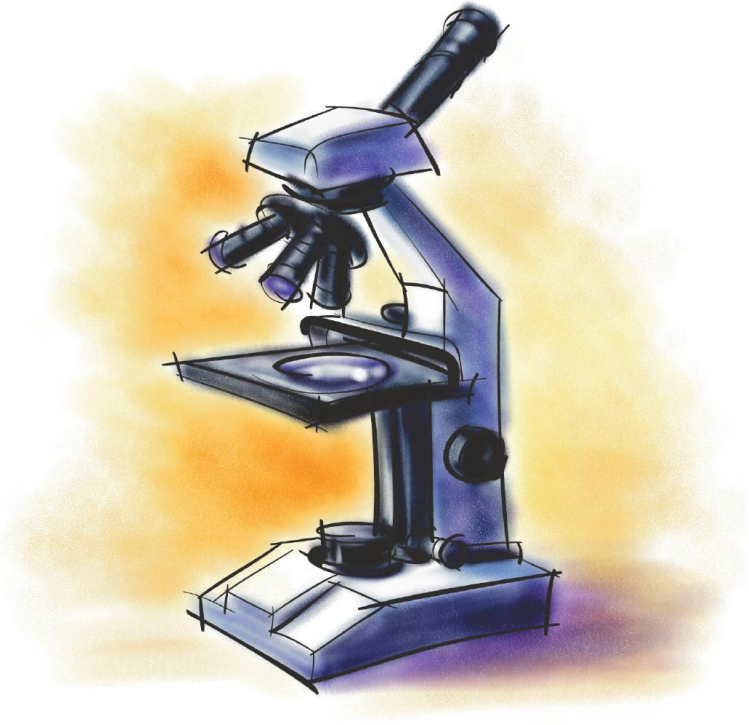
JC Biology Revision

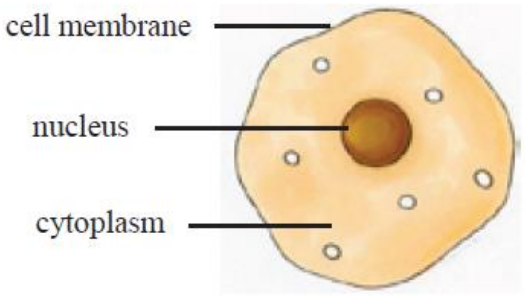


Biology - Living Things

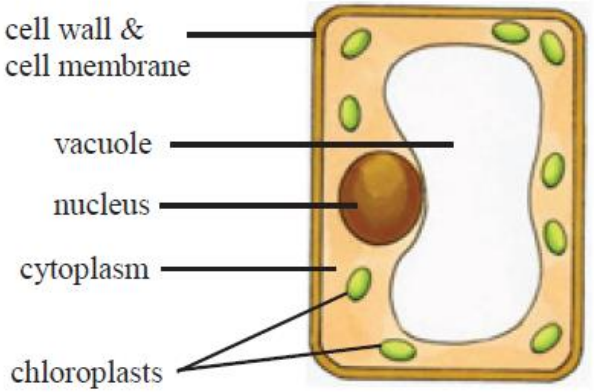
- The **7 characteristics** of living things are: **Movement**, **Respiration**, **Sensitivity**, **Feeding**, **Excretion**, **Reproduction** and **Growth**.
- **Respiration** is the release of **energy** from our food.
- The **Animal Kingdom** is divided into 2 main groups: the **Invertebrates** (no backbone); and the **Vertebrates** (animals with a backbone).
- Green **plants** make their own food by photosynthesis. They use a green chemical called chlorophyll.
- **Animals** are consumers - they can only consume food.
- A **key** is a **set of questions** used to identify an animal or plant.

Animal and Plant Cells

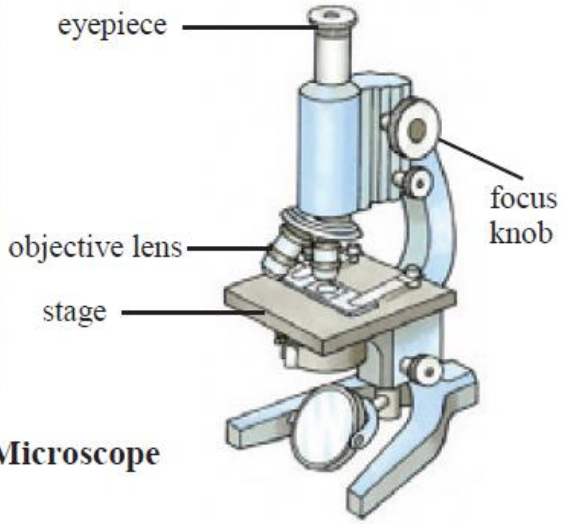
- All cells have a **cell membrane**, **cytoplasm**, **nucleus**, and **small vacuoles**.
- Plant cells also have **chloroplasts**, a **cell wall**, and a **large central vacuole**.
- The microscope has 4 main parts; the **eyepiece**, the **stage**, the **objective lens** and the **focus knob**.



Animal Cell



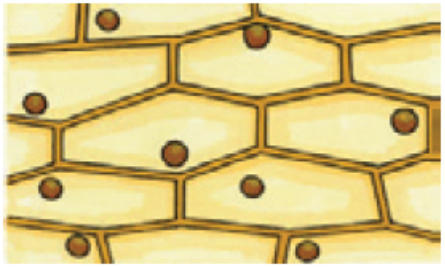
Plant Cell



Microscope

- A **tissue** is a group of similar cells with a special function.
- An **organ** is a group of different tissues that work together to carry out a special function.
- A **system** is a group of organs working together.
- **Growth** results from cells dividing.

Plant cells seen under high power



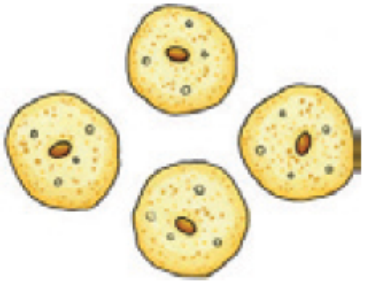
EXPERIMENTS:

2.1 Using the Microscope

2.2 To Examine Plant Cells
Plant cells are stained with **iodine**.

2.3 To Examine Animal Cells
Stain with **methylene blue**.

Animal cells seen under high power



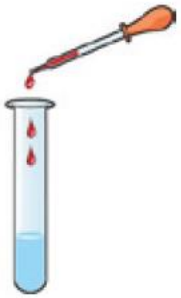
Food

- Food is needed for **energy**, **growth**, **repair** and **protection** against disease.
- The 5 major nutrients are: **Carbohydrates**, **Fats**, **Proteins**, **Vitamins** and **Minerals**.
- A **balanced diet** has 6 constituents: carbohydrates (including fibre), fats, proteins, vitamins, minerals and water.
- **Vitamin C**, found in **citrus fruits**, is for **healthy skin and gums**.
- **Vitamin D**, found in **milk**, yogurt and cheese, is for strong, **healthy bones**.
- The mineral **calcium**, found in **milk** and cheese, is for **healthy bones**.
- The mineral **iron**, found in **liver** and cabbage, is used to make **red blood cells**.
- A **balanced diet** is one that contains the **right amounts** of all the nutrients needed to stay healthy.
- A **food pyramid** shows **how much** of each food type is needed for a healthy diet.

EXPERIMENTS:

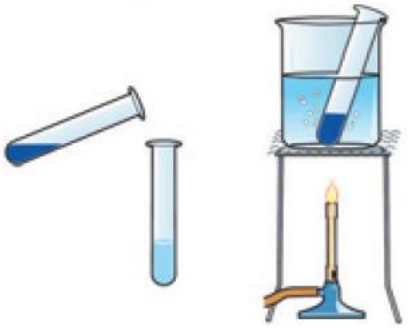
3.2 To Test for the Presence of Starch

Starch is tested for by adding **iodine** solution to it.
If starch is present, it turns **blue-black** in colour.



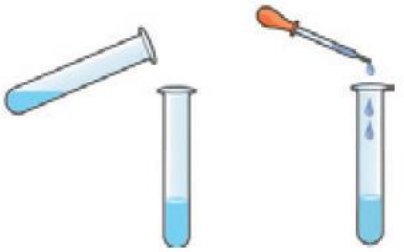
3.3 To Test for the Presence of Glucose - a Reducing Sugar

Glucose is tested for by adding **Benedict's solution**, and **heating**.
It turns a **brick red** colour.



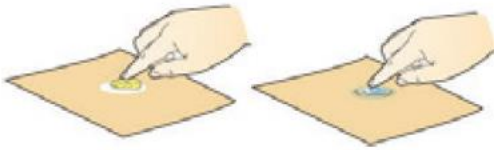
3.4 To Test for the Presence of Protein (the Biuret Test)

Protein is tested for by adding **copper sulfate** to protein with **sodium hydroxide** added.
It turns a **violet** colour.



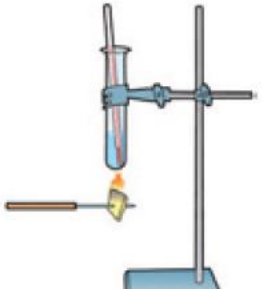
3.5 To Test for the Presence of Fats (the Brown Paper Test)

Fats are tested for by rubbing them on **brown paper**.
A **translucent spot** appears.



3.6 To Investigate the Conversion of Chemical Energy in Food to Heat Energy

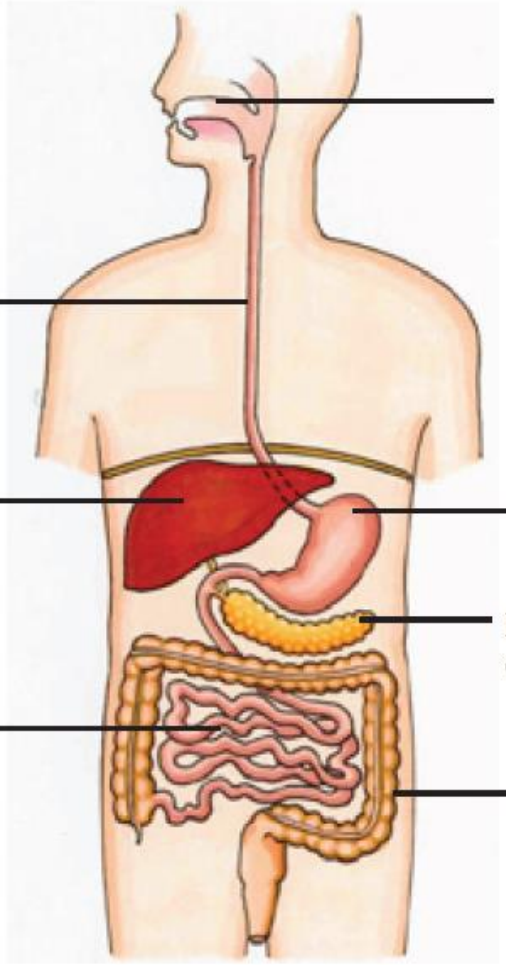
Food is burned and the **heat energy** released is used to raise the temperature of water in a test tube.



The Digestive System

- The **digestive system** is a group of organs working together to **break down** food into **tiny molecules**.

The Digestive System



Mouth: amylase breaks down starch here

Oesophagus: a tube that carries food to the stomach

Liver: makes bile which helps to break down fats

Stomach: stores the food and mixes it with digestive juices

Pancreas: makes more digestive enzymes

Small intestine: after final breakdown by enzymes, food molecules are absorbed into the bloodstream from here

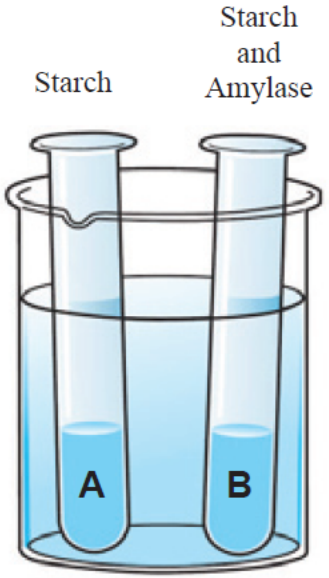
Large intestine: passes water back into the blood, leaving wastes

- The **5 stages** of nutrition are: **Ingestion**; **Digestion**; **Absorption**; **Assimilation**; **Egestion**.
- **Physical digestion** involves chewing the food into smaller pieces in the mouth.
- There are **4 types** of teeth: **Incisors**; **Canines**; **Premolars**; **Molars**.
- **Chemical digestion** involves the use of chemicals, called **enzymes**, to **chemically break down** the food.
- An **enzyme** is a chemical, made in a living cell, which can **speed up** a **chemical reaction**, without itself being changed.
- An **enzyme** acts on its **substrate** and breaks it down into the **product**.
- **Starch** is broken down by the enzyme **amylase** into the sugar **maltose**.

EXPERIMENT:

4.1 To Show the Action of Amylase on Starch

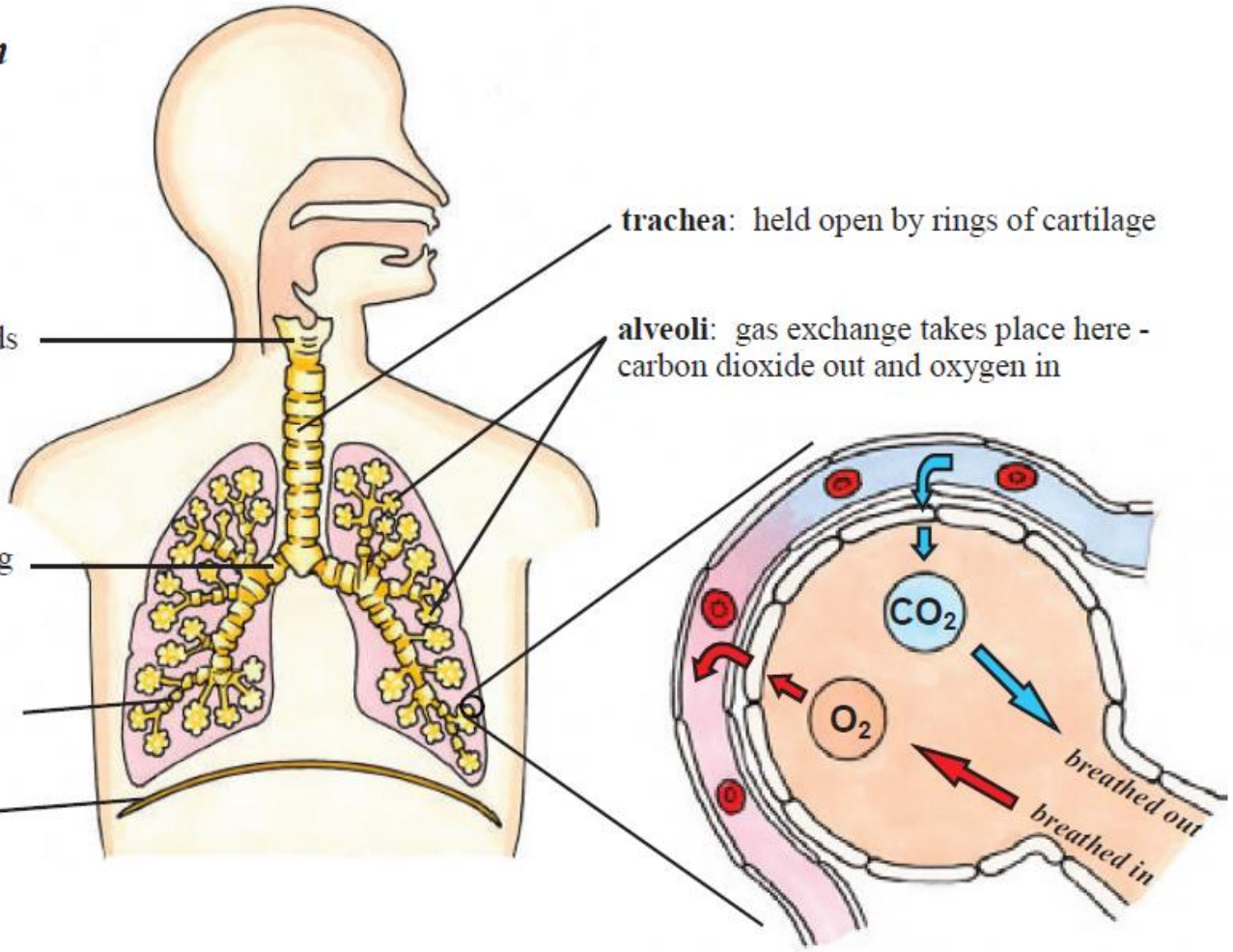
Two test tubes, **A** (**containing starch**) and **B** (**containing starch and amylase**) are heated. The contents of each test tube are tested for the presence of (i) **starch** and (ii) the **reducing sugar maltose**.
A tests **positive** for **starch**, **negative** for **maltose**.
B tests **negative** for **starch**, **positive** for **maltose**, as the amylase in **B** broke down the starch to maltose.



Respiration and Breathing

- **Respiration** is the **release of energy** from food.
- **Aerobic respiration** requires **oxygen**.
- The **word equation** for aerobic **respiration** is:
  Glucose + Oxygen ⟶ Energy + Carbon dioxide + Water Vapour.
- **Respiration** occurs in **every living cell** to produce the energy the cell needs.
- The human breathing organs are the **lungs**.
- The human breathing system consists of the **nose**, **mouth**, **trachea**, **bronchi**, **bronchioles**, **alveoli**, and **diaphragm**.

The Breathing System



- Smoking causes cancer, bronchitis and heart attacks.

EXPERIMENTS:

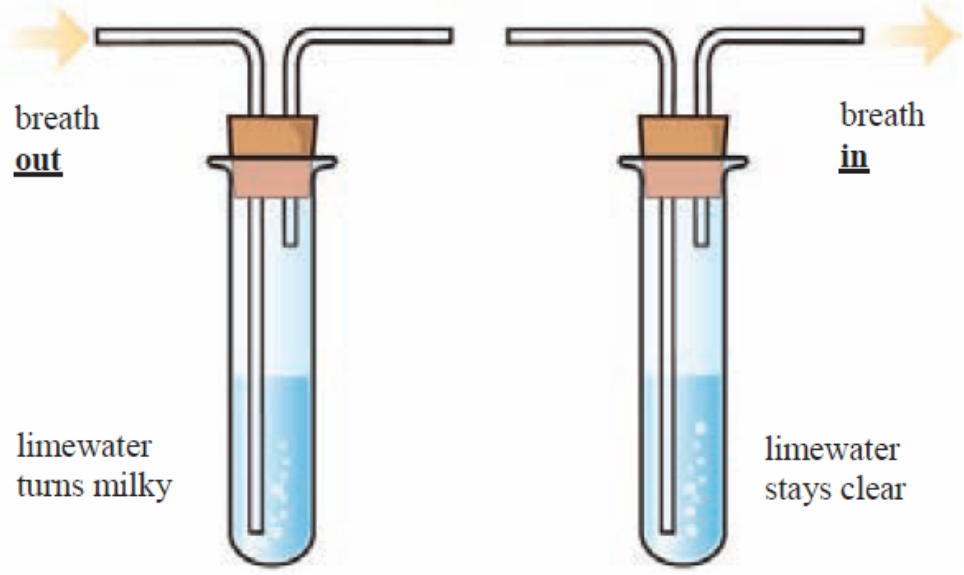
5.1 To Show that Expired Air has more Carbon Dioxide than Inspired Air

Expired air is breathed out through the **long tube** in the first test tube.

This bubbles **carbon dioxide rich air** through the **limewater**, turning it **milky** very quickly.

Inspired air is breathed in through the **short tube** in the second test tube.

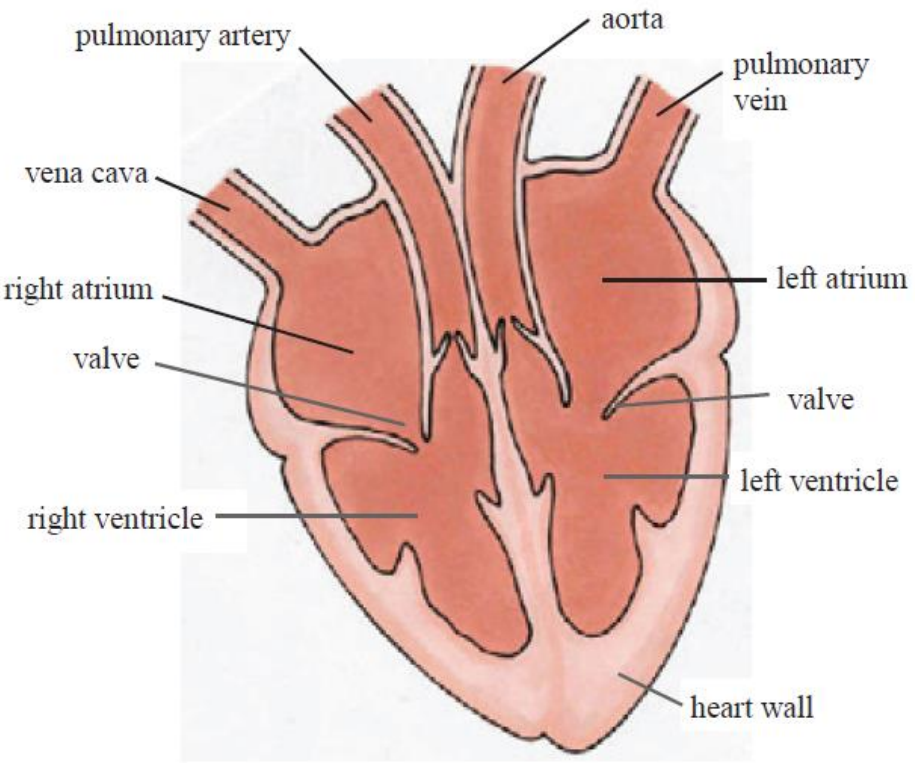
The limewater is **slower** to turn milky.



The Circulation System

- The **circulation system** consists of the **blood**, **arteries**, **veins**, **capillaries**, and the **heart**.
- Blood is made up of a watery **plasma** in which are suspended red blood cells, white blood cells, and platelets.
- **Red blood cells** contain the chemical **haemoglobin** which carries **oxygen**.
- **White blood cells** protect the body against disease by **eating bacteria** and **making poisons** called **antibodies** to kill them.
- **Platelets** help the blood to **clot**.
- The **functions** of the blood are **transport** and **protection** against disease.
- **Transport**: **red blood cells** carry **oxygen** and the watery blood **plasma** carries dissolved substances such as **carbon dioxide** and **food molecules** around the body.
- There are **3 types** of blood vessels: **arteries**, **veins** and **capillaries**.
- **Arteries** have thick walls, a narrow lumen, no valves, and carry blood away from the heart.
- **Veins** have thin walls, a wide lumen, valves, and carry blood to the heart.
- **Capillaries** link arteries to veins. Their wall is only one cell thick and this allows substances to pass into and out of the blood.

- The **heart** is made of **cardiac muscle** - it never tires.
- There are **4 chambers** in the heart: **right** and **left atria**, and **right** and **left ventricles**.
- The **left ventricle** has a **thick wall** because it pumps blood all around the body.
- Normal **body temperature** of the human body is **37°C**.
- The average **resting pulse rate** is **70 beats per minute**.
- **Heart disease** is prevented by: regular **exercise**, a healthy **diet**, not **smoking**, and avoiding too much **stress**.



EXPERIMENTS:

6.1 To Show the Effect of Exercise on the Pulse Rate

Exercise increases the **pulse rate**.
This allows more food to the cells of the body.

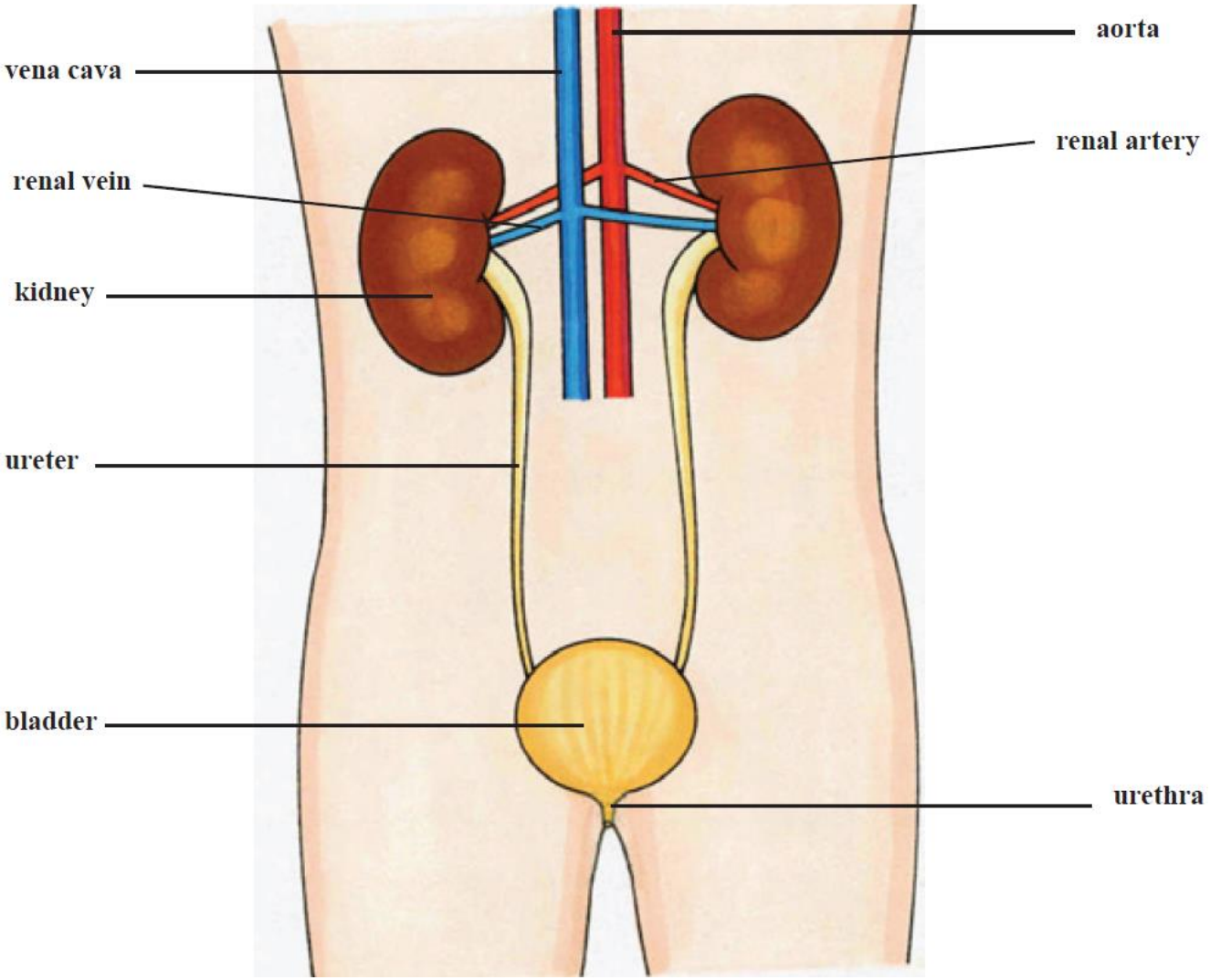
6.2 To Show the Effect of Exercise on the Breathing Rate

Exercise increases the **breathing rate**.
This allows more oxygen to the cells of the body

Excretion

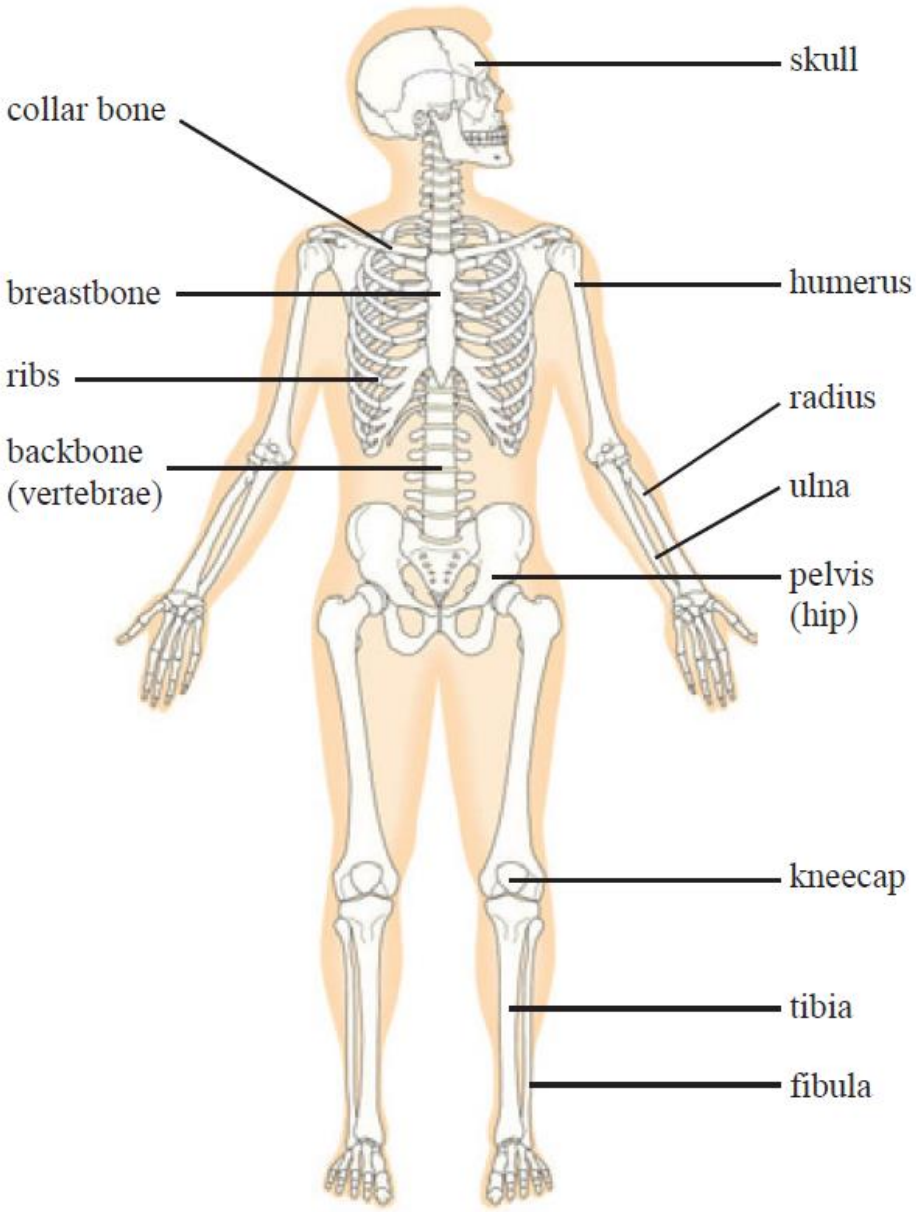
- **Excretion** is the removal of wastes made in the body.
- The three excretory organs are the **lungs**, the **skin** and the **kidneys**.
- The **lungs** excrete **carbon dioxide** and **water vapour**.
- The **skin** excretes **sweat** (water and salts).
- The **kidneys** excrete **urine** (urea, salts and water).
- Blood enters the kidney in the **renal artery** and exits in the **renal vein**.
- The kidneys **filter the wastes out of the blood**.
- The kidneys **control the amount of water in the blood**.
- The **bladder** stores urine.
- Urine passes from the kidneys, through the **ureters**, **bladder** and **urethra** to the outside.

The Urinary System

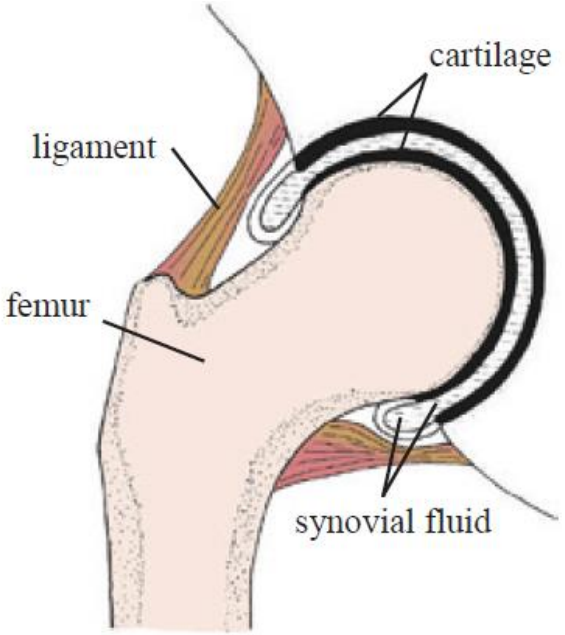


The Skeleton and Movement

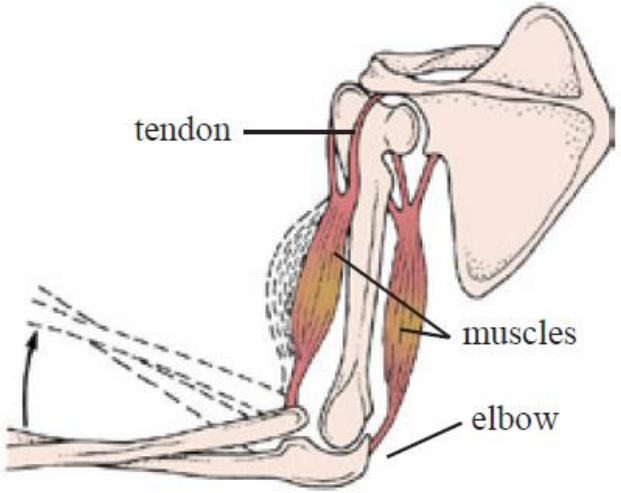
- The **functions** of the skeleton are: **Support**; **Protection**; and **Movement**.
- **Bone** consists of **cells** (the living part) and **calcium compounds** (the non-living part).
- Bones of the **arm** are the **humerus**, **radius** and **ulna**.
- Bones of the **leg** are the **femur**, **tibia** and **fibula**.
- The **spine** is made up of bones called **vertebrae**.
- A **joint** is where bones meet.
- **Fused joints** in the skull are immovable.
- **Moveable joints** contain **synovial fluid** and are called synovial joints.
- Examples of **synovial joints** are: **ball and socket joint** (e.g. hip and shoulder); **hinge joint** (e.g. knee and elbow).
- Both **cartilage** and **synovial fluid** in the joint help to **reduce friction** where bones meet.
- **Cartilage** also acts as a **shock absorber** in the joints.
- **Ligaments** join bone to bone. **Tendons** join muscle to bone.
- **Antagonistic muscles** work opposite each other (e.g. the biceps and triceps).



The human skeleton



The hip - A ball and socket joint.

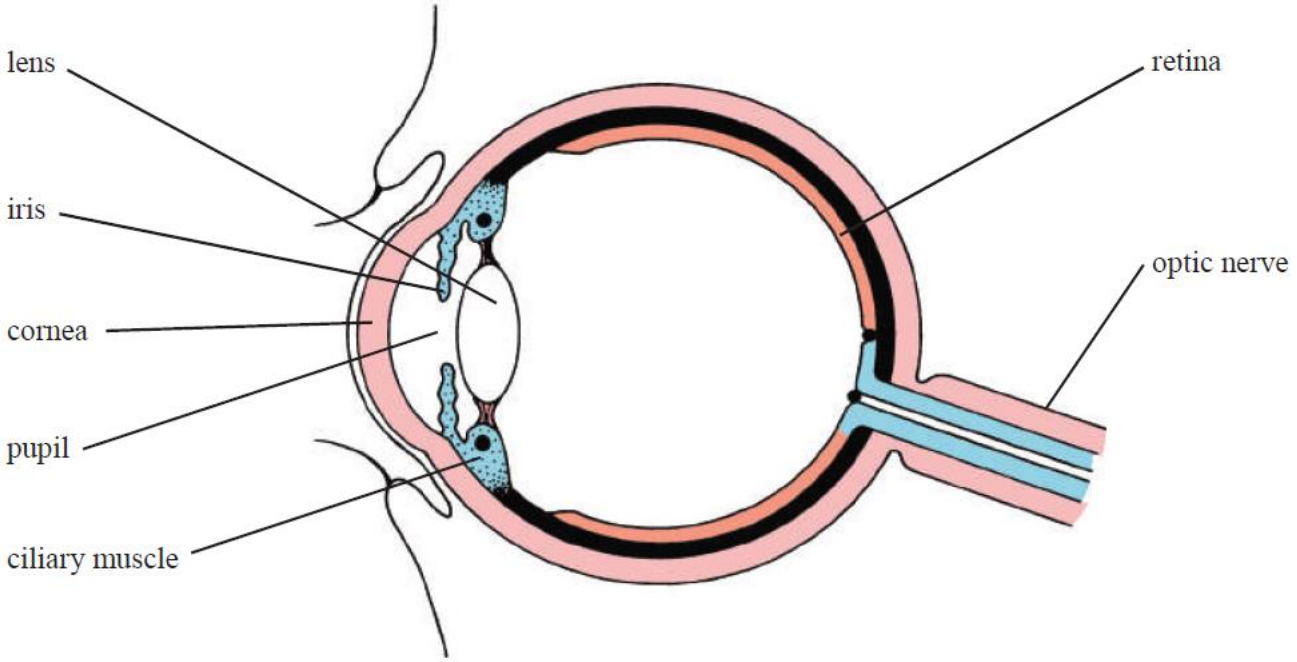


The arm showing an antagonistic muscle pair.

Senses and Nervous System

- **Sensitivity** means **detecting** and **responding** to a stimulus.
- The **sense organs**, the **eyes**, **ears**, **nose**, **tongue** and **skin** can detect stimuli.
- **Responses** to stimuli are controlled by the nervous and endocrine systems.
- The **nervous system** consists of the **brain**, **spinal cord**, and all the **nerves**.
- A **sensory nerve** sends a message **to the brain** or spinal cord from a sense organ.
- A **motor nerve** sends a message **from the brain** or spinal cord to a muscle.
- **Messages** are sent along nerves as pulses of **electricity**.

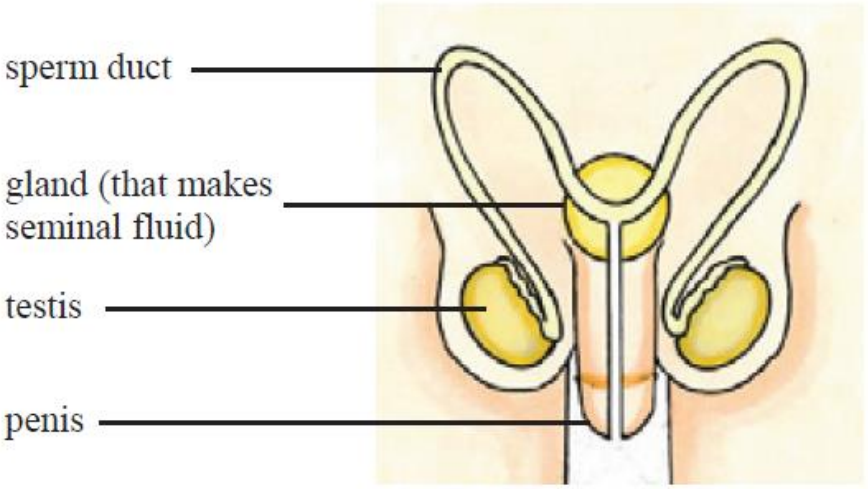
- The **eye** contains the **cornea**, **iris**, **lens**, **pupil**, **retina**, **optic nerve** and **ciliary muscle** - all of which have important functions.



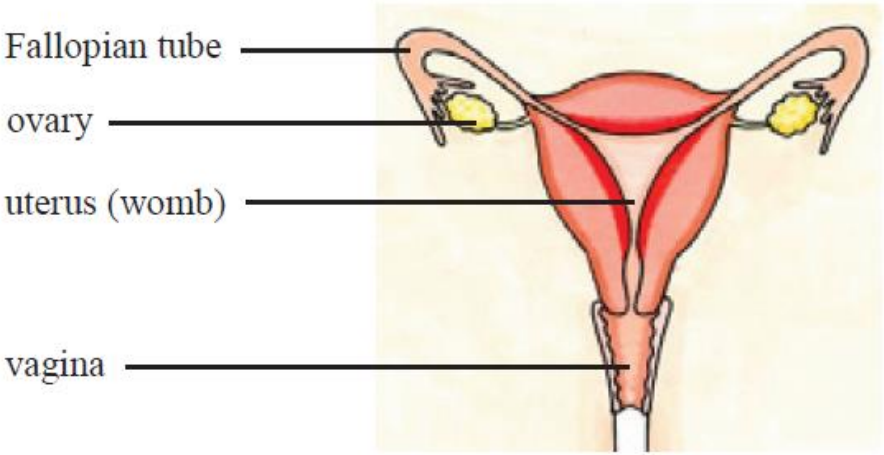
- The **lens focuses light** onto the retina at the back of the eye.
- The **iris** (the coloured part of the eye), **controls the amount of light** entering the eye.
- The **pupil** is the hole (black) that **allows light into** the eye.
- The **ciliary muscle** can **change the shape of the lens** for focusing.
- The **retina** is where the image lands - it contains cells that **can detect light and images**.
- The **optic nerve** takes the **message from the retina to the brain**.

Human Reproduction

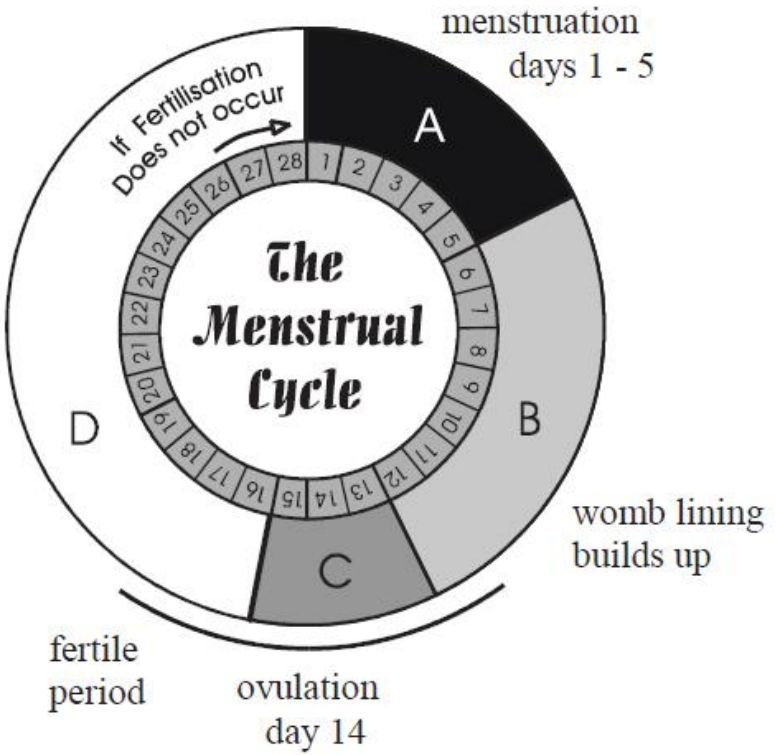
- **Sexual reproduction** involves the **fusion** of a male and female **gamete**.
- The **male gamete** is the **sperm cell**; the **female gamete** is the **egg**.
- **Sperm** cells are produced in the **testes**.
- **Egg** cells are produced in the **ovaries**.
- **Ovulation** is the **release of an egg** from an ovary on day 14 of the monthly cycle.
- **Fertilisation** is the **fusion** of the male and female gametes.
- Fertilisation occurs in the **fallopian tube**.
- **Puberty** is the time when **hormones** cause **changes** in the body.
- **Menstruation** is the **shedding** of the **lining of the uterus** (i.e. having a period).
- The **fertile period** is the time in the menstrual cycle that a woman is most likely to conceive.
- **Implantation** occurs when a **fertilised egg**, after dividing, lodges (implants) itself into the **lining of the uterus**.
- The average length of human **pregnancy** is **40 weeks**.
- The **placenta** acts as a **link** between the mother's bloodstream and that of the developing embryo.
- **Contraception** is the means by which **fertilisation is prevented**.



Male Reproductive System



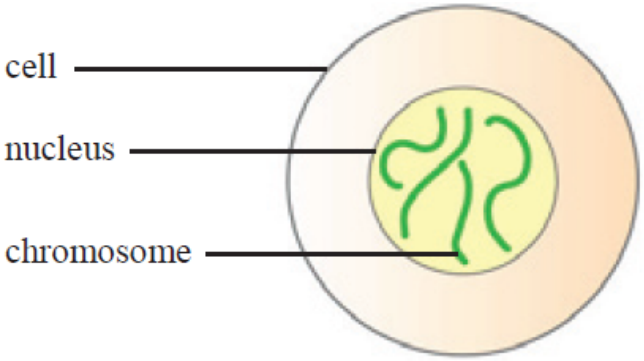
Female Reproductive System

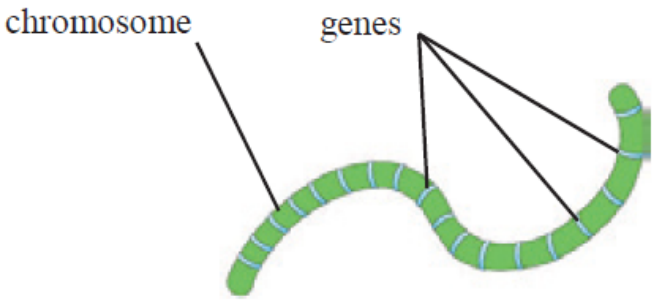


The Menstrual Cycle

Genetics

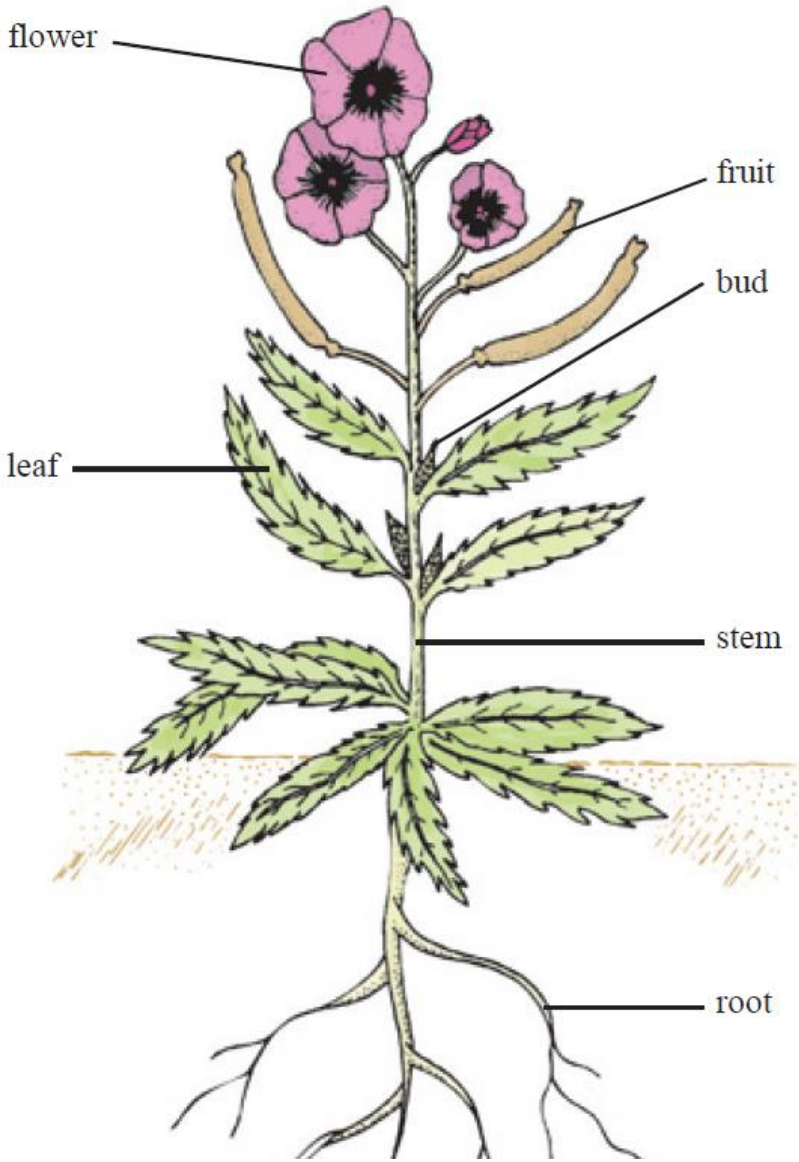
- **Genetics** is the study of the **inheritance** of characteristics.
- **Inherited characteristics** include:
  type of ear lobe, eye colour, shape of nose etc.
- **Non-inherited characteristics** have been gained during a person's lifetime e.g. ability to ride a bicycle, fitness, ability to speak French etc.
- **Chromosomes** are thread-like structures found in the nucleus of a cell.
- **Chromosomes** are made of **DNA** and **protein**.
- Human body cells contain **23 pairs** of chromosomes.
- **Genes** are **chemicals** found on **chromosomes** that carry information.





Plant Structure

- **Flowering plants** consist of a **shoot** and a **root**.
- The **shoot** consists of the stem, leaves, buds and flowers.
- The **root anchors** the plant, **absorbs** water and minerals from the soil, and **stores** food made in the leaves.
- The **stem supports** the leaves and flowers and allows for the **transport** of materials up and down the plant.
- The **leaf makes** food, **loses** water vapour, and **exchanges** the gases **carbon dioxide** and **oxygen** with the air.
- The **flower** is for **reproduction**, it forms the **seeds**.
- **Plants** are **identified** by their **flowers** and **leaves**.



Transport in Plants

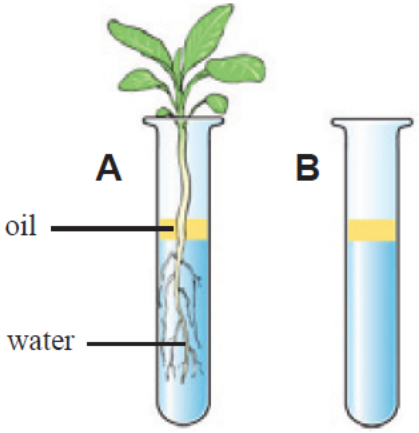
- **Water** is absorbed through the **roots** of a plant.
- **Water** and **minerals** move up through the plant in the **xylem vessels**.
- **Transpiration** is the loss of water vapour from the leaves of a plant.
- Water leaves the plant through the **stomata** of the leaf.
- The **flow** of water through a plant is called the **transpiration stream**.
- **Transpiration** provides **water** for **photosynthesis**, **carries minerals** in the water, and **cools** the plant.
- **Food** is transported from the leaves to the rest of the plant in the **phloem**.

EXPERIMENTS:

14.1 To Show the Absorption of Water by the Roots

A **plant** is placed in a test tube containing **water** and an **oil layer** (to **prevent** water **evaporation**) as shown. The second test tube has no plant and acts as the **control**.

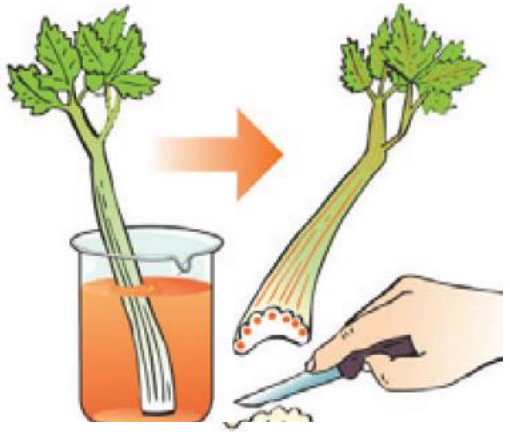
After a week, the water level drops in **A** but not in **B**. **Water was absorbed by the roots in test tube A**.



14.2 To Show the Movement of Water in Plants

A plant stem (e.g. celery) is placed in a beaker of **coloured water** for a week.

The stem is then cut and the coloured dye is seen in the bundles of xylem vessels in the stem. This shows that **water travels in the xylem vessels up the stem**.

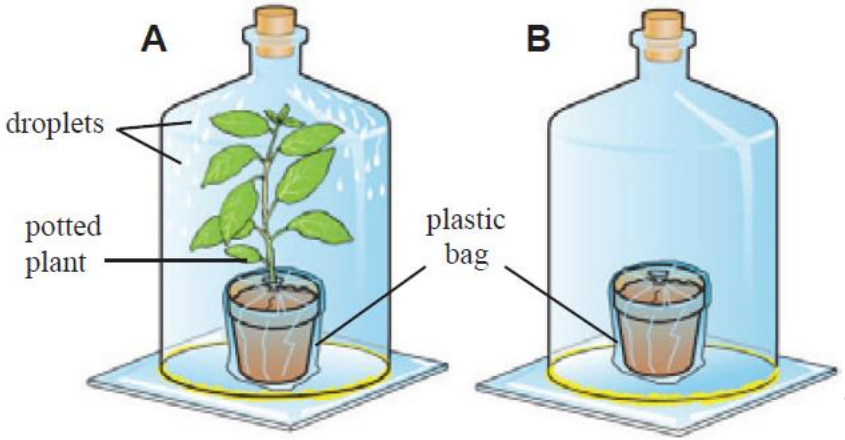


14.4 To Demonstrate Transpiration

A **potted plant**, with the pot sealed in a **plastic bag** is placed in a bell jar as shown. The plastic bag prevents evaporation of water from the pot. Bell jar **B** is set up in the same way, but with no plant - it is the **control**.

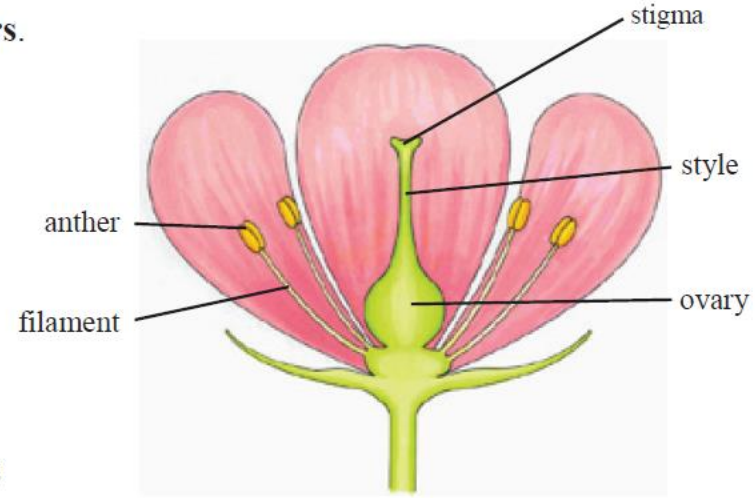
After a few hours, **droplets of water** are seen inside bell jar **A**, but not **B**.

Transpiration has occurred in **A** as water evaporated from the leaves.



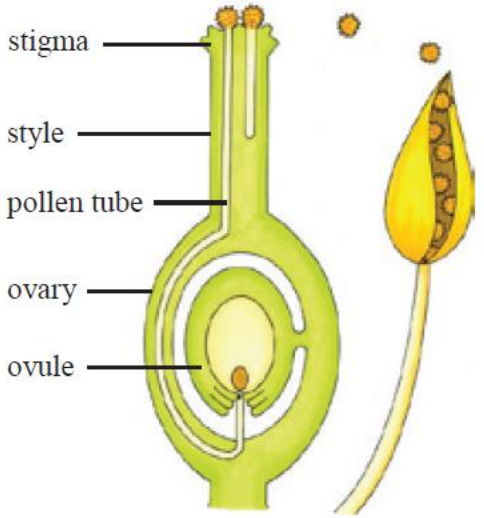
Plant Reproduction

- **Plants reproduce sexually** by means of **flowers**.
- The **male part**, or **stamen**, consists of the **anther** and **filament**.
- The **female part**, or **carpel**, consists of the **stigma**, **style** and **ovary**.
- **Pollen** is made in the **anther** of the **stamen**.
- The **egg** is made in the **ovary** of the **carpel**.
- Reproduction involves **5 stages**: 1. **Pollination**; 2. **Fertilisation**; 3. **Seed and fruit formation**; 4. **Seed dispersal**; 5. **Germination**.



The Structure of a Flower

- **Pollination** is the **transfer of pollen** from anther to stigma.
- Plants are pollinated by either **insects** or **wind**.
- **Fertilisation** is the **fusion** of the **pollen nucleus** with the **egg nucleus**.
- A **seed** is a **fertilised ovule**.
- The **ovary wall** becomes the **fruit**.
- Seeds are **dispersed** to avoid competition.
- Seeds are **dispersed** by **animal**, **wind**, **self-dispersal**, or **water**.
- **Germination** is the growth of a **seed** into a **new plant**.
- **Water**, **oxygen** and **heat** are needed for **germination**.
- **Asexual reproduction** involves only **one parent**.



Pollination and Fertilisation

EXPERIMENT:

16.1 To Show that Water, Oxygen and Heat are Needed for Germination

Four test tubes, with **cress seeds** are set up as follows:

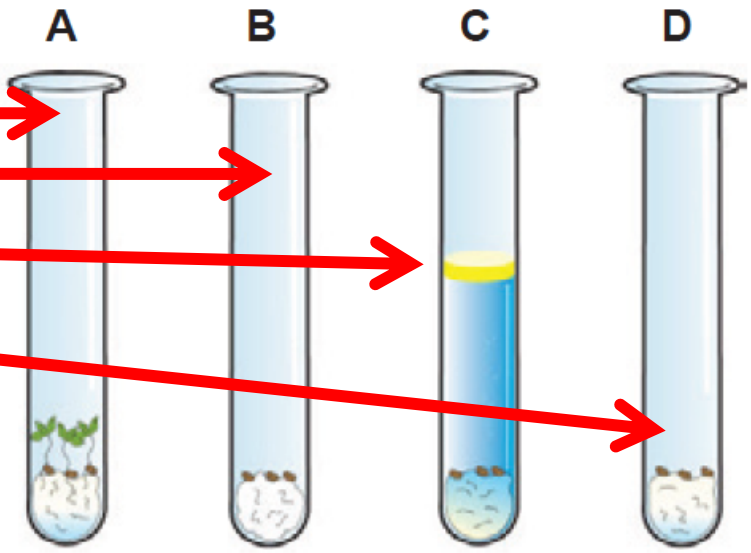
A: **Control** - water, oxygen and heat.

B: No **water** - dry cotton wool.

C: No **oxygen** - boiled water + layer of oil.

D: No **heat** - left in a fridge.

After one week, **only** the seeds in tube **A** will have germinated - only they have the **water** **oxygen** and **heat** needed for germination.



Photosynthesis

- **Photosynthesis** is the process by which **green plants make food**.
- **Chlorophyll** is the green chemical needed for photosynthesis.
- Chlorophyll is found in the **chloroplasts** of plant cells.
- **Photosynthesis** is carried out in all the green (chlorophyll-containing) parts of the plant - especially the leaves.
- **Chlorophyll traps light's energy** and uses it to combine **carbon dioxide** and **water**, to form **glucose** and **oxygen**.
- **Glucose** travels around the plant in special cells called **phloem**.
- **Leaves** are specially designed for photosynthesis. They are flat and thin, have air spaces between the cells and tiny pores on their surface called **stomata**.
- **Carbon dioxide**, **water**, **light** and **chlorophyll** are needed for photosynthesis to occur.
- **Carbon dioxide** enters the leaf from the **air**, **water** is absorbed from the soil through the **roots**.
- The word equation for photosynthesis is:

Carbon dioxide + Water $\xrightarrow[\text{chlorophyll}]{\text{light}}$ **Glucose + Oxygen**

EXPERIMENT:

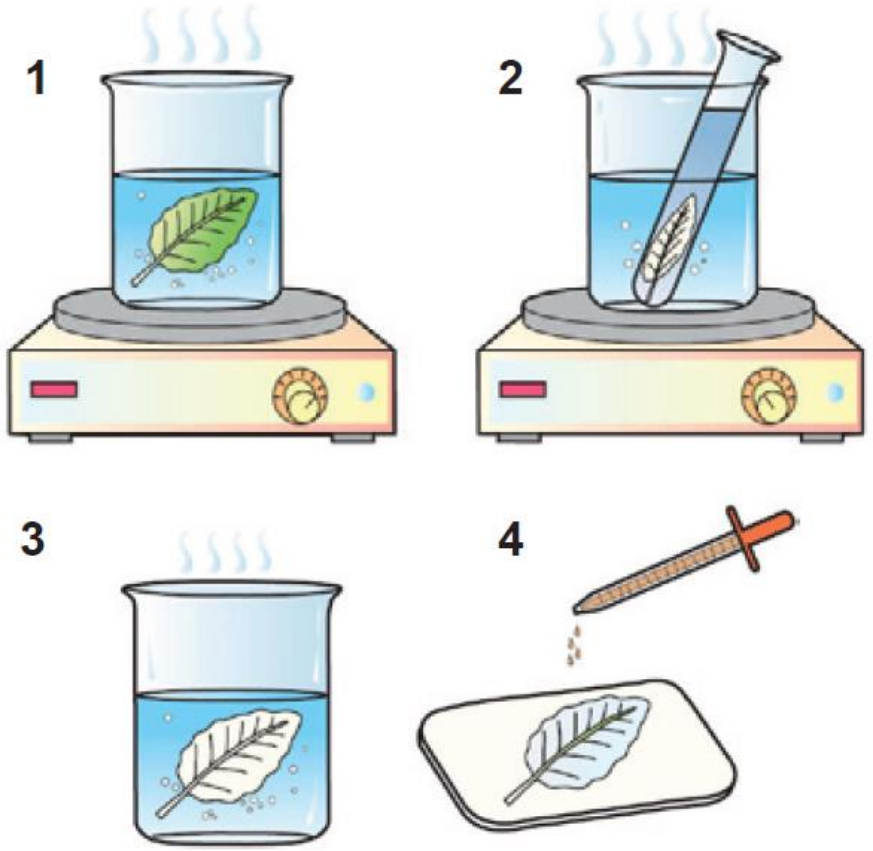
13.1 To Test a Leaf for Starch

1. **Leaf in boiling water for 1 minute.**
   (To kill cells and soften leaf).

2. **Leaf in hot methylated spirit or alcohol.**
   (To remove chlorophyll from the leaf).

3. **Leaf rinsed in hot water.**
   (To soften it).

4. **Leaf placed on white tile and iodine added.**
   (To test the leaf for the presence of starch - if starch is present, leaf turns black).



Testing a leaf for starch

Sensitivity in Plants

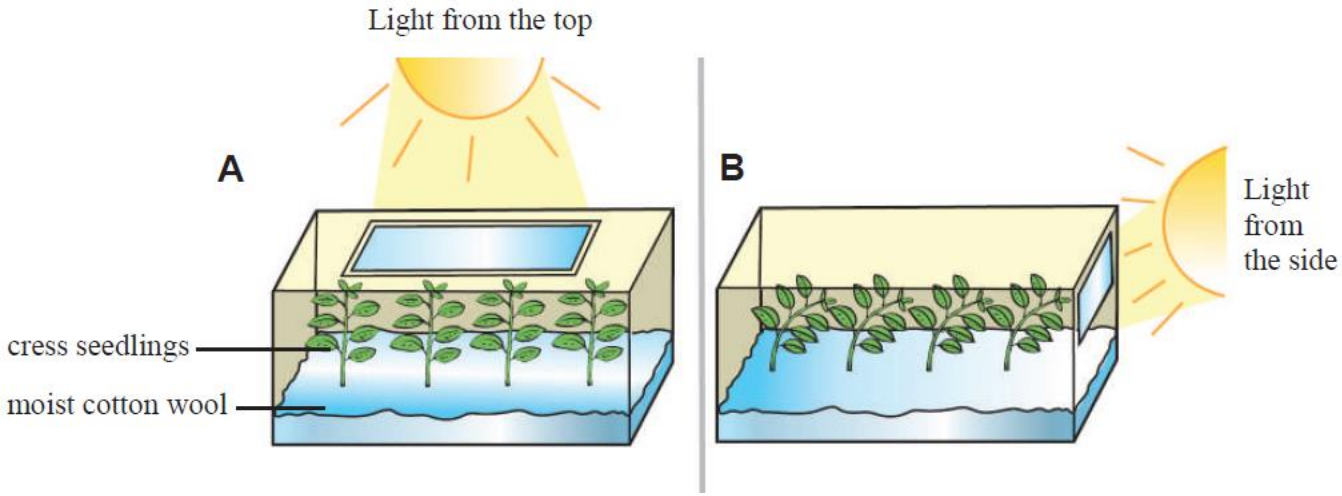
- A **tropism** is the growth of a plant in **response** to a **stimulus**.
- **Phototropism** is a plant's growth response to **light**.
- Plant stems grow towards the light.
- **Geotropism** is a plant's growth response to **gravity**.
- Plant roots grow towards the source of gravity.

EXPERIMENTS:

15.1 To Show Phototropism in Plants

Cress seeds are placed on **moist cotton wool** in boxes with light entering from the **top** (**A**), and light entering from the **side** (**B**).

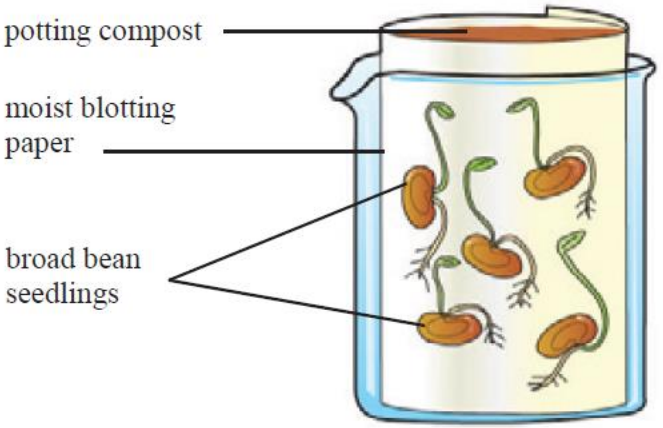
After a **week**, the seedlings are seen to grow **towards the light**.
This experiment demonstrates **phototropism**.



15.2 To Show Geotropism in plants

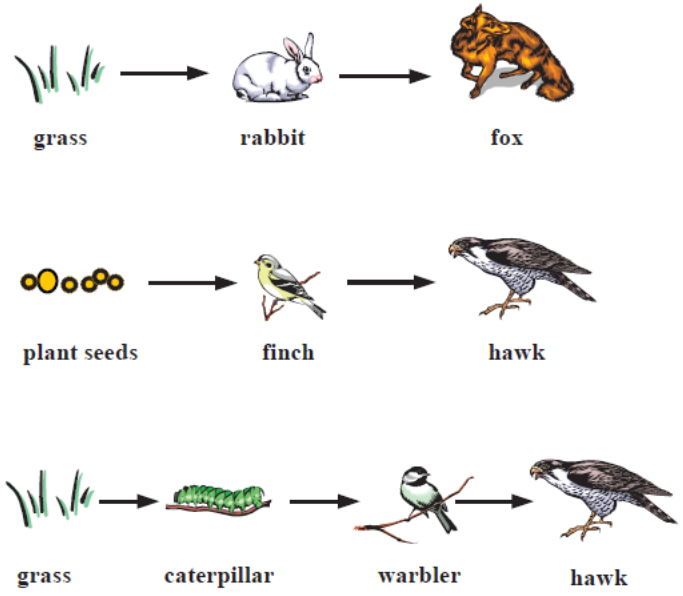
Soaked **broad bean seeds** are placed at different angles in a beaker containing **potting compost** and **moist blotting paper** as shown.

After a week, the young roots are all seen to grow **downwards**.
This experiment demonstrates **geotropism**.

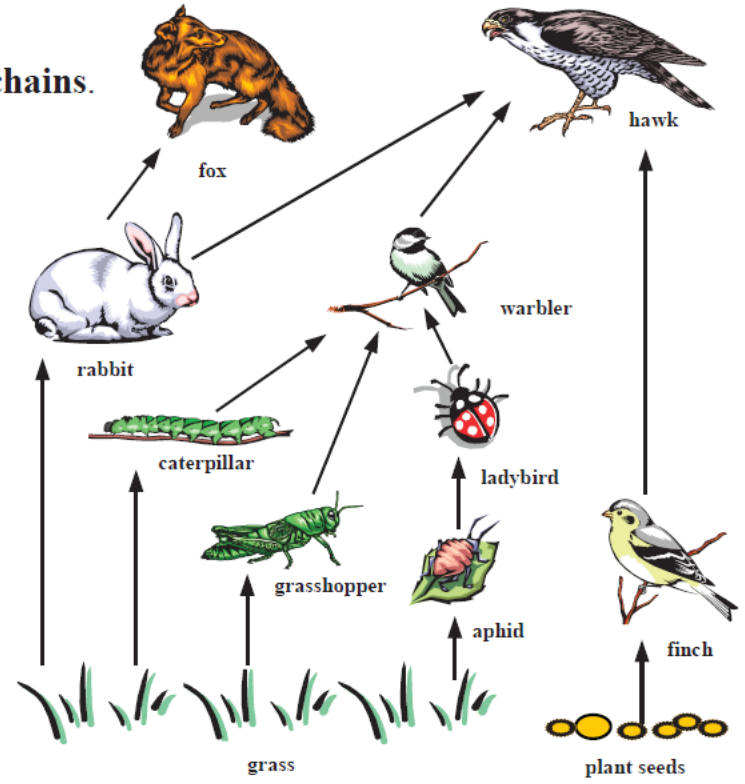


Ecology

- **Ecology** is the study of the **relationships** of living things, both with their **environment**, and with **one another**.
- The **environment** is everything that surrounds an organism.
- The **habitat** is the place where an animal or plant **lives**.
- Each **habitat** has its own **community** of **animals** and **plants**.
- A **food chain** shows how organisms are **linked** by what they eat.
- **Every food chain** must start with a **green plant**.
- A **food web** is a number of **interconnected food chains**.



3 Food Chains from a Woodland Habitat

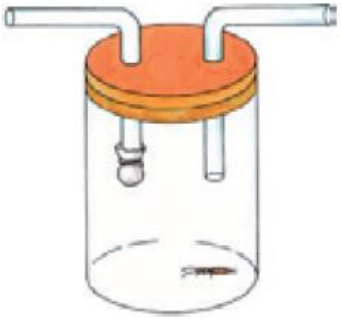


A Food Web from a Woodland Habitat

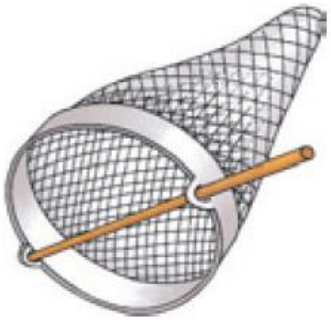
- **Energy** from the **Sun** gets **transferred** through a food chain.
- **Producers** make their **own food** (e.g. green plants).
- **Consumers** are all organisms other than green plants.
- **Decomposers** are organisms that feed on **dead animals** and **plants**.
- The **feeding level** is the **position** an organism has in the food chain.
- **Green plants** are at the **first** feeding level.
- **Competition** occurs when organisms seek a **resource** in the habitat that is **limited**.
- **Plants** compete for **light**, **water**, **minerals** and **space**.
- **Animals** compete for **food**, **shelter**, **territory** and **mates**.
- **Interdependence** is how organisms depend on each other for their survival.
- **Organisms** are **adapted** to their environment so that they can **compete successfully**.

Habitat Study

- **Examples** of **habitats** include: **woodland** habitat, **pond** habitat, **hedgerow** habitat.
- A habitat study involves **5 stages**. They are: (**1**) making a simple map; (**2**) measuring the environmental factors; (**3**) collecting samples; (**4**) identifying and listing samples; (**5**) estimating the numbers of organisms present.
- A **simple map** should include the **direction North**, a **scale** and a **legend**.
- **Air**, **water** and **soil temperatures** are taken using a **thermometer**.
- **Light intensity** in the habitat is measured using a **light meter**.
- Equipment used for **collecting animals** include a **pooter**, a **net**, a **beating tray**, and a **pitfall trap**.



A **pooter** is used to suck up insects into the collecting jar. A gauze on one tube prevents insects from being swallowed.



A **sweep net** is swept through long grass or hedges to collect insects.

A **beating tray** is used to collect small animals from trees and shrubs.

A **pitfall trap** is used to collect small, crawling animals. It is a jam-jar, dug into the ground, with a slate placed over the top.

- A **quadrat** is used to estimate **plant numbers**.
  A square frame, it is placed on the ground at random. About 10 throws are made and, for each throw, the plants present are recorded in a table.
  The **% frequency** of each plant in the habitat can then be found, and the results shown on a **bar chart**.

- A **line transect** is used to show changes in plant numbers across a boundary in the habitat.

- **Plants and animals** in the habitat may be identified by using simple **keys**.
  A **key** is a set of simple **questions** which are asked about the organism you are trying to identify.
  Your answer leads you to **another question** and so on, until you have made an identification.

A **quadrat** is used to estimate the numbers of plants (% frequency) in the habitat.

Conservation and Pollution

- **Conservation** is the **protection**, **preservation** and **careful use** of our **natural resources**.
- **Pollution** is adding **unwanted wastes** to the environment, causing **damage** to it.
- **Air pollution** is caused by **smoke**, **dust** and **harmful gases**.
- When a **fossil fuel** is **burned**, the gases **carbon dioxide** and **sulfur dioxide** are released. They dissolve in rainwater to form **acid rain**.
- **Acid rain** damages **plants**, kills **fish** and eats away the **stonework** of buildings.
- Increasing levels of **carbon dioxide** cause the **'Greenhouse effect'**.
- **Soil pollution** is caused by **pesticides**, **fertilisers** and **acid rain**.
- **Water pollution** is caused by **fertilisers**, **sewage**, **slurry** and **oil**.

The effect of acid rain on a statue.

- **Waste management** involves the careful use of **incineration**, **landfill sites**, and **burial at sea**, so as not to harm the environment.
- Materials such as **paper**, **glass**, some **metals** and **plastics** can be **recycled**.
- Living organisms affect the environment in **positive ways** as well as in negative ways.
- **Positive ways** include using **unleaded petrol**, cars with **low exhaust emissions**, using **less plastic bags** due to the bag tax and using **smokeless coal**.

Overuse of artificial fertilisers and pesticides causes soil pollution.

'Bottle banks' allow individuals to recycle some kinds of materials

Landfill sites are commonly used to mansge wastes.

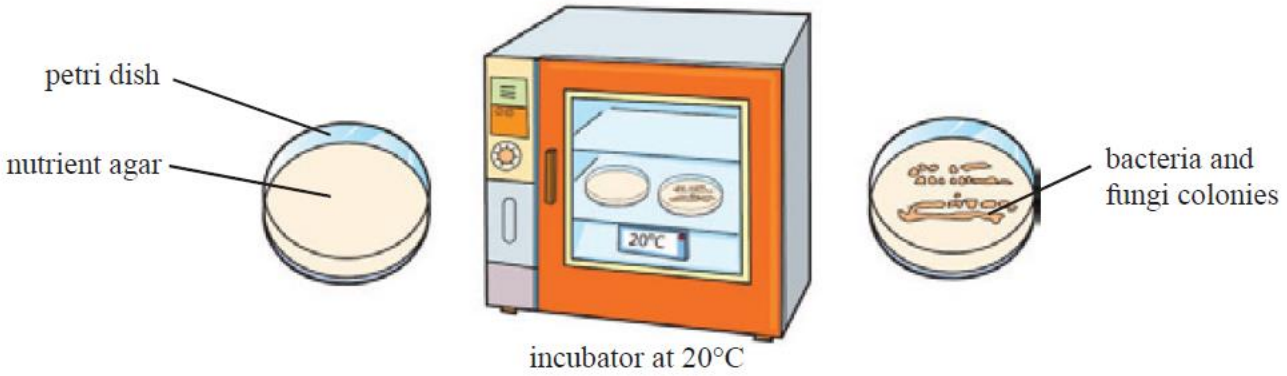
Micro-organisms

- **Microbiology** is the **study** of micro-organisms - **viruses**, **bacteria** and **fungi**.
- **Viruses** can only reproduce inside **living cells** - they all cause **disease**.
- **Viruses** cause **colds**, **'flu**, **measles**, **mumps**, and **AID's**.
- **Bacteria** are simple **living cells** and are found almost everywhere.
- **Soil bacteria** break down (**decompose**) **dead plant** and **animal** material and release their **nutrients** back to the **soil**.
- **Bacteria** are used to: **decay wastes**, and to **make cheese**, **yoghurt**, and **silage**.
- **Harmful bacteria** cause **diseases**, **food spoilage** and **tooth decay**.
- **Fungi** are used in **brewing**, **baking**, making **antibiotics**, and some are **edible**.
- **Harmful fungi** cause animal and plant **diseases**, **food spoilage** and are **poisonous**.
- **Biotechnology** is the use of **living things** (micro-organisms) to make **useful substances**.
- Examples of **biotechnology** are: using **bacteria** to make **cheese; yeast** to make **alcohol.**

EXPERIMENTS:

20.1 To Show the Presence of Micro-organisms in Air

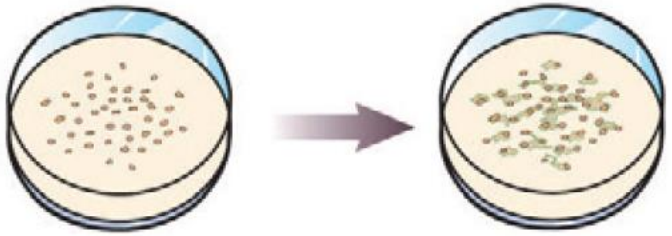
- Leave one agar dish **open to the air** for 20 minutes, replace the lid and incubate for 2 days. As a **control**, leave another **agar dish closed** and incubate as above.
- **Colonies** of bacteria and fungi are seen on the **plate left open**. The **unopened dish** remains **clear**.
- **Bacteria** and **fungi** from the **air** had landed on the agar dish and started to grow.



incubator at 20°C

20.2 To Show the Presence of Micro-organisms in Soil

- Sprinkle **fresh soil** on one agar dish and leave at room temperature for one week. As a **control**, sprinkle another dish with **sterilised soil** (strongly heated) and leave as above.
- **Colonies of bacteria and fungi** are seen on the fresh soil dish. The other dish remains clear.
- **Micro-organisms** in the **fresh soil** had grown on the agar dish.


fresh soil sprinkled on agar dish

bacteria and fungi colonies