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

Grade Level &/or HS Subject: Physics Unit Name: Fluids, Forces and Stability

Plain English Summary: This unit is about static and flowing fluids. For static fluids, the focus is on pressure and how that leads to mechanical advantage and buoyancy. Students will apply buoyancy to develop shoes that are stable for walking on water. For flowing fluids, we'll focus on how pressure and energy relate (Bernoulli's Principle) to create lower pressure with faster flows, and some applications of that concept in nature and engineering.

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

HS-PS2-1

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration

HS-PS3-2

Develop and use models to illustrate that energy at the macroscopic scale can be</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Ask questions and define problems
Develop and use models
Plan and carry out experiments
Analyze and interpret data using computational thinking
Obtain, evaluate, and communicate information (supported by evidence)
Construct explanations and design solutions

(Choose the appropriate content-specific transfer goals)</td></tr>
<tr><td colspan="2">Meaning-Making</td></tr>
<tr><td>Students will understand that…

Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration

Models can be used to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).</td><td>ESSENTIAL QUESTIONS
Students will keep considering...

How can we design a system to be stable?

How do properties of a fluid and its motion affect the pressure it exerts?</td></tr>
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accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). **Which branch(es) of science apply:** **PS**	***Knowledge and Skills Acquisition***	
	Newton's second law accurately predicts changes in the motion of macroscopic objects. When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. Systems can be designed for greater or lesser stability.	*Students will be skilled at…* Design, evaluate, and/or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. Use mathematical representations of phenomena to describe explanations. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Communicate technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
	KEY VOCABULARY Fluid Pressure Pascal's Principle Mechanical Advantage Bernoulli's Principle Density Buoyancy Archimedes' Principle Volume Displaced Volume Submerged	

<table>
<tr><th colspan="3">Stage 2 – Evidence</th></tr>
<tr><th>Evaluative Criteria</th><th colspan="2">Assessment Evidence</th></tr>
<tr><td>Good process skills (rubric); Device meets requirements; Device maintains stability</td><td>PERFORMANCE TASK(S):

Boat Shoes!

Goal: Design and construct a scale version of boat shoes that can support a designated weight while maintaining stability
Role: An engineer
Audience: Themselves – they might want to build a full-scale model of their shoes to walk on water!
Situation: Students will work in groups. They must use a spreadsheet or other programming software to build a model to predict whether their shoes will float in water. They will then build a 1/50th model of their shoes using one of various types of foam. Cost will play a role.
Product: The students will build boat shoes at 1/50th scale that meet the specifications. Students will need to test their shoes and analyze what went right and wrong.
Standards: See Left Column</td><td>Differentiation Considerations:

Students have the choice in the modeling software, materials, range of weights that need to be held.</td></tr>
<tr><td>Accuracy of answers and explanations; lab/inquiry process skills</td><td>OTHER EVIDENCE:

• HW – these will consist of a range of questioning goals, from basic things like vocab understanding to conceptual understanding to application
• Quizzes – MC or FR where work is required; similar to HW, could be fact recall, conceptual understanding or application being assessed.
• Test – 1 for the unit, will contain a mix of recall and application focused on the understandings and knowledge from Stage 1

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

• Notes allowed on some assessments
• Partial credit + test corrections</td></tr>
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