# Unit 02: Chemistry in Biology

Content Area: **Science**
Course(s):
Time Period: **Marking Period 1**
Length: **3-4 weeks**
Status: **Published**

## Summary

The focus of this unit is basic chemistry in biology and how water supports life. Basic chemistry concepts will be explored, centering around atoms, molecules, and simple chemical reactions. The importance of, and the roles that, specific elements play in the biological molecules of carbohydrates, lipids, proteins, and nucleic acids, as well as the formation of living organisms, will be studied. The chemical reactions of photosynthesis and cellular respiration will be examined as examples of types of chemical reactions in biology, in addition to how atoms and matter are conserved. The properties of water and solutions, as they relate to the sustenance of life, will be investigated. The effects of greenhouse gases on water chemistry and properties, due to local and global climate change, will be observed and discussed.

Revised July 2021

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| | There are actions an individual can take to help make this world a better place. |
| MA.S-ID.C.9 | Distinguish between correlation and causation. |
| MA.S-IC.B | Make inferences and justify conclusions from sample surveys, experiments, and observational studies |
| LA.W.9-10.1.A | Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence. |
| LA.W.9-10.1.E | Provide a concluding paragraph or section that supports the argument presented. |
| LA.W.9-10.2 | Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. |
| LA.W.9-10.2.A | Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. |
| LA.W.9-10.2.B | Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. |
| MA.S-MD.A | Calculate expected values and use them to solve problems |
| LA.W.9-10.7 | 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.W.9-10.8 | Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation (MLA or APA Style |

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| | Manuals). |
| LA.W.9-10.9 | Draw evidence from literary or nonfiction informational texts to support analysis, reflection, and research. |
| SCI.HS-LS1-5 | Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.<br><br>Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.<br><br>Assessment does not include specific biochemical steps.<br><br>Developing and Using Models<br><br>Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.<br><br>Use a model based on evidence to illustrate the relationships between systems or between components of a system. |
| SCI.HS.LS1.C | Organization for Matter and Energy Flow in Organisms<br><br>The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.<br><br>Energy and Matter<br><br>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. |
| 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.<br><br>Emphasis is on using evidence from models and simulations to support explanations.<br><br>Assessment does not include the details of the specific chemical reactions or identification of macromolecules.<br><br>Constructing Explanations and Designing Solutions<br><br>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.<br><br>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. |
| SCI.HS.LS1.C | Organization for Matter and Energy Flow in Organisms<br><br>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.<br><br>As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.<br><br>Energy and Matter<br><br>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. |

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| SCI.HS-LS1-7 | Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.<br><br>Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.<br><br>Assessment should not include identification of the steps or specific processes involved in cellular respiration.<br><br>Developing and Using Models<br><br>Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.<br><br>Use a model based on evidence to illustrate the relationships between systems or between components of a system. |
| SCI.HS.LS1.C | Organization for Matter and Energy Flow in Organisms<br><br>As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.<br><br>As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.<br><br>Energy and Matter<br><br>Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. |
| CS.K-2.8.1.2.DA.1 | Collect and present data, including climate change data, in various visual formats. |
| CS.K-2.8.2.2.ED.1 | Communicate the function of a product or device. |
| CS.K-2.8.2.2.ED.2 | Collaborate to solve a simple problem, or to illustrate how to build a product using the design process. |
| LA.9-10.W.9-10.1 | Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence. |
| WRK.9.2.12.CAP | Career Awareness and Planning |
| TECH.9.4.2.CT | Critical Thinking and Problem-solving<br><br>Data can be used to make predictions about the world. |

## Essential Questions / Enduring Understandings

Essential Questions:

What is the relationship between atoms and elements?

What happens during a chemical reaction and how can elements react to form compounds?

What are the important functions of ions and isotopes in biology?

How do the properties of water make it such an important molecule in biology and how does it help sustain life?

How do greenhouse gases affect the chemistry and properties of water?

What is the importance of pH and buffers in biological systems?

What makes a molecule “organic?”

Enduring Understandings:

Certain elements are important in the formation of the major biological macromolecules which compose all organisms.

Chemistry plays a major role in biology.

Water is the “molecule of life.”

Water is affected by greenhouse gases.

## Objectives

Students will know Key Vocabulary: atom, electron, proton, neutron, nucleus, valence electrons, shell, element, molecule, compound, ion, isotope, chemical reaction, reactant, product, biological reaction, catalyst, enzyme, activation energy, water, polar, hydrogen bond, solution, pH, buffer, organic, macromolecule, carbohydrate, lipid, protein, nucleic acid, monomer, polymer.

Students will know the parts of an atom and their characteristics.

Students will know how atoms relate to elements and the Periodic Table of Elements.

Students will know the important elements that relate to organic molecules in biology.

Students will know what a molecule is.

Students will know what a compound is.

Students will know what an ion is and which ions have important functions in the human body.

Students will know what an isotope is and which isotopes have important functions in biology.

Students will know what a chemical reaction is.

Students will know what a catalyst is.

Students will know what activation energy is.

Students will know what makes a water molecule polar.

Students will know how bonds hold water molecules and molecules in various solutions together.

Students will know how the chemistry and properties of water are affected by greenhouse gases.

Students will know what pH and buffers are and why they are important for biological processes.

Students will know the four types of biological macromolecules and what each of their functions is in organisms.

Students will know the difference between monomers and polymers.

Students will be skilled at drawing an atom recognizing the various subatomic particles.

Students will be skilled at identifying the group an element belongs to on the Periodic Table of Elements.

Students will be skilled at describing how various types of simple molecules and compounds are formed.

Students will be skilled at showing how ions are formed.

Students will be skilled at labelling the reactants (inputs) and products (outpus) of a chemical reaction.

Students will be skilled at explaining the function and importance of catalysts as enzymes in biology.

Students will be skilled at relating the importance of water as a molecule and its specific properties to the sustenance of life.

Students will be skilled at distinguishing the term "organic" as it relates to biology.

Students will be skilled at differentiating between the monomers that make up each biological macromolecule polymer.

## Learning Plan

Unit Notes: Students will keep detailed notes in a specific notebook as the questions guiding the unit learning goals are answered through lectures and various activities.

Introduction to the Periodic Table of Elements: Students will become familiar with the periodic table and the elements of life by completing a scavenger hunt activity.

CER Practice: Students will continue to practice making claims based on observations and inferences and providing the evidence and appropriate reasoning to support those claims.

Demo: Students will observe a teacher demonstration for one of the following enzyme investigations: *Enzymes*

*and Hydrogen Peroxide*, *Enzymatic Browning*, or *Enzymatic Activity of Lactase*

Lab: Students will complete one of the following enzyme investigations: *Enzymes and Hydrogen Peroxide*, *Enzymatic Browning*, or *Enzymatic Activity of Lactase*

*Properties of Water*: Part I - Students will use household items to demonstrate specific water properties in real time. Part II - Students will observe and describe the changes in the chemical makeup and specific properties of water with various dissolved greenhouse gases.

*My Ideal Meal*: Students will create an "ideal meal" outline that would be healthy and appropriate for their specific daily schedules and lives, using their knowledge of the biological molecules that are essential for everyday bodily functions.

## Assessment

Formative:

Do Now Questions

Exit Ticket Questions

Whole Class Discussion Participation

Small Group Discussion Participation

Think-Pair-Share Participation

Individual Student Questions/Responses

Independent Tasks (*Properties of Water; My Ideal Meal*)

Lab Demos and Experiments (*Enzymes and Hydrogen Peroxide/Enzymatic Browning/Enzymatic Activity of Lactase*)

Quizzes (*Biological Macromolecules*)

Summative:

Formal Lab Report (*Enzymes and Hydrogen Peroxide/Enzymatic Browning/Enzymatic Activity of Lactase*)

Unit Test

Benchmark:

CP Biology Midterm Exam

Alternative Assessments:

Guided Formal Lab Report

Unit Study Guide/Guided Test

Student Presentation on Properties of Water and/ or Biochemistry

## Materials

Textbook: *Biology* (Glencoe Science) by Alton Biggs

Unit Learning Goals Sheet

Technology: computers for student and teacher, SmartBoard projector

Teacher Slide Presentations

Amoeba Sisters Videos

Whiteboard + Accessories

Guided Notes/Worksheets

Study Guide

Lab Outline

Personal Periodic Tables

Personal Protective Equipment: safety glasses, gloves

Lab Equipment: beakers, graduated cylinders, test tubes, test tube holders, scissors, razor blades/knives, forceps/tongs, stirring rods, fresh apples, lemon juice, sugar, fresh liver, hydrogen peroxide, lactase tablets, water, milk, sucrose, glucose test strips, ice, water kettle, electronic balances, thermometers, timers/stopwatches

Graphing paper, rulers, colored pencils/markers

## Integrated Accommodations and Modifications

https://docs.google.com/spreadsheets/d/1uDlwQcgdvbrOcLnMAKouOe1gQph5rWDWxM74UFeuACM/edit?usp=sharing
See attached document.