rose in the 1200s under Sundiata Keita. Its most famous ruler, Mansa Musa, made the pilgrimage to Mecca in 1324 and passed through Cairo with so much gold, spent and given away, that the Syrian scholar al-Umari, writing about a dozen years later, reported that the value of gold in Cairo had still not recovered. Timbuktu became a city of scholars, mosques and libraries. Then Songhai, ruling from Gao on the Niger, built the largest of the three empires in the late 1400s. Each one stood on the same geographic hinge: the place where camels met boats and the desert met the grass.

Technology overcoming geography. In 1590 Sultan Ahmad al-Mansur of Morocco sent an army south across the Sahara to seize the source of the gold. Its commander, Judar Pasha, led about 4,000 men, many armed with arquebuses (early muskets), on a crossing that took months and killed many of them. At Tondibi, near Gao, in March 1591 the firearms routed a much larger Songhai army. Yet the desert still had its say. Morocco could not easily reinforce or govern lands two months away across the sand, and within a few decades the Moroccan pashas in Timbuktu were ruling on their own. Meanwhile a quieter technology was outflanking the desert altogether. From the 1440s Portuguese caravels sailed down the Atlantic coast, and in 1482 the Portuguese built the fortress of São Jorge da Mina (Elmina) on the Gold Coast. Gold and, in time, enslaved people began to leave Africa by sea instead of by camel. The ship did to the Sahara what the camel had once done: it found a way around the barrier. Much later, European powers drew many of the region's borders as long straight lines across the sand (Unit 9), partly because few settled people lived there and few surveyors ever walked them.



The western Sahara crossing. Ibn Battuta's route of 1352 ran from Sijilmasa through the salt mine at Taghaza to Walata. The Tropic of Cancer runs through the heart of the desert.

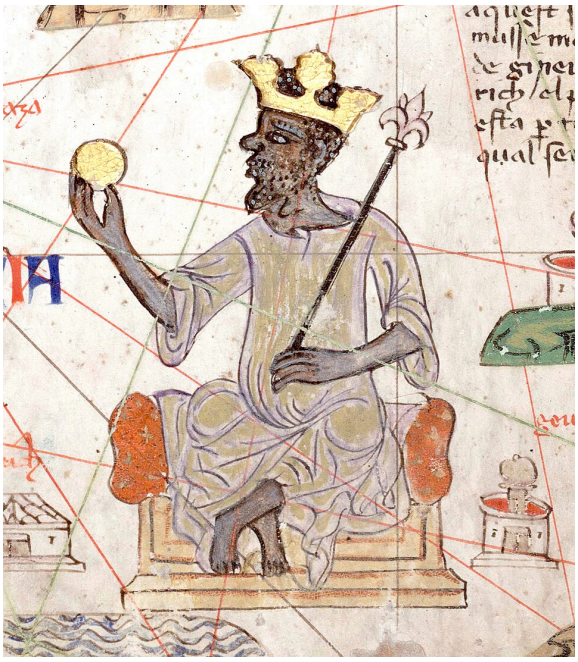
Thinking About Time

What the sign says. Museum signs and textbooks often say the "Green Sahara" dried out about 5,000 to 6,000 years ago and date the oldest rock paintings far earlier.

What we observe. What is actually measured is the rock art itself, old lake beds, buried pollen and the amounts of certain chemical isotopes; the long ages come from assumptions about steady rates of change and how the dating methods are calibrated.

How Christians read it. Christians who read Genesis as history understand the wetter Sahara as part of the changed world after the Flood, when rainfall patterns were different for a time, and the drying as something that happened within the span of recorded biblical history.

PICTURE STUDY



The Catalan Atlas (detail: Mansa Musa of Mali), Attributed to Abraham Cresques, a Jewish mapmaker of Majorca, 1375 · Ink, colors and gold on vellum, mounted on wooden panels · Bibliothèque nationale de France, Paris

The Catalan Atlas was made in Majorca in 1375 and given to King Charles V of France. It is a set of painted sheets showing the world from the Atlantic to China, drawn by mapmakers who gathered news from sailors, merchants and Jewish and Muslim traders. On the sheet for Africa sits a king on a throne holding a large gold nugget. The Catalan writing beside him calls him “Musse Melly,” lord of the black people of Guinea, and says he is the richest and noblest king of that land because of the gold found there.

Only fifty years after Mansa Musa’s pilgrimage through Cairo, his fame had reached a mapmaker’s table in the Mediterranean. The map is a picture of what Europeans knew, and wanted to know, about the gold beyond the desert.

Look closely

- Find Mansa Musa. What is he holding, and how has the artist shown his wealth and power?
- Find the rider on the camel. He is veiled, as Tuareg men still are. Which direction is he traveling, and what might he be bringing?
- Look for the Atlas Mountains drawn as a long band. What do they separate on this map?
- Find the town symbols. How does the mapmaker show that these are places of trade rather than empty sand?

Talk about it

1. Why would a mapmaker in Majorca put a West African king at the center of the African sheet?
2. What does the map get right about the Sahara as a “sea” with ports on both shores? What does it leave out?
3. If you were a Portuguese prince in 1420 looking at this map, what might it make you want to do?

PROJECT: SALT FOR GOLD: A CARAVAN TRADE SIMULATION

You will lay out a scale model of the Sijilmasa to Timbuktu road across a room or yard, carry real salt from station to station, and keep a merchant’s ledger. By the end you will see why salt that was nearly worthless at the mine could buy gold at the river.

You will need

- About 2 cups of coarse salt in small zip bags (your “slabs”)
- A kitchen scale
- 20 brass washers, gold-painted pebbles or buttons (your “mithqals” of gold)
- Painter’s tape or string and a tape measure
- Index cards for station signs and event cards
- A ledger notebook, pencil and calculator

Steps

1. Choose a scale of 1 foot = 50 miles. Sijilmasa to Timbuktu is about 1,000 miles, so the road is 20 feet long. Tape it on the floor or stretch a string outdoors.
2. Place station cards at the right distances: Sijilmasa at 0 ft, Taghaza at about 10.5 ft (about 530 miles south), a last well at about 15 ft and Timbuktu at 20 ft. Mark each with its latitude.
3. Write a price board for each station. Example round numbers: at Taghaza a bag of salt costs 2 gold pieces; at Timbuktu it sells for 16. At Sijilmasa a bag of dates costs 1 and sells at Taghaza for 3.
4. Make six event cards: “Sandstorm: lose 2 days,” “Dry well: pay 2 gold for water,” “Tolls to a desert chief: pay 1 gold per camel,” “Lame camel: leave 1 bag behind,” “Good guide: save 3 days,” “Safe passage.”
5. Start with 10 gold pieces and room for 4 bags per camel (2 camels). Buy dates at Sijilmasa, sell them at Taghaza, buy salt, and walk the road, drawing an event card at each station.
6. At every station record in your ledger: day number (20 miles a day), goods carried, money in hand and the event.
7. At Timbuktu sell your salt, add up your profit and write three sentences explaining which costs mattered most and why the merchant’s profit was really payment for distance and danger.

Tips

- Weigh one bag on the kitchen scale. A real camel carried about 300 to 400 pounds. How many of your bags would equal one camel-load?
- Play twice: once with the event cards and once without. The difference is the price of risk.

Check your work

- My road is drawn to scale and each station is at the right distance and latitude.
- My ledger is complete for every station and the arithmetic is correct.
- I can explain in my own words why salt was worth so much more at Timbuktu than at Taghaza.

MAP NOTEBOOK

1. Draw a north–south cross-section of the Sahara from the Mediterranean to the Niger: Atlas Mountains, reg, erg, Taghaza, Sahel grass and the river. Label the rainfall in each zone.
2. Copy the Catalan Atlas figure of Mansa Musa in pencil and add a caption in your own words.
3. Make a two-column chart: “Went south across the Sahara” and “Went north across the Sahara.” Include at least five goods in each column and do not leave out enslaved people.

> **From history.** Timbuktu’s families and libraries kept tens of thousands of manuscripts on law, astronomy, medicine, grammar and religion for centuries, many of them copied from books carried across the desert by caravan. In 2012 and 2013, when armed militants occupied the city, librarians and families quietly packed hundreds of thousands of manuscripts into metal trunks and smuggled them south to Bamako by road and river. A few thousand were burned before the city was retaken, but most were saved.

WORKED EXAMPLES

Example 1. Sijilmasa lies at about 31.3° N, 4.3° W and Timbuktu at about 16.8° N, 3.0° W. Estimate the straight-line distance between them in miles and kilometers. (One degree of latitude is about 69 miles or 111 km.)

(Use the map or drawing "Sijilmasa and Timbuktu lie nearly on the same meridian." shown earlier in this lesson.)

1. The two towns are almost due north and south of each other, so the latitude difference does most of the work: 31.3° − 16.8° = 14.5°.
2. North–south distance: 14.5 × 69 = 1,000.5 miles; 14.5 × 111 = 1,609.5 km.
3. Check the east–west part: the longitudes differ by 1.3°. At about 24° N, a degree of longitude is 69 × cos 24° ≈ 69 × 0.914 ≈ 63 miles, so 1.3° ≈ 82 miles.
4. Combine with the Pythagorean theorem: $\sqrt{(1{,}000^2 + 82^2)} \approx \sqrt{(1{,}006{,}724)} \approx 1{,}003$ miles. The east–west part adds only about 3 miles.

Answer: About 1,000 miles (about 1,600 km) in a straight line. The real caravan road was longer because it bent from well to well.

Example 2. A caravan of 50 people must cross a 10-day stretch with no wells. Each person needs at least 1 gallon of water a day. Water weighs about 8.3 pounds per gallon, and a pack camel carries about 300 pounds. How many camels must carry nothing but water for the people? (Ignore the camels' own water; they drink before the stretch and after.)

1. Water needed: 50 people × 1 gallon × 10 days = 500 gallons.
2. Weight: 500 × 8.3 = 4,150 pounds.
3. Camels: 4,150 ÷ 300 = 13.8, so round up to 14 camels.
4. In real skins some water leaked and evaporated, so caravan masters carried more than the bare minimum.

Answer: At least 14 camels, carrying about 4,150 pounds (about 1,900 liters) of water.

Example 3. Use these round practice numbers. A merchant buys 4 salt slabs at Taghaza for 2 gold pieces each and loads them on one camel. Food, water, guides and tolls for the camel and its driver cost 12 gold pieces for the trip. At Timbuktu each slab sells for 20 gold pieces. Find the merchant's profit and the ratio of the selling price to the mine price.

1. Cost of salt: $4 \times 2 = 8$ gold pieces.
2. Total cost: $8 + 12 = 20$ gold pieces.
3. Revenue: $4 \times 20 = 80$ gold pieces.
4. Profit: $80 - 20 = 60$ gold pieces.
5. Price ratio: $20 \div 2 = 10$. The salt sold for ten times its price at the mine, but most of that gap paid for distance, danger and the chance of losing everything.

Answer: Profit of 60 gold pieces; the selling price was 10 times the mine price.

PRACTICE

1. EASY What does the Arabic word *sahil* mean, and why is it a fitting name for the Sahel?
2. EASY Name the three great West African trading empires in the order they rose, with one city connected to each.
3. EASY The Sahara covers about 3.6 million square miles. Convert to square kilometers (1 sq mi ≈ 2.59 km²).
4. EASY True or false: most of the Sahara is covered by sand dunes. Explain.
5. MEDIUM Taghaza lies at about 23.6° N and Walata at about 17.3° N, nearly on the same meridian. Estimate the distance in miles and kilometers.
6. MEDIUM At 20 miles a day, how many days would a caravan need for the 435 miles from Taghaza to Walata? Ibn Battuta's whole trip from Sijilmasa to Walata took about two months. Is your answer consistent?
7. MEDIUM Use the map. Which caravan town lies almost exactly on the Tropic of Cancer, and what is its latitude?
   (Use the map or drawing "Find the town closest to the Tropic of Cancer." shown earlier in this lesson.)
8. MEDIUM Explain in two or three sentences why the Sahara is so dry, using the words "sinking air" and "Tropic of Cancer."
9. HARD Al-Umari reported that Mansa Musa's gold lowered its value in Cairo for years. Explain why a sudden flood of gold would make each ounce of gold buy less.
10. HARD A caravan of 30 people faces a 9-day waterless stretch. Each person needs 1 gallon a day, and the caravan master adds 10% for leaking skins. Water weighs 8.3 lb per gallon and each camel carries 300 lb. How many camels must carry water?
11. HARD The Moroccans won at Tondibi in 1591, yet within a few decades Morocco had lost real control of the Niger region. Give one technological reason for the victory and one geographic reason for the loss of control.
12. CHALLENGE Write a short paragraph (4–6 sentences): How did Portuguese ships "outflank" the Sahara after the 1440s, and what does this show about deserts as borders?

COMMON MISTAKES

- Picturing the whole Sahara as rolling sand dunes. Most of it is gravel, rock and mountains; the dunes are only part of the desert.
- Thinking the salt-for-gold trade was foolish because salt is cheap. Salt was cheap at the mine and in our kitchens, but in the hot savanna it was a daily necessity carried two months across the desert.
- Treating the Sahara as a wall that cut Africa in two. For more than a thousand years caravans crossed it regularly, and its edges were lined with trading towns.

Make it a game · Caravan Master. One player is the caravan master and names a town (Sijilmasa, Taghaza, Walata, Timbuktu, Gao, Cairo). The others must answer three questions within thirty seconds: which shore of the Sahara it stands on (north, south, or in the desert), its rough latitude to the nearest 5°, and one good that was bought or sold there. Score one point per correct answer; the first to ten points becomes the next caravan master.

Scripture. “Ye are the salt of the earth: but if the salt have lost his savour, wherewith shall it be salted? it is thenceforth good for nothing, but to be cast out, and to be trodden under foot of men.” (Matthew 5:13, KJV)

In a world without refrigerators, salt preserved food and kept people alive, which is why caravans crossed the Sahara for it. Christ called His people salt: something small, needed everywhere, and worth carrying to the ends of the earth.

Practice answers

1. It means “shore” or “coast.” Arab geographers saw the Sahara as a sea of sand, so the grassland on its southern edge was its shore, where caravans “landed.”
2. Ghana (Wagadu), then Mali, then Songhai. Cities (any correct one): Ghana: Koumbi Saleh (its probable capital) or Awdaghust; Mali: Timbuktu, Walata or Niani; Songhai: Gao (or Timbuktu).
3. $3.6 \times 2.59 \approx 9.3$ million km² (usually given as about 9.2 million km²).
4. False. Sand seas (ergs) cover only about a fifth to a quarter of it; most is gravel plain (reg), bare rock plateau (hamada) and mountains.
5. $23.6 - 17.3 = 6.3°$; $6.3 \times 69 \approx 435$ miles; $6.3 \times 111 \approx 700$ km.
6. $435 \div 20 \approx 22$ days. Yes: about 25 days to Taghaza (with rest stops) plus about 22 days to Walata, plus delays at wells, makes roughly two months.
7. Taghaza, at about 23.6° N; the Tropic of Cancer is at about 23.4° N.
8. Air that rises near the equator spreads out and sinks back toward the ground near the tropics. Sinking air warms and dries, so clouds and rain rarely form. The Tropic of Cancer runs through the middle of the Sahara, right in this belt of sinking air.
9. Gold was valuable partly because it was scarce. When a great deal more gold suddenly entered the market, while the amount of bread, cloth and other goods stayed the same, sellers asked more gold for the same goods. Each ounce of gold therefore bought less: its value fell, and prices measured in gold rose.

10. 30 × 9 = 270 gallons; 270 × 1.10 = 297 gallons; 297 × 8.3 ≈ 2,465 lb; 2,465 ÷ 300 ≈ 8.2, so 9 camels.
11. Victory: firearms (arquebuses) routed the larger Songhai army, which fought mainly with spears, bows and cavalry. Loss of control: the Sahara lay between Morocco and the Niger, a crossing of about two months, so reinforcements, orders and money came slowly and the local pashas became independent.
12. Answers should explain that Portuguese caravels sailed down the Atlantic coast and built a fortress at Elmina (1482), so gold, and later enslaved people, could leave West Africa by sea instead of crossing the desert by camel. This weakened the old caravan towns and the North African middlemen. It shows that a desert is a barrier only for people without the right technology: the camel first turned the Sahara into a sea that could be crossed, and the ship then went around it entirely.

4.2 The Arabian Desert

OBJECTIVES

- Describe the Arabian Peninsula's deserts, mountains and oases and explain how water decided where people settled and how tribes lived.
- Explain, factually, how Islam arose in the towns and oases of the Hejaz and how Arab armies came out of the desert to conquer the lands of the Byzantine and Persian empires in the 600s and 700s.
- Use latitude, area and slope calculations to compare oasis towns, desert regions and the gentle gradients of desert water channels.

Warm-up. Fill a baking pan with dry sand or flour and bury a damp sponge in one corner. Ask a family member to "find the water" by pressing a finger into the surface. How do they find it? Then think: if you lived in a land with no rivers at all, what clues would you use to find water, and what would you do once you found it?

Watch. *3rd March 1938: First major oil discovery in Saudi Arabia at Dammam Well No. 7* (HistoryPod, 2:38). https://www.youtube.com/watch?v=8Y_nDQM5tis
As review: this short clip shows how the discovery of oil at Dammam Well No. 7 in 1938 changed the Arabian Desert's economy; look for what the region relied on before oil and what was built after it.
Note: Captions were not available to check; preview it first. It uses metric measures (the oil was struck at about 1,440 meters). It covers the 1938 oil discovery, not the story's events of 622 or the early Arab conquests; it adds a modern chapter to the lesson.

Backup video. *Arabian Peninsula Outline Drawing Easy Geography Hack!* (Outline Map, 5:48). https://www.youtube.com/watch?v=jmH7CBBwBcY
With On the map: follow along to sketch the Arabian Peninsula and place Saudi Arabia, Yemen, Oman, the UAE, Qatar, Kuwait and Bahrain, then add Mecca and Medina (Yathrib) from the lesson. Note: Captions were not available to check; preview it first. It is a simple drawing tutorial from a low-budget map channel, may have little or no narration, and shows only modern borders.

KEY TERMS

Bedouin
Arabic-speaking desert nomads who herded camels, sheep and goats and moved between wells and pastures, organized by tribe and clan.

wadi
A dry stream bed that carries water only after rare storms. Arabia has no permanent rivers, only wadis.

Hejaz

The western strip of Arabia along the Red Sea, with its mountains and the towns of Mecca, Medina and Taif.

Rub' al Khali
"The Empty Quarter," the great sand desert of southern Arabia and the largest continuous body of sand on earth.

falaj (plural aflaj)
In Oman, a gently sloping channel, often partly underground, that carries water by gravity from a mountain source or aquifer to an oasis. The Persian form is called a qanat.

buffer state
A smaller state or people between two great powers that keeps them apart and absorbs the first blow of war (see Unit 1).

CORE IDEAS

The story. In the year 622, by the reckoning Christians use, a merchant of Mecca named Muhammad slipped out of his hometown and traveled north to the oasis of Yathrib, about 210 miles (340 km) away. He had been born in Mecca around 570 into the clan of Hashim, part of the Quraysh tribe that controlled the town and its shrine, the Ka'ba. Around 610 he began to preach that he had received revelations from the one God and that the idols kept at the Ka'ba must be abandoned. Most of the leading men of Mecca opposed him, because the shrine and the pilgrims it drew were the foundation of their trade and their honor. Then men from Yathrib, an oasis whose two Arab tribes, the Aws and the Khazraj, had been feuding for years, invited him to come as their leader and judge. His move there is called the *Hijra*, "emigration," and Muslims count their calendar from that year. Yathrib came to be called Medina, "the city." From that oasis Muhammad's community fought Mecca, at Badr in 624 and in other battles, and took the town in 630. By his death in 632 most of the tribes of Arabia had joined him by treaty or by force. Within a century, armies from this desert ruled from Spain to the Indus River.

On the map. The Arabian Peninsula covers about 1.2 million square miles (3.2 million km^2), the largest peninsula on earth, about a third the size of the United States. It has no permanent rivers at all, only wadis that flood after rare storms. Along the Red Sea the land rises in the mountains of the Hejaz and the Asir, and in the far southwest the highlands of Yemen catch the summer monsoon rains blowing off the Indian Ocean. That is why the Romans called the southwest *Arabia Felix*, "fortunate Arabia," and why ancient Sheba and its great dam at Ma'rib flourished there. Inland lies desert. In the north is the red sand of the Nafud; a long ribbon of sand called the Dahna curves south to join the Rub' al Khali, the Empty Quarter, which by itself covers about 250,000 square miles (650,000 km^2), nearly the size of Texas. Most of the peninsula receives less than 4 inches (100 mm) of rain a year, for the same reason the Sahara does: it lies under the belt of sinking, drying air near the Tropic of Cancer, which crosses the peninsula about 140 miles (220 km) north of Mecca.

How it worked. In Arabia, water decides everything. Settled life clustered at oases, where springs or shallow wells reached underground water: Medina and Khaybar with their date palms, Taif in the cooler mountains above Mecca, and al-Hasa near the Persian Gulf, one of

the largest oases in the world. In Oman, people dug aflaj, channels sloping only a few feet per mile, to carry water by gravity from the mountains to their palm gardens. Between the oases moved the Bedouin with their camels, sheep and goats, following the scattered rains to fresh pasture. A Bedouin owed loyalty first to family, then to clan, then to tribe. There was no king and no police; a tribe protected its members by the threat of revenge, and the payment of blood money settled feuds. Raiding another tribe's herds was a normal, almost sporting, part of desert life, and poetry was its great art. For centuries caravans had carried frankincense and myrrh from Dhofar and Yemen north along the Incense Road to Petra, Gaza and Damascus, and by Muhammad's time Meccan merchants ran caravans to Syria and Yemen. The desert was poor in farmland but rich in men who could cross it.

The big idea. For a thousand years the desert was a moat that kept the great empires out of Arabia. In 26 BC the Roman governor of Egypt, Aelius Gallus, marched an army into Arabia to seize the incense country; his friend, the geographer Strabo (Unit 1), recorded how heat, thirst, disease and a treacherous guide ruined the expedition. After that, Rome, Byzantium and Persia ruled only the edges and used Arab client kingdoms as buffers: the Christian Ghassanids guarded the desert frontier for Byzantium, and the Lakhmids at al-Hira guarded it for Persia. Then from 602 to 628 Byzantium and Sasanian Persia fought a long and exhausting war; the Persians took Jerusalem in 614, and Heraclius won it back only at the end. Both empires were drained of men and money. Persia had abolished the Lakhmid kingdom around 602, and Byzantium had stopped paying many of its Arab allies, so the old desert buffers were gone. When the first caliphs, Muhammad's successors, united the tribes and turned them outward, the desert became a sea from which armies sailed. Camel-borne forces could move across the waterless steppe where imperial armies could not follow, strike, and fall back into the sand. Byzantium lost Syria after the Battle of the Yarmuk in 636 and Egypt by 642; Jerusalem surrendered around 638; the Persian Empire collapsed after the battles of Qadisiyyah and Nahavand and was gone by 651. In 711 Muslim armies crossed into Spain and also reached Sindh on the Indus.

Under the new rule. These were wars of conquest, and they changed the map of faith. Syria, Palestine, Egypt and North Africa had been Christian lands for centuries; under Muslim rule Christians and Jews were usually allowed to keep their worship as *dhimmis*, protected subjects, but they paid a special tax, the jizya, were barred from bearing arms and building new churches freely, and over the centuries many converted. Arabic became the common language from Iraq to Morocco. The empire also built: the caliphs kept much of the Byzantine and Persian government, scholars in Baghdad later translated Greek science and philosophy into Arabic, and pilgrims and merchants crossed a vast realm under one law. In 732 a Frankish army under Charles Martel stopped a Muslim raid near Tours, in central France, the farthest point of the advance into Western Europe.

Borders in the sand. Modern Arabia's borders were drawn late, because in the Empty Quarter there was little to fight over until oil was found. Ibn Saud united most of the peninsula as the Kingdom of Saudi Arabia in 1932, and several of its desert borders were settled only decades later; the border with Yemen was fixed by the Treaty of Jeddah in 2000. Where people and water were scarce, the lines on the map waited until something under the sand made them worth drawing.

The Arabian Peninsula. Towns cling to the mountains of the west and the oases; the Empty Quarter fills the south.

PICTURE STUDY

The World Map of al-Idrisi (from the Book of Roger), Muhammad al-Idrisi, 1154 (this copy made in Cairo in 1553) · Ink and color on paper (manuscript copies) · Bodleian Library, Oxford (MS. Pococke 375, the copy made in 1553, shown here); other copies in Paris and elsewhere

Muhammad al-Idrisi was an Arab geographer born in Ceuta, on the Strait of Gibraltar, who worked at the court of the Norman king Roger II of Sicily in Palermo. In 1154 he finished a

great geography, often called the *Book of Roger*, with a round world map and seventy regional maps built from older Greek and Arab sources and from questioning travelers.

Like most Arab maps of its day, it puts south at the top. Turn your head and the Arabian Peninsula sits near the middle, with the Red Sea and the Persian Gulf like two arms on either side, which is just how a geographer writing in Arabic, facing Mecca to pray, might picture the world.

Look closely

- Find the Arabian Peninsula. Which two narrow seas wrap around it?
- Find the Mediterranean. Because south is at the top, where is it on the page?
- Look at Africa. How did al-Idrisi picture its size and its southern end compared with a modern map?
- Look for the ring of ocean around the whole world. What did that idea tell readers about the limits of the known world?

Talk about it

1. Why might a map made in Sicily for a Christian king use south at the top and put Arabia near the center?
2. What does this map show about the movement of knowledge between the Muslim and Christian worlds in the 1100s?
3. How would a Bedouin guide's "map" of Arabia, kept in his head, differ from al-Idrisi's?

PROJECT: BUILD A MODEL FALAJ

Oases in Oman were watered by aflaj: channels that carry water by gravity from the mountains to the palm gardens, often for miles, with a slope so gentle it is hard to see. You will build one in a sand tray and measure its slope.

You will need

- A long shallow box or plastic storage tub (at least 24 inches long), lined with a trash bag
- Damp sand, plus a few cups of gravel
- A plastic cup with a small hole punched near the bottom (the mountain spring)
- A drinking straw or a length of aquarium tubing, cut in half lengthwise (the channel)
- A ruler, a tape measure and a small level or a level app on a phone
- Water, a measuring cup and toothpicks or twigs (palm trees)

Steps

1. Pile damp sand high at one end of the tub to make the mountains. Bury the cup in the top of the pile with its hole facing downhill.
2. Shape a long gentle slope from the mountains to a low, flat garden area at the other end. Plant toothpick palms in the garden.

3. Lay your half-straw channel from the cup's hole to the garden. Measure the drop (how much lower the garden end is than the spring end) and the length of the channel.
4. Pour one cup of water into the spring cup and time how long the water takes to reach the garden. Note whether it flows smoothly, stalls or washes out the channel.
5. Lower or raise the slope and test again. Find the gentlest slope that still delivers water steadily.
6. Cover part of the channel with sand, leaving it open only near the garden, the way many aflaj ran underground to keep the water from evaporating. Test again.
7. Calculate your best slope as a fraction and as a percent (drop ÷ length × 100). Compare it with a real falaj that drops about 10 feet per mile (about 0.2%).

Tips

- Too steep a slope cuts into the channel and wastes water in a rush; too gentle and the water stalls. Real builders aimed for the middle.
- Put a towel under the tub. Model water goes everywhere.

Check your work

- My falaj delivers water from the spring to the garden by gravity alone.
- I measured and recorded the drop, the length and the slope as a percent.
- I can explain why covered channels lost less water than open ones.

MAP NOTEBOOK

1. Draw an outline map of Arabia. Shade the mountains of the Hejaz, Asir and Yemen, the Nafud and the Rub' al Khali, and mark six oasis or mountain towns.
2. Draw a cross-section of an oasis: rain on the mountains, water soaking into the rock, the water table, a well and palms. Label each part.
3. Make a timeline from 602 to 732 with at least eight dated events from this lesson.

> **From history.** Christianity reached Arabia long before Islam. At Pentecost, "Arabians" heard the apostles in their own tongue (Acts 2:11), and Paul spent time in Arabia after his conversion (Galatians 1:17). By the 500s there was a large Christian community at Najran in the southwest. Around 523 the Himyarite king Dhu Nuwas, who had adopted Judaism, put many of Najran's Christians to death, and the Christian kingdom of Aksum across the Red Sea in Ethiopia invaded Yemen in response. Ancient Christian writers remembered the victims as the martyrs of Najran.

WORKED EXAMPLES

Example 1. Mecca lies at about 21.4° N, 39.8° E and Medina at about 24.5° N, 39.6° E. Estimate the straight-line distance in miles and kilometers.

(Use the map or drawing "Mecca and Medina lie almost on the same meridian." shown earlier in this lesson.)

1. The longitudes differ by only 0.2°, so the towns are almost due north–south of each other.
2. Latitude difference: 24.5° − 21.4° = 3.1°.
3. Distance: 3.1 × 69 ≈ 214 miles; 3.1 × 111 ≈ 344 km.
4. The east–west part (0.2° × about 63 miles ≈ 13 miles) adds almost nothing: $\sqrt{(214^2 + 13^2)} \approx 214$.

Answer: About 210–215 miles (about 340 km). Travelers on camels and on foot followed the valleys, so the real journey was longer.

Example 2. The Rub' al Khali covers about 250,000 square miles. Texas covers about 269,000 square miles. Express the Empty Quarter as a percent of Texas, and convert its area to km² (1 sq mi ≈ 2.59 km²).

1. Percent: 250,000 ÷ 269,000 ≈ 0.929, or about 93%.
2. Area in km²: 250,000 × 2.59 = 647,500 km², about 650,000 km².

Answer: About 93% of the size of Texas; about 650,000 km².

Example 3. A falaj carries water 3 miles from a mountain spring to an oasis, dropping 30 feet in that distance. Find its slope in feet per mile, as a fraction, and as a percent. (1 mile = 5,280 feet.)

1. Feet per mile: 30 ÷ 3 = 10 feet per mile.
2. Length in feet: 3 × 5,280 = 15,840 feet.
3. Slope as a fraction: 30 ÷ 15,840 ≈ 0.0019, about 1 foot of drop for every 528 feet of channel.
4. As a percent: 0.0019 × 100 ≈ 0.19%.

Answer: 10 feet per mile, about 1/528, or about 0.19%. A slope this gentle needed careful surveying by eye, plumb line and water level.

PRACTICE

1. EASY What is the Hijra, in what year did it happen, and why do Muslims count their calendar from it?
2. EASY Why does Arabia have no permanent rivers? Name the kind of stream bed it has instead.
3. EASY Why did the Romans call southwest Arabia “Arabia Felix”?
4. EASY Name the two Arab client kingdoms that served as buffers for Byzantium and for Persia.
5. MEDIUM Use the map and the lesson. Which town lies farther north, Khaybar or Medina? Which lies at a higher elevation, Taif or Mecca, and why did that matter?
   (Use the map or drawing “Compare the positions of Khaybar, Medina, Taif and Mecca.” shown earlier in this lesson.)
6. MEDIUM A caravan travels 20 miles a day. How long would it need to cover the 214 miles from Mecca to Medina in a straight line? Why would the real trip take longer?
7. MEDIUM Arrange in order: Battle of the Yarmuk; Muhammad’s death; Hijra; Treaty of Jeddah; capture of Mecca; Muslim armies cross into Spain; Battle of Badr.
8. MEDIUM Explain in two or three sentences how the war of 602–628 between Byzantium and Persia helped the Arab conquests that followed.
9. HARD Medina (about 24.5° N, 39.6° E) to Toledo, Spain (about 39.9° N, 4.0° W) is about 2,730 miles (4,390 km) in a straight line. Muslim armies first reached Spain in 711, 79 years after 632. What average rate of advance per year does the straight-line distance give? Why is the real rate higher?
10. HARD A falaj must carry water 4.5 miles and may drop no more than 0.15% of its length. What is the greatest drop allowed, in feet and in meters? (1 mile = 5,280 ft; 1 ft = 0.305 m.)
11. HARD Strabo recorded the failure of Aelius Gallus’s expedition into Arabia in 26 BC. Give three geographic reasons a Roman army struggled there that did not trouble Bedouin raiders.
12. CHALLENGE Write a paragraph (5–7 sentences) on this question: Was the Arabian Desert a border or a highway? Use at least three examples from different centuries.

COMMON MISTAKES

- Thinking all of Arabia is the same flat sand. It has high mountains in the west, monsoon-watered highlands in Yemen, gravel plains, great sand seas and large oases.
- Describing the early Arab conquests as either purely peaceful spreading of a faith or as mere raids. They were organized wars of conquest that built a lasting empire, in which conquered Christians and Jews kept their faith as protected but taxed and restricted subjects.
- Assuming modern Arabian borders are ancient. Many were not settled until the 1900s, and the Saudi–Yemen border not until 2000.

Make it a game · Oasis Hop. Lay ten paper “oases” on the floor about a stride apart, each labeled with a town or region (Mecca, Medina, Taif, Khaybar, al-Hasa, Petra, Sana’a, Ma’rib, Rub’ al Khali, Damascus). A player may hop to an oasis only after answering a question about it correctly: its region of Arabia, one fact about its water, or one event that happened there. Miss, and you must wait one turn “at the well.” The first to cross the room wins.

Scripture. “Neither went I up to Jerusalem to them which were apostles before me; but I went into Arabia, and returned again unto Damascus.” (Galatians 1:17, KJV)

The apostle Paul’s road ran through the edge of the Arabian Desert. Deserts in Scripture are places of testing and of meeting God, and the gospel crossed them long before modern roads did.

Practice answers

1. The Hijra was Muhammad’s move from Mecca to the oasis of Yathrib (Medina) in 622. Muslims count their calendar from it because it marked the beginning of an independent Muslim community with its own leader and law.
2. Most of the peninsula receives less than about 4 inches (100 mm) of rain a year under the belt of sinking dry air near the Tropic of Cancer, so no stream can flow all year. It has wadis, dry beds that carry water only after rare storms.
3. Because the highlands of Yemen catch summer monsoon rains, so the region could grow crops and was rich from the incense trade, unlike the dry interior.
4. The Ghassanids (for Byzantium) and the Lakhmids at al-Hira (for Persia).
5. Khaybar lies farther north (about 25.7° N vs 24.5° N). Taif is higher, in the mountains above Mecca, so it is cooler and gets more rain, which made it a place of gardens and fruit.
6. 214 ÷ 20 ≈ 10.7, so about 11 days. The real route followed valleys and wells and was longer than a straight line, and travelers rested in the worst heat.
7. Hijra (622); Battle of Badr (624); capture of Mecca (630); Muhammad’s death (632); Battle of the Yarmuk (636); Muslim armies cross into Spain (711); Treaty of Jeddah (2000).
8. The long war exhausted both empires in men and money; Persia had abolished the Lakhmid kingdom, and Byzantium had stopped paying many of its Arab allies on the desert frontier. When the united Arab tribes attacked in the 630s, they met weakened armies and empty treasuries, and the buffer kingdoms that had guarded the desert edge no longer held.
9. 2,730 ÷ 79 ≈ 35 miles (about 56 km) per year. The real armies did not move in a straight line: they went through Syria and Egypt and then about 2,000 miles west across North Africa, a path of roughly 4,000 miles or more, and their advance came in bursts with long pauses.
10. Length = 4.5 × 5,280 = 23,760 ft. Drop = 0.0015 × 23,760 ≈ 35.6 ft, about 10.9 m.
11. Any three: scarce and unknown wells, so water had to be carried or found with local guides (and Gallus’s guide misled him); extreme heat that sickened soldiers used to the Mediterranean; long distances with no farmland to feed a large army; and a slow infantry army, while Bedouin rode camels, knew the wells and needed little.
12. A strong answer argues both. As a border, the desert protected Arabia: Aelius Gallus failed in 26 BC, and Rome, Byzantium and Persia ruled only its edges, using the Ghassanids and Lakhmids as buffers. As a highway, it carried incense caravans to Petra and Gaza and Meccan caravans to Syria and Yemen, and in the 630s camel-borne Arab armies crossed it to strike

Syria and Iraq. It concludes that a desert is a border to those who cannot cross it and a highway to those who can, so the camel and the knowledge of the wells made the difference.

4.3 The Steppe Highway

OBJECTIVES

- Locate the Eurasian Steppe from the Hungarian plain to Manchuria, describe its rainfall, grass and climate, and identify its gates and edges.
- Explain how pastoral nomads lived and fought, and trace the movements of the Scythians, the Huns and later peoples along the “grass road.”
- Calculate distances along a parallel of latitude and use pasture and rainfall figures to explain why steppe armies moved fast and spread out.

Warm-up. Lay a long strip of paper (or a row of books) across the table and call it a road 5,000 miles long with no fences. Put a toy horse at one end and a pile of coins (a rich farming city) at the other. Now put a second pile of coins on the near end. Ask: if you lived on the road and owned the fastest animal in the world, what would you do about the two piles? What would the people guarding the piles do?

Watch. *Mongols 01 - Introduction to the Steppe* (Digital Diogenes, 6:32).
https://www.youtube.com/watch?v=7yc-T50OpDU
With the big idea: watch for how the open grassland shaped life on the steppe, with herds, horses, felt tents and moving with the seasons.
Note: Captions were not available to check; preview it first. The video is about Mongol life in the 1100s and 1200s, much later than the Scythians in the lesson story. Covers the Mongols of the 12th–13th centuries AD, not the Scythians of Darius's time (about 513 BC).

Backup video. *The Scythians: Nomads of the Steppe* (The Remnant, 9:16).
https://www.youtube.com/watch?v=_MviYG19LIk
After the story: watch Darius march his huge army into the empty steppe and notice how the Scythians kept retreating instead of fighting. Note: Captions were not available to check; preview it first. The channel is not well known and the description reads like scripted narration, so listen to the first minute to make sure a real person is narrating. Videos on the Scythians sometimes describe their battle and burial customs, which can be graphic.

KEY TERMS

steppe
A wide, nearly treeless grassland with about 10 to 20 inches (250 to 500 mm) of rain a year: too dry for forest, wet enough for grass.

pastoral nomadism
A way of life based on herding animals and moving with them between seasonal pastures rather than farming fixed fields.

kurgan
A burial mound raised over the grave of a steppe chief or noble; Scythian kurgans have yielded famous gold work.

composite bow
A short, powerful bow made of wood, horn and sinew glued in layers, small enough to shoot from horseback.

Dzungarian Gate
A narrow, windy pass between mountains on today's border of Kazakhstan and China, one of the main doors between the eastern and western steppe.

steppe–sown frontier
The zone where grassland used by nomads meets the farmland ("the sown") of settled peoples; for most of history the real border of Eurasia.

CORE IDEAS

The story. Around 513 BC Darius the Great, king of Persia, ruler of the largest empire the world had yet seen, set out to conquer the Scythians, the horse people north of the Black Sea. Herodotus tells the story in the fourth book of his *Histories*. Darius crossed the Bosporus on a bridge of boats built by a Greek engineer, Mandrocles of Samos, marched north through Thrace, and crossed the Danube on another bridge of boats, leaving his Ionian Greek subjects to guard it. Then he entered the steppe, and nothing happened. The Scythians would not fight. They retreated ahead of him, filled in the wells and springs, and destroyed the grass. When Darius sent a message asking their king, Idanthyrsus, either to stand and fight or to submit, the king answered, in Herodotus's telling, that the Scythians had no towns and no farmland to defend and so had no reason to hurry into battle; but if the Persians found the tombs of their fathers, they would learn whether the Scythians could fight. At last the Scythians sent Darius a bird, a mouse, a frog and five arrows. Darius's adviser Gobryas read the riddle: unless the Persians became birds and flew into the sky, or mice and hid in the ground, or frogs and leaped into the lakes, they would never go home, but be shot by these arrows. Darius, his army hungry and worn out, turned back to the Danube, where the bridge was still standing. The greatest king on earth had learned the first lesson of the steppe: you cannot easily conquer people who have nothing they must defend.

On the map. The Eurasian Steppe is a belt of grassland about 5,000 miles (8,000 km) long, running from the Hungarian plain in the heart of Europe across Ukraine, southern Russia and Kazakhstan to Mongolia and the edge of Manchuria. To its north lies forest, at first mixed with grass (the forest-steppe), then the great taiga of Siberia. To its south lie deserts, mountains and the old farming civilizations: the Black Sea and Persia, the oases of Central Asia, and China. The steppe gets about 10 to 20 inches (250 to 500 mm) of rain a year, enough for grass but not for trees, and it has a harsh continental climate, far from any ocean, with hot summers and bitter winters; in Mongolia winter nights often fall below −30 °F (−34 °C). Rivers cross it from north to south, the Dnieper and Don to the Black Sea, the Volga and Ural to the Caspian. The belt is not perfectly open. The Altai and the Tian Shan pinch it in the middle, and travelers between east and west passed through gaps such as the Dzungarian Gate, a windswept pass on today's border of Kazakhstan and China, or the wide

gap between the southern Ural Mountains and the Caspian Sea. At the far western end, the Carpathian Mountains wrap around the Hungarian plain, the last pocket of steppe in Europe and the end of the road.

How it worked. Grass cannot feed people directly, but animals can turn grass into milk, meat, wool, leather and transport. So the peoples of the steppe were pastoral nomads, moving their horses, sheep, goats, cattle and camels between summer and winter pastures and living in felt tents or wagons. Every boy learned to ride almost as soon as he could walk, and every man was a mounted archer with a composite bow of wood, horn and sinew. A rider kept several horses and switched to a fresh one as each tired, so a nomad army could cover distances that stunned settled peoples. But nomads could not make everything they needed. Grain, cloth, iron and luxuries came from the farming lands to the south, so steppe peoples traded with their settled neighbors when they could and raided them when they could not. When a strong leader united many tribes, the raids became invasions, and the steppe produced an empire.

The big idea. The steppe was not a border but a highway, and peoples rode along it again and again, usually from east to west. The Scythians, an Iranian-speaking people, held the grasslands north of the Black Sea from about the 700s BC; they traded grain and slaves with the Greek colonies on the coast and were buried in kurgans full of gold, much of it made for them by Greek goldsmiths. The Sarmatians followed them. In the 370s AD the Huns appeared north of the Black Sea from farther east. They broke the Gothic kingdoms there, and in 376 tens of thousands of Goths begged the Roman Empire to let them cross the Danube. Mistreated by Roman officials, the Goths rebelled, and at Adrianople in 378 they destroyed a Roman army and killed the emperor Valens. Under Attila the Huns ravaged the Balkans, invaded Gaul until they were checked at the Catalaunian Plains in 451, and invaded Italy in 452, where Pope Leo I met Attila and the Huns withdrew. After Attila’s death in 453 his empire fell apart. Then came the Avars, the Bulgars, the Turks and the Magyars, who settled the Hungarian plain in the 890s and were stopped from raiding Germany by Otto I at the Lechfeld in 955. Each wave pushed the people in front of it, and the push was felt from China to Rome.

Technology overcoming geography. For two thousand years the horse archer held the advantage, and settled empires answered with walls and fortified lines: China’s Great Wall (Lesson 4.5) and, much later, Russia’s chains of forts and felled-tree barriers across the southern steppe in the 1500s and 1600s. What finally closed the steppe highway was gunpowder, together with the money and numbers of settled states. Cannon and muskets made fortresses hard to take and nomad charges costly. In the 1600s and 1700s Russia advanced from the north and west and Qing China from the east until the two empires met and agreed on borders in the Treaties of Nerchinsk (1689) and Kyakhta (1727). In the 1750s Qing armies destroyed the Dzungar state, the last great steppe empire, and through war, smallpox and deliberate killing most of the Dzungar people perished. The steppe that had carried conquerors was itself divided by surveyors. Today it lies mostly in Hungary, Ukraine, Russia, Kazakhstan, Mongolia and China, and Mongolia, squeezed between Russia and China, is what remains of the old homeland of the horse peoples.

The grass road. The Eurasian Steppe runs about 5,000 miles from the Hungarian plain to Manchuria. The Huns rode west along it in the 370s–450s.

PICTURE STUDY

The Gold Pectoral from Tovsta Mohyla, Unknown Greek goldsmith working for Scythian patrons, 4th century BC · Gold · Museum of Historical Treasures of Ukraine, Kyiv

In 1971 the Ukrainian archaeologist Boris Mozolevsky was excavating a Scythian kurgan called Tovsta Mohyla, “the fat grave,” in southern Ukraine, when he found this crescent of gold, about a foot across, lying in a part of the tomb that ancient grave robbers had missed. It was worn on the chest of a Scythian king or noble.

The workmanship is Greek, almost certainly from the Greek cities on the Black Sea coast, but the subject is the life of the steppe. It is a picture of what the Scythians valued: herds, horses and the fierce animal world around them.

Look closely

- Find the two men in the center of the inner tier. What are they making, and from what?
- Count the kinds of animals in the inner tier. Which are mothers with young? What does that say about where the Scythians' wealth came from?
- Look at the outer tier. Which animals are hunters and which are prey? Why would a warrior people wear such scenes?
- Look at the middle tier of flowers. How does it separate the peaceful world inside from the violent world outside?

Talk about it

1. What does this ornament tell us about trade between steppe nomads and Greek cities?
2. Herodotus said the Scythians had no towns or fields. How does this pectoral agree with him?
3. Why do so many treasures of nomad peoples survive in graves rather than in cities?

PROJECT: THE GRASS ROAD STRIP MAP

You will make a scroll map of the whole Eurasian Steppe, 5,000 miles long, on a roll of paper, and mark the peoples who rode along it. A scroll is the right shape for the steppe: long, narrow and meant to be traveled.

You will need

- A roll of adding-machine tape or butcher paper, about 5 feet long and 6–8 inches wide
- A yardstick or tape measure, pencils and colored pencils (green, yellow-brown, dark green, blue)
- An atlas or printed map of Eurasia
- Small sticky notes

Steps

1. Use a scale of 1 inch = 100 miles. The steppe is about 5,000 miles long, so mark a 50-inch strip, leaving a few inches at each end.
2. Mark longitude lines along the top edge: Budapest (19° E) at the left end and Beijing (116° E) near the right end. Space the meridians between them evenly (this is a simple strip map, not a true projection).
3. Shade three bands: dark green forest along the top, yellow-green grassland in the middle, and tan desert and mountains along the bottom. Pinch the grassland in the middle where the Altai and Tian Shan stand.
4. Draw and label the north–south rivers: Danube, Dnieper, Don, Volga, Ural. Mark the Dzungarian Gate, the Ural–Caspian gap and the Carpathians.
5. Mark farming cities along the bottom edge: Constantinople, Samarkand, Beijing. These are the "piles of coins."
6. On sticky notes, write each people with dates and an arrow showing direction: Scythians (from about 700 BC), Huns (370s–453), Avars (500s), Magyars (890s), Mongols (1200s), Dzungars (1600s–1750s). Place them where they ruled.

7. Along the bottom, write the average rainfall for three places from the lesson (Moscow in the forest, Astana on the steppe, Kashgar in the desert).

Tips

- Roll the map from the east end to the west end as you “ride” it. Every people you pass was pushed by the one behind.
- Keep this map; you will add the Mongol Empire in Lesson 4.4 and the Great Wall in Lesson 4.5.

Check your work

- My strip is drawn to scale, with the correct order of rivers and gates.
- The forest, steppe and desert bands are clear, with the pinch in the middle.
- At least six peoples are marked with correct dates and directions.

MAP NOTEBOOK

1. Draw the bird, the mouse, the frog and the five arrows, and write Gobryas’s reading of the riddle in your own words.
2. Draw a north–south cross-section through Kazakhstan: taiga, forest-steppe, steppe, desert, mountains. Label rainfall for each band.
3. Draw a nomad’s yearly circle: summer pasture, autumn move, winter camp, spring move, with the animals in each place.

> **From history.** The stirrup, which lets a rider stand, brace and fight from the saddle, appears in China by the 300s AD and spread west across the steppe; it was in use in Europe by about the 700s. Historians still argue over how much it changed warfare, but it is a good example of how the grass road carried ideas and inventions as well as armies. Silk, paper and, later, gunpowder crossed Eurasia by the same steppe and oasis routes.

WORKED EXAMPLES

Example 1. Budapest (47.5° N, 19.0° E) and Karakorum, the Mongol capital (47.2° N, 102.8° E), lie at almost the same latitude. Estimate the distance between them along the parallel at about 47.3° N. (At the equator, 1° of longitude ≈ 69.2 miles or 111.3 km; at latitude φ, multiply by cos φ.)

(Use the map or drawing "Budapest and Karakorum lie on nearly the same parallel, at opposite ends of the " shown earlier in this lesson.)

1. Longitude difference: 102.8° − 19.0° = 83.8°.
2. Length of 1° of longitude at 47.3° N: 69.2 × cos 47.3° ≈ 69.2 × 0.678 ≈ 46.9 miles (111.3 × 0.678 ≈ 75.5 km).
3. Distance: 83.8 × 46.9 ≈ 3,930 miles; 83.8 × 75.5 ≈ 6,330 km.
4. A great-circle route would be a little shorter, because it bows north of the parallel, but along the grass road riders followed the steppe, not a straight line.

Answer: About 3,900 miles (about 6,300 km) along the parallel.

Example 2. Suppose a stretch of steppe can feed one horse for a season on 10 acres of pasture. An army of 10,000 riders brings 3 horses per rider. How many acres, square miles and square kilometers of pasture does it need for the season? (640 acres = 1 sq mi; 1 sq mi ≈ 2.59 km².)

1. Horses: 10,000 × 3 = 30,000.
2. Acres: 30,000 × 10 = 300,000 acres.
3. Square miles: 300,000 ÷ 640 ≈ 469 sq mi.
4. Square kilometers: 469 × 2.59 ≈ 1,215 km², about a square 22 miles on each side.

Answer: About 300,000 acres, about 470 sq mi (about 1,200 km²). Nomad armies had to keep moving and spread out to feed their horses, which is one reason they were fast, and one reason they struggled where grass was scarce.

Example 3. Classify each place as forest, steppe or desert using this rule of thumb: under 10 inches of rain a year, desert; 10 to 20 inches, steppe; over 20 inches, forest or farmland. Approximate yearly rainfall: Moscow about 700 mm; Astana (Kazakhstan) about 320 mm; Kashgar (western China) about 70 mm. (1 inch = 25.4 mm.)

1. Moscow: 700 ÷ 25.4 ≈ 27.6 inches. Over 20: forest.
2. Astana: 320 ÷ 25.4 ≈ 12.6 inches. Between 10 and 20: steppe.
3. Kashgar: 70 ÷ 25.4 ≈ 2.8 inches. Under 10: desert (it is an oasis city fed by mountain rivers).

Answer: Moscow ≈ 27.6 in, forest; Astana ≈ 12.6 in, steppe; Kashgar ≈ 2.8 in, desert. A line drawn north to south through Central Asia crosses all three belts.

PRACTICE

1. EASY Define a steppe, giving its approximate rainfall in both inches and millimeters.
2. EASY What were the Scythians' gifts to Darius, and how did Gobryas interpret them?
3. EASY Name the two ends of the Eurasian Steppe and its approximate length in miles and kilometers.
4. EASY Put in order: Battle of Adrianople; the Magyars defeated at the Lechfeld; Darius's Scythian campaign; Attila invades Gaul; Treaty of Nerchinsk; Huns appear north of the Black Sea.
5. MEDIUM Use the map. Name the pass between the eastern and western steppe on today's Kazakhstan–China border, and give its approximate coordinates.
   (Use the map or drawing "Find the gate between the Kazakh steppe and the east." shown earlier in this lesson.)
6. MEDIUM Kiev (50.45° N, 30.5° E) and Astana (51.2° N, 71.4° E) lie at nearly the same latitude. Estimate the distance between them along the parallel at about 50.8° N (cos 50.8° ≈ 0.632).
7. MEDIUM A Hunnic or Mongol rider with remounts might cover 60 miles a day, while an infantry army marched about 15 miles a day. How many days would each need to cover 900 miles?
8. MEDIUM Explain why nomads both traded with and raided farming peoples.
9. HARD Using the pasture rule from Worked Example 2 (10 acres per horse per season), how many square miles would an army of 30,000 riders with 4 horses each need? Express it as the side of a square, in miles.
10. HARD The Huns never fought the Romans in 376, yet that year began a chain of events that ended with an emperor's death. Explain the chain in three or four sentences.
11. HARD Why did the Hungarian plain become the place where several steppe peoples (Huns, Avars, Magyars) settled or based themselves in Europe?
12. CHALLENGE Write a paragraph (5–7 sentences): Why did the age of steppe empires end in the 1600s and 1700s? Use the words "gunpowder," "Nerchinsk" and "Dzungar."

COMMON MISTAKES

- Thinking nomads were “wandering” aimlessly. Pastoral nomads moved on regular seasonal routes between known pastures, wells and winter camps.
- Treating the steppe as a border between Europe and Asia. For most of history it was a highway that connected them; the real border was the edge between grass and farmland.
- Assuming the steppe peoples were one nation. Scythians, Huns, Turks and Mongols spoke different languages and came from different places along the same road.

Make it a game · Push Down the Road. Seat players in a row from east to west, each holding a card with a steppe people (Scythians, Huns, Avars, Turks, Magyars, Mongols, Dzungars). A leader reads a clue (“I stopped the Magyars at the Lechfeld,” “I sent Darius a frog”). The player whose people the clue fits must stand, name their date and say which people they pushed or were pushed by. A correct answer lets that player trade places one seat west; the first to reach the Hungarian end of the row wins.

Scripture. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;” (Acts 17:26, KJV)

Few lands show the movement of nations more clearly than the steppe, where peoples rose, rode and vanished. Paul told the philosophers of Athens that God set both the times and the bounds of every people, so that they should seek Him.

Practice answers

1. A wide, nearly treeless grassland with about 10 to 20 inches (250 to 500 mm) of rain a year: too dry for forest, wet enough for grass.
2. A bird, a mouse, a frog and five arrows. Gobryas said that unless the Persians could fly like birds, hide in the ground like mice or leap into the lakes like frogs, they would never get home but would be shot by Scythian arrows.
3. The Hungarian plain in the west and Mongolia and the edge of Manchuria in the east; about 5,000 miles (8,000 km).
4. Darius’s Scythian campaign (about 513 BC); Huns appear north of the Black Sea (370s); Battle of Adrianople (378); Attila invades Gaul (451); Lechfeld (955); Treaty of Nerchinsk (1689).
5. The Dzungarian Gate, at about 45° N, 82.5° E.
6. Longitude difference ≈ 40.9°. One degree ≈ 69.2 × 0.632 ≈ 43.7 miles (111.3 × 0.632 ≈ 70.3 km). Distance ≈ 40.9 × 43.7 ≈ 1,790 miles (about 2,880 km).
7. Rider: 900 ÷ 60 = 15 days. Infantry: 900 ÷ 15 = 60 days. The horseman is four times as fast.
8. Herds supplied milk, meat, wool and hides, but nomads could not easily grow grain, weave fine cloth or make much iron. They needed goods from the farmers, so they traded when the farmers would trade fairly and raided when trade was refused or when the farming state was weak.

9. 120,000 horses × 10 = 1,200,000 acres; ÷ 640 = 1,875 sq mi. Side of a square: √1,875 ≈ 43 miles (about 70 km).
10. The Huns, coming from the east, broke the Gothic peoples north of the Black Sea. In 376 tens of thousands of Goths asked to cross the Danube into the Roman Empire for safety. Roman officials mistreated and exploited them, the Goths rebelled, and at Adrianople in 378 they destroyed a Roman army and killed Emperor Valens. Pressure on one end of the steppe was felt at the other.
11. It is the westernmost pocket of steppe grassland, ringed by the Carpathian Mountains and the Alps, so it offered pasture for horses and herds like their homeland, natural protection, and a base for raids into the farmland and towns of Europe beyond.
12. A strong answer explains that gunpowder weapons, cannon and muskets, made fortresses hard to take and gave settled states with large populations and treasuries a lasting advantage over horse archers. Russia advanced from the west and north and Qing China from the east until they fixed borders at Nerchinsk (1689) and Kyakhta (1727), dividing the steppe between them. In the 1750s Qing armies destroyed the Dzungar state, the last great steppe empire, and war, disease and deliberate killing destroyed most of the Dzungar people. The open highway became a land of borders drawn by settled empires.

4.4 Genghis Khan's Empire

OBJECTIVES

- Tell the story of Temüjin's rise to become Chinggis (Genghis) Khan in 1206 and trace how he and his successors built the largest contiguous land empire in history, naming both its achievements and its massacres plainly.
- Explain how the Yam relay system of stations, horses and passes worked and how it overcame the distances of the steppe.
- Calculate relay times, average speeds and areas to compare the Mongol Yam with caravans and with the Pony Express, and to compare the size of the empire with modern countries.

Warm-up. Stand at one end of a hallway or yard and have a family member stand at the other. Time how long it takes you to carry a folded note to them at a fast walk. Now put two more people in between and pass the note hand to hand, each running only their own short stretch. Which is faster, and why? What would you need to keep this working over a thousand miles?

Watch. *Ten Minute History - Genghis Khan and the Mongol Empire (Short Documentary)* (History Matters, 9:59). https://www.youtube.com/watch?v=CUQhuC31ieI
After the story: watch how Temüjin rose from the warring tribes of the eastern steppe to become Genghis Khan, and follow the map as the Mongol Empire grows into the largest connected land empire in history.
Note: Captions were not available to check; preview it first. Expect descriptions of Mongol conquests and slaughter, and it also covers Kublai Khan and the empire's later civil wars. The lesson spells the title Chinggis Khan and notes that Europeans later wrote it as Genghis; the video uses Genghis.

Backup video. *3rd September 1260: Mamluks permanently halt the Mongol advance at the Battle of Ain Jalut* (HistoryPod, 2:44). https://www.youtube.com/watch?v=nMJtbbTa49w
As review: watch this short account of Ain Jalut in 1260, and look for how the Mamluks used hidden cavalry in the terrain to stop the Mongol advance into Egypt. Note: Captions were not available to check; preview it first. It mentions that envoys were executed and describes battle deaths.

KEY TERMS

kurultai
A great assembly of Mongol chiefs and nobles that chose a khan and decided on war; Temüjin was proclaimed Chinggis Khan at a kurultai in 1206.

tumen

A Mongol army unit of about 10,000 men, made of ten units of 1,000, each of ten units of 100, each of ten units of 10.

Yam
The Mongol relay system of post stations, spaced roughly a day's short ride apart, that supplied fresh horses, food and lodging to messengers and officials.

paiza
A tablet of gold, silver, bronze, iron or wood carried by Mongol officials and messengers as a passport, entitling the bearer to horses and supplies at Yam stations.

khanate
A realm ruled by a khan; after about 1260 the Mongol Empire split into four: the Yuan in China, the Golden Horde, the Ilkhanate and the Chagatai Khanate.

contiguous empire
An empire whose lands touch one another in a single unbroken block, as opposed to one spread across oceans.

CORE IDEAS

The story. In the spring of 1206, near the source of the Onon River in what is now northern Mongolia, the chiefs of the steppe tribes gathered in a great kurultai and raised a white standard hung with nine tails. They proclaimed as their ruler a man about forty-four years old named Temüjin and gave him the title Chinggis Khan, which Europeans later spelled Genghis. His road there had been hard. When he was a boy his father, a minor chief, was poisoned by Tatar enemies, and the clan abandoned the widow and her children to live on roots and fish. Temüjin was once captured and held in a wooden collar before he escaped. He rose by courage, cunning and loyalty: by sworn alliances, by rewarding followers for merit rather than birth, and by defeating rival after rival, including his boyhood blood brother Jamukha. When he had finished, every tribe of the Mongolian plateau, Mongol, Tatar, Kerait, Naiman and Merkit, answered to one man. He then did something new. He broke up the old tribes and organized all the fighting men into units of 10, 100, 1,000 and 10,000, deliberately mixing men of different tribes so that their loyalty ran to their commanders and to the khan. He adopted the Uyghur script to write Mongolian and issued a body of law and decrees known as the Yasa. A people of herders had become an army.

How the empire grew. Chinggis attacked the Tangut kingdom of Western Xia in 1209 and the Jin dynasty of northern China in 1211, riding through the passes of the old border walls; the Jin capital, Zhongdu (on the site of modern Beijing), fell in 1215. In 1218 the governor of Otrar, a frontier town of the Khwarazmian Empire in Central Asia, seized a caravan of merchants sent under Mongol protection and had them killed, and the shah of Khwarazm then killed or humiliated the envoys Chinggis sent to demand justice. The punishment that followed, from 1219 to 1221, was one of the most terrible in history. Bukhara, Samarkand, Urgench, Merv and Nishapur were taken one after another. Cities that surrendered quickly were often spared; cities that resisted were destroyed, and their people were killed except for craftsmen, who were carried off to work for the conquerors. The death tolls given by Persian chroniclers, sometimes more than a million for a single city, are surely exaggerated, but the destruction was real, and parts of Iran and Central Asia took centuries to recover.

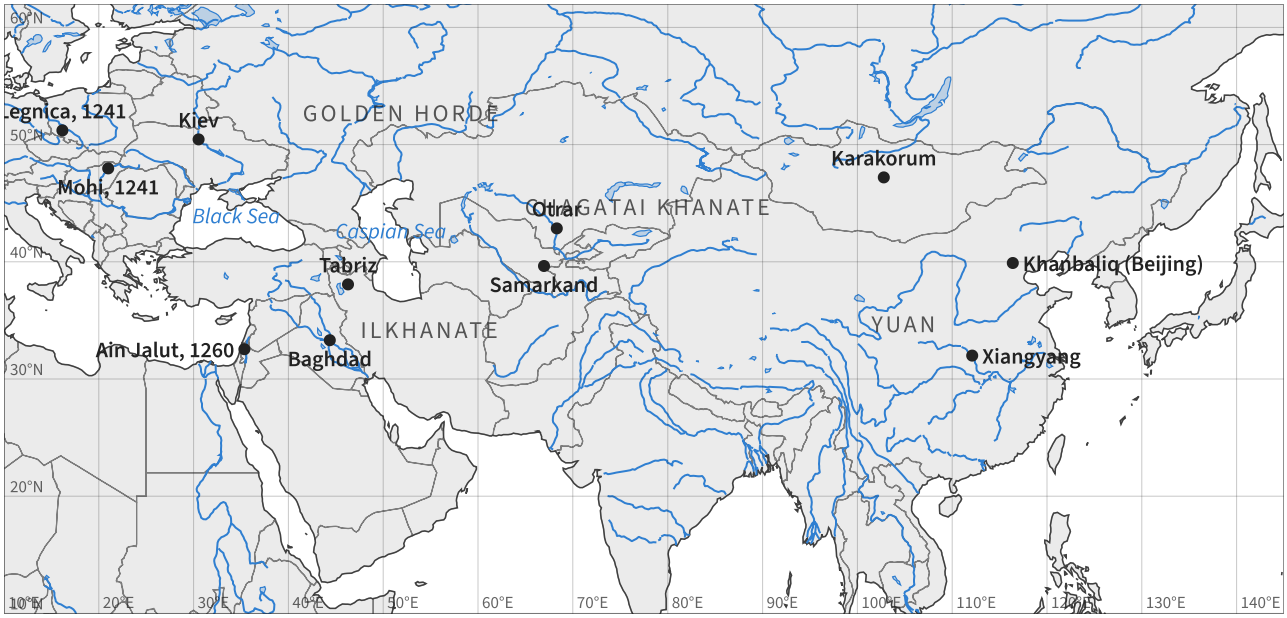
Chinggis died in 1227, and his sons and grandsons kept going. Ögedei built a capital at Karakorum in 1235 and sent armies west; they destroyed Kiev in 1240 and defeated the Poles and Germans at Legnica and the Hungarians at Mohi in 1241, then withdrew after news of Ögedei's death. Hülegü took Baghdad in 1258, killed the caliph and massacred much of the city. Kublai Khan made Beijing (Khanbaliq) his capital, proclaimed the Yuan dynasty in 1271 and completed the conquest of Song China in 1279. At its height the empire covered about 9 million square miles (about 23 to 24 million km²), the largest contiguous land empire there has ever been.

On the map. The empire's shape follows the grass. Its heart was the steppe belt from Mongolia to the Black Sea, and its armies, riding with several horses per man, needed pasture as an engine needs fuel. Where the grass ran out, the conquests slowed or stopped. Mongol armies were beaten by the Mamluks of Egypt at Ain Jalut in Palestine in 1260, after most of the Mongol host had withdrawn and the dry pastures of Syria could not support a large horse army for long. The Vietnamese kingdom of Đại Việt, with its heat, jungle and rivers, drove the Mongols out three times. The Delhi Sultanate repelled repeated raids across the hot plains of India. And twice, in 1274 and 1281, invasion fleets sent against Japan were wrecked (Unit 5). Some historians have argued that even the Hungarian plain, the last pocket of European steppe, was too small to feed the Mongol herds for long. This is an idea to weigh, not a law; politics, leadership and the death of khans mattered too. But it is striking how closely the borders of the greatest land empire match the borders of grassland.

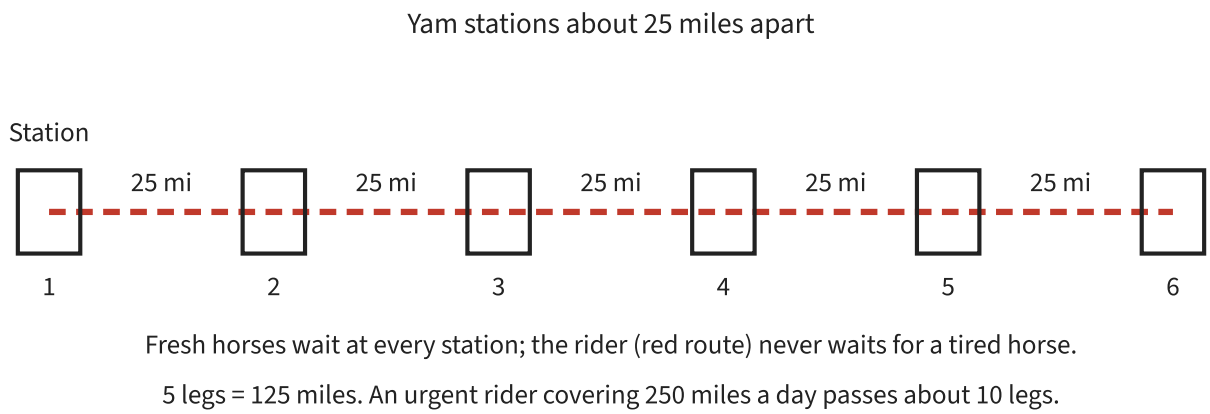
Technology overcoming geography. An empire 5,000 miles wide is useless if the khan's orders take half a year to arrive. The Mongols' answer was the **Yam**, a relay system that Chinggis began and Ögedei organized across the empire. Post stations were set along the main roads, roughly every 20 to 30 miles; Marco Polo, who served Kublai Khan in the 1270s and 1280s, wrote of stations about 25 miles apart, some keeping hundreds of horses, with lodgings fit for a king's messenger. A rider carrying urgent news changed to a fresh horse at each station and rode on, and Polo claimed such riders could cover as much as 250 miles in a day. Officials and messengers carried a **paiza**, a metal or wooden tablet inscribed with the khan's authority, which entitled them to horses, food and guides. The system had a heavy cost: the households near each station were forced to supply horses, fodder and men. But for the first time in history one government could send a message from China to the Black Sea in weeks rather than months. The Mongols borrowed technology as readily as horses. They brought Chinese and Persian engineers with their armies, and in 1273 Persian engineers built counterweight trebuchets that helped break the long siege of the Song city of Xiangyang.

The big idea. By joining the whole steppe under one rule and guarding its roads, the Mongols made the grass road safer for merchants and travelers than it had ever been, a time later historians called the *Pax Mongolica*, the Mongol peace. Envoys crossed Eurasia: the Franciscan friar William of Rubruck, sent by King Louis IX of France, reached Karakorum in 1253–1254, and Marco Polo and his father and uncle reached Kublai's court about 1275. Silk, porcelain, medicine, maps, gunpowder and printing moved along the routes. The empire that began in slaughter became for a time the world's great connector. Its political unity did not last. Quarrels among Chinggis's grandsons split it after about 1260 into four

khanates. The Yuan fell to the Ming in 1368; the Golden Horde lingered on the Russian steppe into the 1400s and beyond. But the borders of Russia, Iran, Central Asia and China still show the marks of the empire the grass road built.



The Mongol Empire about 1280, divided into four khanates. Battle sites mark the places where the conquests reached their limits.



How the Yam worked: a messenger changed horses at each station, so the message never had to wait for a tired animal.

PICTURE STUDY

Mounted Warriors Pursuing Their Enemies, from the Jami' al-tawarikh (Compendium of Chronicles), Painters of the workshop of Rashid al-Din, Tabriz, Early 1300s (first quarter of the fourteenth century) · Ink, opaque watercolor and gold on paper · Staatsbibliothek zu Berlin (Diez Albums, Diez A fol. 70, p. 58); other pages are in Edinburgh University Library and the Khalili Collection, London, with later copies in Paris and Istanbul

Rashid al-Din (about 1247–1318) was born into a Jewish family in Hamadan in Iran, became a physician, converted to Islam and rose to be chief minister to the Mongol rulers of Iran, Ghazan and Öljeitü. Ghazan asked him to write the history of the Mongols, and Rashid al-Din went further: his *Jami' al-tawarikh*, the "Compendium of Chronicles," was one of the first attempts at a history of the whole known world, from China and India to the Franks. In a workshop he endowed in Tabriz, scribes and painters copied it in Persian and Arabic.

The paintings are a meeting of worlds, just as the empire was. Persian painters borrowed the twisting mountains, cloud shapes and long scroll format of Chinese art that came west along the Mongol roads, and used them to show Mongol horsemen, khans in tents and the sieges of cities. Rashid al-Din himself was executed after a court intrigue in 1318, and his quarter of Tabriz was plundered, but his book survived.

Look closely

- Look at the horses. How has the painter shown speed and motion?
- Find the riders' weapons. Which do you see most often, and how does that match what you learned about steppe warfare?
- Look at the mountains, clouds and trees. Which details look Chinese rather than Persian?
- Look at the long, low shape of the picture. Why would that shape suit scenes of armies on the move?

Talk about it

1. What does a book like this tell us about how the Mongols wanted to be remembered?
2. How does the mixing of Chinese and Persian styles in these paintings illustrate the Pax Mongolica?
3. Why should a historian be careful when using pictures painted for the conquerors as evidence of what happened?

PROJECT: RUN THE YAM: A RELAY EXPERIMENT

You will build a scale model of the Yam outdoors, with stations, riders and paizas, and time a message carried by one runner against the same message carried by a relay. Then you will scale your results up to the steppe.

You will need

- A tape measure or a measured stretch of sidewalk, field or park path
- Six cones, buckets or chairs (the stations)
- Cardboard, aluminum foil and string to make paizas
- Index cards for messages
- A stopwatch (phone timer) and a notebook
- At least three people, the more the better

Steps

1. Make a paiza for each runner: cut a cardboard rectangle about 3 × 8 inches, cover it with foil, punch a hole and add a string. Write a short “order of the khan” on it.
2. Choose a scale of 1 yard = 1 mile. Place stations every 25 yards along a straight course of 125 yards (five legs = 125 “miles”).
3. Trial 1: one runner carries a message card the whole 125 yards. Have them run it three times in a row with no rest, as one horse would have to. Record each time.
4. Trial 2: place a fresh runner at each station. Each runs only 25 yards and hands the card and paiza on. Run it three times, using fresh runners at each leg.
5. Compare the average times and the speed in yards per second for each trial. Note how the single runner slowed down.
6. Scale up: if your relay averaged a certain speed over 125 “miles,” how long would it take to carry a message 850 “miles,” the straight-line distance from Karakorum to Khanbaliq? Show your arithmetic.
7. Write a paragraph: what made the Yam fast, and who paid for it?

Tips

- The point is not who runs fastest but how fresh legs at each station keep the speed up. Any group of family members or friends will show it.
- If you have only three people, let two runners alternate legs while the third keeps time.

Check your work

- My stations were measured and spaced correctly.
- I recorded at least three times for each trial and found the averages.
- I can explain why a relay beats a single rider over long distances, and I scaled my result to the Karakorum–Khanbaliq road.

MAP NOTEBOOK

1. Draw a paiza and copy onto it, in your own words, what it allowed the bearer to do.
2. On your Grass Road strip map from Lesson 4.3, shade the four khanates and mark Karakorum and Khanbaliq.
3. Draw a two-column ledger titled “The Mongol Empire”: in one column, its achievements; in the other, its crimes. Include at least four items in each.

> **From history.** Christians lived among the Mongols. Several steppe tribes, including the Keraits and the Naimans, had many members of the Church of the East (often called Nestorians), and Kublai Khan’s mother, Sorghaghtani Beki, was a Christian. In 1254 William of Rubruck took part in a formal debate at the court of Möngke Khan among Christians, Muslims and Buddhists. In 1287–1288 a monk of the Church of the East named Rabban Bar Sauma, born near Khanbaliq, traveled west as an envoy of the Ilkhan Arghun and met King Philip IV of France, King Edward I of England and Pope Nicholas IV.

WORKED EXAMPLES

Example 1. Karakorum (47.2° N, 102.8° E) to Khanbaliq, modern Beijing (39.9° N, 116.4° E), is about 850 miles (about 1,360 km) in a straight line. If Yam stations stood every 25 miles, how many legs is that? How long would an urgent rider covering 250 miles a day take, compared with a caravan making 20 miles a day?

(Use the map or drawing “Each leg between stations was about 25 miles.” shown earlier in this lesson.)

1. Number of legs: 850 ÷ 25 = 34 legs (35 stations counting both ends).
2. Urgent rider: 850 ÷ 250 = 3.4 days, about three and a half days.
3. Caravan: 850 ÷ 20 = 42.5 days, about six weeks.
4. Ratio: 42.5 ÷ 3.4 = 12.5. The relay was about twelve times faster.

Answer: 34 legs; about 3.4 days by urgent relay versus about 42 to 43 days by caravan, roughly twelve times faster (taking Marco Polo’s 250 miles a day as an upper limit).

Example 2. In 1860–1861 the Pony Express carried mail about 1,966 miles from St. Joseph, Missouri, to Sacramento, California, in about 10 days at its best regular schedule. Compare its daily distance with Marco Polo's claim of up to 250 miles a day for urgent Yam riders.

1. Pony Express: 1,966 ÷ 10 ≈ 197 miles a day.
2. Yam (Polo's upper figure): 250 miles a day.
3. Ratio: 250 ÷ 197 ≈ 1.27.
4. Both systems used the same idea, fresh horses at stations, so their speeds are in the same range. Polo's figure was probably a best case, not an everyday speed.

Answer: About 197 miles a day for the Pony Express; Polo's Yam figure is about 1.27 times as fast. Six centuries apart, the same relay idea gave similar speeds.

Example 3. At its height the Mongol Empire covered about 9 million square miles. The world's total land area is about 57.5 million square miles, and the forty-eight contiguous United States cover about 3.1 million square miles. Find the empire's area in km^2, its share of the world's land, and how many times the size of the contiguous United States it was.

1. Area in km^2: 9 × 2.59 ≈ 23.3 million km^2.
2. Share of world land: 9 ÷ 57.5 ≈ 0.157, about 16%.
3. Compared with the contiguous U.S.: 9 ÷ 3.1 ≈ 2.9 times.

Answer: About 23 million km^2; about 16% (roughly one-sixth) of the world's land; nearly three times the size of the forty-eight contiguous states.

PRACTICE

1. EASY In what year and at what kind of assembly was Temüjin proclaimed Chinggis Khan?
2. EASY Why did Chinggis Khan mix men of different tribes in his units of 10, 100, 1,000 and 10,000?
3. EASY What was a paiza, and what did it allow its bearer to do?
4. EASY Name the four khanates the empire split into after about 1260 and the region each ruled.
5. MEDIUM What happened at Otrar in 1218, and why did it matter?
6. MEDIUM Use the map. Which battle sites mark the farthest Mongol advance into Europe and the southwestern limit of their conquests in the Middle East? Give their dates.
   (Use the map or drawing "Find the battle sites at the edges of the empire." shown earlier in this lesson.)

7. MEDIUM Yam stations were about 25 miles apart. How many stations would a messenger pass on a 1,500-mile road (count the end stations)? If each station kept 50 horses, how many horses served the road?
8. MEDIUM Put in order: Kublai proclaims the Yuan dynasty; Fall of Zhongdu; Sack of Baghdad; Death of Chinggis Khan; Battle of Mohi; Song conquest completed; Kurultai on the Onon.
9. HARD A message must go 2,400 miles from Karakorum to the Volga. An urgent relay averages 200 miles a day; an ordinary courier on one horse averages 40 miles a day. How many days does each take, and how many days does the relay save?
10. HARD Give three examples of places where Mongol conquest slowed or failed, and explain how geography helps account for each.
11. HARD Who bore the cost of the Yam, and why does that matter when we judge the system?
12. CHALLENGE Write a paragraph (6–8 sentences) weighing the Mongol Empire by the standards of its own time: what did it destroy and what did it build? Use at least four specific examples.

COMMON MISTAKES

- Saying Chinggis Khan himself ruled the whole empire at its height. He died in 1227; the empire reached its greatest extent under his sons and grandsons, especially by about 1279.
- Calling the Mongol Empire the largest empire ever. It was the largest *contiguous* land empire; the British Empire of the early 1900s was larger in total but spread across oceans.
- Treating the Yam as a mail service for ordinary people. It served the khan's government, officials and approved envoys, and local people were forced to support it.

Make it a game · Paiza Pass. Make five cardboard paizas, each with a city name (Karakorum, Khanbaliq, Samarkand, Baghdad, Kiev). Players stand in a line as Yam stations. The first player draws a question card about the lesson, answers it and passes the paiza on. A wrong answer means the "horse is lame": the paiza goes back one station. Time how long it takes to carry each paiza down the line, and try to beat your record.

Scripture. "And he changeth the times and the seasons: he removeth kings, and setteth up kings: he giveth wisdom unto the wise, and knowledge to them that know understanding:" (Daniel 2:21, KJV)

No empire seemed more unstoppable than the Mongols in 1241, yet less than a century after Kublai's death the Yuan had fallen. Daniel spoke these words in Babylon, in the service of another conqueror, Nebuchadnezzar, who also learned that kingdoms rise and fall under God.

Practice answers

1. In 1206, at a kurultai, near the source of the Onon River.
2. To break the old tribal loyalties that had kept the steppe divided, so that men's loyalty ran to their commanders and to the khan instead of to their tribe.
3. A tablet of metal or wood inscribed with the khan's authority. It served as a passport, entitling the bearer to fresh horses, food, lodging and guides at Yam stations.
4. The Yuan dynasty (Mongolia and China), the Golden Horde (the Russian and western steppe), the Ilkhanate (Iran and Iraq) and the Chagatai Khanate (Central Asia).
5. The governor of Otrar, a Khwarazmian frontier town, seized a caravan of merchants under Mongol protection and had them killed, and the shah then killed or humiliated Chinggis's envoys. This led to the Mongol invasion of Khwarazm in 1219–1221, with the destruction of its great cities.
6. Europe: Legnica and Mohi (1241). Middle East: Ain Jalut (1260), where the Mamluks defeated the Mongols.
7. 1,500 ÷ 25 = 60 legs, so 61 stations. 61 × 50 = 3,050 horses.
8. Kurultai on the Onon (1206); Fall of Zhongdu (1215); Death of Chinggis Khan (1227); Battle of Mohi (1241); Sack of Baghdad (1258); Yuan dynasty proclaimed (1271); Song conquest completed (1279).
9. Relay: 2,400 ÷ 200 = 12 days. Single courier: 2,400 ÷ 40 = 60 days. The relay saves 48 days.
10. Any three: Ain Jalut (1260), where Syria's dry pastures could not support a large horse army for long and most of the Mongol host had withdrawn; Đại Việt (Vietnam), whose heat, jungle and rivers defeated three invasions; India, where the hot plains and the Delhi Sultanate's defense repelled raids; Japan (1274, 1281), where the sea and storms wrecked invasion fleets; possibly Hungary, where some historians argue pasture was too limited for the herds.
11. The households near each station had to supply horses, fodder, food and men as a compulsory duty. The system's speed was a real achievement, but it was paid for by forced labor and requisitions from ordinary people, so an honest account names both the benefit to the rulers and traders and the burden on the subject peoples.
12. A strong answer names destruction plainly (the massacres at cities that resisted such as Merv, Nishapur and Urgench in 1219–1221; the sack of Baghdad in 1258; the destruction of Kiev in 1240), notes that even by the hard standards of medieval war, which knew sieges and sacks, the Mongol killing of whole cities shocked contemporaries, and then names achievements: the unification of the steppe, the Yam, safer trade on the Silk Roads, the travels of Rubruck and Polo, the exchange of goods and ideas, and Rashid al-Din's world history. It reaches a balanced judgment supported by evidence rather than slogans.

4.5 The Great Wall

OBJECTIVES

- Explain why China's northern walls were built where the steppe meets farmland, roughly along the 15-inch (about 400 mm) rain line, and weigh this geographic explanation with its strengths and limits.
- Trace the history of the walls from the Warring States and Qin Shi Huang through the Ming, including the disaster at Tumu (1449) and the opening of Shanhai Pass (1644).
- Plot a wall and a rainfall line from coordinates, measure lengths along a parallel, and calculate signal and travel times along a fortified frontier.

Warm-up. Water a strip of paper towel across a tray from one end only, so one end is soaked and the other dry. Mark with a pencil the line where it stops being wet. That line is an "isohyet," a line of equal moisture. If the wet side were farmland and the dry side grassland, where would farmers build a fence to keep out herders' animals? Where would herders build one?

Video. Coming soon. Search The History Guy and Kings and Generals for the Great Wall of China, the Xiongnu wars, the Tumu Crisis (1449) and the Battle of Shanhai Pass (1644); Library of Congress for early maps and photographs of the Great Wall; RealLifeLore (candidate, needs vetting) for the geography of China's farming and pastoral regions.

KEY TERMS

isohyet
A line on a map joining places that receive the same amount of rain or snow in a year.

15-inch rain line
The isohyet of about 15 inches (about 380–400 mm) a year, roughly the dry limit of dependable rain-fed farming in northern China; the Great Wall runs close to it for much of its length.

rammed earth
A building method in which damp earth is pounded hard in layers between wooden boards; most early Chinese walls were built this way.

Ordos
The grassland and desert inside the great northward loop of the Yellow River, long fought over by Chinese dynasties and steppe peoples.

Hexi (Gansu) Corridor
A narrow strip of oases between the Qilian Mountains and the Gobi Desert that connected China with Central Asia; Han and Ming walls guarded it.

beacon tower

A watchtower from which smoke by day or fire by night signaled the approach of raiders to the next tower and to the garrisons behind.

CORE IDEAS

The story. In the summer of 1449 the Oirat Mongols, led by a chief named Esen, raided China's northern frontier. The young Zhengtong Emperor of the Ming dynasty, twenty-two years old and urged on by his favorite, the eunuch Wang Zhen, decided to lead a huge army against them in person, an army said to number in the hundreds of thousands. The expedition was badly planned and badly supplied. Marching through the passes northwest of Beijing, it ran short of food, turned back, and in early September camped at a post called Tumu, on high ground with no water. The Oirat cavalry surrounded it. Thirsty soldiers broke ranks to reach a river, the Mongols charged, and the army was destroyed. Wang Zhen was killed, many high officials died, and the Son of Heaven himself was taken prisoner by the nomads. He was released a year later, but the shock changed Ming policy for good. The Ming gave up trying to beat the steppe on its own ground and turned instead to building walls, and over the next century and a half they built most of the brick and stone Great Wall that visitors see today.

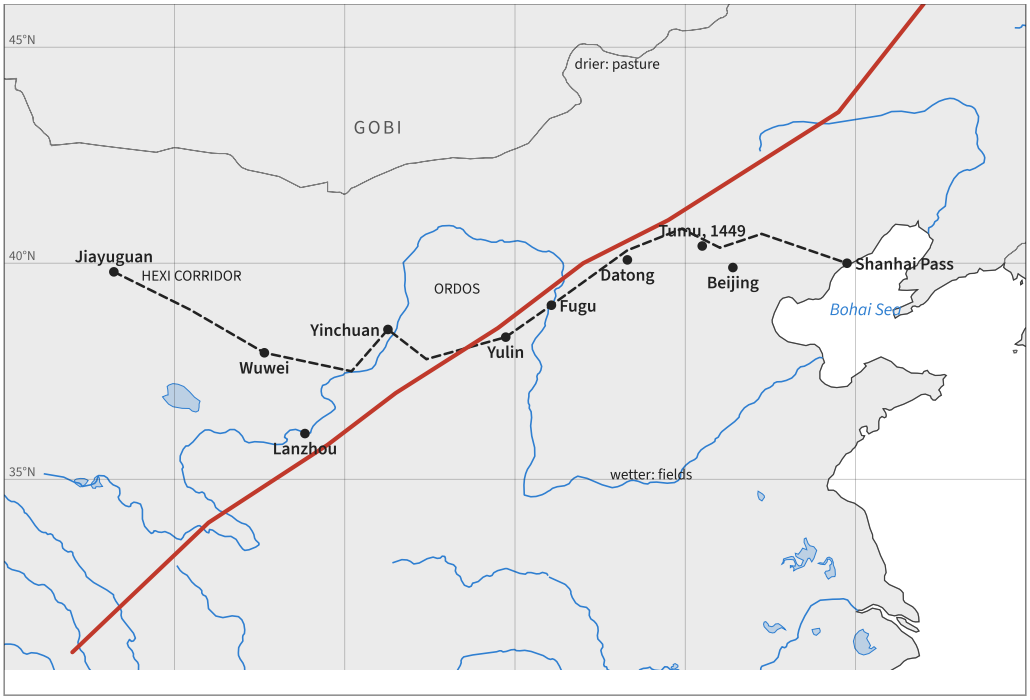
On the map. There is no single "Great Wall." China's 2012 national survey counted more than 13,000 miles (21,196 km) of walls, trenches and natural barriers built by many dynasties over two thousand years, and the Ming walls alone measure about 5,500 miles (8,850 km), counting branches and double lines. The best-known Ming line runs from Jiayuguan, a fortress in the Hexi Corridor of Gansu at about 98° E, to Shanhai Pass on the Bohai Sea at about 120° E, where the wall runs into the water at the "Old Dragon's Head." Between them it crosses the Yellow River twice, skirts the Ordos, and climbs the steep Yan Mountains north of Beijing, where its famous sections at Badaling and Mutianyu guard the passes to the capital. Now lay a rainfall map over it. South and east of the wall, most places receive more than about 15 inches (about 380–400 mm) of rain a year, enough for dependable crops of millet and wheat without irrigation. North and west of it, the rain falls below that line and the land becomes steppe and then the Gobi Desert, fit for herds, not fields. The historian Ray Huang pointed out that for much of its length the Great Wall follows the 15-inch rain line. The wall stands where the farmland ends and the grassland begins.

How they built it. Walls in northern China are older than the empire. In the Warring States period, before 221 BC, the northern kingdoms of Qin, Zhao and Yan built walls of rammed earth against the horse peoples and against each other. When Qin Shi Huang united China in 221 BC, he sent his general Meng Tian north. According to the Han historian Sima Qian, Meng Tian led 300,000 men, drove the Xiongnu out of the Ordos and joined the old walls into a line he described as more than 10,000 li long. The labor was forced and brutal, and Chinese legend has never forgotten it: in the tale of Lady Meng Jiang, a wife travels north with winter clothes for her husband, finds that he has died on the wall, and weeps until a stretch of it collapses. The Han dynasty fought the Xiongnu for generations and pushed walls and watchtowers far west along the Hexi Corridor toward Dunhuang to protect the road to Central Asia. Later dynasties built or neglected walls according to who they were: the Tang, who ruled much of the steppe, built little, while the Mongol Yuan and the Manchu Qing, who

came from beyond the wall, had no need of one. The Ming built the most and built best, with fired brick and cut stone near the capital. After 1568 the general Qi Jiguang lined the walls near Beijing with hundreds of brick watchtowers where soldiers could live, store weapons and signal by smoke and fire.

The big idea. A wall is a border made visible, and the Great Wall marks one of the deepest borders on earth: the line between the steppe and the sown. The historian Owen Lattimore, in *Inner Asian Frontiers of China* (1940), argued that this frontier was really a zone rather than a line. Chinese farmers who moved north of the rain line tended to become herders, and nomads who settled south of it tended to become farmers or rulers of farmers. The wall tried to fix in stone a boundary that nature drew in grass and rainfall. Did it work? Against small raids, often yes: walls slowed horsemen, beacon towers gave warning, garrisons could gather, and gates channeled trade into markets where Chinese tea and silk were traded for steppe horses. Against a great army or a determined people, it could not hold by itself. The geographic explanation is strong, but it is not the whole story. Some walls ran far into the steppe and others well inside farmland, depending on the politics and wars of each dynasty, and the rain line itself shifts from wet years to dry ones.

Technology overcoming geography. The wall's end came through a gate, not a breach. In April 1644 a Chinese rebel army under Li Zicheng took Beijing, and the last Ming emperor hanged himself on a hill behind the palace. The Ming general Wu Sangui, holding Shanhai Pass against the Manchus, chose to ally with the Manchu prince Dorgon against the rebels and opened the gate. Their combined army defeated Li Zicheng beside the pass in May, and the Manchus entered Beijing in June and founded the Qing dynasty, which ruled both sides of the wall. No wall is stronger than the loyalty of the men who keep its gates. Later, technology made the barrier irrelevant. In 1909 the Beijing–Zhangjiakou railway, the first railway designed and built by Chinese engineers under Zhan Tianyou, climbed through the wall at Badaling using a switchback, a zigzag track, to beat the grade. Since 2019 a high-speed line tunnels beneath the same mountains, with a station deep underground at Badaling. As of 2026 the wall is one of the most visited monuments on earth, and, contrary to a popular myth, it cannot be seen with the naked eye from the Moon.



The Ming Great Wall (simplified) and the approximate 15-inch (about 400 mm) rain line. For much of its length the wall stands near the dry edge of dependable farming.

PICTURE STUDY

Map of China (Chinae, olim Sinarum regionis, nova descriptio), Luís Jorge de Barbuda, published by Abraham Ortelius, 1584 · Hand-colored copperplate engraving · Published in Ortelius's atlas *Theatrum Orbis Terrarum* (Antwerp); copies in many libraries, including the Library of Congress

Luís Jorge de Barbuda was a Portuguese mapmaker who gathered information from Portuguese traders and from Chinese sources. In 1584 the great Flemish atlas maker Abraham Ortelius printed his map of China in the *Theatrum Orbis Terrarum*, the first modern

atlas. It was the first map printed in Europe devoted to China alone, and one of the first to show the Great Wall.

The map is drawn with west at the top, so China's northern frontier, and the wall along it, runs down the right-hand side. Europeans had heard rumors of the wall for centuries; here it appears as a real line on a real map, built where the mountains and the steppe begin.

Look closely

- Turn the map so north is at the top. Where does the wall now run?
- Look at how the wall is drawn between mountains. What does that suggest about how the mapmaker understood it?
- Find the great rivers. How does the mapmaker show that China's heartland is a land of rivers and towns?
- Look at the ships and the coast. What does that tell you about where the Portuguese got their information?

Talk about it

1. Why would a European mapmaker in 1584 think the wall important enough to show?
2. What does the map get right about the wall as a border between farmland and steppe? What does it get wrong?
3. How would a Mongol herder have drawn this border differently?

PROJECT: THE RAIN LINE OVERLAY

You will plot the Ming Great Wall and the 15-inch rain line from real coordinates on two separate sheets, then lay one over the other and test the claim that the wall follows the rain line.

You will need

- A printed outline map of China with latitude and longitude lines (any free classroom outline map; enlarge it to at least letter size)
- Two sheets of tracing paper or baking parchment
- A ruler, a sharp pencil, a red pencil and a blue pencil
- Tape and a calculator
- Optional: an atlas map of China's rainfall or vegetation

Steps

1. Tape the outline map to the table and check that you can read latitude and longitude every 5°.
2. Sheet 1, the wall (red): tape the first tracing sheet over the map and plot these points of a simplified Ming line, joining them in order: Jiayuguan (39.8° N, 98.2° E); Zhangye (38.9° N, 100.5° E); Wuwei (37.9° N, 102.6° E); near Zhongwei (37.5° N, 105.2° E); near Yinchuan (38.5° N, 106.3° E); Yanchi (37.8° N, 107.4° E); Yulin (38.3° N, 109.7°

E); Fugu (39.0° N, 111.1° E); north of Datong (40.3° N, 113.3° E); Zhangjiakou (40.8° N, 114.9° E); Badaling (40.4° N, 116.0° E); Jinshanling (40.7° N, 117.2° E); Shanhai Pass (40.0° N, 119.8° E). Mark Beijing (39.9° N, 116.4° E) as a star.

3. Sheet 2, the rain line (blue, dashed): on the second tracing sheet, plot this approximate 15-inch (about 400 mm) rain line: 46.0° N, 122.0° E; 43.5° N, 119.5° E; 42.0° N, 116.5° E; 41.0° N, 114.5° E; 40.0° N, 112.0° E; 38.5° N, 109.5° E; 37.0° N, 106.5° E; 35.8° N, 104.5° E; 34.0° N, 101.0° E; 31.0° N, 97.0° E. Write “wetter: fields” on the southeast side and “drier: pasture” on the northwest side.
4. Lay both sheets over the base map. Where is the wall within about 1° (about 70 miles) of the rain line? Where does it run well away from it? Shade the close stretches in purple.
5. Measure with your ruler and the map’s scale: about what fraction of the wall’s length lies close to the rain line?
6. Compute the straight-line length from Jiayuguan to Shanhai Pass along about 40° N (see Worked Example 1) and compare it with your plotted wall length.
7. Write a paragraph: Does the wall follow the rain line? Where does it depart from it, and what might explain the departures (the Hexi Corridor, the Ordos, the defense of Beijing)?

Tips

- The rain line here is approximate and shifts from year to year; treat it as a band about 100 miles wide, not a sharp edge.
- In the far west the wall runs through land much drier than 15 inches. That is not a failure of the theory: there it guards the oasis road of the Hexi Corridor, not a farming border.

Check your work

- Both lines are plotted accurately from the coordinates and clearly labeled.
- I measured where the wall lies near the rain line and estimated what fraction of its length that is.
- My paragraph weighs the rain-line explanation with at least two departures and their reasons.

MAP NOTEBOOK

1. Draw a cross-section of a Ming wall near Beijing: foundation of stone, rammed-earth core, brick facing, walkway, crenellations and a two-story watchtower. Label the parts.
2. On your Grass Road strip map from Lesson 4.3, draw the Great Wall along the southern edge of the steppe near the eastern end.
3. Draw two small sketches side by side: Tumu, 1449 (an army without water) and Shanhai Pass, 1644 (an open gate). Under each, write one sentence on what it teaches about walls.

From history. The geographer Hu Huanyong drew another famous line across China in 1935. Running from Heihe on the Amur River in the far northeast to Tengchong near the Burmese border in the southwest, it divided China into a larger, drier northwest (about 64% of the land) and a smaller, wetter southeast (about 36%). He found that about 96% of China's people lived on the southeastern side. The "Hu line" and the 15-inch rain line tell the same story: China's people, fields and cities crowd into the wetter southeast, while the drier northwest is wide, high and thinly settled.

WORKED EXAMPLES

Example 1. Jiayuguan (39.8° N, 98.2° E) and Shanhai Pass (40.0° N, 119.8° E) lie at nearly the same latitude. Estimate the straight-line distance between them along 40° N, and compare it with the Ming wall's total length of about 5,500 miles (8,850 km). (cos 40° ≈ 0.766.)

(Use the map or drawing "The two ends of the Ming wall lie close to 40° N." shown earlier in this lesson.)

1. Longitude difference: 119.8° − 98.2° = 21.6°.
2. One degree of longitude at 40° N: 69.2 × 0.766 ≈ 53.0 miles (111.3 × 0.766 ≈ 85.3 km).
3. Distance: 21.6 × 53.0 ≈ 1,145 miles; 21.6 × 85.3 ≈ 1,840 km.
4. Ratio: 5,500 ÷ 1,145 ≈ 4.8.

Answer: About 1,145 miles (about 1,840 km) end to end. The Ming walls total nearly five times that, because they bend with the mountains, run in double and triple lines near Beijing, and include many branches.

Example 2. Convert 15 inches to millimeters. Then classify these places as farmland (at or above the rain line) or pasture/desert (below it), using approximate yearly rainfall: Beijing about 570 mm; Lanzhou about 320 mm; Yinchuan about 200 mm. (1 inch = 25.4 mm.)

1. 15 × 25.4 = 381 mm. Geographers often round this to the 400 mm line.
2. Beijing: 570 mm ≈ 22.4 inches, above the line: dependable rain-fed farming.
3. Lanzhou: 320 mm ≈ 12.6 inches, below the line: farming needs irrigation from the Yellow River.
4. Yinchuan: 200 mm ≈ 7.9 inches, well below the line: steppe or desert, farmed only with irrigation.

Answer: 15 in = 381 mm. Beijing (about 22 in) lies on the farming side; Lanzhou (about 13 in) and Yinchuan (about 8 in) lie on the dry side, where fields depend on river water.

Example 3. Suppose beacon towers stand every 2.5 miles along a 300-mile stretch of wall, and each tower takes 3 minutes to see the signal and light its own. How long does a warning take to travel the 300 miles? How long would a rider take at 40 miles a day, or at 200 miles a day by relay?

1. Number of tower-to-tower jumps: 300 ÷ 2.5 = 120.
2. Beacon time: 120 × 3 = 360 minutes = 6 hours.
3. Single rider: 300 ÷ 40 = 7.5 days.
4. Relay riders: 300 ÷ 200 = 1.5 days (36 hours).

Answer: About 6 hours by beacon, versus 7.5 days for a single rider or 1.5 days by relay. The towers carried only a simple message ("enemy coming") but carried it six times faster than the fastest horses.

PRACTICE

1. EASY What is an isohyet? What is the 15-inch rain line in millimeters?
2. EASY What happened at Tumu in 1449, and how did it change Ming policy?
3. EASY Name the fortresses at the western and eastern ends of the best-known Ming wall and the body of water at the eastern end.
4. EASY True or false: the Great Wall can be seen with the naked eye from the Moon. Explain.
5. MEDIUM Use the map. Between which two points does the wall cross the Yellow River near the Ordos, and why was the Ordos contested?
   (Use the map or drawing "Follow the wall around the Ordos." shown earlier in this lesson.)
6. MEDIUM Sima Qian said Meng Tian's walls ran more than 10,000 li. If a Qin li was about 0.415 km, how long is 10,000 li in kilometers and miles? (1 mile ≈ 1.609 km.)
7. MEDIUM Put in order: Qin Shi Huang unites China; Zhan Tianyou's railway reaches Badaling; Tumu; Battle of Shanhai Pass; Qi Jiguang begins building brick watchtowers; Meng Tian drives the Xiongnu from the Ordos.
8. MEDIUM Why did the Mongol Yuan and the Manchu Qing dynasties build little or no wall?
9. HARD Beacon towers stand every 3 miles along 450 miles of frontier, and each tower needs 4 minutes to relay the signal. How long does the warning take? How many times faster is it than relay riders covering 180 miles a day?
10. HARD In the far west, near Jiayuguan, the land gets far less than 15 inches of rain, yet the Ming built a wall there. Does this disprove the rain-line explanation? Explain.
11. HARD Explain how the events of 1644 at Shanhai Pass show both the strength and the weakness of walls as borders.
12. CHALLENGE Write a paragraph (6–8 sentences): "The Great Wall was built where nature had already drawn a border." Weigh this claim, using the rain line, Lattimore's idea of a frontier zone, and at least two historical examples.

COMMON MISTAKES

- Thinking the Great Wall is one continuous wall built at one time. It is many walls built by many dynasties over two thousand years; most of the stone and brick wall visitors see is Ming work of the 1500s.
- Thinking the wall was meant to stop every invader completely. Its main work was to slow raids, give warning, protect passes and channel trade; against a great army or a betrayed gate it could not hold by itself.
- Treating the 15-inch rain line as a sharp, fixed edge. Rainfall changes from year to year, so it is really a band, and the wall departs from it where politics or strategy required.

Make it a game · Light the Beacons. Players stand in a long line, each a beacon tower, holding a flashlight or a colored card. The first player is given a secret warning card ("raiders from the north, 500 horse"). Only a simple signal may pass down the line: one flash for "danger," two for "large army." Time how long the signal takes to reach the last tower, then compare with how long it takes to walk the full message down the line. Discuss: what is gained in speed, and what is lost in detail?

Scripture. "Except the LORD build the house, they labour in vain that build it: except the LORD keep the city, the watchman waketh but in vain." (Psalm 127:1, KJV)

The Ming built thousands of miles of wall and manned it with watchmen, yet in 1644 a single opened gate let in a new dynasty. Walls and watchmen are good and needful, but the psalmist reminds us where true security lies.

Practice answers

1. A map line joining places with the same yearly rainfall. 15 inches ≈ 381 mm, usually rounded to the 400 mm line.
2. The Oirat Mongols under Esen destroyed a large Ming army camped without water at Tumu and captured the Zhengtong Emperor. Afterward the Ming turned from offensive campaigns on the steppe to building walls, producing most of the brick and stone Great Wall seen today.
3. Jiayuguan in the west; Shanhai Pass in the east, where the wall meets the Bohai Sea.
4. False. The wall is only a few yards wide and similar in color to the land around it; from the Moon, about 239,000 miles away, no human structure can be picked out by eye.
5. In the west, just east of Yinchuan, between Yinchuan and Yanchi; in the east, near Fugu, between Fugu and Datong. The Ordos is grassland and desert inside the Yellow River's loop, close to China's farmland but good for herds, so both Chinese dynasties and steppe peoples wanted it.
6. 10,000 × 0.415 = 4,150 km; 4,150 ÷ 1.609 ≈ 2,580 miles. ("Ten thousand li" was also a traditional way of saying "very long.")
7. Qin Shi Huang unites China (221 BC); Meng Tian drives the Xiongnu from the Ordos (soon after 221 BC); Tumu (1449); Qi Jiguang's watchtowers (from 1568); Battle of Shanhai Pass (1644); railway at Badaling (1909).

8. Both came from beyond the wall and ruled both the farmland and the steppe peoples, so the wall no longer divided their realm from an enemy; the frontier it guarded lay inside their empire.
9. 450 ÷ 3 = 150 jumps × 4 min = 600 min = 10 hours. Riders: 450 ÷ 180 = 2.5 days = 60 hours. The beacons are 60 ÷ 10 = 6 times faster.
10. Not entirely. In the west the wall guarded the Hexi Corridor, a narrow line of irrigated oases fed by mountain streams, which was the road to Central Asia. There the wall protected a strategic corridor rather than marking the edge of rain-fed farming, so the rain-line idea explains the wall's eastern and central course better than its western end. Good answers note that geographic explanations have limits.
11. Strength: the fortified pass had held the Manchus out, so they could not easily enter China while it was defended. Weakness: when Beijing fell to Li Zicheng's rebels, the Ming general Wu Sangui allied with the Manchus and opened the gate, so the wall failed through politics and loyalty, not because the stones gave way.
12. A strong answer explains that the wall follows the 15-inch rain line for much of its length, so it marks the edge of dependable rain-fed farming (Ray Huang's observation). It uses Lattimore to argue the frontier was a zone, where farmers north of the line became herders and nomads south of it became farmers or rulers. It notes departures: the Hexi Corridor wall guarding oases in very dry land, the Ming lines near Beijing placed by the defense of the capital, and dynasties that pushed walls into the steppe or built none. It may cite Tumu (1449) and Shanhai Pass (1644) to show that politics and leadership mattered as much as rainfall, and it reaches a balanced conclusion.

Unit 4 test

Answer each question. Show your work for every calculation and give units (miles and kilometers where asked). Use complete sentences for explanations. Use 1° of latitude ≈ 69 miles (111 km), 1 inch = 25.4 mm and 1 sq mi ≈ 2.59 km². The test is worth 100 points.

1. (6 pts) Explain why the Sahara receives less than about 4 inches (100 mm) of rain a year over most of its area. Use the terms “Tropic of Cancer” and “sinking air.”
2. (6 pts) Taghaza (about 23.6° N) and Timbuktu (about 16.8° N) lie close to the same meridian. Estimate the distance in miles and kilometers, and the days needed by a caravan making 20 miles a day.
3. (8 pts) Why was salt worth so much in the lands south of the Sahara? Name two other things that crossed the desert besides salt and gold, and name one great wrong that traveled the same roads.
4. (6 pts) How did the Portuguese fortress at Elmina (1482) change the importance of the Sahara as a trade route?
5. (6 pts) Mecca lies at about 21.4° N and Medina at about 24.5° N, almost on the same meridian. Estimate the distance between them in miles and kilometers. What happened on this road in 622?
6. (8 pts) Explain how the Arabian Desert served first as a protective moat for Arabia and then as a base for Arab armies. Give one example of each.
7. (6 pts) A falaj carries water 2 miles and drops 18 feet. Find its slope in feet per mile and as a percent. (1 mile = 5,280 ft.)
8. (8 pts) Herodotus says the Scythians would not fight Darius but retreated, filling wells and destroying pasture. Explain why this strategy worked for nomads and why a farming kingdom could not easily use it.
9. (6 pts) Budapest (19.0° E) and Karakorum (102.8° E) both lie near 47.3° N. Using 1° of longitude ≈ 46.9 miles (75.5 km) at that latitude, find the distance along the parallel.
10. (8 pts) Trace the chain of events from the Huns’ appearance north of the Black Sea in the 370s to the Battle of Adrianople in 378. What does it show about the steppe?
11. (6 pts) Karakorum to Khanbaliq (Beijing) is about 850 miles. With Yam stations every 25 miles and an urgent relay rider covering 250 miles a day, how many legs and how many days? How many days for a caravan at 20 miles a day?
12. (8 pts) The Mongol Empire was the largest contiguous land empire in history. Explain what “contiguous” means, give its approximate area in square miles and square kilometers, and name two places where geography helped stop its expansion.
13. (8 pts) Write a balanced judgment (4–6 sentences) of the Mongol conquests, naming at least two crimes and two achievements.
14. (10 pts) The Great Wall runs from Jiayuguan (98.2° E) to Shanhai Pass (119.8° E) near 40° N, where 1° of longitude ≈ 53 miles (85 km). (a) Find the end-to-end distance. (b) Convert 15 inches of rain to millimeters. (c) Explain the claim that the wall follows the 15-inch rain line and give one place where it does not, with the reason. (d) What happened at Shanhai Pass in 1644, and what does it teach about walls?

UNIT PROJECT: THE STEPPE AND THE EMPIRES THAT CROSSED IT

Make a large hand-drawn map of the dry belts of the Old World, from the Atlantic edge of the Sahara to the Pacific edge of the steppe. Shade the desert belt (Sahara and Arabia) and the steppe belt from Hungary to Manchuria in different colors, mark the Tropic of Cancer, and label at least twelve places from the unit (for example Sijilmasa, Taghaza, Timbuktu, Mecca, Medina, Budapest, the Dzungarian Gate, Karakorum, Khanbaliq, Samarkand, Jiayuguan and Shanhai Pass). Draw arrows for the caravans and the riders: the salt and gold road, the Arab conquests, the Huns, and the Mongol campaigns, each with dates, and shade the four Mongol khanates.

Include your Rain Line Overlay from Lesson 4.5 and your Grass Road strip map from Lesson 4.3, and write a one-page essay answering the unit question: In deserts and steppes, why do borders fall where they do, and what technologies (the camel, the horse, the relay, gunpowder, the ship, the railway) changed them?

- **Accuracy**: Deserts, steppe, rain line, places and routes are placed correctly by latitude and longitude, with correct dates and labels.
- **Geographic reasoning**: The map and essay connect borders to rainfall, grass, water and distance, and weigh the rain-line and grass-limit explanations with their exceptions.
- **Honest history**: The essay gives real achievements their due and names real wrongs (slave caravans, conquests, massacres) plainly and fairly, judging people by the standards of their own time.
- **Craft and care**: The map is neat, clearly colored and keyed; the strip map and overlay are complete; the essay is clearly organized and correctly written.

Answer key

1. Air that rises near the equator spreads toward the tropics and sinks there. Sinking air warms and dries, so clouds and rain seldom form. The Tropic of Cancer runs through the middle of the Sahara, in this belt of sinking dry air.
2. 6.8° × 69 ≈ 469 miles; 6.8° × 111 ≈ 755 km. 469 ÷ 20 ≈ 23.5, about 24 days. (Allow about 485 miles and 24–25 days if the student includes the 2° longitude difference, about 126 miles east–west.)
3. People and animals in the hot savanna lose salt through sweat and need it daily, yet the region had few salt deposits; salt had to come two months across the desert, so it was scarce and costly. Other goods (any two): copper, cloth, horses, books or dates carried south. The trans-Saharan slave trade carried captives north across the desert for centuries.
4. Portuguese ships reached the gold-producing coast directly by sea, so gold (and later enslaved people) could leave West Africa by ship instead of by camel caravan. The sea route outflanked the desert and weakened the caravan towns and the North African middlemen.
5. 3.1° × 69 ≈ 214 miles; 3.1° × 111 ≈ 344 km. In 622 Muhammad left Mecca for the oasis of Yathrib (Medina), the Hijra, from which the Islamic calendar is counted.
6. Moat: great empires could not easily cross it; the Roman expedition of Aelius Gallus (26 BC) was ruined by heat, thirst and a bad guide, and Rome, Byzantium and Persia ruled only the edges through buffer kingdoms such as the Ghassanids and Lakhmids. Base: after the tribes

were united under the caliphs, camel-borne armies could cross the desert where imperial armies could not follow and strike Syria and Iraq, winning at the Yarmuk (636) and Qadisiyyah and toppling the Persian Empire by 651.

7. 18 ÷ 2 = 9 feet per mile. 18 ÷ 10,560 ≈ 0.0017, about 0.17%.
8. Nomads had no towns or fields to defend and carried their homes and herds with them, so they could retreat and still live, while the invader's army starved without wells and grass. A farming kingdom has fixed cities, fields and stored harvests; if it retreats, the enemy seizes or burns them, so it must stand and fight.
9. 83.8° × 46.9 ≈ 3,930 miles; 83.8° × 75.5 ≈ 6,330 km.
10. The Huns broke the Gothic peoples north of the Black Sea; in 376 tens of thousands of Goths asked to cross the Danube into the Roman Empire; mistreated by Roman officials, they rebelled and at Adrianople in 378 destroyed a Roman army and killed Emperor Valens. It shows that the steppe was a highway along which pressure at one end pushed peoples into the settled lands far away.
11. 850 ÷ 25 = 34 legs. 850 ÷ 250 = 3.4 days. 850 ÷ 20 = 42.5 days.
12. Contiguous means its lands touched in one unbroken block, unlike an overseas empire. About 9 million sq mi (about 23–24 million km²). Any two: Ain Jalut (1260), where dry Syrian pastures could not feed a large horse army; Đại Việt's jungles, heat and rivers; India's hot plains; Japan, protected by the sea (1274, 1281); possibly the limited pasture of the Hungarian plain.
13. A strong answer names crimes plainly, such as the massacres in Khwarazm (Merv, Nishapur, Urgench, 1219–1221), the sack of Baghdad (1258) or the destruction of Kiev (1240), and achievements such as the unification of the steppe, the Yam relay, safer Silk Road trade under the Pax Mongolica, the travels of Rubruck and Marco Polo, and the exchange of goods and ideas recorded in works like Rashid al-Din's history. It judges by the standards of the time, noting that even contemporaries used to war were shocked by the destruction of whole cities.
14. (a) 21.6° × 53 ≈ 1,145 miles; 21.6° × 85 ≈ 1,840 km. (b) 15 × 25.4 = 381 mm (about 400 mm). (c) South and east of the line there is enough rain for dependable rain-fed farming; north and west lie steppe and desert fit for herds, so the wall marks the edge between the sown and the steppe. Exception: in the far west it runs through very dry land to guard the irrigated oases of the Hexi Corridor, the road to Central Asia (or: lines near Beijing placed for the capital's defense). (d) After rebels took Beijing, Ming general Wu Sangui allied with the Manchus and opened the pass; the Manchus took Beijing and founded the Qing. A wall is only as strong as the loyalty of those who hold its gates.

UNIT 5

Seas and Islands

A river can be waded and a mountain pass can be marched, but a sea must be *crossed*, and only by people with ships, harbors, fair weather and the strength to hold the water long enough to make the trip. In this unit you will see how the sea has worked both as a wall and as a highway. For an island, the coastline is the border, and the strait in front of it is a moat. For a sea ringed by one power, as the Mediterranean was ringed by Rome, the water becomes the road that holds an empire together.

You will stand on the cliffs of Dover as the Spanish Armada sails up the Channel in 1588, and watch Napoleon's barges and Hitler's invasion plans come to nothing. You will follow Kublai Khan's fleets across the Korea Strait into the typhoon of 1281, then watch Commodore Perry's steamships end two centuries of Japanese seclusion. You will hear Cato drop his figs in the Roman Senate, sail with Rome's grain ships and with the apostle Paul, row a trireme at Salamis, and stand on the walls of Malta in 1565 and 1942.

The thread running through every lesson is a simple rule: **the sea protects only the side that commands it**. You will measure moats of 3, 33 and 200 km and see how their width shaped the history of Sicily, Britain and Japan. You will also see technology (the steamship, the airplane, radar and the tunnel) shrink the sea, and you will build an island-defense board game that brings all of it together.

BEFORE YOU BEGIN

- Can read latitude and longitude and use a map scale bar
- Can compute speed, time and distance and convert between kilometers, miles and nautical miles
- Knows the meaning of a natural border and of core and frontier (Unit 1)
- Has met the Mongol Empire and Kublai Khan's background on the steppe (Unit 4)

MASTERY CHECKLIST

- I can explain why an island's coastline is its border and why the sea is a moat only for the side that commands it.
- I can trace the Spanish Armada's campaign of 1588 and explain why it failed, and compare it with the invasions of 1066, 1688, 1803–1805 and 1940.
- I can tell the story of the Mongol invasions of Japan, the Tokugawa seclusion and Perry's opening of Japan, and measure the Korea Strait against the Strait of Dover.
- I can explain how Rome won command of the Mediterranean and why sea transport held the empire together.
- I can explain how mountains divided the Greeks into city-states while the Aegean connected them, and how sea power made and unmade Athens.
- I can explain why Sicily and Malta were fought over from ancient times to 1943, and compute distances and times on a map of the central Mediterranean.

OPTIONAL BOOKS AND RESOURCES

- **Perseus Digital Library (Tufts University)** (https://www.perseus.tufts.edu/hopper/): Free. English translations of Herodotus (Salamis, Book 8), Thucydides (Pericles's strategy and the Mytilene race, Books 2–3) and Plutarch's *Life of Cato the Elder* (the figs). A parent may choose the passages.
- **ORBIS: The Stanford Geospatial Network Model of the Roman World** (https://orbis.stanford.edu/): Free. Choose two Roman cities, a season and a way of travel, and the model estimates the time and cost of the trip by road, river and sea. Excellent for Lesson 5.3.
- **Project Gutenberg** (https://www.gutenberg.org/): Free. Search for Richard Hakluyt's *Voyages* for English accounts of 1588, and for Plutarch's *Lives* (Themistocles, Pericles, Pompey).

5.1 Britain: The Moat

OBJECTIVES

- Explain how the English Channel and the North Sea made the coast England's real border, and why an island kingdom built a navy instead of a large standing army.
- Trace the campaign of the Spanish Armada of 1588 on a map and explain how wind, tide, harbors and the Dutch coast shaped its failure.
- Compare the invasions that never came (1588, 1803–1805, 1940) with the two that succeeded (1066, 1688) and state the rule that connects them: the sea is a moat only for the side that commands it.

Warm-up. Fill a baking dish with water and set a brick, book or block in the middle as a "castle." Set a second block at the edge of the dish as the "mainland." Now try to move five dry cereal pieces (the army) from the mainland to the castle using only a spoon (the ship), while a partner blows across the water with a straw (the wind). How many trips did it take? How many "soldiers" ended up wet? Talk for two minutes: what would make the crossing easier, and what would make it harder?

Watch. *Ten Minute English and British History #18 - The Late Tudors: Elizabeth and the Spanish Armada* (History Matters, 10:00). https://www.youtube.com/watch?v=87kZSY9On7k
After the story: watch why Philip II of Spain sent the Armada against Elizabeth I, and listen for how the Protestant–Catholic quarrel and English help for the Dutch led to the attack.
Note: Captions were not available to check; preview it first. The first part covers Edward VI and Mary I and their church changes, including Mary's persecution of Protestants, before it reaches the Armada.

Backup video. *18th August 1940: "The Hardest Day" of the Battle of Britain during the Second World War* (HistoryPod, 2:35). https://www.youtube.com/watch?v=Jhgb1rWdfIg
As review: watch this short account of "The Hardest Day" in 1940, and look for why Hitler had to beat the RAF before Operation Sea Lion could ever cross the Channel. Note: Captions were not available to check; preview it first. It describes air combat and the loss of pilots.

KEY TERMS

moat
A ditch of water around a castle; used here for a stretch of sea that protects an island country from invasion.

command of the sea

Control of a stretch of water strong enough that your ships can cross it and your enemy's cannot, at least for the time that matters.

Strait of Dover
The narrowest part of the English Channel, about 21 miles (33 km) wide between the South Foreland near Dover and Cap Gris-Nez in France.

Armada
Spanish for "armed fleet"; in English, usually the great Spanish fleet Philip II sent against England in 1588.

Old Style and New Style
Dates in the Julian calendar (used in England until 1752) and the Gregorian calendar (used in Spain from 1582). In 1588 Old Style dates were 10 days behind New Style.

fireship
An old ship filled with pitch, tar and powder, set alight and sent drifting with wind and tide into an enemy fleet at anchor.

CORE IDEAS

The story. On a summer afternoon in 1588, watchers on the Cornish coast near the Lizard saw sails on the southwest horizon: the Spanish Armada, about 130 ships carrying roughly 30,000 soldiers and sailors. King Philip II of Spain had many reasons to strike at England. Queen Elizabeth I was helping the Protestant Dutch who were in revolt against him; English captains such as Francis Drake had raided Spanish treasure ships and ports; and in February 1587 Elizabeth had put to death her Catholic cousin, Mary, Queen of Scots. Philip, a devout Catholic, saw the war as both a political and a religious duty. Beacons were lit on hilltop after hilltop, carrying the alarm toward London faster than a horse could ride. The Armada had come to do what no enemy had done since 1066: carry an army across the water and conquer England.

How it worked. Philip's plan was a hinge, and the hinge was geography. The Armada itself was not meant to conquer England alone. Its commander, the Duke of Medina Sidonia, was to sail up the Channel, join hands with the Duke of Parma, whose veteran army stood in Flanders, and shepherd Parma's troop barges across the narrow sea to Kent. But the Spanish held no deep-water harbor on that coast where big ships could anchor safely and load an army, and the shallow Flemish waters were watched by nimble Dutch rebel ships that could bottle Parma's barges inside their canals. The Armada sailed slowly up the Channel in a defensive crescent while the English fleet under Lord Howard of Effingham, with Drake, Hawkins and Frobisher, harried it from windward with long-range guns. On 6 August (New Style) Medina Sidonia anchored in the open roads off Calais. That night of 7–8 August the English sent eight fireships drifting down on wind and tide. The Spanish cut their cables and scattered, and the next day the English fought them hard off Gravelines. Then a southwesterly wind pushed the Armada into the North Sea. Unable to turn back through the Channel, it sailed north around Scotland and down the west coast of Ireland in autumn storms. Historians estimate that around a third of the ships never came home, and thousands of men drowned, died of sickness or were killed after reaching the Irish shore. Afterward

England’s Dutch allies struck a medal with a Latin motto meaning that God blew and they were scattered.

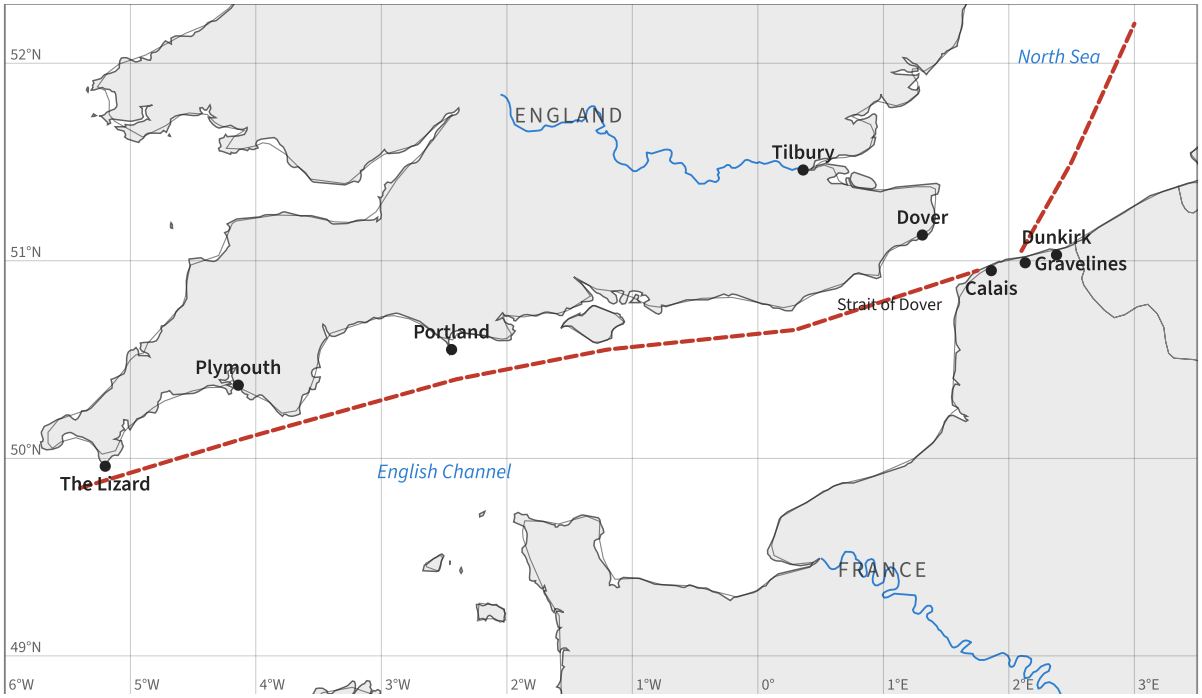
The big idea. For an island, the coastline *is* the border, and the sea in front of it works like a moat. A land border can be crossed by any army that can march; a sea border can be crossed only by an army that has ships, a harbor to load them in, fair weather, and above all **command of the sea** long enough to make the trip. This is why England, and after 1707 Great Britain, spent its money on a navy while the great powers of the Continent spent theirs on huge standing armies. It is also why Britain’s rulers watched one stretch of foreign coast more closely than any other: the Low Countries, with their harbors at the mouth of the Scheldt and the Rhine facing the Thames. Whoever held Antwerp and the Flemish coast held the best launching place for an invasion. England fought to keep that coast out of the hands of the strongest Continental power in 1588, again against Louis XIV and Napoleon, and again in 1914, when Germany invaded neutral Belgium.

The invasions that never came. From 1803 to 1805 Napoleon gathered an army of well over 100,000 men in camps around Boulogne and built a flotilla of flat-bottomed barges to carry it. He is reported to have said that if he could be master of the Channel for a few hours, he would be master of the world. He never got them. In late August 1805 he marched the army east against Austria, and on 21 October 1805 Nelson’s fleet destroyed the French and Spanish fleets at Trafalgar. In 1940 Hitler’s armies stood on the same coast after the fall of France. His plan, Operation Sea Lion, needed the Luftwaffe to drive the Royal Air Force from the sky so that German barges could cross under the guns of a Royal Navy that was still far stronger at sea. The Battle of Britain was fought over that question, and on 17 September 1940 Sea Lion was postponed, never to be launched. Yet the moat has failed twice. In 1066 William of Normandy landed unopposed at Pevensey because King Harold’s fleet had broken up and his army was far to the north. In 1688 William of Orange, invited by leading English Protestants, landed at Torbay on 5 November when an easterly wind blew his fleet down the Channel and pinned King James II’s fleet in the Thames estuary. The rule is plain: the sea protects only the side that commands it.

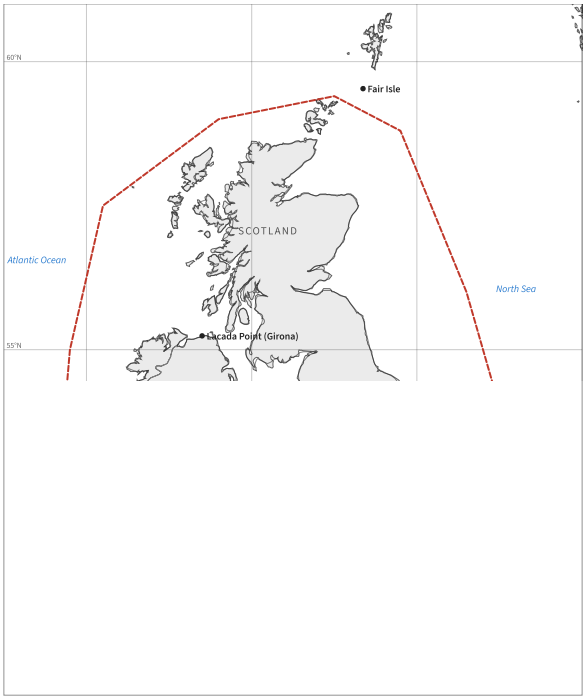
On the map. The English Channel is about 350 miles (560 km) long, wide in the west and narrowing to about 21 miles (33 km) at the Strait of Dover. The prevailing winds blow from the southwest, which helped the Armada sail up the Channel but made it nearly impossible to beat back down it. Strong tides race through the strait twice a day, and the eastern coast from Calais to the Scheldt is low, sandy and shallow, full of banks that wrecked deep-draft ships. Spain’s great ships could reach England’s doorstep, but there was no Spanish harbor at the door.

Technology overcoming geography. Each new machine has narrowed the moat. On 25 July 1909 Louis Blériot flew a monoplane from near Calais to Dover in about 37 minutes, and newspapers warned that England was no longer an island. In 1940 the moat still held partly because of another machine: the Chain Home radar stations along the coast gave RAF fighters warning of incoming raids. In 1994 the Channel Tunnel opened, about 31 miles (50 km) long, with about 23 miles (38 km) of it under the sea. Today trains carry passengers

under the water that turned back the Armada, but a nation's border on an island is still, as it was for Elizabeth, the coast.



The Armada's route up the Channel, July–August 1588 (New Style dates).



The long way home: the Armada's route around Scotland and Ireland, August–October 1588.

PICTURE STUDY

The Armada Portrait of Elizabeth I, Unknown English artist (once attributed to George Gower), about 1588 · Oil on panel · Woburn Abbey, Bedfordshire, England (Duke of Bedford collection); other versions are at Royal Museums Greenwich and the National Portrait Gallery, London

This portrait was painted soon after the defeat of the Armada to celebrate the victory and the queen. It is a state portrait, which means it is a picture of an idea as much as of a person: every jewel, window and object carries a message. Three versions survive; the Woburn Abbey version has been in the Russell family (the Dukes of Bedford) for centuries.

Behind the queen, two windows tell the story of 1588 like a two-panel comic strip. On one side the English fleet and its fireships go into action on a bright sea; on the other, Spanish ships are driven onto a rocky shore under dark storm clouds. The queen sits calmly between them, her hand on the world.

Look closely

- Find the two windows. Which shows the battle, and which shows the shipwrecks? How does the painter make one hopeful and one dark?
- Look at the queen’s right hand. What is under it, and where on that object are her fingers resting?
- Find the crown beside her. Why might the painter have placed the crown and the globe so close together?
- Look at the pearls, bows and jewels. What do they tell a viewer in 1588 about England’s wealth and confidence?

Talk about it

1. What message about England’s place in the world does this painting send? What part did the sea play in that message?
2. The painting shows the storms as part of England’s victory. How did the English of 1588 understand the wind and weather, and how does that compare with the medal’s motto?
3. If you were Philip II and saw this portrait, how would you read it?

PROJECT: THE CHANNEL BOARD: FIRST PIECE OF AN ISLAND-DEFENSE GAME

Across this unit you will build an island-defense board game. This first piece is the board for the English Channel in 1588, drawn to scale on a grid, with wind cards that make the weather matter as much as it did for Medina Sidonia and Howard.

You will need

- Poster board or the back of a large cereal box (about 18 by 24 inches)
- Ruler, pencil, fine black marker, blue and green colored pencils
- An atlas or printed map of the English Channel (or the map in this lesson)
- Index cards cut in half for wind cards
- Small tokens: buttons, beans or coins in two colors for ships

Steps

1. Rule a grid of 1-inch squares. Let one square equal 10 nautical miles (about 18.5 km). Mark a scale bar in one corner.
2. Copy the coastlines of southern England and northern France from the Lizard to the mouth of the Scheldt, using the grid to place the Lizard, Plymouth, Portland, the Isle of Wight, Dover, Calais, Gravelines and Dunkirk.
3. Shade sandbanks along the Flemish coast in a speckled pattern. Large ships may not enter these squares.
4. Make 12 wind cards: 5 southwest, 2 west, 2 northwest, 2 east and 1 calm. Wind blowing toward your direction of travel lets a ship move 3 squares; wind from the side, 2; wind against you, 0. Calm means no one moves except rowed barges (1 square).
5. Place the Armada (one color) off the Lizard and the English fleet (the other color) in Plymouth. Draw a wind card each turn and play the Armada’s passage to Calais.
6. Add a rule for the Duke of Parma: his barges sit in Dunkirk and may move only if no Dutch or English token is within 2 squares.
7. Play twice and record the number of turns it took to reach Calais and whether Parma ever got out.

Tips

- Keep the coastline simple; accuracy of the key places matters more than every bay.
- Notice how often the southwest card comes up. That is the point: the real wind usually blew the Armada forward and would not let it come back.

Check your work

- My board has a scale bar and at least eight correctly placed places.
- My wind deck makes southwest winds the most common.
- I can explain from my game why Parma's barges were the weak link in Philip's plan.

MAP NOTEBOOK

1. Draw the British Isles freehand from memory, then check against an atlas. Mark the Strait of Dover with its width in miles and km.
2. Make a timeline strip of five attempts to cross the moat: 1066, 1588, 1688, 1803–1805 and 1940. Color the successes one color and the failures another.
3. Sketch the two windows of the Armada Portrait as small thumbnails and label what each one shows.

> **From history.** One Armada ship, the galleass *Girona*, crammed with survivors from other wrecks, struck the rocks at Lacada Point near the Giant's Causeway in Ireland in October 1588; only a handful of the men aboard survived. In 1967 the Belgian diver Robert Sténuit found the wreck, and its gold jewelry, coins and a gold salamander pendant are now displayed in the Ulster Museum in Belfast.

WORKED EXAMPLES

Example 1. The Armada was sighted off the Lizard on 19 July 1588 (Old Style) and anchored off Calais on 27 July (Old Style). The distance along its course was about 275 nautical miles (510 km). What was its average speed in knots and in km/h, and what does that tell you?

(Use the map or drawing "Measure the route from the Lizard to Calais." shown earlier in this lesson.)

1. Time: from 19 July to 27 July is 8 days, or 8 × 24 = 192 hours.
2. Speed in knots (nautical miles per hour): 275 ÷ 192 ≈ 1.43 knots.
3. Speed in km/h: 510 ÷ 192 ≈ 2.7 km/h (about 1.7 mph).
4. Compare: a person walks about 5 km/h. The Armada averaged about half a walking pace.

Answer: About 1.4 knots, or about 2.7 km/h (1.7 mph). The fleet moved slowly because it kept a tight defensive formation at the pace of its slowest supply ships and fought running battles along the way, which gave the English days to gather ships and harry it.

Example 2. English records date the Battle of Gravelines 29 July 1588; Spanish records date it 8 August 1588. Show that these are the same day.

1. In 1582 Pope Gregory XIII's calendar reform dropped 10 days. Spain adopted it at once; England kept the old Julian calendar until 1752.
2. So in 1588 a New Style (Gregorian) date = Old Style (Julian) date + 10 days.
3. 29 July + 10 days = "39 July." July has 31 days, so 39 − 31 = 8.
4. 29 July (Old Style) = 8 August (New Style).

Answer: They are the same day: 29 July Old Style is 8 August New Style. Always check which calendar a source uses before comparing English and Continental dates between 1582 and 1752.

Example 3. Estimate the width of the Strait of Dover from coordinates: Dover is at about 51.13° N, 1.31° E and Cap Gris-Nez at about 50.87° N, 1.58° E. Use 1° of latitude ≈ 111 km and 1° of longitude ≈ 111 km × cos(latitude).

1. North–south difference: 51.13 − 50.87 = 0.26°; 0.26 × 111 ≈ 28.9 km.
2. East–west difference: 1.58 − 1.31 = 0.27°. At about 51° N, cos 51° ≈ 0.63, so 1° of longitude ≈ 111 × 0.63 ≈ 70 km; 0.27 × 70 ≈ 18.9 km.
3. Straight-line distance (small area, so treat as flat): $\sqrt{(28.9^2 + 18.9^2)} = \sqrt{(835 + 357)} = \sqrt{1192} \approx 34.5$ km.
4. In miles: 34.5 ÷ 1.609 ≈ 21.4 miles.

Answer: About 34 km (21 miles), close to the usual figure of about 33 km (21 miles), which is measured from the South Foreland just east of Dover.

PRACTICE

1. EASY How wide is the Strait of Dover at its narrowest, in miles and kilometers?
2. EASY Why did the Armada need to meet the Duke of Parma? What was each part of the plan supposed to do?
3. EASY Convert 19 July 1588 (Old Style) to New Style.
4. MEDIUM The Channel Tunnel is about 50 km long, with about 38 km under the sea. What percentage is under the sea? Give both lengths in miles.
5. MEDIUM Suppose Napoleon's barges had to cross about 48 km (26 nautical miles) from Boulogne to the Kent coast at an average of 2 knots (3.7 km/h). How many hours would the crossing take? The tide turns about every 6 hours 12 minutes. About how many times would it turn during the crossing?
6. MEDIUM The Armada was sighted off the Lizard on 29 July (New Style) and fought at Gravelines on 8 August (New Style). How many days passed?

7. MEDIUM The moat was crossed successfully in 1066 and 1688. What did the two successful invasions have in common?
8. HARD Use the map of the Armada's route home. In what direction did the Armada sail after Gravelines, and why did it not simply turn around and go back through the Channel?
   (Use the map or drawing "Follow the route from Gravelines." shown earlier in this lesson.)
9. HARD Dover is at about 51.13° N, 1.31° E and Calais at about 50.95° N, 1.86° E. Estimate the distance between them in km and miles (1° latitude ≈ 111 km; cos 51° ≈ 0.63).
10. HARD Suppose a Chain Home radar station in 1940 detected a bomber formation 100 miles (160 km) away flying toward it at 250 mph (400 km/h). How many minutes of warning did the defenders have?
11. CHALLENGE In one paragraph, explain the statement "The sea is a moat only for the side that commands it," using at least two examples from this lesson.
12. CHALLENGE Why did England, and later Britain, care so much about who controlled the Low Countries? Give two historical examples.

COMMON MISTAKES

- Thinking the storms alone defeated the Armada. The decisive moments were the failure to link with Parma, the fireships at Calais and the fighting at Gravelines; the storms came afterward and turned defeat into disaster.
- Mixing Old Style and New Style dates. English sources of 1588 are 10 days behind Spanish ones, so the same battle seems to happen on two different days.
- Thinking Britain was never successfully invaded. The Norman Conquest (1066) and William of Orange's landing (1688) both crossed the moat when the defender did not hold the sea.

Make it a game · Cross the Moat. One player is the invader, one the island. The invader names a year (1066, 1588, 1688, 1805 or 1940) and states one condition needed to cross: ships, a harbor, wind, or command of the sea or air. The island player must answer with the real reason that condition was or was not met that year. A correct answer scores a point; first to five wins.

Scripture. "And said, Hitherto shalt thou come, but no further: and here shall thy proud waves be stayed?" (Job 38:11, KJV)

God speaks of setting the bounds of the sea. The English of 1588 saw His hand in the winds that scattered the Armada. We should be humble about reading the meaning of particular storms, but the lesson of Job stands: the sea and its boundaries belong to the Lord who made them.

Practice answers

1. About 21 miles (33 km).

2. The Armada was to win control of the narrow sea and protect the crossing; Parma's veteran army in Flanders was to be ferried in barges across the Strait of Dover to land in Kent. Neither could conquer England alone.
3. 29 July 1588 (add 10 days).
4. 38 ÷ 50 = 0.76, so about 76%. 50 km ≈ 31 miles; 38 km ≈ 23.6 miles.
5. 26 ÷ 2 = 13 hours (48 ÷ 3.7 ≈ 13 hours). 13 ÷ 6.2 ≈ 2.1, so the tide would turn about twice, sweeping the slow barges first one way and then the other. In practice the crossing would have needed command of the Channel for far more than a few hours.
6. 10 days (2 days left in July after the 29th, plus 8 in August).
7. In both, the defender did not command the sea at the moment of crossing. In 1066 Harold's fleet had broken up and his army was in the north, so William landed unopposed. In 1688 an easterly wind carried William of Orange down the Channel while it kept James II's fleet pinned in the Thames estuary.
8. North into the North Sea, then around Scotland and south down the west of Ireland. A southwesterly wind was blowing it northeast, the English fleet lay to the west between it and the Channel, and its ships sailed poorly into the wind.
9. North–south: 0.18° × 111 ≈ 20 km. East–west: 0.55° × 111 × 0.63 ≈ 38.5 km. Distance ≈ $\sqrt{(20^2 + 38.5^2)} \approx \sqrt{1882} \approx 43$ km, about 27 miles.
10. 100 ÷ 250 = 0.4 hour = 24 minutes (160 ÷ 400 = 0.4 hour). That was enough time to get fighters into the air, which is why radar mattered so much to the moat in 1940.
11. A strong answer explains that water stops an army only if the defender's ships (or aircraft) can prevent the crossing. Examples: in 1588 and 1805 the English fleet held the sea and no army crossed; in 1940 the RAF kept command of the air over the Channel and Sea Lion was postponed; but in 1066 and 1688 the defenders' fleets were absent or pinned, and the invaders landed.
12. The harbors and river mouths of the Low Countries (Antwerp and the Scheldt, the Flemish ports) lie directly across from the Thames and were the best place to gather an invasion. England opposed Spain there in 1588 (supporting the Dutch revolt), opposed Louis XIV and Napoleon, and went to war in 1914 when Germany invaded neutral Belgium.

5.2 Japan: The Island Nation

OBJECTIVES

- Measure the Korea Strait and its stepping-stone islands and explain why Japan was close enough to the mainland to borrow from it but far enough to resist conquest.
- Narrate the Mongol invasions of 1274 and 1281 and explain how distance, defense works and the typhoon season combined to defeat them.
- Explain how island geography made the Tokugawa policy of seclusion possible, and how Commodore Perry's steam warships in 1853–1854 ended it.

Warm-up. Lay out three sheets of paper on the floor in a line, about one long step apart, with a fourth sheet farther away: these are Korea, Tsushima, Iki and Kyushu. Cross from "Korea" to "Kyushu" stepping only on paper. Now take away the middle two sheets and try again. Talk about it: what do stepping-stone islands do for travelers, traders and invaders?

Watch. *Why couldn't the Mongols conquer Japan? (Short Animated Documentary)* (History Matters, 8:52). https://www.youtube.com/watch?v=uw8sjn7z0Ls
After the story: watch why Kublai Khan's two invasions of Japan in 1274 and 1281 failed, and look for how the sea, the defenders and the storms protected the islands.
Note: Captions were not available to check; preview it first. It mentions that Japan killed Kublai's messengers and describes battle deaths.

Backup video. *How Europeans Tried to End Japanese Isolation - Colonialism DOCUMENTARY* (Kings and Generals, 19:53). https://www.youtube.com/watch?v=wFJRc6jYOaI
As review: watch how Russian, French, Dutch and other visitors tried to open Tokugawa Japan before Commodore Perry's Black Ships finally did in 1854. Note: Captions were not available to check; preview it first. It includes a sponsor message for Japanese snack boxes (Sakuraco/TokyoTreat) that you can skip. "Colonialism" in the title is the channel's series name, not the video's slant.

KEY TERMS

Korea Strait
The sea passage between the southern tip of Korea and the Japanese island of Kyushu, about 200 km (125 miles) wide, divided by the islands of Tsushima and Iki.

kamikaze
Japanese for "divine wind"; the name given to the storms, above all the typhoon of 1281, that wrecked the Mongol fleets.

shogun

The military ruler of Japan who governed in the name of the emperor; the Kamakura shogunate faced the Mongols, and the Tokugawa shogunate ruled from 1603 to 1867.

sakoku
"Closed country": the Tokugawa policies from the 1630s that banned Christianity, forbade Japanese to go abroad and limited foreign trade to a few controlled gates.

Dejima
A small fan-shaped artificial island in Nagasaki harbor where the Dutch were allowed to trade, under close watch, from 1641.

Black Ships
Japanese name (kurofune) for Western ships, especially the dark-hulled, smoke-belching steam warships of Commodore Matthew Perry in 1853.

CORE IDEAS

The story. In November 1274 a fleet of perhaps 900 ships carrying some 25,000 to 30,000 Mongol, Chinese and Korean soldiers and sailors crossed from Korea. Kublai Khan, grandson of Genghis Khan and ruler of China, had sent letters demanding that Japan submit. The Kamakura shogunate, led by the young regent Hōjō Tokimune, refused to answer. The fleet stormed the islands of Tsushima and Iki, slaughtering many of the islanders, and landed at Hakata Bay on the north coast of Kyushu. Japanese warriors, trained for duels of mounted archers, met massed Mongol archery, shields in close formation and exploding bombs. One of those warriors, a minor samurai named Takezaki Suenaga, later had his own charge painted in a pair of scrolls. After a day of hard fighting the invaders returned to their ships, and according to Japanese and Korean accounts, a storm wrecked many of them on the way home.

How it worked. Kublai sent envoys again; Tokimune had them beheaded, and Japan used the years that followed to dig in. Along Hakata Bay the shogunate ordered a stone wall about 20 km (12 miles) long and 2 to 3 meters high, built by the warriors of Kyushu. In 1281 Kublai sent two fleets: an Eastern Army from Korea and a much larger Southern Army from the port of Ningbo in southern China. Medieval sources give some 140,000 men and over 4,000 ships; modern historians think those numbers are too high, but it was still one of the largest seaborne invasions before modern times. The Eastern Army arrived first in early summer and found the wall manned. Unable to land in force, it held offshore, while Japanese raiders rowed out in small boats at night to attack the anchored ships. The Southern Army came late, and the two fleets gathered near the island of Takashima. Then, in August, at the height of the typhoon season, a great storm struck. Ships crowded together in the anchorage smashed into one another and onto the rocks, and the invasion was over. Japanese priests had been praying at shrines and temples for deliverance, and the storm became known as the *kamikaze*, the divine wind. Since the 1980s, divers off Takashima have found anchors, hull timbers, weapons and ceramic bomb shells from Kublai's fleet; some of the ships seem to have been river boats hastily pressed into service, poorly suited to the open sea.

The big idea. Distance makes the moat. Britain lies about 33 km (21 miles) from the Continent; Japan lies about 200 km (125 miles) from Korea and much farther from China.

That is close enough for things to cross by peaceful means: rice farming, Chinese writing, Buddhism, and the arts of government all came to Japan by way of Korea and China. But it is far enough that an invader must carry a whole army across open water, with only Tsushima and Iki as stepping stones, and then keep it supplied. Japan was invaded seriously only twice before modern times, and no foreign army conquered the home islands before the Allied occupation that followed Japan's surrender in 1945.

The closed country. An island can also choose to shut its gates. In 1549 the Jesuit missionary Francis Xavier landed at Kagoshima, and within a few decades there were perhaps 300,000 Japanese Christians. Japan's rulers came to fear that the faith would bind Japanese to foreign powers. Toyotomi Hideyoshi had 26 Christians crucified at Nagasaki in 1597; the Tokugawa shoguns banned Christianity in 1614, and after the Shimabara Rebellion of 1637–1638 they tightened the ban. Portuguese ships were expelled in 1639, and by 1641 the Dutch, who did not preach, were confined to the little island of Dejima in Nagasaki harbor. Thousands of Japanese Christians were tortured and executed, and suspects were forced to tread on images of Christ to prove they were not believers. Japan was not completely sealed: trade continued through four controlled "gates" (Nagasaki for the Dutch and Chinese, Tsushima for Korea, Satsuma for the Ryukyu Islands, and Matsumae for the Ainu of the north). But for about two centuries Japan lived largely in peace, at the price of near-isolation and religious persecution. Only an island could have managed such a policy for so long.

On the map. The Korea Strait runs from southwest to northeast between Busan and northern Kyushu. Tsushima sits about 50 km (30 miles) off Korea; Iki lies between Tsushima and Kyushu. Japan's main islands, Honshu, Kyushu, Shikoku and Hokkaido, stretch some 3,000 km (1,900 miles) from end to end, mountainous, with most people living on narrow coastal plains. The capital of the shoguns, Edo (modern Tokyo), depended on ships to bring rice and goods along the coast, which made it vulnerable to anyone who could close its bay. From late summer into autumn, typhoons sweep north from the tropical Pacific across these waters.

Technology overcoming geography. On 8 July 1853 Commodore Matthew C. Perry of the United States Navy steamed into the entrance of Edo Bay at Uraga with four warships, two of them side-wheel steam frigates that could move against the wind. He carried a letter from President Millard Fillmore asking for trade, coal for steamers and the protection of shipwrecked American sailors. He promised to return, and in February 1854 came back with a larger squadron. On 31 March 1854 the Treaty of Kanagawa opened the ports of Shimoda and Hakodate to American ships. The shogunate understood the lesson: steam had shrunk the Pacific moat, and an island that could not command its own waters could be opened by force. Within fifteen years the shogunate fell, and the Meiji government (from 1868) set out to build railways, factories and a modern navy so that Japan would never again be at the mercy of foreign steamships.

The Korea Strait and the Mongol invasions of 1274 and 1281.

PICTURE STUDY

Illustrated Account of the Mongol Invasions (Mōko Shūrai Ekotoba), Unknown Japanese artists, commissioned by Takezaki Suenaga, about 1293 · Two handscrolls, ink and color on paper · Museum of the Imperial Collections (Sannomaru Shōzōkan), Tokyo

Takezaki Suenaga was a samurai of modest rank from Higo in Kyushu who fought in both invasions. Afterward he traveled all the way to Kamakura to ask for a reward for his deeds, and he got one. He had these scrolls made to record his battles and to honor the official who had helped him, so they are both a war record and a personal thank-you.

The most famous scene shows Suenaga charging on a wounded horse as an exploding bomb bursts overhead. It is one of the earliest pictures anywhere of a gunpowder weapon in battle. Scholars have shown that the scrolls were damaged and repaired over the centuries, and some think a few figures were added later, so historians read them carefully, as they would any old source.

Look closely

- Find the bomb. What is it made of, and how has the artist shown the explosion?
- Compare the Japanese warrior's armor and weapons with the Mongol soldiers'. How are they dressed differently?
- In the sea scenes, find the small Japanese boats attacking the large invasion ships. How do the sizes compare?
- Look for the stone wall along the shore. Who is standing on it?

Talk about it

1. Suenaga paid for these scrolls to record his own deeds. How might that shape what they show and what they leave out?
2. What do the scrolls tell us about why the wall and the small boats were good tactics against an invader who came by sea?
3. How is this picture like the Armada Portrait, and how is it different?

PROJECT: THE KOREA STRAIT BOARD AND THE TYPHOON CALENDAR

Add a second board to your island-defense game: the Korea Strait. This board adds two new rules that Britain's board did not need: stepping-stone islands and a typhoon season.

You will need

- Poster board or cardboard, ruler, pencil, markers
- An atlas or the map in this lesson
- Index cards for season cards; a six-sided die
- Tokens in two colors; small stones or sugar cubes for the wall

Steps

1. Rule 1-inch squares; let one square equal 20 km (about 11 nautical miles). Draw southern Korea, Tsushima, Iki and northern Kyushu with Hakata Bay. The strait should be about 10 squares wide.
2. Mark a landing beach of 4 squares along Hakata Bay. Before the second game, the island player may build the wall: place stones on up to 4 beach squares. An invader may not land on a walled square.
3. Make 12 season cards, one per month. When the invader's turn count reaches the month of August or September, roll the die each turn: on a 1 or 2 a typhoon strikes, and every ship in an anchorage loses half its tokens.
4. Play 1274 first: the invader starts in Korea with 9 tokens and must take Tsushima and Iki before landing. Then play 1281 with 14 tokens arriving in two groups, the second group 3 turns late.
5. Record each game: the month the invader landed, how many tokens reached shore, and whether a typhoon struck.

6. Write three sentences comparing your Korea Strait games with your Channel games from Lesson 5.1.

Tips

- Measure the distances carefully so that the strait is about six times as wide as your Strait of Dover square count (scaled to the same unit).
- The typhoon rule teaches timing: an invader who delays into late summer is gambling with the weather.

Check your work

- My board shows Tsushima and Iki as stepping stones in the right places.
- My rules include the wall and a typhoon season.
- I can explain from my games why the late arrival of the Southern Army mattered.

MAP NOTEBOOK

1. Draw the Korea Strait and label Busan, Tsushima, Iki, Hakata Bay and Takashima, with the width of the strait in km and miles.
2. Make a two-column table comparing Britain and Japan: distance from the mainland, main invasions attempted, what defeated them, and how the island was finally “opened” or crossed by technology.
3. Draw Dejima as a small fan-shaped island connected to Nagasaki by a single bridge, and label the “four gates” of Tokugawa Japan on a small outline map.

> **From history.** For more than two centuries some Japanese Christians, called Hidden Christians, kept their faith in secret, passing prayers and baptism down through families without priests. In 1865, soon after Japan reopened, a French priest, Bernard Petitjean, opened a church in Nagasaki for foreigners. On 17 March 1865 a group of villagers from nearby Urakami came in and quietly told him that they shared his faith. Their families had kept it hidden since the 1600s.

WORKED EXAMPLES

Example 1. The Korea Strait is about 200 km wide and the Strait of Dover about 33 km wide. How many times wider is Japan’s moat? Give both widths in miles.

1. Ratio: 200 ÷ 33 ≈ 6.1.
2. Miles: 200 km ÷ 1.609 ≈ 124 miles; 33 km ÷ 1.609 ≈ 21 miles.
3. Check: 124 ÷ 21 ≈ 5.9, so about 6 times either way.

Answer: About 6 times as wide: about 200 km (124 miles) against 33 km (21 miles).

Example 2. The Southern Army of 1281 sailed from Ningbo to the waters off Takashima, a distance of about 850 km (460 nautical miles). If its ships averaged 3 knots, how many days did the voyage take? How would a delay of two weeks have changed its risk?

1. Convert: 850 km ÷ 1.852 ≈ 459 nautical miles.
2. Time: 459 ÷ 3 ≈ 153 hours.
3. Days: 153 ÷ 24 ≈ 6.4 days.
4. The voyage itself was short, but the army was weeks late in arriving. Each week of delay pushed the combined fleet deeper into the typhoon season of late summer.

Answer: About 6 to 7 days at sea. The real danger was not the length of the voyage but the delay that left the fleet anchored off Kyushu in August, when typhoons strike.

Example 3. An invader crossing from Korea uses Tsushima and Iki as stepping stones. The open-water legs are about 50 km (Korea to Tsushima), 55 km (Tsushima to Iki) and 65 km (Iki to Hakata Bay). What is the total open-water distance, and how long is the longest leg at 3 knots (5.6 km/h)?

(Use the map or drawing "Find the three open-water legs." shown earlier in this lesson.)

1. Total: 50 + 55 + 65 = 170 km (about 106 miles).
2. Longest leg: 65 km ÷ 5.6 km/h ≈ 11.6 hours.
3. Compare: the whole Strait of Dover (33 km) would take about 6 hours at the same speed.

Answer: About 170 km of open water in three legs; the longest takes about 11 to 12 hours, nearly twice the time to cross the Strait of Dover. The islands made the crossing possible but also gave the defenders early warning.

PRACTICE

1. EASY In what two years did the Mongols invade Japan, and who ordered the invasions?
2. EASY What does kamikaze mean, and to what event was the name first given?
3. EASY Which Europeans were allowed to trade at Dejima after 1641, and why them rather than the Portuguese?
4. EASY Name the two islands that act as stepping stones in the Korea Strait.
5. MEDIUM Portuguese ships were expelled in 1639. The Treaty of Kanagawa was signed in 1854. How many years apart are these events?
6. MEDIUM Perry arrived on 8 July 1853 and the Treaty of Kanagawa was signed on 31 March 1854. How many days passed? (1854 was not a leap year.)
7. MEDIUM The Hakata Bay wall was about 20 km long. Express this in miles. Why build a wall on a beach rather than a fortress on a hill?

8. HARD Redo the Southern Army's voyage of about 850 km at an average of only 2 knots (3.7 km/h). How many days would it take?
9. HARD Why did Perry's steam warships alarm the shogunate more than earlier sailing ships had?
10. HARD Use the map. In what compass direction does the Korea Strait run from Busan toward Hakata Bay? About how far is it?
    (Use the map or drawing "Measure from Busan to Hakata Bay." shown earlier in this lesson.)
11. CHALLENGE Japan's seclusion was never total. Name the four controlled "gates" and whom each one connected Japan with.
12. CHALLENGE In a paragraph, explain how geography made Tokugawa seclusion possible, and why it was still a human choice with real costs.

COMMON MISTAKES

- Thinking the typhoon alone stopped the Mongols. The Hakata Bay wall and the Japanese raids kept the Eastern Army from landing for weeks, which is why the fleets were still at sea when the storm came.
- Imagining that Tokugawa Japan had no foreign contact at all. Trade went on through four controlled gates, and Dutch books brought Western science ("Dutch learning") into Japan.
- Confusing the kamikaze of 1281 with the suicide pilots of 1944–1945, who were named after it centuries later.

Make it a game · Gate or Moat?. One player names something that crossed (or tried to cross) the sea to Japan: rice farming, Buddhism, the Mongol army, Francis Xavier, Dutch books, Perry's steamships. The other player says "gate" if it came through peacefully or by permission, or "moat" if the sea or the shogun turned it back, and gives the date. Correct answers with a date score two points.

Scripture. "For he commandeth, and raiseth the stormy wind, which lifteth up the waves thereof." (Psalm 107:25, KJV)

The psalmist sees the storm as under God's command. The Japanese of 1281 believed their gods had sent the wind; the English of 1588 thanked the Lord. Christians confess that the wind obeys its Maker, while remaining humble about declaring which side He favors in any particular storm.

Practice answers

1. 1274 and 1281, by Kublai Khan, Mongol ruler of China.
2. "Divine wind"; the storms that wrecked the Mongol fleets, especially the typhoon of August 1281.
3. The Dutch. They came only to trade and did not send missionaries, while the shogunate associated the Portuguese with spreading Christianity.
4. Tsushima and Iki.

5. 1854 − 1639 = 215 years.
6. July 8–31: 23; August 31; September 30; October 31; November 30; December 31; January 31; February 28; March 31. Total 266 days.
7. About 12.4 miles. An army arriving by sea must come ashore at a beach; a wall at the water's edge stops the landing itself, leaving the invader crowded on ships, exposed to raids and weather.
8. 850 ÷ 3.7 ≈ 230 hours ≈ 9.6 days, almost 10 days.
9. Steamships could move against the wind and in calms, enter Edo Bay at will and hold position. Edo depended on coastal shipping for rice and goods, so a steam squadron could threaten to blockade the capital. Japan had no ships able to match them.
10. Roughly southeast (the strait itself runs southwest to northeast); about 200 km (125 miles).
11. Nagasaki (Dutch and Chinese merchants), Tsushima (Korea), Satsuma (the Ryukyu Kingdom) and Matsumae (the Ainu of Hokkaido and lands to the north).
12. A strong answer notes that an island 200 km from Korea with no land border could control every point of entry through a few ports, which a continental country could not. But seclusion was a policy chosen by the shoguns: it brought about two centuries of peace, while costing Japan contact with outside learning and bringing the torture and execution of thousands of Japanese Christians. It could not survive once steamships made the sea crossable at will.

5.3 The Mediterranean: A Sea in the Middle of the Land

OBJECTIVES

- Describe the shape of the Mediterranean basin (its length, its narrow outlet at Gibraltar, its peninsulas and islands) and explain why it worked as a highway rather than a barrier.
- Explain how Rome won command of the sea in the Punic Wars and cleared it of pirates, so that it could call the Mediterranean *mare nostrum*, “our sea.”
- Calculate sailing times and transport costs on Roman sea routes, and explain why winds and the sailing season shaped the grain trade from Egypt to Rome.

Warm-up. Put a fig, a date or a raisin on the table. Tell the student that in about 150 BC a Roman senator held up a fresh fig in the Senate and asked his colleagues how long ago they thought it had been picked. Ask: what point was he making with a piece of fruit? Write a guess, and check it against the story in the lesson.

Watch. *What type of ship did Paul take to Rome?* (Drive Thru History with Dave Stotts, 4:44). https://www.youtube.com/watch?v=Tl3OaA2SpaU
After the story: watch Dave Stotts explain the kind of big Alexandrian grain ship Paul sailed on, and think about how ships like it carried Egypt's wheat across the sea to feed Rome.
Note: Captions were not available to check; preview it first.

Backup video. *Where was Paul shipwrecked on his way to Rome?* (Drive Thru History with Dave Stotts, 5:09). https://www.youtube.com/watch?v=Dk-jHfF954M
With On the map: follow Paul's voyage from the Bible to the island where he was shipwrecked, and find Malta in the middle of the Mediterranean. Note: Captions were not available to check; preview it first.

KEY TERMS

mare nostrum
Latin for “our sea,” the Romans’ name for the Mediterranean once they ruled every shore of it.

basin
A sea or region of land ringed by higher ground or by coasts, so that its parts face inward toward one another.

Punic Wars
Three wars between Rome and Carthage (264–241, 218–201 and 149–146 BC) for control of the western Mediterranean.

corvus
"Raven": a hinged boarding bridge with an iron spike that Roman ships dropped onto enemy decks so soldiers could fight as if on land.

sailing season
The months when sailing was considered safe in ancient times, roughly late spring to early autumn; in winter most shipping stopped.

annona
Rome's public grain supply, much of it shipped from Egypt, North Africa and Sicily to feed the city.

CORE IDEAS

The story. Around 150 BC the old Roman statesman Marcus Porcius Cato, called Cato the Elder, stood in the Senate and let some large, fresh figs fall from the fold of his toga. When the senators admired them, he told them, as Plutarch records, that the land where they grew was only three days' sail from Rome. That land was Carthage, Rome's great rival on the coast of North Africa. Cato's point was geographic: the sea did not keep Carthage far away; it brought Carthage close. He is famous for ending his speeches with the demand that Carthage be destroyed. In 146 BC, at the end of the Third Punic War, Roman soldiers took Carthage, burned it and sold its surviving people into slavery. With Carthage gone, no rival fleet remained in the western Mediterranean.

How they figured it out. Rome began as a land power. When the First Punic War broke out in 264 BC over Messana in Sicily, Rome had almost no warships, while Carthage was the greatest naval power of the western sea. According to the Greek historian Polybius, the Romans copied a Carthaginian warship that had run aground and built a fleet of about a hundred ships in a few months, training rowers on benches set up on dry land. To make up for their lack of seamanship, they added the *corvus*, a boarding bridge that let Roman legionaries storm enemy decks. At Mylae in 260 BC it worked. Rome lost whole fleets to storms in the years that followed, but it kept building, and by 241 BC it had won the war and taken Sicily, its first province. A century later Rome faced a different enemy at sea: pirates based on the rugged coasts of Cilicia, in what is now southern Turkey, who raided shipping and coastal towns and held Roman travelers for ransom, among them the young Julius Caesar. In 67 BC the Senate gave Pompey sweeping command over the whole sea and its coasts. He divided the Mediterranean into districts, gave each a commander and squadron, and swept the sea from west to east in about three months. From then on, for centuries, the Mediterranean was a Roman lake.

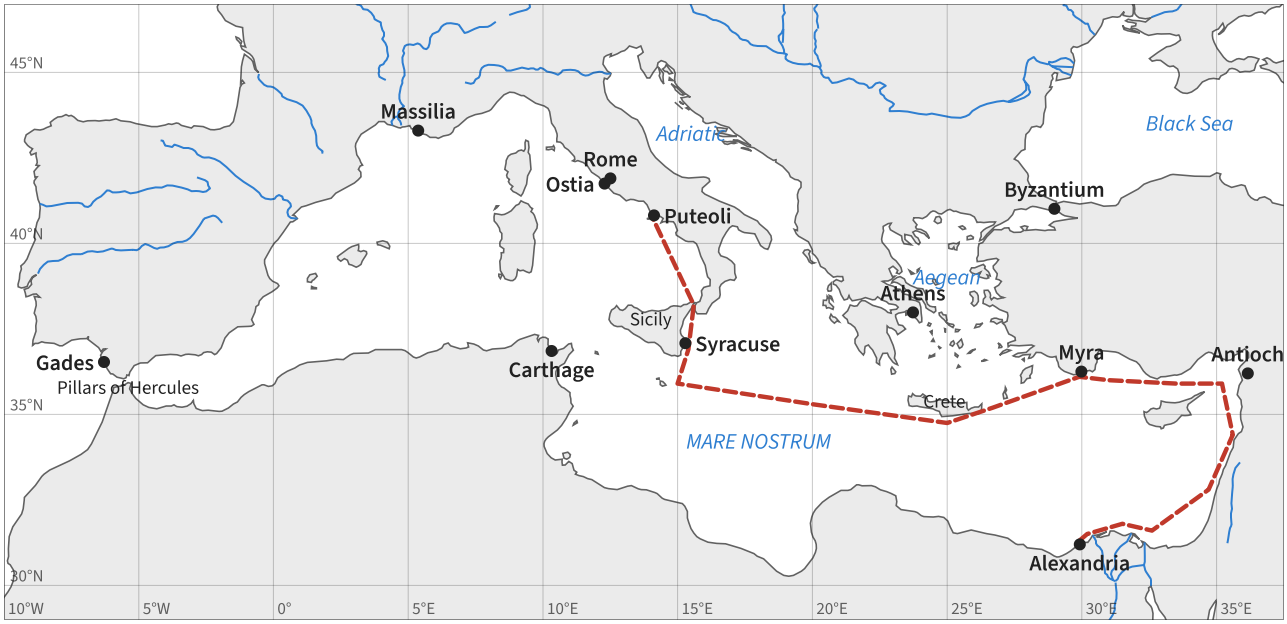
The big idea. A sea can be a border or a highway, and the Mediterranean shows how it becomes a highway: when one power commands every shore. A barrier of water stops armies, but it carries ships, and ancient ships were by far the cheapest way to move heavy goods. Historians working from the Emperor Diocletian's Price Edict of AD 301 estimate that carrying goods overland by ox-cart cost roughly thirty to fifty times as much per mile as carrying them by sea. That is why Roman cities clustered near the coast and why Rome itself, a city of perhaps a million people at its height, could be fed with grain grown in Egypt,

Sicily and North Africa. Rome's famous roads moved armies and messengers, but its sea lanes moved its bread. The empire's borders were drawn on the far edges of the land (the Rhine, the Danube, the desert of Syria and the Sahara), while its center was water.

On the map. The Mediterranean stretches about 2,500 miles (4,000 km) from the Strait of Gibraltar to the coast of Syria. Its only natural outlet to the ocean, the Strait of Gibraltar, is just under 9 miles (14 km) wide; the Romans called the rocks on either side the Pillars of Hercules. Italy, Greece and the Iberian Peninsula reach down into it from the north, and Sicily nearly closes the gap between Italy and Africa, splitting the sea into a western and an eastern basin. Because it is nearly enclosed, its tides are small, which made harbors easier to build than on the Atlantic. In summer, steady winds from the north and northwest (the Greeks called them the Etesian winds) blow across the eastern basin. A ship from Italy to Egypt ran south before the wind; a ship coming back had to work its way north along the coasts of Palestine and Asia Minor, around Crete and west by way of Malta or Sicily. Historians estimate the outbound voyage often took two or three weeks and the return voyage one to two months.

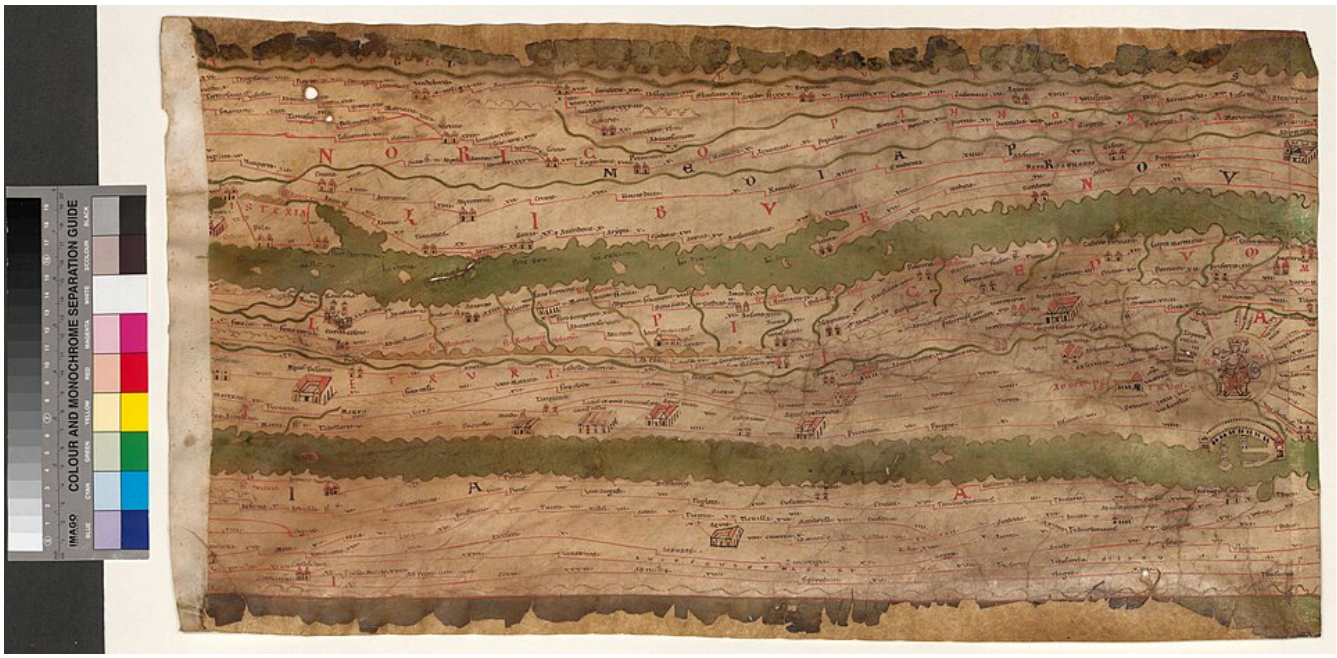
The sailing season. Winter storms and cloudy skies, which hid the stars that pilots steered by, closed the sea for months. The Roman writer Vegetius described the safest season as late May to mid September, with sailing possible but risky from March to early November. The apostle Paul's voyage to Rome in Acts 27 shows what happened to those who pushed their luck: his ship, an Alexandrian grain ship, set out after the autumn fast, met a violent northeaster off Crete and was wrecked on Malta. Grain ships that missed the season might winter in a harbor along the way, as Paul's next ship had done.

Technology overcoming geography. Rome improved on nature with engineering. Ostia, at the mouth of the Tiber, was too shallow for big grain ships, which had long unloaded at Puteoli near Naples. The Emperor Claudius began a new artificial harbor, Portus, north of Ostia in AD 42, and Trajan added a six-sided inner basin early in the next century. Lighthouses such as the Pharos of Alexandria guided ships into port, and great warehouses stored the grain. Even so, Rome never overcame the winds and seasons; it organized its life around them.



The Mediterranean world of Rome, with the grain route from Alexandria to Italy.

PICTURE STUDY



The Peutinger Table (Tabula Peutingeriana), Unknown medieval copyist, from a Roman original, copy made about AD 1200–1300; the Roman original is centuries older · Ink and color on parchment, a scroll about 22 feet (6.7 m) long and about 13 inches (34 cm) high · Austrian National Library, Vienna

The Peutinger Table is a medieval copy of a Roman road map. It is named after Konrad Peutinger, a scholar of Augsburg who owned it in the 1500s. It shows the Roman world from Britain to India, with roads, towns, distances between stops, baths, harbors and lighthouses.

Because it was made to be rolled up and carried, it squeezes the whole world into a long, thin strip. The Mediterranean becomes a narrow ribbon of water. It is not wrong so much as

a different kind of map: like a subway diagram, it tells you what comes next along a route, not true shapes or directions.

Look closely

- Find the Mediterranean. What has happened to its shape, and why?
- Find Rome, shown with a seated figure in a circle. What does that tell you about how the mapmaker saw the city?
- Look at the little pictures for towns: some are twin towers, some are buildings around courtyards. What might the different symbols mean?
- Find a lighthouse or harbor along the coast. Where are they placed?

Talk about it

1. What would a Roman traveler use this map for? What would it be useless for?
2. Compare the Peutinger Table with a modern map of the Mediterranean in this lesson. What does each one show best?
3. The map shows roads, not sea lanes. Why might a road map still put so much water in the middle?

PROJECT: THE MEDITERRANEAN BOARD: ROME'S SEA LANES

The third board of your island-defense game is the whole Roman Mediterranean. This board adds trade and seasons: ships must carry grain to Rome, and the winds and months decide how fast they move.

You will need

- Large poster board (about 22 by 28 inches) or two boards taped together
- Ruler, pencil, colored markers
- The map in this lesson or an atlas
- 12 month cards (index cards), tokens, dried beans for grain

Steps

1. Draw the Mediterranean from Gibraltar to Syria. Use a scale of 1 inch to 100 miles (about 160 km), so the sea is about 25 inches long. Add a scale bar.
2. Mark at least ten Roman places: Rome, Ostia, Puteoli, Carthage, Syracuse, Athens, Alexandria, Antioch, Massilia and Gades. Shade the Strait of Gibraltar and label the Pillars of Hercules.
3. Draw the grain route from Alexandria to Puteoli: south-to-north along the east coast, west past Crete, then by Malta or Sicily to Italy.
4. Make the month cards. From late May to mid September a ship moves 4 inches a turn (with the wind) or 2 inches (against it). In March, April, October and early November it moves half as far and must roll a die each turn: on a 1 it is wrecked. From mid November to February ships stay in port.

5. Each player is a grain merchant starting at Alexandria with 10 beans. Race to deliver grain to Rome before winter. Pirates (a die roll of 6 near Cilicia or the Balearic Islands) steal half a cargo unless Pompey has cleared the sea.
6. Record each run: start month, arrival month, days at sea and grain delivered.

Tips

- Make outbound trips to Egypt fast and return trips slow; that is the lesson of the Etesian winds.
- Keep this board: your unit portfolio game will join the Channel, Korea Strait and Mediterranean boards.

Check your work

- My map has a scale bar, the Strait of Gibraltar and ten correctly placed places.
- My rules show the sailing season and the difference between sailing with and against the wind.
- I can explain why Rome cared so much about who controlled the sea lanes to Egypt.

MAP NOTEBOOK

1. Draw the outline of the Mediterranean and color the Roman provinces around it. Label Gibraltar, Sicily, Crete, Cyprus and the Adriatic, Aegean and Tyrrhenian Seas.
2. Make a wind rose for the eastern Mediterranean in summer, with a long arrow from the north and northwest, and draw the outbound and return routes between Italy and Egypt.
3. Copy one small section of the Peutinger Table and beside it draw the same area as it really looks on a modern map.

> **From history.** Monte Testaccio, a hill in Rome about 35 meters (115 feet) high, is made almost entirely of broken pottery jars (amphorae) that once carried olive oil to the city, most of them from southern Spain. Once emptied, the oil jars could not easily be reused, so they were broken and stacked in a carefully managed dump for about two and a half centuries. Archaeologists estimate the hill holds tens of millions of jars, a mountain-sized record of the sea trade that fed Rome.

WORKED EXAMPLES

Example 1. Cato said Carthage was three days' sail from Rome. The distance from Ostia to Carthage is about 570 km (310 nautical miles). What average speed does three days require? Is it believable for an ancient merchant ship?

(Use the map or drawing "Find Ostia and Carthage." shown earlier in this lesson.)

1. Three days = 72 hours.
2. Speed: 570 km ÷ 72 h ≈ 7.9 km/h.
3. In knots: 310 ÷ 72 ≈ 4.3 knots.
4. Ancient merchant ships with a fair wind are thought to have made about 4 to 6 knots, so a quick passage of three days is believable.

Answer: About 4.3 knots (7.9 km/h, about 5 mph). That is a quick but believable passage with a fair wind, which is exactly why Cato's figs made his point: Carthage was close enough to strike Rome.

Example 2. The direct distance from Puteoli to Alexandria is about 1,000 nautical miles (1,850 km). Suppose a grain ship makes the outbound trip in 12 days and the return trip, by the longer coastal route, in 50 days. What was its average speed made good (straight-line distance divided by time) each way?

1. Outbound: 12 days × 24 = 288 hours. 1,000 ÷ 288 ≈ 3.5 knots.
2. Return: 50 days × 24 = 1,200 hours. 1,000 ÷ 1,200 ≈ 0.83 knots.
3. Ratio: 3.5 ÷ 0.83 ≈ 4.2.

Answer: About 3.5 knots outbound and only about 0.8 knot made good on the return, roughly four times slower. The ship was not sailing slowly all the time; it was sailing a longer route, tacking and waiting in harbors for a fair wind against the summer northerlies.

Example 3. Using the estimate that land carriage cost about 30 times as much per mile as sea carriage, compare the cost of moving a cargo of grain 1,000 miles by sea with moving it overland. How far overland could the same money move it?

1. Let the sea cost be 1 unit per mile. Then 1,000 miles by sea costs 1,000 units.
2. Overland the cost is 30 units per mile.
3. Distance overland for 1,000 units: 1,000 ÷ 30 ≈ 33 miles.
4. Overland cost for the full 1,000 miles: 1,000 × 30 = 30,000 units.

Answer: The money that carries the grain 1,000 miles (1,600 km) by sea would carry it only about 33 miles (53 km) by ox-cart, and the full trip by land would cost about 30 times as much. This is why the Mediterranean, not the road network, fed Rome.

PRACTICE

1. EASY What does *mare nostrum* mean, and when could the Romans truly say it?
2. EASY How long is the Mediterranean from Gibraltar to Syria, and how wide is the Strait of Gibraltar? Give both units.
3. EASY Give the dates of the three Punic Wars.
4. EASY What was the corvus, and what problem did it solve for Rome?
5. MEDIUM Pompey's campaign against the pirates in 67 BC took about three months. If he divided the sea into 13 districts, about how many weeks of work did that mean per district if they were cleared one after another? Why did he instead give each district its own commander?
6. MEDIUM Suppose a Roman grain ship carried about 300 tonnes of grain. If a person ate about 200 kg of grain a year, how many people could one cargo feed for a year?
7. MEDIUM Vegetius's safest season ran from about 27 May to 14 September. How many days is that?
8. MEDIUM Use the map. Name the islands or ports a grain ship passed on the route from Alexandria to Puteoli shown there.
   (Use the map or drawing "Trace the grain route from Alexandria." shown earlier in this lesson.)
9. HARD A messenger on Roman roads could cover about 80 km (50 miles) a day. How many days would he need to travel 1,850 km (1,150 miles)? Compare with a 12-day voyage over the same distance.
10. HARD Why did Roman engineers build Portus when Ostia already existed at the mouth of the Tiber?
11. CHALLENGE Rome's borders lay on the Rhine, the Danube and the deserts, yet its center was a sea. In a paragraph, explain how the Mediterranean held the empire together.
12. CHALLENGE Why was Sicily so important to both Rome and Carthage? Use the map in your answer.

COMMON MISTAKES

- Thinking Rome was always a sea power. It was a land power that built a navy out of necessity in the First Punic War and learned seamanship the hard way.
- Imagining that ancient ships sailed year-round. Most shipping stopped in winter, and the safe season was only about four months.
- Assuming the outbound and return voyages took the same time. The summer winds made the trip from Italy to Egypt much faster than the trip back.

Make it a game · Mare Nostrum Relay. Lay ten index cards in a ring on the floor, each naming a Roman port (Gades, Carthage, Rome, Syracuse, Athens, Byzantium, Antioch, Caesarea, Alexandria, Massilia). A player standing on one card must name the next port clockwise and one thing that sailed between them (grain, oil, wine, soldiers, apostles). A correct answer lets the player move on; a stumble sends the turn to the next player. First to sail all the way around wins.

Scripture. “Now when much time was spent, and when sailing was now dangerous, because the fast was now already past, Paul admonished them,” (Acts 27:9, KJV)

Luke, a careful traveler, records exactly what every Mediterranean sailor knew: after the autumn fast (the Day of Atonement), the sailing season was ending. The Bible’s history is told in real places, with real winds and real seasons.

Practice answers

1. “Our sea.” After Rome had destroyed Carthage (146 BC), taken the eastern kingdoms and cleared the pirates (67 BC), so that it ruled every shore.
2. About 2,500 miles (4,000 km) long; the strait is just under 9 miles (14 km) wide.
3. 264–241 BC, 218–201 BC, 149–146 BC.
4. A hinged boarding bridge with a spike that dropped onto an enemy deck. It let Rome’s skilled soldiers fight at sea as if on land, making up for Rome’s lack of experienced sailors.
5. About 13 weeks ÷ 13 districts = 1 week each. By attacking all districts at once, he kept pirates from simply fleeing from one district to another, and he finished far faster than one fleet could.
6. 300,000 kg ÷ 200 kg = 1,500 people. Feeding a city of perhaps a million took hundreds of such cargoes every year.
7. Counting both end days: May 27–31 is 5 days; June 30; July 31; August 31; September 1–14 is 14. Total 5 + 30 + 31 + 31 + 14 = 111 days, less than four months.
8. Up the coast past Cyprus to Myra in Lycia, west past Crete, then by Malta or Sicily (Syracuse), through the Strait of Messina to Puteoli.
9. 1,850 ÷ 80 ≈ 23 days. The sea voyage with a fair wind was nearly twice as fast, and a ship could carry hundreds of tonnes; but a messenger could travel in winter when ships could not.
10. Ostia’s river mouth was shallow and silting, so large grain ships could not enter and had long unloaded at Puteoli, far to the south. Portus gave Rome a deep, sheltered artificial harbor near the city, begun under Claudius (AD 42) and enlarged by Trajan.

11. A strong answer explains that sea transport was far cheaper than land transport, so grain, oil, wine, soldiers and officials moved across the sea between provinces; that once Rome held every shore, no rival fleet could cut these links; that coastal cities faced one another across the water; and that the dangerous outer borders were on land, far from the safe interior sea.
12. Sicily lies in the middle of the Mediterranean, about 3 km from Italy and about 145 km from Africa, dividing the western and eastern basins. Whoever held it could control the passage between the two halves of the sea, threaten the other’s homeland and draw on its rich grain fields. That is why the First Punic War was fought over it.

5.4 Greece and the Aegean

OBJECTIVES

- Explain how mountains divided the Greek world into many small city-states while the island-studded Aegean Sea connected them.
- Narrate the Battle of Salamis (480 BC) and explain how Athens became a sea power, using the trireme and its crew as evidence.
- Use the horizon formula and speed, time and distance reasoning to show why Greek sailors could island-hop across the Aegean almost always in sight of land.

Warm-up. Crumple a large sheet of paper into a tight ball, then open it out on the table without flattening it. The ridges are mountains; the low creases are valleys. With a marker, put a dot in each separate low pocket: each is a “city.” Now pour a little imaginary sea around the edges: which cities could reach one another more easily over the ridges, or by going around by water?

Watch. *The Sin Of Pride | Themistocles & The Battle of Salamis | Famous Men of Virtue* (Memoria Press, 7:10). https://www.youtube.com/watch?v=q3qgB0uK-aQ
After the story: watch how Themistocles drew the Persian fleet into the narrow straits at Salamis, and notice how the video talks about the pride that later brought him down.
Note: Captions were not available to check; preview it first.

Backup video. *Why Sparta Beat Athens - The Fall of the Empire - Peloponnesian War* (Kings and Generals, 19:44). https://www.youtube.com/watch?v=loQ1MGcnyWg
As review: watch how Athens's sea empire was finally beaten by Sparta, and look for why ships, grain routes and Persian gold mattered so much. Note: Captions were not available to check; preview it first. The video opens with a sponsor message for a coin seller (skip it), and it is about 20 minutes long, with battle scenes and the destruction of Melos.

KEY TERMS

polis
A Greek city-state: a city and the farmland around it, governing itself with its own laws, gods, army and citizens (plural poleis).

archipelago
A group or chain of islands; the word first named the Aegean Sea itself.

trireme
A Greek warship about 37 m (120 feet) long, rowed by 170 oarsmen in three banks and armed with a bronze ram at the bow.

colony
In Greek history, a new, independent city founded overseas by settlers from a mother city, such as Syracuse (founded from Corinth) or Byzantium (from Megara).

Delian League
An alliance of Greek cities, founded in 478 BC under Athenian leadership against Persia, that Athens gradually turned into an empire.

sea power
Strength that rests on a navy, merchant ships, harbors and command of sea routes, as opposed to strength that rests on a great army.

CORE IDEAS

The story. In September 480 BC the city of Athens stood empty. The great Persian king Xerxes had crossed the Hellespont with the largest army the Greeks had ever seen, broken through at Thermopylae, and marched on Athens. The Athenians had carried their families to the island of Salamis and to towns across the water, and Persian soldiers burned the temples on the Acropolis. Everything now depended on the Greek fleet anchored in the narrow strait between Salamis and the mainland. Its strongest squadron was Athenian, and it existed because of one man. A few years earlier, in about 483 BC, the Athenians had struck a rich new vein of silver in their mines at Laurium. Some wanted to divide the money among the citizens. Themistocles persuaded them instead to build some two hundred triremes. When the Delphic oracle told the Athenians that a “wooden wall” would not be taken, Themistocles argued that the wooden wall meant the ships.

How it worked. Themistocles wanted to fight in the narrows, where the larger Persian fleet could not spread out. According to Herodotus, he sent a trusted servant to tell Xerxes that the Greeks were about to slip away. The Persian ships rowed into the strait in the night to trap them, and in the morning they found themselves crowded together in a channel only about a mile wide, where the Greeks, roughly 370 ships against perhaps twice as many, rammed them as they came. Xerxes watched from a throne on the hillside as his fleet was broken. He soon returned to Asia, and the next year the Greeks defeated his army at Plataea. The ship that won the battle was a narrow, light hull built for speed and ramming. Each trireme carried 170 rowers in three banks (62 in the top bank and 54 in each of the two lower banks) plus about 30 officers, deck hands, marines and archers. In 1987 a full-size reconstruction, the *Olympias*, was launched in Greece, and volunteer crews rowed it at about 9 knots in short bursts. A trireme had little room for food, water or sleeping, so crews landed on a beach for meals and for the night. Greek warships were tied to the shore, and that made the island-studded Aegean perfect for them.

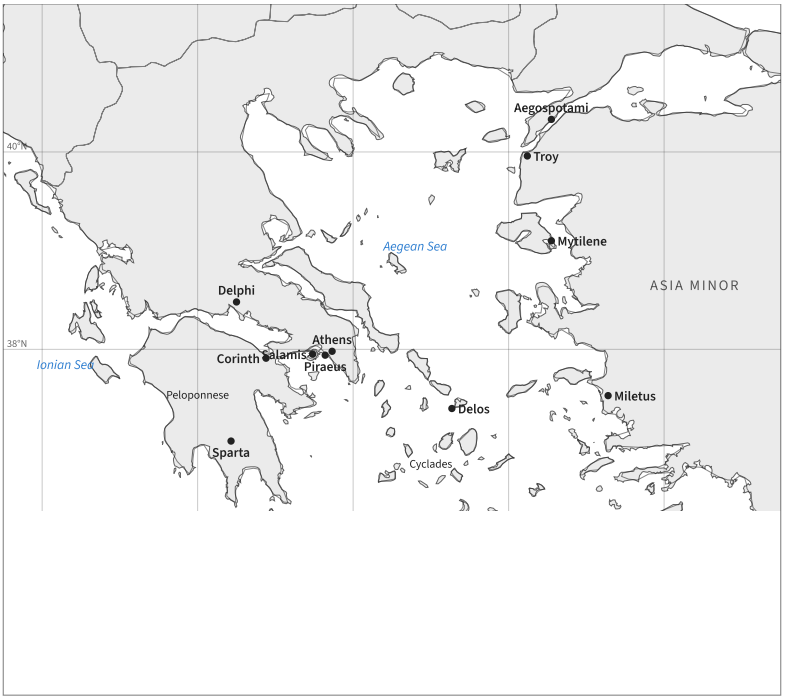
The big idea. The geography of Greece explains why the Greeks were one people but many states. Mountains cover most of the land, cutting it into small valleys and coastal plains, each with room for one city and its fields. Each valley became a **polis**, fiercely independent, with its own laws and army. Athens, Sparta, Corinth and Thebes were sometimes allies and often enemies. Yet nearly every polis lay near the sea, and the sea joined what the mountains divided. Greeks shared a language, gods, the poetry of Homer and the Olympic Games, and when a city grew too crowded for its narrow plain, it sent out settlers by ship to found colonies. Between about 750 and 550 BC Greek cities sprang up from Spain and southern France to the shores of the Black Sea and Sicily. Plato has Socrates say that the Greeks lived

around the sea like frogs around a pond. The border of the Greek world was not a line on land at all; it was the coastline wherever Greeks had settled.

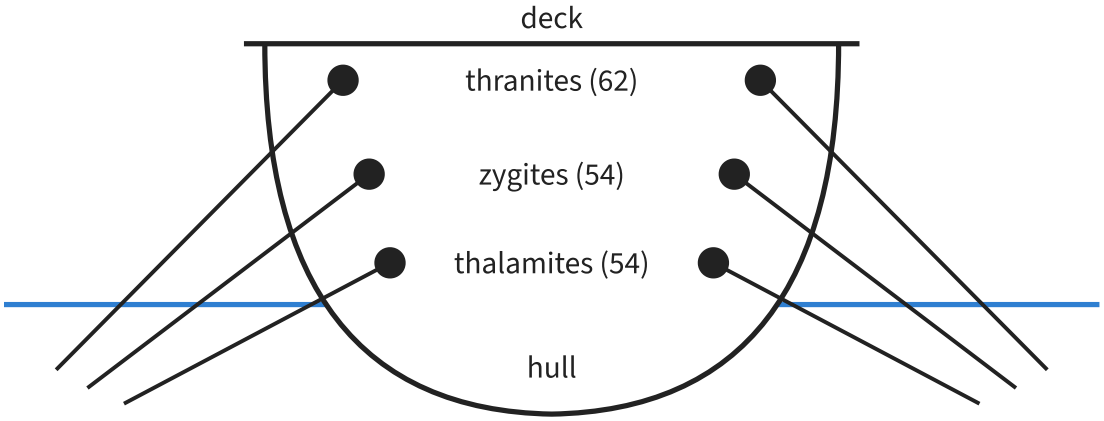
Sea power and its price. After the Persian Wars, Athens led the Delian League, an alliance of island and coastal cities that paid money or ships toward a common fleet. In 454 BC the league treasury was moved from the island of Delos to Athens, and the alliance became an Athenian empire. Athens built the Long Walls, about 6 km (4 miles) long, linking the city to its harbor at Piraeus, so that the city could be supplied by sea even if an enemy army held the countryside. When the Peloponnesian War began in 431 BC, Pericles told the Athenians to treat their city as if it were an island. Sparta, a land power, ravaged the fields of Attica each summer, but Athens lived on grain shipped from the Black Sea through the Hellespont. Athenian sea power had a dark side as well as a bright one. The silver of Laurium was dug by enslaved miners in brutal conditions, and in 416 BC, when the neutral island of Melos refused to join the empire, Athens besieged it, put its men to death and sold its women and children into slavery. In the end, Athens fell when it lost its fleet: in 405 BC the Spartan commander Lysander captured the Athenian ships at Aegospotami on the Hellespont, the grain route was cut, and Athens surrendered in 404 BC.

On the map. The Aegean Sea lies between Greece and Asia Minor, closed to the south by the long island of Crete and opening to the northeast through the Hellespont toward the Black Sea. Greece counts several thousand islands and islets, of which a little over two hundred are inhabited. The Cyclades form a rough circle around the sacred island of Delos. From almost anywhere in the Aegean on a clear day, a sailor can see at least one mountain peak, so early Greek seamen could cross the whole sea without ever losing sight of land. In summer strong northerly winds, called the meltemi today, blow down the Aegean, making southbound voyages quick and northbound ones slow.

Technology overcoming geography. The Isthmus of Corinth, only about 6 km (4 miles) wide, forced ships between the Aegean and the Ionian Sea either to sail all the way around the stormy capes of the Peloponnese or to cross the land. In the 500s BC the Corinthians built the Diolkos, a paved stone trackway on which ships or cargoes were hauled across the isthmus. The emperor Nero began a canal in AD 67, but the work was abandoned. The Corinth Canal was finally opened in 1893, cut through solid rock about 6.3 km (4 miles) long and so narrow, only about 21 to 25 m (70 to 80 feet) wide, that large modern ships cannot use it.



The Aegean world of the Greek city-states.



Blue line: waterline. Total 62 + 54 + 54 = 170 rowers

A trireme in cross-section: 170 rowers in three banks.

PICTURE STUDY

The Dionysus Cup, Exekias (potter and painter), about 530 BC · Black-figure painting on a clay drinking cup (kylix), about 30 cm (12 inches) across · State Collections of Antiquities (Staatliche Antikensammlungen), Munich

Exekias of Athens was one of the greatest Greek vase painters, and he signed his work. Inside this wine cup he painted the god Dionysus reclining in a ship. In the old Greek story, pirates captured Dionysus; he made a vine grow up the mast and turned the terrified sailors into dolphins.

Instead of leaving the clay plain, Exekias covered the inside of the cup with a rich coral-red glaze, so that the sea looks warm and glowing. When a Greek drinker tipped the cup, the wine would cover the ship, so the picture seemed to float on a little sea of wine.

Look closely

- Find the sail. How does Exekias make it stand out against the red sea?
- Count the dolphins. How do they fill the circle and make the picture feel like it is moving?
- Look at the shape of the ship’s hull, its curved stern and the beast’s head at the bow. What does it tell you about Greek ships?
- Follow the vine from the mast. What has grown from it?

Talk about it

1. Why might a Greek artist put a ship and the sea at the very center of an everyday object?
2. How does this cup show that the sea was part of Greek imagination as well as Greek trade and war?

3. Compare this ship with the warships at Salamis. Which features were built for war and which for carrying goods or people?

PROJECT: THE AEGEAN BOARD: ISLAND-HOPPING AND SIGHT LINES

Your fourth game board is the Aegean. It adds a rule found nowhere else in the unit: ships must stay within sight of land or risk getting lost. You will use the horizon formula to set the sight range of each island.

You will need

- Poster board, ruler, compass (drawing tool), pencil and markers
- The map in this lesson or an atlas showing island heights
- A calculator
- Tokens and a six-sided die

Steps

1. Rule a grid with 1 square = 20 km. Draw mainland Greece from Thessaly to the Peloponnese, Crete, the Cyclades, and the coast of Asia Minor from Troy to Rhodes.
2. Choose six islands or headlands and look up the height of their highest point (for example Naxos about 1,000 m, Crete over 2,400 m).
3. For each, compute how far away a sailor whose eye is 2 m above the water could see the peak: $d\ (\text{km}) \approx 3.57 \times (\sqrt{h} + \sqrt{2})$, where h is the peak height in meters.
4. With a drawing compass, draw a circle of that radius (to scale) around each peak. Shade the sea that lies outside every circle: that is “out of sight of land.”
5. Game rule: a ship ending its turn in shaded sea rolls a die; on a 1 or 2 it is lost for a turn. Each player sails a trireme from Piraeus to Miletus and back, landing on an island each night.
6. Add the meltemi: ships moving south move 3 squares; ships moving north move 1.

Tips

- Haze often shortens real sight lines in summer, so your circles show the best case.
- Notice how little of the Aegean ends up shaded; that is the geographic secret of Greek seafaring.

Check your work

- My board has a scale and at least ten correctly placed places.
- I computed sight distances for six peaks and drew them to scale.
- I can explain why the Aegean taught the Greeks to be sailors.

MAP NOTEBOOK

1. Draw an outline of Greece and the Aegean and shade the mountain areas. Label Athens, Sparta, Corinth, Thebes and Delos.

2. Sketch the Battle of Salamis in three small frames: the Persians entering the strait at night, the battle at dawn, and Xerxes watching from the shore.
3. Draw the cross-section of a trireme and label the three banks of rowers with their numbers.

> **From history.** About AD 50 the apostle Paul crossed the northern Aegean from Asia into Europe, the same direction Xerxes had taken, but on a very different errand. After a vision of a man of Macedonia asking for help (Acts 16:9), he sailed from Troas by way of the island of Samothrace to Neapolis and carried the gospel into Europe at Philippi. A little later, standing before the council of the Areopagus in Athens, a city full of temples, he spoke the words that are the series verse of this course (Acts 17:26).

WORKED EXAMPLES

Example 1. A sailor whose eye is 2 m above the sea looks toward an island peak 1,000 m high. Using $d\ (\text{km}) \approx 3.57 \times (\sqrt{h_1} + \sqrt{h_2})$, how far away can the peak first be seen?

1. $\sqrt{1{,}000} \approx 31.6$ and $\sqrt{2} \approx 1.41$.
2. Sum: $31.6 + 1.41 = 33.0$.
3. Distance: $3.57 \times 33.0 \approx 118$ km.
4. In miles: $118 \div 1.609 \approx 73$ miles.

Answer: About 118 km (73 miles) in perfectly clear air. Since the islands of the central Aegean are mostly much closer together than that, a sailor could almost always see land ahead or behind.

Example 2. Athens wanted a fleet of 200 triremes. Each needed 170 rowers and about 30 other men. How many men were needed to crew the whole fleet, and how does that compare with Herodotus's figure of about 30,000 Athenian citizens?

(Use the map or drawing "Each trireme carried 62 + 54 + 54 = 170 rowers." shown earlier in this lesson.)

1. Rowers: $200 \times 170 = 34{,}000$.
2. Others: $200 \times 30 = 6{,}000$.
3. Total: $34{,}000 + 6{,}000 = 40{,}000$ men.
4. That is more than all the citizen men Herodotus counted.

Answer: About 40,000 men, more than the whole citizen body. Athens had to fill the benches with poorer citizens, resident foreigners, allies and others, and the poorest citizens, who rowed the fleet, gained a strong voice in Athenian democracy.

Example 3. In 427 BC, Thucydides tells us, Athens sent a second trireme racing to Mytilene to cancel an order to kill its men; the crew rowed without stopping, eating at their oars. Suppose it covered about 300 km (160 nautical miles) in about 24 hours. What was its average speed?

(Use the map or drawing "Trace a route from Piraeus to Lesbos." shown earlier in this lesson.)

1. Speed in km/h: 300 ÷ 24 = 12.5 km/h.
2. Speed in knots: 160 ÷ 24 ≈ 6.7 knots.
3. Compare with the Olympias, which reached about 9 knots in short bursts: a crew could not hold top speed for a day, so 6 to 7 knots is a hard but believable sustained pace.

Answer: About 12.5 km/h, or about 6.7 knots (7.8 mph). The ship arrived just as the first order was being read, and the people of Mytilene were spared.

PRACTICE

1. EASY What was a polis, and why were there so many in Greece?
2. EASY What did Themistocles persuade the Athenians to do with the silver from Laurium?
3. EASY How many rowers did a trireme carry, and how were they arranged?
4. EASY Why did Themistocles want to fight in the strait of Salamis rather than in open water?
5. MEDIUM Find the sight distance of a 300 m hill for a sailor whose eye is 2 m above the water. Use $d \approx 3.57 \times (\sqrt{h_1} + \sqrt{h_2})$.
6. MEDIUM The Long Walls ran about 6 km from Athens to Piraeus. How long would a mule cart moving at 4 km/h take to bring grain from the harbor to the city? Why did that matter in wartime?
7. MEDIUM The Diolkos was about 6 km long. If a ship was hauled across it at 2 km/h, how long did the crossing take? Compare that with sailing about 400 km around the Peloponnese at 5 km/h.
8. MEDIUM Use the map. Which island group surrounds Delos, and why was Delos a fitting place for the treasury of an alliance of island cities?
   (Use the map or drawing "Find Delos." shown earlier in this lesson.)
9. HARD Explain Pericles's strategy at the start of the Peloponnesian War. Why did he tell the Athenians to think of their city as an island?
10. HARD Redo the Mytilene race at a steadier 5 knots. How long would 160 nautical miles take? What would that have meant for the people of Mytilene?
11. CHALLENGE How did losing its fleet at Aegospotami (405 BC) end the Peloponnesian War? Answer using geography.
12. CHALLENGE Sea power made Athens both a defender of Greek freedom and an imperial ruler. In a paragraph, give evidence for both sides, judging Athens by the standards of its own age.

COMMON MISTAKES

- Thinking “Greece” was one country in ancient times. It was a world of hundreds of independent city-states that shared a language and culture but often fought each other.
- Imagining triremes as ships that cruised for weeks at sea. They had almost no room for food, water or sleep and normally landed every night.
- Treating Athenian democracy and Athenian empire as separate stories. The same fleet, rowed by the same citizens, did both.

Make it a game · Polis Pairs. Write the names of eight Greek places on cards (Athens, Sparta, Corinth, Syracuse, Byzantium, Delos, Miletus, Salamis) and eight facts on other cards (for example, “won by triremes in 480 BC,” “colony of Corinth,” “treasury of the Delian League”). Shuffle and lay them face down. Players turn over two at a time and keep matching pairs. Score a bonus point for pointing to the place on the map.

Scripture. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;” (Acts 17:26, KJV)

Paul spoke these words in Athens, the proudest city of a people divided into many small states by mountains and sea. The Greeks thought of themselves as different from all “barbarians”; Paul told them that God made all nations of one blood and set their times and bounds.

Practice answers

1. A self-governing city-state: a city with its surrounding farmland. Mountains divided Greece into many small valleys and plains, each able to support one independent city.
2. Build a fleet of about 200 triremes instead of dividing the money among the citizens.
3. 170 rowers in three banks: 62 in the top bank and 54 in each of the two lower banks.
4. In the narrow strait the larger Persian fleet could not spread out or use its numbers; its ships got in each other’s way while the Greeks rammed them.
5. $\sqrt{300} \approx 17.3$; $\sqrt{2} \approx 1.41$; sum 18.7; $3.57 \times 18.7 \approx 67$ km (about 41 miles).
6. $6 \div 4 = 1.5$ hours. Because the walls protected the road, grain landed at Piraeus could reach the city in a couple of hours even while a Spartan army held the fields outside.
7. $6 \div 2 = 3$ hours across the isthmus. Around the Peloponnese: $400 \div 5 = 80$ hours of sailing, more than three days, plus the danger of the stormy southern capes.
8. The Cyclades (“circling islands”). Delos lay in the middle of the Aegean islands, was sacred to Apollo and belonged to no great power, so it suited a league of many island and coastal cities.
9. Sparta had the stronger army; Athens had the stronger navy. Pericles had the country people move inside the walls, let Sparta ravage the fields, and fed the city by sea through Piraeus and the Long Walls while the fleet raided enemy coasts. Behind its walls and with its fleet, Athens behaved like an island that land armies could not starve.
10. $160 \div 5 = 32$ hours, about 8 hours longer. The second ship arrived only just in time, so at that pace it would very likely have come too late and the first order would already have been carried out.

11. Athens depended on grain shipped from the Black Sea through the Hellespont. When Lysander destroyed the Athenian fleet at Aegospotami on the Hellespont, Sparta controlled the grain route and could blockade Piraeus. Without ships Athens could no longer act as an island; it was starved into surrender in 404 BC.
12. A strong answer credits Athens with saving Greece at Salamis and leading the defense against Persia, and with a democracy in which poor rowers had a voice. It also names the wrongs plainly: the Delian League’s money taken to Athens, allies forced to stay, enslaved miners at Laurium, and the killing and enslavement of the people of Melos in 416 BC. Even many Greeks of the time, including Thucydides, recorded these acts as harsh.

5.5 Sicily and Malta: Islands at the Crossroads

OBJECTIVES

- Locate Sicily and Malta at the narrow waist of the Mediterranean and measure the gaps that make them crossroads: the Strait of Messina, the Strait of Sicily and the channel between Sicily and Malta.
- Narrate the Great Siege of Malta (1565) and the siege of Malta in the Second World War, and explain why great powers fought so hard for such small islands.
- Contrast crossroads islands, which are prizes that change hands, with large, distant islands such as Britain and Japan, which became powers in their own right.

Warm-up. Lay a long strip of blue paper or a towel across the table as the Mediterranean. Pinch it in the middle with your fingers so it narrows like a waist. Put a coin at the pinch. Ask: if you were a merchant sailing from one end to the other, could you avoid passing near the coin? If you owned the coin, what could you do to every ship that passed?

Watch. *Great Siege of Malta 1565 - Ottoman Wars DOCUMENTARY* (Kings and Generals, 23:26). https://www.youtube.com/watch?v=gcyzP8pxjJ8
After the story: watch the animated maps of the 1565 siege, and look for how Malta's harbors and forts let the Knights hold out against Suleiman's fleet.
Note: Captions were not available to check; preview it first. It includes a Skillshare sponsor message (skip it), battle violence and heavy losses, and it runs about 23 minutes.

Backup video. *Operation Ladbroke: Sicily 1943* (The History Guy: History Deserves to Be Remembered, 19:36). https://www.youtube.com/watch?v=HZfjyW4IiYc
As review: watch how Allied gliders tried to land in Sicily the night before the 1943 invasion, and notice why the island's place in the middle of the sea made it a target. Note: Captions were not available to check; preview it first. Many glider soldiers drowned when their gliders came down in the sea, which may be hard for younger children. Operation Ladbroke was the glider landing that opened Operation Husky; the video covers only that part of the invasion.

KEY TERMS

crossroads island
An island lying on or between major sea routes, so that whoever holds it can watch, protect or cut the traffic passing by.

Strait of Messina
The narrow channel, about 3 km (2 miles) wide at its narrowest, between Sicily and the toe of Italy.

Strait of Sicily

The sea passage, about 145 km (90 miles) wide, between western Sicily and Cape Bon in Tunisia, joining the western and eastern basins of the Mediterranean.

Knights of St John
A Catholic religious and military order (the Knights Hospitaller), founded to care for pilgrims in Jerusalem, which ruled Rhodes and then Malta from 1530 to 1798.

siege
An attempt to capture a fortified place by surrounding it, cutting off supplies and attacking its walls.

convoy
A group of merchant ships sailing together under the protection of warships.

CORE IDEAS

The story. On 18 May 1565 the lookouts of Malta saw the sea fill with sails. The Ottoman sultan Suleiman the Magnificent had sent one of the great fleets of the age, carrying an army that historians estimate at 30,000 to 40,000 men, to take the island from the Knights of St John. The Knights had been driven out of Rhodes by Suleiman himself in 1522, and in 1530 the Emperor Charles V had given them Malta. From its harbors their galleys raided Ottoman shipping. Against the invaders, the Grand Master, Jean Parisot de Valette, then about seventy years old, had perhaps 6,000 to 9,000 defenders: around 500 Knights, Spanish and Italian soldiers, and several thousand Maltese militia. Their hope lay in Sicily, 93 km (58 miles) to the north, where the Spanish viceroy was gathering a relief force.

How it worked. The siege was shaped by the ground. Malta's Grand Harbour is a deep inlet with rocky fingers of land reaching into it. On the bare ridge of Mount Sciberras at its mouth stood the small star fort of St Elmo; across the water, the Knights' towns of Birgu and Senglea sat on two peninsulas behind walls and ditches cut in the rock. The Ottomans attacked St Elmo first so that their fleet could use the neighboring harbor. Their engineers found the ground there almost solid limestone, too hard for trenches, and had to haul earth to build cover for their guns. The little fort was expected to fall in days; it held for about a month, until 23 June. The great corsair commander Dragut was mortally wounded during the fighting there. Both sides then acted with terrible cruelty. The Ottomans floated the bodies of slain knights across the harbor tied to wooden crosses; Valette answered by having Ottoman prisoners beheaded and firing their heads from his guns into the enemy camp. Through July and August the Ottomans assaulted Birgu and Senglea again and again, and failed. Disease, heat and the lack of water and wood on the bare island wore them down. On 7 September a relief army from Sicily landed in the north of the island; on 8 September the Ottomans abandoned the siege, and after a last defeat near St Paul's Bay on 11 September their fleet sailed away. The Maltese still keep 8 September as Victory Day.

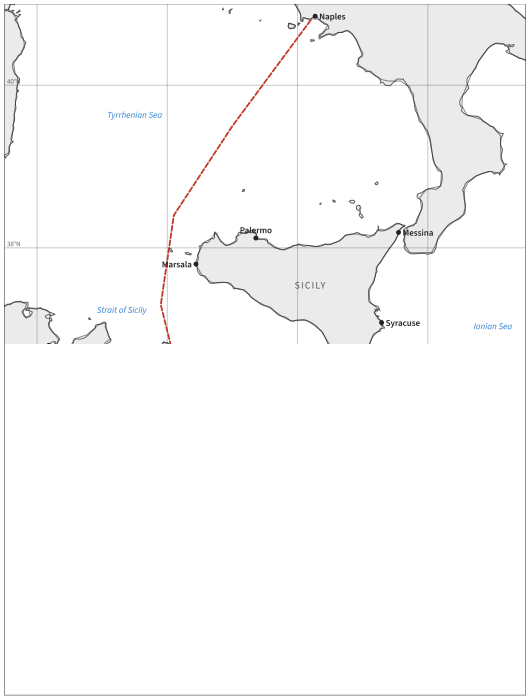
The big idea. Look at the Mediterranean on a map and you will see that it has a waist. Sicily nearly closes the gap between Italy and Africa, and Malta sits just south of it in the Strait of Sicily. Ships passing between the western and eastern basins must go within reach of these islands. That is why almost every power that wanted the Mediterranean wanted Sicily and Malta. Greeks founded Syracuse in Sicily (from Corinth, in about 733 BC), while the

Phoenicians of Carthage held the western tip. Rome took Sicily in the First Punic War as its first province, and the island became one of Rome's granaries. Byzantines, then Arab rulers from North Africa (who began their conquest in 827), then Normans under Roger I and his son Roger II, crowned king in 1130, held it in turn. Under the Normans, Palermo mixed Latin, Greek and Arabic learning and art in a way few cities ever have. Large, distant islands like Britain and Japan became powers in their own right. Small crossroads islands became prizes: rich in position, but usually ruled from somewhere else. Malta, for example, did not become an independent country until 1964.

Nearly four centuries later, the same geography. When Italy entered the Second World War in June 1940, Malta was a British naval and air base lying across the supply route from Italy to the Axis armies in Libya. Ships and aircraft from Malta sank Axis convoys bound for Tripoli, so Italian and German bombers pounded the island for two years; by 1942 it was one of the most heavily bombed places on earth. On 15 April 1942 King George VI awarded the whole island the George Cross for its courage, and the cross is still on Malta's flag. Food and fuel ran so low that the island came close to surrender. In August 1942 a convoy called Operation Pedestal fought its way through; most of the merchant ships were sunk, but on 15 August the crippled tanker *Ohio*, lashed between destroyers, was brought into the Grand Harbour with the fuel that kept Malta's aircraft flying. The next summer the Allies used Malta as a base for Operation Husky, the invasion of Sicily, which began on 10 July 1943 and ended on 17 August.

On the map. Sicily is the largest island in the Mediterranean, about 25,700 km² (9,900 square miles), triangular, with the volcano Etna, about 3,300 m (10,900 feet) high, on its east coast. The Strait of Messina, only about 3 km (2 miles) wide at its narrowest, separates it from Italy; the Strait of Sicily, about 145 km (90 miles) wide, separates it from Tunisia. Malta, Gozo and Comino together cover only about 316 km² (122 square miles), a little less than twice the area of Washington, D.C., 93 km (58 miles) south of Sicily. The apostle Paul was shipwrecked there in about AD 60, on his way to Rome as a prisoner, and the islanders showed him and his shipmates kindness (Acts 28:1–2).

Technology overcoming geography. Aircraft and radar turned Malta into what some called an unsinkable aircraft carrier: from its airfields, planes could strike convoys hundreds of kilometers away. A bridge across the Strait of Messina has been proposed for more than a century; as of 2026 it has not been built, and Sicily is still reached by ferry, ship and air.



Sicily and Malta at the waist of the Mediterranean, with the Axis supply route of 1941–1942.

PICTURE STUDY

The Siege of Malta: Siege and Bombardment of Saint Elmo, 27 May 1565, Matteo Perez d'Aleccio, late 1500s (after his frescoes of 1576–1581) · Oil on canvas, one of a series of eight · National Maritime Museum, Greenwich (Royal Museums Greenwich). The artist's fresco cycle of the siege is in the Hall of St Michael and St George, Grand Master's Palace, Valletta, Malta.

About a decade after the siege, the Knights hired the Italian painter Matteo Perez d'Aleccio to paint its story around the walls of the great hall of their new palace in Valletta. He worked from the accounts of men who had fought, and the scenes march around the room from the

arrival of the Ottoman fleet to the coming of the relief army. He also painted the story in oil on canvas, and a set of eight of these paintings is now at the National Maritime Museum in Greenwich, England.

This one shows the Ottoman attack on Fort St Elmo, the small star-shaped fort at the tip of the peninsula between Malta's two great harbors, in late May 1565, seen from behind the Ottoman lines. Like the frescoes, it is almost a map: harbors, peninsulas, forts and batteries are painted from high above, as a bird would see them. His scenes were later published as engravings and became the way Europe pictured the siege.

Look closely

- Find Fort St Elmo on the point of land between two harbors. Why would its position make it the Ottomans' first target?
- Find the Ottoman tents and gun batteries. How close have the gunners dug in to the fort?
- Find the smoke of the guns. Where is the fighting heaviest?
- Look at how small the people are compared with the land and sea. What is the painter most interested in showing?

Talk about it

1. Why might a painter of a battle choose a bird's-eye view instead of a close-up of soldiers?
2. How does the shape of the harbor in the painting help explain why the defenders could hold out?
3. These paintings were made for the Knights' own palace. How might that affect the story they tell?

PROJECT: GRAND HARBOUR IN A SAND TRAY, AND THE FINAL BOARD

Build a model of Malta's Grand Harbour to see why the defenders could hold, then make the last board of your island-defense game: the waist of the Mediterranean, with Sicily, Malta and the convoy routes.

You will need

- A shallow tray or baking pan, damp sand or play dough
- Sugar cubes, small blocks or LEGO bricks for walls and forts
- A cup of water and a spoon; toothpicks and paper for flags
- Poster board, markers, tokens, dice

Steps

1. Using a map of Grand Harbour, shape a deep inlet with a long ridge at its mouth (Mount Sciberras) and two shorter fingers of land opposite (Birgu and Senglea). Pour water carefully into the inlet.

2. Build a small fort at the tip of the ridge (St Elmo) and walls across the necks of the two peninsulas. Flag each.
3. Place “attacker” tokens on the open ridge and count from how many directions they can reach each fort. Record which forts can be attacked only across a narrow neck of land.
4. Now draw the final game board at 1 square = 20 km: Sicily, Malta, the toe of Italy and the coast of Tunisia and Libya, with Naples and Tripoli marked.
5. Rules: the Axis player moves convoys from Naples to Tripoli; the Malta player may attack any convoy within 10 squares (200 km) of Malta on a roll of 4, 5 or 6. Each turn the Axis player may instead bomb Malta, reducing its attacks for the next two turns.
6. Play three convoys. Record how many reached Tripoli and how many were sunk.

Tips

- Keep the sand damp so the peninsulas hold their shape when you add water.
- The game shows the dilemma of 1941–1942: every bomb dropped on Malta was a bomb not dropped elsewhere, but every convoy sunk was an army in Africa without fuel.

Check your work

- My harbor model shows the ridge, the two peninsulas and the inlet.
- My board shows Malta, Sicily, Naples and Tripoli at the right scale.
- I can explain why Malta mattered in both 1565 and 1942.

MAP NOTEBOOK

1. Draw the central Mediterranean and label the three gaps with their widths: Strait of Messina (3 km), Sicily to Malta (93 km), Strait of Sicily (145 km).
2. Make a ribbon timeline of the rulers of Sicily: Greeks and Carthaginians, Romans, Byzantines, Arabs, Normans, and on to modern Italy, with one date for each.
3. Sketch the Maltese flag with the George Cross in the corner and write one sentence about why it is there.

> **From history.** On 28 March 1566, six months after the siege, Grand Master de Valette laid the first stone of a new fortified city on Mount Sciberras, the very ridge from which the Ottomans had bombarded the harbor. Planned by the Italian military engineer Francesco Laparelli with a regular grid of streets and massive bastions, it was named Valletta after him. Valletta is still the capital of Malta.

WORKED EXAMPLES

Example 1. The Ottoman fleet arrived on 18 May 1565 and the siege was lifted on 8 September. How many days did the Great Siege last?

1. Days remaining in May after the 18th: 31 − 18 = 13.
2. June: 30. Running total 43.
3. July: 31. Running total 74.
4. August: 31. Running total 105.
5. September 1–8: 8. Total 113.

Answer: 113 days, nearly four months. The defenders had to hold through the whole summer campaigning season, which is why the delay at Fort St Elmo (about a month) mattered so much.

Example 2. Valletta is at about 35.9° N, 14.5° E. An Axis convoy passing near Pantelleria is at about 36.0° N, 12.3° E. Estimate the distance, and how long an aircraft from Malta flying at 300 km/h would need to reach it. (1° latitude ≈ 111 km; cos 36° ≈ 0.81.)

(Use the map or drawing "Measure from Malta to the convoy route near Pantelleria." shown earlier in this lesson.)

1. North–south: 36.0 − 35.9 = 0.1°; 0.1 × 111 ≈ 11 km.
2. East–west: 14.5 − 12.3 = 2.2°; 2.2 × 111 × 0.81 ≈ 198 km.
3. Distance: $\sqrt{(11^2 + 198^2)} \approx \sqrt{(121 + 39{,}204)} \approx 198$ km (about 123 miles).
4. Time: 198 ÷ 300 ≈ 0.66 hour ≈ 40 minutes.

Answer: About 200 km (125 miles), roughly 40 minutes' flight. Convoys could not route far enough from Malta to escape its aircraft, which is why the Axis tried to bomb the island into helplessness.

Example 3. In 1565 Malta's relief came from Sicily, about 93 km away; the Ottomans' home base at Constantinople lay roughly 1,600 km away by sea. If galleys averaged 5 km/h, how long was each voyage? What advantage did this give the defenders?

1. From Sicily: 93 ÷ 5 ≈ 19 hours, less than a day.
2. From Constantinople: 1,600 ÷ 5 = 320 hours ≈ 13 days of rowing and sailing, in practice longer with stops for water.
3. Ratio: 1,600 ÷ 93 ≈ 17 times as far.

Answer: Less than a day from Sicily against about two weeks or more from Constantinople. The defenders' help and supplies were close; the attackers' reinforcements, food, powder and replacement men were far away, and every week of siege used up what they had brought.

PRACTICE

1. EASY How wide is the Strait of Messina at its narrowest? Which two lands does it separate?
2. EASY Who ruled Malta from 1530 to 1798, and who gave them the island?
3. EASY What honor did Malta receive on 15 April 1942, and from whom?
4. EASY What name does the King James Bible give Malta, and how did the islanders treat Paul and his shipmates?
5. MEDIUM Operation Husky began on 10 July 1943 and the campaign in Sicily ended on 17 August 1943. How many days did it last?
6. MEDIUM Sicily covers about 25,700 km² and the Maltese islands about 316 km². About how many times larger is Sicily? Give both areas in square miles.
7. MEDIUM Use the map. Which of the three gaps (Messina, Sicily to Malta, the Strait of Sicily) must a ship pass to sail from Carthage's coast to the eastern Mediterranean without going through the Strait of Messina? Why is that gap the true waist of the sea? *(Use the map or drawing "Find the three gaps." shown earlier in this lesson.)*
8. MEDIUM Put these rulers of Sicily in order and give one date for each: Normans, Romans, Arabs, Greek colonists.
9. HARD Malta lies about 355 km (220 miles) from Tripoli. How long would a bomber flying at 350 km/h take to reach Tripoli harbor? What does this tell you about Malta's value in 1941–1942?
10. HARD In 1565 the defenders were outnumbered roughly 5 to 1. Give three geographic reasons they were able to hold.
11. CHALLENGE "Crossroads islands are prizes, not powers." Test this statement against Sicily and Malta, and contrast them with Britain and Japan.
12. CHALLENGE Compare the three moats you have studied in this unit: the Strait of Messina (3 km), the Strait of Dover (33 km) and the Korea Strait (200 km). Compute how many times wider Dover is than Messina, and Korea than Dover, and explain how the width of the moat relates to the history of each island.

COMMON MISTAKES

- Thinking a small island is unimportant. Position, not size, made Malta worth a great siege in 1565 and two years of bombing in 1940–1942.
- Remembering only one side's cruelty in 1565. Both the Ottomans and the Knights killed prisoners, and both sides kept galley slaves taken in raids.
- Confusing the Strait of Messina, a narrow channel between Sicily and Italy, with the Strait of Sicily, the wide passage between Sicily and Tunisia.

Make it a game · Who Held the Island?. One player calls out a year: 733 BC, 241 BC, AD 60, 827, 1130, 1565, 1942 or 1943. The other says which island it belongs to (Sicily or Malta), who held or attacked it, and why the island's position mattered that year. Two points for a complete answer, one for a partial answer. Switch roles after each round.

Scripture. "And when they were escaped, then they knew that the island was called Melita." (Acts 28:1, KJV)

Luke's account of Paul's shipwreck, with its soundings, anchors and winter harbors, reads like a sailor's log. The same island that later stood two great sieges first appears in Scripture as a place of rescue and kindness.

Practice answers

1. About 3 km (2 miles); Sicily and the toe of mainland Italy (Calabria).
2. The Knights of St John (the Knights Hospitaller), who received it from the Emperor Charles V after losing Rhodes to the Ottomans in 1522.
3. The George Cross, awarded to the whole island by King George VI for its courage under siege.
4. Melita (Acts 28:1). They showed them "no little kindness," building a fire because of the rain and cold (Acts 28:2).
5. July 10 to 31 is 21 days; plus 17 in August = 38 days.
6. 25,700 ÷ 316 ≈ 81 times. About 9,900 square miles and about 122 square miles.
7. The Strait of Sicily, between Sicily and Tunisia. It is the narrowest passage between the western and eastern basins that large ships can use freely, so nearly all east–west traffic passes through it, within reach of Sicily, Malta and Tunisia.
8. Greek colonists (Syracuse founded about 733 BC); Romans (first province, 241 BC); Arabs (conquest began AD 827); Normans (Roger II crowned king, 1130).
9. 355 ÷ 350 ≈ 1 hour. Aircraft from Malta could strike both the convoys at sea and the port where Axis supplies were unloaded, threatening the whole supply line to North Africa.
10. Any three: the rocky peninsulas of Birgu and Senglea could be attacked only across narrow necks of land; the hard limestone made it difficult for the Ottomans to dig trenches; the island had little water, wood or food for a besieging army; the defenders could expect help from nearby Sicily while the attackers were far from home; and the siege had to succeed within one summer sailing season.
11. A strong answer notes that Sicily was ruled in turn by Greeks, Carthaginians, Romans, Byzantines, Arabs, Normans and others, and Malta by many powers until 1964, because their position made them valuable to every Mediterranean empire, while they were too small or too

close to the mainland powers to defend themselves alone. Britain and Japan, larger and set off by wider moats on the edge of their regions, could build their own fleets and states. It may also note exceptions, such as the Norman Kingdom of Sicily, which was a real power for a time.

12. Dover ÷ Messina = 33 ÷ 3 = 11 times; Korea ÷ Dover = 200 ÷ 33 ≈ 6 times. Sicily, with the narrowest moat, was conquered again and again; Britain, with a moderate moat, was invaded successfully only when the defender lost command of the sea (1066, 1688); Japan, with the widest, was invaded seriously only twice before modern times and could even close itself off for two centuries.

Unit 5 test

Answer each question. Show your work for calculations, give units (km and miles where asked), and use complete sentences for explanations. The test is worth 100 points.

1. (6 pts) Explain Philip II's plan for the Armada in 1588. What was the Armada supposed to do, what was the Duke of Parma supposed to do, and why did the two never join?
2. (6 pts) English sources say the fireships were sent into the Armada on the night of 28 July 1588. Give the New Style date, and explain why the two calendars differed.
3. (6 pts) The Strait of Dover is about 33 km wide. How long would a barge moving at 3.7 km/h (2 knots) take to cross it? Give the width in miles too.
4. (8 pts) Invasions of England failed in 1588, 1803–1805 and 1940 but succeeded in 1066 and 1688. State the rule that explains the difference and apply it to two of these cases.
5. (6 pts) The Korea Strait is about 200 km wide. Convert this to miles and compare it with the Strait of Dover. Name the two islands that serve as stepping stones.
6. (8 pts) Give three reasons the Mongol invasion of 1281 failed.
7. (6 pts) What was sakoku? Give two of its rules and explain what Dejima was.
8. (8 pts) Explain how Commodore Perry's ships in 1853–1854 showed that technology had changed Japan's geography. Give the dates of his arrival and of the Treaty of Kanagawa.
9. (6 pts) What does mare nostrum mean? Give the approximate length of the Mediterranean and the width of the Strait of Gibraltar, in both units.
10. (8 pts) Ostia is about 570 km (310 nautical miles) from Carthage. How many hours would a ship averaging 5 knots take? Convert to days. What point did Cato make with his figs?
11. (6 pts) Using $d\ (\text{km}) \approx 3.57 \times (\sqrt{h_1} + \sqrt{h_2})$, find how far a sailor whose eye is 2 m above the sea can see a 600 m island peak.
12. (8 pts) How did geography make Athens both a sea power and vulnerable at sea? Use Salamis, the Long Walls and Aegospotami in your answer.
13. (8 pts) Malta lies about 93 km south of Sicily. (a) How long would a convoy at 15 knots (27.8 km/h) take to cover that distance? (b) Explain why Malta mattered in both 1565 and 1942.
14. (10 pts) Essay: Compare Britain, Japan and Sicily as islands. Use the widths of their moats (33 km, 200 km, 3 km), at least one invasion of each, and the role of technology to explain why their histories differ.

Unit project: Island defense: a board game of seas and islands

Combine the boards you built in this unit (the English Channel, the Korea Strait, the Aegean, the Roman Mediterranean and the waist of the Mediterranean around Sicily and Malta) into one island-defense board game. Each board should be drawn to a stated scale with a scale bar, and each should use rules drawn from real geography: wind and tide, typhoon season, sight of land, the sailing season, choke points and the range of aircraft.

Add a deck of at least 15 history cards (for example “Fireships at Calais,” “The wall at Hakata Bay,” “Pompey clears the pirates,” “The *Ohio* reaches Grand Harbour”), each with a date and a one-sentence explanation. Playtest the game at least three times with family or friends, keep a record of every game, and write a one-page designer’s note explaining what the game teaches about why the sea protects only the side that commands it.

- **Geographic accuracy**: Every board has a scale bar, correctly placed places and correct distances for the key straits (Dover, Korea, Gibraltar, Messina, Sicily).
- **Rules from real geography**: The rules reflect real winds, seasons, sight lines, choke points and technologies, and each rule can be traced to a lesson.
- **History cards and playtest record**: At least 15 accurate, dated history cards; three recorded playtests with results and changes made.
- **Designer’s note**: A clear page explaining how the game shows that the sea is a moat only for the side that commands it, with at least three real examples from the unit.

Answer key

1. The Armada was to sail up the Channel, win control of the narrow sea and protect a crossing; Parma was to ferry his veteran army from Flanders to Kent in barges. They never joined because the Spanish had no deep-water harbor on that coast for the big ships, Dutch ships blockaded Parma’s barges in the shallows, and the English fireships and the battle off Gravelines drove the Armada from its anchorage at Calais into the North Sea.
2. 7 August 1588 (28 July + 10 days = 38 July = 7 August). Spain had adopted the Gregorian calendar in 1582, which dropped 10 days; England kept the Julian calendar until 1752.
3. 33 ÷ 3.7 ≈ 8.9 hours, about 9 hours. 33 km ≈ 21 miles.
4. The sea is a moat only for the side that commands it. In 1588 and 1805 the English fleet held the Channel (Gravelines; Trafalgar), and in 1940 the RAF kept command of the air, so no army crossed. In 1066 Harold’s fleet had broken up and his army was in the north, and in 1688 an east wind pinned James II’s fleet in the Thames estuary, so the invaders crossed unopposed.
5. About 124 miles; about 6 times as wide as the Strait of Dover (33 km, 21 miles). The stepping stones are Tsushima and Iki.
6. Any three: the stone wall along Hakata Bay kept the Eastern Army from landing in force; Japanese raiders attacked the anchored ships in small boats; the Southern Army arrived late, so the combined fleet was still at anchor in August; a typhoon (the kamikaze) wrecked the crowded fleet; some ships appear to have been poorly built river boats unsuited to the open sea.
7. The Tokugawa policy of seclusion from the 1630s. Rules included the ban on Christianity, the expulsion of the Portuguese (1639), forbidding Japanese to travel abroad and limiting trade to controlled gates. Dejima was a small artificial island in Nagasaki harbor where the Dutch were allowed to trade under close watch from 1641.
8. Perry arrived at Uraga in Edo Bay on 8 July 1853 with steam warships that could move against the wind and threaten a blockade of Edo, which depended on coastal shipping. Japan had no ships to match them. The Treaty of Kanagawa (31 March 1854) opened Shimoda and Hakodate. Steam had shrunk the Pacific moat that had protected Japan’s seclusion.
9. “Our sea.” About 2,500 miles (4,000 km) long; the Strait of Gibraltar is just under 9 miles (14 km) wide.

10. 310 ÷ 5 = 62 hours, about 2.6 days. Cato showed that Carthage was only a few days' sail away, so the sea brought Rome's rival dangerously close rather than keeping it far off.
11. √600 ≈ 24.5; √2 ≈ 1.41; sum ≈ 25.9; 3.57 × 25.9 ≈ 92 km (about 57 miles).
12. Athens built a fleet of triremes from the silver of Laurium and won at Salamis (480 BC) by fighting in narrow waters. The Long Walls joined the city to Piraeus so it could live by sea like an island while Sparta held the countryside. But Athens depended on grain from the Black Sea through the Hellespont; when Lysander captured its fleet at Aegospotami (405 BC), the grain route was cut and Athens surrendered in 404 BC.
13. (a) 93 ÷ 27.8 ≈ 3.3 hours. (b) Malta sits in the Strait of Sicily at the waist of the Mediterranean. In 1565 it was the Knights' base for raiding Ottoman shipping and a gateway to the western Mediterranean; in 1942 it was a British base astride the Axis supply route from Italy to Libya, so both sides fought hard to hold or neutralize it.
14. A strong essay notes that Sicily, separated from Italy by only about 3 km and lying at a crossroads, was conquered again and again (Greeks, Romans, Arabs, Normans, the Allies in 1943); Britain, behind 33 km of water, was invaded successfully only when it lost command of the sea (1066, 1688) and turned back the Armada, Napoleon and Hitler; Japan, behind about 200 km, saw only two serious invasions before modern times, defeated both, and could close itself off until steamships opened it in 1853–1854. It notes that technology (steam, aircraft, radar, the tunnel) has narrowed every moat, and that command of the sea, not water alone, has decided the outcome.

UNIT 6

Harbors and Choke Points in History

Some of the most fought-over places on earth are only a few miles wide. A strait where two seas meet, a rock beside a narrow channel, a point of land at the end of a long peninsula, a deep harbor behind a narrow gate: these are the **choke points** and **harbors** where trade is squeezed together and where empires have staked their power. In this unit you will see why Constantine built New Rome on the Bosporus in 330 and how Mehmed II took it in 1453, how Britain came to hold Gibraltar in 1704 and has kept it since the Treaty of Utrecht, how Stamford Raffles founded Singapore in 1819 and how it fell in 1942, and why the narrow waters of the Dardanelles defeated a great fleet and an army in 1915.

Every lesson asks the same two questions: what made this place strong, and what finally made its strength not enough? You will measure straits, currents and distances, work out sailing times and solar time, test whether guns could close a strait, and decide whether a ship can safely enter a harbor on the tide. The unit ends with four of the world's great natural harbors, Sydney, Halifax, Pearl Harbor and San Francisco Bay, and with a harbor-defense model of your own. The series verse reminds us that God "hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26): the shape of coasts and seas is His work, and what nations do with them is their responsibility.

BEFORE YOU BEGIN

- Can convert between kilometers, statute miles and nautical miles, and knows that a knot is one nautical mile per hour
- Can read latitude and longitude and estimate distances with 1° of latitude ≈ 111 km
- Knows the outline of Mediterranean and Roman history from Unit 5 (Seas and Islands)
- Can locate Europe, Asia, Africa, Australia and the Pacific on a world map

MASTERY CHECKLIST

- I can define a choke point and a natural harbor and give real examples of each.
- I can explain why Constantine chose the Bosporus and how Mehmed II overcame the city's geography in 1453.
- I can tell how Britain gained Gibraltar (1704, 1713) and explain why a base beside a strait matters even when guns cannot close it.
- I can explain why Singapore was founded where it was and give geographic reasons for its fall in 1942.
- I can explain why narrow waters defeated the Allied fleet at the Dardanelles in 1915 and why the Gallipoli landings stalled.
- I can use charted depth, tide and draft to decide whether a ship can enter a harbor.

OPTIONAL BOOKS AND RESOURCES

- **Australian War Memorial** (https://www.awm.gov.au/): Free. Photographs, diaries, maps and paintings of the Gallipoli campaign, including George Lambert's Anzac, the landing 1915 (Lesson 6.4).
- **Naval History and Heritage Command** (https://www.history.navy.mil/): Free. The U.S. Navy's official history site, with photographs, maps and accounts of the attack on Pearl Harbor and its salvage (Lesson 6.5).
- **Library of Congress: Maps Collection** (https://www.loc.gov/maps/): Free. Search for historic charts and maps of Constantinople, Gibraltar, Singapore, San Francisco Bay and Halifax to compare with the lesson figures.

6.1 Constantinople

OBJECTIVES

- Explain why Constantine chose the site of Byzantium on the Bosporus for his new capital in 330, using the ideas of a choke point, a defensible site and a central position between frontiers.
- Describe the defenses of Constantinople (the three waters, the Golden Horn chain and the Theodosian Walls) and explain how they held the city through many sieges.
- Explain how Mehmed II overcame the city's geography in 1453 with a fortress on the Bosporus, great cannon and an overland haul of ships, and why a fortress city cannot stand forever without the land around it.

Warm-up. Cut a triangle about the size of your hand out of a sheet of paper and lay it on a dark table or towel. Pretend the table is water. On which sides could an enemy reach your triangle only by boat? Now lay a pencil across the one side that touches "land." If you had to build one strong wall, where would it go, and how long would it be compared with the whole edge of the triangle? Spend two minutes, then compare your answer with the shape of Constantinople in the figure.

Watch. *When did Constantinople become Istanbul? (Short Animated Documentary)* (History Matters, 2:50). https://www.youtube.com/watch?v=Lq8o2QjnqwM
As review: after reading about Constantine's city and its fall in 1453, watch this short cartoon to learn when and why the name Constantinople gave way to Istanbul.
Note: Captions were not available to check; preview it first. The channel sometimes uses light, joking humor. The video is about the city's names more than its founding; it does not tell the 330 dedication story.

Backup video. *Hagia Sophia and the Byzantine Empire* (Drive Thru History with Dave Stotts, 3:07). https://www.youtube.com/watch?v=TNRn0tI44tw
With the big idea: watch Dave Stotts inside Hagia Sophia, and look up at the great dome that made it the largest church in the world for about a thousand years. Note: Captions were not available to check; preview it first. The video description includes a preorder ad. The description says Justinian built Hagia Sophia starting in 537; building actually began in 532, and the church was dedicated in 537.

KEY TERMS

choke point
A narrow place on a route (a strait, a pass or a canal) where traffic is squeezed together, so that whoever holds it can watch, tax or block the traffic.

strait

A narrow channel of sea joining two larger bodies of water. The Bosporus joins the Black Sea to the Sea of Marmara.

Bosporus
The strait, about 19 miles (31 km) long and as narrow as about 2,300 feet (700 m), that divides Europe from Asia at Istanbul.

Golden Horn
A long, deep, sheltered inlet on the north side of old Constantinople; the city's chief harbor, closed in wartime by a great chain.

Theodosian Walls
The triple line of land defenses (moat, outer wall and inner wall) built across the landward side of Constantinople under Emperor Theodosius II, finished about 413.

bombard
A very large early cannon that fired heavy stone balls; Mehmed II's bombards battered the walls of Constantinople in 1453.

CORE IDEAS

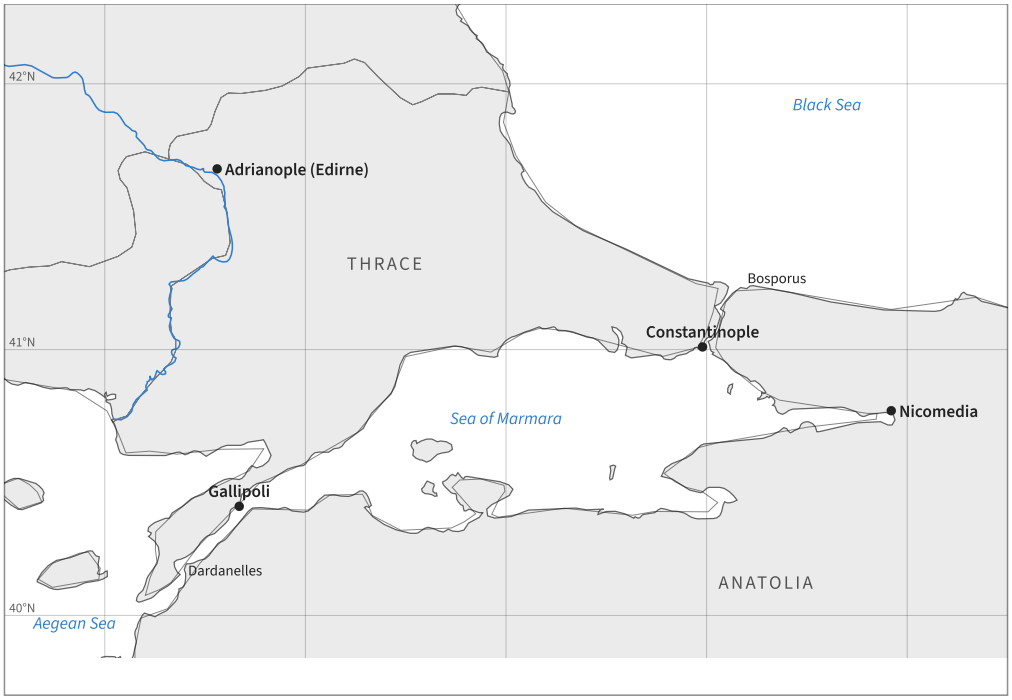
The story. On 11 May 330, Emperor Constantine dedicated a new capital for the Roman world on the site of an old Greek town called Byzantium. Greek settlers, by tradition from the city of Megara, had founded Byzantium in the 600s BC on a hilly point of land where Europe almost touches Asia. Constantine knew the place well. In 324 he had beaten his rival Licinius at Chrysopolis, just across the water on the Asian shore, and become sole ruler of the empire. He marked out walls far wider than the old town's, filled the city with churches, a palace, a great racecourse and statues brought from all over the empire, and called it New Rome. People soon called it Constantinople, "Constantine's city." Eleven centuries later, on 29 May 1453, the Ottoman sultan Mehmed II, only twenty-one years old, rode into the same city after a siege of fifty-three days. The last emperor, Constantine XI Palaiologos, died fighting near the walls. The city has been called Istanbul ever since, and it is still one of the great cities of the world.

How it worked. Look at the site and you will see why Constantine chose it. The old city stands on a triangle of land with water on two sides. On the north lies the **Golden Horn**, a deep, curving inlet about 4.5 miles (7 km) long, one of the finest natural harbors in the Mediterranean world. On the south and east lies the Sea of Marmara, and at the eastern tip the **Bosporus** opens north toward the Black Sea. Only the western side faces land. There, about 413, under Emperor Theodosius II, the Romans built the **Theodosian Walls**: a wide moat, an outer wall and a taller inner wall with nearly a hundred towers, running about 3.5 miles (5.7 km) from the Sea of Marmara to the Golden Horn. Sea walls ran along the other shores, and in time of war a great iron chain was stretched across the mouth of the Golden Horn to keep enemy ships out. Behind all this the city had cisterns for water and a harbor through which grain could arrive by sea. In 626 the city held against Avars and Persians together; in 674 to 678 and again in 717 to 718 Arab fleets and armies besieged it and were driven off, in part by "Greek fire," a burning liquid sprayed from ships whose recipe was a state secret.

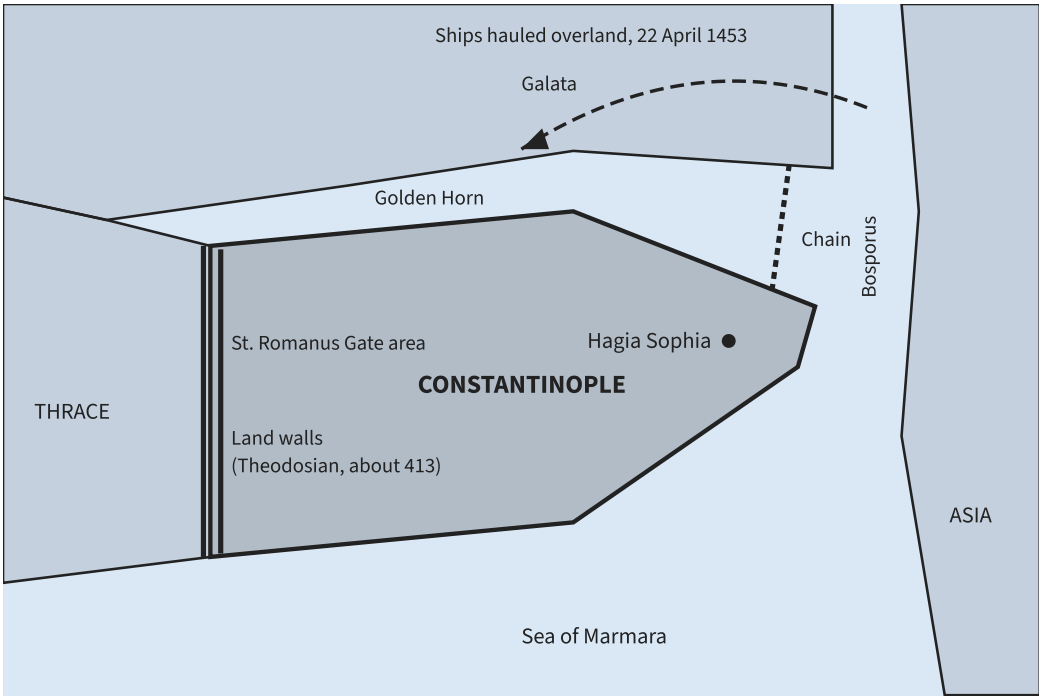
The big idea. Constantinople shows the three gifts a site can give. First, it was a **choke point**: every ship sailing between the Black Sea and the Mediterranean had to pass under its walls, so the city could tax the trade in grain, fish, timber, furs and slaves that moved through the strait. Second, it was a **crossroads**: the main land road from Europe to Asia crossed the Bosporus here. Third, it was **central** to the frontiers that mattered most in the 300s, the Danube in the north and the Persian frontier in the east, far closer to both than Rome was. A choke point, a crossroads and a fortress all at once is rare. But geography also has limits. A fortress city lives on the land and sea around it. When the Fourth Crusade came in 1204, Venetian ships broke into the Golden Horn, the crusaders stormed the weaker harbor walls and sacked the city, a plain wrong done by Christians to a Christian city. The Byzantines won it back in 1261, but the empire never recovered its strength. Meanwhile the Ottoman Turks crossed into Europe at Gallipoli in 1354 and later made Adrianople (Edirne), behind the city, their capital. By 1453 the “empire” was little more than the city itself, surrounded on land and short of soldiers.

Technology overcoming geography. Mehmed II attacked each of the city’s natural advantages in turn. In 1452 he built the fortress of Rumeli Hisarı at the narrowest point of the Bosporus, facing an older fortress his great-grandfather Bayezid I had built on the Asian shore. With cannon on both banks he could stop ships coming from the Black Sea; a Venetian ship that refused to halt was sunk that November. Against the land walls he brought great **bombards**, some cast by a Hungarian gunfounder named Urban (Orban), who had first offered his skill to the Byzantine emperor. The guns pounded the walls for weeks, and the defenders, perhaps 7,000 men including Genoese volunteers under Giovanni Giustiniani, rebuilt the broken places each night with timber and earth. The chain across the Golden Horn held, so on 22 April Mehmed had dozens of ships dragged on greased logs over the hill behind Galata and launched into the Golden Horn. Now the defenders had to stretch their few men along the harbor walls too. Before dawn on 29 May the Ottomans attacked at the walls where they dip into the valley of the Lycus stream near the Gate of St. Romanus; Giustiniani was badly wounded and carried away, and the defense broke. The city was sacked and many of its people were killed or sold as slaves, as the customs of war of that age allowed after a city refused to surrender. Mehmed made Hagia Sophia, the great church built by Justinian in 537, into a mosque, then brought in settlers to fill the half-empty city and made it his capital. It stayed the Ottoman capital until 1923.

On the map. In the regional map, find the Black Sea, the Bosporus, the Sea of Marmara, the Dardanelles and the Aegean. Notice that Constantinople guards one end of a water corridor and Gallipoli guards the other; you will study that second strait in Lesson 6.4. Find Adrianople and see how the Ottomans held land on both sides of the city long before 1453. In the city plan, trace the land walls, the chain and the route of Mehmed’s ships. Ask the question this whole unit asks: what made this place strong, and what finally made the strength not enough? Those who lived in the city called themselves Romans, and they believed, as Psalm 127 says, that walls and watchmen are vain unless the Lord keeps the city. Their city stood for more than eleven hundred years.



The water corridor from the Black Sea to the Aegean. Constantinople guards the Bosporus at one end; Gallipoli guards the Dardanelles at the other.



Constantinople in 1453 (simplified, not to scale): water on two sides, walls on the third, a chain across the harbor, and Mehmed's overland route into the Golden Horn.

PICTURE STUDY

The Entry of Mehmed II into Constantinople, Fausto Zonaro, Early 1900s (exact year not recorded) · Oil on canvas · Turkish National Palaces collection, Istanbul

Fausto Zonaro (1854–1929) was an Italian painter who moved to Constantinople in 1891 and from 1896 served as court painter to the Ottoman sultan Abdul Hamid II. He painted scenes of Ottoman history and of daily life in the city along the Bosporus that he came to love.

This painting imagines the moment, about 450 years before Zonaro's time, when Mehmed II entered the conquered city. It is not an eyewitness picture. It shows how the Ottoman court of the early 1900s wished to remember the conqueror: young, calm and victorious. As you look, remember the walls, the cannon and the long siege that came before this moment.

Look closely

- Find the sultan. How does the painter make him stand out from everyone around him?
- Look at the walls and the gate. What do they tell you about the defenses the Ottomans had to overcome?
- Look at the soldiers, banners and weapons. What feeling about the conquest does the painter want you to have?
- Where is the light strongest? What do you look at first, and what do you notice last?

Talk about it

1. A Byzantine painter of 1453 would have shown this day very differently. What might such a picture have shown?
2. How is a history painting made 450 years later different from an eyewitness record? What can it teach, and what can it not?
3. Which of the city's natural defenses can you see or imagine behind the scene?

PROJECT: THE TRIANGLE, THE CHAIN AND THE HILL: A MODEL OF CONSTANTINOPLE

You will build a scale model of Constantinople and its waters on a tray, mark the land walls, the sea walls and the chain, and then show how Mehmed II got around the chain. By the end you will be able to explain, with your hands on the model, why the city was so hard to take and how it was taken.

You will need

- A baking sheet or tray, at least 12 by 16 inches (30 by 40 cm)
- Blue paper or blue paint for water
- Salt dough (2 cups flour, 1 cup salt, about 3/4 cup water) or modeling clay
- Craft sticks or cardboard strips for walls; a short piece of thin chain, string or paper-clip chain
- Toothpicks or wooden skewers for the log track; small paper boats
- Ruler, pencil, labels and the city-plan figure from this lesson

Steps

1. Choose a scale. If the land walls (about 5.7 km) are to be 20 cm long on your model, your scale is 1 cm = 285 m. Write the scale on a label.
2. Cover the tray with blue paper. Using the city plan as a guide, shape the city triangle, the land to the west, the Galata hills north of the Golden Horn and the Asian shore east of the Bosporus from dough.
3. Make the Golden Horn about 25 cm long at your scale (7 km ÷ 285 m per cm is about 25 cm; bend it to fit the tray if needed).
4. Build the land wall as three lines: a moat (a groove), a low outer wall and a taller inner wall. Build a single low wall along the sea shores.
5. Stretch the chain across the mouth of the Golden Horn from the city to Galata.
6. Lay a track of toothpick logs over the Galata hill from the Bosporus to the upper Golden Horn and “haul” a paper boat along it.
7. Mark three places with flags: the Gate of St. Romanus, Hagia Sophia and Rumeli Hisarı up the Bosporus.
8. Count how many “defenders” (dried beans) you can spread one per centimeter along the land wall, then along the Golden Horn wall. Write down what happens to your line when the ships appear in the harbor.

Tips

- Let the dough dry overnight, or bake it at a low temperature with an adult’s help, before painting.
- Keep the shapes simple. The point is the relationship of land, water and walls, not every street.

Check your work

- I can show on my model which sides of the city were protected by water and which by walls.
- I can explain what the chain did and how Mehmed got around it.
- I can use my model's scale to give a real length for the land walls and the Golden Horn.

MAP NOTEBOOK

1. Draw the triangle of Constantinople from memory. Label the Golden Horn, the Bosporus, the Sea of Marmara, the land walls and the chain.
2. Make a timeline from 330 to 1453 with at least six events: the founding, the walls, the sieges of 626 and 717–718, 1204, 1261, 1354 and 1453.
3. Draw a cross-section of the land defenses: moat, outer wall, terrace, inner wall. Add a cannon ball flying toward them and write one sentence on why stone walls built for arrows and rams suffered against cannon.

> **From history.** Hagia Sophia, the "Holy Wisdom," was built for Emperor Justinian between 532 and 537 by the architects Anthemius of Tralles and Isidore of Miletus. Its dome seemed to float above a ring of windows, and for nearly a thousand years it was the largest church in Christendom. After 1453 it served as a mosque, with minarets added outside. The Turkish Republic made it a museum in 1934, and in 2020 it was made a mosque again; visitors may still enter outside prayer times (as of 2026).

WORKED EXAMPLES

Example 1. The Bosporus is about 31 km long. Its surface current runs south, from the Black Sea toward the Sea of Marmara. Suppose the current averages 2.5 knots and a rowed galley can make 4 knots through still water. How long would the galley take to pass the whole strait going north, against the current, and going south, with it? (1 nautical mile = 1.852 km; 1 knot = 1 nautical mile per hour.)

1. Convert the length to nautical miles: 31 km ÷ 1.852 km per nautical mile ≈ 16.7 nautical miles.
2. Going north, the current works against the galley: 4 − 2.5 = 1.5 knots over the ground.
3. Time north: 16.7 ÷ 1.5 ≈ 11.1 hours.
4. Going south, the current helps: 4 + 2.5 = 6.5 knots. Time south: 16.7 ÷ 6.5 ≈ 2.6 hours, about 2 hours 34 minutes.

Answer: About 11 hours northbound and about 2.6 hours southbound. Ships heading for the Black Sea crept slowly past the city and its later fortresses, which made the Bosporus easy to watch and to block.

Example 2. In 1453 the city had perhaps 7,000 defenders. The Theodosian land walls ran about 5.7 km. If half the defenders manned the land walls, about how many meters of wall did each man have to cover? What happened to this number when Mehmed's ships entered the Golden Horn?

1. Half of 7,000 is 3,500 men.
2. 5.7 km = 5,700 m. Meters per man: 5,700 ÷ 3,500 ≈ 1.6 m.
3. That is one man for about every 1.6 m (about 5 feet) of wall, with no reserves, before counting the sea walls, which together were more than twice as long as the land walls.
4. Once enemy ships floated inside the Golden Horn, the harbor wall had to be manned too, so men had to be taken from the land walls and the gaps there grew wider.

Answer: About 1.6 m (5 ft) of land wall per man. The ships in the Golden Horn forced the defenders to thin this line further, which helped the final assault succeed.

Example 3. Use the coordinates Rome (41.90°N, 12.50°E), Constantinople (41.01°N, 28.98°E) and Antioch, a great city near the Persian frontier (36.20°N, 36.16°E). Estimate the straight-line distances Rome to Antioch and Constantinople to Antioch. Use 1° of latitude ≈ 111.2 km and 1° of longitude ≈ 111.2 km × cos(average latitude).

1. Rome to Antioch: $\Delta lat = 41.90 - 36.20 = 5.70°$, so north–south distance ≈ 5.70 × 111.2 ≈ 634 km. $\Delta lon = 36.16 - 12.50 = 23.66°$; average latitude ≈ 39.05°, cos 39.05° ≈ 0.777, so east–west ≈ 23.66 × 111.2 × 0.777 ≈ 2,044 km.
2. Distance ≈ $\sqrt{(634^2 + 2{,}044^2)} \approx \sqrt{(401{,}956 + 4{,}177{,}936)} \approx \sqrt{4{,}579{,}892} \approx 2{,}140$ km.
3. Constantinople to Antioch: $\Delta lat = 4.81°$, so ≈ 535 km. $\Delta lon = 7.18°$; average latitude ≈ 38.6°, cos ≈ 0.781, so ≈ 7.18 × 111.2 × 0.781 ≈ 624 km.
4. Distance ≈ $\sqrt{(535^2 + 624^2)} \approx \sqrt{(286{,}225 + 389{,}376)} \approx \sqrt{675{,}601} \approx 822$ km.

Answer: Rome to Antioch ≈ 2,140 km (about 1,330 mi); Constantinople to Antioch ≈ 820 km (about 510 mi). An emperor in Constantinople was nearly three times closer to the eastern frontier than one in Rome.

PRACTICE

1. EASY On what date did Constantine dedicate his new capital, and what was the old Greek town on the site called?
2. EASY Name the three bodies of water that touch the old city of Constantinople.
3. EASY Who conquered Constantinople, on what date, and who was the last Byzantine emperor?
4. MEDIUM The Bosporus is about 31 km long. Convert this to statute miles (1 km ≈ 0.621 mi).

5. MEDIUM At its narrowest the Bosporus is about 700 m wide. Express this in feet (1 m ≈ 3.281 ft) and in miles.
6. MEDIUM Constantinople was the capital of the Roman (Byzantine) Empire from 330 to 1453, except from 1204 to 1261, when crusaders held it. For how many years in all was it the imperial capital?
7. MEDIUM The Theodosian Walls were finished about 413. For about how many years did they protect the city before the fall in 1453?
8. MEDIUM Why did Mehmed II haul ships overland into the Golden Horn instead of sailing them in?
9. HARD A ship rowing at 5 knots heads north up the Bosporus (16.7 nautical miles) against a 3-knot current. How long does it take? How long does the return trip south take?
10. HARD Using the regional map, give the direction from Constantinople (41.01°N, 28.98°E) to Adrianople (41.68°N, 26.56°E) and estimate the distance. Why did it matter that the Ottomans made Adrianople their capital?
    (Use the map or drawing "Find Constantinople and Adrianople." shown earlier in this lesson.)
11. HARD Give three reasons the city survived the Arab sieges of 674–678 and 717–718 but fell in 1453.
12. CHALLENGE Durostorum (modern Silistra, 44.12°N, 27.27°E) was a Roman fortress on the Danube frontier. Estimate its straight-line distance from Constantinople and from Rome (41.90°N, 12.50°E). In two or three sentences, explain what your numbers show about Constantine's choice of capital.

COMMON MISTAKES

- Mixing up the two straits. The Bosporus is at Constantinople (Istanbul) and joins the Black Sea to the Sea of Marmara; the Dardanelles begins about 125 miles (200 km) to the southwest and joins the Sea of Marmara to the Aegean.
- Thinking the cannon alone won the siege. The guns broke the walls, but the defenders kept repairing them; Rumeli Hisarı, the overland haul of ships, the great size of the Ottoman army and the city's isolation all mattered.
- Thinking the Byzantines were not "really" Roman. They called themselves Romans, kept Roman law and ruled from New Rome; "Byzantine" is a name later historians gave them.

Make it a game · Hold the Queen of Cities. One player is the defender with 20 beans to place along three "walls" drawn on paper: the land wall, the Golden Horn wall and the Marmara wall. The attacker secretly writes one of four moves on a slip each turn: Bombard (land wall), Ships over the Hill (Golden Horn), Block the Bosporus (the defender loses 2 beans for lack of supplies) or Assault (pick a wall). The defender may move up to 3 beans each turn. An assault succeeds if the chosen wall has fewer than 5 beans. Play six turns, then switch roles and talk about which geographic advantage was hardest to take away.

> **Scripture.** “Except the LORD build the house, they labour in vain that build it: except the LORD keep the city, the watchman waketh but in vain.” (Psalm 127:1, KJV)

Constantinople had the best site and the strongest walls of the medieval world, and it stood for more than eleven centuries. Yet no place is safe because of its geography alone. The psalm reminds us that our security finally rests in God, not in walls or water.

Practice answers

1. 11 May 330; the town was Byzantium.
2. The Golden Horn (north), the Bosporus (east) and the Sea of Marmara (south).
3. The Ottoman sultan Mehmed II, on 29 May 1453. The last emperor was Constantine XI Palaiologos, who died in the fighting.
4. $31 \times 0.621 \approx 19.3$ miles.
5. $700 \times 3.281 \approx 2{,}300$ ft, which is about 0.43 mile.
6. $1453 - 330 = 1{,}123$ years in total; $1261 - 1204 = 57$ years of Latin rule; $1{,}123 - 57 = 1{,}066$ years.
7. $1453 - 413 = 1{,}040$ years (they were breached in 1204 only on the harbor side, not on land).
8. A great chain across the mouth of the Golden Horn, guarded by ships, kept the Ottoman fleet out. Hauling ships over the hill behind Galata got around the chain and forced the defenders to man the harbor walls, thinning their line on the land walls.
9. North: $5 - 3 = 2$ knots, so $16.7 \div 2 \approx 8.4$ hours. South: $5 + 3 = 8$ knots, so $16.7 \div 8 \approx 2.1$ hours.
10. North–south: $0.67 \times 111.2 \approx 75$ km; east–west: $2.42 \times 111.2 \times \cos 41.3° (\approx 0.751) \approx 202$ km; distance $\approx \sqrt{(75^2 + 202^2)} \approx 215$ km (about 134 mi), toward the west-northwest. With their capital in Thrace behind the city, the Ottomans held the land on both sides of Constantinople and cut it off from Europe by land.
11. Any three of: in the earlier sieges the empire still held large lands and armies that could help; Greek fire and the Byzantine fleet controlled the water; the land walls could not be broken by the weapons of the time. In 1453 the empire was little more than the city; the Ottomans already held land on both sides; great cannon could batter the walls; Rumeli Hisarı cut off help from the Black Sea; the overland haul put enemy ships in the Golden Horn; the defenders were too few.
12. From Constantinople: north–south $3.11 \times 111.2 \approx 346$ km; east–west $1.71 \times 111.2 \times \cos 42.6° (\approx 0.736) \approx 140$ km; distance $\approx \sqrt{(346^2 + 140^2)} \approx 373$ km (about 232 mi). From Rome: north–south $2.22 \times 111.2 \approx 247$ km; east–west $14.77 \times 111.2 \times \cos 43.0° (\approx 0.731) \approx 1{,}201$ km; distance $\approx \sqrt{(247^2 + 1{,}201^2)} \approx 1{,}226$ km (about 762 mi). Constantinople was about one-third as far from the Danube and also far closer to the Persian frontier, so an emperor there could reach both dangerous frontiers quickly, while also holding the strait and the crossroads between Europe and Asia.

6.2 Gibraltar

OBJECTIVES

- Describe the geography of the Strait of Gibraltar and the Rock (width, height, currents and harbor) and explain why it is the gateway of the Mediterranean.
- Tell how an Anglo-Dutch force took Gibraltar in 1704, how the Treaty of Utrecht (1713) gave it to Britain, and how the Great Siege of 1779–1783 tested it.
- Explain why a base beside a strait matters even when its guns cannot close the strait, and describe Gibraltar's border as a line drawn by treaty rather than by nature.

Warm-up. Fill a clear jar or glass most of the way with warm tap water. Stir two big spoonfuls of salt and a few drops of food coloring into a small cup of cold water. Tip the jar slightly and pour the colored salt water very slowly down the inside wall. Where does it go? Watch for two minutes and describe what you see. You have just made a model of what happens under the Strait of Gibraltar every day.

Watch. *Why Does Britain Own Gibraltar? (Short Animated Documentary)* (History Matters, 4:03). https://www.youtube.com/watch?v=LMTJW_eEYDs
After the story: watch this short cartoon about the capture of 1704 and the Treaty of Utrecht, and notice why Britain kept the Rock even when Spain wanted it back.
Note: Captions were not available to check; preview it first. It may briefly mention the present-day disagreement between Britain and Spain over Gibraltar.

Backup video. *"This Is Gibraltar"- 16mm Rock of Gibraltar Documentary (Circa 1957)* (Canada 160 Archive, 14:32). https://www.youtube.com/watch?v=wEuPRzctZNg
With On the map: watch this 1950s film to see the Rock, its harbor and the narrow strait between Europe and Africa as they looked about seventy years ago. Note: Captions were not available to check; preview it first. This is an old 1950s film, so some of its wording and attitudes are dated.

KEY TERMS

Strait of Gibraltar
The channel, about 36 miles (58 km) long and as narrow as about 9 miles (14 km), that joins the Atlantic Ocean to the Mediterranean Sea between Spain and Morocco.

Pillars of Hercules
The ancient name for the two great headlands on either side of the strait: the Rock of Gibraltar in Europe and a mountain on the African side (Jebel Musa or Monte Hacho at Ceuta).

cession
The formal handing over of territory by one state to another in a treaty, as Spain ceded Gibraltar to Britain at Utrecht in 1713.

exchange flow
Two currents moving opposite ways through a strait at different depths: lighter Atlantic water flows in on top and heavier, saltier Mediterranean water flows out beneath.

heated shot
Iron cannon balls heated red-hot in furnaces before firing so they would set wooden ships on fire; used by the Gibraltar garrison in 1782.

isthmus
A narrow neck of land joining two larger areas; Gibraltar is joined to Spain by a low, sandy isthmus.

CORE IDEAS

The story. In early August 1704 a British and Dutch fleet under Admiral Sir George Rooke anchored in the bay beside the Rock of Gibraltar. Europe was fighting the War of the Spanish Succession. King Charles II of Spain had died in 1700 without children, and two princes claimed his throne: Philip of Anjou, grandson of Louis XIV of France, and Archduke Charles of Austria, backed by Britain, the Dutch Republic and their allies. On 4 August, after a heavy bombardment and a landing of marines and sailors led by Prince George of Hesse-Darmstadt, the small Spanish garrison under Governor Diego de Salinas surrendered on honorable terms. The allies took the town in the name of Archduke Charles, but it was British forces who held it. Most of the Spanish townspeople chose to leave rather than live under the new masters, and many settled nearby at San Roque, which still keeps the old town's records. When the war ended, Spain, in Article X of the **Treaty of Utrecht** (1713), ceded to Britain the town and castle of Gibraltar with its port and fortifications, to be held forever. Britain has held it ever since.

How it worked. The Strait of Gibraltar is the only natural sea entrance to the Mediterranean from the ocean. It is about 36 miles (58 km) long and only about 9 miles (14 km) wide at its narrowest, between Point Marroquí near Tarifa in Spain and Point Cires in Morocco. At its eastern end rises the Rock, a ridge of limestone about 1,398 feet (426 m) high with a sheer northern cliff facing the low sandy isthmus that joins it to Spain. Behind the Rock lies the Bay of Gibraltar, a sheltered anchorage with fresh water and room for a fleet. The water itself is unusual. The hot, dry Mediterranean loses more water to evaporation than its rivers and rain can replace, so it is always slightly lower and saltier than the Atlantic. Lighter Atlantic water pours in on the surface, while heavier, saltier Mediterranean water slides out along the bottom over an undersea ridge called the Camarinal Sill. Sailing ships heading west against that surface current, and often against westerly winds, sometimes waited for days at the Rock for a fair east wind, the Levanter, so an anchorage at Gibraltar was an inn on the busiest sea road of Europe.

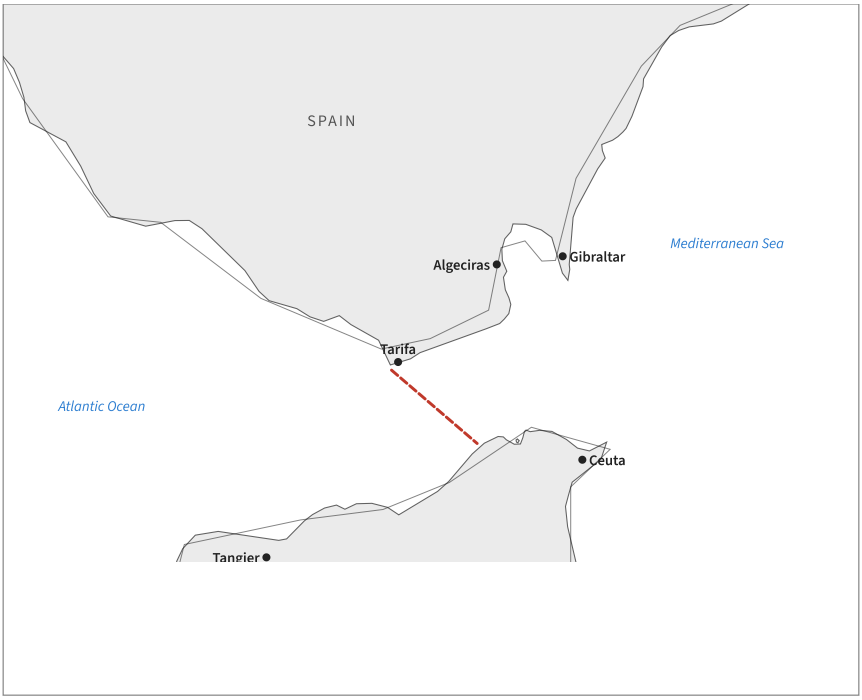
The big idea. Can guns on the Rock close the strait? No. In the age of sail a cannon could hit a ship at most a mile or two away, and the strait off Gibraltar is about 15 miles (24 km) across to Ceuta in Africa. What Gibraltar gave was a **base**: a safe harbor, a dockyard and stores right beside a choke point, from which a fleet could watch every ship that passed and strike at any enemy fleet trying to move between the Atlantic and the Mediterranean. In

1805, ships of Nelson’s fleet took on supplies there in the weeks before Trafalgar, and his flagship *Victory* was towed back to Gibraltar for repairs after the battle. A choke point is held by ships and the bases that serve them, not by walls alone.

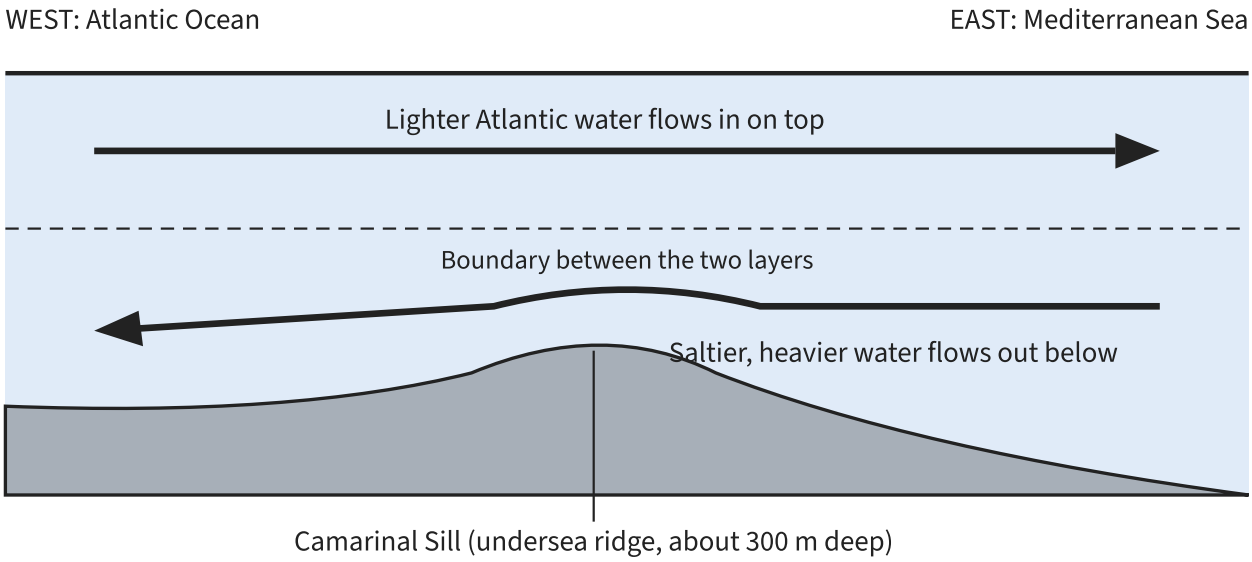
The Great Siege. Spain tried several times to win Gibraltar back. The longest attempt, the **Great Siege**, began in June 1779, when Spain, allied with France, joined the war that had begun with the American War of Independence. For three years and seven months, Spanish and French forces blockaded the Rock by land and sea. The governor, General George Augustus Eliott, rationed food carefully, and British fleets broke through with supply convoys in 1780, 1781 and 1782. On 13 September 1782 the besiegers sent in ten specially built floating batteries, armored with thick timber, cork and wet sand, to batter the walls from close range. The garrison answered with **heated shot**, cannon balls heated red-hot in furnaces. By the next morning the floating batteries were burning and exploding, and British gunboats under Captain Roger Curtis rowed into the fire to rescue hundreds of Spanish sailors from the wreckage. During the siege Sergeant Major Henry Ince began tunneling into the north face of the Rock to mount guns in galleries high above the isthmus. The siege ended in February 1783, and the peace treaty of that year left Gibraltar British.

Technology overcoming geography. Steam made Gibraltar more important, not less. Steamships needed coal, and after the Suez Canal opened in 1869, the short road from Britain to India ran through the Mediterranean, past a chain of British coaling stations and bases at Gibraltar, Malta, Port Said and Aden. In the Second World War the Rock was hollowed with miles of new tunnels, an airfield was built across the isthmus, and in November 1942 General Dwight D. Eisenhower directed the Allied landings in North Africa from headquarters inside the Rock. Germany had planned an attack on Gibraltar through Spain in 1940, but Spain’s ruler, Francisco Franco, kept his country out of the war, and the plan was never carried out.

On the map. In the strait map, find the Rock, the Bay of Gibraltar, Algeciras, Tarifa, Tangier and Ceuta. Notice that Spain holds Ceuta on the African shore, a city Morocco claims, so each side of the strait has a disputed European foothold. Gibraltar’s land border runs across the isthmus, a line drawn by treaty and practice, not by any river or ridge. Spain has never given up its claim. Spain closed the land border in 1969, and it was not fully reopened until 1985. The people of Gibraltar have twice voted on the question: in 1967, 12,138 voted to remain under British sovereignty and 44 to pass to Spain, and in 2002 they rejected a proposal for shared British and Spanish sovereignty by a large majority. As of 2026, Britain and the European Union, with Spain’s agreement, were completing a treaty on how people and goods cross the border after Britain left the EU, while the question of sovereignty remained unchanged.



The Strait of Gibraltar. The narrowest crossing is near Tarifa, about 14 km; the Rock stands at the eastern end, about 24 km from Ceuta.



The exchange flow: light Atlantic water in on top, heavy Mediterranean water out underneath (not to scale).

PICTURE STUDY

The Siege and Relief of Gibraltar (The Defeat of the Floating Batteries, 13 September 1782), John Singleton Copley, 1783–1791 · Oil on canvas · Guildhall Art Gallery, London

John Singleton Copley (1738–1815) was born in Boston and became one of the finest portrait painters in the American colonies before moving to London in 1774. The Corporation of the City of London asked him to paint the defeat of the floating batteries at Gibraltar. He traveled to see the officers, studied models of the ships and took years to finish the enormous canvas, one of the largest paintings of its day.

Copley shows General Eliott and his officers on the heights of the Rock while the Spanish floating batteries burn below. Notice that he also shows British sailors saving their enemies from the water.

Look closely

- Find General Eliott and the officers. Where has Copley placed them, and why do you think he chose a high position?
- Find the burning floating batteries. What do the fire and smoke tell you about the heated shot?
- Find the small boats in the water. What are the sailors doing?
- Look for the Rock itself. How does the painter show that this is a fortress high above the sea?

Talk about it

1. Why might the City of London have wanted this victory painted so large?
2. What does the rescue of Spanish sailors tell you about how some men fought even in the middle of a battle?

3. How does the painting show the advantage of holding high ground beside the sea?

PROJECT: THE STRAIT IN A SHOEBOX AND THE RANGE-RING MAP

In two short experiments you will see the two great facts of Gibraltar: the hidden two-layer current under the strait, and the reason guns on the Rock could not close the strait by themselves.

You will need

- A clear plastic storage box or loaf pan, and a piece of stiff cardboard cut to fit snugly across it as a divider
- Salt, food coloring and water
- Tracing paper, a drawing compass and a ruler
- The strait map from this lesson (or an atlas map of the strait with a scale bar)

Steps

1. Part 1: Slide the cardboard divider into the middle of the box. Fill one side with plain water (the Atlantic) and the other with very salty, colored water (the Mediterranean) to the same depth.
2. Pull the divider straight up. Watch from the side for one minute. Sketch what you see: the colored salt water slides under the plain water, while the plain water runs over the top the other way.
3. Write two sentences linking your model to the real strait: which way does the surface water move, and which way does the deep water move?
4. Part 2: Trace the coastlines of the strait onto tracing paper with the scale bar.
5. Using the scale, set your compass to 2.5 km and draw circles around Gibraltar, Tarifa and Ceuta. These show the reach of an assumed 18th-century heavy gun.
6. Measure how much of the narrowest crossing and of the crossing from Gibraltar to Ceuta lies outside every circle.
7. Now draw circles of 20 km (an assumed long-range 20th-century coast gun). How much of the strait is still open?
8. Write a paragraph: why did Britain value Gibraltar even though its guns could not close the strait in the age of sail?

Tips

- Make the salt water very salty (several spoonfuls per cup) and pull the divider slowly for the clearest layers.
- The gun ranges in Part 2 are teaching assumptions, not exact figures for any one gun.

Check your work

- I can explain the exchange flow through the strait and why it happens.
- I can use a scale and a compass to draw range rings and measure the gaps between them.

- I can explain the difference between closing a strait with guns and controlling it with a fleet based nearby.

MAP NOTEBOOK

1. Draw the Rock of Gibraltar seen from the Spanish side, showing the sheer north face and the low isthmus. Label the bay, the town and the airfield.
2. Draw the cross-section of the strait with arrows for the two currents. Label the Atlantic, the Mediterranean and the Camarinal Sill.
3. Make a timeline: 711 (Tariq ibn Ziyad), 1462 (Castile takes the Rock), 1704, 1713, 1779–1783, 1805, 1869, 1942, 1967, 1969–1985.

> **From history.** The Rock is famous for its Barbary macaques, the only wild monkeys in Europe. A popular saying holds that Britain will keep Gibraltar as long as the monkeys stay. During the Second World War, when their numbers fell very low, Prime Minister Winston Churchill is said to have ordered that the colony be kept up, and new animals were brought from North Africa. The garrison long kept an officer responsible for the monkeys, and they are still cared for today.

WORKED EXAMPLES

Example 1. The strait is about 14 km wide at its narrowest. Suppose a heavy 18th-century coast gun could hit a ship up to 2.5 km away, and guns stood on both shores. What width of water at the narrowest crossing is out of range of both sides? What fraction of the crossing is that?

1. Each shore covers 2.5 km out from the coast: $2.5 + 2.5 = 5$ km covered.
2. Uncovered width: $14 - 5 = 9$ km.
3. Fraction uncovered: $9 \div 14 \approx 0.64$, or about 64%.
4. Off Gibraltar itself the strait is about 24 km wide to Ceuta, so a gun on the Rock reaches only about $2.5 \div 24 \approx 10\%$ of the way across.

Answer: About 9 km (5.6 mi), roughly 64% of the narrowest crossing, lay out of range of both shores. Gibraltar’s value lay in its harbor and dockyard for a fleet, not in its guns closing the strait.

Example 2. In the 1967 referendum, 12,138 Gibraltarians voted to remain under British sovereignty and 44 voted to pass to Spain. What percentage of the valid votes chose each option?

1. Total valid votes: 12,138 + 44 = 12,182.
2. Remain British: 12,138 ÷ 12,182 ≈ 0.9964, or about 99.64%.
3. Pass to Spain: 44 ÷ 12,182 ≈ 0.0036, or about 0.36%.
4. Check: 99.64% + 0.36% = 100%.

Answer: About 99.64% (roughly 99.6%) for remaining British and about 0.36% (roughly 0.4%) for Spain.

Example 3. A supply convoy sails from Plymouth (50.37°N, 4.14°W) to Gibraltar (36.14°N, 5.35°W). Estimate the straight-line distance in km and nautical miles, and the time at an average of 5 knots. Use 1° of latitude ≈ 111.2 km and 1° of longitude ≈ 111.2 km × cos(average latitude).

1. North–south: 50.37 − 36.14 = 14.23°; 14.23 × 111.2 ≈ 1,582 km.
2. East–west: 5.35 − 4.14 = 1.21°; average latitude ≈ 43.3°, cos ≈ 0.728; 1.21 × 111.2 × 0.728 ≈ 98 km.
3. Distance ≈ $\sqrt{(1{,}582^2 + 98^2)}$ ≈ $\sqrt{(2{,}502{,}724 + 9{,}604)}$ ≈ $\sqrt{2{,}512{,}328}$ ≈ 1,585 km. In nautical miles: 1,585 ÷ 1.852 ≈ 856 nmi.
4. Time at 5 knots: 856 ÷ 5 ≈ 171 hours ≈ 7.1 days. The real route is longer, because ships must swing out around Brittany and Cape Finisterre and tack against contrary winds.

Answer: About 1,585 km (985 mi; 856 nautical miles) in a straight line, roughly a week at 5 knots; in practice, longer.

PRACTICE

1. EASY In what war was Gibraltar captured in 1704, and which admiral commanded the fleet?
2. EASY Which treaty gave Gibraltar to Britain, and in what year?
3. EASY Where does the name Gibraltar come from?
4. MEDIUM The Rock is about 426 m high. Convert to feet (1 m ≈ 3.281 ft).
5. MEDIUM The strait is about 14 km wide at its narrowest. Express this in statute miles and in nautical miles.
6. MEDIUM As of 2026, how many years has Britain held Gibraltar since its capture, and how many since the Treaty of Utrecht?
7. MEDIUM Why does surface water flow from the Atlantic into the Mediterranean through the strait?

8. MEDIUM Gibraltar lies at about 5.35°W. The sun appears to move 15° of longitude per hour (1° every 4 minutes). How many minutes after it is noon by the sun at Greenwich is it noon by the sun at Gibraltar?
9. HARD Gibraltar keeps Central European Time (one hour ahead of Greenwich in winter). Using your answer to Problem 8, at about what clock time does the sun reach its highest point in Gibraltar in winter?
10. HARD Using the strait map, Algeciras (36.13°N, 5.45°W) lies across the bay from Gibraltar (36.14°N, 5.35°W). Estimate the distance and the time for a boat to cross at 4 knots.
    (Use the map or drawing "Find Gibraltar and Algeciras on either side of the bay." shown earlier in this lesson.)
11. HARD Why did the floating batteries of 13 September 1782 fail?
12. CHALLENGE In a short paragraph, explain why Gibraltar became more valuable to Britain after 1869, naming at least three other places in the chain it belonged to.

COMMON MISTAKES

- Thinking Gibraltar's guns could close the strait. Even at its narrowest the strait is about 14 km wide, far beyond the range of guns of the sailing age; Gibraltar mattered as a base for ships.
- Thinking Britain took Gibraltar at the Treaty of Utrecht. It was captured in 1704; the treaty of 1713 confirmed the cession.
- Assuming the current through the strait runs one way only. The surface water flows in from the Atlantic, but a deep current of salty water flows out underneath.

Make it a game · Run the Strait. Draw the strait on a long sheet of paper divided into ten squares from the Atlantic to the Mediterranean. One player is a convoy of three paper ships; the other holds the Rock with a "fleet" token based at Gibraltar. Each turn the convoy rolls a die to move (subtract 1 if sailing west against the current). The fleet may move 2 squares from Gibraltar; if it lands on a ship's square, roll: 4, 5 or 6 captures it. Then play again with no base at Gibraltar, so the fleet must start from the edge of the board. Compare: how much did the base matter?

Scripture. "The LORD is my rock, and my fortress, and my deliverer; my God, my strength, in whom I will trust; my buckler, and the horn of my salvation, and my high tower." (Psalm 18:2, KJV)

"As strong as the Rock of Gibraltar" became a saying in English. David, who knew the rocky strongholds of Judah, used the same picture of God: a rock, a fortress and a high tower. The Rock of Gibraltar has changed hands; the Lord does not change.

Practice answers

1. The War of the Spanish Succession; Admiral Sir George Rooke, with a British and Dutch fleet.
2. The Treaty of Utrecht, 1713 (Article X).

3. From the Arabic Jabal Tariq, “Mountain of Tariq,” after Tariq ibn Ziyad, who landed there in 711 at the start of the Muslim conquest of Spain.
4. 426 × 3.281 ≈ 1,398 ft.
5. 14 × 0.621 ≈ 8.7 statute miles; 14 ÷ 1.852 ≈ 7.6 nautical miles.
6. 2026 − 1704 = 322 years since the capture; 2026 − 1713 = 313 years since the treaty.
7. The Mediterranean, in a hot, dry climate, loses more water by evaporation than rivers and rain supply. Its level stays slightly lower and its water saltier and heavier, so lighter Atlantic water flows in on the surface while dense Mediterranean water flows out along the bottom.
8. 5.35 × 4 ≈ 21.4 minutes later (ignoring the small seasonal correction called the equation of time).
9. Solar noon is about 12:21 Greenwich time, which is 13:21 Central European Time: about 1:21 p.m. on Gibraltar’s clocks.
10. East–west 0.10° × 111.2 × cos 36.1° (≈ 0.808) ≈ 9.0 km; the north–south difference is tiny. 9.0 km ÷ 1.852 ≈ 4.9 nautical miles; at 4 knots about 1.2 hours (about 73 minutes).
11. Though armored with thick timber, cork and wet sand against ordinary shot, they were still wooden. The garrison fired heated (red-hot) shot that lodged in the timber and set them on fire; the batteries burned and blew up, and Captain Curtis’s gunboats rescued many of their crews.
12. The Suez Canal (1869) made the Mediterranean the short route from Britain to India and the East. Steamships needed coal and repair stations along the way, so Gibraltar became the western gate of a chain of British bases and coaling stations: Gibraltar, Malta, Port Said (Suez) and Aden. Holding the entrance meant the route could be protected end to end. Other places on the route, such as Cyprus (from 1878), Bombay, Ceylon, Singapore and Hong Kong, are also acceptable.

6.3 Singapore

OBJECTIVES

- Explain why Stamford Raffles founded a British port at Singapore in 1819, using the geography of the Strait of Malacca, the monsoon winds and the idea of a free port.
- Trace the Japanese campaign down the Malay Peninsula (December 1941 to February 1942) and explain the geographic reasons Singapore fell on 15 February 1942.
- Evaluate the claim that Singapore was an “impregnable fortress,” and explain why a choke-point port depends on its hinterland, its water and command of the sea and air.

Warm-up. Hold your left hand flat on the table with the fingers together, pointing down toward you. Your hand is the Malay Peninsula. Lay a pencil along the left edge of your hand: that is the Strait of Malacca, with Sumatra beyond it. Your fingertips are Singapore. Now imagine every ship sailing between India and China must pass your fingertips. Where would you build a port? Where would an enemy attack it from if the port’s guns all faced the sea? Talk it over for two minutes.

Watch. *1819 - Signing of the Treaty between Singapore and the British* (Singapore Bicentennial, 2:00). https://www.youtube.com/watch?v=vpRHA8CKHsk
After the story: watch this two-minute video about the 1819 treaty, and listen for the three men who signed it and what each one wanted.
Note: Captions were not available to check; preview it first. It was made for Singapore's official 200th-anniversary celebration.

Backup video. *Time-lapse: transit W-Singapore Strait and arrival at Singapore [4K / UHD, 60fps]* (SeaTube, 3:04). https://www.youtube.com/watch?v=IQOBJPFsGBM
With On the map: watch this sped-up voyage through the Singapore Strait, and count how many ships are crowded into one of the busiest waterways in the world.

KEY TERMS

Strait of Malacca
The long sea passage, about 550 miles (900 km), between the Malay Peninsula and the island of Sumatra; the main sea route between the Indian Ocean and the South China Sea.

monsoon
A seasonal wind that reverses direction during the year. In this region the southwest monsoon blows roughly June to September and the northeast monsoon roughly December to March.

free port
A port where goods can be landed, stored and reshipped without paying customs duties, which draws merchants and trade.

entrepôt

A trading port where goods from many places are brought, stored, sold and shipped on to other places.

hinterland
The land behind a port or coast that supplies it with food, water, goods and protection; for Singapore, the Malay Peninsula.

Phillips Channel
The narrowest part of the shipping lane in the Singapore Strait, only about 1.7 miles (2.8 km) wide.

CORE IDEAS

The story. On 28 January 1819 a small British squadron anchored off the mouth of the Singapore River, at the southern tip of the Malay Peninsula. Aboard was Sir Thomas Stamford Raffles, an officer of the East India Company who governed the little station of Bencoolen on Sumatra. Raffles was looking for a harbor where Britain could protect its China trade, for after the Napoleonic Wars the Dutch had returned to Java and Malacca and controlled the southern sea lanes. On the island he found a small settlement of Malays and some Chinese under the Temenggong, a local chief. On 6 February 1819 Raffles signed a treaty with Hussein Shah, whom he recognized as Sultan of Johor, and the Temenggong, allowing the Company to set up a trading post. He left William Farquhar as Resident and declared Singapore a **free port**: ships of every nation could trade without paying duties. Merchants came quickly, Chinese, Malay, Bugis, Arab, Indian and European, and by 1824 more than ten thousand people lived there. That year the Anglo-Dutch Treaty of London divided the region, leaving Britain north of the strait and the Dutch to the south.

How it worked. Singapore sits at about 1.3°N, roughly 90 miles (140 km) north of the equator, where the **Strait of Malacca** meets the South China Sea. The strait runs about 550 miles (900 km) between the Malay Peninsula and Sumatra, and the mountains on both sides shelter it from the worst storms. For sailing ships the key was the **monsoon**. The southwest monsoon carried ships from India toward the strait in the summer months; the northeast monsoon carried ships from China southward in winter. Ships from both directions met at the strait and often waited there for the wind to turn, so the southern end of the strait had been a trading place for centuries; a Malay town called Singapura stood there in the 1300s. Raffles chose well: deep water close to shore, a sheltered anchorage, a river for small boats and a position that every ship between India and China had to pass. Singapore became an **entrepôt**, where Chinese tea and silk, Indian cloth and opium, island spices and later Malayan tin and rubber were stored, sold and shipped on. Opium was a large part of the trade, sold under license to raise revenue for the colony, a business that did real harm and that the Chinese government tried to stop. In 1826 Singapore joined Penang and Malacca as the Straits Settlements, and after the Suez Canal opened in 1869 steamers and coaling made it busier still.

The big idea. A choke-point port is strong at sea but can be weak behind. After the First World War, Britain built a great naval base on Singapore’s north shore, on the narrow Johor Strait, finished in 1938 at enormous cost. Heavy guns, including 15-inch guns, guarded the

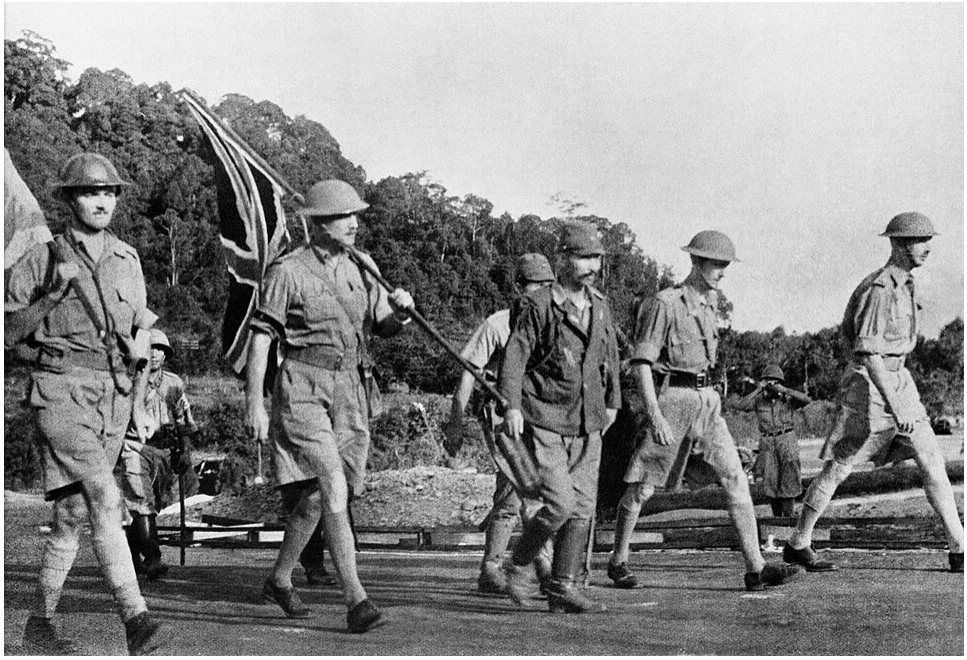
sea approaches. Britain's plan, the "Singapore strategy," was to send the main fleet from Europe if Japan attacked. Planners believed the jungles, swamps and rivers of Malaya would protect the base from the land side. A popular story says the guns "faced the wrong way." In fact most of the big guns could turn to fire north, and some did, but they had been supplied mainly with armor-piercing shells meant for ships, which did little against troops. The real weaknesses were geographic and strategic: the base depended on the peninsula behind it, on water piped across the Johor Strait, and on command of the air and sea, and Britain, fighting for its life in Europe, could not send the fleet or enough aircraft.

The fall. In the early hours of 8 December 1941 (local time, shortly before the attack on Pearl Harbor), the Japanese 25th Army under Lieutenant General Yamashita Tomoyuki landed at Kota Bharu in northern Malaya and at Singora and Patani in Thailand. Two days later Japanese aircraft sank the British battleship *Prince of Wales* and battlecruiser *Repulse* off Malaya's east coast. With command of the air, Japanese troops moved fast down the peninsula's roads, many on bicycles, and when British, Indian, Australian and Malay troops made a stand, the Japanese went around them through rubber estates and jungle or landed behind them from the sea. On 31 January 1942 the last defenders crossed to the island and blew a gap in the causeway. On the night of 8 February the Japanese crossed the Johor Strait, less than a mile wide in places, on the northwest coast. Within a week they held the reservoirs and the high ground at Bukit Timah, and the crowded city was short of water. On 15 February Lieutenant General Arthur Percival surrendered at the Ford factory at Bukit Timah. Some 80,000 troops became prisoners, many of them later forced to work on the Thailand–Burma Railway, where thousands died. Churchill later called it the worst disaster and the largest surrender in British history. The Japanese occupation that followed was harsh. In the Sook Ching ("purge") of February and March 1942, Japanese military police killed many thousands of Chinese men whom they screened as hostile; estimates run from about 25,000 to 50,000.

On the map. In the map, trace the Japanese advance from Singora to Singapore, find Kota Bharu, Penang, Kuala Lumpur and Malacca, and see how the peninsula funnels down to a point. Notice that the Strait of Malacca is the shortest route between the Indian Ocean and the Pacific. Britain recovered Singapore in September 1945. It became self-governing, joined Malaysia in 1963 and became an independent republic on 9 August 1965 under Prime Minister Lee Kuan Yew. As of 2026, Singapore is one of the world's busiest ports and transshipment hubs, tens of thousands of ships pass the strait each year, and the city still buys part of its water from Johor across the causeway. Raffles's choice of site has outlasted the empire that made it.

The Strait of Malacca and the Japanese advance, December 1941 to February 1942.

PICTURE STUDY



Lieutenant General Percival and his party on the way to surrender, Singapore, 15 February 1942, Unknown Japanese army photographer, 15 February 1942 · Black-and-white photograph · Imperial War Museum, London (HU 2781)

This photograph was taken by a Japanese army photographer on the afternoon of 15 February 1942. It shows Lieutenant General Arthur Percival, commander of British and Commonwealth forces in Malaya, and three of his officers walking under a flag of truce to

meet General Yamashita at the Ford motor factory at Bukit Timah. One officer carries the Union flag; another carries a white flag.

The Japanese took the picture on purpose, to show the world that the great British fortress had fallen. It became one of the best-known photographs of the war in Asia.

Look closely

- Count the officers and find the two flags. Who is carrying each one?
- Look at the officers' uniforms and faces. What do they suggest about the heat and about their mood?
- Look at the road and the surroundings. What can you tell about the place?
- Why do you think the photographer chose to show the Union flag so clearly?

Talk about it

1. Why would the Japanese army want this picture taken and shown widely?
2. How might a British newspaper reader in 1942 have felt on seeing it?
3. What does a single photograph like this show well, and what does it leave out of the story of a campaign?

PROJECT: WHICH WAY WILL THEY COME? A SAND-TABLE CAMPAIGN

Military staff officers have long used sand tables, trays of shaped sand, to study ground. You will build a sand table of the Malay Peninsula and Singapore, mark the roads, jungle, rivers and causeway, and then play out the 1941–1942 campaign to see why a fortress facing the sea fell from the land.

You will need

- A shallow box lid, baking sheet or under-bed storage box
- Damp sand, or a mix of flour and a little oil ("cloud dough")
- Blue yarn or paper for rivers and straits; green paper or moss for jungle; string for roads
- Small blocks or game pieces for armies, a coin for the naval base, toothpick flags
- The map figure from this lesson and a ruler

Steps

1. Shape the peninsula from Singora to Singapore along the length of the tray (about 1,000 km). Work out your scale: if the tray is 50 cm long, 1 cm = 20 km.
2. Mark the central mountain spine with a raised ridge, the west-coast road with string, the main rivers with yarn and the jungle with green.
3. Model Singapore island at the tip with a narrow strip of blue (the Johor Strait) and a causeway made of a craft stick. Put the naval base on the north shore and the guns on the south shore facing the sea.

4. Place reservoirs (blue paper circles) in the center of the island and a pipeline across the causeway from Johor.
5. Play the campaign: the attacker moves 2 cm (40 km) a turn along roads; the defender may block one road square each turn, but the attacker may go around a block through jungle (1 cm a turn) or land behind it from the sea once every three turns.
6. When the attacker reaches the Johor Strait, ask: where are the reservoirs? Where is the high ground? Which way do the big guns face?
7. Write a short after-action report: list three geographic reasons Singapore fell.

Tips

- Keep a ledger of turns and positions so you can compare your campaign's speed with the real one (8 December to 31 January).
- Cloud dough holds its shape well indoors and cleans up easily.

Check your work

- I can show on my model why the peninsula funnels an attacker toward Singapore.
- I can explain why the reservoirs and the causeway mattered.
- I can name three geographic reasons for the fall of Singapore.

MAP NOTEBOOK

1. Draw a map of Southeast Asia with arrows for the southwest and northeast monsoons. Mark Singapore and explain in one sentence why ships met there.
2. Make a two-column chart: "What made Singapore strong (1819–1941)" and "What made Singapore weak (1941–1942)."
3. Draw Singapore island with the Johor Strait, the causeway, the naval base, the reservoirs and Bukit Timah. Add the date of each Japanese move.

> **From history.** Henry Nicholas Ridley, director of the Singapore Botanic Gardens from 1888, worked out a way of tapping rubber trees that did not kill them and urged planters across Malaya to grow rubber. The seedlings came from trees brought from Brazil by way of Kew Gardens in London. Within a few decades Malaya became the world's leading rubber producer, and Singapore became the port that shipped it, another way a choke-point harbor grew rich from its hinterland.

WORKED EXAMPLES

Example 1. The Japanese landed at Singora on 8 December 1941 and reached Johor Bahru, opposite Singapore, by 31 January 1942. The road distance is roughly 1,000 km. Find the number of days and the average advance per day in km and miles.

1. Days left in December after the 8th: 31 − 8 = 23. Add 31 days of January: 23 + 31 = 54 days.
2. Average advance: 1,000 km ÷ 54 days ≈ 18.5 km per day.
3. In miles: 18.5 × 0.621 ≈ 11.5 miles per day.
4. That is like walking a little over 11 miles every day for almost eight weeks while fighting, in tropical heat.

Answer: About 54 days, an average of roughly 18.5 km (11.5 mi) a day.

Example 2. Singapore lies at about 103.85°E. By the sun, how far ahead of Greenwich is Singapore? Singapore's clocks are set to UTC+8. At about what clock time is the sun highest over Singapore?

1. The sun appears to move 15° of longitude per hour, or 1° every 4 minutes.
2. 103.85 × 4 = 415.4 minutes ≈ 6 hours 55 minutes. So solar noon in Singapore comes 6 h 55 min before solar noon at Greenwich; Singapore's sun time is UTC + 6 h 55 min.
3. The clocks read UTC + 8 h, which is 8 h − 6 h 55 min = 1 h 05 min ahead of sun time.
4. Solar noon therefore happens at about 12:00 + 1:05 = 13:05 by the clock (ignoring the small seasonal correction).

Answer: Sun time is about 6 h 55 min ahead of Greenwich; the sun is highest at about 1:05 p.m. by Singapore's clocks.

Example 3. The Singapore Strait is about 105 km long, and its shipping lane narrows to about 2.8 km in the Phillips Channel. How long does a container ship take to pass the whole strait at 12 knots? How many times wider is the Strait of Gibraltar at its narrowest (about 14 km) than the Phillips Channel?

1. Convert to nautical miles: 105 ÷ 1.852 ≈ 56.7 nautical miles.
2. Time at 12 knots: 56.7 ÷ 12 ≈ 4.7 hours, about 4 hours 43 minutes.
3. Width ratio: 14 ÷ 2.8 = 5.
4. So the busiest strait in Asia narrows to a lane one-fifth as wide as the narrowest point of the Strait of Gibraltar.

Answer: About 4.7 hours; the Strait of Gibraltar's narrowest point is about 5 times wider than the Phillips Channel.

PRACTICE

1. EASY When did Raffles arrive at Singapore, and when did he sign the treaty with the Sultan and the Temenggong?
2. EASY Which two lands border the Strait of Malacca?
3. EASY On what date did Singapore surrender, and who were the British and Japanese commanders?
4. MEDIUM Singapore lies at about 1.29°N. How far is it from the equator in km and miles (1° of latitude ≈ 111.2 km)?
5. MEDIUM How many days passed from the Japanese landings on 8 December 1941 to the surrender on 15 February 1942?
6. MEDIUM The Phillips Channel is about 2.8 km wide. Express this in miles and in feet.
7. MEDIUM What is a free port, and why did making Singapore one help it grow so quickly?
8. MEDIUM Which monsoon helped a sailing ship from India reach the Strait of Malacca, and which helped a ship from China sail south to it?
9. HARD A tanker passes the 105-km Singapore Strait at 10 knots. How long does it take?
10. HARD Using the map, find the direction and straight-line distance from Kota Bharu (6.13°N, 102.24°E) to Singapore (1.29°N, 103.85°E).
    (Use the map or drawing "Find Kota Bharu and Singapore." shown earlier in this lesson.)
11. HARD Explain what is true and what is false in the saying that Singapore's guns "faced the wrong way."
12. CHALLENGE In a paragraph, compare the fall of Singapore in 1942 with the fall of Constantinople in 1453. What do the two stories teach about fortress cities at choke points?

COMMON MISTAKES

- Thinking Singapore was attacked from the sea. The Japanese came down the Malay Peninsula by land and crossed the narrow Johor Strait from the north.

- Confusing the Strait of Malacca (between Malaya and Sumatra) with the Singapore Strait (the narrow passage south of Singapore island that joins it to the South China Sea).
- Thinking Raffles found an empty island. There was a settlement under the Temenggong, and the site had been a trading town centuries before.

Make it a game · Monsoon Merchants. Make a board with four ports in a ring: Calcutta, Singapore, Canton and Batavia. Each player is a merchant with a paper ship and cards for goods (cloth, tea, spices, tin). Draw a monsoon card each round: "Southwest" lets ships move only from west to east; "Northeast" lets them move only from east to west. Singapore is a free port where any goods can be traded with no tax; the other ports take one card as duty. Play six rounds. The richest merchant wins, and everyone explains why most trades ended up happening at Singapore.

Scripture. "Pride goeth before destruction, and an haughty spirit before a fall." (Proverbs 16:18, KJV)

Newspapers before 1941 called Singapore the "Gibraltar of the East," an impregnable fortress. Confidence in a strong position made leaders slow to see its weaknesses. Geography gives advantages, but it never excuses carelessness or pride.

Practice answers

1. He arrived on 28 January 1819 (going ashore the next day) and signed the treaty on 6 February 1819.
2. The Malay Peninsula on the east (northeast) and the island of Sumatra on the west (southwest).
3. 15 February 1942; Lieutenant General Arthur Percival (British) and Lieutenant General Yamashita Tomoyuki (Japanese).
4. 1.29 × 111.2 ≈ 143 km, about 89 miles.
5. 23 days (rest of December) + 31 (January) + 15 (February) = 69 days.
6. 2.8 × 0.621 ≈ 1.74 miles; 2,800 m × 3.281 ≈ 9,190 ft.
7. A free port charges no customs duties on goods landed and reshipped. Merchants of every nation could trade there more cheaply than at ports that taxed trade (such as Dutch ports), so ships and traders were drawn to Singapore.
8. The southwest monsoon (roughly June to September) carried ships from India east toward the strait; the northeast monsoon (roughly December to March) carried ships from China southwest toward it.
9. 105 ÷ 1.852 ≈ 56.7 nautical miles; 56.7 ÷ 10 ≈ 5.7 hours (about 5 hours 40 minutes).
10. North–south: 4.84 × 111.2 ≈ 538 km south. East–west: 1.61 × 111.2 × cos 3.7° (≈ 0.998) ≈ 179 km east. Distance ≈ $\sqrt{(538^2 + 179^2)}$ ≈ 567 km (about 352 mi). Direction: south-southeast (about 18° east of due south, a bearing of about 162°).
11. False: most of the heavy coast guns could traverse to fire north, and some did fire on Japanese forces in Johor and on the island. True in part: they were placed to guard the sea approaches and were supplied mostly with armor-piercing shells meant for ships, which were poor against troops. The deeper problem was not the guns but the lack of air power, the absence of the fleet and the land approach down the peninsula.

12. Both cities held superb positions on straits and had strong sea defenses. Both fell when an enemy controlled the land behind them and found a way around their defenses: Mehmed by building Rumeli Hisarı, using cannon and hauling ships overland; the Japanese by advancing down the peninsula, winning command of the air and sea and cutting off water. Both show that a choke-point fortress depends on its hinterland, on outside help and on enough defenders; strong walls or guns facing the sea are not enough by themselves.

6.4 The Dardanelles

OBJECTIVES

- Describe the geography of the Dardanelles (length, width, the Narrows, the current and the Gallipoli peninsula) and explain why it has been fought over since ancient times.
- Explain why the Allied naval attack of 18 March 1915 failed and why the Gallipoli landings of 25 April 1915 became a costly stalemate, using the ground and the water.
- Explain how the Montreux Convention (1936) governs the Turkish Straits today and how a modern bridge has crossed the Dardanelles.

Warm-up. Lay a long strip of aluminum foil or a rain gutter section on a slight slope over a sink, and pinch the middle of the foil channel narrower with two blocks or two lumps of clay. Pour a steady stream of water in at the top and drop a small piece of cork or a bit of paper on it. Watch where it moves fastest. Then talk for two minutes: if this were a strait, where would a ship sailing against the current have the hardest time, and where would a defender put his guns?

Watch. *Gallipoli 1915 - The Great War DOCUMENTARY* (Kings and Generals, 13:48).
https://www.youtube.com/watch?v=IeAPkEl8hHg
After the story: watch the animated maps of the fleet trying to force the Narrows, then the landings at Anzac Cove and Cape Helles, and notice how the narrow strait and steep hills shaped the whole campaign.
Note: Captions were not available to check; preview it first. The video opens with an ExpressVPN sponsor message (skip it), and it describes heavy casualties on both sides.

Backup video. *Prelude to Gallipoli - Naval Bombardement of the Dardanelles I THE GREAT WAR Week 31* (The Great War, 9:46). https://www.youtube.com/watch?v=6LsF7gIrHh0
Before the story: watch why Britain and France wanted to force the Dardanelles, and look on the map for the forts at the Narrows and the route to Constantinople. Note: Captions were not available to check; preview it first. This is a well-researched weekly World War I series; it describes the war plainly and may mention casualties. This episode covers the opening bombardment in February 1915 and probably stops before the 18 March attack and the sinking of the Bouvet.

KEY TERMS

Dardanelles
The strait, about 38 miles (61 km) long, joining the Sea of Marmara to the Aegean Sea between the Gallipoli peninsula in Europe and Anatolia in Asia; called the Hellespont in ancient times.

the Narrows
The tightest part of the Dardanelles, at Çanakkale, about three-quarters of a mile (1.2 km) wide, guarded by forts on both shores.

naval mine
An explosive charge moored under the surface that blows up when a ship strikes it; cheap to lay and very hard to clear under fire.

amphibious landing
An attack in which soldiers are carried by sea and put ashore on a hostile coast.

ANZAC
The Australian and New Zealand Army Corps, formed in Egypt in 1914 and landed at Gallipoli on 25 April 1915.

Montreux Convention
The 1936 treaty that recognizes Turkish control of the Bosporus and Dardanelles, guarantees merchant ships free passage in peacetime and limits warships passing through.

CORE IDEAS

The story. Late in the morning of 18 March 1915, a great fleet of British and French battleships steamed into the mouth of the Dardanelles to silence the forts at the Narrows and force a passage to Constantinople. For hours they traded fire with the Ottoman guns. Then, a little before two in the afternoon, the French battleship *Bouvet* struck a mine, rolled over and sank in about two minutes; more than six hundred of her crew died. Later that afternoon the British battleships *Irresistible* and *Ocean* also struck mines and sank, and the battlecruiser *Inflexible* was badly damaged. The mines had been laid ten days earlier, on the night of 8 March, by the small Ottoman minelayer *Nusret*: a single line of 26 mines placed parallel to the Asian shore in Erenköy Bay, where Ottoman observers had noticed the Allied ships turning during earlier attacks. The fleet withdrew. The Allies decided that the strait could be opened only if soldiers took the Gallipoli peninsula and the guns on it.

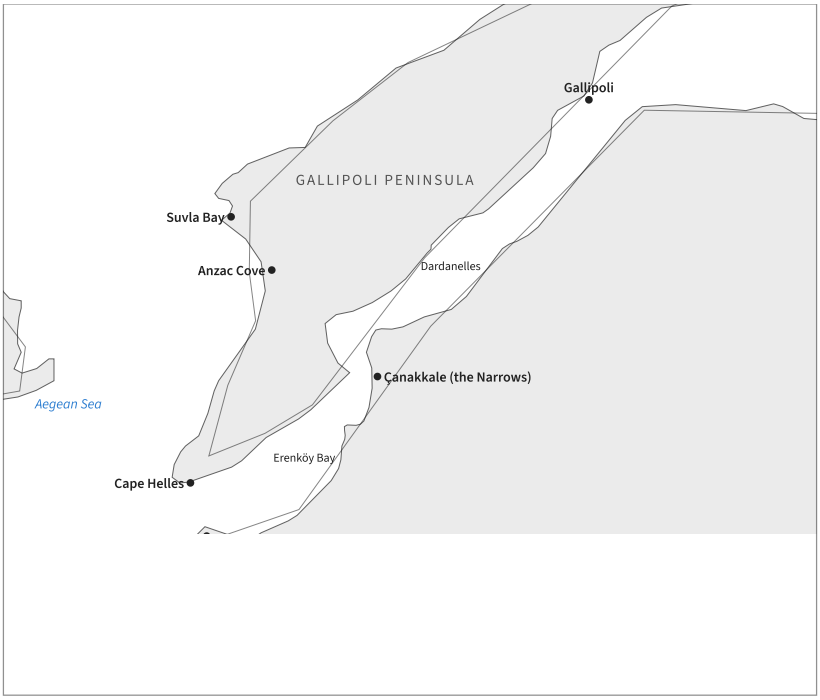
How it worked. The Dardanelles is about 38 miles (61 km) long and from about 0.75 mile (1.2 km) to about 4 miles (6 km) wide. A steady current flows out from the Sea of Marmara toward the Aegean, commonly 2 to 3 knots and faster in the Narrows, so a ship heading for Constantinople pushes against the water the whole way. In 1915 the Ottomans, with German advisers, had built a layered defense: lines of mines across the strait below the Narrows, searchlights to light them at night, forts at Kilitbahir and Çanakkale, and mobile howitzers hidden in the hills on both shores. The minesweepers were converted fishing trawlers, many crewed by civilian fishermen, that could barely steam against the current and could not sweep while the mobile guns fired on them; the big ships could not silence the mobile guns until the mines were swept. Each part of the defense protected the others. The strait had been a crossing since ancient times. The Persian king Xerxes bridged it with boats in 480 BC to invade Greece, and in 1354 the Ottomans crossed it at Gallipoli to begin their conquests in Europe. A navy that could pass it could threaten Constantinople; a power that held both shores could shut it.

The big idea. Why did Britain and France try? The Ottoman Empire entered the First World War on Germany's side in the autumn of 1914 and closed the straits. Russia, Britain's ally, lost its warm-water route to the outside world: its grain could not get out, and the weapons and supplies it badly needed could not get in. Winston Churchill, First Lord of the Admiralty, argued that forcing the Dardanelles could reopen the route, threaten Constantinople and perhaps knock the Ottomans out of the war. The geography of narrow waters worked against the plan. In a strait, cheap weapons such as mines and hidden guns can stop the most expensive ships in the world, because the ships have no room to maneuver and no way to go around.

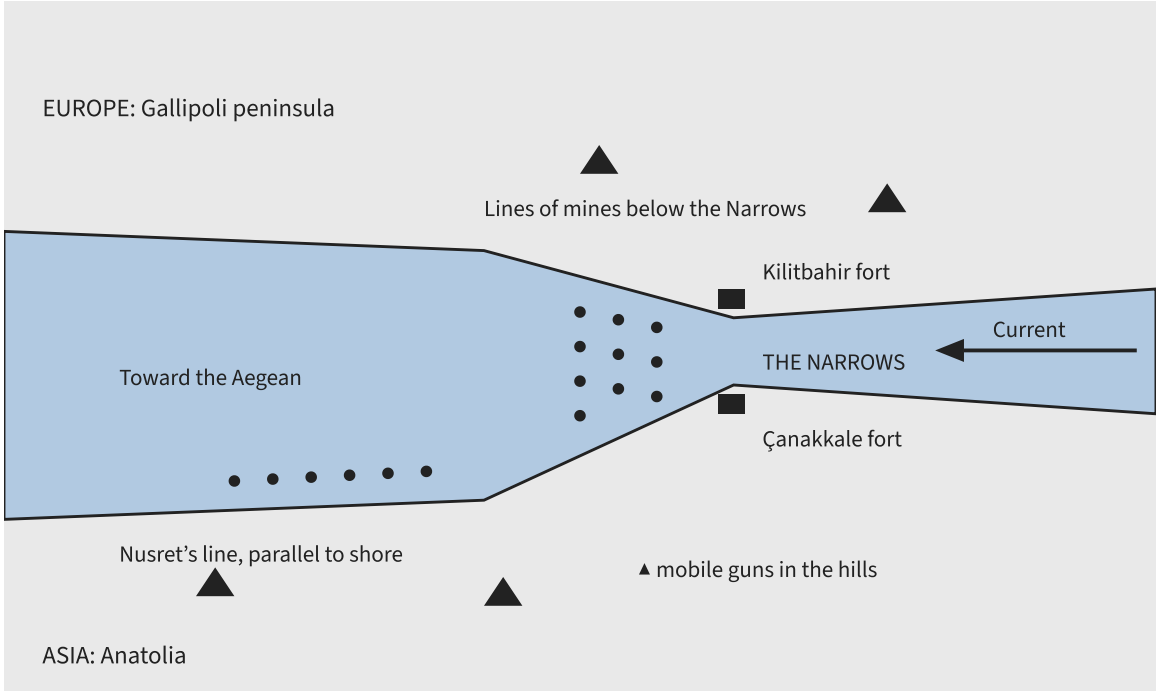
The landings. On 25 April 1915 British and French troops landed at Cape Helles at the tip of the peninsula, the French also made a diversionary landing at Kum Kale on the Asian shore, and the Australian and New Zealand Army Corps landed farther north near Ari Burnu, at the small beach soon called Anzac Cove. The ground beyond the Anzac beach rose in steep ridges and gullies covered with thick scrub, and units became mixed and lost as they climbed. An Ottoman division commander, Lieutenant Colonel Mustafa Kemal, rushed his men to the heights and held the high ground of the Sari Bair ridge. At Helles, soldiers wading ashore at V Beach and W Beach were cut down by machine guns and rifle fire. Neither side could break the other. Trenches were dug within yards of each other, and summer brought heat, flies and dysentery. A new landing at Suvla Bay and attacks on Sari Bair in August, including Lone Pine and The Nek, also failed. The Allies evacuated Anzac and Suvla in December 1915 and Helles in January 1916, with almost no losses, the most successful operation of the campaign. More than 100,000 men died in all, roughly 44,000 on the Allied side (including about 8,700 Australians and 2,800 New Zealanders) and well over 50,000 Ottoman soldiers.

After Gallipoli. The Gallipoli campaign shaped nations. Australians and New Zealanders keep 25 April as Anzac Day. Mustafa Kemal, later called Atatürk, founded the Republic of Turkey in 1923. In 1936 the **Montreux Convention** confirmed Turkish control of the straits: merchant ships of every nation pass freely in peacetime, but the warships of countries outside the Black Sea are limited in size and in how long they may stay in it, and in wartime Turkey may close the straits to the warships of countries at war. Turkey did so in February 2022, after war broke out between Russia and Ukraine. Meanwhile technology has overcome the old barrier in a new way. The 1915 Çanakkale Bridge, opened in March 2022 between Gelibolu and Lapseki, has a main span of 2,023 m (about 1.26 miles), the longest suspension span in the world when it opened, its length chosen to honor the Republic's centenary in 2023.

On the map. In the Dardanelles map, find Cape Helles, Anzac Cove, Suvla Bay, Kum Kale, Erenköy Bay, the Narrows at Çanakkale and the town of Gallipoli. Notice how the peninsula's high ground looks down on the strait. Whoever held the hills could shell any ship trying to pass, which is why the navy needed the army, and why the army could not win while the enemy held the heights.



The Dardanelles and the Gallipoli campaign, 1915.



The layered defense of the Narrows in 1915 (simplified, not to scale).

PICTURE STUDY

Anzac, the landing 1915, George Washington Lambert, 1920–1922 · Oil on canvas · Australian War Memorial, Canberra

George Lambert (1873–1930) was an Australian official war artist. In 1919 he went back to Gallipoli with the Australian Historical Mission and walked and sketched the ground where the landing had taken place four years earlier. Back in his studio he painted this large canvas of the first wave climbing the slopes above the beach on the morning of 25 April 1915.

Lambert was not at the landing himself, but he studied the ground closely and talked with men who were. The steepness of the hillside is the real subject of the picture.

Look closely

- Find the beach and the top of the ridge. How much of the painting does the slope fill?
- Look at how the soldiers move. Are they marching in lines or scrambling? What does that tell you about the ground?
- Look at the scrub and the light. What time of day is it, and how can you tell?
- Look for any soldiers who have fallen. How does the painter show the cost of the landing without making it the whole picture?

Talk about it

1. Why did the Australian War Memorial want a painting made from close study of the actual ground?
2. How does this painting help explain why the landing could not reach the high ground quickly?
3. How might an Ottoman soldier on the ridge above have seen this same scene?

PROJECT: FORCING THE NARROWS: A CURRENT CHANNEL AND MINEFIELD MODEL

You will build a model strait that narrows in the middle, measure how much faster the current runs in the narrow part, and then lay a model minefield to see why a line of mines parallel to the shore caught the Allied fleet.

You will need

- A rain-gutter section, long baking pan or a channel made of foil at least 3 feet (1 m) long
- Modeling clay to narrow the channel and to make the shores and hills
- A pitcher or a hose with gentle flow; a few small corks or bits of foam
- A stopwatch, a ruler and a marker
- Metal washers or buttons for mines, toothpick flags, paper ships about 2 inches long

Steps

1. Shape the shores with clay so the channel is wide at both ends and narrows to about one-fifth of the width in the middle (the Dardanelles is about 6 km at its widest and 1.2 km at the Narrows).
2. Mark two 20-cm test stretches: one in a wide part and one in the narrow part.
3. Tilt the channel slightly and pour water steadily from the “Marmara” end. Time a cork across each stretch three times and average.
4. Compute the speed in each stretch (cm per second) and the ratio narrow ÷ wide. Write a sentence explaining why the same water must move faster through the narrow part.
5. Drain the channel. Lay several lines of washers across it below the Narrows. Then lay one line of washers along one shore in a bay, parallel to the shore.
6. Steam a paper ship up the channel and have it turn in the bay, as the Allied ships did. Does it cross the parallel line?
7. Add hills on both shores with toothpick “guns.” Explain in a paragraph why minesweepers could not clear the lines while the guns fired and why the ships could not destroy the guns until the mines were cleared.

Tips

- Do the water part outside or over a sink, and pour as steadily as you can so the timings are fair.
- If the cork sticks to the side, start it in the middle of the channel.

Check your work

- I can measure and compare current speeds in a wide and a narrow channel.
- I can explain why the Nusret’s line of mines was placed parallel to the shore.
- I can explain how mines, guns and searchlights protected one another at the Narrows.

MAP NOTEBOOK

1. Draw the Gallipoli peninsula and the Dardanelles. Mark the landing beaches of 25 April 1915 and the Narrows, and shade the high ground.
2. Draw a cross-section from Anzac Cove inland to the Sari Bair ridge. Show the beach, the steep slopes and the ridge, and label who held the top.
3. Make a timeline: 480 BC (Xerxes), 1354 (Ottomans cross), 18 March 1915, 25 April 1915, August 1915, December 1915 to January 1916, 1923, 1936, 2022.

> **From history.** Ancient legend told of Leander, a young man of Abydos on the Asian shore, who swam the Hellespont every night to visit Hero, a priestess at Sestos on the European side, guided by her lamp, until he drowned in a storm. On 3 May 1810 the English poet Lord Byron swam across the strait from the European to the Asian shore to show it could be done, and wrote a short comic poem about it, “Written After Swimming from Sestos to Abydos.” Swimmers still cross the strait each year in an organized race.

WORKED EXAMPLES

Example 1. A battleship that can make 10 knots heads up the 61-km Dardanelles against an average current of 3 knots. How long does it take to reach the Sea of Marmara? How long would the return trip take with the current?

1. Convert the length: $61 \div 1.852 \approx 32.9$ nautical miles.
2. Against the current: $10 - 3 = 7$ knots. Time: $32.9 \div 7 \approx 4.7$ hours.
3. With the current: $10 + 3 = 13$ knots. Time: $32.9 \div 13 \approx 2.5$ hours.
4. Going up, the ship spends nearly five hours within range of guns on both shores, and longer if it must slow for minesweepers.

Answer: About 4.7 hours going up and about 2.5 hours coming down.

Example 2. Model a mine line. Suppose mines in a line are spaced 100 m apart and a battleship is about 25 m wide. (a) How long is a line of 26 mines? (b) If a ship crosses the line at right angles at a random point, about what is the chance it strikes a mine? (c) Why was the Nusret's line, laid parallel to the shore where ships turned, more dangerous?

1. (a) A line of 26 mines has 25 gaps: 25 × 100 m = 2,500 m = 2.5 km.
2. (b) In each 100-m stretch, the ship hits a mine if its 25-m width overlaps the mine's position: chance ≈ 25 ÷ 100 = 0.25, or about 25% (a simple model that ignores the mine's own size).
3. (c) A ship steaming along a line, rather than across it, passes over many mine positions in a row instead of one, so the chance of striking one becomes very high.
4. Ships turning in Erenköy Bay ran along the line, not across it.

Answer: (a) 2.5 km. (b) About 25% for one crossing at right angles. (c) A ship moving along a parallel line meets many mines in turn, so it is very likely to strike one.

Example 3. The 1915 Çanakkale Bridge has a main span of 2,023 m. Compare it with the width of the Narrows (about 1.2 km) and with the main span of the Golden Gate Bridge (1,280 m). Express the span in miles.

1. Span ÷ Narrows: 2,023 ÷ 1,200 ≈ 1.69, so the span is about 1.7 times the width of the Narrows.
2. Span ÷ Golden Gate span: 2,023 ÷ 1,280 ≈ 1.58.
3. In miles: 2.023 km × 0.621 ≈ 1.26 miles.
4. The bridge stands north of the Narrows, where the strait is wider, so a very long span was needed to clear the shipping lane without piers in the water.

Answer: The span is about 1.7 times the width of the Narrows and about 1.6 times the Golden Gate's span; it is about 1.26 miles long.

PRACTICE

1. EASY What did the ancient Greeks call the Dardanelles?
2. EASY Give the dates of the great naval attack and of the first landings at Gallipoli.
3. EASY Which Ottoman officer held the heights above Anzac Cove, and what did he later become?
4. MEDIUM The Dardanelles is about 61 km long. Convert to statute miles and nautical miles.
5. MEDIUM The Narrows are about 1.2 km wide. Express this in feet and in yards.
6. MEDIUM The land campaign lasted from 25 April 1915 to the final evacuation on 9 January 1916. How many days is that?

7. MEDIUM Why did the closing of the straits in 1914 matter so much to Russia and its allies?
8. MEDIUM In what year was the Montreux Convention signed, and what does it allow merchant ships and warships to do?
9. HARD A minesweeping trawler can make 7 knots. How long does it take to steam 8 km up the strait against a 4-knot current in the Narrows?
10. HARD Using the map, estimate the straight-line distance and direction from Cape Helles (40.05°N, 26.18°E) to Çanakkale (40.15°N, 26.41°E).
    (Use the map or drawing "Find Cape Helles and Çanakkale." shown earlier in this lesson.)
11. HARD Using the simple mine model, what is the chance that a 24-m-wide ship crossing a mine line at right angles strikes a mine if the mines are 60 m apart? If they are 120 m apart?
12. CHALLENGE In a paragraph, give the geographic reasons the naval attack failed and the geographic reasons the land campaign failed.

COMMON MISTAKES

- Confusing the Dardanelles with the Bosporus. The Dardanelles is the southwestern strait, between Gallipoli and Asia; the Bosporus runs through Istanbul.
- Thinking Gallipoli was only an Australian and New Zealand battle. British troops were the largest Allied force, French and Indian troops also fought, and the Ottoman army suffered the heaviest losses.
- Thinking the fleet was stopped by the forts alone. The mines, and the mobile guns that kept the minesweepers from clearing them, did the most to stop the ships.

Make it a game · Sweep and Shoot. Draw the strait as a grid of 10 squares long and 3 wide. The defender secretly marks 8 mine squares and places 3 gun tokens on the shores. The attacker has 3 minesweepers and 4 battleships. Each turn a minesweeper may clear one square, but if it is within two squares of a gun token it is driven off on a die roll of 4 to 6. A battleship may fire at one gun (destroyed on a 6). A battleship entering a mine square is lost. Can the attacker reach the far end with two battleships? Then play again with a landing force that can remove one gun each turn, and talk about why the navy needed the army.

Scripture. "Greater love hath no man than this, that a man lay down his life for his friends." (John 15:13, KJV)

This verse is carved on many war memorials, including memorials to the men who died at Gallipoli. Whatever we judge about the plans of the generals, the courage and sacrifice of ordinary soldiers on both sides deserve to be remembered with honor.

Practice answers

1. The Hellespont.
2. The naval attack was on 18 March 1915; the landings were on 25 April 1915.

3. Lieutenant Colonel Mustafa Kemal; he later founded the Republic of Turkey (1923) and became known as Atatürk.
4. 61 × 0.621 ≈ 37.9 statute miles; 61 ÷ 1.852 ≈ 32.9 nautical miles.
5. 1,200 × 3.281 ≈ 3,940 ft, which is about 1,310 yards (about 0.75 mile).
6. From 25 April to 25 December 1915 is 244 days (30 + 31 + 30 + 31 + 31 + 30 + 31 + 30); from 25 December to 9 January is 15 more; total 259 days, about eight and a half months.
7. The straits were Russia's main warm-water route to the outside world. With them closed, Russia could not export its grain to pay for the war, and Britain and France could not easily send it weapons and supplies.
8. 1936. Merchant ships of all nations may pass freely in peacetime; warships of non-Black Sea states are limited in tonnage and in length of stay in the Black Sea; in wartime Turkey may close the straits to the warships of countries at war.
9. 8 ÷ 1.852 ≈ 4.3 nautical miles; speed over the ground 7 − 4 = 3 knots; time ≈ 4.3 ÷ 3 ≈ 1.4 hours (about 1 hour 26 minutes), all of it under fire.
10. North–south: 0.10 × 111.2 ≈ 11 km. East–west: 0.23 × 111.2 × cos 40.1° (≈ 0.765) ≈ 19.6 km. Distance ≈ $\sqrt{(11^2 + 19.6^2)}$ ≈ 22.5 km (about 14 mi), toward the east-northeast (a bearing of about 60°).
11. 24 ÷ 60 = 0.40, about 40%; 24 ÷ 120 = 0.20, about 20%. Closer spacing makes a line much more dangerous but needs more mines.
12. Naval attack: the strait was narrow and long, so ships had no room to maneuver and spent hours under fire; the outflowing current slowed ships and minesweepers; mines blocked the channel, and hidden mobile guns on both shores stopped the sweepers, while the ships could not destroy the guns until the mines were swept. Land campaign: the landing beaches were small and overlooked; steep ridges and gullies covered in scrub broke up the attackers; the defenders held the high ground (Sari Bair, Achi Baba) and could reinforce quickly by land; heat, lack of water and disease wore down the troops; and every supply had to come by sea.

6.5 Natural Harbors

OBJECTIVES

- Name the qualities of a good natural harbor (depth, shelter, a defensible entrance, fresh water, an ice-free season, room and a hinterland) and classify harbors by how they were formed.
- Explain how the geography of Sydney, Halifax, Pearl Harbor and San Francisco Bay shaped their founding and their history, including the Halifax Explosion of 1917 and the attack on Pearl Harbor in 1941.
- Calculate whether a ship can safely enter a harbor using charted depth, tide and draft, and explain how dredging and engineering have changed which harbors matter.

Warm-up. Fill a sink or a large baking dish with water and float a light plastic lid or a small toy boat. Blow hard across the water from one end to make waves. Now make a “harbor” by curving a piece of foil or a few books around the boat, leaving only a narrow gap facing away from your breath. Blow again. What changed? Make the gap wider and try once more. In two minutes, list what a sailor would want from a harbor.

Watch. *What happened to the USS Arizona? (Pearl Harbor)* (Jared Owen, 14:41). https://www.youtube.com/watch?v=WZI_g6WMbCk
As review: watch the 3D animation of the USS Arizona at Pearl Harbor, and look for how the sheltered, shallow harbor that protected the fleet also became a trap during the attack and made salvage possible afterward.
Note: Captions were not available to check; preview it first. The video describes the ship's destruction and the loss of more than a thousand crewmen on December 7, 1941. The video is mostly about the battleship's engineering and loss rather than the harbor's geography, and the lesson's story is about Sydney Harbour.

Backup video. *Golden Gate Bridge | How a Wonder was Constructed?* (Sabin Civil Engineering, 13:55). https://www.youtube.com/watch?v=Ag_C3ikX_sk
As review: watch how engineers built the Golden Gate Bridge across the narrow, windy, deep-water mouth of San Francisco Bay, and notice why a natural harbor's entrance was so hard to span. Note: Captions were not available to check; preview it first. The video may include a short sponsor or Patreon plug; skip it. The video focuses on bridge engineering more than on the bay as a natural harbor.

KEY TERMS

natural harbor
A stretch of deep, sheltered water along a coast, made by the shape of the land, where ships can anchor safely without large man-made breakwaters.

ria

A drowned river valley: a branching inlet formed where the sea has flooded a river's valley, such as Port Jackson at Sydney.

draft
The depth of a ship's hull below the waterline; the least depth of water a ship needs to float.

chart datum
The low-water level from which depths on a nautical chart are measured; the tide adds water above it.

under-keel clearance
The safety margin of water between the bottom of a ship's keel and the seabed.

dredging
Digging sand, mud or rock from the bottom of a harbor or channel to make it deeper for larger ships.

CORE IDEAS

The story. In January 1788 Captain Arthur Phillip of the Royal Navy brought the eleven ships of the First Fleet, carrying about 750 convicts and some 1,400 people in all, to Botany Bay on the east coast of Australia, where Captain James Cook had landed in 1770. Phillip did not like what he found. The bay was shallow, open to the easterly swells and short of good fresh water. So on 21 January he set out with three small boats to look at an inlet a few miles north that Cook had seen from the sea and named Port Jackson but had never entered. Inside a gap of little more than a mile between two high sandstone headlands, Phillip found a great branching harbor of deep coves. He wrote to Lord Sydney that he had found "the finest harbour in the world, in which a thousand sail of the line may ride in the most perfect security." He chose a cove with a freshwater stream, named it Sydney Cove, and on 26 January 1788 raised the British flag there. The colony that grew there became the city of Sydney. Its founding was also the beginning of the loss of their land for the Eora people who lived around the harbor, and in 1789 an outbreak of smallpox killed many of them.

How it worked. Phillip was judging a harbor by the qualities sailors had always looked for. A good natural harbor has **depth** enough for the largest ships; **shelter** from wind and waves; a **narrow entrance** that keeps out swells and can be defended; good holding ground for anchors; **fresh water**; **room** for many ships; water that does not freeze; and a **hinterland** that can feed a city and send goods to the port. Harbors form in different ways. Port Jackson is a **ria**, a river valley flooded by the sea, which is why it branches like a tree. Halifax Harbour is a deep inlet scoured by ice and flooded by the sea. Pearl Harbor is a set of flooded valleys, called lochs, behind a coral reef bar. San Francisco Bay is a broad basin between ranges of hills, entered through one narrow strait. Books often date these changes to the rise of the seas at the end of the "Ice Age," a museum word you will meet on signs and in textbooks; what we can see for ourselves is that these valleys were carved by water or ice and later filled by the sea.

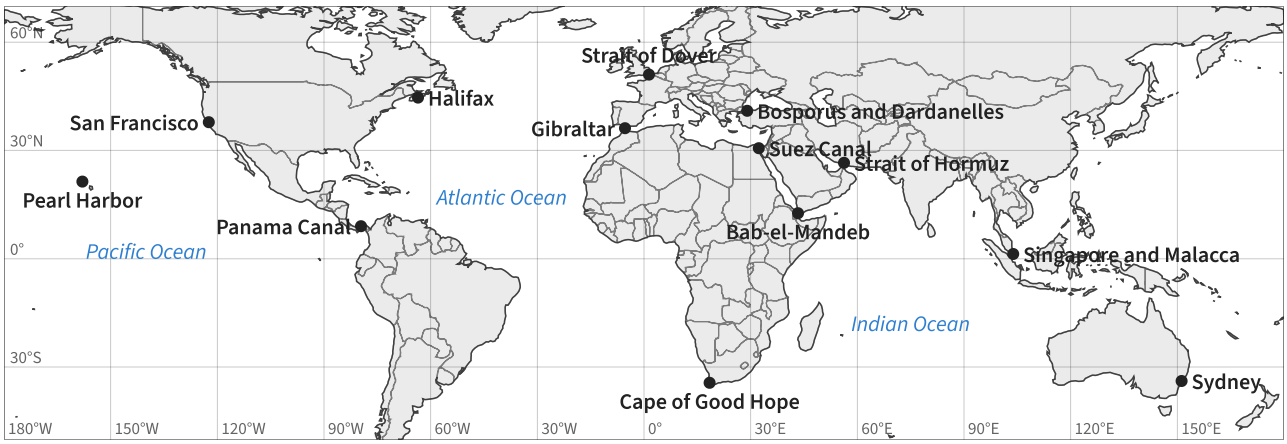
The big idea. A great harbor is a gift of geography, but it carries dangers, especially in war. **Halifax**, founded by Edward Cornwallis with some 2,500 settlers in 1749 as a British naval

base, has one of the largest ice-free natural harbors in the world, opening inland through a strait called the Narrows into the wide Bedford Basin. In both world wars convoys of merchant ships gathered in the basin before crossing the Atlantic. On the morning of 6 December 1917 the French ship *Mont-Blanc*, loaded with explosives for the war in Europe, collided in the Narrows with the Norwegian ship *Imo*. The *Mont-Blanc* caught fire, drifted toward the Halifax shore and blew up, in the largest man-made explosion before the atomic bomb. About 2,000 people were killed and some 9,000 injured. The same narrow passage that made the harbor safe crowded ships together. **Pearl Harbor** on Oahu was blocked by a coral bar until the United States, which gained rights to the harbor by treaty with the Kingdom of Hawaii in 1887 and annexed Hawaii in 1898, dredged a channel and built a naval base. In 1940 the Pacific Fleet was moved there. On 7 December 1941 Japanese carrier aircraft attacked the battleships moored around Ford Island. The single narrow entrance meant the fleet could not get out quickly; the harbor was only about 40 feet (12 m) deep, but Japanese planners had fitted their torpedoes with wooden fins so they would not dive into the mud. The attack killed 2,403 Americans, 1,177 of them aboard the battleship *Arizona*. Yet the same shallow water helped the Americans recover: of the eight battleships hit, six were raised or repaired and fought again, and the attackers left the fuel tanks and repair shops untouched.

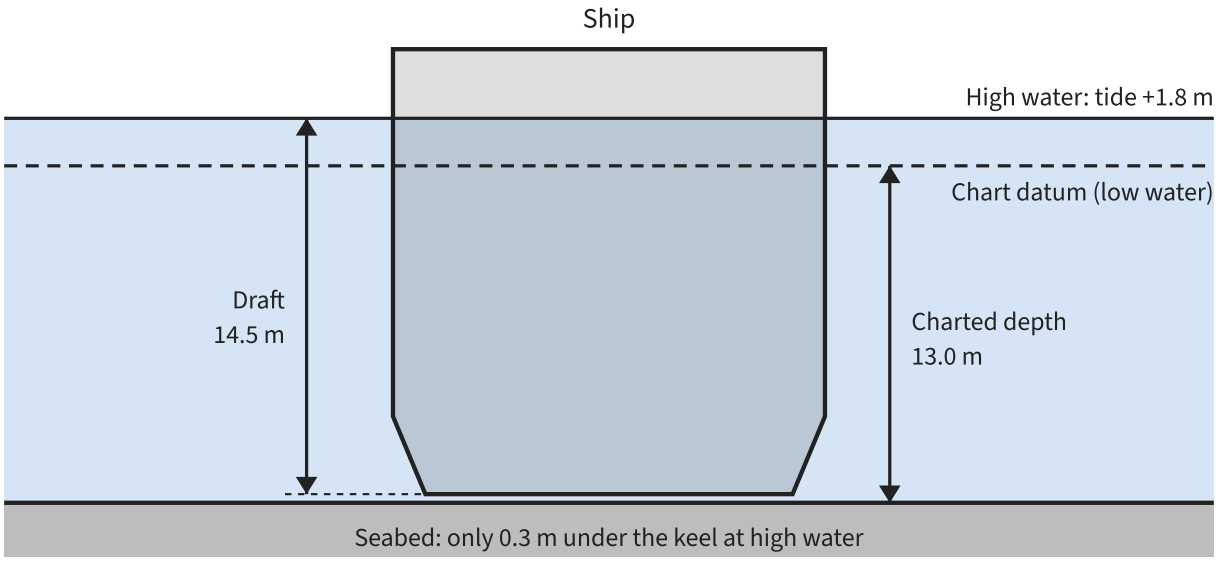
Hidden in plain sight. San Francisco Bay is one of the finest harbors on earth, yet Spanish ships sailed past it for two centuries without seeing it. Its entrance, the strait later called the Golden Gate, is only about a mile wide and is often hidden by summer fog, with hills behind it that seem to close the coast. The first Europeans known to have seen the bay were soldiers of Gaspar de Portolá's overland expedition in November 1769. The first ship to sail in was the Spanish *San Carlos* under Juan Manuel de Ayala on 5 August 1775, and a presidio and mission were founded the next year. John C. Frémont named the strait the Golden Gate in 1846, before the gold rush of 1849 turned a village into a city.

Technology overcoming geography. Engineering keeps changing which harbors matter. The Golden Gate Bridge, with a main span of 4,200 feet (1,280 m), crossed the strait in 1937, and the Sydney Harbour Bridge crossed Port Jackson in 1932. Dredging can deepen a poor harbor and breakwaters can shelter an open one. Today the largest container ships draw around 50 feet (about 15 to 16 m) of water, deeper than many old harbors, and Sydney's main container port stands at Botany Bay, the very harbor Phillip rejected, made usable by dredging and long wharves.

On the map. In the world map, find the four harbors of this lesson and the choke points of this unit. Notice that the great harbors lie on the sea roads that pass through the straits. A harbor is a place to stop; a choke point is a place you must pass. Together they form the map of sea power and trade.



The world's great harbors and choke points studied in this unit and the course.



Depth, tide and draft. Charted depth 13.0 m + tide 1.8 m = 14.8 m of water; a ship drawing 14.5 m has only 0.3 m beneath it.

PICTURE STUDY

Photograph taken from a Japanese plane during the attack on Pearl Harbor, Unknown Japanese naval aviator (captured photograph), 7 December 1941 · Black-and-white aerial photograph · Naval History and Heritage Command, Washington, D.C. (NH 50930)

This photograph was taken from a Japanese aircraft in the first minutes of the attack on 7 December 1941, and was captured by American forces later in the war. It looks across the harbor toward Ford Island, with the battleships of “Battleship Row” moored in pairs along its eastern side.

It is one of the most important images of the attack because it shows the harbor’s geography exactly as the attackers saw it: an island in the middle of shallow, enclosed water, with the fleet lined up at its moorings.

Look closely

- Find Ford Island and the line of battleships beside it. How are the ships arranged?
- Find the splashes and ripples in the water. What do they show is happening?
- Look at the shape of the harbor. Is it open sea or enclosed water? How can you tell?
- Look for smoke and for other ships farther away. What does the photograph suggest about the timing of the attack?

Talk about it

1. Why did ships moored in pairs, close together in a sheltered harbor, make such a clear target from the air?
2. How did the same harbor that protected the fleet from storms and submarines make it vulnerable to aircraft?
3. How does an aerial photograph like this teach geography in a way a painting cannot?

PROJECT: HARBOR-DEFENSE MODEL WITH DEPTHS AND CHOKE POINTS

You will design and build a model harbor of your own, or a real one from this unit, in a tray of clay and water. You will mark depths with contour lines and flags, cut a channel, mark the choke point at the entrance and place defenses. Then you will test it with model ships of different drafts. This model is the heart of your unit portfolio.

You will need

- A deep baking dish, plastic storage box or foil roasting pan
- Modeling clay or plasticine (salt dough dissolves in water, so use clay here)
- A ruler, a fine permanent marker, toothpicks and small paper flags
- Three small boats made from foil or plastic bottle caps, with metal washers glued under them to give different drafts
- Water, blue food coloring (optional), string or a chain of paper clips for a boom
- Graph paper for a plan drawing

Steps

1. Choose your harbor: Sydney, Halifax, Pearl Harbor, San Francisco Bay, Constantinople's Golden Horn, Gibraltar Bay or an invented one. Sketch a plan on graph paper with a scale (for example, 1 cm = 200 m).
2. Shape the land and the harbor floor from clay in the pan. Make one narrow entrance, a deep channel and shallower coves.
3. Choose a depth scale (for example, 1 cm of model depth = 4 m of real depth). Mark depths every 1 cm with toothpick flags, and draw contour lines on your plan drawing.
4. Mark the chart datum with a line of tape on the inside wall of the pan. Fill with water exactly to the line.
5. Test each boat: which ones can reach the inner harbor at "low tide"? Add water to raise the level 0.5 cm (high tide) and test again. Record the results in a table.
6. Mark the choke point at the entrance. Place forts on the headlands, a boom (string or paper-clip chain) across the channel, and a flag where you would put mines or nets.
7. Write a short "harbor report": the depths, the tide, which ships can enter and when, the choke point and how it is defended, and one weakness an enemy might use.

Tips

- Press the clay firmly to the bottom of the pan so water does not lift it.
- Measure each boat's draft by floating it in a clear glass and marking the waterline.

Check your work

- I can show the deep channel, the shallows and the choke point on my model.
- I can use depth, tide and draft to decide which ships can enter.
- I can explain how my harbor is defended and what its weakness is.

MAP NOTEBOOK

1. Draw outline maps of Port Jackson, Halifax Harbour, Pearl Harbor and San Francisco Bay side by side. Mark the entrance of each with an arrow and write its type (ria, ice-scoured inlet, lochs behind a reef, basin with a strait).
2. Make a checklist chart of the harbor qualities (depth, shelter, narrow entrance, fresh water, ice-free, room, hinterland) and score each of the four harbors.
3. Draw the cross-section from the figure and add your own numbers for a ship of your choice.

> **From history.** Halifax and Boston are bound by the 1917 explosion. Within hours of the disaster, the city of Boston and the state of Massachusetts sent a relief train with doctors, nurses and supplies through a blizzard. Every year since 1971, Nova Scotia has sent Boston a large Christmas tree in thanks; it stands on Boston Common through the Christmas season.

WORKED EXAMPLES

Example 1. A harbor channel has a charted depth of 13.0 m below chart datum. At high water the tide stands 1.8 m above chart datum. A ship draws 14.5 m, and the harbor master requires at least 1.0 m of under-keel clearance. Can the ship enter? If not, how much must its draft be reduced?

(Use the map or drawing "Charted depth + tide = water available; draft + clearance = water needed." shown earlier in this lesson.)

1. Greatest depth of water available (at high water): 13.0 + 1.8 = 14.8 m.
2. Water needed: draft + clearance = 14.5 + 1.0 = 15.5 m.
3. 14.8 m is less than 15.5 m, so the ship may not enter even at high water. (The keel would have only 14.8 − 14.5 = 0.3 m beneath it.)
4. Shortfall: 15.5 − 14.8 = 0.7 m. The ship must reduce its draft to 14.5 − 0.7 = 13.8 m, for example by unloading part of its cargo into smaller vessels outside the harbor.

Answer: No. It needs 15.5 m of water but has at most 14.8 m. It must lighten to a draft of 13.8 m or less.

Example 2. Pearl Harbor was only about 40 ft (12 m) deep. Aerial torpedoes of the time, dropped in the usual way, were reported to plunge about 100 ft (30 m) before rising to running depth. By how much did the plunge exceed the depth of the harbor, and by what percentage did the Japanese need to reduce it, at the least, to keep the torpedoes off the bottom?

1. Excess: 100 − 40 = 60 ft (about 18 m).
2. To stay above a 40-ft bottom, the plunge had to be cut from 100 ft to less than 40 ft: a reduction of at least 60 ft.
3. As a percentage: 60 ÷ 100 = 60%.
4. The Japanese solved this by fitting wooden fins to the torpedoes and training pilots to drop them low and slow.

Answer: The normal plunge was about 60 ft (18 m) deeper than the harbor; it had to be reduced by more than 60%.

Example 3. The sea distance from San Francisco to Pearl Harbor is about 2,090 nautical miles. Convert this to km and statute miles, and find how long a ship steaming at 18 knots takes.

1. In km: 2,090 × 1.852 ≈ 3,871 km.
2. In statute miles: 2,090 × 1.151 ≈ 2,405 miles.
3. Time: 2,090 ÷ 18 ≈ 116 hours.
4. In days: 116 ÷ 24 ≈ 4.8 days.

Answer: About 3,870 km (2,400 mi), roughly 116 hours or a little under 5 days at 18 knots.

PRACTICE

1. EASY Who chose Sydney Cove as the site of the first British settlement in Australia, and on what date was the flag raised there?
2. EASY List five qualities of a good natural harbor.
3. EASY What caused the Halifax Explosion, and when did it happen?
4. MEDIUM The Golden Gate Bridge has a main span of 4,200 ft. Convert to meters (1 ft = 0.3048 m).
5. MEDIUM Which two battleships were permanently lost at Pearl Harbor, and why were the others able to fight again?
6. MEDIUM Give three reasons Phillip preferred Port Jackson to Botany Bay.
7. MEDIUM Match each harbor to its type: Port Jackson, Pearl Harbor, San Francisco Bay. Types: (a) lochs behind a coral reef bar, (b) a drowned river valley (ria), (c) a broad basin between hills entered through a narrow strait.

8. MEDIUM Halifax was founded in 1749. How many years later did the Halifax Explosion occur? How many years passed between the Explosion and the attack on Pearl Harbor?
9. HARD A ship draws 12.2 m. The channel's charted depth is 11.0 m, and the harbor requires 0.6 m of under-keel clearance. What height of tide is needed before the ship can enter? If high water that day is +2.1 m, can it enter?
10. HARD Using the world map, describe the direction from San Francisco (37.8°N, 122.4°W) to Pearl Harbor (21.35°N, 157.95°W), and explain why the U.S. Navy valued a base in Hawaii.
    (Use the map or drawing "Find San Francisco and Pearl Harbor." shown earlier in this lesson.)
11. HARD The great-circle distance from Halifax to Liverpool is about 4,380 km. Convert to nautical miles and statute miles, and find how many days a convoy at 8 knots would take.
12. CHALLENGE In a paragraph, explain how the geography of Pearl Harbor both helped the attackers on 7 December 1941 and helped the United States recover afterward.

COMMON MISTAKES

- Thinking depth is all that matters. A good harbor also needs shelter, a defensible entrance, fresh water and a hinterland. Botany Bay failed Phillip on several counts at once (shallow, open to the swell and short of water), while some very deep inlets have no flat land for a city.
- Adding tide and draft the wrong way. The water available is charted depth plus tide; the water needed is draft plus clearance. Compare the two.
- Thinking Cook founded Sydney. Cook named Port Jackson from the sea in 1770 but never entered it; Arthur Phillip explored it and founded the settlement in 1788.

Make it a game · Harbor Master. Write ten ship cards, each with a name and a draft (for example, 9 m to 16 m), and five tide cards (0.0, +0.5, +1.0, +1.5, +2.0 m). The harbor's charted depth is 13.0 m and the required clearance is 1.0 m. Draw a tide card, then turn over ship cards one at a time. The harbor master must say "Enter" or "Wait" within ten seconds. A correct call scores a point; a wrong "Enter" runs the ship aground and loses two points. Take turns as harbor master and play until all the ship cards are used.

Scripture. "He maketh the storm a calm, so that the waves thereof are still. Then are they glad because they be quiet; so he bringeth them unto their desired haven." (Psalm 107:29–30, KJV)

A haven is a harbor. For sailors in the age of sail, reaching a safe harbor after a storm was a picture of God's care. Every natural harbor is part of the shape God gave the land, a gift that sailors and cities have used for thousands of years.

Practice answers

1. Captain Arthur Phillip, commander of the First Fleet; 26 January 1788.

2. Any five of: depth, shelter from wind and waves, a narrow defensible entrance, good holding ground, fresh water, room for many ships, ice-free water, a productive hinterland.
3. On 6 December 1917 the French munitions ship Mont-Blanc collided with the Norwegian ship Imo in the Narrows of Halifax Harbour, caught fire and exploded.
4. 4,200 × 0.3048 ≈ 1,280 m.
5. The Arizona and the Oklahoma. The harbor was shallow, so most sunk or damaged ships settled on the bottom and could be raised, repaired and returned to service; the repair shops and fuel tanks were also left intact.
6. Port Jackson was deep where Botany Bay was shallow; it was sheltered by headlands and a narrow entrance where Botany Bay was open to easterly swells; it had coves with fresh water, especially Sydney Cove; and it had room for many ships.
7. Port Jackson: (b) ria. Pearl Harbor: (a) lochs behind a coral bar. San Francisco Bay: (c) basin entered through the Golden Gate.
8. 1917 − 1749 = 168 years; 1941 − 1917 = 24 years.
9. Water needed: 12.2 + 0.6 = 12.8 m. Tide needed: 12.8 − 11.0 = 1.8 m above chart datum. High water is +2.1 m, so yes, it can enter while the tide is at or above +1.8 m, around high water.
10. Pearl Harbor lies to the west-southwest of San Francisco (about 16° of latitude south and 36° of longitude west). A base there, about 2,090 nautical miles out in the middle of the Pacific, let the fleet guard the approaches to the West Coast and reach far across the ocean toward Asia.
11. 4,380 ÷ 1.852 ≈ 2,365 nautical miles; 4,380 × 0.621 ≈ 2,720 statute miles. Time: 2,365 ÷ 8 ≈ 296 hours ≈ 12.3 days.
12. Helped the attackers: the fleet lay crowded in an enclosed harbor around Ford Island, easy to find and hit from the air; the single narrow entrance meant ships could not escape quickly to open water; the attackers adapted their torpedoes to the shallow depth. Helped the defenders recover: because the water was shallow, most sunk ships settled on the bottom and could be raised and repaired (six of eight battleships fought again); the base, its dry docks, repair shops and fuel tanks remained; and the harbor stayed usable as the main base for the Pacific war.

Unit 6 test

Answer each question. Show your work for every calculation, give units (km and miles, or nautical miles and knots, as asked), and use complete sentences for explanations. Use 1 nautical mile = 1.852 km and 1 km ≈ 0.621 mile. The test is worth 100 points.

1. (6 pts) Name the three bodies of water around old Constantinople and give two reasons Constantine chose the site in 330.
2. (6 pts) The Theodosian Walls were finished about 413, and the city fell in 1453. Constantine dedicated the city in 330. (a) How long did the walls stand before the fall? (b) How long after its founding did the city fall?
3. (7 pts) Describe two things Mehmed II did in 1452–1453 to overcome the geography of Constantinople, and explain what each one achieved.
4. (7 pts) When and in what war was Gibraltar captured, by whose forces, and which treaty ceded it to Britain?
5. (8 pts) The Strait of Gibraltar is about 14 km wide at its narrowest. Suppose guns on each shore can hit ships 3 km out. What width of water is out of range of both shores, and what percentage of the crossing is it? What does this show about the value of Gibraltar?
6. (6 pts) Explain the two-layer current in the Strait of Gibraltar and why it exists.
7. (7 pts) Why did Raffles found a port at Singapore in 1819, and why did declaring it a free port matter?
8. (8 pts) Singapore lies at about 103.85°E and keeps clocks at UTC+8. How far ahead of Greenwich is Singapore by the sun, and at about what clock time is solar noon in Singapore? Show your work.
9. (7 pts) Give three geographic or strategic reasons Singapore fell to Japan on 15 February 1942.
10. (7 pts) Explain why the Allied naval attack on the Dardanelles on 18 March 1915 failed.
11. (8 pts) The Dardanelles is about 61 km long. A ship that can make 9 knots steams up the strait against a 3-knot current. How long does the passage take? How long is the return trip with the current?
12. (7 pts) Match each event to its harbor (Sydney, Halifax, Pearl Harbor, San Francisco Bay): (a) a munitions ship exploded in the Narrows in 1917; (b) Arthur Phillip raised the flag at a cove with a freshwater stream in 1788; (c) the San Carlos became the first ship to enter in 1775; (d) shallow water let six of eight damaged battleships be raised and repaired after 1941.
13. (8 pts) A harbor channel has a charted depth of 12.5 m. A ship draws 13.4 m, and the harbor requires 0.8 m of under-keel clearance. What height of tide above chart datum is needed for the ship to enter? If high water that day is +2.0 m, can it enter, and when?
14. (8 pts) Choose two places from this unit (Constantinople, Gibraltar, Singapore, the Dardanelles or one of the natural harbors). In a well-organized paragraph, compare

what made each place strong and what, in the end, limited that strength. Use at least two specific dates or numbers.

UNIT PROJECT: HARBORS AND CHOKE POINTS: A HARBOR-DEFENSE MODEL AND A WORLD MAP

Build a harbor-defense model in a tray of clay and water, either of a real harbor from this unit (the Golden Horn, Gibraltar Bay, Singapore, Sydney, Halifax, Pearl Harbor or San Francisco Bay) or an invented one. Mark depths with flags and contour lines, the chart datum, the deep channel, the choke point at the entrance and the defenses (forts, a boom or chain, minefields). Include a plan drawing at a stated scale and a “harbor report” that gives the depths, the tide, which ships can enter and when, and one weakness an attacker might use.

Alongside the model, draw a large world map of the great harbors and choke points: the Bosporus and Dardanelles, Gibraltar, Dover, Suez, Bab-el-Mandeb, Hormuz, Malacca and Singapore, Panama, the Cape of Good Hope, Sydney, Halifax, Pearl Harbor and San Francisco Bay. For each, add one line telling a key date from its history.

- **Accuracy**: Depths, scale, choke point and defenses on the model are clearly and correctly marked; places on the world map are located correctly and the dates are right.
- **Reasoning**: The harbor report correctly uses charted depth, tide and draft, and explains how the choke point is defended and where the weakness lies.
- **History**: The model and map connect to real events from the unit (1453, 1704, 1782, 1915, 1917, 1941, 1942) and explain what geography had to do with each.
- **Care**: The model is sturdy and neat, the plan and map are labeled clearly with a scale and key, and the written work is in complete sentences.

Answer key

1. The Golden Horn, the Bosporus and the Sea of Marmara. Reasons (any two): water on two sides made it easy to defend, with only one land side to wall; it controlled the strait between the Black Sea and the Mediterranean (a choke point); it stood on the crossroads of the land route from Europe to Asia; it was much closer than Rome to the Danube and Persian frontiers; the Golden Horn was a fine sheltered harbor.
2. (a) 1453 − 413 = 1,040 years. (b) 1453 − 330 = 1,123 years.
3. Any two: built Rumeli Hisarı at the narrowest point of the Bosporus, so with guns on both shores he could stop help and supplies coming from the Black Sea; used great bombards to batter the Theodosian land walls; hauled ships overland behind Galata into the Golden Horn on 22 April, getting around the chain and forcing the defenders to man the harbor walls, which thinned the line on the land walls.
4. On 4 August 1704, during the War of the Spanish Succession, by an Anglo-Dutch fleet under Admiral Sir George Rooke with marines led by Prince George of Hesse-Darmstadt. Spain ceded it to Britain in Article X of the Treaty of Utrecht (1713).
5. Covered: 3 + 3 = 6 km. Uncovered: 14 − 6 = 8 km (about 5 mi). 8 ÷ 14 ≈ 0.57, about 57%. Guns could not close the strait; Gibraltar’s value lay in its harbor, dockyard and stores as a

base for a fleet that could control the strait.

6. The Mediterranean loses more water by evaporation than its rivers and rain replace, so its water is saltier and denser and its level slightly lower. Lighter Atlantic water flows in eastward on the surface, while heavy Mediterranean water flows out westward along the bottom over the Camarinal Sill.
7. Singapore sits at the southern end of the Strait of Malacca where it meets the South China Sea, on the route every ship between India and China must take, with deep water, a sheltered anchorage and a river. Britain wanted a station to protect its China trade against Dutch control of the region. As a free port with no customs duties, it drew merchants of every nation away from taxed ports and grew quickly into an entrepôt.
8. 103.85° × 4 min per degree ≈ 415 min ≈ 6 h 55 min ahead of Greenwich by the sun. The clocks are 8 h ahead, so they run 8 h − 6 h 55 min = 1 h 05 min ahead of sun time. Solar noon is at about 13:05 (1:05 p.m.) by the clock.
9. Any three: the Japanese came by land down the Malay Peninsula, the side the fortress was least prepared for; they had command of the air and sank the Prince of Wales and Repulse, so the sea could not be held; they outflanked defensive positions through jungle and plantations and by landings behind the lines; the island depended on its hinterland, and once Johor fell, the Johor Strait was narrow enough to cross; the reservoirs and high ground at Bukit Timah were taken, leaving the crowded city short of water; the British fleet that was supposed to come from Europe never arrived; the heavy coast guns had mainly armor-piercing shells meant for ships.
10. The ships ran into a line of 26 mines laid by the Nusret parallel to the shore in Erenköy Bay, where the Allied ships turned; the Bouvet, Irresistible and Ocean sank and others were damaged. More broadly, the strait was narrow and the current ran against the ships; minefields blocked the channel, and the minesweepers (slow trawlers) could not clear them under fire from hidden mobile guns, while the battleships could not destroy those guns until the mines were cleared.
11. 61 ÷ 1.852 ≈ 32.9 nautical miles. Up: 9 − 3 = 6 knots, 32.9 ÷ 6 ≈ 5.5 hours. Down: 9 + 3 = 12 knots, 32.9 ÷ 12 ≈ 2.7 hours.
12. (a) Halifax. (b) Sydney. (c) San Francisco Bay. (d) Pearl Harbor.
13. Water needed: 13.4 + 0.8 = 14.2 m. Tide needed: 14.2 − 12.5 = 1.7 m. High water is +2.0 m, so yes: the ship can enter only while the tide stands at +1.7 m or more, in a window around high water.
14. Answers will vary. A full answer names two places, explains the geographic strengths of each (for example, the Bosporus choke point and walls of Constantinople; Gibraltar’s harbor beside a 14-km strait; Singapore’s position at the end of the Strait of Malacca; the 1.2-km Narrows of the Dardanelles; Pearl Harbor’s sheltered lochs), explains a limit (loss of hinterland, new technology such as cannon or aircraft, a single narrow entrance, dependence on outside help or water), and uses at least two accurate dates or numbers (such as 330, 1453, 1704, 1713, 1819, 15 February 1942, 18 March 1915, 7 December 1941).

UNIT 7

The North European Plain

From the fields of northern France to the foot of the Ural Mountains runs one of the largest lowlands on earth, with no mountain wall anywhere along its length. The North European Plain and the East European Plain have been an open road for traders, settlers and above all armies, in both directions. In this unit you will learn how a land without natural barriers shapes the history of the nations that live on it: why borders there have moved so often, why Russia has relied on sheer distance for defense, and why the plain widens like a funnel toward the east.

You will follow Charles XII of Sweden to Poltava in 1709, watch Poland vanish from the map in 1795 and slide westward in 1945, march with Napoleon to Moscow and back in 1812, and trace the German invasion of 1941 along the same road into the mud and the cold. You will study Charles Joseph Minard's famous 1869 flow map of Napoleon's campaign and redraw it yourself. Finally, you will take up a real historical debate: did Russia build its railways to a wider gauge to stop invaders, or is that a story told after the fact? Throughout, you will ask the course's question: "He set the bounds of the people" (Deuteronomy 32:8), but what happens when the land itself draws no bounds at all?

BEFORE YOU BEGIN

- Can convert between miles and kilometers and between Celsius and Fahrenheit
- Can use latitude to estimate north–south distances (1° ≈ 69 miles or 111 km)
- Knows the ideas of core, frontier and buffer from Unit 1
- Can read a map scale and a simple line graph

MASTERY CHECKLIST

- I can locate the North European Plain and the East European Plain, their narrow places, their corridors and the Pripet Marshes on a map.
- I can explain why borders on an open plain have moved so often, using Poland's history from 1772 to 1945 as an example.
- I can explain how distance, supply, disease, mud and winter worked against the invasions of 1812 and 1941, and why weather alone did not decide either war.
- I can read Minard's map of 1812 and compute rates, losses and temperature conversions from historical data.
- I can weigh the evidence on whether Russia's rail gauge was chosen for defense, distinguishing a decision's intention from its later effects.
- I can name the real wrongs done on the plain (partition, massacre, the Holocaust, mass deportation and expulsion) plainly and factually.

OPTIONAL BOOKS AND RESOURCES

- **Charles Joseph Minard's map of the 1812 campaign (Wikimedia Commons)** (https://commons.wikimedia.org/wiki/File:Minard.png): Free, public domain. Print a large copy for Lesson 7.3 and the unit portfolio, so the student can study the band widths and the temperature graph closely.
- **Leo Tolstoy, *War and Peace* (free at Project Gutenberg)** (https://www.gutenberg.org/ebooks/2600): Free. The great novel of 1812. A parent may choose passages for reading aloud, such as the Battle of Borodino or the French leaving Moscow; the whole book is long and best for strong readers.
- **Prokudin-Gorskii Collection, Library of Congress** (https://www.loc.gov/pictures/collection/prok/): Free. Color photographs of the Russian Empire taken about 1905–1915, including railways, rivers and towns of the plain. Useful for picturing the land the armies crossed and the railways of Lesson 7.5.

7.1 An Open Road

OBJECTIVES

- Locate the North European Plain and the East European Plain from western France to the Ural Mountains, and describe their landforms, rivers and climate.
- Explain why a plain with no mountain wall has been a highway for armies in both directions, and why it widens like a funnel toward the east.
- Measure widths and distances on the plain with latitude and map scale, and read an elevation profile from Paris to Moscow.

Warm-up. Lay a bath towel flat on a table. At one end, scrunch the towel into three or four tall ridges; leave the other end flat. Push a toy car (or roll a marble) across each end. Which end is easier to cross? Now lay two rulers on the flat end in a V shape, narrow end toward you. If you had only ten coins to guard the open end of the V, where would you stand them: at the narrow end or the wide end? Why?

Watch. *Battle of Poltava 1709 - Great Northern War DOCUMENTARY* (Kings and Generals, 20:36). https://www.youtube.com/watch?v=vMkiWDExIY8
After the story: follow the animated map as Charles XII marches east across the open plain toward Russia, and notice how distance, winter and Peter's retreating army wore the Swedes down before Poltava.
Note: Captions were not available to check; preview it first. The video includes a sponsor message for a hair-loss product (skip it) and describes battle casualties.

Backup video. *Ten Minute History - Peter the Great and the Russian Empire (Short Documentary)* (History Matters, 9:59). https://www.youtube.com/watch?v=3tBNr2gjAA0
With the big idea: watch for how Peter the Great built up Russia's army and won the Great Northern War, which turned Russia into a power on the North European Plain.
Note: Captions were not available to check; preview it first. History Matters sometimes uses light, joking humor.

KEY TERMS

North European Plain
The broad lowland that runs from western France through Belgium, the Netherlands, northern Germany, Denmark and Poland to the borders of Belarus and Ukraine.

East European Plain
The even larger lowland, often called the Russian Plain, that continues east from Poland across Belarus, Ukraine and European Russia to the Ural Mountains.

moraine
A long, low ridge or hummocky band of gravel, sand and boulders left behind by a melting ice sheet or glacier.

Pripet Marshes
A huge region of forest, bog and slow rivers in southern Belarus and northern Ukraine (also called Polesia) that splits the eastern plain into a northern and a southern corridor.

strategic depth
The distance between a country's front line and its heart (capital, cities, industry). Great depth lets a defender retreat, trade space for time and wear an invader down.

corridor
A natural lane of easy movement between obstacles such as seas, mountains or marshes, along which armies, roads and railways tend to run.

CORE IDEAS

The story. In the late summer of 1707, King Charles XII of Sweden led about 40,000 of the finest soldiers in Europe east out of Saxony. At twenty-five he had beaten nearly every army sent against him, including a larger Russian army at Narva in 1700. Now he meant to end the Great Northern War by marching on Moscow and forcing Tsar Peter the Great to make peace. Nothing in nature stood in his way. Between the Vistula River and Moscow there is no mountain range, only fields, forests, marshes and rivers. Peter knew he could not stop the Swedes at a wall, because there was no wall. So he gave ground and burned it: villages, grain and fodder went up in smoke ahead of the Swedish columns. By the autumn of 1708 the hungry Swedes turned south into Ukraine, hoping for food and for an alliance with the Cossack leader Ivan Mazepa. Their great supply column under General Lewenhaupt was beaten at Lesnaya and lost its wagons. Then came the winter of 1708–1709, one of the cruelest in Europe's records. On 8 July 1709, at Poltava, Peter's army crushed what remained of the Swedish army. Charles fled to the Ottoman Empire, and Sweden never again stood among the great powers.

The lay of the land. Charles had marched across the eastern half of one of the largest lowlands on earth. The **North European Plain** begins in western France and runs through Belgium, the Netherlands, northern Germany and Denmark and across Poland. East of Poland it opens into the **East European Plain**, which rolls on to the Ural Mountains, roughly 2,400 miles (3,900 km) from the Atlantic coast of France. Most of the plain lies below about 650 feet (200 m), and the East European Plain averages only about 560 feet (170 m) above the sea. Its "high ground" is modest: the Valdai Hills northwest of Moscow, where the Volga, the Dnieper and the Western Dvina all begin, rise to only about 1,135 feet (346 m). Across the north, the land carries the marks of ice sheets that museum signs call the "Ice Age": long low **moraines** of gravel, sandy outwash plains, thousands of lakes in Poland and Belarus, and bogs. The greatest wetland of all is the **Pripet Marshes**, a maze of forest, bog and slow rivers hundreds of miles across in southern Belarus and northern Ukraine.

How the land shapes movement. In the west, the big rivers run north: the Seine and the Rhine to the Channel and the North Sea, the Weser, the Elbe, the Oder, the Vistula and the Neman to the North Sea and the Baltic. An army marching east or west must cross them one after another, so each river is a natural line to defend. But none of them is a Pyrenees. Rivers

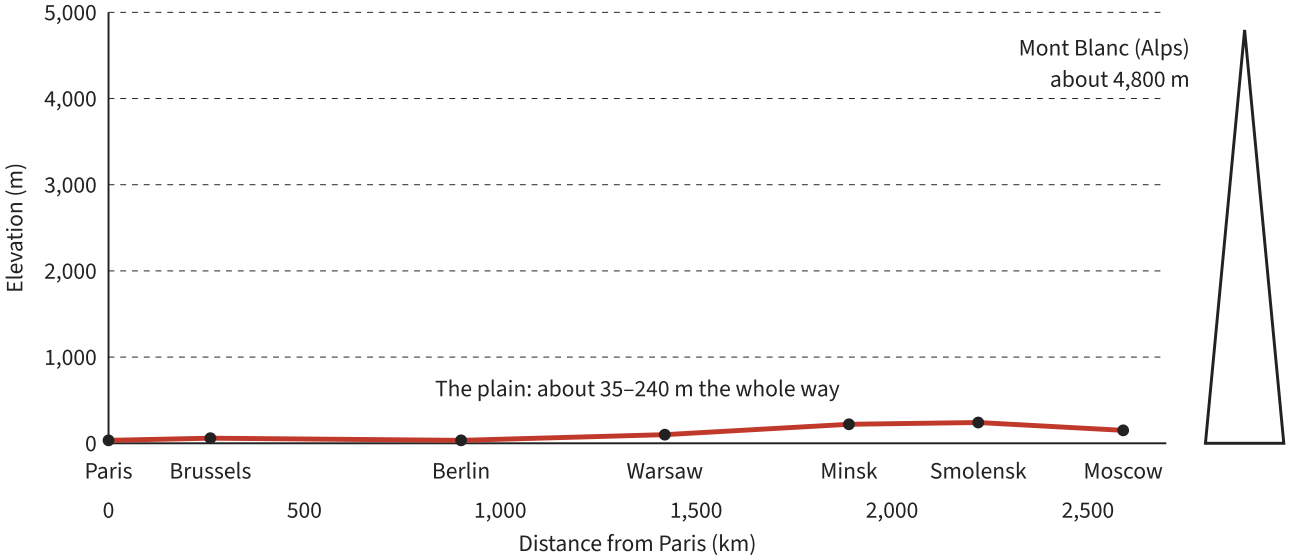
can be forded, bridged or crossed on boats, and in a hard winter they freeze solid. Farther east the great Russian rivers, the Dnieper, the Don and the Volga, flow south toward the Black and Caspian Seas, so they run alongside an invader instead of across his path. The Pripet Marshes divide the eastern plain into two **corridors**: a northern lane through Minsk and Smolensk to Moscow, and a southern lane through Ukraine toward Kyiv. The climate changes as you go east, too. Far from the mild Atlantic, winters grow colder and longer: Paris averages about 41°F (5°C) in January, Moscow about 20°F (−6°C). Each spring thaw and each autumn rain turns the unpaved roads of the east to deep mud.

The big idea. A plain is an open road, and an open road runs both ways. Mongol horsemen crossed it to reach Silesia in 1241. Swedes marched east in 1708, the French in 1812 and the Germans in 1914 and 1941. Russian armies marched west to Paris in 1814 and Soviet armies to Berlin in 1945. Notice the plain's shape. It is narrow in the west, pinched between the sea and the uplands of the Ardennes and central Germany. In Poland it is about 300 miles (480 km) wide from the Baltic Sea to the Carpathian Mountains. At Russia's old western edge it is about 900 miles (1,500 km) wide from the Gulf of Finland to the Black Sea. It is a funnel. An army driving east must spread itself thinner and thinner over a widening front, while a defender in Poland has a narrower gap to hold. Russia, with no wall to stand behind, has relied on **strategic depth**: trading space for time and letting distance, hunger and winter wear invaders down. It has also tried again and again to push its frontier west toward the narrow neck of the funnel. That is one reason borders on the plain have moved so often, as the next lesson shows with Poland. Still, the land does not decide everything. Charles XII chose to turn south, away from Moscow, and Peter chose to burn his own country. Geography sets the stage; people make the choices.

On the map. Draw a straight line from Paris to Moscow: about 1,545 miles (2,486 km). Along the way you pass Berlin, Warsaw, Minsk and Smolensk and cross the Rhine, the Elbe, the Oder, the Vistula, the Bug and the upper Dnieper. Yet you climb almost nothing: Paris lies about 115 feet (35 m) above the sea, and Moscow about 490 feet (150 m). Beside Mont Blanc on the elevation profile (figure), the whole plain is a pencil line along the bottom of the page. On the map, find the two narrow places (Belgium between the Ardennes and the sea, and Poland between the Baltic and the Carpathians) and the two corridors around the Pripet Marshes.

Technology overcoming geography. Flat land is easy to build on. The Dutch and Germans linked their north-flowing rivers with east–west canals, such as Germany's Mittelland Canal. In the 1800s railways spread across the plain faster than across any mountainous land, and Prussia's lines radiated out from Berlin. But in the east the sheer distance remained. Until the railway came, every loaf of bread for an army moved at the pace of a horse and wagon on dirt roads. The same flat land that carries an invader in also stretches his supply line out behind him. The plain is also a gift: its rich black soils in Ukraine and southern Russia have fed millions. "When the most High divided to the nations their inheritance" (Deuteronomy 32:8), He gave some nations mountains and seas, and gave the peoples of the plain wide fields and open frontiers, with all the blessings and dangers those bring.

The open road: the North European Plain and the East European Plain, from Paris to the Urals.



Elevation profile from Paris to Moscow, with Mont Blanc for comparison. Elevations are approximate.

Thinking About Time

What the sign says. Museum signs print long ages beside the moraines, boulder fields and layers of sand and clay that ice sheets left across northern Europe.

What we observe. Geologists can see and map those landforms; those are observations. The long ages come from assuming that rates of deposition and decay have stayed steady over immense spans.

How Christians read it. Many Christians who read Genesis as history understand the Ice Age as a single period of heavy snowfall in the centuries after the Flood, when warm

> oceans and cooling continents fed great ice sheets. Either way, the landforms are real, and they still guide where armies, roads and railways go.

PICTURE STUDY

Vladimirka, Isaac Levitan, 1892 · Oil on canvas · State Tretyakov Gallery, Moscow

Isaac Levitan was one of Russia's greatest landscape painters and a friend of the writer Anton Chekhov. In 1892 he painted the Vladimirka, the old road east from Moscow through Vladimir. For generations prisoners sentenced to exile had walked this road in chains on the long march toward Siberia. Levitan painted no prisoners and no crowds, only one tiny walker far down the road, the grass and the sky, and let the land tell the story.

For a geography student, the painting is a portrait of the East European Plain itself: a horizon as flat as a table, a dirt road that would turn to mud in spring and autumn, and a distance that seems to have no end. Every army that crossed this plain marched on roads like this one.

Look closely

- Follow the road from the bottom of the canvas to the horizon. How many times does it bend? How far away does the end of it seem?
- How much of the painting is sky, and how much is land? Why might Levitan have given the sky so much room?
- Find the small roadside shrine and the tiny far-off details. What do they tell you about the size of the land?
- Look at the ruts in the road. What would this road be like after a week of autumn rain?

Talk about it

1. Levitan painted an empty road that was famous for the people who suffered on it. How does the emptiness make you feel?
2. If you were leading an army of 40,000 men and their wagons along this road, what would worry you most?
3. How does this painting help explain why distance itself has been one of Russia's defenses?

PROJECT: THE FUNNEL: A TABLETOP MODEL OF THE PLAIN

You will build a flat tabletop model of Europe from the Atlantic to the Urals, with the mountains that border the plain built up and the plain itself left flat. Then you will measure the funnel: how wide the open land is in Belgium, in Poland and at Russia's western edge.

You will need

- A large piece of cardboard (at least 24 × 18 inches) or a flattened box
- A printed or traced outline map of Europe from France to the Urals (an atlas page enlarged at a copy shop works well)
- Newspaper, masking tape and white glue, or salt dough (2 cups flour, 1 cup salt, about 3/4 cup water)
- Blue yarn or blue marker for rivers; green and brown paint or markers
- Ruler, string and a calculator
- Small paper flags on toothpicks

Steps

1. Glue or trace your outline map onto the cardboard. Write the map's scale in a corner (for example, 1 inch = 100 miles). If your map has no scale bar, use the distance from Paris to Moscow (about 1,545 miles) to work one out.
2. Build up the mountains that frame the plain with crumpled newspaper taped down and covered with glue-soaked paper strips, or with salt dough: the Pyrenees, the Alps, the Ardennes uplands (low), the Carpathians, the Caucasus and the Urals. Keep the plain itself completely flat.
3. Paint the plain green and the mountains brown. Mark the Valdai Hills with a tiny bump and a label; it is the highest ground on the plain at only about 1,135 feet.
4. Glue blue yarn along the Seine, Rhine, Elbe, Oder, Vistula and Neman (flowing north), and along the Dnieper, Don and Volga (flowing south). Draw small arrows to show which way each one flows.
5. Shade the Pripet Marshes with blue-green dots and draw the two corridors around them with pencil arrows.
6. Measure the width of the open plain with your ruler and the map scale in three places: (a) in Belgium, between the coast and the Ardennes; (b) in Poland, from the Baltic coast near Gdańsk to the Carpathians; (c) from the Gulf of Finland near St. Petersburg to the Black Sea near Odesa. Record each in miles and kilometers.

7. Place paper flags at Poltava (1709), Moscow (1812 and 1941) and Berlin (1945). Write one sentence on each flag about who came that way.

Tips

- To convert miles to kilometers, multiply by 1.609. To convert kilometers to miles, multiply by 0.621.
- If your model looks bumpy where the plain should be, sand or press it flatter. The whole point is how little stands in the way.
- Let salt dough dry for two days, or bake it at 200°F for a few hours, before painting.

Check your work

- I can point to the plain's narrow places and its wide places and give their approximate widths.
- I can show which rivers cross an east–west route and which run alongside it.
- I can explain why a funnel shape matters to an army moving east and to a defender.

MAP NOTEBOOK

1. Draw a sketch map of the plain from Paris to the Urals. Label six cities, eight rivers, the Pripet Marshes and the Valdai Hills, and add arrows showing the direction each river flows.
2. Copy the funnel diagram: draw the plain as a wedge, narrow at the west and wide at the east. Write the three widths you measured along it.
3. Make a two-column chart titled "Open Road": invasions going east on one side (1241 toward Silesia, 1708, 1812, 1914, 1941) and armies going west on the other (1814, 1945).

> **From history.** After Poltava, Charles XII spent five years as an uneasy guest of the Ottoman sultan at Bender on the Dniester before riding back to Sweden in 1714, reportedly covering the distance across Europe in about two weeks. He was killed by a bullet in 1718 while besieging the fortress of Fredriksten in Norway. Peter the Great, meanwhile, had already begun building his new capital, St. Petersburg, on the marshy shore of the Gulf of Finland in 1703. The Treaty of Nystad (1721) confirmed Russia's gains on the Baltic, and Peter took the title of Emperor.

WORKED EXAMPLES

Example 1. Gdańsk on the Baltic coast lies at about 54.35°N, and Kraków near the foot of the Carpathians lies at about 50.06°N. Using the north–south difference in latitude, estimate the width of the plain across Poland in miles and kilometers. (One degree of latitude is about 69 miles or 111 km.)

(Use the map or drawing "Gdańsk and Kraków mark the narrow neck of the plain in Poland." shown earlier in this lesson.)

1. Difference in latitude: 54.35° − 50.06° = 4.29°.
2. In miles: 4.29 × 69 ≈ 296 miles.
3. In kilometers: 4.29 × 111 ≈ 476 km.
4. The two cities are about 1.3° of longitude apart, so the true straight-line distance is a little more, but the north–south width is what matters for the gap between sea and mountains.

Answer: About 300 miles (480 km) from the Baltic to the Carpathians.

Example 2. St. Petersburg (59.94°N, 30.31°E) and Odesa (46.48°N, 30.73°E) lie almost on the same meridian. Estimate the width of the plain between the Gulf of Finland and the Black Sea, and compare it with the width across Poland from Example 1.

1. Because the longitudes differ by less than half a degree, the distance is almost all north–south.
2. Difference in latitude: 59.94° − 46.48° = 13.46°.
3. In miles: 13.46 × 69 ≈ 929 miles. In kilometers: 13.46 × 111 ≈ 1,494 km.
4. Compare: 929 ÷ 296 ≈ 3.1.

Answer: About 930 miles (1,490 km), roughly three times as wide as the gap across Poland. An army driving east must cover a front about three times longer.

Example 3. Paris lies about 35 m (115 ft) above sea level and Moscow about 150 m (492 ft). The straight-line distance between them is about 2,486 km (1,545 miles). Find the average rise per kilometer and per mile, and describe it in everyday terms.

(Use the map or drawing "The Paris–Moscow profile is almost a flat line." shown earlier in this lesson.)

1. Rise: 150 m − 35 m = 115 m, or 492 ft − 115 ft = 377 ft.
2. Per kilometer: 115 m ÷ 2,486 km ≈ 0.046 m, or about 4.6 cm per kilometer.
3. Per mile: 377 ft ÷ 1,545 mi ≈ 0.244 ft, and 0.244 × 12 ≈ 2.9 inches per mile.
4. That is like a table 1 mile long whose far end is raised by the height of a playing card standing on its short edge.

Answer: About 4.6 cm per km (about 3 inches per mile): far too gentle for anyone to notice.

PRACTICE

1. EASY Name the mountain range at the eastern end of the East European Plain and the mountain range that closes off the southern side of the plain in Poland.
2. EASY In which general direction do the Elbe, the Oder and the Vistula flow? Why does that direction matter to an army marching from Berlin toward Moscow?
3. EASY Define strategic depth and explain how Peter the Great used it against Charles XII.
4. MEDIUM Berlin and Warsaw are about 518 km apart. How many miles is that?
5. MEDIUM An army on foot averages 20 km (12.4 miles) a day. Warsaw is about 1,150 km (715 miles) from Moscow. How many days of marching would it take, without rest days?
6. MEDIUM On a wall map at a scale of 1:10,000,000, 1 cm represents 100 km. How long would the 2,486-km line from Paris to Moscow be on that map, in centimeters and in inches?
7. MEDIUM The Valdai Hills reach about 346 m. Convert this to feet (1 m = 3.281 ft) and compare it with Mont Blanc, about 4,800 m. How many times taller is Mont Blanc?
8. MEDIUM Using the map, explain why the Pripet Marshes have mattered to every large army crossing the eastern plain.
9. HARD Minsk lies at about 53.90°N, 27.57°E and Kyiv at about 50.45°N, 30.52°E. Estimate the north–south distance between them from latitude alone. Which great obstacle lies between them?
10. HARD At 55°N, one degree of longitude is about 111 km × cos 55° ≈ 64 km (40 miles). Smolensk (32.05°E) and Moscow (37.62°E) both lie near 55°N. Estimate the east–west distance between them.
11. HARD List three invasions that crossed the plain from west to east and two that crossed it from east to west, with dates. What does the list suggest about the plain as a border zone?

12. CHALLENGE In a paragraph, explain why rulers in Moscow have often tried to push their western frontier toward Poland, using the ideas of the funnel and strategic depth. Then name one limit of this geographic explanation.

COMMON MISTAKES

- Thinking “plain” means perfectly empty land. The plain has rivers, moraines, forests and huge marshes; it simply has no mountain wall.
- Assuming rivers make strong borders here. The plain’s rivers can be forded, bridged or crossed on ice; they slow an army but rarely stop one.
- Treating geography as destiny. The open plain made invasion easier, but the outcomes of 1709, 1812 and 1941 turned on choices, leadership, supply and weather as well.

Make it a game · Cross the Plain. Lay a strip of paper 6 feet long on the floor as the route from Paris to Moscow, with taped marks for the Rhine, Elbe, Oder, Vistula and Dnieper. One player is the invader and moves a token forward by rolling a die; the other is the defender and holds three “river line” cards. At each river the defender may play a card to force the invader to stop and roll a 5 or 6 to cross. After the Vistula, every roll of 1 means “supply wagon lost” and costs a turn. If the invader reaches Moscow in 15 turns, the invader wins; otherwise distance wins. Switch sides and discuss which advantages the land gave each player.

Scripture. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;” (Acts 17:26, KJV)

On the open plain, “the bounds of their habitation” have shifted more than almost anywhere else on earth. God has determined both the times and the bounds; men and nations remain responsible for how they treat their neighbors when the land offers no wall between them.

Practice answers

1. The Ural Mountains in the east; the Carpathian Mountains on Poland’s southern side.
2. North, to the North Sea and the Baltic. Because they flow north, they lie across an east–west line of march, so an army must cross them one by one and a defender can try to hold each river line.
3. Strategic depth is the distance between a country’s front line and its vital center. Peter retreated across that distance, burning crops and villages, so the Swedes grew hungrier and weaker the farther they marched.
4. 518 × 0.621 ≈ 322 miles.
5. 1,150 ÷ 20 = 57.5, so about 58 days (715 ÷ 12.4 ≈ 58).
6. 2,486 ÷ 100 ≈ 24.9 cm, and 24.9 ÷ 2.54 ≈ 9.8 inches.
7. 346 × 3.281 ≈ 1,135 ft. 4,800 ÷ 346 ≈ 13.9, so Mont Blanc is about 14 times taller.
8. The marshes are a wide belt of bog and forest that wheeled armies cannot easily cross, so they split the plain into a northern corridor (Minsk–Smolensk–Moscow) and a southern

corridor (through Ukraine toward Kyiv). An invader must choose one corridor or divide his forces around the marshes.

9. 53.90 − 50.45 = 3.45°; 3.45 × 111 ≈ 383 km, or 3.45 × 69 ≈ 238 miles. The Pripet Marshes lie between them.
10. 37.62 − 32.05 = 5.57°; 5.57 × 64 ≈ 356 km, or 5.57 × 40 ≈ 223 miles. (The true distance is a little more because Moscow is about 1° farther north.)
11. West to east: Charles XII (1708–1709), Napoleon (1812), Germany (1914 and 1941). East to west: Mongols into Silesia (1241), Russian armies to Paris (1814), Soviet armies to Berlin (1945). The plain is a two-way road: no side has a natural wall, so borders there have been set by armies and treaties and have moved often.
12. Sample answer: The plain is about 300 miles wide in Poland but about 900 miles wide at Russia's old western edge, so a frontier in Poland is a much shorter line to defend than one farther east. Pushing the frontier west also adds depth in front of Moscow, giving more space to trade for time. Limit: geography explains pressures, not decisions. Rulers also acted from ambition, ideology and fear, and other states on the plain (Poland, Lithuania, the Baltic peoples) had their own rights and reasons, so the land does not justify every conquest.

7.2 Poland on the Plain

OBJECTIVES

- Trace the history of Poland's borders from the Polish–Lithuanian Commonwealth through the partitions of 1772, 1793 and 1795, rebirth in 1918, and the westward move of 1945.
- Explain how Poland's position on the open plain between powerful neighbors made its borders unusually unstable, and how the nation survived without a state.
- Measure border shifts, distances and changes in area on maps, and explain why the postwar western border follows the Oder and Neisse Rivers.

Warm-up. Cut a sheet of paper into the rough shape of a country. Lay it on a table between three books (your "neighbors"). Have a family member slide the books inward, one at a time, and tear off the part of your paper each book covers. Then slide the whole leftover paper two hands to the left and tape on a new piece from the left-hand book. Is it still the same country? What stayed the same, and what changed?

Watch. *1st August 1944: Warsaw Uprising begins in German-occupied Poland during the Second World War* (HistoryPod, 2:42). https://www.youtube.com/watch?v=Kks97YXXtG4
As review: watch this short account of the 1944 Warsaw Uprising as one more example of Poland, with no natural barriers on the plain, caught between powerful neighbors on both sides.
Note: Captions were not available to check; preview it first. The video describes German mass executions of civilians and the destruction of Warsaw, which may be hard for younger students. The lesson's story is Kościuszko's uprising of 1794; this video covers the Warsaw Uprising of 1944.

KEY TERMS

Polish–Lithuanian Commonwealth
The union of the Kingdom of Poland and the Grand Duchy of Lithuania made permanent at Lublin in 1569; in the early 1600s one of the largest states in Europe.

partition
The dividing of a country's territory among other states. Russia, Prussia and Austria partitioned Poland in 1772, 1793 and 1795.

nation and state
A nation is a people bound by language, memory and faith; a state is a government ruling a territory. From 1795 to 1918 the Polish nation lived on without a Polish state.

Curzon Line
A line proposed by the British foreign secretary Lord Curzon in 1920, running roughly along the Bug River; the basis of Poland's eastern border after 1945.

Oder–Neisse line

Poland's western border since 1945, following the Oder River and its tributary the Lusatian Neisse from the Baltic to the Czech border.

population transfer
The forced movement of whole peoples to fit new borders, as when millions of Germans were expelled from lands given to Poland and Poles were moved out of lands taken by the Soviet Union.

CORE IDEAS

The story. On 24 March 1794, in the market square of Kraków, Tadeusz Kościuszko swore an oath to fight for the freedom of Poland. He was no stranger to such fights: as a volunteer engineer in the American War of Independence he had helped fortify the field at Saratoga and planned the defenses at West Point. Now his own country had been carved up twice by its neighbors. On 4 April at Racławice his small army, joined by peasants armed with scythes straightened into pikes, beat a Russian force. But the uprising could not stand against three empires at once. Kościuszko was wounded and captured at Maciejowice in October. In November, Russian troops under General Suvorov stormed Praga, the suburb of Warsaw across the Vistula, and slaughtered thousands of soldiers and civilians. In 1795 Russia, Prussia and Austria divided what was left of Poland, and on 25 November King Stanisław August abdicated. For 123 years there was no Poland on the map of Europe.

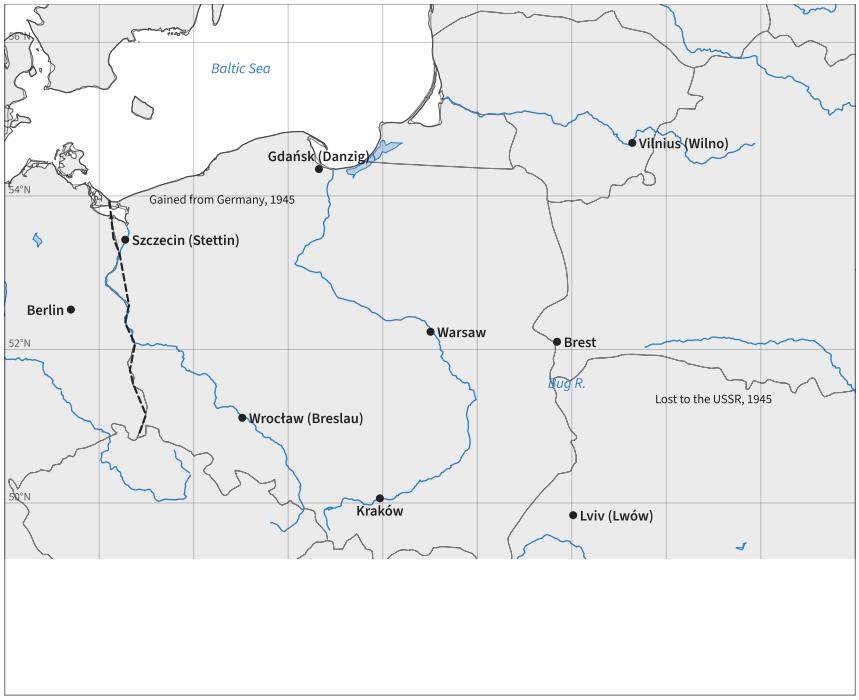
How it happened. Poland's very name is a geography lesson: it comes from the Polanie, the "people of the fields," and its heartland lies in the open middle of the North European Plain. Poland accepted Christianity with the baptism of Duke Mieszko I in 966, and in 1569 the Union of Lublin bound it to Lithuania in a great Commonwealth stretching from the Baltic nearly to the Black Sea. That Commonwealth had real achievements: a parliament of nobles, a long tradition of religious toleration for its time, and the cavalry of King Jan III Sobieski, which helped lift the Turkish siege of Vienna in 1683. But it had no natural frontiers, and its government was weak. Kings were elected, and any single deputy could block the parliament with the *liberum veto*. Meanwhile its neighbors (Russia, Prussia and Austria) grew into centralized military powers. In the First Partition of 1772 they took nearly a third of the Commonwealth's land. Poland answered with reform, including the Constitution of 3 May 1791, the first modern written constitution in Europe. Its neighbors answered with the Second Partition (1793, Russia and Prussia) and the Third (1795).

A nation without a state. Poland's borders kept moving even while it had none. Napoleon created a Duchy of Warsaw in 1807; the Congress of Vienna in 1815 turned most of it into a "Congress Kingdom" ruled by the Russian tsar. Poles rose against Russia in 1830 and 1863 and were crushed both times. Yet the nation endured, carried by its language, its Catholic faith, its families and its art: Frédéric Chopin's music and Adam Mickiewicz's poetry were loved as voices of a people who would not disappear. The song of the Polish Legions, written in 1797, began, "Poland has not yet perished, so long as we live." In November 1918, as the three empires that had partitioned Poland collapsed at the end of World War I, Poland was reborn. In August 1920 its army turned back the Soviet Red Army at the gates of Warsaw.

The country that moved. On 23 August 1939, Nazi Germany and the Soviet Union signed a pact with a secret protocol dividing Poland between them. Germany invaded on 1 September and the Soviets on 17 September. The occupation was among the worst in history. Nazi Germany murdered about three million Polish Jews in the Holocaust, many in death camps it built on occupied Polish soil such as Auschwitz, and killed millions of other Polish citizens. The Soviet secret police shot about 22,000 Polish officers and other prisoners at Katyn and other sites in 1940 and deported hundreds of thousands to the east. At Yalta and Potsdam in 1945 the victorious Allies redrew Poland. The Soviet Union kept the eastern lands it had seized in 1939, roughly up to the Curzon Line, including the old Polish cities of Wilno (Vilnius) and Lwów (Lviv). In exchange Poland received German lands to the west and north: Silesia, Pomerania, the city of Danzig (Gdańsk) and the southern part of East Prussia. The whole country slid west by roughly 125 to 200 miles (200 to 320 km), depending on where you measure. Millions of Germans fled or were expelled from the new Polish lands, often brutally, and Poles from the east were resettled in their place. Professors and books from Lwów, for example, moved to Breslau, which became Wrocław.

The big idea. On a plain, borders follow armies and treaties more than nature. Poland had no mountain wall on the east or west, so its size and shape depended on the strength of its neighbors and the decisions of great powers. When the Allies drew the new western border in 1945, they reached for the only natural lines available, two rivers, the Oder and the Lusatian Neisse. Communist East Germany recognized the line in 1950, West Germany accepted it in a 1970 treaty, and reunited Germany confirmed it in a treaty signed in November 1990. As of 2026, Poland is a member of NATO (since 1999) and the European Union (since 2004), and its borders have been stable for more than eighty years.

On the map. Compare four maps: the Commonwealth in 1772, the partitions of 1795 with no Poland at all, the Poland of 1921–1939, and Poland since 1945 (figure). Interwar Poland covered about 388,600 km² (150,000 square miles); postwar Poland covers about 312,700 km² (120,700 square miles). Find the Oder–Neisse line on the west and the Bug River on the east, then find Lviv and Vilnius outside Poland today and Wrocław and Szczecin inside it.



Poland moved west in 1945: lands in the east went to the Soviet Union, and German lands up to the Oder–Neisse line went to Poland.

PICTURE STUDY

Rejtan, or the Fall of Poland, Jan Matejko, 1866 · Oil on canvas · Royal Castle, Warsaw

Jan Matejko of Kraków painted great scenes from Polish history at a time when Poland did not exist as a state. Here he shows the parliament (Sejm) of 1773, which was forced to approve the First Partition. The deputy Tadeusz Rejtan threw himself across the doorway to stop the members from leaving to sign the agreement, crying that they would have to walk over him.

Matejko crowded the room with real historical figures, some bribed by foreign powers. The painting caused an uproar when it was shown, because it blamed not only the foreign empires but Poland's own nobles for the fall of their country.

Look closely

- Find Rejtan. Where is he, and what is he doing with his body?
- Look at the faces of the men above him. Which ones look ashamed, which look angry, and which look unconcerned?
- Find the documents, coins or signs of wealth in the room. What might Matejko be suggesting about why the partition passed?
- Where is the light brightest? What does the painter want you to see first?

Talk about it

1. Matejko blamed Poland's neighbors and Poland's own leaders. Why might a painter want his people to remember their own faults as well as the wrongs done to them?
2. How does this painting help explain why Poland, with no natural borders, needed a strong and united government?
3. Why would Poles living under Russian, Prussian and Austrian rule in 1866 treasure a painting like this?

PROJECT: THE MOVING COUNTRY: OVERLAYS AND A BALANCING CENTER

You will trace Poland's borders from four different years onto tracing paper, lay them over one base map, and find how far the country's center moved by cutting out each shape and balancing it on a pin.

You will need

- A base map of central and eastern Europe with a scale bar (atlas or printout)
- Four sheets of tracing paper or baking parchment
- Colored pencils (four colors)
- Light cardboard (cereal box), scissors, glue stick
- A pushpin or straight pin, a pencil and a ruler
- Historical atlas maps of Poland in 1772, 1815, 1921–1939 and after 1945 (a library atlas or Library of Congress maps)

Steps

1. Mark four or five fixed reference points on the base map (for example Berlin, Warsaw, Vilnius, Kyiv and Prague) and copy them onto each tracing sheet so the sheets line up.
2. Trace the borders of the Polish–Lithuanian Commonwealth in 1772 on the first sheet, the Congress Kingdom of 1815 on the second, interwar Poland (1921–1939) on the third and Poland after 1945 on the fourth. Use a different color for each.
3. Stack the sheets over the base map and look through them. Which cities were inside Poland in one year and outside it in another? Make a list.

4. Glue the interwar and postwar tracings onto cardboard and cut out each shape.
5. Find each shape's center of gravity: poke a pin through a point near the edge, let the shape hang freely, and draw a vertical line down from the pin with a ruler (use a string with a small weight as a plumb line). Repeat from a second point. Where the lines cross is the center.
6. Lay the cut-outs back on the base map and measure the distance between the two centers with the scale bar. Record it in miles and kilometers.
7. Write a paragraph: How far did Poland's center move in 1945, in what direction, and why?

Tips

- Your answer will probably fall somewhere between about 120 and 200 miles; the exact figure depends on your maps and your care in cutting.
- Hang the shape from a point close to the edge, not near the middle, or the lines will be hard to draw.
- Label each overlay with its year and the treaty or event that made it.

Check your work

- I can name the events that set Poland's borders in 1772, 1795, 1815, 1918–1921 and 1945.
- I can show which lands Poland lost in the east and which it gained in the west in 1945.
- I can measure and explain how far the country moved.

MAP NOTEBOOK

1. Draw a timeline from 966 to 1990 with the baptism of Mieszko I, the Union of Lublin, the three partitions, 1807, 1815, 1918, 1920, 1939, 1945 and the 1990 border treaty.
2. Sketch Poland's outline before and after 1945 on the same axes, and shade the lost and gained lands in different colors.
3. Write four lines of the Polish Legions' song in English ("Poland has not yet perished, so long as we live…") and, under it, explain in two sentences how a nation can live without a state.

> **From history.** When Warsaw was rebuilt after the Germans deliberately destroyed it following the Warsaw Uprising of 1944, Polish architects used the detailed eighteenth-century paintings of the Italian artist Bernardo Bellotto, who had painted the city's streets for King Stanisław August, as a guide to reconstructing the Old Town. Warsaw's rebuilt historic center was added to UNESCO's World Heritage List in 1980.

WORKED EXAMPLES

Example 1. Interwar Poland covered about 388,600 km², and postwar Poland covers about 312,700 km². Find the net loss of area in square kilometers, square miles and as a percent of the interwar area. (1 km² ≈ 0.386 square miles.)

1. Net loss: 388,600 − 312,700 = 75,900 km².
2. In square miles: 75,900 × 0.386 ≈ 29,300 square miles.
3. Percent: 75,900 ÷ 388,600 ≈ 0.195, or about 19.5%.

Answer: About 75,900 km² (29,300 square miles), roughly one-fifth of the interwar area, even though Poland gained large German lands in the west.

Example 2. After 1945 many Poles from Lwów (Lviv), at about 49.84°N, 24.03°E, were resettled in Wrocław, at about 51.11°N, 17.03°E. Estimate the distance they moved. (One degree of latitude is about 111 km; one degree of longitude at about 50.5°N is about 111 × cos 50.5° ≈ 70.6 km.)

(Use the map or drawing "Lviv, now in Ukraine, and Wrocław, formerly German Breslau, now in Poland." shown earlier in this lesson.)

1. North–south: 51.11 − 49.84 = 1.27°, and 1.27 × 111 ≈ 141 km.
2. East–west: 24.03 − 17.03 = 7.00°, and 7.00 × 70.6 ≈ 494 km.
3. Straight-line distance (Pythagorean theorem, fine for short distances): $\sqrt{(141^2 + 494^2)} = \sqrt{(19{,}881 + 244{,}036)} = \sqrt{263{,}917} \approx 514$ km.
4. In miles: 514 × 0.621 ≈ 319 miles, almost due west-northwest.

Answer: About 514 km (320 miles), mostly westward.

Example 3. Since 1945 Poland's eastern border has run along the Bug River near Brest (about 52.10°N, 23.69°E). Warsaw lies at about 52.23°N, 21.01°E. Estimate how far Warsaw is from that border crossing, and explain what this means for Poland's strategic depth. (At 52°N, one degree of longitude is about 111 × cos 52° ≈ 68 km.)

1. The latitudes are almost the same, so the distance is nearly all east–west.
2. Difference in longitude: 23.69 − 21.01 = 2.68°.
3. Distance: 2.68 × 68 ≈ 182 km; 182 × 0.621 ≈ 113 miles.
4. An army crossing the Bug could reach Warsaw in a few days of open country.

Answer: About 182 km (113 miles). Poland's capital has very little depth in front of it on the open plain, which helps explain why Poles have placed such weight on alliances.

PRACTICE

1. EASY Which three powers partitioned Poland, and in which years?
2. EASY What does the name “Poland” suggest about the land where the Polish people lived?
3. EASY Name two rivers that form Poland’s western border today and one river that forms much of its eastern border.
4. MEDIUM Poland disappeared from the map in 1795 and was reborn in 1918. For how many years did it have no state of its own? What kept the nation alive?
5. MEDIUM In the First Partition (1772), the Commonwealth lost about 211,000 km² out of roughly 733,000 km². What percent of its land was that?
6. MEDIUM Interwar Poland covered about 150,000 square miles and postwar Poland about 120,700 square miles. Convert both to km² (1 square mile ≈ 2.59 km²).
7. MEDIUM Name two cities that were Polish before 1939 but lie outside Poland today, and two that were German before 1945 but are Polish today. Give both names where they differ.
8. MEDIUM On the map at a scale of 1 cm = 50 km, the westward shift of Poland’s border near Wrocław measures 4 cm. How far is that in kilometers and miles?
9. HARD Explain why the Allies chose rivers for Poland’s new western border in 1945, and why that border is more stable today than Poland’s borders were in the 1700s.
10. HARD Name one wrong done to Poles by Nazi Germany, one done by the Soviet Union, and one wrong done to Germans as the borders moved in 1945.
11. HARD Warsaw is about 182 km from the Bug River border. A mechanized column advances 40 km a day. How many days would it take to reach Warsaw unopposed? What does this suggest about relying on distance for defense in Poland?
12. CHALLENGE Write a paragraph weighing this claim: “Poland was partitioned because it lay on a plain.” Use at least two geographic and two non-geographic reasons.

COMMON MISTAKES

- Thinking Poland’s borders changed only once. They changed in 1772, 1793, 1795, 1807, 1815, 1918–1921, 1939 and 1945.
- Confusing the nation with the state. The Polish state vanished in 1795, but the Polish people, language and faith did not.
- Forgetting that the 1945 border shift moved people as well as lines: millions of Germans and Poles were forced from their homes.

Make it a game · Border Shuffle. Make a deck of cards with one year on each: 966, 1569, 1772, 1793, 1795, 1807, 1815, 1918, 1939, 1945, 1990. Shuffle and deal. On your turn, place a card in the timeline on the table and, in one sentence, say what happened to Poland’s borders that year. If you are right, you score a point; if another player catches a mistake, they score it. Bonus point for pointing to the right area on a map.

> **Scripture.** “God is our refuge and strength, a very present help in trouble.” (Psalm 46:1, KJV)

Poland had no mountains to hide behind and, for 123 years, no state to protect it. Many Poles held to their faith as the one refuge that no partition could take away.

Practice answers

1. Russia, Prussia and Austria, in 1772, 1793 (Russia and Prussia only) and 1795.
2. It comes from the Polanie, the “people of the fields”: they lived on the open plain.
3. The Oder and the Lusatian Neisse in the west; the Bug in the east.
4. 1918 − 1795 = 123 years. Language, the Catholic faith, family life, memory, literature and music (Mickiewicz, Chopin) and repeated uprisings kept the nation alive.
5. 211,000 ÷ 733,000 ≈ 0.288, or about 29%, nearly a third.
6. 150,000 × 2.59 ≈ 388,500 km²; 120,700 × 2.59 ≈ 312,600 km² (matching the published figures of about 388,600 and 312,700 km²).
7. Outside Poland now: Wilno (Vilnius, Lithuania) and Lwów (Lviv, Ukraine). Polish now: Breslau (Wrocław), Stettin (Szczecin), and also Danzig (Gdańsk), which was a Free City between the wars.
8. 4 × 50 = 200 km; 200 × 0.621 ≈ 124 miles.
9. On an open plain rivers were the only clear natural lines to follow, easy to survey and describe in a treaty. The border is stable today not because the rivers are walls but because it has been recognized by treaty (East Germany 1950, West Germany 1970, reunited Germany 1990), the populations were (forcibly) moved to match it, and Poland and Germany are both in alliances that rule out war between them.
10. Nazi Germany murdered about three million Polish Jews in the Holocaust and millions of other Polish citizens. The Soviet NKVD shot about 22,000 Polish officers and others at Katyn and other sites in 1940 and deported hundreds of thousands. Millions of Germans were expelled from the lands given to Poland, many dying on the way.
11. 182 ÷ 40 ≈ 4.6, so about 5 days. Poland has little strategic depth, so it cannot trade space for time as Russia did; it must rely on armies, fortifications and allies.
12. Sample answer: Geography mattered: Poland had no mountain or sea barriers on its long eastern and western frontiers, and it lay between three growing powers that could march in from several sides. But geography was not the whole story. Poland’s elected kings and the liberum veto kept its government and army weak, foreign powers bribed its nobles, and Russia, Prussia and Austria chose to cooperate rather than fight over it. The 1791 Constitution shows Poles saw the danger and tried to reform. So the plain made Poland vulnerable, but human decisions turned vulnerability into partition.

7.3 Napoleon in Russia

OBJECTIVES

- Narrate Napoleon's 1812 campaign from the crossing of the Niemen to the retreat across the Berezina, and locate its key places on a map.
- Explain how distance, supply, disease, Russian strategy and finally winter destroyed the Grande Armée, and weigh which mattered most.
- Read Charles Joseph Minard's 1869 flow map, compute rates of advance and losses from its data, and convert its Réaumur temperatures.

Warm-up. Fill a glass with exactly 40 dried beans or pieces of cereal: this is your army. Walk slowly from one end of your house to the other. Every time you pass through a doorway, take out 3 beans ("sickness and hunger"). When you reach the far wall, take out 10 more ("the battle"). Now walk back the same way, taking out 4 beans at every doorway ("cold and Cossacks"). How many are left? Which part of the trip cost more: the battle or the walking?

Watch. *Why did Napoleon Invade Russia? (Short Animated Documentary)* (History Matters, 3:28). https://www.youtube.com/watch?v=qNeckncEKCU
Before the story: watch this short animated explainer of why Napoleon decided to invade Russia in 1812, then read about what happened when his army crossed the Niemen.
Note: Captions were not available to check; preview it first. History Matters sometimes uses light, joking humor.

Backup video. *How Russia Prepared for Napoleon's Invasion - Fatal Trap* (Kings and Generals, 19:36). https://www.youtube.com/watch?v=PN8SNBW330E
After the story: watch how Russia prepared for Napoleon, and look for the plan to fall back across the vast plain instead of meeting the Grande Armée at the border. Note: Captions were not available to check; preview it first. Kings and Generals videos often include a short sponsor or channel-membership plug; skip it.

KEY TERMS

Grande Armée
Napoleon's "Great Army," the multinational force of French, Polish, German, Italian and other troops that invaded Russia in 1812.

line of supply (line of communication)
The road and depots that connect an army to its sources of food, ammunition, fodder and replacements. The longer it grows, the harder it is to keep full and safe.

scorched earth
Destroying crops, stores, shelter and transport in the path of an enemy so that he cannot live off the land.

flow map
A map that shows movement with bands or arrows whose width is proportional to the amount moving, such as people, goods or troops.

Réaumur scale
An old temperature scale on which water freezes at 0° and boils at 80°. To convert to Celsius, multiply by 1.25.

culminating point
Carl von Clausewitz's term for the point at which an attacker's strength, drained by distance and losses, no longer exceeds the defender's; beyond it, the attack begins to fail.

CORE IDEAS

The story. On 24 June 1812, French engineers threw pontoon bridges across the Niemen River near Kovno (today's Kaunas, Lithuania), and the largest army Europe had ever seen began to cross into the Russian Empire. Napoleon Bonaparte, Emperor of the French and master of most of the continent, led perhaps 450,000 men in the first wave, with more following later; more than half were not French but Poles, Germans, Italians, Dutch, Swiss and others from his empire and allied states. Tsar Alexander I had broken with Napoleon's Continental System, the blockade meant to strangle British trade, and Napoleon meant to force him back into line with one quick, decisive battle near the frontier. That battle never came. The Russian armies under Barclay de Tolly fell back, and the French followed them deeper and deeper into the plain: Vilna, Vitebsk, Smolensk, which burned in August.

How the plain fought back. The first enemy was distance. Moscow lies about 550 miles (880 km) from the Niemen in a straight line, and much farther by road. Napoleon had prepared huge depots in Poland and East Prussia, but his wagons and horses could not keep up with the march over sandy or rutted roads, and the country beyond the frontier was thinly peopled and poor. Armies that had lived off rich farmland in Italy and Germany found little to eat in Lithuania and Belarus, especially after the retreating Russians burned what they left behind. The second enemy was summer. Heat, dust, bad water and lice spread dysentery and typhus through the ranks, and tens of thousands of horses died of exhaustion and lack of fodder in the first weeks. By the time Napoleon reached Borodino, about 70 miles (110 km) west of Moscow, his main army had shrunk to perhaps 130,000 men, without a great battle having been fought.

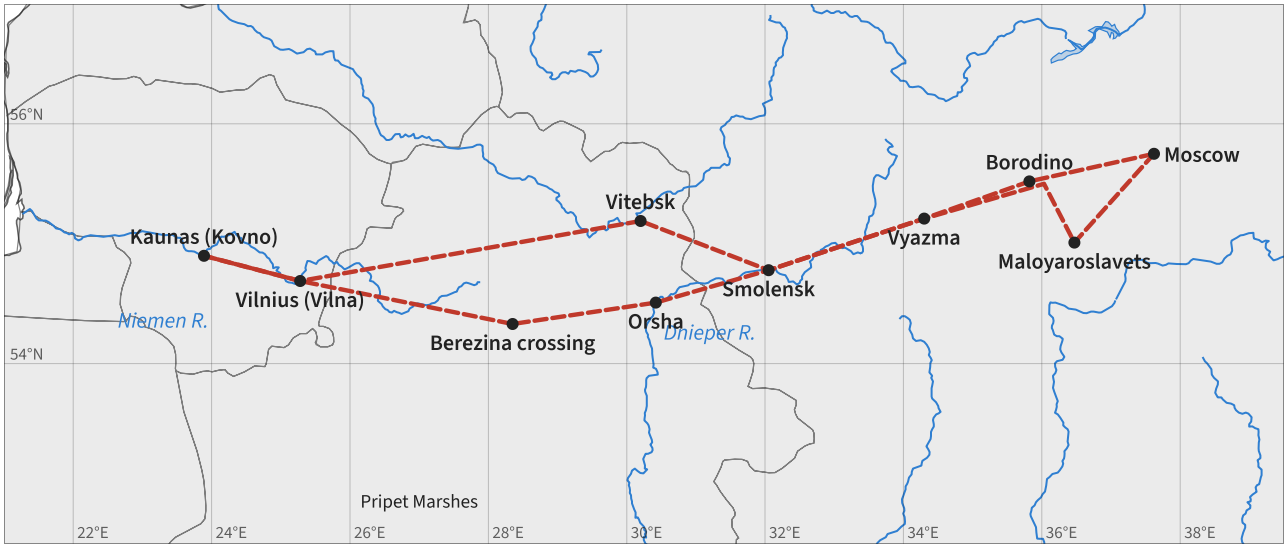
Moscow and the road back. At Borodino on 7 September, the new Russian commander, Mikhail Kutuzov, finally stood and fought. In one terrible day the two armies lost more than 70,000 men killed and wounded between them. Kutuzov withdrew, and on 14 September Napoleon rode into an almost empty Moscow. That night fires broke out, set at least partly on the orders of the Russian governor, Count Rostopchin, and burned most of the city. Napoleon waited five weeks for Alexander to ask for peace. No answer came. On 19 October the army left Moscow, heavy with loot, trying to return by a southern road through unspoiled country. At Maloyaroslavets on 24 October the Russians blocked the way, and Napoleon turned back onto the road he had come by, through a land his own army had already stripped bare. Cossacks and partisans picked off stragglers. Then, in early November, the frost came.

At the Berezina River in late November, Russian armies closed in from three sides. Napoleon's engineers under General Éblé stood chest-deep in the icy water to build two bridges near Studianka, and most of them died of the cold afterward; their sacrifice let the core of the army escape. Napoleon left for Paris on 5 December. In mid-December a few tens of thousands of frozen, starving men recrossed the Niemen. Historians' estimates vary, but of the more than 600,000 who entered Russia with all the reinforcements, perhaps 400,000 died of battle, disease, hunger and cold, and some 100,000 more were taken prisoner. Russian soldiers and civilians suffered terribly too.

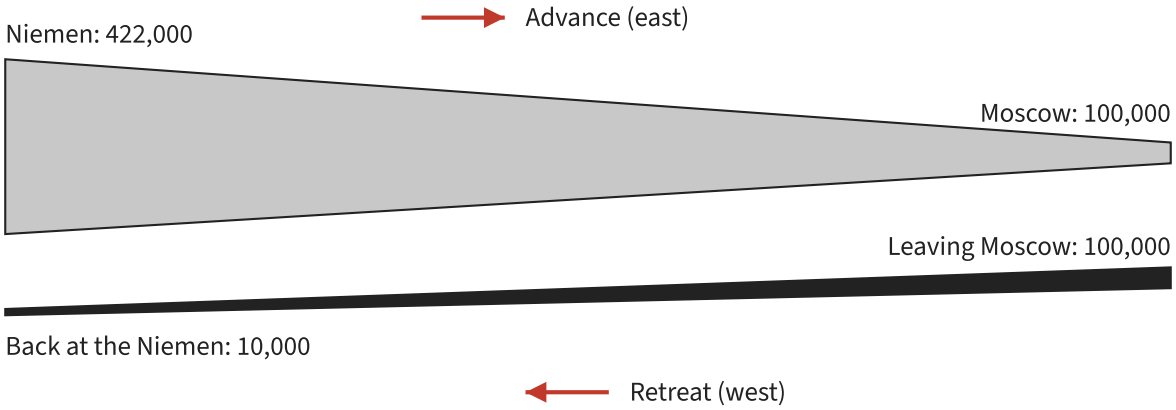
The big idea. People often say "General Winter" beat Napoleon. Winter finished the work, but the army was already gutted before the first snow, by distance, poor supply, disease and a Russian strategy of retreat and destruction that turned the plain itself into a weapon. The Prussian officer Carl von Clausewitz, who served with the Russians in 1812, later wrote that every attack weakens as it advances, until it reaches a **culminating point** beyond which it can only fail. Russia's strategic depth let it give up even Moscow and still not lose the war. Napoleon's pride mattered as well: he pressed on past Smolensk and lingered in Moscow when every sign said stop. Geography made the gamble dangerous; decisions made it fatal.

On the map. In 1869 the retired French civil engineer Charles Joseph Minard drew the campaign as a single flow map. A tan band shows the army marching east from the Niemen; its width shows the number of men, one millimeter for every 10,000. The band begins at 422,000 men, thins to 100,000 at Moscow, and a black band shows the retreat, dwindling to 10,000 by the time it returns to the Niemen. Under the map, a line graph gives the temperature on the retreat in degrees Réaumur, down to 30 degrees below zero on 6 December. Minard drew on French histories of the campaign and published it alongside a similar map of Hannibal's march over the Alps. The design expert Edward Tufte later wrote that "it may well be the best statistical graphic ever drawn." In this lesson's project you will redraw it.

Technology overcoming geography (and failing to). In 1812 there were no railways, no canned food and no telegraph. Every bushel of oats and every barrel of flour moved at the walking pace of horses on dirt roads, and the horses themselves had to eat. Napoleon's logistics were the best of their age, with depots, wagon battalions and bakeries, but the technology of 1812 could not carry the needs of half a million men 550 miles across a thinly settled plain. When the next great invader came along the same road in 1941, he would have engines, railways and radios, and he would discover how much the plain could still resist.

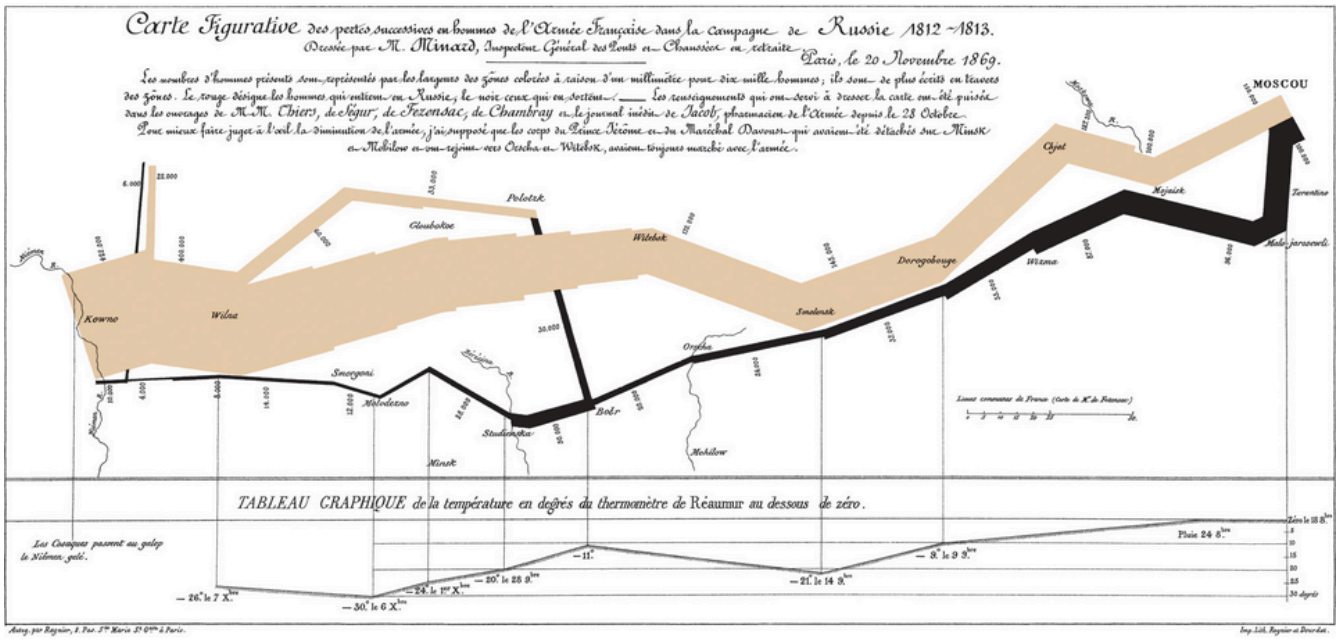


Napoleon's advance (June–September 1812) and retreat (October–December 1812).



Minard's idea in miniature: band width shows the number of men (1 mm = 10,000).

PICTURE STUDY



Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813 (Figurative map of the successive losses in men of the French army in the Russian campaign, 1812–1813), Charles Joseph Minard, 1869 · Lithographed flow map with line graph, printed in color · Published in Paris, 1869; widely reproduced and in the public domain

Charles Joseph Minard (1781–1870) spent his working life as an engineer of roads, bridges and canals for the French state and became a pioneer of statistical maps. At the age of eighty-eight he drew this map of Napoleon's Russian campaign. In one picture he combined six kinds of information: the size of the army, its location (latitude and longitude), its direction of travel, the dates, the temperature on the retreat and the rivers it crossed.

Minard had lived through the Napoleonic age himself. His map tells the story of 1812 without a single adjective. The shrinking band says everything.

Look closely

- Find the starting width of the tan band at the Niemen and its width at Moscow. What do the numbers beside them say?
- Follow the black band back to the west. Where does it suddenly grow thinner? Find the river there.
- Look at the temperature graph at the bottom. How do the dates and temperatures line up with places on the black band?
- Find the smaller bands that split off from the main army. What might they represent?

Talk about it

1. Minard used no words of praise or blame. Is his map more powerful or less powerful because of that? Why?

2. What can this map tell you that a paragraph of text cannot? What can a paragraph tell you that the map cannot?
3. If you made a Minard-style map of a journey in your own life, what would the band's width show?

PROJECT: REDRAW MINARD'S MAP WITH YOUR OWN DATA

You will redraw Minard's flow map on graph paper using the campaign's real numbers and then make a second Minard-style map of a journey of your own, showing how something grew or shrank along the way. This project becomes the center of your unit portfolio.

You will need

- Two sheets of large graph paper (or 1 cm grid paper taped together to about 60 cm long)
- Pencil, eraser, ruler, fine black pen
- Tan or light brown and black colored pencils (or any two contrasting colors)
- A copy of Minard's map to look at (printed or on screen)
- Data for your own journey (see step 6)

Steps

1. Set your scales. Across the paper, let 1 cm stand for 1° of longitude from 23°E (the Niemen) to 38°E (Moscow): 15 cm of map. Up the paper, let 1 cm stand for 0.5° of latitude from 53.5°N to 56°N. Choose a band scale, such as 1 mm of width for every 10,000 men, as Minard did.
2. Plot the advance: Kaunas (54.9°N, 23.9°E), Vilnius (54.7°N, 25.3°E), Vitebsk (55.2°N, 30.2°E), Smolensk (54.8°N, 32.0°E), Borodino (55.5°N, 35.8°E), Moscow (55.75°N, 37.6°E). Draw a tan band whose width is 42 mm at Kaunas, narrowing to about 18 mm at Vitebsk, and to 10 mm at Moscow. (Minard's map shows roughly 175,000 at Vitebsk.)
3. Plot the retreat in black: Moscow, Maloyaroslavets (55.0°N, 36.5°E), Vyazma (55.2°N, 34.3°E), Smolensk, Orsha (54.5°N, 30.4°E), the Berezina near Studianka (54.3°N, 28.4°E), Vilnius, Kaunas. Narrow the band to about 10 mm at Moscow, 2.8 mm after the Berezina and 1 mm back at Kaunas.
4. Under the map, draw a temperature graph for the retreat. Use Minard's Réaumur readings converted to Celsius (multiply by 1.25): 18 Oct 0°, 9 Nov −9°R, 14 Nov −21°R, 28 Nov −20°R, 1 Dec −24°R, 6 Dec −30°R. Draw thin lines connecting each reading to the place on the black band.
5. Add a title, a scale for distance, a scale for band width and the names of the main rivers (Niemen, Dnieper, Berezina, Moskva).
6. Now your own map. Choose a journey with something that changes along the way: a family car trip with fuel in the tank, a hike with water in your bottles, a bicycle ride with your energy rated 1 to 10, or a week of school with your homework stack. Record the amount at five or more points.

7. Draw a simple route map of the journey and a band whose width shows the amount at each point, with a second graph underneath (temperature, elevation or time of day). Give it a Minard-style title.

Tips

- Draw everything in pencil first. The band is easiest to draw by marking its width at each town with two dots and then connecting the dots.
- Minard's numbers come from 1869 sources; modern historians give somewhat different figures. Note on your map that you used Minard's data.
- Keep your map clean: Minard used only two colors for the bands, and that is part of why it is so clear.

Check your work

- My Napoleon map shows the advance, the retreat, the band scale and the temperatures, with accurate places.
- My own map uses band width to show a real quantity that I measured.
- I can explain what each part of Minard's map shows and why the design is so clear.

MAP NOTEBOOK

1. Draw a small sketch map of the 1812 route and label the Niemen, Smolensk, Borodino, Moscow, Maloyaroslavets and the Berezina, with dates.
2. Make a two-column chart: "Before the first snow" and "After the first snow." List the causes of the Grande Armée's losses in each column.
3. Copy Tufte's judgment of Minard's map in quotation marks and write one sentence agreeing or disagreeing, with a reason.

> **From history.** The year Minard published his map, 1869, was also the year Leo Tolstoy published the final volumes of *War and Peace*, the great Russian novel of 1812, with its long scenes of Borodino, the burning of Moscow and the retreat. Tolstoy argued that history is moved by countless ordinary people more than by great men like Napoleon. Russians call 1812 the Patriotic War, and Moscow's Cathedral of Christ the Saviour was built in thanksgiving for the deliverance; it was demolished by the Soviet government in 1931 and rebuilt in the 1990s.

WORKED EXAMPLES

Example 1. Napoleon crossed the Niemen on 24 June 1812 and entered Moscow on 14 September. The straight-line distance from Kaunas to Moscow is about 880 km (550 miles). Find the number of days and the average daily advance in km and miles.

(Use the map or drawing "The advance from the Niemen to Moscow." shown earlier in this lesson.)

1. Days: 6 days left in June (25–30) + 31 in July + 31 in August + 14 in September = 82 days.
2. Rate: 880 km ÷ 82 days ≈ 10.7 km per day.
3. In miles: 550 ÷ 82 ≈ 6.7 miles per day.
4. Real road distances were longer, so the soldiers actually marched farther each day than this straight-line average.

Answer: 82 days, about 10.7 km (6.7 miles) per day in a straight line.

Example 2. On Minard's map, 1 mm of band width stands for 10,000 men. The band is 422,000 men wide at the start, 100,000 at Moscow and 10,000 when the survivors return to the Niemen. Give each width in millimeters, and find the percent of the starting force that reached Moscow and the percent that returned.

(Use the map or drawing "Band widths at the start, at Moscow and at the end." shown earlier in this lesson.)

1. Widths: 422,000 ÷ 10,000 = 42.2 mm; 100,000 ÷ 10,000 = 10 mm; 10,000 ÷ 10,000 = 1 mm.
2. Reached Moscow: 100,000 ÷ 422,000 ≈ 0.237, or about 24%.
3. Returned: 10,000 ÷ 422,000 ≈ 0.024, or about 2.4%.

Answer: 42.2 mm, 10 mm and 1 mm. About 24% of the main column reached Moscow, and about 2.4% came back with it across the Niemen (by Minard's figures).

Example 3. Minard's graph gives −30° Réaumur on 6 December 1812. Convert this to Celsius and to Fahrenheit. (°C = °R × 1.25; °F = °C × 1.8 + 32.)

1. Celsius: −30 × 1.25 = −37.5°C.
2. Fahrenheit: −37.5 × 1.8 = −67.5, and −67.5 + 32 = −35.5°F.

Answer: −37.5°C, or about −35.5°F. Men without proper winter clothing, shelter or food could freeze to death in a single night at such temperatures.

PRACTICE

1. EASY Put these in order and give the date of each: the Battle of Borodino, the crossing of the Niemen, the crossing of the Berezina, the entry into Moscow, the departure from Moscow.
2. EASY Why did Napoleon invade Russia in 1812?
3. EASY What is a flow map? What does band width show on Minard's map?
4. MEDIUM Convert Minard's reading of −21° Réaumur (14 November) to Celsius and Fahrenheit.
5. MEDIUM Borodino lies about 110 km (70 miles) west of Moscow. If the army marched 15 km a day after the battle, about how many days would the march take? Compare with the real dates (7 to 14 September).
6. MEDIUM Suppose each soldier needs about 1 kg of food a day and each horse about 10 kg of fodder. An army of 400,000 men and 150,000 horses would need how many metric tons a day? If a wagon carries 0.5 t, how many wagonloads is that per day?
7. MEDIUM Napoleon's main army had about 130,000 men at Borodino, down from about 450,000 in the first wave. Some had been detached to guard the flanks and supply line, but many had been lost. What percent of the first-wave strength was present at Borodino?
8. MEDIUM Napoleon left Moscow on 19 October and the survivors recrossed the Niemen around 14 December. How many days did the retreat last? About how many km a day did it average over the 880-km straight-line distance?
9. HARD The French held the town after the battle at Maloyaroslavets on 24 October, but the battle was still a Russian strategic success. Explain why it was so costly for Napoleon, using the idea of supply.
10. HARD Explain Clausewitz's idea of the culminating point and apply it to Napoleon's campaign.
11. HARD On Minard's map, the black band is about 50,000 men wide just before the Berezina and about 28,000 just after. How many millimeters thinner does the band become, and what percent of the force was lost at the crossing?
12. CHALLENGE Write a paragraph answering: "Did winter defeat Napoleon?" Use evidence from Minard's map and the dates of the campaign.

COMMON MISTAKES

- Saying winter alone destroyed the Grande Armée. Most of the invading force was already lost before the first snow.
- Thinking the Grande Armée was simply a French army. More than half its men came from other nations of Napoleon's empire and its allies.
- Misreading Minard's map as a map of roads. The band's width is the key; its route is simplified.

> **Make it a game · Minard Relay.** Give each player a paper strip 4.2 cm wide, 1 mm of width for each 10,000 men as on Minard's map (or simply 42 paper clips, one for each

10,000 men). Read out the campaign's stages one at a time (crossing the Niemen, the march to Vitebsk, Smolensk, Borodino, Moscow, Maloyaroslavets, Vyazma, the frost, the Berezina, the Niemen). At each stage, players guess how many "men" to remove, then check against Minard's figures. Closest guess scores a point. End by laying the strips side by side to make your own Minard band.

Scripture. "Or what king, going to make war against another king, sitteth not down first, and consulteth whether he be able with ten thousand to meet him that cometh against him with twenty thousand?" (Luke 14:31, KJV)

Jesus used a king counting the cost of war as a picture of counting the cost of following Him. Napoleon counted soldiers and guns, but not the cost of distance, hunger and a plain that would not end.

Practice answers

1. Niemen crossing (24 June 1812); Borodino (7 September); entry into Moscow (14 September); departure from Moscow (19 October); Berezina crossing (26–29 November).
2. Tsar Alexander I had broken with the Continental System, Napoleon's blockade of British trade. Napoleon meant to force Russia back into his system by winning a quick, decisive battle.
3. A flow map shows movement with bands or arrows whose width is proportional to the quantity moving. On Minard's map, band width shows the number of men in the army (1 mm = 10,000).
4. −21 × 1.25 = −26.25°C; −26.25 × 1.8 + 32 = −15.25°F, about −15°F.
5. 110 ÷ 15 ≈ 7.3, so about 7 days, which matches the week between the battle and the entry into Moscow.
6. Men: 400,000 kg = 400 t. Horses: 1,500,000 kg = 1,500 t. Total 1,900 t a day. 1,900 ÷ 0.5 = 3,800 wagonloads every day, and the wagon horses must eat too. This is why the army had to live off the land.
7. 130,000 ÷ 450,000 ≈ 0.289, about 29%.
8. 12 days left in October (20–31) + 30 in November + 14 in December = 56 days. 880 ÷ 56 ≈ 15.7 km (9.8 miles) a day: a faster pace than the advance, under far worse conditions.
9. It forced him to turn back onto the road he had come by through Mozhaisk, Vyazma and Smolensk. Both armies and the Russian scorched-earth policy had already stripped that country of food, fodder and shelter, so the army had to retreat through a desert of its own making as winter came on.
10. An attacker grows weaker as he advances, through losses, detachments and the lengthening line of supply, while the defender often grows stronger nearer home. At some point the attacker's advantage is used up; pressing on past it leads to defeat. Napoleon likely passed his culminating point at or after Smolensk; by Moscow he was too weak to force peace and too far from his bases to hold on.
11. 5.0 mm to 2.8 mm, a narrowing of 2.2 mm (22,000 men). 22,000 ÷ 50,000 = 44% lost at the crossing.
12. Sample answer: Winter finished the Grande Armée, but it did not defeat it alone. Minard's band shrinks from 422,000 to 100,000 between June and September, in summer and early autumn, before any frost; those losses came from distance, poor supply, disease, desertion,

detachments and battle. The cold began only in November, when the army was already retreating through stripped country. The temperature graph lines up with the final collapse between Smolensk and the Niemen, so winter turned a defeat into a catastrophe. Napoleon’s own choices, to push past Smolensk and to wait five weeks in Moscow, made the winter retreat possible.

7.4 1941: The Same Road

OBJECTIVES

- Describe Operation Barbarossa (1941): its aims, its three army groups, its early victories, the drive on Moscow and the Soviet counteroffensive of December.
- Explain how the size of the plain, the Pripet Marshes, the rasputitsa mud seasons, the winter and the supply problem worked against a modern mechanized army, and compare 1941 with 1812.
- Compute rates of advance, temperature conversions and supply loads, and read a seasonal calendar of the eastern plain.

Warm-up. Fill two shallow pans or plastic tubs with garden soil. Leave one dry, and mix water into the other until it is soupy mud. Press a toy truck (or a block with a coin taped under it as a narrow wheel) into each, then push it across. Now press a wide piece of cardboard under the same weight into the mud. Which sinks deeper? What would happen to an army's trucks on a thousand miles of road like the muddy tub?

Watch. *22nd June 1941: Operation Barbarossa begins as German forces and their allies invade the USSR in WW2* (HistoryPod, 2:39). https://www.youtube.com/watch?v=nUiHnwzUEHU
After the story: watch this short summary of June 22, 1941, and on the map notice the front stretching from the Baltic Sea to the Black Sea across the same open plain Napoleon crossed.
Note: Captions were not available to check; preview it first. The video discusses Hitler's aims for the war in the east and may mention the huge numbers of soldiers killed or captured.

Backup video. *Red Army on the Run - Operation Barbarossa Continues* (Kings and Generals, 17:19). https://www.youtube.com/watch?v=jzBwAB9DvdM
With On the map: follow the animated arrows as German armies race across the plain toward Minsk, Pskov and Smolensk, and notice how the open land helped them at first while their supply lines stretched thinner. Note: Captions were not available to check; preview it first. This is a detailed, week-by-week military account that may include a sponsor plug and descriptions of heavy losses.

KEY TERMS

Operation Barbarossa
Nazi Germany's invasion of the Soviet Union, launched on 22 June 1941, named after the medieval German emperor Frederick Barbarossa.

army group

A very large command made of several armies. Germany attacked with three: North (toward Leningrad), Center (toward Moscow) and South (toward Kyiv and Ukraine).

rasputitsa
Russian for the “season of bad roads”: the weeks of spring thaw and autumn rain when unpaved roads and fields turn to deep mud.

encirclement (pocket)
Surrounding an enemy force by driving around both of its sides and closing the ring behind it, cutting it off from supply and retreat.

logistics
The planning and work of moving and supplying an army: fuel, food, ammunition, spare parts, men and the trains, trucks and roads that carry them.

war of annihilation
The Nazi leadership’s plan for the war in the East as a racial war to destroy the Soviet state, murder Jews and communist officials, and starve and enslave the Slavic peoples.

CORE IDEAS

The story. Before dawn on Sunday, 22 June 1941, thousands of German guns opened fire along a front that ran from the Baltic Sea to the Black Sea. Almost exactly 129 years after Napoleon crossed the Niemen, Adolf Hitler sent about three million German soldiers, joined later by Romanian, Finnish, Hungarian, Italian and other allied troops, into the Soviet Union. They brought more than 3,000 tanks, thousands of aircraft, some 600,000 motor vehicles and about 600,000 horses. The plan, called Operation **Barbarossa**, was to destroy the Red Army near the frontier in a few weeks and then drive on to a line from Archangel to Astrakhan, far beyond Moscow. Joseph Stalin had ignored many warnings that the attack was coming. The Red Army, whose officer corps Stalin had gutted in the purges of 1937–1938, was caught badly unprepared.

The war of annihilation. This was not an ordinary war of armies. Hitler’s regime planned it as a racial war of conquest. Its plans counted on millions of Soviet civilians starving as food was taken for Germany. Behind the front, SS killing squads called Einsatzgruppen shot Jews by the hundreds of thousands; at the ravine of Babi Yar outside Kyiv they murdered 33,771 Jews in two days at the end of September 1941. About three million of the some 5.7 million Soviet soldiers captured by the Germans died in captivity, many by deliberate starvation. Stalin’s regime was itself a brutal tyranny that had starved, shot and imprisoned millions of its own people, and its NKVD shot prisoners as it retreated. The peoples of Ukraine, Belarus and Russia suffered between two murderous ideologies.

How the plain fought back. At first Barbarossa seemed unstoppable. German armored spearheads drove deep and closed huge encirclements around Soviet armies at Minsk and Smolensk in the summer, and around Kyiv in September, where more than 600,000 prisoners were taken. Army Group North reached Leningrad and began a siege of nearly 900 days in which perhaps a million civilians died. But the land itself kept pushing back. The front was shaped like the funnel from Lesson 7.1: as the Germans advanced, it lengthened, and the Pripet Marshes split Army Group Center from Army Group South. Soviet roads were few and

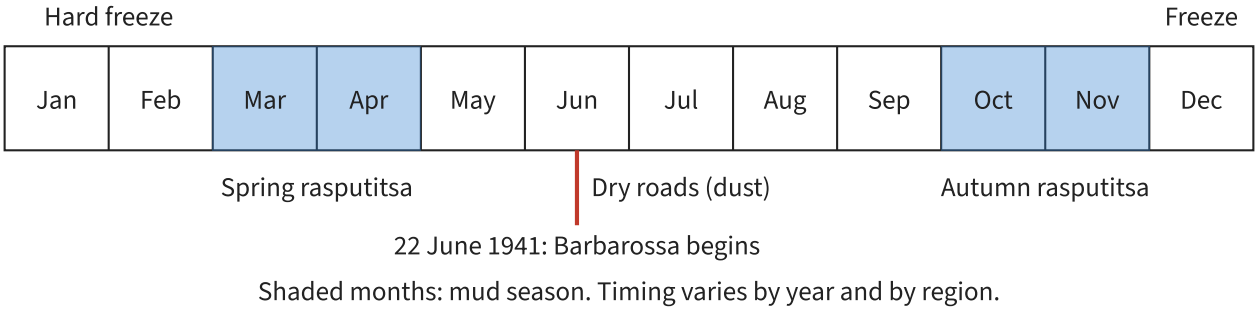
mostly unpaved, and dust choked engines in the summer. The Soviet railways ran on a wider gauge than Germany's, so captured lines had to be converted track by track before German trains could use them (Lesson 7.5). Fuel, ammunition and spare parts fell farther and farther behind the tanks. The Red Army kept fighting, losing whole armies and raising new ones, while Soviet factories, more than 1,500 of them, were dismantled and carried by rail east toward the Volga, the Urals and beyond, out of German reach.

Mud and cold. At the start of October the Germans launched Operation Typhoon, the drive on Moscow, and trapped hundreds of thousands more Soviet soldiers around Vyazma and Bryansk. Moscow was in a panic by mid-October. Then the autumn rains came. The **rasputitsa** turned roads to rivers of mud as deep as an axle; trucks sank, horses died pulling guns, and supply columns stalled for days. When the ground froze hard in November, the advance resumed. In early December German soldiers came within about 20 miles (30 km) of the Kremlin. But the frost that hardened the roads kept falling. Temperatures dropped at times below −30°C (−22°F); engines would not start, oil thickened, guns jammed and locomotives froze. German planners had expected to win before winter, and most soldiers had no winter clothing. On 5–6 December, the Red Army under General Georgy Zhukov counterattacked with fresh divisions, many brought from Siberia and the Far East, and drove the Germans back between about 60 and 150 miles (100 to 250 km). Moscow was saved. The war in the East would go on for three and a half more years and cost the Soviet peoples tens of millions of lives before it ended in Berlin.

The big idea. In 1812 the invader had horses and wagons; in 1941 he had tanks, trucks, aircraft, radios and railways. Yet the same geography caught him: great distance, a widening front, a defender with strategic depth who could lose millions of men and whole regions and still fight, two mud seasons a year and a hard winter. As with Napoleon, mud and frost did not win the war alone. The Soviet soldiers and workers who held on, the evacuation of industry, Stalin's mobilization of a vast population, and the invaders' own decisions all mattered. Hitler expected a quick campaign, refused to prepare for winter, and turned his armies south to Kyiv in August before resuming the drive on Moscow. Technology had shrunk the plain, but not enough.

On the map. Trace the three German thrusts on the map: North from East Prussia through the Baltic states to Leningrad, Center from Brest through Minsk, Smolensk and Vyazma toward Moscow, and South from southern Poland toward Kyiv. Notice how the Pripet Marshes sit between Center and South, and how the front from Leningrad to the Black Sea is far longer than the start line along the 1941 border. Brest to Moscow is about 620 miles (1,000 km): Army Group Center needed more than five months to come close to the end of that road, and never reached it.

Operation Barbarossa, June–December 1941: the three thrusts and the obstacles between them.



The road year on the eastern plain (typical; dates vary from year to year and from south to north).

PICTURE STUDY

Parade on Red Square, 7 November 1941: Machine Gunners, Mikhail Kalashnikov (1906–1944), Soviet photojournalist, 7 November 1941 · Black-and-white photographs · Published in Kalashnikov's photo book "With a Leica and a Notebook"; public domain, on Wikimedia Commons

On 7 November 1941, with German armies less than a hundred miles away, Stalin held the traditional parade for the anniversary of the Bolshevik Revolution on Red Square in Moscow. Snow was falling. Soldiers, tanks and horse-drawn guns marched past the Kremlin, and many units went straight from the parade toward the front.

This photograph was taken by the Soviet photojournalist Mikhail Kalashnikov. Pictures like it were published as propaganda, to show the country and the world that Moscow would not fall. Look at it as historical evidence: it records real men and real weather, chosen and framed by a government that wanted a particular story told.

Look closely

- Look at the soldiers' clothing and the ground beneath them. What does it tell you about the season and the weather?
- Find the Kremlin wall, its tower and Lenin's tomb with the leaders standing on top. Why would the government want those places in the picture?
- Look at the weapons the men carry and how they march. What do their faces and steps suggest about how ready they are?
- What is left out of the frame? What would a photograph of the same day at the front have shown?

Talk about it

1. Why would Stalin risk holding a parade within reach of German bombers? What message did it send?
2. How can a historian use a propaganda photograph honestly?
3. Compare this picture with Minard's map. One shows people, the other shows numbers. What does each help you understand about war on the plain?

PROJECT: THE MUD TEST

You will test how wheels, tracks and feet sink in dry, wet and frozen soil and measure the difference. This is the problem that stopped the trucks and tanks of 1941 on the roads to Moscow.

You will need

- Three shallow containers (foil pans or plastic tubs) of the same size
- Garden soil with some clay in it (not potting mix), and water
- Freezer space for one container
- A small toy truck or car with narrow wheels, and a strip of cardboard or a toy with wide tracks
- A weight such as a can of soup or a bag of rice (about 1 lb or 0.5 kg)
- Ruler with millimeters, toothpicks, notebook

Steps

1. Fill all three containers with soil to the same depth (at least 2 inches or 5 cm). Leave container A dry. Mix water into containers B and C until the soil is soupy mud.
2. Put container C in the freezer overnight. This is your November road.
3. Set the weight on the narrow-wheeled truck (tape it on if needed) and place it on container A. Measure how deep the wheels sink with a toothpick and ruler. Then push it across and note how hard it is.
4. Repeat on container B (mud). Then repeat with the wide-tracked model carrying the same weight. Record the sinkage for each.
5. Take container C out of the freezer and repeat both tests on the frozen mud.
6. Make a table: rows for dry, mud and frozen; columns for narrow wheels and wide tracks; record sinkage in millimeters and a 1–5 rating for how hard it was to push.
7. Calculate ground pressure: weight divided by contact area. Measure the area the wheels touch and the area the tracks touch (length × width) and compare.
8. Write a paragraph connecting your results to October and November 1941 near Moscow.

Tips

- Keep the weight exactly the same for every test so the comparison is fair.
- The Soviet T-34 tank had wider tracks than most German tanks of 1941, which gave it lower ground pressure in mud and snow. Your test shows why that mattered.
- Do the frozen test quickly before the surface thaws.

Check your work

- I measured sinkage in three conditions and two kinds of contact.
- I can explain ground pressure and why wide tracks sink less.
- I can explain why the freeze first helped and then hurt the German advance.

MAP NOTEBOOK

1. Draw a sketch map of the three German thrusts of 1941 and label Leningrad, Moscow, Kyiv, Smolensk, Vyazma, Brest and the Pripet Marshes.
2. Make a Venn diagram comparing 1812 and 1941: what was different (technology, ideology, numbers) and what was the same (distance, mud, winter, supply, strategic depth).
3. Draw the road-year calendar strip from the figure and add the dates of Barbarossa, Typhoon, the autumn rasputitsa and the December counteroffensive.

> **From history.** Leningrad's lifeline during the siege was the "Road of Life" across the frozen surface of Lake Ladoga. When the ice grew thick enough in late November 1941, trucks began carrying flour into the starving city and evacuating civilians on the return trip, driving across the lake at night to avoid German aircraft. The same winter that froze the German army outside Moscow made a road where none had been. Many trucks broke through the ice, but the road helped the city survive until the siege was fully lifted in January 1944.

WORKED EXAMPLES

Example 1. Army Group Center began at Brest on 22 June 1941 and came within about 30 km of Moscow by 5 December. Brest is about 1,000 km (620 miles) from Moscow in a straight line. Find the number of days and the average daily advance, and compare it with Napoleon's 10.7 km a day in 1812.

(Use the map or drawing "Army Group Center's road from Brest to Moscow." shown earlier in this lesson.)

1. Days: 8 left in June (23–30) + 31 (July) + 31 (August) + 30 (September) + 31 (October) + 30 (November) + 5 (December) = 166 days.
2. Distance covered: 1,000 − 30 = 970 km (about 600 miles).
3. Average: 970 ÷ 166 ≈ 5.8 km a day; 600 ÷ 166 ≈ 3.6 miles a day.
4. Napoleon averaged about 10.7 km a day from the Niemen to Moscow, though he fought only one great battle on the way, while the Germans fought huge battles and halted to regroup and resupply.

Answer: 166 days at about 5.8 km (3.6 miles) a day: slower, on average, than Napoleon's march to Moscow.

Example 2. Convert −30°C and −40°C to Fahrenheit. What is special about −40?

1. °F = °C × 1.8 + 32.
2. −30 × 1.8 + 32 = −54 + 32 = −22°F.
3. −40 × 1.8 + 32 = −72 + 32 = −40°F.

Answer: −30°C = −22°F; −40°C = −40°F. At −40 the Celsius and Fahrenheit scales read the same.

Example 3. Suppose an army group needs 10,000 metric tons of supplies a day. A truck carries 3 t, and a round trip on a muddy 200-km road takes 4 days. A freight train carries about 450 t. How many trucks are needed to keep up, and how many trains a day would do the same job?

1. Each truck delivers 3 t every 4 days, or 3 ÷ 4 = 0.75 t a day.
2. Trucks needed: 10,000 ÷ 0.75 ≈ 13,333 trucks, plus spares for breakdowns, and the trucks burn fuel that must also be carried.
3. Trains: 10,000 ÷ 450 ≈ 22.2, so about 23 trains a day.
4. But trains need track of the right gauge, so railway troops had to convert Soviet lines before German trains could run on them.

Answer: About 13,300 trucks, or about 23 trains a day: which is why railways, and the gauge they ran on, decided how far the army could go.

PRACTICE

1. EASY On what date did Operation Barbarossa begin, and what were the targets of the three German army groups?
2. EASY What is the rasputitsa, and when does it come each year?
3. EASY How many years separate Napoleon's invasion from Hitler's? How many days apart on the calendar did they begin?
4. MEDIUM Convert −25°C to Fahrenheit.
5. MEDIUM Leningrad (59.94°N) and Kyiv (50.45°N) lie close to the same meridian (30.3°E and 30.5°E). Estimate the north–south length of the front between them. Compare it with the roughly 300-mile (480-km) gap across Poland.
6. MEDIUM Using the figure, explain why the Pripet Marshes affected German planning.
7. MEDIUM A truck that makes 30 km an hour on a dry road makes only 5 km an hour in deep mud. How long does a 150-km trip take in each condition?
8. MEDIUM The Soviet counteroffensive of December 1941 pushed the Germans back between about 100 and 250 km. Express this range in miles.
9. HARD Explain why the November freeze first helped and then hurt the German drive on Moscow.

10. HARD Name two things the Soviet Union did that allowed it to survive the losses of 1941, and explain how geography helped each one.
11. HARD Name two crimes of the Nazi regime in the East in 1941 and one crime of Stalin's regime, stated factually.
12. CHALLENGE In a paragraph, compare 1812 and 1941. What had technology changed, and what had it not changed?

COMMON MISTAKES

- Thinking mud and winter alone defeated the Germans. Soviet resistance, industrial evacuation, reserves and German strategic errors were just as important.
- Believing the German army of 1941 was fully motorized. Most of its infantry marched on foot, and it relied on hundreds of thousands of horses.
- Treating Barbarossa as an ordinary war. It was planned as a war of annihilation, and the crimes committed behind the front are part of the history, not a side note.

Make it a game · Road Season. Make a deck of twelve month cards. Each player commands a supply convoy and needs 6 points to reach the front. Draw a month: May–September moves you 2, December–February moves you 1 (frozen roads but freezing men), March–April and October–November move you 0 (rasputitsa). A player who draws a mud month may play a "railway" card once per game to move 2 anyway. First to the front wins. Afterward, discuss which month you would choose to start an invasion and why both Napoleon and Hitler chose late June.

Scripture. "He giveth snow like wool: he scattereth the hoarfrost like ashes. He casteth forth his ice like morsels: who can stand before his cold?" (Psalm 147:16–17, KJV)

The psalmist knew that no army is stronger than the weather God sends. The planners of 1941 assumed they could finish before winter. Wisdom remembers that seasons and storms are in God's hands, not ours.

Practice answers

1. 22 June 1941. North: Leningrad. Center: Moscow (by way of Minsk and Smolensk). South: Kyiv and Ukraine.
2. The "season of bad roads," when spring thaw (roughly March–April) and autumn rains (roughly October–November) turn unpaved roads and fields to deep mud.
3. 1941 − 1812 = 129 years. Napoleon crossed on 24 June, Hitler attacked on 22 June: two days apart on the calendar.
4. −25 × 1.8 + 32 = −45 + 32 = −13°F.
5. 59.94 − 50.45 = 9.49°; 9.49 × 111 ≈ 1,053 km, or 9.49 × 69 ≈ 655 miles. That is more than twice the width across Poland, and the front was even longer counting its bends and its extension to the Black Sea.
6. The marshes are a huge area of bog and forest unsuited to tanks and trucks. They split the attack into Army Group Center north of them and Army Group South below them, with a gap

between, so the two groups could not easily support each other, and Soviet forces could shelter in the marshes.

7. Dry: 150 ÷ 30 = 5 hours. Mud: 150 ÷ 5 = 30 hours, six times as long, and it burns much more fuel.
8. 100 × 0.621 ≈ 62 miles; 250 × 0.621 ≈ 155 miles. About 60 to 155 miles.
9. Freezing hardened the mud so that trucks and tanks could move again, and the advance resumed. But the cold kept deepening; without winter clothing, antifreeze and winterized equipment, German soldiers froze, engines and weapons failed and locomotives broke down, just as fresh Soviet divisions counterattacked.
10. It evacuated more than 1,500 factories by rail to the Volga, the Urals and beyond, using its enormous depth to move industry out of reach. It also raised new armies from a vast population and brought fresh divisions from Siberia and the Far East across the great distances by the Trans-Siberian Railway to defend Moscow.
11. Nazi: the Einsatzgruppen mass shootings of Jews, including 33,771 at Babi Yar near Kyiv in September 1941; the deliberate starvation of Soviet prisoners of war, about three million of whom died in captivity. Stalin’s regime: the purges and the Gulag, and the NKVD’s shooting of prisoners as it retreated in 1941 (Katyn, in 1940, is another).
12. Sample answer: By 1941 engines, aircraft, radios and railways let the Germans move faster in bursts, fight far larger battles and supply troops in ways Napoleon could not. But technology did not abolish distance: trucks still needed fuel carried hundreds of miles, railways had to be regauged, and the front widened as it went east. It did not abolish weather: the rasputitsa stopped wheels and tracks as it had stopped wagons, and the winter froze engines as it had frozen men. In both years the defender’s strategic depth let it lose battles, ground and even Moscow’s outskirts and fight on, and in both years the invader’s overconfidence made the geography deadlier.

7.5 Rail Gauges and Defense ⚙

OBJECTIVES

- Define track gauge and break of gauge, and explain how Russia came to build its railways to a 5-foot (1,524 mm) gauge while most of Europe used 4 feet 8½ inches (1,435 mm).
- Weigh the evidence for and against the popular claim that Russia chose its wide gauge for defense, distinguishing a decision's intention from its later effects.
- Calculate gauge differences, scale measurements and the time costs of transshipment and regauging, and locate the main breaks of gauge on a map of Europe.

Warm-up. Lay two strings or strips of tape on the floor about the width of your shoulders apart: this is a track. Walk along it with one foot on each line. Now have someone move one line out by the width of two fingers. Can you still walk with one foot on each line in the same stride? Imagine a train whose wheels are fixed on a steel axle. What happens when it reaches the place where the lines spread apart?

Watch. *The Day The Gauge Changed* (The History Guy: History Deserves to Be Remembered, 10:05). https://www.youtube.com/watch?v=4v81Gwu6BTE
After the story: watch how the American South changed thousands of miles of 5-foot track in 1886 in a day and a half, and notice that this was the same 5-foot gauge Whistler brought to Russia, which Russia kept.
Note: Captions were not available to check; preview it first. The History Guy is a trusted channel, and this video is about the United States, not Russia. This covers the 1886 gauge change in the American South, not Russian railways. It shows why a break of gauge mattered but says nothing about Russia's gauge or defense.

Backup video. *The Story of Russian Railways: Rise, Fall, and What Comes Next* (Railways Explained, 20:36). https://www.youtube.com/watch?v=0e-A7lqEzDY
As review: watch the early part on the 1830s Tsarskoye Selo line and the St. Petersburg–Moscow railway, and listen for how Russia's wide gauge set its network apart from Europe's. Note: Captions were not available to check; preview it first. It runs about 20 minutes, mentions the channel's e-book and Patreon, and the later 'what comes next' part may cover recent politics or sanctions, so you may want to stop after the history section. Modern sources often give Russia's gauge as 1,520 mm instead of 5 feet (1,524 mm).

KEY TERMS

track gauge
The distance between the inner faces of the two rails of a railway track.

standard gauge

4 feet 8½ inches (1,435 mm), the gauge of George Stephenson's early British railways, made the British standard by the Gauge Act of 1846 and now used by most of the world's railways.

Russian gauge (broad gauge)
5 feet (1,524 mm), chosen for the St. Petersburg–Moscow railway in the 1840s; redefined as 1,520 mm by Soviet railways from 1970. Used in Russia, Belarus, Ukraine, the Baltic states, Central Asia, Mongolia and (at 1,524 mm) Finland.

break of gauge
A place where railways of different gauges meet, so that trains cannot run straight through.

transshipment
Moving cargo or passengers from cars on one gauge to cars on the other at a break of gauge.

bogie
The wheeled frame under each end of a railway car. At a break of gauge, cars can be lifted and their bogies swapped for bogies of the other gauge.

CORE IDEAS

The story. In 1842 Tsar Nicholas I ordered a railway built between his capital, St. Petersburg, and Moscow, about 400 miles (650 km) apart across the plain. Russia had only one short line so far, the Tsarskoye Selo Railway of 1837, built to a 6-foot gauge. For the great new line the Russians hired an American, Major George Washington Whistler, a West Point–trained engineer who had built railways in New England (and the father of the painter James McNeill Whistler). Working with the Russian engineers Pavel Melnikov and Nikolai Kraft, Whistler recommended a gauge of 5 feet, which was then common on railways in the American South, and in 1843 the Russian government adopted it. Whistler died of cholera in St. Petersburg in 1849, two years before the line opened in 1851. A famous tale says Nicholas laid a ruler on the map and drew the route in a straight line, and that a bend near Verebye marks where the pencil went around his finger. It is a legend. The line really is remarkably straight, but the Verebye bend was a detour built to ease a steep grade.

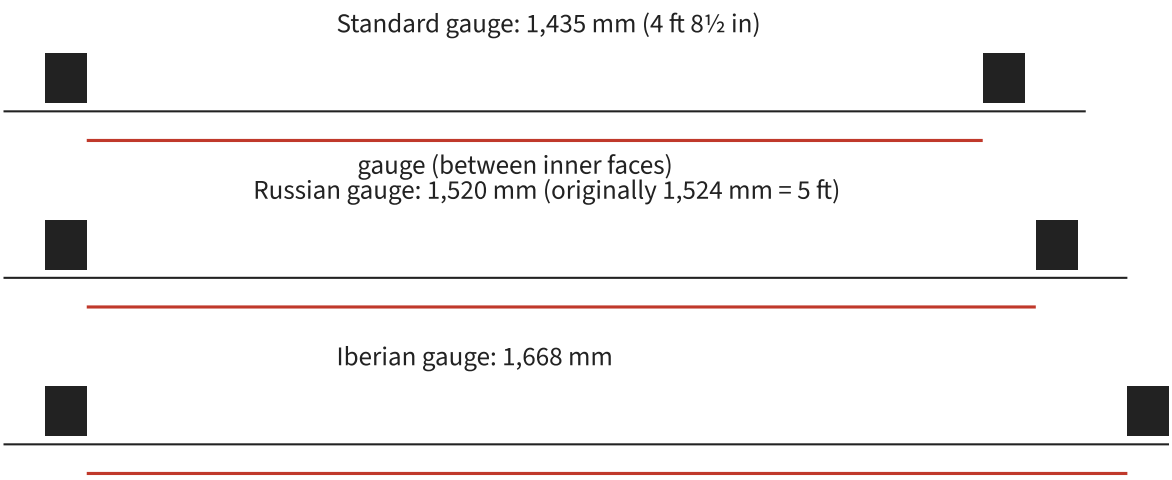
How it worked. The **gauge** of a railway is the distance between the inner faces of its rails. A railway car's wheels are fixed in pairs on solid steel axles, so a car built for one gauge cannot run on another. Britain's early railways mostly used George Stephenson's 4 feet 8½ inches, and after a hard-fought "gauge war" with Isambard Kingdom Brunel's much wider Great Western Railway, Parliament made Stephenson's gauge the British standard in 1846. Most of continental Europe followed: France, the German states, Austria and Italy all built to 1,435 mm. Russia's 1,524 mm differs by only 89 mm, about 3½ inches. That is a small number with very large consequences. Wherever the two systems meet there is a **break of gauge**, and every passenger, sack of grain and crate of shells must be **transshipped** to new cars, or every car must be lifted and its **bogies** exchanged, which still happens at Brest on the border of Belarus and Poland.

The debate. Many books, guides and websites say Russia chose a wider gauge on purpose, so that an invader from the west could not run his trains into Russia. Is that true? A historian asks two different questions: why was the decision made, and what effects did it later have? On the first question, the surviving evidence points mainly to engineering. Whistler and the Russian commission argued that a wider gauge allowed larger, more powerful locomotives with bigger boilers and gave a steadier ride, and the 5-foot gauge was already proven in America. Historians have not found clear documents from the early 1840s showing that defense was the main reason. There was also no European standard to defend against yet: Britain itself did not settle its gauge until 1846, and the railways of the German states were only beginning. Nor did Russia insist on its gauge everywhere at first. The Warsaw–Vienna Railway in Russian Poland, opened in the 1840s, was built to standard gauge to connect with Austria.

The effects. On the second question, the effects, the break of gauge certainly mattered in war, and Russian and Soviet military planners came to value it. When Germany invaded in 1941, its railway troops had to convert thousands of miles of Soviet track to standard gauge before German trains could carry supplies forward, and few Soviet locomotives and cars were captured to use on the wide track. German engines, built for milder winters, often froze. Supplies piled up at the gauge breaks while the armies far ahead went short. But the break cut both ways. Historians note that it complicated Russia's own invasion of East Prussia in August 1914, and in 1944–1945 Soviet railway troops in turn had to convert lines as the Red Army advanced west into Poland. Spain offers a parallel. In 1844 it chose a gauge of six Castilian feet (about 1,672 mm, later adjusted to today's 1,668 mm), wider still, and the same story is told that it was meant to stop a French invasion, though the report behind the decision gave engineering reasons about larger locomotives. A reasonable conclusion: Russia's gauge was probably chosen for technical reasons, kept partly out of cost and habit, and later valued for defense. Defense was a real effect, but probably not the original cause.

On the map. Find the main breaks of gauge on the map: Brest–Terespol between Belarus and Poland, Chop on the border of Ukraine with Hungary and Slovakia, Tornio–Haparanda between Finland and Sweden, and Irun–Hendaye between Spain and France. Notice that the Russian-gauge world is the whole of the East European Plain: the gauge line runs almost along the line where the North European Plain opens into the eastern plain. The old political frontier of the Russian Empire became a frontier of steel.

Technology overcoming geography. The railway did more than any other invention to shrink the distances of the plain. A journey from St. Petersburg to Moscow that took days by road took less than a day by train after 1851, and the Trans-Siberian Railway later stretched Russian gauge all the way to the Pacific. Engineers have also found ways around the break of gauge itself: bogie exchange, dual-gauge track with a third rail, and cars with variable-gauge axles whose wheels slide along the axle as the train rolls slowly through a special installation. Freight trains between China and Europe change gauge twice, once entering the Russian-gauge lands and once leaving them at the Polish border. As of 2026, the Baltic states of Estonia, Latvia and Lithuania are building Rail Baltica, a new standard-gauge line to link them directly with Poland and the rest of the European network. A decision made by a handful of engineers in 1843 still shapes the trains of the plain today.



Scale: 0.3 px per mm. Rails shown as black blocks; red line = gauge.

Three gauges drawn to the same scale. Gauge is measured between the inner faces of the rails.

Where the gauges meet: the main breaks of gauge in Europe.

PICTURE STUDY

Repair Work on the Railway, Konstantin Savitsky, 1874 · Oil on canvas · State Tretyakov Gallery, Moscow

Konstantin Savitsky belonged to the Russian “Wanderers” (Peredvizhniki), painters who traveled with their exhibitions and painted the real life of ordinary Russians. In 1874 he showed this picture of laborers building up a railway embankment by hand, shovel by shovel and barrow by barrow.

Russia’s railways are often talked about in terms of tsars, engineers and gauges. Savitsky reminds us that every mile of track across the plain was raised by the labor of thousands of workers, many of them peasants who left their villages for seasonal work on the lines.

Look closely

- Find the foreman. How does the painter set him apart from the workers?
- Follow the line of wheelbarrows up the embankment. Why would the railway need to be raised above the surrounding land on the flat, wet plain?
- Look at the faces and bodies of the workers. What do they tell you about the work?
- Find any signs of tools or machinery. How much of this work is done by human muscle?

Talk about it

1. Why might the builders of a railway across a flat plain still have to move enormous amounts of earth?
2. Savitsky painted this only about two decades after the St. Petersburg–Moscow line opened. What does it suggest about how Russia’s railways were built?
3. How does the picture change the way you think about the gauge debate, which is usually told as a story about rulers and engineers?

PROJECT: TWO GAUGES AND A BREAK

You will build two short sections of model track at 1:20 scale, one standard gauge and one Russian gauge, and run a timed contest between two ways of getting cargo across the break: transshipment and bogie exchange.

You will need

- A long piece of cardboard (about 30 × 8 inches) as a base
- Eight wooden craft sticks or thin dowels for rails, and more sticks for ties
- Ruler with millimeters, glue
- Two small toy cars or two boxes on removable cardboard “bogies” (a cardboard strip with two pairs of bottle-cap or button wheels on skewers)
- Twenty small blocks, dried beans or dice as cargo
- A stopwatch

Steps

1. Compute the scale gauges: 1,435 mm ÷ 20 = 71.75 mm (about 72 mm) for standard gauge, and 1,520 mm ÷ 20 = 76 mm for Russian gauge.
2. Glue ties across the cardboard. On the left half, glue two rails with their inner faces 72 mm apart. On the right half, glue two rails 76 mm apart. Mark the joint in red: this is Brest.
3. Build two wheel sets on skewers: one with its wheels set to run just inside the 72 mm rails, and one set to the 76 mm rails. Check that each runs only on its own gauge.
4. Transshipment race: load a car on the left gauge with 20 blocks. Roll it to the break. Move the blocks by hand, one at a time, into a car on the right gauge, and time how long it takes.
5. Bogie exchange race: build a car body that sits on removable bogies. Roll it to the break, lift the body, swap the left-gauge bogies for right-gauge bogies, set it back down and roll on. Time it.
6. Repeat each method three times and average your times. Then scale up: if one model block stands for 2 tons and a real crane moves 2 tons in 2 minutes, how long would a 1,000-ton train take to transship?
7. Fill in an evidence table with two columns, “Evidence the gauge was chosen for defense” and “Evidence it was chosen for other reasons,” and write your verdict in three sentences.

Tips

- Measure the gauge between the inside edges of the rails, not their centers.
- Real bogie exchanges lift many cars at once on jacks; your one-car test is a model of the idea, not of the full time.
- In your verdict, separate “why it was chosen” from “what it later did.” That distinction is the heart of this lesson.

Check your work

- My two tracks are built to the correct scale gauges.
- I timed and compared transshipment and bogie exchange.
- I can give evidence on both sides of the defense debate and state a reasoned conclusion.

MAP NOTEBOOK

1. Draw a cross-section of a railway track and label the rails, ties, ballast, wheel flange and the gauge measurement between the inner faces of the rails.
2. Draw a map of Europe and shade the Russian-gauge area. Mark the four breaks of gauge from the lesson.
3. Make a two-column evidence chart for the debate: “Intention (why chosen)” and “Effect (what it later did).” List at least three items in each.

> **From history.** The United States once had its own great break of gauge. Many Southern railways were built to 5 feet, the gauge Whistler took to Russia, while most Northern lines used 4 feet 8½ inches or close to it. Over two days, 31 May and 1 June 1886, crews across the South moved one rail of more than 11,000 miles of track inward to 4 feet 9 inches, a gauge close enough to standard for trains to run through. Russia, with far more track and different priorities, never made such a change; when the Soviet railways adjusted their gauge from 1970, they narrowed it by only 4 mm, to 1,520 mm.

WORKED EXAMPLES

Example 1. Find the difference between Russian gauge (5 ft = 1,524 mm) and standard gauge (4 ft 8½ in = 1,435 mm) in millimeters and inches. Then find the difference for the modern 1,520 mm Russian gauge.

(Use the map or drawing “The difference between gauges is small on paper but decisive for a wheel fixed t” shown earlier in this lesson.)

1. In inches: 5 ft = 60 in, and 4 ft 8½ in = 56.5 in. Difference: 60 − 56.5 = 3.5 in.
2. In millimeters: 1,524 − 1,435 = 89 mm (check: 3.5 × 25.4 = 88.9 mm).
3. Modern Russian gauge: 1,520 − 1,435 = 85 mm, about 3.3 inches.

Answer: 89 mm (3.5 in) for the original 5-foot gauge; 85 mm (about 3.3 in) for today’s 1,520 mm.

Example 2. A freight train of 50 wagons, each carrying 2 containers, reaches the Polish–Belarusian border. Method A: a gantry crane moves one container from a Russian-gauge wagon to a standard-gauge wagon every 2.5 minutes. Method B: wagons are lifted in groups of 10 to exchange bogies, taking 45 minutes per group. Which method is faster, and by how much? (These are illustrative figures.)

1. Method A: 50 × 2 = 100 containers; 100 × 2.5 = 250 minutes ≈ 4 hours 10 minutes.
2. Method B: 50 ÷ 10 = 5 groups; 5 × 45 = 225 minutes = 3 hours 45 minutes.
3. Difference: 250 − 225 = 25 minutes, in favor of bogie exchange.
4. Either way the train loses hours that a train on a single gauge would not.

Answer: Bogie exchange is faster by about 25 minutes (3 h 45 min versus about 4 h 10 min), but both add hours to the trip.

Example 3. The straight-line (great-circle) distance from St. Petersburg to Moscow is about 635 km (395 miles), and the railway opened in 1851 is about 650 km (404 miles) long. By what percent is the railway longer than a perfectly straight line? What does this say about the plain and about the ruler legend?

(Use the map or drawing "The St. Petersburg–Moscow railway runs almost straight across the plain." shown earlier in this lesson.)

1. Extra length: 650 − 635 = 15 km.
2. Percent: 15 ÷ 635 ≈ 0.024, or about 2.4%.
3. In miles: 404 − 395 = 9 miles; 9 ÷ 395 ≈ 2.3%, the same answer allowing for rounding.

Answer: Only about 2.4% longer. The flat plain allowed a nearly straight line, which may be why the ruler legend sounds believable, even though the real route was surveyed by engineers.

PRACTICE

1. EASY What is track gauge, and where exactly is it measured?
2. EASY Who recommended the 5-foot gauge for the St. Petersburg–Moscow railway, and where had that gauge already been used?
3. EASY Name two ways cargo can get past a break of gauge.
4. MEDIUM Spain's Iberian gauge is 1,668 mm. How much wider is it than standard gauge, in millimeters and inches?
5. MEDIUM At a scale of 1:87 (HO model trains), how wide is standard gauge on the model? How wide would Russian 1,520 mm gauge be at the same scale?
6. MEDIUM The St. Petersburg–Moscow railway opened in 1851. How many years after Whistler arrived in Russia (1842) was that, and how many years after his death (1849)?

7. MEDIUM Suppose a German railway construction unit could convert 15 km of Soviet track to standard gauge per day. How many days would it take to convert the roughly 1,000 km from Brest to Moscow? How many days if four units worked on separate sections at once?
8. MEDIUM Using the map, name the break of gauge between (a) Belarus and Poland, (b) Finland and Sweden, (c) Spain and France.
9. HARD Give two pieces of evidence that Russia's gauge was not originally chosen mainly for defense.
10. HARD Give two pieces of evidence that the gauge difference later mattered for defense, and one way it hurt Russia itself.
11. HARD Explain the difference between a decision's intention and its effect, using the Russian gauge as your example.
12. CHALLENGE Write a reasoned paragraph answering: "Did Russia choose its wide rail gauge for defense?" Present the evidence on both sides fairly and state your conclusion.

COMMON MISTAKES

- Assuming that because something had a defensive effect, it must have been planned for defense. Effects and intentions are different questions.
- Measuring gauge from the center of one rail to the center of the other. Gauge is measured between the inner faces of the rails.
- Thinking the difference is large. It is only about 3½ inches (89 mm), but because wheels are fixed to their axles, any difference at all stops a train.

Make it a game · Intention or Effect?. One player reads out a statement about a historical decision (for example: "The Great Wall kept out nomad raiders," "The Russian gauge slowed German supply trains in 1941," "Whistler preferred bigger locomotives," "The Oder–Neisse line follows rivers"). The others hold up a card marked I (intention: why it was chosen) or E (effect: what it later did). Score a point for each correct card and a bonus point for naming the evidence that tells you which. Write five statements each and swap.

Scripture. "For which of you, intending to build a tower, sitteth not down first, and counteth the cost, whether he have sufficient to finish it?" (Luke 14:28, KJV)

Builders who choose a standard, whether for a tower or a railway, live with the cost of that choice for generations. Wise planning counts costs that reach far beyond the day the work is finished.

Practice answers

1. The distance between the two rails of a track, measured between the inner faces of the rails.
2. The American engineer George Washington Whistler; the 5-foot gauge was then common on railways in the American South.

3. Transshipment (moving cargo to cars of the other gauge) and bogie exchange (lifting the cars and swapping their wheel sets). Variable-gauge axles and dual-gauge track are other solutions.
4. 1,668 − 1,435 = 233 mm; 233 ÷ 25.4 ≈ 9.2 inches.
5. 1,435 ÷ 87 ≈ 16.5 mm; 1,520 ÷ 87 ≈ 17.5 mm. The models differ by only about 1 mm.
6. 1851 − 1842 = 9 years after his arrival; 1851 − 1849 = 2 years after his death.
7. 1,000 ÷ 15 ≈ 67 days for one unit; 67 ÷ 4 ≈ 17 days for four units, but only if the sections were already captured and the units could be supplied.
8. (a) Brest–Terespol; (b) Tornio–Haparanda; (c) Irun–Hendaye.
9. (1) The 1840s arguments of Whistler and the Russian commission were about engineering: larger locomotives, bigger boilers and stability, and the 5-foot gauge was already proven in America. (2) There was no settled European standard yet to defend against (Britain's Gauge Act came only in 1846), and the Warsaw–Vienna Railway in Russian Poland was built to standard gauge. Historians have not found clear 1840s documents giving defense as the main reason.
10. In 1941 German railway troops had to convert thousands of miles of Soviet track before German trains could supply the front, and few Soviet locomotives and cars could be captured to use on the wide track; supplies piled up at the gauge breaks. Russian and Soviet planners came to value the break of gauge as an obstacle. But it hampered Russia's own invasion of East Prussia in 1914, and Soviet troops had to convert lines as they advanced west in 1944–1945.
11. The intention is the reason the decision-makers had at the time; the effect is what the decision later caused, intended or not. Russia's gauge seems to have been intended for engineering reasons in 1843, but one of its effects, decades later, was to slow invaders who depended on railways. Confusing the two leads people to read later results back into earlier motives.
12. Sample answer: The popular story that Russia chose the 5-foot gauge to stop invaders is attractive, because in 1941 the gauge break really did slow the German supply system, and later Russian planners valued it. But the evidence from the 1840s points elsewhere. The gauge was recommended by an American engineer who knew it from the American South, the arguments recorded were about locomotive size and stability, Europe had no single standard yet, and Russia even allowed a standard-gauge line in its Polish lands. Spain's wide gauge has a similar legend and a similar engineering explanation. I conclude that the gauge was most likely chosen for technical reasons and kept for cost and habit, and that its defensive value was a real but later effect rather than the original cause. A historian should remain open to new documents that could change this judgment.

Unit 7 test

Answer each question. Show your work for every calculation, give units (miles and kilometers where asked), and use complete sentences for explanations. A calculator is allowed. The test is worth 100 points.

1. (6 pts) Describe the extent of the North European Plain and the East European Plain from west to east. Name the mountain range at the eastern end and the highest ground on the eastern plain, with its approximate height.
2. (6 pts) In which direction do the Elbe, Oder and Vistula flow, and in which direction do the Dnieper and Volga flow? Explain what this means for an army marching east from Berlin to Moscow.
3. (8 pts) Gdańsk lies at about 54.35°N and Kraków at about 50.06°N. St. Petersburg lies at about 59.94°N and Odesa at about 46.48°N. Estimate both north–south widths in miles and kilometers and explain what the comparison shows about the shape of the plain.
4. (6 pts) Name the three powers that partitioned Poland and the years of the three partitions. For how many years did Poland have no state of its own afterward?
5. (8 pts) Interwar Poland covered about 388,600 km² and postwar Poland covers about 312,700 km². Find the net change in km², in square miles (1 km² ≈ 0.386 sq mi) and as a percent of the interwar area. Then name one city Poland lost and one it gained.
6. (6 pts) Why did the Allies use the Oder and Neisse Rivers for Poland's western border in 1945, and what has made that border stable since?
7. (8 pts) Napoleon crossed the Niemen on 24 June 1812 and entered Moscow on 14 September. The straight-line distance is about 880 km (550 miles). Find the number of days and the average daily advance in kilometers and miles.
8. (6 pts) On Minard's map, 1 mm of band width represents 10,000 men. The band is 422,000 men wide at the Niemen and 100,000 at Moscow. Give both widths in millimeters, and explain what the narrowing between them shows about the cause of the army's losses.
9. (6 pts) Minard's graph shows −24° Réaumur on 1 December 1812. Convert to Celsius (°C = °R × 1.25) and Fahrenheit (°F = °C × 1.8 + 32).
10. (8 pts) Army Group Center started at Brest on 22 June 1941 and came within about 30 km of Moscow on 5 December. Brest is about 1,000 km from Moscow. Compute the average daily advance and compare it with Napoleon's. Give one reason for the difference.
11. (6 pts) What is the rasputitsa? Explain how the autumn mud and then the frost affected the German drive on Moscow in October–December 1941.
12. (6 pts) Find the difference between the original Russian gauge (1,524 mm, 5 ft) and standard gauge (1,435 mm, 4 ft 8½ in) in millimeters and inches. Why does such a small difference stop a train?
13. (8 pts) Give one piece of evidence that Russia's wide gauge was chosen for engineering reasons and one piece of evidence that it later had defensive effects. Then explain the difference between intention and effect.

14. (12 pts) Essay (two paragraphs): “The North European Plain has been both Russia’s greatest danger and its greatest defense.” Explain this statement using at least three of the following: the funnel shape, strategic depth, Poland’s moving borders, 1709, 1812, 1941, the rail gauge. Include one limit of a purely geographic explanation.

UNIT PROJECT: INVASIONS ACROSS THE PLAIN: A MINARD-STYLE ATLAS

Prepare a two-part atlas of the plain. Part one is your finished redrawing of Minard’s map of 1812 from Lesson 7.3, together with your own Minard-style flow map of a journey you measured. Part two is a large hand-drawn map of the plain from Paris to the Urals that shows the invasions across it: Charles XII (1708–1709), Napoleon (1812), Germany (1941) and the westward marches of 1814 and 1945, each in its own color with dates, plus the Pripet Marshes, the narrow neck in Poland, Poland’s 1945 borders and the main breaks of rail gauge.

Beside the maps, write a one-page essay answering the unit question: what happens to nations and borders when the land draws no bounds? Use at least two numbers you calculated in this unit (a rate of advance, a band width, a width of the plain, a change in area or a gauge difference).

- **Accuracy**: Places, routes, dates and borders are correctly located; the Minard redrawing uses the correct data and scales.
- **Data and design**: Band widths, scales and keys are clear and proportional; the student’s own flow map shows a real measured quantity.
- **Reasoning**: The essay uses geography and calculated numbers to explain the invasions and border changes, and states a fair limit of geographic explanation.
- **Care and honesty**: The atlas is neat and readable, sources of data are noted, and real wrongs and achievements are described plainly and fairly.

Answer key

1. The plain runs from western France through Belgium, the Netherlands, northern Germany, Denmark and Poland, then broadens into the East European Plain across Belarus, Ukraine and European Russia to the Ural Mountains, roughly 2,400 miles (3,900 km). The Valdai Hills are its highest ground, only about 1,135 ft (346 m).
2. The Elbe, Oder and Vistula flow north to the North Sea and Baltic, so they lie across the line of march and must be crossed one after another (natural defense lines, though crossable). The Dnieper and Volga flow south, so they run alongside the invader’s path rather than across it.
3. Poland: 4.29° × 69 ≈ 296 miles (4.29 × 111 ≈ 476 km). Eastern edge: 13.46° × 69 ≈ 929 miles (13.46 × 111 ≈ 1,494 km). The plain is about three times wider in the east: it is a funnel, so an invader moving east must hold an ever longer front, while a defender in Poland has a narrower gap to hold.
4. Russia, Prussia and Austria; 1772, 1793 (Russia and Prussia) and 1795. Poland was reborn in 1918: 1918 − 1795 = 123 years.
5. 388,600 − 312,700 = 75,900 km² lost; 75,900 × 0.386 ≈ 29,300 sq mi; 75,900 ÷ 388,600 ≈ 19.5%. Lost: Lwów (Lviv) or Wilno (Vilnius). Gained: Breslau (Wrocław), Stettin (Szczecin) or

Danzig (Gdańsk).

6. On the open plain, rivers were the only clear natural lines to follow and describe. The border is stable because it has been recognized by treaty (East Germany 1950, West Germany 1970, reunited Germany 1990), because populations were moved (forcibly) to fit it, and because Poland and Germany are now allies.
7. 6 + 31 + 31 + 14 = 82 days. 880 ÷ 82 ≈ 10.7 km per day; 550 ÷ 82 ≈ 6.7 miles per day.
8. 42.2 mm and 10 mm. About three-quarters of the main column was lost before Moscow, in summer and early autumn, before any frost, so distance, supply failure, disease, detachments and battle did most of the damage; winter finished an army already gutted.
9. −24 × 1.25 = −30°C; −30 × 1.8 + 32 = −22°F.
10. Days: 8 + 31 + 31 + 30 + 31 + 30 + 5 = 166. Distance: 970 km. 970 ÷ 166 ≈ 5.8 km (3.6 miles) per day, slower than Napoleon's 10.7 km. Reasons: the Germans fought huge battles and encirclements all along the way against a defending army that kept fighting, halted to regroup and resupply, turned south to Kyiv in August, and were stopped for weeks by the autumn mud.
11. The "season of bad roads," when rain or thaw turns unpaved roads to deep mud. In October the mud stopped trucks, tanks and supply columns. The November freeze hardened the ground so the advance resumed, but the deepening cold then froze unprepared soldiers, engines and locomotives just as the Soviets counterattacked on 5–6 December.
12. 1,524 − 1,435 = 89 mm; 60 − 56.5 = 3.5 inches. A railway car's wheels are fixed in pairs to solid axles, so a car built for one gauge cannot run on another at all; cargo must be transshipped or bogies exchanged.
13. Engineering: the American engineer Whistler recommended the 5-foot gauge, already used in the American South, citing larger locomotives and stability, and no 1840s documents clearly give defense as the main reason (also: no European standard existed yet; the Warsaw–Vienna line in Russian Poland was standard gauge). Effect: in 1941 German railway troops had to regauge thousands of miles of Soviet track before supplies could move forward. Intention is the reason at the time of the decision; effect is what the decision later caused, intended or not.
14. A strong answer explains that the plain has no mountain wall, so invaders (Swedes in 1708–1709, the French in 1812, the Germans in 1941) could march straight toward Moscow, and that rulers in Moscow therefore pushed their frontier west toward the narrow neck in Poland, one reason Poland was partitioned and moved. It also explains that the same plain gave Russia enormous depth: the funnel widens eastward, supply lines lengthened, mud and winter slowed the invaders, and Russia could trade space for time, give up even Moscow in 1812, and move its factories east in 1941. The gauge may add a later defensive effect. A limit: outcomes also depended on choices and people, such as Charles XII's turn south, Napoleon's delay in Moscow, Hitler's refusal to prepare for winter, Soviet soldiers' endurance, and the reforms and failures of Poland's own government. Grade on accuracy of facts (4), use of at least three examples (4), and a fair stated limit (4).

UNIT 8

The American Continent

In 1783 the United States was a strip of former colonies between the Atlantic and the Mississippi, walled off from the interior by the Appalachian ridges. Less than a century later it reached the Pacific, bound coast to coast by rail. This unit reads that growth through the land. You will stand at the Cumberland Gap where Daniel Boone's axmen cut the Wilderness Road through a line the king had drawn on the mountain crest, follow the flatboats down the Mississippi to the one city that controlled the trade of half a continent, and watch diplomats in 1846 settle the Oregon Country on the 49th parallel.

Then you will ride the first transcontinental railroad over the Sierra and the Rockies and see why it went exactly where the wagon trails had gone, and you will step back to ask what two wide oceans did for American history, from Washington's Farewell Address to the missile age. Along the way you will meet the Native nations, the enslaved and the immigrant workers whose lives were bound up in this story, and you will name its achievements and its wrongs plainly, judging the people of the past by what they knew and believed. You will also study John Gast's *American Progress* (1872) as a picture of an idea: manifest destiny, which you will learn to separate from the geographic facts that made expansion possible.

The course verse reminds us that God "set the bounds of the people" (Deuteronomy 32:8) and "hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26). A continent is a gift. How a nation receives it, by purchase, treaty, settlement or war, is a matter of human choice and responsibility.

BEFORE YOU BEGIN

- Can read latitude and longitude and convert degrees and minutes to decimal degrees (Units 1 and 2)
- Can compute distance from degrees of latitude (about 69 miles or 111 km per degree) and use speed = distance ÷ time
- Knows the difference between a river as a border and a river basin as a region (Unit 2)
- Can describe how mountains and passes shape routes and borders (Unit 3)

MASTERY CHECKLIST

- I can explain why the Appalachians were a barrier, locate the Cumberland Gap and the other gaps, and tell why the Proclamation Line of 1763 did not hold.
- I can draw the Mississippi basin and explain why control of New Orleans meant control of the interior, and why the Louisiana Purchase united it.
- I can explain the Oregon dispute, the lines at 42°N, 49°N and 54°40′N, and why the 1846 treaty chose the 49th parallel.
- I can trace the first transcontinental railroad, compute its grades and travel times, and explain both its achievements and its costs.

- I can explain how two oceans shaped American history and how technology strengthened and then thinned that shield.
- I can read Gast's *American Progress* as a picture of an idea and separate the belief of manifest destiny from the geography that made expansion possible.

OPTIONAL BOOKS AND RESOURCES

- **Cumberland Gap National Historical Park (National Park Service)** (https://www.nps.gov/cuga/): Free. History of the gap, the Wilderness Road and the Warriors' Path, with maps and photographs (Lesson 8.1).
- **Golden Spike National Historical Park (National Park Service)** (https://www.nps.gov/gosp/): Free. The story of May 10, 1869, the locomotives Jupiter and No. 119, and the workers who built the line (Lesson 8.4).
- **Library of Congress Map Collections** (https://www.loc.gov/maps/): Free. Search for historical maps of the Louisiana Purchase, the Oregon Country, railroad surveys and the territorial growth of the United States to compare with your own maps.

8.1 The Appalachian Barrier

OBJECTIVES

- Describe the Appalachian Mountains as a barrier of parallel ridges with only a few usable gaps, and locate the Cumberland Gap, the Mohawk Valley and the routes to the Ohio country.
- Explain why the Proclamation of 1763 drew its line along the watershed divide, what it tried to do, and why it failed to hold.
- Weigh the claims of the British Crown, the Native nations of the Ohio country and the colonial settlers by the knowledge and standards of their own time.

Warm-up. Crumple a sheet of paper, then flatten it partly so it has long wrinkles running in one direction. Lay it on the table and pour a spoonful of dry rice along the highest wrinkle. Watch which way the grains roll on each side. Now try to “walk” a fingertip across the wrinkles at right angles, and then along them. Which way is easier? Where is the one place you would choose to cross?

Watch. *29th March 1806: Construction of the Cumberland Road, the first federally funded highway, authorised* (HistoryPod, 2:28). https://www.youtube.com/watch?v=H4YQD27caJI
With On the map: find the Cumberland Road (later called the National Road) running from the Potomac in Maryland across the mountains to the Ohio River, and compare it with Boone's Wilderness Road through the Cumberland Gap.
Note: Captions were not available to check; preview it first. This is a short British-narrated clip about an 1806 road, not about the 1763 Proclamation. The Cumberland Road (1806–1811, Maryland to Ohio) is a different route from the Wilderness Road through the Cumberland Gap in the lesson. Don't mix up the two names.

KEY TERMS

watershed divide
The high ground that separates land draining to one river system or ocean from land draining to another. The Eastern Continental Divide separates Atlantic rivers from rivers that reach the Gulf of Mexico by way of the Ohio and Mississippi.

Proclamation Line of 1763
The boundary set by King George III on October 7, 1763, along the heads of the Atlantic rivers, beyond which colonists were forbidden to settle or to buy land from Indian nations.

gap
A low notch through a mountain ridge that people, animals and later roads and railroads can pass through. A gap cut by a river is a water gap; a dry notch is a wind gap.

Ridge and Valley

The part of the Appalachians made of long, parallel ridges separated by long valleys, running from southwest to northeast.

Wilderness Road
The route Daniel Boone's axmen blazed in 1775 from the Holston River through the Cumberland Gap into Kentucky; widened for wagons in 1796.

fall line
The line where rivers drop from the hard rock of the Piedmont onto the soft Coastal Plain in falls and rapids, marking the head of navigation for ships from the sea.

CORE IDEAS

The story. On October 7, 1763, King George III signed a proclamation in London that drew a line down the spine of North America. Britain had just won the Seven Years' War, which the colonists called the French and Indian War. By the Treaty of Paris in February 1763, France gave up Canada and all its claims east of the Mississippi, except New Orleans, to Britain. But peace on paper did not bring peace in the forests. That spring the Ottawa leader Pontiac and warriors of many nations of the Great Lakes and Ohio country rose against the British, took most of the western forts, and besieged Detroit and Fort Pitt. The king's ministers wanted no more costly wars. Their answer was a line: colonists might settle the lands whose rivers ran east into the Atlantic, but the lands beyond the sources of those rivers were reserved to the Indian nations. Settlers already there were told to leave, and no private person could buy Indian land; only the Crown could, at a public meeting.

How it worked. The line followed a **watershed divide**, the crest where the rain on one side runs to the Atlantic and on the other to the Ohio and the Mississippi. A divide is a line no surveyor needs to run: every farmer knows which way his creek flows. And the Appalachians were a real barrier. They run almost 2,000 miles (3,200 km) from Alabama into Canada. They are not especially high; Mount Mitchell in North Carolina, the tallest, rises 6,684 feet (2,037 m). Their strength lies in their shape. In the **Ridge and Valley** country, long, steep, forested ridges run southwest to northeast like the wrinkles of a rug, and a traveler heading west must climb one after another. East-coast rivers were no help past the **fall line**, where rapids stopped boats from the sea. So the westward roads were few, and each followed a **gap**: the Mohawk Valley in New York, the only water-level route through the mountains, but held by the powerful Iroquois Confederacy; Braddock's Road and Forbes Road in Maryland and Pennsylvania, cut by armies to reach the Forks of the Ohio; and, far to the south, the Cumberland Gap.

The gap. The Cumberland Gap is a notch in Cumberland Mountain, about 1,600 feet (490 m) high, where Virginia, Kentucky and Tennessee now meet. Buffalo had used it for generations, and Native hunters and war parties followed the Warriors' Path through it. Dr. Thomas Walker, exploring for a land company in 1750, passed through it and named the nearby Cumberland River for the Duke of Cumberland; the gap and the mountain later took the same name. In March 1775, after Richard Henderson's Transylvania Company bought a huge tract from Cherokee leaders at Sycamore Shoals, a purchase that broke the Proclamation and that Virginia later refused to honor, Daniel Boone led about thirty axmen to blaze a trail

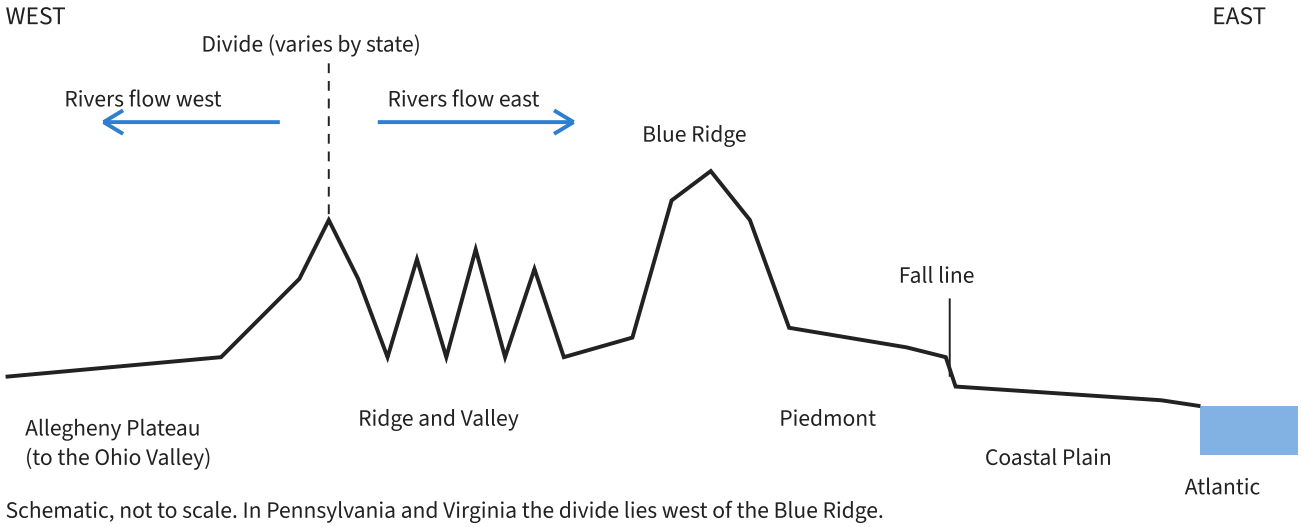
from the Holston River through the gap to the Kentucky River. There they built Boonesborough. Not all the Cherokee accepted the sale; the war leader Dragging Canoe opposed it. The Shawnee, who also hunted Kentucky, fought the newcomers for twenty years, and many settlers and many Indians died. Still the people came. Kentucky widened Boone's path for wagons in 1796, and by about 1810 perhaps 200,000 to 300,000 people had passed through the gap.

The big idea. A border that follows a natural barrier is strong only where the barrier is strong. The Appalachian line followed real mountains, but mountains with gaps, and the people on both sides wanted what lay across. The line began to move almost at once: the treaties of Fort Stanwix and Hard Labour in 1768 shifted it west to the Ohio River in the north, though the Iroquois sold lands that the Shawnee and Cherokee also claimed. George Washington, a surveyor and land buyer himself, wrote privately in 1767 that he saw the Proclamation only as "a temporary expedient to quiet the minds of the Indians." Many colonists who had fought for the Ohio country felt robbed of it, and the line became one of the grievances that led to revolution. In 1783 the peace treaty set the new nation's western border not at the mountains but at the Mississippi. Judged by their own time, each side acted from real interests: the Crown sought peace and lower costs, the Native nations defended homelands and hunting grounds, and the settlers sought farms of their own. The settlers had the numbers, and the line gave way.

On the map. Trace the divide on the map below and notice what happens to anyone who crosses it. On the east side, every river carries trade toward Philadelphia, Baltimore or Charleston. On the west side, every river flows toward the Ohio, and the Ohio flows to the Mississippi and New Orleans. A Kentucky farmer's wheat and pork could not easily go back over the ridges; they went downstream. That raised a dangerous question for the new United States: would the people beyond the mountains stay loyal to the seaboard, or to whoever held the mouth of the Mississippi? Washington himself crossed the mountains in 1784 and urged roads and canals to bind the West to the East. The next lesson follows the rivers downstream.

Technology overcoming geography. The barrier was beaten one gap at a time. The National Road, begun at Cumberland, Maryland, in 1811, reached Wheeling on the Ohio in 1818, the first road built by the federal government. The Erie Canal (1825) used the Mohawk gap to join the Hudson to Lake Erie. The Baltimore and Ohio Railroad, begun in 1828, reached the Ohio River at Wheeling in 1852. Each of these followed the same gaps the buffalo and the Warriors' Path had found first, because a railroad, like a buffalo, must climb as little as it can.

The Proclamation Line of 1763 (approximate) and the Wilderness Road through the Cumberland Gap.



A schematic cross-section of the Appalachian barrier (not to scale).

PICTURE STUDY

Daniel Boone Escorting Settlers through the Cumberland Gap, George Caleb Bingham, 1851–1852 · Oil on canvas · Mildred Lane Kemper Art Museum, Washington University in St. Louis

George Caleb Bingham grew up in Missouri, the son of settlers who had come west from Virginia. Seventy-five years after Boone's trail was cut, he painted the crossing of the Cumberland Gap as a grand founding scene. Boone strides forward with his rifle, leading a white horse that carries his wife Rebecca, while the rest of the party presses behind out of the shadowed gorge.

Many viewers have noticed that the group in the center looks like old paintings of the Holy Family's flight into Egypt. Bingham was painting a memory and an idea, not a photograph: a people passing through a narrow door in the mountains into a new country.

Look closely

- Find where the light comes from. Where is the painting dark and where is it bright?
- Look at the walls of the gap. How does Bingham make the pass feel narrow and dangerous?
- Find the animals and tools the settlers bring. What do they tell you they plan to do in Kentucky?
- Look at the dead tree and broken branches near the path. What mood do they add?

Talk about it

1. Why would a painter in 1851 want to show the Cumberland Gap as a doorway from darkness into light?
2. Who is not shown in this painting, though they knew the gap long before Boone? How might their picture of the same scene differ?

3. What does the painting get right about the geography of a gap, and what does it exaggerate?

PROJECT: FOLD-MOUNTAIN BARRIER MODEL

You will build the Ridge and Valley country from layers of cloth or paper, find the divide, and test why travelers looked for gaps. The model will show in your hands why a line along the crest seemed like a natural border.

You will need

- Two or three old towels or felt sheets of different colors (or several sheets of construction paper)
- A shallow baking pan or a sheet of cardboard
- A spray bottle or watering can with water
- A long piece of yarn and a few toothpicks with paper flags
- Scissors, a ruler and a small toy figure or bead for a traveler
- Optional: modeling clay to firm up the ridges

Steps

1. Stack the towels or felt in the pan and push the two ends gently toward each other so the layers fold into four or five parallel ridges running across the pan. This is the Ridge and Valley pattern.
2. Make one ridge higher than the rest near the middle. Mark it with yarn laid along its crest: this is your divide and your Proclamation Line.
3. Cut a small notch in one ridge and a deeper notch through all the ridges at one place. Label the deep notch “Cumberland Gap.”
4. Spray water along the top of the highest ridge. Watch which side each trickle runs to. Label one side “Atlantic” and the other “Ohio and Mississippi.”
5. Move your traveler across the ridges at right angles. Count how many climbs it takes. Then move it along a valley to the gap and through. Count again.
6. Place flags for Philadelphia, Pittsburgh, the Cumberland Gap and Boonesborough in the right relative places.
7. Photograph or sketch your model from above and from the side, and write three sentences: Why did the Crown choose the divide for its line? Why was the line hard to enforce? What does the gap do to a border?

Tips

- Fold the cloth slowly so the ridges stay parallel; real Appalachian ridges run southwest to northeast.
- Put a towel under the pan, since the water will run off both sides, just as it should.

Check your work

- I can show the divide and explain which way water flows on each side.

- I can explain why travelers followed valleys to a gap instead of climbing straight over.
- I can explain how a border along a ridge can be strong and weak at the same time.

MAP NOTEBOOK

1. Draw a simple map of the Appalachians from Georgia to New York. Mark the divide with a dashed line, the Cumberland Gap, the Mohawk Valley and the Forks of the Ohio at Pittsburgh.
2. Draw the cross-section of the barrier from the Ohio Valley to the Atlantic and label the plateau, the ridges, the Blue Ridge, the Piedmont, the fall line and the Coastal Plain.
3. Make a three-column chart: the Crown, the Native nations, the settlers. In each column write what that group wanted west of the mountains and why.

> **From history.** Dr. Thomas Walker, who passed through the Cumberland Gap in 1750, kept a journal of his journey. He and his companions built a small log cabin in what is now Kentucky, one of the first by English colonists west of the mountains, but the rugged hill country they found near the gap discouraged them, and they turned back before reaching the rich Bluegrass country that Boone's generation would settle.

WORKED EXAMPLES

Example 1. Philadelphia is at about 39.95°N, 75.17°W, and Pittsburgh at the Forks of the Ohio is at about 40.44°N, 80.00°W. Estimate the straight-line distance between them. Then estimate how many days an ox wagon making 15 miles a day would need if the winding road over the ridges was about 20 percent longer than the straight line.

(Use the map or drawing "Philadelphia and Pittsburgh lie on opposite sides of the divide." shown earlier in this lesson.)

1. Difference in latitude: $40.44 - 39.95 = 0.49°$. One degree of latitude is about 69 miles, so $0.49 \times 69 \approx 34$ miles north–south.
2. Difference in longitude: $80.00 - 75.17 = 4.83°$. At about 40°N a degree of longitude is about $69 \times \cos 40° \approx 69 \times 0.766 \approx 53$ miles, so $4.83 \times 53 \approx 256$ miles east–west.
3. Straight-line distance: $\sqrt{(256^2 + 34^2)} = \sqrt{(65{,}536 + 1{,}156)} = \sqrt{66{,}692} \approx 258$ miles (about 415 km).
4. Road distance: $258 \times 1.2 \approx 310$ miles. Days: $310 \div 15 \approx 21$ days.

Answer: About 258 miles (415 km) in a straight line; about 310 miles by road, or roughly three weeks by ox wagon.

Example 2. The Cumberland Gap is at about 36.60°N. The boundary between Kentucky and Tennessee was meant to follow the parallel of 36°30′N. How far north of that parallel is the gap, in miles and kilometers?

1. Convert 36°30′ to decimal degrees: 30′ = 30/60 = 0.50°, so 36°30′ = 36.50°.
2. Difference: 36.60 − 36.50 = 0.10°.
3. One degree of latitude is about 69 miles (111 km), so 0.10 × 69 ≈ 7 miles and 0.10 × 111 ≈ 11 km.

Answer: About 7 miles (11 km) north of 36°30′. The gap sits right at the corner where Virginia, Kentucky and Tennessee meet.

Example 3. Boone's Trace ran about 200 miles (320 km) from the Long Island of the Holston to the Kentucky River. If a family on foot with packhorses averaged 10 miles a day, how long did the trip take? If they could only travel on 6 days out of 7, how many calendar days?

1. Travel days: 200 ÷ 10 = 20 days.
2. Weeks of travel: 20 ÷ 6 = 3 weeks and 2 days of travel, so 3 rest days are needed in the first three weeks.
3. Calendar days: 20 travel days + 3 rest days = 23 days.

Answer: About 20 days of walking, or about 23 calendar days with a rest day each week: more than three weeks through the wilderness.

PRACTICE

1. EASY Who issued the Proclamation of 1763, and on what date?
2. EASY What natural feature did the Proclamation Line follow?
3. EASY Which three present-day states meet at the Cumberland Gap?
4. EASY Name two events of 1763 that led the British government to issue the Proclamation.
5. MEDIUM Mount Mitchell is 6,684 feet high. Convert this to meters (1 m = 3.281 ft). Is it higher or lower than the 1,600-foot Cumberland Gap by more than a mile (5,280 ft)?
6. MEDIUM Using the map (Cumberland Gap 36.60°N, 83.67°W; Boonesborough 37.90°N, 84.27°W), give the general compass direction from the gap to Boonesborough and estimate the straight-line distance. (At this latitude 1° of longitude ≈ 55 miles.)
   (Use the map or drawing "The Wilderness Road." shown earlier in this lesson.)
7. MEDIUM Why was the Mohawk Valley the best natural route through the Appalachians, and why did few colonists use it before the Revolution?
8. MEDIUM The National Road ran about 130 miles from Cumberland, Maryland, to Wheeling on the Ohio. How many days would a freight wagon making 15 miles a day

need? How many hours would a modern truck at 50 mph need on the same distance?

9. HARD Kentucky had about 74,000 people in the census of 1790 and about 221,000 in 1800. By what factor did the population grow? What does this tell you about the Proclamation Line?
10. HARD Pittsburgh is at 40.44°N and the Cumberland Gap at 36.60°N. How far apart are they north to south, in miles and kilometers?
11. CHALLENGE A watershed line seems easy to enforce because everyone can see which way the water runs. Give two reasons the Appalachian line was nevertheless hard to enforce.
12. CHALLENGE In a short paragraph, explain the Proclamation from the point of view of a British minister, a Shawnee leader and a Virginia settler in 1763, judging each by what they knew and valued at the time.

COMMON MISTAKES

- Thinking the Appalachians were a barrier because they are very high. They are modest mountains; the barrier was their many parallel forested ridges and their few gaps.
- Thinking the Proclamation Line was surveyed and marked. It was described by the watershed and was never run as a marked line on the ground along its whole length.
- Thinking the Proclamation was meant to be permanent and was simply ignored. The Crown itself moved the line by treaty in 1768 and 1770, and it was replaced by the boundary of 1783.

Make it a game · Find the Gap. Draw a grid of 8 by 8 squares and shade five long ridges running diagonally across it, leaving only two or three one-square gaps. One player starts on the east edge with a traveler and rolls a die each turn: on a 1–4 they may move that many squares along a valley, on a 5–6 they may climb one ridge square. The other player places a “fort” on any gap square after each turn, closing it. Reach the west edge in ten turns to win. Then swap roles and talk about why the Crown’s line and the settlers both depended on the gaps.

Scripture. “I will lift up mine eyes unto the hills, from whence cometh my help. My help cometh from the LORD, which made heaven and earth.” (Psalm 121:1–2, KJV)

To a family standing at the foot of the ridges, the hills were a wall. The psalmist looks past the hills to the One who made them. God set the mountains where they stand, and men and nations still have to choose rightly how to cross them.

Practice answers

1. King George III of Great Britain, on October 7, 1763.
2. The watershed divide along the Appalachian Mountains: the heads of the rivers that flow into the Atlantic. Land beyond those sources was reserved to the Indian nations.
3. Virginia, Kentucky and Tennessee.

4. The Treaty of Paris (February 1763), which gave Britain France's lands east of the Mississippi, and Pontiac's War, the uprising of Great Lakes and Ohio country nations that began in the spring of 1763.
5. 6,684 ÷ 3.281 ≈ 2,037 m. The difference is 6,684 − 1,600 = 5,084 ft, which is a little less than a mile.
6. North, slightly west (north-northwest). North–south: 1.30 × 69 ≈ 90 miles. East–west: 0.60 × 55 = 33 miles. Distance $\sqrt{(90^2 + 33^2)} \approx \sqrt{(8{,}100 + 1{,}089)} \approx 96$ miles (about 154 km).
7. It is the only water-level route through the mountains, joining the Hudson to the Great Lakes without high climbs. But it ran through the homeland of the Iroquois Confederacy, a strong power that controlled the route and the land around it.
8. 130 ÷ 15 ≈ 8.7, so about 9 days. 130 ÷ 50 = 2.6 hours, about 2 hours 36 minutes.
9. 221,000 ÷ 74,000 ≈ 3.0, so it roughly tripled in ten years. Within a generation of 1763, the land beyond the line had been settled by large numbers of people; the line did not hold.
10. 3.84° × 69 ≈ 265 miles; 3.84° × 111 ≈ 426 km.
11. Possible reasons: the mountains had gaps (Cumberland Gap, Forbes Road, the Mohawk Valley) that let people through; settlers were already living west of the line; the army was small and far away; land companies and colonial leaders wanted the western lands; colonial governments and some Native leaders made sales the Crown had forbidden; the line was moved by new treaties within five years.
12. A good answer notes that the minister wanted to end a costly Indian war, protect the fur trade and keep the empire's finances in order; the Shawnee leader wanted to keep his people's hunting grounds and homes and saw the colonists' farms as the end of that way of life; the settler had often fought in the war for the Ohio country, wanted land for a family farm and saw the line as a broken promise. Each acted on real interests and beliefs of the time.

8.2 The Mississippi System

OBJECTIVES

- Describe the Mississippi drainage basin, its great tributaries and its single outlet, and explain why the mouth of a river system controls the trade of its whole basin.
- Tell how and why the United States bought Louisiana from France in 1803, and compute the scale and cost of the purchase.
- Explain what the Purchase did and did not settle: vague boundaries, the lands of the Native nations who lived there, and the spread of slavery.

Warm-up. Lay a large sheet of paper on a slightly tilted tray and crumple it into gentle hills. Drip water from a spoon at five different spots near the top edge. Watch where the trickles meet. Mark with a pencil the one place at the bottom where all the water leaves. If you could stand guard at only one spot on this paper, where would it be, and why?

Watch. *The Mississippi River Explained in under 3 minutes* (FactSpark, 2:59).
https://www.youtube.com/watch?v=YgwGk1wfFx4
With the big idea: watch how the Missouri, Ohio and other big rivers all drain into the Mississippi, and why all that trade had to pass New Orleans, just as Jefferson said.
Note: Captions were not available to check; preview it first. There is a short 'Environment' section at the end (2:11) that we could not check.

Backup video. *How did Creoles React to the Louisiana Purchase? (Short Animated Documentary)* (History Matters, 3:22). https://www.youtube.com/watch?v=p7xTZ0W7POE
After the story: listen for how the French and Spanish Creoles of New Orleans felt when they suddenly became Americans after the 1803 Louisiana Purchase. Note: Captions were not available to check; preview it first. History Matters is a reliable animated channel that sometimes uses light joking humor.

KEY TERMS

drainage basin
All the land drained by a river and its tributaries. Rain falling anywhere in the Mississippi basin, from Montana to Pennsylvania, ends up passing New Orleans.

tributary
A river or stream that flows into a larger river. The Missouri and the Ohio are the Mississippi's greatest tributaries.

right of deposit
Permission to unload goods at a port and store them, without paying duty, until they are loaded onto ocean ships. Spain granted Americans this right at New Orleans in Pinckney's Treaty of 1795.

Louisiana Purchase

The 1803 treaty by which the United States bought France's claim to Louisiana, about 828,000 square miles (2.14 million km²) west of the Mississippi, together with New Orleans, for about $15 million.

sovereignty
The right of a state to govern a territory. In 1803 the United States bought France's claim of sovereignty over Louisiana, not the lands owned and used by the Native nations who lived there.

flatboat
A large, square-ended wooden boat that drifted downstream with the current carrying farm goods; at New Orleans it was broken up and sold for lumber, because it could not be pushed back upstream.

CORE IDEAS

The story. On April 18, 1802, President Thomas Jefferson wrote a letter to Robert Livingston, the American minister in Paris, that began with a piece of geography. "There is on the globe one single spot," he wrote, "the possessor of which is our natural and habitual enemy. It is New Orleans, through which the produce of three-eighths of our territory must pass to market." Jefferson had just learned that Spain, which had held Louisiana since 1762, had secretly handed it back to France by the Treaty of San Ildefonso in 1800. Spain was weak and friendly; Napoleon Bonaparte was neither. Since Pinckney's Treaty of 1795, Spain had let Americans float their goods down the river and store them at New Orleans under a **right of deposit**. In October 1802 the Spanish official at New Orleans, still in charge until the French arrived, suddenly suspended that right. In Kentucky and Tennessee, farmers and their congressmen were furious, and some talked of war.

How it worked. To see why one city mattered so much, look at the **drainage basin**. The Mississippi and its tributaries drain about 1.2 million square miles (3.1 million km²), roughly 40 percent of the lower forty-eight states, from the Rockies to the Appalachians and from Canada to the Gulf. The Missouri, the Ohio, the Tennessee, the Arkansas and the Red all gather into one trunk, and the trunk has one mouth. Before the steamboat, almost all trade on these rivers went one way: downstream. Western farmers built **flatboats**, loaded them with flour, pork, whiskey and tobacco, and drifted for weeks to New Orleans. There the cargo went onto ocean ships for the East Coast, the West Indies or Europe, and the boat itself was broken up and sold for lumber. The crews walked or rode home up the Natchez Trace, about 440 miles (710 km) from Natchez to Nashville. Young Abraham Lincoln made two such flatboat trips to New Orleans, in 1828 and 1831. Hauling the same goods east over the mountains by wagon cost far more than the long water route. So whoever held New Orleans, about 100 miles (160 km) up the river from the Gulf on a crescent of high ground, held the door of half a continent.

The purchase. Jefferson sent James Monroe to Paris in early 1803 with authority to offer up to $10 million for New Orleans and West Florida. But events in the Caribbean had already changed Napoleon's mind. He had wanted Louisiana to feed France's rich sugar colony of Saint-Domingue. There, the enslaved and free Black population, led first by Toussaint

Louverture and then by Jean-Jacques Dessalines, fought the French army sent to restore control and slavery, and yellow fever killed soldiers by the thousands, including their commander, General Leclerc, in November 1802. Without Saint-Domingue, Louisiana had little value to France, and with war against Britain about to resume, the Royal Navy could seize New Orleans whenever it liked. On April 11, 1803, Napoleon's foreign minister Talleyrand startled Livingston by asking what the United States would pay for all of Louisiana. The treaty, dated April 30, 1803, set the price at 60 million francs plus up to 20 million francs of American claims against France that the United States agreed to pay itself, about $15 million in all. The Senate approved it in October, and the American flag was raised at New Orleans on December 20, 1803. The nation had roughly doubled in size, at less than three cents an acre. Jefferson, who believed in reading the Constitution strictly, doubted it gave him power to buy land and drafted an amendment, but he went ahead without one rather than risk losing the bargain.

The big idea. A river system unites the land it drains, but only if one power holds the outlet. Before 1803 the West was tied to the seaboard by politics and to New Orleans by geography, and men in Kentucky had even schemed with Spain. After 1803 the whole basin answered to one government, and the river that might have divided the country became its spine. Yet the Purchase settled less than it seemed. Its boundaries were vague: the treaty gave Louisiana "with the same extent that it now has in the hands of Spain," and when Livingston asked what that meant, Talleyrand answered, "You have made a noble bargain for yourselves, and I suppose you will make the most of it." The line with Spain was fixed only in 1819, and the northern line at the 49th parallel in 1818. What the United States bought was France's claim to govern, good against other European powers. The land itself was home to the Osage, Pawnee, Lakota and many other nations, and it passed to American settlers over the following century by treaty, purchase and war, including the forced removals of the 1830s. And New Orleans, already a slave port, became the largest slave market in the country, while the question of whether slavery would spread into the new lands led to the Missouri Compromise of 1820 and to bitter quarrels that ended in civil war.

On the map. Find St. Louis, just below the meeting of the Missouri and the Mississippi. In 1804 Lewis and Clark set out from near there to follow the Missouri to its source and seek a water route to the Pacific; the river system told them where to go. Now find Vicksburg, on its bluff above a bend of the river. In the Civil War the Union fought for two years to open the Mississippi, and when Vicksburg surrendered on July 4, 1863, and Port Hudson a few days later, the Confederacy was cut in two. Lincoln wrote that summer, "The Father of Waters again goes unvexed to the sea." Geography had set the war aims of both sides.

Technology overcoming geography. The one-way river became a two-way highway in 1811, when the steamboat *New Orleans* made its way down the Ohio and Mississippi. Within a generation, hundreds of steamboats were carrying cargo upstream in days instead of the months a keelboat crew needed to pole and haul against the current, and the bond between the basin and its port grew tighter still.

The Mississippi system: one outlet for a basin of about 1.2 million square miles.

PICTURE STUDY

Fur Traders Descending the Missouri, George Caleb Bingham, 1845 · Oil on canvas · Metropolitan Museum of Art, New York

George Caleb Bingham grew up on the Missouri River and painted the people who worked on it. Here a French fur trader and his son drift downstream at dawn in a dugout loaded with pelts, bound for St. Louis. Bingham's first title used the period phrase "French Trader and Half-Breed Son," a term of his day for a child of a French father and a Native mother; the fur trade of the Missouri was built on such families.

The river is glassy and the light is golden. Nothing in the picture strains or hurries, because nothing needs to: the current does the work. That is the geography of a river system in one image. Everything in the basin flowed down toward St. Louis and New Orleans.

Look closely

- Find the reflection in the water. What does it tell you about the speed of the river?
- Look at what is piled in the boat. What were these men carrying, and where were they taking it?
- Find the animal chained at the front of the boat. Viewers still argue whether it is a bear cub or a fox. What do you think?
- Compare the old man's face with the young man's. How has Bingham shown two different characters?

Talk about it

1. Why is this boat going downstream and not up? What would it take to bring it back to the mountains?
2. How does this painting help explain why Jefferson cared so much about New Orleans?
3. What does the painting tell you about who lived and worked on the Missouri before the American farmers came?

PROJECT: WATERSHED MAP: WHY THE MISSISSIPPI UNITED THE INTERIOR

This is the unit's main map project. You will trace the Mississippi drainage basin on a large map of the United States, color its sub-basins, and show with arrows how goods flowed to one outlet. Then you will test your map with a sand-and-water model.

You will need

- A large outline map of the United States (printed or traced from an atlas)
- Colored pencils in at least six colors and a fine black pen
- An atlas or a printed physical map showing rivers
- For the model: a baking pan, sand or soil, a small cup, water and a spray bottle

Steps

1. Using the atlas, draw the Mississippi from Lake Itasca to the Gulf, then the Missouri, Ohio, Tennessee, Arkansas and Red rivers.
2. Find the high ground that separates the basin from its neighbors: the Rocky Mountains on the west, the Appalachians on the east, the low divide south of the Great Lakes on the north. Draw the basin edge as a heavy dashed line.
3. Color each sub-basin differently: Upper Mississippi, Missouri, Ohio (with the Tennessee), Arkansas–Red and Lower Mississippi.
4. Mark New Orleans, St. Louis, Pittsburgh, Cincinnati, Louisville, Nashville, Natchez and Vicksburg. Draw arrows along the rivers showing the direction of flow and of trade before 1811.

5. Shade lightly the Louisiana Purchase (the western half of the basin) and the lands east of the river that were already American.
6. In the pan, build a model with a mountain ridge on each side and a low valley between. Spray “rain” on both ridges and watch where the water collects and leaves. Compare with your map.
7. Write a paragraph in the map margin: Why did one city at the mouth matter more than any city upriver? Why did buying the mouth make the interior one country?

Tips

- The basin edge often does not follow the highest peaks; it follows the line where water changes direction. Look for where the headwaters of neighboring rivers come close.
- Keep this map: it is part of your unit portfolio.

Check your work

- I can draw the Mississippi basin and name its five largest tributaries.
- I can explain why trade in the basin flowed to New Orleans before the steamboat.
- I can explain how the Louisiana Purchase put the whole basin under one government.

MAP NOTEBOOK

1. Draw a simple tree diagram of the Mississippi system with the trunk at New Orleans and branches for the Missouri, Ohio, Tennessee, Arkansas and Red, labeling each with one city on it.
2. Copy Jefferson’s sentence about New Orleans into your notebook and underline the geographic words.
3. Sketch a flatboat and a keelboat side by side, and note which way each traveled and how it was moved.

> **From history.** When Abraham Lincoln was nineteen, in 1828, he and a friend took a flatboat of produce from Indiana down the Ohio and Mississippi to New Orleans. In 1831 he made a second trip from Illinois. In New Orleans young Lincoln saw men, women and children bought and sold at the city’s slave markets, and more than thirty years later, as president, he directed the war that reopened the same river from its source to the Gulf and ended slavery in the nation.

WORKED EXAMPLES

Example 1. The Louisiana Purchase covered about 828,000 square miles and cost about $15,000,000. There are 640 acres in a square mile. What was the price per acre, in cents?

1. Acres: 828,000 × 640 = 529,920,000 acres, about 530 million acres.
2. Price per acre: $15,000,000 ÷ 529,920,000 ≈ $0.0283.
3. Convert to cents: $0.0283 × 100 ≈ 2.8 cents.

Answer: About 2.8 cents an acre, which is why it is often called “less than three cents an acre.”

Example 2. A flatboat crew leaves Pittsburgh for New Orleans, about 1,850 river miles (2,980 km) down the Ohio and Mississippi. Drifting with the current, the boat makes about 36 miles a day. After selling the boat, two of the crew take passage to Natchez and walk home up the Natchez Trace, about 440 miles, at 20 miles a day. How long are the boat trip and the walk?

(Use the map or drawing “The flatboat route and the walk home.” shown earlier in this lesson.)

1. Boat trip: 1,850 ÷ 36 ≈ 51 days, about seven weeks.
2. Walk: 440 ÷ 20 = 22 days, about three weeks.
3. Together: 51 + 22 = 73 days of travel, not counting the trip from New Orleans to Natchez or any stops.

Answer: About 51 days downstream and about 22 days walking the Trace: more than two months of travel for one load of goods.

Example 3. The Mississippi basin drains about 1.2 million square miles. The lower forty-eight states cover about 3.1 million square miles. What percent of the lower forty-eight lies in the basin? Express the basin’s area in square kilometers (1 sq mi = 2.59 km^2).

1. Percent: 1.2 ÷ 3.1 ≈ 0.387, about 39 percent, or roughly 40 percent.
2. Area: 1,200,000 × 2.59 = 3,108,000 km^2, about 3.1 million km^2.

Answer: About 39 to 40 percent of the lower forty-eight; about 3.1 million km^2.

PRACTICE

1. EASY In his letter of April 18, 1802, which “one single spot” did Jefferson call the possession of America’s “natural and habitual enemy,” and why?
2. EASY What was the date of the Louisiana Purchase treaty, and about how much did the United States pay?

3. EASY Which 1795 treaty gave Americans free navigation of the Mississippi and the right of deposit at New Orleans, and with which country?
4. EASY Name the five great rivers of the Mississippi system that the lesson lists as gathering into one trunk.
5. MEDIUM Convert 828,000 square miles to square kilometers (1 sq mi = 2.59 km^2).
6. MEDIUM Before the Purchase, the United States covered about 888,000 square miles. About what was its area afterward, and by what factor did it grow?
7. MEDIUM Explain how the fighting in Saint-Domingue helped make the Louisiana Purchase possible.
8. MEDIUM St. Louis (38.63°N) and New Orleans (29.95°N) lie at nearly the same longitude. Estimate the straight-line distance between them. The river distance is about 1,040 miles. What is the ratio of river distance to straight distance, and what does it tell you about the river?
   (Use the map or drawing "St. Louis and New Orleans." shown earlier in this lesson.)
9. HARD New Orleans to Louisville is about 1,240 river miles upstream. A keelboat crew, poling and hauling against the current, averaged about 15 miles a day. How long did the trip take? If a steamboat averaged 100 miles a day, how long would it take, and how many days would it save?
10. HARD What did Talleyrand mean when he told Livingston, "You have made a noble bargain for yourselves, and I suppose you will make the most of it"? How and when were the western and northern boundaries later settled?
11. CHALLENGE In Unit 2 you studied rivers as borders. Explain why a whole river basin tends to unite the people in it rather than divide them, and what condition must be met for that to happen.
12. CHALLENGE Write a short paragraph explaining exactly what the United States bought in 1803, and what it did not buy.

COMMON MISTAKES

- Thinking the Louisiana Purchase was only the present state of Louisiana. It covered all or part of fifteen later states, from Louisiana to Montana.
- Thinking Jefferson set out to buy all of Louisiana. He sought New Orleans and West Florida; the offer of the whole territory came from Napoleon's government.
- Confusing the river as a border with the basin as a region. The Mississippi was a border in 1783, but after 1803 the basin it drains became the heart of one country.

> **Make it a game · Who Holds the Mouth?.** Draw a river tree on a large sheet with five branches and one mouth. Each player places three farm tokens on the branches. On each turn, roll a die: the number tells how many spaces a cargo token drifts downstream. When a cargo reaches the mouth, the player who holds the mouth card decides whether to let it pass for a fee of one point or to block it. Pass the mouth card around after each round. Afterward, talk about why Kentucky farmers in 1802 cared so much who held the mouth card.

> **Scripture.** “All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again.” (Ecclesiastes 1:7, KJV)

The Preacher saw the great circle God set in motion: rain gathers into streams, streams into rivers, rivers into the sea. Every drop in the Mississippi basin runs to one mouth, and that simple fact of creation shaped the treaties of nations.

Practice answers

1. New Orleans, because the produce of three-eighths of the nation’s territory had to pass through it to reach market.
2. It is dated April 30, 1803. The price was 60 million francs plus up to 20 million francs of American claims, about $15 million in all.
3. Pinckney’s Treaty (the Treaty of San Lorenzo), with Spain.
4. The Missouri, the Ohio, the Tennessee (which joins the Ohio), the Arkansas and the Red.
5. 828,000 × 2.59 ≈ 2,144,520 km², about 2.14 million km².
6. 888,000 + 828,000 = 1,716,000 square miles. 1,716,000 ÷ 888,000 ≈ 1.93, so it nearly doubled.
7. Napoleon wanted Louisiana to supply France’s sugar colony of Saint-Domingue. The people of Saint-Domingue, led by Toussaint Louverture and Dessalines, defeated the French army sent to retake it, with yellow fever killing thousands of soldiers, including General Leclerc. Without the colony, Louisiana lost its value to France, and Napoleon chose to sell it before war with Britain resumed.
8. 8.68° × 69 ≈ 599 miles (about 964 km). 1,040 ÷ 599 ≈ 1.7. The river winds a great deal: its meanders make it about 70 percent longer than the straight line.
9. Keelboat: 1,240 ÷ 15 ≈ 83 days, nearly three months. Steamboat: 1,240 ÷ 100 ≈ 12.4 days, about 12 or 13 days. Savings: about 70 days.
10. The treaty did not say exactly where Louisiana’s boundaries were, and Talleyrand was hinting that the Americans could interpret them as broadly as they could make good. The northern line was set at the 49th parallel from the Lake of the Woods to the Rockies in the Convention of 1818 with Britain, and the line with Spain by the Adams–Onís Treaty of 1819.
11. A river is often a border, but a basin is a single system of highways: goods, people and news flow along the tributaries to the same trunk and the same outlet, so the people of the basin share interests and markets. For the basin to unite them, one government must hold the whole system, especially the outlet; if a rival holds the mouth, it can choke the trade of everyone upstream, as Spain did in 1802.
12. The United States bought France’s claim of sovereignty over Louisiana, meaning its right, recognized among European powers, to govern the territory and keep other empires out, together with the city of New Orleans and French public property there. It did not buy the lands of the Native nations who lived across the territory, such as the Osage, Pawnee and Lakota; those lands passed to the United States and its settlers over the following century by treaty, purchase and war.

8.3 Manifest Destiny as Geography

OBJECTIVES

- Define “manifest destiny” as a belief of the 1840s, identify who coined the phrase, and distinguish the idea from the geographic facts that shaped American expansion.
- Explain the Oregon dispute between the United States and Britain, the lines at 42°N, 49°N and 54°40′N, and why the Oregon Treaty of 1846 settled on the 49th parallel.
- Read and compute the growth of the United States from 1783 to 1867 from a table and a map of territorial acquisitions.

Warm-up. Take a sheet of paper and draw a quick sketch of North America. Without looking anything up, draw a line where you think the border between the United States and Canada runs west of the Great Lakes. Is it straight or crooked? Now think: if two neighbors each claimed the same big field and could not survey it, what kind of line would be the easiest to agree on?

Watch. *Why did Britain give up Oregon? (Short Animated Documentary)* (History Matters, 3:51). https://www.youtube.com/watch?v=YqEtdM0c4qc
After the story: watch why Britain gave up the joint claim to Oregon in 1846, and look for the line on the map that became the 49th parallel border.
Note: Captions were not available to check; preview it first. History Matters is a reliable animated channel that sometimes uses light humor.

Backup video. *2nd May 1670: Hudson’s Bay Company established with a royal charter from King Charles II of England* (HistoryPod, 2:32). https://www.youtube.com/watch?v=k1esmucOh7M
With the big idea: learn how the Hudson's Bay Company began in 1670 and why it controlled the fur trade across the lands that drain into Hudson Bay, which explains how Britain later held posts like Fort Vancouver. Note: Captions were not available to check; preview it first. It is narrated in British English and gives the area in square kilometres. This covers the company's founding in 1670, not Fort Vancouver or Oregon in the 1840s.

KEY TERMS

manifest destiny
The belief, popular in the United States in the 1840s, that the nation was meant by Providence to spread across North America. The phrase was coined by the editor John L. O’Sullivan in 1845.

Oregon Country
The region between Spanish (later Mexican) California at 42°N and Russian America at 54°40′N, from the Rocky Mountains to the Pacific, claimed by both the United States and Britain.

joint occupation
The arrangement, agreed by the Convention of 1818 and renewed in 1827, under which citizens of both the United States and Britain could settle and trade in the Oregon Country while neither nation ruled it alone.

parallel of latitude
An east–west line connecting all points at the same angle north or south of the equator; easy to describe in a treaty and to find by observing the stars.

Oregon Treaty
The treaty signed June 15, 1846, that divided the Oregon Country between the United States and Britain along the 49th parallel to the sea channel, giving all of Vancouver Island to Britain.

cession
Territory formally given up by one state to another by treaty, such as the Mexican Cession of 1848.

CORE IDEAS

The story. In the summer of 1845 a New York editor named John L. O'Sullivan wrote, in an essay defending the annexation of Texas, of "our manifest destiny to overspread the continent allotted by Providence for the free development of our yearly multiplying millions." Later that year he used the phrase again about Oregon, and it caught on. It named a feeling many Americans shared: that their republic was meant to stretch from sea to sea. That is the idea. This lesson asks a different question: what did the land itself do? Why did the nation's northwest border end up on a straight line at 49°N, and not on the Columbia River or at 54°40′N, where the loudest voices of 1846 wanted it?

The contest. The Oregon Country was a huge, rainy, forested land between the Rockies and the Pacific. Spain had given up its claims north of 42°N in the Adams–Onís Treaty of 1819, and Russia agreed in treaties of 1824 and 1825 to stay north of 54°40′N. That left the United States and Britain. The Americans pointed to Robert Gray, the Boston captain who sailed into the Columbia River in 1792 and named it for his ship, to Lewis and Clark, who wintered at its mouth in 1805–1806, and to John Jacob Astor's trading post at Astoria in 1811. The British pointed to George Vancouver's survey of the coast in 1792, to the overland journeys of Alexander Mackenzie and David Thompson, and above all to the Hudson's Bay Company, whose chief factor, John McLoughlin, ruled the fur trade from Fort Vancouver on the Columbia. Unable to agree, the two nations had already extended their border along the 49th parallel from the Lake of the Woods to the Rockies in 1818, and agreed to **joint occupation** of the land beyond.

How it was settled. Geography and numbers broke the tie. Missionaries came first: Methodist Jason Lee in 1834, and in 1836 Marcus and Narcissa Whitman, who crossed the Rockies by South Pass, Narcissa among the first American women to make the crossing. Their letters helped draw settlers. In 1843 about a thousand emigrants made the "Great Migration" over the Oregon Trail, about 2,000 miles (3,200 km) from Missouri, a journey of four to six months by ox wagon. By 1845 several thousand Americans lived in the Willamette

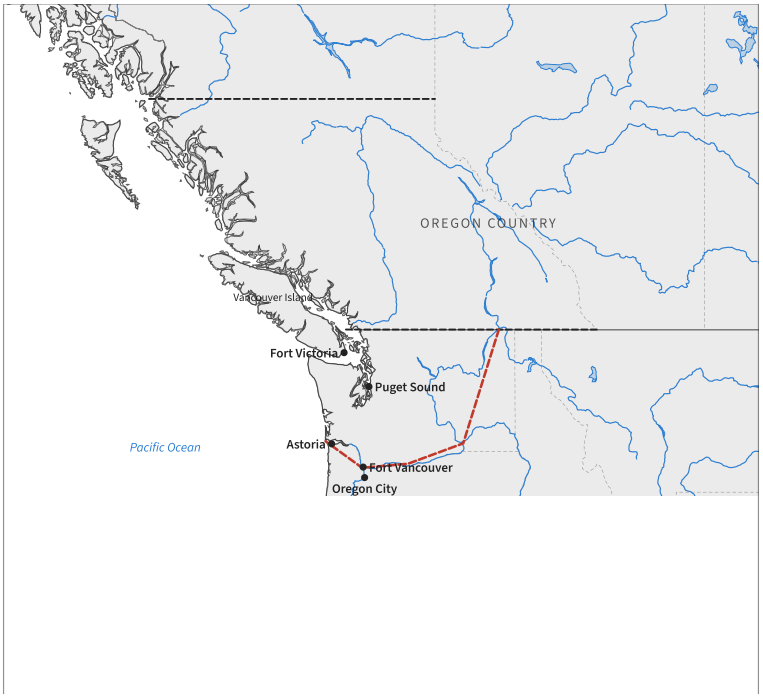
Valley, far outnumbering the British subjects south of the Columbia. In the election of 1844 James K. Polk ran on a platform claiming all of Oregon, and the slogan “Fifty-four forty or fight!” became famous, though historians note it was more popular in 1846 than in Polk’s campaign. But Polk had a second dispute on his hands. Texas had joined the Union in 1845, and war with Mexico began in May 1846. Polk did not want two wars at once, and Britain did not want to fight over a remote fur country whose beaver were nearly trapped out. The Hudson’s Bay Company, expecting to lose the land south of the line, had already built Fort Victoria on Vancouver Island in 1843. On June 15, 1846, Secretary of State James Buchanan and the British minister Richard Pakenham signed the **Oregon Treaty**: the border would continue along the 49th parallel to the middle of the channel separating the continent from Vancouver Island, then run south through that channel and the Strait of Juan de Fuca to the Pacific.

The big idea. The line was a compromise between what each side wanted, and the geography explains it. Britain had offered the Columbia River as the border; the United States had offered the 49th parallel. The land between them, roughly the western half of today’s Washington State, held the real prize: Puget Sound, one of the finest deep-water harbors on the Pacific. The mouth of the Columbia is guarded by a shifting sandbar so dangerous that sailors called it the Graveyard of the Pacific. A nation on the Pacific needed safe harbors, and the 49th parallel gave the United States Puget Sound while leaving Britain all of Vancouver Island and its harbor at Victoria. A parallel had another virtue: it was already the border east of the Rockies, and it could be found anywhere by observing the stars. Yet the treaty’s wording about “the channel” was not exact, because more than one channel runs among the San Juan Islands. In 1859 an American settler shot a British-owned pig, and both nations sent troops to San Juan Island in the bloodless “Pig War.” Arbitration by the German emperor, Wilhelm I, gave the islands to the United States in 1872. Marking the line on the ground is the story of Lesson 10.4.

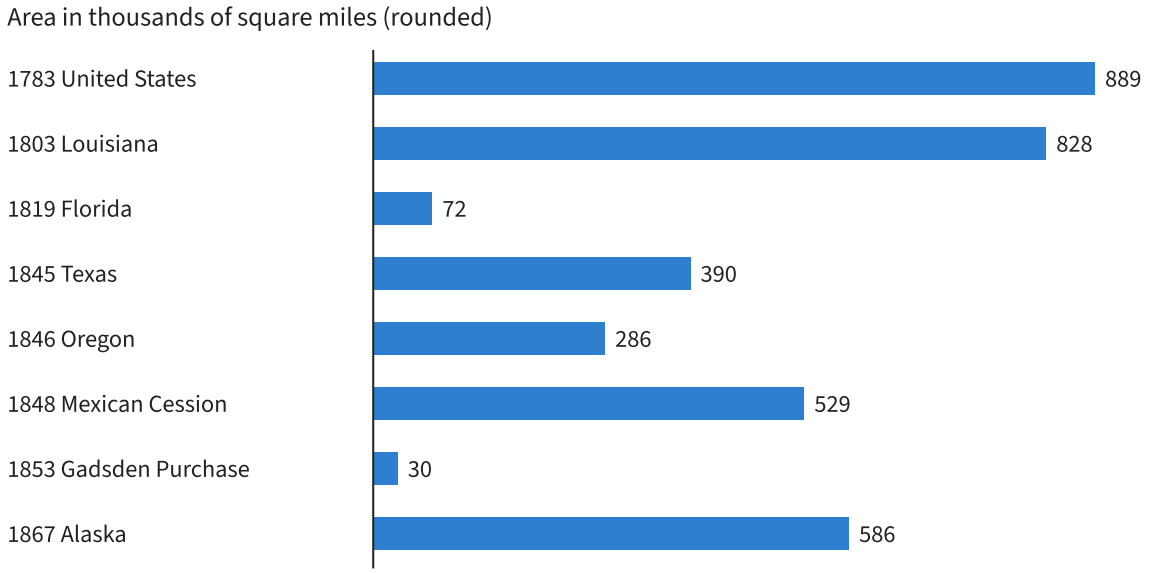
On the map. The Oregon Treaty was one of a series of acquisitions that built the United States: the Louisiana Purchase (1803), Florida from Spain (1819), the annexation of Texas (1845), Oregon (1846), the Mexican Cession by the Treaty of Guadalupe Hidalgo after the war with Mexico (1848), the Gadsden Purchase (1853), and Alaska from Russia (1867). Some came by purchase, some by agreement, and one by war. The war with Mexico was opposed at the time by many Americans, among them a young Illinois congressman named Abraham Lincoln and the soldier Ulysses S. Grant, who later called it one of the most unjust wars ever waged by a stronger nation against a weaker. And none of these treaties consulted the Native nations of the West. In Oregon the Cayuse, struck by a measles epidemic that killed about half the tribe and suspecting the mission doctor, killed the Whitmans and eleven others in November 1847; war followed, and over the next decades the tribes of the Northwest were moved onto reservations by treaty and by force.

Reading the idea. Manifest destiny was a belief, not a force of nature. Americans of the 1840s held it sincerely, and it drew on real things: a growing population, cheap land, faith in self-government, and a continent with no strong rival nearby. Its critics at the time, including many Whigs and many Christians, warned against the pride of claiming to know God’s plan

for one’s own advantage. A geographer can see both: the open continent made expansion possible, and the people of the time made choices, good and bad, about how to do it.



The Oregon Country, from 42°N to 54°40′N, and the line of 1846.



The growth of the United States: areas of the main acquisitions (rounded, in thousands of square miles).

PICTURE STUDY

American Progress, John Gast, 1872 · Oil on canvas · Autry Museum of the American West, Los Angeles

John Gast was a Brooklyn painter and lithographer. The western travel-guide publisher George Crofutt commissioned this small painting and then sold color prints of it, so it became widely known. It is not a picture of any real place or day. It is a picture of an idea: the belief that the advance of American settlement across the continent was the march of progress itself.

A giant woman, a figure of Columbia or of Progress, floats westward with a schoolbook in one hand while she strings telegraph wire with the other. Behind her, in the light, come farmers, a stagecoach, wagons and railroad trains; before her, in the shadow, Native people and buffalo retreat. Read it the way you would read a speech: ask what it claims, what it shows, and what it leaves out.

Look closely

- Find the east and the west in the painting. How does the light change from one side to the other?
- List every kind of transportation and communication you can find. Put them in order from oldest to newest.
- Look at the left side of the painting. Who is moving away from the light, and how are they shown?
- Find the book in the woman’s arm. Why would the artist put a schoolbook there instead of a weapon?

Talk about it

1. What argument is this painting making? Write it in one sentence as Crofutt's customers in 1872 would have understood it.
2. How would a Lakota or Cheyenne viewer in 1872 have read the same picture?
3. Which parts of the painting are true to the geography and technology of the West, and which are symbols?

PROJECT: THE GROWTH OF THE UNITED STATES: A LAYERED MAP

You will build the unit map: the growth of the United States from 1783 to 1867, drawn in layers on tracing paper so you can add each acquisition one at a time and see the country grow.

You will need

- A base outline map of North America (printed or traced)
- Eight sheets of tracing paper or clear page protectors cut to the same size
- Colored pencils or fine markers, a ruler and tape
- An atlas or a printed map of U.S. territorial acquisitions

Steps

1. On the base map, draw the parallels 42°N, 49°N and 54°40′N with a ruler, and the Mississippi and Columbia rivers.
2. On the first tracing sheet, shade the United States of 1783 (east of the Mississippi, north of Florida, south of the Great Lakes). Label it with the year.
3. On separate sheets, shade the Louisiana Purchase (1803), Florida (1819), Texas (1845), Oregon (1846), the Mexican Cession (1848), the Gadsden Purchase (1853) and Alaska (1867, as an inset).
4. Tape the sheets along the top edge so they flip down one by one over the base map.
5. Beside each sheet, write how it was gained (purchase, treaty, annexation, war) and its area in square miles from the bar chart.
6. On the Oregon sheet, draw the British offer (the Columbia River) and the American offer (the 49th parallel), and shade the disputed land between them.
7. Finish with a short caption: Which acquisitions followed natural features, and which followed lines on the globe?

Tips

- Use one color family for acquisitions by purchase and another for acquisitions by war or annexation so the pattern shows at a glance.
- This map is part of your unit portfolio. Keep it flat.

Check your work

- I can show each major acquisition in order and give its year.

- I can locate 42°N, 49°N and 54°40′N and explain what each line meant in the Oregon dispute.
- I can explain why the 49th parallel border gave the United States Puget Sound.

MAP NOTEBOOK

1. Draw the Oregon Country from 42°N to 54°40′N and shade the land between the Columbia and the 49th parallel. Mark Puget Sound and the Columbia bar.
2. Copy O'Sullivan's phrase and, under it, write two lists: "What the land made possible" and "What people chose."
3. Sketch one detail from Gast's painting (the woman, the telegraph wire, the train, or the figures on the left) and write what it stands for.

> **From history.** The 49th parallel cuts across a small peninsula that hangs down from the British Columbia mainland just south of Vancouver. Its tip, Point Roberts, lies south of the line, so it is part of Washington State and the United States, yet it can be reached by land only by passing through Canada. It is a reminder that a line drawn on the globe does not care what the coastline looks like.

WORKED EXAMPLES

Example 1. The American claim reached 54°40′N; the treaty set the line at 49°N. How wide, north to south, was the strip the United States gave up from its full claim? Give the answer in miles and kilometers.

(Use the map or drawing "The lines of the Oregon dispute." shown earlier in this lesson.)

1. 54°40′ = 54 + 40/60 = 54.667°.
2. Difference: 54.667 − 49.000 = 5.667°.
3. One degree of latitude is about 69 miles (111 km): 5.667 × 69 ≈ 391 miles; 5.667 × 111 ≈ 629 km.

Answer: About 391 miles (629 km) from north to south.

Example 2. An emigrant wagon left Independence, Missouri, in early May for Oregon City, about 2,000 miles away. Oxen averaged about 15 miles a day, and the party rested about one day in seven. When would they arrive?

1. Travel days: 2,000 ÷ 15 ≈ 133 days.
2. Rest days: one per six travel days, so 133 ÷ 6 ≈ 22 rest days.
3. Total: 133 + 22 = 155 days, about 5 months.
4. Five months after early May is early October.

Answer: About 155 days, arriving around early October, before the snows closed the Cascade passes. Leaving late was dangerous.

Example 3. Use the bar chart. The Mexican Cession was about 529,000 square miles and Oregon about 286,000. Together with Texas (about 390,000), how much territory did the United States add in the four years 1845–1848? Compare it with the Louisiana Purchase (about 828,000).

(Use the map or drawing "Areas of the main acquisitions." shown earlier in this lesson.)

1. Sum: 390,000 + 286,000 + 529,000 = 1,205,000 square miles.
2. Compare: 1,205,000 ÷ 828,000 ≈ 1.46.
3. In square kilometers: 1,205,000 × 2.59 ≈ 3,121,000 km².

Answer: About 1.2 million square miles (about 3.1 million km²) in four years, about one and a half times the Louisiana Purchase.

PRACTICE

1. EASY Who coined the phrase "manifest destiny," and in what year?
2. EASY What were the southern and northern limits of the Oregon Country, and which nations had given up claims beyond them?
3. EASY When was the Oregon Treaty signed, and what line did it set?
4. EASY Name one American and one British claim to Oregon from before 1820.
5. MEDIUM How far is it from 42°N to 49°N, in miles and kilometers?
6. MEDIUM Why did Polk compromise on Oregon in 1846 instead of insisting on 54°40′?
7. MEDIUM Why was Puget Sound more valuable to the United States than the mouth of the Columbia River as a harbor?
8. MEDIUM List the main U.S. acquisitions from 1803 to 1867 in order, with the year and how each was gained.
9. HARD The bar chart gives Alaska as about 586,000 square miles, bought for $7.2 million. What was the price per acre? Compare with the Louisiana Purchase at about 2.8 cents an acre.
   (Use the map or drawing "Areas of the main acquisitions." shown earlier in this lesson.)

10. HARD What caused the “Pig War” of 1859, what part of the Oregon Treaty was to blame, and how was it settled?
11. CHALLENGE Explain why a parallel of latitude made a sensible border west of the Rockies in 1846, and give one weakness of such a line.
12. CHALLENGE In a paragraph, separate manifest destiny the belief from the geographic facts that made expansion possible. Include at least two facts and one criticism made at the time.

COMMON MISTAKES

- Treating manifest destiny as a cause by itself. It was a belief that explained and justified expansion; population, land, geography, diplomacy and war did the work.
- Thinking the U.S.–Canada border is the 49th parallel everywhere. It follows the 49th only from the Lake of the Woods to the Strait of Georgia; east of that it follows rivers, lakes and older lines.
- Thinking “Fifty-four forty or fight!” was settled by fighting. There was no war; the dispute ended in a compromise treaty.

Make it a game · Fifty-Four Forty or Compromise. Two players face a map of the Oregon Country with lines drawn at 42°, 46° (the Columbia, roughly), 49° and 54°40′. Each holds cards worth 1 to 5 “settlers,” “ships,” “forts” and “wars elsewhere.” In each round, both play a card face down; the higher total moves the line one step toward the other side, but a “wars elsewhere” card forces its holder to accept the middle line. After five rounds, compare where your line landed with 1846, and explain which cards decided it in real history.

Scripture. “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;” (Acts 17:26, KJV)

Paul tells the Athenians that God sets the times and the bounds of nations. That is a comfort and a caution. It is a comfort because borders are not mere accidents; it is a caution because no nation may simply read God’s plan off its own ambitions. All the peoples of the Oregon Country, settlers, traders and tribes, were made of one blood.

Practice answers

1. John L. O’Sullivan, a New York editor, in 1845.
2. 42°N on the south, given up by Spain in the Adams–Onís Treaty of 1819, and 54°40′N on the north, agreed by Russia in treaties of 1824 and 1825.
3. June 15, 1846. It extended the border along the 49th parallel from the Rockies to the channel between the mainland and Vancouver Island, then through that channel and the Strait of Juan de Fuca to the Pacific, giving all of Vancouver Island to Britain.
4. American: Robert Gray’s entry into the Columbia (1792), Lewis and Clark’s winter at its mouth (1805–1806), or Astoria (1811). British: George Vancouver’s survey (1792), the

journeys of Alexander Mackenzie or David Thompson, or the fur posts of the North West and Hudson's Bay companies.

5. 7° × 69 ≈ 483 miles; 7° × 111 ≈ 777 km.
6. War with Mexico had begun in May 1846, and he did not want to fight Britain and Mexico at the same time. The 49th parallel also gave the United States what mattered most: Puget Sound and the settled Willamette Valley.
7. Puget Sound is a deep, sheltered inlet with safe anchorages. The mouth of the Columbia is blocked by a shifting, dangerous sandbar where many ships were wrecked, so it was a poor harbor for ocean shipping.
8. Louisiana Purchase, 1803 (purchase from France); Florida, 1819 (treaty with Spain); Texas, 1845 (annexation of an independent republic); Oregon, 1846 (treaty with Britain); Mexican Cession, 1848 (treaty after war with Mexico); Gadsden Purchase, 1853 (purchase from Mexico); Alaska, 1867 (purchase from Russia).
9. 586,000 × 640 = 375,040,000 acres. $7,200,000 ÷ 375,040,000 ≈ $0.019, about 1.9 cents an acre, cheaper per acre than Louisiana.
10. An American settler on San Juan Island shot a pig belonging to the Hudson's Bay Company, and both nations sent troops. The cause underneath was the treaty's vague phrase "the channel," since more than one channel separates Vancouver Island from the mainland and the San Juan Islands lie between them. Arbitration by Emperor Wilhelm I of Germany awarded the islands to the United States in 1872. No one was killed except the pig.
11. Strengths: the 49th parallel was already the border from the Lake of the Woods to the Rockies, so extending it was simple; a parallel can be found anywhere by star sightings; and it split the disputed land in a way each side could accept. Weaknesses: it ignores the land, cutting across rivers, valleys and peoples; it must be surveyed and marked on the ground, which is hard in forests and mountains; and where it meets the sea, as at Point Roberts and the San Juan Islands, it can create odd or disputed results.
12. A good answer explains that manifest destiny was a belief of the 1840s that Providence intended the United States to spread across the continent, and that the belief itself moved no wagons. Geographic facts that made expansion possible include the open, fertile interior, the Mississippi system, the South Pass route through the Rockies, the lack of a strong rival power nearby, the distance of Britain and Mexico from their frontier lands, and the good harbors of the Pacific coast. Critics at the time, such as many Whigs, Lincoln and Grant on the Mexican War, and many Christian ministers, warned against pride and against wars of conquest dressed up as destiny.

8.4 Rails West

OBJECTIVES

- Trace the route of the first transcontinental railroad from Omaha to Sacramento and explain how it used river valleys, passes and basins to cross the Rockies and the Sierra Nevada.
- Compute grades, distances, travel times and government aid per mile, and compare travel to the Pacific before and after 1869.
- Explain how the railroad bound the Union together, and name plainly both its achievements and its costs: to the workers who built it, to the Plains nations and to honest government.

Warm-up. Lay a ruler on a stack of books so it slopes. Roll a toy car or a marble down it. Now add books until the car will not stay still on the slope and will not climb it with one push. Measure the rise (height of the stack) and the run (length along the table). Divide rise by run and multiply by 100. That number is the grade in percent. Real mainline railroads try to stay near or below 2 percent. Why do you think they are so fussy?

Watch. *Golden Spike National Historic Site* (Nate's Vintage Trains, 6:56).
https://www.youtube.com/watch?v=oKoP9itG9aM
After the story: tour Promontory Summit and look closely at the copies of the Jupiter and No. 119 standing face to face, where the golden spike was driven in 1869.
Note: Captions were not available to check; preview it first. This is a hobbyist's visit video, not a full history lesson.

KEY TERMS

Pacific Railway Act
The law signed by President Lincoln on July 1, 1862, that chartered the Union Pacific and authorized the Central Pacific to build a railroad and telegraph to the Pacific, with grants of land and loans of government bonds.

grade
The steepness of a road or railroad: rise divided by run, often given in percent or in feet per mile. A 1 percent grade rises 52.8 feet in a mile.

land grant
Public land given to a railroad company to help pay for building. The transcontinental grants were alternate square-mile sections on each side of the track, making a checkerboard of railroad and government land.

snowshed
A long wooden roof built over a railroad track in the mountains so that snow and avalanches slide over the trains instead of burying the line.

standard time

Clock time shared across a whole zone instead of each town keeping its own sun time; adopted by American railroads on November 18, 1883.

railhead
The farthest point to which track has been laid, where materials are unloaded and construction goes on.

CORE IDEAS

The story. On May 10, 1869, at Promontory Summit in the Utah Territory, two locomotives stood face to face on a single track: the Central Pacific's *Jupiter*, which had come from California, and the Union Pacific's *No. 119*, from the Missouri River. Officials gave speeches, and Leland Stanford, president of the Central Pacific and a former governor of California, helped drive a ceremonial golden spike into a laurel tie. A telegraph wire had been connected to the spike and the hammer, and at the final blows the operator tapped out one word to a waiting nation: "DONE." Cannon fired in San Francisco and New York; bells rang across the country; Chicago held a parade miles long. For the first time, the Atlantic and the Pacific coasts of the United States were joined by rail. The golden spike is kept today at Stanford University.

Why it mattered. California had become a state in 1850, and Oregon in 1859, but they were cut off from the rest of the Union by about 2,000 miles (3,200 km) of plains, mountains and desert. An emigrant wagon took four to six months. By sea from New York to San Francisco around Cape Horn was about 13,000 miles; through Panama, with a railroad across the isthmus after 1855, about a month. Even the Pony Express of 1860–1861, galloping relays of riders, needed about ten days to carry a letter from Missouri to California. When the Civil War began, Union leaders worried that the Pacific states, with their gold, might drift away. On July 1, 1862, President Lincoln signed the **Pacific Railway Act**. The Union Pacific would build west from the Missouri River near Omaha; the Central Pacific would build east from Sacramento. Each would receive **land grants**, alternate square-mile sections along the line (doubled by a second act in 1864), and loans of government bonds for each mile completed: $16,000 a mile on the plains, $32,000 a mile in the high country between the ranges, and $48,000 a mile in the mountains.

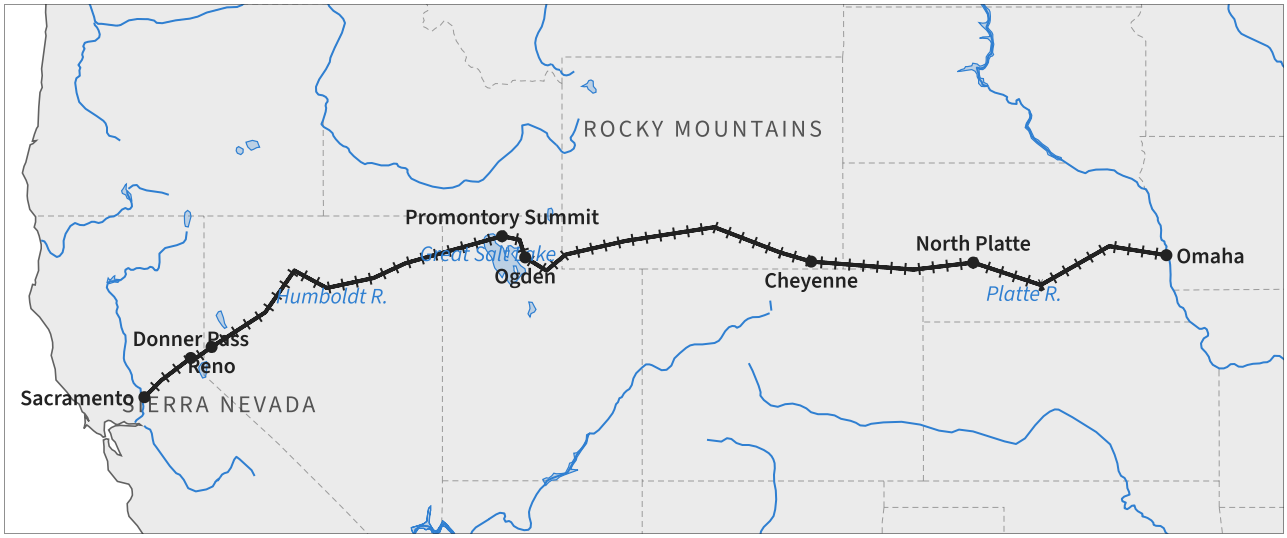
How they built it. The Central Pacific faced the hardest wall first. Its engineer, Theodore Judah, had found a route up a long ridge and over Donner Pass, about 7,000 feet (2,100 m) high, only about 105 miles (170 km) from Sacramento, which sits barely above sea level. Judah died in 1863, and the four Sacramento merchants who ran the company, Stanford, Collis Huntington, Mark Hopkins and Charles Crocker, pressed on. Workers were scarce in gold-rush California, so in 1865 the company began hiring Chinese immigrants; within two years they made up most of its labor force, perhaps 90 percent, at the peak well over ten thousand men. They blasted fifteen tunnels through Sierra granite, sometimes advancing only a foot or so a day, and worked through the terrible winter of 1866–1867, when avalanches swept away camps and killed men whose bodies were not found until spring. The company built miles of wooden **snowsheds** to keep the line open. Chinese workers were paid less than white workers and had to buy their own food; in June 1867 several thousand of

them struck for equal pay, and the strike ended after about a week when the company cut off their supplies. Out on the plains, the Union Pacific's chief engineer, Grenville Dodge, and the construction bosses Jack and Dan Casement drove crews of Irish immigrants and Civil War veterans from both armies up the Platte River valley at a fast pace, followed by rough tent towns that moved with the **railhead**. On April 28, 1869, a Central Pacific crew laid ten miles of track in a single day, a record that still stands for hand labor. By the end the Central Pacific had built about 690 miles and the Union Pacific about 1,086.

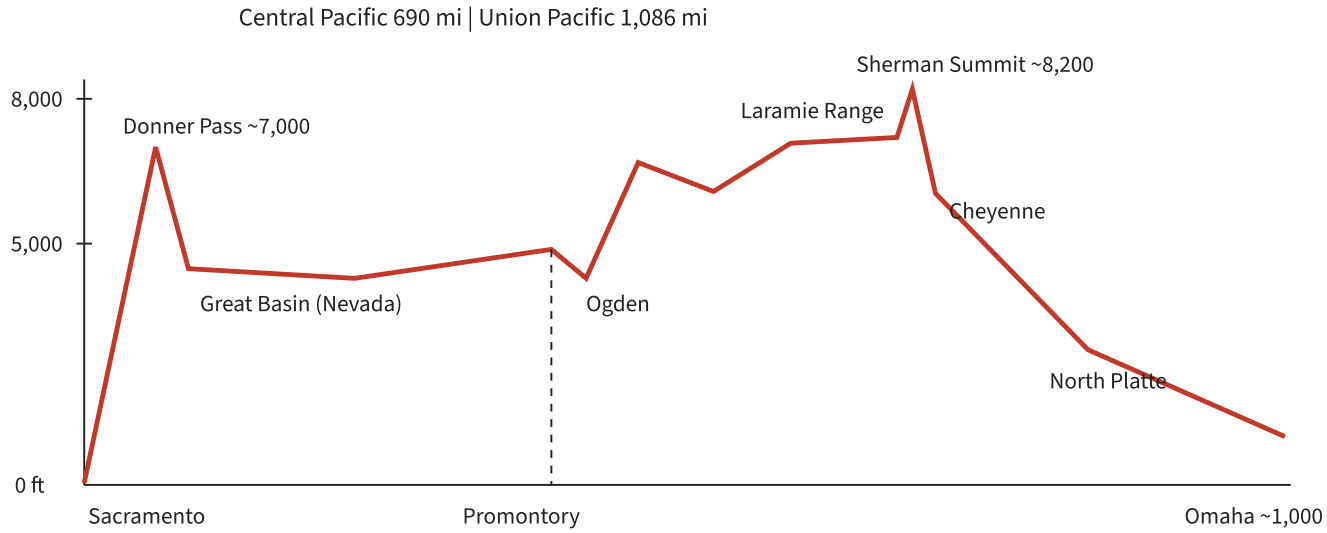
The big idea. The railroad bound the Union. A traveler could now go from New York to San Francisco in about a week. Mail, troops, settlers, machinery and California's produce moved across the continent in days, and the line drew towns, ranches and farms onto the Great Plains. Within fifteen years the railroads had even remade time: on November 18, 1883, they replaced hundreds of local sun times with four standard time zones. But the line had real costs. For the Lakota, Cheyenne and Arapaho, it cut through their hunting grounds; they attacked survey parties and trains, and the army guarded the builders. The railroads carried hunters and hides, and the great buffalo herds, on which the Plains nations depended, were nearly destroyed by the early 1880s. In 1872 the Crédit Mobilier scandal revealed that Union Pacific insiders had enriched themselves through their own construction company and had given its stock to members of Congress. Both sides of the story are true: an astonishing feat of engineering and labor, and a work bought in part with injustice and corruption.

Technology overcoming geography. Notice that the railroad did not ignore the land; it obeyed it. A locomotive's wheels grip the rail only by friction, so a train cannot climb steep slopes. The Central Pacific's steepest grades in the Sierra were about 116 feet per mile, about 2.2 percent, and the engineers spent years finding long ridges and side-hill shelves that kept the climb that gentle. The route on the map follows the old trails because they had already found the easy ground: the Platte valley, the low crossing of the Laramie Range at Sherman Summit (about 8,200 feet, the highest point on the line), the dry basins of Wyoming, Echo and Weber canyons down to the Great Salt Lake, and across Nevada the Humboldt and Truckee rivers. The railroad was faster than the wagon, but it went where the wagon had gone.

On the map. Compare the route below with the Oregon Trail of Lesson 8.3: they share the Platte. Then study the elevation profile and find the two great climbs, the Sierra in the west and the Rockies in the east, and the long basin between. Where would you put the snowsheds? Where would the most expensive miles be?



The first transcontinental railroad, completed May 10, 1869.



Elevation profile, Sacramento to Omaha (approximate elevations, vertical scale greatly exaggerated).

PICTURE STUDY

East and West Shaking Hands at the Laying of the Last Rail, Andrew J. Russell, May 10, 1869 · Albumen print from a glass-plate negative · Prints survive in many libraries and museums; widely reproduced

Andrew J. Russell had photographed the Civil War for the Union army and then worked for the Union Pacific, recording its construction. At Promontory he made the most famous picture of the day: the two locomotives pilot to pilot, the crowd packed between them, and in the center the two chief engineers, Samuel Montague of the Central Pacific and Grenville Dodge of the Union Pacific, shaking hands. Men on the engines hold up bottles of champagne.

A photograph in 1869 needed a long exposure, so the crowd had to stand still and pose. That means this, too, is a composed picture of an idea: East and West joined. Look at who was placed in the frame, and notice who is hard to find. The Chinese crews who had built most of the Central Pacific and laid the last rails that morning are scarcely visible in it.

Look closely

- Find the two locomotives. Which way is each one facing, and what does that tell you about where each came from?
- Find the two men shaking hands in the center. Why would the photographer put them there?
- Look at the clothes of the people in the crowd. Can you tell officials from workers?
- Look at the land in the background. What kind of country is this?

Talk about it

1. Compare this photograph with Gast's painting from Lesson 8.3. Both show the same idea. What can a photograph show that a painting cannot, and what can a photograph

leave out?
2. Why do you think the Chinese workers are so hard to find in the most famous picture of the day?
3. If you had been the photographer, what one more picture would you have taken that day?

PROJECT: RULING GRADE: BUILD A MOUNTAIN RAILROAD

You will build a model mountain and lay a “railroad” of string or flexible track up it without ever exceeding a fixed grade, the way Judah and Dodge had to. You will discover why railroads loop, zigzag and follow ridges and rivers.

You will need

- Modeling clay, salt dough, or a stack of books with a towel over it to make a mountain about 6 inches (15 cm) high
- String or yarn about 6 feet (2 m) long, and pins or toothpicks
- A ruler or tape measure and a pencil
- A small toy train car or a marble (optional)
- Graph paper

Steps

1. Build the mountain with a broad base about 18 inches (45 cm) across. Mark a “valley town” at the base and a “pass” at the top.
2. Measure the height of the pass. Your ruling grade is 4 percent (steeper than a real railroad, so it fits on the table). Find the shortest track length allowed: height ÷ 0.04. For a 6-inch mountain that is 150 inches.
3. Lay the string from the town to the pass, pinning it as you go. Every few inches, check that the rise is no more than 4 percent of the distance along the string.
4. Use a ridge, a side valley or a loop to gain length. Count how many times your track has to turn back on itself.
5. Measure the final track length and compute your actual average grade.
6. Draw your route from above on graph paper, with contour lines every inch of height.
7. Write a paragraph: Why is the shortest path over a mountain not the best path for a railroad? How did your route compare with the Central Pacific’s climb of about 7,000 feet in about 105 miles?

Tips

- If your mountain is too steep to fit a long enough track, make it lower or wider, as real engineers did by choosing a different pass.
- Follow a long, smooth ridge if you can; Judah’s great discovery was a ridge that climbed steadily toward Donner Pass.

Check your work

- I can compute a grade as rise ÷ run × 100.
- I can explain why railroads need gentle grades and how engineers gain length to climb.
- I can show on my model why railroads follow the same valleys and passes as the old trails.

MAP NOTEBOOK

1. Draw the route from Omaha to Sacramento and label the Platte River, Sherman Summit, Ogden, Promontory, the Humboldt River and Donner Pass.
2. Copy the elevation profile and mark the two most expensive stretches of track and the most dangerous stretch for snow.
3. Make a two-column chart: “Achievements of the railroad” and “Costs of the railroad,” with at least four items in each.

> **From history.** The Central Pacific’s Summit Tunnel near Donner Pass, about 1,659 feet long through solid granite, was the hardest single piece of the line. To speed the work, crews sank a shaft down into the middle of the tunnel line so they could dig outward in two more directions, four faces at once. The company also experimented with nitroglycerin, mixed on the site, which cut faster than black powder but was deadly dangerous to handle.

WORKED EXAMPLES

Example 1. The Central Pacific’s steepest grade in the Sierra was about 116 feet per mile. Express this as a percent. Then find the average grade from Sacramento (about 30 feet above sea level) to the summit near Donner Pass (about 7,000 feet), about 105 miles of track.

(Use the map or drawing “The Sierra climb.” shown earlier in this lesson.)

1. One mile is 5,280 feet. Steepest grade: 116 ÷ 5,280 ≈ 0.022, or about 2.2 percent.
2. Total climb: 7,000 − 30 = 6,970 feet.
3. Average rise per mile: 6,970 ÷ 105 ≈ 66 feet per mile.
4. Average grade: 66 ÷ 5,280 ≈ 0.0125, or about 1.25 percent.

Answer: The steepest grade was about 2.2 percent; the average from Sacramento to the summit was about 66 feet per mile, or about 1.25 percent.

Example 2. Suppose a company built 150 miles in the mountains, 400 miles in the high country between ranges, and 140 miles of plains. Using the bond rates of the Pacific Railway Act ($48,000, $32,000 and $16,000 a mile), how much would it receive in government bonds? What is the average per mile?

1. Mountains: 150 × $48,000 = $7,200,000.
2. High country: 400 × $32,000 = $12,800,000.
3. Plains: 140 × $16,000 = $2,240,000.
4. Total: $7,200,000 + $12,800,000 + $2,240,000 = $22,240,000 for 690 miles.
5. Average: $22,240,000 ÷ 690 ≈ $32,232 a mile.

Answer: $22,240,000 in bonds, an average of about $32,000 a mile. (These were loans the companies had to repay, not gifts; the land grants were gifts.)

Example 3. Before 1883, each town kept its own sun time, with noon when the sun was highest. Omaha is at about 95.9°W and Sacramento at about 121.5°W. When it was noon by the sun in Omaha, what was the sun time in Sacramento?

(Use the map or drawing "Omaha and Sacramento." shown earlier in this lesson.)

1. The earth turns 360° in 24 hours, so 15° an hour, or 1° every 4 minutes.
2. Difference in longitude: 121.5 − 95.9 = 25.6°.
3. Time difference: 25.6 × 4 = 102.4 minutes, about 1 hour 42 minutes.
4. Sacramento is west, so its sun time is earlier: 12:00 − 1:42 = 10:18 a.m.

Answer: About 10:18 a.m. sun time in Sacramento. Under the standard time adopted in 1883, the difference became exactly two hours (Central to Pacific).

PRACTICE

1. EASY Where and when were the rails of the first transcontinental railroad joined, and which two companies met there?
2. EASY Which law authorized the railroad, who signed it, and when?
3. EASY Who made up most of the Central Pacific's workforce, and who made up much of the Union Pacific's?
4. EASY The Central Pacific built about 690 miles and the Union Pacific about 1,086 miles. What was the total, in miles and kilometers (1 mile = 1.609 km)?
5. MEDIUM An emigrant wagon covering about 2,000 miles at 15 miles a day took how many days? If the train took about 7 days from Omaha to the coast, about how many times faster was the train?
6. MEDIUM The Pony Express carried mail about 1,900 miles from St. Joseph, Missouri, to Sacramento in about 10 days. What was its average speed in miles per day and in miles per hour, counting day and night?

7. MEDIUM On April 28, 1869, a Central Pacific crew laid ten miles of track in one day. If each rail was 30 feet long, how many rails were laid (remember there are two rails side by side)?
8. MEDIUM Name three river valleys or natural corridors the transcontinental route followed, and explain why railroads follow such corridors.
   (Use the map or drawing "The route follows the valleys." shown earlier in this lesson.)
9. HARD Omaha is about 1,000 feet above sea level and Sherman Summit about 8,200 feet, about 549 miles of track apart. What is the average climb in feet per mile and in percent? Compare it with the Central Pacific's average climb into the Sierra (about 66 feet per mile).
   (Use the map or drawing "Compare the two climbs." shown earlier in this lesson.)
10. HARD Under the 1864 act, a railroad received 20 square-mile sections of land for each mile of track (10 on each side). How many acres would the Central Pacific receive for 690 miles? (1 square mile = 640 acres.)
11. CHALLENGE Describe the costs of the railroad to three different groups, using facts from the lesson and without exaggeration.
12. CHALLENGE Write a paragraph explaining how the transcontinental railroad "bound the Union," using geographic reasoning. Include travel time, the Civil War and the Pacific states.

COMMON MISTAKES

- Thinking the transcontinental railroad started in New York. It began at the Missouri River near Omaha, where eastern railroads already reached, and ran to Sacramento, with connections to the San Francisco Bay soon after.
- Thinking a train can climb any hill a wagon can. Steel wheels on steel rails grip only by friction, so railroads need much gentler grades and must go around or through what a wagon could climb.
- Telling only half the story: either a heroic engineering triumph with no costs, or a tale of injustice with no achievement. Both are true at once.

Make it a game · Race to Promontory. Draw a track of 30 spaces from each end of the board, with the Central Pacific starting at the west end in the "Sierra" (the first 10 spaces cost double) and the Union Pacific at the east on the "plains" (the first 15 spaces cost single). Each turn, roll two dice for miles of track, and draw a card: snow, strike, raid, bond payment, nitroglycerin, or ten-mile day. The teams meet wherever their tracks touch. Afterward, compare where you met with Promontory and explain why the Union Pacific laid more miles.

Scripture. "Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight, and the rough places plain:" (Isaiah 40:4, KJV)

Isaiah pictures a highway prepared for the coming of the Lord, with the valleys filled and the hills cut down. Railroad builders did exactly that with fills, cuts and tunnels. Their work was great, but the prophet points to a greater road and a greater King.

Practice answers

1. At Promontory Summit, Utah Territory, on May 10, 1869. The Central Pacific (from Sacramento) met the Union Pacific (from Omaha).
2. The Pacific Railway Act, signed by President Abraham Lincoln on July 1, 1862.
3. Chinese immigrants made up most of the Central Pacific's workers (perhaps 90 percent at the peak). The Union Pacific relied heavily on Irish immigrants and Civil War veterans.
4. 690 + 1,086 = 1,776 miles; 1,776 × 1.609 ≈ 2,858 km.
5. 2,000 ÷ 15 ≈ 133 days. 133 ÷ 7 = 19, so the train was about 19 times faster.
6. 1,900 ÷ 10 = 190 miles a day. 190 ÷ 24 ≈ 7.9 miles an hour, around the clock.
7. 10 miles = 52,800 feet. 52,800 ÷ 30 = 1,760 rail lengths for each side, so 1,760 × 2 = 3,520 rails.
8. The Platte River valley in Nebraska, Echo and Weber canyons in Utah, the Humboldt River across Nevada, and the Truckee River into the Sierra. Railroads follow river valleys because rivers have already carved long, gentle, even slopes through rough country, so the grades are low and the construction cheaper.
9. 8,200 − 1,000 = 7,200 feet. 7,200 ÷ 549 ≈ 13 feet per mile, or 13 ÷ 5,280 ≈ 0.25 percent. The Sierra climb averaged about five times steeper, which is why the Central Pacific's first 100 miles were so slow and costly.
10. 690 × 20 = 13,800 sections. 13,800 × 640 = 8,832,000 acres, about 8.8 million acres.
11. Chinese workers: paid less than white workers and made to buy their own food; many died in blasting accidents and avalanches, and their 1867 strike for equal pay was broken. The Plains nations (Lakota, Cheyenne, Arapaho and others): the line ran through their hunting lands, brought settlers and soldiers, and carried the hunters and hides that nearly destroyed the buffalo herds by the early 1880s. The public: in the Crédit Mobilier scandal, Union Pacific insiders overcharged through their own construction company and gave its stock to members of Congress.
12. A good answer explains that before 1869 California and Oregon were separated from the East by about 2,000 miles of plains, mountains and desert, and could be reached only by months of wagon travel or long sea voyages; that Union leaders during the Civil War feared the Pacific states and their gold might drift away, which is why Congress passed the Pacific Railway Act in 1862; and that after 1869 the trip took about a week, so people, mail, troops, goods and news moved quickly between the coasts, tying the West economically and politically to the rest of the nation.

8.5 Two Oceans as a Shield

OBJECTIVES

- Explain how the Atlantic and Pacific oceans and weak neighbors shaped American foreign policy, military forces and history from Washington's Farewell Address to the Second World War.
- Compute ocean distances, crossing times and the savings of the Panama Canal, and compare a great-circle route with a route through a waypoint.
- Describe how technology (the steamship, the canal, the airplane and the missile) first strengthened and then thinned the ocean shield.

Warm-up. Fill a bathtub, sink or large basin with water. Put a toy boat or a plastic lid at one end and blow it across with a straw, timing how long it takes. Now set a toy on a table the same distance away and push it across with one finger. Which was faster and surer? Which would be easier for an enemy to stop along the way? Talk about what a wide stretch of water does to anyone trying to attack across it, and to anyone trying to trade across it.

Watch. *The Great White Fleet: 16 Battleships Around the World (1907–1909)* (The Photographed Past, 8:12). https://www.youtube.com/watch?v=0rNA8OPrZbM
With the big idea: follow the Great White Fleet around South America through the Straits of Magellan (there was no Panama Canal yet), and notice how much coal it took to move a navy between two oceans.
Note: Captions were not available to check, and this channel is new to us; preview it first to make sure the narration is a real person and not an AI voice. It mentions the fleet helping after the 1908 Messina earthquake.

Backup video. *Why did Europe obey the Monroe Doctrine? (Short Animated Documentary)* (History Matters, 3:34). https://www.youtube.com/watch?v=qZYrj2YOmsw
As review: watch why European powers mostly kept out of the Americas after the 1823 Monroe Doctrine, even though the young United States could not yet enforce it. Note: Captions were not available to check; preview it first. History Matters is a reliable animated channel that sometimes uses light humor.

KEY TERMS

strategic depth
Distance and space between a country's heartland and its enemies, which gives it time to prepare and makes attack costly. For the United States, most of its strategic depth was water.

Monroe Doctrine

President James Monroe's message of December 2, 1823, declaring that the Americas were no longer open to new European colonization and that the United States would stay out of Europe's wars.

two-ocean navy
A navy strong enough to defend both the Atlantic and the Pacific at the same time, authorized by Congress in July 1940.

great circle
The shortest path between two points on a globe, lying on a circle whose center is the center of the earth. On flat maps, great-circle routes usually look curved.

knot
A speed of one nautical mile an hour. A nautical mile is about 1.15 statute miles (1.852 km).

CORE IDEAS

The story. On January 27, 1838, a twenty-eight-year-old lawyer named Abraham Lincoln spoke to the Young Men's Lyceum of Springfield, Illinois. He asked where danger to the American republic might come from, and he answered with geography. "All the armies of Europe, Asia and Africa combined," he said, "with all the treasure of the earth (our own excepted) in their military chest; with a Buonaparte for a commander, could not by force, take a drink from the Ohio, or make a track on the Blue Ridge, in a trial of a thousand years." If destruction came, Lincoln warned, it would come from within: "If destruction be our lot, we must ourselves be its author and finisher." He was not boasting. He was describing a fact every American of his day understood. The United States sat on a continent with no great power beside it and an ocean on either side.

How it worked. From New York to Lisbon is about 3,400 miles (5,500 km) of open Atlantic; from San Francisco to Tokyo, about 5,100 miles (8,300 km) of Pacific. In the age of sail an army crossing the Atlantic needed weeks at sea, and every musket ball and sack of flour had to follow it. On land, the United States had only two neighbors: British Canada, large but thinly peopled, and Mexico. In his Farewell Address of 1796, George Washington built a policy on that position: "Our detached and distant situation invites and enables us to pursue a different course," he wrote, and asked, "Why forego the advantages of so peculiar a situation?" Because of the oceans, the United States could keep a small army in peacetime, avoid the alliances and conscript armies of Europe, and spend its energy on farms, canals and railroads. Compare Poland on the open plain in Unit 7: a nation with no natural walls must stay armed; a nation behind the sea can choose.

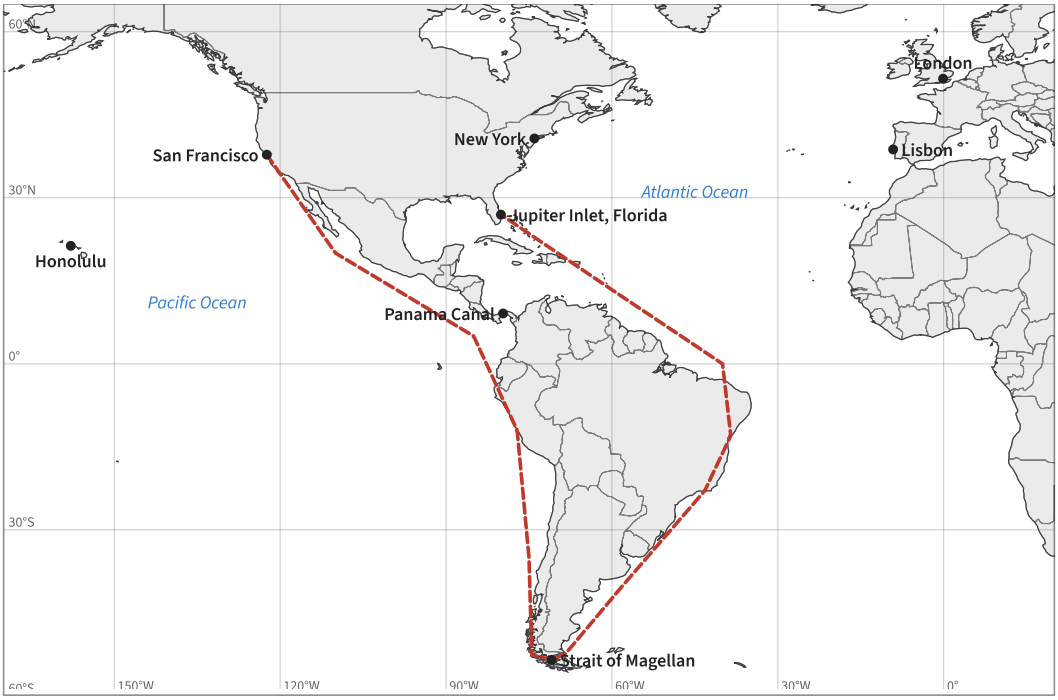
Where the shield was thin. An ocean protects only against those who cannot command it. In the War of 1812, the Royal Navy ruled the Atlantic; British troops landed in Maryland and burned the Capitol and the White House on August 24, 1814. Yet distance worked even then. Peace was signed at Ghent in Belgium on December 24, 1814, but the news had to cross the ocean by sail, and on January 8, 1815, Andrew Jackson's army defeated a British force at New Orleans, two weeks after the war had officially ended. In 1823 President Monroe declared that the Americas were closed to new European colonies. The young republic had

little navy to back the claim; in practice Britain, which wanted Latin American trade open, kept other powers away with its own fleet. Geography and a friendly navy did the work together.

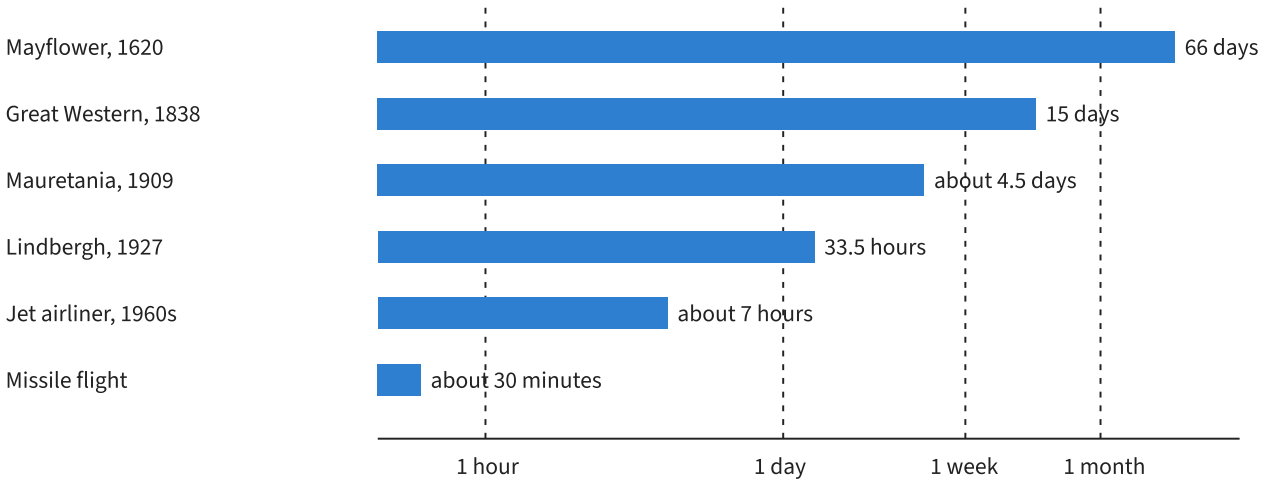
Technology overcoming geography. Two oceans were a shield, but they were also a problem: a fleet in one could not quickly help the other. When war with Spain came in 1898, the battleship USS *Oregon* was in San Francisco. She steamed about 14,000 miles (22,500 km) south along the Pacific coast, through the Strait of Magellan at the tip of South America, and north to Florida in 66 days, arriving in time to fight at Santiago de Cuba. The nation cheered, and its leaders drew the lesson: a canal across Central America would let one navy guard both coasts. The Panama Canal opened on August 15, 1914, cutting the sea route from New York to San Francisco from about 13,000 miles to about 5,200. President Theodore Roosevelt had already sent sixteen battleships, painted white, around the world from 1907 to 1909 to show that American sea power could reach any ocean. In July 1940, with Germany and Japan both threatening, Congress voted a **two-ocean navy**.

The shield in the world wars. In both world wars the oceans gave the United States time. It entered the First World War in 1917, nearly three years after it began, and the Second only after Japan attacked Pearl Harbor on December 7, 1941. Meanwhile its factories, out of reach of enemy bombers, became what President Franklin Roosevelt in December 1940 called “the arsenal of democracy,” building ships, tanks and aircraft by the tens of thousands. The American mainland suffered almost no damage; the only deaths from enemy action in the forty-eight states during the Second World War came when a Japanese balloon bomb killed a pastor’s wife and five children on a church picnic near Bly, Oregon, on May 5, 1945. Compare the cities of Europe and the Soviet Union that you studied in Unit 7.

The big idea. Position is a gift, not a guarantee. The same oceans that slowed invaders also carried American trade, missionaries and immigrants, and drew the nation outward to Hawaii, the Philippines and the Panama Canal. Then technology thinned the shield. Long-range bombers in the 1940s, the Soviet satellite *Sputnik* in 1957, and intercontinental missiles able to cross from one continent to another in about thirty minutes meant that, for the first time, the American homeland could be struck from across the sea within an hour. The Cuban Missile Crisis of October 1962 showed how near the danger could come. As of 2026, the United States still keeps major fleets in both the Atlantic and the Pacific, and strategists debate how much its ocean position still protects it in an age of missiles, aircraft and cyberattack. Lincoln’s point still stands: the oceans can delay an enemy, but they cannot make a nation good or united, and no wall of water can save a people that destroys itself from within.



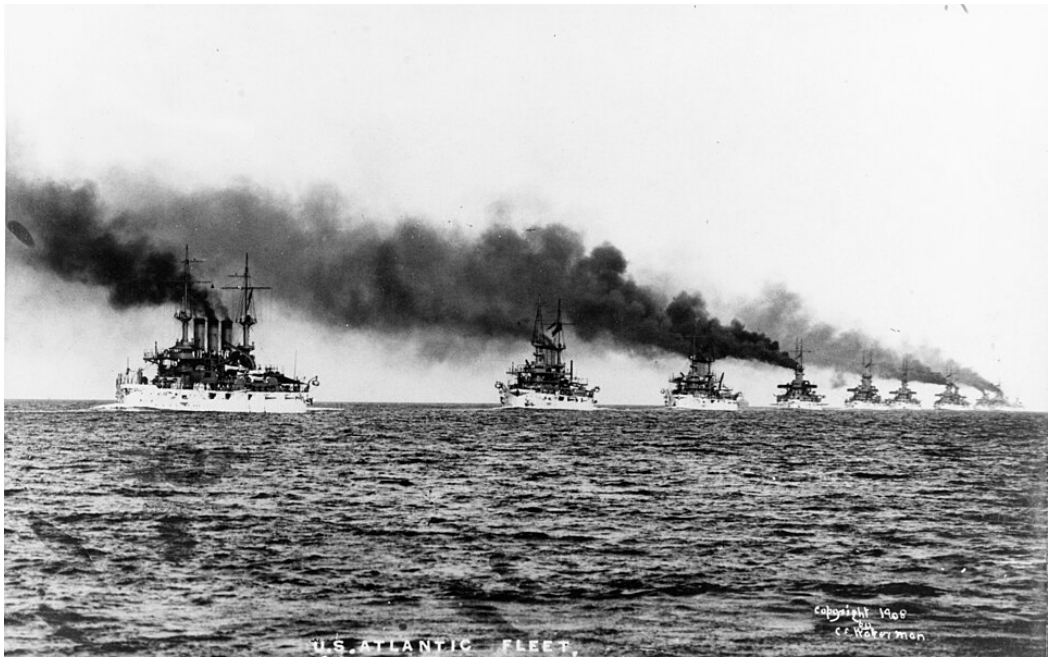
Two oceans and one navy: the voyage of USS Oregon, 1898, and the shortcut at Panama.



Bars start at 20 minutes; each grid step multiplies the time. Lindbergh flew New York to Paris.

How long does it take to cross the Atlantic? Each step to the left is a big shrink in the ocean's protective width.

PICTURE STUDY



The Atlantic Fleet Steaming in Column, Probably Leaving Hampton Roads, Virginia, C. E. Waterman, photographer, Hampton, Virginia, December 1907 · Photograph · U.S. Naval History and Heritage Command, Washington, D.C. (NH 92091)

On December 16, 1907, sixteen battleships of the U.S. Atlantic Fleet, their hulls painted white, steamed out of Hampton Roads, Virginia, while President Theodore Roosevelt watched from the presidential yacht. They would sail about 43,000 nautical miles around the world, calling at ports on six continents, and return in February 1909. The fleet had to go around South America, because the Panama Canal was not yet finished.

The photograph shows the ships in a long column, each following the one ahead. It is a picture of an idea, as Gast's painting was: that a nation protected by two oceans could also reach across them.

Look closely

- Count the ships you can see. How are they arranged, and why might a fleet sail in a single column?
- Look at the funnels and the smoke. What fuel drove these ships, and what did that mean for where they had to stop?
- Notice the color of the hulls. Why would a navy paint its ships white for a peaceful voyage and gray for war?
- Look at the water and the sky. What does the photographer want you to feel about this fleet?

Talk about it

1. Roosevelt sent the fleet around the world in peacetime. What message do you think he wanted to send to other nations, and to Americans?
2. Coal-burning ships needed coaling stations along their route. How did that make distant islands and harbors important to a naval power?
3. Why did this voyage make Americans even more eager to finish the Panama Canal?

PROJECT: STRING ROUTES ON A GLOBE

You will measure ocean distances on a real globe with string, compare them with a flat map, and discover why the shortest route across an ocean often looks curved on paper. Then you will plan the Oregon's 1898 voyage and the same voyage through Panama.

You will need

- A globe (a borrowed one is fine) and a flat world map
- Thin string or thread, a ruler and a fine marker
- Masking tape and small sticky dots
- A calculator

Steps

1. Find the globe's scale: measure the string along the equator for 10° of longitude. Since 10° on the equator is about 690 miles (1,110 km), write down how many miles one inch of string equals.
2. Stretch the string tight between New York and Lisbon. Mark it, measure it and convert to miles. Do the same from San Francisco to Tokyo.
3. Look at where the tight San Francisco–Tokyo string runs. Does it pass near Hawaii or near Alaska? Lay the same route on the flat map: does it look straight?
4. Now stretch the string from San Francisco to Honolulu and then on to Tokyo. Measure both legs and compare the total with the direct route.
5. Lay the string along the Oregon's route: San Francisco, down the coast to the Strait of Magellan, up to Florida. Measure it. Then measure San Francisco to Panama to New York.
6. Make a table of all your measurements and compute the differences.
7. Write a paragraph: How do these distances explain why the oceans protected the United States, and why the Panama Canal mattered to a two-ocean nation?

Tips

- Keep the string tight against the globe's surface; a tight string on a globe follows a great circle.
- Your answers will be close to, not exactly, the published distances. Ten percent is good work on a school globe.

Check your work

- I can measure a distance on a globe and convert it to miles and kilometers.

- I can explain why a great-circle route looks curved on a flat map.
- I can show how much the Panama Canal shortened the voyage between the coasts.

MAP NOTEBOOK

1. Draw a world map centered on North America with the Atlantic and Pacific labeled with their widths in miles. Mark Hawaii, Panama and the Strait of Magellan.
2. Make a timeline from 1796 to 1962 with at least eight events from this lesson that show the ocean shield working or thinning.
3. Copy one sentence from Lincoln's Lyceum Address and one from Washington's Farewell Address, and under each write what it says about geography.

> **From history.** The battleship Oregon's 1898 voyage made her famous across the nation, and newspapers followed her progress from port to port by telegraph. After the war she was kept for decades as a memorial in Portland, Oregon. During the Second World War she was sold for scrap, but one of her masts was saved and stands today in Tom McCall Waterfront Park in Portland.

WORKED EXAMPLES

Example 1. USS Oregon steamed about 14,000 miles from San Francisco to Florida in 66 days in 1898. What was her average speed in miles per day, in miles per hour and in knots (1 nautical mile = 1.15 statute miles)?

(Use the map or drawing "The Oregon's voyage." shown earlier in this lesson.)

1. Miles per day: 14,000 ÷ 66 ≈ 212 miles a day.
2. Miles per hour: 212 ÷ 24 ≈ 8.8 mph.
3. Knots: 8.8 ÷ 1.15 ≈ 7.7 knots.
4. This average includes stops for coal, so her steaming speed was higher.

Answer: About 212 miles a day, about 8.8 mph, or about 7.7 knots on average, stops included.

Example 2. Before the Panama Canal, the sea route from New York to San Francisco was about 13,000 miles; through the canal it is about 5,200. How many miles does the canal save, and what percent of the old route is that? For a ship averaging 250 miles a day, how many days does it save?

1. Miles saved: 13,000 − 5,200 = 7,800 miles.
2. Percent: 7,800 ÷ 13,000 = 0.60, or 60 percent.
3. Days: old route 13,000 ÷ 250 = 52 days; new route 5,200 ÷ 250 ≈ 21 days.
4. Days saved: 52 − 21 = 31 days.

Answer: The canal saves about 7,800 miles, 60 percent of the old route, or about a month of sailing at 250 miles a day.

Example 3. The Panama Canal lies at about 9°N. The Strait of Magellan lies at about 53.5°S. Going from Panama south to the strait along the coast means covering at least how many miles of latitude? What does that tell you about the detour a ship from the Pacific coast had to make before 1914?

1. From 9°N to the equator is 9°; from the equator to 53.5°S is 53.5°. Total: 9 + 53.5 = 62.5°.
2. One degree of latitude is about 69 miles (111 km): 62.5 × 69 ≈ 4,313 miles (about 6,940 km).
3. The ship must go that far south and then come that far north again on the Atlantic side: 2 × 4,313 ≈ 8,600 miles of north–south travel alone.

Answer: At least about 4,300 miles (6,900 km) each way, about 8,600 miles of extra north–south distance, which is why the canal cut the voyage by more than half.

PRACTICE

1. EASY In the Lyceum Address of 1838, what did Lincoln say no army could do, and where did he say the real danger to the nation lay?
2. EASY What phrase did Washington use in his Farewell Address (1796) to describe the nation's position, and what policy did he draw from it?
3. EASY Why was the Battle of New Orleans fought on January 8, 1815, after the Treaty of Ghent had been signed on December 24, 1814?
4. EASY When did the Panama Canal open, and why was it so important to the U.S. Navy?
5. MEDIUM New York to Lisbon is about 3,400 miles. Convert to kilometers (1 mile = 1.609 km) and to nautical miles (1 nautical mile = 1.15 miles).
6. MEDIUM A troop convoy must cross 3,000 nautical miles of ocean at 10 knots. How many hours and days will it take? Why does this matter to an attacker?

7. MEDIUM The Mayflower took 66 days to cross the Atlantic in 1620. A jet airliner takes about 7 hours. How many times faster is the jet?
   (Use the map or drawing "Atlantic crossing times." shown earlier in this lesson.)
8. MEDIUM What did the Monroe Doctrine (December 2, 1823) declare, and what really kept European powers from new colonies in the Americas at that time?
9. HARD An intercontinental missile can cover about 5,000 miles in about 30 minutes. What is its average speed in miles per hour? Compare it with the Oregon's 8.8 mph.
10. HARD Why did Congress authorize a two-ocean navy in July 1940? Use the map to explain why one fleet was not enough.
    (Use the map or drawing "Two coasts, two oceans." shown earlier in this lesson.)
11. CHALLENGE San Francisco to Tokyo is about 5,100 miles by the shortest (great-circle) route. San Francisco to Honolulu is about 2,400 miles and Honolulu to Tokyo about 3,850. How much longer is the route through Honolulu, as a number and a percent? Where does the great-circle route actually run, and why?
12. CHALLENGE Write a paragraph comparing the geographic position of the United States with that of Poland (Unit 7). Explain how position shaped each nation's history, and what position can and cannot do.

COMMON MISTAKES

- Thinking the oceans made the United States impossible to attack. They made attack slow and costly; the British burned Washington in 1814 and Japan struck Pearl Harbor in 1941.
- Thinking the Monroe Doctrine was enforced by the U.S. Navy from the start. In the 1820s the United States lacked the naval power; Britain's navy did much of the work for its own reasons.
- Reading great-circle routes as straight lines on a flat map. On most flat maps the shortest ocean route looks curved, often bending toward the poles.

Make it a game · Cross the Ocean. Lay a strip of paper 12 squares long between two "continents." The attacker moves a fleet token across, rolling one die each turn; on a roll of 1 a storm or supply shortage sends the fleet back two squares. The defender builds one "fort" for every turn the attacker spends at sea. When the fleet lands, it wins if its roll beats the number of forts. Play three eras: Sail (12 squares), Steam (6 squares) and Air (2 squares). Afterward, explain what happened to the defender's forts as the ocean shrank.

Scripture. "Except the LORD build the house, they labour in vain that build it: except the LORD keep the city, the watchman waketh but in vain." (Psalm 127:1, KJV)

God gave the American people a remarkable position between two oceans, and they were right to be thankful for it and to guard it well. But the psalmist reminds every nation that its safety rests finally with God, not with walls, distance or fleets.

Practice answers

1. He said that all the armies of Europe, Asia and Africa, even led by a Bonaparte, could not take a drink from the Ohio or make a track on the Blue Ridge in a thousand years. He said the real danger lay within: “If destruction be our lot, we must ourselves be its author and finisher.”
2. “Our detached and distant situation.” He argued that this position allowed the United States to avoid permanent alliances and entanglement in Europe’s quarrels.
3. News of the treaty had to cross the Atlantic by sailing ship, which took weeks, so neither army at New Orleans knew the war was over.
4. August 15, 1914. It let warships move between the Atlantic and the Pacific in days instead of steaming around South America, so one navy could defend both coasts.
5. 3,400 × 1.609 ≈ 5,470 km. 3,400 ÷ 1.15 ≈ 2,960 nautical miles.
6. 3,000 ÷ 10 = 300 hours; 300 ÷ 24 = 12.5 days. For twelve and a half days the convoy is exposed at sea and must carry or be followed by all its supplies, while the defender has time to prepare.
7. 66 days × 24 = 1,584 hours. 1,584 ÷ 7 ≈ 226, so about 226 times faster.
8. It declared the Americas closed to further European colonization and promised that the United States would stay out of European wars. In practice, the young United States had a small navy, and Britain’s Royal Navy, which wanted Latin American trade open, kept other European powers away.
9. 5,000 ÷ 0.5 = 10,000 mph. 10,000 ÷ 8.8 ≈ 1,136, so more than a thousand times faster. A trip that once took weeks now takes half an hour, which is why missiles ended the ocean’s role as a time shield.
10. In 1940 Germany had conquered much of Europe and threatened the Atlantic, while Japan was expanding in the Pacific. One fleet could not be in both oceans at once, and even with the Panama Canal the oceans are thousands of miles apart, so the nation needed a fleet strong enough to fight in each ocean at the same time.
11. 2,400 + 3,850 = 6,250 miles. 6,250 − 5,100 = 1,150 miles longer, about 23 percent. The great-circle route curves north, passing near the Aleutian Islands of Alaska, because on a globe the shortest path between two points in the Northern Hemisphere bends toward the pole. Hawaii lies well south of it, so it is a stopping place and outpost, not a point on the shortest line.
12. A good answer explains that Poland lies on the open North European Plain with no natural barriers between strong neighbors, so it was invaded, partitioned and moved, and had to keep large armies; while the United States lay behind two wide oceans with weak neighbors, so it could keep a small army, avoid European alliances, grow in safety and enter world wars late with its factories untouched. It should note the limits: the oceans did not stop the British in 1814, Pearl Harbor in 1941 or the missile age, and, as Lincoln said, no position can save a nation from its own failings.

Unit 8 test

Answer each question. Show your work for every calculation, give units, and use complete sentences for explanations. Use 69 miles (111 km) per degree of latitude where needed. The test is worth 100 points.

1. (7 pts) What line did the Proclamation of October 7, 1763, draw, what natural feature did it follow, and give two reasons the British government drew it.
2. (7 pts) Explain why the Appalachians were a barrier even though they are not very high, and name two gaps or routes through them.
3. (7 pts) Pittsburgh is at 40.44°N and the Cumberland Gap at 36.60°N. How far apart are they north to south, in miles and kilometers?
4. (7 pts) Explain in your own words why Jefferson called New Orleans the “one single spot” whose possessor was America’s natural enemy. Use the term drainage basin.
5. (7 pts) The Louisiana Purchase covered about 828,000 square miles and cost about $15 million. Find the price per acre in cents (640 acres = 1 square mile).
6. (7 pts) Give two reasons Napoleon was willing to sell all of Louisiana in 1803, and name one question the Purchase left unsettled.
7. (7 pts) Who coined the phrase “manifest destiny,” and when? In one or two sentences, explain the difference between manifest destiny as a belief and the geographic facts that made expansion possible.
8. (7 pts) How wide, north to south, is the land between 49°N and 54°40′N? Give miles and kilometers.
9. (7 pts) Give three reasons the Oregon Treaty of 1846 settled on the 49th parallel rather than the Columbia River or 54°40′.
10. (7 pts) The Central Pacific’s steepest grade was about 116 feet per mile. Express it as a percent, and explain why railroads need such gentle grades.
11. (7 pts) A wagon covered about 2,000 miles to the Pacific at 15 miles a day; after 1869 a train made a similar trip in about 7 days. Compute the wagon’s time and how many times faster the train was, and give two ways the railroad “bound the Union.”
12. (7 pts) Name two real costs or wrongs connected with building the transcontinental railroad, stated factually.
13. (8 pts) The Panama Canal shortened the sea route from New York to San Francisco from about 13,000 miles to about 5,200. How many miles and what percent were saved? Why did this matter so much to a nation with two ocean coasts? Use the 1898 voyage of USS Oregon in your answer.
14. (8 pts) In a paragraph, explain how the Atlantic and Pacific acted as a shield in American history and how technology thinned that shield. Include at least one event before 1900, one from the world wars and one after 1945.

UNIT PROJECT: HOW THE LAND BUILT A NATION: THE GROWTH OF THE UNITED STATES

Assemble a portfolio of two large maps and a written essay. Map 1 is your watershed map of the Mississippi basin (Lesson 8.2), showing its tributaries, its edges, the cities on it and the direction of trade before 1811. Map 2 is your layered map of the growth of the United States (Lesson 8.3), with each acquisition from 1783 to 1867 on its own sheet, labeled with year, area and how it was gained, and with the Proclamation Line, the Wilderness Road, the Oregon Trail and the transcontinental railroad drawn on the base map.

Add a short essay of 500 to 700 words answering the question: *Why did the United States grow across the continent where and when it did?* Use at least four geographic facts from the unit (a barrier, a river system, a line of latitude, a pass or valley, an ocean) and at least one primary source (Jefferson's letter, O'Sullivan, the Oregon Treaty, Washington or Lincoln). Treat the people involved fairly, naming achievements and wrongs plainly, and include a paragraph on Gast's *American Progress* as a picture of an idea.

- **Map accuracy**: Rivers, basin edges, acquisitions, lines of latitude, routes and cities are correctly placed, dated and labeled; areas and years match the unit.
- **Geographic reasoning**: The essay explains growth through barriers, gaps, river systems, harbors and oceans, using numbers and specific places rather than general claims.
- **Historical fairness**: The essay distinguishes belief (manifest destiny) from geographic fact, judges people by the standards of their time, gives achievements their due and names wrongs plainly without slogans.
- **Craft and sources**: Maps are neat, readable and keyed; the essay is clearly organized, quotes at least one primary source accurately and is free of careless errors.

Answer key

1. It forbade colonial settlement and private land purchases beyond the heads of the rivers flowing into the Atlantic, following the Appalachian watershed divide. Reasons: to end Pontiac's War and avoid further costly wars with the Indian nations; to keep order in the newly won lands; to control land sales through the Crown; to protect the fur trade.
2. They are made of many long, parallel, forested ridges (the Ridge and Valley) that a westbound traveler must cross one after another, and the eastern rivers are blocked by rapids at the fall line. Routes: the Cumberland Gap, the Mohawk Valley, Forbes Road, Braddock's Road (or the later National Road).
3. 3.84° × 69 ≈ 265 miles; 3.84° × 111 ≈ 426 km.
4. The Mississippi drainage basin funnels the rivers of the whole interior to one outlet near New Orleans. Before the steamboat, western farmers could send their goods to market only downstream past New Orleans, so whoever held the city could choke the trade of about three-eighths of the nation's territory, as Spain did when it suspended the right of deposit in 1802.
5. 828,000 × 640 = 529,920,000 acres. $15,000,000 ÷ 529,920,000 ≈ $0.028, about 2.8 cents an acre.
6. Reasons: France's army failed to retake Saint-Domingue, defeated by its people and by yellow fever, so Louisiana lost its purpose as a supply base; war with Britain was about to resume,

and Britain’s navy could seize New Orleans; France needed money. Unsettled questions: the exact boundaries; the lands and rights of the Native nations living there; whether slavery would spread into the new territory.

7. John L. O’Sullivan, in 1845. Manifest destiny was a belief that Providence meant the United States to spread across the continent; it justified expansion but did not cause it by itself. Geographic facts such as an open, fertile interior, the river systems, passes like South Pass, good Pacific harbors and the absence of strong nearby rivals made expansion possible.
8. 54°40′ = 54.667°. 54.667 − 49 = 5.667°. 5.667 × 69 ≈ 391 miles; 5.667 × 111 ≈ 629 km.
9. Any three: the 49th was already the border from the Lake of the Woods to the Rockies; American settlers greatly outnumbered British south of the Columbia; the war with Mexico had begun and Polk did not want two wars; Britain did not want war over a fur country whose beaver were declining; the line gave the U.S. Puget Sound’s harbors and Britain all of Vancouver Island; a parallel is easy to describe and find by the stars.
10. 116 ÷ 5,280 ≈ 0.022, about 2.2 percent. Steel wheels on steel rails grip only by friction, so a locomotive cannot pull a heavy train up steep slopes; engineers must find long, even routes along ridges and river valleys or build tunnels and cuts.
11. 2,000 ÷ 15 ≈ 133 days; 133 ÷ 7 = 19 times faster. Ways: tied California and the Pacific states to the rest of the nation during and after the Civil War; carried mail, troops and news in days; moved settlers and goods to and from the West; created national markets and, later, standard time.
12. Any two: Chinese workers were paid less than white workers, had to buy their own food, died in blasting and avalanches, and their 1867 strike for equal pay was broken; the line cut through the hunting lands of the Lakota, Cheyenne and Arapaho, brought conflict and carried the hunters who nearly destroyed the buffalo; the Crédit Mobilier scandal revealed insiders’ overcharging and stock given to members of Congress.
13. 13,000 − 5,200 = 7,800 miles; 7,800 ÷ 13,000 = 60 percent. In 1898 the Oregon needed 66 days and about 14,000 miles to steam from San Francisco to Florida around South America; with the canal, one navy could move between the Atlantic and Pacific in days and defend both coasts.
14. A good answer explains that distance and weak neighbors let the United States keep a small army and avoid European alliances (Washington’s “detached and distant situation”); that the shield was thin against a navy that commanded the sea (the burning of Washington, 1814) yet distance still delayed news (New Orleans, 1815); that in the world wars the oceans gave time and kept American factories out of enemy reach, though Pearl Harbor (1941) showed aircraft carriers could cross the Pacific; and that long-range bombers, Sputnik (1957), missiles and the Cuban crisis (1962) meant the homeland could be struck within an hour. It may add Lincoln’s warning that the greatest danger comes from within.

UNIT 9

Lines Drawn by Treaties

So far in this course, most borders have followed something you could see: a river, a mountain crest, a desert's edge, a strait. This unit turns to the borders drawn with a pen. In 1494 two kings divided the Atlantic world along a meridian no one could find. In 1884–1885 European diplomats met in Berlin to set the rules for dividing Africa, and over the next thirty years they drew lines across lands few of them had seen. After 1918 Britain and France drew new states out of the Arab provinces of the Ottoman Empire. In 1947 a London lawyer had five weeks to divide the Punjab and Bengal between India and Pakistan. And in 1945 and 1959 two lines were drawn in cold places: the 38th parallel across Korea, and the line of 60°S around Antarctica.

In each lesson you will ask the same questions. Who drew the line, with what knowledge, and by what right in the eyes of their own time? Did the line follow the land or ignore it? Who lived on the wrong side of it, and what happened to them? You will meet real achievements, such as treaties that kept the peace between rivals and a continent set aside for science, and real wrongs, such as the crimes of Leopold's Congo and the killings of 1947, and you will name both plainly. You will study the Cantino planisphere of 1502, the oldest surviving map to show the Tordesillas line, and you will finish the unit with a straight-line borders study and a map of the treaty borders of the world.

Scripture says that God "hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26). Treaty lines are human work, often hurried and sometimes unjust. Yet they fall within the providence of the God who sets the bounds of the peoples, and those who draw them are answerable to Him for how they treat the people who live along them.

BEFORE YOU BEGIN

- Can read latitude and longitude, convert degrees and minutes to decimal degrees, and compute north–south distances at about 69 miles (111 km) per degree (Units 1, 2 and 8)
- Can find the length of a degree of longitude at a given latitude (69.17 miles or 111.32 km × the cosine of the latitude)
- Can classify borders as natural or artificial and explain core, frontier and buffer (Unit 1)
- Knows the outline of the Age of Exploration, World War I and World War II

MASTERY CHECKLIST

- I can explain the Treaty of Tordesillas, locate its line from the treaty's words, and tell why Brazil speaks Portuguese.
- I can state what the Berlin Conference decided and did not decide, and classify Africa's borders as geometric, physical or mixed.

- I can describe the wartime commitments of 1915–1917, the mandates and the treaties that drew the borders of the Middle East, neutrally and accurately.
- I can explain how the Radcliffe Line was drawn, what it cut through in the Punjab and Bengal, and what followed.
- I can compare the 38th parallel in Korea with the 60°S line of the Antarctic Treaty and read a polar diagram of the Antarctic claims.
- I can weigh the claim that straight-line borders cause conflict, using evidence from at least four regions.

OPTIONAL BOOKS AND RESOURCES

- **Library of Congress Geography and Map Division** (https://www.loc.gov/maps/): Free. Search for historical maps of Africa after 1885, the Ottoman Empire and the mandates, British India and Korea to compare with your own maps.
- **The Avalon Project, Yale Law School** (https://avalon.law.yale.edu/): Free. Texts of historic treaties and documents. Search for the documents of this unit (for example the Balfour Declaration and the Sykes–Picot agreement) and read the actual words before reading what others say about them.
- **Secretariat of the Antarctic Treaty** (https://www.ats.aq/): Free. The full text of the Antarctic Treaty of 1959 (fourteen short articles, easy to read in one sitting), the list of parties and maps of research stations (Lesson 9.5).

9.1 The Treaty of Tordesillas

OBJECTIVES

- Explain why Spain and Portugal divided the newly reached lands of the Atlantic world in 1493–1494, and describe the papal line of 1493 and the treaty line of 1494.
- Locate the Tordesillas line from the treaty's own words (370 leagues west of the Cape Verde Islands), and explain why no one in 1494 could fix it exactly on the ground.
- Trace the results of the line: Portuguese Brazil, the Treaty of Zaragoza (1529) on the other side of the world, the refusal of other nations to accept it, and the later treaties that replaced it.

Warm-up. Peel an orange in one piece if you can, or take a ball and a rubber band. Stretch the band around the ball from top to bottom so it divides the ball into two halves. Now imagine the ball is the earth in 1494 and two kings agree that everything on one side belongs to one of them. Turn the ball over. Where does the line go on the back side? Did the agreement say? Keep that question in mind: it took Spain and Portugal thirty-five years to answer it.

Watch. *Tordesillas - How the Pope divided the world between Spain and Portugal* (Kings and Generals, 18:50). https://www.youtube.com/watch?v=o1Qllx4YH9A
After the story: watch how King John II and Ferdinand and Isabella argued over Columbus's discoveries, and look for the pope's line on the map being moved west at Tordesillas.
Note: Captions were not available to check; preview it first. Kings and Generals usually opens with a sponsor read (here, Audible), so skip the first minute or so. The video also brings in Pope Julius II's later approval of the treaty (1506), which the lesson may not mention.

Backup video. *Ten Minute History - The Early Spanish and Portuguese Empires (Short Documentary)* (History Matters, 9:59). https://www.youtube.com/watch?v=uZFW_BfD9M0
As review: watch the first part on why Spain and Portugal set out to explore, and listen for how the two kingdoms split their spheres before the video moves on to the Americas and India. Note: Captions were not available to check; preview it first. This is a broad overview of both empires that covers the conquest of the Aztecs and Incas, so Tordesillas is probably only a short part of it.

KEY TERMS

line of demarcation
A boundary line agreed on to separate the claims of two parties. The term is used for both the papal line of 1493 and the treaty line of 1494.

papal bull

A formal decree issued by a pope, named for the lead seal (Latin *bulla*) attached to it. Alexander VI's bull *Inter caetera* of 1493 drew the first line.

Treaty of Tordesillas
The treaty signed June 7, 1494, at Tordesillas in Castile, by which Spain and Portugal agreed to divide newly reached lands along a meridian 370 leagues west of the Cape Verde Islands: Spain to the west, Portugal to the east.

league
An old unit of distance, roughly 3 to 4 miles (about 5 to 6.5 km), whose exact length varied from country to country and from author to author.

meridian
A north–south line running from pole to pole and joining all places of the same longitude.

antimeridian
The meridian exactly opposite a given meridian, 180° away on the other side of the globe. Where a dividing line is drawn around the world, it must be settled on both sides.

CORE IDEAS

The story. On March 4, 1493, a storm-battered little caravel, the *Niña*, limped into the mouth of the Tagus River below Lisbon. Her captain was Christopher Columbus, a Genoese sailor in the service of Ferdinand and Isabella of Spain, home from the islands he had reached the previous October. King John II of Portugal received him and listened with alarm. Portugal had spent seventy years feeling its way down the coast of Africa under Prince Henry and his successors, and only five years before Bartolomeu Dias had rounded the Cape of Good Hope. By the Treaty of Alcáçovas of 1479, Spain had recognized Portugal's rights to the lands and seas south of the Canary Islands. John II argued that Columbus's islands fell under that treaty and began to prepare a fleet. Spain needed a quicker answer than war.

The papal line. Ferdinand and Isabella turned to the pope. Alexander VI, born Rodrigo Borgia in Valencia, was a Spaniard, and in the spring of 1493 he issued the bull *Inter caetera*. It granted to the Spanish crowns the lands they might find west of a line running from pole to pole 100 leagues west and south of the Azores and Cape Verde Islands, provided no Christian prince already held them. In the thinking of the age, the pope was the proper judge between Christian rulers, and the grants were joined to a charge to send missionaries to the peoples of the new lands. John II did not dispute the pope's authority. He disputed the line. One hundred leagues was too close to Africa: it left his ships too little sea room to swing west into the open Atlantic, as they had to do to catch the winds for the run south around Africa.

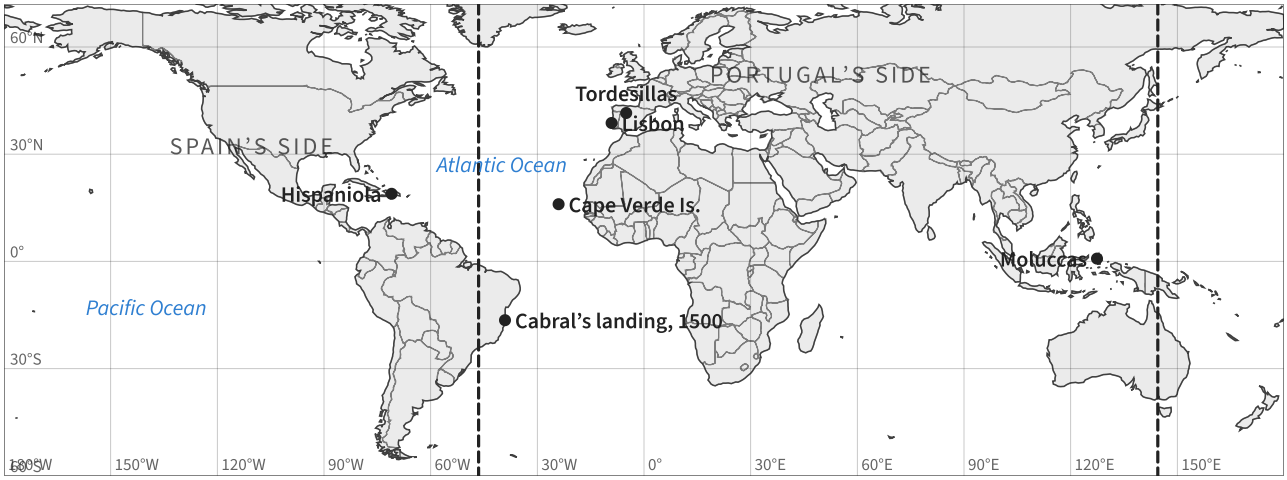
How they settled it. So the two kingdoms negotiated directly. On June 7, 1494, in the Castilian town of Tordesillas on the Duero River, their ambassadors signed a treaty that moved the line to **370 leagues west of the Cape Verde Islands**. Everything already found or to be found west of it would belong to Castile, everything east of it to Portugal. Spain ratified the treaty in July and Portugal in September, and Pope Julius II confirmed it in 1506. The treaty even provided for a joint expedition of pilots and astrologers to measure the line on the sea. It never sailed, because no one could do what it asked. Which island of the Cape

Verde group should the measure start from? How long was a league? Most of all, how could a navigator in mid-ocean know his longitude? Latitude could be read from the sun or the Pole Star; longitude at sea could not be found reliably until John Harrison's chronometers more than 250 years later. Using the common reckoning of 17½ leagues to a degree, the line fell at roughly 46° to 47° W, cutting through the bulge of South America near the mouth of the Amazon.

The big idea. The Tordesillas line was the first great border drawn by treaty across land that its makers had not seen. It followed no river or mountain, only a number. Its consequences were enormous. On April 22, 1500, a Portuguese fleet under Pedro Álvares Cabral, swinging wide into the Atlantic on its way to India just as John II had wanted room to do, sighted land in South America. It lay east of the line, and Cabral claimed it for Portugal. That is why Brazil speaks Portuguese while its neighbors speak Spanish. Yet the line had a second half. When Ferdinand Magellan's Spanish expedition crossed the Pacific in 1519–1522, both crowns claimed the Moluccas, the clove-growing Spice Islands. A line around the world must have an antimeridian. In the Treaty of Zaragoza of 1529, Spain gave up its claim to the Moluccas for 350,000 ducats, and a line was fixed about 17° east of the islands. Spain later settled the Philippines anyway, from 1565, though they lay on Portugal's side.

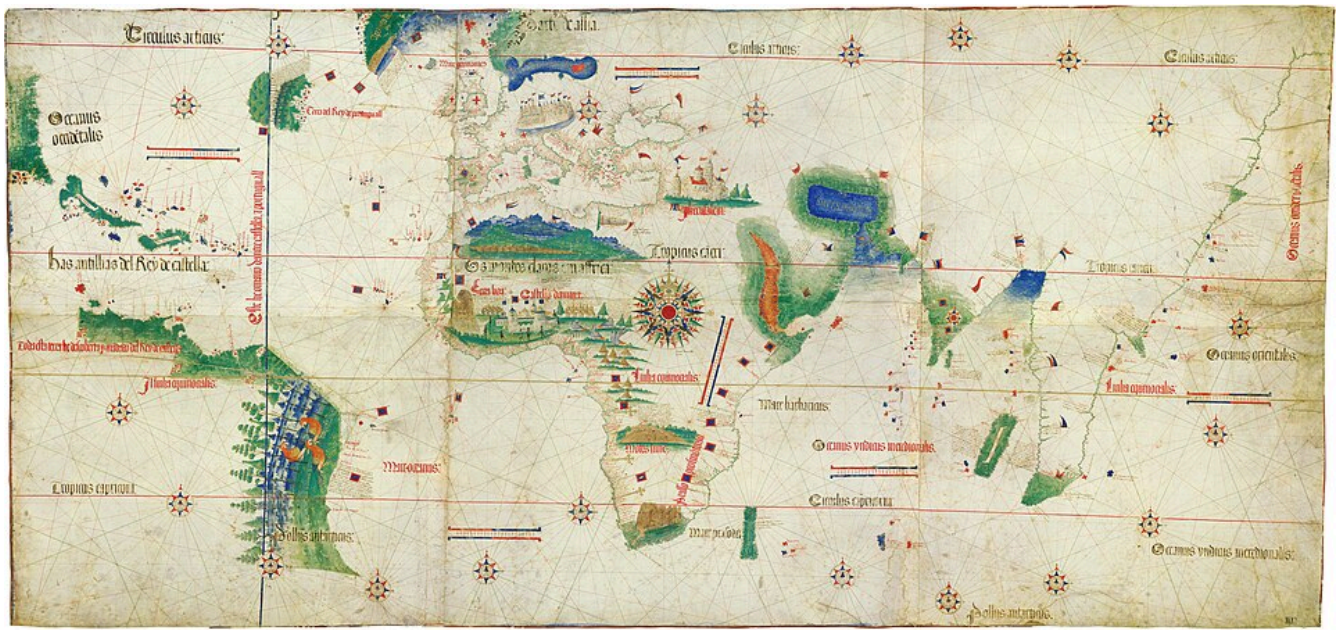
Who said no. The other nations of Europe were not parties to the treaty and did not accept it. France, England and later the Netherlands sent their own explorers, traders and privateers. King Francis I of France is said to have asked to be shown the clause in Adam's will that divided the world between his brothers of Spain and Portugal. After the Reformation, Protestant powers rejected papal grants of land entirely, and in 1609 the Dutch jurist Hugo Grotius argued in *Mare Liberum* (The Free Sea) that the ocean could belong to no one. Nor were the peoples who lived in the Americas, Africa or Asia asked. The treaty was a bargain between two Christian kingdoms over the claims of each against the other; the conquests that followed, with their real achievements and their real cruelties, are a larger story told elsewhere.

On the map. Meanwhile Portuguese settlers, cattle ranchers and the slave-raiding *bandeirantes* of São Paulo pushed far west of the line into the interior of South America. In the Treaty of Madrid of 1750, Spain and Portugal abandoned Tordesillas and accepted the principle of *uti possidetis*, "as you possess," letting each keep what it actually occupied, with borders following rivers and watersheds. That is why Brazil today covers about 3.3 million square miles (8.5 million km^2), most of it west of the old meridian. Tordesillas teaches a lesson that runs through this whole unit: a line on a map is a promise, but people, rivers and the land itself decide whether the promise holds.



The two lines that divided the world between Spain and Portugal: Tordesillas (1494) and Zaragoza (1529). Both positions are approximate, as they were in their own day.

PICTURE STUDY



The Cantino Planisphere, Unknown Portuguese cartographer (obtained in Lisbon by Alberto Cantino), 1502 · Ink, color and gold leaf on parchment (vellum), about 7 feet (2.2 m) wide · Biblioteca Estense Universitaria, Modena, Italy

In 1502 Alberto Cantino, an agent of Duke Ercole I d'Este of Ferrara, obtained this chart in Lisbon and sent it to Italy. Portugal guarded its sea charts as state secrets, so Cantino had to obtain it quietly; he wrote to the duke that it had cost him twelve gold ducats. It is the oldest surviving map to show the Tordesillas line, and one of the first to show the coast of Brazil, only two years after Cabral. After centuries in the Este family library, it was lost during the unrest in Modena in 1859 and is said to have been rediscovered years later in a local butcher's shop.

The chart is a working navigator's picture of the world in the age of Vasco da Gama. Africa is drawn with remarkable accuracy, because the Portuguese had sailed all of its coasts. The

New World appears only as island chains and broken coastlines, because no one yet knew what lay behind them.

Look closely

- Find the straight line running from top to bottom through the Atlantic. Which side shows Portuguese flags, and which shows Spanish ones?
- Find the coast of Brazil. Which side of the line is it on? Now find the land in the far northwest that the Portuguese mapmaker placed on his own side (Newfoundland, reached by the Corte-Real brothers in 1500–1501).
- Compare the drawing of Africa with the drawing of the Americas. What does the difference tell you about what the Portuguese had actually seen?
- Find the equator and the tropics. Why would a navigator want these lines on a chart when longitude could not yet be measured?

Talk about it

1. The mapmaker placed Newfoundland east of the line. Do you think that was honest error, wishful thinking or both? How could anyone have checked in 1502?
2. Why would Portugal treat its maps as state secrets, and why would an Italian duke pay to have one copied?
3. What does this map prove about how quickly the 1494 treaty became part of how people saw the world?

PROJECT: FIND THE LINE: TORDESILLAS ON A FLAT MAP AND A GLOBE

The treaty gave a distance, not a longitude. You will turn the treaty's words into a line on a map, test how much the answer changes with the length of the league, and then carry the line around the world on a ball to see why a second treaty was needed.

You will need

- A printed outline map of the Atlantic with lines of longitude every 5° or 10° (or a world map from an atlas)
- A ball (a playground ball or a large orange), two rubber bands and a marker
- Ruler, protractor and colored pencils
- A calculator

Steps

1. Mark the Cape Verde Islands on your map. Their westernmost island, Santo Antão, lies at about 17°N, 25°W.
2. Convert 370 leagues to degrees using three different league values used by scholars: 17½ leagues per degree, 16⅔ leagues per degree, and 18 leagues per degree. Write the three answers.
3. Add each answer to 25°W and draw the three possible lines in three colors. Measure how far apart the westernmost and easternmost lines are where they cross South

America.
4. Label Cabral’s landing near Porto Seguro (about 16.4°S, 39.1°W) and the mouth of the Amazon. Are they east or west of each of your lines?
5. On the ball, draw the equator. Stretch a rubber band around the ball from pole to pole for the Tordesillas meridian. Mark the Moluccas (about 1°N, 127.5°E) with a dot.
6. Notice that the rubber band crosses the far side of the world at the antimeridian (about 133°E if the line is at 47°W). Which side of that point are the Moluccas on? Explain why both Spain and Portugal could argue about them.
7. Stretch a second band for the Zaragoza line about 17° east of the Moluccas. Write a caption explaining why one meridian drawn in 1494 needed a second treaty in 1529.

Tips

- On a flat map with straight meridians, a meridian is easy to draw. On the ball, keep the band passing through both poles or it is not a meridian.
- Keep your Atlantic map: you will add it to the unit map of treaty borders of the world.

Check your work

- I can turn a distance in leagues into degrees of longitude and draw the line.
- I can explain why the line could not be fixed exactly in 1494.
- I can explain why a meridian line around the world creates a second dispute on the far side.

MAP NOTEBOOK

1. Sketch the Atlantic with the Tordesillas line, Lisbon, Tordesillas, the Cape Verde Islands, Hispaniola and Cabral’s landing in Brazil. Shade Portugal’s side and Spain’s side in two colors.
2. Make a three-column table: 1479 Alcáçovas, 1493 *Inter caetera*, 1494 Tordesillas. In each column write who agreed, where the line ran and what it gave each side.
3. Draw one detail from the Cantino planisphere (a flag, a ship, the line, the African coast) and write a sentence on what it reveals about Portuguese knowledge in 1502.

> **From history.** Tordesillas still keeps the houses where the treaty is believed to have been signed, the Casas del Tratado, now a museum. In 2007 UNESCO placed the original treaty documents, one copy kept in Spain’s General Archive of the Indies in Seville and one in Portugal’s national archive at the Torre do Tombo in Lisbon, on its Memory of the World register. The two copies of the treaty are still kept on either side of the border it once mattered so much to keep.

WORKED EXAMPLES

Example 1. The treaty set the line 370 leagues west of the Cape Verde Islands. Assume the measure starts at Santo Antão (about 25°W) and that a degree of longitude at the latitude of the islands holds 17½ leagues. At about what longitude is the line?

(Use the map or drawing "The Tordesillas line and the Cape Verde Islands." shown earlier in this lesson.)

1. Convert leagues to degrees: 370 ÷ 17.5 ≈ 21.1°.
2. The line lies west of the islands, so add to the west longitude: 25° + 21.1° = 46.1°W.
3. Check on the map: 46°W crosses South America near the mouth of the Amazon in the north and near today's São Paulo state in the south.

Answer: About 46°W. Other assumptions about the league and the starting island give answers from about 46° to 49°W, which is exactly why the line was never fixed in practice.

Example 2. The treaty moved the papal line from 100 leagues to 370 leagues west. How far did it move, in degrees and in miles and kilometers, measured along the parallel at 15°N? (A degree of longitude at 15°N is about 66.8 miles or 107.5 km.)

1. Change in distance: 370 − 100 = 270 leagues.
2. In degrees: 270 ÷ 17.5 ≈ 15.4°.
3. Along the parallel at 15°N: 15.4 × 66.8 ≈ 1,030 miles; 15.4 × 107.5 ≈ 1,660 km.

Answer: About 15° of longitude, roughly 1,030 miles (1,660 km): a huge stretch of ocean, enough to bring the eastern bulge of South America onto Portugal's side.

Example 3. Brazil's easternmost point, Ponta do Seixas, lies at about 7.1°S, 34.8°W. Taking the line at 46.1°W, how far east of the line is it? (At 7°S a degree of longitude is about 68.7 miles or 110.5 km.)

1. Difference in longitude: 46.1° − 34.8° = 11.3°.
2. Distance along the parallel: 11.3 × 68.7 ≈ 776 miles; 11.3 × 110.5 ≈ 1,250 km.

Answer: About 11° of longitude, roughly 780 miles (1,250 km) east of the line, so the whole eastern bulge of Brazil lay securely on Portugal's side.

PRACTICE

1. EASY When and where was the Treaty of Tordesillas signed, and between which two kingdoms?
2. EASY Which pope issued *Inter caetera* in 1493, and where did its line run?

3. EASY Why did John II of Portugal object to the line of 1493?
4. EASY Who reached Brazil for Portugal, and when? Why was the claim valid under the treaty?
5. MEDIUM Using 16⅔ leagues per degree and a starting point of 25°W, where does the line fall? How far is that from the answer using 17½ leagues per degree?
6. MEDIUM Give three reasons the line could not be marked exactly in 1494.
7. MEDIUM If the Tordesillas line is at 47°W, at what longitude is its antimeridian on the other side of the globe?
8. MEDIUM What did the Treaty of Zaragoza (1529) settle, and what did Spain receive?
9. HARD Brazil's coast at Porto Seguro is at about 39.1°W. Taking the line at 46.1°W and 1° of longitude at 16°S as about 66.5 miles (107 km), how far inland from Cabral's landing would the line run?
10. HARD Name two European nations that rejected the treaty and explain the grounds on which each could object.
11. CHALLENGE Why is Brazil today far larger than the land east of the Tordesillas line? Name the treaty and the principle that replaced the line.
12. CHALLENGE In a paragraph, evaluate the Tordesillas line as a border. Consider what it achieved for Spain and Portugal, its weaknesses as a line on the earth, and whose consent it lacked. Judge it by the standards and knowledge of 1494.

COMMON MISTAKES

- Thinking the pope's line of 1493 and the treaty line of 1494 were the same. The bull put the line 100 leagues west; Spain and Portugal moved it to 370 leagues by their own treaty.
- Thinking the line had an exact longitude. The treaty gave a distance from a group of islands in an unfixed unit, and no one could measure longitude at sea; modern estimates range from about 46° to 49°W.
- Thinking the treaty divided the world for all of Europe. Only Spain and Portugal were bound by it; France, England and the Netherlands rejected it.

Make it a game · Which Side of the Line?. Hang a world map and stretch a string down it at 46°W. One player calls out a place and a year (Brazil 1500, Hispaniola 1492, Newfoundland 1501, the Moluccas 1521, Manila 1571, Rio de la Plata 1516, Goa 1510). The other player has ten seconds to say "Spain," "Portugal" or "Disputed!" and give one reason. Score a point for each correct answer and a bonus point for naming the treaty that applied (Tordesillas or Zaragoza). Play to ten.

Scripture. "The earth is the LORD's, and the fulness thereof; the world, and they that dwell therein." (Psalm 24:1, KJV)

Kings in 1494 divided half the world with a pen and a number. The psalmist reminds us that the whole earth, with every people on it, belongs first to the Lord. Human claims to land are real and may be just, but they are always claims under God, not over His world.

Practice answers

1. June 7, 1494, at Tordesillas in Castile (Spain), between Castile and Aragon (the crowns of Ferdinand and Isabella, Spain) and Portugal.
2. Alexander VI (Rodrigo Borgia, a Spaniard). It ran from pole to pole 100 leagues west and south of the Azores and Cape Verde Islands, with lands to the west granted to Spain.
3. It ran too close to Africa. Portuguese ships bound around Africa had to swing far west into the Atlantic to find favorable winds, and he wanted that ocean, and any lands in it, on Portugal's side.
4. Pedro Álvares Cabral, April 22, 1500. The coast he reached lay east of the Tordesillas line, on Portugal's side.
5. 370 ÷ 16.67 ≈ 22.2°; 25 + 22.2 = 47.2°W. With 17½ leagues per degree it was 46.1°W, so the two differ by about 1.1° of longitude, roughly 75 miles (120 km) near the equator.
6. The treaty did not say which Cape Verde island to measure from; the league had no single agreed length; and no one could measure longitude reliably at sea (that waited for the marine chronometer in the 1700s). The joint expedition to fix the line never sailed.
7. 180° − 47° = 133°E. (A meridian at 47°W and the meridian at 133°E together form one great circle through the poles.)
8. It settled the dispute over the Moluccas (Spice Islands) on the far side of the world. Spain gave up its claim for 350,000 ducats, and a dividing line was set about 17° east of the islands, leaving them to Portugal.
9. 46.1 − 39.1 = 7.0°. 7.0 × 66.5 ≈ 466 miles; 7.0 × 107 ≈ 749 km. The line ran roughly 470 miles (750 km) inland.
10. France and England (later the Netherlands). They were not parties to the treaty, so it did not bind them; Francis I mocked it by asking to see Adam's will. After the Reformation, Protestant England and the Netherlands rejected the pope's authority to grant lands at all, and Hugo Grotius argued in *Mare Liberum* (1609) that the sea was free to all.
11. Portuguese settlers, ranchers, missionaries and *bandeirantes* pushed far west of the line into the interior, along rivers such as the Amazon and its tributaries, and Spain was too thinly settled there to stop them. The Treaty of Madrid (1750) abandoned the Tordesillas line and adopted *uti possidetis*, each side keeping what it actually occupied, with borders along rivers and watersheds.
12. A good answer notes that the treaty kept the peace between two rival Catholic kingdoms at a moment when war was possible, gave each a clear zone for exploration, and used a meridian because nothing else was known about the lands it divided; by the standards of the time, a treaty confirmed by the pope was a lawful way for Christian princes to settle claims. Its weaknesses were that it could not be located (no measure of longitude, no agreed league), had no defined antimeridian, and ignored the land itself. It lacked the consent of other European powers, who ignored it, and of the peoples who lived in the lands it divided. It was finally replaced by occupation (1750).

9.2 The Berlin Conference

OBJECTIVES

- Describe the Berlin Conference of 1884–1885: who called it, who attended, who was absent, and what the General Act of Berlin actually decided.
- Explain how most of Africa's colonial borders were drawn afterward in treaties between European powers, and classify borders as geometric (straight lines, parallels, meridians), physical (rivers, lakes, watersheds) or a mixture.
- Weigh the results of those borders, including the decision of independent African states in 1964 to keep them, and state plainly both the wrongs and the real achievements of the colonial period.

Warm-up. Open an atlas or a map of Africa. Using a ruler, count how many borders you can find that are perfectly straight for more than 100 miles. Then find three borders that clearly follow a river or a lake shore. Which kind seems more common in the north of Africa, and which in the middle? Make a guess why before you read.

Watch. *How did Ethiopia survive the Scramble for Africa? (Short Animated Documentary)* (History Matters, 3:27). https://www.youtube.com/watch?v=hZvUAlxtpB4
With the big idea: after reading how Europe divided Africa, watch how Ethiopia under Menelik II stayed independent, and look for the Battle of Adwa in 1896.
Note: Captions were not available to check; preview it first. It includes war and battle scenes from the Italian invasion. The video sometimes calls Ethiopia by its older name, Abyssinia.

Backup video. *Why didn't the USA also Scramble Africa? (Short Animated Documentary)* (History Matters, 3:15). https://www.youtube.com/watch?v=_kIF9tg3QVo
As review: watch why the United States sent a delegate to Berlin in 1884 but took no African colonies. Note: Captions were not available to check; preview it first. This is a side question about the Scramble for Africa, not a full account of the Berlin Conference.

KEY TERMS

Scramble for Africa
The rapid division of nearly all of Africa among European powers between about 1880 and 1914.

General Act of Berlin
The agreement signed February 26, 1885, at the end of the Berlin Conference. It set rules for free trade and navigation in the Congo and Niger basins, for claiming new coasts, and against the slave trade.

effective occupation

The rule, in the General Act, that a power claiming new territory on the African coast must notify the other signers and establish real authority there, not merely plant a flag.

geometric boundary
A border drawn as a straight line, an arc, or along a parallel or meridian, without regard to the land. Also called an artificial or astronomical boundary.

sphere of influence
A region where one power claims special rights and excludes rivals, short of ruling it directly.

uti possidetis
Latin, “as you possess.” In modern African and Latin American history, the principle that new states keep the borders of the colonies they replaced.

CORE IDEAS

The story. On November 15, 1884, Otto von Bismarck, chancellor of the new German Empire, welcomed the delegates of fourteen nations to his official residence on the Wilhelmstrasse in Berlin. Germany, France, Britain, Portugal, Belgium, the Netherlands, Spain, Italy, Austria-Hungary, Russia, Denmark, Sweden-Norway, the Ottoman Empire and the United States sent diplomats. On the wall hung a large map of Africa. No African ruler was invited, and none attended. Over the next three and a half months the delegates met in sessions and committees, and on February 26, 1885, they signed the **General Act of Berlin**.

Why then? In 1870 European powers ruled only a fringe of Africa: French Algeria, the British Cape Colony and Natal, Portuguese footholds in Angola and Mozambique, and trading forts along the west coast. The interior was protected less by its armies than by its geography. Rivers that drop over rapids near the coast, like the Congo below its great cataracts, block ships from the sea. Malaria killed so many Europeans that West Africa was called the White Man’s Grave. Then the barriers began to fall. Quinine, taken regularly, let Europeans survive in the tropics. Steamboats could be carried in pieces past the rapids and reassembled above them. Explorers mapped the interior: David Livingstone, the Scottish missionary who crossed the continent in the 1850s and died at Chitambo in 1873, and Henry Morton Stanley, who followed the Congo River to the sea in 1874–1877. King Leopold II of Belgium hired Stanley to build stations up the Congo and gather treaties from local chiefs, while the French officer Pierre Savorgnan de Brazza signed rival treaties north of the river. When Britain and Portugal signed a treaty in 1884 giving Portugal the Congo’s mouth, the other powers objected, and Bismarck, with France, called the conference.

What Berlin decided. It is often said that the delegates at Berlin sat around the map and carved up Africa. They did not, at least not directly. The General Act declared free trade for all nations in the vast basin of the Congo and free navigation on the Congo and Niger rivers. It required any power taking new territory on the African coast to notify the others and to establish **effective occupation**. The signers pledged to help suppress the slave trade, to protect missionaries, scientists and explorers, and to watch over the welfare of the native peoples. Alongside the conference, the powers recognized Leopold’s International Association as the government of the Congo, which became the Congo Free State, ruled by

Leopold personally and not by Belgium. What Berlin really did was set the rules of the race. The lines themselves were drawn afterward, in dozens of bilateral treaties: Britain and Germany in 1886 and 1890, Britain and Portugal in 1891, Britain and France in 1898–1899 after the two nearly went to war at Fashoda on the upper Nile. By 1914 only Liberia and Ethiopia were independent, and Ethiopia had earned it on the battlefield, when Emperor Menelik II crushed an Italian army at Adwa on March 1, 1896.

The big idea. Diplomats in London, Paris and Berlin drew lines across lands that few Europeans had seen. Where they knew little, they used the tools of the surveyor's desk: parallels, meridians and straight lines. In the Sahara, where few people lived and nothing was surveyed, long ruler-straight borders appeared, such as Egypt's southern border along 22°N, set in the Anglo-Egyptian agreement of 1899. Where they knew a river, they followed it. Britain kept the Gambia as a narrow strip on either bank of the Gambia River, about 10 km (6 miles) wide on each side, surrounded on land by French Senegal. Sometimes a line served a strategy rather than the land. In 1890 Germany obtained the Caprivi Strip, a panhandle reaching from German South West Africa to the Zambezi, in hope of river access to the east; but the Zambezi plunges over Victoria Falls and other rapids, and no ship could use it. Such lines sometimes divided peoples who had lived together, such as the Maasai between British and German East Africa or the Ewe between the British Gold Coast and German Togoland, and placed old rivals inside one colony.

The record. Judged by what it promised, Berlin's record was mixed. Colonial governments and missions did help end the East African slave trade that Livingstone had exposed; the slave market at Zanzibar was closed under British pressure in 1873, and an Anglican cathedral was built on its site. Missionaries founded schools, hospitals and churches across the continent, many of which still serve today. But the promise to watch over native welfare was broken worst in the very state Berlin created. In Leopold's Congo, companies and officials forced villagers to gather wild rubber, held wives and children hostage, burned villages and cut off hands as punishment. Missionaries, among them the American Presbyterian William Sheppard and the English Baptists John and Alice Harris, sent out reports and photographs; the journalist E. D. Morel and the British consul Roger Casement, whose report appeared in 1904, made the crimes known. In 1908 Belgium took the Congo from its king.

On the map today. When African nations won independence, mostly between 1956 and 1975, they faced a hard choice. Redraw the colonial lines, and every border might become a war. In July 1964, at Cairo, the Organization of African Unity resolved that its members would respect the borders existing at independence. Most have held. Exceptions are few: Eritrea separated from Ethiopia in 1993 and South Sudan from Sudan in 2011, while attempts at secession such as Biafra (1967–1970) ended in war. The colonial lines were drawn hastily and from far away, but the decision to keep them was made by Africans.

Africa's borders: straight lines in the desert, river lines in the west and center, and a few lines drawn for strategy.

PICTURE STUDY

The Congo Conference in Berlin (Die Kongokonferenz in Berlin), Adalbert von Rößler (Roessler), 1884 · Wood engraving, published in the Stuttgart illustrated weekly *Über Land und Meer* (Allgemeine Illustrirte Zeitung) · Published print; copies in many libraries and archives

Illustrated weekly newspapers of the 1880s carried the news to readers by engravings made from artists' sketches. This one, by the German illustrator Adalbert von Rößler, shows the

opening days of the conference in Bismarck's residence. It is one of the most reproduced images of the age of empire.

Look at it the way you would look at a photograph of a modern summit: not only at who is there, but at what is on the wall and who is missing.

Look closely

- Find Bismarck. How has the artist made him the center of the scene?
- Find the map of Africa on the wall. How much detail does it seem to show of the interior compared with the coasts?
- Count the people in the room. Is anyone present from the continent being discussed?
- Look at the furnishings and clothing. What impression of the conference did the newspaper want its readers to have?

Talk about it

1. Why would European newspaper readers in 1884 have seen this scene as a sign of order and progress?
2. How might a ruler such as Menelik II of Ethiopia, or a Kongo chief who had signed one of Stanley's treaties, have read the same picture?
3. The engraving shows a conference, but most African borders were drawn later in other rooms. What does this tell you about how pictures can shape what people remember?

PROJECT: STRAIGHT LINES AND NATURAL LINES: A BORDER STUDY

This is the main project of the unit. You will measure and classify the borders of Africa (and later of the world) as geometric, physical or mixed, and then research what happened along a few of them. The goal is to test a claim you will hear often: that straight borders cause trouble and natural borders bring peace. Is it true?

You will need

- A political map of Africa at a known scale, printed as large as you can (an atlas page or a free outline map)
- Thin string or thread, a ruler, and a fine marker in three colors
- A notebook ruled as a table
- An atlas or encyclopedia for research

Steps

1. Choose ten borders between two African countries. Include at least three in the Sahara, three in West or Central Africa and two in East or southern Africa.
2. For each border, trace every section in color: red for geometric (straight lines, parallels, meridians, arcs), blue for physical (rivers, lakes, watersheds, mountain crests), green for anything else (old kingdom or tribal boundaries, roads).

3. Lay string along each colored section, then measure the string against the map's scale bar. Record the length of each type for each border.
4. Compute, for each border, the percentage that is geometric. Then compute the percentage for all ten together.
5. Pick two mostly geometric borders and two mostly physical borders. For each, find out who lived along it and whether it has seen a war, a dispute or a peaceful history since independence.
6. Fill in a results table: border, percent geometric, population along it (sparse or dense), and what happened.
7. Write a paragraph answering: Did straightness matter as much as where the line ran and who lived along it?

Tips

- Straight borders across empty desert and straight borders through farmland are very different cases. Note the population density for each.
- Keep your table. In Lesson 9.5 and in the unit portfolio you will add examples from the Middle East, South Asia, Korea and the Americas.

Check your work

- I can classify a border as geometric, physical or mixed and measure each part with a scale.
- I can give at least two real examples of each type in Africa.
- I can support or challenge the claim that straight borders cause conflict with evidence.

MAP NOTEBOOK

1. Sketch the outline of Africa with only five borders drawn: Egypt–Sudan (22°N), Egypt–Libya (25°E), the Gambia strip, the Caprivi Strip and the Kenya–Tanzania line bending around Kilimanjaro. Label why each looks the way it does.
2. Make a two-column list: "What the General Act of Berlin decided" and "What it is often wrongly said to have decided."
3. Draw a timeline from 1870 to 1914 with at least six events: Livingstone's death, Stanley's Congo journey, the Berlin Conference, the Caprivi Strip, Adwa, Fashoda, and Belgium's takeover of the Congo.

> **From history.** The Anglo-German agreement of 1886 ran the boundary between British and German East Africa in a nearly straight line from the coast to Lake Victoria, but with a bend that left Mount Kilimanjaro, Africa's highest mountain at 19,341 feet (5,895 m), on the German side. A popular story says Queen Victoria gave the mountain to her grandson, the future Kaiser Wilhelm II, as a birthday present. Historians find no evidence for it; the bend reflected the claims German explorers and agents had already made in the Kilimanjaro region. Today the mountain stands in Tanzania, about ten miles (15 km) south of the Kenyan border.

WORKED EXAMPLES

Example 1. Egypt's southern border follows 22°N from 25°E to the Red Sea coast near 36.9°E. How long is this line? (At 22° latitude, one degree of longitude is about 64.1 miles or 103.2 km.)

(Use the map or drawing "Egypt's straight southern border on the 22nd parallel." shown earlier in this lesson.)

1. Span of longitude: 36.9° − 25.0° = 11.9°.
2. Length along the parallel: 11.9 × 64.1 ≈ 763 miles; 11.9 × 103.2 ≈ 1,228 km.
3. Check the factor: 69.17 miles × cos 22° = 69.17 × 0.927 ≈ 64.1 miles per degree.

Answer: About 760 miles (1,230 km), one of the longest straight borders in the world.

Example 2. The Congo Free State covered about 905,000 square miles (2,345,000 km²). Belgium covers about 11,850 square miles (30,700 km²). How many times larger than Belgium was the state Leopold ruled personally?

1. In square miles: 905,000 ÷ 11,850 ≈ 76.4.
2. In square kilometers: 2,345,000 ÷ 30,700 ≈ 76.4.
3. Both units give the same ratio, as they should.

Answer: About 76 times the size of Belgium, ruled not by Belgium's parliament but by one man until 1908.

Example 3. Africa covers about 11.7 million square miles (30.4 million km²). Historians commonly estimate that Europeans ruled about 10 percent of it in 1870 and about 90 percent in 1914. How much territory came under European rule in those 44 years, and at what average rate per year?

1. 1870: 0.10 × 11.7 million ≈ 1.17 million square miles. 1914: 0.90 × 11.7 million ≈ 10.53 million.
2. Increase: 10.53 − 1.17 = 9.36 million square miles (× 2.59 ≈ 24.2 million km²).
3. Average per year: 9.36 million ÷ 44 ≈ 213,000 square miles (about 550,000 km²), roughly the area of France every year.

Answer: About 9.4 million square miles (24 million km²), averaging about 210,000 square miles (550,000 km²) a year.

PRACTICE

1. EASY Who called the Berlin Conference, and what were its opening and closing dates?

2. EASY How many nations sent delegates? Name four, including the one from the Americas.
3. EASY Name three things the General Act of Berlin decided.
4. EASY Which two African states were independent in 1914, and what battle secured one of them?
5. MEDIUM Name two geographic barriers that kept Europeans out of interior Africa before about 1870, and the technology that helped overcome each.
6. MEDIUM Egypt's western border runs along 25°E from near the coast at about 31.6°N to 22°N. How long is it, north to south, in miles and kilometers?
7. MEDIUM The Gambia follows its river for about 300 miles (480 km) inland, with the border about 6 miles (10 km) from the river on each side. Estimate its area with a rectangle model and compare with its actual area of about 4,400 square miles (11,300 km^2).
8. MEDIUM What was the Caprivi Strip meant to do, and why did geography defeat its purpose?
9. HARD Explain what is wrong with the statement "At the Berlin Conference, Europeans drew the borders of Africa."
10. HARD Who exposed the abuses in the Congo Free State, and what happened as a result?
11. CHALLENGE In 1964 the Organization of African Unity resolved to respect the borders existing at independence. Give one argument for this decision and one cost of it.
12. CHALLENGE Write a paragraph judging the Berlin Conference by the standards and knowledge of 1884. What did its makers believe they were doing, what did they achieve, and where did they fail even by their own stated goals?

COMMON MISTAKES

- Saying the Berlin Conference drew Africa's borders. It set the rules; most borders were drawn in later bilateral treaties.
- Saying the Congo Free State was a Belgian colony from the start. It was Leopold II's personal state from 1885 until Belgium annexed it in 1908.
- Assuming every straight border runs through crowded farmland. Many of Africa's straight lines cross nearly empty desert, where a straight line was the only practical choice.

Make it a game · Ruler, River or Ridge?. One player shows a border on a map of Africa for five seconds (Egypt–Sudan, Gambia–Senegal, DR Congo–Central African Republic along the Ubangi, Algeria–Mali, Namibia's Caprivi Strip, Kenya–Tanzania, Zambia–Zimbabwe along the Zambezi, Western Sahara–Mauritania). The other player calls "Ruler!" (geometric), "River!" (physical) or "Ridge!" (watershed or mountains), and names the colonial powers who drew it. One point for the type and one for the powers. Play to fifteen.

Scripture. "Remove not the ancient landmark, which thy fathers have set." (Proverbs 22:28, KJV)

In Israel the landmark stone marked a family's inheritance, and moving it was a kind of theft. The diplomats of 1884–1914 drew new lines across old landmarks they had never seen. The proverb teaches that boundaries are moral matters, and that those who draw them owe justice to the people who live within them.

Practice answers

1. Otto von Bismarck, chancellor of Germany (with French support). It opened November 15, 1884, and the General Act was signed February 26, 1885.
2. Fourteen. Any four of: Germany, France, Britain, Portugal, Belgium, the Netherlands, Spain, Italy, Austria-Hungary, Russia, Denmark, Sweden-Norway, the Ottoman Empire and the United States.
3. Any three: free trade in the Congo basin; free navigation on the Congo and Niger rivers; new coastal claims must be notified to the other powers and backed by effective occupation; pledges to suppress the slave trade and to protect missionaries, explorers and native peoples. Alongside it, the powers recognized Leopold's association as the government of the Congo.
4. Liberia and Ethiopia. Ethiopia's Emperor Menelik II defeated Italy at Adwa on March 1, 1896.
5. Disease, especially malaria: overcome in part by regular doses of quinine. Rivers blocked by rapids near the coast, such as the lower Congo: overcome by steamboats carried in pieces past the rapids and later by railways around them.
6. $31.6 - 22.0 = 9.6°$. $9.6 \times 69 \approx 662$ miles; $9.6 \times 111 \approx 1{,}066$ km. About 660 miles (1,070 km).
7. Width ≈ 12 miles (20 km). Area ≈ 300 × 12 = 3,600 square miles (480 × 20 = 9,600 km^2). The model is a little low, about 80 to 85 percent of the actual area, because the strip is wider near the coast.
8. Germany obtained it in 1890 to connect German South West Africa to the Zambezi River, hoping for a water route toward the east. The Zambezi is broken by Victoria Falls and other rapids downstream, so it could not be navigated from there to the sea.
9. The conference set rules (free trade, free navigation, notification and effective occupation for coastal claims) and recognized the Congo Free State, but it did not draw most of Africa's borders. Those were set afterward in many bilateral treaties between European powers from 1885 to about 1914, such as the Anglo-German agreements of 1886 and 1890, the Anglo-Portuguese treaty of 1891 and the Anglo-French agreements after Fashoda.
10. Missionaries such as William Sheppard and John and Alice Harris sent reports and photographs; the journalist E. D. Morel led a public campaign; and the British consul Roger Casement published an official report in 1904. International pressure led Belgium to take the Congo away from Leopold II and annex it in 1908.
11. For: reopening every colonial border would have invited endless wars among new states, since nearly every country contained several peoples and almost any new line would leave someone on the wrong side. Cost: peoples divided by colonial lines, such as the Somali or the Ewe, stayed divided, and states had to hold together peoples with little shared history, which contributed to some civil wars.
12. A good answer explains that many Europeans of the time sincerely believed, as Livingstone had urged, that commerce and Christianity would end the slave trade and lift Africa, and that the powers wanted above all to avoid war among themselves over African claims; it notes real achievements such as the suppression of the slave trade, the absence of a European war over Africa before 1914, and the schools, hospitals and churches founded by missionaries. It names the failures plainly: no African ruler was consulted; the pledge to protect native welfare was

broken, most terribly in Leopold’s Congo; and the lines were drawn with little knowledge of the land or its peoples.

9.3 The Middle East After 1918

OBJECTIVES

- Describe the three wartime commitments Britain made concerning the Arab lands of the Ottoman Empire (the Hussein–McMahon letters, the Sykes–Picot agreement and the Balfour Declaration) and state accurately what each said.
- Explain the mandate system and trace how the states of Iraq, Syria, Lebanon, Jordan, Saudi Arabia and Turkey received their borders between 1918 and 1932, and how Israel's lines arose in 1948–1949.
- Compare the Sykes–Picot plan with the borders actually drawn, and explain how rivers, deserts, mountains and oil shaped the lines.

Warm-up. Take a sheet of tracing paper and lay it over a modern map of the Middle East. Trace only the borders of Syria, Iraq, Jordan and Saudi Arabia. Now remove the map. Which borders are straight? Which seem to follow something? Guess, before reading, which of those lines were drawn in a single year and which took decades to settle.

Watch. *How the Ottoman Empire was Carved Up (Short Animated Documentary)* (History Matters, 3:52). https://www.youtube.com/watch?v=4QKIxObizXM
After the story: watch how Britain and France divided the Ottoman lands, and look for the Sykes–Picot lines and the oil fields of Mosul on the map.
Note: Captions were not available to check; preview it first.

Backup video. *10th June 1916: Arab Revolt begins with the Battle of Mecca when Sharif Hussein attacks the Ottomans* (HistoryPod, 2:22). https://www.youtube.com/watch?v=P5vljh7Lmq8
Before the story: watch how Sharif Hussein started the Arab Revolt at Mecca in June 1916, which sets up Faisal's ride into Damascus. Note: Captions were not available to check; preview it first. It is a short battle account with some fighting.

KEY TERMS

Sykes–Picot agreement
The secret understanding concluded in May 1916 by Britain and France, with Russian assent, dividing much of the Ottoman Empire's Arab lands into zones of direct control and influence after the war. Named for its negotiators, Sir Mark Sykes and François Georges-Picot.

mandate
A territory taken from Germany or the Ottoman Empire after World War I and placed by the League of Nations under the administration of a victorious power, which was to prepare it for self-government.

vilayet

A province of the Ottoman Empire. Iraq was formed from the three vilayets of Mosul, Baghdad and Basra.

Balfour Declaration
A letter of November 2, 1917, from British Foreign Secretary Arthur Balfour to Lord Rothschild stating British support for a Jewish national home in Palestine, while protecting the rights of the existing non-Jewish communities.

Treaty of Lausanne
The treaty of July 24, 1923, between the Allies and the Turkish nationalist government that replaced the Treaty of Sèvres and fixed most of the borders of modern Turkey.

armistice line
A line where opposing armies agree to stop fighting, which may become a de facto border without a final peace treaty.

CORE IDEAS

The story. On October 3, 1918, Emir Faisal, son of Sharif Hussein of Mecca, rode into Damascus at the head of the Arab army that had fought the Ottoman Turks for two years alongside the British. Crowds cheered him. That afternoon he met the British commander, General Edmund Allenby, at the Hotel Victoria. According to the record of the meeting, Allenby told him that France was to be the protecting power in Syria, that Faisal would administer the interior under French guidance, and that Lebanon and Palestine lay outside his authority. Faisal protested that he had been led to expect otherwise. In that hotel room, the gap between wartime promises and postwar lines came into the open.

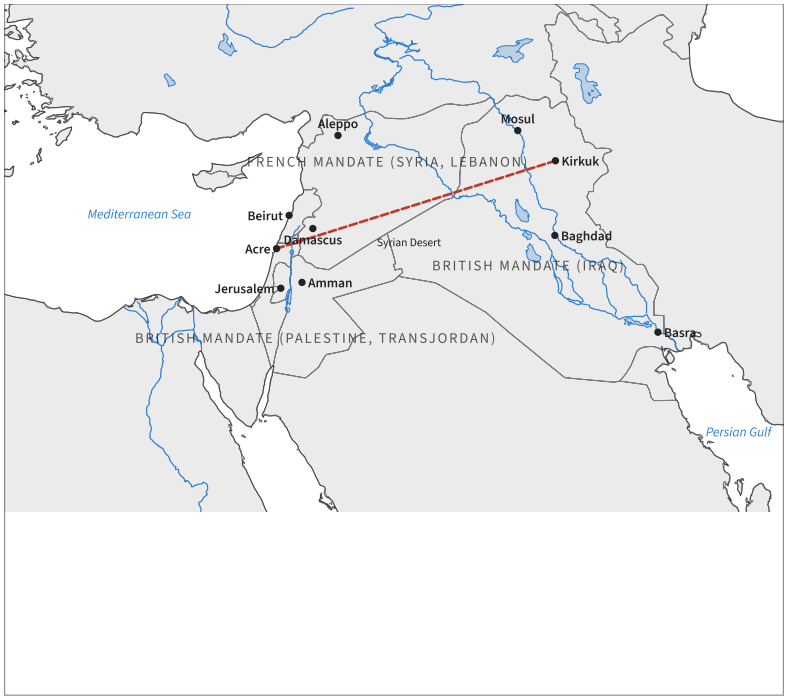
Three commitments. For four centuries, since the conquests of Selim I in 1516–1517, the Arab lands from Aleppo to Mecca had been provinces of the Ottoman Empire. When the empire joined Germany in 1914, Britain made three commitments about their future. First, in letters of 1915–1916 the British High Commissioner in Egypt, Sir Henry McMahon, promised Sharif Hussein British support for Arab independence if the Arabs rose against the Turks, with certain areas excluded and others reserved for French interests; Arab leaders and British officials later disputed exactly which areas. Hussein launched the Arab Revolt in June 1916. Second, in May 1916 Britain and France concluded the secret **Sykes–Picot agreement**. France would rule the Syrian and Lebanese coast directly and have influence over the interior, including Damascus, Aleppo and Mosul; Britain would rule southern Mesopotamia, including Baghdad and Basra, and have influence over a belt from the Sinai to Kirkuk; Palestine would be under an international administration. Sykes is reported to have described his dividing line as running from the “e” in Acre to the last “k” in Kirkuk. Third, on November 2, 1917, Foreign Secretary Arthur Balfour wrote that “His Majesty’s Government view with favour the establishment in Palestine of a national home for the Jewish people,” provided nothing should prejudice the civil and religious rights of existing non-Jewish communities. After the Russian Revolution, the Bolsheviks published the secret Sykes–Picot text in November 1917, and Arabs learned of it while the war was still on. Historians continue to debate how far these commitments contradicted one another.

How the lines were drawn. The Ottoman Empire signed the Armistice of Mudros on October 30, 1918. The League of Nations Covenant created the **mandate** system, describing the well-being and development of peoples under mandate as “a sacred trust of civilisation.” At the San Remo conference in April 1920, Syria and Lebanon were assigned to France and Mesopotamia and Palestine to Britain. Faisal had been proclaimed king of Syria in March 1920; French troops defeated his forces at Maysalun on July 24, 1920, and he left the country. France then carved Greater Lebanon out of Syria, adding the coastal cities and the Bekaa Valley to the Christian heartland of Mount Lebanon. At the Cairo Conference of March 1921, Colonial Secretary Winston Churchill and his advisers, including Gertrude Bell and T. E. Lawrence, made Faisal king of Iraq and his brother Abdullah emir of Transjordan, the land east of the Jordan River. The mandates were confirmed by the League in 1922. In December 1922, at Uqair, the British official Sir Percy Cox drew the borders between the Sultanate of Najd, Kuwait and Iraq, adding two diamond-shaped neutral zones for the wandering grazing tribes. Ibn Saud, who conquered the Hejaz in 1924–1925, proclaimed the Kingdom of Saudi Arabia in 1932.

Turkey and Mosul. In the north, the victors’ Treaty of Sèvres (1920) would have shrunk Turkey to part of Anatolia and allowed for Kurdish autonomy. Turkish nationalists under Mustafa Kemal rejected it and won their war, and the Treaty of Lausanne (July 24, 1923) fixed most of Turkey’s borders without a Kurdish state. The Kurds, a people of the mountains, were left divided among Turkey, Iraq, Syria and Iran. The oil-rich Mosul province, which Sykes–Picot had placed in the French zone, had been yielded by France to Britain in 1918; a League of Nations commission awarded it to Iraq, and Turkey accepted the result in 1926. Oil was struck near Kirkuk in October 1927.

The big idea. Sykes–Picot is often blamed for the borders of the Middle East, but the lines actually drawn differ greatly from its zones. The real borders came from San Remo, Cairo, Uqair, Lausanne and the League, shaped by armies, oil, local rulers and geography. Iraq followed the rivers: the Tigris and Euphrates bind Mosul, Baghdad and Basra into one long valley to the Persian Gulf. Lebanon follows its mountains. Where the Syrian Desert spreads between the river valleys and the Mediterranean coast, the borders of Syria, Jordan, Iraq and Saudi Arabia run in long straight lines across country with few settled people. The Jordan River and the Dead Sea separate the coastal hills from the plateau to the east.

On the map. Independence came over three decades: Iraq in 1932, Lebanon in 1943, Syria and Jordan in 1946. In Palestine, Jewish immigration and Arab opposition led to growing conflict, and Britain handed the question to the United Nations, which voted for a partition plan on November 29, 1947. On May 14, 1948, as the British mandate ended, Israel declared independence; the armies of neighboring Arab states entered the country, and the war ended in armistice lines in 1949, which became Israel’s working borders, while hundreds of thousands of Arabs left or were driven from their homes. As of 2026 the final borders of Israel, the West Bank, Gaza and the status of Jerusalem remain disputed. A geographer’s task is to know the lines, their dates and their causes, and to describe each side’s claims accurately.



The mandates and the line Sykes described from Acre to Kirkuk, drawn over today's borders.

1915–16	Hussein–McMahon letters
1916	Sykes–Picot agreement (May); Arab Revolt begins (June)
1917	Balfour Declaration (Nov. 2); Sykes–Picot published by the Bolsheviks
1918	Faisal enters Damascus (Oct. 3); Armistice of Mudros (Oct. 30)
1920	San Remo assigns mandates; Maysalun; Treaty of Sèvres
1921	Cairo Conference: Faisal king of Iraq, Abdullah in Transjordan
1922	League confirms the mandates; Uqair Protocol
1923	Treaty of Lausanne; Republic of Turkey
1926	Turkey accepts Mosul as part of Iraq
1932	Iraq independent; Kingdom of Saudi Arabia proclaimed
1943	Lebanon independent
1946	Syria and Jordan independent
1948	State of Israel declared (May 14); armistice lines 1949

From empire to states: the Middle East, 1915–1948.

PICTURE STUDY

Map of the Sykes–Picot Agreement, signed by Mark Sykes and François Georges-Picot, Sir Mark Sykes and François Georges-Picot (annotations on a printed map of the region), May 8, 1916 · Printed map with hand-colored zones, letters and signatures · The National Archives, Kew, United Kingdom (MPK 1/426)

This is the working map of the 1916 agreement, signed by the two men who negotiated it. A blue area along the coast marks direct French control and a red area in Mesopotamia marks direct British control. The large inland regions lettered A and B were to be French and British zones of influence, and a separate area around Jerusalem was set aside for an international administration.

The map is a primary source for what was planned, not for what happened. Compare it with today's borders and you will see how much changed between 1916 and 1923.

Look closely

- Find the blue and red zones. Which cities lie in each?
- Find the A and B areas. Where does the boundary between them run, and does it follow any river or mountain range you can identify?
- Find Mosul. Which zone was it placed in? Where is it today?
- Look at the signatures and the date. Why would negotiators sign a map as well as a text?

Talk about it

1. Which lines on this map match today's borders, and which do not? What does that tell you about the popular claim that Sykes–Picot drew the modern Middle East?
2. Why would the agreement have been kept secret, and what happened when it was published in 1917?

3. If you were an Arab officer in Faisal’s army in 1918, how would you have read this map? If you were a French diplomat?

PROJECT: PLANNED LINES AND DRAWN LINES: AN OVERLAY STUDY

You will make a layered map that puts the Sykes–Picot plan of 1916, the mandates of 1920–1922 and today’s borders on separate sheets, so you can flip between them and measure how much the plan and the result differ.

You will need

- A base outline map of the region from Turkey to the Persian Gulf, with the Mediterranean, the Tigris, the Euphrates and the Jordan drawn in
- Three sheets of tracing paper or clear page protectors
- Colored pencils (blue, red and a third color), a ruler and tape
- A copy of the Sykes–Picot map (from the picture study) and a modern political map

Steps

1. On the base map, mark Acre, Kirkuk, Beirut, Damascus, Aleppo, Mosul, Baghdad, Basra, Jerusalem and Amman, and shade the Syrian Desert lightly.
2. Sheet 1 (1916): copy the Sykes–Picot zones: blue, red, area A, area B and the international zone. Draw a dashed line from Acre to Kirkuk.
3. Sheet 2 (1920–1922): shade the French mandate (Syria and Lebanon) and the British mandates (Iraq, Palestine and Transjordan).
4. Sheet 3 (today): draw the modern borders of Turkey, Syria, Lebanon, Israel, Jordan, Iraq and Saudi Arabia, and label each with its year of independence.
5. Tape the three sheets along the top so they flip over the base map.
6. Find three places where the plan of 1916 differs from the borders of today (for example Mosul, Palestine, the northern border of Syria). Write what changed and why.
7. Classify each modern border segment as river, mountain, desert straight line or coastline, and add the results to your straight-line study table from Lesson 9.2.

Tips

- Keep the zones of 1916 lightly shaded so the later borders show through.
- Write only what each document actually said. Accuracy, not opinion, is the goal of this map.

Check your work

- I can show the Sykes–Picot zones, the mandates and today’s borders in order.
- I can name at least three differences between the plan of 1916 and the borders actually drawn.
- I can explain which borders follow rivers or mountains and which cross the desert in straight lines.

MAP NOTEBOOK

1. Sketch the Fertile Crescent: the Mediterranean coast, the Tigris and Euphrates to the Gulf, and the Syrian Desert in the middle. Add today's borders and circle the straight ones.
2. Make a three-column chart: Hussein–McMahon letters, Sykes–Picot, Balfour Declaration. For each give the date, the parties and the main commitment.
3. Draw the two diamond-shaped neutral zones of the Uqair Protocol (1922) and write one sentence on why a border in nomad country might be drawn that way.

> **From history.** The Hatay, the region around the port of Alexandretta (İskenderun) and the ancient city of Antioch, was part of the French mandate of Syria. In 1938–1939, as war approached in Europe, France allowed it to become first a separate state and then part of Turkey, hoping for Turkish friendship. Antioch, where "the disciples were called Christians first" (Acts 11:26), has been part of Turkey ever since, though Syria long objected. It is a reminder that borders drawn in the 1920s were still moving on the eve of World War II.

WORKED EXAMPLES

Example 1. Sykes described his dividing line as running from Acre (32.93°N, 35.08°E) to Kirkuk (35.47°N, 44.39°E). Estimate its length and its compass bearing. (At the middle latitude, about 34.2°N, one degree of longitude is about 92 km or 57 miles; one degree of latitude is about 111 km or 69 miles.)

(Use the map or drawing "Sykes's line from Acre to Kirkuk." shown earlier in this lesson.)

1. North–south distance: $(35.47 - 32.93) = 2.54° \times 111 \approx 282$ km.
2. East–west distance: $(44.39 - 35.08) = 9.31° \times 92 \approx 857$ km.
3. Straight-line distance: $\sqrt{(282^2 + 857^2)} = \sqrt{(79{,}500 + 734{,}400)} \approx \sqrt{813{,}900} \approx 902$ km, about 560 miles.
4. Bearing: $\tan \theta = 857 \div 282 \approx 3.04$, so $\theta \approx 72°$ east of north (east-northeast).

Answer: About 900 km (560 miles), on a bearing of about 72°, running east-northeast from the Mediterranean to the edge of the Zagros foothills.

Example 2. Iraq was formed from the vilayets of Mosul, Baghdad and Basra. Estimate the distance from Mosul (36.34°N, 43.13°E) to Basra (30.51°N, 47.81°E). (At about 33.4°N one degree of longitude is about 93 km or 58 miles.) Why does this distance matter for understanding why one state was formed from the three provinces?

1. North–south: $(36.34 - 30.51) = 5.83° \times 111 \approx 647$ km.
2. East–west: $(47.81 - 43.13) = 4.68° \times 93 \approx 435$ km.
3. Distance: $\sqrt{(647^2 + 435^2)} = \sqrt{(418{,}600 + 189{,}200)} \approx \sqrt{607{,}800} \approx 780$ km, about 485 miles.

Answer: About 780 km (485 miles). All three cities lie on the Tigris–Euphrates river system, which links the north to the Gulf at Basra; the rivers gave the new state a natural spine and its only sea outlet, even though its peoples (Kurds in the north, Sunni Arabs in the center, Shia Arabs in the south) differed.

Example 3. Use the timeline. How many years passed between the Sykes–Picot agreement (1916) and the independence of Iraq, Lebanon, Syria and Jordan? What was the average?

(Use the map or drawing "From empire to states." shown earlier in this lesson.)

1. Iraq: $1932 - 1916 = 16$ years. Lebanon: $1943 - 1916 = 27$. Syria: $1946 - 1916 = 30$. Jordan: $1946 - 1916 = 30$.
2. Sum: $16 + 27 + 30 + 30 = 103$. Average: $103 \div 4 \approx 26$ years.

Answer: 16, 27, 30 and 30 years; an average of about 26 years. The lines were drawn quickly, but the states took a generation to become independent.

PRACTICE

1. EASY Name the two men who negotiated the 1916 agreement between Britain and France, and the month and year it was concluded.
2. EASY What did the Balfour Declaration state, and on what date?
3. EASY At the San Remo conference (1920), which mandates went to France and which to Britain?
4. EASY Which three Ottoman provinces were joined to form Iraq, and what geographic feature links them?
5. MEDIUM What happened to Faisal between October 1918 and August 1921?
6. MEDIUM How did Greater Lebanon (1920) differ from the older region of Mount Lebanon, and what natural feature gives Lebanon its shape?
7. MEDIUM Why are the borders between Syria, Jordan, Iraq and Saudi Arabia mostly straight lines?

8. MEDIUM What did the Treaty of Lausanne (1923) do, and what did it not do that Sèvres had proposed?
9. HARD Sykes–Picot placed Mosul in the French zone of influence. Where did Mosul end up, how, and why did it matter so much?
10. HARD The Uqair Protocol (1922) created neutral zones between Najd and Kuwait and between Najd and Iraq. Why would a border-maker in nomad country create a shared zone rather than a single line?
11. CHALLENGE Evaluate the claim “Sykes–Picot drew the borders of the modern Middle East.” Give at least three pieces of evidence.
12. CHALLENGE Write a paragraph describing the wartime commitments of 1915–1917 fairly from two points of view: an Arab leader who fought in the Revolt and a British official responsible for the war effort.

COMMON MISTAKES

- Treating the Sykes–Picot map as the map of today. Most of today’s borders were drawn between 1920 and 1926, and several differ completely from the 1916 zones.
- Thinking the mandates were colonies with no end date. Under the League’s Covenant they were meant to lead to independence, and Iraq, Lebanon, Syria and Jordan became independent between 1932 and 1946.
- Confusing the three wartime commitments. The McMahon letters were with Sharif Hussein, Sykes–Picot was between Britain and France, and the Balfour Declaration was a letter to Lord Rothschild.

Make it a game · Plan or Result?. Make twelve cards, each naming a place and a ruler: “Mosul: French,” “Mosul: Iraq,” “Damascus: Faisal’s kingdom,” “Jerusalem: international zone,” “Jerusalem: British mandate,” “Beirut: Greater Lebanon,” “Antioch: Turkey,” and so on. Shuffle. The other player sorts each card into one of three piles: 1916 Plan, 1920s Result or Later Change, and must give the date and the treaty. One point for the right pile and one for the treaty. Play to twenty.

Scripture. “When the most High divided to the nations their inheritance, when he separated the sons of Adam, he set the bounds of the people according to the number of the children of Israel.” (Deuteronomy 32:8, KJV)

This is the course verse, and it fits a lesson about the very lands where the Bible’s story took place: Damascus, Antioch, Babylon on the Euphrates, Jerusalem. Diplomats in 1916–1923 believed they were dividing an empire. Scripture reminds us that the bounds of the peoples are finally in God’s hands, and that rulers who draw lines will answer to Him for how they do it.

Practice answers

1. Sir Mark Sykes (Britain) and François Georges-Picot (France); May 1916.

2. On November 2, 1917, Arthur Balfour wrote that the British government viewed with favor the establishment in Palestine of a national home for the Jewish people, provided nothing be done to prejudice the civil and religious rights of existing non-Jewish communities in Palestine.
3. France: Syria and Lebanon. Britain: Mesopotamia (Iraq) and Palestine (which came to include Transjordan).
4. Mosul, Baghdad and Basra. The Tigris and Euphrates river system links them from the northern hills to the Persian Gulf.
5. He entered Damascus in October 1918 and led an Arab government there; he was proclaimed king of Syria in March 1920; French forces defeated his army at Maysalun on July 24, 1920, and he was expelled; at the Cairo Conference of 1921 the British chose him as king of Iraq, and he was crowned in August 1921.
6. France added the coastal cities (such as Beirut, Tripoli, Sidon and Tyre) and the Bekaa Valley to the mountain district, making a larger state with a more mixed population. Lebanon's shape follows the Lebanon and Anti-Lebanon mountain ranges and the coast between them and the sea.
7. They cross the Syrian Desert and northern Arabian Desert, where there were few settled people, no rivers or ridges to follow, and little survey work; straight lines between agreed points were the simplest way to divide the land.
8. It replaced the Treaty of Sèvres and fixed most of the borders of modern Turkey after the Turkish nationalists won their war. Unlike Sèvres, it made no provision for Kurdish autonomy or independence, leaving the Kurds divided among Turkey, Iraq, Syria and Iran.
9. France yielded its claim to Britain in December 1918; Turkey also claimed Mosul; a League of Nations commission recommended that it go to Iraq, and Turkey accepted this by treaty in 1926. It mattered because of its oil (struck near Kirkuk in 1927), its farmland and its strategic position on the upper Tigris.
10. Bedouin tribes moved seasonally across the land to wells and pastures, so a single line would cut them off from water and grazing they depended on. A neutral zone let herders use the land without deciding sovereignty; the zones were later divided by agreement.
11. The claim is largely inaccurate. Evidence: the international zone for Palestine became a British mandate; Mosul moved from the French to the British sphere and then to Iraq; Lebanon and Transjordan were created later by the mandatory powers; Turkey's southern border was set by the Franco-Turkish agreement of Ankara (1921) and confirmed at Lausanne (1923) after a Turkish victory; the Saudi borders came from Uqair (1922) and later agreements; Israel's lines came from the 1949 armistice. Sykes–Picot did establish the principle of dividing the region into British and French spheres, which San Remo carried out in a different form.
12. A good answer gives the Arab view that Hussein's sons and their soldiers fought on the promise of independence in the McMahon letters and felt betrayed when France took Syria and Britain kept Iraq and Palestine; and the British view that the letters excluded certain areas and reserved French interests, that Britain was fighting a world war and needed both France and Arab support, and that the mandates were meant as a path to independence (which Iraq reached in 1932). It notes that the Balfour Declaration added a further commitment, and that historians still debate how far these conflicted. It avoids slogans and states each side's case accurately.

9.4 Partition of India

OBJECTIVES

- Explain why British India was divided in 1947, who drew the Radcliffe Line, under what instructions and in how much time.
- Analyze the geography of the line in the Punjab and in Bengal: rivers, canals, railways, ports, farmland and the census districts on which it was based.
- Describe the human results of Partition plainly (the great migration and the killings on all sides), and trace its long consequences: Kashmir, the Indus Waters Treaty, Bangladesh and the Bengal enclaves.

Warm-up. Draw a 5 × 5 grid of squares on paper. In each square write M or N at random (or flip a coin: heads M, tails N). Now try to draw one continuous line that separates the M squares from the N squares, putting each in a single connected region. Can you do it without leaving some squares on the “wrong” side? That is the problem Cyril Radcliffe faced, with millions of people in every square and five weeks to solve it.

Watch. *Why was India Partitioned? (Short Animated Documentary)* (History Matters, 3:25). https://www.youtube.com/watch?v=3AsvcUn3XQc
With the big idea: watch why Britain decided to leave India in 1947 and why it was split into two countries instead of one.
Note: Captions were not available to check; preview it first. It focuses on British government decisions more than on the Radcliffe Line itself.

Backup video. *14th August 1947: Partition of India begins with creation of the independent Dominion of Pakistan* (HistoryPod, 2:38). https://www.youtube.com/watch?v=qkGqmfExrM0
After the story: watch for Mountbatten's deadline and Radcliffe's five weeks to draw the line through the Punjab and Bengal. Note: Captions were not available to check; preview it first. It mentions the violence between Hindus and Muslims, and probably the deaths and refugees of 1947. The video gives Pakistan's independence date as 14 August 1947; India's was 15 August.

KEY TERMS

Partition
The division of British India in August 1947 into two independent dominions, India and Pakistan, with Pakistan in two parts, West and East, about 1,000 miles apart.

Radcliffe Line
The boundary between India and Pakistan in the Punjab and in Bengal, drawn by Sir Cyril Radcliffe as chairman of the two boundary commissions and published on August 17, 1947.

tehsil
A subdivision of a district in British India (called a thana or subdivision in parts of Bengal). Census figures for tehsils were the building blocks of the boundary.

contiguous
Touching; sharing a border. The boundary commissions were told to divide the provinces by "contiguous majority areas," so that each country's land would be joined together, not scattered in islands.

princely state
One of more than 560 states in British India ruled by its own prince under British overlordship. In 1947 each ruler had to accede to India or Pakistan.

enclave
A piece of one country's territory entirely surrounded by another country.

CORE IDEAS

The story. On July 8, 1947, Sir Cyril Radcliffe, a London barrister of great reputation, landed in Delhi. He had never been to India. He had been chosen partly for that reason: he could not be accused of favoring either side. He was to chair two boundary commissions, one for the Punjab in the northwest and one for Bengal in the east, each with two judges nominated by the Indian National Congress and two by the Muslim League. Independence was set for August 15. In the heat of a Delhi summer, working from census tables and maps, Radcliffe had about five weeks to divide two provinces with a combined population of roughly 88 million people. When the judges divided evenly along party lines, as they did on almost every question, the decision was his alone.

Why divide? British rule in India had begun with the East India Company and passed to the Crown in 1858. By the 1940s independence was certain; the question was whether one state or two would follow. The Indian National Congress, led by Jawaharlal Nehru with the moral leadership of Mohandas Gandhi, sought a single India. The Muslim League, led by Muhammad Ali Jinnah, argued that Muslims, about a quarter of the population, were a nation and needed their own state, and in its Lahore Resolution of 1940 called for independent states in the Muslim-majority regions of the northwest and east. Talks failed, and on Direct Action Day, August 16, 1946, riots in Calcutta killed thousands. In February 1947 the British government announced it would leave by June 1948. The new viceroy, Lord Louis Mountbatten, concluded that partition could not be avoided and moved the date forward. His plan of June 3, 1947, was accepted by the leaders of Congress, the League and the Sikhs. The legislators of the Punjab and Bengal voted to divide their provinces, and the British Parliament passed the Indian Independence Act in July.

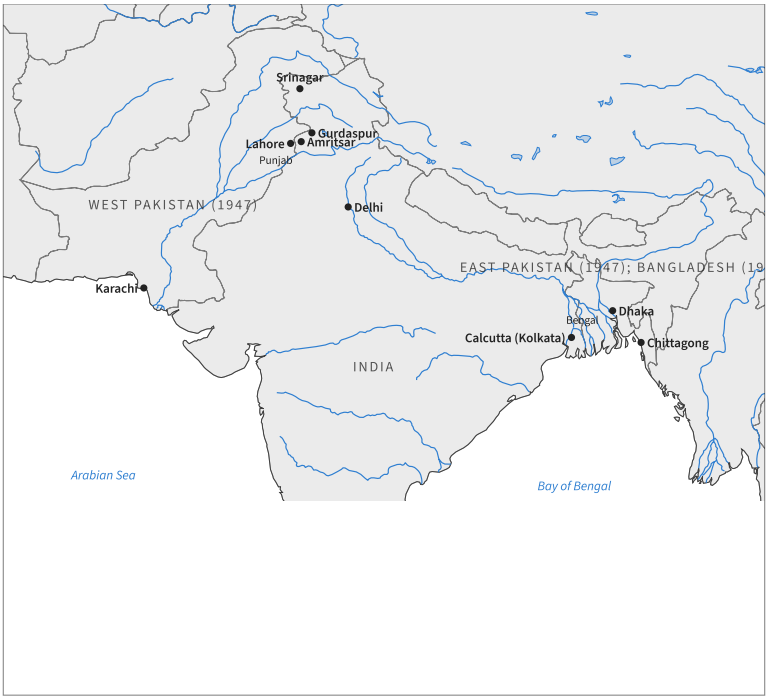
How the line was drawn. Radcliffe's instructions were to divide each province by "contiguous majority areas" of Muslims and non-Muslims, using the census of 1941, while also taking into account "other factors." The other factors were the hard part. The Punjab, the "land of five rivers" (the Jhelum, Chenab, Ravi, Beas and Sutlej), had been turned by British engineers since the 1880s into one of the richest farming regions in Asia by a network of canals fed from headworks on the rivers. A line by population would cut that

network, leaving headworks on one side and the fields they watered on the other. Lahore, a Muslim-majority city with much Hindu and Sikh wealth, went to Pakistan; Amritsar, the holy city of the Sikhs, went to India, only about 32 miles (51 km) away. The Sikhs, about 13 percent of the Punjab's people, were spread across the province, and the line cut their homeland in two; Nankana Sahib, the birthplace of Guru Nanak, fell to Pakistan. In Gurdaspur district the award gave India three of four tehsils, including two with narrow Muslim majorities, which also gave India a road toward Kashmir; Pakistan has disputed that choice ever since. In Bengal, Calcutta, the great port and the home of the jute mills, went to India, while most of the jute fields went to East Pakistan, together with the port of Chittagong.

What followed. Radcliffe signed his awards on August 12. They were kept secret until August 17, two days after independence, so that the celebrations would not be marred. But millions had already begun to move. Fear and revenge spread through the Punjab, and Hindus, Sikhs and Muslims alike committed massacres and were their victims. Trains crossed the border with their passengers murdered; refugee columns on foot stretched for miles; tens of thousands of women were abducted. Estimates of the dead range from about 200,000 to about two million, and of the uprooted from 10 to 20 million, commonly about 15 million: one of the greatest migrations in history. In Calcutta, Gandhi's fast in September 1947 helped calm the city. Radcliffe left India within days of independence, is reported to have destroyed his papers, and never returned. Within months the two new states were at war over Kashmir, a princely state with a Muslim majority whose Hindu ruler acceded to India in October 1947 after tribal fighters from Pakistan invaded. A ceasefire line of 1949, renamed the Line of Control in 1972, still divides it; as of 2026 Kashmir remains divided and disputed among India, Pakistan and China.

The big idea. The Radcliffe Line was drawn by population, not by nature, and so it cut across the rivers, canals, railways and markets that nature and engineering had joined. Some of those cuts were later sewn up by treaty. In the Indus Waters Treaty of 1960, arranged by the World Bank, India received the three eastern rivers (Ravi, Beas, Sutlej) and Pakistan the three western (Indus, Jhelum, Chenab). It survived three wars; in April 2025 India declared the treaty held in abeyance, and as of 2026 its status remains in dispute. In the east, the two halves of Pakistan were separated by about 1,000 miles of India; after a war in 1971, East Pakistan became Bangladesh.

On the map. Some odd shapes on the Bengal border are older than Radcliffe. Around Cooch Behar there were about 160 enclaves, pockets of one country inside the other, left from old agreements between a local raja and Mughal officers; one, Dahala Khagrabari, was an Indian enclave inside a Bangladeshi enclave inside an Indian enclave inside Bangladesh. In 2015 India and Bangladesh exchanged them, and the residents chose their citizenship. Today the India–Bangladesh border runs about 2,545 miles (4,096 km), one of the longest land borders in the world. Every evening at Wagah, between Lahore and Amritsar, Indian and Pakistani border guards perform a high-stepping flag-lowering ceremony, held since 1959, before crowds on both sides.



The Radcliffe Line cut the two great provinces of the Punjab (west) and Bengal (east); Pakistan began as two wings about 1,000 miles apart.

PICTURE STUDY

Prevailing Religions of the British Indian Empire, John George Bartholomew, for the Imperial Gazetteer of India, 1909 · Color-printed map, from the Atlas volume (Vol. XXVI) of the Imperial Gazetteer of India, Oxford: Clarendon Press · Published in the Imperial Gazetteer of India; copies in many libraries; widely reproduced

In 1909 the British government of India published the Imperial Gazetteer, a great survey of the land and its people, with an atlas drawn by the Scottish mapmaker John George

Bartholomew. This map colors each part of the empire by the religion most of its people followed, using the census of 1901.

Thirty-eight years later, the men who divided India in 1947 worked from the same kind of evidence: census figures showing which districts had Muslim majorities and which did not. Look at this map as they had to. It shows where the line would have to go, and it also shows why no line could be drawn without leaving millions of people on the wrong side of it.

Look closely

- Find the two large areas colored for a Muslim majority. Where are they, and how far apart are they? What problem would that create for a single new country?
- Find the Punjab in the northwest and Bengal in the east. Are their colors solid, or do they break into patches? What does that tell you about where the border would have to run?
- Find the small area marked for the Sikhs. Where is it, and what happens to it if a line is drawn through the Punjab?
- Look at the key. What does a map like this show, and what can it not show about the people living in each colored area?

Talk about it

1. The map shows which religion had a majority in each area, not where every family lived. Why does that difference matter when a border is drawn?
2. Why would a border that followed the colors on this map still force millions of people to move or to become minorities in a new country?
3. How might a Punjabi farmer, Hindu, Muslim or Sikh, whose village lay near the edge of two colors have felt when the new line was announced in 1947?

PROJECT: BE THE BOUNDARY COMMISSION

You will play Radcliffe. On a grid of census districts with rivers, a canal, a railway and two cities, you will draw a boundary by “contiguous majority areas,” then test it against the “other factors” and count the people left on each side.

You will need

- A sheet of graph paper with a 10 × 10 grid of large squares (each square a district)
- A die, colored pencils (two colors for majorities, blue for rivers and canals, black for the railway)
- A ruler and a calculator

Steps

1. Roll the die for each district: 1–3 means a Muslim majority (M), 4–6 a non-Muslim majority (N). Shade them in two light colors. Then make the left three columns mostly

M and the right three mostly N by re-rolling any square in those columns once if it comes up the other way, so your province has a mixed middle like the real Punjab.
2. Give each district a population: roll the die and multiply by 100,000. Write it in the square.
3. Draw two rivers flowing from the top edge to the bottom. Put a canal headworks (a small triangle) on one river near the top, and draw a canal from it running across the middle of the grid. Draw a railway from a city in the left half to a city in the right half, and mark a holy site in one M or N square of the minority's color.
4. Now draw your boundary as one continuous line from the top edge to the bottom edge, following the district edges, so that each side is a single connected area.
5. Count the people in each district on the "wrong" side of your line, and compute the percentage of the total.
6. List each "other factor" your line cuts: the canal from its headworks, the railway, the holy site. Could you move the line to fix one without making another worse?
7. Write a one-paragraph award, as Radcliffe did, explaining your choices. Compare with a classmate or parent who drew a different line.

Tips

- There is no perfect answer. The point is to feel why every line left millions on the wrong side.
- Add your best line to your straight-line study table: was it straight, natural or neither?

Check your work

- I can draw a contiguous boundary on a grid of majority districts.
- I can compute how many people a boundary leaves on the minority side.
- I can explain how rivers, canals, railways and holy sites complicated the real Radcliffe Line.

MAP NOTEBOOK

1. Draw the Punjab with its five rivers labeled from west to east (Jhelum, Chenab, Ravi, Beas, Sutlej), and mark Lahore, Amritsar and the Radcliffe Line between them.
2. Draw Bengal with Calcutta, Dhaka and Chittagong. Mark where the jute grew and where the mills were, and draw the line between them.
3. Make a timeline of 1940–1972: the Lahore Resolution, Direct Action Day, the June 3 Plan, Independence, the award, the Kashmir war, the Indus Waters Treaty, Bangladesh and the Simla Agreement.

> **From history.** In 1966 the English poet W. H. Auden wrote a short poem titled "Partition" about Radcliffe's task: a judge sent out to divide a land he did not know, given too little time, who did his work and then sailed home to forget it. Radcliffe himself rarely spoke about it, though he is reported to have declined his fee for the work. He went on to a long career as a judge in Britain and became Viscount Radcliffe.

WORKED EXAMPLES

Example 1. Lahore is at about 31.55°N, 74.34°E and Amritsar at about 31.63°N, 74.87°E. How far apart are they? (At 31.6°N one degree of longitude is about 94.8 km or 58.9 miles; one degree of latitude is about 111 km or 69 miles.)

(Use the map or drawing "Lahore and Amritsar on either side of the line." shown earlier in this lesson.)

1. East–west: $(74.87 - 74.34) = 0.53° \times 94.8 \approx 50.2$ km.
2. North–south: $(31.63 - 31.55) = 0.08° \times 111 \approx 8.9$ km.
3. Distance: $\sqrt{(50.2^2 + 8.9^2)} = \sqrt{(2{,}520 + 79)} \approx \sqrt{2{,}599} \approx 51$ km, about 32 miles.

Answer: About 51 km (32 miles). Two great cities of one province, closer than many commutes, ended up in different countries with the border, at Wagah, between them.

Example 2. A hypothetical district has four tehsils. A: 300,000 people, 60% Muslim. B: 250,000, 53% Muslim. C: 250,000, 52% Muslim. D: 200,000, 30% Muslim. Tehsils A, B, C and D lie in a row from west to east. (a) Does the whole district have a Muslim majority? (b) If the line is drawn by tehsils, which go to each side? (c) If D is given an exit to a road that runs through C, what happens?

1. Muslims in each: A 180,000; B 132,500; C 130,000; D 60,000. Total 502,500 of 1,000,000 = 50.25%.
2. (a) Yes, barely: 50.25 percent.
3. (b) By tehsil, A, B and C (all over 50 percent Muslim and touching) go to one side; D goes to the other.
4. (c) If a commission gives C to the other side to keep D's road, about 130,000 Muslims (52% of C) join a non-Muslim-majority area, and the district's Muslim-majority area shrinks to A and B.

Answer: (a) Yes, 50.25 percent. (b) A, B, C to one side and D to the other. (c) Moving C for the road puts about 130,000 more Muslims on the other side. Tiny majorities and "other factors" made almost every decision contestable, as at Gurdaspur.

Example 3. Suppose about 15 million people crossed the new borders in the four months from mid-August to mid-December 1947 (about 120 days). What was the average number per day? If a refugee train carried about 3,000 people, how many trainloads would that be?

1. Per day: 15,000,000 ÷ 120 = 125,000 people a day.
2. Trainloads: 15,000,000 ÷ 3,000 = 5,000 trains, about 42 trains every day for four months.
3. In fact most refugees walked, rode carts or bullock wagons, so the columns on the roads were vast.

Answer: About 125,000 people a day, the equivalent of about 5,000 crowded trains.

PRACTICE

1. EASY Who was Sir Cyril Radcliffe, and why was he chosen?
2. EASY On what dates did India and Pakistan become independent, and when was the Radcliffe award made public?
3. EASY Name the five rivers of the Punjab from west to east.
4. EASY Which leaders headed the Indian National Congress and the Muslim League in 1947, and who was the last viceroy?
5. MEDIUM What were the boundary commissions told to use as the basis of the line, and what were the “other factors” that made it difficult? Give three.
6. MEDIUM Lahore is at about 31.55°N, 74.34°E and Dhaka at about 23.81°N, 90.41°E. Estimate the distance between Lahore, capital of West Punjab, and Dhaka, capital of East Pakistan, using about 98.6 km (61.3 miles) per degree of longitude at their middle latitude.
7. MEDIUM Why was the division of Bengal especially hard on its economy?
8. MEDIUM How did the Indus Waters Treaty of 1960 divide the rivers of the Indus system?
9. HARD Explain why the Sikhs suffered especially from the Radcliffe Line in the Punjab.
10. HARD What were the Cooch Behar enclaves, where did they come from, and how was the problem solved?
11. CHALLENGE Why did the award’s publication two days after independence matter, and what would have been the arguments for and against publishing earlier?
12. CHALLENGE In a paragraph, judge the Radcliffe Line by the standards of 1947. Consider the task Radcliffe was given, what he achieved, what went wrong, and who bears responsibility for the violence.

COMMON MISTAKES

- Thinking Radcliffe decided whether India would be partitioned. The leaders of the Congress, the League and the Sikhs and the British government made that decision; Radcliffe drew where the line would run.

- Thinking the line followed rivers. In the Punjab and Bengal it followed district and tehsil boundaries from the census, crossing rivers and canals many times.
- Assuming violence came from one side. Hindus, Muslims and Sikhs were both perpetrators and victims in 1947.

Make it a game · Which Side in 1947?. One player names a place: Lahore, Amritsar, Calcutta, Dhaka, Chittagong, Karachi, Delhi, Nankana Sahib, Sylhet, Peshawar, Srinagar, Gurdaspur. The other says “India,” “West Pakistan,” “East Pakistan” or “Disputed,” then gives one geographic reason (river, port, majority, road). One point for the side, one for the reason. Bonus point for naming what the place is called or which country holds it as of 2026. Play to fifteen.

Scripture. “If it be possible, as much as lieth in you, live peaceably with all men.” (Romans 12:18, KJV)

Paul’s words “if it be possible” admit that peace is sometimes hard. In 1947 neighbors who had lived side by side for generations turned on one another, yet in many villages men and women of every faith hid and protected their neighbors at the risk of their own lives. A line on a map does not decide whether we will live peaceably; our hearts do.

Practice answers

1. A distinguished London barrister who had never been to India; he was chosen to chair the Punjab and Bengal boundary commissions partly because he had no ties to either side.
2. Pakistan on August 14 and India on August 15, 1947. The award was signed August 12 and published August 17, 1947.
3. Jhelum, Chenab, Ravi, Beas and Sutlej. (The Indus lies to the west of the five.)
4. Jawaharlal Nehru led the Congress (with Gandhi as its moral leader and Patel as a chief organizer); Muhammad Ali Jinnah led the Muslim League; Lord Louis Mountbatten was the last viceroy.
5. “Contiguous majority areas” of Muslims and non-Muslims, from the 1941 census. Other factors: the canal network and its headworks, railways and roads, the location of cities and their trade, Sikh holy places and communities, the Calcutta port and the jute-growing districts, and natural boundaries such as rivers.
6. East–west: $16.07° \times 98.6 \approx 1{,}584$ km. North–south: $7.74° \times 111 \approx 859$ km. Distance $\approx \sqrt{(1{,}584^2 + 859^2)} \approx \sqrt{(2{,}509{,}000 + 738{,}000)} \approx 1{,}800$ km, about 1,120 miles.
7. Jute, Bengal’s great cash crop, was grown mostly in the east, which became East Pakistan, while the jute mills and the port that shipped the product were in and around Calcutta, which went to India. The line cut the crop from its mills and its port.
8. It gave India the use of the three eastern rivers (Ravi, Beas and Sutlej) and Pakistan the three western rivers (Indus, Jhelum and Chenab), with India allowed limited uses of the western rivers. It was arranged with the help of the World Bank.
9. About 13 percent of the Punjab’s population, the Sikhs were spread across the province rather than forming a majority in any large block of districts, so no contiguous-majority line could keep them together. The line cut their homeland in two, leaving rich farmlands and holy places such as Nankana Sahib, Guru Nanak’s birthplace, in Pakistan; nearly all Sikhs in West Punjab fled east.

10. About 160 small pockets of Indian territory inside Bangladesh and Bangladeshi territory inside India, including a counter-counter-enclave (Dahala Khagrabari). They dated from old agreements between the raja of Cooch Behar and Mughal officers, not from Radcliffe. In 2015 India and Bangladesh exchanged the enclaves under their Land Boundary Agreement, and the residents chose their citizenship.
11. Millions did not know which country their village would be in when power changed hands, so there was no lawful authority ready in disputed areas and fear spread. For earlier publication: people could prepare, armies and police could be positioned, and rumors would have less power. Against (Mountbatten's view): publishing before August 15 would have spoiled the independence celebrations and left the outgoing British government responsible for the violence that the award was expected to cause. Many historians judge the delay a mistake.
12. A good answer recognizes that the decision to partition was made by the Indian leaders and the British government, not by Radcliffe; that he was given an almost impossible task, five weeks to divide 88 million people by census figures that left minorities on both sides of any line; and that his line was accepted and in the Punjab still stands. It notes the failures: the haste set by the British timetable, the lack of reliable maps and local knowledge, the secret award, and too few troops to protect refugees. It states plainly that the killings were committed by Hindus, Muslims and Sikhs against one another, and that responsibility rests on those who did them and on leaders who failed to prepare, not on a line alone.

9.5 Lines in Cold Places

OBJECTIVES

- Explain how the 38th parallel was chosen to divide Korea in August 1945, and how the Korean War replaced it in 1953 with the Military Demarcation Line and the Demilitarized Zone.
- Describe the territorial claims in Antarctica, the sector principle on which they rest, and what the Antarctic Treaty of 1959 decided about them.
- Compare the two lines of the early Cold War: one became the most heavily guarded border on earth, and the other set aside a continent for peace and science. Read a polar diagram and compute sector angles and distances.

Warm-up. Take a paper plate. Put a dot in the center for the South Pole. With a ruler, draw lines from the center to the rim like slices of a pie. If seven nations each wanted a slice, and three of them wanted the same slice, how would you settle it? Now look at the rim: it stands for the line 60°S. Why might a whole group of nations agree to treat everything inside that rim differently from the rest of the world?

Watch. *25th June 1950: Korean War begins when North Korean forces cross the 38th parallel* (HistoryPod, 2:42). https://www.youtube.com/watch?v=legiW8QyxVg
After the story: watch how the temporary line at the 38th parallel became a border, and how North Korea's invasion in June 1950 started the Korean War.
Note: Captions were not available to check; preview it first. It covers only Korea, not the Antarctic part of the lesson, and uses British spellings.

KEY TERMS

38th parallel
The line of 38° north latitude, chosen by American officers in August 1945 as the dividing line between the Soviet and American zones of occupation in Korea.

Military Demarcation Line (MDL)
The line where the armies stood when the Korean War armistice was signed on July 27, 1953. It is the working border between North and South Korea.

Demilitarized Zone (DMZ)
A strip about 2.5 miles (4 km) wide, 2 km on each side of the MDL, running about 155 miles (250 km) across Korea, from which the armistice barred military forces.

sector claim
A claim to a wedge of Antarctica bounded by two meridians, running from the coast (or from 60°S) to the South Pole.

Antarctic Treaty
The treaty signed in Washington on December 1, 1959, by twelve nations, which reserves the area south of 60°S for peaceful purposes and scientific research and freezes all

territorial claims.

polar projection

A map centered on a pole, on which meridians appear as straight lines radiating from the center and parallels as circles.

CORE IDEAS

The story. Late on the night of August 10, 1945, in an office in Washington, two young American Army officers, Charles Bonesteel and Dean Rusk, were given about half an hour to solve a problem. Japan, which had ruled Korea since 1910, was about to surrender. Soviet troops had entered the war two days before and were already pushing into northern Korea; the nearest American troops were hundreds of miles away on Okinawa. The two officers needed a line where the Soviets would accept the Japanese surrender in the north and the Americans in the south. According to Rusk's later account, they looked at a National Geographic map and chose the 38th parallel, because it put the capital, Seoul, in the American zone. To their surprise, the Soviets accepted it. A line chosen in thirty minutes for a temporary military purpose became one of the most lasting borders of the twentieth century.

What the line did. The 38th parallel followed no river or ridge. It cut across roads, railways, valleys and farms, and it left the Ongjin peninsula on the west coast reachable from the South only by sea. In the north the Soviets installed a communist regime under Kim Il Sung; in the south, after elections supervised by the United Nations, the Republic of Korea was founded on August 15, 1948, under Syngman Rhee, and the Democratic People's Republic of Korea followed on September 9. On June 25, 1950, with Stalin's approval, the North Korean army invaded across the parallel and took Seoul within three days. United Nations forces, led by the United States, held a perimeter around Pusan, then landed behind the enemy at Inchon on September 15 and drove north toward the Yalu River. In October and November Chinese armies entered the war in great numbers, and the front swung south again. By mid-1951 it had settled in the mountains near the 38th parallel, where it ground on for two more years while negotiators argued, above all over whether prisoners who did not wish to go home could refuse. On July 27, 1953, at Panmunjom, the armistice was signed. Estimates of the dead, soldiers and civilians, run into the millions; about 36,500 Americans were killed.

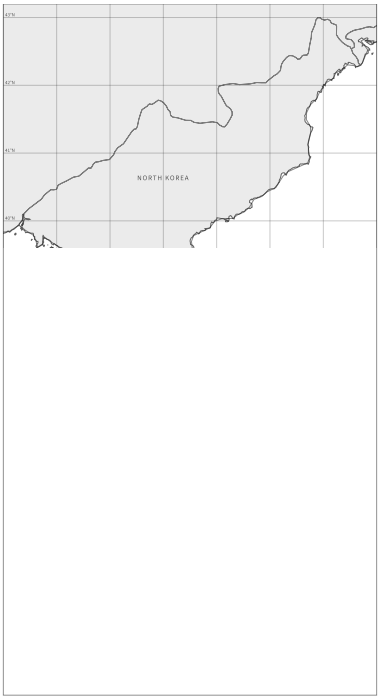
The new line. The **Military Demarcation Line** of 1953 is not the 38th parallel. It is the line where the armies stood, and it follows the hills each side had fought to hold. In the west it runs south of the parallel, so the old capital of Kaesong, in the South before the war, lies in the North. In the east it runs north of the parallel, so the South gained the mountains above the old line. Around it lies the **Demilitarized Zone**, about 155 miles (250 km) long and 2.5 miles (4 km) wide. No peace treaty has ever been signed; as of 2026 the armistice still holds and the two Koreas remain divided. The results of the division are visible from space. Satellite photographs of the peninsula at night show the South blazing with light and the North almost dark, except around Pyongyang. The North became one of the most closed and repressive states in the world, ruled by three generations of the Kim family, where Christians

are severely persecuted, though Pyongyang was once so full of churches after the revival of 1907 that missionaries called it the Jerusalem of the East. The South, poor in 1953, became a prosperous industrial democracy with a large Christian population.

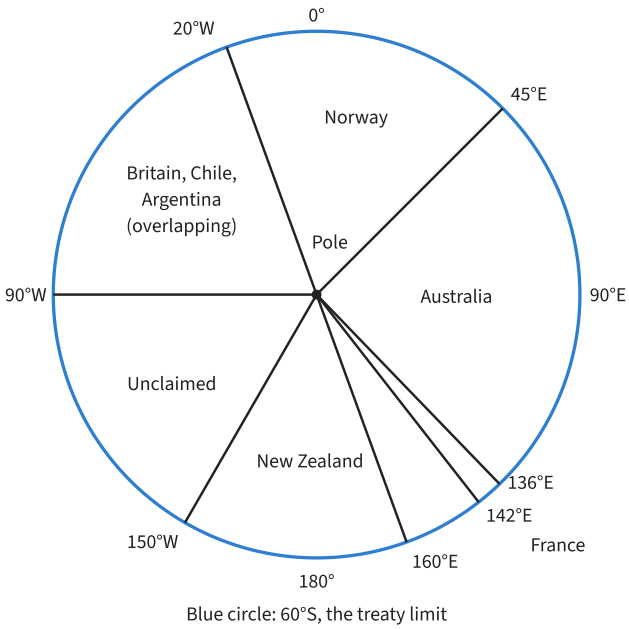
The other cold place. At the bottom of the world, lines were being drawn too. After Roald Amundsen reached the South Pole on December 14, 1911, and Robert Falcon Scott a month later, seven nations claimed parts of Antarctica: Britain in 1908, New Zealand in 1923, France in 1924, Australia in 1933, Norway in 1939, Chile in 1940 and Argentina in the 1940s. Most were **sector claims**, wedges between two meridians meeting at the Pole. The claims of Britain, Chile and Argentina overlapped on the Antarctic Peninsula, and in the 1940s and 1950s their parties sometimes confronted one another there. The United States and the Soviet Union made no claims but refused to recognize anyone else's. Then science intervened. During the International Geophysical Year of 1957–1958, twelve nations ran research stations across the continent, including an American station at the South Pole itself.

The big idea. On December 1, 1959, in Washington, those twelve nations signed the **Antarctic Treaty**. It applies to everything south of 60°S. Antarctica is to be used for peaceful purposes only; military bases and maneuvers are forbidden, though military people and ships may support science. Scientists may work anywhere and must share their results. Nuclear explosions and the dumping of radioactive waste are banned, making the treaty the first arms-control agreement of the Cold War. Any party may inspect any station at any time. And Article IV froze the claims: no one gives up a claim, no new claim may be made, and nothing done while the treaty lasts can strengthen or weaken one. The treaty took effect in 1961. In 1991 the Madrid Protocol added a ban on mining. As of 2026 more than fifty nations are parties.

On the map. Why could a line be frozen in Antarctica but not in Korea? Geography answers much of it. Antarctica, about 5.4 million square miles (14 million km^2), is almost entirely covered by ice more than a mile thick on average, ringed by the stormy Southern Ocean, with no native people, no farms and no cities. No one lived on the wrong side of a line, and no army could easily hold it. Korea held some 30 million people in 1950, and its line ran through their homes. Both lines were drawn in the cold of the early Cold War, by the same great powers, within fourteen years of each other. One became a wall; the other became a laboratory. The difference shows that the same kind of line, a parallel or a meridian, can serve war or peace depending on the land it crosses and the will of those who draw it.

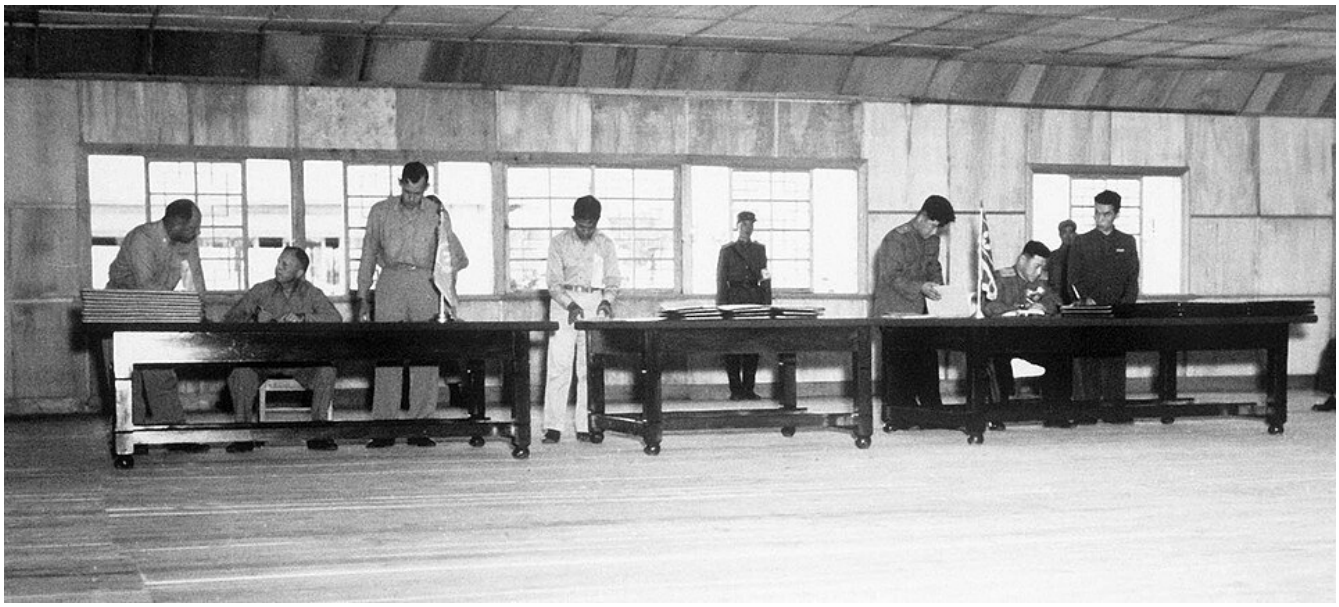


The 38th parallel (1945) and the armistice line of 1953 shown by today's border.



Antarctic sector claims (simplified). The treaty area is everything inside the 60°S circle.

PICTURE STUDY



The Signing of the Korean Armistice at Panmunjom, F. Kazukaitis, U.S. Navy photographer, July 27, 1953 · Black-and-white photograph · U.S. National Archives and Records Administration (80-G-625728; public domain)

The armistice was signed at 10 a.m. on July 27, 1953, in a building put up for the purpose at Panmunjom. Lieutenant General William K. Harrison Jr. signed for the United Nations Command and General Nam Il for the North Korean army and the Chinese People's Volunteers. They sat at separate tables, signed the copies of the agreement almost without a word, and left without shaking hands. The fighting stopped twelve hours later.

Harrison was a devout Christian who read his Bible daily throughout the war. The photograph records a moment that ended the shooting but not the war: as of 2026 no peace treaty has been signed.

Look closely

- Count the tables. Why would the two sides insist on separate tables rather than one?
- Find the flags on the tables. Which ones can you identify?
- Look at the building itself. Does it look permanent or temporary? What does that suggest about how both sides thought of the agreement?
- Look at the faces of the people standing around. What feelings do you read there?

Talk about it

1. The Republic of Korea did not sign the armistice. Why might President Syngman Rhee have refused, and what does that tell you about the line?
2. Is a photograph of a signing evidence of peace? What would you need to see to know whether the agreement worked?
3. Compare this picture with the engraving of the Berlin Conference in Lesson 9.2. What is similar and what is different about how these two lines were made?

PROJECT: TREATY BORDERS OF THE WORLD: THE UNIT MAP, WITH A POLAR INSET

This is the map of the unit. You will draw a world map of the treaty lines you have studied, and add an inset of Antarctica on a paper plate, drawn in polar projection, with its sector claims and the treaty boundary at 60°S.

You will need

- A large outline world map (or poster board on which you trace one)
- A paper plate, a protractor, a ruler and a compass (for drawing circles)
- Colored pencils or fine markers; your straight-line study table from Lesson 9.2

Steps

1. On the world map draw and label each treaty line in red: Tordesillas (1494, about 46°W) and Zaragoza (1529, about 144°E); Egypt's 22°N and 25°E lines; Sykes's Acre–Kirkuk line (1916, dashed); the Radcliffe Line in the Punjab and Bengal (1947); the 38th parallel in Korea (1945) and the armistice line (1953). Add from earlier units the 49th parallel (1818, 1846) and the Rio Grande (1848).
2. Beside each line write its year, the treaty, and whether it is geometric, physical or mixed.
3. On the paper plate, mark the South Pole at the center. The rim is 60°S. Draw a smaller circle about one-third of the way in to suggest the coast.
4. With a protractor at the center, mark 0° at the top and measure east longitudes clockwise. Draw radial lines at 20°W, 45°E, 136°E, 142°E, 160°E, 150°W and 90°W.
5. Label the sectors: Norway (20°W–45°E), Australia (45°E–136°E and 142°E–160°E), France (136°E–142°E), New Zealand (160°E–150°W), unclaimed (150°W–90°W), and the overlapping claims of Britain (20°W–80°W), Argentina (25°W–74°W) and Chile (53°W–90°W) on the peninsula side.
6. Tape the plate to the map as an inset near the bottom, and write the key articles of the Antarctic Treaty around its edge.
7. Add a legend and a title, and write a paragraph comparing the 38th parallel and 60°S as two lines of the Cold War.

Tips

- On a south polar map, east longitudes run clockwise when 0° is at the top. Check: the Antarctic Peninsula (about 60°W) should appear at the upper left.
- This map is part of your unit portfolio. Keep it flat and neat.

Check your work

- I can draw and date the major treaty lines of the world.
- I can draw the Antarctic claims on a polar projection and identify where they overlap.
- I can explain what the Antarctic Treaty did to the claims and why.

MAP NOTEBOOK

1. Sketch Korea with the 38th parallel and the 1953 line. Shade the land the North gained in the west (around Kaesong) and the land the South gained in the east.
2. Draw a small polar diagram of Antarctica and shade the three overlapping claims on the peninsula in three colors.
3. Make a two-column chart comparing the DMZ and the Antarctic Treaty area: year, who drew the line, kind of line, people living there, weapons allowed, result.

> **From history.** The American station at the South Pole, first built in 1956–1957 for the International Geophysical Year, is named the Amundsen–Scott South Pole Station in honor of both men who reached the Pole in 1911–1912. Because the Pole sits where all the sector lines meet, a visitor can walk around the ceremonial marker there and pass through the claims of several nations in a few seconds, all of them frozen by the treaty.

WORKED EXAMPLES

Example 1. The 38th parallel crosses Korea from the west coast near 125.0°E to the east coast near 128.65°E. How long is the line across the peninsula? (At 38° latitude one degree of longitude is about 87.7 km or 54.5 miles.)

(Use the map or drawing "The 38th parallel across Korea." shown earlier in this lesson.)

1. Span of longitude: 128.65° − 125.0° = 3.65°.
2. Length: 3.65 × 87.7 ≈ 320 km; 3.65 × 54.5 ≈ 199 miles.
3. Check the factor: 111.32 km × cos 38° = 111.32 × 0.788 ≈ 87.7 km.

Answer: About 320 km (about 200 miles), roughly 70 km longer than the 250-km DMZ of 1953, mainly because the parallel begins far to the west on the Ongjin peninsula while the armistice line begins farther east in the Han River estuary.

Example 2. The DMZ is about 250 km (155 miles) long and 4 km (2.5 miles) wide. Find its area. Then find how far Seoul (37.57°N, 126.98°E) is from Panmunjom (37.96°N, 126.68°E). (At 37.8°N one degree of longitude is about 88 km or 54.6 miles.)

1. Area: 250 × 4 = 1,000 km²; 155 × 2.5 ≈ 388 square miles.
2. North–south: (37.96 − 37.57) = 0.39° × 111 ≈ 43.3 km.
3. East–west: (126.98 − 126.68) = 0.30° × 88 ≈ 26.4 km.
4. Distance: $\sqrt{(43.3^2 + 26.4^2)} = \sqrt{(1{,}875 + 697)} \approx \sqrt{2{,}572} \approx 51$ km, about 32 miles.

Answer: About 1,000 km² (about 390 square miles). Seoul, a city of millions, lies only about 51 km (32 miles) from Panmunjom on the armistice line.

Example 3. Australia claims the sectors from 45°E to 160°E, except France's sector from 136°E to 142°E. What fraction of a full circle is Australia's claim? How long is its share of the 60°S circle, which has a circumference of about 20,040 km (12,450 miles)?

(Use the map or drawing "Sector claims in Antarctica." shown earlier in this lesson.)

1. Australia's angle: (160 − 45) − (142 − 136) = 115 − 6 = 109°.
2. Fraction: 109 ÷ 360 ≈ 0.303, about 30 percent.
3. Length along 60°S: 0.303 × 20,040 ≈ 6,070 km; 0.303 × 12,450 ≈ 3,770 miles.
4. Note: Australia's claim covers about 42 percent of the continent's area, more than 30 percent, because East Antarctica reaches farther north toward 60°S in those sectors.

Answer: 109°, about 30 percent of the circle, or about 6,070 km (3,770 miles) along 60°S.

PRACTICE

1. EASY Who chose the 38th parallel, when, and why that line?
2. EASY When did the Korean War begin and when was the armistice signed? Where was it signed?
3. EASY When and where was the Antarctic Treaty signed, how many nations signed it, and what area does it cover?
4. EASY Name the seven nations that claim parts of Antarctica.
5. MEDIUM Use the polar diagram. The unclaimed sector runs from 90°W to 150°W. What fraction of the circle is it, and how long is its stretch of the 60°S circle (20,040 km; 12,450 miles)?
   (Use the map or drawing "The unclaimed sector lies between 90°W and 150°W." shown earlier in this lesson.)
6. MEDIUM Britain claims 20°W–80°W, Argentina 25°W–74°W and Chile 53°W–90°W. Over how many degrees do all three claims overlap? Over how many degrees do Britain and Chile overlap?
7. MEDIUM How does the Military Demarcation Line of 1953 differ from the 38th parallel? Give one example in the west and one in the east.
8. MEDIUM Name four main provisions of the Antarctic Treaty.
9. HARD Amundsen reached the South Pole on December 14, 1911, and Scott on January 17, 1912. How many days later did Scott arrive? Why do explorers' journeys matter for later sector claims?
10. HARD Seoul fell three days after the invasion of June 25, 1950. Seoul is about 51 km (32 miles) from the armistice line at Panmunjom, and the 38th parallel was a little farther north. What does this tell you about the geographic weakness of the 38th parallel as a defensive border for the South?

11. CHALLENGE Why was it possible to freeze the claims in Antarctica but not to settle the line in Korea peacefully? Give at least three geographic or human reasons.
12. CHALLENGE Write a paragraph comparing the 38th parallel and the 60°S line as two lines of the early Cold War. Include who drew each line, why, what kind of line it is, and its results as of 2026.

COMMON MISTAKES

- Thinking today's border between the Koreas is the 38th parallel. The 1953 armistice line crosses the parallel, lying south of it in the west and north of it in the east.
- Thinking the Korean War ended with a peace treaty. It ended with an armistice in 1953; as of 2026 no peace treaty has been signed.
- Thinking the Antarctic Treaty cancelled the claims. Article IV froze them: no claim was given up, and no new claim can be made while the treaty is in force.

Make it a game · Pole to Parallel. Make two decks of cards. Deck one has numbers in degrees (20°W, 45°E, 136°E, 142°E, 160°E, 150°W, 90°W, 38°N, 60°S, 22°N, 49°N). Deck two has places and treaties (Norway's claim, France's Adélie Land, New Zealand's Ross Dependency, the unclaimed sector, Korea 1945, the Antarctic Treaty boundary, Egypt and Sudan, the Oregon Treaty). Lay them face down and play Concentration: turn over one card from each deck and keep the pair if they match. Explain each match aloud to keep it. The player with the most pairs wins.

Scripture. "Out of whose womb came the ice? and the hoary frost of heaven, who hath gendered it? The waters are hid as with a stone, and the face of the deep is frozen." (Job 38:29–30, KJV)

God asks Job whether he understands the ice. Antarctica, with most of the world's ice, still humbles every nation that claims it. The treaty that set it aside for peace echoes the prophet's hope that nations would one day beat their swords into plowshares (Isaiah 2:4), while the DMZ shows how far the world still is from that day.

Practice answers

1. Two American Army officers, Charles Bonesteel and Dean Rusk (later Secretary of State), on the night of August 10–11, 1945, in Washington. It put Seoul in the American zone and was a line the Soviets might accept.
2. It began June 25, 1950, when North Korea invaded the South; the armistice was signed July 27, 1953, at Panmunjom.
3. December 1, 1959, in Washington, by twelve nations. It covers everything south of 60°S.
4. Britain, New Zealand, France, Australia, Norway, Chile and Argentina.
5. 60° ÷ 360° = 1/6, about 16.7 percent. 20,040 ÷ 6 ≈ 3,340 km; 12,450 ÷ 6 ≈ 2,075 miles.
6. All three overlap from 53°W to 74°W: 21°. Britain and Chile overlap from 53°W to 80°W: 27°.
7. It follows the line where the armies stood, along the hills they held, not a parallel. In the west it lies south of the 38th, so Kaesong, once in the South, is now in the North (along with the

Ongjin peninsula). In the east it lies north of the 38th, so the South gained mountainous land above the old line.

8. Any four: peaceful purposes only, no military bases or maneuvers; freedom of scientific research and exchange of results; claims frozen (Article IV); no nuclear explosions or radioactive waste; any party may inspect any station; applies south of 60°S.
9. December has 31 days: 17 days remained in December after the 14th, plus 17 days in January = 34 days. Discovery, exploration and occupation were the traditional grounds for claims; Britain, New Zealand and Norway based their claims partly on the expeditions of Scott, Shackleton, Amundsen and others.
10. The South’s capital, its largest city and its government lay very close to an open, unfortified line with no river or ridge to defend, so an attacking army could reach it in days. The parallel had been drawn for a military surrender, not for defense; the 1953 line, by contrast, follows hills that each side had fought to hold.
11. Antarctica had no native population, no cities or farms, and no one living on the wrong side of a line; its ice, cold and isolation made claims nearly impossible to occupy or enforce; and its value lay in science, which all nations shared. Korea held about 30 million people with one language and history, divided by an arbitrary line between two hostile regimes, each of which wanted to rule the whole; it bordered the Soviet Union and China and was a battleground of the Cold War.
12. A good answer explains that American officers chose the 38th parallel in 1945 as a temporary boundary for accepting the Japanese surrender, a geometric line ignoring the land; that it hardened into two hostile states, led to the Korean War (1950–1953) and was replaced by the armistice line and the DMZ, which as of 2026 still divide a free, prosperous South from a closed communist North without a peace treaty. It explains that twelve nations, including both superpowers, chose 60°S in 1959 to set aside Antarctica for peace and science, freezing rival sector claims; that the line follows the ring of the Southern Ocean around a continent without people; and that the treaty has held for more than sixty years. It concludes that the land a line crosses, and the will of those who draw it, matter more than its shape.

Unit 9 test

Answer each question. Show your work for every calculation and give units in both miles and kilometers where asked. Use about 69 miles (111 km) per degree of latitude, and 69.17 miles (111.32 km) × cos(latitude) per degree of longitude. Use complete sentences for explanations, and describe disputed questions fairly. The test is worth 100 points.

1. (7 pts) What did the Treaty of Tordesillas (1494) decide, and how did it differ from Pope Alexander VI's line of 1493? Why did Portugal want the change?
2. (7 pts) Using 17½ leagues per degree and a starting point of 25°W, find the longitude of the Tordesillas line. Give two reasons the line could not be marked exactly in 1494.
3. (7 pts) Explain how the Tordesillas line led to the Treaty of Zaragoza (1529) and why Brazil today extends far west of the line.
4. (7 pts) Picture study: What is the Cantino planisphere, and what does it show about the Tordesillas line and Portuguese knowledge in 1502?
5. (7 pts) State three things the General Act of Berlin (1885) decided, and explain why it is wrong to say that the conference drew Africa's borders.
6. (7 pts) Egypt's southern border runs along 22°N from 25°E to about 36.9°E. Find its length in miles and kilometers (cos 22° ≈ 0.927). Why was a straight line used here?
7. (7 pts) Describe the Congo Free State: who ruled it, what wrongs were committed there, who exposed them and how it ended.
8. (7 pts) Identify each and give its date: (a) the Sykes–Picot agreement, (b) the Balfour Declaration, (c) the San Remo conference, (d) the Treaty of Lausanne.
9. (7 pts) Explain how geography shaped the borders of Iraq and Lebanon, and why many borders in the region are straight lines.
10. (7 pts) Sykes described his line as running from Acre (32.93°N, 35.08°E) to Kirkuk (35.47°N, 44.39°E). Using 92 km (57 miles) per degree of longitude at that latitude, estimate the line's length.
11. (7 pts) Who drew the Radcliffe Line, on what basis, and in how much time? Name two "other factors" that made the work hard.
12. (7 pts) Describe the human results of Partition in 1947 and two long-term consequences that still shape the map.
13. (8 pts) How was the 38th parallel chosen, how long is it across Korea (125.0°E to 128.65°E; cos 38° ≈ 0.788), and how does the 1953 armistice line differ from it?
14. (8 pts) State four provisions of the Antarctic Treaty (1959). Then compute the angle and the fraction of the circle of Australia's claim (45°E–160°E, excluding France's 136°E–142°E), and explain why claims could be frozen in Antarctica but not in Korea.

UNIT PROJECT: TREATY BORDERS OF THE WORLD: A STRAIGHT-LINE BORDERS STUDY

Assemble your unit map of treaty borders of the world (Lesson 9.5), with every treaty line drawn, dated and labeled as geometric, physical or mixed, and the paper-plate polar inset of Antarctica. Add your straight-line study table (begun in Lesson 9.2 and extended in Lessons 9.3–9.5) covering at least fifteen border segments from at least five regions, with the length

of each type measured from a map scale, the population along it (sparse or dense) and its history since it was drawn.

Write an essay of 600 to 800 words answering the question: *Do straight-line borders cause conflict?* Use at least four cases from this unit (for example the Egypt–Sudan line, the Syrian Desert borders, the Radcliffe Line, the 38th parallel and 60°S) and at least one natural border from earlier units for comparison. Weigh where each line ran, who lived along it, who drew it and with whose consent, and judge the people of the past by the standards and knowledge of their own time.

- **Map accuracy**: Treaty lines are correctly placed with accurate years and treaties; the polar inset shows the claims in the right order and positions with 60°S marked; the legend is clear.
- **Data and measurement**: The study table includes at least fifteen segments from five regions, with lengths measured from the scale, correct classifications and correct percentage calculations.
- **Reasoning and fairness**: The essay uses specific evidence to weigh the claim, distinguishes the shape of a line from the land and people it crosses, presents disputed questions neutrally, and names achievements and wrongs plainly without slogans.
- **Craft**: Maps and table are neat and readable; the essay is clearly organized, quotes at least one treaty or primary document accurately, and is free of careless errors.

Answer key

1. It divided newly reached lands between Spain and Portugal along a meridian 370 leagues west of the Cape Verde Islands, Spain to the west and Portugal to the east. The papal bull *Inter caetera* (1493) had set the line only 100 leagues west of the Azores and Cape Verde Islands. Portugal wanted the line moved west to keep the open Atlantic its ships used when swinging west to catch the winds around Africa, and any lands in it.
2. 370 ÷ 17.5 ≈ 21.1°; 25 + 21.1 = 46.1°W. Reasons: the treaty did not name the starting island; the league had no agreed length; longitude could not be measured reliably at sea; the joint expedition to fix it never sailed.
3. A meridian around the globe has a second half; when Magellan's Spanish expedition reached the Moluccas, both crowns claimed them, and at Zaragoza Spain sold its claim for 350,000 ducats and a line was set about 17° east of the islands. Brazil extends west because Portuguese settlers, ranchers and bandeirantes occupied the interior, and the Treaty of Madrid (1750) replaced Tordesillas with *uti possidetis*, letting each side keep what it held.
4. A Portuguese world chart of 1502, obtained in Lisbon by Alberto Cantino for the Duke of Ferrara and now in the Biblioteca Estense in Modena. It is the oldest surviving map showing the Tordesillas line, drawn down the Atlantic, with Brazil and Newfoundland placed on Portugal's side. Africa is drawn accurately because the Portuguese had sailed its coasts, while the New World appears only as fragments.
5. Any three: free trade in the Congo basin; free navigation on the Congo and Niger; notification and effective occupation for new coastal claims; pledges against the slave trade and for the protection of missionaries and native peoples (and recognition of Leopold's Congo). Most borders were drawn afterward in bilateral treaties between European powers from 1885 to about 1914.

6. 11.9° × 69.17 × 0.927 ≈ 763 miles; 11.9° × 111.32 × 0.927 ≈ 1,228 km. It crosses the Sahara and Nubian Desert, where few people lived, there were no rivers or ridges to follow and the land was unsurveyed.
7. It was ruled personally by King Leopold II of Belgium from 1885. Under its rubber regime, villagers were forced to gather rubber, hostages were taken, villages burned and hands cut off as punishment. Missionaries such as William Sheppard and John and Alice Harris, the journalist E. D. Morel and consul Roger Casement (1904 report) exposed it, and Belgium annexed the Congo in 1908.
8. (a) May 1916: secret British–French division of the Ottoman Arab lands into zones of control and influence. (b) November 2, 1917: British support for a Jewish national home in Palestine without prejudice to the rights of non-Jewish communities. (c) April 1920: assigned the mandates, Syria and Lebanon to France, Iraq and Palestine to Britain. (d) July 24, 1923: replaced Sèvres and fixed most of the borders of modern Turkey.
9. Iraq was formed from the vilayets of Mosul, Baghdad and Basra, joined by the Tigris–Euphrates river system that runs to the Gulf. Lebanon follows the Lebanon and Anti-Lebanon mountains and the coast. Borders across the Syrian and Arabian deserts, among Syria, Jordan, Iraq and Saudi Arabia, are straight because few settled people lived there and there were no natural features to follow.
10. N–S: 2.54° × 111 ≈ 282 km; E–W: 9.31° × 92 ≈ 857 km. Length ≈ $\sqrt{(282^2 + 857^2)}$ ≈ 902 km, about 560 miles.
11. Sir Cyril Radcliffe, a London barrister who had never been to India, chairing the Punjab and Bengal boundary commissions, about five weeks (July 8 to August 12, 1947), on the basis of “contiguous majority areas” of Muslims and non-Muslims from the 1941 census. Other factors: the canal network and its headworks, railways, cities such as Lahore and Calcutta, Sikh holy places, the jute fields and mills of Bengal.
12. About 15 million people (estimates 10 to 20 million) crossed the new borders, and between about 200,000 and two million were killed in massacres in which Hindus, Muslims and Sikhs were both perpetrators and victims; tens of thousands of women were abducted. Long-term: the Kashmir dispute and the Line of Control; the Indus Waters Treaty (1960) dividing the rivers; East Pakistan becoming Bangladesh (1971); the Cooch Behar enclaves (exchanged 2015).
13. American officers Charles Bonesteel and Dean Rusk chose it on the night of August 10–11, 1945, using a National Geographic map, because it put Seoul in the American zone; the Soviets accepted. Length: 3.65° × 111.32 × 0.788 ≈ 320 km; 3.65 × 69.17 × 0.788 ≈ 199 miles. The 1953 line follows the battle line along the hills: south of the parallel in the west (Kaesong went to the North) and north of it in the east.
14. Provisions (any four): applies south of 60°S; peaceful uses only; freedom of science and exchange of results; claims frozen (Article IV); no nuclear explosions or radioactive waste; inspection of any station. Australia: 115° − 6° = 109°, about 30 percent of the circle. Antarctica has no native population, no one on the wrong side of a line, claims that could not be occupied or enforced, and a shared scientific value; Korea held some 30 million people divided between two hostile regimes, each seeking to rule the whole.

UNIT 10

The Surveyors

For nine units you have watched rivers, mountains, deserts, seas and treaties decide where borders fall. But a border described in a treaty is only words until someone goes out and finds it on the ground. In this last unit you meet the surveyors who did that work: Charles Mason and Jeremiah Dixon reading latitude from the stars in the forests of Pennsylvania (1763–1767); Thomas Hutchins and the land surveyors who stamped a grid of townships and sections across the American West; William Lambton and George Everest, who measured India triangle by triangle from 1802 and laid the framework that fixed the height of the world's highest mountain; and the British and American boundary commissions that marked the 49th parallel through forest, swamp and prairie.

Each lesson is also a working session in the field. You will build a straw quadrant and find your latitude by Polaris, make a 66-foot surveyor's chain, lay out a true square, build a sighting board and triangulate distances you never walk, set monuments with witnesses, and finally draft your own scaled survey map. The quantitative work is real: degrees, minutes and seconds; chains and acres; the law of sines; the curvature of the earth; the convergence of meridians; and the difference between a parallel and a great circle.

The unit closes with a review of the whole course built around four questions you can ask of any border on earth: what nature offered, what power decided, what a treaty said, and what surveyors marked. Behind them all stands the verse that has guided the course: God "hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26). The final exam is given separately.

BEFORE YOU BEGIN

- Can read latitude and longitude in degrees and minutes and convert between them
- Can use a map scale and convert between miles and kilometers
- Can use sine, cosine and tangent on a calculator and solve a right triangle
- Knows the treaty borders of Units 8 and 9, especially the Oregon Treaty (1846) and the 38th parallel

MASTERY CHECKLIST

- I can explain how Mason and Dixon found latitude by the stars and marked a parallel on the ground, and why their line later came to stand for North and South.
- I can read and write a Public Land Survey legal description and compute its acreage, and explain why correction lines are needed.
- I can solve a survey triangle with the law of sines and compute a mountain's height with the curvature correction, as the Great Trigonometrical Survey did.
- I can explain why the U.S.–Canada boundary zigzags slightly around the 49th parallel and why the marked line, not the mathematical parallel, is the border.

- I can survey a small area with homemade instruments and draft a scaled map with area, closure error, north arrow and scale bar.
- I can use the four questions (nature, power, treaty, survey) to explain why any border in the course falls where it does.

OPTIONAL BOOKS AND RESOURCES

- **Library of Congress, Geography and Map Division** (https://www.loc.gov/maps/): Free. Search for “Mason and Dixon,” “Seven Ranges” or “boundary survey” to view historic survey maps and plats in high resolution, including the kinds of maps studied in this unit.
- **George Washington’s papers at the Library of Congress** (https://www.loc.gov/collections/george-washington-papers/): Free. Includes Washington’s early diaries and survey records. Read aloud a page of his 1748 journey over the mountains (Lesson 10.5) and compare his spelling and field notes with your own.
- **National Geodetic Survey (NOAA)** (https://geodesy.noaa.gov/): Free. The federal agency that maintains survey marks across the United States. Its datasheets let you look up a real benchmark near your home and visit it.

10.1 Mason and Dixon: Surveying by the Stars

OBJECTIVES

- Explain why the Penn and Calvert families needed a surveyed line and how the 1760 agreement defined it as a parallel of latitude 15 miles south of Philadelphia.
- Describe how Mason and Dixon found latitude with a zenith sector and the stars, measured distance with a Gunter's chain, and marked the line with milestones and crownstones.
- Convert between miles, chains, degrees and minutes of latitude, and compute a latitude from a star's declination and its distance from the zenith.

Warm-up. Stand in a room and point to where you think "due north" is. Now try to walk a perfectly straight line across the room with your eyes closed, then open them. How far did you drift? Mason and Dixon had to run a line more than 230 miles through forest and over mountains without drifting more than a few feet north or south. Write down one tool you think they would need.

Watch. *Searching for the Mason Dixon Line! | Outdoors Maryland* (Outdoors Maryland, 8:26). https://www.youtube.com/watch?v=6cnzhlywke4
After the story: watch modern surveyors track down the stone markers Mason and Dixon set, and look closely at a crownstone with its two coats of arms.
Note: Captions were not available to check; preview it first. It is a Maryland Public Television program and should be family-friendly. Focuses on finding and caring for the boundary stones today more than on how Mason and Dixon surveyed by the stars.

KEY TERMS

latitude
Distance north or south of the equator, measured as an angle in degrees (°), minutes (′) and seconds (″). One degree of latitude is about 69 miles (111 km); one minute is about 1.15 miles (1.85 km).

zenith sector
A long telescope hung from a pivot and aimed nearly straight up, with a plumb line and a finely divided arc, used to measure how far a star passes from the zenith (the point directly overhead).

declination
A star's position north or south of the celestial equator, the sky's version of latitude. Astronomers in the 1760s took it from printed star tables.

Gunter's chain
A surveyor's measuring chain 66 feet long, made of 100 links. Eighty chains make one mile, and ten square chains make one acre.

parallel

A line on the earth joining all places with the same latitude. A parallel is a curve, not a straight line, so a surveyor running one must keep checking and correcting.

crownstone
A larger boundary stone set every fifth mile along the Mason–Dixon Line, carved with the Penn coat of arms on the Pennsylvania side and the Calvert arms on the Maryland side.

CORE IDEAS

The story. On November 15, 1763, two Englishmen stepped ashore at Philadelphia. Charles Mason was an astronomer who had worked as an assistant at the Royal Observatory at Greenwich. Jeremiah Dixon was a surveyor from County Durham in the north of England. They had worked together once before: in 1761 the Royal Society sent them to observe the transit of Venus from Sumatra, but a French warship attacked their ship soon after it left England, and they made their observations at the Cape of Good Hope instead. Now they had been hired by two families who owned two colonies. Thomas and Richard Penn were the proprietors of Pennsylvania, and Frederick Calvert, the sixth Lord Baltimore, was proprietor of Maryland. Their families had quarreled for about eighty years over where one colony ended and the other began.

Why a line was needed. The trouble began on paper. Maryland's charter of 1632 carried its northern edge to the fortieth parallel. Pennsylvania's charter of 1681 assumed a southern edge near the same latitude. But Philadelphia, founded by William Penn in 1682, turned out to lie at about 39°57′ N, south of the fortieth parallel. Read strictly, Maryland's charter put Pennsylvania's capital inside Maryland. Settlers on both sides paid taxes to whichever colony they chose, and in the 1730s the quarrel turned violent in a string of raids, arrests and burnings remembered as Cresap's War. After long lawsuits in England, the families signed an agreement in 1760. The boundary would be a parallel of latitude exactly 15 English miles south of the southernmost point of Philadelphia, running west for five degrees of longitude from the Delaware River. The agreement also fixed the line between Maryland and the "Three Lower Counties" that later became Delaware. Local surveyors tried for several years and could not get the accuracy the agreement required, so the families sent to London for the best men they could find.

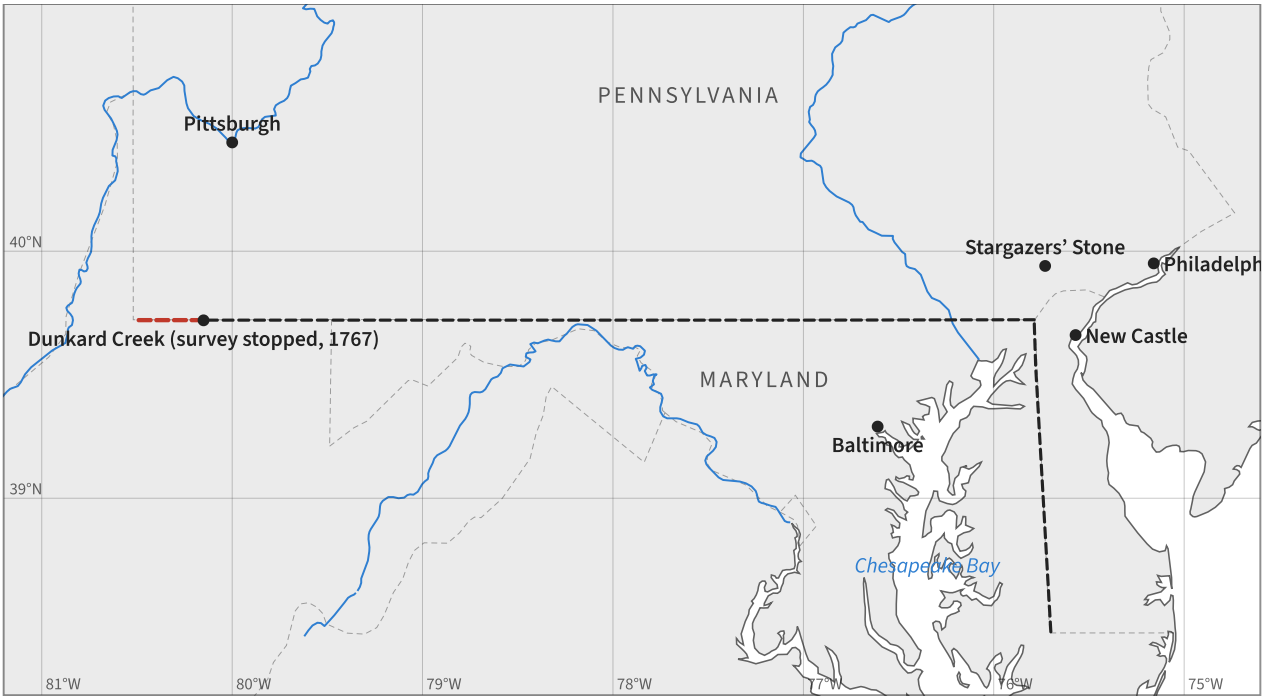
How it worked. Latitude cannot be seen on the ground, but it can be read in the sky. Mason and Dixon carried a zenith sector built by the London instrument maker John Bird, a telescope about six feet long that hung from a pivot and swung along a finely divided arc. A plumb line marked the true vertical. On clear nights they watched particular stars cross the meridian close to the zenith and measured how far each one passed north or south of straight overhead. Star tables gave each star's declination. If a star passes south of the zenith, latitude = declination + zenith distance; if north, latitude = declination − zenith distance. Averaging many stars over many nights fixed a latitude to within a few seconds of arc. They first fixed the latitude of the southernmost point of Philadelphia, the north wall of a house on Cedar Street (today South Street), at about 39°56′29″ N. Because a line run due south from there would cross the Delaware River and its marshes, they went about 31 miles west to the farm of John Harlan in Chester County, set up their observatory, and planted a

marker now called the Stargazers' Stone. From there they chained 15 miles due south, keeping the chain level on sloping ground, and set the "Post mark'd West," the starting point for the West Line. They also surveyed the Maryland–Delaware boundary: the Tangent Line, run north to touch a 12-mile circle around New Castle, and the North Line, which carried it up to the parallel.

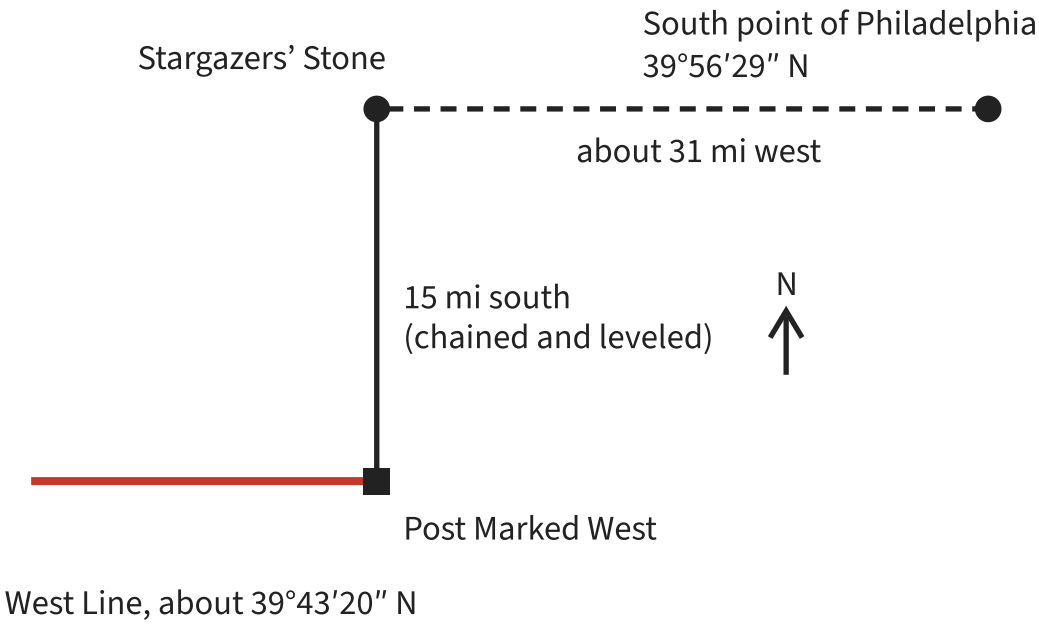
Running the West Line. A parallel of latitude is a curve, so it cannot be run by simply sighting straight ahead. Mason and Dixon ran straight stretches, then measured small offsets north back onto the true parallel, and stopped often to check their latitude by the stars again. Axmen cut a cleared lane through the forest, which the surveyors called a "visto," so that the line could be seen and followed. Beginning in 1765 they pushed west across the Susquehanna River and the ridges of the Appalachians. Milestones of limestone, cut in England and shipped across the Atlantic, were set along the line: each ordinary stone was carved with an M on the Maryland side and a P on the Pennsylvania side, and every fifth mile received a crownstone bearing the two coats of arms. West of Sideling Hill the mountains were too steep for wagons to haul stones, so the line there was marked with heaps of earth and stones. The western country still belonged to the Indian nations, and an escort of men from the Six Nations (the Iroquois) traveled with the party under an agreement made for the survey. In October 1767, at a war path near Dunkard Creek, the escort's leaders said the surveyors must go no farther. The party stopped about 233 miles west of the start of the West Line. Mason and Dixon sailed home in 1768. The last stretch to Pennsylvania's southwest corner was finished in 1784 by commissioners for Pennsylvania and Virginia, including the astronomer David Rittenhouse and the surveyor Andrew Ellicott.

The big idea. The Mason–Dixon Line is an artificial border: no river or ridge told anyone where it should go. A sentence in a legal agreement became a lane through the forest and a row of carved stones because careful men could read the stars and measure the ground. The line settled taxes, land titles and courts, and it lasted. It also took on a meaning the surveyors never planned. Pennsylvania passed a law for the gradual abolition of slavery in 1780, while Maryland kept slavery until 1864, so the line became a border between a free state and a slave state, and for enslaved people escaping north, crossing it was a real step toward freedom (though federal fugitive slave laws still threatened them in the North). By the 1800s Americans used "the Mason–Dixon Line" as shorthand for the divide between North and South, even though the line itself ran only along the borders of Pennsylvania, Maryland and Delaware.

Technology overcoming geography. The forests had no landmarks fine enough to settle the quarrel. Bird's zenith sector turned starlight into latitude, and the chain and level turned rough ground into exact distance. Look at the map (figure ha-mason-dixon-map): the line runs straight across ridges and rivers that a natural border would have followed.

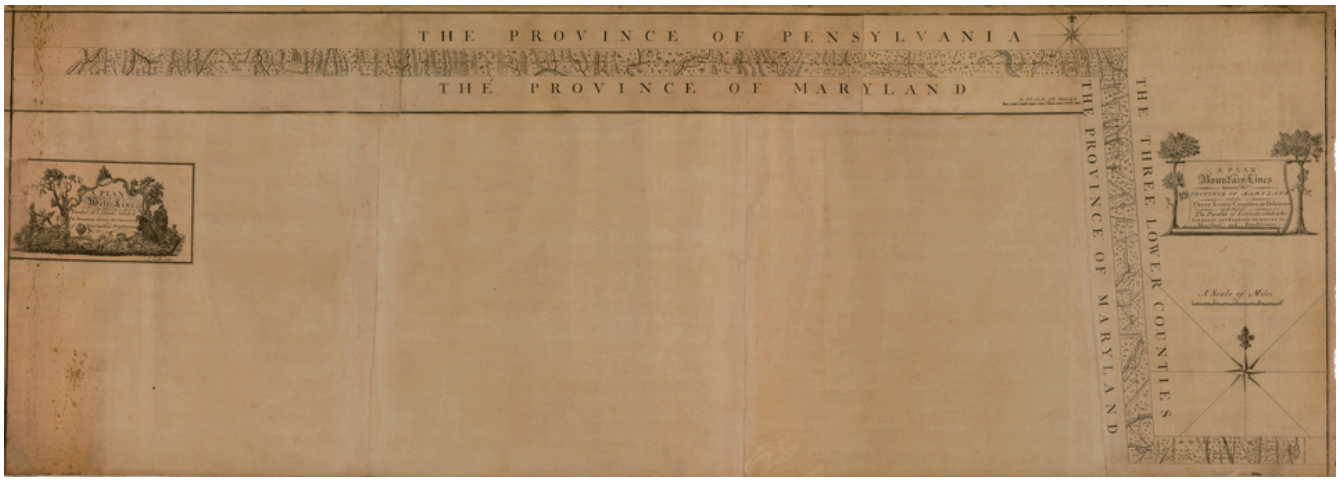


The lines Mason and Dixon ran, 1763–1767. The dashed western end was completed in 1784.



How Mason and Dixon carried Philadelphia's latitude 15 miles south without crossing the Delaware River.

PICTURE STUDY



A Plan of the West Line or Parallel of Latitude, which is the Boundary between the Provinces of Maryland and Pensylvania (the 1768 map of the Mason–Dixon Line), From the survey of Charles Mason and Jeremiah Dixon; engraved by Henry Dawkins and James Smither; published by Robert Kennedy, Philadelphia, 1768 · Copperplate engraving on paper · Library of Congress, Geography and Map Division (copies also in other collections)

When Mason and Dixon finished, the proprietors wanted a public record of the line. This engraved plan, printed in Philadelphia in 1768 from the surveyors' own work, is the first printed map of the boundary. Because the line is so long and the strip of land so narrow, the map is shaped like a ribbon.

A map like this was a legal document as well as a picture. Landowners, sheriffs and tax collectors could use it to see on which side of the line a farm or a river crossing lay.

Look closely

- Follow the line from east to west. How is distance marked along it?
- Find where the line crosses rivers and mountain ridges. Does the line bend for any of them?
- Find the eastern end, where the Delaware boundaries and the circle around New Castle appear. Why is there a circle?
- Find the place near the western end where the survey stopped. What does the map say happened there?

Talk about it

1. Why would a long, narrow strip map be more useful here than a map of the whole two colonies?
2. What does this map tell you about which landforms the surveyors thought were worth recording?
3. How is a printed, public map different in purpose from a private survey journal?

> **Safety first.** Never look at the sun through a sighting tube or straw, even for a moment. Do night observations with an adult, in a safe open place away from roads.

PROJECT: A STRAW QUADRANT AND THE LATITUDE OF YOUR HOME

This is the first instrument of your unit project. Over five lessons you will build simple surveying tools and finish with a survey map of a real yard or field. Tonight you will do what Mason and Dixon did in a simpler way: read your latitude from the sky. The altitude of Polaris, the North Star, above the horizon is very nearly equal to your latitude.

You will need

- A plastic protractor (180°) or a quarter circle of stiff cardboard marked from 0° to 90°
- A drinking straw
- About 12 inches (30 cm) of thread and a small weight such as a washer or nut
- Tape, a pencil and your survey notebook
- A clear night and a phone map app or atlas to check your latitude afterward

Steps

1. Tape the straw along the flat edge of the protractor so you can sight through it.
2. Tie the thread through the small hole at the center of the protractor's flat edge and hang the washer from it so the thread swings freely across the scale.
3. Practice in daylight on a treetop or roof edge (never the sun). Sight through the straw, let the thread settle, and pinch it against the scale. The angle between the thread and the 90° mark is your angle of elevation. Write it down.
4. On a clear night, find the Big Dipper and follow the two "pointer" stars at the end of its bowl to Polaris, a medium-bright star standing alone.
5. Sight Polaris through the straw. Have a partner read the thread. Take five readings and record each one.
6. Average your readings. This is your estimate of your latitude in degrees.
7. Check your true latitude on an atlas or map app. Find your error in degrees and convert it to miles (1° ≈ 69 miles, or 111 km).
8. In your notebook, write two sentences about what limited your accuracy and how Mason and Dixon's zenith sector solved the same problems.

Tips

- Brace your arms on a car roof or fence post so the instrument does not shake.
- Your instrument may read the angle from the zenith instead of from the horizon, depending on how you hold it. Subtract from 90° if needed.
- An error of 2° is common with a straw quadrant. That is about 140 miles, which shows why Mason and Dixon needed a six-foot telescope.

Check your work

- My quadrant hangs freely and reads angles of elevation.
- I took at least five readings of Polaris and averaged them.
- I compared my result to my true latitude and converted the error to miles.

MAP NOTEBOOK

1. Sketch figure ha-mason-dixon-offset from memory: Philadelphia's south point, the Stargazers' Stone, the Post Marked West and the West Line. Label each distance.
2. Draw a crownstone in elevation (side view) with an M face and a P face, and write one sentence about why the stones were cut in England.
3. Make a two-column chart: "Natural borders" and "Lines from the sky." Put three borders from earlier units in each column, with the Mason–Dixon Line in the second.

> **From history.** After the boundary was done, Mason and Dixon stayed on in 1768 to measure the length of a degree of latitude along the flat Delmarva Peninsula for the Royal Society, one of the first such measurements made in America and a contribution to the question of the earth's exact shape. Dixon went home to County Durham and died in 1779. Mason returned to America with his family and died in Philadelphia in 1786. Their partnership lasted only a few years, but their two names, joined by a hyphen, became among the best known in American geography.

WORKED EXAMPLES

Example 1. The 1760 agreement put the line 15 miles south of the southernmost point of Philadelphia, which Mason and Dixon fixed at 39°56′29″ N. Using 1′ of latitude ≈ 1.151 miles, estimate the latitude of the line.

(Use the map or drawing "The 15-mile measurement south from the Stargazers' Stone." shown earlier in this lesson.)

1. Convert 15 miles to minutes of latitude: 15 ÷ 1.151 ≈ 13.03′.
2. Convert the decimal part: 0.03′ × 60 ≈ 2″, so 15 miles ≈ 13′02″.
3. Subtract from Philadelphia's latitude: 39°56′29″ − 13′02″ = 39°43′27″.
4. Compare: the line on the ground lies at about 39°43′20″ N, a few seconds south. Mason and Dixon set the line by chaining 15 miles on the ground, not by converting miles to minutes, and latitudes read from the stars differ slightly from this simple calculation.

Answer: About 39°43′27″ N (the surveyed line is at about 39°43′20″ N).

Example 2. Mason and Dixon stopped about 233 miles west of the start of the West Line. Express this distance in Gunter's chains, in feet and in kilometers.

1. One mile = 80 chains, so 233 × 80 = 18,640 chains.
2. One chain = 66 feet, so 18,640 × 66 = 1,230,240 feet. (Check: 233 × 5,280 = 1,230,240 feet.)
3. One mile ≈ 1.609 km, so 233 × 1.609 ≈ 375 km.

Answer: 18,640 chains; 1,230,240 feet; about 375 km.

Example 3. Suppose a star with a declination of 41°20′00″ N crosses the meridian 1°36′40″ north of the zenith, as measured with the zenith sector. What is the observer's latitude? What if a second star of declination 38°10′00″ N crosses 1°33′20″ south of the zenith at the same spot?

1. A star north of the zenith has a declination greater than your latitude, so latitude = declination − zenith distance: 41°20′00″ − 1°36′40″ = 39°43′20″.
2. A star south of the zenith has a smaller declination than your latitude, so latitude = declination + zenith distance: 38°10′00″ + 1°33′20″ = 39°43′20″.
3. The two stars agree. Surveyors used many stars on both sides of the zenith so that small errors in the instrument would cancel.

Answer: 39°43′20″ N from both stars, the latitude of the Mason–Dixon Line.

PRACTICE

1. EASY Who hired Mason and Dixon, and what quarrel were they hired to settle?
2. EASY How long is a Gunter's chain, and how many chains are in a mile?
3. EASY What was carved on an ordinary milestone and on a crownstone?
4. EASY Why did Maryland's 1632 charter seem to put Philadelphia in Maryland?
5. MEDIUM Convert 5 miles to chains and to minutes of latitude (1′ ≈ 1.151 miles).
6. MEDIUM One second of latitude is about 101 feet (31 m). If a zenith sector reading is off by 3″, how far north or south could the line be misplaced?
7. MEDIUM Why did Mason and Dixon go about 31 miles west of Philadelphia before measuring their 15 miles south?
8. MEDIUM A star of declination 42°05′00″ N crosses the meridian 2°21′40″ north of the zenith. Find the latitude.
9. MEDIUM On figure ha-mason-dixon-map, the West Line runs along about 39.72° N. One degree of longitude there is about 53 miles (85 km). If the West Line from the Delaware corner (75.79° W) to the southwest corner of Pennsylvania (80.52° W) were measured, about how long would it be?
   (Use the map or drawing "Use the longitudes given in the problem." shown earlier in this lesson.)

10. HARD Using your answer to problem 9, about how many miles of the West Line were left for the 1784 commissioners if Mason and Dixon stopped at about 233 miles? About how many crownstones would the whole line need at one per five miles?
11. HARD Why is a parallel of latitude harder to run on the ground than a straight line, and how did Mason and Dixon deal with it?
12. CHALLENGE In one paragraph, explain how the Mason–Dixon Line, drawn to settle a property quarrel between two proprietors, came to stand for the division between North and South. Keep to facts.

COMMON MISTAKES

- Thinking the Mason–Dixon Line was drawn to divide slave and free states. It was surveyed to settle a property and boundary dispute between two colonial proprietors; its later meaning came after Pennsylvania began abolishing slavery in 1780.
- Treating a parallel of latitude as a straight line. On the globe it is a curve, and surveyors had to correct for it.
- Mixing up degrees, minutes and seconds when subtracting. Borrow 60 seconds from a minute or 60 minutes from a degree, just as you borrow 10 in ordinary subtraction.

Make it a game · Find the Line. Mark a starting post in a yard or gym. One player, the "astronomer," secretly writes a compass bearing and a distance (for example, due west, 20 paces). The "surveyor" must walk it with eyes on a compass only, then plant a marker. Measure how far the marker lies from the true line. Swap roles. The player with the smallest total error after three rounds wins and is crowned "Mason and Dixon."

Scripture. "Remove not the ancient landmark, which thy fathers have set." (Proverbs 22:28, KJV)

In Bible lands a boundary stone protected a family's land, and moving it was a kind of theft. The crownstones of the Mason–Dixon Line served the same purpose: an honest, visible boundary that neighbors could trust. Good surveying is a form of honesty and justice.

Practice answers

1. The Penn family (proprietors of Pennsylvania) and Frederick Calvert, sixth Lord Baltimore (proprietor of Maryland), to settle the long dispute over the boundary between their colonies (and Maryland's line with the Lower Counties, later Delaware).
2. 66 feet (100 links); 80 chains = 1 mile.
3. Ordinary milestones: an M on the Maryland side and a P on the Pennsylvania side. Crownstones (every fifth mile): the Calvert coat of arms on the Maryland side and the Penn coat of arms on the Pennsylvania side.
4. Maryland's charter ran north to the fortieth parallel, and Philadelphia lies at about 39°57′ N, south of that parallel.
5. $5 \times 80 = 400$ chains; $5 \div 1.151 \approx 4.34'$ (about 4′20″).
6. $3 \times 101 \approx 303$ feet (about 93 m).

7. A line due south from Philadelphia would have crossed the Delaware River and its marshes, where chaining was impossible. Since every point on a parallel has the same latitude, they carried the latitude west on land first, then measured south.
8. North of zenith, so subtract: 42°05′00″ − 2°21′40″ = 39°43′20″ N.
9. 80.52 − 75.79 = 4.73°; 4.73 × 53 ≈ 251 miles (about 404 km).
10. About 251 − 233 ≈ 18 miles using these rounded figures. In fact Mason and Dixon's 233 miles were measured from the Post Marked West, a few miles east of the Delaware corner, so about 22 miles were actually left. The whole line would need about 251 ÷ 5 ≈ 50 crownstones (in fact the western mountain section was marked with mounds, not stones).
11. A parallel (other than the equator) is a curve on the globe, so a straight sighted line drifts away from it toward the equator. They ran straight stretches, then measured small calculated offsets back north onto the parallel, and checked their latitude often by observing stars.
12. Answers should note that the line was surveyed in 1763–1767 to settle a colonial boundary dispute; that Pennsylvania began gradual abolition in 1780 while Maryland kept slavery until 1864, so the line became a border between free and slave states; that enslaved people escaping north crossed it; and that Americans came to use the name loosely for the North–South divide, though the line itself runs only along Pennsylvania, Maryland and Delaware.

10.2 The Public Land Survey: Townships and Sections Across the West

OBJECTIVES

- Explain why Congress chose to survey public land into a rectangular grid before selling it, and contrast the grid with the older metes-and-bounds method.
- Read and write a Public Land Survey legal description (quarter, section, township and range) and compute its area in acres and square kilometers.
- Explain why meridians converge and why the survey needed correction lines, and describe how the grid still shapes farms, roads and borders across the West.

Warm-up. Take a sheet of paper and describe the location of your bedroom door to a stranger without using any measurements: only things like “past the bookshelf, near the window.” Now describe it with a grid: “3 feet from the north wall, 7 feet from the east wall.” Which description would still work after the furniture was moved? That is the difference between the old way of describing land and the new way Congress chose in 1785.

Watch. *Land Ordinances of 1785 - May 20, 1785* (The Appendix, 7:49).
https://www.youtube.com/watch?v=3O-LspaJZNg
Before the story: listen to the Land Ordinance of 1785 that set up the survey, and listen for the part that set aside land for schools.
Note: Captions were not available to check, and this is a small channel whose narrator may be an AI voice; preview it first.

Backup video. *How to Use the Public Land Survey System* (Michigan Geological Survey, 7:43). https://www.youtube.com/watch?v=BqWp_0a291o
Before the project: watch from about 2:02 to see a township broken into 36 sections and how to read township, range and quarter-quarter notation. Note: Captions were not available to check; preview it first. It comes from a state geological survey and looks like a straightforward how-to.

KEY TERMS

metes and bounds
An old way of describing land by walking its edges from landmark to landmark (“from the white oak by the creek, north 40 poles to a stone”). It fits the land but leads to gaps, overlaps and lawsuits.

township
In the Public Land Survey, a square about 6 miles on a side (36 square miles), identified by its tier north or south of a baseline.

range

A north–south column of townships, counted east or west of a principal meridian (for example, Range 2 West).

section
One of the 36 squares in a township, about 1 mile on a side, containing 640 acres. Sections are numbered 1 to 36, back and forth, starting in the northeast corner.

principal meridian and baseline
The north–south and east–west survey lines that cross at an initial point. Every township and range in that survey district is counted from them.

correction line
A standard parallel, usually every 24 miles, where the survey is restarted at full width because meridians converge toward the pole. Roads on section lines often jog at these lines.

CORE IDEAS

The story. On September 30, 1785, Thomas Hutchins, the Geographer of the United States, stood on the north bank of the Ohio River at the spot where the western boundary of Pennsylvania met the river, near today's East Liverpool, Ohio. There he began the first line of the public land survey of the United States. A stone marker now calls the place the Point of Beginning. From it his crews ran a line due west, the Geographer's Line, about 42 miles into the Ohio country, and south of it they laid out the first ranges of square townships, known ever after as the Seven Ranges. The work was slow and dangerous, because the Indian nations of the Ohio country did not accept that the land was Congress's to sell. But the pattern Hutchins began would eventually be stamped across most of the continent.

Why a grid? At the end of the Revolution, the new United States was deep in debt, and its greatest asset was land. The states with western claims, such as Virginia, ceded them to Congress, which now held the country northwest of the Ohio River. In the colonies, land had usually been described by **metes and bounds**: a surveyor walked the edges of a claim from tree to rock to creek. That method fit the land, but trees fell, streams moved and claims overlapped. Kentucky was so tangled in overlapping titles that even Daniel Boone lost land he thought was his. A committee led by Thomas Jefferson proposed a better idea in 1784: survey first, sell later, and use a rectangular grid. The Land Ordinance of May 20, 1785, set the rules. Land would be laid out in townships 6 miles square, each divided into 36 sections of one square mile, or 640 acres. In every township, section 16 was reserved for the support of schools. Two years later the Northwest Ordinance of 1787 set up a government for the territory, promised that new states would join on an equal footing with the old, forbade slavery in the territory, and declared: "Religion, morality, and knowledge, being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged."

How it worked. After an act of 1796 set the pattern still used today, every survey district began at an **initial point**. Through it ran a **principal meridian** north and south and a **baseline** east and west. Townships were counted in tiers north or south of the baseline and in ranges east or west of the meridian, so "Township 3 North, Range 2 West" (written T3N,

R2W) names one exact 36-square-mile block. Inside a township, sections are numbered from 1 in the northeast corner, running west along the top row to 6, then back east from 7 to 12, and so on, back and forth like an ox plowing a field, ending with 36 in the southeast corner (figure ha-township-grid). A section could be split into halves and quarters: a quarter section is 160 acres, and a quarter of a quarter is 40 acres, the “forty” of American farm talk. Surveyors measured with Gunter’s chains and compasses, set posts, stones or mounds at every corner, and blazed nearby “bearing trees” so a corner could be found again. They also wrote field notes on the soil, timber, water and Indian trails along every mile, so their notebooks became the first inventory of the American interior.

The curve of the earth. A grid of squares cannot lie flat on a globe. Meridians draw closer together toward the North Pole, so a township whose east and west lines both follow meridians is a little narrower at its north side than at its south side. At 40° N, a township 6 miles wide loses about 40 feet of width in 6 miles of northing; after four townships, the loss is about 160 feet. To keep the squares from shrinking, surveyors restarted the measurement at full width along **standard parallels**, or correction lines, usually every 24 miles. A country road in Iowa or Kansas that jogs sideways for no visible reason has reached a correction line. The ground itself could fool a surveyor too. In 1844, William Austin Burt, surveying in Michigan’s Upper Peninsula with the solar compass he had invented, saw his magnetic needle swing wildly: he was standing on the iron ore of the Marquette Iron Range.

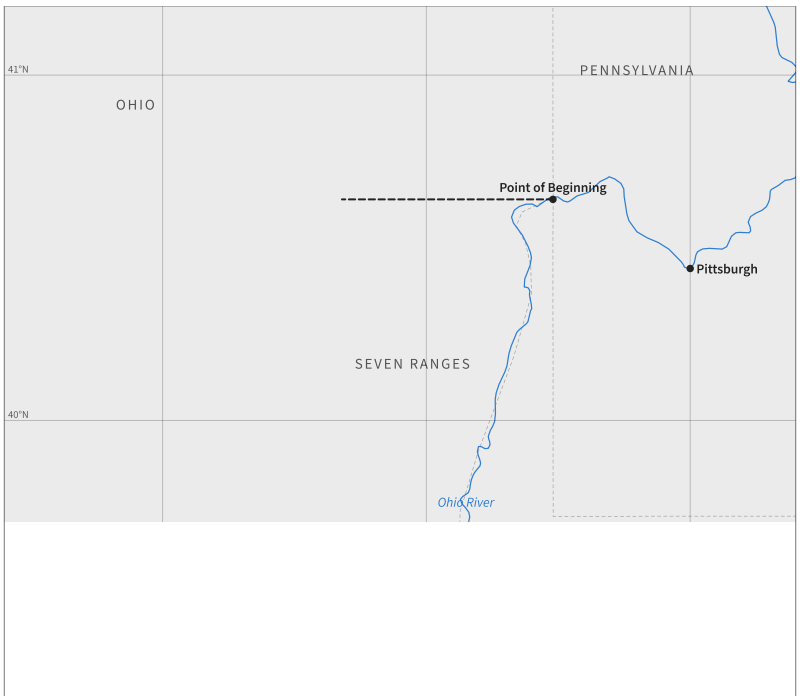
The land and its people. The grid moved west after the treaties that opened the land, and many of those treaties followed war. The Ohio surveys advanced only after the Battle of Fallen Timbers (1794) and the Treaty of Greenville (1795), in which the northwestern tribes ceded most of what is now Ohio. Later, under the Indian Removal Act of 1830, many eastern nations were forced west, and the Cherokee removal of 1838–1839 cost thousands of lives. The surveyors’ chains followed these events and made them permanent on paper. The same grid also made it possible for ordinary families to own land with a clear title. Under the Homestead Act of 1862, a settler could claim a quarter section, 160 acres, and own it after living on it and farming it for five years.

The big idea. The Public Land Survey eventually covered about 30 of the 50 states. The original thirteen and a few others, such as Kentucky, Tennessee and Texas (which kept its own public lands when it joined the Union), use older systems. Each district had its own principal meridian, from the Fifth Principal Meridian, whose initial point was set in Arkansas in 1815 for the lands of the Louisiana Purchase, to the Willamette Meridian, marked in 1851 near Portland, Oregon. From an airplane over the Midwest you can see the result: square fields, roads every mile, and county lines that run straight for miles. Many western state borders, such as those of Colorado and Wyoming, are survey lines too. The surveyors did not draw where nature put the rivers. They drew where arithmetic said, and the land has taken their shape.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

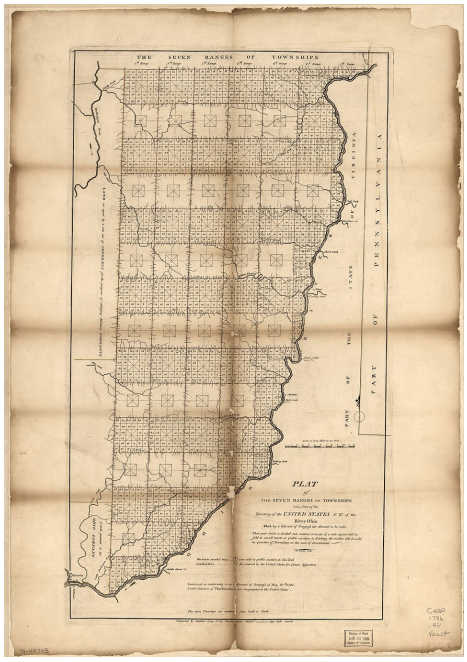
Township: 6 miles square. North is at the top.
Each section: 1 mile square (640 acres).

Section numbering in a township (north at the top). Section 16 was reserved for schools.



The Point of Beginning (1785) and the Geographer's Line. The Seven Ranges lay south of the line, between it and the Ohio River.

PICTURE STUDY



Plat of the Seven Ranges of Townships, Being Part of the Territory of the United States N.W. of the River Ohio, Engraved by W. Barker from the surveys of Thomas Hutchins, Geographer of the United States; published by Mathew Carey, Philadelphia, 1796 · Engraving on paper · Library of Congress, Geography and Map Division (copies in other collections)

This printed plat shows the first piece of the American public land survey: the Seven Ranges of eastern Ohio, south of the Geographer's Line. It was published so that buyers, most of them far away in the East, could choose land they had never seen. Over a landscape of creeks and the curving Ohio River lies something new in the world, a grid of numbered squares.

Compare it with the Mason–Dixon plan of 1768 from the last lesson. That map recorded one boundary. This one records a whole system for dividing land.

Look closely

- Find the Ohio River. How do the squares meet it? What happens to townships cut off by the river?
- Find the line along the top of the grid. That is the Geographer's Line, run west from the Pennsylvania border.
- Look closely at the townships. How are they numbered or labeled, and how could a buyer use the labels?
- Notice which features the engraver kept (rivers, creeks) and which are missing (hills, forests, Indian towns). Why?

Talk about it

1. Why would a buyer in Philadelphia or New York prefer land described this way to land described by metes and bounds?

2. What does a grid ignore about the land? Name one problem a farmer might meet because of it.
3. How did this map help turn a promise in an ordinance into real farms?

PROJECT: A ROPE CHAIN AND ONE SQUARE CHAIN OF GROUND

Part two of your unit survey. You will make a surveyor's chain from rope, calibrate your pace, and lay out a perfect square one chain on a side, one-tenth of an acre, with true right angles. Then you will write field notes the way the land surveyors did.

You will need

- About 70 feet (21 m) of non-stretch cord or clothesline
- A 100-foot or 25-foot tape measure
- Colored tape or markers for the cord; 4 stakes or tent pegs; a hammer
- A compass, your survey notebook and a pencil

Steps

1. Measure 66 feet (20.1 m) of cord and tie a loop at each end. This is your chain.
2. Mark every 6.6 feet (10 links) with colored tape, and mark the middle (33 feet) with a different color.
3. Calibrate your pace: walk the chain's length three times at a normal step, count steps each time, and find your average feet per pace.
4. Drive a stake for your starting corner. Use the compass to lay the chain due north and drive a second stake at 66 feet.
5. Make a right angle at the first stake with the 3-4-5 rule: mark 3 units along the north line, 4 units toward the east, and adjust until the diagonal between those marks is exactly 5 units (for example 12 ft, 16 ft and 20 ft).
6. Chain 66 feet east along that right angle and set the third stake. Set the fourth by measuring 66 feet from both the second and third stakes.
7. Check your square: both diagonals should be about 93.3 feet (66 × 1.414). Record how much they differ.
8. Write field notes like a land surveyor: the date, the bearing and length of each side, and a line about the soil, trees, slope and water you saw along each side.

Tips

- Keep the chain tight and level; a sagging chain makes every side too short.
- Steel fences, cars and phones can pull a compass needle off. Stand clear of them, as Burt learned on his iron range.
- Keep your stakes in place if you can; you will reuse your square as a baseline in Lesson 10.3.

Check your work

- My chain measures 66 feet with marks every 10 links.
- My square's diagonals agree within about 1 foot.
- My field notes give bearings, lengths and a description of the ground.

MAP NOTEBOOK

1. Copy figure ha-township-grid from memory, numbering all 36 sections, and shade section 16.
2. Draw one section and divide it into four quarters, then divide the northeast quarter into four forties. Label each with its legal description and acreage.
3. Sketch a country road that jogs at a correction line, with the north arrow and a note explaining why it jogs.

> **From history.** Abraham Lincoln worked as a deputy surveyor in Sangamon County, Illinois, in the 1830s, laying out roads and town lots with a chain and compass. He had taught himself the work from surveying books in a few weeks of hard study, and his neighbors trusted him to settle boundary questions fairly. George Washington, as you will see in Lesson 10.5, had begun as a surveyor too.

WORKED EXAMPLES

Example 1. A standard township is 6 miles by 6 miles. How many sections and acres does it contain? What is its area in square kilometers (1 square mile ≈ 2.59 km²)?

1. Area: 6 × 6 = 36 square miles, so 36 sections of one square mile each.
2. Acres: 36 × 640 = 23,040 acres.
3. Square kilometers: 36 × 2.59 ≈ 93.2 km².

Answer: 36 sections; 23,040 acres; about 93 km².

Example 2. A deed describes land as “the SW¼ of the NE¼ of Section 16, T3N, R2W.” How many acres is it, and where is Section 16 in the township?

(Use the map or drawing “Find Section 16 in the third row.” shown earlier in this lesson.)

1. Read a legal description from the end backward: the township and range give the 36-square-mile block, then Section 16, then its NE quarter, then the SW quarter of that.
2. Section 16 = 640 acres. Its NE quarter = 640 ÷ 4 = 160 acres. The SW quarter of that = 160 ÷ 4 = 40 acres.
3. On figure ha-township-grid, Section 16 is in the third row from the top, third square from the west (left) side, near the center of the township.
4. The township is the third tier north of the baseline and the second range west of the principal meridian.

Answer: 40 acres, in the third row and third column of the township, just west of its center.

Example 3. At latitude 40° N, how much narrower is the north line of a township than its south line if both sides follow meridians? Use: change in width ≈ width × (distance north ÷ earth’s radius) × tan(latitude), with earth’s radius 3,959 miles and tan 40° ≈ 0.839. Then find the loss after 24 miles.

1. For one township: 6 × (6 ÷ 3,959) × 0.839 ≈ 6 × 0.001516 × 0.839 ≈ 0.00763 mile.
2. Convert: 0.00763 × 5,280 ≈ 40 feet (about 12 m).
3. For 24 miles (four townships): 6 × (24 ÷ 3,959) × 0.839 ≈ 0.0305 mile ≈ 161 feet (about 49 m).
4. That is why surveyors restarted at full width on a correction line every 24 miles.

Answer: About 40 feet (12 m) per township; about 160 feet (49 m) after 24 miles.

PRACTICE

1. EASY How many acres are in a section, a quarter section and a quarter-quarter section?
2. EASY Which section in each township did the Land Ordinance of 1785 reserve for schools?
3. EASY Where and when did Thomas Hutchins begin the public land survey?
4. EASY On figure ha-township-grid, which section number lies in the northeast corner, and which in the southeast corner?
   (Use the map or drawing “North is at the top.” shown earlier in this lesson.)
5. MEDIUM Name the sections that border Section 16 on its north, south, east and west sides.

6. MEDIUM How many acres is “the N½ of the SE¼ of Section 22”? Convert to hectares (1 acre ≈ 0.405 ha).
7. MEDIUM A homesteader under the 1862 Homestead Act claims a quarter section. How long is each side in miles, in feet and in Gunter’s chains?
8. MEDIUM In a township, a farmer walks from the center of Section 6 to the center of Section 36. How far is that in a straight line (sections are 1 mile square)? Give miles and km.
9. MEDIUM Explain two weaknesses of describing land by metes and bounds.
10. HARD The width of a degree of longitude is about 69.17 × cos(latitude) miles. Compute it at 40° N (cos 40° ≈ 0.766) and at 49° N (cos 49° ≈ 0.656). How many 6-mile townships fit in one degree of longitude at each latitude?
11. HARD On figure ha-seven-ranges, the Geographer’s Line runs about 42 miles west of the Point of Beginning. How many 6-mile ranges is that? About how many degrees of longitude, using 52.5 miles per degree at 40.6° N?
    (Use the map or drawing “The first public land survey.” shown earlier in this lesson.)
12. CHALLENGE Write a paragraph weighing the Public Land Survey: what did it achieve, and what did it cost? Use at least one fact about settlers and one about the Indian nations, stated plainly.

COMMON MISTAKES

- Reading a legal description from front to back as if the first part were the largest. The largest unit (township and range) comes last; read it backward.
- Numbering sections like reading a book, left to right on every row. The rows go back and forth, starting at 1 in the northeast corner.
- Thinking townships are perfect squares. Because meridians converge, they narrow slightly to the north, which is why correction lines exist.

Make it a game · Township Battleship. Each player draws two blank 6 × 6 township grids and numbers the sections the official way. Hide three “farms” (a section, a quarter section and a forty) on your grid. Take turns calling legal descriptions such as “NE¼ of Section 14.” Your opponent answers hit or miss. A player who numbers a section wrong loses a turn. First to find all three farms wins.

Scripture. “The lines are fallen unto me in pleasant places; yea, I have a goodly heritage.” (Psalm 16:6, KJV)

David uses the picture of a surveyor’s measuring line marking out a family’s share of land. For a homesteading family in 1870, a quarter section with a clear title was exactly that kind of heritage, and David reminds us that every good inheritance is a gift from God.

Practice answers

1. 640 acres; 160 acres; 40 acres.
2. Section 16.

3. On the north bank of the Ohio River where Pennsylvania's western boundary meets it, near today's East Liverpool, Ohio, on September 30, 1785 (the Point of Beginning).
4. Section 1 is in the northeast corner; Section 36 is in the southeast corner.
5. North: 9. South: 21. East: 15. West: 17.
6. SE¼ = 160 acres; N½ of that = 80 acres ≈ 32.4 hectares.
7. A quarter section is ½ mile on a side = 2,640 feet = 40 chains.
8. Section 6 is in the NW corner and 36 in the SE corner, so the centers are 5 miles apart east–west and 5 miles north–south: √(25 + 25) ≈ 7.07 miles ≈ 11.4 km.
9. Landmarks like trees, stumps and creeks change or vanish, so boundaries become uncertain; and claims made separately can leave gaps or overlap, causing disputes and lawsuits (as in early Kentucky).
10. At 40°: 69.17 × 0.766 ≈ 53.0 miles, about 8.8 townships. At 49°: 69.17 × 0.656 ≈ 45.4 miles, about 7.6 townships.
11. 42 ÷ 6 = 7 ranges (the Seven Ranges). 42 ÷ 52.5 = 0.8° of longitude.
12. Strong answers note achievements (clear, cheap titles; orderly sale and settlement; school lands in section 16; the Homestead Act letting families own 160 acres; roads and counties laid out in order) and costs (the grid ignored terrain and water; land was surveyed after cessions that often followed war, such as Fallen Timbers and the Treaty of Greenville, and later forced removals such as the Cherokee removal of 1838–1839).

10.3 The Great Trigonometrical Survey of India ⚙

OBJECTIVES

- Tell the story of the Great Trigonometrical Survey of India from William Lambton's baseline at Madras (1802) through George Everest's Great Arc and the measurement of Peak XV.
- Explain triangulation: why one carefully measured baseline and many measured angles can fix distances across rivers, jungles and mountains, and solve a survey triangle with the law of sines.
- Compute the height of a distant peak from an angle of elevation, including the correction for the curvature of the earth, and weigh the survey as both a scientific achievement and a tool of British rule.

Warm-up. Hold your thumb up at arm's length and close one eye, then the other. Your thumb seems to jump against the background. Now walk to a window and try it on a distant tree. The jump gets smaller with distance. Your two eyes are a tiny baseline, and the jump is an angle. Write one sentence guessing how a surveyor could use the same trick to measure the distance to a mountain he could never reach.

Watch. *The Great Trigonometrical Survey and the World's Tallest Peak* (The History Guy: History Deserves to Be Remembered, 11:19). https://www.youtube.com/watch?v=VI6OJACISgg
After the story: watch how the survey began in 1802 and grew into the Great Arc, and listen for how careful triangle measurements across India finally showed which mountain was the tallest in the world.
Note: Captions were not available to check; preview it first. The History Guy is usually a clean, family-friendly channel, and this video is on topic.

KEY TERMS

triangulation
A surveying method that measures one side of a triangle (the baseline) with great care and then measures angles only, using trigonometry to compute every other side, triangle after triangle.

baseline
A straight line on level ground measured directly, inch by inch, with chains or bars. Every distance in a triangulation is scaled from it.

theodolite
A telescope mounted on finely divided horizontal and vertical circles, used to measure angles between distant points and angles of elevation.

law of sines

In any triangle, each side divided by the sine of the opposite angle gives the same number: $a/\sin A = b/\sin B = c/\sin C$.

Great Arc

The chain of triangles run north along a meridian near 78° E, from the southern tip of India to the Himalayan foothills, to measure the length of a degree of latitude and the shape of the earth.

curvature correction

The amount a distant object's base drops below a level line because the earth is round, about $0.667 \times d^2$ feet for a distance of d miles.

CORE IDEAS

The story. On April 10, 1802, on a flat plain near St. Thomas Mount outside Madras (today Chennai), an infantry officer named William Lambton began measuring a straight line on the ground. Lambton had fought in the American Revolution as a young British soldier and had spent years teaching himself mathematics and astronomy. He had persuaded the East India Company, which then ruled much of southern India, that a true map needed a true framework. For weeks his men laid a 100-foot steel chain, made by the London instrument maker Jesse Ramsden, in wooden boxes set level on stands, recording the temperature to correct for the chain's growth in the heat. The result was a baseline about 7½ miles (12 km) long, measured with extraordinary care. It was the first measured line of what became the Great Trigonometrical Survey of India, one of the largest scientific projects of the 1800s.

How it worked. A surveyor cannot stretch a chain across a river, a jungle or a gorge, but he can measure an angle across all of them. Stand at each end of a known baseline, sight a distant hilltop or tower, and measure the two angles. The third angle is 180° minus the other two, and the **law of sines** gives the two unknown sides. Each new side then becomes the base of the next triangle, and the chain of triangles marches across the country (figure ha-triangulation). Lambton's main instrument was a great theodolite made in London by William Cary, with a horizontal circle three feet across; it weighed about half a ton and needed a dozen men to carry. To see over trees, surveyors hauled it up temple towers and hills. In 1808, at the great temple of Thanjavur (Tanjore), a rope broke as it was being raised, and the theodolite smashed against the tower. Lambton shut himself away for about six weeks and rebuilt it by hand. Every so often the survey measured a new baseline and compared it with the length the triangles predicted; close agreement proved the triangles in between.

The Great Arc. Lambton's first chain of triangles crossed the peninsula from coast to coast and showed that southern India was narrower than earlier maps claimed. Then he began his great work: a chain running north along a meridian near 78° E, measuring the length of each degree of latitude. Because the earth bulges at the equator, a degree of latitude is slightly shorter near the equator than near the poles, so a long arc reveals the earth's exact shape. Lambton worked on for twenty years and died in the field at Hinganghat, in central India, in 1823. His assistant George Everest, an artillery officer in the East India Company's service, took over and drove the Arc north. Everest brought in compensation bars, made of two metals arranged so that the length between their end marks stayed constant in heat, and

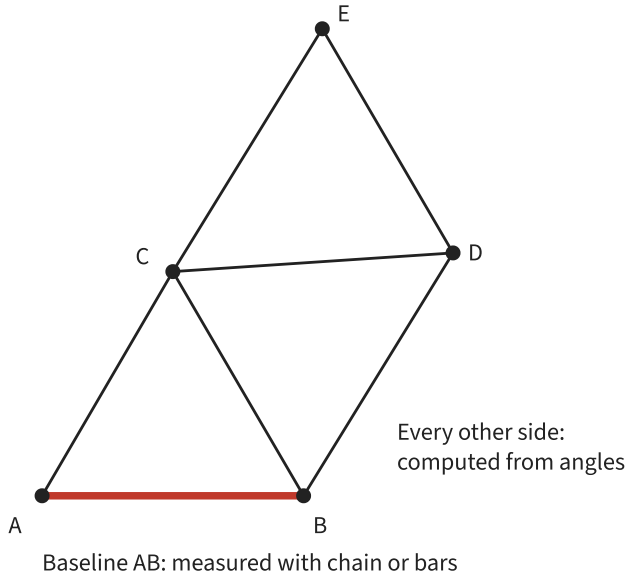
built masonry towers on the flat northern plains, where crews signaled with mirrors called heliotropes by day and bright lamps by night. By 1841 the Great Arc stretched more than 21 degrees of latitude, about 1,500 miles (2,400 km), from the southern tip of India to the foothills of the Himalaya. It was the longest arc of the meridian measured up to that time.

Peak XV. The northern triangles brought the surveyors face to face with the Himalaya. Nepal and Tibet were closed to foreigners, so the great peaks had to be measured from stations on the plains of India more than 100 miles away. In 1847–1849, survey parties took angles to a summit they listed as Peak XV. The calculations were made in the survey office by a team of mathematicians called computers, led by the gifted Bengali mathematician Radhanath Sikdar. Each sight had to be corrected for the curve of the earth and for refraction, the bending of light through the thick lower air, which was the hardest correction of all. When the results were reduced, Peak XV proved to be higher than any mountain yet measured. In 1856 Everest's successor, Andrew Scott Waugh, announced its height as 29,002 feet and proposed naming it after his old chief. Everest himself objected, preferring local names, but the Royal Geographical Society adopted the name in 1865. (He pronounced his own name EEV-rest.) The modern height, agreed by China and Nepal in 2020, is 8,848.86 m, about 29,032 feet, remarkably close to the 1856 figure. Tibetans call the mountain Chomolungma, and Nepalis call it Sagarmatha.

The big idea. The survey was both a triumph of science and a tool of empire. The East India Company and later the British Crown wanted accurate maps to govern, tax, build roads and railways, and defend frontiers. Many of the men who carried the instruments, cleared the lines and computed the figures were Indians whose names are mostly lost, and many of them, as well as British officers, died of malaria and other fevers in the jungles. Yet the measurements were honest and exact, and they still underlie the maps of India, Pakistan, Bangladesh and their neighbors. The borders of South Asia, from the Radcliffe Line you studied in Unit 9 to the frontier with China in the Himalaya, were drawn on maps that rested on this framework of triangles.

Technology overcoming geography. Triangulation let surveyors measure what they could not cross or even enter: wide rivers, roadless forest, and mountains in closed kingdoms. Later the survey trained Indian explorers called pundits to pace secretly through Tibet, counting steps on rosaries of 100 beads instead of the usual 108. Today satellites do in seconds what took Lambton and Everest forty years, but GPS rests on the same idea: known positions, measured angles or distances, and geometry.

The Great Arc of the Meridian, begun by Lambton and finished by Everest in 1841.



Triangulation: measure one baseline, then only angles.

PICTURE STUDY

Portrait of William Lambton, William Havell, 1822 · Oil on canvas · Royal Asiatic Society, London

William Havell was an English landscape painter who spent several years in India. In 1822, a year before Lambton died, he painted the old surveyor. It is the best-known likeness of the man who began the Great Trigonometrical Survey. Lambton was then in his late sixties and had spent twenty years in the field, much of it in fever country.

A portrait is a kind of record too. Like a survey, it tries to set down what is really there.

Look closely

- Study the face. What does it tell you about the man's age, health and character?
- Look at his clothing. What does it suggest about his rank and work?
- Look at the background and any objects the painter included. What did Havell choose to show, and what did he leave out?
- Where does the light fall? What does the painter want you to look at first?

Talk about it

1. Lambton is shown as a calm, private man. How does that fit a person who spent twenty years measuring angles?
2. Why do you think so few portraits exist of the Indian computers, flagmen and carriers who worked on the survey?
3. If you painted a portrait of a surveyor today, what objects would you include?

PROJECT: A SIGHTING BOARD AND A TRIANGULATED TREE

Part three of your unit survey, and the heart of it. You will build a simple theodolite, a sighting board, and use your 66-foot baseline from Lesson 10.2 to measure the distance to a tree, post or corner you never walk to. Then you will check your answer with a tape, the way Lambton checked his triangles against a new baseline.

You will need

- A square of plywood or stiff cardboard about 12 inches (30 cm) on a side
- A large paper protractor (print one or draw a 360° circle marked every 5°) taped to the board
- A drinking straw or thin ruler with a small sighting notch at each end, and a pushpin for a pivot
- A sturdy box, stool or camera tripod to set the board on
- Your rope chain or a long tape, stakes, a notebook and a calculator with sine

Steps

1. Pin the straw at the center of the protractor so it pivots freely. This is your alidade.
2. Set the board level on a box at stake A, one end of your 66-foot baseline. Turn the board so the 0° line points exactly at stake B, the other end.
3. Choose a target C at least 40 feet away, such as a tree trunk or a fence post. Swing the straw until you see C through it, and read angle A between the baseline and the target.
4. Move the board to stake B. Point 0° back at A and measure angle B to the same target.
5. Compute angle C = 180° − A − B, then use the law of sines: AC = AB × sin B ÷ sin C and BC = AB × sin A ÷ sin C.
6. Also draw the triangle to scale (for example 1 inch = 10 feet) and measure AC with a ruler. Compare the drawing with the calculation.
7. Now check with a tape: measure AC and BC directly. Compute your error in feet and as a percent.
8. Add a second target D and triangulate it too. Save all your angles; you will map them in Lesson 10.5.

Tips

- Measure each angle three times and average. Surveyors called this “repeating” an angle.
- Small angles at C make large errors. Pick targets roughly as far away as your baseline is long, so the triangle is not too thin.
- Sight the center of a trunk or post, and use the same spot from both ends.

Check your work

- My sighting board pivots smoothly and reads angles to about 1°.
- I computed at least two distances with the law of sines and checked them with a tape.

- My error is recorded as feet and as a percent.

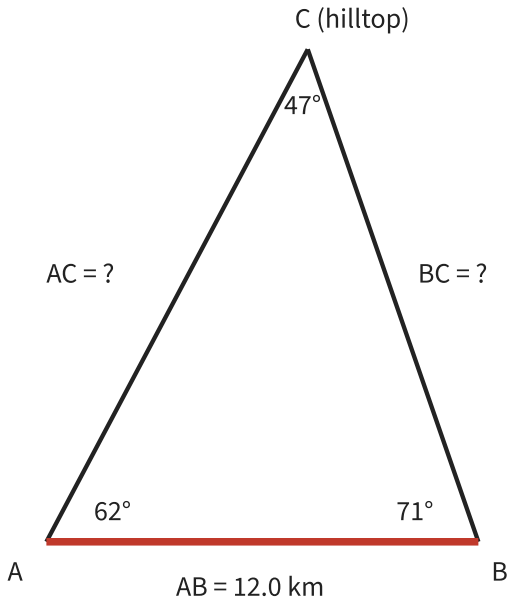
MAP NOTEBOOK

1. Trace or sketch figure ha-great-arc and add the dates 1802 (Madras baseline), 1823 (Lambton dies), 1841 (Arc finished) and 1856 (Peak XV announced).
2. Draw a survey tower of the plains with a theodolite on top and a heliotrope signal on a distant tower. Label the line of sight.
3. Draw a side view of the earth's curve showing an observer, a distant peak and the curvature correction. Label d, the angle of elevation and the drop.

> **From history.** The survey's explorers went where its officers could not. In 1865–1866, Nain Singh, a schoolmaster from the Kumaon hills trained by the survey, traveled in disguise to Lhasa, the capital of Tibet. He measured his paces with a string of prayer beads, hid his notes in a prayer wheel, and fixed Lhasa's latitude by observing the stars. The Royal Geographical Society later awarded him its gold medal.

WORKED EXAMPLES

Example 1. A survey baseline AB is 12.0 km (7.46 miles) long. From A, the angle between B and a hilltop C is 62°; from B, the angle between A and C is 71°. Find the distances AC and BC.



One survey triangle.

1. Third angle: C = 180° − 62° − 71° = 47°.
2. Law of sines: AC ÷ sin B = AB ÷ sin C, so AC = 12.0 × sin 71° ÷ sin 47° = 12.0 × 0.9455 ÷ 0.7314 ≈ 15.51 km.
3. BC = 12.0 × sin 62° ÷ sin 47° = 12.0 × 0.8829 ÷ 0.7314 ≈ 14.49 km.
4. Convert: 15.51 km ≈ 9.64 miles; 14.49 km ≈ 9.00 miles.

Answer: AC ≈ 15.5 km (9.6 miles); BC ≈ 14.5 km (9.0 miles).

Example 2. A surveyor on the plains, at a station 300 feet above sea level, sights a peak 110 miles away at an angle of elevation of 2°02′. Ignoring refraction, estimate the height of the peak. Use tan 2°02′ ≈ 0.03551 and curvature ≈ 0.667 × d^2 feet (d in miles).

1. Horizontal distance in feet: 110 × 5,280 = 580,800 ft.
2. Height above the observer's level line: 580,800 × 0.03551 ≈ 20,624 ft.
3. Curvature: the peak's base has dropped below that level line by 0.667 × 110^2 = 0.667 × 12,100 ≈ 8,071 ft, so add it.
4. Add the station's elevation: 20,624 + 8,071 + 300 ≈ 28,995 ft, about 8,838 m.
5. Real surveyors also corrected for refraction, which makes a peak look a little higher than it is; small errors in that correction are why early heights differ by tens of feet.

Answer: About 29,000 ft (8,840 m), close to the 29,002 ft announced for Peak XV in 1856.

Example 3. Suppose a chain of triangles, carried several hundred miles from one baseline, predicts that a new baseline should be 7.50 miles long, and the new baseline is measured on the ground as 7.50 miles plus 7 inches. What is the error as a fraction of the baseline?

1. Convert the baseline to inches: 7.50 × 5,280 × 12 = 475,200 inches.
2. Fraction: 7 ÷ 475,200 ≈ 0.0000147.
3. As a ratio: 475,200 ÷ 7 ≈ 67,900, so about 1 part in 68,000.
4. For comparison, an error of 1 part in 68,000 over 1,500 miles is about 1,500 × 5,280 ÷ 68,000 ≈ 116 feet.

Answer: About 1 part in 68,000 (0.0015 percent).

PRACTICE

1. EASY Where and in what year did Lambton begin measuring his first baseline?
2. EASY In triangulation, which one length is measured directly, and what is measured everywhere else?
3. EASY Who succeeded Lambton, and when was the Great Arc completed?
4. EASY A survey triangle has angles of 58° and 64° at the ends of the baseline. What is the third angle?
5. MEDIUM A baseline is 10.0 km long. The angles at its ends are 50° and 60°. Find the side opposite the 60° angle. (sin 60° ≈ 0.8660, sin 70° ≈ 0.9397)
6. MEDIUM Using curvature ≈ 0.667 × d^2 feet, how far does the earth's surface drop below a level line at 10 miles and at 50 miles?
7. MEDIUM The Great Arc spans about 21.5 degrees of latitude. Using 69 miles per degree, about how long is it in miles and kilometers?
   (Use the map or drawing "The Arc runs near 78° E." shown earlier in this lesson.)

8. MEDIUM Why did the survey measure Peak XV from more than 100 miles away instead of going closer?
9. MEDIUM Why did Everest replace the steel chain with compensation bars?
10. HARD Convert the 1856 height of Peak XV (29,002 ft) to meters, and find the difference from the modern height of 8,848.86 m in meters and feet (1 ft = 0.3048 m).
11. HARD From a station 400 ft above sea level, a surveyor sights a peak 100 miles away at an angle of elevation of 1°30′ (tan ≈ 0.02619). Ignoring refraction, estimate the peak's height.
12. CHALLENGE Write a paragraph judging the Great Trigonometrical Survey by the standards of its own time: what did it achieve, whom did it serve, and who did the work?

COMMON MISTAKES

- Using the law of sines with the wrong angle. Each side pairs with the angle opposite it, not the angle beside it.
- Forgetting the curvature correction when computing heights or long sight lines. Over 100 miles it is more than 6,000 feet.
- Thinking George Everest discovered or climbed Mount Everest. He had retired by the time Peak XV was measured; the peak was named for him, against his wishes, and was first climbed in 1953.

Make it a game · Triangulate the Treasure. One player hides a small object in a yard and stands at a stake. From two marked stakes 20 feet apart, the other players are told only the two angles to the treasure (measured with the sighting board). Each team draws the triangle to scale on graph paper, measures where the treasure should be, and walks straight to it. Closest team on the first try scores 3 points; then switch hiders.

Scripture. "Where wast thou when I laid the foundations of the earth? declare, if thou hast understanding. Who hath laid the measures thereof, if thou knowest? or who hath stretched the line upon it?" (Job 38:4–5, KJV)

Lambton and Everest spent forty years measuring part of one country with chains and angles. God laid the measures of the whole earth when He made it. Careful measurement is a way of tracing, at a small scale, the order the Creator built into the world.

Practice answers

1. Near St. Thomas Mount outside Madras (Chennai), in 1802.
2. The baseline is measured directly on the ground; everywhere else only angles are measured, and the other sides are computed.
3. George Everest; the Great Arc reached the Himalayan foothills in 1841.
4. 180° − 58° − 64° = 58°.
5. Third angle = 70°. Side = 10.0 × 0.8660 ÷ 0.9397 ≈ 9.22 km (5.73 miles).
6. 10 miles: 0.667 × 100 ≈ 67 feet (20 m). 50 miles: 0.667 × 2,500 ≈ 1,668 feet (508 m).
7. 21.5 × 69 ≈ 1,484 miles, about 2,390 km (roughly 1,500 miles or 2,400 km).

8. Nepal and Tibet were closed to foreigners, so the surveyors had to take their sights from stations on the plains of British India.
9. Steel expands in heat, so a chain's length changes with temperature. Compensation bars used two metals that expand at different rates, arranged so the distance between their end marks stayed constant.
10. 29,002 × 0.3048 ≈ 8,840 m. Difference ≈ 8,848.86 − 8,839.8 ≈ 9 m, about 30 feet.
11. Distance = 528,000 ft. Rise = 528,000 × 0.02619 ≈ 13,828 ft. Curvature = 0.667 × 10,000 = 6,670 ft. Height ≈ 13,828 + 6,670 + 400 ≈ 20,900 ft (about 6,370 m).
12. Strong answers note its scientific achievement (an accurate framework for maps of the subcontinent, the longest meridian arc of its day, a better figure of the earth, the height of Everest); that it served the East India Company and British rule in governing, taxing and defending India; and that it depended on Indian computers such as Radhanath Sikdar and on many unnamed Indian laborers and signalmen, with heavy loss of life to fever among Indians and Britons alike.

10.4 Marking the 49th Parallel: Boundary Commissions in the Wilderness

OBJECTIVES

- Explain how the treaties of 1783, 1818 and 1846 defined the boundary between the United States and British North America, and how the commissions of 1857–1861 and 1872–1874 turned those words into marks on the ground.
- Describe how astronomical stations, the deflection of the plumb line and the shape of a parallel produced a boundary that zigzags slightly, and why the line as marked, not the mathematical parallel, is the legal border.
- Compute lengths along a parallel, convert errors in seconds of latitude to feet and meters, and compare a parallel with a great-circle line between two of its points.

Warm-up. Draw a dot near the top and another near the bottom of a sheet of paper and connect them with a ruler. Now have someone else draw “a line from the northwest point of the lake straight west” on a blank sheet with no lake on it. What problem do they have? Many border troubles start with words that sounded clear in a treaty room and made no sense on the ground.

Watch. *Why the US–Canada border is like that* (Lines On The Map, 4:56).
https://www.youtube.com/watch?v=t3O8J5hWkps
With On the map: watch how the border follows the 49th parallel west from the Lake of the Woods, and look for the Northwest Angle, Point Roberts and the cleared boundary vista through the forest.
Note: Captions were not available to check; preview it first. This is a small channel, so listen to make sure the narrator is a real person and not an AI voice.

KEY TERMS

boundary commission
A team of surveyors, astronomers and laborers appointed by two governments to mark an agreed boundary on the ground, usually working side by side and checking each other.

delimitation and demarcation
Delimitation is describing a boundary in words in a treaty; demarcation is marking it on the ground with monuments.

astronomical station
A point where surveyors fixed latitude by observing stars, usually over many nights, to locate the parallel there.

deflection of the vertical
The small sideways pull of nearby mountains or dense rock on a plumb line, which makes an astronomical latitude differ slightly from the true geometric latitude.

vista
The cleared strip along a boundary through forest. Along the U.S.–Canada border it is kept about 20 feet (6 m) wide, 10 feet on each side.

exclave
A piece of a country cut off from the rest of it by another country's territory or by water, such as the Northwest Angle of Minnesota or Point Roberts, Washington.

CORE IDEAS

The story. In the autumn of 1872, two survey parties, one British and one American, gathered at the Lake of the Woods, on the edge of today's Minnesota and Manitoba. The British commissioner was Donald Cameron, an officer of the Royal Artillery, with a strong party of Royal Engineers; the American commissioner was Archibald Campbell, who had already led the American side of the boundary survey in the Pacific Northwest fifteen years before. Their job was to mark the 49th parallel across the plains from the lake to the Rocky Mountains, more than 800 miles of country that had never been surveyed. They worked into the winter, chaining across frozen swamps where summer work was impossible, then crossed the open prairie in 1873 and reached the mountains in 1874. The British hired Métis scouts from the Red River country, nicknamed the 49th Rangers, as guides and hunters. When the North-West Mounted Police made their long march west to the foothills in 1874, they used the boundary commission's trail and supply depots for part of the way.

Words before lines. The boundary had been described long before it was marked. The Treaty of Paris (1783) ran the line through the lakes to "the most northwestern point" of the Lake of the Woods and then due west to the Mississippi River, which the treaty makers believed rose farther north. It does not. The Convention of 1818 repaired the error: from that northwestern point the line would run due north or south to the 49th parallel, then west along it to the "Stony Mountains," the Rockies. The Oregon Treaty of 1846, which you studied in Unit 8, carried the parallel on to the Pacific coast and then down "the middle of the channel" to the ocean, leaving all of Vancouver Island to Britain. Because the most northwestern point of the lake lies north of the 49th parallel, the 1818 rule left a small piece of American land, the Northwest Angle, cut off by water from the rest of Minnesota. On the Pacific, the parallel crosses the tip of a peninsula, leaving Point Roberts, Washington, reachable by land only through Canada. Neither oddity was planned. Both came from straight-line rules meeting real water.

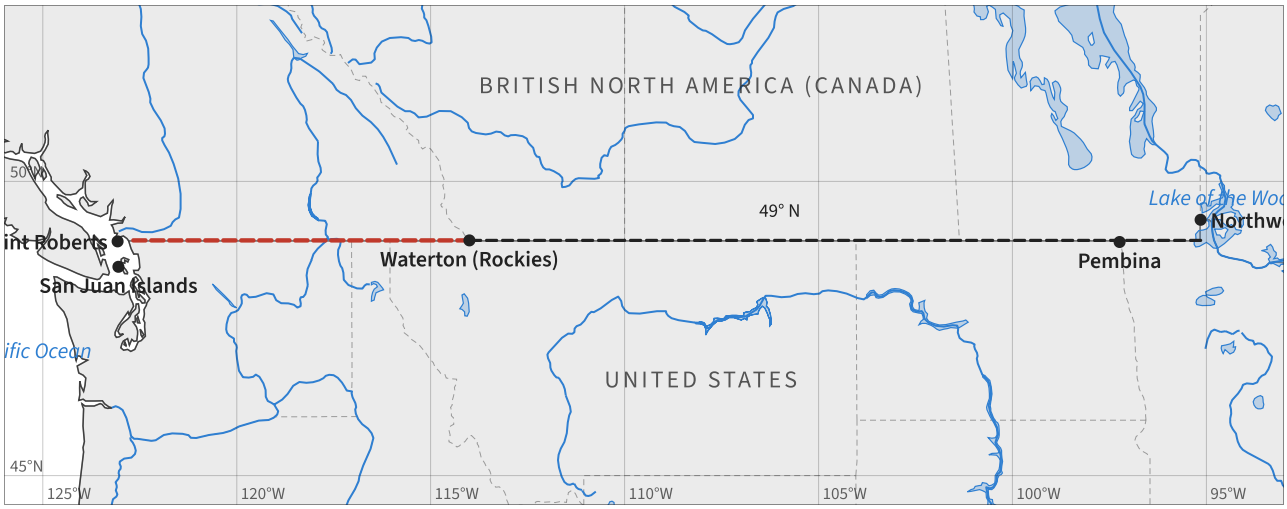
How it worked. No one can see a parallel, so the commissions fixed it the way Mason and Dixon had, by the stars. At astronomical stations along the line, astronomers with zenith telescopes observed pairs of stars passing north and south of the zenith, night after night, until they knew their latitude to a fraction of a second. One second of latitude is about 101 feet (31 m) on the ground. Between stations, survey parties ran the parallel and set markers: on the open prairie, earth mounds and stone cairns; in places, iron posts. Something strange appeared in the results. Each station was correct by its own stars, but nearby hills and hidden dense rock pulled the plumb line slightly sideways, so the "49th parallel" found at one station did not quite line up with the next. This **deflection of the vertical** means the

boundary on the ground zigzags gently, in places by a few hundred feet, around the smooth mathematical parallel. Later treaties settled the question wisely: the boundary is the line the commissioners marked, monument to monument, not a perfect parallel no one could ever find. That rule kept farms and towns from being shifted by every new measurement.

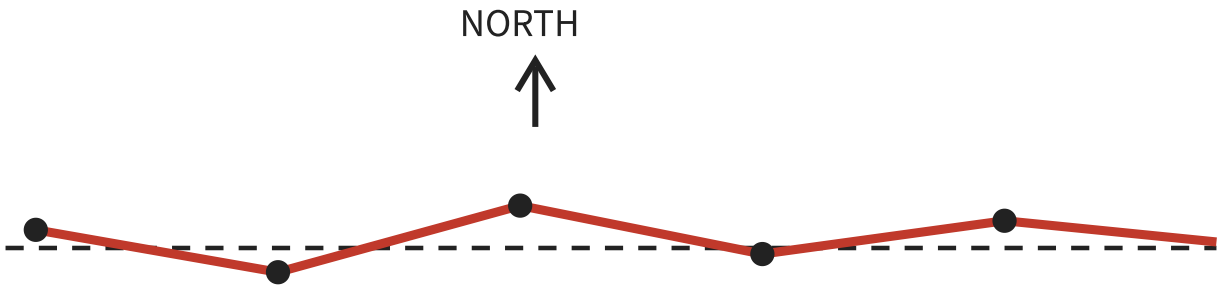
The forest and the water. The western part had been marked first, by the Northwest Boundary Survey of 1857–1861. There the trouble was not open plain but dense forest and the Cascade Mountains. Axmen cut a vista through the timber so that one marker could be seen from the next, a strip that is still cleared today. The water boundary caused worse trouble. “The middle of the channel” did not say which channel, and there were two around the San Juan Islands. In June 1859 an American settler on San Juan Island shot a pig belonging to the Hudson’s Bay Company. The quarrel that followed brought British warships and American soldiers to the island, but the two governments agreed to a joint military occupation, and no one was killed in the so-called Pig War except the pig. In 1872 the German emperor, Wilhelm I, acting as arbiter, awarded the islands to the United States.

The big idea. The 49th parallel is the most famous straight border in the world, and it was marked peacefully by two nations that had fought each other in 1812. It cut across country that belonged to neither in the eyes of its first peoples. The Blackfoot, Lakota, Cree and Métis had hunted buffalo across it for generations, and the line soon mattered to them in new ways: after the Battle of the Little Bighorn (1876), Sitting Bull led his followers north into Canada, and the Lakota called the boundary the “Medicine Line” because American soldiers would not cross it. Today the International Boundary Commission, made permanent by a treaty of 1925, keeps the monuments repaired and the vista clear along the whole border.

Technology overcoming geography. The zenith telescope, the chronometer and the chain let two small parties draw a line straight across forests, swamps and plains that had no natural divide. Today the commission records every monument with satellite positioning. Look at figure ha-49th-map: the line ignores the Red River, the Missouri’s headwaters and the Cascades, and runs on regardless.



The 49th parallel boundary, marked 1857–1861 in the west and 1872–1874 from the Lake of the Woods to the Rockies.



Dashed: true (geometric) 49° N parallel

Solid: boundary as marked between stations

Dots: astronomical stations

Offsets exaggerated; real ones are up to a few hundred feet.

Why the marked boundary zigzags: each station's stars were read with a plumb line pulled slightly by local rock (offsets greatly exaggerated).

PICTURE STUDY

Man standing among tree stumps on bank of the Moyie River at the boundary cut, with cairn marking the boundary line between United States and Canada, Royal Engineers photographers attached to the British North American Boundary Commission, 1860 · Albumen photographic print from a glass negative · Library of Congress, Prints and Photographs Division (album "British Northwest Boundary Commission and Related Subjects, 1859–1861," leaf 39)

The 49th parallel was marked in two great campaigns. From 1857 to 1861 British and American commissions marked it west of the Rocky Mountains, from the Pacific coast

through the forests and mountains of what are now British Columbia, Washington and Idaho. From 1872 to 1874 a second pair of commissions carried it east of the Rockies across the open prairie. The British parties brought Royal Engineers trained as photographers, and their pictures are among the earliest photographs of the borderlands.

This photograph was taken around 1860 where the line crosses the Moyie River. In the forest, a line of latitude could not simply be pointed at. Men had to cut a lane through the trees, called the boundary cut, so that surveyors could see along it, and then pile up stones to mark it. Wet-plate photography meant carrying glass plates, chemicals and a dark tent on mules and in canoes through this country. These are working pictures, made to record what the commission did.

Look closely

- Find the man and the tree stumps around him. What has happened to the forest here, and why?
- Look for the straight lane through the trees. Which way does it run, and what does it have to do with the 49th parallel?
- Find the cairn. What is it made of, and how long do you think it would last in this forest?
- Look at the river and the slopes. Is there any natural feature here that could have served as a border instead?

Talk about it

1. Why would a government want photographs of a boundary survey, not just maps and notebooks?
2. Compare this photograph with the 1768 Mason–Dixon plan from Lesson 10.1. What can each kind of record show that the other cannot?
3. On the prairie in 1872–1874 there were no trees to cut, but also almost no stones or landmarks. How would marking the line there have been easier, and how would it have been harder, than in this forest?

PROJECT: MONUMENTS, WITNESSES AND A BOUNDARY DESCRIPTION

Part four of your unit survey. A boundary is only as good as its marks and its description. You will set monuments at the corners of the area you are surveying, tie each one to “witness” objects, and write a description so clear that someone else can find every corner without you.

You will need

- Your stakes and survey area from Lessons 10.2 and 10.3 (a yard, field or park corner, with permission)
- Four or more corner markers: wooden stakes, flat stones or painted bricks
- Your rope chain or tape, compass and sighting board
- A notebook, and a helper who has not seen your corners

Steps

1. Choose the boundary of your survey area: four to six corners. Set a monument at each corner and number them.
2. For each corner, pick two permanent “witness” objects nearby (a tree, a fence post, a building corner). Measure the bearing and distance from the corner to each witness, as the land surveyors did with bearing trees.
3. Walk the boundary from corner to corner, recording the compass bearing and length of each side.
4. Write a boundary description in two styles: first metes and bounds (“from Corner 1, a stake 14 feet north 30° east of the maple, north 5° west 66 feet to Corner 2…”), then a simple list of corners with their distances from a fixed origin.
5. Pull up or hide one corner marker. Give your helper only the written description and ask them to replace it.
6. Measure how far their replacement is from your original spot. Revise your description where it was unclear.

Tips

- Bearings are measured clockwise from north. Write them the same way every time.
- Pick witnesses that will still be there next year, not a parked car or a flowerpot.
- This is exactly why the treaty rule matters: the corner you marked, not the one you meant, is the one people can find.

Check your work

- Every corner has a monument and two measured witnesses.
- My description gives bearings and lengths for every side.
- A helper replaced a missing corner within about 2 feet using only my description.

MAP NOTEBOOK

1. Draw a close-up sketch map of the Lake of the Woods showing the Northwest Angle and the line due south to the 49th parallel. Label the 1818 rule in your own words.
2. Sketch figure ha-zigzag-line and add a mountain beside one station, with an arrow showing how it pulls the plumb line.
3. Draw a cross-section of a forest boundary vista 20 feet wide with a monument in the middle. Label each side with the country’s name.

> **From history.** The Treaty of Paris of 1783 was drawn on John Mitchell’s map of North America, first published in 1755 and the best map of its day. Mitchell’s map showed the Lake of the Woods and the upper Mississippi in the wrong relation to each other, which is why the treaty’s line “due west to the Mississippi” could never be run. It took the Convention of 1818, and the commissions that followed, to repair a mistake made on paper thirty-five years earlier.

WORKED EXAMPLES

Example 1. The 49th parallel boundary runs from the Lake of the Woods (about 95.15° W) to the Pacific coast at Semiahmoo Bay (about 122.76° W). One degree of longitude at latitude φ is about 69.17 × cos φ miles. Find its length in miles and kilometers (cos 49° ≈ 0.6561).

(Use the map or drawing "Measure from the Lake of the Woods to the coast." shown earlier in this lesson.)

1. Longitude difference: 122.76 − 95.15 = 27.61°.
2. Miles per degree at 49° N: 69.17 × 0.6561 ≈ 45.38 miles (73.0 km).
3. Length: 27.61 × 45.38 ≈ 1,253 miles.
4. Kilometers: 1,253 × 1.609 ≈ 2,016 km.

Answer: About 1,250 miles (about 2,020 km).

Example 2. Near a mountain range, the plumb line at an astronomical station is pulled 4″ toward the north. The astronomers, trusting their plumb line, set the 49th parallel there. How far, and in which direction, is their mark from the true geometric parallel? (1″ of latitude ≈ 101 ft or 31 m.)

(Use the map or drawing "Stations lie slightly off the smooth parallel." shown earlier in this lesson.)

1. The plumb line hangs tilted toward the north, so the instrument's "straight up" leans south. Stars appear to pass slightly farther north of the zenith than they truly do, so the station reads a latitude about 4″ too low.
2. To read exactly 49° 00′ 00″, the astronomers move north until their instrument says 49°; the mark ends up about 4″ north of the true parallel.
3. Distance: 4 × 101 ≈ 404 feet (about 124 m).

Answer: About 400 feet (124 m) north of the geometric parallel; this is the kind of offset that makes the boundary zigzag.

Example 3. Two monuments both lie on 49° N, 10° of longitude apart. A great circle (the shortest path, which a surveyor gets by sighting straight ahead) joins them. How far north of the parallel does it run at its midpoint? Use $\tan \varphi_{max} = \tan \varphi \div \cos(\Delta\lambda/2)$, with $\tan 49° \approx 1.1504$ and $\cos 5° \approx 0.9962$.

1. $\tan \varphi_{max} = 1.1504 \div 0.9962 \approx 1.1548$.
2. $\varphi_{max} = \arctan 1.1548 \approx 49.11°$.
3. Offset: 0.11° × 69 miles per degree ≈ 7.5 miles (about 12 km).
4. So a line sighted straight from one monument to the other would bow about 7½ miles into Canada at its middle. That is why surveyors ran short stretches and corrected back to the parallel, as Mason and Dixon had.

Answer: About 0.11°, roughly 7.5 miles (12 km) north of the parallel at the midpoint.

PRACTICE

1. EASY What is the difference between delimitation and demarcation? Which one did the 1872–1874 commission do?
2. EASY Which agreement first set the 49th parallel from the Lake of the Woods to the Rocky Mountains, and which carried it to the Pacific?
3. EASY Name the two American exclaves created by the 49th parallel rules and say where each is.
4. EASY How wide is the cleared boundary vista kept along the U.S.–Canada border today?
5. MEDIUM Convert an error of 2.5″ of latitude into feet and meters.
6. MEDIUM The 1872–1874 commission worked from the Lake of the Woods (95.15° W) to the Rockies near 114.0° W. About how long is that stretch of the parallel, using 45.4 miles per degree?
7. MEDIUM Compare one degree of longitude at 49° N with one at the equator (69.17 miles). What fraction is it?
8. MEDIUM Why does the U.S.–Canada boundary zigzag slightly instead of following a perfect parallel, and what rule did the two countries adopt about it?
9. MEDIUM What caused the Pig War of 1859, and how was the boundary question settled?
10. HARD Two monuments on 49° N are 1° of longitude apart. Using $\tan \varphi_{max} = \tan \varphi \div \cos(\Delta\lambda/2)$ with $\cos 0.5° \approx 0.99996$, the great circle between them reaches about 49.0011° N. How many feet north of the parallel is that? (1° of latitude ≈ 364,000 ft)
11. HARD On figure ha-49th-map, find Pembina (about 49.0° N, 97.2° W) and the Rockies near Waterton (about 114.0° W). Using 45.4 miles per degree, how many miles of boundary lie between them? At an average of 4 miles a day, how many working days would chaining that take?
    (Use the map or drawing "Use the longitudes given in the problem." shown earlier in this lesson.)
12. CHALLENGE The Lakota called the 49th parallel the "Medicine Line." In a paragraph, explain what that name shows about how a surveyed line can change life for people who did not draw it.

COMMON MISTAKES

- Assuming the border lies exactly on 49° 00′ 00″ everywhere. The legal border is the line between the monuments, which wanders slightly around the true parallel.
- Thinking a straight sighted line between two points on a parallel stays on the parallel. It is a great circle and bows toward the pole.
- Treating the Northwest Angle and Point Roberts as deliberate land grabs. Both came from treaty rules written without accurate maps.

Make it a game · Treaty Room Trouble. One player writes a boundary rule in words for a blank map drawn by another player, without seeing it (for example, “from the northernmost point of the pond, due west to the creek”). The mapmaker must draw the line exactly as written. Score a point for every exclave, gap or impossible instruction the rule creates. Then rewrite the rule to fix it. Fewest problems after three rounds wins.

Scripture. “Thou shalt not remove thy neighbour's landmark, which they of old time have set in thine inheritance, which thou shalt inherit in the land that the LORD thy God giveth thee to possess it.” (Deuteronomy 19:14, KJV)

The two commissions trusted each other’s monuments, and their countries agreed to honor the line as it was marked. Respecting a neighbor’s boundary, whether a fence between farms or a border between nations, is part of loving our neighbor.

Practice answers

1. Delimitation describes a boundary in a treaty; demarcation marks it on the ground. The commission did demarcation.
2. The Convention of 1818; the Oregon Treaty of 1846.
3. The Northwest Angle of Minnesota, on the Lake of the Woods; and Point Roberts, Washington, on the tip of a peninsula south of Vancouver, British Columbia.
4. About 20 feet (6 m), 10 feet on each side of the line.
5. 2.5 × 101 ≈ 253 feet; 2.5 × 31 ≈ 78 m.
6. 114.0 − 95.15 = 18.85°; 18.85 × 45.4 ≈ 856 miles (about 1,380 km).
7. 45.4 ÷ 69.17 ≈ 0.656, about two-thirds (this fraction is cos 49°).
8. Each astronomical station fixed latitude with a plumb line pulled slightly by local mountains or dense rock (deflection of the vertical), so stations lie a little off the true parallel. The countries agreed that the boundary is the line as marked between the monuments, not the mathematical parallel.
9. The Oregon Treaty’s “middle of the channel” did not say which channel around the San Juan Islands; when an American settler shot a Hudson’s Bay Company pig on San Juan Island in 1859, both sides sent forces. They agreed to a joint occupation, and in 1872 the German emperor Wilhelm I, as arbiter, awarded the islands to the United States.
10. 0.0011 × 364,000 ≈ 400 feet (about 120 m).
11. 114.0 − 97.2 = 16.8°; 16.8 × 45.4 ≈ 763 miles. 763 ÷ 4 ≈ 191 working days.
12. Strong answers explain that the line was drawn by two governments across lands the Lakota, Blackfoot, Cree and Métis had used for generations; that once marked, it limited the reach of

each country’s army, so after the Little Bighorn (1876) Sitting Bull’s people found refuge north of it; and that a line invisible on the prairie became real through law and enforcement, for good and ill.

10.5 Final Review: Reading Any Border on Earth

OBJECTIVES

- Use four questions (what nature offered, what power decided, what a treaty said, and what surveyors marked) to explain why any border in the course falls where it does.
- Review the key places, dates and skills of all ten units, including map scale, latitude and longitude, distances along parallels, and survey arithmetic, in preparation for the final exam.
- Finish and present a scaled survey map of a real yard or field from your own measurements, with a title block, north arrow, scale bar, legend and computed area.

Warm-up. Without looking at your notes, list as many borders from this course as you can in three minutes. Then sort them into four piles: rivers, mountains, seas and deserts; lines of latitude or longitude; lines drawn by treaty through settled land; and lines that moved. Which pile is largest? Keep the list; you will use it in session one.

Watch. *How Young George Washington Started a World War - Seven Years War* (Kings and Generals, 18:44). https://www.youtube.com/watch?v=zsks48kTYB4
After the story: watch to see how the land Washington learned to survey turned into a fight over who owned the Ohio Country, and notice how competing land claims and forts worked like borders.
Note: Captions were not available to check; preview it first. It runs about 19 minutes and covers battles and the killing of a French officer at Jumonville Glen, and this channel often opens with a sponsor message you can skip. This covers 1753–1754 and the start of the Seven Years' War, not Washington's 1748 surveying trip with James Genn.

KEY TERMS

natural border
A boundary that follows a physical feature such as a river, ridgeline, desert or sea (Units 2–5).

geometric border
A boundary that follows a line of latitude or longitude or a straight line between points, such as the 49th parallel or the Mason–Dixon Line.

antecedent and superimposed borders
An antecedent border was drawn before many people settled the land; a superimposed border was imposed on peoples already living there, often by outside powers (such as many lines from the Berlin Conference).

traverse
A survey made by measuring the bearing and length of each side of a figure in turn, corner to corner, until you return to the start.

closure error

How far a traverse misses its starting point when the measured sides are plotted. A small closure error shows careful work.

providence
God's wise governing of the world and its history, which works through ordinary means, including geography and human choices, without removing human responsibility.

CORE IDEAS

The story. On March 11, 1748, a tall sixteen-year-old named George Washington rode west from the Potomac with George William Fairfax and an experienced surveyor named James Genn. They were going over the Blue Ridge into the Shenandoah Valley to survey land for Thomas, Lord Fairfax, who owned the vast Northern Neck grant of Virginia. For a month Washington carried the chain, read the compass and kept a journal. He slept in settlers' cabins under a single threadbare blanket swarming with fleas and lice and decided he would rather sleep by the fire in the open air. He crossed rivers swollen with rain, met German settlers who spoke no English, and watched a party of Indians returning from war perform a dance by firelight. The next year, at seventeen, he was commissioned surveyor of Culpeper County, and over the next few years he made about two hundred surveys on the frontier. With his first earnings he bought land of his own. The boy who measured Lord Fairfax's acres would one day lead the army of a new nation and serve as its first president.

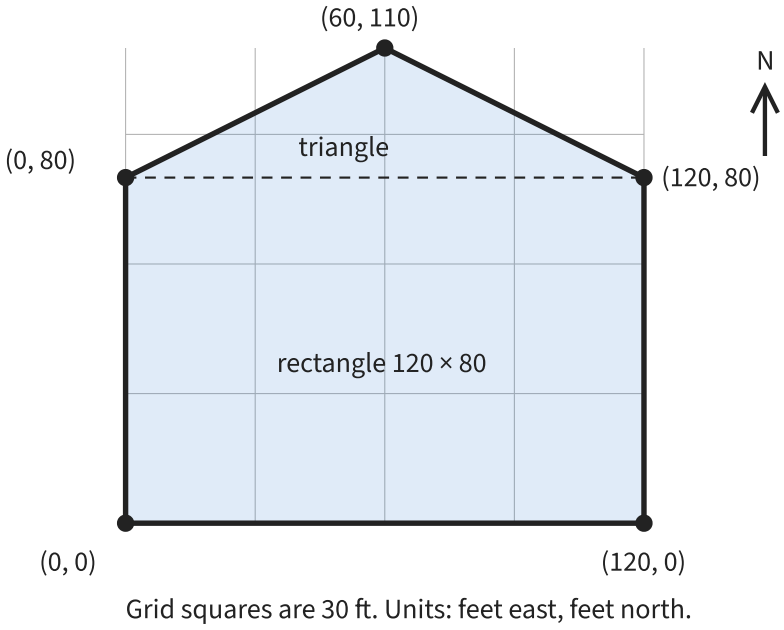
Why end here? Washington's survey brings the whole course together. Lord Fairfax's grant was bounded by rivers, the Rappahannock and the Potomac, and its western edge had been settled only two years earlier, in 1746, when commissioners ran the Fairfax Line from the head spring of the Rappahannock to the head spring of the Potomac. One of those surveyors was Peter Jefferson, whose son Thomas later framed the plan for the Public Land Survey. So in one valley you can see a river border, a line run between two springs, a surveyor's chain, a frontier still contested by Indian nations and empires, and a young man whose choices would change the map. Nature, power, treaties and surveyors all had a hand.

Four questions for any border. Over ten units you have studied dozens of borders. You can read nearly all of them with four questions. **First, what did nature offer?** Rivers (the Rhine, the Rio Grande, the Amur), mountain walls (the Pyrenees, the Alps, the Himalaya, the Andes, the Caucasus), deserts and steppes, and seas and narrow straits (the Channel, the Bosporus, Gibraltar). **Second, what did power decide?** Armies crossed the open North European Plain in 1812 and 1941, the Mongols rode the steppe, and empires held the choke points. **Third, what did a treaty say?** Tordesillas (1494), the Pyrenees (1659), Utrecht (1713), Guadalupe Hidalgo (1848), Aigun (1858), the Berlin Conference (1884–1885), the Radcliffe Line (1947), and the Antarctic Treaty (1959) all drew lines in words. **Fourth, what did surveyors mark?** Mason and Dixon, the public land surveyors, Lambton and Everest, and the boundary commissions on the 49th parallel turned those words into stones, mounds, cleared lanes and numbered squares. Most real borders need more than one answer. The Pyrenees border followed nature but was fixed by a treaty and later by surveyors; the 38th parallel in Korea followed no landform at all and was hardened by war.

The technology thread. In every unit you asked what changed when technology crossed a barrier. Bridges and ferries crossed rivers; the Georgian Military Road crossed the Caucasus; the Yam relay tied the Mongol Empire together; railways bound the American Union and, with Russia's broad gauge, shaped a defense debate; and the surveyor's chain, zenith sector and theodolite drew lines that nature never drew. Technology has never abolished geography. It changes the cost of crossing it. The airplane flies over the Himalaya, but borders there are still argued along ridgelines measured by the Great Trigonometrical Survey.

The faith thread. Scripture says that God "hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26), and that "when the most High divided to the nations their inheritance, when he separated the sons of Adam, he set the bounds of the people" (Deuteronomy 32:8). That is not geographic determinism. Rivers and mountains do not force nations to act; men choose, and they answer for their choices: conquest and slavery were real wrongs, and honest surveys and kept treaties were real goods. Providence works through the land God made and the free choices of the people on it. Paul's purpose in Acts 17 was that men "should seek the Lord" (Acts 17:27). The study of borders is finally a study of people, made of one blood, living within bounds that God has set.

On the map. This lesson ends with your own survey map. Like Mason and Dixon's plan of 1768, it records what you measured, not what you guessed. Draw it to scale from your field notes, plot your triangulated points, compute the area of your figure (figure ha-field-plot shows how), and sign it as a surveyor would. The final exam is given separately; use the review problems below and the unit tests to prepare for it.



A surveyed field plotted from corner coordinates in feet. Its area is found in worked example 1.

PICTURE STUDY

A Crownstone of the Mason–Dixon Line, Carved in England for the Penn and Calvert proprietors; set by the survey party of Charles Mason and Jeremiah Dixon, 1760s · Carved limestone · In place along the Pennsylvania–Maryland border; this one stands near Zora, Adams County, Pennsylvania (photograph: Historic American Buildings Survey, 1950, Library of Congress)

In Lesson 10.1 you studied the printed plan of the Mason–Dixon Line. Now look at the line itself. Every fifth mile, Mason and Dixon's men set a crownstone: a squared limestone post, cut and carved in England, shipped across the Atlantic and hauled by wagon to the line. On the north face is the coat of arms of the Penn family; on the south face, the arms of the Calverts, Lords Baltimore. Many still stand where they were set more than 250 years ago.

A crownstone is a map you can touch. It does exactly what Proverbs 22:28 describes: it is an ancient landmark that neighbors can see and trust.

Look closely

- Find the coat of arms. The Penn arms show a horizontal band with three round discs; the Calvert arms show vertical stripes crossed by a diagonal band. Which one faces you?
- Look at the weathering. Which parts of the carving have worn most, and why?
- Estimate the stone's height above the ground compared with a person. How much of it do you think is buried?
- Look at what surrounds the stone today: field, fence, road or woods. Does the land show that a boundary is here?

Talk about it

1. Why did the proprietors pay to ship carved stones from England instead of setting wooden posts?

2. What would happen to the boundary if all the stones were lost? How would surveyors find the line again?
3. If you set a monument at the corner of your own survey, what would you carve on it?

PROJECT: DRAFTING THE SURVEY MAP

This is the finish of your unit project. You have a latitude from the stars (10.1), a chained square and field notes (10.2), triangulated points (10.3) and monumented corners with a boundary description (10.4). Now you will draft them into one survey map, as Mason and Dixon drafted their plan of 1768.

You will need

- Your field notebook from Lessons 10.1–10.4
- Graph paper (or plain paper and a ruler), a protractor and a sharp pencil
- Fine black pen, colored pencils, an eraser and a calculator

Steps

1. Choose a scale so your whole survey fits on the sheet with margins (for example 1 inch = 10 feet, or 1 cm = 1 m). Write it as both a statement and a ratio.
2. Choose a starting corner and an origin. Plot each corner from your traverse bearings and lengths, or convert each corner to east and north coordinates first.
3. When you return to the start, measure your closure error on the drawing and convert it to feet. Record it.
4. Plot your triangulated points from Lesson 10.3 by drawing their angles from both ends of the baseline. They should land where your tape said they were.
5. Add features from your field notes: trees, fences, buildings, slopes, water. Make a legend with a symbol for each.
6. Compute the area of your boundary figure with the coordinate (shoelace) method or by splitting it into rectangles and triangles. Give square feet, acres and square meters.
7. Add a north arrow, a scale bar, your latitude from Lesson 10.1, and a title block with the place, date and “Surveyed and drawn by” followed by your name.
8. Ink the final lines and present the map to your family, explaining one place where your measurements disagreed and how you resolved it.

Tips

- Pencil everything first. Ink only after the traverse closes.
- A closure error under 1 percent of the perimeter is good work with a rope chain.
- Keep the map clean: a few clear labels are better than many crowded ones.

Check your work

- My map has a title block, north arrow, scale statement and bar, and legend.
- All corners and triangulated points are plotted to scale from my notes.

- I computed the area and recorded my closure error.

MAP NOTEBOOK

1. Make a one-page “border field guide”: draw one small sketch map for each of the four questions (nature, power, treaty, survey) using a border from this course.
2. Draw a timeline from 1494 to 1959 and place at least ten treaties, surveys and events from the course on it.
3. Copy the Penn and Calvert coats of arms as described in the picture study, and draw a crownstone for your own survey with your initials.

> **From history.** Three of the most famous men in early American history were surveyors. Peter Jefferson helped run the Fairfax Line in 1746 and, with Joshua Fry, drew the Fry–Jefferson map of Virginia (first published in 1753), the best map of the colony in its day; his son Thomas later shaped the Public Land Survey. George Washington surveyed for Lord Fairfax and the frontier counties. Abraham Lincoln worked as a deputy surveyor in Illinois in the 1830s. The habits of a good surveyor (careful measurement, honest records and respect for boundaries) proved useful in governing a nation.

WORKED EXAMPLES

Example 1. A surveyed field has corners at (0, 0), (120, 0), (120, 80), (60, 110) and (0, 80), in feet east and north of the first corner (figure ha-field-plot). Find its area in square feet, acres (1 acre = 43,560 sq ft) and square meters (1 sq ft ≈ 0.0929 m²).

(Use the map or drawing “Split into a rectangle and a triangle.” shown earlier in this lesson.)

1. Split the figure: a rectangle 120 ft by 80 ft, plus a triangle on top with base 120 ft and height 110 − 80 = 30 ft.
2. Rectangle: 120 × 80 = 9,600 sq ft. Triangle: ½ × 120 × 30 = 1,800 sq ft. Total: 11,400 sq ft.
3. Check with the shoelace method: sum of $(x_1y_2 - x_2y_1)$ around the figure = 0 + 9,600 + 8,400 + 4,800 + 0 = 22,800; half is 11,400 sq ft.
4. Acres: 11,400 ÷ 43,560 ≈ 0.262 acre. Square meters: 11,400 × 0.0929 ≈ 1,059 m².

Answer: 11,400 sq ft, about 0.26 acre or 1,060 m².

Example 2. You want the 120-foot side of that field to be 8 inches long on your map. What scale should you use? Write it as a statement and as a ratio, and find how long the 60-foot-wide roof line of a shed would be on the map.

1. 120 ft ÷ 8 in = 15 ft per inch, so the scale is 1 inch = 15 feet.
2. As a ratio: 15 ft = 15 × 12 = 180 inches, so the ratio is 1:180.
3. Shed: 60 ft ÷ 15 ft per inch = 4 inches.

Answer: 1 inch = 15 feet (1:180); the shed would be 4 inches long on the map.

Example 3. Unit 9 studied the 38th parallel in Korea; this unit studied the 49th parallel. How far apart are the two parallels north to south? How long is one degree of longitude on each? (69.05 miles per degree of latitude; cos 38° ≈ 0.788, cos 49° ≈ 0.656; one degree of longitude at the equator ≈ 69.17 miles.)

1. Difference in latitude: 49° − 38° = 11°.
2. Distance: 11 × 69.05 ≈ 760 miles; × 1.609 ≈ 1,222 km.
3. Longitude at 38°: 69.17 × 0.788 ≈ 54.5 miles (87.7 km).
4. Longitude at 49°: 69.17 × 0.656 ≈ 45.4 miles (73.0 km).

Answer: About 760 miles (1,220 km) apart; 1° of longitude is about 54.5 miles at 38° N and 45.4 miles at 49° N.

PRACTICE

1. EASY Match each treaty to its year: Tordesillas, the Pyrenees, Utrecht, Guadalupe Hidalgo, Aigun, the Oregon Treaty. Years: 1494, 1659, 1713, 1846, 1848, 1858.
2. EASY Classify each border as natural or geometric: the Rio Grande between Texas and Mexico; the 49th parallel; the Pyrenees between France and Spain; the Mason–Dixon Line; the Amur between Russia and China.
3. EASY How old was George Washington when he first went surveying in the Shenandoah Valley, and for whom?
4. EASY Name the surveyor associated with each: the Great Arc of India (two names); the 1763–1767 Pennsylvania–Maryland line (two names); the Point of Beginning of 1785 (one name).
5. MEDIUM On a map at a scale of 1:24,000, two survey monuments are 3.5 inches apart. How far apart are they on the ground in feet, miles and kilometers?
6. MEDIUM Chile is about 2,670 miles (4,300 km) long and averages about 110 miles wide (Unit 3). Estimate its area and compare with its actual area of about 292,000 square miles.
7. MEDIUM A survey triangle has a baseline of 66 feet and angles of 70° and 60° at its ends. Find the side opposite the 70° angle. (sin 70° ≈ 0.9397, sin 50° ≈ 0.7660)

8. MEDIUM A traverse of a yard has a perimeter of 340 feet. When plotted, the last side misses the starting corner by 2.0 feet. What is the closure error as a percent and as a ratio? Is it under 1 percent?
9. MEDIUM Why did Napoleon in 1812 and Germany in 1941 both invade Russia across the North European Plain rather than elsewhere, and what geographic factors defeated them?
10. HARD A homesteader's 160-acre quarter section lies at 41° N. How long is each side in feet and meters, and what fraction of a degree of longitude does one side span there? (cos 41° ≈ 0.755)
11. HARD Explain, with two examples from the course, how technology changed the cost of crossing a geographic barrier without removing the barrier.
12. CHALLENGE In a paragraph, explain the difference between geographic determinism and the biblical teaching of providence in Acts 17:26. Use one border from the course as an example.

COMMON MISTAKES

- Giving only one cause for a border. Most borders combine nature, power, treaty and survey.
- Treating geography as fate. Mountains and rivers shape choices, but people make them and answer for them.
- Drawing a survey map without a scale or north arrow. Without them the map cannot be measured or turned to match the ground.

Make it a game · Border Detective. Write the names of thirty borders and places from the course on cards. Draw a card and, within one minute, answer the four questions aloud: what nature offered, what power decided, what a treaty said, and what surveyors marked. Score one point for each correct answer, plus a bonus point for a correct date. Play in teams to forty points.

Scripture. "And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation;" (Acts 17:26, KJV)

This verse has run through the whole course. Paul spoke it in Athens, a city surrounded by mountains and sea, to people proud of their own land. The nations and their borders are real, and God has set them in His providence; yet all the nations are of one blood, and the next verse gives the purpose: "That they should seek the Lord."

Practice answers

1. Tordesillas 1494; the Pyrenees 1659; Utrecht 1713; Oregon Treaty 1846; Guadalupe Hidalgo 1848; Aigun 1858.
2. Natural: the Rio Grande, the Pyrenees, the Amur. Geometric: the 49th parallel, the Mason–Dixon Line.

3. Sixteen, in 1748; he surveyed for Thomas, Lord Fairfax, owner of the Northern Neck grant.
4. William Lambton and George Everest; Charles Mason and Jeremiah Dixon; Thomas Hutchins.
5. 3.5 × 24,000 = 84,000 inches = 7,000 feet ≈ 1.33 miles ≈ 2.13 km.
6. 2,670 × 110 ≈ 293,700 square miles, very close to the actual 292,000 (within about 1 percent).
7. Third angle = 50°. Side = 66 × 0.9397 ÷ 0.7660 ≈ 81.0 feet (24.7 m).
8. 2.0 ÷ 340 ≈ 0.0059 = 0.59 percent, about 1 part in 170. Yes, it is under 1 percent.
9. The plain offers an open road without mountain or sea barriers from western Europe toward Moscow. Distance, supply over long lines, mud in autumn and spring, and the severe Russian winter wore down both invading armies (along with Russian resistance).
10. Each side is ½ mile = 2,640 feet ≈ 805 m. One degree of longitude at 41° ≈ 69.17 × 0.755 ≈ 52.2 miles, so 0.5 ÷ 52.2 ≈ 0.0096° (about 34.5 seconds).
11. Answers vary. Examples: the transcontinental railroad cut the trip across the West from months to about a week, but mountains still set grades and routes; the Georgian Military Road made the Caucasus passable, but the passes still controlled movement; triangulation let surveyors measure the Himalaya without entering Nepal, but the mountains still shaped the border.
12. Strong answers explain that determinism says geography forces history, while providence teaches that God governs history, sets the bounds of nations and works through land, climate and human choices, yet people remain free and responsible. Example: the Pyrenees made a natural frontier, but the 1659 treaty and later surveys were human choices; or the 38th parallel followed no landform at all, so its course came from decisions by the powers in 1945.

Unit 10 test

Answer each question. Show your work for every calculation, give units (and both miles and kilometers where asked), and use complete sentences for explanations. A calculator with sine, cosine and tangent is allowed. The test is worth 100 points.

1. (5 pts) Why did the Penn and Calvert families need a surveyed boundary, and how did their 1760 agreement define the line between Pennsylvania and Maryland?
2. (6 pts) A star of declination 40°58′10″ N crosses the meridian 1°14′50″ north of the zenith. Find the observer's latitude. Then convert 15 miles to minutes of latitude (1′ ≈ 1.151 miles).
3. (6 pts) How many Gunter's chains, feet and kilometers are in 12 miles? How many crownstones would mark 75 miles of line, one at every fifth mile (not counting mile 0)?
4. (6 pts) Explain how the Mason–Dixon Line, surveyed to end a property dispute, came to stand for the line between North and South.
5. (6 pts) Number the top two rows of a township's 36 sections from west to east, as they appear on a map with north at the top. Which section is reserved for schools, and where is it?
6. (6 pts) How many acres are in "the E½ of the NW¼ of Section 9, T2S, R4E"? Convert to hectares (1 acre ≈ 0.405 ha), and explain what T2S and R4E mean.
7. (7 pts) Why can't townships be perfect squares across the West, and what did surveyors do about it? Estimate how much narrower the north side of a 6-mile township is than its south side at 45° N (use width × distance ÷ 3,959 × tan 45°, with tan 45° = 1).
8. (6 pts) Give one achievement and one cost of the Public Land Survey, stated factually.
9. (8 pts) A baseline AB is 8.0 km long. The angle at A to a hilltop C is 55°, and the angle at B is 75°. Find AC and BC in km and miles. (sin 55° ≈ 0.8192, sin 75° ≈ 0.9659, sin 50° ≈ 0.7660)
10. (8 pts) From a station 500 ft above sea level, a surveyor sights a peak 80 miles away at an angle of elevation of 2°00′ (tan ≈ 0.03492). Ignoring refraction and using curvature ≈ 0.667 × d^2 feet, estimate the peak's height in feet and meters.
11. (6 pts) Who were William Lambton, George Everest and Radhanath Sikdar, and what did each contribute to the Great Trigonometrical Survey?
12. (6 pts) Find the length of 20° of longitude along the 49th parallel in miles and kilometers (69.17 × cos 49°, cos 49° ≈ 0.6561).
13. (7 pts) Explain why the U.S.–Canada border zigzags slightly around the 49th parallel, and how far off the line would be from a 3″ error in latitude.
14. (6 pts) Explain how the Northwest Angle of Minnesota and Point Roberts, Washington, came to be cut off from the rest of the United States.
15. (7 pts) A surveyed yard has corners at (0, 0), (100, 0), (100, 60) and (0, 90), in feet. Find its area in square feet and acres, and choose a map scale that makes the 100-foot side 5 inches long. Write the scale as a ratio.
16. (4 pts) Use the four questions (nature, power, treaty, survey) to explain where the U.S.–Canada border runs west of the Lake of the Woods.

UNIT PROJECT: THE SURVEYOR'S FIELD BOOK AND MAP

Survey a real yard, field or park corner (with permission) using the instruments you made in this unit: your straw quadrant, rope chain, sighting board and compass. Present a bound field book containing your latitude observations of Polaris, your chained square and its check diagonals, your triangulation angles and law-of-sines computations with tape checks, and your boundary description with monuments and witnesses.

With the field book, present a finished survey map drawn to scale: every corner and triangulated point plotted, features and legend, north arrow, scale statement and bar, computed area in square feet, acres and square meters, closure error, your measured latitude, and a title block signed "Surveyed and drawn by" with your name and the date. Add a one-page essay comparing your work with that of one surveyor from this unit.

- **Field records**: The field book is complete, dated and legible, with every bearing, length and angle recorded, repeated measurements averaged and errors honestly noted.
- **Computation**: Latitude, triangle sides, area and closure error are computed correctly with work shown, in both customary and metric units.
- **Map**: The map is drawn accurately to scale with title block, north arrow, scale bar, legend and clear, uncluttered labels.
- **Essay**: The essay accurately describes the chosen surveyor's methods and instruments and thoughtfully compares the challenges of their work with the student's own.

Answer key

1. Their charters overlapped: Maryland's ran to the fortieth parallel, which would have put Philadelphia (about 39°57′ N) inside Maryland, and settlers on the border had quarreled and even fought. The 1760 agreement set the line as a parallel of latitude 15 miles south of the southernmost point of Philadelphia, running west five degrees of longitude from the Delaware River.
2. North of zenith, so subtract: 40°58′10″ − 1°14′50″ = 39°43′20″ N. 15 ÷ 1.151 ≈ 13.0′.
3. 12 × 80 = 960 chains; 960 × 66 = 63,360 feet; 12 × 1.609 ≈ 19.3 km. 75 ÷ 5 = 15 crownstones.
4. Pennsylvania passed a gradual abolition law in 1780 while Maryland kept slavery until 1864, so the line became a border between a free state and a slave state; enslaved people escaping north crossed it, and Americans began using its name for the whole North–South divide, though the line itself runs only along Pennsylvania, Maryland and Delaware.
5. Top row (west to east): 6, 5, 4, 3, 2, 1. Second row: 7, 8, 9, 10, 11, 12. Section 16 was reserved for schools; it is in the third row, third from the west.
6. NW¼ = 160 acres; E½ of that = 80 acres ≈ 32.4 ha. T2S: the second tier of townships south of the baseline. R4E: the fourth range of townships east of the principal meridian.
7. Meridians converge toward the pole, so township sides that follow meridians draw together. Surveyors restarted at full width on correction lines (standard parallels), usually every 24 miles. Narrowing: 6 × 6 ÷ 3,959 × 1 ≈ 0.0091 mile ≈ 48 feet (about 15 m).
8. Achievement (any one): clear, simple land titles; orderly sale and settlement; school sections; quarter sections for homesteaders under the 1862 Homestead Act. Cost (any one): the grid

ignored terrain and water; the survey followed land cessions that often came after war (such as Fallen Timbers and the Treaty of Greenville) and later forced removals.

9. C = 50°. AC = 8.0 × 0.9659 ÷ 0.7660 ≈ 10.09 km (6.27 miles). BC = 8.0 × 0.8192 ÷ 0.7660 ≈ 8.56 km (5.32 miles).
10. Distance = 80 × 5,280 = 422,400 ft. Rise = 422,400 × 0.03492 ≈ 14,750 ft. Curvature = 0.667 × 6,400 ≈ 4,269 ft. Height ≈ 14,750 + 4,269 + 500 ≈ 19,519 ft ≈ 5,950 m.
11. Lambton began the survey with the Madras baseline in 1802 and the Great Arc, working until his death in 1823. Everest took over, introduced compensation bars and survey towers, and completed the Great Arc in 1841; the highest mountain was later named for him. Sikdar, a Bengali mathematician, led the computers who reduced the observations that showed Peak XV to be the highest mountain measured.
12. 69.17 × 0.6561 ≈ 45.38 miles per degree; 20 × 45.38 ≈ 908 miles ≈ 1,461 km.
13. Each astronomical station found latitude with a plumb line slightly pulled by nearby mountains or dense rock (deflection of the vertical), so stations sit a little north or south of the true parallel, and the line between them zigzags; by treaty the marked line is the border. 3″ × 101 ft ≈ 303 feet (about 93 m).
14. The Northwest Angle: the 1783 treaty and the Convention of 1818 started the line at the most northwestern point of the Lake of the Woods, which lies north of 49°, then ran it due south to the parallel, leaving a piece of land cut off by the lake. Point Roberts: the Oregon Treaty carried the 49th parallel to the coast, and it crosses the tip of a peninsula whose base is in Canada.
15. It is a trapezoid with parallel sides 60 and 90 ft and width 100 ft: ½ × (60 + 90) × 100 = 7,500 sq ft ≈ 0.172 acre. Scale: 100 ÷ 5 = 1 inch = 20 feet = 240 inches, so 1:240.
16. Nature: the plains offered no river or ridge as a divide. Power: Britain and the United States, after the War of 1812, chose to settle claims by negotiation. Treaty: the Convention of 1818 and the Oregon Treaty of 1846 set the 49th parallel. Survey: the boundary commissions of 1857–1861 and 1872–1874 marked it with mounds, cairns, posts and a cleared vista.

Midterm Exam

Units 1–5 · 100 minutes

You have 100 minutes. A calculator is allowed (scientific, with sine, cosine and square root); no notes, atlas or phone. Use these values unless a problem gives others: 1 mile = 1.609 km; 1° of latitude ≈ 111 km (69 miles); 1° of longitude ≈ 111.3 km (69.2 miles) × cos(latitude); 1 nautical mile = 1.852 km and 1 knot = 1 nautical mile per hour; 1 square mile = 2.59 km² = 640 acres; 1 m = 3.281 ft. Great-circle distance: $\cos d = \sin \varphi_1 \sin \varphi_2 + \cos \varphi_1 \cos \varphi_2 \cos \Delta\lambda$, with 1° of arc = 111.2 km.

How points are earned. In calculation problems, write the setup, show each step with units, and give the answer in both kilometers and miles when distances are asked; correct method with a small arithmetic slip earns partial credit. In identification and map-reasoning problems, each named part earns its share of the points. The two essays are graded on the points listed with them: accurate facts and dates, fair weighing of evidence on more than one side, and a clear conclusion. Scripture must be quoted exactly from the King James Version. The exam has **26 problems worth a total of 100 points**.

1. (4 pts) Eratosthenes found that at noon on the summer solstice the sun shone straight down a well at Syene, while at Alexandria a vertical stick cast a shadow at 1/50 of a circle. He took the distance from Syene to Alexandria as 5,000 stadia. (a) What is the shadow angle in degrees? (b) What circumference did he obtain, in stadia? (c) Express it in kilometers and miles if a stadion was 175 m. (d) By what percent does this differ from the modern value of about 40,000 km?
2. (3 pts) (a) Define *environmental determinism* and *possibilism*, and name the French geographer associated with possibilism. (b) Explain how the history of Korea since 1945 tests the claim that “geography is destiny.” (c) Distinguish the *site* and the *situation* of ancient Alexandria.
3. (4 pts) A border river is 500 m wide. Its deepest channel lies 350 m from Country A’s bank and 150 m from Country B’s bank. (a) For a 2-km stretch of river, how much water surface does each country receive under the median-line rule and under the thalweg rule? Give km² and square miles. (b) Why do many treaties prefer the thalweg? (c) The river later shifts slowly over thirty years by wearing one bank and building the other; in another place a flood cuts a new bed in one night. By long-standing practice, what happens to the border in each case? (d) Classify the 49th parallel across the northern prairies by form and by origin.
4. (3 pts) (a) A historical atlas plate has a scale of 1:5,000,000. Two cities measure 8.2 cm apart on it. How far apart are they in kilometers and miles? (b) On a map of Europe about 1550, Spain, the Netherlands, Milan and Naples are all printed in the same color. What does the color mean, and what error would a reader make by treating that area as one country? (c) Name one other pitfall a careful reader of historical maps must avoid.
5. (4 pts) (a) Find the great-circle distance from Rome (41.90° N, 12.50° E) to the legionary fortress at York (53.96° N, 1.08° W), in km and miles. (Use sin 41.90° = 0.6678, cos

41.90° = 0.7443.) (b) How many days would an official courier at 75 km a day and a legion marching 30 km a day need for that distance (ignore the Channel crossing and the bends of the roads)? (c) Explain, in terms of core and frontier, why Hadrian placed his wall across the neck of land from the Tyne to the Solway Firth.

6. (3 pts) Rhine distances are counted from km 0 at Konstanz. The France–Germany river border runs from about Rhine-km 168 near Basel to about km 352 at Lauterbourg. (a) How long is the border in km and miles? (b) Tulla's straightening of the Upper Rhine shortened the Basel–Worms stretch from about 354 km to about 273 km. By what percent was it shortened, and why did this help the border? (c) A barge averaging 12 km/h runs the whole border stretch. How long does it take?
7. (4 pts) The Rhine–Main–Danube Canal (opened 1992) is 171 km long with 16 locks and crosses the divide between the two river systems at a summit of about 406 m above sea level. Suppose it climbs from about 231 m at Bamberg on the Main side through 11 locks, and descends to about 338 m at Kelheim on the Danube side through 5 locks. (a) Find the average lift per lock on each side, in meters and feet. (b) What is the total vertical distance a barge is raised and lowered in one passage? (c) Express the canal's length in miles. (d) Why must a canal crossing a drainage divide have locks on both sides, and what did the canal make possible?
8. (3 pts) (a) A flood cuts across the neck of a Rio Grande meander in one night, leaving a tract of Mexican land on the U.S. side of the new channel. Under the 1884 convention, where is the border? What is such a tract called, and what did the 1905 convention provide for most of them? (b) Which side argued what in the Chamizal dispute, and how was it settled in 1963? (c) Counting the $15 million payment and the up to $3.25 million in claims, what was the price of the Mexican Cession (about 525,000 square miles) per square mile and per acre?
9. (4 pts) (a) How did the Russia–China border move from the Treaty of Nerchinsk (1689) to the Treaty of Aigun (1858) and the Convention of Peking (1860)? (b) A border river is 800 m wide. Its deepest channel lies 300 m from the Russian bank. An island lies 200 m from the Chinese bank. Who owns the island under a line along the Chinese bank, under the median line, and under the thalweg? (c) What happened on Zhenbao (Damansky) Island on March 2, 1969, and how was the island's fate finally settled?
10. (3 pts) The Nile from Aswan to Cairo is about 884 km by river. An ancient boat drifting north with the current covers 40 km a day; sailing south with the steady north wind it covers 65 km a day. (a) Give the river distance in miles and the time each way. (b) Explain why this made the Nile a two-way highway that could hold Egypt together, and state the general rule about rivers through the heart of a land, with the Mississippi in 1863 as a second example.
11. (3 pts) (a) Where and in what year was the Treaty of the Pyrenees signed, and what did it make the border between France and Spain? (b) Explain the difference between the highest-crest rule and the watershed rule, and show how the Val d'Aran is an exception. (c) Why is Llívia a Spanish exclave inside France?
12. (4 pts) (a) The Po plain lies at about 200 m and the temperature there is 14°C. Using a lapse rate of 6.5°C per 1,000 m, find the temperature at a pass at 2,400 m in °C and °F. (b) Polybius says Hannibal crossed the Ebro with about 90,000 foot and 12,000 horse

and came down into Italy with about 20,000 foot and 6,000 horse. What percent of the force arrived? (c) How did the Gotthard Pass help make the Swiss confederation, and what events of 1291 and 1315 mark its beginning?

13. (4 pts) (a) The McMahon Line was drawn on a map at 8 miles to the inch. If the line was 1/20 inch thick, how wide a strip of ground does it cover, in miles, feet and meters? (b) Darjeeling receives about 2,500 mm of precipitation a year and Lhasa about 430 mm. How many times wetter is Darjeeling? Explain the cause. (c) State neutrally the two great India–China disputes in the Himalaya as of 2026 and what the war of 1962 showed about mountain frontiers.
14. (3 pts) Trace how Chile and Argentina kept peace along the Andes: (a) the rule of the 1881 treaty and why it failed in Patagonia; (b) how the dispute was settled in 1902; (c) the monument dedicated in 1904; (d) the Beagle Channel crisis of 1978 and its settlement.
15. (4 pts) (a) Name the two gates through or around the Greater Caucasus and say where each lies. (b) From Vladikavkaz to Tbilisi is about 208 km by the Georgian Military Road; the detour around the eastern end by Derbent and Baku is about 1,300 km. A truck averages 35 km/h on the mountain road and 65 km/h on the detour. Find each distance in miles, each driving time, and the time saved. (c) Why did Russia need this road after 1801?
16. (4 pts) (a) A caravan of 40 people must cross a 12-day stretch with no wells. Each person needs at least 1 gallon of water a day; water weighs 8.3 pounds per gallon; a pack camel carries 300 pounds. How many gallons and pounds of water are needed, and how many camels must carry water only? (b) Explain why salt went south and gold went north across the Sahara. (c) Name the three West African empires that grew on the desert's southern shore, and the geographic "hinge" they shared.
17. (3 pts) (a) A falaj carries water 5 miles from a mountain spring to an Omani oasis, dropping 40 feet. Find its slope in feet per mile, as a percent, and in meters per kilometer. (b) Why did the southwest corner of Arabia earn the Roman name *Arabia Felix* while most of the peninsula is desert? (c) Give two geographic or political reasons the Byzantine and Persian empires could not hold back the Arab armies after the 630s.
18. (4 pts) (a) Kyiv (50.45° N, 30.52° E) and Astana (51.17° N, 71.43° E) both lie close to 51° N. Estimate the distance between them along the parallel of 51° N in miles and km (cos 51° = 0.6293). (b) Astana gets about 320 mm of precipitation a year. Convert to inches and classify the land as forest, steppe or desert. (c) Explain, using Herodotus's account of Darius and the Scythians, why the steppe was hard for settled empires to conquer.
19. (3 pts) (a) A message must travel 1,000 miles along a Yam road with stations every 25 miles. How many legs is that? How long would it take an urgent rider at Marco Polo's upper figure of 250 miles a day, and a caravan at 20 miles a day? Give the distance in km. (b) What was a *paiza*, and who bore the cost of the Yam stations?
20. (3 pts) (a) English records say the Armada anchored off Calais on 27 July 1588; what is that date in the Spanish (New Style) calendar, and why do the dates differ? (b) Why did Philip II's plan fail at its "hinge" with the Duke of Parma? (c) State the rule that connects 1588, 1805 and 1940 with the successful landings of 1066 and 1688.

21. (4 pts) (a) An invasion fleet crossing from Korea uses Tsushima and Iki as stepping stones, with open-water legs of about 50 km, 55 km and 65 km. At 4 knots, how long is the longest leg, and how long are all three legs together? Give the total distance in miles. (b) The Korea Strait is about 200 km wide and the Strait of Dover about 33 km. How many times wider is Japan's moat? (c) Give three reasons the Mongol invasion of 1281 failed.
22. (4 pts) (a) Cato said Carthage was three days' sail from Rome. Ostia to Carthage is about 570 km. How long would a ship averaging 5 knots take? Is Cato's claim believable? (b) If land carriage cost about 30 times as much per mile as sea carriage, how far could an ox-cart carry grain for the money that ships it 570 km by sea? Give km and miles. (c) Explain why Rome could call the Mediterranean *mare nostrum* after 67 BC.
23. (3 pts) (a) A sailor whose eye is 3 m above the sea looks toward an island peak 1,500 m high. Using $d\ (\text{km}) \approx 3.57 \times (\sqrt{h_1} + \sqrt{h_2})$, how far away can the peak first be seen, in km and miles? What does this mean for Greek sailing in the Aegean? (b) Each trireme carried 170 rowers and about 30 others. How many men did a fleet of 150 triremes need? (c) Why did Greek geography produce many city-states but one people?
24. (3 pts) (a) Operation Husky, the Allied invasion of Sicily, began on 10 July 1943 and ended on 17 August. How many days elapsed? (b) In 1565 Malta's relief came from Sicily, about 93 km away, while the Ottoman base at Constantinople lay about 1,600 km away by sea. At 5 km/h, how long was each voyage? Give the shorter distance in miles. (c) Why have great powers fought for Sicily and Malta, and how do such "crossroads islands" differ from Britain or Japan?
25. (8 pts) **Essay.** Quote Acts 17:26 exactly (KJV). Then explain how God's providence, the land and human choice work together in history. Use at least two examples from Units 1–5, sorting the causes of at least one of them into what was *given*, what was *chosen* and what was *changed*, and show how a sound view avoids both fatalism and pride.
26. (8 pts) **Essay.** The historian Ray Huang pointed out that for much of its length the Great Wall follows the 15-inch rain line. Weigh this geographic explanation of where China's northern walls stand. Give evidence that supports it, evidence that limits it, and a conclusion.

Answer key

1. (a) 360° ÷ 50 = **7.2°**.
   (b) The whole circle is 360° ÷ 7.2° = 50 times the arc: 50 × 5,000 = **250,000 stadia**.
   (c) 250,000 × 175 m = 43,750,000 m = **43,750 km**; 43,750 ÷ 1.609 ≈ **27,190 miles**.
   (d) (43,750 − 40,000) ÷ 40,000 = 0.094, about **9.4 percent too large**. (The method was sound; the uncertainty lies in the length of the stadion.)
2. (a) Environmental determinism: the physical environment (climate, landforms, soils, location) largely decides how a people live and what their history will be. Possibilism: nature sets limits and offers possibilities, but people choose among them; associated with **Paul Vidal de la Blache**.
   (b) The Korean peninsula has one climate, one set of rivers and soils, and was one people under one government until 1945; divided after the Second World War, it became two states in 1948. South Korea became a leading industrial and trading nation while North Korea remains poor and closed with repeated food shortages. The same land produced opposite

results, so choices of government and economy, not geography, made the difference.
(c) Site: a narrow strip of land between a lake and the sea at the western edge of the Nile Delta. Situation: where the trade of the Nile met the sea lanes of the Mediterranean, which made it one of the great cities of the ancient world.

3. (a) Median line: 250 m × 2,000 m = 500,000 m² = **0.50 km² each** (0.50 ÷ 2.59 ≈ 0.19 sq mi). Thalweg: A gets 350 m × 2,000 m = **0.70 km²** (≈ 0.27 sq mi); B gets 150 m × 2,000 m = **0.30 km²** (≈ 0.12 sq mi).
(b) Ships follow the deepest channel; the thalweg gives both countries a share of the navigable shipping lane, which a median line might leave entirely to one side.
(c) Gradual change (erosion and accretion): the border moves with the river. Sudden change (avulsion): the border stays in the old bed.
(d) **Geometric** in form (it follows a parallel of latitude) and **antecedent** in origin (drawn before most people settled there).
4. (a) 1 cm = 5,000,000 cm = 50,000 m = 50 km. 8.2 × 50 = **410 km**; 410 ÷ 1.609 ≈ **255 miles**.
(b) The color stands for a ruler or dynasty, the emperor Charles V, who held all these lands, not for one nation in the modern sense. Treating it as one country reads the modern idea of a nation back into the past.
(c) Any one: **anachronism** (e.g., showing “Germany” or “Italy” as states in 1500, though they were united only in 1871 and 1861); mistaking **claims for control** (a colored area means a ruler claimed it, not that he governed every valley); mistaking **lines for walls** (old frontiers were often zones, though the map draws a sharp line); ignoring the **mapmaker’s own time** and purpose.
5. (a) Δλ = 12.50° − (−1.08°) = 13.58°. sin 41.90° × sin 53.96° = 0.6678 × 0.8086 ≈ 0.5400. cos 41.90° × cos 53.96° × cos 13.58° = 0.7443 × 0.5884 × 0.9720 ≈ 0.4257. cos d ≈ 0.9657, so d ≈ 15.1°. Distance ≈ 15.06 × 111.2 ≈ **1,675 km (about 1,040 miles)**.
(b) Courier: 1,675 ÷ 75 ≈ **22 days**. Legion: 1,675 ÷ 30 ≈ **56 days** (more in practice).
(c) The frontier lay weeks from Rome’s core, so it had to be held cheaply. Hadrian chose a narrow neck between the North Sea and the Irish Sea, where the shortest line (about 117 km, 73 miles) could be held by the fewest soldiers. The wall, with a gated milecastle every Roman mile, was meant to control who crossed and with what goods, not to seal Britain off.
6. (a) 352 − 168 = **184 km**; 184 × 0.621 ≈ **114 miles**.
(b) Shortening 354 − 273 = 81 km; 81 ÷ 354 ≈ **23 percent**. A wandering river with many channels made the border shift with every flood or left it in dispute over which channel was the river; one fixed channel gave one clear, stable line.
(c) 184 ÷ 12 ≈ **15.3 hours** (about 15 hours 20 minutes).
7. (a) Main side: 406 − 231 = 175 m ÷ 11 ≈ **15.9 m (about 52 ft) per lock**. Danube side: 406 − 338 = 68 m ÷ 5 = **13.6 m (about 45 ft) per lock**.
(b) 175 + 68 = **243 m** (about 797 ft) of lifting and lowering.
(c) 171 ÷ 1.609 ≈ **106 miles**.
(d) The divide is the high ground between two basins; water runs away from it on both sides, so a boat must be raised up one slope and let down the other, step by step. The canal let a barge travel all the way from the North Sea to the Black Sea, joining the Rhine and the Danube.
8. (a) A sudden change (avulsion): the border **stays in the old bed**, even if dry. The stranded tract is a **banco**; the 1905 convention provided that most bancos pass to the country on whose side of the river they now lie.
(b) Mexico said the shift at El Paso (especially after 1864 floods) was sudden, so El Chamizal was still Mexican; the United States said it was gradual, so the land was American. After the

1911 award was refused, the 1963 Chamizal Convention built a new concrete-lined channel and gave Mexico 366 acres of the Chamizal plus 71 acres east of Cordova Island, and the United States 193 acres of Cordova Island.
(c) $18,250,000 ÷ 525,000 ≈ **$34.76 per square mile**; ÷ 640 ≈ **5.4 cents per acre**.

9. (a) Nerchinsk drew a **watershed** border along the Argun and the mountains of the Stanovoy range, leaving the whole Amur basin to China. Aigun moved the line down to the **Amur River**, giving Russia the north bank (about 600,000 km²); Peking gave Russia the land east of the **Ussuri** to Korea (about 400,000 km² more). China calls them unequal treaties.
(b) The thalweg is 800 − 300 = 500 m from the Chinese bank; the median line is 400 m from either bank. Chinese-bank line: all water and the island on the Russian side → **Russia**. Median (400 m): island at 200 m is on the Chinese side → **China**. Thalweg (500 m): island on the Chinese side → **China**.
(c) Chinese troops dug in on the island ambushed a Soviet patrol, killing 31 Soviet border guards; a larger battle followed on March 15. A 1991 agreement fixed most of the border on the thalweg and Zhenbao went to China (with the last islands near Khabarovsk divided by a 2004 agreement, transferred in 2008).
10. (a) 884 ÷ 1.609 ≈ **549 miles**. North (downstream): 884 ÷ 40 ≈ **22 days**. South (upstream, sailing): 884 ÷ 65 ≈ **13.6 days**.
(b) The river flows north while the prevailing wind blows from the north, so boats drift down with the current and sail back with the wind; granite, grain and officials could move the length of a kingdom more than 600 miles long, which let kings govern Upper and Lower Egypt as one. Rule: a river along the edge of a country divides, but a river through its heart unites. When Vicksburg (July 4, 1863) and Port Hudson fell, the Union held the whole Mississippi, split the Confederacy and reopened the Midwest's outlet; Lincoln wrote that "the Father of Waters again goes unvexed to the sea."
11. (a) On **Pheasant Island** in the Bidasoa River, in **1659** (signed 7 November by Mazarin and Don Luis de Haro). It made the Pyrenees the border; France gained Roussillon and northern Cerdanya.
(b) The highest-crest rule joins the highest peaks; the watershed rule follows the ridge that divides water flowing to one side from water flowing to the other. The Val d'Aran lies on the north side of the main water-parting (its river is the Garonne, flowing through France to Bordeaux), yet it was not among the lands handed over and remained Spanish.
(c) The treaty gave France 33 villages of Cerdanya; Llívia argued it was a **town, not a village**, so it stayed Spanish, an island of Spain about 12.8 km² (about 5 sq mi) surrounded by France.
12. (a) Climb 2,400 − 200 = 2,200 m; cooling 2.2 × 6.5 = 14.3°C; 14 − 14.3 = **−0.3°C**; −0.3 × 1.8 + 32 ≈ **31.5°F**, just below freezing.
(b) 26,000 ÷ 102,000 ≈ **25.5 percent** (about a quarter; many had been left as garrisons or sent home, and many died or deserted).
(c) After the Schöllenen gorge road opened early in the 1200s, the Gotthard became the shortest route between the Rhine lands and Milan, and Uri held its northern approach; the pass gave the mountain valleys both a reason to resist overlords and narrow ground a few could hold. In early August **1291** Uri, Schwyz and Unterwalden swore the Federal Charter of mutual help; in **1315** they ambushed and destroyed a Habsburg army at **Morgarten**, where the road ran between a steep slope and a lake.
13. (a) (1/20) × 8 = **0.4 mile** = 0.4 × 5,280 = **2,112 feet** ≈ 0.4 × 1,609 ≈ **644 m**.
(b) 2,500 ÷ 430 ≈ **5.8 times**. The summer monsoon drives moist air from the Indian Ocean against the mountains; rising air cools and drops its rain on the south side, leaving Tibet in the rain shadow.

(c) In the west, the **Aksai Chin** plateau, claimed by India from old British maps but held by China, which built a road across it in the 1950s; in the east, the land south of the McMahon Line (Arunachal Pradesh), held by India and claimed by China, which never accepted the 1914 line. In 1962 China attacked, defeated the Indian army, then pulled back in the east roughly to the McMahon Line while keeping Aksai Chin; the side with better roads to the front held the advantage.

14. (a) The line was to follow the highest peaks of the Cordillera that divide the waters. In the north and center these are the same ridge, but in Patagonia some rivers rise on the eastern side and cut west through the range, so peaks and water-parting differ: Argentina argued for the highest peaks, Chile for the water-parting.
(b) The two signed the **Pacts of May** (1902), limiting their navies, and accepted the arbitration award of **King Edward VII** of Britain, whose surveyors under Sir Thomas Holdich split the difference.
(c) **Christ the Redeemer of the Andes**, dedicated 13 March 1904 at the La Cumbre (Bermejo) pass, about 3,832 m.
(d) Both armies moved to the border over three islands near Cape Horn; both accepted the mediation of **Pope John Paul II** (envoy Cardinal Samorè), and the 1984 Treaty of Peace and Friendship gave the islands to Chile and most surrounding sea rights to Argentina.
15. (a) The **Darial Gorge** of the Terek River through the center of the range (the “Gate of the Alans”), and **Derbent**, on the narrow strip, about 3 km wide, between the mountains and the Caspian Sea in the east.
(b) 208 km ≈ **129 miles**; 1,300 km ≈ **808 miles**. Mountain road: 208 ÷ 35 ≈ **5.9 hours**. Detour: 1,300 ÷ 65 = **20 hours**. Saved: about **14 hours** of driving.
(c) Russia annexed the eastern Georgian kingdom in 1801, a province on the far side of a mountain wall; to hold it and to move armies against Persia and the Ottomans it rebuilt the old track up the Terek, through the Darial and over the Jvari (Cross) Pass, about 2,379 m, into a highway for coaches and artillery.
16. (a) 40 × 12 × 1 = **480 gallons** (about 1,820 liters); 480 × 8.3 = **3,984 pounds** (about 1,810 kg); 3,984 ÷ 300 = 13.3, so **14 camels**.
(b) People and cattle in the hot lands of the south lose salt through sweat and must replace it, and the savanna had few salt deposits; mines such as Taghaza supplied it. The south had gold fields at Bambuk and Bure near the upper Senegal and Niger, and later from the forest lands, which the Mediterranean world wanted.
(c) **Ghana, Mali and Songhai**. Each stood where the camel caravans met the Niger River boats and the desert met the grass (the Sahel), at entrepôts such as Walata, Timbuktu and Gao.
17. (a) 40 ÷ 5 = **8 feet per mile**; 40 ÷ (5 × 5,280 = 26,400) ≈ 0.0015 = **0.15 percent** (about 1 in 660); 12.2 m ÷ 8.05 km ≈ **1.5 m per km**.
(b) The highlands of Yemen catch the summer monsoon rains off the Indian Ocean; the rest of the peninsula lies under the belt of sinking, drying air near the Tropic of Cancer and gets under about 100 mm (4 in) a year.
(c) Any two: the war of 602–628 had drained both empires of men and money; the old Arab buffer kingdoms were gone (Persia abolished the Lakhmids about 602; Byzantium stopped paying many Arab allies); camel-borne forces could move across waterless steppe where imperial armies could not follow, strike and withdraw into the desert.
18. (a) Δλ = 71.43 − 30.52 = 40.91°. One degree at 51° N: 69.2 × 0.6293 ≈ 43.5 miles (111.3 × 0.6293 ≈ 70.0 km). Distance ≈ 40.91 × 43.5 ≈ **1,780 miles**; 40.91 × 70.0 ≈ **2,865 km**.
(b) 320 ÷ 25.4 ≈ **12.6 inches**; between 10 and 20 inches, so **steppe**.
(c) When Darius invaded about 513 BC, the Scythians, who had no towns or farmland to

defend, retreated ahead of him, filled in wells and destroyed the grass, and would not give battle; his hungry army had to turn back to the Danube. Nomads could move with their herds, trade space for time and let distance and hunger wear the invader down.

19. (a) 1,000 ÷ 25 = **40 legs**; distance 1,000 × 1.609 ≈ **1,609 km**. Urgent rider: 1,000 ÷ 250 = **4 days**. Caravan: 1,000 ÷ 20 = **50 days**, about twelve and a half times slower.
    (b) A tablet of gold, silver, bronze, iron or wood bearing the khan's authority, carried by officials and messengers as a passport entitling them to horses, food and guides at the stations. The households near each station were forced to supply horses, fodder and men.
20. (a) 27 July + 10 days = **6 August 1588** (New Style). Spain had adopted Pope Gregory XIII's calendar of 1582, which dropped 10 days; England kept the Julian calendar until 1752.
    (b) Spain held no deep-water harbor on the Flemish coast where big ships could anchor and load Parma's army; Dutch rebel ships could bottle his barges in the shallow waters; and the fireships off Calais scattered the anchored fleet before the battle of Gravelines, after which the southwest wind drove it into the North Sea.
    (c) **The sea protects only the side that commands it.** Invasions failed when the defender held the Channel (Armada 1588; Napoleon gave up after 1805, Trafalgar; Sea Lion postponed after the Battle of Britain, 1940); William of Normandy (1066) and William of Orange (1688) landed when the English fleet was broken up or pinned by the wind.
21. (a) 4 knots = 4 × 1.852 = 7.41 km/h. Longest leg: 65 ÷ 7.41 ≈ **8.8 hours**. Total 50 + 55 + 65 = 170 km (≈ **106 miles**); 170 ÷ 7.41 ≈ **23 hours** of sailing.
    (b) 200 ÷ 33 ≈ **6 times**.
    (c) Any three: the stone wall about 20 km long built along Hakata Bay after 1274 kept the Eastern Army from landing in force; Japanese raiders attacked anchored ships at night from small boats; the larger Southern Army from Ningbo arrived late, so the fleets lay offshore into August; a great typhoon (the *kamikaze*) smashed the crowded ships near Takashima; some ships were river boats poorly suited to open sea.
22. (a) 570 ÷ 1.852 ≈ 308 nautical miles; 308 ÷ 5 ≈ **62 hours, about 2.6 days**. Yes: with a fair wind a three-day passage is believable, which was Cato's point that Carthage was close enough to threaten Rome.
    (b) 570 ÷ 30 = **19 km (about 12 miles)**.
    (c) Rome had destroyed Carthage, the rival fleet of the western sea, in 146 BC; in 67 BC Pompey, given command over the whole sea and its coasts, divided it into districts with squadrons and swept the Cilician pirates from west to east in about three months. With every shore Roman, the sea became a highway that fed the city with grain from Egypt, Sicily and North Africa.
23. (a) √1,500 ≈ 38.73; √3 ≈ 1.73; 3.57 × 40.46 ≈ **144 km (about 90 miles)**. The Aegean islands lie much closer together than that, so a sailor could almost always see land ahead or behind and cross the sea island to island.
    (b) 150 × 200 = **30,000 men**.
    (c) Mountains cut the land into small valleys and coastal plains, each with room for one city and its fields, so each became an independent polis; but nearly every polis lay near the sea, and the sea joined what the mountains divided: a shared language, gods, Homer and the Olympic Games, and colonies founded by ship from Spain to the Black Sea.
24. (a) July 11–31 = 21 days, plus 17 = **38 days**.
    (b) 93 km ≈ **58 miles**; 93 ÷ 5 ≈ **19 hours**. 1,600 ÷ 5 = 320 hours ≈ **13 days** (longer in practice with stops). The defenders' help was close; the attackers' supplies were far.
    (c) They sit at the narrow waist of the Mediterranean, where ships passing between the western and eastern basins must come within reach; whoever holds them can watch or cut the traffic (as Malta did to Axis convoys to Libya in 1940–1942). Large, distant islands such as

Britain and Japan became powers in their own right; small crossroads islands became prizes usually ruled from elsewhere (Malta was independent only in 1964).

25. **Grading points (8):** (2) Exact quotation: “And hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation.” (1) Explains the three claims: one blood (one human family), the times (seasons of rise and fall), the bounds (where peoples dwell), with Paul’s purpose in 17:27 that men “should seek the Lord.” (2) Shows providence working through ordinary means without cancelling responsibility, e.g., Paul’s crossing from Troas to Macedonia (two days one voyage, five another: winds were God’s means, but Paul chose to board the boat), or Jeremiah 18:7–8 and Nineveh, spared on repenting and fallen in 612 BC. (2) A case sorted into given/chosen/changed (e.g., the Netherlands: low land given; dikes chosen; the Afsluitdijk of 1932 changed what the land could be; or the Swiss: steep valleys given, the oath of 1291 and Morgarten chosen, the Gotthard tunnels changing the barrier). (1) Names the two errors (fatalism: “geography decides everything”; pride: a nation claiming it made itself or is owed land, as at Babel or in Nazi “living space”) and concludes fairly.
    Model answer: Paul told the Athenians that God “hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation.” Every people is one family; God sets when nations rise and fall and where they live, so that they should seek Him. Yet Scripture never treats this as fate. God works through means: the sea and wind carried Paul from Troas to Neapolis in two days, while a later crossing took five, but Paul still chose to board. Nineveh repented under Jonah and was spared, then returned to cruelty and fell in 612 BC. Consider Switzerland. Given: steep valleys and the Gotthard road through narrow ground. Chosen: the men of Uri, Schwyz and Unterwalden swore mutual help in 1291 and ambushed the Habsburgs at Morgarten in 1315; geography gave them a fighting chance, but their oaths and courage won it. Changed: the 1882 tunnel and the 2016 Base Tunnel pierced the wall. Korea shows the same lesson the other way: one land, two governments, two outcomes. The sound view avoids fatalism, which makes choices meaningless, and pride, which forgets that the land and its bounds are God’s gift and that nations answer to Him for how they gain and use it.
26. **Grading points (8):** (1) Explains the rain line: about 15 inches (381 mm, often rounded to 400 mm) a year, roughly the dry limit of dependable rain-fed farming; south and east lies farmland, north and west steppe and the Gobi. (2) Supporting evidence: e.g., Beijing (about 570 mm) is on the farming side, Lanzhou (about 320 mm) and Yinchuan (about 200 mm) on the dry side where fields need irrigation; the wall marks the steppe–sown frontier between herders and farmers; walls, beacon towers and gates slowed raiders, gave warning and channeled trade (tea and silk for horses) into markets. (2) Limiting evidence: e.g., some walls ran far into the steppe and others well inside farmland according to each dynasty’s wars; the rain line shifts between wet and dry years; dynasties that ruled both sides (Tang, Yuan, Qing) built little; Lattimore argued the frontier was a zone, not a line, where farmers became herders and nomads farmers. (2) Human choice: the Ming built most of the brick wall after the disaster at Tumu (1449), when a poorly planned expedition was destroyed and the emperor captured, a policy decision; in 1644 the wall ended not by breach but when Wu Sangui opened Shanhai Pass to the Manchus. (1) A balanced conclusion.
    Model answer: The rain-line explanation is strong. A rainfall map laid over the Ming wall shows it running close to the 15-inch isohyet: Beijing, with about 22 inches, can farm on rain alone, while Lanzhou and Yinchuan, with about 13 and 8 inches, depend on river water and border the steppe. The wall therefore marks the deepest divide in the region, between the steppe and the sown, and against small raids it worked, with beacon towers carrying warning faster than horses and gates turning raiders into traders. But the explanation is not the whole

story. The rain line moves from year to year, and walls were built far north or south of it as each dynasty’s fortunes dictated; Owen Lattimore showed the frontier was a zone where peoples changed ways of life. Whether to build at all was a political choice: the Tang, Yuan and Qing, who ruled both sides, needed little wall, while the Ming turned to wall-building only after the defeat at Tumu in 1449. And the wall’s end in 1644 came through an opened gate, not a breach. Conclusion: geography explains where the frontier lay; human decisions explain whether, when and how well it was walled.

Final Exam

Units 1–10 · 120 minutes

You have 120 minutes. A calculator is allowed (scientific, with sine, cosine, tangent and square root); no notes, atlas or phone. The exam is cumulative, with most questions on Units 6–10. Use these values unless a problem gives others: 1 mile = 1.609 km; 1° of latitude ≈ 111 km (69 miles); 1° of longitude ≈ 111.3 km (69.2 miles) × cos(latitude); 1 nautical mile = 1.852 km = 1.151 miles, and 1 knot = 1 nautical mile per hour; 1 square mile = 2.59 km^2 = 640 acres; 1 acre = 43,560 sq ft; 1 m = 3.281 ft; °F = °C × 1.8 + 32. Great-circle distance: $\cos d = \sin \varphi_1 \sin \varphi_2 + \cos \varphi_1 \cos \varphi_2 \cos \Delta\lambda$, with 1° of arc = 111.2 km.
How points are earned. In calculation problems, write the setup, show each step with units, and give distances in both kilometers and miles; correct method with a small arithmetic slip earns partial credit. In identification and map-reasoning problems, each named part earns its share of the points. The three essays are graded on the points listed with them: accurate facts and dates, fair weighing of evidence on more than one side, and a clear conclusion that answers the question.
The exam has **28 problems worth a total of 100 points**.

1. (3 pts) (a) The Bosporus is about 31 km long, and its surface current runs south at about 2 knots. A galley can make 5 knots through still water. How long does it take to pass the strait northbound and southbound? (b) Name the three waters that surround old Constantinople and the defense that closed its harbor. (c) How did Mehmed II get around that defense in 1453?
2. (3 pts) (a) The Strait of Gibraltar is about 14 km wide at its narrowest. If coast guns on each shore could hit ships 3 km out, what width of water lay beyond the reach of both, in km and miles, and what percent of the crossing is that? (b) What, then, was Gibraltar's real value to Britain? (c) How and when did Britain gain Gibraltar, and how did the Great Siege of 1779–1783 end its fiercest attack?
3. (3 pts) (a) Why did Stamford Raffles found a free port at Singapore in 1819? Give two geographic reasons. (b) The Japanese landed in Malaya on 8 December 1941 and Singapore surrendered on 15 February 1942. How many days was that? (c) A container ship passes the 105-km Singapore Strait at 15 knots. How long does it take? Give the strait's length in miles.
4. (3 pts) (a) A battleship that can make 12 knots heads up the 61-km Dardanelles against a 3-knot current. How long does it spend in the strait, and how long would the return take? (b) Explain why the naval attack of 18 March 1915 failed: how did the mines, the mobile guns and the minesweepers depend on one another? (c) Why did the army's landings of 25 April also stall?
5. (4 pts) (a) A harbor channel has a charted depth of 11.5 m below chart datum. At high water the tide is 2.1 m above datum. A ship draws 12.4 m, and the harbor master requires 0.8 m of under-keel clearance. Can it enter at high water? At low water (tide at datum)? What is the least tide height that allows entry? Give the water available at

high tide in feet. (b) Name four qualities Arthur Phillip found at Port Jackson in 1788 that Botany Bay lacked or that make a good natural harbor.

6. (3 pts) Answer in words. (a) Why is the North European Plain called an open road, and why does it run both ways? Give one army that marched east and one that marched west. (b) Explain the “funnel” shape of the plain from Poland to Russia and what it means for an invader. (c) What do the Pripet Marshes do to movement on the eastern plain, and why do the great Russian rivers not block an army coming from the west?
7. (3 pts) (a) Before 1939 Wilno (Vilnius, 54.69° N, 25.28° E) was a Polish city; after 1945 it lay outside Poland. Estimate its straight-line distance from Warsaw (52.23° N, 21.01° E), in km and miles. (Treat the area as flat; at the mean latitude, 53.46°, cos = 0.5954.) (b) Why did the Allies choose the Oder and Lusatian Neisse for Poland’s new western border in 1945, and when did reunited Germany confirm it? (c) Name the three powers that partitioned Poland and the years of the three partitions.
8. (3 pts) (a) On Minard’s map of 1812, 1 mm of band width stands for 10,000 men. How wide is the band at the start (422,000 men) and at Moscow (100,000)? What percent of the main column was lost between the Niemen and Moscow? (b) Convert −24° Réaumur to Celsius and Fahrenheit. (c) Name two causes, other than winter, that had already gutted the army before Moscow.
9. (3 pts) Answer in words. (a) Why did the Proclamation of 1763 draw its line along a watershed divide, and what did it forbid? (b) What made the Appalachians a barrier even though they are not especially high? Name two gaps that westward routes used. (c) Give two reasons the line failed to hold.
10. (3 pts) (a) A flatboat floats 1,850 river miles from Pittsburgh to New Orleans at 40 miles a day; afterward a crewman walks the 440-mile Natchez Trace at 22 miles a day. How long is each trip? Give the river distance in km. (b) Express the Louisiana Purchase (about 828,000 sq mi) in km². (c) Why was Napoleon ready to sell all of Louisiana in 1803?
11. (3 pts) (a) Britain had offered the Columbia River as the Oregon boundary; its mouth lies near 46.25° N. How far south of the 49th parallel is that, in miles and km? (b) Give three reasons the Oregon Treaty of 1846 settled on the 49th parallel. (c) Who coined the phrase “manifest destiny,” in what year, and how should a geographer distinguish the idea from the geography?
12. (3 pts) (a) Under the Pacific Railway Act, bonds were loaned at $48,000 a mile in the mountains, $32,000 in the high country between ranges and $16,000 on the plains. How much would a company receive for 100 mountain miles, 300 high-country miles and 200 plains miles, and what is the average per mile? (b) Express the Central Pacific’s steepest Sierra grade of 116 feet per mile as a percent, and explain why railroad engineers fought for gentle grades. (c) When and where were the two lines joined?
13. (3 pts) (a) San Francisco to Tokyo is about 5,100 miles. How long does a ship at 15 knots take? Give the distance in km. (b) The Panama Canal cut the sea route from New York to San Francisco from about 13,000 miles to about 5,200. What percent does it save, and what voyage of 1898 showed the need? (c) How did technology later thin the ocean shield?

14. (3 pts) (a) The Treaty of Tordesillas (1494) set its line 370 leagues west of the Cape Verde Islands. Suppose the measure starts at 25° W and a degree holds 16⅔ leagues. At what longitude is the line, and how far is 370 leagues along the parallel of 15° N, where a degree is about 66.8 miles (107.5 km)? (b) Why could no one fix the line exactly in 1494? (c) Why does Brazil speak Portuguese, and which treaty of 1750 replaced the line with what principle?
15. (3 pts) Identify each wartime commitment Britain made about the Arab lands of the Ottoman Empire and state accurately what it said: (a) the letters of 1915–1916 with Sharif Hussein of Mecca; (b) the agreement of May 1916; (c) the letter of 2 November 1917. (d) Name two of the postwar conferences or treaties that actually fixed the borders.
16. (3 pts) (a) A hypothetical Punjab district has three tehsils in a row: A, 400,000 people, 56% Muslim; B, 300,000, 48% Muslim; C, 300,000, 40% Muslim. A borders other Muslim-majority land. Does the district as a whole have a Muslim majority? If the commission divides by contiguous majority tehsils, where does each go? (b) What instructions and how much time did Radcliffe have? (c) How did the Indus Waters Treaty of 1960 divide the six rivers?
17. (3 pts) (a) Argentina claims the Antarctic sector from 25° W to 74° W. What fraction of a full circle is that, and how long is its share of the 60° S circle (about 20,040 km, 12,450 miles, around)? (b) Chile claims 53° W to 90° W. How many degrees of the two claims overlap? (c) What did Article IV of the Antarctic Treaty (1959) do with such claims? (d) How does the Military Demarcation Line of 1953 differ from the 38th parallel chosen in 1945?
18. (3 pts) (a) At a station on the Mason–Dixon Line, a star of declination 37°55′10″ N crosses the meridian 1°48′10″ south of the zenith, and a second star of declination 40°58′30″ N crosses 1°15′10″ north of the zenith. Find the latitude from each star. (b) Express the 15-mile offset south of Philadelphia in Gunter’s chains, feet and km. (c) Why was a surveyed line needed at all between Pennsylvania and Maryland?
19. (3 pts) (a) A deed reads “the N½ of the SE¼ of Section 23, T4S, R3E.” How many acres is the parcel, and what is it in km² (1 acre ≈ 0.004047 km²)? Where is Section 23 within its township, and where is the township? (b) At 45° N (tan 45° = 1), how much narrower is the north side of a block 6 miles wide after 24 miles of northing, if its sides follow meridians? Use width × (distance north ÷ 3,959) × tan(latitude). What do surveyors do about it?
20. (4 pts) (a) A survey baseline AB is 10.0 km long. The angle at A between B and a hilltop C is 55°, and the angle at B between A and C is 75°. Find AC and BC in km and miles. (Use sin 55° = 0.8192, sin 75° = 0.9659, sin 50° = 0.7660.) (b) From a station 300 ft above sea level, a surveyor sights a peak 100 miles away; the tangent of the angle of elevation is 0.0400. Ignoring refraction, estimate the peak’s height in feet and meters, using a curvature drop of 0.667 × d² feet (d in miles). (c) Why did the Great Trigonometrical Survey measure new baselines from time to time?
21. (3 pts) (a) At an astronomical station, nearby mountains pull the plumb line 3″ toward the south. The astronomers trust their plumb line and set the 49th parallel there. Is their mark north or south of the true parallel, and by how much (1″ of latitude ≈ 101

ft)? (b) Why do the treaties make the marked line, not the mathematical parallel, the legal border? (c) Explain how straight-line rules meeting real water produced the Northwest Angle and Point Roberts.

22. (4 pts) A surveyed field has corners at (0, 0), (150, 0), (150, 90), (75, 130) and (0, 90), in feet east and north of the first corner. (a) Find its area in square feet, acres and square meters (1 sq ft ≈ 0.0929 m^2). (b) Find its perimeter. (c) The student's traverse failed to close by 0.5 ft. Express the closure error as "1 part in …". (d) What scale makes the 150-ft side 6 inches long on paper? Write it as a statement and as a ratio.
23. (3 pts) **Cumulative.** (a) Find the great-circle distance from Rome (41.90° N, 12.50° E) to Constantinople (41.01° N, 28.98° E), in km and miles. (Use sin 41.90° = 0.6678, cos 41.90° = 0.7443.) (b) How many days would an official courier at 75 km a day need? (c) In core-and-frontier terms, what did Constantine gain by moving the capital east?
24. (3 pts) **Cumulative map reasoning.** The Franco-Spanish border in the Pyrenees has hardly moved since 1659, while Poland's borders moved again and again between 1772 and 1945. Explain the difference in words, and say what geography alone does *not* explain about either case.
25. (3 pts) **Cumulative.** Classify each border by form (physical, geometric or other) and, where it applies, by origin (antecedent, subsequent, superimposed or relic): (a) the 49th parallel across the northern prairies; (b) Hadrian's Wall today; (c) the Egypt–Sudan line on the 22nd parallel set by Britain and Egypt in 1899; (d) the Rio Grande from El Paso to the Gulf; (e) the Portugal–Spain border fixed in 1297 between two kingdoms already settled.
26. (8 pts) **Essay.** "General Winter defeated both Napoleon in 1812 and Hitler in 1941." Weigh this claim. Use evidence from both campaigns about distance, supply, the land and its seasons, the defenders, and the invaders' own decisions, and reach a conclusion.
27. (6 pts) **Essay.** Many books say Russia chose its 5-foot (1,524 mm) railway gauge to stop invaders. (a) How much wider is it than standard gauge (1,435 mm), in mm and inches? (b) Weigh the evidence for why the gauge was *chosen* and what *effects* it later had, and state a conclusion that keeps intention and effect distinct.
28. (8 pts) **Essay.** "Straight-line borders cause conflict." Weigh this claim using evidence from at least four regions studied in the course. Consider borders that are straight and peaceful, straight and troubled, and natural or irregular borders that were troubled too, and state what you think matters more than the shape of the line.

Answer key

1. (a) 31 ÷ 1.852 ≈ 16.7 nautical miles (about 19 miles). Northbound: 5 − 2 = 3 knots → 16.7 ÷ 3 ≈ **5.6 hours**. Southbound: 5 + 2 = 7 knots → 16.7 ÷ 7 ≈ **2.4 hours**.
   (b) The **Golden Horn** on the north, the **Sea of Marmara** on the south, and the **Bosporus** at the eastern tip; a great iron **chain** across the mouth of the Golden Horn.
   (c) On 22 April 1453 he had dozens of ships dragged on greased logs over the hill behind Galata and launched into the Golden Horn, forcing the few defenders to man the harbor walls as well.

2. (a) Covered 3 + 3 = 6 km; uncovered 14 − 6 = **8 km (about 5 miles)**; 8 ÷ 14 ≈ **57 percent**.
   (b) Not closing the strait with guns, but a **base**: a safe harbor, dockyard and stores beside the choke point, from which a fleet could watch every passing ship and strike any enemy fleet moving between the Atlantic and the Mediterranean.
   (c) An Anglo-Dutch force under Admiral Rooke took it on **4 August 1704**, in the War of the Spanish Succession; Spain ceded it in Article X of the **Treaty of Utrecht (1713)**. On 13 September 1782 the garrison under General Eliott destroyed the floating batteries with **heated shot**, and British gunboats rescued hundreds of Spanish sailors.
3. (a) Any two: it lies where the **Strait of Malacca**, the main route between the Indian Ocean and the South China Sea, meets the South China Sea, so every ship between India and China passed it; the **monsoons** brought ships from India in summer and from China in winter to meet and wait there; deep water close to shore, a sheltered anchorage and a river for small boats. As a free port it drew merchants of every nation.
   (b) December 9–31 = 23, January 31, February 15: **69 days**.
   (c) 105 km ≈ **65 miles** = 105 ÷ 1.852 ≈ 56.7 nautical miles; 56.7 ÷ 15 ≈ **3.8 hours** (about 3 h 47 min).
4. (a) 61 ÷ 1.852 ≈ 32.9 nautical miles (about 38 miles). Up: 12 − 3 = 9 knots → **3.7 hours**. Down: 12 + 3 = 15 knots → **2.2 hours**.
   (b) Lines of mines (including the *Nusret*'s 26 mines laid parallel to the shore in Erenköy Bay, where ships turned) sank the *Bouvet*, *Irresistible* and *Ocean*. The minesweepers, converted trawlers that could barely steam against the current, could not sweep under fire from hidden mobile howitzers; the battleships could not silence the mobile guns until the mines were swept. Each part of the defense protected the others, and in narrow waters the ships had no room to maneuver or go around.
   (c) Whoever held the hills commanded the strait. Beyond Anzac Cove steep ridges and gullies scattered the attackers; Mustafa Kemal rushed troops to hold the Sari Bair heights; at Helles machine guns swept the beaches. Trench stalemate followed until evacuation in December 1915–January 1916.
5. (a) Available at high water: 11.5 + 2.1 = 13.6 m (about **44.6 ft**). Needed: 12.4 + 0.8 = 13.2 m. 13.6 ≥ 13.2, so **yes**, with 1.2 m under the keel. At low water: 11.5 m < 13.2 m, so **no**. Least tide: 13.2 − 11.5 = **1.7 m** above datum.
   (b) Any four: deep water; shelter from wind and the easterly swells (Botany Bay was shallow and open); a narrow entrance between high headlands, easy to defend; fresh water (the stream at Sydney Cove); room for many ships in its branching coves; good holding ground. (Ice-free water and a hinterland also count.)
6. (a) From western France to the Urals there is no mountain wall; most land lies below about 200 m, and its rivers can be bridged, forded or crossed on ice. Any one each: east, Charles XII (1708), Napoleon (1812), Germany (1914, 1941), the Mongols to Silesia (1241); west, Russian armies to Paris (1814) or Soviet armies to Berlin (1945).
   (b) The plain is about 300 miles (480 km) wide across Poland but about 900 miles (1,500 km) from the Gulf of Finland to the Black Sea. An invader driving east must spread over an ever longer front, while Russia can trade space for time (strategic depth).
   (c) The marshes split the plain into a northern corridor (Minsk–Smolensk–Moscow) and a southern one (Ukraine toward Kyiv), dividing an invader's forces. The Dnieper, Don and Volga flow south to the Black and Caspian Seas, so they run alongside an army marching east rather than across its path.
7. (a) North–south: 2.46° × 111 ≈ 273 km. East–west: 4.27° × 111 × 0.5954 ≈ 282 km. Distance ≈ $\sqrt{(273^2 + 282^2)}$ ≈ **393 km (about 244 miles)**.
   (b) On an open plain with no mountain wall, the two rivers were the only natural lines

available. Reunited Germany confirmed the line in a treaty signed in **November 1990** (after East Germany in 1950 and West Germany in 1970).

(c) **Russia, Prussia and Austria**: 1772, 1793 (Russia and Prussia) and 1795.

8. (a) **42.2 mm** and **10 mm**. Lost: (422,000 − 100,000) ÷ 422,000 = 322,000 ÷ 422,000 ≈ **76 percent**.

   (b) −24 × 1.25 = **−30°C**; −30 × 1.8 + 32 = **−22°F**.

   (c) Any two: distance (Moscow about 880 km, 550 miles, from the Niemen) and supply wagons that could not keep up on poor roads in a thinly peopled land; Russian retreat and scorched earth; summer heat, bad water, dysentery and typhus; tens of thousands of horses dead for lack of fodder; the bloody battle of Borodino.

9. (a) After Pontiac's rising, the Crown wanted no more costly wars; a divide is a line every farmer can find, since he knows which way his creek flows. Colonists might settle lands whose rivers ran east to the Atlantic, but not beyond the heads of those rivers, and no private person could buy Indian land; only the Crown could, at a public meeting.

   (b) In the Ridge and Valley country long, steep, forested ridges run southwest to northeast, so a westbound traveler must climb one after another; east-coast rivers stopped boats at the fall line. Any two: the Mohawk Valley, the Cumberland Gap, the routes of Braddock's Road and Forbes Road.

   (c) Any two: the mountains had gaps; settlers had the numbers and wanted the land; land companies and treaties moved it (Fort Stanwix and Hard Labour, 1768; the Transylvania purchase of 1775); colonial leaders such as Washington saw it as temporary; in 1783 the peace treaty set the border at the Mississippi.

10. (a) Boat: 1,850 ÷ 40 ≈ **46 days**; walk: 440 ÷ 22 = **20 days**. 1,850 × 1.609 ≈ **2,980 km**.

    (b) 828,000 × 2.59 ≈ **2.14 million km²**.

    (c) He had wanted Louisiana to feed Saint-Domingue, but the French army sent there was worn down by the forces of Toussaint Louverture and then Dessalines and ravaged by yellow fever (General Leclerc died in 1802). Without Saint-Domingue, Louisiana had little value to France, and with war against Britain resuming, the Royal Navy could seize New Orleans at will.

11. (a) 49 − 46.25 = 2.75°; 2.75 × 69 ≈ **190 miles**; 2.75 × 111 ≈ **305 km**.

    (b) Any three: the land between held **Puget Sound**, one of the finest deep-water harbors on the Pacific, while the Columbia's mouth was guarded by a dangerous bar; the 49th parallel was already the border east of the Rockies (1818) and could be found anywhere by the stars; several thousand Americans had settled the Willamette Valley; Polk did not want war with Britain while fighting Mexico; Britain did not want to fight for a fur country nearly trapped out, and the Hudson's Bay Company had already built Fort Victoria on Vancouver Island, all of which Britain kept.

    (c) Editor **John L. O'Sullivan**, in **1845**. Manifest destiny was a belief held by many Americans; the open continent with no strong rival, cheap land and a growing population made expansion possible, but people chose how to expand, sometimes by purchase, sometimes by agreement, and by war: with Mexico in 1846–1848 and in many campaigns against Indian nations.

12. (a) 100 × $48,000 = $4,800,000; 300 × $32,000 = $9,600,000; 200 × $16,000 = $3,200,000; total **$17,600,000** for 600 miles, about **$29,300 a mile**.

    (b) 116 ÷ 5,280 ≈ **2.2 percent**. A locomotive's wheels grip the rail only by friction, so trains cannot climb steep slopes; engineers sought long ridges, valleys and low passes, which is why the route followed the old trails.

    (c) **May 10, 1869**, at **Promontory Summit**, Utah Territory.

13. (a) 5,100 ÷ 1.151 ≈ 4,430 nautical miles; 4,430 ÷ 15 ≈ 295 hours ≈ **12.3 days**. 5,100 × 1.609 ≈ **8,200 km**.
    (b) Savings 7,800 miles; 7,800 ÷ 13,000 = **60 percent**. The battleship *Oregon* steamed about 14,000 miles from San Francisco around South America through the Strait of Magellan to Florida in 66 days to fight in the Spanish-American War.
    (c) Long-range bombers in the 1940s, *Sputnik* (1957), and intercontinental missiles able to cross between continents in about thirty minutes meant the homeland could be struck from across the sea within an hour (as the Cuban Missile Crisis of 1962 showed).
14. (a) 370 ÷ 16⅔ = 22.2°; 25° + 22.2° = **47.2° W**. Distance 22.2 × 66.8 ≈ **1,480 miles**; 22.2 × 107.5 ≈ **2,390 km**.
    (b) The treaty did not say which Cape Verde island to start from; the league's length varied; and longitude could not be found reliably at sea until Harrison's chronometers more than 250 years later.
    (c) Cabral, swinging wide into the Atlantic on the way to India, sighted South America on 22 April 1500 east of the line and claimed it for Portugal. The **Treaty of Madrid (1750)** accepted *uti possidetis*, "as you possess," letting each keep what it actually occupied, with borders along rivers and watersheds.
15. (a) The **Hussein–McMahon letters**: Sir Henry McMahon promised British support for Arab independence if the Arabs rose against the Turks, with certain areas excluded or reserved for French interests (their extent was later disputed). Hussein launched the Arab Revolt in June 1916.
    (b) The secret **Sykes–Picot agreement** with France (Russian assent): France to rule the Syrian–Lebanese coast and influence the interior including Damascus, Aleppo and Mosul; Britain to rule southern Mesopotamia including Baghdad and Basra and influence a belt from Sinai to Kirkuk; Palestine to be internationally administered.
    (c) The **Balfour Declaration**: the government viewed with favour a national home for the Jewish people in Palestine, provided nothing should prejudice the civil and religious rights of existing non-Jewish communities.
    (d) Any two: San Remo (1920), the Cairo Conference (1921), the Uqair conference (1922), the League mandates (1922), the Treaty of Lausanne (1923), the League's Mosul award (accepted 1926).
16. (a) Muslims: A 224,000; B 144,000; C 120,000; total 488,000 of 1,000,000 = **48.8 percent, no majority**. By tehsil, **A goes to Pakistan**; **B and C to India**. Dividing by whole districts and by tehsils give different answers, which is why the unit chosen mattered so much.
    (b) Divide the Punjab and Bengal by "contiguous majority areas" of Muslims and non-Muslims, using the 1941 census, while taking account of "other factors"; he arrived 8 July 1947 and had about **five weeks** before independence on 15 August.
    (c) India received the three eastern rivers, **Ravi, Beas and Sutlej**; Pakistan the three western, **Indus, Jhelum and Chenab**.
17. (a) 74 − 25 = 49°; 49 ÷ 360 ≈ **0.136 (13.6 percent)**; 0.136 × 20,040 ≈ **2,730 km** (≈ 1,690 miles).
    (b) From 53° W to 74° W: **21°**.
    (c) It **froze** them: no one gives up a claim, no new claim may be made, and nothing done while the treaty lasts strengthens or weakens one.
    (d) The 38th parallel was a straight line chosen in about half an hour in August 1945 as a temporary zone boundary. The MDL is where the armies stood at the armistice of 27 July 1953, following hills fought over: south of the parallel in the west (Kaesong went to the North) and north of it in the east, with a 4-km-wide DMZ around it.

18. (a) Star south of the zenith: latitude = declination + zenith distance = 37°55′10″ + 1°48′10″ = **39°43′20″ N**. Star north: latitude = declination − zenith distance = 40°58′30″ − 1°15′10″ = **39°43′20″ N**. They agree.
(b) 15 × 80 = **1,200 chains**; 1,200 × 66 = **79,200 ft**; 15 × 1.609 ≈ **24.1 km**.
(c) Maryland's 1632 charter ran to the 40th parallel, but Philadelphia lay at about 39°57′ N, so read strictly Maryland's charter put Pennsylvania's capital in Maryland; settlers paid taxes to either colony, and the quarrel turned violent in Cresap's War. The 1760 agreement defined a parallel 15 miles south of Philadelphia's southernmost point, which only an exact survey could find.
19. (a) SE¼ = 160 acres; its N½ = **80 acres** ≈ 80 × 0.004047 ≈ **0.32 km²**. Sections run back and forth from 1 in the northeast; the fourth row reads 19, 20, 21, 22, 23, 24 from west to east, so Section 23 is in the **fourth row, second square from the east side**. The township is the **fourth tier south of the baseline** and the **third range east of the principal meridian**.
(b) 6 × (24 ÷ 3,959) × 1 ≈ 0.0364 mile ≈ **192 ft (about 58 m)**. Surveyors restart the townships at full width on a **correction line** (standard parallel), usually every 24 miles, which is why section-line roads jog there.
20. (a) Angle C = 180° − 55° − 75° = 50°. AC = 10.0 × sin 75° ÷ sin 50° = 9.659 ÷ 0.7660 ≈ **12.6 km (7.8 miles)**. BC = 10.0 × sin 55° ÷ sin 50° = 8.192 ÷ 0.7660 ≈ **10.7 km (6.6 miles)**.
(b) Horizontal distance 100 × 5,280 = 528,000 ft; rise above the level line 528,000 × 0.0400 = 21,120 ft; curvature 0.667 × 100^2 = 6,670 ft; plus station 300 ft: total ≈ **28,090 ft (about 8,560 m)**.
(c) To check the chain of triangles: comparing a newly measured base with the length the triangles predicted showed how accurate the work in between had been (and kept errors from accumulating).
21. (a) A plumb line pulled south tilts the instrument's "straight up" toward the north, so the station reads a latitude about 3″ too high; to read exactly 49°, the astronomers move south. The mark lies about **3″ south** of the true parallel, about 3 × 101 ≈ **300 ft (about 92 m)**.
(b) No one can find the perfect parallel on the ground, and every new measurement would move it; fixing the boundary monument to monument keeps farms, towns and titles from shifting.
(c) Northwest Angle: the 1818 rule ran from the "most northwestern point" of the Lake of the Woods due north or south to the 49th parallel; that point lies north of the parallel, leaving a piece of Minnesota cut off by water. Point Roberts: the 1846 treaty ran the parallel to the coast and then down the channel, and the parallel crosses the tip of a peninsula, leaving American land reachable by land only through Canada.
22. (a) Rectangle 150 × 90 = 13,500 sq ft, plus triangle ½ × 150 × (130 − 90) = 3,000 sq ft: **16,500 sq ft** (shoelace check: (0 + 13,500 + 12,750 + 6,750 + 0) ÷ 2 = 16,500). 16,500 ÷ 43,560 ≈ **0.38 acre**; 16,500 × 0.0929 ≈ **1,530 m²**.
(b) Sloping sides: $\sqrt{(75^2 + 40^2)} = \sqrt{7{,}225}$ = 85 ft each. Perimeter 150 + 90 + 85 + 85 + 90 = **500 ft**.
(c) 500 ÷ 0.5 = **1 part in 1,000**.
(d) 150 ft ÷ 6 in = **1 inch = 25 feet**; 25 ft = 300 in, so **1:300**.
23. (a) Δλ = 16.48°. sin 41.90° × sin 41.01° = 0.6678 × 0.6562 ≈ 0.4382. cos 41.90° × cos 41.01° × cos 16.48° = 0.7443 × 0.7546 × 0.9589 ≈ 0.5386. cos d ≈ 0.9768, d ≈ 12.4°. Distance ≈ 12.37 × 111.2 ≈ **1,375 km (about 855 miles)**.
(b) 1,375 ÷ 75 ≈ **18 days**.
(c) Constantinople lay far closer to the frontiers that mattered most in the 300s, the Danube

and the Persian frontier (about 820 km to Antioch against about 2,140 km from Rome), and it sat on a choke point and a crossroads that could be fortified on three sides by water.

24. The Pyrenees are a wall about 430 km (270 miles) long with almost no low gap except at the two ends; armies and trade must squeeze through a few passes, the crest or watershed is a line both sides can see, and a few forts at the passes guard the whole frontier. Poland lies in the open middle of the North European Plain with no mountain wall east or west, so its size and shape depended on the strength of its neighbors (Russia, Prussia, Austria, later Germany and the Soviet Union) and the decisions of great powers; when the Allies needed a line in 1945 they reached for the only natural features, the Oder and Neisse rivers. Geography does not explain everything: the 1659 line still had to be agreed by treaty and marked by stones in the 1850s–1860s, and peace held because both kingdoms accepted it; Poland's weak elected monarchy and *liberum veto*, its neighbors' ambitions, and the pacts and conferences of 1939–1945 were human choices.
25. (a) **Geometric, antecedent** (drawn before most people settled there). (b) **Relic**: it no longer divides anything but can still be seen on the land. (c) **Geometric, superimposed** (laid down by outside powers across lands already lived in, as with many colonial borders in Africa). (d) **Physical** (a river border, set by the Treaty of Guadalupe Hidalgo in 1848). (e) **Subsequent**: drawn after settlement, following divisions that already existed between peoples, as many old European borders do.
26. **Grading points (8):** (2) 1812 evidence: about 450,000 crossed the Niemen on 24 June; Moscow about 880 km (550 miles) away; supply wagons could not keep up; Russian retreat and scorched earth; heat, dysentery, typhus and dead horses shrank the main army to about 130,000 by Borodino; Moscow burned; Napoleon waited five weeks, was blocked at Maloyaroslavets, and retreated through stripped country before frost came in early November; Berezina in late November. (2) 1941 evidence: three army groups on 22 June; the widening front and the Pripet Marshes; few paved roads; the Soviet broad gauge forced track conversion; the autumn *rasputitsa* mud stalled Operation Typhoon; then frost below −30°C (−22°F) froze engines and men without winter clothing; Zhukov's counteroffensive of 5–6 December with fresh divisions. (2) Human causes: Clausewitz's culminating point; Russian strategic depth; Napoleon's pressing on past Smolensk and lingering in Moscow; Hitler's expectation of a quick war, refusal to prepare for winter, and the August turn to Kyiv; Soviet resistance, mobilization and the evacuation of more than 1,500 factories. (2) A balanced conclusion: winter finished or deepened defeats already prepared by distance, supply, the defender and the invaders' choices.

    Model answer: Winter was real and terrible, but it was the last blow, not the first. In 1812 the Grande Armée was gutted before any snow fell: distance outran its wagons, the retreating Russians burned what they left, and disease and heat killed men and horses so fast that the main army had shrunk to about 130,000 by Borodino. Napoleon then chose to wait five weeks in a burned Moscow and was forced back along the road his army had stripped; the frost of November and the Berezina crossing destroyed what remained. In 1941 the invader had engines, radios and railways, yet the plain still fought back: the front widened like a funnel, the Pripet Marshes split the army groups, roads were few, captured track had to be regauged, and the autumn mud halted the drive on Moscow. Frost then hardened the roads but also froze engines and men, because Hitler had not prepared for winter. Above all, the defenders kept fighting: the Red Army raised new armies, factories moved east, and Zhukov's December counteroffensive saved Moscow. Both invaders passed Clausewitz's culminating point by their own decisions. Winter was the executioner; distance, supply, the defenders and the invaders' pride had already passed sentence.

27. **Grading points (6):** (1) 1,524 − 1,435 = **89 mm = 3.5 inches** (60 in − 56.5 in). (2) Evidence on the choice: in 1842–1843 the American engineer George Washington Whistler, with Melnikov and Kraft, recommended 5 feet, already common in the American South, for larger, more powerful locomotives and a steadier ride; no clear early-1840s documents show defense as the main reason; no European standard yet existed (Britain fixed its gauge only in 1846); Russia built the Warsaw–Vienna Railway to standard gauge to meet Austria. (2) Evidence on effects: in 1941 German railway troops had to convert thousands of miles of track, few wide-gauge engines and cars were captured, and supplies piled up at gauge breaks; but the break also hampered Russia's own invasion of East Prussia in 1914 and forced Soviet troops to convert lines moving west in 1944–1945; Spain's even wider gauge has a similar legend though its report gave engineering reasons. (1) Conclusion: probably chosen for technical reasons, kept partly from cost and habit, and later valued for defense, a real effect but probably not the original cause.
28. **Grading points (8):** (2) Straight and troubled: e.g., the Berlin Conference era lines in Africa, drawn from far away across lands Europeans had not seen, sometimes divided peoples (Maasai, Ewe) or joined rivals; the 38th parallel in Korea, chosen in half an hour in 1945, cut roads and farms (though the war came from the North's invasion and the Cold War, not the shape); Bir Tawil left unclaimed between two lines; Tordesillas ignored by other nations and overrun by settlers. (2) Straight and peaceful: e.g., the 49th parallel, marked peacefully by two nations that had fought in 1812; Colorado and Wyoming; the Mason–Dixon Line, which ended a violent quarrel (Cresap's War); the Antarctic Treaty's 60°S and frozen sector claims; the OAU's 1964 decision to keep colonial borders, most of which have held. (2) Natural or irregular borders also troubled: the Rhine (a thousand years of contest), the Rio Grande (Chamizal), the Amur–Ussuri (Zhenbao, 1969), the Himalayan crest (1962), the Radcliffe Line, drawn along census districts rather than straight lines, with massacres and some 15 million uprooted. (2) Conclusion weighing other causes: when and over whom a line is drawn (antecedent across empty land vs superimposed on settled peoples), whether both sides agreed to it, how precisely it was described and marked, and the power and will of the states on each side.

    Model answer: The claim has some truth. Lines drawn with a ruler in London, Paris or Berlin across African lands few Europeans had seen sometimes split peoples like the Ewe or Maasai, and the 38th parallel, chosen in thirty minutes, cut Korea's roads and valleys. Yet many straight lines have been among the most peaceful on earth: the 49th parallel was marked by British and American parties working side by side; the Mason–Dixon Line ended a feud; the Antarctic Treaty froze sector claims bounded by meridians and kept a continent for science. Meanwhile natural borders have been fought over bitterly: France and Germany contested the Rhine lands for a thousand years, Soviet and Chinese troops fought on an island in the Ussuri, India and China fought along a Himalayan crest, and the Radcliffe Line, which followed census districts rather than straight lines, was followed by massacre and mass flight. Korea's war came from an invasion backed by a Cold War power, not from the geometry of the parallel. What matters more than shape is whether a line was drawn before settlement or imposed on peoples already living there, whether both sides accepted it, whether it was clearly described and marked, and whether the powers on each side chose to keep the peace. A straight line across empty prairie agreed by two willing nations keeps peace; any line imposed by force on settled peoples invites trouble.