

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Describe the structure of Earth
- Relate movement of Earth's crust to geologic activity
- Describe the three main types of rock and how they change in the rock cycle

✓ Determine Student Readiness

Determine students' readiness for learning about geology by asking them to describe what they know about the different ways that rocks can form. Prompt students as needed to determine how much general information they can recall about the processes that form igneous, sedimentary, and metamorphic rock.

Key Concept

Earth is made of several layers. Rocks change form in a never-ending process called the rock cycle.

Concept Background: Geology is the study of Earth's layers and the processes that affect them. Tell students that they will examine Earth's structure, tectonic movements, the rock cycle, and minerals. Encourage students to apply what they learn by taking nature walks or visiting a local museum of natural history. Have students search the internet for information about local geological features and write a list of possible topics for further research.

Develop Core Skills

Core Skill: Integrate Text and Visuals

Ask students to make a two-column chart in their notebook. Have them label the first column *Text* and the second column *Visuals*. Select a magazine or newspaper article, in print or online, that covers a recent event. First, read aloud a descriptive paragraph from the story and have students record their impressions in the *Text* column of their table. Next, show students a series of images (without words) from the event and have them record their reactions in the *Visuals* column of their table. Ask students what information would be missing if the story were composed of only text or only visuals.

Core Skill: Apply Scientific Models

Tell students that in science, a model can be a representation of a complex object or process. Often, the object or process is too large or too complex to be studied directly. A model makes it easier to understand a particular scientific process or event. Have students work in pairs and use dictionaries to look up the word *model*. Compare its scientific definition to other definitions that are commonly used in an everyday context.

Pre-Teach Vocabulary

Relate Word Parts

Write and discuss the following word parts and definitions on the board: the Greek word *meta*, meaning “change,” and *morph*, from the Greek word *morphe*, meaning “form or shape.” Tell students that the suffix *-ic* means “taking the form of or relating to.” Ask: *Based on these definitions of word parts, what do you think metamorphic means?* Then ask students how rocks that change form might be related to the rock cycle.

Tier 3 Words:

igneous (p. 386)

inner core (p. 382)

metamorphic (p. 387)

outer core (p. 382)

rock cycle (p. 387)

sedimentary (p. 387)

DURING THE LESSON

Earth's Structure

PAGE 382

Review with students the four layers of Earth. Draw four concentric circles on the board and have students copy the drawing in their notebooks. Also write the words *crust*, *mantle*, *outer core*, and *inner core* on the board in random order. Challenge students to write the four terms in the correct relative positions in their sketches. Remind students that visual notes, such as hand-drawn sketches, can be a powerful memory tool and a beneficial study aid.

Evidence-based Reading Support: Fluency

Collaborative Oral Reading

Read aloud *Earth's Structure* on page 382. Read the first sentence, then select a student to read the next sentence. After the student reads, have him or her select the next reader. Continue until the entire page has been read. Assist students as needed. Have students pause at the end of the first paragraph in order to find the sentence that forecasts the remaining content on this page. (*Instead of three layers, however, it has four.*)

PAGE 383

Integrate Text and Visuals

Have students read the text on this page. Challenge students to find the three steps explaining how to use visual tools. After students have found the steps (in the third paragraph), ask them to number the sentences describing the steps as 1, 2, and 3. Invite student volunteers to explain how the text and diagram work together to help them understand the process of deformation using the three steps.

THINK ABOUT SCIENCE**ANSWER KEY**

Both Earth and an apple have a thin, hard, outer layer (the crust or apple skin), a softer inner layer (the mantle or apple flesh), and a central core (inner core or apple core).

Movement of the Crust**PAGE 384**

Although Earth seems static and unmoving, geologic activity is constantly shaping Earth's surface. Have students read pages 384–386 to discover three major ways that Earth is constantly changing: mountain building through tectonic plate movement, volcanoes, and earthquakes.

Evidence-based Reading Support: Comprehension Make Connections**PAGE 385**

Pair each student with a partner. One person will read aloud the first two paragraphs on page 385, which describe the events that occur when a volcano forms as a result of subduction, while the second person points out these events as they are shown in the *Formation of a Volcano* diagram. Have pairs pause to make connections between the text and the diagram.

Core Skill: Integrate Text and Visuals

Review the *Formation of a Volcano* and the *Path of Volcanic Islands* diagrams with students. Ask students to describe the specific ways in which the diagrams integrate, or build in, and support the text.

21st Century Skill: Initiative and Self-Direction**PAGE 386**

Have students read the text and find the definition of *initiative* (the ability to take action and follow through on completing a task) in the first paragraph. Point out that initiative and self-direction are important in all careers. Ask students to describe examples of situations in which workers in different fields need these qualities. Challenge students to suggest reasons why they might be especially important for someone who works alone in his or her own business.

Engage and Extend

ELL Instruction: Promote Interactive Learning When dividing students into groups, make sure each group contains both English language learners and fluent English speakers. Ask pairs to say and define the boldfaced words in the lesson. Have one student say the word and the other define the word. Then have them switch tasks. Fluent speakers can help English language learners with difficult vocabulary by explaining complex topics in simpler terms.

Ask students to use dictionaries to define the term *monitor*. Tell students that self-monitoring is an important aspect of improving one's own performance.

WRITE TO LEARN**ANSWER KEY**

Invite students to describe why a map illustrating how to get to a location might be more helpful than a written description of how to find that location. For example, ask students if two people are likely to provide the same written description, or if two people are likely to point out the same landmarks along the way.

PAGE 387**THINK ABOUT SCIENCE****ANSWER KEY**

1. C
2. A
3. B

Core Skill: Apply Scientific Models

Have student volunteers share their new models of the rock-cycle process. Invite class members to review and critique the models. Help students remember that any model must show that some of the steps of the rock cycle can move in either direction. Remind students that scientists often use models to help people understand a concept that they cannot observe directly.

Weathering and Soil**PAGE 388**

Guide students through reading the paragraphs on weathering and soil. Draw a flow chart on the board. At the beginning of the flow chart, write *Rocks and other materials*. At the end of the flow chart, write *Soil*. Invite students to fill in information for any of the intermediate steps leading to soil formation. Ask students to describe how some of the intermediate steps might differ from location to location.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student page 494.

Extension Activity: Draw Conclusions about

Earthquakes Have students visit the US Geological Survey's Web site to learn more about earthquakes. Allow students to discover how many earthquakes occur around the world every day. Then have them create a world map indicating where the ten most recent earthquakes over a magnitude of 6.0 occurred. Have students compare the distribution of these ten earthquakes to the boundaries of tectonic plates shown in the *Plates and Quakes* map on page 386, and ask students to draw conclusions about the relative likelihood of earthquakes in these areas.

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify Earth's major oceans and the features of the ocean floor
- Recognize the effects of ocean currents and waves

✓ Determine Student Readiness

Engage students in a discussion of oceans and ocean life. Although students have not yet read the lesson, they are probably aware of or interested in some aspect of oceanography. Ask: *Have you read about underwater exploration or the discovery of shipwrecks?* Some students may also have considerable knowledge about ocean animals, such as dolphins, whales, or sharks. Engage students in an active discussion of the ocean, and use questions related to prior knowledge to guide the discussion.

Key Concept

Oceans cover most of Earth's surface. They affect Earth's climate and the shape of land.

Concept Background: Write the word *oceanography* on the board. Explain that the suffix *-graphy* at the end of a word can have different meanings. It can refer to a style, method, or kind of writing, as in *biography* and *calligraphy*. It can refer to a written list, such as a *bibliography*. It can also refer to a descriptive science, such as *geography* and *oceanography*. Explain that oceanography is the description of the chemical, physical, and biological sciences related to the world's oceans. For example, the components of seawater and the reactions that occur within it are chemical features. Their floors, mountains, and basins represent physical features, as do their waves and currents. Ocean zones and ecological succession are biological features.

Develop Core Skills

Core Skill: Determine Central Ideas

Share a news article about a topic of interest to your students. Before you read, tell students to think about the article's main or central idea. Encourage students to record any details they think might be important. After reading, engage students in a discussion of the article's central idea. Explain that being able to recognize a text's central idea is essential for understanding the text.

Reading Skill: Determine Meaning

Use the article that you selected for introducing "Determine Central Ideas." Before reading, ask students to be prepared to raise their hands when they hear an unfamiliar word. Then read the article again, noting when students raise their hands and recording on the board some or all of the words they identify. After reading, ask

students to share some strategies they use when they come across unfamiliar words in a text. Ask students to explain why understanding a text's most important ideas aids in understanding the meanings of unfamiliar words.

Pre-Teach Vocabulary

Illustrate a Word

Write and number the vocabulary words on the board. Next to each word, write a brief definition. Read the words and meanings aloud. Then assign each student a number from 1 to 5. Have students illustrate the word that corresponds to the numbers they were given and write sentences with the word. Afterward, ask students to share and explain their work.

Tier 2 Words:

current (p. 393)
pattern (p. 393)

Tier 3 Words:

continental shelf (p. 392)
ecological succession (p. 394)
mid-ocean ridge (p. 392)

DURING THE LESSON

PAGE 390

Earth's Oceans

Write the following question on the board: *Why are phytoplankton essential for life on Earth?* Read the question aloud, and explain to students that they won't find the answer stated explicitly in the text, but they can use the text to infer the answer, or come to a conclusion through reasoning and evidence. Have students read the text. Afterward, invite students to share their answers. Guide students to understand that because so much of Earth is covered with water, the populations of phytoplankton are enormous. These photosynthetic organisms add more oxygen to the atmosphere than land plants do.

Ocean Zones

Before reading, examine the diagram as a class. After reading the title, encourage students to read the labels and the parts of the diagram that they identify. Then read the text as a class. Ask the following questions and engage students in a discussion of their answers: *What three factors determine ocean zones? Why is life more abundant in the neritic zone than in the intertidal zone? Why don't more forms of life inhabit the abyssal zone?*

Evidence-based Reading Support: Comprehension Make Connections

If possible, project the Ocean Zones diagram on the board or on a wall. Write the following words on the board: *intertidal zone, neritic zone, bathyal zone, abyssal zone*. Ask volunteers to read the specific text related to each term and locate the term on the diagram. Then ask students to explain how making connections between text and visuals helps them comprehend important details and develop a better understanding of main ideas. Use the diagram on page 392 to repeat this activity.

Determine Meaning

PAGE 391

Read the text as a class. Then give students time to read the passage, identify unfamiliar words, use context clues to predict meaning, and then use a print or online dictionary to check their predictions.

The Ocean Floor

PAGE 392

Examine the diagram as a class before reading the text together. After reading, ask volunteers to connect the boldfaced words in the text with labels in the diagram. Ask students to use the diagram to explain each term. Finally, have a volunteer summarize the process of seafloor spreading. Then have students work in pairs to draw a model of the cyclical process of seafloor spreading. Ask pairs to share and explain their work. Clear up any confusion students may have.

THINK ABOUT SCIENCE

ANSWER KEY

1. seafloor spreading
2. continental slope
3. mid-ocean ridge

21st Century Skill: Flexibility and Adaptability

Have students imagine planning a camping trip with friends. Ask them why it might be necessary for them to remain flexible and adaptable as they choose a destination, travel dates, and methods of transportation. Encourage students to discuss the advantages of such traits in life in general, in school, and in the workplace.

Currents

PAGE 393

Examine the diagram as a class before reading the text together. Ask volunteers to describe any patterns they see. After reading, give volunteers markers to trace the different currents represented in the diagram. Ask the following questions and discuss the answers: *How do ocean currents affect temperatures on land? What factors determine the direction of a current? How is water density related to water movement?*

THINK ABOUT SCIENCE

ANSWER KEY

1. wind
2. cold-water
3. cools
4. deep water

Engage and Extend

ELL Instruction: Describe a Process Use print or online sources to show students diagrams of ecological succession, both on land and in lakes and ponds. Discuss the process, encouraging students to talk about the stages of succession in the examples of ecosystems you share.

Core Skill: Determine Central Ideas

Explain to students that sometimes, titles and visuals provide enough clues to determine the central idea of a text, even before reading the text. For example, point to the title “Currents.” Then point to the diagram and read the title and subtitle aloud. Ask: *Are the subtitle and the visual sufficient for you to determine the central idea of the text?* Then, read the text as a class.

Waves

PAGE 394

Read the title of this section aloud, and then examine the diagram as a class. Ask students to use the diagram to predict the definitions of *crest*, *trough*, and *wavelength*.

Lake to Land

Discuss the “Core Skill: Determine Meaning” before reading this section. Have students work with partners to read the text, numbering each step in the process of ecological succession. Afterward, have pairs share their steps and explanations.

Reading Skill: Determine Meaning

Write the term *ecological succession* on the board. Ask volunteers to define the term. Guide them to understand that the word *ecological* refers to ecology, or the study of relationships between living and nonliving things in an environment, and the word *succession* refers to things or people with similar characteristics that follow one another. Then read the text as a class and ask students to complete the activity presented in the second paragraph while reading the related text.

WRITE TO LEARN

ANSWER KEY

Encourage students to select a very familiar activity as the focus of this assignment. Students with identical interests may want to collaborate to complete the writing task.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student pages 494–495.

Extension Activity: Explain Phenomena in Terms of Concepts Challenge students to research an example of ecological succession within their community, town, or city. Have them seek information from print and online texts, and from local experts, such as county agricultural agents and parks and wildlife scientists. Ask students to record notes of their research and interviews, and then use those notes to write an explanation of the specific example of ecological succession they have studied.

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify the factors that cause weather
- Explain how winds form
- Describe major storms and their causes

✓ Determine Student Readiness

Determine students' readiness by engaging them in a discussion of what they know about weather. Have students describe the weather at the moment, and how the weather tends to change from day to day and season to season. Ask volunteers to share their prior knowledge of extreme weather, either from weather they have experienced or they have observed while watching news.

Key Concept

The atmosphere includes temperature, air pressure, and moisture content. These factors interact to cause weather.

Concept Background: Weather is the daily condition of Earth's atmosphere at a particular place and time, and it is different from climate. Climate is the long-term average of atmospheric patterns over a specific region. Ask students to restate their understanding of the difference between weather and climate in their own words.

Develop Core Skills

Core Skill: Apply Scientific Models

Explain to students that a scientific model is a representation or a description of a process that occurs in nature. A weather map, for example, is a scientific model. Also explain that scientists can use the models they create to predict events. For example, meteorologists collect numerical data related to variables such as temperature, pressure, and wind, to represent existing weather conditions. They use these representations to predict future weather events should one or more of the variables change. Also explain that some meteorologists do more than collect and process numerical data to predict weather. They also use models to represent air quality, to detect patterns that lead to drought and severe weather like hurricanes, and to gather evidence to determine the threat of global warming. Discuss examples of meteorological models found in a local newspaper or online at the National Weather Service.

Core Skill: Distinguish Between Facts and Speculation

Write the words *fact* and *speculation* on the board. Ask students to help you define both words. Guide them toward understanding that a fact is information that is true, or indisputable, and can be proved, while no facts or firm evidence are required for speculation. Instead, when someone speculates, they use information that may or

may not be true to form a conclusion. Share a news article about a topic of interest to students, such as an article about a sports team or the release of a new movie. Ask students to identify facts in the article. If no speculation exists in the article, ask students to suggest one or two examples that the writer could have included.

Pre-Teach Vocabulary

Word Study: Context Clues

Write the vocabulary words and brief definitions on the board. Organize students into small groups. Give each group the weather pages from a local newspaper, or invite them to go online to find a weather report. Ask students to look or listen for the use of words from the list. Encourage them to use the definitions on the board to interpret the meanings of the words in their contexts.

Tier 2 Words:

forecast (p.396)
humidity (p.398)
weather (p.396)
wind (p.398)

Tier 3 Words:

air pressure (p.398)
greenhouse effect (p.398)
meteorology (p.396)

DURING THE LESSON

PAGE 396

Earth's Atmosphere and Weather

Before reading the text with students, ask them to examine the diagram, read the caption, and then read the labels. Point to Earth in the diagram, and ask: *In which of the four atmospheric layers do you think weather occurs?* Help students recognize that weather occurs in the layer closest to Earth. After reading the text, list the layers on the board and ask students to cite information from the text to describe or explain more about each layer.

Evidence-based Reading Support: Comprehension

Base Words

Explain to students that asking questions and looking for answers while they read is an effective comprehension strategy. Looking for answers can include finding specific information in a text, combining information in the text with reasoning based on prior knowledge or experience to infer answers, and using other sources to collect more information. Encourage students to ask questions such as "I wonder ..." and "What does the author mean by..." to support comprehension.

PAGE 397

Differences and Changes in the Weather

Write the following question on the board: *What causes weather?* Read the question aloud and ask students to think about the answer as they read. After reading, invite students to share their answers. Guide students toward understanding how the Sun's uneven heating of Earth's surface and the differences between land and water contribute toward creating weather.

Composition of the Atmosphere

Before students read, examine the graph as a class and ask students to interpret it. Then read the first paragraph with students. Next, write the word *humid* on the board and explain that it comes from the Latin word *humere*, meaning “to be moist.” Add the letters *-ity* to the end of the word, and ask volunteers to define the word *humidity*. Read the text. Then, ask students to describe humidity in their own words or through their own experiences.

The Greenhouse Effect

If possible, show or project a diagram to help students understand the greenhouse effect. The National Oceanic and Atmospheric Administration (NOAA), for example, offers diagrams and explanations of the effect among their online teacher resources. Help students recognize carbon dioxide as one of several greenhouse gases, or GHGs, that exist in the atmosphere. GHGs absorb re-radiated wavelengths of sunlight given off by Earth’s surface, preventing them from returning to space. After reading the text as a class, explain that the greenhouse effect is a natural process and helps maintain habitable temperatures on Earth. However, increased amounts of GHGs have made an impact on Earth’s climate.

Air Pressure

Before reading the text with students, explain that air pressure is a force that works upon them all day, every day. Write the following questions on the board: *Why does air pressure vary from place to place on Earth? How is air pressure related to winds?* Read the questions aloud and ask students to use them to guide their reading. Have students read the text independently or in pairs and discuss the answers as a class.

21st Century Skill: Creativity and Innovation

Invite students to use prior knowledge and experience to define the words *creativity* and *innovation*. Encourage them to give specific examples of both. Engage students in a discussion of how creativity and innovation in science, medicine, and engineering can affect their daily lives. Have students read the text and share the questions they would like scientists to answer.

Core Skill: Apply Scientific Models

Read the text with students before giving them time to work in small groups to research other models meteorologists use to predict weather patterns. You may want to direct students toward online government sites, such as NOAA, for information.

Engage and Extend

ELL Instruction: Describe a Concept Ask students to tell you what they know about each topic identified in the titles and subtitles on pages 398–399. Ask questions to guide further discussion of any topic students appear to find most interesting or most difficult to understand.

Thunderstorms

Write the following questions on the board and ask students to use them to guide their reading: *What causes a cloud to form? What is a squall? What is the relationship between lightning and thunder?* Organize students into small groups, and have them read to find answers. After reading, discuss students’ answers and correct any misunderstandings that may occur.

Tornadoes and Hurricanes

Most students have heard of or seen programs showing tornadoes and hurricanes. Still other students may have experienced their effects firsthand. Engage students in a discussion of what they know about these forms of weather. Then have students read both sections and compare their understandings with the facts presented in the text. After reading, draw a Venn diagram on the board. Label the first circle: *Tornadoes*. Label the second circle: *Hurricanes*. Ask students to help you compare and contrast the two phenomena.

THINK ABOUT SCIENCE

ANSWER KEY

1. thunder
2. tornado
3. hurricanes

Core Skill: Distinguish Between Facts and Speculation

Have students read the text and follow the directions to identify facts that support the main ideas about tornadoes and hurricanes that were presented in the lesson. Ask students why they should not expect to find examples of speculation in this book.

WRITE TO LEARN

ANSWER KEY

Encourage students to think carefully about the topic they will write about. Explain that the topic can be any nonfiction science topic; it doesn’t have to be restricted to meteorological topics. Emphasize the importance of recording important facts before beginning to write.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student 495.

Extension Activity: Collect and Display Data Have students gather weather data for seven consecutive days. Data should include temperatures, humidity, wind speeds, and precipitation. Have students organize the data in charts and graphs and then use them to present a weather report in the form of a live presentation or a prerecorded video.

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Describe the unique characteristics of Earth that allow it to sustain life
- Sequence events in the development of Earth and the Moon

✓ Determine Student Readiness

Determine students' readiness for learning about Earth's origins by asking them to recall what they already know about how Earth was formed. Have students begin a KWL chart to connect what they already know, what they want to know, and what they will learn from the lesson.

Key Concept

Earth, which formed 4.6 billion years ago, has unique characteristics that allow it to support life.

Concept Background: Our planet, Earth, is the third planet from the Sun. Its distance from the Sun provides Earth with the ideal environment for fostering life. Earth's unique atmosphere, made up of gases and oxygen given off by plants, forms a blanket of protection between the Sun and us. Of course, life could not survive without Earth's abundant supply of water. Students will also read about Earth's moon and its origin.

Ask students what they need to live. For example, people need air, water, and food. List their responses on the board. Ask students if they think they could get what they need from another celestial body in our solar system. Discuss the reasons why or why not.

Develop Core Skills

Reading Skill: Understand Science Texts

Ask students if they read short stories or novels in the same way they read a science text. Discuss the difference in reading these types of texts. Remind students that science texts are written to inform and to explain. Tell students that when they recognize that science texts are written for these purposes, they can decide which strategies will best help them understand and retain information.

Core Skill: Identify Hypothesis

Remind students that a hypothesis is a proposed explanation based on limited evidence. Challenge students to use the word *hypothesis* correctly in a sentence. Remind students that after a hypothesis is stated, it must still be tested before it can be accepted or rejected.

Pre-Teach Vocabulary

Relate Words

Write the vocabulary words on the board or on a chart. Have students work in pairs and use dictionaries or online etymology websites to determine the meaning of each word. Point out related words that may be familiar to students, such as the words *comprehend* or *inhabit*. Invite students to share their findings and reach a consensual definition for each word. Have volunteers write the definitions on the chart. Remind students to be on the lookout for any words that have multiple meanings. For example, ask student volunteers to provide at least two different meanings for the word *mantle*. *Mantle* can mean the layer of Earth below the crust, a shell-producing gland in mollusks, or a loose, sleeveless item of clothing resembling a shawl or a cloak. Point out that all three meanings describe something that covers, wraps, or conceals. Distinguish the word *mantle* from *mantel*, which is an architectural term for a shelf above a fireplace.

Tier 2 Words:

habitable (p. 412)

Tier 3 Words:

mantle (p. 410)

nebula (p. 410)

Test Words:

comprehension

(p. 410)

DURING THE LESSON

PAGE 410

Earth and Its Origins

Guide students as they read the text. As students read the passages on this page, help them track the events that lead to the formation of the Earth and the Moon. You may wish to have students work in teams of two, with one partner reading each paragraph aloud while the other partner makes a bulleted list of the events described in the paragraph.

Evidence-based Reading Support: Fluency

Choral Reading

Have students read aloud "Dating Earth" on page 410. Tell students that when they read chorally, they should use the same pace, expression, and intonation as the group. Some words in this lesson, such as *radioactive*, *expelling*, *debris*, and *ignited*, could be unfamiliar to some students, so review them before reading.

Reading Skill: Understand Science Texts

Before students begin reading the lesson, divide the class into teams of two. Ask one member of each team to read aloud the first paragraph on this page to the other team member, pausing to circle any word or phrase that seems confusing. When the first student is finished, direct the two team members to work together to look for descriptions, examples, or other context clues that can help the student better understand the text. Have team members switch roles and read the second paragraph.

THINK ABOUT SCIENCE**ANSWER KEY**

The Moon formed when a planetary body slammed into Earth about 4.5 billion years ago. During the collision, some of Earth's material flew off into space, where gravity later pulled it together to form the Moon.

21st Century Skill: Information Literacy

Point out the six recommended questions (in italics) that students should ask when evaluating a web page. Invite six individual volunteers to each read aloud one of the six questions, and then encourage students to ask any questions they might have. Have students, either working singly or as small groups, visit a web site and use these questions to critically evaluate the site. Ask at least one individual or group to share their findings with the class.

WRITE TO LEARN**ANSWER KEY**

Invite students to share their written explanations of why they found a particular strategy effective for evaluating an online science article. Have them describe the strategy as steps in a sequence.

Engage and Extend

ELL Instruction: Practice Pronunciation Use the words in the vocabulary list to demonstrate pronunciation of multisyllable words. After you have pronounced the words, ask students to do the same. Correct any mispronunciations.

Conditions for Life

Point out to students that the text on this page is a continuation of the sequential events described on the first page of the lesson. Provide students with copies of the *Sequence* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students review pages 410–412, and have them fill in the sequence graphic organizer showing the main events of Earth's origin and the subsequent development of conditions for life.

Core Skill: Identify Hypotheses

Draw a flow chart with three boxes on the board (the third box should be large). In the first box, write the words *Origins of Earth's Water*. Have a volunteer write his or her summary of the current hypothesis in the second box of the flow chart. Invite students to research how scientists are investigating this hypothesis. Then have volunteers write a brief description of the investigations in the box following the hypothesis.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student page 497.

Extension Activity: Compare Science and

Myths Challenge students to investigate a myth or legend that describes how Earth and the Moon came into existence. Suggest students compare what the myth or legend says to what they are learning and use a Venn diagram to compare the similarities and differences. (See the Graphic Organizer section of the Instructor Resource Binder for a blackline master of a Venn diagram.)

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Describe the big bang theory
- Discuss the origins of the elements that make up Earth

✓ Determine Student Readiness

Invite students to recall what they learned about Earth's origins in the previous lesson. Ask questions, such as: *How are crashing nebula related to the origins of stars and planets? What happened inside the clouds of gas and dust that led to the creation of the Sun and Earth?* Students' answers will reveal their understanding of the enormous energy that leads to the birth of stars, the topic of this lesson.

Key Concept

According to the big bang theory, the universe began with an explosion of matter and energy from an extremely small and dense particle. The universe has been expanding ever since. Reactions that occur during the life cycle of a star form the elements found on Earth.

Concept Background: The big bang theory describes the birth of the universe and formation of the galaxy and solar system. From the same materials—cosmic dust and gases—that formed the stars came the planets, including Earth. Explain to students that although those stars are now light-years away, the nebulae from which new stars come are always forming in space. Given this information, ask: *What does the constant presence of nebulae tell you about the universe? (Stars continue to form.)* Invite students to suggest reasons stars continue to form. After reading, ask students to revise their suggestions, if necessary.

Develop Core Skills

Core Skill: Apply Scientific Models

Help students recall that a scientific model is a description of a process that occurs in nature, expressed in the simplest way. Astronomers, or scientists who study space, use models to explain phenomena like the formation and deaths of stars, the formation of planets, and the movement of bodies in space. Explain to students that scientists rely on advanced technologies, such as powerful telescopes, to gather data. They then use these data to create scientific models. Organize students into small groups to do an online search for models of the big bang, or project a set of models to discuss as a class. Encourage students to note similarities and differences among the models they observe, and ask them to explain the helpfulness of such models in understanding astronomical events.

Core Skill: Determine the Conclusion of a Text

Write the word *conclusion* on the board. Help students understand that a conclusion summarizes an event, an

argument, or a text. It combines important details from a text, for example, and summarizes the text's main message. Some conclusions are not directly stated, so the reader must make a judgment about the message of the text. If some information is missing, the reader infers, or combines existing information with personal knowledge to make a logical judgment. Share or project an article from a local print or online newspaper. Read the article aloud and ask students to help you identify its main idea. Then ask students to help you identify specific details that support that idea. Finally, ask students to locate the article's conclusion, or if no clear conclusion is evident, have students help you write one.

Pre-Teach Vocabulary

Word Study: Multiple-Meaning Words

Write the word *nebula* on the board. Explain that the word comes from the Latin word *nebula*, meaning “mist, fog, smoke, vapor.” Then explain that in the study of the universe, a nebula is a cloud of gas and dust, but the word also has other forms with different meanings. Write the word *nebulous* on the board and explain that it is an adjective that can describe someone's ideas or arguments. Ask volunteers to define the term *nebulous* as it is used in the following sentence: *The student's argument was nebulous, leaving his audience to wonder if he supported or rejected the new grading policy.*

Tier 2 Words:

assumption (p. 416)

Tier 3 Words:

light-year (p. 414)

nebula (p. 416)

supernova (p. 416)

DURING THE LESSON

PAGE 414

Origins of the Universe

Show or project images of the Milky Way galaxy. Ask: *Why do you think early scientists called our galaxy the Milky Way?* Explain that in early Greece, scientists saw a band of light in the night sky and called it the Milky Circle. Later, the Romans changed the name to the Milky Road. Today, we call it the Milky Way, and it is a galaxy. Read the text as a class, and explain that our solar system is only one of many systems that belong to the Milky Way galaxy.

The Big Bang

Organize students into pairs. Before they begin reading the text, ask them to record important details while reading. Then have them use the details to write a summary of the big bang theory. Suggest that they add drawings to illustrate their summaries. Have students share their summaries and drawings with the class. Help students resolve any misconceptions that may occur.

An Expanding Universe

Write the following question on the board: *How did Edward Hubble contribute to our understanding of the movement of galaxies?* Read the question aloud, and ask students to use it to guide their reading. Have them read the text. Invite volunteers to share their answers, and use the answers to engage students in a discussion about what may happen to the universe in the future.

Evidence-based Reading Support: Comprehension

Ask Questions

Pair students and have them read “An Expanding Universe” independently, recording questions they can ask about the text. Questions might include: *What 1929 discovery helps scientists explain movement within the universe today? What is happening to galaxies beyond the Milky Way and even to the Milky Way itself? What question do scientists want to answer regarding Hubble’s 1929 discovery?* Give students time to ask and answer their questions, working together to use the text to clarify any misunderstandings.

21st Century Skill: Critical Thinking and Problem Solving

Write the word *rigorous* on the board and explain that it has a number of similar meanings. Write the following synonyms on the board and read them aloud: *strict, inflexible, severe, exact, and precise*. Ask students to use these synonyms to define the term *rigor* as it is applied to scientific work. Read the text as a class and give students time to record their ideas. Then discuss how rigor applies to other kinds of work, such as art, music, writing, mathematics, and engineering.

Determine the Conclusions of a Text

PAGE 415

Invite three volunteers to read one of the first three paragraphs of the text aloud and then paraphrase it. Then read the fourth paragraph to students, explaining the directions for the activity. Give students time to read the passage and identify the scientists’ conclusion. Resolve any discrepancies that may occur.

THINK ABOUT SCIENCE

ANSWER KEY

1. light-years
2. big bang
3. expanding

Core Skill: Apply Scientific Models

Read the first paragraph of text with students. Then ask them to paraphrase the principle of Occam’s Razor.

Engage and Extend

ELL Instruction: Revisit Vocabulary Write the words *light-year, nebula, and supernova* on the board. Ask students to explain each term in their own words, citing evidence from the text to support their explanations. Provide support, if necessary.

Help students understand that observations can lead scientists to a simpler and more truthful explanation of an event. Read the last paragraph aloud, and ask students why, once scientists have formed an explanation, they continue to search for facts that support the explanation. Help students recognize that additional observations can further scientists’ understanding of an event, or cause them to revise their thinking.

The “Life” of a Star

PAGE 416

Before reading, write the following question on the board and read it aloud: *What makes a star similar to a living thing?* Ask students to keep the question in mind as they read the text. After reading, invite students to share their answers. Then organize students into pairs and have them list the steps of the formation of a star in the proper order. Encourage students to compare lists and resolve any disagreements that may exist.

Element Factories

Organize students into small groups. Have groups work together to read the text and draw a series of diagrams showing the steps involved in the creation of elements. Encourage groups to show and explain their diagrams.

Core Skill: Determine the Conclusion of a Text

Read the text as a class. Invite several students to define the term *assumption* in their own words. As a class, review the lesson, seeking other examples of assumptions they can make based on the text.

WRITE TO LEARN

ANSWER KEY

Read the task aloud to help students understand that they may choose any news article of interest to them. Then while reading, they should highlight or note the article’s main points and use those points to determine if the writer used them to write a conclusion. If students select articles with conclusions, help them understand that their task is to evaluate the strengths and weaknesses of those conclusions. However, if they select articles with no conclusions, they should use the main points they noted to write conclusions.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student pages 497–498.

Extension Activity: Show Time Scale To help students gain an appreciation for the time scale involved in the formation of the universe, have them make a time line to show the following events: the big bang, formation of our solar system, and formation of Earth. Remind students to use a scale that can be shown with relative ease (for example, 1 inch = 1 billion years). Then they will write a summary explanation of the relationship between the events as illustrated on the time line.

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Describe the Milky Way galaxy
- Identify the objects that make up the solar system
- Understand the definition of a planet

✓ Determine Student Readiness

Determine students' readiness for learning about the Milky Way and the Solar System by gauging how much students can recall about the stars, constellations, and planets that make up the Milky Way galaxy. Ask students to share their ideas about what they think a planet is, and ask them why a star is not a planet.

Key Concept

Earth is one of eight planets that orbit the Sun in our solar system. Other objects in the solar system include asteroids, dwarf planets, and comets.

Concept Background: Earth originated as a result of a collision between the remains of an exploding star and a cloud of cosmic dust and gas. The development of early photosynthetic organisms produced Earth's first oxygen about one billion years after Earth's formation. The development of an atmosphere containing the oxygen and other gases and the presence of abundant water made it possible for Earth to support life.

Develop Core Skills

Reading Skill: Analyze Author's Purpose

Remind students that a science text is informational text. The author's purpose is to inform. Have students prepare an outline consisting of the heads and subheads in this lesson. Ask students to describe how the heads and subheads tell the reader that the text in this lesson is informational text. Have students compare the subheads to those in a text that is meant to entertain, such as an entertainment article in a magazine or a newspaper, or text that is meant to persuade, such as an editorial or opinion piece.

Core Skill: Evaluate Conclusions

Remind students that conclusions are based on facts and evidence. Ask students to list examples of evidence that might be found at a crime scene (*fingerprints, blood, footprints, or DNA*). Challenge students to describe the role of evidence in the plot development of a crime drama. Point out that when new evidence is discovered, a previous conclusion may need to be reevaluated. For example, the discovery of new evidence might mean that a suspect previously believed to be guilty is instead found innocent. Evidence might lead investigators to conclude that a particular individual is connected to the crime scene. Just as police rely on evidence to draw accurate

conclusions, a reader must rely on evidence within the written passage before drawing conclusions about the meaning of the text.

Pre-Teach Vocabulary

Relate Words

Tell students that a good way to build vocabulary is to relate unfamiliar words to words they already know. Challenge students to think of words that are similar to the new vocabulary terms. For example, point out that the vocabulary word *asteroid* is similar to the words *astronaut*, *astronomy*, *astrology*, and *asterisk*. Like *asteroid*, these familiar words are all derived from the Greek word *asteri*, which means "star."

Tier 2 Words:

criteria (p. 422)

Tier 3 Words:

asteroid (p. 421)

comet (p. 422)

galaxy (p. 418)

satellite (p. 421)

solar system (p. 418)

Test Words:

bias (p. 419)

DURING THE LESSON

The Milky Way Galaxy

PAGE 418

Help students distinguish between *galaxy* and *solar system*. Explain that a solar system is a collection of planets and their moons in orbit around a star, whereas a galaxy is a large group of stars.

Evidence-based Reading Support: Comprehension Reread/Read More Slowly

Have students work with a partner to read the text on page 418. Remind students that informational text containing many details will often need to be read more than once. As students read, have them occasionally pause to connect what they already know about our solar system and the Milky Way galaxy with what they read. Then have them reread the page without stopping.

Analyze Author's Purpose

PAGE 419

Read *Analyze Author's Purpose* as a class. Encourage students to focus on the four italicized questions in the fourth paragraph. Invite volunteers to ask and answer these four questions as they read the boxed passage. Point out to students that the author's purpose here is twofold, to inform and to entertain. Have students compare the portions of the passage that are informative with the portions that are entertaining.

THINK ABOUT READING

ANSWER KEY

1. galaxy
2. 200 to 400 billion; 120,000
3. elliptical galaxies, irregular galaxies

The Solar System

Invite students to interpret the illustration. Ask: *What does this illustration show?* Then guide them through the reading of the text. Pause after each paragraph to refer to the illustration again, helping students use it to support their understanding of the text.

THINK ABOUT SCIENCE

ANSWER KEY

1. gravity
2. eight
3. star

21st Century Skill: Information, Communication, and Technology Literacy

Have students read the text. Prepare a two-column chart on the board. Label the first column *Benefits* and the second column *Hazards*. Enter students' ideas into the chart as they discuss the potential benefits and possible hazards that may ensue when scientists use the internet to share their experimental results.

The Planets

Guide students as they read the text. To help students remember the names of the planets in order of their distance from the Sun, allow students to make up a class mnemonic with which they can remember the planets in sequence (example: My Very Educated Mother Just Sat Upon Nails).

Pause occasionally to ask students to identify the main ideas discussed under the subheadings *The Planets* and *Asteroids, Comets, and Dwarf Planets*. Draw a "Main Idea" graphic organizer on the board similar to the *Main Idea* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Show students how to organize details by first entering the subtitle *The Planets* in the first Main Idea bar at the top of the graphic organizer. Then demonstrate how students can add important details to the *Detail* boxes descending from each *Main Idea* bar. Elicit details (such as the definitions of *planet* and *satellite*, the difference between inner planets and outer planets, and the characteristics of gas giants) from student volunteers as they read the four paragraphs under the "The Planets." Provide students with their own copies of the *Main Idea* graphic organizer

Engage and Extend

ELL Instruction: Recognizing Bias To demonstrate author's bias, write two sentences on the board: one that is a fact and another that is an opinion. Ask a volunteer to identify which is which. Then have students write fact or opinion sentences and have others identify them.

found in the Instructor Resource Binder. Have students work individually to fill out the graphic organizer as they read pages 421–422.

THINK ABOUT SCIENCE

ANSWER KEY

1. Inner planets are smaller, warmer, and rocky and have few or no moons. Outer planets are gas giants with multiple moons; some have rings
2. Asteroids are rocky objects that orbit the Sun. Scientists believe they are fragments left over from the formation of the solar system.

Reading Skill: Analyze Author's Purpose

Have students identify clues that help them determine that the lesson is informational text. Point out to students that topics are introduced at the beginnings of paragraphs, with details following in the subsequent sentences. For example, point out that the second paragraph introduces the concept of inner planets and then discusses their characteristics, while the third paragraph introduces the outer planets and then discusses their features.

WRITE TO LEARN

ANSWER KEY

Ask students to discuss how they can identify the differences among informative text, entertaining text, and persuasive text. Invite student volunteers to read aloud the three paragraphs that they have written and challenge the rest of the class to identify the type of writing used in each paragraph.

Core Skill: Evaluate Conclusions

Guide students through the second paragraph on this page, which discusses Pluto's new classification as a dwarf planet. Ask students how and why Pluto was reclassified and guide them to the recognition that scientists reevaluate conclusions whenever new information becomes available.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student pages 497–498.

Extension Activity: Collect and Display Information about the Solar System

Have students make a mobile of the solar system, organizing the eight planets at their relative distances from the Sun. Students should estimate the relative sizes of the planets and distinguish between the inner planets and the outer planets. Students can also include other celestial objects of their choosing. All of the pieces should be labeled. Allow them to do further research if they need additional information.

BEFORE THE LESSON

Objectives

- After completing this lesson, students will be able to
- Relate Earth's motion to day and night and to the seasons
 - Discuss the characteristics that make Earth habitable for living things
 - Identify the interactions between the Earth, Sun, and Moon that cause the phases of the Moon and tides

✓ Determine Student Readiness

Begin a concept map on the board or on a large sheet of paper attached to a wall. Draw a circle in the center of the map and label it *Earth*. Invite students to add information about Earth to the concept map, making as many connections as possible. Use students' contributions to the map to determine their readiness for the lesson.

Key Concept

Earth is in constant motion. It turns on its axis, causing the cycle of day and night. Earth's tilt on its axis and its movement around the Sun result in Earth's seasons. Earth's distance from the Sun makes it habitable, a place for living things.

Concept Background: Project an animation of the positions of the Earth, Sun, and Moon. Explain that Earth rotates on its axis, and that it takes one day for Earth to make one rotation. Discuss how this movement leads to day and night. Then explain that while Earth is rotating, it is also revolving around the Sun. Explain that it takes one year to complete one revolution, and that as Earth revolves, it tilts toward and away from each hemisphere, leading to the changing seasons. At the same time, the Moon is rotating as it revolves around Earth about once each month. The Moon's proximity to Earth and its movements result in tides. Invite students to share what they know about tides and to predict the cause of these changes in sea level.

Develop Core Skills

Reading Skill: Cite Textual Evidence

Tell students that when they cite evidence, they use text to justify their explanations and conclusions. Evidence consists of facts and can help a reader determine whether a statement, argument, or conclusion is true. Select a short news article of interest to your students. Read the article aloud. Afterward, state a conclusion and ask students to identify evidence in the text that supports it.

Core Skill: Apply Scientific Models

Hold up a globe and spin it. Explain that the globe is an example of a model. The model demonstrates a number of things, including the shapes of continents and oceans and how they are arranged on Earth's surface, Earth's tilt,

and Earth's rotation on its axis. Invite students to discuss how using models of Earth helps explain processes such as night and day, climates and physical environments on different parts of the planet, and changing seasons.

Pre-Teach Vocabulary

Word Study: Suffixes

Write the suffix *-tion* on the board. Explain that it is a common suffix, or word ending, and that a suffix changes the meaning of a base word. Tell students that the suffix *-tion* changes action words into nouns. Write the vocabulary terms that end in *-tion* on the board, and ask students to identify the action word, or verb, in each term. Explain the meanings of the verbs and ask students to define the vocabulary terms.

Tier 2 Words:

interactions (p. 427)
revolution (p. 424)
rotation (p. 424)
tides (p. 427)

Tier 3 Words:

habitable (p. 426)
phase (p. 426)

DURING THE LESSON

PAGE 424

Earth's Journey

Show the video animation of Earth's rotation and revolution around the Sun again. Ask volunteers to describe the motions. Read the text as a class. Then use a globe or the animation once more to explain the seasons. Next, encourage volunteers to use the diagram and the globe or animation to model and explain the seasons.

Evidence-based Reading Support: Comprehension Use Prior Knowledge

Before students begin reading, ask them to discuss with a partner what they already know about seasons and the changing shape of the Moon throughout a month. Then have partners read the text together and have them confirm their prior knowledge or correct any misconceptions or misunderstandings they may have had.

PAGE 425

Cite Textual Evidence

Invite three volunteers to read the first three paragraphs of the text aloud and paraphrase it. Then read the fourth paragraph to students, explaining the directions for the activity. Give students time to read the passage and identify the statements that provide evidence supporting the passage's main idea. Ask a volunteer to read the sentence that establishes the paragraph's main idea (*Sentence 3*). Then ask another volunteer to summarize the purpose of sentences 4 and 5. (*They are supporting details.*) Invite students to discuss the purpose of the paragraph's first two sentences.

THINK ABOUT SCIENCE**ANSWER KEY**

1. rotation
2. revolution
3. northern

21st Century Skill: Communication

Before reading the text, ask students to identify different ways people communicate. Then ask them to describe the qualities of good communication. Give students time to complete the activity presented in the last paragraph. Afterward, invite pairs of volunteers to role-play providing an explanation of how to do something, such as accessing the internet on a smartphone, to another student. Have one member of a pair provide an explanation that lacks precision and a member of the other pair provide a precise explanation. Then have the other members of each pair demonstrate or explain the consequences of the explanations.

A Habitable Planet**PAGE 426**

Before reading, write the following question on the board and read it aloud: *What makes Earth habitable?* Organize students into small groups. Ask them to read the text, using the question to guide their reading. Ask each group to write an answer to the question based on their readings. Then have students record their answers on the board. Help students reach a consensus about what qualifies Earth as a habitable planet.

THINK ABOUT SCIENCE**ANSWER KEY**

Earth's temperature, atmosphere, and energy from the Sun allow it to sustain life.

The Moon

Before reading, invite students to tell you what they know about the Moon. Write their responses on the board. Then write the following questions on the board: *What might happen to Earth's axis if the Moon weren't present? What is "moonlight"? What must happen before an eclipse can occur?* Read the questions aloud. Help students use the questions to guide their reading. Read the text with students, pausing to answer the questions and eliminate confusion. To help students understand the Moon's cyclical phases, encourage them to work in groups to search online for an activity they can use to demonstrate

Engage and Extend

ELL Instruction: Explain the Seasons Explaining the occurrence of seasons is challenging for many students. While you use the globe to model Earth's revolution around the Sun, ask students to explain the differences in the angle of light reaching each part of the globe at different points along its orbit. You may want to use a flashlight to represent the Sun. Engage students in a discussion of how the changing angle of light results in seasons in the northern and southern hemispheres.

the process. For example, students can follow the step-by-step online procedure "Modelling the Phases of the Moon" presented by the University of Cambridge or "Modelling Moon Phases" by Museum Victoria SCIENCEWORKS.

Reading Skill: Cite Textual Evidence

In their reading and discussion of the section "A Habitable Planet," students recorded the attributes that make Earth habitable. Ask students to return to their statements and cite specific evidence from the text to support their statements.

WRITE TO LEARN**ANSWER KEY**

Remind students that they are writing two paragraphs describing a favorite sport or hobby, and that each paragraph must have its own main idea supported by specific details. For example, if students write about playing tennis, the main idea of the first paragraph might be the sport's history, and the main idea of the second paragraph might be the current rules of the game.

PAGE 427**Tides**

Read the text with students. To help explain the concept of tides further, you may want to visit the National Oceanic and Atmospheric Administration's Education Resources website to select animations, fact sheets, discussions, and demonstrations that will help reinforce your students' understanding of tide cycles.

Core Skill: Apply Scientific Models

Read the text as a class and discuss the lunar cycle and what questions students may have about the existing models scientists use. Give students time to contact experts or consult print or online resources to find the answers to their questions. Encourage students to share their findings. As a class, discuss any discrepancies that students have found among their answers. Ask them to suggest ways to resolve these discrepancies.

AFTER THE LESSON

Read through with the students the answers to the vocabulary and skill reviews and the skill practice items located on student page 498.

Extension Activity: Collect and Display Data Have students research the most effective and safest ways to observe a solar eclipse. Ask students to create a guide for viewing a solar eclipse that includes safety measures, viewing tips, and an explanation of why eclipses happen. Encourage students to illustrate their guides to assist in explaining important steps, precautions, or information.