

Roller coasters

Overview: Marbles can teach us a lot about energy, especially while they zoom down a custom-made coaster track! Today you'll learn how energy can be transferred from kinetic energy to potential energy and back again.

What to Learn: You'll discover important concepts about how potential energy is converted into motion energy.

Materials

- Marbles
- Masking tape
- 3/4" pipe foam insulation (NOT neoprene and NOT the kind with built-in adhesive tape)

Lab Time

1. Check your insulation tube. One side should be cut, so turn the tubing over and cut the other side, so you have two halves of the tubing.
2. To join the track, put tape on the inside and backside of the tubing.
3. To make a loop or corkscrew, use a third piece of tape to wrap all the way around the tube.
4. Tape one end of the tube as high as you can reach on the wall to start the marble rolling. Once you're ready, release the marble and watch it fly down the track!

Observations

Where is the marble going the fastest?

When does the marble seem to slow down?

Why doesn't the marble fly off the track when it goes upside-down?

To make the roller coasters, you'll need foam pipe insulation, which is sold by the six-foot increments at the hardware store. You'll be slicing them in half lengthwise, so each piece makes twelve feet of track. It comes in all sizes, so bring your marbles when you select the size. The 3/4" size fits most marbles, but if you're using ball bearings or shooter marbles, try those out at the store. (At the very least you'll get smiles and interest from the hardware store sales people.) Cut most of the track lengthwise (the hard way) with scissors. You'll find it is already sliced on one side, so this makes your task easier. Leave a few pieces uncut to become "tunnels" for later roller coasters.

Reading

You might have heard how energy cannot be created or destroyed, but it can be transferred or transformed (if you haven't, that's okay – you'll pick it up while doing this activity). We will observe two types of energy here today: kinetic energy, and potential energy.

Kinetic energy is the energy of motion that an object has when it is pushed, flies, or falls.

Potential energy is the energy that an object has in relation to the system in which it exists. To imagine this, pretend that you are shooting a bow and arrow. When you pull your arm back, the arrow doesn't have kinetic energy, because it isn't moving. Yet the system has given it a lot of energy so that when you release your fingers, the arrow will fly fast and far.

Roller coasters are a prime example of energy transfer: You start at the top of a big hill at low speeds (high gravitational potential energy), then race down a slope at breakneck speed (potential transforming into kinetic) until you bottom out and enter a loop (highest kinetic energy, lowest potential energy). At the top of the loop, your speed slows (increasing your potential energy), but then you speed up again and you zoom near the bottom exit of the loop (increasing your kinetic energy), and you're off again!

Exercises Answer the questions below:

1. What type of energy does a marble have while flying down the track of a roller coaster?
2. What type of energy does the marble have when you are holding it at the top of the track?
3. At the top of a camel back hill, which is higher for the marble, kinetic or potential energy?
4. At the top of an inverted loop, which energy is higher, kinetic or potential energy?

Answers to Exercises: Roller Coasters

1. What type of energy does a marble have while flying down the track of a roller coaster? (kinetic)
2. What type of energy does the marble have when you are holding it at the top of the track? (potential)
3. At the top of a camel back hill, which is higher for the marble, kinetic or potential energy? (potential)
4. At the top of an inverted loop, which energy is higher, kinetic or potential energy? (potential)