Carbohydrates

Carbohydrates

#Chemistry

Polymers

- Polymers are large covalent molecules made from repeating subunits (monomers) joined together in chains.
- Polymers are named from their monomer (e.g., polyethene).

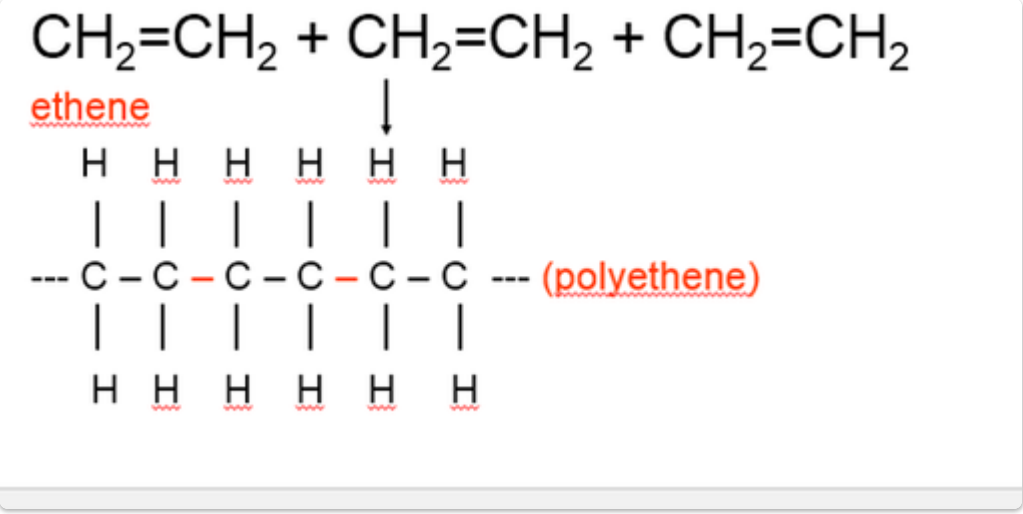
Monomers

- Monomers have double bonds which break to form the polymer.
- Monomers have three forms:
  - Structural
  - Molecular
  - Chemical

When monomers link together to form a polymer the process is called polymerisation.

Addition Polymerisation

Polymerisation is the process in which monomers react to form polymer chains. Addition polymerisation occurs when double bonds from alkenes break apart, allowing single bonds to form the polymer. Ethene undergoes an addition reaction (double bond in alkene is broken) with itself to form the polymer, polyethene. The length of the polymer chains can vary from 100 to 1000 carbon atoms. Modifying ethene by substituting different functional groups produces other monomers which make polymers with different properties.



Condensation Polymerisation

Condensation polymers are formed by the “head to tail” joining of monomer units. Each join (link) is accompanied by loss of a small molecule such as water, H20. The reaction requires the presence of 2 reactive functional groups on each monomer. Condensation Polymerisation doesn’t need a double bond. Monomers need reactive side groups in order for condensation polymerisation to happen. Often times, $\mathrm{H_2O}$ is a by-product but it can be other small molecules too (e.g., $\mathrm{HCl}, \mathrm{NH_3}$)

Carbohydrates

Carbohydrates are made from carbon, hydrogen and oxygen. The formula for carbohydrates can be generalised as $C_x(H_2O)_y$.

Carbohydrates are commonly found as a group of chemicals known as saccharides. There are three types of saccharides. They are monosaccharides, disaccharides and polysaccharides.

Monosaccharides

Monosaccharides are simple single ringed sugars. These rings are either 5 carbon rings (pentose sugars) or 6 (hexose sugars). Monosaccharides have either an aldehyde group (aldose) or a ketone group (ketose).

Monosaccharides also have hydroxy groups (consisting of an oxygen and hydrogen atom, OH). This makes the molecules polar.

Monosaccharides are a simple sugar. There are three main types of monosaccharides. They are glucose, fructose and galactose.

These are white crystalline solids that are highly soluble in water.

These
molecules consist of a number of functional groups. Functional groups are the parts of molecules that affect the properties of the molecule. The hydroxy (-OH) is the functional group present on each of these molecules. Making the molecules polar and therefore highly soluble in water.

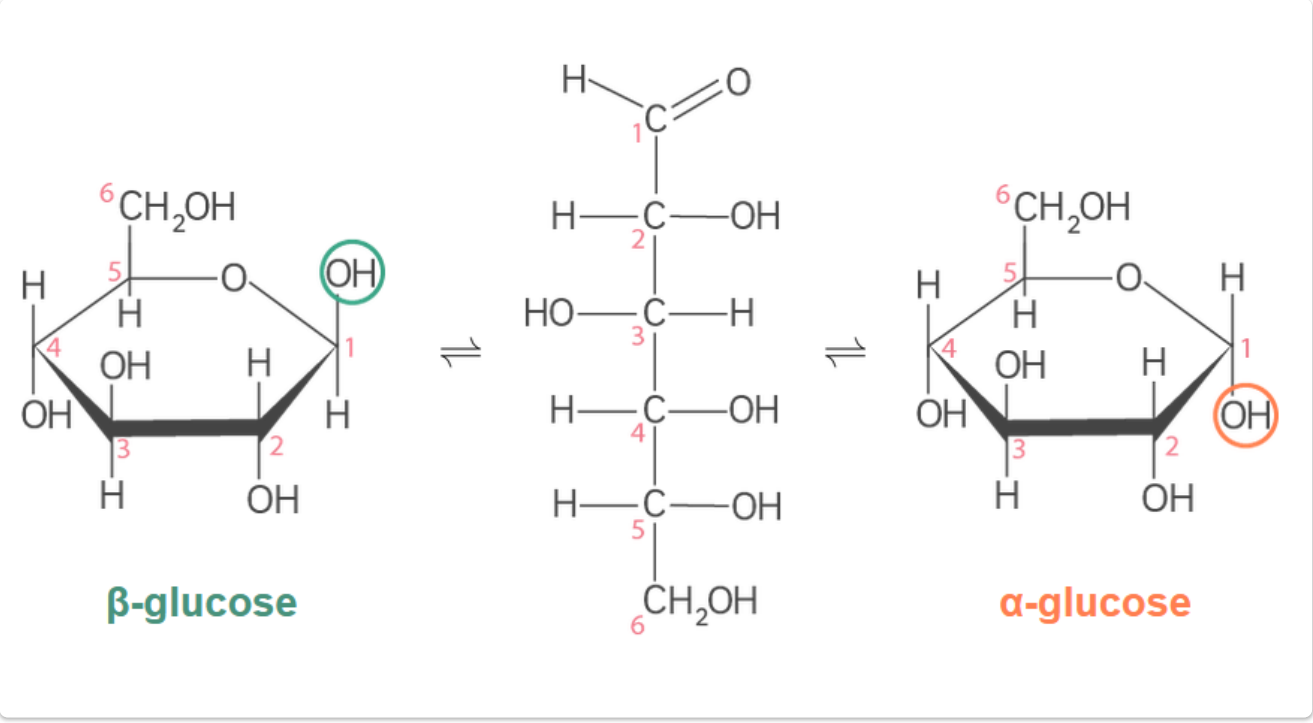
Glucose

Glucose is the most common monosaccharide, formed by the photosynthesis:

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

Glucose has three glucose isomers:

- Linear glucose
- α-glucose
- β-glucose



Disaccharides

Disaccharides are formed when 2 monosaccharides undergo a condensation reaction. In this reaction, as with all condensation reactions, water is produced. The only change to the

structures of the reactants is in the linkage between the two monosaccharides that for the disaccharide. The link is called a glycosidic (or ether) linkage.

Polysaccharides

Polysaccharides are known to be complex carbohydrates. They are formed by the polymerisation of the monomer glucose, again by a condensation reaction. They are insoluble in water and tasteless. Three important polysaccharides include glycogen, starch, and cellulose.

Glycogen

Animals store energy in the body. One of the methods used to store energy is to convert excess glucose in the body into the polymer glycogen. The glycogen is stored in muscle and body tissue, and when required converted back into glucose ready to be turned into energy.

Starch

Plants store glucose in the form of starch rather than glycogen.

Cellulose

This particular type varies in the orientation of the components in the polymer. It is not readily broken down into the glucose monomer and so not easily used as a source of energy. It is important in keeping our digestive system regular. Cellulose is referred to as dietary fibre or roughage. Glycogen and starch store energy.