Roller Coasters

EIGHTH GRADE PROJECT
2011

Due Monday, January 24, 2011

The Roller Coaster Project

What you need to know:
1. How to work with formulas and solve for an unknown;
2. How to work with velocity and acceleration formulas;
3. How to work cooperatively in a group when building the roller coaster;
4. How to use your materials wisely and carefully;
5. How to create graphs and charts using Excel.

How to do it

Build A Roller Coaster: Part I – Lab Activity

Materials:

- One 6 ft. length of 1" diameter semi-split foam pipe insulation
- meter stick or tape measure
- scissors and masking tape
- marble
- stopwatch to mark time
- Calculator, if needed

Procedure:

1. Using your fingers, find the slit in the pipe insulation and open it down the middle.
2. Using the meter stick, measure across the opening of the pipe and find the midpoint. Mark the midpoint with a marker or piece of tape.
3. Using the end of the scissors and the straight edge of the meter stick as a guide, score a line down the center for the length of the pipe insulation. Be as accurate as possible so that your tracks are the same width.
4. Use your scissors to cut along the scored line. You will now have two "tracks" for your roller coaster.

Part I – Lab Activity #1: Relationship between Height and Velocity

Demonstrate the relationship between the height of the roller coaster ramp and velocity in this activity.

Materials

1 roller coaster track
Masking tape
Marble
Stopwatch
Tape measure or meter stick
Calculator, if needed

With one partner holding the top of the ramp, have another partner measure a height of 20 cm.

Holding the ramp at that height, measure a 2-meter length from the end of the ramp onto the floor. Mark that distance with masking tape. One partner should be at the end of the tape ready to catch the marble. See diagram below.

The fourth partner is responsible for timing the marble once it leaves the end of the ramp and travels the 2-meter distance on the floor. Time the number of seconds the marble travels the 2-meter distance and record this value on the recording sheet.

Repeat this procedure for the rest of the recording sheet. Turn in your completed recording sheet to your teacher.

Part 1: Lab Activity #2: Loops, Curves, and Velocity

This lab activity is similar to Lab Activity #1, except that your ramp will no longer be straight.

Using masking tape and any other structures for support, create a ramp that has one banked curve coming out of one loop.

Follow the same procedures as for Lab Activity #1, timing the marble as it travels across the 2-meter distance off the track on the floor. Turn in the completed recording sheet.

Part 2: Independent Project

In **Part I**, you have learned to create some of the basic features of roller coasters. In the experiments, you have learned that there is a relationship between the heights of ramps and the speed of the “car” or marble. You also learned that certain structures such as loops, banked curves, or corkscrew curves challenge the ability of the marble to stay on the track.

In **Part 2**, you and your group will build another coaster according to the guidelines below. You may use the tracks you used in the lab activities or you may purchase additional materials, if you wish.

Your Roller Coaster must conform to the following:

- Free standing: Create a platform or other support for the coaster. It should stand by itself.
- Structure: The coaster must have one or two loops, and at least one banked curve or one corkscrew curve.
- Create a name and logo for your coaster.
- The coaster should work with a marble as the “car”.

Work together as a design team. Video or photograph your work as a team. **Every member must be visible on the video or photos** as contributing something important to the roller coaster. Demonstrate how your coaster works.

Present your findings to the class in an oral presentation. You may use PowerPoint. You may show your DVD to the class.

Your oral presentation MUST include:

- Discuss what problems you encountered and how you decided to solve them.
- What are your roller coaster’s best features?
- Demonstrate how your coaster works.
- What were some of the challenges you faced in building your coaster and how did you overcome those challenges?
- Calculate the speed for three trials. Use the 2-meter distance in the same way as in Lab Activities #1 and #2. Calculate the average speed. Be sure to record your data on the recording sheet.

GRADING:

The following rubric will explain how your project is graded. Remember, a project is always a reflection of your very best work and effort.

Categories	*4*	*3*	*2*	*1*
Work Product	Project is complete and on time. Group worked independently with minimal supervision.	Project is mostly complete and on time. Teacher intervention rarely needed.	Project is incomplete OR project is one day late. Teacher intervention needed to settle disagreements or to negotiate a completion time.	Project is incomplete and late OR more than 1 day late. Teacher intervention was required to set a completion time.
Structure	Roller coaster is freestanding. Creative use of materials to create an elaborate structure; Coaster has many interesting features such as height, loops, and turns. Roller coaster works smoothly and reliably.	Roller coaster may or may not be freestanding. The structure is basic using the materials provided. Coaster has one or two interesting features. Roller coaster works most of the time.	Roller coaster may or may not be free standing. The structure is very basic with no additional loops or curves. Roller coaster works most of the time.	Roller coaster may or may not be freestanding. The structure appears unstable and "last minute". No additional creative input evident; Roller coaster may or may not work.
Data Collection	Recording sheet is included in the project. Calculations are accurate. Relationships between loops/speed and banked curve/speed are explained in detail and supported by experimental data.	Recording sheet is included in the project. Calculations are accurate. Relationships between loops/speed and banked curve/speed are complete.	Recording sheet is included in the project. Most of the calculations are accurate. Relationships between loops/speed and banked curve/speed are incomplete.	Recording sheet is incomplete and or late. Some of the calculations are accurate. No explanation is given for the relationships of loops/speed and banked curve/speed.
Oral Presentation	Creatively presented using multimedia (i.e. DVD or PowerPoint).All the group members shared equally in the labor and in the presentation. Students demonstrated a deep understanding of their structure and were able to answer questions from the class.	Well presented using poster board, pictures, or a PowerPoint; All the group members shared equally in labor and presentation. Students demonstrate a good understanding of their structure and most of the group members were able to answer questions form the class.	Simply presented using poster board and pictures; Not everyone spoke in the presentation. Students demonstrated a basic understanding of their structure and were not prepared to answer questions from the class.	Simply presented using very little in the way of pictures or other media; One speaker was dominant. The group appeared unprepared. Understanding of their structure was not evident.

Lab Activity #1
Data Recording Sheet

This is the recording sheet for Lab Activity #1. Record all your experimental data here. Answer the questions based on your experimental results.

Note: To calculate the velocity, you divide the distance by the time. The distance in each of your trials is **2 meters** (**NOT the height of the ramp**).

Trial	Ramp Height	Time (seconds)	Velocity (m/s)
1	40 cm		
2	60 cm		
3	100 cm		
			Average:

Questions

1. Before beginning the lab activity, predict how the velocity may be affected by the height of the ramp.

2. How does the height of the ramp affect the marble's velocity? Use your data to support your statement.

3. **Using Excel**, graph the relationship between height and velocity. Identify the independent variable on the x-axis. Identify the dependent variable on the y-axis. Using your graph, predict what the velocity would be if the ramp height were 150 cm. **You will upload your graph on our wikispace.**

Lab Activity #2: Loops and Banked Curves
Data Recording Sheet

Trial	Ramp Height	Time (seconds)	Velocity (m/s)
1	40 cm		
2	60 cm		
3	100 cm		

Questions

4. Before beginning the lab activity, predict how the velocity may be affected by the loop and banked curve of the ramp.

5. How does the height of the ramp affect the marble's velocity? Does the loop or banked curve affect the velocity? How does your data in this activity compare with the data in Lab Activity #1? Use your data to support your statement. Attach a separate sheet of paper if needed.

6. **Using Excel**, graph the relationship between height and velocity. Identify the independent variable on the x-axis. Identify the dependent variable on the y-axis. Using your graph, predict what the velocity would be if the ramp height were 150 cm. **Upload your graph onto the wikispace.**

Part 2: Independent Project Recording Sheet

Trial	Time (seconds)	Velocity (m/s)
1		
2		
3		
		Average:

Questions:

1. What were some special features of your rollercoaster?

2. What were some of the unique challenges you and your team had to overcome to make your coaster work?

Reflection
3-2-1

List 3 things you learned from this project:

1.

2.

3.

List 2 questions or ideas for further exploration about roller coasters.

1.

2.

List 1 thought, comment, suggestion, or question you may have regarding this project.