Design a Roller Coaster – Teacher Notes

Purpose: To study the transfer of energy from potential to kinetic energy and the combination of forces in a roller coaster.

Materials:

- **Foam Pipe Insulation** – This is the dark gray insulation that is used to keep pipes from freezing and can be found at home improvement stores or Wal-Mart. These should be about six feet long with an inner diameter of ¾ to ⅞ inches. Cut the foam in half lengthwise. You will need 2 lengths of insulation per group. You may want to have extra lengths available for creative designs.
- **Marbles** – one per group (may add a bigger marble later for extension)
- **Masking Tape** – You will use several pieces per group. It might be a good idea to have a roll of tape for each group. You don't know how much each group will use.
- Meter stick, for measurement only

Procedure: (The 7th grade teachers will be a good source of information since this lab has been in the 7th grade curriculum)

1. Do the demonstration (next page).
2. Divide the students into groups.
3. Explain to the students that they will be designing a roller coaster that has to meet a certain criteria. Go through the directions and rubric.
4. Provide the students with the materials.

Criteria

ALL ROLLER COASTERS:

- Must have 2 hills (15 points each) **OR** 1 loop and 1 hill (15 points each)
- Marble MUST complete the track (30 points)

BONUS POINTS ARE AWARED FOR:

- Extra hills (5 points each)
- Extra loops (10 points each)

Teacher's Key

- Label your roller coaster's final design with a "P" at every point where potential energy is found.

Answers may vary, but there should be a "P" at the high points of the track.

- Label your roller coaster's final design with a "K" at every point where kinetic energy is found.

Answers may vary, but there should be a "K" on the up hills, down hills, and straight-aways where the marble was in motion (the slopes).

- Draw a square next to the point of greatest potential energy?

At the highest point

- Draw a star next to the point of greatest kinetic energy?

Right before the bottom of the tallest downhill after the highest point.

Rollercoaster

*****demonstration*****

Purpose: have students identify that the height of an object is related to the distance an object can travel. This is an example of the energy conversion from potential to kinetic energy.
Background: Kinetic and potential energy, forces and motion of objects, unbalanced forces.
Practice: http://www.fossweb.com/modulesK-2/BalanceandMotion/activities/rollercoaster.html

Materials:

6ft foam pipe insulation tubing (can be purchased at home improvement stores or Wal-Mart)
Masking tape
Small marble
Stand or side of the wall
Meter Stick

Procedures:

1. Cut foam insulation in half length wise to create (2) 6ft long "tracks"
2. Tape the 2 halves together to create one long track
3. Attach one end of the track to a stand or side of the wall.
4. Attach the "track" with a 40 cm drop, rolling into the first hill that is approx. 80 cm tall.
5. Using a marble as the "car" let the marble roll down the track.
6. Have students observe results

Discussion Questions:

What happened?
Why didn't the marble make it up the next hill?
What can we do so that the marble will make it to the end of the track? (have class state in if/then hypothesis form)
What are the variables (dependent/independent)? *("DRY MIX" = Dependent responding Y axis, Manipulated independent X axis)*
Make modifications according to student suggestions. Once the marble makes it to the end of the track discuss the changes that were made and why some worked and some didn't.

Rollercoaster Design

Problem: Where is the greatest amount of potential and kinetic energy in a roller coaster?

Materials:

- 2 lengths of Foam Pipe Insulation (a 6 feet = 182.88 centimeter length cut lengthwise in half)
- Masking Tape
- Marble
- Meter stick, for measurement only

Procedure:

Build a roller coaster that has 2 hills **OR** 1 loop and 1 hill (15 points each). The marble must complete the course (20 points). You may only use the provided materials. Your original design must be one of the above choices.

After you have successfully completed the basic project and your teacher has approved your design, you may modify it for extra credit points: additional hills, loops, and/or your marble stopping within 15 cm off the end.

1. Discuss with your group how you would like your coaster to look and sketch the basic design of your coaster (on a blank page).
2. Use the materials and build your coaster.
3. Once your coaster is complete, try it out using your marble.
4. Make adjustments to your design to fulfill the requirements.
5. Draw your final design; include measurements of all the heights (5 points).
6. Label your roller coaster's final design with a kinetic energy and potential energy Label each twice. (20 points).
7. Label your roller coaster's final design showing where there is friction and acceleration (10 points)
8. Once your roller coaster works and is complete, have your teacher grade your design.
9. Write the conclusion (10 points).
10. Everyone turns in a lab page and staple together neatly and in a well-organized fashion.

Design a Roller Coaster

Names in your group: Class:_____

(YOU)_____

_____

_____

_____

Design Sketch

Design a Roller Coaster

Problem:
Where is the greatest amount of potential and kinetic energy in a roller coaster?

Conclusion:
(Claim)

(Evidence)

(Reasoning)

Rubric

	Possible Points	Grade
First hill	10	
Second hill or loop	15	
Marble completed course	20	
Labeled Potential Energy-2	10	
Labeled Kinetic Energy-2	10	
Labeled friction and acceleration –once each	10	
Cooperative attitude, responsible behaviors, lab safety rules followed	10	
Measurements	5	
Conclusion	10	
Total	100	
EXTRA Points		
Hill		
Marble stopping within 15 cm of the end of track		