GREAT BEAR

The constellation, Ursa Major (the Great Bear), can be identified in the night sky by the seven bright stars which most of us know as the Big Dipper. GREAT BEAR the ride, is also characterized by seven major features along with an awesome growl that adds to the excitement of the ride. Two of these features, the 360° rolls, will be focus of this activity.

As you stand on the ground by the Wave Swinger, you can observe the first roll that GREAT BEAR undergoes. Walk over by the SOOPERDOOPERLOOPER to see the second roll the riders experience on GREAT BEAR. In both cases, the riders' bodies move in a circular path around the track as they move forward. The seat of the ride provides a centripetal force to keep the rider moving in the circular path.

Questions:

1. What is the maximum amount of centripetal acceleration the rider experiences within the rolls?

2. Will the centripetal acceleration in the first roll be greater than, less than, or equal to the acceleration in the second roll?

Prediction:

1. The maximum amount of centripetal acceleration the rider feels will be: (choose one)
   1 g   2 g's   3 g's   4 g's

2. The centripetal acceleration in the first roll will be
   Greater Than   Less Than   Equal To   the acceleration in the second roll. (choose one)

Try It!!: We'll answer both questions at the the same time, first by doing calculations from the ground and then, by using the accelerometer while on the ride.

From the ground: Stand in a position where you can observe GREAT BEAR's first roll. Measure the time it takes for the front seats to make the complete roll (from the time it is hanging straight down as it starts the roll until it is hanging straight down again at the end of the roll). Take this reading at least five times and record the average of your measurements below. Follow the same procedure for the second roll and record your results below.

Time interval for the first roll:_________s   Time interval for the second roll:_________s

Next we'll calculate the tangential speed, v, and centripetal acceleration, a_c, for the two rolls.

NOTE: Use the Radius of Roll 1 (2.1 meters).

First Roll:

$$v = 2 \bullet \pi \ r_1/T = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ m/s}$$

$$a_c = v^2/r_1 = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ m/s}^2 \div 9.8 \text{ m/s}^2 = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ g's}$$

NOTE: Use the Radius of Roll 2 (2.1 meters)

Second Roll:

$$v = 2 \bullet \pi \ r_2/T = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ m/s}$$

$$a_c = v^2/r_2 = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ m/s}^2 \div 9.8 \text{ m/s}^2 = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ g's}$$

On the Ride: Use the vertical accelerometer to measure the maximum acceleration you feel while in the two rolls. Remember to place the rubber band restraint around your wrist to keep the accelerometer from falling - it could be very dangerous to others on the ride! Have your partner yell “NOW!” just before you are starting each roll so you can keep your eyes on the accelerometer. You may have to do this activity more than once!! Record your maximum readings for the rolls below.

Maximum Acceleration for Roll 1:____________ g’s

Maximum Acceleration for Roll 2:____________ g’s

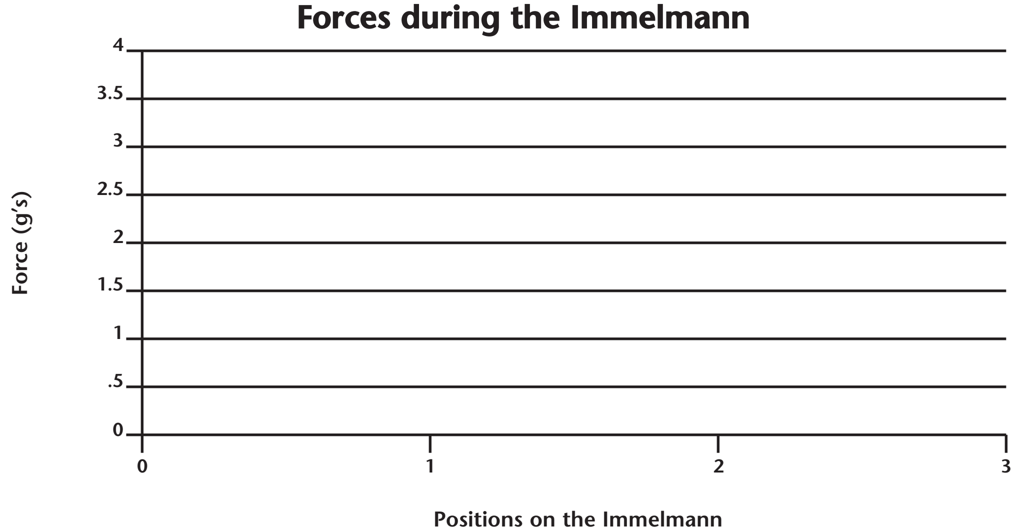
Observations/Conclusions:

1. How do the accelerations for the two rolls compare? Use your calculations and the accelerometer readings to back up your answers.

2. How do the calculations for Roll 1 compare to the maximum accelerometer readings for Roll 1? Should they be equal? If not, why? (HINT: Check part II B for the Pirate activity.)

Graph It!!: Just after going through the GREAT BEAR loop, you travel around a structure called an Immelmann. Draw a rough **bar graph** that represents the vertical forces (with respect to your seat) that you feel as you move upward (Position 1 on the graph), across the top (Position 2), then downward (Position 3) in the Immelmann.

Forces during the Immelmann



Engineering Specifications:

Radius of the first roll (Roll 1): 2.1 m

Radius of the second roll (Roll 2): 2.1 m