

# Accelerometers on Roller Coasters

This worksheet is designed to accompany electronic data collection on a roller coaster. It can be used with Vernier or PASCO data collection equipment. Note that while we call the basic unit an "accelerometer", it actually responds to forces. Data you obtain in  $\text{m/s}^2$  can also be expressed in  $\text{N/kg}$ , emphasizing the force nature of the measurement.

## Before you ride

- The name of the ride you went on is: \_\_\_\_\_
- Make a sketch of the ride profile on the back of this page. Mark the approximate position of a passenger every 10 seconds on your sketch. (This can be worked out either before or after riding.)
- In the space below, describe your data collection strategy for this ride. Will you collect data for the entire ride, or concentrate on a specific portion? Which portion? How long does it take to go through the ride or that part of the ride, and how many data points would you like to acquire? Which axis or axes of acceleration will you focus on in your analysis?
  
- Secure the instruments in a fixed orientation relative to your body. The three axes relative to your body are straight ahead (longitudinal), directly to the side (lateral) and/or straight up and down (vertical). If an axis is not used, don't circle it.
  - Accelerometer X (#1): **longitudinal - lateral - vertical** (circle one)
  - Accelerometer Y (#2): **longitudinal - lateral - vertical** (circle one)
  - Accelerometer Z (#3): **longitudinal - lateral - vertical** (circle one)

## When you ride

When you reach the place on the ride where you want to begin collecting data, press the [Start/Stop] button once. If collecting for the whole ride, start collecting just as you begin to move. For some equipment, you will need to press the [Start/Stop] button to cease collecting once you're finished.

## After you ride

Return the data collection unit back to the Electronic Data Center, EDC, or to your teacher. Download the data so it can be saved. If possible, print the graphs of your Force (acceleration) vs. Time and Altitude vs. Time so you can do onsite analysis or even analysis after returning to school.

## Questions:

Use additional pages to answer the questions that follow:

1. On the graph of Altitude vs. Time, indicate 5 places that stand out with circled letters. Describe where each is on the ride and what is happening to the rider at each place.

- For each of the 5 locations you chose in Step 1, locate the corresponding points in the Force (acceleration) graphs. Describe significant forces you recorded in each location. For example, your statement might be, "I felt an upward (vertical) force of 35 N/kg and virtually no lateral or longitudinal force."
- For each of these 5 locations, explain why you felt the forces you did, accounting for the direction of the forces and the magnitudes.
- The larger the acceleration, the larger the net force acting on your body. Are the places where the instruments recorded the largest values the same places you felt the largest forces? Why or why not?

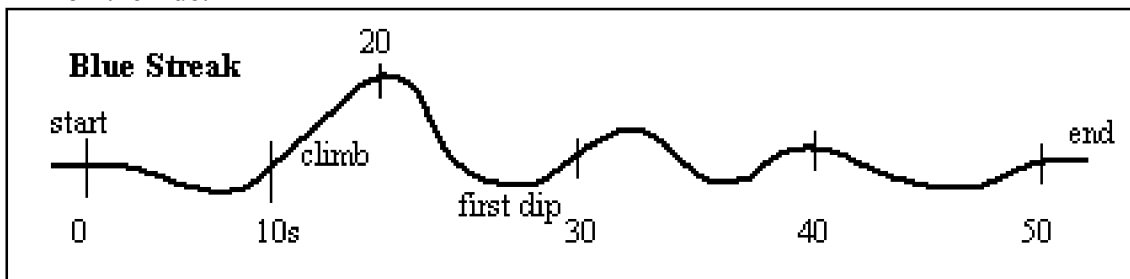
### Sample Data Table

	Location & Motion	Forces	Explanation
A			

The spaces need to be much larger than indicated here.

### Ride Profile:

- In this area, sketch the shape of the ride if it were stretched out in a straight line. Sketch loops as loops. Make other notations that will help you to decode your data later on.
- Indicate on your ride profile the approximate location of a passenger every 10 seconds. This will enable you to match up your accelerometer data with your location on the ride.



Example: A simple roller coaster for toddlers that makes a single loop around a closed track.