

A decorative border of various scientific and biological illustrations surrounds the text. At the top left are safety goggles, a pair of forceps, a magnifying glass, and a stack of petri dishes. On the left side, there is a test tube, a beaker with orange liquid, a round-bottom flask with green liquid, and a full human skeleton. At the bottom left is a laptop. At the bottom center are a butterfly and a pencil. At the bottom right is a microscope. On the right side, there is a beaker with blue liquid, a Bunsen burner, and three small green containers.

WJEC GCSE SCIENCE

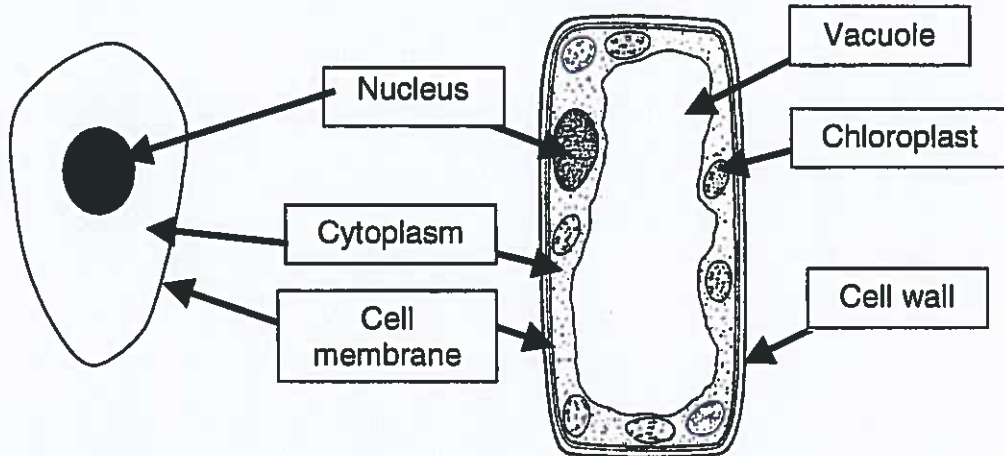
Double Award Biology Topics Year 10

Revision Guide

Cells and Cell Processes

Plant and Animal Cells

Every organism, except viruses, contains one or more cells. The size of the organism depends on the number of cells and not the size of the cells.



Examiners also like to compare animal and plant cells:

Plant Cells	Animal Cells
Cell wall present	No cell wall present
Chloroplast present	No chloroplasts present
Large permanent vacuole present	No permanent vacuole present

Function of cell parts

Part of cell	Function
Cell membrane	Controls substances entering and leaving the cell
Cytoplasm	Where most chemical reactions take place
Nucleus	Controls the activities of the cell/codes for making proteins
Cell wall	Supports the cell
Chloroplast	Absorb light for photosynthesis
Vacuole	Space filled with cell sap (a dilute solution of sugars and mineral salts)

Cell Theory

Cells were first described by Robert Hooke in 1665.
In the 1830s two German scientists, Theodor Schwann and Matthias Schleiden, using light microscopes, suggested the **cell theory**:

1. All organisms are composed of cells.
They may be **unicellular** (one celled) or **multicellular** (many celled).
2. The cell is the basic 'unit' of life.

Scientists have modified the cell theory over time as new technology leads to new discoveries. Additions to the original cell theory are:

3. Cells are formed from pre-existing cells during cell division.
4. Energy flow (the chemical reactions that create life) occurs within cells.
5. Hereditary information (DNA) is passed on from cell to cell when cell division occurs.
6. All cells have the same basic chemical composition.

Microscopy

Light Microscopes

Light microscopes allow you to see the image because light passes through it. The properties of light mean that it is impossible to magnify an image by more than *x1500*

Electron Microscopes

The electron microscope was developed in the 1930s.
It uses a beam of electrons instead of light.
It is possible to get much larger magnifications, up to *x50,000,000*.
Because you can't see electrons, the image is displayed on a monitor.
The disadvantage of electron microscopes is that you cannot see colour, and can only study dead cells.
Electron microscopes allowed scientists to discover the internal structures of cells.

Confocal Laser Scanning Microscopy

Lasers build up an image via a computer by scanning an object in the microscope.
Highly detailed images can be built up using this technique.
The technique does not produce as high a magnification as electron microscopy, but it produces clearer images than light microscopy.

1.1(c) Cell Form and Function, Specialised Cells


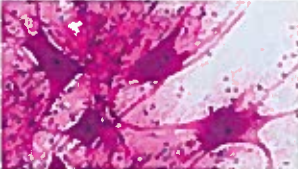




Image	Type of animal cell	Function	Special features
	Red blood cells	To carry oxygen	<ul style="list-style-type: none"> • Large surface area, for oxygen to pass through • Contains haemoglobin, which joins with oxygen • Contains no nucleus
	Nerve cells	To carry nerve impulses to different parts of the body	<ul style="list-style-type: none"> • Long • Connections at each end • Can carry electrical signals
	Female reproductive cell (egg cell)	To join with male cell, and then to provide food for the new cell that's been formed	<ul style="list-style-type: none"> • Large • Contains lots of cytoplasm
	Male reproductive cell (sperm cell)	To reach female cell, and join with it	<ul style="list-style-type: none"> • Long tail for swimming • Head for getting into the female cell • Streamlined

Image	Type of plant cell	Function	Special features
	Root hair cell	To absorb water and minerals	<ul style="list-style-type: none"> • Large surface area
	Leaf cell Palisade Mesophyll	To absorb sunlight for photosynthesis	<ul style="list-style-type: none"> • Large surface area • Lots of chloroplasts



Xylem

Phloem

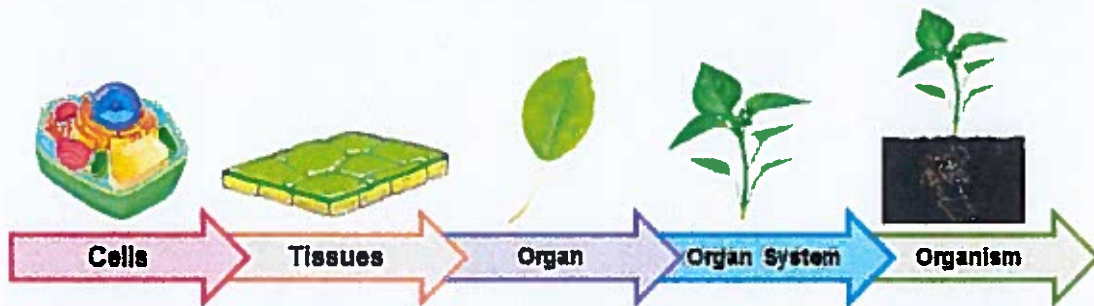
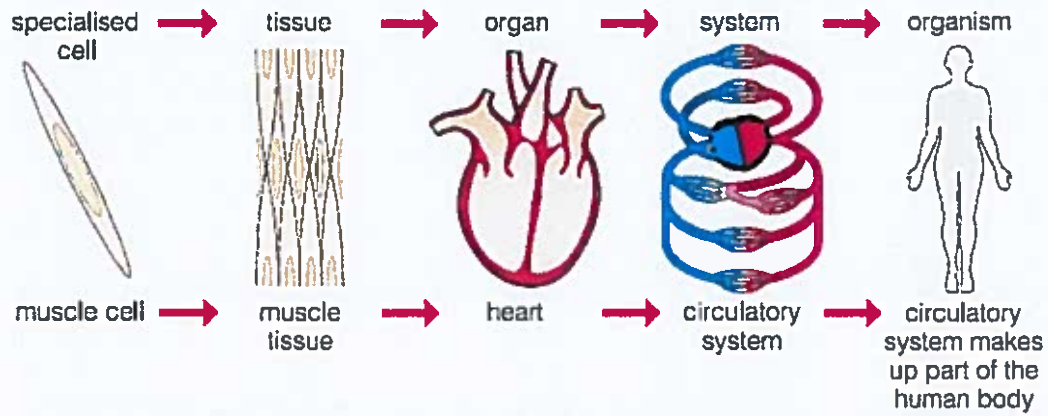
Xylem Carries water and minerals from the roots to the leaves.

Phloem carries sugars made in the leaves to the rest of the plant.

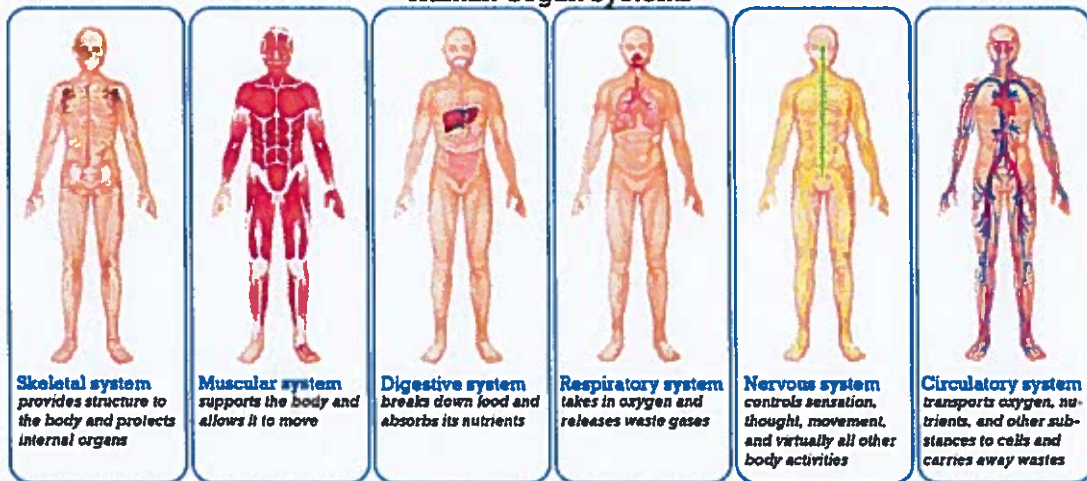
Xylem have a primary and secondary cell wall. They have no cell contents and vessel elements at each end allowing the flow of water.

Phloem have companion cells next to them which help load the sugars into them.

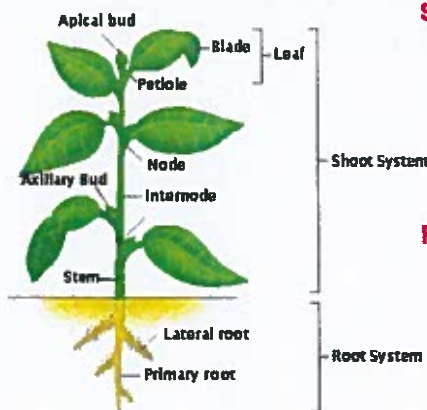
1.1(d) Levels of Organisation in Organisms



Human Organ Systems



The Plant Body Consists of the Shoot System and the Root System



Shoot System - Functions

- Photosynthesis
- Reproduction
- Storage
- Transport
- Hormones

Root System - Function

- Anchorage
- Absorption
- Storage
- Transport
- Hormones

Substances Enter and Leave Cells Through the Cell Membrane

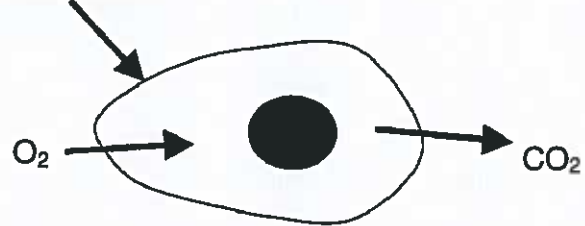
Diffusion

Molecules are constantly moving.

Molecules of liquids and gases collide against each other all the time.

We see this process of **mixing and moving** in **diffusion**.

Cell membrane



Oxygen and carbon dioxide pass through the cell membrane by diffusion.

Molecules diffuse from an area of high concentration to an area of low concentration.

This process does not require energy.

Fig. 1
Diffusion.

All liquid and gas molecules have kinetic energy; they are constantly moving and mixing.



The rate of diffusion can be affected by the following factors:

1. Concentration

The greater the difference in concentration between two areas (the concentration gradient), the faster the rate diffusion happens.

2. Temperature

As the temperature increases, the rate of diffusion increases to (molecules have more kinetic energy).

3. Pressure

If there is high pressure, the molecules will quickly move from the area of high pressure to low pressure.

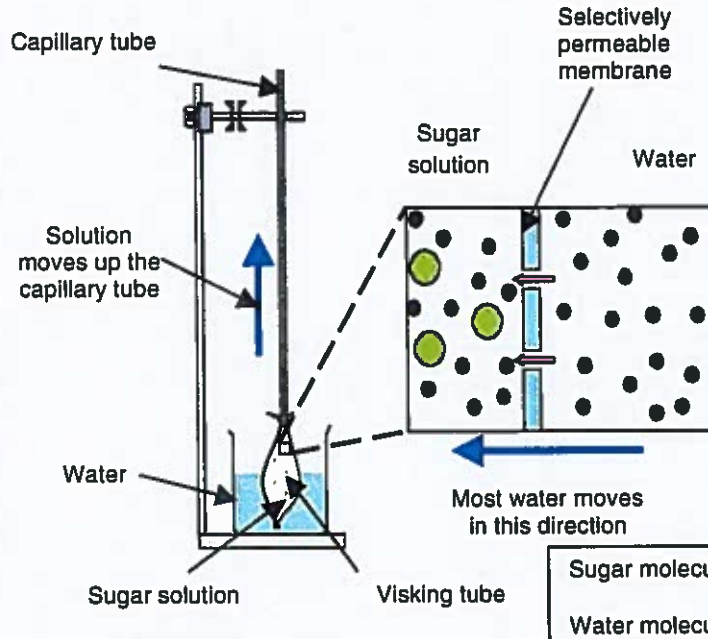
Osmosis Investigations 1 – Modelling Living Material

Visking tubing is very similar to the cell membrane. It is also a selectively permeable membrane. It has tiny holes (pores), which allow small molecules through, but stop molecules that are too large to fit through them.

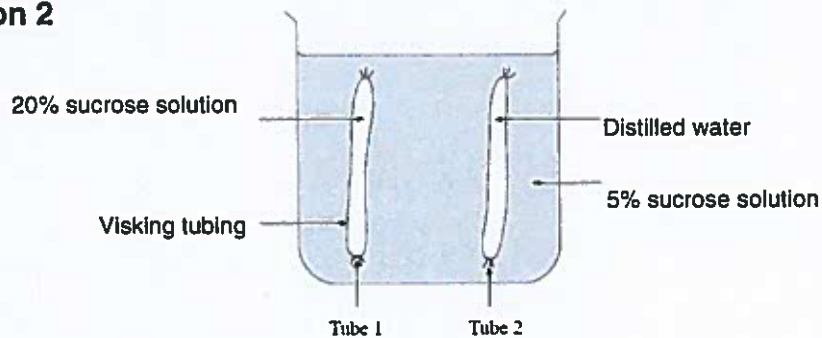
You will also come across visking tubing in experiments to do with the digestive system).

Investigation 1

The concentration of water outside the visking tubing is higher than the concentration of water inside the visking tubing. Water moves in through the pores in the selectively permeable membrane by osmosis. This increases the pressure inside the visking tubing causing the solution to move up the capillary tube.



Investigation 2



Tube 1

Gets bigger (becomes turgid). The **concentration of water outside** the visking tubing is **higher** than the **concentration of water inside**. Water has moved in through the selectively permeable membrane by osmosis.

Tube 2

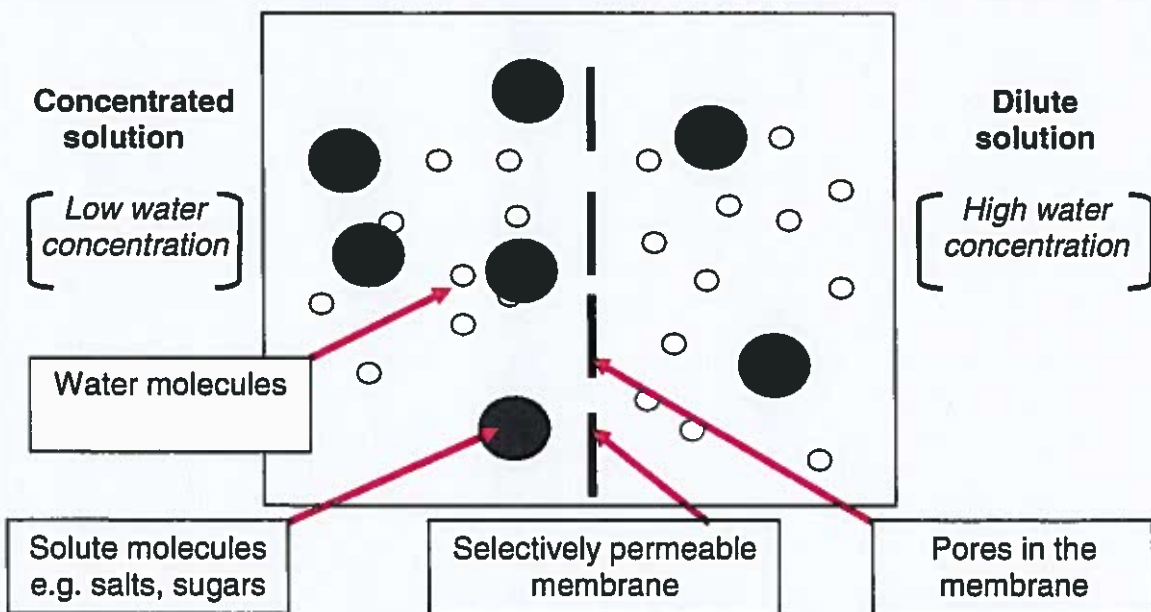
Gets smaller (becomes flaccid). The **concentration of water inside** the visking tubing is **higher** than the **concentration of water outside**. Water has moved out through the selectively permeable membrane by osmosis.

Substances Enter and Leave Cells Through the Cell Membrane

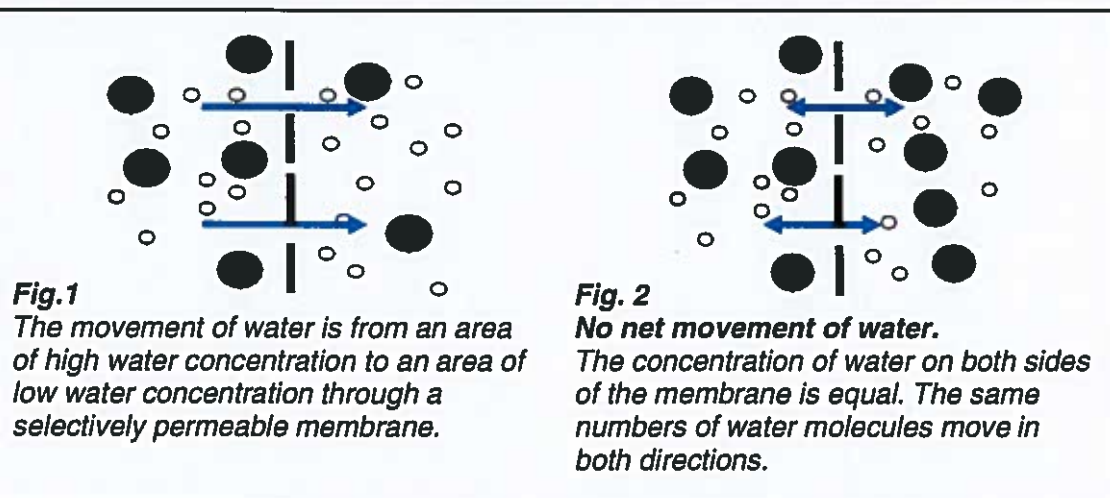
Osmosis

Osmosis is the **diffusion of water molecules** from an area of high water concentration to an area of low water concentration through a **selectively permeable membrane**.

The cell membrane is a **selectively permeable membrane**; it lets some molecules through but not others.



The pores in the membrane allow small water molecules to pass through. The solutes are too large to pass through the pores in the membrane.



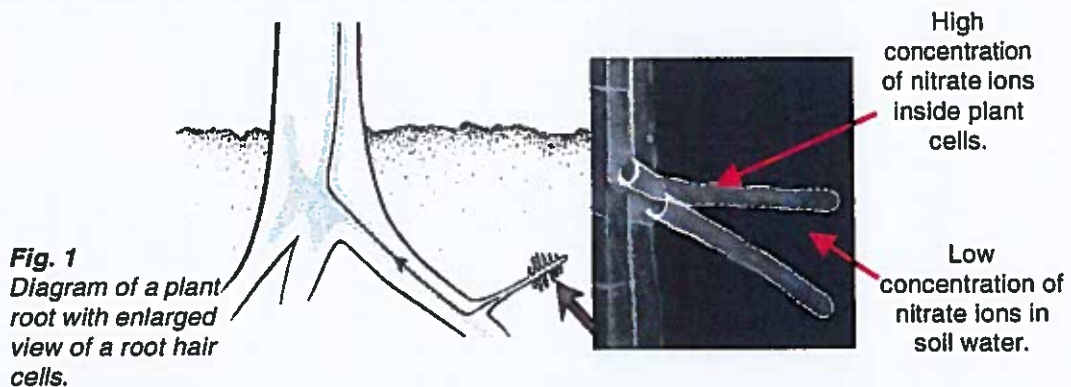
Substances Enter and Leave Cells Through the Cell Membrane

Active Transport

When the concentration of a material is lower outside the cell it must be **actively transported** into the cell (sometimes referred to as **active uptake**).

During active transport, salts or ions are pumped from an area of low concentration to an area of higher concentration. This process requires energy released by the cell.

Example – Uptake of nitrate ions by root hair cells



- Nitrate ions cannot move in by diffusion.
- Nitrate ions must be actively transported from the soil water (an area of low nitrate concentration) to the inside of the plant cells (an area of high nitrate concentration).

Other examples of active transport include:

- Glucose actively transported from the small intestine into the blood.
- Marine algae can use active transport to concentrate iodine in their cells to concentrations a million times greater than surrounding sea water.

Factors affecting active transport

- Active transport needs **energy**.
- Energy is released during **respiration**.

Any factor that affects the rate of respiration will affect the rate of active transport:

- **Glucose concentration** – respiration needs glucose.
- **Oxygen** – aerobic respiration needs oxygen.
- **Temperature** – affects the enzymes controlling respiration.
- **Toxic substances** – e.g. cyanide stops respiration.

Enzymes

An enzyme is a biological catalyst; it speeds up a reaction, but it does not take part in the reaction.

At any one point in time, there are over 500 different chemical reactions taking place in every cell.

These reactions are controlled by a special type of molecule called an enzyme.

How do enzymes work?

The way enzymes work is described by the lock and key model.


A substrate is held in an active site, this increases the probability that a reaction will take place.

The Lock and Key Model

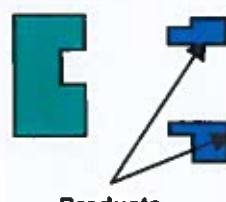
Active site
Enzyme
Substrate
Fig. 1
Enzyme and substrate



Enzyme
Enzyme/substrate complex
Fig. 2
Enzyme/substrate complex.
Only a substrate with a specific shape can 'fit' into the active site. The enzyme is specific to a certain substrate.



Enzyme
Products
Fig. 3
Enzyme and products
Enzyme unchanged at the end of the reaction.



Properties of enzymes

1. Enzymes are **proteins**
2. Enzymes speed up/catalyse the rate of a chemical reaction.
3. All enzymes are **specific** and can only catalyse **one type** of molecule. (See lock and key model above).
4. Enzymes work best at a particular temperature – the **optimum temperature**.
 - If the temperature is higher or lower than this temperature the enzymes will catalyse the molecule at a much slower rate.
 - If the temperature gets too high the enzyme's active site will change shape and stop working – this is called **denaturation**.
5. Enzyme work best at a particular pH – the **optimum pH**.

How are the activities of a cell controlled?

All the activities of a cell depend on chemical reactions, which are controlled by special molecules called **enzymes**.

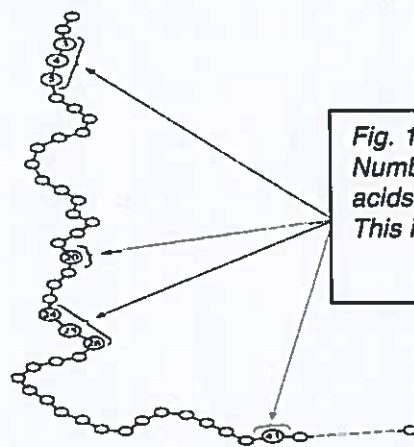
Enzymes are **proteins**.

Proteins have a number of important functions:

- enzymes,
- hormones (e.g. insulin)
- muscle tissue

The structure of proteins

Proteins are made of different **amino acids** linked together to form a **chain**:



*Fig. 1 – amino acid chain.
Numbers refer to the sequence of the amino acids in the protein chain.
This is determined by the 'triplet code' of DNA.*

The chain is then **folded** to form a **specific shape**:

The specific shape of an enzyme enables it to function.

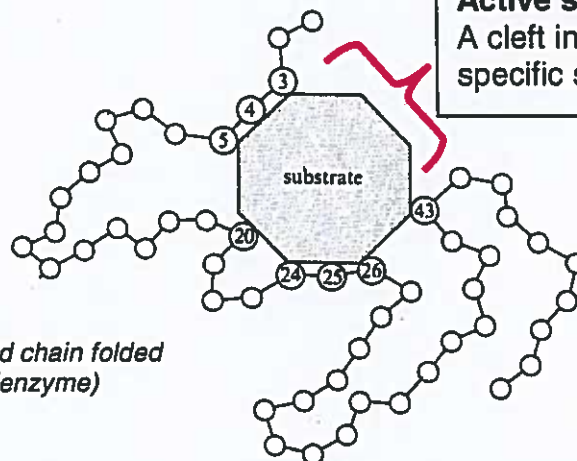


Fig. 2 – amino acid chain folded to form a protein (enzyme)

The active site of an enzyme depends on the shape (of the protein), which is held by the chemical bonds.

The Digestive System

The Effect of Temperature on Enzyme Action

The effect of temperature on enzymes can be demonstrated using the following investigation.

Investigating effect of temperature on the activity of lipase

This investigation shows:

- how lipase activity changes with temperature
- how indicators can help us to follow chemical reactions.

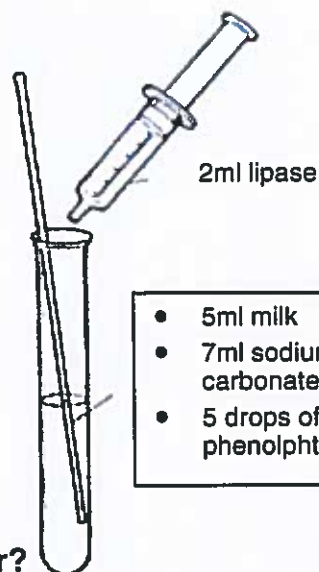
1. Place test tubes containing milk, sodium carbonate and phenolphthalein in different water baths until the contents reach the same temperature as the water bath.

2. Add 2 ml of lipase and start timing.

3. The time taken for the solution to lose its pink colour is recorded.

How is *rate of reaction* calculated (s^{-1})?

$$= \frac{1}{\text{time taken for solution to lose colour.}}$$



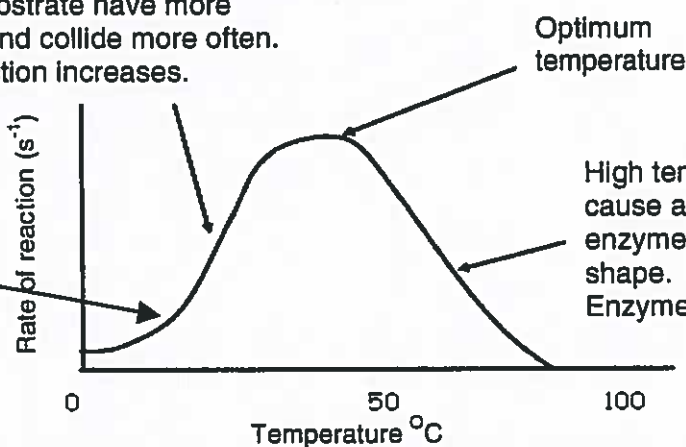
Why does the phenolphthalein change colour?

- When the fat in milk breaks down, fatty acids and glycerol are produced.
- The fatty acids lower the pH of the mixture, which changes the colour of the phenolphthalein from pink to colourless.

Interpreting effect of temperature on enzymes

Enzyme and substrate have more kinetic energy and collide more often. The rate of reaction increases.

Kinetic energy is low. There are fewer collisions between enzyme and substrate.



Respiration

Aerobic Respiration

Releasing energy from food (glucose) using oxygen

Through aerobic respiration, a cell gets its energy to do work or grow. Respiration occurs all the time (day and night) in all plant and animal cells.

You need to learn the formula for respiration:

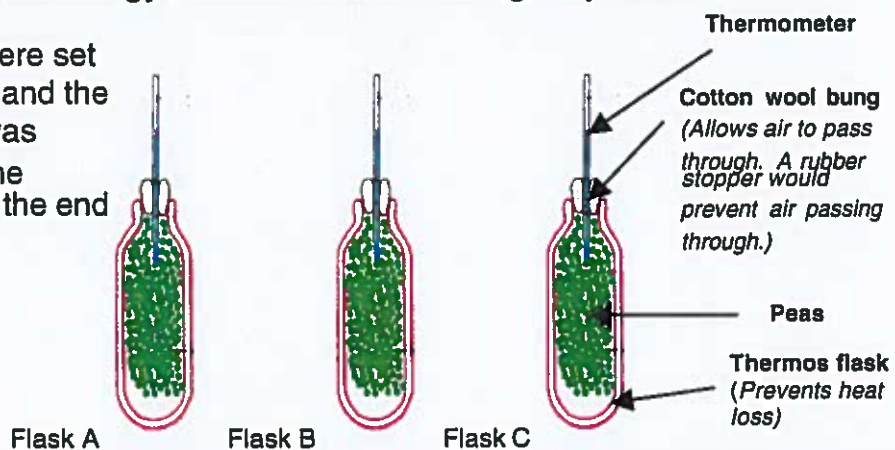


Water and carbon dioxide are the **waste products** that are removed from the body.

In animals, muscle cells use the energy to contract, and move their bodies. **Some energy is released as heat**, and this keeps the body temperature constant.

Investigating the energy released as heat during respiration.

Three flasks were set up (as shown) and the temperature was measured at the beginning and the end of a week.



Flask	Contents of flask	Flask temperature (°C)	
		At start	At the end
A	Pea seeds	20	32
B	Boiled pea seeds	20	28
C	Boiled pea seeds in disinfectant	20	20

Flask A – Temperature has increased because heat is released during respiration from the living cells of the peas.

Flask B – Temperature has increased because microbes such as bacteria are present. These release heat during respiration in their cells.

Flask C – A **control** flask. It shows the difference between living and dead peas. (The disinfectant has killed any bacteria).

Respiration

Anaerobic Respiration

Releasing energy from food without using oxygen

This is what happens when there is not enough oxygen available. It releases much less energy from each molecule of glucose than aerobic respiration because the glucose molecule is not completely broken down.

You also need to learn this equation:



Disadvantage of anaerobic respiration

- Lactic acid is released in the muscles, which can cause pain (cramp).

Advantage of anaerobic respiration

- Muscles can release energy for a short period when not enough oxygen is available, e.g. 100m sprints.

What is an 'oxygen debt'?

After using anaerobic respiration to release energy, an 'oxygen debt' is created.

Breathing deeply after finishing exercise, to get oxygen to the muscle, breaks down lactic acid to water and carbon dioxide.

It is a good measure of fitness to see how quickly you can recover from an 'oxygen debt'.

A fit person can:

- Breathe in a greater volume of air.
- Produce less lactic acid,
- Break down lactic acid faster.

Anaerobic Respiration in Yeast (Fermentation)

Anaerobic respiration in yeast results in different products compared to animals:

Another equation you also need to learn:



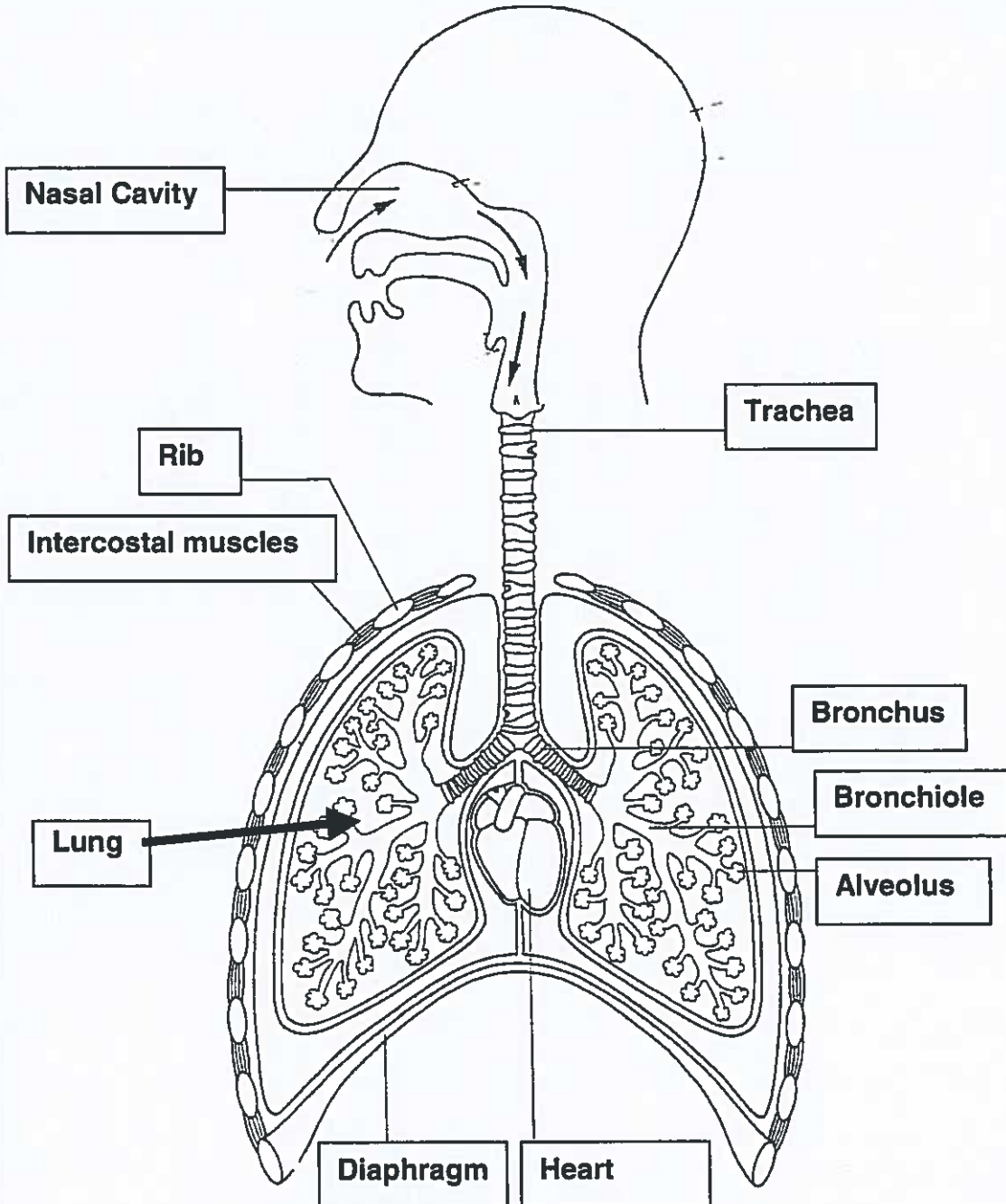
Humans, who brew alcoholic drinks by growing yeast in anaerobic conditions, use the reaction.

Respiratory System

The Respiratory System

The function of the respiratory system is to:

- get oxygen into the blood
- remove carbon dioxide from the blood.



Respiratory System

Gaseous Exchange in the Alveoli

The alveoli are the **respiratory surface** of the lungs.
The alveoli are full of air and are covered on the outside by blood capillaries.

Oxygen **diffuses** across the walls of the alveoli from the air into the blood.
Carbon dioxide **diffuses** across the walls of the alveoli from the blood into the air in the alveoli.

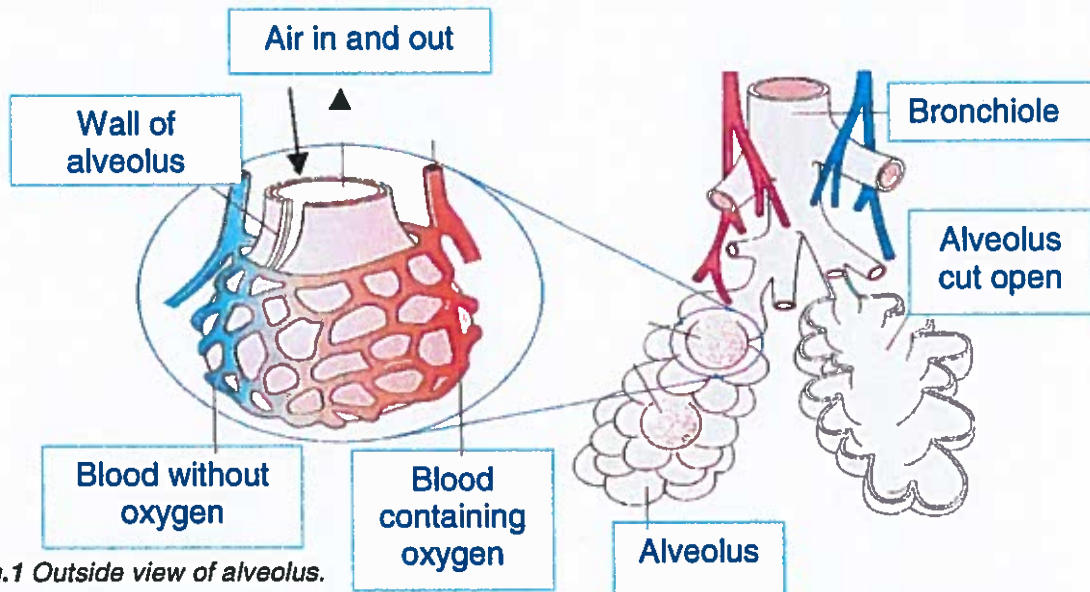


Fig.1 Outside view of alveolus.

How are alveoli adapted for gaseous exchange?

The diagram shows a cross-section of an alveolus with four numbered boxes describing its adaptations for gaseous exchange:

- 1. Good blood supply**
So that more gases can be exchanged.
Red blood cells (carry oxygen)
- 2. Large surface area**
Increases gaseous exchange.
(Provided by a large number of alveoli.)
- 3. Thin walls**
Gases can pass through by diffusion much easier.
- 4. Moist lining**
To dissolve oxygen so that it can diffuse through the alveolus wall.

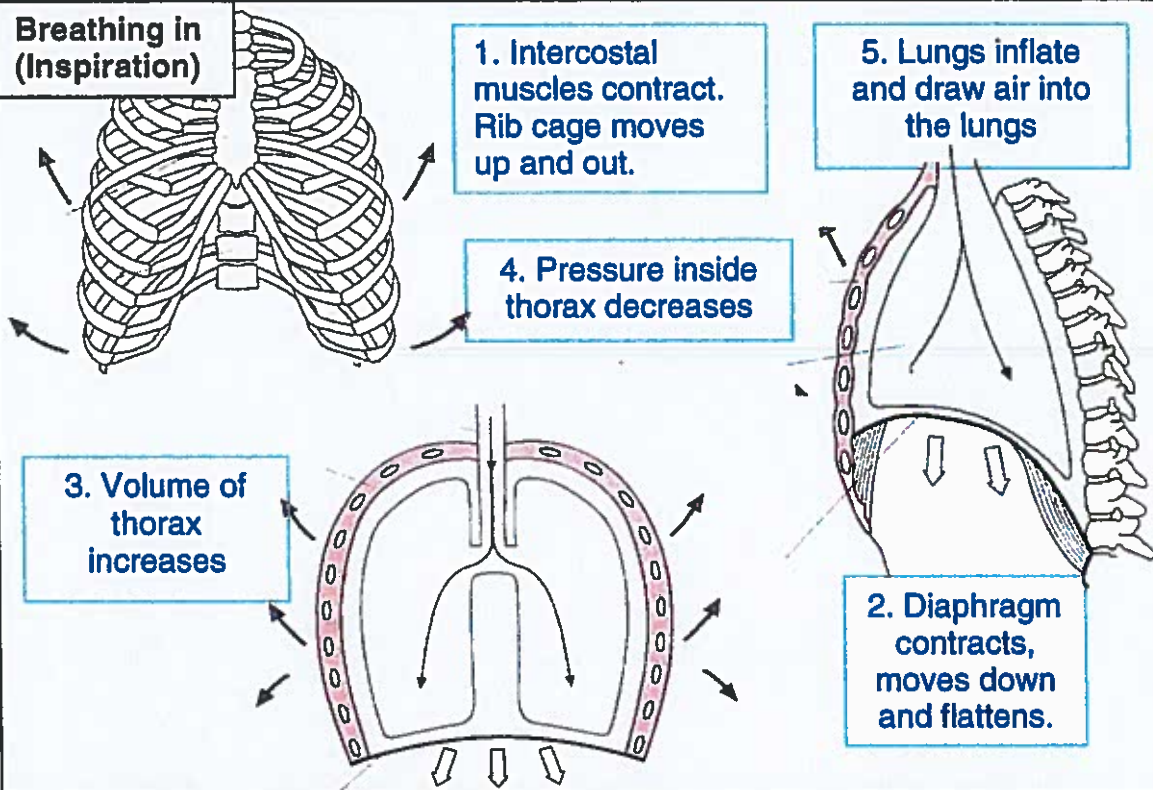
The diagram also shows arrows indicating the movement of CO_2 from the blood into the alveolus and O_2 from the alveolus into the blood.

Fig.2 View of alveolus cut open.

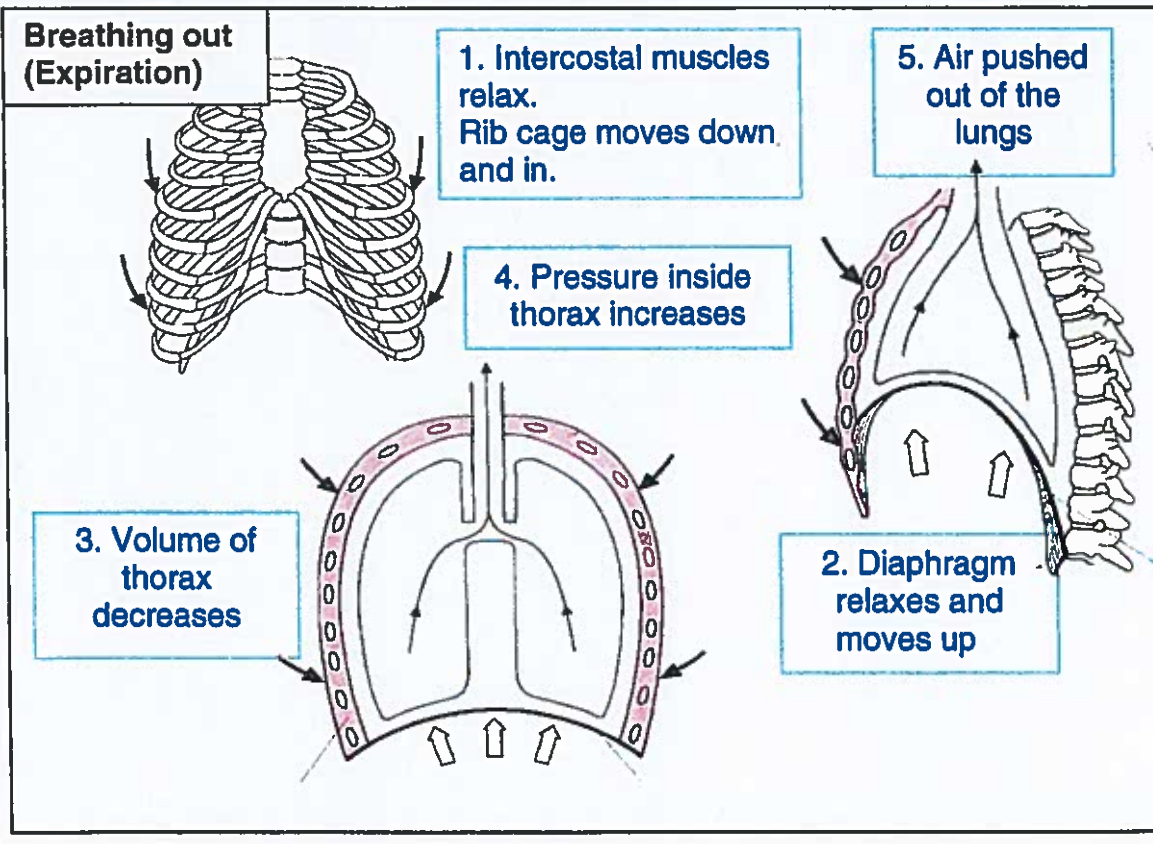
Respiratory System

Breathing

Breathing in (Inspiration)

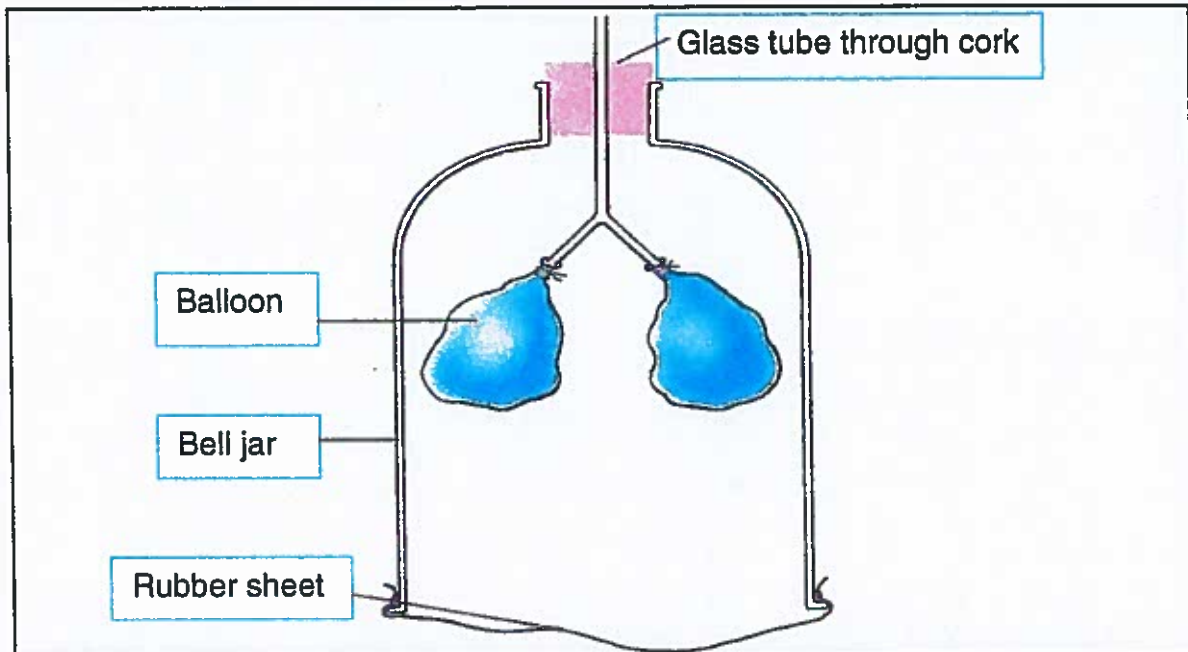


Breathing out (Expiration)



Respiratory System

Model of the Respiratory System



Part of model	Part of real body	How model is the same as the body	How the model is different from the body
Bell jar	Ribcage	Approximately the same shape.	Has no muscles attached to 'ribs' and so is rigid and cannot move up and down/ in and out.
Balloon	Lung	Inflates and deflates.	<ul style="list-style-type: none"> • Single bag, not a series of tubes with terminal alveoli; • balloon does not fill the space, or stick to the inside of the ribcage.
Rubber sheet	Diaphragm	Domed up position matches position when air is exhaled.	<ul style="list-style-type: none"> • pulls down further than flat; • has to be pushed in and out by us;
Tube into balloon	Trachea	The windpipe is a relatively wide tube conducting air into the lungs.	Is not held open by horseshoe shaped stiffening rings.

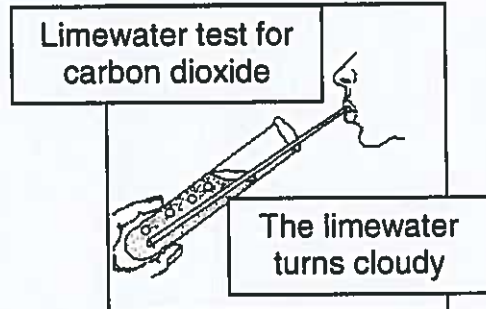
Respiratory System

Differences between inspired air and expired air

Inspired air is breathed in and expired air is breathed out. The body absorbs oxygen from inspired air and adds carbon dioxide and water vapour to expired air.

- Expired air has less oxygen than inspired air.
- Expired air has more carbon dioxide than inspired air.
- Expired air has more water vapour than inspired air.

	Inspired air	Expired air
Oxygen	21%	16%
Carbon dioxide	0.04%	4%
Water vapour	Varies	Saturated
Nitrogen	79%	79%

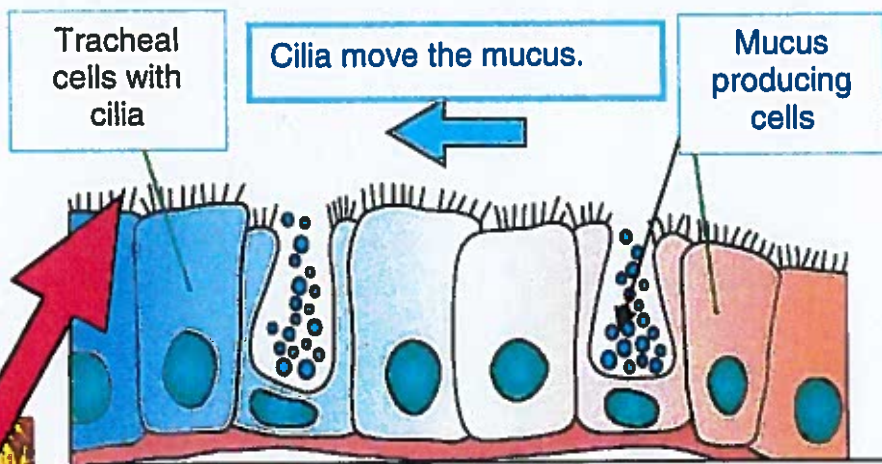


Keeping the Lungs Clean

The air you breathe contains dust, bacteria and viruses. The alveoli are very delicate, so the air has to be 'cleaned' before it reaches them



Electron micrograph showing tracheal cells with cilia.



The mucus traps any dust and bacteria in the air.

- The cilia move the mucus out of the lungs into the back of your throat in a wave like motion (like a Mexican wave).
- You swallow the mucus and acid in the stomach destroys any bacteria.

Effects of tobacco smoke on the body

Effects of smoking on cilia and mucus

Smoke from tobacco paralyses cilia in the trachea and bronchi for about an hour after a cigarette has been smoked.

Dry dust and chemicals in the smoke irritate the lungs, and clog up the mucus. Cilia normally sweep this mucus away, but smoke has paralysed them. Mucus builds up and if this becomes infected it can cause bronchitis.

Coughing causes damage to the alveolar walls, this reduces their surface area for gas exchange and results in the sufferer being short of oxygen.

Tobacco smoke contains many chemicals

Tar is a dark brown, sticky substance, which collects in the lungs as the smoke cools. It contains **carcinogens** – chemical substances known to cause cancer.

Carbon monoxide is a gas that combines with haemoglobin, and reduces the oxygen-carrying capacity of the blood by as much as 15% in heavy smokers.

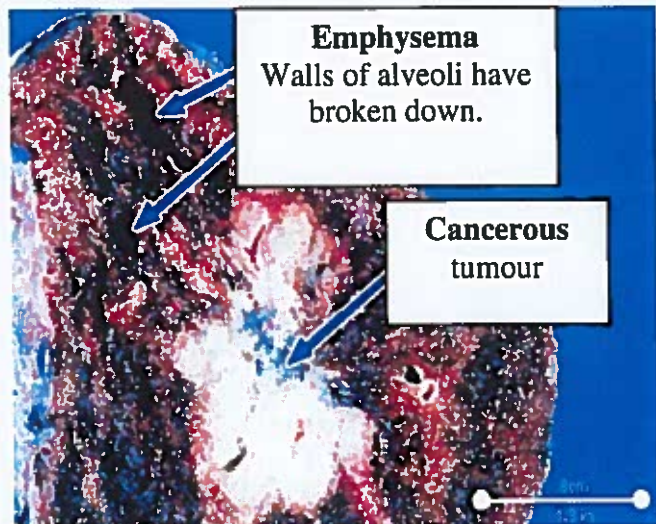
Nicotine is the addictive drug that makes smoking such a hard habit to give up. Nicotine makes the heart beat faster and the blood pressure rise.

Nicotine narrows blood vessels – vaso constriction.

Smoking related diseases

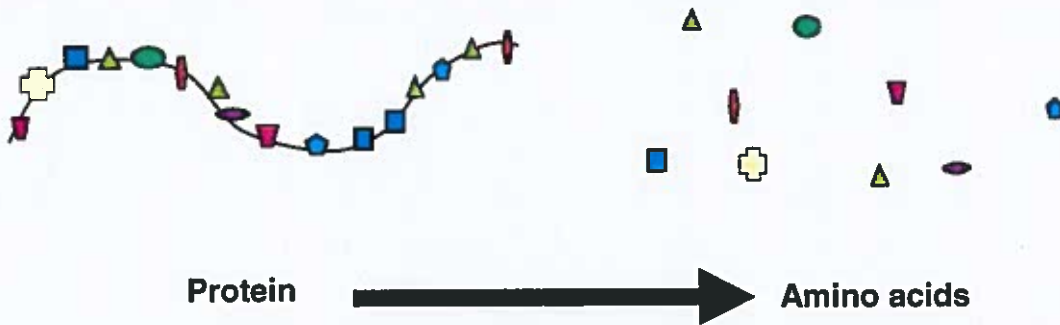
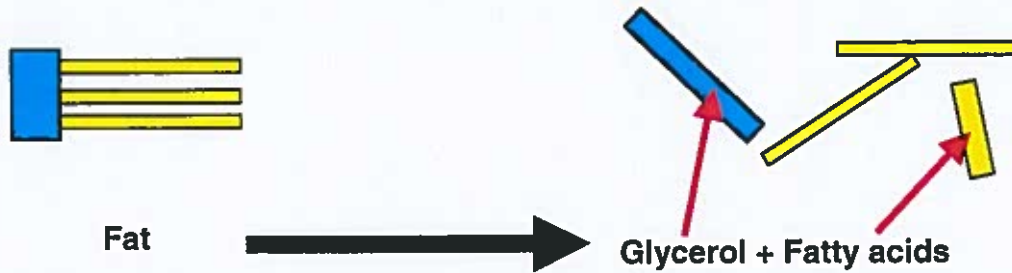
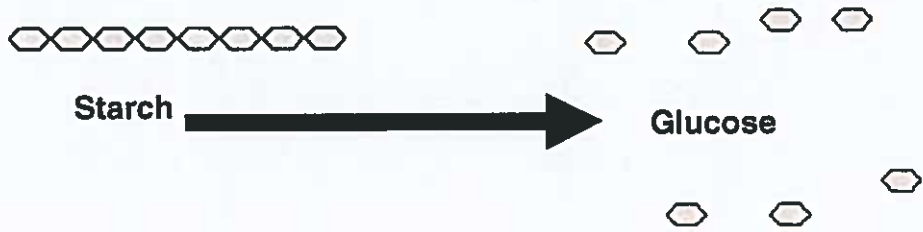
Lung cancer
90% of lung cancers are thought to be caused by smoking. One in ten moderate smokers, and one in five heavy smokers die from the disease.

Emphysema
The chemicals in tobacco smoke damage the walls of the alveoli, and they eventually break down. This reduces their surface area for gas exchange and results in the sufferer being short of oxygen.



The Digestive System

Digestion of Fats, Proteins and Carbohydrates

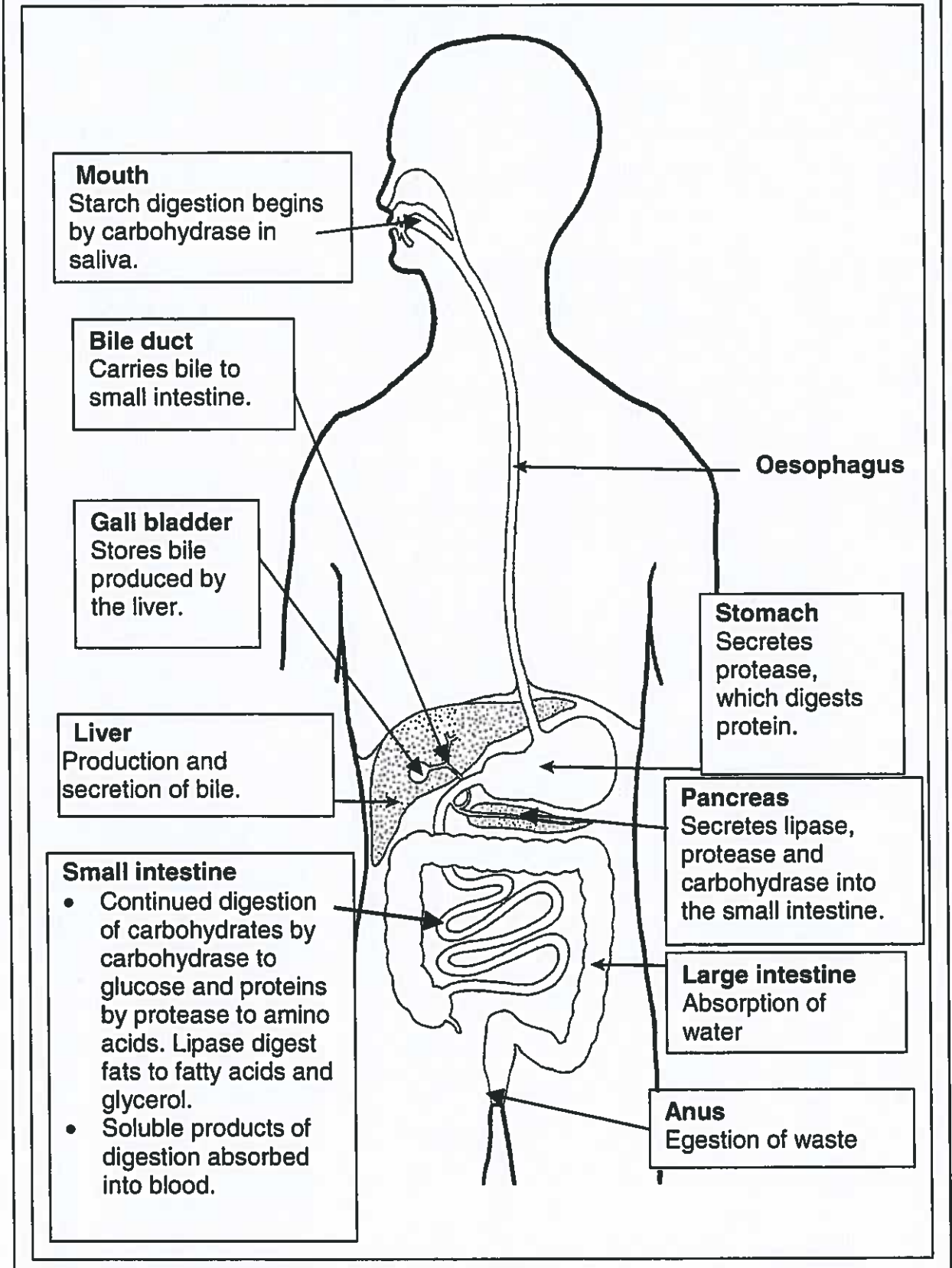


Testing for Products of Digestion

Food	Reagent	Method	Positive Result
Protein	Biuret	<ul style="list-style-type: none"> • Add blue Biuret to some food in a test tube. 	Lilac colour
Glucose	Benedict's	<ul style="list-style-type: none"> • Add blue Benedict's to some food in a test tube. • Place the test tube in boiling water bath for 5 minutes. 	Turns green, orange then brick red. (Colour change depends on concentration of glucose)
Starch	Iodine	<ul style="list-style-type: none"> • Add brown iodine to some food. 	Blue-black colour.

The Digestive System

Organs of the Digestive System and their Functions

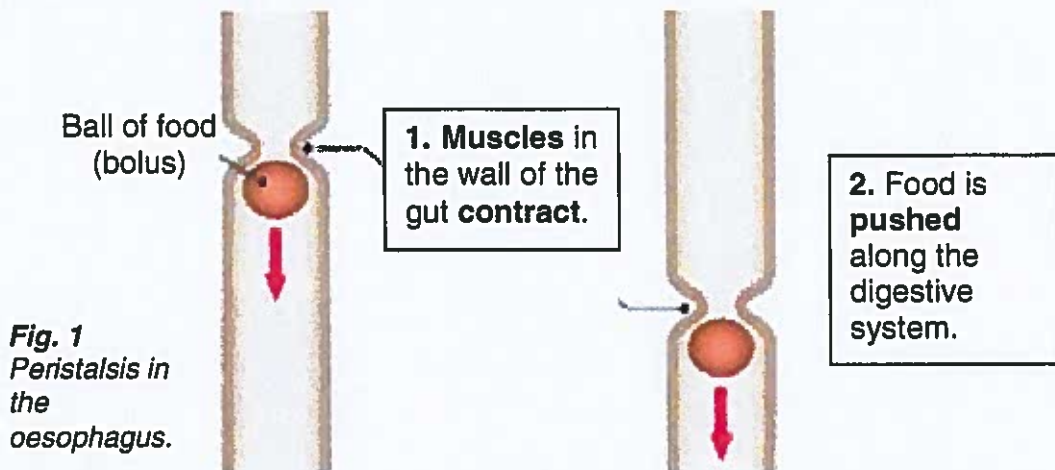


The Digestive System

How is food moved along the digestive system?

Food is moved along the digestive system by the contraction of muscles in the gut wall. This movement is called **peristalsis**.

The gut walls contain two layers of muscles running in different directions:



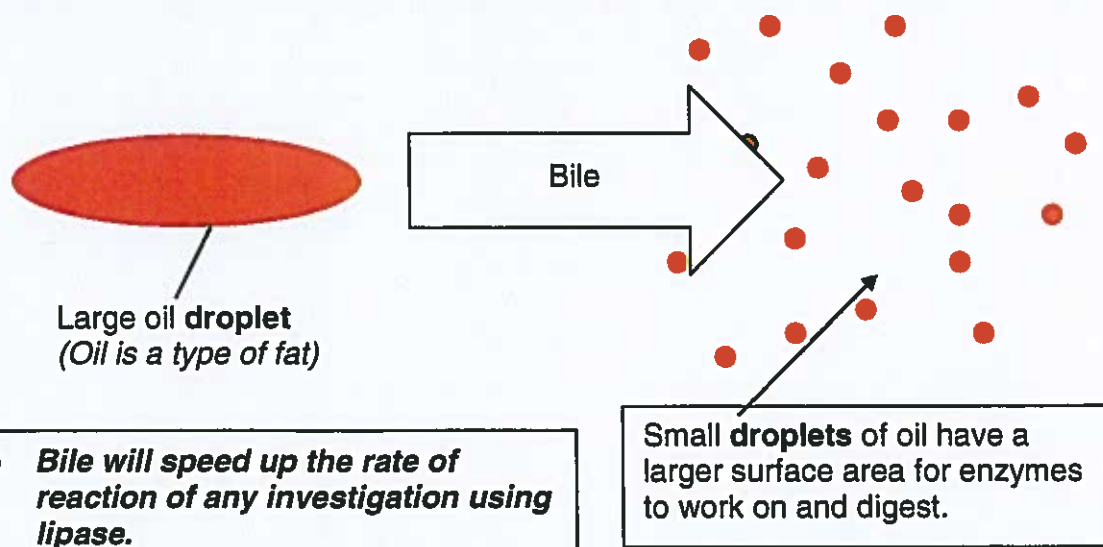
What does bile do?

Bile is produced in the liver and stored in the gall bladder.

Bile is not an enzyme.

Bile **emulsifies** fats, which means breaking down large droplets of fat to smaller droplets (a physical change not a chemical change).

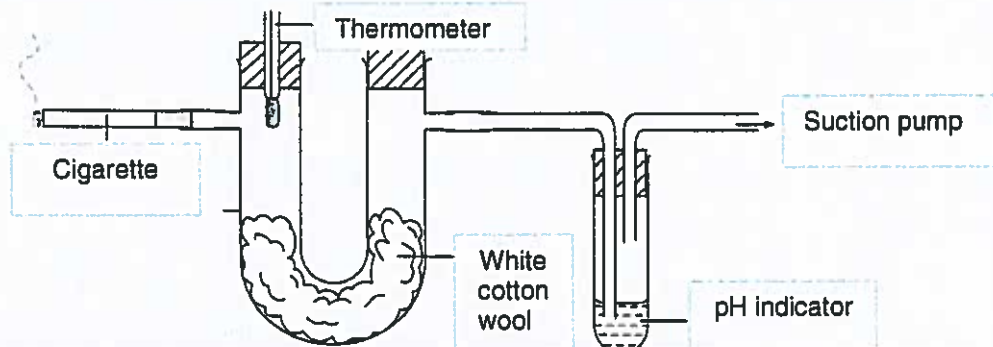
This increases the surface area of the fats for the enzyme lipase to work on.



Respiratory System

What's in cigarette smoke?

The following apparatus can be used to analyse the smoke from cigarettes:



The air is drawn through the apparatus before the cigarette is lit. This is the **control experiment**.

This is to show that it is the smoke from burning tobacco that causes any changes and not drawing air through unlit tobacco.

Result

- The white cotton wool will turn brown as it filters tar from the tobacco smoke.
- The pH indicator will turn red; this shows tobacco smoke is acidic.

Smoking – Ethical Issues

How have attitudes to smoking changed?

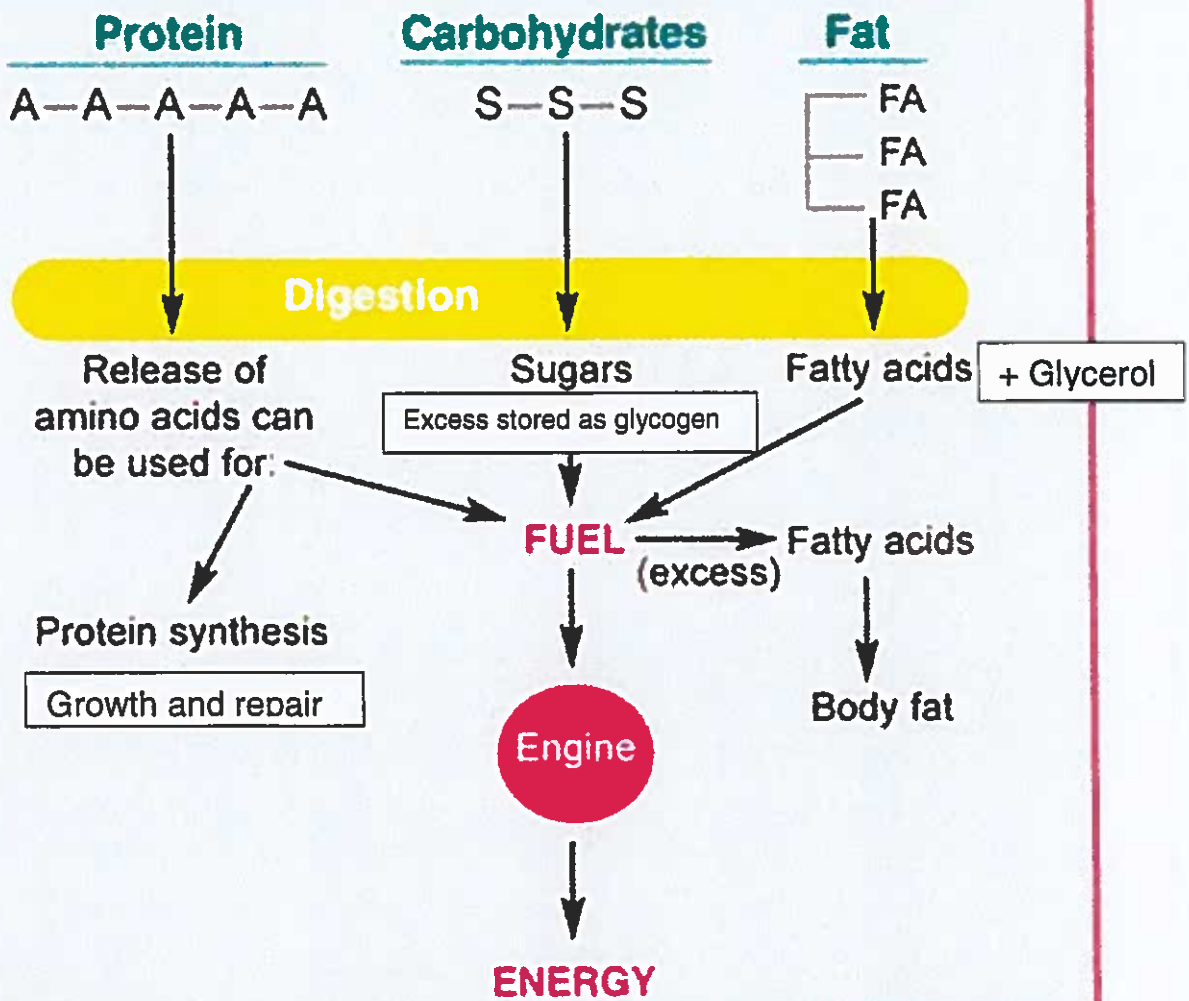
- Less people smoke now;
- More smokers are trying to give up;
- There are more help lines and advertising to encourage people not to or to stop smoking;
- Smoking is socially unacceptable;
- There are no cigarette advertisements;
- Sponsorship of sports by tobacco companies has been banned;
- Cigarette packets carry health warnings;
- Cigarettes for sale are no longer displayed in large shops;
- Smoking has been banned in public places.

Why have attitudes to smoking changed?

- People know that nicotine is an addictive drug;
- People know that smoking can cause lung cancer and emphysema;
- The dangers of smoking are now recognised, e.g. **passive smoking**.

1.3(j) How the digested products are used within the body

Figure 4



CARBS

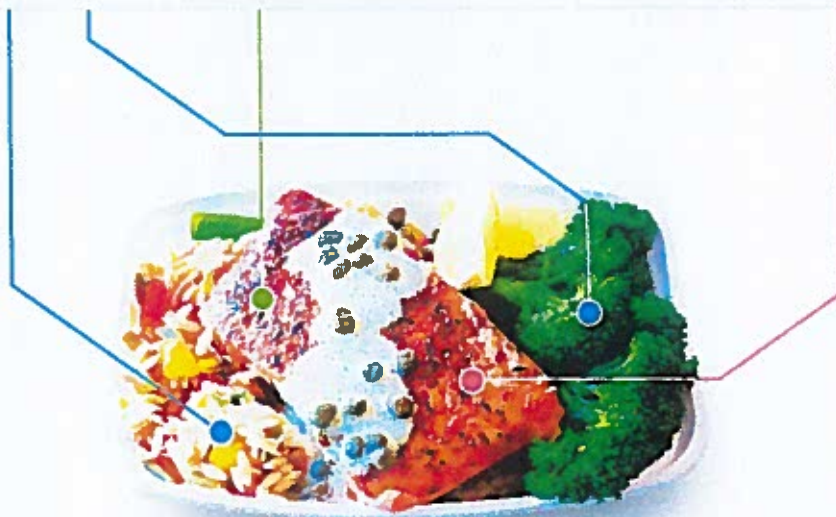
ENERGY: 4 CALORIES PER GRAM
FUNCTIONS: PROVIDE ENERGY, FACILITATE FAT METABOLISM, PREVENT PROTEIN BREAKDOWN
RECOMMENDED INTAKE: 45% - 65%

PROTEIN

ENERGY: 4 CALORIES PER GRAM
FUNCTIONS: PROVIDE ENERGY, BUILD AND REPAIR TISSUE, USED AS ENZYMES TO FACILITATE BODY REACTIONS
RECOMMENDED INTAKE: 20% - 45%




FAT

ENERGY: 9 CALORIES PER GRAM
FUNCTIONS: PROVIDE ENERGY, ABSORB VITAMINS, REGULATE BODY TEMPERATURE, PROVIDE ESSENTIAL FATTY ACIDS
RECOMMENDED INTAKE: 15% - 35%



1.3(k) The Need for a Balanced Diet

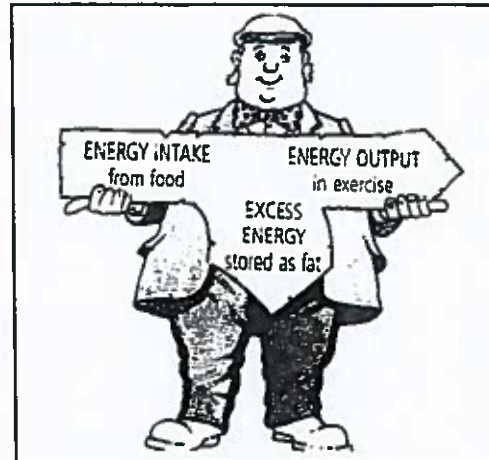
Food type	How does it help?	When do we need it in sport?	Where do we get it?
<p>Carbohydrates</p> 	<p>Provides quick energy. 60% of our diet should comprise 'carbs'. Glucose is used during cellular respiration to produce energy (ATP)</p>	<p>Running. Athletes in training will eat more 'carbs'. Marathon runners will 'load' before the event.</p>	<p>Plant origin from photosynthesis, stored as the insoluble polysaccharide starch (repeating units of glucose): pasta, cereals and potatoes</p>
<p>Fats NB Unsaturated fats are healthy. Too much saturated fat from animal products can lead to heart disease.</p> 	<p>Used in making cell membranes, hormones, storage of energy and insulation</p>	<p>Walking and low impact exercise - it produces energy too slowly to be used when working hard.</p>	<p>Oils, dairy products, nuts and fish</p>
<p>Protein</p> 	<p>Builds and repairs all cells. We need 15% of our diet to be protein.</p>	<p>When training hard and recovering from injury. 'Power' athletes such as weight lifters will eat more protein.</p>	<p>Meat, pulses and fish</p>
<p>Vitamins</p>  <p>eg</p> <ul style="list-style-type: none"> A - for vision B - for energy production and stress reduction C - to keep skin healthy D - to help bones and teeth 	<p>Helps the body work. Helps concentration.</p>	<p>Staying calm, making quick decisions</p>	<p>Fresh fruit and vegetables</p> <ul style="list-style-type: none"> Vitamin A- Carrots, sweet potatoes Vitamin B – Meat, fish Vitamin C – Citrus Fruits Vitamin D - Cod liver oil,

Food type	How does it help?	When do we need it in sport?	Where do we get it?
<p>Minerals</p> 	<p>Calcium - to strengthen bones</p> <p>Iodine - making thyroxine that controls activity</p> <p>Iron - making red blood cells</p>	<p>When training hard and competing</p>	<p>Calcium- milk and diary</p> <p>Iodine- Sea fish, table salt</p> <p>Iron- Red meat, spinach</p>
<p>Fibre</p> 	<p>Can't be digested. Fills you up and keeps you 'regular'.</p> <p>Absorbs water and binds the food into a bolus. This is then easier to pass through the intestines by peristalsis.</p>	<p>Healthy digestion, (no constipation) helps in sport. Also helps with weight control.</p>	<p>Fresh fruit, vegetables and wholegrain cereals</p>
<p>Water</p> 	<p>Maintains fluid levels.</p> <p>Needed for chemical reactions in cells.</p> <p>Used to maintain body temperature.</p>	<p>Whenever you sweat. It prevents dehydration</p>	<p>The tap! It's all you need most of the time.</p>

Balanced Diet

A balanced diet involves eating the right amounts of the essential food groups.
Overeating can lead to serious dietary diseases.

We can think of a person as taking in energy (**energy intake**) and giving out energy (**energy output**).



The energy content in food eaten must be balanced with the energy used,
Obesity is caused by a person's energy intake being greater than the energy output.

Excess (too much) energy is stored as fat.

The most fattening foods are therefore those that provide most energy.

Carbohydrate foods contain a lot of energy.

Foods that contain **fat** contain a lot of energy because 1g of fat has twice as much energy than 1 g of carbohydrate.

Eating too much

You are eating too much if the energy value of the food you eat each day is more than the amount of energy you use in that time.

Eating too much can lead to **weight increase** and **obesity**.

Obesity can contribute to heart disease, high blood pressure, diabetes (type 2), gall bladder disease, cancer of the bowel and also breast and womb cancer.

Food Labelling

Nutrition information on labels is provided 'per 100g' (or 'per 100ml' for liquids) and usually per serving too.

Looking at the nutrients 'per 100g' helps you compare the levels of nutrients in different products.

Too much sugar can lead to an increased chance of developing type 2 diabetes

Saturated fat tends to be from animal fat. It is high in cholesterol and increases the chances of developing heart disease.

A high salt diet can increase blood pressure.

High blood pressure is linked to an increased chance of a heart attack, stroke or kidney disease.

NUTRITION			GDA	
Typical values	per 100g	per pack	adult	per pack
Energy kJ	450	1345		
Energy kcal	105	315	2000	16%
Protein	7.9g	23.7g	45g	53%
Carbohydrate	8.8g	26.4g	230g	11%
of which sugars	1.2g	3.6g	90g	4%
Fat	4.2g	12.6g	70g	18%
of which saturates	2.7g	8.1g	20g	41%
Fibre.	1.2g	3.6g	24g	15%
Sodium	0.24g	0.72g	2.4g	30%
Equivalent as salt	0.60g	1.80g	6g	30%

GDA = Guideline daily amount

- Knowing how much energy is in food helps people control their diet, especially if they want to lose weight.
- Information of food additives helps inform people with food allergies.

Blood and Circulation

Blood

Red Blood Cells.

These cells carry oxygen around the body.

They are flattened, biconcave, disc shaped cells; they are red in colour because of a pigment called **haemoglobin**. This joins with oxygen to transport it around the body. Red blood cells don't have a nucleus.



Fig. 1 – micrograph of red blood cells

Iron is needed to produce haemoglobin. If there is a shortage of iron a person won't have enough red blood cells, this is called **anaemia**, less oxygen will be carried around the body.

White blood cells

These cells defend the body against pathogens (microbes that cause disease).

They are bigger than red blood cells, and have a nucleus, but don't contain a pigment so are colourless.

If you have an infection the number of white blood cells in you body increases rapidly.

There are many types of white blood cells, but you only need to learn about two of them:

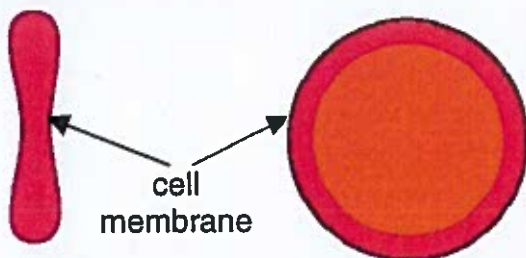
- **Phagocytes** – ingest and digest 'foreign' cells.
- **Lymphocytes** – produce antibodies and antitoxins.

Comparing red and white blood cells

(You should be able to draw, label and compare a red and white blood cell)

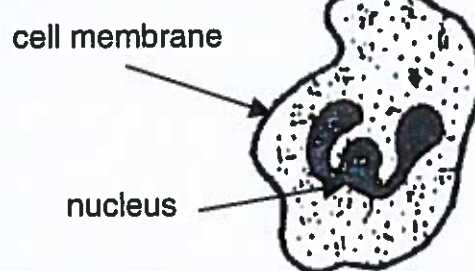
Red blood cells

Fig. 2 – side view (left) and front view (right) of red blood cell (not to scale)



White blood cells

Fig. 3 –white blood cell (phagocyte) (not to scale)



No nucleus present

Regular disc shaped

Smaller than white blood cells

Nucleus present

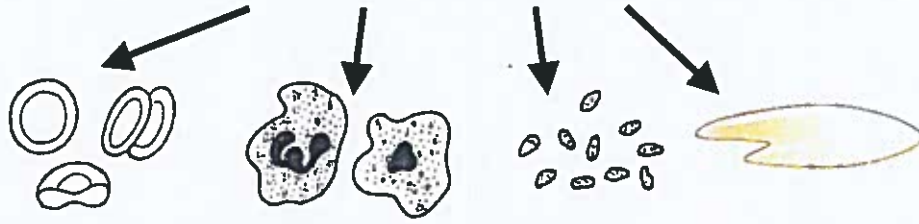
Irregular shape

Larger than red blood cells

Blood and Circulation

Blood

Blood is made up of



Red blood cells
carry oxygen

White blood cells
defend the body against pathogens

Platelets
clotting of blood

Plasma
carries dissolved substances

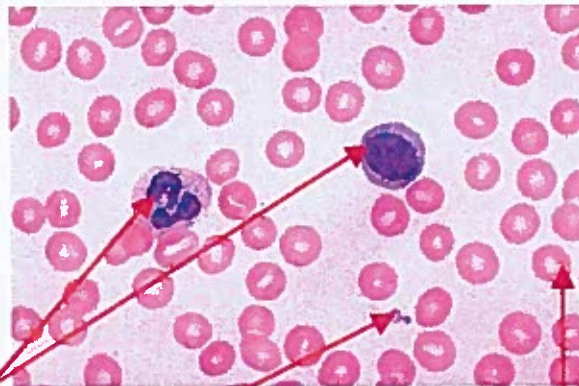
Fig. 1 – Illustration of the components of blood.

Examining blood smears

(These are diagrams you should be able to label).

Fig 2. Micrograph of a blood smear.

The centre of red blood cells appear paler because they have no nucleus and therefore more light from the microscope passes through them.



White blood cell

Platelet

Red blood cell

Fig.3 – Illustration of blood smear



Platelets
Platelets clot the blood.



Fig. 1 – micrograph showing red blood cells clotting.

When the skin is cut you bleed. Platelets make the blood clot, forming a thick jelly. This hardens to form a scab, **preventing bleeding and blood loss.** The scab keeps the wound clean as new skin grows underneath.

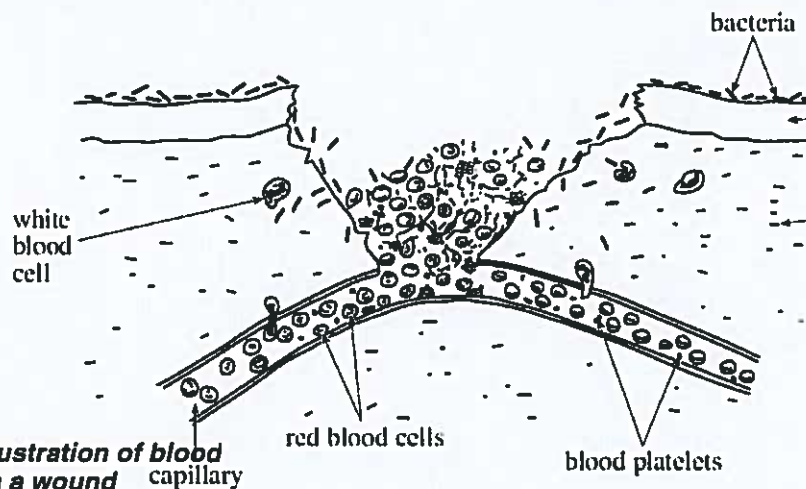


Fig 2. – Illustration of blood clotting in a wound

Plasma

Plasma carries dissolved substances.

This is the liquid part of blood. It is pale yellow in colour and is 90% water.

Plasma carries many dissolved substances around the body:

- Small soluble food molecules, e.g. **glucose, amino acids**, etc.
- Waste chemicals produced by the body, e.g. **carbon dioxide** from respiration and **urea** produced by the liver.
- **Hormones** carried from the endocrine glands to their target organs, e.g. insulin.
- **Antibodies** produced by lymphocytes (white blood cells).
- **Mineral salts**, e.g. sodium ions.

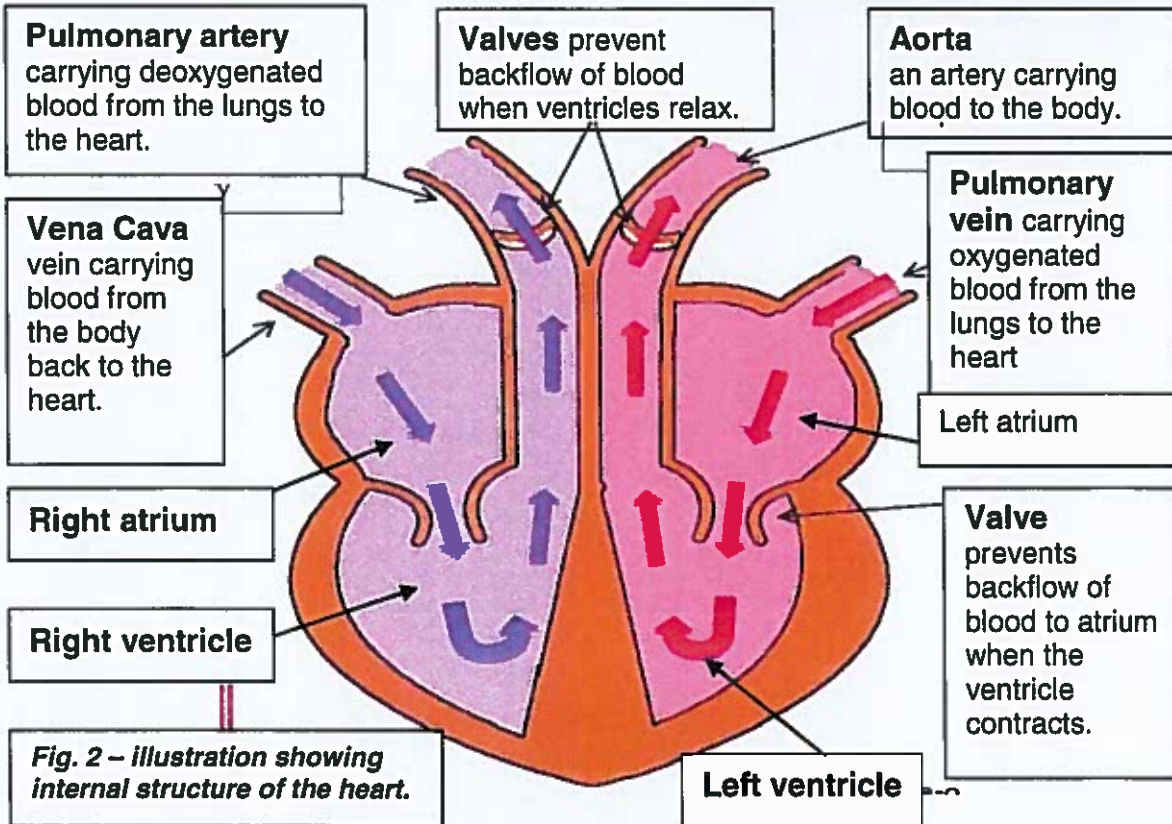
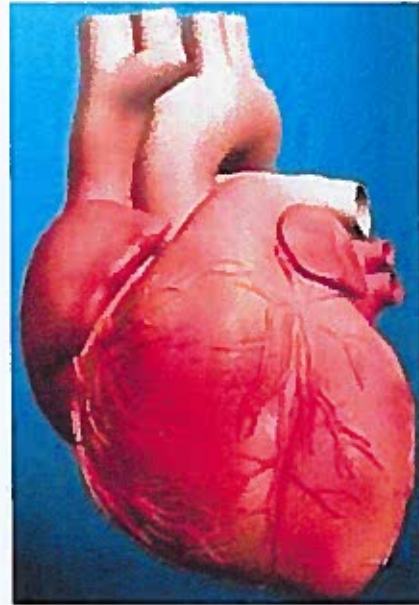
The Heart

Structure of the Heart

The function of the heart is to pump blood.
The heart is made of a special muscle called cardiac muscle.

There are blood vessels on the outside of the heart – the **coronary arteries**.
These supply oxygen and glucose to the heart muscle.
Without a steady supply of oxygenated blood the heart muscle couldn't keep contracting and pumping blood.

If a blood clot blocks a coronary artery, the heart muscles won't get enough oxygen and will stop working – this is a heart attack.



Blood and Circulation

Blood Vessels



Fig.1 – (Left to right) Illustration of an artery, capillary and vein (not drawn to scale).

- **Arteries** have thick walls because they carry blood under pressure away from the heart.
- **Veins** have thin walls because they carry blood under low pressure back to the heart.

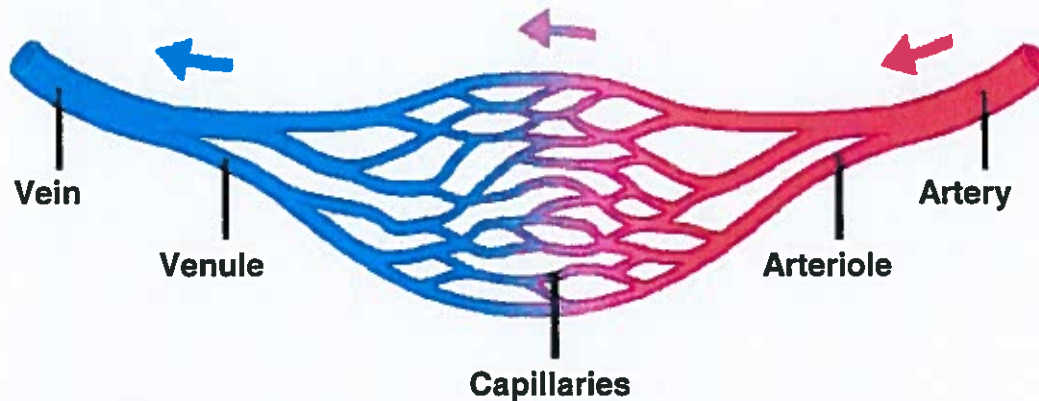
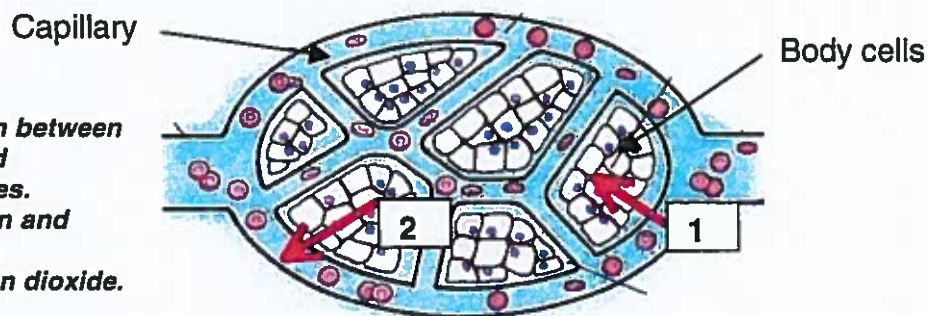


Fig. 2 Illustration showing structural relationship between blood vessels.

Capillaries are the smallest blood vessels that carry blood through the organs of the body.

- They form extensive networks so that no cell is far away from a capillary.
- Their walls are very thin to allow materials to diffuse easily between the blood and the body cells.

Fig. 3
Diffusion between
cells and
capillaries.
1 Oxygen and
glucose.
2. Carbon dioxide.



Facts you must learn about the heart:

- The heart is divided into 2 halves.
- Blood flows in one direction through each half of the heart.
- There are valves between the atria and ventricles. These can close to stop backflow of blood when the ventricles contract.
- There are valves at the bottom of the pulmonary artery and aorta to prevent backflow of blood to the ventricles when they relax.
- There are tendons attached to the valves so they don't get pushed inside out.
- The right side of the heart pumps blood to the lungs.
- The left side of the heart pumps blood to the body.
- The atria (*more than one atrium*) have thin walls because they only pump blood to the ventricles.
- The ventricles have thick muscular walls, because when they contract they have to pump blood out of the heart.
- The left ventricle has a thicker muscular wall than the right ventricle because it pumps blood to all parts of the body – the right ventricle only pumps blood to the lungs.

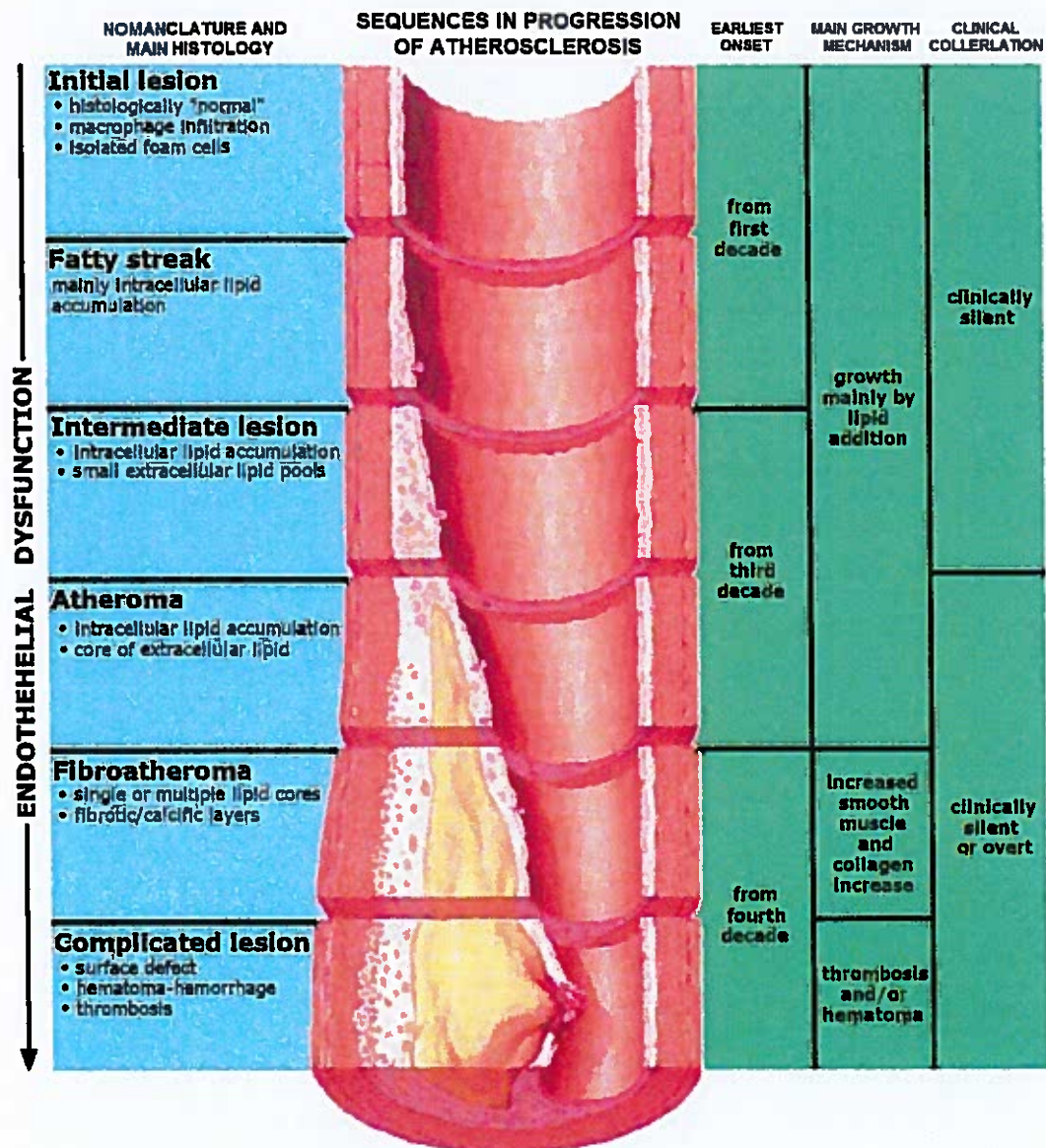
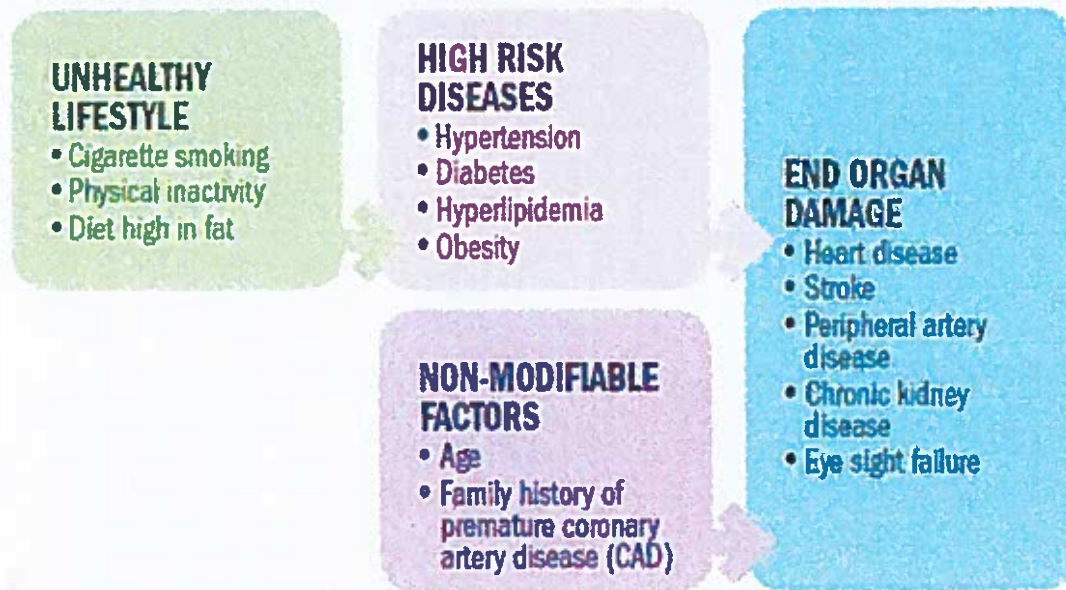
Flow of Blood Through the Heart

- The **vena cava** carries blood from the organs of the body to the **right atrium**.
- Blood passes through a **valve** to the **right ventricle**.
- The **right ventricle** contracts, pumping blood through the **valve** into the **pulmonary artery**.
- The **pulmonary artery** carries the blood to the **lungs** where it is oxygenated.
- The **pulmonary vein** carries blood back from the **lungs** to the **left atrium**.
- Blood passes through the **valve** into the **left ventricle**.
- The **left ventricle** contracts, pumping blood through the **valve** into the **aorta**.
- The **aorta** carries blood from the heart to the organs of the **body**.

ZWC questions sometimes ask you to describe the flow of blood through the heart. Always check to see where you need to start and finish.

Remember, you will lose marks by including irrelevant information!

Major risk factors for cardiovascular disease

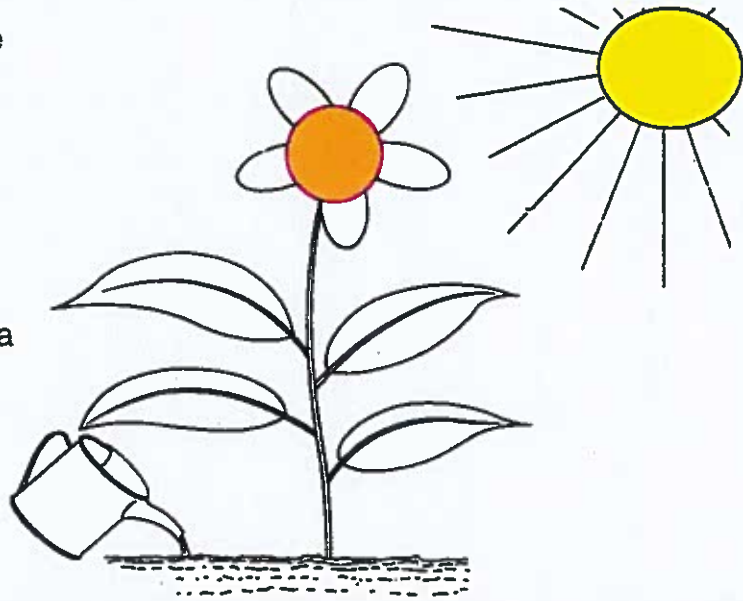


Photosynthesis

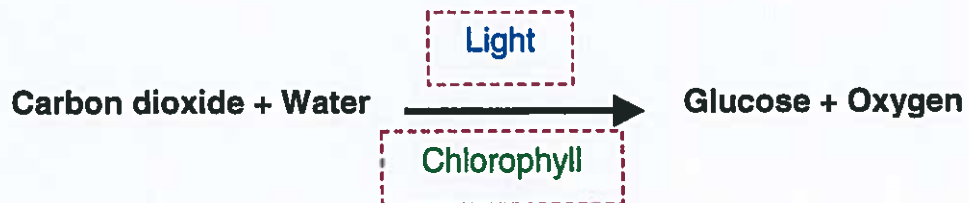
Photosynthesis is the process that 'produces food' in green plants and other photosynthetic organisms (e.g. algae)

Photosynthesis takes place in the green parts of plants – mostly in leaves.

- Chlorophyll (found in the chloroplasts) absorbs light energy.
- This energy is used to convert carbon dioxide and water into glucose.
- Oxygen is produced as a by-product.



The word equation for photosynthesis:



Enzymes control the chemical reactions of photosynthesis.

Photosynthesis

Some other factors we can investigate with this experiment:

Independent variable	How to change independent variable	Dependent variable	Controlled variables
Carbon dioxide levels	Different concentrations of potassium hydrogen carbonate solutions.	Volume of oxygen produced every minute OR Number of bubbles of oxygen produced every minute	<ul style="list-style-type: none"> • Temperature. • Distance of light • Same species of plant.
Temperature	Carry out experiment in water baths at different temperatures.		<ul style="list-style-type: none"> • Distance of light. • Same species of plant. • Mass of potassium hydrogen carbonate in water.
Species of plant	Using different species, e.g. <i>Elodea</i> (pondweed), <i>Cabomba</i> , etc.		<ul style="list-style-type: none"> • Distance of light. • Mass of sodium hydrogen carbonate in water. • Temperature.

Environmental Factors Affecting the Rate of Photosynthesis

Temperature

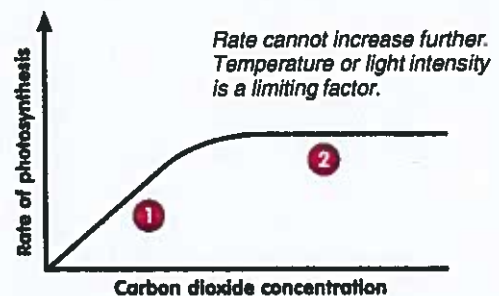
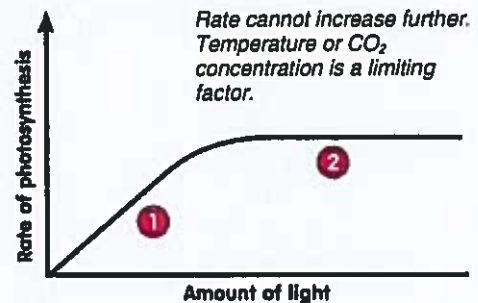
This affects the enzymes controlling photosynthesis.

Light intensity

This provides energy for photosynthesis. Increasing light intensity will increase rate of photosynthesis (1) up to a point when another factor will be **limiting** (2).

Carbon dioxide concentration

Increasing carbon dioxide concentration will increase rate of photosynthesis (1) up to a point when another factor will be **limiting** (2).

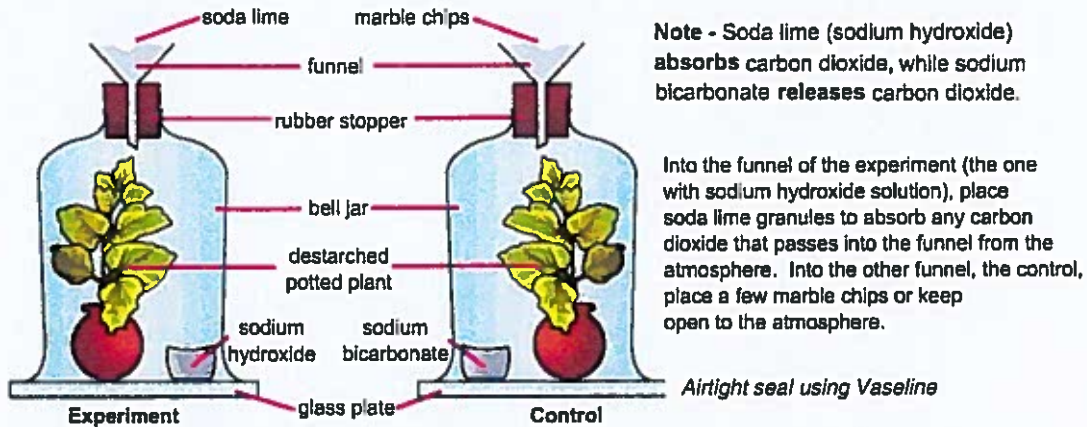


A limiting factor is the factor that is controlling the rate of photosynthesis at a given time. Increasing this factor will increase the rate of photosynthesis.

Photosynthesis

Experiment 3 – To show that carbon dioxide is needed for photosynthesis

We can deprive a plant of carbon dioxide and then test it for the presence of starch.



Result:

Leaves of plant from bell jar with sodium hydrogen carbonate (plenty of carbon dioxide) stained blue-black - starch is present.

Leaves of plant from bell jar with sodium hydroxide (no carbon dioxide) iodine remains orange – no starch present.

Conclusion:

Plants need carbon dioxide to be able to photosynthesise.

Does the presence or absence of water affect photosynthesis?

It is difficult to set up an experiment to prove that water is needed for photosynthesis because you cannot easily remove water from the system. If you remove water from a plant it will die.

To follow how water is used in photosynthesis you need to use water containing radioactive isotopes of hydrogen or oxygen.

Uses of glucose produced in photosynthesis:

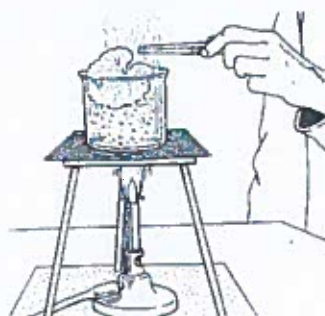
1. Glucose is used to **release energy** in respiration
Respiration is taking place all the time in plant cells.
2. Glucose can be changed to **starch** and **stored**.
3. Glucose can be used to **make cellulose** which make up the body of plants (e.g. cell walls)
4. Glucose can be used to **make proteins**, which also make up the body of plants.

Testing a Leaf for the Presence of Starch

- Glucose produced during photosynthesis cannot be stored and is either used up or stored as insoluble starch.
- We can test a leaf to see if photosynthesis has happened by testing for the presence of starch.
- The plant must be kept in the dark for 24-48 before the experiment. This is so that the plant will use up its store of starch.
- Any starch found afterwards must have been formed by photosynthesis during the experiment.

You need to learn how this experiment works and explain the importance of each step.

1. The leaf is placed in a beaker of boiling water for 1 minute.
(This breaks down the cell membrane, making it easier for iodine to enter the cell and to remove the chlorophyll in step 3).



Turn off the Bunsen burner
Ethanol is highly flammable

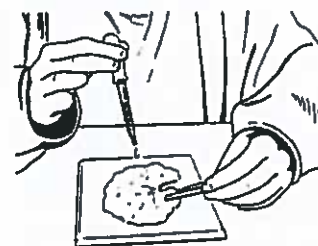
2. The leaf is removed from the water and put into a boiling tube half full of ethanol.
- 3.



4. The boiling tube containing the leaf and ethanol is placed in the hot water for 10 minutes.
(The boiling ethanol will dissolve the chlorophyll. This removes the green colour from the leaf.)



5. The leaf is removed from the boiling tube and washed in the beaker of water.
(This softens the leaf)



6. The leaf is placed on a white tile and covered in iodine.
(Any parts containing starch will be coloured dark blue-black).

Photosynthesis

Identifying the Conditions Needed for Photosynthesis

Testing leaves for the presence of starch can be used to show how photosynthesis is affected by:

- the presence of chlorophyll in the cells of a leaf;
- light reaching a leaf;
- carbon dioxide in the atmosphere around a leaf.

Experiment 1 – To show that chlorophyll is needed for photosynthesis

We can test a plant to show it needs **chlorophyll** for photosynthesis by using a **variegated leaf** and testing it for the presence of starch.

Before



After



Result:

Green parts containing chlorophyll- stained blue-black - starch is present.
Light parts of plant with no chlorophyll the iodine remains orange – no starch present.

Conclusion:

Chlorophyll must be present in leaf cells for photosynthesis to occur.

Experiment 2 – To show that light is needed for photosynthesis

We can deprive a part of a leaf of light and then test it for the presence of starch.

*A tin foil stencil is cut out and put on one of the leaves of a plant.
This excludes all light, except at the edges and on the pattern.*

Before



After



Result:

Parts exposed to light stained blue-black - starch is present.
Parts excluded from light iodine remains orange – no starch present.

Conclusion:

Leaves must be exposed to light for photosynthesis to occur.

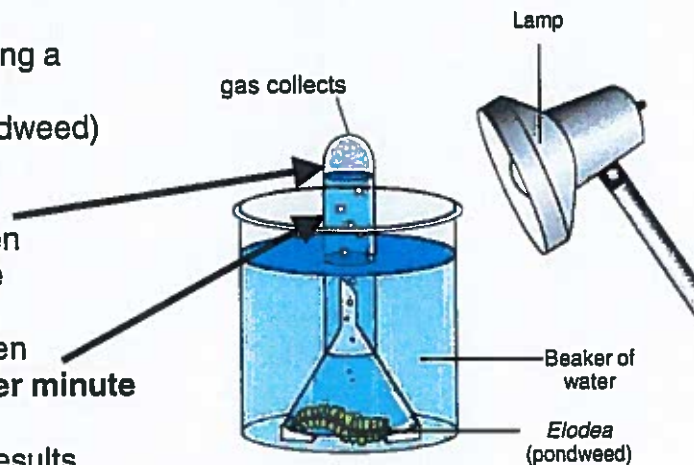
Photosynthesis

Investigating the Conditions Needed for Photosynthesis

As oxygen is given off during photosynthesis, its rate of production can be used to measure the rate of photosynthetic activity.

This is made possible by using a plant that grows in water, e.g. *Elodea* (also called pondweed) and measuring:

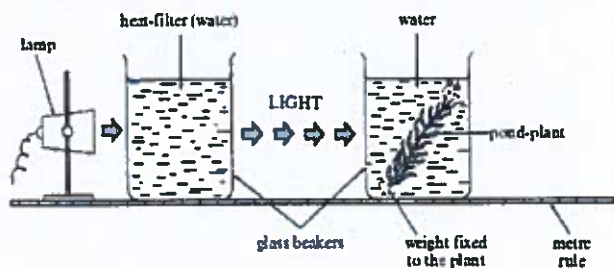
- The volume of oxygen produced per minute
- OR
- The number of oxygen bubbles produced per minute



This allows us to compare results under different conditions.

Investigation – Effect of Light Intensity on the Rate of Photosynthesis

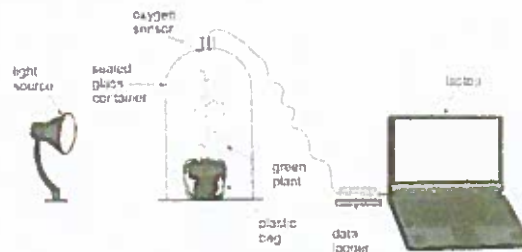
- Measure and record the distance of the lamp from the plant (e.g. 10cm);
- Count the number of bubbles given off every minute;
- OR
- Measure volume of gas produced every minute.



- Repeat experiment to check the repeatability of the results;
- Redo the experiment at different distances by moving the lamp a further 10cm from the plant each time.

The rate of photosynthesis can also be measured by using oxygen or carbon dioxide sensors and data loggers to measure:

- Oxygen produced per minute;
- Carbon dioxide used up per minute;



Monitoring the Environment, Energy Flow and Nutrient Transfer

Energy and Nutrient Transfer

Light energy from the sun is the source of all energy for all living things on the planet.

Green plants absorb only a small percentage of this energy (about 1%), using the chlorophyll in their chloroplasts. The rest of the light is either reflected or is at the wrong wavelength.

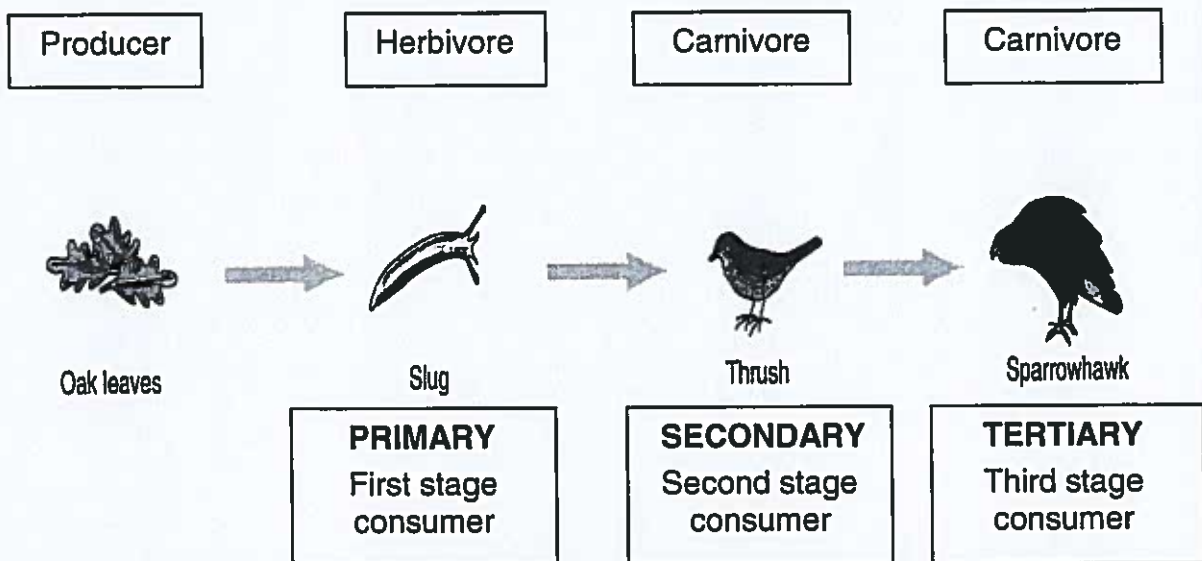
The **absorbed energy** is used for **photosynthesis** to produce substances that become part of the cells. These **increase the biomass** of the plant.

- Biomass is the mass of living material in plants and animals.

Food Chains – Glossary of terms

There are many terms to describe the organisms in a food chain. Some organisms can be described using more than one label.

E.g. an herbivore can also be described as a first stage consumer.

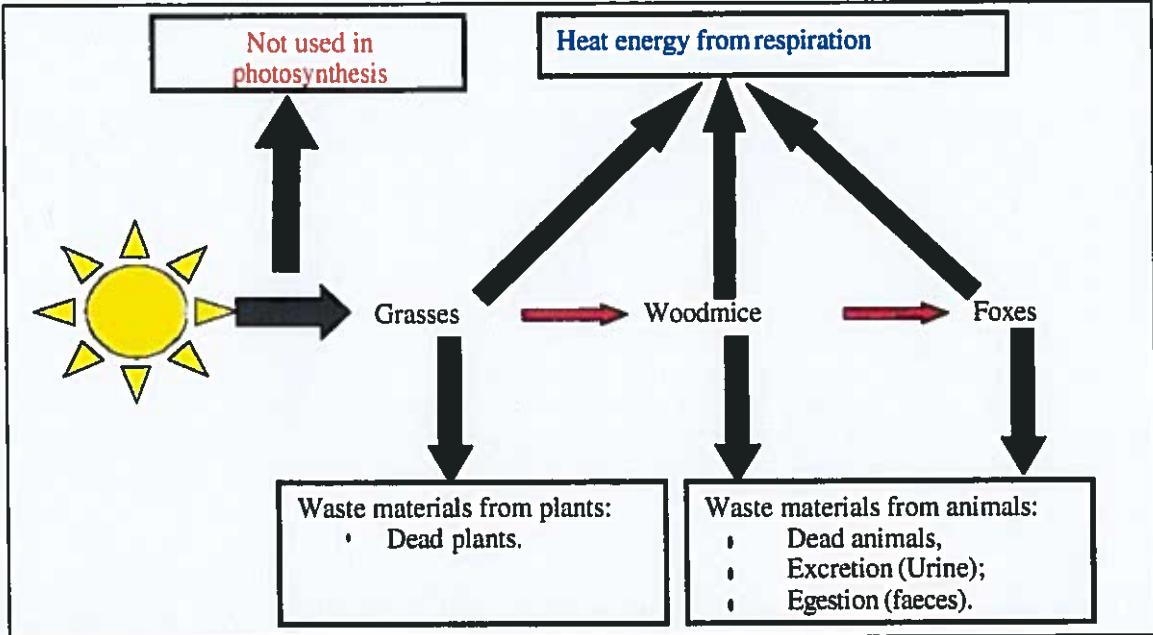


- The **arrows** in a food chain show **energy being passed** from one living thing to the next. (*This is sometimes described as a **flow of energy***).

Producer	Makes it's own food by photosynthesis.
Consumer	An organism that eats other organisms.
First stage consumer	The first organism that is 'eating' in a food chain.
Second stage consumer	The second organism that is 'eating' in a food chain.
Third stage consumer	The third organism that is 'eating' in a food chain.
Herbivore	An organism that only eats plants.
Carnivore	An organism that only eats animals.
Omnivore	An organism that eats both animals and plants.

Energy Flow Through a Food Chain

There is energy lost at each step of a food chain, so there's less available for the next animal. This is why the numbers of organisms in a food chain is limited. The more energy lost every step, the shorter the food chain.



Energy is also 'lost' from the food chain for the repair of animal or plant cells.

Some things to consider about energy lost as heat during respiration.

- € Animals lose more heat than plants because their metabolism is higher (the amount of chemical activity in cells).
- € Animals lose more heat than plants because they move around; plants don't.
- € Warm-blooded animals (mammals and birds) lose more heat than cold-blooded animals (all the others) because they need to keep their body temperature constant. (*See homeostasis*).
- € Land animals lose more energy than animals in water, because they have to support their bodies. E.g. we humans have to stand, a jellyfish just floats!

Efficient Food Production

More food can be produced from an area of land if it is used for growing crops rather than grazing animals.

Less energy is lost if people eat plants, because the food chain is shorter.

However, potatoes wouldn't grow on a mountain, but sheep can graze there, so no need to stop all animal production.



Monitoring the Environment, Energy Flow and Nutrient Transfer

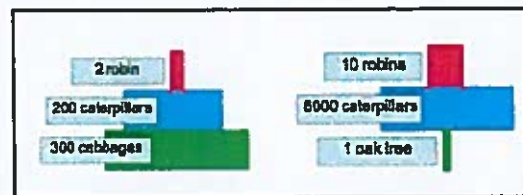
Food Pyramids

Pyramids of number show the **number of organisms** in a given area or volume for every feeding level.

Rules for pyramids of number:

1. The producer is always at the bottom.
2. The size of every block (area or volume) shows the **number** of plants or animals in the food chain.

Pyramids of numbers can be misleading. The pyramid on the left represents a cabbage field, and the one on the right woodland. Their shapes are different even though they show the number of individual organisms. A tree can support thousands of animals; therefore the base of the pyramid is smaller than the levels above.



Pyramids of biomass shows the **dry mass of organisms** in a given area or volume for every feeding level.

Rules for pyramids of biomass:

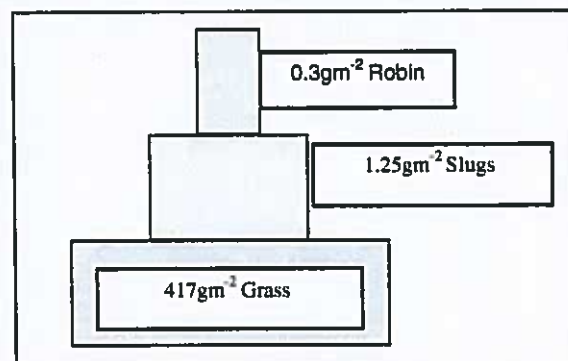
1. The producer is always at the bottom.
2. The size of every block (area or volume) shows the **dry mass of the of plants or animals** in the food chain

The shape of a pyramid of biomass can change during the year, depending on the time a survey is carried out.

The pyramid on the right has been drawn from grassland during May.

If a survey were carried out in December the mass of grass would be less.

During the winter it is colder and there is less sunlight, therefore the grass would be producing less biomass by photosynthesis.



Remember

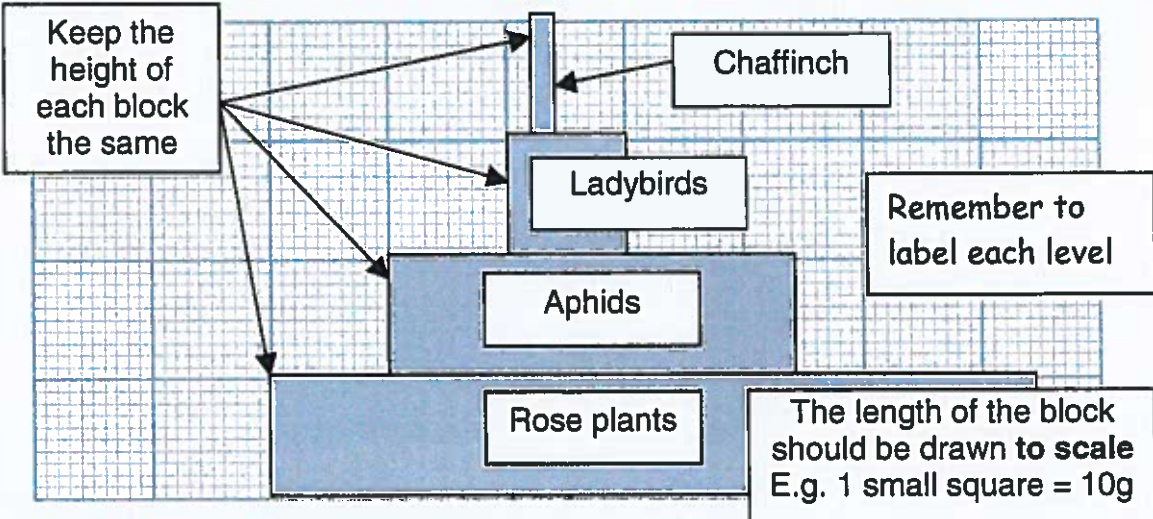
A pyramid of biomass will always be pyramid shaped.

Building Food Pyramids

Organisms are represented as small squares on graph paper. Drawing a line around all the small squares will give a box that represents the numbers or biomass of an organism.

Organism	Number in the food chain	Mass of each organism (g)	Total biomass of organisms (g)
Rose plants	1	640	640
Aphids	7000	0.05	350
Ladybirds	400	0.25	100
Chaffinch	1	25	25

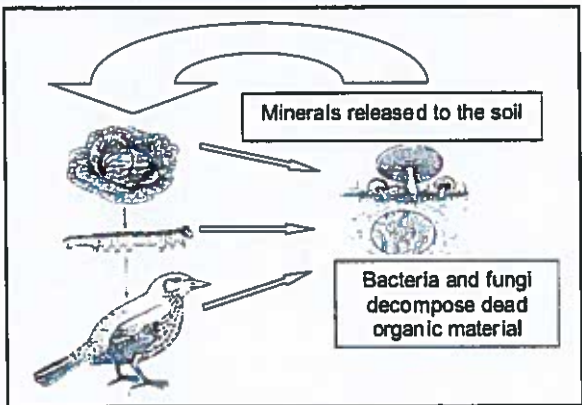
Number x mass



Natural Recycling

Not every animal or plant gets eaten!

- **Decomposers are bacteria and fungi.**
- Decomposers digest and use animal and plant waste for growth and respiration.
- Minerals such as nitrates are released to the soil, and are then used by plants for growth.



Factors that affect the activity of decomposers (bacteria and fungi):

- Temperature
- Oxygen
- pH
- Heavy metals

1.6(d) How to calculate the efficiency of energy transfers between trophic levels

Nearly all organisms are dependent on energy from the Sun.

Plants harness light energy to drive food production. By the process of photosynthesis, organic compounds like glucose are made from carbon dioxide and water using this energy. Plants only absorb a small percentage of the Sun's energy (1%) for the process of photosynthesis. The energy is absorbed in chemicals that make up the plants' cells.

Energy transfer

Animals cannot make their own food so they have to eat. This is one way in which energy is transferred between organisms in an ecosystem. The energy is used for a number of life processes.

In a food chain only around 10% of the energy is passed on to the next level. The rest of the energy, 90%, passes out of the food chain in a number of ways (life processes Mrs Gren):

- via heat energy
- is used for life processes (Mrs Gren)
- uneaten parts that pass to decomposers
- is excreted and passes to decomposers.



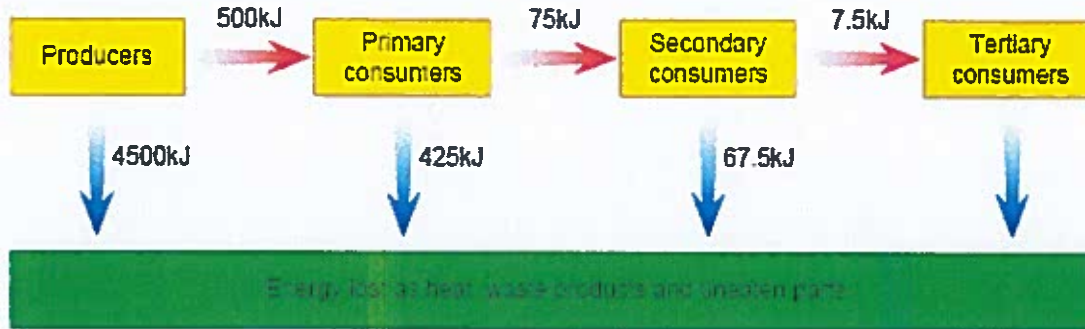
**Movement
Respiration
Sensitivity**

**Growth
Reproduction
Excretion
Nutrition**

As less energy is transferred at each level (trophic level) of the food chain, the number of organisms at each level gets smaller, due to the much reduced available energy.

Percentage efficiency of energy transfer

An example of energy flow through an ecosystem is shown below:



Energy flow through an ecosystem

If we want the percentage efficiency of energy transfer between producers and primary consumers.

1. Calculate the total energy that came into the level of the food chain:

$$4,500\text{kJ} + 500\text{kJ} = 5,000\text{kJ}$$

2. Identify how much energy is transferred to the primary consumers:

500kJ

3. Calculate the efficiency of the transfer from the primary producer to the primary consumers using the equation:

$$(\text{Energy transferred to next level} \div \text{Total energy in}) \times 100$$

$$(500\text{kJ} \div 5,000\text{kJ}) \times 100 = 10\%$$

This shows the percentage efficiency of energy transfer between producers and primary consumers in this ecosystem is **10 per cent**.

4. Calculate the efficiency of the transfer from the primary consumers to the secondary consumers using the equation:

$$(\text{Energy transferred to next level} \div \text{Total energy in}) \times 100$$

$$(75\text{kJ} \div 500\text{kJ}) \times 100 = 15\%$$

5. Calculate the efficiency of the transfer from the secondary consumer to the tertiary consumers using the equation:

$$(\text{Energy transferred to next level} \div \text{Total energy in}) \times 100$$

$$(7.5\text{kJ} \div 75\text{kJ}) \times 100 = 10\%$$

Biodiversity and Environment

Biodiversity and Protecting Endangered Species

Biodiversity is the number of different species in a particular area.

Biodiversity leads to stable ecosystems that can resist possible harmful situations.

This is important because ecosystems help to:

- regulate the atmosphere,
- regulate water supply,
- regulate nutrient cycles, e.g. the nitrogen cycle,
- provide fertile soil.

Biodiversity is important for:

- food,
- potential foods,
- industrial materials,
- new medicines,
- human well being.

These days more and more species are becoming **extinct** because man is destroying their habitats.

This leads to a **decrease in biodiversity**.

Habitats are being destroyed because of increases in the use of land for:

- Building
- Quarrying
- Dumping rubbish
- Agriculture

The methods of protecting biodiversity and rare species are listed below:

- **CITES** (*Convention on International Trade in Endangered Species*) – Agreement in the international market to prevent trade in endangered species.
- **SSSI** – Sites of Special Scientific Interest
- **Captive breeding programs** (e.g. Zoos)
- **National Parks**
- **Seed banks**
- **Local biodiversity conservation schemes**

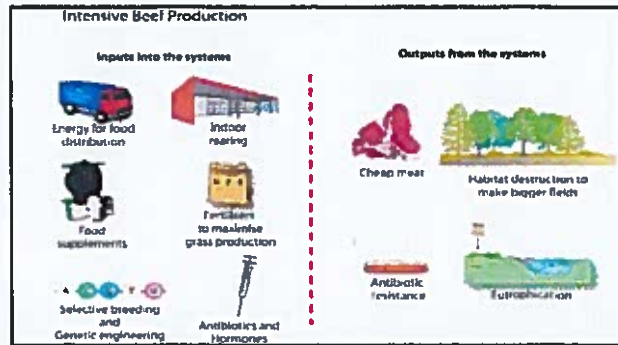
Computer programs can be used as simulations of environmental interactions and to predict trends.

For example:

- modeling climate change,
- investigating the effect of pollutants on populations,
- predicting trends in populations of endangered species.

Intensive Farming

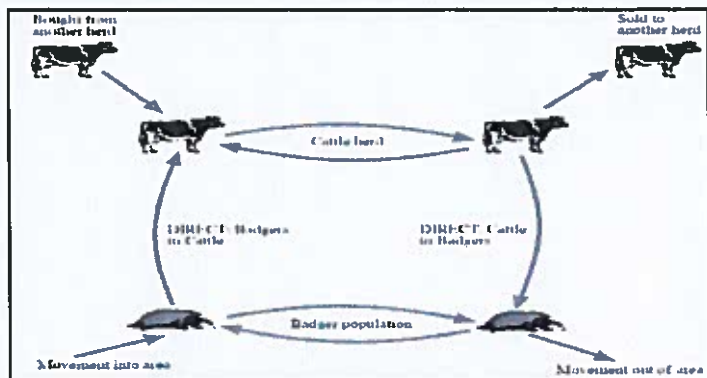
In order to feed the growing world population we need get as much **yield** (from plants or animals) from **less land**.
We can do this by using **intensive farming methods**.



You need to be able to name **methods** of intensive farming and describe their **advantages** and **disadvantages**:

Methods	Advantages	Disadvantages
Fertilisers	Increase plant yield.	Can wash out of soils and pollute rivers and streams.
Pesticides	Increases yield by stopping pests from eating or competing with crop plants.	Can destroy non-pest species. Can lead to bioaccumulation.
Disease control	Prevents losses of plants and animals.	Antibiotics given to animals may still be found in meat form treated animals.
Battery methods	Less room to move. Less energy wasted. Less food needed. Reduced costs.	Poor quality of life for animal.

TB infection in cattle and badgers
Bovine tuberculosis (bTB) is a very serious disease of cattle in Britain. There is very strong evidence of a link between bTB in cattle and bTB in badgers.



Farmers believe that badgers should be culled to prevent the spread of bTB.

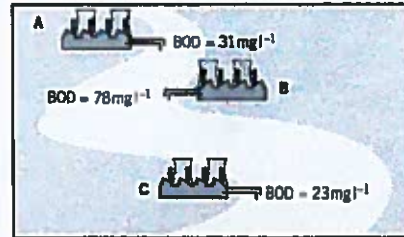
Arguments supporting a cull	Arguments against a cull
Badgers carry bTB and pass it on to cattle.	Badger culls have not always been effective.
Many cattle die each year.	Badgers that survive can move to other areas spreading the disease.
	Vaccination may be more effective.

Measuring pollution in rivers and streams

Populations can be upset by the introduction of harmful materials into the environment, which results in pollution.

Pollution in rivers and streams can be measured using:

- Changes in pH levels
- Changes in oxygen levels
- Indicator species



• **Changes in pH**

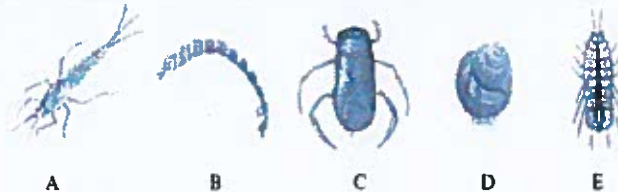
Acidification of rivers and streams is due to acid rain and run-off from surrounding land. Below pH 4.5-5 aluminium is released from rocks. This is toxic to fish.

• **Changes in oxygen levels**

The change in oxygen concentration shows how much bacteria there is in the water. The more bacteria there are, the more polluted the water is.

• **Indicator species**

You can estimate the amount of pollution by recording the presence or absence of certain indicator species.



• **Carrying out a survey**

A survey should be a **fair test**. Therefore only one factor should change (the independent variable).

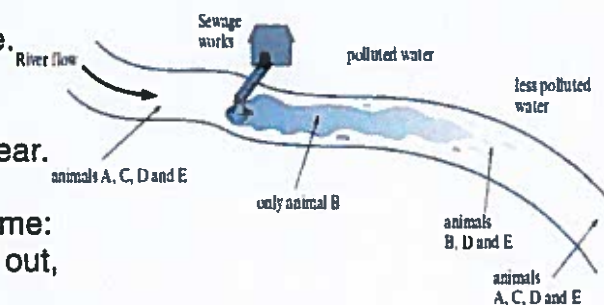
Everything else should stay the same.

Example of an annual survey

- The independent variable is the year.

The variables that should stay the same:

- Time of year the survey is carried out,
- Same locations sampled,
- Time of day the survey is carried out,
- Volume of water sampled,
- Method of sampling,
- Same water conditions, e.g. temperature, flow rate, turbidity.



Measuring Air Pollution

Lichen can be used as indicator species for air pollution. Lichens are sensitive to **sulphur dioxide** gas (produced from burning fossil fuels). Some species are so sensitive that a very low concentration of the gas will kill them. Lichen found growing on trees or rocks could be used to indicate the concentration of sulphur dioxide in the air.



Zone	Description	Sulphur dioxide content of the air (ug/m ³)
0		High sulphur dioxide concentration Low sulphur dioxide concentration
1		
2		
3		
4		
5		
6		
	Clean Air	

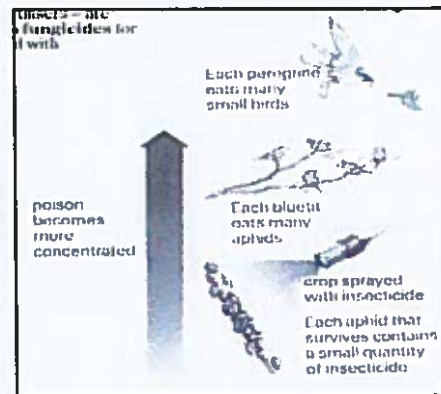
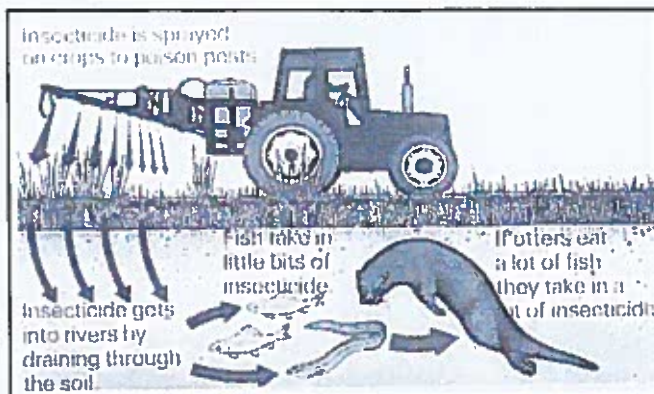
Note, some of the species found in more polluted air can also be found in purer air. Always look for the lichen giving the *highest* zone reading on the scale.

Pesticides in Food Chains

These are chemicals that farmers use to control pests and diseases on crop plants.

- **Insecticides** kill insect pests feeding on plants.
- **Herbicides** (weed killers) reduce competition for water and light between pest plants and crops.
- **Fungicides** kill fungi that cause plant diseases.

Environmental Effects of Pesticides - Bioaccumulation



Pesticides can be sprayed on crops. Pesticides from crops may be washed into lakes, rivers and natural underground water stores and so contaminate drinking water.

Some chemicals are not broken down by the cells of living organisms and therefore enter the food chain. The further along a food chain an organism is, the more chemicals accumulate in its tissues. The scientific name for this is **bioaccumulation**. The organism at the end of a food chain will receive a **toxic dose** that has harmful effects, e.g. **reducing fertility or death**.

DDT – A Case Study for Bioaccumulation

Between 1960 and 1970 seeds were often treated with pesticides, such as DDT to try and stop insects from eating them.

Before long, the numbers of birds of prey, such as the Sparrowhawk were decreasing. Many were found dead with high levels of pesticides in their bodies.

Scientific evidence has shown that DDT stays in the environment for a long time.

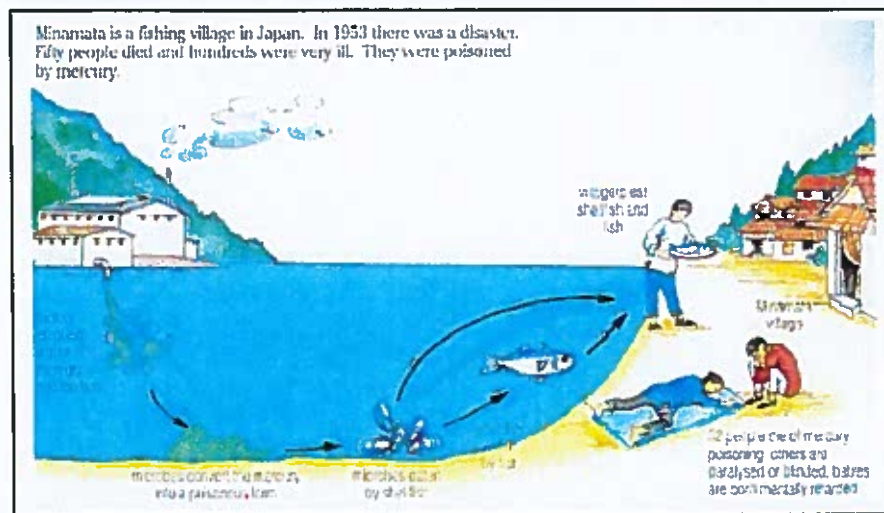
DDT has been banned in the USA since 1972 and in the UK since 1984.

Heavy Metals in Food Chains

In the year 2000 new laws were passed to reduce the level of pollution by industry.

Many industries (**oil refineries, chemical works, steel plants and paper mills**) used to release chemicals into rivers and the sea. These chemicals included **heavy metals** such as **lead, mercury, cadmium and tin**.

A well-known case of industrial pollution is the tragedy of Minamata, a fishing village in Japan.



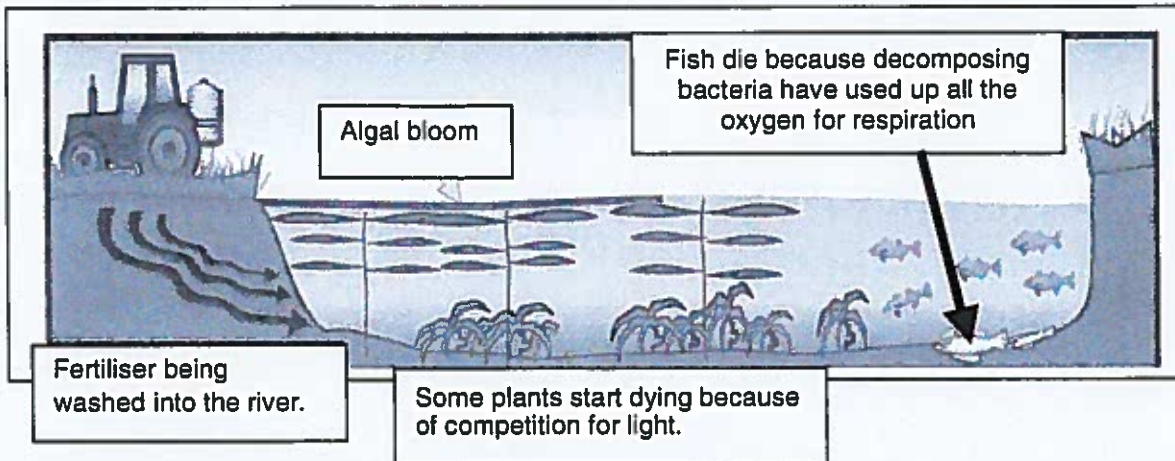
52 people died from mercury poisoning. Others were paralysed and babies were born with brain damage. Mercury affects the nervous system.

Explanation

- A plastics factory released mercury compounds into the sea.
- Plant plankton (microscopic plants) absorbed mercury.
- Animal plankton (microscopic animals) ate a lot of the plant plankton, and mercury built up inside them.
- Fish ate a lot of the animal plankton. Because they could not excrete the mercury (get rid of it from their bodies), the concentration increased inside them.
- When people ate a lot of the fish they received a very high concentration of mercury.
- This toxic or poisonous dose was enough to kill them or make them very ill.

Effect of Fertilisers and Sewage on the Environment

Fertilisers contain the minerals that crop plants need to grow, e.g. **nitrates** and **phosphates**. Chemical fertilisers are important in intensive farming, but they must be used carefully especially near streams, rivers and ponds.



Explanation – (QWC question model answer)

- Fertilisers containing nitrates and phosphates are washed into streams, rivers, ponds and the sea.
- Nitrates and phosphates cause an increase in the growth of water plants or algal blooms.
- Some plants start dying because there is increased competition for light.
- Decomposing bacteria decompose (rot) the dead plants.
- The number of decomposing bacteria increases.
- The decomposing bacteria use up the oxygen in the water for respiration.
- There is less oxygen in the water.
- Animals, such as fish, die because there is not enough oxygen in the water.



What about sewage?

- Untreated sewage causes an increase in the growth of water plants. (It has the same effect as fertilisers).
- Bacteria in the water also feed on untreated sewage, using up the oxygen in the water for respiration.

the 1990s, the number of people in the world who are illiterate has increased from 1.1 billion to 1.5 billion (UNESCO 2003).

There are a number of reasons for this increase. One of the main reasons is that the population of the world is growing rapidly. In 1990, the world population was 5.3 billion. In 2000, it was 6.1 billion. In 2010, it is expected to be 7.1 billion (UNESCO 2003).

Another reason is that the number of people who are illiterate is increasing in many developing countries. This is because of a number of factors, including a lack of access to education, a lack of resources, and a lack of political will.

There are a number of ways to reduce the number of illiterate people in the world. One way is to increase access to education. This can be done by building schools, training teachers, and providing textbooks.

Another way is to provide resources to people who are illiterate. This can be done by providing literacy materials, such as books and newspapers, and by providing training in basic literacy skills.

A third way is to increase political will. This can be done by educating the public about the importance of literacy and by encouraging governments to invest in literacy programs.

There are a number of challenges to reducing the number of illiterate people in the world. One challenge is that there are a large number of people who are illiterate in many developing countries.

Another challenge is that there are a number of factors that are making it difficult to reduce the number of illiterate people, such as a lack of resources and a lack of political will.

There are a number of ways to overcome these challenges. One way is to increase access to education. This can be done by building schools, training teachers, and providing textbooks.

Another way is to provide resources to people who are illiterate. This can be done by providing literacy materials, such as books and newspapers, and by providing training in basic literacy skills.

A third way is to increase political will. This can be done by educating the public about the importance of literacy and by encouraging governments to invest in literacy programs.

There are a number of ways to measure the success of literacy programs. One way is to measure the number of people who are literate. This can be done by conducting literacy surveys.

Another way is to measure the number of people who are able to read and write. This can be done by testing people on their literacy skills.