Physics
Roller Coaster Activity

Purpose

This activity applies math, geometry and physics to make riding roller coasters **even more fun**! Each student will be required to complete all parts of this assignment and answer **all** questions **and show all of your work** (attach additional pages if necessary) in order to get academic credit for having fun. **The completed assignment must be turned in to your driver by the time you arrive back at school**.

Equipment Needed

Each **student** should bring **all** of the following with them to the park:

- Scientific calculator
- Mechanics formulae handout (from Q2)
- Pencil
- Scratch paper

Each **lab group** should bring **all** of the following to the park:

- Tape measure
- Inclinometer
- Accelerometer
- Stopwatch

Before Arriving at the Park

1. Calculate your own weight in newtons (Hint: 1 kg weighs approximately 2.2 pounds on the Earth's surface, and I'm sure you remember what g is.)

2. Come up with a method for estimating the height of a roller coaster using your tape measure, inclinometer and geometry (**hints**: measure the length of your paces, similar triangles, tangent, law of sines). **Test out your method** using reasonable guesses for the measurements you'll be making in the field. **Note**: It may not be possible to get very close to the point directly below the top of the coaster, so your method may **need** to use the law of sines.

Before Riding the Coaster

3. Pick a roller coaster to analyze. Enter the name of the ride here: _____

4. Use geometry to estimate the height of the first hill. Compare your answer to the height claimed by the park and calculate your percentage error.

5. Estimate your personal GPE at top of first hill. **Note**: if bottom of first hill is significantly above ground, then adjust height to give GPE with respect to bottom of first hill.

6. Estimate the length of a section of track near the bottom of the first hill (minimum of 50 meters). Measure the time the coaster takes to cover this distance as accurately as possible (2 significant figures). Calculate the average coaster speed over this section of track. Compare your answer to the speed claimed by the park and calculate your percentage error.

7. Calculate your personal KE near the bottom of the first hill.

8. Assuming your KE was essentially zero at top of first hill, what is the difference between your GPE at the top and your KE at the bottom? What happened to that portion of your GPE? What percentage of your total GPE does this represent?

9. Review the entire coaster track carefully and predict the location where you will feel heaviest as well as another location where you will feel the lightest. Choose a second pair of locations on the ride where you predict that you will experience the next heaviest and next lightest feeling. Describe the four locations you chose below **in the order they appear in the ride** and predict the G-force for each (**Note**: the G-force you're feeling now is 1.0g):

Location	Description	Predicted G-force
Location 1		
Location 2		
Location 3		
Location 4		

While Riding the Coaster

10. **IMPORTANT! Always attach the accelerometer to your wrist so that it won't fly away during the ride**! Keep the accelerometer oriented perpendicular to your seat at all times (perhaps by resting it on something like your knee). Conduct at least 2 trials (i.e., take at least 2 rides) noting the G-force readings at the four locations you chose in **Step 9**. Try to estimate the G-forces to 2 significant figures (e.g., "1.8g") and work together to remember all four readings until the end of the ride. Write down the four readings in the following table **immediately after** each ride:

Location	Trial 1 G-force	Trial 2 G-force	Trial 3 G-force	Trial 4 G-force	Average G-force
Location 1					
Location 2					
Location 3					
Location 4					

11. Calculate the force applied to your rear end by the seat at each of these four locations, using the average G-forces you calculated above. If the force applied by the seat was zero, calculate the force applied by your shoulder harness on your shoulders instead.

12. How could this activity/assignment be modified to achieve **both** of my goals: having fun and deepening your understanding of physics?