

Learning Objectives

- 1) Know Newton's first law of motion (law of inertia): an object in motion tends to stay in motion, unless acted on by and outside and unbalanced force; and an object at rest tends to stay at rest, unless acted upon by an outside force. One must exert force on object to overcome its inertia and cause it to move, change speed, change direction, or stop moving. The amount of inertia an object possesses never changes, unless the mass of an object shifts. The greater the mass of an object, the more inertia it has. Consequently, more force is required to conquer the object's inertia. Two examples of outside forces are gravity and friction.
- 2) Understand what gravity is and how it interacts with objects. Gravity is a force that pulls objects toward each other. All objects have gravitational force. The strength of the gravitational force is dependent upon the amount of mass an object possesses. Earth, for example, has a very heavy mass; therefore, it has a very strong gravitational pull. A baseball has a lot less mass than the earth; thus, a ball possesses a lot less gravity and is easier to move than the earth. The baseball will fall toward the earth, rather than the earth falling toward the ball. The gravitational force of the earth is able to keep objects, including people, from flying off the earth. The closer two objects are to each other, the greater the gravitational pull between them. For example, if two objects of the same mass, one out in space and the other resting on the earth's surface, are weighed, the object on earth will weigh more than the object in space. This phenomenon occurs because weight is the measurement of how much the earth's gravity is pulling on an object. Since the ball out in space is far away from the earth, the gravitational pull of the earth has only a small effect on the ball.
- 3) Comprehend the concepts of velocity and acceleration. Velocity is the speed of an object plus the direction in which it is traveling (the car headed **east at 60 mph**). Acceleration is the measure of the change of velocity of an object over time. Negative acceleration, or deceleration, is the measure how much an object slows over time. Outside forces, like gravity and friction, cause acceleration and deceleration.
- 4) Know the concepts important to understanding Newton's second law of motion. This law can be expressed by the formula: $F=MA$ (F =force, M =mass, A =acceleration).

When enough force is applied to an object to overcome the object's inertia, the object will move, move faster, slow, stop, or change direction. When the mass of an object changes, the force required to move or accelerate it also changes. For example, more force is required to move objects with more mass than objects with less mass. In addition, the more force that is applied to an object, the faster it will move (it will accelerate).

- 5) Understand Newton's third law of motion: for every action, there is an equal and opposite reaction. This means that the force of motion comes in two's (for every push, there is a pull). Swimming and walking are two excellent examples of Newton's third law in action. When one swims, his or her arms push against the water, and the water pushes against the person's arms to move him or her forward. When one walks, his or her feet push against the pavement; conversely, the pavement pushes in the opposite direction against the person's feet to move him or her forward.

Suggested Activities

- 1) Before viewing the video:
 - a) Throw a ball into the air and catch it. Roll it across the room. Place a book on a table. Blow up a balloon and let the air out. Ask the students what happened when you did the preceding activities and why those things happened. Watch the video to learn more.
- 2) After viewing the video:
 - a) Get two toy cars, one heavier than the other; a board and the block to make a ramp; and chalk for marking. Allow the two cars to roll down the ramp one at a time. Use the chalk to mark the distance to which each car traveled. Try this several times to see if the same result occurs. Ask students which laws of motion are involved in this experiment and how they were demonstrated.
 - b) Hold a marble and a rock with significantly greater mass than the marble in each hand. Ask the class which object they believe will reach the ground first. From the same height release the two objects at the same time. The objects will hit the ground at the same time regardless of their mass and size because all objects fall to the earth at an acceleration of 9.8 meters per second squared. Ask the

class to explain what happened. Was their original hypothesis supported by this experiment?

- c) Take the class to the playground and have a student hit a baseball with a bat. What happens to the ball? Why does it travel? Have the class explain the relevance of this experiment to Newton's third law of motion.
- d) Have students devise experiments to demonstrate the laws of motion.

Vocabulary

Acceleration — A change in velocity

Force — A push or a pull

Friction — A force that acts on two objects when their surfaces come in contact; this force can slow or stop a moving object; rough surfaces cause more friction and smooth surfaces cause less friction

Gravity — A force that pulls two objects toward each other

Inertia — A property of matter where an object remains at rest or continues in uniform motion unless acted upon by an outside force

Mass — The amount of material in an object

Speed — Rate of an object's motion

Velocity — Speed plus direction

Weight — The measurement of how much the gravity of the earth is pulling on an object

