GHANA LEBANON ISLAMIC SENIOR HIGH SCHOOL

INTEGRATED SCIENCE (BIOLOGY NOTE)

CONTENT OF NOTE

CHAPTER ONE
DIVERSITY OF LIVING THINGS

Living things differ from non-living things by seven main characteristics or life processes. These characteristics are; Movement, Respiration, Irritability, Growth, Excretion and Reproduction.

Difference between living things and non-living things

Living thing	Non-living thing
They exhibit respiration	They do not exhibit respiration
They exhibit nutrition	They do not exhibit nutrition
They respond to stimuli	They do not respond to stimuli
They exhibit excretion	They do not exhibit excretion
They can reproduce	They do not reproduce
Their body consist of cells	They lack cells

1. **Movement** is the change in position of part or whole body of an organism. Movement of the whole body from one place to another is called **locomotion**. Plants can move but they cannot exhibit locomotion. Animals move and can exhibit locomotion.
2. **Respiration** is the process by which food is broken down to release energy. They are two types of respiration. These are;
   - ✓ Aerobic respiration: involve the use of oxygen
   - ✓ Anaerobic respiration: does not use oxygen.
3. **Nutrition** is the process by which organisms obtain and use the food. The two modes(kinds) of nutrition are;
   - ✓ **Autotrophic nutrition:** it is the type of nutrition in which living organism make their own food. E.g. plants
   - ✓ **Heterotrophic nutrition:** it is the type of nutrition in which living organism depend on other organisms for their food. E.g. man.
4. **Irritability** is the ability of an organism to respond to **stimulus.**
   - ✓ **Stimulus** refers to any change in the environment of an organism which can be detected by the senses. E.g. heat, sound, touch etc.
5. **Growth** it is the increase in size and structure of an organism.
6. **Excretion** is the removal of waste products of metabolism from the body. Both plants and animals excrete.
7. **Reproduction** is the process by which organisms give rise to young ones (offspring) of their own kind. There are two forms of reproduction. These are;
   - ✓ **Sexual reproduction:** it involves the fusion of male and female gemmates.
   - ✓ **Asexual reproduction:** it involves part of the body of an organism breaking away to form an offspring.

Difference between plant and animals

plants	animals
Plants cannot exhibit locomotion. They can however move	Animals can exhibit locomotion
Plants can manufacture their own food. They are autotrophic	Animals cannot manufacture their own food. They are heterotrophic
Plants generally respond slowly to stimuli	Animals respond to stimuli faster
They do not possess special sense organs	They possess special sense organs
Excretion is slower in plants	Excretion is faster in animals
Plants exhibit unlimited growth (grow throughout their lives)	Animals exhibit limited growth (adult animals stop growing in height)

Note;

1. **Aero means Air**
2. **An means without**
3. **Auto means self**
4. **Hetero means other**
5. **Trophic means to feed**

HOMEWORK

CLASS TEST

CLASS WORK

CHAPTER TWO

BIOLOGICAL CLASSIFICATION

It is the Sorting out or grouping of living things according to their common similarities and differences.

Or the scientific method of dividing organisms into smaller and larger groups, on basis of their similarities

Taxonomy: The science of naming and classifying a wide range of living things.

Due to the vast number of organisms that exist on Earth, scientists group organisms according to features/ characteristics they have in common. This is just like sorting out cutlery in the kitchen or the clothes in your cupboard.

CONTRIBUTION OF SCIENTIST TO CLASSIFICATION

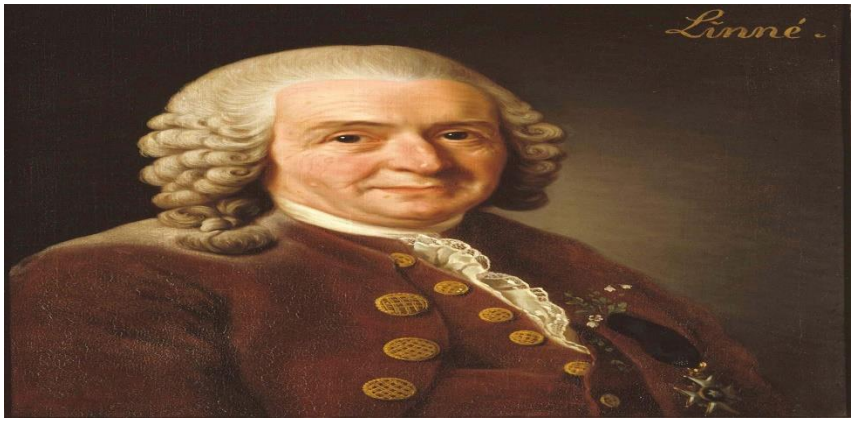
(History of classification)

Aristotle (384-322 BC) was a 4th century Greek philosopher. He divided organisms into two main groups, namely plants and animals.

1. **He classified the plants into herbs, shrubs and trees.**
2. **The animals were grouped into; Animals that can fly, walk or run.**

His system was used into the 1600's. People who wrote about animals and plants either used their common names in various languages or adopted more-or-less standardized descriptions.

Carolus Linnaeus



Carolus Linnaeus: Swedish scientist introduced the binomial nomenclature system (two name system of classification) using **the Genus** and **species** naming system. **Capital letter** used for genus and **small letter** for species e.g. Homo (genus) and sapiens (species) to classify modern humans or Panthera leo for a lion and Panthera pardus for a leopard. He further classified organisms using the seven taxonomic levels. He

- **Grouped organisms based on their body plan**
- **Classified organisms on the basis of their features or how their bodies were built**
- **Put every organism into a group (the science of TAXONOMY)**
- **Give every organism a name (the science of NOMENCLATURE).**

Binomial Nomenclature

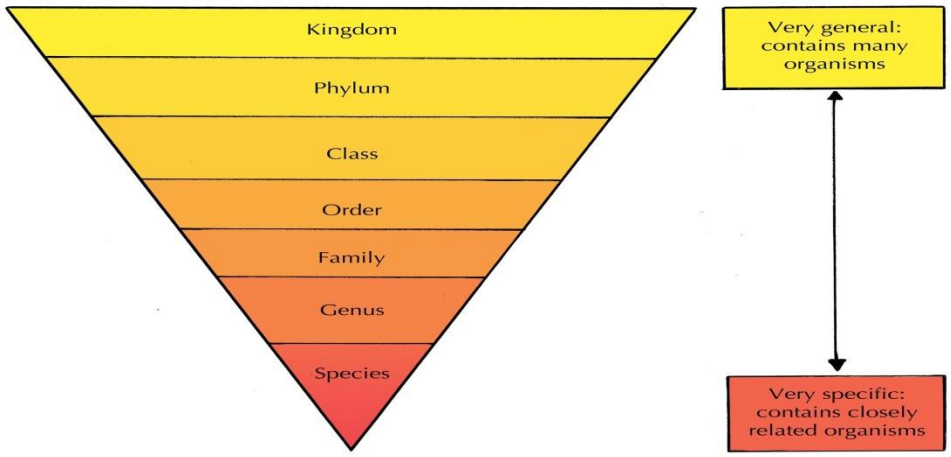
This is a system of naming in which an organism is given a two-part Latin name indicating the genus and species of the organism.

- ✓ One of Linnaeus' greatest contributions was that he designed a scientific system of naming organisms called binomial nomenclature
- ✓ bi - two, nomial – names
- ✓ The genus and species names would be similar to your first name and surname.
- ✓ Genus name is always written with a capital letter whereas species name is written with a small letter. The scientific name must always be either written underlined or printed in italics.

LEVELS OF CLASSIFICATION

There are several living things on earth. The living things may be sorted into groups called **taxa** (singular: taxon). **A taxon refers to a level of biological classification**. There are 7 major taxa into which organism are classified. The seven levels of classification are given in the sequence below:

Kingdom → Phylum→ Class → Order→ Family → Genus → Species



The highest and largest of the seven taxa is the **kingdom.**

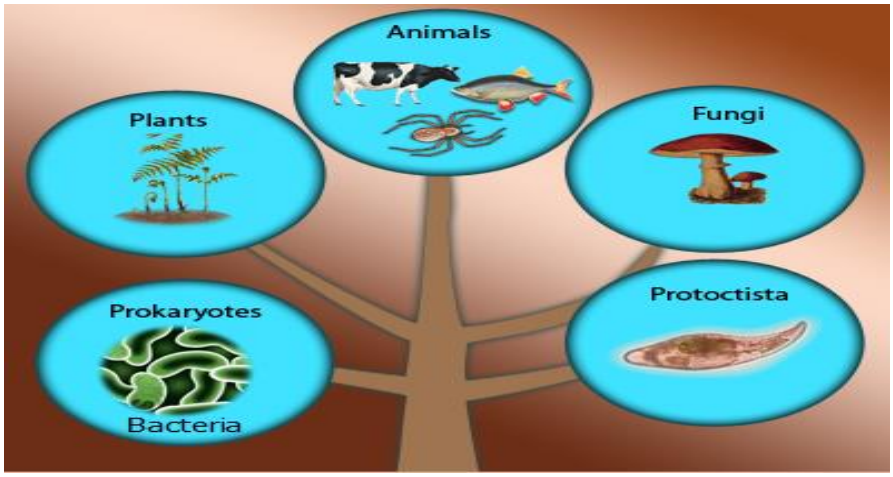
- ✓ The kingdom is divided into phyla. In the classification of plants, division is used instead of phylum.
- ✓ **Species** is the smallest or least taxon into which living things are classified.

Species is a group of identical organisms that can **interbreed** to produce **fertile offspring**.

THE FIVE KINGDOM CLASSIFICATION SYSTEM

One of the currently accepted classification systems is the Five-kingdom system. It is used to classified living things into 5 kingdoms. These are;

- ✓ Kingdom Monera (Bacteria)
- ✓ Kingdom Protista (amoeba)
- ✓ Kingdom Fungi (moulds)
- ✓ Kingdom Plantae (plants)
- ✓ Kingdom Animalia (animals)



1. **KINGDOM PROKARYOTES (MONERA)**

Prokaryotes are unicellular organisms made up of cells that do not have a nuclear envelope (**pro - before, karyon - nucleus**). The genetic material is not bound in a nucleus.

Characteristics

- ✓ Reproduction by simple mitosis
- ✓ Smallest living organism
- ✓ Unicellular – one cell only
- ✓ Prokaryotic – has no nucleus
- ✓ Mostly heterotrophic
- ✓ No membrane bound organelle
- ✓ Examples: Bacteria and blue green algae

2. **KINGDOM PROTISTA**

Are Eukaryotes that possess a membrane-bound nucleus that holds genetic material (**eu - true, karyon - nucleus**). Eukaryotes may contain other membrane-bound cell organelles, such as mitochondria and chloroplasts. **Eukaryotic organisms can be unicellular or multicellular. Eukaryotes include organisms such as plants, animals, fungi, and protists.**

Characteristics

- ✓ have a nucleus
- ✓ Unicellular and multicellular
- ✓ Can be autotrophic, heterotrophic,
- ✓ Parasitic
- ✓ Examples: amoeba, seaweed, algae, malaria protozoa, slime moulds, diatoms

3. **KINGDOM FUNGI**

- ✓ Unicellular or Multicellular with cell walls of **CHITIN**
- ✓ Heterotrophic,
- ✓ parasitic, saprophytic

- ✓ Reproduce sexually and asexually by means of spores
- ✓ Possess vegetative body called **mycelium**
- ✓ No true roots, leaves and stem
- ✓ Lack chlorophyll
- ✓ Examples: bread mould, mushrooms, yeast, penicillin, ringworm

4. KINGDOM PLANTAE

- ✓ Eukaryotes
- ✓ Multicellular, with cell walls of **CELLULOSE**
- ✓ Autotrophs
- ✓ Have chlorophyll and produces nutrition during **PHOTOSYNTHESIS**
- ✓ E.g. Bryophyte (mosses), Pteridiophyta (ferns), conifers and angiosperms.

5. KINGDOM ANIMALIA

- ✓ Eukaryotes
- ✓ Multicellular, without cell walls
- ✓ Heterotrophs
- ✓ sexual reproduction
- ✓ Lack chlorophyll
- ✓ E.g. Coral, insects, reptiles, birds and mammals

Note:

- ✓ **Protozoa and algae** are groups of organisms belonging to the **kingdom protoctista**.
- ✓ Protozoa are animal-like while algae are plant-like
- ✓ Blue green bacteria were formally called blue green algae

IMPORTANCE OF CLASSIFCATION

- ✓ It makes identification of organisms easier
- ✓ It enables scientists from different parts of the world to make reference to the same organism
- ✓ It allows scientists to communicate to each other
- ✓ It allows scientists to identify similarities (natural relationships) and differences between organisms.

Biodiversity refers to the variety of living organisms on earth, which includes species diversity.

Try me

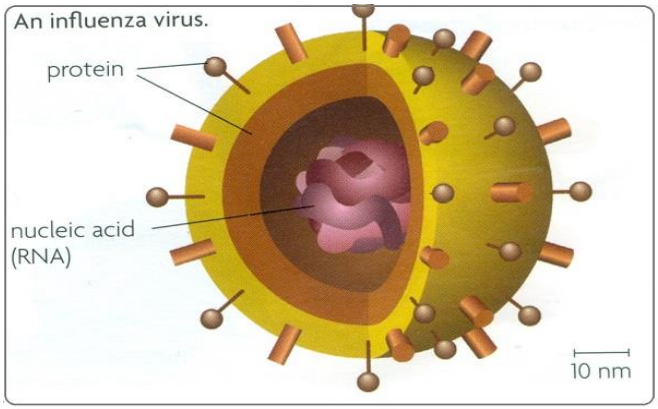
1. Explain the binomial system of naming organisms.
2. What are the seven taxa into which organisms are classified?
3. Name the five kingdoms and give examples of each kingdom
4. State the characters of each kingdom.

CHAPTER THREE
AKARYOTES

Akaryotes are cells without nucleus. Examples are viruses.

Viruses are particles that cannot be seen with the naked eye. They are nucleoprotein particles.

- ✓ A virus is a-cellular, parasitic, and extremely small and has many different shapes. It uses the host to replicate itself so it multiplies inside a host's cell.
- ✓ They are made up of **nucleic acid which contain either DNA or RNA but not both**
- ✓ They can only be seen with the electron microscope
- ✓ Viruses can cause rabies, HIV/AIDS, distemper, foot-and-mouth, influenza, chickenpox, and measles. Illnesses caused by viruses are often difficult to cure but vaccines work to protect an organism against the virus



CHARACTERISTICS OF VIRUSES AS LIVING THINGS (THEY SHARE WITH LIVING THINGS)

Viruses may be classified as living things because of the following reasons.

- ✓ They possess nucleic acid (either DNA or RNA)
- ✓ They can reproduce or replicate within living things

CHARACTERISTICS OF VIRUSES AS NON-LIVING THINGS (THEY SHARE WITH NON-LIVING THINGS)

Viruses are sometimes classified as non-living things because of the following;

- ✓ They lack nucleus, cytoplasm and cell membrane
- ✓ They exist as crystals outside a living thing
- ✓ They cannot exhibit the life processes (growth, movement etc.)

ECONOMIC IMPORTANCE OF VIRUSES

- ✓ They cause diseases in man
- ✓ They are used to produce vaccine
- ✓ They are used for research purposes

CHAPTER FOUR
CELL AND CELL DIVISION

Cells are the basic structural and functional units of all living organisms. The word 'cell' was first used by the 17th century scientist **Robert Hooke** to describe the small pores in a cork that he observed under a **microscope.** Most living things are made of cells. Cell shape varies according to its function. Plant and animal cells differ in size, shape and structure (plants cells are usually larger than animal cells).

Based on the number of cells an organism possesses, it may be classified as either unicellular or multicellular.

- ✓ Unicellular organisms - one cell only. Examples: amoeba, bacteria
- ✓ Multi-cellular organisms - many cells. Examples: plants, animals

Prokaryotic and eukaryotic cells

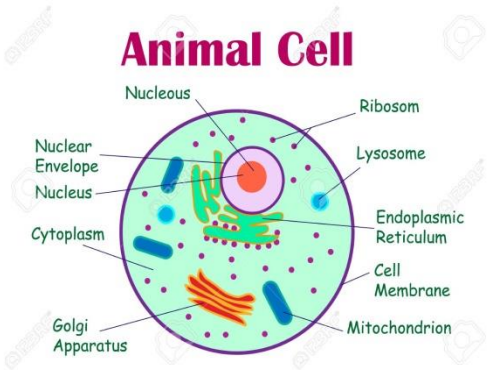
Cells may also be classified as either prokaryotic or eukaryotic.

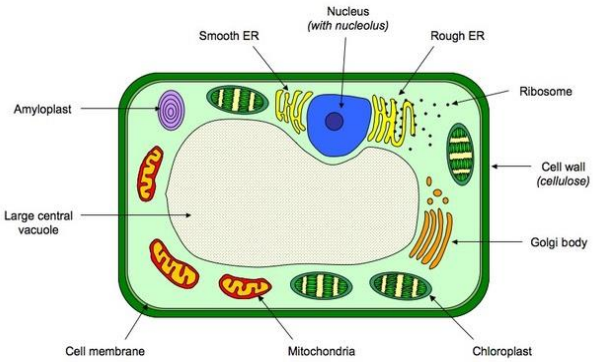
- ✓ **Prokaryotes** are uni- or multicellular organisms made up of cells that do not have a nuclear envelope (pro - before, karyon - nucleus). The genetic material is not bound in a nucleus. They also lack cell organelles such as an endoplasmic reticulum, a Golgi apparatus, lysosomes, and mitochondria. Prokaryotes are divided into two main groups namely the Bacteria and the Archaea (ancient bacteria).

- ✓ **Eukaryotes** are organisms that possess a membrane-bound nucleus that holds genetic material (eu - true, karyon - nucleus). Eukaryotes may contain other membrane-bound cell organelles, such as mitochondria and chloroplasts. Eukaryotic organisms can be unicellular or multicellular. Eukaryotes include organisms such as plants, animals, fungi, and protists.

Structure of the cell

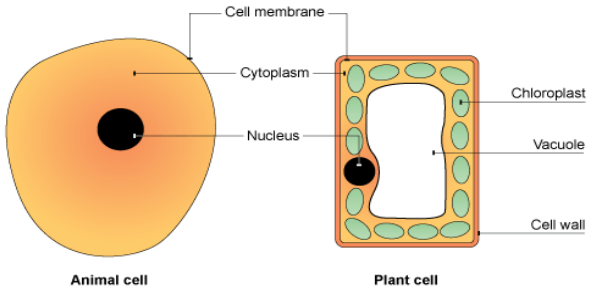
Plant cell





Similarities and differences between animal cell and plant cell

- ✓ Both have a cell membrane
- ✓ Both have a nucleus
- ✓ Both have a cytoplasm
- ✓ Both have mitochondria, ribosomes and endoplasmic reticulum.



Differences between plant cell and animal cell

Plant cell	Animal cell
Cellulose cell wall present	Cellulose cell wall absent
Has a definite/ regular shape	No definite / regular shape
Chloroplast present	Chloroplast absent
Has a large permanent vacuole	Vacuole if present is small and temporary
Centrioles are absent	Centrioles are present
Store food as starch	Store food as glycogen

Functions of the parts of the cell

1. CELL WALL

Cell walls consist of a tough carbohydrate called **cellulose.** Between the walls of neighboring cells there is a **middle lamella** that holds the cells together. This layer is also made of cellulose.

Function of Cell Wall:

- ✓ It protect and support the cell
- ✓ The cell walls act as a rigid frame to hold plants upright as plants do not have a skeleton.

2. The Cell Membrane/ Plasma membrane

The membrane is a thin, living structure that surrounds all living plant and animal cells.

Function of the Cell Membrane:

- ✓ It allows the movement of substance in and out of the cell
- ✓ The molecules of the membrane are able to move and change position; the protein molecules help to carry substances through the membrane.
- ✓ **The membrane is semi-permeable** that allow only small molecules to pass through.

3. **The Nucleus**

The nucleus is surrounded by a double membrane that has many pores to allow substances to enter or leave the nucleus. The jelly-like fluid inside the nucleus is called **nucleoplasm**; this suspends the chromatin material and the nucleolus.

Function of the Nucleus:

- ✓ It controls the life activities of the cell
- ✓ The **chromatin** material is made of **DNA** and appears as fine long strands scattered throughout the nucleoplasm. **Chromatin material** carries hereditary messages and stores genetic characteristics. The nucleolus contains a substance called RNA that is used as a messenger to make protein.

4. The Cytoplasm

Structure of the cytoplasm:

Cytoplasm is a granular, semi-gel fluid that fills the cell and suspends the organelles.

Many useful substances and waste products are found in the cytoplasm. Other substances have larger molecules that will not dissolve and therefore are suspended in the gel-like cytoplasm.

6. **Endoplasmic Reticulum (ER):** It is divided into two.

- ✓ **Smooth ER**: does not have any ribosomes attached. It is involved in the synthesis of lipids, including oils, phospholipids and steroids. It is also responsible for metabolism of carbohydrates, regulation of calcium concentration and detoxification of drugs.

- ✓ **Rough ER**: is covered with ribosomes giving the endoplasmic reticulum its rough appearance. It is responsible for protein synthesis and plays a role in membrane

production. The folds present in the membrane increase the surface area allowing more ribosomes to be present on the ER, thereby allowing greater protein production.

- ✓ It gives mechanical support to the cytoplasm.

- ✓ It aid in the movement of substances like protein

7. **Golgi body:**

It is important for proteins to be transported from where they are synthesized to where they are required in the cell. The organelle responsible for this is the Golgi body. The Golgi body is the sorting organelle of the cell.

8. **The Plastids:**
   Plastids are sac-like, double membranous structures found in many plant cells.
   There are three types of Plastids:
9. **Chloroplasts**
   They contain chlorophyll. These are found in green plant cells that produce glucose (food) during photosynthesis.

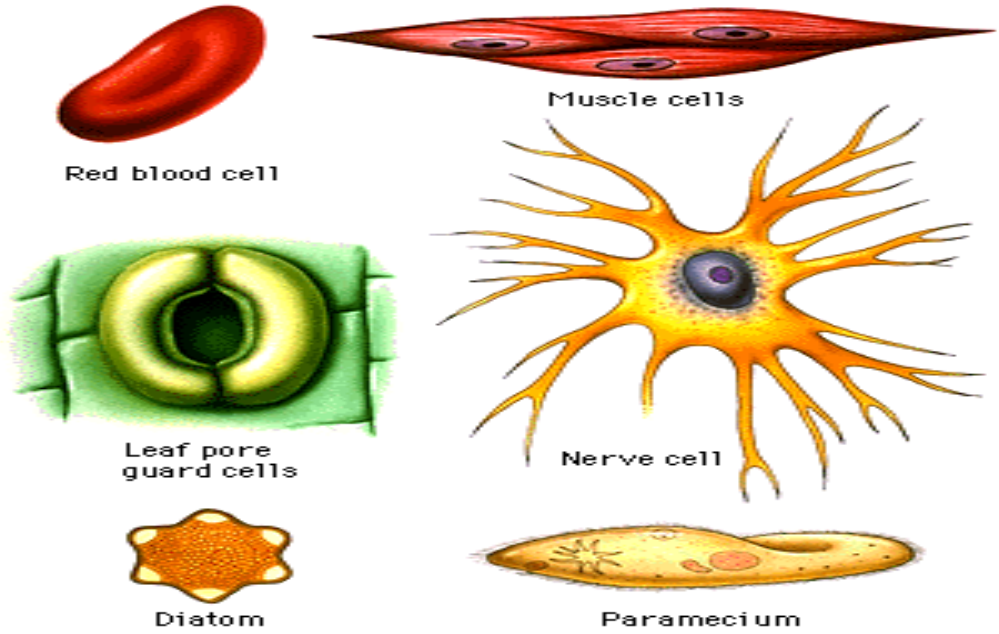
10. **The Mitochondrion**
    - ✓ They are rod-shaped and are surrounded by a double membrane. The inner membrane is folded to form finger-like projections called cristae, they increase the surface area.
    - ✓ Production of energy
11. **The Centrosome**
    - ✓ Production of spindle fibres during cell division.
12. **The Central Vacuole**
    - ✓ It helps for the storage of food and waste materials
    - ✓ These are found in plant cells and consist of a single membrane called the tonoplast that is filled with a fluid called cell sap.
    - ✓ It is involved in water balance in the cell (osmoregulation)
13. **Ribosome** : it is involved in protein synthesis
14. **Lysosome**: it contains digestive enzymes (lysozymes) for breaking down materials in the cell.

Note: cell organelles are minute structures found in the cytoplasm of the cell. All the structures found in the cytoplasm of the cell are called organelles.

SPECIALIZED CELLS

These are cells structurally adapted to perform a specific function.

- ✓ A specialized cell is designed to do a particular job.
- ✓ Nerve cells have long fibres to carry massages.
- ✓ Muscle cells can contract and relax.
- ✓ White blood cells attack bacteria.
- ✓ Platelets help clotting.



1) **Red blood cell (RBC);**

✓ **Features:** have no nucleus, contain hemoglobin

✓ **Function:** transport oxygen around the body

2) **Root hair cell (plants):**
   - ✓ **Features:** the hair gives a large surface area
   - ✓ **Function:** absorb water and mineral ions; anchor the plant firmly in the soil

3) **Nerve cell:**

✓ They are long and thin

✓ **Function**: they transmit impulse

4) **Muscle cell**

✓ It has spindle shape with ability to contract and relax

✓ **Function:** for movement and locomotion

5) **Leaf palisade cell**

✓ contain high concentration of chloroplast

- ✓ **function:** for photosynthesis

6) **Sperm cell**

- ✓ Has long tail for swimming
- ✓ Has mitochondria in the middle piece for energy
- ✓ Presence of acrosome containing hydrolytic enzymes
- ✓ **Function:** for fertilization of eggs

7) **Leaf epidermal cell**

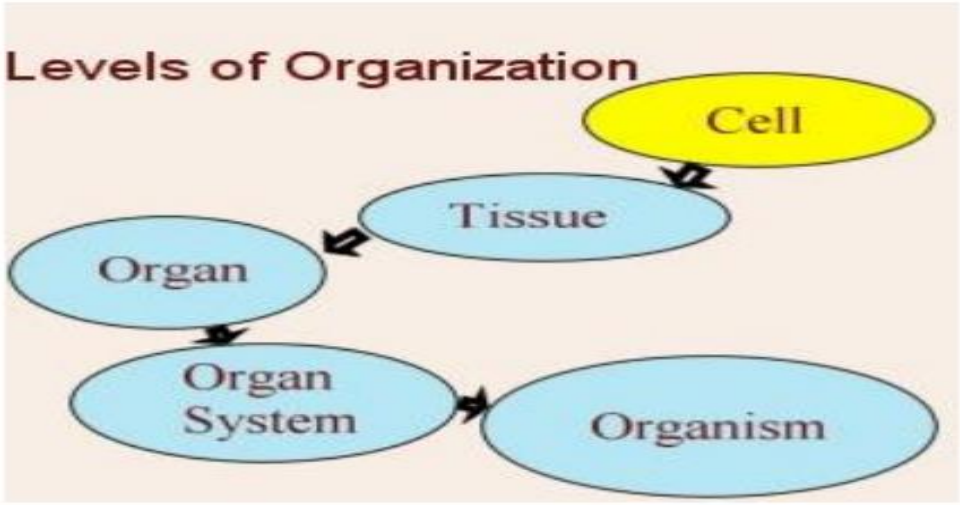
- ✓ it is transparent
- ✓ It allows light to reach photosynthesis.

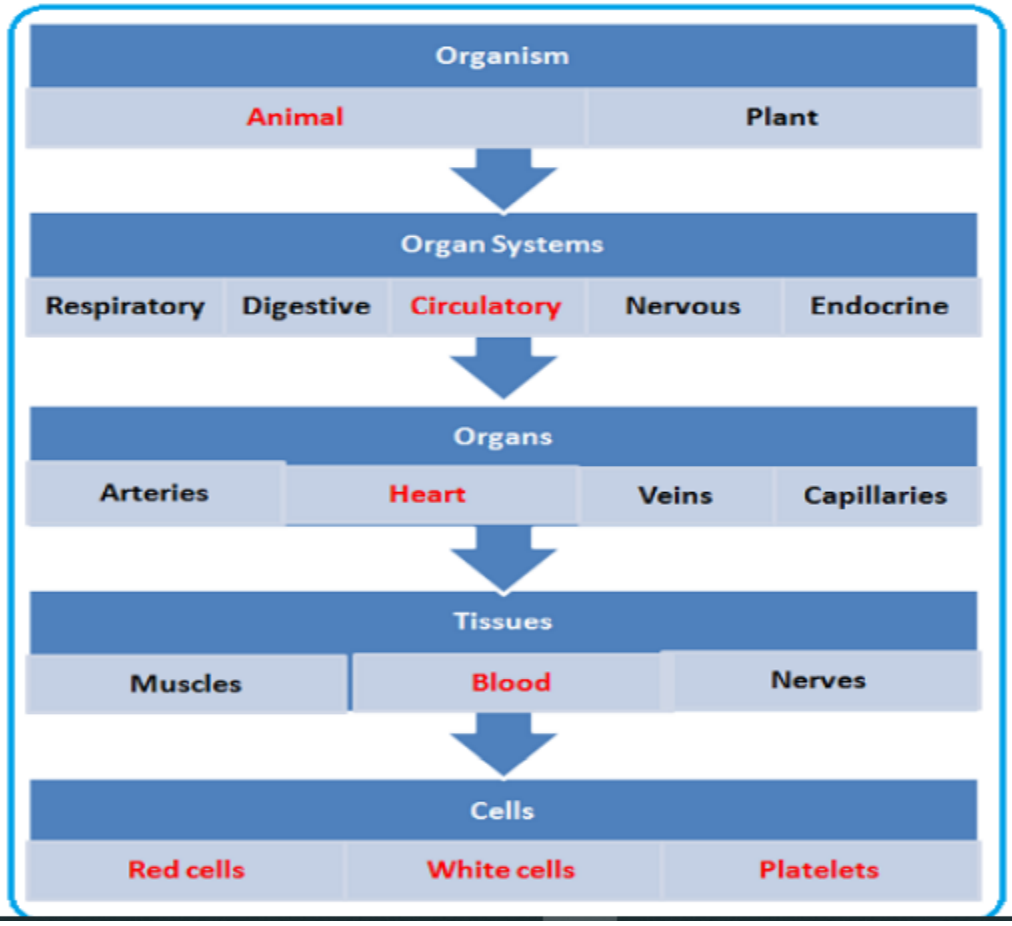
Homework

Draw the above specialized cells and label the parts

LEVELS OF ORGANISATION IN MULTICELLULAR ORGANISM

Cells are organized to form tissue, organs, and organ systems. In a healthy organism, all the systems work together.





A TISSUE

Tissues are made up of a group of similar cells that are adapted for a particular function. Or

Or it is a group of similar cells that perform the same function. Examples are;

- ✓ **Epithelial tissue**: Tissue for covering and lining
- ✓ **Connective tissue**: tissue for structure, strength, binding and transport
- ✓ **Muscle tissue:** tissue for movement
- ✓ **Nerve tissue**: tissue for communication
- ✓ **Photosynthetic tissue**: manufactures food
- ✓ **Xylem tissue**: transport water and minerals
- ✓ **Phloem tissue**: transport manufactured food

Homework

Group the above tissues into plant and animal tissue

Organ

It is a group of different tissues which perform the same function. Examples are root, stem, leaf, eye, ear, heart etc.

- ✓ **Leaf**: for photosynthesis and transpiration
- ✓ **Stem:** it produces and supports the leaves. It also conducts water and nutrients up the plant
- ✓ **Roots**: it anchors plants in the soil. It absorbs nutrients and water to be used by plant
- ✓ **Lungs:** for respiration/ exchange of gases
- ✓ **Heart:** pump blood to the whole body
- ✓ **Kidney:** excretion of urine

Organ system

It is a group of different organs that work together to perform a specific function. Examples are digestive system, excretory system, nervous system, circulatory system etc.

- ✓ **Digestive system**: digestion and absorption of food
- ✓ **Respiratory system**: gaseous exchange
- ✓ **Circulatory system**: transport of materials (oxygen, food and wastes) in the blood
- ✓ **Shoot system**: photosynthesis and transpiration
- ✓ **Root system** : gives support to the plant

Cell division

It is the process by which the nucleus and cytoplasm of a parent cell divide to give rise to daughter cells. There are two types of cell division. These are;

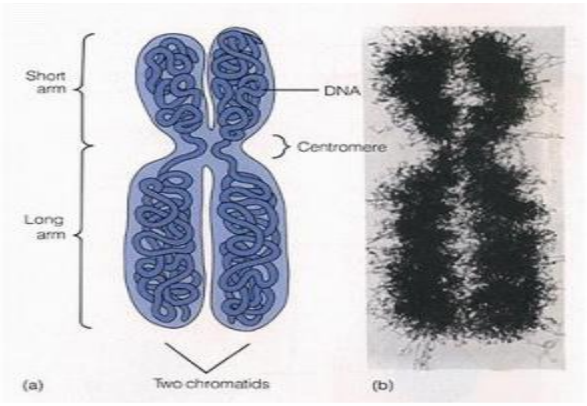
- ✓ Mitosis
- ✓ Meiosis

Mitosis

It is the type of cell division in which the parent cells divide into two daughter cells each having the same number of chromosome as the original cell. Mitosis takes place in **somatic or body cells**.

What are chromosomes?

Chromosomes are thread-like materials found in the nucleus that is made of DNA. Each chromosome consists of two strands, called **chromatids** held together by a **centromere.**



Diploid: Refers to cells that have the full set of chromosomes. Somatic cells (ordinary body cells) receive one of each type of chromosome from female parent (maternal chromosomes) and one of each type of chromosome from male parent (paternal chromosomes)

Haploid: Refers to cells that have half of chromosomes. Gametes (sex cells) must have half the number of chromosomes so that when fertilization occurs the resultant zygote has the full set of chromosomes.

Why do cells divide? (During Mitosis)

New cells are produced for:

- ✓ Growth
- ✓ Repair
- ✓ replace damaged or old cells
- ✓ asexual reproduction

STAGES OF MITOSIS

There are four stages of mitosis. Interphase is a resting or preparation phase.

1. Interphase
2. Prophase
3. Metaphase
4. Anaphase
5. Telophase

Meiosis

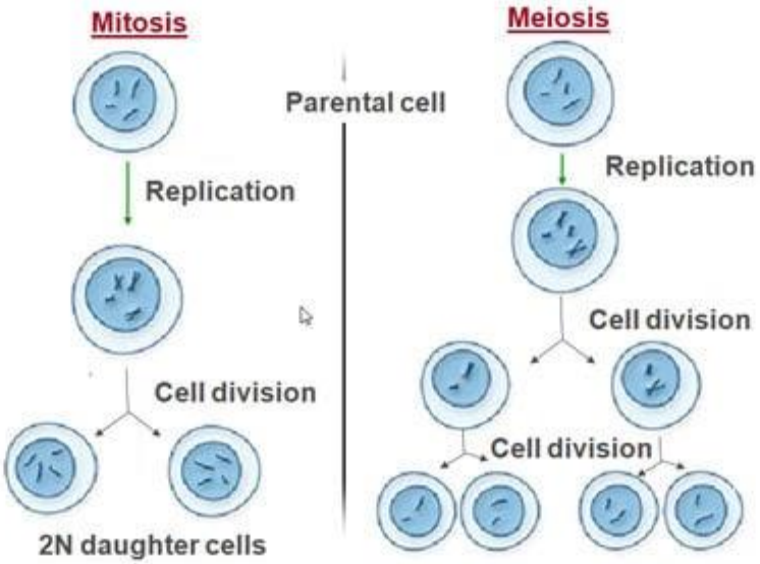
Is the form of cell division that results in the formation of reproductive cells or gametes. The reproductive cells are the male and female sex cell (sperm and egg). Meiosis is also called a reduction division

- ✓ It is takes place in reproductive cells
- ✓ It leads to the formation of four daughter cells
- ✓ Each daughter cell is haploid
- ✓ It leads to the formation of gametes.

Difference between mitosis and meiosis

Mitosis	Meiosis
It occurs in somatic cells or body cells	It occurs in reproductive cells or sex cells
There is one nuclear division	There are two nuclear division
Produces two identical diploid cells	Produces four non-identical haploid cells
Daughter cells have the same number of chromosomes as the parent cell	Daughter cells contain half the chromosome number of the parent cell
It is involved in growth and replacement of worn out cells	It is involved in reproduction
There is no pairing up of chromosomes	There is pairing up of homologous chromosome
No chiasma formation	There is formation of chiasma

Mitosis vs. Meiosis Side By Side



CHAPTER FIVE

THE SKELETAL SYSTEM

Skeleton is the hard part of the body that forms the framework of an organism.

Types of skeletal system

There are three types of skeletal system in animals. These are;

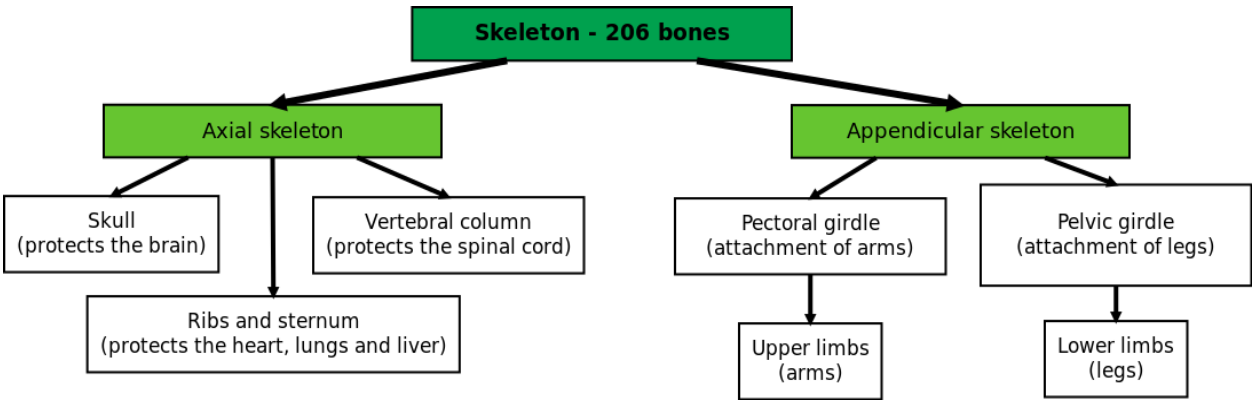
- ✓ Exoskeleton: it is the skeleton found outside the body of an organism. Examples are crab, shrimps, scorpions and insects etc.
- ✓ Endoskeleton: it is the skeleton found inside the body of an organism. Examples are man, fishes, amphibians (frog) etc.
- ✓ Hydrostatic skeleton: it is the skeleton found in organisms with fluid filled body cavity surrounded by tubes of muscles. Examples are earthworm, schistosoma, tapeworm etc.

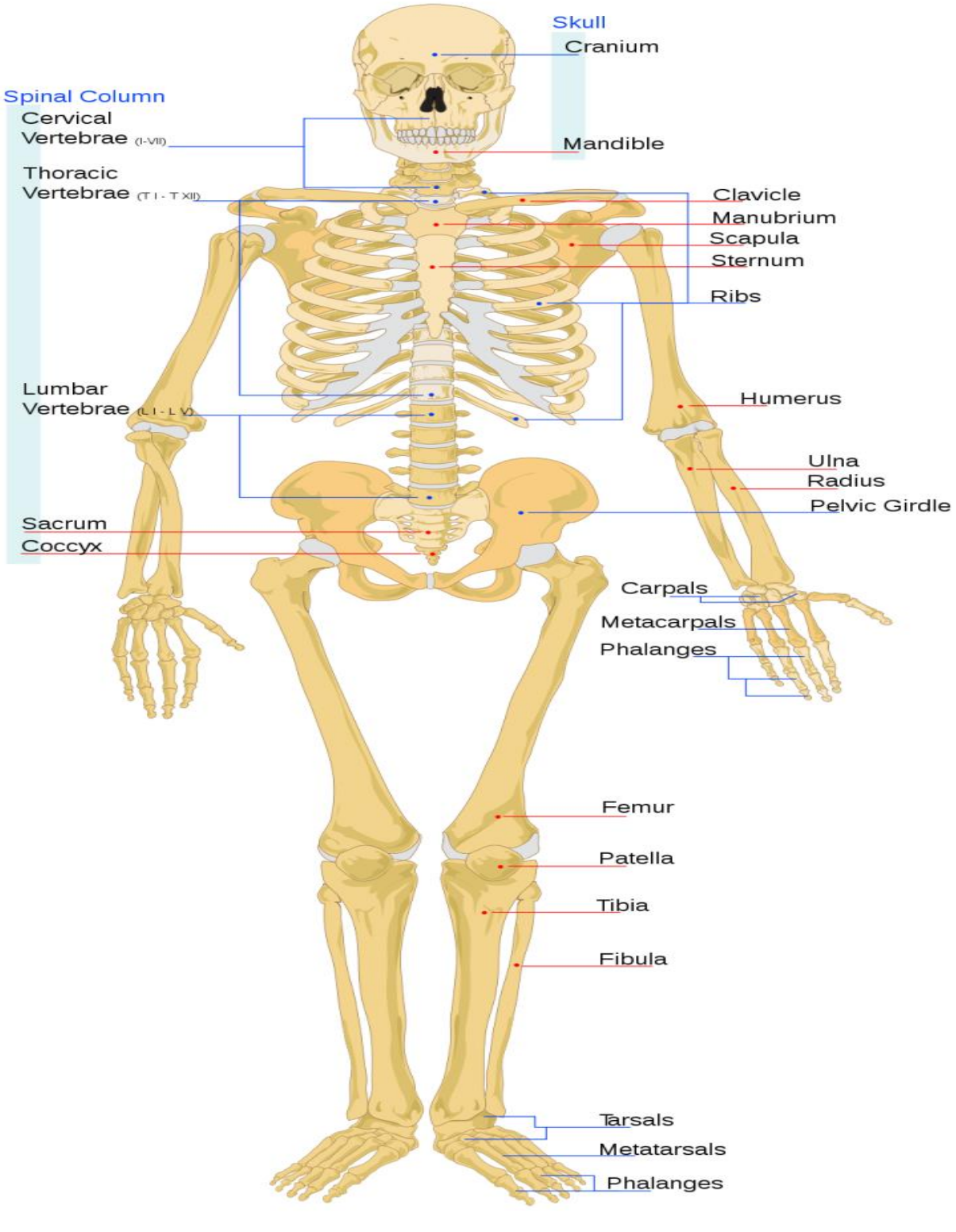
FUNCTIONS OF THE SKELETON

- ✓ **Support -** framework that supports body and cradles its soft organs
- ✓ **Protection** - for delicate organs, heart, lungs, brain
- ✓ **Movement -** bones act as levers for muscles
- ✓ **Mineral storage** - calcium & phosphate
- ✓ **Blood cell formation** - from bone marrow

ENDOSKELETON

THE HUMAN SKELETAL SYSTEM




Skull
Cranium
Spinal Column
Cervical
Vertebrae (I-VII)
Mandible
Thoracic
Vertebrae (T I - T XII)
Clavicle
Manubrium
Scapula
Sternum
Ribs
Lumbar
Vertebrae (L I - L V)
Humerus
Ulna
Radius
Pelvic Girdle
Sacrum
Coccyx
Carpals
Metacarpals
Phalanges
Femur
Patella
Tibia
Fibula
Tarsals
Metatarsals
Phalanges

AXIAL SKELETON

Consists of the

- ✓ **Skull:** is made up of bones joined by immovable joints called sutures. They are strong and protect the brain.
- ✓ vertebral column,
- ✓ sternum and ribs

The Vertebral Column

- ✓ Consists of 33 irregular bones called **vertebrae**
- ✓ Have intervertebral discs that act as shock absorbers

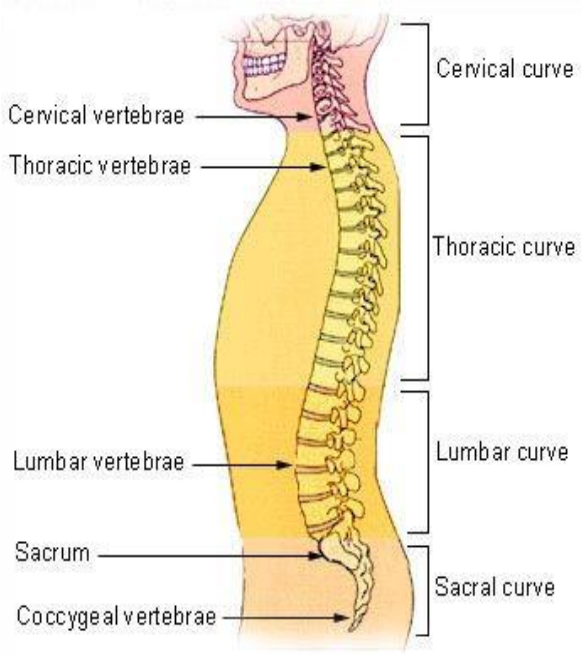
Vertebra refers to the individual bones of the backbone or the vertebral column.

Vertebrae	Location
Cervical vertebra 7	Neck
Thoracic vertebrae 12	Chest
Lumbar vertebra 5	Abdominal region
Sacral vertebra 4	Hip
Caudal vertebra 3	Tail

Functions of the vertebral column

- ✓ Protects the spinal cord
- ✓ Shock absorber for the upper body
- ✓ The skull, ribs and pelvic girdle are attached to it
- ✓ Muscles are attached to allow movement
- ✓ The spinal curves allow for strength and support of body weight and balance

The vertebral column structure

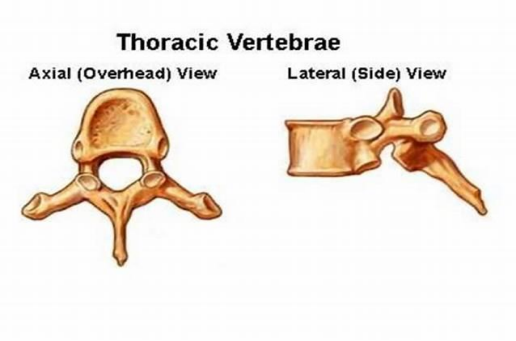


Part and functions of a typical vertebra

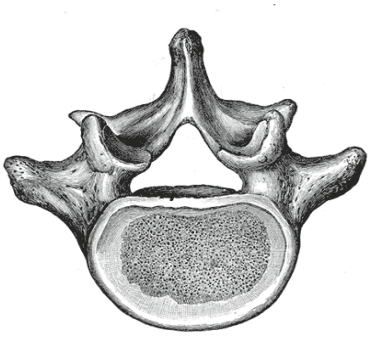
part	Function and essential features
Neural canal	It serves as a passage for the spinal cord
Neural spine	Provides surface for attachment of muscles
Neural arch	Provides surfaces for muscles attachment
Centrum	It provides support and protection for the spinal cord
Transverse process	It provides surfaces for the attachment of muscles.

Cervical vertebra

Thoracic vertebrae



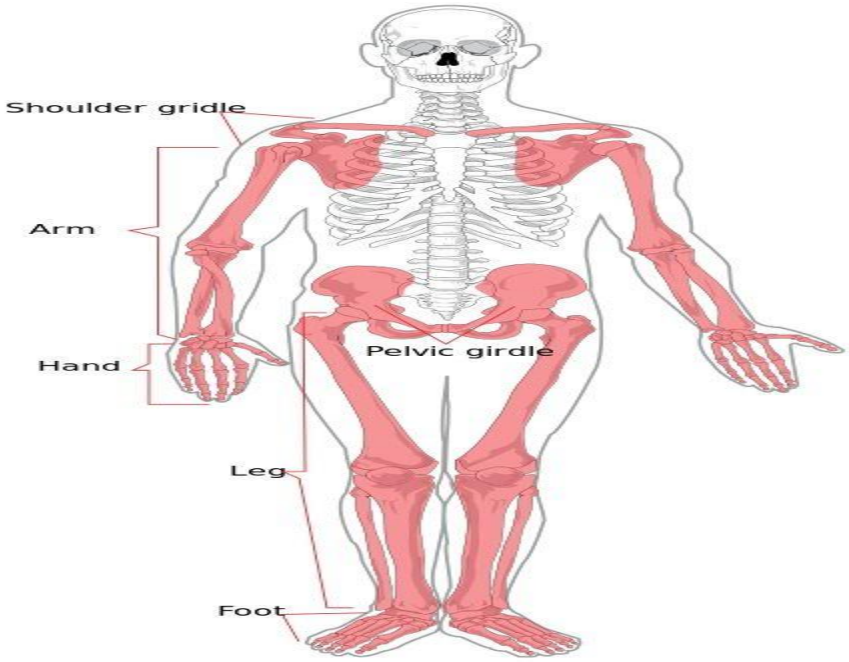
Lumbar vertebrae



Homework

Draw the five different types of vertebrae and label the parts

Appendicular skeleton

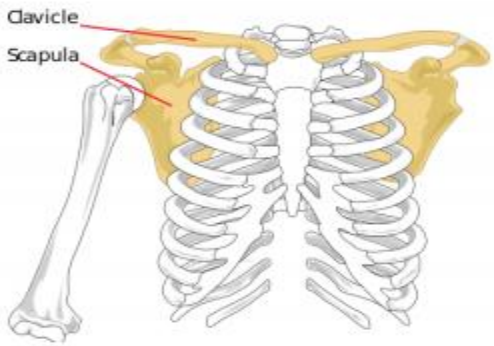


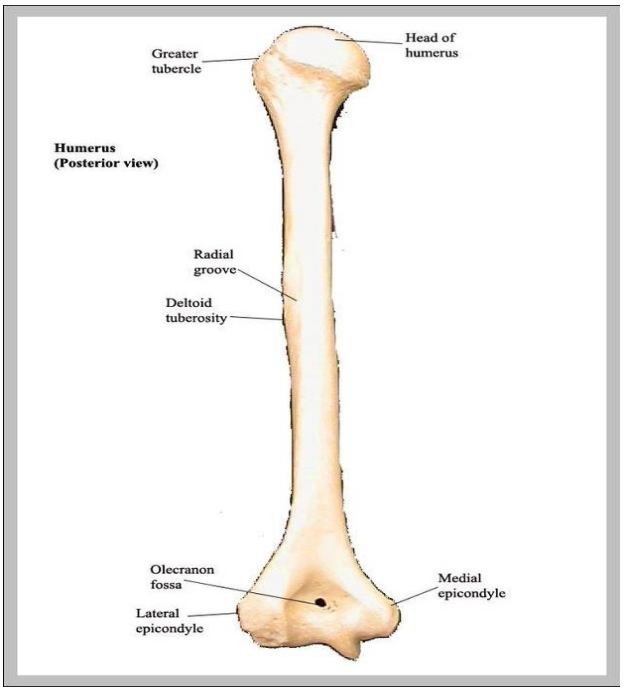
Consists of

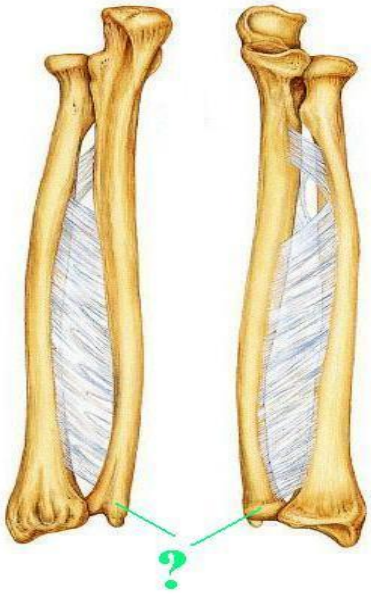
- ✓ **Limbs (forelimb and Hind limb)**
- ✓ **Limb girdle** (**the pectoral girdle** and **pelvic girdle**

The pectoral girdle consists of

- ✓ two **scapulae** and two collar bones
- ✓ The forelimb (**arm)** consists of the **humerus, radius, ulna, carpals (wrist) metacarpals (palm of the hand) and phalanges (fingers).**



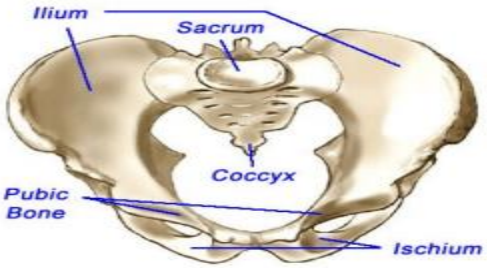


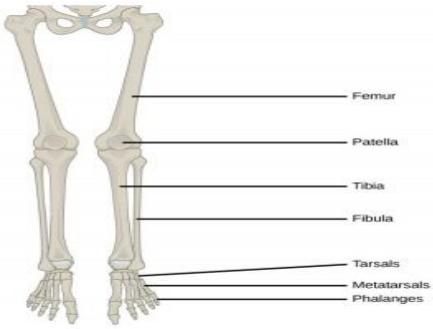


Humerus **radius and ulna**

The Pelvic Girdle and Hind limb (Leg)

- ✓ The pelvic girdle consists of **three pairs of fused bones :ischium, ilium and pubis**
- ✓ The hind limb (leg) consists of the **femur, tibia, fibula, tarsals (ankle) metatarsals (arch of the foot) and phalanges (toes)**





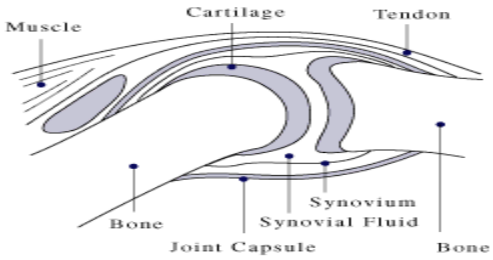
Femur **tibia and fibula**

Functions of pectoral girdle

- ✓ Forms a strong support structure for the attachments of the arms.
- ✓ Provides large area of bone for the attachment of muscles.
- ✓ Forms ball-and-socket joints with the arms which allow the arms to move freely.

JOINT

A joint is a point at which two bones make contact or meet. It allows movement in many planes.



TYPES OF JOINTS

There are two broad classifications of joints. These are;

- ✓ Immovable/fixed joints
- ✓ Movable joints

MOVABLE JOINTS

Are types of joints that allow movement. The different types of movable joints are;
There are a number of different types of synovial joints. The four main types of synovial joints include:

1. **Ball and socket joint**: It allows forwards/backwards, up/down and roundabout movement. Found in structures such as the shoulder.
2. **Hinge joint**: It allows the forearm to move up and down and acts like the hinge of a door. Found in structures such as the elbow
3. **Pivot joint**: Allows turning of the head in a rotational movement from side to side. The joint between the atlas and the axis.
4. **Gliding joint:** It allows bones to slide over one another. Found in the wrist and foot.

PARTS AND FUNCTIONS OF A JOINT

- ✓ **Synovial fluid**: it lubricates joints to reduce friction during movement
- ✓ **Synovial membrane**: it produces the synovial fluid. The synovial membrane lines all internal surfaces of the cavity except for the articular cartilage of the bones
- ✓ **Cartilage**: It prevents wearing away of bones
- ✓ **Ligament**: It prevents dislocation during movement. It attach bones to each other
- ✓ **Articular surface**: the parts of bones which move against each other in a joint.

Note: **Ligaments** join bone to bone, and **tendons** join muscles to bone

MUSCLES

Are tissues that have the ability to contract to bring about movement in the body.

Types of muscles

Three main kinds of muscles exist. These are;

- ✓ Skeletal muscle: they are attached to portions of the skeleton
- ✓ Cardiac muscles: they are found in the heart
- ✓ Smooth muscle: they are found in the skin, blood vessels and other internal body organs such as the digestive tract.

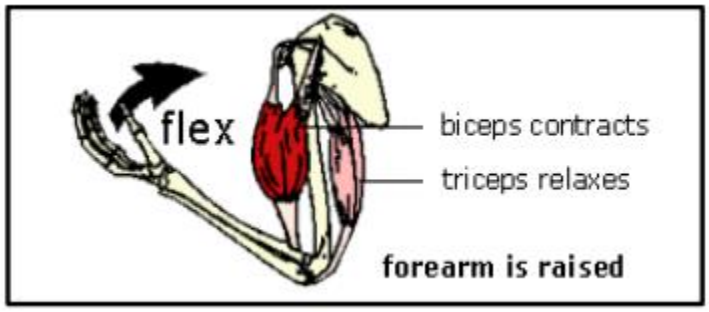
Tendons

Muscles are attached to bones by structures called **tendons.**

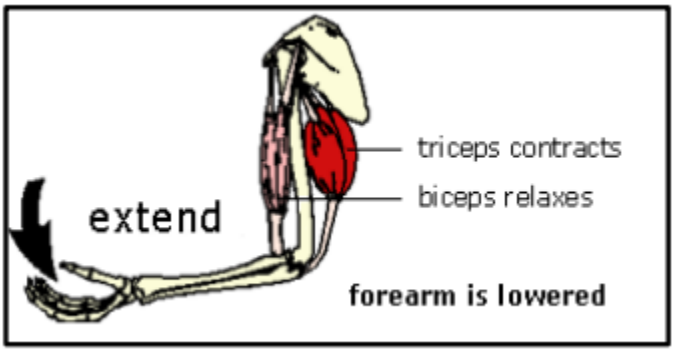
Antagonistic muscles

Refer to a pair of muscles that act together such that when one contracts, the other relaxes. The biceps and triceps muscles of the hand are examples of antagonistic muscles.

When the forearm is raised/bent: the biceps contracts and the triceps relax.

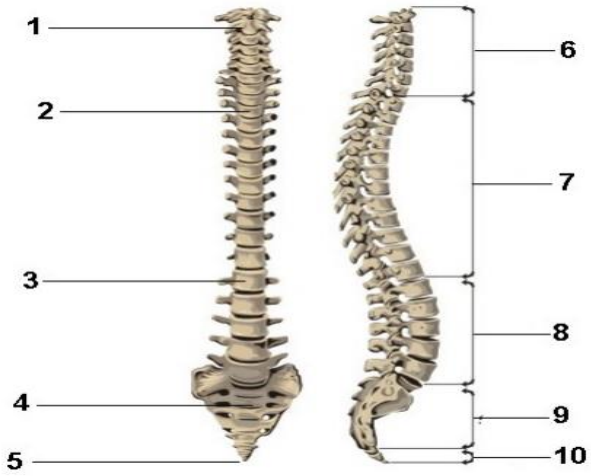


When the arm is straightened: the triceps contracts and the biceps relax.



Homework

1. What are antagonistic muscles? Give an example of antagonistic muscles.
2. Discuss the role of bones, muscles and tendons in movement.
3. Study the accompanying diagrammatic representation of the vertebral column and answer the questions that follow



1. Identify the type of vertebra labeled 1-5, as well as how many there are of each, in diagram A

2. State the location and number of each type of vertebrae in the human body

3. Name three functions of the vertebral column.

CHAPTER ONE

INTERACTION IN NATURE (ECOLOGY)

Living things do not live in isolation. They interact with other living things and their non-living environment.

The study of the relationships of living organisms with one another and with their environment is known as **ecology**. The word ecology comes from the Greek words that mean "**study of the home**.

Ecology is the study of the relationships of living things and non-living things in the environment.

Or

Ecology is the study of living things in relation to their environment.

Atom →molecule→cell→tissue→organ→system→organism→ecosystem

1.1 ESSENTIAL TERMINOLOGIES

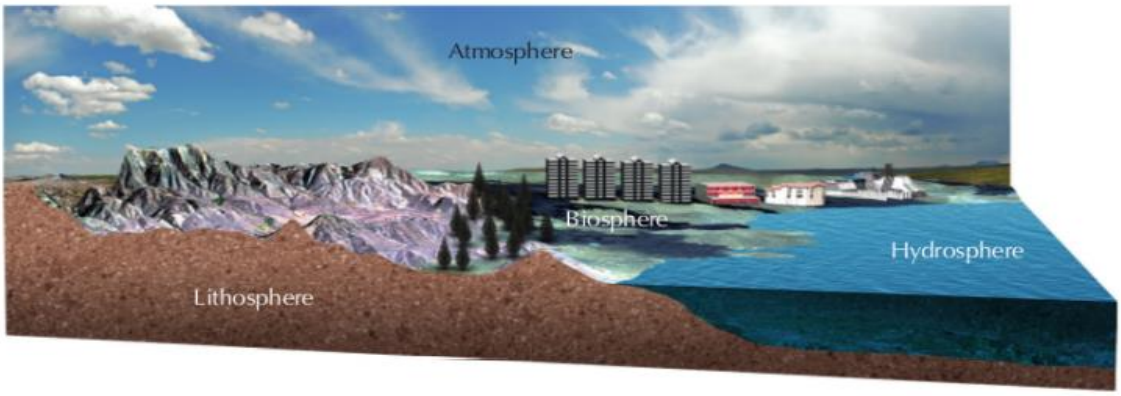
1. **Environment:** refers to everything that surrounds us, including the place where we live. We usually use the term '**environment**' to refer to the physical aspects of our surroundings, which may be living (biotic) or non-living (abiotic).This means that if you live in a city, the environment consists of the buildings, roads and other infrastructure, while if you live on a farm, your environment consists of you pastures, farm house etc.
2. Community: A group of species living together at the same place and time.
3. **Ecosystem:** is a complex system that consists of all the living organisms in a particular area, as well as the environment with which the organisms interact.

   Or it is the interaction between the biotic and the abiotic component.

   The living organisms and non-living components of the ecosystem interact in such a way as to maintain balance. Ecosystems are divided into biotic (living) and abiotic (non-living) components respectively.

   Ecosystem=Biotic (living) component + Abiotic (non-living) component.
4. **Biosphere:** it is part of the earth where life can be found.

   "Bio" means life. It includes the atmosphere, hydrosphere and lithosphere.



5. **Habitat:** it is a particular place where an organism can live successfully. It includes;
   a) Aquatic habitat: refers to habitat in water. Examples are pond, ditch, and stream.
   b) Terrestrial habitat: refers to habitat on land. Example is farm.
   c) Arboreal habitat: refers to habitat on trees.
6. **Population**: it is a group of organisms of same species living together in a habitat. Example is a population of tilapia in a pond.
7. **Community:** refers to a group of organisms of different species living and interacting with each other in a habitat. A community thus consists of populations of different species living together and interacting with each other. Example; an area of soil may contain a community of organisms made up of small plants, termites, earthworms and bacteria.
8. **Niche:** is the role an organism plays in an ecosystem.

1.2 ECOSYSTEM

Are comprised of two parts; the non-living aspects of the environment called the abiotic factors and the living aspects called the biotic components.

All living things depend on this specific ecosystem for food, water, shelter etc. The growth and development of plants and animals in an ecosystem is as direct result of interactions with several abiotic factors.

1.3 COMPONENTS OF ECOSYSTEM

Factors in an ecosystem may be classified into;

1. Abiotic factors
2. Biotic Factors:

Biotic factors: are the living components of an ecosystem.

Bio means life. Predation, competition, symbiosis, Plants, animals, fungi, protest and bacteria are all biotic or living factors and other stuff like competition, disease, and overpopulation are all biotic factors.

Each biotic factor needs energy to do work and for proper growth. To get this energy, organisms either need to produce their own energy using abiotic factors, or interact with other organisms by consuming them. Biotic components typically include:

A) Producers: also known as **autotrophs** include all green plants. Producers make their own food using chemicals and energy sources from their environment. The producers include land and aquatic plants, algae and microscopic phytoplankton in the ocean.

B) Consumers: are also known as **heterotrophs**. They eat other organisms, living or dead, and cannot produce their own food. Consumers are classed into different groups depending on the source of their food.

Herbivores

i) **Herbivores** (e.g. buck) feed on plants and are known as ***primary consumers*.**

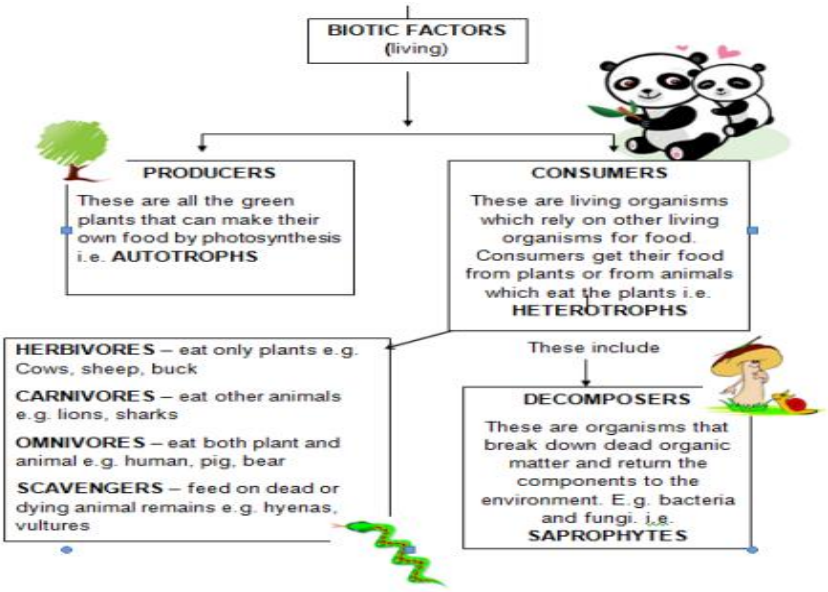
ii) **Carnivores** (e.g. lions, hawks, killer whales) feed on other consumers and can be classified as ***secondary*** **consumers**. They feed on primary consumers.

iii) ***Tertiary consumers*** feed on other carnivores. Some organisms known as **omnivores** (e.g. Crocodiles, rats and humans) feed on both plants and animals.

iv) Organisms that feed on dead animals are called **scavengers** (e.g., vultures, ants and flies).

v) **Detritivores** (detritus feeders, e.g. earthworms, termites, crabs) feed on organic wastes or fragments of dead organisms.

C) **Decomposers**: (e.g. bacteria, fungi) also feed on organic waste and dead organisms, but they can digest the materials outside their bodies. The decomposers play a crucial role in recycling nutrients, as they reduce complex organic matter into inorganic nutrients that can be used by producers. If an organic substance can be broken down by decomposers, it is called *biodegradable.*



3. **Abiotic factors:** are the non-living factors that affect living organisms. Environmental factors such habitat (pond, lake, ocean, desert, mountains) or weather such as temperature, cloud cover, rain, snow, hurricanes, etc. are abiotic factors.

ABIOTIC FACTOR	MEASURING INSTRUMENT
Altitude of A place	Altimeter
Amount of Rainfall	Rain Gauge
Light intensity	photometer
pH of a habitat	PH meter
Pressure	Barometer
Slope of land/Topography	Slope Gauge
Temperature	Thermometer

Turbidity of water	Secchi Disc
Wind direction	Wind Vane
Wind Speed	Anemometer

Slope: is the gradient or steepness of a particular surface of the Earth.

Altitude: is the height of the land above sea level.

PH of soil is a measure of how acid or alkaline soil is and can be measured by using the pH scale.

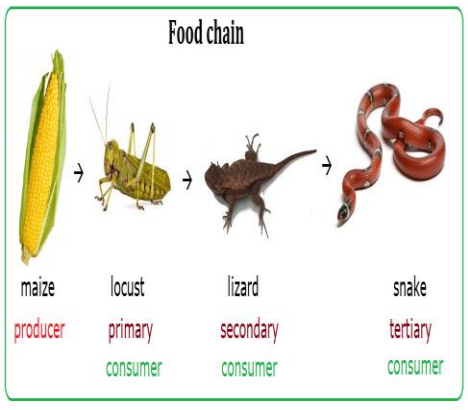
1.4 FOOD CHAIN

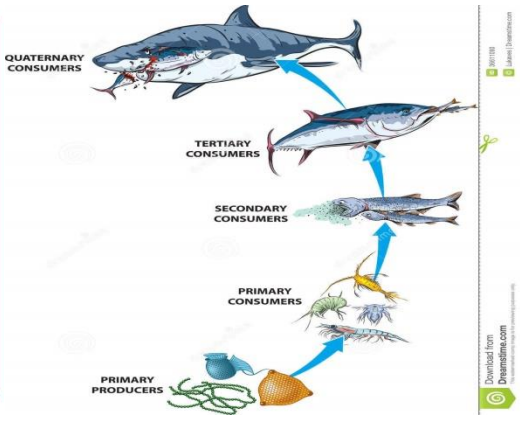
Food chain is a sequence of organisms involving feeding and being fed on. Or

It is sequence of organisms in which energy is transferred from one trophic level to another by the process of feeding. Or

A chart showing the flow of energy (food) from one organism to the next beginning with a producer.

- The arrows used to link each organism to the next represent the direction of energy flow. They always points towards the 'eater', and away from the plant.
- The feeding level is known as the trophic level.
- It always begins with a producer and terminates with decomposers. Below is an example of a simple food chain. The arrows show the movement of energy from one organism to another.

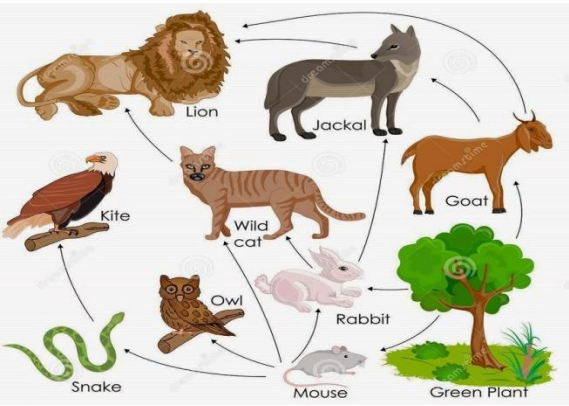


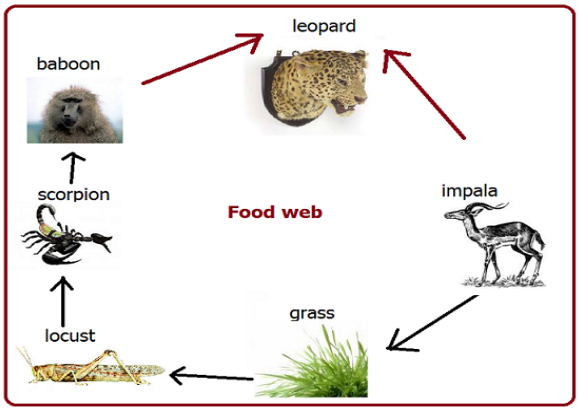


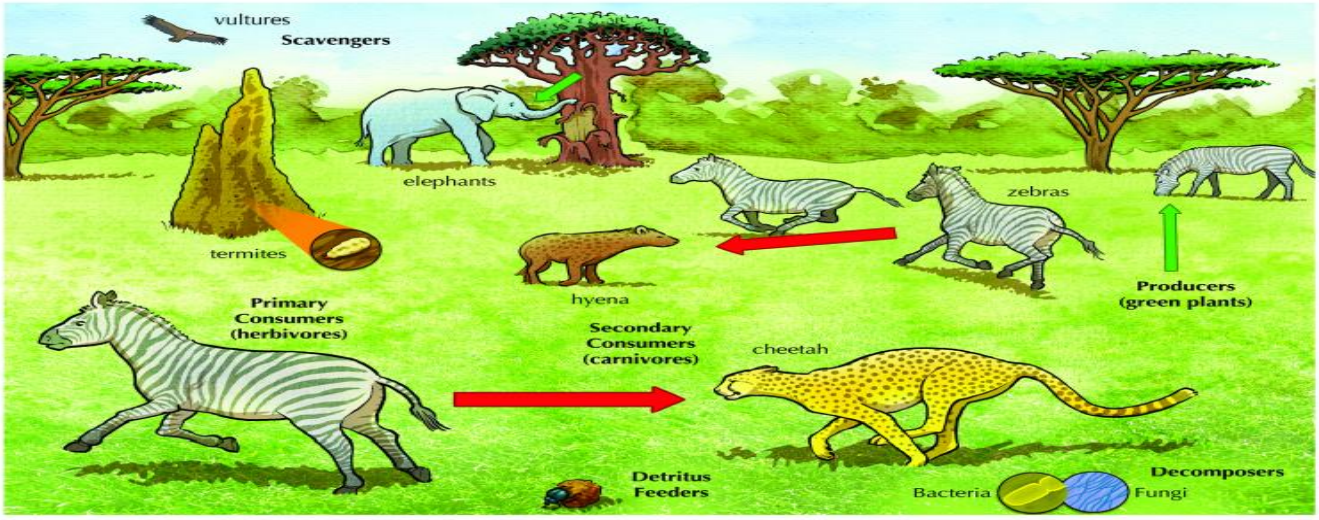
Trophic level refers to any stage in a food chain. The trophic level of an organism is the position it holds in a food chain and depends on how much energy it consumes or produces. The trophic level of each organism can be drawn as a pyramid starting with the producers at the bottom and moving up through the food chain.

1.5 FOOD WEB

It is a network of interconnected food chains showing the energy flow through part of an ecosystem. A food web is made up of a number of food chains. It represents the different feeding relationships in an ecosystem or a biome. It is usually more complicated than a food chain because organisms can get their energy or food from more than one source. The presence of a number of food sources makes the system more stable. If one organism is removed, the whole system will not collapse, unlike in a single food chain







1.6 DIFFERENCE BETWEEN FOOD CHAIN AND FOOD WEB

FOOD CHAIN	FOOD WEB
It is a linear feeding relationship	It is a complex feeding relationship
Involves fewer organisms	Involves many organisms

1.7 Food pyramid

A food pyramid is another way of representing the relationships between organisms in an ecosystem.

Trophic levels and the food pyramid

- **Producers:** Plants are on the first level, or bottom of the pyramid, because they produce their own organic food using energy from the sun and therefore have a lot of energy to pass on.
- **Primary Consumers**: Herbivores are on the second level because they feed on plants. Herbivores consume plants; therefore, to maintain balance, there are far fewer herbivores than plants.
- **Secondary Consumers**: Carnivores feed on herbivores. Consequently, to maintain balance, there are fewer carnivores than herbivores. Carnivores get their energy from plants indirectly and are on the third level.

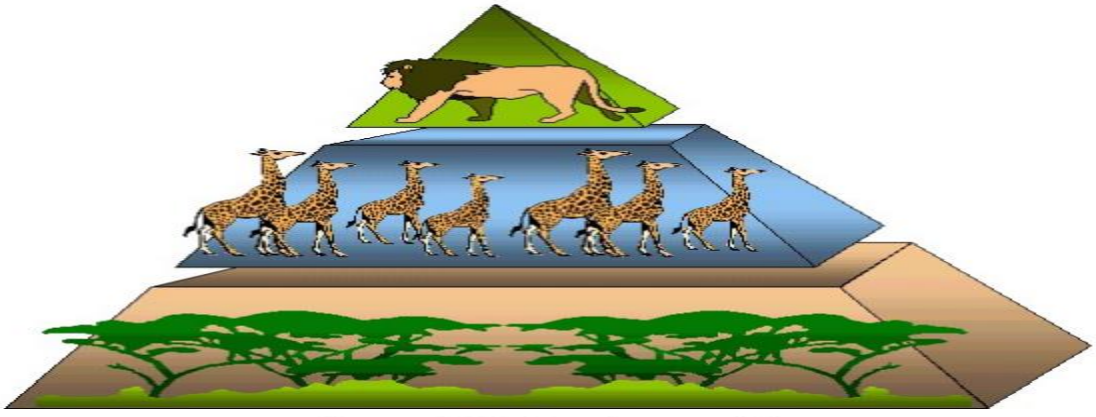


Figure 9.20: Food pyramid.

1.8 TYPE OF FOOD PYAMIDS

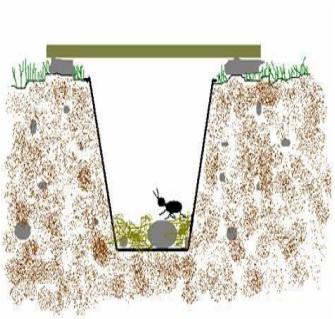
Trophic levels can be drawn as one of the following:

- Pyramid of numbers: This shows the total number of organisms in each trophic level.
- Pyramid of biomass: This shows the total amount of biomass (living matter) at each trophic level.
- Pyramid of energy: This shows the total amount of energy contents in the biomass of each trophic level.

Most pyramids are drawn as energy pyramids, and are always triangular, whereas number pyramids are not.

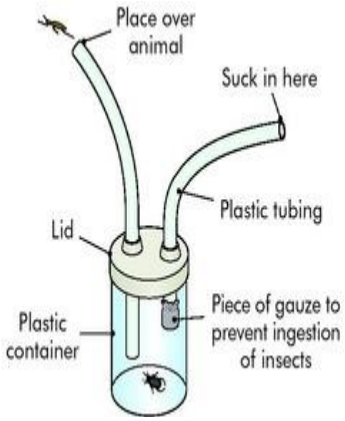
1.9 ECOLOGICAL TOOLS

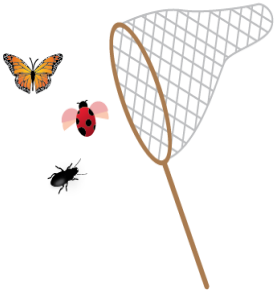
ECOLOGICAL TOOLS	**USES/KEY NOTES**
Butterfly net	For trapping flying insects
Sweep net	For trapping crawling insects
Pitfall trap	For sampling small animals that walk on land surface
Pooter	It is used to collect small insects and other invertebrates rocks and crevices
Quadrat	It is used for estimating the total number of plants in a habitat.
Hand net/long handled net	used to scoop up specimens from water
Plankton net	For collecting tinny organisms from water
Wicker fish trap	For trapping fish,crabs,shrimps.



1. Pitfall trap

3. Secchi Disc





1.10 HUMAN POPULATION DYNAMICS

A population is the total number of individuals of the same species that occupy a specific area.

1.11 Parameters of a Population

Population parameters are factors that characterize a population. A population parameter is a factor that determines the size of a population and the changes that occur to the size of the population over time. Parameters that affect population size are:

- **natality** – the rate at which new individuals are added to a population through reproduction
- **mortality** – the rate at which new individuals are lost to a population through death
- **immigration** – the rate at which new individuals join a population from somewhere else
- **Emigration** – the rate at which individuals from a population leave it to go somewhere else.

1.12 Species Interactions

A) Predation: An interaction in which an individual of one species **(a predator)** kills and/or consumes individuals (or parts of individuals) of another species **(its prey).**

B) Predator: An organism that kills and/or consumes individuals (or parts of individuals) of another species (its prey).

C) Prey: An organism killed and/or consumed by a predator as an energy source.

D) Parasitism: A relation in which the **predator (a parasite)** lives symbiotically on or in the **prey (its host)** and consumes only certain tissues without necessarily killing the host.

E) Parasite: An organism that kills and/or consumes parts of an organism much larger than itself (known as its host).

F) Host: An organism that harbors a parasite or symbiont and provides it with nourishment.

G) Competition:

H) Mutualism: A type of symbiotic relation in which both species benefit.

I) Commensalism: A type of symbiotic relation in which one species benefits from the interaction while the other is unaffected.

HOMEWORK

1)

2)

3)

CLASS WORK

CLASS TEST

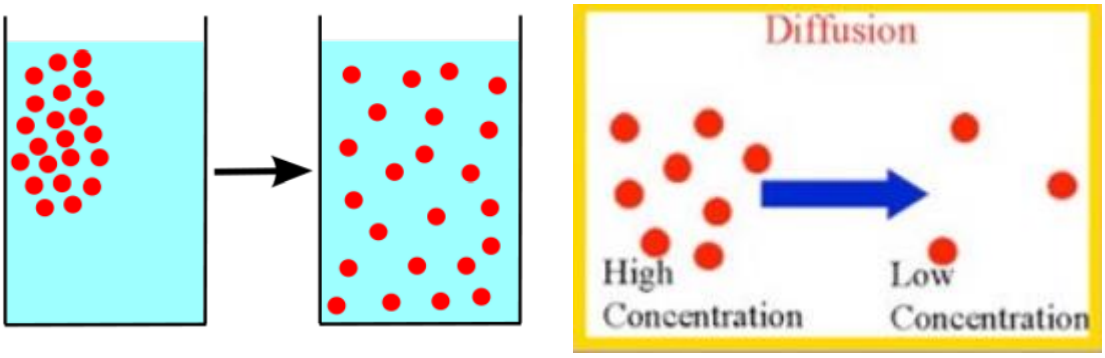
CHAPTER TWO

MOVEMENT OF SUBSTANCES IN AND OUT OF THE CELL (OSMOSIS AND DIFFUSION)

Movement of substances across cell membranes is necessary as it allows cells to acquire oxygen and nutrients, excrete waste products and control the concentration of required substances in the cell (e.g oxygen, water, hormones, ions, etc.). The key processes through which such movement occurs include diffusion, osmosis, facilitated diffusion and active transport.

1) **Diffusion**

Diffusion is the movement of substances from a region of high concentration to low concentration. It is therefore said to occur down a concentration gradient. The diagram below shows the movement of dissolved particles within a liquid until eventually becoming randomly distributed.



Diffusion is a passive process which means it does not require any energy input. It can occur across a living or non-living membrane and can occur in a liquid or gas medium. Examples of substances moved by diffusion include carbon dioxide, oxygen, water and other small molecules that are able to dissolve within the lipid bilayer.

Factors favoring diffusion

- Distance (the shorter the better), e.g. thin walls of alveoli and capillaries.
- Concentration gradient (the bigger the better). This can be maintained by removing the substance as it passes across the diffusion surface. Size of the molecules (the smaller the better).

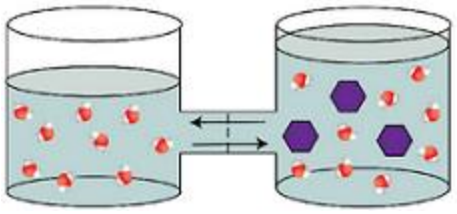
- Surface area for diffusion (the larger the better).
- Temperature (molecules have more kinetic energy at higher temperature).

EXAMPLES OF DIFUSSION IN LIVING THINGS

- ✓ Absorption of some mineral salts by the root hairs
- ✓ Movement of carbon dioxide into and out of the leaves of plants
- ✓ Exchange of nutrients and waste products between the focus and mother
- ✓ Absorption of some digested food substances from the small intestine

OSMOSIS

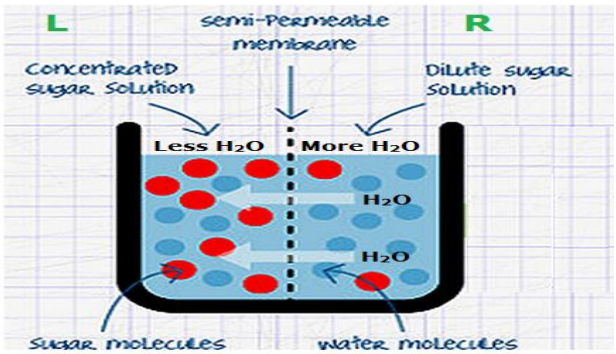
It is the movement of solvent molecules from a dilute solution to a more concentrated solution across a semi-permeable membrane.



Osmosis is a special form of diffusion and always involves the movement of H2O across a membrane. Osmosis is:

- The movement of H2O
- Across a selectively permeable membrane
- Down a water potential gradient.

  In the picture below
- -The concentration of sugar molecules is higher on the concentrated solution (L) and lower on the diluted one (R).The concentration of water molecules is higher on the (R) and lower on the (L) (a lot of place is taken up by sugar molecules).



FACTORS AFFECTING OSMOSIS

- Concentration gradient: the higher the concentration gradient, the faster the rate of osmosis.
- Temperature: the higher the temperature, the higher faster the rate of osmosis.
- Nature of the semi-permeable membrane

EXAMPLES OF OSMOSIS

- Absorption of water by root hairs of plants
- Movement of water from one cell to another in the root cortex of plants
- Movement of water into unicellular organisms living in water e.g.Amoeba,paramecium
- Osmoregulatory functions in the contractile vacuoles of unicellular organisms.

NB: 1. Concentration gradient: is the measure of difference in the concentration between two regions.

2. **A semi-permeable membrane/partially permeable membrane:** is a membrane which allows some substances to pass through but prevents others from doing so. The cell membrane is an example of living semi-permeable membrane.

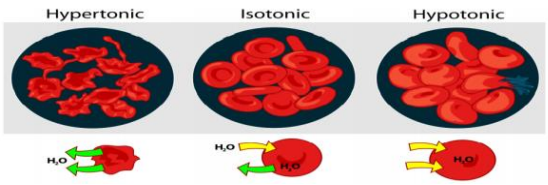
Cellophane and visking tubing are examples of non-living semi-permeable membranes.

Difference between diffusion and Osmosis

Osmosis	Diffusion
Osmosis is the movement of solvent molecules from a dilute solution to a more concentrated solution across a semi-permeable membrane	Diffusion is the movement of molecules from a region of higher concentration to a region of lower concentration
Occur with only solvent molecules	Occurs in solids, liquids and gases
Semi-permeable membrane is required	Can occur in the absence of a semi-permeable membrane

OSMOSIS PHENOMENA IN CELLS AND TISSUES

1) **FLACCIDITY:** A flaccid cell is the one that has lost water. Cells get flaccid when placed in hypertonic solution. A flaccid animal cell becomes wrinkled while a flaccid plant cell gets plasmolysed.
    - **A hypertonic solution:** is the solution whose concentration is greater than that of the cell sap (the one it is compared with).
    - **A hypotonic solution:** is the one whose concentration is lesser than that of the cell sap (the one it is compared with).
    - **An isotonic solution:** it is the one whose concentration is equal to that of the cell sap.



NB: Iso- means same (equal)

Hyper- means high

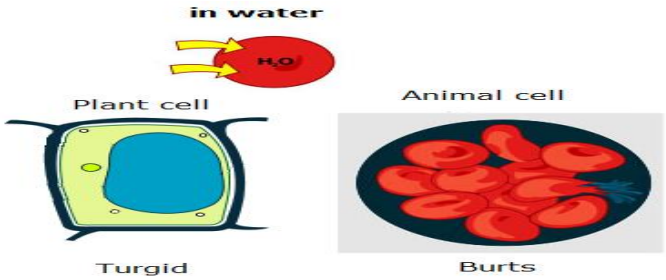
Hypo- means low

Tonic- means strength

2) **Plasmolysis** is the shrinkage of the cytoplasm of a plant cell when placed in a hypertonic solution. In plasmolysis, the cell loses water by osmosis. This results in the reduction of the size of the cytoplasm.
3) **Turgidity:** This is the process by which cells absorb water to attain their maximum size when placed in hypotonic solution.

Effect of Osmosis on plant and animal cells

1. **When placed in H2O:** Concentration of H2O outside the cell is higher than inside it. Cells will take in H2O by osmosis:
    - ❖ Plant cells become turgid (swollen) but do not burst (have tough cell wall which is fully permeable).
    - ❖ Animal cells will burst (no cell wall).



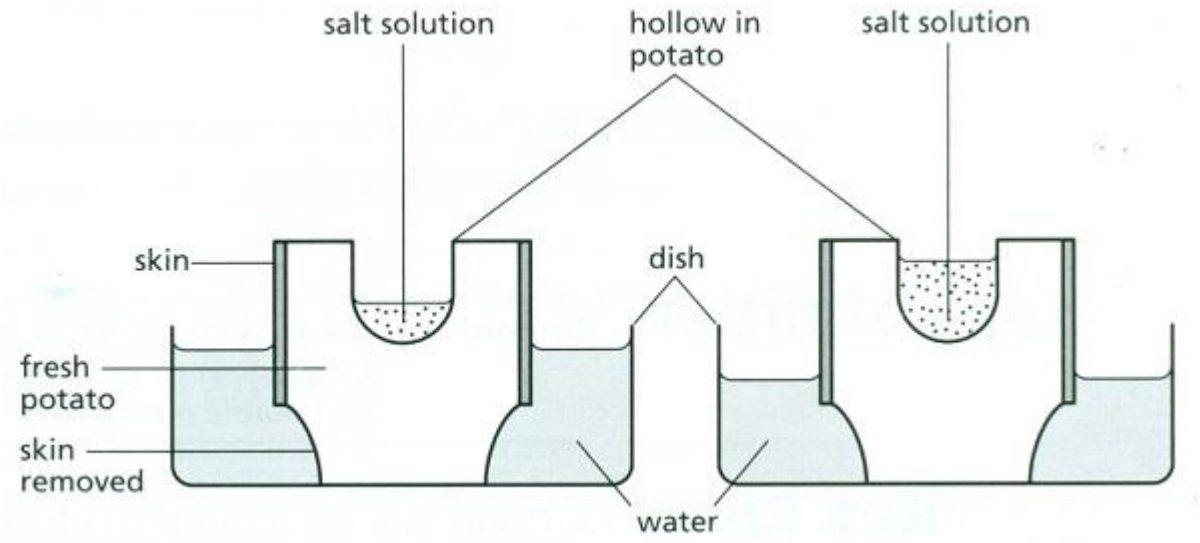
2. **When placed in concentrated sugar or salt solutions:** Concentration of H2O inside the cell is higher than outside it. H2O get out of the cells by osmosis:
    - ❖ Plant cells become flaccid (soft and limp), cytoplasm is no longer pressed against the cell wall. The plants lose it firmness and begin to wilt.
    - ❖ Animal cells shrink, become crenated.

Active transport

Active transport is the movement of substances against a concentration gradient, from a region of low concentration to high concentration using an input of energy.

TRY ME

A potato was set up as shown in the figure below (left-hand side). The investigation was left for several hours. The results are shown on the right hand side of the figure.



1. Describe what happened to

a) The water in the disk

b) The salt solution in the hollow in the potato. [2 marks]

2. a. Name the process that is responsible for the changes that have occurred. [1 mark]

B. Explain why these changes have occurred. [3 mark]

c. Where does this process occur in a plant? [1 mark]

d. What is the importance to the plant of this process? [1 mark]

HOMEWORK

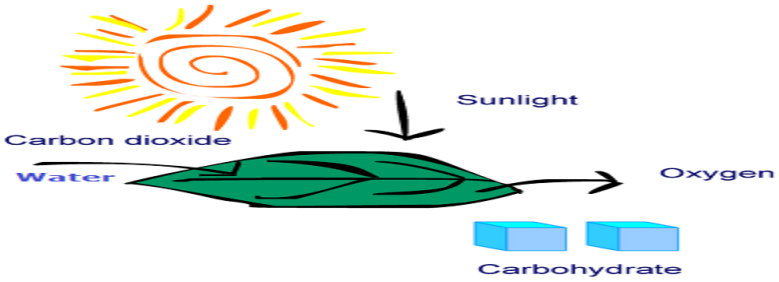
CLASS WORK

CLASS TEST

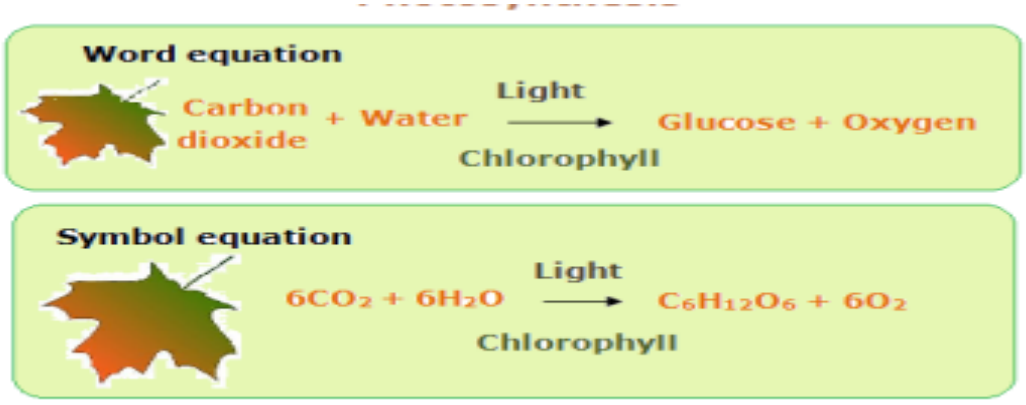
CHAPTER THREE

NUTRITION IN PLANTS (PHOTOSYNTHESIS)

Photosynthesis is the process by which plants manufacture their food (carbohydrates) from raw materials (CO2 and H2O) using energy from light. Photosynthesis occurs in the chloroplast of a leaf. Photosynthesis is a process whereby light is converted into chemical energy. Sunlight is changed into the chemical energy of sugars and other organic compounds.



The equation for photosynthesis



- The raw materials are CO2, H2O and light energy.
- The products are glucose (starch) and O2
- By-product/waste product is oxygen.

The process of photosynthesis

- Green plants take in CO_2 through their leaves (by diffusion).
- H_2O is absorbed through plants' roots (by osmosis), and transported to the leaf through xylem vessels.
- Chlorophyll traps light energy and absorbs it.
- This energy is used to break up H_2O molecules, than to bond hydrogen and CO_2 to form glucose.
- Glucose is usually changed to sucrose for transport around the plant, or to starch for storage. O_2 is released as a waste product, or used by plant for respiration.
- In this process, light energy is converted to chemical energy for the formation of glucose and its subsequent storage.

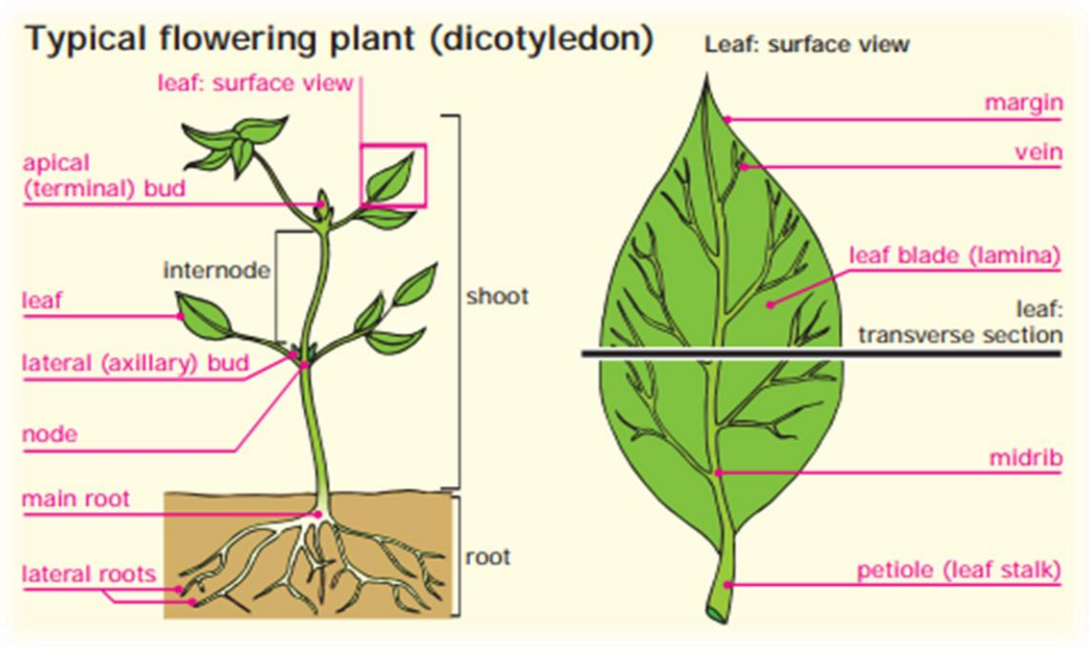
Factors Affecting the Rate of Photosynthesis

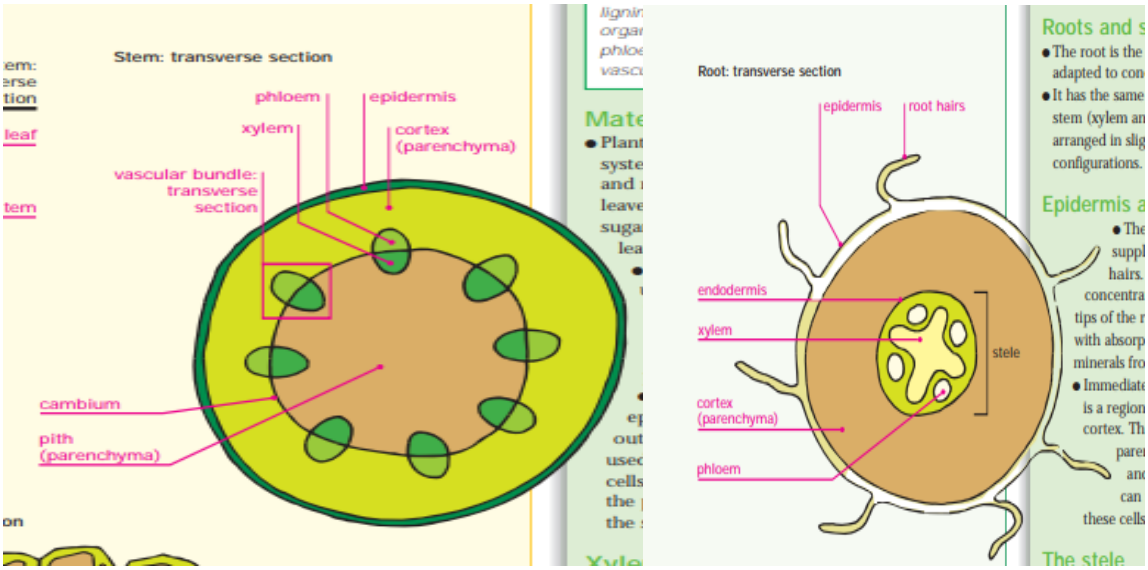
- Light intensity: the greater the intensity of light, the greater the rate of photosynthesis
- Concentration of carbon dioxide: an increase in carbon dioxide will increase the rate of photosynthesis.
- Temperature: enzymes work optimally at 37°C. Lower temperatures mean lower rate of photosynthesis.

Importance of Photosynthesis

- Production of oxygen
- Absorption of carbon dioxide
- Production of food

LEAF STRUCTURE

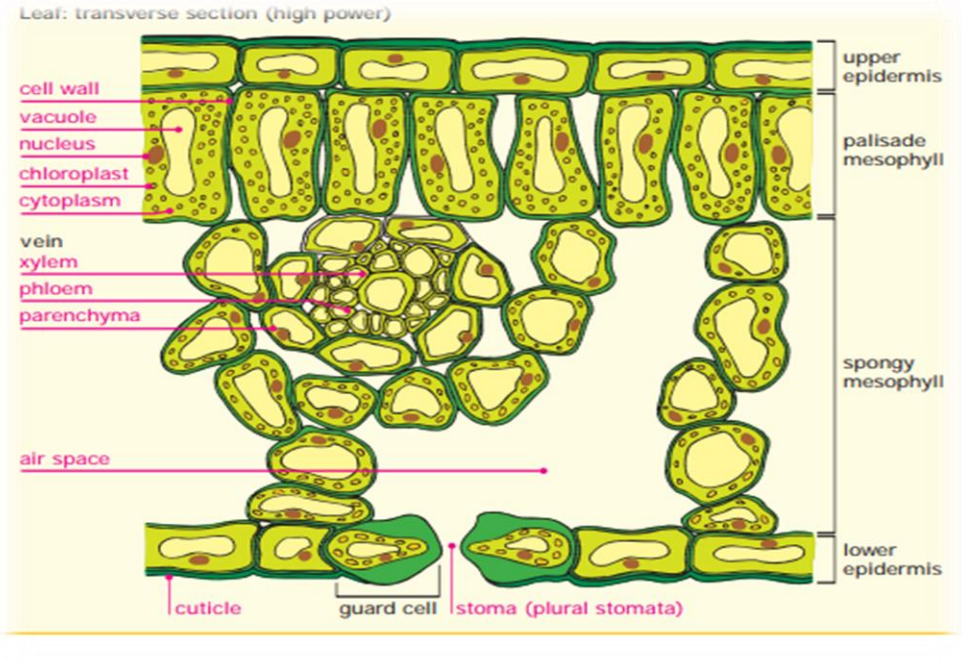




The leaf consists of a broad, flat part called the lamina, which is joined to the rest of the plant by a leaf stalk or petiole. Running through the petiole are vascular bundles, which then form the veins in the leaf.

Although a leaf looks thin, it is made up of several layers of cells. You can see these if you look at a **transverse section (cross-section) of a leaf under a microscope.**

Transverse section of the leaf



1. **Cuticle:**
   - ✓ Made of wax – waterproofing the leaf
   - ✓ Secreted by cells of the upper epidermis

2. **Upper epidermis**
   - ✓ Thin and transparent – allows light to pass through
   - ✓ no chloroplasts are present
   - ✓ act as a barrier to disease organisms

3. **Palisade mesophyll**
   - ✓ main region for photosynthesis

- ✓ cells are columnar (quite long) and packed with chloroplasts to trap light energy
- ✓ receive CO2 by diffusion from air spaces in the spongy mesophyll

4. Spongy mesophyll

- ✓ cells are more spherical and loosely packed
- ✓ contain chloroplasts, but not as many as in palisade cells
- ✓ air spaces between cells allow gaseous exchange – co2 to the cells, o2 from the cells during photosynthesis

5. Vascular bundle

- ✓ this is a leaf vein, made up of xylem and phloem
- ✓ xylem vessels bring water and minerals to the leaf
- ✓ phloem vessels transport sugars and amino acids away (translocation)

6. Lower epidermis

- ✓ acts as a protective layer
- ✓ stomata are present to regulate the loss of water vapour (transpiration)
- ✓ site of gaseous exchange into and out of the leaf

7. Stomata

- ✓ each stomata is surrounded by a pair of guard cells
- ✓ guard cells control whether the stoma is open or closed
- ✓ water vapour passes out during transpiration
- ✓ CO2 diffuses in and O2 diffuses out during photosynthesis

Photosynthesis investigations - Principles and Starch test

Experiments can be used to find out what factors (CO2, light, cholorophyll) are needed for photosynthesis. But first of all you need to destarch the plants. To be certain that they are thoroughly destarched, test a leaf for starch before you begin your investigation.

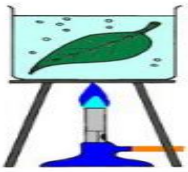
Principles of investigations

1. Investigations need controls

- Control plant (or leave) has all substances it needs.
- Test plant lacks one substance (light/chlorophyll/CO2) 2. Plants must be destarched
- It is very important that the leaves you are testing should not have any starch in them at the beginning of the experiment.
- So, first of all, you must destarch the plants. Leave them in the dark for 48 hours. The plants use up all stores of starch in its leaves.

Testing for the presence of Starch

- **Boil the leaf in water for 30 second**. This kill the cells in the leaf à break down the membrane à iodine solution gets through cell membrane to reach starch inside the chloroplasts and react with them.



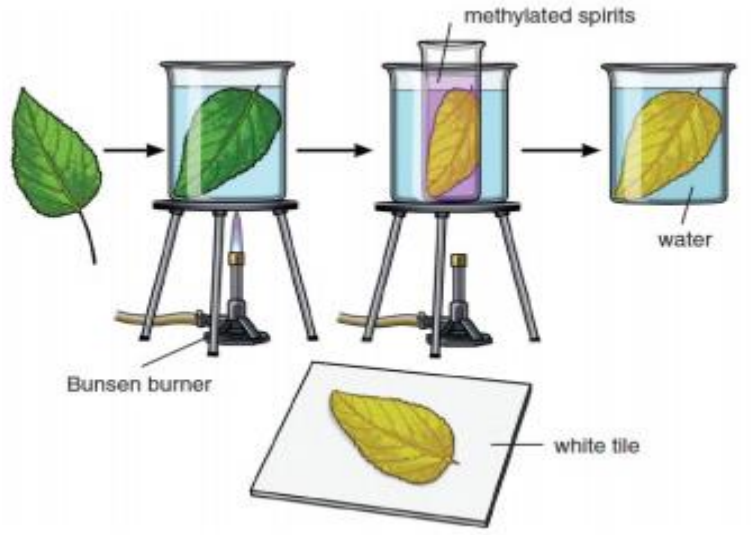
Boil the leaf in water.

- **Boil the leaf in alcohol (ethanol) in a water bath**: The green colour of the leaf and the brown iodine solution can look black together, so you need to remove chlorophyll by dissolving it out with alcohol. Leave it until all the chlorophyll has come out of the leaf.

Boil the leaf in alcohol.

- **Rinse the leaf in water**: Boiling the leaf in ethanol makes it brittle, the water softens it.
- Spread the leaf out on a white tile à easy to see the result.
- **Add iodine solution to the leaf à blue**- black colour is positive, starch is present.

A leaf before (on the left) and after (on the right) starch test.

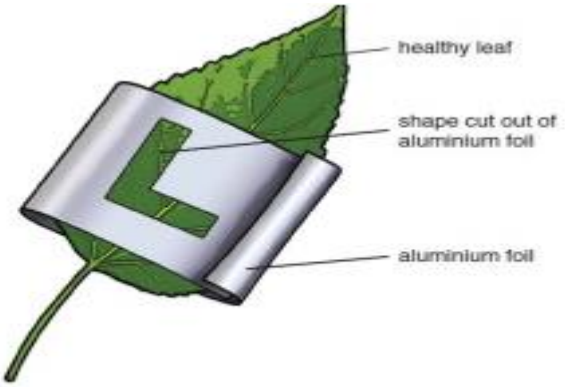


PROCEDURE (Method)

- Remove a leaf from a healthy growing plant.
- Put the leaf in boiling water

- When the leaf has gone soft (flaccid) take it out of the water and put it into methylated spirits or ethanol. (Keep the spirits away from flame.)
- The chlorophyll will move out of the leaf and into the methylated spirits or ethanol.
- Remove the leaf from the methylated spirits and wash it in the boiling water.
- Put the leaf onto the white tile and flatten it out.
- Drop a few drops of iodine solution onto the leaf and watch for a colour change.

To determine whether light is necessary for photosynthesis



Method:

- Cut a shape into a wide strip of tinfoil.
- Wrap the tin foil around the leaf with the shape on the top of the leaf. You don't have to cover the whole leaf.
- Leave the plant in the sun for several hours.
- After several hours remove the leaf from the plant and perform the starch test on it.

To determine whether chlorophyll is necessary for photosynthesis

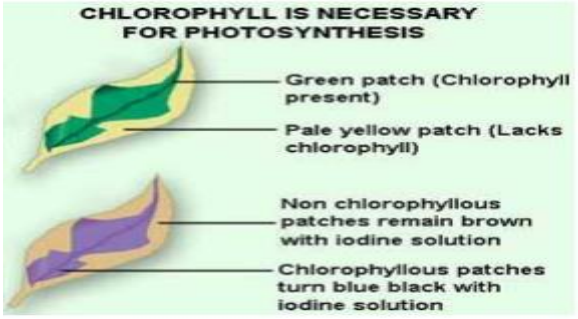
Procedure

- Take a potted plant with variegated (green and white) leaves.

- Destarch the plant by keeping it in complete darkness for about 48 hours.
- Expose the plant to the sunlight for a few days.
- Test one of the leaves for starch with iodine solution.

Observations: Areas with previously green patches test positive (turn blue black). Areas with previously pale yellow patches test negative (remain brown).

Conclusion: Photosynthesis takes place only in green patches because of the presence of chlorophyll. - The pale yellow patches do not perform photosynthesis because of the absence of chlorophyll.

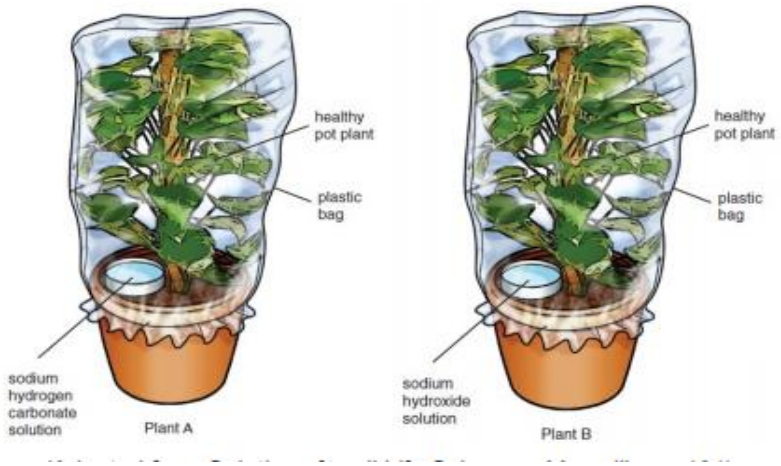


To determine whether carbon dioxide is necessary for photosynthesis (Two options)

Requirements:

- 2 pot plants left in the dark for 48 hours
- Sodium hydroxide solution (NaOH)
- Sodium hydrogen carbonate solution (NaHCO3)
- 2 large plastic bags
- 2 elastics
- Starch test materials

OPTION A



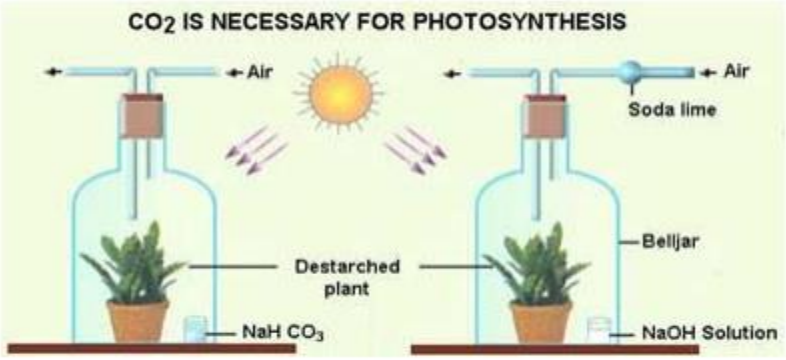
Method:

- ✓ Remove the plants from the dark
- ✓ Place a container of sodium hydroxide on the soil of one plant.
- ✓ Place a container of sodium hydrogen carbonate on the soil of the second plant.
- ✓ Cover both plants with a plastic bag and secure with the elastics.
- ✓ Leave the plants in the sun for several hours.
- ✓ Remove a leaf from each plant
- ✓ Perform the starch test on each leaf.

Result:

- ✓ The plant that had sodium hydroxide with it in the plastic bag will produce less starch.
- ✓ The plant that had sodium hydrogen carbonate with it in the plastic bag will produce more starch.

OPTION B



Process

- ✓ Take two destarched potted plants.
- ✓ Cover both the plants with bell jars and label them as A and B.
- ✓ Inside Set-up A, keep NaHCO3 (sodium bicarbonate). It produces CO2.
- ✓ Inside Set-up B, keep NaOH (Sodium hydroxide). It absorbs CO2.
- ✓ Keep both the set-ups in the sunlight at least for 6 hours.
- ✓ Perform the starch test on both of the plants

Observations: Leaf from the plant in which NaHCO3 has been placed gives positive test. Leaf from the plant in which NaOH has been kept gives negative test.

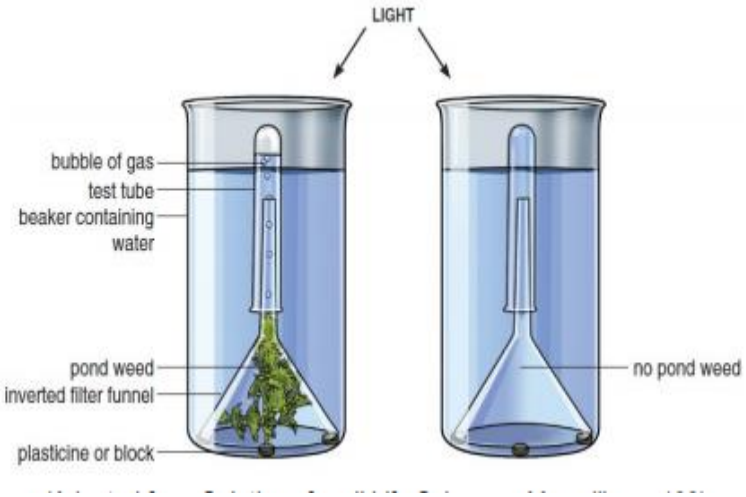
Conclusion: Plant in Set up A gets CO2 whereas plant in Set-up B does not get CO2. It means CO2 is a must for photosynthesis

To determine whether oxygen is produced during photosynthesis

Requirements:

- ✓ Two beakers
- ✓ Water
- ✓ Two filter funnels
- ✓ Two test tubes
- ✓ Prestick

- ✓ Canadian pond weed (Elodea)
- ✓ 2 elastics
- ✓ A wooden splint
- ✓ Matches



Method:

- ✓ Pour water into the two beakers
- ✓ Place the Elodea in one beaker
- ✓ Place the funnel upside down over the Elodea and use prestick to keep it above the bottom of the beaker
- ✓ Place a funnel upside down in the second beaker also slightly elevated
- ✓ Fill a test tube with water and close it with your thumb
- ✓ Place it over the top of the funnel
- ✓ Leave the beakers in the sun for several days
- ✓ After a few days remove the test tube from the Elodea and close it with your thumb
- ✓ Light a splint and blow it out.
- ✓ Remove your thumb from the top of the test tube and put the splint in.

HOMEWORK

CLASS WORK

CLASS TEST

CHAPTER ONE
FOOD AND NUTRITION

FOOD

is anything solid or liquid when taken into the body, provides it with the necessary nutrients. Examples of food are Milk, eggs and meat etc.

CLASSES OF FOOD

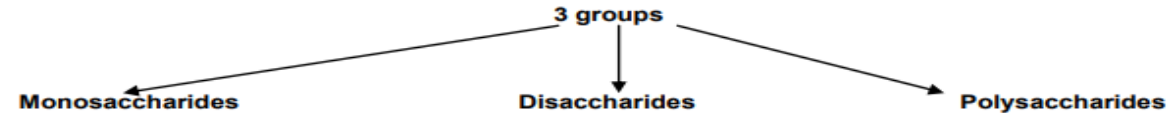
The classes of food are carbohydrate, protein, lipids (fat and oil), vitamins, minerals and water.

A) **CARBOHYDATE:** These are compounds that contain carbon, hydrogen and oxygen, with the ratio of 1:2:1. The general formula is $C_x(H_2O)_y$.

Classes of carbohydrate

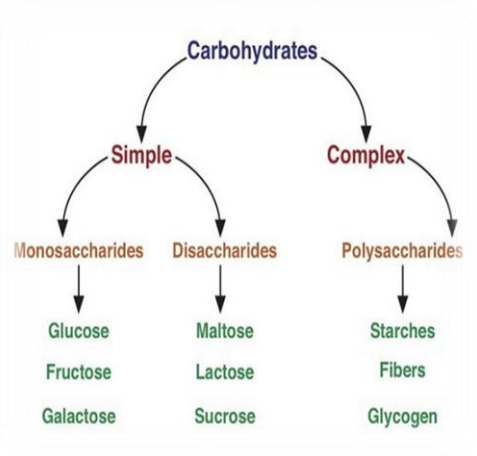
There are three classes of carbohydrate namely;

- Monosaccharide
- Disaccharides
- Polysaccharides



	Monosaccharides	Disaccharides	Polysaccharides
Types of Carbohydrates:	glucose	Maltose (glucose+ glucose)	starch
	fructose	Sucrose (glucose + fructose)	cellulose
	galactose	Lactose (glucose + galactose)	glycogen

The three classes of carbohydrate can be divided into simple and complex sugar as shown below;



1) **Monosaccharide**

Monosaccharides simple sugars consist of one unit of sugar that cannot be further broken down into simpler sugars. **Examples of monosaccharides** are shown below

Monosaccharide	**Sources**
Glucose	Fruits (orange,honey,grape)
Fructose	Fruits and honey
Galactose	Milk

The characteristics of Monosaccharides are

- Crystalline solids at room temperature and
- Soluble in water,
- Reducing sugar; they reduce Benedict's reagents
- Taste sweet

Note:

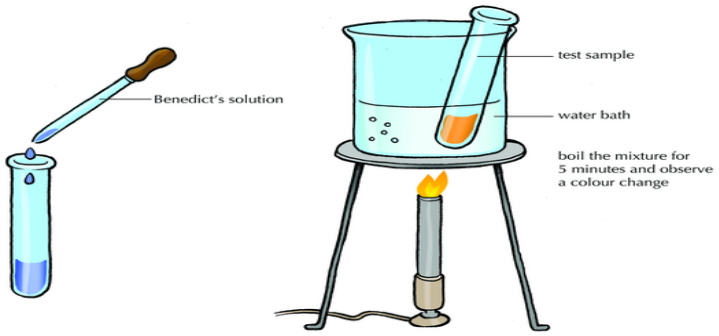
Reagents are chemicals that act on other chemicals and used for identifying substances in the lab. Examples are benedict reagent, Fehling reagent millon reagent, biuret reagent, Sudan III reagent.

Reducing sugars are sugars that give a positive test with Benedict solution or Fehling solution.

Reducing sugar	Non-reducing sugar
glucose	Sucrose
fructose	
lactose	
maltose	
galactose	

TEST FOR REDUCING SUGARS (Example is glucose)

- Take few drops of food substance and place it in a test tube
- Add equal quantities of benedict solution or Fehling solution A and B to the sugar solution in the test tube
- Lower the test tube into a beaker of boiling water or water bath for about five minutes
- A brick red colour indicates the presence of a reducing sugar



2) DISACCHARIDES

Disaccharides are carbohydrates consisting of two simple sugar units. They are formed by joining two monosaccharides unit.

Disaccharide	Constituent Monosaccharide	Sources
Maltose	Glucose + glucose	Malted cereals
Lactose	Glucose + Galactose	Milk of mammals
Sucrose	Glucose + Fructose	Sugar cane, sweet fruits

Note: maltose and lactose are reducing sugar while sucrose is non-reducing sugar

TEST FOR NON-REDUCING SUGAR (sucrose)

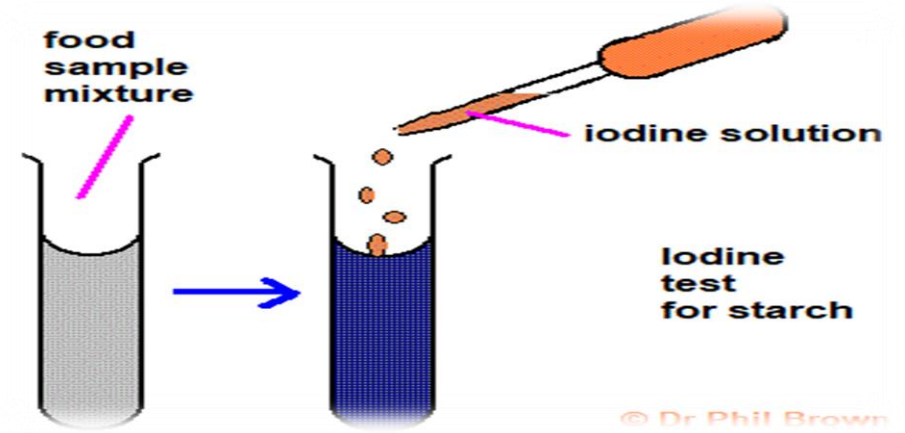
- Take drops of food substance in a test tube
- Add small drops of dilute hydrochloric acid (HCl); **the HCl will hydrolyze or break down the sucrose into its monosaccharide sugars (glucose and fructose)**
- Place the test tube in a water bath and heat for about 3 minutes
- Cool the test tube and add a few drops of caustic soda (**sodium hydroxide or sodium bicarbonate NaOH or NaHCO3): this is done to neutralize the excess hydrochloric acid.**
- Add equal quantities of Benedict or Fehling solution A and B to the test tube
- Place the test tube in a beaker of boiling water to heat again
- A brick red (orange-red) precipitate is formed indicating the presence of non-reducing sugar.

3) POLYSACCHARIDES: are carbohydrates containing more than two simple sugar units. They contain many monosaccharides units joined together. Examples of polysaccharide are

- Glycogen : found in animal cell and stored in the liver and muscles
- Starch : found in plants (plant sugar)
- Chitin : found in insects and fungi
- Cellulose : found in the cell wall of plants

TEST FOR STARCH

- Take few drops of starch suspension in a test tube
- Add few drops of iodine solution to the starch solution
- A blue-black colour appears indicating the presence of starch.



Note:

- **Mono- means one, di- means two, poly- means many, and saccharide- means sugar.**
- **The basic unit of carbohydrate is glucose**

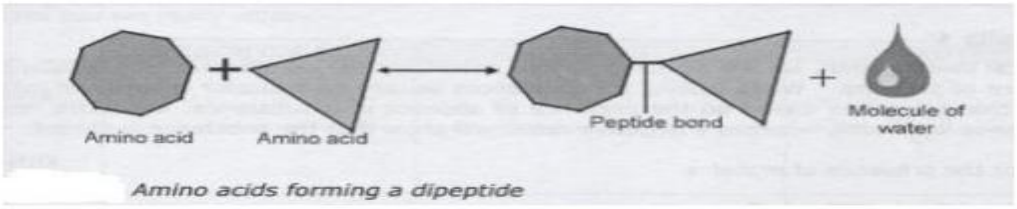
FUNCTIONS OF CARBOHYDRATE

- The main function is to provide energy
- Used to build certain body parts such as the exoskeleton of insects
- Structural components of body such as cell wall of plants

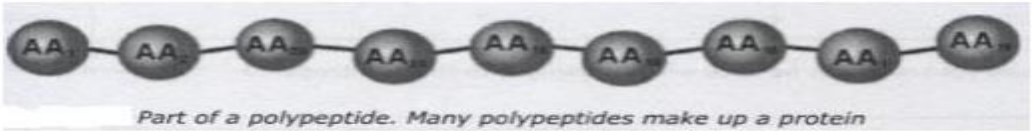
B) PROTEIN: Are compounds containing carbon, hydrogen, oxygen and **nitrogen** and sometimes sulphur and phosphorus. Examples of proteins are milk, fish, eggs, chicken and bean curd.

Structure:

The monomers are amino acids that are held together by peptide bonds



Amino acids forming a dipeptide



Part of a polypeptide. Many polypeptides make up a protein

The basic unit of protein is amino acid. There are 20 standard amino acids, which are grouped into essential and non-essential amino acids.

- **Essential amino acids**, also known as **indispensable amino acids**, are amino acids that cannot be produce within the body but are needed for metabolic activities.
- **Non-essential amino acids: are** amino acids that can be produced in our body

CLASSES OF PROTEIN

- **First class protein:** are proteins that **contain all the essential amino** acids needed for healthy growth. Most animal proteins are first class protein. **Examples are lean meat and fish etc.**
- **Second class protein:** are proteins that **contain some of the essential amino acids** needed for healthy growth. Most plant proteins are first class protein. **Example is beans.**

IMPORTANCE OF PROTEIN

- For growth and development
- For repair and replacement of worn out tissues
- Serve as enzymes and hormones

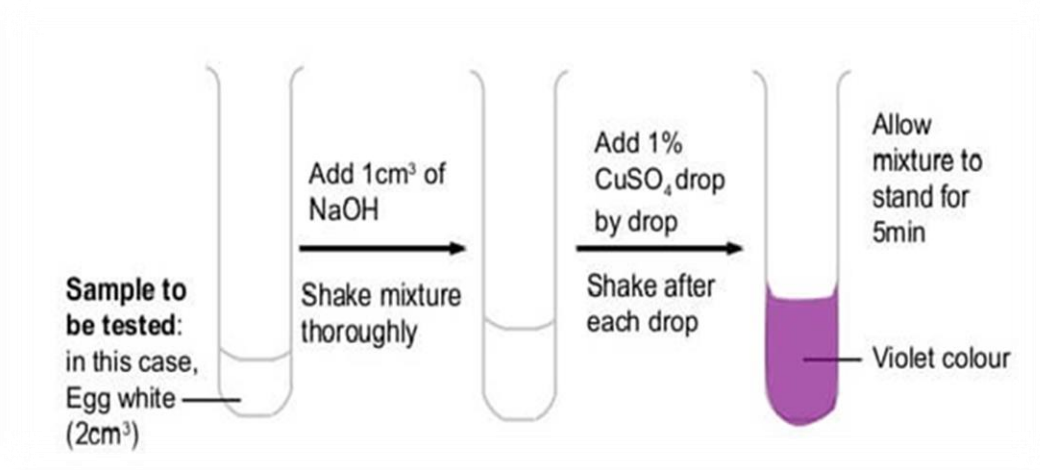
TEST FOR PROTEIN

The following are the tests carried out to find the presence of proteins in a given sample. **The last two would not be considered for this class.**

- Biuret test
- Millon test
- Xanthoproteic test
- Ninhydrin test

a) BIURET TEST

- Take small amount of food substance in a test tube
- Add a few drops of dilute sodium hydroxide to the food substance
- Add 1% copper sulphate ($CuSO_4$) drop by drop, shake the test tube after each drop.
- A violet or purple colour is an indication of the presence of protein.



b) Millon Test

- Take small amount of protein solution in a test tube
- Add millon reagent to the protein solution and heat it
- A deep red colour appears indicating the presence of a protein

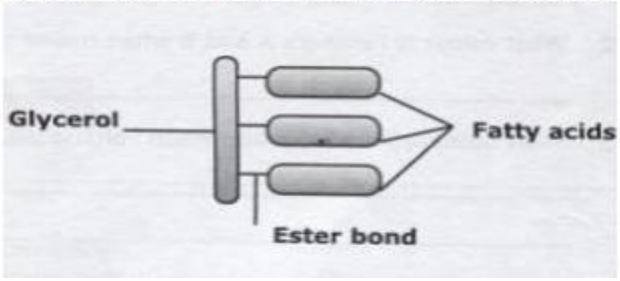
C) LIPIDS (FATS AND OILS)

Lipids are compounds made up of carbon, hydrogen and lower proportion of oxygen.

Fats and oils are lipids. Source of lipids are margarine, butter, palm oil, olive oil, meat, and groundnut oil. **The basic units of lipids are fatty acid and glycerol.**

Structure:

A lipid is made up of 3 fatty acid molecules joined to 1 glycerol molecule by an ester bond



- **Saturated lipids (fats):** These are from animals, are solid and have single bonds between atoms. Examples: Lard and butter
- **Unsaturated lipids (oils):** These are form plants, are liquid and have double bonds between some of the atoms. Examples of Oils (Mono-saturated and polysaturated Oils) Olive oil; cod liver oil, sunflower and margarine

DIFFERENCE BETWEEN FATS AND OILS

Fats	Oils
Solid at room temperature	liquid at room temperature
Mostly saturated	Unsaturated
Higher melting point	Low melting point

IMPOTANCE OF LIPIDS

- Serve as source of energy
- Lipids (fats) form an insulating layers under the skin in humans
- They are solvent for fat soluble vitamins and hormones
- They form part of the cell membrane.

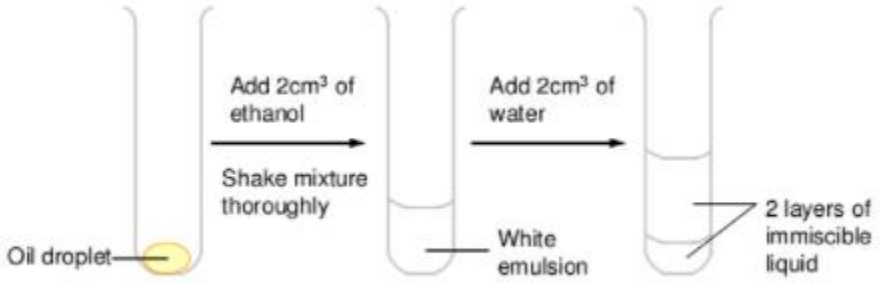
TEST FOR LIPIDS

- Emulsion test
- Spot test

- Sudan III test

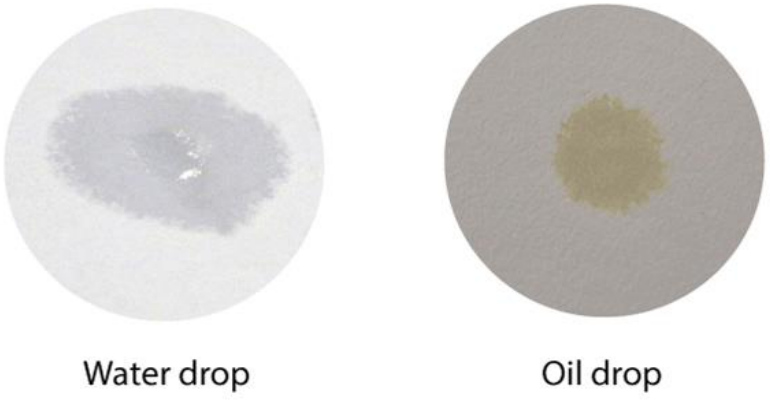
1) Emulsion test

- Pour a little of the food sample containing the lipid in a test tube
- Add a few drops of ethanol to it and shake the mixture in the test tube
- Pour the mixture into a second test tube containing a few drops of water.
- A milky emulsion is formed indicating the presence of lipid



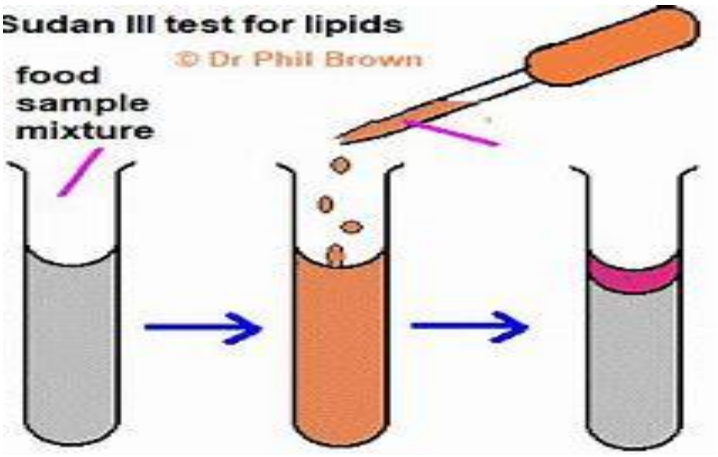
2) Spot test

- A spot of oil is placed on a clean sheet of absorbent paper
- A translucent mark appears indicating the presence of fat and oil



3) Sudan III test

- Take small amount of the lipid into a test tube
- Add few drops of Sudan III solution to it
- A red coloration occurs, indicating the presence of a lipid,



	Carbohydrates	Proteins	Lipids
Elements	C;O and H	C;H;O;N P, S	C;H; O
Ratio of H : O	2 :1		Greater than 2:1
Monomers	Glucose	Amino acids	Fatty acids and glycerol
Bond	Glycosidic	Peptide	Ester
Examples	Sugar; Potato; Pasta: Bread	Meat; Beans; eggs; nuts	Lard; oils; margarine; nuts

D) VITAMINS

Vitamins are organic compounds needed in small amounts by our body for health and growth.

- Vitamins are divided into two groups which are **water-soluble vitamins and fat-soluble vitamins.**
- Water-soluble vitamins are vitamins B and C
- fat-soluble vitamins are vitamins A, D, E and K

Vitamin	Source	Function	Deficiency Disease
A	Milk, butter, egg yolk, carrot, tomato, green vegetables	- night vision, - healthy skin	- night blindness - skin defections
B	Yeast, eggs, liver	- Releases energy from carbohydrates - Healthy nervous system - Healthy skin - Formation of red blood cells	- beriberi - anaemia
C	Fresh fruits and vegetables	- healing of wounds - resistance to disease	- scurvy (bleeding gums)
D	Butter, fish oils, eggs	- strong bones and teeth	- rickets (soft bones and dental decay)
E	Cereals, green vegetables	- May be needed for reproduction - Helps to fight against diseases	- sterility
K	Milk, butter, egg yolk, carrot, tomato, green vegetables	- clotting of blood	- prolonged bleeding

E) Minerals:

Minerals are organic substances needed in our body in small amounts for healthy growth and development. These are elements found naturally in the environment and are needed by the body. They are called **essential nutrients**.

- Two Types: Macronutrients and Micronutrients
- Macronutrients: These are needed in large quantities
- Micronutrients: These are needed in small quantities

Mineral	Source	Function	Deficiency Disease
Calcium	Cheese, milk. Eggs. green vegetables	- strong bones and teeth - blood clotting - muscle and nerve activities	- rickets - osteoporosis - prolonged bleeding - muscular cramps
Sodium	Tables salt, cheese, meat	- maintains body fluids - proper functioning of nerves	- muscular cramps
Iron	Meat, eggs, green vegetables	- needed to form haemoglobin in red blood cells	- anaemia
Iodine	Seafood, iodised salt	- needed to make hormones of the thyroid glands	- goitre (swelling of the thyroid gland in the neck)
Phosphorus	Eggs, meat, milk, cheese, vegetables	- strong bones and teeth - muscle contraction - stores energy	- rickets - weakness
Potassium	Meat. Nuts, bananas	- maintains body fluids - proper functioning of nerves - regulation of heartbeat	- weak muscle - paralysis

F) Water

Water makes up 70% of our body.

- Water is the main components of our blood and body fluids.
- Water can dissolve a lot of other chemicals in our body and allows chemical to react.
- Waste substances such as urea and salts are passed from our body in water.
- Water helps us to regulate our body temperature.
- Water lost through urine and sweat MUST be replaced.

THE IMPORTANCE OF WATER

- Universal solvent
- Transportation medium
- Medium for chemical reactions
- Turgidity in plants
- Removes waste product

TEST FOR WATER

- Using anhydrous copper Sulphate
- Using anhydrous cobalt chloride

G) ROUGHAGE (FIBRES)

Roughage is indigestible fibrous material. Fibre is also known as roughage.

- Fibre is made up of cellulose from plant cell walls.
- Fibre cannot be digested in our body.
- Fibre holds a lot of water so that our faeces remain soft and can pass from our body easily.
- Fibre can prevent constipations

BALANCED DIET

A balanced diet is a diet that contains all the main nutrients in the correct amounts and proportions to maintain good health. The food an animal eat every day is called **diet.**

MALNUTRITION

Refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients. Malnutrition is defined as poor nutrition.

- **There are two main types of malnutrition, under nutrition and over nutrition**.
- **Under nutrition** is caused by a lack of food and examples of this are **kwashiorkor, marasmus and anorexia.**
- **Over nutrition** is caused by excessive eating of energy-rich foodstuffs

EFFECTS OF MALNUTRITION

- Obesity
- Coronary heart disease

- Starvation
- Childhood protein-energy malnutrition (Kwashiorkor)

CHAPTER TWO

DENTITION AND DIGESTIVE SYSTEM

Dentition is the arrangement of teeth in the mouth (buccal cavity) of an organism.

CLASSIFICATION OF DENTITION

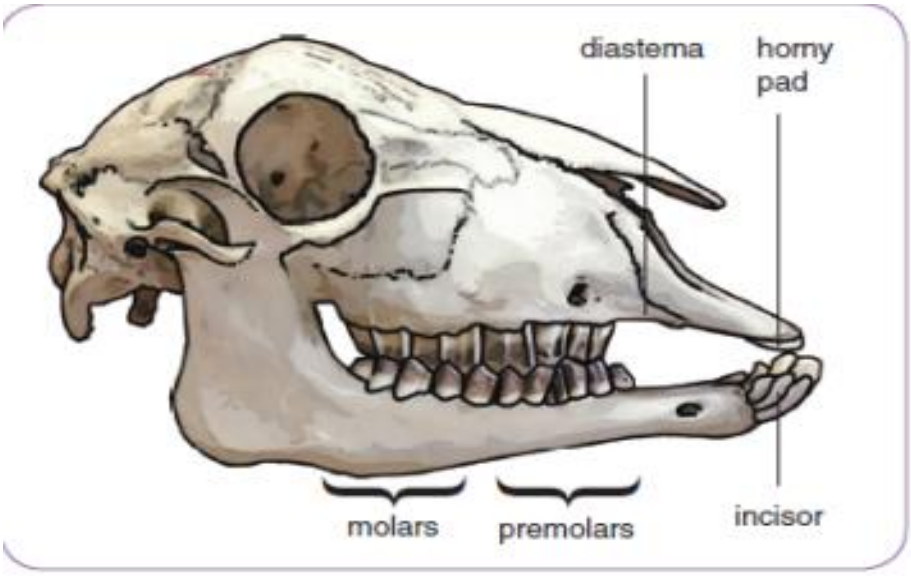
Dentition is classified based on

- Nutrition
- Type and size of teeth

TYPE OF DENTITION BASED ON NUTRITION

1) **Herbivore dentition** is a type of dentition found in mammals that consume plant material. Their dentition and digestive tract have adapted to consuming large amounts of plant material.

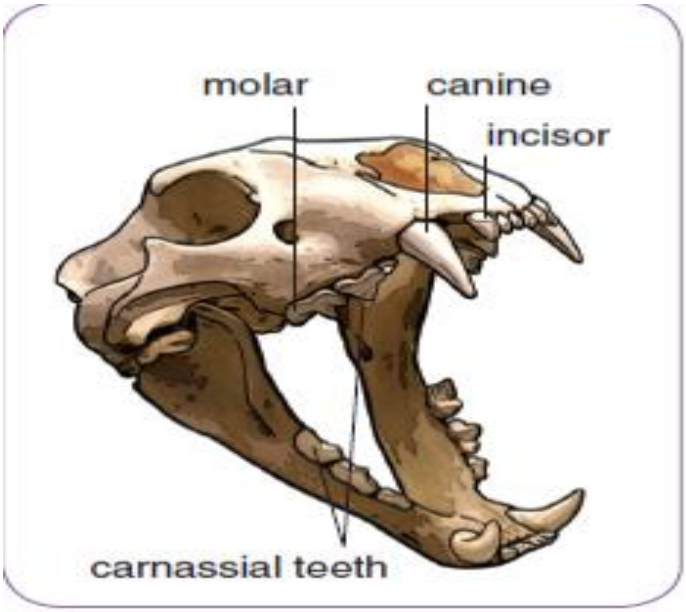
- Their mouths are smaller and their tongues are muscular.
- The upper jaw has a tough **horny pad instead of incisors**.
- The incisors are well developed
- There is a large gap between the incisors and the premolars. **This gap is called diastema**.
- The premolars and molars have broad grinding surfaces with complex ridges.



2) **Carnivore dentition** is a type of dentition found in mammals that eat flesh/meat.

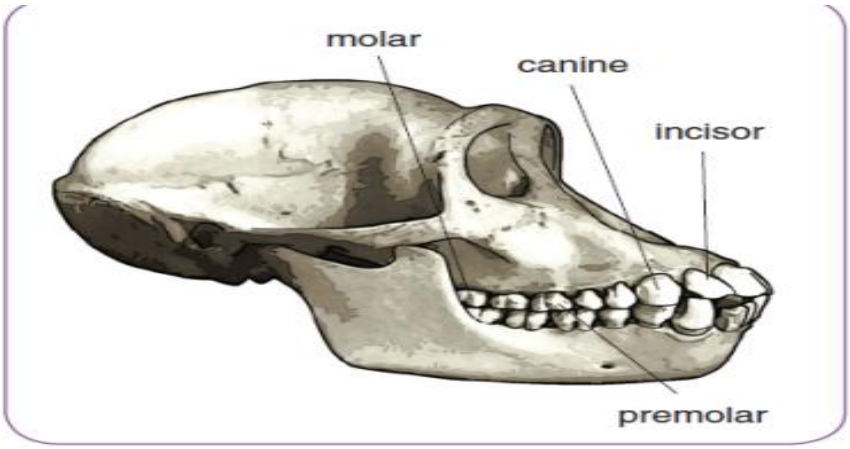
- The distinctive feature of carnivores is the **carnassial teeth**. The upper fourth molar and the lower first molar have sharp knife like edges that slide past each other and slice through flesh.

- The canines are long and sharp and are used for the killing of prey and tearing of the flesh.
- The incisors are short and prong like for holding and shredding.
- The molars (carnassial teeth) are sharp and uneven and they are used for chewing the tough meat



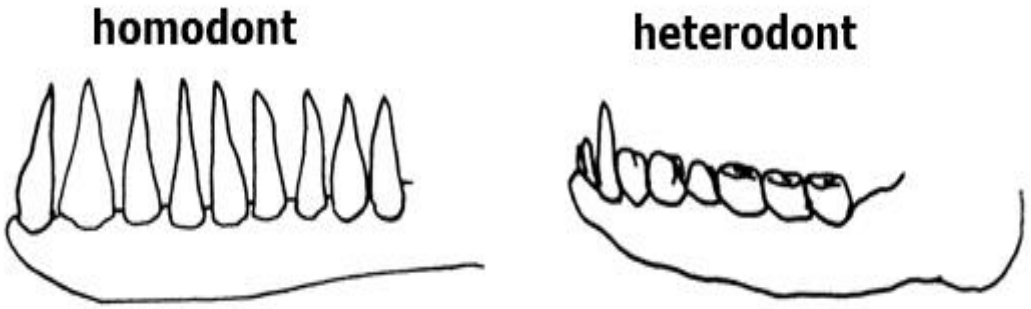
3) **OMNIVORE DENTITION** Is a type of dentition found in mammals that feed on both flesh and grass.

- The canines are pointed for tearing off large pieces.
- The molars are flat and have crowns for grinding food



TYPE OF DENTITION BASED ON SHAPE AND SIZE

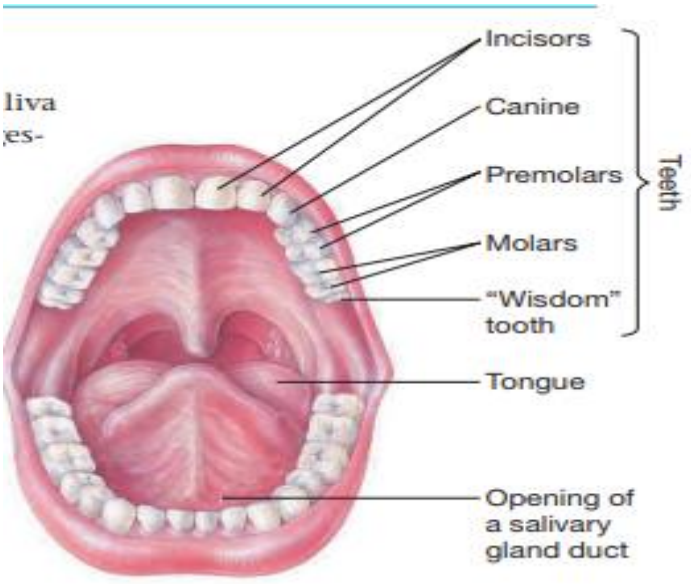
1) **HOMODENT DENTITION:** This is a type of dentition in which the teeth are of the same size and shape.
2) **HETERODONT DENTITION:** It is a type of dentition in which the teeth are of different size and shape. Example is the dentition in humans.

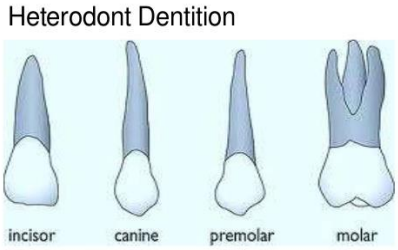


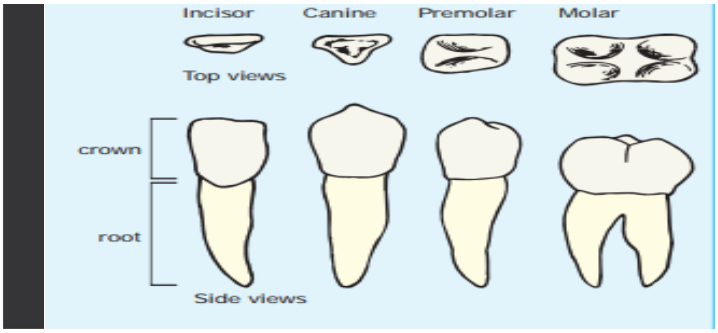
TYPES OF HETERODONT DENTITION

There are 4 different types of heterodont dentition. These are;

- Incisor (I)
- Canine (C)
- Premolar (P)
- Molar (M)
- **Mammals have two set of teeth in their life time; namely milk teeth and permanent teeth**.
- Milk teeth are the first set of teeth to appear. They are short lived
- Permanent teeth are the more complex set of teeth that replaces the milk teeth. Permanent teeth consist of the incisors, canines, molars and premolars.

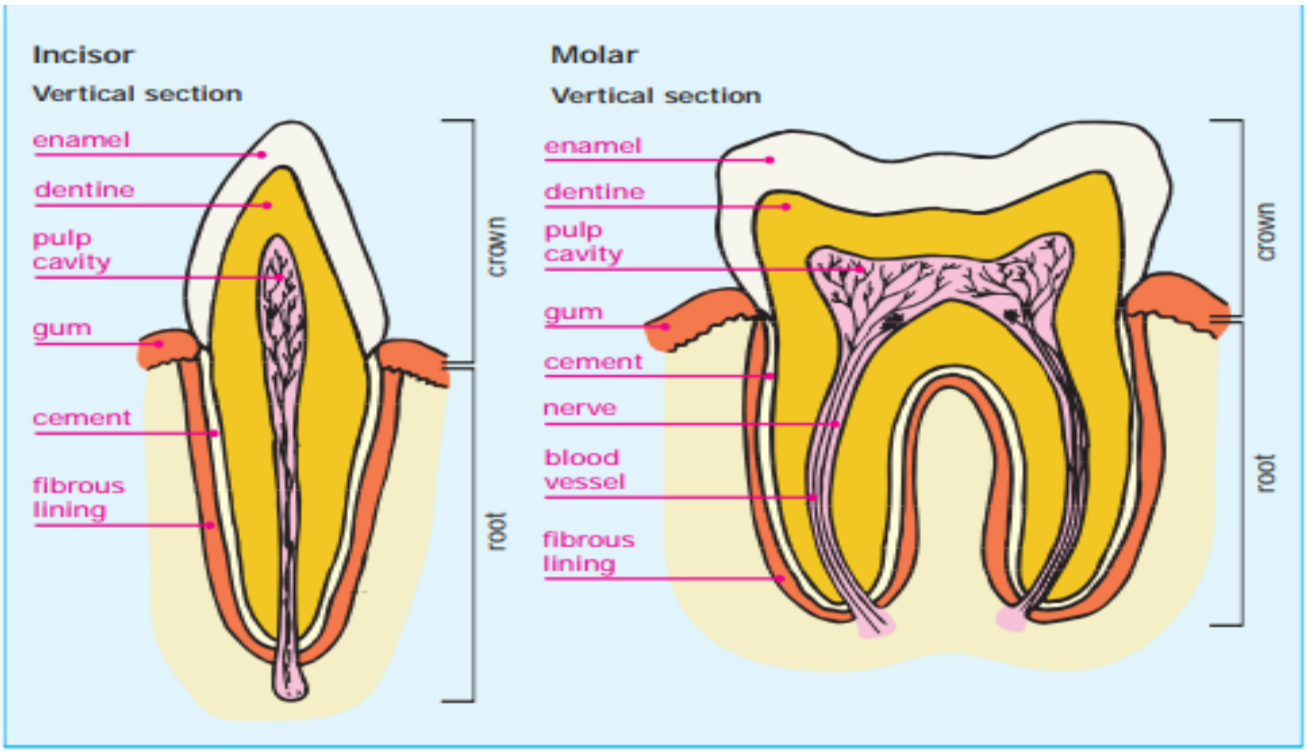






- Incisors are chisel shaped, broad and flat with cutting edges and are well developed in herbivores
- Canines are conical and pointed. It has blunt edges and are well developed in carnivores
- Premolars and molars have broad surfaces. They also have projections called cusps.
- Molars and premolars are collectively called **cheek teeth.**
- **Molars** are larger and have more cusps than premolar.

Types of teeth	Number of teeth	Functions
Incisors	8	Cutting and biting
Canines	4	Tearing and piercing
Premolars	8	Crushing and grinding
Molars	12	Crushing, grinding and mastication



- **Enamel** is the hardest substance made by animals. It is deposited on the outside of the crown of the tooth by cells in the gum before the tooth reaches the surface. The enamel is a non-living substance containing calcium salts; it forms an efficient, hard, biting surface.
- **Dentine** is more like bone in its structure. **It is hard but** not so brittle as enamel and running through it are strands of cytoplasm from cells in the pulp. These cells are able to add more dentine to the inside of the tooth. Pulp. In the centre of the tooth is soft

connective tissue called pulp. From this the living strands of cytoplasm in the dentine derive their food and oxygen.

- **The pulp** contains sensory nerve-endings and blood capillaries. Oxygen and food brought by the blood enable the tooth to live and grow.
- **The nerveendings** are particularly sensitive to heat and cold but produce only the sensation of pain.
- **The root** is not set rigidly in the jawbone, but is held by tough fibres so that it moves slightly in its socket as a result of chewing and biting movements.
- **Cement** is a thin layer of bone-like material covering the dentine at the root of the tooth. The fibres which hold the tooth in the jaw are embedded in the cement at one end and in the jawbone at the other.

Difference between herbivore dentition and carnivore dentition

Herbivore	**carnivore**
Presence of diastema	Absence of diastema
Absence of carnassial teeth	Presence of carnassial teeth
Presence of horny pad	Absence of horny pad
Absence of canines	Presence of canines

DENTAL CARE

- Avoid sugary food
- Use fluoride toothpaste (or drink fluoridated water) – **fluoride hardens tooth enamel**.
- Visit a dentist regularly to make sure and tooth decay is reacted early and any stubborn plaque is removed
- Don’t used your tooth in opening bottles
- Don’t drink or eat too hot or too cold foods
- Eat food rich in calcium for proper teeth formation

DISEASES AFFECTING THE TOOTH

- **Dental caries (tooth decay):** is damage to a tooth that can happen when decay-causing bacteria in your mouth make acids that attack the tooth's surface, or enamel
- **Periodontal diseases**: are mainly the result of infections and inflammation of the gums and bone that surround and support the teeth. In its early stage, called gingivitis, the gums can become swollen and red, and they may bleed. In its more serious form, called periodontitis
- **Pyorrhea:** is an older term that used to refer to any kind of gum disease or periodontal disease. In common usage today it generally refers to an advanced stage of periodontal disease known as periodontitis. It is at this stage that the ligaments and bone that support the teeth become inflamed and infected.

Enzymes:

Enzymes are biological catalyst that speeds up the rate of a chemical reaction. They are proteins.

Properties:

- They are specific in the actions
- They are sensitive to change in temperature and pH
- They are not used up in a reaction; i.e. they only participate in the reaction without being changed (destroyed or used)

Functions of Enzymes

1. Perform building up (anabolic) and breaking (catabolic) reactions

2. They control specific reactions due to their shape and chemical structure

3. Act as Catalyst

CHAPTER THREE

DIGESTIVE SYSTEM

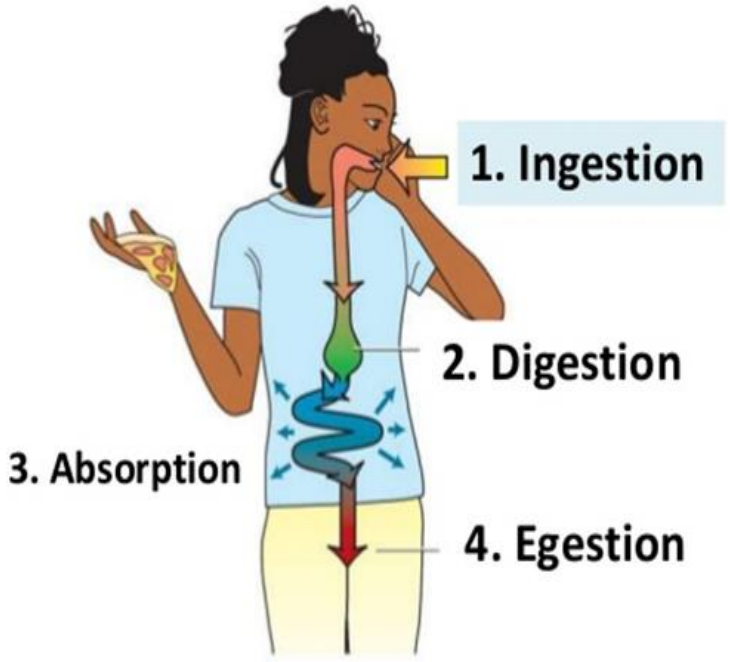
The digestive system is divided into two main components

- **Alimentary canal**
- **The accessory organs**

ALIMENTARY CANAL is the tube that runs from the mouth and ends at the anus. **It consists of the mouth, esophagus, stomach, intestine (small and large intestine), and anus.**

Accessory organs are organs that assist the alimentary canal in digestion. **It consists of the liver, pancreas, gall bladder and kidney.**

PROCESS OF THE DIGESTIVE SYSTEM (STAGES)



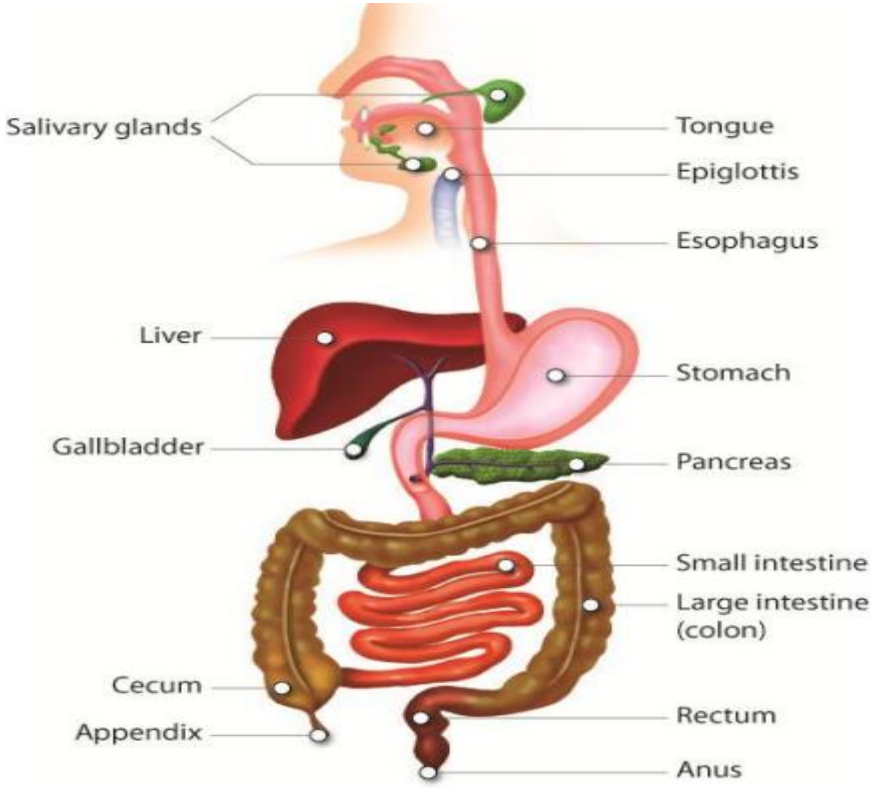
- **Ingestion** is the process where food is taken in – this occurs in the mouth.
- **Digestion** is the process where large molecules are broken down into smaller molecules either mechanically or chemically.
- **Absorption** is the process where the molecules move through the intestinal walls (small intestine) into the blood vessels.

- **Assimilation** is the used of absorbed food by the cells of the body or process where nutrients are moved into and used by the cells of the body.
- **Egestion** is the process whereby unused nutrients are eliminated from the digestive system

Types of digestion

- **Mechanical digestion** is the breakdown of large lumps of food into smaller particles. This begins in the mouth.
- **Chemical digestion** uses enzymes to break the food into its basic chemical compounds for absorption by the body. The enzymes control the chemical breakdown.

STRUCTURE AND PARTS OF THE DIGESTIVE SYSTEM OF HUMAN

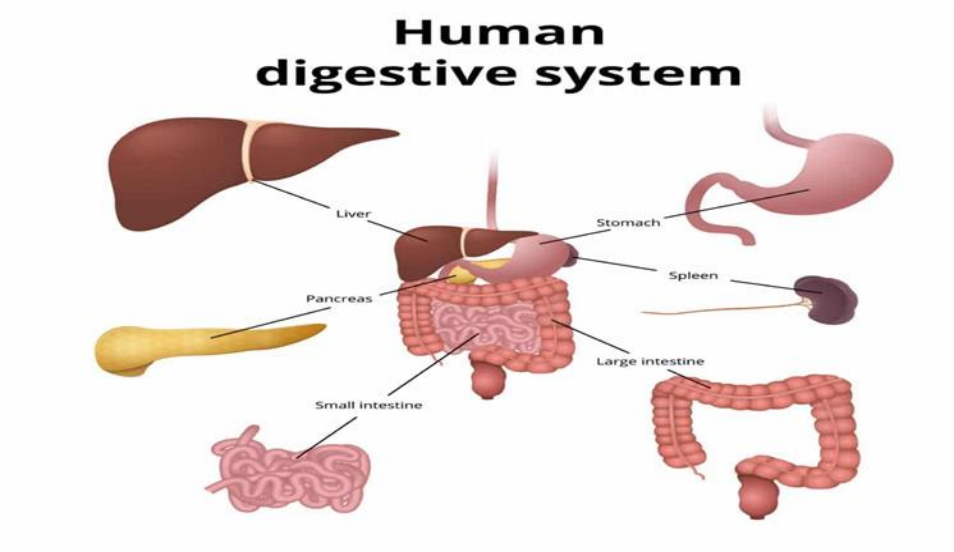


FUNCTIONS OF THE PARTS OF THE DIGESTIVE SYSTEM

- **Mouth** : for ingestion, grinding of food and digestion of cooked starch
- **Oesophagus/gullet** : swallowing of food
- **Stomach:** temporary storage of food. Digestion of proteins begins here.

- **Small intestine (duodenum):** bile is released by the gall bladder into the duodenum. The bile emulsifies fats.
- **Ileum:** digestion of carbohydrates, fats and protein is completed here. Absorption of food occurs here.
- **Colon:** absorption of water from undigested food
- **Rectum:** temporary storage of undigested food before they are egested as faeces
- **Anus:** egestion of food.

ORGANS AND GLANDS ASSOCIATED WITH THE DIGESTIVE SYSTEM



- **The salivary glands** situated in the mouth produce an enzyme called amylase that begins the digestion of starches and carbohydrates.
- **The Liver** produces bile and breaks down amino acids, alcohol, hormones and drugs.
- **The Gall Bladder** stores bile produced by the liver
- **The pancreas** produces insulin, glucagon and pancreatic juice.
- **The stomach** contains cells that produce and secrete hydrochloric acid.

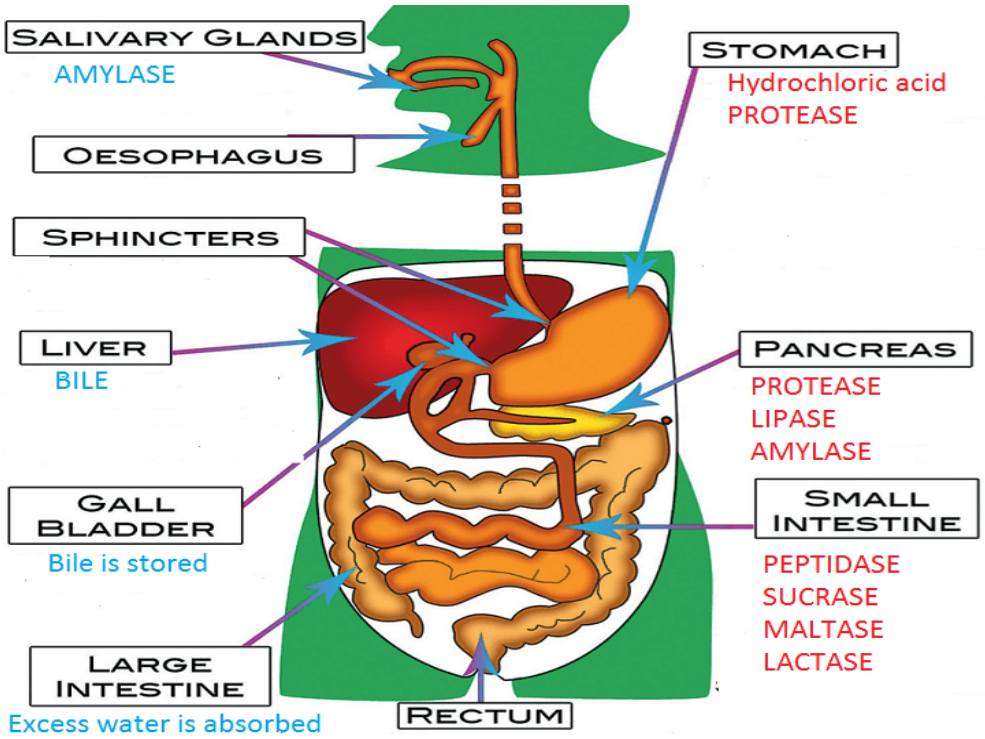
DIGESTIVE JUICE OF THE DIGESTIVE SYSTEM

The main digestive juices are saliva, gastric juice, bile, pancreatic juice and intestinal juice.

1) **Saliva** is secreted by **salivary gland** in the mouth.
   - ✓ It contains water to soften the food

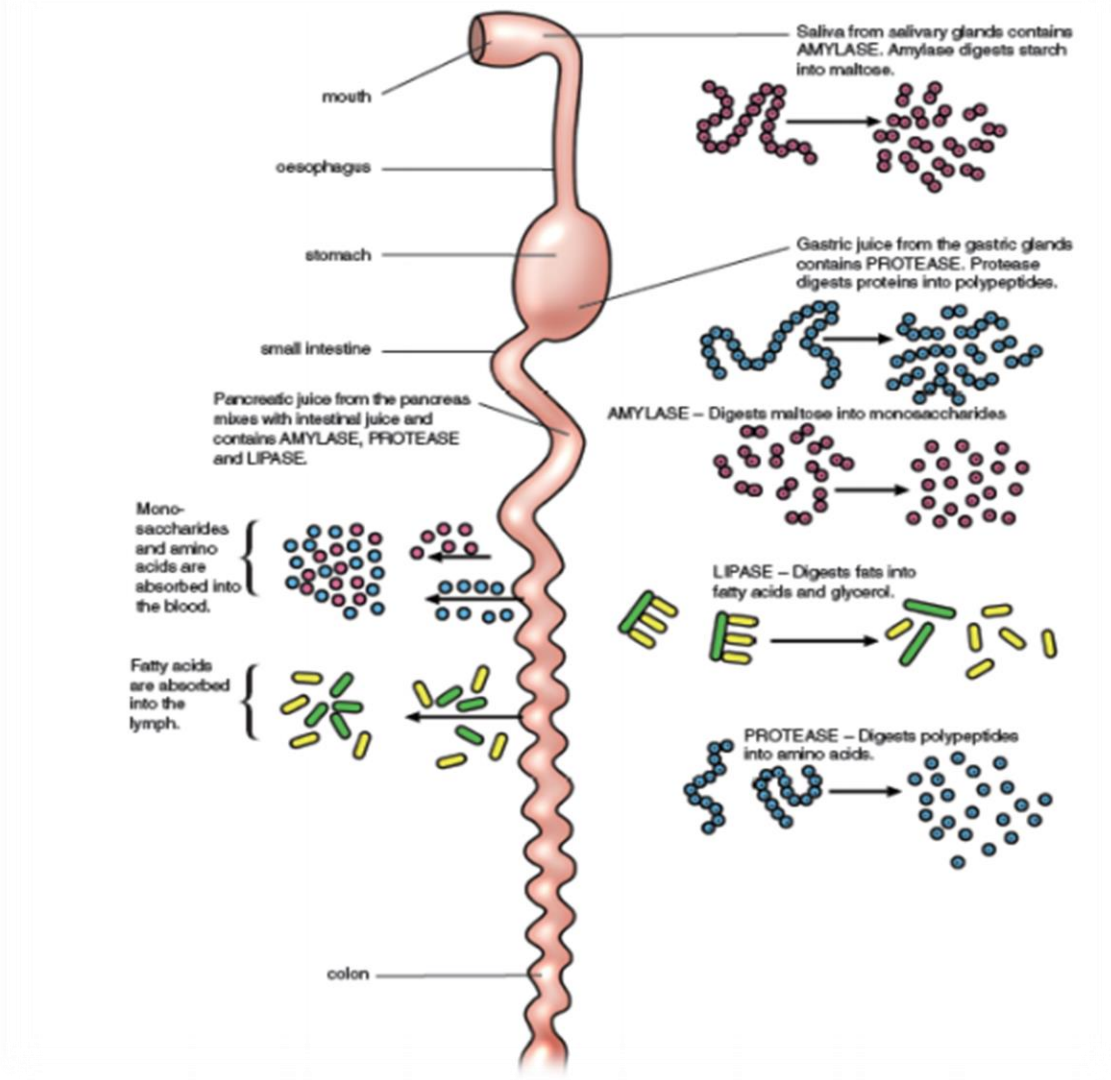
- ✓ bicarbonate to provide the right PH for digestion
- ✓ Salivary amylase to digest food.

2) **Gastric juice** is secreted by gastric glands in the stomach
   - ✓ Contain enzymes pepsin and renin and hydrochloric acid
   - ✓ HCl kills germs brought in with food and also provide right PH for stomach enzymes to function
3) **Bile** is produced by the liver but stored in the gall bladder. Bile is secreted into the duodenum
   - ✓ Bile emulsifies fats
   - ✓ Emulsification is the process by which fat is broken down into tiny droplets. This provides large surface area for digestion of fats by enzymes
4) Pancreas secretes **pancreatic juice** into the duodenum.



Site of digestion	**secretion**	**Organs that produced secretion**	**Enzymes present**	**function**
Mouth	Saliva	Salivary gland	**Ptyalin or salivary amylase**	Convert cooked starch to maltose

Stomach	Gastric juice	Walls of stomach (by gastric glands)	**pepsin**	Converts protein to polypeptide
			Renin	Curdles or clots milk protein. This enables milk to be acted upon by the pepsin
Small intestine	Pancreatic juice	Pancreas	**Pancreatic amylase**	Convert starch to maltose
			trypsin	Converts protein to polypeptide
			lipase	Converts fats and oils into fatty acids and glycerol
	bile	Liver		Emulsify fats
	Intestinal juice	Wall of ileum	**Maltase**	Converts maltose to glucose and glucose
			Lactase	Converts lactose to glucose and galactose
			Sucrase	Converts sucrose into glucose and fructose
			Lipase	Converts fats and oils into fatty acids and glycerol
			Erepsin	Converts polypeptides into amino acids
Large intestine				Absorbs water from undigested food


mouth
oesophagus
stomach
small intestine
colon
Saliva from salivary glands contains AMYLASE. Amylase digests starch into maltose.
Gastric juice from the gastric glands contains PROTEASE. Protease digests proteins into polypeptides.
Pancreatic juice from the pancreas mixes with intestinal juice and contains AMYLASE, PROTEASE and LIPASE.
AMYLASE – Digests maltose into monosaccharides
LIPASE – Digests fats into fatty acids and glycerol.
PROTEASE – Digests polypeptides into amino acids.
Mono-saccharides and amino acids are absorbed into the blood.
Fatty acids are absorbed into the lymph.

1) CARBOHYDRATE DIGESTION

- ✓ Carbohydrate digestion starts in the mouth
- ✓ The salivary glands release saliva. The saliva contains salivary amylase which converts cooked starch to maltose
- ✓ In the duodenum, the pancreas secrets amylase which also converts cooked starch to maltose
- ✓ In the ileum of the small intestine, specific enzymes are produced to convert maltose, sucrose, and lactose to glucose, and other monosaccharides.

2) FAT DIGESTION

- ✓ Fat digestion starts in the duodenum of the small intestine
- ✓ In the duodenum, bile released by the gall bladder is used to emulsify fat to form tiny fat droplets
- ✓ The pancreas produces an enzyme called lipase
- ✓ The lipase converts fats into fatty acids and glycerol.

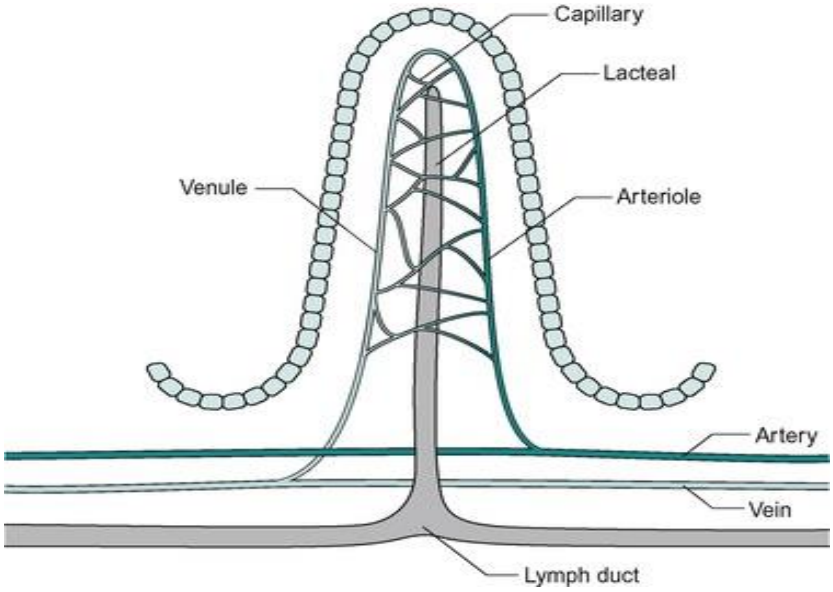
3) PROTEIN DIGESTION

- ✓ Protein digestion starts in stomach
- ✓ The stomach produced pepsin and renin. Renin curdles milk proteins while pepsin converts protein into polypeptide
- ✓ In the duodenum, an enzyme called erepsin is secreted which converts polypeptides into amino acids.

4) ABSORPTION OF FOOD

- ✓ Absorption of food occurs in the small intestine
- ✓ The small intestine is suited for absorption because of the following reasons;
  a) It is very long and coiled. This increase the surface area for absorption
  b) It contains structures called **Villi** which increase the surface area for absorption
  c) Absorbed food is transported from the small intestine to the liver via a vessel called **Hepatic portal Vein.** A lymph vessel called **lacteal** absorbs fatty acid.

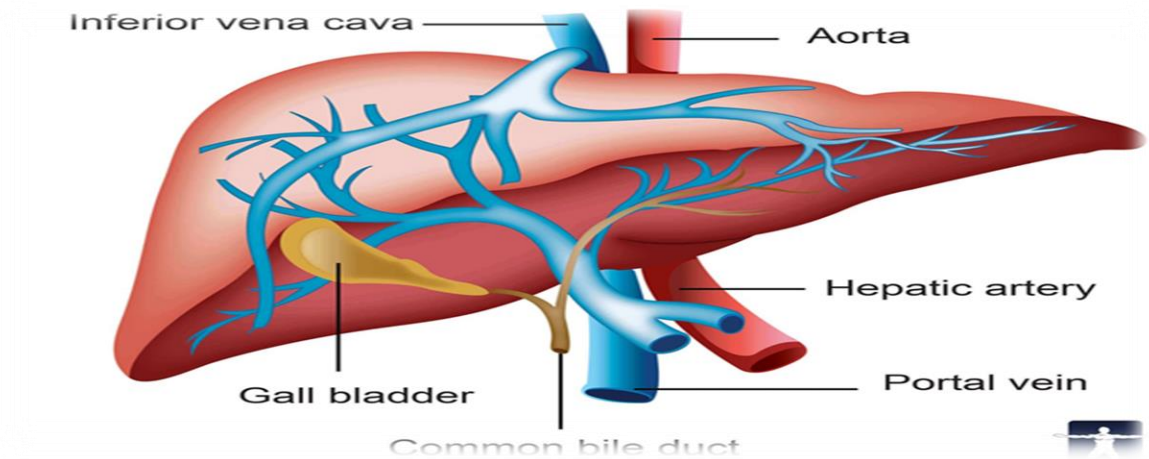
STRUCTURE OF A VILLUS (VILI-PLURAL)



5) **ASSIMLATION:** It is the process by which the products of digestion are used by the body cells.

food	**End product of digestion**	**Function**
Carbohydrate	Glucose	Produce energy
Protein	Amino acids	Build of body tissues
Lipids (fat and oil)	Fatty acids and glycerol	Production of energy

THE LIVER



It is the largest internal organ of the body. The following are functions of the liver

- ✓ Digestion: the liver produce bile which is important for emulsification
- ✓ Deamination of excess amino acid. **Deamination** is the removal of excess amino acids from the body. The amino acids are converted into urea and carbohydrates.
- ✓ Detoxification of harmful substances. **Detoxification** is the conversion of toxic substances into harmless forms.
- ✓ Regulation of body temperature by producing heat
- ✓ Control of blood glucose level
- ✓ It stores excess glucose as glycogen
- ✓ It plays a role in plasma proteins production.

DISEASES OF THE LIVER

- ✓ Cirrhosis
- ✓ Hepatitis
- ✓ Jaundice
- ✓ Liver cancer

CONSTIPATION

It is the difficulty in passing stools. A constipated stool is hard and dry because it contains less water.

CAUSES OF CONSTIPATION

- ✓ Insufficient roughage or fibre in diet
- ✓ Eating foods rich in animal fats
- ✓ Irregular eating habits
- ✓ Ignoring the desire to empty your bowels
- ✓ Lack of exercises
- ✓ Reduced intake of water
- ✓ Certain medications

EFFECTS OF CONSTIPATION

- ✓ Headache
- ✓ Tear in the lining of the rectum
- ✓ Intestinal obstruction

PREVENTION OF CONSTIPATION

- ✓ Eating food rich in roughage
- ✓ Developing regular eating habits
- ✓ Taking adequate amount of fluids
- ✓ Exercising regularly
- ✓ Not postponing defecation

INDIGESTION

It is the inability to break down food

SYMTOMS OF INDIGESTION

- ✓ abdominal pain
- ✓ nausea
- ✓ heartburn

CAUSES OF INDIGESTION

- ✓ poor eating habits
- ✓ eating improperly cooked food
- ✓ eating excessive amount of fatty foods
- ✓ excess intake of alcohol and acidic food
- ✓ diseases such as stomach ulcers, duodenal ulcers and stomach cancers
- ✓ certain medications

PREVENTION OF INDIGESTION

- ✓ developing good eating habits
- ✓ eating properly cooked food

- ✓ avoiding excessive intake of fatty food
- ✓ avoiding intake of alcohol

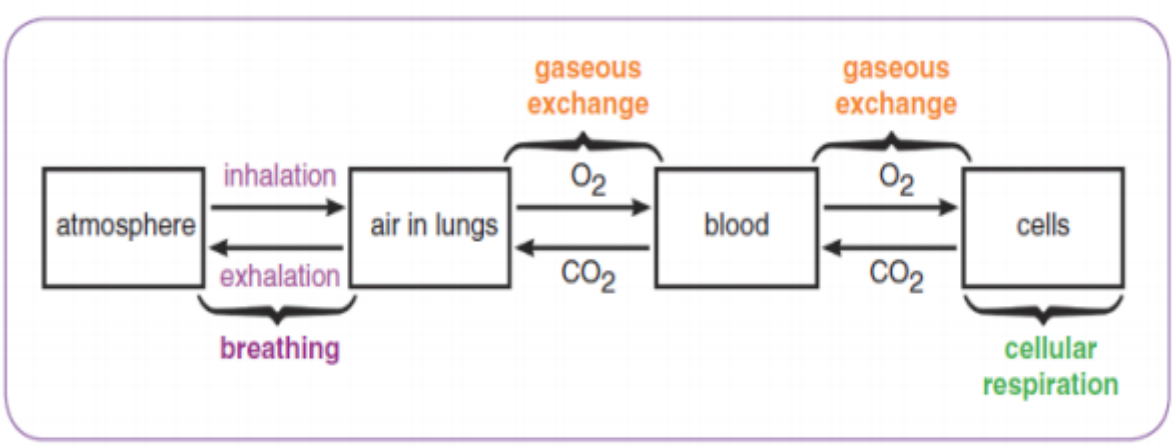
Chapter four

THE RESPIRATORY SYSTEM

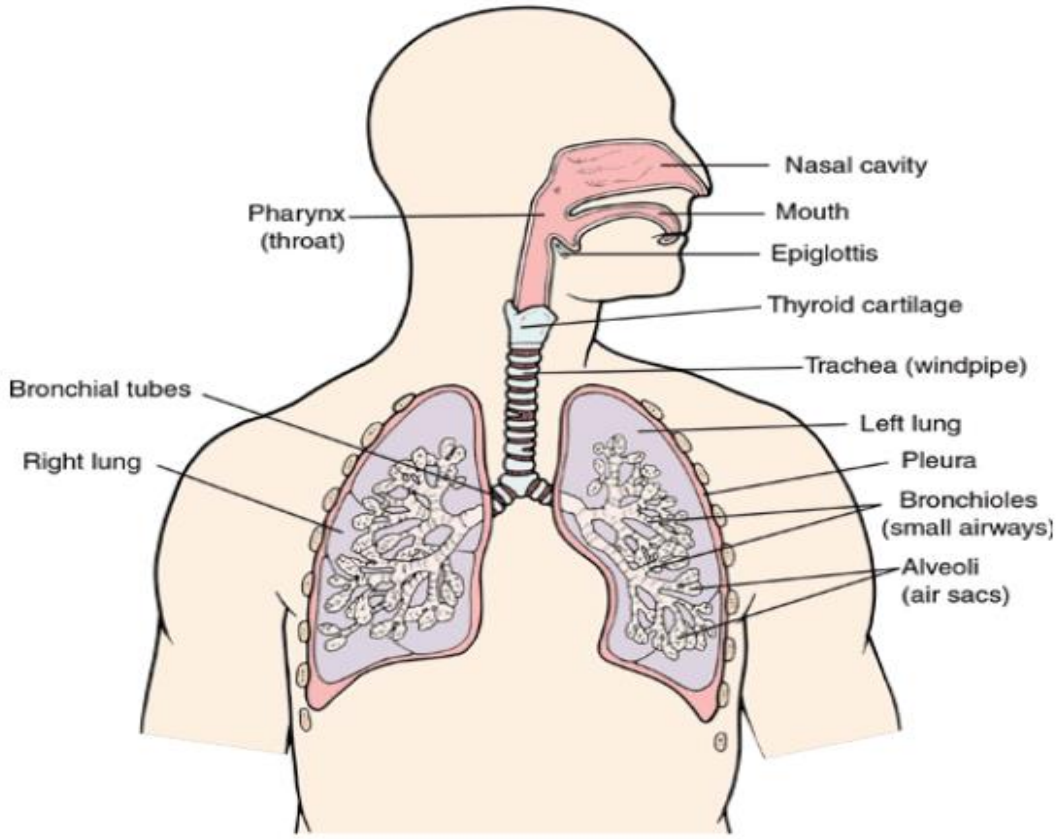
The main function of the respiratory system is to take in oxygen from the atmosphere and make it available to the cells for cellular respiration.

STAGES OF RESPIRATION

- ✓ **Breathing** – the mechanical process whereby air moves into and out of the lungs. (inhalation and exhalation)
- ✓ **Gaseous exchange** – the exchange of oxygen and carbon dioxide across a gaseous exchange surface.
- ✓ **Cellular respiration** – it is the breakdown of food (glucose) to release energy with or without oxygen.

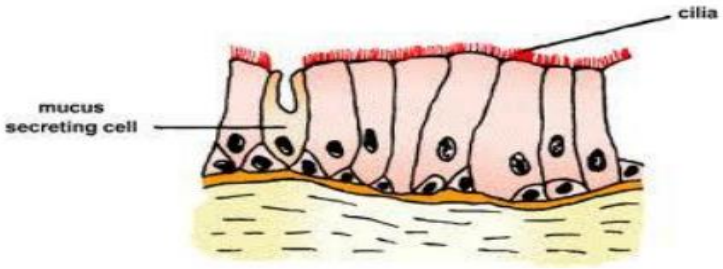


STRUCTURE OF THE RESPIRATORY SYSTEM



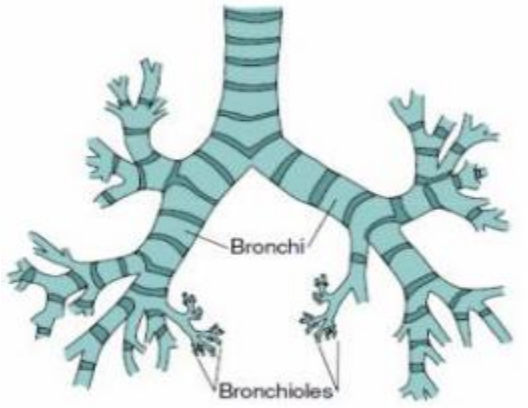
PARTS AND FUNCTIONS OF THE RESPIRATORY SYSTEM

1) **Trachea:** Lined with ciliated epithelium
   - ✓ C-shaped cartilaginous rings hold the trachea open
   - ✓ **Dust particles trapped by mucous and transported to the exterior by mucous**



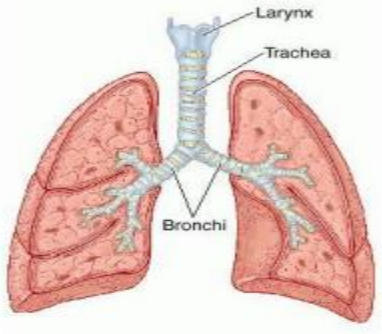
2) **Bronchi and Bronchiole:**
   - ✓ The trachea divides into the right and left bronchus which enter the lung.

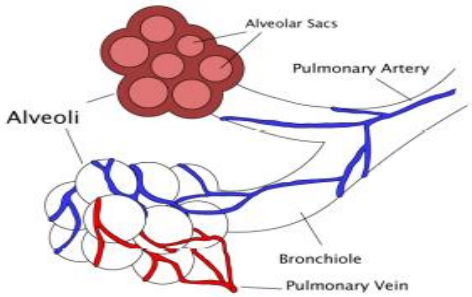
- ✓ Inside the lung they divide into smaller branches called bronchiole
- ✓ Lined with mucous membrane and kept open by O-shaped cartilaginous rings
- ✓ Smaller the bronchiole the cartilage is no longer present



3) **THE LUNGS:**

- ✓ Two lungs. The right lung has three lobes and the left two
- ✓ Protected by the intercostal muscles between the ribs.
- ✓ Surrounded by a double pleural membrane with pleural fluid in between to stop friction
- ✓ The lungs rest on a dome shaped muscular plate, **the diaphragm Internal Structure of the Lungs**
- ✓ **Bronchiole end in small air sacs called alveoli**
- ✓ **Gaseous exchange takes place in the alveoli**
- ✓ The wall of the alveoli is thin and consists of a single layer of squamous epithelium.
- ✓ **The alveoli are surrounded by a system of capillary blood vessels**





FEATURES/CHARACTERISTICS/REQUIREMENTS OF AN EFFECTIVE GASEOUS EXCHANGE SURFACE (ALVEOLI)

To enable oxygen and carbon dioxide to diffuse through it easily, it must be:

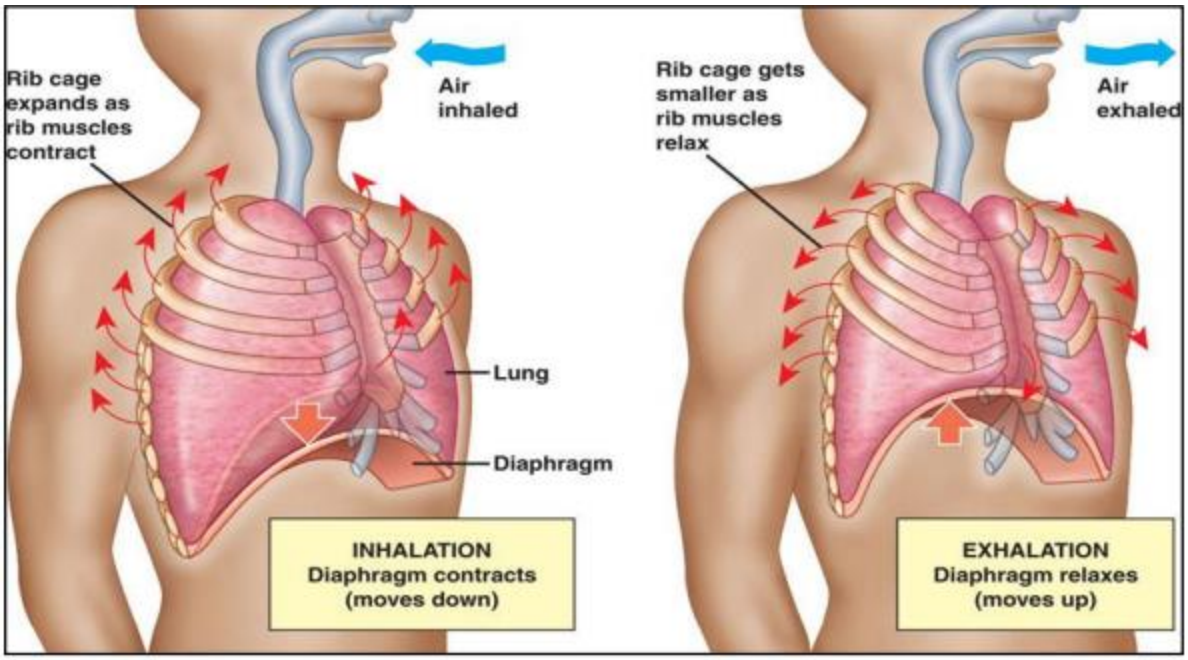
- ✓ **Large** – to ensure the maximum exchange of gases can take place.
- ✓ **Thin and permeable** – so that diffusion can take place easily and rapidly.
- ✓ **Moist** – so that gases can dissolve to form a solution.
- ✓ **Well ventilated** – good oxygen supply and carbon dioxide removal. (maintain a diffusion gradient)
- ✓ **Efficient transport system** – for effective transport of gases.
- ✓ **Well protected -** to prevent desiccation (drying out) and mechanical injury

1) BREATHING

It is a mechanical process whereby air moves into and out of the lungs. Breathing is controlled by the respiratory centre in the **medulla oblongata**

TYPES OF BREATHING

- ✓ Inhalation/ inspiration/Breathing in
- ✓ Exhalation/expiration/breathing out



Mechanism of Breathing

INHALATION	EXHALATION
• **Active** process • Diaphragms **contracts and flattens** • Thoracic cavity **enlarges** • External intercostals muscles **contract** • The ribs **move up and outward** and enlarges the thoracic cavity • **Abdominal muscle relax** to accommodate the intestines that are pushed down by the diaphragm • Total volume of the thoracic cavity **increases** • **Decrease** in air pressure • The elastic lungs **expand** and air flows **into** the lungs	• **Passive** process • Diaphragm **relaxes** and returns to dome shape • External intercostals **relax** • The ribs move down and inwards • Decrease in the volume of the thoracic cavity • Increase in air pressure • Air flows out of the lungs

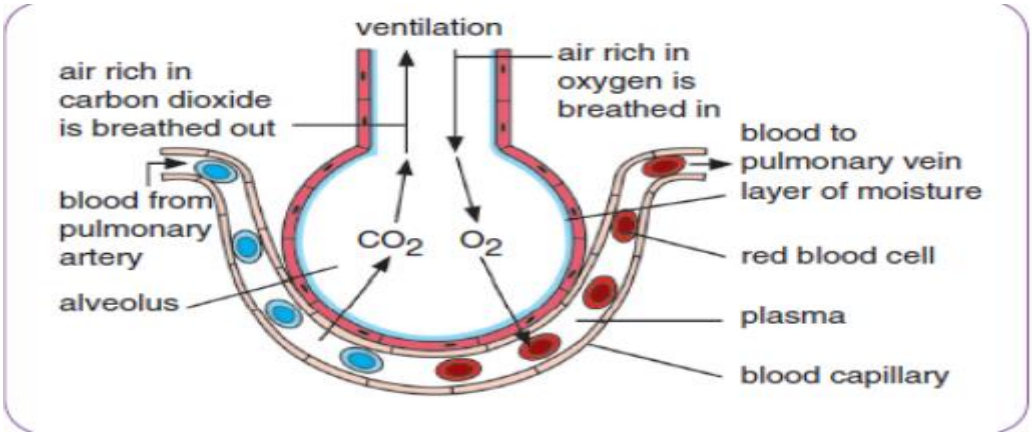
Composition of Inhaled Air vs. Exhaled Air

Constituent	Inhaled Air	Exhaled Air
Oxygen	20.9%	16%
Carbon dioxide	0.03%	4.0%
Water vapour	Variable	Variable but more than in inhaled air
Nitrogen	78.1%	78.1%
Noble gases	0.94%	0.94%

Lung Capacity

Lung capacity refers to the amount of air that enters or leaves the lungs. It is measured by a spirometer.

2) Gaseous Exchange at Lung Surface



- ✓ **Gaseous exchange takes place in the lungs between the air in the alveoli and the blood in the capillaries surrounding the alveoli and in the body tissues between the blood and the cells**.
- ✓ Deoxygenated blood flows into the capillaries around the alveoli from the body tissues.
- ✓ The air breathed into the alveoli contains a higher concentration of oxygen than the blood.

- ✓ The steep concentration gradient results in diffusion of oxygen from the air in the alveoli to the blood capillaries.
- ✓ Oxygen dissolves in the moisture lining each alveolus and diffuses through the thin wall of the alveolus and the thin wall of the capillary into the blood. The blood becomes oxygenated.
- ✓ The oxygenated blood leaves the lungs and passes through the heart to the tissues of the body.
- ✓ The deoxygenated blood in the capillaries around the alveoli contains a high concentration of carbon dioxide.
- ✓ Again because of a steep concentration gradient, carbon dioxide diffuses from the blood into the air in the alveoli to be exhaled from the lungs.

Transport of Gases in the Blood

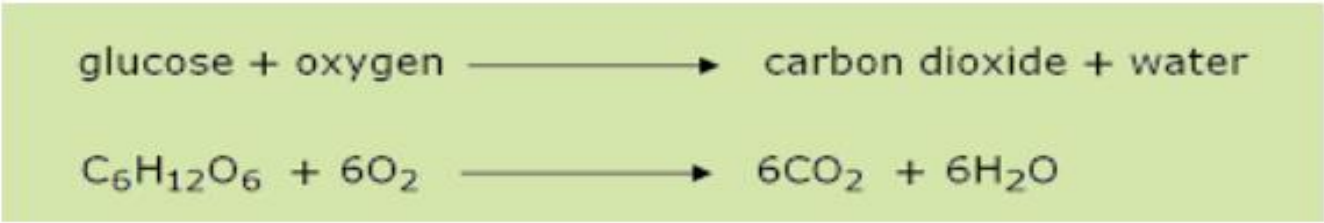
Oxygen	Carbon dioxide
• Small portion **dissolves** in the blood plasma • Most oxygen combines with haemoglobin to form **oxyhaemoglobin**	• Small portion **dissolves** in the blood plasma • Most CO_2 combines with haemoglobin to form **carbaminohaemoglobin** • Most CO_2 is transported as **bicarbonate ions**

3) Cellular respiration

It is the breakdown of food (glucose) to release energy with or without oxygen.

TYPES OF CELLULAR RESPIRATION

- ✓ **Aerobic Respiration** It is the breakdown of glucose in the presence of oxygen to release energy. A lot of energy (many ATP molecules) is produced



- ✓ **Anaerobic respiration:** it is the breakdown of food (glucose) to produced energy in the absence of oxygen.
- ✓ Muscles respire anaerobically when exercising vigorously, because the blood cannot supply enough oxygen to maintain aerobic respiration. However, the formation and build-up of lactic acid in muscles causes cramp (muscle fatigue).

glucose ⟶ ethanol + carbon dioxide + energy

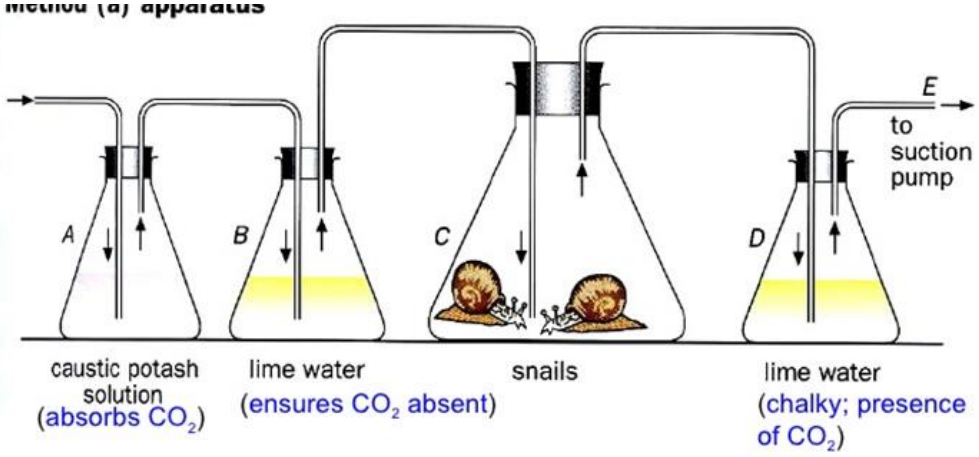
$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2 + \text{energy}$

Comparison of Photosynthesis and Respiration

1. Occurs only in the chlorophyll-bearing cells of plant.	1. Occurs in every living plant and animal cell.
2. Needs the presence of light	2. Occurs at all times.
3. Water and Carbon dioxide are used.	3. Water and Carbon dioxide are given off as waste products.
4. Oxygen is given off as a waste product.	4. Oxygen is used in the process.
5. Food is built or synthesized.	5. Food is destroyed to release its energy.
6. The weight of the plant is increased	6. The weight of the plant is decreased.
7. Energy is stored.	7. Energy is released.

Aerobic respiration	Anaerobic respiration
1) It takes place in the presence of oxygen.	1) It takes place in the absence of oxygen.
2) In aerobic respiration, complete oxidation of glucose takes place.	2) In anaerobic respiration, the glucose molecule is incompletely oxidised.
3) End products are CO_2 and water.	3) End products are either ethyl alcohol or lactic acid and CO_2.
4) Lot of energy is liberated (38 ATP).	4) Relatively small energy is liberated (2 ATP).
5) It occurs in plant's and animal's cells.	5) Occurs in many anaerobic bacteria and human muscle cells.
6) $C_6H_{12}O_6 + 6O_2 \rightarrow 6\,CO_2 + 6H_2O + 686$ K.cal	6) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + 56$ K.cal

EXPERIMENT TO FIND OUT WETHER CO_2 IS GIVEN OFF DURING RESPIRATION



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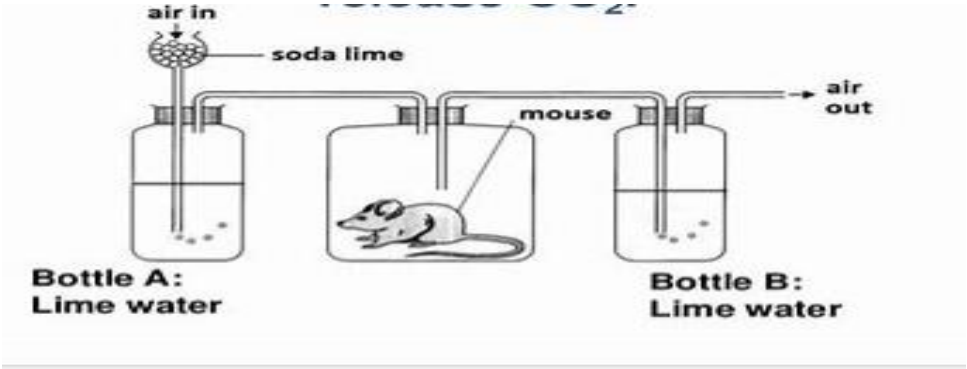
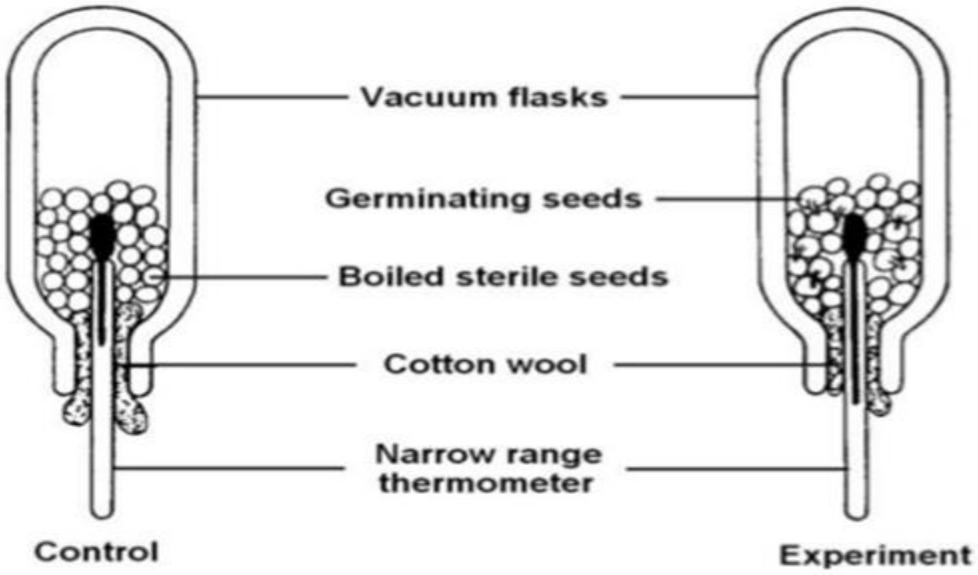


EXPERIMENT TO SHOW THAT HEAT IS PRODUCED DURING RESPIRATION

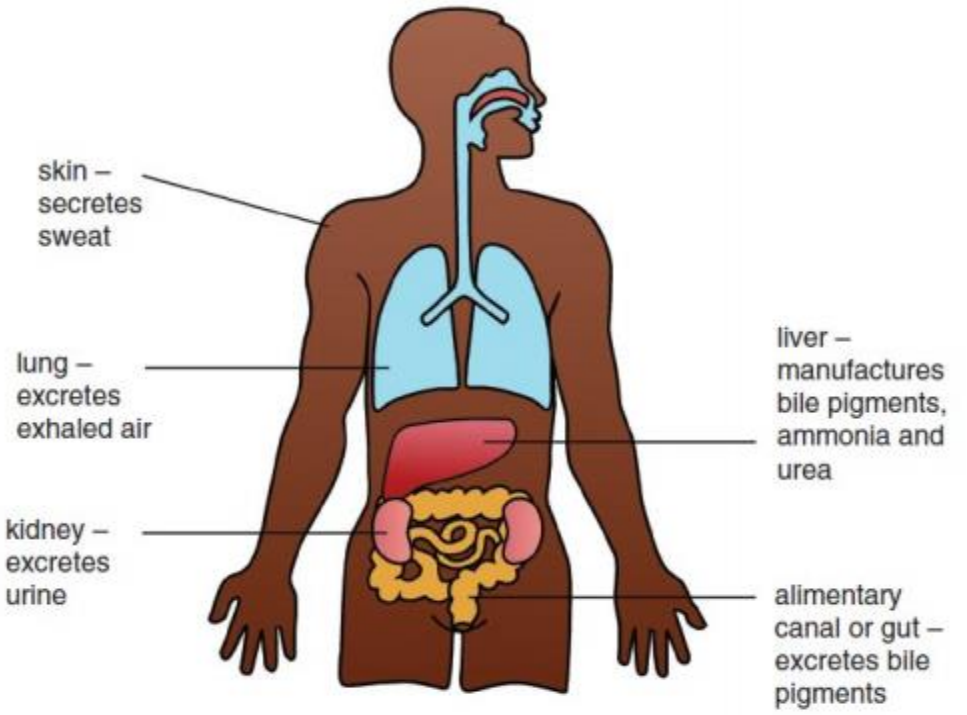


Diseases related to Gaseous Exchange

- ✓ Tuberculosis
- ✓ Asthma
- ✓ Hay fever
- ✓ Bronchitis
- ✓ **Emphysema** - a condition in which the thin walls of the alveoli break down forming large air spaces in the lungs.
- ✓ Lung cancer

CHAPTER ONE

EXCRETORY SYSTEM



Excretion Is the removal of waste products of metabolism from the body of an organism. Excretion is different from **egestion and secretion.**

Egestion is the process by which undigested food substances are removed as faeces.

Secretion: is the release of useful substances from the body.

EXCRETION IN PLANTS

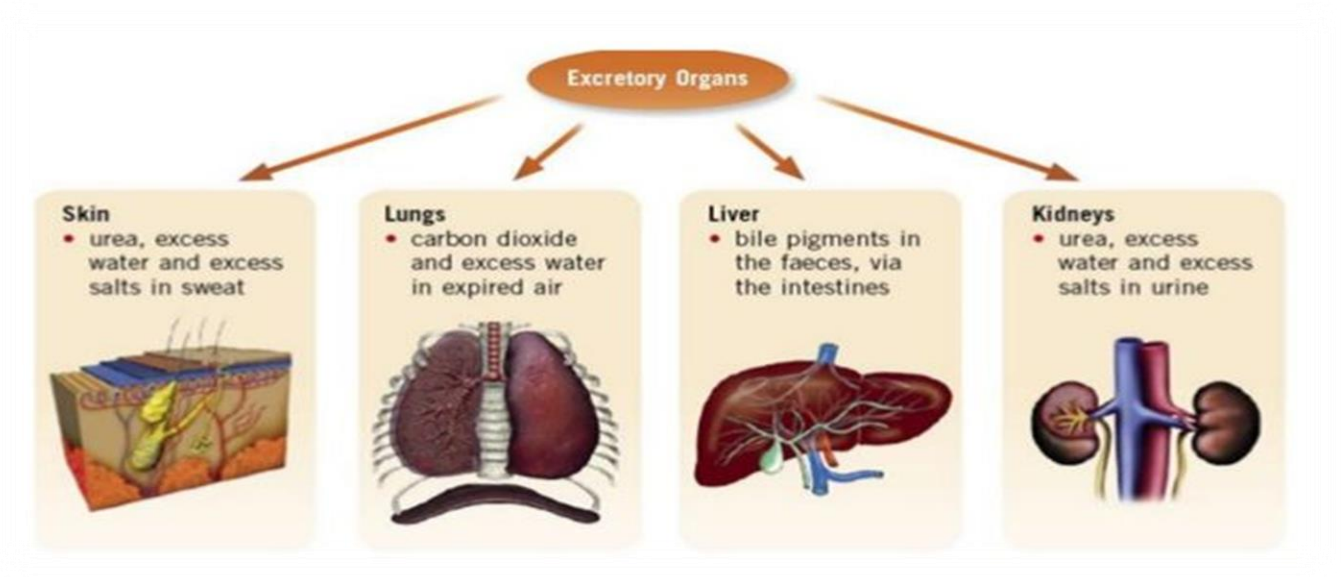
The main excretory products in plants are oxygen, carbon dioxide and water vapour. Other excretory products are excess salts, latex, tannins, gums, resins and alkaloids.

Excretory in plants is less important than in animals because of the following reasons;

- Excretion in plants is generally slow and hence smaller quantities of excretory wastes are produced
- The excretory products are useful for other processes in the plant

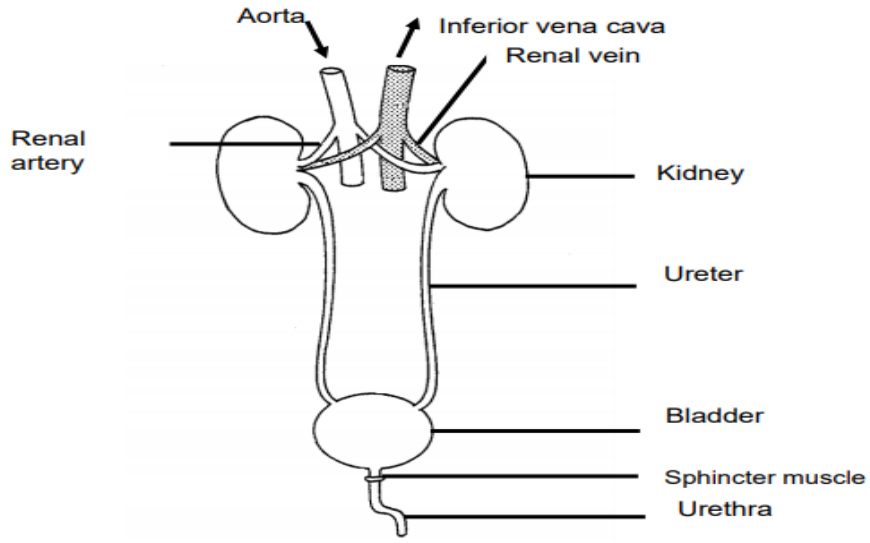
- The excretory products in plants is less harmful

EXCRETION IN HUMAN



Excretory organ	Excretory product
Kidney	Urea, mineral salts and water vapour in a form of urine
Liver	Bile pigments
Lungs	Carbon dioxide and water
Skin	Mineral salts, water and urea in the form of sweat

STRUCTURE AND FUNCTION OF THE URINARY SYSTEM

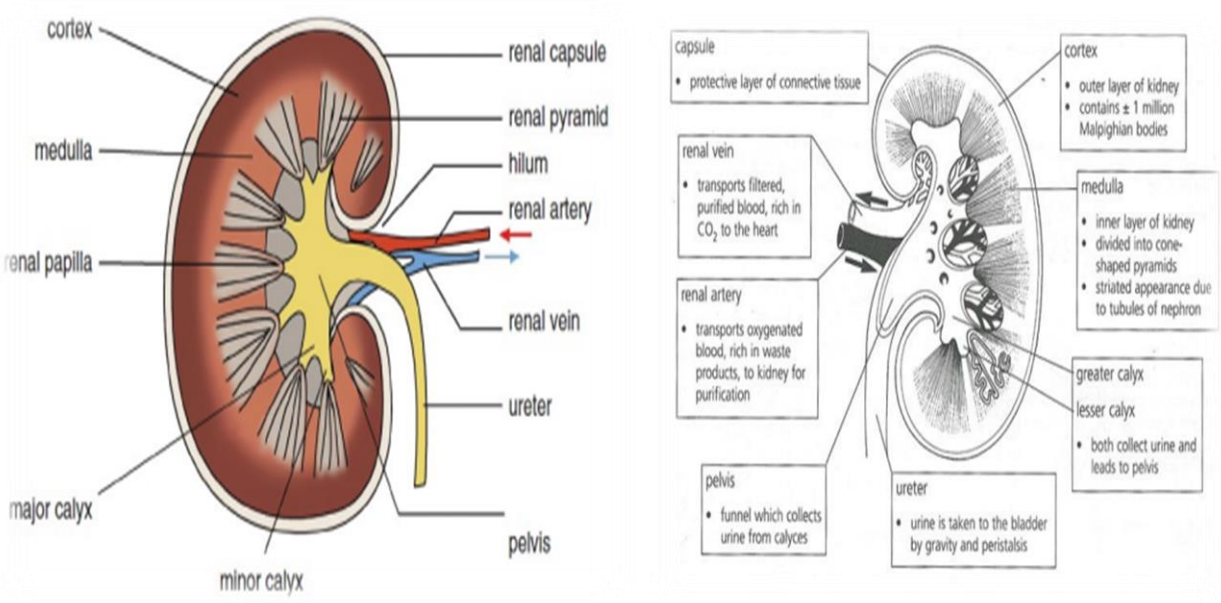


The **main organs of the urinary system are the kidneys**. Humans have two kidneys located at the back of the **abdominal cavity**

- A thick layer of fat covers and protects each kidney.
- The kidneys receive **oxygenated blood** from the **aorta via the renal arteries** and renal veins carry deoxygenated blood from the kidneys to the inferior vena cava.
- A narrow tube called the **ureter** carries urine from each kidney to the bladder where the urine is stored.
- The bladder is a muscular bag and its walls can stretch and it can store up to 500 ml of urine.
- The urine passes out of the body through a wider tube called the **urethra**.
- **Sphincter muscles** contract to close the urethra and relax to allow urine to flow out of the body in the process of urination.

THE KIDNEY

The kidney has 3 main parts: the cortex, medulla, and pelvis. Leading form the pelvis is a tube, called the ureter. The ureter carries urine that the kidney has made to the bladder.



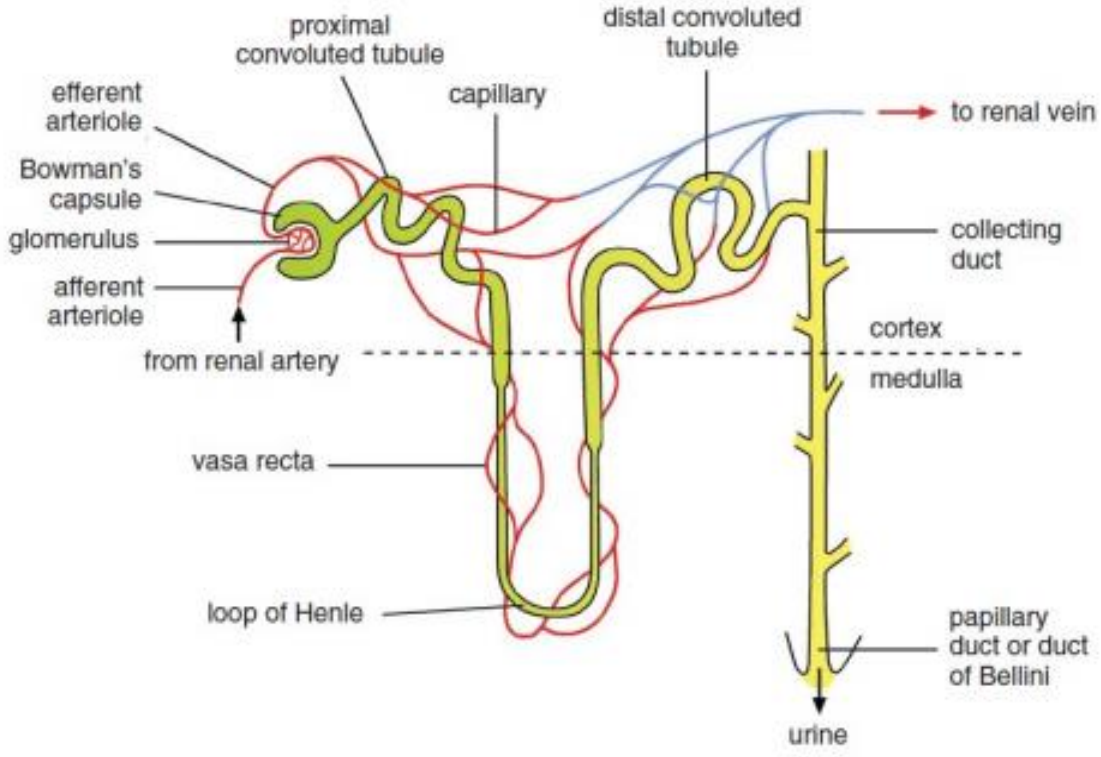
FUNCTIONS OF THE KIDNEY

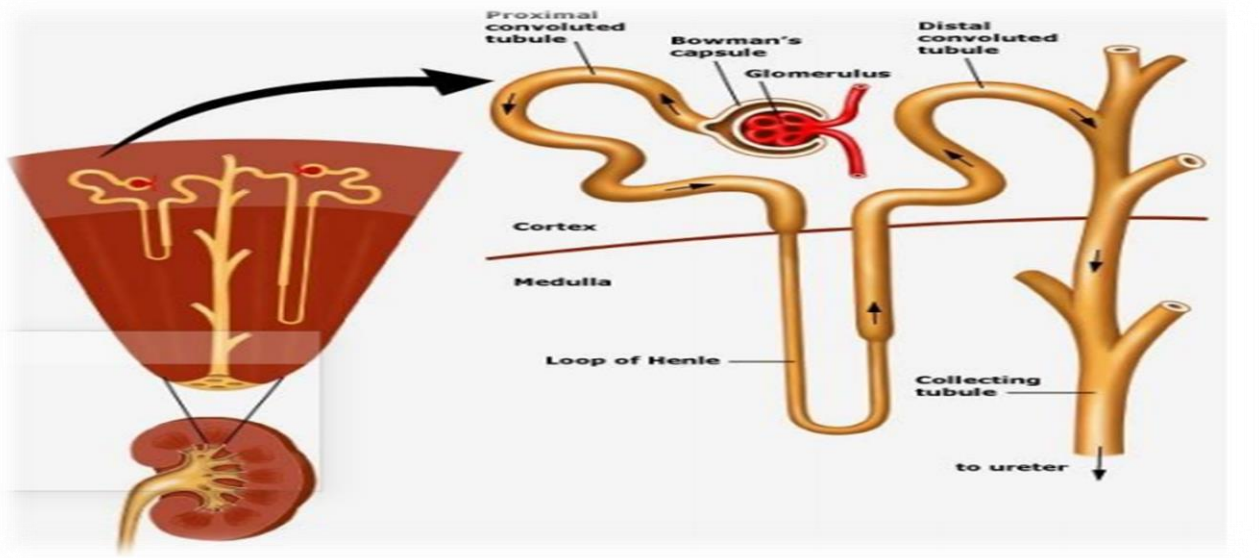
- It excretes metabolic wastes like urea
- It regulates water and salt levels in the blood
- It plays a role in the formation of blood cells
- It plays a role in the maintenance of blood pressure
- It plays a role in the elimination of drugs

THE NEPHRON

- Inside each kidney there are many tiny little tubules called **nephrons.**
- **A nephron is a functional unit of the kidney**. It is situated partly in the **cortex** and partly in the **medulla**.
- Each nephron consists of a **cup-shaped Bowman's capsule, a coiled proximal convoluted tubule, a loop of Henle and a coiled distal convoluted tubule which leads to a collecting duct.**
- The Bowman's capsule contains a network of capillaries called the **glomerulus**.

- **The Bowman's capsule and glomerulus together are called the Malpighian body.**
- The **renal artery carries oxygenated blood into the kidney**. It divides up into smaller arteries which divide into many afferent arterioles.
- The afferent arterioles lead into a glomerulus and away from the glomerulus in efferent arterioles. These capillaries reunite to form venules that carry deoxygenated blood, with wastes removed from it, to the renal vein.





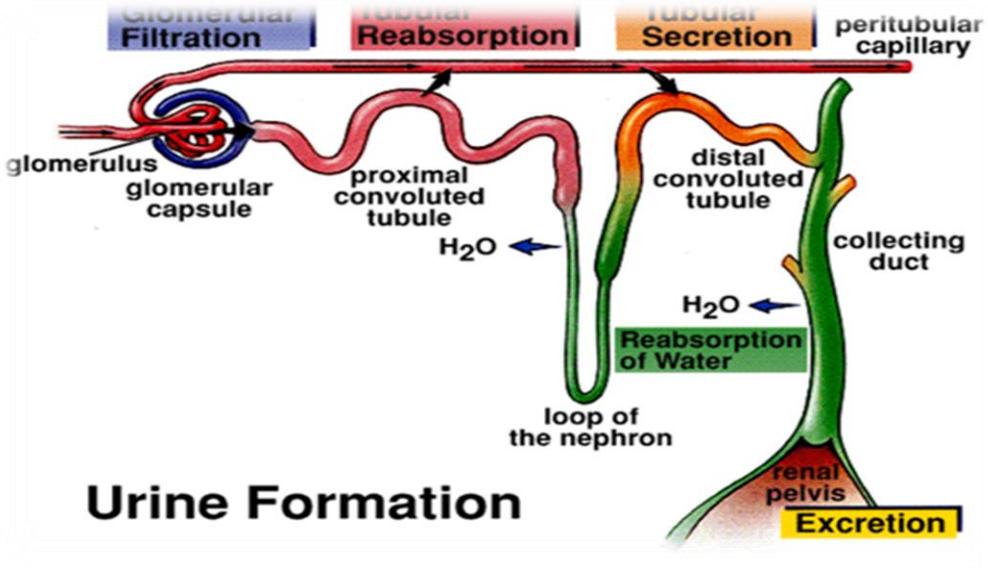
FUNCTIONS OF THE PARTS OF THE NEPHRON

- **Glomerulus:** for ultrafiltration
- **Bowman capsule:** for ultrafiltration
- **Proximal convoluted tubule :** Absorption of most water and selective reabsorption of all glucose, amino acids and vitamins
- **Loop of Henle:** reabsorption of water. Urine is concentrated and water is conserved
- **Distal convoluted tubule:** concentration of urine (absorption of water from urine)
- **Collecting duct:** concentration of urine (absorption of water from urine)

Blood supply of the nephron:

Renal artery → afferent arterioles → glomerulus → efferent arteriole → second capillary network → venules → renal vein

PROCESS OF URINE FORMATION



Urine formation in our body is mainly carried out by three processes namely

- **Glomerular filtration:** refers to the process by which blood in the **glomerulus** is filtered under pressure into the **Bowman capsule.** The filtrate formed is called glomerular filtrate. **Blood cells and proteins (like fibrinogen) are too large to be filtered and hence are absent in the glomerular filtrate.** Glucose and ions like sodium and chloride ions are present in the filtrate
- **Selective Reabsorption:** is the process by which useful substances in the glomerular filtrate are absorbed back into the blood. Unwanted substances still remain in the filtrate and are excreted as urine.
- **Secretion:** tubular cells secrete substances like hydrogen ions, potassium ions into the **filtrate.** The secreted ions combine with the filtrate and form urine. The urine passes out of the **nephron tubule** into a **collecting duct**.

OSMOREGULATION IN THE KIDNEYS

The **Loop of Henle and the collecting ducts** are concerned with regulating the amount of water in the blood through **modifying the concentration of the urine**. If the body is dehydrated, mechanisms come into play to reabsorb water from the urine to add to the blood. In this case, the body would produce small volumes of concentrated urine. If the body is well hydrated, less water will be reabsorbed from the urine and the body will produce larger volumes of dilute urine. **Two essential hormones drive this process**

- **Aldosterone:** secreted by the **adrenal gland** helps maintain the sodium (Na+) and potassium (K+) ion balance in the blood by causing the **reabsorption of Na+ and the secretion of K+** . This ultimately leads to an **increase of water reabsorption**.
- **Anti-diuretic hormone (ADH):** secreted from the **posterior pituitary gland**, increases the **permeability of the collecting ducts to water so more water is drawn out of the urine before the urine leaves the nephron.** The water is drawn out of the collecting duct as a result of the actions of aldosterone. The water moves out by osmosis into the medulla of the kidney and into the blood to regulate the water potential. The more dehydrated the body, more ADH secreted and therefore the more water reabsorbed into the blood

THE SKIN

The skin is the largest organ of the mammalian body. It consists of two regions **namely the outer epidermis and the inner dermis.**

LAYERS OF THE EPIDERMIS OF THE SKIN

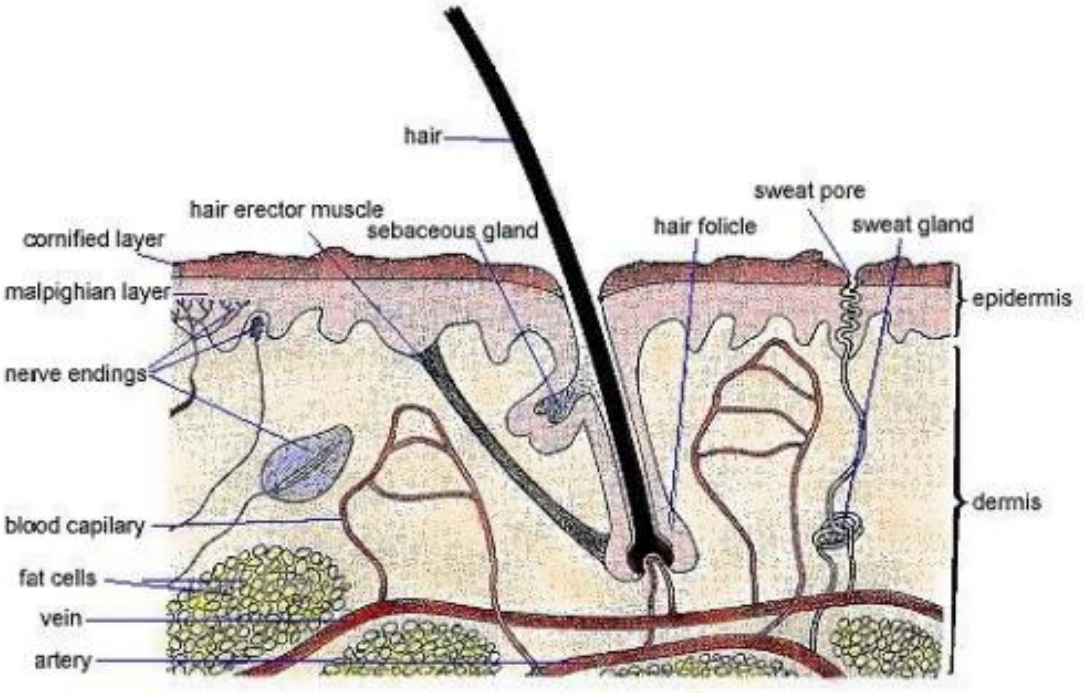
The skin has three layers namely

- **Cornfied layer**: consists of dead cells which constantly peeled off
- **Granular layer**: contain cells which replace the cells in the cornified layer. The cells may be keratinized.
- **Malpighian layer**: contains actively dividing cells. Melanin is found in the Malpighian layer. Melanin is the pigment that determines the skin colour.

PARTS OF THE DERMIS OF THE SKIN

- **Hair follicles**: the cells of the hair follicle produces hair
- **Hair:** helps to regulate body temperature
- **Sebaceous gland:** produces an oily secretion called sebum which helps to waterproof the skin surface and also keep the hair flexible
- **Sweat gland**: produces sweat
- **Sweat pore**: sweat moves through this pore to the surface of the skin
- **Nerves and receptors**: for detection and transmission of stimuli
- **Blood vessels**: they supply the skin with nutrients and take away waste products

STRUCTURE OF THE SKIN



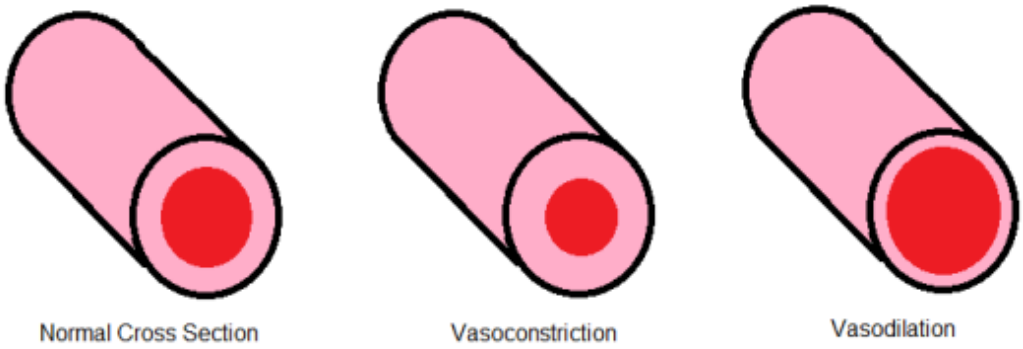
FUNCTIONS OF THE SKIN

- It protect the body against mechanical injury
- It helps to regulate body temperature
- It helps to regulate the amount of water in the body
- The skin produces vitamin D when exposed to sunlight.

- Excretes excess water, salts and little urea as sweat

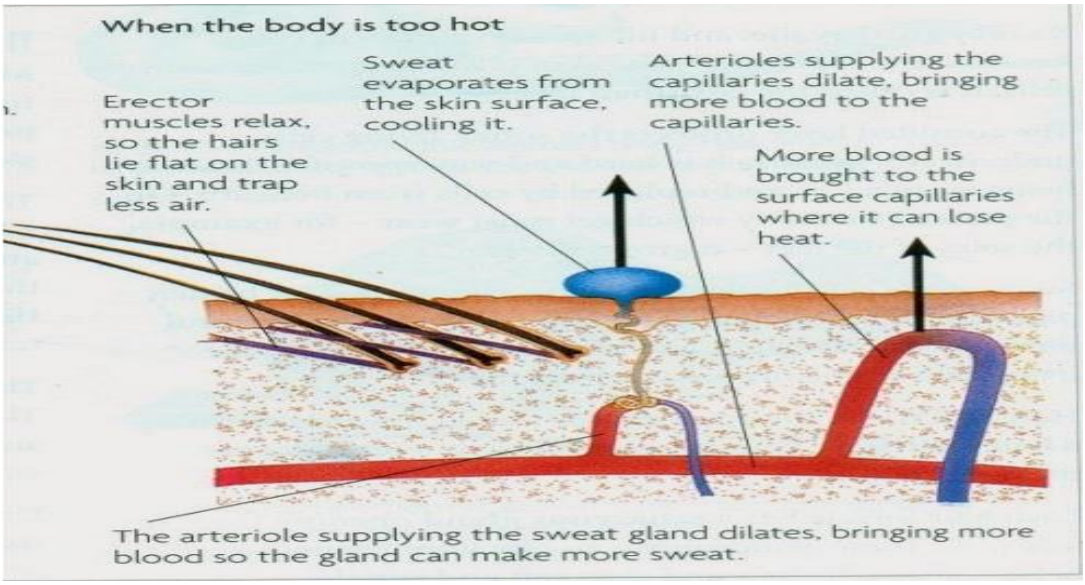
Homeostasis is the maintenance of a constant internal environment

- Organisms that can control their internal body temperature are called **homeotherms.** Mammals and birds are **homeotherms.** All other animals are **poikilotherms**, meaning that they have only limited ways of controlling their temperature.
- The control of body temperature in humans involves **the hypothalamus, the skin and muscles**.
- When the body becomes too hot, **sweating and vasodilatation increase the rate of heat loss from the skin**. When the body becomes too cold, **shivering increases heat production, and vasoconstriction reduces the rate of heat loss from the skin**.



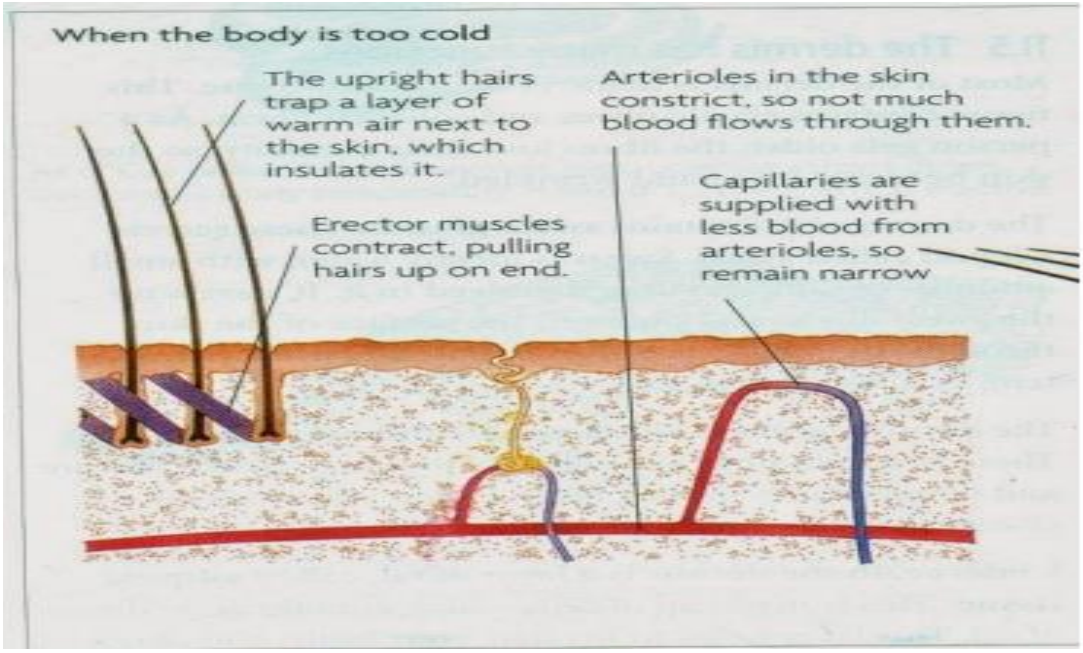
The skin as a thermoregulator

1) **Too Hot**
   - Sweating: droplets of sweat evaporate thereby cooling the body
- **Vasodilation occurs**: Blood vessels leading to the skin capillaries become wider (dilate) allowing more blood to flow through the skin, and more heat is lost.
- Hair lies flat.
- Sweat glands in the skin release more sweat, which evaporates, removing heat from the skin



2) Too cold

- Shivering: muscles contract and relax spontaneously
- Produces heat which warms the blood
- Vasoconstriction: arterioles near skin become narrower so little blood can flow through them (the blood flows through the deep-lying capillaries instead) leading to conserving heat
- Metabolism may increase leading to release of energy
- Hair stands up.
- In human, it just produces 'goose pimples'. But in hair animals (cat), it acts as an insulator: trap a thicker layer of warm air next to the skin; prevent skin from loosing more warmth.



DISORDERS OF THE HUMAN URINARY SYSTEM

- **Bed wetting :** is involuntary urination while asleep
- Urine retention
- Urinary tract infections
- Bilharzia (schistosomiasis)
- Bladder cancer
- Kidney failure (renal failure)

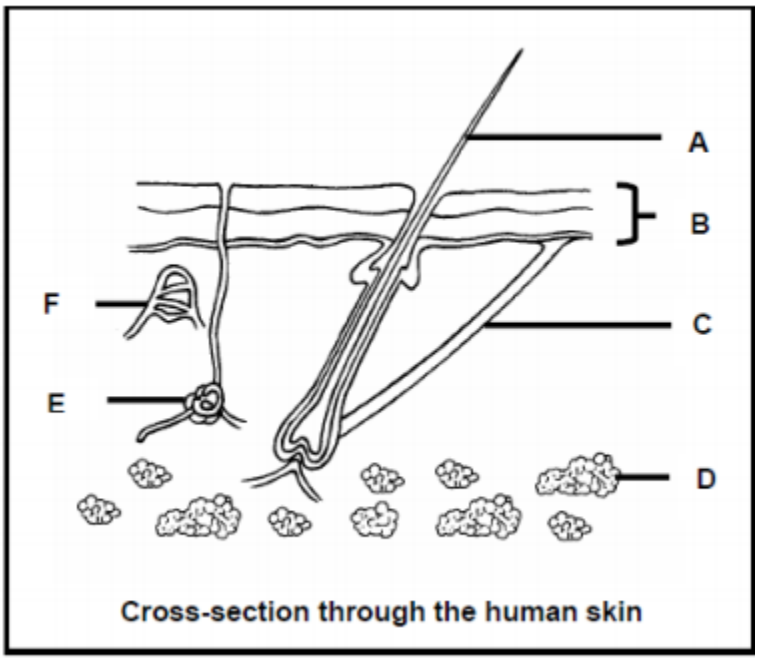
PROTECTION OF THE KIDNEYS:

We can keep our kidneys healthy by:

- Drinking enough water
- Avoiding overuse of painkillers, anti-inflammatory drugs,
- Avoiding physical injury

Try me

1) Study the diagram below and answer the questions that follow it



Cross-section through the human skin

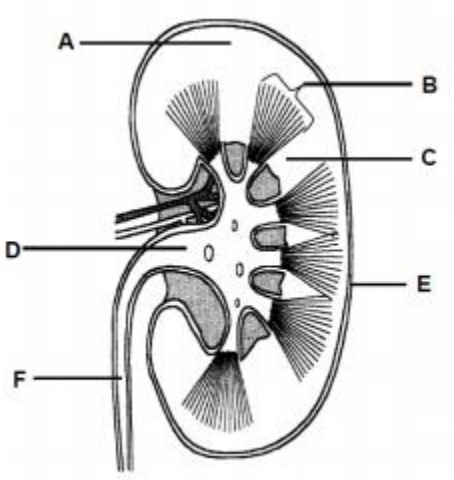
a.) Label layer B and part C.

b.) Write down the letters of TWO parts in the diagram which are involved in the insulation of the body.

c.) Describe how the human skin maintains the core body temperature on a day when the environmental temperature is around 40 °C.

d.) Explain how the skin is suited for thermoregulation

2) Study the diagram below and answer the questions that follow.



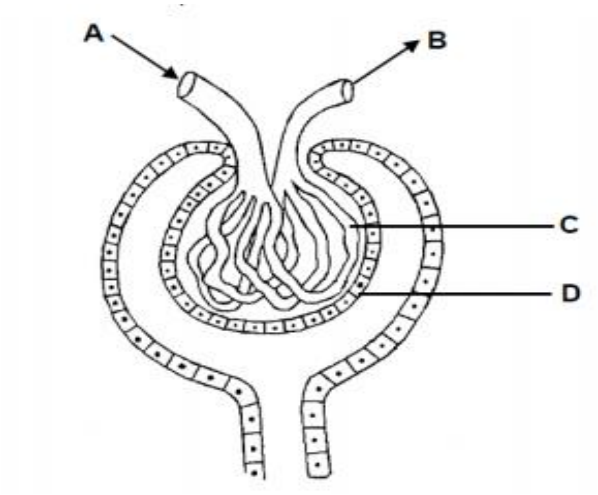
Study the figure above

a) Name the organ represented in the diagram.
b) Identify region A and parts B and D.
c) Give the function of each of the following parts:

i) E ii) F

d) Give THREE functions of the organ named in (a).

3) Study the diagram below and answer the questions that follow.



a) In which region of the kidney would you find this structure?
b) Name the process in urine formation that occurs in this structure. (1)
c) Identify part C.

d) Describe TWO structural adaptations of part C for the process in (c) above.

e) Part A is wider than part B. What is the importance of this?

f) Name the hormone secreted when there is a shortage of water in A.

g) Describe how the hormone named in (f) plays its role under such conditions.

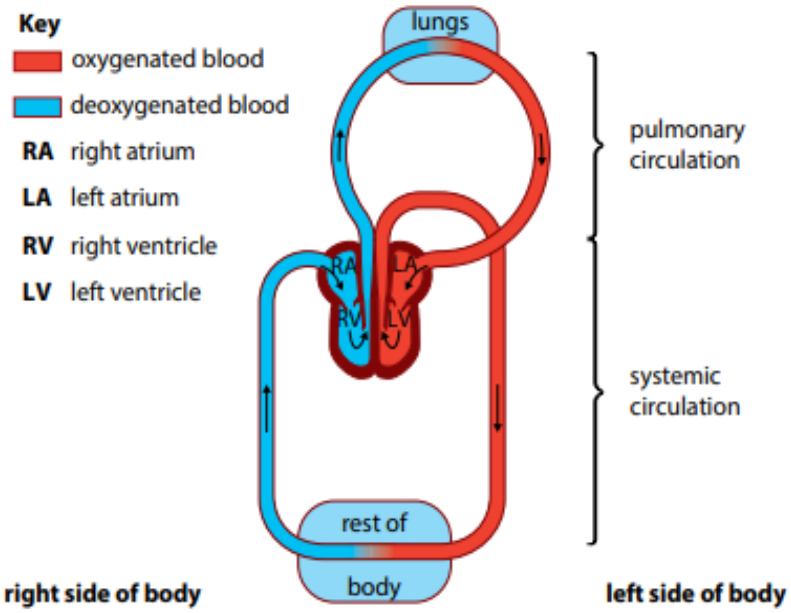
CHAPTER TWO

CIRCULATORY SYSTEM

Multicellular organisms need transport or circulatory systems to supply all their cells with food, oxygen and other needed materials.

Circulatory system is a system of tubes **(blood vessels)** with a **pump (the heart)** and **valves** to ensure one-way **flow of blood**. Circulatory system consists of the **heart, blood and blood vessels**.

- There are **two types of circulatory systems found in animals:** open and closed circulatory systems.
- **Closed circulatory systems** can be further divided into **single circulatory systems** and **double circulatory systems**
- All mammals have a closed blood circulatory system: blood always flows inside blood vessels.
- A double circulatory system : blood passes through the heart twice
- The **human circulatory system** involves the **pulmonary** and **systemic circulatory systems**
- **Pulmonary circulation**: The blood is pumped from the heart to the lungs to oxygenate the blood and then back to the heart.
    - ✓ **Right ventricle (DeO2) ---pulmonary arteries ----lungs ----oxygenation ---- pulmonary veins ---left atrium ---bicuspid valve -----left ventricle**
- **Systemic circulation (to all the systems)**: The blood is pumped from the heart to all parts of the body and back to the heart again.
    - ✓ **Left ventricle----aorta -----tissues of body ----deoxygenation----veins ---- inferior & superior venae cava ----right atrium ----tricuspid valve ----right ventricle**



FUNCTIONS OF THE CIRCULATORY SYSTEM

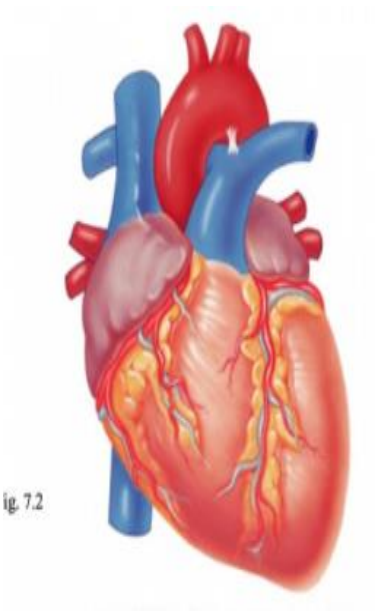
- To transport nutrients and oxygen to the cells.
- To remove waste and carbon dioxide from the cells.
- To provide for efficient gas exchange.

THE HEART

The heart is a large muscle, about the size of your clenched fist that pumps blood through repeated rhythmic contractions. The heart is situated in your thorax, just behind your breastbone, in a space called the pericardial cavity.

- Enclosed in a protective sac called the **pericardium**
- In the walls of the heart, two layers of tissue form a sandwich around a thick layer of muscle called the **myocardium.**
- Contractions of the myocardium pump blood through the circulatory system.
- The right and left sides of the heart are separated by **a septum**.
- **The septum prevents the mixing of oxygen rich and oxygen poor blood.**
- On each side of the **septum are two chambers**.
- The upper chamber (receives blood) is the atrium.
- The lower chamber (pumps blood out of heart) is the ventricle.

- **The heart has a total of 4 chambers:**
  - ✓ **Right atrium**
  - ✓ **Left atrium**
  - ✓ **Right ventricle**
  - ✓ **Left ventricle**
- Deoxygenated blood passes from the right atrium into the right ventricle and then goes to the lungs.
- From the lungs, blood moves back toward the heart into the left atrium to the left ventricle and then passes into the aorta to go to the rest of the body.



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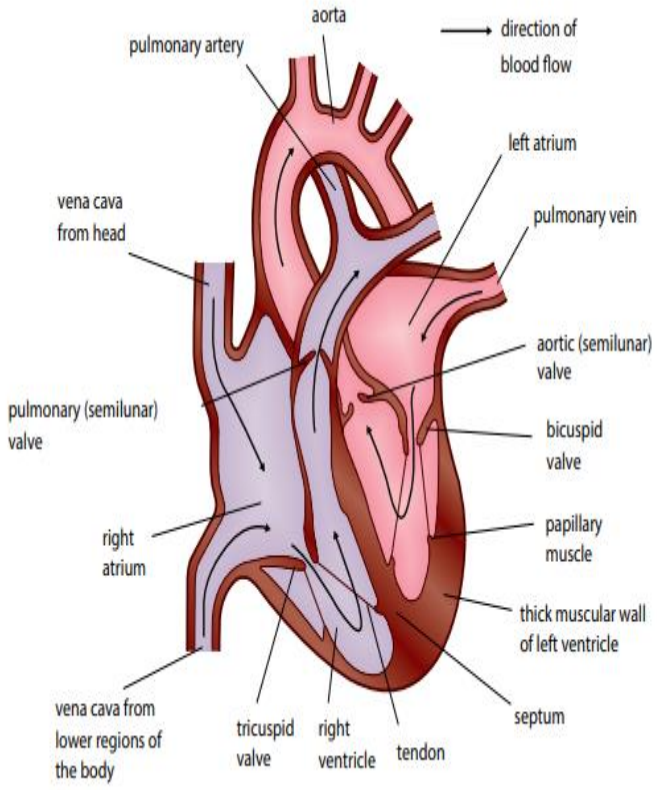
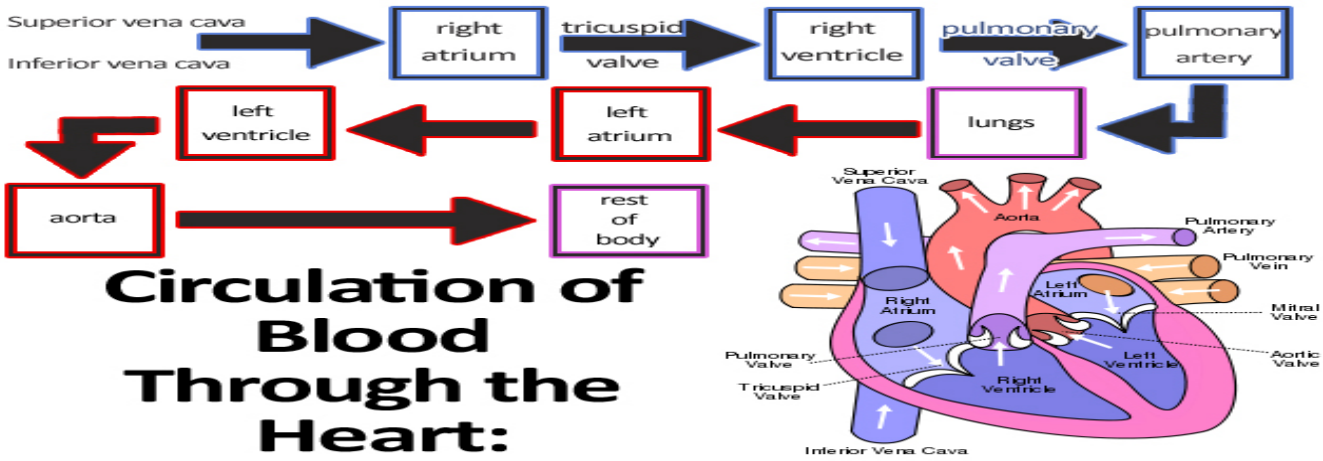


FUNCTIONS OF THE PARTS OF THE HEART

- ✓ **Aorta**: carries oxygenated blood from the heart to all parts of the body
- ✓ **Vena cava:** bring into

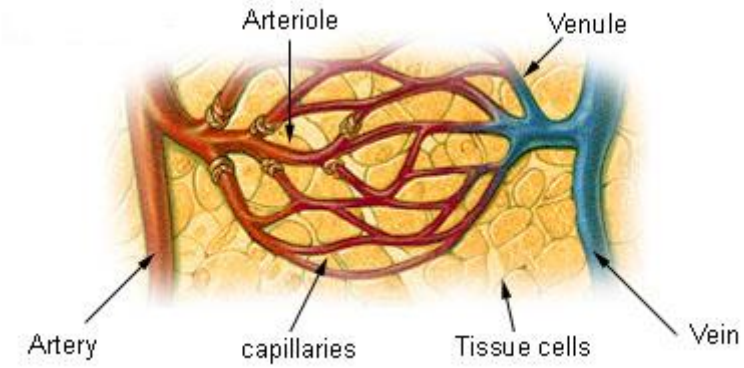
SEQUENCE OF BLOOD FLOW THROUGH THE HEART



BLOOD VESSELS

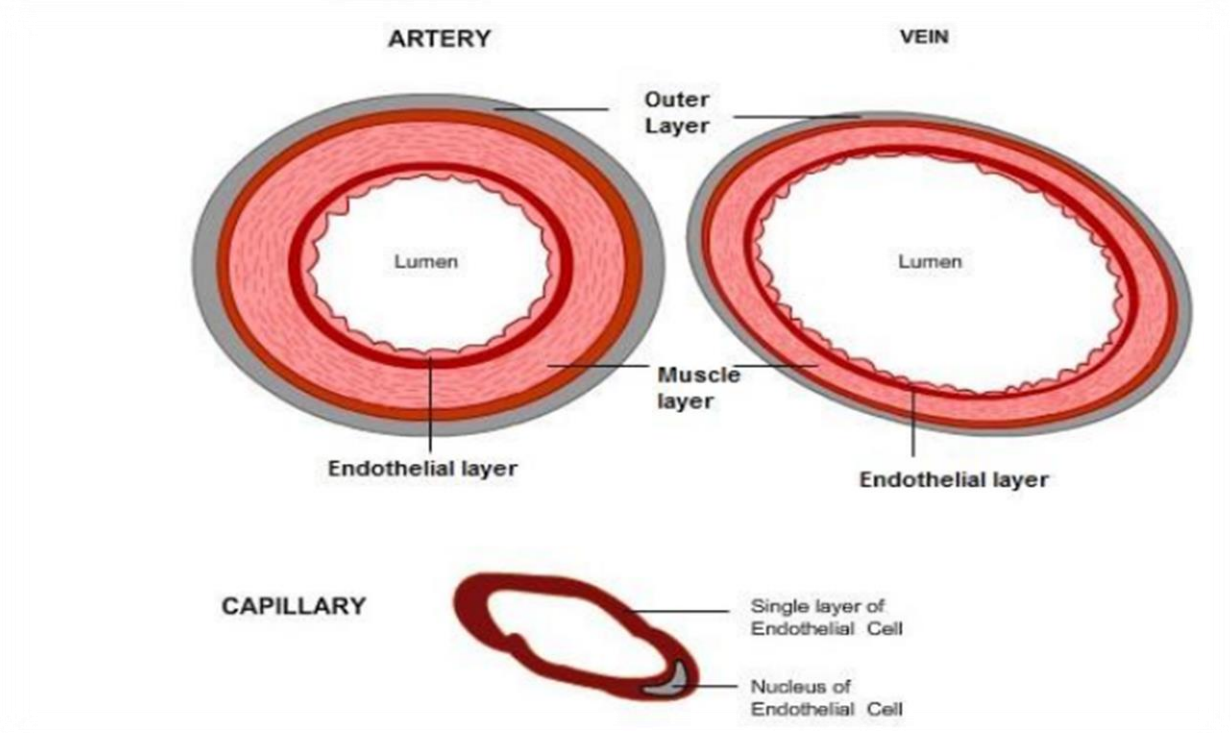
Blood vessels are tubes that help to carry blood round the body. As blood moves through the circulatory system it moves through 3 types of blood vessels.

- There are **3 main kinds of blood vessels** – arteries, veins and capillaries.
- Arteries carry **blood AWAY** from the heart. The smallest artery is called **Arteriole.**
- Veins carry blood back **TO the heart**. The smallest vein is called **Venule**
- Capillaries, which are located between the arteries and the veins. **They allow water, nutrients and gases to diffuse out of the blood and waste materials to diffuse into the blood. This exchange occurs between the blood and the tissue fluid.**



COMPARISON OF ARTERIES, VEINS AND CAPILLARIES

Arteries	Capillaries	Veins
Blood **away** from the heart	Blood supply at **tissue level**	Blood **back to** the heart
Thick middle layer of involuntary muscle to increase or decrease diameter	**One layer of endothelium** with very small diameter	**Thin middle layer** of involuntary muscle as pressure is reduced
Narrower inner layer of endothelium which reduces friction	Only **endothelium** layer present	**Larger diameter** of inner cavity, lined with endothelium to reduce friction
Situated **deeper** in the tissue to maintain body temperature	Situated **at tissue level** only	Situated **near the surface** of the skin to release heat
No valves except in the base of the aorta and the pulmonary arteries	**No valves** present	**Semi-lunar valves** are present at intervals, to prevent back-flow of blood
Blood always under **high pressure**	Blood under **high pressure** where red blood cells are forced to flow through in single file	Blood is under **low pressure**
A pulse can be felt as blood flows	**No pulse**	**No pulse** can be detected



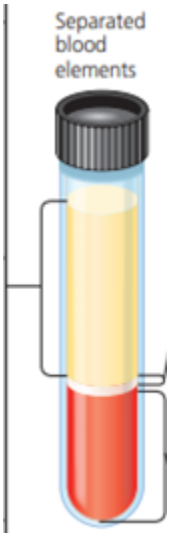
BLOOD

Blood is a connective tissue consisting of **cells** suspended in a **liquid medium called plasma.** Adult humans have about 5.5 litres of blood flowing through their blood vessels.

- Blood consists of **plasma (the watery part) and the cells**

COMPOSITION/COMPONENTS OF BLOOD

- 55% Plasma
- 45% Cells (Red blood cells , White blood cells and Blood platelets)



Functions of the blood

- Transportation of R.B.C's, W.B.C's, oxygen, food nutrients, hormones, and waste products.
- Defence against disease, by white blood cells phagocytosis and production of antibodies.
- Supplying cells with glucose to respire and keep a constant temperature

1) **Plasma:** is straw-coloured liquid that contain water with many dissolved substances.

Plasma transports:

- blood cells
- Soluble nutrients e.g. glucose (products of digestion) from the small intestine to the organs
- Amino acids
- Plasma proteins that is important in blood clotting (e.g. fibrinogen).
- CO2 (waste gas produced by respiration in cells) from the organs to lungs
- Other wastes of digestion (e.g. urea) from the liver to the kidneys.
- Antibodies and antitoxins
- Hormones
- Ions
- Heat from the liver and muscles to all parts of the body.

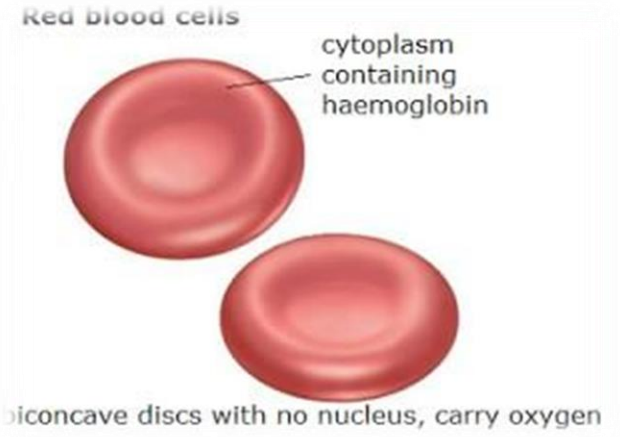
2) Blood cells - structure and functions

- **Blood** consists of cells floating in plasma.

TYPES OF BLOOD CELLS

1. Red blood cells (erythrocytes)

- Made in the bone marrow. Produced at a very fast rate – about 9000 million per hour
- Transport O2 from lungs to all respiring tissues.
- Contain haemoglobin (Hb), **a red iron-containing pigment which can carry O2**. In the lungs, **Hb combines with O2 to form oxyhaemoglobin**. In other organs, oxyhaemoglobin splits up into Hb and O2
- Have no nucleus but can lives only for about 4 months.
- Have a **biconcave disc shape** which increases the surface area and makes the diffusion of oxygen into & out of the cell easier.
- Old red blood cells are broken down in the liver, spleen and bone marrow. Some of the iron from the Hb is stored, and used for making new Hb, some of it is turned into bile pigment and excreted



2. White blood cells (leukocytes)

- Made in the bone marrow and in the **lymph nodes**.
- Have a **nucleus**, often large and lobed.
- Can move around and squeeze out through the walls of blood capillaries into all parts of the body.
- There are many different kinds of white blood cells. **They all have the function of fighting pathogens (disease-causing bacteria and viruses) and to clear up any dead body cells in your body:**

a. Phagocytes:

- ✓ Have lobed nuclei and granular cytoplasm.
- ✓ Can move out of capillaries to the site of an infection.
- ✓ Remove any microorganisms that invade the body and might cause infection, engulf (ingest) and kill them by digesting them.

b. **Lymphocytes:** produce antibodies to fight bacteria and foreign materials.

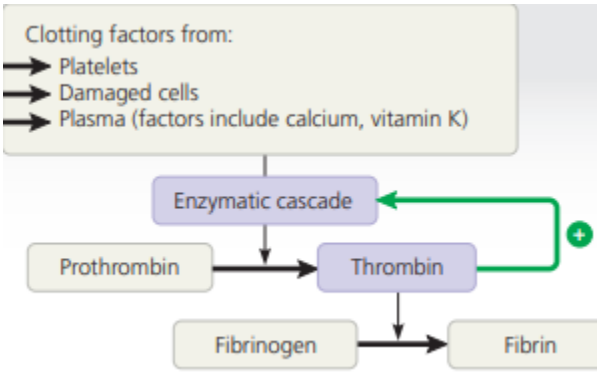
- ✓ Have large nuclei
- ✓ Responsible for immunity
- ✓ There are two different types of lymphocytes: **B-lymphocytes**: secrete special proteins called antibodies in response to contact with their particular antigen, which may be an invading pathogen or a foreign tissue that has been transplanted. **T-lymphocytes** attack foreign or infected cells and kill them

3. Platelets (thrombocytes)

- Small fragments of cells, with no nucleus.
- Made in the red bone marrow.
- **Involve in blood clotting: form blood clot, which stop blood loss at a wound and prevent the entry of germs into the body.**

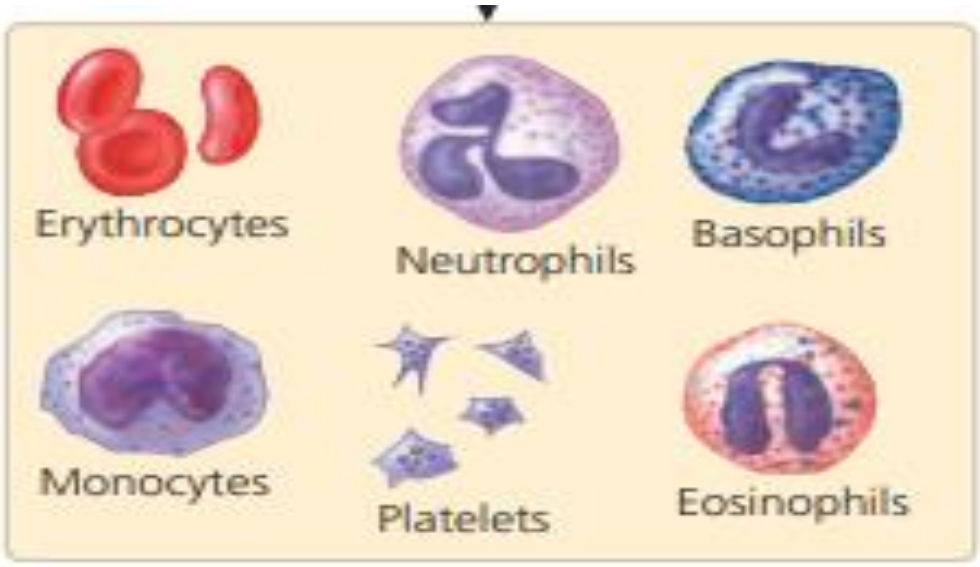
HOW BLOOD CLOT

When an injury causes a blood vessel wall to break, **platelets are activated**. They change shape and stick to the broken vessel wall and each other. The platelets also interact with **fibrinogen**, a **soluble** plasma protein, to form **insoluble fibrin**. Calcium is required for that. **Fibrin strands** form a network that entraps more platelets and other blood cells (red cells and white cells), producing a clot that plugs the break.



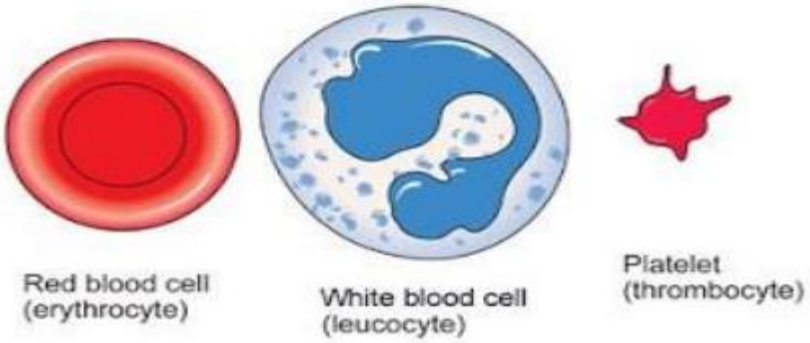
IMPORTANCE OF BLOOD CLOTTING

- Prevent excessive blood loss from the body when there is a damage of the blood vessel.
- Maintain the blood pressure.
- Prevent the entry of microorganism and foreign particles into the body.
- Promote wound healing.



Functions of blood cells

- **Red blood cells (RBC)** transport oxygen.
- **White blood cells (WBC)** protect against disease.
- **Blood platelets** help the blood to clot.



The Lymphatic System:

It is a collection of lymph vessels and glands**.** The fluid in the human body:

- blood (plasma and cells)
- tissue fluid (bathes cells): Is a fluid surrounding the cells of a tissue
- Lymph fluid (drains excess fluid and carries fats).

FUNCTIONS OF THE LYMPHATIC SYSTEM

- Drainage of excess tissue fluid
- Return of plasma proteins to circulation
- Removal of bacteria and toxins
- Transport of absorbed fat from the villi
- Manufacture of lymphocytes.

DISORDERS OF THE BLOOD

- Haemophilia
- Anamia
- Sickle cell anaemia
- Leukaemia
- Hypercalcaemia

DISORDERS OF THE CIRCULATORY SYSTEM

- high blood pressure (hypertension)
- low blood pressure (hypotension)
- stroke
- coronary thrombosis
- hole in the heart

TRY ME

1)

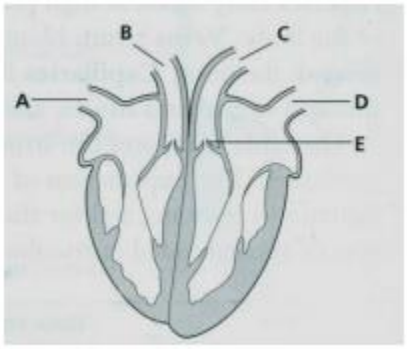


Figure above shows a section through the heart

i) Name the two blood vessels A and B

ii) Which of blood vessels A, B, C or D carry oxygenated blood?

iii) Name valve E and state its function

CHAPTER THREE

REPRODUCTION IN HUMAN

Reproduction is the process by which living organism produce young ones of their kind. There are two types of reproduction

1) **Asexual reproduction**: it involves part of the body of an organism breaks away to form a new species.

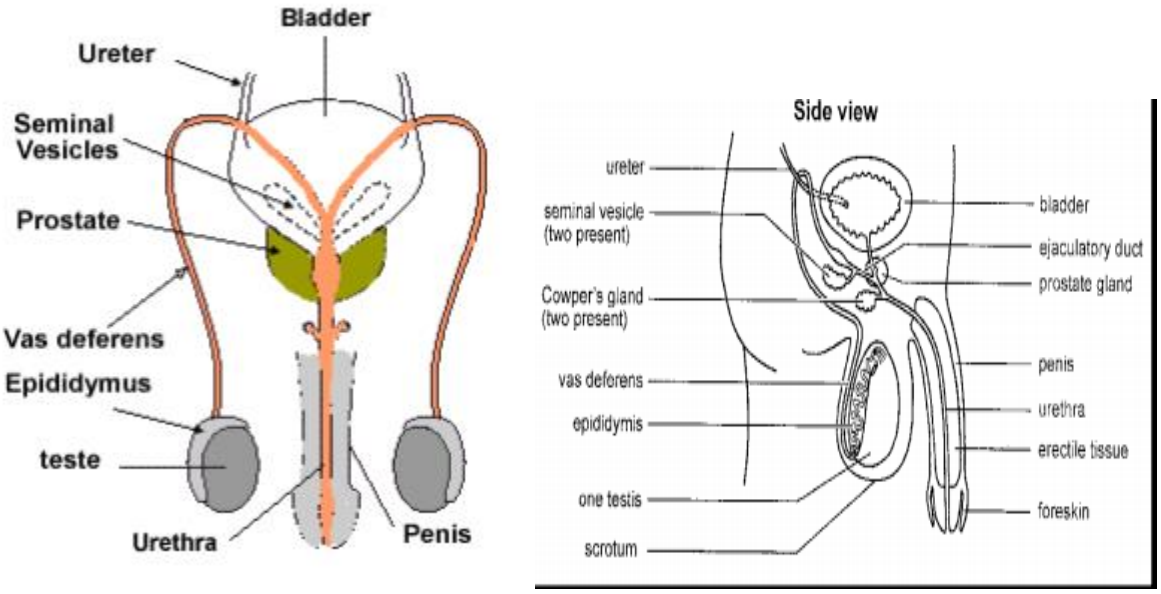
- The process resulting in the production of genetically identical offspring from one parent.
- Formation of a new organism, without involvement of gametes or fertilization.

2) **Sexual reproduction:** involves the fusion of male and female gametes to form a zygote.

Comparison of Sexual and Asexual Reproduction

Sexual Reproduction	Asexual Reproduction
Advantages	
• Offspring are genetically different to each other and to parents • Increased chances of survival due to increased variation • The cross fertilisation of organisms to produce better / stronger / more viable organisms is possible	• Only 1 parent needed • New individuals genetically identical to parent • Offspring produced in a short amount of time • No need for pollinators or dispersal agents
Disadvantages	
• A genetic weakness in the parent will be passed on to offspring • No genetic variation from generation to generation • Too many offspring in a short time can lead to overcrowding • Two parents required • Offspring born helpless and vulnerable and may take a long time to mature • Some plants may require pollinating agents or dispersal agents	• A genetic weakness in the parent will be passed on to offspring • No genetic variation from generation to generation • Too many offspring in a short time can lead to overcrowding

Structure of the male reproduction system



FUNCTION OF THE PARTS OF THE MALE REPRODUCTIVE SYSTEM

1) **Testes:** produce sperm and the male hormone **testosterone**.

- **Testosterone** is responsible for:
  - ✓ The secondary sexual characteristics when the males mature like a deeper voice, pubic hair and facial hair.
  - ✓ Rapid physical growth at puberty
  - ✓ the maturation of reproductive organs and production of sperm

2) **Scrotum:** a sac that keeps testes cools (outside body). Holds the **testis and hangs outside of the abdominal cavity to regulate the temperature of the testes at 35 °C**. The scrotal sac can contract into the body when it is cold or relax and hang away from the body if the temperature is high.

3) **Seminiferous tubules:** Each testis consists of about a thousand coiled seminiferous tubules lined with germinal epithelium. Contains the Leydig cells, the spermatogonia and cells of Sertoli.

4) **Seminal vesicle (a short glandular tube):** Tube secretes mucus and a watery alkaline fluid containing fructose, an energy source for the sperm during ejaculation

5) **Vas deferens** : Tube that connects each **testis from the epididymis to the urethra**, just after the urethra leaves the bladder

6) **Sperm ducts:** link testis to urethra: allow passage of semen containing sperm

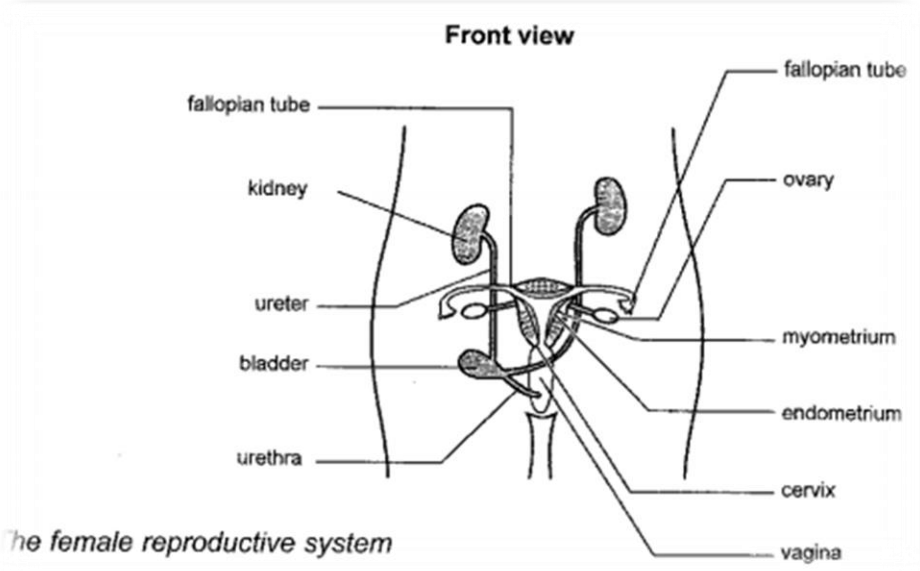
7) **Prostate gland**: produce alkaline fluid called semen

8) **Urethra**: urinate; pass semen which contain sperm through penis

9) **Penis**: become firm, inserted into vagina during sexual intercourse - transfer sperm

10) **Cowper's gland**: Secretes an alkaline fluid directly into the male's urethra to neutralize acidity caused by urine residue

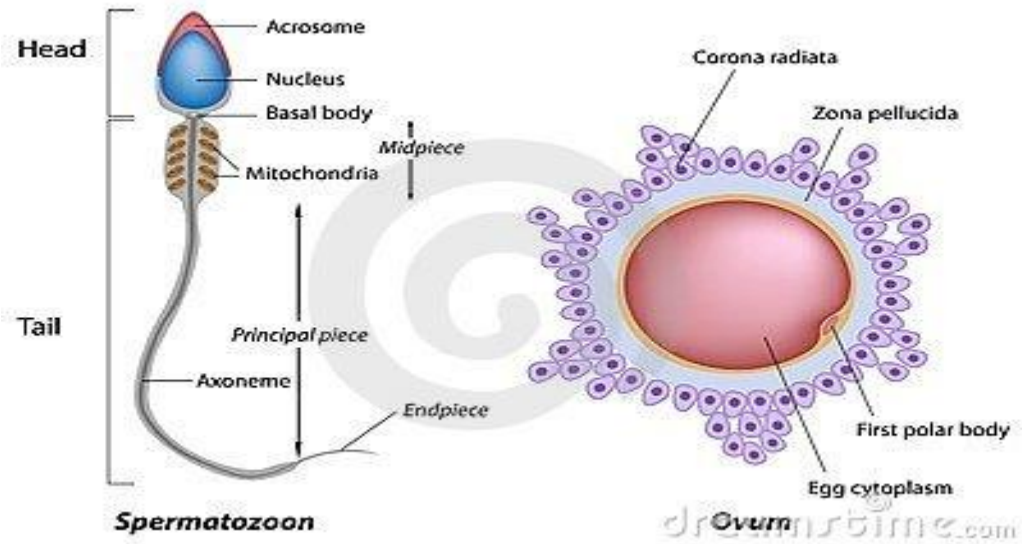
FEMALE REPRODUCTIVE SYSTEM



he female reproductive system

FUNCTIONS OF THE PARTS OF THE MALE REPRODUCTIVE SYSTEM

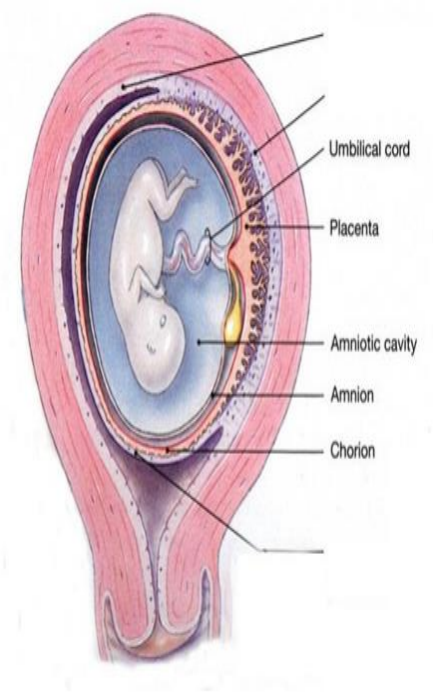
- **Ovaries:** contains follicles, produce and stores eggs, produce oestrogen
- **Oviducts**: carries ovum to uterus; Fallopian tubes ; site of fertilization
- **Uterus** : where fetus develops
- **Cervix**: a ring of muscles that separate the vagina from the uterus
- **Vagina:** receives sperm from erect penis during intercourse

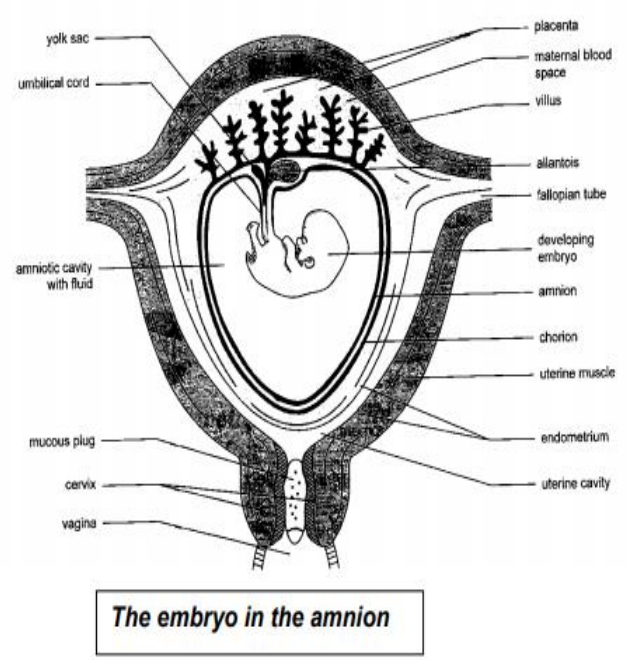


Feature	Sperm cell	Egg cell
Size	Small	Much larger than sperm cell
Mobility	Swims using the tail	Does not move- it is moved along the oviduct by cilia.
Number produced	Millions constantly produced after puberty, throughout life	One in a month after puberty till menopause
Number of chromosomes	23 (haploid)	23 (haploid)
Food store	Uses sugar in the seminal fluid	Protein and fat present in the cytoplasm

Stages in sexual reproduction

- **Ovulation:** it is the process by which ovum or egg is released from the ovary into the fallopian tube
- **Copulation:** it is the insertion of the penis into the vagina
- **Ejaculation:** it is the release of sperms from the penis into the vagina
- **Fertilization:** the fusion of the male and female gametes to form a zygote.
- **Implantation:** it is the attachment of the embryo to the inner lining of the womb or uterus.
- **Birth:** it is the passage of the offspring from the womb to the outside world.





The embryo in the amnion

1) **Placenta** The placenta is a structure that forms a link between the mother and the developing foetus. It ensures that there is no direct transfer of the mother's blood to the foetus. **The placenta develops about 12 weeks after conception and allows for the safe exchange of a number of substances between the mothers to the foetus through the umbilical cord:**

- Nutrients, oxygen, hormones and antibodies from mother to foetus
- Carbon dioxide and wastes from the foetus to the mother, for excretion by the mother
- Harmful substances like nicotine from cigarette smoking, alcohol, drugs and viruses, hepatitis B and HIV can also move through the placenta.

2) **Umbilical cord**: links the placenta to the developing foetus
3) **The amnion** is a membranous bag-like structure that develops around the embryo and is filled with amniotic fluid. It is a fluid-filled sac where the embryo develops in the uterus. It has the following functions:

- To protect the embryo by acting as a shock absorber and
- Regulating the embryo's body temperature.

4) **Amniotic fluid:** fluid surrounding the foetus in the amnion.
5) **Amniotic sac:** membrane from embryo cells: encloses fetus, prevents entry of bacteria

Note:

Terminology & definitions

1) **Corpus luteum**: structure that result when the Graafian follicle releases the egg cell during ovulation. The corpus luteum also secretes progesterone if the egg is fertilized.
2) **Gametogenesis**: the formation of gametes.
3) **Luteinizing hormone (LH):** a hormone produced by the anterior lobe of the pituitary gland that stimulates the release of oestrogen into the bloodstream which causes ovulation
4) **Menstrual cycle**: this cycle begins with menstruation and continues for 28 days. It is controlled by hormones to co-ordinate the release of the mature egg cell with the readiness of the uterus for implantation, if fertilization takes place.
5) **Menstruation**: when there is no fertilization, the lining of the uterus is shed to prepare for the next cycle. This results in a flow of blood that lasts for approximately 5 days.
6) **Oestrogen**: a hormone secreted by the ovaries, causing ovulation.
7) **Oogenesis**: the process to produce haploid egg cells in the follicles of the ovary.
8) **Progesterone:** a hormone secreted by the corpus luteum when the egg cell is fertilized to ensure pregnancy.
9) **Copulation:** the insertion of the male reproductive organ into the female reproductive organ to transfer sperm to the egg cell.
10) **Pregnancy:** it is the development of the embryo inside the uterus. It can also be called gestation.
11) **Vasodilation**: i s the increase of blood volume causing the penis to become erect. The erect penal tissue closes the valve of the urethra to prevent the possibility of urination during ejaculation of the sperm cells.

TWINS

Twins can either be identical, non-identical or Siamese (Conjoint).

- **Identical twins**: They are formed when one sperm fertilizes one egg and the fertilized egg divides into two halves. They look alike
- **Non-identical twins (fraternal twins):** they are formed when two eggs released are fertilized by two different sperms. They do not look alike
- **Siamese (Conjoint) twins**: they are identical twins that do not separate completely during development. They are joined to each other at some point.

PRE-NATAL CARE / ANTENATAL CARE

This refers to the care given to the pregnant mother and foetus before birth.

IMPORTANCE OF PRE-NATAL CARE

- Ensures healthy development of foetus
- It helps detect abnormality associated with the pregnancy at an early stage.
- It ensures the mother stays healthy and strong during pregnancy
- It enhances safe delivery

POST- NATAL CARE

It is the care given to the mother and baby after birth.

IMPORTANCE OF POST-NATAL CARE

- It ensures healthy growth and development of baby
- It helps mother to return to her normal body form and health after pregnancy
- It helps detect defect associated with mother or baby during or after delivery

DISORDERS OF THE REPRODUCTIVE SYSTEM

1) **Infertility**:

   It is the inability of a couple to achieve pregnancy after 12 months of regular unprotected sexual intercourse

In the male reproductive system, infertility may be caused by:

- Obstruction of the reproductive tract causing dysfunctionalities in the ejection of semen.
- Hormonal disorders leading to abnormalities in hormones produced by the pituitary gland, hypothalamus and testicles
- Testicular failure to produce sperm, for example due to medical treatments that impair sperm-producing cells.
- Abnormal sperm function and quality.

In the female reproductive system, infertility may be caused by:

- Sexually transmitted infections (STIs)
- Complications of unsafe abortion
- uterine disorders which could be inflammatory in nature
- Disorders of the endocrine system causing imbalances of reproductive hormones.

2) **Impotence:** it is inability of the penis to erect for sexual intercourse.
   - It is **caused** by stress / tiredness, intake of drugs, abnormalities with penis and psychological dysfunction.

3) **Ectopic pregnancy**: it is a form of pregnancy in which the embryo develops in any part of the body aside the womb.
   - **It caused** by blockage or narrowing of the fallopian tube.
   - The **symptoms** include severe abdominal or pelvic pain and abnormal vagina bleeding.

4) **Uterine fibroid:** refers to a tumor or abnormal growth that develops in the wall of the uterus or womb.

- The **exact cause of fibroid is unknown.**
- Hereditary factors and the overproduction of hormones in females are associated with uterine fibroids.
- The **symptoms** include irregular menstrual periods, heavy menstrual bleeding, abdominal or pelvic pain and feeling of a mass in the abdomen.
- The **effects of fibroid** include anemia, infertility, miscarriage and severe abdominal pain
- The **treatment of fibroids** is usually by surgery

CIRCUMCISION

Is the removal of the prepuce or clitoris. **Female circumcision** involves the removal of clitoris. **Male circumcision** involves the removal of the prepuce (foreskin at the tip of the penis).

ADVANTAGES OF MALE CIRCUMCISION

- It prevention of certain cancers
- Prevention of certain infections

DISADVANTAGES OF MALE CIRCUMCISION

- It may lead to excessive bleeding
- Infection may occur if procedure is not performed under hygienic or aseptic conditions

ADVANTAGES OF FEMALE CIRCUMCISION

- It female circumcision has known major advantage

DISADVANTAGES OF FEMALE CIRCUMCISION

- It may lead to excessive bleeding
- Infection may occur if procedure is not performed under hygienic conditions

SEX HORMONES

Sex hormones (**testosterone in boys and oestrogen in girls**) are responsible for the development of secondary sexual characteristics at puberty.

Sex hormones

	Testosterone	Oestrogen
Secreted by	testes	ovaries
Make changes	in boys	in girls

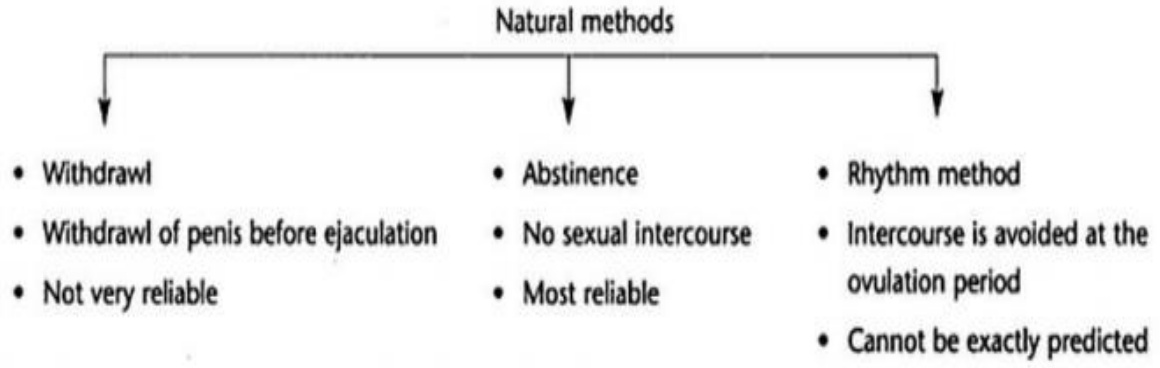
Secondary sexual characteristics at puberty

Male	Female
Voice becomes much lower (breaks)	Breasts grow, nipples enlarge
Hair start to grow on chest, face, under arms and in pubic area	Hair develops under arms and in pubic area
Body becomes more muscular	Hip become wider
Penis becomes larger	Uterus and vagina become larger
Testers start to produce sperm	Ovaries start to release eggs and period begin (menstruation)

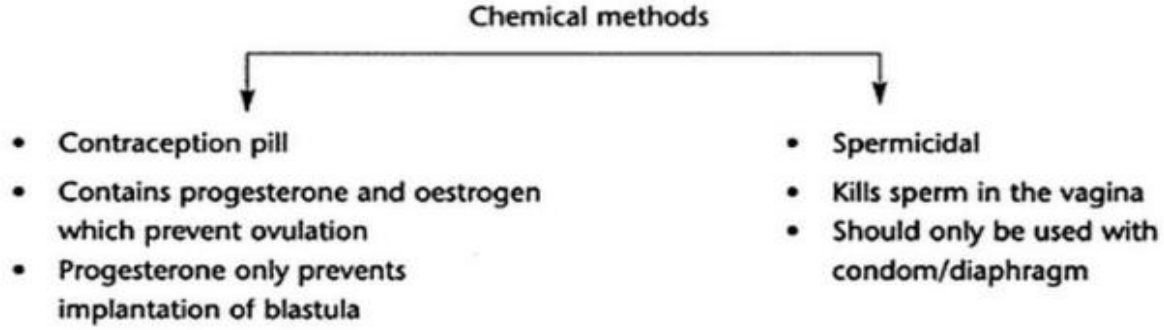
Method of birth control

There are 4 main groups of birth control methods: **natural, chemical, mechanical and surgical.**

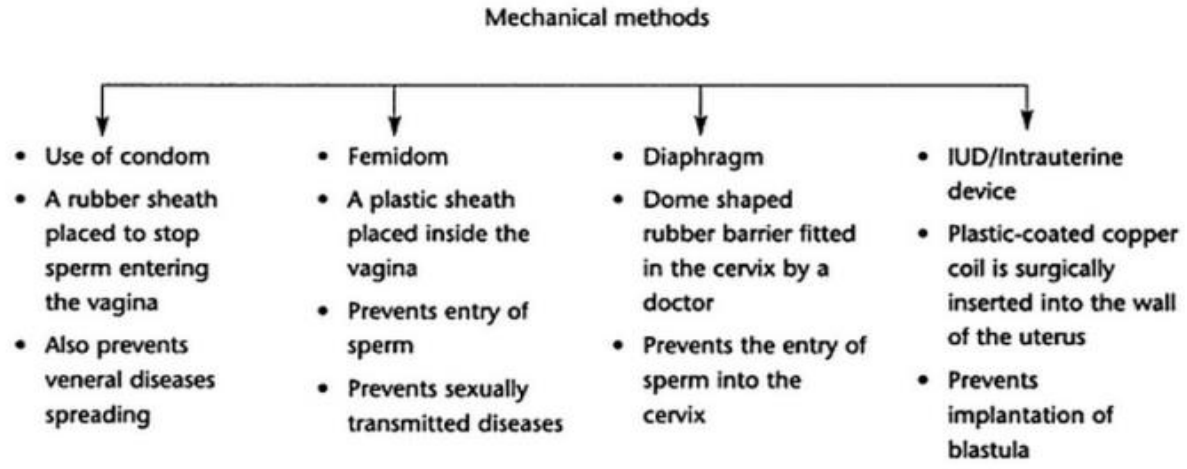
1. Natural methods



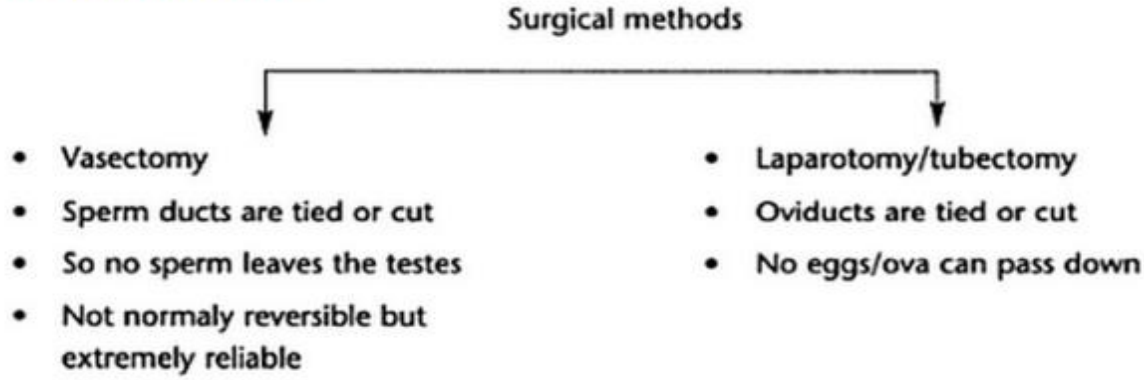
2. Chemical methods



3. Mechanical methods



4. Surgical methods



STDs

Sexually transmitted diseases (STDs) are diseases that are transferred by sexual contact. They are very common and widely spread

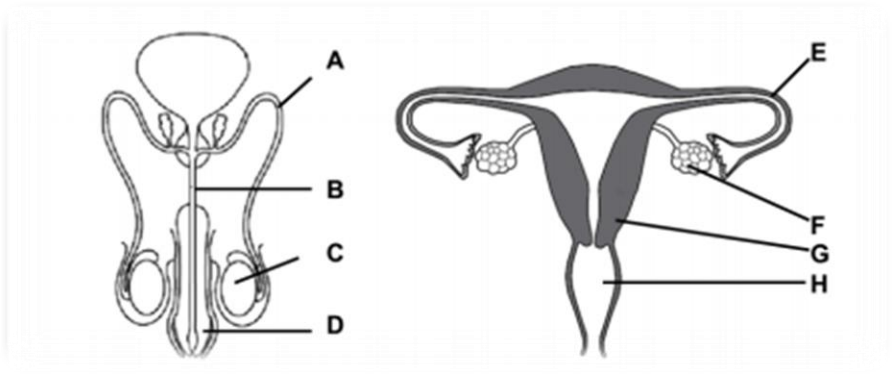
	HIV/AIDS:
General:	HIV/AIDS is known as the killer of the twenty-first century. It is caused by a retrovirus called the **human immunodeficiency virus** (HIV), which in turn causes acquired immune deficiency syndrome (AIDS). AIDS is the **final stage** of the HIV infection where **opportunistic diseases** infect the body and the person finally dies. The virus is transmitted in body fluids like **sperm, breast milk, vaginal fluid and blood**. The HIV is transferred from an infected mother to her unborn child. Touching, kissing, shaking hands, tears do not transfer HIV, sneezing, coughing or mosquito bites.
Cause:	The virus attacks the **lymphocytes**, which weakens the immune system thereby reducing the body's resistance to illness. The infected person has no resistance to any diseases that may attack the body and will contract an illness like flu, TB, diarrhoea, some cancers or pneumonia. The **immune system** eventually stops working completely. It is the infection from the contracted diseases that causes death and not the HIV.
Symptom:	HIV shows no symptoms for up to 10 years. This time span from infection

The most common symptoms are:

- severe weight loss
- diarrhoea and fevers
- skin cancer may develop beginning with small swollen spots which spread over the whole body
- organs begin to swell, especially lymph nodes
- Secondary illness infection that results in severe symptoms. For this reason, AIDS is often confused with malnutrition, skin cancer, TB, a bad cold or flu, and blood cancer.

Try me

1) The diagrams below show the human male and female reproductive systems.



a) Write the LETTER (A–H) and NAME of the part:

b) Which transports urine to the outside of the body

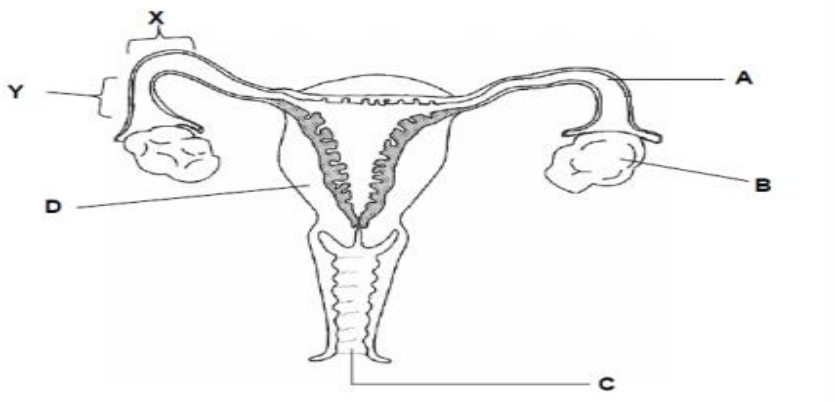
c) Where fertilization occurs

d) Where sperms are produced

e) Where ova are produced

2) Draw Diagrams to illustrate the differences between a human sperm and ovum

3) The diagram below represents the female reproductive system. Study the diagram and answer the questions that follow



a) Label structures A, B and C.

b) State THREE functions of D.

c) Fertilization usually takes place at Y. Why will a blockage at X:

(i) Prevent fertilization at Y

(ii) Not necessarily lead to infertility

4) Study the diagram of the developing foetus below.

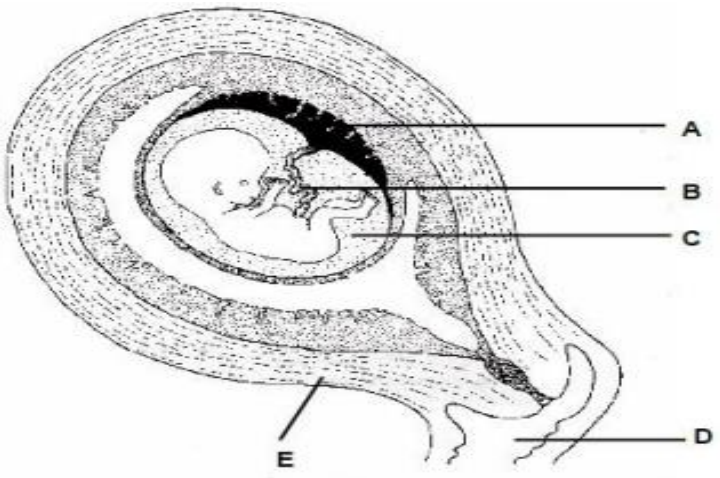


Diagram of a developing foetus

a) Label structures A, B and D.

b) Give TWO functions of the fluid found in C.

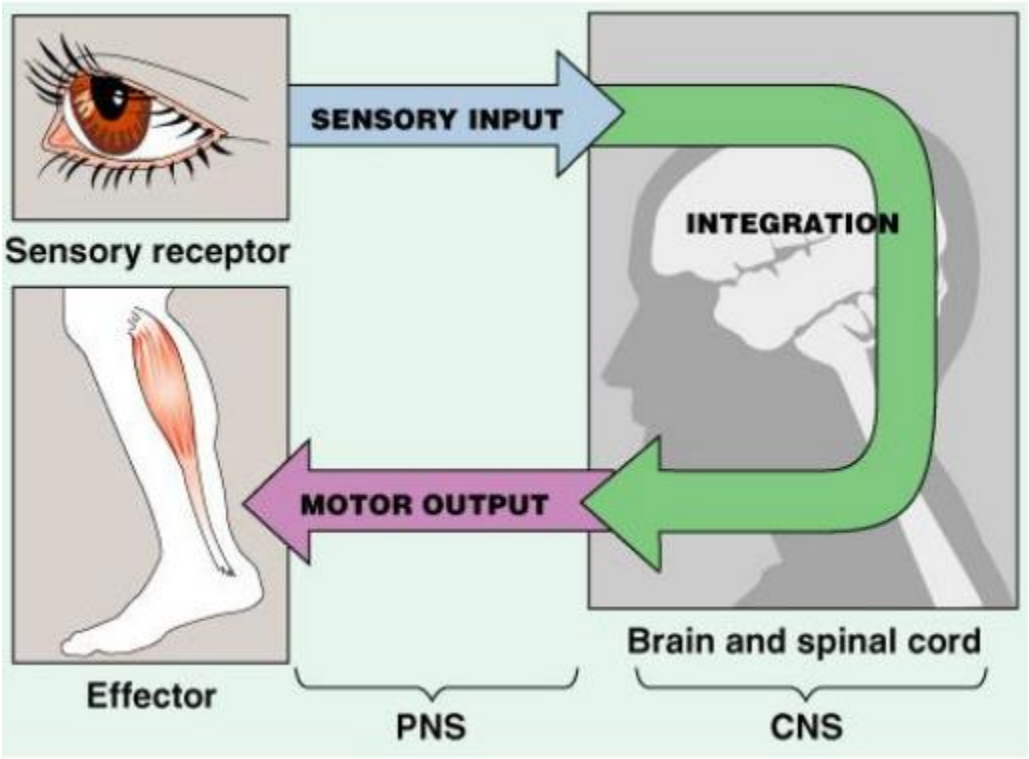
c) Name the process by which some of the fluid from C is withdrawn by doctors to test for abnormalities in the foetus.

d) Describe the function of E during the birth process.

CHAPTER THREE

CO-ORDINATION (NERVOUS AND ENDOCRINE SYSTEM)

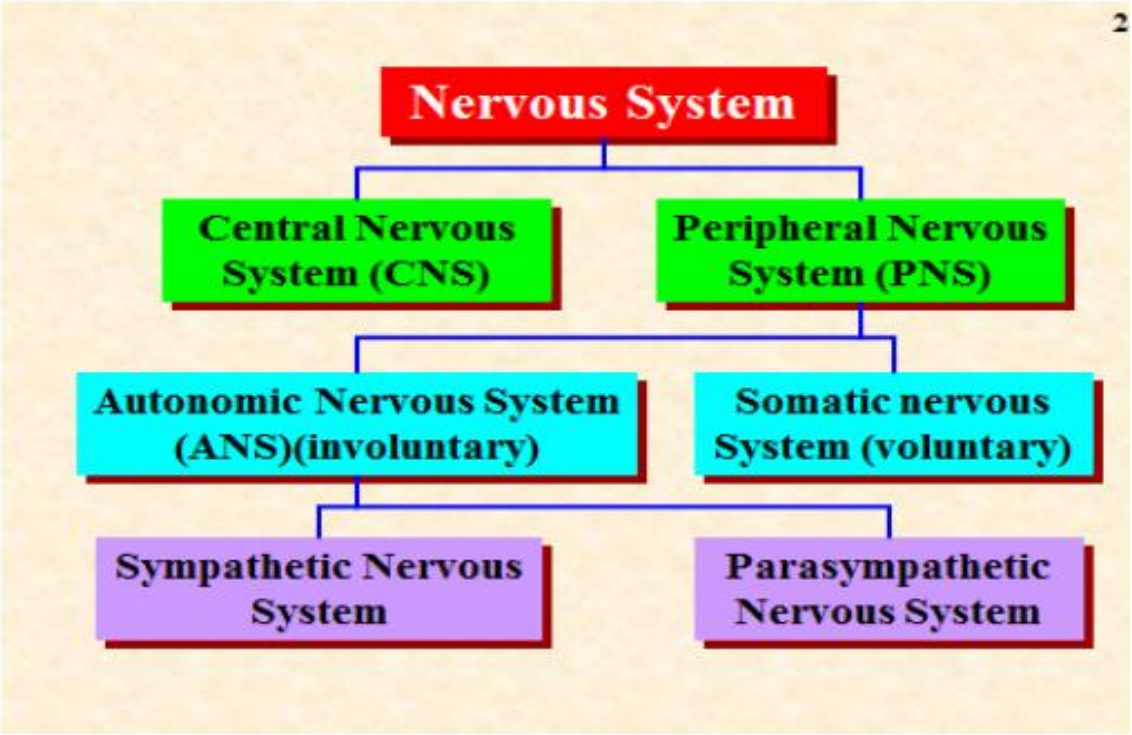
For co-ordination to occur effectively, an organism must receive the **stimulus,** convert the stimulus to **an impulse** send the impulse to a "**control centre**" for processing and interpretation, and then respond to the stimulus



ORGANISATION OF THE NERVOUS SYSTEM

The human nervous system is made up of the **Central nervous system** (CNS) (brain and spinal cord) and the **Peripheral nervous system (**nerves).

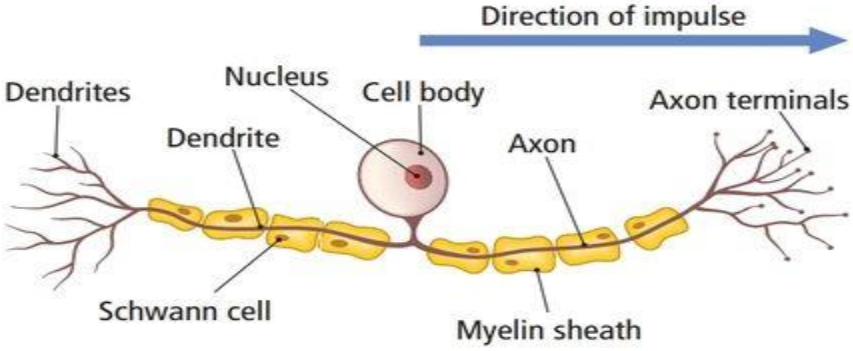
- The nervous system: controls the functioning of all the systems in the body allowing humans to react to stimuli from their environment



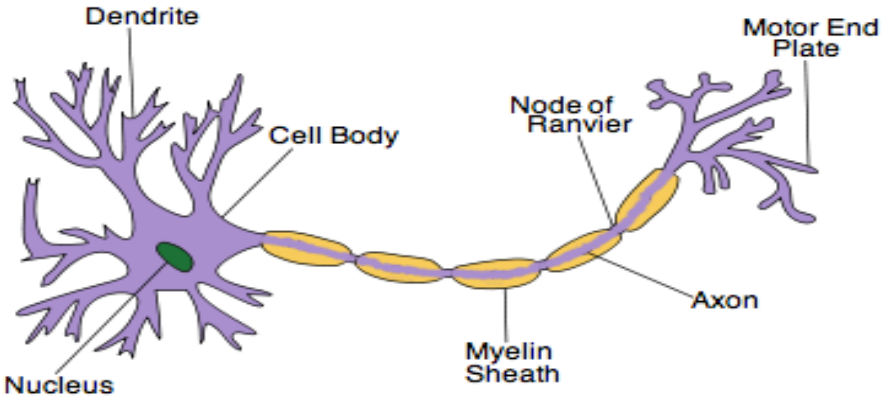
Nervous Tissue

Nervous tissue consists of a complex system called **neurons or nerve cells** that are adapted to conduct and react to all stimuli.

- **Neuron is the basic functional unit of the nervous system. There are three types of neurons.**
- **Sensory neurons**: they carry impulse from sense organs to the Central Nervous System (CNS). Sensory neurons always conduct impulses from the **receptor to the CNS (spinal cord and brain)**. They are unipolar (one pole) and bipolar (two poles).



- **Motor neurons**: They carry impulse from the CNS to muscles and glands. Motor neurons always carry **impulses away from the CNS** (spinal cord and brain). They are multipolar neurons with many dendrites



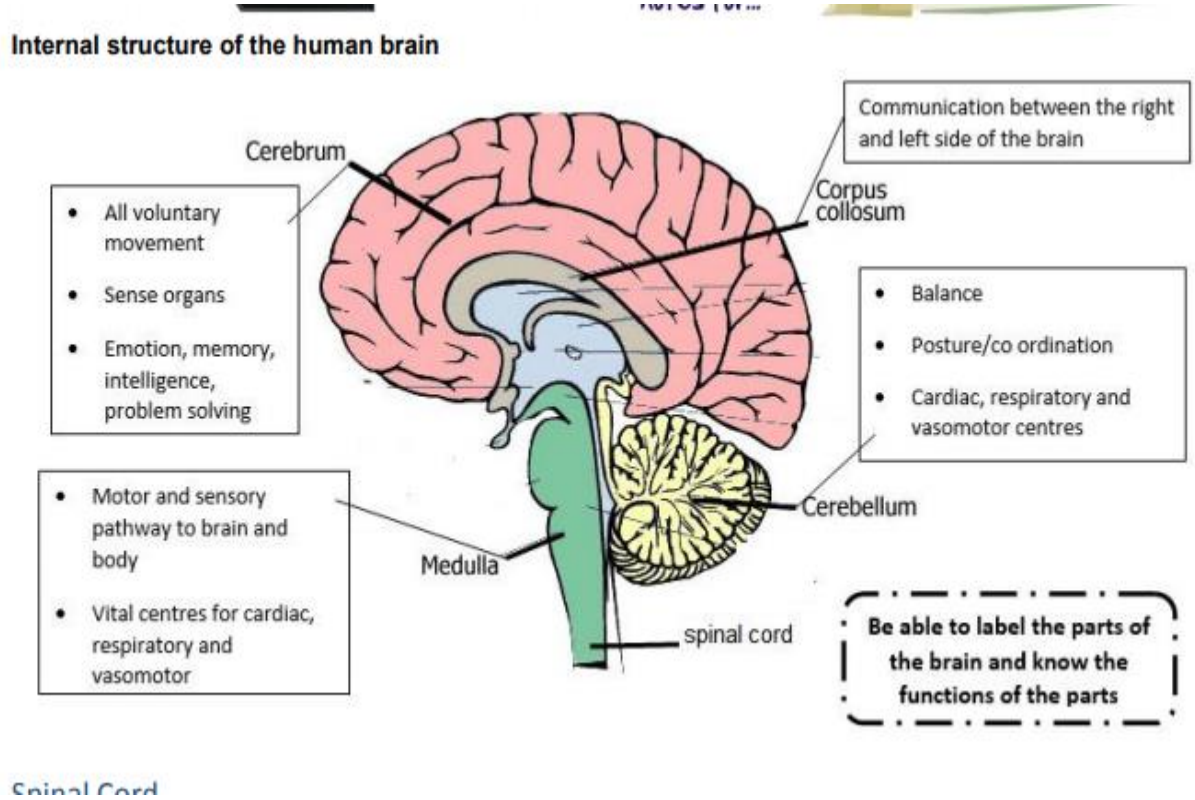
- **Relay / inter-neurons**: They connect sensory neurons to motor neurons in the spinal cord and the brain.

THE CENTRAL NERVOUS SYSTEM (CNS)

1) **Brain:** protected by the **bones of the cranium** and is surrounded by **three layers of membranes or meninges for protection**. The **cortex consists of cell bodies and is called the grey matter**. The **medulla consists of the nerve fibres or axons and is called the white matter.**

- It has three main regions; forebrain, midbrain and hindbrain
  - ✓ **The forebrain** consists of the cerebrum. The cerebrum contains two cerebral hemispheres.
  - ✓ **The midbrain** links the forebrain to the hindbrain
  - ✓ **The hindbrain** consist of the cerebellum and the medulla oblongata

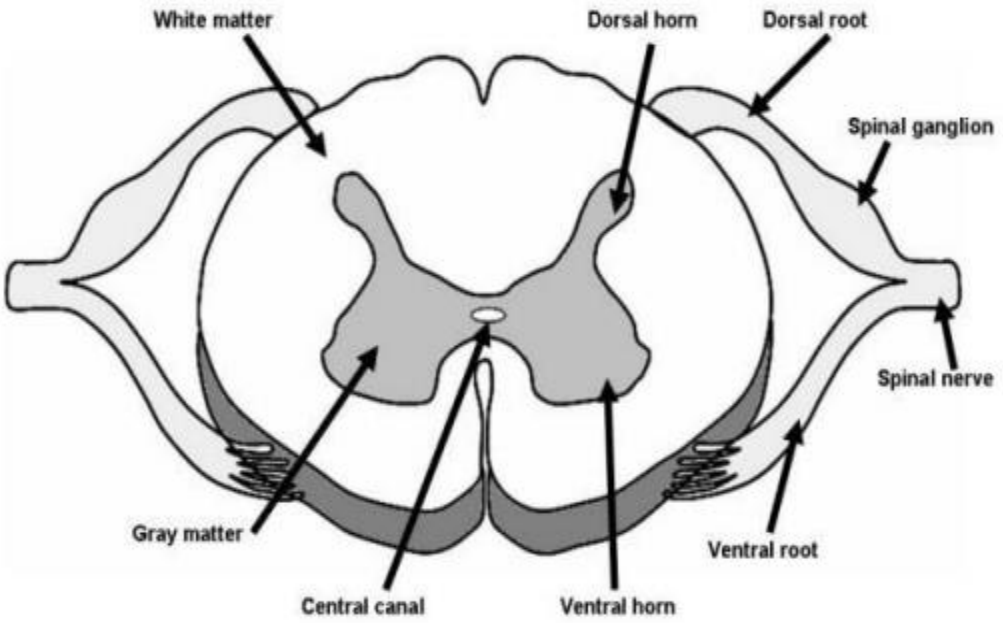
STRUCTURE OF THE BRAIN



PART OF THE BRAIN	FUNCTION
Cerebrum	Controls voluntary actions. It also controls conscious thought and memory.
Cerebellum	Controls the coordination of movement, posture and balance
Medulla oblongata	Controls involuntary actions like breathing and heartbeat
Pituitary gland	Secretes hormones that control several body processes
hypothalamus	Coordinates the activities of the autonomic nervous system. It also controls thirst, hunger and sleep

2) **SPINAL CORD:** Spinal Cord is protected by the **vertebrae and cerebrospinal fluid**.

- Nerves from the body parts enter the spinal cord as 31 pairs of spinal nerves.
- The spinal cord is **the pathway for all the impulses that are conducted to and from the brain and also processes reflex actions.** Sympathetic and parasympathetic nerve impulses are conducted along the spinal cord to all organs.

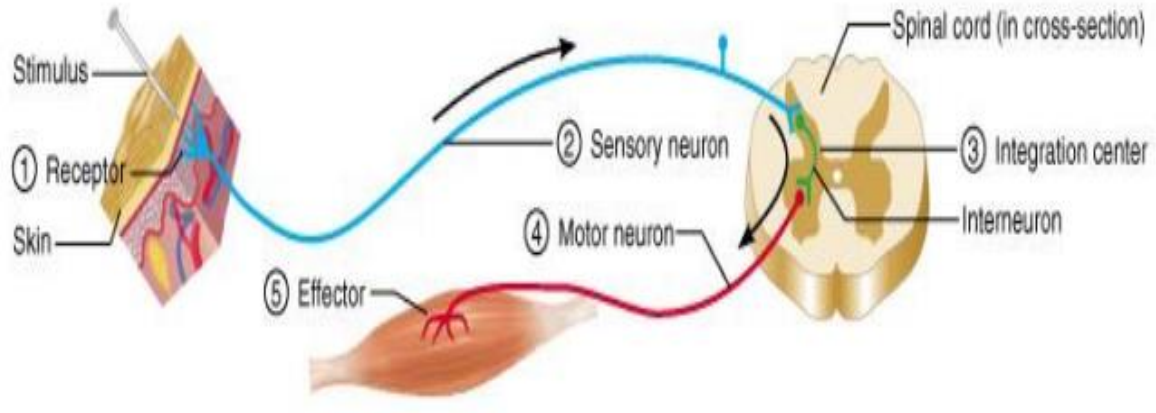


REFLEX ARC

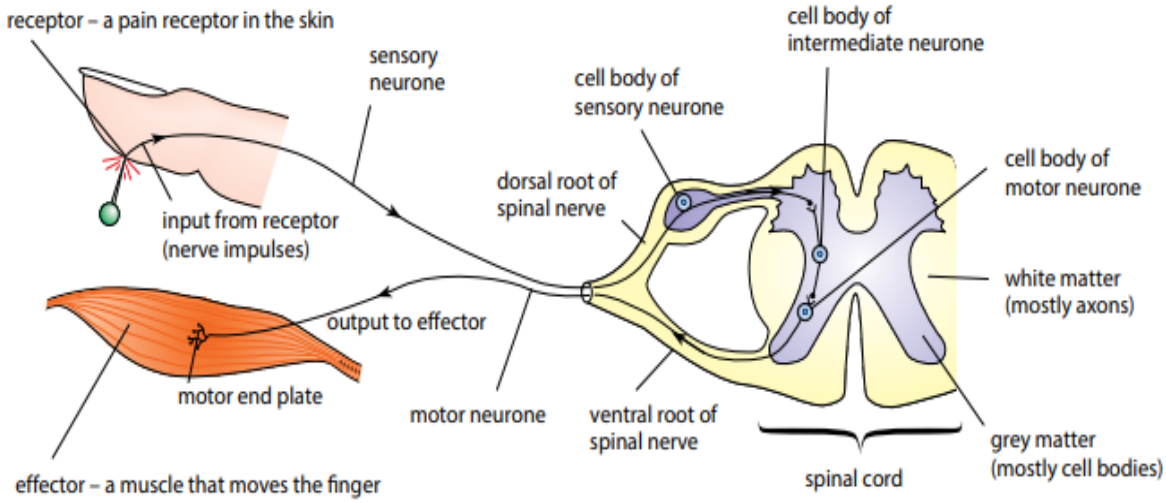
It is the path along which a reflex action travels. The **reflex arc will cause a reflex action** allowing the body to respond very quickly to protect itself and prevent severe injury.

REFLEX ACTION

Is a quick and automatic response to stimulus. It is initiated by the spinal cord. Examples are knee jerk reflex, blinking of the eye and immediate removal of the hand when one touches a hot plate.



Or



Note: **A SYPNASE** is a place where neurons meet

Drug is any substance taken into the body that modifies or affects chemical reactions in the body

EFFECTS OF DRUGS ON THE CENTRAL NERVOUS SYSTEM

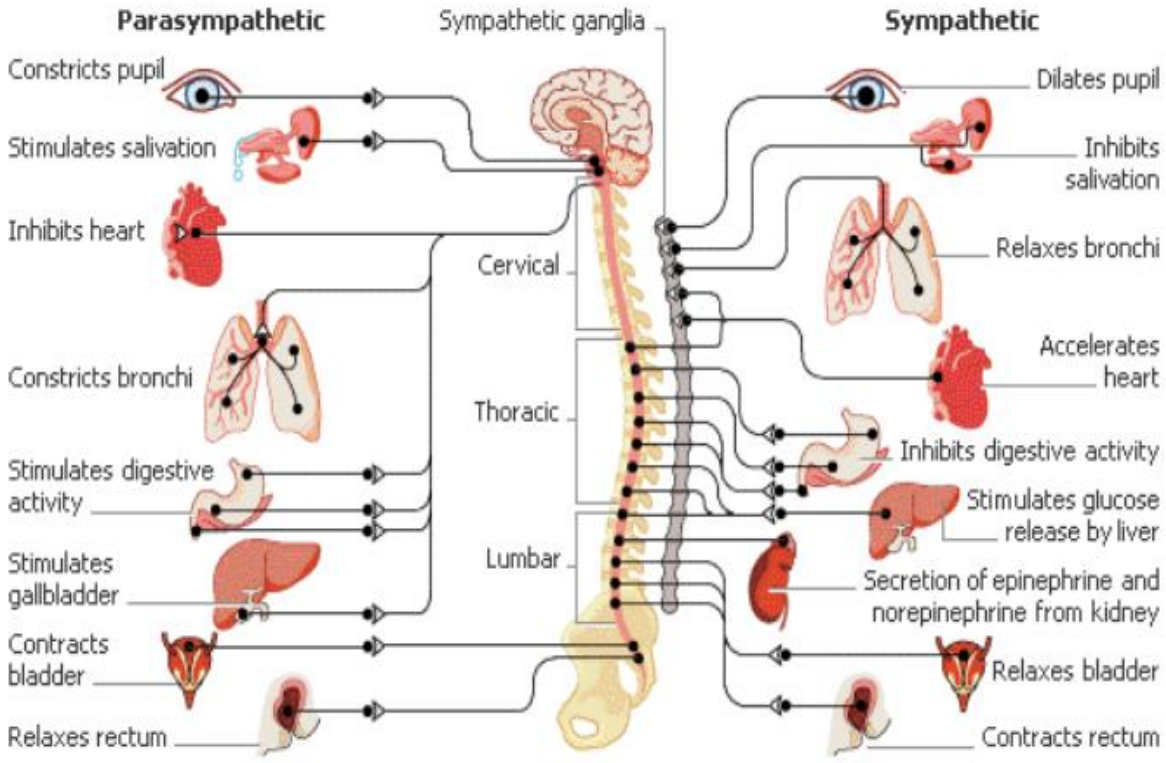
- Some drugs can **stimulate the nervous system**.
  - ✓ **Effects like** alertness, wakefulness, endurance, increased heart rate, increased blood pressure and a reduction in appetite and need for sleep, are stimulated.
  - ✓ **Examples of stimulants** are amphetamines, caffeine, cocaine and nicotine. Stimulants are addictive. Examples are ecstacy, heroin and dagga.

- **Sedatives:** Sedatives work directly on the central nervous system by slowing down and blocking function.
  - ✓ Examples are alcohol, barbiturates
- **Pain killers**: Analgesics are used to relieve pain by working on the central and peripheral nervous system to inhibit the transmission and reception of pain stimuli.
  - ✓ These include opium and derivatives of opium like morphine, codeine and heroin

THE PERIPHERAL NERVOUS SYSTEM (PNS)

1) **Autonomic Nervous System:** Controls the involuntary actions of the body

- Control all internal organs (glands, smooth muscle, cardiac muscle)
- The autonomic nervous system consists of the sympathetic and parasympathetic systems. The 2 systems act antagonistically to maintain a steady internal environment.
  - ✓ **Sympathetic system** – prepares the body for an emergency – increase heart rate, higher blood pressure, faster respiration, increased rate and depth of breathing
  - ✓ **Parasympathetic system** – allows the body to return to normal after an emergency situation.

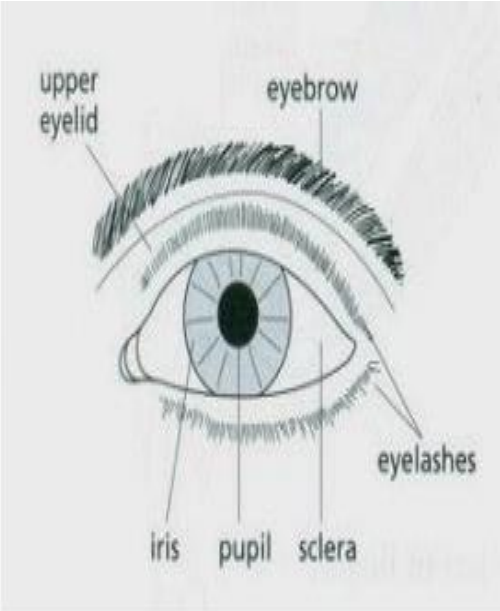


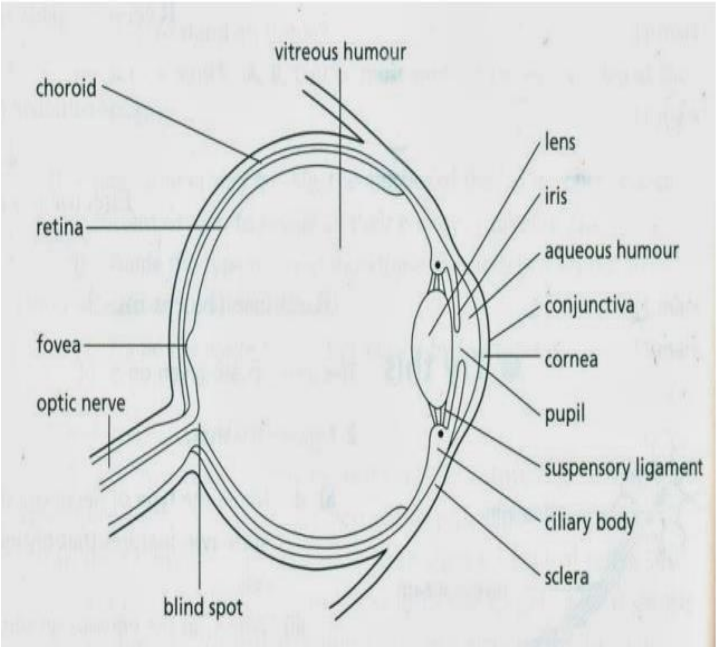
SENSE ORGANS

They are special organs specialized to receive impulse from the outside. There are five sense organs.

Sense organ	Essential features
Eye	The eye is sensitive to light. For sight and vision
Ear	The ear is sensitive to sound. For hearing and balancing
Nose	The nose is sensitive to chemicals. For smelling
Tongue	It is sensitive to chemicals, touch and temperature. It contains taste buds for tasting
skin	It is sensitive to pressure/touch, temperature and pain. It contains receptors to detect pain, pressure, heat and cold

STRUCTURE AND FUNCTION OF THE EYE





Part	Function
Conjunctiva	Protection, refraction
Cornea	Refracts light - bends it as it enters the eye
Iris	Controls how much light enters the pupil
Pupil	Allows light to pass through
Lens	Focuses light onto the retina
Suspensory Ligaments	Holds lens in position/accommodation
Ciliary muscle and body	Accommodation
Retina	Contains the light receptors
Choroid	Prevents reflection of light/nourishment of the eye
Sclera	Protection/attachment of muscles
Optic nerve	carries impulses from the eye to the brain

THE EYES ARE ORGANS THAT MAKE IT POSSIBLE FOR US TO SEE. HOW DO WE SEE?

- Light rays pass from an object to the eye, through the transparent **convex cornea**, **aqueous humour**, the **biconvex lens** and **vitreous humour.**
- As the light rays pass through the curved surfaces (the cornea and the lens), light is refracted (bent).
- The lens refracts the light rays and forms an inverted (upside-down) image on the retina, bringing the image into focus by making fine adjustments.
- The rod and cone cells (photoreceptors) are stimulated by the light rays, and convert the stimulus into impulses.
- These impulses are transmitted along the optic nerve so that impulses enter the lower visual centres on opposite sides of the mid-brain at the occipital lobes.
- Here, the upright images are interpreted for size, shape and colour of the object that was seen.

ACCOMODATION

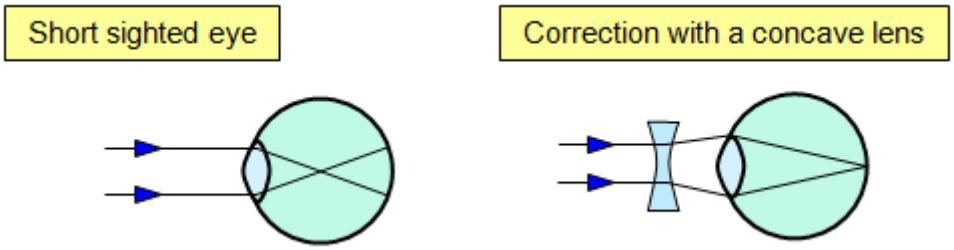
It is the ability of the eye to change it focal length of the lens to be able to see both distant and near objects.

Near Vision (lens is round)	**Distant Vision (lens is long and at rest)**
Object is less than 6 m	Object is further than 6 m
ciliary muscles **contract** (causing the ciliary body to move closer to the lens)	ciliary muscles **relax** (causing the ciliary body to pull away from the lens)
suspensory ligaments **slacken**	suspensory ligaments become **taut**
tension on the lens decreases	tension on the lens increases
lens becomes more convex and **rounded**	lens is pulled to a **longer** and thinner shape (**less convex)**
increasing the **refractive power** of the lens	decreasing the **refractive power** of the lens
focal length **decreases**, bringing the object into focus onto the yellow spot of the retina(clear image formed)	focal length increases, bringing the object into focus onto the yellow spot of the retina. (clear image is formed)

EYE/ VISUAL DEFECTS

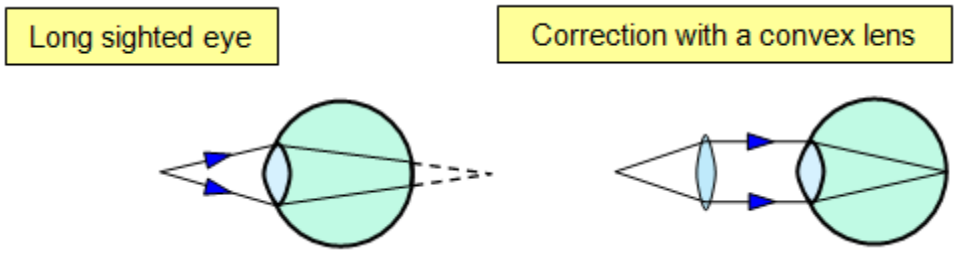
1) **Short-sightedness**: **also called myopia or near sightedness**. It is the ability to see near objects clearly but not distant objects.

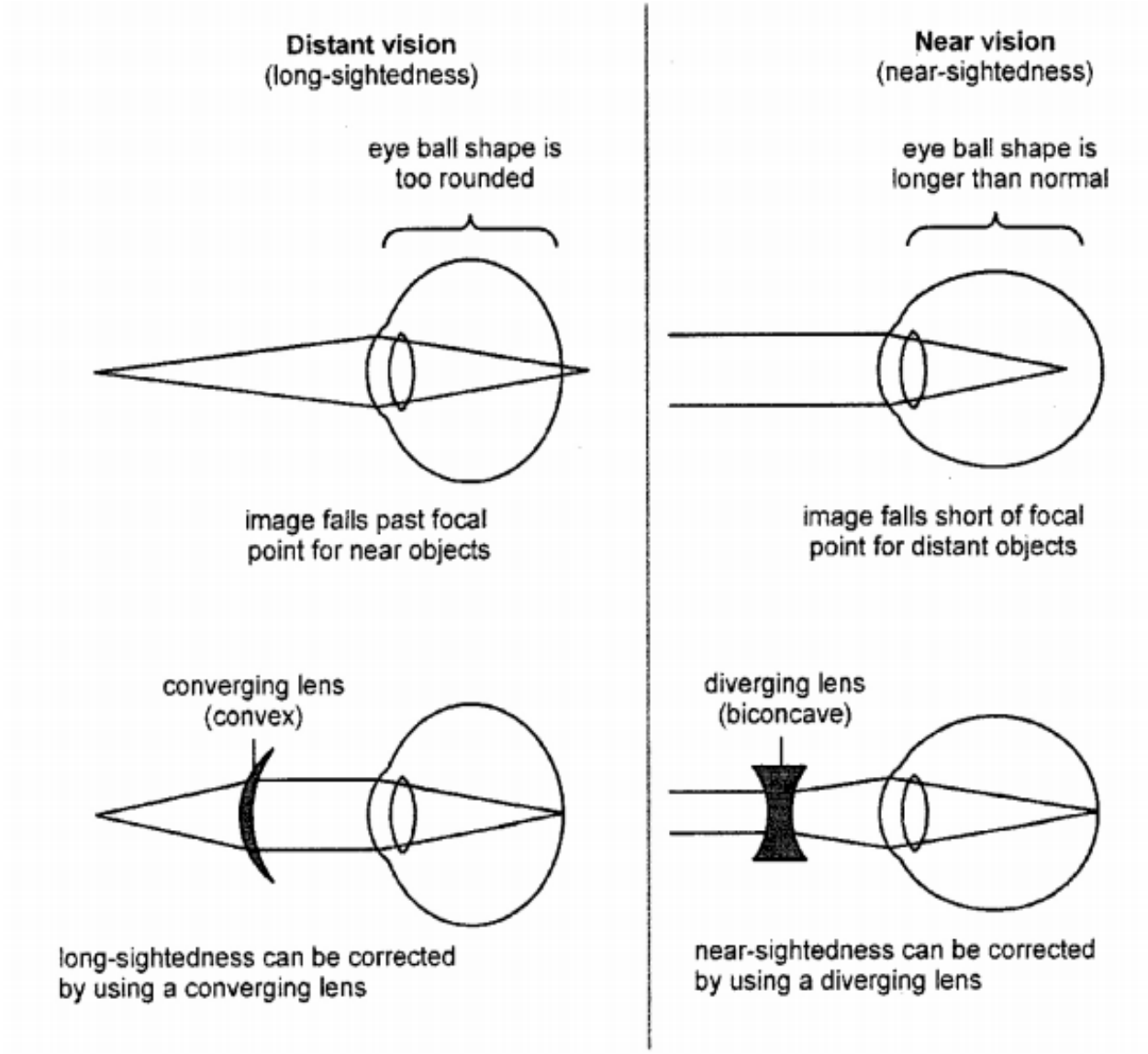
- **It is due to the longness of the eyeball and is corrected by diverging or concave lens.**



2) **Long-sightedness: also called hypermetropia or farsightedness:** It is the ability to see distant objects clearly but not near objects.

- **It is due to the shortness of the eyeball and is corrected by converging or convex lens.**





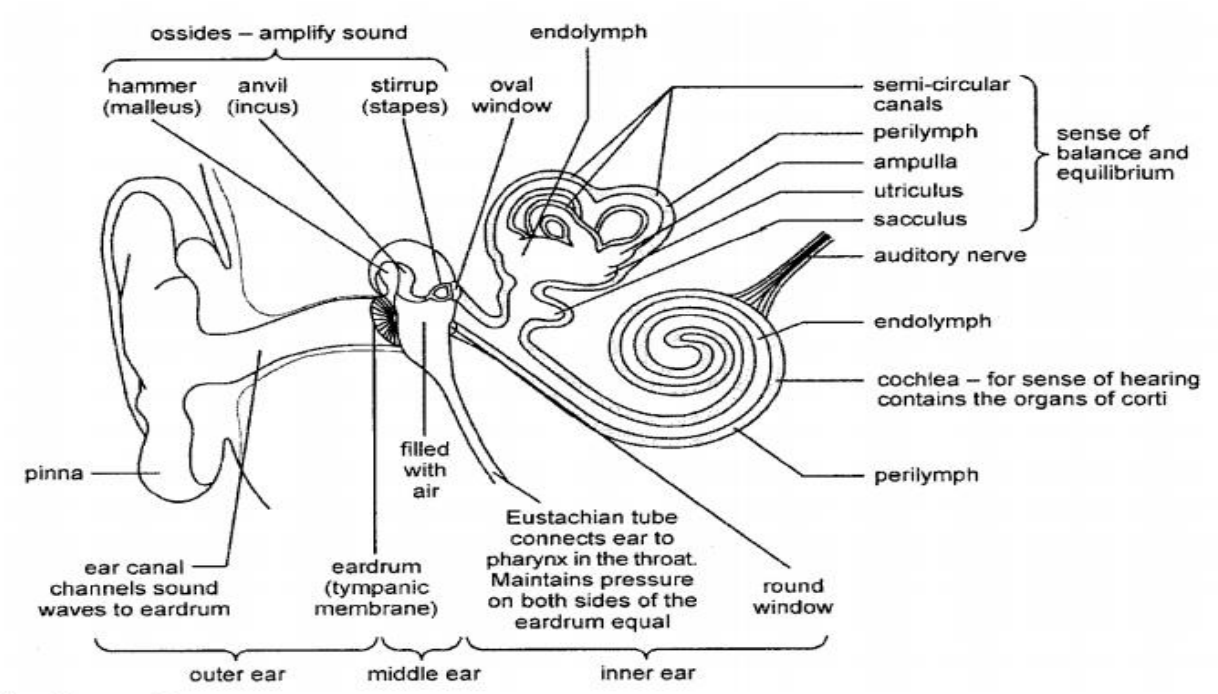
Correction of visual defects

3) **Astigmatism**: is an optical defect that results in **blurred vision**. It is caused by an **irregular curvature of the cornea or the lens so the eye has different focal points that occur in different planes**. Glasses and hard contact lenses correct the irregular focal points

4) **Cataracts:** is the clouding of the lens when the lens cortex liquefies to form a milky white fluid. Cataracts progress over time and may result from long-term exposure to ultra-violet light, radiation, diabetes, hypertension, old age and physical trauma. Genetically, people may have a predisposition to cataracts. Cataracts must be removed surgically.

2) The Human Ear

The ears are the sense organs for hearing with mechanoreceptors in the cochlea of the ear that are stimulated by sound waves, which are converted to impulses. The impulses are transmitted via sensory neurons to the auditory centre in the cerebral cortex of the brain where they are interpreted. The ears are also the organs for balance and equilibrium. These impulses are transmitted via sensory neurons to the cerebellum where they are interpreted to ensure balance and equilibrium.



The Human Ear

PART OF THE EAR	FUNCTION
Pinna	Picks up sound waves from the air and guides them into the auditory canal.
External Auditory Canal	Transmits sound waves from the pinna to the eardrum.
Eardrum/Tympanic Membrane	Transmits sound waves from the auditory canal to the ossicles (hammer).
Ear Ossicles (Hammer, Anvil and Stirrup)	Transmit sound waves from the tympanic membrane to the oval window. They also amplify sound waves.
Eustachian Tube	A tube that connects the middle ear with the pharynx. It equalises air pressure on either side of the eardrum.
Oval Window	Transmits sound waves from stirrup to the inner ear
Round Window	Absorbs excess sound waves.
Cochlea	Contains the **organ of Corti** which converts sound waves into nerve impulses
Utriculus and Sacculus	Able to detect changes in the position of the head with respect to gravity and are therefore involved in balance.
Semi-circular Canals	Able to detect the direction and rate of movement of the head and are therefore involved in balance.
Perilymph	The liquid that surrounds the membranous labyrinth in the inner ear.
Endolymph	The liquid that is found inside the membranous labyrinth of the inner ear.
Auditory Nerve	The nerve that carries nerve impulses from the ear to the brain.

MECHANISM OF HEARING

Pinna ------auditory canal -------tympanic membrane ----hammer ---anvil ---- stirrup ---- oval window----perilymph---organ of Corti---auditory canal ----brain

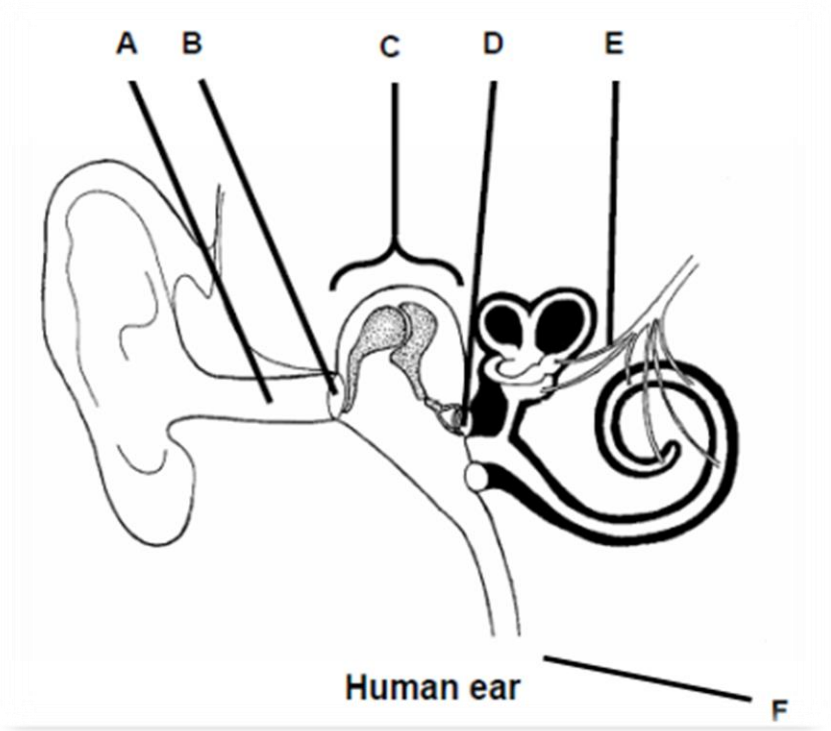
- Sound waves are trapped by the pinna
- Directed into the auditory canal
- Cause the eardrum to vibrate
- Which in turn causes the hammer, anvil and stirrup to vibrate
- This causes the oval window to vibrate

MECHANISM OF BALANCING

- Changes in direction and speed cause the end lymph of the semicircular canals, which are in three different planes to move.
- The movement of the fluid stimulates the cristae in the ampullae: situated at the base of the semicircular canal.
- Gravitational pull stimulates maculae : in the sacculus and utriculus, when the direction of the head changes
- The stimuli is converted to impulses within the cristae and maculae
- These impulses are sent to the brain by the vestibular branch of the auditory nerve to the cerebellum.

TRY ME

1) Study the diagram of the human ear below and answer the questions that follow



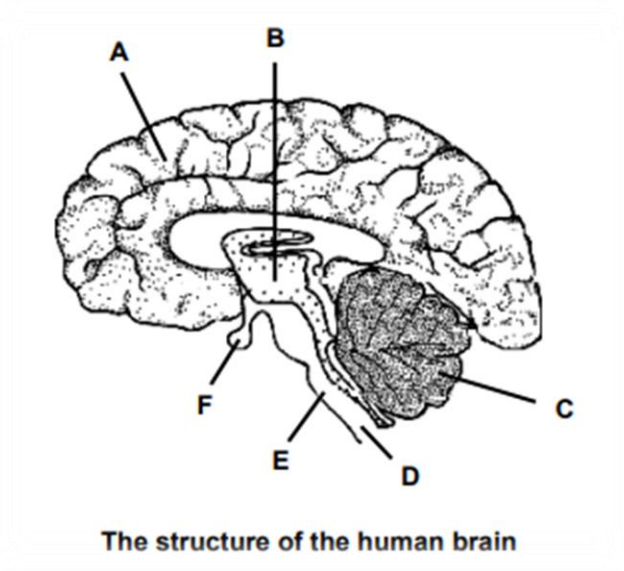
1. Label parts labeled A, B, C, D and E.

2. Provide the function/s of parts labeled A, C and E.

3. Will sound waves reach part D if part C was removed? Give a reason for your answer.

4. How is the structure drawn above suited to its functions?

2) Study the diagram representing the structure of the human brain below.



The structure of the human brain

a.) Identify the parts labeled:

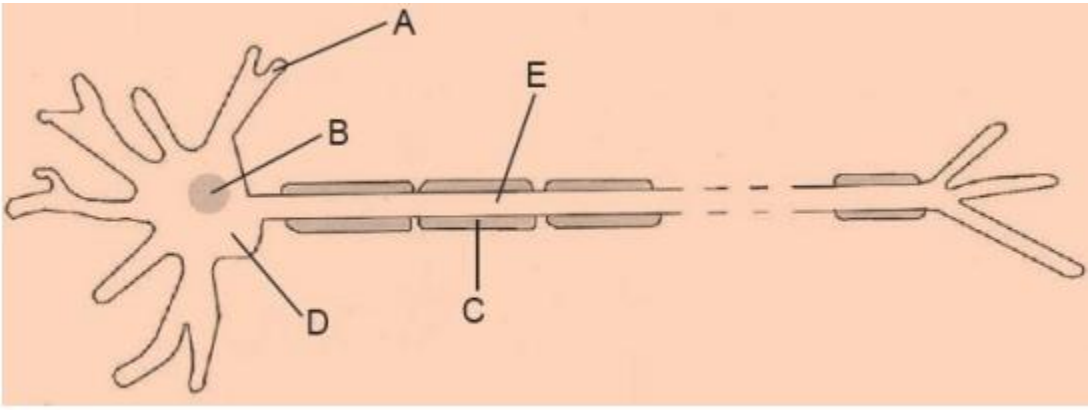
i.) C

ii.) E

b.) Write down the LETTER (A to F) of the part which controls body temperature.

c.) Explain how the body would be affected if part A were to be damaged in an accident.

b.) The following diagram shows the structure of one kind of neuron.

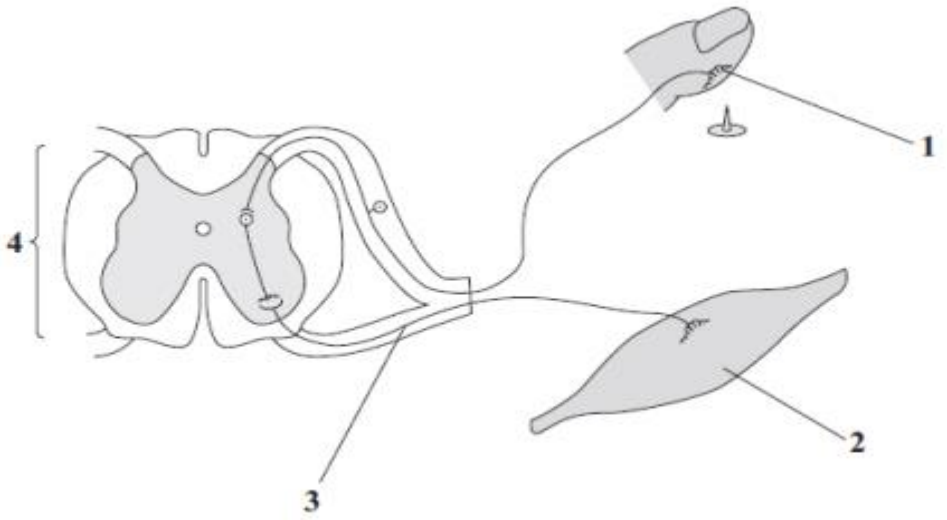


i.) What kind of neuron is this?

ii.) Provide labels for parts A–E.

iii.) Explain how a nerve impulse gets from one neuron to another.

3)A person puts their finger on a pin. A reflex action causes them to pull their hand away quickly. The diagram shows the structures involved in this reflex action.

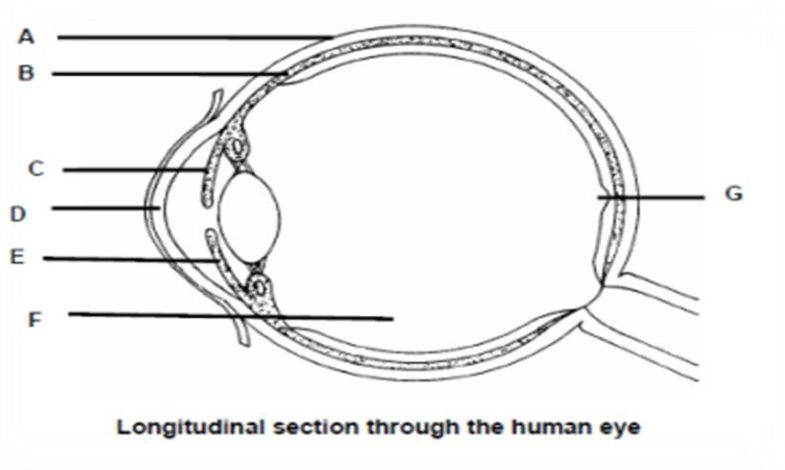


1. Provide labels for structure 1, tissue 2 and neuron 3 and organ 4.

2. Draw a labelled diagram to illustrate neuron.

3. Predict what would happen if neuron 3 snapped when this person fell from a building.

4) Study the diagram below and answer the questions that follow.



Longitudinal section through the human eye

1. Write down the letter of the part (A–G):

(a) At which the clearest image is formed

(b) That is responsible for maintaining the shape of the eyeball

(c) That is responsible for the nutrition of the eye

2. State the function of part F.

3. Explain how part E functions in dim light.

HUMAN ENDOCRINE SYSTEM

The endocrine system consists of **endocrine glands** (also called ductless glands) and the **hormones** they produce.

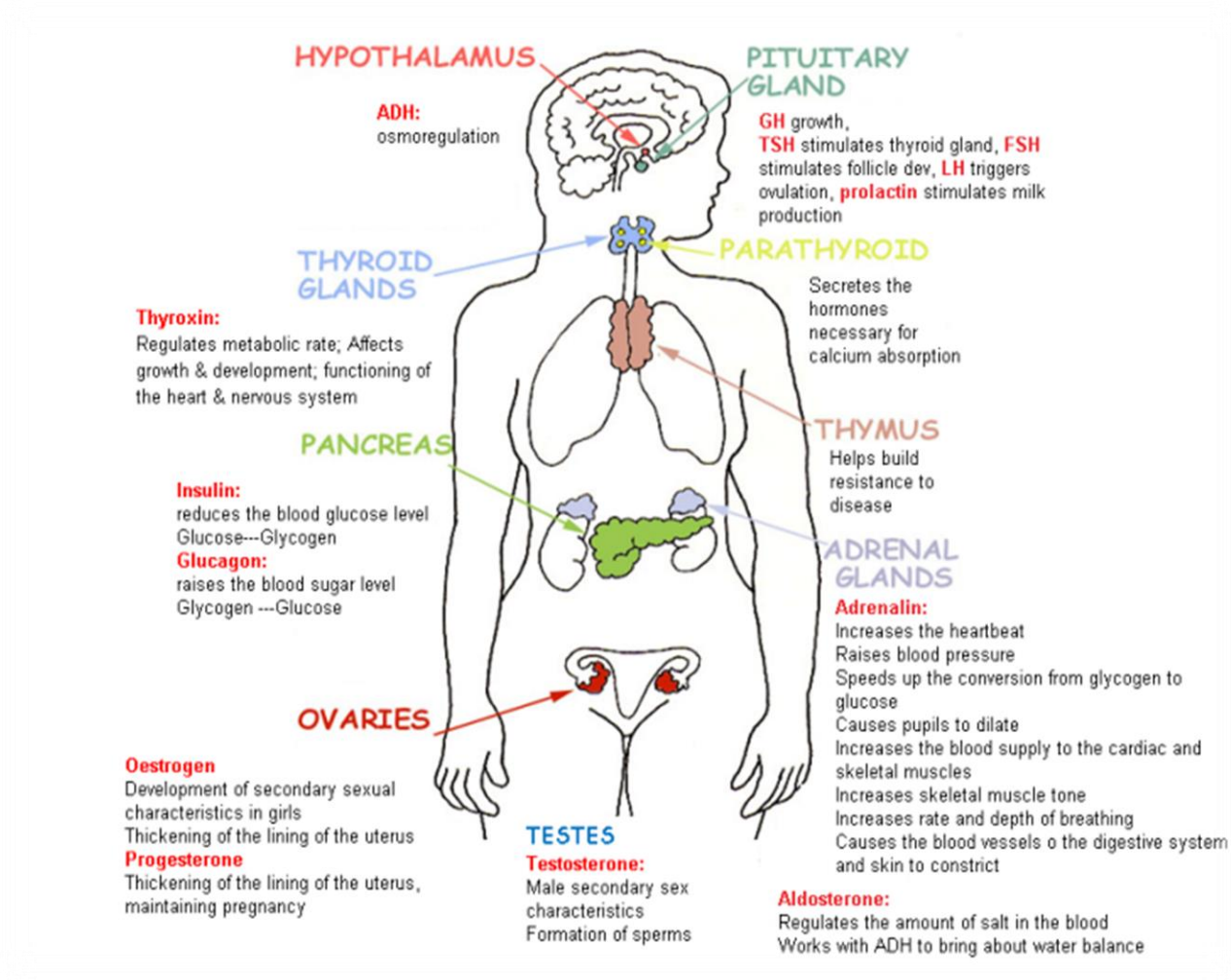
CLASSIFICATION OF GLAND

- **Endocrine gland:** are glands without duct and whose secretions are released into and transported by the blood stream. Examples are hypothalamus, pituitary gland, pancreas, thyroid gland, parathyroid gland, adrenal gland, testes and ovaries.
- **Exocrine gland:** are glands whose secretions are transported through ducts. Examples are pancreas, salivary gland and gastric gland. **The pancreas is both an endocrine and exocrine gland.**

HORMONES

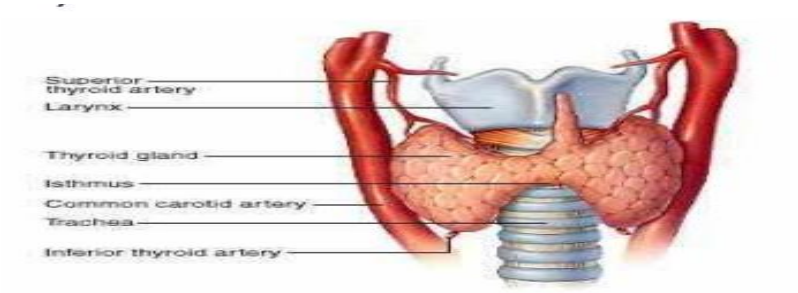
Are chemicals substances secreted by endocrine glands to regulate several body processes. Hormones are produced in minute quantities in one part of the body and are transmitted to their site of action where they perform specific functions.

Hormones are sometimes called **chemical messengers**. Examples of hormones are growth **hormone, thyroxin, insulin, glucagon, estrogen, progesterone, testosterone and adrenaline.**



Endocrine Glands & their Hormones

1) **Thyroid Gland:** Thyroxin:
   - Regulates metabolic rate;
   - Affects growth & development
   - Affects functioning of the heart & nervous system



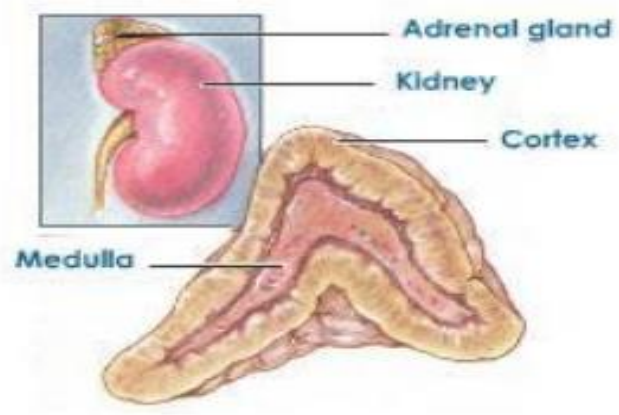
2) **Adrenal Gland:**

✓ **Adrenalin**

- Increases the heartbeat
- Raises blood pressure
- Speeds up the conversion from glycogen to glucose
- Causes pupils to dilate
- Increases the blood supply to the cardiac and skeletal muscles
- Increases skeletal muscle tone
- Increases rate and depth of breathing
- Causes the blood vessels o the digestive system and skin to constrict

✓ **Aldosterone:**

- Regulates the amount of salts in the blood
- Works with ADH to bring about water balance



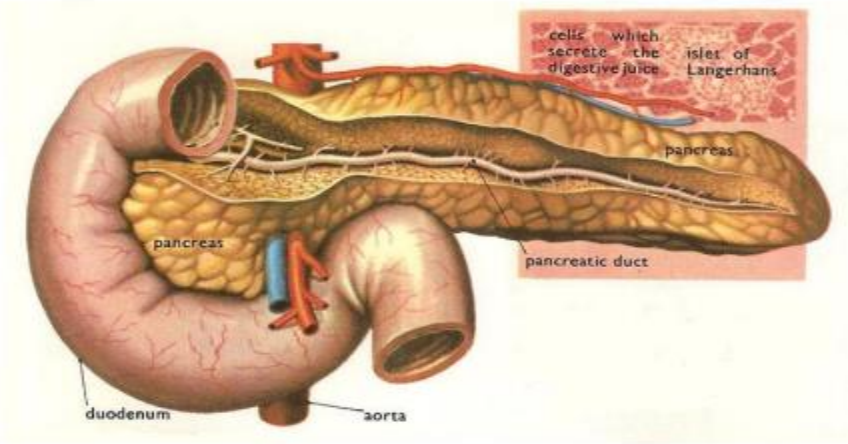
3) **Islets of Langerhans of the Pancreas**

✓ **Insulin:**

- Reduces the blood glucose level, by stimulating the conversion of glucose into glycogen and fat in the liver and muscles, and promoting the absorption of glucose from the blood into the cells, and increasing the use of glucose by the liver and muscles

✓ **Glucagon:**

- Raises the blood sugar level by Converting stored glycogen, from the liver or muscles, into glucose



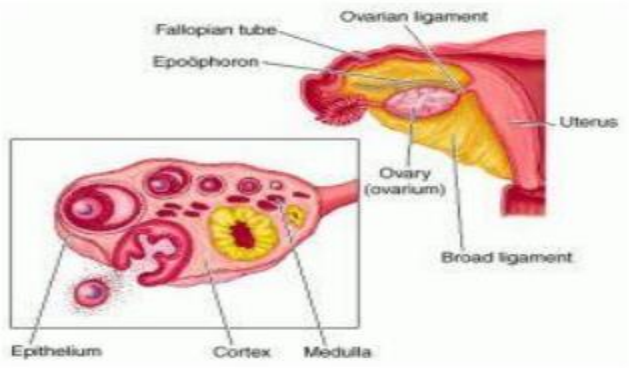
4) Ovary

✓ **Oestrogen:**

- Development of secondary sexual characteristics in girls e.g. development of breasts, soft skin, feminine voice, pubic hair
- Thickening of the lining of the uterus

✓ **Progesterone:**

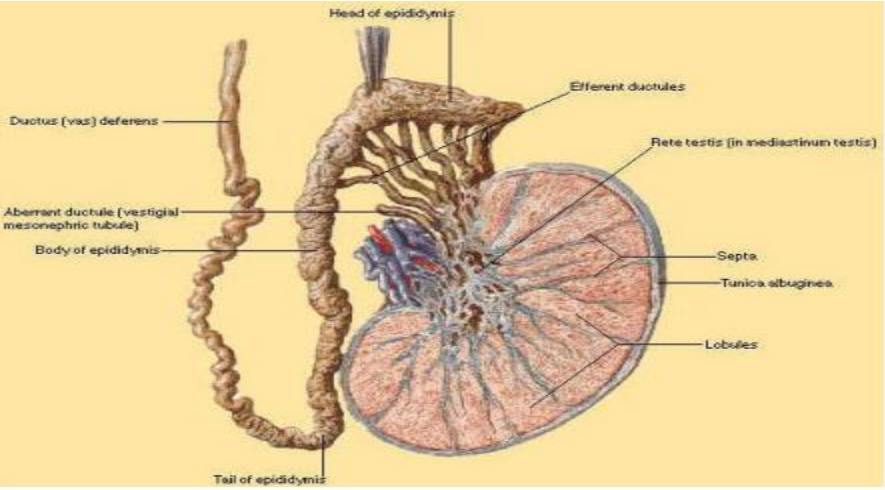
- Thickening of the lining of the uterus, maintaining pregnancy



5) Testis

✓ **Testosterone:**

- Development of secondary sexual characteristics, e.g. deep voice, more body hair, development of muscles



DISORDER	CAUSE	SYMPTOMS	MANAGEMENT
Endemic Goitre	Lack of iodine	Endemic/simple goitre	Increase iodine intake
Hypothyroidism	Thyroid produces too little thyroxin	Low metabolic rate – in adults – sluggishness, weight gain Children – cretinism – slow skeletal growth, slow mental development, skin becomes thick and dry Tongue enlarges & sticks out of the mouth	Medication
Hyperthyroidism	Thyroid produces too much thyroxin	High metabolic rate – irritability, hyperactivity, weight loss	Medication and therapeutic activities
Growth Disorders: Gigantism	Too much GH in childhood	The muscles and bones grow more rapidly than normal	
Dwarfism	Too little GH in childhood	The muscles and bones grow more slowly than normal	All treated by medication
Acromegaly	Too much GH in adulthood	The bones of the hands and legs and face become enlarged	
Diabetes mellitus	Shortage of insulin or insensitivity of target cells to insulin	Higher than normal glucose levels Glucose in urine Eyesight problems Slow healing of wounds	Medication Diet Exercise

Comparison of nervous and hormonal control systems

Feature	Nervous	Hormonal (endocrine)
Made up of	Neurones	Secretory cells
Form of transmission	Electrical impulses	Chemical (hormones0
Transmission pathway	Nerves fibres (axons and dendrons)	Blood plasma
Speed of transmission	Fast	Slow
Duration of effect	Short term	Long term
Response	Localised	Widespread (although there may be a specific target organ)

Try me

1) a.) What is a hormone?

b.) What are the characteristics of hormones?

c.) Distinguish between and endocrine gland and an exocrine gland and provide an example of each.

2) Name the **endocrine gland** which secretes each of the following:

a.) TSH

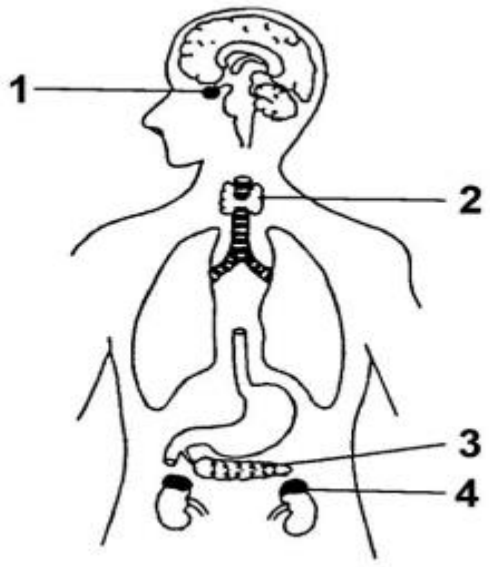
b.) Adrenalin

c.) Thyroxin

d.) Growth hormone

e.) Aldosterone

2) **Study the diagram below and answer the questions that follow.**



a.) Label the parts numbered 1 to 4.

b.) Write down only the NUMBER of the gland that:

i. Produces the hormone glucagon

ii. Produces a hormone that controls the growth of long bones iii. Produces an iodine-containing hormone

iv. Produces a hormone that is involved in the re-absorption of some salts by the kidneys

(c.) Tabulate three differences between the nervous system and the endocrine system.

d.) Explain the mechanism between gland 1 and 2 when the metabolic rate is low.

CHAPTER FOUR

GENETICS (HEREDITY, VARIATION AND EVOLUTION)

Genetics is a science **of heredity** and **variation**.

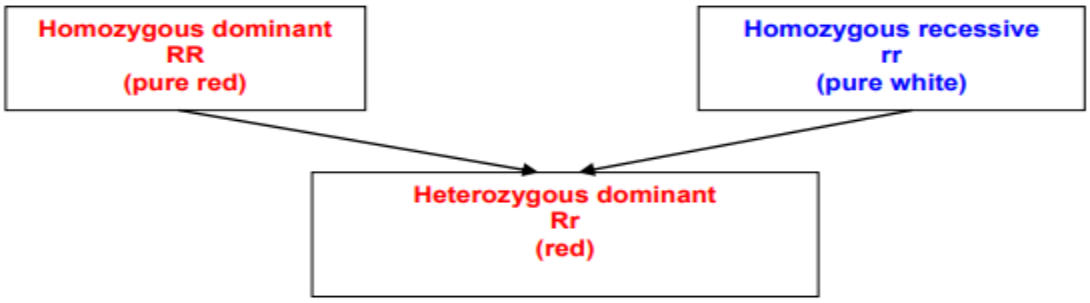
- **Heredity (Inheritance)** is the transmission of characters (genetic information) from parents to offspring.
- **Variation** is the differences in characteristics between organisms of the same species.

Gregor Mendel - "Father of Genetics"

TERMINOLOGIES RELEVANT TO THE TOPIC

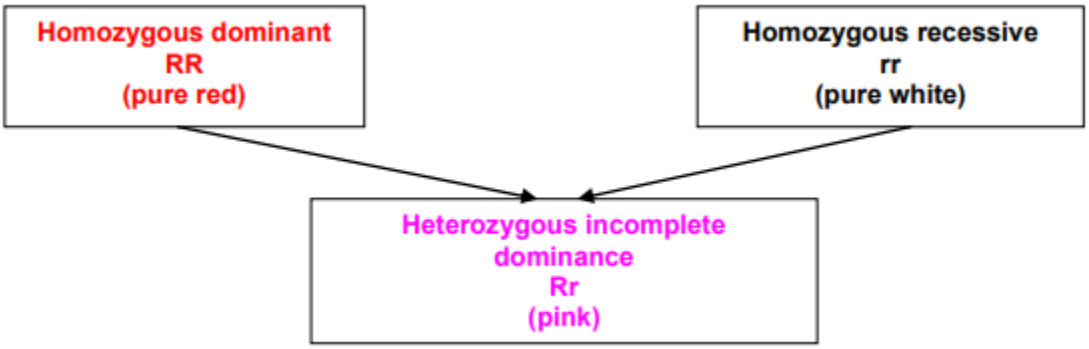
- **Chromosome:** is a thread-like structure of DNA made up of genes found in the nucleus of a cell.
- **Gene:** it is the basic functional unit of inheritance. Or a section of DNA, which codes for the formation of a protein controlling a specific characteristic of the organism.
- **Locus**: This is the exact position or location of a gene on a chromosome.
- **Allele:** it is an alternative form of a gene. Pairs of alleles occupy the same relative positions on chromosome pairs. Or a pair of genes that are located at the same point on each of the two homologous chromosomes and represent a specific trait – one from the father and one from the mother.
- **A character** is an observable physical feature, such as flower color.
- **A trait** is a particular form of a character, such as purple flowers or white flowers.

- **A heritable trait** is one that is passed from parent to offspring.
- **Homozygous**: (**Homo = same and zygous = zygote)**. Having a pair of identical alleles controlling the same characteristics. Or when two alleles of a pair of genes are the same for one trait e.g. TT, where T=tall.
- **Heterozygous**: (**Hetero = different and zygous = zygote)**. Having a pair of dissimilar alleles for a characteristic, e.g. Tt. **Or** when two alleles of a pair of genes are different for a trait e.g. one of the alleles is for red flowers and one is for white flowers, the cross will result in a mixture of the two genes called a hybrid.
- **Dominant trait**: A gene that always shows in the phenotype of an organism whether the organism is heterozygous (Tt) or homozygous (TT).
  - ✓ **Homologous dominant alleles** means that both genes are the same for the same dominant trait. It will be represented by RR, which represents both the genes for red flowers. The offspring will be red because two dominant genes are present.
  - ✓ **Heterozygous alleles** means that one gene is dominant and one gene is recessive for the same trait, e.g. red flowers. It will be represented by Rr, which represents one gene for red and one gene for white. The offspring will display red flowers, because red is dominant over white.
- **Recessive trait**: The recessive allele is the trait that is dominated over by the dominant gene. It is written with a small letter: r = white



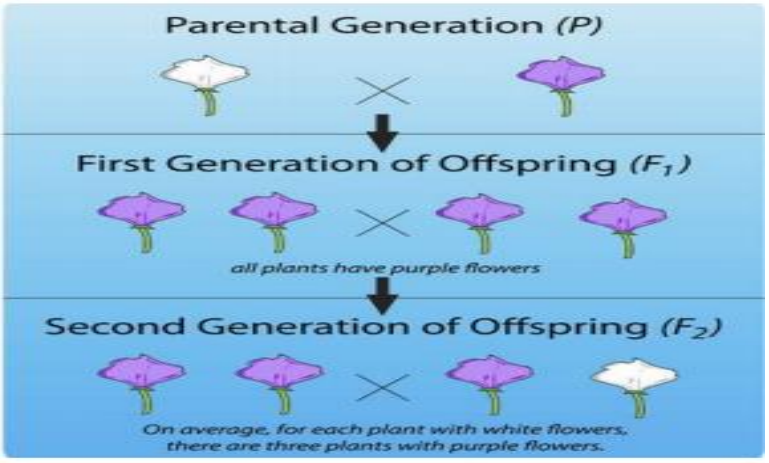
- ✓ **Homologous recessive alleles:** Means that both recessive genes are the same, i.e.: rr – two genes for are present for white flowers. The offspring will display the recessive white colour only. The recessive trait will only ever be seen when it is in the homologous state.

- ✓ **Heterozygous alleles:** Means that the genes are different with one gene dominant (red colour) and one gene is recessive (white colour) represented by Rr. The offspring will display red flowers because red is dominant over white which is recessive.
- ➢ **Incomplete dominance**: when the dominant gene allele is not able to completely dominate over the recessive gene allele, a mix of the two genes results, e.g. **red + white = pink**. When the offspring is heterozygous with incomplete dominance, you will be able to see the combination of the two gene alleles traits:



- ➢ **Co-dominance**: Both gene alleles are equally dominant, so the heterozygous individual expresses both traits. Example: blood type is determined by proteins that may or may not be present on the surface of the red blood cells. Protein A and protein B are coded by alleles A and B and if no protein A or B is present, then these cells will be coded by the allele O. The alleles A and B are codominant and A and B completely dominant allele O.
- ➢ **Genotype**: This is the genetic makeup of an organism. For example RR, Rr, rr. You cannot see this because it is in the genes.
- ➢ **Phenotype:** This is the physical appearance of an individual. I.e. what you will see when you look at the offspring. **The phenotype is determined by the genotype**. You will see white flowers for rr, but you will see red flowers if the genotype is RR or Rr.
- ➢ **Monohybrid cross: (Mono = ONE)**: involves the crossing of individuals and the examination of one character**. Or** so, when one pair of contrasting traits is crossed to determine the possible inheritance of the offspring. There will be 4 possible combinations that result from the cross – 2 possibilities from the male and 2 possibilities from the female (2 x 2 = 4).
- ➢ **Filial generation**: The parents are represented by P1. The parents reproduce to produce offspring that result from the cross. The **offspring** are the **first filial generation** and this

is represented by **F1**. When the offspring become mature and reproduce, they are **represented by P2**. Their offspring will be the **second filial generation represented by F2**.



- **Punnet square**: This is a schematic representation of a cross. Take careful note of the way the information is written. The example below: one parent is BB and the other is bb
  B = brown hair colour b = blonde hair colour

P_1√ **BB x bb √**

gametes	**B**	**B**
b	Bb	Bb
b	Bb	Bb

√ (√)

√√

F_1√

Genotype:√ 4:4 Bb heterozygous offspring √√ (always include the ratios)

Phenotype:√ 100% brown √√ (always include the %)

MENDEL'S LAWS

Gregor Mendel (1822–1884): an Augustinian monk who enjoyed experimenting with plants and the first known biogeneticist.

Mendel's First Law: The Law of dominance and segregation

When two individuals with contrasting homozygous characteristics are crossed, the individuals of the **F1 hybrid generation** will all resemble the parent possessing the dominant characteristic.

- Pea plants either grow tall (TT or Tt) or are short plants (tt). Mendel crossed the homozygous tall and homozygous short varieties to prove his theories.

P_1 TT x tt

gametes	T	T
t	Tt	Tt
t	Tt	Tt

F_1
Genotype: 4:4 Tt heterozygous offspring
Phenotype: 100% Tall

Mendel's Second Law: The Law of Independent Assortment

Different pairs of chromosomes segregate independently in dihybrids cross so that each characteristic separates independently and each gamete randomly receives only one allele from each gene pair.

- So, if you have blonde hair, you can inherit brown eyes because eye colour is independent of hair colour. Mendel used peas with a genetic trait for a round seed versus a wrinkled seed AND a yellow versus green colour of the seeds. Independent combinations for the traits round and yellow, round and green, wrinkled and yellow or wrinkled and green will result. (4x4 = 16 combinations).

Try me

1) The offspring of a tall man and short woman were all found to be tall. With the aid of genetic crosses, illustrate the above observation

ANSWER:

2) A woman with one sickle-cell gene was married to a man with one sickle-cell gene. Using appropriate crosses, explain the genetic constitution of their children.

ANSWER:

3) The offspring resulting from the cross between a red-flowered plant and a white-flowered plant were all found to be red. With the aid of appropriate crosses, illustrate the observation.

ANSWER:

4) Explain why father of blood group AB cannot produce a child with blood group O when he marries a woman of blood group O.

ANSWER:

5) Sheep homozygous for white wool are crossed with sheep homozygous for black wool. All the offspring are white. Use the letters B and b to represent a genetic cross to show the results and show the expected results if the F1 were to interbreed.

ANSWER:

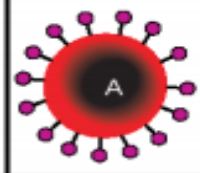
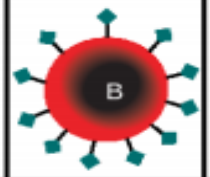
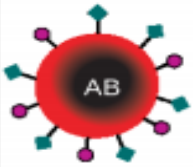
MULTIPLE ALLELES

Blood Type

Human blood type is governed by the presence of 3 different alleles:

- A
- B
- O
- However, each person only **has 2 of these 3 alleles in their DNA**
- Blood types follow both **Co-dominant and simple Dominant inheritance**
- The **A allele and B allele are co-dominant with each other**
- The A allele and B allele are both purely dominant over the O allele
- The O allele is recessive

Blood Type	Genotype	Can receive blood from
A	I^AI^A /I^Ai	A or o
B	I^BI^B /I^Bi	B or o
AB	I^AI^B	All
o	ii	o

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	A antigen	B antigen	 A and B antigens	None

Blood Group Inheritance:

- Blood is determined by **THREE alleles (A, B and O) and not two as for the other characteristics** – this is termed **multiple alleles**
- The alleles A and B are co-dominant (both dominate equally) over O, which is recessive.
- The **Rhesus factor also plays a role in determining blood type**: **Rh-positive – is the presence of the rhesus antigen on the surface of the red blood cell** and **Rh-negative – the absence of the antigen.**
- **Blood groups are classified by the gene and also the rhesus factor, e.g.: A+ or A–**

Monohybrid Crosses – Sex Determination and Sex Linked Genetic Diseases

Sex Determination In humans, the somatic cells are diploid and contain 23 pairs of chromosomes in each nucleus of which:

- 22 pairs of autosomes
- 1 pair of sex chromosomes: females
  - ✓ **XX sex chromosomes** and males
  - ✓ **XY sex chromosomes**
- Gametes are formed in the ovaries and testes. The **egg cell (female gamete)** can only ever contain **one X chromosome**, but half the **sperm cells will have X** and half will have

Y chromosomes. When fertilization occurs, there is a 50 % chance that the zygote is male and a 50 % chance that the zygote is female:

X + X = XX or
X + Y = XY

P_1/parent

Phenotype	female	x	male
Genotypes	XX	x	XY

Meiosis

Gametes	X, X	x	X, Y

Fertilisation

gametes	X	X
X	XX	XX
Y	XY	XY

F_1

Genotype: X X 50% X Y 50%)

Phenotype: 50% males and 50% females

Genetic Disorders

This is a condition that may be inherited and that results in disturbance of a person's normal body functioning.

- Mutations of genes or chromosomes may cause a person to have a genetic disorder.
- Examples of FOUR genetic disorders to be studied are: **Down's syndrome, Sickle cell anaemia, Haemophilia and Albinism.**

GENETIC DISORDER	NATURE	CAUSES	SYMPTOMS
Down's Syndrome	If non-disjunction (chromosomes do not separate during meiosis) happens in chromosome 21 during gamete formation, a zygote with 47 chromosomes is produced.	It is caused by faulty meiotic division during the production of gametes.	• Mental retardation because the brain has not developed properly. • Hearing, heart and eyes defects • Depressed nasal bridge • Small hands and fingers
Sickle Cell Anaemia	Sickle-cell anaemia causes the red blood corpuscles to become sickle shaped and this causes blockage in the small blood vessels.	It is caused by a single mutated gene on chromosome number 11.	• Spleen enlargement • Fatigue • Damage to parts of the brain leading to stroke
Haemophilia	Bleeding caused by the lack of essential blood clotting factors.	Caused by two genes. Both Haemophilia A and B are caused by X- linked recessive genes.	• Abnormal bleeding • Bleeding in the muscles and joints causes pain and severe swelling • Muscle-atrophy – muscles simply waste away.
Albinism	Refers to a group of genetic disorders all of which are characterised by a lack of the pigment melanin.	Caused by a single pair of recessive alleles and will only show in the homozygous state.	• Poor vision. • Sunburn can result in blisters, sores and eventually skin cancer.

1) **Haemophilia**: is the inability of the blood to clot. The alleles of the genes for these disorders are recessive and located on the X chromosome. Females are generally 'carriers' of the gene, with the gene masked by the normal allele gene. **Males have only ONE X** chromosome, so if the gene is present, there is NO masking allele and they will inherit and display the trait.

Sex-Linked Genetic Crosses

H = normal (dominant) h = haemophilia (recessive)

Carrier female: $X^H X^h$ where H = normal (dominant) and h = haemophilia (recessive)

Normal male: X^HY there is no 'arm' on the chromosome to carry the allele

P_1/parents

phenotype	normal male	x	carrier female
genotype	X^HY	x	X^HX^h -

Meiosis

Gametes	X^H, Y	x	X^H, X^h

Fertilisation

Gametes	X^H	X^h
X^H	X^HX^H	X^HX^h
Y	X^HY	X^hY

F_1/offspring

Genotype: 25% X^HX^H, 25% X^HY, 25% X^HX^h, 25% X^hY

Phenotype: 25% normal female (X^HX^H)

25% normal male (X^HY)

25% carrier female (X^HX^h)

25% male with haemophilia (X^hY)

VARIATION

Is the difference in characteristics between organisms of the same species.

- There are two kinds of variation: **continuous and discontinuous variation.**

Continuous variation

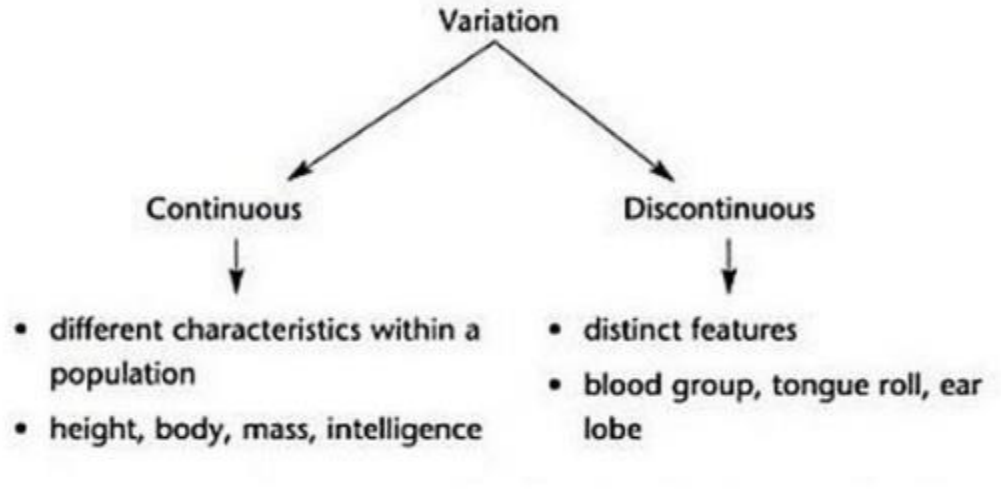
It is a type of variation in which there is differences between individuals in which there are intermediate forms.

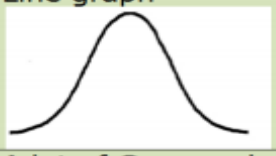
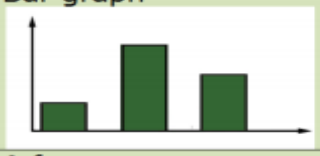
- Shows a complete range of the characteristic within a population.
- caused both by both gens (often a number of different genes) and environment:
- **Plants:** availability of/competition for: nutrients, light, water; exposure to disease
- **Animals:** availability of food/balanced diet; exposure to disease (or the availability of health serviced for humans).

DISCONTINUOUS VARIATION

It is a type of variation in which there is a clear cut distinct categories for a feature.

- No intermediates between categories, the feature cannot usually change during life.
- Caused by a single gene/a small number of genes, with no environmental influence.



	Continuous variation	Discontinuous variation
Properties	- No distinct categories - No limit on the value - Tends to be quantitative	- Distinct categories. - No in-between categories - Tends to be qualitative
Examples	• height • weight • heart rate • finger length • leaf length	• tongue rolling • finger prints • eye colour • blood groups
Representation	Line graph 	Bar graph 
Controlled by	A lot of Gene and environment → range of phenotypes between 2 extremes, e.g. height in humans.	A few genes → limited number of phenotypes with no intermediates e.g. A, B, AB and O blood groups in humans

Mutation is the sudden change in the genes or chromosome number of an organism.

TYPES OF MUTATION

- ✓ Chromosome mutation
- ✓ Gene mutation

Try me

1. A homozygous plant with red flowers (R) was cross-pollinated with a homozygous plant with white (W) flowers. All the plants that grew from the cross had pink flowers. Represent a genetic cross to determine the genotype of the F1 generation of plants.
2. In dogs, there is a hereditary deafness caused by a recessive gene, "d." A kennel owner has a male dog that she wants to use for breeding purposes if possible. The dog can hear, so the owner knows his genotype is either **DD or Dd**. **If the dog's genotype is Dd**, the owner does not wish to use him for breeding so that the deafness gene will not be passed on. This can be tested by breeding the dog to a deaf female (dd). Use a genetic diagram to illustrate this cross.
3. Ms. Johnston, Ms. Johnson, and Ms. Johnstone all entered the same hospital and gave birth to **baby girls on the same day**, and **all three babies were taken to the nursery to receive care, there**. **Someone later claimed that the hospital mixed up the babies**. As a hospital administrator, it is your job to make sure that each pair of parents has the correct baby, so you order blood typing to be done on all the parents and all the babies.

The results are as follows:

Ms. Johnston A

Mr. Johnston B

Ms. Johnson B

Mr. Johnson O

Ms. Johnstone A

Mr. Johnstone A

Baby 1 O

Baby 2 AB

Baby 3 B

Represent a genetic cross to show which baby belongs to which parents.