GODDARD LAB STATIONS: NEWTON'S 1ST LAW OF MOTION

FIRST NAME: ______________________________ DATE: ________________ PERIOD: ___

LAST NAME: ______________________________ **POINT VALUE: 50 points** (10 per station)

Until the end of the Middles Ages, the common European understanding of objects and motion was based on the ideas of the Greek philosopher Aristotle (384-322 BC). Aristotle believed that all objects had their natural place of rest in the universe, and would progress toward those states. Rocks fell to Earth because their natural place was land; smoke rose to the sky because its natural place was the sky. Once an object reached its natural state, it would remain at rest. When slid along the ground, rocks would eventually stop moving because their natural state on Earth was rest.

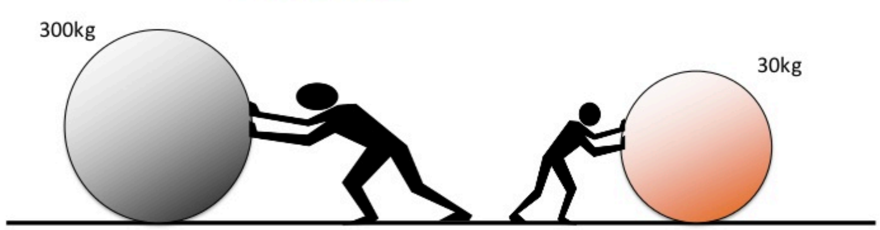
Isaac Newton (1642-1727), basing his work on ideas already in place by Galileo Galilei (1564-1642) and René Descartes (1596-1650), developed his *First Law of Motion*, also called the law of inertia. Rather than believing an object's natural state was at rest, Newton proposed that an object in motion with a constant velocity tends to stay in motion maintaining that velocity unless acted upon by an external force. **If an object is at the rest, the object tends to stay at rest unless acted upon by an external force.** Inertia may be defined as the tendency of an object to resist change in motion. Inertia is directly related to mass — the greater the mass of an object, the greater its inertia. The reason a rock comes to rest when slid across the ground is not that its natural state is rest, but rather another force is acting upon it—in this case, friction from the ground and the air. In the absence of all forces—e.g., a rock thrown in the vacuum of space—the rock would remain in constant motion. *[Flinn Scientific, Inc.]*

Newton's First Law of Motion: Inertia

An object will not change its motion unless acted on by an unbalanced force.

- *if it is at rest, it will stay at rest*
- *if it is in motion, it will remain at the same velocity*

Objects with a **greater mass** have **more inertia**.
It takes **more force** to change their motion.



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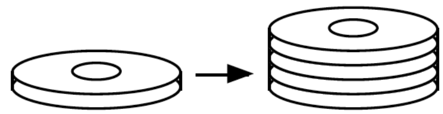
LAB 1: WACKY WASHERS

Newton's First Law of Motion

What is Newton's First Law of Motion?

Part A: Wacky Washers

To prepare for this experiment, stack 4 washers one on top of the other so that you form a tower of washers. Place the stack of washers on top of your textbook or on the floor so that you have a smooth, slick surface.



Aim one washer at the bottom of the stack of four washers and give it a good hard flick with your finger or hand. What happens?

Flick a stack of two washers into a stack of four washers. What happens?

Flick a stack of four washers into a stack of four washers. What happens?

Explain your observations in terms of Newton's 1st Law.

LAB 2: THE COIN DROP

MATERIALS: Glass, Index Card, Pennies

EXPERIMENT

1 Lay the card on top of the glass. Have one edge of the card a little beyond the rim so you can give that edge a good flick without smacking your fingertip on the glass.

2 Place a penny on top of the card so it's centered over the glass.

3 Use a finger to flick an edge of the notecard. You want to flick the card directly from the **side**. (Don't flick it downwards or upwards by hitting from above or below the card.)

Watch the penny drop straight into the glass!

HOW DOES IT WORK

Sir Isaac Newton has had a lock on this outcome since the 17th Century. The First Law of Motion (there are three) says something like this: "An object at rest stays at rest unless an outside force is strong enough to make it move. An object that is moving, will continue moving at the same speed in a straight line unless an outside force is strong enough to speed it up, slow it down, stop it, or cause it to change direction."

In the case of the Coin Drop activity, the penny is at rest sitting on top of the card. Watch it as long as you like but, on it's own, the penny will not move from that spot. When you flick the card out from under the penny, you allow gravity (an outside force) to act on it and drop it into the glass. The bottom of the glass stops the penny from falling. However, if the penny were a lot heavier (had more mass) and were falling much faster, it could go right through the glass (and probably the table supporting it, too).

So, why doesn't the penny take off when the card is flicked? If you flick the card correctly, it simply slides out from between the glass and the penny. There's not enough friction from the card to take the penny with it.

Lab Results:

Number of Pennies	Number of Flicks	Observations

https://www.stevespanglerscience.com/lab/experiments/the-coin-drop-sick-science/

<u>LAB 3:</u> LEARNING ABOUT NEWTON'S LAW WITH JENGA!

"It's the classic block-stacking, stack-crashing game of JENGA! How will you stack up against the law of gravity? Stack the wooden blocks in a sturdy tower, then take turns pulling out blocks one by one until the whole stack crashes down. Is your hand steady enough to pull out the last block before the tower collapses? If it is, you'll win at JENGA!" http://www.jenga.com/

Jenga is a game based Newton's 1st Law of Motion (The Law of Inertia), gravity and friction. Continue removing one block at a time while not upsetting any of the other blocks. Eventually the tower will become unbalanced and topple over.

What did you observe? Write 5-8 complete legible sentences with proper punctuation.

LAB 4: DOMINO DASH

Domino Dash (1st Law of Motion)

Newton's First Law of Motion, also called the Law of Inertia, states that objects at rest stay at rest and objects in motion will remain in motion until pushed or pulled by a force. When objects are not moving they are said to be at rest.

Average speed is the rate of motion calculated by dividing the total distance traveled by the total amount of time it takes to travel that distance or S = d / t

Materials			
Domino Set	Meter Stick	Stopwatch	Calculator

Procedure:

1. Set up all dominoes with equal spacing between them. Set the dominoes in a straight line to cause a chain reaction when the first domino is pushed.
2. Measure the length of the domino row. Record this data in the table.
3. Use the stopwatch to measure the time it takes for the entire row of dominoes to fall after the first domino is tipped until the last is down. Record the data.
4. Calculate the speed at which the dominoes fell. Record the data.
5. Set up another row of a different length. Repeat steps 2 – 4.
6. Repeat for a total of five different trials.

Speed of Falling Dominoes		
Length of domino row (cm)	Time to fall (sec)	Speed of falling dominoes (cm/sec)

LAB 5: NEWTON'S FIRST LAW - AIR PUCKS

Materials:

- Air pucks, 2
- Balloons, 2
- Clothespins (to temporary seal the balloon), 2
- Pennies or washers

Safety Precautions:

- Latex balloons may be an allergen. Wear safety glasses. Please follow all normal laboratory safety guidelines. Aggressive or excessive pushing of the pucks is not permitted.

Procedure:

1. Inflate one balloon and twist (but do not tie) the neck shut to prevent air from escaping. Alternatively, use a clothespin to seal the neck of the balloon.
2. Without allowing the neck to untwist, carefully stretch the mouth of the balloon over the stem of the air puck assembly. ***Note: The balloon may tear if overstretched.***
3. To levitate the puck, untwist the neck of the balloon.
4. Gently push the puck to accelerate it over any smooth surface. Record observations of the movement of the puck on the worksheet. Note: If using a surface such as a lab table, do not allow the puck to fall off.
5. Repeat steps 1-4 if necessary to make detailed observations.
6. Repeat steps 1-3.
7. Allow the puck to hover motionless until the balloon deflates. Record observations on the worksheet.
8. Repeat steps 1-3 with two balloons and two air pucks.
9. Gently push one puck toward a levitating stationary puck so the two pucks collide.
10. Record observations of the collision on the the worksheet. Describe the observations in terms of Newton's first law of motion.
11. Increase the mass of the stationary puck using pennies or washers, and repeat steps 8-10.

LAB 5: NEWTON'S FIRST LAW - AIR PUCKS *CONTINUED*

Data Table and Observations:

	Newton's First Law of Motion
Velocity of one puck (Step 4)	
Non-accelerated puck (Step 7)	
One puck colliding with a stationary puck (Step 9)	
Stationary weighted puck collision (Step 11)	

Lab Questions:

1. In your own words, define the following terms.

    A. Force:

    ____

    ____

    B. Inertia

    ____

    ____

    C. Acceleration

    ____

    ____

2. How can you tell whether or not all forces acting on the non-accelerated puck in step 7 are balanced?

    ____

    ____

    ____

    ____

3. Imagine an air puck with a limitless air supply—i.e., a level air table of infinite length.

   A. Once the puck was pushed, would it continue to travel forever?

   ____

   ____

   ____

   B. Why or why not?

   ____

   ____

   ____

4. List three more examples of Newton's First Law in action in everyday life.

   A. ____

   ____

   B. ____

   ____

   C. ____

   ____