5 Electromagentic Radiation

Content Area: **Science**
Course(s): **Applied Physical Science**
Time Period: **February**
Length: **25 days**
Status: **Published**

Unit Overview:

In this unit of study, 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.

Enduring Understandings:

- Light is a phenomena that has both wave and particle behaviors.
- There are a variety of wave types and classifications.
- Wave have predictable characteristics and behaviors.
- Waves are nature's way of transferring energy without transferring matter.

Essential Questions:

- How can one explain the varied effects that involve light?
- What creates EM waves?
- What other forms of electromagnetic radiation are there?
- Why are EM waves given different names?
- Why are there different colors of light?

Standards/Indicators/Student Learning Objectives (SLOs):

- SWBAT demonstrate proficiency in asking questions, engaging in argument from evidence, and obtaining, evaluating, and communicating information
- SWBAT explain what causes EM waves and why they are given different names
- SWBAT explain why some forms of light are more dangerous than others

- SWBAT why different forms of radiation have different frequencies

SCI.HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
SCI.HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
SCI.HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
SCI.HS-PS4-3	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.
9-12.HS-PS4-3.PS4.A.1	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. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.)
9-12.HS-PS4-5.PS4.B	Electromagnetic Radiation
9-12.HS-PS4-5.PS4.B.1	Photoelectric materials emit electrons when they absorb light of a high-enough frequency.
9-12.HS-PS4-4.PS4.B.1	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.

Lesson Titles:

- digital transmission
- Dual nature of light
- Effects on EM waves on matter
- EM spectrum
- Photoelectric effect
- Solar Cells
- Technology and Waves

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RH.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
LA.RH.11-12.2	Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text.
LA.RH.11-12.3	Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
LA.RH.11-12.4	Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
LA.RH.11-12.6	Evaluate authors' differing perspectives on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RH.11-12.8	Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.RH.11-12.9	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
MA.N-VM.A.1	Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\lvert\boldsymbol{v}\rvert$, $\lvert\lvert\boldsymbol{v}\rvert\rvert$, $\boldsymbol{v}$).
MA.N-VM.B.5	Multiply a vector by a scalar.
LA.WHST.11-12.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.WHST.11-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
LA.WHST.11-12.6	Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.
	An expression is a record of a computation with numbers, symbols that represent numbers, arithmetic operations, exponentiation, and, at more advanced levels, the operation of evaluating a function. Conventions about the use of parentheses and the order of operations assure that each expression is unambiguous. Creating an expression that describes a computation involving a general quantity requires the ability to express

the computation in general terms, abstracting from specific instances.

An equation is a statement of equality between two expressions, often viewed as a question asking for which values of the variables the expressions on either side are in fact equal. These values are the solutions to the equation. An identity, in contrast, is true for all values of the variables; identities are often developed by rewriting an expression in an equivalent form.

Algebraic manipulations are governed by the properties of operations and exponents, and the conventions of algebraic notation. At times, an expression is the result of applying operations to simpler expressions. For example, p + 0.05p is the sum of the simpler expressions p and 0.05p. Viewing an expression as the result of operation on simpler expressions can sometimes clarify its underlying structure.

The same solution techniques used to solve equations can be used to rearrange formulas. For example, the formula for the area of a trapezoid, ð˜ˆ = ((ð˜£â‚+ð˜£â‚‚)/2)ð˜©, can be solved for ð˜© using the same deductive process.

The solutions of an equation in one variable form a set of numbers; the solutions of an equation in two variables form a set of ordered pairs of numbers, which can be plotted in the coordinate plane. Two or more equations and/or inequalities form a system. A solution for such a system must satisfy every equation and inequality in the system.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Digital Transmission notes
- EM waves notes
- Microwave online lab
- NASA background information
- Photoelectric online lab
- Radio waves online lab
- Solar Cells notes
- wave interference simulation

Modifications

ELL Modifications:

- Focus on domain specific vocabulary and keywords
- Front load information
- Group students
- Provide ELL students with multiple literacy strategies
- Sheltered English Instruction
- Use real objects when possible

IEP & 504 Modifications:

- less none of the above, all of the above, which of the following apply, or which do not apply type questions (again it is testing for understanding of the question not the content)
- providing students with content vocabulary prior to teaching a lesson including that vocabulary (pre-teaching)
- providing study guides that don't lead the student to study too much extraneous information (less unnecessary details)/scaffolded study guides
- scaffolded notes
- teaching the main ideas/concepts (limiting not needed details)to be taught and repeating them in several different ways over several different days (goal is 7 different ways same concept for students with learning disabilities)

G&T Modifications:

- Determine where students' interests lie and capitalize on their inquisitiveness. (Is there a specific career they are interested in? How would this apply to their interest?)
- Employ differentiated curriculum to keep interest high.
- Encourage students to explore concepts in depth and encourage independent studies or investigations.
- Invite students to explore different points of view on a topic of study and compare the two.
- Provide additional rigorous challenge problems for advanced students
- Student led/directed discussions

At Risk Modifications

- guided notes
- hands-on Instruction
- modeling and showing lots of examples
- non-verbal redirection of behaviors
- outlines & graphic organizers
- scaffolded notes
- slower pacing of materials
- study guides

Alternative assessments:

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Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Benchmark Assessments:

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Skills-based assessment

Reading response

Writing prompt

Lab practical

Formative Assessment:

- Anticipatory Set
- Applied Light quiz
- Closure
- EM spectrum quiz
- Warm-Up

Summative Assessment:

- Alternate Assessment
- EM radiation unit test
- Marking Period Assessment
- Personalized assessment

Resources & Materials:

- Lab equipment

- Notes
- practice
- study guides

Technology:

- Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs. 8.1.12.D.5
- Apply previous content knowledge by creating and piloting a digital learning game or tutorial. 8.1.12.B.2
- chromebook
- Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community. 8.1.12.C.1
- https://phet.colorado.edu/en/simulation/color-vision
- https://phet.colorado.edu/en/simulation/microwaves
- https://phet.colorado.edu/en/simulation/mri
- https://phet.colorado.edu/en/simulation/radio-waves
- https://phet.colorado.edu/en/simulation/wave-interference
- https://sites.google.com/site/mantonphysicalscience/
- Internet
- Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers. 8.1.12.E.2

TECH.8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
TECH.8.1.12.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.F.CS1	Identify and define authentic problems and significant questions for investigation.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.