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

Grade Level &/or HS Subject: Physics Unit Name: Vibration and Waves

Plain English Summary: The focus in this unit is on basic wave types with emphasis on mechanical / physical waves. However, many wave behaviors, like the Doppler Effect, are applicable to EM waves and this unit will be built upon later when discussing optics and light properties. The performance task is on producing and measuring sound waves, so topics like resonance with strings and tubes is included.

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

HS-PS3-3

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS4-1

Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-5</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…

Mathematical representations can be used to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media

Devices that work within given constraints to convert one form of energy into another form of energy can be designed, built and refined.

Some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...

How is energy transferred and conserved?

How can sound be produced or altered?

How do the properties of matter affect the properties of matter waves?</td></tr>
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Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. **Which branch(es) of science apply:** **PS**	***Knowledge and Skills Acquisition***	
	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment. 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. The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. Systems can be designed to cause a desired effect. Earthquake epicenters can be identified using different speeds of different types of waves and in different materials. Sound can be produced by vibrations, and specific frequencies can be amplified through resonance. Wave frequency can be shifted by a moving source and/or observer through a phenomenon called the Doppler Effect.	*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 Frequency Amplitude Period Longitudinal Wave Transverse Wave Mechanical Wave EM Wave Doppler Effect Shockwave Resonance Fundamental Frequency Harmonics / Overtones	

<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); quality//consistency of notes (frequency can be measured)</td><td>PERFORMANCE TASK(S):

Musical Instrument Creation

Goal: Students will make their own musical instruments out of a common, everyday object. They will study the frequencies produced by changing a parameter of the object, and then produce music with the instrument.
Role: Instrument designers and musicians
Audience: The Listeners (class/teacher/the world via YouTube)
Situation: Students will work in groups so that they can achieve a range of sounds. They can use an everyday object for an instrument, such as a bottle, a rubber band/balloon, drinking straw, ruler) that can be modified in some way to produce different sounds and perform for their adoring audience.
Product: They will vary that parameter (for instance, free length of a ruler) and use a graph that they create to allow them to modify the instrument to produce specific notes. They will then determine a piece of music they can play as a group and record it or play it live for the class. Frequencies/notes can be measured using sound sensors.
Standards: See Left Column</td><td>Differentiation Considerations:

Students have choice in what material(s) they wish to use and what parameter they wish to modify; they can also choose their music and how to perform it. Different materials can be easier or harder, as can different pieces of music.</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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