Activity 2 - Push or Pull – Adding Vectors

Activity/Demo

In this activity, you will be using a cart pulled by a weight to demonstrate Newton's Second Law of Motion: **F = ma**. The "**force**" provided by the weight will "**accelerate**" the "**mass**" of the cart.

Activity/Demo:

1. Enter the following table in your lab notebook (be sure to use a ruler!):

Interval	Starting point	Ending point	Distance (cm)
I			
II			
III			

Your instructor will inform you where each interval begins and ends. Record those intervals here and in your lab notebook.

2. Enter the following table in your lab notebook also (Again: be sure to use a ruler!):

Interval	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Average (s)	Distance (cm)	Velocity (cm/s)
I						
II						
III						

3. Next you need to setup the pulley, cart, and "track" that the cart will be traveling along.

a) Attach the pulley to the edge of the table/counter/board. Tighten the pulley in place using the set screw.

b) Attach a string to the cart. The string should be about a meter in length.

c) Make a loop on the end of the string opposite the cart. Hanging a 10 g weight on that loop to hold the string in place, position the string in the pulley with the weight hanging over the edge, and pull the cart back on the table/counter as far back as it will go with the string still going over the pulley and the weight still hanging over the edge of the table/counter.

d) Put a 200 g weight in the cart.

e) Place a piece of tape on the table/counter next to where the cart's front axle is. This is your "0 cm" point. You will always start your cart from this point.

f) Using a meter stick, measure off every 10 cm with a piece of tape. Use a small piece of tape, and place it on the table/counter ***next*** to where the cart will be traveling, ***not*** under where the wheels will travel (the tape will actually slow the cart down if it has to drive over the tape marks).

4. You and your partner will now be recording how long it takes your cart to travel the various intervals. One person will control the cart, and one person will be timing with the stopwatch. Be sure one person is ready to catch the car so that it doesn't collide with the pulley or go over the edge of the counter/table.
   a) Line the car up with the 0 cm point. When the timer is ready, let go of the cart. Press the start button on the stopwatch as the car passes the starting point for the first interval. Press the stop button as the car passes the ending point for the first interval. Do this for a couple trial runs to get a feel for how the procedure will go. If the time it takes for the car to travel the first interval is slow (three seconds or more), try decreasing the weight in the cart and/or increasing the weight hanging from the pulley, until you get a time less than two seconds for the first interval. If the time is too fast (less than half a second), then add some weight to the cart and/or decrease the weight hanging from the pulley. Be sure to record which weights you're using (both on the pulley *and* in the cart) in your notebook.
   b) When you get to a reasonable speed, time how long it takes for the cart to travel Interval I. Repeat this procedure three times. Record each of the times in your notebook.
   c) Repeat this procedure (take three readings) for each of the three intervals.
5. Calculate the average times and speeds in your data table for each of your intervals.
6. What can you say about the speed as your cart travels further along the track? Is the car getting slower? Faster? Maintaining the same speed? What do we call this change in speed?
7. Newton's Second Law of Motion says that if there is "acceleration", there must also be a "force" involved. What is supplying the force in this experiment to accelerate the cart?
8. Write down the equation that summarizes Newton's Second Law of Motion. What two variables in that equation could we change to increase the acceleration in the case of our cart? Describe specifically what you would change in this experiment to adjust each of those two variables.