

Biological Molecules

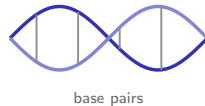
IGCSE Biology ■ Topic 4

IGCSE Biology



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

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Molecules

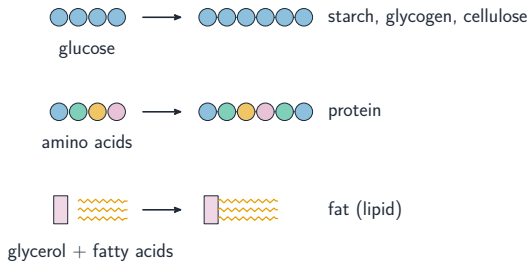
Elements in food

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.)

Building large molecules



Large molecules are joined from many small ones, like beads on a string.

- **starch** 淀粉, **glycogen** 糖原, **cellulose** 纤维素 – many **glucose** 葡萄糖 units
- proteins – **amino acids** 氨基酸, about 20 kinds
- fats – three **fatty acids** 脂肪酸 to one **glycerol** 甘油

Starch and glycogen *store* energy;
cellulose builds *cell walls*.

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** 化学键 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)		 blue-black
Reducing sugar (Benedict's, heat)		 brick-red
Protein (biuret)		 purple
Fat (ethanol emulsion)		 cloudy white
Vitamin C (DCPIP)		 colourless

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

Only **Benedict's**

本尼迪特试剂 needs **heat**.

DCPIP goes **colourless**; the others gain a colour.

The five 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.

Vitamin 维生素 C

Add the food to blue DCPIP: blue → colourless. The only test whose colour is *lost*.

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

Benedict's test in the lab



Benedict's test in real life: blue means no reducing sugar; an orange to brick-red precipitate means it is there

Test colours

starch
iodine → blue-black

reducing sugar
Benedict's → brick-red

protein
biuret → purple

fat
emulsion → cloudy

vitamin C
DCPIP → colourless

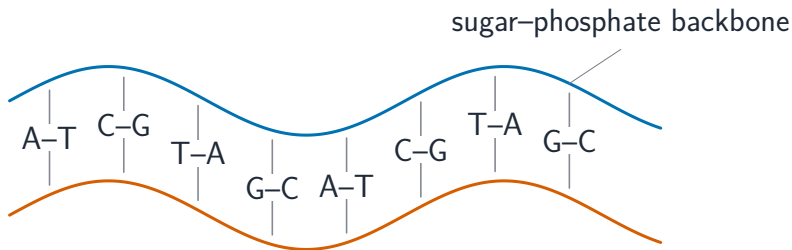
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DNA

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.



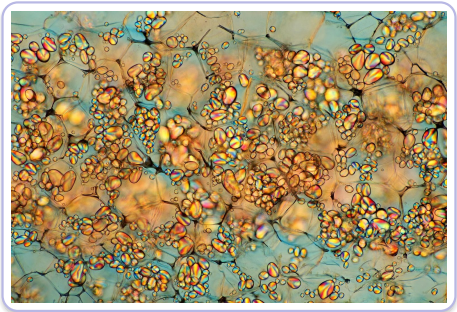
two strands form a double helix; bases pair A–T and C–G

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 $\Rightarrow$ **reducing sugar present**, and a lot of it.
- Biuret purple $\Rightarrow$ **protein present**.
- Iodine **stays** orange-brown $\Rightarrow$ **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 $\rightarrow$ brick-red (heat needed), iodine orange-brown $\rightarrow$ blue-black, biuret blue $\rightarrow$ 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