

Lesson 2 Marble Roller Coasters

Note: If potential and kinetic energy is to be emphasized, it is best to do this lesson in two class periods with exploration of specified websites between class periods. If this lesson is used primarily as a fun building project, one class session is enough.

Objectives: Students will experience many of the basic physics and engineering concepts inherent in roller coasters.

Students will demonstrate the concepts of potential and kinetic energy.

Materials: For each student:

- ∞ Pencil
- ∞ Journal
- ∞ Pre-packaged materials for home connection (optional)

For each group of 3-4 students:

- ∞ 2 pieces of pipe insulation
- ∞ Masking tape
- ∞ Rubber bands
- ∞ Plastic rods from Lesson 1
- ∞ 1 marble
- ∞ Pack of colored markers
- ∞ Glue stick
- ∞ Scissors

For the class:

- ∞ Pictures of roller coasters (Handout: Roller Coaster Pictures)
- ∞ Optional: Computer with the following websites available:
 - Funderstanding Roller Coasters website
<http://www.funderstanding.com/k12/coaster/> (a Java applet that allows students to play with parameters on a roller coaster).
 - How Stuff Works website – section on roller coasters
<http://science.howstuffworks.com/roller-coaster2.htm>

Sponge: Students do roller coaster pretest. Optional: glue picture from previous session into journals.

Initial

Discussion: If previous Home Connection was used, have students tell about the projects they did with their families using straws and paper clips.

Present problem. Students write problem definition and constraints into their journals.

Problem: Build a marble roller coaster with at least one vertical loop.

Constraints: Cannot cut or damage pipe insulation; roller coaster must stand on its own; marble cannot fall out; cannot use force to start marble.

Define the terms potential energy and kinetic energy.

Project: Build a roller coaster for marbles using materials provided. Roller coaster must have at least one vertical loop.

Constraints:

- ∞ Marble must stay on track.
- ∞ Roller coaster must stand on its own without help.
- ∞ Marble must be placed in track without extra force.
- ∞ Materials may not be destroyed.



Vocabulary: Potential energy – The energy of a particle or system of particles derived from position, or condition, rather than motion.

Kinetic energy – The energy possessed by a body because of its motion.

Final

Discussion: Students walk around the room to see all the projects. Those who want to can share their experience with the entire group.

Students show where the marble has potential energy and where it has kinetic energy.

Ask students the following questions:

- ∞ How did you solve the problem?
- ∞ What worked well?
- ∞ What didn't work?
- ∞ What kinds of problems occurred? What did you do to solve the problems?

Students write in their journals what worked and what didn't work. Encourage them to draw pictures of their roller coasters and to point out where the marble has potential energy and where it has kinetic energy.

Clean up: Take apart roller coasters. Be careful when removing tape from pipe insulation – tape removal can tear the insulation.

Extension: To make this into a two day challenge, on the first day, students make a roller coaster with one vertical loop. Students do the roller coaster pretest before starting. Between the first and second day of class, allow students to explore the applications following websites: <http://www.funderstanding.com/k12/coaster/> and <http://science.howstuffworks.com/roller-coaster.htm>

On the second day, students make a roller coaster with two vertical loops. Students explain potential and kinetic energy. Students do the roller coaster posttest and have a discussion on potential and kinetic energy.

Credits: Based on:
<http://thetech.org/education/downloads/donline/physicsRollercoasters.pdf>