



**Physical Science Pacing Guide**  
**Cause and Effect in Force and Motion**

**Crosscutting Concepts:** Cause and Effect; Systems and systems models; Stability and Change; Energy and Matter

**Topics:** Force and Motion; Newton’s Laws; Gravitational force; Simple Machines; Energy of movement

6-week Instructional Segment

Anchoring Phenomenon	GSE	Sample Lessons	Disciplinary Core Ideas	Science and Engineering Practices	Instructional Notes
<p>Overall: Car or rockets and how they stop, start and/or change direction.</p> <p>Lesson Level: When a car starts or stops, a person or object will initially move in the opposite direction of the car</p>	SPS8 a, b, c, d	<b>Car Stop – Seatbelts and Airbags</b>	<p><u>A Framework for K-12 Science Education:</u>  <i>By the end of grade 12</i>  <b>PS2.A: Forces and Motion</b></p> <ul style="list-style-type: none"> <li>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).</li> <li>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.</li> <li>The greater the mass of the object, the greater the force needed to achieve the same change in motion.</li> <li>For any given object, a larger force causes a larger change in motion.</li> <li>Forces on an object can also change its shape or orientation.</li> <li>All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame.</li> <li>Momentum is defined for a particular frame of reference; it is</li> </ul>	<p>Planning and carrying out investigations</p> <p>Constructing explanations</p> <p>Analyzing and interpreting data</p> <p>Use mathematical and computational thinking</p>	<p>Additional topic, focus, and phenomena notes can be found within the instructional segment.</p> <p><b>Safety</b> Take careful safety precautions when measuring and observing velocity, acceleration and other phenomena. Proper eyewear and other personal protective equipment should be used particularly if you will be firing or launching any objects.</p> <p>By the end of this unit, students are using the following language in their speaking and writing during EXPLAIN or ELABORATE.</p> <ul style="list-style-type: none"> <li>Force</li> <li>Mass</li> <li>Motion</li> <li>Newton’s Laws</li> <li>Gravitational force</li> <li>Work</li> </ul>

			<p>the mass times the velocity of the object. In any system, total momentum is always conserved.</p> <p><b>SPS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"> <li>• 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—for example, Earth and the sun. Long-range gravitational interactions govern the evolution and maintenance of large-scale systems in space, such as galaxies or the solar system, and determine the patterns of motion within those structures.</li> <li>• When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. For example, when energy is transferred to an Earth-object system as an object is raised, the gravitational field energy of the system increases. This energy is released as the object falls; the mechanism of this release is the gravitational force.</li> </ul> <p><b>PS3.A: Definitions of Energy</b></p> <ul style="list-style-type: none"> <li>• “Mechanical energy” generally refers to some combination of motion and stored energy in an operating machine.</li> <li>• Machines are judged as efficient or inefficient based on the amount of energy input needed to perform a particular useful task. Inefficient</li> </ul>		<ul style="list-style-type: none"> <li>• Inertia</li> <li>• Acceleration</li> <li>• Velocity</li> <li>• Mechanical advantage</li> </ul>
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			machines are those that produce more waste heat while performing a task and thus require more energy input.		
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This instructional segment will connect to all of instructional segments of this course. Specifically, the motion of atoms is governed by the same laws as all other objects, energy is required to start motion, the motion of waves is what creates sound, etc. By helping students to make these connections, their understanding of the content will be deepened. This segment should also be linked to the motion of a car or rocket as the anchoring phenomena for the year-long study. Cars and rockets can be used as models to demonstrate many of the physical science concepts covered in this segment.