

CIE Biology GCSE

4: Biological Molecules Notes

Biological molecules are important in organisms to **build structures** and for use in **metabolic reactions**. Large molecules are made when many smaller molecules bind together.

Carbohydrates:

Carbohydrates are made up of many sugar molecules, containing **carbon, hydrogen and oxygen** atoms. **Glucose** is a small sugar molecule. When many glucose molecules bind together in a chain **cellulose, starch and glycogen** can be made. Cellulose is used for **structure** and makes up **plant cell walls**. Whereas starch and glucose are **stored in cells** and used in **respiration** to provide energy for the organism. Starch is stored in plants, whereas glycogen is stored in animals.

Fats:

Fats and oils are made up of **glycerol and fatty acids**, which contain **carbon, hydrogen and oxygen**. Fats have a variety of roles in organisms including insulation, energy, waterproofing, structure and protection around delicate organs.

Proteins:

Proteins are made up of **nitrogen, carbon, hydrogen, oxygen and sulphur**. These elements make up **amino acids**, which bind together in a chain to make proteins. Different arrangements of amino acids make up different proteins and form different shapes. Enzymes are proteins; each enzyme's active site has a **specific shape**, allowing it to bind to a specific **substrate** molecule to catalyze metabolic reactions. **Antibodies** also have a specific shape, formed by a specific sequence of amino acids. This allows them to bind to **antigens** on foreign pathogens to kill them.

Water:

Water is an important molecule that is a major component of cells. It acts as a **solvent** in which chemical reactions occur, helps to maintain a **constant temperature** in the body, and is a **metabolite**.

Water is needed for **digestion** to provide a **medium for enzymes** to act in and to allow free passage of digestive products, so they can be absorbed into the blood. It also allows soluble molecules, such as the products of digestion, to be **transported** around the body and through cell membranes. It also transports **waste products** such as urea and carbon dioxide to be excreted.

DNA:

DNA is composed of **two strands** coiled around each other to form a **double helix**. Each strand is made up of a **sugar backbone** with **bases** attached. These bases bind to bases on the other strand to form **cross-links** when they are wound together. There are four types of base: **G, C, A and T**. G always binds to C and A always binds to T.

Chemical tests:

- **Starch** - add **iodine solution** to the sample. A colour change to **blue-black** indicates the presence of starch.
- **Reducing sugars** - Glucose is a reducing sugar. Glucose and other reducing sugars are detected using **Benedict's solution**. Benedict's solution contains copper sulphate which makes it blue. When a reducing sugar is added to the Benedict's solution and heated to 80°C, the Cu²⁺ ions are reduced to an **insoluble brick red** copper (I) oxide.
- **Proteins** - The sample solution is placed in a test tube with an equal amount of **sodium hydroxide** solution. Add a few drops of **dilute copper II sulphate** solution, if the sample turns **purple**, a protein is present in the sample. If it remains **blue**, no protein is present. This test is known as the **biuret test**.
- **Fats and oils** - place sample in a test tube and add **ethanol**. Shake tube to dissolve any fats and oils. Add water and shake gently. If the sample contains fats or oils, it will turn **cloudy white**. This test is known as the **emulsion test**.
- **Vitamin C** - Add **DCPIP** solution to a test tube, this is a **blue** colour. Add the sample and shake gently. If the DCPIP becomes **colourless**, vitamin C is present.