Biological Molecules

The elements in carbohydrates, lipids, proteins and DNA, how large molecules are built from smaller ones, and the food tests for starch, reducing sugars, protein and lipids.

4.1 Biological molecules

The elements in each type of molecule

Molecule	Elements
carbohydrates	carbon, hydrogen, oxygen
lipids (fats and oils)	carbon, hydrogen, oxygen
proteins	carbon, hydrogen, oxygen, nitrogen (and sometimes sulfur)
DNA	carbon, hydrogen, oxygen, nitrogen, phosphorus

Large molecules from small molecules

Many biological molecules are large molecules made of many small molecules joined together.

Large molecule	Made from
starch (a store of energy in plants)	many **glucose** molecules
glycogen (a store of energy in animals, in liver and muscles)	many **glucose** molecules
cellulose (in plant cell walls)	many **glucose** molecules
proteins	**amino acids**
lipids (fats and oils)	**three fatty acids** and one **glycerol**
DNA	**nucleotides**

The order of the amino acids in a protein decides its shape and its function, and there are about 20 different amino acids.

Functions of the main groups.

- **Carbohydrates** (sugars, starch): a source of **energy**.
- **Lipids**: a store of energy, insulation, and part of cell membranes.

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- **Proteins**: growth and repair, and used to make enzymes, hormones and antibodies.
- **DNA**: carries the genetic information.

Food tests

Test for	Reagent	Method	Positive result
starch	iodine solution	add a few drops to the food	**blue-black** (it stays orange-brown if starch is absent)
glucose and maltose (reducing sugars)	Benedict's solution	add Benedict's solution to the food solution and **heat in a hot water bath**	blue → **green, yellow, orange, then brick-red precipitate**, depending on the amount of sugar
protein	biuret reagent (sodium hydroxide and copper(II) sulfate solution)	add to the sample	blue → **purple (lilac)** (stays blue if there is no protein)
lipids	ethanol emulsion test	mix with ethanol, shake, then pour into water	a **cloudy white emulsion** forms (it stays clear if no lipid)

NOTE

The sample must be a **solution** (crushed in water) for the Benedict's and biuret tests. The more sugar, the further the colour change goes along the series green, yellow, orange, brick-red. Benedict's solution needs **heating**; the other tests do not.

TRY IT

A food gives a purple colour with biuret reagent and a blue-black colour with iodine solution. What does it contain?

It contains **protein** (biuret) and **starch** (iodine).

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