**Newton’s 2nd Law Inquiry Activity**



***Treat the qualitative portion (#1-8) as Pre-Lab questions in your formal write-up in your notebooks***

Materials: Cart, track, pulley, hanging mass, fishing line, spring scale, triple beam balance, extra masses

Purpose: To investigate Newton’s second law of motion

Using the set-up above, conduct several trials and answer the following questions qualitatively.

1. What force is causing the system to accelerate?
2. How many objects in the system are accelerating?
3. If more than one object is accelerating, how do the rates of accelerations between the objects compare?
4. Does your answer to #2 change your answer in #1? (*Remember: an object cannot apply a force to itself!*)
5. How many objects in the system are experiencing a force?
6. Are the objects in the system experiencing the same force? (*Think about Newton’s 2nd law!*)
7. Vary the amount of mass on the hanging mass, but keep the mass of the cart constant. What happens to the acceleration of the system as the hanging mass changes? Make a graph that shows this relationship.
8. Keep the hanging mass constant, but add mass to the cart. What happens to the acceleration of the system as the mass of the cart changes? Make a graph that shows this relationship.

Now, let’s explore this relationship quantitatively.

First, we’ll look at different forces being applied to the same amount of mass.

1. Use the spring scale to determine the force that is applied to the system in each trial. (*Refer to your answer in #1!*)
2. Use the triple beam balance to determine the mass that is being accelerated in the system. (*Refer to your answer in #2! What units should you use for the mass?*)
3. Experimentally determine the acceleration of the cart-mass system. (*Kinematics!*)
4. Move masses from one object to the other in the system in order to maintain the total mass in the system.
5. Repeat for a combination of five different forces on the same amount of mass in the system. (*How would you minimize error?*)
6. Graph the Force vs. Acceleration, make a line of best fit, and determine the slope of the line of best fit.
7. What does the slope of a Force vs. Acceleration graph equal? Find the percent error between the slope of your line of best fit and the corresponding value used in these trials.

Next, we’ll look at the same amount of force being applied to different amounts of mass in the system.

1. Use the spring scale to determine the force being applied to the system in each trial.
2. Use the triple beam balance to determine the mass that is being accelerated in the system.
3. Experimentally determine the acceleration of the cart-mass system.
4. Change the amount of mass being accelerated in the system, but do so without changing the force accelerating the system.
5. Repeat for a combination of five different masses being accelerated by the same amount of force.
6. Graph the Acceleration vs. Mass and make a smooth curve line.