



Standard #: SC.912.P.10.18

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Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications.

General Information

Subject Area: Science

Grade: 912

Body of Knowledge: Physical Science

Idea: Level 3: Strategic Thinking & Complex Reasoning

Standard: Energy -

Date Adopted or Revised: 02/08

A. Energy is involved in all physical and chemical processes. It is conserved, and can be transformed from one form to another and into work. At the atomic and nuclear levels energy is not continuous but exists in discrete amounts. Energy and mass are related through Einstein's equation $E=mc^2$.

B. The properties of atomic nuclei are responsible for energy-related phenomena such as radioactivity, fission and fusion.

C. Changes in entropy and energy that accompany chemical reactions influence reaction paths. Chemical reactions result in the release or absorption of energy.

D. The theory of electromagnetism explains that electricity and magnetism are closely related. Electric charges are the source of electric fields. Moving charges generate magnetic fields.

E. Waves are the propagation of a disturbance. They transport energy and momentum but do not transport matter.

Content Complexity Rating: [Level 3: Strategic Thinking & Complex Reasoning](#) - [More Information](#)

Date of Last Rating: 05/08

Status: State Board Approved

Related Courses

Course Number	Course Title
2001350:	Astronomy Solar/Galactic (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2020910:	Astronomy Solar/Galactic Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000370:	Botany (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003340:	Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003350:	Chemistry 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001310:	Earth/Space Science (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001320:	Earth/Space Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002480:	Forensic Science 1 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2002490:	Forensic Sciences 2 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2002440:	Integrated Science 3 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002450:	Integrated Science 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003400:	Nuclear Radiation (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2020710:	Nuclear Radiation Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003310:	Physical Science (Specifically in versions: 2015 - 2022 (current), 2022 and beyond)
2003320:	Physical Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003380:	Physics 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003390:	Physics 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003410:	Physics 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003610:	Principles of Technology 2 (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2003800:	Florida's Preinternational Baccalaureate Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
7920011:	Access Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
7920020:	Access Earth/Space Science (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
2002445:	Integrated Science 3 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2003345:	Chemistry 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)

2003385:	Physics 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2003500:	Renewable Energy 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003836:	Florida's Preinternational Baccalaureate Physics 1 (Specifically in versions: 2015 - 2022 (current), 2022 and beyond)
2003838:	Florida's Preinternational Baccalaureate Physics 2 (Specifically in versions: 2015 and beyond (current))
7920022:	Access Physical Science (Specifically in versions: 2016 - 2018, 2018 and beyond (current))
2001330:	Meteorology Honors (Specifically in versions: 2016 - 2019, 2019 - 2022 (current), 2022 and beyond)

Related Access Points

Access Points Number	Access Points Title
SC.912.P.10.In.9:	Identify common applications of electromagnetic waves moving through different media, such as radio waves, microwaves, x-rays, or infrared.
SC.912.P.10.Su.10:	Recognize examples of electromagnetic waves moving through different media, such as microwave ovens, radios, and x-rays.
SC.912.P.10.Pa.10:	Recognize primary and secondary colors in visible light.

Related Resources

Lesson Plan

Name	Description
Rainbow Lab: Investigating the Visible Spectrum:	This activity will explore the connection between wavelength and frequency of colors in the visible light using web sites, hand-spectroscopes, spectral tubes and CSI type investigations.

Perspectives Video: Experts

Name	Description
Fire Energy and Intensity:	In this video, wildland fire scientist Kevin Hiers explains how technology can be used to aid fire behavior research in fire-dependent ecosystems. Download the CPALMS Perspectives video student note taking guide .
Conservation and Conversion of Energy in a Military Weapons Testing Environment:	Dr. Betta Jerome, a senior mechanical engineer with the United States Air Force, explains energy conversion and conservation within the context of military weapons testing. Download the CPALMS Perspectives video student note taking guide .
Light Spectrum for Growing Plants:	Plants need visible light, just not all of it. Learn how space plants and their lights strive for efficiency. Download the CPALMS Perspectives video student note taking guide .

Perspectives Video: Professional/Enthusiasts

Name	Description
Skin Radiation Technologies for Medical Therapy:	Dr. George Cohen discusses a variety of skin treatments that utilize electromagnetic radiation, including lasers, UV light, and x-rays. Download the CPALMS Perspectives video student note taking guide .
Protection from Radiation during Glass Art Fabrication:	Glass artist Russel Scaturro explains protective measures taken to prevent damage from UV and IR radiation during glass art fabrication. Download the CPALMS Perspectives video student note taking guide .
Color in Glass Art Fabrication:	Glass artist Russel Scaturro explains some of the chemistry, purpose, and methodology behind his use of color in glass art fabrication. Download the CPALMS Perspectives video student note taking guide .
Practical Applications of Radar for Global Space Monitoring:	Second Lieutenant Caleb McComas, a crew commander with the 20th Space Control Squadron at Eglin Air Force Base, explains how radar technology is vital to missions and objectives of the United States Air Force. Download the CPALMS Perspectives video student note taking guide .
Understanding Light and Color for Bird Photography:	Don't feel blue because you don't understand how light is used in bird photography! Watch this instead. Produced with funding from the Florida Division of Cultural Affairs. Download the CPALMS Perspectives video student note taking guide .
Seeing into Atoms with Electromagnetic Energy:	If you want to understand the atom, you'll need a lot of energy. Learn how physicists use high energy light and electrons to study atomic structure. Download the CPALMS Perspectives video student note taking guide .
Using X-rays in Archeology:	An archaeologist explains how he is using x-rays to reconstruct a nineteenth-century battle! Download the CPALMS Perspectives video student note taking guide .
Plan Your Archaeological	Archaeologists can see underground trends before everyone else with ground penetrating radar (GPR).

Excavations with Radar Waves! :	Download the CPALMS Perspectives video student note taking guide .
Optical Spectroscopy: Using Electromagnetic Waves to Detect Fires:	Hydrogen is used to launch spacecraft, but accidental fires are difficult to see. Learn about the physics of these fires and how we detect them. Download the CPALMS Perspectives video student note taking guide .
Art and Prototyping with Laser-cut Materials:	Blaze a trail when you utilize laser technology to make art. Download the CPALMS Perspectives video student note taking guide .

Perspectives Video: Teaching Ideas

Name	Description
Which has More Energy, Red or Blue Light?:	This colorful light and energy lesson idea will make you glow! Download the CPALMS Perspectives video student note taking guide .
Light Frequency and Energy:	Check out this idea for an illuminating demonstration of light energy. Download the CPALMS Perspectives video student note taking guide .

Resource Collection

Name	Description
Exploring Magnetism Lesson Series:	"These seven NASA-funded magnetism guides contain activity- or math-based lessons on magnetic fields. The science and mathematics education standards these activities cover are in the beginning of the guides... These guides were developed as part of the Education and Public Outreach programs of the following NASA science missions: STEREO-IMPACT, RHESSI, THEMIS, and FAST." These are modules, including student worksheets, about magnetism in general and especially about the Earth's magnetic field.

Text Resources

Name	Description
The Electromagnetic Spectrum:	This informational text resource is intended to support reading in the content area. The text explains the source of electromagnetic waves and surveys the types, including examples of each.
Noble Gas Molecule Discovered in Space:	This informational text resource is intended to support reading in the content area. The article discusses how the noble gas compound was discovered along with suggestions on how it might have formed and some of its properties.
X-ray 'Eyes':	This informational text resource is intended to support reading in the content area. Scientists have discovered that X-rays can be used to photograph the movement of atoms and molecules in chemical reactions (i.e., photosynthesis).

Tutorials

Name	Description
Refraction of Light:	This resource explores the electromagnetic spectrum and waves by allowing the learner to observe the refraction of light as it passes from one medium to another, study the relation between refraction of light and the refractive index of the medium, select from a list of materials with different refractive indices, and change the light beam from white to monochromatic and observe the difference.
Basic Electromagnetic Wave Properties:	<ul style="list-style-type: none"> • Explore the relationship between wavelength, frequency, amplitude and energy of an electromagnetic wave • Compare the characteristics of waves of different wavelengths

Video/Audio/Animation

Name	Description
Light is a Particle:	This video contains a demo that can be performed to show that light consists of particles It also uses Lasers with different wavelengths

Virtual Manipulatives

Name	Description
Black body Spectrum:	In this simulation, learn about the black body spectrum of the sun, a light bulb, an oven and the earth. Adjust the temperature to see how the wavelength and intensity of the spectrum are affected.
Photoelectric Effect:	This virtual manipulative will help the students to understand how the light shines on a metal surface. Students will recognize a process called as photoelectric effect wherein light can be used to push electrons from the surface of a solid. Some of the sample learning goals can be: <ul style="list-style-type: none"> • Visualize and describe the photoelectric effect experiment. • Predict the results of the experiment, when the intensity of light is changed and its effects on the current and energy of the electrons. • Predict the results of the experiment, when the wavelength of the light is changed and its effects on the current and the energy of the electrons. • Predict the results of the experiment, when the voltage of the light is changed and its effects on the current and energy of electrons.

This activity will help to investigate how a greenhouse gas affects the climate, or why the ozone layer is important. Using this simulation, explore how light interacts with molecules in our atmosphere.

Areas to explore:

- How light interacts with molecules in our atmosphere.
- Identify that absorption of light depends on the molecule and the type of light.
- Relate the energy of the light to the resulting motion.
- Identify that energy increases from microwave to ultraviolet.
- Predict the motion of a molecule based on the type of light it absorbs.
- Identify how the structure of a molecule affects how it interacts with light.

[Molecules and Light:](#)

Student Resources

Perspectives Video: Expert

Name	Description
Light Spectrum for Growing Plants:	Plants need visible light, just not all of it. Learn how space plants and their lights strive for efficiency. Download the CPALMS Perspectives video student note taking guide .

Perspectives Video: Professional/Enthusiasts

Name	Description
Seeing into Atoms with Electromagnetic Energy:	If you want to understand the atom, you'll need a lot of energy. Learn how physicists use high energy light and electrons to study atomic structure. Download the CPALMS Perspectives video student note taking guide .
Using X-rays in Archeology:	An archaeologist explains how he is using x-rays to reconstruct a nineteenth-century battle! Download the CPALMS Perspectives video student note taking guide .
Plan Your Archaeological Excavations with Radar Waves! :	Archaeologists can see underground trends before everyone else with ground penetrating radar (GPR). Download the CPALMS Perspectives video student note taking guide .
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[Molecules and Light:](#)

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- Identify that energy increases from microwave to ultraviolet.
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- Identify how the structure of a molecule affects how it interacts with light.

Parent Resources

Perspectives Video: Expert

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