

# Phoenixville Area School District Understanding by Design (UbD) Science Template

**Grade Level: 6**

**Unit Name: Forces and Motion**

**Author: L. Freeman**

Stage 1 Desired Results		
<p><b>Overarching NGSS &amp; PA Standards:</b></p> <p><b>3.2.6-8.G</b> Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.</p> <p><b>3.2.6-8.H</b> Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p>	<i>Transfer</i>	
	<p><i>Students will be able to independently use their learning to...</i></p> <ol style="list-style-type: none"> <li>1. Ask questions and/or define problems</li> <li>2. Develop and/or use models</li> <li>3. Plan and/or carry out investigations</li> <li>4. Analyze and interpret data using computational thinking</li> <li>5. Obtain, evaluate, and communicate information (supported by evidence)</li> <li>6. Construct explanations and design solutions</li> </ol>	
	<i>Meaning-Making</i>	
	<p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li>• Motion can be characterized by an object's speed and direction of travel. An object's average speed can be calculated from knowledge of distance and time.</li> <li>• Balanced forces do not cause a change in the motion of an object</li> <li>• Unbalanced forces do cause a change in the motion of an object.</li> <li>• Gravity is a force that acts between masses over large distances and can influence the motion (or change in motion) of an object. Gravity acts vertically downward on the local scale and vertically inward on the global scale.</li> <li>• Forces that influence the motion (or change in motion) of objects can be identified and combined to determine the overall effect of these forces</li> <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</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b> <i>Students will keep considering...</i></p> <ol style="list-style-type: none"> <li>1. What is a force?</li> <li>2. How can I differentiate between balanced and unbalanced forces?</li> <li>3. How can you use the direction of motion to help determine the direction of a force such as air resistance and friction?</li> <li>4. How can you determine the net force on an object?</li> <li>5. What effect do forces have on the motion and speed of objects?</li> </ol>
<i>Knowledge and Skills Acquisition</i>		

<p><b>3.2.6-8.J</b> Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.</p> <p><b>Which branch(es) of science apply:</b></p> <p><b>PS</b></p>	<p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li>• The motion of an object is determined by the sum of the forces acting on it.</li> <li>• Force has magnitude and direction.</li> <li>• If the total force on the object is not zero, its motion will change. 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>• All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size.</li> <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— e.g., Earth and the sun.</li> <li>• Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).</li> <li>• The impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle (Newton’s third law).</li> <li>• The components within the system that are involved in the collision and the force that will be exerted by the first object on the second object.</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li>• Identify the force, whether it is a push or pull force, the direction of force</li> <li>• Conducting investigations to determine balanced and unbalanced forces</li> <li>• Calculating the net force on an object and predicting change of motion</li> <li>• Measuring the force necessary to move an object using a spring scale</li> <li>• Identify the forces of gravity, supporting forces, air resistance, elastic forces and tension forces</li> <li>• Providing evidence that the change in an object’s motion is due to the following factors: balanced or unbalanced forces acting on the object and the mass of the object</li> <li>• Conducting investigations and describing how a force can be directed to increase the speed of an object or decrease the speed of the object</li> <li>• Design and conduct an experiment to determine the speed of a moving object</li> <li>• Compare the speeds of two moving objects qualitatively (which is faster, which is slower) and quantitatively (how much faster).</li> </ul>
<p><b>KEY VOCABULARY</b></p> <ul style="list-style-type: none"> <li>• Force</li> <li>• Contact vs. Non-Contact Forces</li> <li>• Motion</li> <li>• Inertia</li> <li>• Balanced Force</li> <li>• Unbalanced Force</li> <li>• Newton’s Law of Inertia</li> <li>• Spring Scale</li> <li>• Newton (N)</li> <li>• Friction</li> <li>• Speed</li> <li>• Mass</li> <li>• Acceleration</li> <li>• Newton’s Second Law</li> <li>• Newton’s Third Law</li> <li>• Action</li> </ul>		

	<ul style="list-style-type: none"> <li>• Reaction</li> </ul>	<ul style="list-style-type: none"> <li>• Measure time (in seconds) and distance (in centimeters)</li> <li>• Collect data from multiple trials</li> <li>• Calculate average speed</li> </ul>
--	--	---

**Stage 2 – Evidence**

<b>Evaluative Criteria</b>	<i>Assessment Evidence</i>	
----------------------------	----------------------------	--

<b>Evaluative Criteria</b>	<i>Assessment Evidence</i>	
	<b>PERFORMANCE TASK(S):</b>	
Rubric (see below)	<ol style="list-style-type: none"> <li>1. Illustrate and explain each Law of Motion with pictures and words.               <ul style="list-style-type: none"> <li>• You may draw, use images from magazines or the Internet.</li> <li>• Include an explanation of how the illustration demonstrates or describes the law of motion.</li> <li>• Put the explanation next to the illustration.</li> </ul> </li> <li>2. Project should be planned out, neat, and creative.</li> <li>3. Include color and be creative</li> </ol>	<b>Differentiation Considerations:</b>  Different modes of presentation a. PowerPoint b. poster c. choice  Use of notes and resources  Chunked Assignment  Checklists
Graded Test	Forces and Motion Common Summative  AND/OR  2. Forces and Motion Assessment	Adapted Assessment  Chunked Assignment  Checklists
Lab Report Rubric	<ol style="list-style-type: none"> <li>3. Egg Drop               <ul style="list-style-type: none"> <li>• Follow the Scientific Method to form a hypothesis, gather evidence, research, and conduct an experiment.</li> <li>• Students research materials needed to build a contraption to keep an egg from breaking when dropped from a 2<sup>nd</sup> story window.</li> <li>• Students identify various forces acting on the object.</li> <li>• Students design and build a model to keep the egg from breaking.</li> <li>• Students draw conclusions based upon experiment after the egg is dropped.</li> </ul> </li> </ol>	Checklists
	Egg Drop Scientific Method Egg Drop Rubric	

	OTHER EVIDENCE:	Differentiation Considerations:
Content Criteria/ Observation	1. Investigating Inertia Labs <ul style="list-style-type: none"> <li>Follow the Scientific Method to form a hypothesis, gather evidence, collect data and form a conclusion</li> <li>Inertia Lab Recording Sheet</li> </ul>	Adapted/Modified Quizzes
Content Criteria/ Observation	2. Unbalanced Force Mini-Labs <ul style="list-style-type: none"> <li>Follow the Scientific Method to form a hypothesis, gather evidence, collect data and form a conclusion</li> <li>Hands on-lab to differentiate between balanced and unbalanced forces</li> <li>Unbalanced Force Mini Labs Stations 1-8</li> </ul>	Homogeneously grouped labs to allow for teacher support
Content Criteria/ Observation	3. Phet Simulation - <a href="https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html">https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html</a> <ul style="list-style-type: none"> <li>Identify Net Force on an Object</li> <li>Determine the connection between force, mass, and acceleration</li> <li>Experiment with friction as a force opposing motion</li> </ul>	Pictures to support vocabulary
Graded Quizzes		Flexible grouping
Content Criteria/ Observation	4. Balanced, Unbalanced, and Net Force Quiz: Balanced, Unbalanced, and Net Force Quiz	Guided/Cloze Notes
Content Criteria/ Observation	5. Investigate and Calculate Speed Lab: <ul style="list-style-type: none"> <li>Students use distance/time to calculate the overall speed of an object traveling down a ramp</li> <li>Speed Data</li> </ul>	Pictures and videos to support vocabulary
Content Criteria/ Observation	6. WHODUNNIT – Review <ul style="list-style-type: none"> <li>Students use knowledge of forces and motion to answer questions and solve a “Clue-Like” investigation</li> <li>WHODUNNIT - Newton's Second Law</li> </ul>	Sentence Starters
		Product modification in place of writing: <ul style="list-style-type: none"> <li>-Drawing</li> <li>-Verbal explanation</li> </ul>

<p>Content Criteria/ Observation</p>	<p>7. Newton's 3<sup>rd</sup> Law – Inquiry Based Stations</p> <ul style="list-style-type: none"><li>• Follow the Scientific Method to form a hypothesis, gather evidence, collect data and form a conclusion</li><li>• Identify Action-Reaction in various hands-on investigations</li><li>• Newton's 3rd Law - Inquiry Based Stations</li></ul> <p>8. Science Notebook Entries</p> <ol style="list-style-type: none"><li>a. Concept maps</li><li>b. Notes</li><li>c. Vocabulary/Glossary entries</li><li>d. Guided Research</li></ol> <p>9. Class Participation</p> <ul style="list-style-type: none"><li>• Volunteering</li><li>• Note-taking</li><li>• Participation in Labs</li></ul>	
--	--	--