01 Basic Building Blocks of Life

Content Area: **Science**
Course(s): **Biology CP**
Time Period: **Semester 1**
Length: **5 weeks**
Status: **Published**

Standards

HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
LS1.C	Organization for Matter and Energy Flow in Organisms
	Energy and Matter
	Stability and Change
	Cause and Effect
	Obtaining, Evaluating, and Communicating Information
	Constructing Explanations and Designing Solutions
ESS1.A	The Universe and Its Stars
HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
PS1.C	Nuclear Processes
HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
ESS1.C	The History of Planet Earth
HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
	Planning and Carrying Out Investigations
ESS2.C	The Roles of Water in Earth's Surface Processes
	Structure and Function
	Engaging in Argument from Evidence
SCI.HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Enduring Understandings

1. Geologic processes constantly recycle Earth's surface, requiring scientists to use unaltered, extraterrestrial materials and impact records to reconstruct the planet's early history

2. The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics and the existence of life. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy; transmit sunlight; expand upon freezing; dissolve and transport materials; and lower the viscosities and melting points of rocks.

3. Science seeks to understand and explain the world around us. Scientific knowledge is tentative. As more knowledge is gained, theories may change.

4. Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.

5. Defining life has proven to be a difficult task, even though many of us can look at most things and tell if they're alive or not. We can at least look at the characteristics that living things have in common to better understand life. For instance, life is made of cells, maintains homeostasis, grows and develops, has the ability to reproduce, metabolizes, responds to the environment, and, over time, evolves. However, just having some of these characteristics doesn't necessarily make something alive.

6. Living organisms are composed of cellular units that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions.

7. Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions. Water is required for the reactions to build, breakdown and transport the building blocks for these molecules.

8. Proteins are manufactured by organisms through joining amino acids in a set sequence and then folding these polypeptides into a unique 3D structure. They have a wide variety of functions in the human body that include defense, catalysis, transport, structure, and serving as a chemical messenger.

9. Enzymes are chemical catalysts in all living things. Without enzymes, chemical reactions could not occur fast enough for life to be maintained.

10. Temperature and pH are two factors that need to be maintained within fairly narrow ranges, because they significantly impact protein structure, which in turn can impair functionality to the point that death or cell damage occurs.

Essential Questions

1. What is the universe, and what is Earth's place in it?

2. Where did all of the elements come from?

3. What effect has the presence of water had on Earth and Earth's living things?

4. What molecules are necessary for life?

5. What organic molecules are required to build the main components of a cell, and how does their structure relate to their function?

6. How do we know if something is living or nonliving?

7. Should viruses be considered living organisms?

8. How do organisms obtain and use the matter and energy they need to live and grow?

9. How do the properties and movements of water shape Earth's surface and affect its systems?

Knowledge and Skills

Knowledge:

1. Students will know that sugar molecules thus formed obtain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (DCI LS1.C Organization for Matter and Energy Flow in Organisms)

2. Students will know that as matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (LS1.C Organization for Matter and Energy Flow in Organisms)

3. Students will know that other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (DCI ESS1.A The Universe and its Stars)

4. Students will know that although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (DCI ESS1.C The History of Planet Earth)

5. Students will know that spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (DCI PS1.C Nuclear Processes)

6. Students will know that the abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (DCI ESS2.C The Role of Water in Earth's Surface Processes)

Skills :

1. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

2. Communicate scientific ideas about the way stars, over their life cycles, produce elements.

3. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

4. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

5. Analyze and compare the chemical structures of the four major categories of biological macromolecules (carbohydrates, lipids, proteins, and nucleic acids) to differentiate between their respective monomer subunits and polymer forms.
6. Construct and revise evidence-based explanations for how the specific shape of a macromolecule directly dictates its biological function inside a cell (how a protein's shape allows enzyme binding or how DNA's double-helix stores genetic data)
7. Cite experimental evidence from laboratory investigations (such as molecular modeling, biochemical indicator tests, or carbohydrate comparison labs) to demonstrate how cells construct diverse polymers from a shared pool of elemental building blocks (C,H,N,O,P,S)
8. Plan and conduct an investigation of enzymes and their work in catalyzing chemical reactions inside of the cell under optimal conditions.

Resources

Core Resource: "Modern Biology" by Holt, Rinehart & Winston

Supplemental Resources:

Unit 1: The Building Blocks of Life

- seed germination lab
- Are Viruses alive?
- Properties of Water Investigation
- Glucose molecular structure lab
- catalase exploration lab

- Pivot Interactives

- Phet Simulations - build an atom

- Radiolab -Elements

- Bozeman Science-Water a Polar Molecule

- BiologySimulations.com - Enzymes

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing