Identifying Newton's Laws Worksheet

9/04

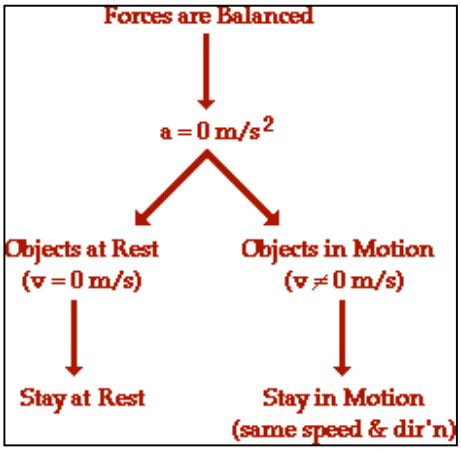
Integrated Science 1

Redwood High School **Name:** **Per:**

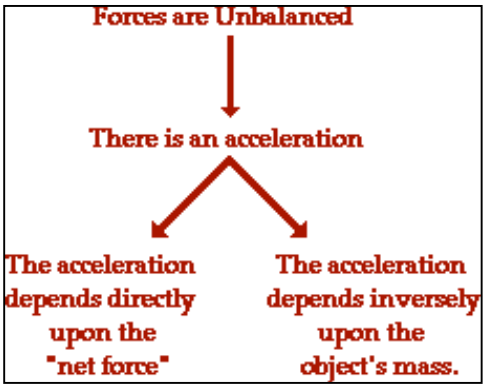
Directions: Carefully read the information below about Newton's Laws. Using this information and information presented in the 'Newton's Laws PowerPoint Presentation' answer the questions on the backside of this sheet. Then, state if the question is an example of Newton's first, second or third law of motion.

Relevance to Bottle Rocket Lab: During the upcoming experiment we will be shooting "rockets" containing different amounts of water into the air using the same pressure, environmental conditions and rocket launching mechanism. Consider Newton's Laws of Motion when making predictions about the outcomes of this experiment. *Hint: What variable are you changing when you add more water to the rocket? How does this effect the rockets change of rate of speed (acceleration) in the air? Which forces are acting on the rocket when it slows down and/or changes direction?*

■ **Newton's first law of motion** predicts the behavior of objects for which all existing forces are balanced. The first law – sometimes referred to as the "law of inertia" – states that if the forces acting upon an object are balanced, then the acceleration of that object will be 0 m/s^2. Objects at equilibrium (the condition in which all forces balance) will not accelerate. According to Newton, an object will only accelerate if there is a net or unbalanced force acting upon it. The presence of an unbalanced force will accelerate an object – changing its speed, its direction, or both.



■ **Newton's second law of motion** pertains to the behavior of objects for which all existing forces are not balanced. The second law states that the acceleration of an object is dependent upon two variables:



- the net force acting upon the object
- the mass of the object

The acceleration of an object depends directly upon the net force acting upon the object, and inversely upon the mass of the object. As the net force increases, so will the object's acceleration. However, as the mass of the object increases, its acceleration will decrease. In terms of an equation, the net force is equal to the product of the object's mass and its acceleration.

- Force = Mass X Acceleration

■ **Newton's third law of motion**

A force is a push or a pull upon an object which results from its interaction with another object. According to Newton, whenever objects A and B interact with each other, they exert forces upon each other. When you sit in your chair, your body exerts a downward force on the chair and the chair exerts an upward force on your body. There are two forces resulting from this interaction — a force on the chair and a force on your body. These two forces are called action and reaction forces and are the subject of Newton's third law of motion. Formally stated, Newton's third law is: "*For every action, there is an equal and opposite reaction.*" The statement means that in every interaction, there is a pair of forces acting on the two interacting objects. The *size* of the force on the first object equals the size of the force on the second object. The *direction* of the force on the first object is opposite to the direction of the force on the second object. Forces always come in pairs – equal and opposite action-reaction force pairs.

Which Law Is It?

Answer the following questions and then state if the question is an example of Newton's first, second or third law of motion

1. If you walk on a log that is floating in the water, the log moves backward. Why is this so?_____

2. Heavier football players tend to play on the front line. Why?_____

3. Many automobile passengers have suffered neck injuries when struck by cars from behind. How does Newton's law of inertia apply here? How do headrests help to guard against this type of injury? _____

4. Suppose you place a ball in the middle of a wagon, and then accelerate the wagon forward. Describe the motion of the ball relative to (a) the ground and (b) the wagon._____

5. Suppose you are standing on a skateboard and shoot a paintball gun at your friend. Which direction relative to your friend will you move? Explain. _____

6. Two closed containers look the same, but one is packed with lead and the other with a few feathers. How could you determine which had more mass if you and the containers were orbiting in a weightless condition in outer space?_____

7. If you are sitting in a bus that is traveling along a straight, level road at 100 km/hr., you are traveling at 100 km/hr too. (a) If you hold an apple over your head, how fast is it moving relative to the road? (b) Relative to you? (c) If you drop the apple, does it still have the same horizontal motion? Explain._____

8. A rocket fired from its launching pad not only picks up speed, but its acceleration increases significantly as firing continues. Why is this so? (hint: 90% of the mass and weight of a newly launched rocket is fuel)_____