Skeletal and Muscular Systems

LESSON 1.1
PAGES 16–23

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify main parts of the human skeletal system
- Classify different types of joints
- Explain how the skeletal and muscular systems work together for movement

✓ Determine Student Readiness

Determine students' readiness for learning about the skeletal and muscular systems by asking them to imagine themselves a marathon runner during a race. Encourage students to compare the job of the bones in the runner's legs to the job of the muscles. Ask how bones and muscles are alike and how they are different. Guide them toward a discussion of the purpose of each.

Key Concept

The human skeletal and muscular systems work together for support, protection, and movement.

Concept Background: Explain to students that bones and muscles work together to provide support and movement. Different kinds of muscles are specialized to do different tasks in different parts of the body. Some muscles are under conscious control, while others are not. Ask students who have broken a bone or damaged a muscle to describe how the injury affected their ability to move.

Develop Core Skills

Reading Skill: Understand Text Organization

Invite students to describe a writing task they completed recently. Ask them to identify their reasons for writing and how they collected and organized text in such a way that it would be most sensible or most effective. Ask questions such as: *How did you decide what the most important ideas were? How did you decide in what order to organize those ideas? Did you prepare an outline before you began writing? How did the outline help you organize your text?* Explain to students that authors know that organization contributes to effective communication. Invite students to discuss the advantages of well-organized science text.

Core Skill: Determine Meaning

Explain to students that science, like other areas of study, has a special vocabulary, and that it is helpful to determine the meanings of unfamiliar science words before attempting to read a science text. Invite students to share and demonstrate some of the strategies they use for determining the meaning of a new word. Or, demonstrate a strategy for them. For example, direct students' attention to the word *marrow* on page 16. Show students how to use context clues to find the word's meaning. Ask: *How does understanding the meaning of a science word help you read and understand a text more easily?*

Pre-Teach Vocabulary

Word Study

Write the vocabulary words on the board. Write a brief definition next to each word. Then ask a riddle, such as "I squeeze and relax, pumping blood around your body. What am I?" After students answer, invite a volunteer to use the definitions you wrote to ask a new riddle. Then have that student choose a new player, and so on, until all of the words have been used.

Tier 2 Words:

organization (p. 18)
voluntary (p. 20)

Tier 3 Words:

cardiac muscle (p. 20)
cartilage (p. 18)
ligaments (p. 18)
marrow (p. 16)
skeletal muscle (p. 20)
smooth muscle (p. 20)

DURING THE LESSON

PAGE 16

Evidence-based Reading Support: Comprehension

Set a Purpose for Reading

Draw a KWL chart on the board. Title the chart: *The Skeletal System.* Label the columns: *What I Know; What I Want to Know;* and *What I Learned.* Explain to students that a KWL chart is one of many effective tools they can use to make meaning of a text. Tell students that you're going to complete this chart together. Begin by inviting students to share what they know about the skeletal system. Record their responses in the chart. Then ask them to tell you what they want to know about the skeletal system. Again, record their answers in the chart. After reading the text, revisit the chart to complete the last column. If students don't find the answers to all of their questions, discuss what they could do to find the answers they seek.

The Skeletal System

Students will likely have some prior knowledge of aspects of their own bones and muscles, but they may not think of bones as active, living tissue. Read the text with students. Pause after each paragraph to ask students to identify the main idea of each paragraph.

Refer to the diagram on page 17. Ask questions such as: *Which pair of bones work together in your lower arm? What bones do you stand on? What bone is on the opposite side of the body from the scapula?* Invite volunteers to use the diagram to answer questions and to ask their own questions.

THINK ABOUT SCIENCE **ANSWER KEY**

1. marrow 2. bones

PAGE 17

21st Century Skill: Communication and Innovation
Invite students to discuss the value of precision in writing. Engage them in a discussion of the value of stating what's most important without cluttering a text with unrelated information. Also ask them how visuals, such as diagrams, can clarify text further. Then read the text together and emphasize points in the text that correspond to points students made during the discussion. Have them work in pairs or in small groups to complete the writing task. Ask students to share their work.

PAGE 18

Joints
Ask students to examine the diagram. Invite volunteers to identify the joints they see in the diagram on their bodies. Then read the text as a class. After reading, ask students to model moveable joints. Invite students to discuss how the absence of any one of these joints would affect movement or protection.

Reading Skill: Understand Text Organization
Read the text with students. Then return to the text to ask students to describe the text's organization. Ask guiding questions such as: *Why did the author begin the text by explaining the purpose of ligaments? Why is the text related to joints that can twist and glide presented before text related to joints that allow only a little or no movement? Does this text's organization communicate important ideas effectively? Would you make any changes if you were rewriting this text?*

PAGE 20

Evidence-based Reading Support: Alphabetics
Prefix *in–*
Write the words *voluntary* and *involuntary* on the board. Help students recall that any letter or group of letters attached to the beginning of a word that changes the meaning of that word is called a *prefix*. Also explain that knowing the meaning of specific prefixes helps them determine the meaning of base words. For example, explain that the prefix *in–* means "not." Ask a volunteer to define the term voluntary. Write the definition on the board. Then circle the prefix *in–* in *involuntary*, and ask a volunteer to define the word. Write the definition on the board. Use the pair of words and definitions to encourage students to offer similar examples.

The Muscular System
Use the diagram on this page to show students how to locate the various muscles of the upper arm. Remind students that the movement of the skeleton requires the action of opposing pairs of muscles. To demonstrate this, direct students to place the fingers of their left hand on their right biceps muscle, then raise and lower their right forearm. When the forearm is being raised, point out that the biceps are contracting, while the triceps are relaxing. When the forearm is being lowered, ask students which muscle is contracting (triceps) and which muscle is relaxing (biceps).

Core Skill: Determine Meaning
Read the text with students. Then ask volunteers to explain the relationship between voluntary and involuntary muscles and voluntary and involuntary nervous system responses. Ask students to explain the connection between involuntary responses and survival.

PAGE 21

Importance of Exercise
Write the words *Cause* and *Effect* on the board. Draw an arrow between the words, starting from *Cause*. Explain the meaning of the diagram to students, that is, help them understand that a cause is something that makes something else happen, and what happens is called an effect. Read the text as a class. Help students identify examples of cause-effect relationships in the text. Invite volunteers to write them on the board.

THINK ABOUT SCIENCE **ANSWER KEY**

1. Exercise benefits all of the major systems of the human body and helps lead to a longer, healthier life.
2. People should exercise throughout their lives because exercise increases bone density, size, and strength, even in older adults.
3. Yoga and tai chi help increase flexibility and range of motion.

WRITE TO LEARN **ANSWER KEY**

Remind students to think through the physical activity or exercise that they have selected before attempting to write. Help students decide which pattern of organization—order of importance, time order, or cause-and-effect order—is best suited for describing their chosen subject.

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 455.

Engage and Extend

ELL Instruction: Explain a Diagram Gather students into small groups. Encourage them to examine the diagram of the arm on page 20 and use their own words to explain the role of muscle pairs in the raising and lowering of the forearm. Students may want to number the steps they describe, either orally or on paper, as they explain.

Extension Activity: Construct a Model to Show How a Knee Flexes Challenge students to research the parts of a knee, including bones, ligaments, cartilage, membranes, and bursa, or fluid-filled sacs. Have students examine how the parts work together to allow movement. Ask them to use the data they gather to build and explain a model of a knee in a flexed position.

Digestive, Respiratory, Excretory, and Circulatory Systems

LESSON 1.2
PAGES 24–29

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Recognize the organs and processes of the digestive, excretory, circulatory, and respiratory systems
- Explain how these systems work together to provide the body's cells with energy and remove cellular wastes

✓ *Determine Student Readiness*

Determine students' readiness for learning about the digestive, respiratory, excretory, and circulatory systems by asking volunteers to name one organ from each system. Provide assistance, if necessary. Ask students to brainstorm aloud about the function of each organ is. Guide students to recognize that every organ plays a role in two vital tasks: providing cells with energy and removing cellular waste.

Key Concept

To carry out life activities, cells require food and oxygen. They also produce wastes. Each system plays a role in delivering the materials that cells need and carrying away wastes they make.

Concept Background: Tell students that the levels of organization in the body include cells, tissues, organs, and body systems. Just as every cell in the body is interdependent, so are the body systems. Communication and teamwork among these systems make it possible for the body to do jobs such as pumping blood and getting rid of wastes. Stress this interdependence in body systems as students read.

Develop Core Skills

Core Skill: Determine Central Ideas

Explain that a text normally has one central idea. Invite students to describe a recent writing task they completed. Encourage them to describe the central idea, or main idea, of their writing. Invite students to discuss how they developed that central idea to make it plain to their readers. Ask: *Did you develop an outline to find the most effective way to assemble paragraphs to support your writing's central idea? What other strategies did you use to help your readers grasp the most important idea in your writing?*

Core Skill: Integrate Text and Visuals

Ask students to describe a writing task in which they drew pictures, graphs, diagrams, or built tables and charts, or included photographs to support the text. Engage students in a discussion of why authors put words and different kinds of visuals together. Ask: *Why aren't words always enough to communicate important information, explain a process, or provide examples? How can words and visuals work together to accomplish more than either can do alone?*

Pre-Teach Vocabulary

Use Word Parts

Write the vocabulary words and brief definitions on the board. Circle the letters *–ory* at the end of the words *excretory* and *respiratory*. Explain that these letters represent a suffix, or a collection of letters that changes the meaning of the word to which it is attached. Explain that the suffix *–ory* means "having to do with, characterized by, or a place for." Encourage students to think of other words that end with *–ory*, such as *laboratory*, *introductory*, *territory*, *sensory*, and *observatory*. Ask students to explain how the suffix helps them define the words they choose.

Tier 3 Words:

digest (p. 24)
excretory system (p. 26)
plasma (p. 26)
platelet (p. 26)
respiratory system (p. 28)
trachea (p. 28)

DURING THE LESSON

PAGE 24

The Digestive System

Explain that the energy from the food we eat is unavailable to the body until the food is broken down into molecules that are small enough to enter our blood vessels. Read the text with students. Afterward, ask a volunteer to compare the digestive system to a car's engine, explaining characteristics that make them similar.

Evidence-based Reading Support: Comprehension

Words as Context Clues

Invite students to work with a partner to reread the text on this page. Model questions that students can ask themselves while reading, such as: *What is this paragraph about? How is this paragraph organized? What are the important ideas? Do they form a pattern?* After reading, have students underline words that serve as context clues. Point out that the words *in*, *down*, *into*, *there*, *across*, *carries*, *passes*, and *leave* indicate location and movement from place to place. Students will notice that the text follows the sequence of food as it moves through the body. Help students recognize that the writer has placed ideas in the order that events happen. The text therefore follows a time-order pattern of organization.

THINK ABOUT SCIENCE ANSWER KEY

Answers will vary but should explain that food enters the mouth, is ground into small pieces by teeth and broken down further by saliva. It travels down the esophagus to the stomach where it is broken down further by churning and acids. It then travels to the small intestine where nutrients diffuse into the bloodstream. Undigested food moves into the large intestine where water is removed and solid wastes exit via the anus.

PAGE 25

Integrate Text and Visuals

Before reading the rest of the lesson, have students scan the diagrams on pages 26, 27, and 28. Ask them to read the title of each diagram and study the labels and what they identify. Ask students to discuss how they think the diagrams will help them understand the content of the text. Invite a student volunteer to write a caption for the diagram of the human digestive system on this page.

PAGE 26

The Excretory System

Before reading the text with students, explain that as food molecules are broken down and used for energy, some parts of food molecules cannot be used and must be removed from the body as waste. In the kidneys, some substances are kept (*useful molecules such as water, glucose, hormones, or vitamins*), while others (*wastes, toxins*) are discarded. It is the job of the kidneys to filter these materials as they pass through. Ask students how the role of the kidneys is similar to the role of a community recycling center (*materials pass through the center; valuable components that can be kept are retained, while wastes are discarded*).

The Circulatory System

Read the first sentence with students. Afterward, ask a volunteer to identify the key word that describes the function of the circulatory system (*transports*). Point out that the circulatory system is a system that transports materials throughout the human body. Read the remainder of the text with students. Ask volunteers to explain the roles of plasma and platelets in the blood.

Core Skill: Determine Central Ideas

As a class, look for the central idea of the first paragraph of "The Excretory System." Encourage students to read this paragraph to find one or more words (such as *remove*, *waste*, or *filters*) that suggest the function of the excretory system.

PAGE 27

The Heart

Refer to the diagram as you read the text with students and help them understand that the heart is a two-part organ that functions as two separate halves that work together. Explain to students that the two upper chambers, the atria, collect the blood returning to the heart. The two lower chambers, the ventricles, pump blood away from the heart. Have students skim the first paragraph to search for the two phrases that describe the function of the heart (*collect the blood and pump blood away*).

THINK ABOUT SCIENCE ANSWER KEY

1. kidneys
2. liver
3. platelets
4. red
5. ventricles
6. lungs

Core Skill: Integrate Text and Visuals

Read the text with students. Encourage students to discuss how integrating text and visuals helps them make meaning of text and understand complex concepts or processes.

WRITE TO LEARN ANSWER KEY

Answers will vary, depending on which diagram the student selects. Remind students to use information from both the text and the diagram when writing their paragraphs.

PAGE 28

The Respiratory System

Guide students as they read the text. Ask students to look in the first paragraph to find a pair of verbs (*supply and remove*) describing the two functions of the respiratory system (*supply oxygen and remove carbon dioxide*). Have students summarize the steps that occur as air enters the respiratory system. You may want to have them work in pairs to read the text while they follow the pathway of air in the diagram.

21st Century Skill: Information Literacy

Have students read the text and then explain the meaning of the terms *reliable* and *reputable* in their own words. Invite students to give specific examples of how they can assess the reliability of a website and the articles found there. A reliable article should list an author, along with the author's credentials (information about their qualifications, degree, and employer). Remind students to look for the purpose of a website. For example, is the site selling a product? If so, information at the site might be biased.

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 455.

Engage and Extend

ELL Instruction: Practice Pronunciation Select words or phrases that students might find difficult or that do not transfer well from their first languages. Model intonation and emphasize the stressed syllable in multisyllabic words. Have students repeat the words.

Extension Activity: Investigate Body Systems Have small groups of students work together to find additional details about a body system. They might research the system in more detail, identify diseases associated with the system, and determine the cause and effects of each disease. In their research, students should cite evidence regarding the cause of each disease and summarize possible treatments.

Nervous, Endocrine, and Reproductive Systems

LESSON 1.3
PAGES 30–35

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Recognize the organs and processes of the nervous and endocrine systems
- Differentiate between male and female reproductive organs
- Sequence the events in the development of a fetus from a fertilized egg
- Identify conclusions and supporting details

✓ *Determine Student Readiness*

Determine students' readiness for learning about the nervous, endocrine, and reproductive systems by asking them to brainstorm a list of the various ways that messages can be delivered throughout an office building. Some messages might be delivered from person to person (via intercom, telephone, or e-mail), while other messages automatically occur in response to physical conditions in the building. Ask students to think about different kinds of conditions that can be "sensed" by a room in a building. Examples might include monitoring devices that turn off the room lights when no one is present, or thermostats that adjust the room temperature when it becomes too warm or too cold. Help students to distinguish between messages that are very quick (for example, a telephone call) and those that take longer (for example, a thermostat that eventually turns the heat on or off). Explain to students that these messaging systems are similar to the nervous and endocrine systems.

Key Concept

The nervous system and the endocrine system are responsible for communications within the body. They control many processes in the body, including those of the reproductive system.

Concept Background: Hormones, produced by the endocrine system, are chemical messengers. They tell various organs what to do and when to do it. This is particularly true of the reproductive system, which relies on hormones to function. The brain, however, is the master organ that sends hormones to their targets. As the main organ of the nervous system, the brain coordinates all of the human body systems. Point out the connection between the brain and other organs as students read the lesson.

Develop Core Skills

Core Skill: Determine Central Ideas

Explain to students that texts, including textbook passages, newspaper articles, and other materials familiar to them, each have a central, or main idea. Select an article from your local school or community newspaper. Read the article, or project the article for students to read independently. Ask students to identify the article's central, or main, idea. Explain that the central idea may become clearer if they ask themselves the question: What is this article mostly about? Give students time to share, discuss, and reach a consensus on the article's central idea.

Core Skill: Cite Textual Evidence

Write the word evidence on the board. Next to the word, write: from the Latin word *evidentia*, meaning "obvious to the eye or mind." Ask students to define the term and to give examples of ways they have heard or seen the word used. Explain to students that when they read a text, the text will have one or more big ideas. Authors provide evidence, or important facts and details, to support those ideas. Those facts and details are evidence. Invite students to discuss something they have written recently and what kinds of evidence they provided to support the ideas they presented.

Pre-Teach Vocabulary

Word Study: Multiple-Meaning Words

Write the vocabulary words and their definitions on a board or chart. Discuss each word's meaning with students. Then write the sentences below on the board. Read each sentence aloud and discuss it with students. Explain to students that multiple-meaning words are words that have several meanings depending upon how they are used in a sentence.

1. Hannah went into *labor* and had the baby the next morning.
2. The bill for the car repair included parts and *labor*.

Tier 2 Words:	Tier 3 Words:	Test Words:
labor (p. 34)	fetus (p. 34) hormones (p. 32) menstrual cycle (p. 33)	sequence (p. 34)

DURING THE LESSON

PAGE 30

The Nervous System

Ask students to read page 30. Provide students with a copy of the Sequence graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students reread page 30, this time pausing to fill in the graphic organizer with a series of steps that may occur when a sense organ receives information. Students' graphic organizers may vary, depending on whether they depict the usual pathway (peripheral nerves sensing a stimulus → spinal cord → brain → spinal cord → peripheral nerves→ action) or a reflex that travels from sensory nerves to the spinal cord then directly to motor nerves.

PAGE 31

Identify Conclusions

Read with students the sample passage on this page, which describes some of the effects of alcoholism on the liver. Help students identify the *claim*. Ask for student volunteers to point out the evidence (supporting details) and the scientific knowledge in the passage. Guide students to recognize that they should always remember to look for the evidence and the scientific knowledge behind it before accepting claims when they read articles in magazines, newspapers, or on the internet.

PAGE 32

The Brain

Have students examine the diagram of the brain on this page. Have them work with a partner to tell in their own words where the cranium and the spinal cord are located in their bodies. Discuss with them who might use this type of diagram (*doctors, researchers, medical students*).

Evidence-based Reading Support: Vocabulary

Word Parts

Write the words *cerebrum* and *cerebellum* on the board. Invite students to point out the portion of each word that is shared by both words, and then circle the word part *cere*. Explain to students that the word *cerebrum* comes from the Latin word for brain. The word *cerebellum* is the Latin diminutive for *cerebrum*, meaning "little brain." Explain to students that a diminutive is a word form that indicates smallness. Explain to students that it is possible to understand the meaning of many words if they know the meanings of the word parts. Ask students to look up the meaning of the word *cerebral* in a dictionary.

The Endocrine System

Write the word *hormone* on the board. Next to the word, write: *form of the Greek word* horman, *meaning* "to set in motion." Read the text with students. Ask: *Why do you think scientists used the word hormone to describe the chemical messengers that work within the endocrine system?* Help students to recognize that hormones trigger other events, or set activities within the body in motion.

Core Skill: Determine Central Ideas

Invite students to work with you to identify the key words and statements that help readers understand the central ideas in this passage about the brain. After students have finished the central idea/supporting details graphic organizer in their notebooks, draw a blank version of this graphic organizer on the board. Encourage student volunteers to fill in their ideas regarding the central idea and the supporting details.

PAGE 33

The Reproductive System

Ask students to write down unfamiliar terms in their notebooks as they read the text. Suggest that students organize their terms in two columns, one column for the male reproductive system and a second column for the female reproductive system. Invite students to use dictionaries to look up any terms in the diagrams not included in the text.

THINK ABOUT SCIENCE ANSWER KEY

1. testes
2. ovaries
3. fertilized

21st Century Skill: Communication and Collaboration

Have students read the text and then write a paragraph describing a successful collaboration. Invite students to share specific examples of their experiences. Ask students to offer opinions on why collaboration might be particularly helpful in the workplace.

WRITE TO LEARN ANSWER KEY

Remind students that a *claim* is a statement or conclusion that is based on evidence and knowledge. Help students identify supporting details in the text.

PAGE 34

Growth of the Fetus

Guide students as they read the first two paragraphs. Pause occasionally to ask students to identify the main idea of a paragraph or to identify important details that support a topic sentence.

Core Skill: Cite Textual Evidence

Help students look for the words and phrases (such as: *as soon as, begin, begins, during,* and *at the end of*) that are cues identifying actions occurring in sequence. Invite students to point out the portions of the passage that state the development periods when the embryo is very sensitive and when good nutrition is especially important.

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 456.

Engage and Extend

ELL Instruction: Elaborate Discuss words associated with the reproductive system that students might not know, such as *fertilization, nutrition,* and *contraction*. Help students understand some details about each word, such as how each uses the suffix *–ion*, which refers to the act, result, or state of something.

Extension Activity: Draw Conclusions about Hormones

Challenge students to find out more about hormones. Ask them to research how hormones were discovered, and to summarize the names, sites of origin, and functions of some major hormones of the body. Encourage students to share what they learn in a class presentation.

Health and Disease

LESSON 1.4
PAGES 36–45

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify common diseases and their causes
- Discuss the types of nutrients used by the body
- Relate different types of drugs to their effects on the body

✓ *Determine Student Readiness*

Determine students' readiness for learning about health and disease by asking them to briefly describe health-related stories that they have recently seen in the media. Ask students what stories have been the most interesting to them and which ones have been most relevant to their life or to the lives of their family members. Tell students that the public must be skeptical when hearing popular health-related news, and remind them that they must use their critical thinking skills before accepting every news story at face value.

Key Concept

To promote wellness and avoid common diseases, it is important to maintain a well-balanced diet and avoid any substances that change the normal functioning of the body.

Concept Background: Ask a student volunteer to read the two paragraphs following the Key Concept. Ask students to describe the ways in which the roles played by gasoline (*in a car*) and food (*in the body*) are similar. Introduce the term *wellness* and ask students how many of them have heard this term. Point out that the current emphasis on maintaining wellness places a greater emphasis on one's personal responsibility to choose actions that will maintain one's health, just as a car's owner takes responsibility for maintaining his or her automobile.

Develop Core Skills

Core Skill: Evaluate Conclusions

Invite students to consider the phrase *jump to a conclusion*. Tell students that to jump to a conclusion is to judge or decide something without having all the facts. Ask students to describe a time they jumped to a conclusion. Follow their examples by asking them to describe the consequences of their actions. Ask: *Why is it helpful to gather facts, or evidence, before reaching a conclusion? What consequences may occur if we reach a conclusion before having all of the information we need?*

Core Skill: Compare and Contrast Multimedia Sources

Remind students that media messages are constructed for specific purposes. Share an example of a recent television, internet, newspaper, or magazine health-related story. Ask students to think about the story. Challenge them to answer the following questions: *What is the source of the story? For what purpose was this media message created? Whose point of view is included? Whose point of view is excluded? How could this media message influence personal beliefs or behaviors?*

Pre-Teach Vocabulary

Prior Knowledge

Write the vocabulary words on the board and read them aloud. Ask students to imagine being in a doctor's office and to identify words from the list that they might hear or read in the office. Then have them imagine being in a drugstore or pharmacy, and again, ask them to identify words from the list that they might hear or read there.

Tier 2 Words:	Tier 3 Words:	Test Words:
drug (p. 42)	antibiotic (p. 43)	acquire (p. 36)
well-balanced diet (p. 40)	over-the-counter (p. 42)	
calorie (p. 40)		
immunity (p. 36)		
prescription (p. 42)		
symptom (p. 38)		

DURING THE LESSON

PAGE 36

Health and Disease

Explain that some diseases can be acquired, or caught, through contact with infected individuals, while others are the result of wear and tear due to advanced age. Point out that many diseases can be influenced by lifestyle choices. Provide students with copies of the *Main Idea* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students fill out the graphic organizer as they read pages 36–39, pausing to fill in the *Main Idea* bar each time they encounter another subhead. Show students how they can add important details to the *Detail* boxes descending from each *Main Idea* bar.

PAGE 37

Compare Multimedia Sources

Invite student volunteers to share their written responses to each example. Ask students to discuss the potential advantages and drawbacks in using an animation to learn about cell division, or in using internet sources to learn about current treatments for heart disease.

Evidence-based Reading Support: Comprehension

Clarify Meaning

Tell students that charts and tables hold information in an organized way and help to clarify the meaning of the text. Have students look at the chart at the top of page 37. Tell students to look at the heading of each row and column to determine the content of the chart, and explain how to locate information on the chart using the headings.

PAGE 38

Core Skill: Evaluate Conclusions

Have students read aloud the first two paragraphs. Ask students to point out the factors in each paragraph that are known to increase the risk of heart and blood vessel disease. Remind students that clinical evidence supports the conclusions about the dangers of these factors.

PAGE 39

THINK ABOUT SCIENCE ANSWER KEY

1. C
2. E
3. F
4. D
5. A
6. B

WRITE TO LEARN ANSWER KEY

Remind students to write down their notes about the main idea and the supporting details before attempting to write their summary.

Workplace Connection

In recent years, computers have changed the way scientists conduct their research and investigations. Have students look up information on the use of computer technology in science research. How has computer technology benefited scientists? What are the concerns scientists have about computer technology?

PAGE 40

Nutrition and Diet

Ask students to explain what is meant by the first sentence in the last paragraph on page 40. (*Nutritionists know that some foods are more valuable than others.*) To help students understand that some foods have more food value than others, invite the class to call out the names of foods in a typical daily menu for an adult. As students respond, write the food item name on the board. Then invite the class to replace the items that are low in food value with nutrient-rich, healthful items. Emphasize that valuable foods might not be low in calories, but are high in nutrient content.

Core Skill: Compare and Contrast Multimedia Sources

Have students look online for digital or online resources geared for children. Ask them to analyze and evaluate the educational effectiveness. Ask students to find a similar or comparable product for adults. Challenge students to compare the resources and capabilities for these products.

Engage and Extend

ELL Instruction: Extend Language Discuss and define additional common words associated with health and disease with which students might not be familiar. Ask students to identify words from the lesson that are unfamiliar and help them to understand their definitions. Create a list of words for students' notebooks.

PAGE 41

A Balanced Diet

Ask students to name one food from each of the five food groups shown. Invite students to describe how their most recent meal would look if placed onto the ChooseMyPlate.gov graphic. In their meal, which food groups would need to be larger to fit the designated parts of the plate? Which food groups would need to be smaller?

THINK ABOUT SCIENCE ANSWER KEY

Review with students the answers on page 456 of the student lessons.

21st Century Skill: Flexibility and Adaptability

Before reading the text, direct students' attention to the MyPlate.gov diagram. Explain that an online image search will lead you to earlier nutritional models promoted by the USDA. Choose one or more of these models to share with students, and ask them to explain why such models change. Help students understand that such changes reflect flexibility and adaptability in scientific thinking. As technologies change and scientists have access to more information, they revise existing models.

PAGE 42

Drugs

Guide students through reading the subsections on over-the-counter drugs and prescription drugs. Help students to recognize the key differences between these two groups. Point out that over-the-counter drugs can be dangerous, too, when taken incorrectly.

PAGE 43

Inventing New Drugs

Help students to understand that the use of antibiotics helps to fuel drug-resistant strains of bacteria. Many antibiotics kill bacteria by interfering with their ability to make new cell walls. (Since human cells do not have cell walls, antibiotics do not kill our cells.) Since viruses are not alive and are not made of cells, antibiotics do not affect them.

THINK ABOUT SCIENCE ANSWER KEY

Review with students the answers on page 456 of the student lessons.

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 456–457.

Extension Activity: Collect and Display Nutrition Information Invite students to collect and display nutrient labels from a variety of snack-food packages. Ask students to create posters classifying the foods as high or low in food value and to assess the overall nutrient content of each food. When finished, encourage students to share their completed posters with the class.

Flowering Plants

LESSON 2.1
PAGES 54-61

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify the basic parts of a flowering plant
- Understand the food-making process in a plant
- Describe how flowering plants reproduce

✓ *Determine Student Readiness*

Determine students' readiness for learning by discussing prior knowledge of flowers and flowering plants. As a class, make a list of various kinds of flowering plants along with brief descriptions. Point out that there is great variety in the appearance of flowers, including their shape and color.

Key Concept

Flowers contain male and female reproductive structures and attract pollinators that transfer reproductive materials.

Concept Background: Explain to students that just like humans, flowering plants contain specific reproductive structures for passing on their genetic material and producing offspring. Other (nonreproductive) structures are also important in helping the plant remain healthy and capable of reproducing. Pollination is the process by which plants transfer reproductive materials between one another. Lead a discussion exploring why certain flowers and plants might attract different kinds of pollinators.

Develop Core Skills

Core Skill: Apply Scientific Models

Ask students to look around the classroom and determine the kinds of models that can be found, such as a globe. Have them list all the models that they can find. Remind students that not all models are three-dimensional or even physical. Even chemical equations and formulas are models.

Core Skill: Integrate Text and Visuals

Have students review the illustrations used in previous lessons they have completed. Ask students to consider how the labels are used in each illustration to help the student connect the illustrations to the text. As they read this lesson, have students note where labels in the illustrations reinforce what is being discussed in the text.

Pre-Teach Vocabulary

Word Study: Form Sentences

Provide students with definitions of the vocabulary terms. Ask them if they can use one or more words in a sentence. Provide an example: *Chlorophyll is the green pigment in plant leaves.*

Tier 2 Words:	Tier 3 Words:	Test Words:
precise (p. 56)	chlorophyll (p. 56)	visual (p. 55)
reproduction (p. 56)	photosynthesis (p. 58)	
	pistil (p. 59)	
	pollination (p. 59)	
	stamen (p. 56)	

DURING THE LESSON

PAGE 54

Flowering Plants

Students are probably familiar with flowering plants, but they may not realize just how many thousands of flowering plant species there are. All of these species have the same structures in common. The structures include roots, flowers, leaves, and stems. Despite these commonalities, flowering plants around the world can look very different from each other. Have students research some of the most unusual flowering plants found on Earth.

Each part of a flowering plant's structure plays a role in the plant's functions, including reproduction. Roots anchor the plant to the ground and absorb water and some nutrients from the soil. Stems support the plant and transport food and water. Leaves produce food for the plant and control the entry and exit of gases. Flowers are a specialized part of the stem that contain four different types of leaves: sepals, petals, stamens, and carpels.

Guide students as they read the text on page 57. Discuss with students the difference between single flowers and composite flowers. Students might find it confusing that composite flowers can sometimes look like single flowers. Provide students with many examples of each type to ensure that they are clear on the difference.

PAGE 55

Integrate Text and Visuals

Review the illustration with students. Explain to students that even though the different types of leaves are described in detail in the paragraphs on this page, the images provide a visual representation of the text that aids in comprehension. Visual representations like this one are very important in science. Visuals can help you compare different types of items, as in this case. Visuals are also useful for understanding items that are too small to see, such as atoms, or two large to see, such as the solar system.

PAGE 56

21st Century Skill: Communication

Ask students to review the diagrams in the lesson. Ask: *What purpose does each of these diagrams have? Are they the same purpose?* Help students see that different diagrams have different purposes, including describing, explaining, and giving examples. Then discuss how visual tools provide details that are critical to clear communication. Read the sidebar text with students. Invite them to work independently or in pairs to write about a topic of interest. Remind them to include critical details that help readers understand the topic. Also encourage them to provide a diagram or some other visual device to communicate content related to their topics. Encourage students to share their final work.

PAGE 57

THINK ABOUT SCIENCE ANSWER KEY

1. C
2. B
3. D
4. E
5. A

Core Skill: Apply Scientific Models

Read the text with students and work with them to answer each question. Afterward, ask students why models are so useful in science. Then write the term *computer model* on the board. Explain that a computer model is a program that simulates an event, or in other words, shows how an event happens in the real world. For example, explain that in 2007, researchers at the University of Illinois used a computer model to simulate photosynthesis, a process too elaborate and microscopic to observe in nature. Invite students to discuss the kinds of computer models they have seen or would like to see to help them understand a natural process.

PAGE 58

Photosynthesis

Photosynthesis is the process by which plants use the energy from the Sun to turn carbon dioxide and water into sugar and oxygen. Through this process, plants provide oxygen and food for all living things on the planet. Photosynthesis occurs in chloroplasts, which are organelles that are found in cells of plant leaves. Review the equation for photosynthesis with students. Clarify for students that sunlight is not an actual reactant in the reaction; rather, it provides energy that helps the reaction take place.

THINK ABOUT SCIENCE ANSWER KEY

1. sunlight
2. oxygen
3. carbon dioxide
4. water

WRITE TO LEARN ANSWER KEY

Remind students to think through every part of their journey before attempting to write. Encourage students to use the best possible type of diagram to show their journey, such as a map or a flow chart. Afterward, ask students to compare their visuals with the visuals in the lesson. Explain that the visuals in the lesson provide levels of detail and accuracy sufficient to help readers understand important concepts. Ask: *Does your visual have sufficient detail and accuracy to make it useful to someone unfamiliar with your neighborhood? What could you do to make it more useful?*

PAGE 59

Reproduction in Flowering Plants

Flowering plants have male reproductive structures (stamens) and female reproductive structures (pistils). Help students identify these structures in the illustration. Pollination is the process by which reproductive material is transferred between plants. Several organisms, such as bees, birds, and insects, can transfer pollen from one plant to another. Pollination can occur between plants or even within the same plant.

Evidence-based Reading Support: Fluency
Collaborative Reading

Read aloud the section titled *Reproduction in Flowering Plants*. Read the first sentence, and then select a student to read next. The student reads a sentence and selects the next reader. Repeat until every student has had a chance to read aloud. Assist students as needed.

THINK ABOUT SCIENCE ANSWER KEY

1. carpel
2. genetic information

Core Skill: Integrate Text and Visuals

Review the illustration on this page with the class. Lead a discussion about how the illustration, along with its labels, helps in understanding the text on the page. Be sure to point out the use of labels in identifying structures.

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 459.

Engage and Extend

ELL Instruction: Demonstrate with a 3-D Model To help students understand the parts of a flower, bring a flower to class. Help students identify each part of the flower and create labels for each part.

Extension Activity: Construct an Advertisement Have students select a particular flower and market that flower to potential pollinators. Have them develop a brochure, poster, or video that advertises the flower's merits to its potential pollinators.

Respiration

LESSON 2.2
PAGES 62–69

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Relate respiration to energy
- Identify step-by-step scientific procedures
- Describe the role of oxygen in the process of respiration
- Explain the process of cellular respiration

✓ *Determine Student Readiness*

This lesson requires students to be familiar with the process of respiration in living organisms. Students learn that oxygen is required for cellular respiration, and carbon dioxide is given off as a waste product. Ask students to describe how their bodies responded to a period of heavy exercise or rigorous sport. Prompt students to explain how their activities affected their breathing rates. Explain that these experiences are connected to what they will learn about in this lesson.

Key Concept

When you breathe, you respire, or bring oxygen into your body. This process is called respiration. There's another kind of respiration, too. Within your cells, microscopic structures use the oxygen that you respire to release the energy locked in food molecules.

Concept Background: Explain to students that respiration, or breathing, has two parts—inhalation and exhalation. Tell them that during inhalation, they breathe in oxygen, which leaves the lungs and enters the bloodstream, where it is delivered to the body's cells. The cells use it to break down sugar molecules to produce high-energy ATP molecules. The process releases carbon dioxide as a waste gas. Relate this process to students' descriptions of how their breathing changed during heavy exercise or sport. Invite a volunteer to draw a simple diagram on the board to represent the gas exchange that occurs during rest and during activity.

Develop Core Skills

Core Skill: Determine Meaning of Terms

Encourage students to explain the strategies they use when they come upon an unfamiliar science word in their work. Explain that one helpful strategy is identifying the meanings of word parts, such as prefixes, base words, and suffixes. Discuss the following example. Write the word *glycolysis* on a board or chart. Explain that the prefix *glyco–* means "sugar," and the base word *lysis* means "to split or break apart." Help students conclude that the word *glycolysis* means the "splitting or breaking apart of sugar."

Core Skill: Follow a Multistep Procedure

Remind students that scientists spend much of their time investigating problems. They follow procedures that can be replicated, or copied by other scientists. To get consistent and reliable results, scientists follow each step of a procedure exactly. Invite students to list the steps of a daily procedure, such as getting up in the morning or preparing to play a sport.

Pre-Teach Vocabulary

Respond to Questions

Organize students into groups. Give each group eight note cards with a different vocabulary word printed on each card. Have students choose among themselves which word card to take. If there are extra cards, invite students to collaborate to complete them. Provide definitions to students and have them write the appropriate definition on the back of their card. Then have them write a sentence that contains the word and makes the word's meaning clear. Have students in each group take turns reading the definitions and the sentences and having other students guess the related word.

Tier 2 Words:
aerobic (p. 63)
initiative (p. 65)
procedure (p. 64)
process (p. 62)

Tier 3 Words:
cellular respiration (p. 63)
glycolysis (p. 65)
mitochondria (p. 64)

DURING THE LESSON

PAGE 62

The Need for Energy

Explain that energy is required to do work. In cars, energy comes from fossil fuels. In humans, energy comes from the food we eat. Whether we depend on fossil fuels or food for energy, all energy begins with the Sun.

Plants make their own food through a process called photosynthesis. During photosynthesis, carbon dioxide and water chemically react in the presence of sunlight to produce sugar and oxygen. The energy that went into making the sugar is stored in the bonds of each sugar molecule. Plant cells break down the sugars to release that energy to do work. This process is called cellular respiration, or respiration. It is the opposite of photosynthesis.

Evidence-based Reading Support: Alphabetics

Word Parts

Write the word *carbohydrate* on the board. Explain that the word comes from two word parts: *carbo* + *hydrate*. Also explain that the word part *carbo* comes from the chemical element carbon, and the word part *hydro* comes from the Greek word *hydor*, meaning "water." Remind students that the chemical structure of water is H_2O, or two hydrogen atoms bonded to one oxygen atom. Explain that all carbohydrates, from simple sugars to starches, are a combination of carbon, hydrogen, and oxygen atoms. Show or project models of the chemical structures of a variety of carbohydrates and invite students to identify the carbon, hydrogen, and oxygen atoms in each structure.

PAGE 63

Core Skill: Determine Meaning of Terms

Read the explanation aloud and as a class use the word parts to define each term. Encourage students to construct and share sentences that use the words.

PAGE 64

THINK ABOUT SCIENCE ANSWER KEY

In photosynthesis, water and carbon dioxide are combined in the presence of sunlight to yield sugar (glucose) and oxygen. The opposite occurs in cellular respiration, as the molecular bonds of sugar molecules are broken to create molecules of ATP, energy-rich molecules. The process also produces carbon dioxide and water as waste.

Mitochondria

Refer to the illustration of the cell organelles. Point out the mitochondria and ask students to summarize their function. (*Cellular respiration occurs in the mitochondria.*) Ask students to explain why some cells have more mitochondria than others. (*Some cells, like muscle cells, do more work than other cells.*)

Core Skill: Follow a Multistep Procedure

Review the steps in the procedure for examining microorganisms in pond water. If possible, have students use tools and samples of pond water to complete the procedure. Discuss the value of writing numbered steps. Help students understand the value of writing explicit instructions for a scientific investigation. (*Steps make the investigation reproducible, meaning results should be similar.*)

PAGE 65

Inside the Cell

Have students summarize the steps in cellular respiration, beginning with glycolysis, which forms two molecules of pyruvate. The pyruvate molecules move into the mitochondria, where they undergo further chemical changes to produce carbon dioxide, water, heat, and thirty-eight molecules of ATP.

THINK ABOUT SCIENCE ANSWER KEY

The purpose of cellular respiration is to break the molecular bonds of food molecules to release energy, which is then stored in molecules of ATP.

21st Century Skill: Initiative and Self-Direction

Have students read the text and then explain initiative and self-direction in their own words. Invite students to give specific examples of personal initiative and explain that the result or effect of that initiative. Ask students to offer opinions on why such behaviors might be particularly helpful in the workplace.

PAGE 66

Bioremediation

Help students break apart the word *bioremediation* to understand its meaning. The prefix *bio-* means "living," and the base word *remediate* means "to correct or solve a problem." Ask students to explain how microorganisms that use pollutants as a food source contribute to bioremediation. Help students understand that bioremediation can speed up normal processes for removing contaminants from water. Encourage students to discuss the advantages of bioremediation over other technologies. (*Bioremediation is far less expensive. Students may also say that using a living organism to do the job doesn't require extra energy input, lots of equipment, or waste disposal.*)

THINK ABOUT SCIENCE ANSWER KEY

Special bacteria digested molecules of jet fuel to get the energy and nutrients they needed for growth and survival. These molecules were broken down during cellular respiration. Consequently, bacterial cellular respiration eliminated the jet fuel from the water supply.

PAGE 68

WRITE TO LEARN ANSWER KEY

Remind students to think through the process of the experiment before attempting to write. Then have them order and number the steps. If possible, have students compare their steps with a partner to determine if all necessary steps are included and ordered properly.

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 459–460.

Engage and Extend

ELL Instruction: Explain a Diagram Gather students into small groups. Encourage them to examine the close-up of a mitochondrion in the diagram on page 64 and explain cellular respiration in their own words. Students may want to number the steps they describe, either orally or on paper, as they explain.

Extension Activity: Interpret a Multistep Process

Organize students into small groups and provide drawing materials. Have students write the steps for a familiar process, such as repairing a bicycle or changing an automobile tire. Have students draw diagrams to support the directions in each step.

Fermentation

LESSON 2.3
PAGES 70–77

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Relate fermentation to energy
- Relate the absence of oxygen to fermentation
- Explain the process of fermentation

✓ *Determine Student Readiness*

In this lesson students will learn about the process of fermentation as a means of breaking the bonds of sugar molecules to harvest the energy of those bonds in the absence of oxygen. To determine their readiness for the lesson, invite students to discuss their experiences baking or observing the preparation of yeast breads, such as loaf bread, rolls, and doughnuts. Or bring in a loaf of bread, and ask students to observe the bread's texture. Ask students to predict what might cause the holes they see to form.

Key Concept

Fermentation is a process that produces energy within a cell in the absence of oxygen.

Concept Background: Explain to students that cellular fermentation is similar to cellular respiration, in that cells use the process to harvest the energy locked in the chemical bonds of sugar molecules. However, cellular respiration occurs in the presence of oxygen, so it is aerobic. Fermentation occurs in the absence of oxygen, so it is anaerobic. Ask students when they have heard or read the terms *aerobic* before. Prompt them, if necessary, to think of aerobic exercise, and that such exercise requires more oxygen intake. Then explain that the prefix *an–* means "without." Ask a volunteer to define the term *anaerobic*.

Develop Core Skills

Core Skill: Apply Scientific Processes

Remind students that science is all about identifying problems and devising methods for finding the solutions to those problems. Scientists ask questions, collect background research, form hypotheses, design investigations to test those hypotheses, analyze data, and determine if data support or reject hypotheses. Finally, scientists share the results of their work, inviting feedback from other scientists.

Core Skill: Compare and Contrast Information

Draw a Venn diagram on the board. Invite students to name any two sports, books, or movies of interest to them. Use students' selections to label the Venn diagram. Explain that a Venn diagram is a visual tool they can use to compare and contrast information. Model the process by comparing and contrasting the topics students chose. Afterward, ask students to explain why comparing and contrasting topics is an effective way to understand topics more thoroughly. Tell students that after reading the lesson, they will use a Venn diagram to compare and contrast lactic acid and alcohol fermentation.

Pre-Teach Vocabulary

Respond to Questions

Write the vocabulary words on a board or chart. Also provide the definitions. Give each student a notecard with a vocabulary word written on it. Tell each student to turn the card over and write a sentence using his or her assigned word but to leave a blank where the word belongs. Collect and shuffle the cards. Hide the answers as you read sentences aloud and invite students to fill in the blanks.

Tier 2 Words:	Tier 3 Words:	Test Words:
accountability (p 73)	anaerobic (p. 70)	compare (p. 72)
productivity (p. 73)	fermentation (p. 70)	contrast (p. 72)
research (p. 71)		

DURING THE LESSON

PAGE 70

Fermentation

Remind students that cellular respiration depends on the presence of oxygen, and the result is thirty-eight high-energy molecules of ATP. The process of fermentation also breaks down sugar molecules to harvest energy, but in the absence of oxygen. The result is far fewer ATP molecules, making fermentation a less-effective means of energy production. Write the terms *lactic acid fermentation* and *alcohol fermentation* on a board or chart. Explain to students that they will learn more about these common kinds of fermentation.

Evidence-based Reading Support: Fluency

Model Fluent Reading

Remind students that each punctuation mark in a text serves a purpose. Review the first paragraph on page 70 as a class, asking students to identify the places where commas appear. Ask students what those commas tell a reader to do. Then ask students to listen as you read the paragraph aloud, first reading while ignoring the commas and then reading while acknowledging the commas. Afterward, ask students to describe the differences in what they heard. Invite volunteers to read the paragraph again, modeling fluent reading.

PAGE 71

THINK ABOUT SCIENCE ANSWER KEY

Your muscle cells couldn't get enough oxygen for cellular respiration to occur, so lactic acid fermentation began. The process produces lactate as a waste product. This waste product builds up in your muscle cells, causing a burning sensation. The sensation disappears after your breathing returns to normal and your muscle cells get the oxygen they need to resume cellular respiration.

Core Skill: Apply Scientific Processes

Invite students to discuss professionals who conduct investigations, collect data, or information, and form hypotheses, or conclusions based on that data. Students may say, for example, that police officials conduct investigations to gather data and come to some conclusions about specific crimes. Companies hire chemists and engineers to collect data on new products to be sure they are safe for consumers. Help students understand that no matter the purpose of their work, these professionals follow similar procedures to be sure their conclusions are valid. Read the text in the Core Skill with students. Then organize students into small groups, and have each group draw and label the steps in the scientific process. Encourage students to share their work.

PAGE 72

Core Skill: Compare and Contrast Information

After students have completed the investigation, ask them to use print, online, or other resources to find a similar experiment to observe the process of fermentation. Invite volunteers to describe similarities and differences between the investigation they conducted and the investigations they found. Ask students to consider the similarities and differences to offer suggestions for improving the investigation they conducted.

PAGE 73

Ethanol: An Alternative Energy Source

Help students understand the meaning of the term *nonrenewable resource* in the context of using fossil fuels as an energy source. Then ask them why scientists continue to seek alternative energy sources. (*Fossil fuels cannot be replaced, but the demand for energy will only grow greater as the world's population grows.*) After students read the text, ask volunteers to offer their opinions on the use of food crops as fuel alternatives.

Engage and Extend

ELL Instruction: Explain a Diagram Gather students into small groups. Encourage them to recall the "Blow Up a Balloon" experiment. Ask students to use their own words to explain why the balloon inflated. Invite students to write simple sentences or draw illustrations to support their explanations.

THINK ABOUT SCIENCE ANSWER KEY

Photosynthesis helps plants such as corn to grow. Corn and other plants with high sugar content are taken to an ethanol processing plant where alcohol fermentation produces ethanol. Gasoline is added to the ethanol to produce a fuel for operating cars and other machinery, producing carbon dioxide as a waste product. Carbon dioxide is a necessary ingredient in photosynthesis.

21st Century Skill: Productivity and Accountability

Write the words *productivity* and *accountability* on the board or on a chart. Ask students to explain what they think each word means. Guide their responses to help them understand that productivity is the effective use of time and resources to produce a result, and accountability is personal responsibility for making something happen. Encourage students to give examples of times they have been both productive and accountable. Then have them read the text and explain how their behaviors are similar to the behaviors of scientists.

PAGE 74

WRITE TO LEARN ANSWER KEY

Remind students to read carefully before beginning to write. Encourage them to think in terms of their own experiences as they 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 page 460.

Extension Activity: Write an Explanation of a Process

Encourage students to learn more about yeast, a microscopic fungus that reproduces rapidly in certain conditions. Have them work in pairs, small groups, or independently to learn how yeast are manufactured for use in baking. Ask students to collaborate to write an explanation for how yeast work in the baking process.

Ecosystems

LESSON 3.1
PAGES 88–95

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Understand the organization of ecosystems
- Describe interactions between organisms
- Identify biomes of the world

✓ *Determine Student Readiness*

Determine students' readiness for learning by discussing prior knowledge about how organisms interact with their environment. Remind students that the word *organisms* includes not only animals but also plants and even microorganisms. Ask students to start by thinking about the environment outside their school. Then have them consider environments that are very unlike the school environment. Lead a discussion with the class about how the nature of the environment affects the organisms that live in it.

Key Concept

Within an ecosystem, organisms interact with one another and with nonliving things in their environment.

Concept Background: Ask students to think of examples of ways they interact with their environment at home, at school, or at work. Remind students that they interact with other people, with furniture, with appliances and other machines, with the air they breathe, and with the water and food they ingest. Discuss cause-and-effect relationships among these interactions and what the consequences of removing items from these environments might be.

Develop Core Skills

Core Skill: Analyze Author's Purpose

Ask students to recall something they wrote recently, whether for a class or for personal reasons. Prompt students to talk about their purpose for writing, that is, what they intended to communicate in their work. Help students recognize that all authors have a reason for writing. Brainstorm some purposes that prompt authors to write, such as to entertain, to explain a process, and to persuade readers to do something. Explain to students that analyzing text to identify an author's purpose relates to improved media literacy.

Core Skill: Understand Text

The study of ecosystems includes learning many interrelated words that must be understood in relation to each other. Provide students with copies of the *Vocabulary Map* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students fill in these maps as they read the lesson. Have students create an additional section on each map where they can indicate a word's relationship to other words in the lesson.

Pre-Teach Vocabulary

Word Study: Relate New Words

Tell students that a good way to build vocabulary is to relate new words to words or concepts they already know. Have students work in pairs to determine whether some of the vocabulary words are similar to words they already know. As a class, discuss the relationship between the familiar words and the vocabulary words.

Tier 2 Words:	Tier 3 Words:	Test Words:
environment (p. 88)	biome (p. 91)	prediction (p. 92)
interact (p. 88)	biosphere (p. 88)	
	ecosystem (p. 88)	
	food chain (p. 90)	

DURING THE LESSON

PAGE 88

Communities of Living Things

Students are probably familiar with the common usage of the word *community*. Help students to understand that *community* has a specific meaning in science: all the organisms that are in an environment. Many populations can live in a community. Each population has its own habitat in which it fills its own niche.

THINK ABOUT SCIENCE — ANSWER KEY

1. biosphere
2. habitat
3. community
4. niche

Evidence-based Reading Support: Alphabetics

Prefixes

Write the words *prefix* and *suffix* on the board. Explain that prefixes come before a base word, and suffixes come after the word. Point out the prefix *bio–* in *biome* and *biosphere*. Tell students the prefix *bio–* means "life." Ask students to list other words they can think of with the prefix *bio–* (*biology*, *biography*).

PAGE 89

Analyze Author's Purpose

Review the two numbered passages with students. Help students understand that most of the time in science textbooks, the author's purpose is to inform and educate. Ask students to identify words they could look for in any kind of passage that might provide clues that the author has a purpose other than to inform.

PAGE 90

Energy Cycles

The Sun is the source of energy for every living thing on Earth. Have students examine the illustration to see how the Sun's energy circulates through a food chain. Make sure that students understand the differences between food chains and food webs. Challenge students to name other chains and webs involving different organisms.

THINK ABOUT SCIENCE ANSWER KEY

1. producers
2. If there were no decomposers, dead material would not be decomposed and necessary nutrients would not be returned to the soil.
3. If the number of grasshoppers decreased, the voles would have to find another food source, or their numbers might decrease due to lack of food. This, in turn, could reduce the number of hawks.

21st Century Skill: Social and Cross-Cultural Skills
Write the words *independently* and *collaboratively* on the board. Ask students to explain what these words mean when they are applied to how people work. Invite students to give examples of times they have worked collaboratively to complete a project. Then read the text in the sidebar as a class. Ask students to consider the text and the examples they shared to answer the following questions: *How do sharing your ideas and considering people's responses to those ideas challenge you to be more creative? How does sharing responsibility for completing a task increase a group's productivity?*

PAGE 91

Biomes

Guide students as they read the text. Discuss with students the differences between the different types of biomes. Ask students which type of biome they live in now. If any students have visited one of the other types of biomes, encourage them to share with the class how that biome differs from the one they live in currently and how well it matches the description provided here.

The ocean biome is the largest on Earth. Ask students to consider how different ocean organisms are compared with land organisms. Have them reflect on how the environment in which an organism lives shapes its adaptations to the environment. Then have students similarly compare the differences between animals that live in the ocean versus those that live in freshwater areas.

Core Skill: Analyze Author's Purpose
Reviewing the way the text is structured can be helpful in analyzing an author's purpose. Have students review the information about biomes on this page and the next. Ask students whether they think the author had a purpose in organizing the biomes in the order shown. Have students provide the reasoning behind their answers.

PAGE 92

THINK ABOUT SCIENCE ANSWER KEY

1. F
2. A
3. E
4. D
5. C
6. B

WRITE TO LEARN ANSWER KEY

Have partners exchange their predictions about biomes and tell why the predictions did or did not match the text.

PAGE 93

Protecting Biomes

Biodiversity is important to the health of the planet and to the success of all species. Have students refer to the illustration on page 90 as they read the information in the "Ecology" section about predators, prey, producers, consumers, decomposers, and scavengers.

Ecology

Read the first sentence aloud. Then write the following words on the board: *predator*, *prey*, *producer*, *consumer*, *scavenger*, and *decomposer*. Organize students into small groups, and give each group a large sheet of drawing paper. Have students read and discuss the text as a group. Then have them collaborate to create a model of an ecosystem they have read about in this lesson. Tell students to include and label at least one example of each of the words you wrote on the board. Afterward, have students share and explain their drawings. Ask questions to be sure students can differentiate among the roles organisms play in an ecosystem.

Core Skill: Understand Text
Read the text as a class. Then ask students to think about the ecosystem models they created and the labels they used to identify organisms in their models. Ask students to explain the relationship between the labels in their models and jargon. Invite students to share other examples of texts they have read that contained jargon. Ask students to explain the value of identifying and interpreting jargon before they use a product.

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 463.

Engage and Extend

ELL Instruction: Using Reference Sources to Understand Meaning Tell students that a thesaurus is a good reference source. Have them look up vocabulary terms they do not know to locate synonyms that are more familiar. Have them use those synonyms in meaningful sentences, and then replace those familiar terms with the lesson vocabulary term.

Extension Activity: Identify Stages of a Food Chain
Have students select a particular biome, such as a desert. Have them create a diagram of a typical food chain within that biome. The food chain should include a producer, an herbivore, and a carnivore. Invite students to present their diagrams to the class in a creative way.

Carrying Capacity

LESSON 3.2
PAGES 96–101

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify limiting factors that affect carrying capacity
- Identify different kinds of relationships within a habitat
- Explain the relationship between equilibrium and carrying capacity

✓ *Determine Student Readiness*

This lesson requires students to explain the concept of carrying capacity. To determine their readiness for the lesson, write the words *serving size* on the board, and ask students to describe where and when they have seen those words. Ask students to imagine that they have opened a package containing two serving sizes, but they must share the contents among four people. Have students explain some of the possible consequences of having fewer servings than are needed.

Key Concept

A habitat's limited ability to support the living things within it is called its carrying capacity. Carrying capacity is shaped by limiting factors in the environment.

Concept Background: To understand the concept of carrying capacity, students need to fully grasp the concept of an ecosystem and of habitats of varying sizes within ecosystems. A habitat is the place where a population lives. An ecosystem is a collection of populations of different plants and animals that occupy and interact within a physical environment, either on land or water. The largest terrestrial ecosystems, or biomes, include different kinds of grasslands, deserts, forests, and alpine or mountain biomes. Ask students to identify the largest ecosystem in which they live. For example, the town or city in which students live may be on a prairie or in the foothills of a mountain ecosystem. Ask students to describe the physical environment and to name some of the organisms that live in the ecosystem.

Develop Core Skills

Core Skill: Cite Textual Evidence

Explain to students that writers don't always explicitly tell readers all the information provided in a text. Nor can writers anticipate all of the questions readers might have. So it is important to look for clues in text, or textual evidence, when trying to answer questions. Share or project an article from the school or local newspaper that would be of interest to students. Read the article aloud, and then ask a series of questions. Challenge students to locate specific text evidence to answer the questions.

Core Skill: Understand Text

Remind students that it is helpful before beginning to read a science text to skim the text in search of unfamiliar terms. Explain that defining these words before reading makes reading easier. Also explain that parsing, or chunking text, is another effective strategy for understanding text. When students parse, they disassemble complex sentences into manageable parts that they can restate in their own words. Then they can reassemble the parts to make meaning of the whole. Share or project a brief text of interest to students. For example, select a print or digital news brief about a recent science discovery. Ask students to scan the text in search of unfamiliar words, define the words, and restate them. Then invite volunteers to demonstrate specific places in the text where parsing makes the text more understandable.

Pre-Teach Vocabulary

Word Study: Find Personal Connections

Write the vocabulary words and their definitions on the board. Review the words and their meanings before organizing students into small groups and giving each group a large sheet of drawing paper. Ask students to draw a local ecosystem, such as a garden on the school campus, or a nearby park, river, or lake. Have students work together to create images that represent as many of the vocabulary words as possible. Give students time to share their work and explain the representations.

Tier 2 Words:	Tier 3 Words:	Test Words:
exceeded (p. 97)	carrying capacity (p. 96)	concept (p. 100)
equilibrium (p. 97)	limiting factor (p. 96)	
habitat (p. 96)		
jargon (p. 98)		
population (p. 96)		

DURING THE LESSON

PAGE 96

Carrying Capacity

Read the text with students, pausing after each paragraph to ask volunteers to summarize the text. Invite a volunteer to explain the similarities between a dinner party with too many guests and a habitat's carrying capacity. Ask other volunteers to explain how limiting factors affect them and others in their community. Engage in a discussion of what happens to people when weather, natural disasters, and human activities reduce the quantity or quality of a critical resource, such as water. Ask questions such as: *What kinds of limiting factors affect humans? How do humans respond to shortages of critical resources? How do human behaviors affect limiting factors for themselves, as well as other living things?*

Evidence-based Reading Support: Vocabulary
Forms of a Word
Write the word *habitat* on the board. Next to the word, write: *from the Latin word* habitare, *meaning "it dwells, or lives."* Ask a volunteer to define the term as it is used in the lesson. Next, write the following words on the board: *habit, habitable, habitual, habitation, inhabitant,* and *habilitate.* Read the words aloud. Remind students of the origins of the word *habitat*, and then ask them to use that meaning to define the terms you listed. Offer examples of sentences using the related words to guide student understanding. Ask students to explain how knowing a word's history can help them define related words.

PAGE 97

Relationships in a Habitat
Choose two organisms that live in your area. Ask students to explain what they know about the relationship between those organisms. Do they compete for resources? Is one a predator, and the other prey? Ask students to use the organisms you selected to explain equilibrium.

THINK ABOUT SCIENCE ANSWER KEY

Equilibrium doesn't occur in a single moment. Balance is achieved only over time, and even then there will be slight increases and decreases in population numbers.

Core Skill: Cite Textual Evidence
Ask students to read the text and identify supporting evidence before discussing changes to the moose population as a class. Invite students to share their answers and the evidence they used to construct those answers. If students provide answers without citing evidence, have them skim the text again, and if necessary, revise their answers.

PAGE 98

Reindeer on the Pribilof Islands
Organize students into pairs and encourage them to read and summarize the text. Remind them to identify the factors that affected the reindeer population on St. Paul Island and to include the term *carrying capacity* in their summaries. Then invite them to share and compare their summaries.

Core Skill: Understand Text
Before students do the activity, ask them to give examples of jargon associated with math, history, art, or any other area of study. Begin by providing a few common examples from a particular discipline, such as *equation*, *variable*, *area*, *perimeter*, and *volume* from mathematics. Then have students read the text before inviting them to describe what they would do first in an attempt to parse the text to define the jargon. Then have volunteers restate the text in their own words.

PAGE 99

THINK ABOUT SCIENCE ANSWER KEY

The reindeer were isolated on an island, where they relied on lichens for food. They consumed the food faster than lichens could grow back in such a harsh environment, and there was no way for the reindeer to leave the island to find food elsewhere. Consequently, the population fell dramatically as reindeer died of starvation and disease. Refer to the graph in the Answer Key for a visual representation of change over time.

Dietary Diversity
Have students read the text. While they are reading, draw two circles on a board or chart. Label the circles *Otters on San Nicolas Island* and *Otters off the Central Coast*. After students have finished reading, ask volunteers to write what they learned about the eating habits of each group of otters inside the circles. Ask volunteers to refer to the content in the circles as they explain dietary diversity.

Workplace Connection: Wildlife Management
Ask a volunteer to read the text aloud. Then ask students to explain the responsibilities of a wildlife manager. Remind students that some managers may mark and track wildlife movement in an ecosystem. Encourage students to discuss what managers can learn about animals by monitoring their movement.

PAGE 100

WRITE TO LEARN ANSWER KEY

Work with students to identify possible areas in the community where humans are putting pressure on environmental resources or species. Then select one of the areas and ask students to apply the concepts of limiting factors and carrying capacity to describe what might be happening there.

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 463–464.

Engage and Extend

ELL Instruction: Explain a Diagram Encourage students to describe the diagram of the sea otter's dietary diversity in their own words. Explain any words in the diagram that are unfamiliar to students while drawing their attention to the pictures. Cover one or more of the foods in the diagram and ask students to explain the consequences of removing these organisms from sea otters' diets.

Extension Activity: Sketch Your Plan
Provide graph paper and drawing materials. Have students use the paper and materials to develop the ideas they presented in *Write to Learn*. Ask students to draw the area they wrote about and show how organisms are affected by human activity. Encourage students to share and compare their work.

Symbiosis

LESSON 3.3
PAGES 102–109

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Define symbiosis
- Describe mutualism, commensalism, and parasitism
- Give real-world examples of each type of symbiotic relationship

✓ *Determine Student Readiness*

This lesson requires students to be familiar with biotic and abiotic factors in the environment. To determine their readiness, write the words *living* and *nonliving* on the board. Ask students to describe some of the living and nonliving things they see around them. Record their responses on the board. Then have students go beyond the classroom to consider spaces on the school campus. Continue adding students' examples to the lists on the board.

Key Concept

The term *symbiosis* describes specific kinds of relationships between organisms in the same environment.

Concept Background: Explain to students that in any ecosystem, living things interact with each other and with the physical environment. These organisms are constantly competing for resources, such as food, water, and shelter. Organisms live symbiotically, or with other living things. The relationships that organisms share may benefit both, harm one organism, or help one while having no effect on another. Ask students to think of examples of familiar symbiotic relationships within a family, such as a parent and child or two siblings. Invite students to talk about how the two members of those relationships interact and help or benefit one another.

Develop Core Skills

Core Skill: Identify Hypotheses

Remind students that a hypothesis is a possible answer to a scientific question. Explain that it is based on prior research and many observations. To help students conceptualize the term *hypothesis*, ask them to describe what they know and have observed about spoiled milk. Then ask them what hypothesis they might form from this observation. (*Does refrigeration slow the spoiling of milk?*)

Reading Skill: Summarize Text

Remind students that a summary is a short restatement of the main points of a text. When you summarize, you try to use the fewest possible words to present the most important information in a text. This is done by focusing only on key ideas and ignoring unnecessary details or examples. You may want students to practice their summarizing skills by summarizing the text about allergic reactions and interactions in an ecosystem at the beginning of the lesson.

Pre-Teach Vocabulary

Word Study: Illustrate Word Meanings

Write the vocabulary words and definitions on the board. Review the words and their meanings with students before distributing drawing materials, and invite students to work in pairs or small groups to illustrate the words. Encourage students to explain their finished drawings and discuss the different ways groups chose to illustrate the meanings of their words.

Tier 2 Words:	Tier 3 Words:	Test Words:
host (p. 103)	antibodies (p. 104)	summarize (p. 106)
mutualism (p. 103)	symbiosis (p. 102)	
parasite (p. 104)		

DURING THE LESSON

PAGE 102

Evidence-based Reading Support: Alphabetics

Word Parts

Write the word *symbiosis* on the board. Underline the base word *bios*. Explain that its history is Greek, and means "one's life, or way of living." Next, explain that letters attached to the beginning and end of a base word, or affixes, change the meaning of the word. Letters attached to the beginning are called prefixes. Circle the prefix *sym–* and explain that it means "together." Explain that letters attached to the end of a word form a suffix. Circle the suffix *–is*. Explain that it most closely means "having the character of." Ask students to use their understanding of the word parts to define the term *symbiosis*.

Interactions Among Living Things

Write the word interaction on the board, and explain to students that the prefix *inter–* means "between." Ask students to use this knowledge to define the term on the board. Then ask them to visualize a garden, either on the school campus, in a park, or at home. Prompt students to describe some of the living things in the garden and to explain how they interact. For example, students might say that flowers have colors, shapes, and scents that attract butterflies, and butterflies sip nectar from flowers and help them reproduce by transporting pollen from flower to flower. Read the text in this section with students, and ask a volunteer to explain why certain flowers and butterflies are an example of symbiosis.

Mutual Symbiosis

Point out to students that a relationship between two organisms, such as a bee and a flower, that benefits both species is an example of mutualism, or mutual symbiosis. Ask students if they can name other such relationships.

PAGE 103

Termites and Bacteria
Have students read the text independently and then ask volunteers to tell you what the most important information in the text is. Record students' responses on the board or a chart, and then ask students which ideas they would use in a summary of the text.

THINK ABOUT SCIENCE **ANSWER KEY**
The relationship must be beneficial to both organisms.

21st Century Skill: Critical Thinking and Problem Solving
Invite volunteers to talk about the university website they researched. Have students identify their chosen universities and describe the kinds of science investigations that are being conducted there. Ask them to state the hypotheses university scientists are studying and the methods they're using. Encourage students to talk about the investigations that most intrigue them.

PAGE 104

Acacia Trees and Ants
Refer to the photograph on the page. Ask volunteers to explain how the relationship between the ants and the acacia trees is mutually beneficial. (*The ants live inside acacia thorns and sting animals that attempt to eat the trees' leaves.*) Ask students to explain why acacia trees need ants. (*The trees do not produce chemical defenses to protect them from animals that strip leaves and slow growth.*)

Oxpeckers, Rhinos, and Zebras *and* Humans and *E. coli*
Have students read these sections and compare the relationship that rhinos and zebras have with oxpeckers and the relationship humans have with *E.coli*. (*Zebras and rhinos and humans are hosts to organisms with which they have a mutual beneficial relationship. Oxpeckers remove and eat harmful pests from the hides of zebra and rhinos. E.coli live in a human's digestive system, absorbing nutrients while they help with digestion and provide protection from harmful bacteria.*)

Parasitic Symbiosis
Explain to students that parasites get nutrients from their hosts and in doing so, harm the hosts. Point out that there are two main kinds of parasites. Endoparasites live inside an organism's body. Ectoparasites live on the host's skin. As they read through page 105, ask students to classify the tick and the tapeworm as either an endoparasite or an ectoparasite. Ask students to justify their choices.

Engage and Extend

ELL Instruction: Summarize and Illustrate Organize students into small groups. Have students reread different sections of the text aloud ("Mutual Symbiosis," "Parasitic Symbiosis," and "Commensal Symbiosis") and explain what they have read in their own words. Have them select one section to label and illustrate.

Core Skill: Identify Hypotheses
Read the sidebar text aloud. Give students time to consider the scientists' observations of the acacia trees and form hypotheses. Invite students to share their ideas. Record their ideas on the board. (*Acacia trees do not have a mutually beneficial relationship with the different kind of ant.*)

PAGE 105

THINK ABOUT SCIENCE **ANSWER KEY**
Foodborne and waterborne parasites are endoparasites because they live and reproduce within the tissues and organs of infected human and animal hosts.

PAGE 106

Commensal Symbiosis
Explain that commensal symbiosis, or commensalism, happens when one species benefits from a host, but the host is unaffected. Have students read these sections and take notes. After reading, ask students to make a chart summarizing the three commensal relationships in these examples.

THINK ABOUT SCIENCE **ANSWER KEY**
The burs stick to the fur of a passing animal, allowing the seed to travel and be dispersed in a new area in which to grow. The animal is not affected, and the bur plant is able to reproduce.

Reading Skill: Summarize Text
Remind students to think about *what*, *why*, and *how* as they reread their summaries. Tell them to be sure these three questions are addressed.

PAGE 107

WRITE TO LEARN **ANSWER KEY**
Remind students to think through the different kinds of symbiosis before writing. Students should describe the interaction of the mother and the puppy before identifying the kind of symbiotic relationship the two share. Mothers and offspring have a parasitic relationship, as developing fetuses and newborns depend on the mother for resources, leaving fewer resources for the mother.

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 464–465.

Extension Activity: Hypothesize and Propose an Experiment Have students review the lesson and the organisms mentioned in it. Invite students to choose an organism, ask a question that can be answered through an investigation, form a hypothesis, and propose an experiment. You may want to ask students to write their hypotheses and proposals.

Disruption

LESSON 3.4
PAGES 110–117

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify laws of ecology
- Give examples of environmental disruptions
- Explain the consequences of disruptions

✓ *Determine Student Readiness*

Determine students' readiness by engaging them in a discussion about what keeps an ecosystem healthy. Write different scenarios on note cards: mouse population in a field ecosystem grows too large; a wetland undergoes a dry period; a mountain ecosystem has too many predators; a desert ecosystem's cactus plants die off; and so on. Gather students into groups and give each group a note card. Ask students to read their scenarios and describe how equilibrium might be restored.

Key Concept

A disruption is a change that greatly alters an environment. Disruptions transform environments. In some cases, one ecosystem can temporarily or permanently replace another. In other cases, an ecosystem can become degraded, making it unfit for living things. Still other ecosystems are destroyed altogether.

Concept Background: Remind students that an ecosystem includes both living and nonliving factors. Point out that in an ecosystem, organisms interact with one another and with their physical and chemical environment. Organisms depend on the stable functions of each other and the water, gases, and chemicals that cycle through the ecosystem. Invite volunteers to describe the living and nonliving elements of an ecosystem they have visited or would like to visit.

Develop Core Skills

Reading Skill: Determine Meaning

Explain to students that scientists have their own special vocabulary of terms, or jargon. Explain that many of these terms have Latin or Greek origins and that understanding the meanings of common affixes and base words can help students determine the meaning of unfamiliar words. Write the word *disruption* on the board and explain that this word came from the Latin word *disrumpere*. Explain that the prefix *dis–* means "apart" and the base *rumpere* means "to break." Ask students to use the Latin origins to define the word *disruption*.

Core Skill: Cite Textual Evidence

Remind students that textual evidence includes the facts, statistics, expert opinions, anecdotes, and examples that answer or support a conclusion, a question, or an argument. Tell students that they can use textual evidence to find the answers to questions or to support a conclusion. Share a brief news article with students and ask them to identify the article's conclusion, question, or argument. Then challenge students to point out the specific statements in the article that serve as evidence supporting the conclusion, question, or argument. Tell students that they will learn techniques to help them identify similar kinds of evidence in science texts that they read.

Pre-Teach Vocabulary

Predict Meanings

Write the vocabulary words on the board. Next, write the following word parts and meanings on the board: *a–* "*not*, without;" *de–* "un, down;" *en–* "make, put in;" *in–* "in;" *bio–* "life;" *di–* "apart." Ask students to help you use the meanings of the word parts to predict the meanings of the words. Write students' responses on the board. As students progress through the lesson, revisit their predictions, giving students time to revise their predictions.

Tier 2 Words:	Tier 3 Words:
degradation (p. 114)	abiotic (p. 110)
destruction (p. 114)	biodiversity (p. 113)
endangered (p. 114)	biotic (p. 110)
fragmentation (p. 114)	invasive species (p. 112)
threatened (p. 114)	

DURING THE LESSON

PAGE 110

The Laws of Ecology

Write the words *biotic*, *abiotic*, and *ecologists* on the board. Read the words aloud and ask students to find them in the text. Have students skim the text to define each term. Then read the text as a class.

Afterward, ask volunteers to summarize the four basic laws of ecology as described by ecologist Barry Commoner.

PAGE 111

Responding to Change

Write the word *disruption* on the board. Read the word aloud and explain that a disruption is an interruption or break in activities or processes. For example, remind students that living organisms interact constantly with each other and with the nonliving parts of their environments. Things can happen that disrupt, or break, these normal interactions. Read the text as a class. Then ask students to skim the lesson to identify the specific examples of disruptions they will read about.

Fire and Floods as Disruptions

Refer students to the photograph and ask them to predict how fire disrupts an ecosystem. Before reading the text together, ask students to mark or write down important details in the text. Afterward, draw a table with two columns on the board. Title the table *The Effects of Fire* and label the columns *Harmful* and *Helpful*. Ask students to use their notes to help you complete the table.

Reading Skill: Determine Meaning

Ask students to think of their favorite sport or hobby. Encourage them to give examples of words that are unique to those activities, such as *foot fault* and *stoppage time* in soccer. Explain that most areas of interest and study have unique vocabulary associated with them. Read the text aloud and give students time to find and mark words on the first three pages of the lesson that use specialized words. Recall the word parts and meanings you have already studied to help define certain words. Remind students to mark other words as they continue reading.

PAGE 112

THINK ABOUT SCIENCE ANSWER KEY

Answers will vary. Sample answers:

Advantages

Some plants release their seeds.
Burned vegetation adds nutrients to the soil.
Microbial activity in the soil increases.
Scavengers come in search of food.
Seeds are released.

Disadvantages

Water-repellent soil can lead to erosion.
Small animals, insects, and sick or old organisms may die.
Displaced species may not be able to return immediately.

Introduced Species as a Disruption

Write the word *invade* on the board. Explain that the word comes from the Latin word *invadere*, meaning "to attack; enter; assault." Next, write the term *invasive species* on the board and ask students to predict its meaning.

Before reading the text as a class, write the following questions on the board: *What are three examples of invasive species? What effects did they have on their new environments?* Read the questions aloud and tell students to find the answers as they read. Read the text as a class. Afterward, discuss the answers to the question.

Engage and Extend

ELL Instruction: Use a Graphic Organizer Gather students into small groups. Ask students to reread Commoner's laws of ecology presented on page 110 and explain them in their own words. Have students make a four-column chart with a column for each law. Then have students draw or write an example of each law in the chart.

PAGE 113

Evidence-based Reading Support: Fluency Repeated Reading

Ask students to read aloud with you as you read "Introduced Species as a Disruption" (beginning on page 112) several times. Tell students to pay special attention to how the punctuation marks, introductory terms such as *sometimes* and *however*, and introductory phrases that signify time-order sequence all affect the way you read. Emphasize accuracy and phrasing until the group reading sounds smooth and consistent.

THINK ABOUT SCIENCE ANSWER KEY

Humans are constantly moving into new environments. Like other invasive species, they compete with native species for resources, including space. Also, like invasive species, they change the environment, making it difficult or impossible for native species to remain.

Habitat Loss as a Disruptive Force

Write the following questions on the board: *How are habitat degradation and habitat destruction different? How does fragmentation affect wildlife? What are some leading causes of habitat destruction?* Organize students into small groups and have each group read and discuss the text in search of answers to the questions.

21st Century Skill: Media Literacy

Have students read the text and then share how they find reliable media sources. Ask students to give factors that indicate whether a website or resource is trustworthy. Invite students to explain why being media literate is important to their work and their roles as citizens.

PAGE 114

Core Skill: Cite Textual Evidence

Give students time to read the text and complete the activity. Encourage students to share specific examples of text evidence that supports the IUCN's conclusion.

PAGE 115

WRITE TO LEARN ANSWER KEY

Invite students to share their explanations for ways governments can use biodiversity measures to make decisions. Encourage students to discuss how the measures may or may not influence decision making.

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 465–466.

Extension Activity: Collect and Display Data Organize students into small groups. Have them use print and online media to find examples and nonexamples of disruption as it relates to ecosystems. Have students organize their research into tables and encourage them to share their work.

Environmental Issues

LESSON 3.5
PAGES 118–125

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Distinguish between nonrenewable and renewable resources
- Identify types of pollution
- Understand the effects of human activities on the environment

✓ *Determine Student Readiness*

Draw a two-column chart titled *Resources*. Ask students to name resources they use regularly, such as water and gas. Place renewable resources in the left column and nonrenewable resources in the right. Do not tell the students which column is which. After the list is made, ask students to explain the difference between the two columns.

Key Concept

Increased human population makes increased demands on Earth's resources and adds to pollution in the environment.

Concept Background: Discuss with the class recent news concerning pollution, the use of natural resources, and the environment. Encourage students to offer personal knowledge and experience with recycling, pollution, climate change, or other environmental issues. Return to the discussion, as appropriate, as you go through the lesson.

Develop Core Skills

Reading Skill: Distinguish Between Facts and Speculation

Write the word *speculation* and its definition on the board: a conclusion or opinion reached by conjecture. That is, *speculation* is something that a person thinks is true, but the truth has not been verified. Have students take turns stating sentences that are fact and speculation. For example: The car under the tree is brown. (*fact*) The car under the tree hasn't been washed in months. (*speculation*)

Core Skill: Cite Textual Evidence

Invite students to share what they know about the fictional character Sherlock Holmes. If students are unfamiliar with the character, share your knowledge or show a trailer from a recent movie. Emphasize that Holmes, who is a detective, seeks evidence that will lead him to the solution of a crime. Ask students to define the term *evidence*, helping them recognize the word as meaning a body of information that can be used to determine the truthfulness of a conclusion, or judgment. Ask: *Why is it critical to use evidence you find in texts to support your thinking, your conclusions, or your judgments?*

Pre-Teach Vocabulary

List Examples

Write the vocabulary words and definitions on the board. Review the words and their meanings with students. Then ask them to work with a partner. Have partners select one word from the list on the board and write it inside a circle drawn in the middle of a piece of paper. Then have them surround the word with examples. Encourage students to share their ideas with the class. In cases where students chose the same word, discuss the different examples that help explain the word's meaning.

Tier 2 Words:
climate (p. 123)
fact (p. 119)
speculation (p. 119)

Tier 3 Words:
conservation (p. 120)
natural resources (p. 119)
pollution (p. 120)

DURING THE LESSON

PAGE 118

Environmental Problems

Have students review the graph titled *Human Population Growth* and read about how the human growth rate has affected the environment. Ask students to give examples of how humans have impacted their local ecosystems, both through population growth and through other activities.

Help students to understand that natural resources are those things that we use to survive: air, water, and food, for example. Resources can be either renewable or nonrenewable. Have students distinguish between renewable and nonrenewable resources, and encourage students to discuss conservation methods.

Pollution is man-made waste that contaminates the environment. Humans create a lot of trash every year. Discuss with students the graphs on pages 118 and 120. Have them compare these graphs. What can be inferred by observing the similar slopes of these graphs?

Evidence-based Reading Support: Comprehension

Preview the Lesson

Write the word *preview* on the board. Underline the base word *view*, and ask students to provide a synonym, or word with a similar meaning. Then circle the prefix *pre–*, and explain that when these letters appear before a base word, they mean "before." Ask students to explain what people do when they preview a text, such as a lesson in this book. Then organize students into pairs. Give students time to work with their partners to preview the lesson. Tell them that they are going to read titles, subtitles, boldfaced words, and visuals to find clues as to what the text is about. Afterward, give students time to share the clues they found. Explain that previewing a text before reading is an effective comprehension strategy they can apply with any text.

PAGE 120

Pollution

There are different kinds of pollution, and they affect different parts of the environment. Garbage is solid waste from homes, businesses, and other locations. Hazardous wastes come from the chemicals that are produced and used. Air pollution occurs when pollutants enter the atmosphere. Water pollution collects in ponds, lakes, and other bodies of water.

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

Have a class discussion to learn about the results of students' research on satellite technology. Discuss with students that while satellites give us the technology to study what is happening to polar ice caps and glaciers, it does not give us the means to change what is happening. Have students do further internet research to determine ways that scientists propose we can slow or stop polar ice melting.

PAGE 121

THINK ABOUT SCIENCE **ANSWER KEY**

1. Death rate decreased due to improvements in health care, agriculture, and sanitation; birth rates increased.
2. Nonrenewable resources cannot be replaced in our lifetime; renewable resources can be replaced within an average lifetime.

Reading Skill: Distinguish Between Facts and Speculation

Tell students that when researching information about environmental problems, they must be very careful to distinguish between facts and speculation in the materials they find. When doing online research, students should rely mainly on websites that end in ".gov" or ".edu" to ensure they are reviewing research that can be relied on to be factual and objective.

PAGE 122

Uses of Land and Water *and* Endangered Species

Population growth means increased use of land and water. This can have lasting effects on these resources. Laws are in place to govern our use of resources. But these policies can be controversial. Another environmental issue facing us is the loss of species due to overhunting and other activities. The current list of endangered species is long. When all the members of a species die, that species becomes extinct.

Engage and Extend

ELL Instruction: Practice Accuracy Invite students to take turns closing their eyes and pointing to a word on a page. Have them read the word silently and then clap once for each syllable in the word, saying the word aloud at the same time. Help students understand that by recognizing syllables in words, they are better able to read word parts instead of individual letters, which leads to greater fluency.

THINK ABOUT SCIENCE **ANSWER KEY**

1. C
2. D
3. B
4. A

Core Skill: Cite Textual Evidence

Have students compare their answers to the Core Skill activity on this page. Have students discuss the conservation methods that have helped the American bison and bald eagle recover. Have students work together to learn more about some of the other animals listed in this section.

WRITE TO LEARN **ANSWER KEY**

Review with students that cause and effect relationships do not begin and end with one event but continue on, with the effect becoming the cause of another effect, and so on. Have students treat the effect from their original paragraph as the cause of the next event and write another paragraph following the same rules as before.

PAGE 123

Global Climate Change

There is evidence that temperatures around the world are rising and that climates are changing. Make sure that students understand that "global warming" does not *just* mean that the Earth is getting hotter. The term *global climate change* is a more accurate name because it encompasses the drastic weather changes—hotter and colder temperatures; stronger and more frequent storm activity—that scientists have recorded and are observing.

THINK ABOUT SCIENCE **ANSWER KEY**

1. Climate is the average weather conditions from year to year. Daily weather describes the meteorological conditions for a location at just one point in time.
2. Global climate change is the change being observed in climates around the world, including rising temperatures across Earth.

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 466.

Extension Activity: Identify Research Questions

Have students work in pairs or small groups and ask them to select an environmental news story from the television, internet, radio, or a magazine that they can read together. As they read, have them identify and write down questions for further research. Have students compile their lists and select the points of research they will pursue. When their further research is completed, have them create a report that includes their own research.

The Cell

LESSON 4.1
PAGES 134–139

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify the basic structure of cells
- Identify similarities and differences in plant and animal cells
- Understand how cells work

✓ *Determine Student Readiness*

At some point, most students have probably studied cells but may not know or remember much detail. Have a discussion with students about what they already know about plant and animal cells and what they'd like to learn. Write their answers on the board or on a large sheet of paper. Have students check off each item on the list as they work through the lesson.

Key Concept

Cells are the basic units of structure and function in living things.

Concept Background: Each member of a team—whether a sports team, an acting troupe, or a community action committee—plays a specific role within the team and follows a unique set of rules for that role. At the same time, each member contributes to the overall function of the team. Ask students to visualize this concept as they learn about cells.

Develop Core Skills

Core Skill: Support Conclusions

Tell students that in order to determine or evaluate conclusions, they must look at the textual evidence that supports a conclusion. Remind students as they read to look for the evidence that supports conclusions made by the text. Have students underline the textual evidence and circle the conclusion that is supported.

Core Skill: Determine Conclusions

Tell students that determining conclusions is a common way to help understand something by using the information given and your own knowledge to come up with meaning. Hold up the images of a plant cell and an animal cell and ask: *What can you conclude from the fact that plant cells and animal cells are different?* (Sample answer: *Plant cells have different structures and different functions.*)

Pre-Teach Vocabulary

Word Study: Write Sentences

Preview lesson vocabulary words by defining them for students. Have students write a few sentences that use each word correctly and provide a description, example, or explanation. Then have volunteers read their sentences and have the class say what word is described or explained. Monitor students' work to clear up any confusion or errors.

Tier 2 Words:
function (p. 136)

Tier 3 Words:
cell (p. 134)
diffusion (p. 138)
nucleus (p. 136)

DURING THE LESSON

PAGE 134

The Structure of Cells

Have students review the photo of cork cells and read about how Hooke thought the cork looked like it was made of "little rooms." Lead a discussion about how the cells in living things are similar to and different from the "room" kind of cell.

Evidence-based Reading Support: Comprehension

Set a Purpose for Reading

Before students read the lesson, have them make a KWL chart to determine what they know and what they want to know. Later, they can fill in the column about what they learned. Tell students they can also preview the lesson headings and subheadings to get an idea of what topics will be covered. Skim the text to find out how the author presents the material and get an idea of what kinds of diagrams and charts are provided.

PAGE 135

Determine Conclusions

Have students take turns reading aloud the text for "Determine Conclusions." Review with students the conclusions provided. Discuss together why Sentence 3 is the best conclusion that can be drawn from the text. Ask students if there are other conclusions that can be determined from the same text.

THINK ABOUT SCIENCE — ANSWER KEY

1. C
2. D
3. E
4. B
5. A

Core Skill: Support Conclusions

Tell students that most of the time, in science writing, conclusions will be easy to determine and there will be plenty of supporting material included. This is because the practice of science requires that evidence be provided for hypotheses and other scientific statements. Ask students what might happen if scientists did not provide information that supports their conclusions when they share their findings with other scientists.

PAGE 136

Cell Structures

Review the illustration with the class. Be sure to point out that while the plant cell has a cell wall, it also has a cell membrane. Have students discuss why a plant cell might need both of these structures. Ask students to explain why cell walls would be detrimental to an animal cell.

THINK ABOUT SCIENCE ANSWER KEY

The cell membrane and nucleus are parts of both plant cells and animal cells.

21st Century Skill: Critical Thinking and Problem Solving
Have students work in pairs to practice writing explanations. Have students take turns interviewing each other and writing a profile based on the information provided. Interviewers could begin with general questions to find a specific topic of interest. Interviewees may provide information about a hobby or a favorite place to visit. Have students write clear, orderly explanations of the partner's information. Explanations should be factual only and free of opinion.

PAGE 137

Specialized Cell Structures

As students learn about the specialized structures found in cells, have them think about an assembly line. Have students compare and contrast the specialization found in a cell with the specialization found in an assembly line. Ask students to consider what happens in either a cell or an assembly line when one part or structure doesn't work correctly.

Specialized Cell Structures in Plants

Ask students to locate the chloroplasts in the diagram of the plant cell on the previous page. Remind students that chloroplasts do not occur in animal cells. Tell students that chloroplasts are named for the presence of chlorophyll, a light-absorbing substance, or pigment, that plants use during photosynthesis. Point out that *chloro* is from the Greek word *khloros*, meaning green.

How a Cell Works

Ask student volunteers to describe the role of a security guard at the entrance to an office, a neighborhood, or a parking garage. Point out that the cell membrane serves a similar role in the cell. Tell students that a cell membrane acts as a selective gatekeeper that allows only certain kinds of molecules to enter.

THINK ABOUT SCIENCE ANSWER KEY

1. Mitochondria trap the energy from food and release it to the cell.
2. A plant cell has a stiff structure called a cell wall around its outer edge, giving a defined shape. Animal cells do not have cell walls so they do not have a rigid structure.
3. Chlorophyll is found in the chloroplasts of plant cells. It is only useful in plants that trap energy from the Sun to make food.

Core Skill: Determine Conclusions
After students have read the text, have students work together in pairs. Have one student write a conclusion that answers the question *Why does a cell have specialized parts?* Ask the other student to point out the sentences in the text that serve as evidence supporting this conclusion.

PAGE 138

Diffusion

Ask students to visualize the process of diffusion. Point out that spreading and even distribution are qualities of fluid movement.

Active Transport

Review with students how material is transported through and between cells through diffusion and active transport. Help students understand that diffusion is a passive method and does not require the cell's energy.

WRITE TO LEARN ANSWER KEY

Review the definition of a summary and write the definition on the board. Then have partners exchange the summaries they wrote about diffusion. Encourage students to offer their partners suggestions on how to make their summaries more effective.

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 468.

Engage and Extend

ELL Instruction: Create and Label Drawings Have students draw and label the plant cell and the animal cell shown on page 136. Then ask students to prepare a three-column table. Have students list plant cell structures in the first column and animal cell structures in the second column. Remind students that many of these structures are found in both plant and animal cells. In the third column, ask students to use their own words to state the function of each structure. Help students with the pronunciation of the names of cell structures such as *mitochondria, nucleus,* and *endoplasmic reticulum.* As students read the lesson, encourage them to add details to their drawings and their tables.

Extension Activity: Use Reasoning, Planning, and Evidence
Challenge students to research the use of intravenous saline solution to treat dehydration. Ask students to cite evidence supporting the use of IV saline solutions and challenge them to draw conclusions about why an intravenous saline solution is used instead of water.

Simple Organisms

LESSON 4.2
PAGES 140–147

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify basic characteristics of microbes
- Recognize different types of microbes
- Understand the role of microbes in the environment

✓ *Determine Student Readiness*

Find out how much students know about the microbes that are a part of their daily lives. Students may think of microbes only as germs or agents of disease. Explain to students that microbes can be both beneficial and harmful. Ask students if they are familiar with any food items that are made using microbes; for example, some students may know that yogurt, cheese, and bread are made using microbes. Tell students that this lesson may surprise them as to just how many microbes are all around, inside and out of their bodies.

Key Concept

Single-celled organisms, including bacteria and protists, are the simplest of all organisms. Along with viruses, they are both helpful and harmful to other living things.

Concept Background: All living things are made up of cells. Some organisms, such as amoeba, are made up of just one cell, whereas a human being has anywhere from 50 to 100 trillion cells. Although single-celled organisms are called simple, they have played a huge part in developing life on Earth. As students read, help them take notes on the various kinds of microbes that are found in their environment—internally as well as externally.

Develop Core Skills

Core Skill: Compare and Contrast Information

Provide students with a copy of the *Venn Diagram* graphic organizer (found in the Graphic Organizer section of the Instructor Resource Binder). Have students practice comparing and contrasting items in the classroom, favorite foods, or popular artists. Model where to place the qualities or characteristics they name. Ask students to state whether they think the items are similar or different.

Core Skill: Cite Textual Evidence

When presenting information in a text, an author must persuade his or her audience that the statement is true by offering evidence in the form of details. Have students form small groups. Assign one section of the lesson to each group and ask them to find the main idea of their section. As a class, discuss the main idea of each section and cite the textual evidence that supports that main idea.

Pre-Teach Vocabulary

Word Study: Preview Vocabulary

Preview the vocabulary by writing the list of words and pronouncing them. Most students have probably heard some of these words used in everyday conversation. Have students connect what they already know with each of the new words. Have students create a study card for each vocabulary word and include a pronunciation, a definition, and a sentence for each word.

Tier 2 Words:	Tier 3 Words:	Test Words:
thrive (p. 142)	decomposer (p. 142)	compare (p. 143)
	microbe (p. 140)	
	organs (p. 143)	

DURING THE LESSON

PAGE 140

Simple Organisms

Review with students the text describing how scientists have identified organisms throughout history. Discuss the domains and kingdoms of organisms. Share with students that as scientists continue to observe and explore organisms, organisms may be moved between domains, or domains could be added or taken away. In science, things are always changing based on new evidence.

PAGE 141

Cite Textual Evidence

Read together with the class the text in the white box titled "Yellow Fever." Ask students: *What other conclusions can you draw from this reading?* Have students cite textual evidence for their additional conclusions. Encourage students to do library or internet research to learn more about yellow fever or other tropical diseases. Have them write a brief report in which they cite textual evidence to support any conclusions they draw.

THINK ABOUT SCIENCE ANSWER KEY

A microbe is an organism that is not visible without the aid of a microscope.

21st Century Skill: Productivity and Accountability

Ask students to distinguish between productivity and accountability. Point out that accountability means that a person is publicly responsible for something they have done. Ask students to describe the connection between accountability and personal reputation.

PAGE 142

Archaea

Ask students to brainstorm examples of conditions on Earth too harsh to support life and point out that archaea are likely to be found living in many of these places, including hot springs, high-salt environments, highly acidic soils, hydrothermal vents deep in the ocean, and animal intestines.

Bacteria

Explain that while we often think of bacteria as being "bad" because they can cause diseases, we also depend on bacteria for many important processes and products. Lead a discussion about what might happen if there were no more bacterial decomposers available on Earth.

THINK ABOUT SCIENCE ANSWER KEY

1. B
2. A
3. P
4. B

WRITE TO LEARN ANSWER KEY

As students plan their compare-and-contrast paragraphs, discuss alternate organizational structures for their writing. They could list all the relevant characteristics of the first item and then write about how the characteristics of the other item are the same or different, or they could compare and contrast each aspect of the items, one after the other.

PAGE 143

Viruses

Ensure that students understand that while viruses are microbes, they are not living organisms. Students are likely familiar with some of the more common illnesses caused by viruses—influenza, colds, and chicken pox. Most students today are immune to many viral illnesses thanks to vaccination.

THINK ABOUT SCIENCE ANSWER KEY

1. because they are not complete cells capable of reproducing on their own
2. tissue, organ, organ system

Core Skill: Compare and Contrast Information

Draw a Venn diagram on the board and have the class fill it in as a group. After finishing the activity, discuss with students why a Venn diagram is such a helpful graphic organizer for comparing and contrasting information. Have students consider how other graphic organizers could also be used to compare and contrast viruses and other microbes.

PAGE 144

Fungi

While fungi such as mushrooms often grow on the ground, they are not plants. Have students compare the properties of fungi with those of the plants described on these pages. Unlike plants, fungi do not contain chlorophyll. In addition, fungi get their food by digesting the organic matter around them.

Evidence-based Reading Support: Fluency

Echo Reading

Provide a model of expressive, fluent reading by conducting an echo read of the text on this page. Begin by reading the heading and first sentence aloud, and then ask the class to repeat after you. Take care to pronounce unfamiliar words clearly and repeat sentences as needed. Gradually increase your reading speed to encourage students to identify words more quickly.

Core Skill: Cite Textual Evidence

After reviewing the sidebar activity with students, ask them to consider how the other forms of fungi cited in the text—mold, mildew, and yeast—also thrive in moist environments. Encourage student volunteers to tell you where they've seen mold and mildew before, such as in damp outdoor environments.

PAGE 145

Mosses

Ask students to speculate why moss plants do not grow to 1–2 feet high. Guide students to recognize that mosses are extremely limited in size because, unlike other plants, they lack specialized tissues to carry water and nutrients from the ground throughout the plant. Ask students why the lack of these specialized tissues also limits the kinds of places where mosses can grow.

THINK ABOUT SCIENCE ANSWER KEY

1. virus
2. single cell
3. cell wall
4. some
5. multicell
6. yes
7. no
8. no
9. in nucleus

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 468–469.

Engage and Extend

ELL Instruction: Main Idea and Details Show students how to organize details using the *Main Idea* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students use this graphic organizer to summarize the key characteristics of the different kinds of simple organisms described in this lesson. Explain to students how they can add important details to the Detail boxes descending from each *Main Idea* bar.

Extension Activity: Organize, Represent, and Compare Data Have students research the impact of each group of organisms on humans. Ask students to organize the groups archaea, bacteria, eukarya, viruses, fungi, algae, mosses, and ferns in a graphic organizer and compare how they are helpful or harmful to humans. For each group, challenge students to draw a conclusion based on the evidence.

Invertebrates

LESSON 4.3
PAGES 148–155

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Distinguish between invertebrates and vertebrates
- Recognize the basic characteristics of invertebrates
- Organize the steps in four-stage and three-stage metamorphosis

✓ *Determine Student Readiness*

Determine students' readiness for learning about invertebrates by asking them to name ten kinds of animals. Then ask students how many of these animals have backbones. Tell students that most animals that come to mind are vertebrates, animals with a spinal cord protected by rigid vertebrae, or backbone. Challenge students to again name ten kinds of animals, but this time, only animals without backbones.

Key Concept

Animals are made of many cells and can be classified as invertebrates or vertebrates.

Concept Background: The idea of invertebrates as an animal classification may seem unfamiliar to students at first. Inform them that sponges, coral, and hydras, which all live in water, do not have body parts such as a head and legs. Show them pictures, if possible. Certain invertebrates are part of nearly everybody's daily life, no matter where they live. Point out that insects—including ants, houseflies, and butterflies—are invertebrates. In fact, 95 percent of all animal species are invertebrates.

Develop Core Skills

Core Skill: Cite Textual Evidence

Ask students to recall the meaning of the word evidence. If students have difficulty, write the words *scientists*, *doctors*, and *police* on the board. Once students understand the term *evidence*, have them brainstorm the kinds of evidence the professionals in each of the three categories would be interested in. Point out that although the kinds of evidence may vary, all of the types must be thoroughly investigated.

Core Skill: Follow a Multistep Procedure

Remind students that scientists spend much of their time investigating problems. They follow procedures that can be replicated, or copied by other scientists. To get consistent and reliable results, scientists follow each step of a procedure exactly. To show an example, invite students to list the steps of a daily procedure, such as getting ready to leave the house before school or preparing to play a sport. Point out the concept of sequence and have students number their procedure points.

Pre-Teach Vocabulary

Prefix *in-*

Write the words *invertebrate* and *vertebrate* on a board or chart. Remind students that vertebrae are the small bones that form a backbone. Circle the prefix *in–* in *invertebrate* and explain that a prefix, or a collection of letters at the beginning of a base word, changes the meaning of a word. Explain that the prefix *in–* means "not." Ask students to use the meaning of the prefix to define the term *invertebrate*.

Tier 2 Words:
adapt (p. 151)

Tier 3 Words:
invertebrate (p. 148)
metamorphosis (p. 152)
parasite (p. 150)
vertebrate (p. 148)

DURING THE LESSON

PAGE 148

Invertebrates

Explain that all animals share certain features, such as being multicellular and the absence of cell walls. These characteristics distinguish invertebrates from other organisms, such as plants and fungi. Ask students how certain animals function without a backbone. Guide students to recognize that some familiar invertebrates, such as insects, have a hard exterior that provides protection and support.

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

Read the first two paragraphs of "Invertebrates" with students. Then have students reread on their own, taking notes as they read. Afterward, ask a volunteer to compare invertebrates with vertebrates, using humans as an example of a vertebrate. Invite students to make a two-column chart listing the ways in which humans and invertebrates are similar and the ways in which they are different.

PAGE 149

Sponges and Cnidarians

To help students organize the many kinds of animals described on pages 149–153, provide them with copies of the *Main Idea* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students fill out the graphic organizer as they read, pausing to fill in the *Main Idea* bar each time they encounter another subhead. Show students how they can add important details to the *Detail* boxes descending from each *Main Idea* bar.

THINK ABOUT SCIENCE ANSWER KEY

Vertebrates have a backbone. Invertebrates do not have a backbone.

Worms *and* Roles of Worms in the Environment

PAGE 150

Draw a Venn diagram on the board. Label the first circle *Parasitic Worms*. Label the second circle *Earthworms*. Read the text with students. As you read, invite volunteers to add information to the diagram on the board. Afterward, complete the diagram as a class, clarifying the similarities and differences among worms.

THINK ABOUT SCIENCE ANSWER KEY

Statements 1, 2, and 3 apply to earthworms.

Core Skill: Cite Textual Evidence

Invite students to share their pre-reading ideas about worms. Point out that people often form conclusions before analyzing and evaluating the available evidence. Ask students how reading the passage about the role of worms in the environment influenced their post-reading conclusions. Have students highlight the evidence in the passage that supports their conclusions.

Mollusks *and* Arthropods

PAGE 151

Guide students as they read the text. Pause occasionally to ask students to identify the main idea of a paragraph or to identify important details that support a topic sentence. To help students remember the key characteristics of these animals, you may want to have them work in pairs to make a chart showing the similarities and differences between mollusks and arthropods.

Core Skill: Follow a Multistep Procedure

Ask students to think of a procedural document with numbered steps, such as a recipe or a set of instructions for assembling equipment. Ask students if the next person to use the recipe or the instructions would obtain the same results if the first step were missing. In order to be valid, scientific experiments must be repeatable when performed by any investigator.

Insect Body Structure *and* Instect Life Stages

PAGE 152

Have students work with a partner to identify the topic sentences in the paragraphs about insect body structure. Read the text together, pausing occasionally to ask students to summarize important ideas or details. Tell students that they may have earlier learned the two kinds of insect metamorphosis as complete metamorphosis (four stages) and incomplete metamorphosis (three stages). Before students begin reading, provide them with copies of the *Sequence* graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students fill out graphic organizers for four-stage and three-stage metamorphosis as they read pages 152 and 153.

THINK ABOUT SCIENCE ANSWER KEY

1. Mollusks include snails, slugs, squids, octopuses, clams, and oysters.
2. Shedding an exoskeleton enables an arthropod togrow.
3. All insects have six legs and three body regions: a head, a thorax, and an abdomen.

PAGE 153

THINK ABOUT SCIENCE ANSWER KEY

1. egg, larva, pupa, adult
2. In three-stage metamorphosis, the larva and pupa stages are skipped. Instead, the eggs hatch into nymphs.

21st Century Skill: Communication and Collaboration

Have students read the text and then explain communication and collaboration in their own words. Invite students to give specific examples of collaboration and the effect or result of that collaboration. Ask students to offer opinions on why collaboration might be particularly helpful in the workplace.

WRITE TO LEARN ANSWER KEY

After students have finished writing invite them to exchange their instructions with one another. Have each student read their partner's instructions and then retell them in their own words.

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 469.

Engage and Extend

ELL Instruction: Retell a Multistep Process Assign students the *Insect Life Stages* passage on pages 152–153 to retell in their own words. This is an opportunity to evaluate students' comprehension and their ability to articulate information. Correct their syntax as needed.

Extension Activity: Evaluate Two or More Sources of Information Suggest that small groups of students choose an insect species and then work together to learn more about the impact of that species on humans. Have students select a reliable primary source of information, citing evidence for the economic and/or medical benefits or damages caused by the insect. Have students evaluate two or more secondary or tertiary sources of information on the same or related subject. When they have compiled their data, have them summarize their findings in a group report.

Vertebrates

LESSON 4.4
PAGES 156–165

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Give characteristics of vertebrates
- Explain the difference between warm- and cold-blooded animals

✓ Determine Student Readiness

Determine students' readiness for learning about vertebrates by asking students to brainstorm a list of characteristics all vertebrates share. List them on the board and have students debate whether these characteristics are shared by all vertebrates, by most, by some, or by a few.

Key Concept

Vertebrates are animals with backbones. They have more developed systems than invertebrates.

Concept Background: Students can explore their own skeletal systems by pressing on the bones in their hands, wrists, elbows, knees, and ankles. All animals with backbones share this internal skeletal structure, although the specific bones may vary. Some animals have more bones and some have fewer. The bones may be larger or smaller. As students go through the lesson, have them compare the skeletal systems in each kind of vertebrate.

Develop Core Skills

Core Skill: Follow a Multistep Procedure

Challenge students to name examples of professional careers in which it is important to follow precisely a multistep procedure. Ask students to describe what might happen if a pharmacist, auto mechanic, or HVAC (heating, ventilation and air conditioning) systems repair technician omitted a step or carried out two or more steps in the wrong order when preparing medications, taking measurements, or performing technical tasks.

Reading Skill: Analyze Author's Purpose

Help students recognize that the author's purpose in this lesson is to inform the reader of the unique characteristics of vertebrates. To achieve this aim, the author explains the meanings of key terms and ideas that are needed to understand these vertebrate characteristics. Encourage students to look for the ways in which the text is organized to achieve the author's purpose.

Pre-Teach Vocabulary

Word Study: Relate Word Parts

Write the vocabulary words on a board or chart. Have students work in pairs and use dictionaries or online etymology websites to determine the meanings of each word's parts. Invite students to share their findings and reach a consensual definition for each word. Have volunteers write the meanings of the word parts and the definitions on the chart.

Tier 2 Words:	Tier 3 Words:
reflex (p. 156)	amphibians (p. 159)
respond (p. 156)	instinct (p. 156)
	mammals (p. 163)

DURING THE LESSON

PAGE 156

Vertebrates

Explain to students that most of the animals that come to mind when we think of animals are vertebrates. Read the first two paragraphs with students. Afterward, ask a volunteer to name one distinguishing characteristic of vertebrates. Continue calling on students until all of the vertebrate traits listed in the first two paragraphs have been named.

PAGE 157

Analyze Author's Purpose

Review students' explanations for why the author used numbered steps, each in a separate paragraph, to present the directions for preparing a wet mount. Then tell students to imagine seeing the same directions in a single paragraph without numbered steps. Ask students if they think the numbered steps are more effective.

THINK ABOUT SCIENCE ANSWER KEY

An instinctive behavior is automatic and does not have to be taught. A learned behavior is one that is acquired through observing or direct teaching.

Core Skill: Follow a Multistep Procedure

Guide students in reviewing the numbered steps in the procedure for preparing a wet mount. Point out that the last step (directing the reader to start on one side of the drop of water when lowering the cover slip) reduces the chance of introducing air bubbles into the wet mount.

PAGE 158

Cold-blooded Animals

Read with students the first two paragraphs under the subheading "Fish." Help students pronounce the word *cartilage*. Ask students to name the three groups of fish: cartilaginous fish, bony fish, and jawless fish. Point out that bony fish form the largest group and contain the kinds of fish that are most familiar, such as tuna.

THINK ABOUT SCIENCE ANSWER KEY

1. Its body temperature rises.
2. Fish populations can shrink due to overfishing or due to pollution.

PAGE 159

Amphibians

To help students summarize the steps in metamorphosis, you may want to have them work in pairs to number and describe the steps in the process. Provide students with copies of the *Sequence* graphic organizer (found in the Graphic Organizer section of the Instructor Resource Binder). Have students fill out *Sequence* graphic organizers for frog metamorphosis as they read page 159.

Evidence-based Reading Support: Vocabulary Multiple-Meaning Words

Point out that the word *amphibious* is used in contexts other than life science and biology. Tell students that the Greek prefix *amphi-* means both. Challenge students to guess the meaning of the word *amphibious* in the following sentence: *Hunters use amphibious vehicles to travel through shallow streams and over rough ground.*

THINK ABOUT SCIENCE ANSWER KEY

1. egg, tadpole, adult
2. lungs, skin, respiration
3. eggs, water, reproduce

Reading Skill: Analyze Author's Purpose

Ask students to state which of the author's methods—words or diagram—made it easiest for them to understand metamorphosis. Ask students to explain what makes the method they chose most useful to them.

PAGE 160

Reptiles

Read the text together, pausing occasionally to ask students to summarize important ideas or details. Help students recognize the many significant ways in which reptiles differ from amphibians. Draw a Venn diagram on the board and have students summarize the similarities and differences between amphibians and reptiles.

PAGE 161

Warm-blooded Animals

Birds have many unique characteristics that are found in no other vertebrate group. Read the paragraph about birds with the class. Ask student volunteers to point out the important bird characteristics in this paragraph. Show students how to organize details using the Main Idea graphic organizer found in the Graphic Organizer section of the Instructor Resource Binder. Have students fill out the graphic organizer as they read pages 161–162.

THINK ABOUT SCIENCE ANSWER KEY

1. C
2. D
3. A
4. B

PAGE 162

THINK ABOUT SCIENCE ANSWER KEY

All birds are warm-blooded and have feathers, two legs, and two wings.

21st Century Skill: Flexibility and Adaptability

Emphasize that we often cannot choose events that occur, but we can choose our responses; an individual can choose to remain flexible and adaptable. Point out that such challenges often lead to personal growth.

PAGE 163

Mammals

Guide students as they read the text. Pause occasionally to ask students to identify the important characteristics of mammals. Challenge student volunteers to find out more about some of the unusual mammals in the diagram, such as the armadillo, the echidna, or the bat.

THINK ABOUT SCIENCE ANSWER KEY

1. Mothers feed their young with milk produced in special glands.
2. Mammals have hair.
3. Mammals are highly intelligent.

WRITE TO LEARN ANSWER KEY

Remind students to make sure they understand the diagram before attempting to write. Have students share their final paragraphs with the class. Ask students to describe some advantages of using a diagram to show how to use an electronic device. Point out that many products are sold internationally and purchasers may speak many different languages.

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 469–470.

Engage and Extend

ELL Instruction: Elaborate Language Discuss and define additional common words associated with vertebrates with which students might not be familiar. Ask students to identify words from the lesson that may be unfamiliar, such as *shrewlike*, *platypus*, *kangaroo*, *opossum*, or *marsupial*.

Extension Activity: Classify Mammalian Pet Species Assign groups of students to research several mammalian pet species. Have students organize their findings in a report that classifies each species as a good pet species or a bad pet species. Have students cite evidence supporting their classification of each species as a good or bad pet.

Genetics

LESSON 5.1
PAGES 176–183

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Relate genes to chromosomes
- Identify how traits are passed from parents to offspring
- Explain the structure and processes of DNA

✓ *Determine Student Readiness*

Determine students' readiness for learning by discussing prior knowledge of DNA and inheritance of traits. Ask students to think of characteristics they have inherited from their parents. Lead a discussion with the class on what they know about DNA, for example, how it is used in forensics, paternity, and inheritable disease tests.

Key Concept

Genes carry the codes for human traits. They are located on chromosomes within the nucleus of every living cell.

Concept Background: Explain to students that genes are the main determinant of physical attributes, such as height, skin color, and hair texture. However, genes also play a large role in behavior. The combination of our genes and our environment helps determine how we look, how we act, and our overall health. The study of genetics helps us understand, and possibly change, these factors.

Develop Core Skills

Core Skill: Make Predictions

Write the word *prediction* on the board. Next to it, write: *from the Latin word* praedictio, *meaning "a foretelling."* Ask students to interpret the word *foretelling* and use it to define the word *prediction*. Then ask students to give examples of predictions that they hear or read in daily life. For example, have them think about predictions meteorologists make about the weather and sportscasters make about the outcomes of games.

Reading Skill: Summarize Text

Explain to students that a summary is a brief retelling of the main ideas of a text. Tell students that taking time to summarize parts of a text while reading is an effective comprehension strategy. To emphasize your point, read a brief news story from the school or local newspaper aloud and ask students to note details as you read. Afterward, ask students to share the details they recorded. Write the details on the board, and ask students to help you use them to summarize the article.

Pre-Teach Vocabulary

Word Analysis

Write the word *gene* on the board. Next to the word, write: *from the word* pangen. *The letters* pan– *mean "all," and the base word* genos *means "kind or offspring."* Explain to students that a gene is a unit of heredity. Ask students to relate the word's meaning to the meaning of its historical parts. Invite students to predict the meanings of similar words, such as *genetics*, *gene map*, and *gene pool*.

Tier 2 Words:	Tier 3 Words:	Test Words:
dominant (p. 178)	chromosome (p. 179)	prediction (p. 178)
trait (p. 176)	genes (p. 178)	
	genetics (p. 176)	
	recessive (p. 178)	

DURING THE LESSON

PAGE 176

Genetics

Show or project an image of twenty-three pairs of chromosomes found in a human body cell. Refer to the image as you read the paragraph with students.

Gregor Mendel

Read the text with students. If students are intrigued by Gregor Mendel's story, encourage them to go online to learn more about him. They may be interested in the controversy surrounding his data and why his research was not recognized in his lifetime.

Purebred and Hybrid

Have students read the next independently. Then, as a class, discuss why Mendel may have thought that crossing a short plant and a tall plant would result in a medium plant. Help students understand that without an understanding of genetics, Mendel's conclusions seemed logical.

PAGE 177

Summarize Accurately

Have students read the section. Tell students that when they come across an unfamiliar word or phrase, they should pay attention to how the word or phrase is used in context. Have them define *purebred* and *hybrid* based on how they are used in the context of the paragraphs on pages 176 and 178. Ask them what words in the paragraphs offered clues. Then have students complete the activity by writing a summary. Have partners exchange summaries and analyze each other's work to determine whether it is accurate, free of opinion, and does not contain new information.

THINK ABOUT SCIENCE **ANSWER KEY**

1. the study of how traits are inherited
2. Possible answer: Why do plants have differences, such as growing tall or short, or growing yellow peas or green peas?

PAGE 178

Genes and Alleles

Organize students into pairs, and have them read the text independently. Before they read, remind them that alleles are forms of genes. Then relate genes to chromosomes. Hold up a ruler. Tell students to imagine that it represents a single chromosome. Point out the different tick marks (such as millimeters). Explain that each mark represents a single gene located on a specific part of the chromosome. Have students write a sentence describing the relationship between genes and chromosomes.

Human Traits

Write the following question on the board: *How do dominant and recessive alleles help explain human inheritance?* Read the question aloud, and then give students time to read the text to form an answer. Afterward, invite volunteers to answer the question and to offer examples other than eye color that may be familiar to them. Students may say, for example, that eyelash length and eyebrow shape are inherited traits.

Core Skill: Make Predictions

Tell students that a prediction involves using your thinking and experience to make a guess about what will happen next. Then have students complete the activity as they read about Mendel's pea plant research. Ask students whether their predictions were correct.

PAGE 179

Chromosomes and DNA

Refer again to the visual of twenty-three pairs of chromosomes. Ask students to recall what they remember about chromosomes before you read the text aloud. After reading, ask: *How is a gene similar to an instructional manual that comes with a build-it-yourself furniture kit or hobby model?* Ask students to cite evidence from the text to support their answers.

The Genetic Code

Read the text with students. Guide them through the structure and processes of DNA. Then read through page 180, which covers DNA replication and the forty-six chromosomes in human DNA. Use a zipper on a coat or jacket to show the concept of DNA. Show the closed zipper as an example of a DNA molecule with each tooth of the zipper being the chromosomes. A diagram on page 180 also shows DNA "unzipping."

THINK ABOUT SCIENCE ANSWER KEY

1. A
2. D
3. B
4. E
5. C

Reading Skill: Summarize Text

Have students apply the skills they learned in "Summarize Accurately" on page 177 to summarize page 179. Tell students to self-edit their work, making sure it contains facts only and not their own ideas or opinions.

WRITE TO LEARN ANSWER KEY

Before students begin to write, ask them to recall your discussion of using summarization as a comprehension strategy. Then explain that pausing occasionally to make predictions about what they are reading is another effective strategy. Help students understand that predictions are based on existing knowledge, so they must understand a text before they can make predictions related to the text. After students have completed the writing task, encourage them to share their predictions.

PAGE 180

21st Century Skill: Initiative and Self-Direction

Have students discuss the phrase *take the initiative* before reading the text. After reading, have students share examples of when they took the initiative or used self-direction to complete a goal. Allow students time to complete the activity.

PAGE 181

THINK ABOUT SCIENCE ANSWER KEY

1. thymine
2. 46 chromosomes
3. separating
4. mutation

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 472.

Engage and Extend

ELL Instruction: Retell Assign or have students choose a text excerpt from the lesson to retell in their own words. This is an opportunity to evaluate students' comprehension and ability to articulate information. Correct syntax as needed.

Extension Activity: Design a Flow Chart to Show Critical Stages Have students draw a flow chart that outlines Gregor Mendel's method for his landmark experiment on pea plants. Encourage students to use all the vocabulary words from this lesson in the flow chart.

Genotypes and Phenotypes

LESSON 5.2
PAGES 184–193

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Use a Punnett Square to determine an organism's genotype and phenotype
- Explain the relationship between genotype and phenotype
- Describe the role of alleles

✓ *Determine Student Readiness*

Determine students' readiness by engaging them in a discussion of an organism's DNA, or deoxyribonucleic acid. Students should know that instructions for determining an organism's traits, or characteristics, are found in its DNA, and that they inherit their DNA from their parents. Encourage students to discuss traits they share with family members, or traits that their pets share with their offspring.

Key Concept

Traits, or characteristics, are transmitted from one generation to the next. This transmission is called heredity. The young, also called offspring, resemble their parents. However, there are also differences, or variations, between them. The traits we observe in an organism represent its phenotype. The genetic information underlying the phenotype is called the genotype.

Concept Background: An organism's traits, or characteristics, are passed from parents to their offspring on chromosomes. Chromosomes are threads of proteins and a substance called DNA that contains small sections called genes. Each gene lives in a specific spot, or locus, on a chromosome. Help students recall their discussion of genes. Ask them to explain why some people refer to genes as instruction manuals for life.

Develop Core Skills

Core Skill: Distinguish Among Reasoned Judgments

Explain to students that scientists make judgments, or come to conclusions, based on evidence. Sometimes, however, there is too little evidence or conflicting evidence. In these cases, scientists must apply reason, or logic, to form conclusions. To help students understand, ask them to explain why when they visit a doctor about a problem, doctors ask so many questions. Help students see that doctors can use the answers to questions to make reasoned judgments about what is making them ill.

Core Skill: Express Scientific Information

Remind students that scientists use a variety of means to organize and present scientific information. They may, for example, use tables, charts, diagrams, or lists. Ask students to discuss the tools scientists use most often to understand or present complex information. Encourage students to give specific examples of how scientists have expressed scientific information in new ways to help them understand it or share it with others.

Pre-Teach Vocabulary

Map Relationships

Write the vocabulary words and their definitions on the board. Organize students into groups and have them draw concept maps to determine relationships among the words. Encourage students to revise or add more information to their maps as they read the lesson.

Tier 2 Words:	Tier 3 Words:	Test Words:
heredity (p. 184)	allele (p. 185)	distinguish (p. 185)
offspring (p. 184)	genotype (p. 184)	
	phenotype (p. 184)	
	Punnett square (p. 186)	

DURING THE LESSON

PAGE 184

The Science of Heredity

Show students images of animals and their offspring, or invite students to share family photographs. Invite students to describe observable shared traits. Guide them to understand that what they observe is an organism's phenotype, but that phenotype is determined by a set of inherited genes, or a genotype.

PAGE 185

Evidence-based Reading Support: Alphabetics

Base Words

Emphasize how understanding the meaning of word parts can help them determine the meaning of complex words, especially science words. Write the Latin word *dominant* on the board, and explain that it means "ruling, or governing." Write the Latin word *recedere* on the board, and explain that it means "to go back, or withdraw." Write the words *dominant* and *recessive* on the board. Tell students that you want them to underline or highlight these words the first time they appear on the page.

Heredity and the Allele

Read the first paragraph as a class. Students should recognize the appearance of the words *dominant* and *recessive* and highlight them. Ask students to apply what they learned about these words' histories to define the terms. Continue reading the text with students. Afterward, direct their attention to the diagram. Explain that unlike what they see in the diagram, only one pair of alleles coding for hair length would appear on a pair of chromosomes. However, all of the possible allele combinations have been assembled in the diagram to explain the three possible outcomes. Discuss the outcomes and the alleles that code for them.

Core Skill: Distinguish Among Reasoned Judgments
Remind students that a scientific conclusion is based on evidence, and when that evidence varies, so do conclusions. Help students to see that as scientists continue investigating, and as new technologies assist them in their work, more evidence becomes available. That evidence may help explain varying conclusions, or help scientists reconcile different conclusions to form a new conclusion.

PAGE 186

The Punnett Square

Point to and identify the Punnett square at the top of the page. Read the text as a class, pausing after each paragraph to ask volunteers to summarize the paragraph's main idea. After reading, ask volunteers to explain the terms *monohybrid cross*, *parental generation*, and *filial generation* in discussion of the Punnett square at the bottom of page 186. Next, read the text on page 187 as a class. Invite volunteers to explain the information expressed in the Punnett square on page 187.

Core Skill: Express Scientific Information
Observe students as they work, intervening if necessary to guide their understanding.

PAGE 187

THINK ABOUT SCIENCE ANSWER KEY

9: wet earwax, freckled

3: wet earwax, unfreckled

3: dry earwax, freckled

1: dry earwax, unfreckled

PAGE 188

X-Linked Inheritance

Read the first two paragraphs as a class. Afterward, ask students why a male child expresses a recessive trait carried on the X sex chromosome. Read the third paragraph together, and then ask volunteers to interpret the Punnett square that follows. Finally, read the last paragraph as a class. Have volunteers refer to the Punnett square to explain the possible outcomes of a cross between a mother who is a carrier for red-green color blindness and a father with normal vision.

THINK ABOUT SCIENCE ANSWER KEY

The cross is between $X^C X^c$ and $X^C Y$. Outcomes include: $X^C X^C$; $X^C X^c$; $X^C Y$; and $X^c Y$.

Engage and Extend

ELL Instruction: Review a Procedure Ask students to turn to page 191, the procedure for extracting strawberry DNA. Ask students to summarize the steps in the investigation in the order they occurred. Have them describe the safety precautions they took while conducting the task. Invite students to discuss the results and any observations they made that they found particularly interesting.

PAGE 189

Exceptions to Dominance

Organize students into pairs. Have students read about and write one sentence to summarize incomplete dominance. Ask students to share their summarizing statements. Afterward, discuss the monohybrid cross between snapdragons expressed in the Punnett square. Then have students stay in their pairings to read about and write one sentence to summarize codominance. Ask students to share their summarizing statements before discussing the cross between two members of the first filial generation shown in the Punnett square on page 190. Finally, ask students to use their summarizing statements to describe the similarities and differences between incomplete dominance and codominance.

THINK ABOUT SCIENCE ANSWER KEY

Possible phenotypes are: a red flower, a pink flower, a white flower.

PAGE 190

THINK ABOUT SCIENCE ANSWER KEY

The cross is between $I^A I^B$ and $I^O I^O$. From left to right in row 1, the combinations are $I^A I^O$ and $I^B I^O$. From left to right in row 2, the combinations are $I^A I^O$ and $I^B I^O$. There is a 50 percent chance that the offspring will be Type A and an equal chance that they will be Type B.

21st Century Skill: Leadership and Responsibility
Invite volunteers to read paragraphs of the text aloud. Ask students what hobbies or pursuits they participate in that require special safety equipment.

PAGE 191

WRITE TO LEARN ANSWER KEY

Before students write, encourage them to review the lesson to locate important details that will help them define genotypes and phenotypes. Also have them search for specific examples they can use to support their definitions.

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 472–473.

Extension Activity: Compare Data Have students locate a print or online investigation that explains how to extract DNA from a fruit other than strawberries. Have students compare the procedures before they conduct the investigation they find. Ask students to summarize the similarities and differences between the two investigations and the results.

Biological Evolution

LESSON 6.1
PAGES 200–209

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Understand the theory of evolutionary development
- Recognize adaptations that enable organisms to survive in their environments
- Understand the importance of fossil evidence

✓ *Determine Student Readiness*

Determine students' readiness for learning about biological evolution by having the students write, in their own words, their understanding of Darwin's evolutionary theory. Discuss their writings, correcting any misconceptions during the discussion. During the discussion, ask students to think of a particular kind of organism and ask them to suggest traits of that species that enable it to live in its particular environment.

Key Concept

Fossils indicate that organisms have changed over time. The theory of evolution is scientists' best explanation for how those changes occur.

For centuries, humans and scientists have questioned the beginning of life on Earth as we know it. In all walks of life, including naturalists like Charles Darwin, there has always been a question that caused controversy about evolution. From studying the history of the Earth's fossils, we have a scientific explanation of how life in species have evolved. Discuss with students what they know or have heard about evolution and why they think there is controversy about it. Make sure that all students feel comfortable to speak their opinions.

Develop Core Skills

Core Skill: Identify Hypotheses

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 them that after a hypothesis is stated, it must still be tested before it can be accepted or rejected. Collaborate with students on examples of interesting hypotheses that could be tested.

Core Skill: Cite Textual Evidence

Tell students that an editorial is a form °of persuasive writing in which the writer states an opinion. Explain that an editorial must also include facts as evidence supporting the writer's opinion. Show students an example of an editorial on a current issue. Ask students to point out the sentences containing facts that help substantiate the writer's opinion.

Pre-Teach Vocabulary

Relate Words

Tell students that a good way to build vocabulary is to relate unfamiliar words to words or concepts they already know. Have students identify similar or familiar words to the new vocabulary. Semantic maps can help students study the new words. Draw a semantic map on the board and model using this strategy.

Tier 2 Words:
evidence (p. 200)

Tier 3 Words:
adaptation (p. 203)
evolution (p. 200)
fossil (p. 205)
mutation (p. 204)

DURING THE LESSON

PAGE 200

The History of Life

Ask students to preview this lesson by reading the subheadings underneath the heading, *The History of Life*. Point out to students that reading the subheadings will provide them with a "story preview" that forecasts the content of the entire lesson. Provide students with copies of the *Sequence* graphic organizer (found in the Graphic Organizer section of the Instructor Resource Binder). As students read pages 200–203, have students fill out the *Sequence* graphic organizer using the first five subheadings. For each of the five boxes in the graphic organizer, invite students to write a one-sentence summary of the information under that subheading.

Evidence-based Reading Support: Fluency

Choral Reading

Together, have students read aloud the text on page 200. Tell students that when they read chorally, they should use the same pace, expression, and intonation as the rest of the group. Invite students to pause slightly and give special emphasis to boldfaced vocabulary words when they are reading aloud.

PAGE 201

Cite Textual Evidence

Read aloud the paragraph in the white box and invite students to work with you to identify the writer's claim. As students underline the textual evidence supporting the claim, remind them to maintain a sense of skepticism when they read information presented as factual evidence. Encourage students to wonder about broader questions that the paragraph does not address: *What studies are being referenced here? Where were these studies published? Is magnesium a chemical that is in short supply in our diets? Do many other foods contain magnesium?*

THINK ABOUT SCIENCE **ANSWER KEY**

1. Evolution is change over time.
2. The theory of evolution states that older species of living things give rise to newer species over time.

PAGE 202

Core Skill: Identify Hypotheses

Draw a framework for a flow chart on the board, beginning with the word *hypothesis* and ending with the word *theory*. Invite students to read the sidebar and then underline the words and phrases in the sidebar that describe what takes place after a hypothesis is proposed. Ask students to fill in the flow chart, using the underlined words and phrases (*careful experimentation*, *investigation*, and *extensive and repeated testing*) that occur before a hypothesis can be considered a theory.

PAGE 203

Darwin, Modified

To help students summarize the steps in which evolution works, you may want to have them work in pairs to describe the steps in the process. Provide students with the *Sequence* graphic organizer (found in the Graphic Organizer section of the Instructor Resource Binder) and have them fill out the organizers as they read *How Evolution Works* on page 203.

THINK ABOUT SCIENCE ANSWER KEY

1. C
2. B
3. A
4. D

21st Century Skill: Creativity and Innovation

After students read the text, have volunteers give specific examples of times they failed when attempting to do something new. Ask students how they responded to the challenges they faced and what they learned when overcoming these challenges. Provide examples of leaders in politics or industry whose early efforts failed, and describe how these individuals later overcame those failures to achieve subsequent success. Ask students to offer their opinions on how such events might foster personal growth.

PAGE 204

Mutations

Read the text together, pausing occasionally to ask students to summarize important ideas or details. Point out that the kinds of mutations that can affect evolution are those that are passed from parent to offspring. Clarify any student misconceptions that are based on how mutation is portrayed in science fiction films, for example. Point out to students that mutations in which a single individual undergoes sudden changes are not heritable.

Engage and Extend

ELL Instruction: Recognize Supporting Details Explain that to recognize the main idea and supporting details, students should ask themselves questions: *What is each sentence about? Is there one sentence that tells about the whole paragraph or that is more important than the others?* Help students identify the main ideas and supporting details in sections in which students may need more support.

THINK ABOUT SCIENCE ANSWER KEY

1. Mutation is a change in the genes that pass from parent to offspring.
2. Some mutations are harmful, but others have no effect or are beneficial. The beneficial mutations can lead to new, useful traits in the population.
3. Disease-causing bacteria gradually develop resistance mutations to every antibiotic to which they are exposed.

PAGE 205

Fossils

Guide students through reading the text passages on fossils. While they are reading the text, invite students to make a list of the ways that fossils can form. Encourage them to share information about fossils they have seen or collected. Invite students to find information about fossils that have been found in your state or geographic region.

Core Skill: Cite Textual Evidence

Review with students the first two paragraphs of the main text. Invite students to point out the sentences that supply specific evidence supporting the definition of *fossil* in the first sentence.

WRITE TO LEARN ANSWER KEY

When students have finished writing their paragraphs, invite one or more student volunteers to share their paragraphs with the class. If students are having trouble thinking of supporting details to add to their paragraphs, read aloud a magazine or a newspaper article covering a current event and point out the descriptive details used by the writer.

PAGE 206

Eras of Life on Earth

Point out to students that the present day is located at the top of the table and that each row goes further back in time as you read down. Draw a time line on the board and ask students how they would use the information in the table to fill in the time line. Invite students to prepare their own time lines showing the appearances of different kinds of organisms over time.

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 475.

Extension Activity: Summarize Darwin's Journey Assign students to research the journey of the *HMS Beagle*, the ship on which Charles Darwin sailed to study evolution. Invite students to plot Darwin's course on a map and summarize each point with a quote or discovery that Darwin made. Students could also illustrate the discoveries on the map. Then have them write a summarizing statement about the effect of the trip on Darwin's subsequent theory of evolution.

Common Ancestry and Cladograms

LESSON 6.2
PAGES 210–219

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Describe the purpose of cladistics
- Interpret a cladogram
- Identify assumptions behind cladistics

✓ *Determine Student Readiness*

To understand ancestry, students need to understand the relationship between evolution and natural selection. Ask students to identify examples of extinct or nearly extinct organisms and explain what factors may have contributed to their extinction or near extinction. Students may say, for example, that overhunting caused passenger pigeons to disappear.

Key Concept

Cladistics is an analytical method scientists use to hypothesize about the relationships among existing organisms. The foundation of the method is an agreement that members within any clade, or group, share a common evolutionary past.

Concept Background: Explain to students that offspring inherit genetic information from their parents. Genetic changes occur within a population, and those changes are inherited by the offspring of subsequent generations. Over many generations, these changes can lead to new kinds of organisms. Animals that are now extinct may be ancestors of common species. The process of change among descendants is called *biological evolution*.

Develop Core Skills

Core Skill: Determine Meaning

Explain that identifying the meanings of word parts, such as prefixes, base words, and suffixes, is one strategy students can use to make sense of unfamiliar words in any subject, including science. Discuss the following example. Write the word *taxonomy* on a board or chart. Explain that the base word *taxo* comes from a Greek word that means "group or rank." The suffix *–nomy* means "to arrange." Help students conclude that the word *taxonomy* means to "arrange in groups, or classify."

Core Skill: Integrate Explanations with Visual Representations

Remind students that print and online scientific texts are often accompanied with explanatory graphs, tables, maps, diagrams, models, photographs, illustrations, and even videos. Explain that family trees are also visual tools and that they help show relationships among members of a family. Invite students to describe examples of family trees their families have created, or project examples from online sources.

Pre-Teach Vocabulary

Respond to Questions

Write the word *assumption* on the board. Explain that an assumption is an unproven belief that is thought to be true. Write the definition on the board. Then write the following words across the board: *clothing*, *music*, *artists*, *mathematics*, *sports*, *eyeglasses*, *technology*, *school*. Point to a term and ask: *What assumptions do you have about this subject?* Encourage students to comment on each.

Tier 2 Words:

ancestry (p. 210)
assumptions (p. 211)
diverge (p. 212)

Tier 3 Words:

cladistics (p. 211)
cladogram (p. 212)
homologous (p. 214)
phylogeny (p. 211)
systematics (p. 211)
taxonomy (p. 211)

DURING THE LESSON

PAGE 210

A Family Tree

Point to the title and read it aloud. Ask students why they think people selected a tree as representative of generations of a family. Examine the illustration together and ask students to interpret what they see. Read the text as a class.

PAGE 211

What Is Cladistics?

Write on the board all of the boldfaced terms in the text. Read the words aloud and explain that these words are unique to the discussion of ancestry. Explain that the science of biological classification, or taxonomy, makes it possible for scientists to use a common language to discuss specific organisms. Read the text with students, pausing frequently to ask questions and guide students' comprehension.

Evidence-based Reading Support: Vocabulary Context Clues

Organize students into small groups. Have students search for context clues to define each of the boldfaced terms that appear in the reading and that you wrote on the board. Afterward, ask each group to define each term. Write their responses on the board and return to the text, if necessary, to resolve any misunderstandings.

The Main Ideas Behind Cladistics

Explain that the basis for cladistics is the theory that members of a group, or clade, share the same evolutionary history. Further explain that organisms of the same clade have more in common with each other than they do with organisms outside the group. Before reading the text with students, ask them to write questions related to the text as you read together. After reading, give students time to ask their questions and have the class work as a whole to answer them.

Core Skill: Determine Meaning
Read the first two paragraphs with students. Discuss the text to be sure students understand how to apply the meanings of word parts to define new words.

PAGE 212

THINK ABOUT SCIENCE ANSWER KEY

Seeds formed within a female reproductive organ.

21st Century Skill: Information Literacy
Have students read the text and then explain information literacy in their own words. Ask students to respond to the question at the end of the text. Encourage students to discuss how information literacy can contribute to the success or failure of a business.

PAGE 213

How Do You Make a Cladogram?
Read the text with students and examine the table and diagrams as a class. Ask questions that require students to interpret the visuals. For example, ask: *How is the information in the data table related to the diagram beneath it? How is the information in that diagram related to the information in the second diagram, or clade?*

Core Skill: Integrate Explanations with Visual Representations
Read the text with students. Then ask them to examine the Venn diagram. Ask students to explain how the diagram helps them identify two features that the nambaroo and kangaroo share. Afterward, ask students to name other ways the information could be presented visually.

PAGE 214

Ingroups and Outgroups
Read the text aloud for students, having them make notes or write questions in the margins of the page. After reading, invite volunteers to read the individual paragraphs aloud. Pause after each reading to answer students' questions or to invite them to share the notes they recorded. Ask students to explain the relationship between the diagram and the text. Ask: *How does the diagram explain the difference between an ingroup and an outgroup?*

PAGE 215

The Principle of Parsimony
Read the text with students, pausing often to ask questions to check students' comprehension. Invite a volunteer to explain how the diagram of Hypothesis 2 reflects the Principle of Parsimony better than Hypothesis 1.

THINK ABOUT SCIENCE ANSWER KEY

The fewer divergences there are in evolutionary history, the more likely they are to have happened.

PAGE 216

The Parts of a Cladogram
Read the text with students, pausing often to direct their attention to the diagram and using the diagram to help support their understanding. Afterward, invite a volunteer to summarize the meaning of the diagram as it relates to the text. Encourage students to ask any questions that they may still have, and take time to work as a class to answer those questions.

THINK ABOUT SCIENCE ANSWER KEY

Five splitting events occurred. The first occurred at the root; the others occurred at branches B through F. Terminal taxon A represents the outgroup—the plesiomorph. Taxa C and D are sister taxa, which are more closely related to each other than to other taxa in the ingroup.

PAGE 217

Reasons for Cladistics
Before reading the text as a class, write the following question on the board: *What are three reasons for using cladistics to classify Earth's organisms?* Read the text with students. Encourage them to write notes, underline text, or use symbols to identify clues that will help them answer the question on the board. After reading, have students work in pairs to use their notes, marks, and symbols to answer the questions.

WRITE TO LEARN ANSWER KEY

Suggest that students draw a cladogram before writing a response. Students should indicate that shelled mollusks are a root, whereas shell-less mollusks are a branching point.

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 475–476.

Engage and Extend

ELL Instruction: Clarify Language Ask students to revisit the cladogram on page 212 and explain its meaning in their own words. Ask students to tell you what illustrations they would use to help explain each label, and have them justify their decisions.

Extension Activity: Formulate Research Questions Have students review the sidebar on page 213, the text on page 217, and the Write to Learn box on page 217. Ask students to write research questions related to the topics presented in those sections. Encourage students to select one of their questions to research and answer. Have students present their answers in the form of written explanations supported by at least one visual.

Speciation

LESSON 6.3
PAGES 220–229

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Identify different types and causes of speciation
- Describe different kinds of evolution

✓ *Determine Student Readiness*

Determine students' readiness by engaging them in a discussion of genetic traits and how they are passed from one generation to the next over time. Also prompt students to recall the meaning of *evolution* and how it relates to inherited traits.

Key Concept

Speciation refers to the evolutionary process by which new biological species form. The pressures of a different environment, the isolation of a population, or genetic changes that result in successful adaptations may lead to a species with characteristics unlike its ancestors.

Concept Background: Explain to students that individuals within a species population have unique sets of genes. Together, all of the genes in a population form a gene pool. Gradually, the gene pool in a population can change. This change within a population is called *evolution*. Begin a discussion of how gene pools can become more or less common. Simple hypothetical examples may work best to establish the concept firmly.

Develop Core Skills

Core Skill: Determine Central Ideas

Remind students that scientists read other experts' scientific texts to remain in touch with current thinking in their fields of study. Explain that even scientists must be able to determine the central idea of a text quickly and that they use clues such as titles, subtitles, and key words to identify a text's main focus. They also look for visual clues, such as diagrams, illustrations, graphs, tables, and photographs. Ask students to skim the titles, subtitles, and visual clues in the lesson to determine the lesson's central idea.

Core Skill: Analyze Text Structure

Explain that text structures are a way to organize information in a text. Common text structures include descriptions, the sequential or chronological arrangement of information, comparisons between topics, using cause and effect to show text relationships, and the presentation of problems and their solutions. Sometimes authors use multiple text structures in a text. Ask students to read the title on page 221 and use it to predict the text structure the author uses in this section.

Pre-Teach Vocabulary

Relate Words

Write the vocabulary words *gene flow*, *lineage*, *natural selection*, and *speciation* on the board. Next to each word, write a brief definition. Have students work in pairs to make illustrated concept maps to show the relationships among these words. Encourage partners to share and explain their work.

Tier 2 Words:

fossil record (p. 221)
gene flow (p. 225)
hierarchy (p. 220)
lineage (p. 224)

Tier 3 Words:

continental drift (p. 222)
incipient species (p. 223)
natural selection (p. 221)
speciation (p. 224)

DURING THE LESSON

PAGE 220

Classifying Organisms

Write the following list on the board: *School Board; Superintendent; Principal; Vice-Principal; Teacher.* Ask students to look at the vocabulary words you wrote on the board and determine which word corresponds to the list (*hierarchy*). Read the text as a class. Afterward, ask students to explain the hierarchy they see in the diagram and how it relates to taxonomy.

PAGE 221

Lamarck and Darwin

Show students a picture of a giraffe and invite them to describe the animal's physical appearance. Explain that in this section, they will read about two scientists who had different explanations for the giraffe's long neck. Read the text as a class, pausing after each paragraph to ask questions or answer students' questions. At the conclusion, ask students to explain the relationship between natural selection and evolution.

Evidence-based Reading Support: Comprehension

Make Connections

Organize students into pairs. Ask each pair to imagine that they are recording a conversation between Lamarck and Darwin about how the giraffe came to have such a long neck. Have students identify and connect points of view by writing a conversation in the form of a dialogue between the two scientists. Encourage pairs to perform their dialogues.

THINK ABOUT SCIENCE **ANSWER KEY**

Review with students the answer on page 476 of the student lessons.

PAGE 222

Evolution and the Fossil Record

Invite students to describe examples of fossils that they may have seen, or show images of fossils, and encourage students to describe their features. Next, read the text aloud. Refer students to the photograph of the okapi. Ask students to use the resemblance between the okapi and the giraffe to summarize the text.

Continental Drift
Write the following question on the board: *What is significant about the 1982 fossil discovery?* Ask students to keep the question in mind as they read the section. Afterward, invite volunteers to share their answers.

Core Skill: Determine Central Ideas
Read the opening paragraph aloud. Then invite volunteers to read each bulleted item aloud. Organize students into small groups and ask them to follow the bulleted steps as they reread the text on continental drift. Afterward, ask one person in each group to share their interpretation of the text's central idea. Discuss similarities and differences among groups' responses.

PAGE 223

Reproductive Isolation
Organize students into small groups. Explain that they are going to create visual maps to analyze the reading and to share with the class. Give students time to read the text and work collaboratively to create concept maps that explain and illustrate different ways species can become reproductively isolated. Afterward, give each group time to share and explain their work. Encourage listeners to ask important questions following each presentation.

THINK ABOUT SCIENCE **ANSWER KEY**
Review with students the answer on page 476 of the student lessons.

21st Century Skill: Media Literacy
Have students read and summarize the central idea of the text. Ask students to explain how they look for reliable resources. Have students research the claim that 140 species of marsupials live in Australia and document the sources they use to support that information.

PAGE 224

Speciation
Ask students to examine the diagram and table before reading. Write the following question on the board before asking students to read the text: *What purpose does the fossil record serve when scientists are studying lines of descent?* Have students read the text, answer the question, and discuss the different types of speciation.

PAGE 225

Allopatric Speciation
Organize students into small groups. Assign the groups to read the text on allopatric speciation and to prepare a brief presentation of the text's most important details for the class. Explain to students that they must include a reference to the diagram of the finches in their presentations. Give students time to make their presentations. Encourage listeners to ask questions and ask presenters to respond.

THINK ABOUT SCIENCE **ANSWER KEY**
Review with students the answer on page 476 of the student lessons.

Core Skill: Analyze Text Structure
As a class, read all but the last paragraph in the text and review the clue words that signal particular types of text structure. Then read the last paragraph aloud, and give students time to search for examples of text structures in the parts of the lesson they have read and the parts that remain.

PAGES 226–227

Before reading, organize students into three groups. Assign each group a topic: Peripatric, Parapatric, or Sympatric Speciation. Give each group a large sheet of drawing paper and have them to read about the speciation process they have been assigned, diagram the process, and incorporate one living example in their diagrams. After students have had time to complete their tasks, have them share and explain their diagrams. Ask and encourage questions to determine student understanding.

PAGE 227

THINK ABOUT SCIENCE **ANSWER KEY**
Review with students the answer on page 476 of the student lessons.

WRITE TO LEARN **ANSWER KEY**
Before students begin writing, remind them to review the processes that would be involved if speciation occurs gradually versus occurring in quick jumps.

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 476–477.

Engage and Extend

ELL Instruction: Use Examples Ask students to revisit the table on page 224. Ask students to explain how each kind of speciation process occurs by relying on specific examples presented in the text.

Extension Activity: Predict Based on Models Have students conduct research either independently or collaboratively into the geodynamic models that predict continental movement over the next several hundred million years. Ask students to draw and explain the changes that some scientists have predicted based on their models.