



eduresourceza.com

B3 BIOLOGICAL MOLECULES

Downloaded from eduresourceza.com

B3.01 What are you made of?

- The bodies of all living things are made of many different kinds of chemical.
- Most of our bodies is made of water.
We also contain carbohydrates, proteins and fats.

Water

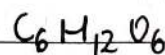
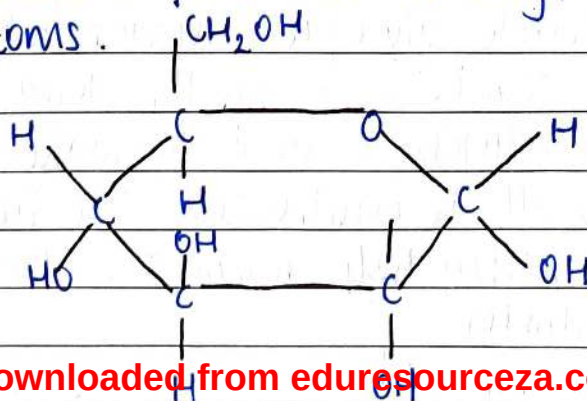
- 80% of body is water.
- In every living organism, chemical reactions are going on all the time. These are metabolic reactions. These are only possible if the chemicals which are reacting are dissolved in water.
- Water is an important solvent.

B3.02 Carbohydrates

Carbohydrates include starches and sugars. Their molecules contain three kinds of atom - carbon (C), hydrogen (H) and oxygen (O).

Sugars

- These are the simplest kinds of carbohydrates - Sugars or Monosaccharides.
- Glucose is a simple sugar. A glucose molecule is made of six carbon atoms joined in a ring, with the hydrogen and oxygen atoms.



Downloaded from eduresourceza.com

→ If two simple sugar molecules join together, a larger molecule called a disaccharide is made.

→ Two examples of complex sugars are sucrose and maltose.

Polysaccharides

→ If many simple sugars join together, a very large molecule called a polysaccharide is made. These contain thousands of sugar molecules joined together in a long chain.

→ Cellulose of plant cell walls is a polysaccharide and so is starch.

→ Animal cells contain a polysaccharide called glycogen. They are insoluble, and do not taste sweet.

Functions of Carbohydrates

→ Carbohydrates are needed for energy.

→ One gram of carbohydrate releases 17kJ of energy. Energy is released by respiration.

→ The carbohydrate that is normally used in respiration is glucose.

→ Plasma contains dissolved glucose. Cells use glucose to release the energy that they need to carry out processes of life.

→ Plants use carbohydrates in respiration - mostly glucose. Plants do not transport glucose around their bodies. Instead, they transport sucrose. Cells change sucrose to glucose when they need it.

→ Animals do not store starch. Instead, they store carbohydrates in the form of polysaccharide glycogen. However, only small quantities of glycogen can be stored. It is mostly stored in the liver and muscles.

→ The polysaccharide cellulose is used to make criss-cross fibres from which the cell wall is constructed. The fibres are extremely strong, and hence, they help maintain the shape of the plant cell.

Testing for Carbohydrates

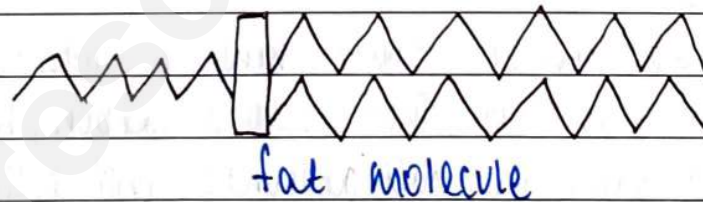
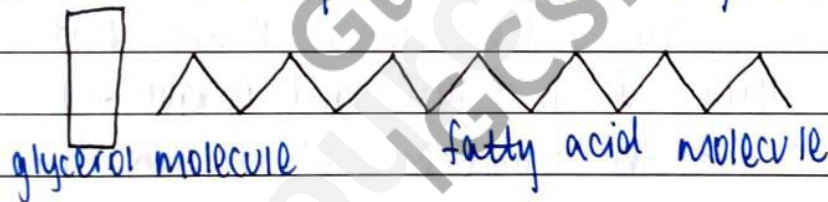
→ This can be done by adding Benedict's solution. If reducing sugar is present, it will turn brick-red. If not, it will remain blue.

Testing for Starch

- This is easier, as it does not involve heating. By adding iodine solution to a sample of food, and if starch is present, the colour blue-black is obtained. If there is no starch, the solution will remain orange-brown.

83.03 Fats

- Fats are known as lipids. Like carbohydrates, fats contain only three kinds of atoms - carbon (C), hydrogen (H) and oxygen (O).
- A fat molecule is made of four smaller molecules joined together. One of these is glycerol. Attached to glycerol, are three long molecules called fatty acids.
- Fats are insoluble in water.
- Fats that are liquid at room temperature are called oils.



Functions of fats

- Fats and oils can be used in a cell to release energy.
- A gram of fat gives about 39kJ of energy. This is more than twice as much of energy as that released by a gram of carbohydrate.
- Cells use carbohydrates in processes first. Once these are over, they then use oils and fats.
- The extra energy from making is extremely useful for storing energy. Some cells, particularly ones under the skin, become filled

with large drops of fats or oils. These stores can be used to release energy when needed. This layer of fat helps to keep heat inside the body - it insulates the body.

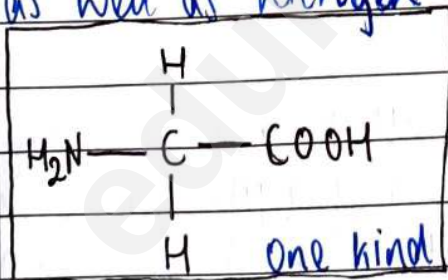
- Animals that live in very cold places, like a walrus, have layers of thick fat. This is known as blubber.
- Many plants store oils in their seeds - for example, peanut, coconut and castor oil. These provide a good store of energy for germination.

Testing for fats and oils

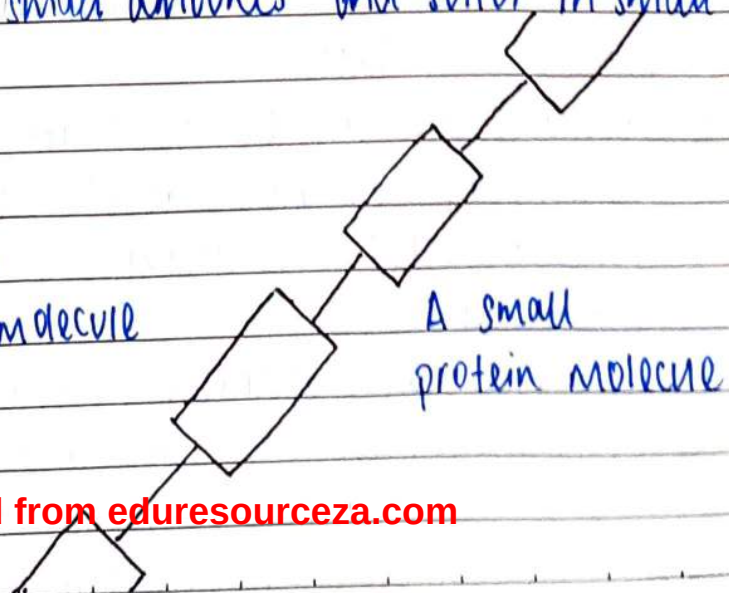
- The best is ethanol emulsion test.
 - Chop the food and shake it up with ethanol.
 - Fats dissolve in ethanol.
 - Pour ethanol into water.
 - If there is fat, the fat-ethanol mixture will break into millions of tiny droplets when it is mixed with water.
 - This is emulsion. It is white and opaque - like milk.
- If there is no fat, the mixture will remain transparent.

B3.04 Proteins

- Protein molecules contain some kind of atoms which carbohydrates and fats do not. They contain carbon, hydrogen and oxygen, as well as nitrogen in small amounts and sulfur in small amounts.



one kind of
amino acid molecule



- Like polysaccharides, protein molecules are made of long chains of smaller molecules. These smaller molecules are called amino acids.
- There are 20 different kinds of amino acid.
- Any of these 20 can be joined together.
- Amino acids are positioned precisely. If a little change in the position, a different protein is made. Hence, there are millions of different proteins.

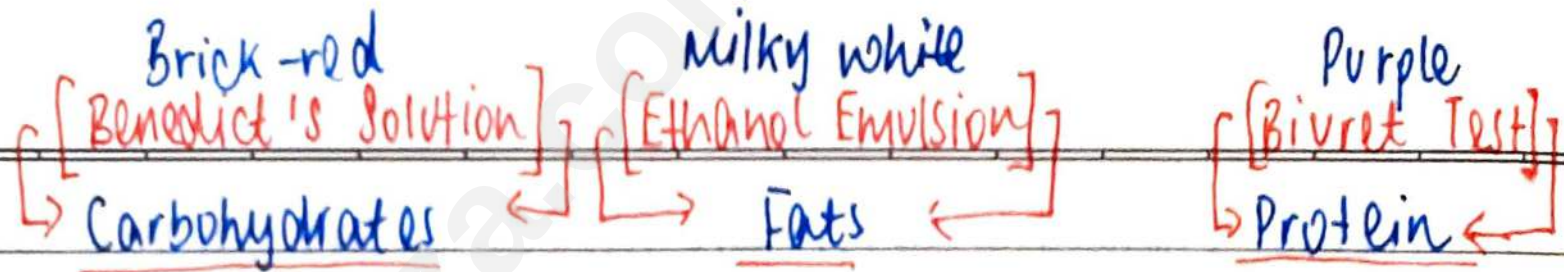
Functions of proteins

- Some proteins are soluble in water like haemoglobin. Others are insoluble like keratin.
- Proteins do not normally provide energy. They are used for repairing and making new cells.
- Cell membranes and cytoplasm contain a lot of protein. Enzymes are also proteins.
- Long chains of amino acids from which protein molecules are formed can curl up into different shapes.
- Their shape directly affects their function.

Testing for proteins

- The test for protein is known as the biuret test.
- This involves mixing the food in water, and then adding dilute copper sulfate solution. Then, dilute potassium hydroxide is gently added.
- A purple colour indicates protein is present.
- If there is no protein, the mixture stays blue.

Starch-iodine test; blue-black



Elements

C, H, O

C, H, O

C, H, O, N, (S)

Smaller molecules of which they are made

Simple sugars
(monosaccharides)

fatty acids and
glycerol

amino acids

Solubility in Water

Sugars are soluble;
polysaccharides are not

insoluble

some are soluble
and some are not

Why organisms need them

easily available
energy (17 KJ/g)

storage of energy
(39 KJ/g)

making and repairing
cells; enzymes; (energy)

Testing for reducing sugar - Benedict's solution

1. Cut or grind a little of the food into small pieces.
2. Put the pieces in a test tube. Add some water, and shake it up to dissolve it.
3. Add some Benedict's solution. Benedict's solution is blue, because it contains copper salts.
4. Heat the tube, in a water bath.

If there is a reducing sugar, then the following colours may form

green - less

yellow - less / medium

orange - medium / high

red - high

Iodine Test for Starch

1. Put a small piece of food on a white tile.
2. Add a drop or two of iodine solution.

If starch is present, the following colour will form
From blue, it will turn blue-black.

Testing for fats - ethanol emulsion

1. Chop or grind a small amount of food, and put it in a clean and dry test tube.
2. Add some pure (absolute) ethanol. Shake it thoroughly.
3. Put distilled water in another test tube.
4. Pour the liquid part from the tube containing food and ethanol into tube with distilled water.

If fat is present, there will be an appearance.
A milky appearance.

Testing foods for proteins - Biuret Test

1. Put the food into a test tube, and add a little water.
2. Add some potassium hydroxide solution. ← Add two drops of
3. Add two drops of copper sulfate solution. ← Biuret solution.
4. Shake the tube gently.

If protein is present, then the following colour will appear.

A purple colour appears from blue.

Blue → Purple

Tests	Initial	Final / Observation
Benedict	Blue	Red / Orange / Yellow / Green
Biuret	Blue	Purple / Lilac
Ethanol emulsion	Colourless	Milky
Iodine	Blue / Brown	Blue-black
DCPIP (Vitamin C)	Blue	Colourless