

Unit 1 - Electromagnetic Radiation and the Origin of the Universe

Content Area: **Science**
Course(s): **Introduction to Astronomy**
Time Period: **1st Marking Period**
Length: **~17 Days (2 Days Per Week)**
Status: **Published**

Unit Overview

In this Unit, students will explore the nature of light, the electromagnetic spectrum and relate those findings to the evidence that the Universe was created in the Big Bang Theory.

[Sequence and Pacing Guide](#)

Transfer

Students will be able to independently use their learning to relate uses of electromagnetic radiation to understanding astronomical findings.

Meaning

Understandings

Students will understand that...

All objects in the Universe influence one another.

Electromagnetic Radiation is the key factor in the origin and evolution of the universe and the sustainability of life.

The Big Bang Theory is responsible for the origin of elements.

Essential Questions

Students will keep considering...

How do interactions between objects influence whether life is sustainable?

How is radiation both bad and good for human life?

How can we recreate natural processes for advancement of science and technology?

Application of Knowledge and Skill

Students will know...

Students will know...

The Doppler Effect is key to understanding how objects in the Universe move.

That the many forms of electromagnetic radiation are used to analyze astronomical objects.

The Big Bang Theory is currently the best explanation for the origin of the Universe.

Students will be skilled at...

Students will be skilled at...

Analyzing Spectra of elements in order to determine amounts of radiation and Energy.

Using various forms of the EM Spectrum to create magnetic fields.

Determine characteristics of EM Radiation in the Universe.

Academic Vocabulary

Astronomical Unit

Big Bang

Doppler Effect

Electromagnetic Radiation

Electromagnetic Spectrum

Galaxy

Light Year

Magnetic Field

Parallax

Photon

Spectroscopy

Radio Waves

Microwaves

Infrared

Visible Spectrum

Ultraviolet Rays

X-Rays

Gamma Rays

Learning Goal 1

Analyze and Evaluate the Electromagnetic Spectrum.

Proficiency Scale

- Analyze and Evaluate the Electromagnetic Spectrum

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-ESS1-1.ESS1.A.1

The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.

9-12.HS-ESS2-2.ESS2.D.1

The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.

9-12.HS-PS3-3.PS3.D.1

Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.

Target 1

SWBAT observe bright line spectra of elements.

- : SWBAT observe bright line spectra of elements

Target 2

SWBAT investigate visible region of the EM Spectrum.

- SWBAT investigate visible region of the EM Spectrum

Target 3

SWBAT investigate invisible regions of the EM Spectrum.

- SWBAT investigate invisible regions of the EM Spectrum

Learning Goal 2

Visualize the Interaction of Objects in Electric and Magnetic Fields.

Proficiency Scale

- Visualize the Interaction of Objects in Electric and Magnetic Fields

SCI.HS-PS3-5

Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

9-12.HS-PS2-3.PS2.B.1

Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

Target 1

SWBAT relate EM Spectrum components to Radiation.

- SWBAT relate EM Spectrum components to Radiation

Target 2

SWBAT diagram interactions of components in a Magnetic Field.

- SWBAT diagram interactions of components in a Magnetic Field

Target 3

SWBAT map Earth's magnetic field

- SWBAT map Earth's magnetic field

Learning Goal 3

Explain that the origin of the Universe and its Evolution are best explained by the Big Bang Theory.

Proficiency Scale

- Explain that the origin of the Universe and its Evolution are best explained by the Big Bang Theory.

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| SCI.HS-ESS1-2 | Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. |
| 9-12.HS-PS1-1.PS1.A.1 | Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. |
| 9-12.HS-PS1-1.PS1.A.3 | Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. |
| 9-12.HS-PS1-8.PS1.C.1 | Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. |
| 9-12.HS-PS3-1.PS3.A.1 | Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. |
| 9-12.HS-PS3-1.PS3.B.1 | Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. |
| 9-12.HS-PS3-1.PS3.B.2 | Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. |
| 9-12.HS-PS3-1.PS3.B.3 | Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. |
| 9-12.HS-PS3-1.PS3.B.4 | The availability of energy limits what can occur in any system. |

Target 1

SWBAT define the Doppler Effect.

- SWBAT define the Doppler Effect

Target 2

SWBAT relate EM Radiation movements to Universe Evolution.

- SWBAT relate EM Radiation movements to Universe Evolution

Target 3

SWBAT create a timeline of the Universe from the Big Bang forward.

- SWBAT create a timeline of the Universe from the Big Bang forward

Formative Assessment and Performance Opportunities

Group Activities include but not limited to: Spectral Lab, Mapping Magnetic Fields, and Timeline of Big Bang Theory. In-class discussion include students weighing evidence and constructing explanations on the nature of EM Radiation. Daily Activities provide reinforcement for Learning Targets for this Unit that build toward understanding the Learning Goals and ultimately the Summative Assessment.

Summative Assessment

This Unit Summative Assessment will include students analyzing spectral sources, creating visual representations of sources of Electromagnetic Radiation, and modelling astronomical scale, both in terms of size and in terms of time.

21st Century Life and Careers

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

12.9.3.ST.2

Use technology to acquire, manipulate, analyze and report data.

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| 12.9.3.ST.6 | Demonstrate technical skills needed in a chosen STEM field. |
| 12.9.3.ST-ET.1 | Use STEM concepts and processes to solve problems involving design and/or production. |
| 12.9.3.ST-ET.6 | Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner. |
| 12.9.3.ST-SM.1 | Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities. |
| 12.9.3.ST-SM.2 | Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. |
| 12.9.3.ST-SM.3 | Analyze the impact that science and mathematics has on society. |
| 12.9.3.ST-SM.4 | Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data. |
| CRP.K-12.CRP1 | Act as a responsible and contributing citizen and employee. |
| CRP.K-12.CRP2 | Apply appropriate academic and technical skills. |
| CRP.K-12.CRP4 | Communicate clearly and effectively and with reason. |
| CRP.K-12.CRP7 | Employ valid and reliable research strategies. |
| CRP.K-12.CRP8 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| CRP.K-12.CRP9 | Model integrity, ethical leadership and effective management. |
| CRP.K-12.CRP11 | Use technology to enhance productivity. |
| CRP.K-12.CRP12 | Work productively in teams while using cultural global competence. |

Accommodations/Modifications

All instruction, labs, activities, and assessments will be modified and enhanced to adhere to individual student's IEPs and 504s.

Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.

Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).

Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.

Use project-based science learning to connect science with observable phenomena.

Structure the learning around explaining or solving a social or community-based issue.

Provide ELL students with multiple literacy strategies.

Collaborate with after-school programs or clubs to extend learning opportunities.

Provide students with opportunities to create their own discussion questions

Provide a variety of EM Spectrum charts formatted in different ways so that students can choose how to best understand its organization.

For EM Spectrum Lab, allow students to use EM Spectrum charts while participating in the activity.

For Magnetic Fields, allow students use of magnets to simulate fields.

For discussion of the big bang theory, use videos and charts created by instructor.

Solar Wind Simulations: http://lasp.colorado.edu/outerplanets/wind_tunnel/

For IR Understanding, work with Photography Classes using IR cameras

Unit Resources

Astronomy: A Self-Teaching Guide, 8th ed. Dinah L. Moche, Wiley and Sons

Teacher Generated Presentations

Student-Generated Discussion Questions

Size and Scale Activity: https://docs.google.com/document/d/1BgfVuuJr85PG_K7ULtoQ2RsAPdMoaQXgj-5RUznRo5k/edit?usp=sharing

NAAP Labs: <https://astro.unl.edu/naap/>

Spectral Tube Lab: https://docs.google.com/document/d/1QkskkGqvS8jJIAGhl_zsGXja7JWcKJCJ6- ezXAVpfSU/edit?usp=sharing

Hubble Law

Lab: <https://drive.google.com/file/d/1xp05s3MbT2iWGrZgkPhpbN8QHVEO2VXV/view?usp=sharing>

Electromagnetic Spectrum Charts

EM Spectrum Lab: http://www.glencoe.com/sites/common_assets/science/virtual_labs/CT05/CT05.html

Magnetic Field Lab: <https://www.nationalgeographic.org/activity/magnetic-fields-lab/>

Big Bang Theory Time Line: <https://www.pbs.org/wgbh/nova/origins/univ-nf.html>

Animations and videos on the Doppler effect and the observed redshift in the universe -

<https://www.ck12.org/earth-science/expansion-of-the-universe/lesson/Expansion-of-the-Universe-HS-ES/>

Universe Evolution - <https://wmap.gsfc.nasa.gov/media/030651/index.html>,

Parallax Lab: https://docs.google.com/document/d/13zg3BheJv5mn8EbRWm-gCCEzU20bbTHr_1rv14EYbrg/edit?usp=sharing

Interdisciplinary Connections

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| LA.SL.11-12.5 | Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. |
| LA.RST.9-10.8 | Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. |
| 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.WHST.11-12.2 | Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. |
| LA.WHST.11-12.7 | Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| LA.WHST.11-12.8 | Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. |
| LA.WHST.11-12.9 | Draw evidence from informational texts to support analysis, reflection, and research. |
| 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. |
| MA.N-Q.A.3 | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. |
| MA.K-12.2 | Reason abstractly and quantitatively. |
| MA.K-12.4 | Model with mathematics. |
| MA.A-CED.A.2 | Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. |
| MA.A-CED.A.4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. |
| MA.A-SSE.A.1 | Interpret expressions that represent a quantity in terms of its context. |
| MA.A-SSE.B.3 | Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. |
| TECH.8.1.12 | Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. |
| TECH.8.2.12 | Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. |

