



Cambridge (CIE) O Level Biology



Your notes

4.1 Biological Molecules

Contents

- * Chemicals & Life
- * Food Tests



Chemical Elements

- Most of the molecules in living organisms fall into four categories: **carbohydrates, proteins, lipids and DNA**
- These **all contain carbon** and so are described as organic molecules

Chemical Elements Table

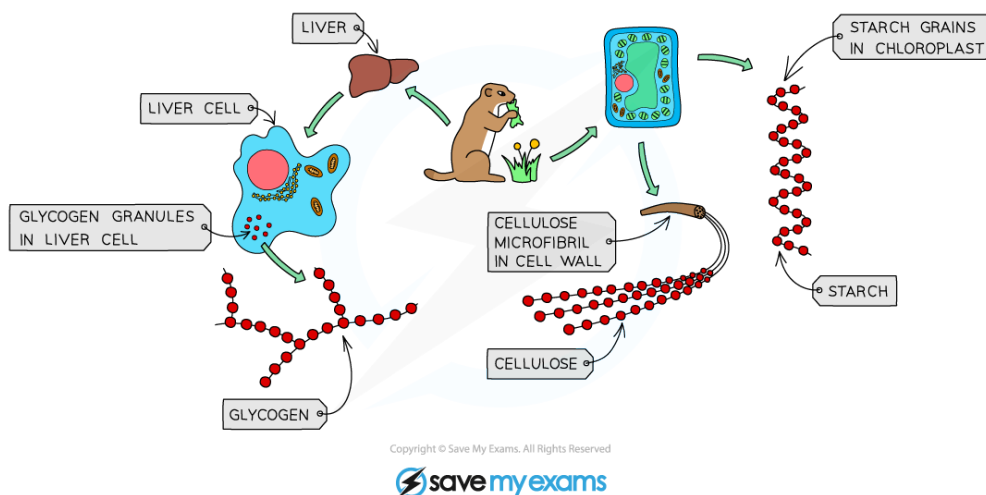
Molecule	Chemical Elements
Carbohydrate	Carbon, oxygen, and hydrogen
Protein	All contain carbon, oxygen, hydrogen, and nitrogen (and some contain small amounts of other elements such as sulfur)
Lipid	Carbon, oxygen, and hydrogen
DNA	Carbon, oxygen, hydrogen, nitrogen, and phosphorous

Large Molecules are Made from Smaller Molecules

Carbohydrates

- Long chains of **simple sugars**
- Glucose** is a simple sugar (a monosaccharide)
- When **two glucose molecules join together maltose is formed** (a disaccharide)
- When **lots** of glucose molecules join together **starch, glycogen or cellulose** can form (a polysaccharide)

Carbohydrates in animals and plants diagram



Glycogen, cellulose and starch are all made from glucose molecules

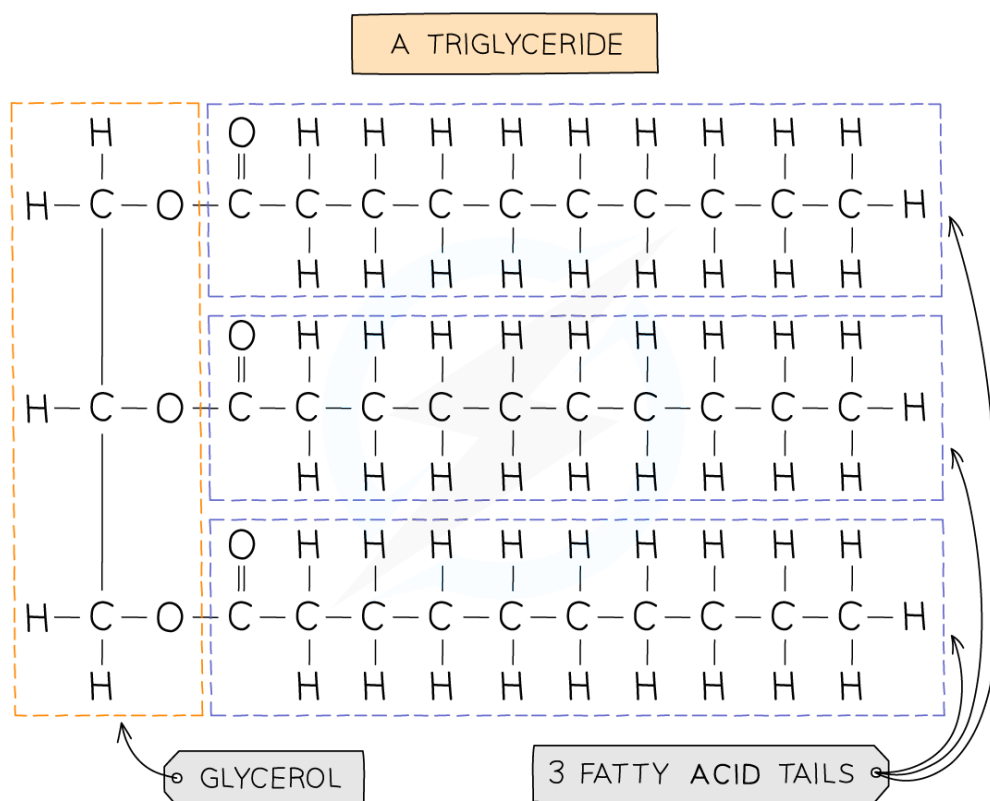
Lipids

- Most lipids (fats and oils) in the body are made up of **triglycerides**
- Their basic unit is **one glycerol molecule chemically bonded to three fatty acid chains**
- The fatty acids vary in size and structure
- Lipids are divided into **fats** (solids at room temperature) and **oils** (liquids at room temperature)

Triglyceride diagram



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Structure of a triglyceride with a glycerol and three fatty acids

Proteins

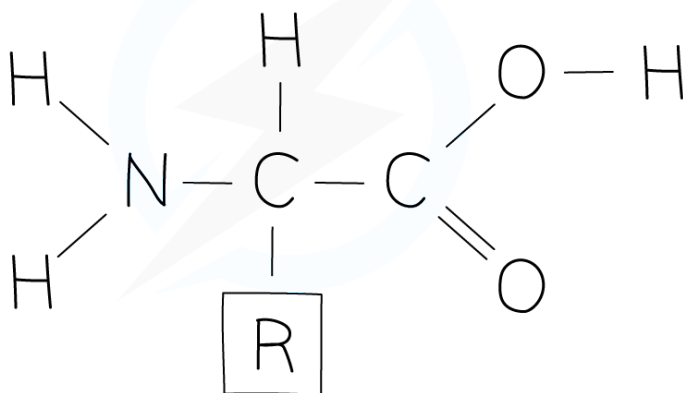
- Long chains of **amino acids**
- There are about 20 different amino acids
- They all contain the **same basic structure** but the '**R**' group is different for each one
- When amino acids are joined together a protein is formed
- The amino acids can be arranged in any order, resulting in hundreds of thousands of different proteins
- Even a small difference in the order of the amino acids results in a different protein being formed

Amino acid chemical structure diagram

GENERAL STRUCTURE OF AMINO ACIDS



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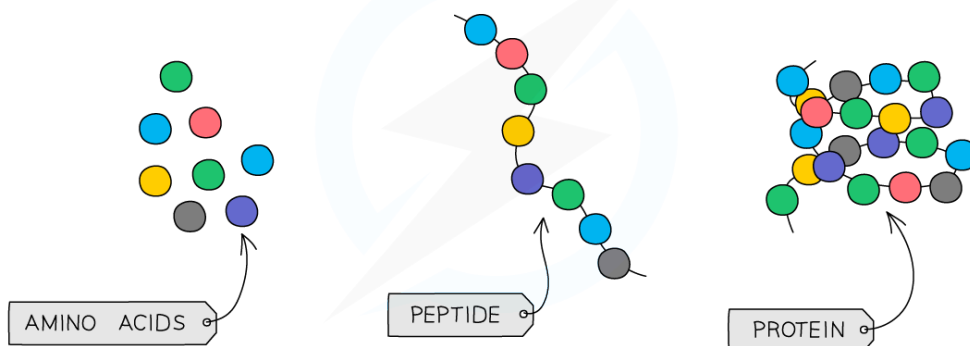
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General amino acid structure. The part that is different for each amino acid is represented by the letter R.

Amino acids join together to form proteins

HOW YOUR BODY USES AMINO ACIDS AS BUILDING BLOCKS



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Amino acids are the monomers that join to form a peptide chain that folds into a functional protein

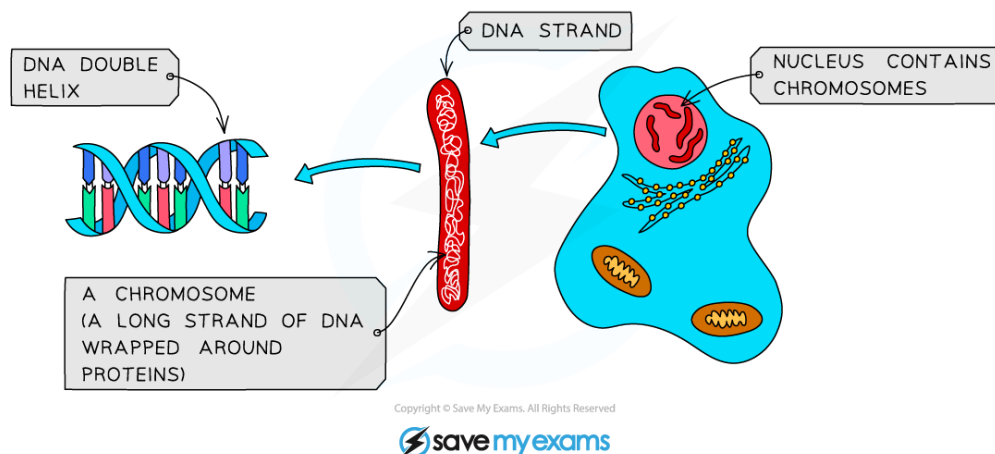
DNA

- DNA, or deoxyribonucleic acid, is the molecule that contains the instructions for the growth and development of all organisms
- It consists of two strands of DNA wound around each other in what is called a **double helix**



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Structure of DNA in the cell diagram



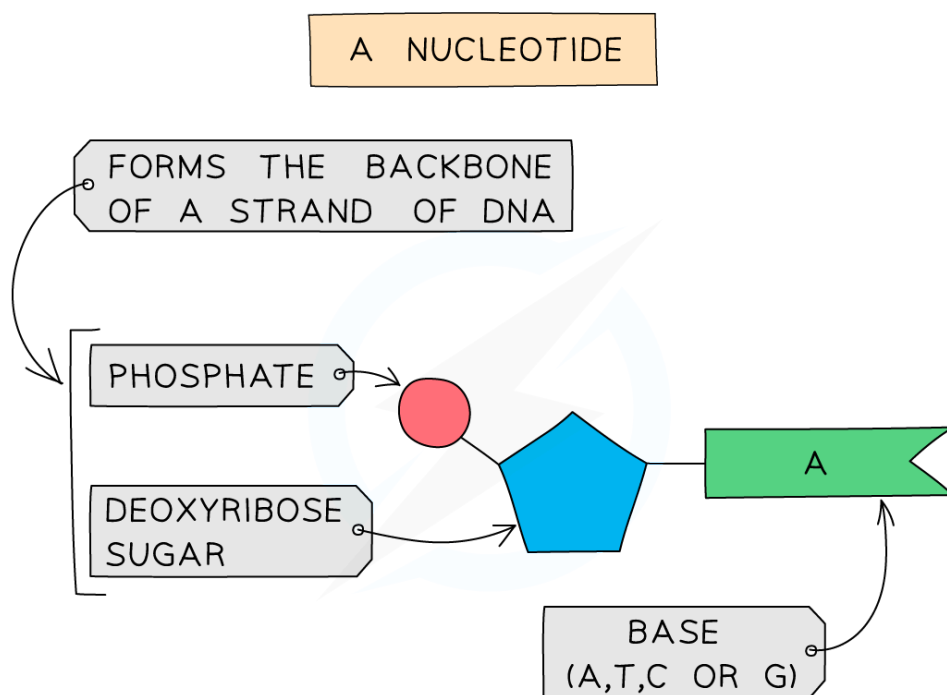
DNA, chromosomes and the nucleus

- The individual units of DNA are called **nucleotides**

Nucleotide structure diagram



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The structure of a nucleotide

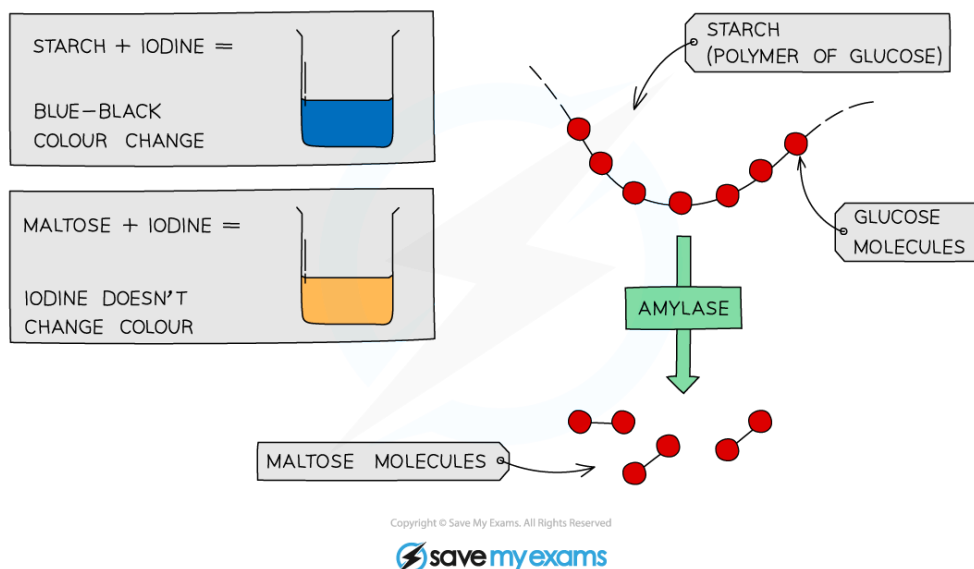


Food Tests

Test for starch using iodine

- We can use **iodine** to test for the presence or absence of **starch** in a food sample

Iodine test for starch diagram

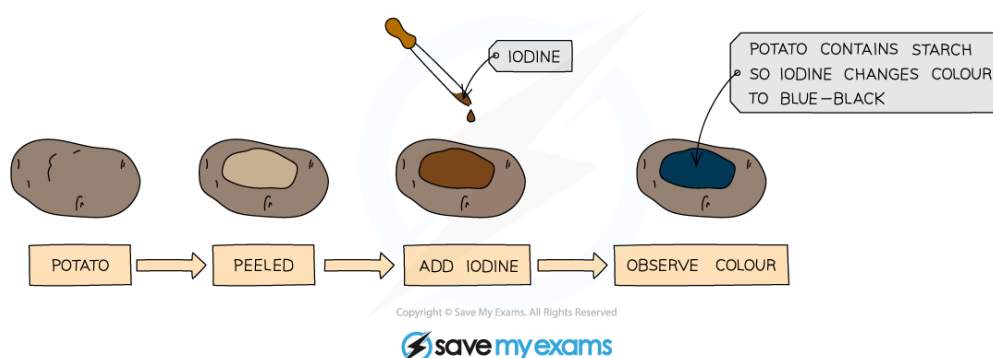


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Iodine turns blue-black in the presence of starch

- Add drops of **iodine solution** to the food sample
- A positive test will show a colour change from **orange-brown to blue-black**

Placing iodine on a potato diagram



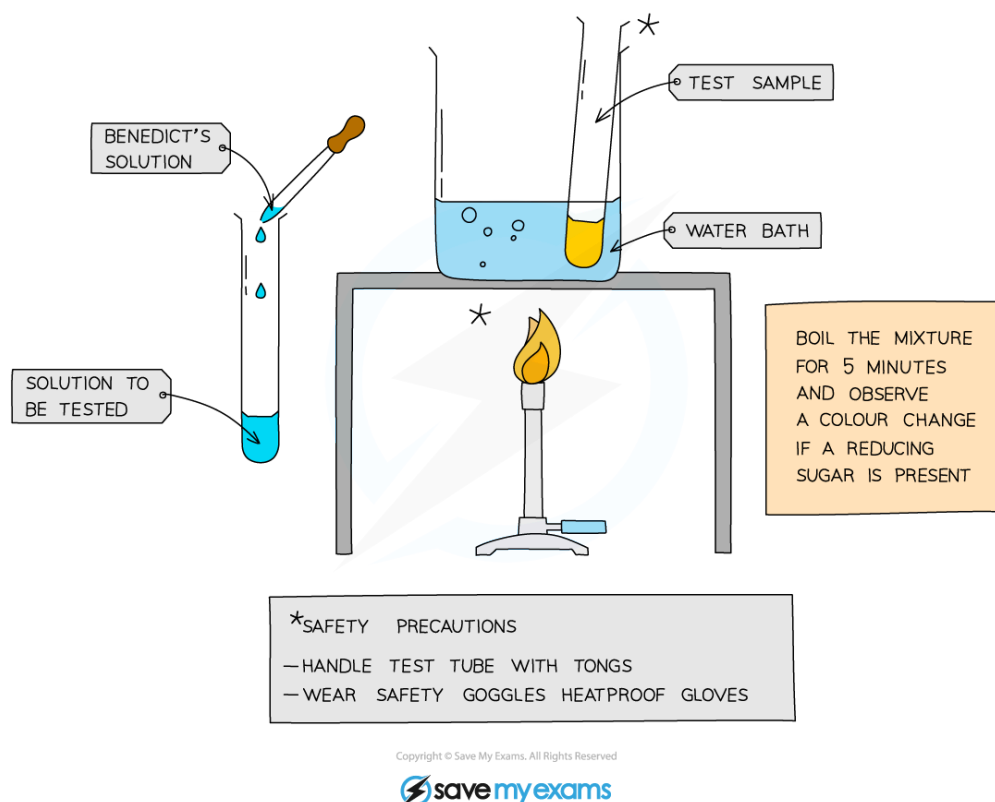


Testing a potato to prove the presence of starch

Test for glucose (a reducing sugar)

- Add **Benedict's solution** into sample solution in test tube
- **Heat** at 60–70 °C in water bath for **5 minutes**
- Take test tube out of water bath and observe the colour
- A positive test will show a colour change from **blue to orange or brick red**

The Benedict's test for glucose diagram

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The Benedict's solution turns brick red when heated in the presence of glucose

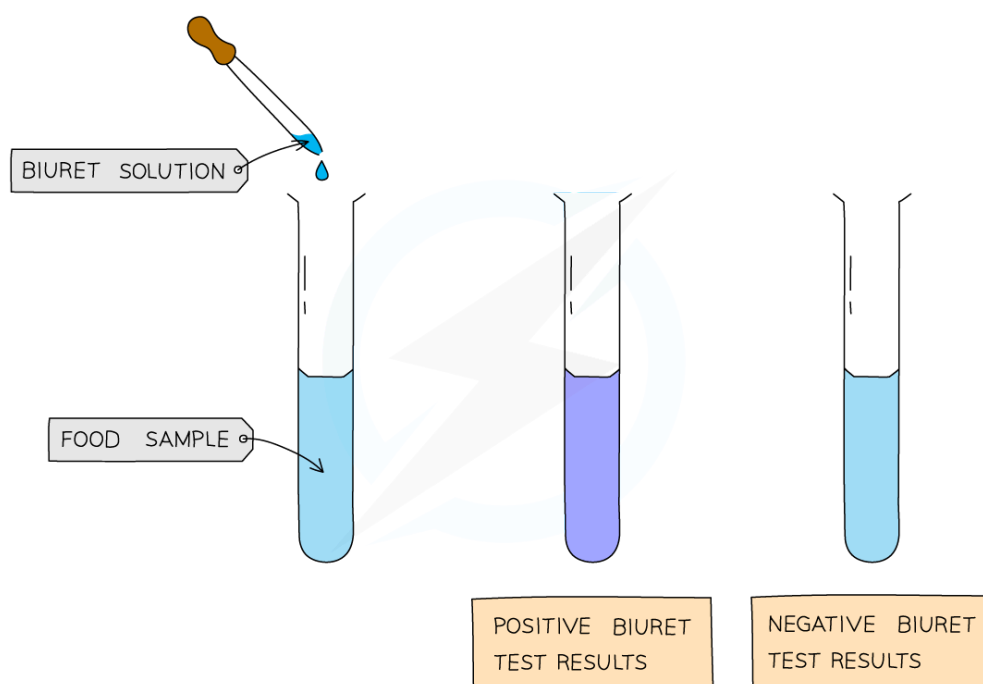
Test for protein

- Add drops of **Biuret solution** to the food sample
- A positive test will show a colour change from **blue to violet / purple**

The Biuret test for protein diagram



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Biuret solution turns purple in the presence of protein

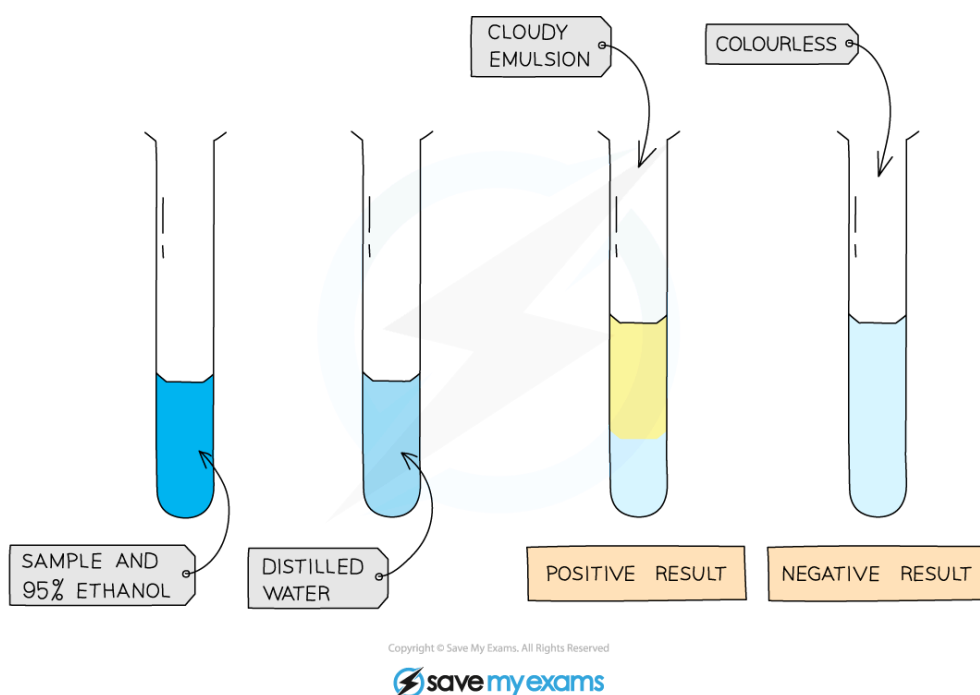
Test for lipids

- Food sample is mixed with 2cm^3 of **ethanol** and shaken
- The ethanol is added to an equal volume of **cold water**
- A positive test will show a **cloudy emulsion** forming

The ethanol emulsion test for lipids



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The ethanol emulsion test shows a cloudy white positive result



Examiner Tips and Tricks

When describing food tests in exam answers, make sure you give the **starting colour** of the solution and **the colour it changes to** for a positive result.