

Macromolecules

# Introduction

- Organic compounds- Contain carbon and hydrogen atoms
- Inorganic compounds- can have one or the other, but do not contain both carbon and hydrogen atoms.

- Most of your body's molecules are organic compounds
- Macromolecules are built from small organic compounds the same way a railroad train is built, by linking lots of smaller units into long chains.



- Large carbon molecules are built from smaller simpler molecules called monomers (mono = one)
- Monomers can bind to one another to form complex molecules known as polymers (poly = many)
- A polymer consists of repeated, linked units, which can also bind forming large polymers called macromolecules (macro = large or long)

- Monomers link to form polymers through a reaction called condensation reaction, or dehydration synthesis. During the formation of polymers, water ( $H_2O$ ), is released or is by-product of the reaction.
- The breakdown of some complex molecules, such as polymers, occurs through a process known as hydrolysis.
- Hydrolysis is the reverse of the condensation reaction. The addition of water, to some polymers, can break the bonds that hold them together.

There are four main types of macromolecules:

- Carbohydrates

- Lipids

- Proteins

- Nucleic acids

# Carbohydrates

- Composed of carbon, hydrogen, and oxygen atoms in the proportion 1:2:1
- General formula:  $(CH_2O)_n$  where  $n$  is the number of carbon atoms.
- Example: glucose is a small carbohydrate, its  $n$  equals 6. Therefore its chemical formula is  $C_6H_{12}O_6$

- The building blocks (or monomers) of carbohydrates are monosaccharides.
- Monosaccharides are simple sugars (saccharides=sugars) Examples:
  - Glucose: commonly found in blood of animals
  - Galactose: sugar found mostly in milk
  - Fructose: commonly found in fruit
- Glucose and fructose both have the same formula, but different structures. These compounds are called isomers.

- Disaccharides contain monosaccharides joined by dehydration synthesis.
- Lactose: commonly found in milk, made of galactose and glucose
- Sucrose: table sugar, transported in plants, made up of fructose and glucose

- Polysaccharides are carbohydrates formed from linking individual sugars into long chains.
- Examples:
  - Starch: A common storage form of glucose in plants (bread, pasta, potatoes)
  - Cellulose: A polysaccharide contained in the cell walls of plants. It gives them strength and rigidity.
  - Glycogen: A common storage form of glucose in animals (stored in muscles and liver for quick energy).
- Complete 1 and 2 on Lab

# Lipids

- Class of macromolecules that do not dissolve in water.
- Lipids serve one of three functions:
  - Energy storage
  - Structural support in cell membranes
  - Reactants (starting materials) for metabolic reactions
- Fatty Acids are the building blocks (or monomers) that make up most lipids

- Fatty acids are either saturated or unsaturated.
- The classification depends on the proportion of hydrogen atoms to carbon-carbon bonds in the molecule
  - Saturated fatty acids have the maximum number of bonds possible, they are full
  - Saturated fats are usually solid at room temperature and most come from animal products
    - Unsaturated fatty acids have double bonds in the carbon chain and are not full
    - Most unsaturated fats are liquid at room temperature and are usually referred to as oils

- Saturated animal fats are associated with circulatory disorders; plant oils can be substituted for animal fats in the diet.
- A common lipid that contains fatty acids is a triglyceride. Triglycerides are glycerol linked to 3 fatty acids in the shape of an E by a condensation reaction.
- Complete number 5 on Lab

# Proteins

- Proteins are organic compounds composed mainly of carbon, hydrogen, and nitrogen atoms.
- Proteins are the construction materials for body parts such as hair, skin, nails, and blood.
- Amino acids are the building blocks (or monomers) that make up most proteins

- There are 20 different kinds of amino acids that humans use
- One important group of proteins- enzymes- help control chemical reactions by acting as catalysts. Catalysts speed up reactions by lowering activation energy.
- Complete 3 and 4 on lab

# Nucleic acids

- Nucleic acids are complex organic molecules that store genetic information in the cell.
- Nucleotides are the building blocks (or monomers) that make up most of the nucleic acids.
- Nucleotides consist of sugar (pentose) + base (nitrogenous) + phosphate
- Example: DNA

- Three main types of nucleic acids:
- DNA = deoxyribonucleic acid
  - Is the genetic information inside the nucleus of cells
- RNA = ribonucleic acid
  - Instructions which code for protein synthesis
- ATP = adenosine triphosphate: has a slightly different structure. It contains a base + sugar + 3 phosphates
  - ATP is used as energy for the cell
- Complete number 6 and 7 on Lab

Complete the review  
questions (notes) and post  
lab questions