

Essential Question Preview

Why do we study Earth and its physical systems?

Have students consider the Essential Question and capture their initial responses.

Explore the Essential Question

- Ask students how seasons affect their lives. Explain that seasons are a result of Earth's tilt on its axis and its rotation around the sun. Places tilting toward the sun at any given time during the year receive more solar energy and experience warmer temperatures.
- Point out that water is a physical feature that also shapes life on Earth. Remind students that water is not only crucial to survival but provides other benefits, such as food, power, and recreation.

Encourage students to keep the Essential Question in mind as they work through the module. Help students plan inquiries and develop their own supporting questions such as:

What signs tell us that Earth is constantly changing and moving?

Why do we care about these changes and movements?

You may want to assign students to write a short essay in response to the Essential Question when they complete the module. Encourage students to use their notes and responses to inform their essays.

► Explore the Online Video

ANALYZE VIDEOS

Climate Change, Part 4

Invite students to watch the video to learn how scientists believe climate change affects extreme weather events.

Geography What are some ways that scientists think climate change may affect weather patterns on Earth?

It will make extreme hot and cold temperatures last longer. The melting Arctic ice is changing the patterns of water currents which also seems to be changing the wind patterns on Earth.



The Physical World



Essential Question

Why do we study Earth and its physical systems?



About the Photo: Many of Earth's features are visible from space. This photo, taken from a satellite orbiting the planet, shows part of the North American continent.

In this module, you will learn about Earth's resources, and the processes that cause the seasons, shape landmasses and climates, and support life. You will also learn how humans use and interact with these resources and processes.

► Explore ONLINE!



VIDEOS, including ...

- The Ring of Fire
- Plate Tectonics and Continental Drift

- ✓ Document-Based Investigations
- ✓ Graphic Organizers
- ✓ Interactive Games
- ✓ Animation: The Water Cycle
- ✓ Channel One News Video: Hunting Hurricanes
- ✓ Channel One News Video: Earthquake Preparedness
- ✓ Interactive Map: Major Climate Regions
- ✓ Image with Rich Media: Desert Ecosystem

What You Will Learn

Lesson 1: Earth and the Sun's Energy 41
The Big Idea Earth's movement and the sun's energy interact to create day and night, temperature changes, and the seasons.

Lesson 2: Water on Earth 46
The Big Idea Water is a dominant feature on Earth's surface and is essential for life.

Lesson 3: The Land 52
The Big Idea Processes below and on Earth's surface shape the planet's physical features.

Lesson 4: Weather and Climate 62
The Big Idea The sun, location, wind, water, and mountains affect weather and climate.

Lesson 5: World Climates 68
The Big Idea Earth's five major climate zones are identified by temperature, precipitation, and plant life.

Lesson 6: Environments and Biomes 77
The Big Idea Plants, animals, and the environment, including soil, interact with and affect one another.

Lesson 7: Natural Resources 82
The Big Idea Earth's natural resources have many valuable uses, and their availability affects people in many ways.

Lesson 1 Big Idea

Earth's movement and the sun's energy interact to create day and night, temperature changes, and the seasons.

Main Ideas

- Earth's movement affects the amount of energy we receive from the sun.
- Earth's seasons are caused by the planet's tilt.

Lesson 2 Big Idea

Water is a dominant feature on Earth's surface and is essential for life.

Main Ideas

- Salt water and freshwater make up Earth's water supply.
- In the water cycle, water circulates from Earth's surface to the atmosphere and back again.
- Water plays an important role in people's lives.

Lesson 3 Big Idea

Processes below and on Earth's surface shape the planet's physical features.

Main Ideas

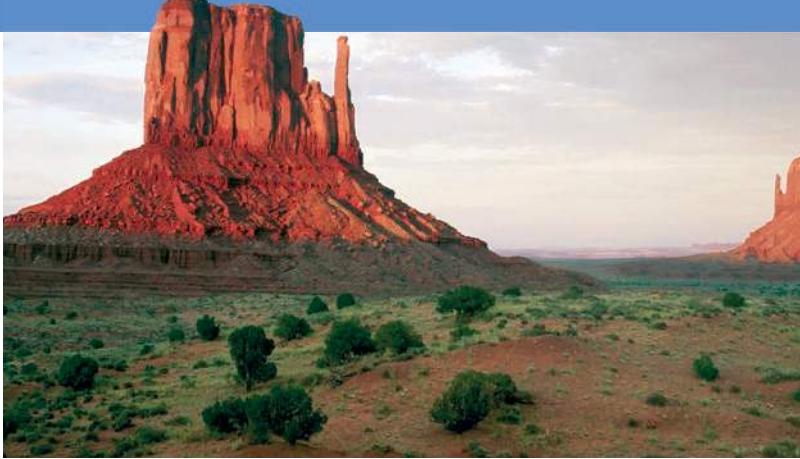
- Earth's surface is covered by many different landforms.
- Forces below Earth's surface build up our landforms.
- Forces on the planet's surface shape Earth's landforms.
- Landforms influence people's lives and culture.

Lesson 4 Big Idea

The sun, location, wind, water, and mountains affect weather and climate.

Main Ideas

- While weather is short term, climate is a region's average weather over a long period.



Land Forces on and under Earth's surface have shaped the different landforms on our planet. Geographers study how mountains and other landforms were made.

Environments Living things, such as this koala, depend on their surroundings.



Water on Earth Water is essential for life on Earth. Much of the planet's water supply is stored in Earth's oceans and ice caps.

The Physical World 39

- The amount of sun at a given location is affected by Earth's tilt, movement, and shape.
- Wind and water move heat around Earth, affecting how warm or wet a place is.
- Mountains influence temperature and precipitation

Lesson 5 Big Idea

Earth's five major climate zones are identified by temperature, precipitation, and plant life.

Main Ideas

- Geographers use temperature, precipitation, and plant life to identify climate zones.
- Tropical climates are wet and warm, while dry climates receive little or no rain.
- Temperate climates have the most seasonal change.
- Polar climates are cold and dry, while highland climates change with elevation.

Lesson 6 Big Idea

Plants, animals, and the environment, including soil, interact and affect one another.

Main Ideas

- The environment and life are interconnected and exist in a fragile balance.
- Soils play an important role in the environment.

Lesson 7 Big Idea

Earth's natural resources have many valuable uses, and their availability affects people in many ways.

Main Ideas

- Earth provides valuable resources for our use.
- Energy resources provide fuel, heat, and electricity.
- Mineral resources include metals, rocks, and salt.
- Resources shape people's lives and countries' wealth.

Explore the Images

Land This photo was taken in the American Southwest, where the temperature is warm and dry most of the year. Discuss with students how they think this landform was created. Ask them how it is different from other mountains they might have seen.

Water on Earth Icebergs are solid forms of water found near the poles. Ask students why they think the icebergs can stay solid.

Environments The koala bears of Australia have adapted to their surroundings in many ways. For example, they have thick fur on their bottoms so that they can comfortably sit on rough branches.

Analyze Visuals

Have students examine the images and then answer the following questions.

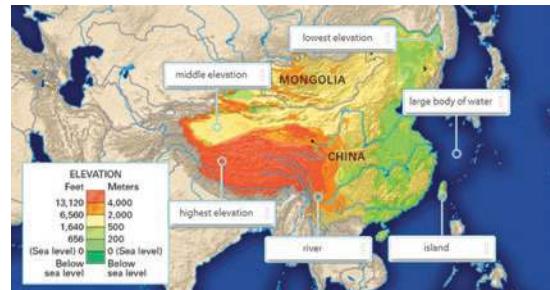
- In the top image, why do you think this tower-like land mass has remained while the land around it has eroded? *Answers will vary. Possible answer: The tower may be made of a substance that is harder than the surrounding land.*
- Based on the caption, what is one purpose served by icebergs? *They store water.*
- What physical abilities would this koala need? *ability to climb trees, hang on to bark, and so forth*

Online Module Flip Cards

Use the flip cards as a whole class activity or in student pairs to preview the module's Key Terms and Places. Students can guess the meaning of each word, then review its definition, or do the reverse, using the flip card's toggle button to switch from "Term" to "Definition" mode. Students can also use the flip cards at the end of the module as a review tool before taking the Module Assessment.

Online Map Activity

Students can use this activity to review some of the locations discussed in this module. To complete, have students drag each label to the correct location on the map.



Reading Social Studies

Reading Social Studies

READING FOCUS

Use Word Parts

Write the following root word and meaning on the board: press ("to push down"). Then, write the following prefixes and meanings on the board: de- ("above"), im- ("below"), re- ("back"). Finally, write the following suffixes and meanings on the board: -ion ("process of"), -able ("capable of"), -ive ("to cause or become"). As a class, try to form as many words as possible from these word parts. Write them on the board as students call them out. Once you have finished the list, ask volunteers to define each word. Have students look up the words in a dictionary to check their definitions.

You Try It!

Students should correctly separate the word parts and identify the following roots: graph ("write"), regard ("to respect"), shape ("form"), move ("to change position"), vis ("see"), season ("time of year"), separate ("move apart"), act ("the process of doing"). Students should use the word parts to formulate their definitions.

Use Word Parts

READING FOCUS

Many English words are made up of several word parts: roots, prefixes, and suffixes. A root is the base of the word and carries the main meaning. A prefix is a letter or syllable added to the beginning of a root. A suffix is a letter or syllable added to the end to create new words. When you come across a new word, you can sometimes figure out the meaning by looking at its parts. Study the charts of common word parts and their meanings.

Common Prefixes		
Prefix	Meaning	Sample Words
geo-	earth	geology
inter-	between, among	interpersonal, intercom
in-	not	ineffective
re-	again	restate, rebuild

Common Suffixes		
Suffix	Meaning	Sample Words
-ible	capable of	visible, responsible
-less	without	penniless, hopeless
-ize	make	equalize
-ment	result, action	commitment
-al	relating to	directional
-tion	the act or condition of	rotation, selection

Common Roots		
Word Root	Meaning	Sample Words
-graph-	write, writing	autograph, biography
-vid-, -vis-	see	videotape, visible

YOU TRY IT!

Use your knowledge of word parts to understand challenging words such as the ones listed below. Work with a partner to read the words. First separate any prefixes or suffixes and identify the word's root. Use the charts to define the root, the prefix, or the suffix. Then work with your partner to write a definition for each word.

geography regardless reshaping movement invisible seasonal
visualize separation interact

As you read this module, look for words that include these word parts.



Earth and the Sun's Energy

- Solar Energy
- The Seasons: Northern Hemisphere

- Focus on Culture: The Midnight Sun
- Earth Selfies
- Monster Vegetables

Visuals

Videos

LESSON 1

Big Idea

Earth's movement and the sun's energy interact to create day and night, temperature changes, and the seasons.

Extend and Enrich

Maps, Graphs, and Charts

Sources

Assessment

- Key Terms Review
- Reading Check
- Graphic Organizer Activity
- Lesson Assessment

► Online Lesson 1 Enrichment Activities

Earth Selfies

Video Students view a video on a satellite mapping project and then write a summary and answer a related question.

Watch Channel One News



PLAY VIDEO 2:50

Space Photos of Earth

1
Channel One News

Monster Vegetables

Article Students conduct research on monster vegetables and then create a table summarizing what they learned.

Earth and the Sun's Energy

The Big Idea

Earth's movement and the sun's energy interact to create day and night, temperature changes, and the seasons.

Main Ideas

- Earth's movement affects the amount of energy we receive from the sun.
- Earth's seasons are caused by the planet's tilt.

Key Terms and Places

solar energy
rotation
revolution
tropics

If YOU lived there . . .

You live in Chicago and have just won an exciting prize—a trip to Australia during winter vacation in January. As you prepare for the trip, your mother reminds you to pack shorts and a swimsuit. You are confused. In January you usually wear winter sweaters and a heavy jacket.

Why is the weather so different in Australia?

Earth's Movement

Energy from the sun helps crops grow, provides light, and warms Earth. It even influences the clothes we wear, the foods we eat, and the sports we play. All life on Earth requires **solar energy**, or energy from the sun, to survive. The amount of solar energy places on Earth receive changes constantly. Earth's rotation, revolution, and tilt, as well as latitude, all affect the amount of solar energy parts of the planet receive from the sun.

Rotation Imagine that Earth has a rod running through it from the North Pole to the South Pole. This rod represents Earth's axis—an imaginary line around which a planet turns. As Earth spins on its axis, different parts of the planet face the sun. It takes Earth 24 hours, or one day, to complete this rotation. A **rotation** is one complete spin of Earth on its axis. As Earth rotates during this 24-hour period, it appears to us that the sun moves across the sky. The sun seems to rise in the east and set in the west. The sun, however, does not move. It is actually Earth's rotation that creates the sense of the sun's movement.

Earth's rotation also explains why day changes to night. As you will see in the illustration on the next page, solar energy strikes only the half of Earth facing the sun. Warmth and light from the sun create daytime. At the same time, the half of the planet facing away from the sun experiences the cooler temperatures and darkness of night. Earth's rotation causes regular shifts from day to night. As a result, levels of solar energy on Earth constantly change.

The Physical World 41

Teach the Main Idea

Earth's movement affects the amount of energy we receive from the sun.

Explain How does rotation explain why day changes into night? *It takes 24 hours for Earth to spin on its axis. The half of the planet that faces the sun during this period experiences daytime, and it experiences night when it turns away from the sun.*

Predict What would happen if Earth did not rotate? *One side would always be in the sun and the other side would always be in darkness.*

Compare and Contrast What is the difference between *rotation* and *revolution*? *Rotation refers to the movement of an object on its axis, whereas revolution*

For additional instruction, go to end of lesson.

refers to movement around another object, such as the sun.

Make Judgments Would you rather live at high or low latitudes? Why? *Students' answers should reflect an understanding of the section's content. Low latitudes are warmer, with more direct sunlight; high latitudes have cooler temperatures and less sunlight.*

More About . . .

Connect to Science: Earth's Trip Around the Sun

On its year-long trip around the sun, Earth travels more than 1,500,000 miles per day.

Teach the Big idea

1. Whole Class Open/Introduction

If YOU lived there . . .

Why is the weather so different in Australia?

Review the scenario describing the trip to Australia with students. Lead a class discussion around responses to the question. Remind students that all responses are valid as long as they are supported with valid reasoning. You may wish to review the following points to frame your discussion.

Consider the LOCATIONS of both areas.

- Chicago in Northern Hemisphere
- Australia in Southern Hemisphere
- Australia closer to the equator, so generally warmer than Chicago

Consider the SEASONS in both areas.

- Chicago is cold in winter.
- Australia experiences summer when Chicago has winter.
- Australia's summer is generally very hot and dry.

2. Direct Teach Introduce the Big Idea: *Earth's movement and the sun's energy interact to create day and night, temperature changes, and the seasons.* Ask students: Do you think Earth's movements affect the temperatures we have in our region? If so, how? *As Earth rotates from day to night, temperatures generally change from warmer to cooler. The tilt of Earth causes us to have different seasons.*

3. Practice/Assess/Inquire Organize the class into small groups. As the students complete the lesson, have half of the groups plan presentations about Earth's rotation and the other half plan presentations about the revolution of Earth around the sun. Encourage students to incorporate key terms from the section and extend their presentations with illustrations, drawings, and/or models.

4. Explore (Collaborative Exploration) Ask students to give their presentations as a review of the section.

5. Whole Group Close/Reflect Have students come up with five questions about the topic of the module and then quiz each member of their group.

*Alternative Assessment Handbook, Rubrics 14: Group Activity; and 24: Oral Presentations

ONLINE INTERACTIVE VISUALS

Solar Energy

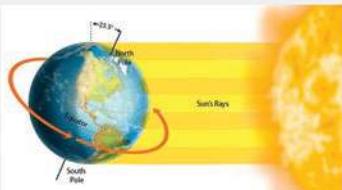
Have students explore the image. You may wish to use the associated question as a discussion prompt.

Analyze Visuals Is the region north or south of the equator receiving more solar energy? How can you tell? *the region north of the equator because it is tilted closer to the sun*

GEOGRAPHY AND SCIENCE

Solar Energy

Earth's tilt and rotation cause changes in the amount of energy we receive from the sun.



ONLINE GRAPHIC ORGANIZER

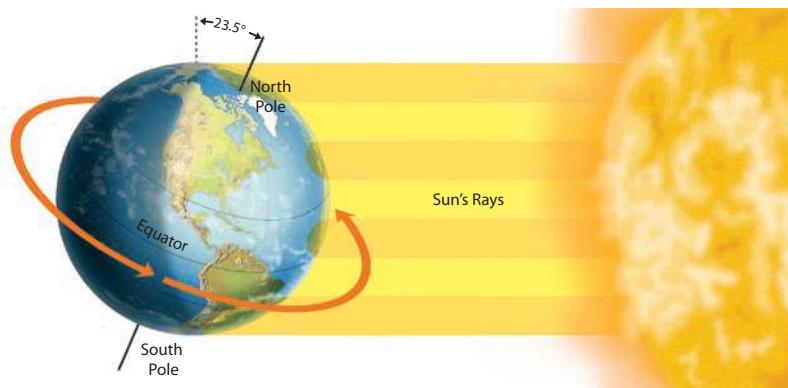
Earth and the Sun's Energy

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Analyze Cause and Effect How do rotation, tilt, and latitude affect the amount of solar energy that Earth receives? *rotation—provides day and night so all the planet receives solar energy each day; tilt—provides more (summer) or less (winter) solar energy in Northern and Southern Hemispheres; latitude—low latitudes near the equator receive direct solar energy all year, high latitudes near the poles receive indirect solar energy*

Solar Energy

Earth's tilt and rotation cause changes in the amount of energy we receive from the sun. As Earth rotates on its axis, energy from the sun creates periods of day and night. Earth's tilt causes some locations, especially those close to the equator, to receive more direct solar energy than others.



Analyze Visuals

Is the region north or south of the equator receiving more solar energy? How can you tell?

Academic Vocabulary
factor cause

Reading Check
Find Main Ideas
What factors affect the solar energy Earth receives?

Revolution As Earth spins on its axis, it also follows a path, or orbit, around the sun. Earth's orbit around the sun is not a perfect circle. Sometimes the orbit takes Earth closer to the sun, and at other times the orbit takes it farther away. It takes 365½ days for Earth to complete one **revolution**, or trip around the sun. We base our calendar year on the time it takes Earth to complete its orbit around the sun. To allow for the fraction of a day, we add an extra day—February 29—to our calendar every four years.

Tilt and Latitude Another **factor** affecting the amount of solar energy we receive is the planet's tilt. As the illustration shows, Earth's axis is not straight up and down. It is actually tilted at an angle of 23.5 degrees from vertical. At any given time of year, some locations on Earth are tilting away from the sun, and others are tilting toward it. Places tilting toward the sun receive more solar energy and experience warmer temperatures. Those tilting away from the sun receive less solar energy and experience cooler temperatures.

A location's latitude, the distance north or south of Earth's equator, also affects the amount of solar energy it receives. Low-latitude areas, those near the equator like Hawaii, receive direct rays from the sun all year. These direct rays are more intense and produce warmer temperatures. Regions with high latitudes, like Antarctica, are farther from the equator. As a result, they receive indirect rays from the sun and have colder temperatures.

42 Module 2

COLLABORATIVE LEARNING

Learn About Earth's Movement

- Provide student pairs with a ball. Have one student observe while the other rotates the ball in front of a light source. Mark Earth's axis on the ball and remind students to tilt the ball at about 23.5°. Students should identify daytime and nighttime from the ball's position.
- Next, have one student represent the sun while the other revolves around him or her carrying the ball. Have students identify the seasons from the position of the sun and Earth.

- Have students write sentences explaining the difference between the terms *rotation* and *revolution*.

*Alternative Assessment Handbook, Rubrics 14: Group Activity and 42: Writing to Inform

ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: *solar energy, rotation, revolution, tropics*.

READING CHECK

Identify Cause and Effect What factors affect the solar energy Earth receives? *rotation, revolution, tilt, altitude*

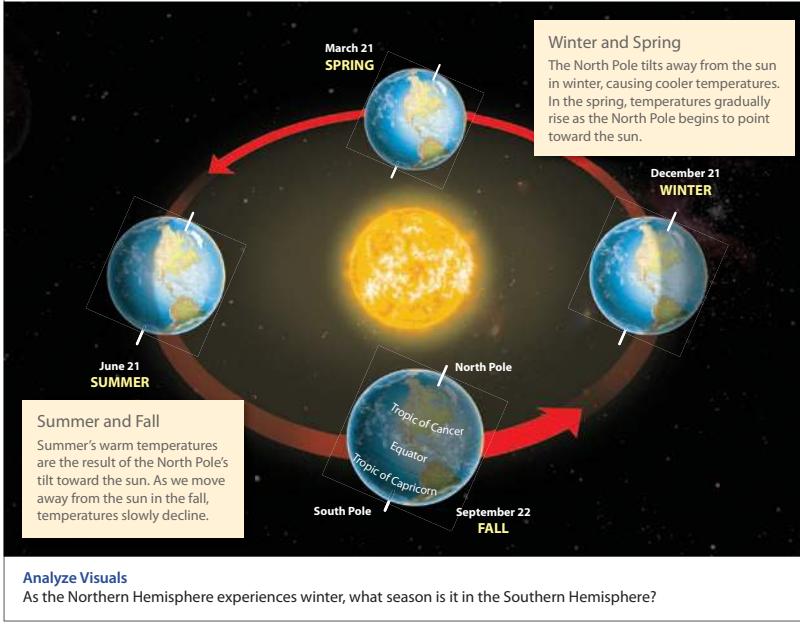
The Seasons

Does snow in July or high temperatures in January seem odd to you? It might if you live in the Northern Hemisphere, where cold temperatures are common in January, not July. The planet's changing seasons explain why we often connect certain weather with specific times of the year, like snow in January. Seasons are periods during the year that are known for certain types of weather. Many places on Earth experience four seasons—winter, spring, summer, and fall—based on temperature and length of day. In some parts of the world, seasons are based on the amount of rainfall.

Winter and Summer Earth's tilt creates the change in seasons. While one of Earth's poles is tilted away from the sun, the other is tilted toward it. During winter part of Earth tilts away from the sun, causing less direct solar energy, cool temperatures, and less daylight. Summer occurs when part of Earth tilts toward the sun, causing more direct solar energy, warmer temperatures, and longer periods of daylight.

The Seasons: Northern Hemisphere

As Earth orbits the sun, the tilt of its axis toward and away from the sun causes the seasons to change. Seasons in the Northern Hemisphere change at about the same time every year.



The Physical World 43

ADVANCED/GIFTED

The Effects of Gravity

1. Have students research the effects of gravity on Earth's rotation and on its revolution around the sun.
2. Students might also investigate how gravity influences the moon and the tides.

3. Have students write a brief report explaining what they have learned. Encourage students to illustrate their reports to clarify difficult concepts.

*Alternative Assessment Handbook, Rubrics 30: Research; and 42: Writing to Inform

Teach the Main Idea

Earth's seasons are caused by the planet's tilt.

Explain When is it summer in South America? when the South Pole is tilted toward the sun

Describe What are monsoons? seasonal winds that bring either moist air or dry air, depending on the time of year

Predict What would happen if Earth's axis did not tilt but pointed straight up and down? There would be no seasons.

Make Inferences How do you think people who live near the Arctic and Antarctic Circles have adapted to the lack of daylight? Possible response: stay inside more to keep warm, use supplies they stockpile during warmer days

More About . . .

Connect to Science NASA engineers have developed a mini-satellite camera, nicknamed "Little Free Flier," for use in space missions. The camera is less than eight inches in diameter. It gives views that aren't possible with fixed cameras on robotic arms. The mini-satellite camera can monitor the outside of a spacecraft for problems, thus astronauts may not have to risk leaving the spacecraft in order to inspect it while in space. To learn more, visit www.nasa.gov.

ONLINE INTERACTIVE VISUALS

Animation: The Seasons: Northern Hemisphere

Have students explore the image using the interactive hotspots. You may wish to use the associated question as a discussion prompt.

Analyze Animations As the Northern Hemisphere experiences winter, what season is it in the Southern Hemisphere? Summer



For additional instruction, go to end of lesson.

FOCUS ON CULTURE

The Midnight Sun

Have students read the feature and answer the related question.

Predict How might people's daily lives be affected by the midnight sun? *It might be more difficult to sleep because of the sunlight. People could pursue activities, such as swimming and boating, at any time of the day or night.*

Because of Earth's tilt, the Northern and Southern Hemispheres experience opposite seasons. As the North Pole tilts toward the sun in summer, the South Pole tilts away from it. As a result, the Southern Hemisphere experiences winter. Likewise, when it is spring in the Northern Hemisphere, it is fall in the Southern Hemisphere.

Spring and Fall As Earth orbits the sun, there are periods when the poles tilt neither toward nor away from the sun. These periods mark spring and fall. During the spring, as part of Earth begins to tilt toward the sun, solar energy increases. Temperatures slowly start to rise, and days grow longer. In the fall the opposite occurs as winter approaches. Solar energy begins to decrease, causing cooler temperatures and shorter days.

Focus on Culture

The Midnight Sun

Can you imagine going to sleep late at night with the sun shining in the sky? People who live near the Arctic and Antarctic Circles experience this every summer, when they can receive up to 24 hours of sunlight a day. The time-lapse photo below shows a typical sunset during this period—except the sun never really sets! This phenomenon is known as the midnight sun. For locations like Tromso, Norway, this means up to two months of constant daylight each summer. People living near Earth's poles often use the long daylight hours to work on outdoor projects in preparation for winter, when they can receive 24 hours of darkness a day.



Predict

How might people's daily lives be affected by the midnight sun?

44 Module 2

ENGLISH LANGUAGE LEARNERS

Collages of Seasons

1. To help students understand how people who live in different hemispheres experience seasons differently, organize the class into eight groups. Provide images of the four seasons, and have each group create a collage that represents what one of the four seasons in either the Northern or Southern Hemisphere is like. For example, winter in the Northern Hemisphere may be cold and snowy, and winter in the Southern Hemisphere may be warm and sunny.

2. Have the students in each group share their collages with the class by describing the pictures they have chosen. Ask the students to explain how the position of Earth in relation to the sun determines the weather in the season and hemisphere they were assigned.

*Alternative Assessment Handbook,
Rubric 8: Collages

Reading Check
Identify Cause and Effect What causes the seasons to change?

Rainfall and Seasons Some regions on Earth have seasons marked by rainfall rather than temperature. This is true in the **tropics**, regions close to the equator. At certain times of year, winds bring either dry or moist air to the tropics, creating wet and dry seasons. In India, for example, seasonal winds called monsoons bring heavy rains from June to October and dry air from November to January.

Summary and Preview Solar energy is crucial for all life on the planet. Earth's position and movements affect the amount of energy we receive from the sun and determine our seasons. The Northern and Southern Hemispheres have opposite seasons. Some regions experience four seasons while others experience only two. In the next lesson you will learn about Earth's water supply and its importance to us.

Lesson 1 Assessment

Review Ideas, Terms, and Places

1. a. **Identify** What is solar energy, and how does it affect Earth?
b. **Analyze** How do rotation and tilt each affect the amount of solar energy that different parts of Earth receive?
c. **Predict** What might happen if Earth received less solar energy than it currently does?
2. a. **Describe** Name and describe Earth's seasons.
b. **Contrast** How are seasons different in the Northern and Southern Hemispheres?
c. **Elaborate** How might the seasons affect human activities?

Critical Thinking

3. **Identify Cause and Effect** Use your notes and the chart to identify the causes of seasons.



READING CHECK

Identify Cause and Effect What causes the seasons to change? *The change in seasons is created by Earth's tilt.*

Print Assessment

Review Ideas, Terms, and Places

1. a. **Identify** What is solar energy, and how does it affect Earth? *Energy from the sun; It warms the planet, helps plants grow, and provides light.*
b. **Analyze** How do rotation and tilt each affect the amount of solar energy that different parts of Earth receive? *Rotation affects how much solar energy parts of Earth receive, which in turn creates day and night and affects temperatures. Tilt causes seasons by affecting when certain regions get more solar energy.*
c. **Predict** What might happen if Earth received less solar energy than it currently does? *Answers may vary, but students should note that Earth would be colder and darker.*
2. a. **Describe** Name and describe Earth's seasons. *Winter—cold temperatures, short days; spring—increasing temperatures, longer days; summer—warm temperatures, long days; fall—decreasing temperatures, shorter days*
b. **Contrast** How are seasons different in the Northern and Southern hemispheres? *When it is summer in the Northern Hemisphere, it is winter in the Southern Hemisphere, and vice versa.*
c. **Elaborate** How might the seasons affect human activities? *Answers may vary, but students may say that people can spend more time outdoors during the spring and summer.*

Critical Thinking

3. **Identify Cause and Effect** Use your notes and the chart to identify the causes of seasons. *Winter—Earth's axis is tilted away from the sun; Spring—Earth's access begins to tilt towards the sun; Summer—Earth's axis is tilted toward the sun; Fall—Earth's axis begins to tilt away from the sun.*

IDENTIFY POINTS OF VIEW

Write a Letter to the Editor

1. Have students research global warming on the Internet or at the library. Ask them to look for answers to these questions: What is global warming? Why does it occur? What effects has it had on the continents and oceans? What effects do scientists predict it will have in the future? What can be done to stop global warming?
2. Have students write letters to the editor explaining what they have learned about global warming and what they think should be done about the problem. Encourage them to include interesting quotes they found in their research.

3. Have volunteers read their letters and discuss their conclusions. Encourage students to submit their letters to the local newspaper.

*Alternative Assessment Handbook, Rubrics 17: Letters to Editors; and 43: Writing to Persuade

► Online Assessment

1. Which of the following affects daily shifts in the levels of solar energy on Earth?

- latitude
- revolution
- rotation
- tilt

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

The Earth's rotation causes **daily** shifts in its levels of solar energy.

2. Which season occurs in a region when the Earth is tilted away from the sun?

- fall
- spring
- summer
- winter

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Earth's **tilt** creates the change in seasons.

3. **Compare and Contrast** Why are low-latitude areas warmer than regions with high latitudes?

Possible answer: Low-latitude areas receive direct rays from the sun all year. These rays are more intense than indirect rays and produce warmer temperatures. Regions with high latitudes receive indirect rays from the sun and have colder temperatures.

4. **Draw Conclusions** When it is winter in the Southern Hemisphere, where would be a good place to go to escape the cold temperatures? Explain your answer.

Possible answer: A good place to go would be somewhere in the Northern Hemisphere. This is because the cold winter temperatures in the Southern Hemisphere are caused by that part of Earth being tilted away from the sun. At this time, the Northern Hemisphere is tilted toward the sun, which results in it experiencing summer while the Southern Hemisphere experiences winter.

ADDITIONAL INSTRUCTIONAL MATERIALS

continued from page 41

More About . . .

Misconception Alert The sun only appears to rise and set. The same is true of the moon. The moon's rotation as it revolves around Earth keeps the same side of the moon always in view. The moon "rises" and "sets" as it revolves around Earth.

continued from page 43

More About . . .

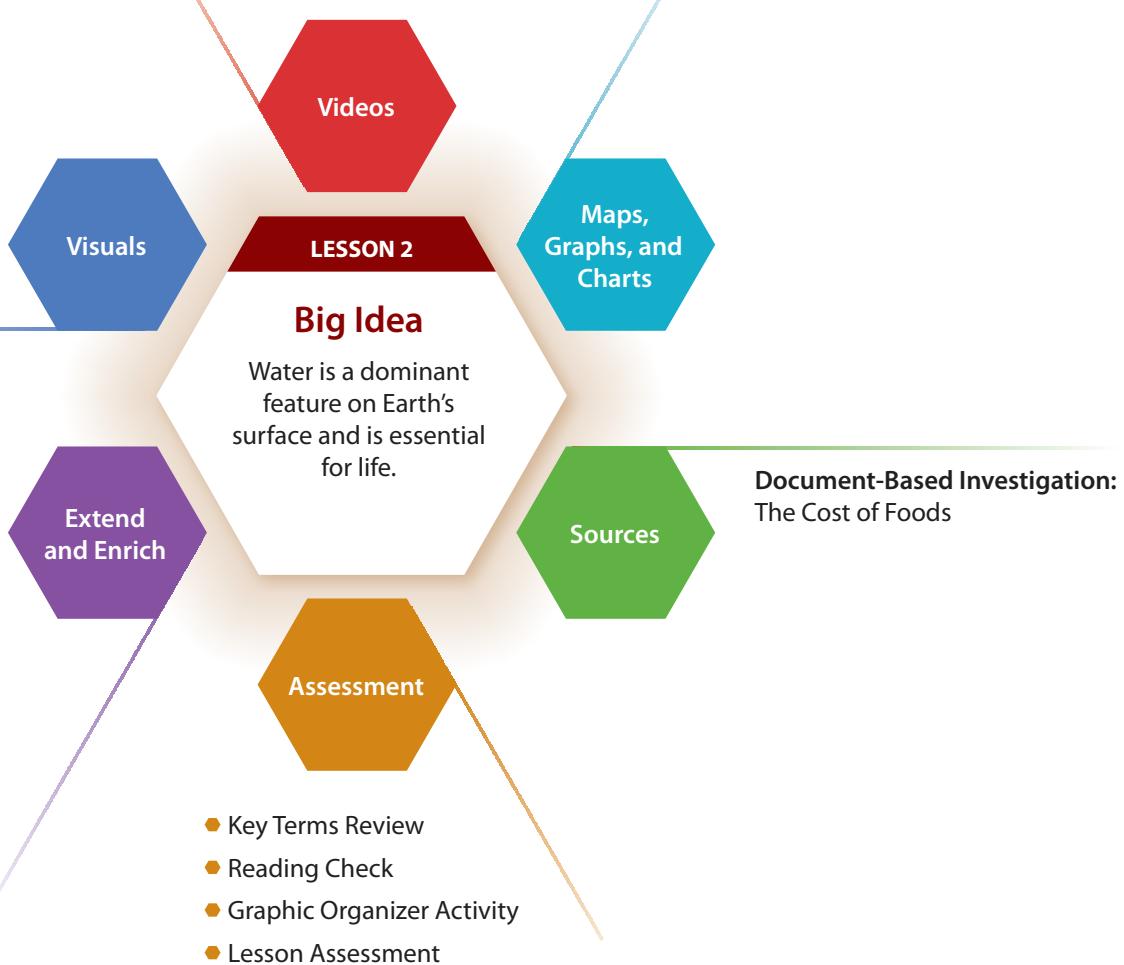
Eileen M. Collins Astronaut Eileen M. Collins was the first female space shuttle commander, leading *Columbia* in July 1999. One of her mission's duties was to record images of Earth's moon, Mercury, Venus, and Jupiter in order to study their atmospheres and surfaces.

Lesson 2 Planner



Water on Earth

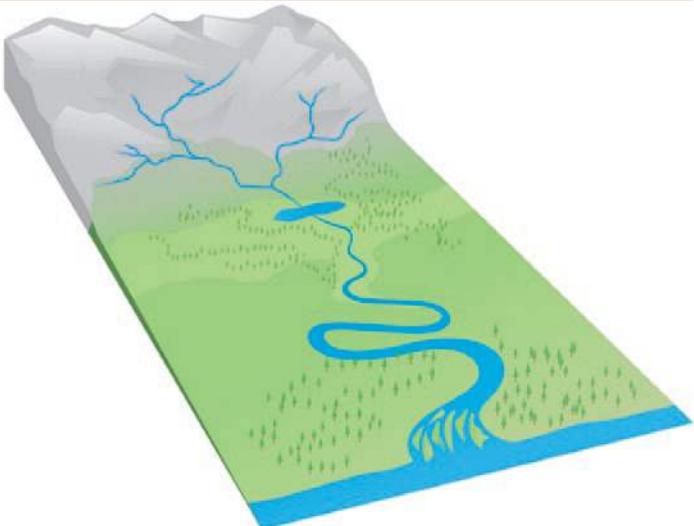
- Types of Water
- The Water Cycle
- How Water Benefits Humans



► Online Lesson 2 Enrichment Activities

Watersheds

Article Students conduct research to learn more about their local watershed and then draw a map of its terrain and features.



Run for the Water

Biography Students learn how Gilbert Tuhabonye helped people in Burundi and then they come up with an idea of how they might help their local community.



Teach the Big idea

1. Whole Class Open/Introduction

If **YOU** lived there . . .

How do you feel about the city's water plan?

Review the scenario with students and lead a class discussion around responses to the question. You may wish to review the following points to frame your discussion.

Consider reasons to CONSERVE water.

- There is a water shortage.
- Water is an important resource.
- Water conservation helps the environment, too.

Consider reasons NOT to conserve water.

- Lawns and gardens need water.
- People need water for cooking, cleaning, and bathing.
- The city can get water from other sources until it rains again.

2. Direct Teach

Introduce the Big Idea: *Earth's movement and the sun's energy interact to create day and night, temperature changes, and the seasons.*

Ask students: What do you think might happen if Earth had only half as much water as it does now?

Why? Answers will vary. Possible answer: *There would probably be fewer plants and animals because there would be less water to sustain them. The oceans would be smaller and there would be more dry land. Rivers and lakes would either dry up or be smaller.*

3. Practice/Assess/Inquire

Tell students to imagine that they are going to interview a geographer about water on Earth. Have them use standard English to write a list of interview questions about the material in the lesson. They should write at least three questions about the information under each major heading.

4. Explore (Collaborative Exploration)

Have students take turns interviewing each other using their questions.

5. Whole Group Close/Reflect

Have students write the answers next to their interview questions. Then have them work to come up with more questions.

*Alternative Assessment Handbook, Rubrics 1: Acquiring Information; and 11: Discussions

Lesson 2

Water on Earth

If **YOU** lived there...

You live in the desert Southwest, where heavy water use and a lack of rainfall have led to water shortages. Your city plans to begin a water conservation program that asks people to limit how much water they use. Many of your neighbors have complained that the program is unnecessary. Others support the plan to save water.

How do you feel about the city's water plan?

Earth's Water Supply

Think of the different uses for water. We use water to cook and clean, we drink it, and we grow crops with it. Water is used for recreation, to generate electricity, and even to travel from place to place. Water is perhaps the most important and abundant resource on Earth. In fact, water covers some two-thirds of the planet. Understanding Earth's water supply and how it affects our lives is an important part of geography.

Salt Water Although water covers much of the planet, we cannot use most of it. About 97 percent of Earth's water is salt water. Because salt water contains high levels of salt and other minerals, it is unsafe to drink.

In general, salt water is found in Earth's oceans. Oceans are vast bodies of water covering some 71 percent of the planet's



Salt Water
Earth's oceans contain some 97 percent of the planet's water supply. Unfortunately, this water is too salty to drink.

46 Module 2

ONLINE GRAPHIC ORGANIZER

Water on Earth

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Analyze Cause and Effect How does the water cycle affect life on Earth? *Water constantly repeats the cycle of evaporation and precipitation, which helps us maintain a fairly constant supply of water on Earth.*

ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: **freshwater, glacier, surface water, precipitation, groundwater, water vapor, water cycle.**

ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

The Cost of Foods is the first of six document-based investigations that students will analyze in The Physical World. Students will watch a video to discover the impact of climate change on food production, particularly with respect to water use.

Glaciers

Tremendous bodies of ice consist of frozen freshwater. This cruise ship looks like a toy next to San Rafael Glacier at Laguna San Rafael National Park on the Pacific coast of southern Chile.



Freshwater

Freshwater from lakes, rivers, and streams makes up only a fraction of Earth's water supply.



surface. Earth's oceans are made up of smaller bodies of water such as seas, gulfs, bays, and straits. Altogether, Earth's oceans cover some 139 million square miles (360 million square km) of the planet's surface.

Some of Earth's lakes contain salt water. The Great Salt Lake in Utah, for example, is a saltwater lake. As salt and other minerals have collected in the lake, which has no outlet, the water has become salty.

Freshwater Since the water in Earth's oceans is too salty to use, we must rely on other sources for freshwater. **Freshwater**, or water without salt, makes up only about 3 percent of our total water supply. Much of that freshwater is locked in Earth's **glaciers**, large areas of slow-moving ice, and in the ice of the Antarctic and Arctic regions. Most of the freshwater we use every day is found in lakes, in rivers, and under Earth's surface.

The Physical World 47

COLLABORATIVE LEARNING

Make a Chart

1. Organize the class into small groups. Have each group find out about your community's water supply. Ask them to brainstorm a list of questions they would like to have answered.
2. Next, have students look for answers by going to the library or using the Internet, or by contacting the local water department.

3. Have groups organize their findings in a two-column chart, with "Question" and "Answer" as column headings. Suggest they title the chart "Our Community's Water Supply."

4. Have groups display their charts and discuss their findings.

*Alternative Assessment Handbook, Rubrics 7: Charts; and 30: Research

Teach the Main Idea

Salt water and freshwater make up Earth's water supply.

Explain Why can't we use most of Earth's water? *It is too salty to drink.*

Summarize What are three ways you have used water in the last day? *Student answers will vary but might include drinking, cooking, brushing teeth, taking a shower, swimming, and so forth.*

Draw Conclusions Why do you think so many human settlements have been built near water? *so that people will have water for crops, to drink, and to use for transportation to travel and to trade with others*

More About . . .

Connect to Science: Desalination

As world populations grow, so does the demand for freshwater. One solution has been to develop technology to desalinate, or take the salt out of, salt water. Thousands of desalination plants around the world produce billions of gallons of freshwater every day. Many Middle Eastern and island nations depend on this desalinated water. Similar technology is appealing to some regions in the United States, where drought and rapidly growing populations have increased the demand for freshwater.

ONLINE INTERACTIVE VISUALS

Image Carousel: Types of Water

Have students explore the image using the interactive hotspots. You may wish to use the associated question as a discussion prompt.

Analyze Visuals Where does freshwater come from? *lakes, rivers, streams, glaciers*

Types of Water

Salt Water

Earth's oceans contain some 97 percent of the planet's water supply. Unfortunately, this water is too salty to drink.

A photograph of a rocky coastline where white-capped waves are crashing against the rocks, creating a misty spray. The water is a bright turquoise color.

Teach the Main Idea

In the water cycle, water circulates from Earth's surface to the atmosphere and back again.

Identify What drives the water cycle? *energy from the sun*

Recall What forms does water take? *solid (snow, ice), liquid (rain, oceans, rivers), gas (water vapor)*

Describe What happens to precipitation during the water cycle? *Some is absorbed into the soil as groundwater; runoff collects in streams, rivers, and oceans.*

More About . . .

Connect to Science: Recycling Water in Space

Whether on a space shuttle or the International Space Station, astronauts need to recycle water. Using new technologies developed by NASA, astronauts' wastewater is collected, cleaned, and then reused. New recycling technologies are in development, including new ways of making water cleaner using bacteria. Perhaps more importantly, NASA's water recycling technologies may be useful elsewhere—on Earth.

READING CHECK

Contrast Ideas How is salt water different from freshwater? *Freshwater is suitable for drinking. It is locked in glaciers or stored as groundwater or surface water, whereas salt water is found in oceans and some lakes and is not suitable for drinking.*

READING CHECK

Contrast Ideas What is the water cycle? *the circulation of water from Earth's surface to the atmosphere and back*

One form of freshwater is surface water. **Surface water** is water that is found in Earth's streams, rivers, and lakes. It may seem that there is a great deal of water in our lakes and rivers, but only a tiny amount of Earth's water supply—less than 1 percent—comes from surface water.

Streams and rivers are a common source of surface water. Streams form when precipitation collects in a narrow channel and flows toward the ocean. **Precipitation** is water that falls to Earth's surface as rain, snow, sleet, or hail. In turn, streams join together to form rivers. Any smaller stream or river that flows into a larger stream or river is called a tributary. For example, the Missouri River is the largest tributary of the Mississippi River.

Lakes are another important source of surface water. Some lakes were formed as rivers filled low-lying areas with water. Other lakes, like the Great Lakes along the U.S.-Canada border, were formed when glaciers carved deep holes in Earth's surface and deposited water as they melted.

Most of Earth's available freshwater is stored underground. As precipitation falls to Earth, much of it is absorbed into the ground, filling spaces in the soil and rock.

Water found below Earth's surface is called **groundwater**. In some places on Earth, groundwater naturally bubbles from the ground as a spring. More often, however, people obtain groundwater by digging wells, or deep holes dug into the ground to reach the water.

The Water Cycle

When you think of water, you probably visualize a liquid—a flowing stream, a glass of ice-cold water, or a wave hitting the beach. But did you know that water is the only substance on Earth that occurs naturally as a solid, a liquid, and a gas? We see water as a solid in snow and ice and as a liquid in oceans and rivers. Water also occurs in the air as an invisible gas called **water vapor**.

Water is always moving. As water heats up and cools down, it moves from the planet's surface to the atmosphere, or the mass of air that surrounds Earth. One of the most important processes in nature is the water cycle. The **water cycle** is the movement of water from Earth's surface to the atmosphere and back.

The sun's energy drives the water cycle. As the sun heats water on Earth's surface, some of that water evaporates, or turns from liquid to gas, or water vapor. Water vapor then rises into the air. As the vapor rises, it cools. The cooling causes the water vapor to condense, or change from a vapor into tiny liquid droplets. These droplets join together to form clouds. If the droplets become heavy enough, precipitation occurs—that is, the water falls back to Earth as rain, snow, sleet, or hail.

When that precipitation falls back to Earth's surface, some of the water is absorbed into the soil as groundwater. Excess water, called runoff, flows over land and collects in streams, rivers, and oceans. Because the water cycle is constantly repeating, it allows us to maintain a fairly constant supply of water on Earth.

Reading Check
Contrast Ideas How is salt water different from freshwater?

Reading Check
Find Main Ideas What is the water cycle?

48 Module 2

EVALUATE INFORMATION

Create a Public Service Announcement

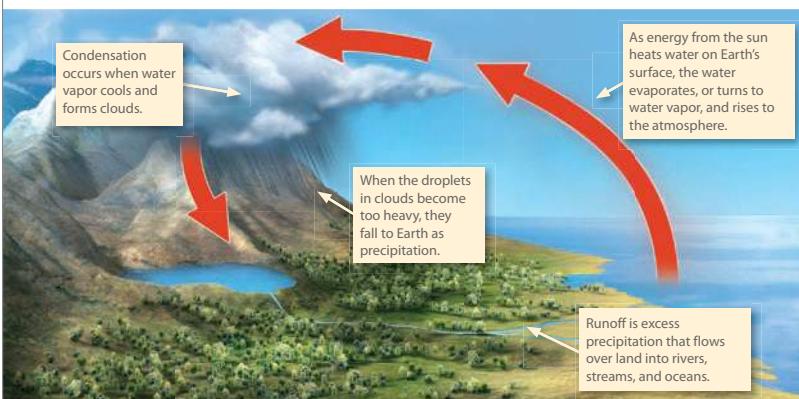
1. Have students write a script for a public service announcement about keeping groundwater free of pesticides.
2. Have them begin by exploring government or nonprofit websites. They should find out where pesticides come from, how they enter the water cycle, and how they affect the environment.
3. Before they begin writing, have students evaluate the information and draw conclusions. Some students might argue that the benefits of pesticides outweigh any harmful effects. Students might write announcements expressing different opinions.

4. Have students read their announcements aloud to the class. Ask listeners to comment or ask questions about information that they found particularly interesting or surprising.

*Alternative Assessment Handbook, Rubrics 16: Judging Information; and 29: Presentations

The Water Cycle

Energy from the sun drives the water cycle. Surface water evaporates into Earth's atmosphere, where it condenses, then falls back to Earth as precipitation. This cycle repeats continuously, providing us with a fairly constant water supply.



Analyze Visuals

How does evaporation differ from precipitation?

Water and People

How many times a day do you think about water? Many of us rarely give it a second thought, yet water is crucial for survival. Water problems such as the lack of water, polluted water, and flooding are concerns for people all around the world. Water also provides us with countless benefits, such as energy and recreation.

Water Problems One of the greatest water problems people face is a lack of available freshwater. Many places face water shortages as a result of droughts, or long periods of lower-than-normal precipitation. Another cause of water shortages is overuse. In places like the southwestern United States, where the population has grown rapidly, the heavy demand for water has led to shortages.

Water shortages lead to many problems. Crops and livestock die without enough water, leading to food shortages. In many places in Africa, women and girls spend hours every day walking to distant water sources instead of doing other work or going to school.

Water shortages can even lead to or worsen conflict. Because water is necessary for survival, people will fight to control it in an attempt to control other groups.

ADVANCED/GIFTED

Draw a Cross Section

1. Have students draw a cross-sectional representation of Earth's water supply. They should include oceans, lakes, glaciers, rivers, streams, and water below Earth's surface.
2. Have students use details from the text to illustrate the proportional amount of freshwater and salt water.

*Alternative Assessment Handbook,
Rubric 3: Artwork

Teach the Main Idea

Water plays an important role in people's lives.

Identify Cause and Effect What problems can be caused by too much or too little water? *too much—flooding; too little—drought*

Recall What is a common cause of sinkholes? *Water can dissolve and weaken limestone, leaving the surface with little support and causing it to collapse, creating a hole.*

Summarize Why is water necessary for humans to survive? *People need water to drink and to produce food.*

Draw Conclusions How can dams be a source of energy? *As the water flows over the dam, the power of the moving water can be harnessed to create electricity.*

ONLINE INTERACTIVE VISUALS

Animation: The Water Cycle

Have students explore the animation of the water cycle and then answer the associated question.

Analyze Animations How is evaporation different from precipitation? *Evaporation occurs when water turns from liquid to gas; precipitation is water that falls to Earth from condensed water vapor.*

In print edition, see visual feature of same title.

Analyze Visuals How is evaporation different from precipitation? *Evaporation occurs when water turns from liquid to gas; precipitation is water that falls to Earth from condensed water vapor.*

ONLINE DOCUMENT-BASED INVESTIGATION

The Cost of Foods

Food production requires resources like good water and soil. Have students watch the video individually or as a class to discover the impact of climate change on agriculture. You may wish to use the question as a discussion prompt.

Analyze Sources What are some ways that climate change might impact food production? *We'll need to eat more foods that require less water to produce. Lack of water will mean less healthy diets for many, and could lead to more deaths as the population increases.*



ONLINE INTERACTIVE VISUALS

Image Carousel: How Water Benefits Humans

Have students navigate through the carousel and note similarities and differences among the images or identify a unifying theme. You may wish to use the associated question as a discussion prompt.

Analyze Visuals What are the three main ways that water benefits humans? *helps us grow plants and raise animals for food, provides recreation, and generates power*

How Water Benefits Humans

Food

Water's most important benefit is that it provides us with food to eat. Everything we eat depends on water. Fruits, vegetables, and animals need water to live and grow. We use water to farm, using inventions such as this irrigation system, and to raise animals so that we will have food to eat.

< >

Even where water is plentiful, it may not be clean enough to use. If chemicals and household wastes make their way into streams and rivers, they can contaminate the water supply. Polluted water can carry diseases. These diseases may harm humans, plants, and animals.

Flooding is another water problem that affects people around the world. Heavy rains often lead to flooding, which can damage property and threaten lives. One example of dangerous flooding occurred in Bangladesh in 2004. Severe floods there destroyed roads and schools, affecting about 25 million people.

Water dramatically impacts the physical environment in other ways as well. In Florida, where limestone is plentiful, sinkholes can arise with little warning. Over time, water dissolves and weakens limestone, leaving the surface with little support. The ground layer collapses. The resulting hole in the ground can swallow cars and houses. The Devil's Millhopper is one example of a well-known sinkhole.

Water's Benefits Water does more than just quench our thirst. It provides us with many benefits, such as food, power, and even recreation.

Water's most important benefit is that it provides us with food to eat. Everything we eat depends on water. For example, fruits and vegetables need water to grow. Animals also need water to live and grow. As a result, we use water to farm and raise animals so that we will have food to eat.

Water is also an important source of energy. Using dams, we harness the power of moving water to produce electricity. Electricity provides power to air-condition or heat our homes, to run our washers and dryers, and to keep our food cold.

Water also provides us with recreation. Rivers, lakes, and oceans make it possible for us to swim, to fish, to surf, or to sail a boat. Although recreation is not critical for our survival, it does make our lives richer and more enjoyable.

Water's Benefits: for Life

Without water, plants won't grow. This modern irrigation system, used for large agricultural projects, ensures that plants get the water they need and humans get the food they need.



50 Module 2

EVALUATE INFORMATION

Estimate Water Use

1. Have students research the amount of water used for daily household tasks, such as washing dishes, brushing teeth, flushing toilets, and watering the lawn. Often this data is expressed as gallons per minute.
2. Instruct students to make a chart listing water use for a given period—a week, or weekend, for example. They should list the activity, how long it took, and how many gallons of water they estimate they used.
3. Have students share their charts in groups, compare amounts of water used, and discuss ways that individuals can conserve water at home.

*Alternative Assessment Handbook, Rubric 1: Acquiring Information

ENGLISH LANGUAGE LEARNERS

Letter to a Friend

1. To help students apply their understanding of the differences between freshwater and salt water, ask them to imagine they have just traveled through the country fishing in lakes, rivers, and oceans.
2. Have students write a letter to a friend describing their experiences. Have them explain to their friend what they learned about the differences between salt water and freshwater and where each is found.

*Alternative Assessment Handbook, Rubric 25: Personal Letters

Water's Benefits: for Fun

This surfer rides a wave at the beach. Many people enjoy swimming, boating, fishing, and other recreational activities on water.



Reading Check
Summarize How does water affect people's lives?

Recognizing all of these benefits, some communities work together to manage freshwater supplies. For example, in Florida, long-term population growth strains the freshwater supply. That, combined with drought conditions, inspired the creation of the Central Florida Water Initiative (CFWI). This organization works to protect and conserve water resources in a 5,300-square-mile (13,727-sq-km) area. The CFWI works with businesses, utilities, environmental groups, agricultural groups, and others to meet people's water needs. Many regions around the world have similar organizations.

Summary and Preview In this lesson you learned that water is essential for life on Earth. Next, you will learn about the shapes on Earth's surface.

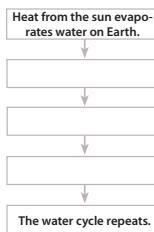
Lesson 2 Assessment

Review Ideas, Terms, and Places

1. a. **Describe** Name and describe the different types of water that make up Earth's water supply.
b. **Analyze** Why is only a small percentage of Earth's freshwater available to us?
c. **Elaborate** In your opinion, which is more important—surface water or groundwater? Why?
2. a. **Recall** What drives the water cycle?
b. **Make Inferences** From what bodies of water do you think most evaporation occurs? Why?
c. **Evaluate** What water problem do you think is most critical in your community? Why?

Critical Thinking

4. **Sequence** Draw the graphic organizer. Then use your notes and the graphic organizer to identify the stages in Earth's water cycle.



READING CHECK

Summarize How does water affect people's lives?

People depend on water for survival. Drought and flooding threaten survival. Water allows people to grow food. It also provides recreational benefits.

Print Assessment

Review Ideas, Terms, and Places

1. a. **Describe** Name and describe the different types of water that make up Earth's water supply.
Freshwater—suitable for drinking, makes up 3 percent of Earth's water supply; salt water—unsafe to drink, makes up 97 percent of Earth's water supply, mainly found in oceans
b. **Analyze** Why is only a small percentage of Earth's freshwater available to us?
Most freshwater is stored underground or locked in glaciers.
c. **Elaborate** In your opinion, which is more important—surface water or groundwater?
Why? Answers will vary but should reflect lesson content. Surface water—more accessible; groundwater—abundant
2. a. **Recall** What drives the water cycle?
evaporation and precipitation
b. **Make Inferences** From what bodies of water do you think most evaporation occurs? Why?
oceans and lakes because of size
c. **Define** What is a drought?
a long period of lower-than-normal precipitation
b. **Analyze** How does water support life on Earth?
We depend on it for drinking, food, energy, and recreation.
c. **Evaluate** What water problem do you think is most critical in your community? Why?
Answers will vary. Students may note pollution, lack of water, or flooding.

Critical Thinking

4. **Sequence** Draw the graphic organizer. Then use your notes and the graphic organizer to identify the stages in Earth's water cycle.
The water vapor cools and forms clouds. Droplets in the clouds become too heavy, causing precipitation. Runoff flows over land into rivers, streams, and oceans.

► Online Assessment

1. Where is most of Earth's available freshwater stored?
- glaciers
 - lakes
 - oceans
 - underground

Alternate Question Which of the following are common sources of surface water? Select the **three** correct answers.

- bays
- gulfs
- lakes
- rivers
- seas
- streams

2. Which of the following is the first step in the water cycle?

- condensation
- evaporation
- precipitation
- solidification

Alternate Question Drag the steps of the water cycle into the correct order from top to bottom.

- | | |
|-----|--|
| (1) | The heat of the sun causes some water on the Earth's surface to evaporate. |
| (2) | Water vapor rises into the air, cools, and condenses into droplets. |
| (3) | Water droplets join together to form clouds, and if these droplets get heavy enough, precipitation occurs. |
| (4) | Precipitation falls to Earth, and some is absorbed into the soil, and some runs off and collects in streams, rivers, and oceans. |

3. How do individuals contribute to problems with the water supply?

- by eating crops
- by creating sinkholes
- by using electrical power
- by producing household waste

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Polluted water is a problem because it can carry **diseases**.

4. **Make Inferences** Why is it important to conserve freshwater?

Possible answer: Freshwater is one of our most important resources. We need it to cook, clean, drink, and grow crops. However, it makes up only about 3 percent of our total water supply. Therefore, it is important to conserve it.

5. **Make Generalizations** How does Earth maintain a fairly constant supply of water?

Possible answer: The water cycle means that Earth's water is constantly moving from Earth's surface to the atmosphere and back. Because the water cycle is constantly repeating, Earth maintains a fairly constant supply of water.

6. **Cause and Effect** How can water shortages lead to problems?

Describe two ways.

Possible answer: Without enough water, crops and livestock can die, which can create food shortages. Water shortages can also lead to or worsen conflict. People will fight for control of water because it is necessary for survival.

ADDITIONAL INSTRUCTIONAL MATERIALS

continued from page 49

More About . . .

Connect to History The earliest dam was probably built on the Nile River around 2900 BC. It supplied water to the Egyptian city of Memphis. Other early dams were built to irrigate fields. A dam built about 1300 BC in Syria is still in use today. Other dams were built elsewhere in the Middle East and also in Saudi Arabia, China, India, and Ceylon (present-day Sri Lanka).

Lesson 3 Planner



The Land

- Type of Landforms
- Earth's Structure
- Making Mountains
- Lava Flows When Plates Separate
- Mount Saint Helens, 1980

- Earthquake Preparedness
- The Ring of Fire

Visuals

Videos

Maps,
Graphs, and
Charts

LESSON 3

Big Idea

Processes below and
on Earth's surface
shape the planet's
physical features.

- **Biography:** Alfred Wegener
- Earth's Plates
- **Geographic Feature:** Living with
Landforms
- Predicting Earthquakes with GPS
- The Great Fossil Mystery

Extend
and Enrich

- **Document-Based Investigation:**
Human Impact on Coastal Erosion

Sources

Assessment

- Key Terms Review
- Reading Check
- Graphic Organizer Activity
- Lesson Assessment

► Online Lesson 3 Enrichment Activities

Predicting Earthquakes with GPS

Article Students read how a professor in Japan has discovered a link between GPS data and earthquakes and then create a multimedia presentation or poster on earthquake preparedness.

The Great Fossil Mystery

Video Students view a video to learn how Alfred Wegener proved his continental drift hypothesis and then write a paragraph about how fossils provide evidence of continental drift.



Teach the Big Idea

1. Whole Class Open/Introduction

If **YOU** lived there . . .

How do you feel about living near a volcano?

Review the scenario with students and lead a class discussion around responses to the question. Remind students that all responses are valid as long as they are supported with valid reasoning. You may wish to review the following points to frame your discussion.

Consider why you **LIKE** living near a volcano.

- unique feature of the land
- beautiful landscape
- exciting to see changes to Earth

Consider why you **DISLIKE** living near a volcano.

- ash covers everything
- lava can be dangerous
- don't know how bad the next eruption will be

2. Direct Teach

Introduce the Big Idea: *Processes below and on Earth's surface shape the planet's physical features.* Ask students if they think the crust of Earth is moving. Encourage them to discuss any current events that show examples of this movement. If necessary, suggest signs of movement such as earthquakes and volcanoes.

3. Practice/Assess/Inquire

Have each student create a chart with three columns. In the first column have them list what they know about landforms. In the second column, have students write questions about landforms. Finally, have students look through the lesson to see if they can find answers to their questions in the illustrations, captions, headings, and terms. Have them write the answers in the third column.

4. Explore (Collaborative Exploration)

Have students quiz a partner by asking the questions in the second column and checking them against their answers in the third column.

5. Whole Group Close/Reflect

Have students create five multiple-choice questions about the section. Remind them to provide an answer key.

*Alternative Assessment Handbook, Rubric 37: Writing Assignments

READING CHECK

Summarize What are some common landforms? *mountains, valleys, plains, islands, and peninsulas*

Lesson 3

The Land

If **YOU** lived there...

You live in the state of Washington. All your life, you have looked out at the beautiful, cone-shaped peaks of nearby mountains. One of them is Mount Saint Helens, an active volcano. You know that in 1980 it erupted violently, blowing a hole in the mountain and throwing ash and rock into the sky. Since then, scientists have watched the mountain carefully.

How do you feel about living near a volcano?

Landforms

Do you know the difference between a valley and a volcano? Can you tell a peninsula from a plateau? If you answered yes, then you are familiar with some of Earth's many landforms.

Landforms are shapes on the planet's surface, such as hills or mountains. Landforms make up the landscapes that surround us, whether it's the rugged mountains of central Colorado or the flat plains of Oklahoma.

Earth's surface is covered with landforms of many different shapes and sizes. Some important landforms include:

- mountains, land that rises higher than 2,000 feet (610 m)
- valleys, areas of low land located between mountains or hills
- plains, stretches of mostly flat land
- islands, areas of land completely surrounded by water
- peninsulas, land surrounded by water on three sides

Because landforms play an important role in geography, many scientists study how landforms are made and how they affect human activity.



52 Module 2

Teach the Main Idea

Earth's surface is covered by many different landforms.

Define What is a landform? *a shape on Earth's surface*

Compare and Contrast How is an island different from a peninsula? *An island is surrounded by water, whereas a peninsula has water on only three sides.*

Describe What is an example of a landform in your area? Describe the landform. *Answers will vary but should describe a local landform, such as a plain, valley, or hill.*

ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

The Human Impact on Coastal Erosion is the second of six document-based investigations that students will analyze in the Physical World module. Students study the image to learn more about human-environment interaction.

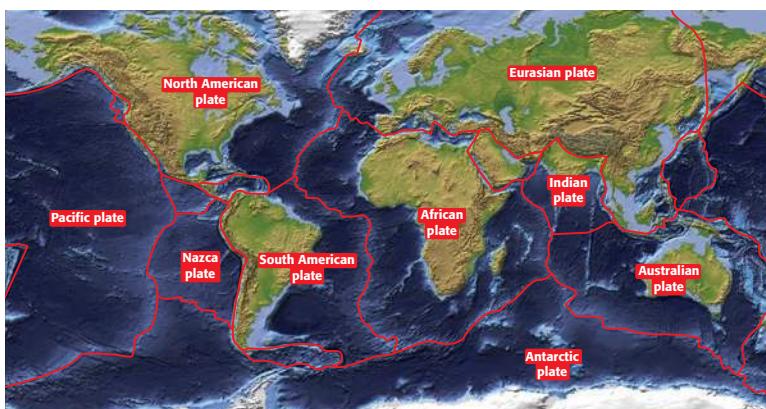
ONLINE INTERACTIVE VISUALS

Image with Text Slider: Types of Landforms

Have students explore the image by revealing additional information using the interactive slider.

Earth's Plates

The theory of plate tectonics states that the plates that make up Earth's crust are moving, usually only a few inches per year. As Earth's plates collide, separate, and slide past each other, they create forces that shape many of Earth's landforms.



Analyze Visuals

Looking at the map, what evidence indicates that plates have collided or separated?

Academic Vocabulary
structure the way something is set up or organized

Forces below Earth's Surface

Geographers often study how landforms are made. One explanation for how landforms have been shaped involves forces below Earth's surface.

Earth's Plates To understand how these forces work, we must examine Earth's **structure**. The planet is made up of three layers. A solid inner core is surrounded by a liquid layer, or mantle. The solid outer layer of Earth is called the crust. The planet's **continents**, or large landmasses, are part of Earth's crust.

Geographers use the theory of plate tectonics to explain how forces below Earth's surface have shaped our landforms. The theory of **plate tectonics** suggests that Earth's surface is divided into a dozen or so slow-moving plates, or pieces of Earth's crust. As you can see in the image above, some plates, like the Pacific plate, are quite large. Others, like the Nazca plate, are much smaller. These plates cover Earth's entire surface. Some plates are under the ocean. These are known as ocean plates. Other plates, known as continental plates, are under Earth's continents.

Why do these plates move? Energy deep inside the planet puts pressure on Earth's crust. As this pressure builds up, it forces the plates to shift. Earth's tectonic plates all move. However, they move in different directions and at different speeds.

The Physical World 53

ONLINE GRAPHIC ORGANIZER

The Land

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Evaluate Why do you think it's important to study how processes change landforms on Earth? *It helps humans have a better understanding of Earth's cycles. It also helps us predict dangerous conditions and prevent the loss of human lives.*

ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: **landforms, continents, plate tectonics, lava, earthquakes, weathering, erosion, alluvial deposition**.

Teach the Main Idea

Forces below Earth's surface build up our landforms.

Define What is plate tectonics? *A theory to explain how landforms are formed; Earth's crust has several plates that create landforms when they collide, separate, or slide past each other.*

Summarize What are the two types of tectonic plates? *ocean plates and continental plates* What three types of plate collisions are there, and what landforms result from these collisions? *two ocean plates—ocean trenches; ocean plates and continental plates—mountain ranges near the ocean; two continental plates—high mountains*

Identify Cause What causes Earth's plates to move? *Energy deep in Earth builds up and puts enormous pressure on the crust, forcing the plates to shift.*

More About . . .

The Supercontinent Alfred Wegener called the original "supercontinent" Pangaea, which in Greek means "all the land" or "all earth." A South African geologist named Alexander L. Du Toit suggested an alternative theory in 1937—that there were originally two continents: Gondwana in the south and Laurasia in the north.

The Continental Drift Theory Many facts support the theory of continental drift. One of them is the similarity in rock formations along the coasts of South America and Africa.

ONLINE INTERACTIVE CHART

Earth's Structure

Have students examine the chart to learn more about the structure of Earth.

GEOGRAPHIC FEATURE

Earth's Plates

Have students explore the map using the interactive features and answer the associated question.

Interpret Maps Looking at the map, which tectonic plate is the largest? *Pacific plate*

In print edition, see visual feature of same title.

Analyze Visuals Looking at the map, what evidence indicates that plates have collided or separated? *The plates of the Americas seem to fit, like pieces of a jigsaw puzzle, with the Eurasian and African plates, indicating that they were once joined then separated. Some continental plates, such as the Indian and the Eurasian plates, seem to have collided.*

For additional instruction, go to end of lesson.

BIOGRAPHY

Alfred Wegener

Have students read the biography of Alfred Wegener. Point out that some earlier scientists had proposed the idea of a supercontinent, but, unlike Wegener, they had not postulated that parts of this massive continent had sunk to create oceans, leaving some land above water.



ONLINE INTERACTIVE VISUALS

Image Compare: Making Mountains

Have students explore and compare the images using the interactive slider. You may wish to use the associated question as a discussion prompt.

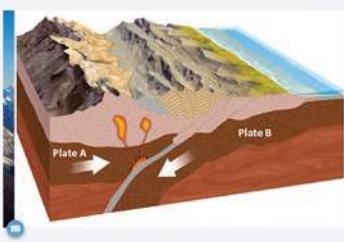
Analyze Visuals What type of landform is created by the collision of two continental plates? *mountains*

In print edition, see image titled Mountains Formed from Plate Collision.

Making Mountains

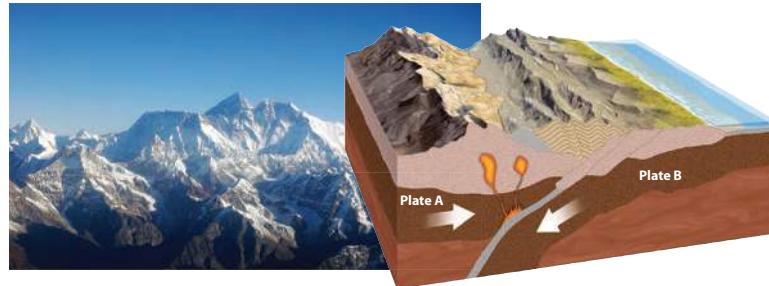
The movement of Earth's tectonic plates has produced many of Earth's landforms.

As Plate A and Plate B collide, it forces one crust to push up on top of the other which creates mountains.



Mountains Form When Plates Collide

The movement of Earth's tectonic plates has produced many of Earth's landforms. For example, the Himalayas in South Asia resulted from the collision of two massive continental plates.



Analyze Visuals
What type of landform is created by the collision of two continental plates?

54 Module 2

COLLABORATIVE LEARNING

Design a Slide Show Presentation

- Organize the class into pairs or small groups. Ask them to imagine that they are park rangers at a national park in a region where landforms were formed by colliding continents.
- Have students work together to design a slide show presentation about plate tectonics, to be shown to park visitors. They should include maps, photographs, and/or drawings to illustrate the information.

- Have students write the commentary to go with the slide show.
- Students should present the slide show to the class, with one student showing the images while the other reads the commentary. Encourage listeners to ask questions about the material.

*Alternative Assessment Handbook, Rubrics 14: Group Activity; and 22: Multimedia Presentations

For additional instruction, go to end of lesson.

The Movement of Continents Earth's tectonic plates move slowly—up to several inches per year. The continents, which are part of Earth's plates, shift as the plates move. If we could look back some 200 million years, we would see that the continents have traveled great distances. This idea is known as continental drift.

The theory of continental drift, first developed by Alfred Wegener, states that the continents were once united in a single supercontinent. Wegener's inspiration came from the similarity he observed between the western coast of Africa and the eastern coast of South America. According to this theory, Earth's plates shifted over millions of years. As a result, the continents slowly separated and moved to their present positions.

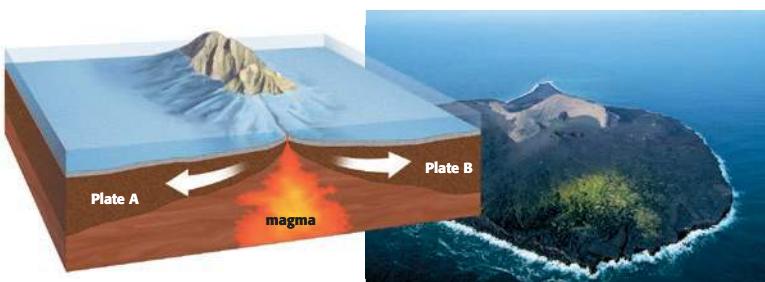
Earth's continents are still moving. Some plates move toward each other and collide. Other plates separate and move apart. Still others slide past one another. Over time, colliding, separating, and sliding plates have shaped Earth's landforms.

Plates Collide As plates collide, the energy created from their collision produces distinct landforms. The collision of different types of plates creates different shapes on Earth's surface. Ocean trenches and mountain ranges are two examples of landforms produced by the collision of tectonic plates.

When two ocean plates collide, one plate pushes under the other. This process creates ocean trenches. Ocean trenches are deep valleys in the ocean floor. Near Japan, for example, the Pacific plate is slowly moving under other plates. This collision has created several deep ocean trenches, including the world's deepest trench, the Mariana Trench.

Lava Flows When Plates Separate

The separation of Earth's tectonic plates produces landforms, just as the collision of plates does. The separation of plates can allow magma to rise up and create volcanic islands like Surtsey Island, near Iceland.



Analyze Visuals

What other landform involves flowing lava?

Ocean plates and continental plates can also collide. When this occurs, the ocean plate drops beneath the continental plate. This action forces the land above to crumple and form a mountain range. The Andes in South America, for example, were formed when the South American and Nazca plates collided.

The collision of two continental plates also results in mountain-building. When continental plates collide, the land pushes up, sometimes to great heights. The world's highest mountain range, the Himalayas, formed when the Indian plate crashed into the Eurasian plate. In fact, the Himalayas are still growing as the two plates continue to crash into each other.

Plates Separate A second type of plate movement causes plates to separate. As plates move apart, gaps between the plates allow magma, a liquid rock from the planet's interior, to rise to Earth's crust. **Lava**, or magma that reaches Earth's surface, emerges from the gap that has formed. As the lava cools, it builds a mid-ocean ridge, or underwater mountain. For example, the separation of the North American and Eurasian plates formed the largest underwater mountain, the Mid-Atlantic Ridge. If these mid-ocean ridges grow high enough, they can rise above the surface of the ocean, forming volcanic islands. Iceland, on the boundary of the Eurasian and North American plates, is an example of such an island.

Plates Slide Tectonic plates also slide past each other. As plates pass by one another, they sometimes grind together. This grinding produces **earthquakes**—sudden, violent movements of Earth's crust. Earthquakes often take place along faults, or breaks in Earth's crust where movement

ONLINE INTERACTIVE VISUALS

Image Compare: Lava Flows When Plates Separate

Have students explore and compare the images using the interactive slider. You may wish to use the associated question as a discussion prompt.

Analyze Visuals How do volcanic islands form?
As the plates separate, magma rises up from beneath the ocean floor that creates underwater mountains. When the landforms get tall enough, they rise above the water's surface as islands.

In print edition, see image of same title.

Analyze Visuals What other landform involves flowing lava? *mid-ocean ridge or underwater mountain*

ANALYZE VIDEOS

Earthquake Preparedness

Have students watch the video individually or as a class.

ANALYZE VIDEOS

The Ring of Fire

Have students watch the video individually or as a class.



▶ PLAY VIDEO 4:01
The Ring of Fire

INTERPRET MAPS

Make a Map of the Ring of Fire

1. Instruct students to use an atlas and other sources from the Internet or library to research the Ring of Fire.
2. Have students draw a map showing the perimeter of the Ring of Fire, labeling continents and bodies of water. Students should add symbols showing where volcanoes and earthquake faults can be found within the area covered by the map. Encourage students to annotate the maps with information about specific volcanoes, faults, and earthquakes.

3. Have students display their maps.

Students should compare their maps with political maps of the region and note how close the earthquake faults and volcanoes are to centers of population.

*Alternative Assessment Handbook, Rubric 20:
Map Creation

Teach the Main Idea

Forces on the planet's surface shape Earth's landforms.

Describe What is weathering? *the process of breaking rock into smaller pieces* What are the causes of erosion? *wind, ice, water* What landforms are shaped by liquid water? *coastlines, canyons, floodplains, deltas*

Explain How does wind erode some landforms? *It can lift soil and move it from place to place, form dunes by depositing sand, and wear down rocks with blowing sand.*

More About . . .

Connect to Science: The Living Dirt of the Canyonlands

Canyonlands Located in Utah, Canyonlands National Park preserves a unique desert ecosystem. The Canyonlands was largely formed out of sedimentary rock deposits from the Colorado River and its tributaries. Continual erosion still shapes life in the Canyonlands today. For example, a layer of dirt, or soil crust, called *Biological Soil Crust* lies over much of the Canyonlands area. This crust includes algae, lichens, and bacteria—and serves as a living, but secure, foundation for desert plants.

ONLINE INTERACTIVE VISUALS

Carousel: Mount Saint Helens, 1980

Have students navigate through the carousel and note similarities and differences among the images or identify a unifying theme. You may wish to use the associated question as a discussion prompt.

Analyze Visuals Why do scientists monitor volcanic activity? *The data helps them better predict and prepare for volcanic eruptions.*

READING CHECK

Find Main Ideas What forces below Earth's surface shape landforms? *Energy in Earth's core and mantle creates pressure against the crust. This pressure can force tectonic plates to move. When these plates collide or separate, they can form volcanoes, ocean trenches, mid-ocean ridges, and mountains. Sliding plates can also cause earthquakes and volcanic eruptions.*

Reading Check
Find Main Ideas
What forces below Earth's surface shape landforms?

occurs. In California, for example, the Pacific plate is sliding by the edge of the North American plate. This has created the San Andreas Fault zone, an area where earthquakes are quite common.

The San Andreas Fault zone is one of many areas that lie along the boundaries of the Pacific plate. The frequent movement of this plate produces many earthquakes and volcanic eruptions along its edges. In fact, the region around the Pacific plate, called the Ring of Fire, is home to most of the world's earthquakes and volcanoes.

Processes on Earth's Surface

For millions of years, the movement of Earth's tectonic plates has been building up landforms on Earth's surface. At the same time, other physical environmental processes are working to change those very same landforms.

Imagine a small pile of dirt and rock on a table. If you poured water on the pile, it would move the dirt and rock from one place to another. Likewise, if you were to blow at the pile, the rock and dirt would also move. The same process happens in nature. Weather, water, and other forces change Earth's landforms by wearing them away or reshaping them.

Weathering One force that wears away landforms is weathering.

Weathering is the process by which rock is broken down into smaller pieces. Several factors cause rock to break down. In desert areas, daytime heating and nighttime cooling can cause rocks to crack. Water may get into cracks in rocks and freeze. The ice then expands with a force great enough to break the rock. Even the roots of trees can pry rocks apart.

Regardless of which weathering process is at work, rocks eventually break down. These small pieces of rock are known as sediment. Once weathering has taken place, wind, ice, and water often move sediment from one place to another.

Erosion Another force that changes landforms is the process of erosion.

Erosion is the movement of sediment from one location to another. Erosion can wear away or build up landforms. Wind, ice, and water all cause erosion.

Wind Erosion
Landforms in Utah's Canyonlands National Park have been worn away, mostly by thousands of years of powerful winds.



Powerful winds often cause erosion. Winds lift sediment into the air and carry it across great distances. On beaches and in deserts, wind can deposit large amounts of sand to form dunes. Blowing sand can also wear down rock. The sand acts like sandpaper to polish and wear away at rocks. As you can see in the photo, wind can have a dramatic effect on landforms.

Earth's glaciers also have the power to cause massive erosion. Glaciers, or large, slow-moving sheets of ice, build

56 Module 2

LINK TO LANGUAGE ARTS

Write an Eyewitness Account

1. Have students research and write an eyewitness account of the eruption of Mount Saint Helens, Mount Vesuvius, Krakatau, or another volcano.
2. Ask them to imagine that they were living in or visiting the area near the volcano when it erupted. Using the information they gather as well as their imagination and prior knowledge, have them write a short story about the eruption and the events that preceded and followed the disaster. Encourage students to include vivid images and details of the experience in their stories.

3. Finally, have students read their short stories aloud. Encourage class members to ask questions about the information.

*Alternative Assessment Handbook, Rubrics 1: Acquiring Information; and 40: Writing to Describe



Water Erosion
For millions of years, the Colorado River has worn away the rock at Horseshoe Bend in Arizona.

Reading Check
Compare
How are weathering and erosion similar?

up when winter snows do not melt the following summer. Glaciers can be huge. Glaciers in Greenland and Antarctica, for example, are great sheets of ice up to two miles (3 km) thick. Some glaciers flow slowly downhill like rivers of ice. As they do so, they erode the land by carving large U-shaped valleys and sharp mountain peaks. As the ice flows downhill, it crushes rock into sediment and can move huge rocks long distances.

Water is the most common cause of erosion. Waves in oceans and lakes can wear away the shore, creating jagged coastlines, like those on the coast of Oregon. Rivers also cause erosion. Over many years, the flowing water can cut through rock, forming canyons, or narrow areas with steep walls. Arizona's Horseshoe Bend and Grand Canyon are examples of canyons created in this way.

Flowing water shapes other landforms as well. When water deposits sediment in new locations, it creates new landforms. For example, in a process called **alluvial deposition**, rivers create floodplains when they flood their banks and deposit sediment along the banks. Sediment that is carried by a river all the way out to sea creates a delta. The sediment settles to the bottom, where the river meets the sea. The Nile and Mississippi rivers have created two of the world's largest river deltas.

READING CHECK

Compare How are weathering and erosion both similar and different? *similar—both cause rock to break up; water contributes to both; different—weathering occurs when, as a result of weather factors, rocks crack and break; erosion occurs when ice, wind, and water cause rocky materials to move from one location to another.*

STRUGGLING READERS

Use Visual Cues

1. To help struggling readers, have them study each photo and then match the text to the photo.
2. Have students discuss what they see and read the text and captions aloud.
3. Remind students to look for illustrations and captions throughout the book.

*Alternative Assessment Handbook, Rubric 1:
Acquiring Information

SPECIAL NEEDS STUDENTS

Create a Collage

1. Provide images of mountains and volcanoes from magazines and the Internet and have students make collages. Challenge them to distinguish between volcanoes and other kinds of mountains.
2. Point out that volcanoes are made when plates pull apart and that mountains are made when plates crash into each other.

*Alternative Assessment Handbook, Rubric 8:
Collages

Teach the Main Idea

Landforms influence people's lives and culture.

Analyze How do the landforms in your area influence your daily life? *Answers will vary.*

Students should identify the landforms in their region and tell how these landforms affect them.

Recall Where was the first civilization built? *in the valley of the Tigris and Euphrates rivers*

Explain How did the location help the civilization thrive? *People had plenty of water for crops and could use the rivers for trade.*

More About . . .

Connect to History: The Hoover Dam A National Historic Landmark located on the Nevada-Arizona border, the Hoover Dam was built in five years—in a harsh, barren desert—during the Great Depression. Although people lived along the Colorado River for thousands of years, the dam changed the area and how people lived there. For the first time ever, the Hoover Dam allowed the Colorado River to be controlled, providing dependable water supplies for millions of people in Nevada, Arizona, and California. To learn more about the Hoover Dam, visit www.usbr.gov/lc/hooverdam.

GEOGRAPHIC FEATURE

Living with Landforms

Have students study the image and answer the associated question.

Analyze Visuals How have people in Rio de Janeiro adapted to their landscape? *They use boats in their bays, build houses in the valleys, and have created ways to get to the higher areas.*



ONLINE DOCUMENT-BASED INVESTIGATION

Human Impact on Coastal Erosion

Have the students explore the image to learn more about some effects of human-environment interaction.

Analyze Sources Study the photo. What purpose do you think the sandbags serve? How effective do you think they are? *The sandbags act as a barrier between the houses and the ocean. Other sandbags are visible under the water. It appears that the sandbags might work temporarily, but there are no sand dunes or natural barriers between the houses and the ocean.*

Landforms Influence Life

Why do you live where you do? Perhaps your family moved to the desert to avoid harsh winter weather. Or possibly one of your ancestors settled near a river delta because its fertile soil was ideal for growing crops. Maybe your family wanted to live near the ocean to start a fishing business. As these examples show, landforms exert a strong influence on people's lives. Earth's landforms affect our settlements and our culture. At the same time, we affect the landforms around us.

Earth's landforms can influence where people settle. People sometimes settle near certain landforms and avoid others. For example, many settlements are built near fertile river valleys or deltas. The earliest urban civilization, for example, was built in the valley between the Tigris and Euphrates rivers. Other times, landforms discourage people from settling in a certain place. Tall, rugged mountains, like the Himalayas, and harsh desert climates, like the Sahara, do not usually attract large settlements.

Landforms affect our culture in ways that we may not have noticed. Landforms often influence what jobs are available in a region. For

Living with Landforms

The people of Rio de Janeiro, Brazil, have learned to adapt to the mountains and bays that dominate their landscape.



Analyze Visuals

How have people in Rio de Janeiro adapted to their landscape?

58 Module 2

ENGLISH LANGUAGE LEARNERS

Describe an Image

- To help students build their vocabulary about landforms, provide them with clay (salt dough or play dough will work just as well) and a paper plate. Tell them the plate represents an island that has many landforms. Their job is to build the landforms on the island using the clay.
- Provide a wordlist (mountains, valleys, plains, islands, peninsulas) and have the students demonstrate their understanding of each of the landforms listed by sculpting them out of clay.

- Have students share their finished projects with a partner, describing the features of the landforms they built.

*Alternative Assessment Handbook, Rubric 3: Artwork

Reading Check
Analyze Effects
What are some examples of humans adjusting to and changing landforms?

example, rich mineral deposits in the mountains of Colorado led to the development of a mining industry there. Landforms even affect language. On the island of New Guinea in Southeast Asia, rugged mountains have kept the people so isolated that more than 700 languages are spoken on the island today.

People sometimes change landforms to suit their needs. People may choose to modify landforms in order to improve their lives. For example, engineers built the Panama Canal to make travel from the Atlantic Ocean to the Pacific Ocean easier. In Southeast Asia, people who farm on steep hillsides cut terraces into the slope to create more level space to grow their crops. People have even built huge dams along rivers to divert water for use in nearby towns or farms.

Summary and Preview Landforms are created by actions deep within the planet's surface, and they are changed by forces on Earth's surface, like weathering and erosion. In the next lesson you will learn how other forces, like weather and climate, affect Earth's people.

Lesson 3 Assessment

Review Ideas, Terms, and Places

1. a. **Describe** What are some common landforms?
b. **Analyze** Why do geographers study landforms?
2. a. **Identify** What is the theory of plate tectonics?
b. **Compare and Contrast** How are the effects of colliding plates and separating plates similar and different?
c. **Predict** How might Earth's surface change as tectonic plates continue to move?
3. a. **Recall** What is the process of weathering?
b. **Elaborate** How does water affect sediment?
4. a. **Recall** How do landforms affect life on Earth?
b. **Predict** How might people adapt to life in an area with steep mountains?

Critical Thinking

5. **Identify and Describe** Use your notes and a two-column chart to identify and describe different physical environmental processes and their effects on Earth's surface.

Physical Environmental Process	Effect on Earth's Surface

READING CHECK

Analyze Effects What are some examples of humans adjusting to and changing landforms? *adjusting to—people living in delta areas can grow food on the fertile land; people living near the sea can trade and travel; people living in areas where rich mineral deposits can be mined; changing—building dams; drilling tunnels through mountains; farming on steep hillsides by building terraces.*

Print Assessment

Review Ideas, Terms, and Places

1. a. **Describe** What are some common landforms?
mountains, valleys, plains, islands
b. **Analyze** Why do geographers study landforms?
to learn how they are made and how they affect human activity
2. a. **Identify** What is the theory of plate tectonics?
It explains landforms through movement of pieces on Earth's crust, or plates.
b. **Compare and Contrast** How are the effects of colliding plates and separating plates similar and different?
Both form landforms; colliding-form ocean trenches, mountains; separating-form ocean ridges, volcanic islands
c. **Predict** How might Earth's surface change as tectonic plates continue to move?
create new landforms, change existing ones
3. a. **Recall** What is the process of weathering?
breaking of rock into smaller pieces
b. **Elaborate** How does water affect sediment?
It moves sediment from one place to another, creating new landforms.
4. a. **Recall** How do landforms affect life on Earth?
Possible answer: People settle in certain areas because of landforms. Landforms also affect what kinds of jobs are available in an area.
b. **Predict** How might people adapt to life in an area with steep mountains?
They might cut terraces to grow crops and build roads for transportation.

Critical Thinking

5. **Identify and Describe** Use your notes and a two-column chart to identify and describe different physical environmental processes and their effects on Earth's surface.
Possible answer: movement of plates: creates ocean trenches and mountains; weathering: wears down landforms; erosion: moves sediment

► Online Assessment

1. Which of the following describes valleys?

- stretches of mostly flat land
- land surrounded by water on three sides
- areas of land completely surrounded by water
- areas of low land located between mountains or hills

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Lands that rise higher than 2,000 feet (610 m) are called **mountains** ▾.

2. Why do the plates that make up the Earth's crust move?

- because the Earth's outer crust is thin
- because the Earth's inner core is solid
- because pressure within the planet forces them to shift
- because the movement of continents forces them to shift

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Pressure within the planet causes Earth's **plates** ▾ to move.

3. What is the immediate effect of weathering?

- Tree roots pry rocks apart.
- Sediment forms into sand dunes.
- Rock is broken down into smaller pieces.
- Sediment is moved from one place to another.

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

The small pieces of rock that are produced by weathering are called **sediment** ▾.

4. Why are many settlements built in river valleys?

- because of travel desires
- because the soil is fertile
- because of mineral deposits
- because terrace farming is possible

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Because of the area's fertile soil, one of the earliest urban civilizations developed in **Mesopotamia** ▾.

5. **Make Generalizations** How do many scientists study landforms?

Describe two ways.

Possible answer: Many scientists study how landforms are made. They also study how landforms affect human activity.

6. **Cause and Effect** How does the collision of plates produce distinct landforms? Describe two ways.

Possible answer: When two ocean plates collide, one plate pushes under the other. These collisions create ocean trenches. When an ocean plate and a continental plate collide, the ocean plate drops below the continental plate. This forces the land above to crumple and form a mountain range.

7. **Compare and Contrast** How are weathering and erosion similar and different? Describe one similarity and one difference.

Possible answer: Weathering and erosion are similar because they shape Earth's landforms. They are different because weathering wears away landforms, while erosion can wear away or build up landforms, such as dunes on beaches and in deserts.

8. **Make Generalizations** How do people sometimes change landforms to suit their needs? Describe two ways.

Possible answer: People sometimes build canals to make it easier to travel, such as the building of the Panama Canal. People who farm on hillsides sometimes cut terraces into the slope to create a level space to grow crops.

ADDITIONAL INSTRUCTIONAL MATERIALS

continued from page 53

More About . . .

Connect to Science: Deep Sea Life The deepest part of the Mariana Trench is more than 36,000 feet (10,973 m) below sea level. (For comparison, Mount Everest is more than 29,000 feet (8,839 m) above sea level.) Over the years, the variety of life found on the deepest sea floor has been astonishing. The creatures on the sea floor do not depend on the sun's energy for life. Instead, they use energy from the chemicals that rise from hydrothermal vents. Students may be interested in visiting the website of the American Museum of Natural History for more information about life on the sea floor. (www.amnh.org)

continued from page 54

More About . . .

Underwater Mountains The Mid-Atlantic Ridge is an underwater mountain chain. About 10,000 miles (16,093 km) long, it reaches from the Arctic Ocean in the North to beyond the southern tip of Africa.

UNDERSTAND CAUSE AND EFFECT

Make a Cause-and-Effect Chart

1. Have students reread the material under the head Plates Collide. Ask them if they can identify the main idea of each paragraph. Point out that the second, third, and fourth paragraphs each begin with a topic sentence that contains the main idea.
2. Ask students to identify the main ideas in the Plates Separate and Plates Slide text. Help them to see that each type of plate movement results in a different kind of landform. Then have them make a two-column chart with columns labeled Cause and Effect. Students will list on the chart the different kinds of plate motion and the resulting landforms.
3. Ask volunteers to share their charts and get feedback. Have the class discuss examples of landforms they are familiar with that were caused by plate movement.

*Alternative Assessment Handbook, Rubrics 6: Cause and Effect; and 7: Charts

continued from page 59

More About . . .

Quake Force Powerful earthquakes have caused huge death tolls and devastation throughout the world. Of the nine most destructive earthquakes in the twentieth century, four occurred in China. In 1976 the town of Tangshan, China, was hit with an earthquake that killed approximately 240,000 people. About 500,000 were estimated to have been wounded. In the United States, the largest magnitude earthquakes have taken place in Alaska. On the mainland, most of the high-magnitude earthquakes have occurred in California. A number of earthquake faults, particularly in California, are closely watched by geologists. The San Andreas fault system runs about 800 miles (1,287 km) north to south through the state. At its widest point, the fault is a few hundred feet wide.

Case Study

Case Study

The Ring of Fire

Lead students in a discussion of how they think the eruption might have affected the area surrounding Mount Saint Helens. For example, what might have happened to the streams and rivers? How might plants and trees be affected? Then have students work in groups to develop storyboards depicting scenes from a documentary movie about the eruption. Or, have students create posters advertising the documentary.

More About . . .

Connect to Today: Recovery The eruption of Mount Saint Helens was devastating. A 230-square-mile (596-sq-km) blast zone was a wasteland of ash, lava, and dead trees. It was hard to believe that the area could ever recover, that plants and animals could regain their former numbers. But more than 35 years after the eruption, many species have returned, including birds, mammals, flowers, and trees. Elk herds have grown, and numerous black-tailed deer now live in the area. In the absence of future eruptions, scientists expect that area will continue to recover.

► ONLINE INTERACTIVE VISUALS

Carousel: Mount Saint Helens, 1980

See the digital activity in *Lesson 3, Forces Below Earth's Surface*.

Have students navigate through the carousel and note similarities and differences among the images or identify a unifying theme. You may wish to use the associated question as a discussion prompt.

Analyze Visuals Why do scientists monitor volcanic activity? *The data helps them better predict and prepare for volcanic eruptions.*

Essential Elements

- The World in Spatial Terms
- Places and Regions
- Physical Systems**
- Human Systems
- Environment and Society
- The Uses of Geography

The Ring of Fire

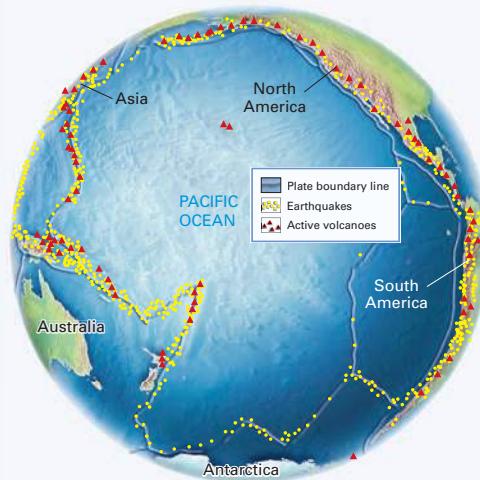
Background

"The Ring of Fire" names not a fantasy novel, but a region that circles the Pacific Ocean. Known for its fiery volcanoes and powerful earthquakes, it stretches from the tip of South America to Alaska and from Japan to the islands east of Australia. Along this belt, the Pacific plate moves against several other tectonic plates. Thousands of earthquakes occur there every year, and dozens of volcanoes erupt.

The Eruption of Mount Saint Helens

One of the best-known volcanoes in the Ring of Fire is Mount Saint Helens in Washington State. Mount Saint Helens had been dormant, or quiet, since 1857. Then in March 1980, it released puffs of steam and ash. Officials warned people to leave the area. Scientists brought in equipment to measure the growing bulge in the mountainside.

The Ring of Fire



Major Eruptions in the Ring of Fire	
Volcano	Year
Tambora, Indonesia	1815
Krakatau, Indonesia	1883
Mount Saint Helens, United States	1980
Nevado del Ruiz, Colombia	1985
Mount Pinatubo, Philippines	1991

Source: *Volcanoes of the World*, Smithsonian Institution.



Mount Saint Helens, 1980 The 1980 eruption of Mount Saint Helens blew ash and hot gases miles into the air. Today, scientists study the volcano to learn more about predicting eruptions.

On May 18, after a sudden earthquake, Mount Saint Helens let loose a massive explosion of rock and lava. Heat from the blast melted snow on the mountain, which mixed with ash to create deadly mudflows. As the mud quickly poured downhill, it flattened forests, swept away cars, and destroyed buildings. Clouds of ash covered the land, killing crops, clogging waterways, and blanketing towns as far as 200 miles (330 km) away. When the volcano finally quieted down, 57 people had died. Damage totaled nearly \$1 billion. If it were not for the early evacuation of the area, the destruction could have been much worse.

What It Means

By studying Mount Saint Helens, scientists learned a great deal about stratovolcanoes. These are tall, steep, cone-shaped volcanoes that have violent eruptions. Stratovolcanoes often form in areas where tectonic plates collide.

Because stratovolcanoes often produce deadly eruptions, scientists try to predict

when they might erupt. The lessons learned from Mount Saint Helens helped scientists warn people about another stratovolcano, Mount Pinatubo in the Philippines. That eruption in 1991 was the second-largest of the 1900s. It was far from the deadliest, however. Careful observation and timely warnings saved thousands of lives.

The Ring of Fire will always remain a threat. However, the better we understand its volcanoes, the better prepared we'll be when they erupt.

Geography for Life Activity

1. **Summarize** Why do scientists monitor volcanic activity?
2. **Investigate the Effects of Volcanoes** Some volcanic eruptions affect environmental conditions around the world. Research the eruption of either Mount Saint Helens or the Philippines' Mount Pinatubo to find out how its eruption affected the global environment.

1. **Summarize** Why do scientists monitor volcanic activity? *to try to predict when volcanoes might erupt so they can warn people*
2. **Investigate the Effects of Volcanoes** Some volcanic eruptions affect environmental conditions around the world. Research the eruption of either Mount Saint Helens or the Philippines' Mount Pinatubo to find out how its eruption affected the global environment. *Students should find in their research that the amount of sulfur released into the atmosphere by the volcanic eruptions caused a decrease in worldwide temperatures.*



Weather and Climate

- Extreme Weather
- Rain Shadow Effect

Videos

LESSON 4

Big Idea

The sun, location, wind, water, and mountains affect weather and climate.

- Geographic Feature: Global Wind Systems
- Coriolis Effect
- Do Cities Affect Rainfall?
- Cloudy with a Chance of ...
- The Great Pacific Garbage Patch

Visuals

Maps,
Graphs, and
Charts

- Map: Major Ocean Currents

Extend
and Enrich

Sources

- Document-Based Investigation: The Science of Prediction

Assessment

- Key Terms Review
- Reading Check
- Graphic Organizer Activity
- Lesson Assessment

► Online Lesson 4 Enrichment Activities

Coriolis Effect

Article Students conduct experiments to learn about the Coriolis effect.

The Great Pacific Garbage Patch

Video Students watch a video about how ocean currents create areas where large amounts of garbage collect. Then they answer research questions about its current status.



Do Cities Affect Rainfall?

Article Students read about rainfall variations, and conduct research to compare rainfall between a large city and surrounding small towns.

Cloudy with a Chance of . . .

Article Students study a local TV weather forecast and then create a script and visuals for a forecast of their own.

Teach the Big Idea

1. Whole Class Open/Introduction

If YOU lived there . . .

Why will winds off the lake drop snow on Buffalo?

Review the scenario with students and lead a class discussion around responses to the question. Remind students that all responses are valid as long as they are supported with valid reasoning. You may wish to review the following points to frame your discussion.

Consider the CLIMATE and LOCATION of Buffalo.

- very cold in the winter
- at the eastern end of Lake Erie
- in the northern part of the United States

Consider how PREVAILING WINDS, LAKES, and LOCATION interact.

- Winds that pass over a large body of water pick up moisture.
- Prevailing winds are westerly in most of the United States.
- Buffalo is directly east of the Midwest.

2. Direct Teach Introduce the Big Idea: *The sun, location, wind, water, and mountains affect weather and climate.* Ask students to describe the climate of your region and list their responses on the board. For example, does the temperature change drastically depending on the season? Or perhaps your region is relatively dry year around? Then ask what they think causes this climate. Explain that in this lesson they will learn about various factors that influence the climate of a place.

3. Practice/Assess/Inquire Distribute one flashcard-sized strip of cardboard or paper to each student. Ask students to write one of these words or phrases on their strip: *altitude, large body of water, high pressure, low pressure, latitude, ocean current, westerly wind, doldrums, moisture, cold air mass, warm air mass, precipitation, desert, hurricane, rain shadow, front, wind, tornado, hurricane, moderate temperatures.* Have a student hold up a card, and ask others to also hold up their cards if their term is related. Have them explain how their term is related.

4. Explore (Collaborative Exploration) Ask students to define their term and to tell if it applies to weather, climate, or both.

5. Whole Group Close/Reflect Have students write ten true statements, each of which uses at least two of the terms in the list.

*Alternative Assessment Handbook, Rubric 40: Writing to Describe

READING CHECK

Find Main Ideas How are weather and climate different from each other? *Weather is the short-term changes in the air, while climate is the long-term average weather conditions of a region.*

Lesson 4

Weather and Climate

If YOU lived there . . .

You live in Buffalo, New York, at the eastern end of Lake Erie. One evening in January, you are watching the local TV news. The weather forecaster says, "A huge storm is brewing in the Midwest and moving east. As usual, winds from this storm will drop several feet of snow on Buffalo as they blow off Lake Erie."

Why will winds off the lake drop snow on Buffalo?

Understanding Weather and Climate

What is it like outside right now where you live? Is it hot, sunny, wet, cold? Is this what it is usually like outside for this time of year? The first two questions are about **weather**, the short-term changes in the air for a given place and time. The last question is about **climate**, a region's average weather conditions over a long period.

Weather is the temperature and precipitation from hour to hour or day to day. "Today is sunny, but tomorrow it might rain" is a statement about weather. Climate is the expected weather for a place based on data and experience. "Summer here is usually hot and muggy" is a statement about climate. The factors that shape weather and climate include the sun, location on Earth, wind, water, and mountains.



Stormy Weather Sometimes weather can be extreme. This photo shows a severe thunderstorm. These storms produce heavy rainfall and strong winds.

The Big Idea

The sun, location, wind, water, and mountains affect weather and climate.

Main Ideas

- While weather is short term, climate is a region's average weather over a long period.
- The amount of sun at a given location is affected by Earth's tilt, movement, and shape.
- Wind and water move heat around Earth, affecting how warm or wet a place is.
- Mountains influence temperature and precipitation.

Key Terms and Places

weather
climate
prevailing winds
ocean currents
front

Reading Check

Find Main Ideas: How are weather and climate different from each other?

Teach the Main Idea

While weather is short term, climate is a region's average weather over a long period.

Define What is climate? *the average weather conditions of a region over a long period of time*

Evaluate If a group of people are discussing the details of a hurricane that occurred in their community, are they most likely talking about weather or climate? *weather*

ONLINE GRAPHIC ORGANIZER

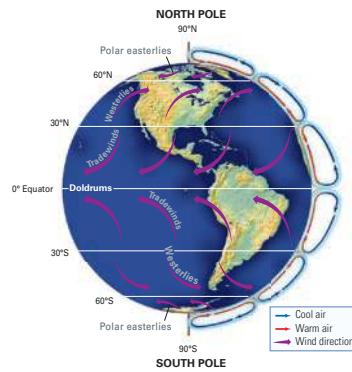
Weather and Climate

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Summarize How do winds affect climate and weather? *As the air rises with heat or sinks with cold, it creates movement—wind. As the winds blow across oceans and land, their temperature and direction affect climate and weather.*

Global Wind Systems

Prevailing winds blow in circular belts across Earth. These belts occur at about every 30° of latitude.



Analyze Visuals

Which direction do the prevailing winds blow across the United States?

Reading Check

Summarize How does Earth's tilt on its axis affect climate?

are cold year-round. Areas about halfway between the equator and poles have more seasonal change. In general, the farther from the equator, or the higher the latitude, the colder the climate.

Wind and Water

Heat from the sun moves across Earth's surface. The reason is that air and water warmed by the sun are constantly on the move. You might have seen a gust of wind or a stream of water carrying dust or dirt. In a similar way, wind and water carry heat from place to place. As a result, they make different areas of Earth warmer or cooler.

Global Winds Wind, or the sideways movement of air, blows in great streams around the planet. **Precipitating winds** are winds that blow in the same direction over large areas of Earth. The illustration under Global Wind Systems shows the patterns of Earth's prevailing winds.

To understand Earth's wind patterns, you need to think about the weight of air. Although you cannot feel it, air has weight. This weight changes with the temperature. Cold air is heavier than warm air. For this reason, when air cools, it gets heavier and sinks. When air warms, it gets lighter and rises. As warm air rises, cooler air moves in to take its place, creating wind.

On a global scale, this rising, sinking, and flowing of air creates Earth's prevailing wind patterns. At the equator, hot air rises and flows toward

Sun and Location

Energy from the sun heats the planet. Different locations receive different amounts of sunlight, though. Thus, some locations are warmer than others. The differences are due to Earth's tilt, movement, and shape.

You have learned that Earth is tilted on its axis. The part of Earth tilted toward the sun receives more solar energy than the part tilted away from the sun. As Earth revolves around the sun, the part of Earth that is tilted toward the sun changes during the year. This process creates the seasons. In general, temperatures in summer are warmer than in winter.

Earth's shape also affects the amount of sunlight different locations receive. Because Earth is a sphere, its surface is rounded. Therefore, solar rays are more direct and concentrated near the equator. Nearer the poles, the sun's rays are less direct and more spread out.

As a result, areas near the equator, called the lower latitudes, are mainly hot year-round.

Areas near the poles, called the higher latitudes,

are cold year-round. Areas about halfway between the equator and poles have more seasonal change. In general, the farther from the equator, or the higher the latitude, the colder the climate.

Teach the Main Idea

The amount of sun at a given location is affected by Earth's tilt, movement, and shape.

Recall What areas of Earth tend to have more seasonal change? *the areas about midway between the poles and the equator*

Identify Cause and Effect Why are the hottest areas on Earth near the equator? *These areas receive more direct and concentrated solar energy.*

GEOGRAPHIC FEATURE

Global Wind Systems

Have students explore the image of the prevailing winds across Earth and then answer the associated question.

Analyze Visuals Which direction do the prevailing winds blow across the United States? *west to east: westerlies*

ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: **weather**, **climate**, **prevailing winds**, **ocean currents**, **front**.

ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

The Science of Prediction is the third of six document-based investigations that students will analyze in the Physical World module. In this video, students learn how advances in technology have improved the accuracy of predicting the paths of dangerous storms.

READING CHECK

Summarize How does Earth's tilt on its axis affect climate? *Because Earth is tilted on its axis, the part of Earth tilted toward the sun receives more solar energy than the part tilted away from the sun. Changes in position create seasons.*

Teach the Main Idea

Wind and water move heat around Earth, affecting how warm or wet a place is.

Recall In which direction do the prevailing winds blow in the middle latitudes? *westerly*

Explain What effect does a large body of water have on a region or climate? *It helps to moderate temperatures.*

Draw Conclusions Why is it a good idea to check a weather forecast when a front moves through your area? *The front may bring severe weather.*

More About . . .

Columbus and the Sargasso Sea Currents in the North Atlantic Ocean flow clockwise, roughly in a circle. In the center of this circle is an area of relatively calm water called the Sargasso Sea. The name comes from the Portuguese word for seaweed, which covers the calm water. Christopher Columbus thought he was close to land when he saw the Sargasso Sea, but in fact land was still hundreds of miles away.

For additional instruction, go to end of lesson.



ONLINE INTERACTIVE MAPS

Major Ocean Currents

Have students explore the map using the interactive features and answer the associated question.

Regions Does a warm or cold ocean current flow along the lower west coast of North America? *cold*

In print edition, see map of same title.

1. Regions Does a warm or cold ocean current flow along the lower west coast of North America? *cold*

2. Movement How do ocean currents move heat between warmer and colder areas of Earth? *When warm water currents flow to colder areas, the air is heated above the currents, then the warmer air is blown by westerly winds.*

the poles. At the poles, cold air sinks and flows toward the equator. Meanwhile, Earth is rotating. Earth's rotation causes prevailing winds to curve east or west rather than flowing directly north or south.

Depending on their source, prevailing winds make a region warmer or colder. In addition, the source of the winds can make a region drier or wetter. Winds that form from warm air or pass over lots of water often carry moisture. In contrast, winds that form from cold air or pass over lots of land often are dry.

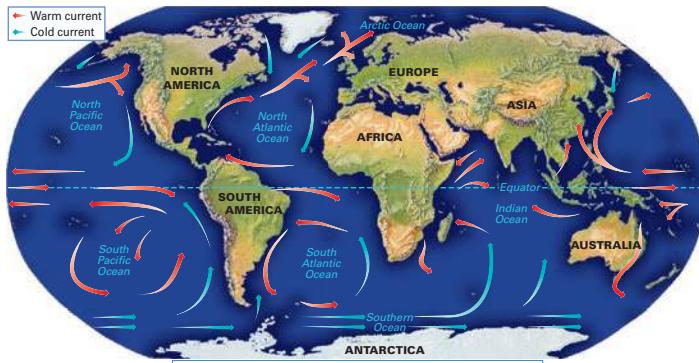
Ocean Currents Like wind, **ocean currents**—large streams of surface seawater—move heat around Earth. Winds drive these currents. The map below shows how Earth's ocean currents carry warm or cool water to different areas. The water's temperature affects air temperature near it. Warm currents raise temperatures; cold currents lower them.

The Gulf Stream is a warm current that flows north along the U.S. East Coast. It then flows east across the Atlantic, to become the North Atlantic Drift. As the warm current flows along northwestern Europe, it heats the air. Westerlies blow the warmed air across Europe. This process makes Europe warmer than it otherwise would be.

Large Bodies of Water Large bodies of water, such as an ocean or sea, also affect climate. Water heats and cools more slowly than land does. For this reason, large bodies of water make the temperature of the land nearby

Explore ONLINE!

Major Ocean Currents



Interpret Maps

1. **Regions** Does a warm or cold ocean current flow along the lower west coast of North America?
2. **Movement** How do ocean currents move heat between warmer and colder areas of Earth?

64 Module 2

COLLABORATIVE LEARNING

Locate the Desert Zone

1. Organize the class into small groups. Have each group create a three-column table on a sheet of paper with the columns labeled Desert, Location, and Latitude.
2. Write the names of these deserts on the board: Sahara, Kalahari, Mojave, Patagonian, Atacama, and Arabian. Be sure the students have access to maps, globes, or the Internet to locate the listed deserts.
3. Have the groups complete the table by finding the location and latitude of each desert. Latitude should be expressed as a range.

4. Point out that most of the world's deserts are located near 30° north or south latitude. Ask the groups which of the deserts on their table support that statement.

*Alternative Assessment Handbook, Rubric 21: Map Reading

For additional instruction, go to end of lesson.

Extreme Weather

Severe weather is often dangerous and destructive. In the photo to the left, rescuers search for people during a flood in Yardley, Pennsylvania. In the photo to the right, a tornado races across a wheat field in North Dakota.



Analyze Visuals

How might weather like that shown in these photos affect the people living nearby?

milder. Thus, coastal areas, such as the California coast, usually do not have as wide of temperature ranges as inland areas.

As an example, the state of Michigan is largely surrounded by the Great Lakes. The lakes make temperatures in the state milder than other places as far north.

Wind, Water, and Storms If you watch weather reports, you will hear about storms moving across the United States. Tracking storms is important to us because the United States has so many of them. As you will see, some areas of the world have more storms than others do.

Most storms occur when two air masses collide. An air mass is a large body of air. The place where two air masses of different temperatures or moisture content meet is a **front**. Cold air masses from the north and warm air masses from the south frequently collide over the United States, producing dramatic storms.

Fronts can produce rain or snow as well as severe weather such as thunderstorms and icy blizzards. Thunderstorms produce rain, lightning, and thunder. In the United States, they are most common in spring and summer. Blizzards produce strong winds and large amounts of snow and are most common during winter.

Thunderstorms and blizzards can also produce tornadoes, another type of severe storm. A tornado is a small, rapidly twisting funnel of air that touches the ground. Tornadoes usually affect a limited area and last only a

ONLINE INTERACTIVE VISUALS

Image Compare: Extreme Weather

Have students explore and compare the images of flooding and tornadoes using the interactive slider.

Analyze Visuals How might weather like that shown in these photos affect the people living nearby? *Answers will vary; people's lives might be in danger and they might lose their homes and other possessions.*

ONLINE DOCUMENT-BASED INVESTIGATION

The Science of Prediction

Have students watch the video individually or as a class to learn more about the scientists who study hurricanes.

Analyze Sources Why are the missions of the U.S. National Oceanic and Atmospheric Administration's scientists so important? *The data they collect by flying into the hurricane can't be gathered in any other way. The data helps scientists predict the storm's path and how strong it is so they can warn people in advance. Early warnings are especially important because many large cities are located along coastal areas.*

DRAW CONCLUSIONS

Interpret Temperature Data

- Using an almanac or the Internet, have students find the monthly average high and low temperatures for San Francisco and St. Louis and record them on paper or a spreadsheet.
- Have students calculate the differences between the highs and lows for each city.
- Remind students that San Francisco is on the ocean and St. Louis is located inland. Ask students to explain the temperature patterns for each city. Call attention to the data for January and July.

- Have students find monthly temperature data for other cities around the world. Invite them to predict where these cities are located and then check their conclusions by finding the cities on a map.

*Alternative Assessment Handbook,
Rubric 12: Drawing Conclusions

Teach the Main Idea

Mountains influence temperature and precipitation.

Recall What part of a mountain is the coldest? *the top*

Cause and Effect What happens when warm, moist air blows against a mountainside? *The air rises and cools, clouds form, and precipitation falls.*

Draw Conclusions If the prevailing winds in a region are from the west, which side of a mountain in the region is less likely to receive rain? *the east side*

More About . . .

Connect to Science: Measuring Humidity Humidity can be measured by using the "wet bulb" method.

1. The bulb of an ordinary thermometer is covered in cloth, and the cloth is dipped in water.
2. The thermometer is whirled around in the air until the water on the cloth evaporates. The evaporation cools the thermometer, lowering its reading.
3. Results from the wet bulb reading are compared to a thermometer that has not been given the wet bulb treatment. The difference between the two readings is looked up on a chart that shows the humidity of the air.

► ONLINE INTERACTIVE VISUALS

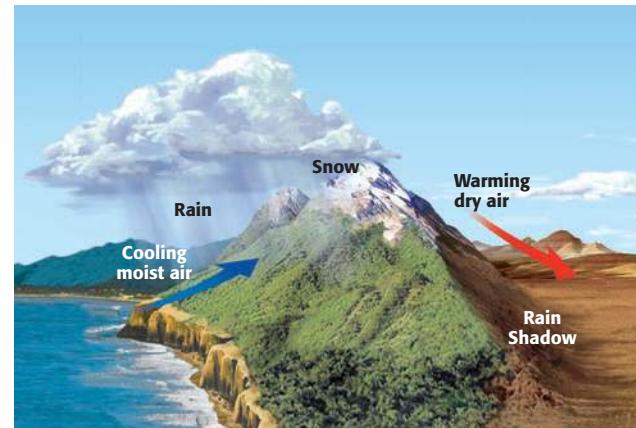
Rain Shadow Effect

Have students practice correctly labeling the different parts of this illustration by positioning the labels in their proper locations.



READING CHECK

Analyze Causes Why do coastal areas have milder climates than inland areas? *Water heats and cools more slowly than land, making the temperatures of nearby land milder.*



Rain Shadow Effect Most of the moisture in the ocean air falls on the mountainside facing the wind. Little moisture remains to fall on the other side, creating a rain shadow.

few minutes. However, they can be highly destructive, uprooting trees and tossing large vehicles through the air. Tornadoes can be extremely deadly as well. In 1925 a tornado that crossed Missouri, Illinois, and Indiana left 695 people dead. It is the deadliest U.S. tornado on record.

The largest and most destructive storms, however, are hurricanes. These large, rotating storms form over tropical waters in the Atlantic Ocean, usually from late summer to fall. Did you know that hurricanes and typhoons are the same? Typhoons are just hurricanes that form in the Pacific Ocean.

Hurricanes produce drenching rain and strong winds that can reach speeds of 155 miles per hour (250 kph) or more. This is more than twice as fast as most people drive on highways. In addition, hurricanes form tall walls of water called storm surges. When a storm surge smashes into land, it can wipe out an entire coastal area.

Mountains

Mountains can influence an area's climate by affecting both temperature and precipitation. Many high mountains are located in warm areas yet have snow at the top all year. How can this be? The reason is that temperature decreases with elevation, the height on Earth's surface above sea level.

Mountains also create wet and dry areas. Look at the diagram titled Rain Shadow Effect. A mountain forces air blowing against it to rise. As it rises, the air cools and precipitation falls as rain or snow. Thus, the side

66 Module 2

STRUGGLING READERS

Create Weather Symbols

1. Ask students what symbols they have seen that indicate weather conditions. Have students draw and label symbols for the following conditions: sunny, raining, snowing, cloudy, partly cloudy, hot, cold, windy, and thunderstorms.
2. Have students present their drawings with the labels covered and have the class guess which condition is represented.

*Alternative Assessment Handbook, Rubric 3:
Artwork

Reading Check
Find Main Ideas
How does temperature change with elevation?

of the mountain facing the wind is often green and lush. However, little moisture remains for the other side. This effect creates a rain shadow, a dry area on the mountainside facing away from the direction of the wind.

Summary and Preview As you can see, the sun, location on Earth, wind, water, and mountains affect weather and climate. In the next lesson you will learn what the world's different climate regions are like.

Lesson 4 Assessment

Review Ideas, Terms, and Places

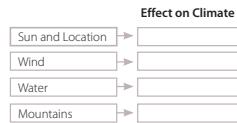
1. a. **Recall** What shapes weather and climate?
b. **Contrast** How do weather and climate differ?
2. a. **Identify** What parts of Earth receive the most heat from the sun?
b. **Explain** Why do the poles receive less solar energy than the equator does?
3. a. **Form Generalizations** Examine the model of Global Wind Systems in this lesson. Pose and answer a question about the geographic patterns of winds shown on the model.
b. **Summarize** How do ocean currents and large bodies of water affect climate?

4. a. **Define** What is a rain shadow?

- b. **Explain** Why might a mountaintop and a nearby valley have widely different temperatures?

Critical Thinking

5. **Identify Cause and Effect** Use your notes and a cause-and-effect chart like the one shown. Use your notes to explain how each factor affects climate.



READING CHECK

Find Main Ideas How does temperature change with elevation? *The temperature decreases as elevation increases.*

Print Assessment

Review Ideas, Terms, and Places

1. a. **Recall** What shapes weather and climate? *the sun, location, wind, water, and mountains*
b. **Contrast** How do weather and climate differ? *Weather is short-term changes; climate is long-term average weather conditions of a region.*
2. a. **Identify** What parts of Earth receive the most heat from the sun? *the areas nearest the equator*
b. **Explain** Why do the poles receive less solar energy than the equator? *Because of Earth's rounded surface, solar rays nearer the poles are less direct and are spread over a larger region than at the equator, where solar rays are more direct and concentrated.*
3. a. **Form Generalizations** Examine the model of Global Wind Systems in this lesson. Pose and answer a question about the geographic patterns of winds shown on the model.
Student responses will vary but should show an understanding of the geographic pattern of winds.
b. **Summarize** How do ocean currents and large bodies of water affect climate? *Ocean currents carry cool or warm water to different areas.*
Because water heats and cools slower than land, air that is heated or cooled by water is blown by winds, bringing moderate temperatures to land near water.
4. a. **Define** What is a rain shadow? *a dry area on a mountainside that is away from the wind*
b. **Explain** Why might a mountaintop and a nearby valley have widely different temperatures? *Temperatures decrease with elevation.*

Critical Thinking

5. **Identify Cause and Effect** Use your notes and a cause-and-effect chart. Use your notes to explain how each factor affects climate. *Possible answers: Sun and location create seasons; Wind moves sun's heat; Water moves sun's heat; Mountains affect temperature and precipitation.*

► Online Assessment

1. How is climate different from weather?

- Climate develops very steadily, but weather does not.
- Climate changes very quickly, but weather does not.
- Climate is measured in degrees, but weather is not.
- Climate is measured over years, but weather is not.

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Weather

2. Why are the sun's rays less direct and more spread out near the poles?

- because of Earth's tilt
- because of Earth's shape
- because of Earth's climate
- because of Earth's movement

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Because Earth's surface is rounded, solar rays are more direct and concentrated near the Equator .

3. How do large bodies of water affect climate?

- by carrying cool water to all land areas
- by making the temperature of the land nearby milder
- by reducing the number of storms that occur in coastal areas
- by creating prevailing winds that influence temperatures in coastal areas

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Lakes make temperatures in Michigan than other places as far north.

4. Why do many high mountains in warm areas have snow on top all year?

- because of the rain shadow effect
- because of the direction they face
- because wind speed increases with elevation
- because temperature decreases with elevation

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Mountains can influence an area's climate by affecting both and precipitation.

5. **Draw Conclusions** Use the quote to answer the question.

"Summer here is usually hot and muggy."

Is the speaker talking about weather or climate? Explain your answer.

Possible answer: The speaker is talking about climate. He or she is saying what the expected weather for a place is, based on experience.

6. **Draw Conclusions** Where would you move to if you lived halfway between the equator and one of the poles and wanted a warmer climate? Explain your answer.

Possible answer: I would move to an area closer to the equator. Solar rays are more direct and concentrated near the equator, and these areas are mainly hot year-round.

7. **Make Generalizations** How do air masses create storms? Provide an example.

Possible answer: Most storms occur when two air masses crash into each other. For example, when cold air masses from the north crash into warm air masses from the south over the United States, storms are frequently produced.

8. **Cause and Effect** Why are areas on mountainsides that face away from the direction of the wind relatively dry?

Possible answer: Mountains force air blowing against them to rise. This air cools as it rises and precipitation falls as rain or snow. This leaves little moisture for the other sides of these mountains.

ADDITIONAL INSTRUCTIONAL MATERIALS

continued from page 63

More About . . .

Connect to Science: Temperature Scales In the United States, most people use the Fahrenheit scale to measure temperature. Water freezes at 32°F and boils at 212°F. Many people use the Celsius system. Water freezes at 0°C and boils at 100°C. Here are some equivalent values:

Fahrenheit	Celsius
32	0
50	10
68	20
86	30
104	40
212	100

continued from page 64

ENGLISH LANGUAGE LEARNERS

Compare Weather and Climate

1. To help students demonstrate their understanding of the difference between weather and climate, have students work in pairs to create a chart with two columns. Ask the students to label one column Weather and the other column Climate.
2. With their partners, ask students to talk about the difference between weather and climate. Have them write at least three statements about weather (such as, “Today is sunny, but tomorrow it might rain”), and three statements about climate (such as, “Summer here is usually hot and muggy”).
3. Have each pair read one statement to the class, and have the students vote on whether they think the statement is about weather or climate.

*Alternative Assessment Handbook, Rubric 7: Charts



World Climates

- India's Monsoon Seasons
- Tropical Climate
- Dry Climates
- Other Temperate Climate Regions
- Highland Climates

Icebergs

Visuals

Videos

LESSON 5

Big Idea

Earth's five major climate zones are identified by temperature, precipitation, and plant life.

Maps,
Graphs, and
Charts

Graph: Climate for Nice, France

- Focus on Culture:** The Tuareg of the Sahara
- Game:** Where Am I?
- Polar Bear Trackers
- Mapping Climate Zones

Extend
and Enrich

Sources

Document-Based Investigation:
Major Climate Regions

Assessment

- Key Terms Review
- Reading Check
- Graphic Organizer Activity
- Lesson Assessment

► Online Lesson 5 Enrichment Activities

Polar Bear Trackers

Video Students watch a video to learn how scientists monitor polar bear populations in the Arctic. Then they choose from two activities: to create a drawing that shows the polar bear's behavioral and structural adaptations to its environment; or to list ways to reduce energy consumption and write a letter explaining how these actions could help polar bears.



Mapping Climate Zones

Create a Map Students create a climate zone map for an imaginary company with recommendations for locations that are conducive to building new factories.

Teach the Big idea

1. Whole Class Open/Introduction

If **YOU** lived there . . .

Why does it get colder as you climb higher?

Review the scenario with students and lead a class discussion around responses to the question. Remind students that all responses are valid as long as they are supported with valid reasoning. You may wish to review the following points to frame your discussion.

Consider the LANDSCAPE.

- high mountains
- low valley where the campsite is
- big change in elevation between valley and mountains

Consider what you know about MOUNTAINS.

- As air blows against a mountain, the air rises.
- The air cools as it rises.
- Snow is often found at the tops of mountains, even in hot areas.

2. Direct Teach Introduce the Big Idea: *Earth's five major climate zones are identified by temperature, precipitation, and plant life.* Discuss with students that Earth is divided into five major climate zones. Ask students to identify the characteristics that might identify each one. For example, do they think temperature or rainfall might be different in each climate zone? Why?

3. Practice/Assess/Inquire Have each student select a specific location. As the student completes the lesson, he or she should write and illustrate a travel brochure about the location. Each brochure should include a cover drawing, information about what the climate is like at different times of year, what kind of recreation is available, and what a traveler should pack for the trip. The brochure can have small spot drawings wherever needed.

4. Explore (Collaborative Exploration) Have each student present a short "sales pitch" for their travel destination to the class.

5. Whole Group Close/Reflect Have students select the three locations they would like to travel to in March, August, and December. Have them write a paragraph explaining each choice.

*Alternative Assessment Handbook, Rubric 40: Writing to Describe

World Climates

The Big Idea

Earth's five major climate zones are identified by temperature, precipitation, and plant life.

Main Ideas

- Geographers use temperature, precipitation, and plant life to identify climate zones.
- Tropical climates are wet and warm, while dry climates receive little or no rain.
- Temperate climates have the most seasonal change.
- Polar climates are cold and dry, while highland climates change with elevation.

Key Terms and Places

monsoons
savannas
steppes
permafrost

Reading Check

Make Inferences
Why do you think geographers consider native plant life when categorizing climates?

If **YOU** lived there . . .

You live in Colorado and are on your first serious hike in the Rocky Mountains. Since it is July, it is hot in the campground in the valley. But your guide insists that you bring a heavy fleece jacket. By noon, you have climbed to 11,000 feet (3,353 m). You are surprised to see patches of snow in shady spots. Suddenly, you are very happy that you brought your jacket!

Why does it get colder as you climb higher?

Major Climate Zones

In January, how will you dress for the weekend? In some places, you might get dressed to go skiing. In other places, you might head out in a swimsuit to go to the beach. What the seasons are like where you live depends on climate.

Earth is a patchwork of climates. Geographers identify these climates by looking at temperature, precipitation, and native plant life. Using these items, we can divide Earth into five general climate zones—tropical, temperate, polar, dry, and highland.

The first three climate zones relate to latitude. Tropical climates occur near the equator, in the low latitudes. Temperate climates occur about halfway between the equator and the poles, in the middle latitudes. Polar climates occur near the poles, in the high latitudes. The last two climate zones occur at many different latitudes. In addition, geographers divide some climate zones into more specific climate regions. The map and chart titled World's Climate Regions describe these specific regions. Read the chart and study the map to see if you can identify some climate patterns.

68 Module 2

ONLINE GRAPHIC ORGANIZER

World Climates

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Make Inferences How might climate zones affect where people settle? *Areas with more rain and moderate temperatures are better for growing food, so more people would want to settle there. Areas where it's harder to keep a steady supply of food and water would likely be less desirable places to settle.*

ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

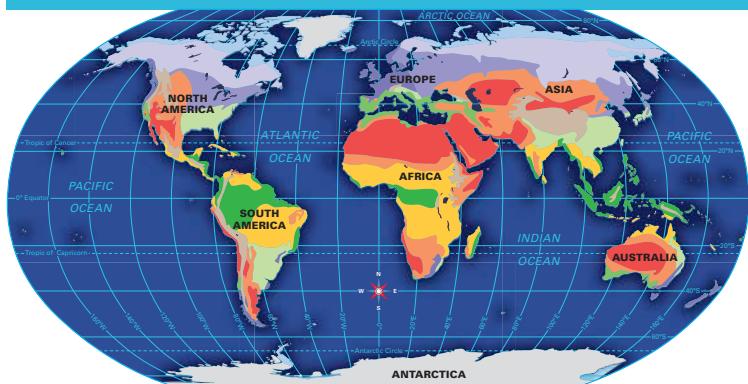
Major Climate Regions is the fourth of six document-based investigations that students will analyze in the Physical World module. Students study the interactive map to learn more about Earth's climate zones.

ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: **monsoons, savannas, steppes, permafrost.**

World Climate Regions



	Climate	Where is it?	What is it like?	Plants
Tropical	HUMID TROPICAL	On and near the equator	Warm with high amounts of rain year-round; in a few places, monsoons create extreme wet seasons	Tropical rain forest
	TROPICAL SAVANNA	Higher latitudes in the tropics	Warm all year; distinct rainy and dry seasons; at least 20 inches (50 cm) of rain during the summer	Tall grasses and scattered trees
Dry	DESERT	Mainly center on 30° latitude; also in middle of continents, on west coasts, or in rain shadows	Sunny and dry; less than 10 inches (25 cm) of rain a year; hot in the tropics; cooler with wide daytime temperature ranges in middle latitudes	A few hardy plants, such as cacti
	STEPPE	Mainly bordering deserts and interiors of large continents	About 10–20 inches (25–50 cm) of precipitation a year; hot summers and cooler winters with wide temperature ranges during the day	Shorter grasses; some trees and shrubs by water
Temperate	MEDITERRANEAN	West coasts in middle latitudes	Dry, sunny, warm summers; mild, wetter winters; rain averages 15–20 inches (30–50 cm) a year	Scrub woodland and grassland
	HUMID SUBTROPICAL	East coasts in middle latitudes	Humid with hot summers and mild winters; rain year-round; in paths of hurricanes and typhoons	Mixed forest
	MARINE WEST COAST	West coasts in the upper-middle latitudes	Cloudy, mild summers and cool, rainy winters; strong ocean influence	Evergreen forests
	HUMID CONTINENTAL	East coasts and interiors of upper-middle latitudes	Four distinct seasons; long, cold winters and short, warm summers; average precipitation varies	Mixed forest
Polar	SUBARCTIC	Higher latitudes of the interior and east coasts of continents	Extremes of temperature; long, cold winters and short, warm summers; little precipitation	Northern evergreen forests
	TUNDRA	Coasts in high latitudes	Cold all year; very long, cold winters and very short, cool summers; little precipitation; permafrost	Moss, lichens, low shrubs
	ICE CAP	Polar regions	Freezing cold; snow and ice; little precipitation	No vegetation
Highland	HIGHLAND	High mountain regions	Wide range of temperatures and precipitation amounts, depending on elevation and location	Ranges from forest to tundra

Interpret Maps

- Location Which climates are found mainly in the Northern Hemisphere?
- Region Where are many of the world's driest climates found on Earth?

The Physical World 69

Teach the Main Idea

Geographers use temperature, precipitation, and plant life to identify climate zones.

Recall What two climate zones can occur at many different latitudes? *dry and highland*

Describe Where do temperate climates occur? *about halfway between the equator and the poles*

Draw Conclusions Can native animal life be used to help identify climate zones? Explain your answer. *Yes. For example, some animals have thick fur for cold weather or can survive only in wet climates.*

ONLINE DOCUMENT-BASED INVESTIGATION

Major Climate Regions

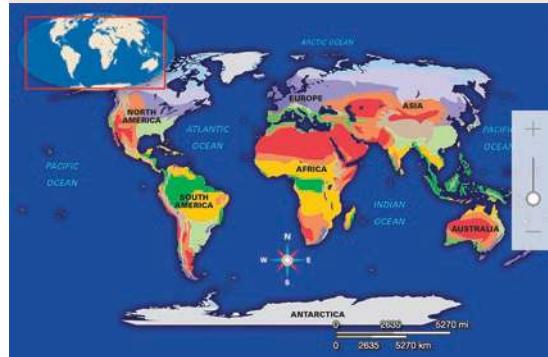
Earth is a patchwork of climates. Geographers identify these climates by looking at temperature, precipitation, and native plant life.

Have students explore the map using the interactive features and answer the associated question.

Analyze Sources Study the map. Which three climates do you think would have the least human population? Why? *Possible answer: Desert, tundra, and ice cap areas because the extreme climates and lack of vegetation make it hard for humans to live there.*

In print edition, see map titled World Climate Regions.

- Location** Which climates are found mainly in the Northern Hemisphere? *subarctic, tundra*
- Region** Where are many of the world's driest climates found on Earth? *mainly around 30° N and 30°S, bordering deserts, and interiors of continents*



READING CHECK

Make Inferences Why do you think geographers consider native plant life when categorizing climates? *Certain plants only thrive under specific climate conditions.*

COLLABORATIVE LEARNING

Give a Weather Forecast

- Have students work with a partner. Assign one of the climate regions to each pair.
- Have each pair use the world climate regions map to find a place where their assigned climate region exists. Have them look on a political world map or globe and identify a city in that climate region.
- Have students present a television news-style weather forecast for their city. During the forecast, students should take turns presenting. Students should use the information in the climate region table to guide them as to what a reasonable forecast would be for the city they selected.

- Encourage students to add visuals to their presentations such as weather maps, pictures of rain clouds, snowflakes, and so on.

*Alternative Assessment Handbook, Rubric 29: Presentations

For additional instruction, go to end of lesson.

Teach the Main Idea

Tropical climates are wet and warm, while dry climates receive little or no rain.

Identify What climate is found in central Australia?

desert

Define What is a monsoon? *prevailing winds that change direction, creating wet and dry seasons*

Draw Conclusions In what kind of climate are trees mostly found? Why? *humid; Trees need a lot of water to grow.*

Explain Why is there no humid tropical climate in Europe? *None of Europe is in the tropics.*

Identify Cause and Effect What causes rapid cooling at night in the desert? *dry air and clear skies*

More About . . .

The Blooming Sahara? The Sahara in northern Africa is the world's largest desert, roughly the size of the entire United States. Like most places on Earth, the Sahara has had different climates at different times. As recently as about 5,000 years ago, the great Sahara Desert enjoyed a period of wetter climate, with far more vegetation than we see today.

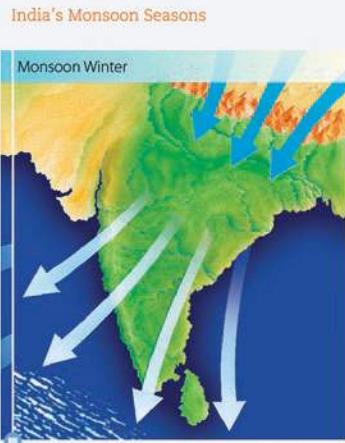


ONLINE INTERACTIVE VISUALS

Image Compare: India's Monsoon Seasons

Have students explore and compare the images of India's two monsoon seasons using the interactive slider.

Analyze Visuals Why do the winter monsoon winds carry so little moisture? *They are dry monsoon winds.*



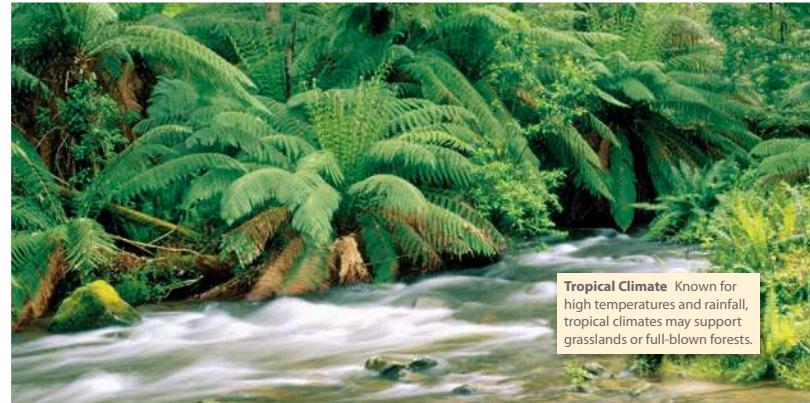
ENGLISH LANGUAGE LEARNERS

Create Travel Brochures

- To help students apply their understanding of the features of the world climate regions, organize them into five groups. Assign each group one of the five climate regions, and ask them to identify a city or country located in that climate region.
- Have students work in groups to research the Internet or reference books to find features of the climate in the location they have identified.

- Have students create a travel brochure to persuade people to come visit the location. Students should use their understanding of the location's climate as selling points, such as precipitation patterns, temperatures, or native plant life.

*Alternative Assessment Handbook, Rubrics 30: Research; and 43: Writing to Persuade



Tropical Climate Known for high temperatures and rainfall, tropical climates may support grasslands or full-blown forests.

Focus on Culture

The Tuareg of the Sahara

In the Sahara, the world's largest desert, temperatures can top 130°F (54°C). Yet the Tuareg (TWAH-reg) of North and West Africa call the Sahara home—and prefer it. The Tuareg have raised camels and other animals in the Sahara for more than 1,000 years. The animals graze on sparse desert plants. When the plants are gone, the Tuareg move on.

In camp, Tuareg families live in tents made from animal skins. Some wealthier Tuareg live in adobe homes. The men traditionally wear blue veils wrapped around their face and head. The veils help protect against windblown desert dust.

Summarize

How have the Tuareg adapted to life in a desert?



Tropical Savanna Climate Moving north and south away from the equator, we find the tropical savanna climate. This climate has a long, hot, dry season followed by short periods of rain. Rainfall is much lower than at the equator but still high. Temperatures are hot in the summer, often as high as 90°F (32°C). Winters are cooler but rarely get cold.

This climate does not receive enough rainfall to support dense forests. Instead, it supports **savannas**—areas of tall grasses and scattered trees and shrubs.

Dry Climates Leaving Earth's wettest places, we head to its driest. These climates are found in a number of locations on the planet.

Desert Climate Picture the sun baking down on a barren wasteland. This is the desert, Earth's hottest and driest climate. Deserts receive less than 10 inches (25 cm) of rain a year. Dry air and clear skies produce high daytime temperatures and rapid cooling at night. In some deserts, highs can top 130°F (54°C)! Under such conditions, only very hardy plants and animals can live. Many plants grow far apart so as not to compete for water. Others, such as cacti, store water in fleshy stems and leaves.

Steppe Climate Semidry grasslands or prairies—called **steppes** (STEHPS)—often border deserts. Steppes receive slightly more rain than deserts do. Short grasses are the most common plants, but shrubs and trees grow along streams and rivers.

Reading Check
Contrast What are some ways in which tropical and dry climates differ?

The Physical World 71

STRUGGLING READERS

Illustrate Adaptation to Climate

- Ask students to select one of the tropical or dry climates and draw a picture showing how people adapt to it.
- Remind students that temperature, precipitation, and native plant life help geographers identify climates. Have them include examples of each in their drawings.
- Have students use standard English to write a short paragraph on a separate sheet of paper identifying the type of climate and describing specifically what the people in the drawing are doing to adapt to it.

- Have students present their drawings to the class and read their descriptive paragraphs, self-correcting their pronunciation as they read. As a class, review the different climates as depicted in students' drawings, comparing and contrasting the variety of human adaptations.

*Alternative Assessment Handbook, Rubric 3:
Artwork

FOCUS ON CULTURE

The Tuareg of the Sahara

Have students read the Focus on Culture about the Tuareg of the Sahara and then answer the associated question.

Summarize How have the Tuareg adapted to life in a desert? *They raise camels and wear veils to protect against windblown dust.*

ONLINE INTERACTIVE VISUALS

Image Carousel: Tropical Climate

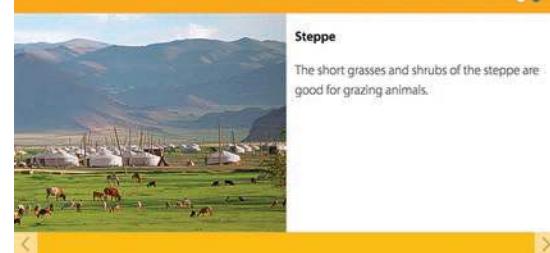
Have students navigate through the carousel and note similarities and differences among the images and identify a unifying theme.



ONLINE INTERACTIVE VISUALS

Image Carousel: Dry Climates

Have students navigate through the carousel and note similarities and differences between the desert and the steppe images and identify a unifying theme.



READING CHECK

Contrast What are some ways in which tropical and dry climates differ? *Tropical climates are usually wet; rain forests are found in the humid tropical climates. There is little rainfall in dry climates; deserts are found there.*

Teach the Main Idea

Temperate climates have the most seasonal change.

Compare What do humid subtropical climates and marine west coast climates have in common?

Both have mild winters, occur near coasts, have evergreen forests, and receive moisture from oceans.

Recall Which climate has four distinct seasons?

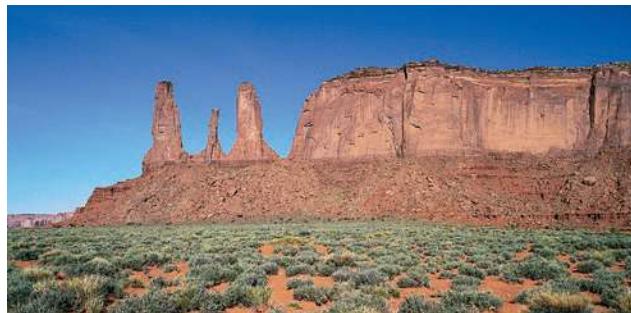
humid continental

Make Generalizations What is often the reason a climate is humid? *Winds are carrying moisture in from a nearby ocean.*

More About . . .

Temperate Caves Caves do not have much weather, but they do have varying temperatures. The temperature inside a cave tends to reflect the average temperature of the air outside. Earth's average temperature is about 60°F, and most caves are not much warmer or cooler than that. Caves in warm areas, of course, are warmer than caves in cool areas. Why does this happen? The soil and rock surrounding a cave moderate its temperature, much like a large body of water affects the land nearby.

Dry Climate Lots of heat and very little rain characterize dry climates. Any plants or animals living here need to be hardy to survive these extremes.



Temperate Climates

If you enjoy hot, sunny days as much as chilly, rainy ones, then temperate climates are for you. *Temperate* means "moderate" or "mild." These mild climates tend to have four seasons, with warm or hot summers and cool or cold winters.

Temperate climates occur in the middle latitudes, the regions halfway between the equator and the poles. Air masses from the tropics and the poles often meet in these regions, which creates a number of different temperate climates. You very likely live in one, because most Americans do.

Mediterranean Climate Named for the region of the Mediterranean Sea, this sunny, pleasant climate is found in many popular vacation areas. In a Mediterranean climate, summers are hot, dry, and sunny. Winters are mild and somewhat wet. Plant life includes shrubs and short trees with scattered larger trees. The Mediterranean climate occurs mainly in coastal areas. In the United States, much of California has this climate.

Humid Subtropical Climate The southeastern United States is an example of the humid subtropical climate. This climate occurs along east coasts near the tropics. In these areas, warm, moist air blows in from the ocean. Summers are hot and muggy. Winters are mild, with occasional frost and snow. Storms occur year-round. In addition, hurricanes can strike, bringing violent winds, heavy rain, and high seas.

A humid subtropical climate supports mixed forests. These forests include both deciduous trees, which lose their leaves each fall, and coniferous trees, which are green year-round. Coniferous trees are also known as evergreens.

Marine West Coast Climate Parts of North America's Pacific coast and of western Europe have a marine west coast climate. This climate occurs on west coasts where winds carry moisture in from the seas. The moist air keeps temperatures mild year-round. Winters are foggy, cloudy, and rainy, while summers can be warm and sunny. Dense evergreen forests thrive in this climate.

Academic Vocabulary
distinct clearly different and separate

Reading Check
Categorize Which of the temperate climates is too dry to support forests?

Humid Continental Climate Closer to the poles, in the upper-middle latitudes, many inland and east coast areas have a humid continental climate. This climate has four **distinct** seasons. Summers are short and hot. Spring and fall are mild, and winters are long, cold, and, in general, snowy.

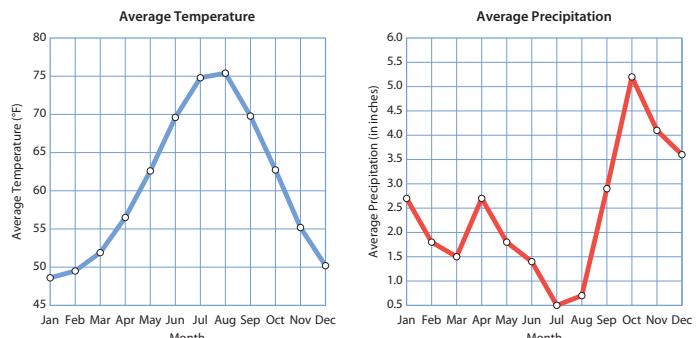
This climate's rainfall supports vast grasslands and forests. Grasses can grow very tall, such as in parts of the American Great Plains. Forests contain both deciduous and coniferous trees, with coniferous forests occurring in the colder areas.

Mediterranean Climate

The climate graph shows average temperatures and precipitation for Nice (NEECE), France, which has a Mediterranean climate.



Climate for Nice, France



Source: Weatherbase.com.

Analyze Graphs

During which month is precipitation lowest?

The Physical World 73

ONLINE INTERACTIVE GRAPHS

Climate for Nice, France

Have students explore the graph and answer the associated question.

Interpret Graphs Which two months have the same average precipitation? *January and April*

In print edition, see feature titled Mediterranean Climate.

Analyze Graphs During which month is precipitation lowest? *July*

ONLINE INTERACTIVE VISUALS

Image Carousel: Other Temperate Climate Regions

Have students navigate through the carousel and note similarities and differences among the images of temperate climate regions and identify a unifying theme.

Other Temperate Climate Regions



Humid Continental Climate

This climate has four distinct seasons. Winters are long, cold, and snowy.

COMPARE AND CONTRAST

Create a Climate Graph

- Review with students the Mediterranean climate graphs of Nice, France. Make sure students understand that two types of data—average monthly temperatures and average monthly precipitation—are shown on the graphs.
- Help students collect monthly temperature and precipitation data for your community. Write the data on the board and have students create climate graphs using the data.

- Ask students to compare the local climate graphs to the graphs for Nice, France. Have them make a table summarizing similarities and differences in climate.

*Alternative Assessment Handbook, Rubric 9: Comparing and Contrasting

READING CHECK

Categorize Which of the temperate climates is too dry to support forests? *Mediterranean*

Teach the Main Idea

Polar climates are cold and dry, while highland climates change with elevation.

Identify What are subarctic evergreen forests called? *taiga*

Recall In which climate zone is the tundra located? *polar*

Explain Why are there different weather patterns in highland areas? *Weather patterns depend on elevation and location.*

Interpret Why does the climate change as you go up a mountain? *The air gets colder.*

More About . . .

Seattle's Marine West Coast Climate Seattle, Washington, is a good example of the marine west coast climate. Temperatures are moderate, and ocean moisture produces 226 cloudy days per year. However, in Puget Sound, not far from Seattle, the island town of Friday Harbor has a very different climate. Located in the rain shadow of the Olympic Mountains, Friday Harbor has only 118 cloudy days per year.

Eastern Siberia Eastern Siberia is neither the hottest nor the coldest place on Earth, but it does hold the record for the greatest temperature range. The town of Verhoyansk, near the Arctic Circle, is a fur-collecting depot in a reindeer-raising area. It has recorded a high of 98°F and a low of 90° below 0°F. This produces an astounding temperature range of 188°F.

ONLINE ANALYZE VIDEOS

Icebergs

Have students watch the video individually or as a class to learn about where the majority of Earth's freshwater is stored.

Analyze Videos How much of Earth's freshwater ice is stored in ice sheets? *99%*

ONLINE INTERACTIVE VISUALS

Image with Hotspots: Highland Climates

Have students explore the image using the interactive hotspots. You may wish to use the associated question as a discussion prompt.

Analyze Visuals Which type of climate is found on the top of Mount Kilimanjaro? *ice cap*

Polar and Highland Climates

Get ready to feel the chill as we end our tour in the polar and highland climates. The three polar climates are found in the high latitudes near the poles. The varied highland climate is found on mountains.

Subarctic Climate The subarctic climate and the tundra climate described below occur mainly in the Northern Hemisphere south of the Arctic Ocean. In the subarctic climate, winters are long and bitterly cold. Summers are short and cool. Temperatures stay below freezing for about half the year. The climate's moderate rainfall supports vast evergreen forests, or taiga (TY-guh).

Tundra Climate The tundra climate occurs in coastal areas along the Arctic Ocean. As in the subarctic climate, winters are long and bitterly cold. Temperatures rise above freezing only during the short summer. Rainfall is light, and only plants such as mosses, lichens, and small shrubs grow.

In parts of the tundra, soil layers stay frozen all year. Permanently frozen layers of soil are called **permafrost**. Frozen earth absorbs water poorly, which creates ponds and marshes in summer. This moisture causes plants to burst forth in bloom.

Highland Climates

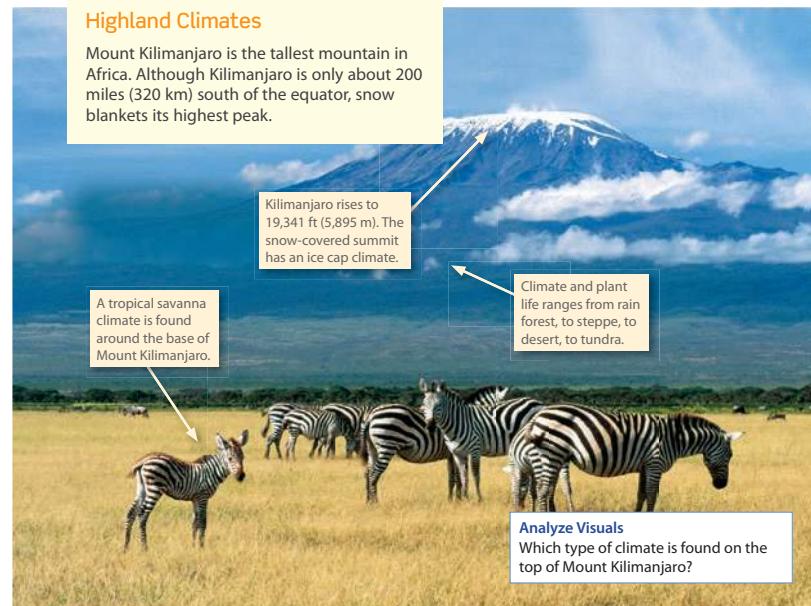
Mount Kilimanjaro is the tallest mountain in Africa. Although Kilimanjaro is only about 200 miles (320 km) south of the equator, snow blankets its highest peak.

Kilimanjaro rises to 19,341 ft (5,895 m). The snow-covered summit has an ice cap climate.

A tropical savanna climate is found around the base of Mount Kilimanjaro.

Climate and plant life ranges from rain forest, to steppe, to desert, to tundra.

Analyze Visuals
Which type of climate is found on the top of Mount Kilimanjaro?



74 Module 2

MAKE PREDICTIONS

Climate in Hawaii

1. Have students collect the following data for each of the Hawaiian Islands: all-time lowest recorded temperature and average year-round temperature.
2. Point out to students that each of the islands has a similar climate. We know this because each island's average year-round temperature is similar. Have students study the all-time lowest recorded temperatures. Make sure they notice that some islands have much lower all-time low temperatures than others.

3. Remind students that temperatures decrease at higher altitudes. Have them predict which of the Hawaiian Islands have tall volcanic peaks, based on analysis of the low temperature data.

4. Have students look up the highest elevation for each of the Hawaiian Islands. Ask them if their predictions were confirmed by these data.

*Alternative Assessment Handbook, Rubric 30: Research



Polar Climate Mountains often sustain polar climates, especially at their peaks. Different kinds of plants and animals may be found at different elevations.

Ice Cap Climate The harshest places on Earth may be the North and South poles. These regions have an ice cap climate. Temperatures are bone-numbingly cold, and lows of more than -120°F (-84°C) have been recorded. Snow and ice remain year-round, but precipitation is light. It is too cold for the water to evaporate into the atmosphere to become precipitation. In fact, the average precipitation is so low that these regions are technically deserts. Not surprisingly, no vegetation grows. However, mammals such as penguins and polar bears thrive. Seals can also live in the ice cap climate, and many birds travel through these cold regions.

GAME

Where Am I? Touring the Climate Zones of the Americas

As students play the game they trace the journey of a friend through different climate zones.



READING CHECK

Compare How are polar and highland climates similar? In the highland climate, the tops of mountains are often cold enough for glaciers, just like at the poles.

Reading Check

Compare How are polar and highland climates similar?

Highland Climates Highland climates are cool to cold climates in mountain areas. They are unique because they contain several climate zones. This is because as you climb to higher elevations on a mountain, the climate changes. Temperatures drop, and plant life grows sparser. Going up a mountain can be like going from the tropics to the poles. On very tall mountains, ice coats the summit year-round.

Summary and Preview As you can see, Earth has many climates, which we identify based on temperature, precipitation, and native plant life. In the next lesson you will read about how nature and all living things are connected.

Lesson 5 Assessment

Review Ideas, Terms, and Places

1. a. **Recall** Which three major climate zones are most closely related to latitude? tropical (in low latitudes), temperate (midway between the equator and the poles), and polar (in high latitudes)
- b. **Summarize** How do geographers categorize Earth's different climates? They categorize climates on temperature, precipitation, and native plant life.
2. a. **Define** What are monsoons? seasonal winds that bring either dry or moist air
- b. **Make Inferences** In which type of dry climate do you think the fewest people live, and why? desert, because it has little water
- c. **Compare** Look at the photographs in this lesson of a polar climate and a dry climate. What similarities do you notice in the physical characteristics of these regions? Both have relatively little vegetation. Neither have large amounts of free-flowing water.
3. a. **Identify** What are the four temperate climates? Mediterranean, humid subtropical, marine west coast, and humid continental
- b. **Geographic Questions** Use the climate graph of Nice, France, to pose and answer a question about its climate patterns. Student responses will vary, but should show an understanding of climate patterns in Nice, France.

4. a. **Describe** What are some effects of permafrost? Because frozen earth absorbs water poorly, marshes form in summer. The moisture makes plants bloom.
- b. **Explain** How are highland climates unique? Highland climates are made up of several other climates.

4. a. **Describe** What are some effects of permafrost?
b. **Explain** How are highland climates unique?

Critical Thinking

5. **Categorize** Create a chart like the one below for each climate region. Then use your notes to describe each climate region's average temperatures, precipitation, and native plant life.



76 Module 2

Critical Thinking

5. **Categorize** Create a chart for each climate region. Then use your notes to describe each climate region's average temperatures, precipitation, and native plant life.
tropical—warm all year, rainy, rainy/dry seasons
at higher latitudes, tropical rain forest, tall grasses, scattered trees; **temperate**—different climates ranging from four distinct seasons, dry, warm summers/wet winters, hot summer/mild winters, scrub woodland and grassland, mixed forests, evergreen forests; **polar**—long, cold winters/short summers, permafrost, snow and ice, northern evergreen forests, moss, lichens, low shrubs in tundra, no vegetation on ice cap; **dry**—sunny and dry, hot in tropics, cooler, varying temps in middle latitudes, cacti, short grasses, trees near water; **highland**—high mountain regions,

temperatures depend on elevation and location, ranges from forest to tundra

► Online Assessment

1. Tropical, temperate, and polar climate zones relate to which of the following?

- elevation
- latitude
- precipitation
- temperature

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Tropical climates occur in **the low** latitudes.

2. How do monsoons affect some places with humid tropical climates?

- by producing tall grasses
- by producing rain forests
- by creating rainy and dry seasons
- by creating cool and windy seasons

Alternate Question Which of the following accurately describe the year-round conditions in places with humid tropical climates?

Select the **three** correct answers.

- cool
- dry
- muggy
- rainy
- warm
- windy

3. Which of the following correctly describes marine west coast climates?

- humid with hot summers and mild winters
- long, cold winters and short, warm summers
- cloudy, mild summers and cool, rainy winters
- dry, sunny, warm summers and mild, wetter winters

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

The plant life found in marine west coast climates is mostly **evergreen forest**.

4. Why do parts of the tundra have ponds and marshes form in the summer?

- because seasonal rains fall heavily
- because glaciers melt during this season
- because plants thaw and release moisture
- because frozen earth absorbs water poorly

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Because frozen earth absorbs water poorly, parts of **tundra** climates have ponds and marshes that form in the summer.

5. **Compare and Contrast** How do dry and highland climate zones differ from tropical, temperate, and polar climate zones?

Possible answer: Only dry and highland climate zones occur at many different latitudes. Tropical, temperate, and polar climate zones occur at specific areas of latitude.

6. **Make Inferences** Why is it important to protect the many rain forests on Earth?

Possible answer: The rain forests on Earth contain more types of plants and animals than anywhere else. If they are not protected, many of these types of plants and animals could become extinct.

7. **Draw Conclusions** Why is weather a factor in many people's decisions to move to California from other parts of the United States?

Possible answer: Much of California has a Mediterranean climate. This climate's dry, sunny, hot summers and mild, wet winters are attractive to many people, especially to those who come from places with cold winters.

8. **Compare and Contrast** How are the subarctic climate and the tundra climate similar and different? Describe one similarity and one difference.

Possible answer: These climates both have winters that are long and bitterly cold. The subarctic climate gets enough rainfall to support vast evergreen forests, while the light rainfall in tundra climates only supports plants such as mosses and small shrubs.

ADDITIONAL INSTRUCTIONAL MATERIALS

continued from page 69

More About . . .

Extreme Weather

Have you had any hot days recently where you live? Or have you complained about too much rain? Here are some all-time weather records, showing how bad weather can really get.

Highest Temperature:

134° Fahrenheit (Furnace Creek Ranch, California, USA)

Lowest Temperature:

-129° Fahrenheit (Vostok, Antarctica)

Highest Average Rainfall:

523.6 inches (Lloro, Colombia)

Lowest Average Rainfall:

0.03 inches (Arica, Chile)

continued from page 74

More About . . .

Connect to History: Ice Ages

Many people in the United States live in areas that were covered by ice until about 10,000 years ago. Glaciers more than one mile thick extended across most of the northern United States. Water from the melting glaciers formed the Great Lakes. Generally, ice ages have come about every 40,000 to 100,000 years. No one knows how or when another ice age will begin. But our knowledge of ice ages reminds us that climate zones can and do change over time.

COMPARE AND CONTRAST

World Climate Regions

1. Instruct the students to create a chart with two rows and two columns. The two columns should be labeled Wet and Dry. The two rows should be labeled Cold and Hot.
2. Referring to the table of world climate regions, have students identify in which box different regions should go: Cold/Wet, Cold/Dry, Hot/Wet, Hot/Dry.
3. Ask students to identify climates they didn't place in a box and explain why.

*Alternative Assessment Handbook, Rubric 9: Comparing and Contrasting



Environments and Biomes

- Soil Layers

- Geographic Feature: Soil Factory
- Invaders!
- Biosphere 2

LESSON 6

Big Idea

Plants, animals, and the environment, including soil, interact and affect one another.

Visuals

Videos

Maps,
Graphs, and
Charts

Extend
and Enrich

Sources

Assessment

- Key Terms Review
- Reading Check
- Graphic Organizer Activity
- Lesson Assessment

- Document-Based Investigation:
A Desert Ecosystem

► Online Lesson 6 Enrichment Activities

Invaders!

Article Students read about nonnative species and the effects they have on ecosystems in the United States. Then they research and report about a specific nonnative species and efforts to limit its population growth.

Biosphere 2

Article Students read about an experimental model of Earth's natural systems and research types of plants that might grow in such an environment.

Environments and Biomes

The Big Idea

Plants, animals, and the environment, including soil, interact with and affect one another.

Main Ideas

- The environment and life are interconnected and exist in a fragile balance.
- Soils play an important role in the environment.

Key Terms and Places

environment
ecosystem
biome
habitat
extinct
humus
desertification

If YOU lived there ...

When your family moved to the city, you were sure you would miss the woods and pond near your old house. Then one of your new friends at school told you there's a large park only a few blocks away. You wondered how interesting a city park could be. But you were surprised at the many plants and animals that live there.

What environments might you see in the park?

The Environment and Life

If you saw a wild polar bear outside your school, you would likely be shocked. In most parts of the United States, polar bears live only in zoos. This is because plants and animals must live where they are suited to the **environment**, or surroundings. Polar bears are suited to very cold places with lots of ice, water, and fish. As you will see, living things and their environments are connected and affect each other in many ways.



Suitable Environment

With thick fur and a layer of fat, this polar bear, wading in shallow water in Svalbard, Norway, is well suited to its cold environment.

The Physical World 77

Teach the Main Idea

The environment and life are interconnected and exist in a fragile balance.

Explain How are biomes related to ecosystems? Both contain groups of plants and animals that depend on each other and specific environments for survival. However, biomes are much larger and typically consist of several ecosystems.

Identify Name some events that can cause an environment to change. *drought, climate change, pollution, humans clearing land, humans causing species to become extinct*

Identify Cause and Effect How might the clearing of plants and trees affect an ecosystem? *Small animals can no longer*

find food, so they die or move away. As a result, larger animals no longer have a food supply and they, too, die or move to another area.

More About ...

Connect to History: Fire in Yellowstone National Park

The year 1988 was the driest on record at Yellowstone National Park. Devastating fires burned 36 percent of the park that year. Scientists studying the aftermath have learned:

- Some grass eaten by elk was more nutritious than it was before the fire.
- The fire had no effect on fish in nearby rivers.
- Lodgepole pine trees have recolonized most of the burned area.
- The number of grizzly bears was not affected.

Teach the Big idea

1. Whole Class Open/Introduction

If YOU lived there ...

What environments might you see in the park?

Review the scenario with students and lead a class discussion around responses to the question.

Remind students that all responses are valid as long as they are supported with valid reasoning. You may wish to review the following points to frame your discussion.

Consider how a city park might be SIMILAR to open spaces in the country.

- Both have trees and plants.
- Both have animals.
- Both are quiet, peaceful areas.

Consider how a city park might be DIFFERENT from open spaces in the country.

- trees and plants less healthy
- no large animals
- sounds of traffic nearby

2. Direct Teach Introduce the Big Idea: *Plants, animals, and the environment, including soil, interact with and affect one another.* Remind students that all animals, including humans, are affected by their environments. Encourage them to discuss how a small animal, such as a squirrel, might be affected by changes in its environment. For example, what might happen if the walnut trees that squirrels depended on for winter food were cut down?

3. Practice/Assess/Inquire As students complete the lesson, have them outline it. When they are done, ask them to write two or three paragraphs summarizing it. Tell students they must include all of the lesson's key terms in their paragraphs. Have them underline the key terms.

4. Explore (Collaborative Exploration) Go through the list of key terms and have students read the sentence they wrote using that term to the class.

5. Whole Group Close/Reflect Have students write five multiple-choice questions based on their section summaries.

*Alternative Assessment Handbook, Rubric 42: Writing to Inform



ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

A Desert Ecosystem is the fifth of six document-based investigations that students will analyze in The Physical World module. Students study the image with hotspots to learn more about how life in ecosystems is interconnected.



ONLINE DOCUMENT-BASED INVESTIGATION

A Desert Ecosystem

The illustration of a desert ecosystem demonstrates how the different species in the ecosystem depend on each other for survival. Students can explore the image using the interactive hotspots.

Analyze Sources What might happen in the desert ecosystem shown if the number of rabbits fell significantly? *The number of rabbit predators might also decline because of a lack of food.*

In print edition, see visual feature of same title.

Analyze Visuals What might happen in the desert ecosystem above if the number of rabbits fell significantly? *The number of rabbit predators might also decline because of a lack of food.*

Limits on Life The environment limits life. As our tour of the world's climates showed, factors such as temperature, rainfall, and soil conditions limit where plants and animals can live. Palm trees cannot survive at the frigid North Pole. Ferns will quickly wilt and die in deserts, but they thrive in tropical rain forests.

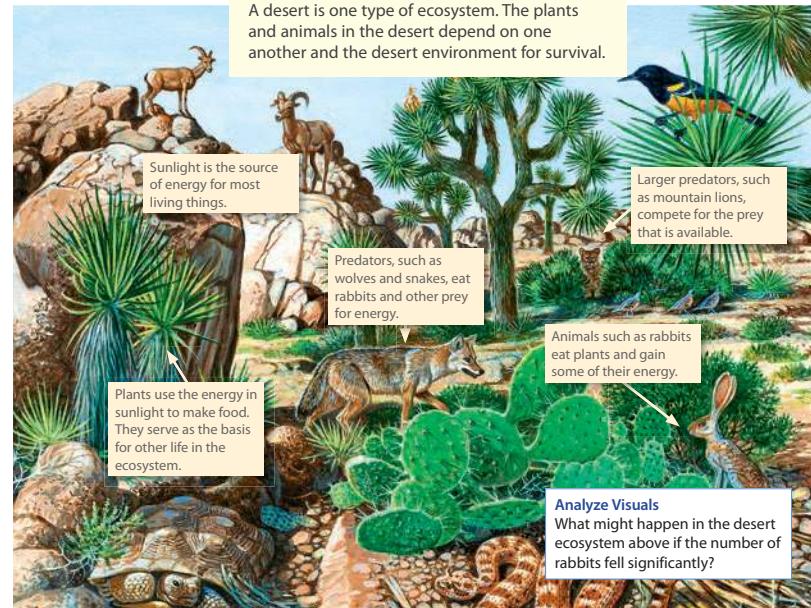
At the same time, all plants and animals are adapted to specific environments. For example, kangaroo rats are adapted to dry desert environments. These small rodents can get all the water they need from food, so they seldom have to drink water.

Connections in Nature The interconnections between living things and the environment form ecosystems. An **ecosystem** is a group of plants and animals that depend on each other and the environment in which they live for survival. Ecosystems can be any size and can occur wherever air, water, and soil support life. A garden pond, a city park, a prairie, and a rain forest are all examples of ecosystems.

In addition to environments and ecosystems, geographers might use the term **biome**. A biome is much larger than an ecosystem. It may be made up of several ecosystems. An entire tropical rain forest can be a biome. Earth itself can be thought of as one big biome.

A Desert Ecosystem

A desert is one type of ecosystem. The plants and animals in the desert depend on one another and the desert environment for survival.



Analyze Visuals
What might happen in the desert ecosystem above if the number of rabbits fell significantly?

78 Module 2



ONLINE GRAPHIC ORGANIZER

Environments and Biomes

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Analyze Cause and Effect Give an example of a change to an ecosystem that could affect its balance. List how the change affects the rest of the ecosystem.
Tip: Be sure your example shows a relationship between the change and the effect or consequence on the ecosystem.



ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: **environment**, **ecosystem**, **biome**, **habitat**, **extinct**, **humus**, **desertification**.

The diagram on the previous page shows a desert ecosystem. Each part of this ecosystem fills a certain role. The sun provides energy to the plants, which use the energy to make their own food. The plants then serve as food, either directly or indirectly, for all other life in the desert. When the plants and animals die, their remains break down and provide nutrients for the soil and new plant growth. Thus, the cycle continues.

Changes to Environments The interconnected parts of an ecosystem exist in a fragile balance. For this reason, a small change to one part can affect the whole system. A lack of rain in the forest ecosystem could kill off many of the plants that feed the rabbits. If the rabbits die, there will be less food for the wolves and mountain lions. Then they too may die.



Extinction The dodo is not the only bird to go extinct. The passenger pigeon, shown in this Audubon illustration, went extinct in 1914. Commercial overhunting played a role in its end.

Academic Vocabulary
consequences the effects of a particular event or events

Many actions can affect ecosystems. For example, people need places to live and food to eat, so they clear land for homes and farms. Clearing land has **consequences**, however. It can cause the soil to erode. In addition, the plants and animals that live in the area might be left without food and shelter. Actions such as clearing land and polluting can destroy habitats. A **habitat** is the place where a plant or animal lives. The most diverse habitats on Earth are tropical rain forests. People are clearing Earth's rain forests for farmland, lumber, and other reasons, though. As a result, these diverse habitats are being lost.

Extreme changes in ecosystems can cause species to die out, or become **extinct**. For example, flightless birds called dodos once lived on Mauritius, an island in the Indian Ocean. When people first settled there, they hunted dodos and introduced predators, such as dogs. First seen in 1507, dodos were extinct by 1681.

COLLABORATIVE LEARNING

Conduct a Radio Interview

1. Have students work with a partner to choose a local ecosystem, such as a wooded area, lake, or a city park.
2. Have students create a two-column table listing the components of this ecosystem. The first column should list each component and the second column should explain that component's purpose. For example, column 1 might contain "Sunlight" and column 2 then would contain "Source of energy for living things."

3. Students then conduct a radio interview.

One student takes on the role of the interviewer who asks questions. The second student plays the role of a scientist who specializes in local ecosystems and answers the questions. The students should use the table as a guideline for their questions and answers.

*Alternative Assessment Handbook, Rubric 14: Group Activity; and 24: Oral Presentations

Teach the Main Idea

Soils play an important role in the environment.

Recall Why is soil important to human life? *Soil supports plant life, which is where humans get much of their food.*

Explain Where do fertile soils get their humus? *decayed plant or animal matter*

Draw Conclusions If there was no soil for growing food, what could we eat? *fish, other seafood, seaweed*

Infer Why do farmers often rotate the crops they plant, for example by planting corn one year and wheat the next? *Rotating crops can help keep soil fertile.*

More About . . .

Soil Erosion Erosion is a natural process that only becomes a problem when it happens too quickly. As long as soil is replaced as fast as it erodes, balance is maintained. Unfortunately, in many areas, human activity has upset the balance. Farming and cattle grazing are two activities that have caused a lot of soil erosion. Trees, wetlands, and plants cover all help to slow down erosion and maintain the balance.

GEOGRAPHIC FEATURE

Soil Factory

Invite students to read the text and examine the photograph and then answer the associated question.

Analyze Visuals What causes a fallen tree to change into soil? *The decaying tree turns into a blend of organic material called humus, which mixes with soil and adds nutrients to it.*

In print edition, see feature of same title.

Summarize What causes a fallen tree to change into soil? *The decaying tree turns into a blend of organic material called humus, which mixes with soil and adds nutrients to it.*

Reading Check

Make Inferences How might one change affect an entire ecosystem?

Recognizing these problems, many countries are working to balance people's needs with the needs of the environment. The United States, for example, has passed many laws to limit pollution, manage forests, and protect valuable ecosystems. These laws rarely please everyone. A law that restricts logging in a forest, for example, may please hikers but frustrate logging companies. A law that bans hunting of threatened species may please wildlife photographers but disappoint hunters.

Nevertheless, laws can produce positive results. For example, since the Endangered Species Act of 1973 became law, 47 species have been removed from the endangered species list because their populations have recovered.

Soil and the Environment

As you know, plants are the basis for all food that animals eat. Soils help determine what plants will grow and how well. Because soils support plant life, they play an important role in the environment.

Fertile soils are rich in minerals and **humus** (HYOO - muhs), decayed plant or animal matter. These soils can support abundant plant life. Like air and water, fertile soil is essential for life. Without it, we could not grow much of the food we eat.

Soils can lose fertility in several ways. Erosion from wind or water can sweep topsoil away. Planting the same crops over and over can also rob

Soil Factory

The next time you see a fallen tree in the forest, do not think of it as a dead log. Think of it as a soil factory. A fallen tree is buzzing with the activity of countless insects, bacteria, and other organisms. These organisms invade the fallen log and start to break the wood down.

As the tree decays and crumbles, it turns into humus. Humus is a rich blend of organic material. The humus mixes with the soil and broken rock material. These added nutrients then enrich the soil, making it possible for new trees and plants to grow. Fallen trees provide as much as one-third of the organic material in forest soil.

Summarize

What causes a fallen tree to change into soil?



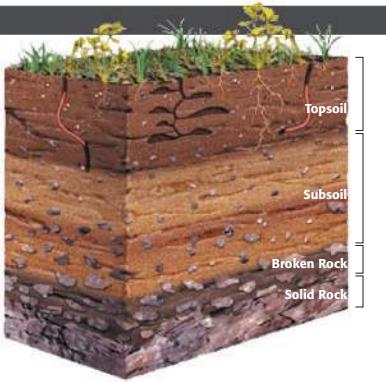
80 Module 2

READING CHECK

Make Inferences How might one change affect an entire ecosystem? *Living things and the environment in an ecosystem are interconnected.*

Soil Layers

The three layers of soil are the topsoil, subsoil, and broken rock. The thickness of each layer depends on the conditions in a specific location. For example, soil can be as much as 100 feet thick in tropical regions.



Analyze Visuals

In which layer of soil are most plant roots and insects found?

Reading Check

Analyze Information What do fertile soils contain, and why are these soils important?

soil of its fertility. When soil becomes worn out, it cannot support as many plants. In fragile, dry environments, this can lead to the spread of desert-like conditions, or **desertification**. The spread of desertlike conditions is a serious problem in many parts of the world.

Summary and Preview Living things and the environment are connected, but changes can easily upset the balance in an ecosystem. Because they support plant life, soils are important parts of ecosystems. In the next lesson you will learn about Earth's many resources.

Lesson 6 Assessment

Review Ideas, Terms, and Places

1. a. **Define** What is an ecosystem, and what are two examples of ecosystems?
b. **Summarize** How do nature and people change ecosystems?
c. **Elaborate** Why can plants and animals not live everywhere?
d. **Contrast** How is a biome different from an ecosystem?
2. a. **Recall** What is humus, and why is it important to soil?
b. **Identify Cause and Effect** What actions can cause desertification, and what might be some possible effects?
c. **Elaborate** Why is it important for geographers and scientists to study soils?

Critical Thinking

3. **Identify Cause and Effect** Review your notes. Then draw a two-row, two-column chart. Label one column Causes and the other Effects. Use the chart to identify some of the causes and effects of changes to ecosystems.



The Physical World 81

ENGLISH LANGUAGE LEARNERS

Build Vocabulary

1. To help students build vocabulary about soil and the environment, have them make a list of all the unfamiliar words in Soil Factory. The list may include such words as *activity*, *bacteria*, *organism*, *invade*, *decay*, *organic*, or *nutrients*.
2. Compile a composite list of each student's results on the board. Assign a word to each student to look up in the dictionary. One by one have students write their definitions on the board.

3. Definitions should include part of speech, language of origin, and the correct meaning (if multiple definitions are included).
4. Have another student write a sentence on the board using the defined word.

*Alternative Assessment Handbook, Rubric 30: Research



ONLINE INTERACTIVE VISUALS

Drag-and-Drop Activity: Soil Layers

Have students explore the image by correctly placing labels on the different layers.

In print edition, see feature of same title.

Analyze Visuals In which layer of soil are most plant roots and insects found? **topsoil**

READING CHECK

Analyze Information What do fertile soils contain and why are these soils important? **humus, minerals; They can support abundant life.**

Print Assessment

Review Ideas, Terms, and Places

1. a. **Define** What is an ecosystem, and what are two examples of ecosystems? **a place where living things depend on each other and the environment for survival; possible examples: a river and a meadow**
b. **Summarize** How do nature and people change ecosystems? **through small changes that affect the system, such as drought or clearing land**
c. **Elaborate** Why can plants and animals not live everywhere? **They are adapted to specific environments.**
d. **Contrast** How is a biome different from an ecosystem? **An ecosystem can be as small as a garden or a pond; a biome is much larger and may contain several ecosystems.**
2. a. **Recall** What is humus, and why is it important to soil? **decayed plants and animals; helps make soil fertile**
b. **Identify Cause and Effect** What actions can cause desertification, and what might be some possible effects? **erosion, or planting the same crops over and over again; the soil can no longer support plant life.**
c. **Elaborate** Why is it important for geographers and scientists to study soils? **Soils determine which plants can grow, and plants are the basis for all animal food.**

(continued)

Print Assessment (continued)

Critical Thinking

3. **Identify Cause and Effect** Review your notes. Then draw a two-row, two-column chart. Label one column Causes and the other Effects. Use the chart to identify some of the causes and effects of changes to ecosystems. *Possible answers: Cause—clearing of land, drought; effect—Plants disappear, causing small animals to lose food supply and die, resulting in large animals losing food supply. Cause—extinction of species; effect—Predators of extinct species lose food supply and die. Cause—pollution; effect—Habitats are destroyed, causing animals to die or move away.*

► Online Assessment

1. What forms ecosystems?
 - the weather and soil conditions in an area
 - the types of plants and animals found in an area
 - the interconnection between air and water in an environment
 - the interconnection between living things and the environment

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

A group of plants and animals that depend on each other and the environment in which they live for survival is called a(n) ecosystem ▾.

2. Why do soils play an important role in the environment?
 - because they aid erosion
 - because they support plant life
 - because they prevent desertification
 - because they contain valuable minerals

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Decayed plant and animal matter help soils to remain fertile ▾.

3. **Make Generalizations** Why do laws aimed at protecting the environment seldom please everyone?

Possible answer: These laws seldom please everyone because people do not agree about the best relationship between humans and their environments. Some people want their environments to be protected as much as possible so that they can enjoy natural beauty, such as being able to hike in an untouched forest. Others want to be able to cut down the trees in forests so that the trees can benefit people by being used to build homes.

4. **Draw Conclusions** How can farmers help to protect soils?

Possible answer: Farmers can help to protect soils by not planting the same crops over and over. By varying what crops they plant, farmers can help to ensure that soils do not lose their fertility and are able to grow the food people need to survive.

ADDITIONAL INSTRUCTIONAL MATERIALS

continued from page 80

More About . . .

Connect to Science: Soil

- As many as 10 million bacteria can live in one gram of soil.
- More than one thousand animal species live in soil, including worms, ants, pill bugs, and millipedes.
- In the temperate Midwest, soil accumulates at about four inches (10.2 cm) per 1,000 years.
- Soil can be as much as 100 feet (30.5 m) thick in tropical regions.
- The United States has lost an estimated 35 percent of its topsoil since 1776.



Natural Resources

- Renewable Energy Sources
- From the Ground to the Air

● The Paris Agreement

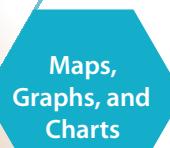


Videos

LESSON 7

Big Idea

Earth's natural resources have many valuable uses, and their availability affects people in many ways.



● Graph: Demand for Power



- **Biography:** Wangari Maathai
- **Geographic Feature:** Products from Petroleum
- Saving Our Forests
- Earthships
- Mineral Scavenger Hunt



● Document-Based Investigation:
Reforestation

Assessment

- Key Terms Review
- Reading Check
- Graphic Organizer Activity
- Lesson Assessment

► Online Lesson 7 Enrichment Activities

Saving Our Forests

Video Students watch a video to learn how professionals and students are working together to preserve our forests. Then students write diary entries as if they were student forestry interns.



Earthships

Video Students watch a video to learn about a movement to build eco-friendly houses for people in need, and then make a brochure that describes the benefits of living in such a home.



Mineral Scavenger Hunt

Research Students explore their classroom to identify objects made from mineral resources.

Teach the Big idea

1. Whole Class Open/Introduction

If YOU lived there ...

How can you help conserve scarce water?

Review the scenario with students and lead a class discussion around responses to the question. Remind students that all responses are valid as long as they are supported with valid reasoning. You may wish to review the following points to frame your discussion.

Consider USES of water.

- watering lawns
- taking showers
- washing dishes

Consider how to USE LESS water.

- water lawn less often, early or late in the day
- take shorter showers
- soak dishes

2. Direct Teach Introduce the Big Idea: *Earth's natural resources have many valuable uses, and their availability affects people in many ways.* Ask students to define the term *natural resource*. *It is any material in nature that people use and value.* Describe for students a scenario in which they are settlers looking to move to a new land. What kinds of natural resources would they look for when deciding where to settle?

3. Practice/Assess/Inquire Have students make a two-column table. As students complete the lesson, they should fill in the table. In the left column, they should list each resource discussed in the lesson. In the right column, they should list how often they use that resource.

4. Explore (Collaborative Exploration) Ask volunteers to share their ideas and write them on the board. If necessary, have students explain the use of a resource. (Example: Paper comes from the forest.)

5. Whole Group Close/Reflect For homework, have students rank all the resources discussed in class in order of importance. Ask them to explain their rankings.

*Alternative Assessment Handbook, Rubric 42: Writing to Inform

Lesson 7

Natural Resources

If YOU lived there ...

You live in Southern California, where the climate is warm and dry. Every week, you water the grass around your house to keep it green. Now the city has declared a "drought emergency" because of a lack of rain. City officials have put limits on watering lawns and on other uses of water.

How can you help conserve scarce water?

Earth's Valuable Resources

Think about the materials in nature that you use. You have learned about the many ways we use sun, water, and land. They are just a start, though. Look at the human-made products around you. They all required the use of natural materials in some way. We use trees to make paper for books. We use petroleum, or oil, to make plastics for cell phones. We use metals to make machines, which we then use to make many items. Without these materials, our lives would change drastically.

Using Natural Resources Trees, oil, and metals are all examples of natural resources. A **natural resource** is any material in nature that people use and value. Earth's most important natural resources include air, water, soils, forests, and minerals.

Understanding how and why people use natural resources is an important part of geography. We use some natural resources just as they are, such as wind. Usually, though, we change natural resources to make something new. For example, we change metals to make products such as bicycles and watches. Thus, most natural resources are raw materials for other products.

Types of Natural Resources We group natural resources into two types: those we can replace and those we cannot.

Renewable resources are resources Earth replaces naturally. For example, when we cut down a tree, another tree can grow in its place. Renewable resources include water, soil, trees, plants, and animals. These resources can last forever if used wisely.

82 Module 2

ONLINE GRAPHIC ORGANIZER

Natural Resources

As students read the lesson, have them use the graphic organizer to take notes. Students can review their graphic organizer notes at the end of the lesson to answer the following question:

Analyze Cause and Effect What are some of the tradeoffs between using renewable and nonrenewable resources? *Nonrenewable resources cannot be replaced, so they must be used thoughtfully. Renewable resources can be replaced, but they must be managed so they are available as needed.*

ONLINE LESSON FLIP CARDS

Review Key Terms and Places

Students can use the flip cards in the Lesson Review at any time to review the lesson's key terms: **natural resource, renewable resources, nonrenewable resources, deforestation, reforestation, fossil fuels, hydroelectric power.**

ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

Reforestation is the last of six document-based investigations that students will analyze in The Physical World module. Students study the image to learn more about human-environment interaction.

Reforestation

Members of the Green Belt Movement plant trees in Kenya. Although trees are a renewable resource, some forests are being cut down faster than new trees can replace them. Reforestation helps protect Earth's valuable forestlands.



Analyze Visuals

How does reforestation help the environment?

Reading Check

Contrast How do renewable and nonrenewable resources differ?

Other natural resources will run out one day. These **nonrenewable resources** are resources that cannot be replaced. For example, coal formed over millions of years. Once we use the coal up, it is gone.

Managing Natural Resources People need to manage natural resources to protect them for the future. Consider how your life might change if we ran out of forests, for example. Although forests are renewable, we can cut down trees far faster than they can grow. The result is the clearing of trees, or **deforestation**.

By managing resources, we can repair and prevent resource loss. For example, some groups are engaged in **reforestation**, planting trees to replace lost forestland.

BIOGRAPHY

Wangari Maathai (1940–2011)

Can planting a tree improve people's lives? Wangari Maathai thinks so. Born in Kenya in East Africa, Maathai wanted to help people in her country, many of whom were poor. She asked herself what Kenyans could do to improve their lives. "Planting a tree was the best idea that I had," she says. In 1977 Maathai founded the Green Belt Movement to plant trees and protect forestland. The group has now planted more than 30 million trees across Kenya! These trees provide wood and prevent soil erosion. In 2004 Maathai was awarded the Nobel Peace Prize. She is the first African woman to receive this famous award.



Analyze Effects:

How has Maathai's Green Belt Movement helped Kenya?

The Physical World 83

COLLABORATIVE LEARNING

Report on Local Resources

- Divide the class into four groups: air, water, soil, and forest. Have each group make a poster and present a report to the class after researching the topics outlined here.
- Have the air team research air quality standards, including the substances measured and the amounts of each considered dangerous. Have them find out which, if any, pollutants have reached dangerous levels in their community.
- Have the water team find out where their water comes from and have them research water quality standards and how the community measures up.

- Have the soil team research how soils are classified and what soil types are found in the area. They might also bring in a sample.
- Have the forest team find out which trees grow in the area and where the closest state or national forest is.

*Alternative Assessment Handbook, Rubrics 14: Group Activity; and 24: Oral Presentations

Teach the Main Idea

Earth provides valuable resources for our use.

Recall Is soil a renewable or nonrenewable resource? *renewable*

Explain What is reforestation? *planting new trees in places where forests have been lost*

Make Inferences Is it better to rely on renewable or nonrenewable resources? *Renewable resources, because nonrenewable resources will run out some day.*

More About . . .

White Pine Forest Much of Wisconsin and Michigan were once covered by majestic white pine forests. Many of these trees were 200 feet (61 m) tall, 5 feet (1.5 m) in diameter, and 200 years old. White pine gained a reputation as an exceptionally fine lumber for building houses. In the mid-1800s, sawmills spread through the area. By 1900, almost all of the upper Midwest's white pine forests had been cut down.

ONLINE DOCUMENT-BASED INVESTIGATION

Reforestation

The photograph shows students planting trees to help with reforestation. Invite students to read the text and examine the image and then answer the associated question.

Analyze Sources How do these children help the environment? *Possible answer: The trees they plant prevent soil erosion.*

In print edition, see feature of same title.

Analyze Visuals How does reforestation help the environment? *Possible answer: The trees prevent soil erosion.*

BIOGRAPHY

Wangari Maathai

Have students read the biography of Wangari Maathai and then answer the associated question.

Analyze Effects How has Maathai's Green Belt Movement helped Kenya? *It helped to protect forestlands.*

READING CHECK

Contrast How do renewable and nonrenewable resources differ? *Renewable resources are replaced naturally, so they can last forever if used wisely. Nonrenewable resources cannot be replaced, so at some point, they will be gone forever.*

For additional instruction, go to end of lesson.

Teach the Main Idea

Energy resources provide fuel, heat, and electricity.

Recall What are some nonrenewable energy resources? *coal, natural gas, petroleum or oil, all of the fossil fuels*

Contrast What are the advantages and disadvantages of coal? *Advantages—It can provide both heat and electricity; it is plentiful. Disadvantages—It creates pollution; it will run out some day.*

Draw Conclusions What is a disadvantage of wind power? *When the wind does not blow, it provides no power.*

More About . . .

Future Energy Use Today all countries rely on energy from nonrenewable resources such as coal and oil. The more developed countries use huge amounts of these resources. As the world's population grows, the need for energy will grow. However, people will not be able to rely on these same resources. Their use causes pollution, and eventually nonrenewable resources will run out. More people around the world will have to develop cleaner, renewable sources of energy.

Natural Resources

Earth provides many valuable and useful natural resources, such as oil.



Energy Resources

Every day you use plants and animals from the dinosaur age—in the form of energy resources. These resources power vehicles, produce heat, and generate electricity. They are some of our most important and valuable natural resources.

Nonrenewable Energy Resources Most of the energy we use comes from **fossil fuels**, nonrenewable resources that formed from the remains of ancient plants and animals. The most important fossil fuels are coal, petroleum, and natural gas.

Coal has long been a reliable energy source for heat. However, burning coal causes some problems. It pollutes the air and can harm the land. For these reasons, people have used coal less as other fuel options became available.

Today we use coal mainly to create electricity at power plants, not to heat single buildings. Because coal is plentiful, people are looking for cleaner ways to burn it.

Petroleum, or oil, is a dark liquid used to make fuels and other products. When first removed from the ground, petroleum is called crude oil. This oil is shipped or piped to refineries, factories that process the crude oil to make products. Fuels made from oil include gasoline, diesel fuel, and jet fuel. Oil is also used to make petrochemicals, which are processed to make products such as plastics and cosmetics.

As with coal, burning oil-based fuels comes with a tradeoff. Such fuels can pollute the air and land. In addition, oil spills can harm wildlife. International concern over the effect of oil spills inspired the creation of international regulations. These regulations address pollution from oil spills and help ensure a coordinated response. Because we are so dependent on oil for energy, it is an extremely valuable resource.

The cleanest-burning fossil fuel is natural gas. We use it mainly for heating and cooking. For example, your kitchen stove may use natural gas. Some vehicles run on natural gas as well. These vehicles cause less pollution than those that run on gasoline.

84 Module 2

ENGLISH LANGUAGE LEARNERS

Create a Newspaper from the Future

1. To help students apply their understanding of the importance of people managing and conserving Earth's natural resources, organize them into groups. Have the students create newspapers dated 100 years from now, imagining what the world will be like in the future.
2. Ask students to consider and discuss what issues future generations may encounter if we continue to use nonrenewable resources. As an alternative they may discuss the positive effects of using renewable resources. Have each group member contribute a brief news story and associated images related to people's management of natural resources.

3. Have the students in each group present their newspapers to the class. Discuss the impact people have on Earth and what can be done to conserve natural resources.

*Alternative Assessment Handbook, Rubrics 11: Discussions; 14: Group Activity; and 23: Newspapers

Many scientists believe that pollution from burning fossil fuels has caused Earth's temperature to increase. This increase, they argue, is bringing about climate change. The growing scientific agreement on this issue has inspired international action. The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted in 1997. The Kyoto Protocol, as it is known, sets internationally binding targets to reduce emissions from burning fossil fuels. More than 190 countries have signed the agreement.

Renewable Energy Resources Unlike fossil fuels, renewable energy resources will not run out. They also are generally better for the environment. On the other hand, they are not available everywhere and can be costly.

The main alternative to fossil fuels is **hydroelectric power**—the production of electricity from water power. We obtain energy from moving water by damming rivers. The dams harness the power of moving water to generate electricity.

Hydroelectric power has both pros and cons. On the positive side, it produces power without polluting and lessens our use of fossil fuels. On the negative side, dams create lakes that replace existing resources, such as farmland, and disrupt wildlife habitats.

Another renewable energy source is wind. People have long used wind to power windmills. Today we use wind to power wind turbines, a type of modern windmill. At wind farms, hundreds of turbines create electricity in windy places.

A third source of renewable energy is heat from the sun and Earth. We can use solar power, or power from the sun, to heat water or homes. Using special solar panels, we turn solar energy into electricity. We can also use geothermal energy, or heat from within Earth. Geothermal power plants use steam and hot water located within Earth to create electricity.

Hydroelectric Power
Glen Canyon Dam, near Page, Arizona, provides roughly 4 billion kilowatt hours per year of hydroelectric power. It also created Lake Powell, which filled to capacity in 1980.



The Physical World 85

DRAW CONCLUSIONS

Research World Energy Consumption

1. Discuss with students how some areas in the world produce more energy than the people who live there use. Others use more energy than they produce.

2. Have students use the Internet or reference books to find energy production and consumption data.

Have them make a chart of the top ten energy producers and the top ten energy consumers.

3. Have students write a short essay exploring what impact a consumption/production imbalance might have on a country's economy.

*Alternative Assessment Handbook, Rubric 30: Research

ANALYZE VIDEOS

The Paris Agreement

Have students watch the video individually or as a class. You may wish to use the associated question as a discussion prompt.

Analyze Videos According to the video what are the pros and cons of the Paris Agreement?

pros—*Environmentalists say the agreement will reduce the amount of fossil fuel pollution and greenhouse gases. They believe it will help keep world temperatures from rising to uncontrollable levels;*

cons—*Businesses fear that more regulations will increase their costs. Also, some details about how the agreement will be enforced are unclear.*

ONLINE INTERACTIVE VISUALS

Image Carousel: Renewable Energy Sources

Have students navigate through the carousel and note similarities and differences among the different energy sources and identify a unifying theme.

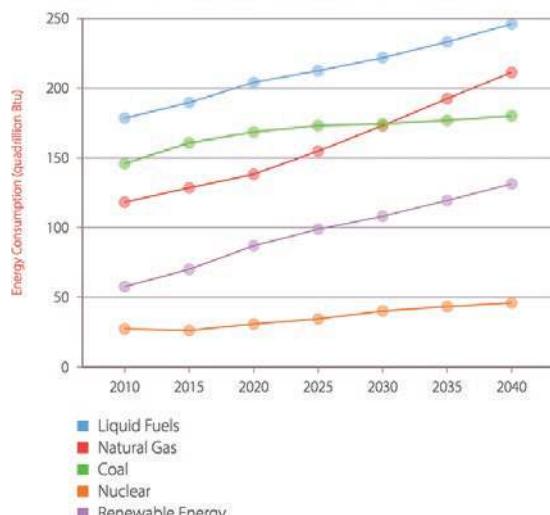
ONLINE INTERACTIVE GRAPHS

Demand for Power

Have students explore the interactive line graph to compare trends of different sources of world energy consumption and answer the associated question.

Interpret Graphs Which fossil fuel is projected to have the fastest-growing consumption? *natural gas*

World Energy Consumption by Source, 2010–2040 (projected)



Source: U.S. Energy Information Administration, *International Energy Outlook 2016*.

Teach the Main Idea

Mineral Resources include metals, rocks, and salt.

Recall What can someone do to conserve aluminum? *recycle cans and other items made of aluminum*

Compare In what ways are minerals similar to fossil fuels, and how are they different? *Like fossil fuels, minerals come from the ground and they are nonrenewable. Unlike fossil fuels, they are not used to produce energy.*

Make Inferences If there were no iron for making steel, what impact would there be on forests?
More trees would be cut down to build buildings.

More About . . .

Minerals from Earth's Crust Silicon is by far the most common mineral, making up more than 28 percent of Earth's crust. Aluminum (8 percent) and iron (6 percent) are the most common metals. All other metals are relatively scarce. For example, there is only about one ten-thousandth as much copper in Earth's crust as there is iron. Copper, in turn, is about 10,000 times more plentiful than gold.

ONLINE INTERACTIVE VISUALS

Image Compare: From the Ground to the Air

Have students compare the images and answer the associated question.

Analyze Visuals How many other aluminum products can you name? *Possible answers: soda cans, ladders, car hub cabs, cooking pans*

Reading Check

Make Inferences
Why might people look for alternatives to fossil fuels?

fossil fuels?

Reading Check

Categorize
What are the major types of mineral resources?

Nuclear Energy A final energy source is nuclear energy. We obtain this energy by splitting atoms, small particles of matter. This process uses the metal uranium, so some people consider nuclear energy a nonrenewable resource. Nuclear power does not pollute the air, but it does produce dangerous wastes. These wastes must be stored for thousands of years before they are safe. In addition, an accident at a nuclear power plant can have terrible effects.

All countries need energy. Yet, energy resources are not evenly spread across Earth. As a result, energy production differs by region. For example, the Middle East has rich oil deposits. For this reason, the Middle East leads the world in oil production.

Mineral Resources

Like energy resources, mineral resources can be quite valuable. Whether used locally or traded to distant regions to obtain other valuable goods, mineral resources help an area's economic growth. These resources include metals, salt, rocks, and gemstones.

Minerals fulfill countless needs. Look around you to see a few. Your school building likely includes steel, made from iron. The outer walls might be granite or limestone. The window glass is made from quartz, a mineral in sand. From staples to jewelry to coins, metals are everywhere.

Minerals are nonrenewable, so we need to conserve them. Recycling items such as aluminum cans and personal electronics will make the supply of these valuable resources last longer.

From the Ground to the Air

Humans gather and process minerals before using them. In nature, minerals are often mixed into rock or other solid material, called ore. People mine, or dig in the earth, to extract the ore. Then the ore is processed to get the mineral, which is used to create final products.



Bauxite, a rock, is mined and used to make aluminum.



Aluminum is used in many products, such as jet planes.

Identify

How many other aluminum products can you name?

86 Module 2

READING CHECK

Make Inferences Why might people look for alternatives to fossil fuels? *Fossil fuels are nonrenewable energy sources and tend to be more harmful to the environment.*

READING CHECK

Categorize What are the major types of mineral resources? *metals, salt, rocks, gemstones*

ANALYZE INFORMATION

Evaluate the Usefulness of Metals

1. Have students draw a three-column table on a sheet of paper and label the columns Metal, Properties, and Uses. Draw a similar table on the board.
2. Have students look for metals used in the classroom. Select one and model completion of one or two rows for students. For example: Metal: iron; Properties: very strong, can rust, is made into steel and stainless steel; Uses: lockers, scissors, nails, cars.

3. Tell students that after they are finished with metals found in the classroom, they can add other metals they know about. Encourage them to look for information in dictionaries, almanacs, encyclopedias, or the Internet.

4. If students have trouble thinking of metals, suggest aluminum, copper, lead, nickel, gold, silver, mercury, uranium, chromium, platinum, and zinc.

*Alternative Assessment Handbook, Rubric 13: Graphic Organizers

Products from Petroleum

This Ohio family shows some common products made from petroleum, or oil.



Analyze Visuals

What petroleum-based products can you identify in this photo?

Resources and People

Natural resources vary from place to place. The resources available in a region can shape life and wealth for the people there.

Resources and Daily Life The natural resources available to people affect their lifestyles and needs. In the United States, we have many different kinds of natural resources. We can choose among many different ways to dress, eat, live, travel, and entertain ourselves. People in places with fewer natural resources will likely have fewer choices and different needs than Americans.

For example, people who live in remote rain forests depend on forest resources for most of their needs. These people may craft containers by weaving plant fibers together. They may make canoes by hollowing out tree trunks. Instead of being concerned about money, they might be more concerned about food.

Teach the Main Idea

Resources shape people's lives and countries' wealth.

Identify Name some natural resources found in the United States. *fertile farmland, forests, oil*

Draw Conclusions If people do not have a particular resource that they need, what can they do? *Trade something else for it, find a substitute for it, or do without it.*

Explain Why was OPEC created? *to help stabilize the world's oil markets and ensure a steady income to member states*

GEOGRAPHIC FEATURE

Products from Petroleum

Have students study the image and answer the associated question.

Analyze Visuals What petroleum-based products can you identify in this photo? *Products with petroleum content such as plastic, vinyl, synthetic fibers, adhesive, and other materials—including the plastic playhouse, the rubber ball, the rubber boots*

TIERED ACTIVITY

Create Visual Displays of Natural Resources

Below Level—Provide students with classroom resources to use to identify major natural resources in your state. Then have students create an illustrated map of your state and its resources and present it to the class. Maps should include "fun facts," such as "The trans-Alaska oil pipeline crosses more than 800 rivers and streams."

At Level—Going beyond the Below Level activity, have students also identify major industries in your state. Have students create a series of cause-and-effect illustrated flow charts, to explain how natural resources have affected industry in your state. Let students present their visuals to the class.

Above Level—Going beyond the Below and At Level activities, have students create a poster presentation of the impact that processing one of these resources has on the environment. Issues might include pollution, renewability, erosion, health effects, and the economy.

READING CHECK

Identify Cause and Effect How can having few natural resources affect life and wealth in a region or country? *Regions or countries with few natural resources often have weak economies and different concerns than regions or countries with abundant resources.*

Reading Check
Identify Cause
and Effect
How can having few
natural resources
affect life and wealth
in a region or country?

Print Assessment

Review Ideas, Terms, and Places

1. a. **Define** What are renewable resources and nonrenewable resources? *renewable—resources that are replaced naturally; nonrenewable—resources that cannot be replaced*
- b. **Explain** Why is it important for people to manage Earth's natural resources? *They could easily disappear in the future.*
- c. **Identify** What are some things you can do to help manage and conserve natural resources? *Possible answers: recycle materials, turn lights off, and water the lawn sparingly.*
2. a. **Define** What are fossil fuels, and why are they significant? *They are nonrenewable resources formed from remains of living things. They are energy resources.*
- b. **Summarize** What are three examples of renewable energy resources? *Possible answers: Hydroelectric, wind, solar, geothermal, and nuclear power.*
3. a. **Recall** What are the main types of mineral resources? *metals, salt, rocks, gemstones*
- b. **Analyze** What are some products that we get from mineral resources? *Possible answers: coins, glass, and cans*
4. a. **Summarize** How do resources affect people? *They are the source of the energy and products people use.*
- b. **Make Inferences** How might a country with only one valuable resource develop its economy? *It could trade with other countries.*

Critical Thinking

5. **Categorize** Draw a chart. Use your notes to identify and evaluate each energy resource. *Charts should reflect details from the lesson.*

In areas where more than one group wants to use the same resources, conflicts can arise. For example, the Aka people of Central Africa sometimes struggle to find enough resources. Logging companies have been harvesting trees from the forests in which the Aka hunt and gather. The loss of trees has reduced animals' habitats, which makes it harder for the Aka to find food.

Resources and Wealth The availability of natural resources affects countries' economies as well. For example, the many natural resources available in the United States have helped it become one of the world's wealthiest countries. In contrast, countries with few natural resources often have weak economies.

Some countries have one or two valuable resources but few others. For example, Saudi Arabia is rich in oil but lacks water for growing food. As a result, Saudi Arabia must use its oil profits to import food. Indeed, a number of countries in Southwest Asia face similar challenges. In 1960, Iran, Iraq, Kuwait, Saudi Arabia and Venezuela founded the Organization of Petroleum Exporting Countries (OPEC). OPEC works to stabilize the oil markets and ensure a steady income to member states. OPEC has grown to 13 countries.

Summary You can see that Earth's natural resources have many uses. Important natural resources include air, water, soils, forests, fuels, and minerals.

Lesson 7 Assessment

Review Ideas, Terms, and Places

1. a. **Define** What are renewable resources and nonrenewable resources?
- b. **Explain** Why is it important for people to manage Earth's natural resources?
- c. **Identify** What are some things you can do to help manage and conserve natural resources?
2. a. **Define** What are fossil fuels, and why are they significant?
- b. **Summarize** What are three examples of renewable energy resources?
3. a. **Recall** What are the main types of mineral resources?
- b. **Analyze** What are some products that we get from mineral resources?

4. a. **Summarize** How do resources affect people?
- b. **Make Inferences** How might a country with only one valuable resource develop its economy?

Critical Thinking

5. **Categorize** Draw a chart like this one. Use your notes to describe and evaluate each type of energy resource.

Fossil Fuels	Renewable Energy	Nuclear Energy
Pros	Pros	Pros
Cons	Cons	Cons

► Online Assessment

1. What is the difference between renewable and nonrenewable resources?
- Only renewable resources can be reused.
 - Only renewable resources can be replaced.
 - Only nonrenewable resources can be recycled.
 - Only nonrenewable resources can be restored.

Alternate Question Which of the following are renewable resources?
Select the **three** correct answers.

- coal
- iron
- oil
- soil
- trees
- water

2. Why has the use of coal decreased over time?

- Burning coal pollutes the air.
- Mining coal pollutes the water supply.
- Coal cannot be used to heat buildings.
- Coal cannot be used to generate electricity.

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

Because coal is **plentiful**, people are looking for cleaner ways to burn it.

3. How do mineral resources help areas?

- by encouraging mining
- by encouraging recycling
- by promoting economic growth
- by promoting energy independence

Alternate Question Which of the following are mineral resources?

Select the **three** correct answers.

- coal
- metals
- oil
- rocks
- salt
- soil

4. Which of the following correctly describes the relationship between natural resources and economic development?

- Countries with vast energy resources are often poor.
- Countries with few natural resources are often poor.
- Countries that export timber resources are often wealthy.
- Countries that conserve natural resources are often wealthy.

Alternate Question Select the answer choice from the drop-down list to complete the sentence correctly.

One reason why **the United States** is one of the world's wealthiest countries is that it has many natural resources.

5. **Make Inferences** Why do many people want to develop renewable sources of energy, such as solar and wind?

Possible answer: Traditional sources of energy, such as coal and oil, will run out one day. Many people want to develop solar and wind energies so that we are prepared when this happens.

6. **Draw Conclusions** Why do some people support the use of nuclear energy, while other people oppose it?

Possible answer: Some people support the use of nuclear energy because it does not pollute the air. Other people oppose its use because it produces dangerous wastes that must be stored for thousands of years before they are safe.

7. **Draw Conclusions** What would happen if people did not recycle items such as aluminum cans and personal electronics? Explain your answer.

Possible answer: If people did not recycle these types of items, we would eventually run out of the resources used to make them. This is because such items are made using nonrenewable mineral resources.

8. **Summarize** How and why was the Organization of Petroleum Exporting Countries (OPEC) founded?

Possible answer: In 1960, five of the world's major oil producers founded OPEC. They did this to stabilize world oil markets and to ensure they would receive a steady income from the oil they produced.

Social Studies Skills

Use a Physical Map

Define the Skill

Physical maps show important physical features, like oceans and mountains, in a particular area. They also indicate an area's elevation, or the height of the land in relation to sea level.

When you use a physical map, there are important pieces of information you should always examine.

- Identify physical features. Natural features, such as mountains, rivers, and lakes, are labeled on physical maps. Read the labels carefully to identify what physical features are present.
- Read the legend. On physical maps, the legend indicates scale as well as elevation. The different colors in the elevation key indicate how far above or below sea level a place is.

Learn the Skill

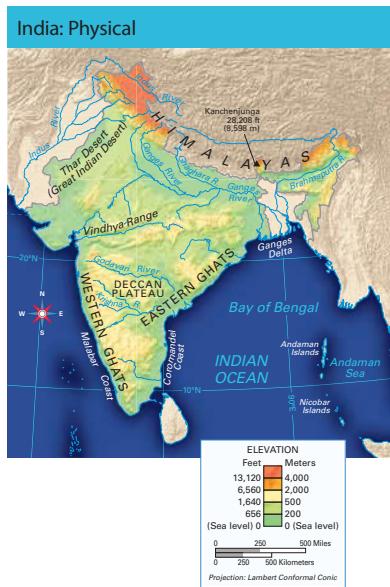
Use the physical map of India to answer the questions below.

- What landforms and bodies of water are indicated on the map?
- What is the highest elevation in India? Where is it located?

Practice the Skill

Locate the physical map of Africa in the Atlas in the back of the book. Use the map to answer the questions below.

- Which region has the highest elevation?
- What bodies of water surround Africa?
- What large island is located off the east coast of Africa?



Social Studies Skills

Use a Physical Map

Make copies of a physical map of the area in which your school is located. Have students identify the natural features of the area. Ask students how the area's topography might affect the people who live in the area. Have them identify an important industry in the area and discuss how the topography affects that industry. Then have students discuss how the topography might have affected early settlers there.

*Alternative Assessment Handbook, Rubric 35: Solving Problems

Answers

Learn the Skill

- What landforms and bodies of water are indicated on the map? mountain, desert, delta, plateau, river, bay, ocean, sea
- What is the highest elevation in India? Where is it located? 28,208 feet (8,598 m); Himalayas

Practice the Skill

- Which region has the highest elevation? the eastern region, Mount Kilimanjaro, Tanzania
- What bodies of water surround Africa? Indian Ocean, Atlantic Ocean, Red Sea, Mediterranean Sea
- What large island is located off the east coast of Africa? Madagascar

Module 2 Assessment

Print Assessment

Review Vocabulary, Terms, and People

For each statement below, write *T* if it is true and *F* if it is false. If the statement is false, write the correct term that would make the sentence a true statement.

1. Weathering is the movement of sediment from one location to another. *F; erosion*
2. Most of our groundwater is stored in Earth's streams, rivers, and lakes. *F; surface water*
3. It takes 365½ days for Earth to complete one rotation around the sun. *F; revolution*
4. Streams are formed when precipitation collects in narrow channels. *T*
5. Earthquakes cause erosion as they flow downhill, carving valleys and mountain peaks. *F; glaciers*
6. The planet's tilt affects the amount of erosion Earth receives from the sun. *F; solar energy*
7. When plant or animal matter has decayed, it is called humus. *T*
8. Conditions or changes in the air in a certain time and place are called climate. *F; weather*
9. Reforestation is the act of planting trees where forests once stood. *T*
10. A species is extinct when it has completely died out. *T*
11. Steppes are areas of tall grasses and scattered shrubs and trees. *F; savannas*
12. Winds that change direction with the season and create wet and dry periods are known as savannas. *F; monsoons*

Comprehension and Critical Thinking

LESSON 1

13. a. **Identify** What factors influence the amount of energy that different places on Earth receive from the sun? *Earth's tilt, rotation, revolution, latitude*
b. **Predict** What might happen to the amount of solar energy we receive if Earth's axis were straight up and down? *Possible answer: There would be no seasons because solar energy levels would remain the same.*

LESSON 2

14. a. **Describe** What different sources of water are available on Earth? *salt water—oceans and seas; freshwater—streams, rivers, lakes, glaciers, underground*
b. **Draw Conclusions** How does the water cycle keep Earth's water supply relatively constant? *Water is constantly evaporating from Earth's surfaces, rising up to the atmosphere, and falling back as precipitation.*
c. **Elaborate** What water problems affect people around the world? What solutions can you think of for one of those problems? *drought, overuse, pollution, flooding; Possible answer: People could use water more wisely and reduce chemical use.*

Review Vocabulary, Terms, and Places

For each statement below, write *T* if it is true and *F* if it is false. If the statement is false, write the correct term that would make the sentence a true statement.

1. **Weathering** is the movement of sediment from one location to another.
2. Most of our **groundwater** is stored in Earth's streams, rivers, and lakes.
3. It takes 365½ days for Earth to complete one **rotation** around the sun.
4. Streams are formed when **precipitation** collects in narrow channels.
5. **Earthquakes** cause erosion as they flow downhill, carving valleys and mountain peaks.
6. The planet's tilt affects the amount of **erosion** Earth receives from the sun.
7. When plant or animal matter has decayed, it is called **humus**.
8. Conditions or changes in the air in a certain time and place are called **climate**.
9. **Reforestation** is the act of planting trees where forests once stood.
10. A species is **extinct** when it has completely died out.
11. **Steppes** are areas of tall grasses and scattered shrubs and trees.
12. Winds that change direction with the season and create wet and dry periods are known as **savannas**.

Comprehension and Critical Thinking

Lesson 1

13. a. **Identify** What factors influence the amount of energy that different places on Earth receive from the sun?
b. **Predict** What might happen to the amount of solar energy we receive if Earth's axis were straight up and down?

Lesson 2

14. a. **Describe** What different sources of water are available on Earth?
b. **Draw Conclusions** How does the water cycle keep Earth's water supply relatively constant?
c. **Elaborate** What water problems affect people around the world? What solutions can you think of for one of those problems?

Lesson 3

15. a. **Define** What is a landform? What are some common types of landforms?

- b. **Analyze effects** What are some things that can happen when two tectonic plates interact?

- c. **Elaborate** What physical features dominate the landscape in your community? How do they affect life there?

Lesson 4

16. a. **Identify** What five factors affect climate?
b. **Analyze** Is average annual precipitation an example of weather or climate?

Lesson 5

17. a. **Recall** What are the five major climate zones?
b. **Explain** How does latitude relate to climate?

Lesson 6

18. a. **Define** What is an ecosystem, and why does it exist in a fragile balance?
b. **Explain** Why are plants an important part of the environment?



ONLINE DOCUMENT-BASED INVESTIGATION

The Physical World

Have students complete and review all the DBI activities in **Part 1**.

Use this Compare-and-Contrast Essay Rubric to score students' work in **Part 2**.

RUBRIC

- Students' essays should
- identify similarities and differences appropriate to the topic
 - attempt comparisons from parallel categories of items
 - cite at least three sources of appropriate text evidence from **Part 1** in support of their comparisons

- be organized into a distinct introduction, a main body consisting of several paragraphs, and a conclusion that sums up the main points

Write a Compare-and-Contrast Essay How do Earth's processes influence the way in which people adapt to and alter their environments? Write an essay that discusses the various ways that people have adapted to Earth's climates, landforms, soils, seasons, natural resources, and environments in order to survive. Be sure to cite specific evidence from at least three sources in your response.

Module 2 Assessment, continued

Lesson 7

19. a. **Define** What are minerals?
b. **Contrast** How do nonrenewable resources and renewable resources differ?
c. **Elaborate** How might a scarcity of natural resources affect life in a region?

Reading Skills

Use Word Parts Use what you learned about prefixes, suffixes, and word roots to answer the questions.

20. The prefix *in-* sometimes means "not." What do the words *invisible* and *inactive* mean?
21. The suffix *-ment* means "action" or "process." What does the word *movement* mean?

Social Studies Skills

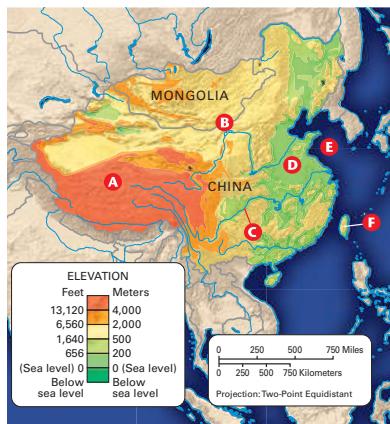
Use a Physical Map Use the physical map of the United States in the World Atlas to answer these questions.

22. What physical feature extends along the Gulf of Mexico?
23. What mountain range in the West lies above 6,560 feet (2,000 m)?

Map Activity

Physical Map Use the map to answer the questions that follow.

24. Which letter indicates a river?
25. Which letter on the map indicates the highest elevation?
26. The lowest elevation on the map is indicated by which letter?
27. An island is indicated by which letter?
28. Which letter indicates a large body of water?
29. Which letter indicates an area of land between 1,640 feet (500 m) and 6,560 feet (2,000 m) above sea level?



Focus on Reading and Viewing

30. **Present and View a Weather Report** Select a place and a season to write a weather report about. Watch weather reports online or on TV as part of your research. Note interesting vocabulary, and look up words you do not understand. Use what you learn in your research to describe the weather and predict upcoming weather. Include vocabulary from this module. Then present your report to the class. Speak using a professional, friendly tone and a variety of sentence types. Make frequent eye contact with your audience. Listen and take notes as your classmates present their reports. Be prepared to give feedback on the content and their presentation techniques.

The Physical World 91

LESSON 3

15. a. **Define** What is a landform? What are some common types of landforms? *a shape on a planet's surface; hills, mountains*
b. **Analyze Effects** What are some things that can happen when two tectonic plates interact? *Possible answers: earthquakes; landforms created such as islands, ocean trenches, mountain ranges; volcanoes erupt*
c. **Elaborate** What physical features dominate the landscape in your community? How do they affect life there? *Student answers will vary but should reflect knowledge of the material and the local area.*

LESSON 4

16. a. **Identify** What five factors affect climate? *sun, location, wind, water, and mountains*
d. **Analyze** Is average annual precipitation an example of weather or climate? *climate*

LESSON 5

17. a. **Recall** What are the five major climate zones? *tropical, temperate, polar, dry, and highland*
e. **Explain** How does latitude relate to climate? *Generally, the higher the latitude is, the colder the climate.*

LESSON 6

18. a. **Define** What is an ecosystem, and why does it exist in a fragile balance? *An ecosystem is a group of plants and animals that depend on each other for survival. If part of the ecosystem changes, it affects the entire system.*
f. **Explain** Why are plants an important part of the environment? *Plants are the foundation for all food eaten by animals.*

LESSON 7

19. a. **Define** What are minerals? *Minerals are nonrenewable resources that come from Earth.*
b. **Contrast** How do nonrenewable resources and renewable resources differ? *Nonrenewable resources cannot be replaced. Earth replaces renewable resources naturally.*
c. **Elaborate** How might a scarcity of natural resources affect life in a region? *It would require people to rely on fewer resources or to trade for the resources they need.*

Reading Skills

Use Word Parts Use what you learned about prefixes, suffixes, and word roots to answer the questions below.

20. The prefix *in-* sometimes means "not." What do the words *invisible* and *inactive* mean? *not visible; not active*
21. The suffix *-ment* means "action" or "process." What does the word *movement* mean? *the action or process of moving*

(continued)

Essential Question ESSAY

Why do we study the Earth and its physical systems?

RUBRIC

- Students' essays should
- respond to the Essential Question with a specific position
 - illustrate valid reasoning supporting their position
 - cite persuasive evidence supporting their position
 - identify key people, events, and/or turning points that demonstrate understanding of the module content
 - be organized into a distinct introduction, main body, and conclusion

Write an argument answering this question. Your essay should include specific details about how our knowledge of Earth's systems may influence how humans interact with our world. Be sure to cite evidence to support your point and organize your essay into an introduction, body, and conclusion.

Alternative Activity Instead of writing essays, address the Essential Question through activities such as holding debates, creating multimedia presentations, or writing journal entries. See the Alternative Assessment Handbook for a selection of project rubrics.

Print Assessment (*continued*)

Social Studies Skills

Use a Physical Map Use the physical map of the United States in the World Atlas to answer these questions.

22. What physical feature extends along the Gulf of Mexico? *Gulf Coast Plain*
23. What mountain range in the West lies above 6,560 feet? *Rocky Mountains*

Map Activity

Physical Map Use the map to answer the questions that follow.

24. Which letter indicates a river? *C*
25. Which letter on the map indicates the highest elevation? *A*
26. The lowest elevation on the map is indicated by which letter? *D*
27. An island is indicated by which letter? *F*
28. Which letter indicates a large body of water? *E*
29. Which letter indicates an area of land between 1,640 feet and 6,560 feet above sea level? *B*

Focus on Reading and Viewing

30. **Present and View a Weather Report** Select a place and a season to write a weather report about. Watch weather reports online or on TV as part of your research. Note any interesting vocabulary, and look up words you do not understand. Use what you learn in your research to describe the weather and predict upcoming weather. Include vocabulary from this module. Then present your report to the class. Speak using a professional, friendly tone and a variety of sentence types. Make frequent eye contact with your audience. Then listen and take notes as your classmates present their reports. Be prepared to give feedback on the content and their presentations techniques.

RUBRIC: Students' weather reports should

- include a description of the current weather, as well as the extended forecast for the chosen area based on typical weather for the given season
- make a connection between the weather and the local environment or resources, if applicable
- speak using a professional, friendly tone
- use a variety of sentence types

► Online Assessment

1. Drag the name of the factor affecting the amount of solar energy Earth receives at a given time.

Solar energy strikes only the half of Earth facing the sun.	rotation
Sometimes Earth is closer to the sun, and at other times it is farther away.	revolution
Some areas receive direct rays from the sun all year, and other areas receive indirect rays.	latitude

2. Which place receives indirect rays from the sun all year?

- Antarctica
 Hawaii
 India
 Utah

3. Which of the following statements are true during the spring? Select the **three** correct answers.

- The days grow longer.
 The days grow shorter.
 Temperatures slowly start to fall.
 Temperatures slowly start to rise.
 Earth begins to tilt toward the sun.
 Earth begins to tilt away from the sun.

4. What causes streams to form?

- absorption
 glaciers
 lakes
 precipitation

5. Which statement about Earth's water is true?

- It is always moving.
 It is always safe to drink.
 It is mostly in solid form.
 It is mostly underground.

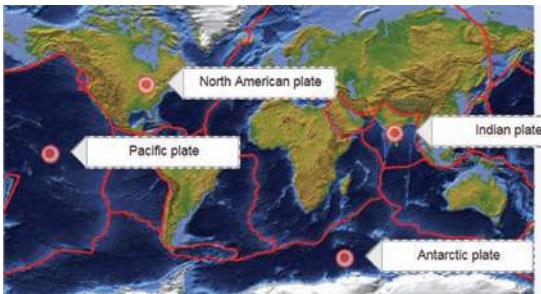
6. Which of the following are water problems? Select the **three** correct answers.

- condensation
 conservation
 droughts
 floods
 pollution
 runoff

7. Drag the name of the landform into the box next to its description.

a stretch of mostly flat land	plain
an area of land completely surrounded by water	island
an area of land surrounded by water on three sides	peninsula

8. Drag the names of the tectonic plates to their correct locations.



- 1 Pacific plate
- 2 North American plate
- 3 Antarctic plate
- 4 Indian plate

9. Which of the following is the most common cause of erosion?

- ice
- sediment
- water
- wind

10. Which of the following affect the amount of sun that Earth receives at any given location?

Select the **three** correct answers.

- energy
- movement
- shape
- temperature
- tilt
- wind

11. Which of the following drives ocean currents?

- landforms
- seasons
- storms
- winds

12. Which of the following decreases with elevation?

- moisture
- precipitation
- temperature
- wind

13. Where do temperate climates occur?

- at low elevations
- at high elevations
- in the high latitudes
- in the middle latitudes

14. Drag the name of the climate into the box next to its description.

warm, muggy, and rainy year-round	humid tropical
long, hot, dry season followed by short periods of rain	tropical savanna
very little rainfall, high daytime temperatures and cool nights	desert

15. Which of the following are characteristics of places that have the ice cap climate?

Select the **three** correct answers.

- They have no vegetation.
- They have long summers.
- They have absorbent soil.
- They have very little precipitation.
- They have snow and ice year-round.
- They have a wide range of temperatures.

16. Drag the term into the box next to its description.

the place where a plant or animal lives	habitat
the land, water, climate, plants, and animals of an area	environment
made up of several ecosystems	biome

17. Why is it important to protect tropical rain forests?

- They contain valuable lumber.
- They contain valuable farmland.
- They contain the most biomes on Earth.
- They are the most varied habitats on Earth.

18. Which of the following would most likely increase soil fertility?

- a vegetable garden
- a freshwater spring
- a decomposing tree
- an animal population

19. Which of the following is a way to manage a renewable resource?

- mining coal
- planting trees
- conserving petroleum
- extracting natural gas

20. Which of the following is a harmful effect of hydroelectric power?

- air pollution
- lost farmland
- water pollution
- dangerous waste

21. Drag the name of the mineral into the box next to the part of a building it is used to make.

steel beams	iron
exterior wall	granite
window glass	quartz