Physics

Newton's 2nd Law – Playing with Acceleration

Name:_____ Block:_____

We have already explored Newton's 1st (inertia) and 3rd (action/reaction) Laws. Today you will be exploring Newton's 2nd Law of Motion. According to Newton's 2nd Law force, mass, and acceleration are related; you will explore that relationship. First we will look at how force affects acceleration and then we will consider how mass affects acceleration.

Materials

- Balloon
- Tape
- Straw
- String (long & short)
- Scissors
- Stop Watch
- Meter Stick
- Weights
- Marker

Procedure

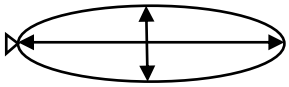
Part 1: Force and Acceleration

1. Define force.

2. Using a balloon, how can you manipulate the amount of force?

3. Define acceleration. What is the formula you have already learned to calculate acceleration?

4. Tape one end of the long string to the wall and have a group member hold the other end. Do not pull on the string; it needs to be taut but still connected to the wall.
5. Blow up your balloon and pinch the mouth closed. Use the short string and meter stick to measure the circumference of the balloon (in meters) and record this data in Table 1. You will need to measure around the balloon short and long directions, then average these two measurements (see diagram).



6. Tape the straw to your balloon so the mouth of the balloon points in the same direction as one of the ends of the straw.
7. Thread the straw onto the long string. Remember, you still have the balloon pinched closed.
8. Have your timekeeper announce when to release the balloon. You need to measure the time and distance the balloon travels along the string. Record this data in Table 1.
9. Repeat steps 5-8 twice more, blowing your balloon up to different circumferences.
10. Use the data to calculate the balloon's acceleration during each trial: $a= 2d/t^2$ where a=acceleration, d=distance traveled, and t=time.
11. Graph the circumference (independent) vs. acceleration (dependent).
12. Based on your data, write a statement that compares force (related to the circumference of the balloon) with the acceleration.

Table 1

Trial	Circumference (m)	Distance (m)	Time (s)	Acceleration (m/s^2)
1				
2				
3				

Part 2: Mass and Acceleration

1. Define mass.

2. Based on the materials given, how can you change the mass?

3. Use the electronic balance to determine the mass of your balloon and record it in Table 2. Using the same setup as in Part 1, prep your balloon "rocket" for your first trial. NOTE: It is VERY important that you blow your balloon up to the same size for each trial!
4. Have your timekeeper announce when to release the balloon. You need to measure the time and distance the balloon travels along the string. Record this data in Table 2.
5. Add mass to the system by adding two or three washers to the FRONT end of the straw. Make sure they are secure and will not fall off. Use the electronic balance to determine the new mass and record it in Table 2.
6. Repeat step 4.
7. Add additional mass to the system by adding two or three more washers to the FRONT end of the straw. Make sure they are secure and will not fall off. Use the electronic balance to determine the new mass and record it in Table 2.
8. Repeat step 4.
9. Use the data to calculate the balloon's acceleration during each trial: $a= 2d/t^2$ where a=acceleration, d=distance traveled, and t=time.
10. Graph the mass (independent) vs. acceleration (dependent).
11. Based on your data, write a statement that compares mass with the acceleration.

Table 2

Trial	Mass (g)	Distance (m)	Time (s)	Acceleration(m/s^2)
1				
2				
3				