NGSS UNIT OVERVIEW

WAVES

Performance Expectation 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.

Performance Expectation MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Performance Expectation 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.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Investigation: It's a Noisy World** Students are introduced to the physical properties of waves with a scenario that engages them in the properties of sound within the context of hearing loss. Students use mathematical representations to analyze data and identify patterns in sound intensity.	MS-PS4.A	Using Mathematics and Computational Thinking Analyzing and Interpreting Data	Patterns	Mathematics: MP.2, MP.4, 6.RP.A.1, 7.RP.A.2 Literacy/ELA: RST.6-8.3
2. **Investigation: Making Sound Waves** Students experiment with producing noises of varied intensity and frequency as they begin to build an understanding of the properties of sound. Students then create a model of a sound wave using a metal spring.	MS-PS4.A	Developing and Using Models	Structure and Function Patterns	Mathematics: MP.2 Literacy/ELA: RST.6-8.3
3. **Reading: The Nature of Sound** Students learn more about longitudinal waves as they obtain, evaluate, and communicate information from text, diagrams, and graphs. Students engage with the crosscutting concept of structure and function as they read about the hearing process and the anatomy of the ear.	MS-PS4.A	Obtaining, Evaluating, and Communicating Information Analyzing and Interpreting Data Using Mathematics and Computational Thinking	Structure and Function Patterns Connections to Engineering, Technology, and Applications of Science	Mathematics: MP.2 Literacy/ELA: RST.6-8.1 RST.6-8.9
4. **Investigation: Noise-Induced Hearing Loss** Students use mathematics and computational thinking as they analyze and interpret data related to the risk of noise-induced hearing loss. Students read the profiles of several individuals and evaluate the risk of noiseinduced hearing loss for each one. Students examine the structure and function of the protection provided by two kinds of ear protection.	MS-PS4.A	Using Mathematics and Computational Thinking Analyzing and Interpreting Data Obtaining, Evaluating, and Communicating Information	Structure and Function	Mathematics: MP.4

WAVES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
5. **Investigation: Telephone Model** Students model how noise interference affects the transmission and reception of analog and digital signals. They find that the structure of digitized signals, sent as wave pulses, function as a more reliable way to encode and transmit information.	MS-PS4.C	Developing and Using Models Obtaining, Evaluating, and Communicating Information	Structure and Function Connections to Engineering, Technology, and Applications of Science	ELA/Literacy: RST.6-8.3 WHST.6-8.9
6. **Reading: Analog and Digital Technology** Students clarify the findings of the previous activity by integrating those results with information in written text. Students explore the history of the development of hearing aids as an example of how technology influences the progress of science and how science has influenced advances in technology. Students are formally assessed on Performance Expectation MS-PS4-3.	MS-PS4.C	Obtaining, Evaluating, and Communicating Information	Structure and Function Connections to the Nature of Science Connections to Engineering, Technology, and Applications of Science	ELA/Literacy: RST.6-8.1 RST.6-8.9 WHST.6-8.9
7. **Investigation: Another Kind of Wave** Students use a model to identify patterns to deduce the inverse relationship between frequency and wavelength, and the direct relationship between amplitude and energy. Students perform calculations and make conceptual connections to make an explanation of the relationships found. Students are formally assessed on Performance Expectation MS-PS4-1.	MS-PS4.A	Developing and Using Models Using Mathematics and Computational Thinking Planning and Carrying OutInvestigations Connections to the Nature of Science Analyzing and Interpreting Data	Patterns	Mathematics: MP.4 ELA/Literacy: RST.6-8.3
8. **Laboratory: Wave Reflection** Students investigate the reflection of sound and light waves. Building on observations of the relationship between the direction of incident and reflected sound waves, students analyze collected data and deduce the law of reflection as applied to light waves. They model the law as they create ray diagrams to represent both regular and diffuse reflection.	MS-PS4.B	Developing and Using Models Planning and Carrying Out Investigations Analyzing and Interpreting Data Using Mathematics and Computational Thinking Connections to the Nature of Science	Patterns Structure and Function	ELA/Literacy: RST.6-8.3

WAVES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
9. **Laboratory: Refraction of Light** Students experiment with the transmission of light rays by planning and carrying out an investigation of the refraction of light through water. Looking for patterns in their data, students search for a qualitative relationship between the angle of incidence, angle of refraction, and total internal reflection.	MS-PS4.B	Developing and Using Models Planning and Carrying Out Investigations Analyzing and Interpreting Data Connections to the Nature of Science	Patterns Structure and Function	ELA/Literacy: RST.6-8.3
10. **Laboratory: Comparing Colors** Students collect evidence that indicates that different colors of light carry different amounts of energy. Students analyzing and interpret light transmission graphs for three different sunglass lenses. They determine which sunglass lens (structure) provides the best protection (function) for the eyes.	MS-PS4.B	Planning and Carrying Out Investigations	Structure and Function	ELA/Literacy: RST.6-8.3
11. **Laboratory: Selective Transmission** Students conduct an investigation to test how different films affect the transmission and absorption of light. As they analyze and interpret the data they have collected, they learn that invisible waves are present at both ends of the visible spectrum. Students select and justify which structural films would be most functional to use on windows in three different situations.	MS-PS4.B	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Structure and Function	Mathematics: MP.2 ELA/Literacy: RST.6-8.3
12. **Reading: The Electromagnetic Spectrum** Students complete a reading that integrates textual and visual information that extends their understanding of the electromagnetic spectrum. Through the examples of classic experiments, students see that scientific knowledge is based on logical and conceptual connections between evidence and explanations. While reading about applications of electromagnetic energy, students are shown how technologies extend the capabilities of scientific investigation.	MS-PS4.A MS-PS4.B	Obtaining, Evaluating, and Communicating Information Connections to the Nature of Science (empirical evidence) Connections to the Nature of Science (new evidence)	Connections to Engineering, Technology, and Applications of Science	ELA/Literacy: RST.6-8.1 RST.6-8.9

WAVES (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
13. **Laboratory: Where Does the Light Go?** Students conduct an investigation of the behavior of ultraviolet and infrared on different surfaces. Students analyze and interpret patterns in their data and then use the model in the activity to explain how structures can be designed to minimize or maximize reflection or absorption. Students are formally assessed on Performance Expectation MS-PS4-2.	MS-PS4.B	Developing and Using Models Planning and Carrying Out Investigations Analyzing and Interpreting Data	Structure and Function Patterns	ELA/Literacy: RST.6-8.3
14. **Laboratory: Blocking Out Ultraviolet** Students apply the concepts of transmission, reflection, and absorption of ultraviolet while planning and carrying out an investigation. Students use models to compare the effectiveness of sunscreen and moisturizing lotion in blocking ultraviolet.	MS-PS4.B	Planning and Carrying Out Investigations Analyzing and Interpreting Data Connections to the Nature of Science Developing and Using Models	Structure and Function	ELA/Literacy: RST.6-8.3
15. **Talking It Over: Personal Protection Plan** Students integrate scientific and technical information in a table with written text to evaluate the relative risk of developing cataracts and skin cancer for several individual profiles. Students create connections between scientific knowledge and society by having students consider how the consequences of actions relate to exposure to ultraviolet.	MS-PS4.B	Obtaining, Evaluating, and Communicating Information	Connections to the Nature of Science	ELA/Literacy: RST.6-8.9 WHST.6-8.9