

Biology 101 Chapter 3 The Molecules of Life

Organic compounds and organic chemistry:

Organic Compounds = any compound that contains carbon and hydrogen

Organic Chemistry = the study of organic compounds

Why carbon?

1. 4 (max) covalent bonds
2. hydrocarbons (only contain C and H)
3. carbon skeletons

Functional groups: main parts designated with the letter R

Ex. Amine group of amino acids

Large molecules from small molecules:

Monomer = individual small units (like a link in a chain)

Polymer = many small units joined together in a long line (like a whole chain)

Macromolecules = very large polymers

Dehydration Synthesis: chemical process whereby monomers, smaller molecules, are linked to form polymers. Also called addition or condensation reactions.

Hydrolysis: process whereby polymers are broken down into individual monomers. A lytic or tear down reaction.

Most Organic Molecules are put into Four Major Classes

** (1) Carbohydrates (the sugars)

Polymeric

** (2) Lipids (fats, oils and waxes)

** (3) Proteins

Polymeric

** (4) Nucleic Acids (DNA + RNA)

Polymeric

The Carbohydrates

• Ranges from simple sugars to complex carbs

I. The Monosaccharides:

- Simple sugars, the **monomers** of carbs
- 3-7 carbon atom molecules
- Example: Glucose
 - Simplest sugar
 - Most important to us
 - $C_6H_{12}O_6$
- Another ex: Fructose
- End in “ose”

Function: fuel for cells

II. The Disaccharides:

- 2 simple sugars joined together
- Ex: Sucrose, Lactose, and Maltose

Function: fuel for cells

III. The Polysaccharides:

- Very, very large + complex, **polymers**
- Multiple units (5 – several thousand)
- Maybe branched
- Ex: Starch, Cellulose, Glycogen

Functions: food storage; structural

Lipids

- Widely diverse group
- Hydrocarbon rings or chains
- Nonpolar, hydrophobic (water-fearing)
- Types:
 - 1) Fatty acids
 - 2) Neutral fats
 - 3) Phospholipids
 - 4) Sterols
 - 5) Waxes

I. Fatty Acids:

- A hydrocarbon chain with a carboxyl group end
- Very long (15-30 carbon atoms)

II. Neutral Fats: (fats and oils)

- Consist of 1, 2 or 3 fatty acid molecules attached to a glycerol molecule base
- Includes the Triglycerides
- Structure:

III. Phospholipids:

- Structural lipids
- Main component of cell membranes
- Similar to fats but contain phosphorus
- Structure:

IV. Sterols:

- Carbon skeleton of 4 fused rings
- Regulate cellular and body functions
- Ex: cholesterol and hormones
- Structure:

V. Waxes:

- Fatty acid linked to an alcohol
- Extremely hydrophobic

Special Terms:

Saturated = *animal fats, solid at room temp., unhealthy*

Unsaturated = *vegetable fats + oils, liquid, "healthy"*

Proteins

- Large polymers, true macromolecules
- Millions of kinds, largest group of organics
- Includes the *enzymes*
- All proteins are encoded by DNA (proteins are the only thing coded for by DNA)
- Made up of smaller monomers called **Amino Acids**
- Only 20 different amino acids (a.a.) make up protein
- Sequence of a.a. determines structure of protein
- Protein structure determines function of protein
- Peptide bonds and polypeptides
- 4 levels of protein structure:
 - 1) Primary: sequence of a.a.
 - 2) Secondary: initial coiling/folding of chain
 - 3) Tertiary: subsequent coiling, overall 3D shape
 - 4) Quaternary: interaction among several proteins and minerals in a larger complex. Ex. Hemoglobin

The Nucleic Acids

- Polymers, macromolecules
- Serve as “blueprints” for life, genetic code
- Monomers called **nucleotides**
- 2 types of nucleic acid
 1. DNA = deoxyribonucleic acid
 2. RNA = ribonucleic acid

Nucleotide Structure: 3 parts

- 1) Five carbon sugar ribose
- 2) Phosphate group
- 3) Nitrogenous base

Nucleic Acid Structure:

- Sugar phosphate backbone
- Helical shape
- Double stranded
- Bases face toward center, bases of opposite strands (if present) hydrogen bond together
- Four bases make up code (A, T, C and G)
- DNA structure and the base pairing rule

Characteristics of DNA vs. RNA

<u>DNA</u>	<u>RNA</u>
Sugar deoxyribose	sugar ribose
Double stranded	single stranded
Four bases	uracil in place of thymine