Workshop 4
Energy in Cycles

Energy plays a crucial role in cycles that we see around us every day, from the bouncing of a ball to the vibration of a guitar string to the motion of a person running or walking. But how can these cycles be understood in the language of physics? It turns out that all of these phenomena, and many others, are examples of the periodic conversion of kinetic to potential energy and back again within a system.

A pendulum is one well-known example of an energy cycle, and this workshop session looks closely at its motion to see how it relates to other systems that involve energy cycles, such as springs, guitar strings, and U-shaped ramps. Students explore both how energy cycles diminish when energy is dissipated by friction and how they can add energy to a cycle to keep it going. Their thinking is compared to scientists' views. The ideas discussed are examined in a variety of contexts, including interviews on playgrounds, a visit to a bell tower, and an interview with the curator of a collection of antique pendulum clocks.

On-Site Activities

Getting Ready (30 minutes)

The Ups and Downs of Energy Conservation

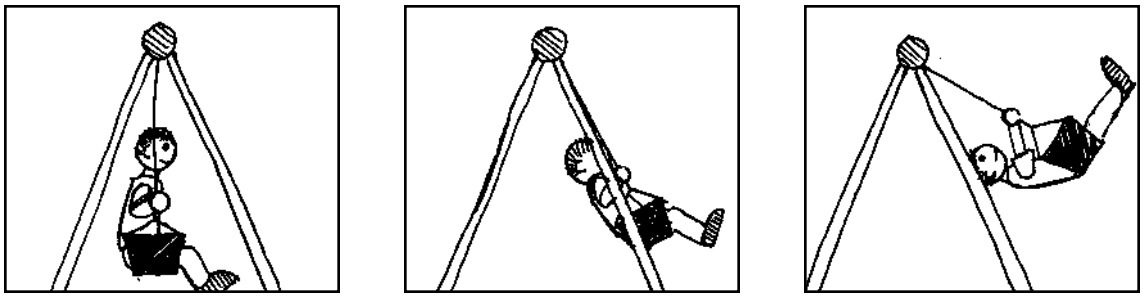
1. Discuss the energy transformations in the toys that you were asked to bring to the session. Which has the most transformations? The fewest?

2. An object gains kinetic energy (KE) when its speed increases and gains gravitational potential energy (PE) when its distance above the ground increases (and its speed decreases). In the following pictures:

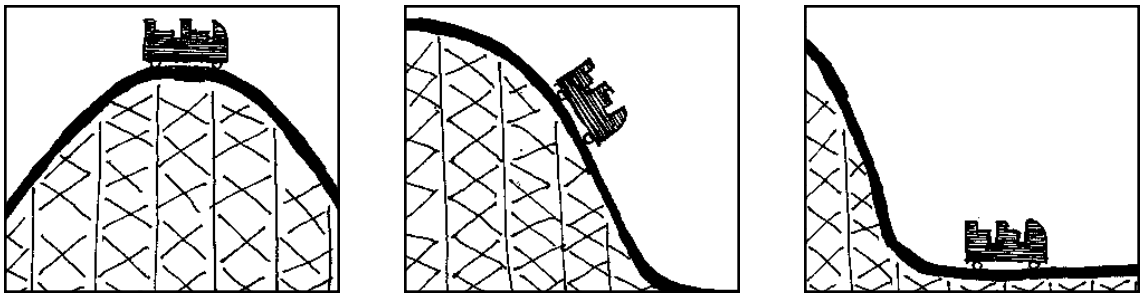
   a. label the spot or spots where the kinetic energy is the greatest.

   b. label the spot or spots where the gravitational potential energy is the greatest.

Discuss your answers with the rest of the group.

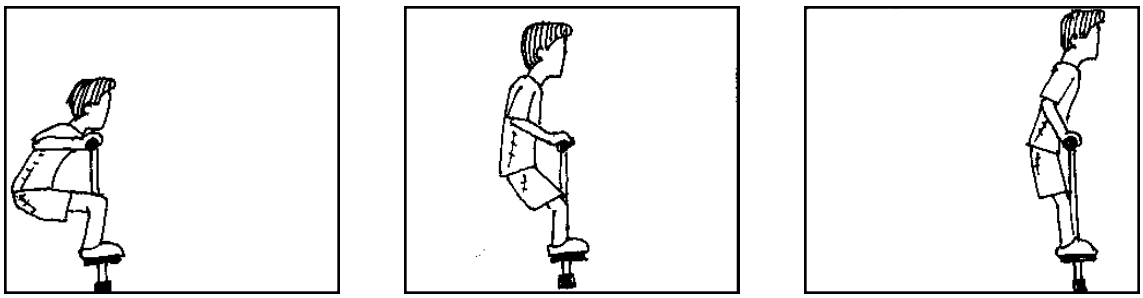


Child on a swing



Roller coaster

On-Site Activities, cont'd.



Boy on a pogo stick

Watch the Video (60 minutes)

As you watch the video, consider the following questions and answers:

1. What happens to energy when an object swings, bounces, or oscillates?

   When an object swings, bounces, or oscillates back and forth, energy is repeatedly converted from potential to kinetic energy and back again.

2. What are some everyday examples of energy cycles? ***Examples of energy cycles include pendulums, bouncing balls, springs, vibrating strings, and people running and walking.***

3. Why do most energy cycles diminish over time? ***In each cycle, some of the energy leaves the system as heat, sound, or other forms of energy. The total amount of energy remains the same, but some of it is no longer available to sustain the cycle.***

4. How can we add energy to maintain a cycle? ***Energy impulses have to be timed—and forces applied in the right direction—so that they add to the total energy in the cycle instead of reducing it.***

Going Further (30 minutes)

Energy Goes Along for the Ride

1. Break up into two groups. One group should discuss how to construct an amusement park ride that *minimizes* changes in gravitational potential energy, but is still fun. The other group should discuss how they would construct an amusement park ride that *maximizes* changes in gravitational potential energy to provide a safe, fun ride for its passengers.

2. After you have decided upon your designs, get together to compare the two rides.

   a. What things are the same?

   b. What things are different?

   c. What kind of ride would you prefer? Why?