



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?



ACTIVE READING

Lesson Vocabulary

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

<hr/>	<hr/>
<hr/>	<hr/>
<hr/>	<hr/>

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

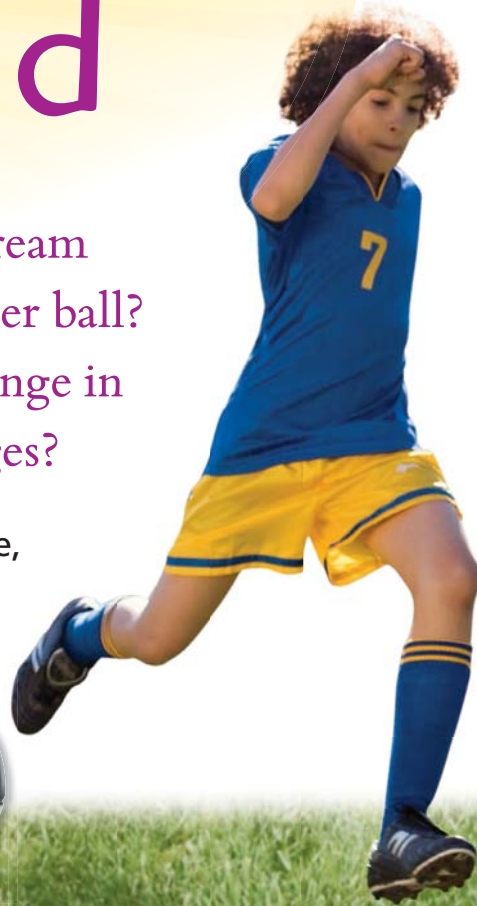
All Around



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.

(Clock) Jupiterimages/Getty Images; (G) Photodisc, Inc.

© Houghton Mifflin Harcourt
Publishing Company

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?

► 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.

Potential Energy	Kinetic 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.

As the car moves downhill, its PE changes to kinetic, or moving, energy. At the bottom of the hill, the car's energy is kinetic. This KE becomes PE as the roller coaster car travels up the next hill.

► 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?

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.

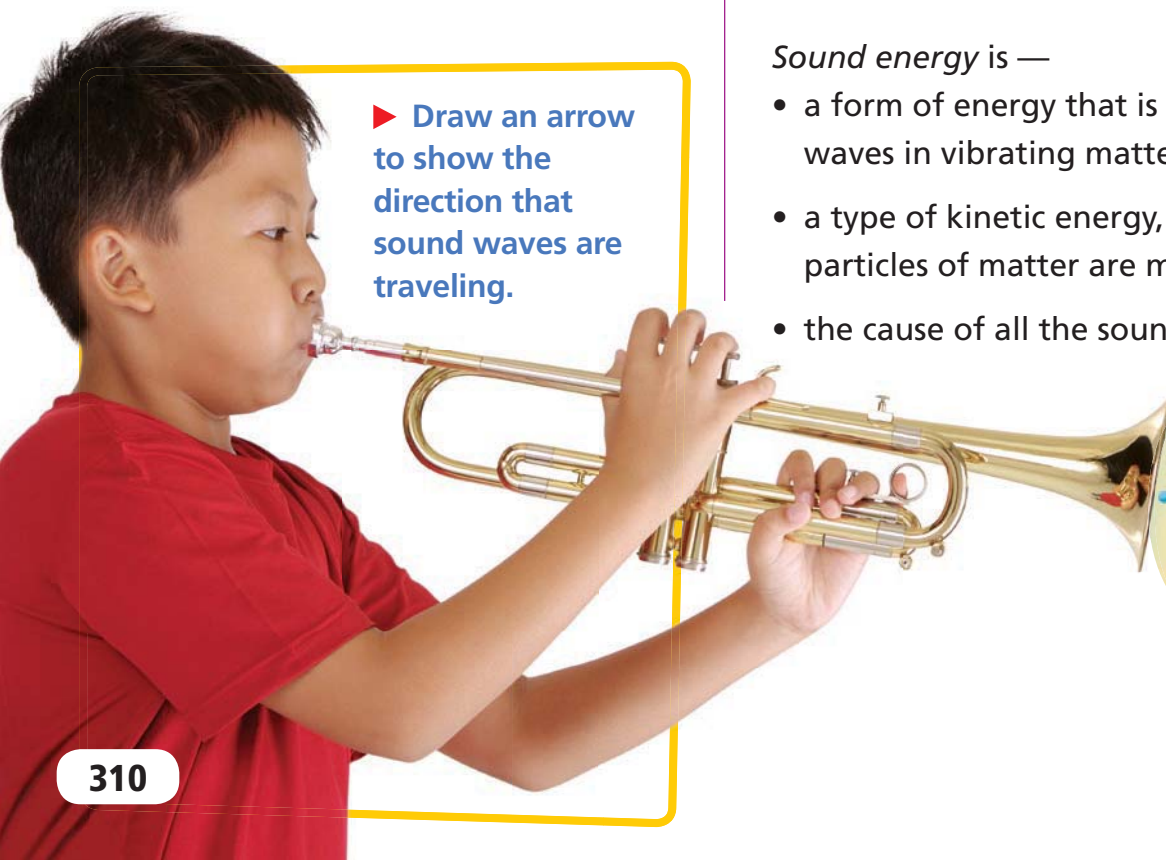
When a trumpet makes noise, it vibrates, or moves back and forth. The trumpet transfers energy to tiny particles of air. Each particle of air moves back and forth, bumping into other particles. The sound travels outward.

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

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.



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

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

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.

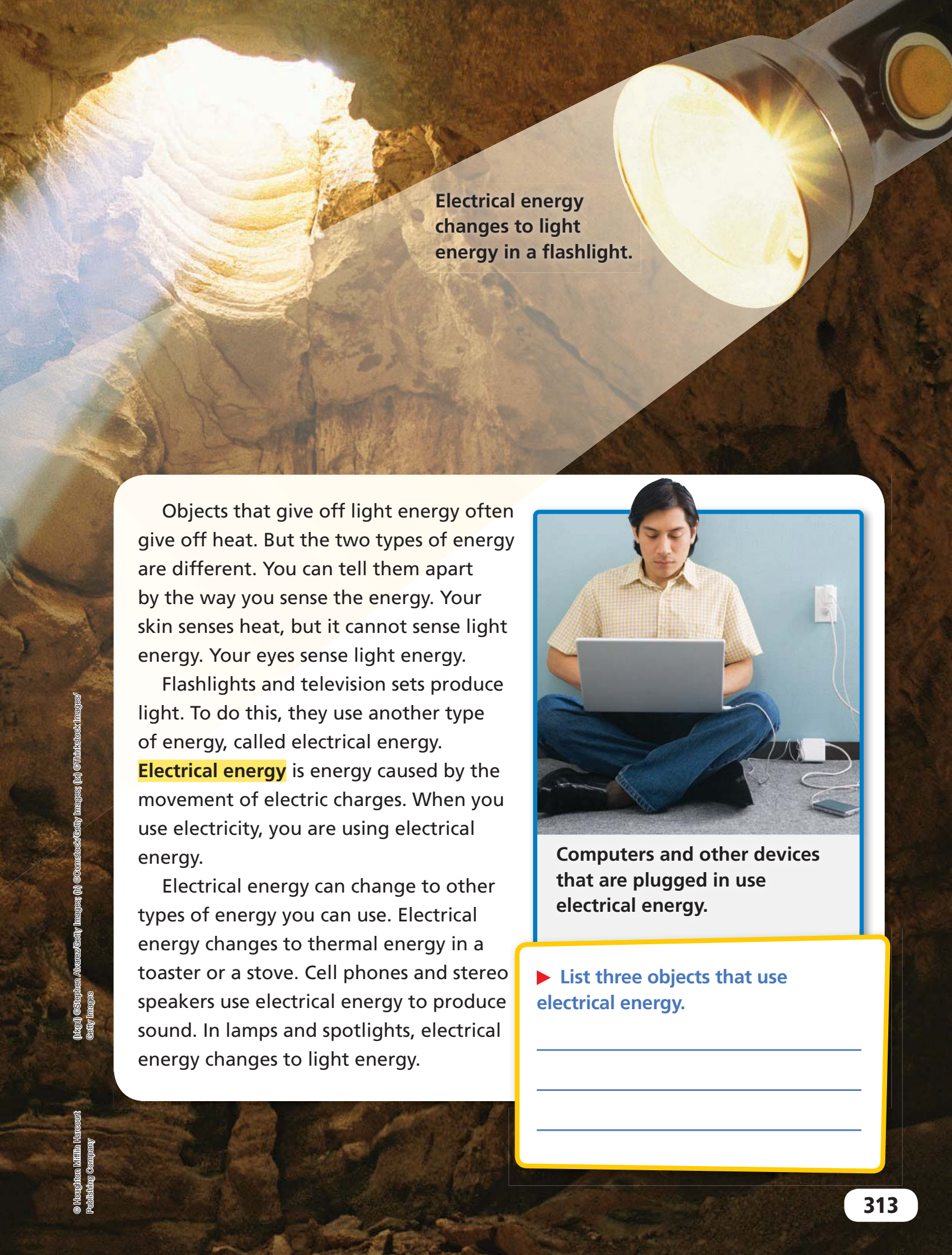
Suppose you are using a flashlight in a dark room. You drop the flashlight and it breaks. What can you see? Nothing! Your eyes need light energy to work.

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.

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

A large flashlight beam is shown shining from the top right corner towards a cave opening in the distance. The cave interior is brightly lit, revealing rock formations. The flashlight itself is visible in the top right corner, with its lens pointing towards the cave.

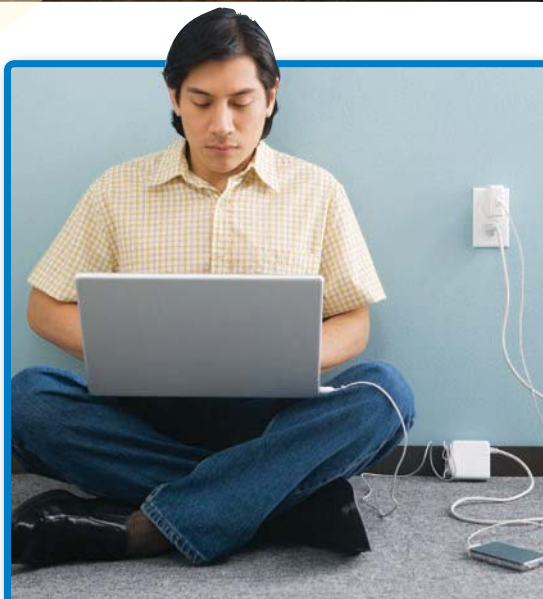
Electrical energy changes to light energy in a flashlight.

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.

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.

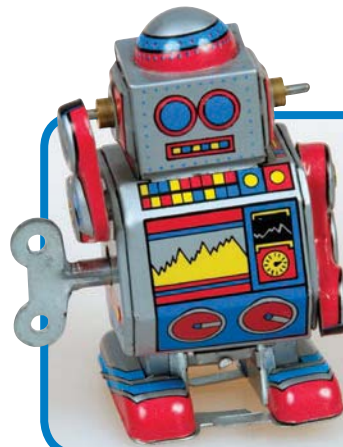


Have you ever felt as if you were going to “run out of energy”? The energy your body uses comes from the food you eat. Food contains a kind of potential energy called chemical energy. **Chemical energy** is energy that is stored in matter and that can be released by a chemical reaction.

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.



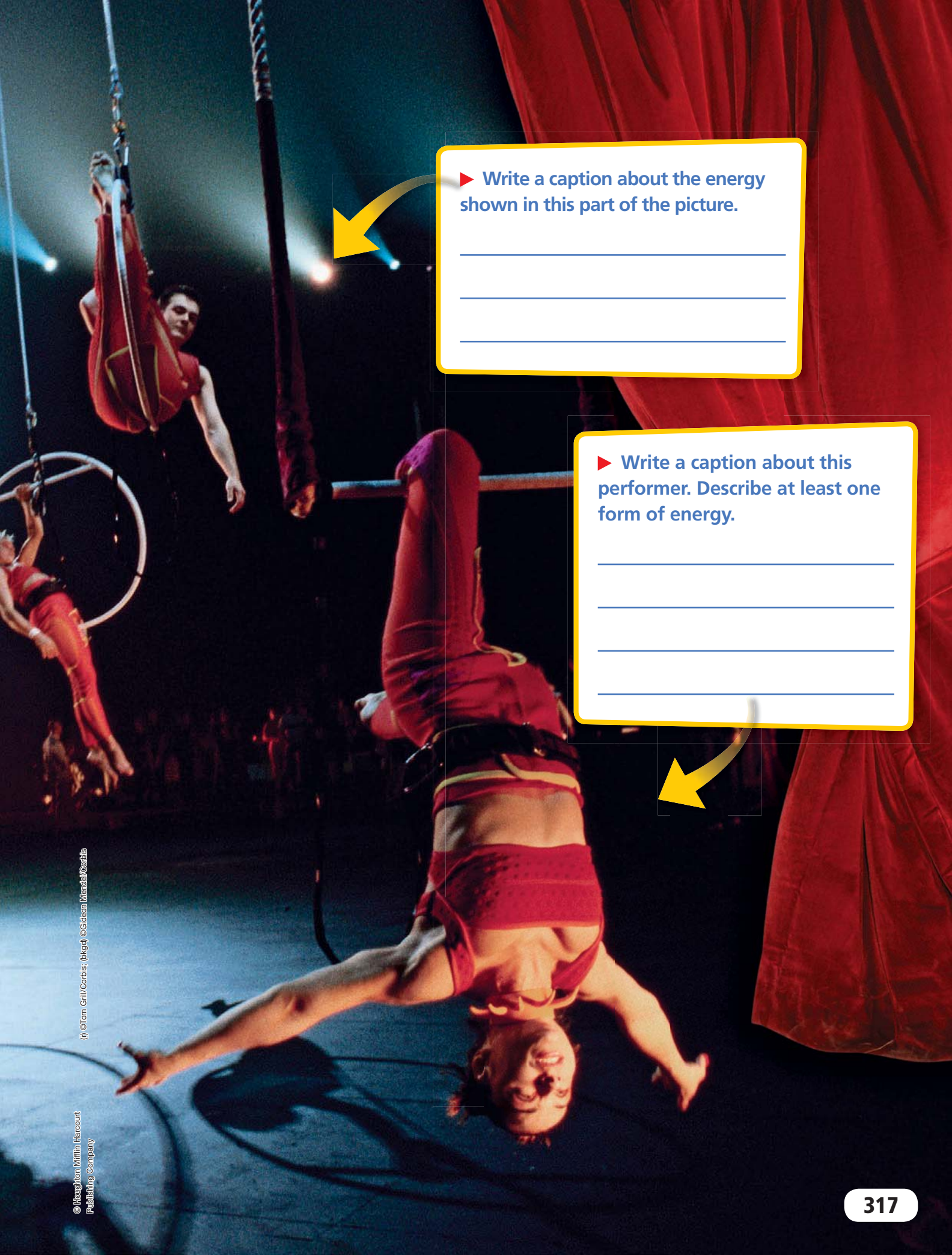
Musicians use mechanical energy to play instruments. The instruments make sound energy that the audience hears as music.

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

(l) © Tom Grill/Corbis; (bkgd) © Gideon Mendel/Corbis; (r) © Jupiterimages/Getty Images; (d)

© Jacques Sarlat/Sygma/Corbis

© Houghton Mifflin Harcourt
Publishing Company



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

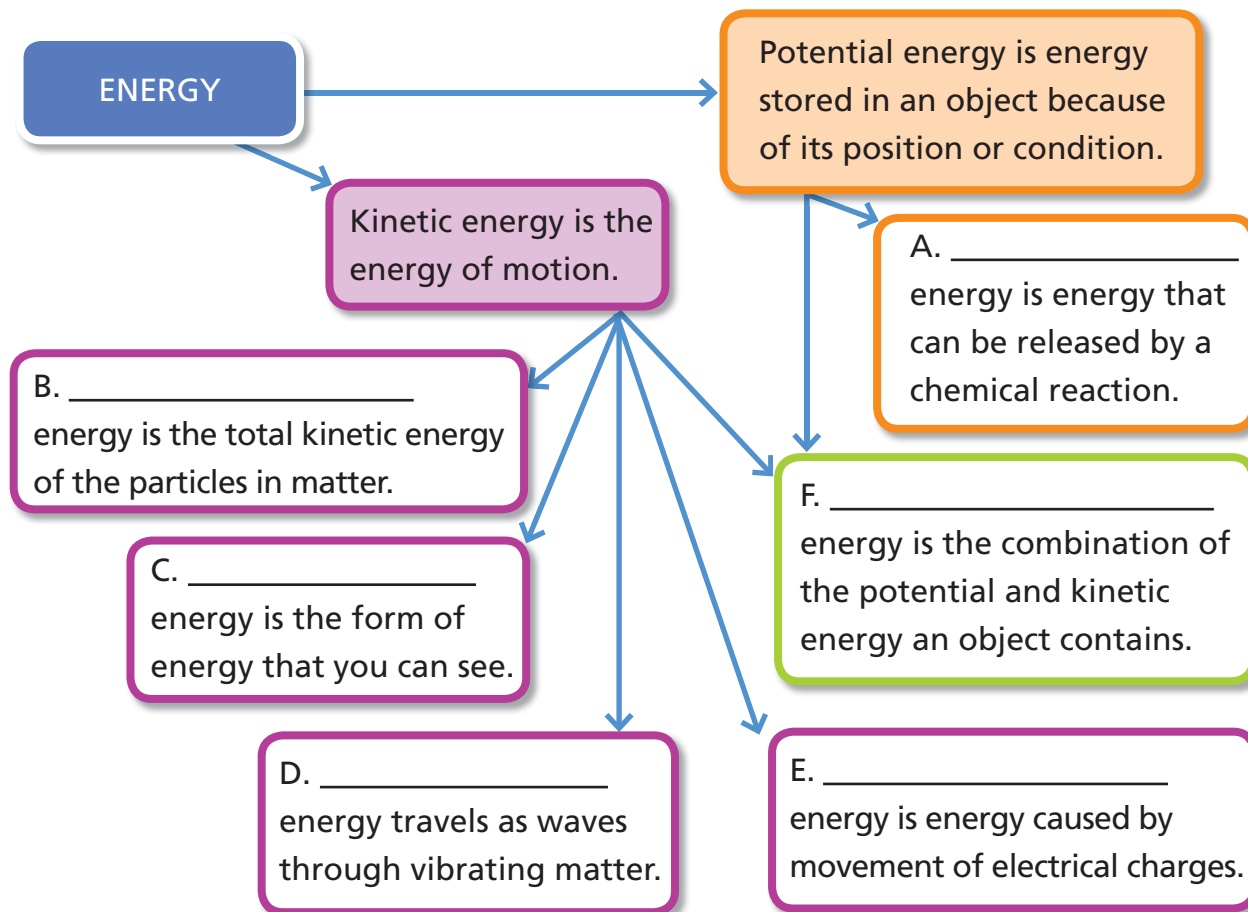
► Write a caption about this performer. Describe at least one form of energy.

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.





Name _____

Vocabulary Review

1

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

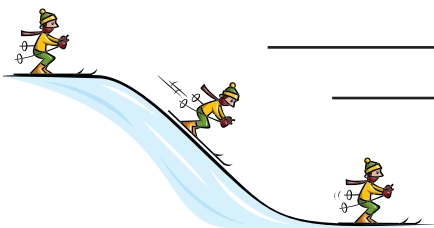
1. __o____a__e____y stored energy due to position or condition
2. __o__ a substance that contains useful chemical energy
3. __l_____ energy caused by the movement of electric charges
4. __n__t__ energy of motion
5. ____a__ to move back and forth
6. __h____a__ energy of moving particles of matter
7. __u__ 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

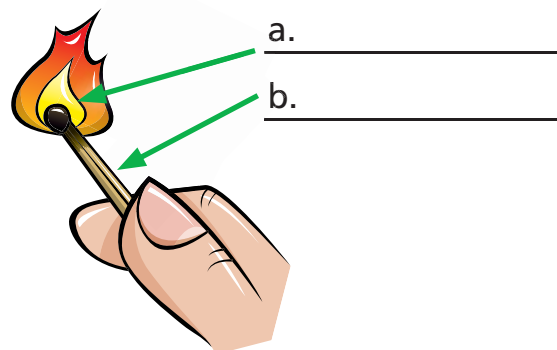
2 Complete the matching game. The first one is done for you.

Light Energy E 3	A. The total kinetic energy of the particles in matter	
Thermal Energy 0 0	B. Energy caused by motion of electric charges	
Sound Energy 0 0	C. Energy that is stored in matter and can be released during a chemical reaction	
Electrical Energy 0 0	D. Energy carried as waves of vibrating matter	
Mechanical Energy 0 0	E. Energy that travels as a wave and that you are able to see	
Chemical Energy 0 0	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.



Take It Home!

See *ScienceSaurus*® for more information about energy.