

Before You Read

Energy comes in many forms. List as many types of energy as you can think of on the lines below.

What You'll Learn

- the different forms of energy
- how energy can be stored

Read to Learn

What is energy?

Changes are taking place all around you all the time. For example, lightbulbs are heating the air around them, and the wind may be blowing leaves in the trees. Even you are changing as you breathe, blink, or move around in your desk.

Does change require energy?

Energy is the ability to cause change. Anything that causes change must have energy. For example, you use energy when you comb your hair. You also use energy when you move between classes, open a book, or write with a pen. You even use energy when you yawn or sleep.

Because work may be done when change occurs, we can describe energy as the ability to do work. Energy then, like work, can be measured in joules. A tennis racket doing 250 joules (J) of work on a tennis ball transfers 250 J of energy to the ball.

What are systems?

Both the tennis racket and the tennis ball are systems. A **system** is anything you can draw a boundary around. A system may be a single object such as a tennis ball, or a group of objects such as the solar system of planets. When one system does work on a second system, energy is transferred from the first system to the second system. You are a system that shares energy with the tennis racket system and the solar system.

Study Coach

State the Main Ideas As you read this section, stop after each paragraph and write the main idea of what you read in your own words.



1. Define What is energy?

Picture This

2. Illustrate In the space below, draw another representation of one of the types of energy shown in the figure.



3. Explain how energy and money are alike.

FOLDABLES

A Find Main Ideas Fold a piece of paper into 12 sections and label. Fill in the main ideas about kinetic and potential energy.

The Nature of Energy	Define	Examples of	Calculate	
Kinetic Energy				
Potential Energy				



What are some different forms of energy?

Turn on an electric light, and a dark room becomes brighter. Turn on your CD player, and sound comes through the headphones. In both of these cases, energy moves from one place to another. These changes are as different from each other as from the change caused by the racket hitting the ball. Energy has many different forms. Some forms are electrical, chemical, radiant, and thermal.

The figure above shows some forms of energy and some objects associated with these forms of energy.

How is energy like money?

Suppose you have \$100. You could have one hundred-dollar bill, two fifty-dollar bills, 100 one-dollar bills, or 10,000 pennies. You could start with the \$100 in one form and change it into another form. But, no matter what form it is in, it is still \$100. Likewise energy is the same no matter what form it is in. Energy from the Sun that warms you and the energy from the food you eat are just different forms of the same thing—energy!

Kinetic Energy

When you think of energy, you might think of moving objects. An object in motion, like the tennis ball, does have energy. <u>Kinetic energy</u> is the energy a moving object has because of its motion. The kinetic energy of a moving object depends on the object's mass and speed. You can find the kinetic energy of an object using the following equation.

kinetic energy (joules) = $\frac{1}{2}$ mass (kg) × [speed (m/s)]² $KE = \frac{1}{2}mv^2$ A jogger whose mass is 60 kg is moving at a speed of 3 m/s. Use the equation to find the jogger's kinetic energy.

$$KE = \frac{1}{2}mv^{2}$$

= $\frac{1}{2}(60 \text{ kg})(3 \text{ m/s})^{2}$
= $\frac{1}{2}(60 \text{ kg})(9 \text{ m}^{2}/\text{s}^{2})$
= $\frac{1}{2}(540 \text{ kg} \cdot \text{m}^{2}/\text{s}^{2})$
= 270 kg \cdot \text{m}^{2}/\text{s}^{2}

The kinetic energy of the jogger is 270 J.

Potential Energy

An object with energy does not have to be moving. Objects that are at rest have stored energy. For example, an apple that is hanging from a tree has stored energy. If the apple stays in the tree, it will keep its stored energy because of its position above the ground. If the apple falls to the ground, a change happens. Because the apple can cause change, it has energy. Stored energy due to position is called **potential energy**. The stored energy of position, potential energy, will change to energy of motion, kinetic energy, when the apple falls.

What is elastic potential energy?

Energy can be stored in other ways, too. Suppose you take a rubber band and stretch it. If you let the rubber band go, it will fly through the air. Where did this kinetic energy come from? The stretched rubber band had something called elastic potential energy. <u>Elastic potential energy</u> is energy stored by an object that can stretch or shrink, like a rubber band or a spring. When you let the rubber band fly through the air, its elastic potential energy becomes kinetic energy.

What is chemical potential energy?

Where does your body get the energy to make it move? The food that you eat each day has stored energy. To be more exact, food's energy is stored in chemical bonds between atoms. Natural gas stores energy in the same way. Energy stored in chemical bonds is called <u>chemical potential energy</u>. In natural gas, energy is stored in the bonds that hold the carbon and hydrogen atoms together. This energy is released when the gas is burned.



Explain Look at the problem about the jogger. Why does (3 m/s)² become (9 m²/s²)?

Think it Over

5. Apply Describe a situation where potential energy becomes kinetic energy.

FOLDABLES

B Compare and Contrast

Make the following Foldable to compare and contrast the properties of different types of potential energy.





6. List two things that determine an object's GPE.

Applying Math

7. Interpret In the formula *GPE* = *mgh*, which symbols represent the constants and which symbols represent the variables?

<u>Picture This</u>

8. **Reasoning** Which probably has a greater GPE, a feather on a high shelf or a large book on the next shelf down? Explain your reasoning.

What is gravitational potential energy?

Anything that can fall has stored energy called gravitational potential energy. **Gravitational potential energy** (GPE) is energy that is stored by objects that are above Earth's surface. The apple in the tree has GPE. The GPE of an object depends on two things—the object's mass and its height above the ground. Gravitational potential energy can be found using the following equation.

gravitational potential energy (J) = mass (kg) \times acceleration of gravity (m/s²) \times height (m)

GPE = mgh

Look at the vase near the bottom of the bookcase. If you fill the vase with water, you increase its GPE by increasing its mass. If you move the vase to a higher shelf, you also increase its GPE by increasing its height. The gravitational potential energy of an object can increase if you change its mass or move the object higher above the ground.

If two objects are at the same height, then the object with the greater mass will have more GPE. If two objects have the same mass, the one that is higher above the ground will have the greater GPE.



After You Read

Mini Glossary

 chemical potential energy: energy stored in chemical bonds
 gravitation that a that a that a stretch or shrink

 chemical potential energy: energy stored by things that a stretch or shrink
 potential energy: energy stored by things that a potential energy: energy stored by things that a stretch or shrink

energy: the ability to cause change

gravitational potential energy: energy stored by things that are above Earth
kinetic energy: energy in the form of motion
potential energy: energy stored in a motionless object
system: anything around which you can imagine a boundary

- **1**. Review the terms and their definitions in the Mini Glossary. Explain the difference between kinetic energy and potential energy.
- **2.** Complete the chart below. Fill in the first column with the three kinds of potential energy. Fill in the second column with an example of something that stores each type of potential energy.



3. < Study Coach Think about what you have learned. How did you decide what was the main idea of each paragraph?

End of Section