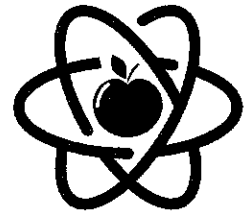


# PS2: Motion and Stability: Forces and Interactions

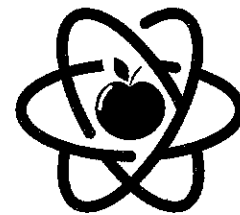
## PS2.A: Forces and Motions



K	3rd Grade	6th Grade	8th Grade	Physical Science	Chemistry	Physics
<p>Pushes and pulls can have different strengths and directions.</p> <p>Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.</p>	<p>Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)</p>	<p>The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.</p>	<p>For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).</p> <p>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change.</p>	<p>Newton's second law accurately predicts changes in the motion of macroscopic objects.</p> <p>Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.</p>	<p>Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.</p>	<p>Newton's second law accurately predicts changes in the motion of macroscopic objects.</p> <p>Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.</p>

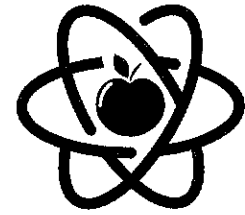
# PS2: Motion and Stability: Forces and Interactions

## PS2.A: Forces and Motions [continued]



K	3rd Grade	6th Grade	8th Grade	Physical Science	Chemistry	Physics
	<p>The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)</p>		<p>The greater the mass of the object, the greater the force needed to achieve the same change in motion.</p> <p>For any given object, a larger force causes a larger change in motion.</p>	<p>If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.</p>		<p>If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.</p>

**PS2: Motion and Stability:  
Forces and Interactions**  
**PS2.B: Types of Interactions**



K	3rd Grade	5th Grade	6th Grade	7th Grade	Physical Science	Chemistry	Physics
When objects touch or collide, they push on one another and can change motion.	Objects in Contact exert forces on each other.  Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.  Forces that act at a distance (electric, magnetic, and gravitational)	Gravitational forces are always attractive.  There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.	Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.  Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.  Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.  Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.