

GRADE 3 GEOGRAPHY: AROUND THE WORLD: CONTINENTS AND OCEANS

A year-long voyage around the globe, one continent and one ocean at a time, from the Andes and the Amazon to the Nile, the Himalaya and the bottom of the Mariana Trench, following the travelers who first tied the world together, from Polynesian star-steerers and the first sailors with a compass to Marco Polo on the Silk Road, Ibn Battuta and Magellan's five ships, and tried out at the kitchen table with orange-peel globes, salt-dough maps, sand-tray rivers, needle compasses and a cardboard caravel.

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 course takes a third grader once around the world. It begins with the globe and its grid: the equator and the prime meridian, lines of latitude and longitude, and how to find a city by its address. Then it visits each continent in turn, with its mountains, rivers and great cities: the Rockies and the Andes, the Mississippi and the Amazon, the Alps and the Rhine, the Nile and the Sahara, the Himalaya and the Yangtze, the Outback and the Great Barrier Reef, and the ice of Antarctica. Next come the oceans and seas, down to the bottom of the Mariana Trench, where Jacques Piccard and Don Walsh took the *Trieste* in 1960. The year ends with the travelers who linked the continents: Polynesian navigators, Marco Polo at the court of Kublai Khan, Ibn Battuta, Columbus, and Magellan's five ships, of which one, the *Victoria*, came home in 1522 with eighteen men after the first voyage around the world.

Every lesson follows the same path. First comes **the story**: a real person, place and date. Then **how they figured it out**: what stood in the way, what the travelers tried and what they learned. Then **the big idea**, explained for a third grader: a hemisphere, a parallel, a meridian, a peninsula, a delta, a strait, a trade route. Last, the student does something with his or her hands, such as a globe made from an orange, a salt-dough map, a Nile in a sand tray, a jar of ocean depths or a Silk Road trading game, and draws a page in the map notebook.

A thread runs through the whole series: **technology overcoming geography**. In this grade it is the story of how the ocean stopped being a wall and became a road. Lessons marked ⚙ follow the Inca rope bridges across the Andes, the stars that guided Polynesian canoes, the lodestone and the first compasses at sea, the lateen sail that could work against the wind, the portolan charts of the Mediterranean, the caravel, and the deep-diving *Trieste*. Students see that mountains, deserts and oceans still shape where people live and trade, and that patient, clever people found ways to cross them.

The course teaches geography as the study of the world God made and the peoples He has spread across it. The series verse is Acts 17:26: "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;" In this grade the sailors and travelers echo Psalm 107:23-24: "They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep." Explorers are presented honestly, with their courage and their real wrongs, and every land is studied with wonder and respect for the people who live there.

WHO IT IS FOR

Written for students in grade 3 (about ages 8-9) who are beginning to read on their own and can add, subtract and compare numbers into the thousands. A parent or teacher reads the core ideas aloud or alongside the student, helps with the projects and plays the games. Nothing needs to be bought beyond ordinary household things: a globe or a printed world

map, paper, colored pencils, an orange or a ball, salt dough, a tray of sand, a sewing needle and a magnet, and some cardboard.

HOW TO USE THIS COURSE

The weekly rhythm. The year has 32 lessons in 8 units, one lesson a week, plus an optional bonus unit, the *Map Lab*, with four map games and puzzles. Each lesson takes two sessions of about 45 minutes. Session 1 is the warm-up, the core ideas read aloud, the video and the picture study. Session 2 is the project, the worked examples and practice, and the map notebook page. In the last week of each unit, add a third session for the unit review and the unit project. Unit 1's globe-and-grid skills come back in every later unit, so keep the globe close all year.

The ★ and ⚙ marks. Ten lessons are marked ★. Together they make the *quarter path*: a one-quarter version of the course for families who want a shorter study, keeping the core map skills, a lesson from every continent and ocean, and the heart of the technology thread. Lessons marked ⚙ carry the technology thread: the tools and inventions that helped people cross mountains and oceans. Unit 6, *The Compass and the Sail*, and Unit 8, *Around the World*, are built around it.

The map notebook. Use one sketchbook or composition book for the whole year. Each unit adds at least one map the student draws: a latitude-longitude grid, the Americas with their rivers and mountains, Europe and Africa, Asia, Australia and Antarctica, the five oceans and ten great seas, a portolan-style chart, the Silk Road and Magellan's route. Date every page, give it a title and a compass rose, and label it neatly. Compare the first page with the last at the end of the year.

Picture study. Each unit has a real painting, print or historic map, such as Holbein's *The Ambassadors* with its two globes, Church's *Heart of the Andes*, Hokusai's "Red Fuji," the Catalan Atlas and Ortelius's map of the Pacific with Magellan's *Victoria*. Look at it quietly for two minutes. Then put it away and have the student tell everything he or she remembers. Bring it back and work through the "look for" items and questions.

Worked examples and practice. Each lesson has two worked examples, solved step by step, and six practice questions: reading a grid, comparing the lengths of rivers or the heights of mountains, counting miles on a route, finding a place by its latitude and longitude. Numbers are sized for a third grader and use U.S. customary units (miles, feet). Answers are given so a parent can check the work at once. Read the common mistakes together before the practice.

Unit reviews, unit projects and the wider series. Each unit ends with a short review (40 points, 8-10 items, which may be done aloud) and a unit project that pulls the unit together, such as a finished globe, a salt-dough map, a needle compass or a planned trip around the world. This course is the third year of the School Launch Geography series, which runs from kindergarten through high school. It pairs well with the School Launch Engineering & Physics course, where boats, sails and compasses are built and tested, and the Business & Finance course, where the Silk Road and the spice trade are studied as stories of trade.

SCOPE AND SEQUENCE

Unit 1: The Globe and the Grid (1-4)

The equator and the prime meridian; lines of latitude and longitude; the Greenwich line chosen in 1884; and finding a city on the globe by its address.

Unit 2: North America and South America (5-8)

The Rockies, the Appalachians and the Canadian Shield; the Mississippi, the St. Lawrence and the Amazon; the Andes with their Inca roads and rope bridges; and three great cities on a lake bed, a harbor and a bay.

Unit 3: Europe and Africa (9-12)

Europe's peninsulas, coasts and harbors; the Rhine, the Danube and the Alps; the Nile and the Sahara; and Africa's Rift Valley, rain forest and savanna, with Kilimanjaro, the Congo and Victoria Falls.

Unit 4: Asia and Australia (13-16)

Asia, the biggest continent, with the Himalaya, Siberia and the Gobi; the Yangtze, the Yellow River, the Ganges and the Mekong; Australia, the island continent; and the ice of Antarctica.

Unit 5: Oceans and Seas (17-20)

The Pacific, bigger than all the land put together; the Atlantic between the Old World and the New; seas, gulfs and bays; and the Mariana Trench and the 1960 dive of the *Trieste*.

Unit 6: The Compass and the Sail (21-24)

Polynesian navigators and the North Star; lodestone and the first compasses at sea; the lateen sail and the caravel; and the portolan charts that mapped the coasts.

Unit 7: Marco Polo and the Silk Road (25-28)

Venice, the city on the water; camels, caravans and silk across Asia; Marco Polo at the court of Kublai Khan and the book that made Europe curious; and Ibn Battuta's thirty years of travel.

Unit 8: Around the World (29-32)

Columbus's four voyages and his mistaken idea of the earth's size; Magellan's five ships and the strait at the tip of South America; Elcano's return in 1522; and the student's own voyage around the globe, port by port.

Unit 9: Map Lab (optional bonus unit) (Optional)

Four map games and puzzles to use any time: latitude battleship on a world grid, a capital cities card game, drawing the world from memory in September and again in May, and a

globe trivia relay.

MATERIALS

- **Map notebook (a sketchbook or composition book):** One for the whole year: every map the student draws, with a date, a title and a compass rose.
- **A globe, or a large printed world map:** Used in every unit. An inexpensive classroom globe is ideal; a free printable world map with latitude and longitude lines works too.
- **Colored pencils, a pencil and eraser, a ruler and a piece of string:** For drawing and labeling maps, and for measuring routes on the globe with string.
- **An orange or a small ball, rubber bands and a marker:** For the Unit 1 globe with the equator, the prime meridian and lines of latitude and longitude.
- **Salt dough (flour, salt and water) and a piece of cardboard:** For the salt-dough map of South America in Unit 2.
- **A shallow tray, sand or soil, and a cup of water:** For the Nile sand tray in Unit 3, with a “flood” that leaves mud for farms.
- **A tall clear jar or a long strip of paper:** For the model of ocean depths in Unit 5.
- **A sewing needle, a magnet, a cork or small piece of foam, and a bowl of water:** For the needle compass in Unit 6. A parent handles the needle. A small fan and a toy or homemade boat are used for the sail test.
- **Cardboard, paper, tape, glue, scissors and a few household odds and ends:** For the Australia map, the Silk Road trading game (dried beans, buttons or coins for goods) and the cardboard caravel.
- **Optional: one of the books or resources listed in a unit:** Never required. See the list in each unit.

GRADING

Grades come mostly from the projects and the map notebook, because geography is learned by looking, making and drawing. A project that did not turn out as planned earns full credit when the student did the work carefully and can explain what he or she learned.

- Projects (effort, care and explaining what was learned): 30%
- Map notebook (dated, titled, labeled maps with a compass rose): 20%
- Practice (worked examples and practice questions): 10%
- Unit reviews (40 points each): 20%
- Unit projects: 20%

A 90–100, B 80–89, C 70–79, D 60–69. Below 60: redo the project or review with help.

- Grade the process, not just the result. Did the student look carefully, label neatly, use the compass directions correctly and tell back the story in his or her own words?
- A map notebook page earns full marks when it has a date, a title, a compass rose, the places named in the lesson labeled in the right spots, and one sentence about what the

map shows.

- Unit reviews may be done orally for a student who writes slowly; the parent writes down the answers.
- Keep each unit project in one folder or box. With the map notebook, they make a fine record of the year, and the world drawn from memory in September and again in May shows how far the student has come.

A NOTE TO PARENTS

You do not need to be a geographer to teach this course. Read the story aloud together, find the place on the globe, watch the video and then make the project side by side. Ask “Where is it?”, “What is it near?” and “How would you get there?” Those three questions are most of what a good geography teacher does, and they work for a mountain in the Andes as well as for the grocery store down the road.

The course tells history honestly. Explorers such as Columbus and Magellan are shown with their courage, skill and faith, and also with the real wrongs some of them did, judged by the standard of truth. The peoples of every continent are presented with respect, and nothing in the course asks you or your child to take a side in present-day public debates.

A word about time. This course is written from a Christian view of creation (Genesis 1:1) and the Flood (Genesis 6-9). Young children do not need ages in the millions of years, and the lessons give none. When your child meets one on a museum sign, in a library book or in a video, you can use the simple habit the later grades call “Thinking About Time”: some things we can watch and measure today, such as how fast a river carries sand or how much a beach changes after a storm, and the very large ages come from assuming things always went at today’s speed. Names such as “Ice Age” are taught as museum words, so your child can read any sign and still know that “in the beginning God created the heaven and the earth” (Genesis 1:1).

Above all, the course hopes to raise a child who looks at a map with wonder and sees in it the work of the Creator who “hath made of one blood all nations of men for to dwell on all the face of the earth.” Keep the globe where the family eats, spin it now and then, and let the student show you where the *Victoria* sailed. By the end of the year, the whole world should feel a little closer to home.

CONTENTS

Unit 1: The Globe and the Grid

- 1.1 Hemispheres ★
- 1.2 Latitude: Lines Around
- 1.3 Longitude: Lines Pole to Pole
- 1.4 Finding a Place by Its Address

Unit 2: North America and South America

- 2.1 North America's Mountains and Plains ★
- 2.2 Great Rivers of the Americas
- 2.3 The Andes ☼
- 2.4 Great Cities

Unit 3: Europe and Africa

- 3.1 Europe: A Peninsula of Peninsulas ★
- 3.2 The Rhine, the Danube and the Alps
- 3.3 Africa: The Nile and the Sahara
- 3.4 Africa's Rift Valley, Rain Forest and Savanna

Unit 4: Asia and Australia

- 4.1 Asia: The Biggest Continent ★
- 4.2 Great Rivers of Asia
- 4.3 Australia: The Island Continent
- 4.4 Antarctica

Unit 5: Oceans and Seas

- 5.1 The Pacific ★
- 5.2 The Atlantic
- 5.3 Seas, Gulfs and Bays
- 5.4 Under the Sea ☼

Unit 6: The Compass and the Sail

- 6.1 Steering by the Stars ★ ☼
- 6.2 The Magnetic Compass ★ ☼
- 6.3 Sails That Go Against the Wind ☼
- 6.4 Making a Map of the Coast ☼

Unit 7: Marco Polo and the Silk Road

- 7.1 Venice: A City on the Water ★
- 7.2 The Silk Road ★
- 7.3 Marco Polo at the Court of Kublai Khan
- 7.4 Ibn Battuta: The Great Traveler

Unit 8: Around the World

- 8.1 Columbus and the New World ☼
- 8.2 Magellan Sets Out ★ ☼
- 8.3 Elcano Comes Home ☼
- 8.4 My Trip Around the World

Unit 9: Bonus: Map Lab (optional)

9.1 Latitude Battleship

9.2 Capital Cities Card Game

9.3 Draw the World from Memory

9.4 Globe Trivia Relay

★ quarter path · ⚙ technology overcoming geography

THE GLOBE AND THE GRID

Before we travel around the world this year, continent by continent and ocean by ocean, we need a way to find our way. In this unit you will learn the great imaginary lines that people have drawn on the round earth God made. The **equator** wraps around the middle, and the **prime meridian** runs from pole to pole through Greenwich, England. Together they cut the earth into four **hemispheres**. Then you will learn the whole grid: lines of **latitude** that measure north and south, and lines of **longitude** that measure east and west.

You will meet French scientists measuring the earth near Quito in 1736, surveyors marking the long, straight border along the 49th parallel, the nations that met in Washington, D.C., in 1884 to choose one prime meridian for the world, and the rescue ship *Carpathia*, which raced through the night in 1912 to a position radioed as two numbers. You will build a globe from an orange and another from a ball, and you will make a world grid board that you will use all year long. By the end, you will be able to give any place on earth its address.

BEFORE YOU BEGIN

- Knows the four cardinal directions: north, south, east and west
- Can find the seven continents and the oceans on a globe
- Can add and subtract two-digit numbers
- Can skip count by 10s and by 15s

MASTERY CHECKLIST

- I can find the equator and the prime meridian on a globe and a map.
- I can name the two hemispheres any place is in.
- I can read a latitude from 0° to 90° N or S and tell which places are farther north or south.
- I can read a longitude from 0° to 180° E or W and tell how the prime meridian through Greenwich was chosen in 1884.
- I can find a city from its latitude and longitude and estimate the address of my own home.

OPTIONAL BOOKS AND RESOURCES

- ***The Ambassadors at the National Gallery, London*** (<https://www.nationalgallery.org.uk/paintings/hans-holbein-the-younger-the-ambassadors>): Free. The museum's page for Holbein's painting lets you zoom in on the two globes, the instruments and the hidden skull (Lesson 1.1).
- **Royal Museums Greenwich** (<https://www.rmg.co.uk/>): Free to browse. The home of the Royal Observatory and the prime meridian, with pictures and short articles about Greenwich, longitude and time (Lesson 1.3).

- **Library of Congress: Maps** (<https://www.loc.gov/maps/>): Free. Thousands of old maps and globes to explore with a parent. Look for maps with latitude and longitude numbers printed around the edges (Lesson 1.4).

1.1 HEMISPHERES ★

OBJECTIVES

- Find the equator and the prime meridian on a globe and a world map.
- Name the four hemispheres and tell which line divides each pair.
- Name the two hemispheres a place is in, such as the United States (Northern and Western) or Australia (Southern and Eastern).

Warm-up. Take a ball, an apple or an orange. Hold it in front of you and slide your finger all the way around its fattest middle. Now pretend to cut it along that line. How many pieces do you have? What would you call each piece? Next, slide your finger from the top to the bottom and back up the other side. That makes a second cut. Talk about it: is every spot on the ball in one of the top or bottom halves, and also in one of the left or right halves?

Video. Coming soon. Hemispheres, the equator and the prime meridian for young children: search Homeschool Pop (Alternate) and NASA; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

globe

A round model of the earth. It shows the true shape of the lands and oceans.

equator

An imaginary line around the middle of the earth, halfway between the North Pole and the South Pole.

prime meridian

An imaginary line that runs from the North Pole to the South Pole through Greenwich, England. It is the starting line for measuring east and west.

hemisphere

Half of the earth. The word means “half a sphere,” or half of a ball.

CORE IDEAS

The story. In the spring of 1736, a small team of French scientists came up into the Andes Mountains of South America, to the old city of Quito. They had sailed across the Atlantic Ocean to answer a big question: is the earth perfectly round like a ball, or is it a little fat around its middle? To find out, they went to the middle of the earth itself, to the line we call the **equator**. For years they climbed mountains, measured angles and watched the stars. Their work, together with the work of another French team sent far north to Lapland, showed that the earth bulges just a little at the equator. Long afterward, the land where they

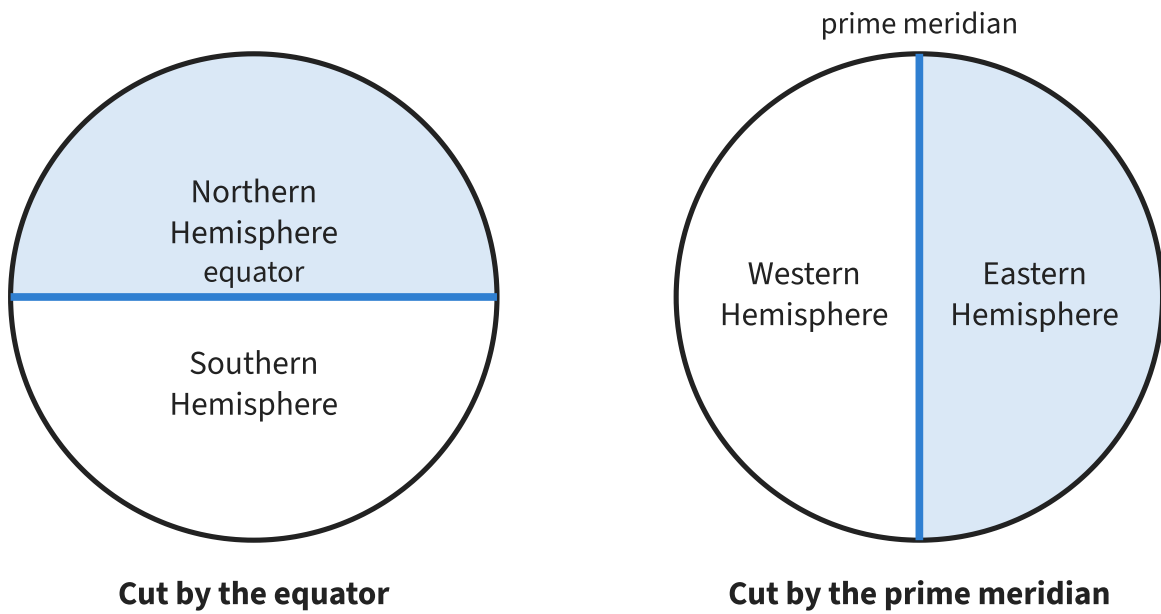
worked took its name from that line. The country of **Ecuador** is named for the Spanish word for equator.

How it works. The equator is not a fence or a road. It is an imaginary line that we draw on globes and maps, exactly halfway between the North Pole and the South Pole. It runs all the way around the earth, about 25,000 miles. The equator cuts the earth into two halves. Everything north of it is in the **Northern Hemisphere**, and everything south of it is in the **Southern Hemisphere**. The word hemisphere means “half a sphere,” or half of a ball.

A second cut. There is another way to cut a ball in half: from top to bottom. Mapmakers draw a line from the North Pole to the South Pole through a place called Greenwich, near London, England. This line is the **prime meridian**. “Prime” means first, because it is the starting line. The prime meridian and its partner line on the far side of the globe cut the earth into the **Western Hemisphere** and the **Eastern Hemisphere**. North and South America lie in the Western Hemisphere. Asia and Australia lie in the Eastern Hemisphere, and so do most of Europe and Africa.

The big idea. Every place on earth is in two hemispheres at the same time: one from the equator cut and one from the prime meridian cut. The United States is in the Northern and Western Hemispheres. Australia is in the Southern and Eastern Hemispheres. Naming both is like saying both your street and your town: it helps someone find you. The lines are imaginary, but the round earth is real. Long ago the prophet Isaiah wrote of God “that sitteth upon the circle of the earth.” God made the round world, and people drew lines on it so they could find their way.

On the map. On a globe, the equator wraps around the middle like a belt, and the prime meridian runs up and down like a seam. On a flat world map, the equator runs straight across and the prime meridian runs straight up and down. Put one finger on each line and slide them until they meet. They cross in the Atlantic Ocean, south of the bulge of western Africa. Now find your own home and say its two hemispheres out loud.



Two ways to cut the earth in half. The equator makes the Northern and Southern Hemispheres; the prime meridian makes the Western and Eastern Hemispheres.

PICTURE STUDY



The Ambassadors, Hans Holbein the Younger, 1533 · Oil on oak panel · National Gallery, London

Hans Holbein was a German painter who worked at the court of King Henry VIII of England. In 1533 he painted two Frenchmen who were in London: Jean de Dinteville, the French ambassador (on the left), and his friend Georges de Selve, a bishop (on the right). An ambassador is a person sent by his king to speak for his country in another land.

Between the two men Holbein painted a table full of the newest learning of his day. On the top shelf is a **celestial globe**, a globe of the stars, with instruments for measuring the sun and the sky. On the bottom shelf is a **terrestrial globe**, a globe of the earth. Holbein painted it so carefully that experts can read place names on it, including Polisy, Dinteville's home in France.

Look closely

- Find the two globes. Which one shows the earth, and which one shows the stars? How can you tell?
- Look for a line that runs around the earth globe. What line on our globes does it remind you of?
- Find the lute, the books and the instruments. Why do you think the men wanted to be painted with these things?
- Look at the strange gray shape on the floor. Now look at it from low and to the right side of the picture. It is a hidden skull, reminding viewers that life is short. In the top left corner, half hidden by the green curtain, find a small crucifix.

Talk about it

1. Why would an ambassador who traveled between countries want a globe?
2. In 1533 no one had a photograph of the whole earth. How do you think people made a globe?
3. The painting is full of learning, but the cross is in the corner. What might Holbein be saying about what matters most?

PROJECT: THE ORANGE GLOBE

You will turn an orange into a small globe, mark its poles, and use rubber bands to show the equator and the prime meridian. Then you will peel it into hemispheres, and at the end you may eat your world.

You will need

- One orange (a navel orange is easiest to peel)
- Two rubber bands, one of them a bright color if you have it
- A fine-tip marker
- A globe or world map to copy from
- A paper plate

Steps

1. Find the little stem spot on the orange. Mark it with an N: that is your North Pole. Turn the orange over and mark the spot on the bottom with an S for the South Pole.
2. Stretch one rubber band around the fattest middle of the orange, halfway between N and S. That is your equator. Check it with your eye from the side: is it the same distance from each pole all the way around?

3. Stretch the second rubber band from N, down one side, through S and up the other side. That is your prime meridian on one side and its partner line on the far side.
4. Look at your globe or map. Using the marker, draw small rough shapes for Africa and Europe touching the prime meridian, then South America and North America to the west, and Asia and Australia to the east. They do not need to be perfect.
5. Write NH on the top half and SH on the bottom half. On the side where you drew the Americas, write WH. On the side with Asia, write EH.
6. Put a dot where you live. Say out loud: "I live in the ___ Hemisphere and the ___ Hemisphere."
7. Take off the rubber bands, keeping the marks. With a parent's help, peel the top half of the orange along the equator line. Hold up the peel: that is a hemisphere! Then share and eat the orange.

Tips

- The prime meridian band goes over both poles. Every line that runs from pole to pole is a meridian.
- If the marker smears, let the ink dry for a minute before you handle the orange.
- Try pressing your hemisphere peel flat on the table. It tears and wrinkles! A round earth never fits perfectly on a flat map, which is why a globe shows it best.

Check your work

- I marked the North and South Poles.
- My equator band is halfway between the poles, and my prime meridian band goes over both poles.
- I can point to all four hemispheres and say which two my home is in.

MAP NOTEBOOK

1. Draw a circle for the earth. Draw the equator across it and label the Northern and Southern Hemispheres.
2. Draw a second circle. Draw the prime meridian from top to bottom and label the Western and Eastern Hemispheres. Color the half you live in.
3. Copy this sentence and fill in the blanks: "I live in ___ (country), in the ___ and ___ Hemispheres."

From history. The country of Ecuador, in South America, is named after the equator, which crosses it just north of its capital, Quito. Near Quito stands a tall monument called Mitad del Mundo, which means "Middle of the World," with a painted line where visitors stand with one foot in each hemisphere. Modern satellite measurements show that the true equator is a short walk away from the painted line, a reminder of how hard it was for early scientists to measure the earth exactly.

WORKED EXAMPLES

Example 1. Cape Town is a city near the southern tip of Africa. It lies south of the equator and east of the prime meridian. Which two hemispheres is it in?

(Use the map or drawing “Use one globe for north and south and the other for west and east.” shown earlier in this lesson.)

1. First look at the equator. Cape Town is south of it, so it is in the Southern Hemisphere.
2. Next look at the prime meridian. Cape Town is east of it, so it is in the Eastern Hemisphere.
3. Put the two together: one answer from each cut.

Answer: Cape Town is in the Southern Hemisphere and the Eastern Hemisphere.

Example 2. The equator is about 25,000 miles around the earth. The North Pole and the South Pole are halfway around the earth from each other. About how far is it from the North Pole, down one side of the earth, to the South Pole?

1. Going all the way around the earth is about 25,000 miles.
2. Going from one pole to the other is only halfway around.
3. Half of 25,000 is 12,500, because $12,500 + 12,500 = 25,000$.

Answer: About 12,500 miles.

PRACTICE

1. **EASY** Which line cuts the earth into the Northern and Southern Hemispheres?
2. **EASY** Which line runs from the North Pole to the South Pole through Greenwich, England, and helps cut the earth into the Western and Eastern Hemispheres?
3. **MEDIUM** Name the two hemispheres the United States is in.
4. **MEDIUM** Australia is south of the equator and east of the prime meridian. Name its two hemispheres.
5. **HARD** Find Brazil on a globe. The equator crosses the northern part of Brazil. Which hemispheres is Brazil in?
6. **CHALLENGE** Explain in one or two sentences why every place on earth is in two hemispheres at the same time.

COMMON MISTAKES

- Thinking the equator and the prime meridian are real lines you can see on the ground. They are imaginary lines drawn on maps and globes to help us find places.

- Mixing up the two lines. The equator goes around the middle like a belt; the prime meridian goes from pole to pole.
- Naming only one hemisphere. Every place is in two: one north or south, and one west or east.

Make it a game · Hemisphere Hop. Lay a jump rope or a strip of tape across the floor for the equator and a second one crossing it for the prime meridian. Mark one end of the room North and one side East. A parent calls out a place: the United States, Australia, Japan, Argentina, Egypt, or your own town. Hop into the correct square and say both hemispheres out loud. Score one point for each correct hemisphere. Play to ten points, then let the child be the caller.

Scripture. “It is he that sitteth upon the circle of the earth, and the inhabitants thereof are as grasshoppers; that stretcheth out the heavens as a curtain, and spreadeth them out as a tent to dwell in:” (Isaiah 40:22, KJV)

The earth that we cut into halves with imaginary lines is held in the hand of the God who made it. Next to Him the whole world is small, yet He knows every person on it.

Practice answers

1. The equator.
2. The prime meridian.
3. The Northern Hemisphere and the Western Hemisphere.
4. The Southern Hemisphere and the Eastern Hemisphere.
5. Brazil is in both the Northern and the Southern Hemispheres (most of it is in the Southern), and it is all in the Western Hemisphere.
6. The earth is cut in half two different ways: once by the equator (north and south) and once by the prime meridian (west and east). Every place gets one half from each cut, so it is always in two hemispheres.

1.2 LATITUDE: LINES AROUND

OBJECTIVES

- Explain that lines of latitude (parallels) circle the earth and measure how far north or south a place is from the equator.
- Read latitudes in degrees from 0° at the equator to 90° N and 90° S at the poles.
- Find the 49th parallel on a map and tell how it became part of the border between the United States and Canada.

Warm-up. Stand at the bottom of a staircase or a ladder (with a parent nearby). The floor is step 0. Climb up one step at a time and count. Now come back down to 0. The equator is like step 0 on the earth, and lines of latitude are like steps going north or going south. How would you tell a friend exactly where you were standing on the stairs?

Video. Coming soon. Latitude for kids, parallels and the equator: search Homeschool Pop (Alternate), NASA and Memoria Press; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

latitude

How far north or south of the equator a place is, measured in degrees.

parallel

A line of latitude. Parallels circle the earth from west to east and never touch each other.

degree (°)

A unit for measuring parts of a circle. The little circle ° stands for degrees.

pole

The farthest point north (the North Pole, 90° N) or south (the South Pole, 90° S) on the earth.

border

A line where one country or state ends and the next begins.

CORE IDEAS

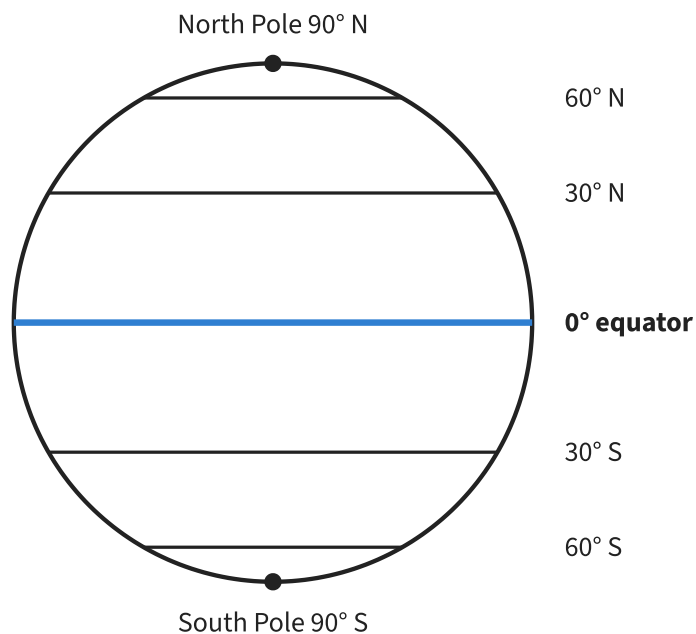
The story. In 1818, the United States and Great Britain, which then ruled Canada, signed an agreement about a long border across the wide plains of North America. No river or mountain ridge was there to mark it, so they chose an invisible line on the globe: the line of latitude called **49 degrees north**. In 1846 another treaty carried the same line west over the Rocky Mountains toward the Pacific Ocean. Surveyors later walked the line with their instruments and set up markers. Today, if you look at a map, you can see a long, straight border running for more than 1,000 miles between the United States and Canada. That border follows the 49th parallel.

How it works. Lines of **latitude** go around the earth like the rings on a barrel or the stripes on a ball. They are also called **parallels**, because they run side by side and never touch, like the two rails of a train track. The equator is the starting line, so its latitude is 0° . The small circle $^{\circ}$ means **degrees**. Lines north of the equator are numbered 10° N, 20° N, 30° N and so on. The circles get smaller as they get closer to the North Pole. The North Pole itself is 90° N. Going south works the same way, down to the South Pole at 90° S.

The big idea. Latitude answers one question: how far north or south am I? A city at 40° N is farther north than a city at 30° N. A city near 0° is close to the equator, where the lowlands are warm all year. Places near 90° are near the poles, where it is very cold. On the earth, one degree of latitude is about 69 miles from north to south. So the higher the number, the farther you are from the equator. Always write N or S after the number, because 30° N and 30° S are on opposite sides of the equator.

How sailors used it. Long before satellites, sailors could find their latitude by looking at the sky. At night in the Northern Hemisphere, the North Star stays almost still above the North Pole. The farther north a ship sails, the higher the North Star stands in the sky. Sailors measured how high it was to know how far north they were. God set the stars in their places, and sailors used them like a ruler hung in the sky.

On the map. On a globe, the parallels are full circles, and the equator is the biggest one. On a flat world map, the parallels are straight lines running across from left to right. Look for the numbers printed at the edges of the map. Put your finger on the 49th parallel border and slide it west to the Pacific Ocean, then find the line where your own home sits.



Lines of latitude (parallels) circle the earth. They are numbered in degrees north and south of the equator.



From the Lake of the Woods west to the Pacific coast, the border between the United States and Canada follows the 49th parallel.

PICTURE STUDY



The Behaim Globe (the “Erdapfel”), Martin Behaim, with painting by Georg Glockendon, 1490–1492 · Painted globe, about 20 inches across · Germanisches Nationalmuseum, Nuremberg, Germany

This is the oldest globe of the earth that still exists. It was made in the city of Nuremberg, in Germany, under the direction of a merchant and traveler named Martin Behaim, and it was finished in 1492. Behaim called it the *Erdapfel*, which means “earth apple.”

Look closely and you will notice something missing. The globe was made just before Columbus came back from his first voyage, so there is no North or South America on it! The ocean west of Europe runs straight across to the islands and coasts of Asia. People in 1492 knew the earth was round, but they did not yet know everything that was on it.

Look closely

- Find the equator on the globe. Why do you think a globe maker would paint that line first?
- Look for other lines circling the globe. Which way do they run?
- Find the metal ring and stand. How would they help someone turn the globe?
- Look at the ocean where America should be. What is there instead?

Talk about it

1. Why is a globe a better picture of the earth than a flat map?
2. What do you think Behaim would say if he could see a globe made today?
3. If you made a globe, which lines would you paint on it?

PROJECT: PARALLELS ON THE BALL GLOBE

You will make a lasting ball globe for this whole unit and add the lines of latitude. Along the way you will discover something surprising: a rubber band will stay on the equator, but it will not stay on any other parallel.

You will need

- A plain ball, such as a playground ball, a foam ball or an old basketball
- Three or four rubber bands big enough to stretch around the ball
- Thin yarn or narrow tape (masking tape or painter's tape)
- A marker that writes on the ball, or small sticky labels
- A globe or world map to copy from

Steps

1. Mark the North Pole (N) at the top of the ball and the South Pole (S) at the very bottom.
2. Stretch a rubber band around the fattest middle, halfway between the poles. That is the equator. Label it 0°.
3. Now try to put a second rubber band partway up the ball, as a parallel. Watch what happens. The band slides up and pops off! A stretched band always pulls itself toward the smallest circle it can find.
4. Instead, use yarn or tape to make the parallels. Lay a line about one third of the way from the equator to the North Pole and label it 30° N. Lay another about two thirds of the way and label it 60° N.
5. Do the same below the equator for 30° S and 60° S.

6. Use your marker to draw rough shapes of the continents, copying from a globe. Notice where the United States sits: mostly between 30° N and 60° N, with much of it near 40° N.
7. Keep the ball. In Lesson 1.3 you will add the lines that run from pole to pole.

Tips

- The equator is the only parallel that is a “great circle,” the biggest circle you can draw on a ball. That is why the rubber band stays there.
- Parallels get smaller as you go toward the poles. At the very pole, the circle shrinks to a single point.

Check your work

- My equator is halfway between the poles and labeled 0° .
- I have parallels for 30° and 60° both north and south, each with N or S.
- I can explain why a rubber band will not stay on the 30° N line.

MAP NOTEBOOK

1. Draw a circle for the earth with the equator and four parallels. Label 0° , 30° N, 60° N, 30° S, 60° S, and both poles at 90° .
2. Draw a ladder going up from the equator to the North Pole. Number the rungs 0° , 10° , 20° and so on up to 90° N.
3. Trace or draw the 49th parallel border between the United States and Canada and label both countries.

From history. Another famous line of latitude in American history is the Mason-Dixon Line. Between 1763 and 1767, two Englishmen, the astronomer Charles Mason and the surveyor Jeremiah Dixon, measured the border between Pennsylvania and Maryland by watching the stars at night and cutting a path through the forest. They set heavy stone markers along the way. The line runs along a latitude a little south of 40° N, and some of their stones still stand today.

WORKED EXAMPLES

Example 1. Miami, Florida, is at about 26° N. Chicago, Illinois, is at about 42° N. Which city is farther north, and how many degrees of latitude apart are they?

1. Both latitudes are N, so both cities are north of the equator.
2. The bigger number is farther north: 42 is bigger than 26, so Chicago is farther north.
3. Subtract to find the difference: $42 - 26 = 16$.

Answer: Chicago is farther north, by 16 degrees of latitude.

Example 2. One degree of latitude is about 69 miles. A ship sails straight north from 30° N to 32° N. About how many miles did it sail?

1. Find how many degrees the ship moved: $32 - 30 = 2$ degrees.
2. Each degree is about 69 miles, so 2 degrees is $69 + 69$.
3. $69 + 69 = 138$.

Answer: About 138 miles.

PRACTICE

1. **EASY** What is the latitude of the equator?
2. **EASY** What is the latitude of the North Pole? Of the South Pole?
3. **MEDIUM** Look at the map of the 49th parallel. Which country lies north of the 49° N line: the United States or Canada?
(Use the map or drawing “The 49th parallel border.” shown earlier in this lesson.)
4. **MEDIUM** Quito, Ecuador, is at about 0°. New Orleans is at about 30° N. Which city is closer to the equator?
5. **HARD** One degree of latitude is about 69 miles. About how many miles is it from 40° N to 43° N?
6. **CHALLENGE** Write one or two sentences: Why do we always write N or S after a latitude number?

COMMON MISTAKES

- Forgetting the N or S. A latitude of “30°” could be north or south of the equator.
- Thinking latitude numbers keep growing past 90°. The poles are 90° N and 90° S, and nothing is farther north or south.
- Mixing up which way parallels run. Parallels go around the earth from west to east, but they measure north and south.

Make it a game • Latitude Elevator. One player is the elevator operator and stands in the middle of the room, the equator. A parent calls out a latitude such as “30 north!” or “60 south!” The operator moves forward (north) or backward (south) one big step for every 10 degrees, then says where they are. Calling “90 north!” means stand on tiptoe at the North Pole. Get it right to score a point; after five turns, switch operators.

Scripture. “He stretcheth out the north over the empty place, and hangeth the earth upon nothing.” (Job 26:7, KJV)

We draw lines on the globe to measure north and south, but the earth itself hangs in space by the power of God, who made both the north and the south.

1. 0° (zero degrees).
2. The North Pole is 90° N. The South Pole is 90° S.
3. Canada.
4. Quito, because 0° is the equator itself.
5. $43 - 40 = 3$ degrees, and $69 + 69 + 69 = 207$, so about 207 miles.
6. Because every latitude number except 0° appears twice, once north and once south of the equator. For example, 30° N and 30° S are on opposite sides of the earth, so the letter tells which one we mean.

1.3 LONGITUDE: LINES POLE TO POLE

OBJECTIVES

- Explain that lines of longitude (meridians) run from the North Pole to the South Pole and measure how far east or west a place is.
- Tell how the nations meeting in Washington, D.C., in 1884 chose the line through Greenwich, England, as the prime meridian.
- Read longitudes from 0° at the prime meridian to 180° east and west, and find the difference between two longitudes.

Warm-up. Cut an orange in half across its middle and look at the cut side, or look at a peeled orange from the top. Count the sections. Notice that every section is wide in the middle and comes to a point at the top and bottom. Where do all the section lines meet? Lines of longitude on the earth meet the same way, at the North Pole and the South Pole.

Video. Coming soon. The prime meridian and the Royal Observatory, Greenwich, and longitude for kids: search Homeschool Pop (Alternate), Smithsonian, The History Guy and NASA; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

longitude

How far east or west of the prime meridian a place is, measured in degrees.

meridian

A line of longitude. Meridians run from the North Pole to the South Pole and meet at both poles.

Greenwich

A town on the River Thames, now part of London, where the Royal Observatory stands on the prime meridian. Say it “GREN-itch.”

observatory

A building where people study the sun, moon and stars.

CORE IDEAS

The story. In October 1884, men from 25 nations gathered in Washington, D.C., at the invitation of President Chester A. Arthur. They had come to settle a puzzle. For north and south, everyone already agreed to start counting at the equator. But for east and west there was no natural starting line, so many countries drew their own. French maps started at Paris, and other maps started somewhere else. Sailors and railroads needed one line for the whole world. Most of the world’s sea charts already used the line through the **Royal Observatory** at **Greenwich**, England, so the meeting voted for it: 22 nations said yes, one

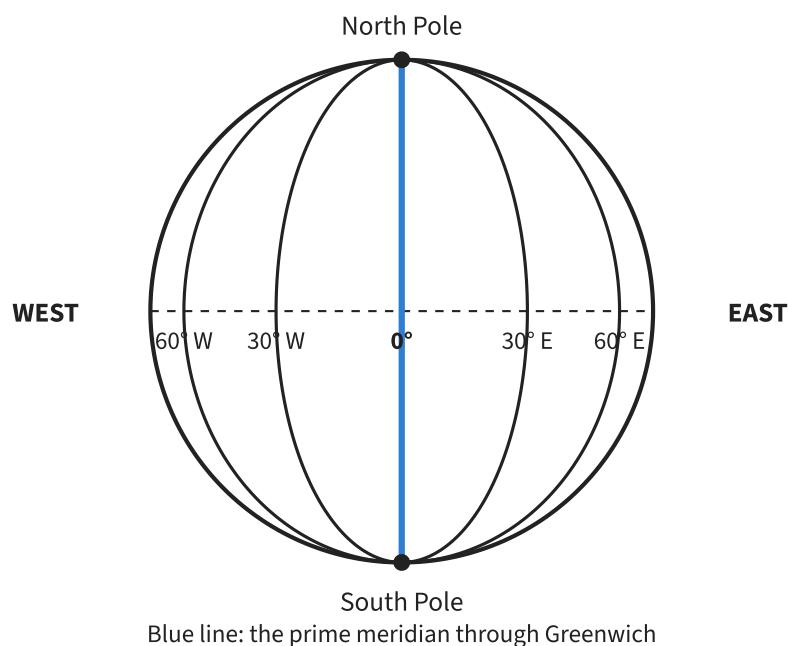
said no, and France and Brazil did not vote. Ever since, the line through Greenwich has been the **prime meridian**, 0° longitude.

How it works. Lines of **longitude**, also called **meridians**, run from the North Pole to the South Pole, like the sections of an orange. They are farthest apart at the equator and all come together at the poles. The prime meridian is 0°. Lines to the east of it are numbered 10° E, 20° E, 30° E and so on. Lines to the west are numbered 10° W, 20° W, 30° W. Both sides go all the way to 180°, which is the same meridian on the far side of the earth from Greenwich. Always write E or W after the number.

The big idea. Longitude answers the question: how far east or west am I? New York City is at about 74° W, west of Greenwich. Cairo, Egypt, is at about 31° E, east of Greenwich. To find how far apart two places are, look at their letters. If both are W (or both are E), subtract. If one is W and one is E, they are on opposite sides of the prime meridian, so add.

Longitude and the sun. The earth turns all the way around, 360 degrees, once a day. That means it turns 15 degrees every hour. When the sun is highest in the sky at Greenwich, it is still early morning in New York, because the sun has to travel west across 74 more degrees to reach it. This is why clocks in different parts of the world show different times. Choosing one prime meridian helped the whole world set its clocks by the same plan.

On the map. On a globe, the meridians look like the seams of a ball, meeting at the poles. On a flat world map, they run straight up and down, and the numbers are printed along the top or bottom edge. Find the prime meridian: it passes through England, France and Spain and down across western Africa. Then find 180°, out in the middle of the Pacific Ocean, the farthest you can go east or west from Greenwich.



Lines of longitude (meridians) run from pole to pole and are numbered east and west of the prime meridian.

PICTURE STUDY



Greenwich Hospital from the North Bank of the Thames, Canaletto (Giovanni Antonio Canal), about 1750–1752 · Oil on canvas · National Maritime Museum, Greenwich, London

Canaletto was a painter from Venice who was famous for his bright, careful pictures of cities and rivers. He lived in England for several years and painted the River Thames many times. Here he stood on the north bank of the river and looked across at Greenwich.

The grand buildings with two domes were a home for old and injured sailors of the Royal Navy, designed by Sir Christopher Wren. Behind them rises the hill of Greenwich Park. On top of that hill stands the Royal Observatory, which King Charles II founded in 1675 to study the stars and help sailors find their way at sea. More than two hundred years later, the line through that observatory became the prime meridian of the world.

Look closely

- Find the two matching domes. How many columns can you count under one of them?
- Look at the river. How many boats can you find, and what kinds are they?
- Find the green hill behind the buildings. That is the hill where the Royal Observatory stands.
- Look at the sky. How much of the painting is sky, and how much is river and buildings?

Talk about it

1. Why would a navy want a home for its sailors and an observatory for the stars in the same town?
2. Why do you think people in 1884 chose a place that sailors already knew so well for the starting line of the world?

3. If you stood on that hill today with one foot on each side of the line, which two hemispheres would your feet be in?

PROJECT: MERIDIANS ON THE BALL GLOBE

Today your ball globe from Lesson 1.2 gets its meridians. This time the rubber bands will stay on, and you will find out why.

You will need

- Your ball globe from Lesson 1.2
- Three rubber bands big enough to stretch around the ball over both poles
- A marker or small sticky labels
- A globe or world map to copy from
- A strip of masking tape about 3 feet long

Steps

1. Stretch one rubber band from the North Pole down through the South Pole and back up the other side. Turn the ball so the band passes through England on your drawing. That half of the band is the prime meridian: label it 0° . The other half, on the far side of the ball, is 180° .
2. Stretch a second band over both poles so it crosses the equator about one third of the way from 0° toward 180° on the east side (toward Asia). Label the east half 60° E. Its far half is 120° W.
3. Stretch a third band the same way on the west side (toward the Americas). Label it 60° W. Its far half is 120° E.
4. Look where the bands meet. All of them cross at the North Pole and at the South Pole.
5. Notice that the bands stay put. Every meridian circle goes over both poles, so it is a biggest-possible circle around the ball, just like the equator.
6. Lay the strip of masking tape on the floor and write " 0° Greenwich" on it. Stand with one foot on each side, as visitors do at the Royal Observatory. Say which foot is in the Eastern Hemisphere and which is in the Western.

Tips

- Each rubber band makes two meridians: one on the front of the ball and one on the back. The two numbers always add up to 180 (for example, 60° E and 120° W).
- If you face north with the prime meridian under your feet, east is on your right and west is on your left.

Check your work

- My prime meridian is labeled 0° and passes through England.
- I have meridians labeled both east and west, each with E or W.
- I can show where all the meridians meet.

MAP NOTEBOOK

1. Draw a circle for the earth with the prime meridian down the middle and curved meridians on each side. Label 0° , 30° E, 60° E, 30° W and 60° W.
2. Draw the Royal Observatory on its hill with a line running through it, and write " 0° Prime Meridian, chosen 1884."
3. Make a two-column chart titled "Latitude or Longitude?" List: measures north and south, measures east and west, starts at the equator, starts at Greenwich, lines are called parallels, lines are called meridians.

From history. Before 1884, many countries used their own starting line. French maps measured longitude from Paris, and some American maps measured from Washington. Even after the 1884 meeting, France kept using the Paris line on many of its maps for years. Today a metal strip set into the courtyard of the Royal Observatory marks the prime meridian, and visitors line up to stand with one foot in the Eastern Hemisphere and one in the Western.

WORKED EXAMPLES

Example 1. New York City is at about 74° W. Cairo, Egypt, is at about 31° E. How many degrees of longitude apart are they?

(Use the map or drawing "Places on opposite sides of 0° : add. Places on the same side: subtract." shown earlier in this lesson.)

1. Look at the letters. New York is W and Cairo is E, so they are on opposite sides of the prime meridian.
2. To get from New York to Cairo, you go 74 degrees east to reach 0° , then 31 more degrees east.
3. Add: $74 + 31 = 105$.

Answer: They are about 105 degrees of longitude apart.

Example 2. The earth turns 15 degrees of longitude every hour. When the sun is highest in the sky at Greenwich (0°), how many hours later will it be highest over a ship at 45° W?

1. The sun's highest point moves west 15 degrees each hour.
2. Skip count by 15 until you reach 45: 15 (1 hour), 30 (2 hours), 45 (3 hours).
3. So it takes 3 hours to move from 0° to 45° W.

Answer: About 3 hours later.

PRACTICE

1. **EASY** What is the longitude of the prime meridian?
2. **EASY** In what year, and in what city, did the nations meet to choose Greenwich as the prime meridian?
3. **MEDIUM** Paris, France, is at about 2° E. New York City is at about 74° W. Which city is east of the prime meridian?
4. **MEDIUM** Chicago is at about 88° W. Denver is at about 105° W. Both are west. How many degrees of longitude apart are they?
5. **HARD** The earth turns 15 degrees every hour. How many degrees does it turn in 4 hours?
6. **CHALLENGE** Write one or two sentences: Why did sailors and railroads want the whole world to use one prime meridian?

COMMON MISTAKES

- Mixing up latitude and longitude. A helpful trick: lines of LONGitude are the LONG ones that run all the way from pole to pole.
- Forgetting the E or W. A longitude of “60°” could be east or west of Greenwich.
- Subtracting when two places are on opposite sides of the prime meridian. If one is E and the other is W, add the numbers.

Make it a game • East or West, Add or Subtract. Write ten city cards with their longitudes: New York 74° W, Chicago 88° W, Denver 105° W, Los Angeles 118° W, London 0°, Paris 2° E, Cairo 31° E, Moscow 38° E, Beijing 116° E, Tokyo 140° E. Draw two cards. First say “add” (opposite sides) or “subtract” (same side) for one point, then find the difference for a second point. A parent checks with a calculator or a globe. First to ten points wins.

Scripture. “As far as the east is from the west, so far hath he removed our transgressions from us.” (Psalm 103:12, KJV)

Going north, you finally reach the North Pole and must turn south. But you can travel east around the world forever and never reach the west. God’s forgiveness is like that: He removes our sins so far that they never come back.

Practice answers

1. 0° (zero degrees).
2. In 1884, in Washington, D.C.
3. Paris (the E means east).
4. Both are W, so subtract: $105 - 88 = 17$ degrees.
5. $15 + 15 + 15 + 15 = 60$ degrees.
6. If every country started counting from its own line, the same place would have different longitudes on different maps, which was confusing and dangerous at sea. One starting line meant every map, ship and clock could use the same numbers.

1.4 FINDING A PLACE BY ITS ADDRESS

OBJECTIVES

- Explain that latitude and longitude together give every place on earth its own address.
- Find a city on a globe or grid map from its latitude and longitude, and give the latitude and longitude of a city.
- Tell how a ship's position, sent by radio in 1912, guided the rescue ship *Carpathia*.

Warm-up. Draw a tic-tac-toe board, or use a muffin tin. Hide a button in one square while your child looks away. Give only one clue: "It is in the top row." Can they find it for sure? Now give a second clue: "It is in the left column." Talk about it: why did it take two clues to find the exact square?

Video. Coming soon. Finding places with latitude and longitude on a map or globe for kids: search Homeschool Pop (Alternate), NASA and Memoria Press; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

grid

A pattern of lines that cross each other to make boxes, like the lines on graph paper.

coordinates

The two numbers, latitude and longitude, that tell exactly where a place is on the earth.

position

The exact place where something is, such as a ship at sea.

estimate

A careful guess that is close to the real number, such as "between 30° and 60°, closer to 30°."

CORE IDEAS

The story. Near midnight on April 14, 1912, the great ocean liner *Titanic* struck an iceberg in the cold North Atlantic Ocean. The ship's radio operators began sending calls for help, and with every call they sent the ship's **position**: about 42 degrees north and 50 degrees west. Fifty-eight sea miles (nautical miles) away, the radio operator on a smaller ship, the *Carpathia*, heard the call. Captain Arthur Rostron turned his ship toward those numbers and raced through the dark, past icebergs, as fast as it could go. The *Titanic* sank before help arrived, and many people were lost. But in the early morning the *Carpathia* reached the lifeboats and rescued more than 700 people. Two numbers had told the rescuers where to go.

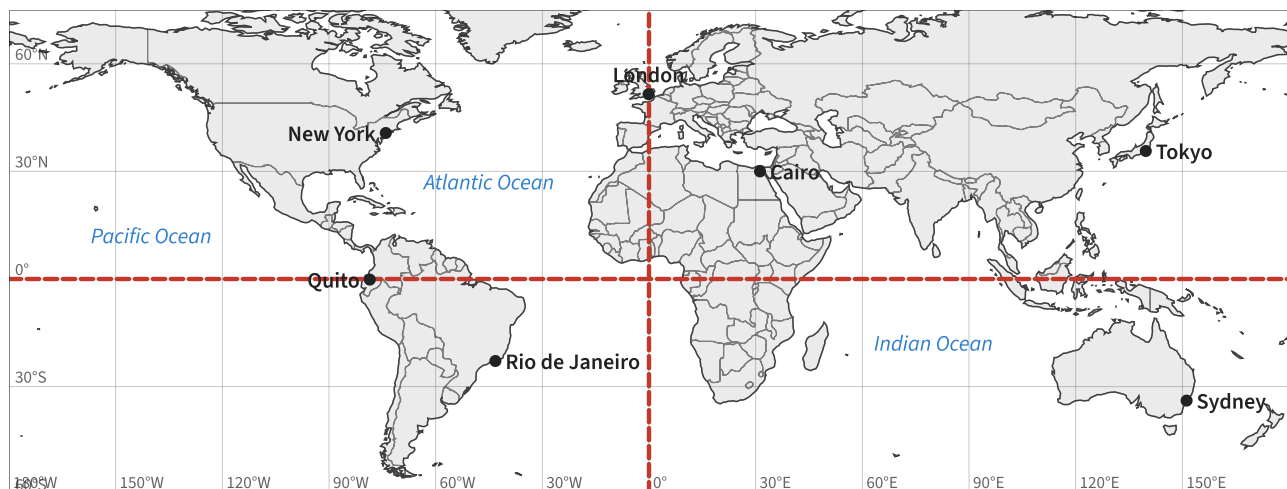
How it works. Latitude alone is not enough. The 40° N line runs all the way around the world, through Philadelphia, Spain and China. Longitude alone is not enough either: the 75°

W line runs from the North Pole to the South Pole. But where a parallel and a meridian *cross*, there is only one spot. Together, latitude and longitude are a place's **coordinates**, its address on the earth. We always say the latitude first and the longitude second, like this: London, 52° N, 0°.

How to find a place. To find a place from its address, take two steps. First, start at the equator and move north or south to the right latitude. Second, move east or west along that line to the right longitude. Most maps show lines only every 10, 20 or 30 degrees, so you will often need to **estimate**. Tokyo, Japan, is at about 36° N, 140° E. That is between the 30° N and 60° N lines, closer to 30°, and between the 120° E and 150° E lines, closer to 150°.

The big idea. Every place God made on the earth, every city, island and mountaintop, has its own address made of two numbers. The grid lines are imaginary, but they let a sailor, a pilot or a rescue ship find one exact spot on a huge round world. The apostle Paul said that God “hath determined the times before appointed, and the bounds of their habitation” for all the nations. He knows where every person lives, and He has given us minds to measure and map His world.

On the map. Look at the world grid map in this lesson. The lines are drawn every 30 degrees. Put one finger on the equator and another on the prime meridian. Move them to find New York, London, Cairo, Tokyo, Sydney, Rio de Janeiro and Quito. Then find the box where your own home sits, and try to estimate your own address.



A world grid with lines every 30 degrees. Find each city by its latitude and longitude.

PICTURE STUDY



The Geographer, Johannes Vermeer, 1669 · Oil on canvas · Städel Museum, Frankfurt, Germany

Johannes Vermeer lived in the Dutch city of Delft. In his day the Dutch were some of the greatest sailors, traders and mapmakers in the world, and Dutch shops sold beautiful globes and charts. Vermeer painted very few pictures, and he worked slowly, paying close attention to light.

Here a geographer, a person who studies and maps the earth, has stopped in the middle of his work. He holds a pair of **dividers**, a tool used to measure distances on a map. Behind him on the cabinet is a globe of the earth, and on the wall hangs a chart of the sea. He looks up toward the window, as if a new idea has just come to him.

Look closely

- Find the dividers. What do you think the geographer was measuring?
- Find the globe on top of the cabinet. Which side of the earth do you think it shows?
- Look at the window and the light. Where does the light fall brightest?
- Find the chart on the wall and the map on the table. How are they different from the globe?

Talk about it

1. Why would a geographer need both a globe and flat maps?
2. What do you think the geographer is thinking about as he looks out the window?
3. What tools would a geographer use today instead of, or along with, these?

PROJECT: MYSTERY CITY GRID GAME

You will make your own world grid board and play a game of finding cities by their addresses. This is the map you will keep using all year whenever a new place appears in a lesson.

You will need

- A large sheet of paper or poster board
- A ruler, pencil and markers (one blue)
- A printed or traced outline map of the world (or the map in this lesson to copy)
- Ten index cards
- Small tokens such as buttons, beans or coins

Steps

1. Trace or copy a simple world map onto the poster, or glue a printed outline map onto it.
2. With the ruler, draw straight lines across for the latitudes 60° N, 30° N, 0°, 30° S and 60° S. Draw the equator in blue. Label each line at the left edge.
3. Draw straight lines up and down for the longitudes 150° W, 120° W, 90° W, 60° W, 30° W, 0°, 30° E, 60° E, 90° E, 120° E and 150° E. Draw the prime meridian in blue. Label each line along the bottom edge.
4. On each index card, write a city's address on the front and the city's name on the back. Use these: New York 41° N, 74° W; London 52° N, 0°; Cairo 30° N, 31° E; Tokyo 36° N, 140° E; Sydney 34° S, 151° E; Rio de Janeiro 23° S, 43° W; Quito 0°, 79° W; Cape Town 34° S, 18° E; Moscow 56° N, 38° E; Mexico City 19° N, 99° W.
5. Shuffle the cards and place them address side up. Draw a card, read the address out loud, and place a token where you think the city is.
6. Turn the card over and check on a globe or atlas. If your token is in the right grid box, keep the card. Take turns until all the cards are gone.
7. Bonus round: a parent points to a spot on the board, and the players race to estimate its latitude and longitude.

Tips

- Always find the latitude first (up or down from the equator), then the longitude (left or right from the prime meridian).
- On a flat map with north at the top, east is to the right and west is to the left.

Check your work

- My grid lines are straight, evenly spaced and labeled with N, S, E or W.
- I placed at least eight of the ten cities in the correct grid box.
- I can estimate the address of my own home.

MAP NOTEBOOK

1. Copy the addresses of five cities into your map notebook and draw a small picture beside each one.
2. Find your own town on a globe or atlas. Write its address to the nearest degree, such as 40° N, 75° W.
3. Draw the *Carpathia* sailing toward a dot marked “42° N, 50° W” in the North Atlantic, and write one sentence about why the numbers mattered.

From history. Today a phone or a car can tell you its own latitude and longitude in seconds by listening to signals from satellites high above the earth. This system is called GPS, and its first satellite was launched in 1978. Ships, airplanes, farmers and rescue teams all use it. But GPS still gives its answer in the same two numbers, latitude and longitude, that sailors were using long before the *Titanic* ever sailed.

WORKED EXAMPLES

Example 1. On the world grid map, find the city at about 36° N, 140° E. Which city is it?

(Use the map or drawing “Move north or south first, then east or west.” shown earlier in this lesson.)

1. Latitude first: 36° N is north of the equator, between the 30° N and 60° N lines, close to 30° N.
2. Longitude next: 140° E is east of the prime meridian, between the 120° E and 150° E lines, closer to 150° E.
3. Look where those two places meet: a city on the islands off the east coast of Asia.

Answer: Tokyo, Japan.

Example 2. The *Titanic* radioed its position as about 42° N, 50° W. In which hemispheres was the ship, and in which ocean?

1. 42° N is north of the equator: the Northern Hemisphere.
2. 50° W is west of the prime meridian: the Western Hemisphere.
3. On the map, 42° N, 50° W is out in the water between North America and Europe, southeast of Newfoundland, in the Atlantic Ocean.

Answer: The Northern and Western Hemispheres, in the North Atlantic Ocean.

PRACTICE

1. **EASY** Which city on the world grid map is at about 52° N, 0°?
(Use the map or drawing “The world grid.” shown earlier in this lesson.)
2. **EASY** When we write a place’s address, which number comes first, latitude or longitude?

3. **MEDIUM** Rio de Janeiro, Brazil, is at about 23° S, 43° W. Is it north or south of the equator? East or west of the prime meridian?
4. **MEDIUM** Put these cities in order from farthest north to farthest south: Sydney (34° S), London (52° N), Quito (0°), New York (41° N).
5. **HARD** Philadelphia is at about 40° N, 75° W. Beijing, China, is at about 40° N, 116° E. Which part of their addresses is about the same, and what does that tell you?
6. **CHALLENGE** What is at 0°, 0°, where the equator crosses the prime meridian? Use a globe and write one sentence.

COMMON MISTAKES

- Giving the longitude first. The rule is latitude first, then longitude.
- Counting from the edge of the map instead of from the equator and the prime meridian. Every count starts at 0°.
- Expecting the city to sit exactly on a grid line. Most places lie between the lines, so estimate which line they are closer to.

Make it a game • Where in the World Am I? One player secretly picks a city from the grid board and says only its latitude, such as “I am at about 30 degrees north.” The others may guess one city each. If no one is right, the player gives the longitude too. Guessing correctly after only the latitude scores 2 points; after both numbers scores 1 point. Take turns until someone reaches 10 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)

God made all the peoples of the world and set them in their lands. Every city on our grid is full of people He made and knows by name.

Practice answers

1. London, England.
2. Latitude comes first, then longitude.
3. South of the equator and west of the prime meridian.
4. London, New York, Quito, Sydney.
5. Their latitudes are about the same (40° N), so both cities are about the same distance north of the equator. Their longitudes are very different, so they are far apart, on opposite sides of the world.
6. Open ocean: the spot is in the Atlantic Ocean (the Gulf of Guinea), south of the bulge of western Africa, so there is no city there.

UNIT 1 REVIEW

Answer each question. Use a globe or the world grid map when a question asks for it, show your work for adding and subtracting, and use complete sentences for explanations. The review is worth 40 points.

1. (4 pts) Name the two imaginary lines that cut the earth into hemispheres, and tell which halves each one makes.
2. (4 pts) Name the two hemispheres for (a) the United States and (b) Australia.
3. (4 pts) Which South American country is named after the equator?
4. (4 pts) What are the latitudes of the equator, the North Pole and the South Pole?
5. (4 pts) Miami is at about 26° N, and Chicago is at about 42° N. Which city is farther north, and by how many degrees?
6. (4 pts) One degree of latitude is about 69 miles. About how far is it from 30° N to 32° N?
7. (4 pts) In what year did the nations meeting in Washington, D.C., choose the line through Greenwich, England, as the prime meridian? What is its longitude?
8. (4 pts) New York is at about 74° W, and Cairo is at about 31° E. Should you add or subtract to find how many degrees of longitude apart they are? Find the answer.
9. (4 pts) Use the world grid map. Which city is at about 34° S, 151° E? Which city is at about 52° N, 0° ?
10. (4 pts) In 1912 the *Titanic* radioed its position as about 42° N, 50° W. In one or two sentences, explain why the rescue ship *Carpathia* needed both numbers.

UNIT PROJECT: MY GLOBE AND MY WORLD GRID

Bring together your ball globe and your world grid board. The ball globe should show the poles, the equator, parallels at 30° and 60° north and south, and meridians labeled east and west, with the continents roughly drawn. The grid board should have straight, labeled lines every 30 degrees, the equator and prime meridian in blue, and at least ten cities placed by their addresses. Add a card with your own home's estimated latitude and longitude and its two hemispheres. Then teach a parent or sibling how to find one city by its address, using both the globe and the grid.

- **Accuracy:** The equator, prime meridian, parallels and meridians are in the right places and labeled with the correct numbers and N, S, E or W.
- **Finding places:** At least ten cities are placed in the correct grid box, and the student's home address is a reasonable estimate.
- **Explanation:** The student explains clearly the difference between latitude and longitude and why a place needs both numbers.
- **Care:** The globe and board are neat, colorful and easy to read.

Answer key

1. The equator makes the Northern and Southern Hemispheres. The prime meridian (with its partner line at 180°) makes the Western and Eastern Hemispheres.
2. (a) Northern and Western. (b) Southern and Eastern.
3. Ecuador.
4. Equator 0° , North Pole 90° N, South Pole 90° S.
5. Chicago, by $42 - 26 = 16$ degrees.
6. 2 degrees, and $69 + 69 = 138$, so about 138 miles.
7. 1884. Its longitude is 0° .
8. Add, because they are on opposite sides of the prime meridian: $74 + 31 = 105$ degrees.
9. Sydney, Australia, is at 34° S, 151° E. London, England, is at 52° N, 0° .
10. Latitude alone tells only how far north the ship was, and the 42° N line runs all the way around the world. The longitude told how far west, and where the two lines cross there is only one spot, so the *Carpathia* knew exactly where to go.

NORTH AMERICA AND SOUTH AMERICA

Our trip around the world begins at home, in the Americas. North America and South America are joined by a narrow neck of land, and each has its great mountains, plains and rivers. In this unit you will climb Pikes Peak with Zebulon Pike and Katharine Lee Bates, look out over the Great Plains, and see how glaciers scraped the old rock of the Canadian Shield into a land of a thousand lakes. You will paddle with an Ojibwe guide to the source of the Mississippi, sail up the St. Lawrence with Jacques Cartier and float the whole length of the Amazon with Francisco de Orellana.

Then you will climb into the Andes, the longest mountain chain on land, and walk the roads of the Inca, who crossed deep canyons on bridges woven from grass. Finally you will visit three great cities and learn why each stands where it does: Mexico City on an old lake bed, New York on its harbor and Rio de Janeiro on its bay. Along the way you will use the latitude you learned in Unit 1 and remember 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).

BEFORE YOU BEGIN

- Can find the equator and tell the Northern Hemisphere from the Southern Hemisphere (Unit 1)
- Can read north, south, east and west on a map
- Can add and subtract numbers in the thousands and multiply by 100 or 500 with help
- Knows that a map scale tells how many miles one inch stands for

MASTERY CHECKLIST

- I can find the Rockies, the Appalachians, the Great Plains and the Canadian Shield on a map and tell how they are different.
- I can trace the Mississippi, the St. Lawrence and the Amazon from source to mouth and name the direction each one flows.
- I can explain what a tributary and a river basin are.
- I can find the Andes and explain why their high places are cold even near the equator.
- I can tell how the Inca crossed the mountains with roads, runners and grass rope bridges.
- I can explain why Mexico City, New York and Rio de Janeiro grew beside water, and tell which hemisphere each is in.

OPTIONAL BOOKS AND RESOURCES

- **Mississippi National River and Recreation Area (National Park Service)** (<https://www.nps.gov/miss/>): Free. Pictures and facts about the Mississippi River from its headwaters to the Gulf, useful for Lesson 2.2.

- **Library of Congress Geography and Map Division** (<https://www.loc.gov/maps/>): Free. Search for old maps of New York Harbor, the Mississippi and South America to compare with your own maps in Lessons 2.2 and 2.4.
- **The Metropolitan Museum of Art collection** (<https://www.metmuseum.org/>): Free. Search the collection for “Heart of the Andes,” “Lander’s Peak” and “Fur Traders Descending the Missouri” to zoom in on this unit’s picture studies in close detail.

2.1 NORTH AMERICA'S MOUNTAINS AND PLAINS ★

OBJECTIVES

- Find the Rocky Mountains, the Appalachian Mountains, the Great Plains and the Canadian Shield on a map of North America.
- Explain how the tall, sharp Rockies are different from the low, rounded Appalachians, and why the Canadian Shield has so many lakes.
- Tell the stories of Zebulon Pike and Katharine Lee Bates at Pikes Peak and use a map scale to measure a mountain range.

Warm-up. Crumple one sheet of paper into a tight, pointy wad and leave a second sheet folded softly into a low hump. Set them at opposite ends of a table with a flat towel between them. Which one looks like a young, tall mountain? Which looks old and worn? What does the flat towel remind you of? You have just built North America from west to east.

Video. Coming soon. Rocky Mountains, Appalachian Mountains, Great Plains and the Canadian Shield for children: search Homeschool Pop (Alternate), Smithsonian, NASA Earth Observatory (satellite views of the Rockies and the Shield's lakes), and National Park Service videos of Pikes Peak and the Great Smoky Mountains.

KEY TERMS

mountain range

A long line of mountains that stand together, like the Rockies or the Appalachians.

plain

A wide stretch of land that is flat or gently rolling, with few hills.

elevation

How high a place is above the level of the sea, usually measured in feet.

glacier

A huge, thick sheet or river of ice that moves very slowly over the land, scraping it as it goes.

Canadian Shield

A giant area of very old, hard rock wrapped around Hudson Bay, covered with thin soil, forests and thousands of lakes.

CORE IDEAS

The story. In November 1806, a young U.S. Army officer named Zebulon Pike was exploring the wide lands the United States had just bought from France in the Louisiana Purchase. Far to the west he saw a mountain that looked at first like a small blue cloud. Pike and a few men tried to climb it, but deep snow and bitter cold turned them back, and they had no winter

coats. The mountain was later named Pikes Peak. In the summer of 1893, a teacher named Katharine Lee Bates rode to its top. She looked east over the flat land stretching away below and began a poem we still sing: “O beautiful for spacious skies, For amber waves of grain, For purple mountain majesties Above the fruited plain!”

The big idea. North America has two great mountain ranges, one on each side. In the west stand the **Rocky Mountains**. They run about 3,000 miles, from New Mexico north through Canada. They are tall, sharp and rocky, and many peaks, like Pikes Peak, rise more than 14,000 feet. In the east stand the **Appalachian Mountains**. They are very old and worn down by wind and rain, so their tops are low and rounded and covered with forest. Their highest peak, Mount Mitchell in North Carolina, is about 6,700 feet high, less than half as tall as Pikes Peak.

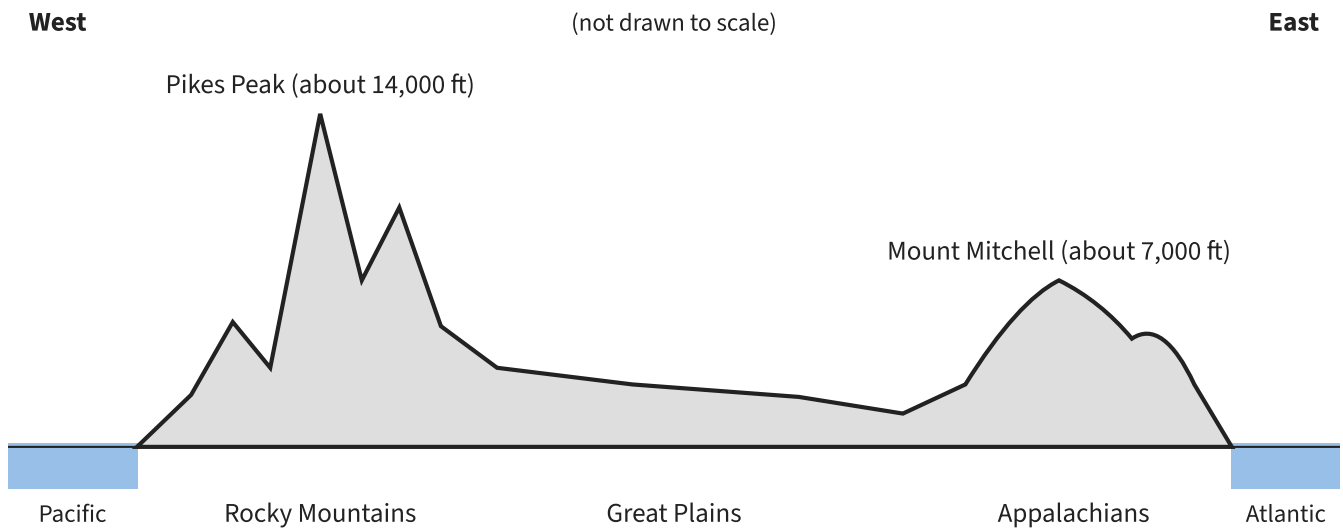
The land between. Between the two ranges lie the great **plains**. The land is flat or gently rolling for hundreds of miles. On the Great Plains, just east of the Rockies, grass once fed huge herds of buffalo. Today farmers grow wheat and corn there. Those are Katharine Bates’s “amber waves of grain.”

The rocky north. Far to the north lies the **Canadian Shield**, a giant horseshoe of very old, hard rock wrapped around Hudson Bay. It covers about half of Canada. Long ago, in the time museums call the *Ice Age* (many Christians think it came in the centuries after Noah’s Flood), thick **glaciers** slid over this land. They scraped away most of the soil and scooped out thousands of hollows in the rock. When the ice melted, the hollows filled with water. That is why the Shield is dotted with more lakes than anyone can count, and why it has forests and mines but few farms.

On the map. Read North America like a sentence, from left to right: tall mountains in the west, flat plains in the middle, low mountains in the east, and old rock and lakes in the north. God set each one in its place. The Psalm says, “In his hand are the deep places of the earth: the strength of the hills is his also.”



North America's great landforms: mountains on each side, plains in the middle and the Canadian Shield in the north.



If you could slice North America from west to east, it would look something like this.

PICTURE STUDY



The Rocky Mountains, Lander's Peak, Albert Bierstadt, 1863 · Oil on canvas · Metropolitan Museum of Art, New York

Albert Bierstadt came to America from Germany as a little boy. In 1859 he traveled west with an army road-building expedition led by Colonel Frederick W. Lander and filled his sketchbooks with mountains, people and animals. Back in his New York studio he turned his sketches into this enormous painting, about 6 feet tall and 10 feet wide. It shows the Wind River Range in Wyoming, part of the Rocky Mountains, with a Shoshone camp in front.

When people in eastern cities saw it, many of them had never seen a mountain taller than the Appalachians. Bierstadt wanted them to feel the size and wonder of the West.

Look closely

- Find the tallest snowy peak. How is its shape different from a low, rounded hill?
- Find the waterfall. Where do you think its water comes from?
- Look at the people, tents and horses in front. How small are they next to the mountains?
- Find where the light is brightest. Where does the painter want your eyes to go first?

Talk about it

1. Does this look more like the Rockies or the Appalachians? How can you tell?
2. Why do you think crowds in eastern cities came to look at this painting?
3. If you could step into the painting, what would you hear and feel?

PROJECT: A TRAY OF NORTH AMERICA

You will build North America's landforms from west to east in a baking pan, then make a little glacier and watch how it scrapes the land and leaves lakes behind, just as on the Canadian Shield.

You will need

- A baking pan or plastic tub
- Play dough or modeling clay (two colors if you have them)
- Sand or soil, about 2 cups
- An ice cube frozen with a spoonful of sand or small pebbles inside
- A cup of water and a spoon
- Toothpicks and small paper flags

Steps

1. Spread a thin layer of sand over the pan. This is the land.
2. On the left (west) side, build the Rockies: a line of tall, sharp, pointy peaks.
3. On the right (east) side, build the Appalachians: a line of low, rounded humps, about half as tall as your Rockies.
4. Leave the middle flat. Lay a few strands of yellow yarn or dry grass there for the plains and their wheat.
5. In the top (north) part, press a flat sheet of clay. This is the hard rock of the Canadian Shield.
6. Now the Ice Age: press your sandy ice cube on the clay and push it slowly across in several directions. Look at the scratches and shallow dents it leaves.
7. Drip water into the dents with a spoon. Count your new "lakes."
8. Add flags: Pikes Peak, Mount Mitchell, Great Plains, Canadian Shield, Hudson Bay.

Tips

- Remember that north is at the top of the pan and west is on the left, just like a map.
- Real glaciers moved far more slowly than your ice cube, but they were thousands of feet thick.

Check your work

- I can point to the Rockies, the plains, the Appalachians and the Canadian Shield on my tray.
- I can explain why the Rockies look sharp and the Appalachians look rounded.
- I can show how a glacier made the Shield's lakes.

MAP NOTEBOOK

1. Trace or draw North America. Draw little pointed triangles for the Rockies and little rounded humps for the Appalachians, and label the Great Plains and the Canadian Shield.
2. Draw the side view of North America from west to east, like the cross-section in this lesson, and label Pikes Peak and Mount Mitchell with their heights.
3. Copy the first four lines of “America the Beautiful” and draw the “purple mountain majesties” and the “amber waves of grain.”

From history. Zebulon Pike never reached the top of the mountain named for him, and he wrote that he thought perhaps no one ever could. The first climb that we have a record of was made in July 1820 by Edwin James, a young doctor and plant collector with an army expedition led by Major Stephen Long. Katharine Lee Bates’s poem “America the Beautiful” was first printed on July 4, 1895, and was later sung to a hymn tune by Samuel A. Ward.

WORKED EXAMPLES

Example 1. On a wall map of North America, 1 inch stands for 500 miles. The Rocky Mountains measure 6 inches long on the map. About how long are the Rockies?

1. Each inch on the map stands for 500 miles on the land.
2. There are 6 inches, so multiply: 6×500 miles.
3. $6 \times 5 = 30$, so $6 \times 500 = 3,000$.

Answer: The Rockies are about 3,000 miles long.

Example 2. Pikes Peak is about 14,000 feet high. Mount Mitchell, the highest peak in the Appalachians, is about 6,700 feet high, which rounds to about 7,000 feet. How much taller is Pikes Peak? About how many Mount Mitchells would stack up to make one Pikes Peak?

(Use the map or drawing “Pikes Peak is drawn about twice as tall as Mount Mitchell.” shown earlier in this lesson.)

1. Subtract to find how much taller: $14,000 - 7,000 = 7,000$ feet.
2. Now add Mount Mitchells until you reach 14,000: $7,000 + 7,000 = 14,000$.
3. That took 2 Mount Mitchells.

Answer: Pikes Peak is about 7,000 feet taller, about 2 times as tall as Mount Mitchell.

PRACTICE

1. **EASY** Which mountain range is in the west of North America and has tall, sharp, snowy peaks?
2. **EASY** What is the name of the huge area of old, hard rock and thousands of lakes that wraps around Hudson Bay?
3. **MEDIUM** On a map where 1 inch stands for 500 miles, the Appalachian Mountains measure 3 inches. About how long are they?
4. **MEDIUM** Mount Elbert in Colorado, the highest peak in the Rockies, is about 14,400 feet high. Mount Mitchell is about 6,700 feet high. How much taller is Mount Elbert?
5. **HARD** Look at the map of North America's landforms. A family drives from Mount Mitchell to Pikes Peak. In which direction do they mostly travel? Name the three kinds of land they see in order.
(Use the map or drawing "Use the dots for Mount Mitchell and Pikes Peak." shown earlier in this lesson.)
6. **CHALLENGE** In two or three sentences, explain why the Canadian Shield has so many lakes but very few farms.

COMMON MISTAKES

- Thinking the Appalachians are taller because they are older. Old mountains have been worn down, so they are lower and rounder than the Rockies.
- Thinking a plain is empty. The plains are full of grass, farms, towns and rivers; they are just flat.
- Calling Denali in Alaska part of the Rockies. Denali, the tallest peak in North America, stands in a different range, the Alaska Range.

Make it a game • Mountain, Plain or Shield?. A parent calls out a clue, such as "sharp and snowy," "low and rounded," "flat with wheat," or "rocks and thousands of lakes." Make the shape with your body: stretch tall and pointy for the Rockies, crouch in a round hump for the Appalachians, lie flat for the plains, or make a circle with your arms for a Shield lake. Then name it and point to it on the map for a point. Play to ten.

Scripture. "In his hand are the deep places of the earth: the strength of the hills is his also." (Psalm 95:4, KJV)

The tallest Rocky Mountain peak and the lowest lake on the Canadian Shield are both in God's hand. When we learn the shape of the land, we are learning the work of the Creator.

Practice answers

1. The Rocky Mountains.
2. The Canadian Shield.
3. $3 \times 500 = 1,500$ miles.
4. $14,400 - 6,700 = 7,700$ feet taller.

5. Mostly west. They start in the Appalachian Mountains, cross the flat plains, and end in the Rocky Mountains.
6. Long ago, thick glaciers scraped across the Shield. They scooped hollows in the hard rock that later filled with water and became lakes, and they scraped away most of the soil, so there is too little good soil left for many farms.

2.2 GREAT RIVERS OF THE AMERICAS

OBJECTIVES

- Name the source, mouth and main tributaries of the Mississippi and find the Mississippi, the St. Lawrence and the Amazon on a map.
- Explain what a tributary and a river basin are, and tell which way each great river flows.
- Tell the real stories of Henry Schoolcraft at Lake Itasca, Jacques Cartier on the St. Lawrence and Francisco de Orellana on the Amazon.

Warm-up. Tilt a cookie sheet a little and set it in the sink. Drip a few drops of water at the high end in three different places and watch. Do the little streams join together before they reach the bottom? Which way does water always go? You have just made a river and its tributaries.

Video. Coming soon. The Mississippi from Lake Itasca to the Gulf, the St. Lawrence River and the Amazon for children: search National Park Service (Mississippi National River and Recreation Area), Smithsonian, NASA Earth Observatory (satellite views of the Amazon and the Mississippi Delta), Homeschool Pop (Alternate), and USGS (candidate, needs vetting) for watershed videos.

KEY TERMS

source

The place where a river begins, often a lake, a spring or melting snow.

mouth

The place where a river ends by flowing into a sea, an ocean, a lake or another river.

tributary

A smaller river or stream that flows into a bigger river.

river basin

All the land whose rain and melted snow drain into one river and its tributaries.

CORE IDEAS

The story. In July 1832, an American explorer named Henry Rowe Schoolcraft set out to find where the Mississippi River begins. An Ojibwe guide named Ozawindib, who knew the woods and waters of northern Minnesota, led him by canoe up small streams and across portages until they reached a clear, quiet lake. Schoolcraft named it Lake Itasca, from Latin words meaning “true head.” There the mighty Mississippi is a little stream you can cross on stepping stones! From Lake Itasca the river runs about 2,340 miles south to the Gulf of Mexico. A raindrop that falls in the lake takes about three months to get there.

The big idea. Every river has a **source**, where it begins, and a **mouth**, where it ends. Water always runs downhill, so a river flows from high land toward lower land and the sea. Along the way, smaller rivers called **tributaries** pour in. The Missouri joins the Mississippi from the west, and the Ohio joins it from the east. All the land that drains into one river is its **river basin**. Rain that falls in all or part of 31 states and two Canadian provinces ends up in the Mississippi!

A road into the continent. In 1535 a French sea captain, Jacques Cartier, sailed from the Atlantic up a wide river into the heart of Canada. He reached an Iroquoian town called Hochelaga and climbed a hill beside it that he named Mount Royal. Today that place is the city of Montreal. Cartier's river was the **St. Lawrence**. It carries the water of the Great Lakes about 750 miles northeast to the Atlantic, and for hundreds of years it was the water road for ships, canoes and fur traders going into North America.

The greatest river of all. In 1541, a Spanish captain named Francisco de Orellana was sent ahead down a jungle river to find food for a hungry expedition. The current was too strong to go back, so he and his men kept floating east. In August 1542 they finally reached the Atlantic Ocean, the first Europeans to travel the whole **Amazon**. The Amazon is about 4,000 miles long. It is fed by snow from the Andes and by heavy rain on the rain forest, and more than a thousand tributaries flow into it. It carries more water than any other river on earth, about one fifth of all the river water that flows into the oceans.

On the map. Trace each river with your finger from source to mouth. The Mississippi flows south, the St. Lawrence flows northeast, and the Amazon flows east across South America. As Solomon wrote long ago, "All the rivers run into the sea; yet the sea is not full."



Three great rivers of the Americas, each running from its source to its mouth.

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 in Missouri, near the great rivers, and spent his life painting the people who worked on them. Here a French fur trader and his son float down the Missouri River, the longest tributary of the Mississippi, carrying furs to sell downstream.

Bingham loved quiet moments. There is no wind, the water is smooth as glass, and the river is carrying the boat along by itself. It is going downhill, toward the Mississippi and at last to the sea.

Look closely

- Find the animal at the front of the canoe. People still argue about whether it is a bear cub or a fox. What do you think?
- Look at the water. How can you tell the river is calm?
- Find the young man and the older man. What is each one doing?
- Look at the far shore. Why does it look so pale and misty?

Talk about it

1. Which way is the canoe going: upstream or downstream? How do you know they are not working hard?
2. Why were rivers like the Missouri and the Mississippi such good roads for traders?
3. If this canoe kept floating, which river would it join next, and where would the water end up?

PROJECT: A CRUMPLED-PAPER RIVER BASIN

You will make mountains and valleys out of crumpled paper, then make it rain and watch the water gather into tributaries, join a main river and run to the sea. You will see a river basin happen in front of you.

You will need

- A sheet of white paper or a white paper towel
- Washable markers (blue, brown and black)
- A spray bottle of water
- A baking pan or tray

Steps

1. Crumple the paper into a ball, then open it partly so it has ridges and valleys. Set it in the pan.
2. With a brown marker, trace along the tops of the highest ridges. These are your mountains.
3. With a blue marker, guess where the rivers will run and draw dotted lines in the low creases.
4. Make it rain: spray the paper gently from above, again and again.
5. Watch where the colored water runs. Do small streams join to make bigger ones? Those are tributaries.
6. Find where the water collects at the lowest point. That is the river's mouth, and the pan is the sea.
7. When it dries, outline one whole area that drained to the same river. That is a river basin. Label one source, one tributary and the mouth.

Tips

- Spray gently. A big splash makes a flood instead of rivers!
- Every bit of land belongs to some river basin. The ridges are the lines that divide one basin from the next.

Check your work

- I can show a source, a tributary and a mouth on my paper model.
- I can explain what a river basin is.
- I can explain why water always flows from the ridges to the low places.

MAP NOTEBOOK

1. Draw the Mississippi as a tree lying on its side: the trunk is the main river and the branches are the Missouri, the Ohio and smaller tributaries. Label Lake Itasca and the Gulf of Mexico.

2. On an outline map of the Americas, draw the Mississippi, the St. Lawrence and the Amazon in blue, with an arrow on each to show which way it flows.
3. Draw Orellana's little boat on the huge Amazon, and write one sentence about why he could not turn back.

From history. Orellana's journey was written down by a priest who traveled with him, Friar Gaspar de Carvajal. He told of a battle in which women fought alongside the men of a river village. That reminded the Spanish of the Amazons, warrior women in old Greek stories, and so the river came to be called the Amazon.

WORKED EXAMPLES

Example 1. The Amazon is about 4,000 miles long. The Mississippi is about 2,300 miles long. How much longer is the Amazon?

1. Subtract the shorter river from the longer one: $4,000 - 2,300$.
2. Take away 2,000 first: $4,000 - 2,000 = 2,000$.
3. Then take away 300 more: $2,000 - 300 = 1,700$.

Answer: The Amazon is about 1,700 miles longer than the Mississippi.

Example 2. Look at the map. In which direction does the St. Lawrence flow, from Lake Ontario past Montreal to the Atlantic Ocean?

(Use the map or drawing "Follow the St. Lawrence from the Great Lakes to the sea." shown earlier in this lesson.)

1. Find the source end: Lake Ontario, near the bottom left of the river.
2. Find the mouth: the Atlantic Ocean, at the top right.
3. Going up the map is north. Going right is east. Up and to the right is northeast.

Answer: The St. Lawrence flows northeast.

PRACTICE

1. **EASY** Where is the source of the Mississippi River?
2. **EASY** Which river carries more water than any other river on earth?
3. **MEDIUM** A raindrop takes about 90 days to travel from Lake Itasca to the Gulf of Mexico. If a month is about 30 days, about how many months is that?
4. **MEDIUM** A towboat pushing barges travels about 100 miles a day down the Mississippi. How many days will it take to go 700 miles?
5. **HARD** On a map where 1 inch stands for 500 miles, the Amazon measures 8 inches. About how long is the Amazon?

6. **CHALLENGE** Rain falls on the city of Pittsburgh and runs into the Ohio River. Use the map to explain where that water goes and where it finally ends up. Use the words tributary and mouth.

(Use the map or drawing “Find Pittsburgh and follow the water.” shown earlier in this lesson.)

COMMON MISTAKES

- Thinking rivers always flow south because south is “down” on a map. Rivers flow downhill, which can be any direction: the St. Lawrence flows northeast and the Amazon flows east.
- Mixing up source and mouth. The source is where a river begins; the mouth is where it ends.
- Thinking the Amazon is famous only for being long. Its greatest wonder is how much water it carries.

Make it a game • Raindrop Race. One player is a raindrop. A parent names a place where the raindrop lands, such as Lake Itasca, Pittsburgh, Montreal or the Andes in Peru. The raindrop must trace its path on the map with a finger, naming each river it rides and the sea where it ends. A correct trip earns a point; a bonus point for naming a tributary on the way. Take turns until each player has made five trips.

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)

Solomon noticed something we can see on every map: rivers run to the sea, and the water returns as rain and snow to fill them again. God made the rivers to keep flowing, year after year.

Practice answers

1. Lake Itasca, in northern Minnesota.
2. The Amazon.
3. $30 + 30 + 30 = 90$, so about 3 months.
4. $700 \div 100 = 7$ days.
5. $8 \times 500 = 4,000$ miles.
6. The Ohio is a tributary of the Mississippi, so the water flows down the Ohio until it joins the Mississippi. Then it flows south down the Mississippi to the river’s mouth at the Gulf of Mexico.

2.3 THE ANDES

OBJECTIVES

- Find the Andes on a map and describe them as the longest mountain chain on land, running down the whole west side of South America.
- Explain why places high in the Andes are cold even near the equator.
- Describe how the Inca crossed the mountains with roads, stairways, runners and woven grass bridges, and build a salt-dough map of South America.

Warm-up. Take three pieces of yarn or string and try to pull one apart with your hands. Now braid all three together tightly and try again. Which is stronger? Then imagine braiding thousands of grass strands into ropes thick enough to hold up a bridge over a deep canyon. That is just what the Inca did.

Video. Coming soon. The Andes, Inca roads and the Q'eshwachaka grass rope bridge for children: search Smithsonian (National Museum of the American Indian, which made an exhibit on the Inca road), NASA Earth Observatory (the Andes from space), Drive Thru History, Homeschool Pop (Alternate), and the Metropolitan Museum of Art for Church's Heart of the Andes.

KEY TERMS

altitude

How high a place is above sea level. The higher you go, the colder and thinner the air.

Inca

A people of the Andes whose rulers built a great empire there in the 1400s, with its capital at Cusco in Peru.

suspension bridge

A bridge whose floor hangs from strong ropes or cables stretched from one side to the other.

terrace

A flat step cut into a steep hillside so that people can farm on it.

chasqui

A runner who carried messages along the Inca roads, passing them to the next runner like a relay race.

CORE IDEAS

The story. Every June, high in the mountains of southern Peru, Quechua families from villages on both sides of a deep canyon walk to the edge of the Apurímac River. Each family brings long cords twisted by hand from a tough mountain grass. For about three or four days they work together. They braid the cords into ropes as thick as a man's leg, stretch them

across the canyon, tie them to stone anchors and weave a floor and walls. Then the old bridge is cut loose and falls into the river. This is the Q'eswachaka bridge, about 90 feet long, the last Inca grass bridge still made the old way.

The big idea. The **Andes** are the longest mountain chain on land. They run about 4,300 miles down the whole western edge of South America, from Venezuela to the stormy southern tip. Many peaks are more than 20,000 feet high. The tallest, Aconcagua, is about 22,800 feet high, the highest mountain in the Americas. The Andes cross the equator, yet their tops are covered with snow, because **altitude** makes a place cold. Quito, in Ecuador, sits almost on the equator, but it is about 9,350 feet up, so its days feel like spring all year.

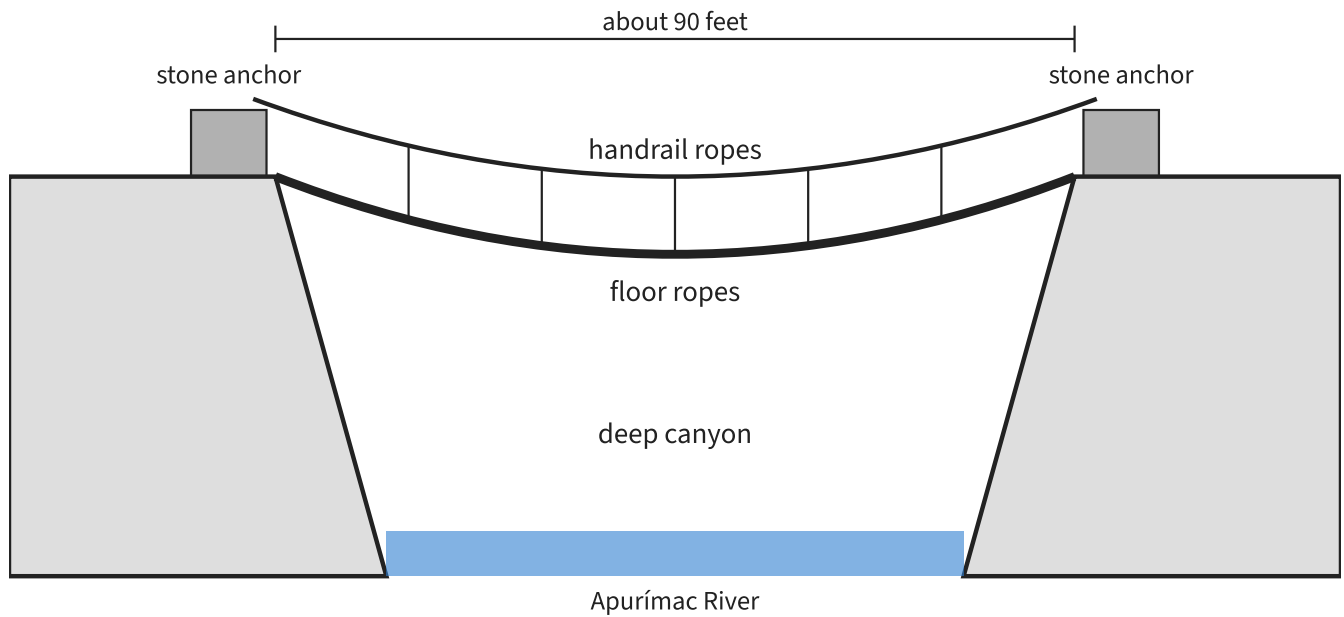
How it worked. In the 1400s the **Inca** ruled an empire stretching along the Andes, with their capital at Cusco. To hold it together they built roads, about 25,000 miles of them in all, over mountains, across deserts and through valleys. Where a slope was steep, they cut stone stairways. The Inca had no horses and no wagons, so people walked, and llamas carried the loads. Rest houses stood along the way. Message runners called **chasquis** ran from one station to the next, handing the message on, so news could travel about 150 miles in a single day. On the steep hillsides, farmers built **terraces**, flat steps of earth held up by stone walls, to grow potatoes and corn.

Technology overcoming geography. A road is useless if a canyon cuts it in two. The Inca answer was the **suspension bridge**: grass ropes stretched from cliff to cliff, with the floor hanging from them. Grass rots, so the bridges were rebuilt again and again by the villages nearby, each family doing its share. When Spanish soldiers led by Francisco Pizarro arrived in 1532, they marveled at the roads and bridges, and then used those very roads to march in and conquer the Inca Empire.

On the map. Find the long spine of the Andes along the Pacific side of South America. Trace the Inca road from Quito south to Cusco and beyond. Isaiah wrote of a road made ready, where "the crooked shall be made straight, and the rough places plain." The Inca did that with stone and grass.



The Andes and the main Inca highland road (approximate).



How an Inca grass suspension bridge hangs across a canyon.

PICTURE STUDY



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

Frederic Edwin Church was an American painter who read the books of the explorer Alexander von Humboldt and longed to see South America for himself. He traveled to Colombia and Ecuador in 1853 and again in 1857, sketching mountains, trees, flowers and birds. Back in New York he combined many sketches into one huge painting, about 5½ feet tall and 10 feet wide. It is not one real view, but a picture of everything he loved about the Andes, from the hot jungle at the bottom to the snowy peak at the top.

In 1859 Church showed it in a dark room, lit by gaslight, in a heavy frame that made it look like a window. More than twelve thousand people paid a quarter each to see it in just a few weeks, and some brought opera glasses to study the tiny plants and birds.

Look closely

- Find the snowy mountain far away. Why is there snow so close to the hot jungle?
- Find the waterfall. Follow the water with your eyes. Where does it go?
- Look for the small cross by the path and the two people beside it. How small are they?
- Find a plant or bird that Church painted in close detail. Why do you think he took such care?

Talk about it

1. Name the different kinds of land you see, from the bottom of the painting to the top. How does altitude change things?
2. Why do you think people in 1859 lined up and paid to see this painting?
3. Church painted the cross and the tiny people beneath the great mountain. What might he be saying about people, the mountains and God?

Safety first. An adult should handle the oven if you bake your salt-dough map. Salt dough is not food; do not eat it.

PROJECT: A SALT-DOUGH MAP OF SOUTH AMERICA

You will build South America in salt dough, with the Andes standing tall along the west side, the low Amazon basin in the middle and the rivers carved in. When it is dry you will paint it and flag the great places of this lesson. This map becomes part of your unit portfolio.

You will need

- 2 cups flour, 1 cup salt and about $\frac{3}{4}$ to 1 cup water, mixed into a stiff dough
- A piece of heavy cardboard about 12 by 16 inches
- An outline map of South America to trace (from an atlas or printed)
- A pencil, a toothpick and a butter knife
- Paints: green, brown, white and blue
- Toothpicks and small paper flags, glue

Steps

1. Trace the outline of South America onto the cardboard. Mark the Andes along the west coast and the Amazon River across the north.
2. Press a layer of dough about $\frac{1}{2}$ inch thick inside the outline, right out to the edges.
3. Build up the Andes: pinch a long, high ridge all the way down the west side, from the top of the continent to the bottom. Make it highest near Peru and Bolivia and near Aconcagua.
4. Keep the Amazon basin low and flat. With a toothpick, carve the Amazon River from the Andes east to the Atlantic, and add two or three tributaries.
5. Press a small dent high in the Andes between Peru and Bolivia for Lake Titicaca.
6. Let the map air-dry for two or three days, or have an adult bake it at about 200°F for two to three hours until hard.
7. Paint the lowlands green, the Andes brown with white snowy tops, and the rivers, lake and oceans blue.
8. Glue on flags for Quito, Cusco, Machu Picchu, Lake Titicaca, Aconcagua and the Amazon River.

Tips

- If the dough cracks as it dries, fill the crack with a little fresh dough and smooth it with a wet finger.
- Look at a relief map in an atlas: notice how close the Andes are to the Pacific and how far the land slopes gently east to the Atlantic.
- Bonus: braid three strands of yarn into a little rope and stretch a tiny bridge across a carved canyon in your Andes.

Check your work

- My Andes run down the whole west side of the continent.
- My Amazon starts in the Andes and flows east to the Atlantic.
- I can point to Quito, Cusco and Aconcagua and tell one fact about each.

MAP NOTEBOOK

1. Draw the rope bridge diagram and label the handrail ropes, the floor ropes, the stone anchors and the river.
2. Draw a mountain from bottom to top in three bands: hot jungle at the bottom, cool fields and llamas in the middle, snow at the top. Label it "Altitude makes it colder."
3. Draw a chasqui runner passing a message to the next runner, and write how far a message could travel in one day.

From history. In 2014 the Inca road system, called the Qhapaq Ñan in the Quechua language, was named a World Heritage Site. It runs through six countries today: Colombia, Ecuador, Peru, Bolivia, Chile and Argentina. The yearly rebuilding of the Q'eswachaka bridge has also been honored as a living tradition that families still pass down to their children.

WORKED EXAMPLES

Example 1. Cusco, the Inca capital, is about 11,000 feet high. A mile is about 5,000 feet (5,280 to be exact). About how many miles high is Cusco?

1. One mile is about 5,000 feet.
2. Two miles is about $5,000 + 5,000 = 10,000$ feet.
3. 11,000 feet is a little more than 10,000 feet, so Cusco is a little more than 2 miles high.

Answer: Cusco is a little more than 2 miles above sea level.

Example 2. Suppose each chasqui ran 5 miles to the next station before passing on the message. How many runners would it take to carry a message 50 miles?

1. Each runner covers 5 miles.
2. Count by fives to 50: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50. That is 10 counts.
3. Or divide: $50 \div 5 = 10$.

Answer: It would take 10 runners.

PRACTICE

1. **EASY** What is the longest mountain chain on land, and on which side of South America does it run?
2. **EASY** Why did the Inca and their neighbors have to rebuild their grass bridges again and again?
3. **MEDIUM** The Q'eswachaka bridge is about 90 feet long. A yardstick is 3 feet long. How many yardsticks laid end to end would reach across it?
(Use the map or drawing "The bridge is about 90 feet long." shown earlier in this lesson.)
4. **MEDIUM** The Andes are about 4,300 miles long. The Rockies are about 3,000 miles long. How much longer are the Andes?
5. **HARD** Chasqui runners could carry a message about 150 miles in one day. How far could a message travel in 4 days?
6. **CHALLENGE** Quito is almost exactly on the equator, but its weather is cool, like spring, all year. Look at the map and explain why.
(Use the map or drawing "Find Quito in the Andes." shown earlier in this lesson.)

COMMON MISTAKES

- Thinking every place near the equator is hot. Altitude matters too: the high Andes are cool or cold, and their tallest peaks are snowy all year.
- Thinking the Inca had wagons and horses on their roads. They walked, and llamas carried the loads; horses came with the Spanish.
- Putting the Andes in the middle or on the east side of South America. They run along the west side, close to the Pacific.

Make it a game • Chasqui Relay. Set up stations around the yard or house, each a few steps apart, one player at each. A parent whispers a short message to the first runner, such as "Three llamas are coming to Cusco." Each runner carries the message to the next station and whispers it on. The last runner says it aloud. Did the message arrive exactly right? Time the relay, then try to beat your time while keeping the message correct.

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 pictured a road made ready for the coming of the Lord, with the valleys filled and the mountains leveled. Road builders in the Andes knew how hard that work is. Every road across rough country is a small picture of preparing the way.

Practice answers

1. The Andes. They run down the west side, along the Pacific Ocean.
2. Grass rots and wears out, so the ropes became weak and had to be replaced.
3. $90 \div 3 = 30$ yardsticks.
4. $4,300 - 3,000 = 1,300$ miles longer.

5. $150 + 150 + 150 + 150 = 600$ miles (or $4 \times 150 = 600$).
6. Quito is high in the Andes, about 9,350 feet above sea level. The higher the altitude, the colder the air, so even near the equator Quito stays cool.

2.4 GREAT CITIES

OBJECTIVES

- Explain why Mexico City, New York and Rio de Janeiro grew where they did: on a lake, on a harbor and on a bay.
- Tell the stories of Cortés reaching Tenochtitlan in 1519, Henry Hudson sailing into New York harbor in 1609 and the Portuguese naming Rio de Janeiro in 1502.
- Find the three cities on a map and use latitude to tell which hemisphere each is in.

Warm-up. Pretend your family must start a brand-new town. Look at a map of your state or a picture of a landscape and choose a spot. Write three reasons for your choice. Did you think of water to drink, a way to travel, safety, or flat land to build on? Every great city began with choices like these.

Video. Coming soon. Tenochtitlan and Mexico City on Lake Texcoco, New York Harbor, and Rio de Janeiro's Guanabara Bay for children: search Smithsonian, Library of Congress (historic maps and photos of New York Harbor and Ellis Island), National Park Service (Statue of Liberty and Ellis Island), Drive Thru History, and Homeschool Pop (Alternate).

KEY TERMS

site

The exact place where a city is built, with its land, water and shape.

harbor

A body of deep, calm water next to the land, where ships can stop safely.

bay

A part of the sea that curves into the land, partly closed in by the shore.

causeway

A raised road built across water or wet, marshy ground.

lake bed

The bottom of a lake; the ground left behind when a lake dries up or is drained.

CORE IDEAS

The story. On November 8, 1519, the Spanish captain Hernán Cortés and his soldiers, with thousands of native allies, marched along a stone causeway across a shining lake. Ahead of them rose Tenochtitlan, the capital of the Aztecs, built on an island in Lake Texcoco. Temples and towers seemed to float on the water. One soldier, Bernal Díaz del Castillo, later wrote that it looked like the enchanted places in the old storybooks, and some of the men wondered if they were dreaming. Tenochtitlan was one of the largest cities in the world at that time.

Mexico City on a lake bed. The Aztecs had settled on the island about 1325. The lake kept them safe, and canoes carried food and goods. Farmers built garden plots of mud right in the shallow water. In 1521, after war and a terrible sickness called smallpox, the Spanish conquered the city and built Mexico City on its ruins. Over hundreds of years they drained most of the lake to stop floods. Today Mexico City stands about 7,300 feet high, on the soft old **lake bed**, and some parts sink several inches every year.

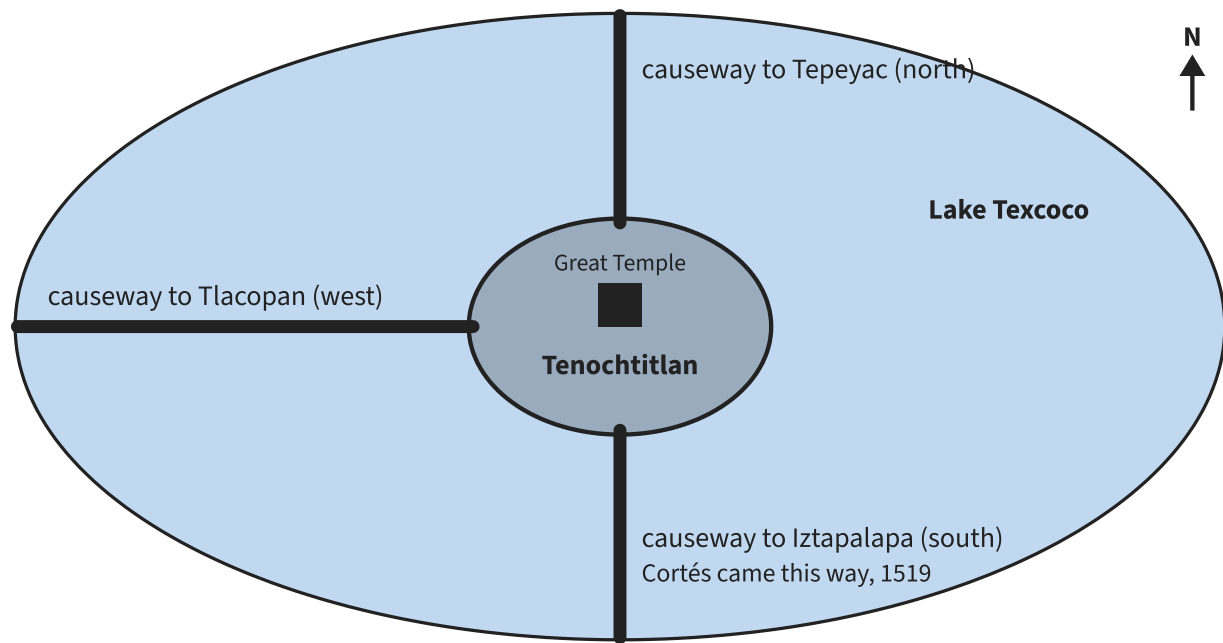
New York on a harbor. In September 1609, Henry Hudson, an English sea captain working for the Dutch, sailed his ship, the *Half Moon*, into a wide, deep **harbor** sheltered by islands, and then up the river that now bears his name. The Dutch built a trading town called New Amsterdam on the island of Manhattan. In 1664 the English took it and named it New York. Ships could sail right up to its docks, and in 1825 the Erie Canal linked the Hudson River to the Great Lakes. New York became the busiest port in America. Millions of newcomers sailed past the Statue of Liberty, which was set up in 1886, to begin new lives.

Rio de Janeiro on a bay. In January 1502, Portuguese sailors sailed into a beautiful **bay** ringed with steep green mountains. Thinking it was the mouth of a river, they named it Rio de Janeiro, “River of January.” It was really Guanabara Bay. The rock called Sugarloaf Mountain guards its entrance, and since 1931 a statue of Christ the Redeemer, about 100 feet tall, has stood with open arms on a mountain above the city.

The big idea. A city’s **site** is its first gift and sometimes its first problem. Water gave all three cities safety, food and a road for ships and canoes. On the map, Mexico City is about 19° north of the equator, New York about 41° north, and Rio about 23° south. As Acts 17:26 says, God “hath determined the times before appointed, and the bounds of their habitation.”



Three great cities of the Americas. The grid lines are every 20 degrees of latitude and longitude.



not to scale

Tenochtitlan on its island, with three causeways to the shore (simple diagram, not to scale).

PICTURE STUDY



Map of Tenochtitlan (the Nuremberg map), Unknown artist; printed in Nuremberg with a letter of Hernán Cortés, 1524 · Woodcut print · Newberry Library, Chicago, and other libraries that hold copies of the 1524 book

Cortés wrote long letters to the Spanish emperor, Charles V, describing what he saw in Mexico. In 1524 one of these letters was printed in Latin in the German city of Nuremberg, and this map was printed with it. It was the first picture of Tenochtitlan that most people in Europe ever saw.

The artist never saw the city. He worked from a drawing sent back from Mexico, so some parts look European. But the big ideas are right: a city in the middle of a lake, joined to the shore by causeways, with a great temple area at its heart. Beside it is a small map of the coast of the Gulf of Mexico, one of the earliest European maps of that coast.

Look closely

- Find the causeways. How many can you count, and where do they lead?
- Find the big square in the middle of the city. What do you think stood there?
- Look for canoes or boats on the lake. Why would people in this city need so many?
- Find the small map beside the city. What body of water does it show?

Talk about it

1. Why was an island in a lake a safe place to build a city? What problems might it cause?
2. The artist never saw Tenochtitlan. How might that change the way he drew it?
3. Compare this map with a modern map of Mexico City. What has happened to the lake?

PROJECT: TENOCHTITLAN IN A PAN

You will build an island city in a lake, join it to the shore with causeways, and then drain the lake to see what is left. You will see how a city on a lake became a city on a lake bed.

You will need

- A large baking pan or plastic storage tub
- Play dough or modeling clay
- Craft sticks or strips of cardboard for causeways
- Small blocks, sugar cubes or bottle caps for buildings
- Water and a cup, plus a turkey baster or sponge
- Sand or soil, about 1 cup

Steps

1. Build up a shore of clay or sand around the inside edge of the pan.
2. In the middle, make a flat, round island of clay. This is Tenochtitlan.
3. Set a tall block in the center of the island for the Great Temple and smaller blocks around it for houses.
4. Lay three causeways of craft sticks from the island to the shore: one north, one west and one south. Press their ends into the clay.
5. Pour water around the island until it is a lake. Float a few “canoes” made of folded paper.
6. Now be the Spanish engineers: use the baster or sponge to drain the lake little by little. Watch what happens to the causeways and the island.
7. Sprinkle sand over the empty lake bottom and set new buildings on it. Press down gently on the soft ground. What happens?

Tips

- Keep north at the top of the pan, so your causeways point the right way.
- Real Mexico City has grown far beyond the old island and covers almost the whole lake bed today.

Check your work

- I can explain why the Aztecs built their city on an island.
- I can show the causeways and tell what a causeway is.
- I can explain why parts of Mexico City sink a little every year.

MAP NOTEBOOK

1. Draw the three cities side by side: Tenochtitlan in its lake, New York on its harbor with the Statue of Liberty, and Rio on its bay with Sugarloaf Mountain. Label the water at each one.
2. On an outline map of the Americas, mark Mexico City, New York and Rio de Janeiro with dots, and write each city's latitude beside it.
3. Write three reasons why people like to build cities next to water.

From history. The Aztecs fed their island city with gardens called chinampas. Farmers piled mud and water plants into long, narrow beds in the shallow lake and planted willow trees along the edges so their roots would hold the beds in place. Corn, beans, squash and flowers grew between canals where canoes could travel. Some chinampas are still farmed today in Xochimilco, on the southern edge of Mexico City, where visitors ride in flat-bottomed boats along the old canals.

WORKED EXAMPLES

Example 1. Use the map. New York is at about 41° north. Rio de Janeiro is at about 23° south. Which city is in the Northern Hemisphere, and which is in the Southern Hemisphere? How many degrees of latitude apart are they?

(Use the map or drawing "The equator is the line at 0° ." shown earlier in this lesson.)

1. North means north of the equator, so New York is in the Northern Hemisphere.
2. South means south of the equator, so Rio is in the Southern Hemisphere.
3. To go from New York to Rio, you travel 41 degrees south to reach the equator, then 23 degrees more.
4. Add: $41 + 23 = 64$.

Answer: New York is in the Northern Hemisphere and Rio is in the Southern Hemisphere. They are about 64 degrees of latitude apart.

Example 2. Mexico City is about 7,300 feet above sea level. A mile is 5,280 feet. Two miles is 10,560 feet. Is Mexico City more than 1 mile high? Is it more than 2 miles high?

1. Compare 7,300 with 5,280. 7,300 is bigger, so Mexico City is more than 1 mile high.
2. Compare 7,300 with 10,560. 7,300 is smaller, so it is less than 2 miles high.

Answer: Mexico City is more than 1 mile high but less than 2 miles high.

PRACTICE

1. **EASY** Which of the three cities was built where a lake used to be?
2. **EASY** What does “Rio de Janeiro” mean, and why did the Portuguese give it that name?
3. **MEDIUM** The Statue of Liberty was set up in 1886. The statue of Christ the Redeemer in Rio was finished in 1931. How many years apart are they?
4. **MEDIUM** Look at the map. Which of the three cities is in the Southern Hemisphere? Which is closest to the equator?
(Use the map or drawing “Find the equator (0°) first.” shown earlier in this lesson.)
5. **HARD** The Aztecs settled Tenochtitlan about 1325. Cortés arrived in 1519. About how many years had the city stood when the Spanish arrived?
6. **CHALLENGE** In two or three sentences, explain why so many great cities stand beside water. Use one of this lesson’s cities as an example.

COMMON MISTAKES

- Thinking Mexico City is on the coast because it is a big city. It is far inland, high in a mountain valley, on an old lake bed.
- Thinking Rio de Janeiro is on a river. Its name means “River of January,” but it is really on a bay of the Atlantic Ocean.
- Forgetting that latitude south of the equator is in the Southern Hemisphere. Rio’s 23° looks a lot like Mexico City’s 19°, but the S means Rio is south of the equator and the N means Mexico City is north of it.

Make it a game • Lake, Harbor or Bay?. A parent reads a clue, such as “Henry Hudson,” “causeways,” “Sugarloaf Mountain,” “Statue of Liberty,” “Aztecs,” “River of January,” or “sinking a few inches a year.” The first player to shout the right city and touch it on the map wins a point. For a bonus point, say whether the city sits on a lake bed, a harbor or a bay. Play until each city has come up at least three times.

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 said this in Athens, a great city of his day. The Aztecs on their lake, the Dutch and English on their harbor and the Portuguese on their bay are all of one blood, made by one

God, who set the times and places where people would live.

Practice answers

1. Mexico City, on the old bed of Lake Texcoco, where the Aztec city of Tenochtitlan stood.
2. "River of January." Sailors came in January 1502 and thought the bay was the mouth of a river.
3. $1931 - 1886 = 45$ years.
4. Rio de Janeiro is in the Southern Hemisphere. Mexico City, at about 19° north, is closest to the equator.
5. $1519 - 1325 = 194$ years, almost 200 years.
6. Water gives people something to drink, food such as fish, and a road for boats and ships to carry people and goods. It can also protect a city. For example, New York's deep, sheltered harbor let ships from all over the world dock there, so it grew into a great port.

UNIT 2 REVIEW

Answer each question. Use the map of the Americas for the map questions. Show your work for calculations and use complete sentences for explanations. The review is worth 40 points.

1. (4 pts) Name the mountain range in the west of North America and the mountain range in the east. Tell one way they look different.
2. (4 pts) Why does the Canadian Shield have thousands of lakes?
3. (4 pts) On a map where 1 inch stands for 500 miles, a mountain range measures 4 inches. How long is the range?
4. (4 pts) Match each river to the direction it flows: Mississippi, St. Lawrence, Amazon. (Choices: east, south, northeast.)
5. (4 pts) What is a tributary? Name one tributary of the Mississippi.
6. (4 pts) The Amazon is about 4,000 miles long and the St. Lawrence is about 750 miles long. How much longer is the Amazon?
7. (4 pts) The Andes are the longest mountain chain on land. On which side of South America do they run, and about how long are they?
8. (4 pts) The Inca had no horses or wagons. Name two ways they overcame the mountains and canyons of the Andes.
9. (4 pts) Match each city to the water it was built beside: Mexico City, New York, Rio de Janeiro. (Choices: a harbor, a bay, a lake.)
10. (4 pts) Mexico City is at about 19° north, and Rio de Janeiro is at about 23° south. Which hemisphere is each city in? How many degrees of latitude apart are they?

UNIT PROJECT: MY MAP OF THE AMERICAS

Make a large hand-drawn map of North America and South America. Draw and label the Rockies, the Appalachians, the Great Plains, the Canadian Shield and the Andes, and draw the Mississippi (with the Missouri and Ohio), the St. Lawrence and the Amazon in blue with arrows showing which way they flow. Mark Mexico City, New York and Rio de Janeiro, the equator, and the main Inca road. Add a small drawing for each lesson: Pikes Peak, Orellana's boat, a grass rope bridge and the Statue of Liberty.

Beside the drawn map, show your painted salt-dough map of South America from Lesson 2.3, and write a short paragraph telling which place in the Americas you would most like to visit and why its land or water makes it special.

- **Accuracy:** Mountains, plains, rivers and cities are in the right places, and each river's arrow points the right way.
- **Salt-dough map:** The Andes run down the whole west side, the Amazon flows east to the Atlantic, and the flagged places are correct.
- **Explanation:** The paragraph names a real place and explains, using words from the unit, how its land or water shapes it.
- **Care:** The maps are neat, colorful, clearly labeled and include a compass rose.

Answer key

1. The Rocky Mountains are in the west and the Appalachian Mountains are in the east. The Rockies are tall, sharp and snowy; the Appalachians are older, lower and rounded, and covered with forest.
2. Long ago, thick glaciers scraped across its hard rock and scooped out hollows. When the ice melted, the hollows filled with water and became lakes.
3. $4 \times 500 = 2,000$ miles.
4. Mississippi: south. St. Lawrence: northeast. Amazon: east.
5. A smaller river that flows into a bigger river. The Missouri or the Ohio is a tributary of the Mississippi.
6. $4,000 - 750 = 3,250$ miles longer.
7. Along the west side, by the Pacific Ocean. They are about 4,300 miles long.
8. Any two: about 25,000 miles of roads with stone stairways; grass rope suspension bridges across canyons; chasqui runners who relayed messages; llamas to carry loads; rest houses along the roads; terraces for farming on steep slopes.
9. Mexico City: a lake (Lake Texcoco, now mostly a dry lake bed). New York: a harbor. Rio de Janeiro: a bay (Guanabara Bay).
10. Mexico City is in the Northern Hemisphere and Rio is in the Southern Hemisphere. $19 + 23 = 42$ degrees apart.

EUROPE AND AFRICA

North of the Mediterranean Sea lies Europe, a land of peninsulas, harbors and snowy mountains. South of it lies Africa, a huge continent of deserts, rain forests, grasslands and the longest river in the world. In this unit you will cross both. You will stand with ten thousand Greek soldiers shouting “The sea! The sea!”, follow Hannibal’s elephants over the Alps, sail the Nile in flood season with the traveler Herodotus, and walk inland from the coast of East Africa with the missionary Johannes Rebmann until he sees snow shining on Kilimanjaro.

Along the way you will learn the shapes of the land: peninsulas and straits, mountain ranges and passes, river sources and mouths, deltas, oases, rift valleys and waterfalls. You will see that mountains divide people and rivers join them, and that the Nile’s yearly flood turned a desert into farmland. You will build a coast in a pan, make it rain on paper mountains, flood a Nile in a sand tray and pull apart a rift valley made of clay.

The God who made all these lands also made the peoples who live in them. As Paul told the men of Athens, He “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).

BEFORE YOU BEGIN

- Can find the equator and the prime meridian on a globe (Unit 1)
- Can use a compass rose to tell north, south, east and west on a map
- Can add and subtract numbers in the thousands
- Knows that rivers flow downhill from a source to a mouth (Unit 2)

MASTERY CHECKLIST

- I can explain what a peninsula is and name five peninsulas of Europe.
- I can find the Alps, the Rhine and the Danube and tell which sea each river flows into.
- I can trace the Nile from its two branches to the Mediterranean and explain why its flood was a gift to Egypt.
- I can describe the Sahara, the Congo rain forest and the savanna and tell how they are different.
- I can find Kilimanjaro, the Great Rift Valley and Victoria Falls, and explain why there is snow near the equator.
- I can compare the lengths of rivers and heights of mountains by subtracting.

OPTIONAL BOOKS AND RESOURCES

- **NASA Earth Observatory** (<https://earthobservatory.nasa.gov/>): Free. Search for the Nile, the Alps or Kilimanjaro to see real photographs taken from space. The green

ribbon of the Nile running through the tan Sahara is unforgettable.

- **Library of Congress Maps Collection** (<https://www.loc.gov/maps/>): Free. Search for old maps of Europe, Africa or the Nile. A parent can help choose one to compare with a modern map.

3.1 EUROPE: A PENINSULA OF PENINSULAS ★

OBJECTIVES

- Explain what a peninsula is and name five peninsulas of Europe.
- Find the Mediterranean Sea, the North Sea, the Baltic Sea and the Black Sea on a map of Europe.
- Tell how Europe's long, wiggly coast and many harbors turned its people into sailors and traders.

Warm-up. Hold out your hand flat on the table with your fingers spread. Your arm is joined to your body, and your fingers stick out into the air. Now imagine the table is the land and the air around your fingers is the sea. Each finger has “water” on three sides but is still joined to the hand. Trace around your hand on paper and color the space between the fingers blue. You have just drawn a land with many peninsulas, a lot like Europe!

Video. Coming soon. Europe's peninsulas, seas and coastline for children: search Homeschool Pop (Alternate), Drive Thru History (Greece and the Mediterranean), NASA (Europe from space at night) and Smithsonian.

KEY TERMS

peninsula

Land with water on three sides that is still joined to a bigger land on the fourth side.

coast

The edge of the land where it meets the sea.

harbor

A calm, sheltered place of water near the coast where ships can stay safe and load and unload.

strait

A narrow strip of sea between two pieces of land, joining two larger bodies of water.

sea

A large body of salt water, smaller than an ocean and often partly surrounded by land.

CORE IDEAS

The story. About 400 years before Jesus was born, ten thousand Greek soldiers were stuck far from home, deep in the land of the Persian king. Their leaders had been killed, and they had no map. For months they marched north through strange mountains, fighting off enemies and wading through deep snow. One day the soldiers at the front of the line climbed a mountain and began to shout. A young officer named Xenophon thought enemies were attacking and rode up fast. Then he heard the words: “The sea! The sea!” Below them shone the Black Sea. The men cried and hugged each other. Why? Greek towns stood along that

shore, and the sea was the road home. Xenophon later wrote down the whole adventure in a book.

The big idea. A **peninsula** is land with water on three sides that is still joined to a bigger land. Look at a globe. Europe and Asia are one giant piece of land, and Europe sticks out from Asia toward the west like a huge peninsula. On Europe's edges are smaller peninsulas, like fingers on a hand. Spain and Portugal sit on the Iberian Peninsula. Italy is shaped like a tall boot kicking a ball (the island of Sicily). Greece is at the tip of the Balkan Peninsula. Norway and Sweden share the Scandinavian Peninsula, and Denmark sits on little Jutland. That is why people call Europe a *peninsula of peninsulas*.

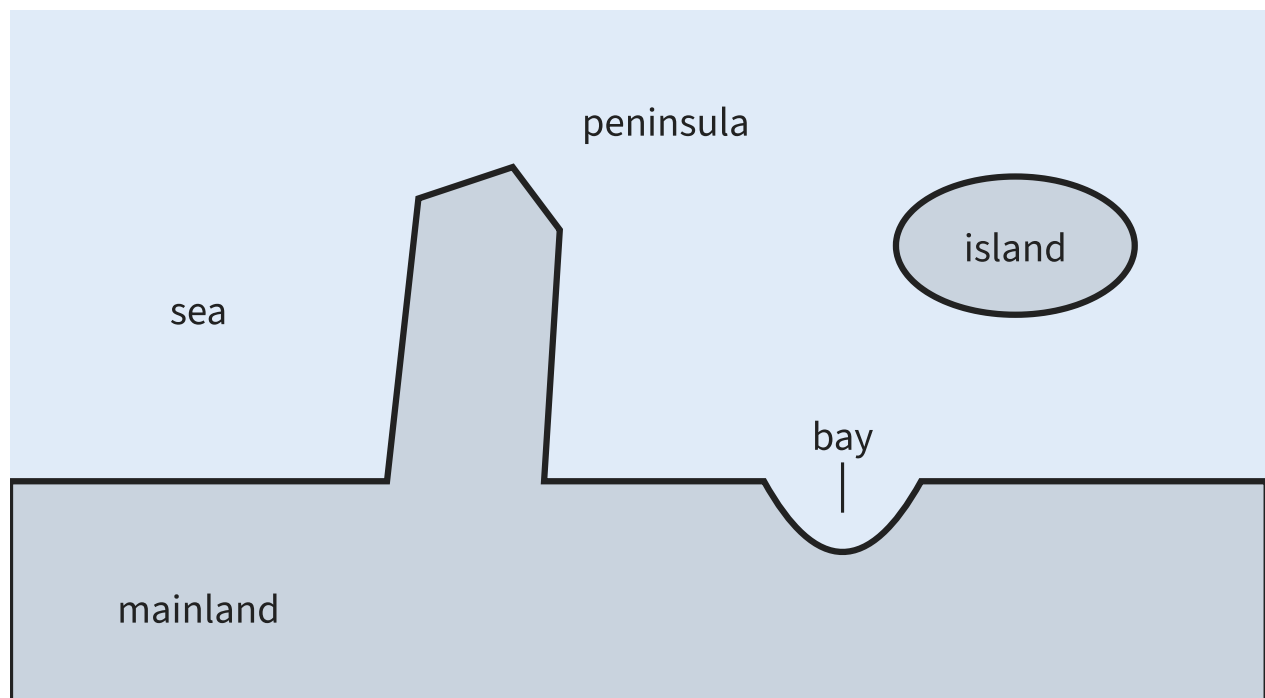
On the map. Seas wrap around Europe. The warm, blue Mediterranean lies to the south. The North Sea and the Baltic Sea lie to the north. The Black Sea lies to the east, and the wide Atlantic Ocean rolls in from the west. Between them are narrow **straits**. The Strait of Gibraltar, only about 9 miles wide, is the doorway from the Mediterranean to the Atlantic. The Strait of Dover, about 21 miles wide, divides England from France. Europe's coast bends in and out with bays, inlets and the deep, narrow fjords of Norway. All those bends make many safe **harbors**.

How it shaped Europe. In most of Europe the sea is never very far away. So for thousands of years Europeans fished, built boats and traded by water. Greek sailors built towns all around the Mediterranean. Viking ships slid out of Norway's fjords. The ships of Venice traded all across the Mediterranean. Later the ships of Portugal, Spain, Holland and England sailed from Europe's harbors to every part of the world. A wiggly coastline full of harbors invited people to become sailors.

God's good design. A harbor is a gift. When storms blow, ships run into calm water and wait. The Bible says that when God stills the storm, the sailors are glad, "so he bringeth them unto their desired haven." Every time you see a harbor on a map, you are looking at one of the places God made where sailors could rest.



Europe, a peninsula of peninsulas. Trace each peninsula with your finger and count the sides that touch water.



Land and water words. A peninsula has water on three sides; an island has water all around.

PICTURE STUDY



View of Delft, Johannes Vermeer, about 1660–1661 · Oil on canvas · Mauritshuis, The Hague, the Netherlands

Johannes Vermeer lived his whole life in Delft, a town in Holland where the land is flat and water is everywhere. Holland sits on Europe's coast beside the North Sea, and its people were some of the greatest sailors and traders in the world. In this painting Vermeer looks across the town's harbor, where boats came and went along the canals and rivers that led to the sea.

This is a quiet picture, but it shows you what a harbor is: calm water close to a town, where boats can tie up safely to load and unload.

Look closely

- Find the boats tied up near the town. Why would boats come right up to the town walls?
- Look at the water. Is it rough or calm? Why does calm water matter for a harbor?
- Find the people standing on the near shore. What might they be waiting for?
- Look at how much of the painting is sky. How does Vermeer make the clouds look bright and dark?

Talk about it

1. How could a boat leave this harbor and reach the North Sea?
2. Why do you think so many towns in Europe were built beside water?
3. If you lived in Delft, what job might you have had?

PROJECT: COASTLINE IN A PAN

You will build a small coast in a baking pan with modeling clay and real water. You will shape a mainland, a peninsula, a bay, an island and a harbor, then sail a tiny boat into your harbor during a “storm.”

You will need

- A baking pan or plastic tub
- Modeling clay or play dough (about two fists’ worth)
- A cup of water, with a drop of blue food coloring if you like
- A bottle cap, cork or folded paper for a boat
- Toothpicks and small paper flags for labels
- A drinking straw

Steps

1. Press clay along one long side of the pan to make the mainland. Make it about as thick as your finger.
2. Pull out a long arm of clay from the mainland so it has water on three sides. That is your peninsula.
3. Push a curved notch into the mainland so water can come in. That is a bay.
4. Make a small lump of clay that does not touch anything. That is an island.
5. Inside your bay, build a little wall of clay with a gap in it, so the water behind it is protected. That is your harbor.
6. Pour water into the pan until it is about as deep as a fingernail is long. Label each part with a toothpick flag.
7. Put your boat out on the open water. Blow through the straw to make a “storm.” Then move the boat into the harbor and blow again. Where does the water stay calmer?

Tips

- Press the clay hard onto the bottom of the pan so the water does not sneak underneath.
- Try making a strait: two pieces of land very close together, with a narrow channel of water between them.

Check your work

- I can point to a peninsula, a bay, an island and a harbor in my pan.
- I can explain why boats are safer in a harbor during a storm.
- I can tell the difference between a peninsula and an island.

MAP NOTEBOOK

1. Trace or draw an outline of Europe. Color the five peninsulas from the map in five different colors and label them.

2. Write the names of the four seas around Europe (Mediterranean, North, Baltic, Black) in blue in the right places.
3. Draw the Greek soldiers on the mountain looking down at the Black Sea. Write their shout in a speech bubble.

From history. About 600 years before Jesus was born, Greek sailors from a city called Phocaea sailed west across the Mediterranean and built a trading town on a fine harbor on the coast of what is now France. They called it Massalia. Today it is the city of Marseille, and it is still one of the busiest ports on the Mediterranean, more than 2,500 years later.

WORKED EXAMPLES

Example 1. The Strait of Dover between England and France is about 21 miles wide. A ship sails 7 miles each hour. How many hours does it take to cross?

1. We need to find how many groups of 7 miles fit into 21 miles.
2. Count by sevens: 7, 14, 21. That is 3 groups.
3. So $21 \div 7 = 3$.

Answer: About 3 hours.

Example 2. Use the map of Europe. A Viking ship leaves Oslo in Norway and sails all the way to Athens in Greece. In which direction is it traveling overall?

(Use the map or drawing “Find Oslo and Athens. Is Athens up or down, left or right from Oslo?” shown earlier in this lesson.)

1. Find Oslo near the top of the map, on the Scandinavian Peninsula.
2. Find Athens near the bottom, at the tip of the Balkan Peninsula. Athens is lower on the map, so it is south of Oslo.
3. Athens is also to the right of Oslo, so it is east of Oslo.
4. South and east together make southeast.

Answer: Southeast.

PRACTICE

1. **EASY** What is a peninsula? How is it different from an island?
2. **EASY** Which two countries share the Iberian Peninsula?
3. **MEDIUM** The Strait of Dover is about 21 miles wide. The Strait of Gibraltar is about 9 miles wide. How much wider is the Strait of Dover?
4. **MEDIUM** Use the map of Europe. Which sea lies between Italy and Africa: the Baltic Sea or the Mediterranean Sea? Which sea lies on the east side of Europe, where

Xenophon's soldiers saw water?

(Use the map or drawing "Find each sea's name on the map." shown earlier in this lesson.)

5. **HARD** On a map, 1 inch stands for 100 miles. The boot of Italy measures 7 inches long from the Alps to the toe. About how long is Italy in miles?
6. **CHALLENGE** Write two or three sentences: Why did so many Europeans become sailors and traders long ago?

COMMON MISTAKES

- Mixing up a peninsula and an island. If the land is joined to more land on one side, it is a peninsula.
- Thinking Europe and Asia are separated by an ocean. They are one big piece of land, and Europe sticks out of it to the west.
- Thinking a sea and an ocean are the same size. Seas are smaller and are usually partly closed in by land.

Make it a game • Peninsula, Island or Bay?. A parent names a place, such as Italy, Sicily, Spain, Great Britain, Norway or the Bay of Biscay, and you must make it with your body. Stand with one arm stretched out for a peninsula, curl up in a ball for an island, or make a C with your arms for a bay. Check each answer on the map. Score a point for each one you get right, and play to eight.

Scripture. "Then are they glad because they be quiet; so he bringeth them unto their desired haven." (Psalm 107:30, KJV)

A haven is a safe harbor. This psalm tells of sailors tossed by a storm who cry to the Lord, and He calms the sea and brings them safely into port. Europe's many harbors remind us that God cares for travelers on the water.

Practice answers

1. A peninsula has water on three sides and is joined to a bigger land on the fourth side. An island has water on all sides.
2. Spain and Portugal.
3. $21 - 9 = 12$. The Strait of Dover is about 12 miles wider.
4. The Mediterranean Sea lies between Italy and Africa. The Black Sea is the one the soldiers saw.
5. $7 \times 100 = 700$. Italy is about 700 miles long.
6. Sample: Europe has many peninsulas, so the sea is never very far away. Its coast bends in and out and has many safe harbors. People could fish, build boats and trade with towns across the water, so the sea became their road.

3.2 THE RHINE, THE DANUBE AND THE ALPS

OBJECTIVES

- Find the Alps, the Rhine and the Danube on a map and tell which sea each river flows into.
- Explain how the Alps acted like a wall and how the rivers acted like roads in Europe's history.
- Compare the lengths of rivers and the heights of mountains using subtraction and rounding.

Warm-up. Crumple a sheet of paper into a loose ball, then open it partly so it has a high ridge in the middle. Set it on a tray. Slowly drip water from a spoon onto the very top of the ridge. Watch which way the drops run. Do they all go the same way? Some run down one side and some down the other. The top of a mountain range can send water to two different seas!

Video. Coming soon. The Alps, the Rhine and the Danube for children (river barges, Alpine passes, the Gotthard tunnel): search Smithsonian, NASA (the Alps from space), Practical Engineering (tunnels), Drive Thru History and Homeschool Pop (Alternate).

KEY TERMS

mountain range

A long line of mountains joined together, like the Alps.

mountain pass

A low gap between mountains where people can cross more easily.

source

The place where a river begins.

mouth

The place where a river ends by flowing into a sea, a lake or another river.

barge

A long, flat-bottomed boat that carries heavy loads on rivers and canals.

CORE IDEAS

The story. In the year 218 BC, a general from North Africa named Hannibal wanted to attack the city of Rome. Rome had a strong navy, so Hannibal did something no one expected. He marched his army out of Spain, across rivers and over mountains, with horses and about three dozen war elephants. Then, in the autumn, he led them up into the Alps. Snow fell. The paths were narrow and icy, and rocks blocked the way. Many soldiers and animals slipped and fell. After about two weeks of climbing, the army came down into Italy. Hannibal had crossed the great wall of Europe, but it cost him dearly.

On the map. The **Alps** are Europe's tallest **mountain range**. They curve like a giant hook across France, Italy, Switzerland, Germany and Austria. The highest peak is Mont Blanc, about 15,800 feet tall, on the border of France and Italy. The Matterhorn, shaped like a sharp tooth, stands about 14,700 feet tall. Even in summer, snow and ice called glaciers cover the highest peaks. For thousands of years, travelers crossed the Alps only through high, cold **passes**.

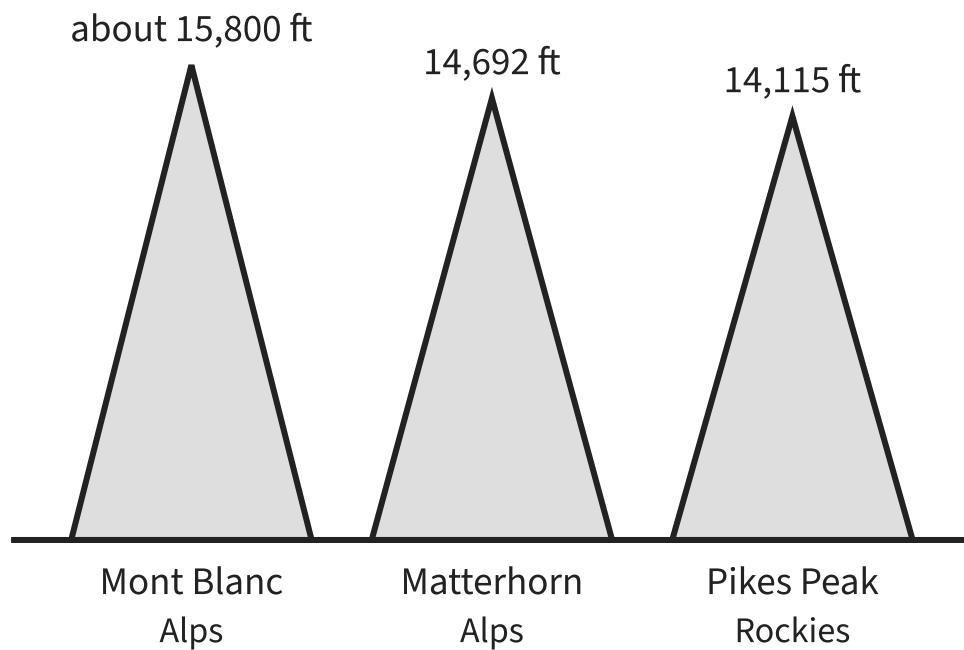
Two great rivers. Melting snow from the Alps feeds Europe's rivers. The **Rhine** has its **source** high in the Swiss Alps. It flows north about 760 miles, past the cities of Basel and Cologne, to its **mouth** at the North Sea in the Netherlands, near the busy port of Rotterdam. The **Danube** begins in the Black Forest of Germany and picks up water from Alpine rivers. It flows east about 1,770 miles through ten countries and past four capital cities: Vienna, Bratislava, Budapest and Belgrade. At last it empties into the Black Sea.

The big idea. Mountains divide people, and rivers join them. The Alps kept armies and travelers apart, so people on each side grew up speaking different languages. The rivers did the opposite. Long, flat-bottomed **barges** could float heavy loads of grain, wine, timber and stone much more easily than wagons could pull them over hills. Towns and castles grew up along the banks. For hundreds of years the Rhine and the Danube also marked the northern edge of the Roman Empire, because a wide river is hard to cross.

Technology overcoming geography. Today people still cannot move the Alps, but they have learned to go through them. In 2016 Switzerland opened the Gotthard Base Tunnel, a train tunnel about 35 miles long, deep under the mountains. And in 1992 a canal was finished that joins a branch of the Rhine to the Danube. Now a barge can travel all the way from the North Sea to the Black Sea across the middle of Europe.



The Rhine flows north to the North Sea. The Danube flows east to the Black Sea. The Alps stand between.



Two Alpine giants beside a famous peak of the Rocky Mountains.

PICTURE STUDY



The Watzmann, Caspar David Friedrich, 1824–1825 · Oil on canvas · Alte Nationalgalerie, Berlin

Caspar David Friedrich was a German painter who loved mountains, seas and skies, and he often painted them to show how great God's creation is and how small we are beside it. The Watzmann is a mountain in the Alps of southern Germany, near the border with Austria. Friedrich painted it as a huge white peak rising up behind layer after layer of hills and rocks.

When you look at this painting, imagine Hannibal's soldiers and elephants trying to cross mountains like these in the snow.

Look closely

- Find the snow on the top of the mountain. Why is there snow up high but not at the bottom?
- Count the layers in the picture from front to back: rocks, hills, forests, the peak. How many can you find?
- Look for a path or a gap where a traveler might climb. Is it easy to see one?
- Look at the sky. Is it stormy or calm?

Talk about it

1. How would you feel standing at the bottom of this mountain, knowing you had to cross it?
2. Where do you think the water from the melting snow goes?
3. Why might people on two sides of mountains like these grow up speaking different languages?

PROJECT: WATER TOWER OF EUROPE: A CRUMPLED-PAPER WATERSHED

The Alps are sometimes called the water tower of Europe, because their snow and rain feed rivers that run to four different seas. You will build a mountain range from paper, mark its rivers, and make it rain to see where the water goes.

You will need

- A sheet of white printer paper or a paper grocery bag
- Washable markers (blue, brown and green)
- A spray bottle of water
- A baking tray or plastic tub
- Four small sticky notes

Steps

1. Crumple the paper gently, then open it so it stands up with a high ridge across the middle. This ridge is your Alps.
2. Set it in the tray. With the brown marker, color along the very tops of the ridges.
3. With the blue marker, draw lines down the valleys where you think water will run.
4. Write North Sea, Black Sea, Mediterranean Sea and Adriatic Sea on sticky notes and stick them on the four sides of the tray.
5. Spray "rain" over the top of the mountains. Watch the blue ink run down the valleys.
6. Notice which side each stream runs to. On the real Alps, the Rhine runs north to the North Sea, the Inn runs east to join the Danube and the Black Sea, the Rhône runs west and south to the Mediterranean, and the Po runs east to the Adriatic.

7. Let the paper dry. Flatten it a little and look at the river map the rain drew.

Tips

- Spray gently and wait a few seconds between sprays so the water follows the valleys.
- Try lifting one end of the tray. Does the water change direction?

Check your work

- I can show where the high ridges and the low valleys are on my model.
- I can explain why rain falling on two sides of a ridge ends up in different seas.
- I can name the sea where the Rhine ends and the sea where the Danube ends.

MAP NOTEBOOK

1. Draw the Alps as a row of pointed peaks. Draw the Rhine running north to the North Sea and the Danube running east to the Black Sea, with an arrow on each river showing which way it flows.
2. Draw Hannibal's elephants on a snowy mountain path. Write one sentence telling why crossing the Alps was so hard.
3. Make a list of the four capital cities on the Danube and draw a dot for each one along a blue line.

From history. On August 8, 1786, two men from the village of Chamonix in France, a crystal hunter named Jacques Balmat and a doctor named Michel-Gabriel Paccard, became the first people known to stand on top of Mont Blanc. They climbed without ropes, ice axes or special boots, and they reached the summit in the evening, cold and tired. People in the valley watched them through a telescope.

WORKED EXAMPLES

Example 1. The Danube is about 1,770 miles long. The Rhine is about 760 miles long. How much longer is the Danube?

1. Subtract the shorter river from the longer one: $1,770 - 760$.
2. Ones: $0 - 0 = 0$. Tens: $7 - 6 = 1$. Hundreds: $7 - 7 = 0$. Thousands: $1 - 0 = 1$.
3. So $1,770 - 760 = 1,010$.

Answer: The Danube is about 1,010 miles longer, more than twice as long as the Rhine.

Example 2. Mont Blanc is about 15,800 feet tall. The Matterhorn is about 14,700 feet tall. How much taller is Mont Blanc?

(Use the map or drawing “Compare the heights of the mountains.” shown earlier in this lesson.)

1. Subtract: $15,800 - 14,700$.
2. Think of it in hundreds: 158 hundreds – 147 hundreds = 11 hundreds.
3. 11 hundreds is 1,100.

Answer: Mont Blanc is about 1,100 feet taller.

PRACTICE

1. **EASY** In which mountains does the Rhine begin? Into which sea does it flow?
2. **EASY** Into which sea does the Danube flow? Which direction does it flow across most of Europe?
3. **MEDIUM** Use the map. Name three capital cities that stand on the Danube.
(Use the map or drawing “Follow the Danube from west to east.” shown earlier in this lesson.)
4. **MEDIUM** A town at the foot of the Alps is about 1,800 feet above the sea. Mont Blanc is about 15,800 feet tall. How much higher is the top of Mont Blanc than the town?
5. **HARD** Big barges can sail the Rhine from Basel to Rotterdam, about 500 miles. If a barge travels 100 miles a day, how many days does the trip take?
6. **CHALLENGE** Write two sentences: How did the Alps keep people apart, and how did the Rhine and Danube bring people together?

COMMON MISTAKES

- Thinking all rivers flow south, or “down” the map. The Rhine flows north and the Danube flows east. Rivers flow downhill, whatever direction that is.
- Thinking the Danube begins in the Alps. Its source is in the Black Forest of Germany, though many Alpine rivers join it.
- Mixing up the source and the mouth. The source is where a river starts; the mouth is where it ends.

Make it a game · Which Way, Raindrop?. Lay a long scarf or rope on the floor as the ridge of the Alps. Put signs for the North Sea, the Black Sea, the Mediterranean and the Adriatic around the room. A parent calls out a river: Rhine, Danube, Rhône, Po or Inn. Start on the ridge as a raindrop and run to the sea where that river ends (the Inn joins the Danube, so it goes to the Black Sea). Get it right and earn a point. Play until every river has been called twice.

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)

Travelers going up to Jerusalem looked at the hills around them. The psalm reminds us that the mountains are not our help; the Lord who made the mountains is. Even the mighty Alps are the work of His hands.

Practice answers

1. It begins in the Alps of Switzerland and flows into the North Sea.
2. The Black Sea. It flows east.
3. Any three of Vienna, Bratislava, Budapest and Belgrade (Vienna, Budapest and Belgrade are marked on the map).
4. $15,800 - 1,800 = 14,000$. About 14,000 feet higher.
5. $500 \div 100 = 5$. About 5 days.
6. Sample: The Alps are high, cold and steep, so armies and travelers had a hard time crossing them, and people on each side grew apart and spoke different languages. The rivers were like roads, because barges could carry heavy goods easily from town to town.

3.3 AFRICA: THE NILE AND THE SAHARA

OBJECTIVES

- Trace the Nile from its two branches to its mouth on the Mediterranean and explain why it flows north.
- Explain how the yearly Nile flood left rich mud that made farming possible in the desert.
- Describe the Sahara as the largest hot desert in the world and tell how people live and travel there.

Warm-up. Put a spoonful of garden soil into a clear jar of water, put the lid on, and shake it. Set it on the table and watch for five minutes. What sinks first? What settles on top? When a muddy river spreads out and slows down, the mud settles out just like this. Ancient Egyptian farmers depended on that mud every single year.

Video. Coming soon. The Nile River, its yearly flood and the Sahara Desert for children: search NASA and NASA Earth Observatory (the Nile's green ribbon from space), Smithsonian, Drive Thru History (Egypt) and Homeschool Pop (Alternate).

KEY TERMS

desert

A very dry place that gets little rain, usually less than 10 inches in a whole year.

flood

When a river rises and spreads water over the land beside it.

silt

Fine, rich mud carried by a river and left behind when the water slows down.

delta

Flat, fan-shaped land at a river's mouth, built up from the mud the river drops.

oasis

A green spot in a desert where water comes up from under the ground.

CORE IDEAS

The story. About 450 years before Jesus was born, a curious Greek traveler named Herodotus sailed to Egypt. He asked questions everywhere he went and wrote down what he saw. He arrived in the season when the Nile River was in flood. The water had spread out over the whole valley, and the towns, built on higher ground, stuck up out of the water like islands in the sea. Herodotus wrote that the land of Egypt was a gift of the river. Without the Nile, there would be no Egypt at all.

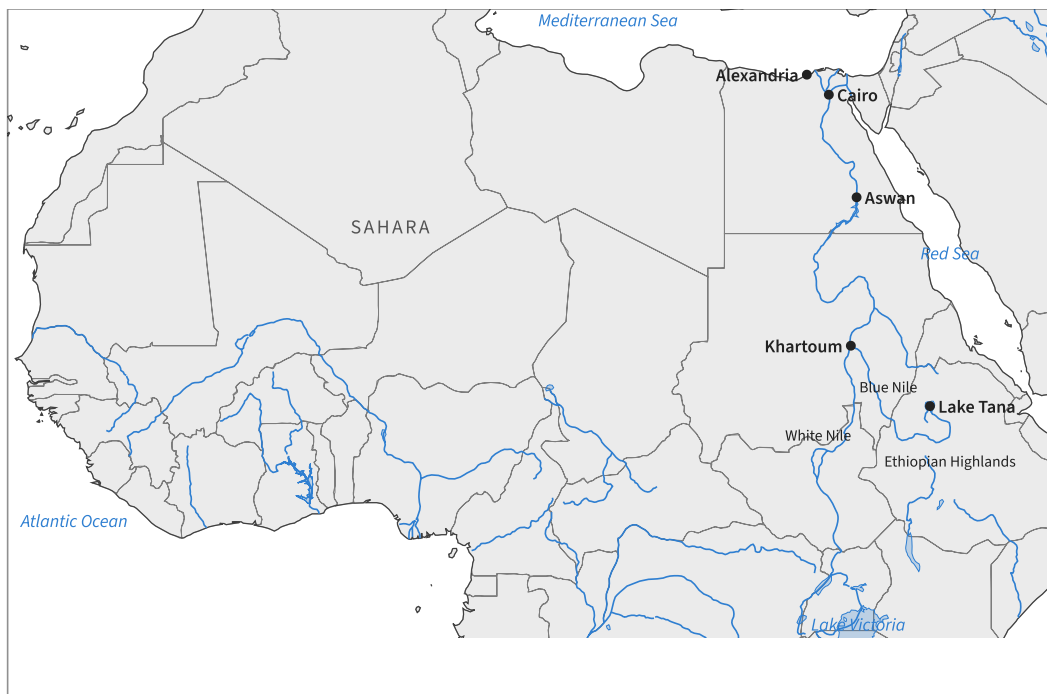
On the map. The Nile is the longest river in the world, about 4,130 miles long. It is made of two branches. The White Nile flows out of the region of Lake Victoria, in the middle of Africa.

The Blue Nile rushes down from the high mountains of Ethiopia. The two meet at the city of Khartoum and flow on together. Then the Nile does something that surprises many people: it flows *north*. That is because the land is higher in the south and lower in the north, and rivers always run downhill. At last it spreads out into a wide, green **delta** and empties into the Mediterranean Sea.

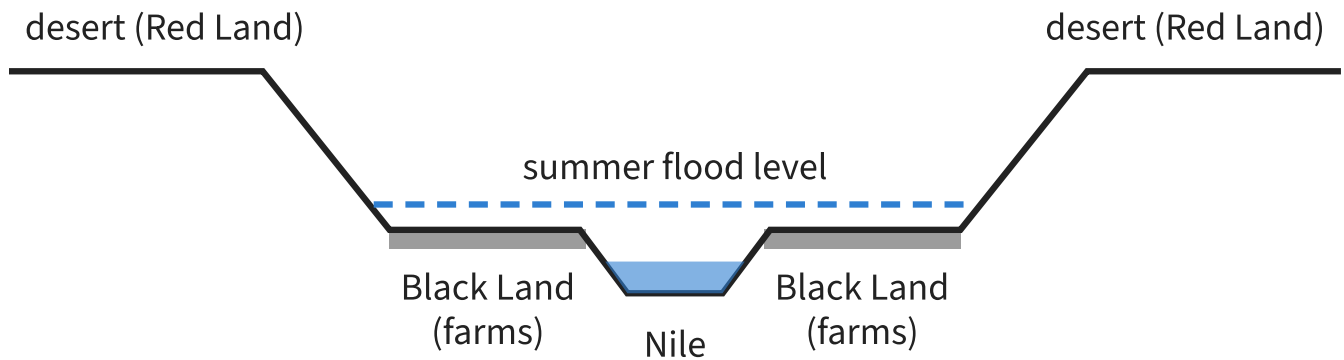
The big idea. Every summer, heavy rains fell on the mountains of Ethiopia. The water rushed down the Blue Nile, and weeks later the river in Egypt rose and spilled over its banks in a great **flood**. When the water went down in the autumn, it left behind a layer of dark, rich **silt**. Egyptian farmers planted wheat and barley in that mud and harvested in the spring. They called their farmland the Black Land, for the dark soil, and the desert beyond it the Red Land. They even divided their year into three seasons of four months: the flood, the growing time and the harvest.

The great desert. On both sides of the Nile stretches the **Sahara**, the largest hot desert in the world. It is almost as big as the whole United States. Some parts are seas of sand dunes, but much more of it is bare rock, gravel and stony mountains. In many places less than one inch of rain falls in a whole year. People live at an **oasis**, where water comes up from under the ground and date palms grow. For hundreds of years, camel caravans crossed the Sahara carrying salt and gold.

Technology overcoming geography. Egyptian farmers lifted river water with a *shaduf*, a long pole with a bucket on one end and a heavy weight on the other. In 1970 Egypt finished the Aswan High Dam, which holds back a huge lake. Now the Nile no longer floods each year. Farmers get water all year round, but the river no longer brings them fresh mud, so they must add fertilizer instead.



The Nile flows north through the Sahara to the Mediterranean Sea.



The Black Land and the Red Land. The flood covered only the low land near the river and left its mud there.

PICTURE STUDY



Statues of Memnon at Thebes, during the Inundation, David Roberts (drawn on stone by Louis Haghe), published 1846–1849, from drawings made on the Nile in 1838–1839 · Hand-colored lithograph · From David Roberts's volumes of *Egypt and Nubia*, published in London; copies are kept in many libraries and museums

David Roberts was a Scottish painter who traveled up the Nile in 1838 and 1839, filling his sketchbooks with temples, pyramids, villages and the river itself. Back in London, his drawings were copied onto stone and printed as beautiful colored pictures called lithographs, published in a set of large books from 1846 to 1849. For many people in Europe, these pictures were the first good look they ever had at Egypt.

Here Roberts shows two giant stone statues of an ancient king, standing near the old city of Thebes. He drew them during the flood season, when the Nile had spread out across the

fields and the statues stood in the water.

Look closely

- Find the two giant statues. Look for something small, like a person or a boat, to help you guess how big they are.
- Find the flood water. Where does the flat water end and the dry land begin?
- Look at the hills far away. What color are they? Is that the Black Land or the Red Land?
- Look at the sky. What season and time of day do you think it is?

Talk about it

1. What will the fields around the statues look like after the water goes down?
2. Why would a farmer be happy to see this flood?
3. Why do you think the ancient Egyptians built such enormous statues?

Safety first. Wash your hands after working with soil and muddy water. Do the project outdoors or on a covered table.

PROJECT: THE NILE IN A SAND TRAY

You will build the Nile valley in a tray of sand, make a summer “flood” of muddy water, and watch it leave a strip of mud along the river. Then you will plant seeds in the mud and in the dry sand to see why Egyptian farmers loved the flood.

You will need

- A large shallow tray or a disposable foil roasting pan
- Play sand or clean sand (enough to fill the tray about 2 inches deep)
- Two cups of garden soil or potting soil
- A pitcher and about 4 cups of water
- A book or block to prop up one end of the tray
- Fast-growing seeds such as cress, radish or grass
- Sticky notes and a pencil
- A spray bottle of water

Steps

1. Fill the tray with damp sand. Pack it down firmly.
2. Prop up one end of the tray about 1 inch with the book. Label the high end “South (Ethiopia)” and the low end “North (Mediterranean Sea).”
3. With your finger, carve a river channel down the middle from the south end to the north end. Leave flat, low land about 2 inches wide on each side of the channel, then pile the sand higher beyond that for the desert cliffs.
4. Stir the soil into the water in the pitcher to make thick muddy water. This is the summer flood coming down from the mountains.

5. Pour the muddy water slowly into the river at the south end. Keep pouring until the river spills over its banks onto the flat land. Watch where the water spreads out at the north end.
6. Wait 30 minutes for the water to soak in. Look closely. Where did the dark mud settle? Did a fan of mud form at the north end, like a delta?
7. Sprinkle seeds in two places: on the dark mud beside the river, and on the dry sand up on the “desert.” Mark each place with a sticky note.
8. Mist both places lightly with the spray bottle once a day for a week. Draw what you see on days 1, 4 and 7.

Tips

- Pour slowly. A flood that is too fast will wash away your banks.
- If you have no seeds, press a finger into the mud and the sand and feel the difference. Which would hold water and feed a plant better?

Check your work

- I can show which way my river flows and explain why the Nile flows north.
- I can point to the Black Land and the Red Land in my tray.
- I can explain why the seeds in the mud grew better than the seeds in the sand.

MAP NOTEBOOK

1. Draw the Nile as a long blue line on a big yellow desert. Draw the White Nile and the Blue Nile joining at Khartoum, and add an arrow pointing north toward the Mediterranean Sea.
2. Draw a shaduf lifting water from the river, and label the pole, the bucket and the weight.
3. Make a three-part circle for the Egyptian year and label it Flood, Growing and Harvest. Draw a small picture in each part.

From history. When the Aswan High Dam was built in the 1960s, its lake was going to cover the giant temples of Abu Simbel, carved into a cliff above the Nile more than 3,000 years ago. So engineers from many countries cut the temples into huge blocks, carried them up the hill and put them back together on higher ground, safely above the new lake. The work was finished in 1968, and the temples still stand there today.

WORKED EXAMPLES

Example 1. The ancient Egyptians divided their year into 3 seasons: the flood, the growing time and the harvest. Each season was 4 months long. How many months were in the year?

1. There are 3 seasons, and each has 4 months.
2. That is 3 groups of 4: $4 + 4 + 4$.
3. $3 \times 4 = 12$.

Answer: 12 months, the same number we have.

Example 2. The Nile is about 4,100 miles long. The Mississippi River, which you studied in Unit 2, is about 2,300 miles long. About how much longer is the Nile?

1. Subtract the shorter river from the longer: $4,100 - 2,300$.
2. Think in hundreds: 41 hundreds $-$ 23 hundreds = 18 hundreds.
3. 18 hundreds is 1,800.

Answer: The Nile is about 1,800 miles longer than the Mississippi.

PRACTICE

1. **EASY** Which direction does the Nile flow? Into which sea does it empty?
2. **EASY** Which two rivers join at Khartoum to make the Nile?
3. **MEDIUM** Use the map. Is Cairo north or south of Aswan? If you sailed down the Nile from Aswan to Cairo, would you go with the current or against it?
(Use the map or drawing “Find Aswan and Cairo along the Nile.” shown earlier in this lesson.)
4. **MEDIUM** A boat on the Nile sails 50 miles a day. How many days will it take to sail 400 miles?
5. **HARD** A town in the Sahara gets about 1 inch of rain in a year. A town in Ohio gets about 40 inches in a year. How many years must the Sahara town wait to get as much rain as the Ohio town gets in one year?
6. **CHALLENGE** Write two or three sentences: Why did Egyptian farmers call the flood a gift? What changed after the Aswan High Dam was built?

COMMON MISTAKES

- Thinking the Nile flows south because south is “down” on a map. Rivers flow downhill, and the Nile’s land slopes down toward the north.
- Thinking the Sahara is all sand dunes. Much more of it is rock, gravel and stony mountains.

- Thinking the flood was a disaster. For Egyptian farmers it was the best part of the year, because it brought water and new soil.

Make it a game · Flood, Grow, Harvest. A parent calls out one of the three Egyptian seasons. For Flood, spread your arms wide and wave them like rising water. For Grow, crouch down and slowly rise like a sprouting wheat plant. For Harvest, pretend to cut the wheat with a sickle. The parent calls faster and faster, and sometimes says a wrong word like “Snow!” If you move on a wrong word, you are out. Then switch places.

Scripture. “And Joseph gathered corn as the sand of the sea, very much, until he left numbering; for it was without number.” (Genesis 41:49, KJV)

In the Bible’s word “corn,” think of grain such as wheat. Joseph was a ruler in Egypt, where the Nile’s flood made rich harvests possible. God warned Pharaoh in a dream, and Joseph stored up grain in the good years so that people would have food in the years of famine.

Practice answers

1. North. It empties into the Mediterranean Sea.
2. The White Nile and the Blue Nile.
3. Cairo is north of Aswan. You would sail with the current, because the Nile flows north.
4. $400 \div 50 = 8$. It takes 8 days.
5. $40 \div 1 = 40$. About 40 years.
6. Sample: The flood watered the fields and left rich black mud, so crops could grow in a desert land. After the Aswan High Dam was finished in 1970, the river stopped flooding. Farmers could water their fields all year, but they no longer got fresh mud and had to add fertilizer.

3.4 AFRICA'S RIFT VALLEY, RAIN FOREST AND SAVANNA

OBJECTIVES

- Find Mount Kilimanjaro, the Great Rift Valley, the Congo River and Victoria Falls on a map of Africa.
- Describe a rain forest and a savanna and tell how they are different.
- Explain why there can be snow on a mountain near the equator.

Warm-up. Hold a sheet of paper flat between your two hands. Slowly pull your hands apart until the paper tears down the middle. Now lay a book over two pieces of a broken graham cracker, then slide the two pieces apart: the book sinks down into the gap. In East Africa the land has been pulling apart in a similar way, and the middle has sunk down into a long valley.

Video. Coming soon. Mount Kilimanjaro, the Great Rift Valley, the Congo rain forest, the Serengeti and Victoria Falls for children: search NASA and NASA Earth Observatory (Kilimanjaro and the Rift from space), Smithsonian, Homeschool Pop (Alternate), and National Geographic Kids (candidate, needs vetting).

KEY TERMS

rift valley

A long, deep valley made where the land has pulled apart and the middle has sunk down.

rain forest

A thick, warm forest where it rains almost every day and the trees stay green all year.

savanna

Warm grassland with scattered trees, with a rainy season and a long dry season.

waterfall

A place where a river drops over a cliff or a steep edge.

equator

The imaginary line around the middle of the earth, halfway between the North Pole and the South Pole.

CORE IDEAS

The story. On May 11, 1848, a German missionary named Johannes Rebmann was walking inland from the coast of East Africa, near the port of Mombasa, with a group of African guides. He had come to tell people about Jesus. Far ahead he saw a huge mountain with something bright white on top. His guides had a word for it that meant “cold.” Rebmann knew at once what it was: snow! He wrote home about the snowy mountain called Kilimanjaro. But some geographers in London refused to believe him. Snow in Africa, almost

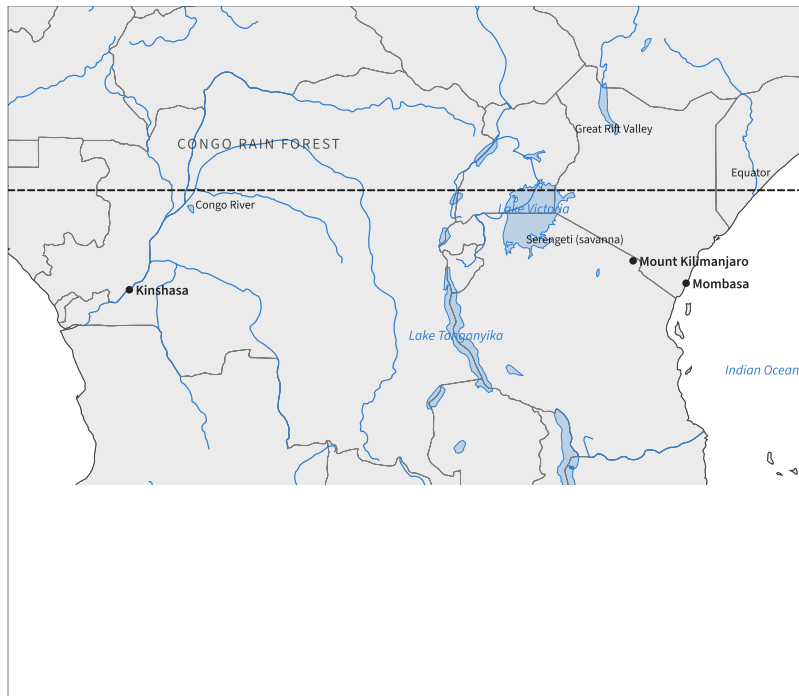
on the equator? Impossible, they said. It took years before everyone agreed that the missionary had been right.

How it works. Rebmann was right because air gets colder the higher you go. At the bottom of Kilimanjaro it is warm, with farms and forests. Kilimanjaro is about 19,300 feet tall, the highest mountain in Africa, so its top is cold enough for snow and ice even though it stands only a short way south of the **equator**. Kilimanjaro is an old volcano. It rises near the **Great Rift Valley**, a long crack in East Africa where the land has pulled apart and sunk down. The Rift Valley runs for thousands of miles, with steep cliffs on each side and long, deep lakes like Lake Tanganyika on its floor.

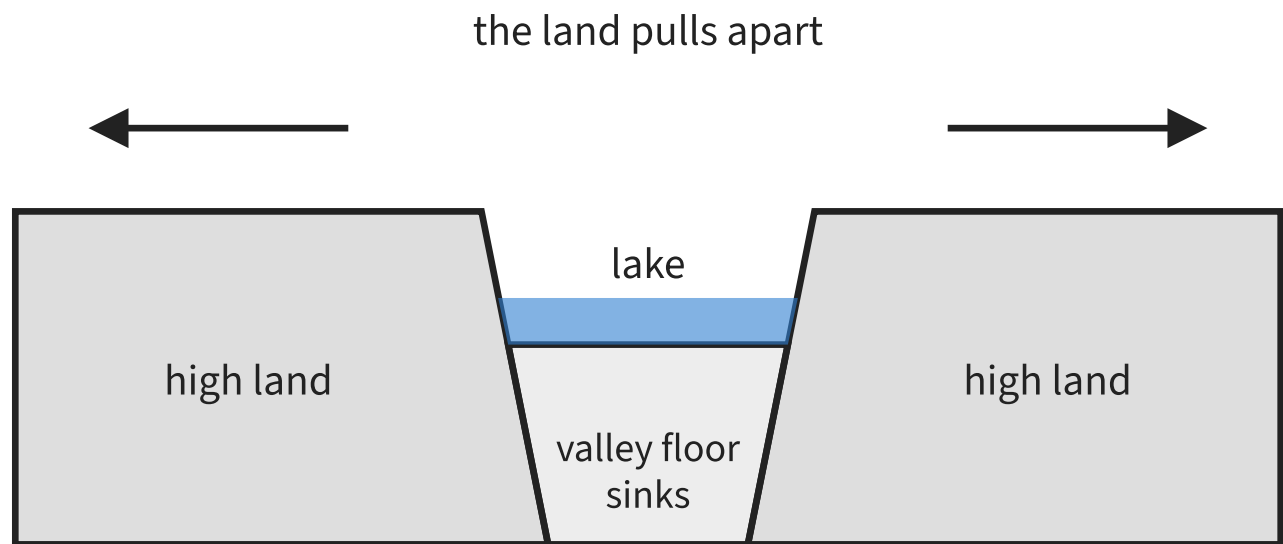
On the map. West of the Rift lies the great **rain forest** of the Congo, the second-largest rain forest in the world after the Amazon. Here it is hot and wet nearly every day. Tall trees make a green roof, and chimpanzees, gorillas and forest elephants live in the shade below. The mighty Congo River winds through it, crossing the equator twice. It is the deepest river in the world, more than 700 feet deep in places.

The big idea. Around the rain forest, where there is less rain, the trees thin out into the **savanna**, a sea of tall grass dotted with flat-topped acacia trees. The savanna has a rainy season and a long dry season. On the Serengeti plains of Tanzania and Kenya, more than a million wildebeest walk in a great circle each year, following the rains to fresh grass, while lions, giraffes and zebras live nearby. Mountains, rain forest and savanna: each is a different home that God made for different creatures.

Africa's great waterfall. Far to the south, the Zambezi River flows across the savanna and then suddenly falls into a deep, narrow crack in the rock. This is Victoria Falls, about a mile wide and about 350 feet high. The spray rises so high that local people called it Mosi-oa-Tunya, "the smoke that thunders." The missionary explorer David Livingstone was the first European to see it, in November 1855, and he named it for Queen Victoria.



Kilimanjaro, the Rift Valley, the Congo rain forest, the savanna and Victoria Falls.



How a rift valley forms: the land pulls apart and the middle sinks.

PICTURE STUDY



The Victoria Falls, Zambesi River: Sketched on the Spot, Thomas Baines, Baines visited the Falls in 1862; the pictures were published in 1865 · Colored lithographs printed from Baines's paintings · Published as a book of plates in London, 1865; copies are kept in libraries

Thomas Baines was an English artist and explorer who spent many years in southern Africa and traveled for a time on David Livingstone's Zambezi expedition. In 1862 he reached Victoria Falls with his own small party and spent days painting it from every side, often standing in the soaking spray. Back in England, his paintings were printed as a book of colored pictures so people at home could see this wonder.

Look closely

- Find the long edge where the river drops over the cliff. How wide does it look?
- Find the spray. Why do you think people called the Falls “the smoke that thunders”?
- Look for a rainbow, trees or tiny people. What helps you guess how big the Falls are?
- Look at the deep gorge at the bottom. Where does the water go next?

Talk about it

1. If you stood where Baines stood, what would you hear and feel?
2. Why do you think Baines wanted to paint the Falls “on the spot” instead of from memory?
3. How is this waterfall different from the calm Nile flood you saw in the last lesson?

PROJECT: A RIFT VALLEY IN CLAY

You will build a block of land from layers of colored clay, set it on two pieces of cardboard, and pull it apart to see how the middle sinks down into a rift valley. Then you will add a lake,

a volcano and Kilimanjaro's snowcap.

You will need

- Modeling clay or play dough in three colors
- Two pieces of stiff cardboard, about 4 by 6 inches each
- A plastic knife
- A rolling pin or a smooth jar
- A little blue clay or blue paper for a lake
- A cotton ball for snow

Steps

1. Roll each color of clay into a flat sheet about as thick as your finger.
2. Stack the three sheets on top of each other to make a layered block. These layers are like the layers of rock in the earth.
3. Lay the two pieces of cardboard side by side, touching. Set the clay block on top so it sits across the line where they touch.
4. With the knife, make two slanted cuts down through the block, one on each side of the middle, so the middle piece is wider at the top than at the bottom, like a wedge.
5. Slowly slide the two pieces of cardboard apart. Watch the middle wedge of clay sink down between the two sides. You have made a rift valley!
6. Press a little blue clay into the low valley floor for a lake like Lake Tanganyika.
7. Build a cone-shaped volcano on one high side. Put a pinch of cotton on top for Kilimanjaro's snow.
8. Look at the sides of your valley. Can you see the colored layers in the cliffs?

Tips

- Pull the cardboard apart slowly and evenly, and push down gently on the middle piece if it sticks.
- If the middle piece falls over, make your cuts slant more steeply.

Check your work

- I can show how a rift valley forms when land pulls apart.
- I can point to the cliffs, the valley floor and the lake on my model.
- I can explain why Kilimanjaro has snow even though it is near the equator.

MAP NOTEBOOK

1. Draw Kilimanjaro in three bands from bottom to top: green farms and forest, brown rocky slopes, and white snow on top. Label it "about 19,300 feet."
2. Fold a page in half. Draw a rain forest on one side and a savanna on the other. Add two animals that live in each.

3. Draw Victoria Falls with spray rising up. Write its local name, Mosi-oa-Tunya, and what it means.

From history. On October 6, 1889, a German geographer named Hans Meyer and an Austrian mountain climber named Ludwig Purtscheller became the first people known to stand on the very top of Kilimanjaro. It was Meyer's third try. Local Chagga men from the villages on the mountain's slopes helped guide and carry for the climb. More than forty years earlier, Rebmann had seen the snow they walked on.

WORKED EXAMPLES

Example 1. Kilimanjaro is about 19,300 feet tall. Mont Blanc, the highest peak of the Alps, is about 15,800 feet tall. How much taller is Kilimanjaro?

1. Subtract: $19,300 - 15,800$.
2. Think in hundreds: 193 hundreds – 158 hundreds.
3. $193 - 158 = 35$, so the answer is 35 hundreds, which is 3,500.

Answer: Kilimanjaro is about 3,500 feet taller than Mont Blanc.

Example 2. On a mountain, the air gets about 3 degrees Fahrenheit colder for every 1,000 feet you climb. A climber starts at a gate on Kilimanjaro about 6,000 feet high, where it is 70°F. About how cold is it at 16,000 feet?

1. Find how far the climber goes up: $16,000 - 6,000 = 10,000$ feet.
2. 10,000 feet is 10 groups of 1,000 feet.
3. Each group makes it about 3 degrees colder: $10 \times 3 = 30$ degrees colder.
4. Subtract from the starting temperature: $70 - 30 = 40$.

Answer: About 40°F, and still colder higher up, which is why snow and ice can stay near the top.

PRACTICE

1. **EASY** What is the highest mountain in Africa? About how tall is it?
2. **EASY** Name one way a rain forest and a savanna are different.
3. **MEDIUM** Use the map. Which river crosses the equator: the Congo or the Zambezi? Which river has Victoria Falls on it?
(Use the map or drawing "Follow each river and see whether it crosses the equator line." shown earlier in this lesson.)
4. **MEDIUM** Victoria Falls is about 350 feet high. A 10-story building is about 100 feet tall. About how many 10-story buildings stacked up would be as tall as the Falls?

5. **HARD** Johannes Rebmann saw Kilimanjaro's snow in 1848. Hans Meyer and Ludwig Purtscheller first climbed to its top in 1889. How many years passed in between?
6. **CHALLENGE** Write two or three sentences: Why did the geographers in London think Rebmann was wrong, and why was he right?

COMMON MISTAKES

- Thinking all of Africa is desert or all of Africa is jungle. Africa has deserts, rain forests, savannas, snowy mountains and long lakes.
- Thinking places near the equator are always hot. High mountains near the equator can be cold and snowy.
- Mixing up the Nile, the Congo and the Zambezi. The Nile flows north to the Mediterranean, the Congo flows through the rain forest to the Atlantic, and the Zambezi pours over Victoria Falls and runs to the Indian Ocean.

Make it a game · Africa Habitat Hop. Make four signs and put them in four corners of the room: Desert, Rain Forest, Savanna and Snowy Mountain. A parent names an animal, plant or thing, such as a camel, a gorilla, a wildebeest, a date palm, snow, a lion, an acacia tree or a chimpanzee. Hop to the corner where it belongs. If you are right, earn a point. If two answers could work, explain why and earn two points.

Scripture. "For he saith to the snow, Be thou on the earth; likewise to the small rain, and to the great rain of his strength." (Job 37:6, KJV)

God commands the snow and the rain. He put snow on top of a mountain near the equator and sends the rains that fill the rain forest and turn the dry savanna green again. Rebmann trusted his eyes, and the God who made the snow, even when wise men said it could not be there.

Practice answers

1. Mount Kilimanjaro, about 19,300 feet tall.
2. Sample: A rain forest gets rain almost every day and has thick, tall trees; a savanna is grassland with scattered trees and has a long dry season.
3. The Congo crosses the equator (twice). Victoria Falls is on the Zambezi.
4. $100 + 100 + 100 = 300$, with 50 feet more, which is half a building. About $3\frac{1}{2}$ buildings.
5. $1889 - 1848 = 41$ years.
6. Sample: They thought it was too hot near the equator for snow. But air gets colder the higher you go, and Kilimanjaro is so tall that its top is cold enough for snow and ice all year.

UNIT 3 REVIEW

Answer each question. Show your work for math problems and use complete sentences for explanations. A parent may read the questions aloud. The review is worth 40 points.

1. (4 pts) What is a peninsula? Name two peninsulas of Europe.
2. (4 pts) The Strait of Dover is about 21 miles wide. The Strait of Gibraltar is about 9 miles wide. How much wider is the Strait of Dover? Why are harbors important to sailors?
3. (5 pts) Fill in the blanks: The Rhine begins in the _____ and flows _____ into the _____ Sea. The Danube flows _____ into the _____ Sea.
4. (4 pts) The Danube is about 1,770 miles long and the Rhine is about 760 miles long. How much longer is the Danube?
5. (4 pts) Which direction does the Nile flow, and why? Name the two rivers that join to make it.
6. (5 pts) Why did the ancient Egyptians call their farmland the Black Land and the desert the Red Land? Why was the yearly flood a gift?
7. (4 pts) A town in the Sahara gets about 2 inches of rain in a year. A town in Virginia gets about 40 inches. How many times as much rain does the Virginia town get?
8. (5 pts) In 1848 Johannes Rebmann saw snow on Kilimanjaro, near the equator. Explain why there can be snow there.
9. (5 pts) Match each place to its description: (a) Victoria Falls, (b) the Congo, (c) the Serengeti, (d) the Great Rift Valley, (e) the Sahara. Descriptions: 1. grassland with scattered trees where wildebeest roam; 2. the smoke that thunders, on the Zambezi; 3. the largest hot desert in the world; 4. a long valley where the land pulled apart; 5. a deep river in the rain forest that crosses the equator twice.

UNIT PROJECT: MY MAP OF EUROPE AND AFRICA

Draw a large map of Europe and Africa on poster board or taped-together paper. Color the land and the seas, and label the Mediterranean, North, Baltic, Black and Red Seas and the Atlantic and Indian Oceans. Outline Europe's five peninsulas in color. Draw and label the Rhine, the Danube, the Nile (with its White and Blue branches), the Congo and the Zambezi in blue, with an arrow on each river showing which way it flows. Add symbols for the Alps, the Sahara, the Congo rain forest, the savanna, the Great Rift Valley, Kilimanjaro and Victoria Falls, and make a key that explains your symbols.

Beside the map, add a photo or drawing of your Nile sand tray with your seed drawings from days 1, 4 and 7, and write a short paragraph explaining how the Nile's flood made farming possible in the desert.

- **Accuracy:** Seas, peninsulas, rivers, mountains and landforms are in the right places, and each river's arrow points the right way.
- **Map key:** The map has a clear key and a compass rose, and every symbol is explained.

- **Sand tray report:** The drawings and paragraph show what happened in the flood and explain why seeds grew better in the mud.
- **Care:** The map is neat, colorful and easy to read, with names spelled correctly.

Answer key

1. Land with water on three sides that is still joined to a bigger land. Any two of: the Iberian Peninsula (Spain and Portugal), the Italian Peninsula, the Balkan Peninsula (Greece), the Scandinavian Peninsula (Norway and Sweden), Jutland (Denmark).
2. $21 - 9 = 12$ miles wider. Harbors give ships calm, safe water to wait out storms and to load and unload.
3. Alps; north; North. East; Black.
4. $1,770 - 760 = 1,010$ miles longer.
5. North, because the land is higher in the south and rivers flow downhill. The White Nile and the Blue Nile (they meet at Khartoum).
6. The farmland near the river was covered with dark mud left by the flood; the desert beyond was dry and reddish. The flood watered the fields and left fresh, rich silt so crops could grow.
7. $40 \div 2 = 20$ times as much.
8. Air gets colder the higher you go. Kilimanjaro is about 19,300 feet tall, so its top is cold enough for snow and ice even near the equator.
9. (a) 2, (b) 5, (c) 1, (d) 4, (e) 3.

ASIA AND AUSTRALIA

In this unit we travel to the biggest continent and the smallest, and then all the way to the bottom of the world. Asia holds the highest mountain on earth, the deepest lake, a cold desert where dinosaur eggs lay hidden, and more people than all the other continents put together. Its great rivers, the Yangtze, the Yellow River, the Ganges and the Mekong, carry water and rich silt from the roof of the world down to the sea, and great cities have grown up along their banks.

Then we sail south with Matthew Flinders and his cat Trim around Australia, the island continent, with its red Outback, its coastal cities and the Great Barrier Reef built by tiny coral polyps. Last of all we follow Roald Amundsen and his dog teams across the ice to the South Pole, on Antarctica, the coldest, driest continent of all. In every place we will ask: what did God place here, and how have people lived with it? As Paul told the men of Athens, 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).

BEFORE YOU BEGIN

- Can name the seven continents and five oceans and find them on a globe
- Can find the equator, the prime meridian and the four hemispheres (Unit 1)
- Can read latitude and longitude written like 28°N, 87°E (Unit 1)
- Can add and subtract numbers in the thousands

MASTERY CHECKLIST

- I can find Asia, Australia and Antarctica on a globe and tell which is biggest and which is smallest.
- I can locate the Himalaya, Siberia, the Gobi Desert and Mount Everest, and tell how Everest was measured.
- I can name four great rivers of Asia and explain how a river carries silt and builds a delta.
- I can explain why Australia is the island continent and why most Australians live near the coast.
- I can explain why Antarctica is a cold desert and why every direction from the South Pole is north.
- I can use a map scale and latitude and longitude to find distances and directions.

OPTIONAL BOOKS AND RESOURCES

- **NASA Earth Observatory** (<https://earthobservatory.nasa.gov/>): Free. Search for satellite pictures of Mount Everest, the Yellow River delta, the Great Barrier Reef and the Antarctic ice sheet. A parent can pick a picture a week to look at together.

- **Library of Congress: Maps** (<https://www.loc.gov/maps/>): Free. Old maps of Asia, Australia and the polar regions to compare with today's maps. Try searching for "Australia" or "Antarctica" and look for maps more than 100 years old.
- **Australian Antarctic Program** (<https://www.antarctica.gov.au/>): Free. Photos and short pages about life at Antarctic research stations, penguins, seals and the ice. Best browsed with a parent.

4.1 ASIA: THE BIGGEST CONTINENT ★

OBJECTIVES

- Find Asia on a globe and explain that it is the biggest continent, with more people than all the other continents put together.
- Locate the Himalaya, Siberia and the Gobi Desert on a map of Asia and tell one fact about each.
- Tell how surveyors in India measured Mount Everest from far away, and compare the heights of real mountains.

Warm-up. Put a globe or world map on the table. Lay your open hand flat on Asia, then on Australia, then on your own country. Which one did your hand cover the least of? Now guess: which continent has the most people? Write your guess on a slip of paper and fold it up. You will open it at the end of the lesson.

Video. Coming soon. Asia for children: Mount Everest and the Himalaya, Siberia and Lake Baikal, the Gobi Desert, and Mount Fuji; search Homeschool Pop (Alternate), NASA and NASA Earth Observatory (Everest and Himalaya from space), Smithsonian, Memoria Press; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

continent

One of the seven great bodies of land on the earth. Asia is the biggest.

mountain range

A long line of mountains joined together, like the Himalaya.

summit

The very top of a mountain.

desert

A place that gets very little rain or snow. A desert can be hot or cold.

survey

Careful measuring of the land to find how far, how big or how high things are, so a true map can be made.

CORE IDEAS

The story. In the 1840s, mapmakers from the Great Trigonometrical Survey of India looked north from the plains of India toward a wall of white mountains. They were not allowed into Nepal, where the tallest peaks stood, so they measured from stations more than 100 miles away. One peak had no name at all. They called it simply “Peak XV.” In 1852 a gifted Indian mathematician named **Radhanath Sikdar** worked through the numbers and found that Peak XV was higher than any mountain anyone had ever measured. In 1856 the Survey announced

its height: 29,002 feet. A few years later it was named Mount Everest, after Sir George Everest, a leader of the Survey. The people who lived near it already had names for it: Chomolungma in Tibet and Sagarmatha in Nepal.

How they figured it out. The surveyors never climbed the mountain. They used a tool with a telescope to measure angles. If you know how far apart two stations are, and you measure the angle up to the top of a peak from each one, you can work out how high the peak is with careful arithmetic called *trigonometry*. It took years of patient work. Today, with modern tools, the summit is measured at about 29,032 feet. The old surveyors were off by only 30 feet!

The big idea. Mount Everest stands in **Asia**, the biggest continent on earth. Asia covers about 17 million square miles, nearly one third of all the land in the world. It stretches from the icy Arctic Ocean in the north to the warm Indian Ocean in the south, and from Europe in the west to the Pacific Ocean in the east. Asia is home to more people than all the other continents put together: about 6 out of every 10 people on earth live there. Look at the guess you folded up in the warm-up. Were you right?

On the map. The **Himalaya** is a mountain range that curves like a great bow across the top of India. Its name means “home of snow.” Far to the north lies **Siberia**, a huge cold region of Russia. Siberia has dark forests of pine and larch, rivers that freeze hard in winter, and **Lake Baikal**, the deepest lake in the world, more than a mile deep. Between Siberia and the middle of China, in Mongolia and northern China, lies the **Gobi Desert**. The Gobi is a cold desert. It gets very little rain because it is far from the ocean and tall mountains block the wet winds. Winters there can fall to 40 degrees below zero. In 1923 explorers from the American Museum of Natural History found nests of dinosaur eggs in the Gobi’s red cliffs.

God’s great mountains. Far to the east, on the islands of Japan, stands Mount Fuji, a volcano about 12,388 feet tall, which you will see in our picture study. From the Himalaya to Fuji, Asia’s mountains remind us how great their Maker is. The psalm says, “the strength of the hills is his also.”



Asia, the biggest continent: the Himalaya in the south, Siberia in the north and the Gobi Desert between.

PICTURE STUDY



*Fine Wind, Clear Morning ("Red Fuji"), from *Thirty-six Views of Mount Fuji*, Katsushika Hokusai, about 1830-1832 · Color woodblock print · Many prints were made; copies are in the Metropolitan Museum of Art, New York, the British Museum, London, and other museums*

Katsushika Hokusai was a Japanese artist who loved Mount Fuji, the tallest mountain in Japan. When he was about 70 years old he made a set of pictures called *Thirty-six Views of Mount Fuji*. In this one, the early morning sun of late summer or autumn turns the mountain red.

This is a woodblock print. Craftsmen carved the picture into blocks of wood, one block for each color, then brushed on ink and pressed paper onto each block by hand. That is why many copies exist, and why a family in Japan long ago could buy one for about the price of a bowl of noodles.

Look closely

- Find the snow near the top of the mountain. Why is there still snow up there when the rest of the mountain is warm and red?
- Look at the clouds. How did Hokusai make them look like they are in rows?
- Find the dark forest at the bottom. How many colors can you count in the whole picture?
- Notice how big the mountain is compared with the paper. What does that make you feel about Fuji?

Talk about it

1. Mount Fuji is a volcano. What shape do volcanoes often have? Can you see that shape here?
2. Hokusai could have put people or houses in this picture, but he did not. Why do you think he showed only the mountain and the sky?
3. Mount Everest is more than twice as tall as Fuji. How do you think Hokusai would have drawn Everest?

PROJECT: MOUNTAIN HEIGHT LADDER

You will make paper mountains to scale, where 1 inch stands for 1,000 feet. Then you will line them up and see with your own eyes how tall Everest is next to other famous mountains.

You will need

- Long strips of paper, about 3 inches wide (adding-machine tape, or sheets taped end to end)
- Ruler or yardstick
- Scissors, tape and markers or crayons
- A wall or door to tape the mountains to

Steps

1. Write the scale at the top of a card: 1 inch = 1,000 feet.
2. Measure and cut a strip 29 inches long for Mount Everest (about 29,000 feet).
3. Cut a strip 20 inches long for Denali in Alaska (about 20,000 feet), the tallest mountain in North America.
4. Cut a strip about 12 and a half inches long for Mount Fuji (about 12,400 feet).
5. Cut a strip about 14 and a half inches long for Mount Whitney in California (about 14,500 feet).

6. Trim the top of each strip into a pointed peak. Color white snow on the tops and label each one with its name and height.
7. Tape all four mountains side by side on a wall, with their bottoms on the same line, like a row of mountains standing on the same ground.
8. At this scale, a 1,000-foot hill is only 1 inch tall. Cut a tiny 1-inch hill and tape it beside Everest. How many of those hills would you need to stack to reach Everest's top?

Tips

- Keep all the bottoms lined up exactly. If one mountain starts higher, it will look taller than it really is.
- Real mountains start from land that is already high. Mountain heights are measured from sea level, so our ladder starts at sea level too.

Check your work

- I made each mountain the right length using 1 inch for 1,000 feet.
- I can tell which mountain is tallest and about how much taller it is than Fuji.
- I can say where each mountain is on the globe.

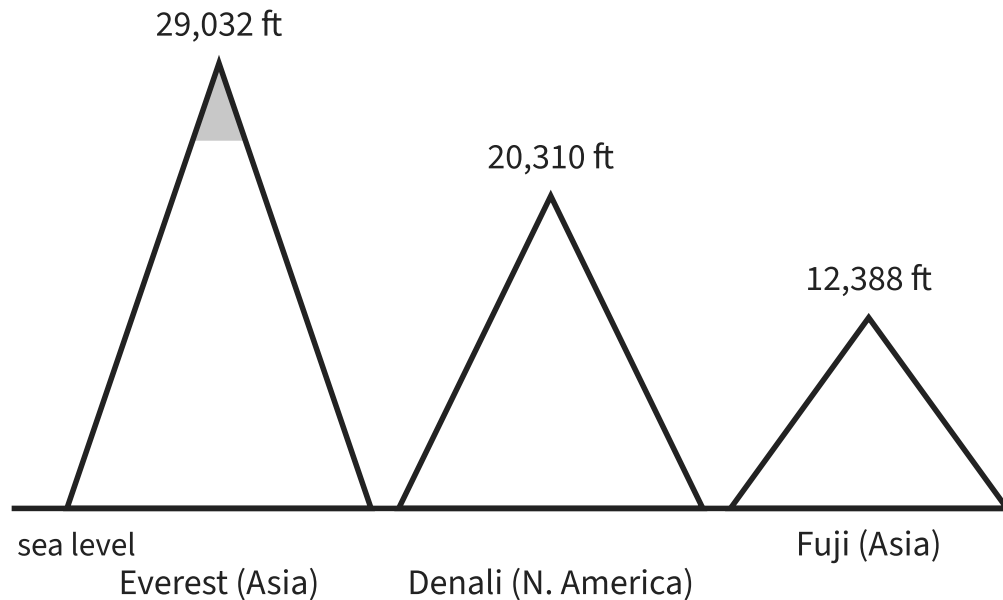
MAP NOTEBOOK

1. Trace or draw the outline of Asia. Draw a row of little peaks for the Himalaya, a pine tree for Siberia and a few dots of sand for the Gobi. Label all three.
2. Draw Mount Everest and Mount Fuji side by side, with Everest a little more than twice as tall. Write each height under it.
3. Draw Lake Baikal as a long, thin blue crescent and write beside it: "The deepest lake in the world, more than a mile deep."

From history. When explorers from the American Museum of Natural History found dinosaur eggs in the Gobi in 1923, they also found the bones of a small dinosaur lying on top of a nest. They thought it had been stealing the eggs, so they named it *Oviraptor*, which means "egg thief." Many years later, scientists found a baby of the same kind of dinosaur inside one of these eggs. The "thief" had most likely been a parent sitting on its own nest.

WORKED EXAMPLES

Example 1. Mount Everest is about 29,032 feet tall. Mount Fuji is about 12,388 feet tall. How much taller is Everest than Fuji?



Three famous mountains drawn to the same scale.

1. We want the difference between the two heights, so we subtract the smaller number from the bigger one.
2. Line up the places: $29,032 - 12,388$.
3. Regroup and subtract: $29,032 - 12,388 = 16,644$.
4. Check by adding back: $16,644 + 12,388 = 29,032$. It matches.

Answer: Everest is about 16,644 feet taller than Mount Fuji. That is more than Fuji's whole height again!

Example 2. Mount Everest is near 28°N, 87°E. Lake Baikal is near 53°N, 108°E. If you traveled from Everest to Lake Baikal, which direction would you go?

(Use the map or drawing “Find Everest, then find Lake Baikal. Which way is it?” shown earlier in this lesson.)

1. Compare the latitudes. 53°N is a bigger number than 28°N, so Lake Baikal is farther north.
2. Compare the longitudes. 108°E is a bigger number than 87°E, so Lake Baikal is farther east.
3. North and east together make northeast.
4. Check on the map: Lake Baikal is up and to the right of Everest.

Answer: You would travel northeast.

PRACTICE

1. **EASY** Which is the biggest continent on earth? About what part of all the people in the world live there?
2. **EASY** In 1856 the Survey said Mount Everest was 29,002 feet tall. Today it is measured at about 29,032 feet. How many feet apart are the two numbers?
3. **MEDIUM** Lake Baikal is about 5,387 feet deep at its deepest. A mile is 5,280 feet. Is Lake Baikal more than a mile deep? By how many feet?
4. **MEDIUM** Mount Everest is near 28°N, 87°E. Is it in the Northern or Southern Hemisphere? Is it in the Eastern or Western Hemisphere?
5. **MEDIUM** Denali, the tallest mountain in North America, is about 20,310 feet tall. Mount Everest is about 29,032 feet tall. How much taller is Everest?
6. **HARD** The Gobi is very cold in winter, yet it is a desert. Write two or three sentences explaining why.

COMMON MISTAKES

- Thinking a desert must be hot. A desert is any place with very little rain or snow; the Gobi is cold, and so is Antarctica.
- Thinking the Himalaya is one mountain. It is a whole mountain range, with Everest as its highest peak.
- Thinking Siberia is its own country. Siberia is a huge region that belongs to Russia.

Make it a game • Higher or Lower. A parent says the name of a mountain or a place: Mount Everest, Mount Fuji, Denali, your house, the top of your church steeple, the bottom of Lake Baikal. You answer “higher” or “lower” than the one before, and point to it on the globe. Score a point for each right answer and a bonus point if you can say which continent it is on. Play to ten points.

Scripture. “In his hand are the deep places of the earth: the strength of the hills is his also.” (Psalm 95:4, KJV)

Asia has both the highest mountain on earth and the deepest lake. The highest peak and the deepest water are both in God’s hand.

Practice answers

1. Asia. About 6 out of every 10 people live in Asia, more than on all the other continents put together.
2. $29,032 - 29,002 = 30$ feet. The old surveyors were very close!
3. Yes. $5,387 - 5,280 = 107$ feet more than a mile.
4. The Northern Hemisphere (N means north of the equator) and the Eastern Hemisphere (E means east of the prime meridian).
5. $29,032 - 20,310 = 8,722$ feet taller.
6. A desert is a place with very little rain or snow, not always a hot place. The Gobi is far from the ocean, and tall mountains block the wet winds, so very little rain or snow falls there. That makes it a cold desert.

4.2 GREAT RIVERS OF ASIA

OBJECTIVES

- Name and locate four great rivers of Asia: the Yangtze, the Yellow River, the Ganges and the Mekong, with the sea each one reaches.
- Explain how a river carries silt, builds rich farmland and a delta, and why it can also flood.
- Compare river lengths and use a map scale of 1 inch for 100 miles.

Warm-up. Put a spoonful of garden soil or sand into a clear jar of water, screw on the lid and shake it hard. What color is the water? Set the jar on the table and leave it alone. Look again at the end of the lesson. Where did the dirt go?

Video. Coming soon. Rivers of Asia for children: the Yangtze, the Yellow River and its silt, the Ganges and its delta, the Mekong through six countries; search NASA Earth Observatory (river deltas and floods from space), Smithsonian, Homeschool Pop (Alternate), Memoria Press; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

source

The place where a river begins, often high in the mountains.

mouth

The place where a river ends by flowing into a sea, a lake or another river.

silt

Fine bits of soil carried along by moving water. When the water slows down, the silt settles.

delta

Flat new land built from silt where a river reaches the sea, often shaped like a fan or a triangle.

dike

A long bank of earth built beside a river to keep its water from spilling over the land.

CORE IDEAS

The story. In the summer of 1855, the Yellow River of China was running high with rain. For hundreds of years farmers had built tall banks of earth called **dikes** to hold it in. That year, at a place in the province of Henan, the water broke through. The great river poured across the farmland. It carved a brand-new path and found a new way to the sea, far to the north, on the other side of the Shandong Peninsula. A whole river had moved! The Chinese have

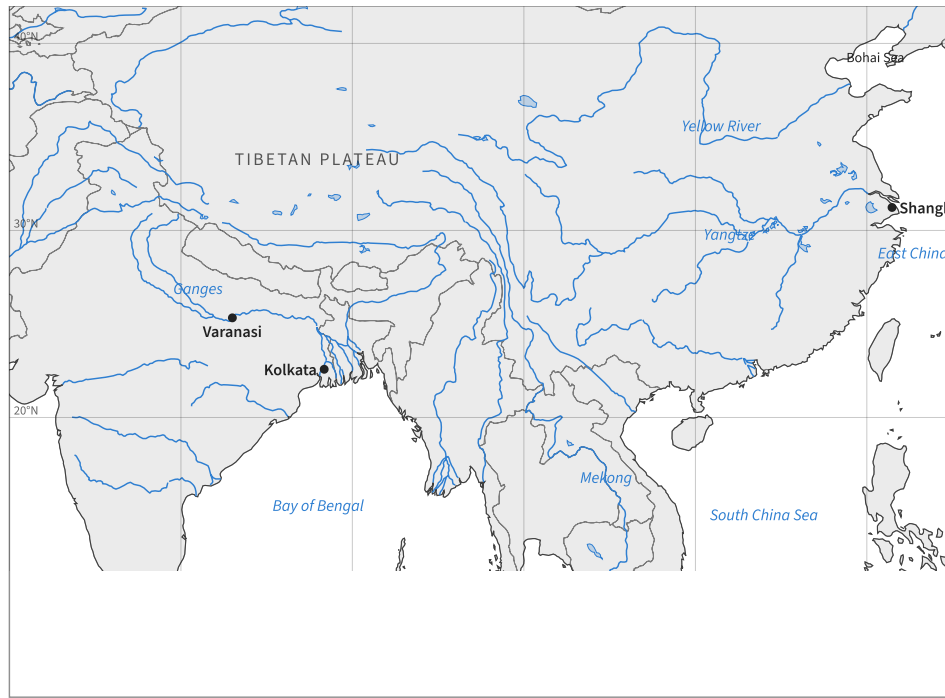
two names for the Yellow River. They call it “Mother River” because it gives water and rich soil, and “China’s Sorrow” because of its terrible floods.

How it works. Why is the Yellow River yellow? It flows through a land of fine, yellow, dusty soil. Rain washes this soil into the river, and the water carries it along as **silt**, just like the dirt in your shaken jar. When the river slows down, the silt sinks. Over many years it piles up on the river bottom and lifts the river higher. People build the dikes higher too, until in some places the river flows above the fields around it! That is why a break in a dike is so dangerous. But silt is also a gift. When floods spread it over the fields, it leaves rich soil for crops. At the river’s **mouth**, the silt builds new land called a **delta**.

The big idea. Rivers are roads, water for farms and builders of land, so people have always lived beside them. Most of Asia’s great rivers begin on the Tibetan Plateau and in the Himalaya, the highest land on earth, where snow and ice melt into streams. From that high **source**, they run downhill to the sea. Some of the largest cities in the world grew up along these rivers.

On the map. The **Yangtze** is the longest river in Asia, about 3,900 miles long. It flows east across the middle of China and reaches the East China Sea at Shanghai, one of the busiest ports in the world. The **Yellow River**, about 3,400 miles long, runs through northern China into the Bohai Sea. The **Ganges**, about 1,600 miles long, begins at a glacier in the Himalaya and flows across India to the Bay of Bengal. Near its mouth it joins another river, the Brahmaputra, and together they build the largest delta in the world. The **Mekong**, about 2,700 miles long, flows south through six countries: China, Myanmar, Laos, Thailand, Cambodia and Vietnam. In Laos, wide waterfalls called the Khone Falls block big boats from sailing up the river.

God’s gift of rivers. Every one of these rivers carries water from high mountains down to the sea, and the sun lifts it back up as clouds to fall again as rain and snow. Solomon saw this long ago: “All the rivers run into the sea; yet the sea is not full.”



Four great rivers of Asia. Three of them begin on the Tibetan Plateau; the Ganges begins in the Himalaya.

PICTURE STUDY



Along the River During the Qingming Festival, Zhang Zeduan, early 1100s (Northern Song dynasty) · Handscroll, ink and color on silk · Palace Museum, Beijing

This painting is a scroll more than 17 feet long but only about 10 inches tall. It was meant to be unrolled a little at a time, like reading a story from right to left. The painter, Zhang Zeduan, showed the busy capital city of China about 900 years ago, beside a river that was fed by the Yellow River.

More than 800 people appear in the scroll, along with boats, camels, oxen, carts, shops and inns. It shows how a river was the city's main road, bringing grain and goods from far away.

Look closely

- Find the big arched wooden bridge. What is happening to the boat under it? Why are the sailors so busy?
- Look for men pulling a boat with ropes from the riverbank. Why would they need to pull it?
- Find a shop or an inn by the water. What do you think people bought there?
- Count the boats you can see in one part of the scroll. Are they all the same size?

Talk about it

1. Why do you think so many people chose to live and work right beside the river?
2. How is this river city like a city near you with a river, a highway or a railroad?

3. The painter put in hundreds of tiny people doing ordinary work. What does that tell you about what he thought was worth painting?

PROJECT: FOUR RIVERS YARN MAP AND SILT JAR

You will make the four great rivers of Asia out of yarn, cut to scale, and lay them on a big paper map. Then you will watch silt settle in a jar and see how a river builds a delta.

You will need

- Blue yarn or string, at least 12 feet
- Yardstick or ruler, scissors and tape
- A large sheet of paper (or several taped together) and markers
- A clear jar with a lid, water and a few spoonfuls of soil
- A baking pan, sand or dirt, and a cup of water for the delta test

Steps

1. Write the scale on your paper: 1 inch = 100 miles.
2. Cut yarn to scale: Yangtze 39 inches (3,900 miles), Yellow River 34 inches (3,400 miles), Mekong 27 inches (2,700 miles), Ganges 16 inches (1,600 miles). Cut one more, 23 inches, for the Mississippi (about 2,300 miles) to compare.
3. Lay the four Asian rivers on your paper in their real shapes, using the map in the lesson as a guide. Tape them down.
4. Mark the source of each river with a small mountain and the mouth with a blue wave. Label each river and the sea it reaches.
5. Lay the Mississippi yarn straight along the bottom of the paper so you can compare it with the others.
6. Silt jar: shake your jar of soil and water again. Watch it for five minutes and draw what you see every minute.
7. Delta test: pile damp sand at one end of a baking pan and tilt the pan a little. Slowly pour water at the top. Watch the sand that washes down spread out into a fan at the bottom. That fan is a little delta!

Tips

- Rivers wiggle, so your yarn will look shorter on the map than when it lies straight. That is fine; it is the same length.
- Do the delta test outside or over a towel.

Check your work

- My four rivers are cut to the right length and placed in the right part of Asia.
- I can name the sea or bay each river reaches.
- I can explain what silt is and how it builds a delta.

MAP NOTEBOOK

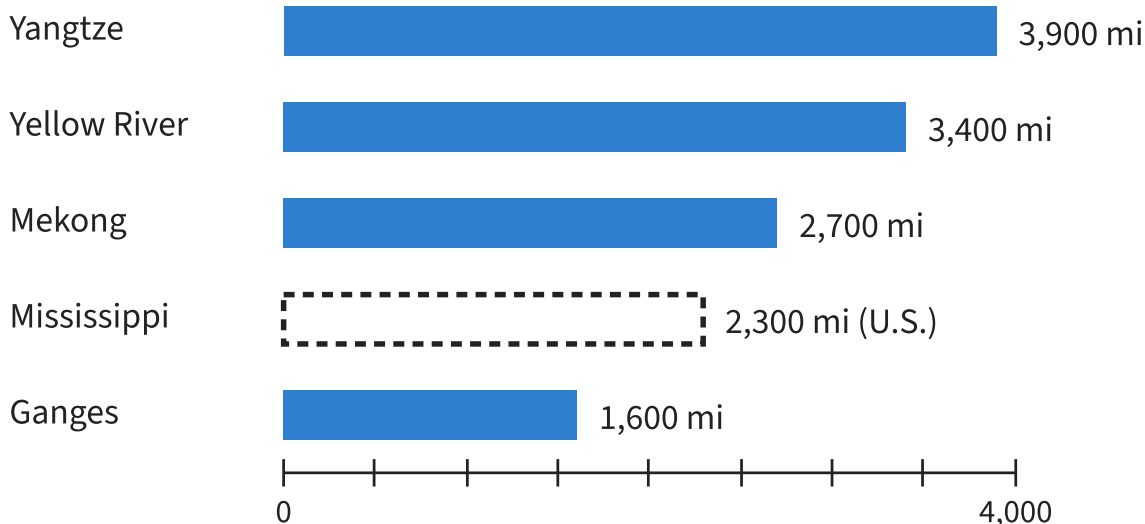
1. Draw a river from its source in the mountains to its mouth at the sea. Label the source, the mouth and the delta.
2. Draw a cut-away picture of the Yellow River flowing above the fields between two tall dikes. Draw the fields lower than the river.
3. Make a list of the four rivers from longest to shortest, with their lengths.

From history. Long ago, the Chinese dug a great canal to join the Yangtze and the Yellow River, so that boats could carry rice from the rainy south to the drier north. It is called the Grand Canal, and parts of it were dug more than 1,400 years ago. It is still the longest canal in the world, more than 1,000 miles long, and boats still use parts of it today.

WORKED EXAMPLES

Example 1. The Yangtze is about 3,900 miles long. The Mississippi is about 2,300 miles long. How much longer is the Yangtze?

Each small mark = 500 miles



The lengths of four great rivers of Asia, with the Mississippi for comparison.

1. We are comparing two lengths, so we subtract: $3,900 - 2,300$.
2. Subtract the hundreds: 39 hundreds $-$ 23 hundreds = 16 hundreds.
3. 16 hundreds is 1,600.

Answer: The Yangtze is about 1,600 miles longer than the Mississippi.

Example 2. On your yarn map, 1 inch stands for 100 miles. The Mekong is about 2,700 miles long. How long should you cut its yarn?

1. Each inch stands for 100 miles. We need to find how many hundreds are in 2,700.
2. 2,700 is 27 hundreds.
3. So we need 27 inches of yarn.
4. Check: $27 \times 100 = 2,700$ miles.

Answer: Cut 27 inches of yarn for the Mekong.

PRACTICE

1. **EASY** Why is the Yellow River yellow?
2. **EASY** Look at the map. Which river reaches the sea at Shanghai? Which river flows into the Bay of Bengal?
(Use the map or drawing "Use the map to find each river's mouth." shown earlier in this lesson.)
3. **MEDIUM** The Yangtze is about 3,900 miles long and the Yellow River is about 3,400 miles long. How much longer is the Yangtze?
4. **MEDIUM** On a map where 1 inch stands for 100 miles, how many inches long is the Ganges, which is about 1,600 miles long?
5. **MEDIUM** Shanghai is near 31°N , 121°E . Is it north or south of the equator? Is it east or west of the prime meridian?
6. **HARD** Rivers like the Yellow River can flood. Write two or three sentences explaining why so many farmers still choose to live beside them.

COMMON MISTAKES

- Mixing up the source and the mouth. The source is where a river begins (usually high up); the mouth is where it ends at the sea.
- Thinking rivers flow north to south. Rivers flow downhill in any direction: the Yangtze flows east, and the Mekong flows south.
- Thinking silt is only bad. Silt makes floods messy, but it also builds rich farmland and new land at the delta.

Make it a game • River Relay. Write the four river names on four cards and the names of their seas on four more cards: East China Sea, Bohai Sea, Bay of Bengal and South China Sea. Mix them up and lay them face down. Take turns flipping two cards. If you flip a river and its own sea, keep the pair and trace the river from source to mouth on the map. The player with the most pairs wins.

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)

God made the water cycle. The Yangtze, the Ganges and every other river pour into the sea day and night, yet the sea never overflows, because the water returns as clouds, rain and snow to the mountains where the rivers begin.

Practice answers

1. It carries a great deal of fine, yellow silt washed from the dusty soil it flows through.
2. The Yangtze reaches the sea at Shanghai. The Ganges flows into the Bay of Bengal.
3. $3,900 - 3,400 = 500$ miles longer.
4. 1,600 is 16 hundreds, so 16 inches.
5. North of the equator (N) and east of the prime meridian (E).
6. Rivers give water for crops, animals and people, and the silt they leave behind makes very rich soil. Rivers are also roads for boats carrying goods. So farmers live there for the good land and water, and build dikes to protect against floods.

4.3 AUSTRALIA: THE ISLAND CONTINENT

OBJECTIVES

- Explain why Australia is called the island continent and tell how Matthew Flinders sailed all the way around it.
- Locate the Outback, the Great Barrier Reef, Uluru and the coastal cities where most Australians live.
- Use a map scale and compass directions to find distances and directions in Australia.

Warm-up. Fill a sink or a big bowl with water and float a plate or a lid in it. Walk your fingers all the way around the edge of the plate. You went around an island! Now look at a globe. Which continent could you sail all the way around without ever touching another continent, and is small enough to be one country?

Video. Coming soon. Australia for children: the Outback and Uluru, the Great Barrier Reef and coral, kangaroos and koalas, Sydney and the coast; search NASA Earth Observatory (Great Barrier Reef from space), Smithsonian, Homeschool Pop (Alternate), Memoria Press; candidates needing vetting: National Geographic Kids, Free School.

KEY TERMS

island continent

A continent with water all the way around it. Australia is the only continent that is also a single country.

Outback

The huge, dry, mostly empty middle of Australia, far from the coast.

coral reef

A long ridge in warm, shallow sea built from the stony skeletons of millions of tiny animals called coral polyps.

coast

The land along the edge of the sea.

station

In Australia, a very large farm or ranch where sheep or cattle are raised.

CORE IDEAS

The story. In July 1802, a young English captain named **Matthew Flinders** sailed out of Sydney in a ship called the *Investigator*. With him went sailors, two artists, a plant scientist and his favorite cat, a black cat with white paws named **Trim**. Flinders had a big question to answer. Sailors had mapped bits and pieces of the land, but was it one great island, or was it split in two by a hidden sea? Flinders sailed north along the coast, west across the top, down

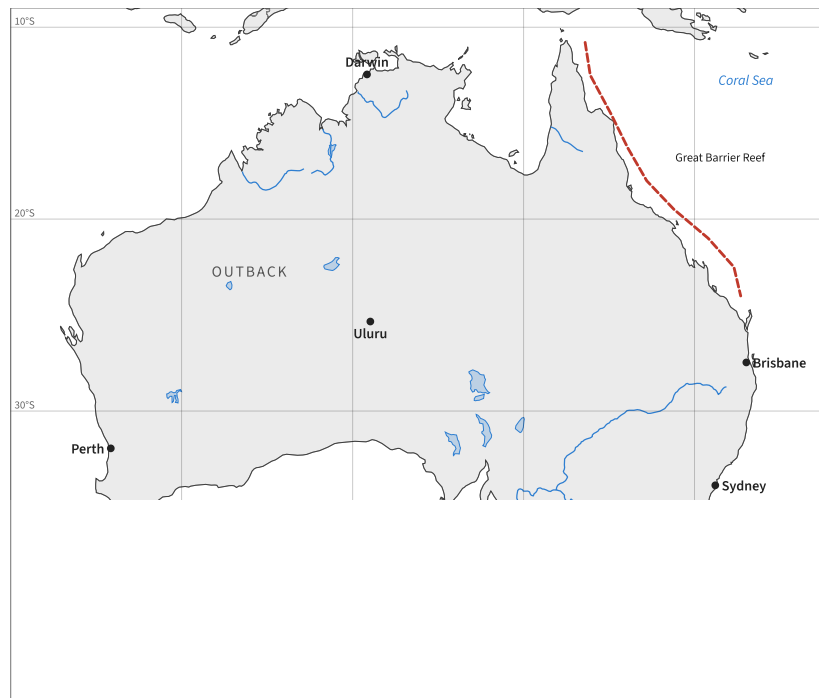
the west side and back east along the south coast. His leaky ship was rotting, but in June 1803 he came back into Sydney. He had sailed all the way around. It was one land!

How they figured it out. Flinders charted the coast mile by mile. He used a compass to find directions, dropped a weighted line to measure how deep the water was, and measured the sun and stars to find his latitude. His careful maps showed that the coast was unbroken. Flinders liked the name **Australia** for the whole land. It comes from a Latin word that means “southern.” In 1814 his book about the voyage helped the name catch on.

The big idea. Australia is the smallest continent and the only continent that is also one country. It is called the **island continent** because water surrounds it on every side. It is almost as big as our 48 states put together, yet only about 27 million people live there, fewer than live in the state of California. Why so few? Most of Australia is very dry. The middle is called the **Outback**: red sand, rocky hills, dry grass and very few towns. In the middle of it rises **Uluru**, a giant red rock about 1,142 feet tall. Cattle and sheep stations in the Outback can be bigger than some American states, and families on them may live hundreds of miles from a town.

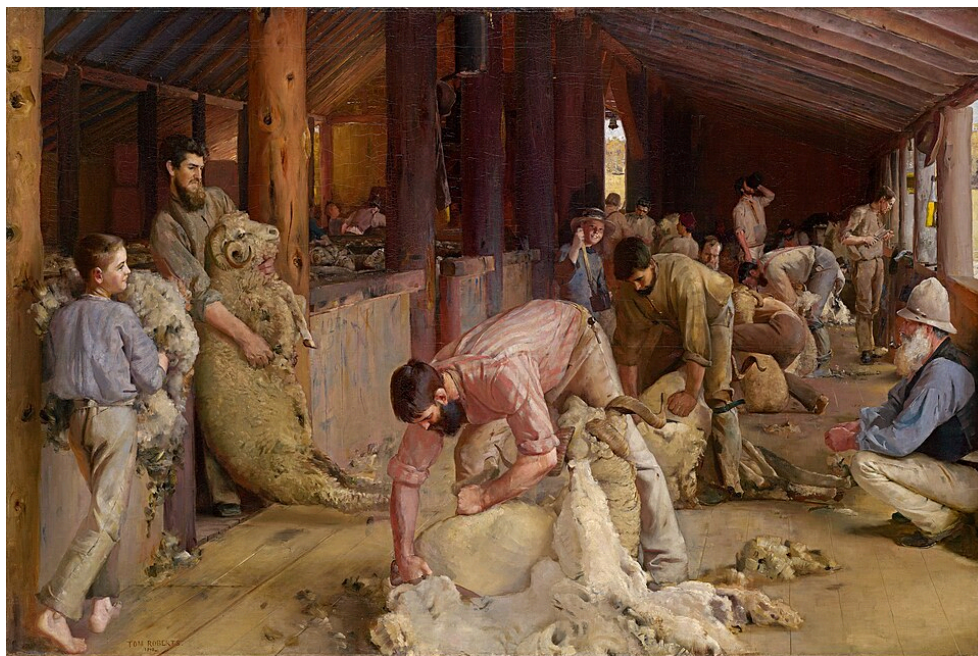
On the map. Most Australians live near the **coast**, especially in the southeast, where more rain falls and the weather is milder. The biggest cities are Sydney and Melbourne, with about 5 million people each, then Brisbane and Perth. The capital is Canberra. The Aboriginal peoples and the Torres Strait Islanders lived in Australia for a very long time before British settlers arrived in 1788. Off the northeast coast lies the **Great Barrier Reef**, the largest coral reef in the world. It stretches about 1,400 miles and is made of about 2,900 separate reefs. Tiny animals called coral polyps, each smaller than your fingernail, built it. In 1770, Captain James Cook’s ship *Endeavour* ran onto this reef at night; his crew threw cannons overboard to float it free.

Wonders of God’s making. Australia is home to animals found almost nowhere else in the wild: kangaroos, koalas, wombats and the duck-billed platypus, which lays eggs. Around the reef swim thousands of kinds of fish, turtles and sharks. As the psalm says of the sea, it is full of “things creeping innumerable, both small and great beasts.”



Australia: most people live on the coast, especially in the southeast. The Great Barrier Reef runs along the northeast.

PICTURE STUDY



Shearing the Rams, Tom Roberts, 1890 · Oil on canvas · National Gallery of Victoria, Melbourne

Tom Roberts was one of Australia's best-known painters. He spent weeks in a shearing shed on a sheep station in New South Wales, making sketches while the men worked, so that he could paint the scene truthfully. He wanted to show the hard work that made Australia famous for its wool.

Wool from Australian sheep was shipped across the oceans to make cloth for coats and blankets all over the world. A good shearer could clip more than 100 sheep in one day with hand shears.

Look closely

- Find the shearers. How are they holding the sheep still?
- Find the young girl and the boy. What job might each of them be doing?
- Look at the light coming through the walls of the shed. Where is it brightest?
- Look at the wood of the shed. Does it look new or old? What does that tell you?

Talk about it

1. Why do you think sheep stations in Australia had to be so large?
2. What might be hard about working in a shearing shed in the hot Australian summer?
3. Tom Roberts painted ordinary workers instead of kings or generals. Why might their work be worth a big painting?

PROJECT: FELT OR PAPER MAP OF AUSTRALIA WITH THE REEF

You will build a map of Australia from felt or colored paper, with the dry Outback, the green coast, the big cities and the Great Barrier Reef. It will be part of your unit map.

You will need

- Felt or construction paper: blue (sea), red-orange (Outback), green (wetter coast), tan or yellow (dry grassland), pink or purple (reef)
- A printed outline map of Australia, or the map in this lesson traced large
- Scissors, glue stick or fabric glue, and a marker
- Small buttons, beads or stickers for cities
- A ruler

Steps

1. Lay the blue felt or paper down as the sea.
2. Trace the outline of Australia, cut it out of tan felt or paper and glue it in the middle of the blue.
3. Cut a big red-orange shape for the Outback and glue it in the middle and west. Leave the edges showing.
4. Cut a thin green strip and glue it along the east and southeast coast, where most of the rain falls. Add a small green patch near Perth in the southwest and along the top in the north.
5. Glue a small red-brown dot near the middle for Uluru.
6. Cut many tiny pink or purple pieces and glue them in a long line off the northeast coast for the Great Barrier Reef. Make it about 7 inches long if your map is drawn so that 1 inch stands for 200 miles.

7. Glue buttons for Sydney, Melbourne, Brisbane, Perth, Adelaide, Darwin and Canberra, and label each one.
8. Add a compass rose, a title and a scale bar.

Tips

- Notice how many of your city buttons sit right on the coast. That is the lesson of the map!
- Don't forget the island of Tasmania off the southeast corner.

Check your work

- My map shows the Outback, the wetter coast, Uluru and the Great Barrier Reef in the right places.
- I placed at least six cities, and I can explain why most of them are on the coast.
- My map has a title, a compass rose and a scale.

MAP NOTEBOOK

1. Draw Flinders' route around Australia as a dotted line with arrows, and draw a little cat on the ship.
2. Draw a close-up of a coral reef with fish, a turtle and coral, and label it "Great Barrier Reef, about 1,400 miles long."
3. Draw Uluru standing alone on the flat red Outback, with a tiny person beside it to show how big it is.

From history. Trim the cat sailed with Matthew Flinders for years and even survived a shipwreck with him. Flinders loved him so much that he wrote a short book about him. Today a bronze statue of Trim sits on a window ledge of the State Library of New South Wales in Sydney, just behind a statue of his captain.

WORKED EXAMPLES

Example 1. On a map of Australia, 1 inch stands for 200 miles. The Great Barrier Reef measures 7 inches on the map. About how long is the reef?

(Use the map or drawing "Find the Great Barrier Reef along the northeast coast." shown earlier in this lesson.)

1. Each inch stands for 200 miles, and there are 7 inches.
2. Multiply: 7×200 . Think $7 \times 2 = 14$, then add two zeros: 1,400.
3. Check: $200 + 200 + 200 + 200 + 200 + 200 + 200 = 1,400$.

Answer: The Great Barrier Reef is about 1,400 miles long.

Example 2. Uluru is near 25°S, 131°E. Sydney is near 34°S, 151°E. If you traveled from Uluru to Sydney, which direction would you go?

1. Both places are in the Southern Hemisphere, so the bigger the S number, the farther south.
2. 34°S is a bigger number than 25°S, so Sydney is farther south.
3. 151°E is a bigger number than 131°E, so Sydney is farther east.
4. South and east together make southeast. Check on the map: Sydney is down and to the right of Uluru.

Answer: You would travel southeast.

PRACTICE

1. **EASY** Why is Australia called the island continent?
2. **EASY** What tiny animals built the Great Barrier Reef?
3. **MEDIUM** Look at the map. Which of these cities is farthest north: Darwin, Perth or Melbourne?
(Use the map or drawing “Find Darwin, Perth and Melbourne.” shown earlier in this lesson.)
4. **MEDIUM** About 27 million people live in Australia. About 5 million live in Sydney and about 5 million live in Melbourne. About how many people live outside these two cities?
5. **MEDIUM** The road from Perth to Sydney is about 2,500 miles long. If a family drives about 500 miles each day, about how many days will the trip take?
6. **HARD** Write two or three sentences explaining why most Australians live near the coast and not in the Outback.

COMMON MISTAKES

- Thinking Australia is just a big island and not a continent. It is a continent, and the smallest one.
- Thinking Australia is cold in December because it is cold here. Australia is in the Southern Hemisphere, so its summer is in December, January and February.
- Thinking the Great Barrier Reef is a pile of rocks. It is built by living animals, the coral polyps.

Make it a game • Coast or Outback?. A parent calls out a place or a thing: Sydney, a camel, Uluru, a surfboard, a sheep station, Melbourne, red sand, a harbor full of ships. Hop to one side of the room for “Coast” or the other side for “Outback.” Then point to it on your felt map. Score one point for each right hop and one for the right spot on the map. Play to ten points.

Scripture. “So is this great and wide sea, wherein are things creeping innumerable, both small and great beasts.” (Psalm 104:25, KJV)

The Great Barrier Reef is one of the best places on earth to see this verse come true: tiny coral polyps, bright little fish, and great sea turtles, sharks and whales, all made by God.

Practice answers

1. Because it is a whole continent with water all the way around it. It is also the only continent that is one country.
2. Coral polyps. Over a very long time their stony skeletons built up the reef.
3. Darwin. It is on the north coast, near 12°S, much closer to the equator.
4. $5 + 5 = 10$ million in the two cities. $27 - 10 = 17$ million live outside them.
5. $500 + 500 + 500 + 500 + 500 = 2,500$, so about 5 days. Australia is wide!
6. The Outback is very dry, with little water for farms, towns and people. The coast, especially in the southeast, gets more rain and milder weather, and it has harbors where ships can bring goods. So the big cities grew up along the coast.

4.4 ANTARCTICA

OBJECTIVES

- Locate Antarctica and the South Pole and explain why Antarctica is the coldest, driest and windiest continent.
- Tell the story of Roald Amundsen's journey to the South Pole in 1911 and how he prepared for the cold.
- Use latitude and a compass to reason about directions and distances near the South Pole.

Warm-up. Hold an ice cube in your bare hand for as long as you comfortably can (no more than a minute), then drop it in a cup. Now wrap the next ice cube in a mitten or a sock and hold it again. Which way was easier? Explorers of the coldest place on earth had to think hard about how to keep warm. Today you will find out how.

Video. Coming soon. Antarctica for children: the South Pole, the ice sheet, penguins, Amundsen and Scott, and life at a research station; search NASA and NASA Earth Observatory (Antarctic ice from space), Smithsonian, Library of Congress, Homeschool Pop (Alternate); candidates needing vetting: National Geographic Kids, NOAA SciJinks, Free School.

KEY TERMS

South Pole

The point at the very bottom of the earth, at 90° south latitude. Every direction from it is north.

ice sheet

A huge, thick blanket of ice that covers land for a very long time. Antarctica's ice sheet is more than a mile thick in most places.

polar desert

A cold place that gets very little snow or rain each year. Antarctica is the biggest one.

iceberg

A large piece of ice that breaks off an ice sheet or glacier and floats in the sea.

research station

A base where scientists live and work for a season or a year to study a place.

CORE IDEAS

The story. On December 14, 1911, five Norwegian men on skis and their dog teams stopped on a flat, white plain of snow. Their leader, **Roald Amundsen**, checked his instruments again and again. They had reached the **South Pole**, the bottom of the world, and they were the first people ever to stand there. They set up a small tent, raised the flag of Norway and

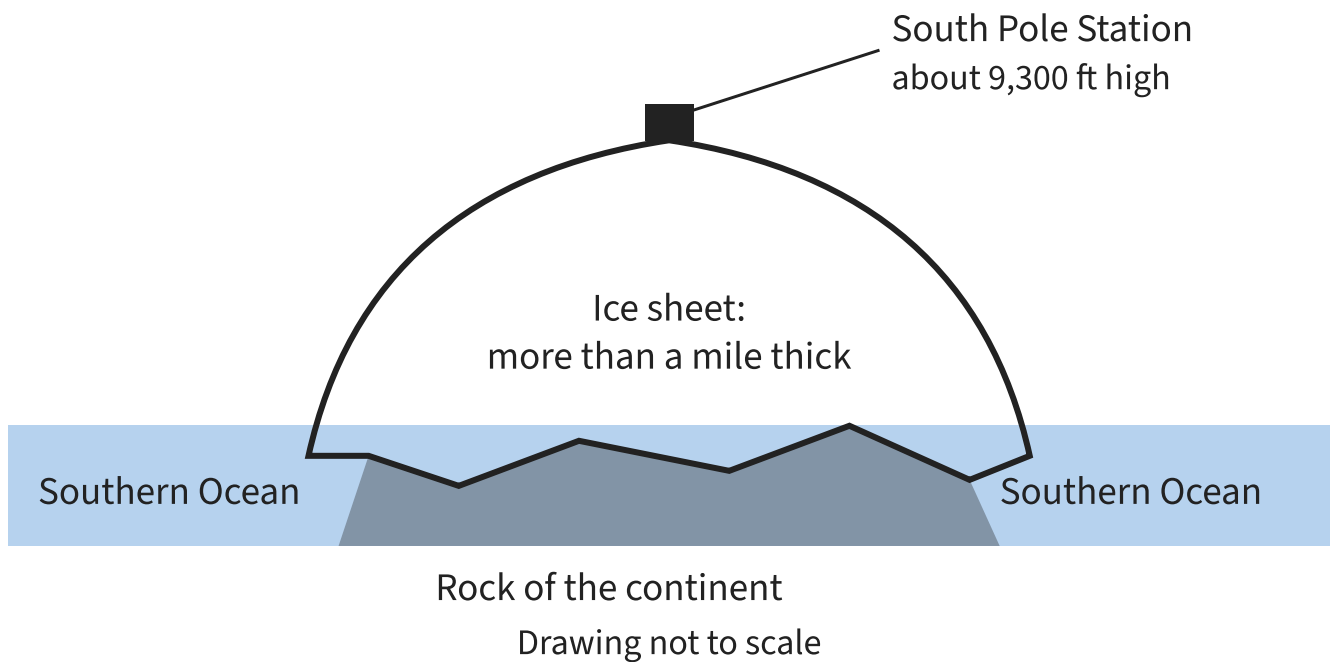
left a letter. Thirty-four days later, a British team led by Captain Robert Falcon Scott arrived and found the Norwegian tent waiting. Scott's five men were brave and determined, but on the long walk back they ran short of food and fuel in terrible cold, and none of them lived to reach home.

How they did it. Amundsen had spent years getting ready. Earlier, in the Arctic, he had lived near the Inuit people and learned how they stayed warm: loose clothes of fur and skins, and dogs to pull sleds. His men were also expert skiers. On the way south they left piles of food and fuel called depots, marked with flags, so they would have supplies on the trip back. Careful planning, good teachers and strong dogs brought every one of his men home safely.

The big idea. Antarctica is the coldest, driest and windiest continent on earth. It is bigger than the United States. Almost all of it lies under an **ice sheet** more than a mile thick in most places, and in the deepest spots nearly three miles thick! This ice holds most of the fresh water on earth. Yet Antarctica is a desert, a **polar desert**, because very little new snow falls each year. The ice built up slowly, over a very long time, because it almost never melts. In 1983, scientists at a Soviet station called Vostok (now run by Russia) measured about 129 degrees below zero, the coldest temperature ever measured on the ground. Because Antarctica is in the Southern Hemisphere, its summer comes in December and January. Then the sun never sets at the South Pole. In winter it never rises.

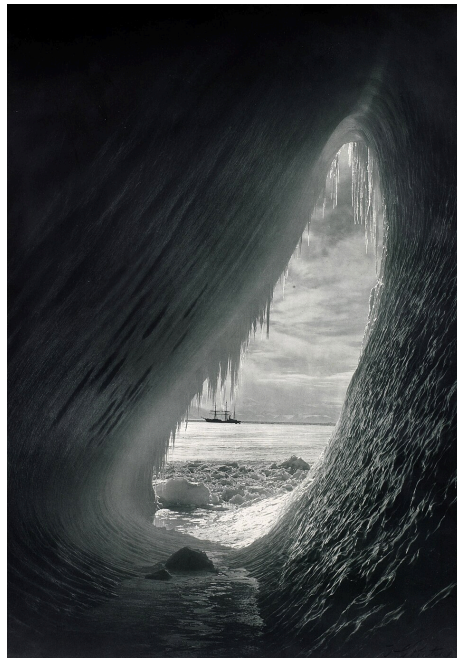
On the map. Antarctica sits around the South Pole, with the Southern Ocean all around it. The closest continent is South America, about 600 miles away across a stormy stretch of water called the Drake Passage. No one lives in Antarctica all the time, and no country rules it. In 1959, twelve nations signed the Antarctic Treaty, agreeing to use Antarctica only for peaceful work and science. Today scientists from many countries live at research stations. The United States runs the Amundsen-Scott South Pole Station, named for both explorers. Along the icy coasts live seals, whales and penguins, including the tall emperor penguins.

God's storehouses of ice. When God spoke to Job out of the whirlwind, He asked him, "Out of whose womb came the ice?" Antarctica is the greatest answer on earth: a whole continent of ice, made and kept by the Creator.



Antarctica's ice sheet sits on top of the rock of the continent. Drawing not to scale.

PICTURE STUDY



A Grotto in an Iceberg, Herbert Ponting, January 1911 · Photograph · Prints are held in several collections, including the Scott Polar Research Institute, University of Cambridge

Herbert Ponting was the photographer on Captain Scott's expedition. He called himself a "camera artist." He carried heavy cameras and glass plates across the ice and worked in the bitter cold, sometimes with his fingers sticking to the frozen metal.

In January 1911 he found a cave inside an iceberg near the expedition's ship, the *Terra Nova*. Two scientists from the expedition stood at the opening, and Ponting framed the ship through the curving ice. It became one of the most famous photographs ever taken in Antarctica.

Look closely

- Find the ship. How did Ponting use the ice cave like a picture frame?
- Find the two men. How big do they look next to the ice?
- Look at the walls of the cave. Can you see where the light shines through the ice?
- Is the water calm or rough? How can you tell?

Talk about it

1. This photograph has no color. What colors do you imagine the ice and sea really were?
2. Why do you think people back home in England wanted so much to see pictures like this one?
3. If you could take one photograph in Antarctica, what would it be?

Safety first. Keep the ice-water test short: take your hand out after one minute or sooner if it hurts. Dry and warm your hands afterward. An adult should handle the shortening and the hot-water cleanup.

PROJECT: THE BLUBBER GLOVE AND THE POLE COMPASS

Penguins, seals and whales stay warm in icy water with a thick layer of fat called blubber. You will make a blubber glove and test it in ice water. Then you will stand on a paper South Pole and find out why every way is north.

You will need

- A big bowl of water with plenty of ice
- Four zip-top sandwich bags and a cup of solid vegetable shortening
- Duct tape or masking tape
- A timer or a clock with a second hand
- A large sheet of paper, a marker and a pencil

Steps

1. Scoop the shortening into one zip bag. Turn a second bag inside out and push it inside the first bag. Squish the shortening around so it makes an even layer between the two bags. Tape the tops of the two bags together so the shortening stays in. This is your blubber glove.
2. Put an empty bag on your other hand.
3. Dip the empty-bag hand into the ice water and count how many seconds until it feels too cold. Take it out by one minute at the most.

4. Now dip the blubber-glove hand in and count again. Which hand stayed warm longer? Write both times in your notebook.
5. Pole compass: draw a big circle on the paper. Put a dot in the middle and label it "South Pole."
6. Draw eight arrows from the dot pointing outward in different directions. Label every arrow "North."
7. Stand on the dot. Turn to face any arrow. Which direction are you facing? Explain to someone why that is true.

Tips

- Penguins also have tightly packed feathers, and they huddle together in big groups in the coldest weather.
- Clean shortening off hands and bags with warm, soapy water.

Check your work

- I tested both hands and wrote down the times.
- I can explain how blubber keeps sea animals warm.
- I can explain why every direction from the South Pole is north.

MAP NOTEBOOK

1. Draw Antarctica as a white shape around a dot for the South Pole, with blue Southern Ocean all around. Add an arrow from the tip of South America to show the Drake Passage.
2. Draw Amundsen's team with skis, sleds and dogs, and a little tent with a flag at the pole. Write the date: December 14, 1911.
3. Draw an emperor penguin standing next to a third grader. Emperor penguins can stand almost 4 feet tall. Who is taller?

From history. In 1820, sailors from Russia, Britain and the United States all reported seeing land at the bottom of the world, and people still argue about which ship saw the mainland first. For many years after that, the main visitors were seal hunters. No one even saw the South Pole for another 91 years, until Amundsen's team arrived in 1911.

WORKED EXAMPLES

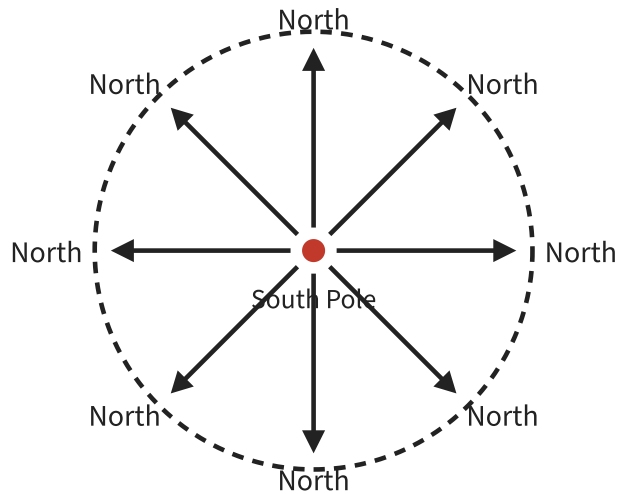
Example 1. The South Pole Station stands on top of the ice, about 9,300 feet above sea level. Denver, Colorado, is called the “Mile High City” because it is about 5,280 feet above sea level. How much higher is the South Pole Station?

(Use the map or drawing “The South Pole Station sits high up on top of the ice sheet.” shown earlier in this lesson.)

1. We are comparing two heights, so we subtract: $9,300 - 5,280$.
2. Regroup and subtract: $9,300 - 5,280 = 4,020$.
3. Check by adding: $4,020 + 5,280 = 9,300$. It matches.

Answer: The South Pole Station is about 4,020 feet higher than Denver. The thick ice makes Antarctica the highest continent on average, which is one reason it is so cold.

Example 2. Amundsen started from the Bay of Whales, near 78°S. The South Pole is at 90°S. Each degree of latitude is about 70 miles. About how far is the Bay of Whales from the South Pole in a straight line, and which direction did Amundsen travel?



Dashed circle: a line of latitude near the pole

At the South Pole, every direction is north.

1. Find the difference in latitude: $90 - 78 = 12$ degrees.
2. Each degree is about 70 miles, so multiply: 12×70 . Think $12 \times 7 = 84$, then add a zero: 840.
3. The pole is farther south (90°S is a bigger S number), so he traveled south.

Answer: About 840 miles in a straight line, traveling south. Coming home, he traveled north.

PRACTICE

1. **EASY** Antarctica is covered with ice. Why is it still called a desert?
2. **EASY** Who led the first team to reach the South Pole, and in what year?
3. **MEDIUM** Amundsen reached the pole on December 14. Scott reached it 34 days later. Is that more or less than one month? About how many weeks is it?
4. **MEDIUM** A ship crosses the Drake Passage, about 600 miles, from South America to Antarctica. If it sails about 200 miles each day, how many days will the crossing take?
5. **MEDIUM** You are standing exactly at the South Pole. You walk ten steps in any direction you choose. Which direction did you walk?
6. **HARD** It is July, and children in the United States are swimming in the summer sun. What season is it in Antarctica, and what is the sky like at the South Pole? Explain why.

COMMON MISTAKES

- Thinking polar bears live in Antarctica. Polar bears live in the Arctic, near the North Pole. Almost all penguins live in the Southern Hemisphere, and many live in Antarctica.
- Thinking Antarctica is just frozen sea, like the ice around the North Pole. Antarctica is real land, a continent, with an ice sheet on top.
- Thinking a country owns Antarctica. No country rules it; many nations share it for science under the Antarctic Treaty.

Make it a game · Pole to Pole. Stand in the middle of the room. A parent calls out “North Pole!” or “South Pole!” and then a word: penguin, polar bear, Amundsen, Arctic Ocean, emperor penguin, Antarctic Treaty, Inuit, Southern Ocean. Run to the north wall or the south wall for the pole where that word belongs. Score a point for each right run. If the parent calls “Stand on the South Pole!” everyone freezes and points, and every direction counts as north.

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 asked Job these questions to remind him how great the Creator is. Around Antarctica the sea itself freezes hard every winter, “hid as with a stone,” just as the verse says.

Practice answers

1. A desert is a place that gets very little rain or snow each year. Very little new snow falls in Antarctica. The ice is thick only because it has built up over a very long time and almost never melts.
2. Roald Amundsen of Norway, on December 14, 1911.
3. More than one month (most months have 30 or 31 days). 34 days is about 5 weeks ($5 \times 7 = 35$).
4. $200 + 200 + 200 = 600$, so about 3 days.
5. North. From the South Pole, every direction is north.
6. It is winter in Antarctica. At the South Pole the sun does not rise at all, so it is dark all day. Antarctica is in the Southern Hemisphere, so its seasons are the opposite of ours.

UNIT 4 REVIEW

Answer each question. Show your work for the number problems and use complete sentences for the explanations. Use the globe or the lesson maps when a question asks you to. This review is worth 40 points.

1. (4 pts) Which continent is the biggest? Name one mountain range, one cold region and one desert found on it.
2. (4 pts) Mount Everest is about 29,032 feet tall. Mount Fuji is about 12,388 feet tall. How much taller is Everest? Show your work.
3. (4 pts) The surveyors who measured Mount Everest in the 1850s never climbed it. How did they find its height?
4. (4 pts) Match each river to the sea or bay it flows into: Yangtze, Ganges, Mekong.
Choices: Bay of Bengal, South China Sea, East China Sea.
5. (4 pts) What is silt? Give one way it helps people and one way it causes trouble.
6. (4 pts) On a map, 1 inch stands for 100 miles. The Yellow River is about 3,400 miles long. How many inches long is it on the map?
7. (4 pts) Why is Australia called the island continent? Who first sailed all the way around it, and when?
8. (4 pts) On a map of Australia, 1 inch stands for 200 miles. The Great Barrier Reef is 7 inches long on the map. How long is the real reef? What built it?
9. (4 pts) Uluru is near 25°S, 131°E. Sydney is near 34°S, 151°E. Which direction is Sydney from Uluru? Explain how you know.
10. (4 pts) Give two reasons Antarctica is a hard place to live. Then tell who first reached the South Pole and in what year.

UNIT PROJECT: MY MAP OF ASIA, AUSTRALIA AND ANTARCTICA

Make a large map of Asia, Australia and Antarctica on poster board or taped-together paper. On Asia, draw the Himalaya with Mount Everest, Siberia with Lake Baikal, the Gobi Desert, Mount Fuji, and the Yangtze, Yellow, Ganges and Mekong rivers with the sea each one reaches. Glue on your felt or paper Australia map with the Outback, Uluru, the coastal cities and the Great Barrier Reef. At the bottom, draw Antarctica around the South Pole with the Southern Ocean and Amundsen's route from the Bay of Whales.

Add a compass rose, a title, a key and the equator line. Beside the map, put your Mountain Height Ladder measurements, your silt jar drawings and your blubber glove times, and write three sentences telling which of the three continents you would most like to visit and why.

- **Accuracy:** Mountains, rivers, deserts, cities, the reef and the South Pole are in the right places and labeled clearly.
- **Map tools:** The map has a title, a compass rose, a key and the equator, and the student can use them to give directions.

- **Records:** The mountain heights, silt jar drawings and blubber glove times are complete and neatly written.
- **Care:** The map is neat, colorful and easy to read, and the three sentences are complete and thoughtful.

Answer key

1. Asia. Mountain range: the Himalaya. Cold region: Siberia. Desert: the Gobi.
2. $29,032 - 12,388 = 16,644$ feet.
3. They measured angles up to the top of the mountain from stations in India, more than 100 miles away, and used careful arithmetic (trigonometry) and the distances between stations to work out the height.
4. Yangtze: East China Sea (at Shanghai). Ganges: Bay of Bengal. Mekong: South China Sea.
5. Silt is fine soil carried by moving water. It helps by leaving rich soil on farm fields and building new land in deltas. It causes trouble by piling up in the river bed, raising the river so it can break through its dikes and flood.
6. 3,400 is 34 hundreds, so 34 inches.
7. It is a whole continent with water all around it (and the only continent that is one country). Matthew Flinders sailed around it in the *Investigator* in 1802–1803.
8. $7 \times 200 = 1,400$ miles. It was built by tiny animals called coral polyps.
9. Southeast. 34°S is farther south than 25°S , and 151°E is farther east than 131°E .
10. Any two: it is the coldest continent (about 129 degrees below zero has been measured); it is very windy; it is covered by an ice sheet more than a mile thick; it is a dry polar desert; it is dark all winter. Roald Amundsen of Norway reached the South Pole first, on December 14, 1911.

OCEANS AND SEAS

Look at a globe and you will see more blue than anything else. God gathered the waters together and called them Seas, “and God saw that it was good” (Genesis 1:10). In this unit you will leave the continents behind and set out on the waters between them. The scattered lands and peoples of the world, whom God “hath made of one blood” (Acts 17:26), are joined by these waters as much as they are separated by them.

You will stand with Balboa on a hill in Panama as he first sees the Pacific, the ocean that is bigger than all the land put together. You will cross the Atlantic with the Pilgrims on the *Mayflower*, sail into icy Hudson Bay with Henry Hudson, and visit the Mediterranean and the Gulf of Mexico. Last of all, you will ride the *Trieste* almost 7 miles down to the deepest place on earth. Along the way you will learn the names of the waters: **ocean, sea, gulf, bay and strait**.

Your hands will be busy too. You will color a hundred-square map of the world, race a sailboat with and against the wind, build a coastline in a pan, and make a long paper model of the ocean’s depths. At the end you will draw your own map of the five oceans and ten great seas.

BEFORE YOU BEGIN

- Can name and find the seven continents on a globe (Units 2-4)
- Can find the equator and tell the Northern Hemisphere from the Southern Hemisphere (Unit 1)
- Can use the four cardinal directions and the in-between directions such as southwest
- Can add and subtract numbers in the thousands and count by 7s, 300s and 400s

MASTERY CHECKLIST

- I can name the five oceans and find them on a globe: Pacific, Atlantic, Indian, Southern and Arctic.
- I can explain why the Pacific is bigger than all the land on earth and tell how Balboa first saw it in 1513.
- I can tell the story of the *Mayflower*’s crossing and explain why winds made the trip west slower than the trip east.
- I can tell the difference between a sea, a gulf, a bay and a strait and find the Mediterranean, the Gulf of Mexico and Hudson Bay.
- I can compare the Challenger Deep with Mount Everest and explain how the *Trieste* reached the bottom in 1960.
- I can draw a map of the five oceans and ten great seas.

OPTIONAL BOOKS AND RESOURCES

- **NOAA Ocean Exploration** (<https://oceanexplorer.noaa.gov/>): Free. Photographs and short articles from U.S. government expeditions to the deep sea, including the Mariana Trench. A parent should choose the pages; many are written for older readers.
- **Naval History and Heritage Command** (<https://www.history.navy.mil/>): Free. The U.S. Navy's history office keeps photographs of the bathyscaphe *Trieste* and its 1960 dive (Lesson 5.4). Search the site for "Trieste."
- **Pilgrim Hall Museum** (<https://www.pilgrimhall.org/>): Free to browse online. The museum in Plymouth, Massachusetts, that owns William Halsall's painting of the *Mayflower* (Lesson 5.2), with pages about the Pilgrims and their voyage.

5.1 THE PACIFIC ★

OBJECTIVES

- Tell the story of Balboa, who in 1513 became the first European to see the Pacific from the Americas.
- Explain that the Pacific is the largest and deepest ocean and is bigger than all the land on earth put together.
- Find the Pacific on a globe and name the continents on its east and west sides.

Warm-up. Hold a globe or a beach-ball globe. Close your eyes, give it a spin and stop it with one finger. Is your finger on land or water? Make a tally mark under “Land” or “Water.” Do it 20 times. Which column won? Now guess: how many of your “water” taps landed in the biggest ocean of all?

Video. Coming soon. The Pacific Ocean for kids: size, islands and the Ring of Fire; Balboa sees the Pacific (1513). Search NASA and NASA Earth Observatory (views of the Pacific from space), Smithsonian, Drive Thru History, Homeschool Pop (Alternate).

KEY TERMS

ocean

One of the five huge bodies of salt water that cover most of the earth.

Pacific Ocean

The largest and deepest ocean, lying between Asia and Australia on the west and North and South America on the east. Its name means “peaceful.”

isthmus

A narrow strip of land with water on both sides that joins two bigger pieces of land. Panama is an isthmus.

island

A piece of land with water all around it. The Pacific has many thousands of them.

Ring of Fire

The long ring of volcanoes and earthquake zones around the edges of the Pacific Ocean.

CORE IDEAS

The story. In September 1513, a Spanish explorer named Vasco Núñez de Balboa was pushing through the hot, steamy jungle of Panama. Panama is an **isthmus**, a skinny strip of land that joins North America to South America. Native guides had told Balboa that a great sea lay beyond the mountains. Near the top of a ridge, Balboa told the others to wait, and he climbed the last stretch alone. There it was: shining blue water as far as he could see. A few days later he waded into the waves with a flag in his hand and claimed the sea, and every shore it touched, for the king of Spain. Balboa was bold and brave, but he could also be

harsh and cruel to the native people, and he could never have found that sea without their help.

How they figured it out. Balboa called the water the South Sea, because in Panama it lay to the south of him. He had no idea how big it was. Only slowly did sailors learn the truth. Ships that tried to cross it sailed for months without seeing land, and map makers had to keep stretching their maps wider and wider. Seven years after Balboa, another captain crossed it and gave it the name we still use, the **Pacific**, which means “peaceful.” (You will sail with him in Unit 8.)

The big idea. The Pacific is the largest and deepest **ocean** on earth. It covers more than 60 million square miles. All the land on earth, every continent and every island put together, covers about 57 million square miles. That means the Pacific Ocean alone is bigger than all the land in the world! At its widest, near the equator, it stretches almost halfway around the globe. On average its water is more than two miles deep. Many thousands of **islands** are scattered across it, from Hawaii to New Zealand to Japan. Around its edges stand so many volcanoes that people call its shores the **Ring of Fire**.

On the map. Turn a globe until the Pacific faces you. You will see almost nothing but blue! Asia and Australia lie on the Pacific’s west side. North America and South America lie on its east side. At the top, the Pacific squeezes through a narrow gap called the Bering Strait into the Arctic Ocean. At the bottom, it meets the Southern Ocean around Antarctica. The equator runs right across the middle of the Pacific, so it lies in both the Northern and the Southern Hemispheres.

Technology overcoming geography. For hundreds of years, crossing the Pacific was one of the hardest things a sailor could do. Today big ships carry cars, toys and food across it every day, and a jet can fly from California to Japan in about half a day. The ocean has not gotten smaller; people have learned to build better ships and airplanes.

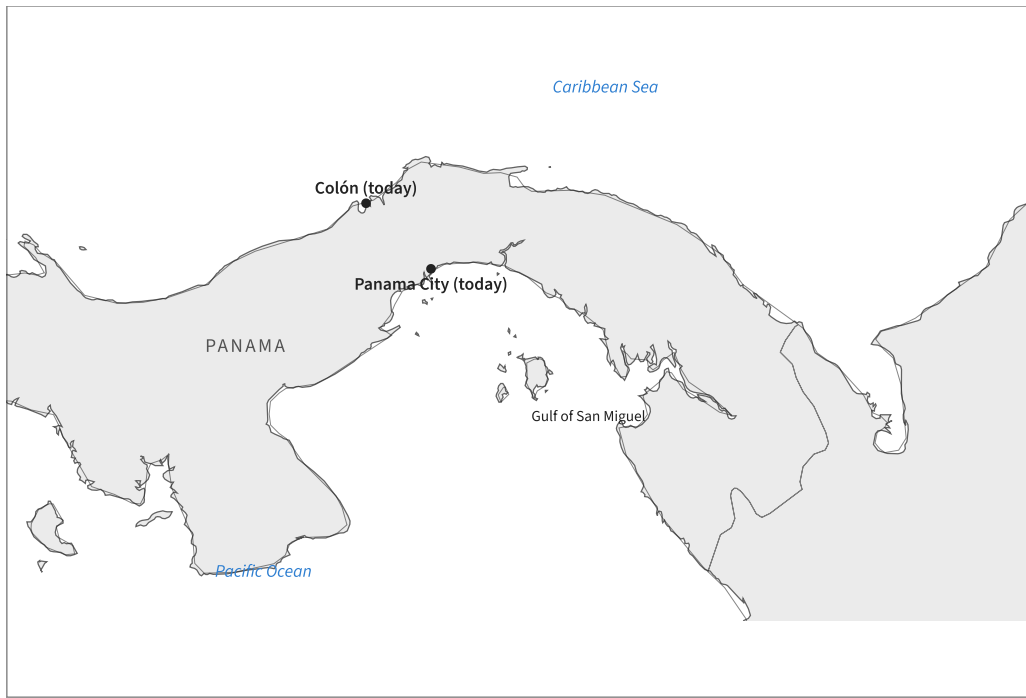
Pacific Ocean: about 60 million square miles



All the land on earth: about 57 million square miles



The Pacific Ocean alone is bigger than all the land on earth put together.



Panama is an isthmus. When Balboa crossed it in 1513, the new sea lay to the south, so he named it the South Sea.

PICTURE STUDY



The Ninth Wave, Ivan Aivazovsky, 1850 · Oil on canvas · State Russian Museum, St. Petersburg

Ivan Aivazovsky was born in 1817 in Feodosia, a town on the Black Sea in Crimea. He loved the sea more than anything and painted thousands of sea pictures in his long life. He did not paint outdoors with the waves in front of him. He watched the sea closely, remembered it, and then painted it in his studio.

Old sailors said that waves come in groups and that the ninth wave is the biggest and most dangerous of all. In this very large painting, almost 11 feet wide, a ship has sunk in a storm during the night. A few sailors are still alive, holding on to a broken mast. The sun is rising, and the ninth wave is coming.

Look closely

- Find the sailors. How many can you count? What are they holding on to?
- Look at the giant wave on the left. Can you see light shining through the water?
- Find the sun. What colors did the painter use for the sky and the sea?
- Look at the sailor waving a cloth. Who might he be signaling to?

Talk about it

1. Is this painting more frightening or more hopeful? What do you see that makes you think so?
2. Why do you think sailors respected the sea so much?
3. Psalm 107 says sailors “see the works of the LORD, and his wonders in the deep.” What wonder do you see in this painting?

PROJECT: A HUNDRED-SQUARE WORLD

If you could cut the whole surface of the earth into 100 equal squares, how many would be Pacific Ocean, how many would be land, and how many would be the other oceans? You will color a 100-square map and see for yourself that the Pacific wins.

You will need

- Graph paper, or a sheet you rule into 10 rows of 10 squares
- Crayons or colored pencils: dark blue, light blue and green or brown
- A globe and a piece of string about 4 feet long
- A ruler or tape measure

Steps

1. Draw a box 10 squares wide and 10 squares tall. Count to make sure it has 100 squares.
2. Color 30 squares dark blue. These stand for the Pacific Ocean.
3. Color 29 squares green or brown. These stand for all the land on earth.
4. Color the rest of the squares light blue for the other four oceans. Count them. You should have 41.
5. Make a key at the bottom: dark blue = Pacific, light blue = other oceans, green = land.
6. Now take the string. On the globe, lay it along the equator from the coast of South America west across the Pacific to the islands of Indonesia. Pinch the string at both coasts.

7. Lay the same string all the way around the equator. About how much of the way around the world does the Pacific stretch?
8. Write one sentence under your map: "The Pacific is bigger than _____."

Tips

- These numbers are rounded. The real Pacific is a little more than 30 out of 100 and the land is a little more than 29.
- If your globe is small, use thread instead of string so it lies flat.

Check your work

- My map has exactly 100 squares and a key.
- I colored 30 Pacific squares, 29 land squares and 41 other-ocean squares.
- I can explain why the Pacific is bigger than all the land put together.

MAP NOTEBOOK

1. Draw a simple world map with an oval for the Pacific. Label Asia and Australia on the west side and North and South America on the east side.
2. Draw Panama as a thin strip of land. Put the Caribbean Sea on the north side and the Pacific on the south side. Add a little stick figure of Balboa on a hill looking south.
3. Draw a ring of small red triangles around the edge of your Pacific and label it "Ring of Fire."

From history. Four hundred years after Balboa crossed Panama on foot, people finished cutting a waterway through it. The Panama Canal opened on August 15, 1914. Ships could now go between the Atlantic and the Pacific in a day or so, instead of sailing thousands of miles around the stormy tip of South America. The isthmus that Balboa struggled across had become a doorway between two oceans.

WORKED EXAMPLES

Example 1. The Pacific Ocean covers about 60 million square miles. All the land on earth covers about 57 million square miles. Which is bigger, and by about how much?

(Use the map or drawing "The blue Pacific bar is a little longer than the bar for all the land." shown earlier in this lesson.)

1. Compare the numbers: 60 million is more than 57 million, so the Pacific is bigger.
2. To find how much bigger, subtract: $60 - 57 = 3$.
3. Keep the word "million": 3 million square miles.

Answer: The Pacific is bigger, by about 3 million square miles.

Example 2. Honolulu, Hawaii, is about 2,400 miles from San Francisco, California. A ship sails about 300 miles a day. About how many days will the trip take?

1. Count by 300s until you reach 2,400: 300, 600, 900, 1,200, 1,500, 1,800, 2,100, 2,400.
2. Count how many 300s you said: 8.
3. Check: $8 \times 300 = 2,400$.

Answer: About 8 days.

PRACTICE

1. **EASY** What does the name “Pacific” mean?
2. **EASY** Look at the map of Panama. In which direction did Balboa look to see the new sea? What did he name it?
(Use the map or drawing “Panama, where Balboa first saw the Pacific in 1513.” shown earlier in this lesson.)
3. **MEDIUM** On the map of Panama, Colón is on the Caribbean side and Panama City is on the Pacific side. In which direction would you travel to go from Colón to Panama City?
(Use the map or drawing “Colón and Panama City sit on opposite sides of the isthmus.” shown earlier in this lesson.)
4. **MEDIUM** On a 100-square map of the earth, 30 squares are Pacific Ocean and 41 squares are the other oceans. How many squares are ocean in all? How many are land?
5. **HARD** A jet flies about 5,500 miles from Los Angeles to Tokyo, Japan. It flies about 500 miles each hour. About how many hours does the flight take?
6. **CHALLENGE** Write two sentences explaining why someone could say, “The Pacific is bigger than all the land in the world.” Use numbers.

COMMON MISTAKES

- Thinking Balboa “discovered” an empty ocean. The native people of Panama already knew the sea was there, and they guided him to it.
- Thinking the Pacific is only between the United States and Asia. It reaches from the Arctic all the way down to the Southern Ocean around Antarctica.
- Mixing up which continents are on which side. Asia and Australia are on the west side of the Pacific; the Americas are on the east side.

Make it a game · Land or Water Spin. Take turns spinning a globe and stopping it with one finger. Score 1 point for land, 1 point for any ocean, and 2 points if your finger lands on the Pacific. Before you score, you must name the ocean or continent under your finger. First to 15 points wins. Afterward, talk about why the Pacific came up so often.

Scripture. “The sea is his, and he made it: and his hands formed the dry land.” (Psalm 95:5, KJV)

The Pacific is bigger than all the land in the world, and yet God made both the sea and the dry land. The biggest ocean is His, and so are we.

Practice answers

1. Peaceful.
2. South. He named it the South Sea.
3. Southeast (south and a little east).
4. $30 + 41 = 71$ squares of ocean. $100 - 71 = 29$ squares of land.
5. About 11 hours, because $11 \times 500 = 5,500$.
6. Sample: The Pacific Ocean covers more than 60 million square miles. All the land on earth together covers only about 57 million square miles, so the Pacific alone is bigger.

5.2 THE ATLANTIC

OBJECTIVES

- Tell the story of the Mayflower's 66-day crossing of the Atlantic in 1620.
- Describe the Atlantic as the S-shaped ocean between the Old World (Europe and Africa) and the New World (the Americas), with the Mid-Atlantic Ridge down its middle.
- Explain why sailing ships crossed the North Atlantic faster going east than going west, and how new technology shortened the trip.

Warm-up. Fill a baking pan or the bathtub with a little water. Float a small paper or cork boat at one end. Blow on it gently from behind. Now try to blow it back toward you from the far side. Which way was easy? Which way was hard? Sailors on the Atlantic felt the same thing with the wind.

Video. Coming soon. The Atlantic Ocean for kids and the voyage of the Mayflower (1620); the Mid-Atlantic Ridge. Search Drive Thru History, The History Guy, Smithsonian, Memoria Press, NASA Earth Observatory, Homeschool Pop (Alternate).

KEY TERMS

Atlantic Ocean

The second-largest ocean, lying between Europe and Africa on the east and North and South America on the west.

Old World

Europe, Africa and Asia, the lands Europeans knew before 1492.

New World

North and South America, the lands that were new to Europeans after 1492.

Mid-Atlantic Ridge

A long chain of mountains on the floor of the Atlantic that runs down the middle of the ocean from north to south.

voyage

A long trip, especially by sea.

CORE IDEAS

The story. In September 1620, a small wooden ship called the *Mayflower* sailed out of Plymouth, England, with 102 passengers crowded below its deck. Many of them were Pilgrims who wanted a place where they could worship God as they believed the Bible taught. Out in the middle of the ocean, fierce storms tossed the ship. One of the great wooden beams that held up the deck cracked! The passengers had brought a great iron screw from Holland, and with it they pushed the beam back into place. During one storm a young man named John Howland was thrown into the sea. He grabbed a rope hanging over

the side and held on until the sailors pulled him back aboard with a hook. A baby boy was born on the voyage, and his parents named him Oceanus. At last, after 66 days, the tired travelers saw the sandy hills of Cape Cod in November 1620.

How it worked. The *Mayflower* had no engine. It went only where the wind could push it. In the northern part of the Atlantic, the winds blow mostly from the west toward the east. That meant a ship going west from England to America had to fight the wind much of the way. In the spring of 1621 the *Mayflower* sailed home to England with the wind behind it, and the trip took only about a month, about half the time!

The big idea. The **Atlantic Ocean** is the second-largest ocean, about half the size of the Pacific. On a map it looks like a long letter S. It reaches from the Arctic Ocean in the north to the Southern Ocean in the south. On its east side are Europe and Africa, part of the **Old World**. On its west side are North and South America, the **New World**. Hidden under the water, down the very middle of the ocean, runs the **Mid-Atlantic Ridge**, part of the longest mountain chain on earth. Most of it is underwater, but in a few places its tops stick up as islands. Iceland sits right on top of it! The Atlantic was named long ago for Atlas, a giant in the old Greek stories.

On the map. Find the place where the Atlantic is narrowest, between the bulge of Brazil and the bulge of West Africa. There the two coasts are less than 2,000 miles apart, and on a map they look like puzzle pieces that could fit together. Then find the North Atlantic between England and New England. For hundreds of years this was the busiest ocean road in the world, carrying people, letters and goods between the Old World and the New.

Technology overcoming geography. The ocean between the Old World and the New stayed the same size, but the trip kept getting shorter. The *Mayflower* took 66 days. In 1838 a steamship called the *Great Western* crossed from England to New York in about 15 days, burning coal instead of waiting for the wind. Today a jet crosses from New York to London in about 7 hours.



The Mayflower's route, 1620 (the line is approximate). The ship sailed west, against the wind, for 66 days.

PICTURE STUDY



The Mayflower in Plymouth Harbor, William Formby Halsall, 1882 · Oil on canvas · Pilgrim Hall Museum, Plymouth, Massachusetts

William Halsall was born in England and went to sea as a boy before he became a painter. He later lived near Boston and became known for his paintings of ships. More than 260 years after the Pilgrims came, he painted the *Mayflower* at rest in Plymouth Harbor after its long, hard crossing.

The painting hangs in Pilgrim Hall Museum in Plymouth, Massachusetts, which opened in 1824 and is one of the oldest public museums in the United States.

Look closely

- Count the masts on the ship. Are the sails spread out to catch the wind, or tied up?
- Find the water. Is it stormy or calm? How is it different from the sea in *The Ninth Wave*?
- Look for any small boats. How would the passengers get from the ship to the shore?
- Look at the size of the ship. Imagine 102 passengers living inside it for 66 days.

Talk about it

1. How do you think the passengers felt when they saw land after 66 days at sea?
2. Why do you think the painter chose to show the ship in a quiet harbor instead of in a storm?

Safety first. Keep the fan far away from the water and plug it in only with a grown-up's help. Never touch a plug or switch with wet hands.

PROJECT: SAILING WITH AND AGAINST THE WIND

You will build a small sailboat and race it across a pan of water, first with the wind behind it and then against the wind. Then you will see why the Mayflower took 66 days going west but only about a month coming home.

You will need

- A large baking pan, storage tub or bathtub with a few inches of water
- A piece of foam, a cork or a plastic lid for the boat
- A craft stick or straw for the mast and a paper sail
- Tape
- A small electric fan (or a paper fan you wave by hand)
- A timer or a clock with a second hand
- Two sticky notes labeled "Old World (England)" and "New World (America)"

Steps

1. Tape the sail to the mast and stick the mast into the foam or cork to make your boat.
2. Put the "New World" note at the left (west) end of the pan and the "Old World" note at the right (east) end.
3. Set the fan at the west end, blowing toward the east. This is like the winds of the North Atlantic.
4. Place the boat at the west end and let the wind carry it to the Old World. Time it.
5. Now place the boat at the east end and try to make it reach the New World while the fan still blows from the west. You may push it gently with a straw, a little at a time, like

a ship zigzagging against the wind. Time it.

6. Write both times in your notebook. Which trip was faster?
7. Turn off the fan and race your boat with no wind at all. What does a sailing ship do when there is no wind?

Tips

- Try a bigger sail and a smaller sail. Which one catches more wind?
- Real sailing ships could not sail straight into the wind. They zigzagged back and forth, which made the trip much longer.

Check your work

- I timed my boat going east with the wind and west against the wind.
- I can explain why the Mayflower's trip west took longer than its trip home.
- I can point to the Old World and the New World on a map of the Atlantic.

MAP NOTEBOOK

1. Draw the Atlantic as a big letter S. Label North America and South America on the left and Europe and Africa on the right. Write "New World" and "Old World" on the correct sides.
2. Draw a dotted line down the middle of your Atlantic for the Mid-Atlantic Ridge, and draw Iceland as a small island sitting on top of it.
3. Draw the Mayflower's route from Plymouth, England, to Cape Cod. Add a wind arrow showing which way the wind usually blew.

From history. On May 20 and 21, 1927, a young American pilot named Charles Lindbergh flew alone, without stopping, from New York to Paris in his small airplane, the *Spirit of St. Louis*. The flight took about 33 and a half hours. The Pilgrims had needed 66 days to cross the Atlantic by sail; Lindbergh crossed it in less than a day and a half.

WORKED EXAMPLES

Example 1. The Mayflower's voyage took 66 days. How many weeks and days is that?

1. There are 7 days in a week. Count by 7s: 7, 14, 21, 28, 35, 42, 49, 56, 63.
2. That is 9 sevens, so 63 days make 9 weeks.
3. Subtract to find the days left over: $66 - 63 = 3$.

Answer: 9 weeks and 3 days.

Example 2. Going west to America, the Mayflower took 66 days. Coming home east to England with the wind behind it, the trip took about 31 days. About how many fewer days did the trip home take?

1. Subtract the shorter trip from the longer trip: $66 - 31$.
2. $66 - 30 = 36$, and $36 - 1 = 35$.
3. Check by adding: $31 + 35 = 66$.

Answer: About 35 fewer days. The wind made the trip home about half as long.

PRACTICE

1. **EASY** Name the continents on the east side of the Atlantic and the continents on the west side. Which side is the Old World and which is the New World?
2. **EASY** Look at the map of the Mayflower's route. In which direction did the ship sail from Plymouth, England, to Cape Cod?
(Use the map or drawing "The Mayflower's route, 1620 (approximate)." shown earlier in this lesson.)
3. **MEDIUM** The Mayflower left England with 102 passengers. During the voyage one young man died and one baby, Oceanus, was born. How many passengers were aboard when the ship reached Cape Cod?
4. **MEDIUM** The Mayflower crossed the Atlantic in 66 days. The steamship Great Western crossed in about 15 days in 1838. About how many fewer days did the steamship take?
5. **HARD** New York and London are about 3,500 miles apart. A jet flies about 500 miles each hour. About how many hours does it take to cross the Atlantic?
6. **CHALLENGE** Write two or three sentences explaining why a sailing ship crossed the North Atlantic faster going east than going west.

COMMON MISTAKES

- Thinking the Atlantic is the biggest ocean because it is the one closest to Europe and the eastern United States. The Pacific is about twice as big.
- Mixing up the Old World and the New World. The Old World is Europe, Africa and Asia; the New World is the Americas.
- Thinking the ocean floor is flat. The Mid-Atlantic Ridge is a huge mountain chain hidden under the water.

Make it a game • Old World, New World. Put a sign that says "Old World" on one side of the room and "New World" on the other, with a blue blanket in the middle for the Atlantic. A parent calls out a place: England, Brazil, Egypt, Canada, Spain, Mexico, Nigeria, Peru, France, the United States. Run to the correct side! If the parent calls "Iceland," stand on the blanket, because Iceland sits on the Mid-Atlantic Ridge in the middle of the ocean.

Scripture. “They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep.” (Psalm 107:23-24, KJV)

The passengers on the Mayflower saw storms, waves and wide water that only God could have made. Psalm 107 goes on to tell how sailors in trouble cry to the Lord and He brings them to the haven where they want to be.

Practice answers

1. East side: Europe and Africa (the Old World). West side: North America and South America (the New World).
2. West (and a little south).
3. $102 - 1 + 1 = 102$ passengers.
4. $66 - 15 = 51$ fewer days.
5. About 7 hours, because $7 \times 500 = 3,500$.
6. Sample: In the North Atlantic the winds blow mostly from the west toward the east. A ship sailing east has the wind pushing it from behind. A ship sailing west has to fight the wind and zigzag, so the trip takes longer.

5.3 SEAS, GULFS AND BAYS

OBJECTIVES

- Tell the story of Henry Hudson, who sailed into Hudson Bay in 1610 looking for a water road to Asia.
- Explain the difference between an ocean, a sea, a gulf, a bay and a strait, and find examples on a map.
- Locate the Mediterranean Sea, the Gulf of Mexico and Hudson Bay and tell one important fact about each.

Warm-up. Press a ball of play dough or clay flat on a plate. With your thumb, push a dent into one edge. Now pinch the dough around another spot until it almost closes into a circle, leaving just a little opening. Pour a spoonful of water into each. You have just made a gulf and a sea! Which one is almost closed in by “land”?

Video. Coming soon. Seas, gulfs, bays and straits for kids; the Mediterranean Sea, the Gulf of Mexico and Hudson Bay; Henry Hudson’s last voyage (1610–1611). Search NASA Earth Observatory (satellite views), Smithsonian, The History Guy, Drive Thru History, Homeschool Pop (Alternate).

KEY TERMS

sea

A large body of salt water, smaller than an ocean, often partly closed in by land.

gulf

A large part of an ocean or sea that reaches into the land.

bay

A body of water partly surrounded by land, with a wide opening to the sea. Most bays are smaller than gulfs, but not all.

strait

A narrow passage of water that joins two larger bodies of water.

Northwest Passage

A water road over the top of North America from the Atlantic to the Pacific that explorers searched for over hundreds of years.

CORE IDEAS

The story. In April 1610, an English sea captain named Henry Hudson sailed from London in a small ship called the *Discovery*. He was looking for a water road over the top of North America to China, called the **Northwest Passage**. That summer he steered through a long, icy **strait** into a huge, wide sea. Hudson was sure he had found the way to Asia! He sailed south, but the water ended in a dead end. Winter came, and the ice froze the *Discovery* in

place. By spring the food was almost gone, and in June 1611 some of the crew rebelled. They put Hudson, his young son John and a few sick or loyal men into a small open boat and sailed away. Hudson was never seen again. But the great water he found still carries his name: **Hudson Bay.**

The big idea. The edges of the oceans reach into the land in many shapes, and we have names for them. A **sea** is a large body of salt water that is smaller than an ocean, often with land around much of it. A **gulf** is a big piece of ocean or sea that reaches into the land. A **bay** is a body of water with land around part of it and a wide opening to the sea. A **strait** is a narrow water passage that joins two bigger waters. Names do not always follow size. Hudson Bay is bigger than many seas and gulfs, but people still call it a bay.

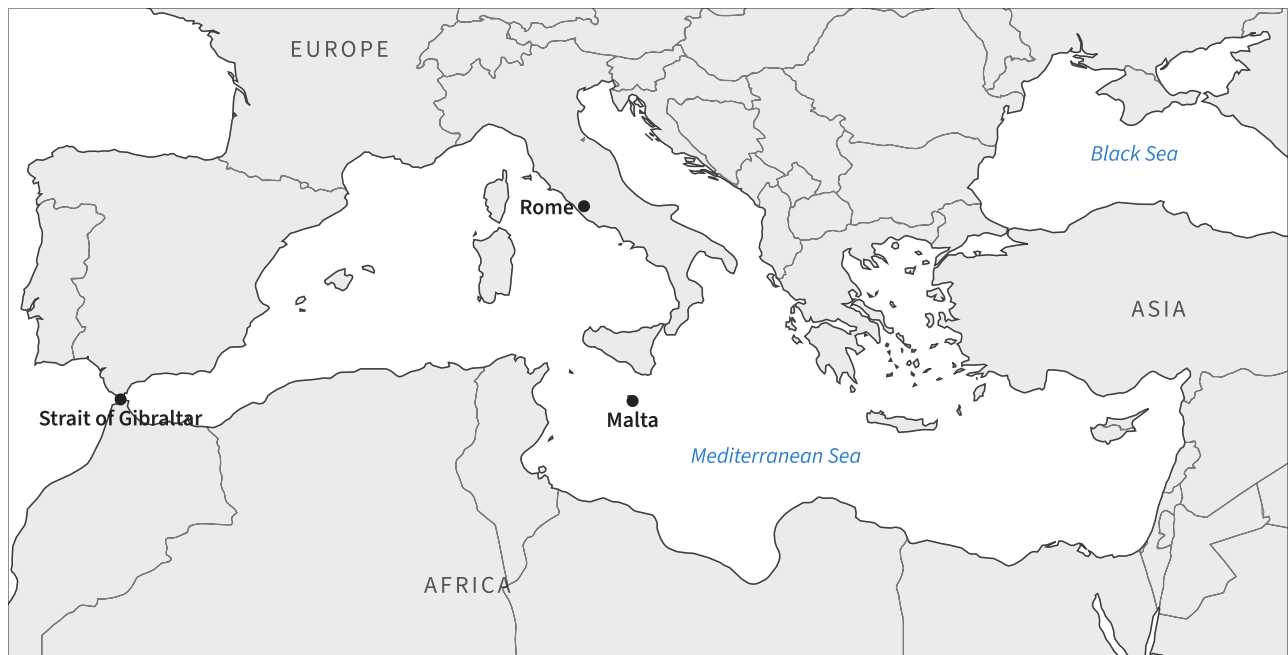
The Mediterranean Sea. “Mediterranean” comes from Latin words that mean “in the middle of the land.” This sea lies between Europe, Africa and Asia, and it is about 2,400 miles long. Its only natural opening to the Atlantic is the Strait of Gibraltar, which is only about 8 miles wide at its narrowest. The Romans ruled every shore of it and called it “our sea.” The apostle Paul sailed across it to carry the gospel, and he was shipwrecked on the island of Malta.

The Gulf of Mexico. This warm gulf is wrapped by the United States on the north, Mexico on the west and south, and the island of Cuba on the east. The mighty Mississippi River pours into it near New Orleans. Big ships carry grain and oil from its ports. In late summer its warm water can feed powerful hurricanes. In 2025 the United States government began calling it the Gulf of America on its maps, while most other countries still call it the Gulf of Mexico.

On the map. Hudson Bay lies in the middle of Canada. It joins the Atlantic through Hudson Strait, the icy passage Hudson sailed through. For much of the year the bay is frozen. Each fall, polar bears gather near the town of Churchill, Manitoba, waiting for the ice to form so they can walk out and hunt seals.



Hudson Bay and the Gulf of Mexico. The red line shows Hudson's route in 1610 (approximate).



The Mediterranean Sea lies "in the middle of the land" between Europe, Africa and Asia.

PICTURE STUDY



The Last Voyage of Henry Hudson, John Collier, 1881 · Oil on canvas · Tate Britain, London

John Collier was an English painter who liked to paint scenes from history. About 270 years after Henry Hudson disappeared, he imagined what the captain's last voyage looked like after his crew set him adrift in a small boat on Hudson Bay.

No one knows exactly what happened to Hudson, his son and the men with him. The painter had to imagine it, using what the survivors of the *Discovery* told about the cold, the ice and the mutiny.

Look closely

- Find Henry Hudson. Where is he looking? What do you think he is thinking about?
- Find the boy. How is he different from his father in the way he sits and looks?
- Look at the water. What tells you that this is a cold northern sea?
- Look at the colors. Are they warm or cold colors? Why did the painter choose them?

Talk about it

1. How does this painting make you feel about Hudson and his son?
2. Hudson found a huge bay, but not the passage he was looking for. Can a journey be important even if it does not reach its goal?

PROJECT: BUILD A COASTLINE IN A PAN

You will build your own coastline out of clay or play dough in a baking pan, then pour in water and find your own sea, gulf, bay and strait. You will finish with a big coastline that looks like the Mediterranean.

You will need

- A large baking pan or plastic tray with sides
- Two or three cans of play dough or a few pounds of modeling clay
- A cup of water with a few drops of blue food coloring
- Toothpicks and small paper flags
- A pencil

Steps

1. Press the clay into the pan to make “land” along three sides, leaving the middle empty for water.
2. Shape one place where the land wraps almost all the way around a wide area of water. That is your sea.
3. Push a big rounded dent into the land. That is your gulf.
4. Push a smaller dent with a wide opening. That is your bay.
5. Make two pieces of land come close together, leaving only a narrow channel of water. That is your strait.
6. Slowly pour the blue water into the open middle. Watch it flow into the sea, gulf, bay and strait.
7. Make a paper flag for each one and stick it into the clay beside the water it names.
8. Now reshape your coastline to look like the Mediterranean: Europe on top, Africa below, and a tiny Strait of Gibraltar on the left side opening to the “Atlantic.”

Tips

- Press the clay firmly against the bottom of the pan so the water does not leak under it.
- Look at a real map of the Mediterranean while you shape it. Look for the boot shape of Italy.

Check your work

- My coastline has a sea, a gulf, a bay and a strait, each labeled with a flag.
- I can explain the difference between a gulf and a strait.
- I can find the Mediterranean, the Gulf of Mexico and Hudson Bay on a globe.

MAP NOTEBOOK

1. Draw four small boxes. In each, draw a coastline showing a sea, a gulf, a bay and a strait. Color the water blue and label each one.
2. Trace or draw North America. Color and label Hudson Bay and the Gulf of Mexico. Draw the Mississippi River flowing into the Gulf.
3. Begin your unit map: on a world outline, label these ten great seas: Mediterranean Sea, Caribbean Sea, Gulf of Mexico, Hudson Bay, North Sea, Red Sea, Arabian Sea, Bay of Bengal, South China Sea and Bering Sea.

From history. The Mediterranean is the sea of the Book of Acts. In Acts 27 and 28, the apostle Paul sailed as a prisoner toward Rome. A storm drove the ship for fourteen days until it ran aground on the island of Malta. Every person aboard reached the shore safely, and the people of Malta showed them great kindness. Ships still sail past Malta today on their way across the middle of the Mediterranean.

WORKED EXAMPLES

Example 1. On a map, 1 inch stands for 400 miles. The Mediterranean Sea measures 6 inches long on the map. About how long is the real Mediterranean?

(Use the map or drawing “The Mediterranean stretches about 2,400 miles from the Strait of Gibraltar to the” shown earlier in this lesson.)

1. Each inch on the map stands for 400 miles.
2. Count by 400s six times: 400, 800, 1,200, 1,600, 2,000, 2,400.
3. Check: $6 \times 400 = 2,400$.

Answer: About 2,400 miles long.

Example 2. The Mediterranean Sea covers almost 1,000,000 square miles. The Gulf of Mexico covers about 600,000 square miles. Using 1,000,000 for the Mediterranean, about how much bigger is it?

1. Think in hundred-thousands: 1,000,000 is 10 hundred-thousands, and 600,000 is 6 hundred-thousands.
2. Subtract: $10 - 6 = 4$ hundred-thousands.
3. Write it out: 400,000.

Answer: About 400,000 square miles bigger.

PRACTICE

1. **EASY** Match each word to its meaning: sea, gulf, strait. (a) a narrow water passage joining two bigger waters (b) a big piece of ocean reaching into the land (c) a large body of salt water smaller than an ocean
2. **EASY** Look at the map of North America. Which great river flows into the Gulf of Mexico near New Orleans? In which country is Hudson Bay?
(Use the map or drawing “Hudson Bay and the Gulf of Mexico.” shown earlier in this lesson.)
3. **MEDIUM** On the map of North America, in which direction would you travel to go from New Orleans to Churchill on Hudson Bay?
(Use the map or drawing “New Orleans and Churchill.” shown earlier in this lesson.)
4. **MEDIUM** The Strait of Gibraltar is about 8 miles wide at its narrowest. A strong swimmer swims about 2 miles each hour. About how many hours would it take to swim across?

5. **HARD** Henry Hudson sailed from London in April 1610. His crew set him adrift in June 1611. How many months passed between those two dates?
6. **CHALLENGE** Hudson Bay is bigger than many seas and gulfs. Why do you think it is still called a bay? Write two sentences.

COMMON MISTAKES

- Thinking a bay is always small. Hudson Bay is huge; names do not always follow size.
- Mixing up a strait and a gulf. A strait is a narrow passage that joins two waters; a gulf is a big piece of sea reaching into the land.
- Thinking the Mediterranean is a lake. It is a sea of salt water joined to the Atlantic through the Strait of Gibraltar.

Make it a game · Make the Shape. A parent calls out a word: sea, gulf, bay or strait. Use your hands and arms as “land” to make the shape. For a strait, hold two hands close with a small gap; for a gulf, curve your arms into a big U; for a bay, a smaller, wide-open curve; for a sea, wrap your arms almost all the way around. Then the parent calls a real name, like “Strait of Gibraltar” or “Hudson Bay,” and you make that shape and point to it on the globe. One point for each correct shape and place.

Scripture. “And God called the dry land Earth; and the gathering together of the waters called he Seas: and God saw that it was good.” (Genesis 1:10, KJV)

On the third day God gathered the waters and named them. When we name seas, gulfs, bays and straits, we are following His example and learning the shape of the world He called good.

Practice answers

1. Sea = (c), gulf = (b), strait = (a).
2. The Mississippi River. Hudson Bay is in Canada.
3. North (and a little west).
4. About 4 hours, because $4 \times 2 = 8$.
5. April 1610 to April 1611 is 12 months, and April to June is 2 more months: 14 months.
6. Sample: People named waters long ago by their shape and by what explorers called them, not by measuring their size. Hudson Bay has land around most of it and an opening to the sea, so it was called a bay, and the name stayed.

5.4 UNDER THE SEA ⚙️

OBJECTIVES

- Tell the story of the Trieste's dive to the bottom of the Challenger Deep on January 23, 1960.
- Describe the ocean floor, including the Mariana Trench, and compare the deepest place in the sea with the tallest mountain on land.
- Explain how the Trieste could sink to the deepest place on earth and float back up again.

Warm-up. Fill a large bowl with water. Push an empty plastic cup, open end down, straight down into the water. Can you feel the water pushing back? The deeper you push, the harder it pushes. That push is called pressure. Now imagine water almost 7 miles deep pressing on you!

Video. Coming soon. The Mariana Trench and the Challenger Deep for kids; the 1960 dive of the bathyscaphe Trieste (Jacques Piccard and Don Walsh); how deep the ocean is. Search NASA, NOAA Ocean Exploration (candidate, needs vetting), Smithsonian, The History Guy, Jared Owen, Homeschool Pop (Alternate).

KEY TERMS

trench

A long, narrow, very deep valley in the floor of the ocean.

Mariana Trench

The deepest trench on earth, in the western Pacific Ocean near the island of Guam.

Challenger Deep

The deepest known spot in the ocean, at the bottom of the Mariana Trench, about 36,000 feet deep.

pressure

A push. The deeper you go in the ocean, the more water is above you pushing down.

bathyscaphe

A deep-diving craft with a strong steel cabin for the crew hanging under a big float. Its name comes from Greek words meaning “deep boat.”

CORE IDEAS

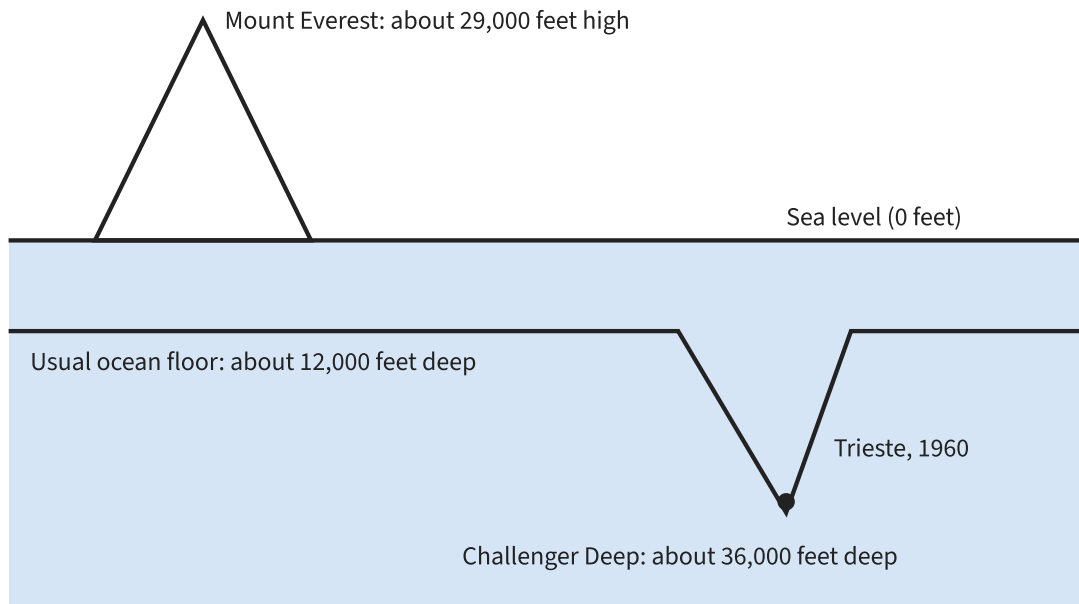
The story. On the morning of January 23, 1960, in the Pacific Ocean southwest of the island of Guam, two men climbed down into a small steel ball. One was Jacques Piccard, a Swiss scientist. The other was Don Walsh, a lieutenant in the United States Navy. Their craft was called the *Trieste*. Down they sank, out of the sunlight and into total darkness. Partway down they heard a loud bang that shook the whole craft. A window in the entry tunnel had

cracked, but their cabin held. After almost five hours they settled onto the soft, pale mud at the bottom of the **Challenger Deep**, the deepest known place in all the oceans. They stayed about 20 minutes, then started the long trip up.

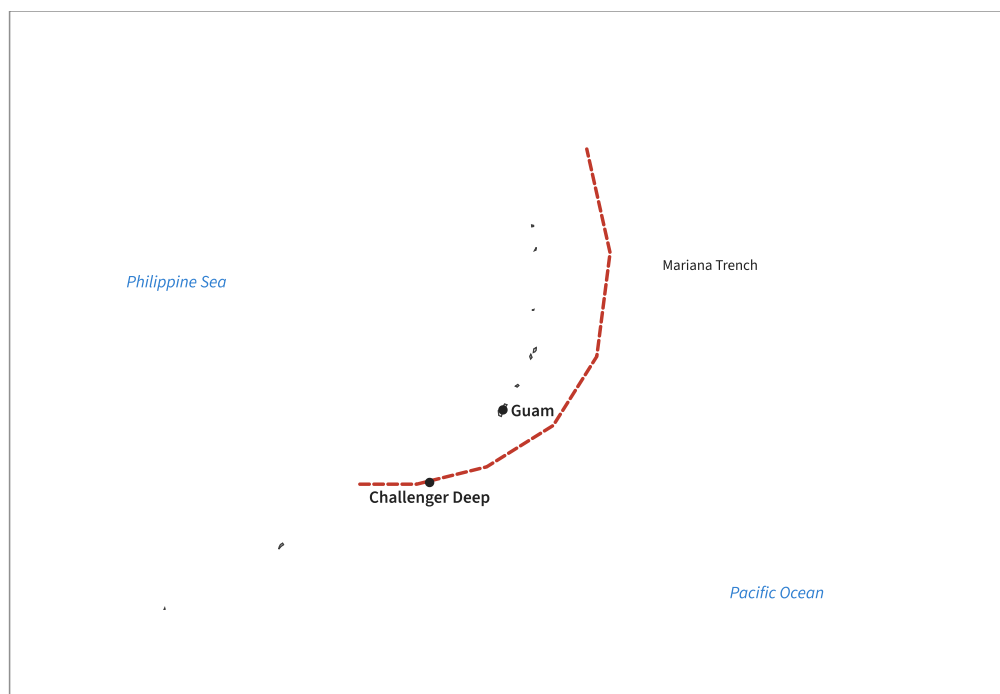
How it worked. Water is heavy. The deeper you go, the more water is piled above you, pushing down with tremendous **pressure**. At the bottom of the Challenger Deep, the water pushes with about 8 tons on every square inch! A submarine of that time would have been crushed. So Jacques Piccard's father, Auguste Piccard, had designed a new kind of craft, a **bathyscaphe**. The crew sat in a steel ball with walls about 5 inches thick. Above the ball hung a big float filled with gasoline, which is lighter than water and hardly squeezes at all. To sink, the *Trieste* let seawater into tanks in the float and carried tons of little iron pellets. To come back up, the pilots let the iron pellets pour out, and the light float carried them up to the sunshine.

The big idea. The ocean floor has landforms just like the land. It has wide, flat plains, tall underwater mountains like the Mid-Atlantic Ridge, and deep valleys called **trenches**. The deepest of all is the **Mariana Trench**, a curved crack in the floor of the western Pacific about 1,500 miles long. Its deepest spot, the Challenger Deep, is about 36,000 feet down, nearly 7 miles! Mount Everest, the tallest mountain on land, is about 29,000 feet high. If you dropped Everest into the Challenger Deep, its peak would still be more than a mile underwater. Most of the ocean floor is about 12,000 feet down. It is cold, and below about 3,000 feet it is completely dark.

Technology overcoming geography. For thousands of years, the deep sea was a wall no one could pass. Divers could hold their breath for only a few minutes, and no ship could go down and come back. The *Trieste* broke through that wall. No person went back to the Challenger Deep for 52 years, until a filmmaker named James Cameron dove there alone in 2012. Today robot craft and ships that map the floor with sound waves are exploring the deep. Still, people have seen only a small part of the sea floor with their own eyes. Under the waves there are still mountains, valleys and creatures no one has ever seen, and God knows every one of them.

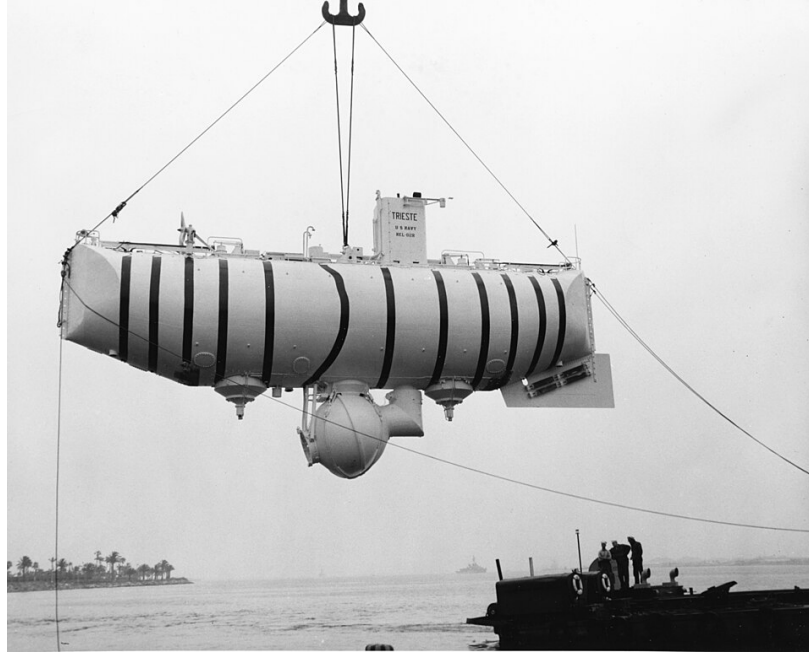


The Challenger Deep is deeper than Mount Everest is tall.



The Mariana Trench curves through the western Pacific. The Trieste dove to the Challenger Deep, southwest of Guam.

PICTURE STUDY



The Bathyscaphe Trieste, U.S. Navy photographers, about 1958–1960 · Black-and-white photographs · Naval History and Heritage Command, Washington, D.C.

The United States Navy bought the *Trieste* in 1958 and took many photographs of it at sea, in harbor and being lifted by cranes. These photographs are now kept by the Naval History and Heritage Command. Choose one that shows the long float, and if you can, one that shows the small round crew cabin hanging underneath it.

Unlike a painting, a photograph shows exactly what the camera saw. Look carefully, because every part of this strange craft had a job to do.

Look closely

- Find the long float. What was inside it, and why did it help the Trieste come back up?
- Look for the small round cabin under the float. How many people could fit inside?
- Look for people in the picture. How big is the Trieste compared with them?
- Does the Trieste look like a ship, a submarine or something else? Why?

Talk about it

1. Would you have wanted to ride in the Trieste? Why or why not?
2. Why did the crew need such a small cabin with such thick walls?
3. What do you think Piccard and Walsh saw out of their tiny window at the bottom?

PROJECT: HOW DEEP IS THE SEA? A DEPTH STRIP

You will make a long paper model of the ocean's depths, from the sunny surface all the way down to the Challenger Deep, with Mount Everest beside it for comparison. Every inch on

your strip will stand for 1,000 feet of water.

You will need

- A long strip of paper at least 4 feet long (adding-machine tape, or sheets of paper taped end to end)
- A yardstick or ruler
- Crayons or markers: light blue, dark blue, black and brown
- A second strip of paper about 30 inches long for Mount Everest
- Tape, scissors and a pencil
- For the jar version: a tall clear jar or vase, masking tape and a marker

Steps

1. Draw a line across the top of the long strip and write "Sea level: 0 feet." Your scale is 1 inch = 1,000 feet.
2. Measure down 3 inches and draw a line: "About 3,000 feet: no more sunlight." Color above it light blue and below it dark blue.
3. Measure down 12 inches from the top: "About 12,000 feet: the usual ocean floor."
4. Measure down 12 and a half inches: "About 12,500 feet: the wreck of the Titanic."
5. Measure down 36 inches (3 feet): "About 36,000 feet: the Challenger Deep." Draw the Trieste here with Piccard and Walsh inside.
6. On the second strip, measure 29 inches and color it brown and white for Mount Everest. Tape it so it starts at sea level and stands beside the ocean strip, pointing down into the deep. See how much water is left below its peak!
7. Hang your strip on a door or wall from top to bottom.
8. Jar version: Put a piece of tape from the top of a tall jar to the bottom. Use a scale of 1 inch = 3,000 feet. Mark the top as sea level, 1 inch down as "no more sunlight," 4 inches down as "usual ocean floor," and 12 inches down as "Challenger Deep." Fill the jar with water to see your ocean.

Tips

- Measure from the top line every time, not from the last mark, so your mistakes do not add up.
- If your jar is not 12 inches tall, mark as far down as it goes and write how many feet deep that would be.

Check your work

- My strip shows sea level, the end of sunlight, the usual ocean floor, the Titanic and the Challenger Deep at the right places.
- My Mount Everest strip is 29 inches long and shows how far below the surface its top would be.
- I can explain my scale: 1 inch stands for 1,000 feet.

MAP NOTEBOOK

1. Draw the Trieste: a long float on top, a small round cabin underneath, and little iron pellets falling out as it comes back up. Label the float, the cabin and the pellets.
2. Draw a side view of the ocean floor with a plain, an underwater mountain and a deep trench. Label each one.
3. On your world map, mark the Mariana Trench near Guam with a small black X and write "Challenger Deep, about 36,000 feet."

From history. The Challenger Deep is named for a British ship. From 1872 to 1876, HMS *Challenger* sailed around the world studying the oceans. Sailors measured the depth by letting out a long rope with a heavy weight on the end until it touched bottom. In 1875, near the Mariana Islands, they found a spot more than 5 miles deep, deeper than anyone had ever measured. Later ships named *Challenger* found the even deeper spot that now bears the name.

WORKED EXAMPLES

Example 1. The Challenger Deep is about 36,000 feet deep. Mount Everest is about 29,000 feet tall. If Mount Everest were set on the bottom of the Challenger Deep, how much water would be above its peak?

(Use the map or drawing "The Challenger Deep is about 7,000 feet deeper than Everest is tall." shown earlier in this lesson.)

1. We want the difference between the depth and the height, so we subtract: $36,000 - 29,000$.
2. Think in thousands: $36 - 29 = 7$.
3. So the answer is 7 thousand: 7,000 feet.

Answer: About 7,000 feet of water, more than a mile, would cover the top of Mount Everest.

Example 2. The Trieste took almost 5 hours to go down. It stayed at the bottom about 20 minutes. The trip back up took about 3 hours. About how long was the whole dive?

1. Add the hours first: $5 \text{ hours} + 3 \text{ hours} = 8 \text{ hours}$.
2. Add the minutes at the bottom: $8 \text{ hours} + 20 \text{ minutes} = 8 \text{ hours } 20 \text{ minutes}$.
3. The times were rounded, so the answer is "about."

Answer: About 8 hours and 20 minutes from start to finish.

PRACTICE

1. **EASY** The Challenger Deep is at about 11 degrees north latitude. Is it in the Northern Hemisphere or the Southern Hemisphere?
2. **EASY** Look at the map of the Mariana Trench. In which direction would you go from Guam to reach the Challenger Deep?
(Use the map or drawing "Guam and the Challenger Deep." shown earlier in this lesson.)
3. **MEDIUM** There are 5,280 feet in a mile. Is the Challenger Deep, about 36,000 feet deep, closer to 5 miles deep or 7 miles deep?
4. **MEDIUM** On a depth strip where 1 inch stands for 1,000 feet, how far down from the top should you mark the usual ocean floor at 12,000 feet? The Challenger Deep at 36,000 feet?
5. **HARD** The Trieste reached the Challenger Deep in 1960. James Cameron dove there alone in 2012. How many years passed between the two dives?
6. **CHALLENGE** Explain in two or three sentences how the Trieste sank to the bottom and how it came back up.

COMMON MISTAKES

- Thinking the ocean floor is flat and smooth. It has plains, mountains and deep trenches.
- Thinking Mount Everest is taller than the Challenger Deep is deep. The Deep is about 7,000 feet deeper than Everest is tall.
- Thinking the Trieste was a submarine that drove around. It was a bathyscaphe that mostly went straight down and straight up, like an underwater balloon.

Make it a game • Deep Dive Freeze. A parent calls out a depth: "sea level," "no more sunlight," "usual ocean floor," "Titanic" or "Challenger Deep." Stand tall for sea level, crouch a little lower for each deeper place, and lie flat on the floor for the Challenger Deep. Then the parent calls "Mount Everest!" and you stretch up on tiptoe as high as you can. Anyone who goes to the wrong height must answer a question from this lesson to stay in the game.

Scripture. "Hast thou entered into the springs of the sea? or hast thou walked in the search of the depth?" (Job 38:16, KJV)

God asked Job this question to show him how great the Lord is. For thousands of years no one could answer "yes." Even after the Trieste, people have seen only a little of the deep, but God made and knows every bit of it.

Practice answers

1. The Northern Hemisphere, because it is north of the equator.
2. Southwest.
3. Closer to 7 miles. $7 \times 5,280 = 36,960$ feet, which is very close to 36,000. (5 miles would be only 26,400 feet.)

4. 12 inches (1 foot) for the usual ocean floor and 36 inches (3 feet) for the Challenger Deep.
5. $2012 - 1960 = 52$ years.
6. Sample: The Trieste let seawater into tanks and carried tons of heavy iron pellets, so it was heavy enough to sink. To come back up, the crew let the iron pellets fall out. Then the big float full of gasoline, which is lighter than water, carried the Trieste back to the surface.

UNIT 5 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use a globe for questions 1 and 8. The review is worth 40 points.

1. (4 pts) Name the five oceans. Which one is the largest?
2. (4 pts) The Pacific covers more than 60 million square miles. All the land on earth covers about 57 million square miles. Which is bigger, and by about how much?
3. (4 pts) Who was the Spanish explorer who saw the Pacific from Panama in 1513? What did he call it, and why?
4. (4 pts) Which continents lie on the east side of the Atlantic and which on the west side? Which side is called the Old World?
5. (4 pts) The Mayflower crossed the Atlantic in 66 days in 1620. A jet today crosses in about 7 hours. Why did the Mayflower's trip west take so long? Give one reason.
6. (4 pts) What is the Mid-Atlantic Ridge? Name one island that sits on top of it.
7. (4 pts) Write the word that matches each meaning: (a) a narrow passage of water joining two bigger waters (b) a big piece of ocean or sea reaching into the land (c) a large body of salt water, smaller than an ocean, often partly closed in by land.
8. (4 pts) Name the body of water: (a) the sea "in the middle of the land" between Europe and Africa (b) the warm gulf where the Mississippi River ends (c) the huge bay in Canada named for an English explorer.
9. (4 pts) The Challenger Deep is about 36,000 feet deep. Mount Everest is about 29,000 feet tall. If Everest were set in the Challenger Deep, how much water would be above its peak?
10. (4 pts) Who rode the Trieste to the bottom of the Challenger Deep in 1960? How did the Trieste come back up?

UNIT PROJECT: THE FIVE OCEANS AND TEN GREAT SEAS

Draw a large world map on poster board or taped-together paper. Color and label the five oceans (Pacific, Atlantic, Indian, Southern and Arctic) and ten great seas: the Mediterranean Sea, Caribbean Sea, Gulf of Mexico, Hudson Bay, North Sea, Red Sea, Arabian Sea, Bay of Bengal, South China Sea and Bering Sea. Mark the routes of Balboa (1513), the *Mayflower* (1620) and Henry Hudson (1610), and put an X on the Challenger Deep.

Display your map beside your depth strip from Lesson 5.4 and your hundred-square world from Lesson 5.1. Then tell a parent, in your own words, one story from each lesson in this unit.

- **Accuracy:** All five oceans and ten seas are in the right places and labeled correctly; the three routes and the Challenger Deep are marked.
- **Depth strip:** The depth strip uses the scale 1 inch = 1,000 feet and shows sea level, the end of sunlight, the usual ocean floor, the Titanic, the Challenger Deep and Mount Everest correctly.

- **Telling:** The student tells the stories of Balboa, the Mayflower, Henry Hudson and the Trieste clearly and in the right order.
- **Care:** The map is neat, colorful and easy to read, with a title, a key and a compass rose.

Answer key

1. Pacific, Atlantic, Indian, Southern and Arctic. The Pacific is the largest.
2. The Pacific is bigger, by about 3 million square miles ($60 - 57 = 3$).
3. Vasco Núñez de Balboa. He called it the South Sea, because in Panama the new sea lay to the south of him.
4. East: Europe and Africa. West: North America and South America. The east side (Europe and Africa) is part of the Old World.
5. Sample: It had no engine and could only go where the wind pushed it, and in the North Atlantic the winds blow mostly from the west, so a ship going west had to fight the wind.
6. A long chain of mountains on the floor of the Atlantic, running down the middle of the ocean. Iceland sits on top of it.
7. (a) strait (b) gulf (c) sea.
8. (a) the Mediterranean Sea (b) the Gulf of Mexico (c) Hudson Bay.
9. $36,000 - 29,000 = 7,000$ feet of water.
10. Jacques Piccard and Don Walsh. The crew let the heavy iron pellets fall out, and the big float full of gasoline, which is lighter than water, carried the Trieste up to the surface.

THE COMPASS AND THE SAIL

For most of history the ocean was a wall. Sailors hugged the coasts, stayed in harbor when clouds hid the sky and turned back when the wind blew in their faces. In this unit you will learn the four great tools that turned the ocean into a road: the stars, the magnetic compass, the sail that can work against the wind and the sea chart. “They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep” (Psalm 107:23–24).

You will sail with Mau Piailug and the canoe *Hōkūle‘a* from Hawaii to Tahiti with no instruments at all, and find the North Star for yourself. You will read how the pilots of Guangzhou in China and the sailors of Europe first trusted a needle rubbed on a lodestone, and you will make a needle compass that works just like theirs. You will follow Gil Eanes past fearsome Cape Bojador and test square and triangle sails with a fan. Last, you will study the Carta Pisana, the oldest sea chart that survives, and draw your own portolan chart of the Mediterranean, crisscross lines and all.

In every lesson, ask the same question: **what did this tool let sailors do that they could not do before?** The God who “hath made of one blood all nations of men for to dwell on all the face of the earth” (Acts 17:26) also gave people the wisdom to find their way across the seas between those nations.

BEFORE YOU BEGIN

- Can name the seven continents and five oceans and find the Pacific Ocean and the Mediterranean Sea on a globe
- Knows the equator and that latitude measures north and south of it (Unit 1)
- Can multiply by 10 and 100 and add two-digit numbers
- Can measure in inches with a ruler

MASTERY CHECKLIST

- I can find the North Star with the Big Dipper and explain how its height shows my latitude.
- I can explain how a needle rubbed on a magnet becomes a compass, and name all eight directions on a compass rose.
- I can tell the difference between a square sail and a lateen sail and explain how a ship tacks toward the wind.
- I can explain how a pilot used a portolan chart’s rhumb lines and scale to choose a direction and a distance.
- I can tell the stories of Mau Piailug, Zhu Yu’s pilots, Gil Eanes and the Carta Pisana.

OPTIONAL BOOKS AND RESOURCES

- **Polynesian Voyaging Society (Hōkūleʻa)** (<https://www.hokulea.com/>): Free. Photos, maps and stories of *Hōkūleʻa*'s voyages and of the star compass used by Hawaiian navigators (Lesson 6.1). A parent may choose what to show.
- **Gallica, the digital library of the National Library of France** (<https://gallica.bnf.fr/>): Free. Search for “Carta Pisana” or “carte portulan” to zoom in on real portolan charts in great detail (Lesson 6.4). The site is in French, but the pictures speak for themselves.
- **Library of Congress Maps Collection** (<https://www.loc.gov/maps/>): Free. Search for “portolan chart” to see more old sea charts drawn on vellum, with their wind roses and rhumb lines.

6.1 STEERING BY THE STARS ★ ⚙️

OBJECTIVES

- Tell how Mau Piailug guided the canoe *Hōkūleʻa* from Hawaii to Tahiti in 1976 with no compass or chart.
- Find the North Star with the help of the Big Dipper and explain why facing it means facing north.
- Explain that the height of the North Star above the horizon equals your latitude, and measure it with your fists.

Warm-up. Stand at one end of a long room or hallway. Close your eyes and try to walk straight to a chair at the other end. Where did you end up? Now ask a parent to turn on a lamp beside the chair, open your eyes and walk to it while looking only at the light. A light you can fix your eyes on keeps you going straight. That is how sailors used the stars.

Video. Coming soon. Polynesian wayfinding, the canoe *Hōkūleʻa* and finding the North Star with the Big Dipper: search Smithsonian, NASA (night-sky and Polaris segments) and Homeschool Pop (Alternate); candidate National Geographic Kids (needs vetting).

KEY TERMS

navigator

The person on a ship who finds the way and decides which direction to steer.

North Star (Polaris)

The star that sits almost exactly above the North Pole. It hardly moves all night, so facing it means facing north.

horizon

The line far away where the sky seems to meet the land or the sea.

swell

A long, smooth ocean wave that rolls in steadily from the same direction, often for days.

Polynesian Triangle

The huge triangle of Pacific islands with Hawaii, New Zealand and Easter Island (Rapa Nui) at its three corners.

CORE IDEAS

The story. On May 1, 1976, a voyaging canoe named *Hōkūleʻa* sailed out of Honolulu Bay on the island of Maui in Hawaii. She was about 62 feet long, with two hulls side by side and two sails shaped like crab claws, built to sail like the canoes of the Polynesian voyagers of long ago. Her navigator, Mau Piailug, came from Satawal, a tiny island in Micronesia, and had learned the old ways of the sea from his grandfather. He used no compass, no chart and no instruments. Thirty-four days later, on June 4, *Hōkūleʻa* reached Papeete on the island of

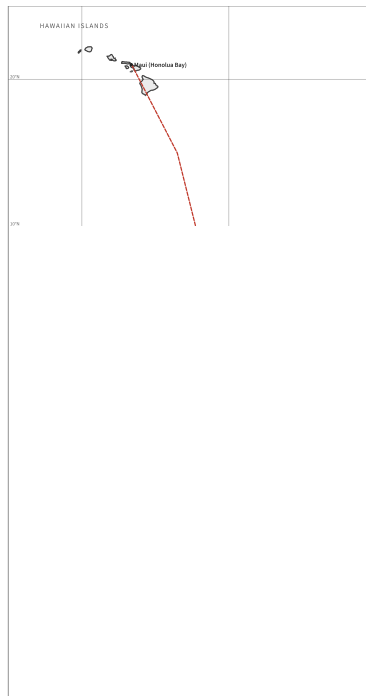
Tahiti, about 2,500 miles to the south, and crowds of people came down to the shore to welcome her. Her name means “Star of Gladness.” It is the Hawaiian name for the bright star Arcturus, which passes almost straight over Hawaii.

How they found the way. Mau carried a map of the sky in his head. Each star rises at the same place on the horizon every night and sets at the same place on the other side. Mau knew where dozens of stars rose and set. He pointed the canoe at a star just rising in the direction he wanted to go. When it climbed too high to steer by, another star rising in the same spot took its place, like a row of lamps along a road. By day he watched the rising and setting sun. He also felt the long ocean **swells** rolling under the hulls from the same direction for days. Near land, seabirds flying home at sunset and clouds piling up over an island showed him where to look.

The big idea. As the earth turns, the stars seem to wheel slowly across the night sky. One star hardly moves at all: **Polaris**, the **North Star**. It sits almost exactly above the North Pole, so when you face it, you are facing north. Its height also tells you how far north you are. At the North Pole it is straight overhead. At the equator it sits right on the horizon. In Hawaii, about 20 degrees north of the equator, it stands about 20 degrees above the horizon. **The height of the North Star equals your latitude**, the lines you learned in Unit 1. As *Hōkūle’a* sailed south, the North Star sank lower every night. Near the equator it slipped below the sea, and the stars of the southern sky, like the Southern Cross, climbed higher instead.

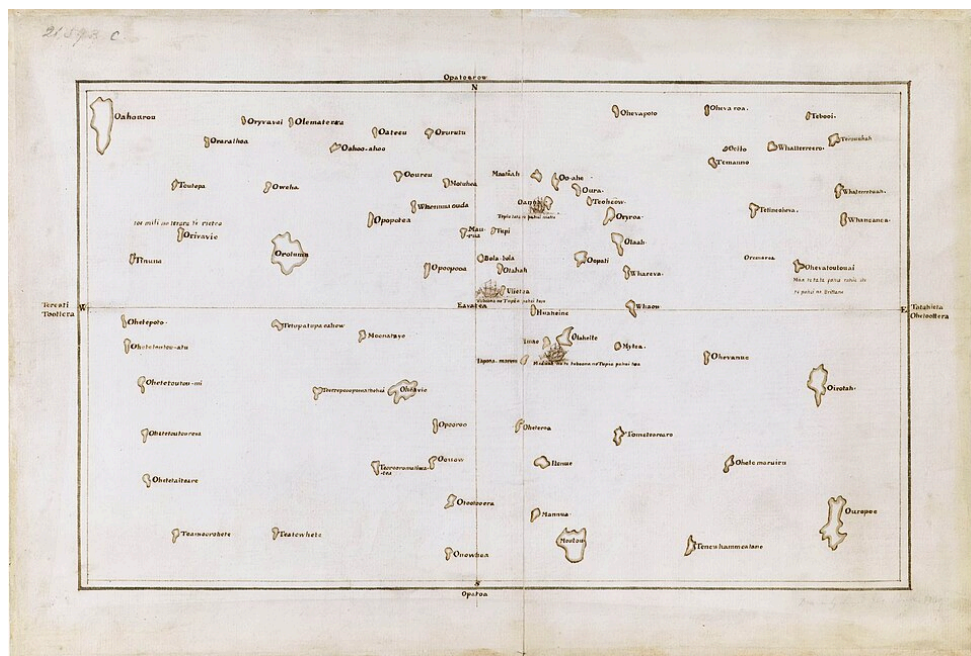
On the map. Find Hawaii, New Zealand and Easter Island (Rapa Nui) on a globe. Draw lines between them and you make a giant triangle, thousands of miles on each side: the **Polynesian Triangle**. Many hundreds of years before Columbus, Polynesian sailors found and settled nearly every island inside it. They sailed double canoes loaded with families, pigs, chickens and plants such as taro and breadfruit. Almost all of the triangle is water, and the islands are tiny dots in it.

Technology overcoming geography. The Pacific is the widest ocean on earth, and to most people of long ago it was a wall. Polynesian navigators turned it into a road with a strong canoe and a tool you cannot hold in your hand: knowledge, carefully learned and handed down from grandparent to grandchild. The stars they steered by keep their places night after night because God set them in the heavens “for signs, and for seasons” (Genesis 1:14).



The route of Hōkūle'a from Maui to Tahiti in 1976 (the line is approximate). The canoe crossed the equator on the way.

PICTURE STUDY



Tupaia's Chart of the Islands, Tupaia, a navigator and priest from Raiatea (copy made aboard HMS Endeavour), 1769 · Ink on paper · British Library, London

In 1769 the English ship *Endeavour*, under Captain James Cook, visited Tahiti. A Polynesian navigator and priest named Tupaia, from the nearby island of Raiatea, joined the ship as a guide. Tupaia knew the sea paths to dozens of islands, some of them many days' sail away, and he drew this chart of them for the English sailors.

The chart is famous because it shows how much a Polynesian navigator carried in his memory. Tupaia had never seen a printed map, yet he could place island after island across a huge stretch of ocean.

Look closely

- Find the small island shapes. Try counting the islands in one part of the chart.
- Look at the names written beside the islands. They are Polynesian names written with English letters.
- Look at how far apart the islands are. What fills all the space between them?
- Compare this chart with a map in your atlas. What is the same, and what is different?

Talk about it

1. How could a navigator know where all these islands were without ever having seen a map?
2. Why do you think the English sailors were so eager to have Tupaia draw this chart?

PROJECT: FIND THE NORTH STAR AND MEASURE IT

On a clear night you will find the North Star with the help of the Big Dipper, measure how high it stands with your fists, and use it to work out your own latitude, just as a navigator would.

You will need

- A clear night and a parent to go outside with you
- A flashlight covered with red cellophane or a red balloon (red light keeps your eyes ready for the dark)
- Your map notebook and a pencil
- A paper plate and a marker for a star compass
- A compass or a phone compass app, to check your answer

Steps

1. Go outside about an hour after dark, away from bright lights. Give your eyes ten minutes to get used to the dark.
2. Find the Big Dipper, seven bright stars shaped like a pot with a long handle. In the fall it sits low in the north.
3. Find the two stars at the end of the Dipper's cup, farthest from the handle. These are the **pointer stars**.
4. Follow a line through the pointer stars, going out from the top of the cup, about five times the distance between them. The first medium-bright star you reach is the North Star. It is not very bright, so look carefully.
5. Face the North Star. You are facing north. Point to east (your right), south (behind you) and west (your left).

6. Stretch your arm straight out and make a fist. One fist at arm's length covers about 10 degrees of sky. Put the bottom of your fist on the horizon and count fists, stacking one on top of the other, until you reach the North Star.
7. Multiply your fists by 10. That is about how high the star stands, and about your latitude. Write the number in your notebook.
8. Back inside, look up your town's latitude on a globe or in an atlas. How close did you come?
9. Make a star compass: write N, E, S and W around the edge of the paper plate, and draw a small star beside the N.

Tips

- If you see a very bright "star" that does not twinkle, it is probably a planet. The North Star is only medium bright.
- Fists are not exact. If your answer is within 5 to 10 degrees of the real latitude, you did very well.
- The North Star stays in the same place all night. Look again an hour later and you will see the Big Dipper has moved, but the North Star has not.

Check your work

- I found the North Star using the pointer stars of the Big Dipper.
- I measured its height in fists and changed it to degrees.
- I can explain why the North Star's height tells me my latitude.

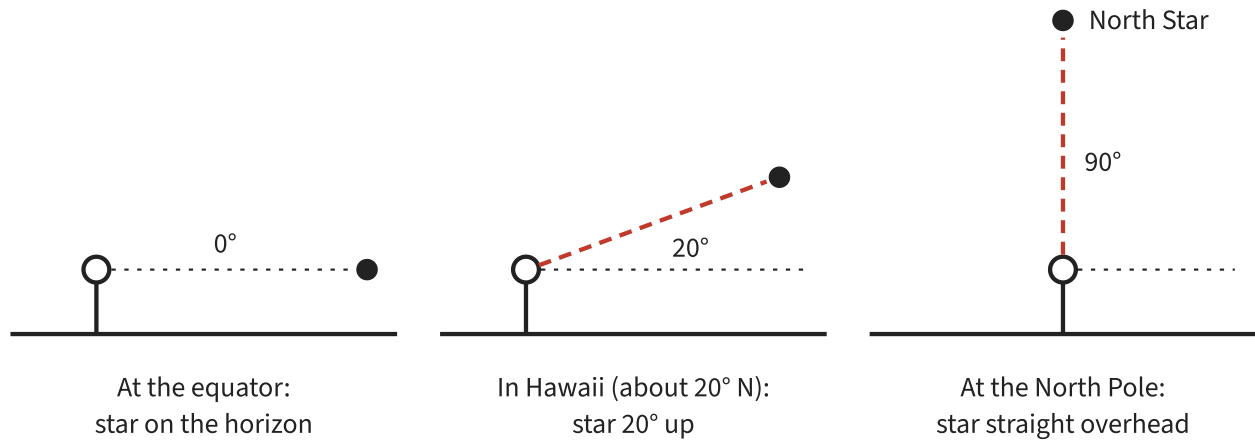
MAP NOTEBOOK

1. Draw the Big Dipper, its two pointer stars and a dotted line to the North Star. Label the North Star.
2. Draw the Polynesian Triangle on an outline of the Pacific and label Hawaii, New Zealand, Easter Island (Rapa Nui) and Tahiti.
3. Draw *Hōkūle'a* with her two hulls and crab-claw sails, and write one sentence about how Mau Pailug found his way.

From history. Mau Pailug was one of the last navigators in the Pacific who still knew the old way of finding islands without instruments, and he chose to teach it to Hawaiians who wanted to learn. One of his students, Nainoa Thompson, guided *Hōkūle'a* to Tahiti and back himself in 1980. From 2014 to 2017, *Hōkūle'a* sailed all the way around the world and came home to Hawaii.

WORKED EXAMPLES

Example 1. Hawaii is about 20 degrees north of the equator. One fist held at arm's length covers about 10 degrees of sky. How many fists above the horizon would a sailor in Hawaii measure to the North Star?



The farther north you go, the higher the North Star climbs.

1. The height of the North Star equals your latitude, so in Hawaii it stands about 20 degrees high.
2. Each fist covers about 10 degrees.
3. $20 \div 10 = 2$, or count by tens: 10, 20. That is 2 fists.

Answer: About 2 fists above the horizon.

Example 2. *Hōkūleʻa* left Maui on May 1, 1976, and reached Tahiti on June 4. May has 31 days. How many days was she at sea?

(Use the map or drawing “The voyage of Hōkūleʻa, 1976.” shown earlier in this lesson.)

1. From May 1 to May 31 is $31 - 1 = 30$ days.
2. From May 31 to June 4 is 4 more days.
3. $30 + 4 = 34$.

Answer: 34 days at sea.

PRACTICE

1. **EASY** You are facing the North Star. Which direction are you facing? Which direction is behind you?

2. **EASY** Besides the stars, name two things Mau Piailug watched or felt to find his way across the ocean.
3. **MEDIUM** Where would the North Star be if you stood at the North Pole? Where would it be if you stood on the equator?
4. **MEDIUM** A family lives at about 40 degrees north latitude. How many fists above the horizon is their North Star?
5. **MEDIUM** On good days a voyaging canoe can sail about 100 miles. How far would it sail in 6 good days?
6. **HARD** Tahiti is about 17 degrees *south* of the equator. Could Mau Piailug steer by the North Star when he was near Tahiti? Explain.

COMMON MISTAKES

- Thinking the North Star is the brightest star in the sky. It is only medium bright; you find it by its place, not its brightness.
- Thinking the North Star can be seen from everywhere. South of the equator it is hidden below the horizon.
- Thinking Polynesian voyagers found islands by luck. Their navigators trained for years and used stars, swells, birds and clouds with great skill.

Make it a game • Steer by the Star. With a parent and a compass app, find which wall of your home faces north and tape a paper star high on it. Stand in the middle of the room. Your parent calls out a direction: “North!” (face the star), “South!” (turn your back to it), “East!” (the star is on your left), “West!” (the star is on your right). Score a point for each correct turn made in three seconds. Then trade places and let the navigator call the directions.

Scripture. “He telleth the number of the stars; he calleth them all by their names.”
(Psalm 147:4, KJV)

Navigators like Mau Piailug learned the names and places of dozens of stars. God knows every one of them, and He keeps them so faithfully in their places that sailors can steer by them across the widest ocean on earth.

Practice answers

1. You are facing north. South is behind you.
2. Any two: the rising and setting sun, ocean swells, seabirds flying home to land, clouds piling up over islands.
3. At the North Pole it is straight overhead (90 degrees up). On the equator it sits right on the horizon (0 degrees up).
4. About 4 fists, because $4 \times 10 = 40$ degrees.
5. $6 \times 100 = 600$ miles.

6. No. South of the equator the North Star is below the horizon, so it cannot be seen. Near Tahiti he steered by other stars, such as the Southern Cross and stars he knew rising and setting on the horizon.

6.2 THE MAGNETIC COMPASS ★ ⚙️

OBJECTIVES

- Tell how sailors in China and Europe began using a magnetized needle to find direction at sea, about 1100 to 1200.
- Explain what lodestone is and how a needle rubbed on a magnet becomes a compass.
- Name the four cardinal and four in-between directions and use a compass rose to turn and steer.

Warm-up. Hold a refrigerator magnet near a paper clip, a coin, a spoon, a pencil and an aluminum foil ball. Which ones does the magnet pull? Sort them into two piles: “pulled” and “not pulled.” What do the pulled things have in common?

Video. Coming soon. How a magnetic compass works, lodestone and making a needle compass: search Science Max, SciShow Kids, Smithsonian and Homeschool Pop (Alternate); candidate Free School (needs vetting).

KEY TERMS

lodestone

A dark rock, a kind of iron ore, that is a natural magnet.

magnet

Something that pulls iron toward itself. A magnet that can swing freely lines up north and south.

compass

A tool with a magnetized needle that always points north and south, so you can find direction even when you cannot see the sun or stars.

cardinal directions

The four main directions: north, east, south and west.

compass rose

A drawing on a map that shows the directions.

CORE IDEAS

The story. In southern China, the great port of Guangzhou (often called Canton) was crowded with ships sailing to the islands and lands of the southern seas. Around the year 1119, a writer named Zhu Yu, whose father had been an official in Guangzhou, wrote down what he had learned about the port. The ship pilots, he said, knew the shapes of the coasts. At night they watched the stars, and by day they watched the sun. But in dark, cloudy weather they looked at a **south-pointing needle**. This is one of the oldest written reports in the world of a compass used at sea. About seventy years later, around 1190, an English teacher named Alexander Neckam wrote that European sailors did the same thing. When

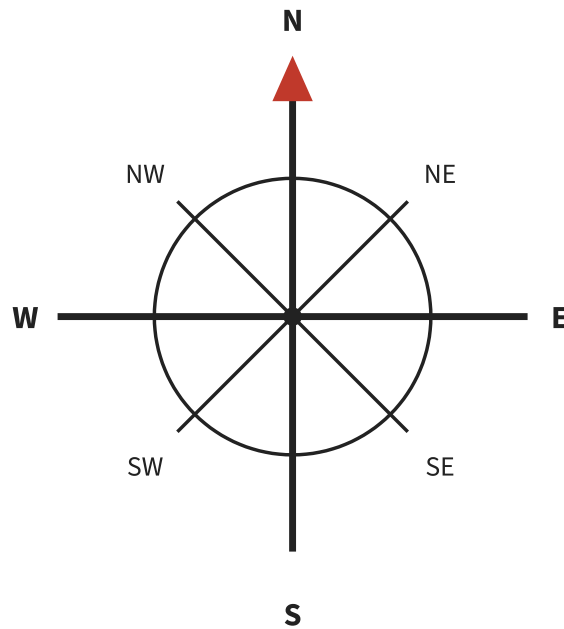
clouds hid the sun, they touched a needle to a magnet, and the needle turned until its point showed north. No one knows for sure whether Europe learned the compass from China or found it on its own.

How it worked. The secret was a strange dark rock called **lodestone**. Lodestone is a kind of iron ore that is a natural **magnet**: it pulls bits of iron to itself. People found that if you rub an iron needle on a lodestone, the needle becomes a magnet too. Float that needle on a bit of straw or cork in a bowl of water, or hang it from a silk thread, and it slowly swings until it lies north and south. One end always points north and the other end always points south. The Chinese named the needle for its south end, and Europeans named it for its north end, but it is the same needle! In 1600 an English doctor named William Gilbert explained why it works: the whole earth acts like a giant magnet, and the needle lines up with it.

The big idea. A compass gives you the four **cardinal directions**: north, east, south and west. Halfway between them are four more: northeast, southeast, southwest and northwest. On a map they are drawn on a **compass rose**. If you face north, east is on your right, west is on your left and south is behind you. Make a quarter turn to the right and you face east. A pilot who knew which way his port lay could keep the bow of the ship pointed that way all day and all night, cloudy or clear.

On the map. Find the Mediterranean Sea and the South China Sea. In both, winter brings clouds and storms that can hide the sun and stars for days. In Roman times, most ships on the Mediterranean stayed in harbor through the winter. With a needle in a bowl, a pilot could find north under a gray sky. Historians think the compass helped Mediterranean merchants sail in more months of the year and helped Chinese ships cross open water toward Southeast Asia and India.

Technology overcoming geography. Clouds and darkness had always been a wall for sailors. A small magnetized needle broke through it. Good navigators still watched the stars and the sun, but now the way home could be found even on the blackest night. The compass did not make the sea any smaller. It made the sea something a sailor could cross with confidence.



A compass rose shows the four cardinal directions and the four in-between directions.

PICTURE STUDY



A Smith Hammering Iron, from De Magnete, Woodcut made for William Gilbert's book, 1600 · Woodcut in a printed book · Printed in London; copies are kept in rare-book libraries around the world (this image comes from the 1900 English edition, which reprinted Gilbert's original woodcuts)

William Gilbert was a doctor in London who served Queen Elizabeth I. For years he tested lodestones, needles and iron bars, and in 1600 he published a book in Latin called *De Magnete*, which means "On the Magnet." In it he explained that the earth itself is a great magnet, which is why a compass needle points north and south.

This small woodcut from the book shows a blacksmith hammering a hot iron bar on his anvil. Gilbert noticed that iron hammered while it lies north and south becomes a little bit magnetic, just like a needle rubbed on a lodestone.

Look closely

- Find the blacksmith, his hammer and his anvil.
- Look at the long iron bar. Which way does it lie?
- Look for Latin words near the edges. *Septentrio* means north and *Auster* means south.
- A woodcut is printed from a carved block of wood. Look at the lines. How did the artist show light and shadow with only black lines?

Talk about it

1. Why did the picture need to show which way is north and which way is south?
2. Gilbert learned about magnets by doing careful experiments. What experiment will you do with a magnet this week?

Safety first. Needles are sharp: hold them by the middle and let a parent handle them if you are young. Keep small, strong magnets away from little brothers and sisters, because swallowing magnets is very dangerous. Keep magnets away from phones, computers and bank cards.

PROJECT: MAKE A NEEDLE COMPASS

You will turn an ordinary sewing needle into a magnet, float it on water just as the first sailors did, and watch it swing around to point north.

You will need

- A steel sewing needle about 1 to 2 inches long
- A strong magnet (a bar magnet or a strong craft magnet; most flat refrigerator magnets are too weak)
- A slice of cork about $\frac{1}{4}$ inch thick, a bottle cap or a small flat leaf
- A plastic or glass bowl of water (not metal)
- A real compass or a phone compass app to check your work
- A marker and a paper plate

Steps

1. Hold the needle by its eye. Stroke it with one end of the magnet from the eye to the point, 40 times, always in the same direction. Lift the magnet away at the end of each stroke.
2. Test it: touch the needle to a pin or small paper clip. If it picks it up, the needle is now a magnet. If not, stroke it 20 more times.
3. Lay the needle flat on the cork, cap or leaf. Tape it down if it rolls.

4. Set the bowl of water on a table away from metal things, and gently float the cork in the middle.
5. Watch the cork turn slowly and stop. Give it a little spin. Does it stop in the same direction again?
6. Check with a real compass to see which end of your needle points north. Mark that end with a dot of marker.
7. Draw a compass rose on the paper plate with N, NE, E, SE, S, SW, W and NW. Set the bowl on the plate and turn the plate until its N lines up with your needle.
8. Bring your magnet close to the bowl and watch what the needle does. Take the magnet away again.

Tips

- Metal pots, steel table legs and electronics can pull your needle the wrong way. Try your compass in a few spots.
- If the needle lies north and south but you are not sure which end is which, the real compass will tell you. Either end might turn out to be the north end.
- Your needle will slowly lose its magnetism. Stroke it again before each use.

Check your work

- My needle picked up a pin after I stroked it with the magnet.
- My floating needle turned and stopped pointing north and south.
- I can name all eight directions on my compass rose.

MAP NOTEBOOK

1. Draw a large compass rose with all eight directions labeled. Write “Never Eat Soggy Waffles” around it to remember N, E, S, W.
2. Draw your needle compass floating in its bowl and label the north end.
3. On an outline map of Asia and Europe, mark Guangzhou in China and England, and write the dates 1119 and 1190 beside them.

From history. In 1088 a Chinese scholar named Shen Kuo described a needle rubbed on a lodestone and hung from a single silk thread. He noticed something surprising: the needle did not point exactly south but a little to the east of south. Today we know that a compass points to the magnetic pole, which is not in exactly the same place as the true North Pole, so navigators must make a small correction.

WORKED EXAMPLES

Example 1. A ship is sailing north. The captain orders a quarter turn to the right. Which way is the ship sailing now? Then he orders another quarter turn to the right. Which way now?

(Use the map or drawing “Turning to the right means going clockwise around the compass rose.” shown earlier in this lesson.)

1. Start at N on the compass rose.
2. A quarter turn to the right (clockwise) moves from N to E. The ship sails east.
3. Another quarter turn to the right moves from E to S. The ship sails south.

Answer: First east, then south.

Example 2. A Chinese ship leaves Guangzhou and sails southwest at 5 miles an hour for 4 hours. How far has it gone? Which way must it sail to come straight back?

1. Distance: 5 miles each hour for 4 hours is $5 + 5 + 5 + 5 = 20$ miles, or $4 \times 5 = 20$.
2. To come back, sail the opposite way. On the compass rose, the point straight across from southwest is northeast.

Answer: 20 miles. To come straight back, it sails northeast.

PRACTICE

1. **EASY** What is lodestone?
2. **EASY** Name the four cardinal directions in order, going clockwise from north.
3. **MEDIUM** You are facing east. You make a quarter turn to the left. Which way are you facing now?

(Use the map or drawing “Turning left means going counterclockwise.” shown earlier in this lesson.)

4. **MEDIUM** What direction is the opposite of northwest?
5. **HARD** A ship sails north at 6 miles an hour for 3 hours. Then it sails east at 6 miles an hour for 2 hours. How many miles does it sail in all?
6. **CHALLENGE** In two or three sentences, explain why a compass was more useful than the stars on a stormy night.

COMMON MISTAKES

- Thinking “north” means “up” in the real world. On a map north is usually at the top, but outside, north is a direction along the ground that a compass shows you.
- Holding a compass near metal or a magnet. Iron and steel nearby can pull the needle the wrong way.

- Thinking the Chinese “south-pointing needle” was a different tool. It was the same kind of needle; one end points south and the other end points north.

Make it a game · Compass Commander. Tape paper signs for N, E, S and W on the four walls of a room (check with your needle compass or a compass app). The Commander calls orders like “Face north! Quarter turn right! Half turn!” and the crew turns and shouts the new direction. Add the in-between directions when you are ready: “Face northeast!” A wrong turn makes you the Commander’s helper until the next round.

Scripture. “A man’s heart deviseth his way: but the LORD directeth his steps.” (Proverbs 16:9, KJV)

A ship’s pilot plans the course, and the compass helps him keep it. But the Bible reminds us that it is God who directs our steps, on land and at sea, and we can trust Him even when the way is dark.

Practice answers

1. A dark rock, a kind of iron ore, that is a natural magnet.
2. North, east, south, west.
3. North.
4. Southeast.
5. North: $3 \times 6 = 18$ miles. East: $2 \times 6 = 12$ miles. In all: $18 + 12 = 30$ miles.
6. On a stormy night clouds hide the stars, so a navigator cannot see them to steer. A compass needle points north and south no matter what the weather is, so the pilot can still keep the ship on course.

6.3 SAILS THAT GO AGAINST THE WIND ⚙

OBJECTIVES

- Tell how Gil Eanes sailed past Cape Bojador in 1434 and why coming home against the wind was the hard part.
- Compare a square sail and a triangular lateen sail and explain how a ship zigzags (tacks) toward the wind.
- Describe the caravel and name explorers who sailed in caravels.

Warm-up. Hold a sheet of paper by its top corners in front of a fan or a parent's gentle breath. Now hold it flat and sideways, like a wing, with the wind blowing across it. How does the paper move each time? Which way did the wind push it?

Video. Coming soon. How sailboats sail against the wind (tacking), the lateen sail and the Portuguese caravel: search Smithsonian, Science Max, Drive Thru History and Homeschool Pop (Alternate); candidate National Geographic Kids (needs vetting).

KEY TERMS

square sail

A four-sided sail hung crosswise on the mast. It works best when the wind blows from behind the ship.

lateen sail

A big triangular sail hung from a long slanting pole. It lets a ship sail with the wind from the side and even partly toward the wind.

tacking

Zigzagging back and forth at a slant to make headway toward the wind.

caravel

A small, light Portuguese sailing ship, usually with lateen sails, used by explorers in the 1400s.

trade winds

Steady winds that blow almost all year. North of the equator in the Atlantic they blow from the northeast.

CORE IDEAS

The story. Long ago, sailors from Portugal feared a place on the coast of Africa called **Cape Bojador**. It is a low point of land where the sea is shallow and rough, and strong winds and currents push ships to the south. Old tales said that no one who sailed past it could ever come back. In 1433 Gil Eanes, a squire serving Prince Henry of Portugal, set out to pass it, but his frightened crew turned back. Prince Henry sent him again, and in 1434 Gil Eanes sailed past Cape Bojador and came home safely. Going south had been easy. Coming home

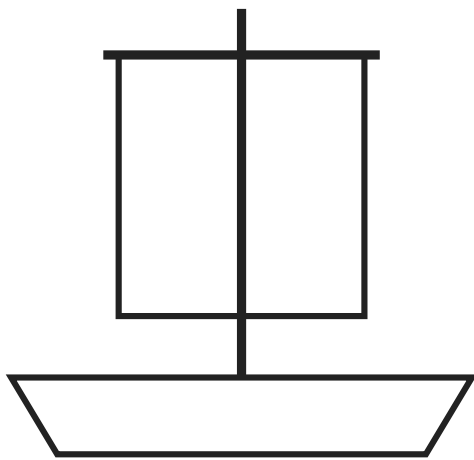
was the hard part, because along that coast the wind blows almost all the time from the north and northeast, right in the face of a ship trying to sail back to Portugal.

How it worked. Many European ships carried **square sails**, hung crosswise on the mast like a sheet on a clothesline. A square sail is wonderful when the wind blows from behind, pushing the ship along. But it is poor at sailing toward the wind. The sailors of the Mediterranean, and the Arab sailors of the Indian Ocean, had long used a different sail: the **lateen sail**, a big triangle hung from a long pole slanting high above the deck and running the long way along the ship. A lateen sail can drive a ship forward when the wind comes from the side, and even when it comes partly from ahead. No sailboat can sail straight into the wind. But a lateen ship can sail at a slant toward it, then turn and slant the other way, zigzagging forward. This zigzag is called **tacking**.

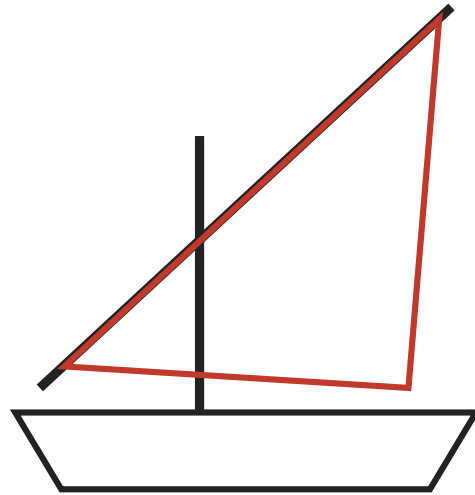
The big idea. By the 1440s, Portuguese shipbuilders were building a small, light ship called the **caravel**. It usually had two or three masts with lateen sails, and it floated high in shallow water. A caravel could creep close to an unknown shore, slip into the mouths of rivers and, best of all, tack home against the north wind. Year after year, caravels carried Portuguese captains farther down the coast of Africa. In 1488 Bartolomeu Dias sailed around the southern tip of Africa with two caravels and a supply ship. In 1492 two of Columbus's three ships, the *Niña* and the *Pinta*, were caravels.

On the map. Winds are named for the direction they come *from*. A north wind blows from the north toward the south. Off the coast of northwest Africa, steady winds called the **trade winds** blow from the northeast almost all year. On your map, draw arrows pointing southwest along the coast, from Portugal past the Canary Islands to Cape Bojador. Sailing south, a ship ran before the wind. Sailing home, it had to tack, or swing far out into the open Atlantic to find winds blowing toward Portugal. Portuguese sailors learned to do both.

Technology overcoming geography. For a ship with only square sails, a wind in its face was a wall. The triangle sail turned that wall into something a sailor could work against, slowly but surely. In time shipbuilders mixed both kinds on one ship: square sails for running before the wind and a lateen sail for steering and tacking. Ships like these, with a compass aboard, would soon cross every ocean in the world.

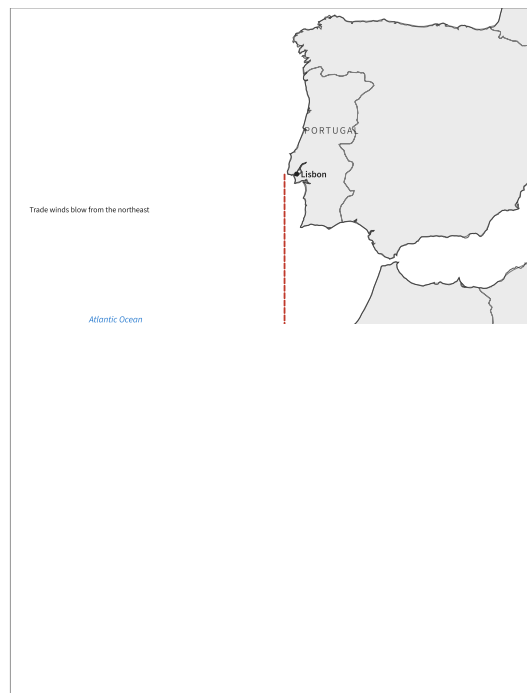


Square sail



Lateen sail (triangle)

A square sail (left) and a lateen sail (right).



The way to Cape Bojador. The trade winds blow from the northeast, so the trip south was easy and the trip home was hard.

PICTURE STUDY



The Return from Fishing, Joaquín Sorolla, 1894 · Oil on canvas · Musée d'Orsay, Paris

Joaquín Sorolla grew up in Valencia, a city on the Mediterranean coast of Spain, and he loved to paint its bright beaches. Here the fishing boats are coming home, and teams of oxen wade into the surf to pull a boat up onto the sand.

Look at the boat's sail: a huge triangle hanging from a long slanting pole. It is a lateen sail, the same kind that Mediterranean sailors had used for hundreds of years before the caravels. Sorolla showed this painting in Paris in 1895, and the French government bought it.

Look closely

- Find the big triangular sail. Can you see the long pole that holds up its top edge?
- Count the oxen. How are they helping the fishermen?
- Look at the wind in the sail. Which way do you think the wind is blowing?
- Find the places where sunlight sparkles on the water and the white foam of the waves.

Talk about it

1. Why would a fishing boat on this coast need a sail that can work with the wind coming from the side?
2. How would you describe this scene to someone who could not see it?

Safety first. A grown-up runs the fan. Keep fingers away from the blades. Never put an electric fan or its cord near the water; set the fan on a dry table or floor at least 3 feet from the tub or tray, or use a small battery fan. Wipe up spills right away so no one slips.

PROJECT: THE GREAT SAIL TEST

You will build a small boat, give it a square sail and then a triangle sail, and test each one with a fan blowing from behind and from the side. You will measure how far the boat goes and find out which sail works best in each wind.

You will need

- A small boat: a clean foam meat tray, a half-gallon milk carton cut in half the long way, or a toy boat
- A plastic straw or a wooden skewer for the mast, and modeling clay to hold it up
- A piece of an old plastic card or stiff cardboard covered in tape, for a keel
- Paper or a plastic bag for sails: one square about 4 inches on each side, and one triangle with sides about 5 inches
- Tape, scissors and a ruler or yardstick
- A bathtub with a few inches of water, or a long plastic storage tub
- A small fan (run by a grown-up) and a timer

Steps

1. Stick a ball of clay in the middle of the boat and push the mast into it.
2. Tape the keel under the boat so it sticks straight down, running from front to back. The keel keeps the boat from sliding sideways, just as a real ship's keel does.
3. Tape the square sail across the mast, facing the back of the boat.
4. Test 1: Set the boat at one end of the water. Have the grown-up point the fan at the back of the boat. Run the fan for 10 seconds and measure how many inches the boat traveled.
5. Test 2: Put the boat back. Point the fan at the side of the boat. Run it for 10 seconds and measure again.
6. Take off the square sail. Tape the triangle sail to the mast so it runs the long way along the boat, slanting a little across.
7. Test 3 and Test 4: Repeat the wind-from-behind test and the wind-from-the-side test with the triangle sail.
8. Make a chart in your notebook: Sail, Wind direction, Inches traveled. Circle the best sail for each wind.
9. Bonus: point the fan partly toward the front of the boat. Turn the triangle sail different ways. Can you make the boat move at a slant across the wind?

Tips

- Run each test two or three times and use the middle number. Toy boats can be fussy.
- If the boat spins, move the mast a little forward or backward until it sails straighter.
- You may find the square sail wins with the wind behind and the triangle sail does better with the wind from the side. That is just what the old sailors found.

Check your work

- I tested both sails in two kinds of wind and recorded the distances.
- I can tell which sail did best with the wind behind and which did best with the wind from the side.
- I can explain why a keel helps a boat sail across the wind.

MAP NOTEBOOK

1. Draw a square-sailed ship and a lateen-sailed caravel side by side and label each sail.
2. Draw a zigzag (tacking) path from a ship to a harbor with the wind blowing from the harbor. Add wind arrows.
3. On an outline map of Europe and Africa, mark Portugal, the Canary Islands and Cape Bojador, and draw trade-wind arrows blowing toward the southwest.

From history. When Columbus stopped at the Canary Islands in 1492, he had the *Niña's* triangle sails changed to square sails. He planned to sail west across the Atlantic with the trade winds behind him, and square sails are best for that. The best rig depended on which way the wind would blow.

WORKED EXAMPLES

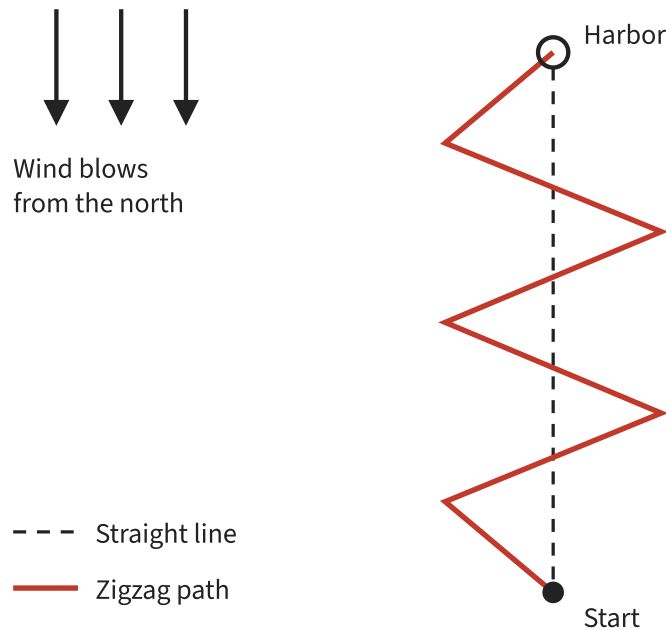
Example 1. Near Cape Bojador the wind blows from the northeast. Which way does it push a ship? Portugal lies to the north. Why was the trip home hard?

(Use the map or drawing “The route to Cape Bojador.” shown earlier in this lesson.)

1. A wind is named for where it comes *from*. A northeast wind comes from the northeast.
2. It pushes things the opposite way. On the compass rose, the opposite of northeast is southwest.
3. Portugal is to the north, so a ship going home must sail almost straight into a wind that blows from the northeast. It cannot sail straight into the wind; it must tack or swing out to sea.

Answer: The wind pushes the ship toward the southwest. Going home to the north meant sailing nearly into the wind, so the ship had to zigzag.

Example 2. A caravel's harbor is 12 miles straight upwind. The caravel tacks in 6 legs, and each leg is 4 miles long. How many miles does it sail in all? How many more miles is that than the straight line?



Tacking: six slanting legs carry the ship toward a harbor that lies straight upwind.

1. Total sailed: $6 \text{ legs} \times 4 \text{ miles} = 24 \text{ miles}$.
2. Extra miles: $24 - 12 = 12 \text{ miles}$.
3. The caravel sails twice as far as the straight line, but it gets home. A square-sailed ship might not get there at all.

Answer: 24 miles in all, which is 12 miles more than the straight line.

PRACTICE

1. **EASY** What shape is a lateen sail?
2. **EASY** A west wind is blowing. Where is it coming from, and which way is it blowing?
3. **MEDIUM** Which sail works best when the wind blows straight from behind the ship? Which sail is better for working toward the wind?
4. **MEDIUM** A caravel sails 4 miles an hour for 8 hours. How far does it go?
5. **HARD** A harbor is 9 miles straight upwind. A ship tacks in 5 legs of 3 miles each. How many miles does it sail? How many extra miles is that?
(Use the map or drawing "This drawing shows 6 legs, but the ship in this problem makes only 5. Multiply t " shown earlier in this lesson.)
6. **CHALLENGE** In two or three sentences, explain why sailing home from Cape Bojador was harder than sailing there, and how the caravel helped.

COMMON MISTAKES

- Thinking a north wind blows toward the north. Winds are named for where they come from, so a north wind blows toward the south.
- Thinking a lateen sail lets a ship sail straight into the wind. No sailboat can; it must zigzag at a slant.
- Picturing the caravel as a giant ship. Caravels were small and light, which is why they were good for exploring shallow coasts and rivers.

Make it a game • Tack to the Harbor. Draw a grid of squares, 9 across and 10 up, on a big sheet of paper. Mark a harbor in the middle of the top row and two starting ships at the bottom. The wind blows from the top, so ships may never move straight up. On your turn, roll a die and move that many squares diagonally, up and to the left or up and to the right, all in one direction. If you hit the edge, you must turn back the other way. The first ship to land exactly in the harbor wins.

Scripture. “The wind goeth toward the south, and turneth about unto the north; it whirleth about continually, and the wind returneth again according to his circuits.” (Ecclesiastes 1:6, KJV)

Long before sailors made maps of the winds, the Bible described them moving in great circuits. God made the winds to follow patterns, and sailors who learned those patterns could plan their voyages.

Practice answers

1. A triangle.
2. It comes from the west and blows toward the east.
3. The square sail works best with the wind behind. The lateen (triangle) sail is better for working toward the wind.
4. $4 \times 8 = 32$ miles.
5. $5 \times 3 = 15$ miles sailed. $15 - 9 = 6$ extra miles.
6. The trade winds along that coast blow from the north and northeast, so sailing south the wind was behind the ship, but sailing home the wind was in its face. The caravel’s lateen sails let it zigzag (tack) toward the wind, so it could work its way home.

6.4 MAKING A MAP OF THE COAST

OBJECTIVES

- Describe the Carta Pisana (about 1275), the oldest sea chart that survives, and explain what a portolan chart is.
- Explain how a pilot used the crisscross rhumb lines and a compass to choose a direction.
- Use a scale bar to find distances on a chart and work out how many days a voyage would take.

Warm-up. Lay a pencil on a table pointing toward the door. Now lay a second pencil somewhere else on the table so it points the very same way, side by side like train tracks. These are *parallel*. Try it with a third pencil. Sailors used this trick with lines on their charts.

Video. Coming soon. Portolan charts, the Carta Pisana and how medieval sailors used sea charts: search Library of Congress (Geography and Map Division), Smithsonian, The History Guy and Homeschool Pop (Alternate); candidate Jay Foreman (Map Men) (needs vetting).

KEY TERMS

portolan chart

A sea chart of coasts and harbors drawn in the Middle Ages, covered with crisscross direction lines. The name comes from the Italian *portolano*, a book of directions from port to port.

rhumb line

One of the straight lines on a portolan chart that shows a compass direction.

wind rose

A circle or star of direction lines, each named for the wind that blows from that direction.

scale

A bar on a map or chart that shows how many miles a length on the map stands for.

dividers

A tool with two sharp metal points used to measure distances on a chart against the scale.

CORE IDEAS

The story. About the year 1275, someone took a single large sheepskin, scraped thin and smooth, and drew on it the whole Mediterranean Sea and the Black Sea. We do not know the mapmaker's name. Many scholars think the chart was made in Genoa, a great seaport of Italy. Long afterward it turned up in the city of Pisa, so today it is called the **Carta Pisana**, the Pisa Chart. It is the oldest sea chart in the world that still survives, and it is kept in the

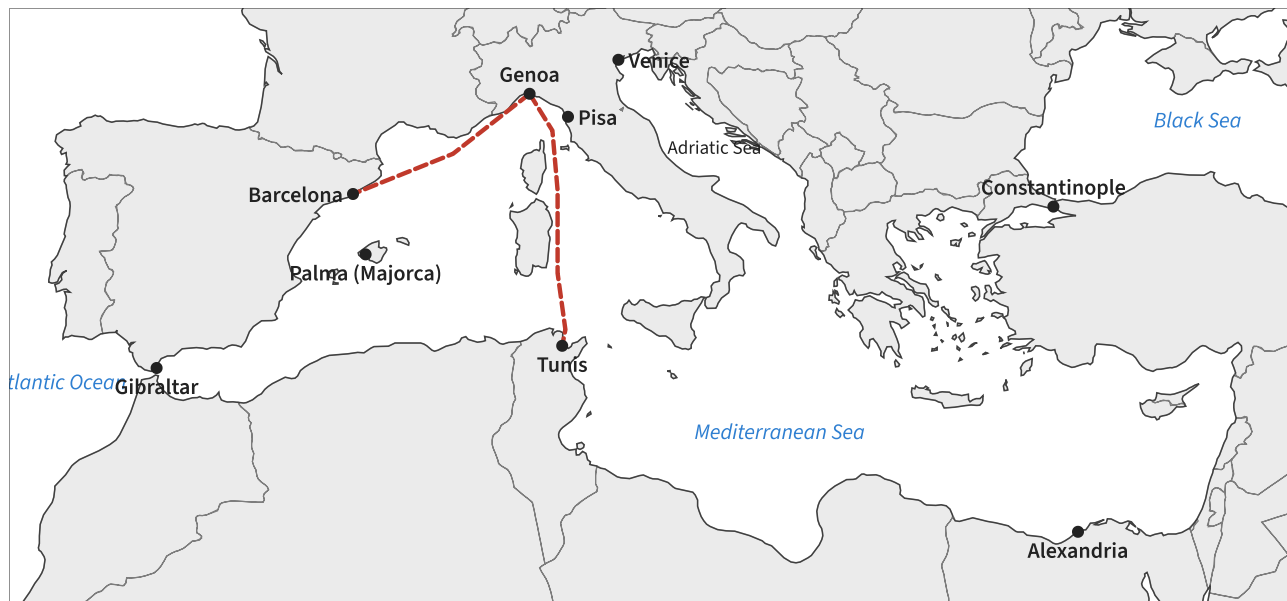
National Library of France in Paris. The coasts of Italy, Greece and the sea around them are drawn so well that you can recognize them at once.

How it worked. The Carta Pisana is a **portolan chart**. Its name comes from the Italian word *portolano*, a book of sailing directions that told pilots how to go from port to port: which way to steer and how many miles to sail. Chartmakers gathered many such directions, checked by compass, and fitted the coastline together piece by piece. They wrote the names of ports in tiny letters along the shore, standing at right angles to the coast so that the sea stayed clear. Then they drew the famous crisscross lines. From a center point they drew lines outward in sixteen directions, one for each point of the compass, and did the same from other points around the chart. These **rhumb lines** cover the sea like a spider's web.

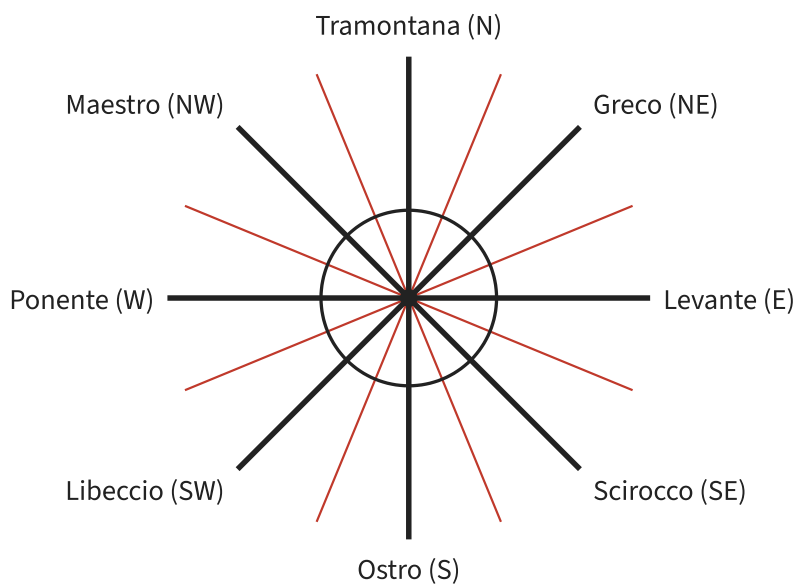
The big idea. How did a pilot use it? Say he was in Genoa and wanted to sail to Barcelona. He laid a ruler from Genoa to Barcelona, looked for a rhumb line running the same way, and followed that line back to its center to see which compass direction it showed. Then he steered that way, watching his compass needle. To find the distance, he used the **scale**, a bar on the chart marked in miles, and a pair of **dividers**. The compass told him which way, and the chart told him how far.

On the map. Find the Mediterranean. In the west, the Strait of Gibraltar is its door to the Atlantic. Constantinople and the Black Sea lie in the northeast, and Alexandria in Egypt in the southeast. The busy trading cities of Genoa and Venice are in Italy. Mediterranean sailors named the eight main directions for the winds that blew from them: the *Tramontana* from the north, the *Levante* from the east, the *Ostro* from the south and the *Ponente* from the west, with the *Greco*, *Scirocco*, *Libeccio* and *Maestro* in between. A portolan chart has no lines of latitude and longitude like the grid you learned in Unit 1. Those came to sea charts later.

Technology overcoming geography. A portolan chart was the work of many sailors who had measured and remembered their way along the coasts. With a compass needle and a chart, a pilot could steer straight across open water instead of creeping along the shore from one cape to the next. The chart turned the sailors' shared knowledge into a tool that anyone aboard could read.



Ports of the Mediterranean that pilots of the 1200s knew well, with two voyages from Genoa.



A wind rose like the ones on portolan charts. Each main line is named for the wind that blows from that direction.

PICTURE STUDY



The Carta Pisana, Unknown mapmaker, probably of Genoa, late 1200s (about 1275–1300) · Ink and color on vellum (sheepskin) · Bibliothèque nationale de France (National Library of France), Paris

The Carta Pisana is the oldest sea chart that has come down to us. It was drawn about 750 years ago, in the years when young Marco Polo was traveling across Asia to China, on a single sheepskin. Time has faded its colors and worn its surface, but its coastlines can still be traced.

Look past the wear and you will see a working tool. The web of lines and the names packed along the shore were not decoration. They were made to help a pilot find his way from one harbor to the next.

Look closely

- Find the web of straight lines. Look for a spot where many lines spread out from one center, like the spokes of a wheel.
- Find the boot of Italy and the many islands of Greece.
- Look along the coasts for the tiny names. Which way do they stand compared with the shore?
- Look at the inland parts of the chart. Are there many rivers, mountains or cities drawn there? What does that tell you about who used this chart?

Talk about it

1. Why do you think the mapmaker drew so much along the coast and so little inland?
2. How is this chart like the map in your atlas, and how is it different?

PROJECT: MY PORTOLAN CHART OF THE MEDITERRANEAN

You will make your own portolan-style chart of the Mediterranean on “sheepskin” made from a paper grocery bag, with a wind rose, rhumb lines, port names and a scale. Then you will use it with your needle compass from Lesson 6.2 to plan a voyage.

You will need

- A large brown paper grocery bag, cut open and flattened
- A map of the Mediterranean from an atlas, the internet or this lesson’s figure
- A pencil, a fine black pen, and green and red colored pencils
- A ruler or yardstick and a long piece of string
- A pushpin (with a parent’s help) or a small coin to mark the center
- Your needle compass from Lesson 6.2

Steps

1. Crumple the paper bag into a ball, then smooth it out flat. Now it looks old, like sheepskin.
2. Lightly draw the coastline of the Mediterranean and Black Sea in pencil, copying from your map. Make it fill most of the paper. When you are happy, go over the coast with the black pen.
3. Mark a center point in the middle of the sea, near Sicily. Hold one end of the string there and use the pencil on the other end to draw a large faint circle.
4. Mark 16 evenly spaced points around the circle: first N, E, S and W, then the four in-between points, then one more point halfway between each pair.
5. With the ruler, draw a line from the center through each point all the way to the edge of the chart. Draw the 8 main lines in black and the 8 in-between lines in green.
6. At the top of each main line, write its wind name: Tramontana (N), Greco (NE), Levante (E), Scirocco (SE), Ostro (S), Libeccio (SW), Ponente (W), Maestro (NW).
7. Mark and name at least eight ports, writing each name at right angles to the coast, pointing inland: Gibraltar, Barcelona, Palma, Genoa, Pisa, Venice, Tunis, Alexandria and Constantinople.
8. Draw a scale bar in a corner. Measure the distance on your chart from Genoa to Barcelona (about 400 miles) and mark that length on your bar as 400 miles. Divide it into four parts of 100 miles each.
9. Plan a voyage: lay the ruler between two ports, find the rhumb line that runs most nearly the same way and read its wind name. Turn your needle compass bowl to face that direction.
10. Decorate the empty land with a few small flags or a ship in the sea, the way old chartmakers did.

Tips

- Keep the coast simple. Real chartmakers cared most about capes, bays and harbors.

- If your rhumb lines cross a port name, write the name a little to one side. The lines are to be read, not hidden.
- Many later portolan charts used black, green and red for different sets of lines. You may add red lines halfway between your black and green ones if you like.

Check your work

- My chart shows the Mediterranean coast, a wind rose with 16 lines and at least eight ports.
- My scale bar is marked in miles, and I can measure a distance with it.
- I can find the direction from one port to another using my rhumb lines.

MAP NOTEBOOK

1. Draw a wind rose with eight lines and write the Italian wind name on each.
2. Copy the shape of Italy and Sicily and write three port names at right angles to the coast, as a portolan chartmaker would.
3. Write two sentences: How did a pilot use a compass and a chart together?

From history. The oldest portolan chart that carries both a date and its maker's name was drawn in 1311 by Pietro Vesconte, a mapmaker from Genoa who later worked in Venice. Chartmakers in Genoa, Venice and on the island of Majorca became famous for their charts, and sailors paid well for them. In the next unit you will see the Catalan Atlas, made on Majorca in 1375.

WORKED EXAMPLES

Example 1. On a pilot's chart, 1 inch stands for 100 miles. The pilot measures 4 inches from Genoa to Barcelona. About how far is it?

(Use the map or drawing "Genoa to Barcelona is about 400 miles by sea." shown earlier in this lesson.)

1. Each inch stands for 100 miles.
2. 4 inches means 4×100 miles.
3. $4 \times 100 = 400$.

Answer: About 400 miles.

Example 2. A pilot in Genoa wants to sail to Tunis. His ruler from Genoa to Tunis runs the same way as the Ostro line on the wind rose. Which way does he steer? The trip is about 500 miles, and his ship sails about 100 miles a day. About how many days will it take?

(Use the map or drawing “The Ostro line points south.” shown earlier in this lesson.)

1. The Ostro line points south, so he steers south by his compass.
2. Count by hundreds: 100, 200, 300, 400, 500. That is 5 hundreds.
3. $500 \div 100 = 5$ days.

Answer: He steers south, and the trip takes about 5 days.

PRACTICE

1. **EASY** What do the crisscross lines on a portolan chart show?
2. **EASY** On a chart, 1 inch stands for 100 miles. A voyage measures 6 inches. How many miles is it?
3. **MEDIUM** A pilot is told to steer toward the Levante. Which way does he sail? A Tramontana wind is blowing. Which way is it blowing from, and which way does it push the ship?
(Use the map or drawing “Use the wind rose to read the directions.” shown earlier in this lesson.)
4. **MEDIUM** The Carta Pisana was drawn about 1275. Columbus sailed in 1492. About how many years apart are they?
5. **HARD** A voyage across the Mediterranean is about 700 miles. The ship sails about 100 miles a day. If it leaves on a Monday, on what day of the week will it arrive?
6. **CHALLENGE** A portolan chart has no lines of latitude and longitude. In two or three sentences, explain how a pilot could still use it to find his way.

COMMON MISTAKES

- Thinking the crisscross lines are roads or routes the ships had to follow. They are direction lines to compare against; a ship could sail anywhere.
- Thinking the port names are written upside down or by mistake. They stand at right angles to the coast on purpose, to keep the sea clear.
- Using one chart’s scale on a different map. Every map has its own scale, so always check the scale bar first.

Make it a game • Rhumb Line Race. Use your portolan chart and a ruler. A parent names two ports, such as “Venice to Alexandria!” The first player to lay the ruler between them, find the rhumb line that runs most nearly the same way and call out its wind name and direction (“Scirocco, southeast!”) scores a point. Score a bonus point for measuring the distance with your scale bar. The first to five points becomes the next chartmaker.

Scripture. “They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep.” (Psalm 107:23-24, KJV)

The sailors who measured the coasts of the Mediterranean spent their lives on the great waters. Every cape, bay and harbor they drew was part of the world God made, and their charts helped others see His wonders safely.

Practice answers

1. Compass directions. Each rhumb line points one way, so a pilot could find which direction to steer.
2. $6 \times 100 = 600$ miles.
3. Levante is east, so he sails east. The Tramontana blows from the north and pushes the ship toward the south.
4. $1492 - 1275 = 217$ years.
5. $700 \div 100 = 7$ days. Seven days after Monday is the next Monday.
6. He laid a ruler between two ports and found a rhumb line running the same way, which told him the compass direction to steer. Then he measured the distance with the scale and dividers, so he knew which way to go and about how far.

UNIT 6 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use your compass rose and wind rose drawings. The review is worth 40 points.

1. (4 pts) How do you find the North Star using the Big Dipper? When you face the North Star, which way are you facing?
2. (4 pts) A girl measures the North Star 3 fists above the horizon. Each fist is about 10 degrees. About what is her latitude?
3. (4 pts) Mau Pailug guided *Hōkūleʻa* from Hawaii to Tahiti in 1976 with no compass or chart. Name three things he watched or felt to find his way.
4. (4 pts) What is lodestone? How did sailors use it to make a compass?
5. (4 pts) You are facing north. You make a half turn. Then you make a quarter turn to the right. Which way are you facing now?
6. (4 pts) Where and about when do we first read of sailors using a compass at sea? Why was it so useful?
7. (4 pts) Which sail is better for working toward the wind, a square sail or a lateen sail? What shape is the lateen sail?
8. (4 pts) A harbor is 9 miles straight upwind. A caravel tacks in 5 legs of 3 miles each. How far does it sail in all? How many extra miles is that?
9. (4 pts) What is the Carta Pisana? About when was it made, and what do its crisscross lines show?
10. (4 pts) On a chart, 1 inch stands for 100 miles. A pilot measures 3 inches from his port to the next. How far is it? If his ship sails 100 miles a day, how many days will the trip take?

UNIT PROJECT: MY NAVIGATOR'S KIT

Put together a navigator's kit that shows how sailors learned to cross the sea. Include your portolan-style chart of the Mediterranean with its wind rose, rhumb lines, at least eight ports and a scale bar; your needle compass (or a drawing and photo of it working); your North Star record with your fist measurement and your real latitude; and your sail-test chart from the fan and toy boat. Then plan one voyage on your chart: write the two ports, the wind name and direction you would steer, the distance from your scale and how many days it would take at 100 miles a day. Finish with a short paragraph telling which tool you think did the most to turn the ocean from a wall into a road, and why.

- **Accuracy:** Ports, directions and distances are placed and labeled correctly; the voyage plan's direction and math are right.
- **Hands-on work:** The needle compass worked, the North Star was measured, and the sail test was run and recorded in a clear chart.
- **Explanation:** The paragraph names a tool, tells what it let sailors do that they could not do before, and gives a real example from the unit.

- **Care:** The chart and records are neat, colorful and easy to read, with names written clearly.

Answer key

1. Find the two pointer stars at the end of the Big Dipper's cup and follow a line through them about five times the distance between them to a medium-bright star. That is the North Star. Facing it, you face north.
2. $3 \times 10 = 30$, so about 30 degrees north.
3. Any three: the rising and setting stars, the sun, ocean swells, seabirds flying home to land, clouds piling up over islands.
4. Lodestone is a dark rock, a kind of iron ore, that is a natural magnet. Sailors rubbed an iron needle on it to make the needle a magnet, then floated the needle on water or hung it on a thread so it could swing and point north and south.
5. A half turn from north faces south. A quarter turn to the right from south faces west. Answer: west.
6. In China, in a book written about 1119 about the pilots of Guangzhou, and in Europe about 1190 (Alexander Neckam). It was useful because it showed direction even on cloudy days and dark nights when the sun and stars could not be seen.
7. The lateen sail, which is a triangle. It lets a ship sail with the wind from the side and zigzag (tack) toward the wind.
8. $5 \times 3 = 15$ miles in all. $15 - 9 = 6$ extra miles.
9. It is the oldest sea chart that survives, a portolan chart of the Mediterranean drawn on sheepskin about 1275. Its crisscross rhumb lines show compass directions.
10. $3 \times 100 = 300$ miles. $300 \div 100 = 3$ days.

MARCO POLO AND THE SILK ROAD

For hundreds of years, the lands of Europe and the lands of China knew each other mostly through the goods that traveled between them: silk, spices, paper and porcelain, passed from hand to hand along thousands of miles of desert trails and sea roads. In this unit you will follow those goods, and the brave travelers who went with them, from one end of the known world to the other.

You will start in **Venice**, a city built on wooden poles in a lagoon, whose merchants sailed to the ports of the eastern Mediterranean. You will join a camel **caravan** on the **Silk Road** across the deserts and mountains of Asia. You will travel with young **Marco Polo** to the court of Kublai Khan and hear the stories that made Europe curious about the East. And you will meet **Ibn Battuta** of Morocco, who traveled about 75,000 miles, from West Africa to China.

As you go, you will practice the map skills from Unit 1: reading latitude, finding directions and measuring distances. And you will see that God, who “hath made of one blood all nations of men” (Acts 17:26), placed the peoples of the earth in many lands, joined by roads and seas.

BEFORE YOU BEGIN

- Can find north, south, east and west on a map with a compass rose
- Can read latitude lines and tell which of two places is farther north
- Can find Europe, Asia, Africa and the Mediterranean Sea on a globe
- Can add, subtract and multiply small numbers (such as 4×20)

MASTERY CHECKLIST

- I can explain how Venice was built on piles in a lagoon and why its people became sailors and merchants.
- I can tell how silk is made and how camel caravans carried goods along the Silk Road.
- I can trace the Silk Road from Venice to Beijing on a map and name at least five places along it.
- I can tell the story of Marco Polo and Kublai Khan and name three wonders from Marco’s book.
- I can tell where Ibn Battuta went and why 75,000 miles is about three times around the earth.
- I can use latitude, directions and map scale to compare places and distances on the trade routes.

OPTIONAL BOOKS AND RESOURCES

- ***The Travels of Marco Polo* (free at Project Gutenberg)**
(<https://www.gutenberg.org/ebooks/search/?query=marco+polo>): Free. The classic English translation by Henry Yule is long and written for grown-ups, so a parent may read aloud short passages, such as Marco’s descriptions of the Khan’s paper money and his message riders (Lesson 7.3).
- **Gallica, the online library of the Bibliothèque nationale de France**
(<https://gallica.bnf.fr/>): Free. Search for “Atlas catalan” to zoom in on the 1375 Catalan Atlas and find the camel caravan (Lesson 7.2) and Mansa Musa (Lesson 7.4). The site is in French, but the pictures speak for themselves.

7.1 VENICE: A CITY ON THE WATER ★

OBJECTIVES

- Tell how Venice was built on wooden poles driven into the mud of a lagoon.
- Explain why a city with almost no farmland became a city of merchants and sailors.
- Find Venice on a map and name the direction its ships sailed to reach Constantinople and Alexandria.

Warm-up. Fill a bowl with wet sand or mud. Stand a pencil on top and let go: it tips over. Now push the pencil straight down until it hits the bottom of the bowl and let go again. What changed? The builders of Venice used this same trick with thousands of wooden poles.

Video. Coming soon. Venice, its lagoon, canals and wooden foundations, and medieval Venetian trading ships: search Drive Thru History, The History Guy, Smithsonian, Memoria Press, and Homeschool Pop (Alternate).

KEY TERMS

lagoon

A shallow body of salt water cut off from the open sea by low strips of land or sandbars.

canal

A waterway dug or shaped by people for boats to travel on. In Venice, canals take the place of streets.

merchant

A person who buys goods in one place and sells them in another.

port

A town or city with a harbor where ships load and unload goods.

galley

A long ship that could be moved by oars as well as sails. Venice built its trading galleys in a great shipyard called the Arsenal.

CORE IDEAS

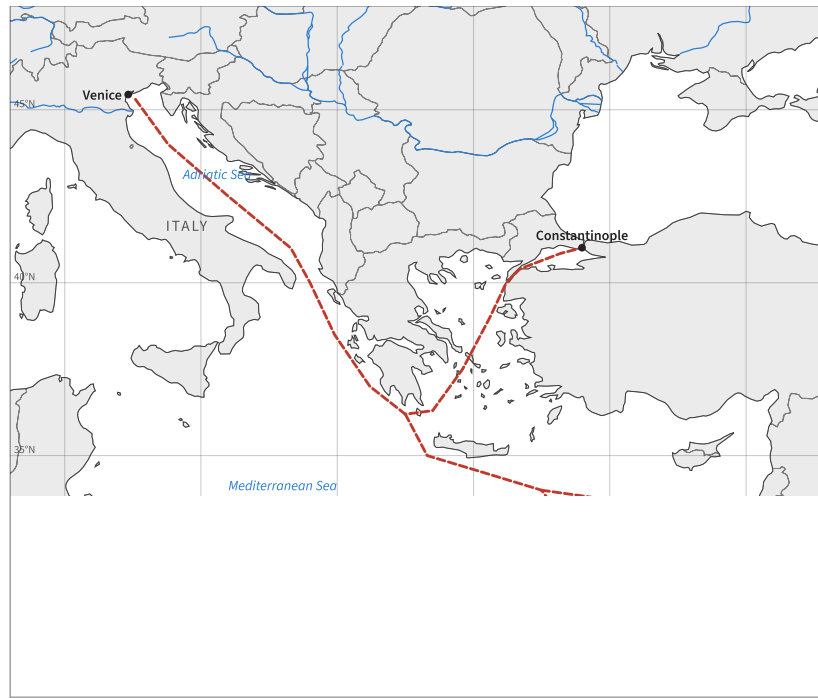
The story. About fifteen hundred years ago, invaders marched through northern Italy. Families from the mainland towns ran for safety to a place no army wanted: a shallow saltwater **lagoon** at the top of the Adriatic Sea, full of muddy islands and marsh grass. Horses could not cross the soft mud, and enemy ships ran aground in the shallow, twisting channels. The families stayed. They fished, gathered salt from the sea, and learned to row and sail. Little by little, their island villages grew into one of the richest cities in the world: Venice.

How they built it. Venice stands on about 118 small islands. You cannot build a stone church on mud, so builders drove thousands of wooden poles, called piles, straight down through the mud until they reached a layer of hard clay. On top of the piles they laid planks and stone, and on the stone they built houses, churches and palaces. Wood that stays deep in wet mud, away from the air, rots very slowly, so many of those old poles still hold up the city today. Instead of streets, Venice has about 150 **canals** crossed by more than 400 bridges. The biggest, the Grand Canal, winds through the middle of the city in a shape like a backward letter S.

The big idea. Venice had almost no farmland, no forests and no mines. What it had was the sea. So the Venetians became **merchants** and sailors. In a huge shipyard called the Arsenal, workers built **galleys**, long ships with oars and sails. The galleys sailed to the great **ports** of the eastern Mediterranean: Constantinople, Acre and Alexandria in Egypt. There, Venetian merchants bought goods that had come from very far away by camel and by ship: silk from China, pepper from India, and cloves and nutmeg from islands far to the east. They carried these treasures home and sold them to buyers from Germany, France and all over Europe. Buying in Alexandria and selling in Venice made many Venetian families rich.

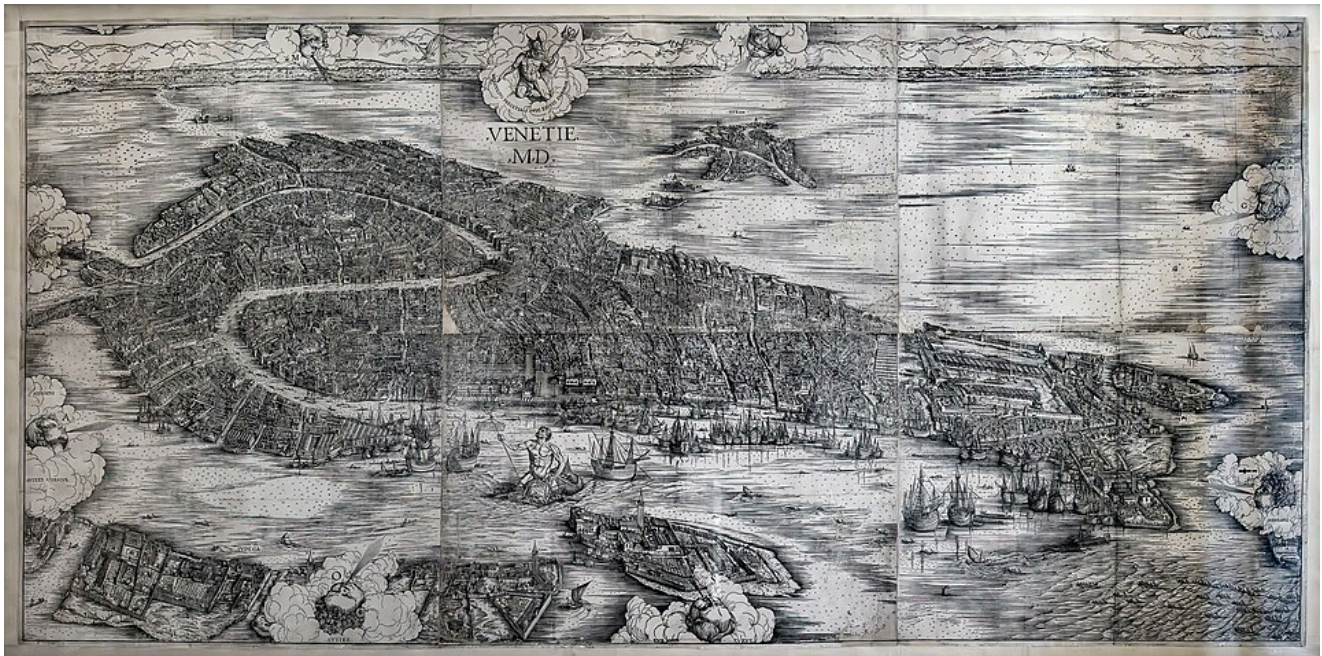
On the map. Find the Adriatic Sea, the long, narrow sea between the boot of Italy and the Balkan Peninsula. Venice sits at its very top, at about 45° north latitude. Almost every place the Venetians wanted to trade with lay to the **southeast**. Their ships sailed down the Adriatic, around the southern tip of Greece, and then either north through the Aegean Sea to Constantinople or south across the open sea to Egypt. Along the way they stopped at harbors for fresh water and food. God placed Venice where the sea was both its wall and its road.

Why it matters for our journey. Venice was the doorway between Europe and the East. Goods from Asia came in, and curious travelers went out. In the year 1271, a seventeen-year-old Venetian boy named Marco Polo would sail out of this lagoon with his father and uncle, bound for the court of the greatest ruler in Asia. You will follow him in Lesson 7.3.



Venice's sea roads. Ships sailed down the Adriatic and around Greece to the great ports of the east.

PICTURE STUDY



View of Venice, Jacopo de' Barbari, 1500 · Woodcut printed from six large wooden blocks · Museo Correr, Venice (which keeps the original woodblocks); prints are in several museums

In the year 1500, an artist named Jacopo de' Barbari made a picture of Venice as a bird would see it, flying high above the lagoon. No one could fly then, so he and his helpers must have climbed bell towers and measured streets and canals to draw it. The picture was carved into six big blocks of pear wood and printed on six sheets of paper glued together. Put together, it is more than 9 feet wide, longer than a grown man lying down.

This is both a work of art and a map. You can still find many of the same churches and canals in Venice today.

Look closely

- Find the Grand Canal. Can you trace its backward S shape through the city with your finger?
- Look at the water around the city. How many ships and boats can you find?
- Look at the top and bottom. The artist drew Mercury, the old Roman god of merchants, in the clouds and Neptune, the god of the sea, riding in the water. Why do you think he chose those two for a city of traders?
- Find the puffy faces around the edges. They show the winds that filled the sails of Venice's ships.

Talk about it

1. Do you see any fields or farms inside the city? What does that tell you about how Venetians got their food?
2. Why would a merchant want a map like this of his city?
3. If you could visit one spot in this picture, where would you go and why?

PROJECT: BUILD A CITY ON PILES

You will build a tiny Venice in a pan of wet sand. First you will see what happens to a house set right on the mud. Then you will drive in piles and build on top of them, just as the Venetians did.

You will need

- A baking pan or plastic tub
- Sand or garden soil, and water to make it muddy
- 20 or more toothpicks or wooden skewers cut short (the piles)
- Craft sticks or thin cardboard squares (the platforms)
- Small blocks, Lego bricks or clay houses
- Blue paper or a little extra water for canals

Steps

1. Fill the pan with sand and add water until it is soft and muddy, like the islands of the lagoon.
2. Set a small block house right on the mud. Press gently on its roof. Does it sink or tip?
3. Now push 6 to 10 toothpicks straight down into the mud close together until they touch the bottom of the pan.
4. Lay a craft stick or cardboard square on top of the piles. Set your house on the platform and press gently again. What happens now?

5. Build three or four island platforms this way, with gaps of water between them. The gaps are your canals.
6. Make a bridge from a craft stick to join two islands, and a boat from a bottle cap or a folded paper.
7. Make one island the Arsenal shipyard and one the market where merchants sell silk and spices.

Tips

- The piles work best when they are packed close together, as they were in Venice.
- If your mud dries out, sprinkle it with water. Real piles last longest when they stay wet and away from air.

Check your work

- I can explain why a house on piles stands better than a house set on mud.
- I can show where the canals and bridges are in my city.
- I can tell why Venetians used boats instead of carts.

MAP NOTEBOOK

1. Draw the Adriatic Sea and the Mediterranean Sea. Put a star at Venice and draw arrows southeast to Constantinople and Alexandria.
2. Draw a cross-section of Venice: water and mud at the bottom, a row of piles, a stone platform, and a house on top. Label each layer.
3. Draw a galley with its oars and sails, and list three goods it might carry home to Venice.

From history. Venice was famous for glass as well as trade. In 1291 the city ordered its glassmakers to move their hot furnaces to the island of Murano, so that a fire could not spread through the crowded wooden houses of the city. Murano glassmakers became so skilled that their glass beads, cups and mirrors were sold all over Europe, and the island still makes glass today.

WORKED EXAMPLES

Example 1. Venice is at about 45° north latitude. Alexandria, in Egypt, is at about 31° north latitude. Which city is farther north, and by how many degrees?

(Use the map or drawing “Use the latitude lines to compare Venice and Alexandria.” shown earlier in this lesson.)

1. The bigger north latitude is farther north. 45 is bigger than 31, so Venice is farther north.
2. Subtract to find the difference: $45 - 31 = 14$.

Answer: Venice is farther north, by about 14 degrees.

Example 2. On a map, 1 inch stands for 300 miles. A ship’s path from Venice around Greece to Constantinople measures 4 inches. About how far did the ship sail?

1. Each inch on the map stands for 300 miles.
2. The path is 4 inches long, so add 300 four times: $300 + 300 + 300 + 300 = 1,200$.
(Or multiply: $4 \times 300 = 1,200$.)

Answer: About 1,200 miles.

PRACTICE

1. **EASY** What is a lagoon?
2. **EASY** Venice has canals instead of streets. Name two ways people travel around the city.
3. **MEDIUM** Look at the map of Venice’s sea roads. In which direction did a ship sail from Venice to reach Alexandria: northeast, southeast or southwest?
(Use the map or drawing “Venice’s sea roads.” shown earlier in this lesson.)
4. **MEDIUM** A galley sails about 60 miles in one day. How far can it sail in 5 days?
5. **HARD** A merchant buys a sack of pepper in Alexandria for 8 gold coins and sells it in Venice for 15 gold coins. How many coins more did he get than he paid? Why would he take the risk of a long sea trip?
6. **CHALLENGE** In two or three sentences, explain why Venice became a city of traders instead of a city of farmers.

COMMON MISTAKES

- Thinking Venice floats on the water. It does not float: it stands on wooden piles driven down into the mud.
- Thinking Venice is on the open ocean. It sits in a sheltered lagoon at the top of the Adriatic Sea, which is part of the Mediterranean.

- Thinking the silk and spices were made in Venice. Venetian merchants bought them in eastern ports and carried them home to sell.

Make it a game · Gondola Port Hop. Lay sheets of paper on the floor as islands and label them Venice, Constantinople, Acre and Alexandria. Put a sign marked N on one wall. The player stands on Venice. A parent calls a port, and the player must say the direction (for example, “southeast!”) before hopping there on the paper islands without touching the floor, which is the water. Each correct direction earns a gold coin (a button). Collect five coins to win.

Scripture. “They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep.” (Psalm 107:23–24, KJV)

The merchants of Venice did business in great waters. Sailors who cross the sea see how big and strong God’s creation is, and the sea that seemed like a wall became a road for trade.

Practice answers

1. A shallow body of salt water cut off from the open sea by low strips of land or sandbars.
2. By boat (such as a gondola, water taxi or water bus) and on foot over the bridges.
3. Southeast.
4. $60 \times 5 = 300$ miles.
5. $15 - 8 = 7$ coins more. He sailed because buyers in Venice paid much more for pepper than it cost in Alexandria, so the long trip could earn him money.
6. Venice was built on small muddy islands in a lagoon, so it had almost no farmland, forests or mines. But it had the sea and good ships. So Venetians earned their living by sailing to other ports, buying goods and selling them in Europe.

7.2 THE SILK ROAD ★

OBJECTIVES

- Tell how silk is made and why people far away wanted it so much.
- Describe how caravans of camels crossed deserts and mountains, resting at caravanserais and oases.
- Trace the Silk Road on a map from China across Asia to the Mediterranean.

Warm-up. Hold a scrap of silk (an old scarf or tie) in one hand and a scrap of wool or cotton in the other. Which is smoother? Which is lighter? Which shines? Now imagine you had to carry a bundle of cloth on a camel for months. Which cloth would be worth the most for its weight?

Video. Coming soon. The Silk Road, Bactrian camel caravans, caravanserais and how silk is made from silkworm cocoons: search Drive Thru History, The History Guy, Smithsonian, Memoria Press, and Homeschool Pop (Alternate).

KEY TERMS

silk

A smooth, shiny cloth woven from the thread that silkworms spin to make their cocoons.

Silk Road

A web of trade routes, about 4,000 miles long, that joined China with the lands around the Mediterranean Sea.

caravan

A group of traders and animals, often camels, traveling together for safety.

caravanserai

An inn with a big courtyard where a caravan could rest, water its camels and sleep safely for the night.

oasis

A green place in a desert where there is water from a spring or a well.

CORE IDEAS

The story. More than two thousand years ago, about 138 BC, Emperor Wu of China sent an officer named Zhang Qian (say “jahng chyen”) on a dangerous trip to the west. He set out with about a hundred men. Enemy horsemen captured him, and he was held prisoner for about ten years! At last he escaped and kept going west, over mountains and deserts, into lands the Chinese knew almost nothing about. When he finally came home, only he and one companion were left. But he brought wonderful news: far to the west were cities, markets, grapes and strong, swift horses. Soon Chinese traders were following the paths Zhang Qian had walked.

How silk is made. The most famous thing they carried was **silk**. Silk comes from a little caterpillar called the silkworm, which eats only mulberry leaves. It spins a cocoon around itself from one single thread, hundreds of yards long. Chinese workers unwound the thread from the cocoons and wove it into cloth that was soft, light and shining. People as far away as Rome paid enormous prices for it. For hundreds of years China kept the secret of silk. Then, about AD 552, an old story says, two monks carried silkworm eggs hidden inside hollow canes to Constantinople, and the secret was out.

How the caravans worked. The **Silk Road** was not one road. It was a web of dusty trails about 4,000 miles long. Traders traveled in **caravans**, long lines of animals and people moving together so robbers would not dare attack. Their best helper was the Bactrian camel, which has two humps. It can carry hundreds of pounds, go for days without drinking, walk on soft sand with its wide feet, and keep warm on freezing desert nights in its shaggy winter coat. A caravan moved slowly, perhaps 20 miles a day. Each night it stopped at a **caravanserai**, an inn with a big courtyard, or at an **oasis**, a green spot with a well in the middle of the desert. Few traders went the whole way. Goods were passed from merchant to merchant like a relay, and the price rose at every stop.

On the map. The Silk Road began at the Chinese capital, Chang'an (today called Xi'an). It ran west to the oasis town of Dunhuang, then split to go around the north and south sides of the dreaded Taklamakan Desert. The two paths met again at Kashgar. From there caravans climbed over the high Pamir Mountains and went on to Samarkand and Baghdad, and at last to ports on the Mediterranean Sea. In later centuries, ships from Venice waited there to carry the goods on to Europe.

More than silk. Silk, paper and fine pottery went west. Horses, glass, silver and wool went east. Ideas traveled too. In AD 635, a Christian teacher named Alopen arrived in Chang'an, and a carved stone set up in that city in 781 still tells of the Christians who lived and worshiped there. The Silk Road carried goods, and it also carried the good news of Jesus Christ.



The Silk Road. Caravans crossed deserts and mountains; ships carried goods on to Venice.

PICTURE STUDY



A Caravan on the Silk Road, from the Catalan Atlas, Attributed to Abraham Cresques and his workshop, Majorca, 1375 · Ink, colors and gold on parchment · Bibliothèque nationale de France, Paris

The Catalan Atlas is one of the most beautiful maps ever made. It was drawn on the island of Majorca, in the Mediterranean Sea, in 1375, probably by a Jewish mapmaker named Abraham Cresques and his son. It was painted on panels of parchment that fold like a screen, and it soon belonged to King Charles V of France.

In the part that shows Asia, the mapmaker painted a caravan of camels and riders traveling toward Cathay, the old European name for northern China. Many people think it shows Marco Polo and his family on their way to Kublai Khan.

Look closely

- Count the camels. What do you think is in the loads on their backs?
- Find the riders. Are they walking, riding horses, or riding camels?
- Which way is the caravan moving? Toward the rising sun in the east, or toward the west?
- Look at the gold and bright colors. Why would a king want such a fancy map?

Talk about it

1. Why did traders travel together in a caravan instead of one by one?
2. This map was made about 650 years ago. What looks different from a map you would use today? What looks the same?

PROJECT: THE SILK ROAD TRADING GAME

You will be a merchant on the Silk Road! Set up five trading cities across your floor or table. Each city has plenty of one thing and wants something else. Buy where things are cheap, carry them by caravan, and sell where people want them. Keep a ledger to see how many coins you earn.

You will need

- Five sheets of paper for cities: Xi'an, Dunhuang, Kashgar, Samarkand and Venice
- Goods: fabric scraps for silk, small paper cups of real spices (peppercorns, cinnamon sticks or whole cloves), and beads or marbles for glass
- 30 coins (pennies, buttons or paper circles) for each player
- One die
- Paper and pencil for a trading ledger

Steps

1. Lay the five city sheets in a long line across the room, from Xi'an in the east to Venice in the west. Draw camels or a desert between them.
2. Write a price card for each city. Example: in Xi'an silk costs 2 coins; in Kashgar silk sells for 5 coins; in Samarkand 8 coins; in Venice 12 coins. Spices are cheap in Samarkand (2 coins) and dear in Venice (6 coins). Glass is cheap in Venice (2 coins) and dear in Xi'an (7 coins).
3. Each player starts in Xi'an with 30 coins and buys goods. A camel can carry only 6 goods, so choose carefully.
4. On your turn, roll the die. On a 1, robbers steal one good. On a 2 to 6, move one city west (or east on the way home).
5. At each city you may sell goods at that city's price and buy new ones.
6. In your ledger, write each trade: city, good, bought or sold, coins, and coins left.
7. After everyone reaches Venice and returns to Xi'an, count your coins. Who earned the most? Talk about which trades were best.

Tips

- Don't taste the peppercorns or cloves. They are for trading, not snacking!
- Notice how silk is worth more the farther west it goes. That is why Silk Road merchants took such long, hard trips.
- Play a second round with a new rule: a caravanserai at Dunhuang keeps you safe from robbers.

Check your work

- I can explain why silk cost more in Venice than in Xi'an.
- I kept a ledger and can add and subtract my coins correctly.
- I can name the cities of my trading game in order from east to west.

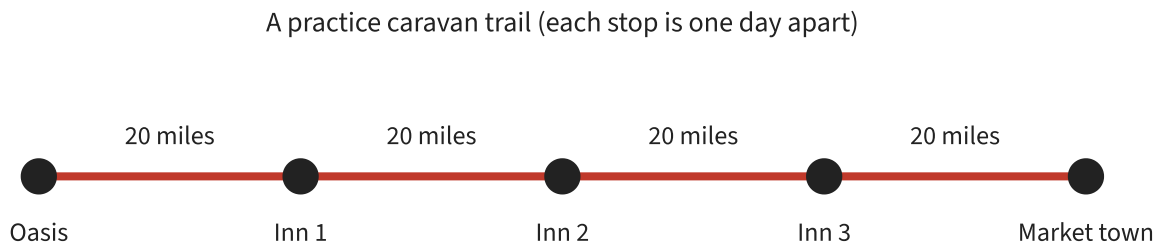
MAP NOTEBOOK

1. Draw the life cycle of a silkworm: egg, caterpillar eating mulberry leaves, cocoon and moth. Under it, draw a bolt of silk cloth.
2. Draw a Bactrian camel and label four things that help it cross the desert: two humps, wide feet, shaggy coat and long eyelashes.
3. Draw a map strip of the Silk Road with Xi'an, Dunhuang, Kashgar, Samarkand and Baghdad. Shade the Taklamakan Desert in yellow.

From history. The name “Silk Road” is much newer than the road itself. The people who traveled it just spoke of the way to the next city. A German geographer, Ferdinand von Richthofen, made up the name in 1877, and it has been used ever since.

WORKED EXAMPLES

Example 1. Look at the practice caravan trail. Each stop is one day's walk apart, and each day the caravan travels 20 miles. How far is it from the Oasis to the Market town, and how many days will the trip take?



A practice caravan trail. Each stop is one day's walk apart.

1. Count the gaps between the stops: Oasis to Inn 1, Inn 1 to Inn 2, Inn 2 to Inn 3, Inn 3 to Market town. That is 4 gaps.
2. Each gap is one day, so the trip takes 4 days.
3. Each day is 20 miles: $20 + 20 + 20 + 20 = 80$, or $4 \times 20 = 80$.

Answer: 80 miles, in 4 days.

Example 2. A bolt of silk costs 2 coins in Xi'an. It is sold from merchant to merchant 4 times on its way west, and each merchant adds 3 coins to the price. What does it cost at the end?

1. The merchants add 3 coins four times: $3 + 3 + 3 + 3 = 12$ (or $4 \times 3 = 12$).
2. Add the starting price: $2 + 12 = 14$.

Answer: 14 coins, seven times what it cost in Xi'an.

PRACTICE

1. **EASY** What do silkworms eat?
2. **EASY** How many humps does a Bactrian camel have? Name one way it is suited to the desert.
3. **MEDIUM** Using the practice caravan trail, how far is it from the Oasis to Inn 2? How many days is that?
(Use the map or drawing "A practice caravan trail." shown earlier in this lesson.)
4. **MEDIUM** Look at the Silk Road map. Name the desert that caravans went around after leaving Dunhuang, and the city where the two paths met again.
(Use the map or drawing "The Silk Road." shown earlier in this lesson.)
5. **HARD** A caravan has 12 camels. Each camel carries 3 bales of silk. How many bales does the caravan carry?
6. **CHALLENGE** The Silk Road was about 4,000 miles long. If a caravan could travel 20 miles every day, how many days would it take to go the whole way? (Hint: 20 miles a day for 10 days is 200 miles.) Why did most traders travel only part of the way?

COMMON MISTAKES

- Thinking the Silk Road was one paved road. It was a web of trails, mountain passes and desert tracks.
- Thinking one trader carried silk all the way from China to Europe. Most goods changed hands many times along the way.
- Thinking only silk traveled the road. Spices, paper, horses, glass and ideas, including the Christian faith, traveled it too.

Make it a game • Caravan Relay. Line up family members or stuffed animals across the room as Silk Road cities: Xi'an, Dunhuang, Kashgar, Samarkand, Baghdad. Put a scarf (the silk) at Xi'an. Each player must say the name of the next city west before passing the silk along. If someone forgets, the silk goes back to Xi'an. When it reaches Baghdad, send a spice cup back east the same way. Then try it with your eyes closed!

Scripture. "Go ye therefore, and teach all nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghost:" (Matthew 28:19, KJV)

Jesus sent His followers to all nations. Hundreds of years later, Christians like Alopen walked the trade routes of Asia to carry the gospel all the way to China.

Practice answers

1. Mulberry leaves.
2. Two humps. It can go for days without drinking (or: it has wide feet for soft sand, or a shaggy coat for cold nights, or it can carry heavy loads).
3. $2 \text{ gaps} \times 20 \text{ miles} = 40 \text{ miles}$, in 2 days.
4. The Taklamakan Desert. The paths met again at Kashgar.
5. $12 \times 3 = 36$ bales.
6. 4,000 is 20 groups of 200, and each 200 miles takes 10 days, so $20 \times 10 = 200$ days, more than half a year. Most traders went only part of the way because the trip was so long, hard and dangerous; they sold their goods to the next merchant, who carried them farther.

7.3 MARCO POLO AT THE COURT OF KUBLAI KHAN

OBJECTIVES

- Tell the story of Marco Polo's journey from Venice to the court of Kublai Khan and home again (1271–1295).
- Name three wonders Marco described in his book and explain why it made Europe curious about Asia.
- Trace the Polos' route on a map and compare the latitudes of Venice and Beijing.

Warm-up. Think of the most amazing place you have ever visited. Close your eyes and tell a family member about it in one minute, with as many details as you can. Did they believe you? Now imagine telling people about a land no one in your town had ever seen.

Video. Coming soon. Marco Polo, Kublai Khan and the Mongol Empire, and Marco Polo's book of travels, for children: search Drive Thru History, The History Guy, Smithsonian, Memoria Press, and Homeschool Pop (Alternate).

KEY TERMS

Mongols

Horse-riding people from the grasslands north of China who built the largest land empire the world had ever seen.

khan

The title of a Mongol ruler. Kublai Khan was the Great Khan, the highest of all the Mongol rulers.

empire

Many lands and peoples ruled by one ruler or one government.

paper money

Paper notes used as money in place of gold or silver coins. Many Europeans first read about it in Marco Polo's book.

CORE IDEAS

The story. In about 1298, a prisoner sat in a jail in the city of Genoa, Italy. His name was Marco Polo, and he had been captured in a war between Genoa and his home city of Venice. To pass the long days, he told his stories to another prisoner, a writer named Rustichello of Pisa. And what stories they were! Marco had spent about seventeen years in the lands of the greatest ruler on earth, **Kublai Khan**. Rustichello wrote it all down. Their book, often called *The Travels of Marco Polo*, made all of Europe curious about the faraway East.

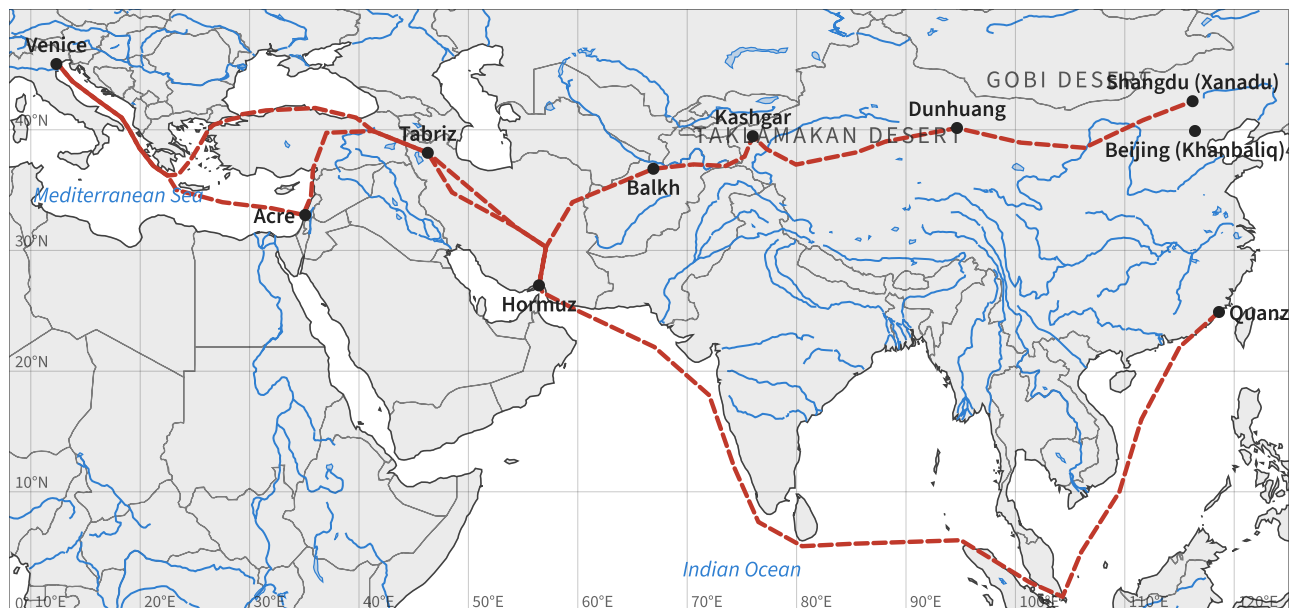
The journey. In 1271, when Marco was seventeen, he set out from Venice with his father, Niccolò, and his uncle, Maffeo. The two brothers had been to China once before and had met the Khan. Now they were going back. The Polos sailed to Acre, then traveled by land across

Turkey and Persia. They crossed the high, cold Pamir Mountains and the edge of the desert of Lop, where, Marco wrote, travelers who fell behind at night sometimes heard voices calling their names. In 1275, about three and a half years after leaving home, they reached Kublai Khan's summer palace at Shangdu.

At the court of the Khan. Kublai Khan was a grandson of Genghis Khan. He ruled the **Mongols** and all of China, and his **empire** stretched across much of Asia. His great capital, Khanbaliq, stood where Beijing stands today. Marco learned several languages, and the Khan sent him on long trips to bring back reports of faraway places. Marco saw wonders no European had read about. The Khan's people spent **paper money** made from the bark of mulberry trees and stamped with his red seal. They burned black stones dug from the ground to heat their houses. We call them coal. Riders carried the Khan's messages from post station to post station on fresh horses. And Marco claimed that the city of Kinsay (today Hangzhou) had canals like Venice and 12,000 bridges!

Home again. At last, in 1292, the Khan let the Polos go home. They sailed by sea, guiding a princess to Persia, where she was to be married, and then traveled on to Venice. They reached home in 1295, twenty-four years after they had left. A few years later Marco was a prisoner in Genoa, telling his tales. His book was copied by hand again and again. Some readers thought he was making things up, but many were filled with wonder. About two hundred years later, Christopher Columbus owned a copy and wrote notes in its margins as he dreamed of sailing west to reach the lands of the Khan.

On the map. Venice is at about 45° north latitude and Beijing at about 40° north, so Beijing lies almost straight east of Venice, a little to the south. As the crow flies the two cities are about 4,900 miles apart, but the Polos' winding path over mountains and deserts was much longer.



The Polos' journey: overland to the Khan (1271-1275) and home mostly by sea (1292-1295).

PICTURE STUDY



Kublai Khan Gives the Polos a Golden Tablet, from the Book of Marvels, Unknown French painters (illuminators), about 1410–1412 · Colors and gold on parchment, in a handwritten book · Bibliothèque nationale de France, Paris (manuscript Français 2810)

About a hundred years after Marco Polo told his stories, a rich French duke had a copy of the book made for his library. It was written by hand and filled with small, glowing paintings, called illuminations. The book is called the *Livre des merveilles*, which means “Book of Marvels.”

The painters had never been to China. They had only Marco’s words to go on, so they painted the Khan and his court in the clothes, castles and colors they knew from France.

Look closely

- Find the Great Khan. How does the painter show that he is the most important person in the picture?
- Find the Polos. What is the Khan handing to them? (It is a golden tablet, a kind of passport that told everyone in his lands to help them on their way.)
- Look at the buildings and clothes. Do they look Chinese or European to you? Why do you think that is?
- Look at the gold. Where did the painter use it, and why?

Talk about it

1. If you had to paint a land you had never seen, using only someone’s stories, what might you get wrong?
2. Why do you think a duke wanted a fancy copy of Marco Polo’s book?

PROJECT: KUBLAI KHAN'S PAPER MONEY AND MY BOOK OF MARVELS

Marco Polo was amazed that the Khan's people paid for things with paper notes instead of gold and silver coins. You will make your own Khan's paper money from brown "bark" paper and stamp it with a red seal. Then you will start a Book of Marvels, writing about wonders the way Marco did.

You will need

- A brown paper grocery bag (your "mulberry bark")
- Scissors, ruler and black marker
- A red ink pad and a cork, eraser or carved potato for a seal (or a red marker)
- Four sheets of paper folded in half and stapled into a little book
- Colored pencils

Steps

1. Crumple the brown paper bag, then smooth it flat so it looks like bark paper. Cut it into notes about 3 inches by 5 inches.
2. On each note, write a value: 1, 5 or 10. Draw a border and a simple picture, such as a horse or a mountain.
3. Make the Khan's seal: press a cork or eraser into the red ink and stamp each note. Marco wrote that the Khan's notes were marked with his red seal.
4. Use your notes to "buy" things from a family member's pretend market. How much easier is it to carry paper than a bag of coins?
5. Now make your Book of Marvels. On the cover, write a title and your name.
6. On page 1, draw and describe one of Marco's wonders: paper money, burning black stones (coal), the Khan's message riders, or the city of 12,000 bridges.
7. On page 2, describe a real wonder you have seen yourself, in Marco's style: tell where it is and what makes it amazing.

Tips

- Marco's book mixes things he saw with things he only heard about. In your book, try writing "I saw..." for one and "People told me..." for the other.
- Keep your Book of Marvels. You will add Ibn Battuta's wonders in the next lesson.

Check your work

- I can explain what paper money is and why Europeans found it surprising.
- I can name three wonders Marco Polo described.
- I can tell the difference between something I saw and something I was told.

MAP NOTEBOOK

1. Trace the Polos' route from Venice to Shangdu. Label Venice, Acre, Tabriz, Kashgar, Dunhuang and Shangdu, and write 1271 at the start and 1275 at the end.

2. Draw a timeline from 1254 to 1324 and mark: Marco is born (1254), leaves Venice (1271), reaches the Khan (1275), comes home (1295), tells his book in prison (about 1298), dies (1324).
3. Draw a Mongol message rider on a galloping horse, and next to him a modern mail truck. Write one way they are alike.

From history. When the Polo brothers made their first trip, Kublai Khan sent them home with a letter asking the pope to send a hundred learned men who could teach the Christian faith to his people. When the Polos set out again in 1271, Pope Gregory X sent only two friars with them, and the friars grew afraid and turned back before they had gone far. Many have wondered what might have happened in China if a hundred teachers had gone. Hundreds of years later, Kublai's summer palace of Shangdu became famous in English as "Xanadu" in a poem by Samuel Taylor Coleridge.

WORKED EXAMPLES

Example 1. The Polos left Venice in 1271 and came home in 1295. How many years were they gone?

1. Subtract the year they left from the year they came home: $1295 - 1271$.
2. Count up from 1271: 1271 to 1291 is 20 years, and 1291 to 1295 is 4 more. $20 + 4 = 24$.

Answer: 24 years.

Example 2. Venice is at about 45° north latitude. Beijing, where Kublai Khan's capital stood, is at about 40° north. Which city is farther north, and by how much? In which main direction would you travel from Venice to Beijing?

(Use the map or drawing "Compare Venice and Beijing using the latitude lines." shown earlier in this lesson.)

1. 45 is bigger than 40, so Venice is farther north.
2. $45 - 40 = 5$ degrees.
3. On the map, Beijing is far to the right of Venice, and right is east. It is only a little lower, so the main direction is east (a little to the south).

Answer: Venice is farther north, by about 5 degrees. You would travel east, a little to the south.

PRACTICE

1. **EASY** Who was Kublai Khan?

2. **EASY** What was the Khan's paper money made from, and what tree also fed the silkworms of Lesson 7.2?
3. **MEDIUM** Marco was 17 years old when he left Venice. He was gone 24 years. How old was he when he came home?
4. **MEDIUM** Look at the map. After the Polos reached Hormuz, they turned and traveled to Balkh and Kashgar. In which direction did they go: northeast, southeast or southwest? *(Use the map or drawing "The Polos' route." shown earlier in this lesson.)*
5. **HARD** Marco claimed the city of Kinsay had 12,000 bridges. Venice has about 400. How many more bridges did Marco say Kinsay had?
6. **CHALLENGE** Write two or three sentences: Why did Marco Polo's book make people in Europe curious about Asia?

COMMON MISTAKES

- Thinking Marco Polo was the first European in China. His father and uncle had been there before him, and a few Christian friars visited the Mongols too.
- Thinking Marco wrote the book himself. He told his stories, and Rustichello of Pisa wrote them down.
- Thinking the Polos came home the same way they went. They went mostly overland, but came home mostly by sea.

Make it a game · Believe It, Great Khan?. One player is the Great Khan on a throne (a chair with a blanket). The others are travelers who tell the Khan a "wonder." A parent hands each traveler a card: some cards have real things from Marco's book (paper money, burning black stones, message riders on fresh horses, a city of canals), and some have silly made-up things (a river of milk, flying camels). The Khan must say "I believe it!" or "Nonsense!" Each right answer earns a paper note from the project. Switch roles and play again.

Scripture. "Then saith he unto his disciples, The harvest truly is plenteous, but the labourers are few;" (Matthew 9:37, KJV)

Kublai Khan asked for a hundred teachers, but only two set out, and they turned back. Jesus told His disciples there are many people ready to hear, but few workers willing to go, and He told them to pray for more.

Practice answers

1. The Great Khan of the Mongols, a grandson of Genghis Khan, who ruled China and a huge empire across Asia. Marco Polo served at his court.
2. The bark of mulberry trees. Silkworms eat mulberry leaves, so the mulberry tree gave China both silk and paper money.
3. $17 + 24 = 41$ years old.
4. Northeast.
5. $12,000 - 400 = 11,600$ more bridges.

6. Sample: The book told of a rich, huge empire with things Europeans had never seen, like paper money, coal and great cities with thousands of bridges. People wanted to see these wonders and trade for silk and spices, so explorers like Columbus dreamed of finding a way to the lands of the Khan.

7.4 IBN BATTUTA: THE GREAT TRAVELER

OBJECTIVES

- Tell the story of Ibn Battuta, who left Tangier in 1325 and traveled for nearly thirty years.
- Find his main stops on a map: Tangier, Cairo, Mecca, Delhi, the Maldives, China and Timbuktu.
- Compare 75,000 miles with the distance around the earth and compare his journeys with Marco Polo's.

Warm-up. Take a ball of string or yarn and wrap it once around a globe or a ball at the equator. Cut it. That string stands for the whole way around the earth, about 25,000 miles. Cut two more pieces the same length. Lay all three end to end. Ibn Battuta traveled about that far in his life!

Video. Coming soon. Ibn Battuta, his travels from Morocco to Mecca, India, China and Mali, and his book the Rihla: search The History Guy, Smithsonian, Drive Thru History, Memoria Press, and Homeschool Pop (Alternate).

KEY TERMS

pilgrimage

A long journey to a holy place for religious reasons. Ibn Battuta first set out on the Muslim pilgrimage to Mecca, called the hajj.

judge

A person who listens to both sides of a quarrel and decides according to the law. Ibn Battuta was trained as a judge, and rulers gave him work along his way.

Rihla

Arabic for “journey.” It is the name of the book that tells Ibn Battuta’s travels.

Sahara

The largest hot desert in the world, across northern Africa. Camel caravans crossed it to trade salt and gold.

CORE IDEAS

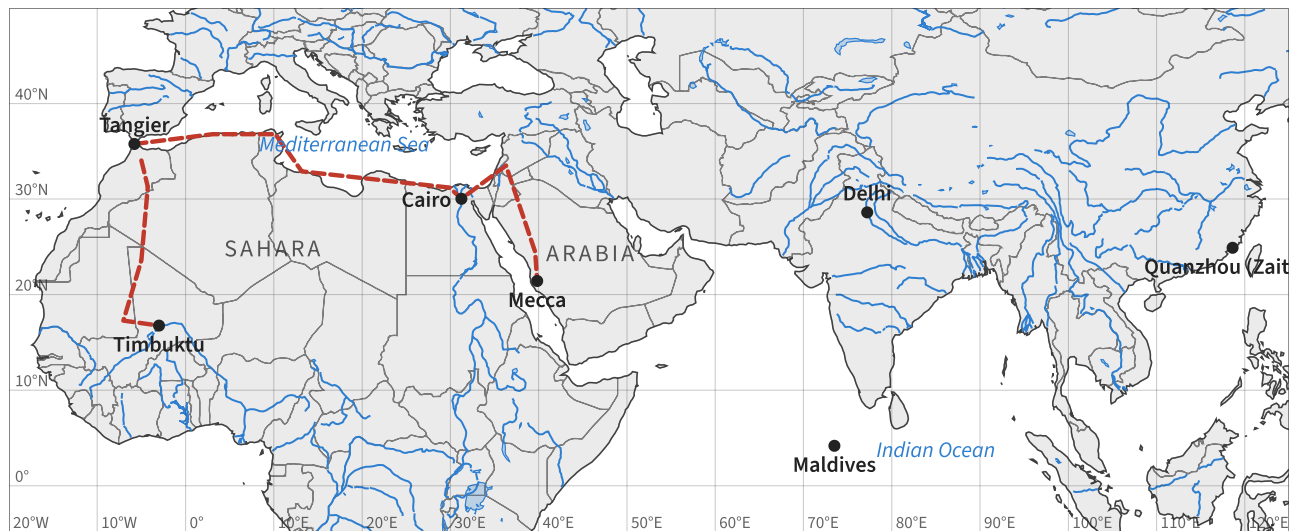
The story. In June 1325, a young man of twenty-one rode out of the city of Tangier, in Morocco, at the northwest corner of Africa. His name was Ibn Battuta (say “IB-un bat-TOO-tah”). He was a Muslim, trained to be a **judge**, and he was going on a **pilgrimage** to Mecca, in Arabia. He later remembered that he set out alone, without a friend or a caravan, and that leaving his mother and father made him very sad. He probably expected to be gone only a year or two. He did not come home to stay for almost thirty years.

How he traveled. Ibn Battuta crossed North Africa to Cairo, the biggest city he had ever seen, then went on to Damascus and Mecca. After that, he simply kept going. He traveled with camel caravans, rode horses, sailed on small Arab ships and huge Chinese ones, and walked. Because he was a judge who could read and write Arabic, rulers in many Muslim lands welcomed him, gave him gifts and sometimes gave him jobs. The Sultan of Delhi, in India, made him a judge for several years and then sent him as an ambassador to China. But a storm wrecked the ships before he could sail, and he ended up as a judge in the Maldives, tiny islands in the Indian Ocean. Later he did reach the busy port of Quanzhou in China, which he called Zaitun.

Home, and away again. In 1349 he came home to Morocco, only to learn that his mother had died of a terrible sickness, the plague. Still he was not done. He visited Granada in Spain. Then, in 1352, he joined a camel caravan across the **Sahara**, the largest hot desert in the world, to the kingdom of Mali in West Africa. On the way he stopped at a salt-mining village called Taghaza, where, he wrote, even the houses were built of blocks of salt. He visited Timbuktu and came home at last in 1354.

The big idea. All together Ibn Battuta traveled about 75,000 miles, through lands that are today more than 40 countries. That is about three times around the earth! The Sultan of Morocco asked a writer named Ibn Juzayy to write down his stories, and their book is called the **Rihla**, which means “journey.” Like Marco Polo, Ibn Battuta told of real places and real people, and also some things he only heard about, so scholars still check his stories carefully. His book tells us what the world looked like from Africa to China in the 1300s.

On the map. Find Tangier near the Strait of Gibraltar, at about 36° north. Mecca lies far to the southeast. Delhi and China lie farther still to the east, and Timbuktu lies south across the Sahara. God “hath made of one blood all nations of men” (Acts 17:26), and travelers like Ibn Battuta and Marco Polo showed how wide and full the family of nations is.



Ibn Battuta's world. His first journey (to Mecca, 1325-1326) and his last (across the Sahara, 1352-1353) are drawn; his other travels went on to India, the Maldives and China.

PICTURE STUDY



A Caravan of Pilgrims, from the Maqamat of al-Hariri, Yahya ibn Mahmud al-Wasiti, 1237 · Ink, colors and gold on paper, in a handwritten book · Bibliothèque nationale de France, Paris (manuscript Arabe 5847)

This painting comes from a handwritten Arabic book of clever stories called the *Maqamat* (“gatherings”). It was copied and painted in Baghdad in 1237 by an artist named Yahya al-Wasiti, about a hundred years before Ibn Battuta set out.

It shows a caravan of pilgrims setting off for Mecca, with riders, camels, banners and music. Ibn Battuta traveled with caravans just like this one.

Look closely

- Count the camels. How many riders can you find?
- Find the banners. Why would a big caravan carry flags?
- Find the musicians with trumpets and drums. Why would a caravan want music as it set out?
- Look at the faces. Do the travelers look excited, worried or tired?

Talk about it

1. How is this caravan like the one in the Catalan Atlas from Lesson 7.2? How is it different?
2. Would you rather travel alone, as Ibn Battuta did at first, or with a big caravan? Why?

PROJECT: THREE TIMES AROUND THE WORLD: A YARN MAP OF IBN BATTUTA'S TRAVELS

You will mark Ibn Battuta's main stops on a world map and stretch yarn between them to see how far he went. Then you will add his wonders to your Book of Marvels from Lesson 7.3.

You will need

- A printed or hand-drawn map of Africa, Europe and Asia taped to a piece of cardboard or a cork board
- Push pins or small balls of clay
- Red yarn or string
- Small sticky notes
- Your Book of Marvels

Steps

1. Put a pin at each stop, in order: Tangier, Cairo, Damascus, Mecca, Delhi, the Maldives, Quanzhou (Zaitun), then back to Tangier, then Timbuktu, then home again.
2. On a sticky note at each pin, write the stop's name and one fact (for example, Mecca: the goal of his pilgrimage; Maldives: he was a judge there).
3. Tie the yarn to Tangier and stretch it from pin to pin in order. This is only his main path. He really made many side trips!
4. Stretch a second color of yarn from Venice to Shangdu to show Marco Polo's journey. Which traveler went to more places?
5. In your Book of Marvels, add a page for Ibn Battuta. Draw the salt houses of Taghaza and write about them.
6. Add one more page: "If I could travel for a year, I would go to..." Name three places and find them on the map.

Tips

- Use a globe to check directions. Mecca is southeast of Tangier, and China is far to the east.
- Remember the yarn is shorter than the real trip: Ibn Battuta did not travel in straight lines.

Check your work

- I can point to Tangier, Mecca, Delhi, the Maldives, China and Timbuktu on my map.
- I can tell why Ibn Battuta first left home.
- I can explain why 75,000 miles is about three times around the earth.

MAP NOTEBOOK

1. Draw a map of Africa and Arabia. Mark Tangier, Cairo and Mecca and draw an arrow along Ibn Battuta's first journey.

2. Draw the salt village of Taghaza with houses made of salt blocks, and a camel caravan arriving.
3. Make a two-column chart, “Marco Polo” and “Ibn Battuta.” Write for each: hometown, year he set out, years away, and one wonder he described.

From history. When Ibn Battuta crossed the Sahara to Mali in 1352, Mali was one of the richest kingdoms in the world because of its gold. A few years earlier, about 1324, Mali’s king, Mansa Musa, had traveled to Mecca with so much gold that people in Cairo talked about it for years. In 1375 the Catalan Atlas, the same map you studied in Lesson 7.2, showed Mansa Musa seated on a throne in West Africa, holding a large gold nugget.

WORKED EXAMPLES

Example 1. The distance around the earth at the equator is about 25,000 miles. Ibn Battuta traveled about 75,000 miles. About how many times around the earth is that?

1. Count by 25,000: 25,000 (once), 50,000 (twice), 75,000 (three times).
2. Check by multiplying: $3 \times 25,000 = 75,000$.

Answer: About 3 times around the earth.

Example 2. Ibn Battuta was 21 when he left Tangier in 1325. He came home from his last journey in 1354. How many years did he travel, and how old was he when he came home?

1. Years traveling: $1354 - 1325$. From 1325 to 1350 is 25 years, and 1350 to 1354 is 4 more. $25 + 4 = 29$ years, almost thirty.
2. His age: $21 + 29 = 50$.

Answer: About 29 years (nearly thirty); he was about 50 years old.

PRACTICE

1. **EASY** Why did Ibn Battuta first leave home in 1325?
2. **EASY** What were the houses of Taghaza made of?
3. **MEDIUM** Look at the map. From Tangier, in which direction is Timbuktu: north, south, east or west?
(Use the map or drawing “Ibn Battuta’s world.” shown earlier in this lesson.)
4. **MEDIUM** Tangier is at about 36° north latitude. Timbuktu is at about 17° north. How many degrees farther south is Timbuktu?
5. **HARD** Marco Polo set out from Venice in 1271. Ibn Battuta set out from Tangier in 1325. How many years apart did they set out? Which traveler was gone longer: Marco (24 years) or Ibn Battuta (29 years), and by how many years?

6. **CHALLENGE** Ibn Battuta was a judge who could read and write Arabic. In two sentences, explain how that helped him travel so far.

COMMON MISTAKES

- Thinking Ibn Battuta traveled in one long, straight trip. He zigzagged, made side trips, stayed for years in some places and went home and out again.
- Mixing him up with Marco Polo. Marco was a Christian merchant's son from Venice; Ibn Battuta was a Muslim judge from Tangier in Morocco, and he set out about fifty years later.
- Thinking 75,000 miles means he went around the world. He never went to the Americas; he traveled back and forth across Africa, Europe and Asia, adding up to about three times the distance around the earth.

Make it a game · Where in the World Is Ibn Battuta?. Hide a small toy traveler somewhere on a big map or globe at one of his stops. Give clues one at a time: "I am on a continent with the Sahara." "I am on an island in the Indian Ocean." "I am a judge here." Players guess the stop. Fewer clues means more points. Then let the players hide the traveler and give the clues, and finish by naming all the stops in order.

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 said these words in Athens. God made every nation Ibn Battuta and Marco Polo visited, from Morocco to China, and He set their times and places. Every people on earth is part of one human family, and every one needs to hear of Christ.

Practice answers

1. To go on a pilgrimage (the hajj) to Mecca.
2. Blocks of salt.
3. South (a very little to the east).
4. $36 - 17 = 19$ degrees farther south.
5. $1325 - 1271 = 54$ years apart. Ibn Battuta was gone longer, by $29 - 24 = 5$ years.
6. Sample: In many Muslim lands from Africa to India, people used Arabic and the same laws, so rulers welcomed a trained judge, gave him gifts and gave him jobs. That meant he could earn a living and find friends and protection wherever he went.

UNIT 7 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. Use a map or globe where a question asks for a direction. The review is worth 40 points.

1. (4 pts) How did the builders of Venice make houses stand on the soft mud of the lagoon?
2. (4 pts) In which direction did Venetian ships sail to reach Constantinople and Alexandria? Name two goods Venetian merchants bought in those ports.
3. (4 pts) On a map, 1 inch stands for 300 miles. A sea route measures 3 inches. About how many miles long is it?
4. (4 pts) Where does silk come from?
5. (4 pts) What is a caravanserai, and why were caravanserais built about a day's journey apart?
6. (4 pts) A caravan travels 20 miles a day. How far does it go in 6 days?
7. (4 pts) Marco Polo left Venice in 1271 and came home in 1295. How many years was he gone? Who wrote down his stories?
8. (4 pts) Name two wonders from Marco Polo's book that surprised people in Europe.
9. (4 pts) Venice is at about 45° north and Beijing at about 40° north. Which is farther north, and by how many degrees? In which main direction is Beijing from Venice?
10. (4 pts) Ibn Battuta traveled about 75,000 miles. The distance around the earth is about 25,000 miles. About how many times around the earth did he travel? Where was his hometown, and why did he first set out?

UNIT PROJECT: THE SILK ROAD FROM VENICE TO BEIJING

Draw a large map that stretches from Venice to Beijing. Show the sea route from Venice to the eastern Mediterranean and the caravan routes across Asia. Mark at least eight places, including Venice, Constantinople or Acre, Baghdad, Samarkand, Kashgar, Dunhuang, Xi'an and Beijing, and shade the Taklamakan and Gobi Deserts. Draw Marco Polo's route in one color and add a small camel caravan, a Venetian galley and a bolt of silk.

Beside the map, include your Silk Road Trading Game ledger, your Book of Marvels, and a few sentences telling which traveler, Marco Polo or Ibn Battuta, you would most like to have journeyed with, and why.

- **Accuracy:** Places, seas, deserts and routes are in the right places and labeled clearly, with a compass rose.
- **Records:** The trading ledger is complete and its coins are added and subtracted correctly.
- **Storytelling:** The Book of Marvels and the sentences tell real facts about Venice, the Silk Road, Marco Polo and Ibn Battuta.
- **Care:** The map is neat, colorful and easy to read.

Answer key

1. They drove thousands of wooden poles (piles) down through the mud to hard clay, laid planks and stone on top, and built on the stone.
2. Southeast. Any two of: silk, pepper, cloves, nutmeg, other spices, cotton, sugar.
3. $3 \times 300 = 900$ miles.
4. From the thread silkworms spin to make their cocoons. Silkworms eat mulberry leaves; workers unwind the thread and weave it into cloth.
5. An inn with a big courtyard where a caravan could rest, water its animals and sleep safely. They were a day apart so a caravan could reach a safe stop every night.
6. $6 \times 20 = 120$ miles.
7. $1295 - 1271 = 24$ years. Rustichello of Pisa wrote them down while they were prisoners in Genoa.
8. Any two of: paper money made from mulberry bark, black stones that burn (coal), message riders with fresh horses at post stations, the huge city of Kinsay with canals and many bridges, the riches of Kublai Khan's court.
9. Venice is farther north by 5 degrees. Beijing is east of Venice (a little to the south).
10. $75,000 = 3 \times 25,000$, so about 3 times. His hometown was Tangier, in Morocco, and he first set out on a pilgrimage to Mecca in 1325.

AROUND THE WORLD

For thousands of years, the great oceans were like walls. In this last unit you will watch brave sailors turn them into roads. You will sail with Christopher Columbus in 1492, who thought the earth was much smaller than it is and reached lands that almost no one in Europe knew were there. You will follow Ferdinand Magellan's five ships south along South America in 1519, searching every bay for a passage, until they found the twisting strait at the bottom of the continent and sailed out into the ocean he named the **Pacific**.

Then you will cross that enormous ocean with the hungry sailors, and come home with Juan Sebastián Elcano and the eighteen men of the *Victoria*, the first ship to sail all the way around the world, in 1522. You will learn how the winds, the compass and the sailing ship made these voyages possible, and you will meet the honest truth about these men: their courage and skill, and also the real wrongs some of them did.

At the end, it is your turn. Like Nellie Bly, who raced around the world in 72 days in 1889–1890, you will plan your own voyage around the globe, port by port, using the latitude and longitude you learned in Unit 1. You will build a cardboard caravel, sail it through a strait in a pan, wrap the *Victoria*'s route around a globe with yarn, and keep your own logbook.

BEFORE YOU BEGIN

- Can find the equator, the prime meridian and the four hemispheres on a globe (Unit 1)
- Can read a latitude and longitude such as 34° S, 18° E (Unit 1)
- Can name the seven continents and five oceans and find them on a map (Units 2–5)
- Knows what a compass and a caravel are (Unit 6)

MASTERY CHECKLIST

- I can tell the story of Columbus's first voyage and explain his mistake about the size of the earth.
- I can explain how the trade winds and the westerlies carried ships across the Atlantic and back.
- I can find the Strait of Magellan and tell how Magellan's fleet found it and named the Pacific.
- I can trace the route of Magellan and Elcano around the world and name the oceans the *Victoria* crossed, in order.
- I can explain the "lost day" and why the voyage showed that the earth is round and very large.
- I can plan a trip around the world port by port, with latitude and longitude, miles and days for each leg.

OPTIONAL BOOKS AND RESOURCES

- ***Around the World in Eighty Days*, by Jules Verne (free at Project Gutenberg)** (<https://www.gutenberg.org/ebooks/103>): Free. The story that inspired Nellie Bly's race (Lesson 8.4). A parent can read aloud a few chapters, such as the start of the wager in London, while the student follows Phileas Fogg's route on a globe.
- **Library of Congress: Maps collection** (<https://www.loc.gov/maps/>): Free. Search for "Agnese" or "Ortelius" to look closely at old world maps like the ones in this unit's picture studies, and zoom in on the ships, winds and coastlines.

8.1 COLUMBUS AND THE NEW WORLD

OBJECTIVES

- Tell the story of Columbus's first voyage in 1492 and name his three ships and the four voyages he made.
- Explain Columbus's mistaken idea of the earth's size and why he thought he had reached Asia.
- Trace the route of the first voyage on a map and explain how the trade winds carried the ships west and the westerly winds carried them home.

Warm-up. Set a ball or a globe on the table. Put a small sticker on Spain and another on Japan. Ask: "Which way is shorter from Spain to Japan, going east or going west?" Stretch a string both ways and compare. Then cover North and South America with your hand. Talk about it: what if you did not know these two continents were there?

Video. Coming soon. Christopher Columbus's four voyages, the caravel and the trade winds, for children: search Drive Thru History, The History Guy, Library of Congress and Homeschool Pop (Alternate); candidates needing vetting: Free School, National Geographic Kids.

KEY TERMS

voyage

A long trip, especially by ship across the sea.

trade winds

Steady winds near the equator that blow from the east toward the west. They carried Columbus's ships across the Atlantic.

westerlies

Winds farther north that blow from the west toward the east. Columbus sailed north to catch them on the way home.

the New World

The name Europeans gave to North and South America, lands that people in Europe, Africa and Asia had not known about before 1492.

caravel

A small, quick sailing ship of Spain and Portugal. Two of Columbus's three ships, the *Niña* and the *Pinta*, were caravels.

CORE IDEAS

The story. Early in the morning of August 3, 1492, three small ships slipped out of the harbor of Palos in Spain: the *Niña*, the *Pinta* and the *Santa María*. Their captain was Christopher Columbus, a sailor from Genoa in Italy, and the king and queen of Spain,

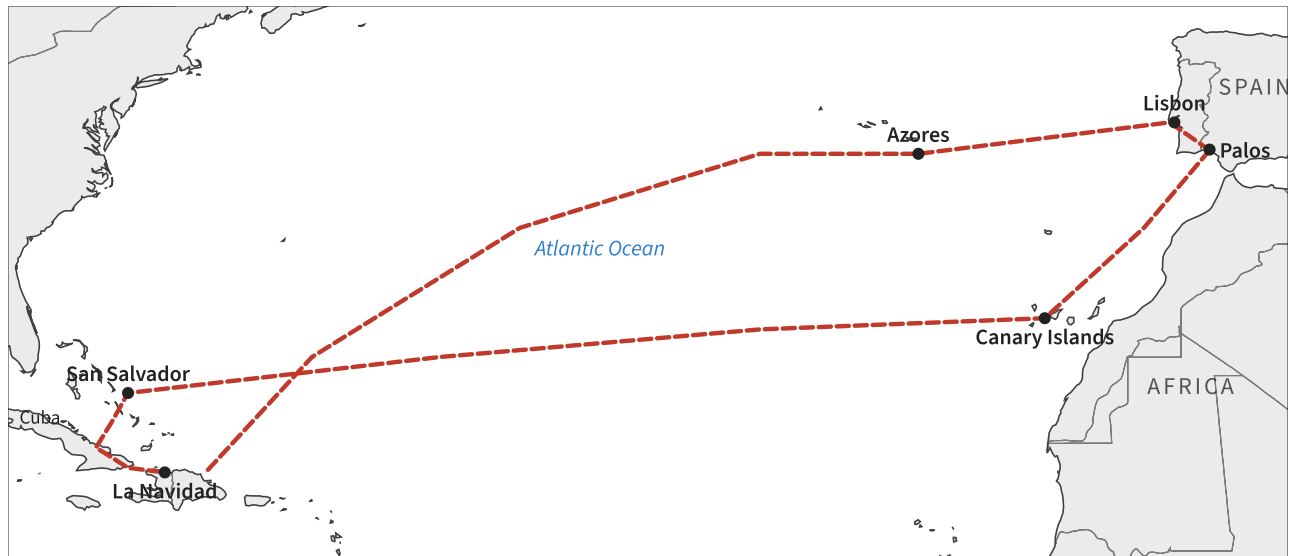
Ferdinand and Isabella, had paid for his trip. He meant to sail *west* across the Atlantic Ocean all the way to Asia, the land of spices and silk. On October 12, after more than a month without seeing land, a lookout on the *Pinta* cried out. In the moonlight he saw a white shore. It was a small island in the Bahamas. Columbus named it San Salvador, which means “Holy Savior.”

A mistaken idea. You may hear that people in 1492 thought the earth was flat. That is not true! Educated people had known for almost two thousand years that the earth is round, and a Greek scholar named Eratosthenes had measured it and come close to the right size. Columbus’s mistake was different. He believed the earth was much *smaller* than it really is, and that Asia stretched much farther east. He guessed that Japan was only about 3,000 miles west of the Canary Islands. Really it is about 12,000 miles, four times as far. If two great continents had not been in the way, his sailors would have run out of food and water long before reaching Asia.

How they did it. Columbus was a skilled sailor. He did not sail straight west from Spain. First he went south to the Canary Islands, off the coast of Africa. There the steady **trade winds** blow from the east, and they pushed his ships west across the ocean. To come home, he sailed north until he found the **westerlies**, winds that blow the other way, from west to east. He steered with a magnetic compass and kept track of his speed and direction every day. His quick caravels could sail in many kinds of wind. That pattern of winds, out in the south and home in the north, became the road that ships used for hundreds of years.

Four voyages. Columbus crossed the Atlantic four times: in 1492, 1493, 1498 and 1502. He explored the islands of the Caribbean, the coast of South America and the coast of Central America. He called the people he met “Indians,” because he thought he was near the Indies of Asia. He was brave and a fine navigator, but he also did real wrong. As governor on the island of Hispaniola, he forced many of the Taíno people to work for the Spanish and sent some to Spain as slaves. He ruled the Spanish settlers so harshly that in 1500 he was arrested and sent home in chains. He died in 1506, still believing he had reached Asia.

Technology overcoming geography. For thousands of years, the wide Atlantic had been like a wall. With the compass, the caravel and a knowledge of the winds, Columbus turned it into a road. After 1492, the Old World and the New World were never apart again. Plants, animals, ideas and people began to cross the ocean, and the Christian faith came to the Americas. Columbus had not found a way to Asia. The next great question was this: how far was it, really, to sail all the way around?



Columbus's first voyage, 1492-1493. Out in the south with the trade winds, home in the north with the westerlies.

Sailing west from the Canary Islands to Japan

Columbus's guess

1

 about 3,000 miles

The real distance

1	2	3	4
---	---	---	---

about 12,000 miles

Each box is about 3,000 miles.

Columbus's guess was about one fourth of the real distance to Japan.

PICTURE STUDY



World Map of Juan de la Cosa, Juan de la Cosa, 1500 · Ink and paint on parchment · Museo Naval (Naval Museum), Madrid

Juan de la Cosa was a Spanish mapmaker and sea captain who sailed with Columbus. In 1500, only eight years after the first voyage, he painted this great map on a large piece of parchment. It is the oldest map we still have that shows the lands of the New World.

Europe, Africa and Asia are drawn with cities, flags and little kings. Far to the left, painted green, are the new coasts and islands found by Columbus and others. De la Cosa did not yet know how big the new lands were, so part of the coastline is hidden behind a painting of Saint Christopher carrying the Christ child across a river.

Look closely

- Find the Old World: Europe, Africa and Asia. How did the mapmaker show cities and kings?
- Find the green lands on the left side. These are the New World. Can you find the islands of the Caribbean?
- Find Saint Christopher, the man carrying a child across the water. Why might a mapmaker put a picture there instead of a coastline?
- Look for crisscross lines across the sea, like the portolan charts you studied in Unit 6.

Talk about it

1. Why do you think the New World looks so small and unfinished on this map?
2. Saint Christopher's name means "Christ-bearer." Why might people have thought of Columbus when they saw him on this map?
3. What would a mapmaker need to finish this map?

PROJECT: A CARDBOARD CARAVEL

Columbus crossed the ocean in caravels, small ships with a deep, rounded hull and three masts. You will build your own caravel from cardboard, sticks and paper, with a triangle lateen sail and a square sail, and sail it on a pan of water. You will use it again in Lessons 8.2 and 8.3.

You will need

- A clean, empty quart or half-gallon milk or juice carton (waxed cardboard floats well)
- Scissors (a parent should make the first cuts)
- Three straws or wooden skewers for masts
- Paper or felt for sails, and tape or glue
- Modeling clay or play dough
- Crayons or markers, and string
- A baking pan or bathtub with a little water

Steps

1. Lay the carton on its side. With a parent, cut away the top side to make an open hull, like a long boat. Leave the bottom and the two long sides.
2. Pinch and tape one end to make a pointed bow (the front). Leave the other end flat for the stern (the back).
3. Press three small balls of clay into the bottom of the hull: one near the bow, one in the middle and one near the stern. These hold the masts.
4. Push the three straws or skewers into the clay. Make the middle mast the tallest.
5. Cut two square sails and tape them to the front and middle masts. Cut one triangle sail and tape it slanted on the back mast. This is the lateen sail that helps a ship sail into the wind.
6. Color a red cross on a square sail, like the crosses on the sails of Spanish ships. Write your ship's name on the side of the hull.
7. Float your caravel in the pan. Blow gently from behind it with a straw: this is a trade wind. Now blow from the side. Does it still move?
8. If your ship tips over, add a small ball of clay low in the middle of the hull. This is ballast.

Tips

- Keep the masts short at first. A tall mast makes the ship tip.
- Columbus's caravels were only about 50 to 70 feet long. Measure 60 feet with your feet in the yard or a hallway to see how small they were for crossing an ocean.

Check your work

- My caravel floats upright.
- It has square sails and one triangle lateen sail.

- I can show how the trade wind pushed the ships west.

MAP NOTEBOOK

1. Trace or draw the Atlantic Ocean. Draw Columbus's route out in red and his route home in blue. Label Spain, the Canary Islands, San Salvador and the Azores.
2. Draw arrows over the ocean to show the trade winds (east to west, in the south) and the westerlies (west to east, farther north).
3. Draw the three ships and label them *Niña*, *Pinta* and *Santa María*.

From history. On Christmas Eve 1492, the *Santa María* ran onto a coral reef off the island of Hispaniola and could not be saved. With the help of a friendly Taíno chief, the sailors carried everything ashore, and Columbus used the ship's timbers to build a small fort he named La Navidad, which means "Christmas." He left 39 men there and sailed home in the *Niña*. When he came back the next year, the fort had been burned and all the men were dead.

WORKED EXAMPLES

Example 1. Columbus's ships left the Canary Islands on September 6, 1492, and saw land on October 12. How many days were they at sea out of sight of land?

1. September has 30 days. From September 6 to September 30 is $30 - 6 = 24$ days.
2. Then add the days in October up to the 12th: 12 days.
3. Add them: $24 + 12 = 36$ days.

Answer: 36 days, a little more than 5 weeks.

Example 2. Columbus guessed that Japan was about 3,000 miles west of the Canary Islands. The real distance is about 12,000 miles. How many times farther is it really?

(Use the map or drawing "Columbus's guess and the real distance to Japan." shown earlier in this lesson.)

1. Count by 3,000s until you reach 12,000: 3,000, 6,000, 9,000, 12,000.
2. That is 4 groups of 3,000, so $4 \times 3,000 = 12,000$.
3. Look at the bar diagram: the real bar is four boxes long, and the guess is one box.

Answer: About 4 times as far. Columbus thought the trip was only one fourth as long as it really was.

PRACTICE

1. **EASY** Name Columbus's three ships on his first voyage. Which two were caravels?

2. **EASY** Look at the map of the first voyage. In which direction did the ships sail from the Canary Islands to San Salvador?
(Use the map or drawing "Columbus's first voyage, 1492-1493." shown earlier in this lesson.)
3. **MEDIUM** Columbus made his first voyage in 1492 and his last in 1502. How many years apart were they?
4. **MEDIUM** On the way home, Columbus stopped at a group of islands far out in the Atlantic. Use the map to name them. Were they north or south of the Canary Islands?
(Use the map or drawing "Columbus's first voyage, 1492-1493." shown earlier in this lesson.)
5. **HARD** Suppose a caravel sails about 100 miles each day. How many days would it take to sail 3,000 miles?
6. **CHALLENGE** Write two or three sentences: Columbus was wrong about the size of the earth. Why did his voyage still not end in disaster?

COMMON MISTAKES

- Saying people in 1492 thought the earth was flat. Educated people knew it was round; Columbus's mistake was about its *size*.
- Thinking Columbus sailed straight west from Spain. He went south to the Canary Islands first to catch the trade winds.
- Thinking Columbus knew he had found new continents. He believed to the end that he had reached Asia.

Make it a game · Catch the Wind. Lay a long rope or a row of pillows down the middle of the room: that is the Atlantic. Mark the south half "trade winds, blowing west" and the north half "westerlies, blowing east." One player is the caravel and stands at Spain. The other player calls out a direction, "Sail to the New World!" or "Sail home!" The caravel must walk to the correct wind lane first, then cross the ocean. Going into the wrong lane means you are blown back to port. Take turns, and add a stop at the Canary Islands or the Azores.

Scripture. "It is he that sitteth upon the circle of the earth, and the inhabitants thereof are as grasshoppers; that stretcheth out the heavens as a curtain, and spreadeth them out as a tent to dwell in:" (Isaiah 40:22, KJV)

Columbus guessed wrong about how big the earth is, but God made it and knows every mile of it. When we study the shape and size of the world, we are learning about the work of the One who sits above it.

Practice answers

1. The *Niña*, the *Pinta* and the *Santa María*. The *Niña* and the *Pinta* were caravels.
2. West (a little south of west).
3. $1502 - 1492 = 10$ years.
4. The Azores. They are north of the Canary Islands.
5. 30 days, because $30 \times 100 = 3,000$.

6. Columbus thought the earth was much smaller than it is, so Asia was really much too far away to reach. But North and South America lay in between, about where he expected Asia to be, so his ships found land after about five weeks, before their food and water ran out.

8.2 MAGELLAN SETS OUT ★ ⚙

OBJECTIVES

- Tell how Ferdinand Magellan's five ships left Spain in 1519 to reach the Spice Islands by sailing west.
- Explain what a strait is and find the Strait of Magellan at the tip of South America.
- Use latitude and a calendar to measure parts of the voyage, and explain why it was winter in the south while it was summer in Spain.

Warm-up. Lay a long towel or a row of books across the middle of a table from one edge almost to the other: this is a wall of land. Put a toy boat on one side. Ask: "How can the boat get to the other side without lifting it?" Let your child search for the gap at the end. Then make a small gap in the middle of the wall. Talk about it: which way is shorter? How would a sailor know where the gap is if he had no map?

Video. Coming soon. Ferdinand Magellan's voyage and the Strait of Magellan, for children: search Homeschool Pop (Alternate), The History Guy, Drive Thru History and Smithsonian; NASA Earth Observatory for satellite pictures of the Strait of Magellan and Tierra del Fuego; candidates needing vetting: Free School, National Geographic Kids.

KEY TERMS

strait

A narrow passage of water that connects two larger bodies of water, such as two oceans.

fleet

A group of ships that sail together under one leader.

Spice Islands

The Moluccas, small islands in what is now Indonesia, where cloves and nutmeg grow. Europeans paid very high prices for these spices.

mutiny

When sailors or officers rise up against their captain and try to take over the ship.

Pacific Ocean

The largest ocean on earth. Magellan named it the "peaceful" sea because it was calm when he first sailed on it.

CORE IDEAS

The story. On September 20, 1519, five ships sailed out from the town of Sanlúcar de Barrameda, where the river from Seville meets the sea in southern Spain. They were the *Trinidad*, the *San Antonio*, the *Concepción*, the *Victoria* and the *Santiago*, with about 250 men aboard. Their captain-general was Ferdinand Magellan, a sailor from Portugal who now served the young King Charles of Spain. A young man from Italy named Antonio Pigafetta

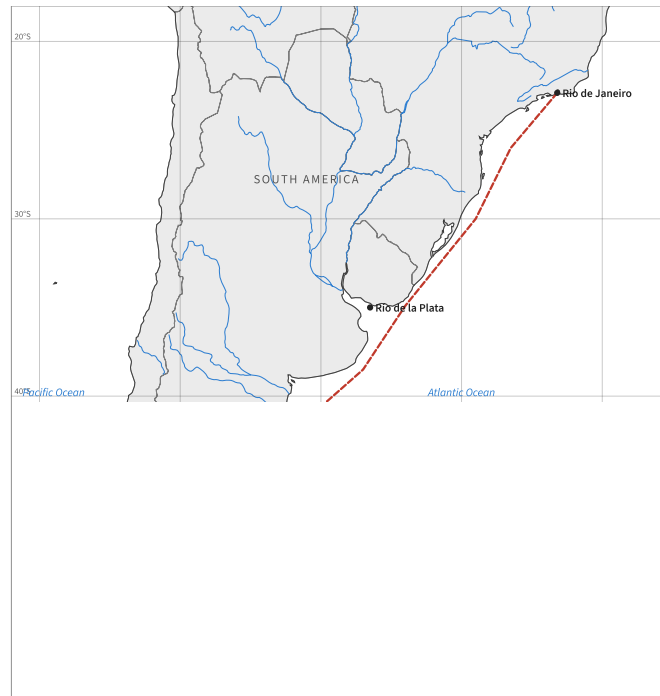
came along and kept a journal of everything he saw. Because of him, we know the story today.

Why go west? The fleet was going to the **Spice Islands**, where cloves and nutmeg grow. A sack of cloves was worth a fortune in Europe. Portugal already sailed east to the spices, around Africa, and Spain had agreed not to use that road. So Spain needed a western road. But Columbus had found that America stood in the way, and in 1513 a Spaniard named Balboa had crossed Panama on foot and seen another great sea beyond it. Magellan was sure there must be a **strait**, a narrow water passage, somewhere through or around America.

The search. The fleet crossed the Atlantic and reached the beautiful bay of Rio de Janeiro in Brazil in December. Then it sailed south along the coast, looking into every wide bay. As they went south the weather grew colder, because south of the equator the seasons are turned around. In March 1520 they stopped for the winter at a cold, lonely harbor called Port San Julián. There some of the captains tried a **mutiny**, and Magellan put it down. The little *Santiago* was wrecked while scouting the coast. Still Magellan would not turn back.

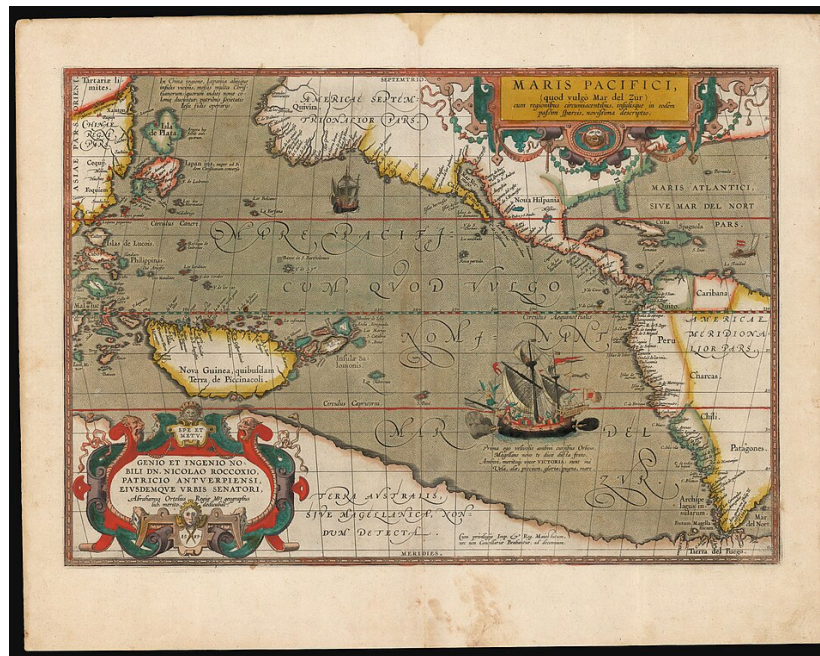
The strait. On October 21, 1520, the ships found an opening in the coast, near a cape that Magellan named the Cape of the Virgins. The passage twisted between snowy mountains for about 350 miles. At night the sailors saw fires burning on the land to the south, so it was later named Tierra del Fuego, "Land of Fire." While the others explored, the *San Antonio* slipped away and sailed home to Spain. At last, on November 28, three ships came out into a wide, open ocean. Pigafetta wrote that Magellan wept for joy. The sea was so calm that Magellan named it the **Pacific**, the peaceful sea.

Technology overcoming geography. North and South America are like a long wall of land stretching from the cold north almost to Antarctica. Magellan's ships, sails and compasses, and his stubborn courage, found the narrow gap in that wall. For hundreds of years ships used his strait or sailed around stormy Cape Horn, found in 1616. In 1914 the Panama Canal cut a new gap through the wall, and today ships can cross from ocean to ocean in about a day. On the map, find the strait at about 53° south latitude, very far south of the equator.



Magellan's fleet searches the coast of South America and finds the strait, 1519-1520.

PICTURE STUDY



*Maris Pacifici (The Pacific Sea), Abraham Ortelius, 1589 · Copper engraving, colored by hand · Printed in Antwerp for Ortelius's atlas *Theatrum Orbis Terrarum*; copies are kept in many libraries and map collections*

Abraham Ortelius was a mapmaker in the city of Antwerp. In 1570 he made the first modern atlas, a book of maps all printed the same size. In 1589 he made this map, the first printed map of the Pacific Ocean all by itself. It shows the great ocean that Magellan named, with Asia on one side and the Americas on the other.

Ortelius drew one ship sailing on the ocean: Magellan's *Victoria*. Beside her he printed a little Latin poem in which the ship herself speaks. She says she was the first to sail around the world, led by Magellan through the new strait, and that she is rightly called *Victoria*, "victory." Her sails were her wings, her prize was glory, and her battle was with the sea.

Look closely

- Find the ship *Victoria*. How many masts can you count? Are her sails full of wind?
- Find the bottom of South America and the narrow strait that Magellan found.
- Look along the bottom of the map. Mapmakers guessed there was a giant southern land there. Was there really? (Look at a modern globe.)
- Find Asia and Japan on the left side. Is the Pacific drawn as wide as it really is?

Talk about it

1. Why do you think Ortelius chose to put the *Victoria* on his map of the Pacific?
2. What did Ortelius know about the Pacific in 1589? What did he still have to guess?
3. If your own ship could speak, what would it say about its voyage?

PROJECT: THE STRAIT IN A PAN

Build the tip of South America in a baking pan and sail your caravel from Lesson 8.1 through your own twisty strait, from the Atlantic side to the Pacific side, using only "wind."

You will need

- A baking pan or plastic tub
- Modeling clay or play dough (about two fists)
- Water
- Your cardboard caravel, or a small boat folded from paper or foil
- A drinking straw
- A piece of string and a ruler
- Toothpicks and small paper flags

Steps

1. Look at the map of the Strait of Magellan. Notice that it bends like a crooked letter V lying on its side.
2. In the pan, press clay into two big lumps: the mainland of South America on one side and the island of Tierra del Fuego on the other. Leave a narrow, crooked channel between them.
3. Pour in water until the channel is about one inch deep.
4. Make toothpick flags: "Atlantic" at the east entrance, "Pacific" at the west exit, "Cape of the Virgins" and "Tierra del Fuego."
5. Set your ship at the Atlantic end. Blow through the straw to sail it through the strait. Count how many puffs it takes, and how many times you bump the shore.

6. Lay the string along the middle of your channel, then straighten it on a ruler. How many inches long is your strait?
7. Now make your channel narrower or add one more bend and sail again. Was it harder? Talk about how Magellan's sailors felt with real cliffs, rocks and wind.

Tips

- Keep the clay walls taller than the water so they do not wash away.
- Real ships could not just blow straight ahead. Sometimes they had to wait days for a good wind, or send small boats ahead to find the way.

Check your work

- My model has a mainland, an island and a crooked strait between them.
- I sailed my ship from the Atlantic side to the Pacific side.
- I can point to the Strait of Magellan on a globe.

MAP NOTEBOOK

1. Draw the tip of South America. Label the Strait of Magellan, Tierra del Fuego, the Atlantic Ocean and the Pacific Ocean.
2. Make a ship chart with five rows, one for each ship: *Trinidad*, *San Antonio*, *Concepción*, *Victoria*, *Santiago*. Write what happened to the *Santiago* and the *San Antonio*. Leave room to finish the chart in Lesson 8.3.
3. Draw two thermometers: Spain in July (warm summer) and Port San Julián in July (cold winter). Write one sentence explaining why.

From history. Along the cold coast of South America, Pigafetta wrote about strange black-and-white birds that could not fly and that the sailors called "geese." They were penguins. Today one kind of penguin that lives in the far south of South America is called the Magellanic penguin, after Magellan, and two small cloudy patches of stars that the sailors saw in the southern night sky are called the Magellanic Clouds.

WORKED EXAMPLES

Example 1. Rio de Janeiro is at about 23° south latitude. The Strait of Magellan is at about 53° south. How many degrees farther south did the fleet sail? Each degree of latitude is about 70 miles. About how many miles south is that?

(Use the map or drawing “From Rio de Janeiro to the Strait of Magellan.” shown earlier in this lesson.)

1. Both places are south of the equator, so subtract: $53 - 23 = 30$ degrees.
2. Each degree is about 70 miles. Multiply: 30×70 . Think $3 \times 7 = 21$, then add two zeros.
3. $30 \times 70 = 2,100$ miles.

Answer: 30 degrees, about 2,100 miles farther south.

Example 2. The ships entered the strait on October 21, 1520, and came out into the Pacific on November 28. How many days were they in the strait?

1. October has 31 days. From October 21 to October 31 is $31 - 21 = 10$ days.
2. Then add the days in November up to the 28th: 28 days.
3. Add them: $10 + 28 = 38$ days.

Answer: 38 days, more than five weeks, to sail about 350 miles of strait.

PRACTICE

1. **EASY** Five ships left Spain. The *Santiago* was wrecked and the *San Antonio* sailed home. How many ships sailed out into the Pacific?
2. **EASY** What is a strait? Which two oceans does the Strait of Magellan connect?
3. **MEDIUM** Look at the map. In which direction did the fleet sail from Rio de Janeiro to Port San Julián?
(Use the map or drawing “Magellan’s route along South America.” shown earlier in this lesson.)
4. **MEDIUM** The fleet stayed at Port San Julián from the end of March to the end of August 1520. About how many months is that?
5. **HARD** The strait is about 350 miles long. If the ships made about 10 miles of progress each day, how many days would it take? Is that close to the real 38 days?
6. **CHALLENGE** The sailors spent June and July of 1520 in snow and freezing wind at Port San Julián. In Spain, those are summer months. Explain why.

COMMON MISTAKES

- Thinking Magellan was Spanish. He was born in Portugal but sailed for the king of Spain.

- Mixing up a strait (a narrow passage of water) with a cape (a point of land sticking out into the sea).
- Thinking Magellan sailed around Cape Horn. He went through the strait, north of Tierra del Fuego. Cape Horn was not found until 1616.

Make it a game · Find the Strait. One player is Magellan and wears a blindfold or closes eyes. The other players stand in a long line with arms linked: they are the coast of South America. Secretly, two players leave a small gap between them. Magellan walks slowly along the line, feeling with one hand for the gap, while the others call out “Bay!” or “River!” to tempt him to stop. When Magellan finds the gap and slips through, he shouts “The Pacific!” Count how many steps it took, then trade places.

Scripture. “If I take the wings of the morning, and dwell in the uttermost parts of the sea; Even there shall thy hand lead me, and thy right hand shall hold me.” (Psalm 139:9–10, KJV)

Magellan’s sailors went farther from home than almost anyone in Europe had ever gone, to “the uttermost parts of the sea.” No place on earth is too far for God, who made the oceans and is present everywhere.

Practice answers

1. $5 - 2 = 3$ ships (the *Trinidad*, the *Concepción* and the *Victoria*).
2. A strait is a narrow passage of water that connects two larger bodies of water. The Strait of Magellan connects the Atlantic Ocean and the Pacific Ocean.
3. South (southwest), along the coast of South America.
4. About 5 months (April, May, June, July and August).
5. $350 \div 10 = 35$ days. Yes, that is close to the real 38 days.
6. Port San Julián is in the Southern Hemisphere, south of the equator. There the seasons are turned around: when it is summer in the north, it is winter in the south.

8.3 ELCANO COMES HOME

OBJECTIVES

- Tell how the *Victoria*, led by Juan Sebastián Elcano, came home to Spain in 1522 as the first ship to sail around the world.
- Trace the whole route of Magellan and Elcano on a world map and name the oceans in the order the *Victoria* crossed them.
- Explain what the voyage taught about the size of the earth, the Pacific Ocean and the “lost day.”

Warm-up. Take a ball, an orange or a globe and a piece of tape. Put the tape on one spot: that is Spain. Walk two fingers around the ball, always going the same way, until you come back to the tape. Ask: “How do you know you went all the way around and not back the way you came?” Talk about it: what would a sailor need to prove he had gone around the whole world?

Video. Coming soon. Juan Sebastián Elcano, the ship *Victoria* and the first voyage around the world (1519–1522), for children: search Homeschool Pop (Alternate), The History Guy, Smithsonian and Library of Congress (Battista Agnese atlas); candidates needing vetting: Free School, National Geographic Kids.

KEY TERMS

circumnavigation

A voyage all the way around the world (or around an island), coming back to where you started.

crew

The people who work on a ship.

cargo

The goods a ship carries to sell or deliver. The *Victoria*’s cargo was cloves.

scurvy

A sickness sailors got on long voyages when they had no fresh fruit or vegetables to eat.

Cape of Good Hope

A rocky point of land near the southern tip of Africa. Ships sailing between the Indian Ocean and the Atlantic pass it.

CORE IDEAS

The story. On September 6, 1522, a battered, leaking ship sailed slowly into the harbor of Sanlúcar in Spain. It was the *Victoria*. Almost three years before, she had left this same harbor with four other ships and about 250 men. Now only one ship came home, with eighteen thin, worn-out men on board. Their captain was Juan Sebastián Elcano, a sailor

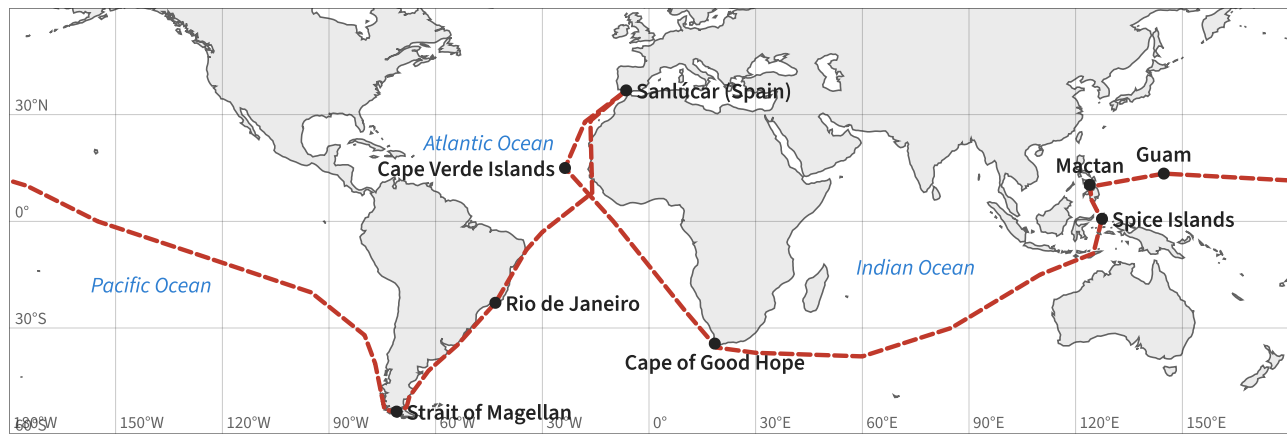
from the Basque country of northern Spain. They had done something no one had ever done before. They had sailed all the way around the world.

Across the Pacific. When we left Magellan in Lesson 8.2, his three ships had just come out of the strait into the calm Pacific. No one knew how big that ocean was. For 98 days the sailors saw almost no land. Their food ran out. Pigafetta wrote that they ate biscuit crumbs full of worms, sawdust, rats, and leather they soaked in sea water to make it soft. Many men died of **scurvy**. At last, in March 1521, they reached the island of Guam and then the Philippines. On Easter Sunday a priest said Mass on the shore of a small island, and a few weeks later many people in Cebu were baptized. But Magellan then tried to force a chief named Lapulapu on the island of Mactan to obey him. On April 27, 1521, Magellan was killed in a battle on Mactan's beach. Filipinos still honor Lapulapu as a hero who defended his home.

Home the other way. Too few men were left to sail three ships, so the sailors burned the *Concepción*. The *Trinidad* and the *Victoria* reached the Spice Islands in November 1521 and filled their holds with cloves. The *Trinidad* was leaking badly and stayed behind, and she never made it home. Elcano took the *Victoria* west across the Indian Ocean, far to the south to stay away from Portuguese ships, around the stormy **Cape of Good Hope** at the bottom of Africa, and north up the Atlantic. The *Victoria* had crossed the Atlantic, the Pacific, the Indian Ocean and the Atlantic again.

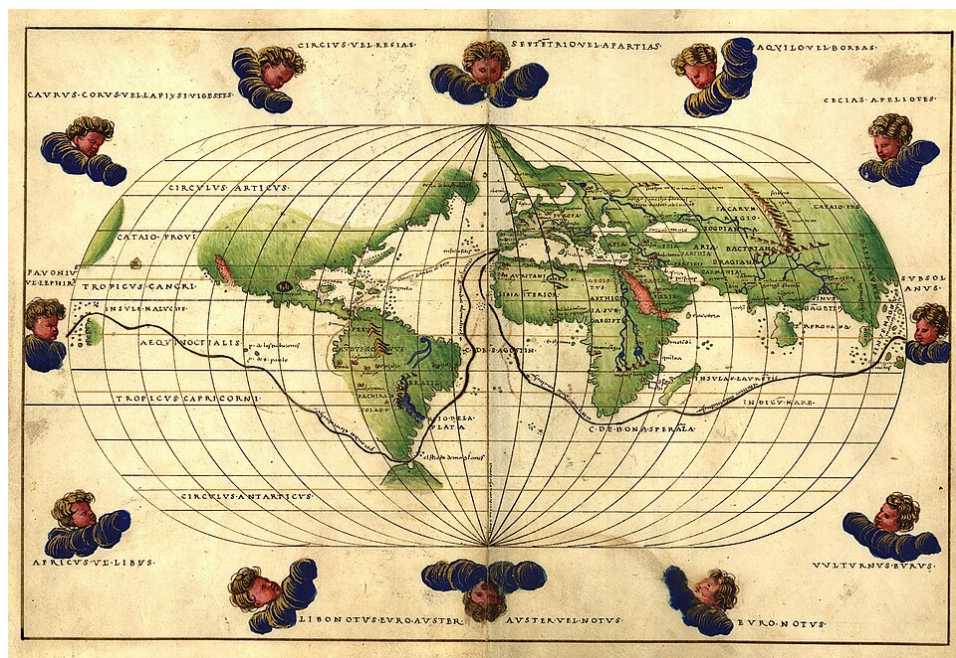
The lost day. When the *Victoria* stopped at the Cape Verde Islands, off Africa, the sailors were puzzled. Pigafetta had written in his journal every single day, and by his count it was Wednesday. But the people on shore said it was Thursday! The sailors had not lost track. Because they had sailed west, following the sun all the way around the earth, each of their days had been a tiny bit longer. All those tiny bits added up to one whole day. Today a line in the Pacific Ocean, the International Date Line, is where travelers change the calendar so they do not lose or gain a day.

The big idea. The voyage proved that all the oceans are joined, that a ship can sail around the whole round earth, and that the earth is much bigger than Columbus thought. The Pacific alone is wider than anyone had dreamed. The king of Spain gave Elcano a coat of arms with a globe and the Latin words *Primus circumdedisti me*, "You were the first to go around me." The cloves in the *Victoria* were worth enough to pay for the whole voyage. Wooden ships, cloth sails, a compass and brave, hungry men had linked the whole world by sea.



The first voyage around the world: Magellan's fleet, 1519-1521, and the Victoria under Elcano, 1521-1522.

PICTURE STUDY



World Map Showing the Route of Magellan's Voyage, Battista Agnese, 1544 · Ink, paint and gold on vellum, from a hand-drawn atlas · Agnese made several copies; one is in the Library of Congress, Washington, D.C.

Battista Agnese was a mapmaker from Genoa who worked in Venice. He made beautiful hand-painted atlases for rich and important people. In the world maps of his atlases, about twenty years after the *Victoria* came home, he drew a thin line showing the path of Magellan's ships all the way around the world.

Around the edge of the map are puffing faces. They are the winds, which sailors depended on to carry them across the seas. Agnese drew the world as an oval, so you can see it all at once.

Look closely

- Put your finger on Spain and follow the thin line of Magellan's route. Where does it cross the Atlantic? Where does it go around South America?
- Find the strait at the tip of South America. Does Agnese draw the land south of it as a small island or a large land?
- Count the wind faces around the edge. Why would sailors care so much about the winds?
- Compare the Pacific on this map to the Pacific on a modern globe. Which is wider?

Talk about it

1. Why do you think a mapmaker twenty years later would want to draw Magellan's route on his map?
2. What can you learn from this map that you could not learn from a list of places?
3. If you drew a line of your own trip around the world, which oceans would it cross?

PROJECT: AROUND THE WORLD WITH YARN

Follow the *Victoria* all the way around a globe or a ball with a piece of yarn, then compare the length of her route with the length of the equator. You will see why the voyage took three years.

You will need

- A globe, or a large ball with the continents drawn on it in marker
- Yarn or string in two colors
- Small pieces of tape and small sticky notes or stickers
- A ruler or tape measure
- Your cardboard caravel from Lesson 8.1 (to set beside your globe)

Steps

1. Put a small sticker or flag on each stop: Spain, Rio de Janeiro, the Strait of Magellan, Guam, Mactan in the Philippines, the Spice Islands, the Cape of Good Hope and the Cape Verde Islands.
2. Tape the end of the red yarn on Spain. Carry it along Magellan's route, taping it down at each stop, until you reach the Spice Islands.
3. Keep going along the *Victoria's* route home: across the Indian Ocean, around the Cape of Good Hope, north to the Cape Verde Islands and back to Spain. Cut the yarn.
4. Now tape the blue yarn once around the equator and cut it where it meets its start.
5. Pull both pieces off and lay them side by side on the floor. Measure each with a ruler or tape measure.
6. Which is longer? About how many equators long was the *Victoria's* route? Write the two lengths in your map notebook.

Tips

- The equator is about 25,000 miles around. If the red yarn is about twice as long as the blue, the *Victoria* sailed about 50,000 miles.
- The real ship did not sail in a straight line. It zigzagged with the winds, which made the trip even longer.

Check your work

- My yarn passes all eight stops in the right order.
- I compared the route with the equator and wrote down both lengths.
- I can name the four oceans the *Victoria* crossed, in order.

MAP NOTEBOOK

1. Draw a world map and trace the whole route in red, from Spain and back again. Label the Atlantic, Pacific and Indian Oceans.
2. Finish your ship chart from Lesson 8.2: write what happened to the *Concepción*, the *Trinidad* and the *Victoria*.
3. Draw Elcano's coat of arms: a globe with the words *Primus circumdedisti me*, "You were the first to go around me."

From history. Elcano did not stay home for long. In 1525 he sailed again for the Spice Islands as second in command of a new Spanish fleet, and in 1526 he died at sea in the Pacific Ocean. Antonio Pigafetta, who was one of the eighteen men who came home on the *Victoria*, wrote out his journal and gave a copy to King Charles. His book is still read today and is the best eyewitness account we have of the first voyage around the world.

WORKED EXAMPLES

Example 1. The ships left the strait on November 28, 1520, and reached Guam on March 6, 1521. How many days were they crossing the Pacific? (November has 30 days, December 31, January 31 and February 28.)

1. Days left in November after the 28th: $30 - 28 = 2$ days.
2. All of December, January and February: $31 + 31 + 28 = 90$ days.
3. Days in March up to the 6th: 6 days.
4. Add them: $2 + 90 + 6 = 98$ days.

Answer: 98 days, more than three months on the open Pacific.

Example 2. Look at the map. List the oceans the *Victoria* sailed across, in order, from the day she left Spain until she came home.

(Use the map or drawing “The route of the first voyage around the world, 1519–1522.” shown earlier in this lesson.)

1. Start at Spain. The ships cross the Atlantic Ocean to South America.
2. Through the strait they enter the Pacific Ocean and cross it to the Philippines and the Spice Islands.
3. Going home, the *Victoria* crosses the Indian Ocean to Africa.
4. Around the Cape of Good Hope she enters the Atlantic again and sails north to Spain.

Answer: Atlantic, Pacific, Indian, Atlantic.

PRACTICE

1. **EASY** Who was the captain of the *Victoria* when she came home? In what year? How many men were aboard?
2. **EASY** Five ships started the voyage. How many sailed all the way around the world? How many did not?
3. **MEDIUM** The crossing of the Pacific took 98 days. How many weeks is that?
4. **MEDIUM** Look at the map. After the Spice Islands, which cape did the *Victoria* sail around, and on which continent is it?
(Use the map or drawing “The route of the first voyage around the world.” shown earlier in this lesson.)
5. **HARD** The earth is about 25,000 miles around at the equator. If a ship could sail straight around it at 100 miles a day, how many days would that take?
6. **CHALLENGE** Pigafetta’s journal said Wednesday, but the people on the Cape Verde Islands said Thursday. In two or three sentences, explain the “lost day.”

COMMON MISTAKES

- Saying Magellan sailed around the world. Magellan died in the Philippines in 1521; Elcano and the *Victoria*’s crew finished the voyage.
- Thinking the *Victoria* came home the same way she went. She kept going west, across the Indian Ocean and around Africa.
- Thinking the sailors made a mistake in their calendar. They counted carefully; the day was “lost” because they went around the world westward.

Make it a game • The Lost Day Spin. In a dim room, shine a flashlight on a globe: the flashlight is the sun. Put a sticker on Spain and a tiny paper ship beside it. Spin the globe slowly toward the east (counterclockwise when you look down on the North Pole) ten times. One player counts each time Spain turns into the light: that is a sunrise at home.

The other player slides the paper ship a little way *west* on every spin, so that it gets all the way around the world and back to Spain by the tenth spin, and counts each time the ship turns into the light. Spain will count 10 sunrises, but the ship only 9! For a second round, the leader names a stop (Rio, the strait, Guam, Mactan, the Spice Islands, the Cape of Good Hope) and the players race to say which ocean comes next.

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)

The *Victoria*’s crew met people in South America, Guam, the Philippines, the Spice Islands and Africa. All of them, and all of us, are of one blood, made by one God, who set each people in its place on the face of the earth.

Practice answers

1. Juan Sebastián Elcano, in 1522, with 18 men.
2. 1 ship (the *Victoria*) sailed all the way around. $5 - 1 = 4$ did not.
3. $98 \div 7 = 14$ weeks.
4. The Cape of Good Hope, at the southern end of Africa.
5. $25,000 \div 100 = 250$ days. (The *Victoria* took much longer, because her route zigzagged with the winds and she had to stop for food, water and repairs.)
6. The *Victoria* sailed west around the world, following the sun, so each day on the ship was a little longer than a day at home. After going all the way around, the ship had seen one fewer sunrise, so its calendar was one day behind. Pigafetta had not made a mistake.

8.4 MY TRIP AROUND THE WORLD

OBJECTIVES

- Tell how Nellie Bly went around the world in 72 days in 1889–1890, and compare her trip with the *Victoria's*.
- Plan a voyage around the world port by port, writing each port's latitude and longitude and putting the ports in order.
- Estimate how many days each leg of a voyage will take, and add the legs to find the length of the whole trip.

Warm-up. Pack a pretend suitcase for a trip around the world, but you may take only what fits in one small bag or backpack. Lay out everything you would want, then choose. Talk about it: what did you leave behind? What will you need in a hot place, a cold place and on a ship?

Video. Coming soon. Nellie Bly's trip around the world in 72 days, and planning a trip around the world on a globe, for children: search Library of Congress, Smithsonian, The History Guy and Homeschool Pop (Alternate); candidates needing vetting: Brightly Storytime-style read-alouds of picture books about Nellie Bly, National Geographic Kids.

KEY TERMS

port

A town or city with a harbor where ships load and unload people and goods.

leg

One part of a long trip, from one stop to the next.

itinerary

A written plan of a trip: where you will go, in what order, and when.

canal

A waterway dug by people so that ships can pass through land. The Suez Canal and the Panama Canal are shortcuts between oceans.

logbook

A ship's daily record of where it is, which way it is going, how far it went and what happened.

CORE IDEAS

The story. On November 14, 1889, a young newspaper writer named Nellie Bly stepped onto a steamship in New Jersey, across the river from New York City. In a famous storybook by Jules Verne, a make-believe gentleman had gone around the world in eighty days. Nellie Bly wanted to do it faster, for real. She carried just one small bag. She crossed the Atlantic to England, took trains across Europe, and even stopped in France to meet Jules Verne himself.

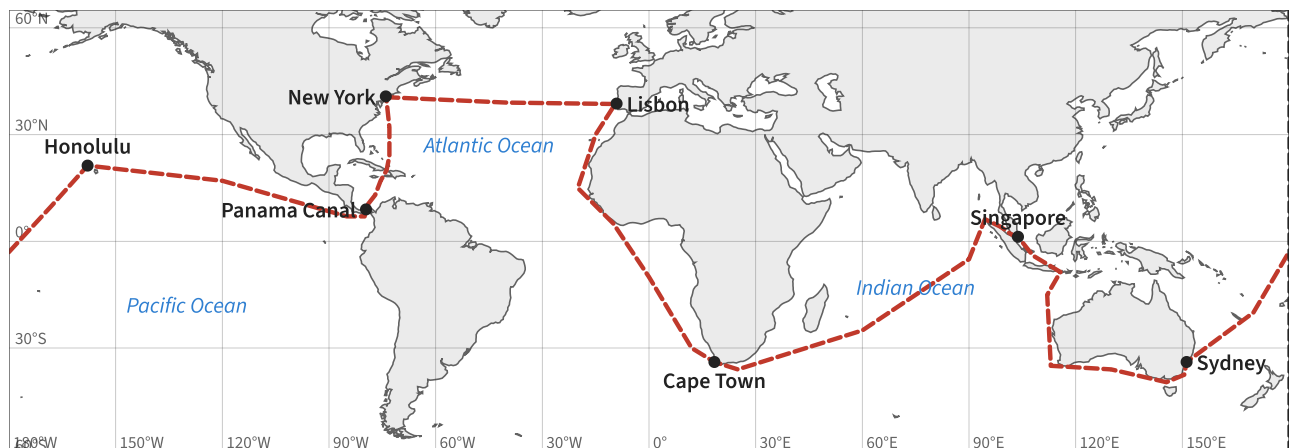
Then she sailed on to Egypt, Ceylon, Singapore, Hong Kong and Japan, crossed the Pacific to San Francisco, and rode a train across America. On January 25, 1890, crowds cheered as she arrived back. Her trip had taken only 72 days.

Technology overcoming geography. The *Victoria* had needed almost three years to go around the world. Nellie Bly needed less than two and a half months. What made the difference? Steamships that did not have to wait for the wind, and railroads that crossed whole countries in days. She also used two shortcuts. The Suez Canal in Egypt, opened in 1869, let her ship sail from the Mediterranean Sea to the Red Sea without going all the way around Africa. And the railroad across the United States, finished the same year, carried her from the Pacific coast to the Atlantic in less than a week. Today a jet airplane can carry you around the world in a few days.

How to plan a voyage. Now it is your turn to plan a trip around the world, port by port. A good navigator plans in steps. First, choose your starting port and one direction, east or west, and keep going that way. Second, pick your stops. Each part of the trip from one port to the next is a **leg**. Third, write each port's address, its latitude and longitude, as you learned in Unit 1. Fourth, for each leg, write the direction you will sail, about how far it is, and about how many days it will take. When all the legs are written down in order, you have an **itinerary**.

On the map. To truly go around the world, you must cross every line of longitude and come back to where you started. As you travel east from New York, the west longitudes count down to 0° at the prime meridian, then the east longitudes count up to 180°, then the west longitudes count down again until you are home. Look for the shortcuts. A ship can use the Panama Canal to cross from the Pacific to the Atlantic, or the Suez Canal to go between Europe and Asia. Without them, you must sail around the Cape of Good Hope or Cape Horn, as the old sailors did.

The big idea. Magellan and Elcano sailed into the unknown with no map at all of the great Pacific. You have something they never had: a globe that shows the whole world God made. Every port on your map is a real place where real people live, work and worship. A traveler who plans well, prays and keeps a careful logbook can go farther than anyone dreamed.



A sample voyage around the world, port by port. Your own trip may use different ports.

PICTURE STUDY



Typus Orbis Terrarum (Map of the Whole World), Abraham Ortelius, 1570 · Copper engraving, colored by hand · From Ortelius's atlas *Theatrum Orbis Terrarum*, printed in Antwerp; copies are kept in many libraries and map collections

This is the world map from the very first modern atlas, made by Abraham Ortelius, the same mapmaker who drew the *Victoria* on his map of the Pacific in Lesson 8.2. It was printed in 1570, about fifty years after the *Victoria* came home. People bought it to see the whole world at once.

Ortelius used the best reports of sailors in his day. Some parts of his map are very good. Other parts are guesses, such as the giant southern land along the bottom, which he labeled as “not yet known.”

Look closely

- Find the oceans that the *Victoria* crossed: the Atlantic, the Pacific and the Indian Ocean.
- Find South America. Is the land south of the Strait of Magellan drawn as an island, or as part of a giant southern land?
- Look at the shape of North America. Is it too wide or too narrow compared to a globe?
- Look at the frame around the map. Why do you think Ortelius put the world in the middle of clouds?

Talk about it

1. What would have been hard about planning a trip around the world with this map?
2. Which parts of this map do you think came from sailors who had really been there?
3. How is a modern world map better for planning your trip?

PROJECT: MY AROUND-THE-WORLD LOGBOOK

Plan your own voyage around the world, port by port, and record it in a logbook. You will choose at least six ports, write their latitude and longitude, measure each leg on a globe, and find out how many days your whole trip would take on a ship.

You will need

- A globe (a 12-inch globe is best) and a world map
- A piece of string and a ruler
- Four or five sheets of paper folded and stapled into a small booklet
- Pencil, colored pencils and stickers
- Your cardboard caravel from Lesson 8.1, to “sail” on the globe

Steps

1. On the cover of your booklet, write “Logbook of” and your ship’s name, and draw your ship.
2. Choose your home port. Pick east or west, and choose at least six ports that will carry you all the way around the world. Use the sample map for ideas.
3. Make one page for each port. Write its name, its country, and its latitude and longitude. Draw one thing you would like to see there.
4. Measure each leg with string on the globe, following the sea, not crossing land. Lay the string on a ruler. On a 12-inch globe, each inch is about 650 miles. Write the miles for each leg.
5. Suppose your ship sails about 500 miles a day. For each leg, figure out about how many days it takes, and write it down.
6. Add up all the days. Is your trip faster than Nellie Bly’s 72 days?
7. On a world map, draw your whole route in red and mark each port with a dot.

Tips

- Use the Panama Canal or the Suez Canal to save many days. Ask: what would happen if a canal were closed?
- Round the miles to the nearest hundred to make the math easier. A good estimate is all a navigator needs to plan.

Check your work

- My trip crosses every line of longitude and comes back to my home port.
- Every port has a latitude and a longitude.
- I wrote the miles and days for every leg and added the days correctly.

MAP NOTEBOOK

1. Draw a world map and mark Nellie Bly’s stops: New York, London, Egypt, Ceylon, Singapore, Hong Kong, Japan and San Francisco. Connect them in order.

2. Make a two-column chart: “The *Victoria*, 1519–1522” and “Nellie Bly, 1889–1890.” Write how each traveled, how long it took and what shortcuts each used.
3. Draw a postcard from your favorite port in your planned trip. On the back, write its latitude and longitude and one sentence about it.

From history. Nellie Bly was not the only one racing. On the very same day she left, another writer, Elizabeth Bisland, set out the other way, going west around the world for a magazine called *The Cosmopolitan*. Bisland came home on January 30, 1890, about 76 and a half days later and five days after Nellie Bly. Both women beat the eighty days of Jules Verne’s story.

WORKED EXAMPLES

Example 1. A ship leaves New York (41° N, 74° W) and sails east around the world. Put these ports in order: Singapore (1° N, 104° E), Honolulu (21° N, 158° W), Lisbon (39° N, 9° W), Sydney (34° S, 151° E), Panama Canal (9° N, 80° W), Cape Town (34° S, 18° E).

(Use the map or drawing “A sample voyage around the world.” shown earlier in this lesson.)

1. Going east from New York, the west longitudes get smaller until 0° . Lisbon (9° W) comes first.
2. After 0° , the east longitudes get bigger: Cape Town (18° E), then Singapore (104° E), then Sydney (151° E).
3. After 180° , the longitudes are west again and get smaller as you go east: Honolulu (158° W), then the Panama Canal (80° W).
4. Then home to New York (74° W).

Answer: New York → Lisbon → Cape Town → Singapore → Sydney → Honolulu → Panama Canal → New York.

Example 2. The first leg, from New York to Lisbon, is about 3,400 miles. Your ship sails about 500 miles a day. About how many days will the leg take?

1. Count by 500s: 500, 1,000, 1,500, 2,000, 2,500, 3,000, 3,500.
2. That is 7 days to go 3,500 miles, which is just a little more than 3,400.
3. 6 days would be only 3,000 miles, not enough. So the ship needs part of the seventh day.

Answer: About 7 days.

PRACTICE

1. **EASY** In Jules Verne’s story, the trip around the world took 80 days. Nellie Bly took 72 days. How many days faster was she?

2. **EASY** Cape Town is at 34° S, 18° E. In which two hemispheres is it?
3. **MEDIUM** Look at the map. Which two ports are at about the same latitude, 34° south?
(Use the map or drawing “A sample voyage around the world.” shown earlier in this lesson.)
4. **MEDIUM** The leg from Sydney to Honolulu is about 5,000 miles. At 500 miles a day, how many days will it take?
5. **HARD** Mia planned a trip with seven legs that take 7, 11, 12, 8, 10, 11 and 5 days. How many days is her whole trip? Is it faster than Nellie Bly’s 72 days, and by how many days?
6. **CHALLENGE** Your ship is in Honolulu and must get to New York. Write two or three sentences explaining why the Panama Canal makes the trip much shorter.

COMMON MISTAKES

- Changing direction partway through. To go around the world, keep going east (or keep going west) until you come home.
- Forgetting that longitude numbers go up to 180° and then count down again on the other side of the world.
- Drawing a sea route straight across land. A ship must go around continents or through a canal.

Make it a game · Around the World in Ten Ports. Write ten real ports on slips of paper with their latitude and longitude (for example, Lisbon 39° N, 9° W; Cape Town 34° S, 18° E; Singapore 1° N, 104° E; Sydney 34° S, 151° E; Honolulu 21° N, 158° W). Shuffle them. Players take turns drawing a port, finding it on the globe, and setting it in the right place in a line that goes east from your home port. If you place it wrong, the next player may move it and score a point. When the line is finished, sail your caravel around the globe from port to port in order, saying each port’s address out loud.

Scripture. “They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep.” (Psalm 107:23-24, KJV)

Columbus, Magellan, Elcano and Nellie Bly all saw the great waters of the world. When you plan your voyage, remember that every ocean, coast and harbor on your map shows the works of the Lord.

Practice answers

1. $80 - 72 = 8$ days faster.
2. The Southern Hemisphere (S) and the Eastern Hemisphere (E).
3. Cape Town and Sydney.
4. $5,000 \div 500 = 10$ days.
5. $7 + 11 + 12 + 8 + 10 + 11 + 5 = 64$ days. Yes, it is faster: $72 - 64 = 8$ days faster.
6. Without the canal, the ship would have to sail far south, all the way around the tip of South America, and then north up the whole Atlantic. The Panama Canal cuts through the narrow

land of Panama, so the ship can go straight from the Pacific into the Caribbean Sea and on to New York, saving thousands of miles and many days.

UNIT 8 REVIEW

Answer each question. Show your work for the number problems and use complete sentences for explanations. You may use a globe or a world map for questions 5, 8 and 9. The review is worth 40 points.

1. (4 pts) In 1492, did educated people think the earth was flat? What was Columbus's real mistake?
2. (4 pts) Columbus guessed Japan was about 3,000 miles west of the Canary Islands. It is really about 12,000 miles. How many times farther is it really? What lay in the way?
3. (4 pts) Why did Columbus sail south to the Canary Islands before going west, and why did he sail north on the way home?
4. (4 pts) Magellan left Spain in 1519 with five ships. The *Santiago* was wrecked and the *San Antonio* went home. How many ships sailed into the Pacific? Why did Magellan give the ocean that name?
5. (4 pts) What is a strait? The Strait of Magellan is at about 53° S. Is it north or south of the equator, and on which continent's tip?
6. (4 pts) The ships entered the strait on October 21 and came out on November 28. October has 31 days. How many days were they in the strait?
7. (4 pts) Who brought the *Victoria* home to Spain, in what year, and with how many men? What happened to Magellan?
8. (4 pts) List, in order, the oceans the *Victoria* crossed from the time she left Spain until she came home. Name the cape at the tip of Africa she sailed around.
9. (4 pts) Put these ports in order for a trip going east from New York (74° W): Sydney (151° E), Lisbon (9° W), Honolulu (158° W), Cape Town (18° E).
10. (4 pts) A leg of your trip is about 4,000 miles, and your ship sails about 500 miles a day. How many days will the leg take? Nellie Bly went around the world in 72 days. How many days faster was she than the 80 days in Jules Verne's story?

UNIT PROJECT: MY VOYAGE AROUND THE WORLD

Make a large world map that shows two voyages around the world. In red, draw the route of Magellan and Elcano (1519–1522), and label Spain, Rio de Janeiro, the Strait of Magellan, Guam, Mactan, the Spice Islands, the Cape of Good Hope and the Cape Verde Islands. In another color, draw your own planned trip from your logbook, with every port marked and labeled with its latitude and longitude.

Display the map with your cardboard caravel and your Around-the-World Logbook. Then tell a parent or the family, in your own words, how the compass, the sail and later the steamship and the canal turned the oceans from walls into roads.

- **Accuracy:** Both routes go the right way around the world, the stops are in the right places and in order, and the oceans are labeled correctly.

- **Logbook:** Every port has a latitude and longitude; every leg has miles and days; the days are added correctly.
- **Telling the story:** The student tells the story of the first voyage around the world, including the strait, the Pacific crossing, Magellan's death, Elcano's return and the lost day.
- **Care:** The map, caravel and logbook are neat, colorful and finished.

Answer key

1. No. Educated people knew the earth was round. Columbus's mistake was that he thought the earth was much smaller than it is, so he believed Asia was only a short sail west of Europe.
2. About 4 times farther ($4 \times 3,000 = 12,000$). North and South America lay in the way.
3. Near the Canary Islands the trade winds blow from east to west and pushed his ships across the ocean. Farther north the westerlies blow from west to east, so he sailed north to catch them home.
4. $5 - 2 = 3$ ships. He named it the Pacific, the "peaceful" sea, because it was calm when he sailed out onto it.
5. A strait is a narrow passage of water connecting two larger bodies of water. The Strait of Magellan is south of the equator, at the southern tip of South America.
6. $31 - 21 = 10$ days in October, plus 28 days in November: $10 + 28 = 38$ days.
7. Juan Sebastián Elcano brought the *Victoria* home in 1522 with 18 men. Magellan was killed in a battle on the island of Mactan in the Philippines in 1521.
8. Atlantic, Pacific, Indian, Atlantic. She sailed around the Cape of Good Hope.
9. Lisbon, Cape Town, Sydney, Honolulu, then back to New York.
10. $4,000 \div 500 = 8$ days. Nellie Bly was $80 - 72 = 8$ days faster.

BONUS: MAP LAB

Map Lab is a bonus unit of games and puzzles. You can use it at any time of the year: a lesson on a rainy afternoon, a week when everyone needs a change, or a cheerful review at the end of the course. Each lesson takes what you have learned about continents, oceans, latitude and longitude and turns it into something to play, make and keep.

You will meet Matthew Fontaine Maury, who cut the oceans into squares of latitude and longitude to find the paths of the winds; Benjamin Banneker and Andrew Ellicott, who measured out the land for a brand-new capital in 1791; the monk Fra Mauro, who drew the whole known world in Venice about 1450; and the crew of *Apollo 17*, who photographed the whole round earth in 1972. Along the way you will build a Latitude Battleship board, make a deck of capital city cards, draw the world from memory in September and again in May, and run a trivia relay to the globe.

BEFORE YOU BEGIN

- Can find the equator and the prime meridian on a globe (Unit 1)
- Can read a latitude and longitude with N, S, E or W
- Can name the seven continents and the five oceans
- Can add, subtract and multiply small numbers

MASTERY CHECKLIST

- I can call out a place on the world grid with latitude first and longitude second.
- I can tell whether a crossing on the grid is on land or in an ocean, and name the ocean.
- I can name at least twelve capital cities and the continents they are on.
- I can draw the world from memory with the seven continents, the five oceans, the equator and the prime meridian.
- I can answer quick questions by finding places on a globe.

OPTIONAL BOOKS AND RESOURCES

- **Library of Congress: Maps** (<https://www.loc.gov/maps/>): Free. Search for “L’Enfant plan” to zoom in on Pierre L’Enfant’s 1791 plan of Washington, D.C. (Lesson 9.2), and browse thousands of old maps for trivia questions.
- **NASA Visible Earth** (<https://visibleearth.nasa.gov/>): Free. Pictures of the earth from space, including versions of the Blue Marble (Lesson 9.4). A good source for “What place is this?” trivia cards.

9.1 LATITUDE BATTLESHIP

OBJECTIVES

- Name a crossing on a world grid by its latitude and longitude, saying latitude first.
- Tell whether a crossing lies on land or in an ocean, and name the ocean.
- Tell how Matthew Fontaine Maury divided the oceans into squares of latitude and longitude to help ships.

Warm-up. Lay a dish towel or a checkered napkin on the table. Hide a coin under one square while your partner closes their eyes. Your partner may ask only “Which row? Which column?” style questions, like “Row 3, column 5?” How many guesses does it take to find the coin? Talk about why two numbers are needed to find one square.

Video. Coming soon. Latitude and longitude for kids, reading a world grid and finding places by coordinates: search Homeschool Pop (Alternate), NASA and Memoria Press; also search Smithsonian for Matthew Fontaine Maury and his ocean charts.

KEY TERMS

grid

A pattern of lines that cross each other and make squares, so every spot has its own address.

coordinates

The two numbers that tell where a place is: its latitude and its longitude, like 30° N, 90° W.

crossing

The point where a line of latitude and a line of longitude meet on a map or globe.

chart

A map made for sailors, showing oceans, coasts and the ways ships travel.

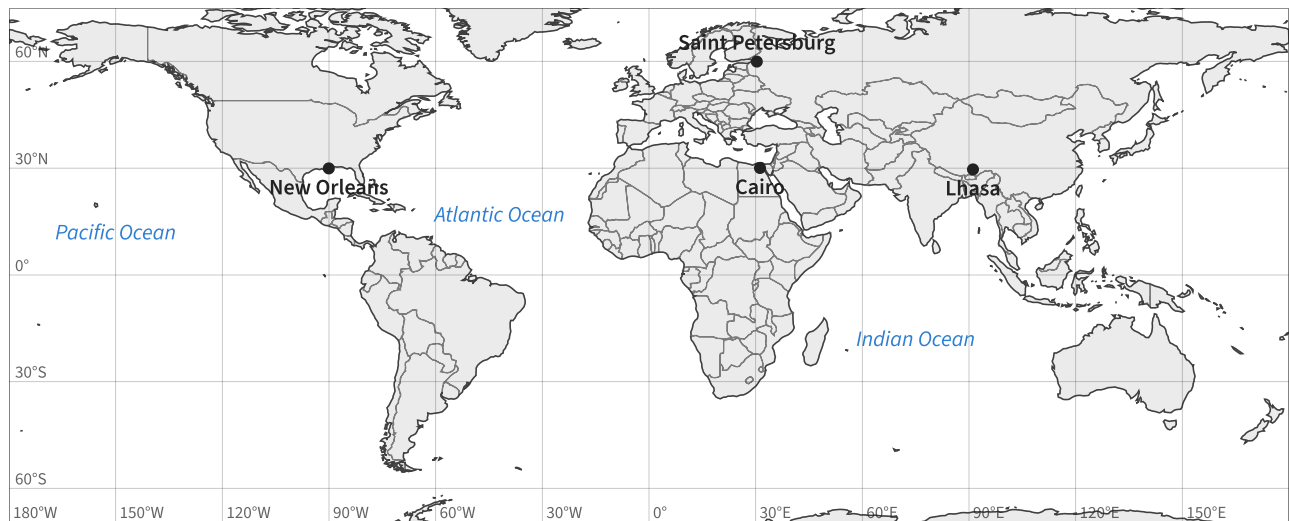
CORE IDEAS

The story. In 1839 a young American navy officer named Matthew Fontaine Maury was hurt in a stagecoach accident. His leg healed badly, and he could no longer serve at sea. A few years later the Navy put him in charge of its office of charts in Washington, D.C. There he found piles of old ship logbooks. Every day, sailors had written down where their ship was, by latitude and longitude, and which way the wind blew. Maury had a big idea. He drew a grid over the oceans and cut them into squares. Then he and his helpers sorted thousands of logbook notes, square by square, to learn which winds and currents were found in each one.

How it worked. When the squares were filled in, Maury could tell a captain, “In this square, the wind usually blows from the northeast. In that square, a current will push you along.” His charts showed faster paths across the sea, and ships that followed them cut days and sometimes weeks off long voyages. People began calling Maury the “Pathfinder of the Seas.”

The secret was the grid. Because every spot on the ocean has an address, notes from hundreds of different ships could be put together in the right place.

On the map. Today you will play a game that uses the same grid. In *Latitude Battleship*, each player hides little ships on a world map, only on crossings that lie in an ocean. Players take turns calling out a crossing, always **latitude first, then longitude**: “30 degrees north, 60 degrees west!” If a ship sits there, it is a hit. Our board has lines every 30 degrees, so there are only a few lines to learn: 60° N, 30° N, the equator (0°), 30° S and 60° S going up and down, and 0°, 30°, 60°, 90°, 120°, 150° and 180° going east and west. The plastic board game *Battleship* came out in 1967, but sailors and children played it with pencil and paper long before that. Ours has a twist: every guess teaches you a real place on the earth.



The Latitude Battleship board. Ships may hide only on crossings that fall in an ocean.

PICTURE STUDY



The Fog Warning, Winslow Homer, 1885 · Oil on canvas · Museum of Fine Arts, Boston

Winslow Homer was an American painter who lived on the rocky coast of Maine and loved to paint the sea. In this painting a fisherman has rowed his small boat, called a dory, far from his big fishing ship. Now a gray fog is rolling in. If the fog hides the ship, how will he find his way back? On the wide ocean, knowing where you are is a matter of life and death.

Look closely

- Find the big ship far away on the horizon. How small does it look?
- Look at the sky. Where is the fog coming from?
- Find the fish in the boat. What has the fisherman been doing?
- Look at his face. Which way is he looking, and why?

Talk about it

1. Why is it so hard to find one small spot on the open ocean?
2. How could a grid of latitude and longitude help a sailor find his ship or his way home?
3. How is this fisherman's problem like a game of Battleship?

PROJECT: MAKE A LATITUDE BATTLESHIP BOARD

You will make two game boards, one for you and one for a partner, and play Latitude Battleship on a real map of the world. Each player hides five ships on ocean crossings and tries to find the other player's ships by calling out coordinates.

You will need

- Two printed outline maps of the world, the same size (a parent can print free ones from a map website)
- Ruler, pencil and colored pencils
- Two pieces of cardboard or two clipboards
- A tall book or a folder to stand up between the players as a wall
- Ten small markers for ships (beans, buttons or paper clips) and a pile of small paper scraps for hits and misses

Steps

1. Glue or clip each map to its cardboard.
2. With a ruler, draw the equator, then the lines of latitude 30° N, 60° N, 30° S and 60° S. Label each one at the edge of the map.
3. Draw the prime meridian (0°), then lines every 30 degrees east and west: 30°, 60°, 90°, 120°, 150° and 180°. Label them along the top: "30 E," "30 W" and so on.
4. Put a small dot on every crossing. Color the dots blue if they are in an ocean and brown if they are on land. Check with a globe if you are not sure.
5. Stand the wall between the boards. Each player secretly places five ships, one on each of five blue crossings.

6. Take turns calling a crossing, latitude first: "Zero degrees, sixty degrees east!" The other player answers "Hit!" or "Miss!" A brown crossing is always a miss and earns the answer, "Land ho!"
7. Mark your guesses on your own board with scraps so you do not call the same crossing twice. The first player to find all five ships wins.
8. After the game, name the ocean where each ship was hiding.

Tips

- Say the full coordinates every time, with north or south and east or west. "Thirty, sixty" is not enough: it could be four different places!
- The equator and the prime meridian are both 0°. Say "zero degrees" and they need no N, S, E or W.

Check your work

- I can call a crossing with latitude first and longitude second.
- I can tell whether a crossing is on land or in an ocean.
- I can name the ocean where a ship is hiding.

MAP NOTEBOOK

1. Draw a small square of ocean and write in it what Maury might have learned there: which way the wind blows and which way the current flows.
2. Make a list of five "Land ho!" crossings from your board and the country or continent each one lands in.
3. Draw a tiny ship and write its secret coordinates beside it, latitude first.

From history. Maury did not keep his idea to himself. In 1853 he helped gather navy officers from many countries at a meeting in Brussels, Belgium. They agreed that ships of all those nations would keep their logbooks in the same way, so that their notes about wind, weather and currents could be shared. It was one of the first times that countries worked together to study the whole ocean.

WORKED EXAMPLES

Example 1. On the Latitude Battleship board, your partner calls out “30 degrees north, 30 degrees west.” Is it on land or in the ocean? If it is in the ocean, which one?

(Use the map or drawing “Find the line 30° N and the line 30° W, then follow them to where they cross.” shown earlier in this lesson.)

1. Latitude comes first. 30° N means start at the equator and go up to the line marked 30° N.
2. Longitude comes second. 30° W means start at the prime meridian and go left (west) to the line marked 30° W.
3. Put one finger on each line and slide them until they meet. The crossing is west of Africa and east of North America.
4. There is no land there, only water between the Americas and Africa and Europe.

Answer: It is in the ocean: the Atlantic Ocean, west of Africa.

PRACTICE

1. **EASY** Is a ship at 30° S north or south of the equator?
2. **EASY** A ship is hiding at 0°, 0°, where the equator and the prime meridian cross. Is it on land or in the ocean? Which ocean?
3. **MEDIUM** Look at the board. Which city is marked near the crossing of 30° N and 90° W? Is that crossing a good hiding place for a ship?
(Use the map or drawing “Use the marked cities to check your answers.” shown earlier in this lesson.)
4. **MEDIUM** Your partner hit your ship at 30° N, 60° W. Name the crossing that is one line farther east, and say whether it is land or ocean.
5. **HARD** Write two sentences: Why did Maury need both the latitude and the longitude from each logbook note to make his charts?

COMMON MISTAKES

- Saying longitude first. The rule is latitude first, then longitude, just as Maury’s sailors wrote it.
- Forgetting N, S, E or W. Without the letter, “30, 60” could mean four different places on the earth.
- Counting west of the prime meridian as east. On a map with north at the top, west is to the left.

Make it a game • Coordinate Echo. One player calls out a crossing, latitude first, such as “60 degrees north, 30 degrees east.” The other player must echo it back correctly, find it on the globe or board within ten seconds, and say “Ocean!” or “Land ho!” (that one

lands near Saint Petersburg in Russia). One point for the echo and one for the right answer. Play to ten points, then switch.

Scripture. “The fowl of the air, and the fish of the sea, and whatsoever passeth through the paths of the seas.” (Psalm 8:8, KJV)

Maury was called the “Pathfinder of the Seas.” The ocean looks empty and trackless, but God made the winds and currents to follow regular paths, and patient study helped sailors find them.

Practice answers

1. South of the equator. The S stands for south.
2. In the ocean: the Atlantic Ocean, south of the bulge of western Africa (the Gulf of Guinea).
3. New Orleans. No: the crossing is at New Orleans, on the coast of the United States in North America, not out in the open ocean. It is “Land ho!” and no ship may hide there.
4. 30° N, 30° W. It is in the Atlantic Ocean (going east from 60° W, the next line is 30° W).
5. Sample: Latitude alone tells only how far north or south a ship was, and longitude alone tells only how far east or west. He needed both numbers to put each note in the right square of the ocean.

9.2 CAPITAL CITIES CARD GAME

OBJECTIVES

- Name the capital cities of at least twelve countries on six continents.
- Sort capitals from north to south using their latitude.
- Tell how Washington, D.C., was surveyed and planned as a brand-new capital city.

Warm-up. Ask everyone at the table: “What is the capital of our state? What is the capital of our country?” Then find both on a map. Is the state capital the biggest city in the state? Many capitals are not!

Video. Coming soon. Capital cities and countries of the world for kids, and the founding of Washington, D.C. (L’Enfant’s plan, Andrew Ellicott and Benjamin Banneker): search Library of Congress, Smithsonian and Drive Thru History; Homeschool Pop (Alternate) for continents and countries; Geography Now (candidate, needs vetting) for single-country profiles.

KEY TERMS

country

A land with its own government, its own borders and its own name, such as Canada or Japan.

capital

The city where a country’s (or a state’s) government meets and its laws are made.

surveyor

A person who measures the land carefully so that borders and maps are exact.

set

In our card game, four capital cities from the same continent.

CORE IDEAS

The story. When the United States was young, Congress met in New York and then in Philadelphia, but the country had no capital of its own. In 1790 Congress let President George Washington choose a spot along the Potomac River. In 1791 a surveyor named Andrew Ellicott began to mark out a square of land ten miles long on each side. His helper was Benjamin Banneker, a free Black farmer from Maryland who had taught himself astronomy. Night after night Banneker watched the stars through an instrument to help find exactly where the first corner stone should go. At the same time, a French-born engineer named Pierre L’Enfant drew a plan for the city itself, with wide avenues spreading out like the spokes of a wheel. In 1800 Congress met in the new city of Washington for the first time.

The big idea. A **capital** is the city where a country’s leaders meet and its laws are made. Some capitals, like London and Cairo, are old cities that grew up first and became capitals

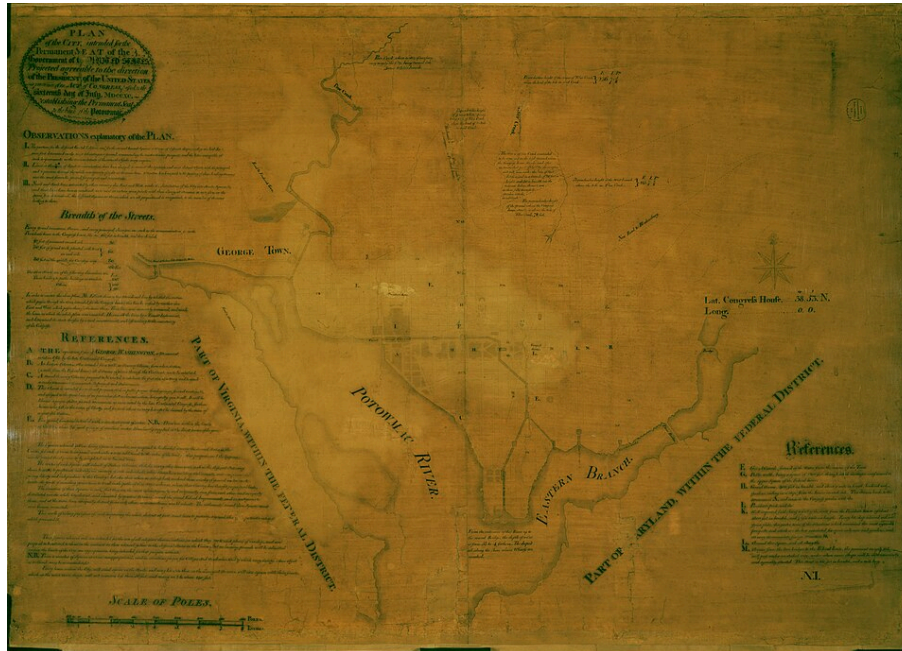
later. Others, like Washington, D.C., Canberra in Australia and Brasília in Brazil, were planned and built on purpose to be capitals. A capital is not always the biggest city. New York is bigger than Washington, and Sydney is bigger than Canberra. That is what makes capitals tricky to remember, and fun to play with.

On the map. In the *Capital Cities Card Game*, each card names a country, its capital, its continent and its latitude and longitude. Players try to collect **sets** of four capitals from the same continent. There are cards for six continents, but none for Antarctica. Antarctica has no countries and no capitals at all, only scientists who come and go from their research stations. Our deck adds one special card for it: the Penguin card. As you play, find each capital on the map. Soon you will know two dozen of the world's great cities by heart.



Twelve capitals from the card deck. Find each one as you play.

PICTURE STUDY



Plan of the City Intended for the Permanent Seat of the Government of the United States, Pierre (Peter) Charles L'Enfant, 1791 · Ink on paper (a hand-drawn manuscript plan) · Library of Congress, Washington, D.C.

Pierre L'Enfant was born in France and came to America to fight for its independence in the Revolutionary War. George Washington asked him to plan the new capital city. L'Enfant drew this plan by hand in 1791. Paper this old is fragile, so the Library of Congress keeps it safe and has made careful copies so that everyone can study it.

Look closely

- Find the two rivers that meet beside the city. The larger one is the Potomac.
- Find the long avenues that cut across the grid of streets on a slant. Where do they meet?
- Look for the places where L'Enfant planned the house for Congress and the house for the President.
- Compare this plan with a map of Washington, D.C., today. What has stayed the same?

Talk about it

1. Why do you think L'Enfant planned wide avenues and open squares for a capital city?
2. Why was it important to measure the land carefully before building a city?

PROJECT: MAKE A CAPITAL CITIES CARD DECK

You will make a deck of 25 cards: four capitals from each of six continents, plus one Penguin card for Antarctica. Then you will play a card game that teaches you two dozen capitals and where they lie on the earth.

You will need

- 25 index cards (or cardstock cut into card-size pieces)
- Six colored pencils or markers, one color for each continent
- A world map or globe
- Pencil and a fine black marker

Steps

1. Choose a color for each continent and draw a colored stripe across the top of each card.
2. On each card, write the country, its capital (in big letters) and its latitude and longitude. Use this list. North America: Canada, Ottawa (45° N, 76° W); United States, Washington, D.C. (39° N, 77° W); Mexico, Mexico City (19° N, 99° W); Cuba, Havana (23° N, 82° W).
3. South America: Brazil, Brasília (16° S, 48° W); Argentina, Buenos Aires (35° S, 58° W); Peru, Lima (12° S, 77° W); Colombia, Bogotá (5° N, 74° W).
4. Europe: United Kingdom, London (51° N, 0°); France, Paris (49° N, 2° E); Italy, Rome (42° N, 12° E); Spain, Madrid (40° N, 4° W).
5. Africa: Egypt, Cairo (30° N, 31° E); Kenya, Nairobi (1° S, 37° E); Nigeria, Abuja (9° N, 7° E); Ethiopia, Addis Ababa (9° N, 39° E).
6. Asia: China, Beijing (40° N, 116° E); Japan, Tokyo (36° N, 140° E); India, New Delhi (29° N, 77° E); South Korea, Seoul (38° N, 127° E).
7. Australia and Oceania: Australia, Canberra (35° S, 149° E); New Zealand, Wellington (41° S, 175° E); Papua New Guinea, Port Moresby (9° S, 147° E); Fiji, Suva (18° S, 178° E).
8. Make the Penguin card: draw a penguin and write "Antarctica: no countries, no capital."
9. To play Capital Go Fish (2 to 4 players): deal five cards each and put the rest face down. On your turn, ask one player for a capital you need, by name: "Do you have Nairobi?" If they do, they give it to you. If not, they say "Go fish!" and you draw a card. When you collect all four capitals of one continent, lay the set down and point to all four cities on the map. The Penguin card is wild: it can stand in for any one missing card. The player with the most sets wins.

Tips

- You may only ask for a capital from a continent you already hold a card for. That helps you learn which capitals go together.
- Say the country and the capital together, like "Kenya, Nairobi," every time you lay a card down.

Check your work

- I can name the capitals of at least twelve countries.
- I can tell which continent each capital is on.

- I can find each capital on a map or globe.

MAP NOTEBOOK

1. Draw a simple map of Washington, D.C., with the Potomac River, the Capitol and the White House, and one long slanted avenue between them.
2. Make a list: three capitals that are old cities and three that were built on purpose to be capitals.
3. Draw a small picture of Benjamin Banneker watching the stars, and write one sentence about how he helped.

From history. Brazil's capital used to be Rio de Janeiro, on the coast. Brazil's leaders wanted more people to settle the wide lands of the interior, so they built a whole new capital, Brasília, on a high, open plain in the middle of the country. It was built in only a few years and opened on April 21, 1960. Seen from the air, its main plan looks like an airplane or a bird with its wings spread.

WORKED EXAMPLES

Example 1. Put these four capitals in order from north to south: Brasília (16° S), Washington, D.C. (39° N), Mexico City (19° N), Ottawa (45° N).

(Use the map or drawing "Check your order on the map: Ottawa is highest, Brasília is lowest." shown earlier in this lesson.)

1. Split the cities into two groups. North of the equator: Washington (39° N), Mexico City (19° N), Ottawa (45° N). South of the equator: Brasília (16° S).
2. In the north group, the bigger the number, the farther north. 45 is bigger than 39, and 39 is bigger than 19. So: Ottawa, then Washington, then Mexico City.
3. Every city south of the equator comes after every city north of it. So Brasília comes last.

Answer: Ottawa, Washington, D.C., Mexico City, Brasília.

PRACTICE

1. **EASY** What is the capital of Canada?
2. **EASY** Why are there no capital cards for Antarctica?
3. **MEDIUM** London is at 51° N and Rome is at 42° N. Which capital is farther north?
4. **MEDIUM** Which of these capitals is closest to the equator: Nairobi (1° S), Bogotá (5° N) or Lima (12° S)?
5. **CHALLENGE** Canberra is at 35° S and Tokyo is at 36° N. The numbers are almost the same. Are the two cities close together? Explain.

(Use the map or drawing "Find Canberra and Tokyo on the map." shown earlier in this lesson.)

COMMON MISTAKES

- Thinking the biggest city is always the capital. Sydney is bigger than Canberra, and New York is bigger than Washington, D.C.
- Mixing up the country and the capital: Brazil is the country; Brasília is its capital.
- Forgetting N or S. Two capitals with nearly the same latitude number can be on opposite sides of the earth.

Make it a game • Capital Lineup. Deal five cards to each player. On “Go!” everyone lays their cards in a row from the farthest north capital to the farthest south, using the latitude on each card. The first player to finish with a correct row reads the capitals aloud, north to south, and wins the round. For an extra point, point to the northernmost and southernmost cities 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)

Every card in the deck stands for a nation, and every nation is made of people God made “of one blood.” Learning their capitals is one small way to learn about our neighbors around the world.

Practice answers

1. Ottawa.
2. Antarctica has no countries, so it has no capitals. No one lives there for good; only scientists and their helpers stay for a while at research stations.
3. London, because 51 is bigger than 42 and both are north of the equator.
4. Nairobi. It is only 1 degree from the equator.
5. No. Canberra is south of the equator and Tokyo is north of it, so they are on opposite sides of the equator, far apart. (Canberra is in Australia and Tokyo is in Japan, in Asia.)

9.3 DRAW THE WORLD FROM MEMORY

OBJECTIVES

- Draw a map of the world from memory showing the seven continents, the five oceans, the equator and the prime meridian.
- Score a memory map with a checklist and measure how much it improves from September to May.
- Tell how the monk Fra Mauro drew a great map of the world in Venice from travelers' reports, about 1450.

Warm-up. Close your eyes and picture a globe. Without peeking, trace in the air with one finger the shape of Africa, then South America. Open your eyes and look at a real globe. How close were you? Which shape was easier to remember?

Video. Coming soon. How to draw the continents of the world freehand, and the Fra Mauro world map in Venice: search Memoria Press (geography drawing samples), Homeschool Pop (Alternate) for continents and oceans, and Smithsonian for old world maps.

KEY TERMS

continent

One of the seven great bodies of land on the earth: North America, South America, Europe, Africa, Asia, Australia and Antarctica.

ocean

One of the five great bodies of salt water: the Pacific, Atlantic, Indian, Arctic and Southern Oceans.

outline

The edge or shape of a piece of land, drawn as a line.

memory map

A map you draw without looking at any other map, to show what you know by heart.

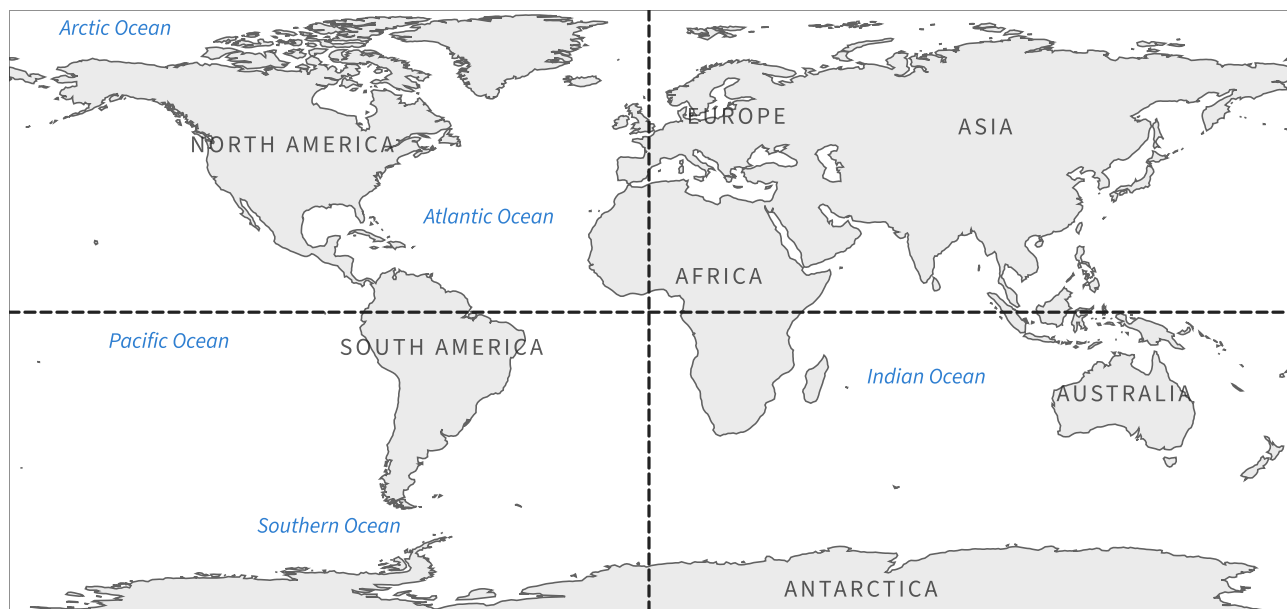
CORE IDEAS

The story. About the year 1450, in a monastery on the little island of San Michele, between Venice and Murano, a monk named Fra Mauro was finishing a map of the whole world. It was round and about six and a half feet across, painted in blue, gold and many colors. Fra Mauro had not traveled to most of the places on it. Instead, he gathered the best knowledge he could find. He read books like Marco Polo's, studied sailors' charts, and listened to merchants and travelers who passed through busy Venice. Then he drew the world as well as he knew it. Some parts are wonderfully good. Other parts, far from Venice, are bent out of

shape, because no one had told him exactly what they looked like. And his map has *south at the top*, the way some mapmakers of his time liked to draw it.

The big idea. A map shows what its maker knows. That is just as true of a map you draw from memory! Today you will draw the world with no globe and no atlas to copy: only what is in your head. You will date it, put it away, and draw it again in May. Your September map may have a lumpy Africa and a lost Australia. That is fine. It is a picture of what you know *now*. When you compare the two maps in May, you will see with your own eyes how much you have learned this year.

How to draw it. Start big and simple. Draw the equator across the middle of the page and the prime meridian from top to bottom. Africa sits right where the two lines cross, so draw it first, like a big pear leaning to the right. Europe goes above it, and huge Asia stretches off to the right. The two Americas go on the left, joined by a thin neck of land. Australia sits low on the right, Antarctica lies along the bottom, and the oceans fill all the space in between. Then label everything you can remember.



The answer key. Look at it only after you finish your memory map.

PICTURE STUDY



The Fra Mauro World Map, Fra Mauro, a Camaldolese monk of San Michele di Murano, with his workshop, about 1450 · Ink and paint, with gold, on parchment, set in a wooden frame · Biblioteca Nazionale Marciana (Marciana Library), Venice, Italy

Fra Mauro's map is one of the most famous maps of the Middle Ages. It shows Europe, Asia and Africa inside a great circle of ocean, filled with tiny castles, ships, rivers and thousands of notes in the Venetian language. It was made just before the great voyages of Columbus and Magellan, so the Americas are not on it at all.

Look closely

- Turn the picture upside down so that north is at the top. Can you find Europe, Africa and Asia now?
- Find the ocean that goes all the way around the edge of the map.
- Look for the tiny painted cities and ships. Why would a mapmaker draw pictures instead of only dots?
- Which continents from your own list are missing from this map?

Talk about it

1. Why do you think the parts of the map close to Venice are more correct than the parts far away?
2. How is Fra Mauro's map like your memory map? How is it different?

PROJECT: MY SEPTEMBER AND MAY MEMORY MAPS

Twice this year you will draw the whole world from memory: once now, in September (or whenever you start this course), and once at the end, in May. You will score each map with

the same checklist and keep both in an envelope to compare.

You will need

- Two large sheets of plain paper (11 by 17 inches is good)
- Pencil, eraser and colored pencils (blue for water)
- A timer
- A large envelope
- A globe or the answer-key map, for checking afterward only

Steps

1. Put away every globe, atlas and map. Write your name and today's date in a corner of the paper.
2. Set a timer for 15 minutes.
3. Draw a frame around the page. Draw the equator across the middle and the prime meridian from top to bottom.
4. Draw the seven continents as well as you can remember. Start with Africa, where the two lines cross.
5. Color the oceans blue and label as many continents and oceans as you can.
6. When the timer rings, stop. Now look at the globe and score your map with the checklist: one point for each continent drawn and labeled in about the right place (7), one for each ocean labeled (5), one for the equator and one for the prime meridian (2). The best score is 14.
7. Write your score on the back, put the map in the envelope and write "Open in May" on it.
8. In May, draw a new map the same way, score it, and lay the two side by side. Write how many points you grew.

Tips

- Do not erase too much. A quick, brave drawing is better than a perfect half-map.
- "About the right place" means on the correct side of the equator and the prime meridian, and next to the right neighbors.

Check your work

- I drew my map with no help from a globe or atlas.
- I scored my map honestly with the 14-point checklist.
- I dated my map and saved it to compare in May.

MAP NOTEBOOK

1. Practice one continent a day this week: draw it three times from memory, then once while looking at the globe.

2. Draw a small circle and make your own “Fra Mauro” map of your neighborhood, with south at the top.
3. Write one sentence about which continent was hardest to remember, and why.

From history. Fra Mauro worked with a skilled Venetian sailor and chart maker named Andrea Bianco. The king of Portugal, Afonso V, asked for a copy of the great map, because Portugal’s sailors were exploring down the coast of Africa. That copy was finished in 1459 but has been lost. The map in Venice survives and can still be seen today.

WORKED EXAMPLES

Example 1. In September, Grace drew North America, South America and Africa, labeled the Atlantic and Pacific Oceans and drew the equator. In May she drew all seven continents, labeled four oceans and drew both the equator and the prime meridian. Score both maps out of 14 with the checklist: one point for each continent, each ocean and each line. How many points did she grow?

1. September: 3 continents + 2 oceans + 1 line (the equator) = 6 points.
2. May: 7 continents + 4 oceans + 2 lines (the equator and the prime meridian) = 13 points.
3. Growth: $13 - 6 = 7$ points.

Answer: September: 6 out of 14. May: 13 out of 14. She grew by 7 points.

PRACTICE

1. **EASY** How many continents and oceans are on the checklist all together?
2. **EASY** Which continent should you draw along the very bottom of your map?
3. **MEDIUM** Sam’s September map scored 5 points. His May map scored 12 points. How many points did he grow?
4. **MEDIUM** Look at the answer key. Which continent should be the biggest on your map, and which should be the smallest?
(Use the map or drawing “Compare the sizes of the continents.” shown earlier in this lesson.)
5. **HARD** Fra Mauro never visited most of the lands on his map. Write two sentences about why some parts of his map were drawn the wrong shape.

COMMON MISTAKES

- Drawing Africa too small. Africa is very large, much bigger than Europe and the United States put together, so give it plenty of room.
- Putting South America straight below North America. South America sits farther to the east, so it leans to the right.
- Peeking at a map during the September drawing. The map is only useful if it shows what you really knew that day.

Make it a game · Mystery Continent. One player turns away and draws the outline of one continent in ten seconds, with no labels. The other players guess which continent it is. If someone guesses right, both the drawer and the guesser score a point. Then the guesser becomes the drawer. Try oceans too: point to an empty space on the globe and name the ocean.

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

Every outline you draw, every coast and ocean, belongs to the Lord who made it. Learning the shape of the world by heart is a way to know His world better.

Practice answers

1. 12: 7 continents and 5 oceans ($7 + 5 = 12$).
2. Antarctica.
3. 7 points ($12 - 5 = 7$).
4. Asia is the biggest; Australia is the smallest.
5. Sample: He had to draw faraway places from what travelers and books told him, and they did not always know the exact shape of the coasts. Places close to Venice, where many sailors had been, came out much better.

9.4 GLOBE TRIVIA RELAY

OBJECTIVES

- Answer quick questions about continents, oceans, lines and places by finding them on a globe.
- Trace the equator around the globe and name, in order, the oceans it crosses.
- Tell the story of the Blue Marble photograph taken by the crew of Apollo 17 in 1972.

Warm-up. Hold a globe (or a ball with the continents drawn on it) and spin it slowly. Stop it with one finger. Is your finger on land or water? Do it ten times and keep a tally. Which won, land or water? Why?

Video. Coming soon. The Blue Marble photograph of the whole earth from Apollo 17 (1972) and views of the earth from space: search NASA and Smithsonian; for a continents and oceans review, Homeschool Pop (Alternate); National Geographic Kids (candidate, needs vetting).

KEY TERMS

globe

A round model of the earth. It shows the true shapes of the lands and oceans better than a flat map.

relay

A race in which team members take turns, one after another, to finish the job together.

trivia

Short questions with quick answers, used in a game.

hemisphere

Half of the earth. The equator divides it into the Northern and Southern Hemispheres.

CORE IDEAS

The story. On December 7, 1972, three American astronauts, Eugene Cernan, Ronald Evans and Harrison Schmitt, blasted off from Florida in *Apollo 17*, bound for the Moon. About five hours later, when they were roughly 18,000 miles from home, one of them looked back through a window and took a picture. The sun was behind the spacecraft, so the whole earth was lit up, round and bright, like a marble floating in the black of space. People named the photograph *The Blue Marble*. It became one of the most famous pictures ever taken. It was the first photograph taken by a person that showed the whole round earth fully lit, just as a globe shows it.

The big idea. A **globe** is the earth made small enough to hold. On a flat map, some lands look stretched, but a globe keeps their shapes and sizes true, because the earth itself is round. A globe also shows how everything fits together: the equator wraps all the way

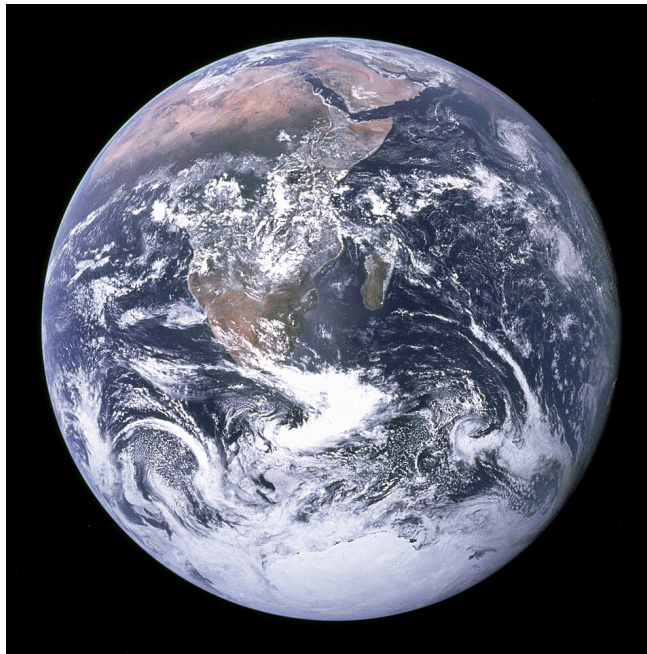
around like a belt, the oceans all connect into one great world ocean, and if you sail far enough east, you come back from the west. In the Blue Marble you can see Africa near the middle, the Arabian Peninsula above it, the island of Madagascar off its east coast, and the white ice of Antarctica at the bottom.

On the map. Today's game is the *Globe Trivia Relay*, and it uses everything you have learned this year. Teams line up at one end of the room with the globe at the other. One runner at a time picks a trivia card, carries it to the globe, finds the answer with a finger and says it out loud. "Which ocean is between Africa and Australia?" Point and say, "The Indian Ocean!" Then the runner goes back and tags the next teammate. Every question is a little trip around the world.



A trip east along the equator, starting at Quito.

PICTURE STUDY



The Blue Marble, The crew of Apollo 17 (NASA), December 7, 1972 · Color photograph taken with a handheld camera from the spacecraft · NASA (photograph AS17-148-22727)

This photograph was taken by the crew of Apollo 17 on their way to the Moon. Because the astronauts were between the sun and the earth, the whole earth was lit, like a full moon. NASA shares the picture freely with everyone.

Look closely

- Find Africa. Which part of the earth is it in: top, middle or bottom?
- Find the long island off Africa's east coast. It is Madagascar.
- Find Antarctica. What color is it, and why?
- Look at the white swirls. They are clouds. Where are there the most clouds?

Talk about it

1. Which ocean do you think fills the right side of the picture, east of Africa?
2. How is this photograph like a globe? How is it different?
3. What would you want to say if you could see the whole earth out of a window?

Safety first. Clear a straight path with nothing to trip on, and set a rule of fast walking, not running, indoors. Keep the globe on a low, steady table so it cannot fall when someone reaches for it.

PROJECT: MAKE A GLOBE TRIVIA RELAY

You will write your own deck of trivia cards from the whole year, then run a relay race in which every answer must be found on the globe.

You will need

- A globe (or a large world map taped to the wall)
- 30 index cards and a pencil
- Two small baskets or bowls for the cards
- A timer
- Paper for keeping score

Steps

1. Write one question on the front of each card and the answer on the back. Write five cards for each kind: continents, oceans, lines (equator, prime meridian, latitude and longitude), rivers and mountains, capitals, and explorers and travelers.
2. Here are some to start: Which continent has no countries? (Antarctica) Which ocean is the biggest? (Pacific) Which river flows north through Egypt? (Nile) Which mountains run down the west side of South America? (Andes) Which line splits the earth into north and south? (Equator) Whose ship *Victoria* went all the way around the world? (Magellan's, brought home by Elcano)
3. Split into two teams. Put the globe at one end of the room and the teams at the other, each with a basket of cards.

4. Set the timer for 10 minutes and say “Go!” The first runner takes a card, walks quickly to the globe, finds the answer and says it aloud while pointing.
5. A grown-up or a judge checks the back of the card. A right answer earns 2 points. A wrong answer earns 0, and the card goes back in the basket.
6. The runner walks back and tags the next teammate, who takes the next card.
7. When the timer rings, add up each team’s points. The team with more points wins.

Tips

- Questions that need pointing are the best ones, like “Point to where the equator crosses Africa.”
- Mix easy and hard cards so younger brothers and sisters can play too.

Check your work

- I wrote at least ten good trivia cards with correct answers.
- I can find continents, oceans and the main lines on a globe quickly.
- I took turns and helped my team fairly.

MAP NOTEBOOK

1. Draw the Blue Marble: a circle with Africa, Arabia, Madagascar and Antarctica, and swirls of cloud.
2. Copy your three favorite trivia questions into your notebook, with their answers.
3. Draw a globe with a belt around its middle and label it “Equator.” Write the three oceans the equator crosses.

From history. Apollo 17 was the last of the Apollo trips to the Moon. Eugene Cernan and Harrison Schmitt spent about three days on the Moon’s surface, while Ronald Evans circled overhead in the command ship. Harrison Schmitt was a geologist, a scientist who studies rocks, and the only scientist to walk on the Moon in the Apollo program.

WORKED EXAMPLES

Example 1. A trivia card says: “Start at Quito, Ecuador, which sits almost on the equator. Travel east along the equator all the way around the world. Name the oceans you cross, in order.”

(Use the map or drawing “Follow the equator east from Quito.” shown earlier in this lesson.)

1. Put your finger on Quito, in the Andes of South America, and move east (to the right) along the equator.
2. You cross the rest of South America, then wide open water: the Atlantic Ocean.
3. You reach Africa and cross it, then more water east of Africa: the Indian Ocean.
4. You pass over the islands of Indonesia, then the biggest water of all: the Pacific Ocean.
5. Keep going and you come back to South America and Quito.

Answer: The Atlantic Ocean, the Indian Ocean and the Pacific Ocean.

PRACTICE

1. **EASY** Which line divides the earth into the Northern Hemisphere and the Southern Hemisphere?
2. **EASY** Which is the biggest ocean on the globe?
3. **MEDIUM** In the relay, each right answer is worth 2 points. Your team gets 7 right answers. What is your score?
4. **MEDIUM** In the Blue Marble photograph, which continent is near the middle of the picture, and which white, icy continent is at the bottom?
5. **HARD** Team A got 6 right answers. Team B got 8 right answers. Each right answer is worth 2 points. What is each team’s score, and which team wins by how many points?

COMMON MISTAKES

- Thinking the oceans are separate pools. On a globe you can see that they all connect into one great world ocean.
- Spinning the globe the wrong way. The earth turns from west to east, so the sun rises in the east.
- Answering without pointing. In this game an answer counts only when you find it on the globe.

Make it a game · Spin and Name. One player spins the globe and stops it with a finger. Everyone races to name what is under the finger: the ocean, or the continent and, for a bonus point, the country. Then name the nearest line: the equator, the prime meridian or a line of latitude. The fastest correct answer wins the point, and the winner spins next. Play to ten points.

Scripture. “And God called the dry land Earth; and the gathering together of the waters called he Seas: and God saw that it was good.” (Genesis 1:10, KJV)

The Blue Marble shows exactly what this verse names: the dry land and the gathered waters, side by side on one round world that God called good.

Practice answers

1. The equator.
2. The Pacific Ocean.
3. 14 points ($7 \times 2 = 14$).
4. Africa is near the middle; Antarctica is at the bottom.
5. Team A: $6 \times 2 = 12$ points. Team B: $8 \times 2 = 16$ points. Team B wins by 4 points ($16 - 12 = 4$).

UNIT 9 REVIEW

Answer each question. Use the world grid, a globe or a map when a question asks you to. Show your work for the number questions. The review is worth 40 points.

1. (5 pts) In Latitude Battleship, which number do you call first, the latitude or the longitude? Call out the crossing where the line 30° N meets the line 60° W, the right way.
2. (5 pts) Using a globe or the Battleship board, say whether each crossing is on land or in an ocean: (a) 0°, 0° (b) 30° N, 120° E. If it is in an ocean, name the ocean.
3. (5 pts) Name the capital of each country: (a) the United States (b) Japan (c) Egypt (d) Brazil (e) Australia.
4. (5 pts) Put these capitals in order from north to south: Lima (12° S), London (51° N), Nairobi (1° S), Cairo (30° N).
5. (10 pts) Draw the world from memory in 15 minutes. Show the seven continents, the five oceans, the equator and the prime meridian, and label as many as you can. Then score your own map out of 14 with the Map Lab checklist. If your September map scored 6, how many points did you grow?
6. (10 pts) (a) Start at Quito and travel east along the equator. Name the three oceans you cross, in order. (b) In a relay, each right answer is worth 2 points. Team A got 9 right and Team B got 7 right. What is each team's score, and who wins by how much?

UNIT PROJECT: MY MAP LAB GAME BOX

Gather everything you made in Map Lab into one box or large envelope decorated like a globe: your Latitude Battleship board with its ships, your deck of 25 capital city cards, your September and May memory maps with their scores, and your trivia relay cards. Add a short page of rules for each game, written so a friend could play without you. Then teach one of the games to a family member or friend and write two sentences about how it went.

- **Accuracy:** Grid lines, coordinates, capitals and trivia answers are correct and clearly labeled.
- **Growth:** Both memory maps are dated and scored honestly, and the student explains how the May map improved.
- **Clear rules:** The written rules for each game are complete and easy for someone else to follow.
- **Care:** The game pieces, cards and maps are neat, colorful and kept together in good order.

Answer key

1. Latitude first. "30 degrees north, 60 degrees west."
2. (a) Ocean: the Atlantic Ocean, in the Gulf of Guinea south of western Africa. (b) Land: China, in Asia.
3. (a) Washington, D.C. (b) Tokyo (c) Cairo (d) Brasília (e) Canberra. One point each.

4. London, Cairo, Nairobi, Lima.
5. Grade the drawing for continents in about the right places and labeled (7), oceans labeled (5), and both lines (2). Growth = this score minus 6; for example, a score of 12 means $12 - 6 = 6$ points of growth. Give up to 10 points for an honest, careful map and correct subtraction.
6. (a) The Atlantic Ocean, the Indian Ocean, the Pacific Ocean. (b) Team A: $9 \times 2 = 18$ points. Team B: $7 \times 2 = 14$ points. Team A wins by 4 points.