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3 Conservation of Energy

Many roller coasters have a mechanism that pulls the cars up to the top of the first hill. But the cars are on their own for the rest of the ride.

As the cars go up and down the hills on the track, their potential energy is converted into kinetic energy and back again. But the cars never return to the same height at which they started. Does energy get lost somewhere along the way? No, it is just converted into other forms of energy.

Where Does the Energy Go?

To find out where a roller coaster's original potential energy goes, you have to think about more than just the hills of the roller coaster. Friction plays a part too. **Friction** is a force that opposes motion between two surfaces that are touching. For the roller coaster to move, energy must be used to overcome friction. There is friction between the cars' wheels and the track and between the cars and the air around them. As a result, not all of the potential energy of the cars changes into kinetic energy as the cars go down the first hill. Likewise, as you can see in **Figure 1**, not all of the kinetic energy of the cars changes back into potential energy.

READING WARM-UP

Objectives

- Explain how energy is conserved within a closed system.
- Explain the law of conservation of energy.
- Give examples of how thermal energy is always a result of energy conversion.
- Explain why perpetual motion is impossible.

Terms to Learn

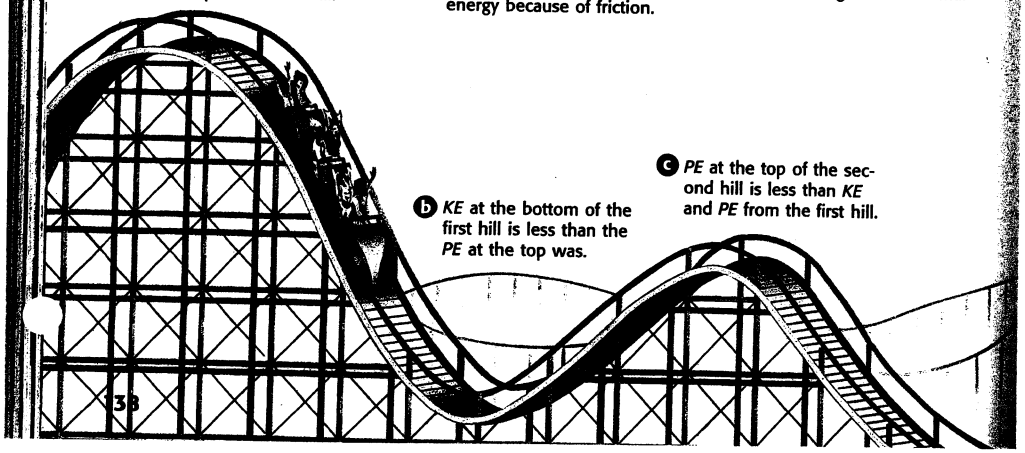
friction
law of conservation of energy

READING STRATEGY

Paired Summarizing Read this section silently. In pairs, take turns summarizing the material. Stop to discuss ideas that seem confusing.

Figure 1 Energy Conversions in a Roller Coaster

Not all of the cars' potential energy (*PE*) is converted into kinetic energy (*KE*) as the cars go down the first hill. In addition, not all of the cars' kinetic energy is converted into potential energy as the cars go up the second hill. Some of it is changed into thermal energy because of friction.



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Energy Is Conserved Within a Closed System

A *closed system* is a group of objects that transfer energy only to each other. For example, a closed system that involves a roller coaster consists of the track, the cars, and the air around them. On a roller coaster, some mechanical energy (the sum of kinetic and potential energy) is always converted into thermal energy because of friction. Sound energy also comes from the energy conversions in a roller coaster. If you add together the cars' kinetic energy at the bottom of the first hill, the thermal energy due to overcoming friction, and the sound energy made, you end up with the same total amount of energy as the original amount of potential energy. In other words, energy is conserved and not lost.

friction a force that opposes motion between two surfaces that are in contact

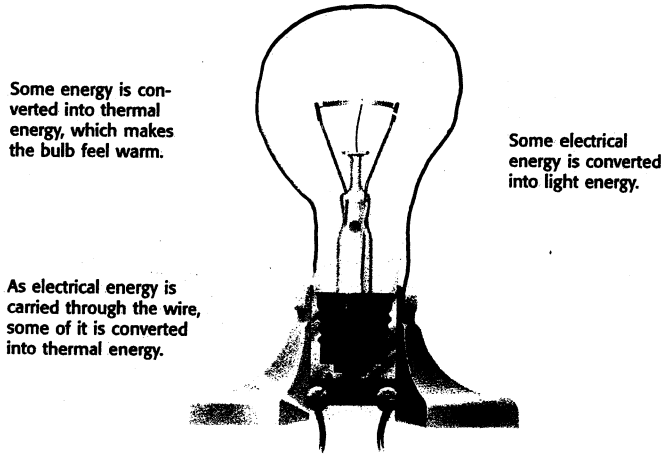
law of conservation of energy the law that states that energy cannot be created or destroyed but can be changed from one form to another

Law of Conservation of Energy

Energy is conserved in all cases. Because no exception to this rule has been found, this rule is described as a law. According to the **law of conservation of energy,** energy cannot be created or destroyed. The total amount of energy in a closed system is always the same. As **Figure 2** shows, energy can change from one form to another. But all of the different forms of energy in a system always add up to the same total amount of energy. It does not matter how many energy conversions take place.

Reading Check **Why is the conservation of energy considered a scientific law?** *(See the Appendix for answers to Reading Checks.)*

Figure 2 Energy Conservation in a Light Bulb



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