

# 01\_Basics of Biochemistry

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

## **General Overview, Course Description or Course Philosophy**

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Biology focuses on the diversity, complexity, and interdependence of life on Earth. Students will develop an understanding of how organisms evolve, reproduce, and adapt to their environments. This will include an exploration of how to relate the structure and function of molecules to their role in cell biology and metabolism. Further understanding of evolution and reproduction will be explored through the science of genetics. Knowledge of biodiversity and adaptation will be illustrated through the science of ecology.

## **OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS**

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- Sugar molecules 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.
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
- 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.
- 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.

## **CONTENT AREA STANDARDS**

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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.

Construct 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-LS1-6

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.

**RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)**

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MA.K-12.4	Model with mathematics.
LA.RI.9-10.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.) and make relevant connections, to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
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.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach, or consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience.
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 Manuals).
LA.W.9-10.9	Draw evidence from literary or nonfiction informational texts to support analysis, reflection, and research.
SCI.HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

## **STUDENT LEARNING TARGETS**

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### **Declarative Knowledge**

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Students will understand that:

- The relationship between the carbon, hydrogen, and oxygen atoms from sugar molecules formed in or ingested by an organism and those same atoms found in amino acids and other large carbon-based molecules.
- Chemical reactions can create products that are more complex than the reactants.
- Sugar molecules are composed of carbon, oxygen, and hydrogen atoms.
- Data collected using proper measurement and lab techniques can be used to prove or disprove a hypothesis.
- Given new evidence or context, students revise or expand their explanation about the relationships between atoms in sugar molecules and atoms in large carbon-based molecules, and justify their

revision.

## **Procedural Knowledge**

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Students will be able to:

- **Explain** that larger carbon-based molecules and amino acids can be a result of chemical reactions between sugar molecules (or their component atoms) and other atoms.
- All organisms take in matter (allowing growth and maintenance) and rearrange the atoms in chemical reactions
- Cellular respiration involves chemical reactions between sugar molecules and other molecules in which energy is released that can be used to drive other chemical reactions.
- Amino acids and other complex carbon-based molecules are composed largely of carbon, oxygen, and hydrogen atoms.
- Chemical reactions involve changes in the energies of the molecules involved in the reaction.
- The atoms in sugar molecules can provide most of the atoms that comprise amino acids and other complex carbon-based molecules.
- The energy released in respiration can be used to drive chemical reactions between sugars and other substances, and the products of those reactions can include amino acids and other complex carbon-based molecules.
- The matter flows in cellular processes are the result of the rearrangement of primarily the atoms in sugar molecules because those are the molecules whose reactions release the energy needed for cell processes.

## **EVIDENCE OF LEARNING**

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### **Formative Assessments**

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- Checks for understanding during lesson.
- Use of student-friendly proficiency scales to track progress.
- Do Now activities.
- Student-centered questioning and discussion that is facilitated by instructor.
- Exit Tickets.

### **Summative Assessments**

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- Benchmarks – departmental benchmark given at the end of MP1, MP2, and MP3 based on lab practices

- Alternative Assessments
  - Lab inquiries and investigations
  - Lab Practicals
  - Exploratory activities based on phenomenon
  - Gallery walks of student work
  - Creative Extension Projects
  - Build a model of a proposed solution
  - Let students design their own flashcards to test each other
  - Keynote presentations made by students on a topic
  - Portfolio

## **ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS**

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See link to Accommodations & Modifications document in course folder.

## **RESOURCES (Instructional, Supplemental, Intervention Materials)**

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[Miller & Levine Biology Textbook](#)

- Unit 1 - The Nature of Life
  - Chapter 1 - The Science of Biology
    - Case Study: *Studying the Natural World*
    - Interactivity: *Simulating a Scientific Investigation*
    - Interactivity: *Safety in the Laboratory*
  - Chapter 2 - The Chemistry of Life
    - Interactivity: *Interactive Periodic Table*
    - Interactivity: *Hydrogen Bonding*
    - Analyzing Data: *Trace Elements*
    - Interactivity: *Sugar Molecules to Macromolecules*
    - Animation: *An Enzyme-Catalyzed Reaction*

POGIL Biology

- Safety First
- Scientific Inquiry
- Analyzing and Interpreting Scientific Data

- Biological Molecules

Gizmos

- Growing Plants
- Dehydration Synthesis

[NSTA](#)

[Data Nuggets](#)

[Online Resources](#)

## **INTERDISCIPLINARY CONNECTIONS**

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ELA/Literacy: POGIL Biology

- Safety First
- Scientific Inquiry
- Analyzing and Interpreting Scientific Data
- Biological Molecules

Gizmos

- Growing Plants
- Dehydration Synthesis

Mathematics: POGIL Biology

- Safety First
- Scientific Inquiry
- Analyzing and Interpreting Scientific Data
- Biological Molecules

Gizmos

- Growing Plants
- Dehydration Synthesis

Technology: Gizmos

- Growing Plants
- Dehydration Synthesis

