

Lesson One: Newton's First Law

Introduction: The first thing we will do is study Isaac Newton's three laws of motion. Isaac Newton was an English physicist and mathematician who is recognized as one of the most influential scientists of all time. His laws of motion formed the basis for the science of mechanics. Nearly everything you experience in daily life that involves motion can be explained by Newton's laws and nearly everything you use is designed with these laws in mind.

Newton's First Law: *Law of Inertia* - An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

Another way to think of this is that objects tend to "keep on doing what they're doing." This is why Newton's First Law is also called the Law of Inertia. **Inertia** is the tendency of an object to resist changes in its state of motion.

State of Motion and Inertia

Again, inertia is the tendency of an object to resist changes in its state of motion. But what do you mean by *state of motion*? The state of motion of an object is defined by its **velocity**, which can be thought of as speed with a direction. For example, an object at rest has zero velocity, and in the absence of an unbalanced force Newton's First Law tells us that it will continue to have zero velocity. The **acceleration** of an object tells you how its velocity changes. Therefore we can also think of inertia as the tendency of an object to resist acceleration.

Mass and Inertia

All objects have inertia, no matter what object you are dealing with it will resist changes

to its state of motion. Some objects have more of a tendency to resist changes than others. Specifically, inertia varies with mass. *The more inertia that an object has, the more mass that it has. The less inertia that an object has, the less mass that it has.*

Balanced and Unbalanced Forces

Recall in the Newton's First Law that we say an object stays the same unless an unbalanced force acts upon it. What do we mean by that?

An object experienced balanced force is said to be at **equilibrium**. Let's consider two examples:

Example 1: Your favorite (because it's safe to assume you have more than one right?) math text book is lying on a table. It does not move because the forces on the book are balanced. The table pushes upward on the book and gravity pulls downward on the book.

Example 2: Suppose you are standing up. You will be at equilibrium. The floor pushes upward on you and the gravity pulls you downward. The two forces balance each other out.

Now let's talk briefly about unbalanced forces. As the name suggests, this is what happens when an object is *not* at equilibrium. Specifically, an object is said to be action upon by an **unbalanced force** only when there is an individual force that is *not* being balanced by a force of equal magnitude and in the opposite direction. Let's consider a tweak to the first example above.

Example 3: Suppose your favorite math book is sitting on a table and is sliding to the left. The table is still pushing up and gravity is still pulling down but there is a force that is making it slide to the left. However the friction from the table will eventually make the book slow down. The push to the left and the friction on the book from the table are unbalanced forces.