Honors Biology - Unit 1 - Biochemistry

Unit Focus

Students will begin their study of Biology by engaging in scientific investigations that allow them to hone their laboratory skills and refine and apply their understanding of proper experimental design. Through the lens of biochemistry, students will work through several complex laboratory experiments. Ultimately, students will plan and conduct their own experiment to develop a deeper understanding of the processes and properties that determine the function of macromolecules. Throughout this unit, students will learn the four major categories of macromolecules and their structures and functions and begin to uncover why these molecules are essential for organisms. As students move through this year of a molecular-based biology course, they will continually engage in content that requires an understanding of macromolecules. Student will not only apply prior knowledge of macromolecules to new situations, but also enhance and deepen their understanding of biochemistry as the year progresses.

Stage 1: Desired Results - Key Understandings

Standard(s)

NGSS/NSTA Science & Engineering Practices
NGSS Science & Engineering Practices: 9-12

- Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. (SE.9-12.1.1)
- Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. (SE.9-12.1.6)
- Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled. (SE.9-12.3.1)
- Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. (SE.9-12.3.3)
- Select appropriate tools to collect, record, analyze, and evaluate data. (SE.9-12.3.4)
- Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. (SE.9-12.3.5)
- Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables. (SE. 9-12.3.6)
- 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. (SE.9-12.4.1)

Transfer

Students will be able to independently use their learning to...
T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
T2 Make observations and ask questions to define a problem based on prior knowledge and curiosity that stimulates further exploration, analysis, and discovery.

Meaning

Understanding(s)

Students will understand that...
U1 Proper experimental design requires an independent and dependent variable, constants and a control set-up in order to obtain results with fidelity.
U2 Macromolecules contribute to the structure of cells and are also involved in their function (chemical reactions)
U3 Macromolecules are composed of Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, and Sulfur in different combination and structures.
U4 The structure of a molecule determines its function.
U5 Organisms require enzymes to catalyze life sustaining reactions.
U6 The structures of macromolecules dictate their properties and functions, both of which allow them to function to maintain organisms.

Essential Question(s)

Students will keep considering...
Q1 What questions do I wonder about? How can I use science to figure it out?
Q2 What do the results tell me? What patterns do I see or what conclusions can I draw?
Q3 How do macromolecules support life?
Q4 How does molecular structure relate to molecular function?
Q5 How do I use tools and materials to carry out my test? How do I collect and record quality data?

Stage 1: Desired Results - Key Understandings

- Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. (SE.9-12.6.1)
- Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects (SE.9-12.6.3)
- Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (SE.9-12.6.4)

Next Generation Science Standards

Performance Expectations: High School Life Sciences

- 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. (HS-LS1-6)

Next Generation Science Standards (DCI)

Science: 9

- 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. (LS1.9.C2)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (LS1.9.C3)

Madison Public Schools Profile of a Graduate

- Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)
- Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
Students will know... **K1** The four macromolecules, carbohydrates, lipids, proteins and nucleic acids, are all crucial for biological structures and processes. **K2** Synthesis is the building of molecules. **K3** Decomposition is the breaking down of molecules. **K4** Monomers are the single sub-unit that composes macromolecules. Polymers are 3+ monomers bonded together.	*Students will be skilled at...* **S1** Demonstrate how molecules are rearranged through chemical processes. **S2** Identify how the structure of a macromolecule relates to its functions. **S3** Plan and conduct an experiment that manipulates variables to develop greater understanding of a scientific concept. **S4** Ask questions and design an experiment that can be performed in a laboratory setting. **S5** Apply understanding of macromolecule structures and the properties and processes that govern their functionality to design a laboratory experiment.