Unit 3a Waves and Electromagnetic Radiation

Content Area: **Science**
Course(s): **Science 7**
Time Period: **Marking Period 3**
Length: **MP3**
Status: **Published**

Essential Questions

- What are the properties of waves?
- What kinds of waves make up the electromagnetic spectrum?

Big Ideas

- Waves transmit energy.

Cross-Curricular Integration

Integration Area: Math

MS-PS4-1 Use mathematical representation to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS-4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Activity:

In this lab rotation, students continue to create models that explain phenomena (SP2). In addition, students utilize the Crosscutting Concept of Patterns, using graphs to identify patterns and relationships between variables such as frequency and wavelength.

However, one new aspect that we begin to discuss is the mathematical representation of what a wave looks like (MP4). On the first day, students are introduced to the idea of how a wave can be graphed in a coordinate plane on a Displacement vs. Time/Distance plot. In this lab, students have to create graphs that demonstrate general relationships of both transverse and longitudinal waves in order to develop their mathematical and conceptual thinking (SP5). On the second day of instruction, students are introduced to graphing a wave based on specific numbers instead of general relationships and begin manipulating the graphs of waves to demonstrate a proportional understanding of wave relationships.

Integration Area: Language Arts

W.IW.7.2. Write informative/explanatory texts (including the narration of historical events, scientific

procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

A. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.

B. Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.

C. Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.

D. Use precise language and domain/ grade-level- specific vocabulary to inform about or explain the topic.

E. Establish and maintain a formal style academic style, approach, and form.

F. Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that follows the flow of ideas, reflects back on the topic, and supports the information or explanation presented.

RL.CI.7.2. Determine a theme in a literary text (e.g., stories, plays or poetry) and explain how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

RI.CI.7.2. Determine a central idea in an informational text and explain how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

Activity:

Sound & Light: A.) What is infrared light? In an explanatory essay that uses facts, details and examples from a variety of credible sources, explain how infrared light can be useful to humans providing at least 3 examples. B.) Cell phones have become an integral part of daily life for a majority of people. They are very useful but may pose some physical dangers to users. Are cell phones dangerous? Based on your research, compose an argument that defends your opinion on this issue. Use at least three pieces of evidence collected from your research and the Socratic Seminar to support your claim. Be sure to identify the specific sources for the underlying research.

Integration Area: Pre-Algebra

Chapter 6: Rates, Ratios and Proportions

7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction* $^{1/2}/_{1/4}$ *miles per hour, equivalently 2 miles per hour*.

7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

Chapter 11/7: Multi-step Equations and Inequalities

7.EE.A.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation*.

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Chapter 4/5: Proportional Relationships/Graphs

7.RP.A.2 Recognize and represent proportional relationships between quantities.

Science and Engineering Practices

Developing and Using Models

- Develop and use a model to describe phenomena. (MS-PS4-2)

Using Mathematics and Computational Thinking

- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

Obtaining, Evaluating, and Communicating Information

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

CSDT Technology Integration

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.

8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

Activity:

Students will watch a video on amplitude and its relation to energy. The students will complete an activity on

the interactions of amplitude, frequency, and wavelength (internet based interactive). The students will then complete questions related to amplitude and its energy in a wave.

Enduring Understandings

MS. Waves and Their Applications in Technologies for Information Transfer

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 how 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 informant than analog signals.

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

Patterns

Graphs and charts can be used to identify patterns in data. (MS-PS4-1)

Structure and Function

Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)

Structures can be designed to serve particular functions. (MS-PS4-3)

Focus Areas

Properties of Waves

- Waves are periodic disturbances that carry energy
- Waves travel outward from the source of energy
- Waves with larger amplitudes have more energy
- A wave's speed is related to its wavelength and frequency
- Reflection, refraction and diffraction change a wave's direction

Electromagnetic Waves

- An electromagnetic wave is made up of vibrating electric and magnetic fields that move through space or some medium at the speed of light.
- Two different models are needed to explain the behavior of electromagnetic waves.
- All electromagnetic waves travel at the same speed in a vacuum, but they have different wavelengths and different frequencies.
- The electromagnetic spectrum is made up of radio waves, microwaves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays.
- Radio waves carry information from the antenna of a broadcasting station to the receiving antenna of your radio.
- Cell phones transmit and receive signals using high-frequency microwaves.
- Communications satellites receive radio, television, and telephone signals and relay the signals to receivers on Earth.

*See Appendix E for Cross Content

Resources

Scientific Inquiry

MS-PS4-1 *Properties of Waves*, Slinky Lab

MS-PS4-2 *Waves Interaction Stations*
MS-PS4-3 *How Does a Cell Phone Work?*