Unit 3: Sound and Light

Content Area: **Science**
Course(s): **Science**
Time Period: **Marking Period 3**
Length: **8-10 Weeks**
Status: **Published**

Unit Overview

This unit will help students formulate the answer to the question, "What are characteristic properties of waves and how can they be used?". Students are to describe and predict characteristic properties and behaviors of waves when they interact with matter. Students can apply understandings of waves as means to send digital signals. Students will model waves and use mathematical thinking to define quantitative properties of waves.

Performance Expectations

MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
MS-PS4-3	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Three Dimensions

Science and Engineering Practices

SEP.1	Asking Questions and Defining Problems
SEP.2	Developing and Using Models
SEP.3	Planning and Carrying Out Investigations
SEP.4	Analyzing and Interpreting Data
SEP.5	Using Mathematics and Computational Thinking
SEP.6	Constructing Explanations and Designing Solutions
SEP.7	Engaging in Argument from Evidence

Disciplinary Core Ideas

PS4.A: Wave Properties

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.(MS-PS4-1)
- A sound wave needs a medium through which it is transmitted. (MS-PS4-2) PS4.B: Electromagnetic Radiation
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) PS4.C: Information Technologies and Instrumentation
- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

Crosscutting Concepts

Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Knowledge, Skills, and Assessment

Essential Insights and Understandings/Guiding Questions	Critical Knowledge and Skills
How does energy travel from place to place?	Waves are disturbances involving transfers of energy from place to place. A material through which a wave travels through is called a medium. Waves th require a medium are known as mechanical waves. Waves that do not requi medium are known as electromagnetic waves. A transverse wave moves the

How do the two types of waves differ?

medium up and down. The highest point is called the crest. The lowest is cal the trough. Longitudinal waves move the medium in the same direction as th direction of the wave. When the medium compresses, it is known as compression. When the medium stretches, it is known as a rarefaction.

Skill: SWBAT...

- **Model transverse and longitudinal waves using a slinky or rope. Students should be able to label or point out the rarefaction and compression/crest and trough.**

How do you measure the energy of waves?

The measure from the midline of a transverse wave to the crest is known as amplitude. High waves have more energy than low waves. The distance of c to crest in a transverse wave is known as the wavelength. The frequency of t wave is how many complete waves (crest and trough) pass a point in a secor is measured in (Hz). Speed of a wave can be measured in how far a wave mo in a given time. Frequency, wavelength, and speed can be related through mathematical formulas.

Skill: SWBAT...

- **Measure wavelength, frequency, and amplitude of a transverse w**

What is sound?

Sound is a disturbance that travels through a medium as a longitudinal wave sound wave begins as vibrations. The usual medium for sound is air but it ca travel through solids and liquids as well. Sound waves can diffract, or bend around corners. This is why you can hear sound without a direct path to the source. Pitch is the sensation of frequency of a sound wave. When a sound w has a higher frequency (shorter wavelength on longitudinal wave) humans perceive the sound as a higher pitch. Pitch is measured in Hz. Loudness is t sensation of amplitude or energy of a sound sound wave. When a sound wa has a larger amplitude (larger compression), it is perceived by humans to be louder. Loudness is measured as dB.

What are the properties of sound?

Why do sounds appear as a different pitch if they are in motion?

Skill: SWBAT...

- **Differentiate between high/low frequency and high/low pitch bas on model of longitudinal wave.**

How do we hear sound?

The Doppler Effect occurs because the motion of the source causes the wave either get closer together or spread out. The ear is a sensory organ that funne sound waves into the skull towards the brain where the wave can be interpre The outer ear (pinna and ear canal) funnels sound waves towards the eardru The eardrum translates sound waves from the air to vibration. The middle ea (three smallest bones in body) carry vibrations to cochlea. Inner ear (cochle transmits vibration to auditory nerve. Medical technology (hearing aids, coc implants) can help alleviate the effects of hearing loss.

Skill: SWBAT

- **Trace sounds waves from the air to the brain.**

How does energy travel through the void of space?

Electromagnetic waves do not require a medium through which to travel. Electromagnetic waves travel at the speed of light but have different wavelengths and frequencies. As the wavelength of EM waves change, they on different properties. They can be arranged on a continuum known as the "Electromagnetic Spectrum".; As wavelengths get smaller, the energy of wa increase: Radio waves, Microwaves, Infrared, Visible Light, Ultraviolet, X F Gamma Rays.

How can electromagnetic waves improve our lives through technology?

Skill: SWBAT...

- **Students should be able to differentiate EM waves based on wavelength and properties.**

Many modern pieces of technology (cell phones, WiFi, fiber optics) contain sensors to help interpret digitalized wave pulses of electromagnetic radiation

Skill: SWBAT...

- **Students will be able to construct an argument stating that digita waves are more reliable than analog signals.**

Color is our sensation of the frequency/wavelength of visible light. Materials be classified by how they transmit or do not transmit light. Transparent mate allow light to pass through without being scattered. Translucent materials sc light that passes through.Opaque materials do not allow any light to pass through.

Skill: SWBAT...

How does visible light allow us to see?

- **Students should be able to classify real life materials as transpar translucent, and opaque. Students should be able to model the pathway of light through each as a ray diagram.**

The color of an opaque object is the color of light it reflects.White objects re all colors of light. Black objects absorb all colors of light. Variations in refle surfaces create distortions in images. You see objects when a process occurs involves both your eyes and brain.The cornea, pupil, and iris work together t focus light on the retina.The optic nerve carries signal to the brain.

Why do we see color?

Skill: SWBAT...

- **Trace the path of electromagnetic radiation from the environme the brain.**

Suggested Resources

CK-12 Flexbook

Wave Properties

- http://www.ck12.org/physics/Mechanical-Wave/
- http://www.ck12.org/physics/Longitudinal-Wave/lesson/Longitudinal-Waves-PPC/?referrer=featured_content
- http://www.ck12.org/physical-science/Transverse-Wave-in-Physical-Science/lesson/Transverse-Wave-MS-PS/

Sound

- http://www.ck12.org/physical-science/Sound-Waves-in-Physical-Science/lesson/Sound-Waves-MS-PS/
- http://www.ck12.org/algebra/Linear-Systems-with-Addition-or-Subtraction/rwa/High-Pitch-Low-Pitch/
- http://www.ck12.org/physical-science/Hearing-and-the-Ear-in-Physical-Science/

The Electromagnetic Spectrum

- http://www.ck12.org/section/The-Electromagnetic-Spectrum/
- http://www.ck12.org/physical-science/Electronic-Signal-in-Physical-Science/lesson/Electronic-Signal-MS-PS/

Visible Light

- http://www.ck12.org/physical-science/Visible-Light-and-Matter-in-Physical-Science/lesson/Visible-Light-and-Matter-MS-PS/
- http://www.ck12.org/physical-science/Lens-in-Physical-Science/lesson/Lens-MS-PS/
- http://www.ck12.org/physical-science/Vision-and-the-Eye-in-Physical-Science/

Technology Integration

CK12 Flexbook

iPads/Smartphone iMovie intergration for demonstration of performance goals.

Digital models of ear and eye.

Differentiation

Differentiation for special education:

- General modifications may include:
  - Modifications & accommodations as listed in the student's IEP
  - Assign a peer to help keep student on task
  - Modified or reduced assignments
  - Reduce length of assignment for different mode of delivery
  - Increase one-to-one time
  - Working contract between you and student at risk
  - Prioritize tasks
  - Think in concrete terms and provide hands-on-tasks
  - Position student near helping peer or have quick access to teacher
  - Anticipate where needs will be
  - Break tests down in smaller increments
- Content specific modifications may include:
  - Provide visual models of waves. Use hands on demonstrations of waves using rope, spring toys, etc.
  - Provide hands on, manipulative models of ear and eye.
  - Provide foldable to organize information on electromagnetic spectrum.

Differentiation for ELL's:

- General modifications may include:
  - Strategy groups
  - Teacher conferences
  - Graphic organizers
  - Modification plan
  - Collaboration with ELL Teacher
- Content specific vocabulary important for ELL students to understand include: waves, medium, mechanical waves, crest, pitch, rarefaction, compression, amplitude, trough, vibration, longitudinal, transverse, wavelength, decibel, translucent, opaque, transparent, Doppler Effect, sensory, cochlea, ray.

Differentiation to extend learning for gifted students may include:

7th Grade Class Blog: Find a topic on DNews, CrashCourse, CrashCourse Kids, or Popular Science relating to sound and/or light. Write a brief response and post on the class blog.

Exploration Topics:

- Seismography: Use seismographer and earthquake board models to create seismographs. Explain how each seismograph represents different types or intensity of EQs.
- Temperature and Speed of Sound: Use Data on temp and speed of sound. Have students analyze data and explain relationship between temp and speed of sound.
- Pitch and Volume in Singing: Use Youtube to find clips of favorite or best singers to show examples of

when their pitch or volume changes. Explain how their vocal cords move to produce changes.

- Musical Instruments: Read 43-52 in Science Explorer text. Complete section assessment.
- Hearing Protector: Design and build a hearing protector to block abnormally loud sounds. Conduct an experiment and gather data about the effectiveness of materials.
- Ray Diagrams: Research rules for creating ray diagrams. Create ray diagrams of mirrors and lens of various types and configurations.

21st Century Skills

CAEP.9.2.8.B	Career Exploration
CAEP.9.2.8.B.1	Research careers within the 16 Career Clusters ® and determine attributes of career success.
CAEP.9.2.8.B.2	Develop a Personalized Student Learning Plan with the assistance of an adult mentor that includes information about career areas of interest, goals and an educational plan.
CAEP.9.2.8.B.3	Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.
CAEP.9.2.8.B.5	Analyze labor market trends using state and federal labor market information and other resources available online.
CAEP.9.2.8.B.6	Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.
CAEP.9.2.8.B.7	Evaluate the impact of online activities and social media on employer decisions.