TE 802: Formative and Summative Assessment

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Part I: Clarifying Your Goals for the Unit

Unit: The Chemistry of Life (Biochemistry)

Topic: Conservation of Matter

Type of Class

- Grade level(s): 9 High school basic
- Type of school: Urban
- Tracking level: College bound

Abstract

This unit will begin with an application cycle to introduce students to the chemistry that is vital to biology. Students will learn that atoms make up molecules, and molecules make up cell organelles. Students will learn that the chemical reactions that occur on the molecular level dictate patterns that happen at a macroscopic level. They will also learn through modeling that macromolecules build to form the structures seen in living organisms.

A. Big Ideas

The patterns seen and studied in biology are deeply rooted in chemistry. Everything on the earth is made up of matter, including living organisms, and subsequently matter is made up of atoms. An atom is the smallest unit of matter that maintains the physical and chemical properties of an element. It is these atoms, or chemicals, that exchange electrons to form ionic bonds to form compounds or share electrons to form covalent bonds creating molecules. Small molecules react during chemical reactions to form macromolecules.

The four main macromolecules that contribute to biology are carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates, commonly known as sugars, are composed of repeating units of carbon, hydrogen and oxygen. Lipids have a high-energy storage in the chemical bonding in their structures. Lipids form membranes such as membrane-bound organelles or the membrane around a cell. Proteins are formed by amino acids and make up enzymes, structure of cells and tissues, and cell signaling. The structure of proteins is directly related to the protein's function. And finally, nucleic acids are the macromolecules that comprise DNA—the genetic material that codes for all living things.

These four types of macromolecules participate in chemical reactions in the cells of all living organisms to form organelles, membranes, and all of the components that make up a cell.

In any chemical reaction, both matter and energy are conserved meaning neither are created nor destroyed. The conservation of matter and the conservation of energy are both illustrated at the macroscopic level studied in biology. Because of the order of the universe, biology cannot exist without chemistry, and therefore to understand biology biochemistry must also be understood.

B. Student Practices or Crosscutting Concepts

1. Naming key practices

Currently we are starting an application cycle to teach students about atoms, chemical bonding, the periodic table, and molecules. Hopefully we will be able to engage the students in a series of inquiry cycles as we transition from atoms and molecules to macromolecules to have students learn about lipids, proteins, carbohydrates, and nucleic acids. Some of the practices students will learn and be able to do by the end of this this unit are:

- Rank the order of the universe (physics, chemistry, biology -- energy, subatomic particles, atoms, elements, heavy elements, molecules, macromolecules, cells, tissues, organisms)
- Identify where the atomic number, atomic mass, and chemical symbol are found for each element on the periodic table.
- Determine the number of neutrons in an atom by subtracting the atomic number from the atomic mass.
- Describe how organisms sustain life by obtaining, transporting, transforming, releasing, and eliminating matter and energy.
- Explain that matter is neither created nor destroyed in a chemical reaction.
- Identify common organic functional groups.
- Explain how carbon can join to other carbon atoms in chains and rings to form large and complex molecules.
- Construct models of common molecules.
- Draw the covalent bonds between atoms in a molecule.
- Recognize the four most common elements in organic molecules (C, H, N, O).
- Explain the general structure and primary functions of the major complex organic molecules that compose living organisms.
- Describe how dehydration and hydrolysis relate to organic molecules.
- Explain the role of enzymes and other proteins in biochemical functions (e.g., the protein hemoglobin carries oxygen in some organisms, digestive enzymes, and hormones).
- Propose how moving an organism to a new environment may influence its ability to survive and predict the possible impact of this type of transfer.
- Recognize and explain that macromolecules such as lipids contain high energy bonds.

2. Using practices or crosscutting concepts to make connections

Students will be using these chemistry principles throughout the course of the year. Our next unit will be cells and cell structure so we'll talk about how all of the macromolecules form the different components in a cell. Students will also see the conservation of matter and the conservation of energy when they learn about how cells obtain energy through respiration. After cells we will cover cell division, DNA, and DNA replication. Students will be learning the chemical structure of DNA and how the structure replicates chemically. The same applies for genetics. Once we transition into "large-scale" topics, students will learn about the chemistry that takes place in plants and photosynthesis. They will see the conservation of matter and energy throughout ecology. And hopefully by the end of the entire year students will have a solid understanding of biochemistry and how it drives the processes and phenomena studies in biology.

C. Objectives for Student Learning

Objective	Type
Michigan Objective(s)	
1. **B2.4f** Recognize and describe that both living and nonliving things are composed of compounds, which are themselves made up of elements joined by energy-containing bonds, such as those in ATP.	Using SP
2. **B2.2C** Describe the composition of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids.)	Identifying SP
3. **B2.2D** Explain the general structure and primary functions of the major complex organic molecules that compose living organisms.	Using SP
Illinois Objective(s)	
1. **12.11.42** Know that there are two major different kinds of bonds (ionic and covalent). Know the distinction between a compound and a mixture.	Identifying SP
2. Understand that the chief energy-storing compound used by organisms is ATP (adenosine triphosphate).	Identifying SP
3. **12.11.64** Understand that energy, defined somewhat circularly, is – the ability to change matter, or – the ability to do work. Understand that energy is defnied by the way it is measured or quantified.	Using SP
Specific Lesson Objective(s)	
1. Differentiate between the four main macromolecules found within cells.	Inquiry
2. Explain that energy is stored in bonds between the atoms in macromolecules.	Application
3. Illustrate how matter is neither created nor destroyed using chemical reaction equations and molecular model kits.	Using SP