

Unit 2 Biomolecules NGSS

Content Area: **Science**
Course(s): **Biology CP, Biology Honors, STEM Biology Honors**
Time Period: **October**
Length: **Approximate Blocks TBD**
Status: **Published**

Transfer Skills

Biological systems utilize energy and molecular building blocks to grow, reproduce, and maintain homeostasis.

Enduring Understandings

The sugar molecules formed by the process of photosynthesis contain carbon, hydrogen, and oxygen. Together with nitrogen in proteins and nucleic acids, these constitute the 4 major elements in living organisms: CHON.

Carbohydrate molecules from photosynthesis are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules.

Large biomolecules (macromolecules) are often composed of long chains (polymers) of simple repeating building blocks (monomers).

The four major types of biomolecules are carbohydrates, lipids, proteins, and nucleic acids.

Essential Questions

What chemical elements are in our bodies?

What is the source of carbon for most molecules found in living organisms?

How are the chemical elements in our bodies used to make the large molecules that make up our structure?

What are the major types of molecules in our bodies?

Content

Essential Vocabulary:

properties of water, pH scale, pH, buffer, biomolecule, macromolecule, monomer, polymer

dehydration synthesis (condensation reaction), hydrolysis, carbohydrate,, protein, lipid, nucleic acid, monosaccharide, disaccharide, polysaccharide, glucose, lactose, sucrose, starch,

cellulose, glycogen, iodine starch test, Benedicts test, triglyceride, phospholipid, steroid,

amino acid, polypeptide, hydrophobic, hydrophilic, levels of protein structure, globular protein,

fibrous protein, DNA, RNA

LAB DESCRIPTIONS:

- **Properties of Water Lab**

- Students will rotate at several lab stations to investigate various properties of water, including: surface tension, cohesion, adhesion, capillary action, polarity, and universal solvent.

-

- **Acid in Your Stomach: Antacid Product Testing Lab (HS-LS1-6)**

- Students are given four different antacid tablets and required to determine which would neutralize the most acid. Vinegar will be used to simulate a potential food product that could bring about acid indigestion and “heartburn.”

-

- **Macromolecules Web Activity (HS-LS1-6)**

- Students will use a WebQuest to investigate the 4 macromolecules of life, including: carbohydrates, proteins, lipids, and nucleic acids.

-

- **Carbohydrate Identification Lab (HS-LS1-6)**

- Students will learn how to write a molecular formula for several carbohydrates and how to read a structural formula for several carbohydrates They will use models to construct the main types of carbohydrates and identify the three main types of carbohydrates by using chemical tests. They will then test different food samples to determine what type of carbohydrate they are.

-

- **Digestive Enzymes at Work Lab**

- Students will use amylase to hydrolyze starch into sugar, trypsin (a pancreatic enzyme) to break down protein into small chains of amino acids, and lipase to break down fats into glycerol and fatty acids.

-

- **Fold-It Protein Folding Simulator (HS-LS1-6)**

- Students will use a WebQuest to investigate and predict the structure of proteins. Knowing the structure of a protein is key to understanding how it works and how to target it with medication. A protein can consist of anywhere between 100 and 1000 amino acids. The number of different ways a small protein can fold is astronomical and figuring out which structure can take up a lot of a scientist's time and budget.

Skills

PE: HS-LS1-6 - Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (Use evidence from models and simulations to support explanations)

- **DCI: LS1-C:**

- Create a model of the four major categories of organic molecules (carbohydrates, fats, proteins, and nucleic acids) using unique characteristics and primary functions.
- Demonstrate that the activities of enzymes are affected by the temperature, ionic conditions, and the pH of the surroundings.
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
- The sugar molecules thus formed contain 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.
- Identify the six elements most common to biological organisms: carbon, hydrogen, oxygen, nitrogen, phosphorous and sulfur.
- Analyze and explain how cells carry out a variety of chemical transformations that allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones.
- Explain how molecules are used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats).
- Recognize that most chemical transformations are made possible by protein catalysts called enzymes.
- Identify enzymes as proteins, and determine how they catalyze biochemical reactions

- **CC:** 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.

- Determine why each major category of organic molecule is essential to life
- Recognize that food molecules are taken into cells and react to provide the chemical constituents needed to synthesize other molecules, and knowing that the breakdown and synthesis are made possible by enzymes.

Resources

[Macromolecules Web Activity](#)

[Carbohydrate Identification Lab](#)

[Fold-It Protein Folding Simulator](#)

Standards

NGSS: Science Performance Expectations

NGSS: HS Life Sciences

HS.Matter and Energy in Organisms and Ecosystems

Performance Expectations

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. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]

NGSS: Disciplinary Core Ideas

Life Sciences

Core Idea LS1: From Molecules to Organisms: Structures and Processes

LS1.C: Organization for Matter and Energy Flow in Organisms

- The sugar molecules thus formed contain 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. (HS-LS1-6)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7)

NGSS: Science and Engineering Practices

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.

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

NGSS: Crosscutting Concepts

5. Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

SCI.HS-LS1

From Molecules to Organisms: Structures and Processes

SCI.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.