Grade 06 -Unit 06 - The Electromagnetic Spectrum (njdoeGr8 Unit 7)

Content Area:	**Science**
Course(s):	
Time Period:	**Generic Time Period**
Length:	**10 days May -June**
Status:	**Published**

Stage 1: Desired Results

In this unit of study, students *develop and use models, use mathematical thinking,* and *obtain, evaluate, and communicate information* in order to describe and predict characteristic properties and behaviors of waves. Students also apply their understanding of waves as a means of sending digital information. The crosscutting concepts of *patterns* and *structure and function* are used as organizing concepts for these disciplinary core ideas. Students *develop and use models, use mathematical thinking,* and *obtain, evaluate, and communicate information.* Students are also expected to use these practices to demonstrate understanding of the core ideas.

Unit Overview/ Rationale

Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is relate wave. *[Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment B does not include electromagnetic waves and is limited to standard repeating waves.]* **(MS-PS4-1)**

Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. *[Clarifica is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Asse Assessment is limited to qualitative applications pertaining to light and mechanical waves.]* **(MS-PS4-2)**

Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to information than analog signals. *[Clarification Statement: Emphasis is on a basic understanding that waves can be used for com Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of store sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not mechanism of any given device.]* **(MS-PS4-3)**

SCI.6-8.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.
SCI.6-8.MS-PS4	Waves and Their Applications in Technologies for Information Transfer
SCI.6-8.MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Big Ideas - Students will understand that...

In this unit of study, students learn that simple waves have repeating patterns with specific wavelengths, frequencies, and amplitudes. They will use both qualitative and quantitative thinking as they describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. For example, students could use a slinky to make a small wave, then increase the energy input and observe that an increase in energy results in an increase in the amplitude of the wave. Or they could push on the surface of a container of water with different amounts of energy and observe the amplitude of the waves created inside the container. Any modeling or demonstrations used to help students visualize this should be followed up with mathematical representations that students could use as evidence to support scientific conclusions about how the amplitude of a wave is related to the energy in a wave. Students can use graphs and charts (teacher provided) to identify patterns in their data.

Students will then develop and use models to describe the movement of waves in various materials. Through the use of models and other multimedia and visual displays, students will describe that 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. Students could then broaden their understanding of wave behavior by using models to demonstrate that waves are reflected, absorbed, or transmitted through various materials. Students can observe the behavior of ways by using a penlight and tracing the path that light travels between different transparent materials (e.g., air and water, air and glass. Students could also shine a light through a prism onto a screen or piece of paper, observe a pencil in a glass of water.

A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. For example, students could observe some of the wave behaviors or light by observing that when light passes through a small opening the waves spread out. They could observe that if the wavelength is short, the waves spread out very little, whereas longer wavelengths spread out more. Students could them produce sketches of their observations. They may need some guidance in the elaboration of their sketches as it relates to the wave properties of light. Students can use a model of the electromagnetic spectrum to make connections between the brightness and color of light and the frequency of the light.

Students will continue their study of waves by observing the behavior of sound waves. Before students begin to study the behavior of sound waves, the teacher could demonstrate the importance of the presence of a medium for sound to travel. For example, if an alarm clock is placed inside a bell jar and the air is removed, the alarm will not be heard outside of the jar. Students could be asked to explain why the can hear the sound before the air is pumped out and not after. This type of demonstration could be followed by discussion of the types of media that sound passes through and how these different media impacts the sound.

Students could then participate in scientific discussions where they compare the behavior of mechanical waves (sound) and light waves. Based on their observations, students should be able to explain that the amplitude of all waves are related to the energy of the wave and that waves are reflected, absorbed, or transmitted through various materials. They should be able to explain that while mechanical waves need a medium in order to be transmitted, light waves do not. Therefore, because light can travel through space, it cannot be a matter wave, like sound or water waves.

Once students have a clear understanding of how different types of waves behave, they can start to explore how society utilizes those waves. The structure of a wave can be modified to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. Devices have been designed to utilize properties of waves to serve particular functions. For example, cell phones use wave properties for mobile communication purposes. These devices use digitized signals (sent as wave pulses) because they are a more reliable way than analog signals to encode and transmit information (compare capacity of an LP record to a CD or MP3 player). Another example of this is how digital signals can send information over much longer distances with less loss of information because background noise can be easily converted out by the receiving devices. Wave related technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. Students will integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals. Examples include basic understanding that waves can be used for communication purposes including using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversation of stored binary patterns to make sound or text on a computer screen.

Essential Questions - What provocative questions will foster inquiry and transfer of learning

How do cell phones work?

Why do surfers love physicists?

How do the light and sound system in the auditorium work?

If rotary phones worked for my grandparents, why did they invent cell phones?

Content - Students will know...

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- Describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- Graphs and charts can be used to identify patterns in data.
- Waves can be described with both qualitative and quantitative thinking.
- 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
- 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.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
- Waves are reflected, absorbed, or transmitted through various materials.
- A sound wave needs a medium through which it is transmitted.
- Because light can travel through space, it cannot be a matter wave, like sound or water waves.

- The structure of a wave can be modified to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.
- Structures can be designed to use properties of waves to serve particular functions.
- Waves can be used for communication purposes.
- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information than are analog signals.
- Wave-related technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.

Skills - Students will be able to...

- Use mathematical representations to describe and/or support scientific conclusions about how the amplitude of a wave is related to the energy in a wave.
- Use mathematical representations to describe a simple model.
- Develop and use models to describe the movement of waves in various materials.
- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals are.

Stage 2: Assessment Evidence

Assessment

End of Unit Assessments (multiple choice and constructed responses)

Mini-lab Performance-based Assessments (rubrics)

Essential Questions Responses

Page Keeley Science Probes (formative assessments)

Chapter 15 assessments including tests and quizzes

Chapter 17 assessments including tests and quizzes

MiniLabs

Inquiry Labs

Essential Question Responses

Lab activity worksheets

Performance Assessment: Cell phone vs Rotary phone Debate

Stage 3: Learning Plan

Learning Activities

Waves on a String: With this simulation (from PHeT), students explore the properties of waves and the behavior of waves through varying mediums and at reflective endpoints. There is a teacher's guide and suggested lessons on related topics that incorporate the simulation.

Sound Waves: Students will learn about frequency, amplitude, how to calculate the speed of sound, and sound waves. Electromagnetic Math is designed to supplement teaching about electromagnetism. Students explore the simple mathematics behind light and other forms of electromagnetic energy including the properties of waves, wavelength, frequency, the Doppler shift, and the various ways that astronomers image the universe across the electromagnetic spectrum to learn more about the properties of matter and its movement. This collection of 84 problems provides a variety of practical application in mathematics and science concepts including proportions, analyzing graphs, evaluating functions, the inverse-square law, parts of a wave, types of radiation, and energy. Each one-page assignment includes background information. One-page answer keys accompany the assignments.

MODIFICATIONS FOR ALL STUDENTS:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory

techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Accommodations for students with IEPs and learning difficulties:

-visual sentence frames using academic vocabulary for discussion

-graphic organizers and sentence starters

-graphic organizers for comparing and contrasting of eclipses and revolution/rotation

-Model using globe and “sun” to show revolution and rotation (how the earth moves)

-Model using globe and “moon” to show how moon moves

-Use visuals to show important vocabulary for students to make connections

-Draw pictures for vocabulary words for visual learners

-Have students share their text to text, text to world, and text to self connections

-One on one teacher support for comprehension and fluency

- Modeling and scaffolding to highlight specific vocabulary and key concepts

-close reading chapters/chunks

-rereading key sections for fluency and comprehension

-colored overylays and reading windows to reduce visual distractions

-Sentence starters for writing assignments

-Vocabulary word banks and strategies (Say it, Define it, Act it)

-Think alouds and Think-Pair-Share

-Modified tests/quizzes

-Use of technology to allow students to be read the text, allow for highlighter use, and stop students to think about key ideas/concepts

-End of Unit project of student choice (powerpoint, children's book, or poster)- included graphic organizer for note taking, page numbers, and specific websites

For ELL students:

-visuals for vocabulary

-word wall

-additional word work such as illustrating vocabulary and playing vocabulary games

-partner reading

-choral reading

-Think-aloud while modeling writing

-analyze sample summaries before writing

-color-coded sticky notes for close reading to identify which sticky notes pertain to vocabulary

-questions about text, etc.

-When students make an error in speaking, answer or restate what they said using the correct form without drawing attention to the mistake.

For gifted students:

-Have students complete extended research projects on a related issue of their choice as it pertains to a content area

-Students perform a written/oral debate on topics related to The Big Bang Theory

Resources

Glencoe Earth and Space iScience, McGraw Hill, 2012 (8th grade book)

Chapter 15

Chapter 17

ConnectEd.Mcgraw-hill.com resources

NJDOE Model Curriculum

Quizlet.com

Padlet.com

ebackpack.com

Page Keeley Science Probes

Brain POP shorts

Various literature selections connected to science topics

Unit Reflections & Teacher Notes