Course Title: Integrated Science

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Unit #4 - Waves

Transfer Goal –

Students will be able to independently use their learning of wave properties to analyze how multiple technologies in our everyday experiences are based on waves and their interactions with matter.

Stage 1 – Desired Results

Established Goals

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-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

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.

21st Century Themes
(www.21stcenturyskills.org)

___ Global Awareness
___Financial, Economic, Business and Entrepreneurial Literacy
___Civic Literacy
___Health Literacy
___Environmental Literacy

21st Century Skills

Learning and Innovation Skills:
_X__Creativity and Innovation
_X__Critical Thinking and Problem Solving
_X__Communication and Collaboration

Information, Media and Technology Skills:
___Information Literacy
___Media Literacy
_X__ICT (Information, Communications and Technology) Literacy

Life and Career Skills:
_X__Flexibility and Adaptability
_X__Initiative and Self-Direction
_X__Social and Cross-Cultural Skills
_X__Productivity and Accountability
_X__Leadership and Responsibility

Enduring Understandings:

Students will understand that . . .

EU 1
waves transport energy that is used in a variety of technological applications.

EU 2
the behavior of a wave is dictated by the medium through which it passes.

Essential Questions:

EU 1
- From where do waves come?
- What evidence is there to support the idea that waves carry energy?
- How do we describe the behavior of a wave?
- Do waves require a medium through which to travel?

EU 2
- What is the best medium through which waves can travel?
- How can the speed of a wave be most effectively changed?
- How is the reflection or refraction of light useful in society?
- Is radiation good or bad?

Knowledge: *Students will know . . .*	**Skills:** Students will be able to . . .
EU 1 ● a medium is a physical environment through which a disturbance can travel. ● mechanical waves require a medium through which to travel. ● the vibrations of a transverse wave are perpendicular to the wave motion. ● the vibrations of a longitudinal wave are parallel to the wave motion. ● sound is an example of a longitudinal wave. ● the range of human hearing is from 0 dB to 130 dB. ● moving wave sources or receivers cause an apparent change in frequency which is known as the Doppler effect. ● longer wavelength electromagnetic (EM) radiation (ie. visible light) is absorbed in matter and generally converted into thermal energy (heat); shorter wavelength EM radiation (ie. X-rays) can ionize atoms and damage living cells. (HS-PS4-4)	*EU 1* ● carry out an investigation that confirms and evaluates the mathematical relationship between the frequency, wavelength and speed of a wave. ● construct and communicate an explanation that distinguishes between particle vibration and overall wave motion. ● utilize a graphical model to interpret and describe the differences between transverse and longitudinal waves. ● obtain and evaluate claims that waves transfer energy without transferring matter. ● develop an explanation that communicates the difference between transverse and longitudinal waves. ● obtain, evaluate and communicate evidence that relates the physical properties of sound waves to perceived pitch and loudness. ● describe how engineers continually modify systems by applying scientific knowledge and engineering design practices. ● design an investigation that demonstrates the Doppler effect then obtain and communicate several applications of this principle. ● evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4)
EU 2 ● mechanical waves generally travel faster in a solid than in a liquid or gas. ● the speed of sound in air is approximately 343 m/s but this varies with temperature. ● the normal range of human hearing is from 20 Hz to 20,000 Hz. ● light is a part of a larger family of radiation known as the electromagnetic spectrum. ● the properties of electromagnetic waves determine their uses. ● the speed of light in a vacuum is 3.0 X 10^8 m/s and this value approximates the speed of light in air. ● 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) ● information can be digitized (e.g., a picture stored as the values of an	EU 2 ● construct a graphical model that can be utilized to communicate the difference between crest, trough, amplitude, and wavelength. ● apply the wave speed equation to predict the frequency and wavelength of a wave in a particular medium. ● use mathematical and computational thinking to relate a wave's speed to the medium through which it passes. ● evaluate the validity of scientific claims regarding the effect that various parts of the electromagnetic spectrum have when they interact with matter. ● obtain evidence to support an argument concerning the dangers and hazards associated with particular types of electromagnetic waves.

array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS- PS4-5) ● photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) ● waves and their interactions with matter are essential for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)	● use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1) ● 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). (HS-PS4-5)

Stage 2 – Assessment Evidence

Other Recommended Evidence:

- Tests/Quizzes on waves
- Informal lab investigations
- Formal lab write ups
- Checked homework
- Class discussion
- Summarizers

Stage 3 – Learning Plan

Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: *Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

- Teacher led discussions on waves and their transfer of energy (A)
- Graphic organizer for different types of waves and their purposes in students' daily lives (A, M)
- Identifying types of waves present in the classroom (A, M)
- Reflection, Refraction, Diffraction demo- highlighting how waves will change direction when an object is placed in a clear glass of water (M)
- Analyze Scientific Literature about the significance of waves in our everyday life(A, M, T)
- Identify frequencies of electromagnetic waves and their relationships to possible effects on the human body (examples: sunburn, x-rays, etc.) (M, T)
- Using a musical instrument to demonstrate the different frequencies of separate pitches (M, T)
- Glencoe Virtual Sound waves Lab to identify the wavelengths and frequencies of certain waves based on position (A, M)
- Teacher demonstration with slinkys and ropes to identify different types of waves (A)
- Identify which animals can hear different sound waves using Glencoe Virtual Soundwave Lab (A, M)
- How has music been stored through history activity (M, T)
- Earthquake's effects on Earth activity (M, T)
- Class demonstration school bleacher activity- start a class wave (M)
- Identify parts of wave diagram worksheet (Catch a Wave worksheet)(A)
- Intro to Waves- students will work in groups and use a slinky to recreate the waves described and answer questions based on their appearance (A,M)
- Create a Milk Carton Reflector Activity - cut a hole in a milk carton, place a piece of a mirror on a piece of tissue paper and place across the hole, shine light at mirror and speak in different pitches and volume. Have students observe the appearance of the light on the wall. (M, T)
- Rubber bands on a doorknob - Tie a rubber band to a doorknob and and pluck it. Observe the differences in volume, pitch, and frequencies at different lengths of the rubber band. (M, T)
- BoomBox Activity - place a blown up non latex balloon in front of a boom box speaker. Turn the volume up and down and have students record observations based off the appearance of the balloon. (M, T)
- Teacher demonstration of substances (liquids, gelatinous, solids in which waves can travel ex. slinky, etc.) as mediums (A, M)
- Identify different types of waves and the different types of matter they travel through (A, M)