

Lecture Number 6: Molecules of Life I

- Topic:**
- * Structure of water and its importance to biological systems (**1:18**).
 - * Biomolecules (**1:23-24**) and the major macromolecules.
 - * The structure and function of proteins (**1:36**).
 - * Structure and function of enzymes (**2:53-56**).
 - * The structure and function of nucleic acids (DNA & RNA) (**1:43**).
 - * DNA replication (**9:207-212**).

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Recommended Reading: All citations are from: Knox, Ladiges, Evans & Saint "*Biology*" 3rd Edition (McGraw-Hill, 2005); citations are for Chap., page number, thus: **9:207-212**.

Theme/Objective: To understand the building blocks of life, the molecules responsible for life as we know it. Today, to understand the structure and function of proteins, including enzymes, and nucleic acids.

Keywords/concepts: macromolecules, protein, peptide bond, amino acid, nucleic acid, DNA, RNA, phosphodiester bond, nucleotide, purines/pyrimidines, base pairs, genes, genetic code, DNA replication.

Summary of Lecture:

1. Molecules of life: Composed of carbon backbones - said to be organic molecules.
2. Water: Cellular reactions are performed in solution. Water is the universal medium for living systems and their chemical reactions.
3. Biomolecules: Backbone of the major macromolecules is made of carbon - valence of four, offers many possibilities such as chains, branched chains, rings, double and triple bonds. These are the hydrocarbons, and various accessory groups can be attached.

4. Major Macromolecules: Proteins, nucleic acids, carbohydrates and lipids = major macromolecules. With the exception of lipids, they are polymers of monomers.

4.1 **Proteins**: Include the enzymes, and are major components of the cytoskeleton which functions in structure and movement. Proteins are also important in regulation (hormones), food storage, defence, and metabolism.

- proteins are composed of linear chains of amino acids that never branch
- amino acids are joined by peptide bonds, with several amino acids forming a polypeptide
- 20 amino acids in proteins (only plants and bacteria are able to synthesise all 20, animals need to eat plants in order to attain certain "essential" amino acids that they are unable to produce from scratch)
- amino acids are joined by a dehydration reaction (a **peptide bond** results)
- 20 amino acids in proteins - each have different R group with different properties
- some R groups are hydrophilic (eg., hydroxyl, serine) or hydrophobic (eg., methyl group in alanine) or aromatic (ring in phenylalanine) while others are charged or neutral, small, large or medium

Levels of organisation of protein:

1° structure-	amino acid sequence
2° structure-	shape of chains due to weak bonds (alpha-helices and - sheets)
3° structure-	bending and folding (eg., stabilised by bridges) residues
4° structure-	association of two or more polypeptides

Enzymes are proteins, and are the catalysts in cells. Enzymes control cellular reactions.

4.2 **Nucleic Acids** (nucleic acids will be discussed in detail during the genetics portion of Biology 142, and will only be briefly discussed in Biology 141)

- polynucleotides make up the genetic material
- nucleotide = nitrogenous base, pentose sugar, phosphate group
- the phosphate group of one nucleotide binds to the hydroxyl group at C3 of ribose in another nucleotide to form phosphodiester bond
- two polynucleotides -
 RNA = ribonucleic acid
 DNA = deoxyribonucleic acid
- DNA & RNA differ in the sugar - ribose in RNA, deoxyribose in DNA

- they also differ in the bases - adenine, thymine, guanine & cytosine in DNA while uracil replaces thymine in RNA
- DNA forms two opposite strands in chromosomes
- two strands of DNA are complementary
- DNA replication depends on the complementary nature of the double helix.

Continued next time: Gene expression and molecular biology

Glossary of New Words: For new words, refer to the glossary in the text (K,L & E).