

Biological Molecules

IGCSE Biology ■ Topic 4

IGCSE Biology



Biological Molecules

What we will cover

- 1 Elements in food
- 2 Building large molecules
- 3 Food tests
- 4 Test colours
- 5 The structure of DNA



the structure of DNA

1 Molecules

Biological Molecules

Elements in food

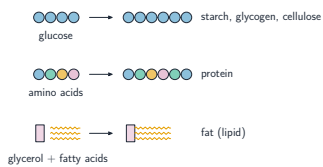
carbohydrates
and fats
C H O

proteins
C H O N

- **Carbohydrates** 碳水化合物 and **fats** 脂肪 contain three elements: **carbon** 碳 (C), **hydrogen** 氢 (H) and oxygen (O).
- **Proteins** 蛋白质 contain carbon, hydrogen and oxygen too, plus **nitrogen** 氮 (N). (Some proteins also contain sulfur, S.)

Biological Molecules

Building large molecules



Large molecules are made by joining many small molecules together, like beads on a string.

| Large molecule | Built from |
| - | - | | **starch** 淀粉, **glyco-**
gen 糖原 and **cellulose** 纤维素
| many **glucose** 葡萄糖
units | | proteins | **amino**
acids 氨基酸 | | fats and oils |
fatty acids 脂肪酸...

Small units, large molecules

Carbohydrates Simple sugars join into starch, glycogen and cellulose.

Fats and oils Built from **fatty acids** 脂肪酸 and **glycerol** 甘油 – three fatty acids to each glycerol.

Proteins Long chains of amino acids, folded into a shape that decides the job.

DNA Two strands of nucleotides. **Bonds** 键 between **pairs of bases** hold the strands together, and DNA is the **genetic material** 遗传物质 – the instructions for building and running the organism.

Each family is one kind of small unit repeated. Name the unit and you have named the molecule.

Food tests

Food substance (test)	start	positive result
Starch (iodine)	orange	blue-black
Reducing sugar (Benedict's, heat)	blue	brick-red
Protein (biuret)	light blue	purple
Fat (ethanol emulsion)	white	cloudy white
Vitamin C (DCPIP)	blue	colourless

Add a test chemical & watch the colour (**biuret** 双缩脲 for protein, an **emulsion** 乳浊液 for fat).

Only **Bene-dict's** 本尼迪特试剂 needs **heat**. DCPIP goes **colourless**; the others gain a colour.

The four food tests, colour by colour

Starch	Add iodine solution 碘液: orange-brown → blue-black.
Reducing sugar	Add Benedict's solution and heat: blue → green → yellow → brick-red.
Protein	Biuret test: blue → purple.
Fats and oils	The ethanol 乙醇 emulsion 乳浊液 test: dissolve in ethanol, then add water – a cloudy white layer forms.

Only Benedict's needs heat, and only the ethanol test needs two liquids. Naming the reagent *and* both colours is what earns the marks.

Test colours

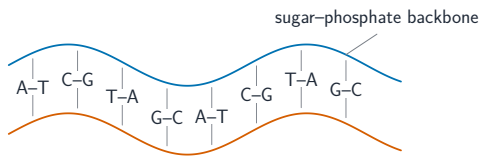
starch iodine → blue-black	reducing sugar Benedict's → brick-red	protein biuret → purple
fat emulsion → cloudy	vitamin C DCPIP → colourless	

2 DNA

The structure of DNA

DNA 脱氧核糖核酸 is a **double helix** 双螺旋 – a twisted ladder of two **strands** 链.

The **bases** 碱基 always pair: **A–T** and **C–G**. So one strand sets the other.



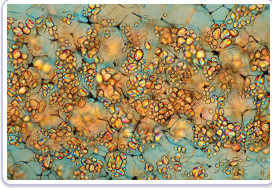
two strands form a double helix; bases pair A–T and C–G

The chemical elements in food



Bread is rich in carbohydrates, one of the main food groups.

Building large molecules from small ones



Starch grains from a potato, seen under a microscope – each grain is built from many glucose units

Exam tips

- Carbohydrates and fats are made of C, H and O. Proteins also contain N (nitrogen).
- Learn each food test and its colour change. For reducing sugars you must **heat** the Benedict's solution.
- DCPIP goes from blue to **colourless**; the other four tests each give a **new** colour.
- In DNA, the bases pair only A–T and C–G. So if you know the bases on one strand, you can work out the other.

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Recap

Worked example – reading food tests

A food gives a brick-red Benedict's result and a purple biuret result, but iodine stays orange-brown. What is in it?

- Benedict's brick-red ⇒ **reducing sugar present**, and a lot of it.
- Biuret purple ⇒ **protein present**.
- Iodine **stays** orange-brown ⇒ **no** starch (blue-black would mean starch).
- So: **reducing sugar + protein, no starch**.

Learn the colour **change**, not just the final colour: Benedict's blue → brick-red (heat needed), iodine orange-brown → blue-black, biuret blue → purple.

Topic 4 – key takeaways

1 Elements

carbs & fats C,H,O; proteins add N

2 Big molecules

chains of glucose / amino acids / fatty acids

3 Food tests

iodine, Benedict's (heat), biuret, DCPIP

4 DNA

double helix; A–T & C–G

Check yourself

- 1 Which element do proteins have that fats do not?
- 2 What are proteins built from?
- 3 Which food test needs heating?
- 4 Which base pairs with C in DNA?



Answers 1. nitrogen 2. amino acids 3. Benedict's (reducing sugars) 4. G