Unit 5 2018. Wave Properties & Sound

Content Area: **Science**
Course(s):
Time Period: **January**
Length: **10 Blocks**
Status: **Published**

Enduring Understandings

- Waves transfer energy without transferring matter.
- Mechanical waves require a medium to propagate, however, electromagnetic waves do not.
- A continuous wave is a regular repeating sequence of wave pulses.
- Interference occurs when two or more waves move through a medium at the same time.
- Sound is a pressure variation transmitted through matter as a longitudinal wave.
- Sound is produced by vibrating objects in matter.
- The velocity of a wave is a function of the wavelength and frequency.

Essential Questions

- How are waves used to send and store information?
- How do waves transfer energy?
- How do waves interact?
- How do waves impact our lives?

Student Learning Objectives (PE, SEP, DCI, CCC) & Aligned Standards

- Students will observe the speed of sound, wavelength, frequency, and period.

Performance Expectations

Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. *[Clarification Statement: Examples of data* *could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]* **(HS-PS4-1)**

Science and Engineering Practices

Using Mathematics and Computational Thinking

- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties

- 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. (HS-PS4-1)

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)

SCI.9-12.1.3	Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.
SCI.9-12.1.4	Mathematical representations are needed to identify some patterns.
SCI.9-12.1.5	Empirical evidence is needed to identify patterns.
SCI.9-12.2.2	Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
SCI.9-12.2.3	Systems can be designed to cause a desired effect.
SCI.9-12.2.4	Changes in systems may have various causes that may not have equal effects.
SCI.9-12.3.2	Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.
SCI.9-12.3.3	Patterns observable at one scale may not be observable or exist at other scales.

SCI.9-12.3.4	Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.
SCI.9-12.3.5	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
SCI.9-12.6.2	The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.
SCI.9-12.7.2	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
SCI.9-12.CCC.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
SCI.9-12.CCC.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
SCI.9-12.CCC.3.1	students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
SCI.9-12.CCC.6.1	students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
SCI.9-12.CCC.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.
SCI.HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.
SCI.HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
SCI.HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
SCI.HS-PS4-5	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.

Resources

Wave on a string: Students will watch a wave on a string. Adjusting the amplitude, frequency, damping and tension will demonstrate wave properties.

Slinky Lab: Students will observe patterns of waves and their interactions using a slinky.

Ripple Tank: Students will investigate wave properties (speed in a medium, reflection, diffraction, interference) using the PhET virtual ripple tank, or use an actual ripple tank.

Resonance Tube: Velocity of Sound. Students will observe the resonance phenomenon in an open ended cylindrical tube, and use the resonance to determine the velocity of sound in air at ordinary temperatures.

Resonance: Students will identify, through experimentation, cause and effect relationships that affect natural resonance of these systems.

Sound Waves: Students will adjust the frequency to both see and hear how the wave changes to explain how different sounds are modeled, described, and produced.

Doppler Effect: Students will explore the detection of sound waves from a moving source and the change in frequency of the detected wave via the Doppler effect.

Refraction through Glass: Students will trace the course of different rays of light through a rectangular glass slab at different angles of incidence, measure the angle of incidence, refraction, measure the lateral displacement to verify Snell`s law.

Light box Lab: ex #2: Prism - To show how a pdsm separates white tight into its component colors and to show that different colors are refracted at different angles through a prism.

Light box Lab: ex #4:Snell's Law **-** To use Snell's Law to determine the index of refraction of the acrylic rhombus.