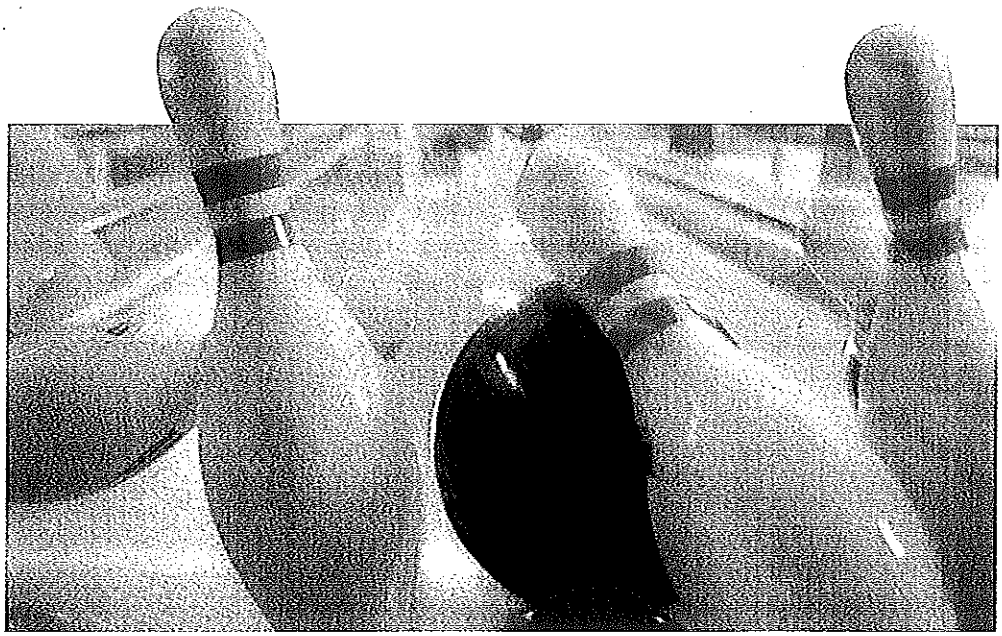


Figure 2 A bowling ball can do work because it is moving. *Applying Concepts* *What is the ability to do work called?*

When an object or organism does work on an object, some of its energy is transferred to that object. **You can think of work, then, as the transfer of energy.** When energy is transferred, the object upon which the work is done gains energy. Energy is measured in joules—the same units as work.

Kinetic Energy

There are two general kinds of energy. **The two kinds of energy are kinetic energy and potential energy.** Whether energy is kinetic or potential depends on whether the energy is being transferred or stored.

The examples you have read about so far have involved things that were moving. A moving object can collide with another object and move it some distance. In that way, the moving object does work. For example, a bowling ball knocks over a bowling pin.

Because the moving object can do work, it must have energy. The energy of motion is called **kinetic energy.** The word kinetic comes from the Greek word *kinetos*, which means "moving."

Mass and Velocity The kinetic energy of an object depends on both its mass and its velocity. Think about rolling a golf ball and a bowling ball so that they travel at the same velocity. Which ball would you have to roll more forcefully? You would have to exert a greater force on the bowling ball because it has more mass than the golf ball.

Since energy is transferred during work, the more work you do, the more energy you give to the ball. So a bowling ball has more kinetic energy than a golf ball traveling at the same velocity. Kinetic energy increases as mass increases.

What would you have to do to make the bowling ball move faster? You would have to throw it harder, or use a greater force.

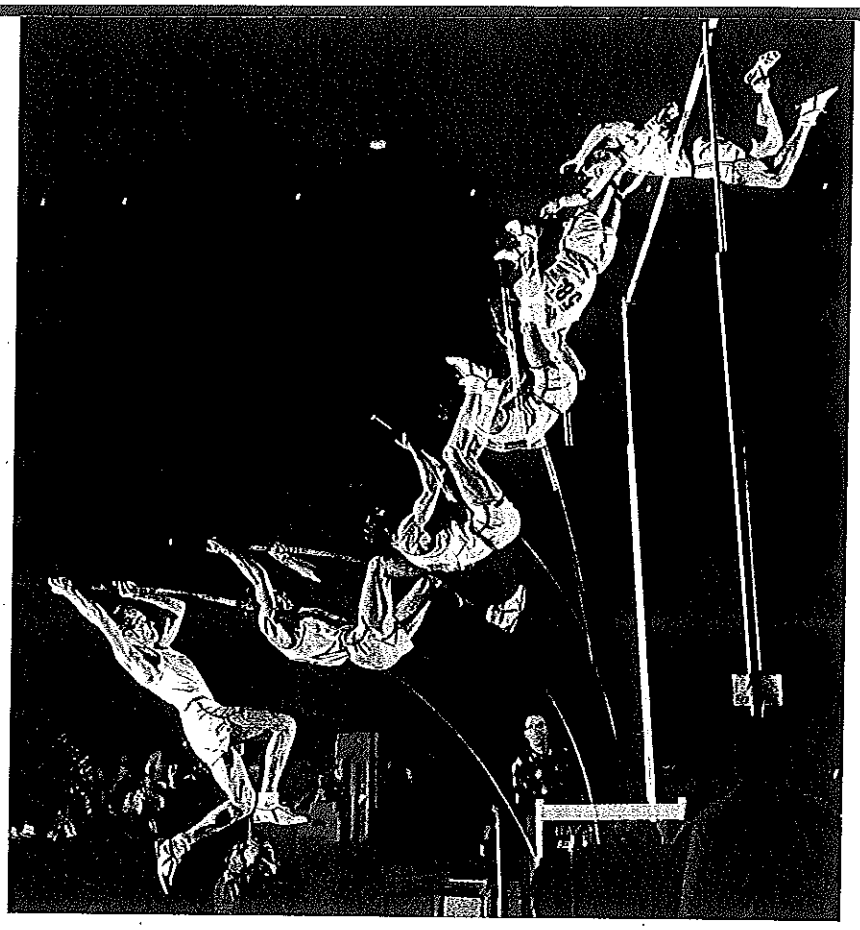


Figure 9 Energy conversions enable this athlete to vault more than six meters into the air. *Predicting What energy conversions will occur after the vaulter falls over the bar?*

Kinetic and Potential Energy

One of the most common conversions is the conversion of potential energy to kinetic energy. 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 band is converted to the kinetic energy of the moving rubber band.

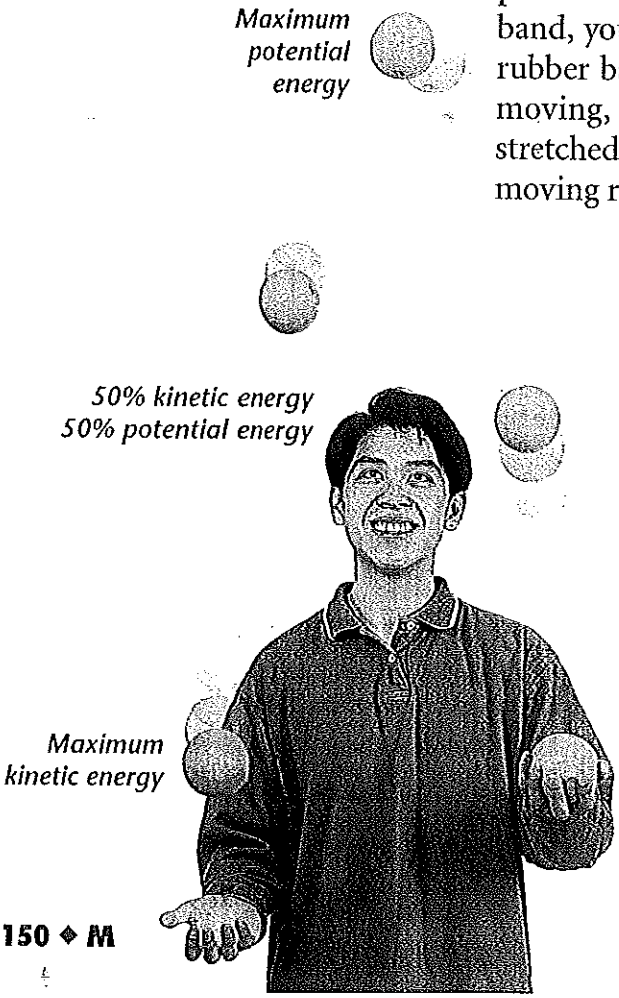


Figure 10 When an object is tossed into the air, energy conversions take place.

Energy Conversion in Juggling Any object that rises or falls experiences a change in its kinetic and potential energy. Look at the orange tossed in the air in Figure 10. When it moves, the orange possesses kinetic energy. As it rises, it slows down. Its kinetic energy decreases. But because its height increases, its potential energy increases. At the highest point in its path, it stops moving. At this point, it no longer possesses kinetic energy, but it possesses potential energy. As the orange falls, the entire energy conversion is reversed—kinetic energy increases while potential energy decreases.

Energy Conversion in a Waterfall There is a conversion between potential and kinetic energy on a large scale at Niagara Falls, which you read about earlier. The water at the top of the falls has

gravitational potential energy because it is higher than the bottom of the falls. But as the water falls, its height decreases and so it loses potential energy. At the same time, its kinetic energy increases because its velocity increases. Thus potential energy is converted into kinetic energy.

Energy Conversion in a Pole Vault As a pole vaulter runs, he has kinetic energy because he is moving. When he plants his pole to jump, the pole bends. His kinetic energy is converted to elastic potential energy in the pole. As the pole straightens out, the vaulter is lifted high into the air. The elastic potential energy of the pole is converted to the gravitational potential energy of the pole vaulter. Once over the bar, the vaulter's gravitational potential energy is converted into kinetic energy as he falls to the safety cushion below.

Energy Conversion in a Pendulum A continuous conversion between kinetic energy and potential energy takes place in a pendulum. At the highest point in its swing, the pendulum in Figure 11 has only gravitational potential energy. As the pendulum starts to swing downward, it speeds up and its gravitational potential energy changes to kinetic energy. At the bottom of its swing, all its energy is kinetic energy. Then, as it swings to the other side and slows down, it regains gravitational potential energy, and at the same time loses kinetic energy. At the top of its swing on the other side it again has only gravitational potential energy. And so the pattern of energy conversion continues.

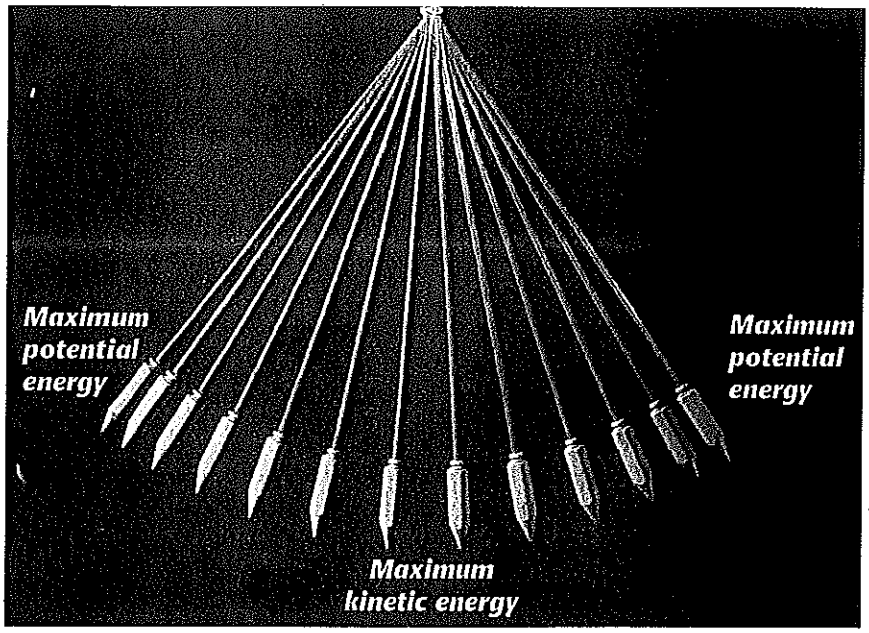
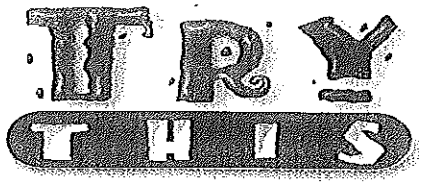


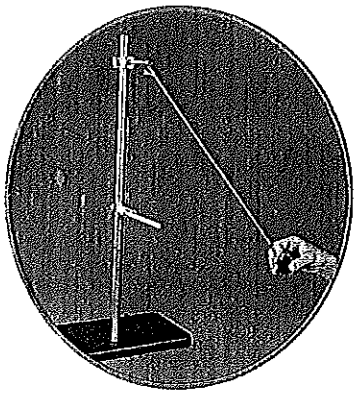
Figure 11 Conversions between kinetic energy and potential energy take place in a pendulum. *Interpreting Diagrams At what two points is potential energy greatest?*



Pendulum Swing

ACTIVITY

1. Set up a pendulum using washers or a rubber stopper, string, a ring stand, and a clamp.
2. Pull the pendulum back so that it makes a 45° angle with the vertical. Measure the height of the stopper. Then set it in motion and observe the height to which it swings.
3. Use a second clamp to reduce the length of the pendulum as shown. The pendulum will run into the second clamp at the bottom of its swing.



4. Pull the pendulum back to the same height as you did the first time. Predict the height to which the pendulum will swing. Then set it in motion and observe it.

Observing How high did the pendulum swing in each case? Explain your observations.