Energy

LESSON 7.1
PAGES 238–243

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Define energy
- Differentiate between kinetic and potential energy
- Recognize different types of energy and energy transformations

✓ *Determine Student Readiness*

Discuss with students what they know about energy and heat. Students may be familiar with forms of energy that they use in their daily lives, such as riding a bike or turning on a light. Ask students how they would define the word *energy* and write their responses on the board. Explain that scientists have a very specific yet simple way of defining this term, which they will learn in this lesson.

Key Concept

Energy, the ability to do work, occurs in different forms that can be changed from one type to another.

Concept Background: Explain to students that there are two types of energy. Potential energy is stored energy; kinetic energy is energy in motion. Potential energy is transformed into kinetic energy when an object moves. Ask students to provide an example of kinetic energy that they encountered on the way to school. *(Sample answers: riding in a car, walking, brushing teeth, riding a bike)*

Develop Core Skills

Reading Skill: Determine the Central Idea of a Text

Discuss with students the headings they see in the lesson. Explain to students that the headings tell what the section is about.

Reading Skill: Determine Meaning

Discuss with students how they determine meaning in what they read. Explain that two words may have different meanings, while the concepts are related. Discuss with students how determining the meanings of the words can help them understand their relationship.

Pre-Teach Vocabulary

Word Study: Multiple-Meaning Words

Write the words and 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. The meaning depends on how the word is used in a sentence.

1. When the hot metal cools, it will *contract*.
2. The quarterback signed a *contract* to play for a new team.

Tier 2 Words:
contract (p. 241)
efficient (p. 238)
energy (p. 238)
expand (p. 241)

Tier 3 Words:
law of conservation of energy (p. 238)
transformation (p. 238)

DURING THE LESSON

PAGE 238

Energy

Have students read the sections on page 238. Help them to differentiate between kinetic and potential energy. Provide students with a copy of the *Venn Diagram* graphic organizer (found in the Graphic Organizer section of the Instructor Resource Binder). Have students fill out the graphic organizer to compare and contrast kinetic energy and potential energy. Ask students to imagine an athlete competing in pole vaulting. When the athlete is standing still, the athlete has potential energy. As the athlete runs and vaults over the bar, potential energy is transformed into kinetic energy.

Ask a student volunteer to read the sentence in the third paragraph that defines the law of conservation of energy. Tell students that to *conserve* means to save or preserve. Remind students that the law of conservation of energy states that energy cannot be created or destroyed. Explain that the energy may seem lost, but it is actually just changing form. Have students read about some forms of energy on page 239 and then study the diagram on page 240.

Evidence-based Reading Support: Comprehension

Reread/Read More Slowly

Have students work with a partner to read the text passages on this page. Remind students that informational text containing many details will often need to be read more than once. As students read, point out that the first two paragraphs define two different kinds of energy (kinetic energy and potential energy), while the second two paragraphs describe how energy behaves.

PAGE 239

Determine the Central Idea of a Text

Remind students that headings, subheadings, and captions tell what information is going to follow and allows the reader to determine the central idea of the text. Have students read the text and complete the activity. After the lesson, have them go back and decide whether they correctly determined the central idea.

21st Century Skill: Flexibility and Adaptability

Have students read the text and discuss examples of flexibility and adaptability in their own lives. Then have them work in small groups to research and describe another historical situation where the scientific community was flexible and adaptable.

PAGE 240

THINK ABOUT SCIENCE ANSWER KEY

1. kinetic
2. potential
3. chemical
4. electrical
5. nucleus

Reading Skill: Determine the Central Idea of a Text
Have students read the text. Ask students to discuss the activity with a partner and summarize the central idea of the section *Energy Changing Form* in a sentence. When finished, write each group's sentence summary of the central idea on the board. As a class, determine which sentence is most accurate.

WRITE TO LEARN ANSWER KEY

Before students attempt to write, brainstorm with the class various energy conversions that occur on a typical day. Make sure the student's titles and opening sentences reflect the central idea.

PAGE 241

Heat
Before reading the section, have students discuss what they think heat is and how they experience it in daily life. After students read the section, discuss how objects expand or contract depending on the temperature. Students may be familiar with running hot water over the metal lid of a glass jar to expand it, making it looser and easier to remove.

Have students read the sections on conduction, convection, and radiation. As they read, have students make a list for each type of heat transfer, listing the different characteristics of each.

Core Skill: Determine Meaning
Have students read the text and complete the activity. Students may say they can observe a change in air temperature by feel or with a thermometer. Students may be able to observe the change in the temperature of hot cocoa more easily. Ask students to predict what will happen to the temperature of the hot cocoa after it sits for thirty minutes; ask students to state where the heat is going as the cocoa cools. Then ask what will happen to a cold drink that is removed from the refrigerator and allowed to sit for thirty minutes. Challenge students to explain where heat is moving in this instance. Lead students to understand that this process of heat transfer is what cools a hot drink or warms a cold drink.

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 479.

Engage and Extend

ELL Instruction: Rephrase or Restate Language Read aloud the text in the Reading Skill box on page 240. Point out the heading *Energy Changing Form* at the top of the page. Invite students to work in teams of two. One member of each team will read the two paragraphs below the heading *Energy Changing Form*. The other member will read and study the *Types of Energy* diagram. (Help students understand the meaning of each symbol used in the diagram.) When students are finished, have each team member explain the information in the text or the diagram to the other team member.

Extension Activity: Sketch Heat Transfer Have students draw a diagram that shows the differences between conduction, convection, and radiation. Have students research to find examples that were not discussed in the text.

Waves

LESSON 7.2
PAGES 244–251

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Relate the characteristics of a wave to the electromagnetic spectrum
- Compare low-energy and high-energy waves
- Describe the visible spectrum

✓ Determine Student Readiness

Discuss students' prior knowledge about waves. They may have seen ocean waves or they may be familiar with radio waves and the concept of light and sound waves.

Key Concept

Energy may travel in the form of a wave. The properties of a wave determine how much energy it has.

Concept Background: All ocean waves carry energy. They release high amounts of energy as they break and crash along a shore. The properties of an energy wave determine how much energy it has and how it can be used.

Develop Core Skills

Reading Skill: Cite Textual Evidence

Have students define the word *evidence*. Lead a class discussion of its meaning in various contexts. Ask students how the term *evidence* is used in crime dramas and have class members provide examples. Challenge students to explain why the presence (or absence) of evidence is often a key turning point in criminal cases. Tell students that they can use evidence from the text to support their answers to the questions in this course. Remind students that evidence is a factual signal, sign, or form of proof that supports a conclusion. Explain to students that evidence is necessary before a reader can draw conclusions from a text, just as it is required to build a case to establish a suspect's guilt.

Core Skill: Draw Conclusions

Lead a class discussion about what it means to draw a conclusion. Have students look up the meaning of *draw conclusions* and select a definition or synonym that they understand. Write student selections on the board.

Pre-Teach Vocabulary

Word Study: Syllables

Have students divide the vocabulary words into their individual syllables. Using any syllable, ask students to see if it reminds them of any other words, or if they recognize any prefixes or suffixes. Students may look up these words in a dictionary to see if there is a relationship.

Tier 2 Words:
frequency (p. 244)

Tier 3 Words:
electromagnetic spectrum (p. 244)
prism (p. 246)
reflect (p. 247)
refract (p. 247)
ultraviolet (p. 245)

Test Words:
support (p. 245)

DURING THE LESSON

PAGE 244

Wave Theory

As students read, draw several waves of varying frequency on the board, using the diagram on page 244. After students finish, discuss wavelength and frequency as a class. Have volunteers identify which wave on the board has the greatest frequency and which wave has the least frequency.

Evidence-based Reading Support: Comprehension

Make Connections

Encourage students to make connections as they read. Provide self-questioning models, such as *What do I already know about X-rays, ultraviolet waves, microwaves, or TV or radio waves? Have I learned something about this topic before? Have I had any experience in my own life that relates to this topic?* When students relate what they are reading to their own lives and educational experience, they consciously monitor their own comprehension.

PAGE 245

Cite Textual Evidence

Explain to students that it can help to build a mental framework of a text before reading in detail. Lead students to understand that a well-written paragraph will start with the main idea and then list details that support the main idea. Have students read the text and find two details that support the main idea. Have them compare their findings with a partner.

Before students read pages 245–246, have them divide a sheet of paper into three columns and label them *High-Energy Waves*, *The Visible Spectrum*, and *Low-Energy Waves*. As students read the text, have them list characteristics and examples of each type of wave. Help students recognize the ways in which high-energy waves can be damaging to humans. Ask a student volunteer to summarize some of the ways in which low-energy waves are useful. Point out to students the correct pronunciation of the term *infrared* (*in-fruh-RED*); explain to students that the prefix *infra–* means "below," so infrared wavelengths are below the wavelengths of red light. Discuss how the *Prism* diagram on page 246 is an expanded version of the central portion of the *Electromagnetic Spectrum* diagram on page 244.

PAGE 246

Reading Skill: Cite Textual Evidence

Have students read the text. Lead a discussion comparing textual evidence to the other types of evidence discussed at the beginning of the lesson. Lead students to understand that citing textual evidence makes their responses more convincing and believable. Have students complete the activity and then exchange papers with a partner to critique each other's evidence.

PAGE 247

How Light Travels

After students read page 247, have volunteers use a bright flashlight to demonstrate how objects may be opaque, translucent, or transparent with regard to light. Provide materials, such as various kinds of glass, fabric, paper, and cellophane. Invite students to find out if they can identify an opaque object held in front of the flashlight beam when the object is hidden behind a translucent substance, such as paper. Ask students to predict which part of their hand is opaque (*palm*) and which part is generally translucent (*fingers*). Have students use a mirror to demonstrate reflection. Ask students to observe refraction by viewing a pencil placed in a glass of water.

THINK ABOUT SCIENCE **ANSWER KEY**

1. gamma rays, X-rays, ultraviolet rays; 2. infrared waves, microwaves, radio waves; 3. waves; 4. shadow; 5. refract; 6. reflect

PAGE 248

Sound

Guide students as they read the text. Discuss the differences between sound waves and light waves. Discuss with students their experiences hearing, feeling, and seeing sound waves. Students may have felt vibrations from the sound waves of a very loud noise, such as at a rock concert. They may have seen oscilloscope pictures in the media.

Draw a wave and have volunteers define and label the compression, rarefaction, wavelength, crest, trough, and amplitude. Help students understand that the frequency affects the sound (how high or low the pitch is).

Core Skill: Draw Conclusions

In small groups, have students discuss their conclusions and identify the details from the text they used to support their conclusions.

WRITE TO LEARN **ANSWER KEY**

After students complete the activity, have them exchange their conclusions about why sonar is an effective method for mapping the ocean floor and analyze each other's justifications. Explain to students that the word *sonar* is derived from the letters at the beginnings of the words **SO**und **NA**vigation **R**anging. Encourage students to do online research to learn more about the development of sonar technology and how it works.

PAGE 249

21st Century Skill: Communication and Collaboration

After students read the text, lead a discussion about ways in which they have worked together to analyze each other's work and conclusions like scientists. When scientists publish their findings, they can be read and discussed by other scientists. Have students think of other ways scientists can share their claims and ideas.

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 479–480.

Engage and Extend

ELL Instruction: Use a Graphic Organizer Before students begin the Write to Learn activity, ask them to make a Word Web to represent their conclusion. Have them write the conclusion in the center and the supporting details in the surrounding circles.

Extension Activity: Categorize Objects by Opacity Have students create a poster that illustrates the differences between transparent, opaque, and translucent objects. Have students attach examples of each type of material to their poster.

Electricity and Magnetism

LESSON 7.3
PAGES 252–257

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Discuss how electric current is produced and used
- Identify parallel and series circuits
- Describe an electromagnet and how it works

✓ *Determine Student Readiness*

Engage students in a discussion of electricity. Invite students to discuss what they know about it. For example, invite students to discuss what they rely upon electricity to do each day. Ask students if they know the source of that electricity and how it reaches their homes and school.

Key Concept

Electric current flowing through a circuit can be harnessed for its energy, and it produces magnetic effects.

Concept Background: Explain to students that the flow of charged particles results in electricity. Charged particles are invisible, but they occur everywhere. Ask: *Who has shuffled along a carpet, touched a doorknob, and seen sparks or felt a shock?* Explain that this is an example of static electricity. Next, ask students to describe displays of lightning they have observed during a storm. Afterward, explain that lightning is another form of static electricity. When electric charges flow in a continuous circuit, however, they form an electric current. Static and current forms of electricity can be harnessed, but the latter produces more powerful effects.

Develop Core Skills

Core Skill: Determine Meaning of Symbols

Write the numbers 1, 2, 3, and 4 on the board, and explain that each of these symbols represents a quantity, or amount. Explain that other subjects use symbols, too. In reading, letters of the alphabet are symbols representing sounds. Scientists use both numbers and letters as symbols, and engineers use special electrical symbols, for example. Invite students to give other examples of symbols that they see or use regularly.

Reading Skill: Understand Text

Explain to students that there are a number of strategies, or action plans, that they can apply to understand any text. Invite students to share some of the strategies they use to understand new text. Write their responses on the board. Add the following strategies if they are not among students' responses: skim headings to look for main ideas; examine visuals to determine what they are about; write definitions of boldface terms in your own words; pause after reading short chunks of text to summarize important ideas; summarize important details after reading. Encourage students to use some or all of these strategies while they read this lesson.

Pre-Teach Vocabulary

Possible Sentence

Write the words and definitions on the board. Have students choose a word and confirm its definition in a dictionary. Organize students into pairs, and tell students to use the words they chose to write two sentences, one that uses the word correctly and one that uses it incorrectly. Have students exchange their sentences with their partners and identify the correct sentence.

Tier 2 Words:	Tier 3 Words:	Test Words:
magnets (p. 255)	circuit (p. 254) electricity (p. 252) electromagnet (p. 255) generator (p. 256) resistance (p. 252)	interpret (p. 254)

DURING THE LESSON

PAGE 252

Electricity

Ask students if they remember a time they brushed or combed their hair and were able to make their hair stand on end. Explain that this was a type of electricity. Have students read the section in pairs to determine the type of electricity. Afterward, ask volunteers to use their own words to explain static electricity.

Electric Current

Write the words *current* and *resistance* on the board. Next to *current*, write *from the Latin word* currere, *meaning "to run."* Next to *resistance*, write *from the Latin word* resistere, *meaning "to hold back."* Ask students to use these word origins to predict the meanings of *electric current* and *resistance*. Have students work in pairs to read the text and reinforce or revise their definitions. Ask volunteers to summarize resistance and how it can lead to fire. Ask other volunteers to explain the difference between resistance and volts.

PAGE 253

Determine Meaning of Symbols

Examine the diagram as a class and invite students to interpret what they see. Then read the text with students. Afterward, ask volunteers to interpret the diagram again. Point out the various symbols in the diagram, including the symbols for ohms, volts, and light-emitting diodes. Ask students to suggest what could be added to the diagram to make it more useful. In this diagram, for example, students might say that a caption or a list of symbols and their meanings would be helpful.

21st Century Skill: Media Literacy

Write the word *literate* on the board and explain that it means being able to read and write. Literacy, then, is the state or condition of being literate. However, people who are literate must be able to do more than read and write. They must be able to comprehend, analyze, determine the quality of, and transfer understandings across media. Write the word *media* on the board, and ask volunteers to list as many examples of media as they can. Then ask students what it means to be *media literate*. Give students time to read the text in the 21st Century Skill. Afterward, discuss how students determine the reliability of the media they use when doing research.

Evidence-based Reading Support: Fluency

Choral Read

Organize students into groups and assign each group one of the headings or subheadings in the lesson. Ask groups to choral read the section. Then ask groups to describe what part of the reading task they found most challenging and what they can do to make the process easier.

PAGE 254

Circuits

Direct students' attention to the diagrams, and ask volunteers to describe the similarities and differences they see. Then organize students into small groups and have each group read the text. While students are reading, draw a Venn diagram on the board. Label the first circle *Series Circuit*. Label the second circle *Parallel Circuit*. Ask students in each group to copy the diagram and use details from the text to complete it.

THINK ABOUT SCIENCE ANSWER KEY

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

Core Skill: Determine Meaning of Symbols

Read the first paragraph with students. Then ask students to read the second paragraph independently. Afterward, ask volunteers to share which lines from the text they used to interpret the meaning of each symbol on the batteries.

PAGE 255

Magnets

Explain that a magnet is a piece of iron, or iron-containing material, that attracts other iron-containing materials. A magnet has a positive and a negative end. The unlike charges attract while the similar charges repel. Write the word *repel* on the board. Next to the word, *write from the Latin word* repellere, *from* re–, *meaning "back," and* pellere, *meaning "to drive."* Ask a volunteer to combine the word parts to define the term *repel*.

Read the text with students. Then show or project an image of a compass. Ask volunteers to explain why the needle on a compass moves as the person holding the magnet changes location.

Electromagnetism

Read the text with students and discuss the supporting diagram. Ask a volunteer to explain the difference between a generator and an electric motor (*the former converts mechanical energy into electricity, while the latter converts electricity into mechanical energy*). Encourage students to work in pairs or small groups to research how electromagnets are used in real-world situations, such as in junkyards and scrap metal facilities.

WRITE TO LEARN ANSWER KEY

Explain to students that before they can write, they will need to locate an instruction manual that accompanied an electric machine they use at home. Encourage students to examine carefully the diagram they find before attempting to write. It may also help them to list details they want to include in their summaries before writing begins.

PAGE 256

Reading Skill: Understand Text

Before reading ask students to recall some of the comprehension strategies they shared at the beginning of the lesson. Review the strategies, including skimming titles and subtitles, scanning diagrams, determining important ideas and supporting details, and using key details to summarize. Have students read the text. Then give them time to summarize the text related to magnets. Encourage students to share their summaries.

Ask volunteers to define the term *compound word*, and give examples, such as *footprint*, *skateboard*, and *homemade*. Give students time to read the text and locate the words that are shortened and combined to create the word *maglev* (magnetic levitation).

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 480.

Engage and Extend

ELL Instruction: Understand Diagrams Ask students to summarize what they see in the diagram on page 254. Have them read the text on the page and compare it to the diagram. Ask: *What does the diagram explain? What labels would you add to the diagram to make it clearer and easier to understand?* If possible, provide students with simple circuit-building materials. Encourage students to build circuits and discuss the process.

Extension Activity: Determine Cause and Effect A power surge is a spike in the voltage of an electric current. Have students investigate different causes of power surges and write an explanation of what happens during a power-surge event. Have students include a visual to support their explanations. Also ask them to describe the damage that can result from power surges and how people can prevent them. Encourage students to share their work.

Sources of Energy

LESSON 7.4
PAGES 258–267

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Compare and contrast different sources of energy
- Distinguish between renewable and nonrenewable resources

✓ *Determine Student Readiness*

Engage students in a discussion on energy, particularly the forms of energy they depend upon in their daily lives. Invite students to discuss energy-related topics that they hear on the news or from family members. Ask students to describe their dependence on energy. Have them discuss how they imagine the future depends on finding or creating new sources of energy.

Key Concept

Energy takes different forms, and each form can be used to do work.

Concept Background: Explain to students that we depend on energy to live. Energy comes from many sources, even the food we eat. Energy may come from a living resource, such as the crops we grow, or a nonliving resource, such as the air we breathe. A resource may also provide us with the energy we need to power our cars or heat our homes.

Develop Core Skills

Core Skill: Analyze an Author's Purpose

Explain that all authors write for a purpose, and they have specific points of view. An author's point of view helps determine what the author writes about and how he or she writes about it. Invite students to discuss something they wrote recently and give their purposes for writing. Encourage students to talk about the kinds of things they like to write about and why those topics interest them.

Core Skill: Analyze Text Structure

Explain that text structure is a means of organizing information in a text. Common text structures include descriptions, sequential or chronological arrangements of text, text organized to show cause-and-effect relationships, and text that presents problems followed by solutions. Ask students to scan the lesson to identify text structures the author may have used.

Pre-Teach Vocabulary

Relate Terms

Write the vocabulary terms on the board and read them for students. Then, draw a tally table with three columns. Label the first column *Never Heard or Read It.* Label the second column *Heard It but Never Used It.* Label the third column *Used It.* Survey students to determine their level of familiarity with the terms. Afterward, ask students who have some level of familiarity with each term help you write a definition on the board. Review the definitions as a class.

Tier 2 Words:
crowdsourcing (p. 262)
nonrenewable (p. 259)
renewable (p. 259)
reservoir (p. 261)

Tier 3 Words:
biomass (p. 259)
energy density (p. 265)
magma (p. 262)
nuclear fission (p. 264)

DURING THE LESSON

PAGE 258

Potential and Kinetic Energy

Hold any kind of ball in your hands. Explain to students that the ball has potential energy. Now drop the ball. Explain to students that they have observed the change from potential to kinetic energy. Ask students to predict the meaning of each term. Then have them read the text and cite evidence from the text to support or revise their definitions.

PAGE 259

Renewable and Nonrenewable Sources of Energy

Write the words *renewable* and *nonrenewable* in a Venn diagram on the board. Have students take notes related to the similarities and differences between the two kinds of energy as they read. Then, ask students to write their notes in the Venn diagram. Discuss the results as a class.

Biomass

Organize students into small groups. Have students read the text and then write a list of advantages and disadvantages for depending on biomass as a source of energy. Ask representatives from each group to share their lists and explain their thinking.

THINK ABOUT SCIENCE **ANSWER KEY**

Since the combination of ethanol and gas would be used as the energy source, less gasoline would be used than if the fuel consisted of only gas. Using less gasoline per gallon makes supplies of gasoline last longer.

PAGE 260

Wind Power

Ask students to examine the photograph and explain what they see. Then write the following questions on the board: *Why do winds form? What makes wind a renewable source of energy?* Have students read the text independently. Ask volunteers to answer the questions.

Solar Power

Write the following questions on the board: *The Sun will eventually die, so why is it considered a renewable source of energy? How is sunlight converted into electrical energy?* Have students read the text independently. Afterward, ask volunteers to answer the questions.

Core Skill: Analyze an Author's Purpose
Read the text with students. Afterward, invite volunteers to summarize the symptoms of "wind turbine syndrome." Then, discuss students' answers to the question that concludes the text. Encourage students to use the term *author's purpose* in their explanations to emphasize that authors always have reasons for writing.

PAGE 261

THINK ABOUT SCIENCE ANSWER KEY

Wind is produced by the Sun's uneven heating of Earth's surface. So, wind power is available as long as the sun shines. The same is true for solar power.

Evidence-based Reading Support: Alphabetics
Word Analysis
Write the prefix *hydro–* on the board and explain that it comes from the Greek word *hudōr*, meaning "water." Next, write the words *hydropower*, *hydroelectric*, and *hydraulic* on the board. Ask students what conclusion they can come to regarding the meaning of all of these words. *(They are all related to water in some way.)*

Hydropower
Examine the diagram of the hydroelectric plant as a class. Challenge students to interpret the diagram, determining the sequence of steps involved in converting the energy in moving water into electricity. Then, have students read the text to confirm or revise their thinking. Discuss the process as a class.

PAGE 262

Geothermal Power
Read the first two paragraphs with students. Then, organize students into three groups, and assign the number 1, 2, or 3 to each group. Have students read about the kind of geothermal power plant associated with their number and create diagrams to explain it. Have groups share and explain their diagrams.

21st Century Skill: Information Literacy
Read the text with students. Before giving students time to respond to the question at the end of the text, ask them to summarize the purposes and advantages of crowdsourcing. Ask students to offer opinions on why crowdsourcing might be helpful in the workplace. (*creativity*, *expense*, *collaboration*)

PAGE 263

Fossil Fuels
Write the terms *coal*, *oil*, and *natural gas* on the board. Invite students to tell what they know about these fossil fuels. Record their responses on the board. Tell students to note other details they can add to the board as they read. After reading, invite volunteers to add information.

THINK ABOUT SCIENCE ANSWER KEY

Biomass and fossil fuels are made of organic matter. Biomass is renewable, but fossil fuels are not.

PAGE 264

Nuclear Power
Ask volunteers to interpret the diagram. Read the text with students. Afterward, allow students to work with partners to summarize the process of converting the energy in nuclear fission into electrical energy. Have them draw and label a diagram to show the steps. Encourage students to share their work.

Core Skill: Analyze Text Structure
Review the different kinds of text structure listed in the text. Have students revisit the 21st Century Skill sidebar on page 262 to determine which text structure the author used to organize the text. (*problem and solution*)

PAGE 265

The Law of Conservation of Energy
Read the text aloud with students. Have students write a brief definition of the Law of Conservation of Energy. Encourage volunteers to share their definitions.

Choosing a Source of Energy
Have students take turns reading the text. Then, organize students into groups. Assign each group a different source of energy. Have each group plan an oral argument in favor of using their assigned source of energy above all others. Give groups an opportunity to defend their arguments.

PAGE 266

WRITE TO LEARN ANSWER KEY

Encourage students to review the content in the lesson related to their choices before they attempt to write. Also encourage them to consider which text structure they will use, such as cause and effect, compare and contrast, problem and solution, order and sequence, and description or list.

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 480–481.

Engage and Extend

ELL Instruction: Explain a Diagram Ask students to "walk" through the lesson with you, pausing at each diagram or image to discuss its content and its relationship to the lesson.

Extension Activity: Cite Evidence and Develop a Logical Solution Organize students into small groups. Have students address an everyday problem related to energy sources or consumption and offer a solution. Encourage students to cite evidence from research to explain their problems and support their solutions. Have students share their solutions.

Endothermic and Exothermic Reactions

LESSON 7.5
PAGES 268–275

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Recognize endothermic and exothermic reactions
- Relate changes in energy to endothermic and exothermic reactions

✓ *Determine Student Readiness*

Engage students in a discussion of heat transfer, a concept they learned about in the first lesson of this chapter. To prompt discussion, ask students to use a cup of steaming cocoa to explain the transfer of heat from an area of greater to lesser thermal energy. Also invite volunteers to explain convection, conduction, and radiation as processes of heat transfer.

Key Concept

Chemical reactions change one substance into another and change their potential energy. When energy is released, the chemical reaction is called exothermic. When energy is absorbed, it is called endothermic.

Concept Background: Explain to students that a chemical reaction is a reaction between two or more substances that produces a new substance. While physical changes can be reversed, chemical changes usually cannot. Each substance has its own set of chemical and physical properties. The properties can be used to identify unknown substances.

Develop Core Skills

Core Skill: Make Predictions

Tell students to visualize a blue sky dotted with clouds. Over a matter of hours, the clouds get bigger and grayer, lightning flashes, and thunder rumbles. Ask students to predict what will happen next. After students share their predictions, ask them how they knew what was likely to happen. Explain that scientists also use prior experience and knowledge to make predictions about what will happen during an investigation.

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 making breakfast or performing a chore.

Pre-Teach Vocabulary

Predict Meanings

Write the vocabulary words on the board. Read the words aloud and ask students to identify words that sound familiar. Invite them to describe the contexts in which they have heard or read those words. Ask students to listen as you use each word in a sentence and then have them predict the meaning of the word.

Tier 2 Words:
catalyst (p. 273)
chemical reaction (p. 268)
compounds (p. 268)
potential energy (p. 269)
product (p. 270)
reactant (p. 270)

Tier 3 Words:
activation energy (p. 272)
endothermic (p. 271)
exothermic (p. 270)

DURING THE LESSON

PAGE 268

Chemical Reactions

Write the following question on the board: *What is the relationship among the words* atom, compound, *and* molecule? Tell students to keep this question in mind as you read the text together. Afterward, ask students to explain the relationship in their own words. Then, ask them to explain what role atoms, compounds, and molecules have in a chemical reaction.

Evidence-based Reading Support: Alphabetics

Suffixes *-ity, -al, -ly*

Model adding suffixes to these words: dense + ity (*density*), origin + al (*original*), potential + ly (*potentially*). Discuss the meaning of each word and point out any changes that occurred to the base word when the suffix was added. Ask students to identify other base words that can be changed using these suffixes, such as *gravitation* and *probable*.

PAGE 269

A Familiar Example

Before reading the text, ask students to examine the diagram of the chemical reaction and tell you what it describes. *(photosynthesis)* Ask volunteers to explain what happens during the chemical reaction they see in the diagram. Read the text with students and allow them to revise their earlier explanations of the chemical reaction, if necessary.

Kinds of Energy

Have students read this section aloud, taking turns. As each term is read (*work*, *kinetic energy*, *potential energy*, *gravitational potential energy*, *elastic potential energy*, *chemical potential energy*) write it on the board. Then, after reading, invite volunteers to write definitions for and give examples of each term.

21st Century Skill: Creativity and Innovation

Have students read the text and then explain creativity and innovation in their own words. Invite students to give specific examples of personal creativity and what it led them to innovate. Ask students to offer opinions on why such talents and behaviors might be particularly helpful in science.

Exothermic Reactions

PAGE 270

Write the following question on the board: *Why is the burning of coal an example of an exothermic reaction?* Ask students to think about this question as you read the text as a class. Afterward, invite volunteers to apply what they read to answer the question.

THINK ABOUT SCIENCE ANSWER KEY

The chemical reaction is exothermic because it releases energy in the form of light and heat.

Core Skill: Make Predictions

Read the text with students, emphasizing the relationship between prior knowledge and predictions. Have students write what they know about chemical reactions in the chart, or create a new, larger chart on their own paper. Tell students that they will be able to add more information to the chart after reading about endothermic reactions.

Endothermic Reactions

PAGE 271

Write the following questions on the board: *Why is photosynthesis an example of an endothermic reaction? Why is the chemical reaction that occurs when ammonium chloride is dissolved in water an endothermic reaction?* Ask students to think about these questions as you read the text as a class. Afterward, invite volunteers to apply what they read to answer the questions.

THINK ABOUT SCIENCE ANSWER KEY

The phase change from ice to liquid water is like an endothermic reaction because heat must be absorbed for the change to occur, and that heat is stored in the liquid water.

Potential Energy in Chemical Reactions

PAGE 272

Read the text with students, pausing after the second paragraph to discuss the connection between the diagram and the text. Continue reading with students, pausing again after the fifth paragraph to support student understanding by integrating the visual into the text.

Finish reading the text with students. Afterward, ask students to explain the need for activation energy. Help students recognize that without it, chemical bonds cannot be broken, and stored potential energy cannot be released and converted to get work done.

THINK ABOUT SCIENCE ANSWER KEY

More energy is required for an endothermic chemical reaction to occur.

Core Skill: Follow a Multistep Procedure

Review the steps in the procedure for making "hot ice," which results in an exothermic reaction. If possible, have students write numbered steps for the procedure. Help students understand the value of writing such explicit instructions for a scientific investigation. Help students understand that steps make an investigation reproducible, meaning other people who repeat the procedure should get similar results.

Catalysts

PAGE 273

Share a personal experience in which something served as a catalyst that made you do something. For example, perhaps you enjoyed a concert so much that the experience became a catalyst that led you to take guitar lessons. Ask students to share similar events that served as a catalyst in their lives. Read the text with students and guide them through the interpretation of the diagram.

THINK ABOUT SCIENCE ANSWER KEY

Reactant 1 + Reactant 2 + Catalyst → Product 1 + Product 2

WRITE TO LEARN ANSWER KEY

Remind students of the definitions of *exothermic* and *endothermic reactions* before they begin to describe examples. Explain to students that they must justify their examples.

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 481–482.

Engage and Extend

ELL Instruction: Describe a Multistep Procedure Ask students to take turns describing processes that they know how to do well, such as tuning a guitar or folding origami to create a figure. Have them explain each step involved in the process, from beginning to end.

Extension Activity: Relate a Process Organize students into small groups. Have them use print and digital media to write an explanation of chemical reactions for young students. Remind students that their explanations must use age-appropriate examples. Encourage students to share their explanations with the class, consider constructive criticism, revise their explanations, and then present them to younger students.

Newton's Laws of Motion

LESSON 8.1
PAGES 284–289

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Apply the characteristics of speed, velocity, and acceleration to describe motion
- Apply Newton's laws of motion to describe the motion of familiar objects

✓ *Determine Student Readiness*

Determine students' readiness by engaging them in a discussion of motion. Invite students to discuss the motion of familiar objects, such as skateboards, bicycles, cars, and even feet upon a sidewalk. Ask them to describe the motion of these objects and what's required to make them turn, speed up, slow down, and stop.

Key Concept

Forces must act upon an object to change its motion. Newton's three laws of motion explain the relationships between forces and moving objects.

Concept Background: Toss a foam ball or dribble a basketball. As students observe the ball's motion, explain that the movement of any object depends upon its position and upon the forces that are acting on it. Tell students that when we describe motion, we usually use Earth as our frame of reference because, despite Earth's movement, it appears stationary. Explain that the concepts of *distance*, *speed*, *velocity*, and *acceleration* are all related to motion and that Isaac Newton described these relationships in the set of laws called Newton's Laws of Motion.

Develop Core Skills

Core Skill: Determine Meaning of Terms

Write the following statement on the board: force = mass × acceleration. Explain to students that some terms, such as *force*, *mass*, and *acceleration* are common to specific areas of study, such as physical science. Tell students that whether terms are special to science or any other area of study, it is helpful to recognize them and their meanings in the context of a specific text. For example, ask students to imagine that they have decided to animate a science concept to explain it to other students. They are reading the directions for a new animation tool, and they read the terms *transitions, frame rate,* and *scale*. Ask: *How does knowing the meaning of terms affect your ability to understand a text?*

Reading Skill: Determine the Central Idea of a Text

Ask students to describe a recent piece of writing they completed, either at school or using social media. Encourage students to identify the central idea of what they communicated. For example, ask: *What was the main point you were trying to make? What big idea did you want your reader to understand?* Explain to students that every text has a central or main idea. Ask: *How does determining the central idea of a text contribute to your understanding of that text?* Invite students to share and discuss their answers.

Pre-Teach Vocabulary

Latin Origins

Explain to students that many English words they hear, speak, and read have long histories, going back to the languages of Latin and ancient Greek. Write the word *motion* on the board. Next to the word, write *from the Latin word* motio(n–), *meaning "to move."* Ask students to use this word history to define the term motion. Next, write the word *velocity* on the board, and then write *from the Latin word* velocitas, *from* veloc–, *meaning "swift."* Ask students to use this word history to define the term *velocity*.

Tier 2 Words:
acceleration (p. 286)
distance (p. 286)
motion (p. 284)
speed (p. 286)

Tier 3 Words:
inertia (p. 287)
velocity (p. 286)

DURING THE LESSON

PAGE 284

Position and Motion

Write the following question on the board: *Why is Earth a good frame of reference?* Read the question aloud and ask students to keep the question and its answer in mind as they read. Then organize students into small groups, and have them read the text. Challenge them to solve the riddle before reading the answer. Afterward, invite volunteers to answer the question you wrote on the board.

PAGE 285

Determine the Central Idea of a Text

Remind students that every text has a central or "big" idea. Read the introductory text with students. Then give them time to read the text in the text box and answer the question that follows. Afterward, ask volunteers to share their statements of the central idea. Discuss any discrepancies that may occur.

21st Century Skill: Initiative and Self-Direction

Ask volunteers to describe topics they enjoy so much that they read about or investigate those topics whenever they have time. Engage students in a discussion of self-direction. What does the term mean at home, in school, and at work? Read the text as a class, and then continue the previous discussion by asking students to share specific experiences that left them wanting to know more. Encourage students to talk about what actions they took to learn more.

PAGE 286

Distance

Have students read the text. Then show or project a map and ask students to examine the key that describes units of distance on the map. Ask students to use those units to estimate the distance between two points on the map. Then read the text with students and ask a volunteer to define the term *distance*.

Speed and Velocity

Write the following question on the board: *What is the difference between speed and velocity?* Ask students to read the text independently to find the answer. Afterward, invite volunteers to share their answers, and discuss any discrepancies that may occur.

Acceleration

Read the text with students. Afterward, use the examples of the roller coaster and figure skater to ask students to explain the concept of acceleration.

Evidence-based Reading Support: Comprehension
Use Prior Knowledge

Encourage students to think about what they already know before they read. To get students started, provide self-questioning models, such as *Have I read about this topic before? Does this sound familiar?* When students can create a context or framework of known information in which to place new information, they consciously monitor their own comprehension.

THINK ABOUT SCIENCE **ANSWER KEY**

1. The sentence describes the airplane's position (above Minneapolis, Minnesota) and its speed (500 miles per hour), but not the direction of its velocity.
2. About 2 hours; 500 miles per hour × 2 hours = 1,000 miles

Core Skill: Determine Meaning of Terms

Read the text as a class. Before students complete the activity, discuss the value of making personal connections with a text. For example, ask volunteers to describe ways that terms are used on this page, including *distance*, *speed*, *velocity*, and *acceleration* relate to their personal experiences. Ask students how thinking of these terms in their scientific context can change their impressions of travel.

PAGE 287

Newton's Laws of Motion

Have students skim the page to determine how many laws of motion there are. Then organize students into three groups. Assign each group a different law of motion. Have groups read and paraphrase the text about each law. Explain that paraphrasing means expressing in your own words ideas you have read about or heard. Ask students who read about the first law of motion explain why you can roll a toy car across a surface and it will stop without any apparent force acting upon it. Ask students who read about the second law of motion to model an example of $F = m \times a$. Ask students who read the third law of motion to diagram equal and opposite reactions acting upon a launched rocket. Afterward, ask students to paraphrase each law of motion.

Reading Skill: Determine the Central Idea of a Text

The central idea in a paragraph is the most important idea. It can usually be found in the first or last sentence of the paragraph. The central idea of a text or a selection is rarely stated in a particular place in a text. Students must understand the overall meaning of the selection and use the supporting details to identify the selection's central idea. Finding the central idea requires students to apply a variety of skills, such as synthesizing information and making inferences. In other words, students need to connect the ideas that are linked across the text, and they sometimes have to make educated guesses about information that is not directly stated.

WRITE TO LEARN **ANSWER KEY**

Encourage students to review the word *inertia*, *mass*, *force*, and *momentum* before they attempt to use them in an original passage. You may want to invite students to complete this writing task with partners.

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 484.

Engage and Extend

ELL Instruction: Review the Text Place students in pairs and ask them to explain to their partner something they know, such as the proper way to prepare for an activity. Then have the partner identify what he or she believes to be the central idea of the explanation and provide details that support that central idea.

Extension Activity: Relate a Procedure Have students review the lesson and seek more examples that demonstrate each of Newton's Laws of Motion. Then have them choose an example and write the steps for performing a procedure that would demonstrate the relationship between the example and a corresponding law of motion. Ask students to demonstrate and explain their procedures for the class.

Forces and Machines

LESSON 8.2
PAGES 290–297

BEFORE THE LESSON

Objectives

After completing this lesson, students will be able to

- Define work
- Describe the relationship between forces and work
- Identify simple machines and compound machines

✓ *Determine Student Readiness*

Ask students if they've ever been able to move an object without using some kind of force. Discuss with them that in science, work cannot be accomplished without force. Ask students if they've ever heard of the word *work* used in a scientific context.

Key Concept

Work occurs when a force is applied to move an object over a distance.

Concept Background: At its simplest, a force is a push or pull. Gravity is an example of a pull. Moving something, such as a shopping cart, from a position behind it is an example of a push. When the forces acting on an object are the same in opposite directions, an object is said to be in equilibrium, meaning that the object will not move. Help students identify the push or pull of forces as they read through the lesson.

Develop Core Skills

Core Skill: Distinguish Between Facts and Speculation

Discuss with students that speculation is a conclusion or opinion reached by conjecture. That is, speculation is something that a person thinks or believes is true. Have students take turns stating sentences that are fact and speculation. For example: That box looks heavy. *(speculation)* The box weighs 23 pounds. *(fact)*

Core Skill: Distinguish Cause and Effect

Tell students that an effect is dependent on a cause. Have students work in pairs to create several statements that describe a cause and its effect. Then have pairs quiz each other using the statements they wrote.

Pre-Teach Vocabulary

Word Study: Syllables

Remind students that with longer vocabulary words, such as *equilibrium*, it may help to sound out the word by breaking it into syllables. Students may use the glossary if they need help doing this. Have pairs of students practice saying the longer words aloud, making sure to emphasize each syllable.

Tier 2 Words:	Tier 3 Words:	Test Words:
force (p. 290)	compound machine (p. 292)	distinguish (p. 291)
friction (p. 290)	equilibrium (p. 290)	
	simple machine (p. 292)	

DURING THE LESSON

PAGE 290

Forces

Have students read the text explaining forces. Ask students to identify other forces. Then have the class determine whether each force is a push or a pull. Encourage students to consider forces that can be found in their own bodies, such as the heart pumping blood.

PAGE 291

Distinguish Between Facts and Speculation

Have students read aloud the passage in the white box. Ask: *How would you find out whether this information is fact or speculation?* Tell students to look for certain clues in the text that help tell whether the author is using facts. Have students ask these questions as they read: *Can the statement be proved? Is the statement based on data or reliable information? Is the statement free of words that express beliefs and feelings? Does the author avoid using words that express judgment?* If the answer to any of these questions is yes, the statement is probably a fact.

21st Century Skill: Creativity and Innovation

Students may find it unusual that creativity is associated with scientific knowledge. Discuss with students how scientists must sometimes think creatively to solve problems and pursue investigations. Discuss with them how keeping an open mind about results through trial and error often helps the creative spirit. Ask students to discuss personal experiences with creativity.

PAGE 292

Machines

Many students may think that a machine has to have many moving parts or even an engine. Actually, a machine can be as simple as a screwdriver used to open a can of paint. Encourage students to note all the machines that are around them in their everyday lives—both simple and compound machines. Tell students that they even have machines in their bodies! The biceps is a type of lever.

THINK ABOUT SCIENCE — ANSWER KEY

1. compound machine
2. force
3. friction
4. equilibrium
5. simple machine

Core Skill: Distinguish Between Facts and Speculation
Have students write down their speculations about future machines. Then divide the class into small groups and have them share their speculations with one another. Have each group decide which of the machines is most likely to be developed the soonest. Have groups share their results with the class.

PAGE 293

Pulleys

Pulleys work simply by changing the direction of a force. Extend learning about pulleys by providing information about all types of pulleys: fixed, movable, and block and tackle. If your school has a stage or theater, the curtains probably work through the use of a pulley. If school policy allows, take the class to observe how the pulley system works.

Core Skill: Distinguish Cause and Effect
After students have finished their charts, create a chart on the board that includes all of their entries. Did students have different causes and effects for the same machines? Discuss any differences in causes and effects for each type of machine.

WRITE TO LEARN ANSWER KEY

Explain to students that the words *affect* and *effect* are easily mixed up. The word *effect* is a noun that means the result of something. The word *affect* is a verb, meaning that someone or something has an impact or influence on someone or something else. Have students use each word in a sentence to clarify the meaning before they begin writing.

PAGE 294

Wheel and Axle

Ask students to name other wheels and axles that they are familiar with. Some examples include doorknobs, the handle of a fishing wheel, and a round or X-shaped faucet handle. The axle is always the smaller of the two circular objects. Have students observe whether there are any wheels and axles in the classroom.

THINK ABOUT SCIENCE ANSWER KEY

1. inclined plane
2. fulcrum
3. wheel and axle
4. direction

PAGE 295

Gears

Most of the machines we encounter every day are compound machines. However, *compound* does not mean *complicated*. Examples of compound machines include can openers, zippers, and wheelchairs. Some compound machines rely on gears and engines.

Evidence-based Reading Support: Comprehension
Ask Questions
Explain that when students ask questions to get information as they read, they can better understand the text and accomplish their purpose for reading. Students' questions vary depending on their purpose for reading and the information they want to gain from the text. Choose a portion of text for students to read or reread. Have students write a question they have about the text. Ask students to trade questions with a partner and look for the answers in the lesson. Then ask students how they might find answers to questions not answered in the text.

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 484–485.

Engage and Extend

ELL Instruction: Elaborate on Cause and Effect To help students identify cause-and-effect relationships, have them make a list of causes and effects using events from their lives. For example, if a person sleeps late (cause), he or she might be late for work or an appointment (effect).

Extension Activity: Collect and Display Data Have students draw or find images of various simple and compound machines. Have students label the images and explain how each one satisfies the definition of simple or compound. Challenge students to be creative with their choices and collect diverse examples.