

Biological molecules revision notes

Living things are built from a small set of large molecules: carbohydrates, fats, proteins and DNA. This topic covers the elements they contain, how they are built from smaller units, and the chemical tests used to identify them in food.

For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

1 Biological molecules Spec 4.1

Carbohydrates, fats and proteins Spec 4.1.1, 4.1.2

Carbohydrates, fats and proteins are made from just a few chemical elements. Each is a **large molecule** built from many smaller molecules joined together.

Elements in the three main food molecules

Molecule	Elements present
Carbohydrates	carbon, hydrogen, oxygen
Fats (and oils)	carbon, hydrogen, oxygen
Proteins	carbon, hydrogen, oxygen, nitrogen

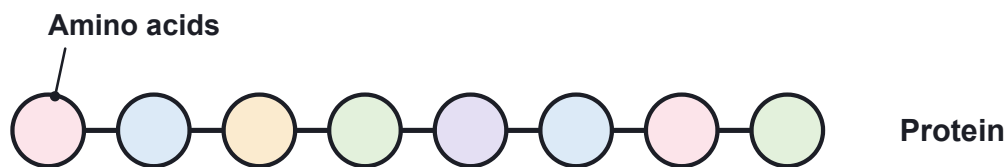
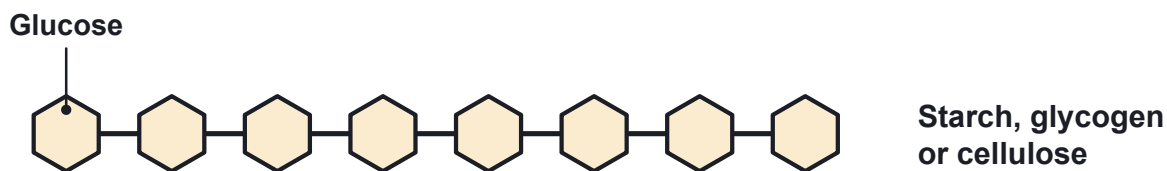
Common mistake: Carbohydrates and fats contain the same three elements. Proteins contain these three plus nitrogen. Write the element names in full, or use the symbols C, H, O and N correctly.

Large molecules are made from smaller molecules

Building blocks

Large molecule	Made from
Starch	many glucose molecules joined together
Glycogen	many glucose molecules joined together
Cellulose	many glucose molecules joined together
Proteins	many amino acids joined together
Fats and oils	three fatty acids joined to one glycerol

Starch is the **energy store** in plants. Glycogen is the energy store in animals and fungi. Cellulose is a **structural** carbohydrate that makes up plant cell walls. All three are built from the same unit, glucose, but the glucose molecules are joined in different arrangements.



Large molecules are built from **smaller molecules** joined together.

Exam tip: Learn the three pairings exactly: glucose makes starch, glycogen and cellulose; amino acids make proteins; fatty acids and glycerol make fats and oils.

Food tests Spec 4.1.3

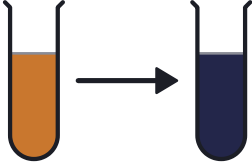
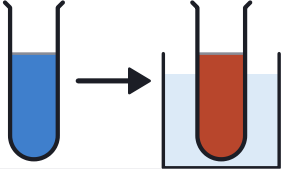
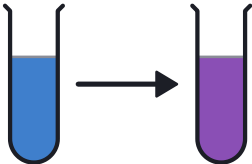
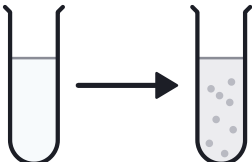
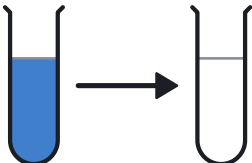
Chemical tests show which biological molecules are in a food. Most foods must first be ground up with a little water and filtered or allowed to settle, so the test is done on the liquid.

Food tests and results			
Test	Food molecule	Method	Positive result
Iodine solution	starch	Add a few drops of iodine solution (orange-brown) to the sample.	turns blue-black (negative: stays orange-brown)
Benedict's solution	reducing sugars	Add Benedict's solution (blue) to the sample, then heat in a hot water bath.	blue turns green, yellow, orange or brick-red as the amount of reducing sugar increases (negative: stays blue)
Biuret test	proteins	Add biuret solution (blue) to the sample and mix.	turns purple / lilac (negative: stays blue)
Ethanol emulsion test	fats and oils	Mix the sample with ethanol, then pour the mixture into water.	a cloudy white emulsion forms (negative: stays clear)
DCPIP test	vitamin C	Add the sample drop by drop to DCPIP solution (blue).	DCPIP changes from blue to colourless

Practical skill: Benedict's solution must be heated to work. Use a water bath at about 80 °C, not a Bunsen flame directly on the tube, and wear eye protection. Compare colours against a set of known samples to judge the amount of sugar.

The DCPIP test works the other way round from the others: the **colour is lost** (blue to **colourless**) when vitamin C is present. The more drops of food sample needed to decolourise a fixed volume of DCPIP, the less vitamin C the sample contains.

*Exam tip: Always give the **start colour and the end colour**, for example 'blue to brick-red'. 'It changes colour' gets no mark.*

Iodine solution test for starch		start: orange-brown positive: blue-black
Benedict's solution test for reducing sugars		start: blue positive: brick-red (heat in a hot water bath)
Biuret test test for proteins		start: blue positive: purple
Ethanol emulsion test test for fats and oils		start: clear positive: cloudy white emulsion
DCPIP test test for vitamin C		start: blue positive: colourless

Learn the **start colour** and the **positive colour** for each test.

The structure of DNA Spec 4.1.4 Supplement

Supplement

DNA is a very long molecule that carries genetic information. A DNA molecule is made of **two strands coiled together** to form a **double helix**.

Supplement

- Each strand contains chemicals called **bases**.
- Bonds between pairs of bases hold the two strands together.
- The bases always pair up in the same way: A with T, and C with G.

Supplement

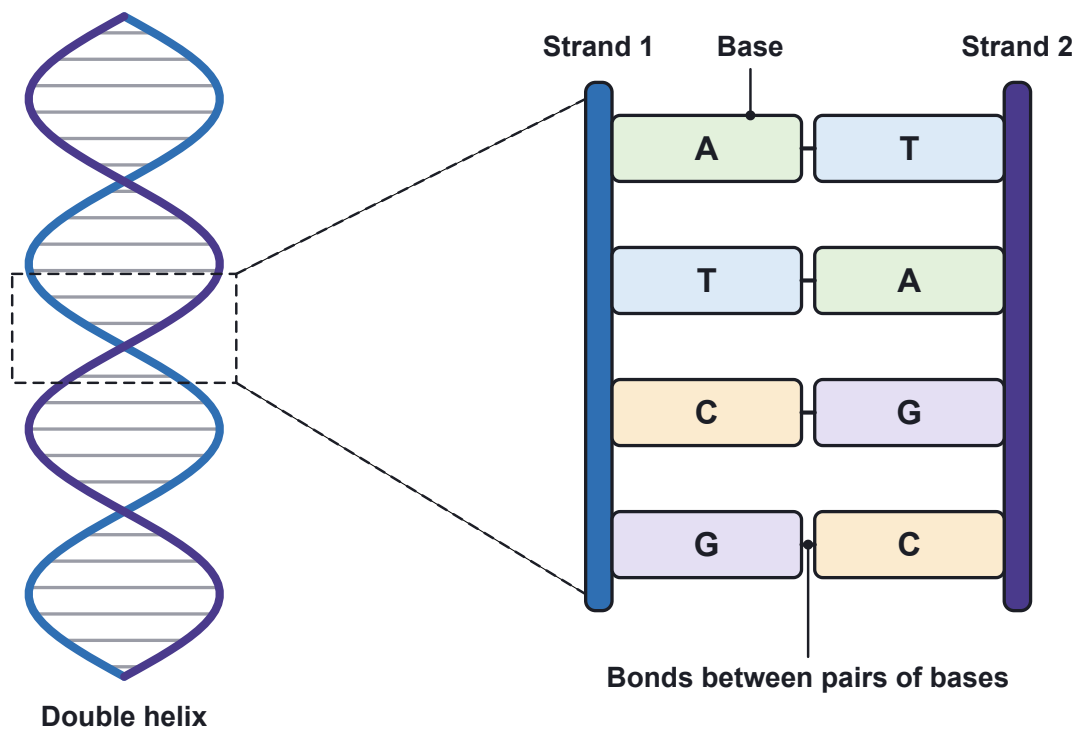
Base pairing

Base	Pairs with
A	T
T	A
C	G
G	C

Supplement

Exam tip: You do not need the full names of the bases; the letters A, T, C and G are enough. The bonds join the bases, so say 'bonds between pairs of bases', not 'bonds between the strands'.

Supplement



Two strands are held together by **bonds between pairs of bases**: A with T, C with G.

Quick check

1. Which element is found in proteins but not in carbohydrates or fats?
2. What small molecules join to make a protein?
3. What is the positive result for the iodine test?
4. Which test uses DCPIP, and what is the positive result?
5. **Supplement** Which bases pair together in DNA?

Quick check answers

Biological molecules

1. Nitrogen.
2. Amino acids.
3. Orange-brown turns blue-black, showing starch.
4. Test for vitamin C; blue DCPIP becomes colourless.
5. A with T, and C with G.