

SCHOOL LAUNCH • GEOGRAPHY K-12

GRADE 4 GEOGRAPHY: THE UNITED STATES: REGIONS, RIVERS AND ROUTES

A year of true stories about the land and waters of the United States, from the township grid of 1785 and the mill towns of New England to the Erie Canal, Fulton's steamboat, the golden spike at Promontory Summit and John Wesley Powell's boats on the Colorado, each region walked through on the map and each great route taken apart to see how Americans overcame distance, then built in miniature at the kitchen table.

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

Fourth grade is the traditional year for American geography, and this course gives it a full school year. The student learns to read a map the way a surveyor does, with scale, grids and the township lines of the Land Ordinance of 1785, and then travels the country region by region: the rocky farms and fishing harbors of New England, the great ports of the Mid-Atlantic, the fall line and coastal plain of the Southeast, the Great Lakes and the Corn Belt, the Great Plains and the sod house, the Rocky Mountains and the Continental Divide, the desert Southwest, the Pacific Coast, Alaska and Hawaii. In the middle of the year the student turns to home and makes a careful study of his or her own state, ending with a written report and a salt-dough relief map.

Every lesson follows the same path. First comes **the story**: a real person, place and date, such as DeWitt Clinton's canal, Robert Fulton's *Clermont* on the Hudson in 1807, the little engine *Tom Thumb* racing a horse, or Ferdinand Hayden's survey of Yellowstone. Then **the map**: where it happened, what the land and water were like, and why that mattered. Then **the big idea** underneath, explained for a fourth grader: scale, the fall line, a watershed, a divide, a lock, a time zone, a natural resource. Last, the student does it with his or her hands, in a model, a measured drawing or a page of the map notebook.

A thread runs through the whole series: **technology overcoming geography**. In 1800 the regions of the United States were nearly separate countries, cut apart by mountains and long miles of bad road. Units 6 and 7 tell how the canal, the steamboat and the railroad tied them into one connected market: the Erie Canal opened in 1825, steamboats crowded the Mississippi, and in 1869 the Central Pacific and Union Pacific met at Promontory Summit. The student builds a working canal lock, follows the river pilots, and learns why the railroads set the nation's clocks in 1883.

The course teaches geography as the study of a good land made by God and given to people to work and keep. 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;" This year's verse is Psalm 65:9: "Thou visitest the earth, and waterest it: thou greatly enrichest it." The year closes with the national parks, the explorers who first mapped them, a map of where the country's coal, iron, oil, timber and grain come from, and a lesson on stewardship: the Lord put the man in the garden "to dress it and to keep it" (Genesis 2:15).

WHO IT IS FOR

Written for students in grade 4 (about ages 9-10) who read on their own, can measure with a ruler to the nearest quarter inch, and are learning to multiply. A parent or teacher reads along, helps with measuring and building, and talks through the map questions. Nothing needs to be bought beyond ordinary household items: a graph-paper notebook, a ruler, colored pencils, a United States map or atlas, and things from the recycling bin and the kitchen.

HOW TO USE THIS COURSE

The weekly rhythm. The year has 32 lessons, one a week, in eight units of four, plus an optional bonus unit, the **Map Lab**, with four lessons of map games and puzzles. Session 1 (about 45 minutes) is the warm-up, the story, the video and the picture study. Session 2 (about 45 minutes) is the worked examples, the practice, the project and the map notebook. The state study in Unit 5 may stretch over a month while the report and relief map are finished.

The quarter path and the technology thread. Ten lessons are marked ★. Together they make a one-quarter version of the course for families who want a shorter study: map scale, one lesson from each region, the state study, the Erie Canal and its locks, the transcontinental railroad, Yellowstone and the resource map. Lessons marked ⚙ carry the technology thread, showing how the windmill, the canal, the steamboat and the railroad helped people overcome the land.

The map notebook. Use one graph-paper composition book for the whole year. Every unit adds at least one map drawn by the student: a scale map of the yard, the fall-line cities, the Great Lakes and the farm belts, the western rivers, the student's own state, the Erie Canal from Albany to Buffalo, the transcontinental line and the time zones, and a natural resources map. Give every map a title, a compass rose, a key and a scale, and date every page.

Worked examples and practice. Each lesson shows two or three problems worked out step by step, such as measuring a distance with a scale bar, finding a town on a letter-number grid, or working out how many hours earlier it is in California. Then the student tries a short set of practice problems alone. Answers are given at the end of each lesson so the parent can check the work quickly, and the common mistakes section names the errors to watch for.

Unit reviews and unit projects. Each unit ends with a short review (50 points) and a unit project that pulls the unit together: the yard map, the fall-line model, the windmill, the mountain cut-away, the state report and relief map, the canal lock, the time-zone clock wall and the resource map. In the last week of a unit, add a third session if needed. Keep the unit projects and the best map notebook pages in one folder for the year.

The School Launch Geography series. This is the fourth year of a K-12 sequence. It builds on the Grade 2 tour of the country and the Grade 3 study of continents and oceans, and it leads into Grade 5, *Explorers, Navigators and Missionaries*. It also pairs well with the School Launch Engineering and Physics course, where locks, windmills and engines are studied as machines, and the Business and Finance course, where the Erie Canal and the railroads are studied as trade and enterprise.

SCOPE AND SEQUENCE

Unit 1: Reading Maps Like a Surveyor (1-4)

Map scale and distance; letter-number grids; physical and political maps of the same state; and the Land Ordinance of 1785, whose township grid can still be seen from an airplane.

Unit 2: The Northeast and the Southeast (5–8)

New England's rocky soil, fishing and mill towns; the great harbors of New York, Philadelphia and Baltimore; the fall line, coastal plain and Chesapeake; and Florida, the Gulf Coast, hurricanes and the port of New Orleans.

Unit 3: The Midwest and the Great Plains (9–12)

The Great Lakes, ore boats and Chicago; the deep soil of the Corn Belt; wheat, cattle and the windmill on the Great Plains; and the homesteaders who built houses of sod.

Unit 4: The West and the Southwest (13–16)

Mining towns and the Continental Divide; canyons, mesas and water carried far in the desert Southwest; gold in California, the Columbia River and Puget Sound; and Alaska and Hawaii.

Unit 5: My State Study (17–20)

The student's own state: its landforms, rivers and climate; where its first towns grew and why; its farms, factories, mines and ports; and a finished state report with a salt-dough relief map.

Unit 6: Canals and Steamboats (21–24)

"Clinton's Ditch" links the Hudson to Lake Erie in 1825; how a lock lifts a boat; Robert Fulton's *Clermont* on the Hudson in 1807; and the steamboat age on the Mississippi.

Unit 7: The Railroad Binds the Nation (25–28)

The Baltimore & Ohio and *Tom Thumb's* race with a horse; the Central Pacific and Union Pacific crews and the Sierra tunnels; standard time in 1883; and the towns, cattle drives and changes the railroad brought.

Unit 8: Wonders and Resources (29–32)

Hayden's survey, Moran's paintings and Yellowstone, the first national park; John Wesley Powell on the Colorado in 1869; where coal, iron, oil, timber and fish come from; and stewardship of a good land.

Unit 9: Bonus: Map Lab (Optional)

Four lessons of map games and puzzles: a states-and-capitals race, drawing the country from memory, planning a road trip by scale in miles and hours, and a national parks passport.

MATERIALS

- **Map notebook (a graph-paper composition book):** One for the whole year: scale maps, region maps, the state study, the canal and railroad maps and the resource map.
- **A wall map or atlas of the United States, and a road map of your own state:** Used in nearly every lesson. A free printable outline map works for drawing; a state

highway map is best for scale and grid practice.

- **A ruler, a tape measure, a piece of string and colored pencils:** For measuring distances on maps, pacing out the yard and coloring maps with a key.
- **Salt dough (flour, salt and water) and a piece of cardboard:** For the state relief map in Unit 5 and the mountain cut-away in Unit 4.
- **Clean milk cartons or plastic bottles, waterproof tape, a craft knife (parent use) and a tray or sink:** For the fall-line mill wheel in Unit 2 and the model canal lock in Unit 6.
- **Paper, a pencil with an eraser, a pin, a straw, string and a few paper clips:** For the paper windmill that lifts a weight in Unit 3.
- **Paper plates and a brad fastener for each clock:** For the time-zone clock wall in Unit 7.
- **Small samples for the resource map: a lump of charcoal or coal, a steel nail, wood, cotton balls and wheat or other grain:** For the resource map in Unit 8. Pictures cut from magazines work for anything you cannot find.
- **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 measuring, drawing and building. A model that did not work the first time but is honestly tested, explained and improved earns full credit.

- Projects (effort, careful measuring and the improve-it step): 30%
- Map notebook (dated pages, title, compass rose, key and scale): 25%
- Unit reviews: 20%
- Unit projects: 25%

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 measure carefully, label clearly, explain what the map shows and suggest an improvement?
- A map notebook page earns full marks when it has a date, a title, a compass rose, a key, a scale 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. Map questions can be answered by pointing.
- The state report and relief map in Unit 5 count as that unit's project. Keep every unit project in one folder; together they make a fine record of the year.

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 map, watch the video, and then be the student's helper in the project. Ask

“Where is it?”, “Why there and not somewhere else?” and “How did people get there?” Those three questions are most of what a good geography teacher does.

The course tells American history honestly. The canals and railroads were great achievements, built by hard and often dangerous labor, and they changed the lives of the farmers, Native nations and settlers who lived along them. The lessons tell what happened, why the land made it happen that way and what it cost, as settled history and without taking sides in present-day public debates. Weather and climate are taught as physical geography: latitude, mountains, oceans and winds.

Above all, the course hopes to raise a young person who knows and loves his or her own country and state, reads a map with confidence, admires the people who overcame rivers and mountains, and cares well for the land God has given. Take the course outdoors whenever you can: walk the yard with a tape measure, find the nearest river and ask where it goes, and keep a road map in the car.

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Unit 1: Reading Maps Like a Surveyor

- 1.1 Map Scale: An Inch for a Mile ★
- 1.2 Grids and Coordinates: Finding Towns by Letter and Number
- 1.3 Physical and Political Maps: One State Shown Two Ways
- 1.4 The Survey of the Land: Townships and Sections

Unit 2: The Northeast and the Southeast

- 2.1 New England: Rocky Soil, Fishing and Mill Towns ★
- 2.2 The Mid-Atlantic: Great Harbors of New York, Philadelphia and Baltimore
- 2.3 The Southeast: The Fall Line, the Coastal Plain and the Chesapeake
- 2.4 Florida and the Gulf Coast: Peninsulas, Hurricanes and New Orleans

Unit 3: The Midwest and the Great Plains

- 3.1 The Great Lakes ★
- 3.2 The Corn Belt
- 3.3 The Great Plains ☼
- 3.4 The Sod House

Unit 4: The West and the Southwest

- 4.1 The Rocky Mountain States ★
- 4.2 The Desert Southwest
- 4.3 The Pacific Coast
- 4.4 Alaska and Hawaii

Unit 5: My State Study

- 5.1 My State's Land and Water ★
- 5.2 My State's History on the Map
- 5.3 My State's Work
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Unit 6: Canals and Steamboats

- 6.1 The Erie Canal ★ ☼
- 6.2 How a Lock Lifts a Boat ★ ☼
- 6.3 Fulton's Steamboat ☼
- 6.4 The Mississippi Steamboat Age ☼

Unit 7: The Railroad Binds the Nation

- 7.1 The First Railroads ☼
- 7.2 Building the Transcontinental Railroad ★ ☼
- 7.3 Time Zones ☼
- 7.4 What the Railroad Changed

Unit 8: Wonders and Resources

- 8.1 Yellowstone, the First National Park ★
- 8.2 John Wesley Powell and the Grand Canyon
- 8.3 Where Things Come From ★
- 8.4 Stewards of a Good Land

Unit 9: Bonus: Map Lab (optional)

9.1 States and Capitals Race

9.2 Draw the U.S. from Memory

9.3 Plan a Road Trip by Scale

9.4 The National Parks Passport

★ quarter path · ⚙ technology overcoming geography

READING MAPS LIKE A SURVEYOR

Before Americans could build canals and railroads across the country, someone had to measure the land. In this unit you will learn to read maps the way a surveyor does. You will ride with sixteen-year-old George Washington over the Blue Ridge in 1748 with a compass and a 66-foot chain. You will camp with Andrew Ellicott and Benjamin Banneker as they mark out the square for the new capital city in 1791. You will stand with Katharine Lee Bates on top of Pikes Peak in 1893, and on the bank of the Ohio River with Thomas Hutchins on the day the great land survey began in 1785.

Along the way you will learn the four tools every map reader needs: the **scale**, which turns inches into miles; the **grid**, which helps you find a town by letter and number; the difference between a **physical map** of the land God made and a **political map** of the lines people drew; and the **township grid**, the checkerboard of square miles you can still see from an airplane window across the Midwest.

At the end of the unit you will become a surveyor yourself. You will measure your own yard and draw it to scale on graph paper, with a north arrow, a scale bar, a key and a grid. God made the earth orderly enough to be measured, and He gave us minds able to measure it. “The lines are fallen unto me in pleasant places; yea, I have a goodly heritage” (Psalm 16:6).

BEFORE YOU BEGIN

- Can measure with a ruler to the nearest half inch
- Can multiply and divide by one-digit numbers and by 10, 20 and 25
- Knows the four cardinal directions (north, south, east, west) on a map
- Can find his or her own state on a map of the United States

MASTERY CHECKLIST

- I can use a map scale to change inches on a map into miles on the land, and back again.
- I can find a town on a map with a letter-number grid and an index.
- I can tell a physical map from a political map and choose the right one for a question.
- I can read an elevation key and compare the heights of two places.
- I can explain townships, sections and acres, and why the Midwest looks like a checkerboard from the air.
- I can measure a real piece of land and draw it to scale with a north arrow, a scale bar and a key.

OPTIONAL BOOKS AND RESOURCES

- **Library of Congress Map Collections** (<https://www.loc.gov/maps/>): Free. Thousands of historic maps you can zoom in on, including early plans of Washington, D.C., and old

state maps. Search for your own state to find a map for Unit 5, too.

- **General Land Office Records, Bureau of Land Management** (<https://glorerecords.blm.gov/>): Free. Search survey plats and original land patents for the thirty public-land states. A parent can help find the township plat for the place where your family lives (Lesson 1.4).
- **USGS topoView** (<https://ngmdb.usgs.gov/topoview/>): Free. Old and new topographic maps from the U.S. Geological Survey for every part of the country. Look for the scale, the grid and the section lines on a map of your area.

1.1 MAP SCALE: AN INCH FOR A MILE ★

OBJECTIVES

- Tell how young George Washington measured land with a compass and a 66-foot chain and drew it smaller on paper.
- Explain what a map scale is and read a scale written in words and as a scale bar.
- Measure the distance between two towns on a state map and change inches into miles.

Warm-up. Lay your hand flat on a sheet of paper and trace around it. Now draw your hand again, but make it fit inside a sticky note. Is the little drawing still your hand? What did you have to keep the same so that it still looked right? (Every finger had to shrink by the same amount.) That is the secret of every map.

Watch. *Types of Maps and Map Scale - Learn How to Read and Use Maps* (Miacademy & MiaPrep Learning Channel, 7:08). https://www.youtube.com/watch?v=u_xHCRrlvQU
After the story of young Washington the surveyor, before the worked examples: watch how a scale bar turns inches on the map into miles on the ground.

Backup video. *Measuring DISTANCE on a Map* (Outlook Adventures Scotland, 2:38). <https://www.youtube.com/watch?v=2Tb3TktJ7E8>

Before the project: a short demonstration of measuring a route with the edge of a piece of paper and the scale bar. Note: The guide is from Scotland and measures in kilometers; the method with the scale bar is exactly the same for miles.

KEY TERMS

surveyor

A person who measures land carefully, its lengths, directions and corners, so it can be drawn on a map and its boundaries known.

Gunter's chain

A surveyor's measuring chain 66 feet long, made of 100 links. Eighty chains make one mile.

plat

A surveyor's drawing of a piece of land, made to scale, showing its boundary lines and corners.

map scale

The rule that tells how much smaller the map is than the real land, such as "1 inch = 1 mile."

scale bar

A small ruler printed on a map that shows how many miles (or feet) one length on the map stands for.

distance

How far it is from one place to another. On a map we measure a straight line and use the scale to find the real distance.

CORE IDEAS

The story. In March 1748 a tall sixteen-year-old named George Washington rode west out of northern Virginia with a surveying party. They were led by an experienced surveyor named James Genn, and with them rode George William Fairfax, a young relative of Lord Fairfax, who owned millions of acres of Virginia land. Their job was to measure Lord Fairfax's lands beyond the Blue Ridge Mountains, in the Shenandoah Valley and along the South Branch of the Potomac River. It rained hard. Rivers ran high. Washington kept a little diary of the trip. One night, he wrote, he lay down in a settler's cabin on a pile of straw with a thin, worn blanket full of lice and fleas, and after that he was glad to sleep outdoors by the fire. Another night the party met a band of Indians coming home from war, who danced for them by firelight. Washington came home with sore bones and a new trade. In the summer of 1749, at seventeen, he became the official surveyor of Culpeper County, and in the next few years he made nearly two hundred surveys.

How they figured it out. A surveyor needed two tools. The first was a **compass**, which told the direction of each boundary line. The second was a **Gunter's chain**, invented by the English mathematician Edmund Gunter about 1620. It was exactly 66 feet long and made of 100 iron links. Two chainmen stretched the chain tight along the ground, stuck a pin at the end, and moved forward again and again while the surveyor counted. Eighty chains make exactly one mile. Washington wrote every direction and every length in his field book. Then, at a table, he drew a **plat**, a small drawing of the land. He let one short length on the paper stand for a certain number of chains on the ground, and he used that same rule for every line. Because every line shrank by the same amount, the shape on the paper matched the shape of the land.

The big idea. Every map is much smaller than the land it shows, and the **scale** tells you how much smaller. Map makers show the scale in three ways. They may write it in **words**: "1 inch = 1 mile." They may draw a **scale bar**, a little striped ruler marked in miles. Or they may write a **ratio**, like the 1:24,000 printed on many United States Geological Survey maps, which means one inch on the map stands for 24,000 inches, or 2,000 feet, on the ground. A map of your yard might use 1 inch = 10 feet. A map of your state might use 1 inch = 25 miles. A map of the whole country might use 1 inch = 200 miles. The idea is always the same: one small length stands for one big length.

On the map. To find how far apart two towns are, lay a ruler from one town's dot to the other's and read the inches. Then multiply by the scale. On an Ohio map where 1 inch = 25 miles, Columbus and Cleveland are 5 inches apart, so they are about $5 \times 25 = 125$ miles apart. If you have no ruler, mark the two dots on the edge of a strip of paper and lay the strip along the scale bar. Remember that this is a straight line, what people call "as the crow flies." The highway between the two cities bends and is longer, about 140 miles. A good surveyor always measures twice.

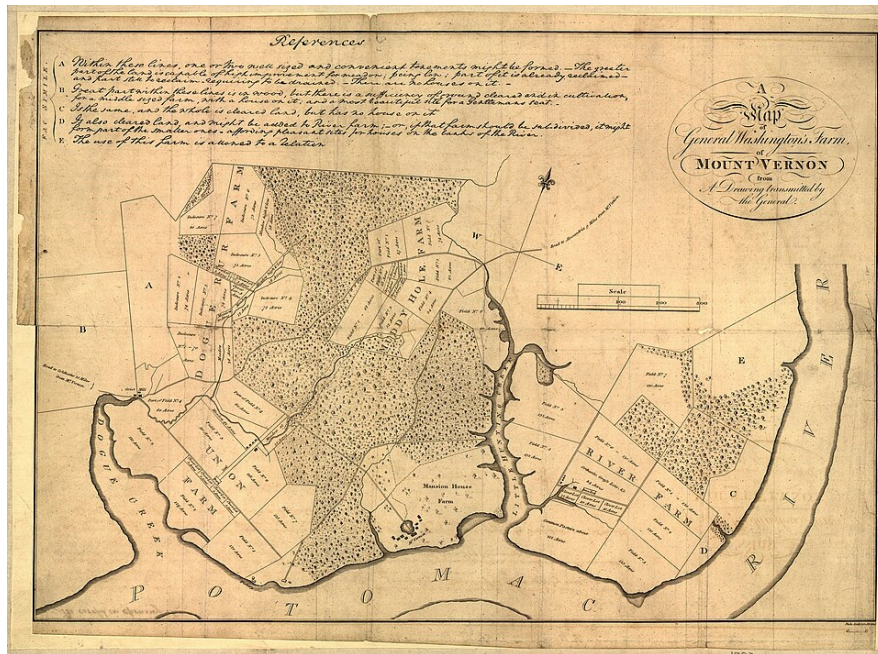
Why it matters. The prophet Isaiah asks who has “comprehended the dust of the earth in a measure, and weighed the mountains in scales.” Only God holds the whole earth in His hand. But He made the world orderly enough that a boy with a chain and a compass could measure a piece of it truly and draw it on a sheet of paper. Every time you measure a map, you are doing what Washington did on the Virginia frontier.



Each section = 1 inch = 100 miles

A scale bar. Each inch on this map stands for 25 miles on the land.

PICTURE STUDY



A Map of General Washington's Farm of Mount Vernon, from a Drawing Transmitted by the General, George Washington (drawing); engraved copy printed in Letters from His Excellency George Washington to Arthur Young (London), 1801 (engraved from Washington's drawing of December 1793) · Engraving on paper, copied from Washington's hand-drawn manuscript map · Library of Congress, Geography and Map Division (Washington's original drawing is at The Huntington Library, San Marino, California)

Forty-five years after his first surveying trip, President George Washington drew a map of his farms with his own hand in December 1793. He was thinking of renting out some of them, so he sent the map to Arthur Young, an English writer on farming, to show farmers in Britain what the land was like. In 1801 Washington's letters to Young were printed in London with this engraved copy of the map. It shows the five farms of his Mount Vernon estate along the Potomac River, with their fields, woods and roads.

The neat lines show a surveyor's skill. They do not show the hard truth that the work on these farms was done by enslaved men and women. A map tells us a great deal, but never everything.

Look closely

- Find the Potomac River. Which edge of the land does it run along?
- Find the lines that divide the fields. Are they all the same size and shape?
- Look for numbers or words written on the land. What might they tell a farmer who had never been there?
- Look for a scale or a compass mark. Why would a surveyor want a reader to have one?

Talk about it

1. How could Washington draw a farm of thousands of acres on one sheet of paper and still keep its shape right?
2. If you were a farmer in England reading this map, what would you want to know that the map does not tell you?

PROJECT: A SURVEYOR'S CHAIN AND A ROOM MAP TO SCALE

You will make a small surveyor's chain of your own, measure a room of your house, and draw it on graph paper so that every square stands for one foot. This is the first step toward the scale map of your yard at the end of the unit.

You will need

- A piece of string or yarn about 12 feet long
- A tape measure or yardstick
- Ten small beads, buttons or bits of colored tape
- Graph paper (quarter-inch squares are good), pencil, eraser and ruler
- A clipboard to use as a field book

Steps

1. Measure 10 feet of string. Tie a knot or a bead at every foot. Wrap a bit of tape around each end. This is your "chain": 10 feet long with 10 "links." (A real Gunter's chain was 66 feet long with 100 links.)
2. Choose a room. In your field book, sketch its shape quickly, not to scale, and number each wall.
3. With a helper as your second chainman, stretch the chain tight along each wall and count. Write each length in feet in your field book, like Washington did. If a wall is 13 feet, it is one chain and 3 links.
4. Measure where the door, windows and one or two big pieces of furniture are, too.
5. Choose your scale: 1 square = 1 foot. Write it at the bottom of your paper.

6. Draw each wall by counting squares. A 12-foot wall is 12 squares long. Draw the door, windows and furniture the same way.
7. Add a title ("My Room, surveyed by ..."), the date and a scale bar showing 0, 5 and 10 feet.

Tips

- Keep the chain tight and straight. A sagging string makes the room look bigger than it is.
- If your room is too big for the paper, change the scale to 1 square = 2 feet and divide every length by 2.

Check your work

- Every wall on my drawing has the right number of squares.
- My map has a title, a written scale and a scale bar.
- I can tell someone how long a wall is just by counting squares.

MAP NOTEBOOK

1. Draw a Gunter's chain stretched between two chainmen. Label it "66 feet, 100 links, 80 chains = 1 mile."
2. Draw a scale bar for a map where 1 inch = 10 miles. Mark 0, 10, 20 and 30 miles.
3. Trace the outline of your state from an atlas. Copy the map's scale bar under it and write the scale in words.

From history. Washington never stopped thinking like a surveyor. The money he earned measuring land as a teenager helped him buy land of his own in the Shenandoah Valley, and the western country he walked with his chain was the same country where he served as a young officer a few years later. Surveying was one of the most useful trades in colonial America: Thomas Jefferson's father, Peter Jefferson, was a surveyor who helped draw a well-known map of Virginia, and Abraham Lincoln also worked as a surveyor as a young man in Illinois.

WORKED EXAMPLES

Example 1. On an Ohio map, the scale is 1 inch = 25 miles. With a ruler, Columbus and Cleveland are 5 inches apart. About how far apart are the two cities in a straight line?



Ohio's largest cities. On a map at 1 inch = 25 miles, Columbus to Cleveland measures 5 inches.

1. Read the scale: each inch on the map stands for 25 miles.
2. Count the inches between the two dots: 5 inches.
3. Multiply: $5 \times 25 = 125$.
4. Check with the scale bar: 4 inches is 100 miles, and one more inch adds 25 more, so 125 miles.

Answer: About 125 miles as the crow flies. (The highway is longer, about 140 miles, because roads bend.)

Example 2. Mia is drawing her yard on graph paper with the scale 1 square = 2 feet. Her garden is 7 squares long on the paper. How long is the real garden? Her fence is 30 feet long. How many squares long should she draw it?

1. Map to land: each square stands for 2 feet, so 7 squares stand for $7 \times 2 = 14$ feet.
2. Land to map: go the other way and divide. $30 \text{ feet} \div 2 \text{ feet per square} = 15$ squares.
3. Check: $15 \text{ squares} \times 2 \text{ feet} = 30 \text{ feet}$. Correct.

Answer: The garden is 14 feet long. The fence should be drawn 15 squares long.

PRACTICE

1. **EASY** A map's scale is 1 inch = 10 miles. Two towns are 3 inches apart on the map. How far apart are they really?
2. **EASY** On the Ohio map (1 inch = 25 miles), Cincinnati and Columbus are 4 inches apart. About how far apart are they?
(Use the map or drawing "Ohio's largest cities." shown earlier in this lesson.)
3. **MEDIUM** On a Virginia map, the scale is 1 inch = 20 miles. Richmond and Washington, D.C., are 5 inches apart. About how far apart are they?
4. **MEDIUM** Two towns are really 60 miles apart. How many inches apart should you draw them on a map with the scale 1 inch = 20 miles?
5. **MEDIUM** Washington's chainmen stretched the 66-foot chain 4 times along a fence line. How long was the fence?
6. **HARD** On a map where 1 inch = 20 miles, two lakes are $2\frac{1}{2}$ inches apart. How far apart are they?
7. **HARD** On the map, Columbus to Cleveland is about 125 miles. A family drives it on the highway and their car shows about 140 miles. Write one or two sentences explaining why the numbers are different.
8. **CHALLENGE** A Gunter's chain is 66 feet long, and 80 chains make a mile. Show that 80 chains really are 5,280 feet.

COMMON MISTAKES

- Forgetting to multiply. The inches on the map are not miles; you must use the scale to change map inches into real miles.
- Using the scale from a different map. Every map has its own scale, so always read the scale on the map you are measuring.
- Thinking the straight-line distance is the driving distance. Roads bend, so a trip by road is almost always longer than the map's straight line.

Make it a game • Scale Hop. Lay a row of paper plates or sticky notes on the floor, each one step apart. Say: "Each plate is 25 miles." A parent names a trip, such as "Columbus to Cincinnati, 100 miles." The player must hop the right number of plates (4) and shout the math: "4 times 25 is 100!" Then change the scale to 10 miles or 20 miles a plate and play again. A correct hop and correct math scores a point.

Scripture. "Who hath measured the waters in the hollow of his hand, and meted out heaven with the span, and comprehended the dust of the earth in a measure, and weighed the mountains in scales, and the hills in a balance?" (Isaiah 40:12, KJV)

A span is the width of a stretched-out hand. To God the whole sky is only a hand's width. When we measure land with chains and rulers, we are measuring a world He has already measured perfectly.

1. $3 \times 10 = 30$ miles.
2. $4 \times 25 = 100$ miles, about 100 miles as the crow flies.
3. $5 \times 20 = 100$ miles, about 100 miles in a straight line.
4. $60 \div 20 = 3$ inches.
5. $4 \times 66 = 264$ feet.
6. 2 inches = 40 miles, and $\frac{1}{2}$ inch = 10 miles, so $40 + 10 = 50$ miles.
7. The map measures a straight line, "as the crow flies." The highway curves around hills, towns and rivers, so the road is longer than the straight line.
8. $80 \times 66 = 80 \times 60 + 80 \times 6 = 4,800 + 480 = 5,280$ feet, which is exactly one mile.

1.2 GRIDS AND COORDINATES: FINDING TOWNS BY LETTER AND NUMBER

OBJECTIVES

- Tell how Andrew Ellicott and Benjamin Banneker surveyed the ten-mile square for the new capital and how its streets were named by letters and numbers.
- Find a town on a map using a letter-number grid and a map index.
- Name the grid square of a place and give directions from one square to another.

Warm-up. Take an egg carton (or draw a grid with four rows and four columns). Write A, B, C ... across the top and 1, 2 ... down the side. While you look away, a parent hides a raisin or button in one cup. Ask questions like “Is it in column B?” or “Is it in row 2?” How few questions do you need to name its exact cup?

Watch. *Map Skills 4: Simple Grid - Learn How To Use Grid Maps* (Miacademy & MiaPrep Learning Channel, 6:29). <https://www.youtube.com/watch?v=xR0Tq8Rkg6c>
Before the worked examples: practice finding a square by its letter and number, the way the map index does.

Backup video. *The President's Collection of Art: Pierre L'Enfant* (William & Mary School of Business, 3:04). https://www.youtube.com/watch?v=RNR1hyS_cew
With the story of Pierre L'Enfant: a sculptor explains his statue of L'Enfant on Jenkins Hill (today's Capitol Hill) in March 1791, with dividers in hand and his plan on his knee.

KEY TERMS

grid

A pattern of straight lines that cross to make rows and columns of squares on a map.

column

A line of grid squares running up and down the map. On most maps the columns are named with letters.

row

A line of grid squares running across the map. On most maps the rows are named with numbers.

grid reference

The letter and number that name one square of a grid, such as D3.

map index

An alphabetical list of the places on a map, each with its grid reference, so you can find it quickly.

quadrant

One of four parts made when a place is divided by two crossing lines, such as the NW, NE, SW and SE parts of Washington, D.C.

CORE IDEAS

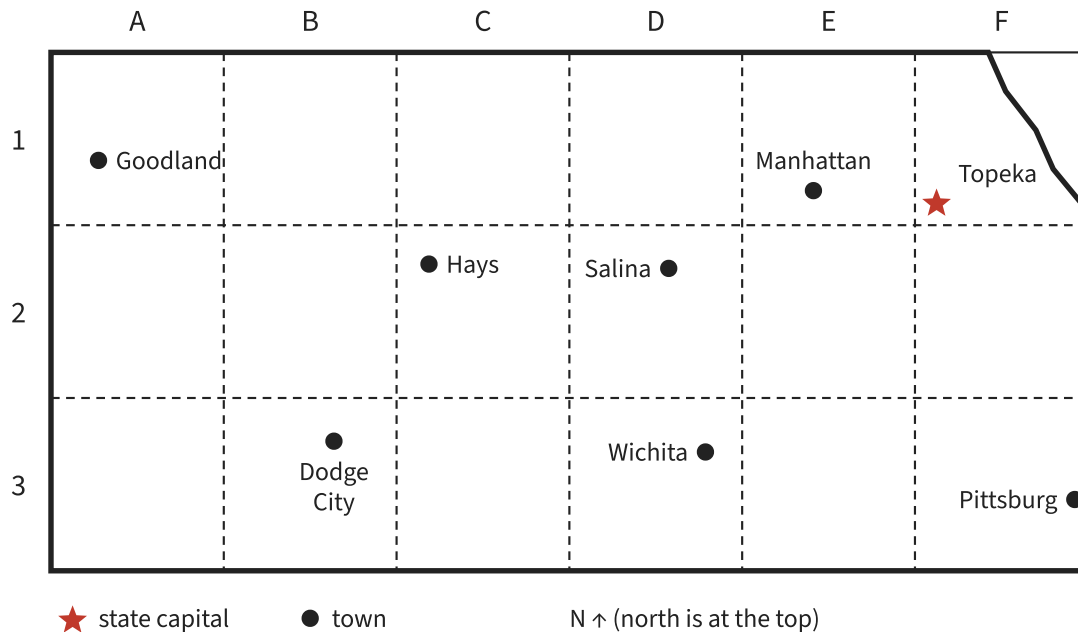
The story. In the winter of 1791 President George Washington, the old surveyor, picked a spot on the Potomac River for the nation's new capital city. He asked Andrew Ellicott, one of the finest surveyors in America, to mark out a square of land ten miles on each side. To help him, Ellicott brought Benjamin Banneker, a free Black farmer from Maryland who had taught himself mathematics and astronomy. Banneker was fifty-nine years old. Night after night in the survey camp, he watched the stars through the instruments and kept the big astronomical clock running, so that the surveyors could fix their lines exactly. On April 15, 1791, the first boundary stone was set at Jones Point, on the Potomac at the southern corner of the square. Then the crews cut a path through forests and fields, and at every mile they set a carved stone. Forty stones marked the square, and many of them still stand today.

How it worked. Inside the square, the planner Pierre Charles L'Enfant laid out a city of wide avenues, and Ellicott finished and printed the plan in 1792. The streets formed a grid. Streets running north and south were given **numbers**: 1st Street, 2nd Street, 3rd Street, counting outward from the Capitol. Streets running east and west were given **letters**: A, B, C, D and so on. The city was also divided into four **quadrants** around the Capitol: Northwest, Northeast, Southwest and Southeast. So if someone tells you to meet at the corner of 4th Street and E Street NW, you know where to go without any other directions. (Look for J Street, and you will not find one. The usual explanation is that in the handwriting of the time, I and J looked almost alike.)

The big idea. Map makers use the same trick to help us find places. They draw a **grid** of lines over a map. The **columns** running up and down get letters across the top, and the **rows** running across get numbers down the side. Every square then has a name, its **grid reference**, like D3. At the back of a road atlas or the side of a city map is a **map index**, an alphabetical list of towns with their squares. A chessboard works the same way: its squares are named from a1 to h8. To find a square, first slide down the column with the right letter, then across the row with the right number, and stop where they meet.

On the map. Look at the grid map of Kansas. The index says Wichita is in D3. Put one finger on the letter D at the top and slide straight down. Put another finger on the number 3 at the side and slide across. Where your fingers meet is the square, and Wichita is inside it. Notice that a grid square is an *area*, not a single point. Each square on this map covers about 70 miles from north to south, with room for several towns. A grid reference tells you which box to search; your eyes do the rest.

Why it matters. Order makes things easy to find. A good grid on a map, like a good plan for a city, is a way of loving your neighbor: it lets a stranger, a mail carrier or a fire truck find the way quickly. The surveyors of 1791 were building the plan for a capital that did not exist yet, and they built it so well that people still find their way by its letters and numbers today.



Kansas with a letter-number grid. Topeka, the capital, is marked with a star.

PICTURE STUDY



Plan of the City of Washington in the Territory of Columbia, Andrew Ellicott, after the plan of Pierre Charles L'Enfant; engraved by Thackara and Vallance, Philadelphia, 1792 · Engraving on paper · Library of Congress, Geography and Map Division, Washington, D.C.

This is one of the first printed plans of Washington, D.C. Andrew Ellicott, the surveyor who marked the ten-mile square, redrew L'Enfant's design and had it engraved in Philadelphia in 1792. When it was printed, most of the land was still farms and woods. The plan showed people what the city was meant to become.

Look closely and you will see two patterns laid on top of each other: a grid of straight streets running north-south and east-west, and long avenues cutting across them on the diagonal, like the spokes of a wheel.

Look closely

- Find the Capitol and the President's House. Which long avenue joins them?
- Find the two rivers, the Potomac and the Eastern Branch (now called the Anacostia). Where do they meet?
- Trace one straight street with your finger. Does it run north-south or east-west?
- Find a place where several avenues meet in a circle or square. Why might a planner do that?

Talk about it

1. Why would it be easier to find an address in a city whose streets are named by letters and numbers?
2. This plan showed a city that was not built yet. What would you need to plan a whole city before anyone lived there?

PROJECT: A GRID AND INDEX FOR MY TOWN

You will put a letter-number grid on a map of your own town or neighborhood and make an index, just like the ones in a road atlas. Then a family member will test your index by finding places with it.

You will need

- A printed map of your town or neighborhood (from a free online map, a visitor's center or a phone book), or one you draw yourself
- A ruler and a sharp pencil
- A fine-tip marker
- Index cards or a sheet of lined paper

Steps

1. Lay your map flat. With the ruler, draw lines across it every 1 inch from top to bottom, and every 1 inch from side to side. Go over them lightly in marker.
2. Write the letters A, B, C ... above each column across the top, and the numbers 1, 2, 3 ... beside each row down the left side.
3. Choose ten places that matter to you: your home, church, library, a park, the post office, a grocery store, a friend's house, a school, a fire station and one more.
4. Find each place on the map and write its grid reference, such as C4.
5. Write your index in alphabetical order: "Fire station ... B2," "Library ... D5," and so on.
6. Test it: read a place from your index to a parent or sibling and time how fast they can find it on the map using only the grid.

Tips

- Measure from the same edge every time, so that your lines stay straight and the squares stay square.
- If a place sits right on a grid line, choose the square that holds most of it, as real map makers do.

Check your work

- My grid squares are even, and every column and row is labeled.
- My index is in alphabetical order, and every grid reference is correct.
- Someone else can find a place on my map using only my index.

MAP NOTEBOOK

1. Draw a 4 by 4 grid. Label the columns A to D and the rows 1 to 4. Draw a tree in B3, a house in D1, a pond in A4 and a church in C2.
2. Draw a small plan of four city blocks with two numbered streets running north-south and two lettered streets running east-west. Put an X at the corner of 2nd Street and C Street.
3. Draw one of the carved boundary stones of the District of Columbia and write a sentence about Benjamin Banneker.

From history. In 1791, the same year he helped survey the capital, Benjamin Banneker finished the calculations for an almanac, a yearly book of sunrises, moon phases, tides and weather. He sent a handwritten copy to Secretary of State Thomas Jefferson with a long letter asking him to consider that Black Americans had the same gifts of mind as anyone else, and Jefferson wrote back. Banneker's almanacs were printed for several years beginning with 1792 and sold widely. Long before, as a young man, he had carved a working wooden clock by studying how a pocket watch was made.

WORKED EXAMPLES

Example 1. The map index says Wichita is in D3. Find Wichita on the Kansas grid map.

(Use the map or drawing "Find Wichita in square D3." shown earlier in this lesson.)

1. Find the letter D across the top. Slide your finger straight down that column.
2. Find the number 3 down the left side. Slide another finger straight across that row.
3. Where your fingers meet is square D3, in the south-central part of the state.
4. Look inside the square: the dot labeled Wichita is there.

Answer: Wichita is in square D3, in south-central Kansas.

Example 2. You are in Hays, in square C2. You want to drive to the town in the next square east, in the same row. What is the grid reference of that square, and what town is there?

1. East is to the right on this map, because north is at the top.
2. The next column to the right of C is D. You stay in the same row, 2.
3. So the square is D2. Look inside it: the town there is Salina.

Answer: Square D2. The town is Salina.

PRACTICE

1. **EASY** On the Kansas grid map, in which square is Topeka, the capital?
(Use the map or drawing “Kansas with a letter-number grid.” shown earlier in this lesson.)
2. **EASY** Which town on the Kansas grid map is in square A1?
3. **EASY** In which square is Dodge City?
4. **MEDIUM** Name the three towns in row 1 on the Kansas grid map, from west to east.
5. **MEDIUM** You travel from Hays (C2) to Wichita (D3). In which direction are you going: northeast, northwest, southeast or southwest?
6. **MEDIUM** In Washington, D.C., does 4th Street run north-south or east-west? Does E Street run north-south or east-west?
7. **HARD** Kansas is about 210 miles from its north border to its south border, and the grid map has 3 rows. About how many miles from north to south does each row cover?
8. **CHALLENGE** Your friend says, “Wichita is at D3, so it must be right in the middle of square D3.” Write two sentences telling why that is not always true.

COMMON MISTAKES

- Reading the number first and the letter second. Most maps name the column letter first, then the row number: D3, not 3D.
- Sliding along the wrong line. Go straight down from the letter and straight across from the number, or you will land in the wrong square.
- Thinking a grid reference marks one exact spot. It names a whole square; you still have to look inside it.

Make it a game • Grid Battleship. Each player draws a 5 by 5 grid (A to E across, 1 to 5 down) and secretly marks five “towns” in five squares. Take turns calling out grid references, like “C4!” The other player answers “Town!” or “Empty prairie!” Keep track of your guesses on a second grid. The first player to find all five of the other player’s towns wins. Bonus point: name a real Kansas town in that square on the lesson map.

Scripture. “Where wast thou when I laid the foundations of the earth? declare, if thou hast understanding. Who hath laid the measures thereof, if thou knowest? or who hath

stretched the line upon it?" (Job 38:4-5, KJV)

Surveyors stretch lines across the land and lay out cities in neat squares. God reminds Job that He measured and laid out the whole earth before any surveyor was born. Our grids are small copies of His order.

Practice answers

1. F1.
2. Goodland.
3. B3.
4. Goodland (A1), Manhattan (E1) and Topeka (F1).
5. Southeast. Wichita is one column to the east and one row to the south.
6. 4th Street (a numbered street) runs north-south. E Street (a lettered street) runs east-west.
7. $210 \div 3 = 70$, so each row covers about 70 miles.
8. A grid square is an area, not a single point, so a town can be anywhere inside it: near a corner, an edge or the middle. The grid reference only tells you which box to look in; then you must search inside the square.

1.3 PHYSICAL AND POLITICAL MAPS: ONE STATE SHOWN TWO WAYS

OBJECTIVES

- Tell the story of Katharine Lee Bates on Pikes Peak in 1893 and what she saw of Colorado's land.
- Explain the difference between a physical map (the land God made) and a political map (the lines and places people made).
- Choose the right kind of map to answer a question and read an elevation key.

Warm-up. Look out a window for one minute. Make two lists. In the first, write things that were there before any people came (hills, a creek, trees, the sky). In the second, write things people made or named (a road, a fence, a house, a street sign). The first list is the stuff of a physical map. The second is the stuff of a political map.

Watch. *Map Skills: Political and Physical Maps* (Teaching Independent Learners, 4:02).

<https://www.youtube.com/watch?v=1WmoMQdUGGM>

After the big idea: a teacher compares a political map and a physical map, then compare them with the two maps in the lesson.

Backup video. *Map Skills 3: Landforms With Map Key - Learn How to Read Maps*

(Miacademy & MiaPrep Learning Channel, 7:21). <https://www.youtube.com/watch?v=DYaWXkEwDRs>

Before the project: how a map key shows mountains, rivers, lakes and other landforms.

KEY TERMS

physical map

A map that shows the land and water God made: mountains, plains, valleys, rivers and lakes, often with colors for height.

political map

A map that shows the lines and places people have made: borders, states, counties, capitals and cities.

elevation

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

border

A line that shows where one state, county or country ends and the next one begins.

map key

The box on a map (also called a legend) that tells what each color and symbol means.

capital

The city where a state's or country's government meets. It is often marked with a star.

CORE IDEAS

The story. In the summer of 1893 an English teacher from Wellesley College in Massachusetts, Katharine Lee Bates, came west to teach a summer class at Colorado College, in Colorado Springs. Before she went home, she and a group of teachers rode up Pikes Peak, partway by wagon and the last part by mule, to the top, more than 14,000 feet high. From the summit she looked out on a sight she never forgot. To the west rose range after range of the Rocky Mountains. To the east the Great Plains stretched away, flat and wide, farther than her eyes could follow. That day she began writing a poem. It was printed in 1895, and set to music it became “America the Beautiful,” with its “amber waves of grain” and “purple mountain majesties.”

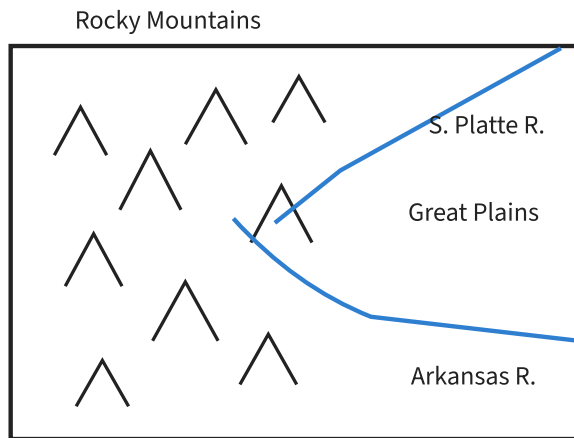
How they figured it out. What Bates saw from the top was Colorado’s **physical geography**: the shape of its land and water. Map makers had been working hard to draw it. In the 1870s a government survey led by Ferdinand Hayden climbed Colorado’s peaks with measuring instruments and in 1877 published a great atlas of the territory, showing every mountain range, valley and river. But Colorado also had a different kind of shape, one drawn by people. In 1861 Congress made Colorado a territory with four straight borders, and on August 1, 1876, it became a state. Those borders do not follow any river or ridge. They follow lines on a map.

The big idea. A **physical map** shows what God made: mountains, plains, valleys, rivers and lakes. It often uses colors for **elevation**, from green for low land to tan and brown for high land. Green on a physical map does not mean grass; it means low. A **political map** shows what people made and named: **borders**, states, counties, **capitals** and cities. Both maps can show the very same state. On a physical map of Colorado, you see the Rocky Mountains filling the west and the Great Plains in the east, with the Arkansas and South Platte Rivers running out of the mountains. On a political map of Colorado, you see a rectangle, the capital, Denver, marked with a star, cities like Colorado Springs and Pueblo, and the seven states that touch it (Arizona touches only at a single corner).

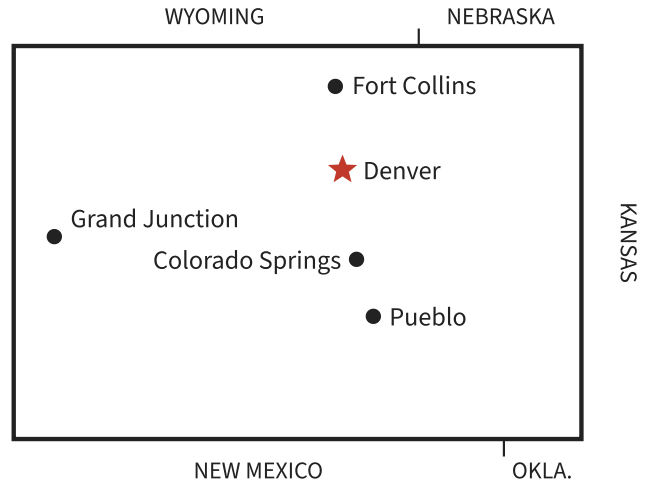
On the map. Always read the **map key** first, because it tells you what kind of map you are holding. Then choose the map that fits your question. Where do the rivers begin? Use a physical map. What is the capital, and which states are next door? Use a political map. Why did a city grow where it did? Often you need both. Denver grew where the South Platte River leaves the mountains and meets the plains, a meeting place of two kinds of land. Denver is called the Mile High City, and one step of the Colorado State Capitol is marked as one mile above sea level.

The land and the lines. Mountains and rivers were set in place by the Creator long before any border was drawn. Borders are drawn by people, and they can change. Yet Scripture says that God also determines “the bounds of their habitation” for the nations. A wise map reader learns to see both: the land itself, and the lines that people, under God’s providence, have drawn upon it.

Physical map



Political map

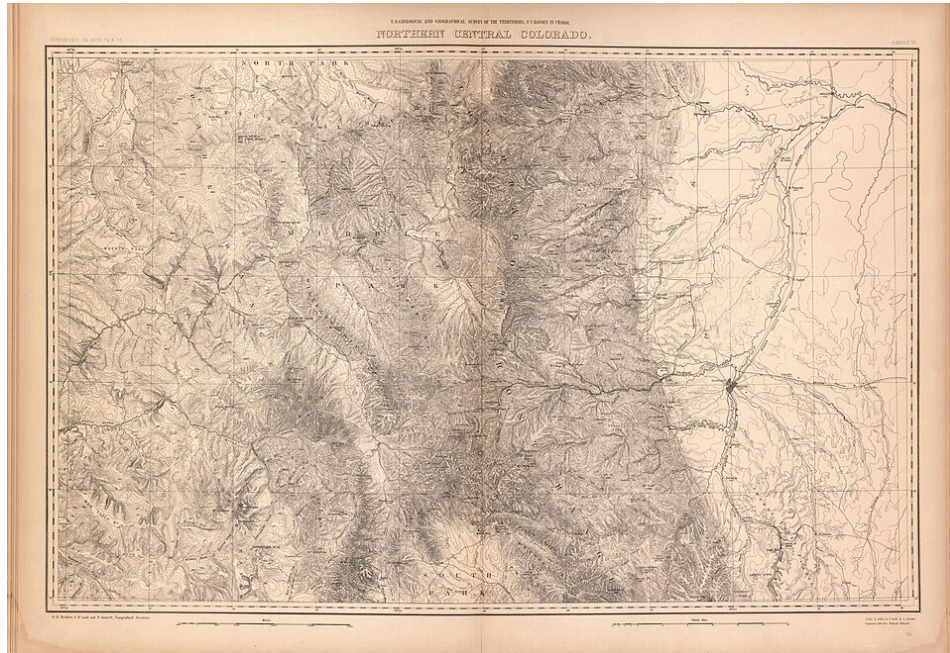


Colorado shown two ways: a physical map (left) and a political map (right).



Colorado: mountains in the west, plains in the east.

PICTURE STUDY



Geological and Geographical Atlas of Colorado and Portions of Adjacent Territory, U.S. Geological and Geographical Survey of the Territories, under Ferdinand V. Hayden, 1877 · Atlas of printed maps and panoramic drawings (lithographs, many hand-colored by printing in several colors) · Library of Congress, Geography and Map Division (and other map libraries)

Ferdinand Hayden led one of the great government surveys of the American West. His men carried heavy instruments up Colorado's peaks, measured angles from summit to summit, and sketched every ridge and stream. In 1877 the survey published this atlas, with large sheets showing Colorado's mountains, rivers and rocks in more detail than anyone had seen before.

Some sheets in the atlas are physical maps of the land's shape. Others show what kind of rock lies under the ground, where the rivers drain, or where the mines and farms were. It is a whole state shown many ways.

Look closely

- Find the mountains. How did the map makers make them look high and steep on flat paper?
- Follow a river from the mountains toward the edge of the sheet. Which way is it flowing?
- Look for any straight lines. Are they made by nature or by people?
- Find the map key or title. What does it tell you the sheet is about?

Talk about it

1. Why would a map maker need to climb the mountains to draw them correctly?
2. Is this sheet more like a physical map or a political map? How can you tell?

PROJECT: ONE STATE, TWO WAYS

You will make a physical map and a political map of your own state, one on top of the other. The physical map goes on plain paper; the political map goes on tracing paper laid over it. Lift the tracing paper to see the land; lay it down to see the lines people drew.

You will need

- An atlas or printed physical and political maps of your state
- Plain white paper and one sheet of tracing paper (or wax paper) the same size
- Colored pencils: green, yellow, tan, brown and blue
- A black fine-tip marker and a red pencil
- Tape

Steps

1. Trace the outline of your state onto the white paper.
2. Look at the physical map. Color the lowest land green, middle land yellow and tan, and the highest land brown. Draw the main rivers and lakes in blue and label two of them.
3. Make a small elevation key in a corner: green = low, yellow and tan = middle, brown = high.
4. Tape the tracing paper along the top edge so it can flip up like a page.
5. On the tracing paper, trace the state outline in black. Then add the capital with a red star, four other cities with dots, and the names of the neighboring states around the edges.
6. Make a political key on the tracing paper: star = capital, dot = city, solid line = state border.
7. Flip the tracing paper up and down. Write one sentence under your map about a city that grew where it did because of the land.

Tips

- Color the elevation lightly first; you can always make it darker.
- Line up the outlines carefully before you tape, so that the cities fall in the right places on the land.

Check your work

- My physical map shows high and low land with a key, and the main rivers.
- My political map shows the border, the capital, cities and neighboring states, with a key.
- I can explain why a city on my map grew where it did.

MAP NOTEBOOK

1. Draw a T-chart titled "Two Ways to Map Colorado" with the columns Physical and Political. Write at least four things in each.

2. Draw the view from the top of Pikes Peak: mountains to the west, plains to the east. Label west and east.
3. Copy a sample elevation key into your notebook with four color bands and their heights in feet.

From history. Pikes Peak is named for Zebulon Pike, an army officer who explored the southern edge of the Louisiana Purchase. In November 1806 he saw the great mountain from far out on the plains and tried to climb it, but deep snow, cold and thin summer uniforms turned his men back. He did not believe anyone would ever reach the top. Today a road and a cog railway climb it, and thousands of visitors stand where Katharine Lee Bates stood.

WORKED EXAMPLES

Example 1. A physical map of Colorado has this elevation key: green = 3,000 to 5,000 feet; yellow = 5,000 to 7,000 feet; tan = 7,000 to 10,000 feet; brown = over 10,000 feet. Denver is about 5,280 feet high. What color is Denver on this map? What color is the top of Pikes Peak (14,115 feet)?

(Use the map or drawing “Find Denver and Pikes Peak.” shown earlier in this lesson.)

1. Denver is 5,280 feet. That is more than 5,000 and less than 7,000, so it falls in the yellow band.
2. Pikes Peak is 14,115 feet. That is more than 10,000, so it falls in the brown band.
3. Notice that the colors stand for height, not for grass or dirt.

Answer: Denver is yellow (5,000 to 7,000 feet). The top of Pikes Peak is brown (over 10,000 feet).

Example 2. Colorado Springs, where Katharine Lee Bates taught, sits at the foot of Pikes Peak, about 6,000 feet above sea level. The summit of Pikes Peak is 14,115 feet. About how many feet did Bates climb from the town to the top?

1. Subtract the lower height from the higher height: $14,115 - 6,000$.
2. $14,115 - 6,000 = 8,115$.
3. Round to a friendly number: about 8,100 feet. That is more than a mile and a half straight up, since a mile is 5,280 feet.

Answer: About 8,100 feet, more than a mile and a half higher than the town.

PRACTICE

1. **EASY** Name two things you would see on a physical map and two things you would see on a political map.

2. **EASY** Which kind of map would you use to find the capital of Colorado? What is the capital?
(Use the map or drawing "Colorado shown two ways." shown earlier in this lesson.)
3. **MEDIUM** Look at the physical map of Colorado in the figure. In which part of the state, west or east, do the Arkansas and South Platte Rivers begin? Which way do they flow?
(Use the map or drawing "Colorado shown two ways." shown earlier in this lesson.)
4. **MEDIUM** Mount Elbert, Colorado's highest mountain, is 14,440 feet high. Pikes Peak is 14,115 feet high. How much higher is Mount Elbert?
5. **MEDIUM** Using the political map in the figure, name the states on Colorado's north side and the states on its south side.
6. **HARD** Colorado's lowest point, where the Arikaree River leaves the state, is about 3,300 feet high. Its highest point, Mount Elbert, is 14,440 feet. How many feet higher is the highest point than the lowest?
7. **HARD** Colorado's north and south borders are 4 degrees of latitude apart, and each degree of latitude is about 69 miles. About how many miles is Colorado from north to south?
8. **CHALLENGE** Colorado's borders are straight lines, but the Rocky Mountains run right through the middle of the state. Write two or three sentences explaining why a border and a mountain range can disagree, and which one God made.

COMMON MISTAKES

- Thinking green on a physical map means grass or forest. It means low elevation; a green desert and a green swamp can both be low.
- Thinking borders can be seen on the ground. Most borders are lines people agreed on; you will not see a painted line when you cross into Kansas.
- Using the wrong map for the question. Look for rivers and mountains on a physical map, and for capitals and borders on a political map.

Make it a game · Physical or Political?. Write twenty cards, each with one map feature: mountain, river, state border, capital city, lake, county line, plain, highway, desert, city, valley, and so on. Make two piles labeled Physical and Political. A parent flips a card; the player has five seconds to slap the right pile and say why ("God made it" or "People made it"). Tricky cards, like a canal or a lake made by a dam, earn a bonus point for a good explanation.

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

This is the verse of our whole geography course. Paul told the people of Athens that God made all nations of one blood and set the times and bounds of where they live. Physical maps show the land He made; political maps show the bounds that peoples have drawn, which He also rules over.

Practice answers

1. Physical: any two of mountains, plains, valleys, rivers, lakes, elevation colors. Political: any two of borders, states, counties, capitals, cities, roads.
2. A political map. The capital is Denver.
3. They begin in the Rocky Mountains in the west and flow east, out onto the Great Plains.
4. $14,440 - 14,115 = 325$ feet higher.
5. North: Wyoming and Nebraska. South: New Mexico and Oklahoma.
6. $14,440 - 3,300 = 11,140$ feet, about 11,100 feet.
7. $4 \times 69 = 276$ miles, about 280 miles.
8. God made the mountains and rivers; people drew the borders. Congress drew Colorado's borders as straight lines on a map in 1861, so they do not follow the land. That is why a physical map and a political map of the same state can look so different.

1.4 THE SURVEY OF THE LAND: TOWNSHIPS AND SECTIONS

OBJECTIVES

- Tell how the Land Ordinance of 1785 divided the western lands and how Thomas Hutchins began the survey at the Point of Beginning.
- Explain townships and sections and do the arithmetic of miles and acres.
- Recognize the township grid on a map or from an airplane window and make a scale map of a real piece of land.

Warm-up. Take a square sheet of paper. Fold it in half, then in half again, then in half once more the other way, and unfold it. How many little rectangles do you have? Now imagine that the paper is a whole county and each fold line is a country road. You have just made a small version of the American land survey.

Watch. *How to Use the Public Land Survey System* (Michigan Geological Survey, 7:43).
https://www.youtube.com/watch?v=BqWp_0a291o

After the story of the Point of Beginning: how townships, ranges and sections are numbered, so you can find a section on the grid yourself.

Note: The video is made for adult map readers. Watch the first five minutes together and pause to point at the grid; skip the rest if it gets too detailed.

Backup video. *Land Ordinances of 1785 - May 20, 1785* (The Appendix, 7:49).
<https://www.youtube.com/watch?v=3O-LspaJZNg>

With the history note: why Congress passed the Land Ordinance of 1785 and how the grid was laid out west of the Ohio River.

KEY TERMS

Land Ordinance of 1785

A law passed by Congress on May 20, 1785, that ordered the western lands to be surveyed into squares before they were sold.

township

A square of land 6 miles on each side, divided into 36 sections.

section

A square of land 1 mile on each side, holding 640 acres.

acre

A measure of land area, a little smaller than a football field without the end zones. There are 640 acres in a square mile.

metes and bounds

The older way of describing land by its edges: from this tree to that stone to the creek, so that every piece has a different shape.

Point of Beginning

The spot on the Ohio River where the first survey of the public lands was begun in 1785.

CORE IDEAS

The story. On September 30, 1785, a surveyor named Thomas Hutchins stood on the north bank of the Ohio River, exactly where the western border of Pennsylvania reached the water. Hutchins held a title no one else has ever held: Geographer of the United States. Congress had sent him to begin measuring the great country north and west of the Ohio River. He and his crews drove a marker into the ground at this spot, now called the **Point of Beginning**, near today's East Liverpool, Ohio. Then they turned due west and began to run a straight line through the forest, chain by chain. It was the first line of a survey that would one day reach the Pacific Ocean.

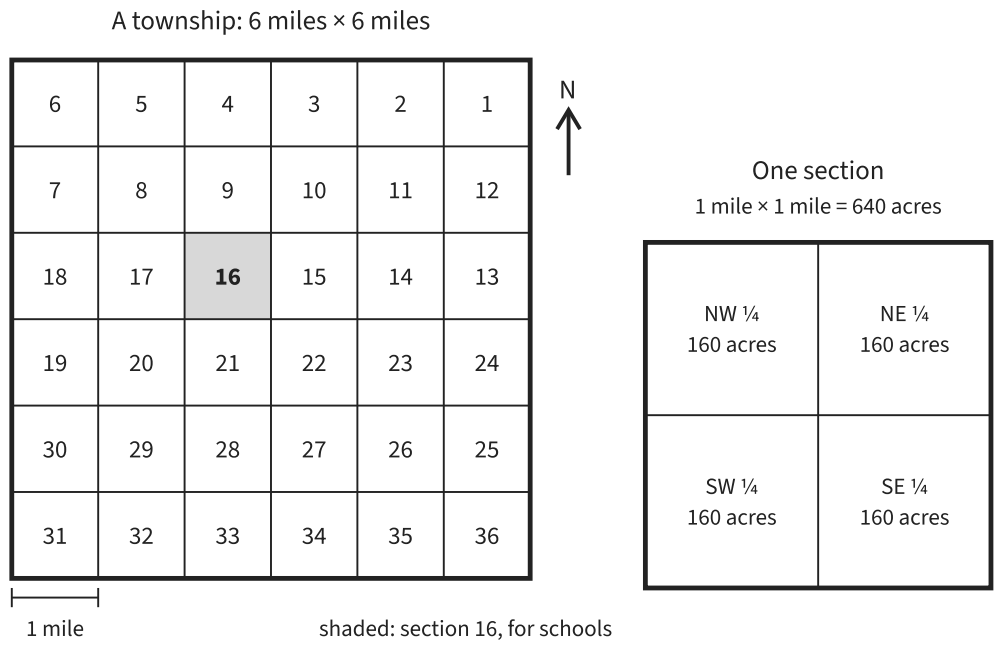
How it worked. The young nation was poor and owed money from the War for Independence, but it owned a huge stretch of western land. On May 20, 1785, Congress passed the **Land Ordinance**. Instead of letting settlers claim land by **metes and bounds**, from this oak to that rock to the creek, the way George Washington had surveyed Virginia, the land would first be measured into squares. Surveyors ran lines north and south six miles apart, and lines east and west six miles apart. Each square they made was a **township**, 6 miles on a side. Each township was divided into 36 **sections**, each one mile on a side and holding 640 acres. At the corners the surveyors set posts or stones and cut marks into nearby "witness trees." The first block Hutchins's crews measured, seven ranges of townships side by side, is still called the Seven Ranges.

The big idea. A grid of squares made land easy to describe, sell and find. Instead of a long list of trees and rocks, a farm could be named by its section, township and range, like a grid reference on a map. A family could buy a whole section, or a quarter section of 160 acres, or less. And Congress did something wise: in every township, it set aside section 16 for public schools. Two years later, the Northwest Ordinance of 1787 said that schools "shall forever be encouraged." Across the Midwest, the land or money from section 16 helped pay for many one-room schoolhouses.

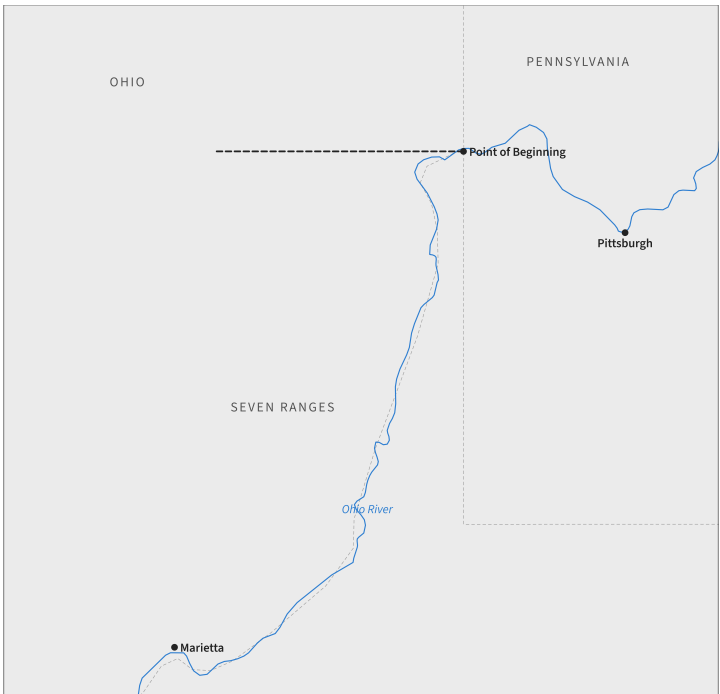
On the map. The survey spread west with the country until it covered thirty states. Fly over Ohio, Indiana, Iowa or Kansas today and look down. You will see a giant checkerboard: square fields and country roads running along the section lines, one mile apart, north-south and east-west. Every so often a north-south road takes a sudden little jog. That is not a mistake. Because the earth is round, lines running north come closer together the farther north they go, so surveyors had to shift the grid now and then to keep the squares square. The grid is missing in places surveyed before 1785, like the thirteen original states, and in a few others, such as Kentucky, Tennessee and Texas.

The whole truth. The land north of the Ohio was not empty. The Shawnee, Delaware (Lenape), Miami, Wyandot and other nations lived and hunted there, and many did not accept the treaties that gave it away. The surveyors worked in fear of attack, and war followed until the Treaty of Greenville in 1795. The survey brought order, schools and farms

to millions of families. It also moved forward on land that other peoples called home. A good historian tells both.

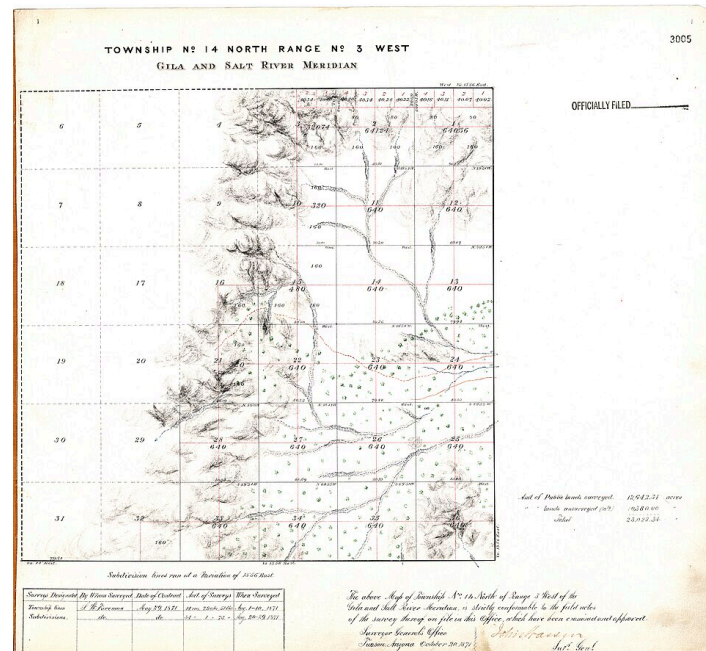


A township of 36 sections (numbered the way surveyors have done it since 1796), and one section split into quarters.



The Point of Beginning (1785) and the Geographer's Line, the first line of the public land survey.

PICTURE STUDY



Township No. 14 North, Range No. 3 West, Gila and Salt River Meridian (Arizona Territory), Surveyed by deputy surveyor Solomon W. Foreman; approved by John Hasson, Surveyor General, Tucson, 1871 · Ink and watercolor on paper (manuscript survey plat) · U.S. General Land Office records (now kept by the Bureau of Land Management); many other original plats are held by the National Archives and state archives

After the surveyors finished each township, they sent their field notes to the Surveyor General's office. There a draftsman drew a **plat**: a neat map of the whole township at a set scale, with its 36 sections numbered. Tens of thousands of these plats were drawn in the 1800s, and they are still used to settle land questions today.

A township plat is a perfect grid laid over real land. The straight lines were made by people; the creeks, hills and trees drawn across them are the land God made. This plat shows a township near Prescott in the Arizona Territory, surveyed in 1871. If you can, also find a plat of a township near you in the online General Land Office Records.

Look closely

- Count the sections. How many are there, and where is section 1?
- Find section 16. What do you see there?
- Find a creek. Does it care about the straight lines?
- Look at the little drawings on the land: shading for hills, dots for trees, and thin lines for streams and roads. Some sections on the left have only dashed lines and no drawings at all. What do you think that means?

Talk about it

1. Why would a family moving west want to see a plat before buying land?
2. How is this plat both a political map and a physical map?

Safety first. Get permission before you measure outside. Stay out of the street, watch for holes and sprinkler heads, and do not push stakes into the ground without an adult, because pipes and wires may be buried there.

PROJECT: SURVEY MY YARD

Now you will be the surveyor. You will measure your yard (or a park, churchyard or garden) with a tape measure or your string chain and draw it on graph paper to scale. This rough map becomes the start of your unit portfolio.

You will need

- A long tape measure (25 feet or more) or your 10-foot string chain from Lesson 1.1
- A clipboard, pencil and plain paper for your field book
- Graph paper and a ruler
- A compass (or a phone compass, used by a parent)
- Four craft sticks or small flags for corners

Steps

1. Walk the yard with a parent. Find its corners and set a stick or flag at each one.
2. In your field book, sketch the yard quickly, not to scale. Number each side and mark the house, driveway, big trees, garden, fence and any slope or low wet spot.
3. Use the compass to find north. Draw an arrow on your sketch.
4. Measure each side of the yard, holding the tape tight and straight. Write each length on your sketch.
5. Measure where things are. Pick one straight base line, like the back wall of the house. For each tree or bed, measure how far along the base line it is and how far out from it.
6. Choose a scale that fits your paper, such as 1 square = 2 feet for a small yard or 1 square = 5 feet for a big one. Divide each length by the scale to get the number of squares.
7. Draw the yard in pencil by counting squares. Add the north arrow, the scale in words and a scale bar.

Tips

- Measure twice, like a real surveyor. If the two numbers do not match, measure a third time.
- Round to the nearest foot. A fourth-grade surveyor does not need inches.
- Keep your field book: real surveyors' field notes were saved for more than two hundred years.

Check your work

- Every side of my yard on paper has the right number of squares for my scale.
- My map shows north, a scale and the main features of the yard.

- I can show someone how I got one length from my field book onto my map.

MAP NOTEBOOK

1. Draw a township as a 6 by 6 grid. Number the sections from 1 to 36 the way surveyors do, starting at the top right corner, and shade section 16.
2. Draw one section divided into four quarters. Label NE, NW, SE and SW, and write 160 acres in each.
3. Draw what you would see looking down from an airplane over Iowa: square fields, straight roads a mile apart and one farmhouse.

From history. The Northwest Ordinance of 1787 set up the government of the lands that Hutchins had begun to survey, the land that became Ohio, Indiana, Illinois, Michigan, Wisconsin and part of Minnesota. It also forbade slavery in that territory. Its third article begins with words many Americans memorized: “Religion, morality, and knowledge, being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged.” The survey grid and the school section were the land’s way of keeping that promise.

WORKED EXAMPLES

Example 1. A township is 6 miles long on each side, and each section is 1 mile on each side. How many sections are in a township? Each section holds 640 acres. How many acres are in a whole township?

(Use the map or drawing “A township is a 6 by 6 grid of sections.” shown earlier in this lesson.)

1. Along one side there are 6 sections, and there are 6 rows of them.
2. $6 \times 6 = 36$ sections.
3. Each section has 640 acres, so a township has 36×640 acres.
4. $36 \times 640 = 30 \times 640 + 6 \times 640 = 19,200 + 3,840 = 23,040$.

Answer: 36 sections, holding 23,040 acres.

Example 2. A farmer drives all the way around the outside edge of one township on the roads along its border. How many miles does she drive? How many miles would she drive around just one section?

1. A township is a square with 4 sides, each 6 miles long.
2. $4 \times 6 = 24$ miles around the township.
3. A section is a square with 4 sides, each 1 mile long, so $4 \times 1 = 4$ miles around a section.

Answer: 24 miles around the township; 4 miles around one section.

PRACTICE

1. **EASY** How many sections are in one township?
2. **EASY** How many acres are in one section?
3. **MEDIUM** A section is split into four equal quarter sections. How many acres are in one quarter section?
4. **MEDIUM** Look at the township in the figure. Which section number is in the northeast corner? Which is in the southwest corner?
(Use the map or drawing “A township of 36 sections.” shown earlier in this lesson.)
5. **MEDIUM** What was special about section 16 in every township?
6. **HARD** The first surveyed block in Ohio was the Seven Ranges: seven columns of townships side by side, each township 6 miles wide. How wide was the whole block from east to west?
(Use the map or drawing “The Geographer’s Line ran west from the Point of Beginning.” shown earlier in this lesson.)
7. **HARD** A family buys half of a quarter section. How many acres do they own?
8. **CHALLENGE** From an airplane over Kansas, you notice that a straight north-south country road suddenly jogs a little to the side and then goes straight north again. Write two or three sentences explaining why.

COMMON MISTAKES

- Mixing up townships and sections. A township is the big square, 6 miles on a side; a section is the small square inside it, 1 mile on a side.
- Numbering sections like reading a book, left to right on every row. Surveyors start at the northeast corner and go back and forth, like a farmer plowing a field.
- Thinking the whole country is on the grid. The thirteen original states and a few others, like Kentucky, Tennessee and Texas, were surveyed the older way.

Make it a game • Find My Section. Draw a large township grid with chalk on a driveway or tape on the floor, and number the 36 sections the surveyors’ way. A parent calls a number, such as “Section 22!” and the player must jump into the right square within five seconds. Then switch: the player calls out “Northeast corner!” or “The school section!” and the parent must find it. Score one point for each correct jump.

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

In Bible times, a landmark was a stone that marked the edge of a family’s field. Moving it was stealing. The surveyors’ corner stones and witness trees did the same work, and Scripture teaches us to respect what belongs to our neighbor.

Practice answers

1. 36 sections.

2. 640 acres.
3. $640 \div 4 = 160$ acres.
4. Section 1 is in the northeast corner. Section 31 is in the southwest corner.
5. Congress set it aside for public schools.
6. $7 \times 6 = 42$ miles.
7. A quarter section is 160 acres, and half of 160 is 80 acres.
8. Lines that run north come closer together the farther north they go, because the earth is round. If surveyors kept the lines straight forever, the townships would get narrower and narrower, so every so often they started the lines fresh. The road follows the section line, so it jogs where the grid was shifted.

UNIT 1 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use a ruler. The review is worth 50 points.

1. (5 pts) What is a map scale? Give one example of a scale written in words.
2. (5 pts) On a state map, the scale is 1 inch = 20 miles. Two towns are 4 inches apart. How far apart are they really?
3. (5 pts) You are drawing your yard at 1 square = 5 feet. The driveway is 40 feet long. How many squares long should you draw it?
4. (5 pts) What two tools did young George Washington use to survey land, and what did each one measure?
5. (5 pts) On the Kansas grid map, in which square is Wichita? Which town is in square B3?
6. (5 pts) In Washington, D.C., which way do the numbered streets run, and which way do the lettered streets run? Who helped Andrew Ellicott survey the ten-mile square in 1791?
7. (5 pts) Tell the difference between a physical map and a political map, and give one thing found on each.
8. (5 pts) Pikes Peak is 14,115 feet high and Denver is about 5,280 feet high. How much higher is Pikes Peak than Denver? On a physical map, does green mean grassy land or low land?
9. (5 pts) How many miles on a side is a township, and how many sections does it hold? How many acres are in one section and in one quarter section?
10. (5 pts) What did the Land Ordinance of 1785 do, and why do country roads in Iowa or Kansas run in straight lines about one mile apart?

UNIT PROJECT: A SCALE MAP OF MY YARD

Turn your yard survey from Lesson 1.4 into a finished map. Redraw it neatly on graph paper at a scale you choose, and add everything you learned in this unit: a title, your name as surveyor and the date; a north arrow; the scale in words and a scale bar; a letter-number grid with an index of at least six features (trees, garden, shed, driveway and so on); a key with symbols; and, using light colors, the “physical” features (slopes, low wet spots, trees) and the “political” ones (property lines, fences, the sidewalk or road).

Include your field book page with the measurements you took, and write three sentences: how long and how wide your yard really is, how you changed those lengths into squares, and one thing you learned about how surveyors like Washington and Hutchins worked.

- **Accuracy:** Lengths on the map match the field-book measurements at the chosen scale, and the shape of the yard is correct.
- **Map tools:** The map has a title, north arrow, written scale, scale bar, labeled grid, index and key, and all are used correctly.

- **Records and explanation:** The field book is included, and the sentences explain the real size of the yard and how the scale was used.
- **Care:** The map is neat, carefully lettered, lightly colored and easy for someone else to read.

Answer key

1. A map scale tells how much smaller the map is than the real land, so you can change map lengths into real distances. Example: "1 inch = 25 miles."
2. $4 \times 20 = 80$ miles.
3. $40 \div 5 = 8$ squares.
4. A compass, which measured the direction of each line, and a Gunter's chain (66 feet long), which measured the length of each line.
5. Wichita is in D3. Dodge City is in B3.
6. Numbered streets run north-south; lettered streets run east-west. Benjamin Banneker, a self-taught astronomer and free Black farmer from Maryland, helped him.
7. A physical map shows the land and water God made, such as mountains, plains and rivers (often with colors for elevation). A political map shows lines and places people made, such as borders, capitals and cities.
8. $14,115 - 5,280 = 8,835$ feet higher. Green means low land.
9. A township is 6 miles on a side and holds 36 sections. A section has 640 acres, and a quarter section has 160 acres.
10. It ordered the western lands to be surveyed into square townships and sections before they were sold (and set aside section 16 for schools). Many roads were built along the section lines, which are one mile apart, so from the air the land looks like a checkerboard.

THE NORTHEAST AND THE SOUTHEAST

The Bible tells us 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). In this unit you will see how the land itself shaped where Americans lived along the East Coast and what work they did. Rocky New England turned to fishing and to mills on fast rivers. The Mid-Atlantic grew great cities on deep, sheltered harbors. The Southeast planted tobacco and cotton on its warm coastal plain, and the low Gulf Coast built ports at the mouths of rivers while learning to live with hurricanes.

You will meet Samuel Slater, who carried the secret of England’s spinning machines across the ocean in his memory; Henry Hudson, who looked for a road to Asia and found a harbor instead; the English explorers who rowed up the James River in 1607 until the rocks stopped them; and Bienville, who chose a strip of high ground in a swamp for New Orleans. In every lesson you will ask: **why did people settle right here?** Along the way you will discover one of the most important lines on the map of the East, the **fall line**, and build a model of it with a waterfall and a working mill wheel.

BEFORE YOU BEGIN

- Can use a map scale to find distances in whole and half inches (Lesson 1.1)
- Can find a square on a letter-number grid (Lesson 1.2)
- Knows the eight compass directions (north, northeast, east and so on)
- Can multiply and divide whole numbers up to about 200

MASTERY CHECKLIST

- I can name the New England, Mid-Atlantic and Southeast states and find them on a map.
- I can explain how rocky soil, fast rivers and the sea shaped work in New England.
- I can name three things that make a great harbor and find New York, Philadelphia and Baltimore.
- I can explain what the fall line is and name at least six fall-line cities.
- I can explain what a peninsula, a delta and a hurricane are and why New Orleans stands where it does.
- I can use a map scale and compass directions to find distances and directions between real cities.

OPTIONAL BOOKS AND RESOURCES

- **Library of Congress Map Collections** (<https://www.loc.gov/maps/>): Free. Search for “Smith Virginia 1612,” “Holme Philadelphia 1683” and “bird’s eye view New Orleans” to zoom in on the historic maps from this unit’s picture studies.

- **Lowell National Historical Park (National Park Service)**

(<https://www.nps.gov/lowe/>): Free information, photographs and visiting details for the mill city on the Merrimack River from Lesson 2.1. If you live near Massachusetts, a visit shows real water-powered mills and canals.

2.1 NEW ENGLAND: ROCKY SOIL, FISHING AND MILL TOWNS



OBJECTIVES

- Name the six New England states and find Boston, Gloucester, Lowell and Pawtucket on a map.
- Explain how rocky soil, a long coast and fast rivers shaped the work people did in New England.
- Tell the story of Samuel Slater's mill at Pawtucket Falls and explain how a water wheel turns falling water into power.

Warm-up. Hold a small plastic bowl or a cup under a gently running faucet and turn it slowly in your hands. Now hold a pinwheel or a paper fan near the stream. Does slow water or fast water push harder? Talk about it: where in a river would the water fall the fastest?

Watch. *Learn the U.S. States: The Northeast Region* (Homeschool Pop, 5:27).

<https://www.youtube.com/watch?v=YH9yMhpyvpQ>.

Before the story: a quick tour of the Northeast states, their coast, harbors and mountains.

Backup video. *Slater Mill and Water Power* (Blackstone River Valley National Historical Park, 4:06). <https://www.youtube.com/watch?v=LYGW0bulC7M>

After the story of Samuel Slater: a National Park Service ranger shows how falling water turned the wheels at Slater Mill.

KEY TERMS

New England

The six states in the northeast corner of the United States: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

glacier

A huge, slow river of ice. Long ago great sheets of ice covered New England and left behind rocks and stones in the soil.

harbor

A sheltered place along a coast where ships can stay safely, load and unload.

water power

The push of moving or falling water, used to turn a wheel that runs machines.

mill

A building with machines for grinding grain, sawing wood or spinning and weaving cloth, often run by a water wheel.

mill town

A town that grew up around mills, usually beside a waterfall or rapids on a fast river.

CORE IDEAS

The story. Late in 1789, a twenty-one-year-old English mill worker named Samuel Slater stepped off a ship in New York. He carried no drawings of machines. England had laws to keep its cotton-spinning machines a secret and tried to stop skilled mill workers from leaving. So Slater carried the machines in the only place no one could search: his memory. He had worked for years in a mill in England and knew every gear and roller by heart. A Rhode Island merchant named Moses Brown hired him, and at Pawtucket, where the Blackstone River tumbles over a rocky waterfall, Slater built spinning machines from memory. In December 1790 they began to spin cotton thread, turned by the power of the falling river. In 1793 he and his partners built a new mill beside the falls. That building, Slater Mill, still stands today.

How it worked. Mill builders put a **dam** across the river above the falls to make a deep pond. From the pond, water ran along a narrow channel to a great wooden **water wheel**. The water poured onto the wheel and pushed it around, and the wheel turned a long iron shaft. Belts and gears carried that turning motion to the machines on every floor of the mill. One falling river could do the work of hundreds of hands. In the 1820s Boston businessmen built a whole new city this way at the falls of the Merrimack River and named it **Lowell**. They dug canals to lead water to mill after mill, and thousands of young women came from New England farms to work the looms and live in boardinghouses.

The big idea. Why did New Englanders turn to mills and the sea instead of only farming? Look at the ground. Long ago, great sheets of ice called **glaciers** covered New England. When they melted, they left the soil full of rocks. Farmers pulled up stones every spring and piled them into the stone walls that still wind through New England's woods. The summers are short and the winters long and snowy, because New England lies far to the north. A farm there could feed a family, but it was hard to grow large crops to sell. The same hilly, rocky land, though, gave New England something else: fast rivers that drop quickly toward the sea. Those falls became the power plants of the young nation.

On the map. Find New England in the northeast corner of the map (Figure 1). Its coast is jagged with bays, capes and harbors, like Boston Harbor and the curled arm of Cape Cod. Out at sea lie shallow banks where cold water is full of fish. From ports like **Gloucester**, fishermen sailed out in schooners to catch cod, and from **New Bedford** and Nantucket, whaling ships sailed around the world. Cod was so important that a carved wooden codfish, the "Sacred Cod," hangs in the Massachusetts State House to this day.

Technology overcoming geography. New England could not change its stony soil or its short summers. But its people learned to use what God had placed there: harbors for ships, fish in the sea and falling water in the rivers. A water wheel is a simple machine, yet it turned the weakness of a hilly land into a strength. As the psalm says to God, "Thou visitest the earth, and waterest it" (Psalm 65:9). A wise people looks closely at the land it has been given and asks, "What is this good for?"

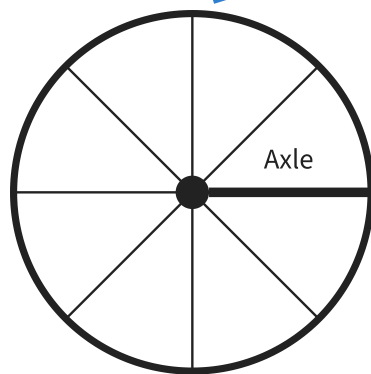


Figure 1. New England's ports and mill towns.

Flume: water from above the falls



Water wheel

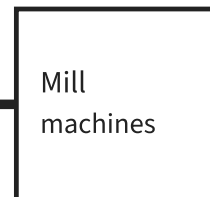


Axle

turns



Mill machines



Tailrace: water returns to the river below

Figure 2. How a water wheel works.

PICTURE STUDY



Boston Harbor, Fitz Henry Lane, about 1850–1855 · Oil on canvas · Museum of Fine Arts, Boston

Fitz Henry Lane (1804–1865) grew up in Gloucester, Massachusetts, one of New England's great fishing ports. An illness in childhood left his legs weak, and he walked with crutches all his life, but he became one of America's finest painters of ships and harbors. He learned his craft drawing pictures for a print shop in Boston.

Lane knew ships so well that sailors could tell exactly what kind of vessel each one was. In this painting he shows Boston Harbor in the quiet light near the end of the day, when the water is still as glass. Boston grew great because of this sheltered harbor.

Look closely

- Find the largest ship. How many masts can you count?
- Look at the water. How does Lane show that it is calm? Can you find reflections?
- Look at the sky. What time of day do you think it is? Why?
- Find the city on the far shore. Is it big and close, or small and far away?

Talk about it

1. Why would a sheltered harbor like this one help a city grow?
2. Lane grew up in a fishing town. How do you think that helped him paint ships so well?
3. If you were a sailor coming home after weeks at sea, how would you feel seeing this harbor?

Safety first. An adult should handle any hot glue and any cutting with a craft knife. Work over a sink, tub or basin, and wipe up spilled water so no one slips.

PROJECT: A WATER WHEEL THAT DOES WORK

You will build a small water wheel, turn it with falling water and make it lift a load, just as the wheels at Pawtucket Falls turned Slater's machines. Keep your wheel: you will set it into your fall-line model in Lesson 2.3.

You will need

- Two sturdy paper plates or two plastic lids of the same size
- 8 plastic spoons or 8 small paper cups (the buckets)
- A pencil or a wooden dowel for the axle
- Tape (waterproof tape works best) or hot glue with an adult
- A piece of string about 2 feet long and a paper clip or a small washer
- A pitcher of water and a basin, sink or tub

Steps

1. Ask an adult to poke a hole through the center of each plate just big enough for the pencil.
2. Tape the 8 spoons or cups between the two plates, evenly spaced around the edge like the numbers on a clock, all facing the same way.
3. Push the pencil through both center holes. The wheel should spin freely when you blow on it.
4. Hold the ends of the pencil over the basin (or rest them on two cups). Pour water slowly onto the *top* of the wheel. Count how many turns it makes while you pour one cup of water.
5. Now pour the same amount of water against the *bottom* of the wheel. Which way turns the wheel faster?
6. Tape one end of the string to the pencil and tie the paper clip to the other end. Pour water on the wheel again and watch the string wind up and lift the clip. Your wheel is doing work!
7. Try pouring from higher up and from lower down. Write down what changes.

Tips

- Water poured from higher up hits the wheel harder. That is why mill builders looked for waterfalls.
- Water poured onto the top of the wheel pushes with its weight as it falls. Many New England mills used this kind of wheel.

Check your work

- My wheel turns when water falls on it.
- My wheel can lift a small load with a string.
- I can explain why a higher fall of water gives more power.

MAP NOTEBOOK

1. Draw an outline map of New England and label the six states, Boston, Gloucester and Lowell. Draw a tiny fish by Gloucester and a tiny mill by Lowell.
2. Draw a stone wall in a New England field and write one sentence telling where the stones came from.
3. Draw Figure 2 in your own way and label the flume, the wheel, the axle and the tailrace.

From history. The “Sacred Cod” is a carved wooden codfish almost five feet long. It has hung in the Massachusetts House of Representatives since the 1700s, and it was moved into the new State House on Beacon Hill in 1798. It reminds lawmakers how much the fishing trade meant to Massachusetts from its earliest days.

WORKED EXAMPLES

Example 1. On a map of Massachusetts, the scale says 1 inch = 10 miles. With a ruler you measure $2\frac{1}{2}$ inches from Boston to Lowell. About how far apart are the two cities?

(Use the map or drawing “Lowell lies northwest of Boston on the Merrimack River.” shown earlier in this lesson.)

1. Each inch on the map stands for 10 miles on the ground.
2. 2 inches stand for $2 \times 10 = 20$ miles.
3. The extra $\frac{1}{2}$ inch stands for half of 10, which is 5 miles.
4. Add them: $20 + 5 = 25$ miles.

Answer: About 25 miles.

Example 2. Use Figure 1. A fishing captain in Boston wants to sail to Gloucester, and a mill owner in Boston wants to ride to Pawtucket. In what direction does each one travel?

(Use the map or drawing “Use the compass directions: north is up, east is to the right.” shown earlier in this lesson.)

1. Find Boston. Gloucester is above Boston (north) and to the right (east), so it is northeast.
2. Pawtucket is below Boston (south) and to the left (west), so it is southwest.
3. Check: northeast and southwest are opposite directions, and the two towns are on opposite sides of Boston.

Answer: The captain sails northeast to Gloucester; the mill owner travels southwest to Pawtucket.

PRACTICE

1. **EASY** Name the six New England states.
2. **EASY** Why is New England soil so full of stones?
3. **MEDIUM** On a map where 1 inch = 20 miles, Boston and Portland, Maine are 5 inches apart. About how many miles apart are they?
4. **MEDIUM** Use Figure 1. In what direction would you travel from Boston to Hartford, Connecticut?
(Use the map or drawing “Find Boston first, then Hartford.” shown earlier in this lesson.)
5. **MEDIUM** A mill’s water wheel turns 8 times every minute. How many times does it turn in 15 minutes?
6. **HARD** A fishing schooner leaves Gloucester for fishing grounds 100 miles away. It sails at 5 miles per hour. How many hours does the trip take? If it leaves at 6 in the morning and sails without stopping, will it arrive before midnight?
7. **HARD** Explain in two or three sentences why mill towns like Pawtucket and Lowell grew beside waterfalls instead of beside slow, flat rivers.
8. **CHALLENGE** Samuel Slater brought no drawings from England. How did he bring the secret of the spinning machines to America, and why did England try to keep it secret?

COMMON MISTAKES

- Thinking New England is the whole Northeast. New England is only the six states in the northeast corner; New York, New Jersey and Pennsylvania are Mid-Atlantic states.
- Thinking any river can run a mill. A mill needs a place where the river drops quickly, like falls or rapids.
- Reading map directions from where you sit. On a map, north is up and east is to the right, no matter which way you are facing.

Make it a game • Farm, Sea or Mill?. A parent names a New England place or thing: a stone wall, Gloucester, a cod, Lowell, a waterfall, Cape Cod, a loom, a schooner, a short summer. Shout “Farm!”, “Sea!” or “Mill!” and give one reason. A correct answer with a good reason scores a point. Then switch, and you name things for your parent. Play to ten points.

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)

New England’s fishermen and sailors did their business in great waters. The sea was dangerous, but it also showed them the wonders of the God who made it.

Practice answers

1. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.
2. Long ago, great sheets of ice (glaciers) covered New England. When they melted they left rocks and stones mixed into the soil.

3. $5 \times 20 = 100$ miles.
4. Southwest.
5. $8 \times 15 = 120$ times.
6. $100 \div 5 = 20$ hours. Leaving at 6 a.m., it arrives at 2 a.m. the next morning, so no, it arrives after midnight.
7. A water wheel needs water that falls or rushes hard to push it. At a waterfall the river drops quickly, so it has much more power to turn wheels and run machines. A slow, flat river would barely turn a wheel.
8. He memorized how the machines were built while working in an English mill and built them again from memory at Pawtucket. England wanted to keep its spinning machines secret so that other countries could not make cloth as cheaply and compete with English mills.

2.2 THE MID-ATLANTIC: GREAT HARBORS OF NEW YORK, PHILADELPHIA AND BALTIMORE

OBJECTIVES

- Name the Mid-Atlantic states and find New York, Philadelphia and Baltimore and the waters they stand on.
- List the things that make a great harbor: deep water, shelter from storms and a river road inland.
- Use a map scale to find the distances between the three harbor cities.

Warm-up. Fill a baking pan with an inch of water and float a bottle cap in it. Make waves by gently pushing the water at one end with a ruler. Now stand a cereal box or a block in the pan as a wall and put the cap behind it. Make the same waves. Where is the cap safer?

Watch. *Learn the U.S. States: The Mid-Atlantic Region* (Homeschool Pop, 5:12).

<https://www.youtube.com/watch?v=UZAiUJKSqfU>

Before the story: the Mid-Atlantic states, their bays and their great harbor cities.

Backup video. *The History of the Star-Spangled Banner for Kids: Francis Scott Key and Fort McHenry - FreeSchool* (Free School, 2:51). <https://www.youtube.com/watch?v=Umg8v6DLZjs>

[v=Umg8v6DLZjs](https://www.youtube.com/watch?v=Umg8v6DLZjs)

With the story of Fort McHenry: how Francis Scott Key came to write the Star-Spangled Banner over Baltimore harbor.

KEY TERMS

Mid-Atlantic

The states in the middle of the East Coast: New York, New Jersey, Pennsylvania, Delaware and Maryland.

port

A town or city with a harbor where ships load and unload goods and passengers.

bay

A part of the sea that reaches into the land, with land around most of it.

sheltered

Protected from wind and waves, often by islands or by land around a bay.

river mouth

The place where a river flows into a bay, lake or the sea.

CORE IDEAS

The story. In September 1609, a small Dutch ship called the *Half Moon* crept through a narrow passage between two hilly islands and into a wide, quiet bay. Her captain was an Englishman named Henry Hudson, hired by the Dutch East India Company to find a shortcut to Asia. Beyond the bay a great river stretched north between steep cliffs. Hudson hoped it was the passage he was looking for, and he sailed up it for about 150 miles, until the water grew too shallow near where Albany, New York, stands today. It was not a road to Asia. But Hudson had found something better for the people who came after him: one of the finest harbors in the world, with a deep river leading far into the land. Dutch traders soon built a town called New Amsterdam at the tip of Manhattan Island. In 1664 the English took it and renamed it **New York**.

How it works. What makes a great harbor? First, **deep water**, so big ships do not scrape bottom. Second, **shelter**, so storms and ocean waves cannot smash the ships at anchor. New York Harbor is guarded by Long Island and Staten Island, and the main way in from the sea is through a narrow gap called the Narrows. Third, a **river road** into the country, so that goods can travel inland and farm crops can come down to the ships. The Hudson River is so deep and low that the ocean tide reaches up it all the way past Albany to Troy. New York had all three gifts.

Philadelphia and Baltimore. In 1682 William Penn arrived in his new colony of Pennsylvania and chose a spot for his city between two rivers, the Delaware and the Schuylkill (say SKOO-kul). It lay about 100 miles from the open ocean, up Delaware Bay and the Delaware River, safe from Atlantic storms. Penn's surveyor, Thomas Holme, laid out the streets in a neat grid, and Philadelphia grew into one of the largest cities in the colonies. Farther south, **Baltimore** was founded in 1729 on the Patapsco River near the top of the great Chesapeake Bay. Because Baltimore lay farther west than the other ports, it was closer to the wheat farms of the back country, and it became a busy port for flour. In September 1814, British warships bombarded Fort McHenry, which guarded Baltimore's harbor. The fort held, and a young lawyer named Francis Scott Key, watching from a ship, wrote the poem that became "The Star-Spangled Banner."

The big idea. Cities grow where roads of water meet roads of land. A harbor is a meeting place: ships from across the sea meet boats and wagons from the farms. Goods change hands there, and people find work loading, building, buying and selling. That is why the three biggest cities of the early Mid-Atlantic all stood on deep, sheltered water with a river reaching inland.

On the map. Find the Mid-Atlantic states in Figure 1: New York, New Jersey, Pennsylvania, Delaware and Maryland. Put your finger on New York and slide it southwest to Philadelphia and then to Baltimore. The three cities lie almost in a line. That is no accident. Philadelphia and Baltimore sit near the place where hard, high land meets the low land along the coast, and where the rivers drop in falls and rapids, and that same edge runs on northeast toward New York. In Lesson 2.3 you will learn the name of that line.

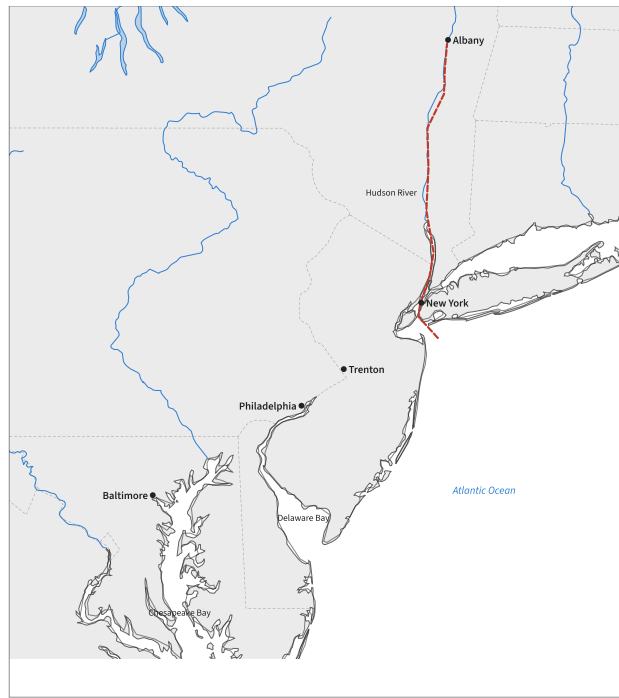
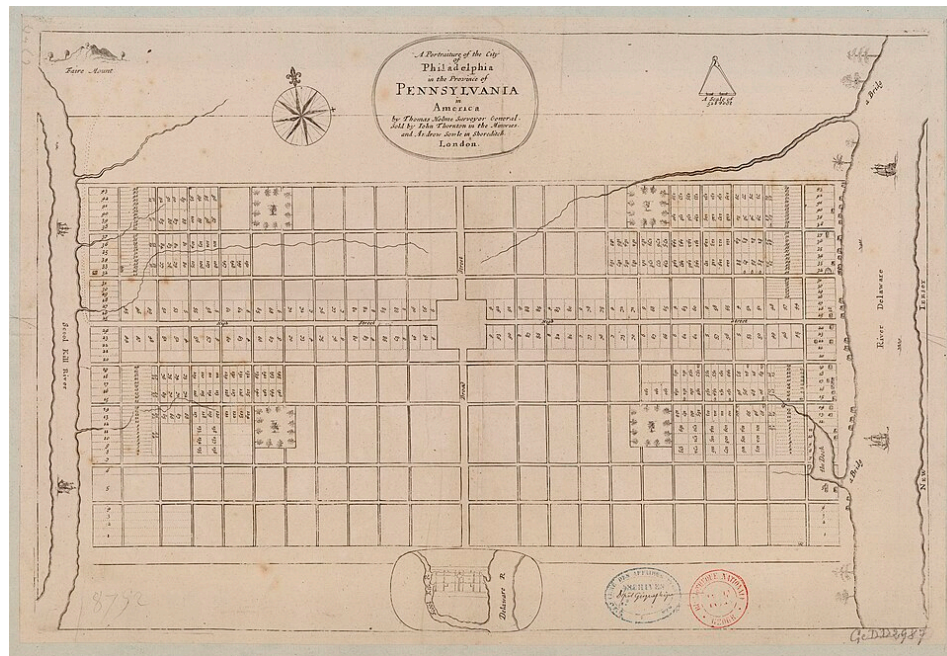


Figure 1. The great harbors of the Mid-Atlantic and Hudson's route in 1609.

PICTURE STUDY



A Portraiture of the City of Philadelphia, Thomas Holme, Surveyor General of Pennsylvania, 1683 · Engraved map · This copy: Bibliothèque nationale de France, Paris (other copies survive in American collections)

William Penn wanted his city to be a “greene Country Towne,” with room for gardens and fresh air, unlike the crowded streets of London. His surveyor, Thomas Holme, drew this plan in 1683 and it was printed in London so that people in England could see the new city and decide to move there.

Holme stretched the city all the way from the Delaware River on the east to the Schuylkill River on the west, so that it would have docks on both rivers. Philadelphia's streets still follow this grid today.

Look closely

- Find the two rivers. Which one is on the right side of the map, and which on the left?
- Find the big square in the middle and the four smaller squares. What do you think Penn wanted them used for?
- Look at the streets. Are they curvy or straight? How is this like the grid you used in Unit 1?
- Find the widest streets that cross in the center of the city.

Talk about it

1. Why do you think Penn wanted the city to touch both rivers?
2. How would a grid of straight streets make it easy for a stranger to find an address?
3. Would you rather live in a city planned on paper first, or one that grew up on its own? Why?

PROJECT: HARBOR IN A PAN

You will build two coastlines in a pan of water, one straight and open, one with a sheltered bay, and test which one keeps boats safe in a storm. Then you will add a river road leading inland. By the end you will be able to explain why New York, Philadelphia and Baltimore became great ports.

You will need

- A large baking pan or plastic storage tub
- Modeling clay or play dough (about two fists' worth)
- Water
- 6 bottle caps or corks for boats
- A ruler or a flat spatula for making waves
- A towel for spills

Steps

1. Press clay along one long side of the pan to make land. Make half of the coast straight. On the other half, curve the clay into a deep bay, and add a small clay island across most of its mouth, leaving a narrow gap like the Narrows.
2. Pour in water about 1 inch deep.
3. Set three boats in the open water along the straight coast and three inside the sheltered bay.
4. Make a storm: push the ruler back and forth at the far end of the pan ten times.

5. Count how many boats in each place tipped over or were pushed onto the shore. Write the numbers in your notebook.
6. Now cut a channel into the clay at the back of the bay to be a river. Push a boat up the river and pretend to load it with wheat from the farms.
7. Write two sentences: Which harbor kept the boats safe? Why does a harbor need a river too?

Tips

- Make the same number of waves each time so the test is fair.
- Try making the gap to the bay wider. Does the bay stay as calm?

Check your work

- I built an open coast and a sheltered bay and tested them fairly.
- I can name three things that make a great harbor.
- I can explain why New York Harbor is so well sheltered.

MAP NOTEBOOK

1. Trace or draw Figure 1. Label New York, Philadelphia and Baltimore and color the water they stand on blue.
2. Draw the *Half Moon* sailing up the Hudson and write one sentence about what Hudson was looking for and what he found.
3. Draw a simple plan of your own “greene Country Towne” on graph paper, with a grid of streets and one square for a park.

From history. Francis Scott Key called his poem “Defence of Fort M’Henry” when it was first printed in 1814. It was soon sung to a popular tune of the day, and in 1931 Congress made “The Star-Spangled Banner” the national anthem. The great flag that flew over the fort, about 30 by 42 feet, is kept today at the Smithsonian’s National Museum of American History in Washington, D.C.

WORKED EXAMPLES

Example 1. On a map where 1 inch = 40 miles, New York to Philadelphia measures 2 inches, and Philadelphia to Baltimore measures $2\frac{1}{4}$ inches. How far is it from New York to Philadelphia? From Philadelphia to Baltimore? From New York to Baltimore by way of Philadelphia?

(Use the map or drawing “The three harbor cities lie nearly in a line from northeast to southwest.” shown earlier in this lesson.)

1. New York to Philadelphia: $2 \times 40 = 80$ miles.
2. Philadelphia to Baltimore: 2 inches = 80 miles, and $\frac{1}{4}$ inch is one fourth of 40, which is 10 miles. $80 + 10 = 90$ miles.
3. Add the two legs: $80 + 90 = 170$ miles.

Answer: About 80 miles, about 90 miles, and about 170 miles in all.

Example 2. A sailing sloop carries flour 150 miles from Albany down the Hudson River to New York. It averages 5 miles per hour. How many hours does the trip take? How many days and hours is that?

1. Time = distance $\div$ speed: $150 \div 5 = 30$ hours.
2. One day has 24 hours. $30 - 24 = 6$.
3. So 30 hours is 1 day and 6 hours.

Answer: 30 hours, which is 1 day and 6 hours.

PRACTICE

1. **EASY** Name the five Mid-Atlantic states.
2. **EASY** Name three things that make a great harbor.
3. **EASY** Match each city with its water: New York, Philadelphia, Baltimore; the Delaware River, the Hudson River, the Patapsco River and Chesapeake Bay.
4. **MEDIUM** Use Figure 1. In what direction do you travel from Philadelphia to New York?
(Use the map or drawing “Start at Philadelphia.” shown earlier in this lesson.)
5. **MEDIUM** On a map where 1 inch = 40 miles, the straight line from New York to Baltimore measures $4\frac{1}{4}$ inches. How many miles is that?
6. **MEDIUM** Who drew the 1683 plan of Philadelphia, and what shape did he give the streets?
7. **HARD** A ship from England must sail about 100 miles up Delaware Bay and the Delaware River to reach Philadelphia. At 4 miles per hour, how long does that part of the trip take? Why were merchants willing to sail so far inland?
8. **CHALLENGE** Henry Hudson failed to find a passage to Asia. Write two or three sentences explaining why his voyage still mattered greatly.

COMMON MISTAKES

- Thinking any spot on the coast makes a good port. Ships need deep water and shelter, and a port also needs a way to reach the land behind it.
- Thinking Philadelphia and Baltimore are right on the ocean. Both lie far up long bays and rivers, which is what kept them safe.
- Mixing up the scale when a measurement has a fraction. Find the miles for the whole inches first, then for the part of an inch, and add.

Make it a game · Harbor Master. One player is the Harbor Master and names a ship and its cargo: “A ship from England with tea and cloth!” The other player must choose New York, Philadelphia or Baltimore and give a reason based on the map: “Baltimore, because it is closest to the wheat farms of the west.” A good reason scores a point. Take turns and play to eight points.

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. After a storm at sea, sailors are glad to reach still water. God is the one who brings travelers safely home.

Practice answers

1. New York, New Jersey, Pennsylvania, Delaware and Maryland.
2. Deep water, shelter from storms and waves, and a river or road leading inland. (A harbor that seldom freezes is a bonus.)
3. New York: the Hudson River. Philadelphia: the Delaware River. Baltimore: the Patapsco River and Chesapeake Bay.
4. Northeast.
5. $4 \times 40 = 160$, and $\frac{1}{4}$ of 40 = 10, so $160 + 10 = 170$ miles.
6. Thomas Holme, William Penn’s surveyor. He laid the streets out in a grid of straight lines, with a center square and four smaller squares.
7. $100 \div 4 = 25$ hours. The long trip inland brought the ship to a harbor safe from Atlantic storms and close to the farms and towns where goods were bought and sold.
8. He found a deep, sheltered harbor with a river reaching about 150 miles inland. Traders and settlers followed him, and New York grew into one of the greatest ports in the world because of that harbor and river.

2.3 THE SOUTHEAST: THE FALL LINE, THE COASTAL PLAIN AND THE CHESAPEAKE

OBJECTIVES

- Explain what the fall line is and why cities like Richmond, Washington and Augusta grew along it.
- Describe the coastal plain and the Chesapeake Bay and how they shaped tobacco and cotton farming.
- Build a fall-line model and draw the fall-line cities of the East on a map.

Warm-up. Stack two or three books on a table and lay a towel over them so it slopes down to the table like a hillside. Roll a marble down the towel. Where does it speed up? Where does it slow down? Now imagine the marble is a river and the table is the flat land near the sea.

Watch. *Learn the U.S. States: The Southeast Region* (Homeschool Pop, 7:11).

<https://www.youtube.com/watch?v=DmAvDdHLL8I>

Before the story: the Southeast states, the coastal plain and the Appalachian Mountains.

Backup video. *The Fall Line - East Coast USA* (Mr. OldPro, 4:44).

<https://www.youtube.com/watch?v=jlpJsBPgDFA>

After How it works: a short look at the fall line, where rivers drop from the Piedmont to the coastal plain and boats had to stop.

KEY TERMS

fall line

The line where the hard, higher land of the Piedmont drops to the soft, low coastal plain, so rivers tumble over falls and rapids.

Piedmont

The rolling, hilly land of hard rock between the Appalachian Mountains and the fall line. The name means “foot of the mountain.”

coastal plain

The low, flat land of sand and clay between the fall line and the ocean.

head of navigation

The farthest point up a river that ships can sail before falls or shallow water stop them.

estuary

A wide river mouth or bay where fresh river water mixes with salty ocean water. The Chesapeake Bay is the largest estuary in the United States.

cash crop

A crop grown mainly to sell, such as tobacco or cotton, rather than to feed the farmer's family.

CORE IDEAS

The story. In May 1607, only days after English settlers landed at Jamestown, Virginia, Captain Christopher Newport took a small boat and about two dozen men up the James River to explore. John Smith was among them. For several days they rowed and sailed past marshes and forests, with the river wide and calm. Then, near a town of the Powhatan people, the river suddenly changed. It foamed and roared over a jumble of rocks. No boat could go farther. Newport set up a wooden cross on the bank and turned back. The place where they stopped is now the city of **Richmond**. Without knowing it, the Englishmen had found one of the most important lines on the map of the East.

How it works. The eastern United States has two kinds of land side by side (Figure 2). Inland lies the **Piedmont**, rolling hills of old, hard rock. Toward the sea lies the **coastal plain**, low and flat, made of soft layers of sand and clay. Where the hard rock meets the soft land, the rivers drop over falls and rapids. That edge is called the **fall line**. It became a natural stopping place. Ships coming up from the sea had to stop and unload there, because the falls were the **head of navigation**. And the same falls could turn water wheels for mills. So towns grew at the falls of river after river: Trenton, Philadelphia, Baltimore, Washington, Fredericksburg, Richmond, Columbia, Augusta, Macon and Columbus (Figure 1). George Washington even started a company in 1785 to dig short canals around the Great Falls of the Potomac so that boats could get past.

The Chesapeake. Below the fall line in Virginia and Maryland, deep rivers like the James, the York and the Potomac flow into the **Chesapeake Bay**. The land here is called the Tidewater, because the ocean tide rises and falls far up these rivers. Ships could sail right up to a planter's own wharf. In 1612 John Rolfe at Jamestown planted a milder kind of tobacco from the Caribbean, and it sold well in England. Tobacco became Virginia's great **cash crop**. It was packed into huge barrels called hogsheads and rolled down to the wharves.

Cotton and a great wrong. Farther south, in the Carolinas and Georgia, the warm, long summers suited cotton. The Southeast lies closer to the equator than New England, so the sun shines more directly and the growing season is months longer. But picking the seeds out of cotton by hand was slow until 1793, when Eli Whitney built a **cotton gin** on a plantation near Savannah, Georgia. The machine cleaned cotton quickly, and cotton farming spread fast across the South. Much of the work in the tobacco and cotton fields was done by enslaved Africans and their children, who were bought and sold as property. The cotton gin made slavery grow instead of fade. This was a great wrong against people made in the image of God, and it did not end in the United States until 1865.

On the map. Find the fall line on Figure 1. Trace it with your finger from Trenton in New Jersey down through Richmond and on to Columbus, Georgia. Notice that it runs roughly parallel to the coast. Notice too that Philadelphia and Baltimore, two of the great harbor cities of Lesson 2.2, sit right on it. Many of the oldest and largest cities of the East are lined

up like beads on this one string, because there the sea road ended and the water power began.



Figure 1. The fall-line cities of the East.

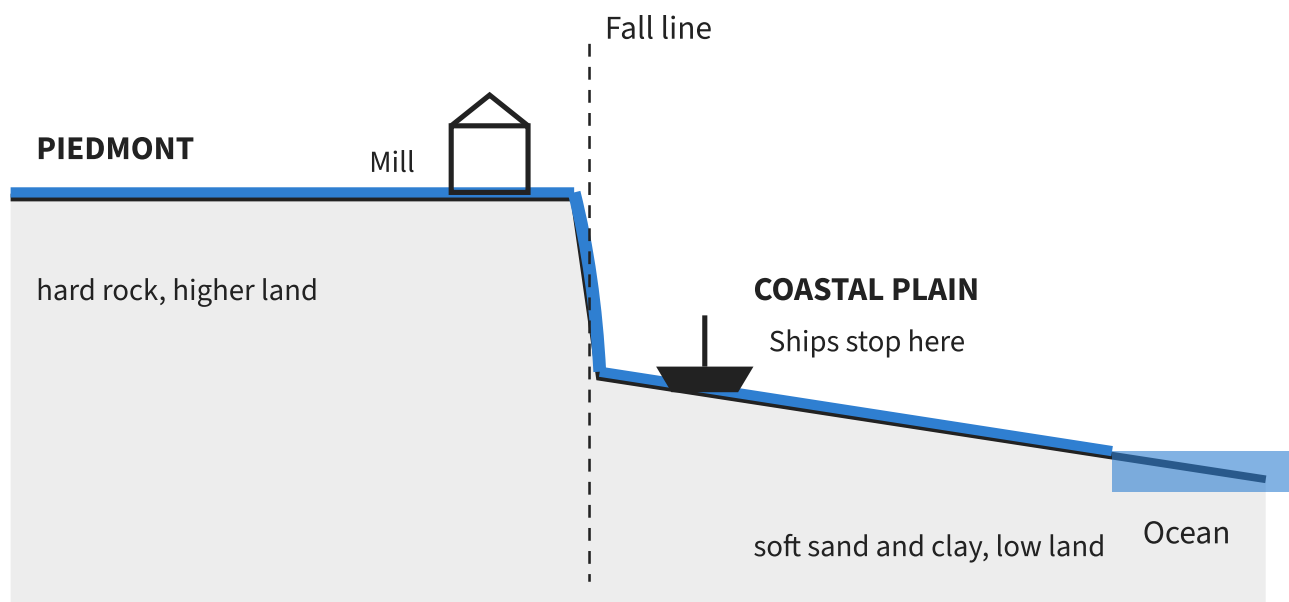


Figure 2. A side view of the fall line.

PICTURE STUDY



Virginia (Captain John Smith's map of Virginia), John Smith; engraved by William Hole, 1612 · Engraved map · Library of Congress, Prints and Photographs Division (one of several surviving copies)

In the summer of 1608 John Smith explored the Chesapeake Bay in an open boat, twice, sailing up its rivers and meeting the peoples who lived along them. From his notes he made this map, printed in England in 1612. It was so good that mapmakers copied it for many years afterward.

Smith turned his map so that *west* is at the top, as if you were sailing in from the sea and looking up the rivers. Small crosses show how far he went himself; beyond the crosses he drew what the Native peoples told him.

Look closely

- Turn the map so that north is up. Can you find the Chesapeake Bay and the rivers flowing into it?
- Find the small crosses along the rivers. What did they show?
- Find the picture of Powhatan, the great chief, sitting in his longhouse. Where is he on the map?
- Look for the compass rose and the scale of miles. How are they like the ones on your maps?

Talk about it

1. Why do you think Smith's crosses are often near the place where the rivers become rocky and narrow?
2. How could Smith map land he never saw himself? Why was that both helpful and risky?
3. Why would a map like this have been so valuable to the English settlers?

Safety first. Water on the floor is slippery, so build the model outdoors, in a tub or on a towel. An adult should help with any cutting.

PROJECT: THE FALL-LINE MODEL

This is the main project of the unit. You will build the high Piedmont, the fall line and the low coastal plain in a tray, send a river over the falls, set your water wheel from Lesson 2.1 at the falls and sail a boat up from the sea until it must stop. Then you will mark where a city would grow.

You will need

- A large foil roasting pan, a plastic storage tub lid or a long baking pan
- Two or three books or a brick to tilt the pan
- Modeling clay or salt dough (2 cups flour, 1 cup salt, about $\frac{3}{4}$ cup water) for the Piedmont
- A few flat stones or pebbles for the falls
- Sand or soil for the coastal plain
- Your water wheel from Lesson 2.1 (or a small wheel made from a bottle cap and plastic spoon pieces on a toothpick)
- A pitcher of water and a cup
- A cork or bottle-cap boat, toothpicks and paper for city flags
- A towel

Steps

1. Tilt the pan by setting one end on books. The high end is the Piedmont; the low end is the sea.
2. At the high end, build a thick, hard block of clay or dough about one third of the length of the pan. This is the Piedmont of hard rock.
3. Make the front edge of the clay a steep step. Press flat stones into it to make a rocky waterfall. This is the fall line.
4. Spread sand below the step in a long, gentle slope down to the low end of the pan. Leave the last few inches bare for the sea.
5. Carve a river channel across the clay, over the falls and through the sand to the sea.
6. Set your water wheel just below the falls so the water will pour onto it. Prop the axle on two lumps of clay.
7. Pour water slowly from the cup at the top of the river. Watch it race over the falls, turn the wheel, then slow down and spread across the sand.
8. Float your boat at the sea end and push it up the river. Where must it stop?
9. Put a toothpick flag at the spot where the boat stops and the wheel turns. Name your city, and label the Piedmont, the fall line and the coastal plain with flags too.
10. Take a photograph or draw your model for your portfolio.

Tips

- Pour slowly. A fast flood will wash away the sand plain, which is just what happens to soft land in a real flood.
- Notice where the sand washes and settles. Soft land wears away easily; hard rock does not. That is why the falls form where the hard rock ends.

Check your work

- My model shows the Piedmont, the fall line and the coastal plain.
- The river turns my water wheel at the falls.
- I can show where a boat must stop and explain why a city grew there.

MAP NOTEBOOK

1. Draw Figure 2, the side view of the fall line, and label the Piedmont, the fall line, the coastal plain, the mill and the ship.
2. On an outline map of the East, draw the fall line in red and mark at least six fall-line cities.
3. Draw a tobacco hogshead and a cotton boll. Under each, write which part of the Southeast grew it and how it got to a ship.

From history. George Washington loved the Potomac River and believed it could become a highway to the West. In 1785 he became the first president of the Patowmack Company, which dug short canals with locks around the falls of the Potomac. The locks around the Great Falls were finished in 1802. You can still walk along the stone walls of the old canal at Great Falls Park in Virginia.

WORKED EXAMPLES

Example 1. On a map where 1 inch = 50 miles, Washington, D.C., and Richmond, Virginia, are 2 inches apart. How far apart are they, and in what direction is Richmond from Washington?

(Use the map or drawing “Both cities stand where rivers drop over the fall line.” shown earlier in this lesson.)

1. Each inch stands for 50 miles, so 2 inches stand for $2 \times 50 = 100$ miles.
2. On Figure 1, Richmond is below Washington and only a little to the left, so it is almost straight south.

Answer: About 100 miles; Richmond is south of Washington.

Example 2. Suppose a river drops 40 feet at its falls. Builders want to dig a canal around the falls with locks, and each lock lifts a boat 8 feet. How many locks do they need?

1. Each lock lifts the boat 8 feet.
2. Divide the whole drop by the lift of one lock: $40 \div 8 = 5$.
3. Check: $8 + 8 + 8 + 8 + 8 = 40$ feet.

Answer: 5 locks.

PRACTICE

1. **EASY** What is the fall line?
2. **EASY** Name four fall-line cities.
3. **MEDIUM** Give two reasons a city grew at the falls of a river.
4. **MEDIUM** On a map where 1 inch = 20 miles, Columbia, South Carolina, and Augusta, Georgia, are $3\frac{1}{4}$ inches apart. How far apart are they?
5. **MEDIUM** Use Figure 1. In what direction is Augusta from Columbia?
(Use the map or drawing “Start at Columbia, South Carolina.” shown earlier in this lesson.)
6. **HARD** A flat boat carries tobacco 30 miles down a river to a wharf on the Chesapeake. The current carries it at 2 miles per hour. How many hours does the trip take? If it starts at 6 in the morning, when does it arrive?
7. **HARD** Compare farming in New England and the Southeast. Give two differences in the land or climate and the crop each became known for.
8. **CHALLENGE** Eli Whitney’s cotton gin was a clever machine. Explain in two or three sentences why it also had a sad result.

COMMON MISTAKES

- Thinking the fall line is a single waterfall. It is a long line of many falls and rapids on many different rivers.
- Thinking the fall line is on the coast. It lies inland, often 50 to 150 miles from the ocean, where the coastal plain ends.
- Thinking the Chesapeake is just a big lake. It is an estuary, where rivers meet the salty ocean tide.

Make it a game • Above or Below the Falls?. A parent calls out a word: ocean ship, water wheel, sandy soil, hard rock, rolling hills, wharf, tide, Piedmont, marsh. You stand tall on your toes if it belongs above the fall line, crouch low if it belongs below, and put your hands together like falling water if it belongs right at the fall line. Then explain one answer. Switch roles after ten words.

Scripture. “Thou visitest the earth, and waterest it: thou greatly enrichest it with the river of God, which is full of water: thou preparest them corn, when thou hast so provided

for it.” (Psalm 65:9, KJV)

God waters the earth with rivers that feed crops and turn mill wheels. Rivers are a gift meant for good, and how people use them, for honest work or for wrong, matters to God.

Practice answers

1. The line where the hard, higher land of the Piedmont meets the low, soft coastal plain, so rivers drop over falls and rapids.
2. Any four of: Trenton, Philadelphia, Baltimore, Washington, Fredericksburg, Richmond, Columbia, Augusta, Macon, Columbus.
3. Ships from the sea had to stop and unload there (the head of navigation), and the falling water could turn water wheels for mills.
4. $3 \times 20 = 60$ miles, and $\frac{1}{4}$ of 20 = 5 miles, so $60 + 5 = 65$ miles.
5. Southwest.
6. $30 \div 2 = 15$ hours. It arrives at 9 o'clock that night.
7. New England has rocky soil and short summers because it is far north, so farms were small and people turned to fishing and mills. The Southeast has a long, warm growing season and rich, flat coastal land, so farmers grew cash crops like tobacco and cotton.
8. The gin made cleaning cotton fast, so growing cotton became very profitable and spread across the South. Planters wanted more workers in the fields, so slavery grew larger instead of fading away, and many more people were held in bondage until 1865.

2.4 FLORIDA AND THE GULF COAST: PENINSULAS, HURRICANES AND NEW ORLEANS

OBJECTIVES

- Find Florida, the Gulf of Mexico, the Mississippi delta and the ports of New Orleans, Mobile and Tampa on a map.
- Explain what a peninsula, a delta and a hurricane are, and why hurricanes strike the Gulf and Atlantic coasts in summer and fall.
- Track a storm on a letter-number grid and tell how people have built seawalls, levees and railroads to live with the coast.

Warm-up. Hold your hand flat on a table and stick out your thumb. Now imagine the table is the sea. Which part of your hand has water on three sides? Find a mitten-shaped or thumb-shaped piece of land on a map of the United States.

Watch. *The 1900 "Great Storm" and Raising Galveston* (The History Guy: History Deserves to Be Remembered, 13:22). https://www.youtube.com/watch?v=BEIQES_Dh0Q. After the section on hurricanes: the Great Storm of 1900 and how the people of Galveston raised their whole city and built a seawall.

Note: The History Guy tells the story plainly, including the loss of life. Watch it with your child.

KEY TERMS

peninsula

Land with water on three sides, joined to the mainland on one side. Florida is a peninsula.

Gulf Coast

The coast of the United States along the Gulf of Mexico, from Florida to Texas.

delta

Low land built of mud and sand that a river drops where it slows down and meets the sea.

levee

A bank of earth along a river, built by floods or by people, that keeps the river from spilling over the land.

hurricane

A huge, spinning storm that forms over warm ocean water, with winds of at least 74 miles per hour.

storm surge

A wall of seawater pushed onto the shore by a hurricane's winds.

CORE IDEAS

The story. In 1718 a French officer named Jean-Baptiste Le Moyne, Sieur de Bienville, picked out a spot for a new town on the Mississippi River, about 100 miles up from where the river meets the Gulf of Mexico. Most of the land nearby was swamp. But Bienville chose a strip of higher ground in a great bend of the river. Behind it, a short path and a little stream called Bayou St. John led to Lake Pontchartrain and from there to the Gulf. Boats could come and go two ways. He named the town **New Orleans**. Because the river curves around it like a new moon, it is still called the Crescent City. Every farmer up the Mississippi needed to send crops past that spot, which is why President Thomas Jefferson wrote in 1802 that any nation holding New Orleans would be America's natural enemy, because the crops of so much of the country had to pass through it to market. In 1803 the United States bought it, with all of Louisiana, from France.

How it works. Why was there high ground in a swamp? When the Mississippi floods, the water spills over its banks and slows down, dropping its heaviest sand right beside the river. Year after year this builds natural **levees**, the highest land around. Farther down, where the river meets the Gulf, it drops the rest of its mud and builds a **delta**, low land reaching out into the sea. The whole Gulf Coast is low and flat, with marshes, bayous, bays and long, thin barrier islands. Good ports grew where rivers and bays reach the Gulf: New Orleans, Mobile on Mobile Bay, Pensacola, Tampa, and Galveston and Houston on the coast of Texas.

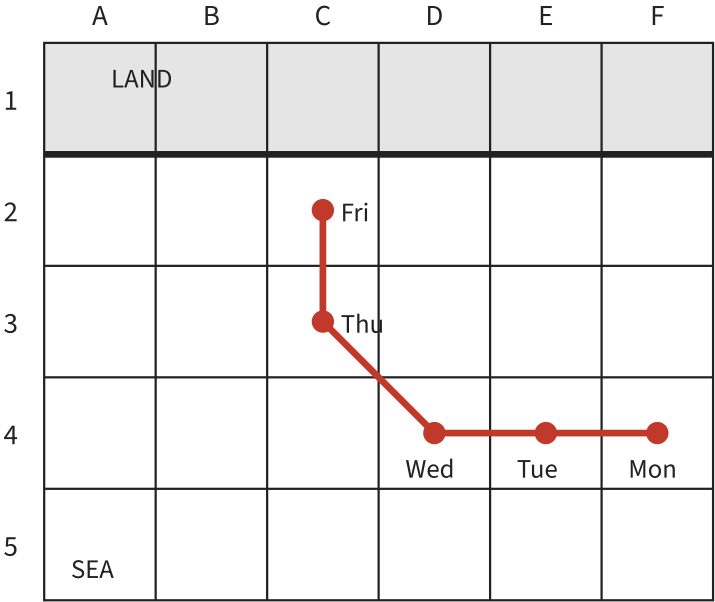
Hurricanes. In late summer the Gulf of Mexico and the Atlantic Ocean near Florida grow very warm. Warm ocean water feeds great spinning storms called **hurricanes**, with winds of 74 miles per hour or more and a calm "eye" in the center. Hurricane season runs from June 1 to November 30. The most dangerous part is often the **storm surge**, seawater pushed over low land. On September 8, 1900, a hurricane struck Galveston, Texas, a city on a low sandy island. At least 6,000 people died, the deadliest natural disaster in American history. The survivors did not give up. They built a concrete seawall 17 feet high and pumped sand to raise the level of their whole city.

Florida. Florida is a **peninsula** about 400 miles long, with the Atlantic on the east and the Gulf on the west. Juan Ponce de León named it La Florida in 1513, and in 1565 Pedro Menéndez de Avilés founded **St. Augustine**, the oldest city in the mainland United States settled by Europeans that has been lived in ever since. Florida is so flat that its highest point, Britton Hill, is only 345 feet above sea level, the lowest high point of any state. Its long, warm growing season is good for oranges.

Technology overcoming geography. At the tip of Florida, a chain of small islands called the Florida Keys curves out into the sea. Many people said no railroad could ever cross them. But Henry Flagler's workers built bridges from island to island, and in January 1912 the first train rolled into **Key West**. A hurricane in 1935 wrecked the line, and the Overseas Highway was built along its path. Seawalls, levees and bridges show how people use their God-given skill to live wisely on a beautiful but stormy coast.



Figure 1. Florida and the ports of the Gulf Coast.



Each square is 100 miles across.

Figure 2. Tracking a storm on a grid.

PICTURE STUDY



Bird's Eye View of New-Orleans, John Bachmann, 1851 · Lithograph · Library of Congress, Prints and Photographs Division

Long before airplanes, artists like John Bachmann drew cities as if seen from a hot-air balloon. He walked the streets, studied maps and imagined how everything would look from high above. These “bird’s-eye views” were sold to people proud of their growing cities.

Here Bachmann shows New Orleans in 1851, when it was one of the busiest ports in the country. Ships from the sea and steamboats from up the river crowded the levee, the riverbank where goods were loaded and unloaded.

Look closely

- Find the Mississippi River. Can you see how it curves around the city like a crescent?
- Look along the riverbank. How many ships and steamboats can you count in one small part?
- Look at the streets. Do they follow the curve of the river?
- Look far behind the city. What kind of land do you see there?

Talk about it

1. Why would so many boats gather at this one city?
2. What would happen to the city if the river rose over its banks? How might people protect it?
3. How is a bird’s-eye view different from a map, and how is it the same?

PROJECT: BUILD A DELTA AND A LEVEE

You will make a river carry sand down a slope and watch it build a delta where it reaches the “sea.” Then you will build a levee to protect a riverside town and test it with a flood.

You will need

- A long baking pan or plastic storage tub
- Books to tilt the pan
- Sand mixed with a little soil (about 4 cups)
- A paper or plastic cup with a small hole poked in the bottom
- A pitcher of water
- Modeling clay for the levee
- Sugar cubes or small blocks for houses
- A towel

Steps

1. Spread the sand in the upper two thirds of the pan and tilt the pan gently so the bare end is lower. The bare end is the Gulf. Pour a little water into it.
2. Carve a river channel down the middle of the sand with your finger.
3. Hold the cup with the hole over the top of the river and fill it with water. Let it drip and trickle for a few minutes.
4. Watch where the river slows down as it reaches the Gulf. Draw what happens to the sand there. That fan of new land is your delta.
5. Set two or three sugar-cube houses on the bank close to the river.
6. Make a flood: pour water quickly down the river. What happens to the houses?
7. Rebuild, and this time press a low wall of clay along the riverbank in front of the houses. That is your levee. Flood the river again.
8. Write two sentences about what the levee did, and one sentence about what might happen if the water rose higher than the levee.

Tips

- Pour slowly at first. Deltas grow from gentle, steady flow.
- Real New Orleans was built on the natural levee, the highest ground near the river. Try to find the highest ground in your pan.

Check your work

- I can point to the delta in my model and explain how it formed.
- I built a levee and tested it with a flood.
- I can explain why Bienville chose higher ground for New Orleans.

MAP NOTEBOOK

1. Draw an outline map of Florida and the Gulf Coast. Label the Gulf of Mexico, the Atlantic Ocean, New Orleans, Tampa, St. Augustine and Key West.
2. Draw a hurricane from above, with its spinning bands of clouds and its calm eye. Label the eye.
3. Draw a side view of New Orleans: the river, the natural levee with the city on it, and the low swamp behind.

From history. St. Augustine is guarded by the Castillo de San Marcos, a Spanish fort begun in 1672 and finished in 1695. It is built of coquina, a soft stone made of tiny seashells pressed together. When cannonballs struck the walls, the shell stone squeezed and soaked up the blow instead of shattering. The fort still stands and is cared for by the National Park Service.

WORKED EXAMPLES

Example 1. Use Figure 2. Each square is 100 miles across. On Monday the storm was in square F4. On Wednesday it was in square D4. How far did it travel, and how many miles did it go each day?

(Use the map or drawing “Read the letter first, then the number.” shown earlier in this lesson.)

1. Find F4 and D4. Both are in row 4, so the storm moved straight across.
2. Count the squares from F to D: F to E is 1, E to D is 2. The storm moved 2 squares.
3. $2 \text{ squares} \times 100 \text{ miles} = 200 \text{ miles}$.
4. From Monday to Wednesday is 2 days. $200 \div 2 = 100 \text{ miles each day}$.

Answer: 200 miles, or 100 miles a day, moving west.

Example 2. On a map where 1 inch = 40 miles, New Orleans and Mobile are $3\frac{1}{4}$ inches apart. How far apart are they? In what direction is Mobile from New Orleans?

(Use the map or drawing “Both are Gulf ports at the mouths of great rivers and bays.” shown earlier in this lesson.)

1. 3 inches stand for $3 \times 40 = 120$ miles.
2. $\frac{1}{4}$ inch stands for one fourth of 40, which is 10 miles.
3. Add: $120 + 10 = 130$ miles.
4. On Figure 1, Mobile is to the right of New Orleans and a little higher, so it is east, a little north of east.

Answer: About 130 miles; Mobile is east of New Orleans.

PRACTICE

1. **EASY** What is a peninsula? Name the peninsula state in this lesson.
2. **EASY** When is hurricane season, and how fast must a storm's winds blow for it to be called a hurricane?
3. **MEDIUM** Use Figure 2. The storm was in E4 on Tuesday, C3 on Thursday and C2 on Friday. On Saturday it moved one more square north. Which square was it in on Saturday, and was that square land or water?
(Use the map or drawing "Row 1 is land." shown earlier in this lesson.)
4. **MEDIUM** Florida's highest point, Britton Hill, is 345 feet high. Mount Washington in New Hampshire is 6,288 feet high. How much higher is Mount Washington?
5. **MEDIUM** Use Figure 1. Which city is farther south, Tampa or Key West? In what direction would a train travel from Miami to Key West?
(Use the map or drawing "Follow the railroad line from Miami." shown earlier in this lesson.)
6. **HARD** Galveston's seawall is 17 feet high. Suppose a storm pushes the sea up 12 feet above normal. How many feet of wall are left above the water? If the surge were 20 feet, what would happen?
7. **HARD** Give two reasons Bienville chose the spot where he built New Orleans.
8. **CHALLENGE** A farmer in Ohio in 1800 wants to sell his corn and pork in faraway cities. Explain in two or three sentences why New Orleans mattered to him, even though he lived hundreds of miles away.

COMMON MISTAKES

- Thinking a peninsula is an island. An island has water all around; a peninsula is still joined to the mainland.
- Thinking the wind is the only danger of a hurricane. The storm surge and flooding often do the most harm.
- Reading a grid square with the number first. In this course we read the letter (column) first, then the number (row), as in Unit 1.

Make it a game • Hurricane Hunters. Draw a 6 by 5 grid with letters A to F across the top and numbers 1 to 5 down the side, and shade row 1 as land. One player secretly plans a storm path of five squares and calls out each square one at a time. The other player marks it with a dot and after each call guesses where the storm will make landfall in row 1. A correct guess before landfall scores 3 points; a correct guess at the last call scores 1. Switch roles.

Scripture. "And he arose, and rebuked the wind, and said unto the sea, Peace, be still. And the wind ceased, and there was a great calm." (Mark 4:39, KJV)

The disciples were terrified in a storm on the Sea of Galilee. Jesus showed that the winds and waves obey Him. People on stormy coasts prepare wisely, and they can also trust the Lord who rules the storm.

Practice answers

1. Land with water on three sides, joined to the mainland on one side. Florida.
2. June 1 to November 30. Winds of at least 74 miles per hour.
3. C1. Row 1 is land, so the storm had come ashore (made landfall).
4. $6,288 - 345 = 5,943$ feet higher.
5. Key West is farther south. The train travels southwest.
6. $17 - 12 = 5$ feet of wall above the water. A 20-foot surge would be 3 feet higher than the wall, so water would pour over it.
7. It was on higher ground (the natural levee) in a bend of the Mississippi, safer from floods than the swamp around it, and a short path and bayou led to Lake Pontchartrain and the Gulf, so boats could come and go two ways. Every boat going down the Mississippi had to pass it.
8. Roads over the mountains to the East were poor, so the easiest way to ship heavy crops was down the Ohio and Mississippi rivers by boat. All those boats had to pass New Orleans to reach ships on the Gulf, so whoever controlled New Orleans controlled the farmer's way to market.

UNIT 2 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use a ruler. The review is worth 50 points.

1. (4 pts) Name the six New England states.
2. (5 pts) New England has rocky soil and short summers. Name two other kinds of work New Englanders turned to, and the part of the land or sea that made each one possible.
3. (4 pts) Who was Samuel Slater, and where did he build his mill?
4. (5 pts) On a map where 1 inch = 40 miles, New York and Philadelphia are 2 inches apart. How far apart are they? In what direction is Philadelphia from New York?
5. (5 pts) Name three things that make a great harbor, and tell which one Long Island and Staten Island give New York.
6. (4 pts) What happened at Fort McHenry in Baltimore in September 1814?
7. (5 pts) What is the fall line, and why did cities grow along it? Give two reasons.
8. (4 pts) Name four fall-line cities.
9. (4 pts) On a map where 1 inch = 50 miles, Washington and Richmond are 2 inches apart. How many miles is that? If a wagon travels 20 miles a day, how many days does the trip take?
10. (5 pts) A storm on a grid map is in square F4 on Monday and square C4 on Thursday. Each square is 100 miles across. How far did it travel, and how many miles a day is that?
11. (5 pts) Explain why Bienville built New Orleans on the high ground in a bend of the Mississippi, and why the city mattered to farmers far up the river.

UNIT PROJECT: THE FALL LINE: MODEL AND MAP

Finish your fall-line model from Lesson 2.3, with the Piedmont, a rocky waterfall, the coastal plain, the sea and your working water wheel from Lesson 2.1. Photograph it or draw it, and label each part. Beside it, make a large map of the East Coast from New Jersey to Georgia. Draw the fall line in red, mark and label at least eight fall-line cities and the rivers they stand on, and add the Chesapeake Bay, New York Harbor and the Atlantic Ocean.

Under your map, write a paragraph explaining why so many of the oldest cities in the East stand on the fall line, using the words *Piedmont*, *coastal plain*, *head of navigation* and *water power*.

- **Model:** The model clearly shows the high Piedmont, the falls, the low coastal plain and the sea, and the water wheel turns when water flows over the falls.
- **Map accuracy:** The fall line runs in the right place, roughly parallel to the coast, and at least eight cities and their rivers are placed and labeled correctly.
- **Explanation:** The paragraph correctly uses all four terms and explains both reasons cities grew at the falls.

- **Care:** The model, map and writing are neat, colorful and easy to read, with a title, a compass rose and a scale on the map.

Answer key

1. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.
2. Fishing (and whaling), made possible by the long coast, harbors and fish-filled banks at sea; and mill work, made possible by fast rivers with waterfalls to turn water wheels.
3. An English mill worker who came to America in 1789 and built cotton-spinning machines from memory. He built his mill at Pawtucket, Rhode Island, at the falls of the Blackstone River.
4. $2 \times 40 = 80$ miles. Philadelphia is southwest of New York.
5. Deep water, shelter from storms and waves, and a river or road leading inland. Long Island and Staten Island give New York shelter.
6. British warships bombarded the fort, but it held. Francis Scott Key watched and wrote the poem that became "The Star-Spangled Banner."
7. It is where the hard, higher land of the Piedmont drops to the soft, low coastal plain, so rivers fall over falls and rapids. Cities grew there because ships from the sea had to stop and unload (the head of navigation) and because the falling water could power mills.
8. Any four of: Trenton, Philadelphia, Baltimore, Washington, Fredericksburg, Richmond, Columbia, Augusta, Macon, Columbus.
9. $2 \times 50 = 100$ miles. $100 \div 20 = 5$ days.
10. F to C is 3 squares, so $3 \times 100 = 300$ miles in 3 days, which is 100 miles a day.
11. The natural levee was the highest, driest ground in the swamp, and a short path and bayou led to Lake Pontchartrain and the Gulf. Farmers up the Mississippi shipped their crops down the river, and every boat had to pass New Orleans to reach the sea.

THE MIDWEST AND THE GREAT PLAINS

In the middle of North America God laid out some of the richest farmland and the greatest freshwater lakes on earth. In this unit you will travel from the cold, deep waters of Lake Superior to the cornfields of Iowa and Illinois, and then west across the wide, windy Great Plains. You will see how iron ore rode the lakes in long ore boats, why a great city grew at the bottom of Lake Michigan, how deep prairie soil was built by roots, and why wheat and cattle fit the drier land farther west. The Bible says that God “hath determined the times before appointed, and the bounds of their habitation” (Acts 17:26), and here you will watch families find their place on a new land.

You will meet the surveyor William Burt and his jumping compass needle, the explorers Jolliet and Marquette at the Chicago portage, the blacksmith John Deere and his shining steel plow, the painter Grant Wood, the windmill maker Daniel Halladay, and the homesteaders who built houses out of the earth itself. In every lesson you will ask: **what did this land give, what did it make hard, and how did people use skill and tools to live well on it?**

BEFORE YOU BEGIN

- Can use a map scale such as 1 inch = 100 miles (Lesson 1.1)
- Knows the township grid: a section is one square mile (Lesson 1.4)
- Can find north, south, east and west on a map
- Can multiply and divide by one- and two-digit numbers

MASTERY CHECKLIST

- I can name and locate the five Great Lakes and explain how their water flows down to the Atlantic Ocean.
- I can explain how ore boats and the Soo Locks carried iron, and why Chicago grew where it did.
- I can explain why the Corn Belt is such good farmland and how John Deere’s steel plow helped farmers break the prairie.
- I can locate the Great Plains and the 100th meridian and explain why the plains are dry and windy.
- I can explain how a windmill pumps water, and I built a paper windmill that lifts a weight.
- I can tell what the Homestead Act promised and how homesteaders built sod houses.

OPTIONAL BOOKS AND RESOURCES

- **Homestead National Historical Park (National Park Service)**
(<https://www.nps.gov/home/>): Free. The park stands on Daniel Freeman’s claim near

Beatrice, Nebraska (Lesson 3.4). Its website has pictures, a history of the Homestead Act and family activities.

- **Library of Congress** (<https://www.loc.gov/>): Free. Search “Solomon Butcher” for photographs of Nebraska homesteaders and their sod houses, and “bird’s-eye view Chicago” for old city views like the one in Lesson 3.1.
- **Willa Cather, *O Pioneers!* (free at Project Gutenberg)** (<https://www.gutenberg.org/ebooks/24>): Free. A 1913 novel about a Swedish homestead family on the Nebraska prairie. The whole book is for older readers, so a parent may read aloud the opening pages describing the windy little prairie town and the wide, hard land.

3.1 THE GREAT LAKES ★

OBJECTIVES

- Name and locate the five Great Lakes (HOMES) and trace how their water flows like a staircase down to the Atlantic Ocean.
- Tell the story of William Burt's jumping compass needle and explain how ore boats and the Soo Locks carried iron to the steel mills.
- Explain why Chicago grew at the south end of Lake Michigan and measure distances on a Great Lakes map with a scale.

Warm-up. Set five bowls or cups on steps: one on a tall stack of books, two on a shorter stack, one a little lower, and one on the floor. Pour water into the top cup until it spills over into the next. Where does the water end up? Which way does water always travel? Keep this staircase in mind: the Great Lakes work the same way.

Watch. *Value and History of the Soo Locks* (Usace Detroit, 5:04).

https://www.youtube.com/watch?v=e1uBFjGN_VY

After the story of the ore boats: the Army Corps of Engineers explains why the Soo Locks were built and what they carry today.

Backup video. *On the Shores of the Great Lakes* (Smithsonian Channel, 2:21).

<https://www.youtube.com/watch?v=gagnnGKprBE>

Before the story: a short look at the shores of the Great Lakes.

KEY TERMS

Great Lakes

Five huge freshwater lakes in the middle of North America: Huron, Ontario, Michigan, Erie and Superior (remember HOMES).

freshwater

Water that is not salty, like the water in most lakes and rivers.

iron ore

Rock with a lot of iron in it. It is melted in furnaces to make iron and steel.

ore boat

A long cargo ship, also called a lake freighter, that carries iron ore across the Great Lakes.

lock

A walled chamber of water with gates at each end that lifts or lowers a boat from one water level to another.

portage

A short path over land where travelers carry their canoes and goods from one river or lake to another.

CORE IDEAS

The story. In September 1844 a surveyor named William Austin Burt was marking survey lines in the wild forests of Michigan's Upper Peninsula, near a little lake called Teal Lake. These were the same township lines you studied in Unit 1. Suddenly the needle of a magnetic compass began to swing and jump. It would not point north at all! Burt was not worried, because he had invented a *solar compass* that found direction from the sun instead of from magnetism. But he told his crew to look around, and they found rocks heavy with **iron ore**. The needle had been pulled by the iron in the ground. Soon miners came to dig, and the iron of the Lake Superior country began to travel to the whole nation.

How it worked. Iron ore is heavy, and the furnaces that turned it into steel were far away, near the coal of Ohio and Pennsylvania. The cheapest way to move heavy things is by water, and here God had laid out a water road hundreds of miles long. But there was a problem. Lake Superior sits about 21 feet higher than Lake Huron, and the water tumbles between them down the rapids of the St. Marys River. At first, cargo had to be unloaded and carried around the rapids. In 1855 the first lock opened at Sault Ste. Marie, which people call "the Soo." Now ships could be lifted and lowered like riders in a water elevator. Long **ore boats** were built to carry the ore. The biggest lake freighters today are about 1,000 feet long, longer than three football fields, and carry more than 60,000 tons of ore from docks at Duluth, Minnesota, to steel mills in places like Gary, Indiana, and Cleveland, Ohio.

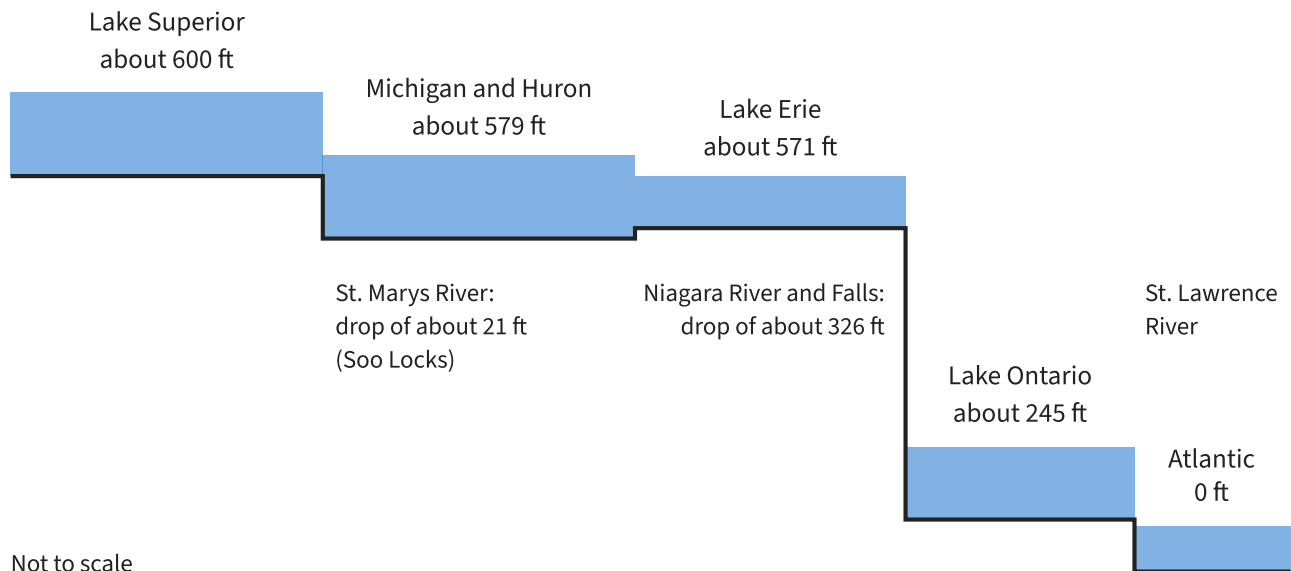
The big idea. The five Great Lakes are Huron, Ontario, Michigan, Erie and Superior. Remember them with the word **HOMES**. Together they are the largest group of freshwater lakes on earth, holding about one-fifth of all the fresh water lying on the surface of the world. Lake Superior covers more area than any other freshwater lake, and in one place it is more than 1,300 feet deep. Lake Michigan is the only Great Lake that lies entirely inside the United States; the other four are shared with Canada. The lakes are like a giant staircase. Water flows from Superior down to Huron and Michigan, then to Erie, then over Niagara Falls into Ontario, and at last down the St. Lawrence River to the Atlantic Ocean.

On the map. Find the bottom tip of Lake Michigan. In 1673 the explorer Louis Jolliet and the missionary Father Jacques Marquette paddled their canoes up the Illinois River on their way home from the Mississippi. Near the lake they carried their canoes over a short, low **portage** to the Chicago River and out onto Lake Michigan. Jolliet saw at once that a short canal there could join the Great Lakes to the Mississippi. In 1848 the Illinois and Michigan Canal did just that, and railroads soon followed, because every railroad going around the lake had to pass its southern end. Grain, lumber and cattle poured in. Chicago grew from a muddy trading post into a city of more than a million people by 1890.

Technology overcoming geography. A lake can be a wall or a highway. With locks, canals and strong ships, people turned the Great Lakes into a highway reaching into the heart of the continent. In Unit 6 you will see how the Erie Canal joined Lake Erie to New York City, and how a lock really lifts a boat.



The Great Lakes and the ore-boat route from Duluth to the south end of Lake Michigan.



The Great Lakes staircase (not to scale). Water always flows downhill toward the sea.

PICTURE STUDY



The City of Chicago, Currier & Ives, 1892 · Color lithograph (a print made from drawing on stone) · Library of Congress, Washington, D.C.

Nathaniel Currier and James Merritt Ives ran a print shop in New York City that sold cheap, colorful pictures to families all over America. Their artists made many “bird’s-eye views,” pictures of a city drawn as if the artist were floating high above it in a balloon. Few artists ever went up in a balloon, so most of them studied maps and walked the streets, then imagined the view from the sky.

This print shows Chicago about fifty years after it became a city. Look at how the lake, the river, the ships and the streets fit together. You are looking at a city that grew because of where it stood.

Look closely

- Find Lake Michigan. Where is it in the picture: in front of the city or behind it?
- Look for ships on the lake. Can you tell which have sails and which have smokestacks?
- Find the Chicago River where it meets the lake. Why would a river mouth be a good place for a harbor?
- Follow the streets back toward the horizon. Do they run in a grid, like the township lines of Unit 1?

Talk about it

1. Why do you think so many ships and trains came to this one spot at the bottom of Lake Michigan?
2. If you could stand in this picture, what sounds and smells do you think you would notice?

3. How is a bird's-eye view like a map, and how is it different?

PROJECT: A SALT-DOUGH GREAT LAKES MAP AND ORE-BOAT VOYAGE

You will build the Great Lakes in salt dough, paint them blue, and then sail a paper ore boat from the iron docks of Duluth to the steel mills at the south end of Lake Michigan, measuring your voyage with a string and a map scale.

You will need

- 2 cups flour, 1 cup salt and about 3/4 cup water (salt dough)
- A piece of stiff cardboard about 12 by 16 inches
- A printed outline map of the Great Lakes (or trace the map in this lesson)
- Blue and green paint, brushes, toothpicks and small paper flags
- A piece of string, a ruler and a small paper boat folded from a sticky note

Steps

1. Trace the outline of the Great Lakes and the land around them onto your cardboard.
2. Mix the salt dough. Press it onto the land parts, about a half inch thick. Leave the lakes as low, flat hollows.
3. Make the lake beds step down a little from Superior to Ontario, like a staircase. Pinch a tiny ridge where Niagara Falls is.
4. Let the map dry for a day or two (or bake at a low heat with a parent's help). Paint the lakes blue and the land green.
5. Make toothpick flags for Duluth, Sault Ste. Marie, Chicago, Gary, Detroit, Cleveland and Buffalo, and push them in at the right places.
6. Write a scale on the corner of your map. Check your printed map to find how many miles one inch stands for.
7. Lay the string along the ore-boat route: across Lake Superior, through the Soo, through the Straits of Mackinac and down Lake Michigan. Measure the string with the ruler and use the scale to find the miles.
8. Sail your paper boat along the route and tell the story of its trip out loud, naming each lake as you pass it.

Tips

- Use HOMES to check that you have all five lakes.
- A ship cannot sail over land, so your string must follow the water, not a straight line.
- If the dough cracks as it dries, fill the cracks with a little fresh dough and smooth them with a wet finger.

Check your work

- I can point to and name all five Great Lakes.
- I can show the ore-boat route and name the lock it passes through.

- I can use a map scale to find the length of a water route.

MAP NOTEBOOK

1. Draw the five Great Lakes from memory. Label them with HOMES and shade Lake Michigan to show it is the only one entirely in the United States.
2. Draw the Great Lakes staircase as a side view, with Superior at the top and the Atlantic Ocean at the bottom. Mark the Soo Locks and Niagara Falls.
3. Draw Jolliet and Marquette carrying their canoe over the Chicago portage. Under it, write one sentence about why Chicago grew there.

From history. The Chicago River once flowed into Lake Michigan, carrying the city's waste into the lake that the city drank from. To fix this, Chicago dug the Sanitary and Ship Canal, and in 1900 engineers opened it so that the river ran backward, away from the lake and toward the Illinois River and the Mississippi. Jolliet's old idea of joining the lake to the Mississippi helped keep a whole city's drinking water clean.

WORKED EXAMPLES

Example 1. Lake Superior sits about 600 feet above sea level. Lake Huron sits about 579 feet above sea level. How many feet must an ore boat be lowered to go from Lake Superior to Lake Huron?

(Use the map or drawing "Lake Superior is the top step of the staircase." shown earlier in this lesson.)

1. Find the difference between the two water levels by subtracting: $600 - 579$.
2. $600 - 579 = 21$.
3. Check the staircase diagram: Superior is the top step and Huron is the next one down, so the boat must go down.

Answer: About 21 feet. That is the drop that the Soo Locks lower a boat (or lift it on the way back up).

Example 2. An ore boat sails from Duluth to the steel mills at Gary, Indiana, a water trip of roughly 800 miles. If the boat goes about 16 miles each hour, about how many hours does the trip take?

1. Distance $\div$ speed = time.
2. $800 \div 16$: think $16 \times 5 = 80$, so $16 \times 50 = 800$.
3. $800 \div 16 = 50$ hours.
4. 50 hours is 2 days (48 hours) and 2 more hours.

Answer: About 50 hours, or a little more than 2 days.

PRACTICE

1. **EASY** Name the five Great Lakes. Use the word HOMES to help you.
2. **EASY** Which Great Lake lies entirely inside the United States? Which Great Lake is the largest?
3. **MEDIUM** On a map where 1 inch stands for 100 miles, Chicago and Detroit are 2.4 inches apart in a straight line. About how far apart are they in miles?
(Use the map or drawing "Find Chicago and Detroit." shown earlier in this lesson.)
4. **MEDIUM** Lake Erie is about 571 feet above sea level and Lake Ontario is about 245 feet above sea level. How far does the water drop between them? Where does most of that drop happen?
5. **MEDIUM** An ore boat travels 16 miles an hour. How long will it take to sail 400 miles across Lake Superior?
6. **HARD** Duluth is about 400 miles from Chicago in a straight line, but an ore boat must sail about 800 miles to get there. Use the map to explain why the water route is longer. How many times longer is it?
(Use the map or drawing "Follow the red route from Duluth to Chicago." shown earlier in this lesson.)
7. **HARD** Here are the areas of the Great Lakes in square miles: Erie 9,900; Huron 23,000; Michigan 22,400; Ontario 7,300; Superior 31,700. List them from largest to smallest. How many more square miles does Superior cover than Ontario?
8. **CHALLENGE** Write three or four sentences explaining why a great city grew at the south end of Lake Michigan.

COMMON MISTAKES

- Thinking the Great Lakes are salty like the ocean. They are freshwater lakes, and many cities drink from them.
- Mixing up the order of the staircase. Water flows from Superior (highest) to Huron and Michigan, then Erie, then Ontario (lowest) and out the St. Lawrence River.
- Measuring a ship's trip with a straight line. A ship must follow the water around the land, so its route is longer than the straight-line distance.

Make it a game • HOMES Hop. Lay five pillows on the floor in the shape of the Great Lakes, with a sheet of paper on each naming one lake. A parent calls out a clue, such as "the largest," "the only one all in the United States," "the lake just above Niagara Falls," or "where the Soo Locks begin." Hop to the right lake. Then play "ore boat": hop the whole route from Superior to Michigan in the right order, saying each lake and the lock or strait you pass. Every correct hop scores a point.

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 of the ore boats do business on great waters, and Lake Superior can raise storms as fierce as the sea. The lakes, the iron in the hills and the low portage at Chicago are all works of the Lord that people discovered and put to good use.

Practice answers

1. Huron, Ontario, Michigan, Erie, Superior.
2. Lake Michigan lies entirely in the United States. Lake Superior is the largest.
3. $2.4 \times 100 = 240$. About 240 miles.
4. $571 - 245 = 326$ feet. Most of it happens at Niagara Falls and in the rapids of the Niagara River.
5. $400 \div 16 = 25$ hours.
6. A boat cannot cross the land of Wisconsin and Michigan. It must sail east across Lake Superior, go down through the Soo Locks, pass through the Straits of Mackinac into Lake Michigan and then sail south. $800 \div 400 = 2$, so the water route is about 2 times as long.
7. Superior, Huron, Michigan, Erie, Ontario. $31,700 - 7,300 = 24,400$ square miles more.
8. Sample answer: Chicago stands where a short, low portage joins the Great Lakes to the rivers that flow to the Mississippi, as Jolliet and Marquette found in 1673. In 1848 a canal joined the two water systems there. Railroads going around Lake Michigan all had to pass its southern end, so they met at Chicago. Ships, canal boats and trains brought grain, lumber and cattle together, and the city grew to more than a million people by 1890.

3.2 THE CORN BELT

OBJECTIVES

- Locate the Corn Belt states on a map and explain how deep prairie soil, flat land and warm, rainy summers make it one of the best farming regions on earth.
- Tell the story of John Deere's steel plow (1837) and explain why the old plows failed in prairie soil.
- Use sections, acres and bushels to figure how much grain a Corn Belt farm can raise.

Warm-up. Dig up a small scoop of soil from a garden or yard (or open a bag of potting soil). Rub some between your fingers. Is it dark or light? Gritty or smooth? Can you find any roots, bits of leaves or tiny creatures? Write three words that describe it. Today you will learn why the soil of the Corn Belt is some of the richest in the world.

Watch. *Corn in the Classroom* (MissouriCorn, 5:45). https://www.youtube.com/watch?v=F2pLonUh_Qk

After the big idea: how corn grows from seed to harvest on a Corn Belt farm.

Note: Says ethanol made from corn is good for the environment; the lesson does not take that up.

Backup video. *Growing corn time lapse* #greentimelapse #gtl #timelapse (Green Timelapse, 2:07). https://www.youtube.com/watch?v=RW_GpNciIuA

As review: a time-lapse of corn growing from seed to tassel. Note: No narration.

KEY TERMS

prairie

A wide, mostly flat or rolling land covered with tall grasses and flowers and few trees.

topsoil

The dark top layer of soil, rich in bits of old roots and leaves, where crops grow best.

Corn Belt

The farming region of the Midwest, centered on Iowa, Illinois, Indiana and nearby states, where corn is the main crop.

bushel

A measure of grain. A bushel of shelled corn weighs about 56 pounds.

section

A square of land one mile on each side, holding 640 acres. A quarter section holds 160 acres.

growing season

The part of the year between the last frost of spring and the first frost of fall, when crops can grow.

CORE IDEAS

The story. In 1836 a young blacksmith named John Deere left Vermont and opened a shop in the little town of Grand Detour, Illinois. The farmers who came to him had a problem. Their plows were made of cast iron, which worked well in the sandy soils back East. But the black prairie soil of Illinois was thick and sticky. It clung to the iron plow like wet clay, and every few steps the farmer had to stop and scrape it off with a paddle. In 1837 Deere tried something new. He took a broken steel saw blade, shaped it, and polished it smooth and bright. When it was pulled through the field, the sticky soil slid right off. The steel plow could cut the prairie, and Deere's little shop grew into one of the great farm-machine companies of the world.

How it worked. Why was the prairie soil so thick and dark? For a very long time, tall grasses and wildflowers had covered the land. Their roots grew down deep, and some prairie plants sent roots more than ten feet into the ground. Every year old roots and leaves died and rotted into the earth, and new ones grew. Little by little this made a deep layer of dark, rich **topsoil**, in many places more than a foot thick. The roots were tangled so tightly that the sod was hard to break. Once it was broken, though, the soil underneath was a treasure.

The big idea. The **Corn Belt** is the middle of the Midwest: Iowa, Illinois and Indiana, with parts of Ohio, Nebraska, Minnesota, Missouri and South Dakota. Four gifts make it one of the best places on earth to grow corn. First, the deep, dark soil. Second, the land is mostly flat or gently rolling, so big machines can work it. Third, the summers are hot and humid, with warm nights, and the rain falls mostly during the **growing season**, just when the corn needs it. Fourth, there are enough frost-free days, about five or six months, for corn to grow tall and ripen. An old farm saying tells how fast it grows: "Knee high by the Fourth of July." Iowa and Illinois grow more corn than any other states, and the United States grows about a third of all the corn in the world.

On the map. Look at the Corn Belt from an airplane and you will see a giant checkerboard. The fields follow the township grid of Unit 1: squares one mile on a side called **sections**, each with 640 acres. A farm might be a quarter section of 160 acres or many sections together. Roads often run along the section lines, one mile apart. Rivers like the Mississippi, Missouri and Illinois carry the harvest on barges, and railroads carry it to Chicago and to ports on the Gulf of Mexico and beyond.

The grain that feeds the world. Corn was first grown long ago by the native farmers of Mexico, who bred it from a wild grass, and Native nations carried it north across America. Today most Corn Belt corn feeds cattle, hogs and chickens, so it comes to your table as beef, pork, eggs and milk. Some becomes cornmeal, corn syrup and cornstarch, some is made into fuel, and much is shipped to other countries. The King James Bible uses the word "corn" for any grain, and it says God "preparest them corn." A Corn Belt farmer plows and plants, but it is God who sends the sun and the rain.



The farm belts of the Midwest and the Great Plains.

PICTURE STUDY



Stone City, Iowa, Grant Wood, 1930 · Oil on wood panel · Joslyn Art Museum, Omaha, Nebraska

Grant Wood was born in 1891 on a farm near Anamosa, Iowa, and grew up in Cedar Rapids, where he later taught art to schoolchildren. He believed that the farms and small towns of the Midwest were worth painting just as much as the famous places of Europe. In 1930 he painted *American Gothic*, which became one of the most famous paintings in America.

That same year he painted *Stone City*, a little limestone-quarry village on the Wapsipinicon River near Anamosa. Wood loved to show the Iowa land as smooth and round, almost like a quilt or a toy landscape, with rows of crops running over the hills like stitching. Look at the very front of the picture: the farmer has just planted his corn.

Look closely

- Find the rows of young corn in the front of the painting. How tall are the plants?
- Find other fields on the far hills. Do their rows run straight, or do they curve with the shape of the hills?
- Look at the shapes of the trees and hills. What do they remind you of?
- Find the windmill, the barns, the bridge and the river. Can you find any people or animals? How small are they compared with the land?

Talk about it

1. How does Grant Wood make the farmland look peaceful and orderly?
2. If corn should be knee high by the Fourth of July, about what month do you think he is showing?
3. Why would a river, a road and a bridge matter to farmers who grow more corn than they can eat?

PROJECT: PRAIRIE SOIL IN A JAR AND A CORN WINDOW

You will do two experiments. First, you will shake soil in a jar of water and watch it settle into layers to see what soil is made of. Second, you will sprout corn seeds against the glass of a jar so you can watch the roots grow day by day, the way prairie roots built the Corn Belt's soil.

You will need

- Two clear jars with lids (pint or quart size)
- About 1 cup of garden soil
- Water and a teaspoon of salt
- Paper towels
- 6 to 8 dried corn kernels (popcorn or field corn from a feed store; soak them in water overnight)
- A ruler and your map notebook

Steps

1. Soil jar: fill the first jar about one-third full of soil. Add water until the jar is nearly full. Add the salt, which helps the fine bits settle.
2. Screw on the lid tightly and shake hard for two minutes. Set the jar where it will not be bumped.
3. After one hour, and again after one day, look at the layers. The heavy sand settles first on the bottom, then silt, then fine clay. Dark bits of old plants may float on top.

4. Draw the jar in your notebook and label each layer. Measure each layer with the ruler.
5. Corn window: roll up two or three wet paper towels and stuff them into the second jar so they press against the glass.
6. Slide the soaked corn kernels between the paper towel and the glass, spaced around the jar, about an inch below the top.
7. Keep the towels damp and the jar in a warm place. Each day, measure the longest root and the longest shoot and record them in a table.
8. After a week, compare: which grew faster, the root or the shoot? Which way did the roots grow?

Tips

- Soil from different places makes different layers. If you can, try a second jar with soil from another spot and compare.
- Corn roots always grow down and shoots always grow up, even if you plant a kernel upside down. Try it with one kernel and see.
- When the seedlings are a few inches tall, you can plant them outside after the last spring frost.

Check your work

- I can explain what soil is made of and why prairie topsoil is dark.
- I measured and recorded root and shoot growth for a week.
- I can explain how deep roots helped build deep soil.

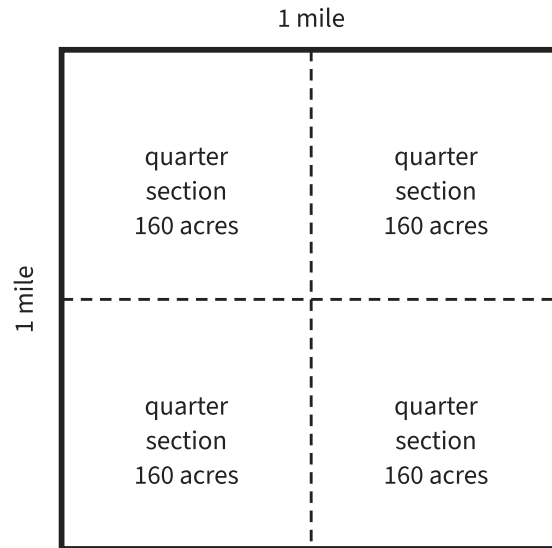
MAP NOTEBOOK

1. Draw a cut-away picture of the prairie: tall grass above the ground and long roots below, with a dark layer of topsoil. Label the topsoil.
2. Draw one section of land as a square with four quarter sections. Label it "1 mile," "640 acres" and "160 acres."
3. On an outline map of the United States, color the Corn Belt states yellow and mark Des Moines, Chicago and Grand Detour.

From history. John Deere did not stay in Grand Detour. In 1848 he moved his business to Moline, Illinois, on the Mississippi River, where the river could bring him steel and carry his plows away to farmers. The company he started is still based in Moline today, and its green and yellow tractors work fields all over the world.

WORKED EXAMPLES

Example 1. A family farms a quarter section in Iowa. A section is 640 acres, and the farm grows about 200 bushels of corn on each acre. How many acres does the family farm, and about how many bushels does it harvest?



One section = 640 acres
Each side of a quarter section = $\frac{1}{2}$ mile

One section holds 640 acres; each quarter section holds 160 acres.

1. A quarter section is one-fourth of a section: $640 \div 4 = 160$ acres.
2. Each acre grows about 200 bushels, so multiply: 160×200 .
3. $160 \times 2 = 320$, so $160 \times 200 = 32,000$.

Answer: 160 acres and about 32,000 bushels of corn.

Example 2. On the farm belts map, 1 inch stands for 100 miles. A straight line from Des Moines, Iowa, to Chicago, Illinois, measures 3.1 inches. About how far is it? In which direction do you travel from Des Moines to Chicago?

(Use the map or drawing "Find Des Moines and Chicago in the Corn Belt." shown earlier in this lesson.)

1. Multiply the inches by the miles each inch stands for: $3.1 \times 100 = 310$.
2. Find Des Moines and Chicago on the map. Chicago is to the right of Des Moines, almost level with it.
3. On a map with north at the top, right is east.

Answer: About 310 miles, traveling east.

PRACTICE

1. **EASY** Which two states grow the most corn?
2. **EASY** What made the prairie soil so deep and dark?
3. **MEDIUM** An ear of corn has 16 rows of kernels with 50 kernels in each row. How many kernels are on the ear?
4. **MEDIUM** A farmer plants 80 acres of corn and harvests 180 bushels from each acre. How many bushels does she harvest?
5. **MEDIUM** A bushel of shelled corn weighs about 56 pounds. About how much do 10 bushels weigh?
6. **HARD** On the farm belts map, 1 inch stands for 100 miles. Omaha and Chicago are 4.3 inches apart. About how far apart are they, and in which direction is Chicago from Omaha?
(Use the map or drawing “Find Omaha and Chicago.” shown earlier in this lesson.)
7. **HARD** Why did the old cast-iron plows fail on the prairie, and why did John Deere’s steel plow work?
8. **CHALLENGE** Write three or four sentences explaining why the Corn Belt is such a good place to grow corn. Name at least three gifts of its geography.

COMMON MISTAKES

- Thinking that most corn is eaten as corn on the cob. Most Corn Belt corn feeds animals or is made into other foods and fuel.
- Thinking that “corn” in the King James Bible always means the corn we grow. In the KJV it means any grain, such as wheat or barley.
- Confusing a section with an acre. A section is a square mile and holds 640 acres; an acre is much smaller.

Make it a game • Corn Belt Checkerboard. Draw a 4-by-4 grid on a big sheet of paper. Each square is one section of 640 acres. Players take turns rolling a die and answering a question card (for example, “How many acres in a quarter section?” or “Name a Corn Belt state”). A right answer lets you “plant” one section by coloring it yellow; a roll of 6 brings a summer storm, and you must answer a second question to keep your crop. When the board is full, each player counts acres: number of sections × 640. The biggest harvest wins.

Scripture. “Thou visitest the earth, and waterest it: thou greatly enrichest it with the river of God, which is full of water: thou preparest them corn, when thou hast so provided for it.” (Psalm 65:9, KJV)

This is the verse of our whole course. Farmers in the Corn Belt work hard, but the deep soil, the summer rain and the growth of every seed are gifts God has provided.

Practice answers

1. Iowa and Illinois.
2. For a very long time the roots and leaves of tall prairie grasses and flowers grew, died and rotted into the ground, building a thick layer of dark, rich topsoil.
3. $16 \times 50 = 800$ kernels.
4. $80 \times 180 = 14,400$ bushels.
5. $56 \times 10 = 560$ pounds.
6. $4.3 \times 100 = 430$ miles. Chicago is east of Omaha.
7. The thick, sticky prairie soil clung to the rough cast-iron plow, so farmers had to stop again and again to scrape it off. Deere's plow was made of smooth, polished steel, so the soil slid off and the plow kept cutting.
8. Sample answer: The Corn Belt has deep, dark topsoil built up by prairie grasses. Its land is mostly flat or gently rolling, so it is easy to plow and plant. Its summers are hot and humid with warm nights, and most of the rain falls during the growing season, when the corn needs it. It also has a long enough frost-free season for corn to grow tall and ripen.

3.3 THE GREAT PLAINS

OBJECTIVES

- Locate the Great Plains and the 100th meridian and explain why the plains are drier, windier and higher in the west than in the east.
- Describe how the bison, the cattle ranch and winter wheat each fit the land of the plains.
- Explain how a windmill pumps water from deep under the ground, and build a paper windmill that lifts a weight.

Warm-up. Hold a sheet of paper loosely by one edge in front of a fan, or go outside on a breezy day. Feel the wind push it. Then blow on a pinwheel or a paper strip. Can you make the wind do work for you, such as moving a feather across the table? Talk about it: the wind is free, but how could a farmer put it to work?

Watch. *#85 How Does A Windmill Pump Water? | At The Ranch* (Alec Peirce At The Ranch, 7:40). https://www.youtube.com/watch?v=6T1HE_USX3U
With Technology overcoming geography: a rancher shows how a farm windmill pumps water up from deep underground.

Backup video. *Windmill Pumping Water* (American Windmill Museum, 0:42). <https://www.youtube.com/watch?v=3AA8s3Jtetg>
A very short clip of a windmill pumping water, good to watch before the project.

KEY TERMS

Great Plains

The wide, high, grassy land between the Midwest and the Rocky Mountains, running from Texas north into Canada.

semi-arid

Rather dry: getting more rain than a desert but not enough for trees and many crops, often less than about 20 inches a year.

100th meridian

The line of longitude 100 degrees west. Roughly west of it, the plains usually get too little rain for farming without care.

windmill

A machine with blades turned by the wind. On the plains, windmills were used to pump water from wells.

aquifer

A layer of sand, gravel or rock under the ground that holds water, which can be pumped up from a well.

ranch

A large farm where cattle, sheep or horses graze on grass.

CORE IDEAS

The story. In 1820 Major Stephen Long led a small army expedition across the plains toward the Rocky Mountains. Week after week his men rode through dry grass under a hot sun, with few trees and few streams. Long decided that this land was almost unfit for farming. A map made from his journey marked the plains as a “Great Desert,” and for many years Americans called them the Great American Desert. Thirty-four years later, in 1854, a mechanic named Daniel Halladay in Ellington, Connecticut, built a new kind of windmill. It turned itself to face the wind, and in a storm its blades tilted so the wheel would not spin too fast and tear itself apart. It could run all by itself. No one guessed it then, but that little machine would help turn the “desert” into farms.

The big idea. The **Great Plains** stretch from Texas north into Canada, between the Corn Belt and the Rocky Mountains. They look flat, but they climb slowly as you go west, from under 1,000 feet above sea level near Kansas City to over a mile high at Denver. The Rockies catch much of the moisture coming from the Pacific Ocean, so the plains lie in their dry “rain shadow.” Roughly west of the **100th meridian**, most places get less than 20 inches of rain a year. The land is **semi-arid**: too dry for forests, but just right for short, tough grasses. And the wind blows and blows across the open land.

Wheat, cattle and bison. For a very long time the grass fed huge herds of bison, perhaps tens of millions of them. The Lakota, Cheyenne, Comanche, Pawnee and other Plains nations lived by hunting them, and after they got horses they followed the herds across the plains. In the 1870s and 1880s hide hunters killed the bison by the millions until only a few hundred were left, a terrible waste that also took away the living of the Plains peoples. Cattle took the bison’s place. Ranchers learned that grass too dry for crops could still feed herds of cattle. Farmers learned to plant the right grain. In 1874 Mennonite families from Russia settled in Kansas and brought **Turkey Red** winter wheat, a hard wheat that could stand cold winters and dry summers. Winter wheat is planted in the fall, rests under the snow and ripens in early summer before the hottest, driest weeks. Kansas became “the Wheat State,” and farther north the Dakotas grow spring wheat.

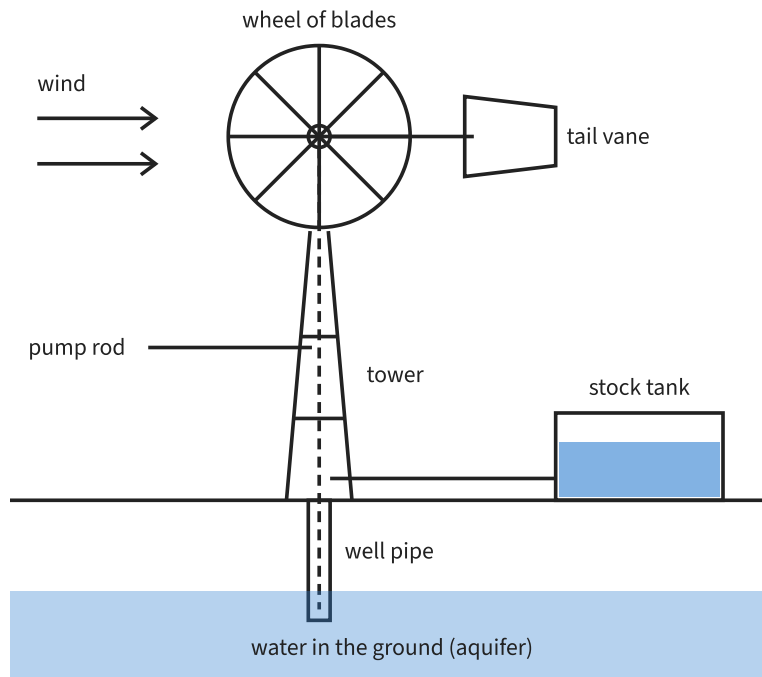
How it worked. Wheat and cattle both need water, and on the plains the streams are few and far apart. But under much of the plains lies an **aquifer**, a huge layer of sand and gravel soaked with water. A farmer could drill a well, but how could he lift the water? The windmill! The wind turns the wheel of blades. Gears turn that spinning into an up-and-down motion, and a long pump rod moves up and down inside the well pipe. Each stroke lifts a little water to the top, where it pours into a stock tank for the cattle. The tail vane keeps the wheel facing the wind, and the windmill works day and night whenever the wind blows. Railroads used windmills too, to fill the water tanks for their steam engines.

Technology overcoming geography. The plains had two problems, little water and few trees, and plenty of one thing: wind. The windmill used the wind to bring up the water. Barbed wire, patented by Joseph Glidden of DeKalb, Illinois, in 1874, let farmers fence fields

without wood. Steel plows broke the sod, and railroads carried wheat and cattle east. By 1900 the “Great American Desert” had become a breadbasket. Good stewardship mattered here too. In the dry years of the 1930s, winds blew away the topsoil of plowed fields in great dust storms. Farmers learned to plant rows of trees as windbreaks and to keep the soil covered, caring for the land God had given them.



The Great Plains and the 100th meridian. Dodge City, Kansas, lies almost exactly on it.



How a farm windmill pumps water from the aquifer to the stock tank.

PICTURE STUDY



Buffalo Hunt under the Wolf-skin Mask, George Catlin, 1832–1833 · Oil on canvas · Smithsonian American Art Museum, Washington, D.C.

George Catlin was a Pennsylvania lawyer who gave up the law to paint. In 1832 he rode a steamboat up the Missouri River into the heart of the plains, and he spent years painting the Plains nations, their villages and their buffalo hunts. He wanted people in the East to see a way of life that he feared would soon disappear.

In this painting two hunters creep toward a bison herd hidden under wolf skins. Bison were not afraid of a lone wolf, so the disguise let the hunters come close enough to shoot with their bows. Look at the wide, open land around them: this is the Great Plains before farms and fences.

Look closely

- Find the two hunters. How are they hiding?
- Look at the land. Do you see many trees? What covers the ground?
- Look at the sky and the horizon. How does Catlin make the plains look huge?
- Find the bison. Are they worried about the “wolves”?

Talk about it

1. What does this painting tell you about how the Plains peoples used their knowledge of animals and the land?
2. How is the land in this picture like and unlike the wheat fields and ranches you read about?
3. Why do you think Catlin worked so hard to paint the plains and its peoples?

Safety first. Ask an adult to help with scissors and the pointed skewer. Keep fingers, hair and loose paper away from an electric fan, and use a hair dryer only on the cool setting.

PROJECT: A PAPER WINDMILL THAT LIFTS A WEIGHT

A real plains windmill uses the wind to lift water. Your windmill will use the wind from a fan (or your breath) to lift a cup of paper clips by winding a thread around its axle. Then you will test which blade design lifts the most.

You will need

- Two sheets of card stock or a file folder, cut into 6-inch squares
- A bendy or straight drinking straw
- A wooden skewer (thinner than the straw) or a pencil-thin dowel
- Masking tape, scissors, a ruler and a pencil
- A tall cereal box or a stack of books, to be the tower
- About 24 inches of thread and a small paper cup
- Paper clips or pennies for weights
- A box fan or hair dryer on the cool setting (or strong breath)

Steps

1. Make the wheel: on a 6-inch square, draw lines from corner to corner to make an X. Cut along each line from the corner, stopping about an inch from the center.
2. Fold every other point into the center (like a pinwheel) and tape them down. Push the skewer through the center and tape the wheel to the skewer so the wheel and skewer turn together.
3. Make the bearing: tape the straw flat across the top of the cereal box so that it sticks out a little past both edges. Slide the skewer through the straw so the wheel is on one side and the other end sticks out the back.
4. Make the lift: tape one end of the thread to the back end of the skewer. Punch two holes in the paper cup, make a little handle of thread, and tie the long thread to it so the cup hangs below the box.
5. Test: point the fan at the wheel from about two feet away. As the wheel turns, the thread should wind around the skewer and lift the cup.
6. Add paper clips to the cup one at a time. Record the most clips your windmill can lift to the top.
7. Make a second wheel with a different design: more blades, bigger blades or a different angle. Test it the same way, with the fan at the same distance, and record the result.
8. Draw your best windmill in your notebook and label the wheel, the axle (skewer), the bearing (straw), the tower (box) and the load (cup).

Tips

- If the wheel spins but the cup will not rise, there is too much rubbing. Make sure the skewer turns freely inside the straw.
- Change only one thing at a time when you test a new wheel, so you know what made the difference.
- Turn the box so that the wheel faces straight into the wind. That is what the tail vane on a real windmill does.

Check your work

- My windmill lifted a load using only the wind.
- I tested two wheel designs fairly and recorded the results.
- I can explain how a real windmill lifts water from a well.

MAP NOTEBOOK

1. On an outline map of the United States, draw the 100th meridian as a dashed line from North Dakota to Texas. Shade the land west of it to the Rockies light brown and label it "drier."
2. Draw a farm windmill and label the wheel, the tail vane, the tower, the pump rod, the well and the stock tank.
3. Draw three pictures in a row: bison on the grass, cattle on a ranch and a field of golden wheat. Under each, write one way it fits the dry plains.

From history. In 1874, the same year that Turkey Red wheat came to Kansas, Joseph Glidden of DeKalb, Illinois, received a patent for his barbed wire. Glidden twisted two wires together with sharp barbs locked between them. On the treeless plains there was little wood for fences, and barbed wire was cheap, light and easy to ship by train. Within a few years it fenced fields and ranges across the West, and the days of the open range came to an end.

WORKED EXAMPLES

Example 1. Kansas City is about 900 feet above sea level. Denver is about 5,300 feet above sea level, and it is about 560 miles west of Kansas City. How much higher is Denver? About how many feet does the land rise for each mile you travel west?

(Use the map or drawing “From Kansas City to Denver the plains climb almost a mile.” shown earlier in this lesson.)

1. Subtract to find how much higher Denver is: $5,300 - 900 = 4,400$ feet.
2. Divide the rise by the miles: $4,400 \div 560$.
3. Try 8: $560 \times 8 = 4,480$, which is very close to 4,400.
4. So the land rises about 8 feet for every mile, so gently that you hardly notice it.

Answer: Denver is about 4,400 feet higher, and the plains rise about 8 feet for each mile west.

Example 2. A windmill pumps about 5 gallons of water each minute while the wind blows. On one day the wind blows for 4 hours. If each cow drinks about 15 gallons a day, how many cows can the windmill water?

(Use the map or drawing “The water collects in the stock tank for the cattle.” shown earlier in this lesson.)

1. Gallons in one hour: $5 \times 60 = 300$ gallons.
2. Gallons in 4 hours: $300 \times 4 = 1,200$ gallons.
3. Number of cows: $1,200 \div 15 = 80$.

Answer: 1,200 gallons, enough for about 80 cows.

PRACTICE

1. **EASY** Name one crop and one farm animal that the Great Plains are famous for.
2. **EASY** What does the tail vane on a windmill do?
3. **MEDIUM** Town A gets 32 inches of rain a year. Town B gets 16 inches. How many more inches does Town A get? Which town is more likely west of the 100th meridian?
4. **MEDIUM** Look at the map. Which Kansas town lies almost exactly on the 100th meridian? Is Kansas City east or west of that line?
(Use the map or drawing “Find the 100th meridian.” shown earlier in this lesson.)
5. **MEDIUM** A windmill pumps 4 gallons a minute. How many minutes will it take to fill a 600-gallon stock tank? How many hours is that?
6. **HARD** Why is winter wheat a good crop for Kansas?
7. **HARD** Kansas City and Denver are about 560 miles apart. A wagon traveled about 15 miles a day. A train in the 1870s might go about 25 miles an hour. About how many

days did the wagon take? About how many hours did the train take?

8. **CHALLENGE** Explain in three or four sentences how the windmill helped people overcome the geography of the Great Plains.

COMMON MISTAKES

- Thinking the Great Plains are perfectly flat and low. They rise slowly from east to west until they are about a mile high at the foot of the Rockies.
- Thinking a plains windmill grinds grain like an old Dutch windmill. Most plains windmills pumped water from wells.
- Thinking the 100th meridian is a wall where the rain stops. It is only a rough line; the land gets gradually drier as you go west.

Make it a game • Windmill Relay. Set two bowls of water at one end of the room and two empty cups at the other. Each team gets a teaspoon. One player is the “wind”: while the wind blows a pinwheel or waves a paper fan, the team’s “pump” may carry water one spoonful at a time to the cup. When the wind stops to answer a plains question (for example, “What line of longitude marks the drier plains?”), the pump must stop too. Answer right to start the wind again. The first team to fill its cup to a marked line wins.

Scripture. “He causeth the vapours to ascend from the ends of the earth; he maketh lightnings for the rain; he bringeth the wind out of his treasures.” (Psalm 135:7, KJV)

The rain that falls on the plains and the wind that sweeps across them both come from God’s hand. A windmill is a way of gratefully using the wind He brings out of His treasures.

Practice answers

1. Wheat and cattle.
2. It turns the windmill so the wheel always faces into the wind.
3. $32 - 16 = 16$ more inches. Town B, because it gets less than 20 inches a year.
4. Dodge City. Kansas City is east of the 100th meridian.
5. $600 \div 4 = 150$ minutes, which is 2 hours and 30 minutes.
6. It is planted in the fall, grows a little, rests under the winter snow and ripens in early summer, so it is ready to harvest before the hottest, driest weeks of summer. Hard wheats like Turkey Red can stand cold winters and dry summers.
7. Wagon: $560 \div 15$ is about 37 days ($15 \times 37 = 555$). Train: $560 \div 25$ is about 22 hours ($25 \times 22 = 550$). The train was more than a month faster.
8. Sample answer: The plains had few streams and little rain, so it was hard to get water for people, crops and cattle. But there was water in the aquifer under the ground, and there was plenty of wind. The windmill used the free wind to pump water up from deep wells, day and night, into tanks. With water, families could settle, ranchers could water cattle and railroads could fill their steam engines far from any river.

3.4 THE SOD HOUSE

OBJECTIVES

- Explain the Homestead Act of 1862 and what a family had to do to earn 160 acres of land.
- Describe how homesteaders built sod houses and dugouts from the earth of the treeless plains, and name their good points and problems.
- Use a quarter section and sod-brick measurements to solve real homestead problems.

Warm-up. Look around your home and name what it is built of: wood, brick, stone, concrete or something else. Where did those materials come from? Now imagine you have been set down on an open grassy plain with no trees and no stones in sight, and winter is coming. What would you build your house from? Talk it over for three minutes.

Watch. *Museum Minute Episode 18 - Sod House* (Hastings Museum, 2:42).

<https://www.youtube.com/watch?v=H7Fy3WOMgK8>

After How they built: a museum minute inside a sod house, how the bricks were cut and stacked roots-up and what life inside was like.

Note: Mentions mice and snakes living in the sod walls.

Backup video. *20th May 1862: President Abraham Lincoln signs the Homestead Act into law* (HistoryPod, 2:20). https://www.youtube.com/watch?v=jIY_L6ep1eg

With the history note: President Lincoln signs the Homestead Act on May 20, 1862, the law that brought the sod-house settlers to the plains. Note: Ends with a short, even-handed paragraph on who gained and who lost land under the act.

KEY TERMS

Homestead Act

A law signed by Abraham Lincoln in 1862 that gave a family 160 acres of public land if they lived on it, built a home and farmed it for five years.

homesteader

A person who claimed land under the Homestead Act and settled on it.

sod

The top layer of grassy ground held together by a thick mat of roots.

sod house

A house with walls built of bricks of sod, also called a “soddy.”

dugout

A home dug into the side of a hill or creek bank, with a front wall and roof of sod or logs.

claim

A piece of land a person has officially asked for and promised to settle.

CORE IDEAS

The story. On May 20, 1862, in the middle of the Civil War, President Abraham Lincoln signed the **Homestead Act**. It made a remarkable promise. Any head of a family, or any adult of 21 who had never fought against the United States, could claim 160 acres of public land, a quarter section. If the homesteader lived on the land for five years, built a home and raised crops, the land would be theirs, for only a small filing fee. The law began on January 1, 1863. That very day a Union soldier named Daniel Freeman filed a claim for a quarter section on Cub Creek near Beatrice, Nebraska. His land is now Homestead National Historical Park.

Who came. Over the next years farm families from the East, immigrants from Germany, Sweden, Norway and the Czech lands, single women and widows, and freed slaves seeking a new start all came west to claim land. In 1877 Black settlers from Kentucky founded the town of Nicodemus on the Kansas plains. Altogether about 1.6 million homestead claims were made good, covering about 270 million acres, roughly a tenth of all the land in the United States. But this land had long been the home of the Lakota, Cheyenne, Pawnee and other nations, and it was opened to settlers as those nations were pushed onto reservations, often through broken treaties. That wrong is part of the true story of the plains.

How they built. A homesteader on the plains faced a hard problem: there were almost no trees for logs and few stones. But there was sod everywhere. The farmer hitched oxen or horses to a breaking plow, which cut the tough prairie sod into long strips about a foot wide and a few inches thick. With a spade he chopped the strips into bricks about two feet long. The bricks were laid grass side down, like giant bricks, with the joints staggered so the wall would be strong. Walls were often two feet thick or more. A ridgepole and rafters of whatever wood could be found held up a roof of brush, grass and more sod. Settlers joked that their walls were made of “Nebraska marble.” Some families first lived in a **dugout**, a room dug into a hillside or creek bank. The idea of a house of earth was not new on the plains: the Pawnee had long lived in large, round earth lodges of timber covered with earth.

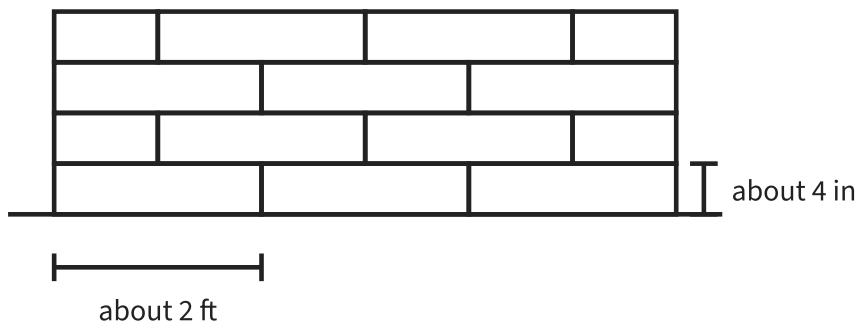
Life in a soddy. A sod house was cool in summer and warm in winter, because its thick walls kept out the heat and the cold. It could not burn when a prairie fire swept past. But dirt sifted down from the ceiling onto the table, mice and snakes sometimes lived in the walls, and after a hard rain the roof might drip muddy water for days. Many women tacked a sheet of cloth under the ceiling to catch the falling dirt. In 1886 a photographer named Solomon Butcher began driving his wagon around Custer County, Nebraska, taking pictures of homesteaders in front of their sod houses. His thousands of photographs show us their faces, their wagons, their cows and their homes of earth.

The big idea. People build with what the land gives them. In New England they built with wood and stone, in the Southwest with adobe, and on the treeless plains with sod. When railroads reached the plains and brought cheap lumber from the forests of Wisconsin and Minnesota, families built frame houses and the soddies slowly melted back into the prairie. The geography of a place shapes how people live, but the courage and hard work of families turned a hard land into home.

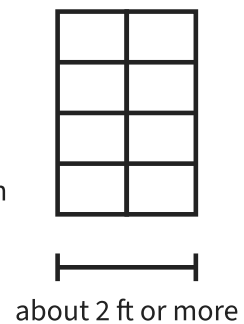


Homestead places in this lesson: Daniel Freeman's claim near Beatrice, Solomon Butcher's Custer County near Broken Bow, Nicodemus, and the Ingalls family's homes at Walnut Grove and De Smet.

Front view: rows of sod bricks
(joints staggered, grass side down)



End view:
two bricks thick



Not to scale

How a sod wall is built (not to scale).

PICTURE STUDY



The Chrisman Sisters on a Homestead in Custer County, Nebraska, Solomon D. Butcher, 1886 · Photograph (glass-plate negative) · History Nebraska (Nebraska State Historical Society), Lincoln; copies in the Library of Congress

Solomon Butcher came to Custer County, Nebraska, as a young homesteader himself and lived in a sod house. He decided to make a history of the county in pictures, so he loaded his heavy camera and glass plates into a wagon and visited family after family. He took thousands of photographs, and in 1901 he published a history of Custer County illustrated with them.

In this famous photograph Butcher shows the four Chrisman sisters, Hattie, Lizzie, Lutie and Ruth, in front of Lizzie's sod house on Lieban Creek. Their father was a rancher, and each daughter planned to take up land of her own. When this picture was taken only Lizzie, the eldest, had her claim; the younger sisters filed theirs as they grew old enough.

Homesteading was not only for men: an unmarried woman of 21 could claim a quarter section and prove it up just as a man could.

Look closely

- Find the sod house. Can you see the rows of sod bricks in the wall?
- Look at the land around the house. Do you see any trees or neighbors?
- Find the door and any window. What do you think they were made of, and where did that material come from?
- Look at the sisters' faces and clothes. What do they tell you about them?

Talk about it

1. Why do you think the sisters wanted their picture taken in front of their sod house?

2. What would be the hardest part of living on a homestead like this one? What would be the best part?
3. How does a photograph like this help us know history better than words alone?

PROJECT: BUILD A MODEL SOD HOUSE

You will make tiny sod bricks from real earth and grass and build a model sod house, laying the bricks the way a homesteader did. Then you will test your house in a rainstorm from a watering can.

You will need

- A small patch of grassy ground you have permission to dig (or a square of sod from a garden store), or garden soil mixed with dried grass clippings
- An ice-cube tray (if making bricks from soil)
- A trowel or old butter knife and a ruler
- A piece of stiff cardboard or a scrap board about 12 by 12 inches for the base
- Small sticks or craft sticks for the roof, and dried grass
- A watering can or spray bottle

Steps

1. Choose your size. Real sod bricks were about 2 feet long and 4 inches thick. Make yours about 2 inches long, 1 inch wide and 1/2 inch thick.
2. If you have real sod, cut it into small bricks with the knife, keeping the roots together. If not, mix soil, a little water and a handful of dried grass, press it into the ice-cube tray and let it dry in the sun for a day or two, then pop the bricks out.
3. Mark the outline of your house on the base, about 6 by 8 inches, leaving a gap for the door.
4. Lay the first row of bricks grass side down. Lay the next row so each brick covers the crack between two bricks below, just as the diagram shows.
5. Build the walls about 5 rows high. Lay a craft stick over the door gap as a lintel and keep building above it.
6. Rest a ridgepole stick across the middle and lay sticks from it to the walls as rafters. Cover them with dried grass, then a thin layer of sod or soil.
7. Sprinkle a gentle “rain” over the house from the watering can. Watch: does the roof leak? Do the walls hold?
8. Draw your house in your notebook and write two sentences about how it held up in the rain.

Tips

- Bricks with lots of roots hold together best. That is why homesteaders looked for the toughest, oldest prairie sod.
- Staggered joints make a strong wall. If you stack bricks straight on top of each other, the wall cracks apart easily.

- Ask permission before digging up any grass, and fill in the hole afterward.

Check your work

- My bricks were laid grass side down with staggered joints.
- My house had a door, walls and a roof on rafters.
- I can explain why homesteaders built with sod and what problems sod houses had.

MAP NOTEBOOK

1. Draw a sod house and label the sod-brick walls, the door, the window, the ridgepole and the sod roof.
2. Draw a quarter section as a square half a mile on each side. Inside it, draw where you would put the soddy, the well with its windmill, the garden and the wheat field.
3. On your farm belts map, mark Beatrice and Custer County, Nebraska, and write "Homestead Act, 1862" beside them.

From history. In 1874 the family of Charles and Caroline Ingalls lived in a dugout in the bank of Plum Creek near Walnut Grove, Minnesota. Years later their daughter Laura Ingalls Wilder described it in her book *On the Banks of Plum Creek*: a room dug into the creek bank, with grass and flowers growing on its roof, so that from above it looked like part of the prairie. In 1880 the family took a homestead claim near De Smet in Dakota Territory, the setting of her later books.

WORKED EXAMPLES

Example 1. A homestead is a quarter section, a square half a mile on each side. How far would a homesteader walk to go all the way around the edge of the claim? How many feet is each side? (1 mile = 5,280 feet)

(Use the map or drawing "Thousands of quarter-section homesteads covered these states." shown earlier in this lesson.)

1. A square has 4 equal sides. Each side is $\frac{1}{2}$ mile.
2. Around the edge: $4 \times \frac{1}{2}$ mile = 2 miles.
3. Each side in feet: half of 5,280 is 2,640 feet.

Answer: 2 miles all the way around. Each side is 2,640 feet long.

Example 2. A homesteader is building one wall of a soddy. The wall is 16 feet long and 8 feet high. Each sod brick is 2 feet long and 4 inches thick. If the wall is one brick thick, how many bricks does it need? (1 foot = 12 inches)

(Use the map or drawing “Each sod brick is about 2 feet long and 4 inches thick.” shown earlier in this lesson.)

1. Bricks in one row: $16 \text{ feet} \div 2 \text{ feet} = 8 \text{ bricks}$.
2. Height of the wall in inches: $8 \times 12 = 96 \text{ inches}$.
3. Number of rows: $96 \div 4 = 24 \text{ rows}$.
4. Total bricks: $8 \text{ bricks} \times 24 \text{ rows} = 192 \text{ bricks}$.

Answer: 192 sod bricks if the wall is one brick thick. If the wall is two bricks thick, it needs 384.

PRACTICE

1. **EASY** In what year was the Homestead Act signed, and which president signed it?
2. **EASY** How many acres did a homesteader receive? What part of a section is that?
3. **MEDIUM** A family filed a homestead claim in 1870. They had to live on the land for 5 years. What was the earliest year they could prove up and own the land?
4. **MEDIUM** A soddy wall is 20 feet long and 24 rows high. Each sod brick is 2 feet long. If the wall is one brick thick, how many bricks does it need?
5. **MEDIUM** Why did so many homesteaders on the Great Plains build with sod instead of logs or stone?
6. **HARD** Name two good things and two problems of living in a sod house.
7. **HARD** On a map where 1 inch stands for 100 miles, Beatrice, Nebraska, and De Smet, South Dakota, are 2.9 inches apart. About how far apart are they? In which direction is De Smet from Beatrice?

(Use the map or drawing “Find Beatrice and De Smet.” shown earlier in this lesson.)

8. **CHALLENGE** The four Chrisman sisters each claimed a quarter section of 160 acres. If their claims lay side by side in a square, how many acres would they have together? What is that much land called on the township grid, and how big is it?

COMMON MISTAKES

- Thinking the land was simply empty before the homesteaders came. The plains had long been home to Native nations such as the Pawnee, Lakota and Cheyenne.
- Thinking a homestead was a gift with no work. A family had to live on the land, build a home and farm it for five years before it was theirs.
- Laying sod bricks grass side up or stacking them in straight columns. Homesteaders laid them grass side down with the joints staggered, so the wall held together.

Make it a game · Prove Up Your Claim. Each player draws a square on paper for a 160-acre claim. To prove up, you need five “years.” In each round, roll a die: 1 means a hailstorm (lose a turn), 2 means grasshoppers (answer a question to keep your crop), and 3 to 6 means a good year. In a good year, answer a question about the plains or the Homestead Act to add one thing to your claim: soddy, well, windmill, garden and wheat field. The first player with five good years and all five things on the claim has proved up and wins the land.

Scripture. “Prepare thy work without, and make it fit for thyself in the field; and afterwards build thine house.” (Proverbs 24:27, KJV)

Homesteaders had to do both: break the sod and plant the field, and build a home from the very ground they farmed. Solomon’s wise order, first preparing the work and then building, fits the hard-working life of a homestead family.

Practice answers

1. 1862, by President Abraham Lincoln.
2. 160 acres, which is a quarter section.
3. $1870 + 5 = 1875$.
4. $20 \div 2 = 10$ bricks in a row; $10 \times 24 = 240$ bricks.
5. The plains had almost no trees and few stones, but tough, root-filled sod was everywhere and cost nothing.
6. Good: cool in summer and warm in winter; it could not burn in a prairie fire; the building material was free. Problems: dirt fell from the ceiling; the roof leaked muddy water after rain; mice, bugs and snakes could live in the walls. (Any two of each.)
7. $2.9 \times 100 = 290$ miles. De Smet is north (a little west) of Beatrice.
8. $4 \times 160 = 640$ acres. That is one whole section, a square one mile on each side (one square mile).

UNIT 3 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. The review is worth 50 points.

1. (5 pts) Name the five Great Lakes. Which is the largest, and which is the only one entirely inside the United States?
2. (5 pts) Lake Superior is about 600 feet above sea level and Lake Huron is about 579 feet. How far must a ship be lowered at the Soo Locks? Why were the locks built?
3. (5 pts) On a map where 1 inch stands for 100 miles, Chicago and Detroit are 2.4 inches apart. How far apart are they? Give one reason Chicago grew into a great city.
4. (5 pts) Name three things about the geography of the Corn Belt that make it good for growing corn.
5. (5 pts) A farm is a quarter section (160 acres). It grows 200 bushels of corn on each acre. How many bushels does it grow? Why did John Deere's steel plow work in prairie soil when cast-iron plows did not?
6. (5 pts) What is the 100th meridian, and how is the land west of it different from the land east of it?
7. (5 pts) A windmill pumps 5 gallons a minute. How many gallons does it pump in 2 hours? Name the windmill parts that (a) keep it facing the wind and (b) move up and down in the well.
8. (5 pts) Why was Turkey Red winter wheat a good crop for Kansas, and who brought it there in 1874?
9. (5 pts) What did the Homestead Act of 1862 promise, and what did a homesteader have to do to earn the land?
10. (5 pts) A soddy wall is 18 feet long and 24 rows high, with sod bricks 2 feet long. If the wall is one brick thick, how many bricks does it need? Why did plains homesteaders build with sod?

UNIT PROJECT: MY MAP OF THE GREAT LAKES AND THE FARM BELTS

Make a large hand-drawn map of the middle of the United States from the Great Lakes to the Rocky Mountains. Label the five Great Lakes, draw the ore-boat route from Duluth through the Soo Locks to Chicago, color the Corn Belt yellow and the wheat lands gold, draw the 100th meridian as a dashed line, and mark at least eight places from the unit (such as Duluth, Sault Ste. Marie, Chicago, Grand Detour, Des Moines, Dodge City, Beatrice and Custer County). Add a scale bar and a compass rose.

Beside the map, display your paper windmill with your test record of how many paper clips each wheel design lifted, and write a paragraph explaining how the lakes, the soil, the dry plains and the wind each shaped the way people lived and worked in this region.

- **Accuracy:** Lakes, farm belts, the 100th meridian and places are in the right spots and labeled clearly, with a correct scale bar and compass rose.

- **Windmill:** The paper windmill lifts a load using only wind, and the test record compares at least two designs fairly.
- **Explanation:** The paragraph explains how the Great Lakes, the prairie soil, the dry plains and the wind shaped work and life, and names at least one tool that helped people overcome the land's difficulties.
- **Care:** The map is neat, colorful and easy to read, and the work shows patience and effort.

Answer key

1. Huron, Ontario, Michigan, Erie and Superior. Superior is the largest; Michigan is the only one entirely in the United States.
2. $600 - 579 = 21$ feet. The St. Marys River drops through rapids between the two lakes, so ships could not pass until the locks (first opened in 1855) lifted and lowered them.
3. $2.4 \times 100 = 240$ miles. Reasons: it stands at a short portage between the Great Lakes and the rivers to the Mississippi; a canal joined them in 1848; railroads going around Lake Michigan all met at its southern end.
4. Any three: deep, dark topsoil built by prairie grasses; flat or gently rolling land; hot, humid summers with warm nights; rain that falls during the growing season; a long enough frost-free season.
5. $160 \times 200 = 32,000$ bushels. Deere's plow was smooth, polished steel, so the sticky prairie soil slid off instead of clinging to it.
6. It is the line of longitude 100 degrees west. Roughly west of it the plains are drier (usually less than about 20 inches of rain a year), with short grass, so they suit wheat and cattle ranching better than corn.
7. $5 \times 120 = 600$ gallons. (a) The tail vane. (b) The pump rod.
8. It is planted in the fall, rests under the snow and ripens in early summer before the hottest, driest weeks, and it can stand cold winters and dry summers. Mennonite families from Russia brought it.
9. It promised 160 acres of public land for a small fee. The homesteader had to live on the land for five years, build a home and farm it.
10. $18 \div 2 = 9$ bricks a row; $9 \times 24 = 216$ bricks. The plains had almost no trees and few stones, but sod was everywhere and free.

THE WEST AND THE SOUTHWEST

West of the Great Plains the land rises into the Rocky Mountains, and nothing in America is quite the same again. In this unit you will stand with Meriwether Lewis on the Continental Divide in 1805, ride with the gold-seekers who painted “Pikes Peak or Bust” on their wagons, and visit mining boomtowns perched two miles high. You will look across a canyon in the snow with two cowboys who found Cliff Palace at Mesa Verde, watch James Marshall pick up the flakes of gold that started the California Gold Rush in 1848, and sail with Robert Gray into the mouth of the Columbia River.

Then you will travel to the two states that lie far from all the others: Alaska, bought from Russia in 1867 and called the Last Frontier, and Hawaii, a chain of volcanic islands in the middle of the Pacific. Along the way you will learn to read a land of extremes: the highest peaks and the lowest valley, rain forests and deserts, glaciers and volcanoes. You will see why rain falls on one side of a mountain and not the other, and how people have carried water hundreds of miles across the desert.

The Psalmist says of God, “Thou visitest the earth, and waterest it: thou greatly enrichest it” (Psalm 65:9). Nowhere is that clearer than in the dry West, where every town depends on snow in the mountains and rivers that carry it down. In every lesson ask: **where does the water come from, and where does it go?** Your capstone is a cut-away model of a mountain range and a map of the western states and their rivers.

BEFORE YOU BEGIN

- Can use a map scale to find a distance (Lesson 1.1)
- Knows the cardinal and intermediate directions on a compass rose
- Can add and subtract numbers in the thousands and multiply by a one- or two-digit number
- Knows what a river’s source and mouth are

MASTERY CHECKLIST

- I can find the Rocky Mountain, Southwest and Pacific Coast states, Alaska and Hawaii on a map and name their main rivers and mountains.
- I can explain the Continental Divide and tell which ocean a river reaches from either side.
- I can tell the difference between a canyon, a plateau, a mesa and a butte, and explain how desert people carried water far.
- I can tell the story of the California Gold Rush and explain how a rain shadow makes one side of a mountain wet and the other dry.
- I can tell how Alaska and Hawaii became part of the United States and use latitude to compare them.
- I can use a map scale and elevations to solve problems about the West.

OPTIONAL BOOKS AND RESOURCES

- **Mesa Verde National Park (National Park Service)**
(<https://www.nps.gov/meve/index.htm>): Free. Photographs, maps and history of Cliff Palace and the Ancestral Puebloans for Lesson 4.2.
- **Hawai'i Volcanoes National Park (National Park Service)**
(<https://www.nps.gov/havo/index.htm>): Free. Photographs and maps of Kilauea and Mauna Loa for Lesson 4.4. A parent may want to preview current eruption pages first.
- **Library of Congress Map Collections** (<https://www.loc.gov/maps/>): Free. Search for "California gold region" or "Alaska 1867" to find real historic maps of the gold country and of Alaska at the time of the purchase.

4.1 THE ROCKY MOUNTAIN STATES ★

OBJECTIVES

- Name the Rocky Mountain states and find the Rocky Mountains and the Continental Divide on a map of the West.
- Explain how the Continental Divide sends rain and melting snow toward the Pacific Ocean on one side and toward the Gulf of Mexico and the Atlantic on the other.
- Tell why mining towns such as Denver, Virginia City, Leadville and Butte grew up where they did, and why some became ghost towns.

Warm-up. Fold an index card in half the long way and stand it on a tray like a little tent. Drip water from a spoon exactly on the top fold. Which way does it run? Now drip a few drops just to the left of the fold, then just to the right. The fold decides where every drop goes. You have just made a tiny divide. Keep the card for the lesson.

Watch. *The Importance of the Continental Divide* (Smithsonian Channel, 2:53).

<https://www.youtube.com/watch?v=kMhrvvoYSHo>

After the big idea: what the Continental Divide is and how it decides which way the rivers run.

Backup video. *Rocky Mountain National Park for Kids!* (National Park Kids!, 6:40).

<https://www.youtube.com/watch?v=ENCq7lGeJe0>

As review: a kids' tour of Rocky Mountain National Park, where the Continental Divide runs along the peaks.

KEY TERMS

Continental Divide

The long line of high ridges in the Rocky Mountains that separates the rivers flowing toward the Pacific Ocean from the rivers flowing toward the Atlantic Ocean and the Gulf of Mexico.

watershed

All the land whose rain and melting snow drain into one river or one sea.

headwaters

The small streams and springs where a river begins.

mountain pass

A low gap between mountains where people, wagons and later railroads and roads can cross.

ore

Rock that holds enough gold, silver, copper or another metal to be worth digging up.

boomtown

A town that grows very fast because of a discovery such as gold or silver. When the ore runs out, it may become a ghost town.

CORE IDEAS

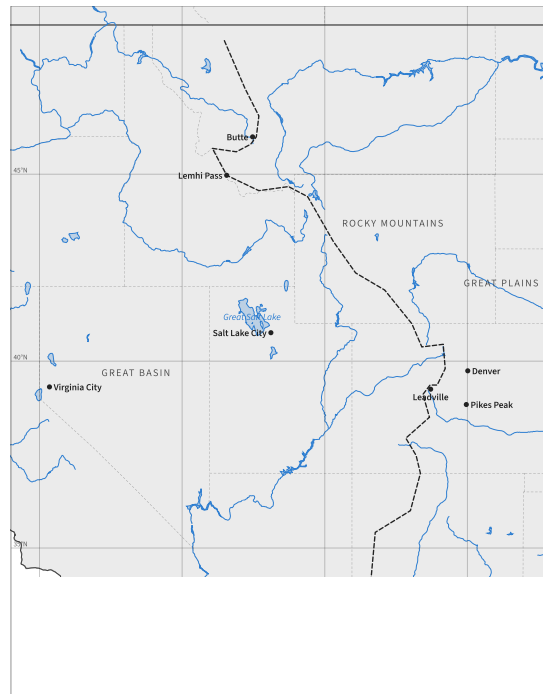
The story. On August 12, 1805, Captain Meriwether Lewis and three men of the Corps of Discovery walked up a long, grassy slope in the mountains of what is now Montana. A tiny stream trickled down beside them, and they knew it was one of the very first beginnings of the Missouri River. One of the men, Hugh McNeal, planted one foot on each side of the little rivulet and thanked God that he had lived to stand astride the mighty Missouri. Lewis drank from the cold spring at its head. Then the men climbed to the top of the ridge, a gap we now call **Lemhi Pass**, on today's border of Montana and Idaho. They walked down the other side and, less than a mile away, Lewis knelt and drank from a creek running *west*. For the first time he had tasted water on its way to the Pacific Ocean. But when he looked ahead, he saw not an easy river but range after range of tall mountains with snow on their tops.

How it works. Lewis had crossed the **Continental Divide**. It is a line along the highest ridges of the Rocky Mountains, running from Canada all the way to Mexico. Rain or snow that falls on the east side runs downhill into rivers like the Missouri, the Platte, the Arkansas and the Rio Grande, and at last into the Gulf of Mexico, which opens into the Atlantic Ocean. Rain that falls on the west side runs into the Snake and Columbia rivers or the Colorado River and travels toward the Pacific. Two snowflakes that land a few feet apart on top of a pass may end up in different oceans thousands of miles from each other! The great rivers of the West begin as **headwaters** high in these mountains. In Glacier National Park in Montana there is even a mountain called Triple Divide Peak, where water can run three ways: to the Pacific, to the Gulf of Mexico and north to Hudson Bay.

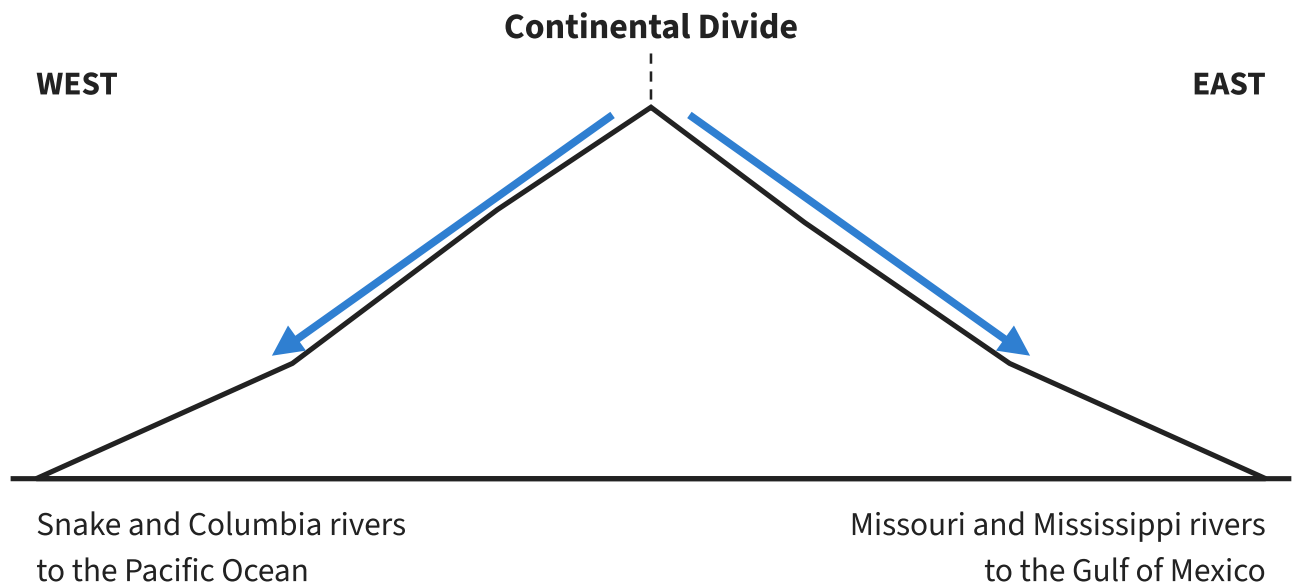
The big idea. Mountains hold treasure. Long ago, great forces inside the earth pushed up and folded the rocks of the Rockies, and in cracks of the rock lay veins of gold, silver and copper. When gold was found where Cherry Creek meets the South Platte River in 1858, thousands of people rushed west in 1859 with "Pikes Peak or Bust" painted on their wagons. Their tents and log cabins grew into **Denver**, the "Mile High City," about 5,280 feet above sea level. In 1859 miners found the rich Comstock silver lode in Nevada, and **Virginia City** sprang up on a bare mountainside; a young newspaper writer there first signed his name "Mark Twain." In the late 1870s silver made **Leadville**, Colorado, a booming city more than 10,000 feet high. In Montana, **Butte** mined so much copper for the new electric wires and telephones that people called it "the Richest Hill on Earth."

Life in a boomtown. A boomtown grew almost overnight, but everything had to be hauled in: flour, coffee, nails, shovels and dynamite came by mule train and freight wagon over steep passes, and later by railroad. Winters were long, and farming high in the mountains was hard. When a mine's ore ran out, the miners packed up and left, and a busy town could become a **ghost town** of empty buildings. Some towns, like Denver, lasted because they became places to trade, to build railroads and to raise cattle on the plains nearby.

On the map. The Rocky Mountain states are **Montana, Idaho, Wyoming, Colorado and Utah**, and with them we study **Nevada**, which lies in the dry Great Basin between the Rockies and the Sierra Nevada. Colorado has more than fifty peaks over 14,000 feet; the highest peak in all the Rockies is Mount Elbert, about 14,440 feet. Pikes Peak (14,115 feet) is named for Zebulon Pike, who saw it in November 1806 but could not reach the top. Salt Lake City stands beside the Great Salt Lake, where Mormon pioneers arrived in 1847 and dug ditches to water their fields from mountain streams. On your map, trace the Continental Divide with a dashed line and color the land east of it one color and the land west of it another.



The Continental Divide (dashed) and some famous mining towns. Water east of the line flows toward the Gulf of Mexico; water west of it flows toward the Pacific, except in the Great Basin (around Salt Lake City and Virginia City), where rivers never reach the sea.



A side view of the Continental Divide. The top of the ridge decides which ocean the water reaches.

PICTURE STUDY



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

Albert Bierstadt was born in Germany and grew up in Massachusetts. In 1859 he traveled west with a government road-building party led by Colonel Frederick W. Lander and sketched the high peaks of the Wind River Range in Wyoming, along the Continental Divide. Back in his New York studio he painted this enormous canvas, about ten feet wide, and named the peak for Lander, who had died serving in the Civil War. Crowds lined up to see it, because most Americans in the East had never seen the Rockies.

Look closely

- Start at the bottom. Find the tents, the horses and the people of the Shoshone camp. What are they doing?
- Follow the water from the waterfall to the lake. Where do you think that water came from?
- Find the highest snowy peak. How did the painter make it look far away and very tall?
- Look at the light. Which part of the picture is brightest, and where are the shadows?

Talk about it

1. Bierstadt painted this in a studio far from the mountains. What do you think he took from his sketches, and what might he have added to make it grand?
2. If you stood at the top of that peak, which oceans might the melting snow reach?
3. Why do you think a painting like this made Americans want to see the West for themselves?

PROJECT: A CUT-AWAY MOUNTAIN RANGE

You will build a small range of mountains from layers of colored clay, mark its Continental Divide, hide a vein of “gold” inside, and then slice it open to see the inside like a miner or a geologist. You will keep this model for your unit portfolio.

You will need

- Modeling clay or play dough in 3 or 4 colors (or salt dough divided and tinted with food coloring)
- A piece of stiff cardboard about 8 by 12 inches for the base
- A strip of aluminum foil or a little gold or yellow clay for the ore vein
- Dental floss or a plastic knife for slicing (with a parent’s help)
- Yarn or string, toothpicks, small paper flags, tape and a marker
- A spray bottle of water and a baking tray

Steps

1. Roll each color of clay into a flat sheet about as thick as your finger. Stack the sheets like a layer cake. These are rock layers.
2. Press a thin strip of foil or yellow clay between two of the layers. This is a vein of ore.
3. Put the stack on the cardboard and push gently from both short ends toward the middle. Watch the layers bend and fold upward into a ridge.
4. Shape the ridge into three or four peaks running from the top of the cardboard (north) to the bottom (south). Pinch out one low gap and flag it “Pass.”
5. Lay yarn along the very top of the ridge and tape its ends to the cardboard. Write “Continental Divide” on a flag. Label the left side WEST and the right side EAST.
6. Set the model on the tray and spray water right on the yarn line, then a little to each side. Watch which way the drops roll. Flag one side “to the Pacific” and the other “to

the Gulf of Mexico.”

7. With a parent, slice straight across the range with floss. Pull the halves apart and look at the folded layers and the ore vein inside.
8. Poke a pencil “mine tunnel” into the side of one half until it reaches the vein. Add a toothpick-and-paper sign with the name of a mining town from the lesson.

Tips

- Clay sheets fold best when they are soft; warm them in your hands first.
- If water soaks into play dough, spray only a few drops, or cover the ridge with plastic wrap before spraying.

Check your work

- My model shows a ridge with a Continental Divide marked along the top.
- I can show which way water runs on each side and name a river on each side.
- My cut-away shows folded layers and an ore vein, and I can explain why miners dug into mountains.

MAP NOTEBOOK

1. Draw the side view of the Continental Divide from the figure. Add arrows and label the Snake and Columbia rivers on the west side and the Missouri and Mississippi on the east side.
2. Draw Lemhi Pass with Hugh McNeal standing astride the little stream. Write one sentence about why that moment was special.
3. Make a small “boomtown” map: a main street, a mine on the hill, a general store, a church, a livery stable and the road out over a pass.

From history. In the summer of 1893 a teacher from Massachusetts named Katharine Lee Bates rode a wagon to the top of Pikes Peak. Looking out over the plains and the mountains, she began a poem that became the song “America the Beautiful.” The words “purple mountain majesties” and “fruited plain” came from what she saw that day from the top of the Rockies.

WORKED EXAMPLES

Example 1. Denver is about 5,280 feet above sea level. The top of Pikes Peak is 14,115 feet above sea level. How much higher is the top of Pikes Peak than Denver?

1. We want the difference, so we subtract the smaller height from the larger one.
2. $14,115 - 5,280$. Line up the places: 14,115 minus 5,000 is 9,115.
3. 9,115 minus 280 is 8,835.

Answer: The top of Pikes Peak is about 8,835 feet higher than Denver, which is more than a mile and a half higher.

Example 2. On a map of Colorado the scale says 1 inch = 20 miles. With a ruler, you measure 3 inches from Denver south to Pikes Peak. About how far apart are they in a straight line?

1. Each inch on the map stands for 20 real miles.
2. There are 3 inches, so multiply: $3 \times 20 = 60$.
3. Check with the map: Pikes Peak is almost straight south of Denver, about one degree of latitude away, and one degree is about 69 miles. Our answer is close.

Answer: About 60 miles in a straight line.

PRACTICE

1. **EASY** Name the five Rocky Mountain states in this lesson, and the dry state next to them that lies in the Great Basin.
2. **EASY** What is the Continental Divide?
3. **EASY** Look at the map. Is Denver east or west of the Continental Divide? Toward which body of water does rain falling on Denver finally flow?
(Use the map or drawing "Use the dashed line to decide." shown earlier in this lesson.)
4. **MEDIUM** Mount Elbert is about 14,440 feet high. Leadville is about 10,150 feet high. How much higher is Mount Elbert than Leadville?
5. **MEDIUM** On a map where 1 inch = 20 miles, Denver and Leadville are about 4 inches apart. About how far apart are they in a straight line?
6. **MEDIUM** Meriwether Lewis drank from a creek on the west side of Lemhi Pass. That water flows into the Lemhi River, then the Salmon River, then the Snake River. Which big river and which ocean does it reach next?
7. **HARD** In 1859 a gold-seeker's wagon traveled about 15 miles a day. The trip from the Missouri River to the new town of Denver was about 600 miles. About how many days did the trip take? About how many weeks?
8. **CHALLENGE** Write three or four sentences: Why did people build towns like Leadville and Virginia City in high, cold, dry places where farming was hard? Why did some of these

towns become ghost towns?

COMMON MISTAKES

- Thinking the Continental Divide is a state border. It is a line of high ground drawn by nature; it crosses through states and only follows a border in a few places, such as part of the Montana and Idaho line.
- Thinking every river in the West flows to the Pacific. The Missouri, Platte, Arkansas and Rio Grande all begin in the Rockies and flow toward the Gulf of Mexico.
- Calling every Western mountain the Rockies. The Sierra Nevada in California and the Cascades in Oregon and Washington are separate ranges.

Make it a game · Which Way, Raindrop?. A parent names a place in the West (Denver, Butte, Pikes Peak, Lemhi Pass west side, Leadville, Yellowstone Lake). You find it on the map and shout “Pacific!” or “Gulf!” for where its water ends up, then name one river on the way. Score one point for the ocean and one bonus point for a correct river. First to ten points wins.

Scripture. “Surely there is a vein for the silver, and a place for gold where they fine it. Iron is taken out of the earth, and brass is molten out of the stone.” (Job 28:1–2, KJV)

Thousands of years before the miners of Colorado and Nevada, the book of Job described men digging for silver, gold and iron. God hid good things in the mountains for people to find and use wisely, and the same chapter reminds us that wisdom is worth more than any mine.

Practice answers

1. Montana, Idaho, Wyoming, Colorado and Utah. The Great Basin state is Nevada.
2. The line along the highest ridges of the Rocky Mountains that separates rivers flowing toward the Pacific Ocean from rivers flowing toward the Gulf of Mexico and the Atlantic.
3. East. It flows by the South Platte, the Platte, the Missouri and the Mississippi into the Gulf of Mexico (part of the Atlantic).
4. $14,440 - 10,150 = 4,290$ feet.
5. $4 \times 20 = 80$ miles (the real straight-line distance is a little under 80 miles).
6. The Columbia River, and then the Pacific Ocean.
7. $600 \div 15 = 40$ days, which is a little less than 6 weeks (5 weeks and 5 days).
8. Sample answer: People came because gold, silver or copper was found in the rocks, and they could earn money mining it and selling supplies to miners. Everything else, like food and tools, had to be hauled in over the mountains. When the ore ran out, the jobs ended and people moved away, so some towns were left empty. Towns lasted when they found other work, such as trade, railroads or ranching.

4.2 THE DESERT SOUTHWEST

OBJECTIVES

- Describe the landforms of the Desert Southwest and tell the difference between a canyon, a plateau, a mesa and a butte.
- Explain why the Southwest is so dry, using rain amounts and the idea that mountains and dry air keep storms away.
- Tell how the Ancestral Puebloans, the Hohokam and modern engineers carried water long distances so people could live in the desert.

Warm-up. Fill a cup with water and carry it carefully from the kitchen sink to the farthest room of your house and back without spilling. Now imagine doing that every day, up and down a cliff, with a heavy clay jar on your head, for all the water your family drinks and cooks with. How many trips would your family need each day?

Watch. *Mesa Verde's Cliffside Dwellings Show a Glimpse of History* | National Geographic (National Geographic, 1:46). <https://www.youtube.com/watch?v=XPI68mdz2HY>

After the story of the cliff dwellings: a short look at the stone houses of Mesa Verde.

Backup video. *Earth's Landforms – Plateaus and Canyons* (Next Generation Science, 2:19). <https://www.youtube.com/watch?v=DHwXKgB3xTY>

With the key terms: how plateaus and canyons form, with pictures of mesas and buttes.

Note: The narrator says canyons take millions of years to form. The lesson itself describes erosion without giving an age.

KEY TERMS

desert

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

canyon

A deep, narrow valley with steep rock walls, usually carved by a river.

plateau

A large area of high, fairly flat land. The Grand Canyon is cut into the Colorado Plateau.

mesa

A hill with a flat top and steep sides that is wider than it is tall. Mesa is the Spanish word for table.

butte

A flat-topped hill with steep sides, smaller than a mesa and taller than it is wide.

aqueduct

A man-made channel, pipe or tunnel that carries water a long way, often from a river to a city or farm.

CORE IDEAS

The story. On a snowy day in December 1888, two cowboys named Richard Wetherill and Charlie Mason rode along the top of a high, flat-topped land in southwestern Colorado, looking for stray cattle. They came to the edge of a canyon and looked across. There, tucked under a huge overhang of rock in the opposite cliff, was a whole silent city of stone: towers, walls and many windows, with no one living in it. They named it **Cliff Palace**. It had about 150 rooms. It had been built about 700 years earlier by people we call the **Ancestral Puebloans**, ancestors of the Hopi, Zuni and other Pueblo peoples who still live in the Southwest. The flat land the cowboys were riding on is called **Mesa Verde**, Spanish for “green table.” Today it is a national park.

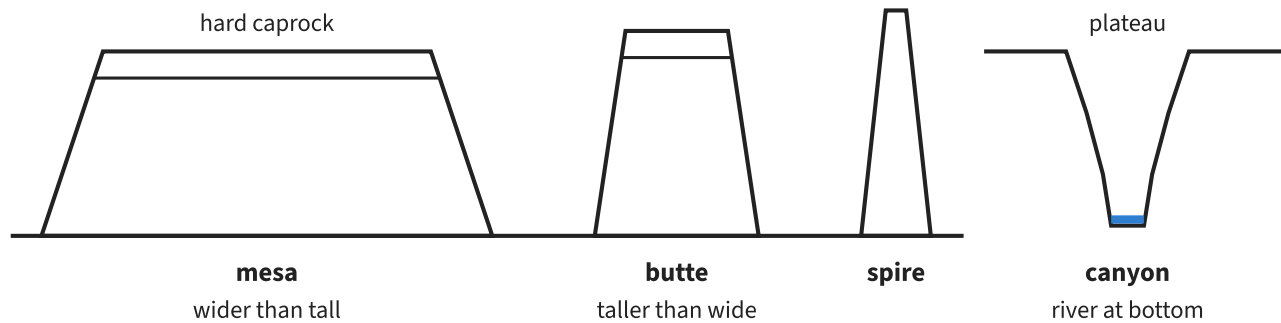
How they lived. The Ancestral Puebloans farmed corn, beans and squash on top of the mesa, where the soil was good. But water was always scarce. They caught rain and melting snow behind small stone walls and in ponds, and they carried water from springs in clay jars, climbing up and down the cliffs on handholds and toeholds cut into the rock. Every drop was precious. By about the year 1300 they had moved away, probably because of long droughts, and their stone houses stood empty for centuries until Wetherill and Mason saw them.

The big idea. The Southwest is a land of **canyons, plateaus, mesas and buttes**. Rivers like the Colorado carve deep canyons into high, flat **plateaus**. The Grand Canyon in Arizona is about 277 miles long, up to 18 miles wide and about a mile deep. Where hard rock sits on top of softer rock, wind and water wear away the sides but not the hard cap, leaving flat-topped **mesas**. As a mesa wears down it becomes a narrow **butte**, and at last a thin spire. You can see giant buttes in Monument Valley, on the border of Arizona and Utah. Why is it so dry? Many of the world’s great deserts lie about 30 degrees north or south of the equator, where dry air sinks and clouds rarely form. Mountains to the west also catch the rain from Pacific storms before it arrives. Phoenix gets only about 8 inches of rain in a year. When summer thunderstorms do come, dry stream beds called **arroyos** can fill with a rushing flash flood in minutes.

Technology overcoming geography. If you live in a desert, you must bring water from far away. About a thousand years ago the **Hohokam** people of the Salt River valley in Arizona dug hundreds of miles of canals with stone tools and digging sticks to water their fields. In 1867 American settlers cleaned out some of those old canal lines and started a farm town. They named it **Phoenix**, after the bird in an old story that rises again from its own ashes. In the 1930s workers built **Hoover Dam** on the Colorado River, a wall of concrete 726 feet tall that holds back Lake Mead. Today giant aqueducts carry Colorado River water about 240 miles west to Los Angeles and more than 300 miles across the desert to Phoenix and Tucson, with pumps lifting it over hills along the way.

On the map. The heart of the Desert Southwest is **Arizona and New Mexico**, with the dry southern parts of Nevada, Utah and California and western Texas. Find the **Four Corners**, the only place in the country where four states (Arizona, New Mexico, Utah and Colorado) meet at one point. Trace the Colorado River from the Rockies through the Grand Canyon, past Hoover Dam and south toward the Gulf of California. Then trace the Rio Grande south

through New Mexico, past Santa Fe, founded by the Spanish around 1610 and the oldest state capital city in the United States. Many place names here are Spanish: mesa, arroyo, Sierra and Rio Grande, “big river.”



A mesa wears down into a butte, and a butte into a spire. Rivers cut canyons into the high plateau.



Water carried far: the Colorado River Aqueduct runs west to the Los Angeles area, and the Central Arizona Project runs east and south to Phoenix and Tucson.

PICTURE STUDY



The Chasm of the Colorado, Thomas Moran, 1873–1874 · Oil on canvas · Smithsonian American Art Museum, Washington, D.C. (lent by the U.S. Department of the Interior Museum)

Thomas Moran was a painter who loved the wild places of the West. In the summer of 1873 he traveled to the North Rim of the Grand Canyon with the explorer John Wesley Powell, whose story you will hear later this year. He filled his sketchbook with drawings and then painted this canvas, about 7 feet tall and 12 feet wide. In 1874 Congress bought it to hang in the U.S. Capitol, next to his painting of Yellowstone.

Look closely

- Find the layers of rock in the cliffs. Can you see the stripes, like the layers of a cake?
- Look at the sky. Is the weather calm or stormy? Where does the light break through?
- Find the deepest, darkest part of the canyon. Can you see the river at the bottom?
- Find a flat-topped shape or a tall rock tower. Is it more like a mesa or a butte?

Talk about it

1. Moran made the canyon look enormous. How did he do it? Think about the size of the canvas, the light and the shadows.
2. What carved this canyon? How long do you think the river had to work?
3. Why might Congress have wanted a painting of the Grand Canyon in the Capitol, where lawmakers would see it?

PROJECT: CARRY THE WATER: A GRAVITY AQUEDUCT

Desert people have always had to move water from where it is to where they need it. You will build an aqueduct from cardboard tubes and foil, test how slope helps water flow, and

discover why engineers need pumps when a hill gets in the way.

You will need

- 4 paper towel tubes, cut in half the long way (or a foam pool noodle cut in half)
- Aluminum foil and tape
- A stack of books or boxes
- A measuring cup and a pitcher of water
- A bowl to be the “city” and a baking tray or bin to catch spills
- A tape measure and a pencil

Steps

1. Line each half-tube with foil, pressing the foil smooth so water will not soak the cardboard. Tape the pieces end to end into one long channel, at least 4 feet long.
2. Rest the high end on a stack of books (this is the river) and the low end over the bowl (this is the city). Do this outside or over a tray.
3. Pour exactly 1 cup of water into the high end. Measure how much reaches the bowl. Write it down.
4. Make the slope steeper with more books, then flatter with fewer. Pour 1 cup each time and record how fast and how much water arrives.
5. Now build a “hill”: lift the middle of the channel higher than the start. Pour again. What happens?
6. Measure the length of your aqueduct. If 1 inch stood for 5 miles, how many miles long would it be?
7. Write two sentences: What helps water flow? Why does the Central Arizona Project need pumps?

Tips

- Water always runs downhill. Roman aqueducts, Hohokam canals and many modern aqueducts slope gently the whole way.
- Lost water is part of the lesson: in a real desert canal, some water soaks into the ground and some dries up in the sun.

Check your work

- My aqueduct carries water from the high end to the bowl.
- I recorded how much water arrived for at least three different slopes.
- I can explain why water cannot cross a hill without a pump.

MAP NOTEBOOK

1. Copy the mesa, butte, spire and canyon drawing and label each one. Under each, write one sentence describing its shape.

2. Draw Cliff Palace under its overhang of rock, with a person climbing the cliff carrying a water jar.
3. On an outline of Arizona, draw the Colorado River and the Central Arizona Project canal, and mark Phoenix and Tucson.

From history. Hoover Dam was built between 1931 and 1936, during the hard years of the Great Depression, by thousands of workers who came looking for jobs. The concrete had to be poured in blocks and cooled with cold water running through pipes inside it; if it had been poured all at once, it would have taken many years to cool and harden. Lake Mead, the lake behind the dam, became one of the largest reservoirs in the country.

WORKED EXAMPLES

Example 1. At Grand Canyon Village on the South Rim, the rim is about 7,000 feet above sea level. The Colorado River at the bottom, below the village, is about 2,400 feet above sea level. About how deep is the canyon there? Is that more or less than a mile (5,280 feet)?

1. Depth is the difference between the top and the bottom: $7,000 - 2,400$.
2. $7,000 - 2,000 = 5,000$, and $5,000 - 400 = 4,600$.
3. Compare to a mile: $5,280 - 4,600 = 680$.

Answer: About 4,600 feet deep, which is about 680 feet less than a mile.

Example 2. The Colorado River Aqueduct carries water about 240 miles from the Colorado River to the Los Angeles area. On a map where 1 inch = 40 miles, how long should you draw it?

(Use the map or drawing “Find the aqueduct that runs west toward Los Angeles.” shown earlier in this lesson.)

1. Each inch stands for 40 miles. We need to know how many 40s are in 240.
2. $240 \div 40 = 6$ (because $6 \times 40 = 240$).
3. So the aqueduct line on the map should be about 6 inches long.

Answer: About 6 inches.

PRACTICE

1. **EASY** What is the difference between a mesa and a butte?
2. **EASY** Which four states meet at the Four Corners?
3. **EASY** Who found Cliff Palace in 1888, and what does the name Mesa Verde mean?
4. **MEDIUM** A gallon of water weighs about 8 pounds. A Pueblo woman’s water jar holds 3 gallons. About how much does the water in a full jar weigh?

5. **MEDIUM** Phoenix gets about 8 inches of rain a year. Atlanta, in the Southeast, gets about 50 inches. How many more inches does Atlanta get? About how many times as much?
6. **MEDIUM** Look at the map. In which direction does the Colorado River Aqueduct carry water to reach Los Angeles? In which directions does the Central Arizona Project carry water to reach Phoenix and then Tucson?
(Use the map or drawing "Use the compass directions: north is at the top." shown earlier in this lesson.)
7. **HARD** Hoover Dam is 726 feet tall. One story of a tall building is about 10 feet. About how many stories tall would a building as tall as Hoover Dam be?
8. **CHALLENGE** Write three or four sentences: The Ancestral Puebloans, the Hohokam and the builders of Hoover Dam lived hundreds of years apart. What problem did all of them face, and how did each one solve it?

COMMON MISTAKES

- Thinking a desert must be hot and sandy. A desert is defined by how little rain falls; much of the Southwest is rock, brush and cactus, and it can be cold at night and in winter.
- Mixing up mesa and butte. Remember: a mesa is a wide table; a butte is a narrow tower.
- Thinking water can flow across a hill on its own. Water only runs downhill; to cross a hill it needs a pump or a tunnel.

Make it a game · Mesa, Butte or Canyon? Build shapes from blocks or books while your partner closes their eyes: a wide flat-topped stack (mesa), a tall narrow stack (butte), a single tall block (spire), or two stacks with a gap between them (canyon). Your partner opens their eyes and names it. Then switch. For a bonus point, name a real place where that landform can be seen (Mesa Verde, Monument Valley, the Grand Canyon).

Scripture. "The wilderness and the solitary place shall be glad for them; and the desert shall rejoice, and blossom as the rose." (Isaiah 35:1, KJV)

After a summer rain the Southwest desert bursts into flowers in a few days. Isaiah used that picture to promise that God can bring life to dry and empty places. When people carry water carefully and share it fairly, they are being good stewards of a land where every drop matters.

Practice answers

1. Both have flat tops and steep sides. A mesa is wider than it is tall; a butte is smaller and taller than it is wide.
2. Arizona, New Mexico, Utah and Colorado.
3. Richard Wetherill and Charlie Mason, two cowboys looking for stray cattle. Mesa Verde means "green table" in Spanish.
4. $3 \times 8 = 24$ pounds (plus the weight of the clay jar).
5. $50 - 8 = 42$ more inches. Atlanta gets about 6 times as much rain ($6 \times 8 = 48$, close to 50).

6. The Colorado River Aqueduct carries water west. The Central Arizona Project carries water east to Phoenix and then southeast to Tucson.
7. $726 \div 10 = 72.6$, so about 73 stories (roughly 70).
8. Sample answer: All of them lived in a dry land where water was scarce and far from where people needed it. The Ancestral Puebloans caught rain and snowmelt and carried water from springs in jars. The Hohokam dug long canals to bring river water to their fields. Modern engineers built dams to store river water and aqueducts with pumps to carry it hundreds of miles to cities.

4.3 THE PACIFIC COAST

OBJECTIVES

- Tell the story of the California Gold Rush, beginning with James Marshall's find at Sutter's Mill in 1848, and compare the routes the forty-niners took to reach California.
- Find California, Oregon and Washington, the Sierra Nevada, the Cascades, the Columbia River and Puget Sound on a map.
- Explain a rain shadow: why the west side of the Pacific Coast mountains is wet and the east side is dry.

Warm-up. Put a handful of sand, a few small pebbles and three coins in a jar of water. Put the lid on tight, shake it hard, and set it down. Watch what settles first. Which things sink fastest? Gold is much heavier than sand, which is the secret every gold panner uses.

Watch. *The California Gold Rush for Kids / Little Patriots Course 33* (Little Patriots, 6:05). <https://www.youtube.com/watch?v=FDupOzHHsYU>

With the story: a cartoon with songs about the forty-niners who came to California for gold.

Note: Little Patriots is a homeschool American-history program for young children.

Backup video. *Rain Shadow* (University of Illinois Extension, 2:40).

<https://www.youtube.com/watch?v=iMu4dShS74w>

With the big idea: how mountains make a rain shadow, wet on one side and dry on the other.

KEY TERMS

gold rush

A sudden rush of many people to a place where gold has been found.

forty-niners

The gold-seekers who rushed to California in 1849.

mouth (of a river)

The place where a river flows into a sea, ocean or lake.

sound

A long, wide arm of the sea reaching into the land, bigger than a bay. Puget Sound is one.

rain shadow

The dry land on the side of a mountain range away from the wind, where little rain falls because the mountains caught it first.

volcano

A mountain built up by melted rock (lava) and ash that came up from deep inside the earth. The Cascades have many volcanoes.

CORE IDEAS

The story. On the morning of January 24, 1848, a carpenter named James Marshall was walking beside a ditch at the sawmill he was building for John Sutter at Coloma, on the South Fork of the American River in California. Water had run through the ditch overnight to wash it out. In the wet gravel something glittered. Marshall picked up a few flakes about the size of grains of wheat. Were they gold, or worthless “fool’s gold”? He pounded one with a rock: fool’s gold would have shattered, but this flattened out without breaking. It was gold! Sutter tried to keep the news secret, but by May a merchant was waving a bottle of gold dust in the streets of San Francisco, and men dropped their work and ran for the hills. Nine days after Marshall’s find, Mexico had signed a treaty giving California to the United States, so the gold rush happened on brand-new American land.

How they got there. In December 1848 President James K. Polk told Congress about the gold, and in 1849 the world came running. These **forty-niners** had three ways to go. They could sail around Cape Horn at the tip of South America, a voyage of about 14,000 miles that took five to eight months. They could sail to Panama, cross its narrow neck of jungle by canoe and mule, and catch another ship north, which was faster but full of fevers. Or they could go overland on the California Trail, about 2,000 miles by wagon from Missouri, crossing the Rockies, the desert and at last the steep Sierra Nevada. Most miners found little gold, but California grew so fast that it became a state in 1850, only two years after Marshall’s find. The rush brought great hardship too: the Native peoples of California lost their land, and many thousands died from disease, hunger and killings, and Chinese miners were made to pay unfair taxes.

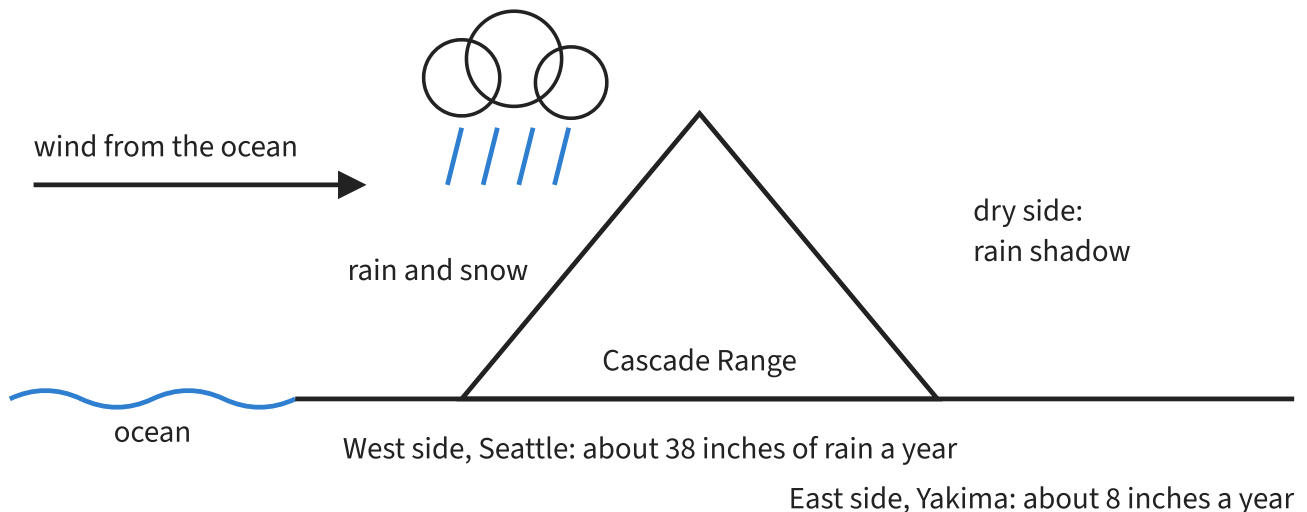
The big idea. The Pacific Coast has two lines of mountains running north and south: the low **Coast Ranges** along the ocean and, farther inland, the high **Sierra Nevada** in California and the **Cascade Range** in Oregon and Washington. The Cascades are a chain of volcanoes, such as Mount Rainier and Mount St. Helens, which erupted on May 18, 1980. Winds blow in from the Pacific full of moisture. When the air is pushed up the mountains, it cools and drops its rain and snow on the west side. By the time it crosses the top, it is dry. The land on the east side lies in a **rain shadow**. Seattle, west of the Cascades, gets about 38 inches of rain a year; Yakima, just east of them, gets only about 8. California’s Death Valley lies in the rain shadow of the Sierra Nevada. Its lowest point is 282 feet *below* sea level, less than 100 miles from Mount Whitney (14,505 feet), the highest peak in the lower 48 states.

Rivers and harbors. On May 11, 1792, an American sea captain, Robert Gray, steered his ship the *Columbia Rediviva* across a dangerous sandbar into the mouth of a great river and named it the **Columbia** after his ship. His voyage helped the United States claim the Oregon Country, and Lewis and Clark reached the river’s mouth in November 1805. The Columbia is about 1,240 miles long and carries more water into the Pacific than any other river in North America. Today dams along it make electricity, and with the help of locks, barges travel up the Columbia and the Snake all the way to Lewiston, Idaho, about 465 miles from the sea. The same year Gray found the Columbia, the British captain George Vancouver explored a deep, branching inlet of the sea and named it **Puget Sound** after one of his officers, Peter Puget. Its sheltered waters made fine harbors for Seattle and Tacoma.

On the map. The Pacific Coast states are **California, Oregon and Washington.** Find San Francisco on its great bay, Sacramento (the capital of California) near the gold fields, and Los Angeles in the south. In California's long Central Valley, rivers from the Sierra snow water some of the richest farmland on earth. Find Portland where the Willamette River meets the Columbia, and Seattle on Puget Sound. Notice how nearly every big city stands on a bay, a sound or a river mouth, where ships can find shelter.



The Pacific Coast states: the gold country, the Columbia River and Puget Sound.



How a rain shadow works. The mountains catch the rain on the windward side.

PICTURE STUDY



Sunday Morning in the Mines, Charles Christian Nahl, 1872 · Oil on canvas · Crocker Art Museum, Sacramento, California

Charles Nahl was born in Germany and came to California in 1851, during the gold rush. He drew and painted the mining camps he saw with his own eyes. Years later, Judge Edwin Crocker of Sacramento asked him to paint a big picture of mining life, and Nahl painted this crowded scene of a camp on the one day of the week the miners did not dig for gold.

Look closely

- Walk slowly across the painting from one side to the other. Make a list of everything the miners are doing.
- Find a man reading. What do you think he is reading on a Sunday morning?
- Find the miners who are rowdy or racing. How is that side of the picture different from the quieter side?
- Look at the clothes, tools and cabins. What do they tell you about life in a mining camp?

Talk about it

1. Nahl seems to show two different ways to spend a Sunday. What are they, and which do you think he admired?
2. Most of these miners were young men far from their families. What would be hard about that life?
3. How does this painting help you understand Proverbs 16:16?

PROJECT: PAN FOR GOLD LIKE A FORTY-NINER

Gold is about seven times heavier than the same amount of sand. Forty-niners used that fact to separate tiny bits of gold from gravel with nothing but a pan and a stream. You will make your own “gold” and pan for it, then mark the gold country on your map.

You will need

- A shallow metal pie pan or a wide plastic bowl
- A dishpan or bucket of water (or work outside with a hose)
- About 2 cups of sand and 1 cup of small gravel
- 6 to 10 small steel nuts or washers, painted gold and dried (or pennies)
- A small jar for your “gold,” a timer and a notebook

Steps

1. Mix the sand, gravel and your painted “gold” together in a bucket. Ask someone else to mix it so you do not know where the gold is.
2. Scoop the pan about half full of the mix and lower it into the water.
3. Shake the pan gently from side to side under the water so the heavy pieces sink to the bottom.
4. Tilt the pan a little away from you and swirl, letting the water carry the light sand over the far edge. Pick out the big stones by hand.
5. Keep swirling and washing until only a little heavy material is left. Pick out your gold and put it in the jar.
6. Time yourself. Record how many pieces you found and how many minutes it took. Do it three times. Do you get faster?
7. On your map of the Pacific Coast, mark Coloma and the American River with a small gold star.

Tips

- Go slowly. Shaking too hard throws the gold out of the pan along with the sand.
- Do this outside or in a tub, and pour the leftover sand outdoors, not down the sink.

Check your work

- I found my gold by letting the heavy pieces sink and washing away the light sand.
- I can explain why panning works.
- I can tell the story of James Marshall and find Coloma on the map.

MAP NOTEBOOK

1. Draw the rain-shadow diagram: wind, mountain, rain cloud on the wet side and a dry side. Label Seattle and Yakima with their rain amounts.
2. Draw a map of the three ways to California in 1849: around Cape Horn, across Panama and overland on the California Trail. Use a different color for each.

3. Draw Robert Gray's ship crossing the sandbar into the mouth of the Columbia, and write the date May 11, 1792.

From history. One of the shopkeepers who did well in the gold rush was a young German immigrant named Levi Strauss, who opened a dry-goods business in San Francisco in 1853. Years later, in 1873, he and a tailor named Jacob Davis received a patent for work pants strengthened with metal rivets at the corners of the pockets, so they would not tear when a working man stuffed them with tools. Those riveted denim pants became the blue jeans people wear all over the world.

WORKED EXAMPLES

Example 1. In 1849 a sailing ship going around Cape Horn traveled about 14,000 miles, averaging about 140 miles a day. A wagon on the California Trail traveled about 2,000 miles, averaging about 15 miles a day. About how many days did each trip take? Which was faster?

1. Ship: $14,000 \div 140$. Take a zero off each number: $1,400 \div 14 = 100$. So about 100 days.
2. Wagon: $2,000 \div 15$. Since $15 \times 100 = 1,500$ and $15 \times 33 = 495$, we get $15 \times 133 = 1,995$, about 2,000. So about 133 days.
3. Compare: $133 - 100 = 33$.

Answer: The ship took about 100 days and the wagon about 133 days, so the ship was about a month faster, even though it went seven times as far. (Ships were often slowed by storms, and wagons by mountains and broken wheels, so real trips varied.)

Example 2. Mount Whitney is 14,505 feet above sea level. Badwater, in Death Valley, is 282 feet below sea level. How many feet higher is the top of Mount Whitney than Badwater?

1. Draw a number line with sea level at 0. Whitney is 14,505 feet above 0, and Badwater is 282 feet below 0.
2. To go from Badwater up to Whitney, first climb 282 feet to reach sea level, then 14,505 more feet to the top.
3. Add: $14,505 + 282 = 14,787$.

Answer: Mount Whitney is 14,787 feet higher than Badwater, and the two places are less than 100 miles apart.

PRACTICE

1. **EASY** Who found gold at Sutter's Mill, and on what date? On what river was the mill?

2. **EASY** Name the three Pacific Coast states and one big city in each.
3. **EASY** What is a rain shadow?
4. **MEDIUM** Before the Panama Canal opened in 1914, a ship from New York to San Francisco sailed about 14,000 miles around Cape Horn. Through the canal the trip is about 6,000 miles. How many miles did the canal save?
5. **MEDIUM** Look at the map. Which city stands where the Willamette River meets the Columbia? Which city is on Puget Sound? Which town is at the mouth of the Columbia? *(Use the map or drawing "Find the rivers and Puget Sound." shown earlier in this lesson.)*
6. **MEDIUM** Seattle gets about 38 inches of rain a year and Yakima about 8. How many more inches does Seattle get? About how many times as much?
7. **HARD** California became a state in 1850. Marshall found gold in 1848. Gray sailed into the Columbia in 1792. How many years passed between Gray's voyage and California becoming a state? Between Marshall's find and statehood?
8. **CHALLENGE** Write three or four sentences: Why do so many big cities of the Pacific Coast, like San Francisco, Portland and Seattle, stand on a bay, a sound or a river?

COMMON MISTAKES

- Thinking the forty-niners arrived in 1848. Gold was found in January 1848, but the great rush from around the world came in 1849, which is why they were called forty-niners.
- Thinking most miners got rich. Most found little gold; many of the people who did well sold food, tools and clothing to the miners.
- Putting the rain shadow on the wrong side. The wet side faces the wind from the ocean; the dry rain shadow is on the far side of the mountains.

Make it a game • Forty-Niner Race. Make three paths across the floor with tape: a long winding one (Cape Horn), a short one with an obstacle you must crawl under (Panama), and a medium one over a pile of pillows (the Sierra Nevada on the California Trail). Each player draws a slip that says which route to take. Before moving, answer a question from the lesson; a right answer lets you move one step. First to reach the gold jar at the end wins.

Scripture. "How much better is it to get wisdom than gold! and to get understanding rather to be chosen than silver!" (Proverbs 16:16, KJV)

Thousands of people left their homes and families to search for gold, and most came back with very little. Solomon says there is a treasure worth more than gold: wisdom, which every person can seek and which no one can steal.

Practice answers

1. James Marshall, on January 24, 1848, on the South Fork of the American River at Coloma, California.

2. California (San Francisco, Los Angeles or Sacramento), Oregon (Portland) and Washington (Seattle or Tacoma).
3. The dry land on the side of a mountain range away from the wind. The wind drops its rain on the windward side, so little is left for the other side.
4. $14,000 - 6,000 = 8,000$ miles.
5. Portland; Seattle; Astoria.
6. $38 - 8 = 30$ more inches. Seattle gets almost 5 times as much ($5 \times 8 = 40$, close to 38).
7. $1850 - 1792 = 58$ years. $1850 - 1848 = 2$ years.
8. Sample answer: Ships need sheltered water where they can load and unload safely, out of the ocean's storms and waves. Rivers like the Columbia let boats carry goods far inland and bring farm products and lumber down to the sea. San Francisco Bay and Puget Sound are large, protected harbors. So trade came to these places, and cities grew there.

4.4 ALASKA AND HAWAII

OBJECTIVES

- Tell how the United States bought Alaska from Russia in 1867 and how Hawaii, an island kingdom, became part of the United States, and name the year both became states.
- Find Alaska and Hawaii on a map and use latitude to explain why one has the Arctic Circle and the other lies in the tropics.
- Describe the landforms of each state (Denali, glaciers and the Yukon River; volcanic islands and Mauna Kea) and how people overcome great distances there.

Warm-up. Find Alaska and Hawaii on a classroom map or a placemat map of the United States. Are they drawn in boxes near Mexico? Now find them on a globe. Where are they really? Measure with a string how far each one is from your home on the globe. Why do mapmakers often move them into little boxes?

Watch. *2nd February 1925: Great Race of Mercy diphtheria antitoxin dogsled relay* (HistoryPod, 3:00). <https://www.youtube.com/watch?v=LeLVGc8Nwv8>

With Technology overcoming geography: the 1925 dogsled relay that carried medicine to Nome.

Backup video. *What is a Volcanic Hotspot?* (IRIS Earthquake Science, 2:13).

<https://www.youtube.com/watch?v=AhSaE0omw9o>

With the big idea on Hawaii: how a hot spot makes a chain of volcanic islands.

KEY TERMS

glacier

A huge, slow-moving river of ice made from snow packed down over many years.

Arctic Circle

The line of latitude at about 66½ degrees north. North of it, there is at least one day each year when the sun does not set and one when it does not rise.

tropics

The warm belt of the earth between the Tropic of Cancer (about 23½ degrees north) and the Tropic of Capricorn (about 23½ degrees south). Hawaii is the only state inside it.

archipelago

A chain or group of islands, like the Hawaiian Islands.

trade winds

Steady winds in the tropics that blow from the east. In Hawaii they bring rain to the northeast sides of the islands.

CORE IDEAS

The story. On October 18, 1867, soldiers of two nations stood at attention on a hill above the harbor of Sitka, Alaska. Russian soldiers slowly lowered the flag of Russia. Then American soldiers raised the Stars and Stripes, and cannons boomed a salute. In that short ceremony, a land more than twice the size of Texas became part of the United States. Earlier that year Secretary of State **William H. Seward** had signed a treaty to buy Alaska from Russia for \$7,200,000, about two cents an acre. Russia had decided its far-off colony was too hard to defend and too costly to keep. Many Americans laughed at the deal and called Alaska “Seward’s Folly” or “Seward’s Icebox.” Then gold was found: at Juneau in 1880, in Canada’s Klondike next door in 1896, and on the beaches of Nome in 1899. Later came fish, timber and oil. Nobody calls it a folly now.

The big idea: Alaska. Alaska is our largest state and has more coastline than all the other states put together. **Denali**, 20,310 feet high, is the tallest mountain in North America. Huge **glaciers** creep down from the mountains to the sea. The **Yukon River** flows across the middle of the state to the Bering Sea, and across the narrow Bering Strait, only about 50 miles wide, lies Russia. Much of Alaska is north of the **Arctic Circle**. In Utqiagvik, the northernmost town in the country, the sun does not rise for about two months in winter, and in summer it does not set for more than two months. Alaska is called **the Last Frontier**. It became the 49th state on January 3, 1959.

Technology overcoming geography. Alaska is so big and rugged that many towns have no road to the rest of the world; even Juneau, the capital, can be reached only by boat or airplane. In January 1925 children in Nome fell sick with diphtheria, and the town needed medicine fast. Winter ice closed the sea and no airplane could make the trip, so the medicine went by train to Nenana and then by dog sled. About twenty mushers and well over a hundred dogs passed it along like a relay baton, about 674 miles through blizzards, in about five and a half days. Today small “bush planes” carry mail, food and doctors to villages, and the 800-mile Trans-Alaska Pipeline, finished in 1977, carries oil from Prudhoe Bay on the Arctic coast south to the ice-free port of Valdez.

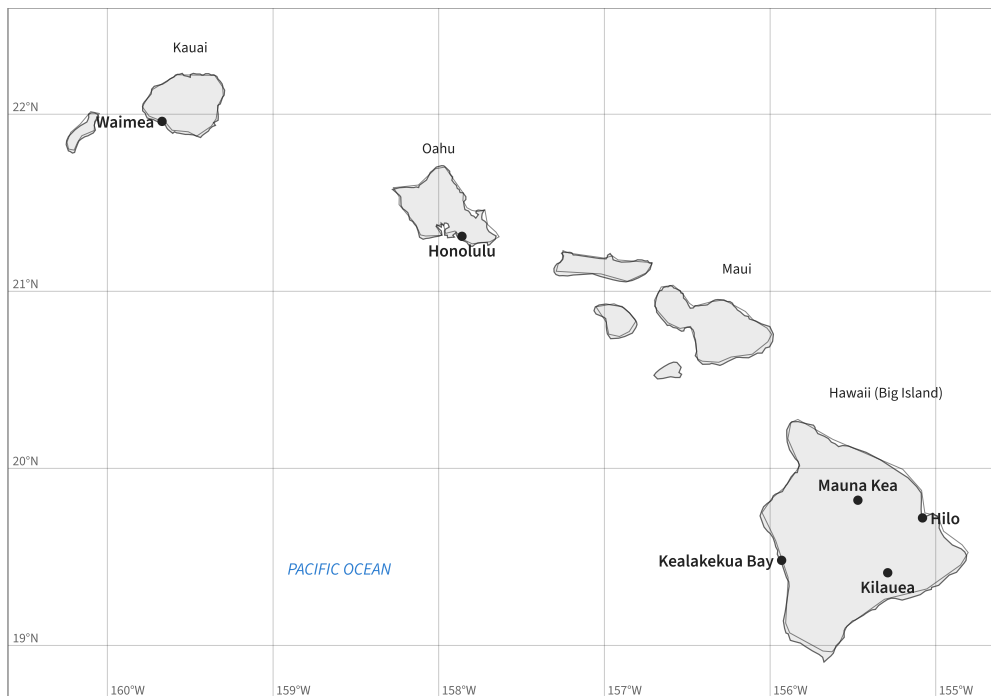
The big idea: Hawaii. About 2,400 miles southwest of California, in the middle of the Pacific Ocean, a chain of islands rises from the sea. Every one of them was built by **volcanoes**. The Island of Hawaii, the “Big Island,” still has active volcanoes like Kilauea. Its mountain **Mauna Kea** rises 13,803 feet above the sea, but its base is far down on the ocean floor; measured from bottom to top it is more than 33,000 feet tall, taller than Mount Everest. The **trade winds** blow from the northeast, so the windward sides of the islands are rainy and green and the other sides lie in a rain shadow. Hawaii is our only state in the **tropics**.

On the map and in history. Polynesian voyagers found these islands many centuries ago, steering great double-hulled canoes by the stars, the swells of the ocean and the flight of birds. Captain James Cook reached Kauai in January 1778; he was killed at Kealahou Bay on the Big Island in February 1779. King **Kamehameha I** united the islands into one kingdom by 1810. In 1820 missionaries from New England arrived; they helped write the

Hawaiian language with an alphabet and opened schools, and many Hawaiians became Christians. In 1893 a group of mostly American businessmen, with U.S. Marines landed nearby, forced Queen Liliuokalani from her throne. She yielded under protest, and the United States annexed the islands in 1898. On August 21, 1959, Hawaii became the 50th state. Find its eight main islands, with Honolulu on Oahu, on your map.



Alaska: the Arctic Circle, the 1925 serum run and the Trans-Alaska Pipeline.



The main Hawaiian Islands. The youngest island, Hawaii (the Big Island), is in the southeast.

PICTURE STUDY



Wreck of the "Ancon" in Loring Bay, Alaska, Albert Bierstadt, 1889 · Oil on paper mounted on board · Museum of Fine Arts, Boston

By the 1880s steamships were carrying travelers up the Inside Passage of southeastern Alaska to see its glaciers and mountains. In 1889 the painter Albert Bierstadt, whose painting of the Rockies you studied in Lesson 4.1, made the trip himself aboard the steamship *Ancon*. On August 28 the ship stopped at Loring, a salmon-cannery town on a quiet bay. As it pulled away from the wharf early that morning, it ran onto hidden rocks only a few hundred feet from shore. No one was lost, but the ship could not be saved. Bierstadt painted the stranded ship.

Look closely

- Find the ship. How can you tell it is stuck and not sailing?
- Look behind the ship. What kind of land and trees do you see?
- Look at the water and the sky. Is this a stormy wreck or a quiet one?

Talk about it

1. Why would ships have been so important in a place like southeastern Alaska, where there were few roads?
2. How is this painting different from Bierstadt's huge, sunny painting of the Rockies?

PROJECT: THE MOUNTAIN UNDER THE SEA

Most of Mauna Kea is hidden underwater. You will build a volcano island on the bottom of a clear container, flood it with an "ocean," and measure how much of your mountain is hidden, just like the real Hawaiian volcanoes.

You will need

- A clear plastic storage bin or a large glass bowl
- Modeling clay or play dough (about 1 pound)
- A ruler, a dry-erase marker or a strip of tape
- A pitcher of water with a few drops of blue food coloring
- Paper and pencil for a record table

Steps

1. Build a wide, gently sloping volcano from clay on the bottom of the bin. Make the slopes gentle, like a shield lying on the ground; Hawaiian volcanoes are shaped this way.
2. Measure your volcano from the bottom of the bin to its peak. Write it down. This is its height from the “ocean floor.”
3. Slowly pour in the blue water until only the top part of your volcano sticks out. Mark the water line on the side of the bin.
4. Measure from the water line to the peak. This is the height “above sea level.” Write it down.
5. Subtract to find how much of your volcano is hidden underwater.
6. Compare with Mauna Kea: about 13,800 feet above the sea and more than 33,000 feet from the sea floor. Is more of the real mountain above or below the water? Is yours the same?
7. Build two smaller, lower islands in a line beside the first one. Which would sailors see first from far away?

Tips

- Press the clay firmly onto the bottom so it does not float up when you add water.
- If your island is mostly above water, add more water. Real Hawaiian volcanoes are mostly hidden.

Check your work

- I measured my volcano’s height from the bottom and above the water.
- I can explain why Mauna Kea can be called taller than Mount Everest.
- I can explain that the Hawaiian Islands are the tops of volcanoes rising from the ocean floor.

MAP NOTEBOOK

1. Draw a large outline of Alaska. Add the Arctic Circle as a dashed line, Denali as a triangle, the Yukon River in blue, and dots for Juneau, Anchorage and Nome.
2. Draw the eight main Hawaiian Islands in a chain from northwest to southeast. Label Oahu, Honolulu and the Big Island.

3. Draw a sled dog team crossing the snow with the box of medicine for Nome, and write one sentence about why the serum run was needed.

From history. The missionaries who came to Hawaii in 1820 sailed from Boston around Cape Horn on the brig *Thaddeus*, a voyage of more than five months. One of their leaders, Hiram Bingham I, helped turn the spoken Hawaiian language into a written one using just twelve letters at first: the five vowels a, e, i, o, u and the consonants h, k, l, m, n, p and w. Within a few years, schools across the islands were teaching Hawaiians to read the Bible and other books in their own language.

WORKED EXAMPLES

Example 1. The United States paid \$7,200,000 for Alaska. Alaska has about 365 million acres of land. Round that to 360,000,000 acres. About how much did each acre cost?

1. Cost for each acre = total price $\div$ number of acres = $\$7,200,000 \div 360,000,000$.
2. Take the same number of zeros off both numbers. Remove five zeros: $72 \div 3,600$.
3. $72 \div 3,600$ is the same as $1 \div 50$ (because $72 \times 50 = 3,600$). One dollar divided into 50 parts is 2 cents.

Answer: About 2 cents an acre, cheaper than a postage stamp.

Example 2. Utqiagvik, Alaska, is at about 71 degrees north latitude. The Arctic Circle is at about $66\frac{1}{2}$ degrees north. Each degree of latitude is about 69 miles. About how far north of the Arctic Circle is Utqiagvik?

(Use the map or drawing "Find Utqiagvik and the Arctic Circle." shown earlier in this lesson.)

1. Find the difference in latitude: $71 - 66\frac{1}{2} = 4\frac{1}{2}$ degrees.
2. Multiply by 69 miles per degree: $4 \times 69 = 276$, and $\frac{1}{2} \times 69 = 34\frac{1}{2}$.
3. Add: $276 + 34\frac{1}{2} = 310\frac{1}{2}$.

Answer: About 310 miles north of the Arctic Circle.

PRACTICE

1. **EASY** In what year did Alaska and Hawaii become states? Which was the 49th state, and which was the 50th?
2. **EASY** Who arranged the purchase of Alaska, from what country, in what year, and for how much?
3. **EASY** Name the tallest mountain in North America, its state and its height.
4. **MEDIUM** Measured from the ocean floor, Mauna Kea is about 33,500 feet tall. Mount Everest is 29,032 feet above sea level. About how much taller is Mauna Kea from bottom to top?

5. **MEDIUM** The 1925 serum run covered about 674 miles in about $5\frac{1}{2}$ days. Was the speed closer to 60, 120 or 200 miles a day? Show how you know.
6. **MEDIUM** Look at the map of Hawaii. On which island is Honolulu? In which direction would you sail from Honolulu to reach Hilo?
(Use the map or drawing “North is at the top.” shown earlier in this lesson.)
7. **HARD** Honolulu is at about 21 degrees north latitude. The Tropic of Cancer is at about $23\frac{1}{2}$ degrees north. Is Honolulu inside the tropics? About how many miles is it south of the Tropic of Cancer? (One degree is about 69 miles.)
8. **CHALLENGE** Write three or four sentences: How have people overcome the great distances of Alaska? Give at least two examples from the lesson.

COMMON MISTAKES

- Believing the map boxes. On many U.S. maps Alaska and Hawaii are drawn in small boxes near Mexico, and Alaska is shrunk. Alaska really lies northwest of Canada, and Hawaii lies about 2,400 miles out in the Pacific.
- Thinking all of Alaska is frozen all year. Southern Alaska has mild, rainy summers and great forests; the coldest lands are in the north and the interior.
- Measuring Mauna Kea only above sea level when comparing it with Everest. Above the sea it is 13,803 feet; from its base on the ocean floor it is more than 33,000 feet.

Make it a game • North or Tropical?. A parent calls out a clue: “The sun doesn’t rise for two months,” “trade winds,” “Denali,” “Kilauea,” “Seward’s Icebox,” “Queen Liliuokalani,” “dog sleds to Nome,” “the 50th state.” You point to Alaska or Hawaii on the map (or hop to an “Alaska” paper on one side of the room or a “Hawaii” paper on the other). Score a point for each right answer and a bonus point if you can add one more fact.

Scripture. “The LORD reigneth; let the earth rejoice; let the multitude of isles be glad thereof.” (Psalm 97:1, KJV)

From the icy islands of the Aleutians to the green volcanoes of Hawaii, the farthest corners of our country are islands, and God reigns over every one of them. As Acts 17:26 teaches, He set the bounds of the lands where peoples live, from the Arctic to the tropics.

Practice answers

1. Both in 1959. Alaska was the 49th (January 3, 1959) and Hawaii the 50th (August 21, 1959).
2. Secretary of State William H. Seward bought it from Russia in 1867 for \$7,200,000.
3. Denali, in Alaska, 20,310 feet.
4. $33,500 - 29,032 = 4,468$, about 4,500 feet taller.
5. Closer to 120. $120 \times 5\frac{1}{2} = 600 + 60 = 660$, which is close to 674. ($60 \times 5\frac{1}{2} = 330$ is too few; $200 \times 5\frac{1}{2} = 1,100$ is too many.)
6. Oahu. Southeast.
7. Yes, it is south of the Tropic of Cancer, so it is in the tropics. $23\frac{1}{2} - 21 = 2\frac{1}{2}$ degrees; $2\frac{1}{2} \times 69 = 138 + 34\frac{1}{2} = 172\frac{1}{2}$, about 170 miles.

8. Sample answer: Alaska is huge and many towns have no roads, so people use boats, airplanes and, long ago, dog sleds. In 1925 mushers and dog teams relayed medicine about 674 miles to Nome when ships and planes could not go. Today bush planes carry mail, food and doctors to villages. The 800-mile Trans-Alaska Pipeline carries oil from the Arctic coast to the port of Valdez.

UNIT 4 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use a blank outline map of the United States. The review is worth 50 points.

1. (5 pts) What is the Continental Divide? Name one river that flows east from it and one that flows west.
2. (5 pts) Name two Western mining towns from the lesson, the metal mined there and the state each is in.
3. (5 pts) On a map where 1 inch = 25 miles, two mining towns are 4 inches apart. How far apart are they? If a mule train travels 20 miles a day, how many days does the trip take?
4. (5 pts) Draw and label a mesa and a butte. Write one sentence telling how they are different.
5. (5 pts) Give two reasons the Desert Southwest gets so little rain.
6. (5 pts) Name two ways people have carried or stored water in the Southwest, one from long ago and one from modern times.
7. (5 pts) Tell the story of the start of the California Gold Rush: who, where, when, and what happened in 1849.
8. (5 pts) Seattle, west of the Cascades, gets about 38 inches of rain a year. Yakima, east of them, gets about 8 inches. How much more rain does Seattle get, and why is Yakima so dry?
9. (5 pts) Who named the Columbia River and when? Who named Puget Sound? Name a big city on each.
10. (5 pts) Alaska was bought for \$7,200,000 in 1867, and Hawaii became a state in 1959. How many years after the Alaska Purchase did Hawaii become a state? Name one landform found in Alaska and one found in Hawaii.

UNIT PROJECT: MY CUT-AWAY MOUNTAINS AND MAP OF THE WEST

Finish your cut-away mountain range from Lesson 4.1 and set it beside a large hand-drawn map of the western states and their rivers. On the map, label the eleven western states plus Alaska and Hawaii in inset boxes, draw the Continental Divide as a dashed line, and trace in blue the Missouri, Snake, Columbia, Colorado and Rio Grande rivers. Mark at least eight places from the unit (such as Lemhi Pass, Denver, Mesa Verde, Hoover Dam, Coloma, Seattle, Sitka and Honolulu) and draw small symbols for gold, silver, a dam, a volcano and a glacier.

Add a short written card that explains three things: how the Continental Divide decides where water goes, how a rain shadow works, and one way people overcame the distances or dryness of the West.

- **Accuracy:** States, rivers, the Continental Divide and the eight places are drawn and labeled in the right locations.

- **Model:** The cut-away model shows folded rock layers, an ore vein, a marked divide and labeled east and west sides.
- **Explanation:** The written card correctly explains the divide, the rain shadow and one way technology overcame Western geography.
- **Care:** The map and model are neat, colorful, clearly labeled and include a compass rose and a map key.

Answer key

1. The line along the highest ridges of the Rocky Mountains that separates rivers flowing toward the Pacific from rivers flowing toward the Gulf of Mexico and the Atlantic. East: the Missouri, Platte, Arkansas or Rio Grande. West: the Snake, Columbia or Colorado.
2. Any two: Denver, Colorado (gold, 1858-1859); Virginia City, Nevada (silver, the Comstock Lode); Leadville, Colorado (silver); Butte, Montana (copper).
3. $4 \times 25 = 100$ miles. $100 \div 20 = 5$ days.
4. Drawings show two flat-topped hills with steep sides. A mesa is wider than it is tall; a butte is smaller and taller than it is wide.
5. It lies near 30 degrees north latitude, where dry air sinks and clouds rarely form, and mountains to the west catch the rain from Pacific storms before it arrives (a rain shadow).
6. Long ago: the Ancestral Puebloans carried water in jars and caught rain and snowmelt; the Hohokam dug long canals. Modern: Hoover Dam stores water in Lake Mead; aqueducts such as the Colorado River Aqueduct and the Central Arizona Project carry it hundreds of miles.
7. James Marshall found gold on January 24, 1848, at Sutter's Mill at Coloma on the American River in California. In 1849 tens of thousands of "forty-niners" rushed to California by sea around Cape Horn, across Panama, or overland on the California Trail. California became a state in 1850.
8. $38 - 8 = 30$ inches more. Yakima is in the rain shadow of the Cascades: wet winds from the Pacific drop their rain on the west side as they rise over the mountains, so the east side gets little.
9. The American captain Robert Gray named the Columbia after his ship when he sailed into it on May 11, 1792. The British captain George Vancouver named Puget Sound for his officer Peter Puget in 1792. Portland is on the Columbia (where the Willamette joins it); Seattle or Tacoma is on Puget Sound.
10. $1959 - 1867 = 92$ years. Alaska: Denali, glaciers, the Yukon River or the Arctic coast. Hawaii: volcanoes such as Kilauea or Mauna Kea, or volcanic islands.

MY STATE STUDY

Every American lives in one of fifty states, and each one has its own hills and rivers, its own first towns and its own kinds of work. In this unit you become the geographer of your own state. You will start, as Thomas Jefferson did when he wrote *Notes on the State of Virginia*, by asking simple questions: Where are the mountains? Which way do the rivers run? What is the climate like? Then you will learn why the first towns grew where they did, following young George Washington to the Forks of the Ohio in 1753, and why people farm, mine, build and ship goods where they do, with the help of Francis Walker's *Statistical Atlas* of 1874.

Each lesson adds a page and a map to your **state notebook**: a physical map of land and water, a political map with towns and a timeline, and a map of your state's work. In the last lesson you put it all together, like the writers of the American Guide books in the 1930s, into a finished state report and a salt-dough relief map you can touch. This unit can stretch over a month so there is time to research, build and present well.

Through it all, remember Paul's words in Acts 17:26: God "hath determined the times before appointed, and the bounds of their habitation." The place where you live is not an accident. Knowing it well is a way to love your neighbors there and to care for the land God has given you.

BEFORE YOU BEGIN

- Can read a map key, compass rose and simple scale (Unit 1)
- Knows the difference between a physical map and a political map (Lesson 1.3)
- Can multiply and divide whole numbers and work with halves and quarters
- Can name his or her own state, its capital and the region it belongs to

MASTERY CHECKLIST

- I can describe my state's landforms, highest point, main rivers and the sea or gulf its rivers reach.
- I can explain how latitude, elevation, nearness to the ocean and mountains shape my state's climate.
- I can explain why my state's first towns and its capital grew where they did.
- I can tell where my state's farms, mines, factories and ports are and why geography put them there.
- I can measure distances with a scale and find places with a grid on my state's maps.
- I can build a relief map with a key, scale and compass rose and present a state report in my own words.

OPTIONAL BOOKS AND RESOURCES

- **Library of Congress Maps Collection** (<https://www.loc.gov/maps/>): Free. Search your state's name to find old state and county maps, including the Fry-Jefferson map of Virginia, Lewis Evans's 1755 map and Mitchell atlas maps, for the picture studies in this unit.
- **Library of Congress Panoramic Maps** (<https://www.loc.gov/collections/panoramic-maps/>): Free. Bird's-eye views of American towns drawn in the 1800s and early 1900s. Look for a town in your state and compare it with a map of that town today (Lesson 5.2).
- **USGS topoView (historical topographic maps)** (<https://ngmdb.usgs.gov/topoview/>): Free. Old and new topographic maps of every part of the country, with contour lines. A parent can help find the area around your town to plan the layers of your relief map (Lesson 5.4).

5.1 MY STATE'S LAND AND WATER ★

OBJECTIVES

- Tell how Thomas Jefferson wrote *Notes on the State of Virginia* by answering questions about his state's rivers, mountains and climate.
- Find my own state's landforms, highest and lowest points, main rivers and the sea or gulf its rivers flow to.
- Explain how latitude, elevation, nearness to the ocean and mountains shape my state's climate, and draw my state's physical map.

Warm-up. Lay a towel flat on a table, then push it together from one side so it wrinkles into "mountains" and "valleys." Slowly drip water from a spoon onto the highest wrinkle. Where does the water go? Which way would a river flow on your towel land? Now look at a printed map of your state: can you guess where its highest land is just from the way the rivers run?

Watch. *Intro to Watersheds - For Kids* (Marys River Watershed Council, 5:41).

<https://www.youtube.com/watch?v=TG4yTMfCMsg>

After the big idea: what a watershed is, and how all the land drains to one river.

Note: Ends with tips for caring for your watershed: shorter showers, recycling, walking or biking.

Backup video. *Exploring Landforms and Bodies of Water for Kids - FreeSchool* (Free

School, 9:19). https://www.youtube.com/watch?v=BsqKTJtK_vw

Before the project: landforms and bodies of water, so you can name what you find on your state map.

KEY TERMS

landform

A natural shape of the land, such as a mountain, hill, valley, plateau or plain.

elevation

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

sea level

The level of the ocean's surface, used as zero when we measure elevation.

physical region

A part of a state or country where the land is much the same, such as a coastal plain or a mountain range.

watershed

All the land that drains into one river or body of water. Rain that falls anywhere in it ends up in that river.

climate

The usual weather of a place over many years: how hot, cold, wet or dry it is in each season.

CORE IDEAS

The story. In 1780, during the War for Independence, a French diplomat in Philadelphia named François Barbé-Marbois wanted to understand the new American states. He sent out a list of questions: What are the state's boundaries? What are its rivers? Its mountains? Its climate? The questions for Virginia reached its governor, Thomas Jefferson. Jefferson took them seriously. He worked on his answers for more than a year, and they grew into a whole book, *Notes on the State of Virginia*, first printed in Paris in 1785. It was, in a way, one of the first great American state reports. Jefferson described the Potomac River cutting through the Blue Ridge Mountains at Harpers Ferry and called it "one of the most stupendous scenes in nature." He added, "This scene is worth a voyage across the Atlantic."

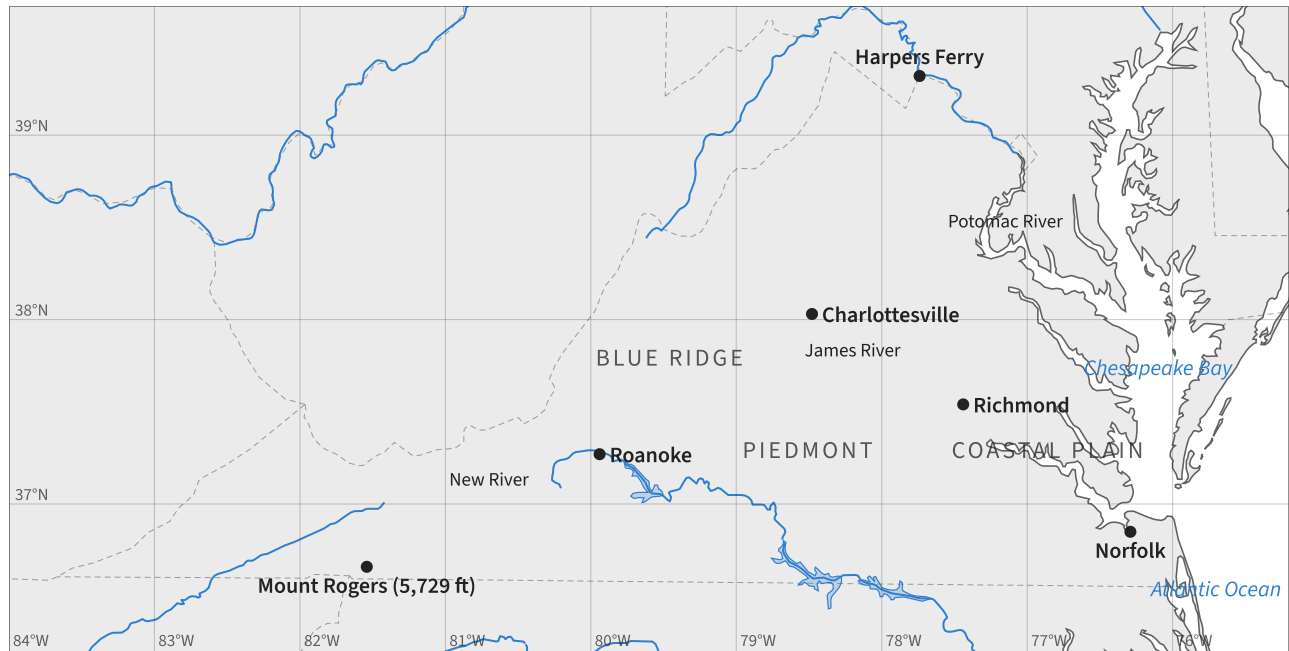
How he figured it out. Jefferson did not guess. He used the best map of Virginia, drawn by his own father, Peter Jefferson, with Joshua Fry. He used what he had seen on his travels on horseback, and he wrote down the temperature and weather at his home again and again, year after year. He asked: Which way do the rivers run? How far can boats go up each one before rocks and falls stop them? Where are the mountains, and how high? Each answer was a fact he could check. In this unit you will do what Jefferson did, but for your own state.

The big idea. A state's physical geography has three parts: **land**, **water** and **climate**. The land has landforms and elevations, from the lowest point (often a riverbank or the seashore) to the highest peak. The water follows the land, because water always runs downhill. Every bit of land is part of a **watershed**. The rain on your roof flows to a creek, the creek to a river, and the river to the sea. In the lower 48 states, rivers drain to the Atlantic Ocean, the Gulf of Mexico, the Pacific Ocean, Hudson Bay in Canada, or the Great Basin, where water has no way out to the sea. Climate is the usual weather over many years. It depends on **latitude** (how far north), **elevation** (air cools about $3\frac{1}{2}^{\circ}\text{F}$ for every 1,000 feet you climb), **nearness to the ocean** (which keeps coasts milder) and **mountains**, which can catch the rain on one side and leave the other side dry.

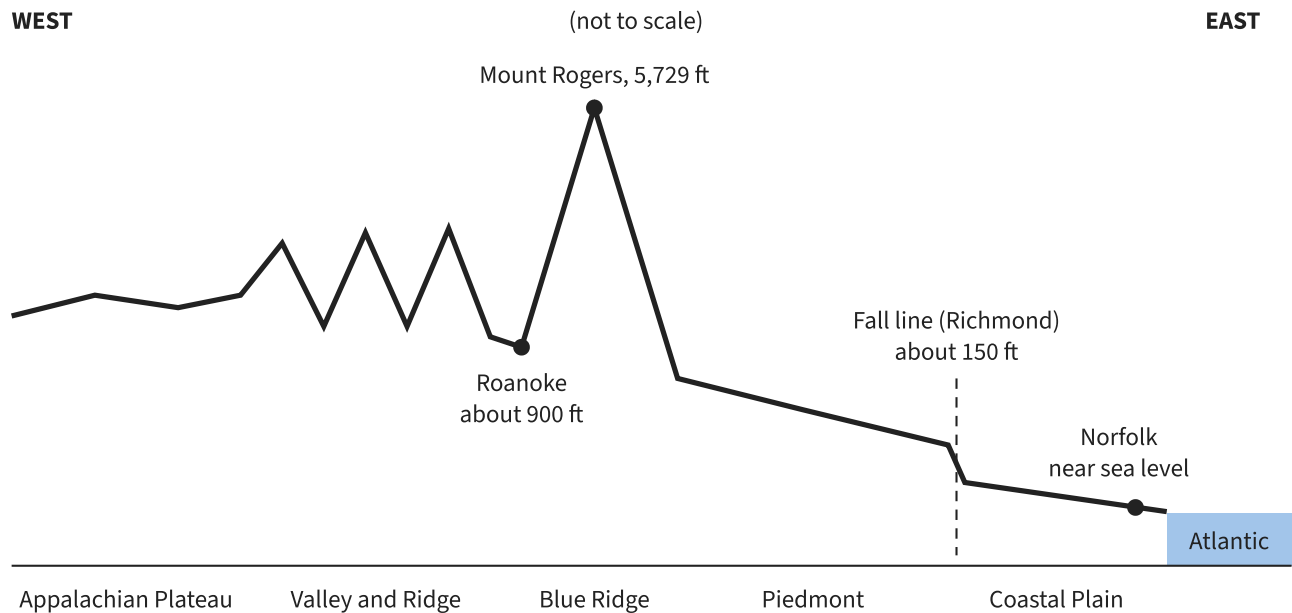
On the map. Look at Virginia from the ocean westward. First comes the flat, low **Coastal Plain**, cut by wide rivers flowing into the Chesapeake Bay. At the **fall line**, where Richmond stands on the James River, the rivers tumble over rocks. Beyond it rolls the hilly **Piedmont**, then the **Blue Ridge**, then the long ridges and valleys of the **Valley and Ridge** (where the Shenandoah Valley lies), and last the **Appalachian Plateau** in the far southwest. The highest point is Mount Rogers, 5,729 feet. Most of Virginia's rivers run southeast to the Chesapeake, but the New River flows north and west. Its water joins the Kanawha, the Ohio and the Mississippi, and reaches the Gulf of Mexico. So rain falling on Virginia ends up in two different seas.

Now your state. Every state has its own pattern. Some, like Kansas, slope gently for hundreds of miles. Some, like Colorado, have peaks over 14,000 feet. Some rivers even run north, like the Red River of the North and Florida's St. Johns. Your task is to become the

Jefferson of your state: find its regions, its high and low points, its main rivers and where they go, and its climate in summer and winter. As you work, remember who shaped the land first. “Thou visitest the earth, and waterest it,” says Psalm 65. Every hill and river in your state was His idea before it was on anyone’s map.



Virginia's land and water. Most rivers flow southeast to the Chesapeake Bay; the New River flows north toward the Ohio.



A cross-section of Virginia, west to east (not to scale).

PICTURE STUDY



A Map of the Most Inhabited Part of Virginia, Joshua Fry and Peter Jefferson, drawn 1751; printed in London in 1753 and later editions · Engraved map, often hand-colored · Library of Congress, Geography and Map Division (copies in other libraries)

Joshua Fry was a mathematics teacher at the College of William and Mary, and Peter Jefferson was a surveyor and planter, the father of Thomas Jefferson. In 1749 the two men surveyed the boundary line between Virginia and North Carolina, and soon after they drew this map. For many years it was the best map of Virginia anyone had. Young Thomas grew up with it, and he used it when he wrote his own book about Virginia.

The map was engraved on copper plates in London and printed many times. In one corner is a decorated title box called a **cartouche**, showing a riverside wharf with barrels of tobacco, the crop that made Virginia's planters rich. You can find this map and thousands of others on the Library of Congress website.

Look closely

- Find the Chesapeake Bay. Count how many large rivers flow into it from the west.
- Look at how the mountains are drawn. Are they shown as lines, as colors, or as rows of little hills?
- Find the place where the rivers stop being wide and start to narrow. That is near the fall line.
- Look at the cartouche. What work is going on in the picture, and how does it connect to the rivers?

Talk about it

1. Why would two surveyors who had walked the land be good mapmakers?

2. What does this map show well, and what does a modern map show that this one cannot?
3. If you could find an old map of your own state, what would you look for first?

PROJECT: MY STATE'S PHYSICAL MAP

You will start your state notebook, the folder that will become your state report in Lesson 5.4. Your first page is a physical map of your state that shows its land and water, plus a climate box. Like Jefferson, you will gather facts you can check.

You will need

- A two-pocket folder or binder for your state notebook
- A printed outline map of your state (or trace one from an atlas)
- A physical map of your state from an atlas, a state road map, or the USGS National Map online
- Colored pencils: blue, green, yellow, orange and brown
- Ruler and pencil

Steps

1. Write your state's name and draw a compass rose in a corner of the outline map.
2. Trace the largest rivers in blue. Make each river thin near its source and thicker downstream, and draw a small arrow showing which way it flows.
3. Label the ocean, gulf, bay or great lake (if any) that touches your state, or write where your rivers finally go: Atlantic, Gulf of Mexico, Pacific, Hudson Bay or Great Basin.
4. Color the land by elevation, copying your atlas: green for the lowest land, yellow for higher, orange for higher still, and brown for the highest. Write the elevation each color stands for in a map key.
5. Mark your state's highest point with a small triangle and write its name and elevation. Mark its lowest point with a small circle.
6. Write the names of your state's physical regions (for example, coastal plain, plateau, mountains) where they belong.
7. Make a climate box: look up the average July high temperature, the average January low, and the average rain and snow in a year for your state capital. You can find these in an almanac or from NOAA.
8. Write three sentences under your map: one about the land, one about the water, one about the climate.

Tips

- Rivers almost always start in the higher land. If your arrows point uphill, check again.
- Keep the map simple. Five rivers clearly drawn are better than twenty tiny squiggles.
- Save this map carefully. You will use it again for your relief map.

Check your work

- My rivers have arrows that show which way they flow.
- My map has a key for the elevation colors and marks the highest point.
- I can name the sea or gulf where my state's rivers end up.
- My climate box has real numbers for my state capital.

MAP NOTEBOOK

1. Draw a side view (cross-section) of your state from one border to the other, like the one of Virginia in this lesson. Label the highest land and the lowest land.
2. Draw the path of one raindrop that falls in your yard: to the street or creek, to the river, to the sea. Name as many of the waters as you can.
3. Copy Jefferson's words "one of the most stupendous scenes in nature" and draw the most beautiful natural place you have seen in your state.

From history. *Notes on the State of Virginia* was the only full-length book Thomas Jefferson ever published. He first had a small number of copies printed in Paris in 1785 to give to friends, and an English edition came out in London in 1787. In it he also described the Natural Bridge, a great stone arch in the Valley of Virginia, just west of the Blue Ridge that he owned and loved to visit. The Natural Bridge still stands today in a Virginia state park.

WORKED EXAMPLES

Example 1. On a wall map of Virginia, 1 inch stands for 50 miles. Richmond and Roanoke are about $2\frac{3}{4}$ inches apart on the map. About how many miles apart are they?

(Use the map or drawing "Richmond is on the James River at the fall line; Roanoke is in a valley near the" shown earlier in this lesson.)

1. Each inch stands for 50 miles.
2. Two inches stand for $2 \times 50 = 100$ miles.
3. Three-quarters of an inch stands for three-quarters of 50. Half of 50 is 25, and half of 25 is $12\frac{1}{2}$, so $\frac{3}{4}$ of 50 = $25 + 12\frac{1}{2} = 37\frac{1}{2}$ miles.
4. Add: $100 + 37\frac{1}{2} = 137\frac{1}{2}$ miles.

Answer: About $137\frac{1}{2}$ miles, or roughly 140 miles in a straight line.

Example 2. Richmond is about 150 feet above sea level. Mount Rogers is 5,729 feet. Air cools about $3\frac{1}{2}^{\circ}\text{F}$ for every 1,000 feet you climb. On a summer day when it is 85°F in Richmond, about how warm might it be on top of Mount Rogers?

(Use the map or drawing “Mount Rogers stands more than 5,500 feet higher than Richmond.” shown earlier in this lesson.)

1. Find the difference in elevation: $5,729 - 150 = 5,579$ feet. That is about $5\frac{1}{2}$ thousand feet.
2. For each 1,000 feet, the air is about $3\frac{1}{2}^{\circ}\text{F}$ cooler. For 5 thousand feet: $5 \times 3\frac{1}{2} = 17\frac{1}{2}^{\circ}\text{F}$.
3. For the extra half thousand feet: half of $3\frac{1}{2}$ is about $1\frac{3}{4}^{\circ}\text{F}$.
4. Total cooling: $17\frac{1}{2} + 1\frac{3}{4} =$ about 19°F , which we can round to about 20°F .
5. $85 - 20 = 65^{\circ}\text{F}$.

Answer: About 65°F on the summit, roughly 20 degrees cooler than Richmond. Elevation is one of the biggest reasons the climate differs from place to place inside a single state.

PRACTICE

1. **EASY** What is elevation, and what do we use as zero when we measure it?
2. **EASY** Name Virginia’s five physical regions in order from the ocean to the far west.
3. **EASY** Look at the map of Virginia. Which way does the James River flow, and into what body of water?
(Use the map or drawing “Follow the James River from the mountains to the bay.” shown earlier in this lesson.)
4. **MEDIUM** The New River flows north out of Virginia. Its water joins the Kanawha, then the Ohio, then the Mississippi. Where does it finally reach the sea?
5. **MEDIUM** On a state map, 1 inch stands for 20 miles. Two towns are $3\frac{1}{2}$ inches apart. How far apart are they?
6. **MEDIUM** A mountain town is 3,000 feet higher than a valley town. It is 80°F in the valley. If air cools about $3\frac{1}{2}^{\circ}\text{F}$ for every 1,000 feet, about how warm is it in the mountain town?
7. **HARD** Why does a river get wider and carry more water as it flows toward the sea?
8. **CHALLENGE** Name three things that shape a state’s climate. Then explain one of them in two sentences.

COMMON MISTAKES

- Thinking rivers flow “down” the map toward the south. Rivers flow downhill, in any direction. The Red River of the North, the St. Johns in Florida and the Monongahela in Pennsylvania all flow north.
- Mixing up weather and climate. Weather is today’s rain or sunshine; climate is the usual pattern over many years.

- Thinking a state is flat because its map is flat. Use the elevation colors in the key to find the high and low land.

Make it a game · Which Way to the Sea?. A parent names a river in your state or a nearby state. You point on the map to where it starts and trace it with your finger all the way to where it ends: another river, a lake, a gulf or an ocean. Score one point for the right direction and one point for naming the final sea. Then switch, and you quiz your parent. Play until someone reaches ten points.

Scripture. “Thou visitest the earth, and waterest it: thou greatly enrichest it with the river of God, which is full of water: thou preparest them corn, when thou hast so provided for it.” (Psalm 65:9, KJV)

The rivers and rains of your state are not accidents. God waters the land and makes it fruitful, and when you trace your state’s rivers you are tracing His provision.

Practice answers

1. Elevation is how high a place is. We measure it from sea level, which counts as zero.
2. Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, Appalachian Plateau.
3. It flows generally east and southeast, past Richmond, into the Chesapeake Bay (and from there to the Atlantic Ocean).
4. The Gulf of Mexico.
5. $3 \times 20 = 60$ miles, plus $\frac{1}{2} \times 20 = 10$ miles, so 70 miles.
6. $3 \times 3\frac{1}{2} = 10\frac{1}{2}^{\circ}\text{F}$ cooler, so about $69\frac{1}{2}^{\circ}\text{F}$, or about 70°F .
7. Smaller streams and rivers, called tributaries, keep joining it and adding their water, and more rain from its watershed drains into it the farther it goes.
8. Any three of: latitude, elevation, nearness to the ocean, mountains (rain shadow), prevailing winds. Sample explanation: Elevation matters because the air gets cooler as you climb, about $3\frac{1}{2}^{\circ}\text{F}$ for every 1,000 feet. So a mountain town is cooler than a town in the valley below it, even on the same day.

5.2 MY STATE'S HISTORY ON THE MAP

OBJECTIVES

- Tell how young George Washington chose the Forks of the Ohio as a place for a fort in 1753, and how that spot grew into Pittsburgh.
- Name the geographic reasons towns grow where they do: rivers meeting, harbors, falls, fords, crossroads and mines, and the reasons people choose sites for capitals.
- Find my state's oldest towns and its capital on a political map and explain why each grew where it did.

Warm-up. Draw a simple island on paper with a river, a hill, a bay and a forest. You and your family are the first settlers and may build only one village. Mark where you would put it and give three reasons. Then compare: did everyone choose a spot near water?

Watch. *Communities and Geography / Learn how geography affects a community / Lesson Boosters* (Lesson Boosters - Kids Science and History Videos, 5:47).

<https://www.youtube.com/watch?v=K5KwEpoIs6c>

After the big idea: how rivers, harbors and good land decide where communities grow.

Note: Mentions vineyards that grow grapes for wine, and solar farms in the desert.

Backup video. *The Forks of the Ohio (Fort Duquesne & Fort Pitt)* (Bobblehead George, 1:08). <https://www.youtube.com/watch?v=iSV9i48a9K4>

With the story: a one-minute tour of the Forks of the Ohio, where Fort Duquesne and Fort Pitt stood.

KEY TERMS

settlement

A place where people make their homes and stay, from a small village to a large city.

confluence

The place where two rivers flow together.

harbor

A sheltered body of deep water where ships can anchor safely.

ford

A shallow place in a river where people, horses and wagons can wade across.

county seat

The town where a county's courthouse and government offices stand.

capital

The city where a state's or country's government meets.

CORE IDEAS

The story. In November 1753, a tall young Virginian named George Washington, only 21 years old, rode northwest through the cold forests of the Allegheny Mountains. Governor Robert Dinwiddie of Virginia had sent him with a letter telling the French to leave the Ohio country, which both France and Britain claimed. On the way, Washington came to the place where the Allegheny River from the north and the Monongahela River from the south flow together to form the Ohio River. He stopped and studied the rivers and the land. In his journal he wrote that the point of land was “extremely well situated for a Fort, as it has the absolute Command of both Rivers.”

What happened next. Washington was right, and others thought so too. In 1754 the French drove off a small crew of Virginians building a fort there and built their own, Fort Duquesne. In 1758 a British army under General John Forbes marched on it, and the French burned the fort and left. The British built a much larger fort and named it Fort Pitt, after William Pitt, a British leader. A village of traders and boat builders grew up around the fort. In 1816 it became the city of Pittsburgh. The land was not empty before any of this. Delaware (Lenape), Shawnee and Seneca people lived and traded along these rivers, and a Delaware village stood near the Forks. On this same trip Washington met with the Seneca leader Tanacharison, called the Half King, at Logstown down the Ohio.

The big idea. Towns do not appear just anywhere. People settle where the land gives them a reason. **Rivers meeting** (a confluence) make a natural crossroads for boats. A **harbor** shelters ships. **Falls** stop boats, so goods must be unloaded there, and falling water can turn mill wheels. A **ford** or a good bridge site brings travelers across. A **crossroads** of trails or roads brings people together to trade. A **mine** draws workers to dig coal, silver or copper. Springs, good soil and high ground safe from floods help too. Later, railroads created many new towns, as you will see in Unit 7. Before roads were good, rivers were the highways, so the oldest towns in almost every state stand by water.

Choosing a capital. Some places were chosen on purpose by lawmakers. Many states moved their capitals toward the middle of the state so that no one had too far to ride on horseback. Virginia moved its capital from Williamsburg to Richmond in 1780. Pennsylvania moved from Philadelphia to Lancaster in 1799 and then to Harrisburg in 1812. Ohio moved its government in 1816 to Columbus, a new town laid out near the center of the state. Counties were often drawn so a farmer could reach the county seat, do his business at the courthouse and get home again without traveling for days.

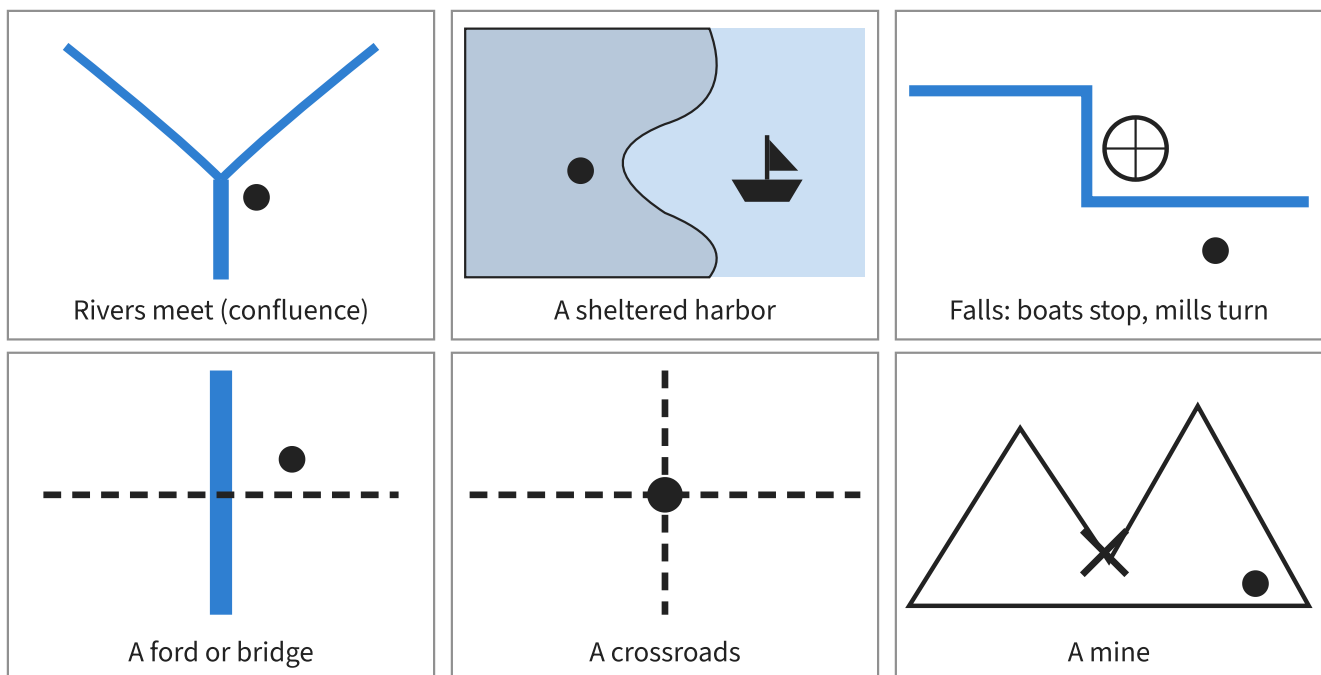
On the map. Follow the Ohio River on the map from Pittsburgh. It flows about 981 miles to Cairo, Illinois, where it meets the Mississippi. Along the way stand Wheeling; Marietta, founded in 1788 where the Muskingum River joins the Ohio; Cincinnati; and Louisville, which grew at the Falls of the Ohio, the one place on the river where boats had to stop or be guided carefully over the rocks. Every one of these towns has a reason written in the land. Your own state has its first towns too. Some began as Native villages, trading posts, forts, missions or mill sites. Sadly, many Native nations were later pushed off their lands, as in the

Indian removals of the 1830s, and their towns vanished from the map. A good geographer learns the whole story of a place.

Providence and place. Paul told the people of Athens that God “hath determined the times before appointed, and the bounds of their habitation” (Acts 17:26). The towns of your state grew in places God made fit for people to live, and the history of each one is part of a larger story He is telling.

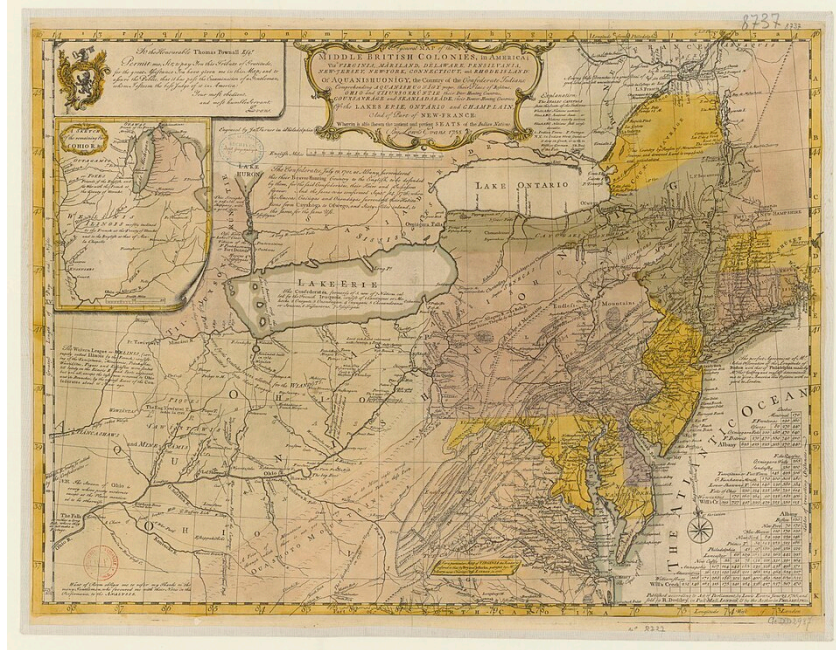


The Ohio River and the towns that grew along it.



Six reasons a town grows where it does.

PICTURE STUDY



A General Map of the Middle British Colonies in America, Lewis Evans (engraved by James Turner), 1755 · Engraved map, hand-colored · Library of Congress, Geography and Map Division (copies in many libraries)

Lewis Evans was a mapmaker in Philadelphia who traveled through the backcountry and collected reports from traders, travelers and surveyors. In 1755, just two years after Washington's journey, he published this map of the land from the Atlantic coast to the Ohio country. It came with a booklet of Evans's own notes, printed by Benjamin Franklin and his business partner David Hall.

Evans wrote small notes right on the map about the land, the rivers and how far boats could travel. Soldiers and settlers used his map for many years, during the French and Indian War and after. It shows the Forks of the Ohio, the place Washington chose, at a time when only a fort and a few cabins stood there.

Look closely

- Find the Ohio River. Follow it upstream to the place where two rivers join to form it.
- Look at how the mountains are drawn as long ridges running from northeast to southwest. Which way would a traveler have to go to cross them?
- Find the small notes printed in tiny letters across the land. Why would a mapmaker write words on a map instead of only drawing?
- Find Philadelphia. How far is it from the Forks of the Ohio, and what lies between them?

Talk about it

1. Why would a map like this have been so valuable to armies and settlers in 1755?
2. Which towns on this map are still large cities today? Why do you think they lasted?

3. What could you learn about your own state's history from an old map of it?

PROJECT: MY STATE'S POLITICAL MAP AND TIMELINE

Now that you have a physical map of your state, you will make its political map, which shows the places people made: the capital, towns, borders and counties. Then you will build a timeline of how your state grew.

You will need

- A second outline map of your state (or trace your physical map's outline)
- A state road map or atlas, and a library book or encyclopedia about your state's history
- Colored pencils, a ruler and a fine black pen
- A strip of paper about 24 inches long (tape two sheets together) for the timeline

Steps

1. Trace your state's outline and label the states, countries, oceans or lakes that border it.
2. Mark the state capital with a star inside a circle. Mark eight to ten important towns with dots, including the oldest town and the largest city.
3. Lightly trace the main rivers in blue from your physical map. Look carefully: how many of your towns stand on a river, a lake or the coast?
4. Next to each town, draw a small symbol for the reason it grew: two lines meeting (confluence), an anchor (harbor), a wavy step (falls), a crossing line (ford or bridge), a plus sign (crossroads), a pick (mine), or a train track (railroad).
5. Draw the outline of your own county and label its county seat.
6. Make your timeline. Put at least six dates on it, such as: the first Native villages you know of, the first European explorer or settlement, the founding of the oldest town, statehood, the year the capital moved (if it did), and the coming of the railroad.
7. Write two sentences under your map explaining why your state's capital is where it is.

Tips

- If you cannot find why a town grew, look at a physical map of the spot. The reason is often a river bend, a bay or a crossing.
- Use the Library of Congress map collection to find an old map of your state. Comparing an old map with today's map shows which towns lasted and which faded away.

Check your work

- My political map shows the capital, eight to ten towns, and the borders of my state.
- Each town has a symbol showing why it grew.
- My timeline has at least six dates in the right order.
- I can explain why my capital is where it is.

MAP NOTEBOOK

1. Draw the Forks of the Ohio: the Allegheny coming from the north, the Monongahela from the south, and Fort Pitt on the point where they join.
2. Draw a small map of your own town or the nearest town and circle the geographic reason it grew.
3. List three towns in your state that are named after a river, a lake, a mountain or a spring.

From history. The oldest building still standing in Pittsburgh is the Fort Pitt Block House, a small brick fort built in 1764 near the walls of Fort Pitt. Today it stands in Point State Park, at the very tip of land where the Allegheny and Monongahela meet. A tall fountain sprays water into the air at the point, just about where Washington stood in 1753 and studied the rivers.

WORKED EXAMPLES

Example 1. In the early 1800s many families floated down the Ohio River on flatboats. It is about 470 river miles from Pittsburgh to Cincinnati. If a flatboat floated about 50 miles a day, about how many days would the trip take?

(Use the map or drawing “Pittsburgh to Cincinnati by river.” shown earlier in this lesson.)

1. Divide the distance by the miles traveled each day: $470 \div 50$.
2. $50 \times 9 = 450$, so 9 days takes the boat 450 miles.
3. $470 - 450 = 20$ miles are left for a tenth day.
4. So the trip takes 9 full days and part of a tenth.

Answer: About 10 days.

Example 2. Use the map. In what direction would a flatboat family travel to go from Pittsburgh to Cincinnati? And in what direction does the Ohio River flow from Louisville to Cairo?

(Use the map or drawing “Use the map’s top as north to find directions.” shown earlier in this lesson.)

1. Find Pittsburgh in the upper right (northeast) of the map and Cincinnati to its left and a little lower.
2. Left on the map is west, and lower is south, so Cincinnati is west and a little south of Pittsburgh.
3. Now find Louisville and Cairo. Cairo is farther left and lower than Louisville, so the river flows west and south there too.

Answer: Pittsburgh to Cincinnati is generally southwest (mostly west). From Louisville to Cairo the river also flows southwest. The whole Ohio runs downhill from the mountains toward the Mississippi.

PRACTICE

1. **EASY** What is a confluence? Which two rivers meet at Pittsburgh, and what river do they form?
2. **EASY** Washington visited the Forks of the Ohio in 1753. Pittsburgh became a city in 1816. How many years apart are those two dates?
3. **MEDIUM** Look at the map. Which town grew at the Falls of the Ohio? Why did the falls help a town grow there?
(Use the map or drawing “Find Louisville on the Ohio.” shown earlier in this lesson.)
4. **MEDIUM** Ohio became a state in 1803. Its government moved to the new capital, Columbus, in 1816. How many years after statehood was that?
5. **MEDIUM** Louisville is about 600 river miles from Pittsburgh. A flatboat floats about 40 miles a day. How many days would the trip take?
6. **MEDIUM** Match each town site with its reason: (a) a town where a road crosses a shallow river, (b) a town on a deep, sheltered bay, (c) a town where two rivers join, (d) a town in the hills beside a silver vein. Reasons: harbor, mine, ford, confluence.
7. **HARD** Give two reasons why many states moved their capitals toward the middle of the state.
8. **CHALLENGE** In three or four sentences, explain why the oldest towns in almost every state stand beside water.

COMMON MISTAKES

- Thinking the land was empty before European settlers came. Native nations lived, farmed, hunted and traded across every state, and many towns grew where their villages or trails had been.

- Mixing up a confluence (where two rivers join) with a river's mouth (where a river empties into a larger body of water).
- Thinking the largest city is always the capital. In many states, like Pennsylvania, New York and Illinois, the capital is a smaller city chosen for its central place.

Make it a game · Where Would You Build?. A parent draws a quick map with rivers, a bay, hills, a waterfall and a road. Each player gets three paper "town" markers and places them one at a time, saying the reason out loud (confluence, harbor, falls, ford, crossroads, mine). A good reason scores a point. A town in a swamp, on a flood plain or far from water loses a point. Then look at a real map of your state and see whether the real towns are in the same kinds of places.

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 appointed the times and places where people would live. The history of your state, with its first villages, its forts and its towns, unfolded under His hand.

Practice answers

1. A confluence is a place where two rivers flow together. The Allegheny and the Monongahela meet at Pittsburgh to form the Ohio River.
2. $1816 - 1753 = 63$ years.
3. Louisville. Boats had to stop at the falls to unload or wait for a guide, so people built warehouses, inns and shops there.
4. $1816 - 1803 = 13$ years.
5. $600 \div 40 = 15$ days.
6. (a) ford, (b) harbor, (c) confluence, (d) mine.
7. So that lawmakers and citizens from every part of the state had a shorter trip by horse or wagon, and so the capital was farther from the coast and safer from attack by enemy ships (as when Virginia moved inland from Williamsburg to Richmond during the War for Independence).
8. Sample: Before there were good roads or railroads, rivers, lakes and the sea were the easiest highways for moving people and goods. Towns grew where boats could land, where rivers met, or where falls stopped boats. People also needed water for drinking, cooking, animals and mills. So the first settlers chose places by water, and those towns had a head start.

5.3 MY STATE'S WORK

OBJECTIVES

- Tell how Francis Amasa Walker turned the numbers of the 1870 census into the first Statistical Atlas of the United States (1874).
- Explain how land and water decide where farms, mines, factories and ports are found, using Pittsburgh's coal, rivers and steel as an example.
- Read a map key and grid to find places of work, and make a map of my own state's work.

Warm-up. Go on a five-minute kitchen hunt. Find three foods or things and read their labels: where were they grown or made? Sort them into three piles: grown on a farm, dug from the ground, or made in a factory. Is anything from your own state?

Watch. *The Resources and Wealth of the United States* (Miacademy & MiaPrep Learning Channel, 9:27). <https://www.youtube.com/watch?v=IjFy-y0Obhs>
After the big idea: the natural resources of the United States and the work people do with them.

Backup video. *Pittsburgh, Pennsylvania - Tugboat Pushing Barges on the Monongahela River (2021)* (ACG Travel Videos, 2:06). <https://www.youtube.com/watch?v=xASP6Xcqk3I>
With On the map: a tugboat pushing barges up the Monongahela River in Pittsburgh.
Note: Plain footage with no narration; it shows how much a barge tow carries.

KEY TERMS

natural resource

Something useful that God placed in nature, such as soil, water, timber, coal, iron or fish.

raw material

A natural resource used to make something else, like iron ore for steel or cotton for cloth.

agriculture

Farming: growing crops and raising animals.

manufacturing

Making goods in large amounts, usually in factories.

port

A town or city with a harbor where ships and barges load and unload goods.

census

An official count of the people. The United States has taken one every ten years since 1790.

CORE IDEAS

The story. In 1870 the United States took its ninth census. Every ten years since 1790, census takers had gone door to door and farm to farm, counting the people and writing down what they grew and made. That year the man in charge was Francis Amasa Walker, a young Union Army veteran of only about thirty. Walker had a problem: the census filled huge books with numbers, and hardly anyone could understand them. So he decided to *draw* the numbers. In 1874 he published the *Statistical Atlas of the United States*. For the first time, Americans could open a book of colored maps and see at a glance where people lived and where wheat, corn, cotton and other crops were grown.

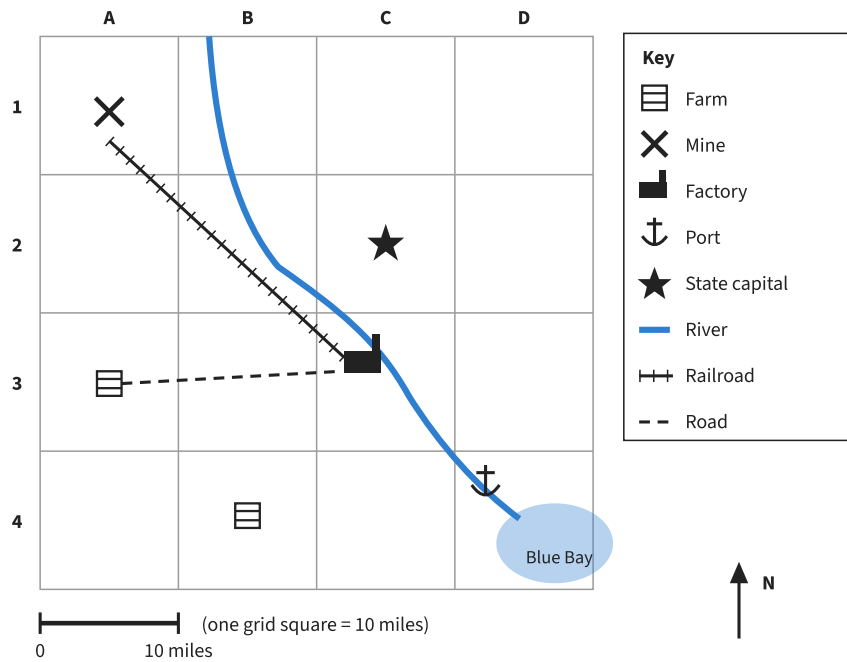
How it worked. The census takers wrote down each farm's crops. Clerks in Washington added up the totals for every county. Then Walker's mapmakers shaded each county: light where little was grown, darker where much was grown. Suddenly patterns jumped off the page. Cotton made a dark band across the warm South. Corn and wheat darkened the deep soils of the Midwest. You could *see* that work follows the land. You will do the same thing for your own state.

The big idea. Where people work depends on geography. **Farms** grow where there is good soil, fairly flat land, enough rain (or water carried to the fields) and a long enough growing season. **Mines** are found only where the rocks hold coal, iron, copper, salt or oil, and those were laid in the earth long before anyone came to dig. **Factories** grow where raw materials, power, workers and good transportation come together. **Ports** grow where deep, sheltered water meets rivers, roads or railroads that reach far inland. Most people today also work in services, like teaching, healing and selling, and those jobs gather wherever people live.

On the map. Think back to Pittsburgh. The hills around it hold a thick, rich bed of coal, the famous Pittsburgh coal seam. Three rivers carry barges cheaply. Iron ore came by boat across the Great Lakes and then by railroad. In 1875 Andrew Carnegie opened his Edgar Thomson Steel Works at Braddock, on the Monongahela River just upstream from Pittsburgh. Coal, iron, rivers and rails all met in one place, and Pittsburgh became the "Steel City." The rivers still matter. One river barge can carry about 1,500 tons, as much as dozens of big trucks, and one towboat can push fifteen barges or more at once.

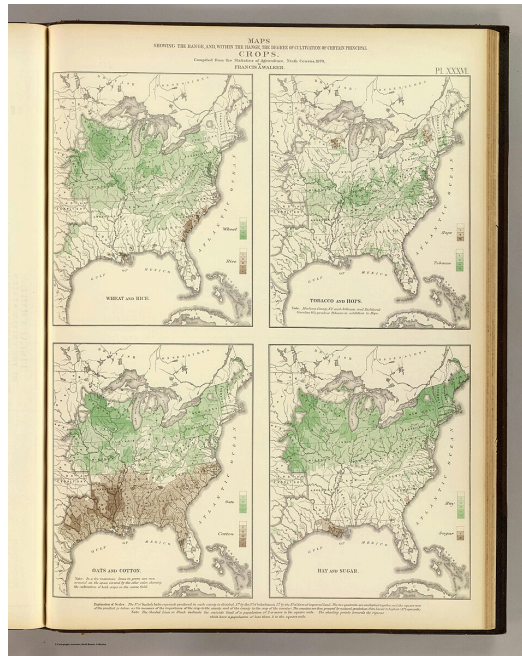
Technology overcoming geography. A state's work changes when people find new ways to beat distance and dryness. A canal or railroad lets a farming town sell its grain far away. Irrigation turns dry land green. New machines open new mines. So when you study your state's work, ask two questions: What did people do here at first, and what do they do now? The land is the same, but tools and routes have changed what people can do with it.

Now your state. Find your state's top farm products, its mines or wells (if it has any), its big factories, and its ports or river landings. Mark them on a map with symbols, like Walker did. Moses told Israel that the Promised Land was "a land whose stones are iron, and out of whose hills thou mayest dig brass." Your state has its own gifts in its soil, rocks and waters, and good work makes them useful to others.



A practice map of work in an imaginary county, with a grid, key and scale.

PICTURE STUDY



Statistical Atlas of the United States Based on the Results of the Ninth Census, 1870, Francis A. Walker (compiler); lithographed by Julius Bien, 1874 · Color lithographs in a large atlas · Library of Congress, Geography and Map Division (digitized online)

This large atlas was the first of its kind in the United States. Francis Walker and his helpers took the numbers from the 1870 census and turned them into maps. The pages were printed in color by Julius Bien, a skilled map printer in New York.

Some maps show where people lived. Others show where crops were grown, with darker shading where more was raised. Look for the maps of your own region and see what people grew there in 1870.

Look closely

- Find the map key. What does the darkest shading mean? What does the lightest mean?
- Find the darkest areas on a crop map. What region of the country are they in?
- Find your own state. Was it dark or light for the crop shown?
- Look at the western part of the map in 1870. Why might so much of it be blank or light?

Talk about it

1. Why is a shaded map easier to understand than a long list of numbers?
2. Does the pattern on the map match what you know about the land and climate of those places?
3. If Walker made a map of your state's work today, what would it show?

PROJECT: MY STATE AT WORK

You will make a third map for your state notebook: a map of your state's work. You will also gather a small "product box" of things grown or made in your state.

You will need

- Another outline map of your state
- An atlas, almanac or library book about your state, or your state's department of agriculture website (with a parent)
- Colored pencils and a fine black pen
- A shoebox or small basket for the product box

Steps

1. Make a key first. Draw a symbol for each kind of work: a wheat stalk or cow for farms, crossed hammers for mines, a building with a smokestack for factories, an anchor for ports, a tree for forestry, a fish for fishing.
2. Find your state's three or four most important farm products and draw their symbols where they are grown.
3. Find any mines, quarries or oil and gas fields and mark them.
4. Mark two or three large factories or manufacturing cities and the ports or river landings that ship goods.
5. Lightly add your main rivers in blue and your main railroads or interstate highways as black lines. Look: are the factories and ports near these routes?
6. Gather four or five items grown or made in your state for your product box. Label each with where it came from and whether it came from a farm, a mine, a factory or the sea.

7. Ask a grown-up you know about his or her job. Write down what the job is, where it is done, and whether geography has anything to do with it.
8. Write a short paragraph: What work did people in my state do long ago, and what do they do now?

Tips

- Keep symbols small and simple so the map does not get crowded.
- If your state has many products, choose the most important few. A good map leaves things out on purpose.

Check your work

- My work map has a key with at least four symbols.
- I can point to my state's main farms, mines, factories and ports and say why each is there.
- My product box has labels telling where each item came from.
- I wrote how work in my state has changed over time.

MAP NOTEBOOK

1. Draw a barge tow on a river: one towboat pushing three rows of barges loaded with coal.
2. Draw a simple diagram showing coal, iron ore and limestone all arriving at a steel mill by river, lake boat and railroad.
3. Draw your state's most famous product and write one sentence about why it is grown or made there.

From history. Francis Amasa Walker went on to run the 1880 census as well, and in 1881 he became president of the Massachusetts Institute of Technology, a school for engineers and scientists, which he led for sixteen years. The idea of his Statistical Atlas lasted too: the Census Bureau went on to make new atlases from later counts, and maps that shade places light to dark are still one of the most common ways to show numbers on a map.

WORKED EXAMPLES

Example 1. One river barge can carry about 1,500 tons of coal. A towboat pushes 15 barges. A large truck carries about 25 tons. How many tons does the whole tow carry, and about how many trucks would it take to carry the same load?

1. Tons in the tow: $15 \times 1,500$. Think $15 \times 1,000 = 15,000$ and $15 \times 500 = 7,500$. Add: $15,000 + 7,500 = 22,500$ tons.
2. Trucks needed: $22,500 \div 25$. There are 4 trucks in every 100 tons ($4 \times 25 = 100$).
3. 22,500 tons is 225 hundreds, so $225 \times 4 = 900$ trucks.

Answer: The tow carries 22,500 tons, about as much as 900 trucks. This is why mines, power plants and steel mills like to be beside rivers.

Example 2. Use the practice map. In which grid square is the factory? How far is it from the farm in A3 to the factory, if each grid square is 10 miles wide?

(Use the map or drawing “Count grid squares and use the scale.” shown earlier in this lesson.)

1. Find the factory symbol in the key, then find it on the map. It sits beside the river in column C, row 3: square C3.
2. The farm is in A3. Both are in row 3, so count the squares going east: A to B is one square, B to C is two squares.
3. Each square is 10 miles, so $2 \times 10 = 20$ miles.

Answer: The factory is in C3, about 20 miles east of the farm in A3.

PRACTICE

1. **EASY** Use the practice map. What kind of work is found in grid square A1?
(Use the map or drawing “Use the key to read the symbols.” shown earlier in this lesson.)
2. **EASY** Use the practice map. Give the grid square of the port and of the state capital.
(Use the map or drawing “Find the port and the star.” shown earlier in this lesson.)
3. **MEDIUM** Use the practice map. How far is it from the mine in A1 straight south to the farm in A3?
(Use the map or drawing “Each square is 10 miles.” shown earlier in this lesson.)
4. **MEDIUM** On the practice map, which way does the river flow, and why is the factory built beside it?
(Use the map or drawing “Follow the river to the bay.” shown earlier in this lesson.)
5. **MEDIUM** A towboat pushes 9 barges. Each barge carries about 1,500 tons. How many tons is that?
6. **MEDIUM** Match each product to the kind of place it comes from: coal, wheat, steel beams, cargo loaded onto ships. Places: farm, mine, factory, port.

7. **HARD** The census was first taken in 1790 and has been taken every ten years since. The 1870 census was the ninth. Which number census was taken in 1900?
8. **CHALLENGE** Explain in three or four sentences how a new railroad could change the work in a small farming town far from any river.

COMMON MISTAKES

- Thinking natural resources are spread evenly. Coal, iron, oil and good soil are found only in certain places, so work differs from place to place.
- Thinking a factory must be right next to every material it uses. Factories grow where materials, workers, power and transportation can be brought together most cheaply.
- Thinking a state's work never changes. New routes, tools and discoveries change what people do with the same land.

Make it a game • Farm, Mine, Factory or Port?. Write twenty products on cards: milk, coal, apples, cars, timber, salt, flour, steel, oranges, oil, shoes, cotton, fish, copper, bread, paper, corn, chairs, containers of cargo, cheese. Shuffle them. Each player draws a card and says where it comes from: farm, mine, factory or port (some come from more than one, so explain). Score one point for each right answer and a bonus point if you can name a state where it is produced.

Scripture. "A land wherein thou shalt eat bread without scarceness, thou shalt not lack any thing in it; a land whose stones are iron, and out of whose hills thou mayest dig brass." (Deuteronomy 8:9, KJV)

God described the Promised Land by its farms and its mines. Your state too has gifts in its soil and stones, and honest work turns them into bread, tools and homes for others.

Practice answers

1. A mine.
2. The port is in D4. The state capital is in C2.
3. Two squares, so $2 \times 10 = 20$ miles.
4. It flows southeast, from B1 to Blue Bay in D4. The factory is beside the river so it can get water and ship heavy goods cheaply by barge down to the port.
5. $9 \times 1,500 = 13,500$ tons.
6. Coal: mine. Wheat: farm. Steel beams: factory. Cargo loaded onto ships: port.
7. From 1870 to 1900 is 30 years, or three more censuses: 1880 (10th), 1890 (11th), 1900 (12th). It was the twelfth census.
8. Sample: Before the railroad, the farmers could sell only what they could haul by wagon to nearby towns, so they grew mostly for themselves. The railroad lets them ship grain and cattle to big cities far away, so they can grow more and earn more. Stores, grain elevators and repair shops open near the station. The town may grow, and new kinds of jobs appear.

5.4 PRESENTING MY STATE

OBJECTIVES

- Tell how the writers of the American Guide Series traveled and wrote a guidebook for every state in the 1930s.
- Build a salt-dough relief map of my state, using layers for elevation and a key, scale and compass rose.
- Organize my notebook into a state report and present it clearly to my family or class.

Warm-up. Stack five coins, then four, then three, two and one, side by side. Look at them from the side: they look like a mountain rising in steps. Now imagine each coin stands for 1,000 feet. How high is your coin mountain? This is the secret of building a relief map in layers.

Watch. *Salt Dough Relief Map : Hands On Education Activity* (Living With Eve, 11:56). <https://www.youtube.com/watch?v=SzWy-f6V-8g>

Before the project: a family builds a salt-dough relief map step by step.

Backup video. *Craft for Kids, Make a Relief Map, featuring Activas Celluclay* (craftbasics, 4:11). <https://www.youtube.com/watch?v=FHLA86vRlZ0>

Another way to build the relief map, using paper-pulp clay instead of salt dough.

KEY TERMS

relief map

A map that shows the height of the land, either with shading and colors or with raised bumps you can touch.

contour line

A line on a map that joins places of the same elevation.

vertical exaggeration

Making the heights on a model taller than true scale so the hills and mountains are easy to see.

map key

The box that explains what the colors and symbols on a map mean. It is also called a legend.

scale

The part of a map that tells how distance on the map compares with real distance on the ground.

report

An organized piece of writing that shares facts you have gathered, in your own words, with maps and pictures.

CORE IDEAS

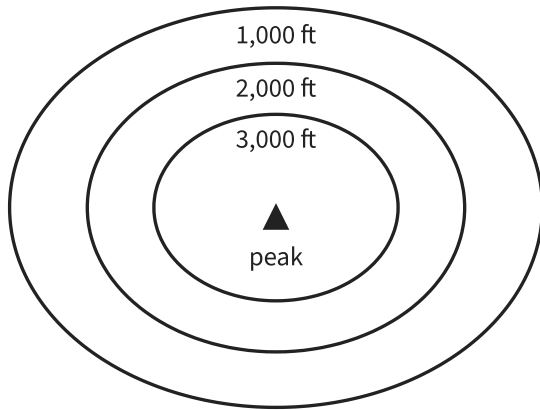
The story. In the hard years of the Great Depression, millions of Americans had no work. In 1935 the government began the Works Progress Administration, which hired people to build roads, bridges and schools. One part of it, the Federal Writers' Project, hired out-of-work writers, teachers and newspapermen for a different job: to write a guidebook to every one of the 48 states. The books were called the American Guide Series. Writers drove the back roads, visited courthouses and libraries, interviewed old-timers, and checked facts. In Florida, the writer Zora Neale Hurston helped gather stories and folk songs for the Florida guide. When the books came out, between 1937 and the early 1940s, each one described its state's land, history, work and people, with maps and tours from town to town.

How they did it. The guide writers followed the same steps you have been following. First they **gathered** facts from maps, books and people. Then they **organized** them into chapters: the land, the history, the work, the towns. Then they **wrote** in clear, lively sentences, and finally they **checked** every fact. Your state notebook already holds three maps and pages of facts from Lessons 5.1, 5.2 and 5.3. Now you will turn them into your own guide to your state.

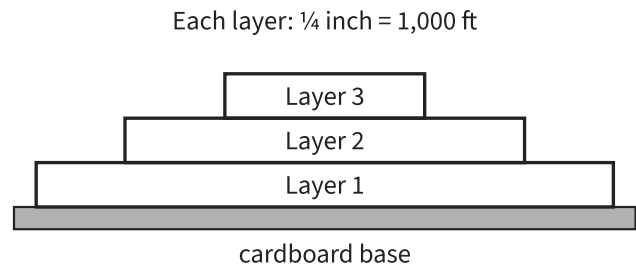
The big idea. A flat map shows height with colors. A **relief map** lets you feel it. But there is a puzzle. Mountains are tiny compared with the width of a state. Suppose your state is 300 miles wide and your map is 20 inches wide. Then 1 inch stands for 15 miles. A mountain one mile high would be only one-fifteenth of an inch tall, thinner than a nickel! So mapmakers use **vertical exaggeration**: they make the heights much taller than true scale so that we can see the shape of the land. Your map key should say so, so no one thinks the mountains are really that steep.

On the map. The neatest way to build a relief map is in layers, like the stacked coins. On your physical map, the elevation colors are separated by **contour lines**: every place on a line has the same height. Draw those lines on your cardboard base. Spread a thin layer of salt dough over all the land. Add a second layer only inside the next contour line, a third inside the next, and so on. The highest land gets the most layers. Then press the rivers into the dough with a pencil point, let it dry, and paint it with the same colors as your physical map. Add a title, a key, a scale and a compass rose, and your map is finished.

Presenting. A good report is not copied. It is written in your own words, with the facts you found. Put your notebook in order: a title page, a page on land and water, a page on history, a page on work, your three maps, and a page on your state's symbols and your favorite place. When you present, stand up straight, point to your relief map as you talk, and share the three most interesting things you learned. Then thank God for the place where He set you. David wrote, "The lines are fallen unto me in pleasant places; yea, I have a goodly heritage." Knowing your state well is the first step to caring for it well.

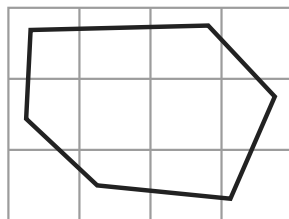


Top view: contour lines

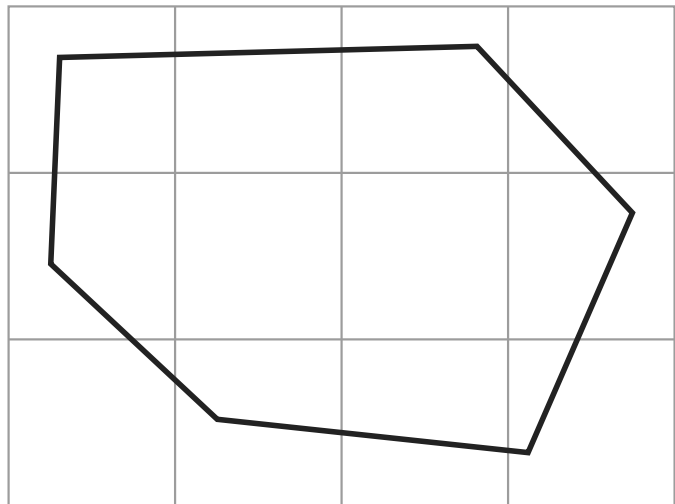


Side view: dough layers

Contour lines on the base show where each dough layer goes.



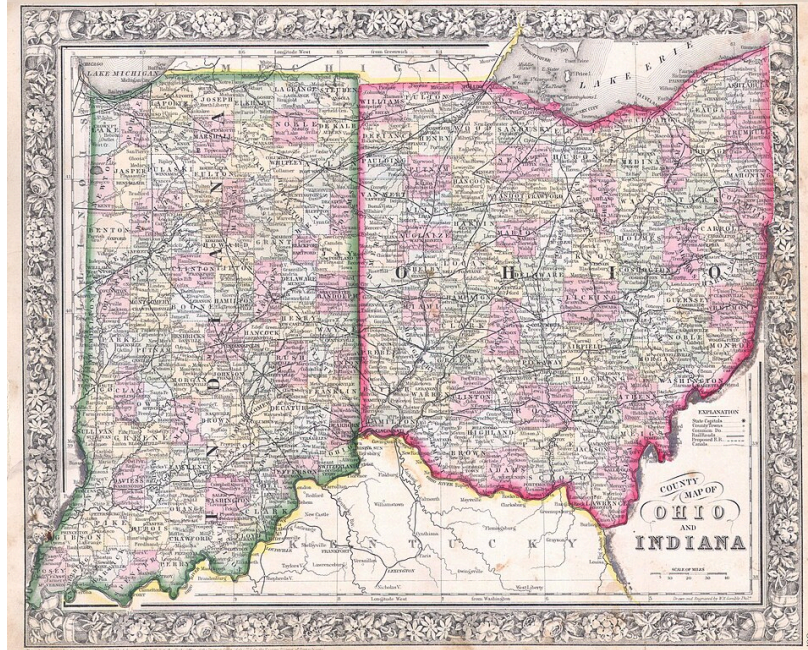
small squares



same number of big squares

Enlarge your state's outline square by square.

PICTURE STUDY



A County Map of Your Own State, from Mitchell's New General Atlas, Samuel Augustus Mitchell Jr. (publisher), 1860s and later editions · Engraved and lithographed maps, hand-colored by county · Library of Congress, Geography and Map Division, and many other libraries (search loc.gov/maps)

Samuel Augustus Mitchell Jr. of Philadelphia published *Mitchell's New General Atlas* in many editions beginning in 1860. It had a county map of nearly every state, each county tinted in soft pink, yellow, green or blue, with a fancy border of curling vines or flowers. Families, schools and businesses used these atlases to learn their own states.

For this picture study, find the Mitchell map of *your* state (or another old map of it) in the Library of Congress map collection online. Search your state's name and the word "county map." Many old atlases from the 1800s, by Mitchell and by other publishers such as Colton, are free to view.

Look closely

- Find your own county. Was it there yet, or was it part of a larger county, with a different shape?
- Find the towns. Which towns on the old map are large cities today? Which ones can you not find on a modern map?
- Look for railroads, drawn as thin lines, sometimes with little cross-ticks. Where did they run?
- Look at the border and the colors. Why do you think the mapmaker colored each county differently?

Talk about it

1. What has changed most in your state since this map was made? What has not changed at all?
2. Which of the reasons for town growth from Lesson 5.2 can you see on this old map?
3. How is an old map like a letter from the past?

Safety first. Use the oven only with a grown-up. Salt dough is not food: it is very salty and can make pets, especially dogs, seriously sick, so keep the dough and the finished map away from pets and little children. Wash hands after working with dough and paint.

PROJECT: SALT-DOUGH RELIEF MAP AND STATE REPORT

This is the capstone of your state study. You will build a raised relief map of your state that you can touch, and put your notebook together as a finished state report to present.

You will need

- Sturdy cardboard or a piece of thin plywood, about 14 by 20 inches
- Salt dough: 2 cups flour, 1 cup salt and about 1 cup water (make two batches for a large map)
- Your physical map from Lesson 5.1, a ruler and a pencil
- Toothpicks, a pencil point and small paper flags
- Poster or acrylic paints (blue, green, yellow, orange, brown) and brushes
- Your state notebook with all your pages and maps

Steps

1. Enlarge your state's outline onto the cardboard. Draw a grid of small squares over your physical map and a grid with the same number of larger squares on the cardboard, then copy the outline square by square.
2. Copy the main contour lines (the edges between your elevation colors) and the rivers onto the cardboard.
3. Make the salt dough: mix the flour and salt, then add water a little at a time and knead until it feels like soft clay.
4. Spread a thin first layer, about $\frac{1}{4}$ inch thick, over the whole state. Press it right up to the outline.
5. Add the next layers only inside each higher contour line, about $\frac{1}{4}$ inch each. Smooth the edges with damp fingers so the land rises in gentle slopes, not stair steps. Build the highest point last.
6. Press the rivers into the dough with a pencil point, from their sources in the high land down to where they leave the state.
7. Let the map air-dry for several days, turning the board now and then, until it is hard. (Do not put the cardboard in the oven.)
8. Paint the land with your elevation colors and the rivers and lakes blue. Add toothpick flags for the capital, your town and three other important places.

9. Add a title, a key, a scale and a compass rose. Write “Heights are exaggerated” in the key.
10. Put your report together: title page; land and water; history; work; your three maps; state symbols and your favorite place. Then present it with your relief map to your family or class in about five minutes.

Tips

- Thin layers dry better and crack less than thick ones. If a crack appears, fill it with a little fresh dough or glue and paint over it.
- Practice your presentation once out loud before the real thing. Look at your listeners, not only at your notes.
- Take a photograph of your finished map for your portfolio.

Check your work

- My relief map rises highest where my state’s land is highest, and my rivers flow from high land to low.
- My map has a title, key, scale, compass rose and labeled places.
- My report has all six parts, written in my own words.
- I presented my state clearly and answered at least one question.

MAP NOTEBOOK

1. Draw the side view of your relief map, showing how the layers stack up from the lowest land to the highest point.
2. Design a cover for your state report, like the cover of an American Guide book, with your state’s name and one picture of its land.
3. Write the three facts you will share first in your presentation, and draw a small picture beside each.

From history. The Library of Congress in Washington holds the largest collection of maps in the world, with more than five million maps, atlases and globes in its Geography and Map Division. Among them are county maps, city plans, railroad maps and thousands of bird’s-eye views of American towns drawn in the 1800s and early 1900s. Many have been scanned, so any family can look at old maps of its own state for free.

WORKED EXAMPLES

Example 1. You are building a relief map of Virginia. Each dough layer is $\frac{1}{4}$ inch thick and stands for 1,000 feet. The highest point, Mount Rogers, is 5,729 feet. About how many layers will you stack there, and how tall will that spot be?

(Use the map or drawing “Each layer stands for 1,000 feet of height.” shown earlier in this lesson.)

1. Divide the height by 1,000 feet per layer: $5,729 \div 1,000$ is about 5.7.
2. Round to the nearest whole layer: about 6 layers.
3. Each layer is $\frac{1}{4}$ inch, so $6 \times \frac{1}{4} = 6$ quarters of an inch.
4. Four quarters make 1 inch, so 6 quarters = 1 inch and 2 quarters = $1\frac{1}{2}$ inches.

Answer: About 6 layers, making that spot about $1\frac{1}{2}$ inches tall. This is far taller than true scale, so the key should say the heights are exaggerated.

Example 2. Your state outline is drawn on a grid 8 squares wide, and each square is $\frac{1}{2}$ inch, so the outline is 4 inches wide. You want the outline to be 20 inches wide on your cardboard. How big should you make each square on the big grid? If your state is 300 miles wide, what is your map’s scale?

(Use the map or drawing “Same number of squares, bigger squares.” shown earlier in this lesson.)

1. Keep the same number of squares: 8 across.
2. $20 \text{ inches} \div 8 \text{ squares} = 2\frac{1}{2} \text{ inches}$ for each big square.
3. Check: the small square is $\frac{1}{2}$ inch and the big one is $2\frac{1}{2}$ inches. $2\frac{1}{2} \div \frac{1}{2} = 5$, so the map is 5 times larger.
4. Scale: $300 \text{ miles} \div 20 \text{ inches} = 15 \text{ miles}$ for every inch.

Answer: Make each big square $2\frac{1}{2}$ inches (the map is 5 times larger). The scale is 1 inch = 15 miles.

PRACTICE

1. **EASY** What is a relief map?
2. **EASY** Name four things every good map should have.
3. **MEDIUM** On your relief map, each layer stands for 500 feet. A hill is 3,000 feet high. How many layers do you stack there?
4. **MEDIUM** A state is 400 miles wide. Your map of it is 20 inches wide. What is the scale?
5. **MEDIUM** The salt-dough recipe is 2 cups flour, 1 cup salt and 1 cup water. You need a double batch. How much of each?
6. **MEDIUM** You enlarge a map so each 1-inch square becomes a 3-inch square. A river is 4 inches long on the small map. How long is it on the big map?

7. **HARD** On a map where 1 inch = 20 miles, how tall would a mountain 1 mile high be at true scale? Why do mapmakers exaggerate heights on relief maps?
8. **CHALLENGE** Write the first three sentences of your state report. Tell where your state is, name its neighbors, and give one interesting fact about its land or water.

COMMON MISTAKES

- Making the dough too thick so the map cracks or never dries. Build thin layers and let each one firm up.
- Forgetting the key, scale and compass rose. A map without them is a picture, not a map.
- Copying sentences from a book or website. Gather facts, then write them in your own words, and name your sources at the end.

Make it a game • State Expert Press Conference. After your presentation, your family becomes a group of newspaper reporters. Each one asks you a question about your state: its highest point, its longest river, its capital, its oldest town, its main crop, its neighbors. You score a point for each question you can answer, and if you cannot, you may “look it up” in your own report for half a point. Then switch: a parent presents a state they know, and you ask the questions.

Scripture. “The lines are fallen unto me in pleasant places; yea, I have a goodly heritage.” (Psalm 16:6, KJV)

The “lines” were the boundary lines of the land God gave to each family in Israel. Your state, with its hills, rivers and towns, is part of the heritage God has given you, and it is good to know it and give thanks.

Practice answers

1. A map that shows how high the land is, with colors and shading or with raised shapes you can touch.
2. A title, a key (legend), a scale and a compass rose (or north arrow). Labels are good too.
3. $3,000 \div 500 = 6$ layers.
4. $400 \div 20 = 20$, so 1 inch = 20 miles.
5. 4 cups flour, 2 cups salt and 2 cups water.
6. $4 \times 3 = 12$ inches.
7. 1 mile is $1/20$ of 20 miles, so the mountain would be only $1/20$ of an inch tall, almost too thin to see. Mapmakers exaggerate heights so that we can see and feel the shape of the land.
8. Answers will vary. Sample: “Ohio is a state in the Midwest, south of Lake Erie. Its neighbors are Michigan, Indiana, Kentucky, West Virginia and Pennsylvania. The Ohio River forms its whole southern border.” Check that the facts are correct for the student’s state and written in the student’s own words.

UNIT 5 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use your own state notebook for question 10. The review is worth 50 points.

1. (5 pts) What is a watershed? Name the five places where rivers in the lower 48 states finally drain, as listed in Lesson 5.1.
2. (5 pts) On a state map, 1 inch stands for 25 miles. Two cities are $4\frac{1}{2}$ inches apart. How far apart are they?
3. (5 pts) Air cools about $3\frac{1}{2}^{\circ}\text{F}$ for every 1,000 feet you climb. A town in the mountains is 2,000 feet higher than a town in the valley. It is 76°F in the valley. About how warm is it in the mountain town?
4. (5 pts) Thomas Jefferson wrote a book that answered questions about his state. What was the book called, and name two things he wrote about in it.
5. (5 pts) In 1753 George Washington said the Forks of the Ohio was a fine place for a fort. Which two rivers meet there, what river do they form, and what city grew there?
6. (5 pts) Name four geographic reasons a town might grow in a certain place, and give an example of one.
7. (5 pts) A flatboat floats about 40 miles a day. How many days would it take to float about 600 river miles from Pittsburgh to Louisville?
8. (5 pts) Name the four kinds of work places in this unit (farms, mines, factories, ports) and tell what geography each one needs.
9. (5 pts) One river barge carries about 1,500 tons. How many tons do 6 barges carry? Why do steel mills and power plants like to be near rivers?
10. (5 pts) On your relief map, each dough layer is $\frac{1}{4}$ inch thick and stands for 1,000 feet. How tall will a spot 4,000 feet high be? Then name the highest point in your own state and its elevation.

UNIT PROJECT: MY STATE STUDY

Gather your finished state study: a report with a title page and pages on land and water, history, work, and your state's symbols and favorite place; your physical map, political map with timeline, and work map; and your painted salt-dough relief map with a title, key, scale and compass rose. Include a photograph of the relief map and a short note on the three most important things you learned about how geography shaped your state. Present it to your family or class in about five minutes.

- **Accuracy:** Landforms, rivers, towns, the capital and places of work are correct and placed correctly on the maps; numbers such as elevations and dates are right.
- **Geographic reasoning:** The report explains why rivers flow where they do, why towns grew where they did and why work is found where it is.
- **Maps and model:** Every map has a title, key, scale and compass rose; the relief map rises where the land is high and its rivers run from high land to low.

- **Writing, care and presentation:** The report is in the student's own words, neat and complete, and the presentation is clear, confident and about five minutes long.

Answer key

1. A watershed is all the land that drains into one river or body of water. Rivers in the lower 48 states drain to the Atlantic Ocean, the Gulf of Mexico, the Pacific Ocean, Hudson Bay (also accept "Hudson Bay/Arctic Ocean"), or the Great Basin (which has no outlet to the sea).
2. $4 \times 25 = 100$ miles, plus $\frac{1}{2} \times 25 = 12\frac{1}{2}$ miles, so $112\frac{1}{2}$ miles.
3. $2 \times 3\frac{1}{2} = 7^\circ\text{F}$ cooler, so about 69°F .
4. *Notes on the State of Virginia* (printed 1785). He wrote about Virginia's boundaries, rivers, mountains, climate and natural wonders such as the Potomac at Harpers Ferry and the Natural Bridge (any two).
5. The Allegheny and the Monongahela meet to form the Ohio River. Pittsburgh grew there (around Fort Pitt).
6. Any four of: rivers meeting (confluence), a sheltered harbor, falls on a river, a ford or bridge site, a crossroads, a mine, a spring or good water, good soil, a railroad stop. Example: Louisville grew at the Falls of the Ohio, where boats had to stop; Pittsburgh grew at a confluence.
7. $600 \div 40 = 15$ days.
8. Farms need good soil, fairly flat land, enough water and a long enough growing season. Mines need rocks that hold coal, metals, salt or oil. Factories need raw materials, power, workers and good transportation brought together. Ports need deep, sheltered water connected to rivers, roads or railroads.
9. $6 \times 1,500 = 9,000$ tons. Rivers let them move huge, heavy loads like coal and ore cheaply by barge, and they also supply water.
10. $4 \text{ layers} \times \frac{1}{4} \text{ inch} = 1 \text{ inch}$. The highest point and elevation depend on the student's state (for example, Virginia: Mount Rogers, 5,729 feet). Check against the student's notebook.

CANALS AND STEAMBOATS

In 1800 the United States was a country of separate regions. Farmers west of the Appalachian Mountains could grow mountains of wheat and corn, but hauling it east over rough roads cost more than the grain was worth. Rivers ran the wrong way, or rushed downhill too fast for boats to climb. In this unit you will see how Americans used two great inventions to beat those mountains and currents: the **canal**, a river made by people, and the **steamboat**, a boat that could push upstream against the current.

You will dig “Clinton’s Ditch” with the Irish and Yankee crews who built the Erie Canal from Albany to Buffalo and ride with Governor DeWitt Clinton to the “Wedding of the Waters” in 1825. You will learn how a lock lifts a boat with nothing but water and gravity, and you will build a working lock from milk cartons or bottles. Then you will stand on the riverbank in 1807 as Robert Fulton’s steamboat chugs up the Hudson, and you will travel down the Mississippi with flatboatmen, steamboat captains and a young river pilot named Samuel Clemens.

All through the unit you will ask one question: **how did people use God’s gifts of water, wind and fire to overcome distance?** The answer turned a scattered country into one connected market, and it set the stage for the railroad in Unit 7.

BEFORE YOU BEGIN

- Can use a map scale to find a distance (Unit 1)
- Can find the Great Lakes, the Hudson River and the Mississippi River on a map of the United States
- Can multiply and divide two-digit numbers
- Knows the four cardinal directions and can say which way a river flows

MASTERY CHECKLIST

- I can trace the Erie Canal from Albany to Buffalo on a map and name the cities along it.
- I can explain why the Erie Canal made goods cheaper and helped New York City and the Great Lakes towns grow.
- I can explain, step by step, how a lock lifts a boat up or lowers it down using only water and gravity.
- I can tell the story of Robert Fulton’s steamboat on the Hudson in 1807 and explain how a paddle wheel pushes a boat.
- I can explain why steamboats changed life on the Mississippi, and tell what river pilots and leadsmen did.
- I can name honestly who did the hard work of the canal and cotton age, including Irish canal diggers and enslaved people on the cotton plantations.

OPTIONAL BOOKS AND RESOURCES

- ***Life on the Mississippi* by Mark Twain (free at Project Gutenberg)** (<https://www.gutenberg.org/ebooks/245>): Free. Twain's own story of learning to be a steamboat pilot. A parent can read aloud the chapters about Twain as a "cub" pilot learning the river (Lesson 6.4). Choose passages, since the whole book is long and written for grown-ups.
- **Erie Canal Museum, Syracuse, New York** (<https://www.eriecanal.org/>): The museum stands in the only surviving weighlock building on the canal. Its website has pictures and stories of canal life, and families near upstate New York can visit.

6.1 THE ERIE CANAL ★ ⚙️

OBJECTIVES

- Trace the Erie Canal on a map from Albany on the Hudson River to Buffalo on Lake Erie and name the cities along the way.
- Explain why New York built the canal and how it cut the cost and time of moving goods.
- Use a map scale to measure distances along the canal and compare the canal route with a straight line.

Warm-up. Put a few inches of water in a sink or bathtub. Float a plastic tub loaded with a handful of coins and pull it along with a string looped over one finger. Now drag the same loaded tub across the carpet with the same string. Which was easier? Water holds up the load, so a small pull moves a big weight. That is why one mule on a canal bank could pull a boat loaded with many tons.

Watch. *Digging the Erie Canal* (Liz and Dave Beebe Camillus Erie Canal Park, 5:53).

<https://www.youtube.com/watch?v=CF3vBn-UH0o>

After the story: volunteers at an Erie Canal park tell how the canal was dug, mostly by hand.

Backup video. *Life on the Canal* (Liz and Dave Beebe Camillus Erie Canal Park, 7:34).

<https://www.youtube.com/watch?v=8sB02kup6SE>

After the big idea: life on the canal for the boat crews, drivers and lock tenders.

KEY TERMS

canal

A waterway dug by people so that boats can travel where no river goes.

towpath

A path along the bank of a canal where mules or horses walked, pulling the boats with long ropes.

lock

A box of water with gates at each end that lifts or lowers boats from one level of a canal to another.

aqueduct

A bridge that carries water, and on the Erie Canal, the canal itself, across a river or valley.

freight

Goods carried from one place to another to be sold, such as flour, lumber, salt or cloth.

CORE IDEAS

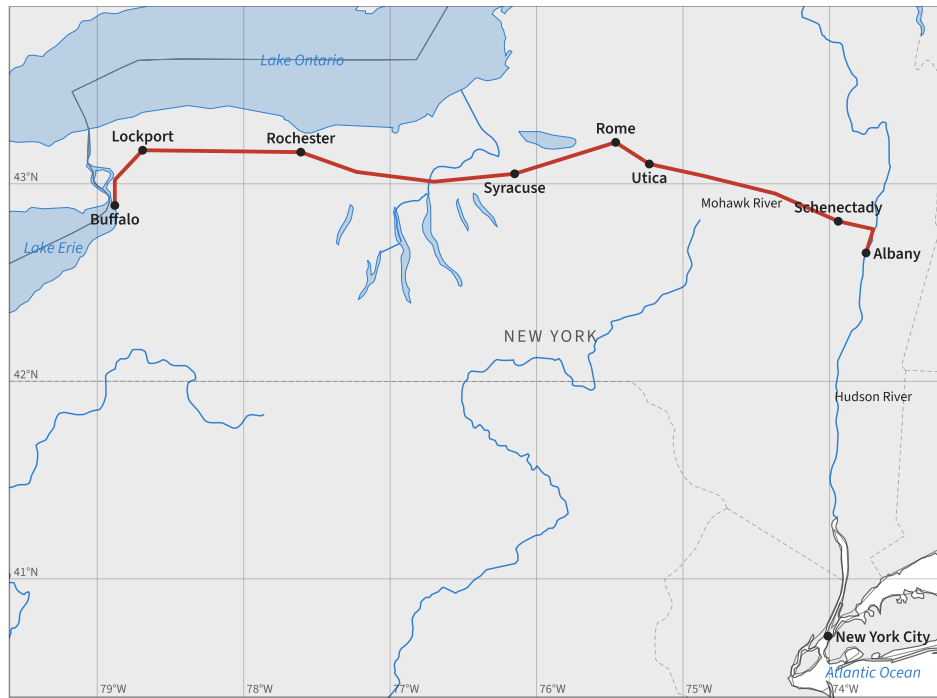
The story. On the morning of October 26, 1825, a boat named the *Seneca Chief* pushed away from the dock at Buffalo, on the shore of Lake Erie. On board was DeWitt Clinton, the governor of New York. As the boat moved into the new Erie Canal, a cannon boomed. A few miles east another cannon heard it and fired, then another, and another, all the way across New York State and down the Hudson River to New York City. The news that the canal was open raced across the state by cannon in well under two hours. The *Seneca Chief* took longer. Nine days later, on November 4, Governor Clinton stood on the deck out in the Atlantic Ocean beyond New York harbor and poured a keg of Lake Erie water into the sea. People called it the “Wedding of the Waters.” The Great Lakes and the ocean were joined.

How they figured it out. Look at a map of the East. The Appalachian Mountains stand like a long wall between the Atlantic coast and the land around the Great Lakes. But in New York there is a gap: the valley of the Mohawk River, which flows east into the Hudson. Clinton saw that a canal could follow this low valley west and then cross the flat land to Lake Erie. Many people laughed. Even President Thomas Jefferson thought the plan was too big for its time, close to madness. Critics called it “Clinton’s Ditch.” The state of New York paid for it anyway, and digging began at Rome, New York, on July 4, 1817. America had almost no trained canal engineers, so surveyors like Benjamin Wright and James Geddes learned by doing. A young man named Canvass White found a kind of cement that hardens under water, just what the locks needed.

The big idea. The workers were local farmers and, more and more, Irish immigrants who had crossed the ocean looking for work. They dug with shovels, picks and wheelbarrows, and used horses and clever stump-pulling machines to clear the forest. In the swamps near Montezuma many fell sick with fever. In eight years they finished a ditch about **363 miles** long, **40 feet** wide and only **4 feet** deep. Lake Erie sits about 570 feet higher than the Hudson at Albany, so the canal needed **83 locks** to lift and lower boats, and 18 aqueducts to carry it over rivers. Mules and horses walked the towpath, pulling the boats at about the speed a person walks.

Technology overcoming geography. Before the canal, sending a ton of goods from Buffalo to New York City by wagon cost about \$100 and took weeks. On the canal it cost about \$10, and the trip took about eight to ten days. Wheat, flour and lumber from the West floated east. Cloth, tools, books and thousands of settlers moved west. Towns along the canal, such as Syracuse, Rochester and Buffalo, grew from villages into cities, and New York City became the busiest port in the country. The tolls the boats paid soon paid back the canal’s cost of about \$7 million. A ditch only four feet deep had tied the young nation together.

On the map. Find Albany on the Hudson River. The canal runs west up the Mohawk Valley through Schenectady, Utica and Rome, then on to Syracuse, Rochester and Lockport, and finally to Buffalo on Lake Erie. Notice that the canal bends to follow valleys and level ground. Engineers chose the easiest path that God’s land allowed, not the straightest one.



The Erie Canal, 1825: about 363 miles from Albany to Buffalo. Boats from Lake Erie could now reach New York City by canal and the Hudson River.

PICTURE STUDY



View on the Erie Canal, John William Hill, 1832 · Watercolor on paper · New York Public Library (I. N. Phelps Stokes Collection)

John William Hill was born in England and came to America as a boy. He and his father made pictures of American towns and scenery. Between 1829 and 1832 the young Hill painted a series of watercolors of the Erie Canal, which had opened in 1825, while it was still new and

busy. This one shows the canal the way travelers saw it every day: long, narrow and calm, with boats gliding along at a walking pace.

Look closely

- Follow the canal into the distance with your finger. Does it look wide or narrow? Straight or curving?
- Look along the bank for the towpath. How does a boat move on this canal without sails or an engine?
- Find the people in the picture. What are they doing?
- Look at the land around the canal. Is it hilly or flat? Why would canal builders look for land like this?

Talk about it

1. How is traveling on this canal different from riding in a wagon on a bumpy road?
2. What kinds of goods do you think boats like this carried east to New York City? What did they carry west?
3. If you could ride this boat for one day, what would you watch for along the way?

PROJECT: MY MAP OF THE ERIE CANAL

You will draw your own map of the Erie Canal from Albany to Buffalo, with a scale bar so that you can measure its length. You will keep this map for the unit portfolio.

You will need

- A large sheet of paper or poster board (at least 12 by 18 inches)
- Pencil, eraser, ruler and colored pencils (blue for water)
- A piece of string about 12 inches long
- The Erie Canal map in this lesson (or a road atlas of New York State)

Steps

1. Lightly sketch the shape of Lake Erie at the left (west) side of your paper and Lake Ontario across the top. Sketch the Hudson River running north and south near the right (east) side.
2. Draw the Mohawk River flowing east from the middle of the state into the Hudson just north of Albany.
3. Mark these cities with dots, from east to west: Albany, Schenectady, Utica, Rome, Syracuse, Rochester, Lockport and Buffalo. Check their places on the lesson map.
4. Connect the dots with a bold blue line for the canal. Let it follow the Mohawk Valley and then curve west across the state, as the real canal does.
5. Make a scale bar. Use the lesson map to decide how many miles one inch stands for on your drawing, and write it in the corner, for example "1 inch = 30 miles."

6. Lay the string along your canal line, then straighten it against your ruler. Multiply by your scale to find the canal's length. Is it close to 363 miles?
7. Add a compass rose, a title ("The Erie Canal, 1825") and New York City at the mouth of the Hudson.

Tips

- Draw lightly in pencil first. Water is easier to color once all the lines are right.
- A string measures a curvy line much better than a ruler does.

Check your work

- My map shows the canal from Albany to Buffalo through at least eight cities in the right order.
- My map has a scale bar, a compass rose and a title.
- I measured my canal with string and compared it with 363 miles.

MAP NOTEBOOK

1. Draw a canal boat being pulled by a mule on the towpath. Label the canal, the towpath, the towrope and the boat.
2. Make a T-chart titled "Before and After the Erie Canal" with the cost and time of shipping a ton of goods from Buffalo to New York City.
3. Draw Governor Clinton pouring the keg of Lake Erie water into the ocean, and write one sentence telling what the "Wedding of the Waters" meant.

From history. The song many children know as "Low Bridge, Everybody Down" ("I've got a mule, her name is Sal, fifteen miles on the Erie Canal") was written by Thomas S. Allen in 1905, long after the canal opened. "Fifteen miles" is usually explained as about how far a mule pulled a boat in one stretch before a fresh team took over. The warning "Low bridge!" was real: farmers' bridges crossed the canal so low that passengers riding on the cabin roof had to duck flat or be knocked into the water.

WORKED EXAMPLES

Example 1. On a map where 1 inch stands for 50 miles, a string laid along the Erie Canal from Albany to Buffalo measures $7\frac{1}{4}$ inches. About how long is the canal?

(Use the map or drawing “Lay a string along the canal line, then measure the string.” shown earlier in this lesson.)

1. Each inch stands for 50 miles, so 7 inches stand for $7 \times 50 = 350$ miles.
2. One quarter of an inch stands for one quarter of 50 miles: $50 \div 4 = 12\frac{1}{2}$ miles.
3. Add them: $350 + 12\frac{1}{2} = 362\frac{1}{2}$ miles.

Answer: About 363 miles, which is the real length of the Erie Canal.

Example 2. A miller in Rochester sends 15 tons of flour to New York City. Before the canal, the trip cost about \$100 a ton. On the canal it cost about \$10 a ton. How much money does the canal save the miller?

1. Cost before the canal: $15 \times \$100 = \$1,500$.
2. Cost on the canal: $15 \times \$10 = \$150$.
3. Savings: $\$1,500 - \$150 = \$1,350$.

Answer: The canal saves the miller about \$1,350. Now his flour can sell for less in New York and still earn him a profit.

PRACTICE

1. **EASY** The Erie Canal connected which river with which Great Lake?
2. **EASY** In what year did the whole Erie Canal open? Who was the governor who pushed to build it?
3. **EASY** Digging began on July 4, 1817, and the canal opened in 1825. About how many years did it take to build?
4. **MEDIUM** Use the map. List the canal cities in order from west to east, starting at Buffalo.
(Use the map or drawing “Start at the western end of the canal, on Lake Erie.” shown earlier in this lesson.)
5. **MEDIUM** On a map where 1 inch stands for 25 miles, Rochester and Syracuse are 3 inches apart in a straight line. About how far apart are they?
6. **MEDIUM** A straight line from Albany to Buffalo is about 260 miles, but the canal is about 363 miles long. How many miles longer is the canal? Why didn’t the builders dig it straight?
7. **HARD** A canal boat travels about 4 miles an hour. If it never stopped, about how many hours would it take to go the whole 363 miles? About how many days is that?
8. **CHALLENGE** In two or three sentences, explain why New York City became the busiest port in the United States after 1825.

COMMON MISTAKES

- Thinking the canal is a natural river. It was dug by hand, mostly with shovels, picks and wheelbarrows.
- Thinking the canal ran in a straight line. It bent to follow valleys and level ground, so it is about 100 miles longer than a straight line from Albany to Buffalo.
- Mixing up the two lakes. The canal ended at Buffalo on Lake Erie, not on Lake Ontario.

Make it a game • Canal Cities Relay. Write the eight canal cities (Albany, Schenectady, Utica, Rome, Syracuse, Rochester, Lockport, Buffalo) on eight cards and lay them in a line on the floor from east to west. Players take turns being the “mule”: walk the towpath beside the cards, naming each city aloud. Then a parent turns two cards face down and mixes them up. The mule must say which cities are missing and put them back in the right places. A perfect run scores a point. Shout “Low bridge!” at any moment, and every player must duck before the count of three.

Scripture. “Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight, and the rough places plain:” (Isaiah 40:4, KJV)

Isaiah pictures a highway being made ready for the Lord, with valleys filled and hills leveled. Canal builders did a small version of this when they leveled a path across New York. They used the valley God had already placed in the mountains, and with hard work they made a rough way smooth for travelers.

Practice answers

1. The Hudson River and Lake Erie.
2. 1825. Governor DeWitt Clinton.
3. $1825 - 1817 = 8$ years.
4. Buffalo, Lockport, Rochester, Syracuse, Rome, Utica, Schenectady, Albany.
5. $3 \times 25 = 75$ miles.
6. $363 - 260 = 103$ miles longer. The builders followed the Mohawk Valley and other low, level ground so they would not have to climb over hills, which would have needed many more locks and much more digging.
7. $363 \div 4$ is about 91 hours ($4 \times 90 = 360$). 91 hours is about 4 days ($4 \times 24 = 96$). Real boats stopped at locks and for rest, so most trips took longer.
8. The Erie Canal and the Hudson River made New York City the cheapest and easiest door between the Atlantic Ocean and the Great Lakes. Grain and other goods from the West flowed down the canal to New York to be shipped to the world, and goods and settlers from overseas went west through New York. Trade brought ships, businesses and people, so the city grew quickly.

6.2 HOW A LOCK LIFTS A BOAT ★ ⚙️

OBJECTIVES

- Name the parts of a canal lock: the chamber, the upper and lower gates and the valves.
- Explain step by step how a lock raises a boat going uphill and lowers a boat going downhill, using only water and gravity.
- Calculate how high a flight of locks lifts a boat and how many locks a climb needs.

Warm-up. Fill a clear plastic cup halfway with water and float a bottle cap in it. Mark the cap's height on the cup with a marker. Now slowly pour in more water from a second cup. Watch the cap rise. Pour some water out with a spoon and watch it sink. You just made a tiny elevator out of water. What made the cap go up, and what made it go down?

Watch. *How a Lock Works* (Canal & River Trust, 3:02). <https://www.youtube.com/watch?v=dmZ7hBMTY8Q>

Before the project: how a lock lifts and lowers a boat, step by step, as the paddles (valves) and gates are opened and closed.

Note: Made in England, where the lock is opened with a “windlass”; the steps are the same as on the Erie Canal.

Backup video. *How does a Canal Lock work?* 📺 *Maddie's Do You Know* 🧑 (Maddie's Do You Know?, 4:54). https://www.youtube.com/watch?v=Vy0B_Wf_kV0

As review: Maddie works a real canal lock and explains each step. Note: Made in England; a lock “keeper” is the same as a lock tender.

KEY TERMS

lock chamber

The long box of water inside a lock where the boat waits while the water rises or falls.

gate

A heavy door at each end of a lock that holds back the water. A lock has an upper gate and a lower gate.

valve

A small door in a gate or wall that lets water flow into or out of the lock chamber. Canal workers called them paddles or wickets.

lift

The difference in height between the water above a lock and the water below it.

flight of locks

Several locks built one right after another, like a staircase, to climb a steep slope.

gravity

The pull that God built into the world that makes water flow downhill and seek its own level.

CORE IDEAS

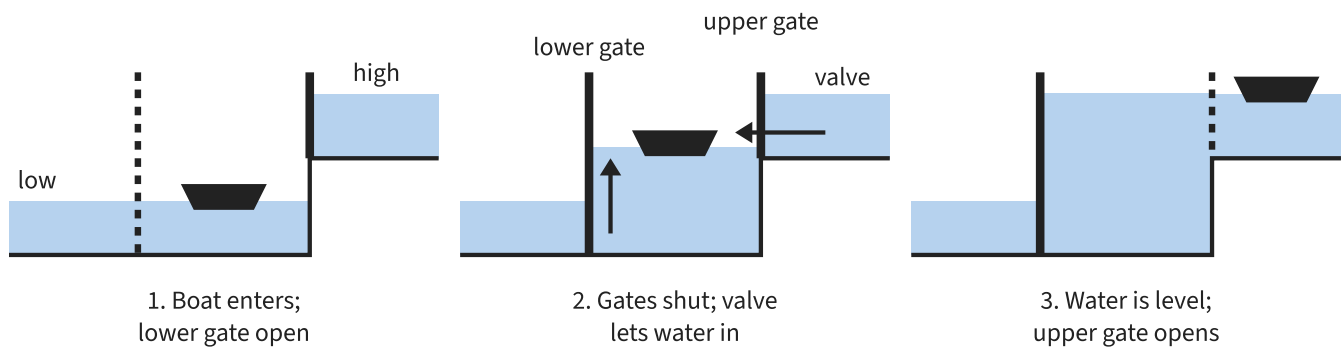
The story. As the Erie Canal crept west toward Lake Erie, the workers came to a wall. Near the village of Lockport, New York, a cliff of hard rock rose about 60 feet in front of them. It is called the Niagara Escarpment, the same long ridge of rock that Niagara Falls pours over about 20 miles to the west. A boat cannot float up a cliff. An engineer named Nathan Roberts drew a plan: two staircases of water, side by side, each with five locks. One staircase was for boats going up and the other for boats going down. Crews blasted rock and fit heavy stone blocks together, and in 1825 the “Flight of Five” was finished. On October 26, 1825, the *Seneca Chief*, starting its trip from Buffalo to New York City, stepped down the stairs one lock at a time. People came from far away just to watch boats climb a hill.

How it worked. A lock is a long stone box called a **chamber**, with a gate at each end. Suppose a boat wants to go up. (1) The water in the chamber is low, level with the canal below. The lower gates open and the boat floats in. (2) The lower gates close behind it. The lock tender opens small **valves** in the upper gates, and water from the higher canal pours into the chamber. The boat rises with the water. (3) When the water in the chamber is as high as the canal above, the upper gates open, and the mule pulls the boat out on the higher level. To go down, the steps run backward: the boat enters from above, the upper gates close, the valves in the lower gates let water out, and the boat sinks gently down to the lower level.

The big idea. A lock is an **elevator made of water**. It has no motor and no pump. It works because of gravity: water always flows downhill until it is level. When the lock tender opens a valve, the water does all the lifting. Every time a boat passes through, a whole chamberful of water moves one step down the canal. That is why canal builders needed a good supply of water at the high points, from streams and from Lake Erie itself.

Clever gates. Each end of an Erie Canal lock had two wooden gates that met in the middle in a shallow V, pointing upstream toward the higher water. The pressure of the high water pushed the two gates tightly together, so the water itself helped seal the lock. The lock tender pushed a long wooden beam, called a balance beam, to swing each gate open or shut. He could not open a gate until the water on both sides was level. Then it swung easily.

Technology overcoming geography. The Erie Canal climbed and dropped through 83 locks between Albany and Buffalo. Each original lock was about 90 feet long and 15 feet wide, and each lifted or lowered a boat several feet, some as much as 12. One step at a time, boats climbed the whole height between the Hudson and Lake Erie, about 570 feet. The same idea still works today in the great locks of the Panama Canal and the St. Lawrence Seaway, which lift ocean ships the size of buildings.



How a lock lifts a boat. A dashed gate is open. No pump is needed: gravity moves the water.

PICTURE STUDY



Lockport, Erie Canal, William Henry Bartlett (drawing), engraved for the book *American Scenery*, published 1840 · Steel engraving (this copy hand-colored) · Published in *American Scenery* by N. P. Willis (London, 1840); copies are held in many libraries

William Henry Bartlett was an English artist who traveled through the United States in the 1830s, drawing its rivers, mountains and towns for a famous book of pictures called *American Scenery*. Engravers in London cut his drawings into steel plates so that thousands of copies could be printed. Lockport was one of the sights every traveler wanted to see, because there a canal climbed a cliff.

Look closely

- Find the locks. Can you see how they step up the slope like stairs?
- Look for canal boats. Which ones seem to be waiting, and which are moving?

- Find the people. What jobs might they be doing around the locks?
- Look at the town around the locks. Why do you think a town grew up in this place?

Talk about it

1. Why did the canal need so many locks right here at Lockport?
2. How do you think the town got its name?
3. If you were a lock tender here, what would you have to do each time a boat arrived?

Safety first. An adult should do the cutting with a craft knife or sharp scissors. Work on a baking sheet or towel, since the model will leak a little.

PROJECT: BUILD A WORKING MODEL LOCK

You will build a canal with a lower level, a lock chamber and an upper level, held apart by two gates. By opening small valves you will lift a boat from the low water to the high water and lower it again, just as the lock tenders at Lockport did.

You will need

- Three clean half-gallon cardboard milk or juice cartons (or one long clear plastic storage box about the size of a shoebox)
- Two pieces of stiff plastic cut from a clean plastic lid or container, each a little larger than the end of a carton, for gates
- Modeling clay, duct tape and waterproof tape
- A pushpin or a sharpened pencil to make valve holes
- A small boat: a cork, a bottle cap or a small piece of foam
- A pitcher of water with a few drops of food coloring
- Ruler, marker and a baking sheet or towel

Steps

1. Lay each carton on its side and have an adult cut away the side facing up, so each becomes an open trough. On one carton (the chamber), also cut off both ends. On the other two, cut off only the spout end, so each has one open end.
2. Line the three troughs up end to end: lower canal, chamber, upper canal. Join them with duct tape inside and out, and press clay into the seams to stop leaks. (If you use a plastic box instead, it is already one long trough.)
3. Slide one plastic gate into each joint, between the lower canal and the chamber and between the chamber and the upper canal. Press clay along the bottom and sides of each gate to seal it. A gate is opened by lifting it straight up.
4. With the pushpin or pencil, poke one small hole near the bottom of each gate. These are your valves. Plug each one with a pea-sized ball of clay.
5. Fill the lower canal and the chamber about 1 inch deep. Fill the upper canal about 2½ inches deep. Use the ruler to check. Your lift is the difference: about 1½ inches.

6. Lift your boat UP: float it in the lower canal, open the lower gate, move the boat into the chamber and close the gate again. Pull the clay out of the upper gate's valve. Watch the boat rise! As the chamber fills, pour a little more water from the pitcher into the upper canal, the way streams and Lake Erie kept the real canal full. When the water is level on both sides, open the upper gate and float the boat out.
7. Lower the boat DOWN by reversing the steps, opening the valve in the lower gate this time. Write down each step in order, and measure how high the boat moved.

Tips

- If a gate will not open, the water is not level yet. Real lock tenders had the same problem: a high water level pushes the gate shut until both sides match.
- Small leaks are normal. Real wooden lock gates leaked too. Keep a towel handy and add more clay.
- Plastic bottle version: cut two 2-liter bottles in half lengthwise to make troughs and use the same gates and valves.

Check your work

- My lock has two gates, a chamber and two water levels.
- I can raise and lower my boat using only valves, gates and gravity.
- I measured the lift of my lock and wrote the steps in order.

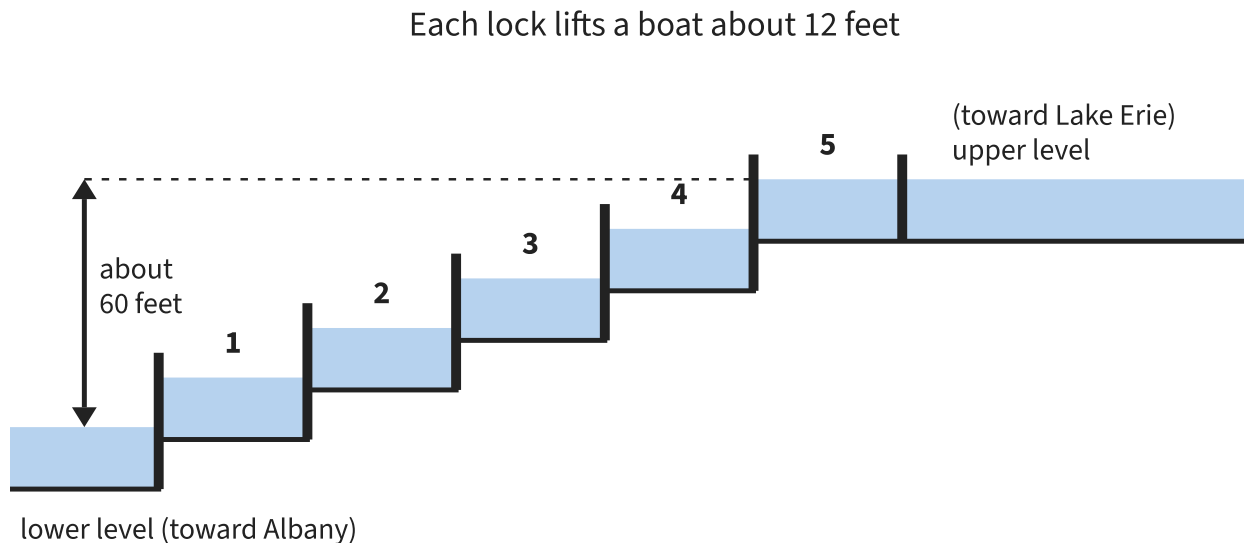
MAP NOTEBOOK

1. Draw the three steps of a boat going UP through a lock, with arrows showing which way the water flows.
2. Draw a lock gate from above, showing the two halves meeting in a V that points toward the higher water. Add an arrow for the water pushing the gate shut.
3. Draw the Lockport "Flight of Five" as a staircase and label the lift of each step and the total climb.

From history. Locks with gates are much older than the Erie Canal. The V-shaped gates you learned about are called miter gates. Leonardo da Vinci, the Italian artist and inventor, drew plans for gates like these for the canals of Milan around the year 1500, and canals around the world still use the same shape more than five hundred years later.

WORKED EXAMPLES

Example 1. At Lockport, a flight of five locks climbs the Niagara Escarpment. Each lock lifts a boat about 12 feet. How much higher is the canal at the top of the flight than at the bottom?



The Flight of Five at Lockport (simplified): five steps of about 12 feet each.

1. Each lock adds one step of 12 feet.
2. Five steps: $5 \times 12 = 60$ feet.
3. Check: $12 + 12 + 12 + 12 + 12 = 60$.

Answer: About 60 feet higher, as tall as a six-story building.

Example 2. A boat traveling east toward Albany comes to a lock. The water above the lock is 10 feet higher than the water below it. List the steps to take the boat through, and tell how far the boat moves and in which direction.

1. The boat is on the higher water, so it must go DOWN. First the chamber is filled level with the upper canal, and the upper gates open. The boat floats in.
2. The upper gates close behind the boat.
3. The lock tender opens the valves in the lower gates. Water flows out of the chamber into the lower canal, and the boat sinks with it.
4. When the chamber water is level with the lower canal, the lower gates open and the boat floats out.

Answer: The boat moves down 10 feet. The water flows out through the lower gates, pulled downhill by gravity.

PRACTICE

1. **EASY** What are the two heavy doors at the ends of a lock called? What do we call the long box of water between them?
2. **EASY** When a boat is going UP in a lock, does water flow into the chamber or out of it?
3. **EASY** Does a canal lock need a pump or an engine to lift a boat? What makes the water move?
4. **MEDIUM** Look at the drawing of the three steps of a lock. In step 2, which gate has its valve open, and why is the boat rising?
(Use the map or drawing "Look at the middle picture." shown earlier in this lesson.)
5. **MEDIUM** A canal must climb a hill 40 feet high. If each lock lifts boats 8 feet, how many locks are needed?
6. **MEDIUM** An Erie Canal lock was about 90 feet long and 15 feet wide. Could a boat 78 feet long and 14 feet wide fit inside? How much room would be left at each end if it were placed in the middle?
7. **HARD** Lake Erie is about 570 feet higher than the Hudson River at Albany. If the canal only climbed and every lock lifted boats 10 feet, about how many locks would it need? The real canal had 83 locks. Why might it need more?
8. **CHALLENGE** A lock chamber is 90 feet long and 15 feet wide, and its lift is 12 feet. How many cubic feet of water flow down the canal each time a boat passes through?
(Multiply length $\times$ width $\times$ lift.)

COMMON MISTAKES

- Thinking a lock pumps water up. Water only flows downhill into the chamber from the higher canal, and out of it into the lower canal.
- Opening both gates at once. Only one end is ever open; otherwise the high water would rush straight through the lock and drain the upper canal.
- Mixing up the order. Going up, the boat enters through the lower gates; going down, it enters through the upper gates.

Make it a game • Lock Tender Says. One player is the lock tender; the others are boats. Players crouch low (low water) or stand tall (high water). The lock tender calls commands such as "Open the lower gates!", "Close the upper gates!" or "Open the upper valves!" Boats must act out the right result: float in, wait, rise slowly, float out. But if the tender gives a command in the wrong order, such as opening the upper gates while the water is still low, the boats must shout "Not level yet!" Any boat that obeys a wrong command is out for one round. Take turns being the tender.

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 water to run downhill toward the sea, and He made the rain and clouds to carry it back up again. A lock does not fight this law; it uses it. The canal builders worked with the

faithful order God placed in creation, and that is why their simple gates and valves could lift heavy boats.

Practice answers

1. The gates (the upper gate and the lower gate). The box between them is the lock chamber.
2. Into the chamber, from the higher canal above.
3. No. Gravity makes the water flow downhill from the higher canal into the chamber.
4. The upper gate's valve is open. Water from the higher canal flows into the chamber, the water level rises, and the floating boat rises with it.
5. $40 \div 8 = 5$ locks.
6. Yes. $90 - 78 = 12$ feet of extra length, so 6 feet at each end. $15 - 14 = 1$ foot of extra width, only 6 inches on each side, so the boat fits snugly.
7. $570 \div 10 = 57$ locks. The real canal needed more because some locks lifted less than 10 feet, and in some places the canal went down into valleys and then had to climb back up again.
8. $90 \times 15 = 1,350$ square feet. $1,350 \times 12 = 16,200$ cubic feet of water. That is about 120,000 gallons, enough to fill thousands of bathtubs.

6.3 FULTON'S STEAMBOAT

OBJECTIVES

- Tell the story of Robert Fulton's steamboat trip up the Hudson River from New York City to Albany in August 1807.
- Explain how a steam engine turns paddle wheels and how pushing water backward moves a boat forward.
- Calculate the time and speed of a river journey and compare steam travel with sailing.

Warm-up. Sit in a wheeled office chair (or stand on a skateboard with a parent holding on). Push a heavy book or a basketball away from you, hard. Which way do you roll? Now float a toy boat in the tub and push water toward the back of it with your hand. Which way does the boat go? Whatever you push backward pushes you forward. Fulton's paddle wheels worked the same way.

Watch. *17th August 1807: The North River Steamboat was launched between New York and Albany* (HistoryPod, 2:37). https://www.youtube.com/watch?v=2C7_E4LarLg. With the story: the North River steamboat's first trip up the Hudson in 1807.

Note: The lesson explains why the boat was later called the Clermont; the video uses both names.

Backup video. *How Shelburne Museum Steamboat Ticonderoga Paddle Wheel Steam Engine Works* (Jon Bondy, 2:57). <https://www.youtube.com/watch?v=ez7ze1RlABg>. With How it worked: a working paddle-wheel steam engine on a museum steamboat.

KEY TERMS

steam engine

A machine that burns fuel to boil water; the steam pushes a piston back and forth to make things move.

boiler

The big closed tank where water is heated by fire until it turns into steam.

piston

A tight-fitting plug that slides back and forth inside a cylinder when steam pushes on it.

paddle wheel

A large wheel with flat boards around its rim that dip into the water and push it backward as the wheel turns.

upstream

Toward the place a river comes from, against the current. Downstream is the way the current flows.

CORE IDEAS

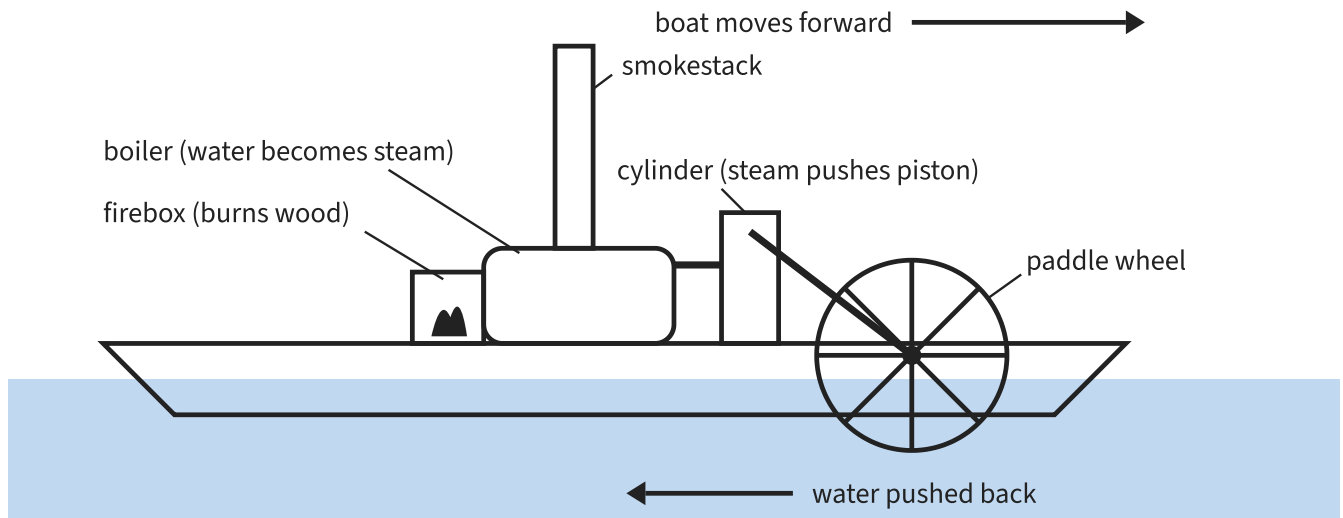
The story. At one o'clock on Monday afternoon, August 17, 1807, a strange boat sat at a dock on the Hudson River in New York City. It was long and narrow, with a tall smokestack in the middle and a big wooden wheel on each side. People on shore called it "Fulton's Folly." They were sure it would sink, burn up or simply sit there. Then the engine began to clank, smoke and sparks poured from the stack, the wheels began to turn, and the boat moved out into the river and headed north, upstream, with no sail and no oars. Sailors on the river stared. Some had never seen anything like it. Robert Fulton called his boat the *North River Steam Boat*, but history remembers it as the *Clermont*.

How they figured it out. Fulton was born in 1765 in Lancaster County, Pennsylvania. As a young man he painted small portraits for a living, and he sailed to London to study painting with the American artist Benjamin West. But Fulton's mind kept turning to machines: canals, bridges, even a submarine. In France he met Robert R. Livingston, an American diplomat who held the right to run steamboats on the waters of New York. The two became partners. Fulton was not the first to try a steamboat. John Fitch had run one carrying passengers on the Delaware River in 1790, but his business failed. Fulton learned from the earlier attempts, bought a strong steam engine from the firm of Boulton and Watt in England, and built a long, slim hull that slipped easily through the water.

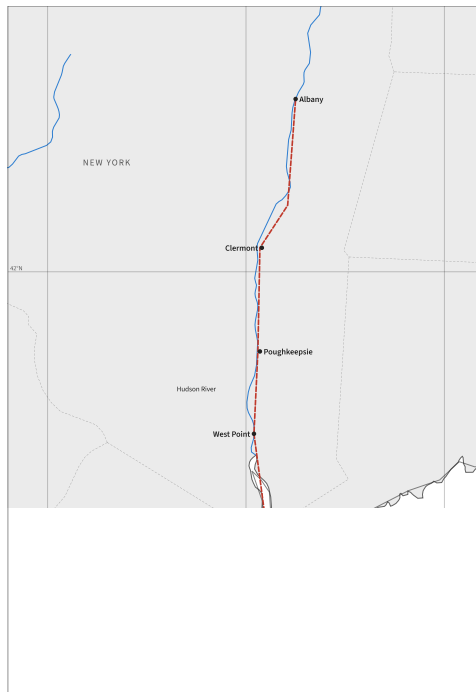
How it worked. A fire of pine wood heated water in the **boiler** until it became steam. Steam takes up much more room than water, so it pushes hard on whatever holds it in. The steam pushed a **piston** back and forth inside a cylinder. Iron rods and cranks turned that back-and-forth motion into round-and-round motion, and the paddle wheels spun. Each paddle dipped into the river and shoved the water backward. When you push water backward, the water pushes you forward. That is how the boat moved.

Technology overcoming geography. Before 1807, a sloop sailing from New York to Albany needed a good wind from the south and a helpful tide. With a poor wind the trip could take several days, or a week. Fulton's boat steamed the 110 miles to the Clermont estate, Livingston's home, in 24 hours. The next morning it went the last 40 miles to Albany in 8 hours: 150 miles in 32 hours of travel. It came back in 30. For the first time people could buy a ticket and know about when they would arrive, whatever the wind did. Within a few years steamboats were running on rivers, lakes and bays all over the country.

On the map. Find New York City at the mouth of the Hudson River. Trace the river north past West Point and Poughkeepsie to Clermont and on to Albany, about 150 miles. Remember that in 1825 the Erie Canal would begin at Albany. Steamboats on the Hudson and canal boats on the Erie together made one long road of water from the Atlantic to the Great Lakes.



How a paddle steamboat works (simplified). Fire makes steam, steam moves the piston, the piston turns the wheel, and the wheel pushes water back.



Fulton's route up the Hudson, August 1807: about 110 miles to Clermont, then about 40 more to Albany.

PICTURE STUDY



Robert Fulton, Benjamin West, 1806 · Oil on canvas · Fenimore Art Museum (New York State Historical Association), Cooperstown, New York

Benjamin West was born in Pennsylvania and became one of the most famous painters in London, where he taught many young American artists. Robert Fulton was one of his students. West painted this portrait of his friend in 1806, the year before the famous steamboat trip. By then Fulton had nearly given up painting to become an engineer. Behind him, West painted a scene at sea that recalls Fulton's experiments with underwater explosives, which Fulton called torpedoes.

Look closely

- Look at Fulton's face and eyes. What kind of person does West show us: dreamy, careful, bold, worried?
- Look at his clothes. Is this a working man in the shop or a gentleman sitting for his portrait?
- Look through the window behind him. What is happening out on the water?
- Where does the light fall brightest? What did West want you to notice first?

Talk about it

1. Fulton started out as a painter and became an engineer. How might an artist's skill in drawing help someone design machines?
2. Why do you think West put a scene of Fulton's inventions in the window instead of a plain background?
3. If someone painted your portrait, what would you want to show behind you?

PROJECT: RUBBER-BAND PADDLE BOAT

Fulton's boat had a paddle wheel on each side. Later river steamboats often had one big wheel at the back, called a stern wheel. You will build a stern-wheel boat powered by a twisted rubber band, test how far and how fast it goes, and see that pushing water backward moves a boat forward.

You will need

- A clean half-gallon cardboard milk carton or a small plastic bottle with the cap on (the hull)
- Two pencils or two wooden paint stirrers (the arms that hold the wheel)
- A thick rubber band
- A clean plastic lid or piece of foam tray, cut into two rectangles about 2 by 3 inches (the paddles)
- Duct tape, scissors and a ruler or tape measure
- A bathtub, wading pool or long sink, and a stopwatch or a clock with a second hand

Steps

1. Lay the carton or bottle on its side. This is your hull. Tape the two pencils along its sides so that they stick out about 3 inches past the back end, like two arms.
2. Cut a slit halfway into each plastic rectangle and slide them together to make a plus-sign-shaped paddle wheel.
3. Stretch the rubber band between the two pencil ends and slip the paddle wheel into the middle of it.
4. Wind the paddle wheel about 20 turns, turning the top of the wheel away from the boat, and hold it so it does not unwind.
5. Set the boat in the water and let go. Which way does it go? If it goes backward, wind the wheel the other way.
6. Test it three times. Measure how far the boat goes and how many seconds it takes, and write the results in a table. Find its speed in feet per second.
7. Try a change, such as bigger paddles or more turns. Test again and write down what happened.

Tips

- If the paddles hit the hull, make the arms longer or the paddles smaller.
- Real steamboats burned wood or coal to keep their wheels turning. Your rubber band stores the energy from your fingers instead, so it runs down quickly.

Check your work

- My boat moves forward by pushing water backward.
- I tested my boat three times and recorded distance and time.
- I tried one change and explained what it did.

MAP NOTEBOOK

1. Draw a side view of the *Clermont* with its smokestack and side paddle wheel. Label the boiler, the smokestack and the paddle wheel.
2. Draw a chain of four boxes with arrows: fire → steam → piston → paddle wheel. Under each box write one sentence about what it does.
3. Draw the Hudson River from New York City to Albany and mark Fulton's two stops with the times he left and arrived.

From history. Before he built his steamboat, Robert Fulton built a submarine. In France, in 1800, he launched the *Nautilus*, a small hand-cranked boat covered in copper that could dive under the water and carried a few men. He tested it in the River Seine and at sea, hoping the French navy would buy it, but they lost interest. Fulton turned instead to the steamboat, and that invention changed the world.

WORKED EXAMPLES

Example 1. Fulton left New York City at 1 p.m. on Monday and reached Clermont, 110 miles away, at 1 p.m. on Tuesday. He left Clermont at 9 a.m. on Wednesday and reached Albany, 40 miles farther, at 5 p.m. How many hours did the boat travel in all, and how many miles?

(Use the map or drawing "Follow the two legs of the trip on the map." shown earlier in this lesson.)

1. First leg: 1 p.m. Monday to 1 p.m. Tuesday is one whole day, 24 hours.
2. Second leg: 9 a.m. to 5 p.m. is 3 hours to noon plus 5 hours after noon, 8 hours.
3. Total time: $24 + 8 = 32$ hours. Total distance: $110 + 40 = 150$ miles.

Answer: The boat traveled 150 miles in 32 hours. (The night at Clermont does not count, because the boat was tied up.)

Example 2. On the second leg, the steamboat went 40 miles in 8 hours. What was its speed? Then suppose a sloop with poor winds needed 4 days to make the whole 150-mile trip. How many times faster was the steamboat's 32 hours?

1. Speed = distance ÷ time = $40 \div 8 = 5$ miles per hour.
2. 4 days = $4 \times 24 = 96$ hours.
3. $96 \div 32 = 3$.

Answer: The steamboat went about 5 miles per hour, and in this example it made the trip 3 times faster than the sloop.

PRACTICE

1. **EASY** In what year did Robert Fulton's steamboat make its famous trip, and on which river?
2. **EASY** Use the map. In which direction did Fulton's boat travel from New York City to Albany: north, south, east or west? Was it going upstream or downstream?
(Use the map or drawing "The Hudson flows south into New York Harbor." shown earlier in this lesson.)
3. **EASY** Put these in order to show how a steamboat moves: piston moves; fire burns wood; paddle wheel pushes water back; water boils into steam.
4. **MEDIUM** Fulton's boat went up to Albany in 32 hours and came back down in 30 hours. How many hours did the round trip take in all? Why might the trip down be quicker?
5. **MEDIUM** A steamboat leaves Albany at 8 a.m. and travels 5 miles each hour. How far has it gone by noon?
6. **MEDIUM** Who was Fulton's partner, and who ran a steamboat on the Delaware River before Fulton?
7. **HARD** On a map where 1 inch stands for 20 miles, how many inches long would the Hudson River route from New York City to Albany (150 miles) be?
8. **CHALLENGE** In two or three sentences, explain why being able to travel on a schedule, no matter what the wind did, mattered so much to farmers, merchants and travelers.

COMMON MISTAKES

- Thinking Fulton invented the steam engine or the first steamboat. Steam engines came from Britain, and John Fitch and others built steamboats before him. Fulton built the first steamboat that succeeded as a regular business.
- Thinking the paddle wheel pulls the boat. The paddles push the water backward, and the water pushes the boat forward.
- Counting the night at Clermont as travel time. The boat traveled for 32 hours; it rested overnight at Livingston's estate.

Make it a game • Steam Chain. Four players (or stuffed animals with one mover) stand in a line as the Fire, the Boiler, the Piston and the Paddle Wheel. A parent calls "Stoke the fire!" The Fire claps, the Boiler hisses like steam, the Piston pumps arms back and forth, and the Paddle Wheel spins arms in circles, each one starting only when the one before it has moved. Go faster each round. Then the parent calls out a mixed-up part, such as "Paddle Wheel first!" and players must shout the right order before the chain can start again. Switch jobs so everyone tries each part.

Scripture. "Seest thou a man diligent in his business? he shall stand before kings; he shall not stand before mean men." (Proverbs 22:29, KJV)

Fulton was laughed at, and many of his ideas failed before the steamboat worked. He kept studying, building and testing. Diligent, careful work is a way to use the gifts God gives, and over time it bears fruit that serves many people.

Practice answers

1. 1807, on the Hudson River.
2. North. It was going upstream, against the river's current.
3. Fire burns wood; water boils into steam; piston moves; paddle wheel pushes water back.
4. $32 + 30 = 62$ hours. Going down, the boat was traveling with the river's current instead of against it.
5. 8 a.m. to noon is 4 hours. $4 \times 5 = 20$ miles.
6. Robert R. Livingston was his partner. John Fitch ran a steamboat on the Delaware River in 1790.
7. $150 \div 20 = 7\frac{1}{2}$ inches.
8. With a steamboat, people could plan when goods and passengers would arrive. Farmers could get fresh crops to market before they spoiled, merchants could promise delivery dates, and travelers could keep appointments. Sailing boats might wait days for a good wind, but a steamboat kept going.

6.4 THE MISSISSIPPI STEAMBOAT AGE ⚙️

OBJECTIVES

- Tell how the steamboat *New Orleans* (1811–1812) opened the Ohio and Mississippi rivers to steam, and compare steamboats with flatboats and keelboats.
- Locate the great river towns from Pittsburgh and St. Louis to New Orleans and explain why cotton and other goods flowed down the river.
- Explain what river pilots and leadsmen did, and convert depth calls like “mark twain” from fathoms to feet.

Warm-up. Fill a sink or tub and stir the water hard in one direction so it flows in a circle. Now try to push a toy boat against the flow with a single finger, then let it ride with the flow. Which way is easy? For thousands of years, boats on the Mississippi could easily go only one way: downstream. Talk about what that would mean for a farmer who sold his crop in New Orleans and wanted to get home.

Watch. *Steamboats on the Mississippi* / *FIND Iowa* (Iowa PBS, 4:40).

<https://www.youtube.com/watch?v=HYZbi5Ogs7g>

With How it worked before: steamboats on the Mississippi, from Iowa PBS.

Backup video. *This is How Mark Twain Got His Pen Name* (Smithsonian Channel, 2:14).

<https://www.youtube.com/watch?v=Ywea-wkGZWc>

With the history note: how a Mississippi riverboat call gave Mark Twain his pen name.

KEY TERMS

flatboat

A big wooden box of a boat that floated downstream with the current carrying goods. It could not go back upstream, so it was taken apart and sold for lumber.

keelboat

A long, narrow boat that crews pushed upstream with poles or pulled with ropes, very slowly.

river pilot

The expert who steered a steamboat and had to know every bend, sandbar and snag of the river by heart.

fathom

A measure of water depth equal to 6 feet. “Mark twain” means two fathoms, or 12 feet.

snag

A sunken tree stuck in the river bottom that could rip a hole in a boat’s hull.

landing

A place on the riverbank where boats tie up to load and unload goods and passengers.

CORE IDEAS

The story. In October 1811 a new steamboat named the *New Orleans* left Pittsburgh, where two rivers meet to form the Ohio. It was built for Robert Fulton and Robert Livingston, and its captain was Nicholas Roosevelt, who brought along his wife, Lydia. They steamed down the Ohio past Cincinnati and waited at Louisville until the river rose high enough to cross its rocky falls. Then, in December, as they steamed on toward the Mississippi, the earth itself began to shake. The great New Madrid earthquakes rocked the river valley. Riverbanks caved in, trees crashed into the water, and the river churned. The little steamboat kept going, and in January 1812 it reached New Orleans. The steamboat had come to the West.

How it worked before. Before steam, farmers in Ohio, Kentucky and Tennessee built **flatboats**, loaded them with flour, pork, corn and whiskey, and floated down to New Orleans. There they sold the cargo, broke up the boat for lumber and walked or rode home, often along the Natchez Trace, a trail of hundreds of miles. Going upstream was slow, hard work. **Keelboat** crews pushed with long poles against the current and might take months to reach Louisville from New Orleans. The great river was like a one-way street.

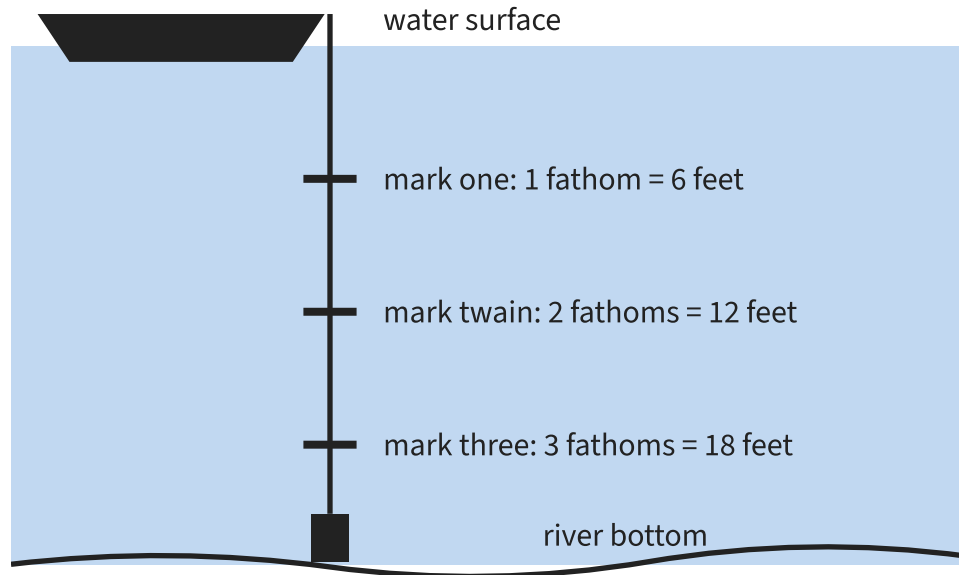
Technology overcoming geography. Steamboats made the river a two-way road. A riverboat captain named Henry Shreve helped design boats for the West: wide and shallow, with the engines up on the main deck and decks stacked above for passengers, so they could float in only a few feet of water. Shreve also built a “snagboat” that pulled sunken trees out of the river. Steamboats burned huge piles of wood, so farmers along the banks cut and sold firewood at woodyards. By the 1850s fast steamboats made trips in days that once took months.

The big idea. Cotton was king of the lower Mississippi. Steamboats stacked with bales of cotton, piled higher than the cabins, carried the crop from plantations in Mississippi, Louisiana, Tennessee and Arkansas down to New Orleans, where ships took it to the cloth mills of New England and Great Britain. By 1860 cotton was the most valuable thing the United States sold to other countries. Most of that cotton was planted and picked by enslaved people, who were held as property and forced to work without pay. Steamboats also carried enslaved men, women and children who had been sold away from their families to plantations farther south. That is where the sad saying “sold down the river” comes from. It was a great wrong against people made in God’s image. River towns grew at good landings: Louisville, Cincinnati, St. Louis, Memphis, Natchez and Vicksburg, and New Orleans became one of the busiest ports in the country.

On the map. The Mississippi changes all the time. Sandbars move, banks wash away and snags hide below the muddy water. So the most important man on a steamboat was the **river pilot**, who had to know every bend for about 1,200 miles between St. Louis and New Orleans, going up and coming down, by day and by night. A boy from Hannibal, Missouri, named Samuel Clemens became a “cub” pilot in 1857 under a master pilot, Horace Bixby, and earned his license in 1859. When the water was shallow, a crewman called a leadsmen dropped a weighted rope over the side and sang out the depth. “Mark twain!” meant two fathoms, 12 feet: safe water. Clemens later wrote books under the name Mark Twain.



The voyage of the New Orleans, 1811-1812, and the great river towns of the steamboat age.



The leadsmen's rope: each fathom is 6 feet. "Mark twain" is the second mark, 12 feet.

PICTURE STUDY



The Jolly Flatboatmen, George Caleb Bingham, 1846 · Oil on canvas · National Gallery of Art, Washington, D.C.

George Caleb Bingham grew up in Missouri, along the Missouri River, and he loved to paint the people of the rivers: fur traders, raftsmen and flatboatmen. In this painting the work is done for a moment. The current carries the boat along, and the crew makes its own music. Bingham painted it in 1846, when steamboats were already taking over the rivers, so he was painting a way of life that was fading away.

Look closely

- Find the dancer. How do you know he is the most important figure? Look at where Bingham placed him.
- Find the musicians. What instruments are they playing? What might the music sound like?
- Look at the shape the group of men makes. Can you trace a triangle?
- Look at the water and the sky. Is the river rough or calm? What kind of day is it?

Talk about it

1. Could this boat go back upstream to where it started? How would these men get home?
2. How is a flatboat different from Fulton's steamboat? Which would you rather ride, and why?
3. Why do you think Bingham chose to paint the men resting and playing instead of working?

PROJECT: SOUND THE RIVER

River pilots and leadsmen had to find the deep channel in a muddy river where they could not see the bottom. You will build a leadline, sound a hidden “river,” chart the deep channel and then steer a boat through it.

You will need

- A bathtub, wading pool or long plastic storage bin
- Bricks, stones, upside-down cups or cans of different heights (sandbars and snags)
- A spoonful of cocoa powder or a few drops of brown food coloring to make muddy water
- String about 2 feet long and a heavy washer, fishing weight or nut (the lead)
- A marker, ruler, graph paper and a small toy boat

Steps

1. Make the leadline: tie the weight to the end of the string. Starting from the bottom of the weight, mark the string every 1 inch with the marker. In your model, 1 inch stands for 1 fathom, so the marks are “mark one,” “mark twain,” “mark three” and so on.
2. While the pilot is out of the room, a helper places the bricks, stones and cups on the bottom to make sandbars, leaving a winding deep channel. The helper adds water and stirs in the cocoa or food coloring so the bottom cannot be seen.
3. On graph paper, draw the outline of the tub. Choose a starting line across the tub.
4. The pilot lowers the leadline straight down every few inches across the tub and calls out the depth, such as “Mark twain!” A partner writes each depth in the right square on the graph paper.
5. Move forward a few inches and sound a new line across the tub. Keep going until the whole tub is charted.
6. Shade the shallow squares (mark one or less) brown and the deep squares blue. Draw the deep channel with a pencil line.
7. Using only your chart, steer the toy boat through the channel from one end to the other. Then drain the water and see how well your chart matched the real bottom.

Tips

- Hold the line straight up and down and wait until the weight touches bottom before you read it.
- Twain wrote that a pilot had to learn the shape of the river so well that he could steer it in the dark. Try saying your channel aloud from memory: “Bear left at the big rock, then hug the right side.”

Check your work

- I made a leadline marked in model fathoms.
- I charted the depths of my hidden river and drew the deep channel.

- I steered a boat through the channel using my chart.

MAP NOTEBOOK

1. Draw a Mississippi steamboat with two tall smokestacks, a big paddle wheel and bales of cotton stacked on the deck. Label the pilothouse where the pilot stood.
2. Draw the Mississippi from St. Louis to New Orleans and mark five river towns. Next to New Orleans, draw a sailing ship that will carry the cotton across the ocean.
3. Make a T-chart: “Flatboat” and “Steamboat.” Write three ways they were different.

From history. As a young man, Abraham Lincoln worked as a flatboatman. In 1828 he and a friend floated a flatboat of farm goods from Indiana down the Ohio and Mississippi to New Orleans, and in 1831 he made a second trip from Illinois. After selling the cargo and the boat, he came home by steamboat. New Orleans was also the largest slave market in the country, and there the young Lincoln could see enslaved people being bought and sold.

WORKED EXAMPLES

Example 1. A steamboat loaded with cotton needs 7 feet of water to float safely. The leadsman calls “Mark twain!” Is the boat safe? How many feet of water are there under the bottom of the boat?

(Use the map or drawing “Count the marks: mark twain is the second one, 12 feet down.” shown earlier in this lesson.)

1. One fathom is 6 feet. “Mark twain” means 2 fathoms.
2. $2 \times 6 = 12$ feet of water.
3. The boat needs 7 feet, and 12 is more than 7, so it is safe.
4. Water under the boat: $12 - 7 = 5$ feet.

Answer: Yes, the boat is safe. The water is 12 feet deep, leaving 5 feet of water under the boat.

Example 2. In 1870 the steamboat *Robert E. Lee* raced the *Natchez* from New Orleans up to St. Louis and won, making the trip in about 3 days and 18 hours. How many hours is that? The trip was about 1,200 miles. About how many miles did the boat go each hour?

1. $3 \text{ days} = 3 \times 24 = 72 \text{ hours}$. Add 18 hours: $72 + 18 = 90 \text{ hours}$.
2. Divide the miles by the hours: $1,200 \div 90$.
3. Try numbers: $90 \times 13 = 1,170$ and $90 \times 14 = 1,260$. The answer is between 13 and 14.

Answer: About 90 hours, at about 13 miles per hour, all the way upstream against the current.

PRACTICE

1. **EASY** What was the name of the first steamboat to travel down the Ohio and Mississippi rivers to New Orleans, and when did it arrive?
2. **EASY** Why did flatboatmen take their boats apart at New Orleans instead of sailing them home?
3. **EASY** A fathom is 6 feet. How deep is the water when the leadsman calls “mark one,” “mark twain” and “mark three”?
4. **MEDIUM** Use the map. A steamboat travels down the Mississippi from St. Louis. List the towns it passes, in order, until it reaches New Orleans.
(Use the map or drawing “The Mississippi flows south to the Gulf of Mexico.” shown earlier in this lesson.)
5. **MEDIUM** A steamboat needs 8 feet of water. The leadsman calls “mark one.” Should the pilot keep going straight? Explain.
6. **MEDIUM** Suppose a steamboat carries 3,000 bales of cotton and each bale weighs about 400 pounds. About how many pounds of cotton is on board?
7. **HARD** A keelboat crew poling upstream might make about 15 miles a day. About how many days would it take them to go 600 miles? If a steamboat covered the same 600 miles in 3 days, how many times faster was it?
8. **CHALLENGE** In two or three sentences, explain who did the work of growing the cotton that steamboats carried, and what the saying “sold down the river” first meant.

COMMON MISTAKES

- Thinking “Mark Twain” was just a made-up name. It was a real call of the river: two fathoms, or 12 feet, safe water for a steamboat.
- Forgetting which way the Mississippi flows. It flows south, so going from St. Louis to New Orleans is downstream, and going north is upstream.
- Thinking steamboats ended flatboats overnight. Flatboats kept floating down the rivers for years after 1812, but steamboats carried more and more of the trade, especially upstream.

Make it a game • Leadsman's Call. One player is the pilot, steering a toy boat down a "river" of blue paper or a hallway. A parent is the leadsman and calls out depths: "Mark one!", "Mark twain!", "Mark three!" or "Quarter less twain!" (a little less than 12 feet). Before each call, the parent announces how many feet the boat needs, such as "We need 10 feet." The pilot must answer "Steady ahead!" if the water is deep enough or "Hard to starboard!" if it is too shallow, within five seconds. Every right call earns a cotton bale (a cotton ball). The first pilot to deliver ten bales to New Orleans wins.

Scripture. "Thou visitest the earth, and waterest it: thou greatly enrichest it with the river of God, which is full of water: thou preparest them corn, when thou hast so provided for it." (Psalm 65:9, KJV)

The great river and its rich valley are gifts from God, who waters the land and makes it fruitful. Those gifts were meant to bless everyone who worked the land. God "hath made of one blood all nations of men" (Acts 17:26), and the river's wealth should never have been built on the forced labor of fellow human beings.

Practice answers

1. The *New Orleans*. It left Pittsburgh in October 1811 and arrived in New Orleans in January 1812.
2. A flatboat could only float downstream with the current. It could not go back up the river, so the men sold it for lumber and walked or rode home.
3. Mark one: 6 feet. Mark twain: 12 feet. Mark three: 18 feet.
4. St. Louis, Cairo, New Madrid, Memphis, Vicksburg, Natchez, New Orleans.
5. No. Mark one is only 6 feet, and the boat needs 8 feet, so it would run aground. The pilot must slow down and steer toward deeper water.
6. $3,000 \times 400 = 1,200,000$ pounds of cotton (one million two hundred thousand).
7. $600 \div 15 = 40$ days. $40 \div 3$ is about 13, so the steamboat was about 13 times faster.
8. Most of the cotton was planted and picked by enslaved people, who were forced to work without pay. "Sold down the river" first meant an enslaved person sold away from family and carried by boat down the Mississippi to a plantation farther south, where life was often harder. It was a cruel wrong done to people made in God's image.

UNIT 6 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. Use the maps from this unit where a question asks for them. The review is worth 50 points.

1. (5 pts) The Erie Canal joined which river to which lake? Name the city at each end of the canal.
2. (5 pts) Put these canal cities in order from east to west: Rochester, Albany, Syracuse, Buffalo, Utica.
3. (5 pts) On a map where 1 inch stands for 40 miles, the Erie Canal measures about 9 inches. About how long is the canal?
4. (5 pts) Before the canal, moving one ton of goods from Buffalo to New York City cost about \$100. After the canal opened, it cost about \$10. How much would a merchant save on 12 tons?
5. (5 pts) A boat is going UP through a lock. Put these steps in order: (a) the upper gates open and the boat moves out; (b) the boat enters through the open lower gates; (c) the valves in the upper gates open and water flows into the chamber; (d) the lower gates close behind the boat.
6. (5 pts) At Lockport, a flight of five locks climbed the Niagara Escarpment. If each lock lifted a boat about 12 feet, how high did a boat rise in all?
7. (5 pts) A lock does not use a pump. Where does the water come from that lifts a boat, and what force makes it flow?
8. (5 pts) In 1807 Robert Fulton's steamboat traveled the last 40 miles from Clermont to Albany in 8 hours. What was its speed in miles per hour?
9. (5 pts) Explain why a steamboat was such a big change on rivers like the Hudson and the Mississippi. Use the words *current* and *upstream*.
10. (5 pts) A leadsman calls out "Mark three!" One fathom is 6 feet. How deep is the water? Is it safe for a steamboat that needs 7 feet of water?

UNIT PROJECT: MY WORKING CANAL LOCK AND ERIE CANAL MAP

Build a working model canal lock from milk cartons or plastic bottles, with two gates and a lower and upper level, and float a small boat up and down through it. Beside it, display your hand-drawn map of the Erie Canal from Albany to Buffalo with a scale bar, at least eight cities, Lake Erie, the Hudson River and the Mohawk River. Add a short written card that explains, in four steps, how your lock lifts a boat, and a second card that tells how the canal and the steamboat changed the cost and time of travel.

- **Working model:** The lock has two gates and two water levels; the boat can be raised and lowered by letting water flow in and out.
- **Map accuracy:** The canal runs from Albany to Buffalo through the right cities in the right order, with a scale bar, a compass rose and labeled waters.

- **Explanation:** The cards explain the four steps of a lock and give at least one real number showing how canals and steamboats cut the cost or time of travel.
- **Care:** The model and map are neat, labeled and carefully made.

Answer key

1. It joined the Hudson River to Lake Erie. Albany is at the eastern end (on the Hudson) and Buffalo is at the western end (on Lake Erie).
2. Albany, Utica, Syracuse, Rochester, Buffalo.
3. $9 \times 40 = 360$ miles, close to the real length of about 363 miles.
4. Before: $12 \times \$100 = \$1,200$. After: $12 \times \$10 = \$120$. Savings: $\$1,200 - \$120 = \$1,080$.
5. b, d, c, a.
6. $5 \times 12 = 60$ feet.
7. The water comes from the higher stretch of canal above the lock. Gravity makes it flow downhill into the lock chamber until the water inside is as high as the water above.
8. $40 \div 8 = 5$ miles per hour.
9. Sailboats needed the right wind and flatboats could only drift downstream with the current. A steamboat's engine turned paddle wheels that pushed against the water, so it could travel upstream against the current on a regular schedule, carrying people and goods both ways.
10. $3 \times 6 = 18$ feet deep. Yes, 18 feet is more than the 7 feet the boat needs, so it is safe.

THE RAILROAD BINDS THE NATION

In Unit 6 you watched Americans dig canals and build steamboats to beat the distances of a huge country. But canals freeze in winter, they cannot climb high mountains, and steamboats can only go where rivers go. In this unit you will meet the machine that went almost everywhere: the **railroad**. You will stand in Baltimore on July 4, 1828, when the Baltimore and Ohio Railroad laid its first stone, and you will cheer for Peter Cooper's little engine *Tom Thumb* as it races a horse.

Then you will climb into the snowy Sierra Nevada with the Chinese crews of the Central Pacific and cross the plains with the Irish workers and Civil War veterans of the Union Pacific until the two lines meet at Promontory Summit, Utah, in 1869. You will learn why the railroads gave America its **time zones** in 1883, and you will follow Texas cattle up the trail to a Kansas railroad town. In every lesson you will ask the same question: **how did the railroad change the map?**

The railroad bound the separate regions you studied this year into one connected nation. It also brought hard changes, especially for the Plains Indian nations and the great bison herds, and we will tell that part of the story plainly too. As the Bible says, God "hath determined the times before appointed, and the bounds of their habitation" (Acts 17:26); the railroad shows how people used the gifts of iron, coal and skill to cross the bounds of mountains and plains.

BEFORE YOU BEGIN

- Can use a map scale to measure distance (Unit 1)
- Knows the regions of the United States and can find the Rocky Mountains, the Great Plains and the Sierra Nevada (Units 2-4)
- Remembers how the Erie Canal and the steamboat changed travel (Unit 6)
- Can tell time on a clock with hands and add and subtract hours

MASTERY CHECKLIST

- I can tell the story of the Baltimore and Ohio Railroad and Tom Thumb's race with a horse, and explain why rails make pulling easier.
- I can trace the transcontinental railroad from Sacramento to Omaha and tell who built each half and how they crossed the mountains.
- I can explain why every town once kept its own sun time and how the railroads created standard time zones in 1883.
- I can find the time in another U.S. time zone by adding or subtracting hours.
- I can explain how the railroad created towns, made cattle drives worth the trip, and helped bring the frontier to an end, including the losses it brought to the Plains Indian nations.

OPTIONAL BOOKS AND RESOURCES

- **Golden Spike National Historical Park (National Park Service)** (<https://www.nps.gov/gosp/>): Free. The park at Promontory Summit, Utah, where the two railroads met in 1869. Its pages have photographs of the replica engines *Jupiter* and *No. 119* and the story of the last spike (Lesson 7.2).
- **Library of Congress digital collections** (<https://www.loc.gov/>): Free. Search “Andrew J. Russell” for his Union Pacific photographs, “Currier and Ives Across the Continent” for the 1868 print in Lesson 7.4, and “railroad maps” for hundreds of historic railroad maps.
- **B&O Railroad Museum, Baltimore** (<https://www.borail.org/>): The museum stands at the B&O’s old Mount Clare shops in Baltimore, where American railroading began. Worth a visit if you live nearby; the website has pictures of early engines (Lesson 7.1).

7.1 THE FIRST RAILROADS

OBJECTIVES

- Tell the story of the Baltimore and Ohio Railroad, begun on July 4, 1828, and of Tom Thumb's race with a horse in 1830.
- Explain why smooth iron rails and flanged wheels make pulling a load much easier, and how a steam locomotive works.
- Trace the B&O from Baltimore over the Appalachian Mountains to the Ohio River on a map and compare it with a canal.

Warm-up. Put three heavy books in a shoebox and tie a string to it. Pull the box across a rug, then across a smooth table or floor. Which was easier? Now put the box on top of four round pencils and pull again. Talk about it: what would make pulling a heavy wagon easiest of all?

Watch. *The Tom Thumb, America's First Locomotive!!!* (Nate's Vintage Trains, 6:35).
https://www.youtube.com/watch?v=riG_1y2Sd1Y
 With the race: the little Tom Thumb locomotive and its race against a horse in 1830.

Backup video. *Steam Engine - How Does It Work* (Real Engineering, 4:50).
<https://www.youtube.com/watch?v=fsXpaPSVasQ>
 With How it worked: how a steam engine turns heat into motion, with the piston, valve and flywheel. Note: Made for older students; the first two minutes give the main idea.

KEY TERMS

railroad

A road made of two steel or iron rails laid on wooden ties, on which trains with flanged wheels run.

locomotive

The engine that pulls a train. The first ones burned wood or coal to make steam.

steam engine

A machine in which a fire boils water, and the pushing steam moves pistons that turn wheels.

flange

The raised rim on the inside edge of a train wheel that keeps the wheel from rolling off the rail.

gauge

The distance between the two rails. Standard gauge in the United States is 4 feet 8½ inches.

friction

The rubbing that slows things down when one surface moves against another. Smooth rails have much less friction than a muddy road.

CORE IDEAS

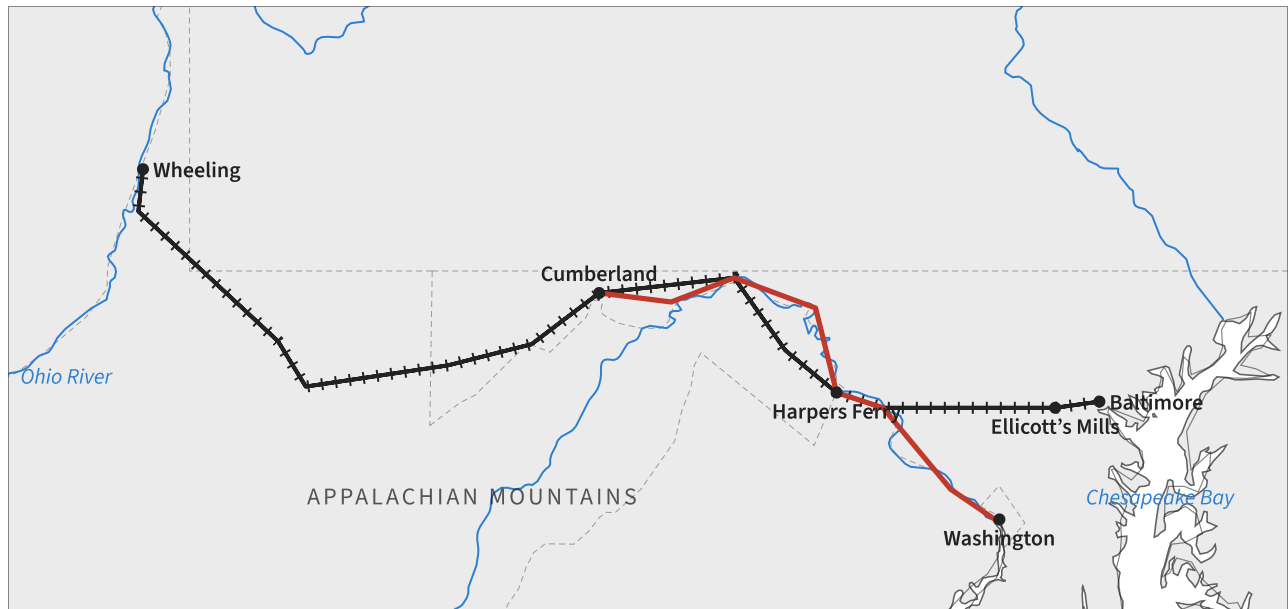
The story. On the Fourth of July, 1828, a great parade wound through Baltimore, Maryland. Bands played, and workers marched with the tools of their trades. At the end of the parade, an old man of ninety stepped forward to lay the first stone of a new kind of road, the **Baltimore and Ohio Railroad**. He was Charles Carroll of Carrollton, the last living signer of the Declaration of Independence. He said he counted this among the most important things he had ever done, second only to signing the Declaration. On that very same day, near Washington, President John Quincy Adams turned the first shovel of dirt for a rival, the Chesapeake and Ohio Canal. Two roads to the West were born on one birthday.

Why Baltimore needed it. Remember the Erie Canal from Unit 6? After it opened in 1825, the farm goods of the West floated east to New York City, and Baltimore's merchants were afraid of losing their trade. Baltimore was closer to the Ohio River than New York was, but the **Appalachian Mountains** stood in the way. A canal needs nearly level water and many locks, and it is very hard to bring enough water to the top of a mountain. Iron rails, though, can climb a gentle slope and curve around hills. So Baltimore chose to build a railroad all the way to the Ohio River.

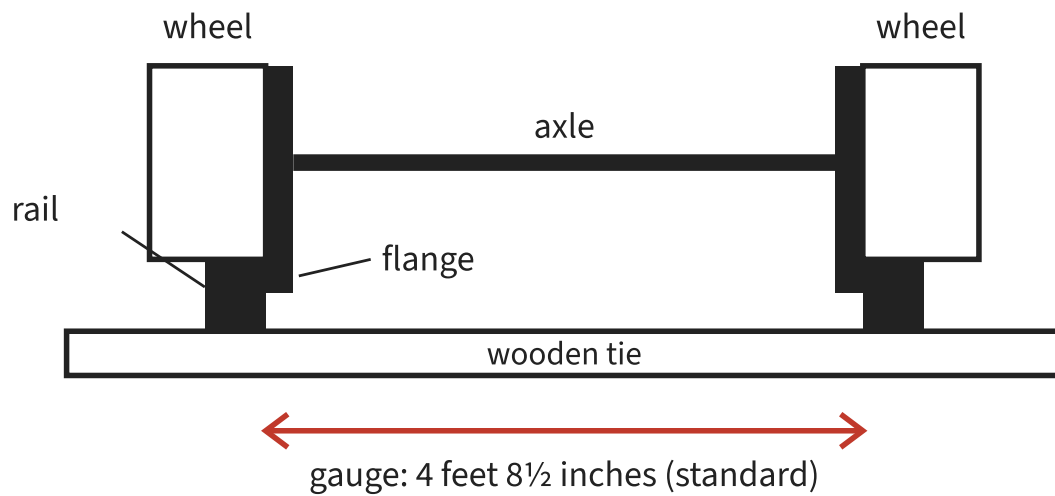
How it worked. A horse pulling a wagon on a muddy road works hard, because the wheels sink and rub. A smooth iron rail has very little **friction**, so the same horse can pull a much heavier load on rails. Each train wheel has a **flange**, a rim on its inside edge, that keeps it on the track. At first the B&O's cars were pulled by horses. Then Peter Cooper, a New York businessman, built a tiny steam **locomotive** he called *Tom Thumb*. In a steam engine, a fire boils water in a boiler, and the steam pushes pistons back and forth to turn the wheels. Cooper's engine was so small that people said it was hardly bigger than a handcar.

The race. In the summer of 1830, the B&O had just opened its first 13 miles, from Baltimore to Ellicott's Mills. A stagecoach company that owned fast horses challenged Tom Thumb to a race on two side-by-side tracks. The horse jumped ahead at first, but soon the little engine caught up and passed it while the passengers cheered. Then the belt that turned the engine's blower fan slipped off its wheel. Without the fan blowing air into the fire, the steam died down, Tom Thumb slowed, and the horse won the race. The story was written down years later, so some details differ, but everyone agrees on the end: the horse won the race, and steam won the future. The B&O soon chose steam engines instead of horses.

Technology overcoming geography. Railroads could do what canals could not. They ran in winter when canals froze, they climbed into mountains, and they could go wherever track was laid, not only where water flowed. The B&O reached Cumberland, Maryland, in 1842 and finally the Ohio River at Wheeling, Virginia (today West Virginia), in 1853. The rival canal reached Cumberland in 1850 and never went farther. By 1860, the United States had about 30,000 miles of railroad track, more than any other country in the world.



The B&O Railroad (1828-1853) and its rival, the C&O Canal, which stopped at Cumberland.



Flanged wheels keep a train on its rails. The gauge is the space between the rails.

PICTURE STUDY



The Lackawanna Valley, George Inness, about 1856 · Oil on canvas · National Gallery of Art, Washington, D.C.

George Inness was an American painter who loved quiet, glowing landscapes. In the 1850s the president of the Delaware, Lackawanna and Western Railroad asked him to paint the company's new roundhouse, the round building where engines were kept and repaired, at Scranton, Pennsylvania. Inness painted a whole valley being changed by the railroad.

Only about twenty-five years after Tom Thumb's race, railroads like this one were carrying coal, lumber and people through the valleys of the East. Look closely and you will see both the beauty of the land and the work of the railroad side by side.

Look closely

- Find the train. Which way is it going, and where does its smoke go?
- Find the roundhouse, the round building where the engines rest. Why would a railroad need such a building?
- Look at the hillside in front. What happened to the trees? Why might the railroad and the town need so much wood?
- Find the person resting under the tree. What do you think he is watching?

Talk about it

1. Does the painter make the railroad look like a friend of the valley, a stranger in it, or both? Why do you think so?
2. What do you think this valley looked like before the railroad came? What might it look like fifty years later?

PROJECT: RAILS OR ROAD? THE ROLLING TEST

Why could a horse pull so much more on the B&O's rails than on a dirt road? You will find out by pulling a loaded toy car across a "road" and along "rails" and measuring how hard you must pull, using a rubber band as your measuring tool.

You will need

- A toy car or small cart with wheels (a toy truck works well)
- Coins, washers or small stones for a load, and a little tape
- A thin rubber band and a piece of string about 12 inches long
- A ruler
- A bath towel or a piece of carpet (the muddy road)
- Two yardsticks or long, straight strips of cardboard (the rails), and a smooth table
- Map notebook and pencil

Steps

1. Tape the load of coins to the top of the car so it does not fall off.
2. Tie the string to the front of the car. Tie the rubber band to the other end of the string. You will pull the car by holding the far end of the rubber band.
3. Lay the towel flat. Pull the car slowly and steadily across the towel. Have a helper hold the ruler beside the rubber band and read how many inches long it stretches while the car is moving. Write it down.
4. Now pull the car across the smooth table. Measure the rubber band again and write it down.
5. Lay the two yardsticks side by side on the table, just far enough apart that the car's wheels sit on them, like rails. Pull the car along the rails and measure again.
6. Make a table in your notebook with three rows: Towel (road), Table, Rails. Write the stretch for each. The longer the stretch, the harder you had to pull.
7. Add more coins and test the rails again. Can the rails carry a heavier load with the same pull that the towel needed for the lighter one?
8. Write two sentences: Which surface had the least friction? Why did the first railroads use smooth iron rails?

Tips

- Pull slowly and at the same speed every time, or your measurements will jump around.
- Measure each surface three times and use the middle number.
- If your car keeps sliding off the rails, glue a craft stick along the inside of each rail. Now you have made the job of a flange!

Check your work

- I measured the pull on three surfaces and recorded the results in a table.
- I can explain why smooth rails let a horse or an engine pull more.

- I can explain what a flange does.

MAP NOTEBOOK

1. Draw a simple map from Baltimore to Wheeling. Show the Appalachian Mountains as a row of bumps, draw the B&O with railroad-track marks (a line with little cross ties), and write the years 1828, 1842 (Cumberland) and 1853 (Wheeling).
2. Draw Tom Thumb and the horse-drawn car side by side on two tracks. Label the boiler, the smokestack, the wheels and the blower belt that slipped.
3. Draw a pair of train wheels on rails seen from the front. Label the rails, the flanges and the gauge, 4 feet 8½ inches.

From history. Some of the B&O's first work still stands. The Thomas Viaduct, a curving stone bridge of eight arches over the Patapsco River near Relay, Maryland, was finished in 1835 for the B&O's line to Washington. It was built for small engines like Tom Thumb, yet it is so strong that heavy modern trains still cross it today, nearly two hundred years later.

WORKED EXAMPLES

Example 1. The B&O's first stretch ran 13 miles from Baltimore to Ellicott's Mills. Suppose a horse-drawn car went $6\frac{1}{2}$ miles an hour and a steam train went 13 miles an hour. How long would each take to make the trip?

1. Time = distance $\div$ speed.
2. Horse car: $13 \text{ miles} \div 6\frac{1}{2} \text{ miles an hour} = 2 \text{ hours}$. (Check: $6\frac{1}{2} + 6\frac{1}{2} = 13$.)
3. Steam train: $13 \text{ miles} \div 13 \text{ miles an hour} = 1 \text{ hour}$.
4. The steam train would save $2 - 1 = 1 \text{ hour}$.

Answer: The horse car would take 2 hours, and the steam train 1 hour, so the train would be twice as fast and save an hour.

Example 2. The B&O laid its first stone in 1828 and reached Wheeling on the Ohio River in 1853. The finished line was about 380 miles long. How many years did it take, and about how many miles of track were built each year?

(Use the map or drawing “Trace the B&O with your finger from Baltimore to Wheeling.” shown earlier in this lesson.)

1. Years: $1853 - 1828 = 25$ years.
2. Miles each year: $380 \div 25$. Since $25 \times 15 = 375$, the answer is about 15 with a little left over.
3. So the line grew about 15 miles a year, about the distance from Baltimore to Ellicott’s Mills and a little more.

Answer: 25 years, at about 15 miles a year.

PRACTICE

1. **EASY** On what day did the Baltimore and Ohio Railroad lay its first stone, and who laid it?
2. **EASY** Who built Tom Thumb, and what kind of engine was it?
3. **EASY** Who won the race in 1830, Tom Thumb or the horse? Why?
4. **MEDIUM** The B&O began in 1828 and reached Cumberland, Maryland, in 1842. How many years did that take?
5. **MEDIUM** Look at the map. In which direction did the B&O travel from Baltimore to reach Wheeling? Which river did it follow for part of the way?
(Use the map or drawing “The B&O and the C&O Canal.” shown earlier in this lesson.)
6. **MEDIUM** Standard gauge is 4 feet 8½ inches. How many inches is that? (1 foot = 12 inches.)
7. **HARD** A train goes 15 miles an hour. How long does it take to go 45 miles? How far would it go in 5 hours?
8. **CHALLENGE** In two or three sentences, explain why Baltimore built a railroad over the Appalachian Mountains instead of a canal.

COMMON MISTAKES

- Thinking Tom Thumb won the race. The horse won, but the race showed the power of steam, and the railroad soon chose engines.
- Thinking the first railroads always used steam engines. The B&O’s first cars were pulled by horses on rails.
- Thinking railroads replaced canals overnight. Canals and railroads worked side by side for many years, but railroads slowly took most of the trade because they could go almost anywhere in any season.

Make it a game • Horse or Engine?. Lay two strips of tape on the floor as side-by-side tracks. One player is the Horse and one is Tom Thumb. A parent reads a question from this lesson. Whoever answers first and correctly takes one big step down their track. But watch out: if Tom Thumb's player answers wrong, the "belt slips" and Tom Thumb must sit out the next question. The first to reach the end of the track wins.

Scripture. "I returned, and saw under the sun, that the race is not to the swift, nor the battle to the strong, neither yet bread to the wise, nor yet riches to men of understanding, nor yet favour to men of skill; but time and chance happeneth to them all." (Ecclesiastes 9:11, KJV)

Tom Thumb was faster than the horse, yet a slipping belt lost the race. Solomon reminds us that the swiftest do not always win and that our plans rest in God's hands. Peter Cooper did not give up after one lost race, and his idea carried the day.

Practice answers

1. July 4, 1828. Charles Carroll of Carrollton, the last living signer of the Declaration of Independence, laid it.
2. Peter Cooper built it. It was a small steam locomotive.
3. The horse won, because the belt that turned Tom Thumb's blower fan slipped off, the fire weakened and the engine slowed down.
4. $1842 - 1828 = 14$ years.
5. West (a little to the north). It followed the Potomac River through Harpers Ferry to Cumberland.
6. $4 \times 12 = 48$ inches, and $48 + 8\frac{1}{2} = 56\frac{1}{2}$ inches.
7. $45 \div 15 = 3$ hours. In 5 hours it would go $5 \times 15 = 75$ miles.
8. A canal needs nearly level water and many locks, and it is very hard to bring enough water to the top of a mountain. A railroad can climb a gentle slope, curve around hills and run in winter when canals freeze. So a railroad was the better way to cross the mountains to the Ohio River.

7.2 BUILDING THE TRANSCONTINENTAL RAILROAD ★ ⚙️

OBJECTIVES

- Tell how the Central Pacific and Union Pacific crews built the first railroad across the West between 1863 and 1869 and met at Promontory Summit, Utah.
- Explain how engineers and workers crossed mountains with gentle grades, bridges and tunnels, especially the Summit Tunnel in the Sierra Nevada.
- Trace the route on a map and read an elevation profile to find the highest and lowest points of the line.

Warm-up. Make a “mountain” by stacking books about 6 inches high. Lay a ruler from the table straight up to the top. Now lay a long strip of cardboard or a belt so it reaches the top in a long, gentle ramp. Roll a toy car or a marble up each. Which slope could a heavy train climb? What could you do if the mountain were too big to go around?

Watch. *The History of Railroads for Kids | Learn about trains and the first railroad in America* (Learn Bright, 6:58). <https://www.youtube.com/watch?v=9nMi1KPB2-Y>

Before the story: how railroads began in America and how they grew.

Note: The video says the first railroad and the Tom Thumb were in 1827; the B&O was chartered in 1827 and the Tom Thumb ran in 1830, as the lesson says. It also calls the Pullman car the first passenger car with windows, which is not right.

Backup video. *10th May 1869: ‘Golden Spike’ completes the first transcontinental railroad in the United States* (HistoryPod, 2:38). <https://www.youtube.com/watch?v=RHQMqS54PZc>

[v=RHQMqS54PZc](https://www.youtube.com/watch?v=RHQMqS54PZc)

With On the map: the golden spike at Promontory Summit on May 10, 1869.

KEY TERMS

transcontinental railroad

A railroad that crosses a whole continent. America’s first one joined the Missouri River at Omaha to Sacramento, California, in 1869.

grade

How steeply a road or railroad climbs. Trains need a gentle grade, so engineers bend the line around hills and cut through ridges.

tunnel

A passage dug through a mountain or under the ground.

trestle

A bridge built of a framework of timbers or iron that carries a railroad across a valley.

elevation

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

end of track

The very end of the line being built, where the newest rails were laid each day.

CORE IDEAS

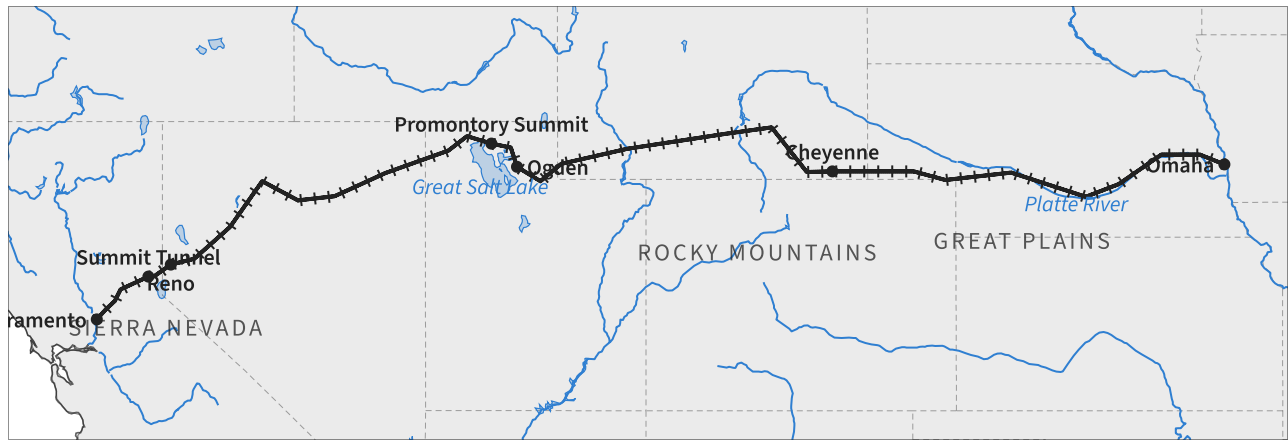
The story. In the winter of 1866–67, snow fell so deep in the Sierra Nevada of California that it buried whole work camps. High near Donner Pass, about 7,000 feet above the sea, crews of Chinese workers kept digging the **Summit Tunnel** through solid granite. They dug passages under the snow to reach their work. By hand they hammered steel drills into the rock, packed the holes with black powder and later with nitroglycerin, and blasted. Some days they gained only about a foot. To go faster, they dug from both ends and also sank a shaft down from the top, so crews could work on four rock faces at once. In 1867 the tunnel, about 1,659 feet long, broke through.

The plan. In 1862, in the middle of the Civil War, President Abraham Lincoln signed the Pacific Railway Act. Two companies would build a railroad across the West. The **Central Pacific** would build east from Sacramento, California, and the **Union Pacific** would build west from Omaha, on the Missouri River. The government paid each company in land and loans for every mile it finished, and paid more for miles in the mountains. So the two companies raced each other. A young engineer named Theodore Judah had found a way over the Sierra, but he died in 1863, before the work was well begun.

The crews. Workers were hard to find in California, where many men hoped to strike it rich in the mines. In 1865 the Central Pacific began hiring Chinese workers, and soon most of its crews were Chinese. They were careful, skilled and hardworking. They were paid less than white workers and had to buy their own food; in 1867 thousands of them went on strike for fairer pay, but the company refused and the strike ended after about a week. On the Union Pacific, many workers were Irish immigrants and veterans of both the Union and Confederate armies, along with freed slaves and, in Utah, Mormon crews. The Union Pacific also crossed the hunting grounds of the Lakota and Cheyenne, who fought to keep the railroad out of their lands. Many workers died in blasts, snow slides and accidents; no one knows exactly how many.

How it worked. First, crews built the **grade**, a smooth bed of earth and rock. Trains cannot climb steep hills, so engineers kept the slope gentle. They cut through ridges, filled in low places, built tall wooden **trestles** across canyons and dug fifteen tunnels in the Sierra alone. Then came the ties, the rails and the spikes. The Union Pacific climbed over the Rocky Mountains at Sherman Summit in Wyoming, about 8,200 feet high, the highest point on the whole line. On April 28, 1869, a Central Pacific crew laid ten miles of track in a single day, a record that still stands.

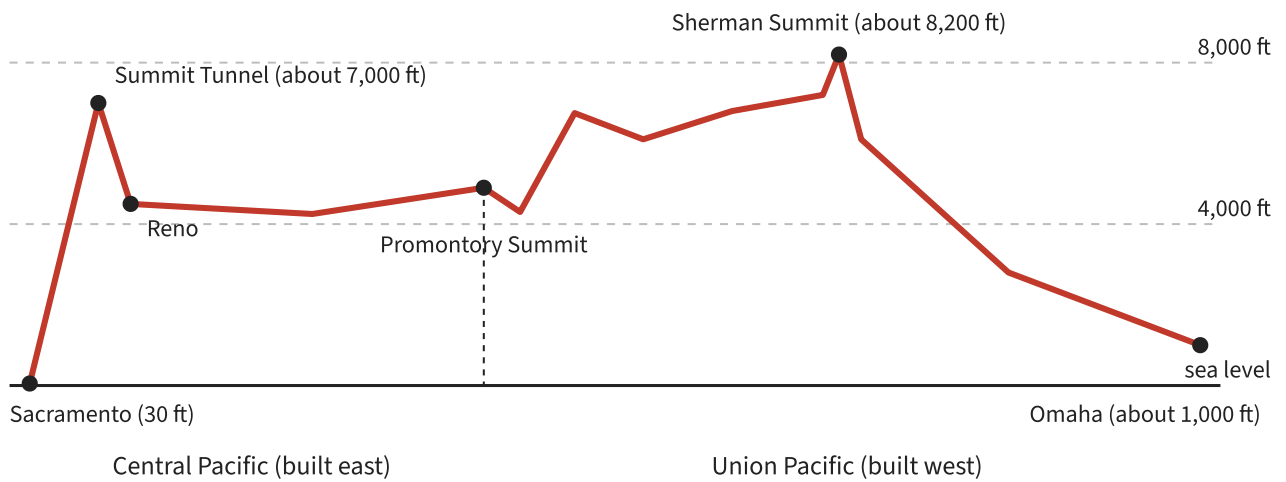
On the map. On May 10, 1869, the two lines met at **Promontory Summit**, Utah Territory, north of the Great Salt Lake. Leland Stanford of the Central Pacific tapped in a golden spike, and a telegraph operator sent one word to the waiting nation: “DONE.” The Central Pacific had built about 690 miles of track and the Union Pacific about 1,086 miles. A trip that once took four to six months by wagon now took about a week by train. Mountains, deserts and plains that had divided the country were crossed by two thin lines of iron.



The first transcontinental railroad, finished May 10, 1869.

WEST

EAST



An elevation profile is a side view of the route, showing how high the track climbs.

PICTURE STUDY



Dale Creek Bridge, Andrew J. Russell, 1868 · Photograph (albumen print from a wet-plate glass negative) · Prints in several American collections; Russell's glass negatives are at the Oakland Museum of California

Andrew J. Russell had been a captain in the Union army, where he photographed the railroads and bridges built during the Civil War. In 1868 the Union Pacific hired him to photograph its new line across the West. He carried a darkroom with him in a wagon, because his large glass-plate pictures had to be made and developed on the spot. In 1869 many of his pictures were printed in a book called *The Great West Illustrated*.

Here Russell photographed the Dale Creek Bridge in the mountains of what is now southern Wyoming, near Sherman Summit. It was a wooden trestle about 650 feet long and more than 120 feet high, built in a hurry in 1868 so the track-layers would not be held up.

Look closely

- Follow the timbers with your finger. How are they joined together to make a tall, strong tower?
- Look for anything that tells you how big the bridge is, such as people or rocks. How tall would you be next to it?
- Look at the valley below. Why couldn't the railroad simply go down into the valley and back up?
- Does the bridge look strong or frail to you? Why?

Talk about it

1. Why do you think the Union Pacific wanted a photographer to travel with its builders?
2. How is a trestle like the locks of the Erie Canal you studied in Unit 6? (Think about what each one helps a train or boat do with the land.)

PROJECT: BUILD THE SIERRA CROSSING

The Central Pacific had to lift its trains about 7,000 feet in about 100 miles without ever making the track too steep. You will build a model mountain and lay a railroad over it with a gentle grade, a trestle and a tunnel, just as the engineers did.

You will need

- A large piece of cardboard for a base (about 18 by 24 inches)
- Salt dough (2 cups flour, 1 cup salt, about $\frac{3}{4}$ cup water) or modeling clay, or crumpled newspaper covered with masking tape
- Two long strips of thin cardboard or two pipe cleaners per foot of track, and craft sticks for ties
- Toothpicks or wooden skewers and glue for a trestle
- A cardboard tube from paper towels for a tunnel
- A ruler, a pencil, a marble or a small toy train car
- Paint or markers

Steps

1. Build a mountain ridge about 5 or 6 inches high across the middle of the base. Put the cardboard tube through the top part of the ridge before the dough dries, to be your Summit Tunnel. Leave a low “valley” on one side.
2. Mark a city on each end of the base: Sacramento on the low west side and Reno on the east side.
3. Plan a gentle grade. Our rule: the track may climb no more than 1 inch for every 10 inches of track. Use a ruler to check. If the slope is too steep, make the track curve back and forth along the mountainside to make it longer.
4. Lay the track: glue craft-stick ties every inch, then lay two strips across them as rails, leading into one end of the tunnel and out the other.
5. Where the track must cross the low valley, build a trestle of toothpicks or skewers glued in crisscross towers, like the Dale Creek Bridge, and lay the track on top.
6. Test it: roll a marble or toy car gently along the track. Where does it stop or roll back? Those places are too steep. Fix them.
7. Paint the mountain gray and white for granite and snow, and add tiny paper snow sheds over part of the track if you like.
8. Measure your finished track and write in your notebook how long it is and how high it climbs.

Tips

- Salt dough takes a day or two to dry. You can build the mountain in the first session and lay the track in the second.
- The real engineers faced the same choice you do: go around, go over or go through. Tunnels are short but very slow to dig.

- A trestle is strongest when its timbers form triangles.

Check your work

- My track climbs gently, no more than about 1 inch in 10 inches.
- My model has a tunnel and a trestle, and I can explain why each was needed.
- I can explain why the Central Pacific could not just build straight over the top of the Sierra.

MAP NOTEBOOK

1. Draw the outline of the western United States. Draw the Central Pacific in one color from Sacramento to Promontory Summit and the Union Pacific in another color from Omaha to Promontory Summit. Put a gold star at Promontory Summit and write May 10, 1869.
2. Copy the elevation profile and label Sacramento, the Summit Tunnel, Promontory Summit, Sherman Summit and Omaha with their heights.
3. Draw a crew at end of track: men carrying a rail, others driving spikes. Write one sentence about the Chinese crews of the Central Pacific and one about the Irish crews of the Union Pacific.

From history. The golden spike tapped in at Promontory Summit was not left in the ground. It was taken out right after the ceremony and replaced with an ordinary iron spike. The golden spike, engraved with the names of the railroad's leaders and the date, is kept today at the Cantor Arts Center at Stanford University in California. The two engines that met there, the Central Pacific's *Jupiter* and the Union Pacific's *No. 119*, were later scrapped, but working copies of both now steam at Golden Spike National Historical Park.

WORKED EXAMPLES

Example 1. The Central Pacific built about 690 miles of track and the Union Pacific about 1,086 miles. How long was the whole railroad? Which company built more, and by how many miles?

(Use the map or drawing "Which line on the map is longer?" shown earlier in this lesson.)

1. Add to find the whole line: $690 + 1,086 = 1,776$ miles.
2. Compare: 1,086 is more than 690, so the Union Pacific built more.
3. Subtract to find how many more: $1,086 - 690 = 396$ miles.
4. Why? The Central Pacific spent years crawling through the granite of the Sierra, while the Union Pacific laid track fast across the flat Great Plains.

Answer: The line was about 1,776 miles long. The Union Pacific built about 396 miles more.

Example 2. Sacramento is about 30 feet above sea level. The Summit Tunnel is about 7,000 feet above sea level and about 100 miles of track from Sacramento. How many feet did the track climb? About how many feet did it climb, on average, for each mile?

(Use the map or drawing “Find the steep climb on the left side of the profile.” shown earlier in this lesson.)

1. Find the climb: $7,000 - 30 = 6,970$ feet. That is almost 7,000 feet.
2. Divide by the miles: $7,000 \div 100 = 70$.
3. So on average the track rose about 70 feet for every mile, or about as high as a seven-story building every mile, mile after mile.

Answer: The track climbed about 6,970 feet, about 70 feet for each mile.

PRACTICE

1. **EASY** Which company built east from Sacramento? Which built west from Omaha?
2. **EASY** Where and on what day did the two railroads meet?
3. **EASY** Name the president who signed the Pacific Railway Act and the year he signed it.
4. **MEDIUM** On April 28, 1869, a Central Pacific crew laid 10 miles of track in one day. There are 5,280 feet in a mile. How many feet of track is 10 miles?
5. **MEDIUM** Look at the elevation profile. What is the highest point on the line, and about how high is it?
(Use the map or drawing “Find the highest point.” shown earlier in this lesson.)
6. **MEDIUM** Omaha is about 1,000 feet above sea level, and Sherman Summit about 8,200 feet. How many feet did the Union Pacific climb from Omaha to Sherman Summit?
7. **HARD** A wagon trip across the West took about 5 months, or about 150 days. After 1869 the train trip took about 7 days. About how many times faster was the train? (Round to the nearest ten.)
8. **CHALLENGE** The Summit Tunnel was dug from both ends and from a shaft sunk down from the top. In two or three sentences, explain why this made the work go faster.

COMMON MISTAKES

- Thinking one company built the whole line. Two companies built toward each other: the Central Pacific from the west and the Union Pacific from the east.
- Thinking the 1869 line ran from ocean to ocean. It joined Omaha to Sacramento; eastern railroads already reached the Missouri River, and the last link from Sacramento to San Francisco Bay was finished later in 1869.
- Thinking the rails were laid first. Crews first built the grade, the cuts, the fills, the bridges and the tunnels; only then could the track-layers bring in the ties and rails.

Make it a game • End of Track Relay. Cut twenty paper “rails” and give each team a pile. Teams start at opposite ends of a hallway, one the Central Pacific and one the Union

Pacific. A parent asks a question from this lesson; a team that answers correctly lays one rail toward the middle. When the two tracks meet, both teams shout “DONE!” as the telegraph did in 1869. The team that laid more rails wins, just as the Union Pacific laid more miles.

Scripture. “Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight, and the rough places plain:” (Isaiah 40:4, KJV)

Isaiah was speaking of preparing the way for the Lord, but the railroad builders did something like it in stone and earth: they filled valleys, cut down hills and made rough places smooth for a road. The hardest roads are made by many hands working together.

Practice answers

1. The Central Pacific built east from Sacramento. The Union Pacific built west from Omaha.
2. At Promontory Summit, Utah Territory, on May 10, 1869.
3. Abraham Lincoln, in 1862.
4. $10 \times 5,280 = 52,800$ feet.
5. Sherman Summit, in the Rocky Mountains of Wyoming, at about 8,200 feet.
6. $8,200 - 1,000 = 7,200$ feet.
7. $150 \div 7$ is a little more than 21, so the train was about 20 times faster.
8. Only a few men could work at one rock face at a time, and the granite was so hard they gained only about a foot a day. A shaft from the top let two more crews dig outward from the middle, so four crews worked at four faces at once, and the tunnel was finished much sooner than one crew could have done it.

7.3 TIME ZONES

OBJECTIVES

- Explain why every town once kept its own sun time and why that caused trouble for the railroads.
- Tell how the railroads created standard time zones on November 18, 1883, the “Day of Two Noons.”
- Find the time in each U.S. time zone by adding or subtracting hours, and explain why zones are about 15 degrees wide.

Warm-up. On a sunny day, stand a pencil upright in a lump of clay on a sheet of paper in a sunny window or outdoors. Mark the tip of its shadow every half hour from late morning to early afternoon. When is the shadow shortest? That moment is “sun noon” where you live. Is it exactly 12:00 by the clock?

Watch. *Time Zones for Kids / Learn about the time zones of the world.* (Learn Bright, 6:34). <https://www.youtube.com/watch?v=m6gnEcMQsZg>. Before How they figured it out: what time zones are and why the clock changes from one zone to the next.

Backup video. *18th November 1883: The Day of Two Noons sees four standard time zones applied in the USA* (HistoryPod, 2:34). <https://www.youtube.com/watch?v=e7dfDoTtfvo>

With the story: the Day of Two Noons in 1883, when the railroads set standard time.

KEY TERMS

sun time (local time)

Time set by the sun in one place, so that noon is the moment the sun is highest in the sky there.

standard time

One agreed time kept by every place in a large area, even though the sun is not exactly overhead at noon in all of them.

time zone

A region where everyone keeps the same standard time. Each U.S. zone is one hour different from the next.

meridian

A line of longitude running from the North Pole to the South Pole. Time zones are built around meridians.

timetable

A printed schedule that tells when each train leaves and arrives at each station.

CORE IDEAS

The story. On Sunday, November 18, 1883, people in New York City gathered to watch the clocks. When noon came by the old New York time, the clocks were set back about four minutes, and a few minutes later it was noon all over again. In Chicago the clocks were set back about nine minutes. Newspapers called it the **Day of Two Noons**. That day the railroads of the United States and Canada stopped using dozens of different times and began to use **standard time**.

The problem. For thousands of years, people set their clocks by the sun. Noon was the moment the sun stood highest in the sky. But the earth turns from west to east, so the sun reaches noon in Boston before it reaches New York, and in New York before Chicago. Every town east or west of another kept a slightly different time. When noon came in Washington, D.C., it was already about 12 minutes past noon in New York. For a farmer that did not matter. For a railroad it was a tangle. Each railroad ran by the time of its home city, and there were more than fifty railroad times in the country. Some big stations hung several clocks, all showing different times. A traveler could miss a train, and worse, two trains on the same track could be running by different clocks.

How they figured it out. The earth turns all the way around, 360 degrees, in 24 hours. Divide 360 by 24 and you get 15: the sun seems to move 15 degrees of longitude every hour, or one degree every four minutes. A schoolmaster named Charles F. Dowd of Saratoga Springs, New York, had suggested time zones years before. William F. Allen, who worked for the railroads' General Time Convention, drew the plan they adopted. He built four zones around four meridians, 75, 90, 105 and 120 degrees West. Each zone was about 15 degrees wide, and the time changed by exactly one hour from one zone to the next. The railroads agreed in October 1883 and made the change the next month.

The big idea. Inside a time zone, every clock reads the same. When you travel west into the next zone, you set your watch *back* one hour; when you travel east, you set it *ahead*. Today the lower 48 states have four zones: Eastern, Central, Mountain and Pacific. Alaska and Hawaii have their own zones too, making six zones for the fifty states. Zone lines are not perfectly straight; they bend to follow state lines and keep cities and counties together.

Technology overcoming geography. The railroad shrank the country so much that the old sun times no longer worked. Fast trains needed one clock for everyone, and the telegraph made it possible: observatories sent exact time signals over the wires so that stations hundreds of miles apart could set their clocks together. In 1884 a meeting of nations in Washington chose the meridian through Greenwich, England, as the starting line for the world's longitude and time. Strangely, it was the railroads, not the government, that set America's clocks. Congress did not make standard time a law until 1918.

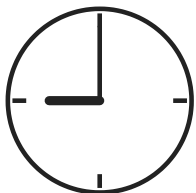


The four time zones of 1883 were built around these four meridians, 15 degrees apart.

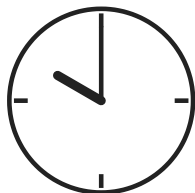
WEST

The sun reaches the east first.

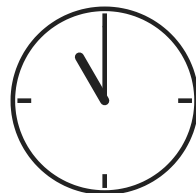
EAST



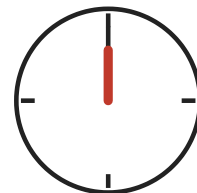
Pacific
9:00
120°W



Mountain
10:00
105°W



Central
11:00
90°W



Eastern
12:00 noon
75°W

When it is noon in the Eastern zone, it is 11:00 in the Central, 10:00 in the Mountain and 9:00 in the Pacific zone.

PICTURE STUDY



Hanging Rock, Foot of Echo Cañon, Andrew J. Russell, 1868 · Photograph (albumen print from a wet-plate glass negative) · Printed in Russell's album *The Great West Illustrated* (1869); prints in several American collections

In 1868 Andrew J. Russell followed the Union Pacific into Echo Canyon in Utah, where red cliffs rise high above the line. A photograph was slow work then. Russell coated a glass plate with chemicals, put it in his big wooden camera while it was still wet, and opened the lens for several seconds. Anyone in the picture had to hold perfectly still, or they would come out as a blur. Then he rushed the plate to the darkroom in his wagon to develop it.

Russell's photographs were made in a world without standard time. When he stood in Echo Canyon at noon by the sun, it was already past one o'clock by the sun in Omaha and past two in New York.

Look closely

- Find the hanging rock. Why do you think people gave it that name?
- Look for people, tents or tracks. Russell often placed people in his pictures so we could judge how big the land was. How big does the rock look next to them?
- Look at the light and the shadows. Can you guess whether the sun was high or low when Russell opened his lens?
- Why do you think Russell chose a place like this to photograph for the railroad?

Talk about it

1. If you had to hold still for several seconds for a photograph, how would you stand? Why do people in old photographs rarely smile?
2. Why would people back east want to see photographs like this one in 1869?

PROJECT: MY TIME-ZONE CLOCK WALL

Big railroad stations and newsrooms once hung rows of clocks showing the time in different places. You will make your own clock wall with one clock for each U.S. time zone, hang them in order from west to east, and use them to answer time-zone questions. This clock wall will become part of your unit portfolio.

You will need

- Six paper plates
- Six brass paper fasteners (brads)
- Heavy paper or a cereal box for clock hands
- Markers, a ruler and scissors
- Masking tape or poster putty for hanging
- A small U.S. map or your map notebook
- A real clock or watch

Steps

1. Write the numbers 1 to 12 around the edge of each plate, starting with 12 at the top, 3 on the right, 6 at the bottom and 9 on the left. Fill in the rest evenly.
2. Cut a short hour hand and a long minute hand for each clock. Push a brad through both hands and the center of the plate.
3. Label each plate at the bottom: Hawaii-Aleutian, Alaska, Pacific, Mountain, Central, Eastern. Under each, write one city in that zone, such as Honolulu, Anchorage, San Francisco, Denver, Chicago and New York.
4. Hang the clocks on a wall in order from west (left) to east (right): Hawaii-Aleutian, Alaska, Pacific, Mountain, Central, Eastern. Above them write "WEST" on the left and "EAST" on the right.
5. Set the clock for your own zone to the real time. Then set every other clock: one hour earlier for each zone to the west, one hour later for each zone to the east.
6. Under your own zone's clock, tape a small star that says "I live here."
7. Several times this week, check the real time and reset all the clocks. Have someone in your family call out a city, and you tell them its time.
8. In your notebook, write the rule in your own words: Going west, the clock goes ____; going east, it goes ____.

Tips

- Use one color for all the hour hands and another for all the minute hands, so the clocks are easy to read from across the room.
- The minute hand is the same on every clock in the U.S. zones. Only the hour hand changes from zone to zone.
- Some places, such as Hawaii and most of Arizona, do not change their clocks in the summer. In summer, Hawaii is two hours behind Alaska instead of one, so if you are

checking real times in summer, ask a parent to help.

Check your work

- My clocks hang in the right order from west to east.
- Each clock is exactly one hour from the clock next to it.
- I can tell the time in any zone if I know the time in mine.

MAP NOTEBOOK

1. Draw an outline of the United States and draw three wavy lines from top to bottom to make the four zones of the lower 48 states. Color each zone a different color and label it Pacific, Mountain, Central or Eastern.
2. Draw a railroad station wall in 1880 with three clocks that all show different times. Under it, draw the same wall after November 18, 1883, with one clock. Write a caption for each.
3. Draw the earth as a circle with the sun on one side. Shade the night side, and write: "The earth turns 15 degrees every hour."

From history. The Standard Time Act, passed by Congress in 1918, did two things. It made the railroad time zones the law of the land, and it began daylight saving time in the United States, setting clocks ahead one hour in summer to save fuel during the First World War. Today the U.S. Department of Transportation is in charge of time-zone lines, because time zones began with the railroads.

WORKED EXAMPLES

Example 1. It is 3:00 p.m. in New York (Eastern Time). What time is it in San Francisco (Pacific Time)?

(Use the map or drawing "Count the zones from Eastern back to Pacific." shown earlier in this lesson.)

1. Find the zones on the clock wall: Eastern, Central, Mountain, Pacific. San Francisco is three zones west of New York.
2. Going west, set the clock back one hour for each zone: 3 zones = 3 hours.
3. 3:00 p.m. – 3 hours = 12:00 noon.

Answer: It is 12:00 noon in San Francisco.

Example 2. Before 1883, each city kept sun time. New York is at about 74 degrees West longitude and Chicago at about 88 degrees West. The sun seems to move 1 degree every 4 minutes. When it was noon by the sun in New York, what time was it by the sun in Chicago?

(Use the map or drawing “Find New York and Chicago. Which one is farther west?” shown earlier in this lesson.)

1. Find the difference in longitude: $88 - 74 = 14$ degrees.
2. Each degree is 4 minutes: $14 \times 4 = 56$ minutes.
3. Chicago is west of New York, so the sun reaches noon there later. Chicago’s clocks were behind: $12:00 - 56 \text{ minutes} = 11:04 \text{ a.m.}$

Answer: It was about 11:04 a.m. by the sun in Chicago, 56 minutes behind New York.

PRACTICE

1. **EASY** How many degrees does the earth turn in one hour? Show how you know.
2. **EASY** On what date did the railroads begin using standard time? What did people call that day?
3. **EASY** Name the four time zones of the lower 48 states in order from west to east.
4. **MEDIUM** It is 10:00 a.m. in Chicago (Central Time). What time is it in New York? In Denver? In San Francisco?
5. **MEDIUM** Look at the map. Which meridian runs closest to Denver, and which time zone is Denver in?
(Use the map or drawing “The four meridians of 1883.” shown earlier in this lesson.)
6. **MEDIUM** Boston is at about 71 degrees West, and New York at about 74 degrees West. By sun time, how many minutes apart were their clocks? Which city’s clocks were ahead?
7. **HARD** A train leaves New York at 9:00 a.m. Eastern Time and arrives in Chicago 20 hours later. What time does the station clock in Chicago (Central Time) read when it arrives?
8. **CHALLENGE** In two or three sentences, explain why the railroads needed standard time more than farmers did.

COMMON MISTAKES

- Adding hours when going west. Going west, the clock goes back (earlier); going east, it goes ahead (later).
- Thinking the government made the time zones in 1883. The railroads made them; Congress made standard time a law in 1918.
- Thinking time-zone lines are perfectly straight. They bend to follow state and county lines so that cities are not split in two.

Make it a game • Clock Hop. Lay four paper plates on the floor in a row from west to east and label them Pacific, Mountain, Central and Eastern. A parent calls out a time and a zone, such as “2:00 in Central!” Hop from plate to plate, calling out the time in each zone: “1:00 Mountain, 12:00 Pacific, 3:00 Eastern!” Get all four right to score a point. For a harder round, the caller names a city instead of a zone.

Scripture. “And God said, Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days, and years:” (Genesis 1:14, KJV)

God made the sun to mark our days. The railroads did not change the sun; they agreed together on how to count its hours across a wide land, so that people could keep their appointments and travel safely.

Practice answers

1. 15 degrees, because $360 \text{ degrees} \div 24 \text{ hours} = 15 \text{ degrees each hour}$.
2. November 18, 1883. People called it the Day of Two Noons.
3. Pacific, Mountain, Central, Eastern.
4. New York (Eastern): 11:00 a.m. Denver (Mountain): 9:00 a.m. San Francisco (Pacific): 8:00 a.m.
5. The 105 degrees West meridian. Denver is in the Mountain Time Zone.
6. $74 - 71 = 3 \text{ degrees}$, and $3 \times 4 = 12 \text{ minutes}$. Boston’s clocks were 12 minutes ahead, because Boston is farther east and the sun reaches it first.
7. $9:00 \text{ a.m.} + 20 \text{ hours} = 5:00 \text{ a.m. the next day}$, Eastern Time. Chicago is one hour behind, so the Chicago clock reads 4:00 a.m. the next day.
8. A farmer worked by the sun in one place, so his own sun time was all he needed. A train crossed many towns, each with a different sun time, so timetables were confusing, travelers missed trains, and two trains on one track might be running by different clocks and crash. One standard time for each zone made timetables clear and travel safer.

7.4 WHAT THE RAILROAD CHANGED

OBJECTIVES

- Explain why towns grew up along railroad lines and how the railroad joined farms and ranches to faraway cities.
- Tell the story of the cattle drives from Texas to Abilene, Kansas, and use a map to measure the trail and the days it took.
- Describe how the railroad helped bring the frontier to an end, including the hard losses it brought to the bison and the Plains Indian nations.

Warm-up. Look around your kitchen and find five things that came from far away: a can, a box of cereal, a piece of fruit, a spice. Read the labels. Where was each one made or grown? How do you think it reached your town? Make a quick list, and keep it for the end of the lesson.

Watch. *Cattle Kingdom: Cowboys, Cattle Drives & the Wild West* / DAILY BELLRINGER (The Daily Bellringer, 5:26). <https://www.youtube.com/watch?v=ITsd66FO-qI>
With the trail: the cattle drives, cowboys and cow towns of the Old West.

Backup video. *How the transcontinental railroad changed America / for kids / US history* (Educational Vids for Kids!, 4:18). <https://www.youtube.com/watch?v=msMTn6ra11s>
After the big idea: how the transcontinental railroad changed the country. Note: Ends with a short, even-handed section on what the railroad cost the Native American peoples and the land.

KEY TERMS

railhead

A town at the end of a railroad line, or on a line, where goods and animals are loaded onto trains.

cattle drive

Moving a large herd of cattle on foot over a long trail to a market or a railroad.

stockyard

A place with many fenced pens where cattle are kept before they are loaded onto trains or sold.

market

A place, or a whole network of places, where people buy and sell goods.

frontier

The edge of settled land, beyond which few settlers lived.

CORE IDEAS

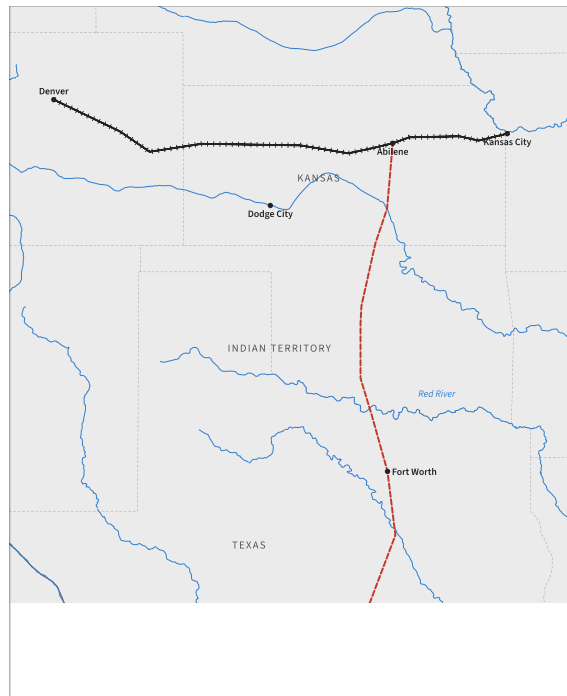
The story. In 1867 a cattle dealer from Illinois named Joseph G. McCoy came to Abilene, Kansas, a tiny prairie village of a few log huts. A new railroad line, soon to be called the Kansas Pacific, ran right past it. McCoy built shipping pens, a stockyard and a hotel beside the tracks and sent word south to Texas: bring your cattle here. After the Civil War, millions of longhorn cattle roamed Texas, where a steer might be worth about \$4. In the cities of the North, the same steer might be worth about \$40. But Texas had no railroad to the North. The answer was to walk the cattle to the railroad.

The trail. So cowboys drove great herds, often 2,000 or 3,000 head, north along the **Chisholm Trail**, named for Jesse Chisholm, a trader whose wagon road crossed Indian Territory (today Oklahoma). A herd walked about 10 to 15 miles a day, crossing the Red River and other rivers, through storms and stampedes, for two months or more. Many cowboys were young men just back from the war; many others were Black or Mexican American, and the Mexican vaqueros had taught Texans much of the cowboy's craft. At Abilene the cattle were loaded into railroad cars and carried east to the great stockyards of Chicago. As railroads pushed farther west, other cow towns followed, such as Dodge City, Kansas.

The big idea. The railroad turned the separate regions of the country into one **market**. Wheat from Kansas and corn from Iowa rode the rails to mills and cities. Lumber from Wisconsin and Michigan rode west to build houses on the treeless plains. Towns grew where the tracks went: Cheyenne, Wyoming, was founded in 1867 when the Union Pacific arrived, and Reno, Nevada, in 1868 when the Central Pacific came through. A town the railroad missed often withered away. Chicago, where many lines met, grew into the busiest railroad city in the world. In 1872 Aaron Montgomery Ward of Chicago began selling goods by mail, and the trains carried his packages to farm families far from any store.

The cost. The railroad also brought hard changes. Before it came, tens of millions of bison roamed the Great Plains, and the Lakota, Cheyenne, Comanche and other Plains nations lived by hunting them. Hunters rode the new trains west, killed bison by the thousands for their hides, and shipped the hides east by rail. By the late 1880s fewer than a thousand bison were left. The Plains nations lost their main food and, after years of war and broken treaties, most of their land, and they were moved onto reservations. This is a true and sad part of the railroad's story.

The end of the frontier. The long cattle drives lasted only about twenty years. Barbed wire, patented by Joseph Glidden in 1874, fenced the open range; railroads reached Texas itself; and the terrible winter of 1886-87 killed huge numbers of cattle. Meanwhile, settlers kept coming by train. In 1890 the United States Census reported that there was no longer a clear frontier line on the map. Three years later, in Chicago, a young historian named Frederick Jackson Turner said that the closing of the frontier marked the end of the first period of American history.



The Chisholm Trail brought Texas cattle north to the railroad at Abilene, Kansas.

PICTURE STUDY



Across the Continent: "Westward the Course of Empire Takes Its Way", Frances Flora Bond Palmer; published by Currier & Ives, 1868 · Hand-colored lithograph · Library of Congress and National Gallery of Art, Washington, D.C. (and other collections)

Currier & Ives was a New York company that sold inexpensive, hand-colored prints that families hung on their walls. Fanny Palmer, an English-born artist who drew many of their most famous prints, made this picture in 1868, while the transcontinental railroad was still

being built. It shows what many Americans of the time believed the railroad would do: carry settlers and towns all the way across the continent.

The title comes from a line of poetry about nations moving west. Look closely at both sides of the track, because the picture tells two stories at once.

Look closely

- Find the train. Which way is it heading, and what is written on its cars?
- Look at the town on one side of the track. What are the settlers building? What tells you this is a brand-new town?
- Look at the other side of the track. Who is watching the train, and where is the smoke drifting?
- Find the telegraph poles. Why would they run right beside the railroad?

Talk about it

1. How do you think the settlers in the town felt about the railroad? How might the riders on the other side have felt?
2. Is this picture a photograph of a real place, or an idea the artist wanted to show? How can you tell?

PROJECT: BUILD A RAILROAD TOWN

Railroad towns on the plains were laid out along the tracks, and almost every one had the same important buildings. You will build a model railroad town on a board, decide where each building belongs, and explain why the railroad brought it there.

You will need

- A piece of cardboard about 18 by 24 inches for the town
- Two long strips of black paper or tape for the track, and craft sticks for ties
- Small boxes (matchboxes, tea boxes, milk cartons) for buildings
- A paper-towel tube for a water tower
- Toothpicks or craft sticks and glue for fences
- Markers, paper, tape and scissors

Steps

1. Lay the railroad track straight across the middle of the board, east to west. Mark north with a small compass rose.
2. Place the depot (station) right beside the track. This is where people, mail and packages arrive.
3. Stand the water tower beside the track. Steam engines had to stop often to fill their tanks with water.
4. Build a stockyard of toothpick fences on one side of the track at the edge of town, with a ramp to load cattle into the cars.

5. Build a grain elevator, a tall box, beside the track, where farmers bring their wheat to be loaded on trains.
6. Build Main Street running away from the depot, with a general store, a bank, a church, a school and houses.
7. Make a small label for each building. On the back of each label, write one sentence about why the railroad made that building important.
8. Give your town a name and write its founding year on a sign at the depot.

Tips

- Put the stockyard downwind, at the edge of town. Real towns learned that lesson quickly.
- Many plains towns were laid out by the railroad companies themselves at stops along the line, so the depot often came before almost anything else.
- Keep your town for your unit portfolio display.

Check your work

- My town has a depot, a water tower, a stockyard and a grain elevator beside the track.
- I can explain why each of those buildings was near the railroad.
- I can explain why a town the railroad missed often shrank.

MAP NOTEBOOK

1. Copy the map of the Chisholm Trail. Draw the trail with a dashed line and the Kansas Pacific with railroad-track marks. Label San Antonio, Fort Worth, the Red River, Abilene and Kansas City.
2. Draw a cowboy on a cattle drive, with a longhorn steer beside him. Write three things he needed for a two-month trail.
3. Make a two-column chart titled "What the Railroad Changed." In one column list good things it brought; in the other, hard things it brought. Put at least three in each.

From history. Chicago's Union Stock Yards opened on Christmas Day, 1865. Because so many railroads met in Chicago, cattle, hogs and sheep came there from all over the West, and the stockyards grew to cover hundreds of acres. By the 1880s, refrigerated railroad cars packed with ice let Chicago's meat packers ship fresh meat to cities all the way to the East Coast, another way the railroad joined the country into one market.

WORKED EXAMPLES

Example 1. A rancher drove 1,000 steers to Abilene. Each steer was worth about \$4 in Texas and sold for about \$40 at the railroad market. How much more was the herd worth at the market than in Texas?

1. Find how much more each steer was worth: $\$40 - \$4 = \$36$.
2. Multiply by the number of steers: $1,000 \times \$36 = \$36,000$.
3. Check another way: in Texas the herd was worth $1,000 \times \$4 = \$4,000$; at market $1,000 \times \$40 = \$40,000$; $\$40,000 - \$4,000 = \$36,000$.
4. The rancher still had to pay the cowboys, buy food and supplies, and lose some cattle on the way, but the trip was clearly worth it.

Answer: About \$36,000 more, before paying the costs of the drive.

Example 2. The straight-line distance from San Antonio, Texas, to Abilene, Kansas, is about 660 miles, and the winding trail was even longer. If a herd walked 12 miles a day, how many days would it take to go 660 miles? About how many weeks is that?

(Use the map or drawing "Follow the trail north from San Antonio to Abilene." shown earlier in this lesson.)

1. Days = miles $\div$ miles each day: $660 \div 12$.
2. $12 \times 50 = 600$, and $660 - 600 = 60$. $12 \times 5 = 60$. So $660 \div 12 = 55$ days.
3. Weeks: $55 \div 7$ is a little less than 8 ($7 \times 8 = 56$).

Answer: About 55 days, nearly 8 weeks, and more on the real winding trail.

PRACTICE

1. **EASY** Who built the stockyards at Abilene, Kansas, and in what year?
2. **EASY** Why did Texas cowboys walk their cattle all the way to Kansas instead of putting them on a train in Texas?
3. **MEDIUM** A steer worth \$4 in Texas sold for \$40 in the North. How many times more was it worth in the North?
4. **MEDIUM** A herd walks 12 miles a day for 30 days. How far does it go?
5. **MEDIUM** Look at the map. In which direction does the Chisholm Trail run from San Antonio to Abilene? Which big river does it cross between Texas and Indian Territory?
(Use the map or drawing "The Chisholm Trail and the Kansas Pacific." shown earlier in this lesson.)
6. **HARD** The transcontinental railroad was finished in 1869. The Census reported that the frontier line was gone in 1890. How many years apart were these events? Name two things that happened in between that helped close the frontier.

7. **HARD** Name three buildings found beside the tracks in almost every plains railroad town, and tell what each was for.
8. **CHALLENGE** In three or four sentences, explain how the railroad changed life for the Plains Indian nations.

COMMON MISTAKES

- Thinking Texas cattle rode trains the whole way from the start. At first they had to walk hundreds of miles to reach a railroad in Kansas.
- Thinking the railroad helped everyone in the same way. It made farmers, ranchers and cities richer, but it brought great losses to the Plains Indian nations and nearly ended the bison.
- Thinking the frontier ended on one day. It faded over many years as railroads, farms and towns filled the West; the 1890 Census only reported what had already happened.

Make it a game · Trail Boss. Draw a trail of 20 squares on paper from San Antonio to Abilene, with the Red River on square 8. Each player has a button for a herd. Take turns answering questions from this unit: a right answer moves your herd 2 squares, a wrong answer means a “stampede” and you stay put. To cross the Red River you must answer a time-zone question correctly. The first herd to reach the railroad at Abilene wins.

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

The railroad changed where people lived across a whole continent: settlers, cowboys, townspeople and the Plains nations. Paul reminds us that all of them were made of one blood by the same Creator, and that God rules over the times and places of every people, even in seasons of great change and loss.

Practice answers

1. Joseph G. McCoy, in 1867.
2. In the late 1860s there was no railroad from Texas to the northern cities, so the cattle had to walk to the nearest railroad, in Kansas.
3. $\$40 \div \$4 = 10$ times more.
4. $12 \times 30 = 360$ miles.
5. North. It crosses the Red River.
6. $1890 - 1869 = 21$ years. Any two: more railroads were built across the West; settlers and farm families came west by train; barbed wire (1874) fenced the open range; the bison herds were destroyed and the Plains nations were moved onto reservations; towns grew along the tracks.
7. Any three: the depot (for passengers, mail and freight), the water tower (to fill the steam engines), the stockyard (to hold and load cattle), the grain elevator (to store and load wheat).
8. The railroad carried hunters west and carried bison hides east, and the great herds were nearly wiped out by the late 1880s. The Plains nations, such as the Lakota, Cheyenne and

Comanche, depended on the bison for food, clothing and shelter, so they lost their way of life. The railroad also brought settlers and soldiers onto their lands, and after years of war and broken treaties they were moved onto reservations.

UNIT 7 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. You may use a clock with hands for the time-zone questions. The review is worth 50 points.

1. (5 pts) Why did the merchants of Baltimore want to build a railroad in 1828? Name the river they wanted to reach.
2. (5 pts) Tell what happened in the race between Tom Thumb and the horse in 1830. Why did the race still help the railroad?
3. (5 pts) The B&O laid its first stone in 1828 and reached Wheeling on the Ohio River in 1853. How many years did it take? The line was about 380 miles long. About how many miles did it grow each year?
4. (5 pts) Which company built the transcontinental railroad east from Sacramento, and which built west from Omaha? Where and when did they meet?
5. (5 pts) The Central Pacific built about 690 miles of track and the Union Pacific about 1,086 miles. How long was the whole line? How many more miles did the Union Pacific build?
6. (5 pts) Describe how the Central Pacific crews dug the Summit Tunnel through the granite of the Sierra Nevada, and name the workers who did most of the work.
7. (5 pts) Before 1883, why did Chicago and New York have different times? What happened on November 18, 1883?
8. (5 pts) It is 4:00 p.m. in New York (Eastern Time). What time is it in Chicago (Central), Denver (Mountain) and San Francisco (Pacific)?
9. (5 pts) Why did Texas cowboys drive longhorn cattle hundreds of miles north to Abilene, Kansas, after 1867?
10. (5 pts) Name one way the railroad helped farm families on the Great Plains and one hard change it brought to the Plains Indian nations. What did the Census of 1890 say about the frontier?

UNIT PROJECT: MY RAILROAD ATLAS AND TIME-ZONE CLOCK WALL

Make a two-part display. First, draw a large map of the United States showing the Baltimore and Ohio Railroad, the transcontinental railroad from Sacramento to Omaha (Central Pacific in one color, Union Pacific in another), the Chisholm Trail to Abilene, and the four time zones of the lower 48 states with their center meridians (75°, 90°, 105° and 120° West). Mark Promontory Summit with a gold star. Second, hang your time-zone clock wall from Lesson 7.3 below or beside the map, with each clock under its own zone, set to show the same moment across the country.

Add a short paragraph that answers: How did the railroad bind the regions of the United States into one nation, and what did that cost? Then teach your family how to read the clock wall by asking them three time-zone questions.

- **Accuracy:** Railroad lines, the trail, cities and time zones are in the right places and correctly labeled, with a compass rose and a scale bar.
- **Clock wall:** The clocks hang west to east in the right order and show times exactly one hour apart.
- **Explanation:** The paragraph explains how the railroad joined the regions into one market and names at least one real cost, told honestly.
- **Care:** The map and clocks are neat, colorful and easy to read, and the family time-zone questions are answered correctly.

Answer key

1. The Erie Canal (1825) was pulling western trade to New York, and the Appalachian Mountains were too high and steep for an easy canal. A railroad could climb gentle grades and reach the West. They wanted to reach the Ohio River (at Wheeling).
2. Tom Thumb pulled ahead, but the belt that drove its blower fan slipped off, the fire weakened and the engine slowed, so the horse won. The race still showed how fast a steam engine could go, and the B&O soon chose steam engines instead of horses.
3. $1853 - 1828 = 25$ years. $380 \div 25$ is about 15, so about 15 miles a year.
4. The Central Pacific built east from Sacramento; the Union Pacific built west from Omaha. They met at Promontory Summit, Utah Territory, on May 10, 1869.
5. $690 + 1,086 = 1,776$ miles in all. $1,086 - 690 = 396$ more miles for the Union Pacific.
6. Chinese workers did most of the work. They drilled holes in the granite by hand, blasted with black powder and later nitroglycerin, and dug from both ends and from a shaft sunk down from the top, so they could work on four faces at once, sometimes gaining only about a foot a day, even through deep winter snow.
7. Each town kept its own sun time, with noon when the sun was highest there; the sun reaches New York before Chicago, so New York's clocks were almost an hour ahead. On November 18, 1883, the railroads switched to standard time with four time zones, so every town in a zone kept the same time.
8. Chicago 3:00 p.m.; Denver 2:00 p.m.; San Francisco 1:00 p.m. (subtract one hour for each zone you go west).
9. Abilene was on a railroad line, and Joseph McCoy built stockyards there in 1867. A steer worth about \$4 in Texas was worth about \$40 in the North, so ranchers walked the herds up the Chisholm Trail to the railroad, which carried them to the stockyards of Chicago.
10. Help (any one): it carried their wheat and cattle to market, brought them lumber, tools and mail-order goods, or carried new settlers to their towns. Hard change: hunters rode the railroad and shipped bison hides east, the great herds were nearly destroyed, and the Plains nations lost their food and most of their land. The Census of 1890 reported that there was no longer a clear frontier line.

WONDERS AND RESOURCES

God made the United States a land of wonders and riches. “Thou visitest the earth, and waterest it: thou greatly enrichest it” (Psalm 65:9). In this unit you will travel with Ferdinand Hayden’s survey into Yellowstone in 1871, where geysers shoot into the sky, and see how Thomas Moran’s paintings and William Henry Jackson’s photographs helped Congress create the world’s first national park in 1872. Then you will push off with one-armed John Wesley Powell and nine other men in 1869 on a hundred-day journey down the Green and Colorado Rivers, through the Grand Canyon that no one had ever charted.

Next you will ask a question that every map can help answer: **where do things come from?** You will stand beside Edwin Drake’s oil well in Pennsylvania in 1859 and learn where America’s coal, iron, oil, timber, fish and farm crops are found. Finally you will think about what God expects of people who have been given such a good land. With Theodore Roosevelt and John Muir camping in Yosemite, and with the farmers who lived through the Dust Bowl, you will learn what it means to “dress” the land and to “keep” it (Genesis 2:15).

The big project of the unit is a large resource map of the United States with real samples of coal, iron, wood, cotton and wheat glued where they come from. Along the way you will measure distances with a map scale, read a letter-number grid, read a canyon cross-section and run three hands-on tests: a geyser drawing, a sand-tray canyon and a soil erosion test.

BEFORE YOU BEGIN

- Can use a map scale to change inches to miles (Unit 1)
- Can find places with a letter-number grid (Unit 1)
- Knows the five regions of the United States and where the Rocky Mountains, Great Plains and Appalachians are (Units 2 to 4)
- Can multiply and divide whole numbers and add and subtract to the thousands

MASTERY CHECKLIST

- I can tell how Hayden, Jackson and Moran helped make Yellowstone the first national park in 1872, and explain how a geyser works.
- I can tell the story of John Wesley Powell’s 1869 journey and explain how a river cuts a canyon.
- I can read a natural resources map with a key and a grid and tell where coal, iron ore, oil, timber, fish and farm crops come from.
- I can sort resources into renewable and nonrenewable.
- I can explain what Genesis 2:15 teaches about being a steward of the land and name ways people care for soil, forests and fish.
- I can use a map scale to find distances and subtract heights to find the depth of a canyon.

OPTIONAL BOOKS AND RESOURCES

- **Yellowstone National Park (National Park Service)** (<https://www.nps.gov/yell/>): Free. Maps, photographs and geyser information for Lesson 8.1. Parents can use the park's pages to check Old Faithful's current eruption predictions together.
- **Grand Canyon National Park (National Park Service)** (<https://www.nps.gov/grca/>): Free. Maps, photographs and the story of Powell's expedition for Lesson 8.2.
- **John Wesley Powell's own account of the river (free at Project Gutenberg)** (<https://www.gutenberg.org/ebooks/8082>): Free. Powell's *Canyons of the Colorado*, later reprinted as *The Exploration of the Colorado River and Its Canyons*. A parent may read aloud a few dramatic days, such as August 13 and August 28, 1869.

8.1 YELLOWSTONE, THE FIRST NATIONAL PARK ★

OBJECTIVES

- Tell how Ferdinand Hayden's survey, William Henry Jackson's photographs and Thomas Moran's paintings helped Congress create Yellowstone National Park in 1872.
- Explain what a national park is and how hot water underground makes geysers and hot springs.
- Find Yellowstone on a map of the United States and measure distances inside the park with a map scale.

Warm-up. Fill a mug with very hot tap water and hold your hand above it (do not touch the water). Watch the steam rise. Now imagine a whole valley of steaming pools, some bubbling like soup and one that shoots water higher than a ten-story building. If you had seen it with your own eyes in 1870, how would you make people back home believe you? Talk about it for two minutes, then write down your best idea.

Watch. *A Brief History of Yellowstone National Park* | National Geographic (National Geographic, 4:22). <https://www.youtube.com/watch?v=RCYSEDqPv4o>
After the story: a short history of how Yellowstone became the first national park.

Backup video. *Inside Yellowstone - Why is Old Faithful Famous* (YellowstoneNPS, 1:36). <https://www.youtube.com/watch?v=6yihJgD1L0I>
With the big idea: a ranger explains why Old Faithful is famous and how its eruptions are predicted.

KEY TERMS

national park

Land that the whole nation sets aside and protects so that everyone can enjoy it, now and in years to come.

survey

A careful trip to measure, map and describe a piece of land.

geyser

A hot spring that shoots water and steam into the air from time to time.

hot spring

A pool or stream of water that comes up from the ground already heated by hot rock below.

plateau

A large, high area of land that is fairly flat on top.

Continental Divide

The line along the high Rocky Mountains that separates rivers flowing toward the Atlantic side from rivers flowing toward the Pacific.

CORE IDEAS

The story. For years, trappers came down out of the Rocky Mountains telling tales that nobody believed. They spoke of mud that boiled like porridge, rivers that steamed in winter and fountains of hot water that shot out of the ground. Mountain man Jim Bridger was famous for tall tales, so people laughed. In the summer of 1871 the United States government sent a geologist named **Ferdinand V. Hayden** to find out the truth. Hayden had been an army surgeon in the Civil War, and now he led a survey party of scientists, mapmakers and helpers out of Fort Ellis, in Montana Territory, and south into the Yellowstone country. Two men in his party mattered most for this story: a photographer named **William Henry Jackson**, who carried heavy glass plates and a darkroom tent on the backs of mules, and a painter named **Thomas Moran**, who came along to sketch.

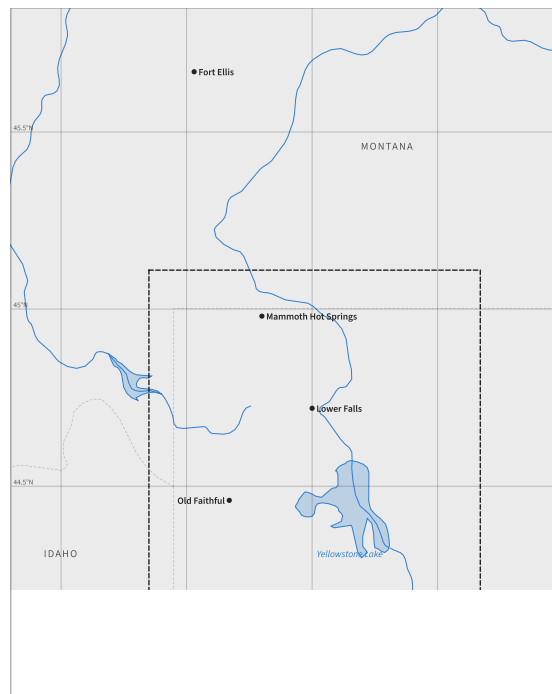
How they figured it out. Hayden's men measured, mapped and wrote down everything. They took the temperature of hot springs, collected rocks, drew the shapes of the valleys and sailed a small boat on Yellowstone Lake to map its shores. Jackson made photographs that proved the wonders were real. Moran filled his sketchbook with pencil drawings and watercolors that showed what a black-and-white photograph could not: the yellow, orange and pink walls of the canyon and the blue of the steaming pools. Back in Washington that winter, Hayden showed the photographs, sketches and rock samples to members of Congress. They were amazed. Congress passed a law, and on **March 1, 1872**, President **Ulysses S. Grant** signed it. The law set Yellowstone apart "as a public park or pleasuring-ground for the benefit and enjoyment of the people." It was the first national park in the world. That same year Moran finished a giant painting, 7 feet tall and 12 feet wide, *The Grand Canyon of the Yellowstone*, and Congress bought it for \$10,000 to hang in the Capitol.

The big idea. A **national park** is land that belongs to the whole nation and is kept for everyone, not sold off to one owner. Yellowstone was protected because of its wonders, and most of those wonders come from hot water. Rain and melted snow soak down through cracks in the ground. Deep below Yellowstone, the rock is very hot, because the park sits on top of an old volcano. The water heats up. In a **hot spring** it simply rises and fills a pool. In a **geyser** the water is trapped in a narrow tube, so it gets hotter and hotter until steam pushes it out in a roaring fountain (see the diagram). Yellowstone holds about half of all the geysers in the world. The most famous, **Old Faithful**, got its name in 1870 because it erupts so regularly, about every hour and a half, often more than 100 feet high.

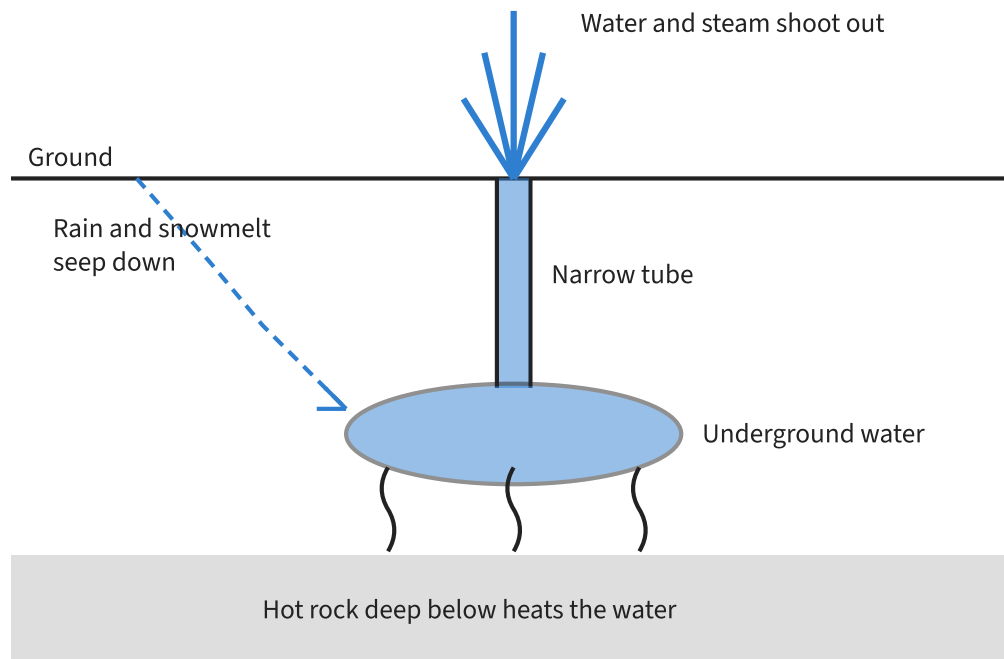
On the map. Yellowstone lies in the northwest corner of Wyoming, with thin edges in Montana and Idaho. It is a high **plateau** in the Rocky Mountains, mostly 7,000 to 8,000 feet above sea level, and the **Continental Divide** runs right through it. Snow that melts on one side may end up in the Gulf of Mexico; snow on the other side may reach the Pacific Ocean. The Yellowstone River flows north out of Yellowstone Lake, tumbles over the Lower Falls, about 308 feet high, and races through the Grand Canyon of the Yellowstone, a gorge about 20 miles long. Then it keeps going north and east until it joins the Missouri River. The whole park covers about 3,500 square miles, bigger than the state of Delaware.

The first people of Yellowstone. Hayden's men were not the first people there. For a very long time the Shoshone, Crow, Blackfeet, Bannock and other nations hunted elk and bison in these valleys. They came to Obsidian Cliff for shiny black volcanic glass to make sharp knives and arrowheads. One band of Shoshone, called the Sheep Eaters, lived in the mountains all year long and hunted bighorn sheep.

Technology overcoming geography. In 1872 Yellowstone was far from everywhere, and only a few hardy visitors came on horseback. Two inventions changed that. Jackson's camera let millions of people who could never go see the wonders for themselves. Then, in 1883, the Northern Pacific Railroad laid a branch line almost to the park's northern edge. A trip that had taken weeks of hard riding now took a few days in a train seat, and Yellowstone became a place that ordinary families could visit.



Yellowstone and the 1871 Hayden survey. The survey set out from Fort Ellis, near today's Bozeman, Montana.



How a geyser works. Water is trapped in a narrow tube until steam pushes it out.

PICTURE STUDY



The Grand Canyon of the Yellowstone, Thomas Moran, 1872 · Oil on canvas, about 7 by 12 feet · Smithsonian American Art Museum, Washington, D.C. (lent by the U.S. Department of the Interior)

Thomas Moran was born in England in 1837 and came to America as a boy. When he traveled with Hayden in 1871 he had never been to the far West. He stood on the rim of the canyon with his watercolors and tried to catch the colors before the light changed. Back in his studio he painted this enormous canvas. He did not copy every rock exactly. He wanted people who would never stand there to feel what he had felt: that this place was grand and wonderful.

Congress bought the painting in 1872 for \$10,000, a huge sum then, and hung it in the Capitol. People began calling the artist “Yellowstone Moran.”

Look closely

- Find the Lower Falls. How far away does it seem? What did Moran do to make it look so far off?
- Find every color you can in the canyon walls. Why do you think the river is called the Yellowstone?
- Look closely for tiny human figures on a rocky ledge in the foreground. How do they make the canyon seem bigger?
- Look at the sky. Is it calm or stormy? How does the sky make you feel about the land below?

Talk about it

1. Why might Moran’s colorful pictures have helped people care about Yellowstone, even though Jackson had photographs?
2. If you were standing next to this painting, which is 12 feet wide, how many of you lying head to toe would fit across it?
3. What does this painting tell you about the God who made the canyon?

PROJECT: A SURVEY REPORT TO CONGRESS

You will be a member of Hayden’s survey party. You will draw a scale map of Yellowstone, paint a field sketch like Thomas Moran, and write a short letter asking Congress to protect the park.

You will need

- Graph paper with 1-inch squares (or draw 1-inch squares with a ruler)
- Pencil, ruler and colored pencils
- Watercolor paints, a brush and a cup of water
- The Yellowstone map in this lesson
- A sheet of plain paper for your letter

Steps

1. Look at the Yellowstone map. Draw the park as a big rectangle on your graph paper about 6 inches wide and 7 inches tall. Your scale will be 1 inch = 10 miles. Write the scale and draw a scale bar at the bottom.
2. Draw a compass rose in a corner. North is the top of the page.
3. Mark these places with a dot and a label, using the map as your guide: Mammoth Hot Springs (near the top), Old Faithful (lower left), the Lower Falls (middle right) and Yellowstone Lake (lower right, colored blue).
4. Draw the Yellowstone River flowing north out of the lake, past the Lower Falls and out the top of the park. Add an arrow showing which way it flows.

5. With your ruler, measure from Old Faithful to the Lower Falls on your map. Use the scale to find the distance in miles and write it on the map.
6. On your plain paper, paint a field sketch of one wonder: a geyser shooting up, a colorful hot spring, or the Lower Falls pouring into the canyon. Use bright colors like Moran did.
7. Write a three-sentence letter to Congress. Tell what you saw, why it is special, and why it should be kept for everyone.

Tips

- Your map does not have to be perfect. Hayden's first maps were rough too. Try to keep places in the right direction from each other.
- Let the watercolor sky dry before you paint the canyon, or the colors will run together.

Check your work

- My map has a title, a scale bar, a compass rose and four labeled places.
- I measured one distance and changed inches to miles correctly.
- My letter gives a real reason to protect Yellowstone.

MAP NOTEBOOK

1. Draw the cut-away of a geyser: label the hot rock, the underground water, the narrow tube and the eruption.
2. Draw a small outline map of Wyoming and shade the corner where Yellowstone lies. Add Montana and Idaho on the edges.
3. Make a three-box comic: Jackson takes a photograph, Moran paints, and President Grant signs the law on March 1, 1872.

From history. A year before Hayden, in 1870, a group of Montana men led by Henry Washburn and guarded by soldiers under Lieutenant Gustavus Doane explored Yellowstone. They were the ones who named Old Faithful. One member, Nathaniel Langford, gave lectures back east about what they had seen, and his talks helped convince Congress to send Hayden's survey the next summer. Later, in 1916, Congress created the National Park Service to care for Yellowstone and all the parks that followed it.

WORKED EXAMPLES

Example 1. On a map of Yellowstone, the scale says 1 inch = 10 miles. A ruler shows that Old Faithful is $3\frac{1}{2}$ inches from Mammoth Hot Springs in a straight line. How many miles apart are they?

(Use the map or drawing “Find Mammoth Hot Springs and Old Faithful.” shown earlier in this lesson.)

1. Each inch stands for 10 miles.
2. 3 inches $\times$ 10 miles = 30 miles.
3. The extra $\frac{1}{2}$ inch is half of 10 miles, which is 5 miles.
4. 30 miles + 5 miles = 35 miles.

Answer: About 35 miles in a straight line. (The winding road between them is longer, about 50 miles.)

Example 2. Suppose Old Faithful erupts exactly every 90 minutes, and it erupts at 8:00 in the morning. How many times will it erupt from 8:00 a.m. until 2:00 p.m., counting both of those times?

1. 90 minutes is 1 hour and 30 minutes.
2. Start at 8:00 and keep adding 1 hour 30 minutes: 8:00, 9:30, 11:00, 12:30, 2:00.
3. Count the times in the list: 5.

Answer: 5 eruptions. (The real geyser varies; it usually erupts every 60 to 110 minutes, so rangers predict each eruption from the last one.)

PRACTICE

1. **EASY** Which President signed the law creating Yellowstone National Park, and on what date?
2. **EASY** Name the photographer and the painter who traveled with Hayden’s survey in 1871.
3. **EASY** In which state is most of Yellowstone? Which two other states does it touch?
4. **MEDIUM** On a map where 1 inch = 10 miles, the Lower Falls are $1\frac{1}{2}$ inches from Yellowstone Lake. How far is that in miles?
5. **MEDIUM** Look at the Yellowstone map. In which direction would you travel to go from Old Faithful to Mammoth Hot Springs?
(Use the map or drawing “Use the map to find the direction.” shown earlier in this lesson.)
6. **MEDIUM** The Lower Falls are about 308 feet tall. A ten-story building is about 100 feet tall. About how many ten-story buildings stacked up would match the falls?
7. **HARD** Moran’s painting is 12 feet wide. If a fourth grader is about 4 feet tall, how many fourth graders lying head to toe would stretch across it? Congress paid \$10,000 for it.

How much is that for each foot of width, to the nearest dollar?

8. **CHALLENGE** Explain in two or three sentences why a geyser shoots water into the air but a hot spring just sits in a pool.

COMMON MISTAKES

- Thinking Hayden discovered Yellowstone. Native peoples had lived and hunted there for a very long time, and trappers and an 1870 expedition came before him. Hayden's survey measured and recorded it so Congress would act.
- Thinking a geyser is a volcano erupting lava. A geyser shoots hot water and steam, not melted rock.
- Confusing the Grand Canyon of the Yellowstone (in Wyoming, about 20 miles long) with the much larger Grand Canyon of the Colorado River in Arizona.

Make it a game • Old Faithful Freeze. One player is the ranger and holds a timer. Everyone else crouches low like water in a geyser tube. The ranger slowly counts up to a secret number between 5 and 15 while the players rise little by little, hissing like steam. When the ranger shouts "Old Faithful!" everyone leaps up with arms high and freezes. Anyone who leaps too early must answer a question about Yellowstone (Who signed the law? What year? Which state?) to stay in the game.

Scripture. "He looketh on the earth, and it trembleth: he toucheth the hills, and they smoke." (Psalm 104:32, KJV)

The psalmist pictured the hills smoking at God's touch. At Yellowstone the hills really do steam and smoke. Every geyser is a reminder that the earth is full of power that God made and rules.

Practice answers

1. President Ulysses S. Grant, on March 1, 1872.
2. The photographer was William Henry Jackson and the painter was Thomas Moran.
3. Most of it is in Wyoming; it also reaches into Montana and Idaho.
4. $1 \times 10 = 10$ miles, plus $\frac{1}{2}$ of $10 = 5$ miles, so 15 miles.
5. North (a little to the east of straight north).
6. About 3 ($3 \times 100 = 300$ feet, very close to 308).
7. $12 \div 4 = 3$ fourth graders. $\$10,000 \div 12$ is about \$833 for each foot of width.
8. In both, rain and snowmelt soak down and are heated by hot rock deep underground. In a hot spring the water can rise freely, so it simply fills a pool. In a geyser the water is trapped in a narrow tube, so it gets hotter and builds up steam until the pressure pushes it out in a fountain.

8.2 JOHN WESLEY POWELL AND THE GRAND CANYON

OBJECTIVES

- Tell the story of John Wesley Powell's 1869 journey down the Green and Colorado Rivers through the Grand Canyon.
- Explain how a river, carrying sand and stones, cuts a deep canyon, and read a simple cross-section of the Grand Canyon.
- Trace the Colorado River on a map from the Rocky Mountains to the Gulf of California and figure distances and depths with simple arithmetic.

Warm-up. Hold a bar of soap (or a block of floral foam) under a thin, slow stream of water from the faucet for three minutes. Look at the groove the water makes. Now rub a little sand on the soap and try again. Which cuts faster: clean water, or water carrying grit? Keep your answer in mind for today's lesson.

Watch. *Exploring the Grand Canyon for Children: Learn How the Grand Canyon was Formed for Kids - FreeSchool* (Free School, 5:54). <https://www.youtube.com/watch?v=zta2y7cAMDk>

After the big idea: how the Colorado River carved the Grand Canyon.

Note: The video says the canyon took millions of years to carve and that the oldest rocks are 1.8 billion years old. The lesson describes erosion without giving an age.

Backup video. *John Wesley Powell in the Grand Canyon* (finleyholiday, 2:24). <https://www.youtube.com/watch?v=wPy9JbZHyqQ>

With the story: John Wesley Powell's 1869 trip down the Colorado in wooden boats.

KEY TERMS

canyon

A deep, narrow valley with steep sides, usually cut by a river.

rapid

A place where a river runs fast and rough over rocks.

erosion

The slow wearing away of rock and soil by water, wind or ice.

portage

Carrying boats and supplies over land around a dangerous part of a river.

cross-section

A drawing that shows what something would look like if you sliced straight through it and looked at the cut side.

rim

The top edge of a canyon.

CORE IDEAS

The story. On **May 24, 1869**, just two weeks after the transcontinental railroad was finished, ten men pushed four wooden boats into the Green River at Green River Station in Wyoming Territory. Their leader was **Major John Wesley Powell**, a 35-year-old science teacher from Illinois. Powell had only one arm. He had lost his right arm to a bullet at the Battle of Shiloh in 1862, during the Civil War. On the maps of 1869, the land where the Green River joins the Colorado and the great canyon below it were still almost blank. No one knew if there were waterfalls too high to pass. Powell meant to find out.

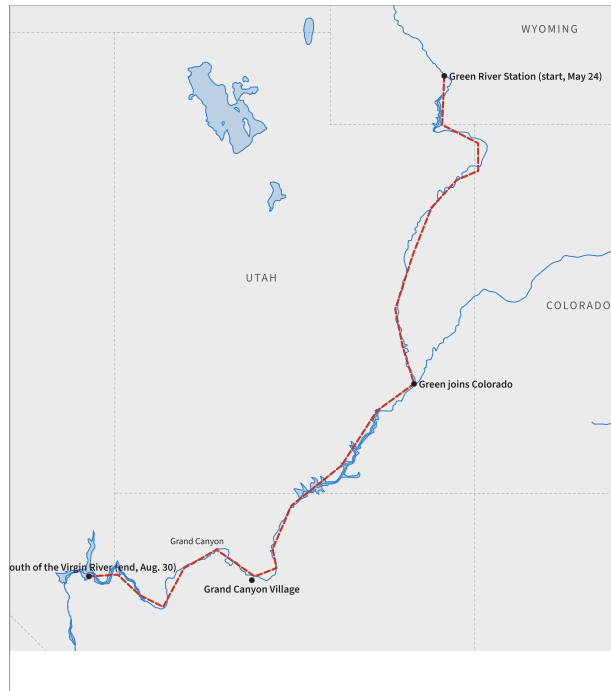
How they did it. The boats had been built in Chicago and shipped west by train. Powell's men carried barometers to measure how high they were, instruments to find their latitude, and food for ten months. When a rapid looked too dangerous, they let the boats down along the shore with ropes, or carried everything around it, which is called a **portage**. Still, disaster came. In June one boat, the *No Name*, smashed on the rocks of a rapid the men named Disaster Falls, and much of their food was lost. Once Powell climbed a canyon wall and got stuck on a ledge, holding on with his one hand. A boatman named George Bradley pulled off his long underwear and let it down so Powell could grab it and be pulled to safety. One man left the trip early. The flour got wet and moldy, and by August they were living on little more than coffee, dried apples and musty bread. On August 13, at the start of the deepest canyon, Powell wrote in his journal, "We are now ready to start on our way down the Great Unknown."

The hardest choice. On August 28 the men reached a roaring rapid. Three of them, the brothers Oramel and Seneca Howland and William Dunn, decided it was too dangerous. They climbed out of the canyon to walk to the settlements and were never seen again; they were killed in the desert, and no one knows for certain by whom. The other six ran the rapid and lived. Powell named it Separation Rapid. Two days later, on **August 30, 1869**, the six men and two battered boats floated out of the canyon country at the mouth of the Virgin River. They had traveled about 1,000 miles in about 100 days.

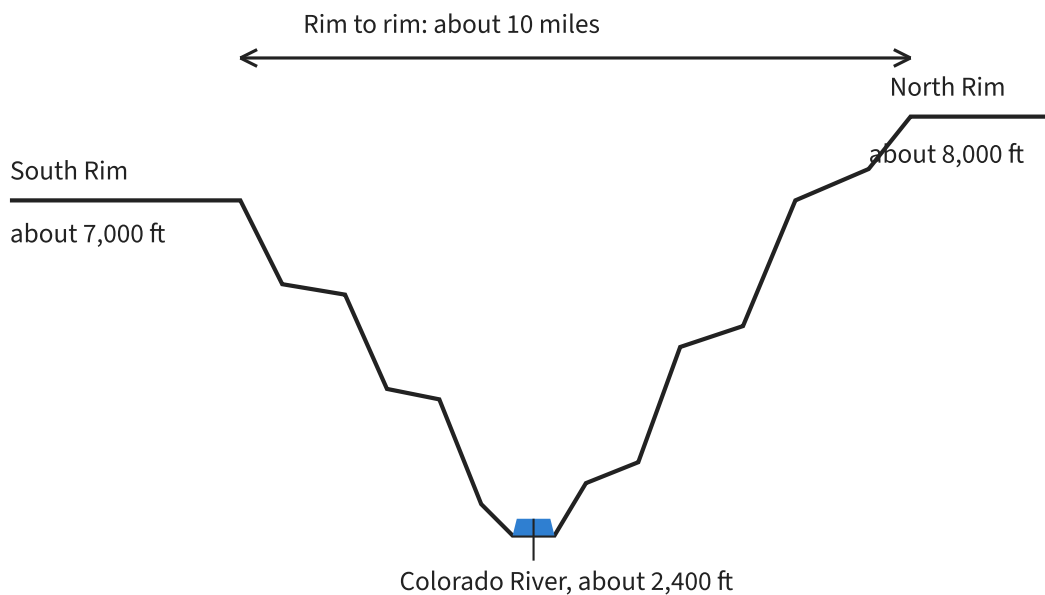
The big idea. How did a river cut a canyon about a mile deep? Remember the soap. Clean water wears rock slowly, but the Colorado is full of sand, gravel and boulders. It works like a moving file, grinding its bed deeper. At the same time, rain, side streams, frost and rockfalls wear back the walls, making the canyon wider. This wearing away is called **erosion**. In the canyon walls you can see layer upon layer of rock, red, tan, gray and white, stacked like the pages of a giant book. The cross-section diagram shows the shape: wide at the **rim**, narrow at the bottom, with steps where hard layers stand out and soft layers wear back.

On the map. The Colorado River begins in the Rocky Mountains of Colorado and flows about 1,450 miles southwest to the Gulf of California in Mexico. The Green River rises in Wyoming and joins it in the canyon country of Utah. The Grand Canyon itself lies in northern Arizona. It is about 277 miles long by river, up to 18 miles wide, and about a mile deep. Congress made it a national park in 1919.

After the river. Powell went back in 1871 with mapmakers and a photographer to map the canyon carefully. He learned Paiute and Ute words and wrote down the ways of the Native peoples he met. Later he became head of the U.S. Geological Survey, the government's map-making office. He warned Congress that much of the West gets very little rain, so settlers would have to plan carefully how to share its rivers. He had learned the land the hard way, and he wanted it used wisely.



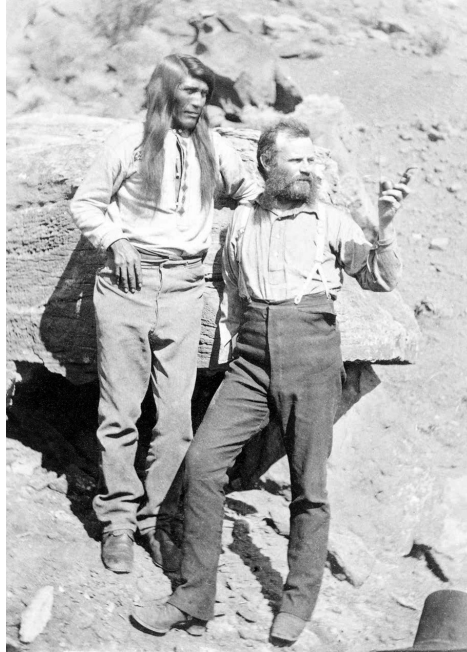
Powell's route, May 24 to August 30, 1869.



Not to scale: the depth is stretched so you can see it.

A simple cross-section of the Grand Canyon near Grand Canyon Village. Rim to rim is about 10 miles.

PICTURE STUDY



Major Powell with Tau-gu, a Paiute Chief, John K. Hillers, about 1873 · Photograph · National Anthropological Archives, Smithsonian Institution; prints also at Grand Canyon National Park and other collections

John K. Hillers joined Powell's second river trip as a boatman and became its photographer. He carried a big wooden camera and glass plates through the canyon country of Utah and Arizona. In this photograph, Powell stands with Tau-gu, a chief of the Southern Paiute people, on a rocky point above the Virgin River. Powell spent many days among the Paiutes, writing down their words and asking about the land, the springs and the trails that they knew far better than any newcomer.

Look closely

- Find Powell. How can you tell he is the man who lost an arm in the Civil War?
- Look at the clothing of each man. What can you learn about how each one lived?
- Look at the land behind them. Is it green or dry? Rocky or smooth?
- Look at how the two men stand together. What might the photographer want us to think about them?

Talk about it

1. Why would an explorer of a dry, rocky land want to learn from the people who already lived there?
2. Hillers had to hold everyone still for the camera. Why do you think old photographs often look so serious?

Safety first. Do this project outdoors or in a bathtub or large plastic bin. Wipe up spilled water and sand right away so no one slips.

PROJECT: CARVE A CANYON IN A SAND TRAY

You will build a stream table and watch running water carve a canyon, just as the Colorado did. Then you will draw a cross-section of the canyon you made.

You will need

- A long shallow box lid, baking pan or plastic storage-bin lid with one short end cut open
- Damp sand, enough to fill the tray about 2 inches deep (play sand works well)
- A little colored sand or crushed colored chalk for layers (optional)
- A paper or plastic cup with a small hole poked near the bottom
- A pitcher of water, a book or block to prop up one end, and a bucket or bin to catch the water
- Ruler, pencil and paper

Steps

1. Pack the damp sand firmly into the tray. If you have colored sand, pack it in three thin layers of different colors, pressing each one flat.
2. Prop the closed end of the tray on a book about 2 inches high. Set the open end over the bucket.
3. Hold the cup at the high end and fill it from the pitcher so a thin stream trickles onto the sand. Keep it trickling for 5 minutes.
4. Watch the stream. Where does it cut down fastest? Do the sides slump in? Does it carry sand to the bottom of the tray?
5. Stop the water. Use the ruler to measure how deep and how wide your canyon is in the middle.
6. Prop the tray one book higher and run the water 5 more minutes. Measure again. Did the steeper slope cut faster?
7. Draw a cross-section of your canyon as if you sliced across it. Label the rim, the walls, the stream and your colored layers.

Tips

- A slow, thin trickle carves a better canyon than a big splash.
- If the sand is too dry it will collapse; if it is too wet it will flow like mud. Damp like a sandcastle is just right.

Check your work

- I built a stream table and watched water cut a channel.
- I measured my canyon's depth and width twice and compared them.
- My cross-section is labeled with the rim, walls and stream.

MAP NOTEBOOK

1. Trace Powell's route from the map. Mark Green River Station, the joining of the Green and the Colorado, the Grand Canyon and the mouth of the Virgin River. Write the start and end dates.
2. Draw the four boats and cross out the one that was wrecked at Disaster Falls. Under them write how many men started (10) and how many finished (6).
3. Draw the Grand Canyon cross-section and label the South Rim, the North Rim and the Colorado River with their heights.

From history. In May 1903, President Theodore Roosevelt stood at the edge of the Grand Canyon and spoke to the crowd. "Leave it as it is," he said. "You cannot improve on it. The ages have been at work on it, and man can only mar it." In 1908 he protected the canyon as a national monument, and in 1919 Congress made it Grand Canyon National Park.

WORKED EXAMPLES

Example 1. Powell's party traveled about 1,000 miles from May 24 to August 30, 1869. How many days is that? About how many miles did they travel each day?

(Use the map or drawing "Powell's 1869 route." shown earlier in this lesson.)

1. Days left in May after the 24th: $31 - 24 = 7$.
2. June has 30 days and July has 31 days.
3. Then 30 days in August, up to the 30th.
4. $7 + 30 + 31 + 30 = 98$ days, which is about 100 days.
5. $1,000 \text{ miles} \div 100 \text{ days} = 10 \text{ miles a day}$.

Answer: 98 days, or about 100 days; about 10 miles a day.

Example 2. Use the cross-section. The South Rim at Grand Canyon Village is about 7,000 feet above sea level, and the Colorado River below it is about 2,400 feet above sea level. How deep is the canyon there? Is that more or less than a mile (5,280 feet)?

(Use the map or drawing "Read the heights from the cross-section." shown earlier in this lesson.)

1. Depth = height of rim – height of river.
2. $7,000 - 2,400 = 4,600$ feet.
3. 4,600 is less than 5,280, so it is a little less than a mile.

Answer: About 4,600 feet deep, a little less than a mile. From the higher North Rim (about 8,000 feet) it is about 5,600 feet, a little more than a mile.

PRACTICE

1. **EASY** How did John Wesley Powell lose his right arm?
2. **EASY** On which two rivers did Powell's party travel in 1869?
3. **EASY** Ten men started the trip and six finished. How many did not finish?
4. **MEDIUM** Look at the map. In which general direction did Powell travel from Green River Station to the mouth of the Virgin River?
(Use the map or drawing "Follow the red route from start to finish." shown earlier in this lesson.)
5. **MEDIUM** The North Rim is about 8,000 feet high and the South Rim is about 7,000 feet high. Which rim is higher, and by how much?
6. **MEDIUM** What is a portage, and why did Powell's men sometimes make one?
7. **HARD** The Grand Canyon is about 277 miles long by river. If a raft trip covers about 15 miles a day, about how many days does it take to float the whole canyon? Round to the nearest day.
8. **CHALLENGE** In two or three sentences, explain how the Colorado River cut the Grand Canyon. Use the word erosion.

COMMON MISTAKES

- Thinking Powell was the first person ever to see the Grand Canyon. Native peoples lived in and around it, and Spanish explorers saw it from the rim in 1540. Powell's party was the first known to travel the length of it by boat.
- Thinking the canyon is the same height on both sides. The North Rim is about 1,000 feet higher than the South Rim.
- Thinking a river cuts mostly with water alone. The sand, gravel and boulders it carries do most of the grinding.

Make it a game • Run the Rapids. Lay ten pillows or towels in a winding line across the floor to be the river, with a few "rapids" marked by a shoe beside the pillow. Players are boats and step from pillow to pillow. At each rapid, the leader asks a question about Powell or the Grand Canyon. A right answer lets you run the rapid. A wrong answer means you must portage: walk back two pillows and carry a "boat" (a cushion) around the rapid before going on. The first boat to reach the mouth of the Virgin River wins.

Scripture. "In his hand are the deep places of the earth: the strength of the hills is his also. The sea is his, and he made it: and his hands formed the dry land." (Psalm 95:4-5, KJV)

Powell called the canyon "the Great Unknown," but it was never unknown to God. Even the deepest canyon lies in His hand.

Practice answers

1. He was shot at the Battle of Shiloh in 1862, during the Civil War, and his arm had to be cut off.

2. The Green River and the Colorado River.
3. 4 (one left early, and three left at Separation Rapid).
4. South and west (southwest).
5. The North Rim, by about 1,000 feet.
6. A portage is carrying boats and supplies over land around a dangerous part of a river.
Powell's men did it when a rapid looked too dangerous to run.
7. $277 \div 15 = 18$ with 7 left over (about 18.5), so to the nearest day, about 18 days.
8. The Colorado carries sand, gravel and stones that grind against its bed like a file, so the river wears the rock deeper and deeper. Rain, side streams, frost and falling rock wear back the walls and widen the canyon. This wearing away of rock is called erosion.

8.3 WHERE THINGS COME FROM ★

OBJECTIVES

- Tell the story of Edwin Drake's oil well at Titusville, Pennsylvania, in 1859.
- Define natural resource and sort resources into renewable and nonrenewable.
- Read a natural resources map of the United States with a key and a letter-number grid, and name where coal, iron, oil, timber, fish and farm crops come from.

Warm-up. Go on a five-minute treasure hunt in your kitchen. Find one thing made from wood or paper, one thing made of metal, one thing made of plastic, one food that grew in a field and one food from the sea (look for a can of tuna or sardines). Line them up on the table. For each one, guess: did this start out in a forest, a mine, an oil well, a farm or the ocean?

Watch. *Natural Resources for Kids* / Teach your kids and students about Earth's Natural Resources (Learn Bright, 9:33). https://www.youtube.com/watch?v=dsTgyb_ITtk
After the big idea: natural resources, renewable and nonrenewable, for kids.

Note: Encourages conservation and renewable energy, and says oil formed over hundreds of millions of years. The lesson treats resources without that framing.

Backup video. *Drake Well Museum: Drilling the Drake Well* (Pennsylvania Historical and Museum Commission, 4:29). <https://www.youtube.com/watch?v=jBKEnZRWm1E>
With the story: how Edwin Drake drilled the first oil well at Titusville in 1859, from the Drake Well Museum.

KEY TERMS

natural resource

Something found in nature that people can use, such as water, soil, trees, fish, coal or oil.

renewable resource

A resource that can grow back or be replaced if people care for it, such as trees, fish and crops.

nonrenewable resource

A resource that exists in a fixed amount and does not grow back, such as coal, iron ore and oil.

ore

Rock that has enough metal in it, such as iron, to be worth digging up.

map key

The box on a map that explains what each symbol or color stands for. It is also called a legend.

CORE IDEAS

The story. In the 1850s, families lit their homes at night with lamps that burned whale oil, and whale oil was getting scarce and expensive. Along Oil Creek in northwestern Pennsylvania, a dark, sticky oil seeped out of the ground and floated on the water. People soaked it up with blankets and sold it as medicine. A company hired a former railroad conductor named **Edwin Drake** to find a way to get more of it. The company sent him letters addressed to “Colonel Drake” to impress the townsfolk, so everyone called him the Colonel, though he had never been a soldier.

How they figured it out. Drake had an idea: drill for oil the way people drilled for salt water. He hired a salt-well driller, William Smith, called Uncle Billy, and set up a wooden derrick and a small steam engine near the town of Titusville. Water and loose dirt kept caving into the hole, so Drake drove an iron pipe down through the mud to the solid rock and drilled inside the pipe. People laughed and called it “Drake’s Folly.” On **August 27, 1859**, the drill reached about 69½ feet. The next morning Uncle Billy looked down the pipe and saw oil floating at the top. The well soon pumped about 25 barrels of oil a day. The oil was made into kerosene for lamps, and within a few years wells were being drilled all along Oil Creek.

The big idea. A **natural resource** is something God placed in the earth that people can use. Some resources are **renewable**: a forest that is cut can be replanted, fish lay eggs and new fish grow, and wheat comes back every year from seed. Others are **nonrenewable**: there is only so much coal, iron ore and oil in the ground, and once it is dug or pumped out, it is gone. Resources are not spread evenly. Coal lies in thick layers in some places and none at all in others. Iron **ore** lies in certain ranges of hills. Oil is trapped in certain rocks deep underground. Where a resource is found, towns, jobs, railroads and ports grow up around it.

On the map. Look at the resource map and its **map key**. *Coal* comes from the Appalachian Mountains in states like Pennsylvania, West Virginia and Kentucky, and today most of all from the Powder River Basin of Wyoming. *Iron ore* comes mostly from the Mesabi Range in northern Minnesota. *Oil* was first drilled in Pennsylvania, but today Texas pumps the most, with more from Alaska, New Mexico, North Dakota and wells far out in the Gulf of Mexico. *Timber* comes from the tall Douglas-fir forests of Oregon and Washington, the pine forests of the South and the woods of Maine. *Fish* come from the cold waters off New England, where Gloucester, Massachusetts, has sent out fishing boats since the 1620s, and most of all from Alaska, home of salmon and pollock. Farms add their own riches: corn in Iowa, wheat in Kansas and North Dakota, and cotton in Texas and the South.

Technology overcoming geography. A resource is not much use if it is stuck far from the people who need it. Iron ore from Minnesota rode on long ore boats across the Great Lakes. Coal from the Appalachians rode on railroad cars to the cities. Pittsburgh became a great steel city because coal from nearby hills and iron ore brought by water met there. Pipes, trains and ships turned resources from faraway places into the steel, fuel and lumber that built the country.



Some of the natural resources of the United States. Alaska, not shown here, adds oil, timber and the largest fish catch of any state.

PICTURE STUDY



The Herring Net, Winslow Homer, 1885 · Oil on canvas · Art Institute of Chicago

Winslow Homer lived on the rocky coast of Maine at Prouts Neck and painted the sea and the people who worked on it. Here two fishermen in a small rowboat called a dory haul in a net heavy with herring. Behind them, in the fog, wait the larger fishing schooners that carried the dories out to sea. Fish were one of the first great resources of New England, and fishing families worked hard and faced real danger to bring them in.

Look closely

- Find the fish. How can you tell the net is heavy?
- Look at the waves. Is the boat steady or rocking? How do the men keep their balance?
- Find the ships in the fog. Why might the fishermen want to stay close to them?
- What colors did Homer use for the sea and sky? What kind of day does it seem to be?

Talk about it

1. Fish are a renewable resource. What would happen if fishermen caught every fish and left none to lay eggs?
2. What other jobs in a fishing town depend on the fish these men catch?

PROJECT: A RESOURCE MAP WITH REAL SAMPLES

You will make a large map of the United States and glue real samples of resources on the places they come from. This is the main project of the unit, so take your time and make it neat. You will add to it in Lesson 8.4.

You will need

- A large poster board or a sheet of cardboard
- A printed outline map of the United States to trace, or the map in this lesson to copy
- Pencil, black marker and colored pencils
- Strong white glue or a hot-glue gun (with a parent)
- Small real samples: a lump of coal (from a rock shop or hobby store) or a piece of charcoal labeled “stand-in for coal”; a small piece of iron ore or a steel nail; a wood chip or thin slice of a twig; a cotton ball or, if you can get one, a real cotton boll; a few wheat grains or a wheat stalk (from a craft store) or a spoonful of flour in a tiny sealed bag
- Pictures cut from magazines or drawn by you for oil and fish
- A magnet

Steps

1. Trace or copy the outline of the United States on the poster board, as large as it will fit. Add the Great Lakes and the Gulf of Mexico. Draw a small Alaska in a box in one corner.
2. Lightly draw a grid over the map with letters A to F across the top and numbers 1 to 4 down the side, like the grid in this lesson.
3. Using the resource map, glue each sample where it comes from: coal on West Virginia and Wyoming, iron on northern Minnesota, wood on Oregon or Washington, cotton on Texas or Mississippi, wheat on Kansas.
4. Draw or glue pictures for oil on Texas and on Pennsylvania (write “Drake’s well, 1859”) and for fish on Massachusetts and Alaska.

5. Make a map key in a corner. Give each resource a symbol or color, and mark R for renewable or N for nonrenewable next to it.
6. Test your iron sample with the magnet. Write in your key whether it was attracted.
7. Write a title across the top: "Where Things Come From," and add a compass rose.

Tips

- Use only a tiny piece of each sample so it stays glued. Heavy samples can go in a small plastic bag stapled to the board.
- Do not put real oil on your map. A picture works better and stays clean.

Check your work

- My map has at least five real samples glued in the right states.
- My key explains every symbol and marks each resource renewable or nonrenewable.
- I can point to each sample and tell where it comes from and what people make from it.

MAP NOTEBOOK

1. Draw Drake's wooden derrick with the iron pipe going down into the ground. Label the pipe, the derrick and the date, August 27, 1859.
2. Make a two-column chart titled Renewable and Nonrenewable. Sort these into it: trees, coal, fish, iron ore, wheat, oil, cotton.
3. Pick one thing in your house and draw a chain showing where it came from, for example: tree, sawmill, lumber truck, store, my bookshelf.

From history. Drake's well was only about 69 feet deep. Forty-two years later, on January 10, 1901, a well on a hill called Spindletop near Beaumont, Texas, blew a fountain of oil more than 100 feet into the air. It gushed for nine days before workers could cap it. Spindletop began the great Texas oil boom, and Texas has been a leading oil state ever since.

WORKED EXAMPLES

Example 1. Use the resource grid. In which square is the iron ore? What resource is found in square E2?

	A	B	C	D	E	F
1	T	C		I		
2			Wh		C	F
3			O			
4				O		

Key
 T = timber
 C = coal
 I = iron ore
 O = oil
 F = fish
 Wh = wheat

N

 West on left,
 east on right

A resource grid of the United States. West is on the left and north is at the top.

1. Find the letter I (iron ore) on the grid.
2. Go straight up from it to read the letter at the top: D.
3. Go straight left to read the number at the side: 1. So the square is D1.
4. Now find column E across the top and row 2 down the side. Where they meet is the letter C.
5. Look up C in the key: coal.

Answer: Iron ore is in D1 (northern Minnesota). Square E2 has coal (the Appalachian coal fields).

Example 2. Ore boats carried iron ore from Duluth, Minnesota, on Lake Superior toward the steel mills. On a map with a scale of 1 inch = 100 miles, Duluth is 4 inches from Chicago in a straight line. How far apart are they?

1. Each inch stands for 100 miles.
2. 4 inches $\times$ 100 miles = 400 miles.

Answer: About 400 miles in a straight line. (A boat must go much farther, all the way around through Lake Superior, the top of Lake Huron and Lake Michigan.)

PRACTICE

1. **EASY** Where and when did Edwin Drake drill his famous oil well?
2. **EASY** Sort into renewable or nonrenewable: timber, coal, fish, oil.
3. **EASY** Which state produces most of the iron ore in the United States, and from what range of hills?
4. **MEDIUM** Use the resource grid. Name the resource in A1 and the resource in F2.
(Use the map or drawing "Read the squares on the grid." shown earlier in this lesson.)
5. **MEDIUM** Use the resource grid. Oil appears in two squares. Which ones? Both are in the state that pumps the most oil today. Which state is it?
(Use the map or drawing "Find both O symbols." shown earlier in this lesson.)
6. **MEDIUM** An oil barrel holds 42 gallons. Drake's well pumped about 25 barrels a day. About how many gallons was that each day?
7. **HARD** Look at the resource map. Which resource is found both in West Virginia and in Wyoming? Which of those two states produces more of it today?
(Use the map or drawing "Find the two coal points." shown earlier in this lesson.)
8. **CHALLENGE** In two or three sentences, explain why Pittsburgh became a great steel-making city.

COMMON MISTAKES

- Thinking every resource is found everywhere. Resources lie only in certain places, which is why a resource map looks spotty.
- Thinking renewable means a resource can never run out. Forests and fish grow back only if people take care not to use them up faster than they grow.
- Reading a grid square backward. Read the letter across the top first, then the number down the side: D1, not 1D.

Make it a game • Resource Bingo. Each player draws a 3-by-3 grid and writes nine resources in the squares (coal, iron ore, oil, timber, fish, wheat, corn, cotton, copper). The caller reads clues: "Mesabi Range," "Gloucester," "Drake's well," "Douglas-fir forests," "Powder River Basin," "Kansas fields." Players cover the resource that matches the clue. Three in a row wins, but the winner must name where each of the three resources comes from.

Scripture. "A land wherein thou shalt eat bread without scarceness, thou shalt not lack any thing in it; a land whose stones are iron, and out of whose hills thou mayest dig brass." (Deuteronomy 8:9, KJV)

Moses described the Promised Land as a land rich in bread, iron and copper. God stores His gifts in the hills and fields of every land, and the United States is richly supplied. The very next verse tells Israel to bless the Lord for the good land He has given.

Practice answers

1. Near Titusville, Pennsylvania, in August 1859 (oil was found on August 28, after reaching about 69½ feet on August 27).
2. Renewable: timber and fish. Nonrenewable: coal and oil.
3. Minnesota, from the Mesabi Range.
4. A1: timber (the Pacific Northwest). F2: fish (New England).
5. C3 and D4. Both are in Texas, the state that pumps the most oil today (C3 is the Permian Basin of west Texas; D4 is near Spindletop on the Gulf Coast).
6. $25 \times 42 = 1,050$ gallons a day.
7. Coal. Wyoming produces more today, mostly from the Powder River Basin.
8. Steel is made from iron ore heated with coal (made into coke). Pittsburgh had coal in the hills right around it, and iron ore could be brought to it by boat and rail. Because both resources met there, mills and jobs grew up in that place.

8.4 STEWARDS OF A GOOD LAND

OBJECTIVES

- Explain what the Bible means by dominion and by keeping the land (Genesis 1:28; 2:15), and what a steward is.
- Tell how Theodore Roosevelt and John Muir worked to protect wild lands, and how the Dust Bowl of the 1930s taught farmers to care for the soil.
- Show with a hands-on test why plant cover and contour plowing keep soil from washing away, and compare results with simple numbers.

Warm-up. Imagine a neighbor goes away for a month and asks you to take care of her garden. Make a quick list of what a good caretaker would do (water, weed, pick the ripe beans) and what a bad one would do (forget it, or pick every bean and let the plants die). Now think: whose garden is the whole earth, and who has been asked to take care of it?

Watch. *History Brief: Roosevelt the Conservationist* (Reading Through History, 4:12).
https://www.youtube.com/watch?v=kIkhpGxe_Tw
 With the story: Theodore Roosevelt the conservationist and his camping trip with John Muir.

Backup video. *History Brief: the Dust Bowl* (Reading Through History, 4:04).
<https://www.youtube.com/watch?v=n-rBhbkvtn0>
 With the section on the soil: the Dust Bowl and how farmers learned to save the soil.

KEY TERMS

steward

A person who takes care of something that belongs to someone else. God owns the earth; people are His stewards.

dominion

The rule and responsibility God gave people over the earth and its creatures (Genesis 1:28): to use it and to care for it well.

conservation

Using natural resources wisely so they are not wasted and will last.

contour plowing

Plowing rows across a slope, around the hill at the same height, so each row catches rainwater instead of letting it rush downhill.

shelterbelt

A long row of trees planted along the edge of fields to slow the wind and hold the soil.

CORE IDEAS

The story. In May 1903, President **Theodore Roosevelt** rode into Yosemite Valley in California with a bearded, white-haired guide named **John Muir**. Muir had been born in Scotland, grew up on a Wisconsin farm, and as a boy learned much of the Bible by heart. He had spent years walking the Sierra Nevada with little more than bread and a notebook. For three nights the President and the mountain man camped out: under giant sequoia trees, on a snowy ridge near Glacier Point, and in the valley below Bridalveil Fall. They talked late by the fire about how to keep such places from being ruined. In the years that followed, Roosevelt set aside about 230 million acres of public land, including national forests, national parks and bird refuges.

The hard lesson. Thirty years later came a warning of what happens when land is used carelessly. On the southern Great Plains, farmers had plowed up millions of acres of thick prairie grass to plant wheat. The grass roots had held the soil in place for as long as anyone could remember. Then, in the 1930s, came years of drought. With no grass and no rain, the wind lifted the dry, bare soil into towering black clouds. On **April 14, 1935**, called **Black Sunday**, a dust storm rolled across Oklahoma and Texas so thick that day turned dark as night. This was the **Dust Bowl**. Families shoveled dust out of their houses, and many lost their farms.

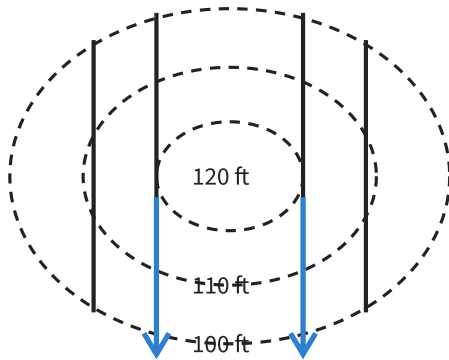
How they figured it out. A soil scientist named **Hugh Hammond Bennett** showed farmers how to fight back, and in 1935 Congress created the Soil Conservation Service with Bennett as its first chief. Farmers learned **contour plowing**: plowing around a hill instead of straight up and down, so every row catches the rain (see the diagram). They planted grass on land too dry to farm. They planted **shelterbelts** of trees, more than 200 million trees across the Plains, to slow the wind. Slowly the soil stayed put. The same land that blew away in the 1930s grows wheat today.

The big idea. On the sixth day of creation, God told the first people to “replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth” (Genesis 1:28). Then He put Adam in the garden “to dress it and to keep it” (Genesis 2:15). To *dress* the land is to work it: plow, plant, mine, build. To *keep* it is to guard it and take care of it. A good **steward** does both. There are two ways to go wrong. One is to waste the land, taking all you can now and leaving ruin behind, like the bare fields of the Dust Bowl. The other is to treat nature as if it were God, too holy to touch. The Bible teaches neither. The earth belongs to the Lord. He gives it to us to use for our families and neighbors, and He expects us to hand it on in good shape to the people who come after us.

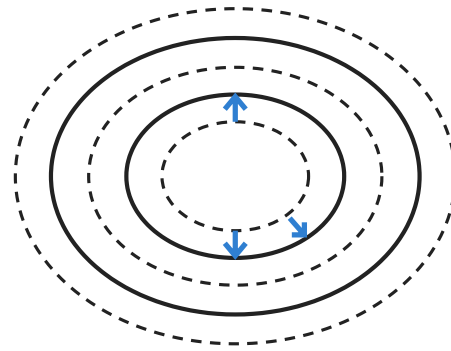
On the map. You can see stewardship on a map and even from an airplane window. Green patches mark national parks and national forests. On hilly farms the fields curve around the hills in contour rows. On the Great Plains, straight lines of trees run along the edges of fields. Remember your resource map: foresters replant trees after cutting, fishermen follow limits so fish can lay eggs, and old mines are filled and planted again. Good people disagreed then, and still do, about which land to keep wild and which to use. John Muir wanted many

places kept just as God made them. Gifford Pinchot, the first chief of the U.S. Forest Service, wanted forests used wisely, cut and regrown, for the good of the most people over the longest time. Both men wanted to stop waste.

The same hill seen from above



Rows up and down the hill:
rain races down the rows
and carries soil away.



Rows around the hill
(contour plowing):
each row catches the rain.

Dashed lines are contour lines. Solid lines are plow rows.

Up-and-down rows (left) let water race downhill and carry soil away. Contour rows (right) catch the water.

PICTURE STUDY



Farmer and Sons Walking in the Face of a Dust Storm, Cimarron County, Oklahoma, Arthur Rothstein, April 1936 · Photograph (black-and-white negative) · Library of Congress, Washington, D.C. (Farm Security Administration collection)

Arthur Rothstein was a young photographer sent by the government to show Americans what was happening on the Great Plains. In the Oklahoma Panhandle he photographed a farmer named Arthur Coble and his two young sons hurrying through the blowing dust toward a shed. Drifts of soil were piled against the buildings like snow. This photograph appeared in newspapers across the country and helped people understand why the Plains needed help and why the soil had to be cared for.

Look closely

- Find the farmer and his two sons. How are they walking? Why?
- Look at the shed and the fence. What has piled up against them?
- Look at the sky and the ground. Can you find any grass or green plants at all?
- Where is the smallest boy? How do you think he feels?

Talk about it

1. The dust in this picture used to be good farm soil. Where did it come from, and why did it blow away?
2. What could a farmer do on this land so that it would not blow away again?
3. How is this photograph different from Moran's painting of Yellowstone? What does each one want you to feel?

Safety first. Do the test outdoors or over a sink or bathtub. Ask a parent before cutting a piece of sod from the yard.

PROJECT: THE SOIL EROSION TEST

You will build three small hillsides of soil and pour the same "rain" on each one. You will see with your own eyes why bare fields wash away and how plants and contour rows protect the soil.

You will need

- Three aluminum baking pans, or three shoeboxes lined with plastic bags, each with a V notch cut in one short end
- Garden soil, enough to fill each pan about 2 inches deep
- A piece of grass sod about the size of one pan (or a thick layer of dead leaves or straw as a cover)
- A pencil or craft stick for making rows
- Three clear cups or jars to catch the runoff
- A watering can or a cup with holes poked in the bottom
- Books or blocks to prop up the pans, a measuring cup and a tablespoon

Steps

1. Fill pan 1 with bare soil and smooth it flat. Fill pan 2 with soil and lay the sod (or the leaves or straw) on top. Fill pan 3 with bare soil and use the pencil to draw rows across the pan, from side to side.
2. Prop the back of each pan on the same number of books so all three slope the same amount. Set a clear cup under each notch.
3. Measure 2 cups of water. Pour it slowly and evenly over pan 1 with the watering can, like a rainstorm. Do the same for pan 2 and pan 3.
4. Look at the three cups. Which water is muddiest? Which cup has the most water?
5. Let the cups sit for an hour so the soil sinks to the bottom. Measure about how many tablespoons of soil settled in each cup, or line the cups up from most soil to least.
6. Record your results in a chart with three rows: bare soil, covered soil, contour rows.
7. On your resource map from Lesson 8.3, add a small stewardship symbol (a sprout) next to two resources, and write one way people can care for each one, such as “replant trees” or “plow along the contours.”

Tips

- Pour the same amount of water the same way on every pan. A fair test changes only one thing.
- If you have no sod, sprinkle grass seed on a pan of soil a week ahead, water it daily and let it sprout.

Check your work

- I tested three pans and kept the slope and the water the same.
- My chart shows which pan lost the most soil and which lost the least.
- I can explain how grass roots and contour rows protect the soil.

MAP NOTEBOOK

1. Draw the two hills from the diagram, one with up-and-down rows and one with contour rows. Draw blue arrows to show where the rain goes on each.
2. Copy Genesis 2:15 in your best handwriting. Under it draw a picture of someone who “dresses” the land and someone who “keeps” it.
3. Draw a Plains farm from above with a shelterbelt of trees along the north and west edges of the fields. Add an arrow for the wind.

From history. On April 10, 1872, just weeks after Yellowstone became a national park, the state of Nebraska held the first Arbor Day. A newspaper editor named J. Sterling Morton had urged settlers on the treeless plains to plant trees for shade, fuel, fruit and windbreaks. People planted about a million trees that single day. Arbor Day is still kept across the country, usually on the last Friday in April.

WORKED EXAMPLES

Example 1. In the soil test, 6 tablespoons of soil settled in the cup from the bare pan and 1 tablespoon settled in the cup from the grassy pan. How many times as much soil did the bare pan lose? How many more tablespoons?

1. To find how many times as much, divide: $6 \div 1 = 6$.
2. To find how many more, subtract: $6 - 1 = 5$.

Answer: The bare pan lost 6 times as much soil, which is 5 more tablespoons.

Example 2. In May 1934 a great dust storm carried soil from the southern Plains all the way to cities on the East Coast. On a map with a scale of 1 inch = 200 miles, Boise City, Oklahoma, is 7 inches from Washington, D.C. How far is that?

1. Each inch stands for 200 miles.
2. 7 inches $\times$ 200 miles = 1,400 miles.

Answer: About 1,400 miles. The wind carried Plains soil that far.

PRACTICE

1. **EASY** What is a steward?
2. **EASY** In Genesis 2:15, God put Adam in the garden to do two things. What were they?
3. **EASY** What happened on Black Sunday, April 14, 1935?
4. **MEDIUM** Look at the contour plowing diagram. On which hill does the water run straight down the rows? Which hill keeps more soil?
(Use the map or drawing "Compare the two hills." shown earlier in this lesson.)
5. **MEDIUM** The first Arbor Day was held in Nebraska in 1872, the same year Yellowstone became a park. Black Sunday came in 1935. How many years apart were they?
6. **MEDIUM** Name two things farmers learned to do after the Dust Bowl to keep their soil from blowing or washing away.
7. **HARD** A Plains farm planted a shelterbelt with one tree every 10 feet along a field edge 1,000 feet long. How many trees did it need, counting a tree at both ends?
8. **CHALLENGE** John Muir and Gifford Pinchot both wanted to stop waste, but they disagreed. In two or three sentences, explain how they were different. Then tell which idea you think fits a national park and which fits a national forest.

COMMON MISTAKES

- Thinking dominion means people may do whatever they want with the earth. Dominion is a responsibility given by God, the true owner, and it comes with the command to keep the land.

- Thinking stewardship means never using anything. The Bible tells people to work the land; good stewards farm, mine and cut timber, but wisely and without waste.
- Thinking the Dust Bowl was caused only by drought. Dry years came often to the Plains; the dust storms were so bad because the grass that held the soil had been plowed away.

Make it a game · Steward or Waster?. The leader reads a short action: “A logger plants three seedlings for every tree he cuts.” “A farmer plows straight down a steep hill.” “A fisherman throws back the young fish.” “A camper leaves trash at Old Faithful.” Players stand tall like a tree for a steward action or flop down like blown dust for a waster action. After each one, someone tells how to turn a waster action into a steward action. Take turns making up new actions.

Scripture. “And the LORD God took the man, and put him into the garden of Eden to dress it and to keep it.” (Genesis 2:15, KJV)

God’s first job for people was to work His garden and to guard it. Every farmer who plows along the contour, every forester who replants and every family that tends a garden is doing a small part of that first assignment.

Practice answers

1. A person who takes care of something that belongs to someone else. People are stewards of the earth, which belongs to God.
2. To dress it (work it) and to keep it (guard and care for it).
3. A huge dust storm rolled across the southern Plains, including Oklahoma and Texas, and turned the day as dark as night.
4. The water runs straight down the rows on the left hill (up-and-down rows). The right hill, with contour rows, keeps more soil.
5. $1935 - 1872 = 63$ years.
6. Any two: contour plowing, planting shelterbelts of trees, planting grass on land too dry to farm, leaving plant stubble on fields.
7. $1,000 \div 10 = 100$ spaces, so 101 trees (one more than the number of spaces, because there is a tree at both ends).
8. Muir wanted many wild places kept just as God made them, with little cutting or building. Pinchot wanted forests used wisely: cut, replanted and regrown, for the good of the most people over a long time. Muir’s idea fits a national park, which is kept for people to see and enjoy; Pinchot’s fits a national forest, where timber is harvested and regrown.

UNIT 8 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. Use the maps from this unit where a question asks for them. The review is worth 50 points.

1. (4 pts) Who led the 1871 survey of Yellowstone, and which two men in his party made pictures that helped convince Congress?
2. (4 pts) What is a national park? Which was the first one, and in what year was it created?
3. (5 pts) Explain in two or three sentences how a geyser works.
4. (4 pts) On a map of Yellowstone, 1 inch = 10 miles. Old Faithful is $4\frac{1}{2}$ inches from the north edge of the park. How many miles is that?
5. (4 pts) Who was John Wesley Powell? Give two facts about his 1869 journey.
6. (5 pts) The North Rim of the Grand Canyon is about 8,000 feet above sea level and the river below is about 2,400 feet. How deep is the canyon from the North Rim? Is that more or less than a mile (5,280 feet)?
7. (4 pts) Look at the map of Powell's route. Name the river he started on and the river that carried him through the Grand Canyon. In which state is the Grand Canyon?
8. (4 pts) What is a natural resource? Sort these into renewable and nonrenewable: coal, timber, oil, fish, iron ore, wheat.
9. (5 pts) Match each resource to the place it mainly comes from: (a) iron ore, (b) the first oil well, (c) the most oil today, (d) cod fishing since the 1620s, (e) Douglas-fir timber. Places: Texas; Gloucester, Massachusetts; Mesabi Range, Minnesota; Oregon and Washington; Titusville, Pennsylvania.
10. (4 pts) Use the resource grid from Lesson 8.3. What resource is in square B1? In which square is the wheat?
11. (4 pts) Copy or explain Genesis 2:15. What two jobs did God give Adam, and what does each job mean?
12. (3 pts) Why were the dust storms of the 1930s so terrible, and what is one thing farmers learned to do about it?

UNIT PROJECT: MY RESOURCE MAP OF THE UNITED STATES

Finish the large resource map you began in Lesson 8.3. It should show the outline of the United States (with Alaska in a box), a letter-number grid, a compass rose, a scale bar and a key. Glue real samples of coal, iron, wood, cotton and wheat where they come from, and add pictures for oil and fish. Mark Yellowstone and the Grand Canyon with a star and write the year each was protected. Add sprout symbols with stewardship notes from Lesson 8.4.

Beside the map, attach your soil erosion test chart and write a paragraph answering this question: How can Americans use the riches God put in this land and still "keep" it for the people who come after us?

- **Accuracy:** Samples, pictures, Yellowstone and the Grand Canyon are placed in the correct states, and the grid, scale bar and compass rose are correct.
- **Key and labels:** The key explains every symbol and marks each resource renewable or nonrenewable; labels are clear and spelled correctly.
- **Explanation:** The paragraph uses Genesis 2:15 and at least one real example (contour plowing, replanting forests, fishing limits, national parks) to explain good stewardship.
- **Care:** The map is neat, colorful and sturdy; samples are firmly attached and the erosion test chart is complete.

Answer key

1. Ferdinand V. Hayden led the survey. William Henry Jackson took photographs and Thomas Moran made sketches and watercolors.
2. A national park is land the whole nation sets aside and protects for everyone to enjoy. Yellowstone was the first, created on March 1, 1872.
3. Rain and melted snow soak down through cracks into the ground. Hot rock deep below heats the water. The water is trapped in a narrow tube, so it gets hotter and builds up steam until the pressure pushes water and steam out in a fountain.
4. $4 \times 10 = 40$ miles, plus $\frac{1}{2}$ of 10 = 5 miles, so 45 miles.
5. Powell was a Civil War veteran who lost his right arm at the Battle of Shiloh and later became a science teacher and explorer. Any two: he started at Green River Station, Wyoming Territory, on May 24, 1869; he had ten men and four boats; he traveled down the Green and Colorado Rivers through the Grand Canyon; one boat was wrecked at Disaster Falls; three men left at Separation Rapid; six men reached the mouth of the Virgin River on August 30, 1869.
6. $8,000 - 2,400 = 5,600$ feet, which is a little more than a mile.
7. He started on the Green River. The Colorado River carried him through the Grand Canyon, which is in Arizona.
8. A natural resource is something found in nature that people can use. Renewable: timber, fish, wheat. Nonrenewable: coal, oil, iron ore.
9. (a) Mesabi Range, Minnesota; (b) Titusville, Pennsylvania; (c) Texas; (d) Gloucester, Massachusetts; (e) Oregon and Washington.
10. B1 has coal (Wyoming). The wheat is in C2 (Kansas).
11. "And the LORD God took the man, and put him into the garden of Eden to dress it and to keep it." To dress it means to work the land (plant, plow, build). To keep it means to guard and take care of it.
12. Farmers had plowed up the prairie grass whose roots held the soil, and then years of drought came, so the wind blew the dry, bare soil away. Farmers learned contour plowing, planting shelterbelts of trees, and planting grass on land too dry to farm (any one).

BONUS: MAP LAB

All year you have read maps like a surveyor, traveled the regions of the United States, dug canals, steered steamboats and laid railroad track across the continent. Now it is time to play! The Map Lab is a bonus unit of four lighter lessons full of races, drawing challenges, trip planning and stamp collecting. Each one still begins with a real story: a teenager who designed the 50-star flag, a mapmaker whose map helped set a border, a doctor who drove a car across America in 1903, and the founding of the National Park Service in 1916.

You will race to name all 50 states and their capitals, draw the whole country from memory using the **box method**, plan a real road trip using a map's **scale** to find miles and hours, and make your own **National Parks Passport**. By the end you will carry a map of the United States in your head, and you will know how to use a map to go somewhere real. These lessons may be done in any order, during the year as a break or at the end as a celebration.

BEFORE YOU BEGIN

- Can find the five regions of the United States on a map (Units 2–4)
- Can use a map scale to change inches into miles (Lesson 1.1)
- Can multiply and divide whole numbers, such as 6×100 and $600 \div 60$
- Knows the story of Yellowstone as the first national park (Lesson 8.1)

MASTERY CHECKLIST

- I can place all 50 states on a blank map and name most of their capitals.
- I can name several state capitals that are not their state's biggest city.
- I can draw the 48 connected states from memory in about the right shape, using the 49th parallel, the Great Lakes, Florida and Texas as anchors.
- I can use a map scale to find the miles of a trip and divide by the speed to find the hours.
- I can find at least ten national parks on a map and explain why the National Park Service was created in 1916.

OPTIONAL BOOKS AND RESOURCES

- **National Park Service** (<https://www.nps.gov/>): Free. Find any park by state, see maps and photographs, and read about the Junior Ranger program and the free passport cancellation stamps at visitor centers (Lesson 9.4).
- **Library of Congress Maps Collection** (<https://www.loc.gov/maps/>): Free. Search for “Melish 1816” to zoom in on John Melish’s map of the United States (Lesson 9.2), and browse historic road maps and state maps for your trip planning (Lesson 9.3).

9.1 STATES AND CAPITALS RACE

OBJECTIVES

- Find all 50 states on a blank map of the United States and name each state's capital.
- Explain why a state capital is often not the state's biggest city, using real examples such as Albany, Springfield and Sacramento.
- Use memory tricks and map clues (region, neighbors, latitude and longitude) to win a states and capitals race.

Warm-up. Set a timer for 3 minutes. On a blank sheet, write the names of as many states as you can remember, with no map. When the timer rings, count them. Circle any state whose capital you also know. Keep this sheet: at the end of the lesson you will race your own score.

Watch. *50 States & Capitals of the USA Song* (GEOGRAPHY Songs, 6:25).

<https://www.youtube.com/watch?v=ojRpmYoOBwM>

Before the game: a song of the fifty capitals, each with a fun fact.

Note: The fun facts are trivia (one mentions Oregon wine); the capitals are what matter.

Backup video. *What U.S. State Was Known as Seward's Folly: History in a Minute (Episode #83)* (Homeschool Connections, 2:18). https://www.youtube.com/watch?v=hfCrKi2T_BA

With the Alaska round: why Alaska was called Seward's Folly.

KEY TERMS

state

One of the 50 parts of the United States. Each state has its own government, laws and capital.

capital

The city where a state's (or a country's) government meets and its lawmakers make laws. Spelled with an *a*.

capitol

The building where the lawmakers meet. Spelled with an *o*, like the round dome on top.

region

A group of neighboring states that share land, climate or history, such as New England or the Great Plains.

mnemonic

A memory trick, such as a silly sentence or picture, that helps you remember a fact.

CORE IDEAS

The story. In 1958 a 17-year-old boy named Robert Heft, from Lancaster, Ohio, had a history assignment. Alaska was about to become a state, and Hawaii might soon follow, so Bob decided to make a new American flag with 50 stars. He cut apart his family's 48-star flag and sewed the stars in neat rows. As Heft told the story, his teacher gave the project a B-minus. Bob sent his flag to his congressman, and after Alaska (January 3, 1959) and Hawaii (August 21, 1959) joined the Union, President Eisenhower chose a 50-star design like his. The new flag flew for the first time on July 4, 1960, and it is the flag we still fly. Each star stands for one state, and each state has a capital city where its lawmakers meet.

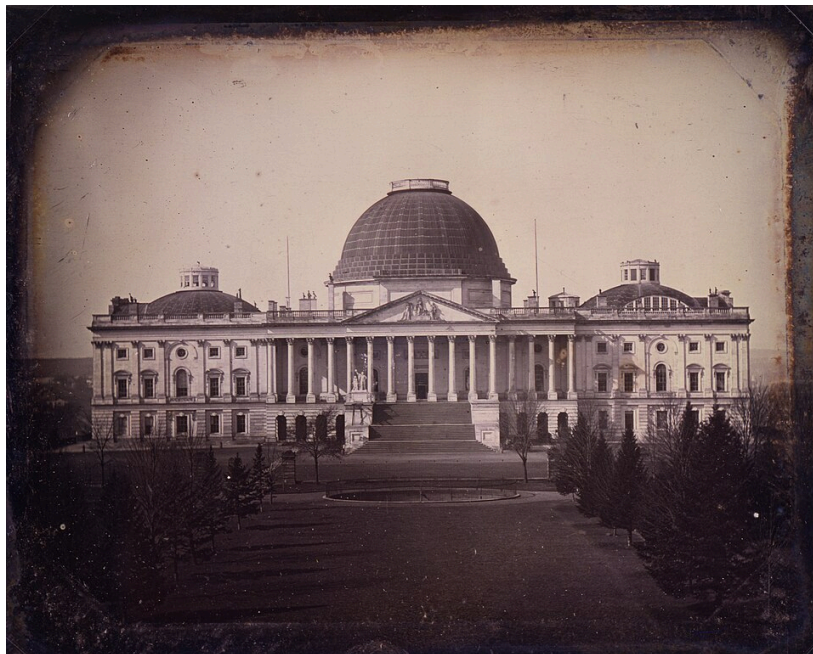
How it works. Many people guess that a state's capital must be its biggest city. Often it is not! The capital of New York is **Albany**, not New York City. Illinois governs from **Springfield**, not Chicago. California's capital is **Sacramento**, not Los Angeles, and Pennsylvania's is **Harrisburg**, not Philadelphia. Long ago, when people traveled by horse and wagon, lawmakers liked a capital near the middle of the state, or on a river, so that no one had too long a trip. That is why many capitals sit inland on rivers: Albany on the Hudson, Sacramento on the Sacramento River, Harrisburg on the Susquehanna. Some capitals, like Boston, Denver and Phoenix, are also the biggest city. You have to learn them one by one, but map clues help.

On the map. The fastest way to learn the 50 states is region by region, the way you studied them this year: the Northeast, the Southeast, the Midwest, the West and the Southwest. Learn a few neighbors at a time and say their capitals out loud while you point. Use tricks: *"Little Rock is a little rock in Arkansas"; "Boise is a boy, and he is in Idaho."* Remember too that Washington, D.C., the nation's capital, is not in any state at all. In this race you are not only memorizing names. You are building a map in your head that will help you every time you read the news, plan a trip or study history. God has *determined the bounds of their habitation* (Acts 17:26), and learning where people live is a way to love our neighbors near and far.



Sixteen state capitals and the nation's capital. Notice how many sit inland, often on rivers, and how many are not the state's biggest city.

PICTURE STUDY



The United States Capitol, East Front, John Plumbe Jr., about 1846 · Daguerreotype (an early kind of photograph on a silvered copper plate) · Library of Congress, Prints and Photographs Division, Washington, D.C.

This is one of the oldest photographs of the United States Capitol, the building in Washington, D.C., where Congress meets. John Plumbe Jr. took it around 1846, only a few years after photography was invented. Look closely at the dome: it is low and made partly of

wood. The tall iron dome we know today was built later, during the 1850s and 1860s, when the Capitol grew bigger as new states joined the Union.

Every state has its own capitol building too, and many of them copy the look of this one, with columns and a dome. When you learn a state capital, you are learning the city where that state's own capitol stands.

Look closely

- Find the dome. Is it tall and pointed, or low and round?
- Count the columns you can see across the front of the building.
- Look at the ground in front. Is it a busy city street or an open yard?
- This picture is black, white and silver. Why do you think there is no color?

Talk about it

1. What is the difference between a *capital* and a *capitol*?
2. Why might a growing country need a bigger capitol building?
3. Have you ever seen your own state's capitol, in person or in a picture? Does it have a dome?

PROJECT: THE 50 STATES RACE CARDS AND WALL MAP

You will make a deck of 50 state cards and a blank wall map, then race yourself (and your family) to put every state in its place and name its capital. Each time you play, write down your time and try to beat it.

You will need

- A printed blank outline map of the United States (from the U.S. Geological Survey, the National Atlas, or a library atlas traced by hand)
- 50 index cards, cut in half if you like
- Colored pencils or markers, one color for each region
- Sticky notes or small pieces of paper and tape
- A kitchen timer or stopwatch
- A pencil and your map notebook

Steps

1. On the front of each card, write a state's name and draw its shape as well as you can. On the back, write its capital and its region.
2. Color the card's edge with the region color, for example blue for the Northeast, green for the Southeast, gold for the Midwest, brown for the Southwest and red for the West.
3. Tape the blank map to a wall or lay it on the floor.
4. Round 1 (States): Shuffle the cards. Start the timer. Read each card and put a sticky note with the state's name on its place on the map. Stop the timer when all 50 are placed. Check with an atlas and write your time and how many you got right.

5. Round 2 (Capitals): Turn the cards so only the state names show. For each one, say the capital before you flip it. Put a check on cards you knew and a dot on cards you missed.
6. Make a “tricky pile” of the cards with dots. Make up a memory trick for each one and write it on the card.
7. Play again on the second day. Record both days’ scores in your map notebook and compare.

Tips

- Start with the big, easy shapes (Texas, California, Florida, Michigan) and use them as anchors for their neighbors.
- Learn the small Northeast states with a finger walk up the coast: Delaware, New Jersey, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, Maine.
- Say capitals out loud. Your ears help your memory.

Check your work

- I placed all 50 states on the map, checked against an atlas.
- I can name at least 40 capitals (and I am working on the rest).
- I can name four capitals that are not their state’s biggest city.

MAP NOTEBOOK

1. Draw your own state and its neighbors. Put a star for your state’s capital and a dot for its biggest city. Are they the same place?
2. Make a two-column chart titled “Not the Biggest City”: State capital on the left, Biggest city on the right. Fill in at least six states.
3. Draw a 50-star flag: 9 rows of stars that take turns, 6 stars then 5 stars, for 5 rows of 6 and 4 rows of 5. Check: $5 \times 6 + 4 \times 5 = 50$.

From history. The flag has changed many times as states joined the Union. Congress decided in 1818 that the flag would keep 13 stripes for the first 13 states and add one star for each new state, with the new star added on the Fourth of July after the state joined. That is why the 50-star flag became official on July 4, 1960, almost a year after Hawaii became a state. The 50-star flag has now flown longer than any other version of the American flag.

WORKED EXAMPLES

Example 1. Look at the capitals map. Which state capital is closest to where the line of 40° north latitude crosses the line of 105° west longitude? Which state is it in?

(Use the map or drawing “Use the grid lines to find a capital by latitude and longitude.” shown earlier in this lesson.)

1. Find 40° N on the side of the map and follow that line across.
2. Find 105° W on the top or bottom and follow that line down.
3. The lines cross in the middle of the Rocky Mountain states. The nearest dot is Denver (about 39.7° N, 105.0° W).
4. Denver is the capital of Colorado.

Answer: Denver, the capital of Colorado.

PRACTICE

1. **EASY** What is the capital of New York? Is it the state’s biggest city?
2. **MEDIUM** Match each state to its capital: Illinois, Pennsylvania, California, Texas. Capitals: Austin, Sacramento, Springfield, Harrisburg.
3. **MEDIUM** On the capitals map, which is farther north: Bismarck or Austin? Which is farther west: Olympia or Denver?
(Use the map or drawing “Compare the positions of the dots.” shown earlier in this lesson.)
4. **HARD** Which two states became the 49th and 50th states in 1959? Which one came first?
5. **CHALLENGE** In two or three sentences, explain why many state capitals are smaller inland cities instead of the biggest port or city.

COMMON MISTAKES

- Guessing that the biggest city is always the capital. Albany, Springfield, Sacramento, Harrisburg, Tallahassee and Olympia prove it is not.
- Mixing up *capital* (the city) and *capitol* (the building with the dome).
- Thinking Washington, D.C., is in the state of Washington. D.C. is the nation’s capital, on the Potomac River between Maryland and Virginia, and it is not part of any state. Washington State’s capital is Olympia.

Make it a game • Capital Lightning Round. A parent or sibling holds the stack of state cards and reads one state name at a time. You have five seconds to say the capital. A right answer wins the card. A wrong answer sends the card to the bottom of the pile to come around again. When you win all 50 cards, write your time in your map notebook. For a team game, two players race to touch the state on the wall map first, and the winner must also name its capital to keep the card.

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 state line, river town and capital city sits where real people live their lives. God made all of them and knows where each one dwells. Learning the map is a first step toward caring about our neighbors in all fifty states.

Practice answers

1. Albany. No, New York City is much bigger.
2. Illinois: Springfield. Pennsylvania: Harrisburg. California: Sacramento. Texas: Austin.
3. Bismarck is farther north (about 47° N; Austin is about 30° N). Olympia is farther west (about 123° W; Denver is about 105° W).
4. Alaska (January 3, 1959) came first and became the 49th state; Hawaii (August 21, 1959) became the 50th.
5. When travel was by horse, wagon or riverboat, lawmakers wanted a capital near the middle of the state or on a river so no one had too long a trip. Big port cities often grew on the edge of the state, so a more central town was chosen. Examples: Albany, Harrisburg, Springfield, Sacramento. (Also accept other sound reasons, such as a compromise between rival regions, safety from attack by sea, or keeping the biggest commercial city from controlling the government.)

9.2 DRAW THE U.S. FROM MEMORY

OBJECTIVES

- Draw an outline of the 48 connected states from memory, keeping the right shape and proportions.
- Use a few “anchor” features (the 49th parallel, the Great Lakes, Florida, the Gulf Coast, the Mississippi River) as a skeleton for the drawing.
- Tell how John Melish’s 1816 map first showed the young United States stretching toward the Pacific.

Warm-up. Close your eyes for ten seconds and picture the United States. Then, with your eyes open but no map, draw its outline on scrap paper in one minute. Do not erase! Put the drawing away. You will compare it with the drawing you make at the end of the lesson.

Watch. *How to Draw the Outline Map of the USA with All 50 States / Complete State-by-State Outline* (Outline Map, 5:28). <https://www.youtube.com/watch?v=vu0hAkSmP4k>
Before you draw: an outline map of the United States drawn step by step.

Backup video. *How To Draw A Globe* (Art for Kids Hub, 8:10).
<https://www.youtube.com/watch?v=hDAQGJCFYrM>
For a warm-up: Art for Kids Hub draws a globe.

KEY TERMS

outline

The edge line that shows the shape of a place on a map.

proportion

How big one part is compared with another. The 48 connected states are much wider than they are tall.

anchor feature

An easy-to-remember shape or line, such as Florida or the Great Lakes, that you draw first and use to place everything else.

49th parallel

The line of 49° north latitude. A long, straight part of the border between the United States and Canada follows it from Minnesota west to the Pacific.

peninsula

Land with water on three sides, such as Florida or the two parts of Michigan (the “mitten” and the Upper Peninsula).

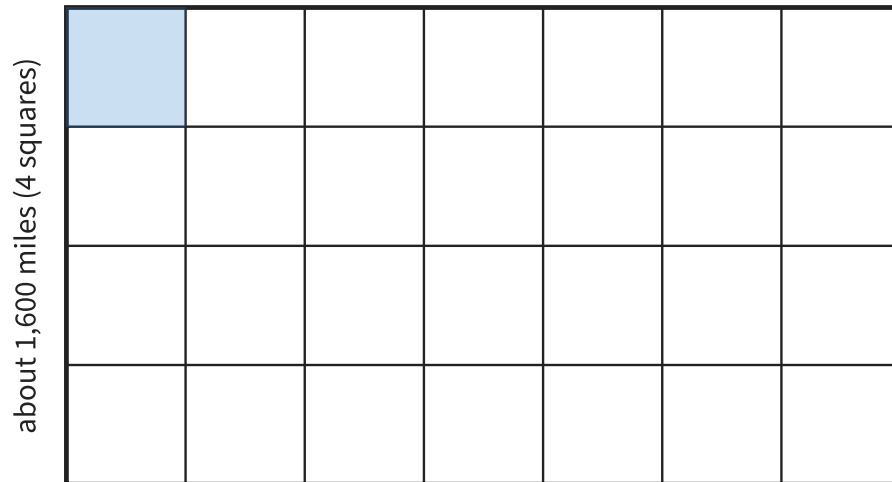
CORE IDEAS

The story. In 1816 a mapmaker in Philadelphia named John Melish published a large new *Map of the United States with the Contiguous British and Spanish Possessions*. It was one of the first maps printed in America to show the whole width of the continent, from the Atlantic Ocean to the Pacific. Melish used the reports of Lewis and Clark, Zebulon Pike and other explorers to fill in the West. His map was so trusted that when the United States and Spain signed the Adams-Onís Treaty in 1819, which set the border between American land and Spanish land and gave Florida to the United States, the treaty named a later (1818) edition of Melish's map to describe where that line ran. A good map in your head can shape real decisions.

How to do it. Mapmakers do not draw a country by starting at one corner and creeping around the edge. They build a **skeleton** first. Try it: (1) Draw a long box that is a little less than twice as wide as it is tall, because the 48 states are about 2,800 miles from coast to coast and about 1,600 miles from the Canadian border to the tip of Texas. (2) Along the top, draw a straight line for the 49th parallel from Washington State to Minnesota. (3) Add the five Great Lakes like a cluster of grapes hanging from the top in the middle-right. (4) Bring the Atlantic coast down the right side, bulging out at Cape Cod and the Carolinas. (5) Hang Florida down like a thumb. (6) Draw the Gulf Coast curving west to the point of Texas, then the Rio Grande up to New Mexico. (7) Finish with the Pacific coast, nearly straight, leaning in toward San Diego. (8) Last of all, run the Mississippi River from Minnesota straight down to the Gulf, splitting the country into East and West.

The big idea. Drawing from memory is not the same as copying. When you copy, your eye does the work. When you draw from memory, your mind has to hold the map. Each time you try, your "mental map" gets truer, and you will start to notice things: Maine sticks out farther east than you thought, the tip of Texas reaches almost as far south as the tip of Florida, and Minnesota has a little bump, the Northwest Angle, that pokes above the 49th parallel. Mapmakers like Melish had to hold the whole country in their heads too, piece by piece, from explorers' notes.

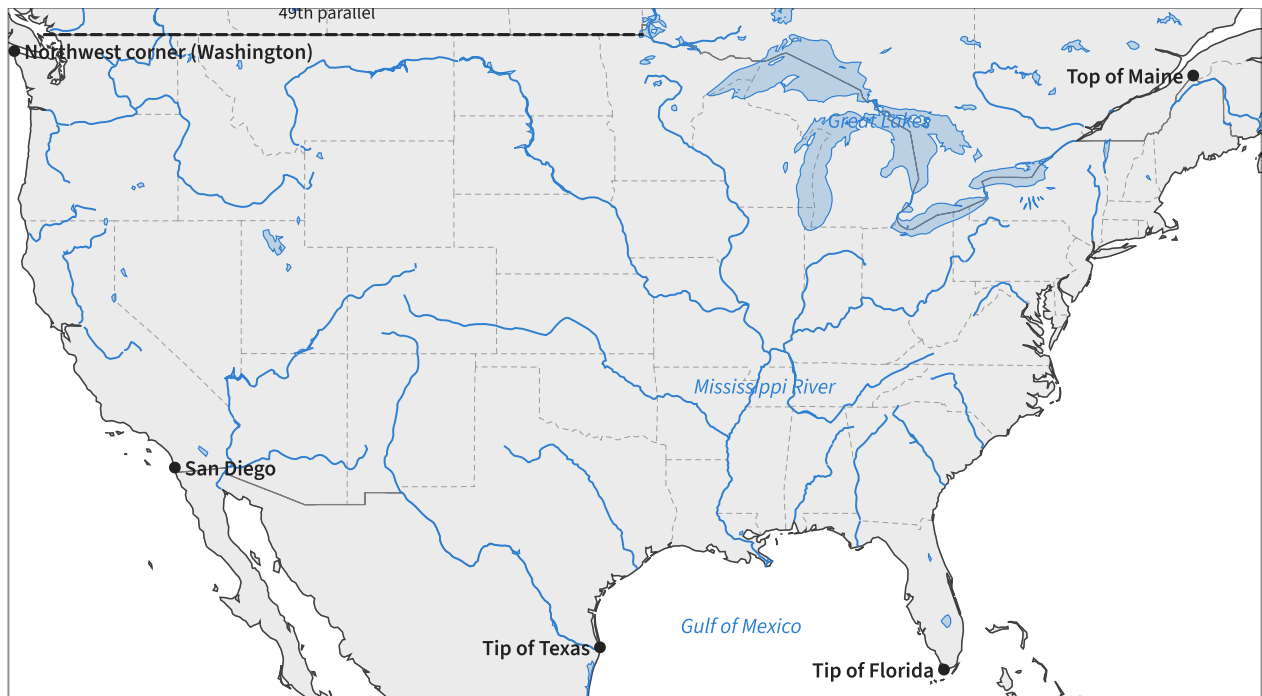
about 2,800 miles (7 squares)



Each square is about 400 miles on each side.

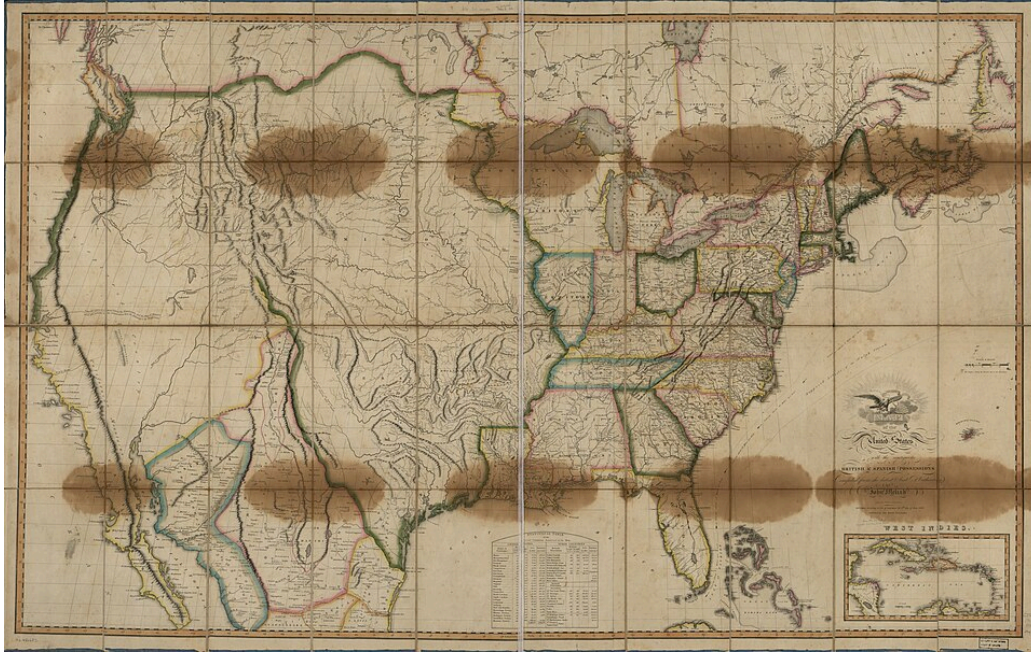
Shaded square = one 400-mile square

The box method: the 48 connected states fit in a box about 7 squares wide and 4 squares tall, if each square stands for about 400 miles.



Anchor points for drawing the U.S.: the four "corners," the straight 49th parallel border, the Great Lakes and the Mississippi River.

PICTURE STUDY



Map of the United States with the Contiguous British and Spanish Possessions, John Melish (engraved by John Vallance and Henry S. Tanner), 1816 · Engraved map on paper, hand-colored · Library of Congress, Geography and Map Division, Washington, D.C.

John Melish was born in Scotland and settled in Philadelphia, where he became one of the first Americans to make a business of publishing maps. His 1816 map was printed on several sheets joined together to make one large map. It shows the United States just after the War of 1812, when the country was still young and much of the West was known only from explorers' reports.

Look at the difference between the East and the West. The eastern states are packed with towns, roads and county lines. The West has long mountain ranges and winding rivers, but few names. Melish was drawing the edge of what Americans knew.

Look closely

- Find the Atlantic coast and the Pacific coast. Does the map reach all the way across?
- Compare the East and the West. Where are most of the names?
- Find Florida. In 1816 it still belonged to Spain. Is it colored like the United States?
- Find the Mississippi River. How does it help divide the map?

Talk about it

1. Why might a map of the West in 1816 be less exact than a map of the East?
2. How could a map help two countries agree on a border?
3. If you made a map of your town from memory, which part would you draw best? Why?

PROJECT: MY MEMORY MAP: FIVE DRAFTS

You will draw the 48 connected states from memory five times over two days, checking with an atlas between drafts. Then you will add Alaska and Hawaii in boxes, the way many maps do. By the fifth draft you will be amazed at how much your mental map has improved.

You will need

- Five sheets of plain paper (or graph paper)
- Pencil, eraser and a ruler
- A wall map or atlas page of the United States, for checking only
- A red pencil for corrections
- Tracing paper (optional)

Steps

1. Draft 1: With no map, use the box method. Draw a box 7 squares wide and 4 squares tall (2 inches per square makes a 14 by 8 inch box). Then draw the skeleton: 49th parallel, Great Lakes, Atlantic coast, Florida, Gulf Coast, Rio Grande, Pacific coast, Mississippi River.
2. Check: lay your drawing beside the atlas. With the red pencil, circle the three places that are most wrong.
3. Draft 2: Put the atlas away and draw again, fixing your three red circles.
4. Draft 3: Add the state lines you know best: your own state, Texas, California, Florida, and the straight-lined states of the West (Colorado, Wyoming, Utah).
5. Draft 4 (next day): Draw the whole outline again from memory, then add as many state lines as you can. Check and circle mistakes.
6. Draft 5: Your best copy. Add the 50 state names (small), two boxes in the lower left for Alaska and Hawaii, a compass rose and a title.
7. Lay all five drafts in a row with your warm-up drawing. Write the date on each.

Tips

- Draw lightly at first. A skeleton is supposed to be erased later.
- Alaska is very large, more than twice the size of Texas. On most U.S. maps it is drawn smaller and moved into a box so the page is not too wide. Hawaii is moved too. Their real places are far to the northwest and in the middle of the Pacific.
- If tracing paper is available, trace the atlas outline once and lay it over Draft 5 to see how close you came.

Check your work

- My best draft has the 49th parallel, the Great Lakes, Florida, Texas and both coasts in about the right places.
- My drawing is about 7 parts wide and 4 parts tall.
- I can point to how my map improved from the warm-up to Draft 5.

MAP NOTEBOOK

1. Draw the five Great Lakes from memory and label them. Use the trick HOMES: Huron, Ontario, Michigan, Erie, Superior.
2. Draw just the four “corners” of the 48 states: the northwest tip of Washington, the top of Maine, the tip of Florida and the tip of Texas. Connect them with a light dotted line. What shape do they make?
3. Draw your state’s outline from memory three times on one page. Which one is best?

From history. The 49th parallel border was set in pieces. The Treaty of 1818 between the United States and Great Britain made the 49th parallel the border from the Lake of the Woods west to the Rocky Mountains. In 1846 the Oregon Treaty carried the same line west to the Pacific coast, swinging around the southern tip of Vancouver Island. Surveyors later marked the line on the ground, and today a narrow cleared strip through the forests shows where it runs.

WORKED EXAMPLES

Example 1. The 48 connected states are about 2,800 miles wide and about 1,600 miles tall. You want your drawing to be 14 inches wide. How tall should it be? How many miles does each inch stand for?

(Use the map or drawing “The box method keeps your drawing the right shape.” shown earlier in this lesson.)

1. Find the miles per inch: $2,800 \text{ miles} \div 14 \text{ inches} = 200 \text{ miles per inch}$.
2. Find the height: $1,600 \text{ miles} \div 200 \text{ miles per inch} = 8 \text{ inches}$.
3. Check with the box method: 7 squares of 2 inches make 14 inches wide, and 4 squares of 2 inches make 8 inches tall. Each 2-inch square stands for 400 miles.

Answer: 8 inches tall; 1 inch stands for about 200 miles.

PRACTICE

1. **EASY** Name the five Great Lakes.
2. **EASY** Which line of latitude makes the long, straight border between the western United States and Canada?
3. **MEDIUM** Look at the anchor map. Which of the 48 connected states reaches farthest east? Which reaches farthest south?
(Use the map or drawing “Use the anchor points to answer.” shown earlier in this lesson.)
4. **HARD** You draw the U.S. 7 inches wide, using about 400 miles for each inch. How tall should your drawing be if the country is about 1,600 miles tall?
5. **CHALLENGE** Why did the Adams-Onís Treaty of 1819 use John Melish’s map? Explain in two sentences why a good map matters when two countries set a border.

COMMON MISTAKES

- Drawing the country too tall, like a square. It is almost twice as wide as it is tall.
- Making Florida point straight down from the middle of the country. Florida hangs from the southeast corner, east of the Mississippi.
- Forgetting that Alaska and Hawaii are in boxes only to fit the page. They are not really off the coast of California and Mexico.

Make it a game • Map Doodle Race. Two players each get a sheet of paper and a pencil. A caller says a feature: “the Great Lakes,” “Florida,” “the Mississippi River,” “Texas,” “Maine.” Each player has 20 seconds to add it to their map from memory. After eight features, compare both maps with the atlas. Score 1 point for each feature in about the right place and the right shape. Switch callers and play again.

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

When you draw the map, you are tracing land that belongs to God. Every coastline, lake and river you remember is part of His world, and every state is full of people He made.

Practice answers

1. Huron, Ontario, Michigan, Erie and Superior (HOMES).
2. The 49th parallel (49° north latitude).
3. Maine reaches farthest east. Florida reaches farthest south (its tip and the Florida Keys).
4. $1,600 \div 400 = 4$ inches tall.
5. Melish’s map was the newest and most trusted map of the whole country, so both sides could point to the same lines and rivers on it. If two countries use a poor map, they may each think the border runs in a different place, which can cause arguments; a good map lets everyone agree on where the line is.

9.3 PLAN A ROAD TRIP BY SCALE

OBJECTIVES

- Use a map's scale to turn inches on the map into miles on the road.
- Find how many hours a trip will take from its miles and speed, and plan a day's driving with stops.
- Tell the story of Horatio Nelson Jackson's first drive across the United States in 1903 and compare it with a trip on today's highways.

Warm-up. Find a road map, an atlas page or a printed map of your state. Look in the corner for the scale bar. Lay a strip of paper along it and mark 0, 50 and 100 miles. Now use your paper strip to find how far your town is from your state capital in a straight line.

Watch. *This Place in History: Dr. H. Nelson Jackson's cross-country car ride* (Vermont Historical Society, 6:47). <https://www.youtube.com/watch?v=etnNBGb4eAI>
With the story: Horatio Nelson Jackson's 1903 drive across the country, from the Vermont Historical Society.

Backup video. *1919 Transcontinental Motor Convoy* (US National Archives, 2:16). <https://www.youtube.com/watch?v=jWsM6Hi0lQA>
With the trip planning: film of the 1919 Army convoy that crossed the country on dirt roads.

KEY TERMS

scale

The rule that tells how many miles on the ground one inch (or one mark) on the map stands for, such as 1 inch = 100 miles.

scale bar

A small ruler printed on a map that shows distances in miles.

road distance

How far you really drive along the roads. It is usually longer than the straight-line distance because roads curve and turn.

speed

How many miles you travel in one hour, written as miles per hour (mph).

interstate highway

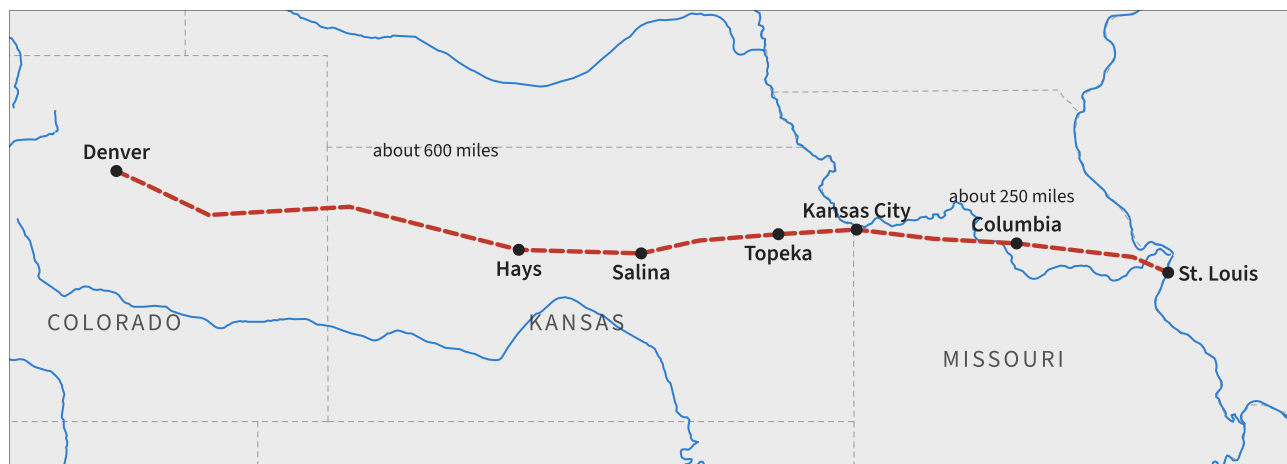
A wide, fast, divided highway that crosses state lines, such as I-70 or I-80. Even numbers usually run east and west; odd numbers usually run north and south.

CORE IDEAS

The story. On May 23, 1903, a doctor from Vermont named Horatio Nelson Jackson set out from San Francisco in a used Winton automobile. He had made a \$50 bet that he could drive all the way to New York City. Almost no one had tried. There were very few paved roads outside of towns, no gas stations, no road signs and no road maps for cars. Jackson hired a young mechanic, Sewall Crocker, and along the way they picked up a bulldog named Bud, who rode in the car wearing goggles against the dust. They got lost, waited days for spare parts to come by train, and sometimes had to pull the car out of mud with ropes. On July 26, 1903, after 63 days, they rolled into New York. They were the first people to cross the country by car.

How to plan by scale. Today you could drive across the country in about five days, and you can plan the trip with a map and two simple steps. **Step 1: Miles.** Measure the route on the map with a ruler or a paper strip, then use the scale. If the scale is 1 inch = 100 miles and your route measures 6 inches, the trip is $6 \times 100 = 600$ miles. (A curvy road is longer than a straight ruler line, so bend a string along the road, then measure the string.) **Step 2: Hours.** Divide the miles by your speed. At 60 miles per hour, 600 miles takes $600 \div 60 = 10$ hours of driving. Then add time for meals, gas and rest. A good family plan is to drive no more than about 8 hours a day.

Technology overcoming geography. Jackson needed 63 days because the land itself fought him: mountains, deserts, rivers without bridges and roads of dirt. In 1919 a U.S. Army convoy of trucks crossed the country to test the roads, and a young officer named Dwight D. Eisenhower rode along. It took the convoy 62 days. Years later, as President, Eisenhower signed the law of 1956 that built the Interstate Highway System. Now smooth highways cut through the mountains and bridge the great rivers, and a 600-mile drive that would once have taken Jackson many days takes one long day. The distance has not changed; the road has.



A road trip on Interstate 70: St. Louis to Kansas City is about 250 miles, and Kansas City to Denver is about 600 miles.



Each section = 1 inch = 100 miles

A scale bar. Each section stands for 100 miles.

PICTURE STUDY



Horatio Nelson Jackson and Sewall Crocker in the Winton Touring Car "Vermont", Unknown photographer, 1903 · Photograph · University of Vermont, Silver Special Collections, Bailey/Howe Library, Burlington, Vermont (the car itself is displayed at the Smithsonian's National Museum of American History, Washington, D.C.)

This photograph was taken during the first car trip across the United States in 1903. The car is a Winton, built in Cleveland, Ohio, and Jackson named it the *Vermont* after his home state. It had no roof, no windshield and no doors. The men carried spare parts, tools, a block and tackle for pulling the car out of mud, and cans of extra fuel.

After the trip, Jackson kept the car for many years. Today it is in the Smithsonian's National Museum of American History in Washington, D.C., where visitors can see the car that first crossed the country.

Look closely

- Find the wheels. Are they like the wheels on your family's car?
- Look at all the gear piled in and on the car. What do you think they packed, and why?

- Is there a roof or a windshield? What would happen in rain or dust?
- Can you find Bud the dog? Jackson later bought him goggles to keep the dust out of his eyes.

Talk about it

1. Why do you think the trip took 63 days?
2. What would you pack if there were no stores or gas stations along your road?
3. What has changed about roads and cars since 1903 that makes the same trip so much faster?

PROJECT: PLAN A FAMILY ROAD TRIP

You are the trip planner! Choose a real trip of 300 to 1,000 miles from your home (or from St. Louis, if you prefer) to a place you would love to visit: a national park, a grandparent's house, a historic site or a big river. Using a map's scale, you will find the miles, figure the hours, and make a day-by-day plan.

You will need

- A U.S. road atlas or a printed map of your region with a scale bar
- A ruler, a piece of string about 2 feet long and a strip of paper
- Your map notebook and a pencil
- Colored pencils or a red marker
- A calculator (optional, for checking)

Steps

1. Choose your start and finish. Mark both with a star on the map.
2. Trace the best route along main highways with a red pencil. Write down the highway numbers (for example, I-70 or I-80).
3. Lay the string along your route, following the curves. Pinch the string at the finish, straighten it along the ruler, and measure it in inches.
4. Use the scale to change inches to miles. Write it in your notebook: ____ inches $\times$ ____ miles per inch = ____ miles.
5. Divide the miles by 60 miles per hour to find the driving hours. Round to the nearest half hour.
6. Split the trip into days of no more than 8 hours of driving. Mark a town where you will stop each night.
7. Make a trip chart with columns: Day, From, To, Miles, Driving hours, Stops (lunch, gas, a sight to see).
8. If you can, check your total with a parent's road atlas mileage chart. How close was your string?

Tips

- Use the string, not a straight ruler, for curvy roads. The straight line is always shorter than the road.
- Plan a stop about every 2 hours to stretch, eat and get gas.
- If your map has no inch scale, measure the scale bar itself with your ruler first.

Check your work

- My route is marked and my miles are found from the map scale.
- My driving hours are correct for my miles and speed.
- My trip is split into reasonable days with planned stops.

MAP NOTEBOOK

1. Draw a strip map of your trip: a long, straight line with each town as a dot, the miles written between dots and a little picture of something you will see.
2. Draw Jackson's car, the *Vermont*, with Bud the bulldog in his goggles. Label three things they packed.
3. Copy the scale bar from your road map exactly, then draw a second bar showing 0, 50 and 100 miles.

From history. The 1919 Army Transcontinental Motor Convoy left Washington, D.C., on July 7, 1919, and reached San Francisco on September 6, after about 3,250 miles. Much of the way it followed the Lincoln Highway, one of the first roads planned to cross the whole country. Trucks sank in mud and broke through wooden bridges. Lieutenant Colonel Dwight D. Eisenhower never forgot it. Later, in World War II, he saw Germany's fast highways. As President he signed the Federal-Aid Highway Act of 1956, which built the Interstate Highway System.

WORKED EXAMPLES

Example 1. On a road map where 1 inch = 100 miles, the drive on I-70 from St. Louis to Kansas City measures $2\frac{1}{2}$ inches. How many miles is the drive? If the family averages 50 miles per hour, counting slow traffic, how many hours will it take?

(Use the map or drawing "St. Louis to Kansas City is the first leg of the trip." shown earlier in this lesson.)

1. Miles: $2\frac{1}{2}$ inches $\times$ 100 miles per inch = 250 miles.
2. Hours: 250 miles $\div$ 50 miles per hour = 5 hours.
3. Check: in 5 hours at 50 miles each hour, you drive $50 + 50 + 50 + 50 + 50 = 250$ miles. ✓

Answer: About 250 miles, which takes about 5 hours.

PRACTICE

1. **EASY** The scale is 1 inch = 100 miles. A route measures 3 inches. How many miles is it?
2. **EASY** How long does it take to drive 180 miles at 60 miles per hour?
3. **MEDIUM** Kansas City to Denver on I-70 measures 6 inches on the same map (1 inch = 100 miles). How many miles is it, and how many hours of driving at 60 miles per hour?
(Use the map or drawing “Kansas City to Denver is the second leg.” shown earlier in this lesson.)
4. **HARD** A family leaves Kansas City at 7:00 in the morning to drive 600 miles to Denver at 60 miles per hour. They stop for 1 hour for lunch and 30 minutes for gas. What time do they arrive? (Do not count the time zone change.)
5. **CHALLENGE** Jackson crossed the country in 63 days in 1903. The Army convoy took 62 days in 1919. Today a family can do it in about 5 days. Write two or three sentences explaining what changed.

COMMON MISTAKES

- Measuring the straight line and calling it the road distance. Roads curve, so use a string along the road.
- Multiplying when you should divide. Inches $\times$ scale gives miles; miles $\div$ speed gives hours.
- Forgetting to add time for stops. A 10-hour drive with meals and gas is really an 11- or 12-hour day.

Make it a game • Road Trip Rally. Each player gets the same road map and a paper-strip ruler. A caller names two cities. Everyone races to measure the distance with the scale and call out the miles. The closest answer (checked with a mileage chart or a parent’s answer) scores 2 points. Then the caller names a speed, such as 50 or 60 miles per hour, and the first player to give the correct driving time scores 1 more point. Play to 10 points.

Scripture. “A man’s heart deviseth his way: but the LORD directeth his steps.” (Proverbs 16:9, KJV)

A wise traveler plans the route, counts the miles and figures the hours. But every trip is in God’s hands, and Christians learn to plan carefully and hold their plans humbly.

Practice answers

1. $3 \times 100 = 300$ miles.
2. $180 \div 60 = 3$ hours.
3. $6 \times 100 = 600$ miles; $600 \div 60 = 10$ hours of driving.
4. Driving: 10 hours. Stops: 1 hour 30 minutes. Total: 11 hours 30 minutes. 7:00 a.m. + 11½ hours = 6:30 p.m. (Kansas City time).
5. The land is the same, but the roads changed. In 1903 there were almost no paved roads, signs, gas stations or bridges, and cars broke down often. The Interstate Highway System

(begun in 1956) built smooth, fast roads through mountains and over rivers, and cars became stronger and faster, so the trip takes days instead of months.

9.4 THE NATIONAL PARKS PASSPORT

OBJECTIVES

- Find at least ten national parks on a map of the United States and tell which region and state each is in.
- Explain why Congress created the National Park Service in 1916 and what “unimpaired for the enjoyment of future generations” means.
- Make a personal National Parks Passport with a page, a map and a hand-made stamp for each park.

Warm-up. Gather three picture books, calendars or postcards that show wild places in America. Lay them out and guess where each one is: mountains, desert, seashore or forest? East or West? Then write down the one place you would most like to stand in person, and why.

Watch. *Junior Rangers, Great Smoky Mountains National Park* (Smokies Life, 2:28). <https://www.youtube.com/watch?v=gIpb3fph238>
Before the project: how children become Junior Rangers at Great Smoky Mountains National Park.

Backup video. *25th August 1916: The U.S. National Park Service signed into law by President Woodrow Wilson* (HistoryPod, 2:41). <https://www.youtube.com/watch?v=wt-cedT5PG8>
With the history note: the founding of the National Park Service in 1916.

KEY TERMS

national park

A special area of land set aside by Congress to protect its scenery, wildlife and history for everyone to enjoy.

National Park Service

The part of the U.S. government, created in 1916, that cares for the national parks and other park sites.

ranger

A person who works in a park to guide visitors, protect the land and animals, and keep people safe.

cancellation

A rubber stamp, with the park’s name and the date, that visitors press into their park passport to show they were there.

unimpaired

Not damaged or spoiled; kept in good condition.

CORE IDEAS

The story. On August 25, 1916, President Woodrow Wilson signed a law creating the **National Park Service**. By then the country already had more than a dozen national parks, starting with Yellowstone in 1872, but no one agency was in charge of them. Some were guarded by soldiers, roads were poor, and visitors sometimes carved their names on rocks or broke off pieces of geysers. A businessman named Stephen Mather had complained to the Secretary of the Interior about the poor care of the parks. The Secretary answered, in effect, that if Mather did not like the way the parks were run, he could come to Washington and run them himself. Mather did. He became the first director of the Park Service and spent years building roads, lodges and a corps of trained rangers. The 1916 law gave the parks a purpose: to conserve the scenery and the wildlife “and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

On the map. Today there are more than 60 national parks and more than 400 park sites of all kinds, from battlefields to seashores. Every region you studied this year has them. In the Northeast is **Acadia** on the rocky coast of Maine. In the Southeast are the misty **Great Smoky Mountains** on the Tennessee–North Carolina line, **Mammoth Cave** in Kentucky, the longest known cave system in the world, and the **Everglades**, a slow “river of grass” in Florida. In the West are **Yellowstone**, **Glacier**, **Rocky Mountain**, **Yosemite** and **Mount Rainier**. In the Southwest are the **Grand Canyon**, **Zion** and **Mesa Verde**, where the cliff houses of the Ancestral Puebloans still stand. In 1986 the parks began selling a little booklet called the *Passport To Your National Parks*. At each visitor center, travelers press a free rubber stamp with the park’s name and date into their passport. Families collect stamps for years.

The big idea. The parks are a way of **stewardship**. God gave the earth to people to use and to care for (Genesis 2:15). Most land is rightly used for farms, towns, mines and roads. But Americans also decided to keep some of the most wonderful places the way God made them, so that children, and their children’s children, could stand at the edge of the Grand Canyon or watch Old Faithful erupt. Your passport is a record of your journeys, but it is also a thank-you note: a list of the places where you saw the work of the Creator.



Twelve national parks to collect in your passport. Can you find one in every region?

PICTURE STUDY



The Tetons and the Snake River, Ansel Adams, 1942 · Gelatin silver photograph · National Archives, Records of the National Park Service, College Park, Maryland

Ansel Adams was a photographer who loved the national parks. In 1941 the Department of the Interior hired him to make photographs of the parks for large wall murals. He made this picture of the Snake River and the Teton Range in Wyoming, near Grand Teton National Park, in 1942. Because he made it for the government, it belongs to all Americans and is in the National Archives.

In 1977 this photograph was chosen to be one of the pictures on the Golden Record carried into space by the Voyager spacecraft, a message from Earth showing what our world looks like.

Look closely

- Follow the river with your finger. What shape does it make?
- Find the brightest part of the picture and the darkest part. Where is the light coming from?
- Look at the mountains. Are they rounded hills or sharp peaks?
- There are no people in this picture. Why do you think Adams chose to leave them out?

Talk about it

1. How does this photograph make you feel? Peaceful, small, excited, something else?
2. Why would someone choose this picture to show other worlds what Earth is like?
3. If you could take one photograph in a national park, what would it be?

PROJECT: MY NATIONAL PARKS PASSPORT

You will make your own passport booklet with a page for twelve national parks, a map to mark them, and a hand-carved stamp. If your family visits a real park, take your booklet along and ask for the free park cancellation stamp at the visitor center. Ask about the park's Junior Ranger program too.

You will need

- Six sheets of plain paper, folded in half and stapled to make a 24-page booklet
- A sheet of colored card stock for the cover
- A blank U.S. outline map, small enough to glue inside the cover
- Pencil, colored pencils and a fine black pen
- A large rubber eraser or a raw potato, and an ink pad or washable paint
- A dull pencil or a plastic knife for carving (with a parent's help)

Steps

1. Make the cover: write *My National Parks Passport*, your name and the year. Draw a small arrowhead or mountain as your emblem.
2. Glue the blank map inside the front cover. Mark the twelve parks from the lesson map with numbered dots.
3. Give each park two facing pages. On the left page write: park name, state, region, year it became a national park (ask your parent to help you look it up), and one wonder found there.
4. On the right page, draw a small picture of the park and leave a box for a stamp.
5. Make your stamp: with a parent, cut a raw potato in half (or use a big eraser). Draw a simple shape on the flat side, such as a mountain, a geyser, a pine tree or a canyon,

then carve away the outside so the shape stands up.

6. Press your stamp on the ink pad and stamp each park's box. Write the date beside it, like a real cancellation.
7. On the last page, make a "Parks I Have Really Visited" list and a "Parks I Hope to Visit" list.

Tips

- Carve away from your fingers, and let a parent do any cutting with a sharp knife.
- A potato stamp works for a day or two; an eraser stamp lasts much longer.
- Park visitor centers keep the real cancellation stamps at the front desk. They are free to use.

Check your work

- My passport has a cover, a map and a page for each of twelve parks.
- Each page names the park's state and region and one wonder found there.
- I can find all twelve parks on a blank map.

MAP NOTEBOOK

1. Draw a map of the United States with twelve national parks. Use a different symbol for each kind of park: a triangle for mountains, a wavy line for water, a sun for desert.
2. Pick one park and draw what you would see from its most famous lookout.
3. Write a short postcard from a national park to a friend. On the front, draw the view. On the back, tell what you saw and heard.

From history. Mesa Verde in Colorado became a national park in 1906, and it was the first national park set aside to protect the works of people rather than only natural wonders. Its cliff dwellings, built of stone in the alcoves of canyon walls, were the homes of the Ancestral Puebloans about 800 years ago. In the 1880s, local ranchers searching for stray cattle brought the great ruins to wide attention, and Congress later protected them so that visitors could walk among them carefully today.

WORKED EXAMPLES

Example 1. Yellowstone became the first national park in 1872. The National Park Service was created in 1916. How many years did the parks go without a Park Service? How many years old will the Park Service be in 2026?

1. Subtract to find the gap: $1916 - 1872 = 44$ years.
2. Subtract to find the Park Service's age in 2026: $2026 - 1916 = 110$ years.
3. Check: $1872 + 44 = 1916$ ✓, and $1916 + 110 = 2026$ ✓.

Answer: 44 years without a Park Service; the Park Service turns 110 years old in 2026.

PRACTICE

1. **EASY** Which national park was the first in the United States (and in the world), and in what year?
2. **EASY** On the parks map, which park is farthest east? Which is farthest south?
(Use the map or drawing “Use the map to compare the parks’ positions.” shown earlier in this lesson.)
3. **MEDIUM** Name the region (Northeast, Southeast, Midwest, West or Southwest) for each park: Grand Canyon, Great Smoky Mountains, Glacier, Acadia.
4. **HARD** The Grand Canyon became a national park in 1919, three years after the Park Service began. Mesa Verde became a national park in 1906. How many years apart are they? Which came first?
5. **CHALLENGE** The 1916 law says the parks should be kept “unimpaired for the enjoyment of future generations.” In two or three sentences, explain what that means and name one thing a visitor can do to help.

COMMON MISTAKES

- Thinking all national parks are in the West. Acadia, the Great Smoky Mountains, Mammoth Cave and the Everglades are in the East.
- Thinking a national park is only for looking. The parks are for enjoying, hiking, camping and learning, as long as they are left unimpaired.
- Mixing up the first national park (Yellowstone, 1872) with the start of the National Park Service (1916).

Make it a game • Passport Stamp Hunt. A parent hides twelve paper “park stamps” around the house, each with a park name. When you find one, run to the wall map, put the stamp on the right spot, and name the park’s state and region to earn a stamp in your passport. Miss the state, and the stamp goes back to be hidden again. When all twelve are placed, read the list in order from east to west.

Scripture. “O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.” (Psalm 104:24, KJV)

Geysers, canyons, caves, glaciers and swamps: the parks show how “manifold,” or many-sided, God’s works are. Keeping them well is a way to say thank you for His riches.

Practice answers

1. Yellowstone, in 1872.
2. Acadia (Maine) is farthest east. The Everglades (Florida) is farthest south.
3. Grand Canyon: Southwest (Arizona). Great Smoky Mountains: Southeast (Tennessee and North Carolina). Glacier: West (Montana). Acadia: Northeast (Maine).
4. $1919 - 1906 = 13$ years apart. Mesa Verde came first.

5. It means the parks should be enjoyed today but not spoiled, so that people many years from now can see them just as beautiful. Visitors help by staying on trails, leaving rocks, flowers and animals alone, not feeding wildlife, and carrying out their trash.

UNIT 9 REVIEW

Answer each question. Show your work for calculations and use complete sentences for explanations. The review is worth 50 points.

1. (8 pts) Name the capital of each state: New York, Illinois, California, Pennsylvania. Then explain in one sentence why a capital is often not the biggest city.
2. (8 pts) Which two states joined the Union in 1959? On what day did the 50-star flag first become the official flag?
3. (8 pts) The 48 connected states are about 2,800 miles wide and 1,600 miles tall. If you draw them 7 inches wide, how tall should the drawing be? Name the line of latitude that forms the long, straight border with Canada in the West.
4. (9 pts) On a map where 1 inch = 100 miles, a trip measures $4\frac{1}{2}$ inches. How many miles is it? How many hours will it take at 50 miles per hour?
5. (9 pts) In 1903 Horatio Nelson Jackson crossed the country by car in 63 days. Give two reasons his trip was so slow, and name the highway system that makes the trip faster today.
6. (8 pts) When was the National Park Service created, and what did the 1916 law say the parks should be kept for? Name one national park in the East and one in the West.

UNIT PROJECT: MY GREAT AMERICAN MAP LAB JOURNEY

Plan a dream journey across the United States that visits at least four national parks in at least three regions. On a large map you draw from memory (then check against an atlas), mark all 50 states, the capitals of every state you pass through, your route and your parks. Beside the map, include a trip chart showing the miles of each day's drive found with the map scale and the driving hours at 60 miles per hour, and your National Parks Passport with a stamped page for each park on your route. Finish with a short paragraph about which place you most want to see and why it should be kept unimpaired for the future.

- **Map accuracy:** The country's shape is about right, the states and the capitals on the route are placed and labeled correctly, and the parks are in the right states.
- **Scale and time:** Each day's miles are found from the map scale, the driving hours are correctly figured, and no day has more than about 8 hours of driving.
- **Passport:** Each park on the route has a passport page with its state, region and one wonder, plus a hand-made stamp and date.
- **Care and explanation:** The map and chart are neat and easy to read, and the paragraph clearly explains why the chosen place is worth seeing and keeping.

Answer key

1. New York: Albany. Illinois: Springfield. California: Sacramento. Pennsylvania: Harrisburg.
When travel was slow, lawmakers often chose a town near the middle of the state or on a river so no one had too long a trip, instead of a big city on the edge of the state.
2. Alaska and Hawaii. The 50-star flag became official on July 4, 1960.

3. $2,800 \div 7 = 400$ miles per inch; $1,600 \div 400 = 4$ inches tall. The border follows the 49th parallel.
4. $4\frac{1}{2} \times 100 = 450$ miles. $450 \div 50 = 9$ hours.
5. Any two: there were very few paved roads, no gas stations or road signs, no road maps for cars, and many rivers had no bridges; the car broke down and he had to wait for parts. Today the Interstate Highway System (begun by the law of 1956) makes the trip much faster.
6. 1916 (the law was signed August 25, 1916). The parks should be enjoyed but kept "unimpaired for the enjoyment of future generations." East: Acadia, Great Smoky Mountains, Mammoth Cave or the Everglades. West: Yellowstone, Yosemite, Glacier, Rocky Mountain, Mount Rainier, Grand Canyon, Zion or Mesa Verde (any correct pair).