Unit 4 Astrobiology: Life in the Universe

Content Area:	**Science**
Course(s):	**Astronomy 2**
Time Period:	**May**
Length:	**6 weeks**
Status:	**Published**

Enduring Understandings

Explain how, life, like planets, stars, and galaxies, is a structure that has evolved through the action of the physical and chemical processes that shape the universe.

Present the general timeline of when scientists think life began on Earth.

Deswcribe the concept and attributes of a habitable zone.

Describe some of the methods used to search for extraterrestrial life.

Explain why all life on Earth must eventually come to an end.

Essential Questions

Are we alone in the universe?

Can life forms other than carbon based exist in the universe?

How does the Drake Equation factor into the possibility of life in the universe?

How can we identify the factors that lead to the evolution of life in other parts of the universe?

Content

<u>Vocab. Terms:</u>

life, organic, stromatolites, cyanobacteria, Cambrian explosion, mutation, heredity, natural selection, entropy, astrobiology, habitable zone, Earth Similarity Index, Drake equation, SETI,

Skills

Explain how life is a chemical process.

Discuss how terresterial life probably began in Earth's oceans.

Discuss how life on Earth may have begun more than 3.6 billion years ago.

Summarize how life evolves from prokaryotic to eukaryotic cellular structure.

Discuss the observations that help verify the theory of organic evolution.

Explain how, to create life, a self-replicating molecule needed to form by chance.

Explain how mutations can breed success.

Discuss why evolution is inevitable.

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Explain why Mars and the icy moons in the outer Solar System are the best candidates for life.

Summarize how the Drake Equation estimates the number of technologically advanced civilizations in the galaxy.

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Outline how the universe continually recycles matter through stars and the Interstellar medium.

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Resources

Standards

NGSS: Science Performance Expectations(2014)
NGSS: HS Physical Sciences
HS.Energy

Performance Expectations
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

HS.Waves and Electromagnetic Radiation
Performance Expectations
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind 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.

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.*Show details

NGSS: Science and Engineering Practices
NGSS: 9-12
Practice 1. Asking questions (for science) and defining problems (for engineering)
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

Practice 3. Planning and carrying out investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Select appropriate tools to collect, record, analyze, and evaluate data.

Practice 4. Analyzing and interpreting data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.

Practice 5. Using mathematics and computational thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Practice 6. Constructing explanations (for science) and designing solutions (for engineering)
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to

explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Practice 7. Engaging in argument from evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Practice 8. Obtaining, evaluating, and communicating information
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.
Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

Connections to the Nature of Science: Most Closely Associated with Practices
Scientific Investigations Use a Variety of Methods
Science investigations use diverse methods and do not always use the same set of procedures to obtain data.

New technologies advance scientific knowledge.

Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based on empirical evidence.

Science disciplines share common rules of evidence used to evaluate explanations about natural systems.

Science includes the process of coordinating patterns of evidence with current theory.

Scientific Knowledge is Open to Revision in Light of New Evidence
Scientific explanations can be probabilistic.

Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that has 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.

NGSS: Crosscutting Concepts
NGSS: 9-12
Crosscutting Statements
1. Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

2. Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

3. Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

5. Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

7. Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
Much of science deals with constructing explanations of how things change and how they remain stable.

Connections to Engineering, Technology and Applications of Science
Influence of Engineering, Technology, and Science and the Natural World
New technologies can have deep impacts on society and the environment, including some that were not anticipated.

Connections to the Nature of Science: Most Closely Associated with Crosscutting Concepts
Science is a Way of Knowing
Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.

Science Addresses Questions About the Natural and Material World.
Not all questions can be answered by science.

NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS1: Earth's Place in the Universe
ESS1.A: The Universe and Its Stars
The Big Bang theory is supported by observations of distant galaxiesreceding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.(HSESS1-2)

Other than the hydrogen and helium formed at the time of the BigBang, nuclear fusion within stars produces all atomic nuclei lighterthan and including iron, and the process releases electromagneticenergy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3)

PS1: Matter and Its Interactions
PS1.A: Structure and Properties of Matter

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6)

Stable forms of matter are those in which the electric and magnetic field energy is minimized. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS1.C: Nuclear Processes

Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption ofenergy. The total number of neutrons plus protons does notchange in any nuclear process. (HSPS1-8)

Spontaneous radioactive decays follow a characteristicexponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5),(secondary to HS-ESS1-6)

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-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
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.
SCI.HS-PS3	Energy
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	Waves and Their Applications in Technologies for Information Transfer