

14-3 How does energy change form?

INVESTIGATE



Observing Energy Change HANDS-ON ACTIVITY

1. Place a windup toy on a flat surface.
2. Give the toy a little push and observe what happens.
3. Now, wind the spring of the toy. Pay attention to how the "feel" of the spring changes as you wind it.
4. Place the toy on a flat surface and release the spring.

THINK ABOUT IT: What kind of energy did the spring have after you wound it? How did this energy change?



Objective

Identify examples of energy changing form.

Key Terms

thermal (THUR-muhl) **pollution:** damage that occurs when waste heat enters the environment

law of conservation of energy: energy cannot be made or destroyed, but only changed in form

Changing Potential and Kinetic Energy

Energy can change from one form to another. Potential energy and kinetic energy often change form. Look at the bouncing ball in Figure 14-8. As the ball falls, potential energy is changed into kinetic energy and back into potential energy as it bounces to a higher position.



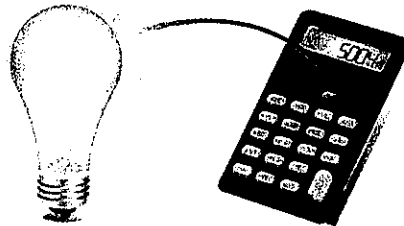
▲ Figure 14-8 The energy of the bouncing ball is always changing form.

The ball in Figure 14-8 has the greatest amount of potential energy at its highest point. It has the greatest amount of kinetic energy just before it hits the ground.

- 1 **ANALYZE:** When does a bouncing ball have the least amount of kinetic energy?

Changing Forms of Energy

You can observe many examples of changing forms of energy all around you. When you turn on an electric light, electrical energy is changed into light energy and heat energy. When you start an automobile, the engine changes the chemical energy in gasoline into mechanical energy. Nuclear reactors change nuclear energy into heat that is used to generate steam. Your muscles change the chemical energy in food into mechanical energy.



▲ Figure 14-9 The light energy from the bulb is captured by the solar cells on the calculator. It is changed to electrical energy that powers the calculator.

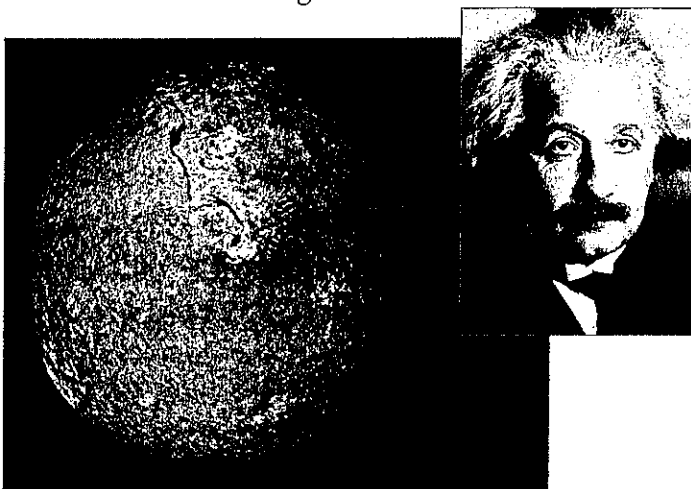
- 2 **IDENTIFY:** What energy change takes place when you turn on an electric light?

Waste Heat When energy changes form, some of the energy is always changed into heat. Most of this heat energy is wasted. When waste heat energy escapes into the environment, it causes **thermal pollution**. For example, the water in lakes and rivers is used to remove waste heat from power plants. The waste heat makes the water warmer. The water may become too warm for living things. If the water gets too warm, fish in the lakes and rivers may die.

3 DEFINE: What is thermal pollution?

Conservation of Energy You know that energy can change from one form to another. Energy also can move from place to place. However, energy can never be lost. Energy can never be created or destroyed. Energy can only be changed in form. This is the **law of conservation of energy**.

Before 1905, the law of conservation of energy did not seem to apply to nuclear energy. In the Sun, nuclear energy is changed into heat energy and light energy. The sun seemed to be producing too much energy for its mass. In 1905, Albert Einstein showed that matter and energy are two forms of the same thing.



▲ Figure 14-10 The Sun's energy gave Einstein (inset) the inspiration for his theory about matter and energy.

Einstein concluded that matter can be changed into energy, and energy can be changed into matter. The total amount of matter and energy in the universe does not change. Einstein stated this idea in the following equation.

$$E = mc^2$$

In this equation, E is energy, m is matter, or mass, and c is the speed of light. Einstein's equation showed that a small amount of matter could be changed into a huge amount of energy. This is what happens in the Sun.

4 DEFINE: What is the law of conservation of energy?

✓ CHECKING CONCEPTS

1. A bouncing ball has the greatest amount of _____ energy at the top of its bounce.
2. When a bouncing ball is at the _____ of its bounce, it has the greatest amount of kinetic energy.
3. When you turn on a light, electrical energy is changed into light and _____.
4. An automobile engine changes _____ energy into mechanical energy.
5. The _____ energy in food is changed into mechanical energy by your muscles.
6. A nuclear reactor changes nuclear energy into _____ energy.

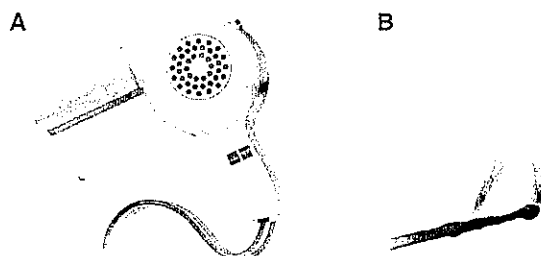
💡 THINKING CRITICALLY

7. **SYNTHESIZE:** Think of a thunderstorm. Describe the forms of energy that occur and the effects they have. Explain each time energy changes from one form to another.

INTERPRETING VISUALS

Study the drawings in Figure 14-11 and answer the following questions.

8. What two forms of energy make item A function?
9. How many forms of energy are shown in B? What are they?



▲ Figure 14-11