

Learning Objectives

- 1) Understand that a force is a push or a pull on an object that causes a change in its motion. For example, a nuclear explosion pushes matter apart with tremendous power; the moon pulls on the Earth's oceans, causing low and high tides; and a magnet pulls iron filings toward it.
- 2) Realize that forces give every object its shape; one can alter the shape of an object by exerting force on the object. For example, one can mold a cube of clay into a sphere by simply applying forces to the clay.
- 3) Know about the different types of forces that exist.
 - a) Friction is the force that opposes the movement between objects. Since the surfaces of objects are not perfectly smooth, they interlock, causing friction; friction occurs whenever two surfaces are in contact. Friction causes moving objects to slow down, and, eventually, come to a stop.
 - b) Gravity is the force that attracts objects to each other as a result of their mass. Gravity is what keeps objects on the earth; it is also what keeps the planets in the solar system orbiting around the sun.
 - c) Electromagnetism is the force produced by the interaction between electricity and magnets; it is the force used to generate electricity; to store memory in computers, and to produce pictures on a television screen.
 - d) The nuclear force is the strongest force that exists in the universe; yet it exists only inside atoms. Nuclear force keeps all of the particles that make up an atom "glued" together. The structure of an atom consists of a nucleus, which contains positively charged protons and neutral neutrons; surrounding the nucleus are negatively charged electrons. The aforementioned particles attract, or pull toward each other and repel, or push away from each other; this attraction and repulsion between the particles within an atom is known as the nuclear force.
- 4) Understand Newton's three laws of motion regarding forces in the world around us.
 - a) The first law of motion states that an object at rest will remain at rest, and an object in motion at a constant speed will remain in motion at a constant speed until some outside (unbalanced) force is applied to it. For example, a ball resting on the floor is not moving because all of the forces acting on it are balanced. If the ball is pushed, the forces are no longer balanced, and it begins to roll. Friction opposes the ball's movement, causing it to stop rolling. If it were not for friction, the ball would roll at a constant speed forever (assuming the path is flat and contains no obstructions). Newton's first law is also known as the Law of Inertia. Inertia is the property of matter that causes an object to resist a change in motion; the more mass an object has, the greater its inertia.
 - b) Newton's second law of motion is expressed in the mathematical formula: force = mass x acceleration ($F=MA$). Acceleration is any change in an object's direction or rate of speed, so even though an object is slowing down, it is still considered to be accelerating. Newton's second law says that an object's acceleration depends on its mass (inertia) and the force that is applied to it (rewrite equation to: $A=F÷M$). For example, a billiard ball will have a greater acceleration than a bowling ball if the same amount of force is applied to both; so objects with greater inertia require greater force inputs to accelerate them. It is also important to realize that objects will accelerate only in the same direction as the force that was applied.
 - c) Newton's third law of motion states that for every action, there is an equal and opposite reaction. This law explains why a rocket is propelled into space. When the thrusters on a rocket ignite, the force from the burning fuel pushes down, and the rocket is pushed with the same force in the opposite direction, upward.
 - d) Pressure describes the force that is exerted on a given area; it is calculated using the equation: $Pressure=Force÷Area$. Knives apply force over a small area, which allows for a greater pressure that can cut through things. It would be extremely difficult to cut an apple with a blunt object because the force would be distributed over a much larger area. It is extremely

important to note that because air has mass, it exerts pressure on all objects.

Suggested Activities

- 1) Experiment with Friction. Before watching the video, give each student a wood block (can be different sizes), newspaper, towel, sand, waxed paper, aluminum foil, etc. Have students push their blocks across each of the surfaces (can be placed on floor or tabletop). Record which surface allows the block to move farther. Compare with different sized blocks. Ask students to comment on why the blocks moved farther on some surfaces than on others. View the video and review the experiment with your students.
- 2) After viewing the video, give students the task of naming different kinds of forces. Have them record each force they notice throughout their day. Have students share their lists with the class and discuss.

Vocabulary

Acceleration – Any change in an object's direction or rate of speed

Electromagnetism – The force produced by the interaction between electricity and magnets

Friction – The force that opposes the movement between objects

Gravity – The force that attracts objects to each other as a result of their mass

Inertia – The property of matter that causes an object to resist a change in motion

Mass – The amount of matter an object contains, or a measure of an object's inertia

Nuclear Force – The attraction and repulsion between the particles inside an atom (the strongest of the fundamental forces)

Pressure – A measure of the force exerted on a given area

