UNIT 6

Forms of Energy

A fisherman drives his boat back to shore after a long day at sea.

FLORIDA BIG IDEA 10

Forms of Energy

I Wonder Why

In the ocean, fishing boats power through and over the waves. Why do fishing boats need gasoline to run?

Turn the page to find out.

Here's Why

Energy is needed to push the boat through the rough waters. This energy comes from gasoline. Without gasoline to burn, the boat's engine wouldn't work.

Essential Questions and Florida Benchmarks

Science Notebook

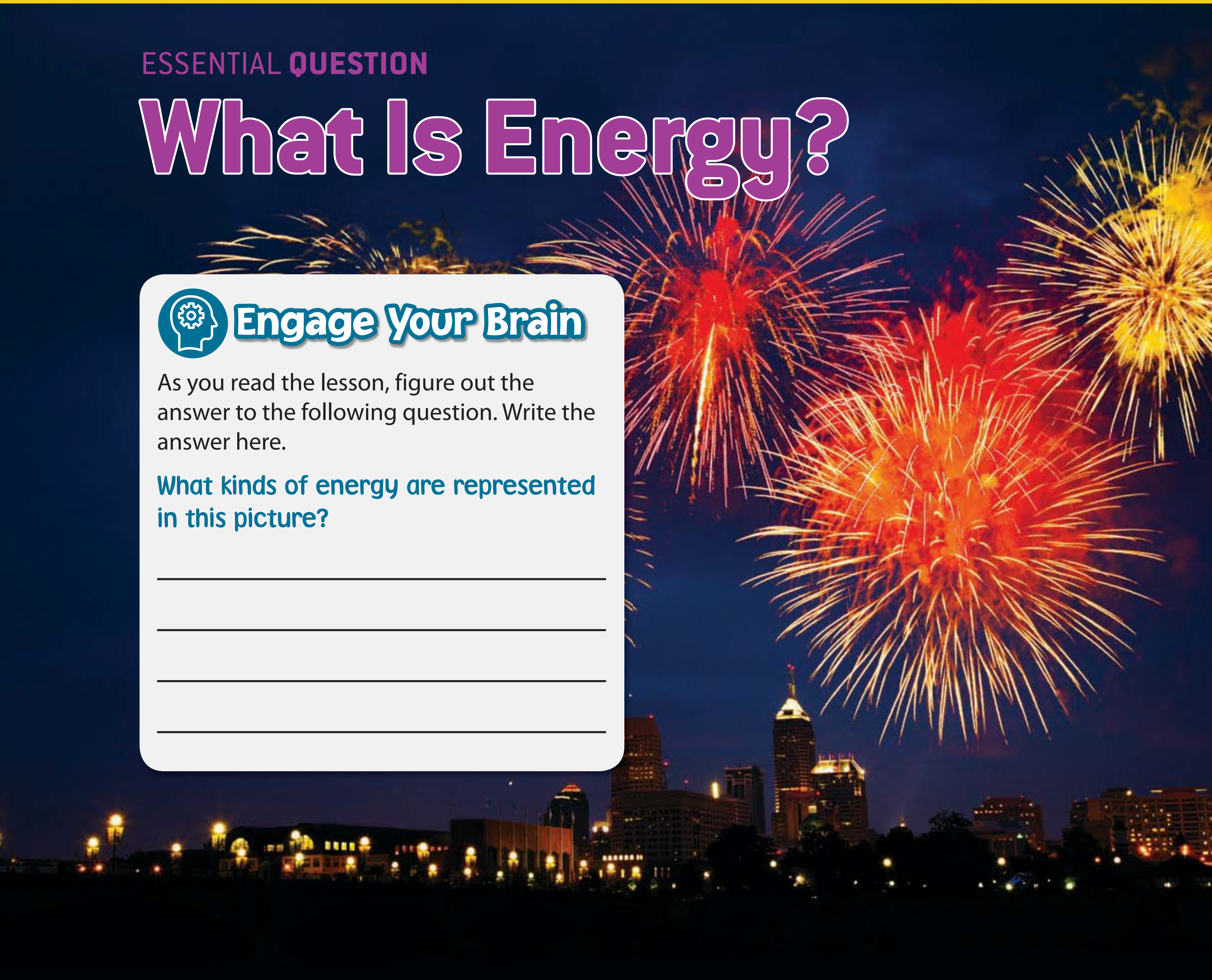
Before you begin each lesson, write your thoughts about the Essential Question.

SC.5.P.10.1 Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical. **SC.5.P.10.2** Investigate and explain that energy has the ability to cause motion or create change.

LESSON 1

ESSENTIAL **QUESTION**

What Is Energy?



Engage Your Brain

As you read the lesson, figure out the answer to the following question. Write the answer here.

What kinds of energy are represented in this picture?

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ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

______________ ______________

______________ ______________

______________ ______________

Compare and Contrast

Many ideas in this lesson are about ways that things are alike or different. Active readers stay focused on comparisons and contrasts by asking how things are alike and how they are different.

Energy All Around

What does a melting scoop of ice cream have in common with a kicked soccer ball? The ice cream and the ball both change in some way. What causes these changes?

ACTIVE READING As you read this page, underline important details about energy.

▶ A soccer ball won't move unless something gives it energy. Energy changes the ball's motion. Circle the thing in the picture that gave the ball energy.

Think about all the ways that you use energy. **Energy** is the ability to cause changes in matter. Energy is involved when matter moves or changes its shape. A change in temperature also involves energy.

Energy can transform, or change, from one form into another. The boy in the picture is using energy to run. The energy came from food that he ate.

When the boy kicks the ball, his foot transfers energy to the ball. The moving ball transfers energy again. Energy moves to particles in the air and on the ground. These tiny particles begin to move faster.

The ball stops moving after it has transferred all its energy. Energy is never used up. It just changes from one form to another.

The tiny particles that make up solid ice cream move slowly. Energy from the sun causes a change in their motion. The particles move faster. The ice cream melts and becomes a liquid.

▶ What caused this ice cream to melt?

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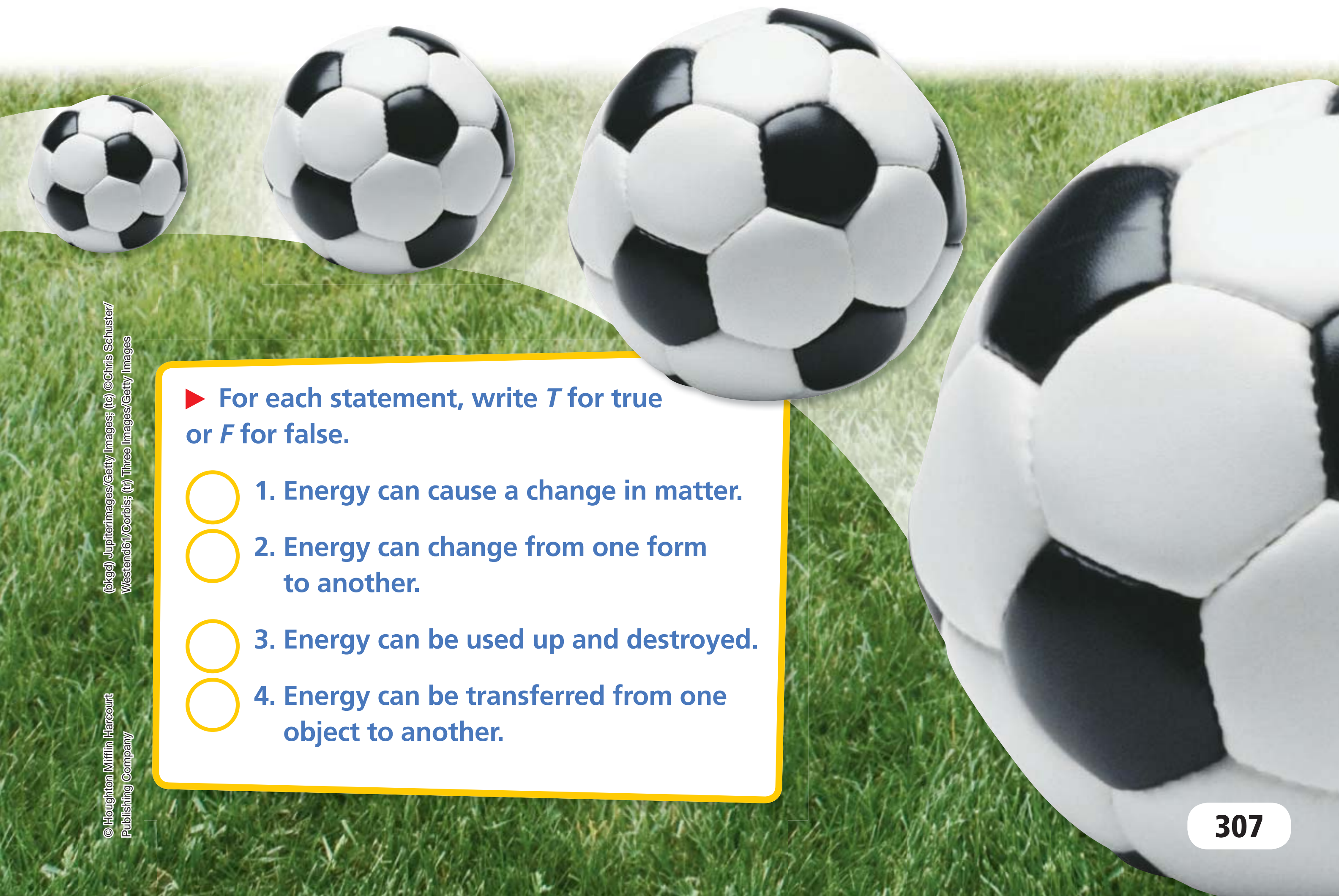


▶ For each statement, write *T* for true or *F* for false.

◯ 1. Energy can cause a change in matter.

◯ 2. Energy can change from one form to another.

◯ 3. Energy can be used up and destroyed.

◯ 4. Energy can be transferred from one object to another.

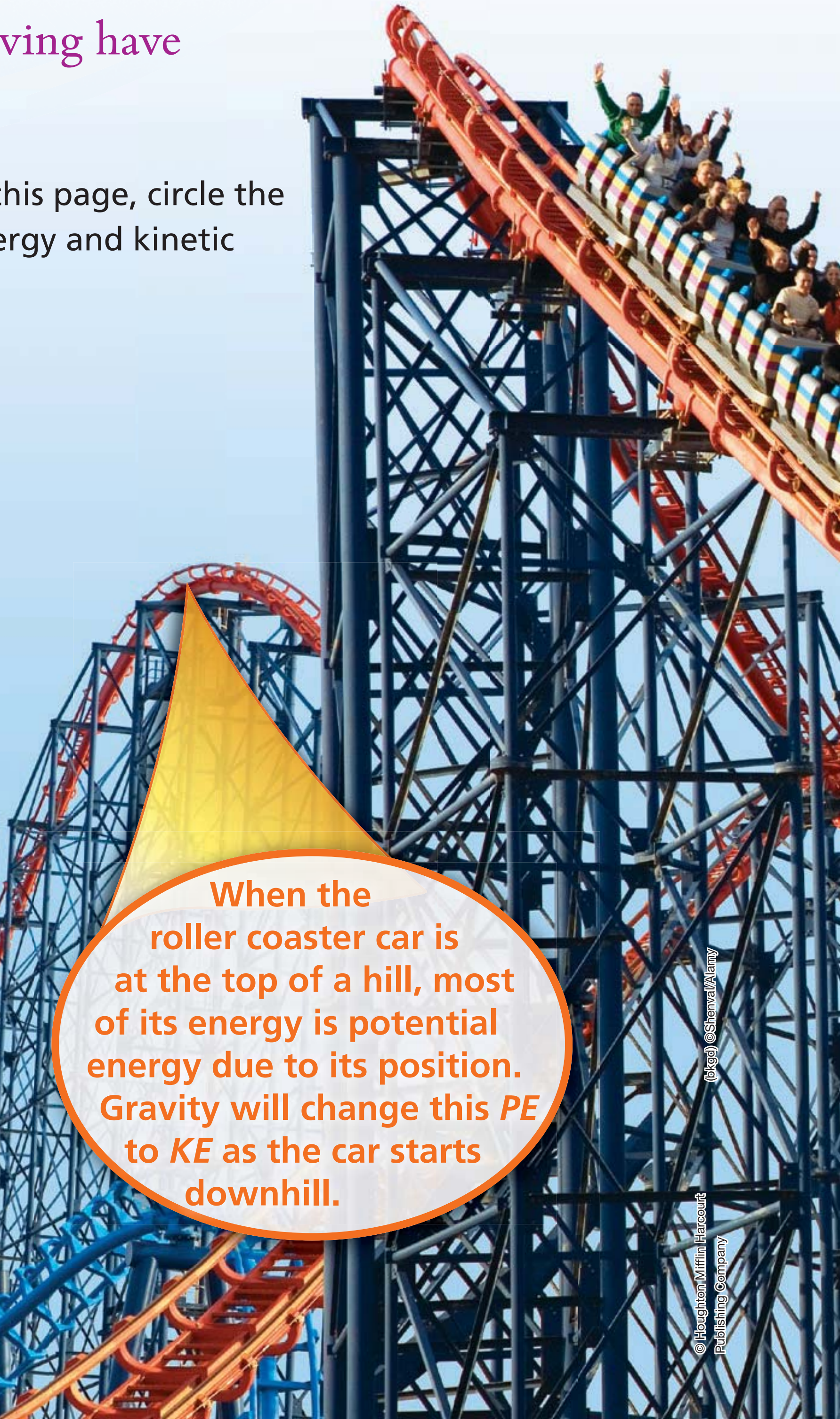
The Ups and Downs of Energy

Does an object that is not moving have any energy? Let's find out!

ACTIVE READING As you read this page, circle the sentences that tell how potential energy and kinetic energy are different.

Does a book sitting on a shelf have energy? Yes! Someone gave it energy by lifting the book to the shelf. The energy is now stored in the book. The energy an object has because of its position or condition is called **potential energy** (PE).

If the book falls off the shelf, it begins moving. Its potential energy changes to the energy of motion. The energy an object has because of its motion is called **kinetic energy** (KE).

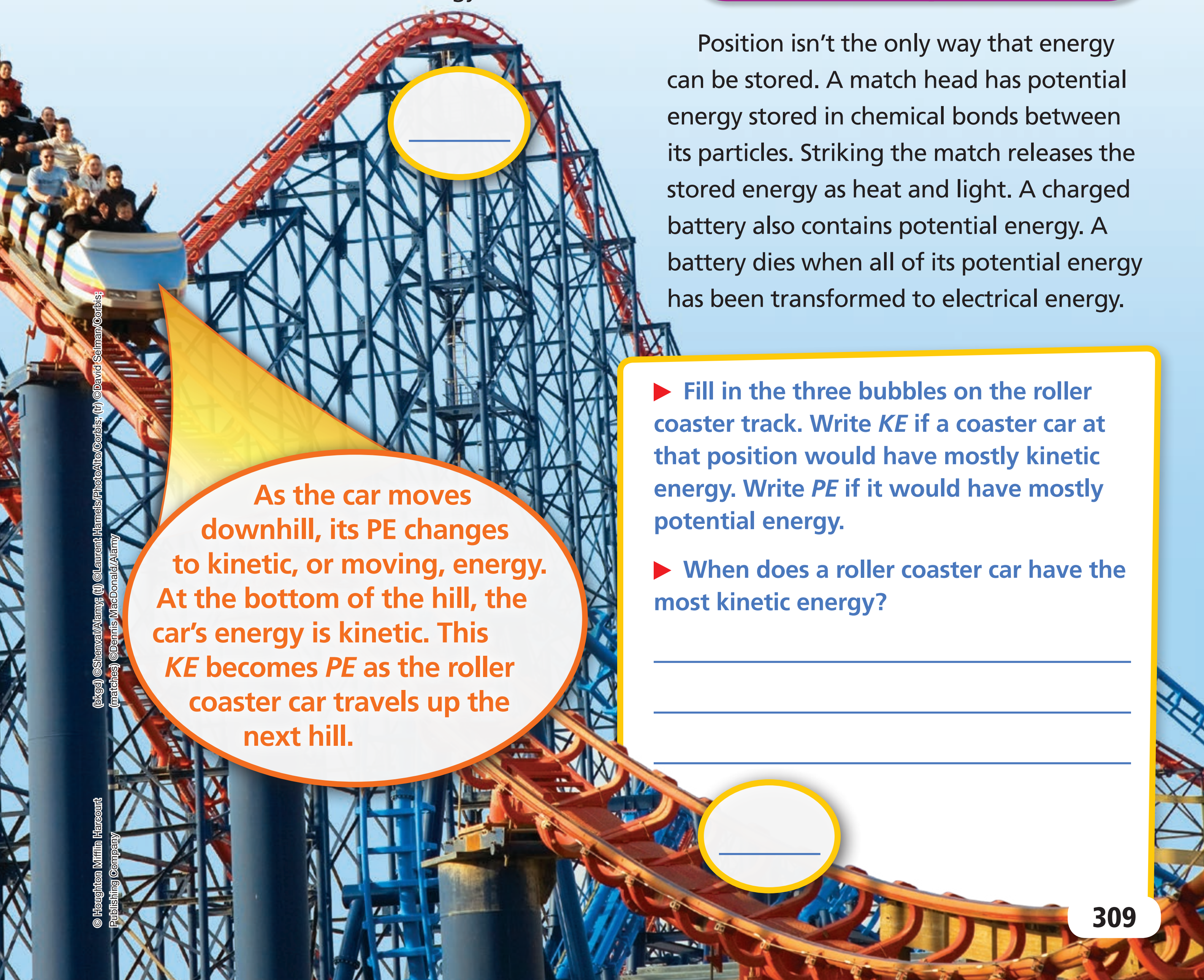


When the roller coaster car is at the top of a hill, most of its energy is potential energy due to its position. Gravity will change this *PE* to *KE* as the car starts downhill.

When you compress a spring or stretch a rubber band, your energy is stored in the object as potential energy. The potential energy changes to kinetic energy when you release the spring or rubber band.

The energy of a falling object, a contracting rubber band, or an expanding spring is not all kinetic. As long as these objects are falling, contracting, or expanding they still have potential energy. Look at the image of the roller coaster. The car is somewhere between a high and a low point in the ride. It has both potential and kinetic energy. The sum of all the kinetic and the potential energy an object has is called mechanical energy.

Position isn't the only way that energy can be stored. A match head has potential energy stored in chemical bonds between its particles. Striking the match releases the stored energy as heat and light. A charged battery also contains potential energy. A battery dies when all of its potential energy has been transformed to electrical energy.



▶ **Fill in the three bubbles on the roller coaster track. Write *KE* if a coaster car at that position would have mostly kinetic energy. Write *PE* if it would have mostly potential energy.**

▶ **When does a roller coaster car have the most kinetic energy?**

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Loud, Soft, Hot, Cold

The kinetic energy of a moving roller coaster car is easy to see. How can you sense energy in tiny particles of matter that are too small to see?

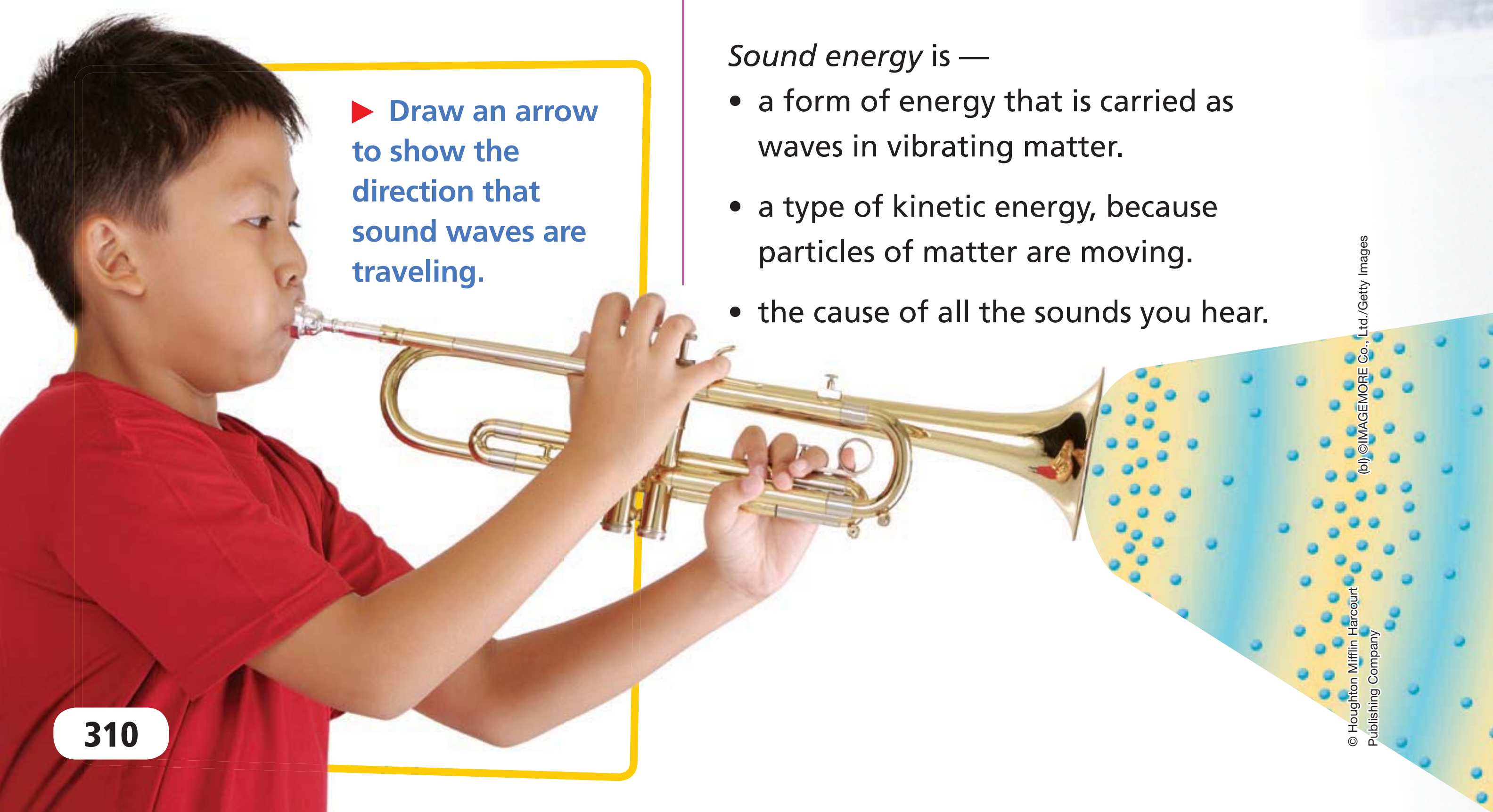
ACTIVE READING As you read these two pages, underline the sentences that tell you how sound energy and thermal energy are alike.

When a trumpet makes noise, it vibrates, or moves back and forth. The trumpet transfers energy to tiny particles of air. Each particle of air moves back and forth, bumping into other particles. The sound travels outward.

If someone knocks on your door, the particles in the door vibrate. They bump into particles in the air on your side of the door. The sound travels through the door and through the air to you as a sound wave.

Sound energy is —

- a form of energy that is carried as waves in vibrating matter.
- a type of kinetic energy, because particles of matter are moving.
- the cause of all the sounds you hear.



▶ Draw an arrow to show the direction that sound waves are traveling.

Another type of energy that involves moving particles is thermal energy. *Thermal energy* is the total kinetic energy of the particles that make up a substance.

Thermometers measure thermal energy. You sense thermal energy as temperature. The more thermal energy an object has, the greater its temperature. Thermal energy helps you to stay warm, to cook your food, and to heat water for washing or bathing.

▶ In a hot-air balloon, the burning of propane produces thermal energy. This energy raises the temperature of the air particles inside the balloon to ______°C.

▶ Rubbing your hands together produces thermal energy.

▶ The air at the top of this icy mountain has very little thermal energy. Its temperature is ______°C.

DO THE MATH

Use Number Lines

Draw a number line. On the line, place the three temperatures (in °C) shown in the pictures on this page. Then add a point for normal room temperature, 22 °C.

See a Sea of Energy

Your ears use sound energy to hear. What kind of energy allows your eyes to see?

ACTIVE **READING** As you read, draw boxes around the descriptions of light energy and electrical energy.

The sun is the source of the light energy entering the cave.

Suppose you are using a flashlight in a dark room. You drop the flashlight and it breaks. What can you see? Nothing! Your eyes need light energy to work.

Light energy is a form of energy that can travel through space. Light can also pass through some types of matter, such as air or glass. Light energy travels as waves.

You can see light energy. Some objects give off light. You see all other objects when light reflects, or bounces off, from them and enters your eyes.

▶ List three sources of light.

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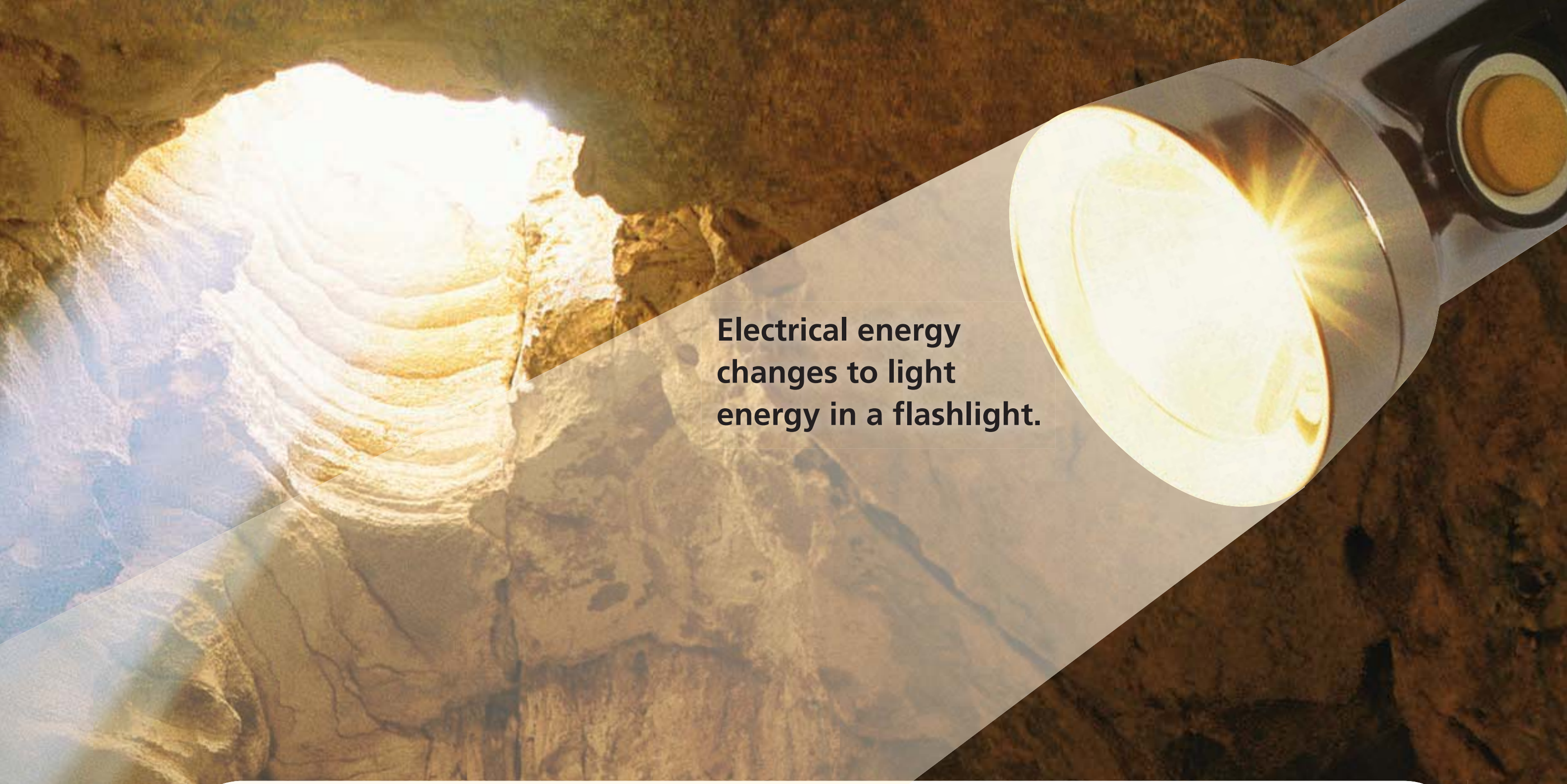
You see the cave walls when light bounces off them and reaches your eyes.

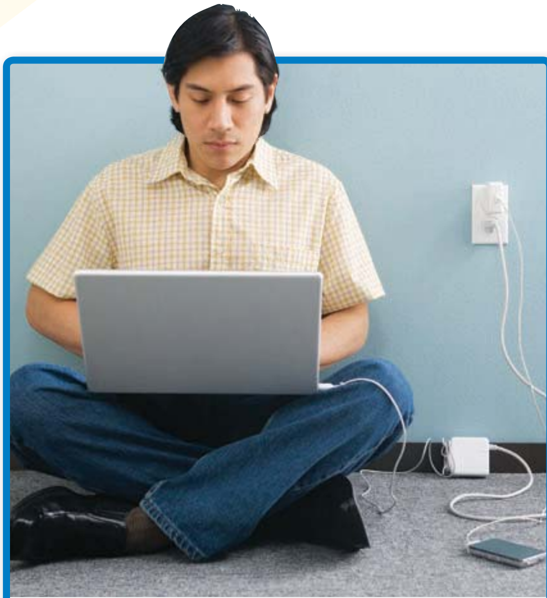


Electrical energy changes to light energy in a flashlight.

Objects that give off light energy often give off heat. But the two types of energy are different. You can tell them apart by the way you sense the energy. Your skin senses heat, but it cannot sense light energy. Your eyes sense light energy.

Flashlights and television sets produce light. To do this, they use another type of energy, called electrical energy. **Electrical energy** is energy caused by the movement of electric charges. When you use electricity, you are using electrical energy.

Electrical energy can change to other types of energy you can use. Electrical energy changes to thermal energy in a toaster or a stove. Cell phones and stereo speakers use electrical energy to produce sound. In lamps and spotlights, electrical energy changes to light energy.



Computers and other devices that are plugged in use electrical energy.

▶ **List three objects that use electrical energy.**

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Energy in Machines and Food

You have learned about machines that use electrical energy. Some machines don't need to be plugged in. What forms of energy do they use?

ACTIVE READING Draw one line under things that have mechanical energy. Draw two lines under things that have chemical energy.

Many objects, such as a ball thrown in the air, have both kinetic and potential energy. **Mechanical energy** (ME) is the total energy of motion and position of an object. As a ball drops, its potential energy decreases as its kinetic energy increases. Its mechanical energy, though, stays constant. The relationship among these forms of energy is shown by the following equation.

Mechanical Energy = Kinetic Energy + Potential Energy

A machine uses mechanical energy to do work. For example, a fan plugged into the wall uses electrical energy. It changes that energy into the mechanical energy of the spinning fan blades. The spinning fan uses the mechanical energy to do work—moving the air in a room.

▶ Describe how energy in gasoline is transformed in a lawn mower.

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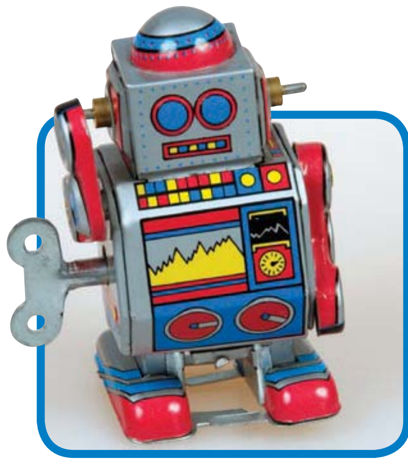
Have you ever felt as if you were going to "run out of energy"? The energy your body uses comes from the food you eat. Food contains a kind of potential energy called chemical energy. **Chemical energy** is energy that is stored in matter and that can be released by a chemical reaction.

When your body needs energy, it breaks down food and releases potential chemical energy from it. If you use that energy to run or jump, it changes into kinetic energy. Your body also uses chemical energy stored in food to produce thermal energy. This keeps your body at a steady temperature.

Cars use chemical energy in liquid fuel such as gasoline. A flashlight uses the chemical energy stored in a battery to produce light. Some stoves change chemical energy to thermal energy by burning a gas called propane.



▶ Winding the key on the toy increases the toy's ______________ energy.

▶ Our bodies use the ______________ energy in food to move and stay warm.

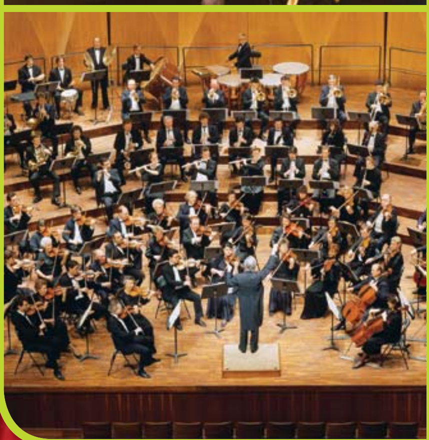
▶ The hands on this watch move because the watch has ______________ energy.

Spotlight on Energy

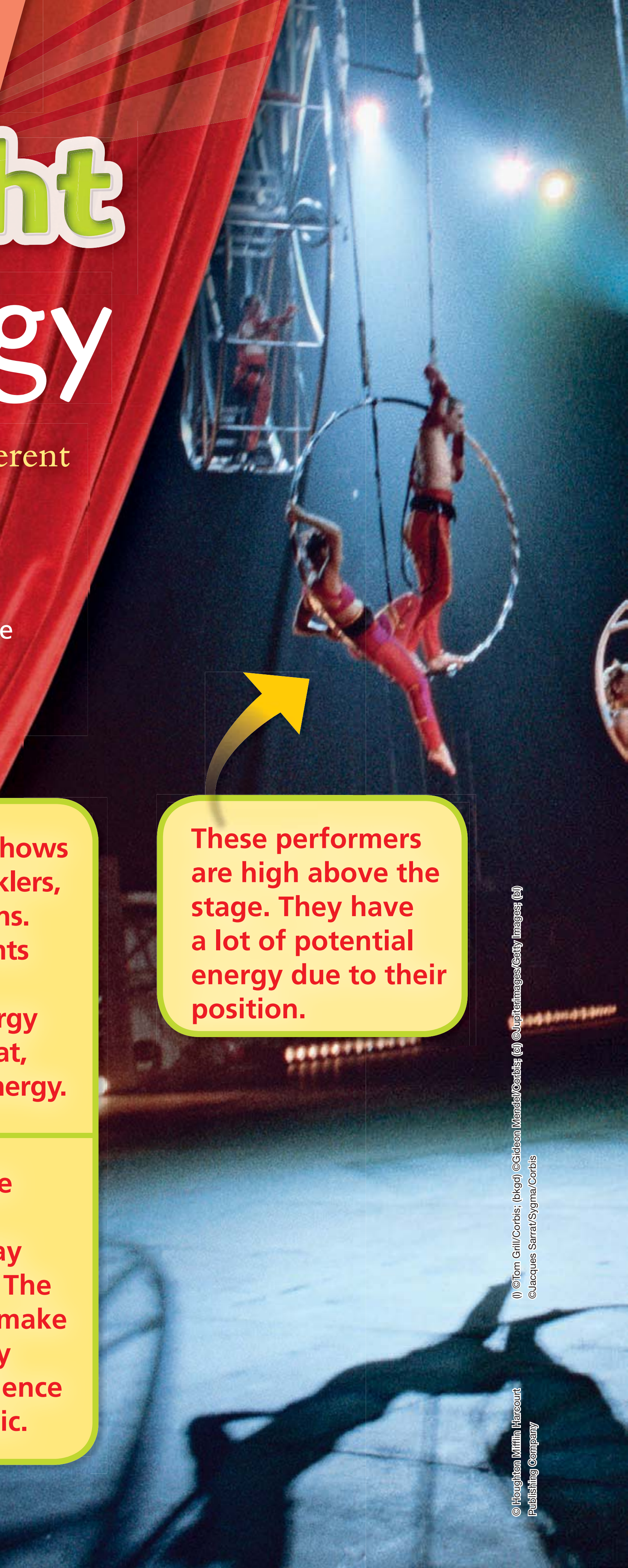
A stage production requires different kinds of energy. How many are being used on this stage?

ACTIVE READING As you read these pages, draw a box around each type of energy.

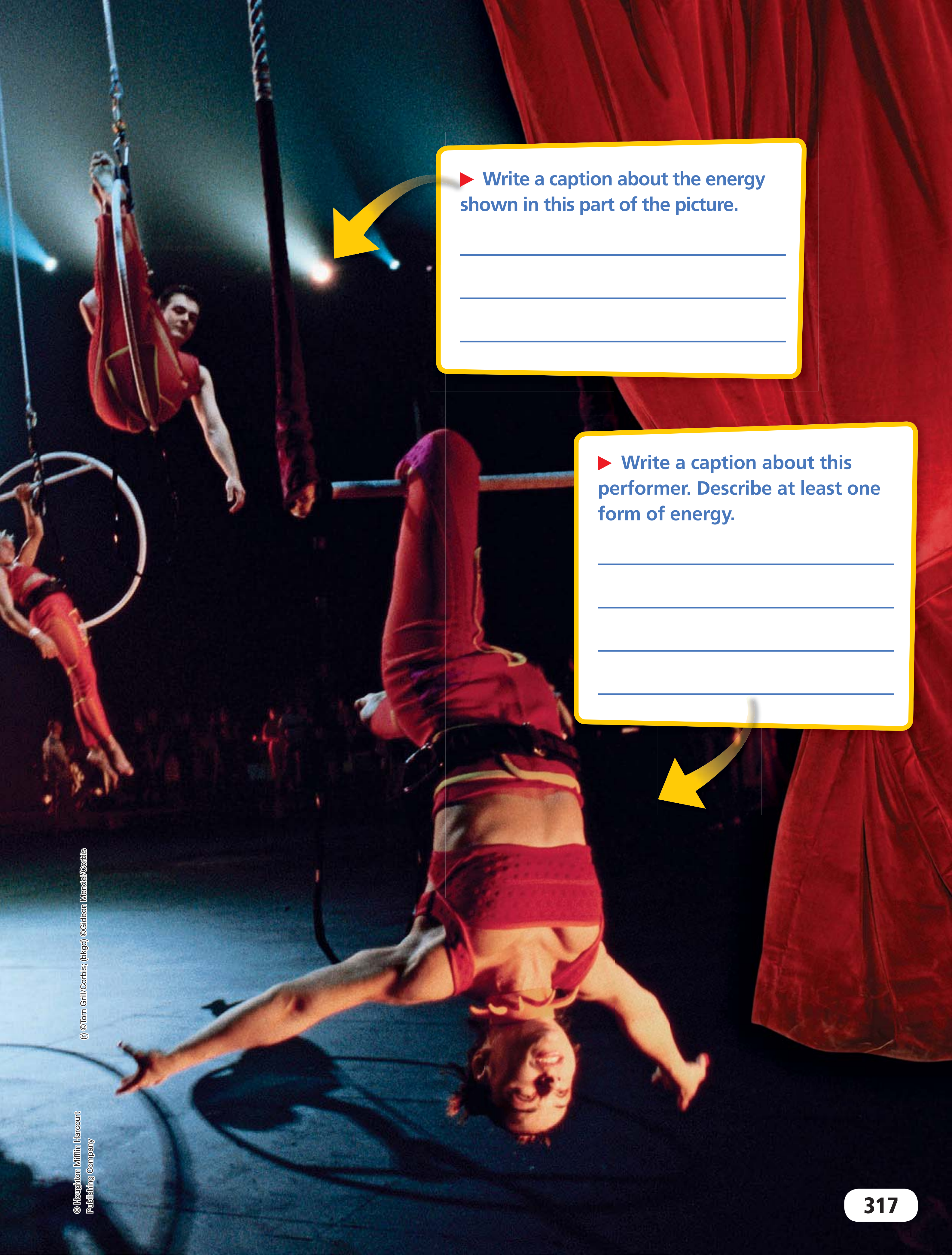
Some stage shows use fire, sparklers, and explosions. These elements turn stored chemical energy into light, heat, and sound energy.



Musicians use mechanical energy to play instruments. The instruments make sound energy that the audience hears as music.



These performers are high above the stage. They have a lot of potential energy due to their position.



▶ Write a caption about the energy shown in this part of the picture.

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▶ Write a caption about this performer. Describe at least one form of energy.

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(r) ©Tom Grill/Corbis; (bkgd) ©Gideon Mendel/Corbis

Sum It Up »

Part I: Circle the word that completes each sentence.

A. Energy is the ability to cause motion or create (matter / change).

B. There are two main categories of energy—potential and (thermal / kinetic).

C. Energy can't be created or (destroyed / captured).

D. Energy can change from one form to another, which is called energy (transformation / conservation).

Part II: Complete the graphic organizer below.

ENERGY

Potential energy is energy stored in an object because of its position or condition.

Kinetic energy is the energy of motion.

A. ____________ energy is energy that can be released by a chemical reaction.

B. ____________ energy is the total kinetic energy of the particles in matter.

F. ____________ energy is the combination of the potential and kinetic energy an object contains.

C. ____________ energy is the form of energy that you can see.

D. ____________ energy travels as waves through vibrating matter.

E. ____________ energy is energy caused by movement of electrical charges.

Name ____________________

Vocabulary Review

1 Use the clues to fill in the missing letters of the words.

1. _o_____a_ e____y — stored energy due to position or condition

2. __o_ — a substance that contains useful chemical energy

3. _l_________ — energy caused by the movement of electric charges

4. __n_t__ — energy of motion

5. ____a__ — to move back and forth

6. _h___a_ — energy of moving particles of matter

7. __u__ — form of energy you can hear

8. ___h_ — form of energy you can see

9. __c____c__ — total potential and kinetic energy of an object

10. ______a_ — energy that can be released by a chemical reaction

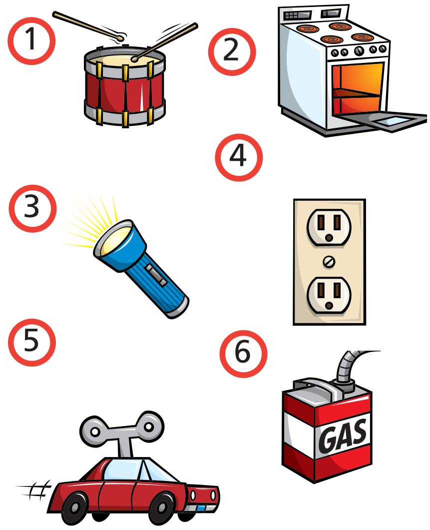
11. _n__g_ — ability to cause changes in matter

12. __a_ — what your body feels thermal energy as

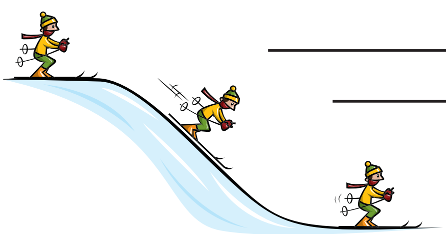
Apply Concepts

2 Complete the matching game. The first one is done for you.

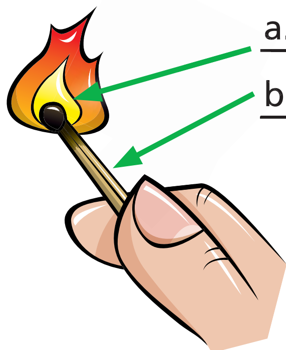
Light Energy (E) (3)	A. The total kinetic energy of the particles in matter
Thermal Energy ◯ ◯	B. Energy caused by motion of electric charges
Sound Energy ◯ ◯	C. Energy that is stored in matter and can be released during a chemical reaction
Electrical Energy ◯ ◯	D. Energy carried as waves of vibrating matter
Mechanical Energy ◯ ◯	E. Energy that travels as a wave and that you are able to see
Chemical Energy ◯ ◯	F. Sum of an object's potential and kinetic energy



3 Use the terms *potential energy* and *kinetic energy* to tell what is happening to the skier.



4 Identify the types of energy present or produced in each lettered part of the picture.



a. ______________________

b. ______________________

Take It Home! See *ScienceSaurus*® for more information about energy.

SC.5.P.10.1 Investigate and describe some basic forms of energy… **SC.5.P.10.2** Investigate and explain that energy has the ability to cause motion or create change. **SC.5.N.1.1** … plan and carry out scientific investigations of various types… **SC.5.N.2.1** Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence.

Name ____________________

ESSENTIAL **QUESTION**

What Changes Can Energy Cause?

EXPLORE

You use thermal energy produced from electrical or chemical energy to cook food. What other energy source might you use?

Materials

- sheet of poster board
- 2 thermometers
- aluminum foil
- scissors
- tape
- string

Before You Begin—Preview the Steps

1. Cut a sheet of poster board in half. Cover one side of each half with aluminum foil.
2. Make a solar cooker. Bend one half of the poster board, foil side in, into the shape of a U. Tape a piece of string to both edges at the top of the solar cooker so that the cooker holds its shape.
3. Build a second solar cooker that is identical to the first. Place a thermometer in each solar cooker.
4. Place one solar cooker in direct sunlight, and place the other in shade. Predict what will happen to the temperature in each solar cooker.
5. Read and record the temperature in each solar cooker every 3 minutes for 15 minutes. **CAUTION:** Do not touch the foil in your solar cookers when they are in the sun.

Set a Purpose

How will this investigation help you observe changes in matter?

State Your Hypothesis

Write your hypothesis, or testable statement.

Think About the Procedure

How hot do you predict the solar cookers will become?

What variable will you change in this experiment? Why is it important to change only one variable?

Name ______________________________

Record Your Data

Draw a data table, and record your temperature measurements.

Draw Conclusions

Was your hypothesis supported by evidence? Why or why not?

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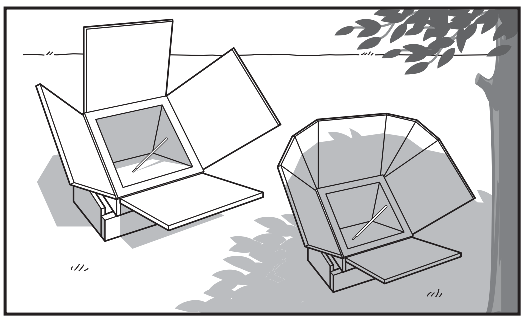
Claims • Evidence • Reasoning

1. What was the purpose of the aluminum foil? How would your results differ if you had made the cooker just from the poster board? Explain your reasoning.

2. Make a claim about how a solar cooker might be useful in places where there is no electricity. Explain your reasoning.

3. How could you improve your solar cooker to make it heat faster?

4. The setup for an experiment is shown below. What problems do you see with the way the experiment is designed? Explain your reasoning.



SC.5.P.10.3 Investigate and explain that an electrically-charged object can attract an uncharged object and can either attract or repel another charged object without any contact between the objects.

LESSON 3

ESSENTIAL **QUESTION**

What Is Electricity?

Engage Your Brain

As you read the lesson, look for the answer to the following question and record it here.

What causes the girl's hair to stand out from her head?

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ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

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Main Ideas

The main idea of a paragraph is the most important idea. The main idea may be stated in the first sentence, or it may be stated elsewhere. Active readers look for main ideas by asking themselves, What is this section mostly about?

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All Charged Up

You can charge a battery. A football player may charge downfield. How is an electric charge different?

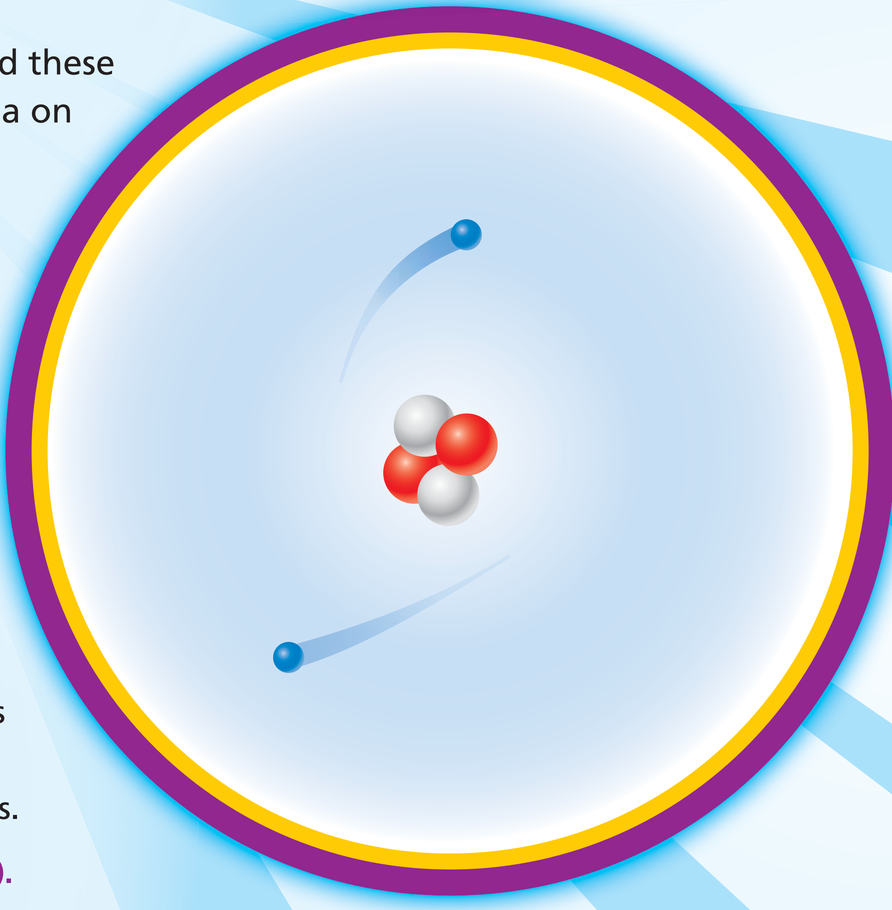
ACTIVE READING As you read these two pages, underline the main idea on each page.

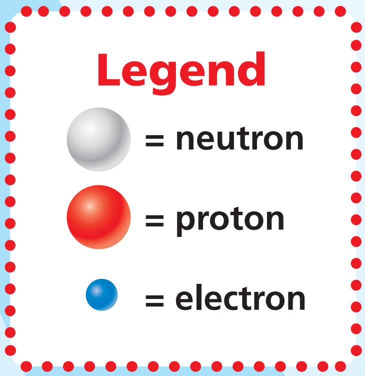
What do you, this book, and your desk have in common? You are all made of atoms. Atoms are the building blocks of all matter. An atom is made of even tinier particles called protons, neutrons, and electrons.

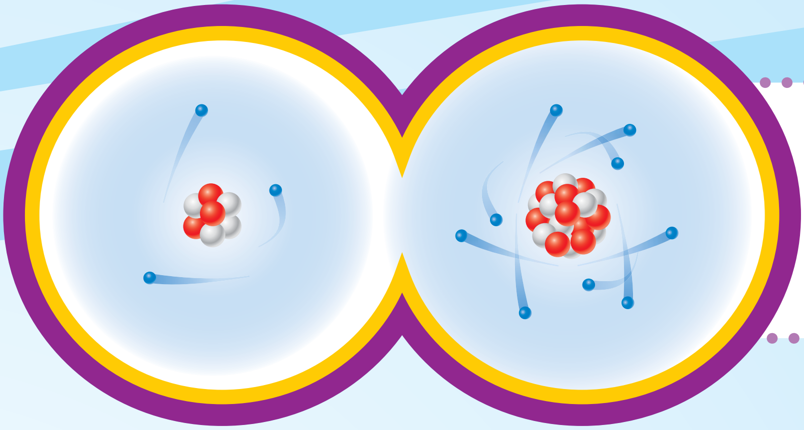
The main difference between protons, electrons, and neutrons is their electric charge. *Electric charge* is a property of a particle that affects how it behaves around other particles.

- **Protons have a positive charge (+1).**
- **Electrons have a negative charge (–1).**
- **Neutrons are neutral. They have no charge.**

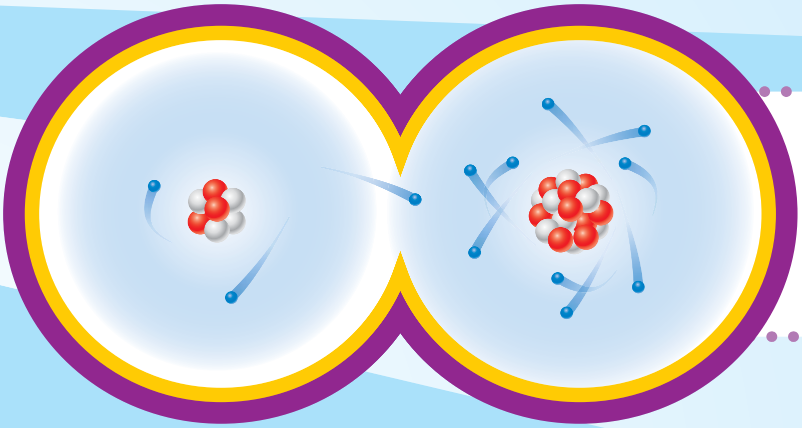
When an atom has equal numbers of protons and electrons, the positive charges and negative charges cancel each other. The atom itself has no charge.



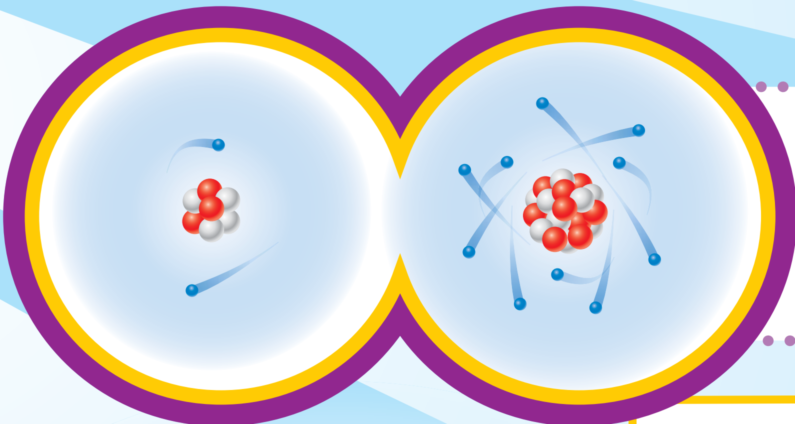




Each of these atoms has equal numbers of protons and electrons. Both atoms are neutral.



An electron from the atom on the left moves to the atom on the right.



The atom on the left now has a charge of +1. The atom on the right has a charge of –1.

Atoms sometimes gain or lose electrons. Such a gain or loss causes an atom to have an unequal number of positive and negative charges. For example, if an atom with four protons and four electrons gains an electron, the atom will have a charge of –1.

If a neutral atom loses an electron, the number of protons will no longer balance the number of electrons. The atom will have a charge of +1.

▶ Draw an atom with three protons, four neutrons, and four electrons.

What is the charge of the atom?

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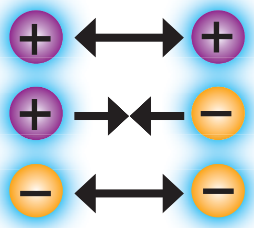
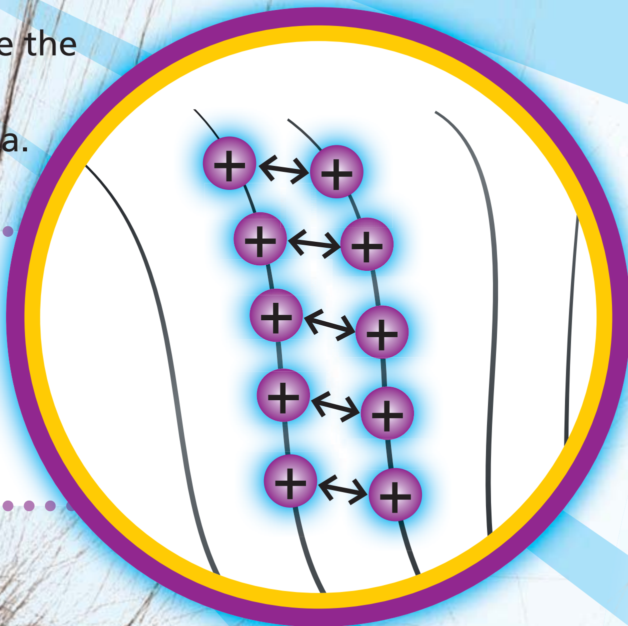
Opposites Attract

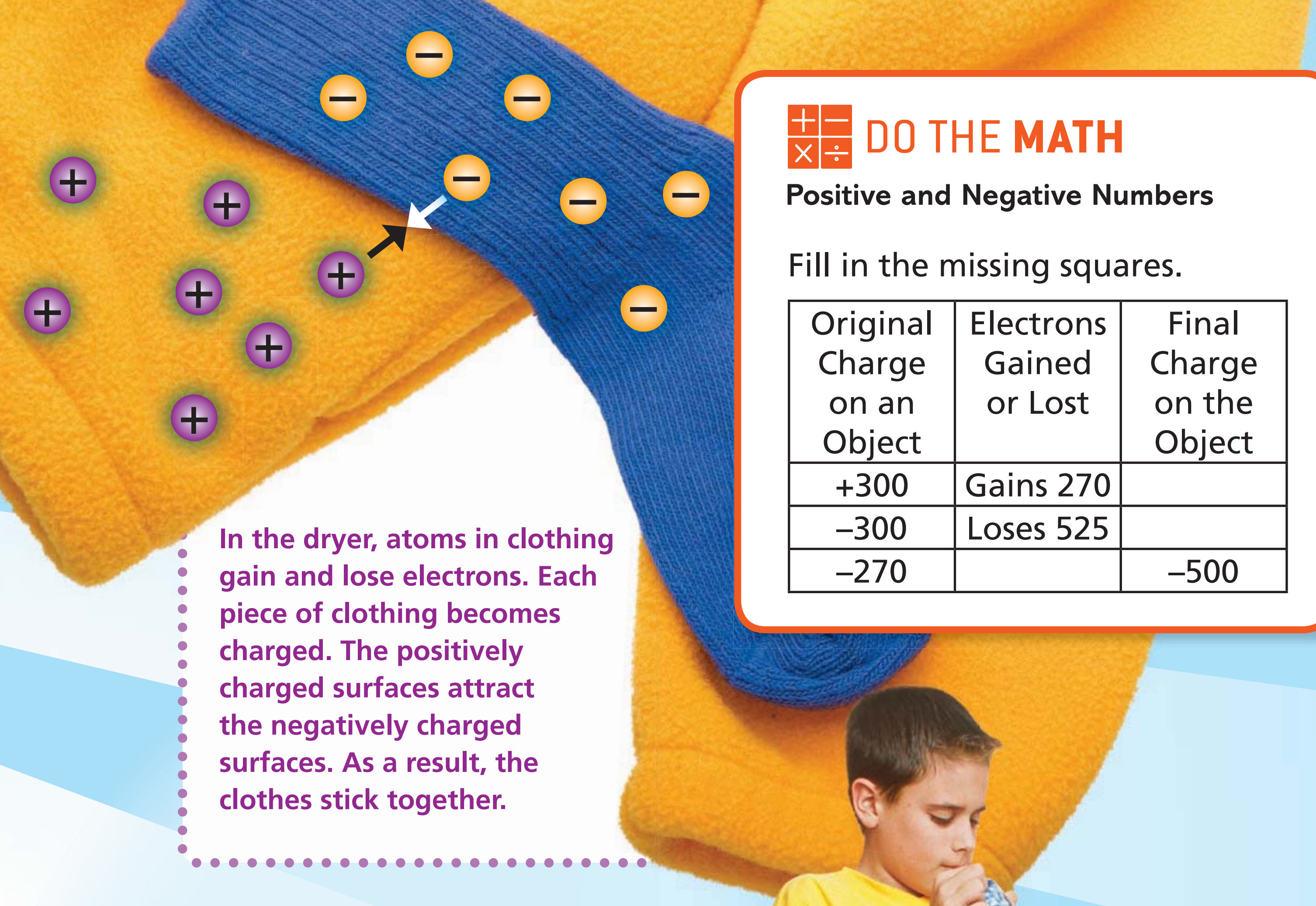
Have you ever had a "bad hair day"? Your hair sticks out in all directions and won't lie flat. What causes that?

ACTIVE READING As you read this page, circle the definitions of *attract* and *repel*. On the next page, draw a box around the sentence with the main idea.



Particles with the same charge repel, or push away from, one another. Particles with opposite charges attract one another, or pull together.





In the dryer, atoms in clothing gain and lose electrons. Each piece of clothing becomes charged. The positively charged surfaces attract the negatively charged surfaces. As a result, the clothes stick together.

DO THE MATH

Positive and Negative Numbers

Fill in the missing squares.

Original Charge on an Object	Electrons Gained or Lost	Final Charge on the Object
+300	Gains 270	
–300	Loses 525	
–270		–500

Electric charges can build up on objects. This buildup of charges is called **static electricity**. Objects with opposite electric charges attract each other. Objects with the same charge repel each other.

When you brush your hair, electrons move from each strand of hair to the brush. Soon all the strands are positively charged. Having the same charge causes the strands to repel one another and stick out.

A charged object can also attract a neutral object. If you rub a balloon on your hair, the balloon picks up extra electrons. They give it a negative charge. When you bring the balloon near a wall, electrons in a small section of the wall are repelled and move away. This leaves a positive charge at the surface of the wall. The balloon sticks to the wall.

Lightning Strikes

Thunderstorms can be scary. Lightning strikes can be deadly. What is lightning, and how can you stay safe during a thunderstorm?

ACTIVE READING As you read these two pages, underline the main idea on each page.

Static electricity is a buildup of charges on an object. The word *static* means "not moving." Charges stay on an object until it comes close to an object with a different charge.

As you walk across a carpet, electrons move from the carpet to you. Because electrons repel each other, they spread out all over your body. When you touch something, the electrons jump from your finger to the object. This jumping is called an electrostatic discharge. You feel it as a tiny shock.

ZAP!
Electrons jump from a person with a negative charge.

▶ Complete this cause-and-effect graphic organizer.

Cause: An object with a negative charge is placed near an object with a positive charge. →	**Effect:** ________________

Not all electrostatic discharges cause small shocks. Some result in huge shocks. During a thunderstorm, tiny raindrops or ice particles bump into each other. These collisions cause an electric charge to build in the clouds.

Positive charges form at the top of a cloud and on the ground. Negative charges form near the bottom of a cloud.

When the difference in charge between a cloud and the ground is great enough, there is a huge electrostatic discharge that we call lightning.

A lightning spark can jump between two clouds, between a cloud and air, or between a cloud and the ground. The temperature inside a lightning bolt can reach 50,000 °F. That's hotter than the surface of the sun!

Lightning Safety

- **Stay inside during thunderstorms.**
- **Turn off electrical appliances and stay away from windows.**
- **If you can't get inside a safe structure, wait in a car with a metal top for the storm to pass.**
- **Know the weather forecast. If you will be outdoors, have a plan in case a thunderstorm develops.**

Objects that lightning strikes can catch on fire. A tree struck by lightning may split.

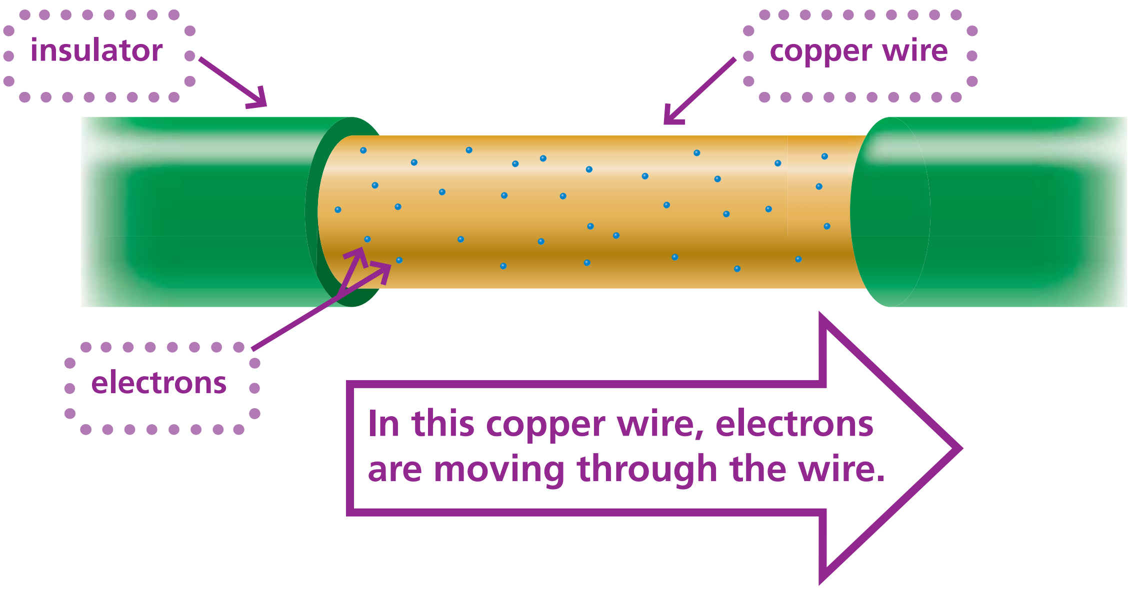
▶ **Draw a cloud above the ground. Then draw positive and negative charges to show what causes lightning.**

Current Events

You can control electrons by making them flow through a wire in the way water flows in a river.

ACTIVE READING As you read these two pages, draw a box around the sentence that contains the main idea.

When electric charges have a path to follow, as they do in the wire below, they move in a steady flow. This flow of charges is called an **electric current**.



Chemical reactions in a battery provide the energy that causes the electrons to flow. An energy station is another source of electric current.

▶ What do the blue dots on this wire represent, and what is it called when they flow?

___

___

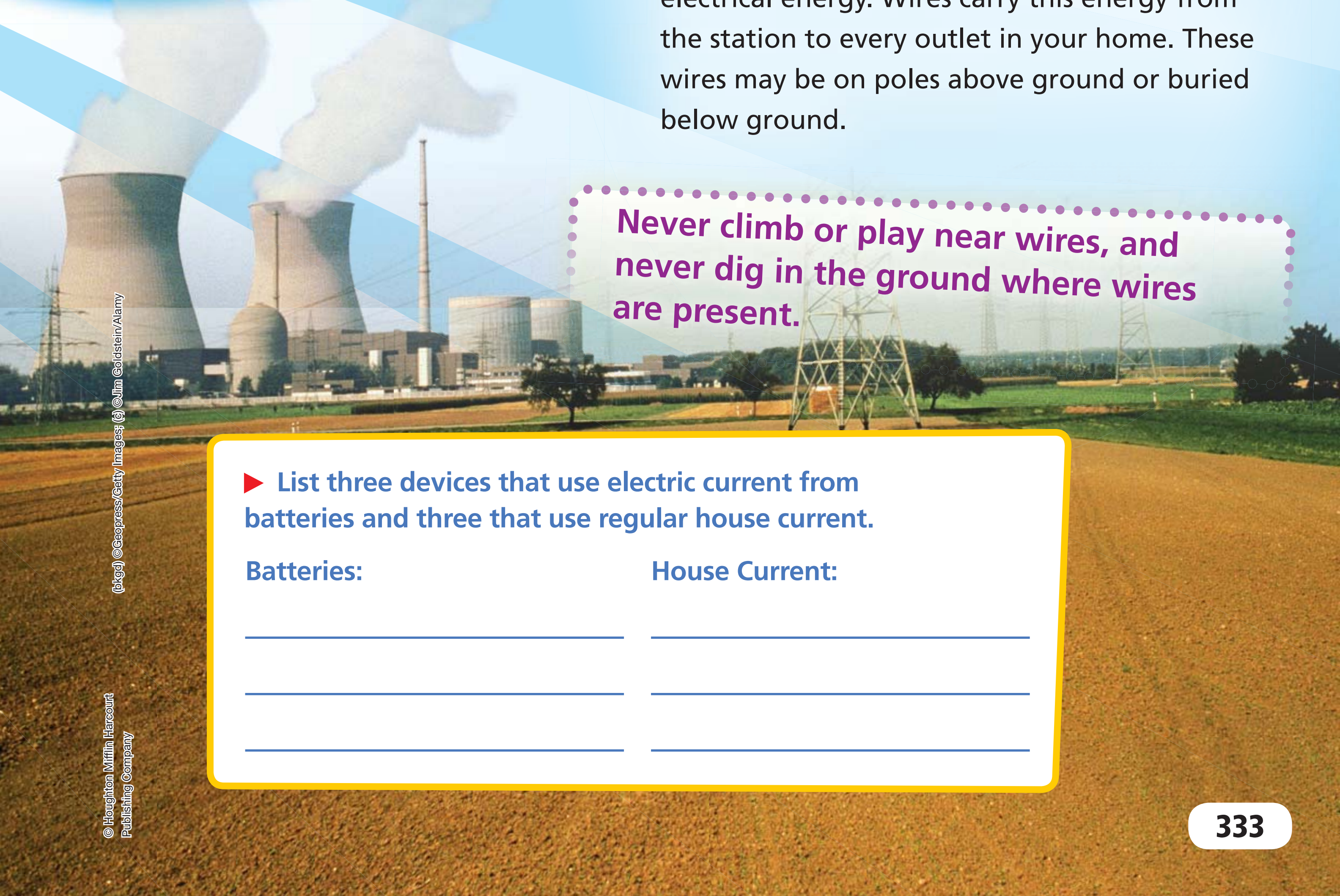
___

These homes are all connected by wires to an energy station.

Electrostatic discharges may be exciting to watch, but flowing charges are more useful. Electrons can be made to move through a wire. They make up an electric current. You can use an electric current to do many kinds of useful work. We use electric currents for cooking food, lighting a room, and producing sound.

A battery is one source of electric current. Most of the electricity used in schools, homes, and businesses does not come from batteries. Instead, it is provided by an electricity generating station, or energy station.

There are many types of energy stations. They all turn other forms of energy into electrical energy. Wires carry this energy from the station to every outlet in your home. These wires may be on poles above ground or buried below ground.



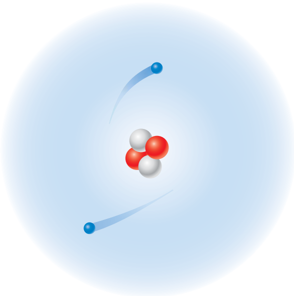
Never climb or play near wires, and never dig in the ground where wires are present.

▶ **List three devices that use electric current from batteries and three that use regular house current.**

Batteries:	House Current:
______________	______________
______________	______________
______________	______________

Sum It Up »

The outline below is a summary of the lesson. Complete the outline.



I. Electric Charges

A. Each of the three types of particles that make up atoms has a different charge.

1. Protons have a positive charge.

2. ______________________________

3. ______________________________

B. Atoms can gain or lose electrons.

II. Static Electricity

A. Definition: the buildup of electric charge on an object

B. Objects with charges interact with each other.

1. Like charges repel.

2. ______________________________

III. Electrostatic Discharge

A. Definition: the jumping of electrons from one object to another

B. Examples

1. Getting shocked after walking across a rug

2. ______________________________

IV. Electric Current

A. Definition: ______________________________

B. Sources

1. ______________________________

2. Electricity generating stations

Brain Check

Name ____________________

Vocabulary Review

1 Use the clues to unscramble the words in the box. Use the word bank if you need help.

1. leepr: what two positive charges do to each other ____________________
2. trattac: what a positive charge and a negative charge do to each other ____________________
3. cattis: the type of electricity that results from the buildup of electric charge on an object ____________________
4. ntrruce: The steady flow of electric charges along a path is electric __________. ____________________
5. stipoive: the charge of a proton ____________________
6. ratleun: the charge of a neutron ____________________
7. ateenvig: the charge of an electron ____________________
8. ategenring nattsoi: where electricity is produced ____________________

WORD BANK:

positive	negative	neutral	current
attract	repel	static	generating station

Apply Concepts

2 List the three particles that make up an atom. Describe the charge of each particle.

Parts of an Atom	
Particle	Charge

Where are these particles found in an atom?

____

____

____

3 Draw an atom with 9 protons, 10 neutrons and a charge of –1. Label each part in your drawing.

4 Explain why the balloons are sticking to this cat.

____

____

____

____

____

5 Look at the pairs of objects below. The charge of each object is shown. Tell how each pair will interact. Write *attract, repel*, or *nothing*.

+22	–34	______________
0	+130	______________
–40	–81	______________
0	0	______________

6 Complete the sequence graphic organizer.

A wool sock and a cotton shirt ________ against each other in a dryer.

↓

Electrons move from the wool to the ____________ .

↓

The two pieces of clothing have ____________ charges and they ____________ each other.

7 List three ways in which electric current helps you do work, and describe the energy transformation that takes place.

____

____

____

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____

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____

8 Explain why the event in the drawing takes place.

____

____

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____

____

____

____

____

9 Match each drawing with its description. Circle the drawings that show sources of current that people use every day.

electric current	static electricity	electrostatic discharge	battery




10 Suppose you are playing soccer at a park and you hear thunder that sounds far away. Describe some things you should and should not do to stay safe.

____

____

____

____

____

____

Take It Home!

Do your clothes stick together when they come out of the dryer? If so, how could you prevent this from happening? If not, why don't they stick together? When you put on a sweater, does it ever stick to your hair? Does this happen throughout the year, or only at certain times?

Name ______________________________

ESSENTIAL QUESTION

How Do Electric Charges Interact?

Materials

2 balloons
string
tape
wool cloth

EXPLORE

What happens when you give something a charge? In this activity, you will explore how objects with different charges behave.

Before You Begin—Preview the Steps

1. Blow up both balloons and tie a knot in each. Tie a length of string to each knot. Tape both strings to a table so that the balloons hang a few centimeters apart.

2. Hold one balloon by the neck, and rub it with a wool cloth. Gently release the balloon. Observe and record what happens.

3. Run your hand over each balloon. Then rub both balloons with a wool cloth. Release the balloons. Observe and record what happens.

4. Try rubbing the balloons with several other materials. Communicate with your classmates by discussing your observations.

Set a Purpose

What do you think you will observe during this activity?

____

____

____

Think About the Procedure

Why do you rub one balloon, but not the other, in Step 2?

____

____

Why do you rub both balloons in Step 3?

____

____

Why is this activity not an experiment?

____

____

Name ______________________________

Record Your Data

Draw diagrams to show what happened during Steps 2 and 3. Label the diagrams.

Draw Conclusions

What caused the balloons to behave as they did in Steps 2 and 3?

____

____

____

____

Claims • Evidence • Reasoning

1. What do you think happens when you rub a balloon with a wool cloth?

____

____

2. Write a claim about what happens when objects with opposite charges are near each other. Support your claim with an example that you have seen in your everyday activities.

____

____

____

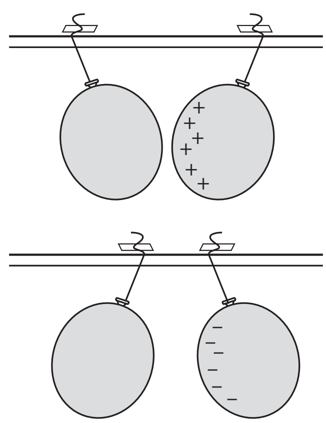
3. Write a claim about what happens when objects with similar charges are near each other. Support your claim with an example.

____

____

____

4. Look at the drawings of balloons to the right. In each pair, the drawing shows the charges on one balloon. Look at the way each pair of balloons is interacting, and draw the charges on the second balloon.



5. What other questions would you like to ask about electric charges?

____

____

SC.5.P.10.4 Investigate and explain that electrical energy can be transformed into heat, light, and sound energy, as well as the energy of motion.

LESSON **5**

ESSENTIAL **QUESTION**

How Do We Use Electricity?

Engage Your Brain

As you read, figure out the answer to the following question and record it here.

How would this scene have been different in 1910?

____

____

____

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

____

____

____

Signal Words: Sequence

Signal words show connections between ideas. Words that signal sequence include *now*, *before*, *after*, *first*, and *next*. Active readers remember what they read because they look for signal words that identify sequence.

(bkgd) ©Tim Platt/Getty Images

Electricity Has Many Uses

Suppose you had lived in 1900 rather than today. The pictures show how different your day might have been.

ACTIVE READING As you read this page, write *before* or *after* in the box next to each object to indicate the sequence.

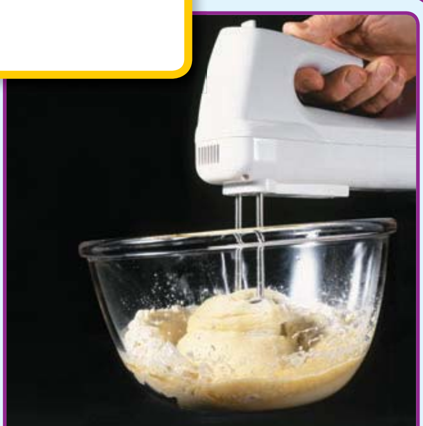
Does a clock radio wake you up in the morning? Do you use an electric toothbrush or hair dryer? How do you cook your breakfast?

Electrical appliances do work. They perform useful tasks by converting electrical energy into other forms of energy, such as sound, thermal, and mechanical energy. Some appliances run on batteries. Others are plugged into a socket, which provides greater electrical energy. Think about the appliances you use each day. How would your day change if there were no electricity?

The only light came from candles or oil-burning lamps. Now we can turn on lamps with the flick of a switch.

Before electricity, food was kept cold in an icebox. Ice was delivered daily to keep food cold.

▶ Draw a picture of the electrical appliance that does the same work as this object.



People used muscles rather than electricity to mix cake batter!

Electricity changed life outside the kitchen, too. The heater in this scene keeps the room warm. Before electricity, a wood stove or fireplace heated the home. Cleaning was harder, too. There were no vacuum cleaners. There was no television to watch or radio to listen to. People entertained themselves by reading or by playing cards.

Many modern appliances, such as mixers and fans, use electric motors. An **electric motor** is a device that converts electrical energy into mechanical energy.

There are many devices in this room that use electrical energy. Each device converts electrical energy into other forms of energy.

Then and Now

Match the objects that do the same kind of work. Draw a picture of the missing appliance. Then describe the energy change that takes place in each electrical appliance.

Electromagnets

Electricity and magnetism are related. One can produce the other.

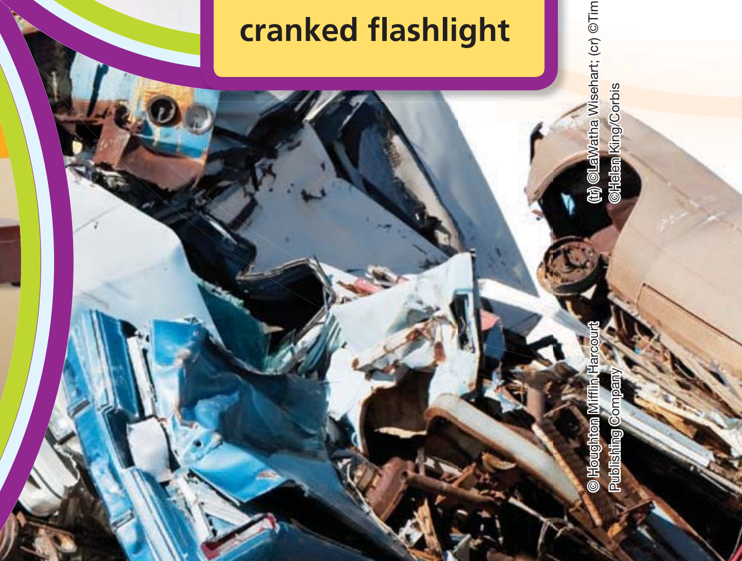
ACTIVE READING As you read this page, circle the sentence that explains how magnetism produces an electric current.

Suppose you slide a coil of wire back and forth around a bar magnet. When the ends of the wire are attached to a light bulb, the bulb lights! Moving a magnet and a wire near each other produces an electric current.

Turning the handle on the device below turns a coil of wire inside three U-shaped magnets. Electricity flows through the wire and lights the lamp.

Modern hand-cranked flashlight

Hand-cranked light bulb



If magnets produce electricity, can electricity make magnets? Yes! Wrapping a coil of current-carrying wire around an iron nail makes the nail a magnet. You can use it to pick up small iron objects such as paper clips. A device in which current produces magnetism is called an **electromagnet**.

Huge electromagnets are used in junk yards. They separate iron and steel objects from other objects. The operator swings the electromagnet over a pile of junk. He turns on the current. All the iron pieces jump to the magnet. The operator then swings the magnet over a container and turns off the current. The magnetism stops, and the iron drops into the container.

Electromagnets have become very important and useful. Every electric motor today contains at least one electromagnet. You can also find electromagnets in telephones, doorbells, speakers, and computers. Doctors can use electromagnets to make pictures of the inside of the body.

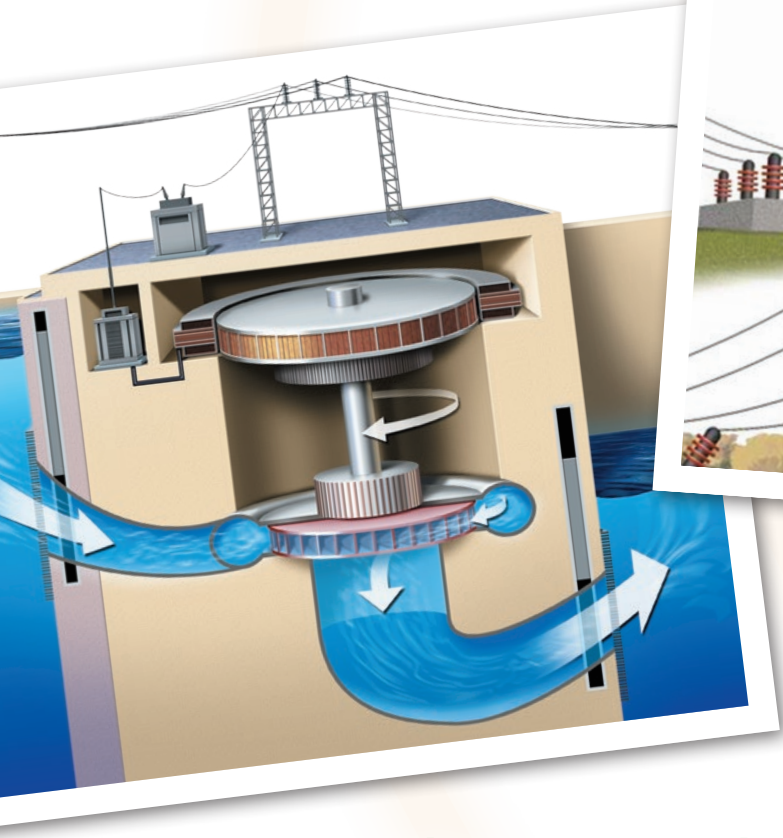
▶ **In the first box, write the cause of the action in the second box. Then figure out what that effect can cause, and fill in the third box.**

____________	→	**An electric current flows through the wire.**	→	____________

Conserving Electricity

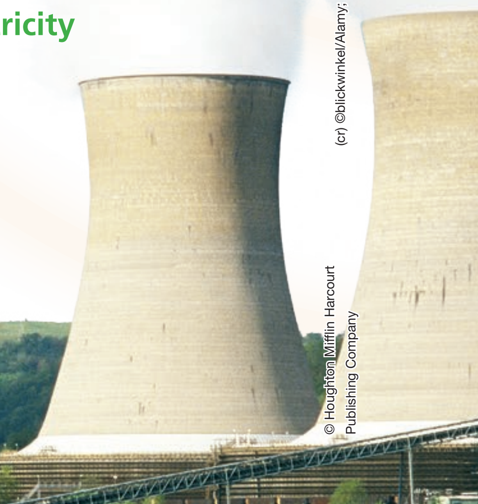
You've probably been asked to conserve, or use less, electricity. Why is conserving electricity important?

ACTIVE READING As you read, underline a sentence that tells how you can conserve energy.



Electricity generating stations, also know as energy stations, may use water, coal, or atoms to produce the electricity you use.

Inside a hydroelectric [hy•droh•ee•LEK•trik] dam, the mechanical energy of falling water is used to turn generators, which change mechanical energy into electrical energy.



The electrical energy is transmitted through a network of substations, high voltage towers, and other comoponents to homes and businesses in the community.

Suppose you spin a magnet inside a coil of wire. A current flows through the wire. You've made a **generator**, a device that converts kinetic energy to electrical energy. Huge generators in energy stations change kinetic energy into electricity. The electricity travels through wires to homes, schools, and businesses.

Some energy stations use falling water or wind to turn generators. Other energy stations convert solar energy to electricity. These resources will never run out. They are called renewable resources.

Most energy stations burn coal or other fuels to heat water. The water rises as steam, which turns the generator. Coal is a limited resource. It will eventually run out. That's why it is important to conserve, or use less, electricity. For example, you can turn off the lights when you leave a room or use a towel instead of a hair dryer.

DO THE **MATH**

Solve a Problem

Sam's electric bill was $200 for the month of June. The air conditioner accounts for $\frac{1}{2}$ of the bill, and the water heater accounts for $\frac{1}{5}$ of the bill. How much did it cost to run each appliance in June?

Sum It Up »

Use information in the summary to complete the graphic organizer.

Electrical appliances use electrical energy to do work and perform useful tasks. Some of these appliances, such as a flashlight or an MP3 player, get electricity from batteries. Others must be plugged into a wall socket. Electrical appliances convert electrical energy into other forms of energy, such as thermal energy, sound energy, and light energy. Many appliances, such as washing machines and fans, contain an electric motor, which converts electricity into the energy of motion. An electric current may also be used to make an electromagnet. Generators in energy stations produce electric current, which travels through wires to homes, schools, and businesses. It is important to conserve electricity because some of the resources energy stations use will eventually run out.

1 Main Idea: Electrical appliances use electrical energy to

____

____

2 Detail: Some appliances work on batteries. Others must be

____

____

____

____

3 Detail: Electrical appliances convert

____

____

____

____

____

4 Detail: Conserving electricity is important because

____

____

____

____

Brain Check

LESSON 5

Name ____________________

Vocabulary Review

1 Unscramble each of the clues to form a word or a phrase from the word bank. Copy each letter in a numbered cell to the cell below with the same number.

TECGARLOETNEM [ ][ ][ ][ ][ ][ ][ ][ ][ ][5][ ][ ][ ]

RECLICTE ROOTM [ ][ ][8][ ][ ][ ][ ][ ] [ ][ ][ ][ ][ ]

TORRAGEEN [ ][ ][4][ ][ ][ ][ ][ ][ ]

ONECREVS [ ][ ][ ][2][ ][ ][ ][ ]

REECUSROS [ ][ ][ ][ ][1][ ][ ][ ][ ]

GANSEITMM [ ][ ][10][7][ ][ ][3][ ][ ]

CICLETERTIY [6][ ][ ][ ][ ][9][ ][ ][ ][ ][11]

WORD BANK
- conserve
- electricity
- electric motor
- electromagnet
- generator
- magnetism
- resources

This lesson is about [1][2][3][4][5] [6][7][8][9][10][11]

Apply Concepts

2 Draw a common electrical appliance. Then explain how it changes electrical energy to other forms of energy and what kind of work it does.

____

____

____

____

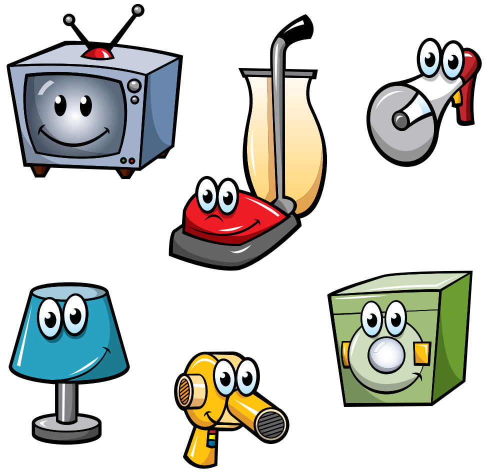
____

3 Draw an X over each appliance that changes electrical energy to mechanical energy.

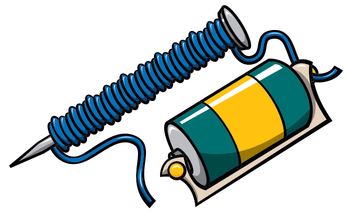
Circle each appliance that changes electrical energy to thermal energy.

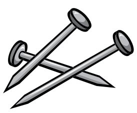
Draw a square around each appliance that changes electrical energy to sound energy.

Draw a triangle around each appliance that changes electrical energy to light energy.



4 What is the device in this drawing called? What would happen if you put this device near a pile of iron nails? Why?





____

____

____

5 A. What are some resources used to generate electricity in energy stations?

____

____

____

____

B. Describe three ways that you can conserve electricity.

____

____

____

____

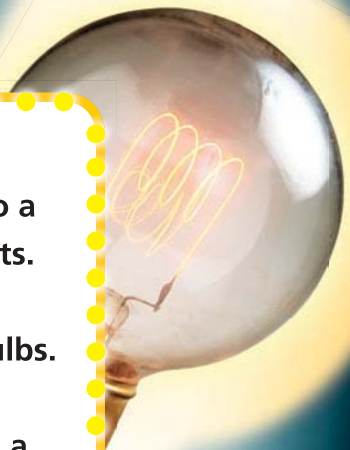
____

Take It Home!

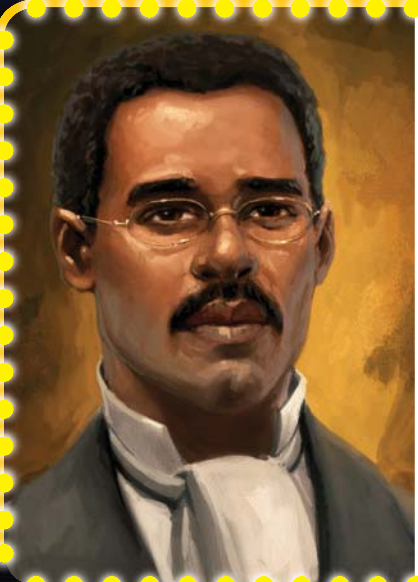
Discuss with your family some specific ways that you could conserve electricity. You might talk about ways to use less electricity or about things you can do by hand rather than using an electrical appliance.

SC.5.P.10.1 Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical.

Meet two Scientists Whose Work Shines Bright



Lewis Latimer



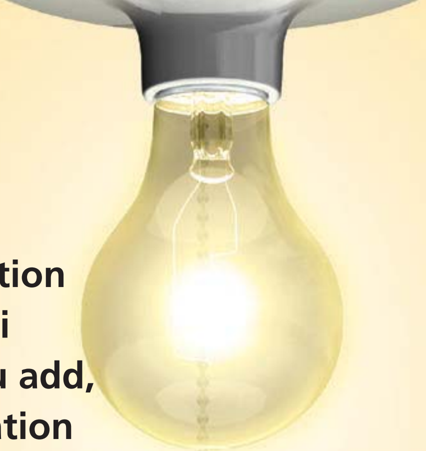
Lewis Latimer was born in 1848. His parents were slaves who had fled to a new life of freedom in Massachusetts. Lewis Latimer worked for Thomas Edison, a pioneer in making light bulbs. But Lewis Latimer made some key improvements. In 1882, he invented a new way to make filaments needed for early light bulbs. He also wrote one of the world's first books explaining electric lighting to the public.

Shuji Nakamura

Shuji Nakamura is a Japanese inventor born in 1954. Working in a small electronics company in 1993, Shuji Nakamura made a discovery. He invented the first successful blue light-emitting diode, or LED. The blue LED made today's bright white LED lights possible. These new LED lights use much less energy than a regular bulb. They can last about 100 times longer, too. Using these lights helps the environment.

Lighting the Way

Fill in the boxes with information about Lewis Latimer and Shuji Nakamura. For each entry you add, draw a line to the correct location on the timeline.



1780 Aimé Argand makes major improvements to the oil lamp.

1879 Thomas Edison's company begins selling incandescent light bulbs, which give off light when a filament inside the bulb heats up.

1923 The first neon lights in the United States are sold.

1938 The first commercial fluorescent lamps become available for purchase.

1960 The first working laser was demonstrated.

1976 Compact fluorescent bulbs were developed.

Think About It!

Lighting has changed a lot since the days of oil lamps. Why do you think people continue to develop new ways to produce light?

Benchmark Review

Name ______________________________

Vocabulary Review

Use the terms in the box to complete the sentences.

kinetic
energy
chemical

1. The batteries of a flashlight contain

   ____________________ energy

2. The ability to cause changes in matter is known

   as ____________________.

3. Sound energy and thermal energy are both types

   of ____________________ energy.

Science Concepts

Fill in the letter of the choice that best answers the question.

4. Olivia is combing her hair. After a while, she notices that the comb attracts the hairs on her head as shown below.

Which explanation best describes why the hairs are attracted to the comb?

Ⓐ Combing the hairs caused them to lose their static charge.

Ⓑ Combing the hairs caused the comb to lose its static charge.

Ⓒ Combing the hairs gave them a charge that is opposite the charge on the comb.

Ⓓ Combing the hairs gave them a charge that is the same as the charge on the comb.

5. You rub two balloons on your hair on a dry day. Your hair is attracted to both balloons. Then you bring the balloons near one another. How would you describe what happens to the balloons?

Ⓕ They repel one another.

Ⓖ They attract one another.

Ⓗ They neither attract nor repel one another.

Ⓘ Opposite charges make one balloon become larger and one become smaller.

6. Imagine you bring a negatively charged rod near a piece of metal. What happens within the metal?

   Ⓐ Protons in the metal move toward the rod.

   Ⓑ Electrons in the metal move toward the rod.

   Ⓒ Protons in the metal move away from the rod.

   Ⓓ Electrons in the metal move away from the rod.

7. When an electric current runs through a doorbell buzzer, a mechanism inside vibrates back and forth and makes the doorbell work. Which energy transformation occurs when someone pushes the button on a doorbell?

   Ⓕ electrical energy into heat energy and sound energy

   Ⓖ electrical energy into motion energy and sound energy

   Ⓗ motion energy into electrical energy and sound energy

   Ⓘ motion energy and sound energy into electrical energy

8. Joe had two toy cars. One car had a spring which he wound up before the car would move. The other car did not have a spring, but it needed a battery to work. How are the two cars different?

   Ⓐ The two cars transform different kinds of energy into motion.

   Ⓑ One car works only on a level surface, and the other can move up a ramp.

   Ⓒ There is no difference between the two cars because they both move forward on a surface.

   Ⓓ The two cars both transform electrical energy into motion, but they get the electrical energy in different ways.

9. When Tishana left her bedroom, she flipped the light switch. The light bulb on her lamp stopped giving off light. What caused the light bulb to go out?

   Ⓕ The filament in the bulb stopped moving, so it could not make light.

   Ⓖ The electric current stopped, so no more electrical energy was converted into light.

   Ⓗ The bulb became cooler, so the light bulb stopped converting heat energy into light.

   Ⓘ The electric current stopped, so light energy could not be converted into electrical energy.

Name ______________________________

10. Which is **not** something that energy can do?

   Ⓐ be completely used up
   Ⓑ cause an object to move
   Ⓒ change an object's temperature
   Ⓓ change into other forms of energy

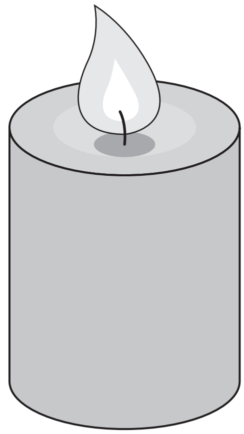
11. One type of energy is the result of waves that travel through matter and cause particles in the matter to vibrate. Which type of energy is it?

   Ⓕ chemical
   Ⓖ electrical
   Ⓗ potential
   Ⓘ sound

12. A thermometer shows that the temperature of the air in a room has increased. Which type of energy has increased?

   Ⓐ chemical
   Ⓑ sound
   Ⓒ electrical
   Ⓓ thermal

13. The picture below shows a burning candle. A candle burns because of energy stored in the particles of wax.



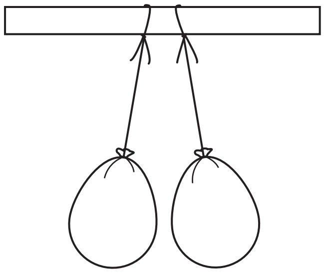
Which type of energy changes take place when the candle burns?

   Ⓕ Chemical energy changes into thermal energy and light energy.
   Ⓖ Electrical energy changes into light energy and chemical energy.
   Ⓗ Kinetic energy changes into potential energy and thermal energy.
   Ⓘ Potential energy changes into kinetic energy and light energy.

Apply Inquiry and Review the Big Idea

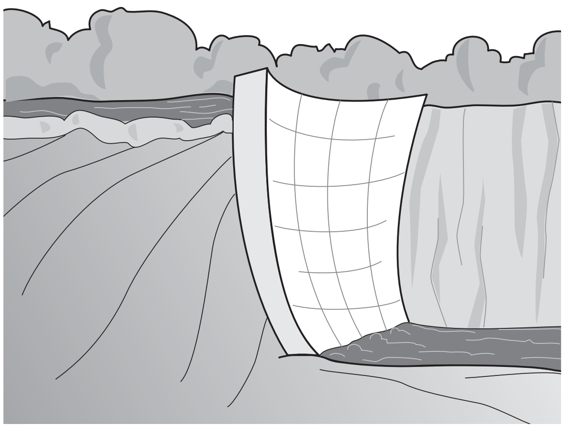
Write the answers to these questions.

14. The balloons shown below are part of Eric's investigation into positive and negative charges. He rubbed both balloons with a wool cloth.



What must be true of the balloons? Explain how you know.

15. The illustration below shows a large dam that is used to produce electricity. Water flows from the lake behind the dam to the river below the dam. It passes through turbines that are connected to generators.



Which energy transformation occurs in this hydroelectric dam? Why is this energy transformation useful?