



## 4 BIOLOGICAL MOLECULES

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[VIEW EXAM QUESTIONS](#)

YOUR NOTES



## 4.1 CARBOHYDRATES, FATS &amp; PROTEINS

## Chemical Elements

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

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 SULPHUR
LIPID	CARBON, OXYGEN AND HYDROGEN

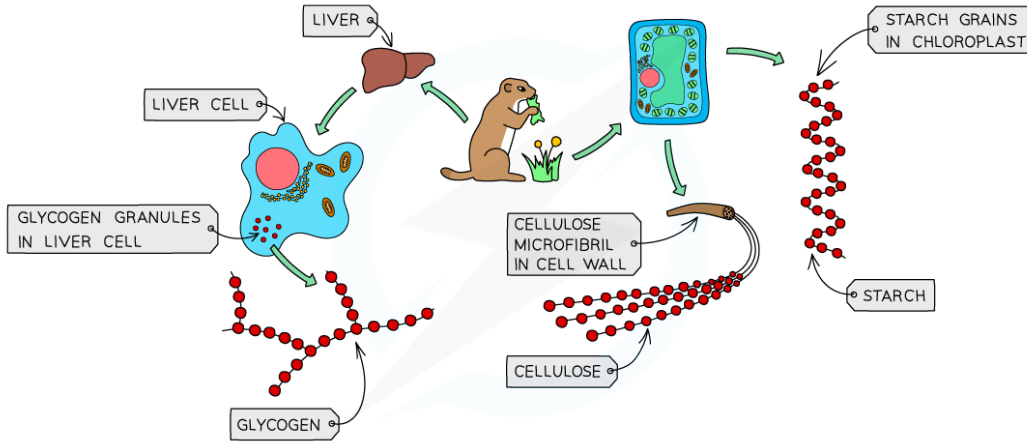
## Carbohydrates

- Long chains of **simple sugars**
- **Glucose** is a simple sugar ( a monosaccharide)
- When **2** glucose molecules join together **maltose** is formed (a disaccharide)
- When lots of glucose molecules join together **starch, glycogen or cellulose** can form (a polysaccharide)

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4.1 CARBOHYDRATES, FATS & PROTEINS cont...

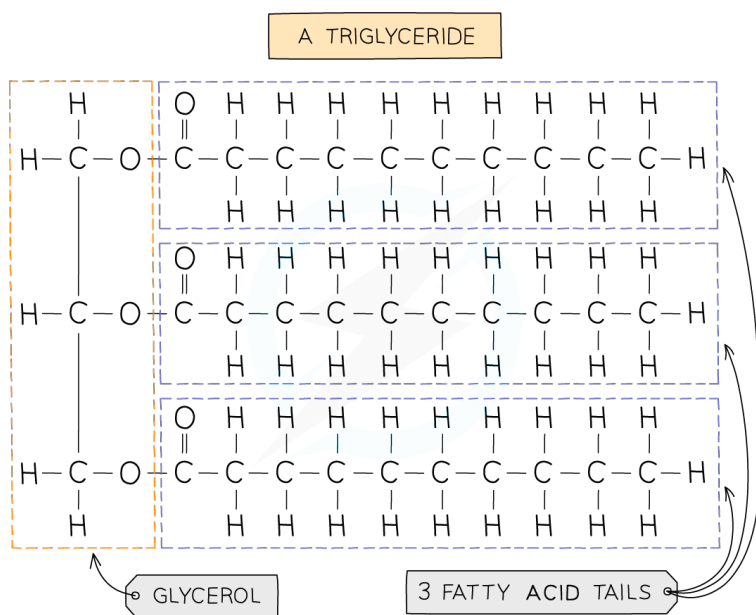
YOUR NOTES



Glycogen, cellulose and starch are all made from glucose molecules

Fats

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



Structure of a triglyceride

## 4 BIOLOGICAL MOLECULES

### 4.1 CARBOHYDRATES, FATS & PROTEINS *cont...*

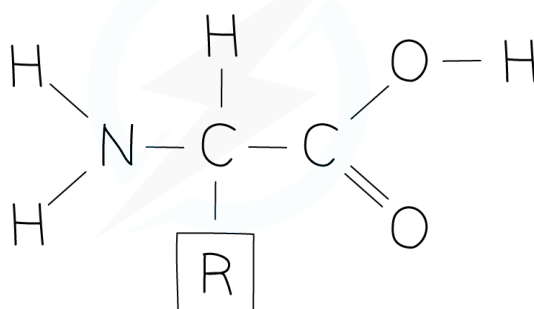
YOUR NOTES



#### Proteins

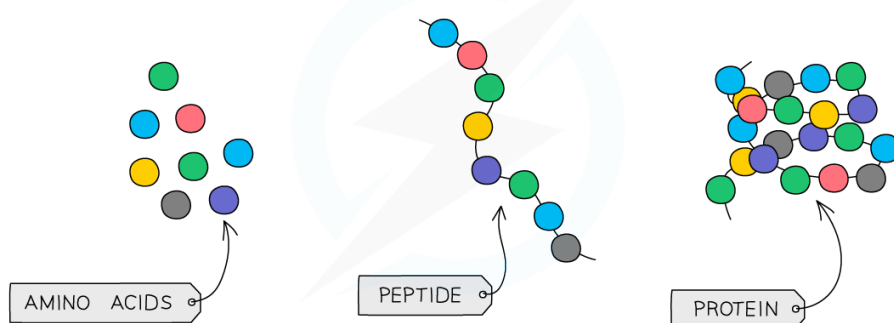
- Long chains of **amino acids**
- There are about 20 different amino acids
- They all contain the **same basic structure** but the '**R**' group is different for each one
- When amino acids are joined together a protein is formed
- The amino acids can be arranged in any order, resulting in hundreds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

#### GENERAL STRUCTURE OF AMINO ACIDS



General amino acid structure

#### HOW YOUR BODY USES AMINO ACIDS AS BUILDING BLOCKS



Amino acids join together to form proteins

 4 BIOLOGICAL MOLECULES

## 4.1 CARBOHYDRATES, FATS &amp; PROTEINS cont...

YOUR NOTES



EXTENDED ONLY

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**Protein Shape**

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- There are thousands of different proteins in the human body and other organisms
- Many of these proteins are **different shapes** and the shape often has an important effect on the function of the protein
- For example:
  - Enzymes have an area in them known as the **active site** – this is important as this is the place where another molecule fits into the enzyme in order for a reaction to take place
  - If the **shape of the active site does not match the shape of the molecule** that fits into it, the **reaction will not take place**
  - Every enzyme has a different shaped active site
  - **Antibodies** are proteins produced by certain types of **white blood cell** to attach to antigens on the surface of **pathogens**
  - The **shape of the antibody must match the shape of the antigen** so that it can attach to it and signal it for destruction
- The **different sequences of amino acids** cause the polypeptide chains to **fold in different ways** and this gives rise to the different shapes of proteins
- In this way every protein has a **unique 3-D shape** that enables it to carry out its function

## 4 BIOLOGICAL MOLECULES

## 4.2 FOOD TESTS

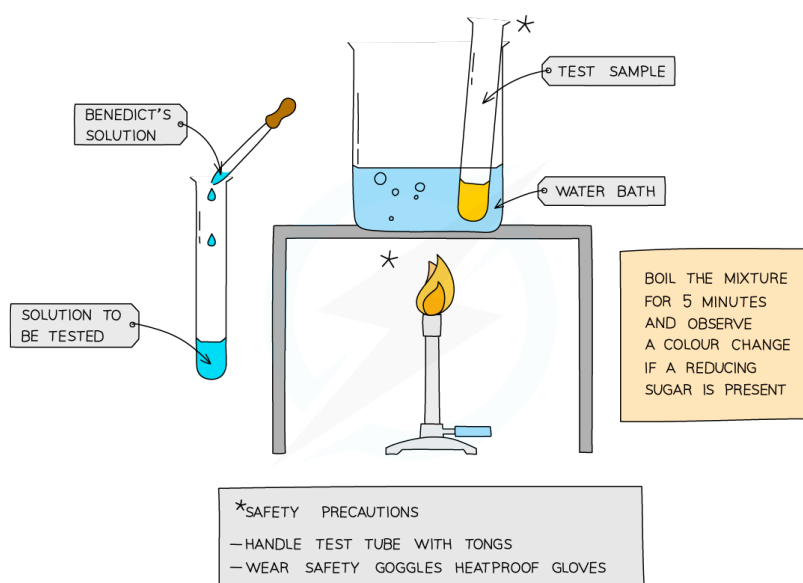
YOUR NOTES



## Describing Food Tests

## Test for glucose (a reducing sugar)

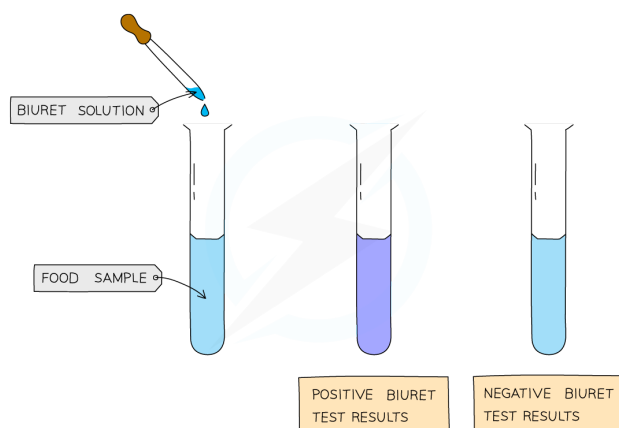
- Add **Benedict's solution** into sample solution in test tube
- **Heat** at 60 – 70 °c in water bath for **5 minutes**
- Take test tube out of water bath and observe the colour
- A positive test will show a colour change from **blue to orange or brick red**



## The Benedict's test for glucose

## 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

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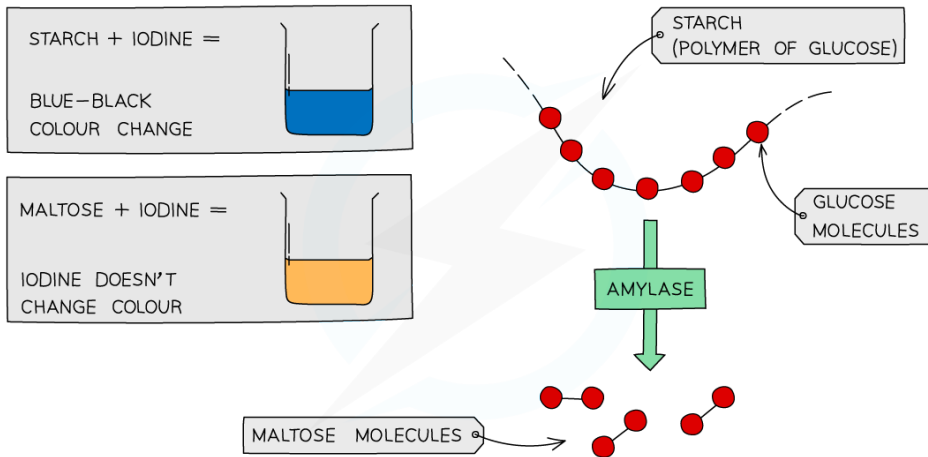
4.2 FOOD TESTS cont...

YOUR NOTES



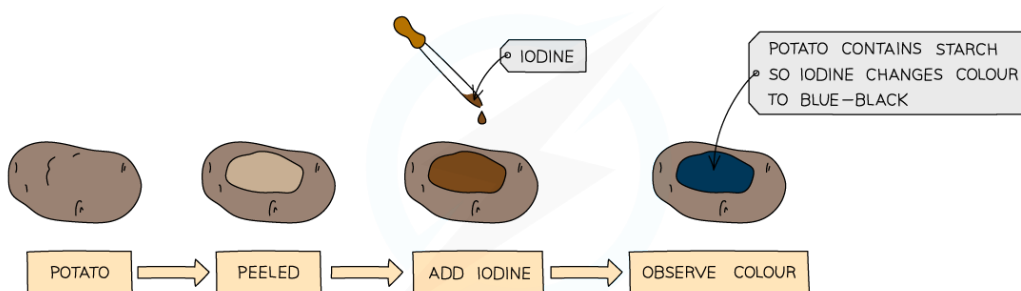
Test for starch using iodine

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



The iodine test for starch

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



Testing a potato to prove the presence of starch



## 4 BIOLOGICAL MOLECULES

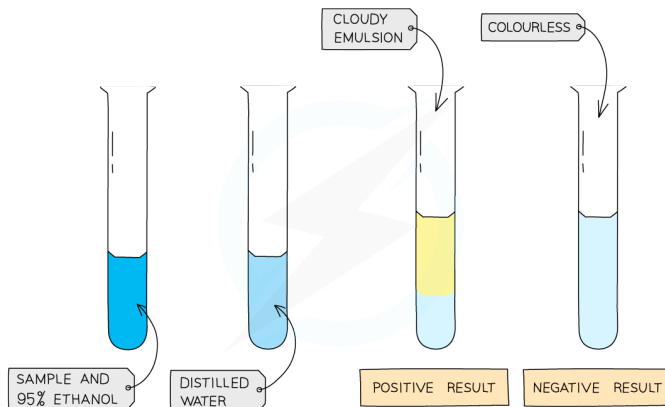
## 4.2 FOOD TESTS cont...

YOUR NOTES



## Test for lipids

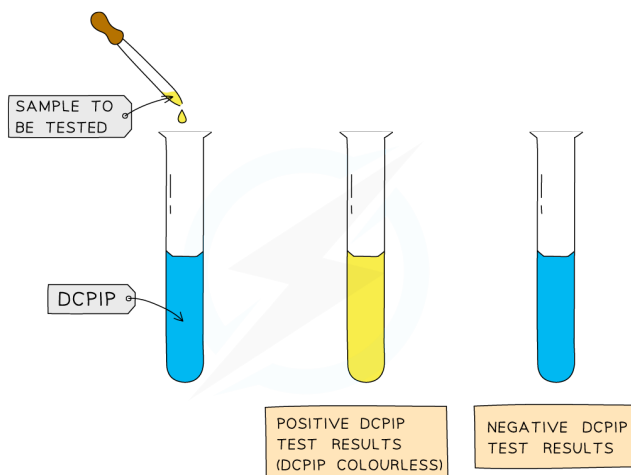
- Food sample is mixed with **2cm<sup>3</sup>** of ethanol and shaken
- The ethanol is added to an equal volume of **cold water**
- A positive test will show a **cloudy emulsion** forming



The ethanol test for lipids

## Test for vitamin C

- Add 1cm<sup>3</sup> of **DCPIP** solution to a test tube
- Add a small amount of food sample (as a solution)
- A positive test will show the **blue colour of the dye disappearing**



The DCPIP test for vitamin C



## EXAM TIP

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.

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4.3 DNA STRUCTURE

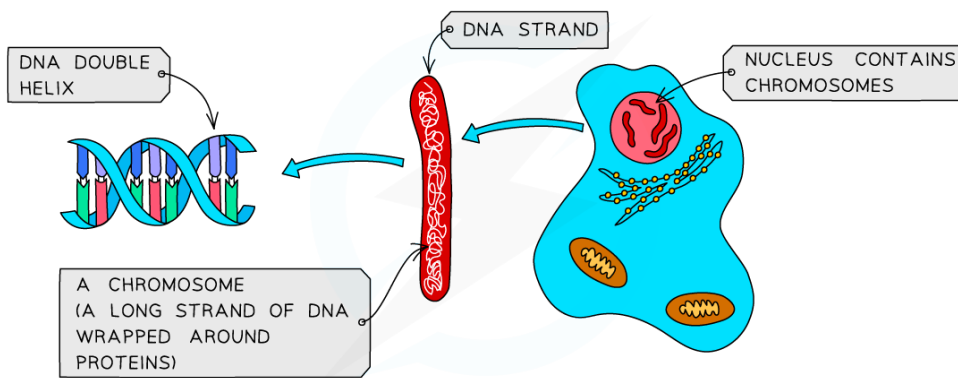
YOUR NOTES



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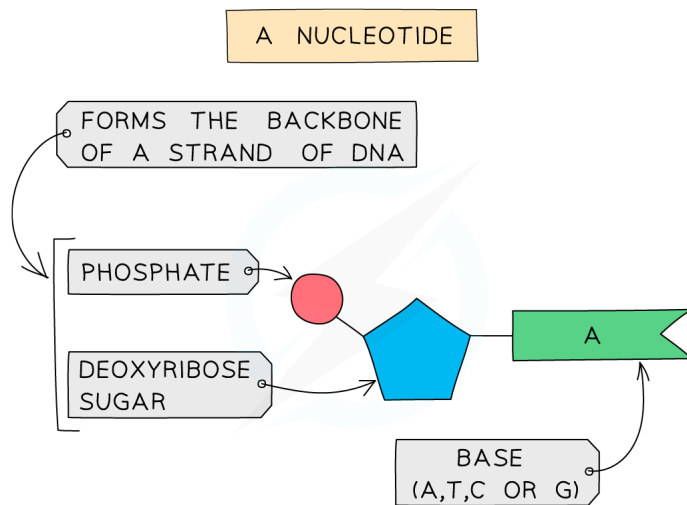
Describing DNA Structure

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



DNA, chromosomes and the nucleus

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



A nucleotide



## 4 BIOLOGICAL MOLECULES

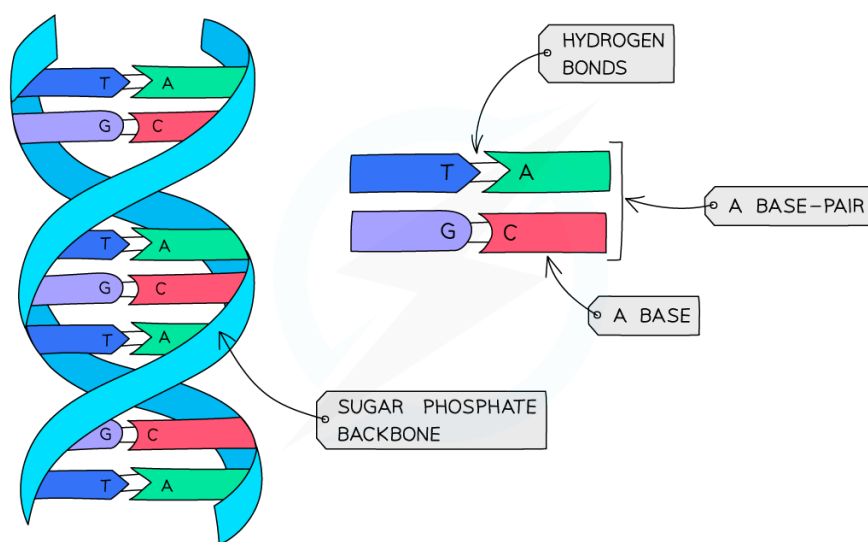
## 4.3 DNA STRUCTURE cont...

YOUR NOTES



## EXTENDED ONLY cont...

- All nucleotides contain the same phosphate and deoxyribose sugar, but differ from each other in the **base** attached
- There are four different bases, **Adenine (A)**, **Cytosine (C)**, **Thymine (T)** and **Guanine (G)**
- The bases on each strand pair up with each other, holding the two strands of DNA in the double helix
- The bases always pair up in the same way:
- Adenine always pairs with Thymine (**A-T**)
- Cytosine always pairs with Guanine (**C-G**)



DNA Base Pairs

- The phosphate and sugar section of the nucleotides form the 'backbone' of the DNA strand (like the sides of a ladder) and the base pairs of each strand connect to form the rungs of the ladder

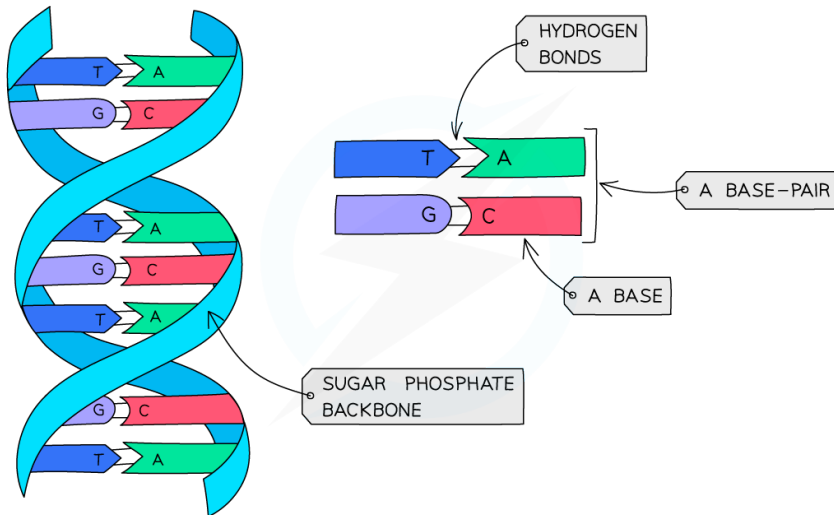
## 4 BIOLOGICAL MOLECULES

## 4.3 DNA STRUCTURE

YOUR NOTES



EXTENDED ONLY cont...



The DNA helix is made from two strands of DNA held together by hydrogen bonds

- It is this sequence of bases that holds the code for the formation of proteins



## EXAM TIP

You do not need to learn the names of the bases, just their letter.

Know which bonds with which as this is the most commonly asked question about this topic.

## 4 BIOLOGICAL MOLECULES

## 4.4 WATER

YOUR NOTES



## Importance as a Solvent

- Water is important for all living organisms as **many substances are able to dissolve in it** (it is a **solvent**)
- This makes it incredibly useful and essential for all life on Earth

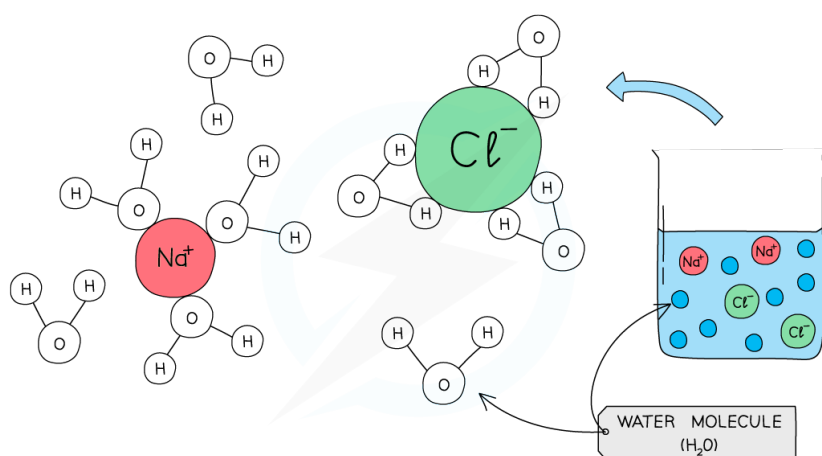


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## Role within Organisms

Water is important as a solvent in the following situations within organisms:

- Dissolved substances can be **easily transported** around organisms – eg xylem and phloem of plants and dissolved food molecules in the blood
- **Digested food molecules** are in the alimentary canal but need to be moved to cells all over the body – without water as a solvent this would not be able to happen
- Toxic substances such as **urea** and substances in excess of requirements such as salts can dissolve in water which makes them easy to **remove from the body in urine**
- Water is also an important part of the **cytoplasm** and plays a role in ensuring **metabolic reactions can happen** as necessary in cells



Water as a solvent

&gt; NOW TRY SOME EXAM QUESTIONS



## 4 BIOLOGICAL MOLECULES

## EXAM QUESTIONS

YOUR NOTES

**? QUESTION 1**

Large food molecules are composed from smaller molecules chemically bonded together.

Which of the following statements is false?

- A Glucose molecules are the basic units of cellulose
- B Glycerol is a basic unit of oils.
- C Simple sugars like glucose are the basic unit of fats.
- D Amino acids are basic units of proteins.

**? QUESTION 2**

DNA is a large molecule made from two chains of nucleotides held together by cross-links between pairs of bases.

Which of the following is a correct base pair?

- A T with C
- B G with A
- C C with G
- D C with A

**? QUESTION 3**

A group of students tested four different foods using some common food tests. Their results are shown in the table below.

Which food contains reducing sugar and Vitamin C but not protein or starch?

	Benedict's test	Biuret test	Iodine test	DCPIP test
A	brick-red	purple	brown	colourless
B	brick-red	blue	brown	colourless
C	blue	blue	black	blue
D	brick-red	blue	black	colourless



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## EXAM QUESTIONS cont...

YOUR NOTES

**? QUESTION 4**

A strand of DNA is shown below:

**T – G – A – A – C – T – A – G – C – C**

What would the correct order of bases be on the complementary strand of DNA?

**A A – C – T – T – A – A – T – C – G – G**

**B C – A – G – G – T – C – G – A – T – T**

**C T – G – A – A – C – T – A – G – C – C**

**D A – C – T – T – G – A – T – C – G – G**

**? QUESTION 5**

Three statements about proteins are given below.

- 1 Different sequences of amino acids give different shapes to protein molecules
- 2 Amylase is made from a sequence of amino acids joined together forming a non-specific 3D shape.
- 3 When mixed with Biuret solution, there is a colour change from blue to purple.

Which of the statements above are true?

**A 1 & 2 only    B 1, 2 & 3    C 1 & 3 only    D 3 only**

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