Energy Pendulum	Grade 5 - Earth & Space Systems

Lesson Plan

Safety Notes: Be careful not to let the pendulum hit you.

Description

In this lesson, students will make a pendulum and watch it swing to investigate potential and kinetic energy.

Materials

- String, rope or yarn
- Something to hang the string, rope or yarn off of (a ruler taped to a table or held down with books; a curtain rod, etc)
- 2 **solid** objects of different weights that can be tied up.
- Optional: a water bottle

Science Background

This experiment looks at energy. Energy can't be created or destroyed, but can change from one form to another. **Kinetic energy** is the energy of movement. Anything that moves has kinetic energy. **Potential energy** is energy that can make things happen. For example, when you lift an object, it has the **potential** to fall, due to gravity, so it has **gravitational potential energy**. If you let it fall, it is moving: it has **kinetic energy.** If you tie a string to the object, and let it swing back and forth, it trades **kinetic** and **potential energy** as it goes up and down. We call that a pendulum.

Activity Procedure

Setup: Tie one end of the string to the lighter object. Fix the other end securely to something high enough to let the object swing as a pendulum, and sturdy enough to hold it in place. Use your imagination!

1. Lift the pendulum and drop it so it swings in a straight line. Keep your hand at the level you drop the pendulum from. Record your observations and answer the questions on your handout.
2. Untie the string from the first object, and repeat with the heavier object. Lift the pendulum to the same height as you did the first object. Record your observations and answer the questions on your handout.
3. To answer the bonus questions on the handout, try using a partly-full water bottle as the weight on your pendulum.

Debrief

When you lift the pendulum, you are giving it gravitational potential energy. When it falls, it gains kinetic energy-- until it swings back up. Then it falls again. Energy cannot be created or destroyed, so if the pendulum stops swinging, it has to have gone somewhere else. Can you guess where? Use the handout to investigate where the energy is going.

Energy Pendulum | Grade 5 - Earth and Space Systems

Handout

Questions:

1. If you drop the pendulum without pushing, does it ever get any higher than when you dropped it?

2. Where in its swing is the pendulum the fastest?

3. Where in its swing is the pendulum the slowest?

4. When does it have the most potential energy?

5. When does it have the most kinetic energy?

6. How many swings does it take for the pendulum to stop moving?

7. Try again with the heavier object. Does it move any faster when you drop it from the same height?

8. How many swings does it take for the heavier pendulum to stop moving?

9. Which do you think had more energy to start, the heavier or the lighter pendulum?

10. Where do you think the energy went? Can you think of a way to test that? Describe an experiment that could test your hypothesis.

BONUS: Try the experiment again with a water bottle, filled to be as heavy as your heaviest object. How many swings does the bottle take to stop moving?

BONUS 2: What do you think the water is doing in the bottle that could take away kinetic energy and slow down the pendulum?

Energy Pendulum | Grade 5 - Earth and Space Systems

Handout

Questions:

1. If you drop the pendulum without pushing, does it ever get any higher than when you dropped it?
   No, because then it would have more potential energy than when it started, and the pendulum has no way of gaining energy.

2. Where in its swing is the pendulum the fastest?
   At the bottom of the swing/in the middle.

3. Where in its swing is the pendulum the slowest?
   At the top/end of the swing.

4. When does it have the most potential energy?
   At the highest point, at the top of the swing.

5. When does it have the most kinetic energy?
   At the lowest point, when it is fastest.

6. How many swings does it take for the pendulum to stop moving?
   This will vary.

7. Try again with the heavier object. Does it move any faster when you drop it from the same height?
   No.

8. How many swings does it take for the heavier pendulum to stop moving?
   This will vary, but should be more than the first one.

9. Which do you think had more energy to start, the heavier or the lighter pendulum?
   The heavier pendulum.

10. Where do you think the energy went?. Can you think of a way to test that? Describe an experiment that could test your hypothesis.
    Answers will vary, the point is to show evidence of scientific thinking. The "right" answer is that Kinetic energy was transferred to air molecules because the pendulum has to push them out of its way as it swings. To test this, you can try putting a 'sail' on the pendulum.

BONUS: Try it with a water bottle, filled to be as heavy as your heaviest object. How many swings does the bottle take to stop moving?
This will vary, but it will be fewer than the heavy object.

BONUS 2: What do you think the water is doing in the bottle that could take away kinetic energy and slow down the pendulum?
The water is sloshing. The sloshing is a form of kinetic energy that gets trapped in the water instead of the swing of the pendulum.