HW #15 - April Vacation Packet. Read & Text mark this packet. As you go, complete all activities marked with butterfly stamps. There are 16 stamps in total. This is due on:

LESSON 2

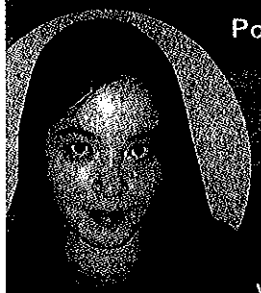
Forms of Energy

UNLOCK THE BIG Q

- How Can You Find an Object's Mechanical Energy?
- What Are Other Forms of Energy?

my Planet Diary

BLOG



Posted by: Lauren

Location: Carlisle, Massachusetts

The first hurricane that I ever saw was a big one! The storm had weakened by the time it arrived in Massachusetts, but the wind was still so powerful it easily flung around our lawn chairs. The trees bent and swayed in the wind. When it was over, branches were scattered across our lawn. The wind even ripped up a tree, blocking our road. The storm did a lot of damage, but we were lucky to be safe inside while watching this awesome force of nature.

Write your answer to the question.

What is some evidence that the storm Lauren described had energy?

PLANET DIARY Go to **Planet Diary** to learn more about forms of energy.

Lab zone® Do the Inquiry Warm-Up *What Makes a Flashlight Shine?*

How Can You Find an Object's Mechanical Energy?

What do a falling basketball, a moving car, and a trophy on a shelf all have in common? They all have mechanical energy. The form of energy associated with the motion, position, or shape of an object is called **mechanical energy.**

Vocabulary

- mechanical energy
- nuclear energy
- thermal energy
- electrical energy
- electromagnetic energy
- chemical energy

Skills

- Reading: Identify the Main Idea
- Inquiry: Classify

An object's mechanical energy is a combination of its potential energy and its kinetic energy. For example, the basketball in Figure 1 has both potential energy and kinetic energy. The higher the basketball moves, the greater its potential energy. The faster the basketball moves, the greater its kinetic energy. You can find an object's mechanical energy by adding together the object's kinetic energy and potential energy.

Mechanical energy = Potential energy + Kinetic energy

Sometimes an object's mechanical energy is its kinetic energy or potential energy only. A car moving along a flat road has kinetic energy only. A trophy resting on a shelf has gravitational potential energy only. But both have mechanical energy.

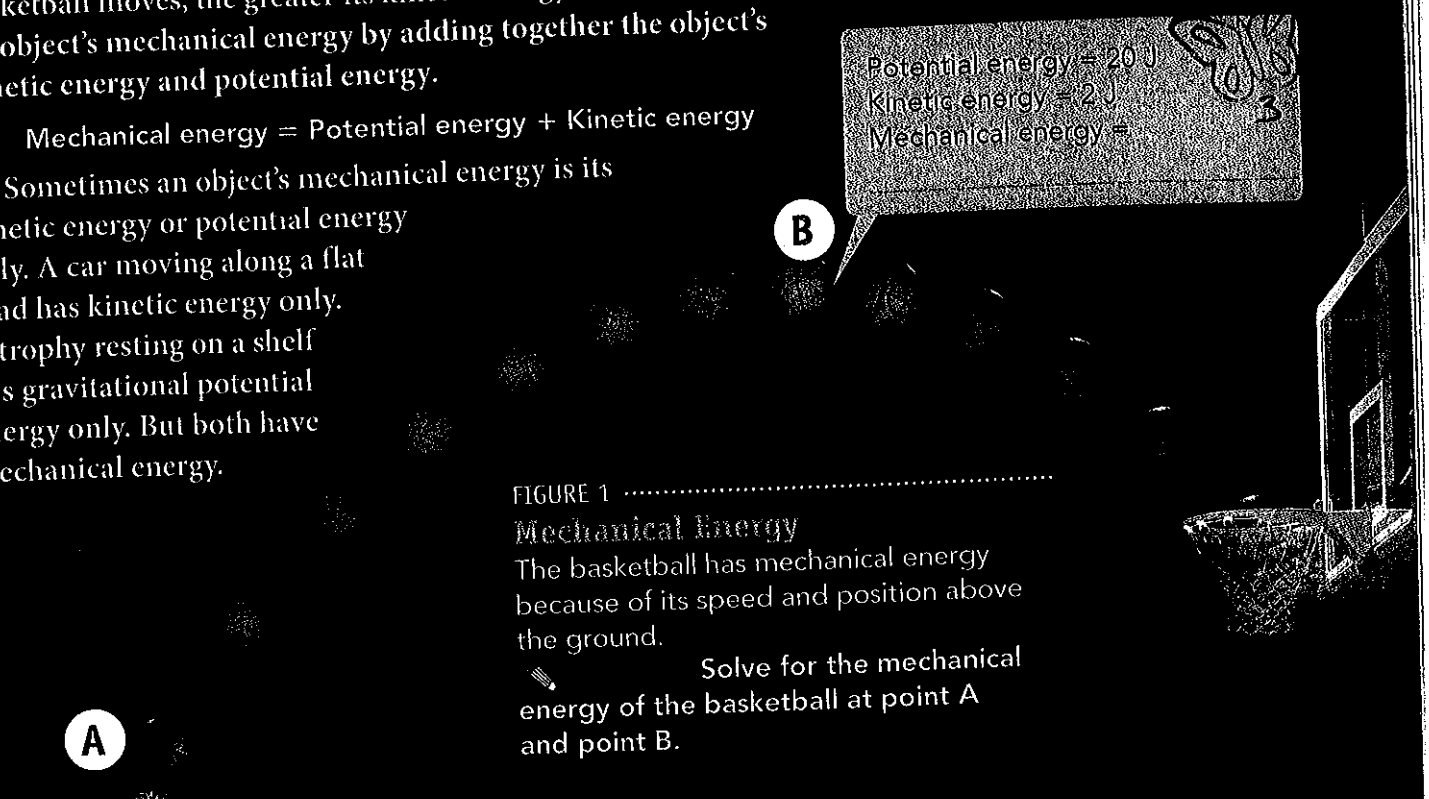


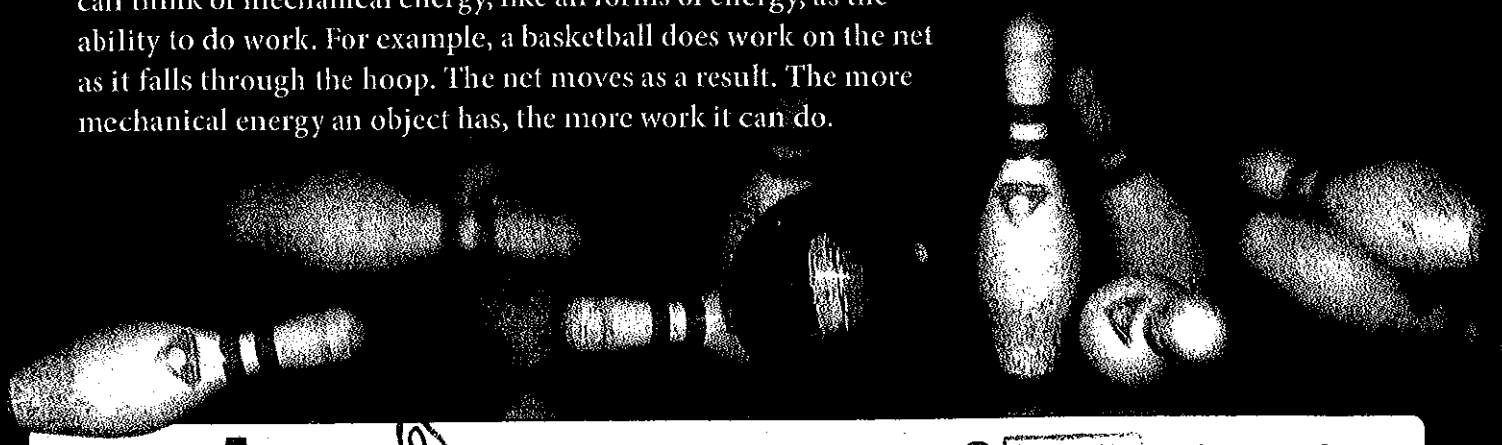
FIGURE 1
Mechanical Energy
The basketball has mechanical energy because of its speed and position above the ground.

Solve for the mechanical energy of the basketball at point A and point B.

Draw Conclusions Why does the ball's gravitational potential energy increase from points A to B?

4

An object with mechanical energy can do work on another object. In fact, you can think of mechanical energy, like all forms of energy, as the ability to do work. For example, a basketball does work on the net as it falls through the hoop. The net moves as a result. The more mechanical energy an object has, the more work it can do.



apply it! 5

The bowling ball does work on the pins when it hits them.

1. Why is the bowling ball able to do work?

2. How should you throw the ball to maximize the amount of work it does on the pins?

3. CHALLENGE In the type of bowling shown in the photo, the ball has a mass of 7.0 kg. In candlepin bowling, the ball has a mass of about 1.0 kg. Does the ball with the greater mass always have the greater mechanical energy? Explain.

Lab zone® Do the Quick Lab *Determining Mechanical Energy.*

Assess Your Understanding 6

1a. Define Mechanical energy is the form of energy associated with the _____, _____, or _____ of an object.

b. Calculate At a certain point the kinetic energy of a falling apple is 5.2 J and its potential energy is 3.5 J. What is its mechanical energy?

c. Infer If an object's mechanical energy is equal to its potential energy, how much kinetic energy does the object have? Explain.

got it?

○ I get it! Now I know you can find an object's mechanical energy by _____

○ I need extra help with _____

Go to my science coach *online for help with this subject.*

What Are Other Forms of Energy?

So far, you have read about energy that involves the motion, position, or shape of an object. But an object can have other forms of kinetic and potential energy. These other forms are associated with the particles that make up objects. These particles are far too small to see with the naked eye. **Forms of energy associated with the particles of objects include nuclear energy, thermal energy, electrical energy, electromagnetic energy, and chemical energy.**

Identify the Main Idea
Underline the main idea under the red heading Nuclear Energy.

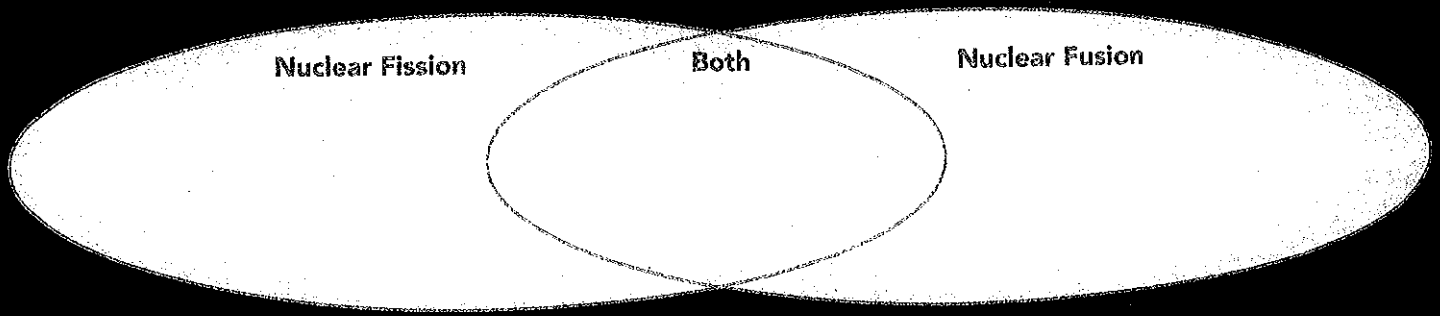
Nuclear Energy

All objects are made up of particles called atoms. The region in the center of an atom is called the nucleus. A type of potential energy called **nuclear energy** is stored in the nucleus of an atom. Nuclear energy is released during a nuclear reaction. One kind of nuclear reaction, known as nuclear fission, occurs when a nucleus splits. A nuclear power plant, like the one shown in **Figure 2,** uses fission reactions to produce electricity. Another kind of reaction, known as nuclear fusion, occurs when the nuclei of atoms fuse, or join together. Nuclear fusion reactions occur constantly in the sun, releasing huge amounts of energy. Only a tiny portion of this energy reaches Earth as heat and light.

FIGURE 2

Nuclear Energy
Controlled nuclear fission reactions occur at some power plants. Nuclear fusion reactions occur in the sun.

Compare and Contrast Use the Venn diagram to compare and contrast nuclear fission and nuclear fusion.



Thermal Energy The particles that make up objects are constantly in motion. This means that they have kinetic energy. These particles are arranged in specific ways in different objects, so they also have potential energy. The total kinetic and potential energy of the particles in an object is called **thermal energy.**

The higher the temperature of an object, the more thermal energy the object has. For example, suppose you heat a pot of water. As heat is applied to the water, the particles in the water move faster on average. The faster the particles move, the greater their kinetic energy and the higher the temperature. Therefore, a pot of water at 75°C, for example, has more thermal energy than the same amount of water at 30°C.

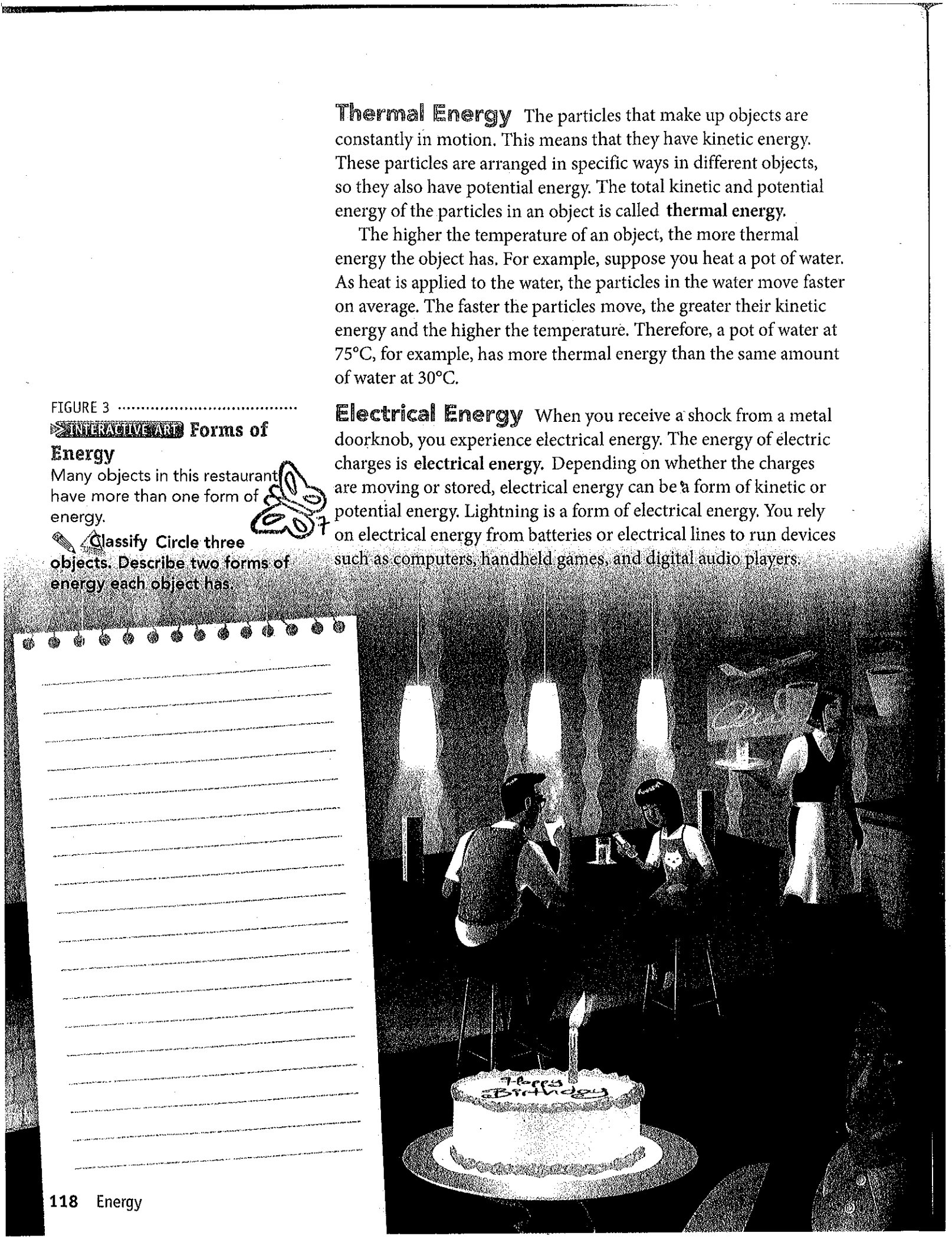
Electrical Energy When you receive a shock from a metal doorknob, you experience electrical energy. The energy of electric charges is **electrical energy.** Depending on whether the charges are moving or stored, electrical energy can be a form of kinetic or potential energy. Lightning is a form of electrical energy. You rely on electrical energy from batteries or electrical lines to run devices such as computers, handheld games, and digital audio players.

FIGURE 3

INTERACTIVE ART Forms of Energy

Many objects in this restaurant have more than one form of energy.

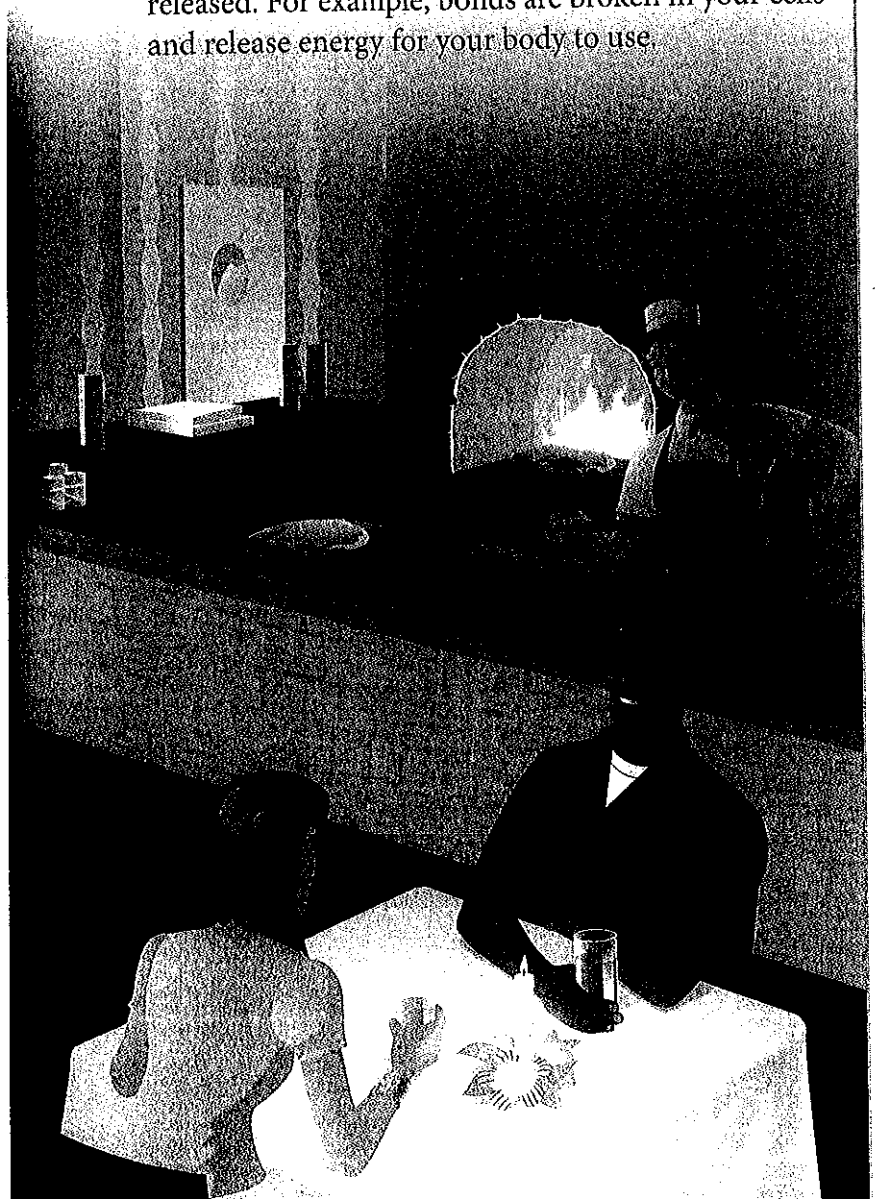
Classify Circle three objects. Describe two forms of energy each object has.



Electromagnetic Energy The light you see is one type of electromagnetic energy. **Electromagnetic energy** is a form of energy that travels through space in waves. The source of these waves is vibrating electric charges. These waves do not require a medium, so they can travel through a vacuum, or empty space. This is why you can see the sun and stars.

The microwaves you use to cook your food and the X-rays doctors use to examine patients are also types of electromagnetic energy. Other forms of electromagnetic energy include ultraviolet rays, infrared (or heat) waves, and radio waves. Cell phones send and receive messages using microwaves.

Chemical Energy Chemical energy is in the foods you eat, in the matches you use to light a candle, and even in the cells of your body. **Chemical energy** is potential energy stored in chemical bonds. Chemical bonds are what hold atoms together. Often when these bonds are broken, this stored energy is released. For example, bonds are broken in your cells and release energy for your body to use.



Vocabulary Identify Multiple Meanings Review the multiple meaning words in the Getting Started section and complete the sentence. During a lightning storm, electric charges move between the clouds and the ground, releasing stored _____.

Lab zone® Do the Quick Lab *Sources of Energy.*

Assess Your Understanding

2a. Explain Why do the particles of objects have both kinetic and potential energy?

_____

_____

_____

_____

_____

_____

b. Classify The energy you get from eating a peanut butter and jelly sandwich is in the form of _____ energy.

got it?

○ I get it! Now I know the forms of energy associated with the particles of objects include _____

_____

_____

_____

○ I need extra help with _____

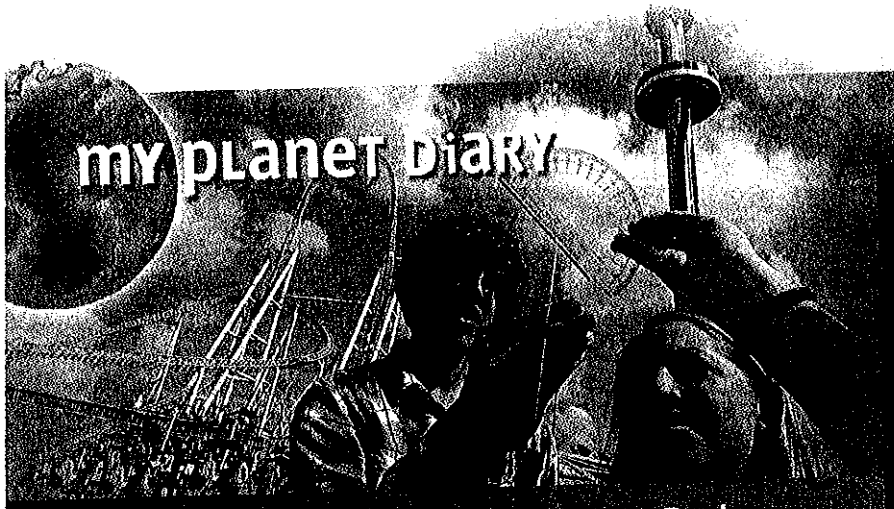
Go to **COACH** *online for help with this subject.*

LESSON 3

Energy Transformations and Conservation

UNLOCK THE BIG QUESTION

- How Are Different Forms of Energy Related?
- What Is the Law of Conservation of Energy?



MY PLANET DIARY

Science Day at the Amusement Park

During science days at Great America Amusement Park™ in Santa Clara, California, the park becomes a giant laboratory! Here is how one investigation might work. You choose a ride like the Drop Tower, which drops you 68 meters in less than four seconds, or the Fire Fall, which contains a series of vertical twists and turns. You observe how your speed and height change during the ride. Then you use your observations to learn about transformations between potential and kinetic energy.

FIELD TRIP

Write your answer to the question below.

How do you think energy is transformed in the Drop Tower?

PLANET DIARY Go to Planet Diary to learn more about energy transformations.

Lab zone® Do the Inquiry Warm-Up *What Would Make a Card Jump?*

How Are Different Forms of Energy Related?

What does flowing water have to do with electricity? In a hydroelectric power plant, the mechanical energy of moving water is transformed into electrical energy. **All forms of energy can be transformed into other forms of energy.** A change from one form of energy to another is called an **energy transformation.** Some energy changes involve single transformations, while others involve many transformations.

Vocabulary

- energy transformation
- law of conservation of energy

Skills

- Reading: Identify Supporting Evidence
- Inquiry: Infer

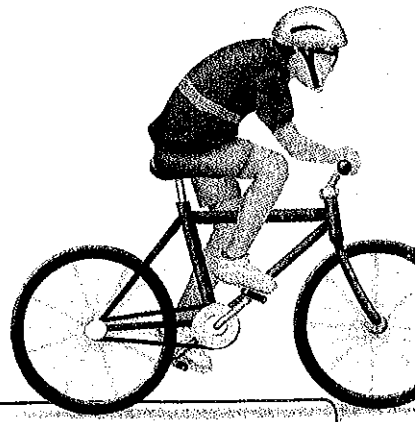
Single Transformations Sometimes, one form of energy needs to be transformed into another to get work done. For example, a toaster transforms electrical energy to thermal energy to toast your bread. A cell phone transforms electrical energy to electromagnetic energy that travels to other phones.

Your body transforms the chemical energy in food to the mechanical energy you need to move your muscles. Chemical energy in food is also transformed to the thermal energy your body uses to maintain its temperature.

Identify Supporting Evidence
Underline the energy transformation that must occur for you to talk on your cell phone.

Multiple Transformations Often, a series of energy transformations is needed to do work. For example, the mechanical energy used to strike a match is transformed first to thermal energy. The thermal energy causes the particles in the match to release stored chemical energy, which is transformed to more thermal energy and to the electromagnetic energy you see as light.

In a car engine, another series of energy conversions occurs. Electrical energy produces a spark. The thermal energy of the spark releases chemical energy in the fuel. The fuel expands as it is broken down into smaller particles. The expansion of the fuel produces pressure on parts of the car. The increased pressure eventually causes the wheels to turn, transforming chemical energy into mechanical energy.



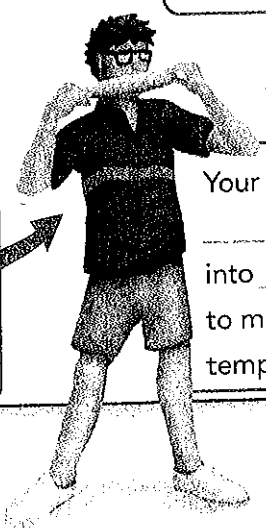
apply it!

10

A series of energy transformations must occur for you to ride your bike. Write the forms of energy involved in each transformation.

Reactions occur within the sun to transform _____ energy into _____ energy.

Plants transform _____ energy into _____ energy.



Your body transforms _____ energy into _____ energy to maintain your body temperature.

Your body also transforms _____ energy into _____ energy when you ride your bike.

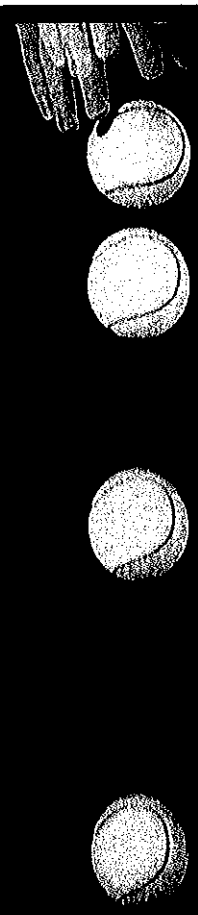


FIGURE 1
Falling Ball
The ball was photographed at equal time intervals as it fell.
Interpret Photos How can you tell that the ball's kinetic energy is increasing?

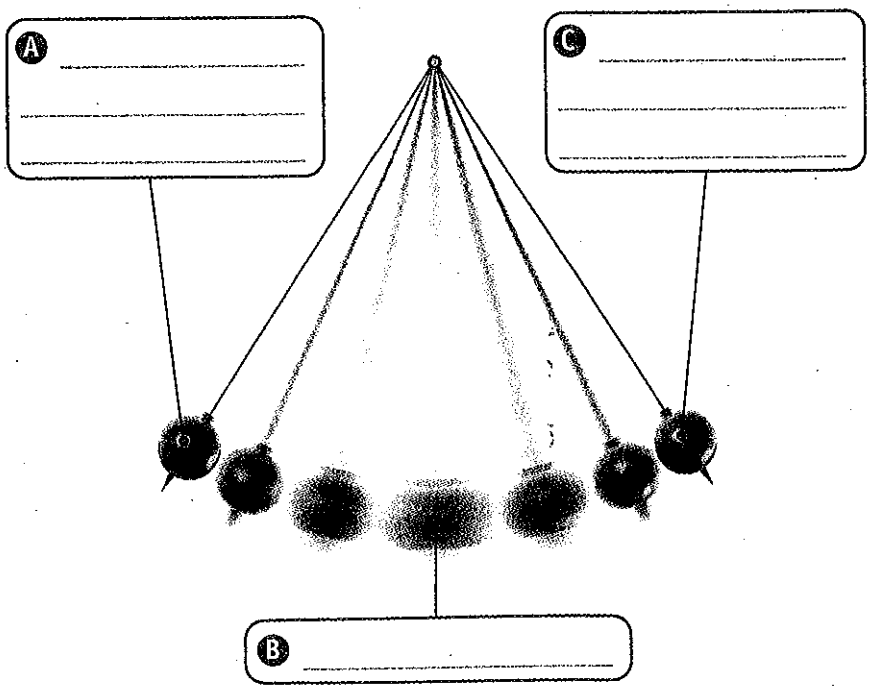
Kinetic and Potential Energy

The transformation between potential and kinetic energy is one of the most common energy transformations. For example, when you stretch a rubber band, you give it elastic potential energy. If you let it go, the rubber band flies across the room. When the rubber band is moving, it has kinetic energy. The potential energy of the stretched rubber has transformed to the kinetic energy of the moving rubber band. Transformations between kinetic and potential energy can also occur in any object that rises or falls. A falling object, a pendulum, and a pole vault are all examples of these transformations.

Falling Object A transformation between potential and kinetic energy occurs in the ball in **Figure 1.** As the height of the ball decreases, it loses potential energy. At the same time, its kinetic energy increases because its speed increases. Its potential energy is transformed into kinetic energy.

Pendulum A pendulum like the one in **Figure 2** swings back and forth. At the highest point in its swing, the pendulum has no movement. As it swings downward, it speeds up. The pendulum is at its greatest speed at the bottom of its swing. As the pendulum swings to the other side, its height increases and its speed decreases. At the top of its swing, it comes to a stop again.

FIGURE 2
INTERACTIVE ART **Pendulum**
A continuous transformation between potential and kinetic energy occurs in a pendulum. **Interpret Diagrams** **Label the type of energy the pendulum has at positions A, B, and C.**



Pole Vault The pole-vaulter in Figure 3 starts out by running forward. When the pole-vaulter plants the pole to jump, his speed decreases and the pole bends. As the pole straightens out, the pole-vaulter is lifted high into the air. Once he is over the bar, the pole-vaulter's speed increases as he falls toward the safety cushion.

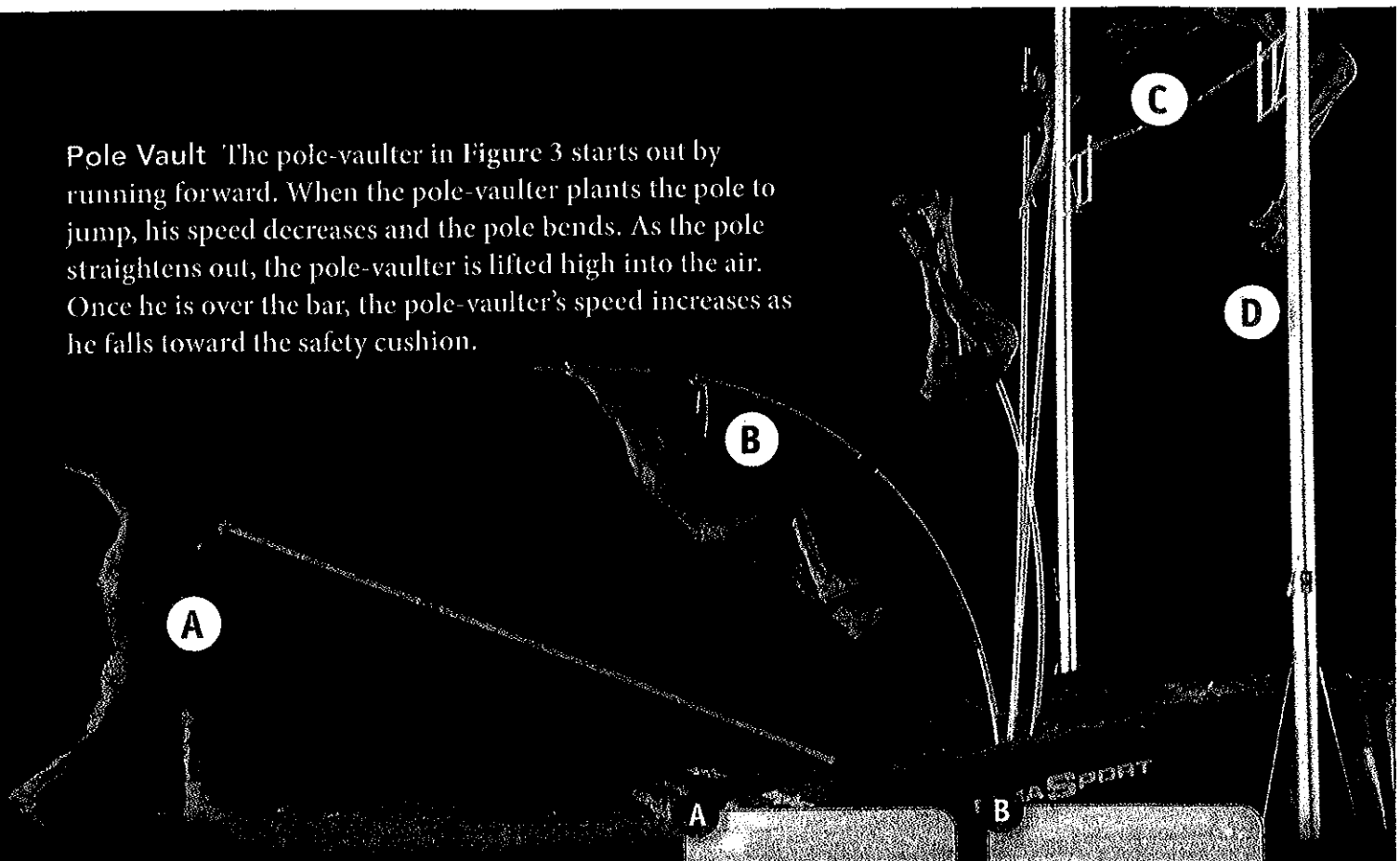


FIGURE 3
Pole Vault
Energy transformations enable this athlete to vault more than 6 meters into the air.
Identify the main forms of energy present at points A through D.

Lab zone® Do the Quick Lab *Soaring Straws.*

Assess Your Understanding

1a. Define A change in one form of energy to another form of energy is called a(n) _____

b. Relate Cause and Effect When you turn on an iron, _____ energy is transformed into _____ energy.

c. Apply Concepts Describe the energy transformation that occurs in a waterfall.

_____

_____

_____

_____

got it?

○ I get it! Now I know that all forms of energy can be transformed into _____

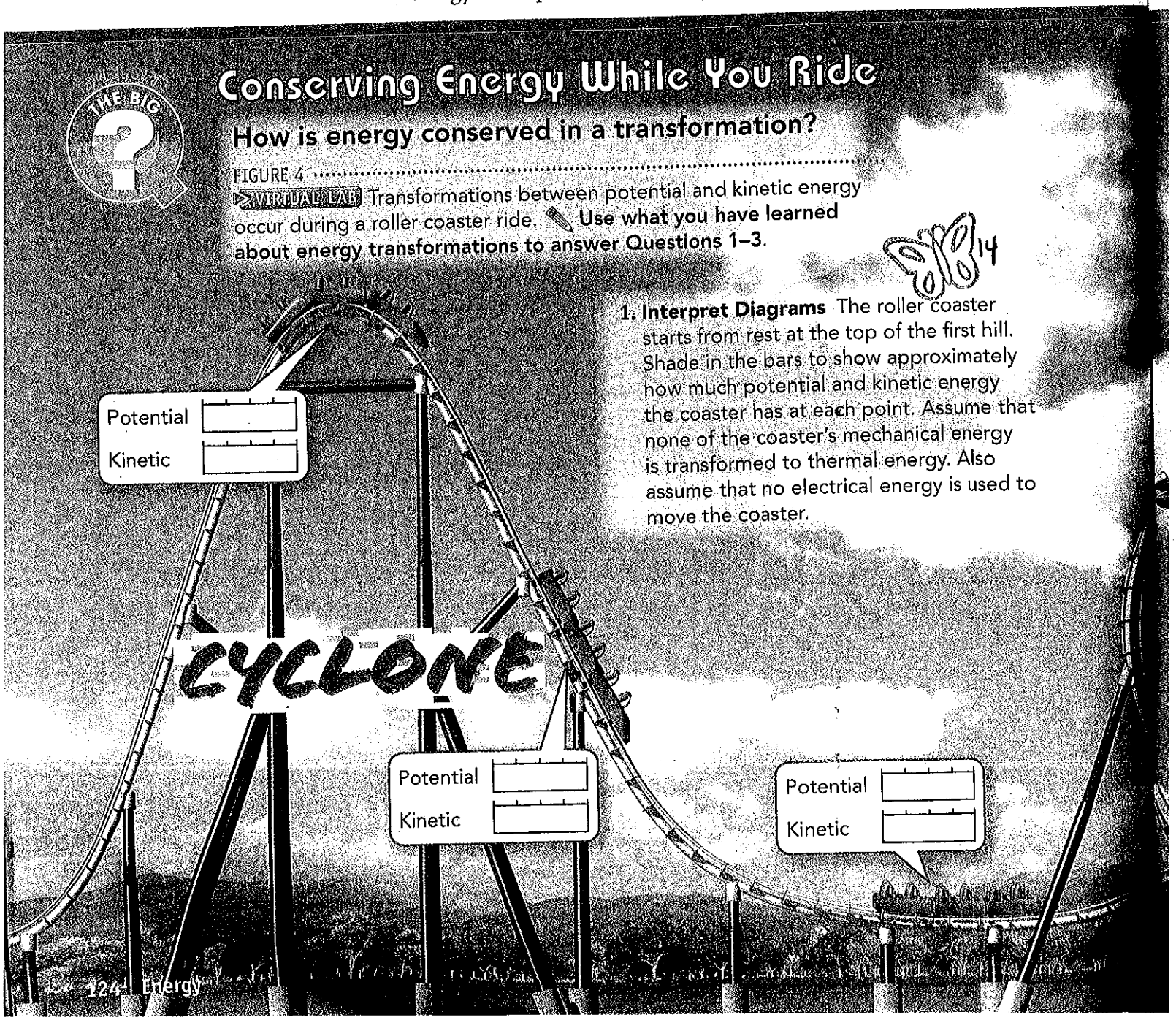
_____

○ I need extra help with _____

Go to my science coach *online for help with this subject.*

What Is the Law of Conservation of Energy?

Once you set a pendulum in motion, does it swing forever? No, it does not. Then what happens to its energy? Is the energy destroyed? Again, the answer is no. The **law of conservation of energy** states that when one form of energy is transformed to another, no energy is lost in the process. **According to the law of conservation of energy, energy cannot be created or destroyed.** The total amount of energy is the same before and after any transformation. If you add up all of the new forms of energy after a transformation, all of the original energy will be accounted for. So what happens to the energy of the pendulum once it stops moving?



As the pendulum swings, it encounters friction at the pivot of the string and from the air through which it moves. Whenever a moving object experiences friction, some of its kinetic energy is transformed into thermal energy. So the mechanical energy of the pendulum is not destroyed. It is transformed to thermal energy.

The fact that friction transforms mechanical energy to thermal energy should not surprise you. After all, you take advantage of such thermal energy when you rub your cold hands together to warm them up. Friction is also the reason why no machine is 100 percent efficient. You may recall that the output work of any real machine is always less than the input work. This reduced efficiency occurs because some mechanical energy is always transformed into thermal energy due to friction.

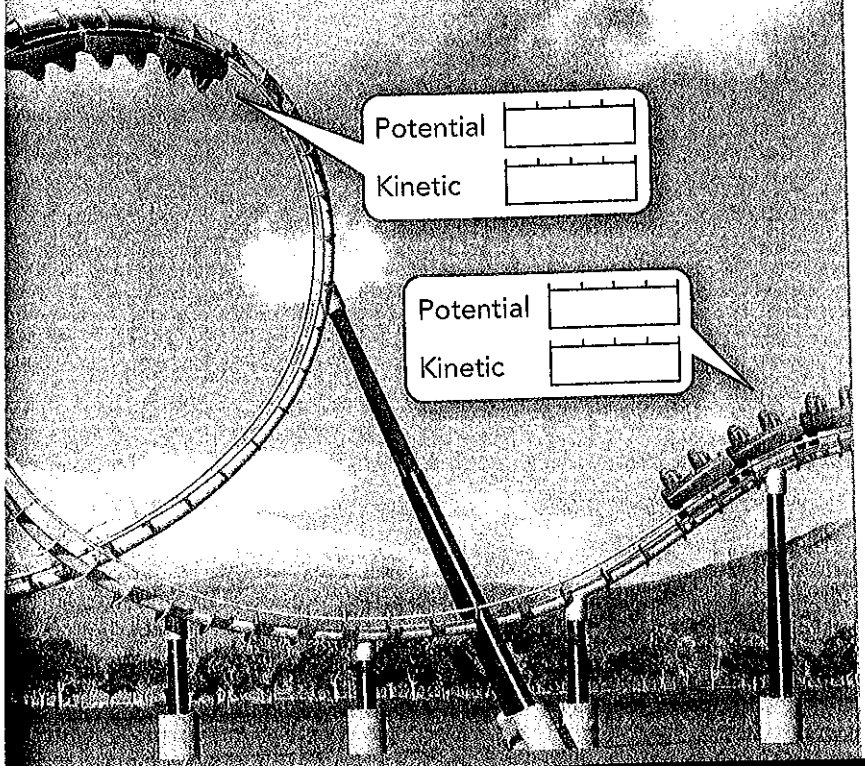
did you know?

When ancient animals and plants died, the chemical energy they had stored was trapped within their remains. This trapped energy is the chemical energy found in coal.

2. Infer Suppose you had taken thermal energy into account in Step 1. Would the total length of the shaded portion of the bars increase, decrease, or stay the same as as result?

◯ Increase ◯ Decrease ◯ Stay the same

3. CHALLENGE Why is the first hill of a roller coaster always the tallest?



Lab zone Do the Quick Lab *Law of Conservation of Energy.*

Assess Your Understanding

2. ANSWER How is energy conserved in a transformation?

got it?

◯ I get it! Now I know that according to the law of conservation of energy, energy

◯ I need extra help with

Go to my science coach *online for help with this subject.*