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

Grade Level 3 **Unit Name: Motion & Matter** **Authors: S. McCluskey & K. Moore**

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">Overarching NGSS & PA Standards:

3.2.3.B
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3.2.3.A
Make and communicate observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

1. Ask questions and/or define problems
2. Develop and/or use models
3. Plan and/or carry out investigations
4. Analyze and interpret data using computational thinking
5. Obtain, evaluate, and communicate information (supported by evidence)
6. Construct explanations and design solutions</td></tr>
<tr><td colspan="2">Meaning-Making</td></tr>
<tr><td>Students will understand that…
• 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.
• 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.
• 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.

(Consider: What specifically do you want students to understand? What inferences should they make?)</td><td>ESSENTIAL QUESTIONS
Students will keep considering...

How can some objects push and pull one another without touching?
How can we use our observations of systems to predict motion?
How can we use observed patterns of motion to design solutions to engineering problems?
How can we use tools to measure the mass of materials in a mixture?</td></tr>
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3.2.3.C Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. **3.2.3.D** Define a simple design problem that can be solved by applying scientific ideas about magnets. **Which branch(es) of science apply:** **PS**	***Knowledge and Skills Acquisition***	
	UNDERSTANDINGS *Students will know…* • Magnetic forces between objects does not require that the objects be in contact. • The strength of the magnetic force between objects depends on the properties of the objects and their distance apart. • The interaction between magnets depends on their orientation (sometimes they attract and sometimes they repel). • Unbalanced forces (pushes or pulls) result in change of motion. • Gravity is the force that pulls masses toward the center of Earth. • The patterns of an object's motion in various situations can be observed and measured. • When past motion exhibits a regular pattern, future motion can be predicted from it • A wheel-and-axle system with two sizes of wheels describes a curved path when rolled down a slope. The system curves toward the smaller wheel. • A twirly bird is a simple winged system that spins when it interacts with air. Twirler performance is affected by variables. • Tops exhibit rotational motion (spinning) when torque is applied to the axial shaft. Top performance is affected by variables. • Possible solutions to a problem are limited by available materials and resources (constraints). • The success of a designed solution is determined by considering the desired features of a solution (criteria). • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • The pattern of an object's or a system's motion in various situations can be observed and measured. • When past motion exhibits a pattern, it can be used to predict future motion. • A mixture is two or more materials distributed evenly throughout one another. • A special class of mixture, a solution, results when a solid material dissolves (disappears) in a liquid.	*Students will be skilled at…* • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Ask questions that can be investigated based on patterns such as cause and effect relationships. • Define a simple problem that can be solved through the development of a new or improved object or tool.

- Starting materials change into new materials during chemical reactions.
- Mass is neither created nor destroyed during physical and chemical interactions. Matter is conserved.

KEY VOCABULARY

attract	magnetic field
balanced force	motion
direction	position
electromagnet	pull
force	push
friction	repel
gravity	speed
inclined plane	static electricity
inertia	transfer
magnet	unbalance force

(Consider: What 10-15 terms are critical to students' understanding of the entire unit?)

Stage 2 – Evidence

Evaluative Criteria	***Assessment Evidence***	
What criteria will be used in each assessment to evaluate attainment of the desired results?	PERFORMANCE TASK(S): Investigations: • **Task(s):** Students explore phenomena that can affect the motion of masses—the forces of magnetism and gravity. Through their investigations, students find that both magnetism and gravity can pull, and magnetism can sometimes push as well. Both forces can make things move even when not in direct contact with another object. Students refine their investigations and	Differentiation Considerations: For labs, some students may wish to: • Explain verbally instead of in a written format • Draw their responses • Write in their first language

Rubrics related to each will be developed.	their abilities to use science practices and collect data regarding their observations of the interaction between paper clips and magnets. They use those data to predict how far the magnetic field extends. Building on their experience with magnetic force, students explore other pushes and pulls, considering strength and direction. Students are introduced to the effects of balanced and unbalanced forces. **Assessment**: Investigation 1 I-Check • **Task(s):** Students use variety of systems as phenomena to explore patterns of motion. They design wheel and-axle systems and roll the systems down ramps to observe the pattern of motion. They extend their rolling investigations to systems with big and little wheels and use the predictable curved rolling path to meet challenges. Students make twirly birds (flying spinners) and explore the variables involved in the interaction between twirling systems, gravity, and air. Students design tops and explore the variables that results in the best spinning top. **Assessment**: Investigation 2 I-Check • **Task(s):** Students tackle an engineering design challenge in incremental steps. They first design a cart that can roll "from here to there," and then improve their designs to meet a specific distance challenge. Students continue with an investigation involving the phenomenon of gravity and explore how start position on a ramp affects the distance the cart travels. The final challenge incorporates students' knowledge of magnetism into their cart design to meet new challenges. This investigation develops understanding of engineering design concepts and provides opportunities for students to engage in engineering practices. **Assessment**: Investigation 3 I-Check • **Task(s):** Students extend grade two experiences with matter by using tools to quantify data to develop evidence for the phenomenon of conservation of mass. They determine the mass of the materials prior to mixing and after	If challenges arise with the complexity of the task(s), some students may need: • Additional incremental steps • An alternative activity Other considerations: • When grouping students' various skills sets and strengths will be considered • When asking students to describe a model, opportunities to draw or write it, as well. • Teacher can scribe written responses for students

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<td>mixing. In one mixture, salt dissolves (disappears), resulting in a solution. Students confirm that the mass of the solution is equal to the starting masses of the water and salt. They mix vinegar and baking soda and observe a bubbling reaction. Students determine that the mass of the ending mixtures is less than the mass of the original materials, which challenges students to infer that carbon dioxide gas, which escaped, has mass. The investigation and module ends with students designing and conducting a metric field day to creatively apply their understanding of standards of measurement.
Assessment: Investigation 4 I-Check

Unit Activities/Projects:
1. Where I Went on a Pretend Vacation: Your task is to research an area's regional climate and create a postcard, PowerPoint, poster, or give a short presentation about the climate of the place as if you went there.
o Project Rubric
2. Independent Study: Your task it to plan and conduct an experiment that demonstrates one of the following:
• Patterns in Motion
• Balanced and Unbalanced Forces
• Magnetic Forces</td>
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<td>What criteria will be used in each assessment to evaluate attainment of the desired results?

Rubrics related to each will be developed.</td>
<td>OTHER EVIDENCE:

• Checklists of collaborative behaviors in investigations
• Checklists of collaborative behaviors in class discussions
• Science Journal Entries
• TO CONSIDER FOR LATER: UNIT TEST(S)

(What evidence will be collected to determine whether Stage 1 goals were achieved?)</td>
<td>Differentiation Considerations:

For journal entries, consider that some students may wish to:
• Draw instead of write entries
• Write in their first language
• Explain responses verbally
If challenges arise with the complexity of the task(s), some students may need:</td>
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		• Additional incremental steps An alternative activity