INSTRUCTIONAL FOCUS DOCUMENT
HS/Biology

UNIT: 02 **TITLE: Biochemistry** **SUGGESTED DURATION:** 10 days

Exemplar Lesson 01: Introduction to Biochemistry
Exemplar Lesson 02: Investigations in Biochemistry

State Resources:

RATIONALE:

This unit bundles student expectations that address biochemistry and serves as a starting point for understanding the levels of organization of life.

Prior to this unit (in middle school), students were introduced to chemical properties of matter and the periodic table. In Grade 7, students identified carbon-containing compounds as organic and recognized that large molecules such as carbohydrates could be broken down into smaller sugars. During this unit, a basic review of chemistry reinforces the students' prior knowledge and provides a knowledge base for application of chemistry concepts in cell biology, genetics, and body systems, and connects biology with concepts further developed in Chemistry. In addition, students have the opportunity to develop controlled experiments in this unit, such as identification of organic compounds and enzyme activity and the factors that affect it. Not only does this unit include supporting standard B.9D and readiness standard B.9A for the STAAR Biology Assessment, but it also builds content that serves as a foundation for many other concepts assessed in Reporting Categories 2-4 of STAAR Biology.

According to the American Association for the Advancement of Science (AAAS), in the *Benchmarks for Science Literacy (Project 2061)* "by the end of 12th grade, students should know that:

- An enormous variety of biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules. 4D/H7
- The configuration of atoms in a molecule determines the molecule's properties. Shapes are particularly important in how large molecules interact with others. 4D/H8
- A living cell is composed of a small number of chemical elements mainly carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur. Carbon, because of its small size and four available bonding electrons, can join to other carbon atoms in chains and rings to form large and complex molecules." 5C/H8 "Most complex molecules of living organisms are built up from smaller molecules. The various kinds of small molecules are much the same in all life forms, but the specific sequences of components that make up the very complex molecules are characteristic of a given species. 5A/H4

American Association for the Advancement of Science. (1993). *Benchmarks on-line*. Retrieved December 21, 2009, from http://www.project2061.org/publications/bsl/online/.

MISCONCEPTIONS/UNDERDEVELOPED CONCEPTS:

MISCONCEPTION:

- Students may think that biology and chemistry are separate and unrelated disciplines.

PERFORMANCE INDICATORS	CONCEPTS	KEY UNDERSTANDINGS FOR LEARNERS
Choose a graphic organizer to compare structures and functions of different types of biomolecules, such as carbohydrates, lipids, proteins, and nucleic acids. (B.2H; B.9A, B.9D)	Properties – Structure Properties – Function	Organic compounds are biomolecules made and used by living organisms. The structure of the biomolecule gives rise to their function.

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PERFORMANCE INDICATORS	CONCEPTS	KEY UNDERSTANDINGS FOR LEARNERS
ELPS 1C; 3F		
Implement a scientific investigation on enzyme action. Complete a formal written laboratory report for the investigation. (B.2E, B.2H; B.9C) ELPS 1E; 3I; 5G	Properties – Processes Properties – Change	Enzymes are an example of an organic compound; they speed up reaction rates and function best within a certain temperature, range, salt concentration, and pH.

KEY ACADEMIC VOCABULARY SUPPORTING CONCEPTUAL DEVELOPMENT

- **Biomolecule** – an organic molecule produced by living organisms and consisting predominantly of carbon, hydrogen, and oxygen
- **Enzyme** – a protein that catalyzes (speeds) a reaction without being changed by it

TEKS# / SE#	TEKS	SPECIFICITY
B.1	***Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:***	
B.1A	**Demonstrate safe practices during laboratory and field investigations.**	Use, Demonstrate SAFE PRACTICES DURING FIELD AND LABORATORY INVESTIGATIONS Including, but not limited to: • Wear appropriate safety equipment • Know location of safety equipment • Follow classroom safety guidelines • Handle organisms appropriately • Use lab equipment appropriately STAAR Note: • The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards.

B.1B	**Demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.**	Demonstrate
		
		AN UNDERSTANDING OF THE USE AND CONSERVATION OF RESOURCES AND THE PROPER DISPOSAL OR RECYCLING OF MATERIALS
		
		Including, but not limited to:
		• Use and conservation of resources
		  • Reducing pollution
		  • Shopping wisely
		  • Decreasing reliance on fossil fuels

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TEKS# / SE#	TEKS	SPECIFICITY
		• Preserving habitats • Disposal or recycling of materials STAAR Note: • The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards.
B.2	***Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:***	
B.2E	**~~Plan and~~ implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology.**	Implement DESCRIPTIVE, COMPARATIVE, AND EXPERIMENTAL INVESTIGATIONS Including, but not limited to: • Observe natural phenomena • Ask questions • Formulate testable hypotheses • Design and conduct investigations • Collaborate on joint projects • Use models to make predictions • Select appropriate equipment and technology • Evaluate the quality and accuracy of information from research sources, such as search engines, databases, and other online tools STAAR Note: • The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards.
B.2H	**Communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.**	Communicate VALID CONCLUSIONS SUPPORTED BY DATA Including, but not limited to: • Communicate conclusions in oral, written, and graphic forms • Use essential vocabulary of the discipline to communicate conclusions • Use appropriate writing practices consistent with scientific writing • Use charts and graphs • Present scientific information in appropriate formats for various audiences\ STAAR Note: • The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards.
B.9	***Science concepts. The student knows the significance of various molecules involved***	

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TEKS# / SE#	TEKS	SPECIFICITY
	in metabolic processes and energy conversions that occur in living organisms. The student is expected to:	

B.9A	**Compare the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids.**
	
	Readiness Standard
		Compare
		
		STRUCTURES AND FUNCTIONS OF BIOMOLECULES
		
		Including, but not limited to:
		• Building of macromolecules
		  • Polymers made from monomers by dehydration synthesis
		  • Polymers broken down to monomers by hydrolysis
		• Carbohydrates
		  • Macromolecules: starch, glycogen, cellulose
		  • Subunit: glucose
		  • Functions: energy, cell wall, structural support
		  • Examples
		• Lipids
		  • Macromolecules: fats, phospholipids
		  • Subunit: glycerol and fatty acids or glycerol and fatty acids, and phosphate group
		  • Functions: stored energy, cell membrane
		  • Examples
		• Proteins
		  • Macromolecules: globular protein, structural protein
		  • Subunit: amino acids
		  • Functions
		  • Examples
		• Nucleic acids (DNA, RNA)
		  • Macromolecules: DNA, RNA
		  • Subunit: nucleotides
		  • Functions: encode genes, gene expression
		  • Examples
		• Recognize these elements in living matter
		  • Carbon
		  • Hydrogen
		  • Oxygen
		  • Nitrogen
		  • Phosphorous
		• Organic vs. inorganic molecules
		• Identify and describe the properties of water
		  • Polarity in relation to living organisms
		  • Hydrogen bonding
		  • Capillary action
		
		2061 Note: By the end of the 12th grade, students should know that:

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TEKS# / SE#	TEKS	SPECIFICITY
		• Most complex molecules of living organisms are built up from smaller molecules. The various kinds of small molecules are much the same in all life forms, but the specific sequences of components that make up the very complex molecules are characteristic of a given species. 5A/H4** (SFAA) • The work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino acid molecules. The function of each protein molecule depends on its specific sequence of amino acids and its shape. The shape of the chain is a consequence of attractions between its parts. 5C/H3 • A living cell is composed of a small number of chemical elements mainly carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur. Carbon, because of its small size and four available bonding electrons, can join to other carbon atoms in chains and rings to form large and complex molecules. 5C/H8 TxCCRS Note: VI. Biology B1-Understand the major categories of biological molecules: lipids, carbohydrates, proteins, and nucleic acids.
B.9C	**Identify and investigate the role of enzymes.** ***Supporting Standard***	Identify, Investigate ROLE OF ENZYMES Including, but not limited to: • Catalysts to chemical reaction • Non-consumption and reusability • Specificity of enzyme for substrate • Factors that affect enzyme activity (e.g. pH, temperature, and salinity) • Example of why enzymes are important to the human body (TxCCRS) • Describe the chemical structure of proteins (TxCCRS) • Peptide bonds and polypeptide formation • Describe the effects of enzymes on reaction rates (TxCCRS) • Effects on activation energy requirements • Environmental effects (TxCCRS) TxCCRS Note: VI. Biology B2 – Describe the structure and function of enzymes.
B.9D	**Analyze and evaluate the evidence regarding formation of simple organic molecules and their organization into long complex molecules having information such as the DNA molecules for self-replicating life.** ***Supporting Standard***	Analyze, Evaluate EVIDENCE REGARDING FORMATION OF SIMPLE ORGANIC MOLECULES AND THEIR ORGANIZATION INTO LONG COMPLEX MOLECULES Including, but not limited to: • Condensation (dehydration synthesis) joins organic monomers to make a polymer. • Hydrolysis breaks down an organic polymer to its monomers.

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TEKS# / SE#	**Scientific Process TEKS:** Use appropriate Scientific processes to support instruction.
B.1	***Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:***
B.1A	**Demonstrate safe practices during laboratory and field investigations.**
B.1B	**Demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.**
B.2	***Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:***
B.2A	**Know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section.**
B.2B	**Know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories.**
B.2C	**Know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.**
B.2D	**Distinguish between scientific hypotheses and scientific theories.**
B.2E	**Plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology.**
B.2F	**Collect and organize qualitative and quantitative data and make measurements with accuracy and precision, using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams or samples of biological specimens or structures.**
B.2G	**Analyze, evaluate, make inferences, and predict trends from data.**
B.2H	**Communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology based reports.**
B.3	***Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:***
B.3A	**In all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.**
B.3B	**Communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials.**
B.3C	**Draw inferences based on data related to promotional materials for products and services.**
B.3D	**Evaluate the impact of scientific research on society and the environment.**
B.3E	**Evaluate models according to their limitations in representing biological objects or events.**
B.3F	**Research and describe the history of biology and contributions of scientists.**

The **English Language Proficiency Standards (ELPS),** as required by 19 Texas Administrative Code, Chapter 74, Subchapter A, §74.4, outline English language proficiency level descriptors and student expectations for English language learners (ELLs). School districts are required to implement ELPS as an integral part of each subject in the required curriculum.

- School districts shall provide instruction in the knowledge and skills of the foundation and enrichment curriculum in a manner that is linguistically accommodated commensurate with the student's levels of English language proficiency to ensure that the student learns the knowledge and skills in the required curriculum.

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- School districts shall provide content-based instruction including the cross-curricular second language acquisition essential knowledge and skills in subsection (c) of the ELPS in a manner that is linguistically accommodated to help the student acquire English language proficiency.

http://ritter.tea.state.tx.us/rules/tac/chapter074/ch074a.html#74.4

ELPS#	Subsection C: Cross-curricular second language acquisition essential knowledge and skills.
C(1)	***Cross-curricular second language acquisition/learning strategies. The ELL uses language learning strategies to develop an awareness of his or her own learning processes in all content areas. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:***
1C	Use strategic learning techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to acquire basic and grade-level vocabulary.
1E	Internalize new basic and academic language by using and reusing it in meaningful ways in speaking and writing activities that build concept and language attainment.
C(3)	***Cross-curricular second language acquisition/speaking. The ELL speaks in a variety of modes for a variety of purposes with an awareness of different language registers (formal/informal) using vocabulary with increasing fluency and accuracy in language arts and all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in speaking. In order for the ELL to meet grade-level learning expectations across the foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. The student is expected to:***
3F	Ask and give information ranging from using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments.
3I	Adapt spoken language appropriately for formal and informal purposes.
C(5)	***Cross-curricular second language acquisition/writing. The ELL writes in a variety of forms with increasing accuracy to effectively address a specific purpose and audience in all content areas. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in writing. In order for the ELL to meet grade-level learning expectations across foundation and enrichment curriculum, all instruction delivered in English must be linguistically accommodated (communicated, sequenced, and scaffolded) commensurate with the student's level of English language proficiency. For Kindergarten and Grade 1, certain of these student expectations do not apply until the student has reached the stage of generating original written text using a standard writing system. The student is expected to:***
5G	Narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired.