

Winslow Township School District
Laboratory Physics
Unit 4

Overview: In this unit of study, students apply their understanding of how wave properties can be used to transfer information across long distances, store information, and investigate nature on many scales. The crosscutting concept of *cause and effect* is highlighted as an organizing concept for these disciplinary core ideas. Students are expected to demonstrate proficiency in *using mathematical thinking*, and to use this practice to demonstrate understanding of the core idea.

Students are able to apply their understanding of wave properties to make sense of how electromagnetic radiation can be used to transfer information across long distances, store information, and be used to investigate nature on many scales. Models of electromagnetic radiation as both a wave of changing electrical and magnetic fields or as particles are developed and used. Students also demonstrate their understanding of engineering ideas by presenting information about how technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. The crosscutting concepts of *systems and system models; stability and change; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world* are highlighted as organizing concepts. Students are expected to demonstrate proficiency in *asking questions, engaging in argument from evidence, and obtaining, evaluating, and communicating information*, and they are expected to use these practices to demonstrate understanding of the core ideas.

Overview	Standards for Science	Unit Focus	Essential Questions
<p><u>Unit 4</u></p> <p>Wave Properties</p> <p>Electromagnetic Radiation</p>	<ul style="list-style-type: none"> • HS-PS4-1 • HS-PS4-3 • HS-PS4-4 • HS-PS4-2 • WIDA 1,4 	<ul style="list-style-type: none"> • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. • Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. • Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture 	<p><i>How are waves used to transfer energy and send and store information?</i></p> <p><i>Why has digital technology replaced analog technology?</i></p>

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		<p>information and energy.</p> <ul style="list-style-type: none"> • Evaluate questions about the advantages of using a digital transmission and storage of information. • Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. • Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 	
<p><i>Unit 4: Enduring Understandings</i></p>	<ul style="list-style-type: none"> • The wavelength and frequency of a wave related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. <p>Empirical evidence is required to differentiate between cause and correlation and to make a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.</p> <ul style="list-style-type: none"> • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. 		

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- A wave model or a particle model (e.g., physical, mathematical, computer models) can be used to describe electromagnetic radiation—including energy, matter, and information flows—within and between systems at different scales.

A wave model and a particle model of electromagnetic radiation are based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.

Cause-and-effect relationships can be suggested and predicted for electromagnetic radiation systems when matter absorbs different frequencies of light by examining what is known about smaller scale mechanisms within the system.

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Curriculum Unit 4	Standards		Pacing	
			Days	Unit Days
Unit 4: Wave Properties Electromagnetic Radiation	PS2.A HS-PS2-1 HS-PS2-2	<ul style="list-style-type: none"> Students will study the periodic motion called simple harmonic motion. They will learn about the relationship between simple harmonic vibrations and waves. Students will study the many physics aspects of sound, including the nature of sound waves, frequency, intensity, resonance and harmonics. 	20	50
	HS-ETS1-2 HS-ETS1-3 PS3.A PS3.B HS-PS3-2 HS-PS3-1 HS-PS3-3 HS-PS4-1 HS-PS4-3	<ul style="list-style-type: none"> Students will learn about the characteristics of light and other forms of electromagnetic. They will learn how flat and curved mirrors can be used to reflect light and create real and virtual images of objects. 	15	
	PS3.A PS3.B HS-PS3-2 HS-PS3-1 HS-PS3-3 HS-ETS1-1 HS-PS4-4 HS-PS4-5	<ul style="list-style-type: none"> Students will study optical phenomena associated with the refraction of light as it passes from one transparent medium to another. They will learn how to analyze converging and diverging lenses and better understand how optical devices work. 	12	
	Assessment, Re-teach and Extension		3	

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Disciplinary Core Ideas	Indicator #	Indicator
<p>PS4.A: Wave Properties</p> <ul style="list-style-type: none"> The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. <p>PS4.B: Electromagnetic Radiation</p> <ul style="list-style-type: none"> Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. Photoelectric materials emit electrons when they absorb light of a high-enough frequency. <p>PS4.C: Information Technologies and Instrumentation</p>	HS-PS4-1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
	HS-PS3-1	Create a computational model or simulation of a phenomenon, designed device, process, or system.
	HS-PS3-3 HS-PS4-3 HS-PS4-4 HS-PS4-5 HS-ETS1-1 HS-ETS1-3	<p>Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.</p> <p>Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.</p> <p>Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.</p> <p>Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.</p>

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<ul style="list-style-type: none">Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. <p>ETS1.A: Defining and Delimiting Engineering Problems</p> <ul style="list-style-type: none">Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none">When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.		<p>Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).</p> <p>Analyze complex real-world problems by specifying criteria and constraints for successful solutions.</p> <p>Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.</p> <p>Evaluate a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.</p>
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• Assessment Plan	
<ul style="list-style-type: none"> • Exploratory activities • Warm-up activities • Individual/Group Lab report • Class discussions • Student Participation • Teacher Observations 	<ul style="list-style-type: none"> • Quizzes • Tests • Authentic assessments and projects • Exploratory activities • Presentations
Resources	Activities
<ul style="list-style-type: none"> • Chromebooks • Textbook • Reading Essentials Workbook • Web Quests • Virtual Field Trips • Video Streaming • BrainPOP • Puzzlemaker: Game Based Learning Discovery Education • Solar System Revolution Webquest: https://njctl.org/courses/archived-courses-units/6thgrade-science/earth-and-the-solar-system/attachments/solar-system-revolution-webquest/ • Eclipse Activity: https://njctl.org/courses/archived-courses-units/6thgrade-science/earth-and-the-solar-system/attachments/eclipse-activity/ <p>Diversity, Equity & Inclusion Educational Resources https://www.nj.gov/education/standards/dei/</p>	<ul style="list-style-type: none"> • Use physical models to examine the phases of the moon using a light source and a moon model to view the various shapes of the moon as it orbits the earth and keep a lunar calendar for one month and analyze the results by looking for differences and patterns. • Measure the acceleration of the objects as they fall from various heights and determine that the objects speed up as they fall, therefore proving that a force is acting on them. • mini-lessons • independent reading • films • website exploration • discussions, dialogues • debates • partner or small group work • student presentations, reports, journals, reflections, • in-class assessments, • written reports, essays, research, and homework

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Instructional Best Practices and Exemplars

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| 1. Identifying similarities and differences
2. Summarizing and note taking
3. Reinforcing effort and providing recognition
4. Homework and practice
5. Nonlinguistic representations | 6. Cooperative learning
7. Setting objectives and providing feedback
8. Generating and testing hypotheses
9. Cues, questions, and advance organizers
10. Manage response rates |
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9.1 Personal Financial Literacy, 9.2 Career Awareness, Exploration, Preparation and Training & 9.4 Life Literacies and Key Skills

- 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs
- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.

The implementation of the 21st Century skills and standards for students of the Winslow Township District is infused in an interdisciplinary format in a variety of curriculum areas that include, English language Arts, Mathematics, School Guidance, Social Studies, Technology, Visual and Performing Arts, Science, Physical Education and Health, and World Language.

Additional opportunities to address 9.1, 9.2 & 9.4:

Philadelphia Mint

<https://www.usmint.gov/learn/kids/resources/educational-standards>

Different ways to teach Financial Literacy.

<https://www.makeuseof.com/tag/10-interactive-financial-websites-teach-kids-money-management-skills/>

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Modifications for Special Education/504

Students with special needs: The students' needs will be addressed on an individual and grade level using a variety of modalities. Accommodations will be made for those students who need extra time to complete assignment. Support staff will be available to aid students related to IEP specifications. 504 accommodations will also be attended to by all instructional leaders. Physical expectations and modifications, alternative assessments, and scaffolding strategies will be used to support this learning. The use of Universal Design for Learning (UDL) will be considered for all students as teaching strategies are considered.

- Small group instruction
- Audio books/ Text-to-speech platforms
- Leveled texts/Vocabulary Readers
- Leveled informational texts via online
- Modeling and guided practice
- Read directions aloud
- Repeat, rephrase and clarify directions
- Extended time as needed
- Break down assignments into smaller units
- Provide shortened assignments
- Modify testing format
- Repeat directions as needed
- Graphic organizers
- Study Guides, Study Aids and Re teaching as needed

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Modifications for At-Risk Students

Formative and summative data will be used to monitor student success. At first signs of failure, student work will be reviewed to determine support. This may include parent consultation, basic skills review and differentiation strategies. With considerations to UDL, time may be a factor in overcoming developmental considerations

- Audio books and Text-to-speech platforms
- Leveled texts/Vocabulary Readers
- Leveled informational texts via online
- Extended time as needed
- Read directions aloud
- Assist with organization
- Use of computer
- Emphasize/highlight key concepts
- Recognize success
- Provide timelines for work completion
- Break down multi-step tasks into smaller chunks
- Provide copy of class notes and graphic organizer

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English Language Learners	Modifications for Gifted Students
<p>All WIDA Can Do Descriptors can be found at this link: https://wida.wisc.edu/teach/can-do/descriptors</p> <p><input type="checkbox"/> Grades 9-12 WIDA Can Do Descriptors:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Listening <input type="checkbox"/> Speaking <input type="checkbox"/> Reading <input type="checkbox"/> Writing <input type="checkbox"/> Oral Language <p>Students will be provided with accommodations and modifications that may include:</p> <ul style="list-style-type: none"> • Relate to and identify commonalities in science studies in student’s home country • Assist with organization • Use of computer • Emphasize/highlight key concepts • Teacher Modeling • Peer Modeling • Label Classroom Materials - Word Walls 	<p>Students excelling in mastery of standards will be challenged with complex, high level challenges related to the topic.</p> <ul style="list-style-type: none"> • Raise levels of intellectual demands • Require higher order thinking, communication, and leadership skills • Differentiate content, process, or product according to student’s readiness, interests, and/or learning styles • Provide higher level texts • Expand use of open-ended, abstract questions • Critical and creative thinking activities that provide an emphasis on research and in-depth study • Enrichment Activities/Project-Based Learning/ Independent Study <p>Additional Strategies may be located at the links:</p> <ul style="list-style-type: none"> ❖ Gifted Programming Standards ❖ Webb’s Depth of Knowledge Levels and/or Revised Bloom’s Taxonomy ❖ REVISED Bloom’s Taxonomy Action Verbs

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Interdisciplinary Connections

- ELA:**
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

- Math:**
MP.2 Reason abstractly and quantitatively.
MP.4 Model with mathematics.
6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
7.RP.A.2 Recognize and represent proportional relationships between quantities.
6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
7.EE.B.6 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.
their context.

Integration of Computer Science and Design Thinking NJSL 8

- 8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
8.2.12.EC.3: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.