BIOL 1306: Biology
Self Study

1 Chemistry of Life

1.1 Structure of Water and Hydrogen Bonding

Most organisms and their environments are made of water. Water has unique properties compared to other molecules. Water is "weird".

Water is **polar**. This means that the overall charge is not evenly distributed. Water is therefore partially positive on one side and partially negative on the other.

This fact allows water to form hydrogen bonds. This is an attraction between different water molecules. Hydrogen bonds are different because they are more like interactions between molecules themselves. The water molecules are constantly interaction with each other and are attracting and repelling each other. Hydrogen bonds break and reform easily.

Water has many unique properties as a result of this - Cohesion, Adhesion, and Surface Tension.

Cohesion is the property that water molecules stick to each other because of hydrogen bonding. Essentially, water is sticky because of its polarity and hydrogen bonds.

Adhesion is the property that water sticks to other polar surfaces.

Water's stickiness allows trees and other plants to transport it upward from the ground because they are able to adhere to the walls of water-conducting cells and water also water molecules cohere together.

Surface tension is a measure of how difficult it is to break the surface of a liquid. Hydrogen bonds keep the liquid intact. Water has a high surface tension compared to other liquids.

1.2 Elements of Life

All living things and the environment are all made of the same elements. Living things need to constantly exchange matter with the environment.

Chemicals that make up living things are carbon-based (except water). Carbon can form a variety of complex organic compounds. Each carbon atom can form four covalent bonds, which means four valence electrons. Hydrocarbons only have carbon and hydrogen.

There are four main classes of biomolecules. These are carbohydrates (C,H,O), proteins (C,H,O,N,S), lipids (C,H,O), and nucleic acids (C,H,N,O,P). Configurations of atoms make biomolecules even more varied. Isomers are compounds with same numbers and types of atoms, but with a different structure.

A structural isomer has a different arrangement of atoms. Cis-trans isomers have a different arrangement of atoms due to double bonds. Enantiomers are "mirror images" of one another due to one carbon being bonded to four different things.

1.3 Introduction to Biological Macromolecules

As mentioned previously, there are four classes of macromolecules - carbohydrates, proteins, lipids, and nucleic acids. Macromolecules are called this because they are big for molecules.

Complex carbohydrates, proteins, and nucleic acids are polymers, which are long molecules made of many building blocks linked by covalent bonds. The building blocks of polymers are monomers.

Monomers and smaller polymers link together to form bigger polymers through dehydration synthesis. Bigger polymers can break down into smaller polymers or monomers through hydrolysis.

Dehydration Synthesis causes a new covalent bond to form with the loss of a water molecule. One molecule gives an -OH, the other -H to form H_2O. Essentially, we are removing a water molecule to form a new covalent bond.

Hydrolysis breaks a covalent bond by adding a water molecule to a polymer. It is the opposite of dehydration synthesis.

1.4 Properties of Biological Macromolecules

1.5 Structure and Function of Biological Macromolecules

1.6 Nucleic Acids

2 Cell Structure and Function

3 Celluar Energetics

3.1 Enzyme Structure

3.2 Enzyme Catalysis

3.3 Environmental Impacts on Enzyme Function

3.4 Celluar Energy

3.5 Photosynthesis

3.6 Celluar Respiration

3.7 Fitness

4 Cell Communication and Cell Cycle

4.1 Cell Communication

4.2 Introduction to Cell Transduction

4.3 Signal Transduction

4.4 Changes in Signal Transduction Pathways

4.5 Feedback

4.6 Cell Cycle

4.7 Regulation of Cell Cycle

5 Heredity

5.1 Meiosis

5.2 Meiosis and Genetic Diversity

5.3 Mendelian Genetics

5.4 Non-Medelian Genetics

5.5 Environmental Effects on Phenotype

5.6 Chromosomal Inheritance

6 Gene Expression and Regulation

6.1 DNA and RNA Structure

6.2 Replication

6.3 Transcription and RNA Processing

6.4 Translation

6.5 Regulation of Gene Expression

6.6 Gene Expression and Cell Specialization

6.7 Mutations

6.8 Biotechnology

7 Natural Selection

8 Ecology