

Introduction to biomolecules: definition-general classification

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❖ Biomolecules Definition

- Biomolecules are molecules that occur naturally in living organisms. Biomolecules include macromolecules like proteins, carbohydrates, lipids and nucleic acids.
- It also includes small molecules like primary and secondary metabolites and natural products.
- Biomolecules consists mainly of carbon and hydrogen with nitrogen, oxygen, sulphur, and phosphorus. Biomolecules are very large molecules of many atoms, which are covalently bound together.

• *Classes of Biomolecules*

- There are four major classes of biomolecules:
 - i. Carbohydrates
 - ii. Lipids
 - iii. Proteins
 - iv. Nucleic acids

1. Carbohydrates

- Carbohydrates are good source of energy. Carbohydrates (polysaccharides) are long chains of sugars. Monosaccharides are simple sugars that are composed of 3-7 carbon atoms.
- They have a free aldehyde or ketone group, which acts as reducing agents and are known as reducing sugars. Disaccharides are made of two monosaccharides. The bonds shared between two monosaccharides are the glycosidic bonds.
- Monosaccharides and disaccharides are sweet, crystalline and water soluble substances. Polysaccharides are polymers of monosaccharides. They are un-sweet and complex carbohydrates. They are insoluble in water and are not in crystalline form.
- **Example:** *glucose, fructose, sucrose, maltose, starch, cellulose etc.*

2. Lipids

- Lipids are composed of long hydrocarbon chains. Lipid molecules hold a large amount of energy and are energy storage molecules. Lipids are generally esters of fatty acids and are building blocks of biological membranes.
- Most of the lipids have a polar head and non-polar tail. Fatty acids can be unsaturated and saturated fatty acids.
- Lipids present in biological membranes are of three classes based on the type of hydrophilic head present:
 - ✓ Glycolipids are lipids whose head contains oligosaccharides with 1-15 saccharide residues.
 - ✓ Phospholipids contain a positively charged head which are linked to the negatively charged phosphate groups.
 - ✓ Sterols, whose head contain a steroid ring. Example steroid.
- **Example of lipids:** *oils, fats, phospholipids, glycolipids, etc.*

3. Nucleic Acids

- Nucleic acids are organic compounds with heterocyclic rings. Nucleic acids are made of polymer of nucleotides. Nucleotides consist of nitrogenous base, a pentose sugar and a phosphate group. A nucleoside is made of nitrogenous base attached to a pentose sugar. The nitrogenous bases are adenine, guanine, thiamine, cytosine and uracil. Polymerized nucleotides form DNA and RNA which are genetic material.

4. Proteins

- Proteins are heteropolymers of strings of amino acids. Amino acids are joined together by the peptide bond which is formed in between the carboxyl group and amino group of successive amino acids. Proteins are formed from 20 different amino acids, depending on the number of amino acids and the sequence of amino acids.
- There are four levels of protein structure:
 - (i) **Primary structure of Protein** - Here protein exist as long chain of amino acids arranged in a particular sequence. They are non-functional proteins.
 - (ii) **Secondary structure of protein** - The long chain of proteins are folded and arranged in a helix shape, where the amino acids interact by the formation of hydrogen bonds. This structure is called the pleated sheet. Example: silk fibres.
 - (iii) **Tertiary structure of protein** - Long polypeptide chains become more stabilizes by folding and coiling, by the formation of ionic or hydrophobic bonds or disulphide bridges, these results in the tertiary structure of protein.
 - (iv) **Quaternary structure of protein** - When a protein is an assembly of more than one polypeptide or subunits of its own, this is said to be the quaternary structure of protein. Example: Haemoglobin, insulin.

• Functions of Biomolecules

- **Carbohydrates** provide the body with source of fuel and energy, it aids in proper functioning of our brain, heart and nervous, digestive and immune system. Deficiency of carbohydrates in the diet causes fatigue, poor mental function.
- Each **protein** in the body has specific functions, some proteins provide structural support, help in body movement, and also defense against germs and infections. Proteins can be antibodies, hormonal, enzymes and contractile proteins.
- **Lipids**, the primary purpose of lipids in body are energy storage. Structural membranes are composed of lipids which form a barrier and controls flow of material in and out of the cell. Lipid hormones, like sterols, help in mediating communication between cells.
- **Nucleic Acids** are the **DNA** and **RNA**; they carry genetic information in the cell. They also help in synthesis of proteins, through the process of translation and transcription.

