

Energy Conversions

Imagine you're finishing a clay mug in art class. You turn around, and your elbow knocks the mug off the table. Luckily, you catch the mug before it hits the ground.

The mug has gravitational potential energy while it is on the table. As the mug falls, its potential energy changes into kinetic energy. This change is an example of an energy conversion. An **energy conversion** is a change from one form of energy to another. Any form of energy can change into any other form of energy. Often, one form of energy changes into more than one other form.

What You Will Learn

- Describe an energy conversion.
- Give examples of energy conversions for the different forms of energy.
- Explain how energy conversions make energy useful.
- Explain the role of machines in energy conversions.

Vocabulary

energy conversion

READING STRATEGY

Brainstorming The key idea of this section is energy conversion. Brainstorm words and phrases related to energy conversion.

Kinetic Energy and Potential Energy

Look at **Figure 1**. At the instant this picture was taken, the skateboarder on the left side of the picture was hardly moving. How did he get up so high in the air? As you might guess, he was moving at a high speed on his way up the half-pipe. So, he had a lot of kinetic energy. What happened to that energy? His kinetic energy changed into potential energy. Imagine that the picture below is a freeze-frame of a video. What happens once the video starts running again? The skateboarder's potential energy will become kinetic energy once again as he speeds down the side of the half-pipe.

energy conversion a change from one form of energy to another

Figure 1 Potential Energy and Kinetic Energy

When the skateboarder reaches the top of the half-pipe, his potential energy is at a maximum.

As he speeds down through the bottom of the half-pipe, the skateboarder's kinetic energy is at a maximum.



Elastic Potential Energy

A rubber band can be used to show another example of an energy conversion. Did you know that energy can be stored in a rubber band? Look at **Figure 2**. The wound-up rubber band in the toy airplane has a kind of potential energy called *elastic potential energy*. When the rubber band is let go, the stored energy becomes kinetic energy, spins the propeller, and makes the airplane fly.

You can change the shape of a rubber band by stretching it. Stretching the rubber band takes a little effort. The energy you put into stretching it becomes elastic potential energy. Like the skateboarder at the top of the half-pipe, the stretched rubber band stores potential energy. When you let the rubber band go, it goes back to its original shape. It releases its stored-up potential energy as it does so, as you know if you have ever snapped a rubber band against your skin!


 **Reading Check** How is elastic potential energy stored and released? (See the Appendix for answers to Reading Checks.)



Figure 2 The wound-up rubber band in this model airplane has potential energy because its shape has been changed.

Conversions Involving Chemical Energy

You may have heard someone say, “Breakfast is the most important meal of the day.” Why is eating breakfast so important? As shown in **Figure 3**, chemical energy comes from the food you eat. Your body uses chemical energy to function. Eating breakfast gives your body the energy needed to help you start the day.

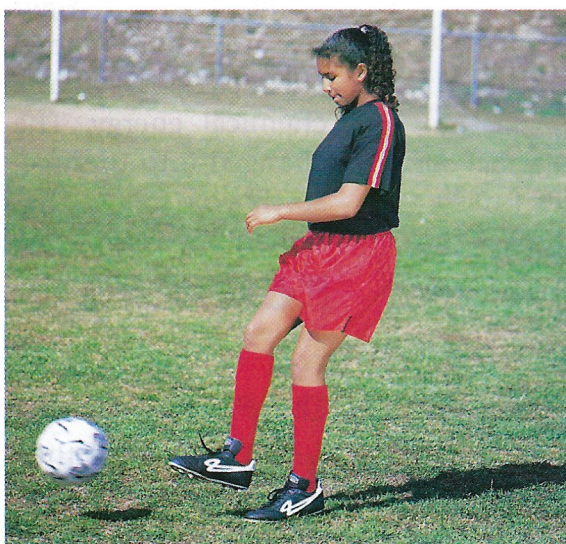
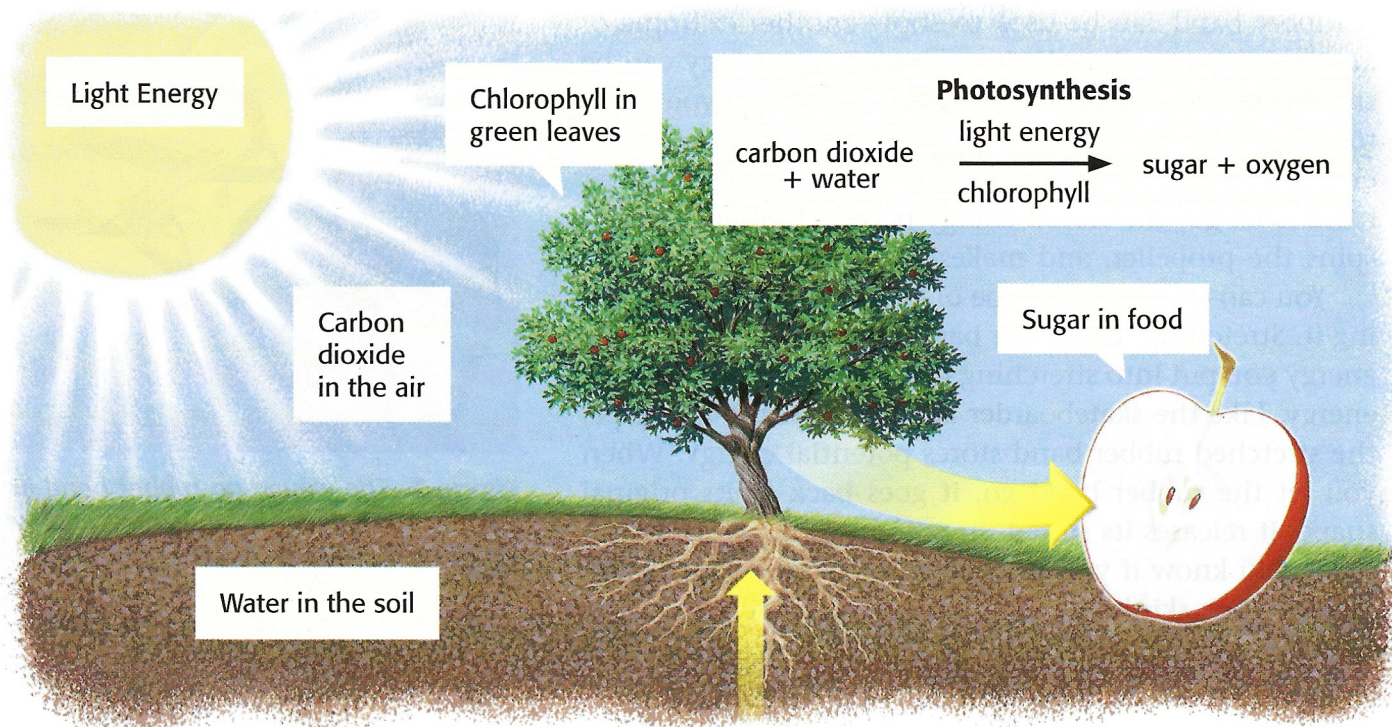


Figure 3 Chemical energy of food is converted into kinetic energy when you are active. It is converted into thermal energy to maintain body temperature.

Figure 4 From Light Energy to Chemical Energy



Energy Conversions in Plants

Did you know that the chemical energy in the food you eat comes from the sun's energy? When you eat fruits, vegetables, or grains, you are taking in chemical energy. This energy comes from a chemical change that was made possible by the sun's energy. When you eat meat from animals that ate plants, you are also taking in energy that first came from the sun.

As shown in **Figure 4**, photosynthesis (FOHT oh SIN thuh sis) uses light energy to make new substances that have chemical energy. In this way, light energy is changed into chemical energy. The chemical energy from a tree can be changed into thermal energy when you burn the tree's wood. So, if you follow the conversion of energy back far enough, the energy from a wood fire actually comes from the sun!

✓ Reading Check Where does the energy that plants use to grow come from?

The Process Continues

Let's trace where the energy goes. Plants change light energy into chemical energy. The chemical energy in the food you eat is changed into another kind of chemical energy that your body can use. Your body then uses that energy to give you the kinetic energy that you use in everything you do. It's an endless process—energy is always going somewhere!

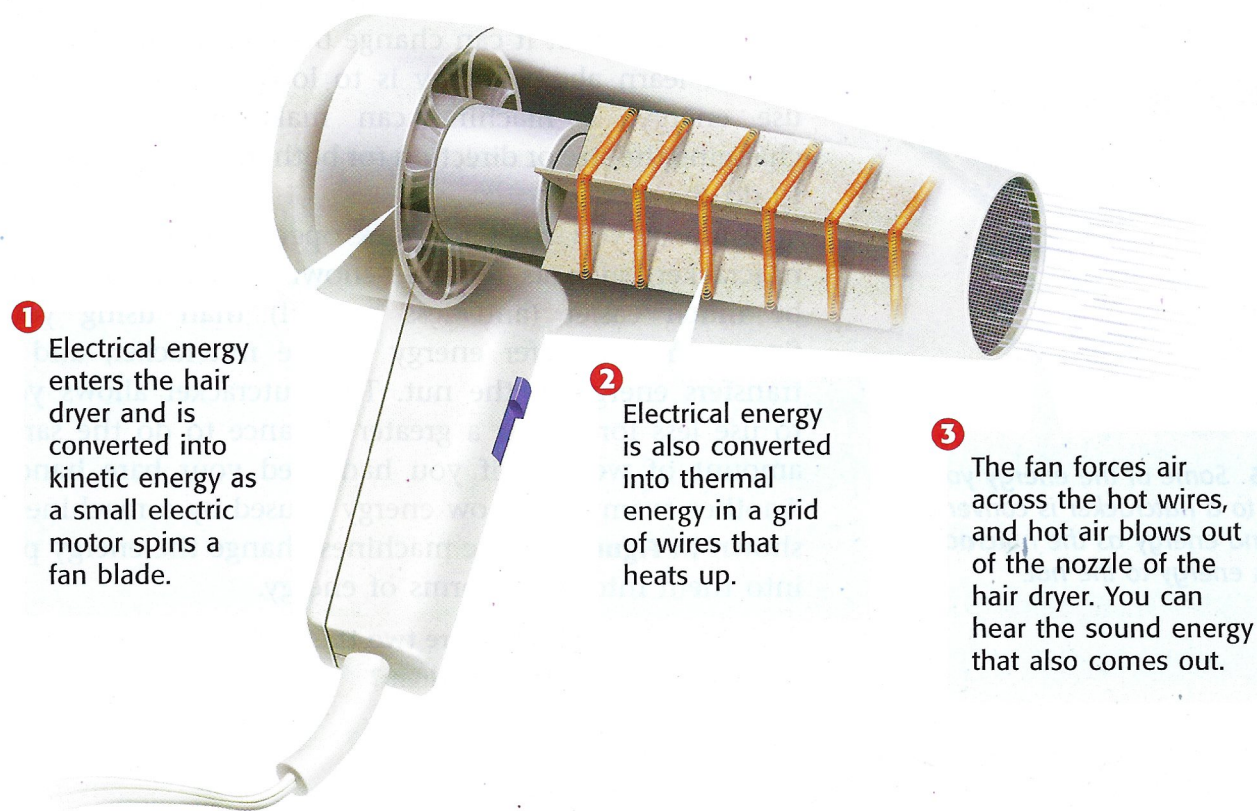
CONNECTION TO Biology

WRITING SKILL

Energy from Plants

All living things need energy. Plants play a major role in providing sources of energy that our bodies use, from the oxygen we breathe to the food we eat. Research the different ways that plants help provide the energy requirements of all living things, and write a one-page report in your **science journal** describing what you learn.

Figure 5 Energy Conversions in a Hair Dryer



Why Energy Conversions Are Important

Energy conversions are needed for everything we do. Heating our homes, getting energy from a meal, and many other things use energy conversions. Machines, such as the hair dryer shown in **Figure 5**, help harness energy and make that energy work for you. Electrical energy by itself won't dry your hair. But you can use a hair dryer to change electrical energy into the thermal energy that will help you dry your hair.

Conversions Involving Electrical Energy

You use electrical energy all of the time. When you listen to the radio, when you make toast, and when you take a picture with a camera, you use electrical energy. Electrical energy can easily be changed into other forms of energy. **Table 1** lists some common energy conversions that involve electrical energy.

Table 1 Some Conversions of Electrical Energy

Alarm clock	electrical energy → light energy and sound energy
Battery	chemical energy → electrical energy
Light bulb	electrical energy → light energy and thermal energy
Blender	electrical energy → kinetic energy and sound energy



Energy and Machines

You've been learning about energy, its different forms, and the ways that it can change between forms. Another way to learn about energy is to look at how machines use energy. A machine can make work easier by changing the size or direction (or both) of the force needed to do the work.

Suppose you want to crack open a walnut. Using a nutcracker, such as the one shown in **Figure 6**, would be much easier (and less painful) than using your fingers. You transfer energy to the nutcracker, and it transfers energy to the nut. The nutcracker allows you to use less force over a greater distance to do the same amount of work as if you had used your bare hands. Another example of how energy is used by a machine is shown in **Figure 7**. Some machines change the energy put into them into other forms of energy.

Figure 6 Some of the energy you transfer to a nutcracker is converted into sound energy as the nutcracker transfers energy to the nut.


 **Reading Check** What are two things that machines can do to force that is put into them?

Figure 7 Energy Conversions in a Bicycle

For your bike to start and keep moving, energy must be transferred and converted.



1 Chemical energy in your body is converted into kinetic energy when your muscle fibers contract and relax.

2 Your legs transfer this kinetic energy to the pedals by pushing them around in a circle.

4 The chain moves and transfers energy to the back wheel, which gets you moving!

3 The pedals transfer this kinetic energy to the gear wheel, which transfers kinetic energy to the chain.

Machines as Energy Converters

Machines help you use energy by converting it into the form that you need. **Figure 8** shows a device called a *radiometer*. It was invented to measure energy from the sun. Inside the glass bulb are four small vanes that absorb light energy. The vanes are dark on one side and light on the other. The dark sides absorb light energy better than the light sides do. As gases next to the dark sides of the vanes heat up, the gas molecules move faster, which causes the vanes to turn. The radiometer shows how a machine can convert energy from one form into another. It changes light energy into heat energy into kinetic energy.

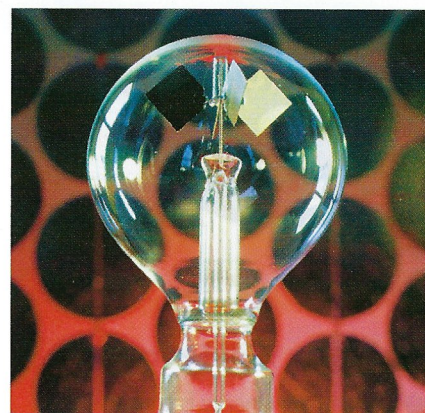


Figure 8 Machines can change energy into different forms. This radiometer converts light energy into kinetic energy.

SECTION Review

Summary

- An energy conversion is a change from one form of energy to another. Any form of energy can be converted into any other form of energy.
- Kinetic energy is converted to potential energy when an object is moved against gravity.
- Elastic potential energy is another example of potential energy.
- Your body uses the food you eat to convert chemical energy into kinetic energy.
- Plants convert light energy into chemical energy.
- Machines can transfer energy and can convert energy into a more useful form.

Using Key Terms

1. In your own words, write a definition for the term *energy conversion*.

Understanding Key Ideas

2. In plants, energy is transformed from
 - a. kinetic to potential.
 - b. light to chemical.
 - c. chemical to electrical.
 - d. chemical to light.
3. Describe a case in which electrical energy is converted into thermal energy.
4. How does your body get the energy that it needs?
5. What is the role of machines in energy conversions?

Critical Thinking

6. **Applying Concepts** Describe the kinetic-potential energy conversions that occur when a basketball bounces.
7. **Applying Concepts** A car that brakes suddenly comes to a screeching halt. Is the sound energy produced in this conversion a useful form of energy? Explain your answer.

Interpreting Graphics

Look at the diagram below, and answer the following questions.

8. What kind of energy does the skier have at the top of the slope?
9. What happens to that energy after the skier races down the slope of the mountain?



SCILINKS®

NSTA

Developed and maintained by the
National Science Teachers Association

For a variety of links related to this chapter, go to www.scilinks.org

Topic: Energy Conversions
SciLinks code: HSM0511