8th Grade Unit 4 - Waves and the Electromagnetic Spectrum

Content Area: **Science**
Course(s): **Science Grade 8**
Time Period: **MP4**
Length: **45 days**
Status: **Published**

NJSLS - Science

PS3.A	Definitions of Energy
MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
PS3.A	Definitions of Energy
	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
PS3.B	Conservation of Energy and Energy Transfer
	Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
MS-PS3-4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
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.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Science and Engineering Practices

Developing and Using Models

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

Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

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)

Engaging in Argument from Evidence

Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

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)

ETS1.B: Developing Possible Solutions

A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2)

Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

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)

Influence of Science, Engineering, and Technology on Society and the Natural World

Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

Rationale and Transfer Goals

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 an understanding of the core ideas.

Enduring Understandings

Characteristics of waves represent repeating quantities, the number of times the pattern repeats, the maximum extent of the repeating quantity from equilibrium, and the distance in which the quantity repeats its value.

Light travels in straight lines, but the path of light is bent at the interface between materials when it travels from one material to another.

Essential Questions

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 - What will students 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 - What will students be able to do?

- 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.

Activities - How will we teach the content and skills?

- Inspire Science Physical Science Unit 2 Module 1: Lesson 1 Wave Properties
- Inspire Science Physical Science Unit 2 Module 1: Lesson 2 Mechanical Wave Interactions
- Inspire Science Physical Science Unit 2 Module 2: Lesson 1 How Light Travels
- Inspire Science Physical Science Unit 2 Module 2: Lesson 2 Reflection and Mirrors
- Inspire Science Physical Science Unit 2 Module 2: Lesson 3 Refraction and Lenses
- Inspire Science Physical Science Unit 2 Module 2: Lesson 4 Color of Light
- Inspire Science Physical Science Unit 2 Module 3: Lesson 1 Communicating with Signals
- Inspire Science Physical Science Unit 2 Module 3: Modern Communication with Digital Signals
- MS-PS4-1 Lesson Examples
- MS-PS4-2 Lesson Examples
- MS-PS4-3 Lesson Examples

Evidence/Assessments - How will we know what students have learned?

- Inspire Science Labs
- Inspire Science STEM Module Projects
- Inspire Science Physical Science Unit 2 Module 1 Assessment
- Inspire Science Physical Science Unit 2 Module 2 Assessment
- Inspire Science Physical Science Unit 2 Module 3 Assessment
- Daily Warm Ups
- Daily Exit Tickets

- Grade 8 Unit 4 Benchmark Assessment

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. • 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. • 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.	By the end of Grade 5, students understand that: The faster a given object is moving, the more energy it possesses. Energy can be moved from place to place by moving objects or through sound, light, or electric currents. Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Light transfers energy from place to place. Energy can be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or	4-PS4-1 Activities 4-PS4-2 Activities 4-PS4-3 Activities

	light. The currents may have been produced to begin with by the transformation of energy of motion into electrical energy. Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. An object can be seen when light reflected from its surface enters the eyes. Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.	

Key Resources

Inspire Science

Waves on a String

Sound Waves

Electromagnetic Math

21st Century Life and Careers

9.2.8.CAP.8	Compare education and training requirements, income potential, and primary duties of at least two jobs of interest.

Career Readiness, Life Literacies, & Key Skills

9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).
9.4.8.CT.3	Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
9.4.8.IML.3	Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
9.4.8.IML.4	Ask insightful questions to organize different types of data and create meaningful visualizations.
9.4.8.IML.5	Analyze and interpret local or public data sets to summarize and effectively communicate the data.
9.4.8.TL.1	Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).

Interdisciplinary Connections/Companion Standards

NJSLS ELA

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3)

RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1, MS-PS4-2)

NJSLS Mathematics

MP.2 Reason abstractly and quantitatively. (MS-PS4-1)

MP.4 Model with mathematics. (MS-PS4-1)

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1)

7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-PS4-1)

8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1)