

## FOOD AND DIET

The main elements present in the human body are:

Hydrogen      Oxygen      Nitrogen      Carbon

These elements are present in compounds - not as free elements.

Unlike plants, we cannot make our own food. We get all the essential elements and compounds we need from the food we eat. The elements we need are present in these foods in compounds - not as the free elements.

The food we eat usually contains the following substances:

### 1. Carbohydrates

Carbohydrates are obtained from plants.

They are compounds which contain Carbon, Hydrogen and Oxygen and are required for energy.

There are two types of carbohydrates in foods:

#### 1. Sugars

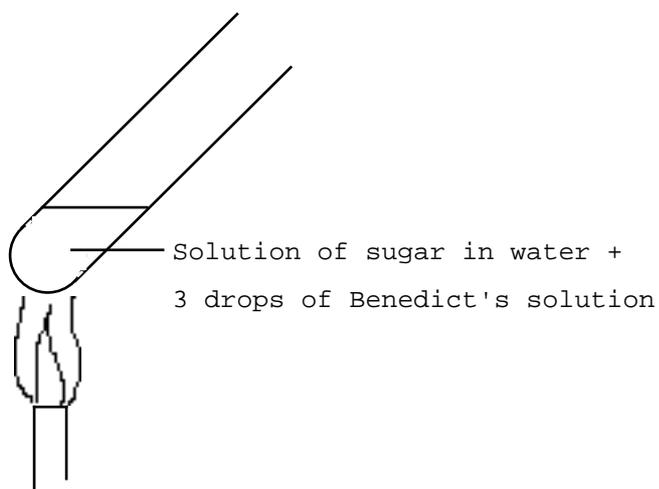
Sugars are carbohydrates with small molecules.

They taste sweet and are very soluble in water.

e.g. Glucose, Fructose, Maltose and Sucrose (table sugar)



Some can be detected by Benedict's test:



Results:

Sugar	Colour of Solution	
	Before heating	After heating
Glucose	blue	brick-red
Fructose	blue	brick-red
Maltose	blue	brick-red
Sucrose	blue	blue

Sucrose is the only one of the four sugars which does not turn Benedict's solution brick-red on heating.

## 2. Starch

Unlike sugars, Starch is not sweet and does not dissolve in water.



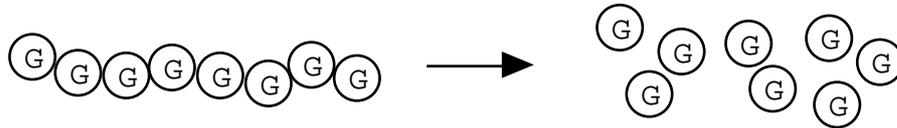
Test for Starch in some foods by adding Iodine solution - the Iodine turns blue/black if Starch is present.

The Starch molecule is a polymer consisting of lots of Glucose molecules linked together to make a big long chain:



Starch molecule

During digestion, Starch is broken down into Glucose:



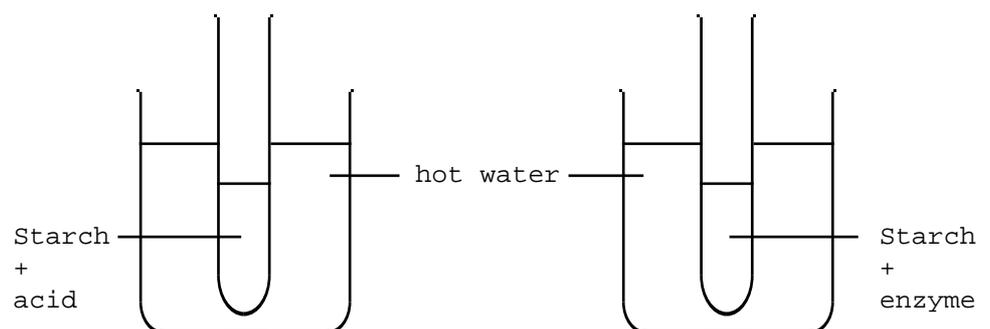
Starch molecule

Glucose molecules

This reaction is speeded up by the enzymes and acids present in the digestive system.



We can simulate the breakdown of Starch by both acid and enzymes in the laboratory:



The Starch/enzyme mixture should be kept at body temperature (37 °C) since enzyme molecules are destroyed at higher temperatures.

After about 15 minutes both solutions give a brick-red colour with Benedict's solution showing that sugars are formed.

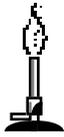
Once formed, the sugars are carried by the blood stream to body cells where respiration occurs:



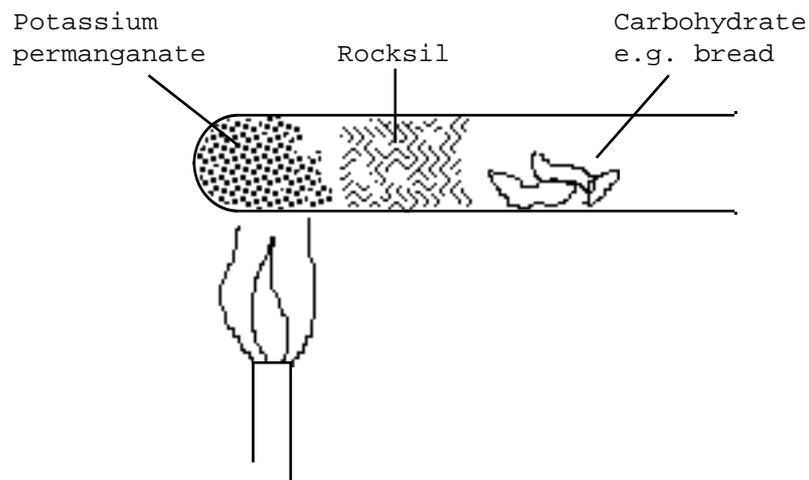
## Energy from Carbohydrates

During digestion, carbohydrates are burned in the Oxygen we breath in.

Carbon dioxide, Water and ENERGY are produced:



We can simulate this reaction in the laboratory by burning carbohydrate foods (bread, crisps etc) in Oxygen generated by heating Potassium permanganate:



## 2. Fats and Oils

Fats and oils are obtained by eating meat, butter, cheese, vegetable oils etc.



Test some foods for fats and oils by rubbing them on filter paper and warming gently. A greasy mark will appear if fats and oils are present.

Fats and oils are required to provide an energy store in the body. They provide us with much more energy than Carbohydrates.

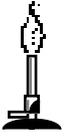
Solid fats, otherwise known as saturated fats, are believed to increase the level of Cholesterol in the bloodstream. Cholesterol blocks arteries and causes heart disease. We should not eat saturated fats.

Liquid fats, otherwise known as unsaturated fats, polyunsaturates or oils, do not produce as much Cholesterol and are less harmful to the heart. If we need to eat fats, we should eat unsaturated fats.

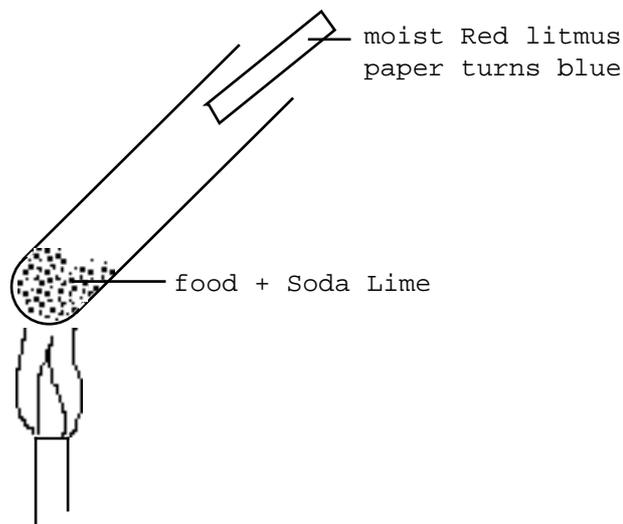
### 3. Proteins

Proteins are compounds which contain Hydrogen, Oxygen, Nitrogen and Carbon and are required for body growth and repair.

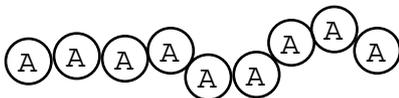
Proteins are obtained by eating meat, cheese, beans etc.



We can test a food for proteins by mixing it with a little Soda Lime and heating: if an alkaline gas is given off (turns moist red litmus paper blue) then we know that the food contains proteins.



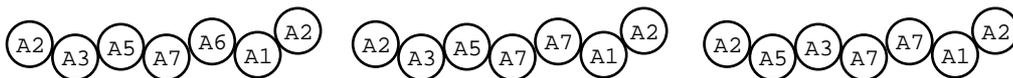
Like Starch, protein molecules are polymers. In proteins, however, thousands of small molecules called AMINO ACIDS are linked together:



Protein molecule

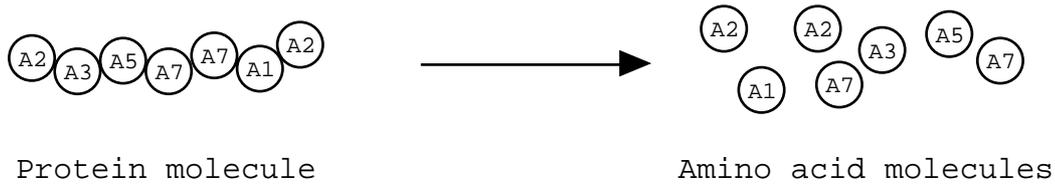
Since there are many different kinds of Amino acids there are many different kinds of proteins depending on which Amino acids are present and the order in which they link

e.g. the three proteins below are all different

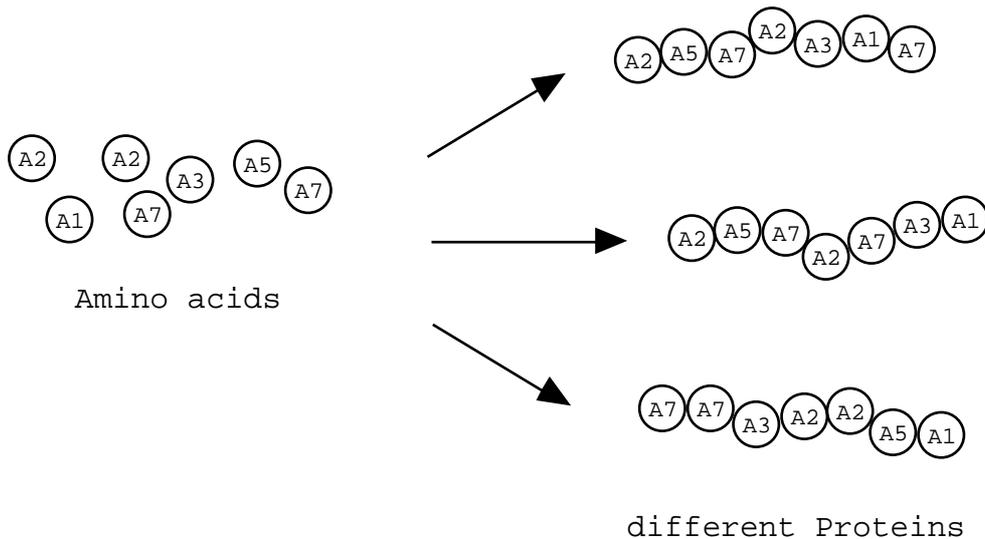


Different proteins are used to make particular parts of the body e.g. the protein in our hair is different from the protein in our skin.

When we eat proteins from animals and plants our bodies break down the proteins into their Amino acids during digestion:



Our bodies then re-assemble the Amino acids back into DIFFERENT proteins e.g. to make our hair, skin and muscle.



Since meat from animals is a much richer source of protein than plants, vegetarians must ensure that they eat a wide variety of vegetables to ensure that they get all the Amino acids necessary to make their proteins.

#### 4. Minerals

These supply the body with small amounts of Calcium for making bones and teeth, Iron for making blood and trace elements e.g. Sodium, present in Sodium chloride (salt).

We must take care when taking mineral supplements: some trace elements, if taken in too large quantities, are poisonous.

#### 5. Vitamins

These are complicated Carbon compounds which are required to keep the body healthy.

e.g. a lack of Vitamin A leads to loss in weight, eye disease and more infections.

#### 6. Water

More than 60% of body weight is made up of Water.  
If you weigh 50 kg then you contain about 30 kg of Water!

## 7. Fibre

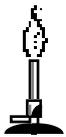
Fibre is the part of the plant we cannot digest. It is, however, very useful. It absorbs water and swells in the gut. This provides bulk for the gut muscles to work on as food is squeezed along. Fibre therefore keeps the gut working well and prevents constipation.

## 8. Food additives

Food additives are chemicals added by the food manufacturer. They can only be used once they have been tested and approved.

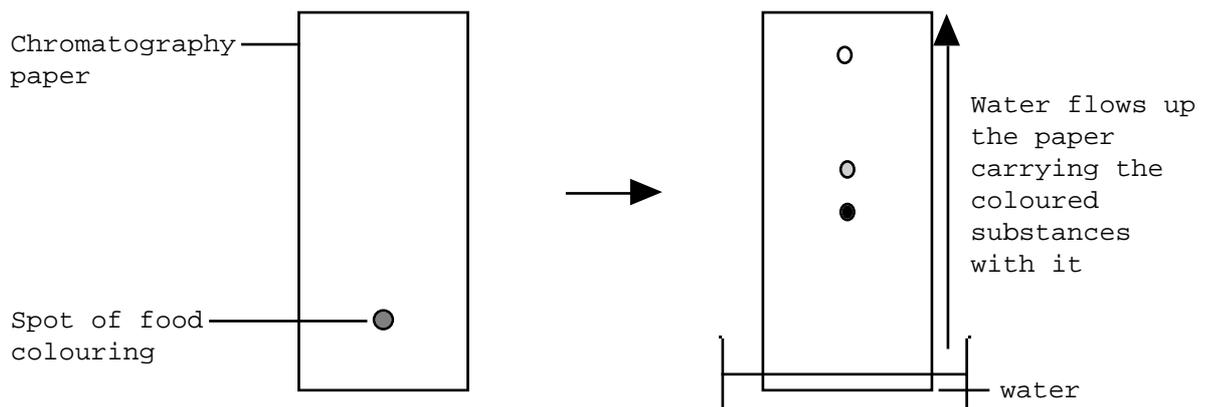
The main additives are listed in the table below:

Food Additive	Reason for adding
Vitamins and minerals	To supply or enhance the nutritional value
Flavouring	To alter the flavour
Colouring	To alter the appearance
Preservative	To prevent decay



We can separate the various coloured substances in food colourings by chromatography.

The coloured substances all flow at different rates along a piece of chromatography paper:



All of the above substances, with the exception of the food additives, are essential for a **balanced diet**.