

BIOLOGY FORM THREE & FOUR

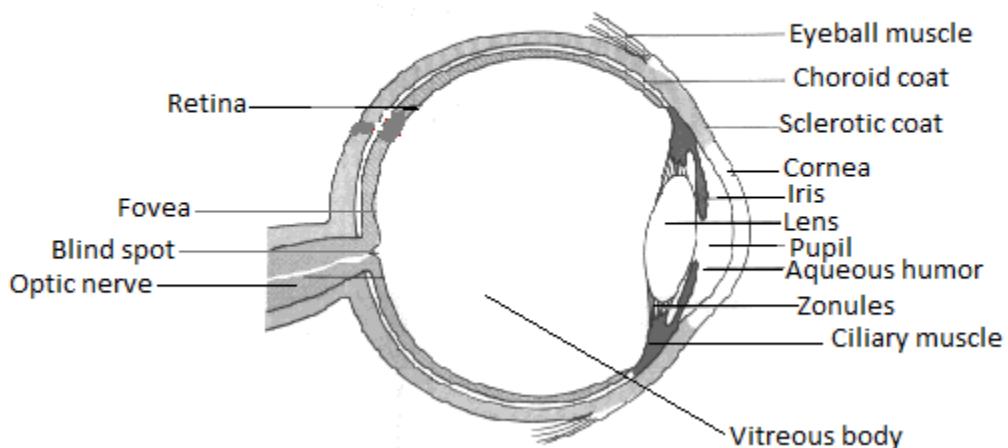
FORM THREE

1. CLASSIFICATION OF LIVING THINGS
2. MOVEMENT
3. COORDINATION
4. EXCRETION
5. REGULATION (HOMEOSTASIS)
6. REPRODUCTION

FORM FOUR

7. GROWTH AND DEVELOPMENT
8. GENETICS AND VARIATION
9. CLASSIFICATION
10. ORGANIC EVOLUTION
11. HIV/AIDS AND STD's

Cross-section of the mammalian eye



SUBJECT HANDOUT

Prepared by Dr. Donny

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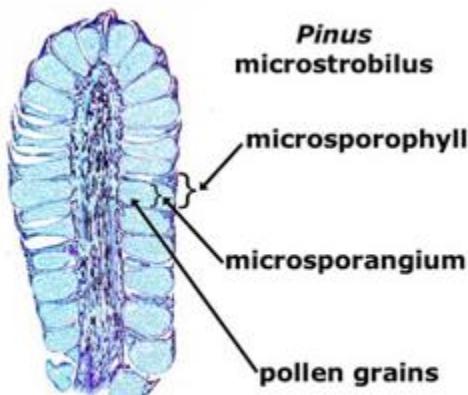
1. CLASSIFICATION OF LIVING THINGS

DIVISION CONIFEROphyta

Coniferophyta is a division containing cone- bearing plants with needle shaped leaves



a) Female pine cone



b) male pine cones

The smaller male cones produce a yellowish powder called **pollen**. It contains the male sex cells of gametes. The large female cone bears small seed like structure called **ovules**. This contains female gametes.

The male cone is comparable to a flower but consisting only of pollen producing structures. The pollen is formed on the leaf like scales of the cone. The female cone is comparable to a flower but with ovule forming parts only. The ovules are attached to the leaf scales of the cone.

The distinguish features and characteristics of the organism in this Division are:-

1. They are mostly shrubs and trees, with needle shaped leaves
2. Their reproductive structures are cones
3. The ovules are not enclosed inside an ovary wall
4. The dominant generation is the saprophyte
5. The majority are evergreen, (they keep their leaves all year round)
6. They are widely distributed, (are commonly found in areas with cold climate)

Advantages

- Conifers are relatively fast growing trees
- Are grown in plantations and produce useful timber (softwood)
- They are used extensively in the building industry, paper making and in furniture making
- The trunks of conifers grow very tall and straight. They are often used as telegram poles

DIVISION ANGIOSPERMOPHYTA (FLOWERING PLANTS)

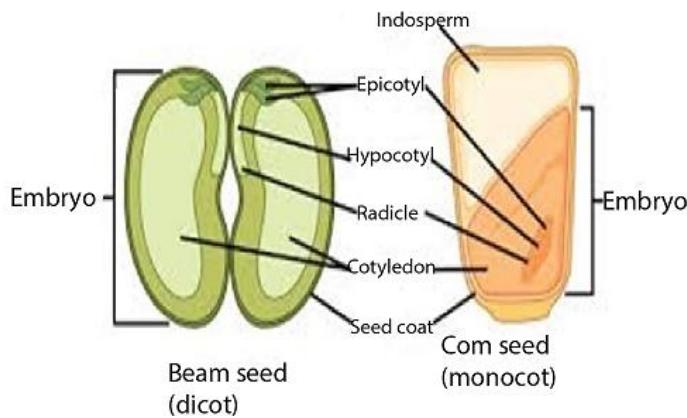
This division contains wide variety of forms, but all have common distinctive features as you will see there are two classes of angiosperms

- a) Monocotyledonae
- b) Dicotyledonae

The feature of angiosperms is leaves, stem, roots and flowers.

Nearly all angiosperms have the same structure in their feature modified according to type and function

1. **Sepal:** protects the flower parts when it is in bud
2. **Petals:** are often brightly colored to attract insect to pollinate the flower
3. **Stamen:** produce the male gametes
4. **Carpel:** produce the female gametes

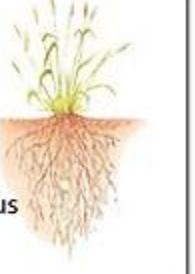


- The flower of angiosperms has male structure called **stamens**. These have a structure called **filament** support **anthers** which produce **pollen**
- The female structures are called carpels. A carpel is composed of stigma, style and ovary. The ovules are formed inside the ovary. Once a carpel has been pollinated and ovule present successfully fertilized the carpel becomes a fruit and the ovules become seeds.

The Distinguishing features of Angiosperms are

1. Their reproductive structure are flowers
 - When anthers and carpels are found in the same flower e.g. Delonix region the flower is said to be bisexual. Some plants produce unisexual flower (maize produce) produce male flower that can release pollen and female flowers that produce ovules.
2. Ovules are enclosed in an ovary and hence the seeds are enclosed in a fruit.
3. Angiosperms vary greatly in form, size and habitat.
 - They can be woody e.g. coconut tree, non- woody (maize plants) some are very small such as groundnut plants while others are very large such as baobab trees
4. They occur in wide range of terrestrial (land) and aquatic (usually fresh water) habitat

Comparing Monocots and Dicots

Monocots plants	Dicots plant
1; Have fibrous root system  Fibrous Root	Have tap root system 
2;Have leaves with parallel venation  (a)	Have leaves with (reticulate)net venation  (b)

3; The floral parts are in three or multiples of three



Monocots in 3s

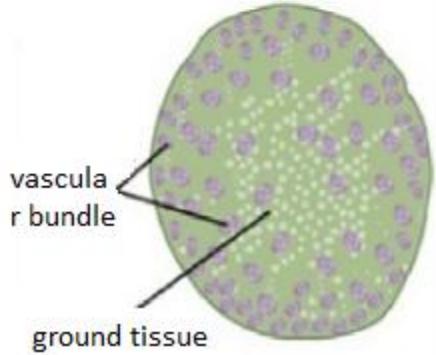
Have floral parts in 4 or 5 or multiple of four or five



Dicots in 4s or 5s

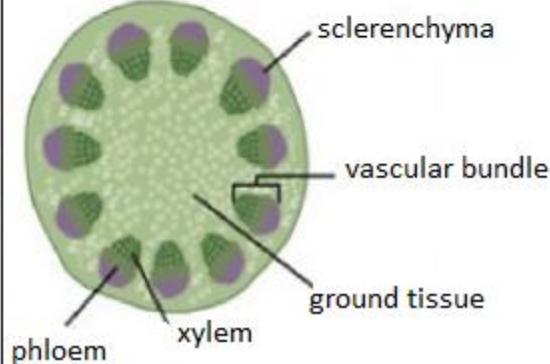
(4) Have vascular bundles which are scattered in the stem

Monocots stem sclerenchyma



Have vascular bundles which form a ring in the stem

Dicots Stem



A bean seed or groundnut seed has 2 cotyledons and is described as **dicotyledonous**. The maize grain has only one cotyledon and is described as **cotyledonous**

Examples of monocotyledons are maize, coconut, millet, palms, Grasse and orchids.

Examples of dicotyledons are beans, castor, groundnuts, mango, hibiscus plants and balsam plant.

Definitions

1. MONOCOTYLEDON PLANTS.

- Are plants whose seeds have one seed each. (One cotyledon)

2. DICOTYLEDON PLANTS

- Are plants whose seeds have two seeds (two cotyledons)

A. DISTINCTIVE FEATURE OF MONOCOTYLEDONS

1. Their seeds have one cotyledon.
2. The vascular bundles of the stem are scattered
3. The petals are arranged in groups of leaves
4. Leaves have veins running parallel to one another
5. Most have fibrous root system.

B. DISTINCTIVE FEATURE OF DICOTYLEDON

1. Their seeds have 2 cotyledons.
2. The vascular bundles of the stem and root are arranged regularly
3. The petals are arranged mostly in groups of 5 or more
4. The leaves have veins arranged in a branched network
5. Most have tap root system

Advantage of Angiosperms

1. Are used for timber
2. Are used as a source of charcoal and wood
3. Are used for manufacturing papers
4. Some angiosperms provide medicine (e.g. foxglove)

5. Some flowering plants are used for decorations
6. Angiosperms can be used in production of certain industrial chemicals plastics, rubber, and tannins.
7. Angiosperms can be a good source of organic manure for the production of our crops when they decay.
8. Are used for manufacturing resins.

Disadvantages of Angiosperms

1. Some flowering plants may be allergic to man (e.g. Pollens are allergic to people)

2. The potted plants in the house compete with man for oxygen

Some plants are poisonous to man. (E.g. certain type of cassava)

2. MOVEMENT

Movement is the act of changing position/posture by the whole organism or part of the organism

Types of movement

- 1 Movement of curvature (growth movement)
- 2 Movement of locomotion

1. MOVEMENT OF LOCOMOTION

This is the type of movement where by the whole organism moves from one place to another

Movement in locomotion is shown in all animals and some protocists exhibit variety of movements. Animals and some protocists exhibit variety of movements, these are

1. Amoebic
2. Ciliary
3. Muscular
4. Flagella

I. AMOEBA MOVEMENT

Is the type of movement exhibited by some protozoans such as **Amoeba** and **white blood cell** (WBC): amoeba movement is caused by streaming of the cytoplasm towards a peripheral region of the cell resulting into projections known as **PSEUDOPODIUM**

The cytoplasm streaming into these projections is withdrawn from others and flows in one direction to bring about movement

II. CILIARY MOVEMENT

This is the type of movement whereby some (protozoan) organism use cilia for movement

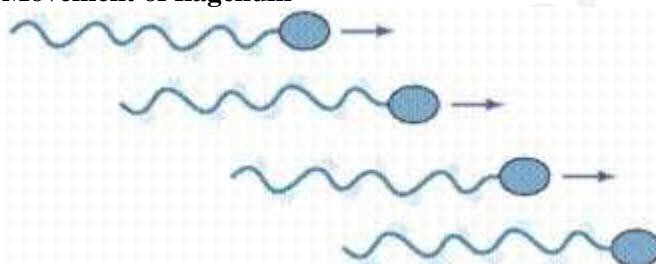
These protozoans are paramecium and larvae of some aquatic animals. The body of such organism is covered by thousands of small hair like structures called cilia. Movement is brought about by word noted backward and forward beating of cilia. The backward pushing of water (propels) pushes the organism forward

III. FLAGELLAR MOVEMENT

This is the type of movement exhibited by some organisms which possess flagella such organisms include Euglena, Chlamydomonas, trypanosome and some bacteria

Flagella are very similar in structure to cilia but are much longer than in euglena the whipping of the flagellum cause the swirling of the water around the organism. This swirling makes the organism rotate at the same time move forward

Movement of flagellum



IV. MUSCULAR MOVEMENT

This is the type of movement exhibited by the contraction and relaxation of muscles. Since muscles alone cannot bring about fast movement, most animals have a firm and hard base for support and attachment of muscle. This firm and hard base is called **skeleton**.

Importance of movement in animal and plant

- Organism moves in search of food and shelter
- Organism move away from a negative stimulus, e.g. predator, chemical, fires, to secure protection
- Movement enables animal to come together for mating
- Movement enables organism to move towards the positive stimulus for instance growth factor such as light, gravity and water.

MOVEMENT OF THE HUMAN BODY

Contraction and relaxation of muscles cause muscular movement in vertebrates animals such as man.

Movement of the human body is made possible by supportive structure like skeleton which provides attachment of muscles and other body organs. The body is supported by skeleton.

The muscle fibres become shorter on contraction. Muscles are paired producing ~~movement in~~ opposite direction.

One muscle contracts while the other is relaxed, this is called **antagonistic action**

THE HUMAN SKELETON

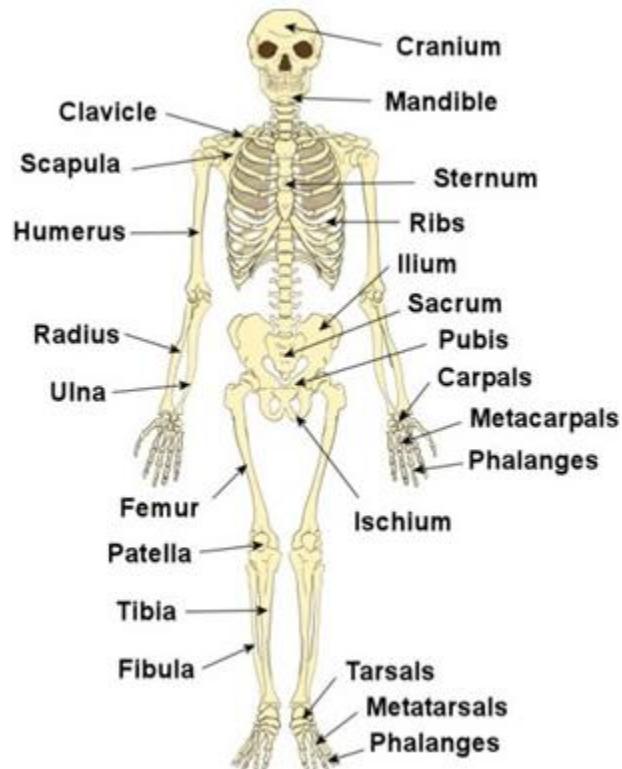
Skeleton is a frame work of tissue supporting a human or animal's body the human mammalian skeleton consist of the following major parts

- 1) Skull
- 2) Vertebral column
- 3) Limb
- 4) Girdles

The human skeleton is made up of separate units which are joined together: the points of junctions where 2 units meet are called **joints** the skull sternum, ribs and the vertebral column form the **axial skeleton**.

The limbs and limb girdles form **appendicular skeleton**

THE HUMAN SKELETON



TYPES OF SKELETON

There are 3 types of skeleton

- I. Hydrostatic skeleton
- II. Exoskeleton
- III. Endoskeleton

I HYDROSTATIC SKELETON

This is a skeleton found in soft bodied animals. The body tube is filled with fluid that produce pressure when muscles around it contract bring about movement e.g. Earthworm

II EXOSKELETON

These are skeleton found outside of the body which is typical arthropods e.g. insect

III ENDOSKELETON

This is a raid frame work of bones cartilages surrounded by muscles that contract and relax bringing about a movement.

Bone - is the one of the hardest tissue and found only in vertebrate.

Cartilage - is softer and more flexible tissue than bones. In animal cartilage found in nose, pair of ear and on the end of bones

FUNCTIONS OF SKELETON

1. Support

The skeleton provides a rigid frame work which supports softer parts of the body. (Provides attachment for muscles and body organs)

2. Locomotion

The skeleton enables the organism to move from one place to another

3. Protection

It protects delicate internal organs. Example the skull protects the brain. The sternum protects spinal cord and ribcage

protects the lungs and heart

4. Formation of blood cells

Red blood cells and white blood cell are made manufactured in the bone marrow.

3. Shape

The skeleton gives animals a definite shape it stores minerals such as calcium and phosphorus

The human skeleton system is divided into two major parts

1. The Axial skeleton

2. The Appendicular skeleton

1. THE AXIAL SKELETON

The axial skeleton consist of four parts which are

1. The skull

2. Ribcage

3. Vertebral

4. Sternum

1. The skull

Is made up of small bones joined together to form the cranium. The bones are joined together by irregular edges called sutures which are **immovable joints**

- It acts like a box enclosing and protecting the brain, parts of the inner ear nose and eyes.
- It consists of the upper and lower jaw bones which hold teeth
- Parts of the skull form hollows which protect the eyes (orbita) and ears
- The main function of the skull is to protect the **brain, olfactory organs, middle and inner ear and the eyes**.

The human skull has the following listed parts; those are:-

1. Mandible

2. Maxilla

3. Maral bone

4. Nasal bone

5. Frontal bone

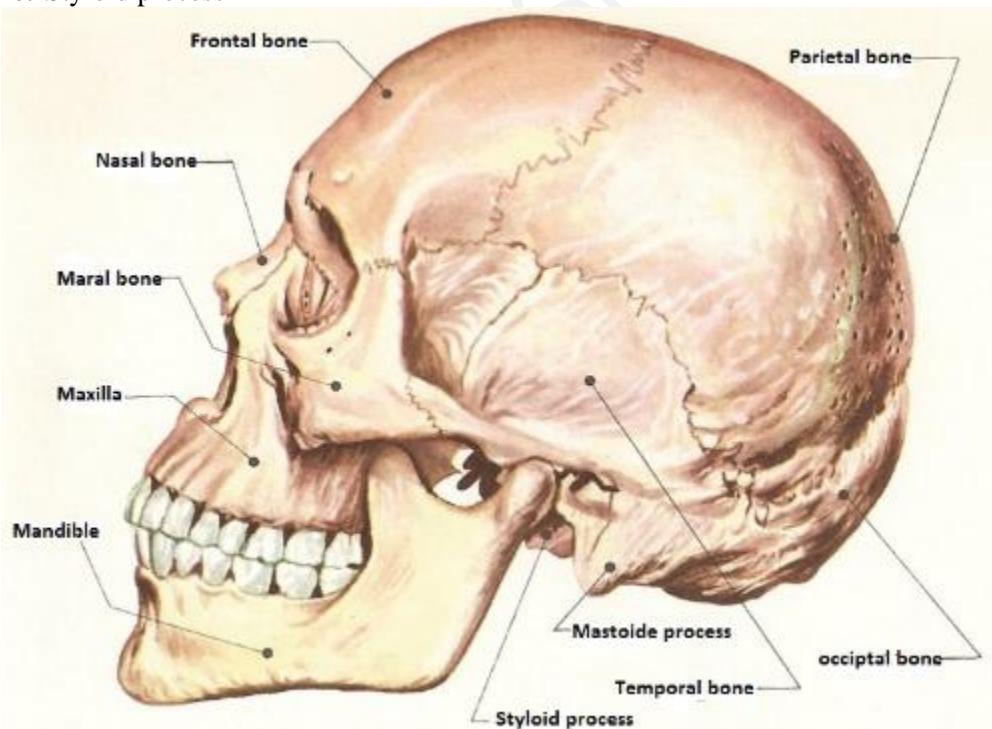
6. Pariental bone

7. Occipital bone

8. Temporal bone

9. Mastolde process

10. Styloid process



2. Ribcage and sternum

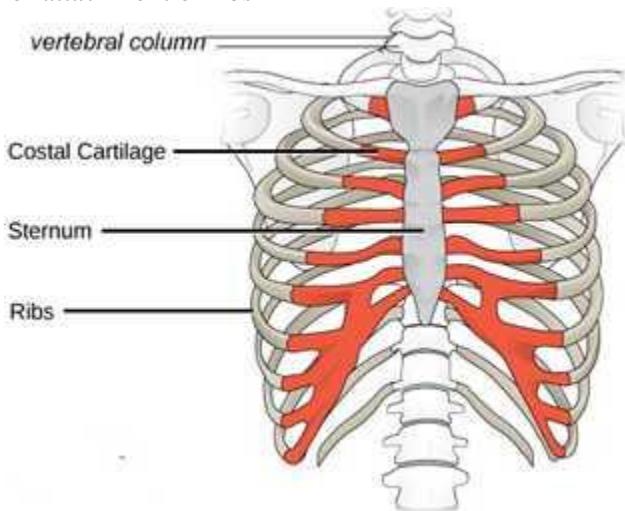
Skull is composed of bones of the sternum and the ribs. These bones form a thoracic cage which encloses the thoracic cavity, protecting heart, lungs and major bloody vessels. It consists of 12 pairs of ribs joined to thoracic vertebrae at the

back and sternum at the front.

The last 2 ribs are not joined at the sternum are known as **floating ribs**.

This arrangement enables a protective cage bones to be formed which enclose the heart and lung. Between the ribs are intercostals muscles. The ribs are associated with the axial skeleton

The sternum consists of small bones known as **Sternebrae**. The sternum forms part of the ribcage and provides surface for attachment of ribs



3. Vertebral column

This is the main axis of the body.

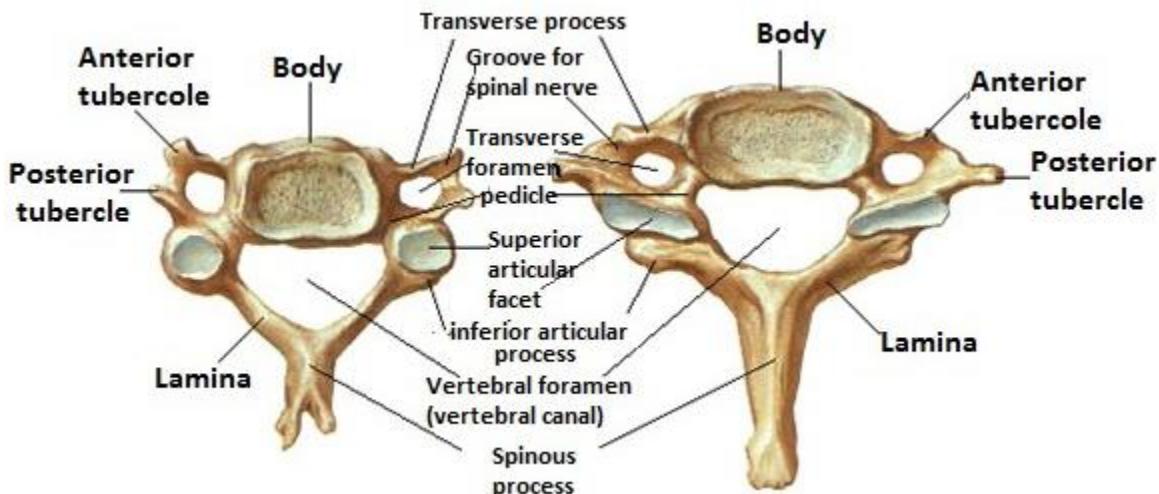
It is made up of small bones (33) known as **Vertebrae**. Between two adjacent vertebrae is a **cartilage** known as intervertebrate disk which act as shock absorbers, and reduce friction

The main function of the vertebral column is to support the body and support the spinal cord. The backbones have five types of vertebrae, which are

- a) Cervical
- b) Thoracic
- c) Lumber
- d) Sacral
- e) Caudal

a) Cervical vertebrae

There are 7 short cervical vertebrae, found in the neck region. The first is below the skull is *atlas* followed by the *axis*. Atlas articulates with the skull to allow nodding movement of head

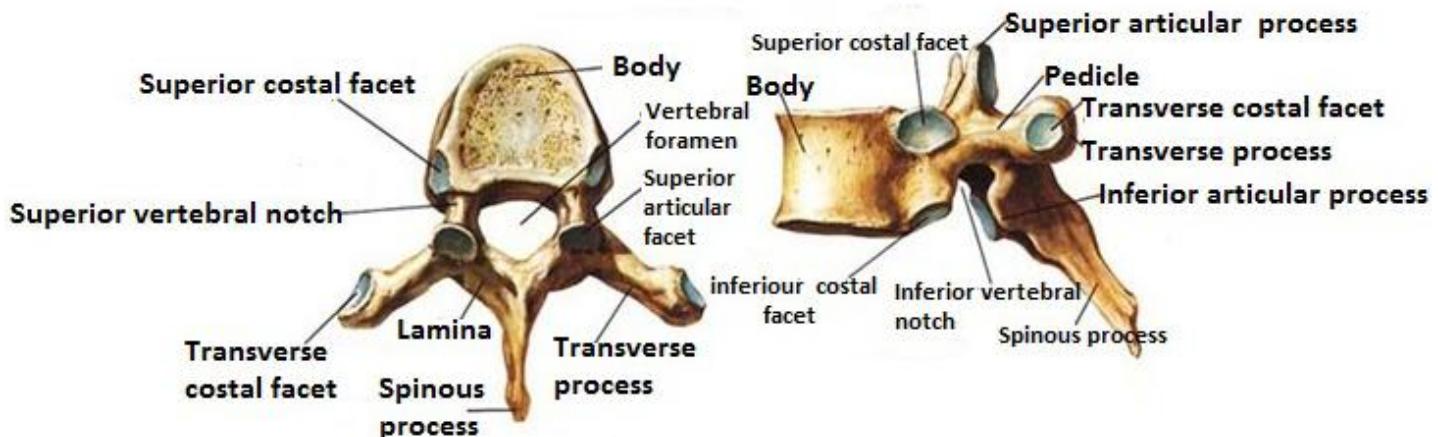


The axis allows rotational movement of the atlas which acts as a pivot this allows turning/side to sideways movement of the head. (Shake the head to say no), also cervical vertebrae support the head region and protect blood vessels that pass through their canals. They also provide surface for the attachment of the neck muscles

(b) Thoracic vertebrae

Are found in the chest region, they are 12 vertebrae. The thoracic vertebrae with the ribs and sternum form the thoracic cage the main role of the thoracic cage is to protect the heart, lungs and major blood vessels also plays major role on breath movement

Thoracic Vertebrae and Ligaments



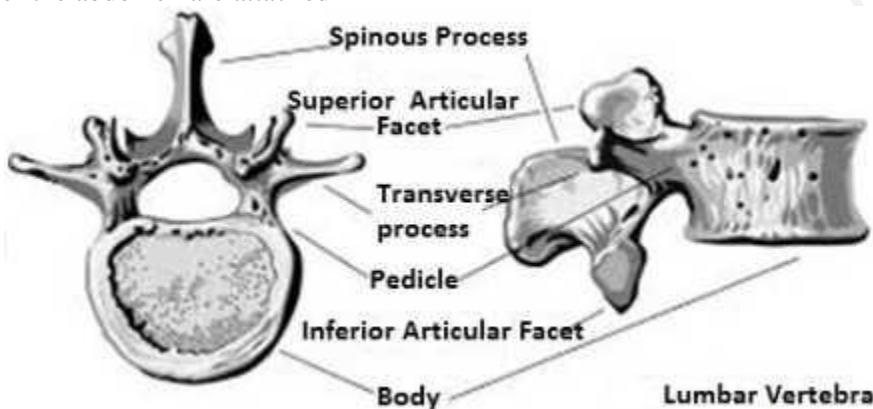
Thoracic Vertebrae and Ligaments

c) Lumbar vertebrae

There are five (5) lumbar vertebrae in human, seven in rabbits and six (6) in rats

They are short bones found in the abdominal region. Lumbar vertebrae have a number of projections that provide surface for attachment of abdominal muscles and muscles of the lower half of the back. The large thick Centrum gives support to the upper half of the body.

Lumbar vertebrae permit bending, sideways movement and rotation of the trunk. This is the region where large muscles of the abdomen are attached



d) Sacral vertebrae

Sacral vertebrae are fused together to form the sacrum, they are found in the sacral region. Sacrum provides a large surface area of the attachment of muscles of the back

e) Caudal vertebrae

These are found in the tail region. The number of caudal vertebrae varies from one animal to another depending on the size of the tail. In man there is no external tail, there are four caudal vertebrae which are used to form which is (no functions)

2) THE APPENDICULAR SKELETON

The appendicular skeleton is composed of the appendage limbs which are attached to the axial skeleton. **There are 2 types of limbs namely**

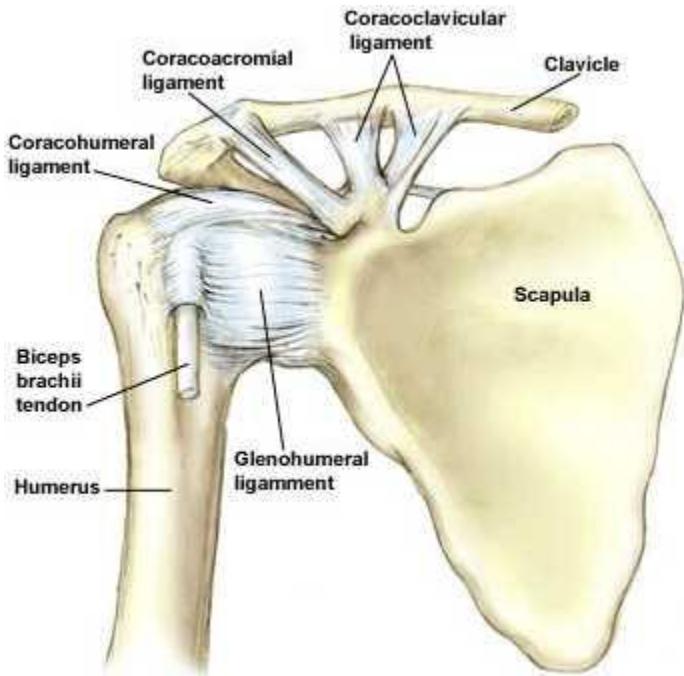
1. Fore limbs
2. Hind limbs

1. FORELIMBS

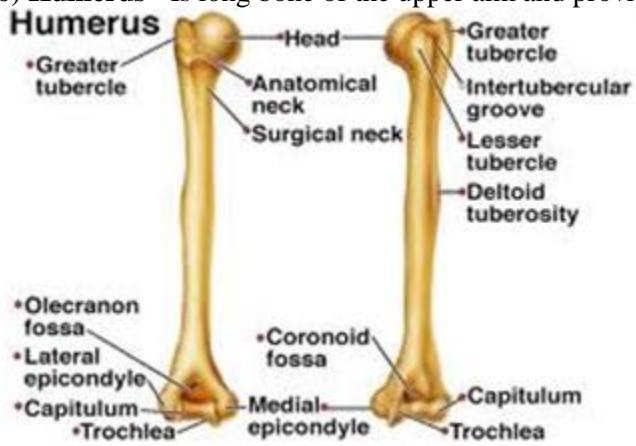
Forelimbs are attached to the axial skeleton to the anterior part of the body. Forelimbs comprise the **following parts**

a) Pectoral girdle

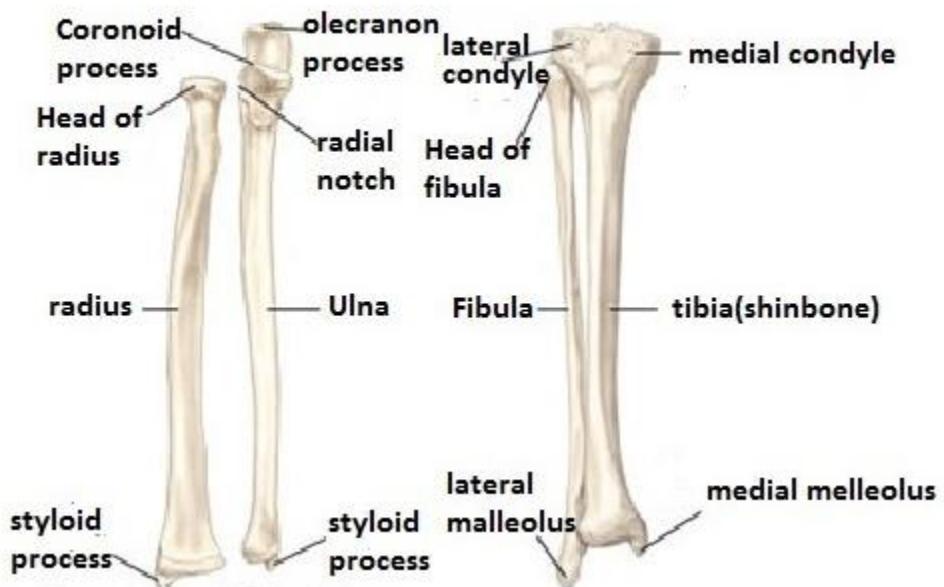
Front view



b) Humerus - Is long bone of the upper arm and provide surface for attachment of muscle



c) Ulna and Radius



d) Carpals, metacarpals and phalanges

- Carpals are nine small bones which form the **wrist**. They articulate with radius and ulna at the upper and metacarpus at the lower ends

i) They allow free movement of hands and wrist

ii) They provide surface for attachment of wrist muscles

Metacarpals are five slightly elongated bones which are found in the palm

- Each of them articulate with phalange of finger bone

1) They provide surface of attachments of palms muscles

2) They support and maintain shape of the arm

e) Phalanges

Phalanges form the skeleton of the fingers



2 HIND LIMBS

Hind limbs are attached to the axial skeleton to the posterior part of the body. Hind limbs comprise of the following

a) Pelvic girdle

Is made up of several bones found around the hip region:

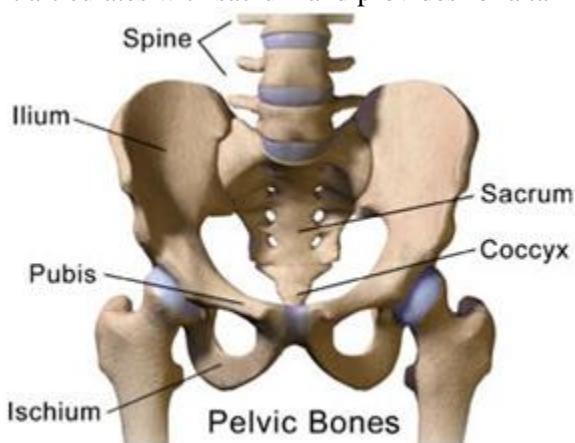
It contains 2 halves, the left and right. Each half lies on either side of the vertebral column. In this way it supports the hind limbs

Pelvic girdles have two bones known as pubic bones, each pubic bone comprises of three (3) bones known as **ischium**, **ilium** and **pubis**.

The ischium and ilium are fused together

The size of the pubic cavity is very important in females during birth. Causing the widening of the female girdle.

- The pelvic girdle forms a protective cage around vital organs such as female reproductive organs.
- It also supports legs, articulating with the head of femur to form hip joint
- It articulates with sacrum and provides for a tail where it is present



b) Femur

Is a long bone on the upper part of the hind limb (on the thigh region)

- The head of femur fits in the pelvic girdle to form hip joint
- It articulates with tibia at lower end to form knee joint
- It provides surface for the attachment of leg muscles and it supports the thigh,

c) Tibia and fibula

These are long bones of the lower

- Tibia is a very long bone, found on the side of the big toe. It may be free or partly fused to the smaller fibula which lies alongside it.
 - Fibula is much smaller in size and fused to the tibia in the lower part of the leg.
- A small round bone is called patella knee cap lies in front of the knee joint, it prevents the leg from bending up wards at the knee.
- The tibia and fibula supports the front part of the leg below knee
 - They provide surface for attachment of the knee (shin) muscles.
 - They articulate with femur to form knee joint, and with metatarsals to form the ankle joint.
 - Red blood cells are manufactured in the tibia and fibula bone marrow.

d) **Tarsals, metatarsals and phalanges**

- **Tarsals** are six (6) small bones in the ankle. Two of them are elongated and one projects backwards to form a heel bone. The tarsals provide surface for attachment of ankle muscle. The heel bone prevents the foot from bending backwards.

- **Metatarsals**

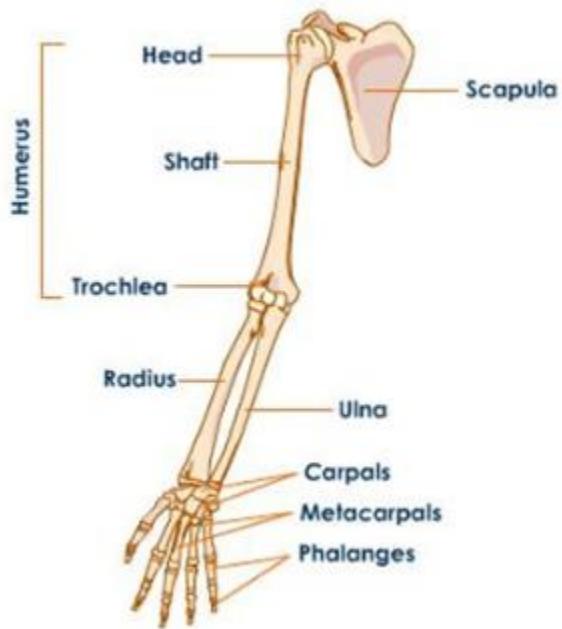
These are elongated bones in foot.

There are 5 in humans and in most animals. Each one leads to a phalange. The metatarsals provide surface for attachments of foot muscles, they also support and maintain the shape of the foot

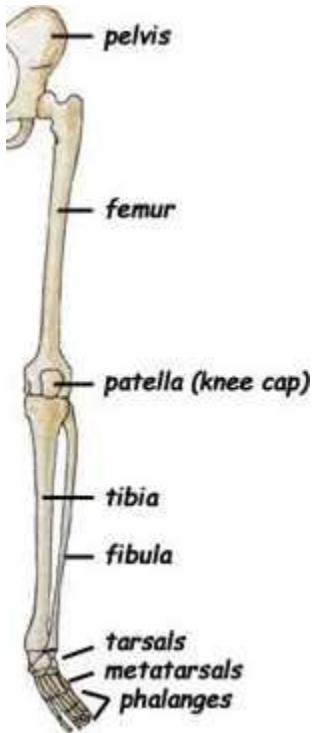
Functions

- Tarsals articulate with fibula to form the ankle joint
- Tarsals articulate with metatarsals to form the foot
- Metatarsals articulate with phalanges to form toes

SKELETON OF HUMAN FORE LIMB



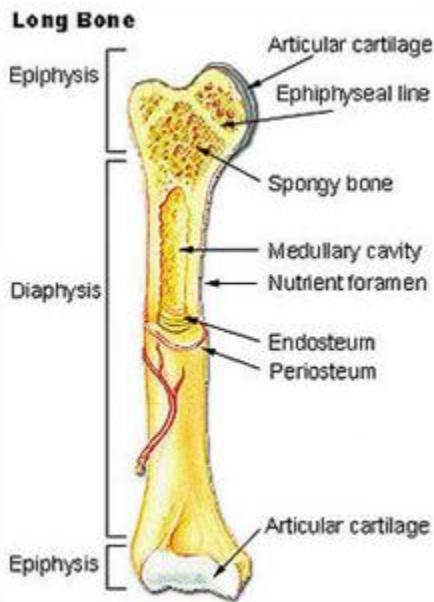
SKELETON OF HUMAN HIND LIMB



DEFINITIONS OF TERMS

1) Bone

This is a hard, tough connective tissue composed of minerals salts: calcium and phosphate



2) Cartilage

This is a soft bone found in the trachea, ear and nose and at the end of the bones especially at joints to reduce friction.

3) Ligaments

These are fibrous tissues which join one bone to another. Ligaments are elastic to allow movement at a joint.

4) Tendon

This is a tough connective tissue which attaches a muscle to bone. Tendons are inelastic to firmly attach muscles to the bones

5) Joints

This is area/region where bones meet. Joints provide articulation between bones making movement possible

Types of joints

1) Movable joints

2) Immovable joints

1. Fixed immovable joints

These are joints that do not allow movement of bones. E.g. Pelvic girdles and sutures (bones found in the skull)

2. Movable joints

These are joints which allow movement of bones E.g. Hip joint and shoulder joint

Types of movable joints

These are classified according to movement of bones at joint in different shapes or structure.

There are four types of movable joints

a) Ball and Socket joints

b) Hinge joints

c) Gliding joints

d) Pivot joints (peg and socket joints)

a) Ball and Socket joint

Is the type of movable joint which allow movement of bones to take place in many direction.

These types of joints allow the greatest flexibility of all joints e.g. hip joint, shoulder joint

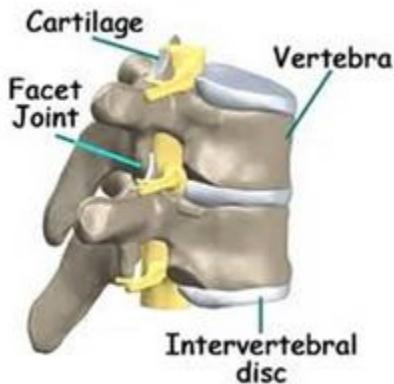


It is called the ball and socket joints because the round head which looks like a ball of one bone it's a socket of another bone. At the shoulder, the rounded head of the Humerus fits into the socket of the pectoral bone. Some joints have synovial fluid which reduces friction by lubricating the bones, e.g. hip joint shoulder and knee joint

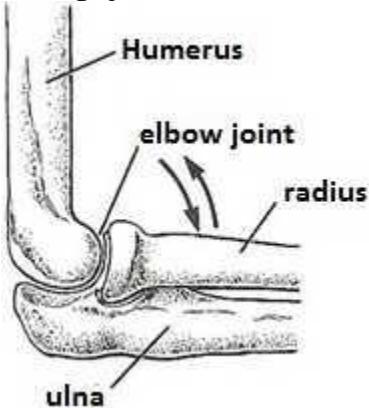
b) Gliding joints (sliding)

These are bones that occur between the vertebrae. This type of joints found where two or more bones surface move over each other. It allows movement in two directions. It occurs at the wrist and ankle and allows hand and foot to be moved up and down or to be rotated only slightly.

They lack fluid between them, and instead they have a layer of cartilage between them that reduce friction

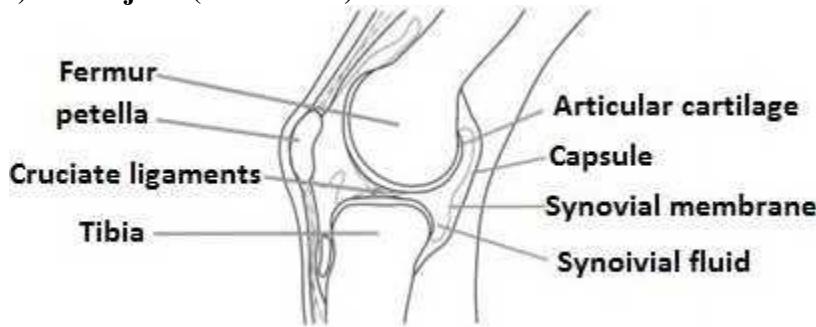


c) Hinge joints



Is a joint which allows only movement of bones to one direction, it is called hinge joint because it operates like the hinge of a door in which a door is allowed to move in one direction only. A joint of this type is found at the elbow, knee, finger, knuckles are between the phalanges of toes.

e) Pivot joint (on the neck)



The skull is pivot at the first cervical vertebra (atlas). The joint allow the head to move sideways. E.g. when a person he shake his head and say no. It allows nodding movement

Adaptations of joints to movement

- Freely movable joints such as those of the limbs may therefore cause dislocation hence movement joint involves more than one bone. Dislocation and friction is presented by the ligament which holds the bones together
- It may also cause knocking of bones against each other, and strains in the bones due to compression of the bones are not well protected.

In freely movable joints such as those of limbs, dislocation is prevented by the ligament which holds together bones.

- Joints which support weight are provided with **cushion**. The cushion absorbs compression due to weight. Cushioning in the joint is provided by the disc (in the intervertebral column) of cartilage as in the case in joints of the vertebrae.

MUSCLES

Muscle is a tissue of consisting of cells that have the capacity to contract and exert a pull

Types of muscles

- I. Skeletal muscle (voluntary)
- II. Cardiac muscle (involuntary)
- III. Smooth muscle (involuntary)

Muscles are tissues that cover the skeleton. The skeleton alone can't bring about locomotion and movement of the body in order to bring about movement there must be muscles. These muscles are attached to the bones. Muscles are composed of many elongated cells called muscles fibres which are able to contract and relax.

During relaxation of muscles can be stretched but they show elasticity which allows the regain to their original size and shape after being stretched

Muscles are made up of specialized tissues which are known contractile tissue. When these tissues contract, they become shorter and tighter as a result they cause movement

1. SKELETAL MUSCLE

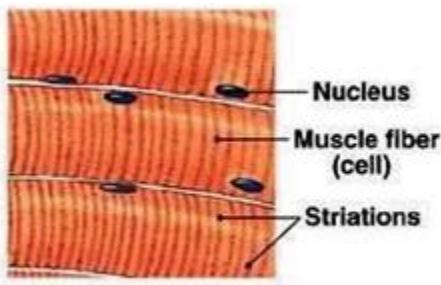
These are muscles which are attached to bones of the skeleton. Are made up of long fibre and cover the skeleton are also known as striated voluntary muscles because they are controlled by the will

Skeleton muscles can contract and relax quickly but get fatigue quickly

Functions

- Skeletal muscles are concerned with movement of the limbs and parts of the skeleton

Skeletal muscle



2. SMOOTH MUSCLE

These are muscles found on the wall of internal organs

- Such internal organs are alimentary canal, bladder, uterus, sperm ducts and blood vessel e.t.c.
- Smooth muscles are controlled by involuntary nervous system meaning they cannot contract at will. So they are involuntary muscles.
- Smooth muscles contract slowly and they get fatigued relatively slowly

Functions of smooth muscle

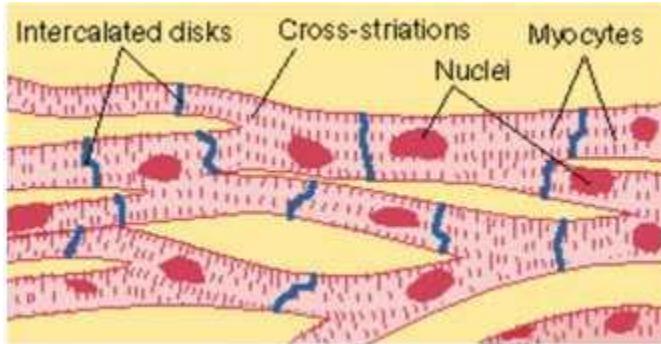
They contract and relax to cause movement in different organs e.g. peristalsis in the alimentary canal cause movement of the materials through the canal with the help of smooth muscle

3. CARDIAC MUSCLE

These are muscles which are found only in the heart. Their muscles are made up of muscle fibres which branch and connect to each other like a network (interconnecting network)

Cardiac muscle has the capacity to contract and relax through its life without becoming fatigued. (They contract softening from fatigue)

The contractions of these muscles are not (initiated) helped by the nervous system so they are involuntary muscle.



MUSCLE AND MOVEMENT

The skeleton alone cannot bring about locomotion and movement of the body parts such as arms, finger and jaws when the aim is straightened.

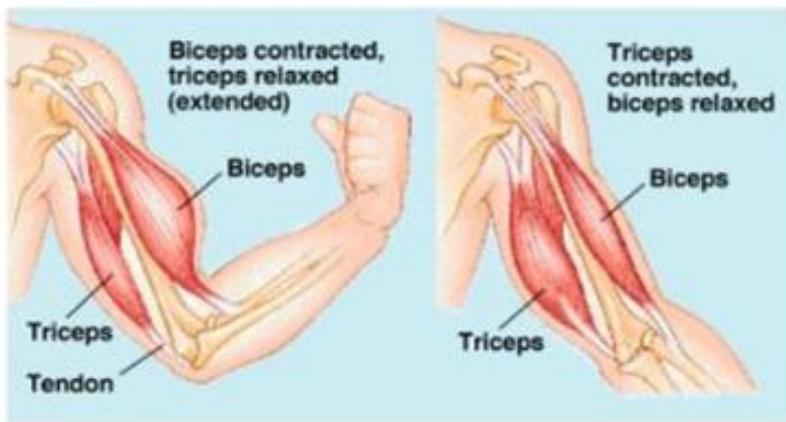
The muscles above the arm become thin while those below become thick. The bending and straightening of the arm is brought by two sets of muscles located above and below the Humerus.

The muscles above the Humerus are called biceps and those at the back are called triceps.

Bending of the arm is brought about by contraction of muscle in which they are called **flexor** and relaxation of triceps muscles are called **extensor** for the arm to straighten the triceps contract biceps relax.

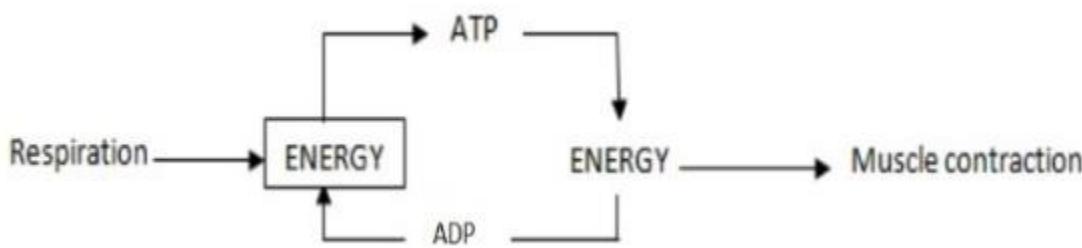
Muscles which work as pairs in opposition to one another are called antagonistic pairs. Their antagonistic action is necessary to bring continued movement. Therefore biceps and triceps are known as antagonistic muscles. Muscles are attached to bones at both ends by strong elastic fibres called **tendons**.

Contraction and Relaxation of Biceps and Triceps during bending and straightening of the arm



Muscles contraction

- * For muscle to contract, energy is required. This energy is derived from respiration and it is found in the muscle cells in the form of ATP.
- * During muscle contraction ATP is broken down to ADP thereby releasing the energy. The released energy is used to cause the muscle tissue to contract.



MUSCLE CRAMPS

These are sudden, involuntary contractions of muscles or groups of muscles.

The tissue may become hard and knotted cramp in skeletal muscle may occur after a period of prolonged exercise e.g. swimming also it may be caused by lack of salt in the body. Stretching and warming the affected muscles can help to cease the cramp

Causes of muscle cramp

1. Dehydration
2. Lack of magnesium
3. Muscle fatigue
4. Excessive exercise

Prevention of muscle cramps

- * Stretching of muscle more often
- * Do a lot of physical exercise
- * Taking salt through a solution of water

GROWTH OF CURVATURE (MOVEMENT IN PLANTS)

Since most plants remain fixed to the ground, they are incapable of moving from one place to another.

However their leaves stems and roots may show growth responses. These response results in part of the plants growing away from or toward a stimulus is growth of curvature

Growth movement enables plants to obtain their requirement despite of being fixed in one place.

Growth curvature movements are the result of tropic responses

The tropic movement is the case where a plant moves either towards or away from the stimulus. If the response is toward the stimulus is referred to as (+) positive response. If the response is away from the stimulus it is referred to as (-) negative responses.

Movement or growth of curvature is categorized in two groups.

Which are following:-

1. Tropic movement or tropism
2. Nastic movement

I. **Tropism** – is movement by plant organs in response to unilateral stimuli in which the direction of the movement is related to the direction of the stimulus.

Tropic Movement includes

i) Phototropism

This is the growth movement in response to the source of light

ii) Hydrotropism

This is the movement by which roots growth toward water

iii) Geotropism

This is the movement in response to the stimulus of gravity

iv) Chemotropism

This is the growth movement in response to source of chemicals

v) Haptotropism

Movement due to touch

II. Nastic movement - Is referred to as non - directional response.

Example of nastic responses are the opening and closing of flower and leaves of certain plants in response to changes in light intensity and temperature, closing of flowers of carnivorous plants when touched. Also closing and opening of dandelion flower in response to changes in humidity.

Tropic and nastic movement of plants are response to external stimulus

Importance of Tropical Movement

- Exposes the leaves of the plant to trap maximum sunlight for photosynthesis
- Enables plants with weak stem to obtain mechanical support

3. COORDINATION

Coordination refers to the co-ordination of the activities of different organs, so that they work at an appropriate time and rate required by the body.

During physical exercise several organs are involved, these include the heart, skeletal muscles, blood vessels and lungs. Hence for any activity to take place smoothly these organs must function in a coordinated manner.

Without coordination body activities become disordered the body may fail to function properly.

Coordination of various organs in the body requires a system which can detect changes in the environment and transfer of information to the appropriate organs so that the body can change in such a way as to ensure its survival.

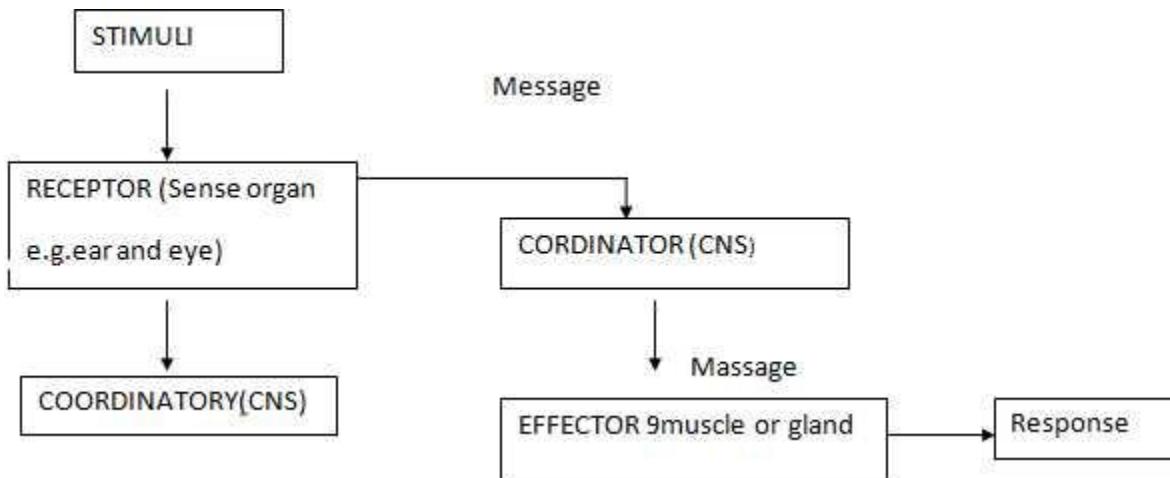
Coordination is affected by nervous system and hormonal coordination. Hormonal coordination involve organs which secrete chemical substance in response to a certain change in the environment both internal and external stimuli.

COORDINATION IN ANIMALS

All animals from simple unicellular organism to large multicellular need to coordinate the body activities. All animals respond to changes in their surroundings and react in an appropriate way.

Coordination in animals consists of five components.

The following figure shows the nervous coordination



STIMULUS

Refers to a factor which causes an organism to react (respond)

E.g. Changes in external or internal environment (outside or inside animal body). **Example** pain, smell, taste and sound

RECEPTORS

Refers to the parts of an animal which detects the changes (stimulus) e.g. tongue, nose, skin and ears. Receptors are called **sense organ**. A receptor produces a type of message called **nerve impulses**, which is then transmitted from one part of the body to another.

COORDINATOR

Consists of brain and spinal cord which receive message as sensory nerve impulses from receptors. It coordinates these and generates motor nerve impulses which pass to the appropriate organs of the body which respond. In this way the activities of the body are coordinated

EFFECTOR

Is an organ which receives motor nerve impulses from the brain or spinal cord and brings about an appropriate response e.g. muscles and glands

RESPONSE

Is a body activities provoked by stimulus. E.g. pulling your hand away from a hot object

NERVOUS COORDINATION IN HUMANS

The nervous system includes specialized cells called **nerve cells or neurons**.

A neuron system includes specialized cells called nerve cell or neurons. A neuron has the following basic properties

- It is highly capable of responding to stimulus. This property is referred to as excitability
- It is highly capable of conducting message (nerve impulses) along it. This property is referred to as a conductivity
- It has a cytoplasm which extends forming long fine thread

NEURONS

Neurons like other animal cells have a plasma membrane surrounding the cytoplasm.

The cytoplasm contains the nucleus and other organelles and is contained in one part of the cell. This is called the **cell**

body.

- Axon is projection arise from the cell body.
- Axon carries nerve impulses away from the cell body
- The shorter projections are called dendrites which conduct impulses towards the cell body.
- The axon is made up by cells called **Schwann cells**; these form a sheath around the axon called **Myelin sheath**.
- The small gap in between adjacent Schwann cells is called a **node of Ranvier**
- Myelin sheath serves to insulate axons from one another. Also it prevents impulses in one axon from interfering with impulses in another axon. Also nerve impulses travel faster in myelinated than in non myelinated nerve fibres

Classification of neurons

Neurons are classified as

1. Sensory (afferent)
2. Motor (efferent)
3. Relay neurons (Intermediate)

1 SENSORY (AFFERENT) NEURONS

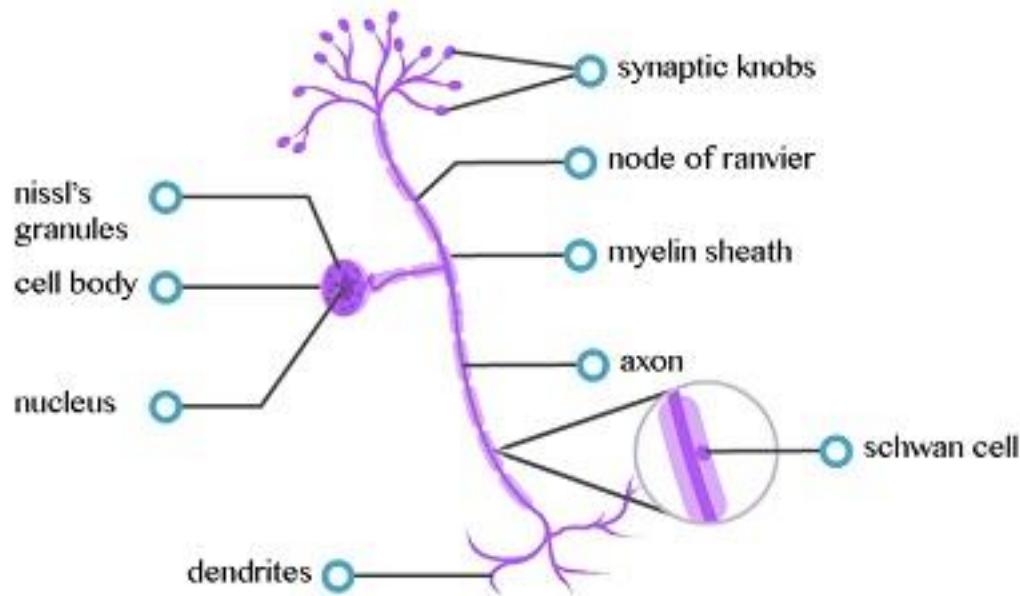
They transmit impulses from sense organs towards the central nervous system (brain and spinal cord).

Each sensory neuron has an axon and Dendron. The Dendron has its origin in a sense organ. When there are changes in the environment the sense organ is stimulated at the tip of the Dendron.

The nerve impulses are transmitted along the Dendron to the cell body and from there via the axon to the finely branches ends of the nerve cells in the brain or spinal cord.

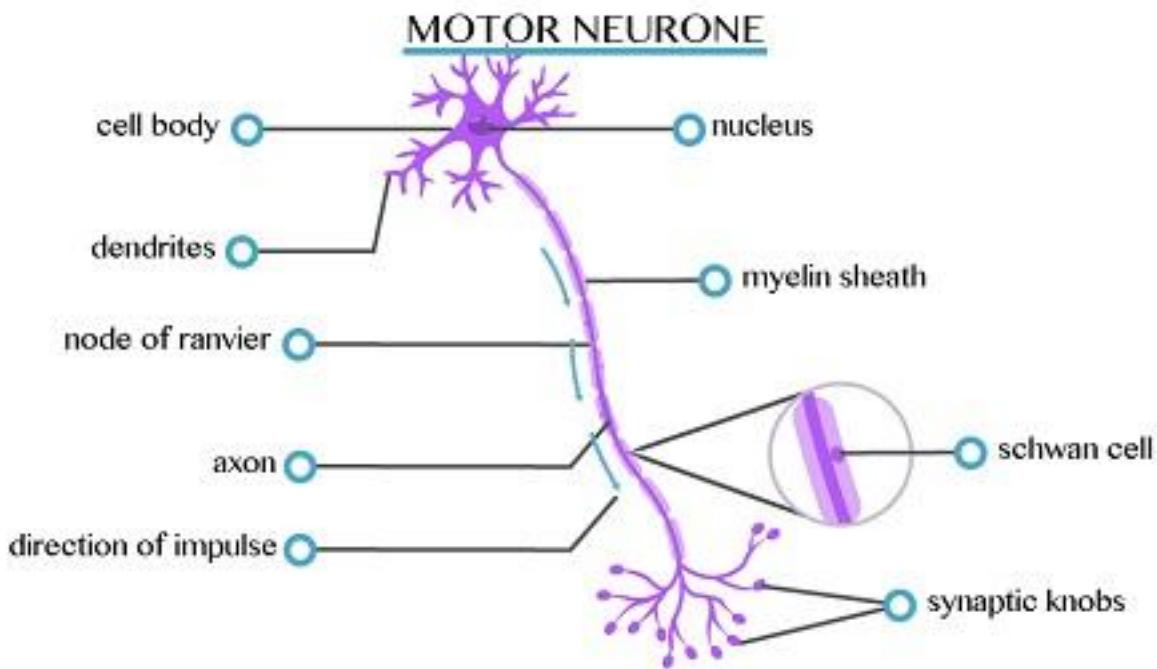
N.B There will be no sensation until the nerve impulses have been interpreted

SENSORY NEURONE



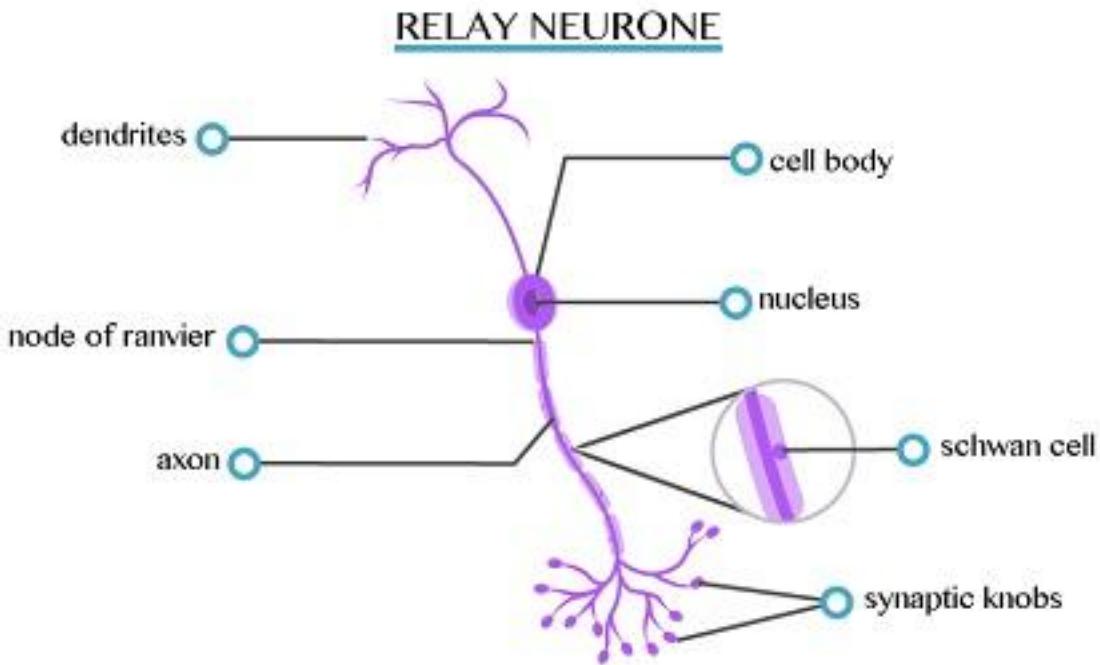
2. EFFERENT (MOTOR) NEURONS

They transmit impulse from central nervous system to effectors organs
from central nervous system to effectors organs



3. RELAY [INTERMEDIATE] NEURONS

Form intermediate links between afferent and efferent neuron. They are found in the brain and spinal cord. The terminal part of the Dendron of relay neurons receives impulses from the terminal part of the axon of a sensory neuron. Impulses from the axon of a relay neuron are passed to the dendron of a motor neuron



CENTRAL NERVOUS SYSTEM

The central nervous systems (C.N.S) consist of the brain and spinal cord.

The CNS analyses the impulses received. It also determines what actions are to be taken in response to stimulus the central nervous system has two main components. Which are:

1. Brain
2. Spinal cord

1. THE BRAIN

Situated in the skull and it is covered by system of membrane called **MENINGES**. Between the inner most membrane and the middle membrane is a space filled with a fluid called cerebrospinal fluid

This fluid cushions the brain against shock. Brain is very sensitive to insufficient supply of oxygen and glucose which causes rapid damage.

The brain is divided into 3 regions: fore brain, mid brain and hind brain

a) FORE BRAIN

This is the anterior portion of the brain. It is composed the Olfactory lobes and Cerebrum. The outer position is grey hence called grey matter, like inner pair is whitish hence called **white matter**.

The cerebrum interlinks impulses and coordinates response. Nerve impulses from the eye, ears and tongues are interpreted in the cerebrum. Also cerebrum is responsible for speech, reasoning, memory, decision making, behavior and imagination.

Also controls activities are under the control of such as running, walking, eating, and playing. Since such activities are under the control of the stall of the animal, they said to be voluntary or consciously done. In human the cerebrum is extremely active, compared with other animals. That is why we can reason and recall past experience.

The olfactory lobes receive impulses of smell via olfactory nerves from the organ that sense smell (nose).

b) MID BRAIN

Mid brain is smaller compared to other regions. This part of the brain is called the **OPTIC LOBES**. It lies between the fore brain and the hindbrain. It is composed of thalamus and hypothalamus together with pituitary gland

- Its function is to relay information between the fore brain and hind brain
- Also to relay information between fore brain and the eyes. It is in this region that optic nerve linking the brain and eyes originates.

c) HIND BRAIN

Hind brain is composed of the cerebellum and medulla Oblongata

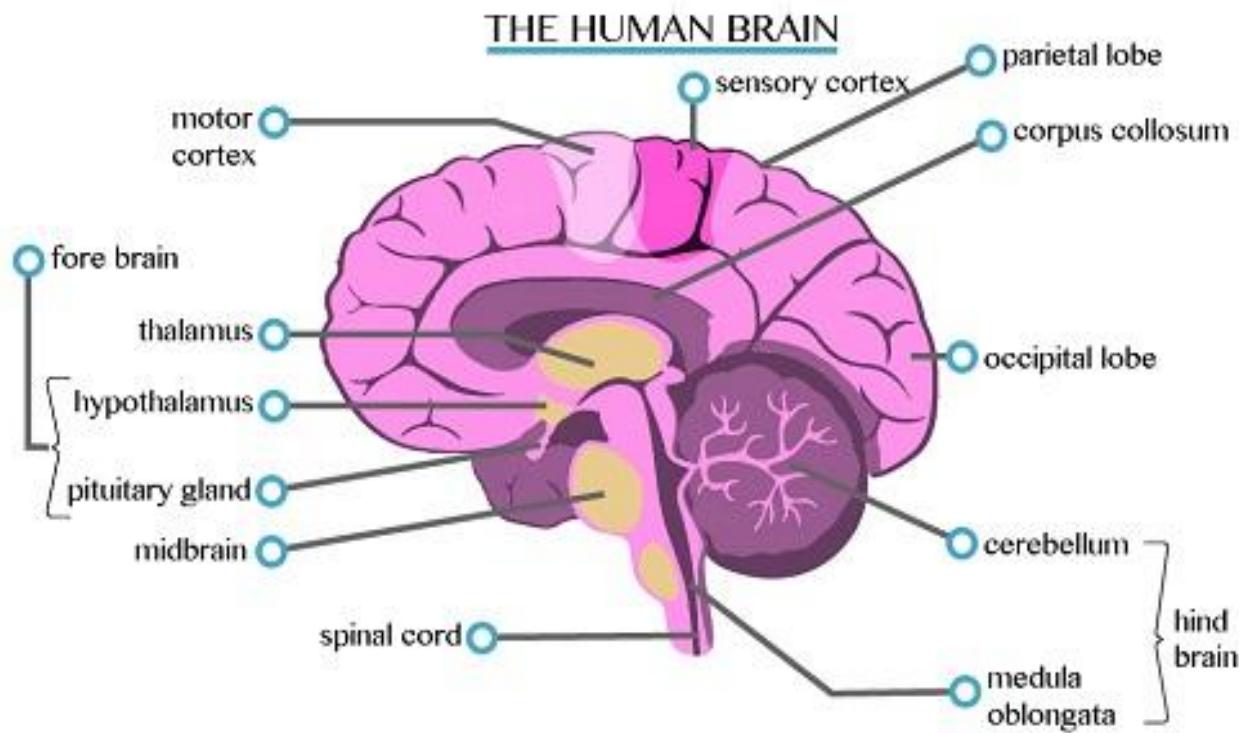
- The cerebellum regulates and coordinates body movements which are concerned with equilibrium

Receive impulses from skeletal muscles, tendons and the inner ear, then relayed to fore brain

- In the fore brain the impulses are analyzed and the animal is made aware of its posture.
- Also cerebellum relays impulses from the inner ear to the appropriate muscles. These muscles act in such a way that the body position is changed to maintain balance.
- The medulla Oblongata) Is the most posterior part of the brain which merges with the spinal cord
- It controls all unconscious activities of the body e.g. Breathing, heartbeat, digestion, dilation and contraction of blood vessels, secretion of juices from glands and temperature regulation
- Oblongata is essential to life of animal because it controls breathing and heart beat. If the medulla oblongata is severely damaged the animal dies immediately. The parts of the nervous system that control these unconscious activities are collectively called the Autonomic N. S.

NB: Meningitis is a disease results from the infection of the meninges by certain types of bacteria or viruses.

- Meningitis are caused by bacteria can be treated with antibiotics but very difficult to treat with antibiotics meningitis which is caused by viruses. If the infection reaches the brain the person may die.
- which is caused by viruses. If the infection reaches the brain the person may die.



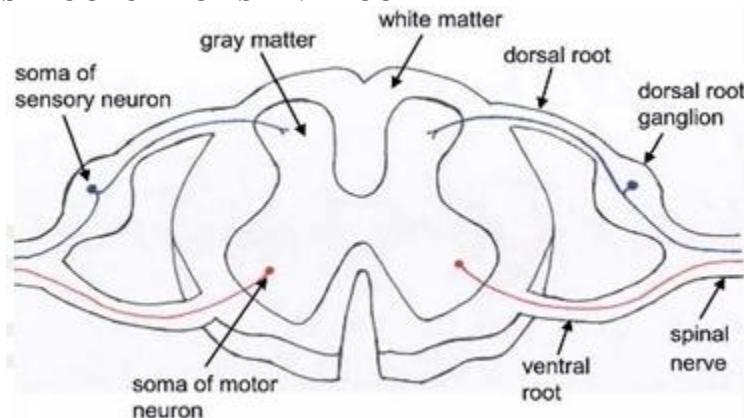
2. SPINAL CORD

The spinal cord is the extension of the central nervous system (CNS) from the brain to the tail. The spinal cord is incased in meninges and protected by the vertebral column. The spinal cord is made up of 2 halves fused together called spinal canal, the canal is filled with cerebrospinal fluid.

The spinal cord gives rise to 31 pairs of spinal nerves which exist between the bones of the vertebral column and connect to all parts of the body.

- The spinal cord serves as nerve impulse conduction pathway. Nerve impulses transmitted by the spinal nerves are relayed to the brain. Then from the brain to the spinal cord, then transmitted to the effector organs
- Spinal cord acts as a **coordinating centre**. It controls actions called *involuntary actions*; these are actions which are fast and automatic. They cannot be controlled by the will power and need not to be learnt.
- Such responses are called **reflex actions** e.g. sneezing and coughing.

STRUCTURE OF SPINAL CORD



GREY MATTER

- Is central part of spinal cord
- It consists of the central canal filled with cerebrospinal fluid
- It consists of relay neurons which connect information between the afferent and efferent.
- The cell body is found inside the grey matter

WHITE MATTER

Is the outer part of the spinal cord, consisting of axons of sensory and motor neurons

VENTRAL ROOT

This is a part of the spinal cord which carries motor nerve fibres

DORSAL ROOT

This is a part of the spinal which carries sensory nerve fibres

Function of the spinal cord

- Conducts sensory nerve impulses from the receptors of the sense organs to the brain.
- Conduct motor nerve impulses from the brain to the effectors.
- Enables animals to attain an upright position through the maintenance of muscle tone

Protection of nervous system

The nervous system is very delicate and vital to the well-being of the animal, it is therefore highly protected from damage

- The brain is protected from mechanical damage by the bones which make up the cranium skull.
- The meninges are tough membrane that protect the brain from shock.
- The cerebrospinal fluid provides a floating environment
- The fluid also helps to protect the brain from blows on the skull and from abrupt head movement.
- The spinal cord is protected by the vertebrae from mechanical damage.
- The nerves are sheathed by membrane.

PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system is made up of sensory and motor nerves. These nerves run to and from the central nervous system and the rest of the body.

REFLEX ACTION

A reflex action is a sudden, automatic and uncontrolled response of parts of the body or the whole body to external stimuli. E.g. - when a hot object is accidentally touched, the hand is quickly withdrawn.

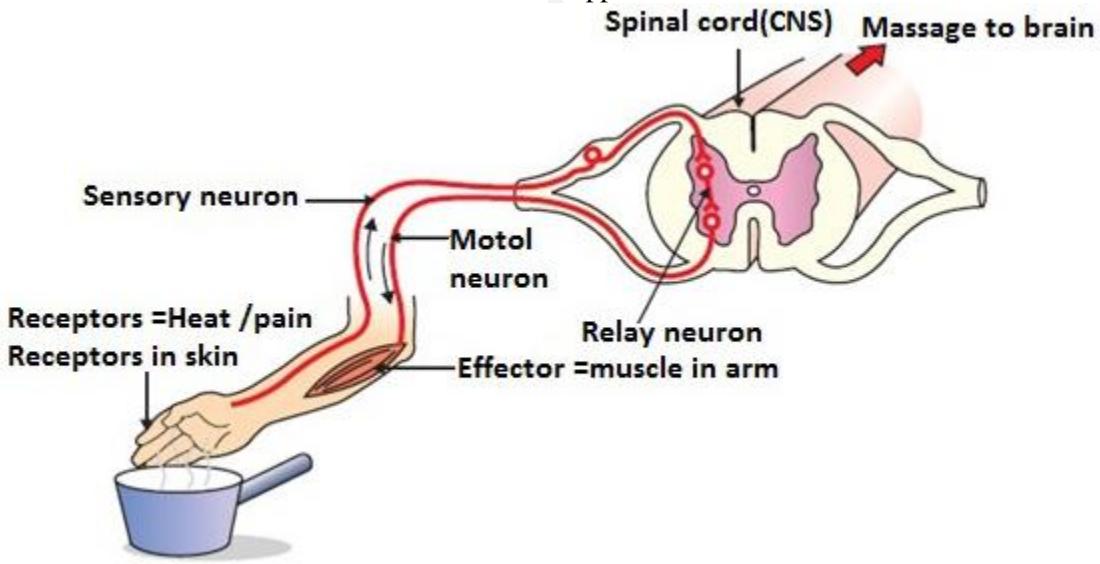
Their eyelids close quickly when a small object comes very close

All these activities are responses which help to protect the individual. Actions occur as a result of impulses that travel along the neurons which are arranged in a path called **reflex arc** (the neural pathway linking a receptor and effectors)

These responses are fast and automatic, i.e. They cannot be controlled and are not learnt.

The sensory neuron transmits impulses from a receptor, enters the spinal cord via the dorsal root of a nerve. Impulses travel from the receptor to the spinal cord or brain. The relay neuron lies in the spinal cord receives impulses from the sensory neuron and passes them to the motor neuron via a relay neuron.

The motor neuron then sends the impulses to an effector via the ventral root so that a very quick response is produced. As a spinal reflex action takes place, impulses are sent to the brain. The brain takes note of what has happened, records it and the individual then becomes aware of what has happened



CONDITIONED REFLEX ACTION

Conditioned reflex action refers to the reflex actions which result from experience or learning. That is the reflex action was not there before

Example of conditioned reflex action: is a dog produces a lot of saliva at the sight of food. The production of saliva is a reflex action in response to the sight of food.

An experiment was carried out on dogs in which a bell was rung every time food was supplied to the dog. After the experiment was repeated several times, it was noticed that when a bell was rung even without supplying the food, the dog salivated

Usually the sound of bell does not cause a dog to salivate the dog had learned to associate the sound of the bell with the presence of food. Thus the second of the bell with induced the secretion of saliva in the same way as did the sight of food. Through conditioned reflex actions, it is possible to change an animal's behavior, in this way help animal to learn new ways of behaving.

Also produce responses which are favorable.

SENSE ORGANS

A sense organ is a mass of specialized sensory receptor cells compacted together. Sensory receptor cells detect stimuli from the environment. Each type of receptor is responsible for registering a particular kind of stimulus.

Receptors will not respond to stimuli other than those for which they are specialized E.g. A sense organ sensitive to touch will not detect the stimuli of heat or cold which is sensitive to chemical, will not detect pressure.

The sense organs or sense cells are connected to the brain or the spinal cord by nerve fibres. When the sense organs receive an appropriate stimulus it sets off an electric impulse which travels along the nerve fibre to the brain or spinal cord

When the impulse reaches one of these centers it may produce automatic or reflex action.

The sense organs of one kind and in a definite are connected with the one particular region of the brain. It is the region of the brain to which the impulse comes that gives rise to the knowledge about nature of the stimulus, and where it was received. Each part of the body has its own sensory area in the brain. E.g. nerve fibres from one's thumb run to one area in the brain or from one's big toe run to another area.

SENSORY ADAPTATION

When the sensory nerve in the receptor is stimulated for the first time, transmission of nerve impulses is very fast, continued stimulation soon leads to a slowing down of impulse transmission and finally it ceases all together.

The sensory adaptation is useful for the comfortable life of an organism

E.g. when a person is cut or bruised, they feel sharp pains to begin with. These pains have not healed yet.

SENSORY RECEPTORS

Human beings have different types of sensory receptors which are located in different parts of the body. They are found in the skin. Eyes, ears, blood vessels, muscles, tendon, nostril and tongue

A) EAR

There are three types of sensory receptors in human ear

- That concerned with hearing.
- Equilibrium of the body (balance)
- With acceleration (structure concerned with detection)

The mammalian ear is divided into three organs.

1. The outer ear
2. The middle ear
3. The inner ear

1) OUTER EAR

The pinna, ear canal and the eardrum form the outer ear.

a. The pinna is the outermost part of the ear and is made up of cartilage. The function of the pinna is to trap sound waves and direct them into the ear canal

b. Ear canal is the tube through which sound waves travel. The walls of the ear tube secrete wax and hairs which traps dust. This tube directs sound waves into the eardrum

c. Eardrum (tympanum): Is a thin double membrane that forms the boundary between the outer ear and middle ear. The eardrum vibrates when hit by sound waves.

2) MIDDLE EAR.

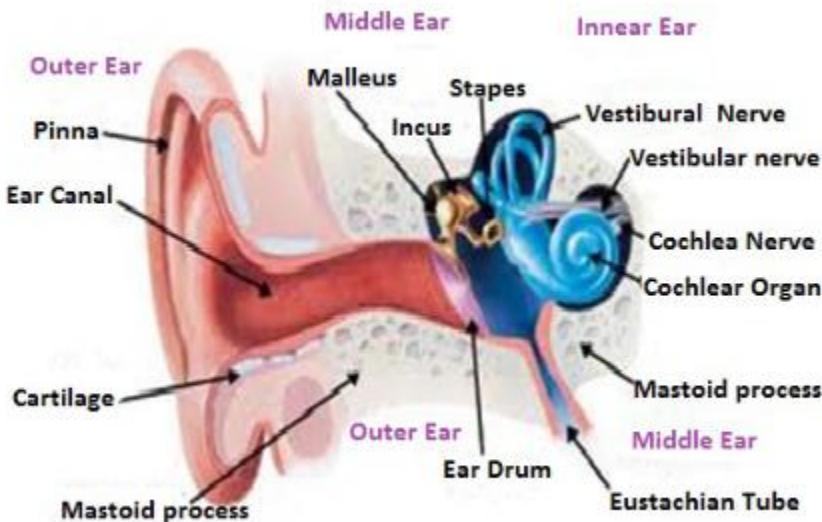
This is an air filled cavity which is behind the eardrum. The middle ear consists of three tiny bones namely Malleus (hammer), Incus (anvil), stapes (stirrup). These **ear ossicles** amplify the vibrations and transmit them towards the inner ear. The cavity is connected to the mouth by a tube called **Eustachian tube**.

Usually the tube is closed but when the pressure in the middle ear increases, the tube opens until the air pressure in the middle ear is equal to that in the throat and therefore to the atmosphere

• Eustachian tube equalizes the air pressure between inside and outside of the eardrum.

• If this tube is blocked by mucus as in the case of cold the hearing is impaired

Opposite to the eardrum, there are two openings, one of them is oval shaped and hence is called **the oval window** (fenestra ovalis). The other is round is called round window (fenestra rotunda)



3) INNER EAR

The inner ear consists of a cavity filled with a fluid called **perilymph**. Two sac-like structures called the **saccus** and **utriculus**, three semi-circular canals and a coiled tube called **cochlea**.

The saccus, utriculus, semi-circular canals and the cochlea are filled with a liquid called **endolymph**.

The cochlea detects sound vibration (hearing) and semi-circular canals, saccus and utriculus control balance and posture.

MECHANISM OF HEARING

- The pinna collects sound waves and directs them to the eardrum through the ear canal.
- When sound waves hit the eardrum it vibrates. The vibrations are transmitted to the ossicles and amplified. The vibration of the stapes causes the membrane at the oval window to vibrate. The vibrations of the oval window are transmitted to the perilymph on the sensory nerve fibres. The impulses are transmitted to the brain for interpretation.

SENSE OF ACCELERATION

The semi-circular canals are concerned with the detection of motion. The ampullae of the semi-circular canals contain sensory cells, attached to sensory nerve endings. The sensory cells have hair which is enclosed in a core of jelly substance called '**cupula**'

Whenever the body or the heart moves the semi-circular canals lag in its motion and apparently move in the opposite direction.

The moving fluids cause the cupula to tilt thus pressing the hair of the sensory cells. The pressing of the sensory hair creates nerve impulses in the sensory nerve endings. The nerve impulses are transmitted to the brain. The brain then interprets direction and speed of motion of the body or head.

SENSE OF EQUILIBRIUM

The **utriculus** and **saccus** are concerned with sense of balance and posture. The inner surface of these structures contains sensory cells. The sensory hair cell, which has protruding hairs embedded in a jelly-like substance containing tiny particles of chalk called "**otoliths**".

When the head is tilted on one side the otoliths move in the **opposite** direction pulling or pressing the sensory hairs they initiate nerve impulses which are transmitted to the brain. Then the brain directs the angle which tends to return the body to its normal.

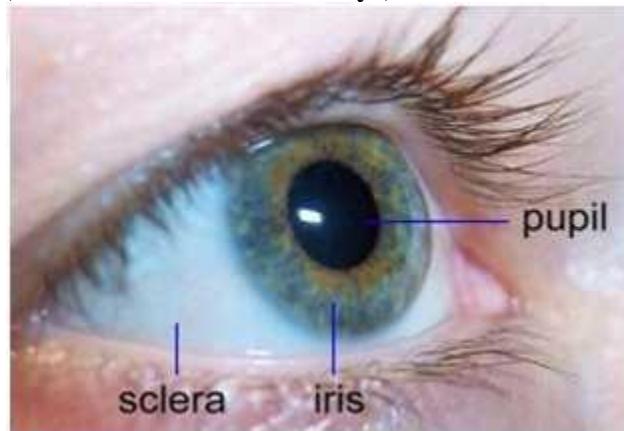
HEARING DEFECTS

Loss of hearing and deafness can be caused by

- 1. BLOCKAGE OF THE EAR CANAL:** Production of too much wax may harden and block the external auditory canal.
- 2. RAPTURE OF THE EARDRUM:** The eardrum may be perforated or burst due to loud noise, physical blow and infection.
- 3. FUSION OF THE EAR OSSICLES:** Due to abnormal growth of connective tissues in the middle ears which fuses the ear ossicles and prevents them from vibrating
- 4. NERVE DESTRUCTION:** This is caused by either the damage of the auditory nerve due to nervous disease
- 5. INFECTION OF THE MIDDLE EAR:** When the eardrum is infected it becomes thick and rigid such that it cannot vibrate even when struck by sound wave.

B) EYE

Receptors which are concerned with the sense of vision are located in the eyes
(Front view of mammalian eye)



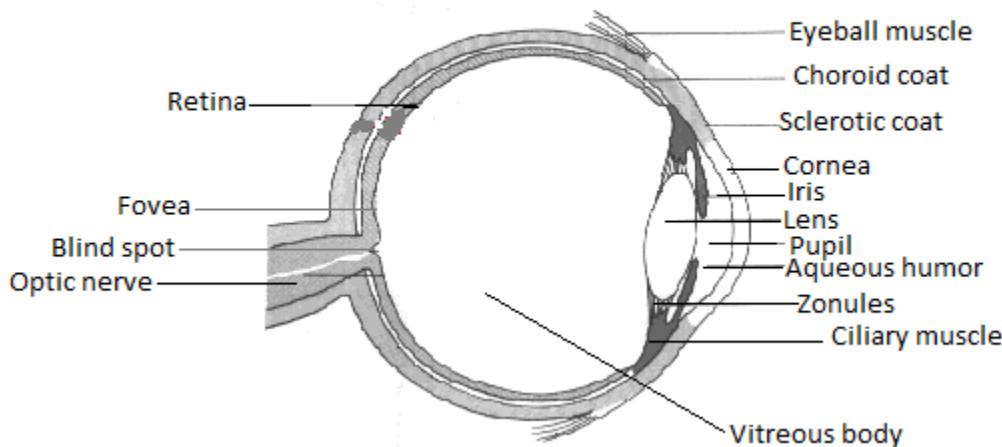
From the front view, the eye has three well marked regions

Pupil - These is a small dark central position which is surrounding by the region called **Iris**

Sclerotic layer - Is the layer which surrounds the iris. This is the largest part of the eyeball.

Cornea: is a transparent region in front of the eyeball passes over the iris and pupil.

Cross-section of the mammalian eye



Function and adaptation of the parts of the eye

The eyeball has a cavity which is divided into two portions:

I. VITREOUS HUMOUR

A large posterior portion filled with jelly like fluid called vitreous humour which is found between the lens and retina. The vitreous humour maintains the shape of the eyeball. The fluid also reflects light and since it's transparent, allows light to pass through

II. AQUEOUS HUMOUR

This is a watery filled in a small anterior portion found between the cornea and lens. Aqueous humor is transparent allows light to pass through. Also reflects light and maintain the shape of the eyeball.

The two chambers are separated by lens

LENS is held in position by fibres called **SUSPENSORY LIGAMENTS**. Lens is transparent to allow light to pass through.

1. **RETINA** is the innermost layer of the eyeball. It is elastic and contains a lot of blood vessels.

It contains PHOTORECEPTORS called **CONES** and **ROD**.

2. **CONES** are sensitive to light of high intensity (bright light) and colour.

3. **RODS** are sensitive and functions in dim light.

4. **FOVEA** is a region where the cones are packed together. The fovea is directly opposite of the lens, is a most sensitive paid of the retina.

5. CILIARY BODY

Contain ciliary muscles that contract to control the shape of the lens,

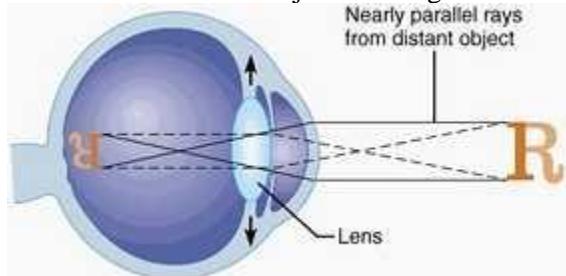
- 6. IRIS**-Is a ring of contractile muscles (circular and radial) they control the amount of light entering the eye.
- 7. PUPIL**- Is a hole an opening in the iris, which allow light to enter the eye.
- 8. SCLERA** - This is the outermost layer of the eye. This layer protects, support and maintains the shape of the eyeball. The sclera continues and become a transparent layer at the front of the eye from cornea.
- 9. CORNEA** - It is a transparent front of the eyeball covered by a thin membrane known as conjunctiva, it is convex to reflect light also allow light to pass through.
- 10. CONJUNCTIVA**: It is a transparent membrane: it covers and protects the cornea
- 11. CHOROID LAYER** - This is a layer next to the sclerotic layer. Choroid layer extends to the front of the eye to form the Ciliary body and Iris. The pigment of the choroid absorbs stray rays of light to prevent reflect on of light within the eye.
- 12. BLIND SPOT** - This is the area in retina through which optic nerve leaves the eyeball. The blind spot has neither rod nor cones. So images from object falling on the blind spot cannot be perceived by the brain

IMAGE FORMATION

Vision depends upon image formation. The formation of an image is dependent upon cone of the proper of light. That is when light passes through from one medium to another its velocity changes. If light goes from air into a denser medium the rays bent. This bending of light is called **Refraction**.

The formation of image depends on the law of refraction. Light rays from the object enter the eye through the cornea. Then they pass through the aqueous humour, pupil, lens, vitreous humour and finally reach the retina where the image is recorded as real upside down and smaller than the objects.

When light rays fall on the retina, they stimulate the photo receptor and impulses are sent to the brain through the optic nerve. The cerebrum then interprets the impulses, making the object visible. The interpretation also means that a person will be able to see the object in its right orientation and correct size



ACCOMODATION OF THE EYE

Accommodation is the ability of the eye to focus, both near and distant objects or ability of the eye to produce clear images of objects at different by altering the focal length of the eye lens.

This is brought about by action of the ciliary muscles, and elastic of the lens.

When the eye is focusing on a distant object the ciliary body muscle relaxes, while the suspensory ligaments become tighter and pull on the lens. The lens gets thinner and gives you clear image of the object

When the eye is focusing on a near object the tension of the suspensory ligament is relaxed or decreased and the lens becomes thick and more convex. This allows light rays to be focused into the retina.

THE COMMON EYE DEFECTS

Defects of the mammalian eye are structure deviations of the eye which **alter** the focusing mechanism of the eye

There are two common eye defects

1. HYPERMETROPIA (long sight)

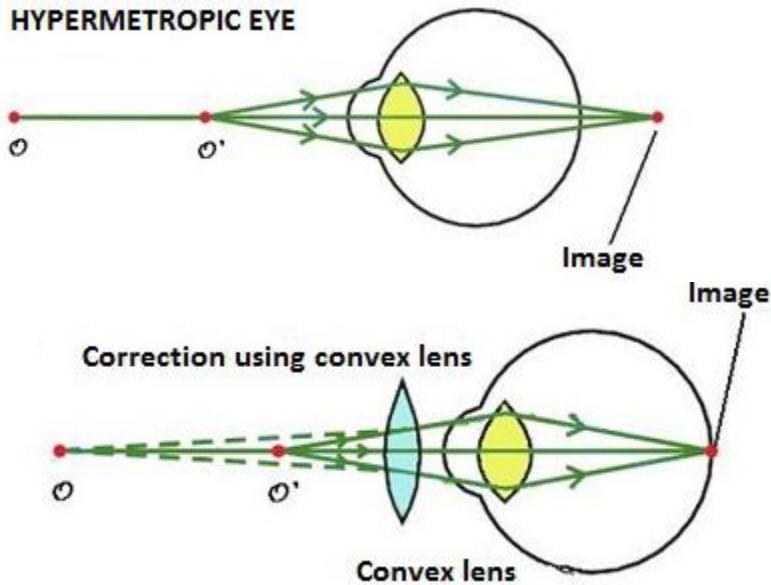
2. MYOPIA (short sight)

1. HYPERMETROPIA (long sight)

This condition is due to compression of the eyeball resulting in the shorting of the normal distance between the lens and the retina. In this condition, light rays from distance object are focused on retina, where light rays from near objects fall behind the retina. This means:

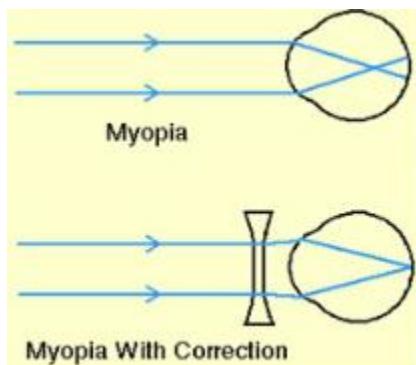
- A person cannot see near objects clearly
- Images of near objects fall behind the retina
- Caused by the eyeball being too short or the lens being too thin, so that it does not converge the light rays enough.
- These defects are corrected by using spectacles with convex lens.
- Convex lens converge the light rays before they reach the eye.

HYPERMETROPIC EYE



2. MYOPIA (short sight)

A short sighted person focus distance objects properly. This individual can only focus near objects clearly. This is because the light rays of distance object converge at a point in front of the retina



This may be due to eyeball being too large. This may be corrected by a biconcave lens. This help to diverge the light rays from distance objects so that they cache focused on the retina

COLOUR VISION

There are three kinds of cone in a human retina, all three respond to more than one colour, but each particular cone is sensitive either to blue, green or yellow light stimulates the green and yellow cone but red light affected the yellow sensitive of redness.

When all three types of cones are equally stimulated, we get the sensation white light.

3. A STIGMATION

This is a condition in which the cornea or lens is uneven such that is not focused properly on the retina. The defect can be corrected by using spectacles with special cylindrical lenses.

4. PRESBIOPIA

This condition, the lens cannot change its shape. It is brought about by loss in elasticity of lens and ciliary muscle due to old age can be corrected by the use of convex lenses

5. CATARACT

The lens gradually becomes cloudy so that light cannot pass through easily and the person cannot see properly. It may become gradually worse. The lens may have to be removed by operation and can be replaced by a plastic lens inside the eye.

6. GLAUCOMA

This defect is common in old people; glaucoma is caused by pressure in the eye

7. COLOETT BLINDNESS

This is the genetic disorder in which a certain colour cannot be distinguished by man. A common type is red green blindness, individual is not in position to determine distinguishing between red and green colour.

8. TRACHOMA

These are a viral disease which affects the lighting of the eyelids. If not treated, trachoma can cause blindness.

C) SKIN

There are different types of sensory receptors in the skin.

1) Touch receptors

Are sensitive to light touch: they enable a person to distinguish between different textures, e.g. rough and smoothness, hard and soft, liquid and solid substances. Touch receptors are scattered all over the body surface but not evenly distributed. They are more concentrated in such areas as fingertips, others attached to the base of hairs

2) Pain receptors

These are evenly distributed throughout the skin. They are also found in muscle, tendons, ligament and walls of the digestive system but not in the brain.

3) Heat receptors

Are sensitive to temperature.

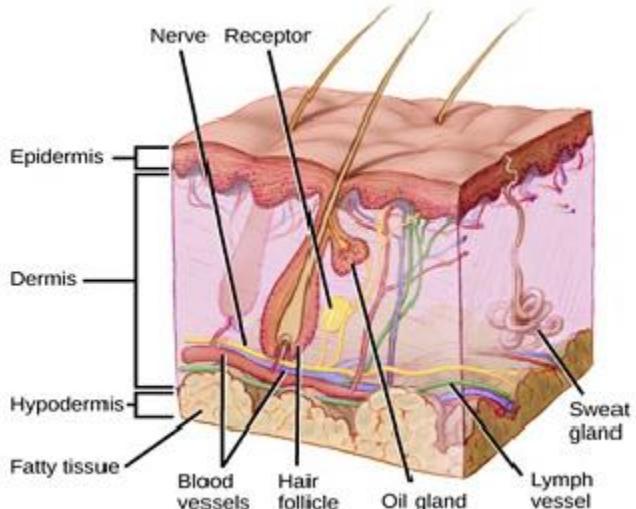
4) Cold receptors

Are also sensitive to temperature.

5) Proprioceptive and visceral senses

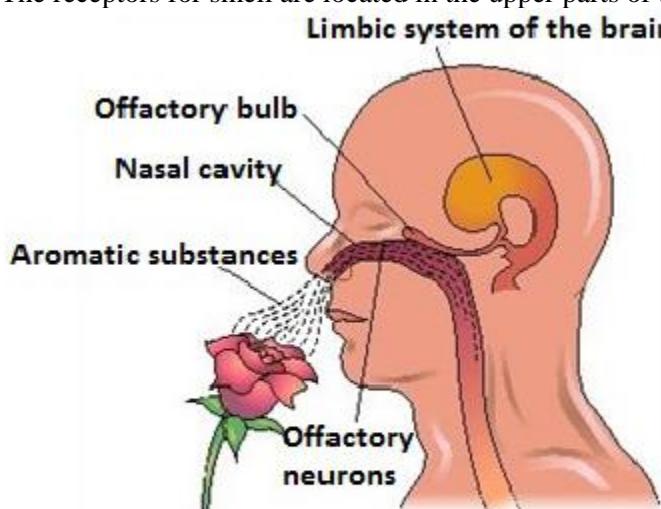
These receptors receive information about the condition of the body itself. Proprioceptive receptors are found in the muscles and tendons. Stretch provides the brain with information about the degree of tension in muscles and angle at which each joint is bent. Such information makes the brain aware of the movement of parts of the body.

TRANSVERSE SECTION OF A MAMMALIAN SKIN

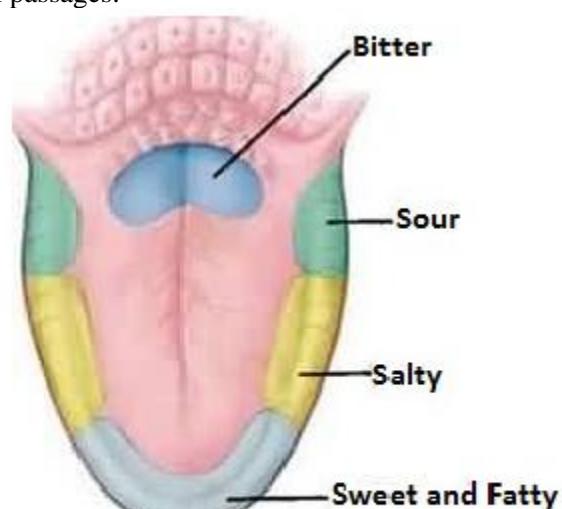


SENSORY RECEPTORS OF THE TONGUE AND NOSTRILS

The sensory receptors of the tongue and nostrils are sensitive to solution of certain chemical substances. The sensory receptors of the taste are located on the upper surface of the tongue and the lesson extends on the surface of the pharynx. The receptors for smell are located in the upper parts of the nasal passages.



Smell receptor in nose



Taste receptor in tongue

There are four (4) basic taste sensations

1. Sweet is detected at the tip of the tongue
2. Sour is detected at the side of the tongue
3. Bitter is detected at the back of the tongue
4. Salt is detected all over the tongue

The combined cavity of taste buds and smell reception gives the sensation of flavor. Sensation of taste is important in that it helps animal to distinguish between suitable substances from unsuitable one for ingestion.

It also stimulates the salivary glands to secrete saliva continuing digestive enzymes

The receptors of taste and smell are similar in its functions. Actually much of what is called "taste" is in fact a function of a sense of smell.

QUESTION

Why hot food often has more taste than cold food?

-This is because they vaporize more, the vapour passes from the mouth up into the nasal passages where it stimulates smell receptors Why we cannot taste foods small when suffering from cold?

-This is because the nasal passages are inflamed and coated with mucus. The smell receptors are essentially non-functional.

In each case of taste and smell, chemical and smell must go in solution in the film of liquid coating the membrane of the receptors cell if they can be detected

The major functional differences between the two (2) kinds of receptors is that smell receptors are more specialized for detecting vapour coming to the organism from distant source. Taste receptors are specialized for detection of chemical present in the mouth itself. Furthermore, smell receptors are much more sensitive than taste receptors.

DRUGS AND DRUG ABUSE

DRUG

This is any substance natural or synthetic, which has a physiological action on a living body it can be used for the treatment of disease or the alleviation of pain.

PSYCHOACTIVE DRUGS

Psychoactive drugs are the drugs that affect the central nervous system. Psychoactive drugs produce a false sense of well being and relieve someone from tension, anxiety, stress and pain

Types of psychoactive drugs

1. Stimulus e.g. cocaine, heroin and nicotine
2. Sedatives/depressant e.g. alcohol, diazepam and mandrax
3. Painkiller/volatile solvent e.g. glue, kerosene, toluene and petroleum
4. Hallucinogens
5. Narcotics

Forms of drug taking

1. **Intravenous:** this is injecting a chemical substance into blood through vein
2. **Inhalation:** some people prefer to inhale volatile solvents such as petrol, glue or paint.
3. **Oral:** some other drugs are taken in through the mouth.
4. **Smoking:** some drugs like marijuana (bhang or ganja) are smoked.
5. **Sniffing:** some drug like cocaine are sniffed through the nose.

DRUG ABUSE

This is when drugs are used for non - medical reasons with no regard to their side effects.

The drugs when used regularly, they can cause a state of dependence called **ADDICTION**.

A drug addiction is to depend up on drug so that life becomes unbearable without it. Depend up if there is a sudden cut - off the drug, a person suffers withdrawal system

1. CAFFEINE

This is bitter substance found in tea, soft drink, chocolate, kola nuts and certain medicine. It has the same effects on the nervous system accelerate the heart rate and increase the amount of sugar in blood. These have negative effect on the well being of the human body.

2. NICOTINE

Is found in tobacco it has the same effects on the nervous system as that of "Caffeine" smoking linked with cancer of lungs, mouth throat, larynx, gullet bladder and pancreas. Also thinning and weakening of lung tissue, smoking delay the healing of stomach ulcers, reduce sense of smell and taste.

3. COCAINE

Is found in the leaves of nuts and of the coca plants, have the same effect as nicotine.

4. ETHYL ALCOHOL

Is found in alcohol and beer, it enforces with the transmission of nerve impulses at synapse little alcohol have a stimulation effects large among distorts vision and interfere with hearing

The person becomes insensitive to touch, experience difficult is speaking. Ethyl alcohols slow reflexes and interfere with concentration and distance judgment. This is why people are advised not to drink when driving.

1 OPIUM, MARIJUANA AND METHADONE

These are found in capsules of the poppy plant. These drugs rise to feeling of person and power. They interfere with nerve impulse transmission resulting in a positive affecting the well being of the body. If inhaled in appreciable amounts with either chlorofluorocarbon or benzene induces unconsciousness, similar to that produced by alcoholic intoxications.

2 VALIUM

Interfere with impulses transmission other tasted to valium interfere with the function of the medulla

3 MARIJUANA & HARIHAR

They produced from a plant called Indian hemp. These drugs disturb the sense of judgment so that a person becomes careless and foolish.

EFFECT OF THE USE OF DRUGS ON HEALTH AND SOCIAL

Social hazard

- Users may lose their jobs as result of repeated failure to up for work.
- Users often turn to crime to find their habit
- Loss of esteem by the user as he or she may be rejected by first family
- Loss of work hours as may users take time off to recover from side effects of their habits
- Relationship may breakup as a result of the increasing impotence of user's habits.

HEALTH HAZARD

1. Smoking may lead to lung cancer or heart disease
2. Alcohol causes brain damage, liver cancer
3. Some drugs affects the reproductive system by slowing down the rate of sperm production.

CAUSES OF DRUG ABUSE

- Social pressure, fear of being rejected in a social group
- Taking drugs might ease anxiety or unpleasant feeding.
- Escapism: some are taking drugs because they think it is the only way to have a pleasant time socially.

PREVENTION

- Avoid taking any form of drugs without description from doctor
- If one realizes that is addicted should seek help from health officials
- To avoid boredom and idleness one needs to get engaged in activities such as games, and sports during leisure time
- To form counseling club in the community to advice people especially youth on how to keep off from drugs.
- Cultivation of drugs producing plants can also be prevented
- Drug dealing can also be controlled or eliminated by communities
- Drug abusers can obtain help in drug rehabilitation centers

HORMONAL COORDINATION IN HUMANS

Hormonal coordination involves organs which secrete chemicals substance. This system is known as endocrine system which is composed glands and secretes chemical substance known as hormones.

These glands have no ducts; their secretions enter directly into the blood stream or body fluid by diffusion. The hormones are then transported through these media to the target tissues or organs, where they initiate response.

Therefore hormonal coordination refers to the regulation of body functions through release of hormones.

Hormones are vital in the body because they coordinate the body functions, some hormones act directly on effectors organs such as muscles) some regulates metabolic activities while others activate other endocrine glands

Still others regulate normal growth and development of the young animals, and keep the adult animal in a health state.

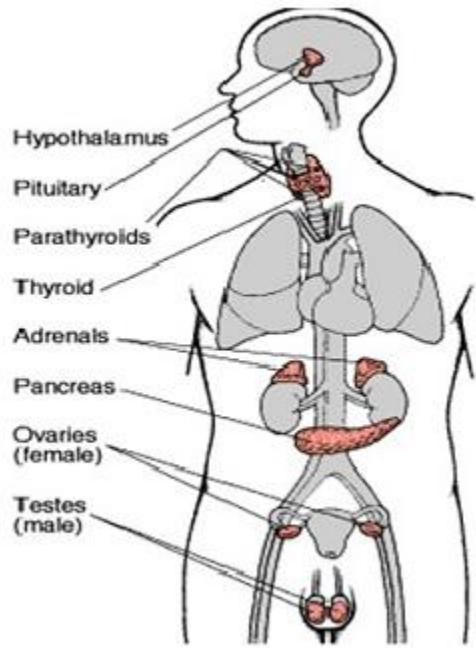
Hormones are produced in some quantities and in most cases their effects is slow.

The endocrine system and the nervous system are similar in two (2) ways:

- They are both set into action by a stimulus to produce a response
- They both involve chemical transmission.

The difference between nervous and hormonal

Nervous	Hormonal
Electrical impulse passing through, blood stream	Chemical passing through, blood stream
Rapid	Slow
The response is immediate	The response is usually slow
Duration of response is short	Long lasting
Response is located at a certain point	Response usually wide spread e.g. adrenalin



Position of endocrine gland in human body

The endocrine system consists of the following glands: pituitary, parathyroid, thyroid, pancreas, adrenal gland, ovaries and testes.

1. PITUITARY GLAND

This is found at the base of the fore brain. It controls the functioning of the body directly by producing its own growth hormone. It is also known as the master gland because it controls the other ductless glands e.g. it controls the production of Thyroxin hormone in thyroid gland.

Pituitary gland produces thyroid stimulating hormone (TSH) which stimulates the thyroid to release off more thyroxin. Pituitary gland secretes at least nine hormones which include the following:

1. Growth hormones (somatotropin)

This influences protein metabolism and growth of bones, normal secretion of the hormones produce normal growth.

- Over secretion of the hormones resulting in abnormal large size of the body. The condition is called **GIGANTISM**
- Under secretion results in dwarfism which may be resulting of **delayed growth or permanently retarded growth**.

1. Pituitary produces **follicle stimulating hormone (FSH)** stimulates development of Graafian follicle in ovary.

2. Testis are **stimulating hormone** cause sperm production in males.

3. **Anti - diuretic hormones (ADH)** increase the absorption of water from kidneys.

4. **Luteinizing hormone** brings about ovulation

5. **Prolactin hormone** stimulates milk production in lactating mammals

6. **Oxytocin** brings about contraction of the uterus at birth, causes expulsion of milk from mammary gland. Hyposecretion birth is delayed while hyper secretion results in premature birth.

2. THYROID GLAND

It is found on the neck, it produces thyroxin. It regulates the rate of metabolism; it stimulates growth, development in young animal and control birth to old age. Under secretion causes **cretinism (stunted growth)** and severe mental retardation in child.

-Over secretion in adult causes goiter reaction and premature ageing. The condition is called **MYXOEDEMA**.

Excess in adult causes under weight, restlessness and mental instability

Goiter is characterized by enlargement of the thyroid gland. The cells in the thyroid gland enlarge in an attempt to contract as much Iodine as possible from the blood

3. PARATHYROID

This is found within the thyroid gland. It produces parathormone in response to a lack of calcium in the blood resulting increased absorption.

4. ADRENAL GLAND

These are found above the kidney. They produce adrenalin hormone which prepares the body for action in an emergence by rising blood pressure increasing heart and breathing rates, increasing blood sugar levels and increasing supply of blood to the muscles. These actions prepare the individual to run away or to fight the enemy.

Adrenaline is thus referred to as a hormone of flight, or fight

Aldosterone regulates blood sugar and deposition of glycogen in to the liver. They also concerned with the re absorption of sodium and chloride ions as well as osmotic pressure

5. PANCREAS (Islets of langerhans)

Produce **insulin** which lowers the level of glucose in the blood stream by causing the liver to store more glycogen.

Too little insulin causes **diabetes Mellitus** (excess glucose in blood stream) which is diagnosed by the presence of sugar in the converting glycogen to glucose again (metabolism excess glucose info facts glycogen)

6. TESTES

Male reproductive organ produce testosterone hormone which is responsible for sperm production and development of male secondary sexual characteristic.

7. OESTROGEN

Isa hormone produced by the ovary in female, **oestrogen** controls the development of female secondary characteristics, promotes development reproductive organs. Also prepares the uterus to receive a ripe fertilized ovum.

•**Progesterone** is also produced by ovary. It is concerned with maintenance of pregnancy. It encourages the development of the uterus lining after ovulation. It inhibits ovulation and prevents the uterus from contracting during pregnancy

•**Relaxin** is also produced by ovaries begins as the time of birth approaches. This hormone causes the ligaments between the pelvic bones to loosen providing a more flexible passage for the baby during birth

COORDINATION IN PLANTS

Plants respond to a variety of stimuli in their environment. Unlike animals, plants cannot move from one place to another. However, they can move by forces of wind or water. Movement in plants in response to a stimulus is continuous and very slow. Movement of plants can be grouped into two:

- Growth movements
- Turgor movement

1. Growth Movement

These are the movements that take place in the meristematic regions due to unequal permanent growth. Growth movements can be classified into two categories namely:

- Autonomic movements
- Paratonic movements.

(a) Autonomic Movements

These are self-controlled movements for instance growth in the meristematic regions i.e. tips of stems and roots.

(b) Paratonic Movements

These are the plant movements induced by external stimuli.

These stimuli include:

- Light
- Moisture
- Gravity
- Chemicals
- Touch

Paratonic movements include **tropic** and **nastic** movements

Tropic Responses

These are growth movements that are caused by a wide range of stimuli. In this case the plant grows either towards or away from the stimulus. If the response is towards the stimulus it is referred to as positive. If the response is away from the stimulus it is referred to as negative. Tropic movements are mediated through plant hormones. Tropisms are growth movements by plant organs in response to a unilateral stimulus, in which the direction of the movement is related to the direction of the stimulus.

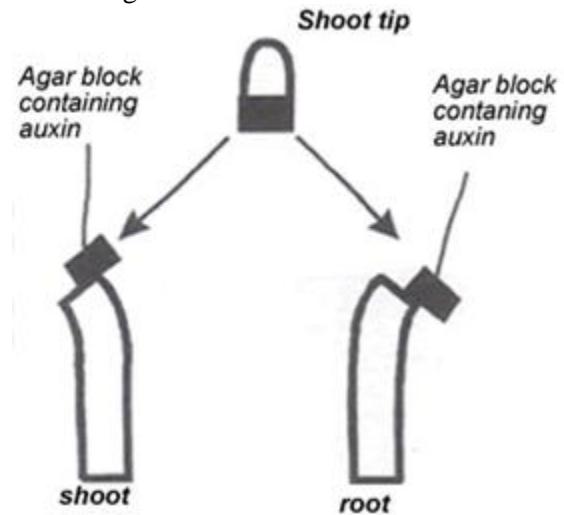
Plant Hormones

The first plant hormones were discovered by a Dutch botanist Fritz Went in the year 1928. Fritz Went called these hormones auxin or more accurately, indoleacetic acid (IAA). This hormone has an extremely powerful effect on growth. Like the animal hormones, plant hormones act in very low concentrations. A solution of 0.001 milligram in a liter of water applied to the side of a shoot is enough to cause bending.

A part from auxins, plant hormones also include gibberellins and cytokinins. Auxins are synthesized from amino acid tryptophan in meristematic tissues such as the shoot tips, buds, young leaves and germinating seeds. Auxins increase cell wall elasticity by losing the bond between the cellulose fibres. Auxins promote cell division, cell elongation and cell differentiation.

Effects of Auxins Concentration on Growth

Experiments have revealed that higher concentrations of auxins stimulate growth in shoots while lower concentrations stimulate growth in roots. Amount of auxins which stimulate shoot growth, normally inhibit root growth



Experiments demonstrating that a hormone regulates growth in shoots and roots

Tropisms

A tropism is a movement by a plant organ in response to a unilateral stimulus, in which the direction of the movement is related to the direction of the stimulus. Tropisms are named according to the nature of the stimulus.

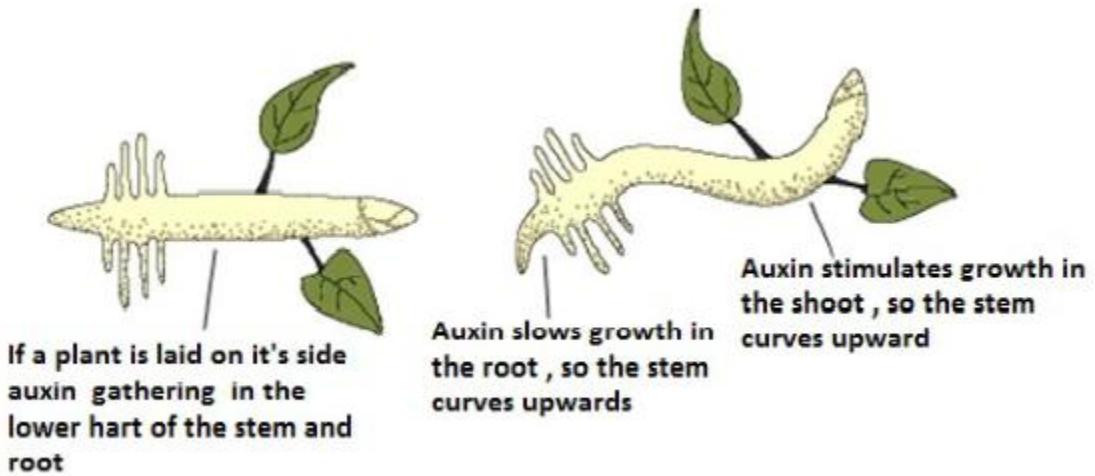
Types of Tropisms

(i) Geotropism

Geotropism is also known as gravitropism. This is the growth movement of plant parts in response to the direction of the force of gravity. The roots grow towards the direction of the force of gravity which means are positively geotropic (gravitropic). The shoot grows away from the force of gravity which means are negatively geotropic (gravitropic).

If a seedling is placed horizontally, the plumule will eventually grow vertically upwards while the radicle will grow vertically downwards. The above observation can be explained as follows:

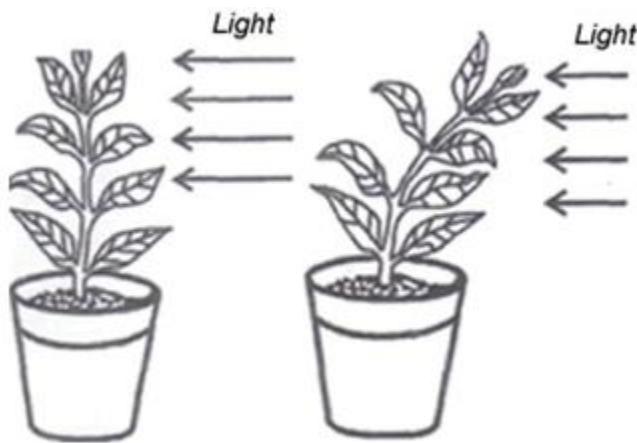
- When the seedling is placed in a horizontal position, more auxin settles on the lower side of the root and shoots due to the pull of gravity.
- Shoots respond to a higher concentration of auxin than roots. In this case the lower side of shoot grows faster than the upper side, resulting in a growth curvature that makes the shoot grow vertically.
- Root growth is inhibited by high concentrations of auxins. Thus, the lower side of the root grows at a slower rate than the upper side where there is less auxin concentration. Consequently, this results in a growth curvature that makes the root grow vertically downwards



The effect of gravity on the growth of roots and root

ii) Phototropism

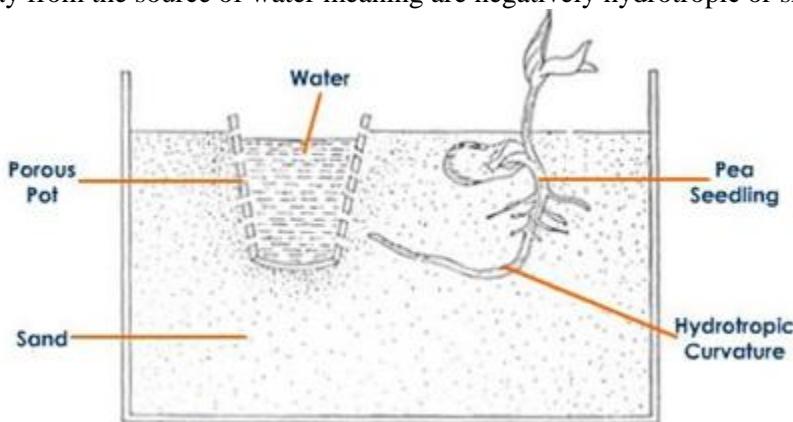
This is the growth movement of plant organs in response to a unilateral source of light. In an experiment it was revealed that auxins are directly involved in phototropism. If a shoot is exposed to light from one direction only, the shoot bends towards the source of light. Light causes an unequal distribution of the hormone (auxin). Light causes auxins to migrate to the darker side. In this case the auxins are more concentrated on the darker side than on the side where the light is coming from. The cells on the dark side grow faster and elongate than the ones on the side where the light is coming from. As a result, the shoot bends towards light. Shoots are positively phototropic because they grow toward the light. Some roots grow away from light, which means they are negatively phototropic. However many roots are not sensitive to light.



Effects of light on shoots

(iii) Hydrotropism

That is growth movement of plant organs in response to unilateral source of water or moisture. In hydrotropism the root grows toward the source of water means the root are positively hydrotropic. On the other hand the shoot either grow away from the source of water meaning are negatively hydrotropic or show no response meaning are neutral.



Root is positively hydrotropic

(iv) Thigmotropism

The term thigmo comes from a Greek word thigma meaning touch. Thigmotropism is also referred to as haptotropism. In plants such as possiflora and gloriosa with tendrils which curl around and cling to stems, auxins also play a major role. When climbing stems or tendrils come into contact with a hard object, the contact causes them to curve and coil round the hard object.

This is caused by the migration of the auxins from the point of plant contact and the hard object. In this case the part in contact with the hard object has a lower auxin concentration than the outer part. Higher auxin concentration promotes faster growth in shoots. Therefore, greater auxin concentration in the outer part causes faster growth than the part in contact with the object; hence the shoot continues to round the object.



Thigmotropism

v) Chemotropism

This is the growth movement of plant organs in response to a unilateral source of chemicals. For instance, pollen tubes grow through the style towards the ovary and finally towards the ovules.

vi) Thermotropism

This is the growth movement of plant organs in response to a unilateral source of heat as shown by movement of sunflower orienting itself towards the sun. However, there is an overlap between thermotropism and phototropism and sometimes a combination of both tropisms.

vii) Rheotropism

This is the growth movement of plant organs in response to a unilateral source of air currents.

IMPORTANCE OF TROPISMS

1. **Phototropism:** exposes the leaves of the plant to trap maximum sunlight for photosynthesis.
2. **Haptotropism:** enables plants with weak stems to obtain mechanical support.
3. **Geotropism:** enables the roots of the plant to grow deep in the ground to provide anchorage.
4. **Chemotropism:** enables the growth of the pollen tube in flowering plants to facilitate fertilization.
5. **Hydrotropism:** enables roots of the plant to obtain water.

Nastic Responses

These are non-directional movements of plant organs in response to diffuse stimuli, such as folding of leaves in warm weather, opening and closing of flowers in response to intensity of light and the closing of leaves when touched. Such movements occur as a result of changes in turgor pressure in certain cells.

TYPES OF NASTIC RESPONSES

(a) Nyctinasty

This is a plant movement in response to temperature changes. This is a thermostatic movement; therefore nyctinasty is referred to as thermonasty.

(b) Photanasty

This is a plant movement in response to a change in light intensity. Some flowers in certain plants open in presence of light and close in its absence.

(c) Seismonasty

This is plant movement in response to shock or vibration.

(d) Hydronasty

This is plant movement in response to changes in atmospheric humidity

(e) Haptonasty

This is plant movement in response to contact. The sensitive plant *Mimosa pudica* response to touch by folding up its leaves.

(f) Chemonasty

This is a plant movement in response to chemical stimuli.

Tactic Movement

This is the movement of whole organism in response to an external stimulus. If the movement toward stimulus the tactic is positive, when the movement is away from the stimulus, the tactic is negative. Tactic movement is known as **taxis**.

Types of Tactic Movement

1. **Phototaxis** - locomotory response to light
2. **Chemotaxis** - locomotory response to chemical
3. **Aerotaxis** - locomotion response to variation in oxygen concentration
4. **Rheotaxis** - locomotory in response to direction of water current
5. **Magnetotaxis** - locomotory in response to magnetic field.
6. **Osmotaxis** - locomotory response to variations in osmotic pressure.
7. **Thermotaxis** - locomotory response to temperature changes.

Other Effects of Auxins

(a) Apical Dominance

This refers to the inhibition of lateral bud development by the terminal bud. If the terminal bud is removed, lateral buds develop into side branches. This is because when the apical bud is cut and removed, the apical dominance is reduced. However, if the apical bud is cut and then a substance containing auxin is applied to the cut end lateral buds do not sprout or develop. This experiment clearly indicates that apical dominance is brought by auxins. The principle of apical dominancy is applied in pruning. Removal of the terminal bud encourages the sprouting of side branches causing the plant to grow sideways instead of upwards.

(b) Development of Adventitious Roots

Adventitious roots are the roots that develop from a stem cutting. Plant cuttings which do not develop roots readily may be dipped in rooting auxins e.g. Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA).

(c) Storage

NAA is used to increase the period of dormancy in tubers and bulbs so that they can be stored for a longer period of time.

(d) Parthenocarpy

This is the formation of fruits without fertilization. Parthenocarpy can be induced by treating unpollinated flowers with auxin. This phenomenon is applied in the development of seedless fruit varieties.

(e) Falling of Leaves and Fruits

Falling of leaves and fruits is brought about by a reduction in the concentration of auxins. Premature falling of fruits occurs due to the failure of the plant to produce adequate amount of auxins. This situation can be reversed by application of auxins.

(f) Weed Killer

In higher concentrations, auxins interfere with normal plant growth and can cause death. In this case auxins are used as herbicides or selective weed killers. For instance 2,4- dechlorophenoxyacetic acid (2,4-C) can be used as a weed killer (herbicide) killing broad-leaved plants.

Other Plant Hormones

(a) Gibberellins

These are a mixture of chemical compounds which have an effect on plant growth. A common example of gibberellins is **Gibberillic acid**. Gibberillic acid causes stem elongation in plants. It stimulates rapid growth in dwarf varieties of certain plants by increasing the length of the internodes. Also used in breaking seed dormancy and inducing parthenocarpy.

(b) Ethylene

Speeds up ripening of fruits such as citrus

(c) Abscisic Acid (ABA)

Regulates fruit drop at the end of the season.

(d) Cytokinins

These are active growth substances which promote growth in plants in the presence of auxins. Cytokinins promote cell division by inducing growth of roots, leaves, callus tissue and repair or wounds in plants.

Phytochromes

These are pale blue-green compounds consisting of a pigment, which absorbs light energy. Phytochrome exists in two interconvertible forms. One absorbs red light at a wavelength of 665mm while the other one absorbs far red light at a wavelength of 725mm. These two forms of phytochrome are designated as Pr and Pf respectively. When Pr absorbs red

light it is rapidly converted into Pf and when Pf absorbs far-red light it is rapidly converted into Pr.

The two phytochromes, that is Pr and Pf have the following effects:

1. Elongation of the stem is stimulated by far-red light but inhibited by the red light.
2. Leaf expansion is stimulated by the red light but inhibited by far-red.
3. Lateral roots growth is stimulated by far-red and inhibited by the red light.
4. Seed germination is stimulated by the red light but inhibited by the far-red light.

Photoperiodism

This is a flowering response in plants relative to lengths of day and night. When a plant is exposed to light, phytochrome absorbs light energy and P725 accumulates. P725 initiates the formation of a flowering hormone known as florigen. This is transported to the stem apices to promote flowering.

With reference to photoperiodism. Plants can be classified into three groups:

- Short day plants
- Long day plants
- Day neutral plants

Short-day

These are the plants that require short-length illumination but shorter night periods to flower. Examples include chrysanthemum and poinsettias.

Long-day Plants

These are the plants that require longer day-length illumination but shorter night periods in order to flower. Examples include wheat and lettuce.

Day - neutral plant

These are the plants that flower irrespective of day - length or night periods. Examples of day-neutral plants include cotton and tomatoes

4. EXCRETION

This is a process of getting rid of waste products from the body of living organism formed during metabolic process. Metabolic process includes all chemical reactions taking place inside living system. **Example;** respiration
During the process of respiration, carbon dioxide is one of the products. Therefore carbon dioxide is known as excretory product and the organs that get rid of them are called excretory organs.

Example

EXCRETORY PRODUCT	WHERE IT IS MADE	EXCRETORY ORGANS
Carbon dioxide	Cell respiration	Lungs in mammals, Leaves(darkness)in plants
Oxygen	Green plant cells during photosynthesis	Plant leaves (light)
Nitrogen waste e.g. urea	Deamination of excess amino acid in the liver	Kidney excreted excretes urea in solution as urine
Bile pigment	Breakdown of hemoglobin by liver cell	Excreted from liver, store in gall bladder as bile, emotied into duodenum.

IMPORTANCE OF EXCRETION

1. It is important that all unwanted products be removed from the body of a living organism, because if they are allowed to remain in the body, they would soon become harmful and poisonous to the living.
2. Also sometimes materials that are taken into the body from outside may be in excess of what is required. If so they will have to be removed as waste. E.g. proteins
3. In some cases excretory product undergo detoxification in order to make them less toxic to the organism before they are moved from the body

EXCRETION IN UNICELLULAR ORGANISM

Unicellular or single celled organism such as amoeba and paramecium get rid of their waste product simply by diffusion through the surface of their bodies

-These waste substances diffuse from cytoplasm where they are at high concentration to outside of the body where concentration is low. Another method of excretion is by use of contractile vacuole

EXCRETION IN HIGH ANIMAL

Excretion in higher animal is carried out by elaborate system made up of specialized tissue and organ. This is because their bodies are complex and have greatest number of cell such that simple diffusion will not suffice.

FORMS OF WASTE PRODUCT IN ANIMAL ARE;

1. NITROGENOUS WASTE PRODUCT.

Excess amino acid protein cannot be stored in the body instead they are broken down to form ammonia .Nitrogenous waste product can be removed in 3 forms.

a. AMMONIA

Ammonia is high poisonous and dissolve in water it is removed in soluble form. It can be rapidly and safely removed if diluted in a sufficient volume of water, e.g. fish

b. UREA

Ammonia with carbon dioxide to form less toxic form of waste product .Urea is formed in the liver and insoluble in water. Urea is formed in the liver and insoluble in water. Urea is excreted by aquatic mammal and terrestrial animal E.g. man

c. ACIDIC UREA/URIC ACID.

Ammonia is also excreted as uric acid; uric acid is unstable and non toxic. This is excreted by animals living in shortage of much water E.g. insects, birds and reptile's uric acid is shortage and excreted in form of crystals.

2. CARBON DIOXIDE

Carbondioxide is produced during respiration. It is excreted through gaseous exchange.

3. EXCESS WATER.

Excess metabolic water form chemical breakdown of glucose lost either as water vapour sweat or urine.

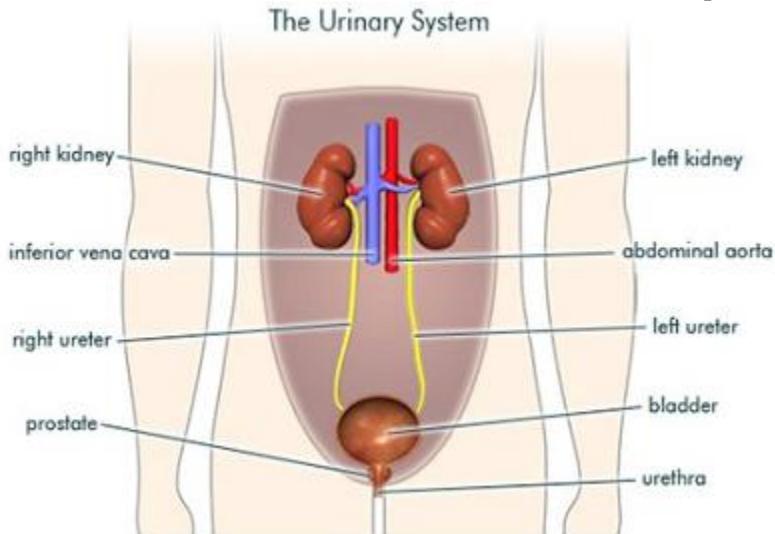
THE KIDNEY

These are dark red bean shaped organ located at the back of abdominal cavity. There are two kidneys in human body the

right kidney and the left kidney. Above each kidney are adrenal glands which secrete hormones which stimulate reabsorption of sodium ions. There are two blood vessels connected to the kidney one of them is RENAL ARTERY, supplies blood to the kidney. The other is the RENAL VEIN, takes blood away from the kidney.

A tube called URETER runs from each kidney to the **bladder**. Urine passes through ureter from the kidney to store in the bladder. From there, it is released periodically through a tube called urethra.

When the bladder is nearly full the stretching stimulates sensory nerve ending in its wall so that nerve impulse are relayed to the brain and argue to urinate develop. The **sphincter muscle** located at the base of the bladder relaxes and the urine is released via urethra. This tube is contained within the penis in mammals



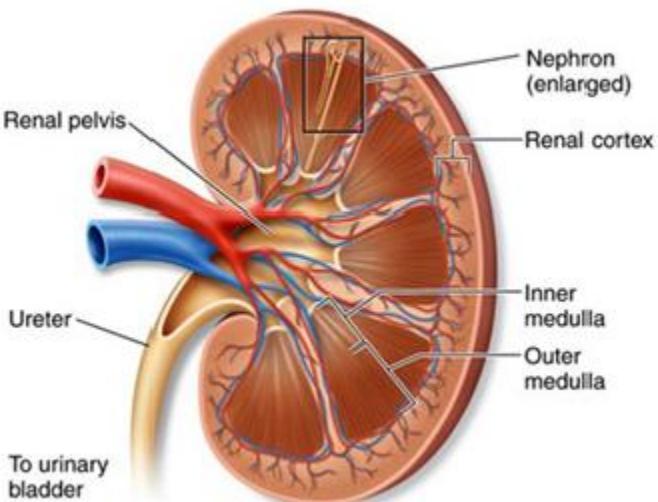
Urinary system

COMPOSITES OF KIDNEY

The kidney is composed of three regions namely

1. CORTEX
2. MEDULLA
3. PELVIS

INTERNAL STRUCTURE OF MAMMALIAN KIDNEY



i) CORTEX

Is the outer zone which is dark in colour contains a dense network of blood capillaries that form the glomeruli of the nephrons, which is the functional unit of the kidney.

ii) MEDULLA

This part lies between the cortex and the pelvis. The surface of the medulla facing the pelvis is folded to form projections called PYRAMIDS

iii) PELVIS

Pelvis narrow to form ureter. Pelvis is a collecting space leading to the ureter which takes the urine to the bladder.

THE NEPHRONE

Nephrone is a function unit of the kidney. The nephrone performs both function of OSMOREGULATION and EXCRETION (Osmoregulation - maintains constant osmotic pressure of body fluids)

Each nephron consists of a long tubule closed at one end and open at the other

The Nephron is divided into four parts

1. Bowman's capsule
 2. Proximal convoluted tubule
 3. Loop of Henle
 4. Distal convoluted tubule.
- i) **BOWMAN'S CAPSULE**

This is a round - cup shaped part of the closed end of the tubule and encloses the glomerulus, which is a network of blood capillaries the glomerulus formed from the afferent blood vessels, a branch from the renal artery.

ii) PROXIMAL CONVOLUTED TUBULE

Is the coiled part of the tubule next to the Bowman's capsule. It lies in the cortex.

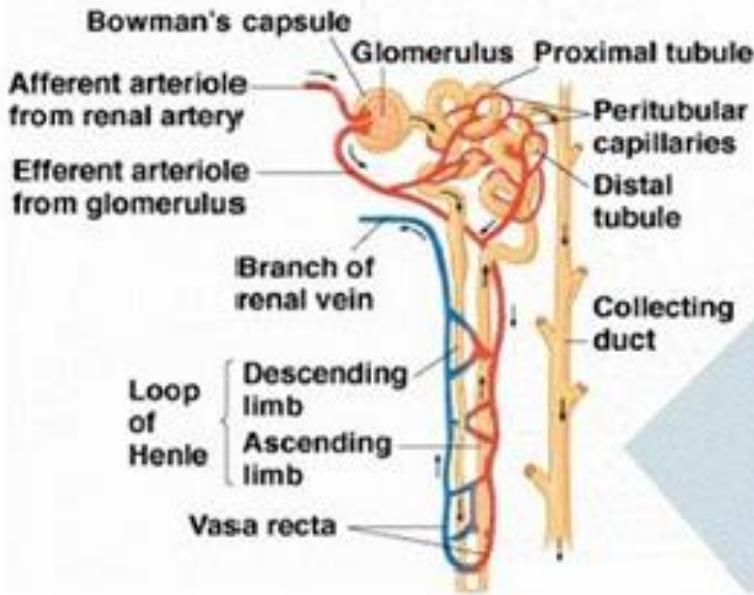
iii) LOOP OF HENLE

The portion of the tubule which extends from the proximal convoluted tubule and dips into the medulla, from the medulla it bends back into the cortex to form a U-shaped loop.

iv) DISTAL CONVOLUTED TUBULE

This is coiled part next to the open end of the tubule which joins with a collecting duct (ureter).

The whole length of the nephron is surrounded by network of capillaries.



MECHANISMS OF EXCRETION

Excretion takes place in three types

- (i) Filtration
- (ii) Reabsorption
- (iii) Removal

i) FILTRATION

Kidney receives blood at high pressure through renal artery (branch of Aorta)

- The blood is rich in nitrogenous waste such as urea, dissolved food substance, plasma, protein, mineral ions, hormones and oxygen.
- The afferent vessels entering the glomerulus are wider than the efferent vessels leaving the glomerulus. The narrowness of the efferent vessels produces resistance to blood flow and thus creates pressure in the glomerulus.
- Due to high pressure in the glomerulus, the liquid of the blood dissolve substance of small molecular sizes are forced out of the glomerulus in the Bowman's capsule (urea, glucose, salt and amino acid).
- Large sized molecule such as proteins and blood cells are not filtered because the walls of the capillaries of glomerulus and Bowman's capsule have very **small pores**. -Hence the blood which remains is rich in plasma and has

very little water.

- This process is known as **ultrafiltration** and the filtrate formed is called **glomerular filtrate**

ii) . REABSORPTION

- As the glomerular filtrate moves along tubules, useful substance to the blood are selected and reabsorbed back into the blood.
- Most of the reabsorption occurs in the proximal convoluted Tubule through the process of **Active transport**.
- For efficient reabsorption of substance, the proximal convoluted tubule is adopted in several ways;
 - a) The cell the tubule has mitochondria which provide necessary energy in form of ATP.
 - b) The cell has microvillus to increase surface area reabsorption
 - c) Tubule is long and coiled to provide large surface area for reabsorption
 - d) Well supplied with blood capillaries.
 - e) The tube is coiled to slow down the speed of the flow of the filtrate.

COMPLICATION AND DISORDERS OF EXCRETORY SYSTEM URINARY SYSTEM

Certain disorders of the body can be diagnosed by examining the contents and measuring the quantity of urine

1. *For example*, if the urine contains glucose then this indicates the disease DIABETS MELLITUS

- Diabetes Mellitus occurs because the pancreas does not produce enough of the hormone (insulin) which controls blood sugar level.
- It can be treated with injections of insulin
- 2. Another type of diabetes is DIABETES INSIDUS. which results from large quantity of dilute urine being produced
- This happens because the sufferer cannot produce enough Anti - Diuretic hormone (ADH). which is responsible for regulation of the amount of water in the blood.
- Diabetes insipidus can be treated by Nasal sprays which contains ADH.

NEPHRITIS

Nephritis is the general term for any infection or inflammation of the kidney.

- In one type the glomeruli fail to function normally and allow protein to filter through into the tubules.
- It is diagnosed by the presence of protein in the urine

Causes of Nephritis

1. Could be allergic reaction
2. It may be blood vessels disorders or high blood pressure
3. Damage of the kidney.

Treatment

- It is dependent on the cause

KIDNEY STONES

Small stones can sometimes be formed in the pelvic region of the kidney.

- These stones may be made of
 - 1) Uric acid
 - 2) Calcium oxalate or (mixture of calcium)
 - 3) Magnesium
 - 4) Ammonium phosphate
- They form as a result of obstruction of urine flow on excess of certain chemicals in the blood stream
- There are often no symptoms of kidney stones unless stones move from their original position
- If a stone moves into the ureter, it causes severe pain (Renal pain) which can be felt in the lower back to the groin, accompanied by vomiting sweating.
- There may also be blood in the urine.

Treatment

1. Can be treated by x- rays some small stones may put down the ureter and out through the bladder with the need for treatment.
2. Larger stones may have to be removed surgically actively they can be shattered into fragments by treatment.
3. The small fragments are passed out harmless in the urine.

NB: An untreated kidney stone may obstruct urine and lead to Nephritis

CYSTITIS

Cystitis is an inflammation at the bladder caused by infection.

Symptoms

1. Symptoms are frequent painful urination and blood urine.

Middle symptoms maybe

2. Slight increase in the frequency of urination accompanies by a burning sensation.
3. If the infection spreads to the kidney, it may cause fever, blood in urine and backache.

Causes

1. It may be caused by bacterial infection of the bladder usually from the urethra.

KIDNEY FAILURE

Kidney failure is a condition where one or both kidney cease to function.

- If it happens to both kidneys it is fatal if not treated
- It can happen suddenly as a result of high blood pressure
- It is possible to live with one kidney only, but the only treatment for failure of both kidneys is DIALYSIS or a KIDNEY TRANSPLANT.
- In dialysis, the patient's blood supply is linked to a kidney machine. The machine performs the functions of normal kidney by filtering the blood and removing excess salts and water.
- The patient spends several hours in a week linked to the machine.
- A kidney transplant involves surgically inserting a healthy kidney from a donor to replace a diseased kidney.
- The kidney has to be compatible to avoid problems with rejections.
- Sometimes a healthy person will donate a kidney to save the life of a close relative suffering from kidney failure.

EXCRETION ON PLANTS

- Plants manufacture all their organic needs according to demand.
- They only make as much protein as they need at any one time, for example
- Therefore they do not excrete urea from excess amino acids because they do not usually have any.
- They do however respire and photosynthesis and as a result produce products.
- However, waste products of one process may be the raw material for the other e.g. carbon dioxide and waste produced by respiration are recycled during daylight hours is usually high enough to produce oxygen faster than its use by respiration.
- Therefore the oxygen is not used up by respiration and the excess is excreted.
- Some plants produce tannins and other organic acids from nitrogen and carbohydrate metabolism.
- These are passed into leaves. Where they build up and are lost from the plant when the leaves fall off.
- Bitter substances such as tannins and other organic acids have a protective role in deterring leaf eating animals, from feeding on the plants.
- Trees produce various gums, resins and latexes which can be collected from the tree and have a wide range of industrial uses.
- Products such as turpentine, paints, varnishes, soap, cosmetics, food, surgical items, gold balls, bubble gum and rubber are manufactured from these plant products.

Mechanism through which plant remove their waste product

1. Diffusion
2. Abscission
3. Degradation

5. REGULATION (HOMEOSTASIS)

REGULATION - This is the maintenance of a relatively constant body internal environment. Internal environment include Temperature, Concentration of salt, Glucose, Water, and also hydrogen ions (pH), which are always changing.

- Such changes affect the rate of chemical processes of the body e.g. enzymes work best within certain temperature ranges. Outside this optimum temperature range, enzymes become inactive or may be destroyed.
- Therefore if enzymes are destroyed, metabolic process may stop. Changes in water, salt and hydrogen ion concentration will also affect the rate of metabolic reaction.
- For efficient functioning of the body, rate of chemical reaction must be kept at their optimum levels, hence the need to maintain the internal environment in a state of equilibrium
- Equilibrium may be achieved by

1. nervous
2. hormonal control

The maintenance of a constant internal environment is called **Homeostasis**.

An animal will survive even if the temperature of its surrounding rises because its body can regulate its internal temperature

Why regulation is important in our body, four reasons.

- Maintaining favorable condition such as pH and required ions concentration for functioning of cells, tissues and organs.
- Enabling organisms to get rid of body wastes and useless material.
- Enabling organisms to get rid of excess materials for example excess water and salts.
- Ensure survival of organism.

Types of regulation

- 1) Temperature regulation (Thermoregulation)
- 2) Osmoregulation
- 3) Blood sugar regulation.

1. Temperature regulation in animals

This is the maintenance of a relatively constant body temperature even when the surrounding temperature varies. A constant body temperature favour efficient enzymes activities.

Enzymes work best at a narrow range of temperature known as optimum temperature

The temperature above a given optimum temperature is less favored by enzymes and may denature enzymes or destroy cell.

Temperature below the optimum inactivates the enzymes slowing down or stopping enzymes catalyzed reaction. It is very- important that body temperature to be kept constant.

External temperature affecting the body is detected by thermal receptors in the skin. The thermal receptors relay information to temperature regulation center in the brain (hypothalamus)

Animals can be divided into two groups based on body response to environmental temperature fluctuations. These groups are;

1. Poikilothermic regulation
2. Endothermic regulation

1. ECTOTHERMS (poikilotherms)

This is type of temperature regulation in which organism temperature fluctuates with those of the environment e.g. all invertebrates and some of vertebrates as fish, amphibians and reptiles. Also organism known as cold blooded

2. HOMOETHERMS (endotherms)

Refers to animal where body temperature remains constant irrespective of environment changes.

Irrespective of whether an animal is ectotherms or homotherms, changes in its body temperature will affect metabolic process. Rise in temperature beyond a certain limit will lead to decrease in the rate of metabolism.

Also organism known as warm blooded.

All mammals and birds are homoethers

A decrease in temperature below the optimum will result in a decrease in the rate of metabolic reactions enzymes become inactive hence metabolic reactions for survival, homoethers and ectotherms must respect to changes in temperature.

MECHANISM OF TEMPERATURE REGULATION IN HOMEOTHERMS

To keep temperature constant, endotherms have developed special mechanisms that help them lose or gain heat.

When it is very hot, the body temperature of animals, becomes higher than that of the surroundings, therefore it has to lose heat energy.

Heat loss can be by physical means, physiological means or behavioral control.

Heat loss by physical means can be done by various methods such as sweating, panting, and vasodilatation.

Physical means are done without the body's will or control but by the control of the nervous system.

Behavioral means are carried out by organism's will for **example** moving to a shaded place during a hot day.

Physical means is when heat is lost or gain through conduction, radiation, evaporation and convection.

Conduction- is the transfer of heat energy from one body to another through direct contact with each other.

Example when a person takes a cold shower on a hot day, he/she loses heat to the surrounding thus cooling his/her body temperature.

The same applies when someone sits on a cold chair, he/she will feel the coldness of the chair due to conduction.

Radiation- is the transfer of heat energy from one body to another without the bodies being in contact with each other.

The transfer of heat energy is usually through infra-red waves.

Example when somebody sitting in a room of 21% may lose heat through radiation.

Evaporation- is the change of liquid to a vapour.

Evaporation is accompanied by cooling. That is why sweating provides a cooling effect.

Convection- is the movement of air resulting from pockets of warm air being replaced by cooler air and vice versa.

When the surrounding temperature is higher than the body temperature, the body may gain heat by conduction, radiation and convection.

Also the body loses heat through evaporation, conduction, convection and radiation.

The skin plays a major role in temperature regulation.

Role of skin in thermoregulation

The skin of mammals is divided into two layers of epidermis and dermis.

The epidermis is thin and contains pores.

Dermis cells sensitive to temperature called thermoreceptors.

Thermoreceptor detects changes in the temperature at the surface of the skin and sends impulse to the skin via nerves. This enable you to feel if the environment around you is hot so that you can move to a cooler place or if it cold so that you keep yourself warm by, wearing warm clothes. Change of temperature inside the body is detected by the hypothalamus.

The dermis also contains erector muscles, sweat glands and blood vessels. Sweat glands secrete sweat via a sweat pores in the epidermis and evaporate it to the atmosphere. As water in the sweat evaporates it carries away the body heat hence cooling the body.

Temperature regulation in cold weather

In cold weather, the body temperature is higher than the surrounding temperature.

- In order that the temperature of the animal to be maintained to normal, the body responds by one or more of the:

1. Increased rate of respiration - which results in the production of heat in the body. The heat energy heats up the body resulting in a raised body temperature.

2. Shivering - this is due to contraction of skeletal muscles. This produces heat which is transferred to the body.

3. Vasoconstriction - this is the narrow of blood vessels at the skin's surface. It reduces blood flow in the skin in this way heat lost by radiation is reduced.

4. Contraction of hair erector muscles. This causes hair to rise; air is trapped between the hair, forming an insulating layer between the skin and the surrounding. Hair is poor conductor of heat hence provides insulation

- Also structural adaptations that regulate the amount of heat gained or heat loss include possessions of fur in mammals and thick layer of skin for animals living in cold areas. Features in birds that provide insulation

When the body temperature rises, the temperature of the blood also rises (this may be due to increased vigorous muscular activity. rise in the temperature of the surround) the blood flows to the brain and stimulate the thermoregulatory- centre.

This triggers the following:

1. Vasodilatation - this is widening of blood vessels supplying the skin, it allows a large volume of blood to reach the skin. Since the blood in the skin is closed to external environment, the body's heat is lost to the environment - cooling effects.

2. Sweating - water fluid produced by sweat glands and brought to the skin by sweat ducts, evaporation of sweat from the skin draws heat from the body which has cooling effects.

Behavioral means of temperature regulation in human

The following behavioural mechanism for temperature regulation is shown by human being during hot and cold weather:

Table: mechanism of temperature regulation in human beings

DURING HOT WEATHER	DURING COLD WEATHER
Moving to a shaded places	Moving to warmer places
Wearing lightly clothes	Wearing warmer clothes
Taking cold beverages	Taking hot beverages
Swimming or taking a cold shower	Basking in the sun or seating by a fire
Fanning using manual or electric fans	Using heating systems in the house
Using air conditioners	Exercising
In houses with large windows, opening all the windows	Building houses with air spaces in the walls to act as insulation against heat loss

TEMPERATURE REGULATION IN ECTOTHERMS

Ectotherms in contrast to homeotherms do not have mechanism to regulate their body temperature.

- When the environmental temperature falls their bodies loose heat to the environment. This results in a fall in body temperature. Under this condition also the rate of metabolism decreases and the animal becomes sluggish.
- They overcome the problems either by moving away from cold to warm areas or by **HIBERNATING (dormant state)**.
- When the environmental temperature rises the body gains heat from the surroundings, eventually the rate of metabolism increases and the animal becomes active.
- Prolonged exposure to higher temperature leads to death. To avoid being over heated, they move to cooler areas or by **AESTIVATE (dormant)**

OTHER MEANS OF LOSING HEAT FROM THE BODY

Evaporating water from respiratory system and buccal cavity e.g. dogs achieve it through quick shallow breathing called **painting**, also saliva to evaporate from the tongue.

ADAPTATIONS TO COLD AND HOT Animals living cold areas

- Animal living cold areas have thick layer of fat under the skin, thick layer of fur throughout their lives while others develop a thick layer during winter. (These acts as insulators against heat loss.)
- These animals have small ears and short noses (reduce heat loss)

Under extreme low temperature, animals whose regulatory mechanisms fail to combat heat loss hide in nests or burrows. During this period they cease to move. Their metabolic processes are reduced to a minimum. This is called **HIBERNATION**. During this period, animals depend on the food store in their bodies in the form of fat.

Animals that have no suitable insulators such as fur or fats cannot hibernate, to avoid extreme temperature by migrating to warmer places.

ANIMALS LIVING IN HOT AREAS

Homeotherms living in hot dry- area have short sparse fur. little fat under the skin.

Large ears and long noses to increase surface area, volume ratio and maximize heat loss.

Also if exposed to prolonged hot temperature, then go into state of rest - **AESTIVATION** (their body metabolism slows down and they become very- inactive).

OSMOREGULATION IN MAMMAL

This is the regulation of concentration of water and mineral salt in an organism. For proper functioning of the body, the amount of water and mineral salt are required at a certain amount. Water and mineral salt serve various physical functions in the animal body.

An excess or deficiency of water and mineral salts in the cell may interfere with osmotic pressure metabolic process of the cells.

Therefore, for the cell to carry- out the physiological process efficiently, the level of water and mineral salts must be maintained within certain limits.

The regulations of concentrations of water and mineral salts in the body are referred to as **Osmoregulation**.

Movement of water into and out of the cell is closely related to the salt concentration. If the concentration of salts in blood and tissue fluid is higher than that of the body cells, then the water will move out of the cells by osmosis and they will shrink.

If the concentration of salts in blood and tissue fluid lower than that of the body cell, water will move into cells by osmosis. Continuous absorption of water makes an animal cell swell abnormally and possibly burst.

The balancing of the amount of water in the blood by selective reabsorption occurs in the distal convoluted tubule and collecting duct of the kidney.

The process is controlled by hormones. The secretion of these hormones depends on the osmotic pressure of the blood.

Osmotic pressure depends on the amount of water and salt present in it.

A rise in the osmotic pressure of blood is brought about by an increase in salt. (NaCl) concentration also brought about by reduction in its water content.

When a rise in the osmotic pressure of the blood is due to a decrease in the amount of water, blood reaching the brain causes the brain to register the water shortage. Thus stimulate the pituitary- gland to produce ANTIDIURETIC HORMONE (ADH)

When the hormones reaches the kidney. ADH makes the distal convoluted tubule and the collecting duct more permeable to water so more water is reabsorbed back into the blood stream.

Water reabsorption will continue until the Osmotic pressure of the blood is brought back to normal. When this happens, secretion of the hormone falls and less water is reabsorption.

When there is a fall in the osmotic pressure of blood as a result of low concentration of sodium chloride (NaCl) concentration, another hormone called ALDOSTERONE is secreted from adrenal glands.

This hormone stimulates the tubules to reabsorb salt (NaCl) back into the blood.

This sodium chloride is returned into the blood circulation through the **RENAL VEIN**.

Re absorption will continue until the osmotic pressure of the blood is brought to its normal level, then the secretion of the hormone stops so no more reabsorption of sodium chloride.

1. BLOOD SUGAR REGULATION IN MAMMALS

One of the most important metabolites in the blood is glucose, so its level must be controlled.

Glucose is the end product of carbohydrates digestion. Glucose is the main respiratory raw material and must be supplied continuously to cells.

The brain cells are especially dependent on glucose and unable to use other metabolites as an energy source. Lack of glucose resulting in fainting

Human blood glucose concentration is between 80 - 110gm per 100c of blood, in order to provide an adequate source of energy and to maintain the required osmotic pressure of the blood. Deviation from this amount will result in an imbalance of energy supply and osmotic pressure of the blood.

If the concentration of glucose in the blood *rises above* normal, the osmotic pressure of blood will also arise resulting in cells losing more water to the blood than they gain from it.

Deficiency of glucose lowers the osmotic pressure of blood resulting in the net movement of water from blood into the tissue. Also the body will not be getting enough energy which may result in convulsions and eventually coma. Thus there is a need to maintain glucose at required level.

The level of glucose in the blood is maintained by two pancreatic hormones, insulin and glucagon. These hormones are secreted by specialized group of pancreatic cells called Islets of langerhans.

The increase in blood sugar concentration stimulates the secretion of insulin, which is carried to the liver and muscles, where it promotes the conversion of the excess glucose into glycogen and stored in the liver. Also glucose is converted into fats by the liver, and stored under the skin, around the heart, along blood vessels and intestines and around the kidney.

Hence if the concentration glucose in blood falls and the secretion of insulin is also lowered

If the level of glucose in the blood fall below the normal, glucagon is secreted which stimulate the conversion of glycogen to glucose which released into blood. Thus the blood glucose concentration is raised to bring it back up to normal.

1. DIABETES MELLITUS

This disease is due to accumulation of glucose in the blood.

Since the glucose is not removed from the blood as a result of conversion to glycogen the concentration remains high.

Re absorption of water in the kidney tubules is reducing as a consequence. Large volume of more dilute urine is produced and the individual may suffer severe dehydration. Because little glycogen is stored in the body, body fat and proteins are used as a respiratory substrates the individual rapidly loses weight.

This disease can be treated by injections of insulin.

6. REPRODUCTION

This is the process by which organism produce new individual of the same species.

This is one of the important features of living things. Reproduction results in the increase in numbers of organisms and the perpetuation of life on earth

Importance of Reproduction

1. It ensures the continuity of individual species. This is because newly born individual replace the dead ones.
2. Reproductions increase the number of populations of living organism on earth.

Types of reproduction

Basically there are two ways in which living things reproduce.

- 1) Sexual reproduction
- 2) Asexual reproduction

I. ASEXUAL REPRODUCTION

It is the reproduction of off springs from single organism without the use of sex cells (gametes).

It means that there is no fusion of gametes. Single celled organism like amoeba and bacteria use asexual reproduction as the only means of reproduction.

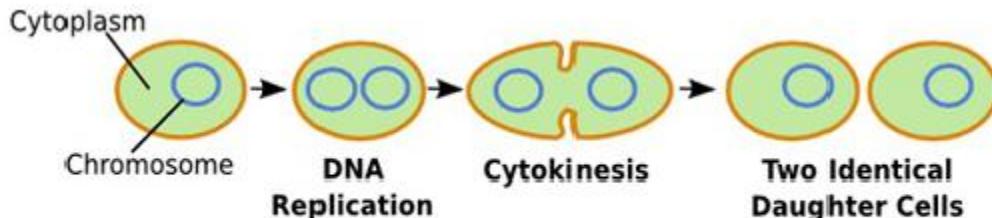
There are different forms/methods of asexual reproduction depending on the type of organisms.

Asexual reproduction may be of different forms such as

- 1) Binary
- 2) Fragmentation
- 3) Multiple fission(sporulation)
- 4) Budding
- 5) Suckers
- 6) Artificial/ Vegetative propagation

1) BINARY FUSSION (SPLITTING)

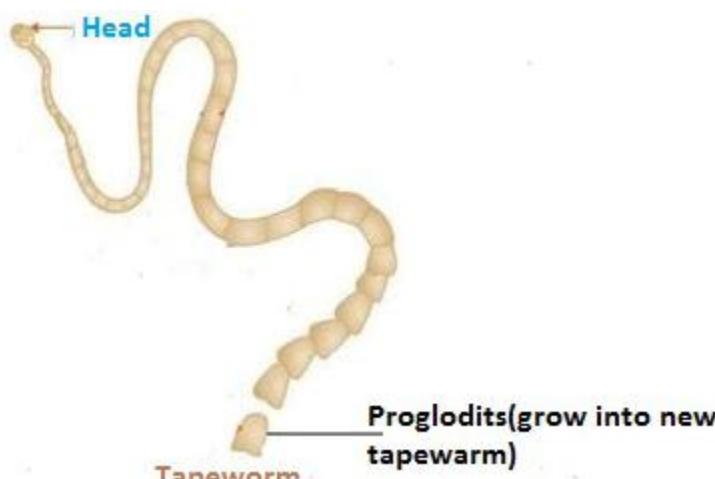
Is the process whereby organism divided into two (2) equally parts and each part then grows to attain the original size of the parent cell and becomes a separate and independent organism. Organism such as amoeba, paramecium euglena and trypanosome practice binary fussion



Binary fission

2) FRAGMENTATION

Is the reproduction where by an organism breaks physically into two or more parts with identical feature with parent. Each of the parts grows to be a complete organism. *Examples* of organism that practice fragmentation are flatworms etc



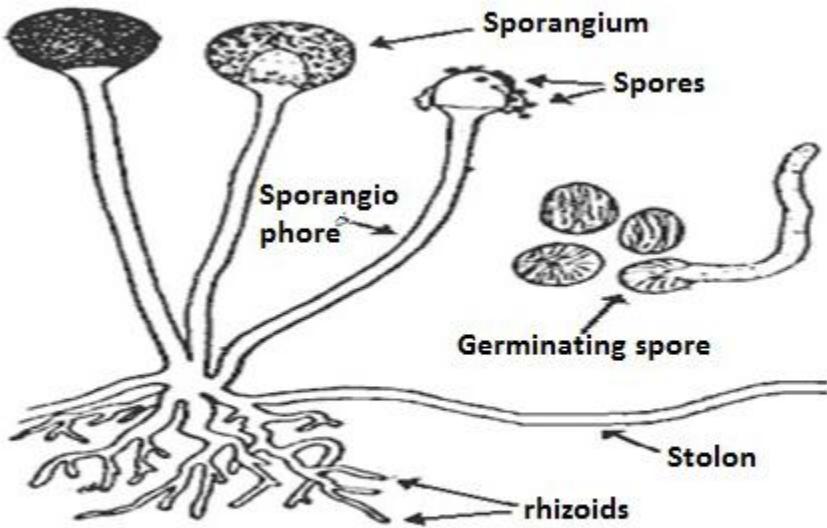
3) MULTIPLE FISSION (SPORULATION)

This is the type of reproduction where by organism produce organism by reproductive cells called spores

Spores are small unicellular structures which contain reproductive cell. The spores develop from a single cell from a structure know sporangium. When the sporangium is fully developed, they burst to release the spores to the ground. When land on a suitable environment germinate into new organisms.

Examples of organisms that reproduce by sporulation include fungi, mosses, ferns and **amoeba**. In amoeba multiple fission only occur when environmental condition do not favor binary fission such as drought.

Spores are produced in specialized structures known as sporangia, but in ferns are called **sorus** and in Moses are sometimes known as **capsules**.



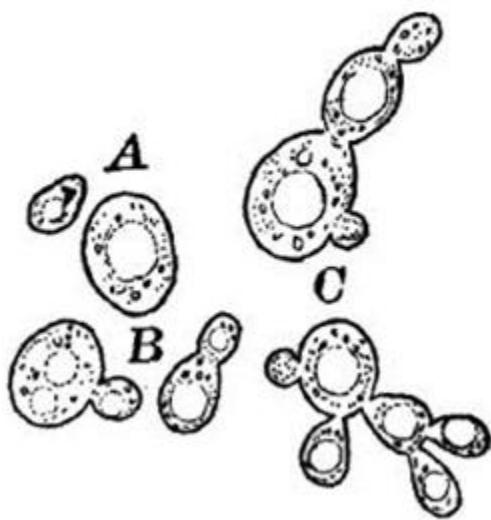
Spore formation

4) BUDDING

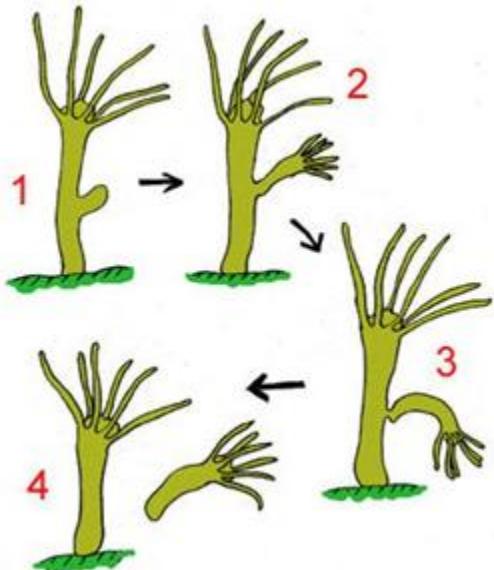
Is a type of reproduction whereby a new organism arises asexually as an outgrowth on the older organism.

The bud finally separates from the parent's body and grows to attain the size of the parent Example are yeast and hydra.

Yeast



Hydra



5) SUCKERS

These are lateral branches with terminal buds which grow from the base of an underground stem. These branches are called suckers *examples* banana.

6) ARTIFICIAL/ VEGETATIVE PROPAGATION

This is a form of a sexual reproduction found in plants in which a bud grows and develops plants. In these type a detached plant, root, stem or leaves grows and develops into an independent plant.

Forms of Artificial Propagation

(i) Propagation by cuttings

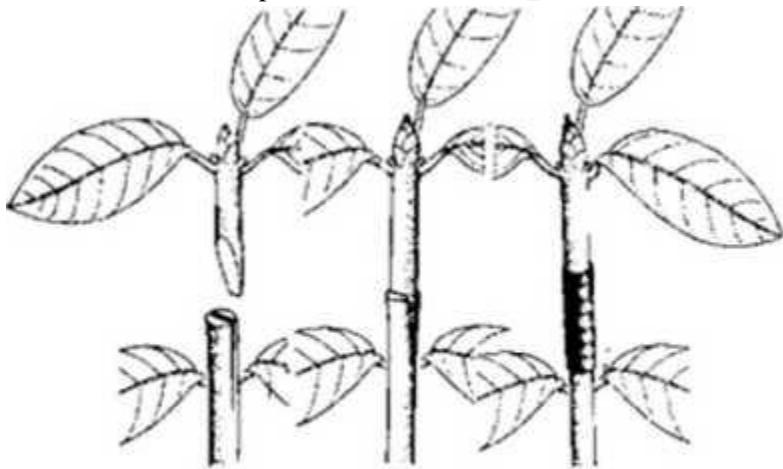
When a portion of a stem or root is cut off and put in a moist soil it produces roots and sprouts and new independent plant produced.

- Plants propagated by stem cutting include — sugar cane, sweet potato, and cassava.
- Plants propagated by root cutting include — lemon and sweet potatoes

(ii) Propagation by grafting

It involves the attachment of a part of a plant to early rooted plant. This type of propagation can be carried out between plant of the same species (or related species), e.g. orange and lemon

For grafting to be successful the xylem and phloem of both plants must be indirecct contract, to ensure the easy movement of materials between two plants.

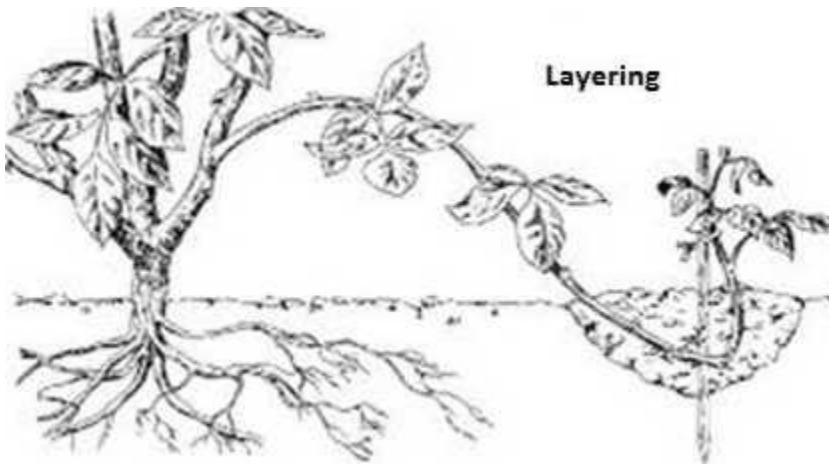


Grafting

(iii) Propagation by layering

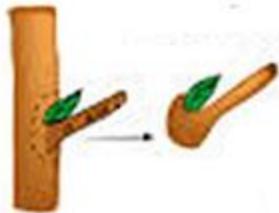
A branch of a plant is bent down until it touches the ground and covered with soil.

After sometime the portion of the branch under the soil grows roots. If the branch is cut off from the main plant it develops into independent plants example: sweet potato



(iv) Propagation by budding

It is similar to propagation by grafting. Here buds are used instead of stem



(a) Bud is removed



(b) T-cut is made in stock



ADVANTAGES OF A SEXUAL REPRODUCTION

1. It results into an organism with the same genetic component as their parents
2. They produce (organism) many offspring which mature fast than sexually organisms. This is beneficial to farmers who need fast growing plants.
3. Asexual reproduction does not waste time.

DISADVANTAGES OF ASEXUAL REPRODUCTION

1. Organisms are at a great risk to perish or get destructed when environmental conditions are not favorable.
2. Parents may pass undesirable characteristic to the offspring's since organisms produced are identical to the parents genetically.
3. Competition for resources such as food and shelter many occur due to large number of organisms being produced.

II. SEXUAL REPRODUCTION

Sexual reproduction involves the fusion of two sex cells called **gametes**. The two gametes differ in form and function, and each is produced from a different organ.

In animals, gametes - production organs are **Gonads (ovaries and testes)**.

In flowering plants structures for producing gametes are called **Anthers** and **ovaries**.

When male and female reproductive structures are born on different individuals it is referred to unisexual. When male and female reproductive structures are produced by the same individual, it is said to be bisexual hermaphrodite.

Characteristic of Sexual Reproduction

1. It always involves a female and male parent
2. The parents must form gametes by meiosis. In bryophytes and filicinophytes formation of gamete does not involve meiosis.
3. A new individual is formed only after a male gamete has fused with a female gamete

NB:

The organism is capable of sexual reproduction only when it is sexually mature. This is because in young organisms the reproductive organs are not fully developed or they may be absent.

ADVANTAGES OF SEXUAL REPRODUCTION

- It results in perpetuation of life.
- Harmful gene of the parent will not necessarily be passed to the offspring gene.

DISADVANTAGES OF SEXUAL REPRODUCTION

- Sexual reproduction may produce individuals with undesired qualities. E.g. disease like hemophilia, sickle cell and anemia
- Time and energy are consumed as it needs two organisms.
- In cases where certain organisms are isolated from another it becomes difficult for sexual reproduction to take place.

MEIOSIS AND REPRODUCTION (CELL DIVISION)

Cell division is the splitting of a cell into two or more parts where each rises into a new cell.

It involves three stages:

- division of the nucleus
- the cytoplasm division
- Cell separation

Chromosomes: are threads like structure found in the nucleus which contain hereditary material (DNA).

Types of cell division

- 1) Meiosis
- 2) Mitosis

1. MEIOSIS

Meiosis is a type of cell division which occurs in reproductive organs, to produce sex cells (gametes).

Meiosis reduces the number of chromosomes from the diploid state (pairs of chromosomes) to the haploid state (single chromosomes). It is also called **reduction division**. Every cell of a multicellular organism contains the same number of chromosomes (46) and it stays constant, generation after generation.

A human develops from a zygote which is the result of the fusion of a male and female gamete. If the gamete has 46 chromosomes the resulting zygote would have 92 chromosomes.

To avoid doubling chromosomes, a special type of division takes place to halve the chromosomes number during gamete formation, which is meiosis.

Meiosis involves a number of processes.

There are two meiotic divisions

- 1) First meiotic division
- 2) Second meiotic division

I. FIRST MEIOTIC DIVISION

This division involves the following stages

- (1) Prophase I
- (2) Metaphase I
- (3) Anaphase I
- (4) Telophase I

INTERPHASE (RESTING STAGE)

Cell grows and carries out normal life functions. The cell is prepared for division.

Interphase



1. PROPHASE I

It is the longest phase of meiosis. During prophase I, DNA is exchanged between homologous chromosomes in a process called homologous recombination. This often results in chromosomal crossover. The new combinations of DNA created during crossover are a significant source of genetic variation, and may result in beneficial new combinations of alleles. The paired and replicated chromosomes are called bivalents or tetrads, which have two chromosomes and four chromatids, with one chromosome coming from each parent. The process of pairing the homologous chromosomes is called **synapsis**. At this stage, non-sister chromatids may crossover at points called **chiasmata** (plural: **singular chiasma**) which result in exchange of chromatid parts.

Prophase I



2. METAPHASE I

- The bivalent of homologous chromosome move to the equator of the spindle.
- The homologous chromosome becomes arranged with the centromeres of the homologous pair pointing toward opposite poles.



Metaphase I

3. ANAPHASE I

Kinetochores (bipolar spindles) microtubules shorten, severing the recombination nodules and pulling homologous chromosomes apart. Since each chromosome has only one functional unit of a pair of kinetochores, whole chromosomes are pulled toward opposing poles, forming two haploid sets. Each chromosome still contains a pair of sister chromatids. During this time disjunction occurs, which is one of the processes leading to genetic diversity as each chromosome can end up in either of the daughter cells. Nonkinetochore microtubules lengthen, pushing the centrioles farther apart. The cell elongates in preparation for division down the center.



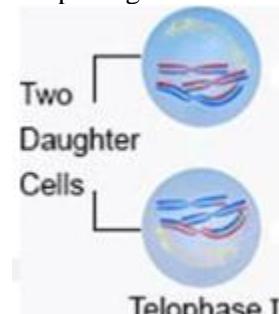
Anaphase I

4. TELOPHASE I

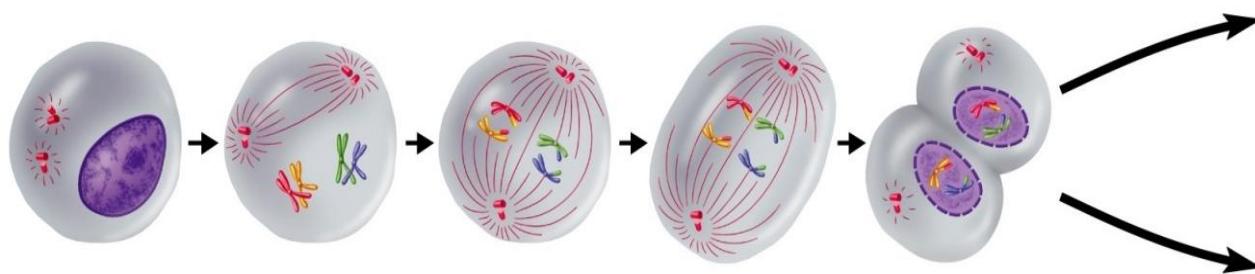
The first meiotic division effectively ends when the chromosomes arrive at the poles. Each daughter cell now has half the number of chromosomes but each chromosome consists of a pair of chromatids.

The microtubules that make up the spindle network disappear, and a new nuclear membrane surrounds each haploid set. The chromosomes uncoil back into chromatin.

Cytokinesis, the pinching of the cell membrane in animal cells or the formation of the cell wall in plant cells, occurs, completing the creation of two daughter cells. Sister chromatids remain attached during telophase I.



SUMMARY OF MEIOSIS I



MEIOSIS I

Interphase I

Cells undergo a round of DNA replication, forming duplicate chromosomes.

Prophase I

Each chromosome pairs with its corresponding homologous chromosome to form a tetrad.

Metaphase I

Spindle fibers attach to the chromosomes.

Anaphase I

The fibers pull the homologous chromosomes toward opposite ends of the cell.

Telophase I and Cytokinesis

Nuclear membranes form. The cell separates into two cells.

II. SECOND MEIOTIC DIVISION

Meiosis II is the second part of the meiotic process, also known as Reduction division. Mechanically, the process is similar to mitosis, though its genetic results are fundamentally different. The end result is production of four haploid cells (23 chromosomes. N in humans) from the two haploid cells (23 chromosomes, each of the chromosomes consisting of two sister chromatids) produced in meiosis I. The four main steps of Meiosis II are: Prophase II, Metaphase II, Anaphase II, and Telophase II.

1. PROPHASE II

We see the disappearance of the nucleoli and the nuclear envelope again as well as the shortening and thickening of the chromatids. Centrioles move to the Polar Regions and arrange spindle fibers for the second meiotic division.



2. METAPHASE II

The centromeres contain two kinetochores that attach to spindle fibers from the centrosomes (centrioles) at each pole. The new equatorial metaphase plate is rotated by 90 degrees when compared to meiosis I. perpendicular to the previous plate.



3. ANAPHASE II

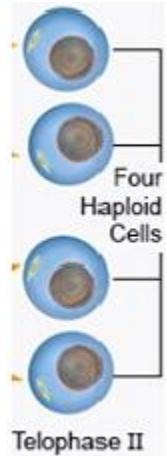
Where the centromeres are cleaved, allowing microtubules attached to the kinetochores to pull the sister chromatids apart. The sister chromatids by convention are now called sister chromosomes as they move toward opposing poles.



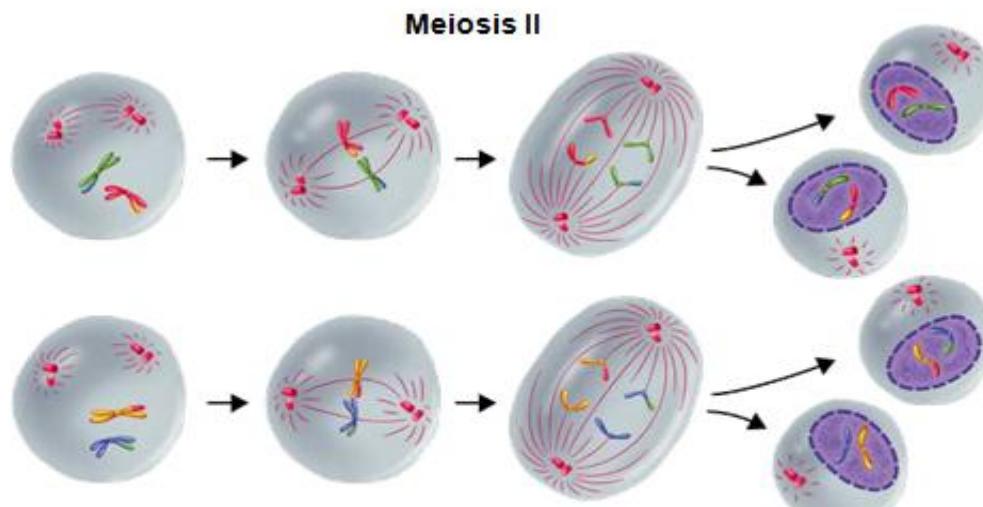
4. TELOPHASE II

This is similar to telophase I, and is marked by uncoiling and lengthening of the chromosomes and the disappearance of the spindle. Nuclear envelopes reform and cleavage or cell wall formation eventually produces a total of four daughter cells, each with a haploid set of chromosomes.

Meiosis is now complete and ends up with four new daughter cells.



SUMMARY OF MEIOSIS TWO



Prophase II

Meiosis I results in two haploid (N) daughter cells, each with half the number of chromosomes as the original.

Metaphase II

The chromosomes line up in a similar way to the metaphase stage of mitosis.

Anaphase II

The sister chromatids separate and move toward opposite ends of the cell.

Telophase II

Meiosis II results in four haploid (N) daughter cells.

IMPORTANCE OF MEIOSIS

1. It ensures a constant number of chromosomes in all the species by reducing the doubling number chromosomes which would result into different species.
2. It involves the possibility of exchange of pieces of genetic information/materials between the paternal and maternal

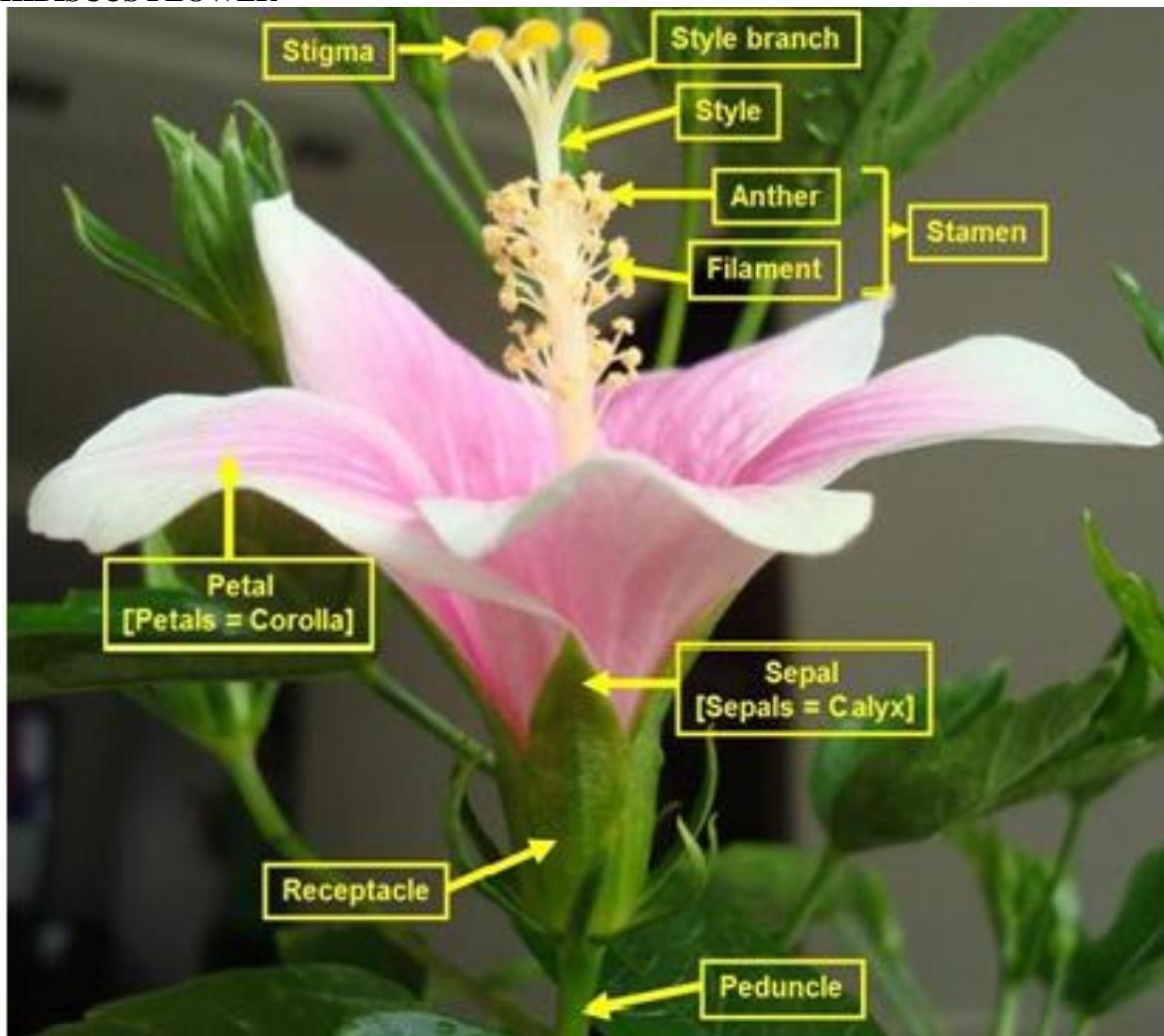
chromosomes leading to new combination of characteristic in the gamete.

3. It provides variation when the membrane of each pair of chromosomes is separated from each other independently.

REPRODUCTION IN FLOWERING PLANTS

Flowering plants or angiosperms reproduce sexually. Flowering plants have specialized structures called the **flowers**, which is used for the reproduction process.

HIBISCUS FLOWER



A flower comprises of different parts

1. PEDUNCLE

It is a flower stalk attached to the plant. It is where flower develops. If it is branched so as to bear many flowers each branch is called **radical**.

2. RECEPTACLE

It is the top of the flower stalk' peduncle to which other parts are attached.

3. CALYX/ SEPAL

It is the outermost ring of floral leaves. Are usually great and protect the inner floral structure when the flower is not open. Some species of plants have flowers with rings of sepals. The outermost ring is called the epicalyx

4. COROLLA

This is a ring of petals on a flower. In some plants the petals are brightly colored. They may fuse to form corolla tube. Corolla and calyx together constitute the Perianth.

5. STAMEN

This is the male reproductive organs. It consists of filament on top with a head of filament called anther

The anther contains pollen grains inside. In the hibiscus flower there are many stamens and filaments which join to form a staminal tube, which is connected to the receptacle.

6. CARPEL

This is the female reproductive organ, it consists of three parts called ovary, style and stigma - Ovary contains eggs/stigma.

- Style is a tube connected to the ovary.

- Stigma is a knob like structure at the top of style. It receives pollen grains during pollination. It is usually have five branches

Types of Flowers

Bisexual flower is a flower which has both female and male organs — examples are hibiscus flower, sunflower, tomato and flamboyant.

Unisexual flower is a flower which has either female or male organs. Examples are maize and some pawpaw flowers

NOTE

- If both male and female flowers are found on the same plants. It is said to be **Monoeious** (maize)
- When the male and female flowers are born on separate plants it is called **dioecious** (pawpaw).

POLLINATION

Pollination is the transfer of pollen grains from the anther to the stigma. It follows that the male's gametes must move from an anther to the carpel (female gametes). When the Anthers are ripe they split open and are expose ready to be transferred to carpel. For a successful fission of gametes, the pollen grains must land on the stigma

Types of pollination

I. SELF POLLINATION

This is the transfer of pollen grains from the anther to stigma of the same flower. It may also occur if the different flowers are of the same plants. Examples are garden peas and dandelion.

II. CROSS POLLINATION

This is the transfer of pollen grains from the anther from a flower of one plant to a stigma of another flower and plant. It involves plants of the same species. E.g. are maize and sorghum.

AGENTS OF POLLINATION

Pollen grains produced from an anther are carried to the stigma by different agents. Such agents are

- Wind,
- Water.
- Insects.
- Bats and
- Birds.

Flower according to mode of pollination are divided into two groups which are;

1. Wind pollinated flower
2. Insect pollinated flower

1. WIND POLLINATED FLOATERS

Flowers may use wind as a pollination agent. When the grains are exposed out and their grains are light, air current easily blows them from anthers.

As pollen floats in the air — it is easily trapped by feathery sticky stigma of other flowers. (Example; maize and grasses).

Characteristic of wind pollinated flowers

1. Are not brightly coloured (are dull coloured)
2. Pollen grains are small and light
3. The flower structure is simple
4. They have no scent
5. They do not have nectar
6. Stigma is large and feathery hanging outside to trap pollen

2. INSECT BIRD POLLINATED FLOWERS

Insects may be the pollination agent. When insects and birds visit the flower to feed, the pollen grains stick to their body.

As they move from flower to flower some pollen (stuck pollens) are transferred and deposited or sticky on stigma of a different flower.

Characteristics of insect pollinated flowers

1. The flower is brightly coloured
2. They produce a sweet fluid (nectar) which is food to most of birds
3. The pollen grains are large and sticky covered with spiky hairs which enables pollen to stuck to the bodies of insect

FERTILIZATION IN FLOATY RING PLANTS

Fertilization is the fusion of male and female gamete. It is followed after pollination one sperm nuclei of pollen grains combines with an egg cell to form a zygote.

- Fertilization by plants takes place in the **embryo sac**.

Types of fertilization

- 1) Self fertilization
- 2) Cross fertilization

I. SELF FERTILIZATION

It is when gametes of the same plants are involved

II. CROSS - FERTILIZATION

It is when gametes involves are of different plants of the same species.

The fertilized ovule develops into a seed, protected by the ovary wall which develops into the fruit wall. In some plant the receptacle becomes part of the fruit such as pineapple

DISPERSAL OF FRUIT AND SEEDS

Dispersal of fruits and seed is of paramount importance because it reduces congestion of plant in a certain habitat. Seed and fruits are dispersed and scattered to other places. Dispersal of fruit and seed reduce overcrowding and competition for light, nutrient and space. Competition between the offspring and parent plant may lower the survival rate to an extent that the plant may become extinct

Since a plant is not motile, the dispersal of fruits and seed is carried by physical agent and explosive mechanism. Depending on the agent of dispersal, fruits and seeds have different adaptive features.

Methods of seeds and Fruits Dispersal

1. Wind Dispersal

Seed and fruit dispersed by wind have the following adaptive feature:

- (a) Are small and light
- (b) Have wing — like structure
- (c) Have feather — like projection

One or combinations of the above adaptive feature enable the seeds and fruit to be carried by wind. *Example include:* Nandi flame, jacaranda, cottonseeds etc.

2. Water Dispersal

Seeds and fruits dispersed by water have the following adaption:

- (a) Have fibrous mesocarp.
- (b) Air pockets.
- (c) Have water proof coats *Example* coconut.

3. Animal Dispersal

Fruits and seeds dispersed have the following adaption:

- (a) Are sticky
- (b) Have hooks
- (c) Are succulent and palatable

4. Self Dispersal

This is the sudden splitting open (dehiscence) of the dry pod. The seed are hurled away from the parent plant.

REPRODUCTION IN MAMMALS

Sexual reproduction occurs in almost all mammals by fusion of male and female gametes. The gametes produced by a male animal are **sperms** while those produced by female animals are **ova**.

Mammals and other animals reproduce sexually, involving **the fusion of gametes**. In most animals, both fertilization and the development occur internally and such animals are called **viviparous**.

Most fish shed gametes directly into water where fertilization occurs externally. In amphibians the tendency of returning to water for fertilization (mating) is observed. Reptiles and birds lay eggs, which hatch and develop into an adult reptile or bird after a number of processes.

Mammals like other animals have specialized structure called reproductive organs (gonads). Which are responsible for production of gametes.

GAMETE FORMATION

Gametes are haploid cells which fuse to form a zygote in the sexual reproduction.

Both male and female humans produce gametes. The process of production of gamete is known as **Gametogenesis**.

There are two types of gametogenesis

- 1) Spermatogenesis
- 2) Oogenesis

1. SPERMATOGENESIS

This is the production of sperms in mammals. It occurs in the testes. The production of sperms starts when males reach puberty

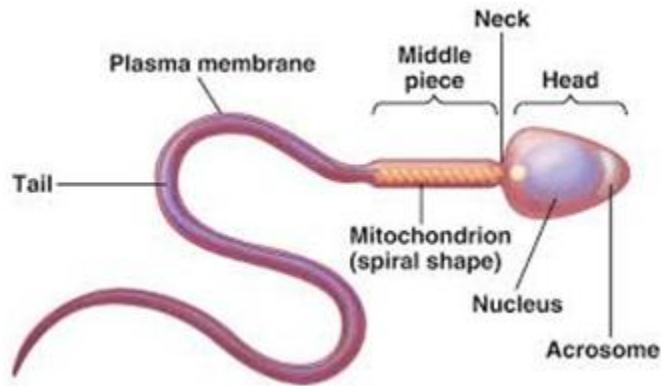
2. OOGENESIS

This is the production of eggs in the ovary. Production of ova is not continuous throughout one's lifetime. The production of egg cells (primary ova) occurs during the foetus development. But only 400 — 500 (primary ova) develop to maturity during the active reproductive age of the female.

STRUCTURE OF SPERM AND OVA SPERM CELL:

Is an extremely small cell. It has three distinct regions

- Head,
- Middle piece
- Tail



The head

The head is flat and oval in shape. It contains nucleus which are contains hereditary materials (DNA).

The middle piece

Have many mitochondria which are concerned with energy production.

The tail

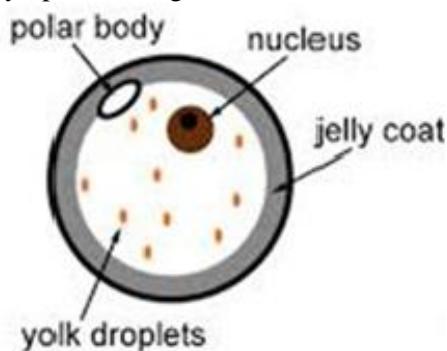
The tail is like flagella in structure for propulsion.

Adaptation of sperm to its function

1. It has structure like tail which helps to move the sperm
2. The presence of mitochondria enables the sperm to produce energy needed during the action.
3. It has an **acrosome** enzyme which help penetrate the egg cell at fertilization
4. They are produced in big number for survival

1. OVA CELL

It is oval in shape; the egg cell contains a nucleus which contains the hereditary material (genetic). It also contains cytoplasm and granules.

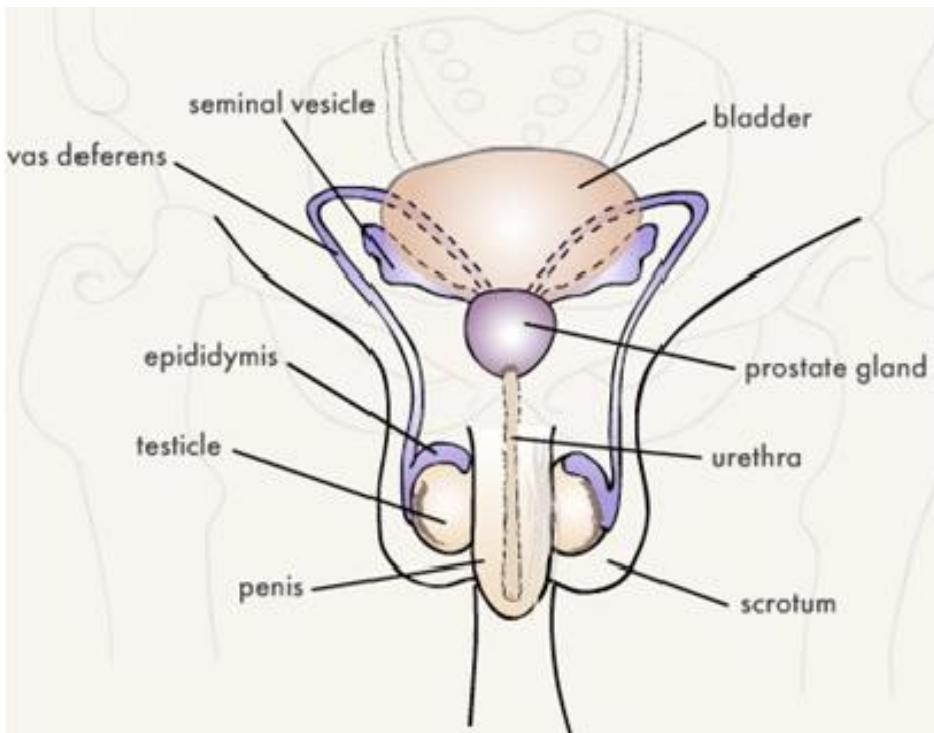


Ovum

REPRODUCTIVE SYSTEM IN MAMMALS

1. IN MAN/MALE REPRODUCTIVE SYSTEM

The male reproductive system is composed of the following parts in diagram below



TESTES

Testes are two oval shaped structures lying behind and below the penis. They are covered in a sac called **scrotum**.

Testes they produce:

- sperm cell
- Men sex hormone (testosterone)
- That hormone is responsible for secondary sexual characteristic
- Testes are suspended outside for a good environment for the production, of sperms which needs lower temperature.

Testes are attached to a coiled structure “**epididymis**” which is temporal storage organ for sperms

SEMINAL VESICLES: Seminal vesicles stores sperms until nourishment takes place. They are located just below the urinary bladder.

PROSTATE GLANDS: This gland together with seminal vesicles secretes a fluid which mixes with sperm as nourishment and protection to the sperm. The sperm together with fluid are called **Semen**.

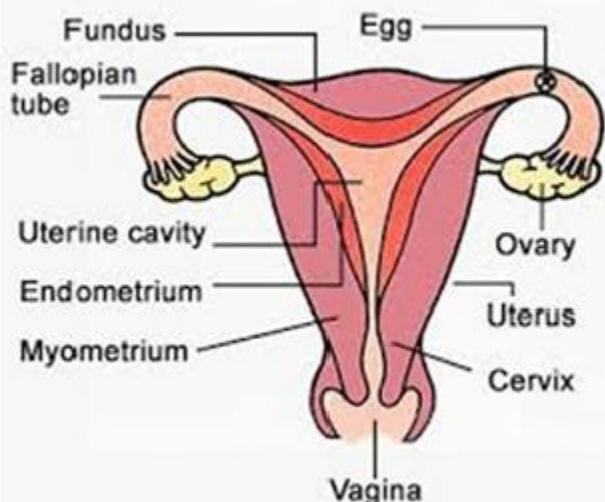
VAS EFFERENTIA: These are ducts which collect sperms from inside the testes and transfer them to epididymis.

SPERM DUCT: This is a straight tube which carries sperms to the urethra.

PENIS: Is copulatory organ which carry sperm from sperm duct to the vagina during copulation. Also take part in excretion process.

FEMALE REPRODUCTIVE SYSTEM

The female reproductive organs are located inside the body, within the pelvis region



OVARIES

These are oval shaped structures near each kidney

Ovaries produce – **ova, estrogen and progesterone**

THE OVIDUCT (FALLOPIAN TUBE)

This is the tube with a funnel shaped opening extending from the ovary to the uterus. The oviduct carries eggs from the ovaries to the uterus. It is where fertilization takes place.

THE UTERUS (WOMB)

This is the muscular thick walled organ within which the zygote implants and develops. As an embryo develops, an organ called **placenta** is formed. It brings uterine tissues into close contact with the tissue of the developing embryo. Placenta also passes nutrients and oxygen from the maternal blood to the embryo, and waste products of metabolism are passed from the embryo's blood to the maternal blood.

Progesterone maintains pregnancy by preventing the production of ova and contractions of uterine walls.

VAGINA

This is the muscular passage from the vulva to the uterus. It is in this region that sperms are deposited during sexual intercourse. The vagina is both a birth canal and a copulatory organ.

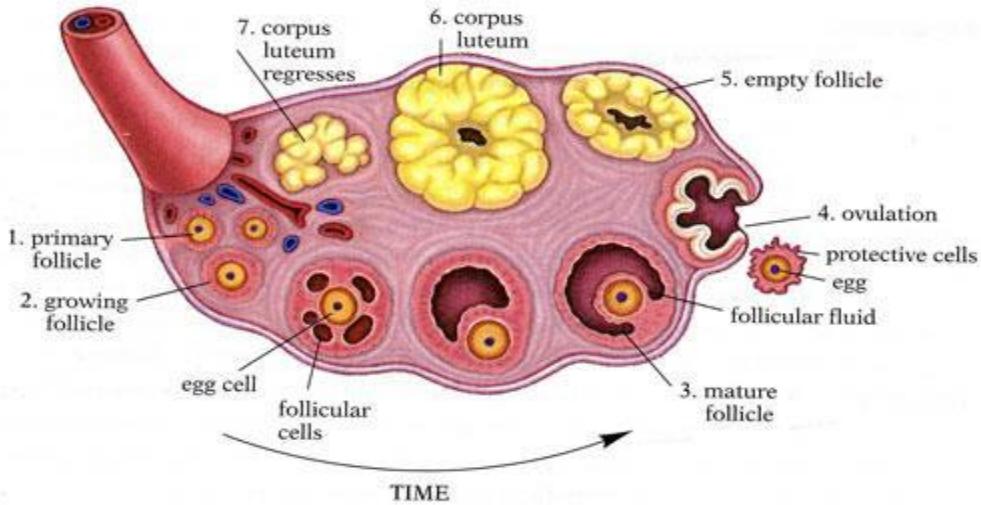
CERVIX

This is the narrow opening to the uterus from the vagina. It is made of muscular ring. It is the entrance from the vagina to the uterus

VULVA These are external genitals of the female reproductive system. The urethra opens to outside through these structures.

OVULATION AND MENSTRUATION

Ovulation-This is the process of releasing an egg from the ovary. The egg reaches maturity approximately once every 28 days. This releasing of eggs alternates between two ovaries. The developing ovum is surrounded by a group of cell called follicle. The mature egg is then released from the ovary. Ovulation is controlled by luteinizing hormones. Before and after the process of ovulation an ovary continues to secrete estrogen and progesterone, which cause thickening of uterus, making it suitable to receive a fertilized ovum. This occurs when the egg passes from the oviduct to the uterus. If the ovum isn't fertilized the uterus lining cells gradually disintegrates, discharging blood and tissue debris from the uterus through the vagina



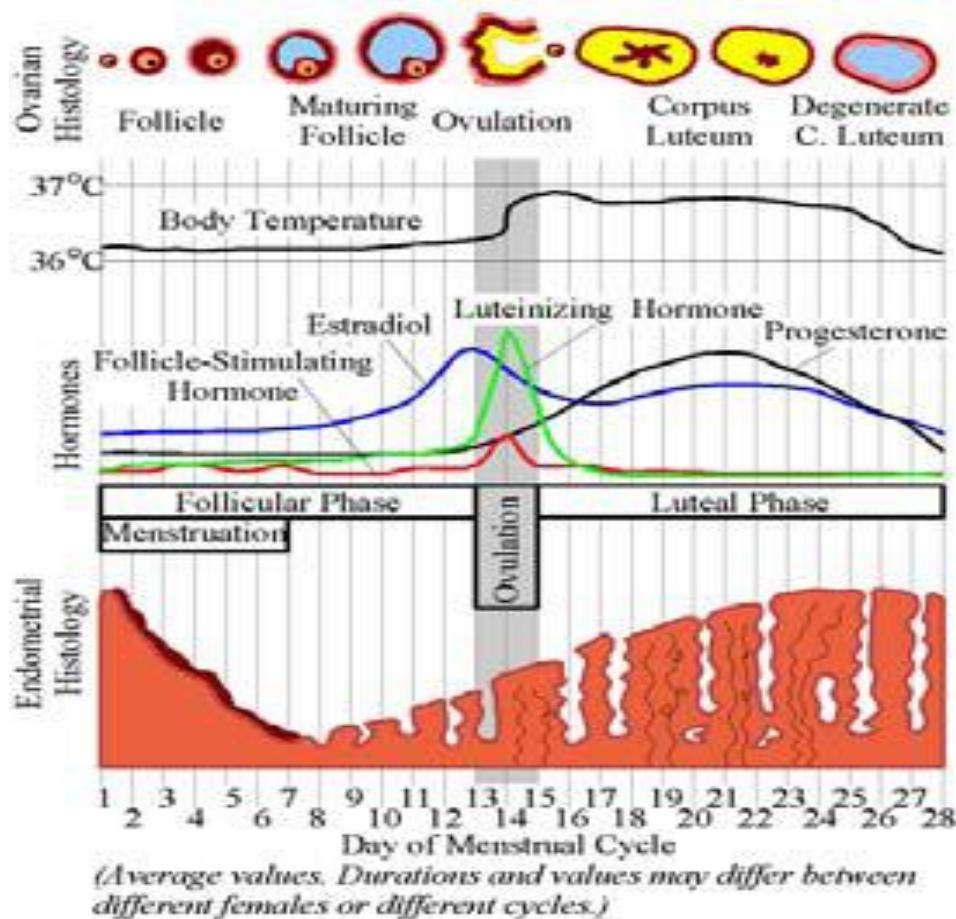
MENSTRUATION

This is the discharge of mucus, epithelial cells and blood through a vagina and the discharge is called **menstrual flow**. A period between one menstruation and the next is called **MENSTRUAL CYCLE**. Menstruation cycle usually occurs on average every 28 day and menstruation last for 3 - 7 days.

After ovulation the follicle enlarges and a yellow pigment accumulates in them to form a corpus luteum. When the **follicle corpus luteum** is developing, the walls of uterus prepare itself for receiving an ovum. The inner layer become thickened and surrounded with many blood vessels and glands.

If fertilization does not occur, the unfertilized egg never be implanted and the thickening lining of uterus disintegrates well as the corpus luteum. Then are discharged through the vagina as the blood. After menstruation the uterus begin to prepare itself for the next ovulation.

MENSTRUAL CYCLE



COPULATION

Copulation is the process of inserting the erect penis into the vagina. When a man is sexually stimulated the penis is filled with blood and becomes erect. The erect penis is inserted into vagina and moved back and forth, stimulating sense organs in the penis and ejaculation occurs.

Ejaculation is the release or discharge of semen. Once the sperm is deposited in the vagina they start swimming towards the oviduct.

The climax of sexual excitement in human is known as **orgasm**, it is accompanied by a feeling of extreme pleasure.

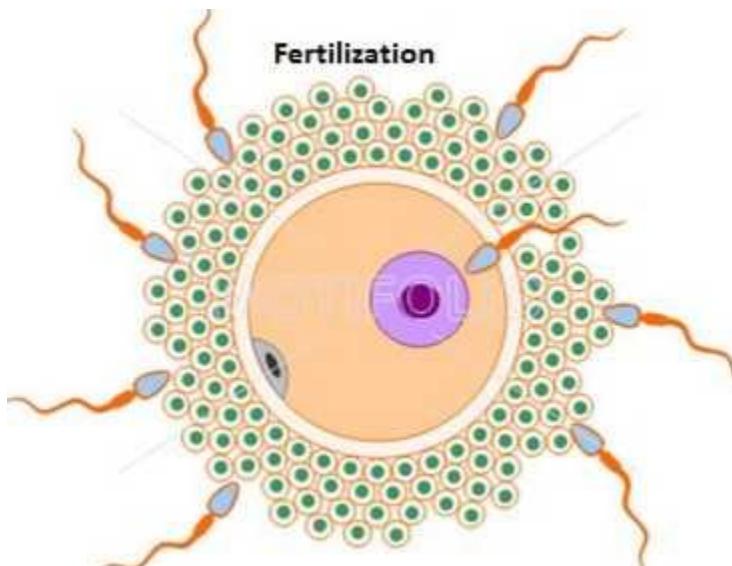
FERTILIZATION AND IMPLANTATION

Fertilization is the process whereby sperm nuclei and ovum nucleic fuse to form a diploid cell called **zygote**. If ejaculation occurs when an ovum is in the oviduct, fertilization is likely to occur.

Sperm takes less than an hour to reach the uterus. At least half the number of sperm dies due to acidic condition of the vagina, and uterus is not their final destination. They have to move to reach the oviduct in order for fertilization to occur; only a few sperms reach the oviduct and can survive for about 72 hours.

The time when fertilization is likely to occur is called the fertile period of a woman. Counting from the first day of menstruation, ovulation is likely to take place on the 14th day, but it can also be on the 13th or 15th day.

Thus the probable time for pregnancy to occur is when the copulation takes place between the 11th day and the 17th day. Only one sperm enters an ovum and other are prevented from entering due to formation of a tough membrane round the ovum.



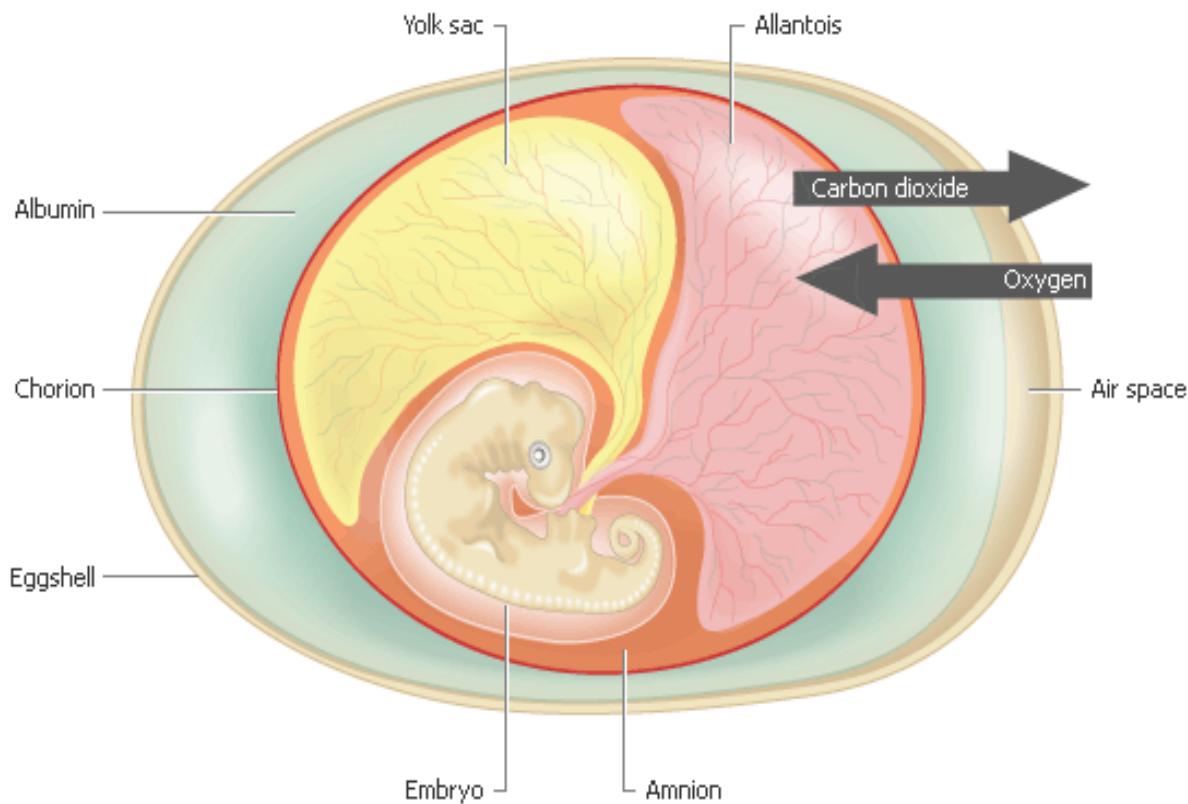
Soon after zygote has been formed it starts to divide so that a ball of cells is produced. Here the zygote is called **EMBRYO**

While zygote is dividing it travels along the oviduct towards the uterus. It takes 3 to 5 days for zygote to reach the uterus. When the embryo reaches the uterus it attaches itself to the **uterine wall**.

This process is called **IMPLANTATION**. Within 4 or 5 days the embryo becomes firmly attached to uterus.

When implantation is complete, the embryo forms two membranes

- Chorion (outer)
- Amnion (inner)



The amnion is filled with a liquid called **amniotic fluid** where the embryo is suspended in

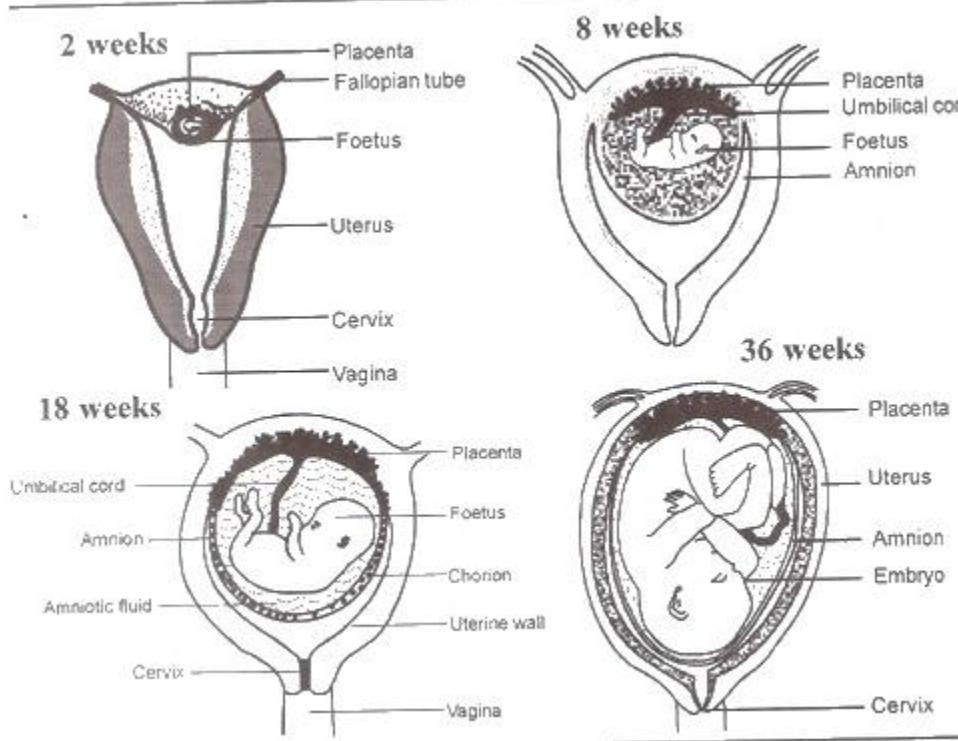
1. Act as shock absorber.
2. Protecting the embryo from mechanical damage.

The chorion is a thin membrane but it has a thick portion that forms finger like projection called **villi**. Villi together with thick portion of chorion form the **placenta**.

The developing embryo is connected to the placenta by cord called **umbilical cord**. It carries two arteries and vein of embryo's circulatory system.

Function of placenta

- * Nutrients and oxygen from maternal circulatory system diffuse to the embryo through placental membrane.
 - Also waste product of metabolism from embryo diffuses in the opposite direction.
- At about three weeks the embryo will have formed the body. Characteristic of human, onwards the embryo is referring as **foetus**.

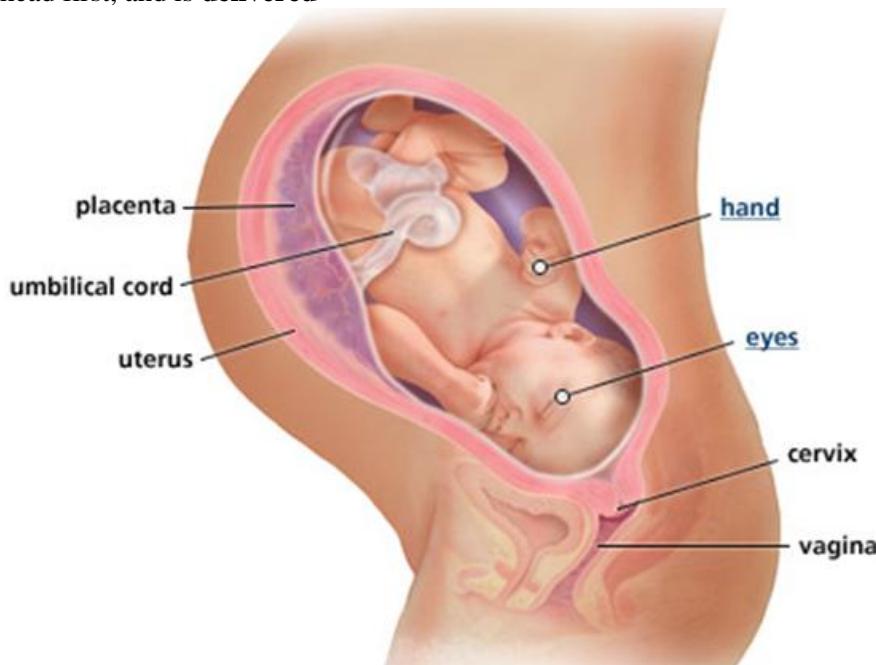


The foetus remains in the uterus for 9 months (280 days). After that time it is expelled by birth. From this time the ovum is implanted in the uterus up to the time of birth the female is said to be **pregnant; gestation** or the **incubation period**.

BIRTH

This is the process by which the baby is expelled from the **uterus**. It starts by a sudden fall in level of oestrogen and progesterone which results in periodic contractions of muscular wall of the uterus, which cause labour pains. As the contractions get strong, they force the foetus into lower part of the uterus at the same time causing the cervix to dilate. As this continues (contractions) the osmotic sac ruptures and the amniotic fluid escapes through the vagina.

When contractions become more frequent and more powerful, the foetus is forced through cervix and vagina usually head first, and is **delivered**



The umbilical cord is still attached to the baby, but is always cut and tied. The final stage of birth involves the removal of placenta through the vagina and is accompanied by some loss of blood because the maternal blood vessels which were supplying to placenta are ruptured.

Immediately after birth the baby must start breathing so as to survive. The concentration of carbon dioxide in the baby's body blood increases when the umbilical cord is cut, lower temperature of the environment stimulate the breathing centre in the medulla oblongata.

FACTORS WHICH MAY HINDER PREGNANCY

Any factor that prevents sperms from reaching ova prevents fertilization. This can happen through natural or artificially.

Factors which can hinder pregnancy in female are

1. Ova are not released in the normal monthly cycle
2. The fallopian tubes may be blocked/ twisted.
3. Uterus may not allow an embryo to implant due to an imbalance of hormones.
4. The woman may make antibodies that destroy the sperm
5. Immature ova

Factors that affect sperm production in male are

1. Very few sperms are produced in one ejaculation
2. A high proportion of sperms produced are abnormal
3. Sperm duct / vas deferens may be blocked
4. Immature sperms.

CAESAREAN DELIVERY

This is the removal of the baby by surgical means through the abdominal and uterine walls.

- This becomes necessary when the baby is so big that it can pass through the mother's cervix.
- It can also be caused by the mother's pelvis being too small to accommodate the normal sized baby.

WAYS WHICH TO OVERCOME HINDRANCE OF PREGNANCY

1. IN -VITRO FERTILIZATION

Women whose oviducts are blocked can overcome by method called in —vitro fertilization.

- Several ova are taken from a woman's ovaries and put into a dish containing sperm from her partner and kept warm for a few hours, the ova are fertilized in a dish.

• One or more embryos are inserted in the woman's uterus where one will implant and develop into a baby

2. FERTILITY DRUGS

Some women are sterile because their ovaries fail to develop ova. This can be because the hormone responsible for the ova production is not there.

Then ovaries are stimulated to produce ova by injecting drug called fertility drug, it contains the hormone responsible for stimulating production of ova.

3. ARTIFICIAL INSEMINATION (AI)

This is the artificial introduction of semen into the female oviduct by syringe during ovulation for the purpose of fertilization. Semen can be rapidly frozen by using liquid nitrogen and then stored in sperm banks without losing its fertile condition.

Advantages of AI

1. Semen can be transported to far distance even where there are no males.
2. Many females can use semen from one male.
3. Semen can be stored and hence used in future.

Importance of AI

1. It makes possible for couples in which a husband is impossible to have a baby by semen donated by another man.
2. The woman can choose the father of her child because she can select semen from different men.

TECHNOLOGICAL ADVANCED IN REPRODUCTION

1. EMBRYO TRANSPLANTS

Nowadays it is possible to remove a developing embryo from an animal before it has implanted into the wall of the uterus. Such an embryo can be kept for a number of days.

When it is placed in the uterus of a different animal it can implant and develop in a normal way.

2. TEST TUBE BABIES

An ovum is sucked from a woman's ovaries. The ovum is placed in a dish containing sperms from her partner and kept warm for a few hours. The ovum is fertilized.

The embryo is then inserted into the woman's uterus where it will implant and develop into a baby.

This method is best for women whose oviducts are blocked thus preventing ova from being fertilized. Such women are therefore unable to have/ bear children.

3. FERTILE DRUGS

These are drugs containing a hormone responsible for stimulating ovaries to produce ova. Some women are sterile because their ovaries fail to develop ova. This happens because the hormone responsible for ova production is not there. Such women are injected with a fertile drug to stimulate ova production.

4. ARTIFICIAL INSEMINATION

Semen is sucked from men and be frozen by using liquid nitrogen and then is stored in sperm banks for several years without losing its fertile condition then it can be introduced into the uterus. If it is introduced at the time of ovulation, fertilization can take place

MULTIPLE PREGNANCIES

If a woman has two babies at once, she has twins this is called multiple pregnancies. Sometimes more than one ovum is released into reproductive tract of female. It is possible for more than one ovum to be fertilized and several viable embryos may enter the uterus. They are implanted and develop.

TWINS

- These are babies born at the same time one after other by the same mother.

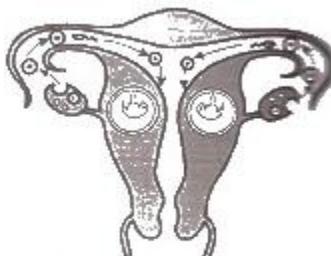
Types of twins

Normally there are two types of twins

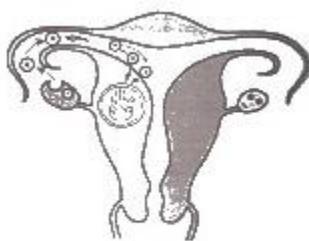
- 1. Fraternal twins (Dizygotic)**
- 2. Identical twins (Monozygotic)**

1. FRATERNAL TWINS

These are twins that occur as a result of simultaneous release of two ova which both become fertilized and develop. They may be of the same or different sexes. The twins are genetically different but have diagram of resemblance.



Fraternal twin



Identical twin

2 .IDENTICAL TWINS

These are twins that occur as a result of one ovum is fertilized and develops into a zygote which then split into two and develops into foetuses. Such twins are genetically identical and so much alike; they are same in every respect.



DISORDERS OF THE REPRODUCTIVE SYSTEM IN FEMALES

1. CANCER

Cancer can affect various parts including cervical and ovarian cancer in women. If diagnosed early, they can be treated with radiotherapy and chemotherapy.

2. OVARIAN CYST

- * It is a benign tumor in the ovary. In younger women, a follicle may develop ~~into~~ a cyst,
- * Cysts can be caused by imbalance of hormones produced by pituitary glands
- * They don't show any symptoms unless they grow so large to cause visible swelling of abdomen.

* They can be removed surgically.

3. FIBROIDS

* Fibroids are tumors that grow on the uterus. They are made up of muscle fibres.

* They are caused when an area of the muscle fails to shrink with the rest of the womb tissue at the onset of menstruation.

* They can be removed by surgery and complete removal of uterus (hysterectomy).

DISORDERS OF THE REPRODUCTIVE SYSTEM IN MALES

1. IMPOTENCE

Impotence is a failure to maintain an erect penis, restricting copulation. The causes are often psychological as depression and anxiety also by diabetes and alcoholism.

* Its treatment depends on the cause.

2. PREMATURE EJACULATION

This is when a man can't delay ejaculation enough to satisfy the woman.

3. PROSTATE PROBLEMS

The prostate glands may become enlarged due to infection. Infections can be treated by antibiotics.

COMPLICATION OF THE REPRODUCTIVE SYSTEM

1. BREECH BIRTH

This is the situation whereby a baby is born feet and bottom first. In this case the babies fail to turn so as to be born bottom first. Breech birth/babies are difficult to deliver. This complication requires Caesarean section.

2. MISCARRIAGE

Is a loss of a developing embryo before the 28th week pregnancy

The causes/ reasons may be

- Development of a deformed embryo.
- Failure of proper implantation of embryo on womb.
- Failure of placenta to develop a sufficient supply.

3. STILL BIRTH

This is giving birth to a dead baby/ foetus

This may be caused by

- Poisonous chemicals.
- Shock.
- Prolonged period of delivery.

4. ECTOPIC PREGNANCY

This is the pregnancy that results when the zygote fails to move to the uterus after fertilization. The embryo is implanted in the fallopian tube. It may be caused by infection in the fallopian tube. Such pregnancy rarely lasts for more than two months as the fallopian tube usually bursts.

5. ABORTION

This is the removal of the foetus before it can survive independently. (Before 28 weeks)

Types of Abortion

1) Spontaneous abortion

2) Induced abortion

1. **Spontaneous abortion.** This is type of abortion which occurs naturally without induction of it.

2. **Induced abortion.** This is the deliberate ending of pregnancy due to medical reasons. It may be recommended by the doctor if tests show a genetic abnormality in the foetus.

Criminal abortion

This is the killing or destroying the unborn baby as a result of irresponsible behaviors. This is to get rid unwanted pregnancies

6. PREMATURE BIRTH

• This is the giving birth after six months are over but before the end of nine months.

• The foetus is never fully developed, so it is put in incubator for growth to continue.

SEXUALITY AND SEXUAL BEHAVIOURS

• **Sexuality** is about "maleness" and "femaleness"

• To be aware of one's sexuality is to be aware of how is attractive to the opposite sex

SEXUAL PRACTICES ACCEPTABLE SEXUAL (BEHAVIOUR) PRACTICE

1. HETEROSEXUALITY (VAGINAL SEX)

This is the sexual practice between members of opposite sex

UNACCEPTABLE SEXUAL BEHAVIOUR DEVIATIONS

1. HOMOSEXUALITY

This is the practice where people are sexually attracted towards membrane of the same sex. They are known as **homosexuals**

- Male is known as **gays**
- Female is known as **lesbians**

2. BISEXUALITY

This is the practice where people are sexually attracted towards members of the same sex as well as members of the opposite sex.

3. ORAL SEX

This is the practice where the mouth (lips and tongue) is used to stimulate genitals of the partner.

4. ANAL SEX

This is the sexual practice where by the erect penis is penetrated into the anus. It is also known as sodomy.

5. MASTURBATION

This is the sexual practice by the stimulation of one's own genitals.

6. RAPE

This is the forceful sexual intercourse without the consent of the partner. It is a crime and is punishable by law.

7. PROSTITUTION

This is an irresponsible behavior practiced by people who allow other people to use their bodies for sexual intercourse for income

Causes of irresponsible sexual behavior

1. Poverty
2. Lack of proper counseling and guidance service
3. Peer pressure and influence
4. Marriage breakdown

Consequences of irresponsible sexual behavior

1. Family and marriage breakdown
2. Transmission of sexually transmitted disease
3. Unwanted/ unplanned pregnancy
4. Psychological trauma
5. Death
6. Reproductive distorts such as sterility.

FAMILY PLANNING AND CONTRACEPTION

It is very important for a couple to space its family properly. It is very important that a couple gets only a number of children they can afford and care for.

Various methods for birth control have been suggested as follows.

A) NATURAL METHODS

1. CALENDAR, RHYTHM METHOD

This method involves abstaining from sexual intercourse a few days before and few days after ovulation, as they are referred to as **fertile period days**.

For 28 average menstrual cycles, ovulation can occur on 14th day, also on 13rd and 15th day. To avoid pregnancy, sexual intercourse is avoided on 11th and 17th from menstruation.

Disadvantage of this method is that menstrual cycles are never regular in women. And even those with regular cycles, the time of ovulation can vary considerably.

2. COITUS INTERRUPTS

This method involves the withdrawal of the penis from the vagina just before ejaculation. Its efficiency is about 70%

Disadvantage of this method is that a small amount of semen often comes from the penis before ejaculation.

- Furthermore, a man must concentrate on removing the penis before ejaculation and this deprives both partners the pleasure of sexual intercourse.

B) CHEMICAL METHOD

This is the use of mixture of artificial hormones resembling oestrogen and progesterone, which inhibit the production of follicle stimulating hormone for maturation of follicle.

It is administered in ways of pills (oral contraceptives)

1. ORAL CONTRACEPTIVES

These pills have the mixture of artificial hormones of oestrogen and progesterone. These hormones stop the development of follicle in the ovary and thus ovulation does not occur.

The disadvantages of pills are that some women experience nausea and weight gain when taking it. Also it may cause

blood clot in circulatory system.

2. INJECTION CONTRACEPTIVE

E.g. Depo-Provera injection given about every three (3) months.

- It prevents ovulation.

Disadvantage

May produce side - effects e.g. irregular menstrual breeding.

3. IMPLANT CONTRACEPTIVE e.g. Norplant-Implant placed under the skin releases artificial oestrogen and progesterone so as to prevent ovulation.

- Disadvantage

Can cause irregular menstrual breeding.

4. SPERMICIDE, jelly or foam inserted into vagina only, effective with mechanical barrier. Spermicide kills sperm

- Disadvantage

- Not effective on its own and may occasionally cause irritation.

C) BARRIER METHOD

1. THE CONDOM

This is a rubber sheath that is worn over the penis to trap semen. The rubber is fitted over the penis just before. Or A sheath of a thin rubber with two springy rings, smaller a ring is insisted into the vagina, larger remain outside. Prevent entry of semen.

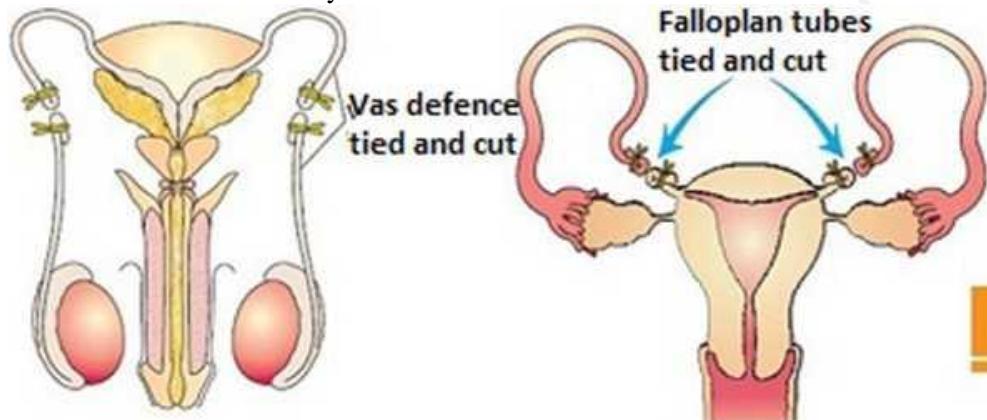
The **disadvantage** is that the condom may burst and leak.

D) STERILIZATION

This is permanent method of birth control. There are two types of sterilization:

1. MALE STERILIZATION (VASECTOMY)

In this type of sterilization the vas deferens (sperm duct) is cut and tied off. As a result the passage of sperm duct from testes is blocked. Vasectomy does not interfere with sexual activities



2. FEMALE STERILIZATION (TUBAL LIGATION)

This involves cutting and sealing or cutting off both fallopian tubes to prevent transport of eggs to the oviduct. Tubal ligation does not affect the ability of a woman to engage in coitus and experience orgasm.

However it is more complex operation which requires hospitalization. Sterilization is almost 100% although in rare occasions the tubes may join.

- Its **disadvantage** is that it is normally irreversible.

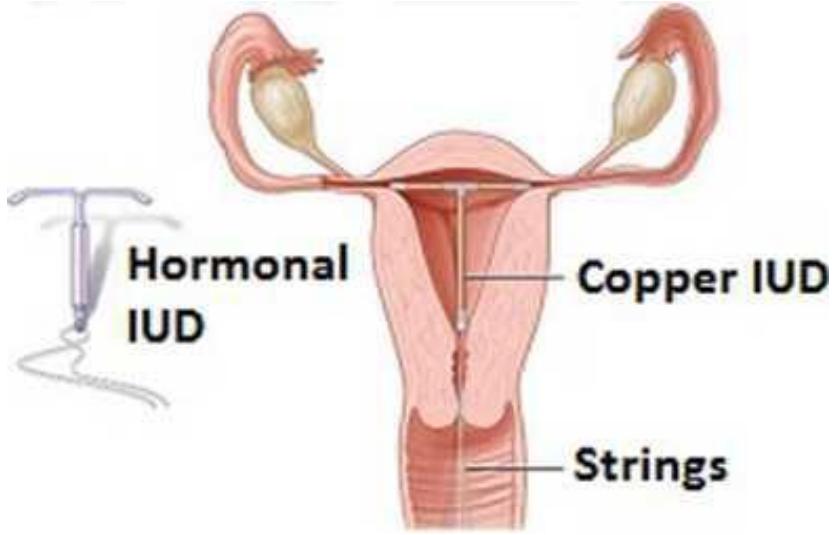
E) INTRA - UTERINE DEVICES

This is devices that are shaped plastic coils and loop. They are inserted in the uterus through the vagina. They prevent normal implantation of a developing embryo.

Disadvantage

1. It could be expelled unnoticed from uterus.

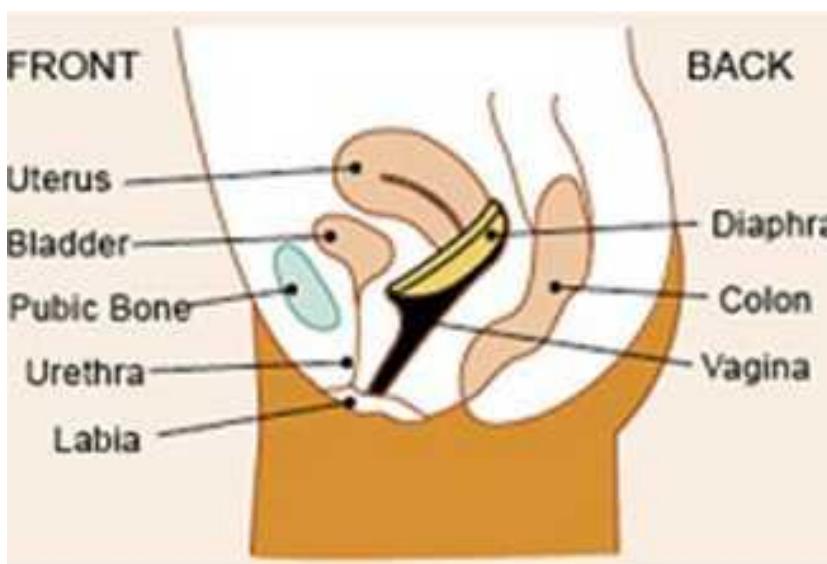
It can irritate or punctuate the uterus, so causing bleeding and cramps.



1. DIAPHRAGM

This is a rubber cap which is inserted into the vagina to cover the opening of cervix. It blocks sperm from entering the uterus, and normally together with spermicidal cream that kills sperm

- **Disadvantages** - it can burst if undersized



During this time a substance called lochia is discharged from the wound and passes out of the vulva. Therefore until the wound heals, regular bathing is essential to keep the vulva clean.

MARTENAL AND CHILD CARE

1. Antenatal care (pre-natal care)

Antenatal or pre natal means before birth. Therefore this is the care given to a pregnant mother before delivery.

Things to be done by a pregnant mother.

- Visit ante-natal clinic for counseling.
- Maintain general body cleanliness all the time.
- Wear loose - fitting dresses and low heeled shoes for comfort.
- Have enough rest.

Eat well balance diet containing protein, carbohydrates, vitamins, roughage and mineral salts especially iron and calcium

Things to be avoided by a Pregnant Mother

- Doing tiring and manual work e.g. lifting heavy loads
- Taking any medicine not prescribed by the doctor.
- Taking drugs such as alcohol cigarettes which could be detrimental to the unborn baby
- Tight clothes and high heeled shoes
- Situation leads to chance of contracting venereal disease such as gonorrhea, syphilis and AIDS which might affect the baby

- Avoid stress situations
- Soon after delivery the mother is called up to carry regular exercises which strengthen the muscle of uterus. It takes 4 to 6 weeks for the wound to heal.

2. Post natal care

Post-natal simply means after birth. This is care given or observed by lactating mother. Lactating mother are breast feeding mother. The mother should attend post-natal health clinic for medical examination and immunization of the newborn baby.

CHILD HEALTH CARE

- Immediately after birth the child starts breast feeding. The baby remains under the care of the mother for food and warmth.
- Proper food for a baby is milk from its mother's breasts. If breast feeding is not possible or not adequate then bottle feeding can be a substitute.
- The baby first receives colostrums from the milk. This liquid is rich in vitamins, proteins and antibodies which will help the baby fight early infections before its own immunity develops.
- The children should take to post natal clinic as instructed by doctor for medical checkup.
- The child should be given food with proteins.
- Child should be clean all the time.
- A child should be immunized against diseases such as polio and measles.

ADVANTAGES OF BREAST FEEDING

1. Breast milk is pure and fresh. Its contents constantly change to exactly meet the needs of the developing baby.
2. Breast milk is quickly and easily digested than bottle milk. This explains why breast - feed babies rarely suffer from constipation.
3. Both colostrums and breast milk contain antibodies which help the baby infections such as diarrhea, bronchitis and nappy rashes.
4. There is evidence to show that chemicals in breast milk aid development of the baby's nervous system.
- Gradually the mother's milk is replaced by solid food, these are called **weaning**

BIRTH CONTROL AND CHILD SPACING

REASONS

1. A human baby needs the most care for the longest time. The recommended length of time a baby should remain under the care of the mother is at least two years. If during this period, the mother becomes pregnant this can lead to neglected and ill health of the child. This is because the mother may be under; unable to continue breast feeding the baby and so deprive it of the best food.
2. The process of birth is very demanding on the health of the mother. That is why after giving birth the mother is allowed to rest. Generally women who have given birth tend to age faster than women without children.
3. Bringing up of a baby is very expensive nowadays particularly where medical care, education, food and clothing are the responsibility of the parents. Where parents have limited resources they cannot afford large families.
4. Birth control provides more time for women to do other work to improve their life and that of the community.

SEXUALLY TRANSMITTED DISEASES

These are infections which are transmitted through sexual contact during sexual intercourse. Sexually transmitted diseases are also referred to as *venereal disease*

Examples are; Syphilis, genital herpes, Chlamydia, Hepatitis B, Gonorrhoea, Trichomoniasis, Candidiasis, AIDS, Chancroid, granuloma

1. Gonorrhoea

This is a bacterial infection. This infection is caused by gonococcus bacteria called *neisseria gonorrhoea*. This bacterium infects the urethra in males and vaginal tract in females.

Symptoms In male

- Pain or difficulty during urination.
- Drop of pus from the penis.
- Sometimes there is painful pain swelling of the testicles.
- Rash or sore over the body.
- He may become sterile if untreated.

In female

- Pain in the lower abdomen
- Menstrual problem
- She may become sterile if untreated.
- Urinary problem
- Yellow discharge from vagina

Mode of transmission

- Through sexually intercourse
- Child effected through eye during birth

Treatment and control

Effectively treated by antibiotics; One injection of 2 gram of kanamycin. One injection of 1g of streptomycin, but only use of streptomycin for gonorrhea that is resistance to penicillin when no other medicine **available**

2. SYPHILIS

This is also another bacterial disease caused by spiral shaped bacteria called *treponema palladium*. Syphilis is much more serious than gonorrhea.

SYMPTOMS

- In male a sore called chancre appear on the gland of the penis. The chancre may look like a pimple, a blister or an open sore.
- Week or month later untreated there may be sore swollen joints.

TRANSMISSION

- Many a time are contracted during sexually intercourse with an infected person.
- Pass from mother infected to a child through placenta. Child affected through this way always become mental retarded and die early.

PREVENTION

Avoid sexually behavior

TREATMENT

- Antibiotics such as benzathine penicillin. If one allergic to penicillin , take tetracycline 500mg 4 times a day for 30 days.

3. GENITAL HERPES.

This is painful skin sores caused by a virus called Herpes simplex

- One or more painful blisters like a drop of water on the skin appear on the sex organ (penis or vagina), anus, buttocks and thigh.
- Blisters bust and form open sore.
- These open sore dry up and become scabs.

TRANSMISSION

- Spread from person to person during sex
- Also appear on mouth as a result of oral sex.

TREATMENT

- Currently there is no medicine for herpes. Keep the area clean. Never have sex while the blisters or sore are present. Wash hand more often ad try not to touch the sores. The infection can spread to the eye if a person rubs them after touching the sores.

4. CHANCRON.

This is bacterial disease.

SYMPTOMS

- Soft painful sore on the genital and anus
- Enlarged lymph nodes may develop in the groin.

TREATMENT

- Give co-tremoxazole or erythromycin for 7 days. Take erythromycin after meal to avoid stomach upset

SECONDARY EFFECT OF SEXUALLY TRANSMITTED DISEASE

1. Infertility sterility
2. Pelvic inflammatory disease
3. Ectopic pregnancy
4. Sepsis which can lead to death
5. Cervical cancer
6. Premature birth, abortion or stillbirths
7. Blindness of foetus
5. AIDS stand for; Acquire Immune Deficiency Syndrome

CAUSES

AIDS is viral infection caused by a strain of a virus called **HIV** means *Human Immunodeficiency Virus*. HIV mainly found in body fluids such as blood, semen and vaginal secretion. Also traces of HIV found on saliva, tear and sweat

MODE OF TRANSMISSION

AIDS are transmitted through various ways;

- By having sexually intercourse with an infected person.

- By transfusion of infected blood.
- By birth from an infected mother to her baby at birth.
- By use of unsterilized surgical and skin piercing tools e.g. needles

SYMPTOMS

- Chronic diarrhea for more than a month.
- Eventually loss of weight.
- Constant, persistent severe cough for longer than a month.
- Skin infection.
- Inflammation of the lymph nodes.

EFFECT OF HIV ON HUMAN BODY IMMUNITY

The immune systems defend the body against infection disease. Normally a white blood cell does this

- Phagocytosis (engulf and digest antigen)

Antibodies

HIV weakens the body immune system by interring into white blood cell (lymphocytes) and a binds itself to chromosomes into the genetic material. Then now multiplies very fast using genetic materials of WBC. The daughter virus invades WBC destroy and kill them. As more WBC is killed the body becomes less and less fight against disease. Patient with aids are prone to opportunistic infection caused by fungi, bacteria and protozoa.

In nutshell people with AIDS die with disease their body cannot resist. These diseases are referred to as *opportunistic infection*.

Example;

1. Tuberculosis
2. Severe diarrhea
3. Skin cancer
4. Pneumonia

DISEASE ASSOCIATED WITH AIDS

- Brain infection
- Cancerous cases
- Chest infection
- Gut infection

TREATMENT

At the moment there is no cure AIDS. However several discover of drugs to treat AIDS have been reported but none has been confirmed as being 100% effective.

PREVENTION AND CONTROL

- The most effective way to prevent spread of AIDS is through health and sexually education. The youth must be enlightened on the risk of acquiring virus through careless lifestyles.
- Through voluntary testing counseling for HIV/AIDS positive people.
- Avoid promiscuous sexually partner, commercial sex worker, prostitute and man visit prostitutes
- Avoid transfusion of blood unless screened for HIV virus
- Avoid using unsterilized surgical and skin piercing instrument.

NB:

High risk group include homosexually and intravenous drug users. Currently scientists in global village are working round the clock to develop a vaccine against HIV virus

FORM FOUR

7. GROWTH AND DEVELOPMENT

GROWTH

Refers to the irreversible (permanent) increase in size and mass of an organism

- Reproduction results in the formation of new organisms. Every newly produced organism is usually small in size, truth time the organism increase in size and weight.
- In multicellular organisms the increase in size and weight is a result of the increase in the number and size of body cells. As the number of cells increases various organs are formed.
- These changes can take place only if energy and raw materials are available. The energy and raw materials are derived from food. Because raw materials are used, growth brings about an increase in the mass of an organism.
- In some multicellular organisms as new cells are formed some old cells usually die off. In such cases there is therefore a continuous addition and less of cells. But for growth to occur the rate of cell increase must exceed the rate of cell less.
- When the rate of cell increase is higher than the rate of cell less growth is referred to as **positive growth**.
- When the rate of cell increase is lower than the rate at which cells are lost from the body, the organism decrease in size and weight. This is also growth and it is referred to as

NEGATIVE GROWTH

It may be caused by an illness or starvation

- It should be noted however that negative growth cannot go on indefinitely. An organism cannot resume the size, freight and body shape of a newly born body. For this reason growth is said to be irreversible

IMPORTANCE OF GROWTH IN LIVING THINGS

- i. Life usually starts as a single cell. E.g. a human zygote (fertilized egg) gives rise to billions of different cells etc.
- ii. During growth and development the cells divide and enlarge giving rise to a more complex and elaborate multicellular organism.
- iii. Growth give rise to various cells specialized in various specific functions

Examples: - Red blood cells carry oxygen

- White blood cells fight pathogens
 - Palisade cells carry out Photosynthesis
 - Guard cells close and open stomata etc.
- iv. This specialization brings about effectiveness and organisms are therefore able to adapt different environments.
 - iv. During growth sexual organism in mammals develop with fully developed sex organs, an organism is capable of reproduction and hence perpetuation of the species.

DEVELOPMENT

Refers to the changes in the complexity of an organism, It involves differentiation and formation of various tissues that perform specialized functions.

NOTE: Growth is brought about by:-

- i. Cell division
- ii. Cell enlargement
- iii. Cell differentiation

TYPES OF GROWTH

i. Diffuse Growth

This is the type of growth whereby growth occurs all over the body of an organism e.g. in animals

ii. Localized Growth

This is the type of growth whereby growth occurs in certain regions, e.g. in plants growth takes place at the tips of roots and shoots. These tips are called meristems,

iii. Intermittent Growth

This is a type of growth in arthropods in which growth takes place in a series of stages called instars. E.g. in insects an egg hatches into a larva which then develops into a pupa and finally into an adult (image)

iv. Isometric Growth

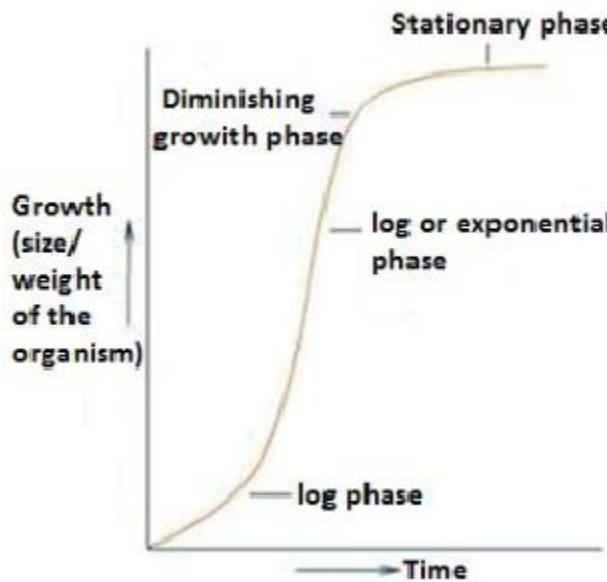
This is the type of growth whereby all body organs grow at the same rate e.g. in fish, locust

THE GROWTH CURVE

Growth can be measured using a curve. A growth curve is a graph obtained when data collected during stages of growth is plotted against the time.

- A growth curve shows growth pattern of the organism. In most organisms growth pattern is almost the same where by first shows slow then speeds up and finally slows down

- This pattern gives an S-shaped curve known as **sigmoid curve**



Lag phase

Lag phase is a period when the rate of growth is very slow, during the stage the number of cell dividing through mitosis are few

Log phase/ exponential phase

This phase involves very rapid growth where by the number of cell division is higher than the dead cells.

Linear growth/ declination phase.

This phase involves the decline in the rate of growth as maturity is approached the rate of cell division decrease.

Stationary phase/ plateau phase

This phase marks the period of no further changes in the size of the organism the organism has attained maturity, new cells are formed only to replace those worn out or dead cells

MEASUREMENT OF GROWTH

Growth can be estimated by measuring any suitable parameter of an organism at suitable intervals of time. Some of the common parameter measured includes Length, Width, Area, Fresh mass and Mass of an organism

a. Length

- This method is reliable if growth occurs mainly in one direction
- Increase in length denotes growth. In plants for example leaves, stem and internodes on stems can be measured.

Advantages

- i. The change in length is easy to work out.
- ii. The same organism is used throughout the investigation
- iii. The organism are not harmed

Disadvantages

- i. It ignores growth in other directions such as width and girth, which can be significant.

b. Total fresh weight (mass)

- This method involves weighing the whole organism at regular intervals
- This is an easy method used to estimate growth in large animals including man

Advantages

- Weighing is easy
- It does not involve injury to the organism

Disadvantages

- Fresh weight measurement method is influenced changes in water content of the body and therefore does not always give accurate results

c. Dry mass (Weight)

- Is used to measure growth of small organisms such as germinating wheat.
- It involves killing the organism and heating it at 110°C to a constant weight to remove water.
- This method is more accurate since it indicates the increase in weight due to synthesis of different materials irrespective of water content.

Disadvantages

- The method involves killing the organisms and thus has limited usage
- A large number of organisms are used, hence the method is wasteful.

d. Width

- The width of parts of an organism can be measured over a period of time.

Advantages

- Width is easily measured
- The same organism is used to monitor growth.

Disadvantages

- Increase in width interpreted as the only aspect of growth occurring.

INTERNAL FACTORS THAT REGULATES GROWTH IN PLANTS

1) Heredity factors.

- These are internal factors that affect the growth of plants. They affect the physical appearance and the size of a plant
- Hereditary units called genes are found in chromosomes inside the nucleus of all plant cells. These units control the various characteristics of plants such as flower color, number of floral parts, growth pattern and so on.
- Genes are passed from parents to offspring. For example tall plants produce tall offspring and vice-versa.

2) Growth hormones.

- Hormones are chemical substances that influence physiological processes. Growth hormones affect growth which is brought about by cell division and enlargement.
- Plant hormones called auxins promotes growth in plants
- Examples* of plant hormones are: Indole Acetic Acid (IAA), Gibberellins, Cytokinins, Ethylene (ethene), Abscisic acid (ABA) and Indolebutyric acid.

3) Apical dominance

- Is the inhibition of the growth of lateral buds by the presence of the growing apical bud
- Apical bud is found at the top of the plant which is responsible for increase in plants height (Apical growth).
- Lateral buds are found on the sides of the plant which are responsible for the formation of branches.
- The apical bud produces auxins that diffuse to the lower parts of the plant. This auxin retards the development of lateral buds. The lateral branches of such a plant are short

EXTERNAL FACTORS AFFECTING GROWTH IN PLANTS

These are also called environmental factors, they include the following:

1) Plant nutrition

- There are several plant nutrients which are needed for better growth of plants.
- The basic nutrients required for plant growth are divided into two main categories namely micro-nutrients and macro-nutrients.

i. Macro-nutrients

Are nutrients that are required by plants in larger quantities. There are six elements in the soil that are termed as macro-nutrients. These are.

- Nitrogen
- Potassium
- Magnesium
- Calcium
- Phosphorous, and
- Sulphur

ii. Micro-nutrients

Are nutrients that are required by plants in smaller quantities. There are eight elements in the soil that are termed as micro-nutrients.

These are.

- Iron
- Zinc
- Molybdenum
- Manganese
- Boron
- Copper
- Cobalt, and
- Chlorine
- Nitrate for instance is an important component for synthesis of proteins. Proteins are needed for plant growth. Absence

of nitrate cause plant to look shorter than their real age (stunting).

2) Water

- Water is one of the most essential factors required in growth of plants. It plays a crucial role for efficient photosynthesis, respiration, transportation and transpiration of minerals and other nutrient through the plant
- Water is also responsible for proper functioning of the stomata opening leaves.

3) Light

- Light is necessary for photosynthesis to take place. Plants make their own food through the process of photosynthesis. Food is necessary for plant growth.
- Absence of light makes plant leaves yellow. It also makes the stems thin, long and the spaces between internodes longer than usual. This condition is referred to as etiolating

4) Temperature

- Optimum temperature, both of the surrounding atmosphere and soil is one of the important factor for many of the plant processes, like photosynthesis, metabolism, germination and flowering
- Temperature affects the rate of metabolism hence growth. Warm temperature increase the rate of metabolism, thus plants grow better in warm climate.
- Extremely high temperature kill cells and enzymes, thus metabolism cannot take place.
- Very low temperature slows down metabolism.

5) Amount of carbon dioxide and oxygen

- The manufacturing of sugar by plants requires the presence of carbon dioxide. It is thus one of the vital elements for plant growths.
- Oxygen is essential for plant respiration and utilization of the by-product of photosynthesis

6) Soil

- Soil with proper humidity and the right balance of all the minerals and nutrients is one of the essential factors in plant growth.

INTERNAL FACTORS AFFECTING GROWTH IN ANIMALS

The following are the internal factors that affect growth in animals.

i. Genetic make up

ii. Hormones

■ GENETIC MAKE UP

- Genetic makeup of parents for instance, determines the height of their children.
- Genes you inherited from your mother and father contribute to your growth. Because each child receives a different combination of genes, growth patterns of children within the same family may differ considerably.

■ HORMONES

- Secretion of hormones also affect growth in animals
- Over secretion of growth hormones during childhood results into Gigantism (gigantism).
- Under secretion of thyroxin during development slows physical and mental development in human beings. This leads to a condition called **Cretinism**.

Cretinism is a condition in which a child becomes stunted and mentally retarded due to under-secretion of thyroxin.

EXTERNAL FACTORS AFFECTING GROWTH IN ANIMALS

i) Temperature

- Since optimum temperature increases the rate of metabolism and very low temperature slow down metabolism, therefore animals grow faster in optimum temperature (warm climate). For example, a tadpole will grow faster in a warm pond than in a cold pond.

ii) Oxygen

- The amount of oxygen has no much effect on the growth of terrestrial animals as it is readily available in the atmosphere.
- However it can have an impact on the growth of aquatic animals if its amount in water varies.

iii) Nutrition

- Nutrition is very important for animal growth.
- Nutrients, especially proteins are very vital for growth. Inadequate amount of protein leads to stunting.

iv) Diseases

- Communicable diseases or infections, especially in children interrupt growth. E.g. a disease like diarrhea inhibits absorption of nutrients in the body that is necessary for growth.

MITOSIS AND GROWTH

Depending on the number of chromosomes found in the nucleus, all cells in the body can be classified into two categories:-

- Somatic (body) cells

- Reproductive cells (gametes)
 - (i) **Somatic cells** contain chromosomes that occur in pairs. The number of chromosomes in a body cell is referred to as diploid number, denoted as $(2n)$. A human being has 46 chromosomes.
 - (ii) **Reproductive cells** are those which give rise to the formation of gametes (sex cells) and are found in reproductive organs (testes for males and ovaries for females). Each gamete has half the number of chromosomes as those of the parent cell. This ensures that the number of chromosomes in every succeeding generation remains the same
 - Animals or sexually producing plants start as just a single cell which is formed after fusion of male and female gametes. That fused single cell is called **zygote**
 - This single cell then grows and divides to form two cells which are identical in everything. Each of the two newly formed cells will divide to form two cells. This process goes on until a whole organism is formed.
 - The newly formed organism is still very young and the cell keeps on dividing until the organism becomes fully.

Meaning of mitosis

Mitosis is the process or an event in which the cells divide during growth to form new cells which are similar to the parent cells.

- Therefore mitosis is very important for growth because it leads to increase in the number of cells within an organism.

NOTE: Meiosis occurs in reproductive cells during gamete formation while mitosis occurs in somatic cells during the growth of an organism

- During mitosis, two daughter cells (new cells) are formed. Each daughter cell has the same number of chromosomes that is 46 and therefore diploid just like the parent cells

NOTE: - Chromosomes are thread like structure found within the nucleus of cells of both plants and animals

- The chromosomes become visible when a cell is dividing
- Chromosomes are composed of chromatin threads that are spread out within the nucleus of the cell.
- It carries the genes that determine an individual's characteristics.

PHASES (STAGES) OF MITOSIS

• It consists of 5 phases namely:

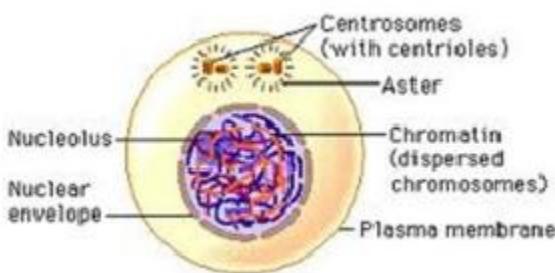
1. Interphase
2. Prophase
3. Metaphase
4. Anaphase
5. Telophase

1. INTERPHASE

- This is the phase where the cell is engaged in many cellular activities to prepare for the cell division

- The entire process takes about 1 hour. It is incorrectly referred to as resting phase.

- The following are observed

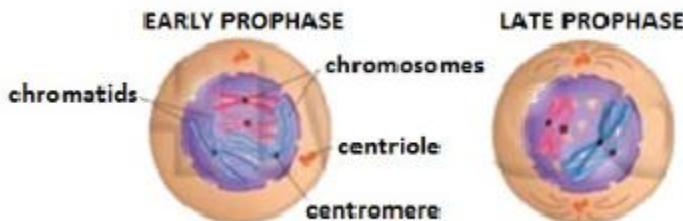


2. PROPHASE

"In this stage centrioles separate and migrate to opposite cell's poles " Chromosomes become visible, thicken and shorten

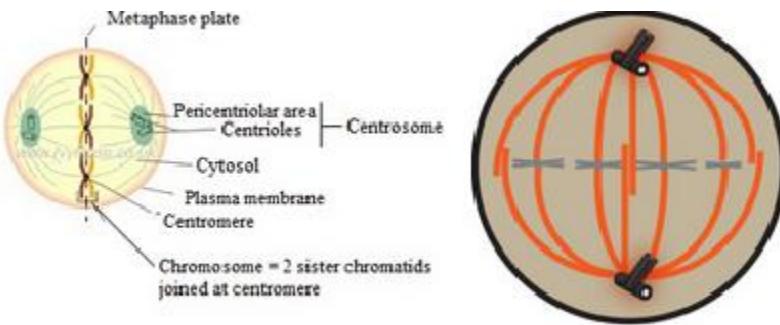
" Each chromosome divides into two along its length except at the centromere. Chromosomes now called **chromatids**

"The nucleus membrane and nucleolus gradually disappears "A network of fibres starts to form



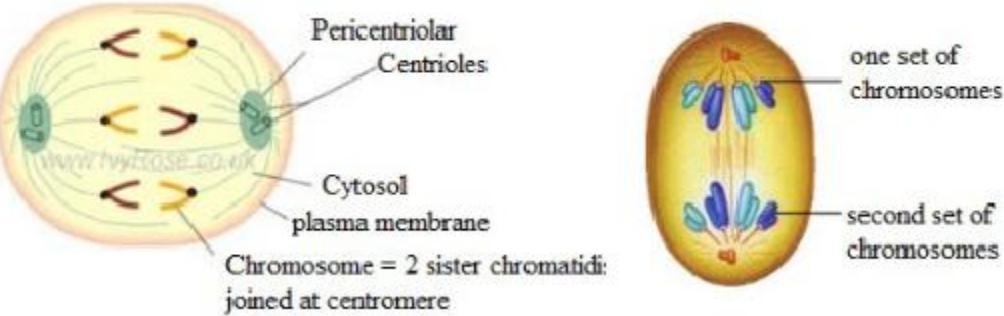
3. METAPHASE

- The chromatids move to the center of cell.
- The chromatids become arranged and attached to spindle fibres by centromeres
- The chromatids draw apart at the centromere region



4. ANAPHASE

- In this stage, after the sister chromatids divide at centromere, they migrate to the opposite poles of the spindle, the centromere leading it



- Chromatids reach their destination towards the poles of the spindle. Now chromatids are called **chromosome**

5. TELOPHASE

- In early telophase, the spindle fibres disappear.
- A nuclear membrane is formed enclosing the newly formed chromosomes.
- At this stage, in animal cells, the cell starts to constrict across the middle into two new cells
- In plant cells a cell wall is formed across the middle of the cell



CYTOKINESIS

This is the division of the cytoplasm. It is through the formation of a new cell wall in plant cell or the constriction of the animal cell

SIGNIFICANCE OF MITOSIS

- It is the basis of asexual reproduction
- It maintains the diploid state of the organism
- It is the basis of growth i.e. it brings about growth in terms of increase in number of cells,
- It helps to recover of dead worn out cell

DIFFERENCE BETWEEN MEIOSIS AND MITOSIS

MEIOSIS	MITOSIS
Occurs in reproductive cells to form gametes	Occurs in body cells during growth and tissue repair (somatic cell)
Gametes fuse to form a zygote	New cells do not fuse to form a zygote
Variation occurs through chromosome recombination	No variation, all are like parents.
Takes place in two phases to complete	Take place in one phase to complete a successful cell division
New formed daughter cells are in haploid state	Newly formed daughter cells are in diploid state
Results in four daughter cells (haploid)	Results in two diploid daughter cells

GROWTH AND DEVELOPMENT IN HUMAN BEING

Human beings like other animals show growth and development. Human beings show diffuse growth where growth occurs all over the body.

- Development is an increase in the complexity of an organism. It includes growth, differentiation, wound healing, tissue regeneration, ageing and death
 - Growth and development in humans can be:-
- (i) Pre-natal
 (ii) Post-natal.
- (i) Pre-natal growth and development takes place in the womb before a body is born.
 (ii) Post-natal growth and development occurs after the body is born

HUMAN POST-NATAL GROWTH AND DEVELOPMENT

The human beings post-natal growth and development comprises of five main stages. These stages are:

- Childhood
- Adolescence
- Adulthood
- Old age (senescence)
- Death

1) CHILDHOOD (Infancy stage).

- Is the period from the time the body is born up to sexual maturity (about 11 years)
- Childhood stage has several stages. These stages are:
 - * Neonatal
 - * Older baby
 - * Toddler
 - * Early childhood
 - * Late childhood
 - * Pre-adolescence

NEONATAL STAGE

Is from birth up to 5 months. New babies are also called neonates.

Changes

- The following are the physical, physiological, behavioral and psychological changes which occur at this stage of growth and development,
 - i) The baby can lie on its back and tries to roll over. It can do a number of things such as crying, moving their arms, legs, heads, swallowing and sucking
 - ii) Babies at this stage suck anything and put in their mouth
 - iii) Neonates can see but only a short distance of about 20cm. They can also hear, smell and feel. They spend most of their time sleeping
 - iv) They cry to show hunger, thirst, pain, tiredness, fear and discomfort such as wet nappies, cold and lot of
 - v) Babies at this stage express their feelings mainly through crying, heat and sickness
 - v) The immune system is immature and the baby depends on the immunity from his or her mother through breast-feeding.

Advantages of breast-feeding

The milk produced by mother in the first days after delivery is called **colostrums**. The colostrum is usually sticky and yellow and contains more proteins and antibodies than white milk produced later.

- Mother milk contains nearly all the nutrients needed for growth and development of the body.

The following are the advantages of breast feeding.

- (i) Breast-feeding creates a special bond between the mother and the baby. i.e. it has psychological benefits.
- (ii) Breast milk is at the right temperature for the baby
- (iii) Breast milk is well balanced, i.e. it contains nearly all nutrients needed for normal functioning.
- (iv) Breast feeding (milk) does not require preparation
- (v) Breast milk is safe and free from contamination.
- (vi) Colostrum contains a lot of antibodies needed to protect the baby against infection

Reasons for substitution of Mothers milk with others foods like rows milk.

- Death of Mother.
- Inability of the Mother to produce enough milk
- In case of multiple births e.g. twins, triplets etc.
- In case the Mother has easily transmitted diseases like tuberculosis

OLDER BABY STAGE

This is the stage from 6 to 12 months

Changes

- (i) At six months, a baby can completely control his/ her head and sit without support.
- (ii) At 7 months the baby learn to crawl
- (iii) He or She can hold and drop objects and stand while holding things like tables or chairs.
- (iv) Teething occurs at this period.
- (v) From 9 to 12 months the baby start to walk
- (vi) The baby responds to his or her own name and other words that are familiar to him.

TODDLER STAGE

This is the age between 1 to 3 years

Changes

- Brain develops by 90%
- The child is able to control maturation and defecation as urinary and anal sphincter control become possible.
- The baby can see everything that an adult can see
- All the 20 milk teeth appear by the age of 2.5 to 3 years.
- Immune system becomes mature
- Hearing has developed well
- At 12 to 14 months, the child uses gestures to express his or her feelings.

For example raising arms when he she wants to be picked up.

- At 15 months, the child copies what adults do.

For example, a child may imitate "cooking" by taking a spoon and "stirring" it in a bowl.

- At 15 to 18 months a child feeds him or herself.
- At 19 to 24 months a child likes to play with others (socialization), likes to dress and undress himself or herself. He mimics social behaviors such as holding and feeding a toy
- At 25 to 36 months, emotional children may feel jealousy, for example toward a new born baby. They also show fear for particular things like fear of some insects, scary noise

EARLY CHILDHOOD

This is the age from 4 to 6 years. At this stage children go to kindergarten

Changes

- (i) A child has good appetite and therefore grows rapidly. Good appetite is important as children at their stage are very active and play a lot
- (ii) Motor coordination has developed well and therefore the child can walk, jump and skip.
- (iii) The child becomes curious and imaginative
- (iv) He or she understands right and wrong.
- (v) He or she becomes curious.

LATE CHILDHOOD

This is the age from 7 to 9 years. At this stage children are in primary school.

Changes

- (i) Children become very active
- (ii) The child can assume simple responsibilities like looking after the house when parents are not at home.
- (iii) The child is very social and likes to socialize and belongs to groups.
- (iv) He or she can help with household chores like washing dishes, setting the table, fetching water.
- (v) The child likes to associate with peers of similar interest
- (vi) This is the time children have friends and best friends. However they prefer friends of the same sex.
- (vii) Children at this stage can listen to peers opinion but still value opinions of their parents

PRE ADOLESCENCE

This is the age from 10 and 11 years

Changes

- (i) Growth starts to increase
- (ii) Appetite increase
- (iii) Secondary sexual characteristics start to show. For example growth of breast and growth of public hair and hair under armpits.
- (iv) Children still prefer friends of the same sex.
- (v) Children are very social and tend to value peers opinion.

Common problems in Infancy (Childhood)

i) Constipation

This is the difficulty in passing out feces. This can be solved by giving fruit juice, vegetables and by increasing the baby's intake of water

ii) Excessive crying

It indicates illness, pain, hunger, thirst, need for love and attention or the baby may be uncomfortable due to excessive heat or wetness.

iii) Heat rash

Heat rash results to a roughing itching skin, which may be painful caused by excessive heat. Putting the baby in a cooler place and loosening the tight clothes may relieve this

iv) Nappy rash

The nappies should be changed frequently to avoid the nappy rash. The baby's skin should be kept clean, dry and well oiled. Use of powder on the skin is recommended

v) Diarrhea

Diarrhea may be a symptom of a disease or may be caused by overfeeding, infection or reaction to particular kind of food.

- The baby should be given plenty of liquid to avoid dehydration.
- In case of excessive diarrhea, the baby should be taken to the nearest health center for treatment.

vi) Colic

- A baby is said to have colic if it seems to be uncomfortable from pain in its abdomen. This causes the baby to cry out loudly.
- The pain is caused by air swallowed at feeding time
- The baby should be held up with its abdomen leaning on the mothers shoulder to force the air out gently a condition known as winding up.

Services required meeting the needs of children

The services required to meet the needs of a child can be categorized into two:-

(a) Essential (basic) services

(b) Supportive services

(a) Essential (basic) services are necessary for baby's survival.

Basic services include:-

- Healthy.
- Warms.
- Shelter.
- Clothing.
- Protection against illness and injury.
- Excessive and rest.

(b) Supportive services are services that will help a child to grow well socially, emotionally and mentally. Supportive

services includes:-

- Love
- Care and comfort
- Security
- Training of habits and skills
- Older children need to be disciplined
- Trained to independent and useful to others and be responsible.

2. ADOLESCENCE

- Is a period in human developed between childhood and adulthood.
- It generally occurs between the ages of 12 and 18 years.
- At adolescence boys and girls attain sexual maturity (puberty).

Puberty is a term used to refer to the period when secondary sexual characteristics develop.

- Girls attain puberty at the ages of 11- 13, boys attain puberty at the age of 12-14.
- During adolescence, an individual experiences a lot of changes which includes emotional, social and physical changes. These changes occur in both boys and girls to prepare their bodies for parenthood
- At puberty the boys secrete the male sex hormone known as androgen that brings about the development of male secondary sexual characteristics
- The girls secrete the female hormone called **estrogen** that brings about development of female secondary sexual characteristics.

Changes in Boys only at Puberty

- (i) Shoulders and chest become broader (wider).
- (ii) Muscles get stronger.
- (iii) Beard grows.
- (iv) The voice breaks (becomes deep).
- (v) Enlargement of sex organs and they occasionally emit some fluid from the penis at night (wet dream).
- (vi) Sperm production starts.

Changes in Girls only at Puberty

- (i) Enlargement of breasts.
- (ii) Widening of pelvic girdle (leads to enlargement of hips).
- (iii) Ovulation starts
- (iv) Menstruation begins
- (v) Enlargement of uterus and vulva.

Changes in both Boys and Girls at Puberty

- (i) Hairs grow in public region and under the armpits.
- (ii) Sex hormones are secreted
- (iii) The skin sweats more often.
- (iv) Attraction by members of the opposite sex.
- (v) Pimples may appear on the face but later disappear.
- (vi) Body increases in size due to rapid growth.

Personal Hygiene during Adolescence

Puberty is a period of rapid growth with so many changes occurring in the body. As a result the body produces a lot of waste products such as sweat, wet dream in boys and menses in girls

- Adolescence should therefore maintain high level of cleanliness to avoid stinking and infections.
- It is important that they should bathe daily and change into clean clothes.
- When bathing, one must pay extra attention to genitals, armpits and areas between the toes.
- If the armpits sweat a lot shave the public hair to reduce warmth and sweating.
- After bathing apply deodorant to kill germs and prevent foul smell.
- For sweaty feet, clean between the toes, dry well and if it can be afforded, dust the areas with talcum powder. The powder absorbs the sweat, prevents bad smell and athletes foot.
- In case acne (pimples) strikes, it should not worry anybody
- Boys need to keep their beards trimmed or well styled
- Girls need to bathe more than once during the menstruation flow to avoid foul smell of blood.
- Girls need to wear sanitary towels (pad) to avoid staining their clothes with blood. The sanitary towels (pads) must be changed regularly to avoid development of too smell
- If commercial sanitary towels cannot afforded, homemade pads can be prepared by folding clean cotton cloth to make pads

Services required meeting the needs of Adolescence

Adolescence requires:

- Healthy food for their growing bodies
- Peaceful home
- Security emotional support.
- Cancelling
- Physical exercise
- Social skills

Avoid breaking the pimples, just keep the face clean, avoid applying oily creams, and avoid diet that has a lot of oil.

3. ADULTHOOD

Adulthood starts at 20-55 years. Adults are physiologically. Psychological and Physical mature to make families.

Changes

- (i) Growth has stopped, only maintenance of body parts, for example repair of worn out cells taken place. A person may gain weight due growth and development.
- (ii) At this stage people are in their best physical conditions that is very strong, energetic, have good memory capacity, sharp senses and stamina.
- (iii) People at this stage are very ambitious and want to succeed. They work hard to meet their goals, for example to finish studies, get a job, and start a family.
- (iv) They have the desire to be socially independent
- (v) In the late forties or early fifties, the rate of deterioration becomes significant.
- (vi) The ability to do tasks that require a lot of energy and high speed decrease, sharpness of vision decreases and memory loss may occur.
- (vii) Hair starts to turn grey, skin starts to lose elasticity.
- (viii) Women reach menopause and their desire to have sex is reduced.

4. OLD AGE

Old age starts from 56 years and over. This is the age of senescence simply after menopause in women. Men tend to diminish their sexual activity but there are not actually sterile to deposit of tact's but not due to Changes

- (i) The ability to focus on objects, smell and hear decreases.
 - (ii) Hair turns grey as a result of reduced production of hair pigment. Some men may develop a bald head.
 - (iii) Loss of memory due to death of brain cells
 - (iv) Kidney functioning cease down and the frequency of urination increases
 - (v) Decreases blood flow to the brain and death of nerve cells.
 - (vi) Elasticity of the skin decreases. The skin gets looser and wrinkles develop.
 - (vii) Bones may become weak especially for those who have been taking food with less calcium in young age.
 - (viii) By the age of 70. about two thirds of taste buds in the mouth die, making a person feel like food is tasteless.
- The above features do not apply to all aged people. Healthy life style during young age may delay occurrence of the above features and make a person lead a normal life even in older age.
- A healthy life style is achieved by eating healthy food, avoiding smoking, alcoholism, overeating, drug abuse and inactivity.

5. DEATH

This is the end of life. The cells and all body processes stop to function.

FACTORS AFFECTING THE RATE OF DETERIORATION OF THE HUMAN BODY

Some people may live a happy health life up to their old age and until they die. Others get very old while they are still very young

- Factors affecting the rate of deterioration of the human body have been categorized into:-

- a. Psychological factors
- b. Environmental factors
- c. Genetically factors

a) PSYCHOLOGICAL FACTORS

(i) Smoking

Smoking reduces life span by 12 years. Smokers suffer more illnesses such as cancer than non-smokers. Smokers leads to permanent building, skin wrinkling.

(ii) Alcoholism

The ability to metabolize alcohol decrease with age. Prolonged use of alcohol leads to damage of the central nervous system and brain and increase the risk of heart stroke and breast cancer for women.

(iii) Drug abuse

Drug abuse weakness the immune system and causes premature ageing. It thus reduces life span.

(iv) Stress

Stress may cause heart problems and high blood pressure. It also causes impairment of the immune system, thus making a person sick often.

- Other problems that may result from stress are failure to sleep (insomnia), fatigue, headache and migraine.

(v) Inactivity

Sedentary work and inactivity such as spending a long time watching TV or doing office work that involves sitting most of the time results in being overweight and its associated risks.

- People who are inactive have more chances of developing health problem such as obesity and high blood pressure than those who are active.

b) ENVIRONMENTAL FACTORS.

(i) Poor diet

Poor diet includes both underfeeding and over-feeding. Under-feeding cause malnutrition which reduces life span over-feeding leads to obesity and diabetes. Obesity cause premature age.

(ii) Diseases and infections

Pathogens produce toxins that accelerate deterioration. They also deprive our bodies the necessary nutrients needed for good health.

(iii) Chemical and radiations

Some chemicals such as those found in cosmetics, medicines, insecticides, pesticides, foodstuffs and sprays may have adverse effects in the human body.

- These chemicals speed up deterioration or shorten life span.
- Some radiations for example x-rays may affect our lives by killing body cells or causing deadly diseases like cancer.

C) GENETIC FACTORS

A small number of individual carry a defective gene that causes Werner syndrome.

- Werner's syndrome is a very rare disease that causes premature ageing. It causes a 20 or 30 years old person may look several decades old.

SOCIO-CULTURAL FACTORS THAT AFFECT GROWTH AND DEVELOPMENT.

(i) Trading beliefs

They affect the kind of food one should eat. *For example* in some tribes pregnant women are not supposed to eat eggs, which contain proteins needed for growth and development of the unborn baby

(ii) Poverty

People having low income may fail to provide the basic needs for proper growth. Poor or insufficient diet and lack of medical care result into poor growth and even death especially at infancy

(iii) Religion

Some religious sects bar certain groups of people e.g. pregnant women from eating certain food. For example Muslims do not eat pork on religious ground.

- Some religious sects do not allow their followed to go for treatment in hospital resulting to poor health and even death.

(iv) Ignorance

Lack of knowledge about proper diet, proper medical care and education contribute to poor health. Most people do not know how to care for themselves, and do not know what is good and bad for them

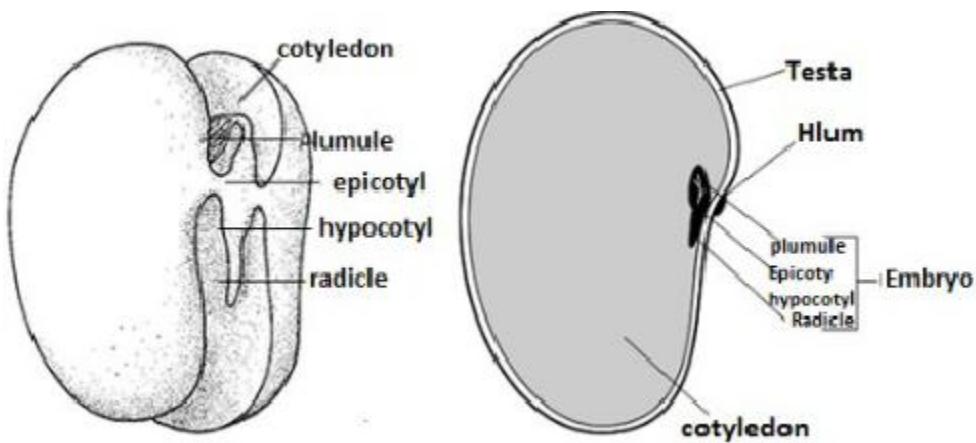
GROWTH AND DEVELOPMENT IN FLOWERING PLANTS

Developments are changes that occur in an organism from the time of fertilization to the formation of an adult body

- In flowering plants, development starts with the growth of zygote into an **embryo**
- In most flowering plants growth starts when the seed begin to germinate
- **Germination** is the process by which the seed develops into seedling (young plants).

A summary of changes which occur during seed germinating

- o The seed absorbs water through micropyle and enlarge.
- o Later on the testa bursts and the radicle emerges. Radicle continues to elongate and gives rise to many roots,
- o Then the plumule emerges, at this stage the young plant is called *a seedling*.



CONDITION NECESSARY FOR GERMINATION

1. WATER

- 1) It is a suitable medium of enzymes to break down the stored food into suitable form,
- 2) It hydrolyze food substance into glucose
- 3) It is used to transport food materials between the cell to where they are used as source of energy,
- 4) It softens the seed coat testa so that it ruptures (bursts easily)

2 OXYGEN/AIR:

In the dormant condition the seeds respiratory rate is very low and so oxygen is required in very small quantities. But for germination, oxygen is needed in large quantities. The seeds obtain oxygen that is dissolved in water and from the air contained in the soil. If soil conditions are too wet, an anaerobic condition persists, and seeds may not be able to germinate

3 TEMPERATURE:

Germination can take place over a wide range of temperature and is specific to individual crop types, and can be specific to varieties. The optimum for most crops is between 65-75°F, but exceptions do apply.

For example lettuce germinates best at 65°F and can be inhibited at temperatures over 68°F while peppers and eggplants prefer warmer temperatures around 80°F and still not germinate well at cooler temperatures. If your soil is too cold or too hot, your seeds may not sprout. Check your seed packet to find the best temperature needed for your seeds

4. LIGHT:

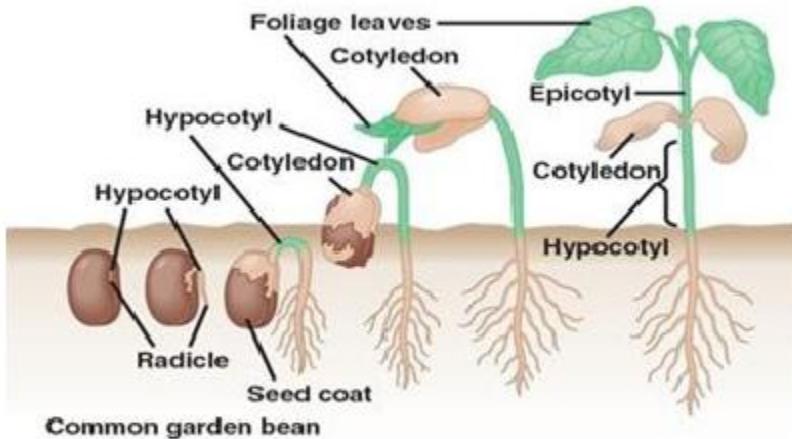
Light has varied effects on germinating seeds of different plants. Some seeds need light for germination, while in some seeds germination is hindered by light. Most wild species of flowers and herbs prefer darkness for germination and should be planted deep in the soil while most modern vegetable crops prefer light or are not affected by it and are planted shallowly to allow small amounts of light to filter through the soil

TYPES OF GERMINATION

1. EPIGEAL GERMINATION

- In epigeal germination the hypocotyl elongates first, plumule and cotyledons are brought above the soil surface.
- Seeds showing epigeal germination generally have small cotyledons, which once exposed to light develops chlorophyll and start to photosynthesis e.g. beans and sunflower.

Common garden bean

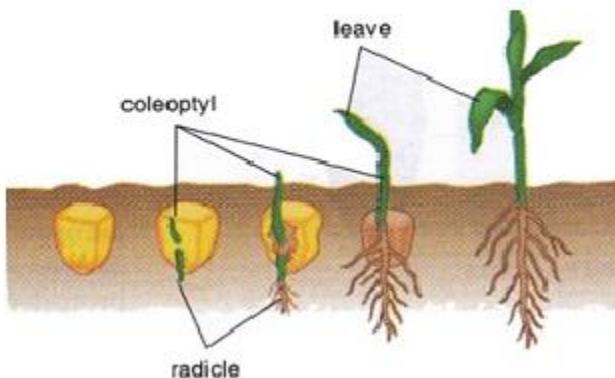


epigeal germination diagram

HYPOGEAL GERMINATION

- In hypogea germination the epicotyl elongates first and plumule is pushed upwards out of the ground These seeds have large food reserved in their cotyledons
- Example of the seeds are maize and reheat

hypogea germination diagram



NOTE:

Germination occurs only in a seed which is viable (whose embryo is alive)

MERISTEMS

- Meristems are regions in plants where growth and development takes place,
- Main meristems are located at the tip of shoot and at the tip of roots
- Active cell division and cell elongation takes place in meristems.
- The growing region of the radicle and hence the root has three main regions, including regions of cell division, elongation and differentiation

Types of Meristems

1. Apical meristems
 2. Lateral meristems
- **Apical meristems** bring about an increase in length and height of roots and shoots
 - **Lateral meristems** give rise to branches of shoot. Lateral meristems bring about the increase in growth of the shoots and roots

SEED DORMANCY

Seed dormancy is an inhibition of growth of an organism or part of it.

Some viable seeds will not germinate even when supplied with proper amounts of heat, water and oxygen. This is the period of reduced activity during which growth does not occur

Factors which bring about seed dormancy

- Nature of the testa
- Presence of certain chemicals
- After ripening
- Food and water
- Climate
- Embryo may not be fully developed
- Lack of moisture and oxygen

1. NATURE OF THE TESTA

Some seeds the testa may be impermeable to oxygen and water. In such seeds time is required before the testa becomes permeable. The testa may also be hard - preventing the radicle and plumule from emerging.

2. Presence of certain chemicals

Certain chemicals present in either the seed or fruit are known to prevent seed germination. These chemicals are removed by **leaching**

3. AFTER-RIPENING

Some seeds will not germinate immediately after harvest. It has been found out that at that time embryos are not fully developed. Such seeds have to go to be stored for some time so that the embryo develops fully. The period is called **after-ripening**

WAYS OF BREAKING SEED DORMANCY

- Provide water
- Provide air
- Provide suitable temperature
- Ensure seed embryo is mature

IMPORTANCE OF SEED DORMANCY

- Seed dormancy has a survival value to plants seeds can survive for a long period especially in adverse environmental conditions such as drought, extreme temperature and shortage of food
- If all seeds germinate at the same time in such conditions all seedlings would perish.
- Seed dormancy helps an organism to withstand unfavorable conditions such as cold and drought, shortage of water etc. It allows time for dispersal of seeds by agents such as water and wind

Seed viability

The seed which retains its capability to germinate are known as viable and the ability is known as viability

FACTORS AFFECTING THE VIABILITY OF SEEDS

1. Seed maturity.
2. Environmental condition.
3. Nature of a testa
4. Availability of moisture.
5. Temperature
6. Light intensity.
7. Storage condition.

GROWTH REGIONS OF A SEEDLING

- Die growth of the radical and the plumule causes the elongation of the seedling. The rate of the growth can be measured at the tip of the root and shoot cells at the root and shoot tips have high capacity to divide
- These dividing cells are known as **meristematic cells**, these cells make a tissue known as apical meristem. These cells rapidly undergo mitosis to provide growth which increases in size of the shoot and root.
- Growth in the tip of the root and shoot is known as **primary growth**.
- Widening of the plant to form the trunk and hard wood is called **secondary growth**.

NOTE: Meristems are regions of the plant in which plant cells divide.

8. GENETICS AND VARIATION

Genetics is a branch of science which deals with the study of inheritance and variation.

Definition of terms

1. Heredity

Is a passing of features from parents to their young.

2. Variation

Possessing of characteristics which are different from these of the parents and other offspring's

3. Genotype

Is the genetic constitution or make up of an organism

4. Phenotype

Is the outward or physical appearance of an organism

5. Dominant gene

Is a gene that prevents the expression of another gene

6. Recessive gene

Is a gene that is masked by another gene.

7. Homozygous

Is a condition where by the two genes for a given trait are similar alike

8. Heterogeneous

Is a condition where the two genes for a trait are different

9. Gene

Is a part of chromosome that carries the genetic material called DNA. Are also referred to as nucleotide chemical units of inheritance arranged along the chromosomes. They are called hereditary factors.

10. Trait

Are characteristics inherited by individual from their parents

11. Allele

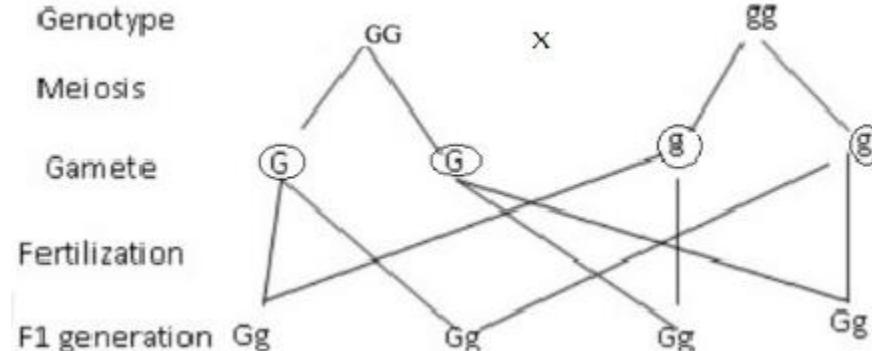
Is an alternative form of a gene controlling the same characteristics but produce different effect Example: T-tallness and t- shortness

12. Monohybrid cross

Are offspring produced by crossing two individual with different character

e.g. homozygous green padded plant (GG) and homozygous yellow padded plant (gg)

13. First filial generation (F_1)



Is the first generation of offspring's produced after crossing the parental genotypes.

14 Second filial generation (F_2)

Are offspring's produced by selfing the F_1 generation

15. Monohybrid inheritance

This is inheritance of one pair of contrasting (different characteristics e.g. height where an individual is either tall or short).

16. Dihybrid inheritance

This is inheritance of two pairs of characteristics

Example: - pure tall pea plant with colours flowers and dwarf pea plant possessing white flowers.

17. Epistasis

It is the interaction between the two different known as allelic dominant genes

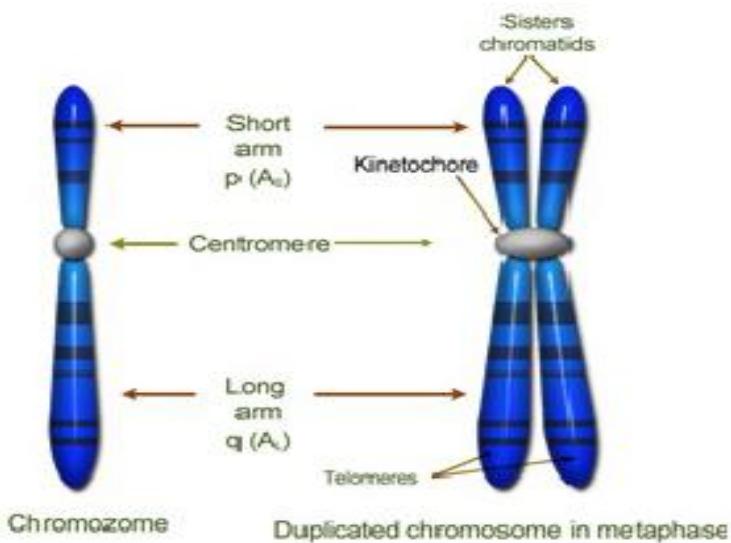
18. Pedigree

Is the historical or ancestral record of individuals shown in a chart .table or diagram

19. Chromosomes

They are thread like structures found in the nucleus of the cell they are only visible when a cell nucleus is about to divide. Every nucleus of the cell of the same species has a constant number of chromosomes e.g. Drosophila has 8 chromosomes, fruit fly pea plant has 40 chromosomes sheep has 56 wheat has 14 chromosomes maize has 20 chromosomes.

Each member of the chromosome pair is known as homologous chromosome



Types of chromosomes

There are two types of chromosomes in the human body

1. Autosomes
2. Heterosomes

Autosomes

These are also known as autosomal chromosomes. They carry all genetic information except that of sex. In humans autosomes are 44 in numbers forming 22 pairs

Heterosomes

These are also known as sex chromosomes these chromosomes determine the sex of the organism in humans. One pair is responsible for the determination of sex

Diploid and haploid nuclei

Diploid nucleus has the chromosomes occurring as homologous pair e.g. 23 pairs in the human this is denoted as $2n$ diploid nuclei are found in the gametes

Haploid nuclei have only one set of unpaired chromosomes. In 23 chromosomes are there haploid nuclei are denoted as n diploid cells are formed after fertilization

GENETIC MATERIALS

Genes are nucleotide chemical units of inheritance arranged along the chromosome and are capable of being replicated and mutated.

Each gene occupies a specific location on a chromosome this location is known as locus (plural is loci) each chromosome contains many genes. Homologous chromosomes when paired together will have similar or different genes called **alleles**. Alleles are an alternative form of gene controlling the same character but producing different effects. The gene can control color of the skin

NUCLEIC ACID

Nucleic acids are polymeric macromolecules or large biological molecules, essential for all known forms of life. Nucleic acids, which include DNA (deoxyribonucleic acid) and RNA (ribonucleic acid), are made from monomers known as nucleotides. Each nucleotide has three components: a 5-carbon sugar, a phosphate group, and a nitrogenous base. If the sugar is deoxyribose, the polymer is DNA. If the sugar is ribose, the polymer is RNA.

Together with proteins, nucleic acids are the most important biological macromolecules; each is found in abundance in all living things, where they function in encoding, transmitting and expressing genetic information—in other words, information is conveyed through the **nucleic acid sequence**, or the order of nucleotides within a DNA or RNA molecule. Strings of nucleotides strung together in a specific sequence are the mechanism for storing and transmitting hereditary or genetic, information via protein synthesis.

DNA (deoxyribonucleic acid)

- DNA has a double stranded shape or coil twisted like a ladder to form a double helix.
- DNA is the genetic material contained in the genes.

COMPONENTS OF DNA

- Deoxyribose sugar
- Phosphate group
- Organic base or Nitrogenous bases.

Nitrogenous base

- Adenine (A)
- Guanine (G)
- Uracil (U)
- Cytosine (C)
- Thymine (T)

Functions of DNA

- There are genetic material which are responsible for genetic characteristics
- they assemble the amino acids to form a protein molecule

RNA (ribonucleic acid)

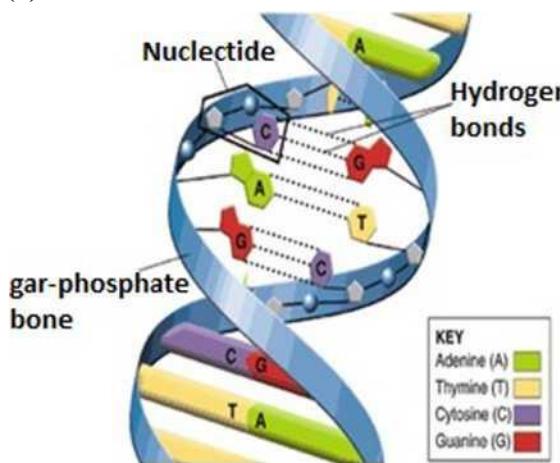
The RNA molecule is responsible for carrying genetic information from the DNA molecule to the ribosome which is the sight of the protein synthesis

TYPES OF RNA

Messenger RNA - carries information from the nucleus in from of base triplets.

Transfer RNA - It transfers the appropriate amino acids to the ribosome.

(a) STRUCTURE OF DNA



(b) STRUCTURE OF RNA



DIFFERENCE BETWEEN DNA & RNA

DNA	RNA
Has a deoxyribose sugar	Has a ribose sugar
Has a double stand	has a single stand
Found in the nucleus, mitochondria and chloroplast	Found in nucleus and cytoplasm.
Has organic bases, cytosine, guanine adenine and thymine	Has organic bases, cytosine guanine, adenine and uracil

PRINCIPLES OF INHERITANCE

Concept of inheritance

Historical background of genetics

Father of genetics is Gregory Mendel

Mendel's experiment

Mendel has selected garden pea plants [pisum sativa]

Reasons for selecting pisum sativa

1. The garden pea has many contrasting and easily recognized characteristics.
2. The hybrid obtained from the cross fertilization was fertile
3. The flowers of a garden pea are bi sexual and naturally self pollinated
4. The garden pea plant matures relatively fast producing many off springs (seeds)

MENDELIAN INHERITANCE.

1. LAW OF SEGREGATION

It states that “characteristics of an organism are controlled by internal factors (genes) occurring in a pair is carried in each gamete”

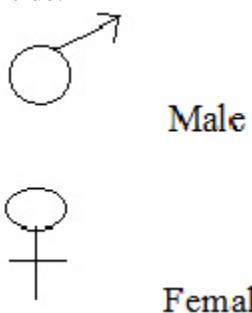
2. LAW OF INDEPENDENT ASSORTMENT

“Each of the 2 alleles of one gene may combine randomly with either of the alleles of another gene independently”

PUNNET SQUARE

- Is a chart showing the possible combination of factors among the offspring of a cross.

It is used to show the formation of zygotes. Female gametes are placed on the right while male gametes are placed on the left side.



Example

A cross between homozygous tall (TT) and homozygous dwarf (tt) plant can be illustrated as follows:

Let assume tall is male and dwarf is female

T	t	t
T	Tt	Tt
	Tt	Tt

Test cross

A cross used to cross an individual of unknown genotype with a homozygous recessive individual.

Example:- A homozygous dominant individual (TT) will phenotypically appear the same.

BACK CROSS

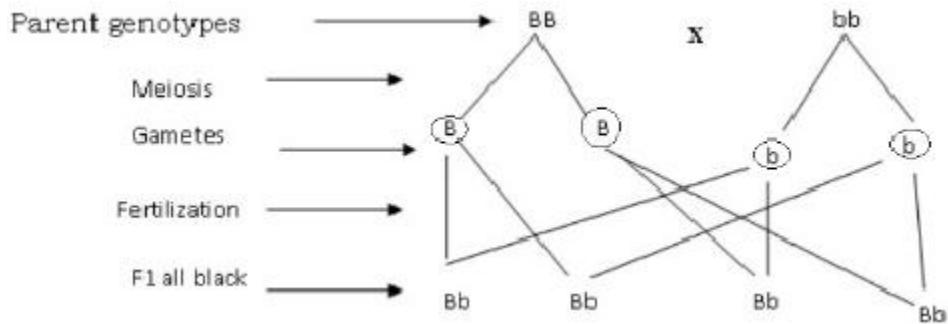
In the crossing of individual of unknown genotype with the homozygous parent.

This is another form of test cross, but the difference is that in test cross, it is crossed with any individual while in back cross with a parent, if the individual is homozygous (bb)

DOMINANCE

Dominance is a state of one character gene from one parent masking the corresponding character from another parent.

Types of dominance



1. Mendelian inheritance - Complete dominance
2. Non-Mendelian inheritance - Incomplete dominance
3. Co-dominance

1. COMPLETE DOMINANCE

- Is the dominance where by one gene masks the expression of the other gene.
- A dominant gene always masks a recessive gene when the two occur together.

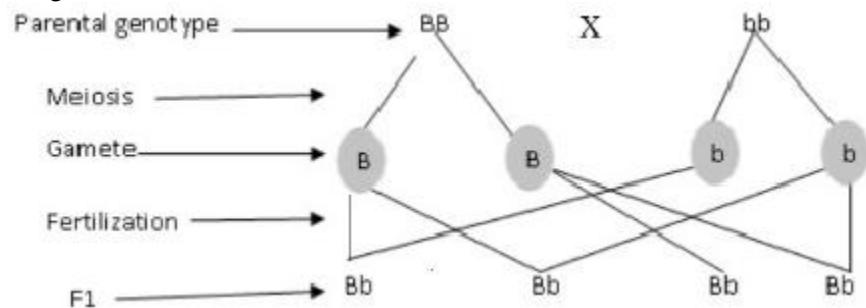
Example:

1. A man homozygote for brown iris marries a woman who has blue iris. Show the results of F₁. What colour would the iris of the cross between 2 members of F₁?

Solution: -

The gene for brown iris is completely dominant over gene for blue iris in woman.

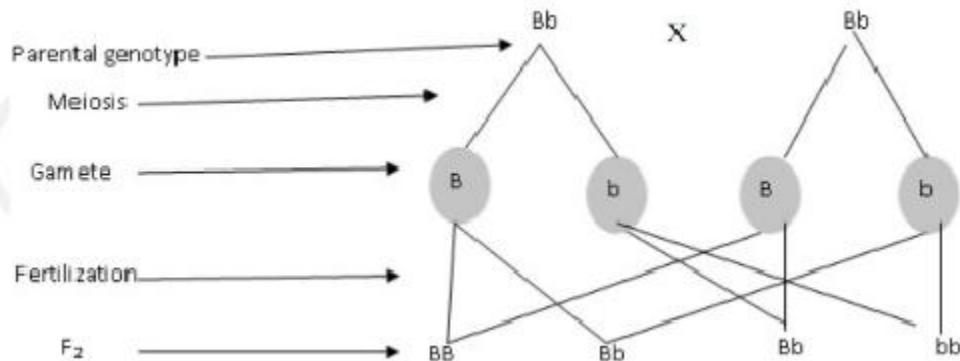
Let gene for brown be B and b for blue



Genotypes - All are Bb.

Phenotype All have brown iris.

Selfing F₁



Genotypes - BB, Bb, bb

Phenotypes - 3 Brown iris, 1 blue iris

Genotypic ratio - 1 : 2 : 1

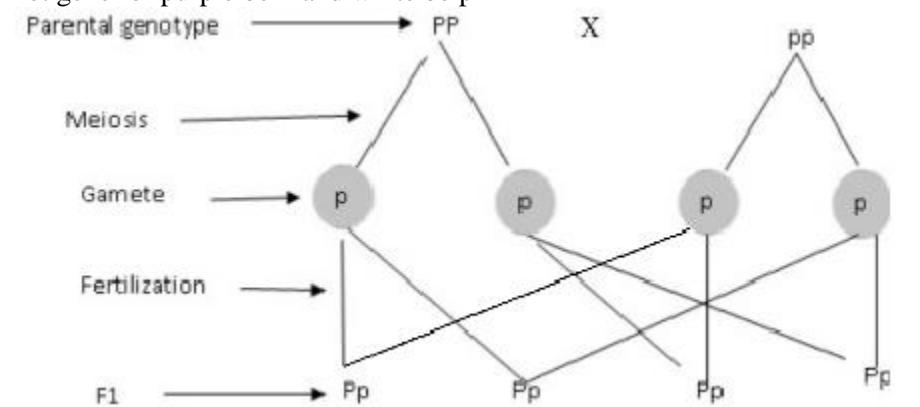
Phenotypic ratio - 3:1

BB, Bb, bb

2. A pure purple flowered pea plant was crossed with pure white pea plant. Offspring's for F₁ were phenotypically all purple flowered plants when F₁ was salved a mixture of purple pea flowered and white pea plant were produced at an approximate ratio of 3:1

Solution: -

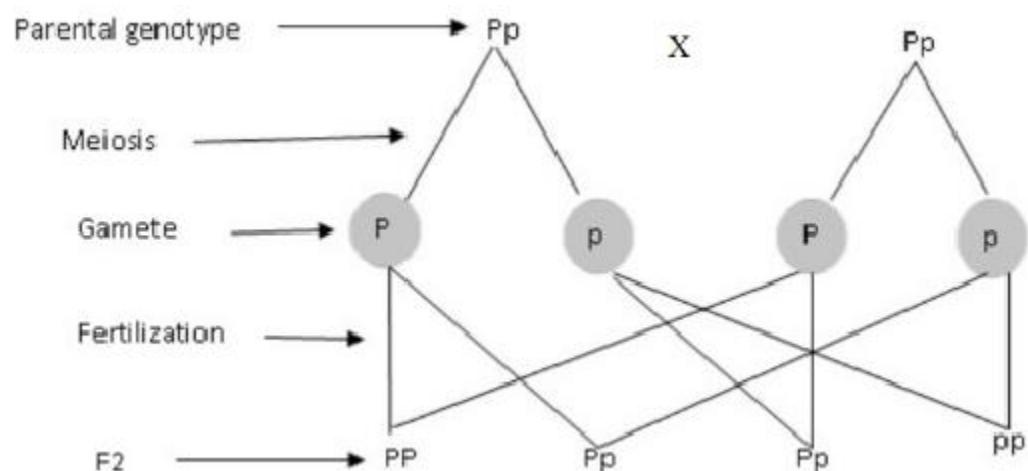
Let gene for purple be P and white be p



Genotypes : all are Pp

Phenotypes : all have purple flower

Self F1



Genotype - PP, Pp, pp

Phenotypic ratio - 3:1

Genotypic ratio - 1 : 2 : 1

2. INCOMPLETE DOMINANCE

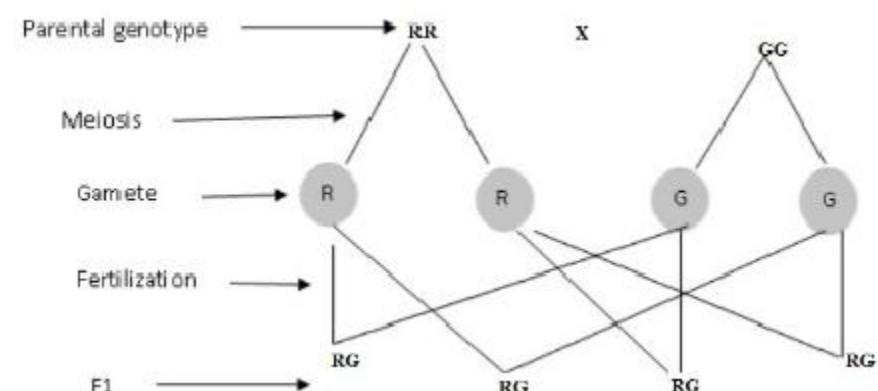
In incomplete dominance there is no dominant or recessive gene, but both express themselves equally. It results in a heterozygous individual which does not resemble any of the homozygous individual which does not resemble any.

Example: -

1. A red flowered rose was crossed with white rose and all members of F1 were pink. When pink were selfed, a mixture of red, pink and white flowered plants were obtained.

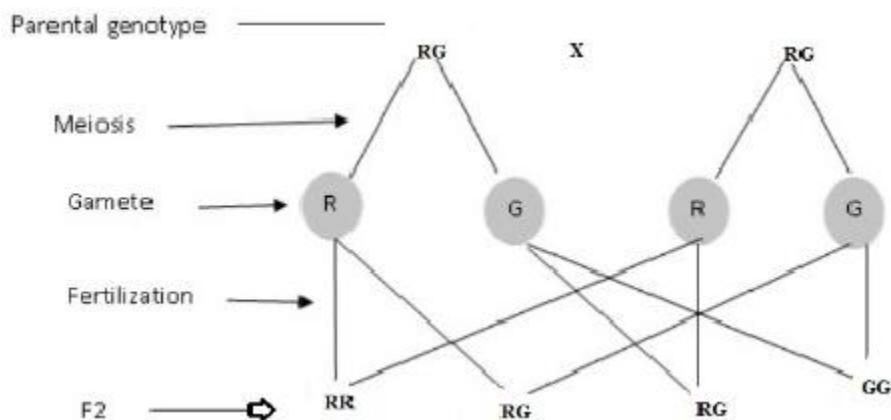
Solution:-

Let, R - Red , G - White



Genotypes : all are RG

Phenotype : all are pink



Genotypes - RR, RG, GG

Genotypic ratio - RR: RG: GG

1 : 2 : 1

Phenotypic ratio - 1 red: 2 pink: 1 green

3. CO-DOMINANCE

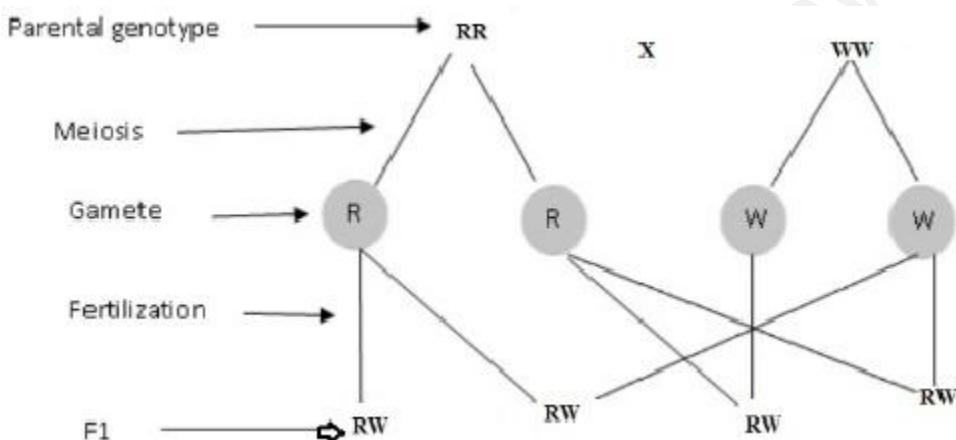
In co-dominance genes from both parents are dominant and are phenotypically expressed in the offspring.

Example: A red cow is mated with white bull. In F1 generation all of offspring's have equal patches of red and white fur. Therefore neither red nor white gene is dominant over the other such cattle and called *Roan*.

When a roan cow is mated with roan bull, offspring's may be red, roan or white mated in the ratio of 1: 2: 1

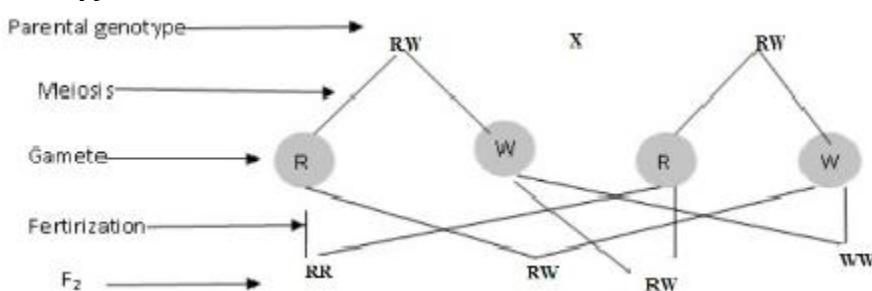
Let: W- white bull

R - Red cow



Genotypes - all are RW

Phenotype - all are Roan



Red: 2 Roan : 1 White

RR : RW : WW

1:2:1

SIMPLE MENDELIAN TRAITS

The following are example of mendelian's traits in man

1. ALBINISM

Albinism is absence of pigmentation melanin in human skin animals or plants. This pigmentation is responsible for dark

colour of the skin. As a result the person has white hair, pink eyes and light skin. In plants are characterized by lack of chlorophyll

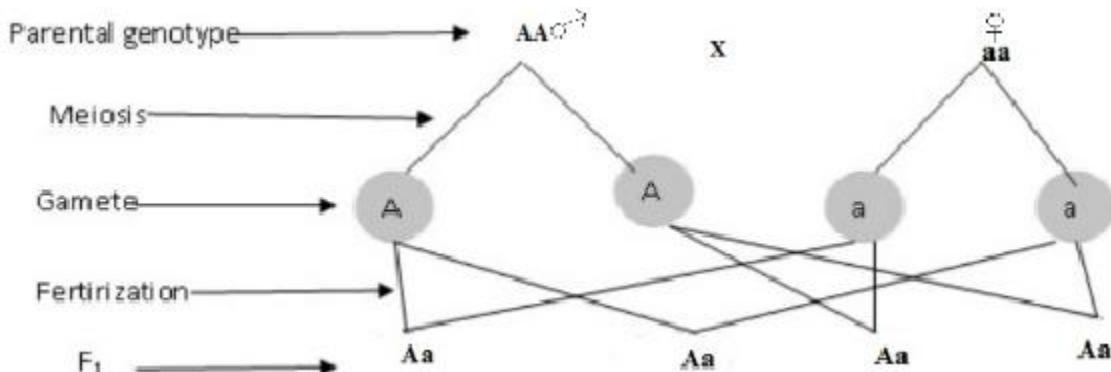
It is controlled by a recessive gene. Human showing this disorder must be homozygous recessive. Heterozygous are normal but carriers.

Examples:-

1. What will be the result of normal man who married an albino woman?

Solution: -

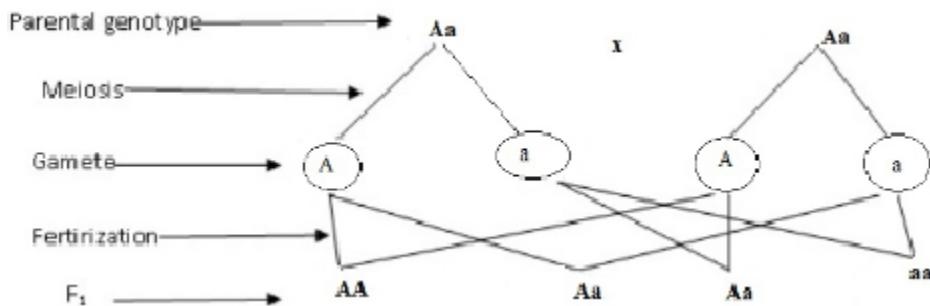
Let gene for normal be "A" and Albino be "a"



Phenotype - all are normal (Heterozygous)

2. What would be the result of a cross between heterozygous parents?

Solution



Genotype – AA, Aa and aa

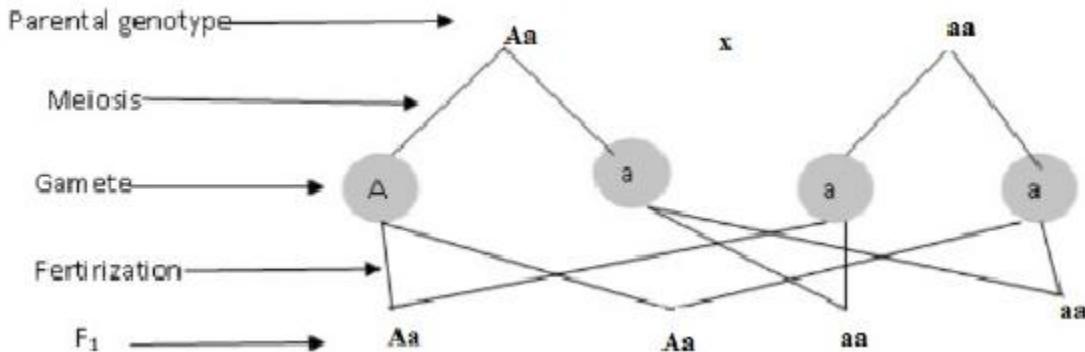
Phenotype - normal man, carrier and albino

3. What would be the result be of crossed between heterozygous parent with an albino parent.

Solution: -

Gene: Aa - heterozygous parent

aa - albino parent



Genotypes - Aa and aa

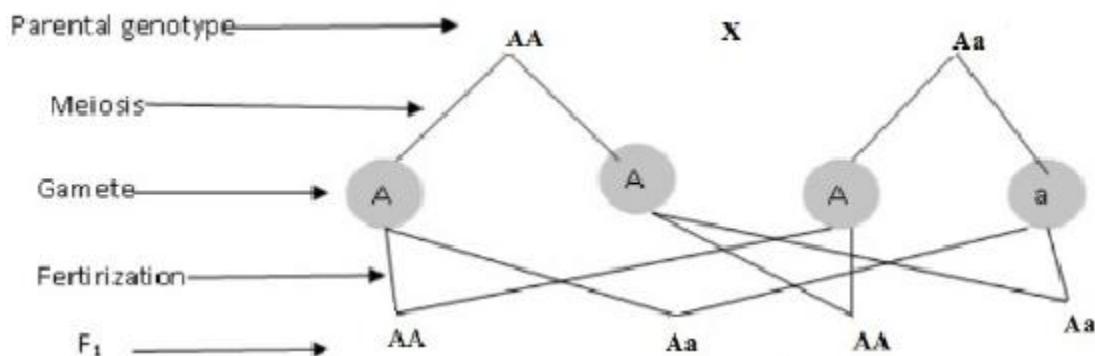
Phenotypes - half normal carriers and albinos.

4. What would be the result of crossed between heterozygous parent and homozygous normal parent

Solution:-

Heterozygous Aa

homozygous AA



Genotypes – AA, Aa

Phenotypes - all are normal (normal, carriers)

2. ACHONDROPLASIA

Achondroplasia is a disorder that is characterized by a shorted body, legs and hands. It is controlled by a dominant gene. Individuals with these disorders are Homozygous dominant or Heterozygous. Homozygous recessive are perfectly normal

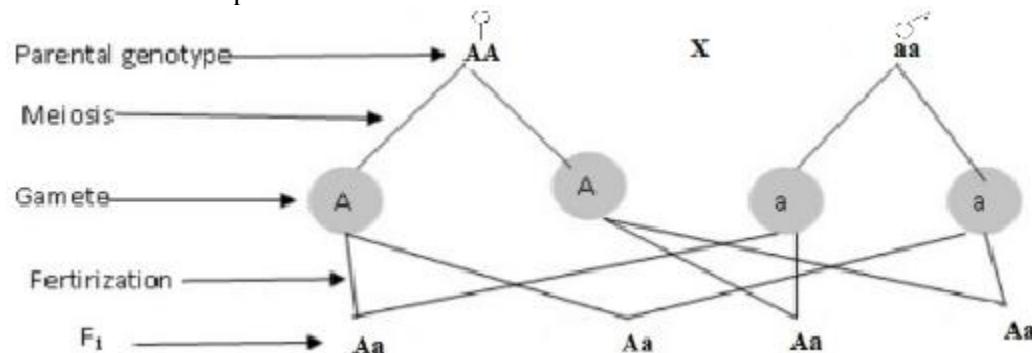
Examples: -

- i. What would be the result of a normal man who married an achondroplasia woman.

Solution: -

Genes for normal man -aa

Genes for achondroplasia women-AA

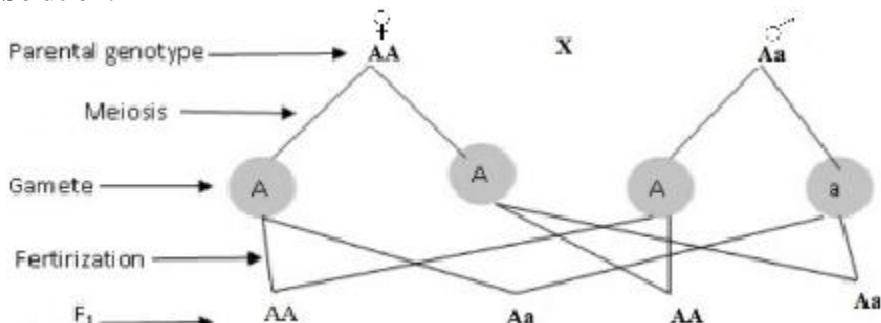


Phenotypes - All are achondroplasia

Genotypes – Aa

- ii. What would be the result of a cross between an achondroplasia woman who is homozygous and achondroplasia man who is heterozygous?

Solution: -

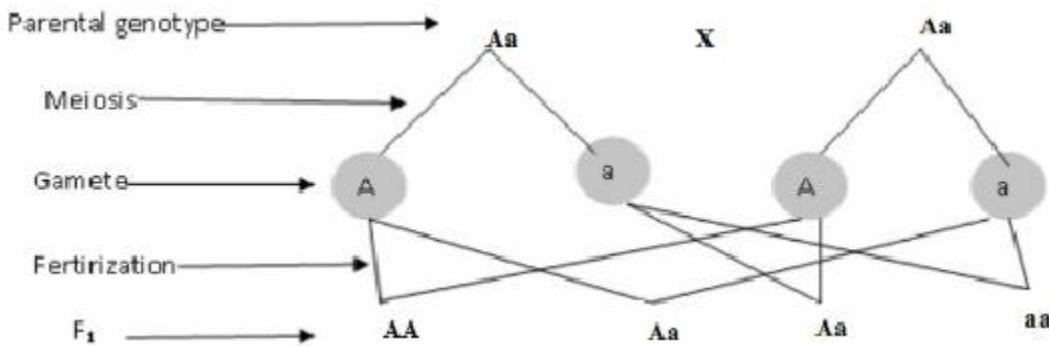


- AA, Aa

- Phenotypes - All achondroplasia

- iii. What would be the result of a cross between heterozygous parents?

Solution: -



Phenotype – Achondroplasia, 1 Normal

Genotype –AA, Aa, aa

Phenotypic ratio - 3: 1

Genotypic ratio - 1 : 2 : 1

3. HAEMOPHILIA

Hemophilia is a hereditary trait characterized by delayed blood clotting. The result is prolonged bleeding even small injuries can lead to death. The hemophilic girl rarely lives beyond puberty because of excessive menstrual bleeding.

It causes high mortality rate.

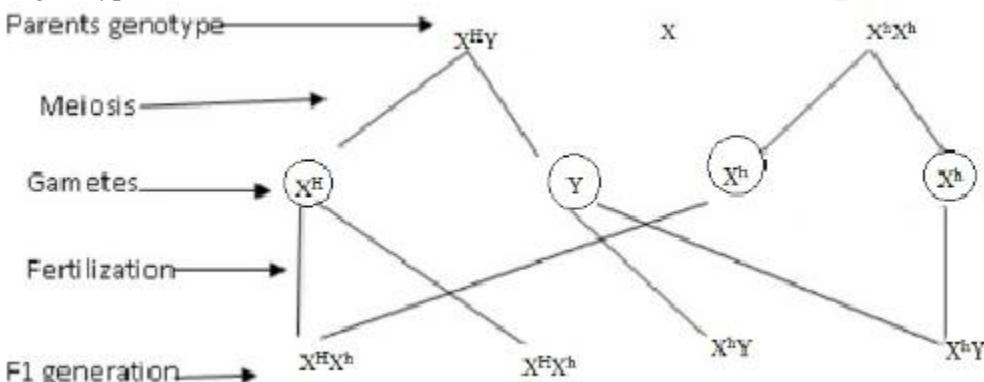
It is controlled by recessive gene. Heterozygous are normal carries but homozygous individuals are hemophilic.

Worked example: -

If a normal man married a hemophilic woman, the offspring's would be

Solution: -

Let genotype for the man is $X^H Y$ and woman is $X^h X^h$



- A hemophilia man will be $X^h Y$
- Hemophilic female will be $X^h X^h$
- H - not suffering from hemophilia while h - hemophilic

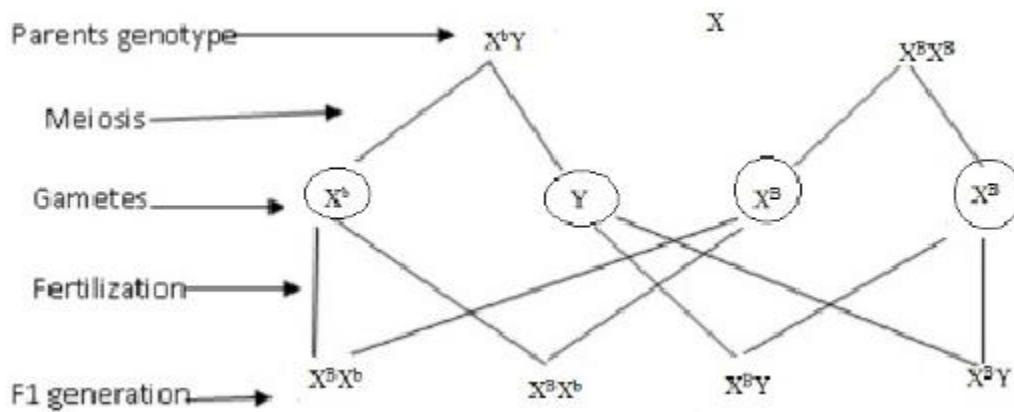
4. COLOUR BLINDNESS

Is the hereditary trait characterized by inability to detect certain colours of the spectrum. The common colour blindness is inability to distinguish between red from green. It is controlled by a recessive gene. Homozygous individual are colour blind while heterozygous are normal or carrier.

e.g. If a colour blindness man marries a normal woman, the offspring will be as follows.

Let: B - normal

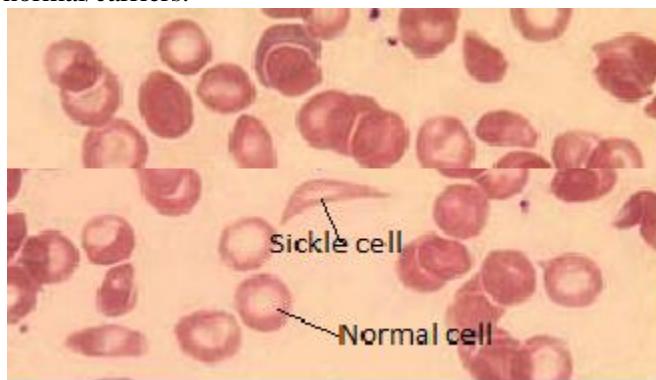
b – Colourblind



5. SICKLE CELL DISEASE

This is a genetic disorder which makes the red blood cell acquire sickle shape under certain conditions. It may occur when the person is attacked by certain diseases e.g. .malaria. Also when oxygen tension in the atmosphere is very low. The sickled cells ability to carry oxygen is reduced

It is controlled by a Recessive gene. Homozygous individuals are sickled cell while heterozygous individuals are normal/carriers.

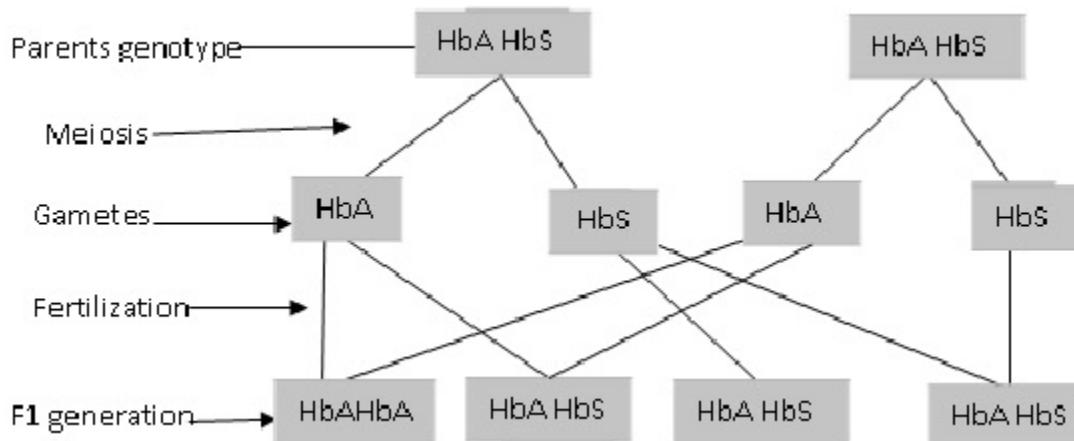


NOTE:

HbA - perfect normal

HbS - sickle cell trait

* If a carrier man marries a carrier woman the offspring will be - **sickle cell anemia**



6. TONGUE ROLLING

This is a hereditary trait which is characterized by rolling a tongue into a U — shape. It is controlled by a dominant gene. Heterozygous and homozygous individuals are tongue rollers. Recessive are not tongue rollers.

TRAITS/ DISORDERS AND THEIR CONTROLLED GENE

DOMINANT GENE	RECESSIVE GENE
Achondroplasia	Haemophilia
Tongue rolling	Colour blind
Night blindness	Sickle cell

Brown iris	Blue iris
Having more than 5 fingers & toes	Normal night vision
	Albinism
	Normal number of ringer and toes.

HOW TO SOLVE GENETIC PROBLEMS BY USING PUNNET SQUARE

1. In human beings normal skin pigment (melanin) is dominant over albinism. An albino male mates with a heterozygous female. If the female gives birth to 6 fraternal twins what will be the probable genotypic and phenotypic ratio of the offspring?

Solution: -

i) Let letter A - dominant gene

a - recessive gene (albinism)

- Write the genotypes of the parents

(male) aa x Aa (female)

ii) Use these genotype to complete the punnet square

Female gamets A	a	a
	Aa	Aa
a	aa	aa

iii) Summarize the genotypic and phenotypic ratios

Genotypic ration - Aa : aa = 1Aa: 1aa

Phenotypic ration - if normal skin pigmented : albino = 1:1

2. In human beings normal skin pigment is dominant (A) over albinism (a) one couple with normal pigment mate and produce six fraternal twins. Out of 6, 4 have normal skin pigment and 2 are albino. What are the genotypes of the parents?

Solution: -

- Write complete partial parents genotypes and offspring Parents A

Four normal skin offspring A

Since normal skin is dominant, each of parent and 4 children must have at least one dominant gene

- Since albino gene is recessive. 2 albino offspring are homozygous recessive (aa) Two albino offspring's (aa)

A - (Normal skin parent A - (normal skin parent)

A - (4 normal offspring aa - (2 albino offspring)

Since one gene for albino comes from each parent. Therefore each parent is heterozygous (Aa)

RHESUS FACTOR

About 85% of the human population has a gene located on the chromosomes number one that produces a function protein called ANTIGEN & (Rhesus factor)

Individuals with rhesus factor are rhesus positive (Rh+) and the remain 15% do not have this factor are rhesus negative (Rh-). Rh+ is dominant over Rh-

Rhesus antibody is normally absentia plasma of human blood. The Rh people produce this antibody if Rh- blood is transfused to them. These Rh+ antigens react with rhesus antibody causing agglutination. The present or absent of Rh+ factor gives the blood groups the + or - signs

The table below shows the reactions of blood types with and without Rh factor.

		Donor							
		O-	O+	A-	A+	B-	B+	AB-	AB+
Recipient	O-	✓	✗	✗	✗	✗	✗	✗	✗
	O+	✓	✓	✗	✗	✗	✗	✗	✗
	A-	✓	✗	✓	✗	✗	✗	✗	✗
	A+	✓	✓	✓	✓	✗	✗	✗	✗
	B-	✓	✗	✗	✗	✓	✗	✗	✗
	B+	✓	✓	✗	✗	✓	✓	✗	✗
	AB-	✓	✗	✓	✗	✓	✗	✓	✗
	AB+	✓	✓	✓	✓	✓	✓	✓	✓

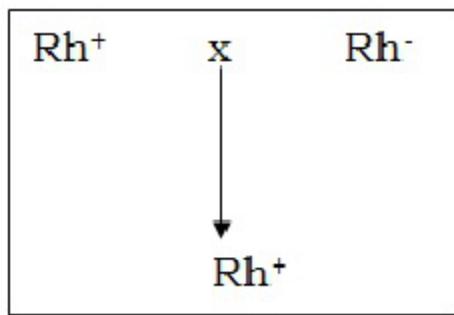
KEY

(✓) - No agglutination

(✗) - Agglutination

WORKED EXAMPLE

A Rh+ man marries a woman who is Rh- and produces 10 children, what trail are the phenotypes of the children

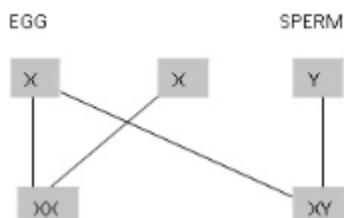


All children will be Rh+

SEX INHERITANCE

Sex is a phenotypic character, it is dependent upon the genotype and environment. In sexually reproducing organisms, each individual is a product of a male and a female. Each individual receives an equal number of chromosome from male and female body. **For example** each individual receives 23 chromosomes from the mother and 23 from the father.

- In many species female chromosomes (sex) are XX and male are XY



The chromosomal mechanism of sex determination varies in different organisms

Example: -

Organisms	Gametes		Zygotes	
	Ova	Sperm	Female	Males
Drosophila. Human beings.	XX	XY	2X	XY
Grasshoppers. Birds. Moths.	XX	XO	2X	XO
Butterflies	XY	XX	XY	2X

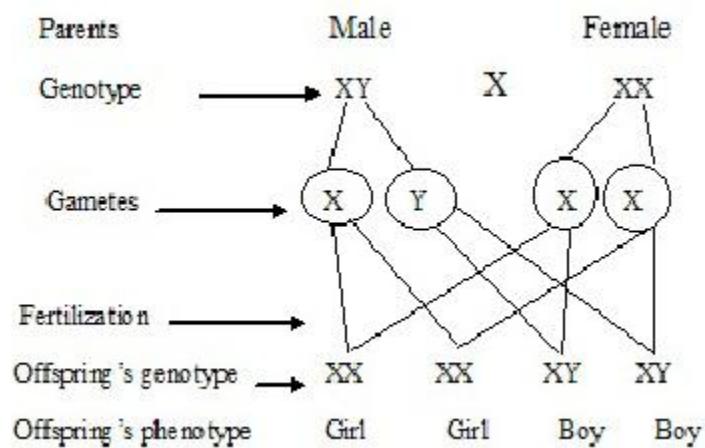
SEX DETERMINATION AND INHERITANCE

Sex of a child (man) is determined by sex chromosomes. Human being has 46 chromosomes (23 pairs of homologous chromosomes) in everybody of these. 2 are sex chromosomes while 44 are referred to as autosomes.

Autosomes determine physical characteristics such as height and body size. There are two types of sex chromosomes which are X and Y. These chromosomes determine the sex of a child.

- The male carries X and Y chromosomes which are different in shape and size and are said to be Heterogametic. The male genotype is XY.
- The female carries two X chromosomes which are similar in shape and size and are said to be Homogametic.
- A sperm (male gamete) has either an X or Y chromosomes while the ovum (female gamete) always contains the X chromosomes.
- Secondary sexual characteristics of females are controlled by genes on the X chromosomes.
- Male secondary sexual characteristics are controlled by genes on the Y chromosomes.
- The sex of a child is a matter of chance and depends on whether the sperm that fertilizes the ovum carries a Y or X chromosomes. The chances of a baby being a girl or a boy are 50:50
- Maleness depends upon the presence of Y chromosomes and Femaleness depends upon the absence of the Y chromosomes.

Sex determination in human



The ratio of boys to girls is 1:1. This means that the probability of getting above or a girl is 50%

SEX-LIMITED CHARACTERS,

These are characters that are restricted to only one sex, either males or females.

Examples of sex-limited characters:-

- i. Growth of facial hairs (Beard and Moustach) in males.

This develops as a result of production of male hormones. The gene for beard growth is also present in females but it is not expressed.

- ii. Baldness in males.

- iii. Breast development in females (lactation).

- iv. Long hairs of male lions (Male: lion. Female: lioness)

- v. Comb plumage of hens (Male: cock. Female: hen)

- vi. Hairy ears and nose is a common characteristics among males especially those of Asiatic descent.

The fact that the characteristics are only present in the males, suggests that the gene responsible for the trait is located on the Y chromosomes.

SEX - INFLUENCED CHARACTERS

Are the characters that are expressed as dominant in one sex and recessive in the other. These are characters or traits that tend to be more conspicuous in one sex than the other. An example of sex - influenced characters is the presence or absence of horns in some breeds of sheep.

- The horned condition behaves as dominant in males but as recessive in females.

- The hornless state is dominant in the female sex but recessive in the male

NOTE: The dominance difference of sex-influenced characters is mainly- the result of hormonal interaction with the genotype.

SEX PREFERENCE AND SEX SELECTION.

- a) Sex preference is favouring one sex (gender) and not the other.
- b) Sex selection means choosing the sex (gender) of the baby to have

c) Therefore, sex preference and selection result into people to like one type of sex more than other. This tendency is very common in African countries and some parts of Asia. Basically, both males and females are equal and depend on each other in many- aspects of life. However, there has been a tendency of some people to prefer one type of sex over the other. Some people in families prefer having boys than girls while others prefer girls over boys.

d) Those who prefer boys do so in a belief that boys will perpetuate the lineage and take care of the parents when females are living far away with their husbands.

e) Those who prefer girls argue that, girls are kind and merciful, therefore they can take care of their parents at old age.

Socio - cultural factors that influence sex- preference and sex selection.

i. Man power generation.

Some societies, especially pastoralists prefer boys over girls because boys help in animal grazing.

ii. Generation and protection of wealth.

In some societies girls are more preferred than boys because they generate wealth upon getting married. A family will get a lot of cattle or money as a bride price

iii. Land ownership

In some societies a woman cannot own land, thus females prefer to have more sons than girls so that they can somehow benefit indirectly through their sons.

Conclusion;

- Sex preference and selection have negative impact as it may- result into inequality and discrimination. In many societies, sex preference and selection has led to boys being educated and given ample time to play and learn while girls stay at home and do house chores.

- Government and NGO'S have to take measures to rectify the situation.

SEX LINKAGE

Sex linked genes carried on sex chromosomes but have nothing to do with sex. Traits whose expression is governed by sex linked traits are called sex linked Units.

One kind of colour blindness is an example of sex linked trait in human beings located on the X — chromosome.

Example of other linked is hemophilia (bleeder's diseases)

VARIATION

The difference that exists between living organisms is called Variation. It is the possession of characteristics which are different from the parent and other offspring

Types of variation

i. Continuous variation

Is the variation which show intermediate form between any two extremes i.e. there is no clear cut distinction between two extremes.

Example in group length ranges from shortest to tallest with several intermediaries continuous variation arises from interaction between genes and environment.

ii. Discontinuous variation

Is the variation which shows clear cut distinction from one form to another form.

Example: -

In human population an individual is either a male or a female, ability to roll the tongue, albinism, blood group (A, AB, O) and rhesus factor.

Environment does not influence the characteristics that show discontinuous variation.

Example blood group cannot be altered by environment

Cause of variation

1. Environment Factors

Food - lack of food of a certain diet leads to deficiency diseases such as Kwashiorkor. Lack of enough food causes starvation. Also pathogens cause diseases in organism making the individual different from the normal ones.

2. Genetic factors

(a) **Meiosis** - during meiosis there is segregation of different gametes

- This reduces the chance of pairs of chromosomes producing a wide variety of different gametes. This reduces the chance of individuals being the same.

(b) **Fertilization** - during fertilization the nuclei of male and female gametes fuse.

- This permits parental genes to be brought together in different combinations

- This may lead to desirable and undesirable qualities of parents be combined in the offspring.

(c) **Mutation**- This is a sudden change in gene which can be inherited are caused by mutagens as x rays, cosmic rays-s. chemicals as mustard gas. The individual is called a mutant after undergoing mutation and appears different from the rest of the population.

3. Migration

As species are not normally informally distributed but occurs in small isolated population called demes. If members from the deme migrate and mate with members of another deme the offspring that results have characteristics that are different from those of both parents.

TYPES OF CHARACTERS

1. Acquired characters

These are traits an individual develops as a result of adaptation to the environment.

Example: - Walking style. They- are never inherited and are also known as no-heritable characteristics

2. Inherited characters

Are traits passed on from parents to the offspring's through sexual reproduction. Are also called **heritable characteristics**.

Difference between acquired and heritable

ACQUIRED CHARACTERISTICS	HERITABLE CHARACTERISTICS
<ul style="list-style-type: none">1. Are due to the environment2. Cannot reappear in offspring3. Sometimes are changeable in life time (one way lose weight)	<ul style="list-style-type: none">1. Are due to genes2. re-appear in offspring's3. Mainly unchangeable in life time (height)

GENETIC DISORDERS

MUTATION

Mutation is changes in the genetic material in the gametes.

1. It includes appearance of next' characters that have never been before in that population
2. Individuals who undergone mutation are called **Mutants**
3. Mutation can be due to
 - Change in a gene itself
 - Change in arrangement of genes
 - Loss of chromosomes (due to unbalanced meiosis)
4. Mutation can be caused by- agents known as **Mutagens**
 - X-rays
 - Cosmic rays
 - Heavy metal (lead & mercury)

TYPES OF MUTATION

- i) Gene mutation
- ii) Chromosomal mutation

1. GENE MUTATION

Gene mutation occur as a result of altering the chemical structure of genes

- There is a change in the sequence of nucleotides in the segments of DNA corresponding to one gene. This in turn alters the sequence of amino acids required in synthesis of a particular protein
- The protein formed will be different from the normal ones and produce a profound effects on both the structure and development of an organism. **Example:** sickle cell, dwarfism

TYPES OF GENE MUTATION

- Substitution
- Insertion
- Deletion
- Inversion

i. SUBSTITUTION

This is the replacement of one or more portions of a gene with a new one. E.g. A thymine (T) on ATA on the DNA molecule is replaced by- cytosine (C) and result to ACA on the DNA

This is exemplified in sickle cell anemia only one nucleotide is changed. This kind of mutation involving the change of one nucleotide is called Point Mutation.

ii. INSERTION

This involves adding a new portion of a gene to an existing one. **Example:** If the base Guanine (G) is inserted between two Adenine result into AGA which does not code for any amino acid.

iii. DELETION

Deletion is the remove of a portion of a gene **Example:** -If base Guanine < G > is deleted in a base triplet CGC of amino

acids

iv. INVERSION

A portion of DNA strand cuts and rotates through 180° the inversion results in alteration of the base sequence at this part

Example: -A base triplet CTA can have its base thymine (T) and Adenine (A) cut and rotated. The result is CAT which is different from amino acid, resulting into alteration of base sequence reducing the number

2. CHROMOSOMES MUTATION

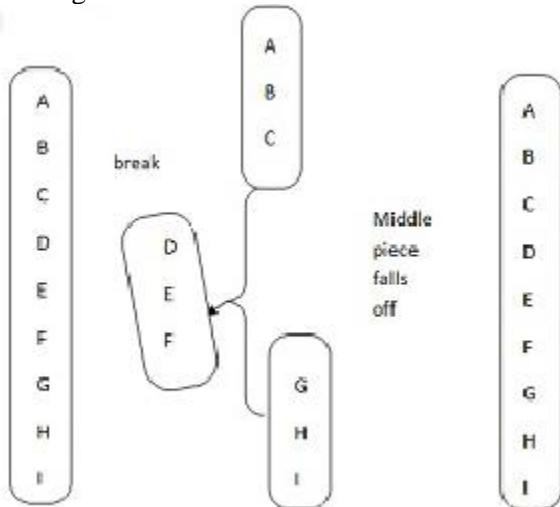
Chromosomes mutation involves changes in the structure of the chromosomes. During meiosis homologous chromosomes intertwine at several points called chiasmata and create opportunity for various changes on the chromatids leading to mutation

TYPES OF CHROMOSOME MUTATION

- a) Deletion
- b) Duplication
- c) Inversion
- d) Trans location
- e) Non-disjunction to Polyploidy

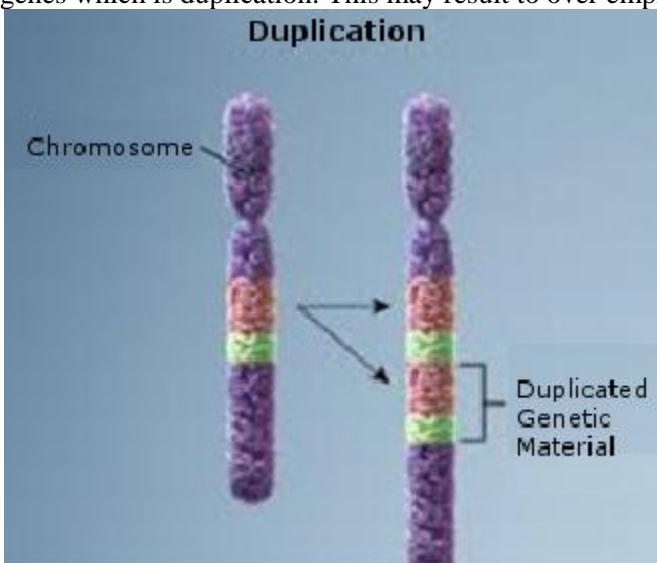
1. DELETION :

This occurs when a portion of the chromosome breaks off and fails to reconnect to any of the chromatids. The result is the loss of genetic materials. Deletion can be caused by error in chromosomal crossover during meiosis. These causes serious genetic deceases



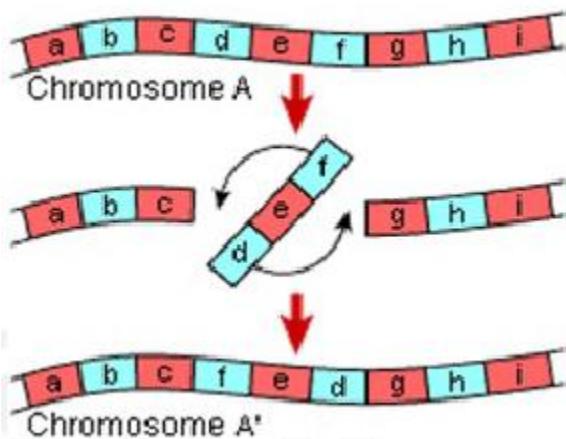
2. DUPLICATION

This occurs when a portion of the chromosome replicates itself adding extra length. The result is addition of a set of genes which is duplication. This may result to over emphasizing of a trait in an organism



3. INVERSION

This occurs when a middle piece of the chromosomes break and rotates at 180° and rejoins the chromatid. This has the effect of reversing the gene sequence.



4. TRANSLOCATION

This occurs when a portion of one chromosome breaks off and becomes attached to another chromatid of non-homologous pair. The result is transfer of genes from one pair of homologous chromosome to another

Original Chromosomes



Translocation



5. NON-DISJUNCTION

This kind of chromosomal mutation is caused by addition or loss of one or more chromosomes. This occurs during meiosis where homologous chromosomes fail to separate. This results in some gametes having more chromosomes than others.

Example of non - disjunction

a. DOWN'S SYNDROME

This is caused by presence of an extra chromosome number 21 individuals with this defect have a total of 47 chromosomes they have

- Resistance to infection
- Mentally retarded
- Have thick tongue
- Short body

Also children of old parents (above 40 years woman and 55 man) have increased chance of Down's syndrome.

b. KLINEFELTER'S SYNDROME

This is caused by failure of X chromosome to separate during the process of egg formation. An individual with this condition has two X chromosome and one Y chromosome (XXY). They are - outwardly male but may also have female characteristics.

c. TURNER'S SYNDROME

This is an individual with 45 (44 +X0) chromosome in a cell instead of 46 (44 +XX). Individual with this condition have one X and no Y i.e. (XO) they individual is sterile and abnormally short female

6. POLYPLOIDY

Occurs if the whole set of chromosomes doubles after fertilization, where the spindle tail to be formed and the cell do not divide. It is rare in animals but common in plants

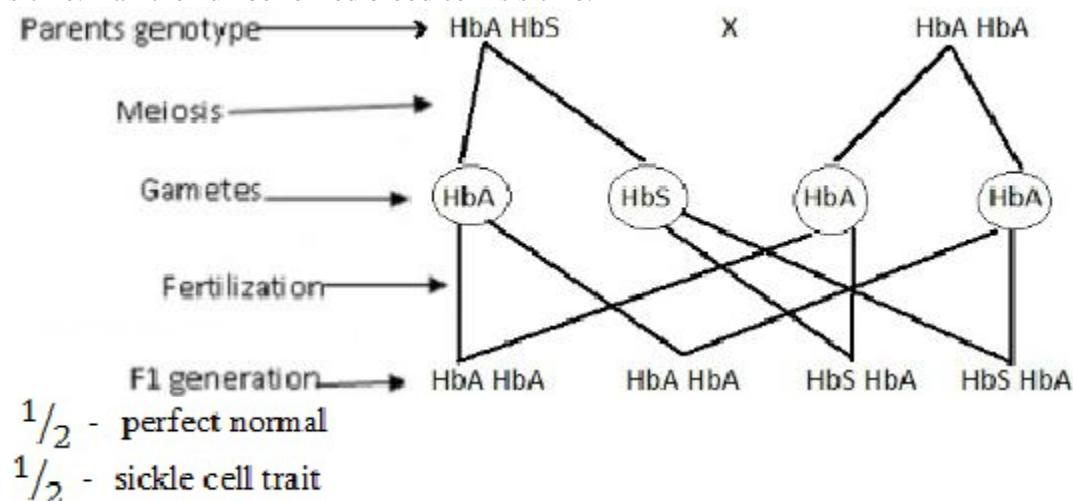
7. SICKLE CELL ANAEMIA

Sickle cell anemia is an example of gene mutation. The normal haemoglobin is entirely replaced by abnormal

haemoglobin known as **haemoglobin S**

In sickle cell anemia, the **glutamic acid** is replaced by another amino acid, the **valine** forming a haemoglobin s denoted by Hbs. Normal haemoglobin is denoted by HbA.

Haemoglobin S begins to crystallize when Oxygen concentration falls and causes red blood cell to assume the shape sickle. Half the number of red blood cell is sickle.



GENETIC COUNSELLING

Genetic information is used to advise couples who have hereditary disorders about chances of children inheriting the disorders. Genetic information could also be used in choosing marriage partners

GENETIC ENGINEERING

This is the alteration of the structure of DNA by man

- Generic engineering enables man to carry out research
- Manufacture protein (insulin)
- Improve animal and plant breeds
- Correct genetic disorders
- **Genetic engineering** is the technique of changing the genotypes of an organism. It involves inserting genes from one organism into the chromosomes of other organisms. Once inserted the foreign genes work as if they were in the organism they were taken from.

APPLICATION OF GENETICS

1. MEDICINE

Genetic engineering has enabled biologists to program and make useful substance.

For example the gene in man that produces insulin was inserted into Escherichia colia for producing pure insulin in large quantities.

- Human growth hormone has also been made by using bacteria which the proper gene has been added.
- Also blood clotting factors such as fibrinogen needed by hemophiliacs are produced
- Vaccines from viruses are produced

2. BIOLOGICAL WARFARE

Genetic engineering can help humans to produce biological weapons i.e. Anthrax and Vibrio cholera

3. AGRICULTURE

- It is common for farmers to select and plant seeds from the healthiest and high yielding varieties of plants with the aim of improving desirable traits as high fruits and crop production
- Also genetics has enabled the beginning of selective breeding. Selective breeding is the crossing of animals or plants that have desirable traits to produce offspring that have a combination of the parents' desirable characteristics
- Also the knowledge of genetics developed in breeding which involves crossing relatively individuals to maintain desirable traits. The various breeds of cattle, dogs, pigeons, chicken and maize, sugarcane and goats are a result of inbreeding

4. GENETIC DISORDERS

- Pregnant women can be informed about the deformation of the fetus
- It can help in the modification of disordered genes

DANGERS OF GENETIC ENGINEERING

- The outcome of genetic engineering can be weird out of our imagination
- Production of new pathogens accidentally or deliberately

9. CLASSIFICATION OF LIVING THINGS

KINGDOM ANIMALIA

The kingdom Animalia is large and composed of a wide variety of animals, which vary greatly in structure, morphology and their body function.

THE DISTINGUISHING CHARACTERS

- Animals are multicellular and each cell is bound by a plasma membrane.
- Animals bodies are differentiated into tissues
- Animals are heterotrophic.
- Animals are capable of locomotion.
- Animals have a nervous system

Animals can be placed into two major groups on the basis of presence or absence of a **Notochord**.

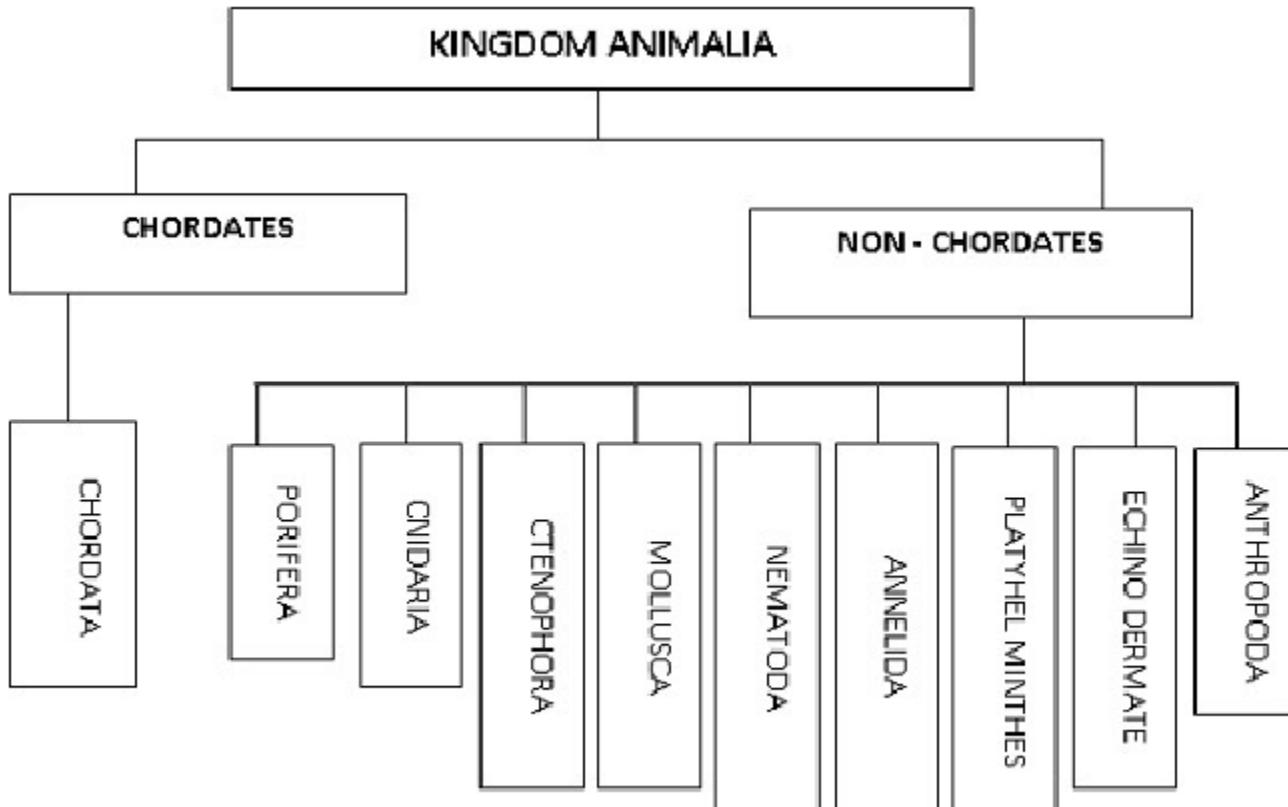
- A Notochord is a supporting rod like structure running longitudinally along the dorsal side of the animal, which may persist in life and replaced by a backbone.

■ **Chordates** are animals with a notochord

■ **Non-chordates** are animals which lack a notochord.

Chordates have only two phyla known as chordata and non-chordata comprises of many distinct phyla.

1. PHYLUM PLATYHELMINTHES



They are also called flat worms

They phylum is divided into three classes

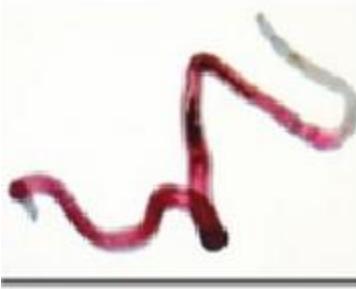
1. Trematoda
2. Cestoda
3. Tubellaria

The distinguishing character is that their bodies are dorsally flattened

(a) TREMATODA (FLUKES)

- They are all parasitic
- Some live in the blood stream, ducts or gills or skin of fish.
- Members of this class are flat
- They have suckers at the anterior end

NB: Parasites are organisms which depend on other organisms for food and other basic needs



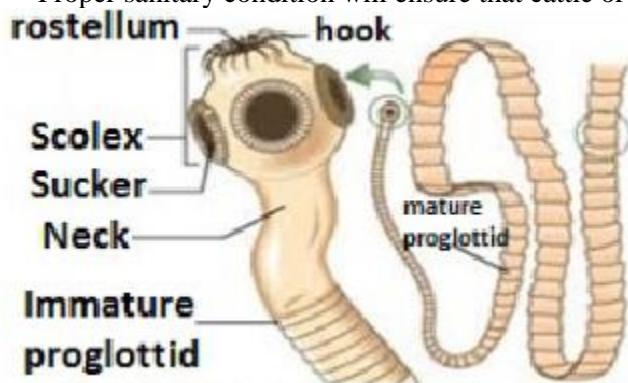
Tapeworm



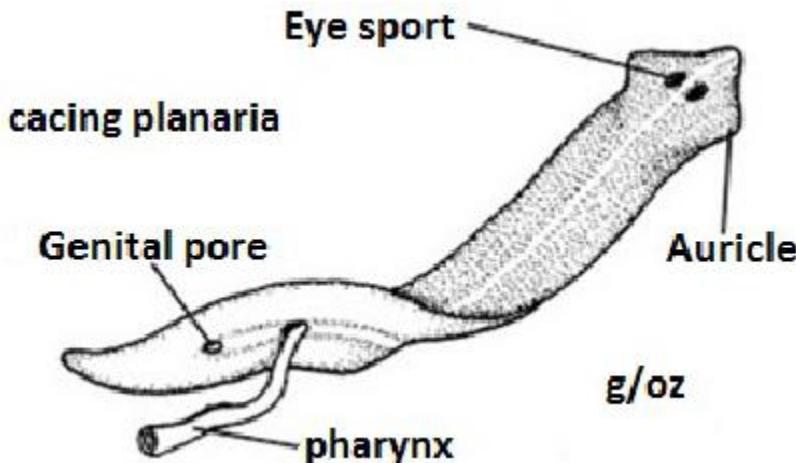
Liver fluke

(b) CESTODA (tapeworm)

- o They are flat
- o Their bodies are segmented
- o They are all parasitic
- o Certain species have suckers and hooks (e.g. pork tapeworm)
 - The adult tape worm lives in humans where it attaches itself to the intestinal wall with hooks and suckers it absorbs its host's partly digested food through its skin.
 - The tapeworm can cause symptoms of malnutrition or anemia, also pain due to irritation on the intestinal wall.
 - Infestation can be avoided by having all meat inspected for the presence of bladder worms and always be sure to cook thoroughly.
 - Proper sanitary condition will ensure that cattle or pigs do not ingest tapeworm egg with human feces.

**(c) TUBELLARIA**

- They are flat
- They have cilia on the ventral side of the body
- Some of them are parasitic
- Some of them are free living (e.g. planarian)

2. PHYLUM NEMATODA (round worms)

Nematodes are usually found in populations of very large numbers, (usually in soil-dwellings). Nematodes are circular

in cross section and have very few cells.

- Unsegmented cylindrical body with pointed ends.
- Cuticle of protein
- No cilia or flagella
- Some are free living and some are parasitic.

Ascariasis is infection of the small intestine with the giant roundworm. *Ascaris lumbricoides* whose eggs pass out in the feces and transmitted by eating food contain with these eggs. Ascariasis rarely causes symptoms and often go untreated.

Threadworms are very small roundworms that infest the intestine often in huge number. The female emerges the anus to lay eggs on the skin causing irritation itching, and these eggs are easily transferred to the transmission is by direct contact between contamination hands and mouth or by eating contaminated food.

Filariasis including Elephantiasis is common in mosquito infested regions. Elephantiasis is caused by filarial worm.

Wuchereria bancrofti which infests the lymph vessels and skin tissues. The microscopic young worms are transmitted by mosquitoes. The worms caused inflammation of the effected parts, usually legs.

Ankylostomiasis is infestation by the Hookworms, *Ancylostoma duodenale* which are small worms entering through the skin travel to the lungs then to the intestine where they attach to the wall with a ring of hooks. The egg passes out in feces. Hookworms cause diarrhea, stomach pain and anemia.

NB: Most roundworm infestations can be treated with drugs which kill the worms. They can be controlled by improved sanitation.



3. PHYLUM ANELIDA

1. This phylum includes all “true worms”

The most common species is the earth worm: marine worm's examples are clam worms, sea mouse, and tubeworm: fresh water examples are leech.

General and distinctive features

- Internal organs and body wall are segmented.
- A thin moist non-chitinous cuticle.
- The presence of **chaetae** (bristles)

The **earthworm** has a long cylindrical body pointed at one end. The anterior end has a mouth and the posterior end has anus. The earth worms have no eyes and spend its life in burrows underground.

However, it anterior part is very sensitive to light which it always moves away from.

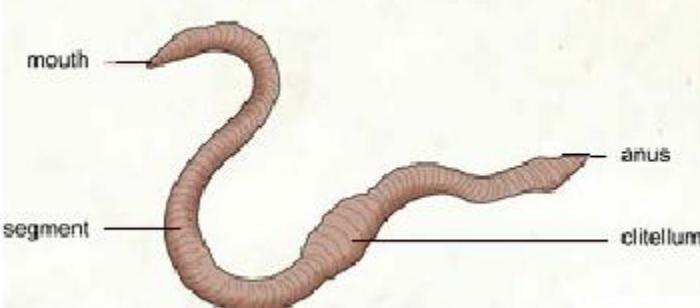
- The soft moist skin is protected by cuticle and layer of mucus.
- Each segment has 4 pairs of chaetae (excluding 1st and 2nd segment)
- **Clitellum** is the part of the body which contains eggs

IMPORTANCE OF EARTHWORMS IN SOIL FERTILITY

- They burrowing breaks up the soil and allows plant roots to grow more easily.
- Their burrowing aerates the soil, providing essential oxygen for respiration of plant roots.
- Their burrows help rainwater to drain through the soil more easily and prevent water logging.

They drag leaves and other plants part into the soil when they feed which adds humus content of the soil.

MORPHOLOGY OF AN EARTHWORM



4. PHYLUM ARTHROPODA

Phylum arthropoda consists of grasshopper, spider and crab.

The distinguishing characteristics of the phylum

- Have jointed appendages
- An exoskeleton made of chitin.

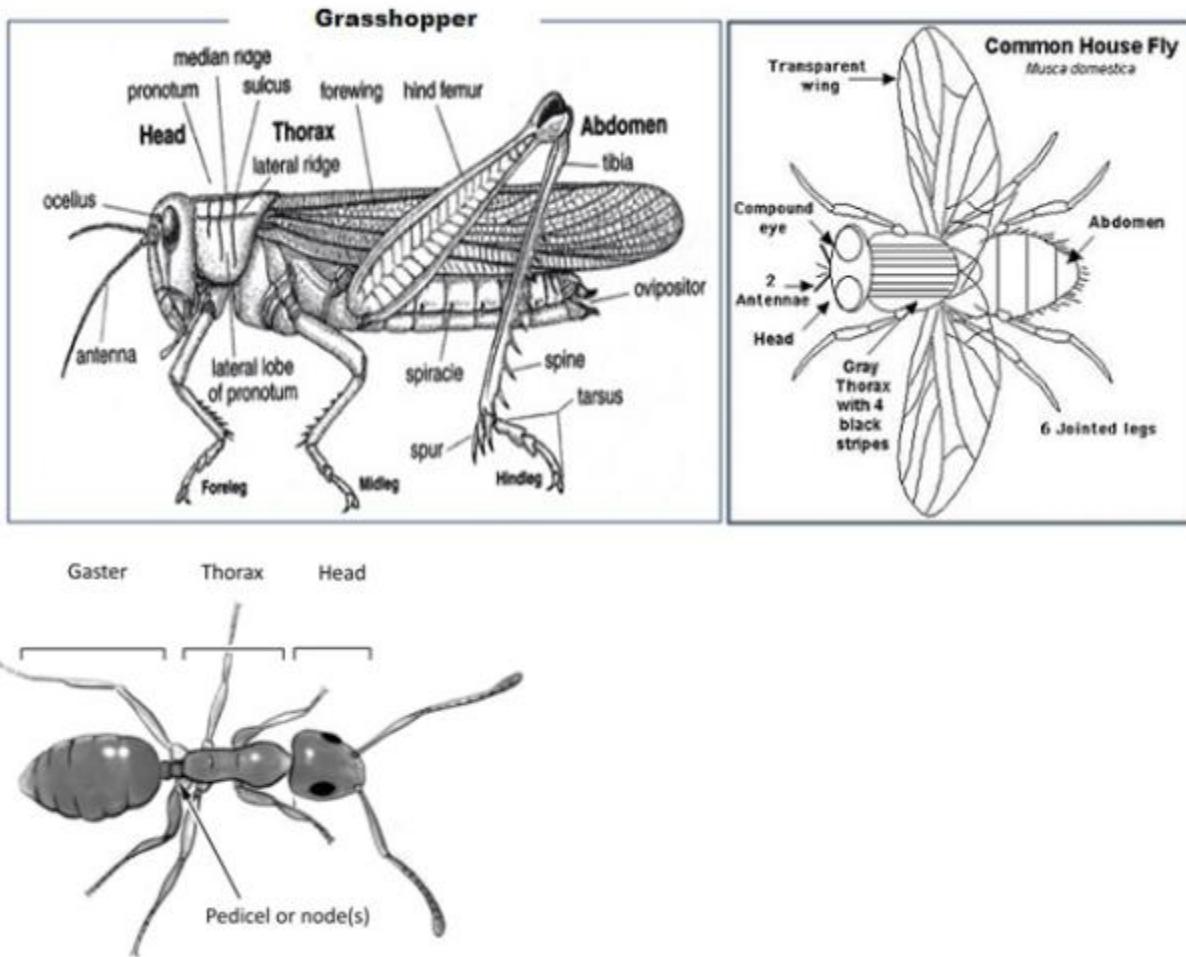
It has 5 classes which are

1. Insecta (grasshopper)
2. Crustacea (Crab)
3. Arachnida (spider)
4. Diplopoda (millipede)
5. Chilopoda (centipede)

1). CLASS INSECTA

Distinguishing characteristics of insects

1. Body is divided into three regions; head, thorax and abdomen
2. Have one pair of antennae
3. Have three pairs of joint legs
4. Most adults forms have wings



Members of this class differ in a number of ways.

- Some have wings (grasshopper) others do not (termite workers)
- Some are large (beetle) others are small (mosquitoes)
- Some are free living in water as water scorpion, in land are cockroach, housefly, grasshopper)
- Some are parasites
- If wings are present may be one pair (housefly) or two pairs (grasshoppers). Insects with 2 pairs of wings may have a hard outer pair and soft membranous inner pair (e.g. in beetles)
- Insects that feed on pollen and nectar are of economic importance as they pollinate plants
- Soil dwelling insects feed on dead plants material and are useful as they speed up the process of decay.

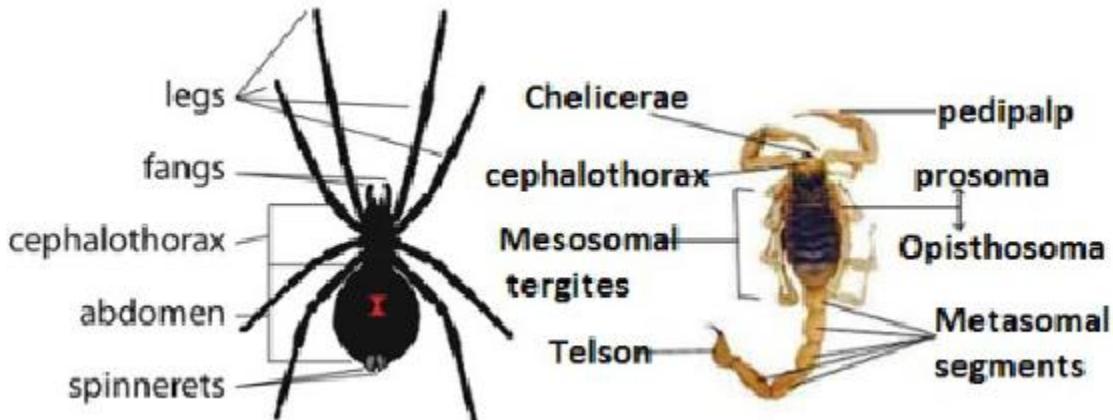
- Other insects are dangerous to humans, some carry diseases
e.g. mosquitoes (transmits malaria, yellow fever and certain forms of filariasis) and tsetse fly (transmits sleeping sickness)
- Some insects termed as pests feed on plant tissues and stored crops.
- Termites feed on living plants and dead woods, they destroy timber and attack furniture, books, boxes and other materials made from wood. (e.g. cockroach, termite, beetle)
- Housefly also transmits diseases by collecting germs from the feces and rotting material and depositing them on uncovered food.

2. CLASS ARACHNIDA

Arachnids includes spiders, scorpions, ticks and mites

Distinguishing characteristics.

- Four pairs of jointed legs
- Head and thorax fuse to form a cephalothorax and abdomen.
- One pair of chelicera (most anterior pair of appendages)



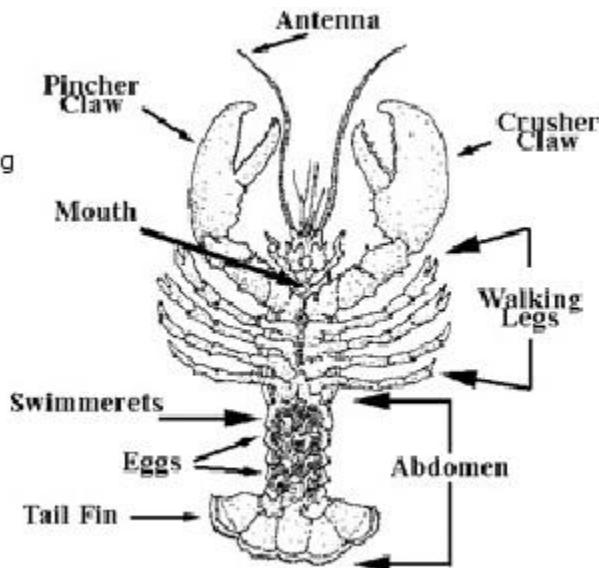
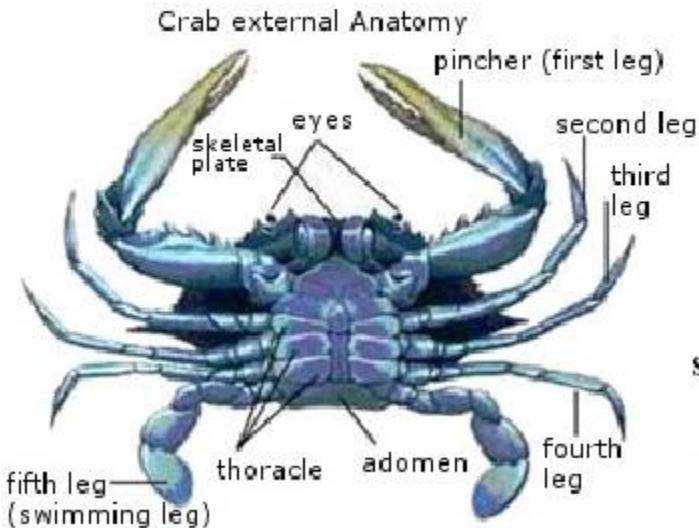
- The arachnids vary in body form and habitat.
In some arachnids as scorpions the abdomen narrow's posterior. Some are aquatic while others are terrestrial.

Economic importance of spiders is that they feed on pests insects. However some are poisonous.

3) CLASS CRUSTACEA

Distinguishing characteristics

1. Two pairs of antennae
 2. Bi - forked appendages
- Members of the class crustacean vary in habit and body form some are marine (crab, lobsters, prawns) others are fresh water or in most places in land.
 - Some have the hard body covering at the anterior end.
 - Aquatic crustaceans may have telson at the posterior end which helps in swimming movement.
 - crab, lobsters, prawns and shrimps are important to human food



CLASS CHILOPODA AND DIPLOPODA

These are two similar classes of phylum arthropoda

Distinguishing features

Have long body consisting of many segments.

4) CHILOPODA:

It consists of centipedes

- The body of centipedes is flattened dorsal ventrally.
- They have one pair of legs on each segment
- Are carnivorous feeders

5) DIPLOPODA:

It consist of millipedes

- The body is rounded
- Have two pairs of legs on each segment
- Are herbivores feeders.
- Millipedes can be dangerous / detrimental in that they feed on roots and other parts of the growing crops
- NB: - Both centipedes and millipedes are soil dwelling animals



Centipede



Millipede

5. PHYLUM CHORDATA

The distinguishing characteristic

- They have a notocord in the embryonic stage. In most of chordates it is replaced by a vertebral column.
- The nerve cord is hollow and placed dorsally to the gut.
- They have gill slits at least during the embryonic stages.
- They have a tail which is behind the anus.

The presence or absence of gill, fins, mammary glands, seabacious glands, dry scaly skin, moist skin, tadpoles, wings, feathers, hard egg shells and beak is used in the classification of this group.

Classes of phylum chordata

1. Class chondrichthyes
2. Class Osteichthyes

3. Class Amphibia
4. Class Reptilia
5. Class aves
6. Class mammalia

1. CLASS CHONDRICHTHYES

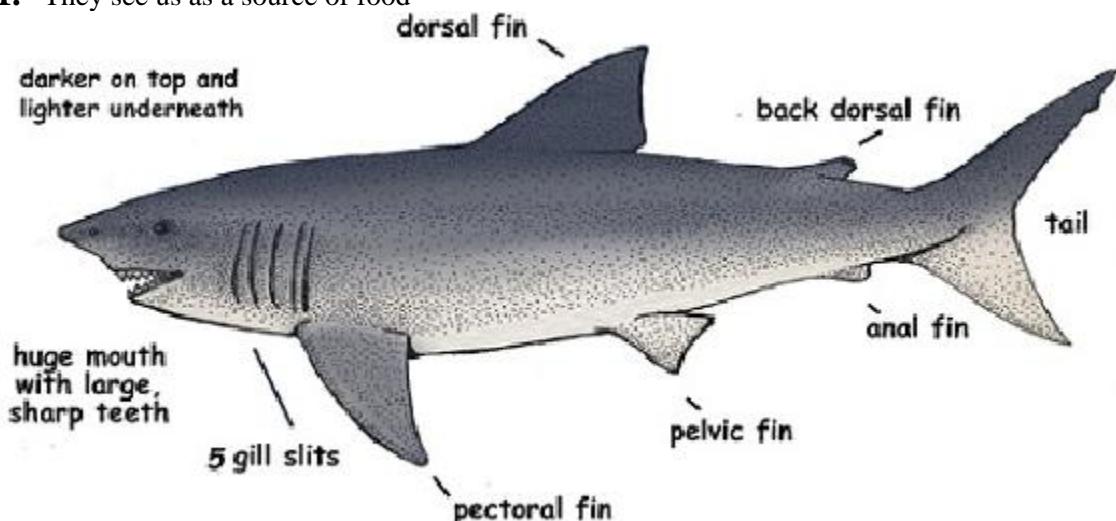
This class include cartilaginous fish include sharks, skate and rays. Almost all are marine some are dorsal ventrally flattened and others are spindle shaped.

Distinguishing characteristics

1. The skeleton is made of cartilage
2. The body is covered with placoid scales
3. The caudal fin (tail) has two lobes that differ in size
4. Each pair of gills is in separate compartment
5. The gills slits are visible (there is no operculum gill cover)
6. The mouth and two nostrils are centrally placed.
7. The body temperature varies with that of the environment i.e. they are ectotherms/poikilotherms/cold blooded some are important source of food to humans.

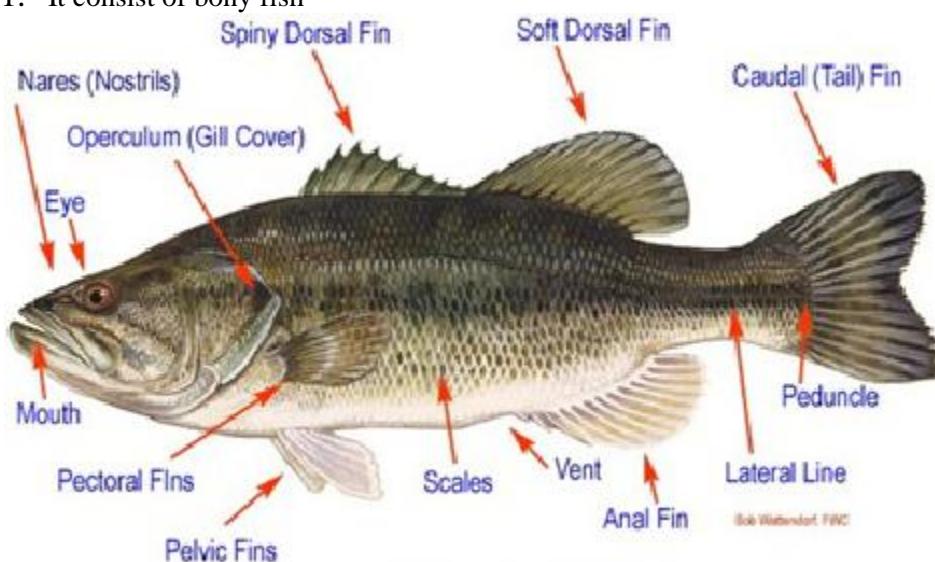
Disadvantage

1. They see us as a source of food



2. CLASS OSTEICHTHYES

1. It consists of bony fish



Distinguishing characteristics

1. Skeleton is made up of bones
2. Their Body is covered with overlapping bony scales
3. Mouth is terminally placed and nostrils found dorsal surface.

4. Gills are found in a common chamber and are covered by an operculum
5. Tail fin has lobes of some size.
6. Most have an air sac (swim bladder) which aids buoyancy
7. Body temperature varies with environment, (they are ectothermic/poor kilothermic).

NB: Member of these class vary in form, size and habitat. The majority have scales while some do not. Are found both in sea water and fish water. Most have gills but small groups have lungs.

Advantage: -

1. Important source of food to humans
2. Important source of employment (fishing)
3. Fish oil are important medicinally
4. Fish meal is used as fertilizer

3. CLASS AMPHIBIA

It includes toad, frog, salamander and limbless amphibians; They have to spend part of their lives in water. Most amphibians lay eggs in water and young stages live in water. Only adults can live on land.

Distinguishing characteristics

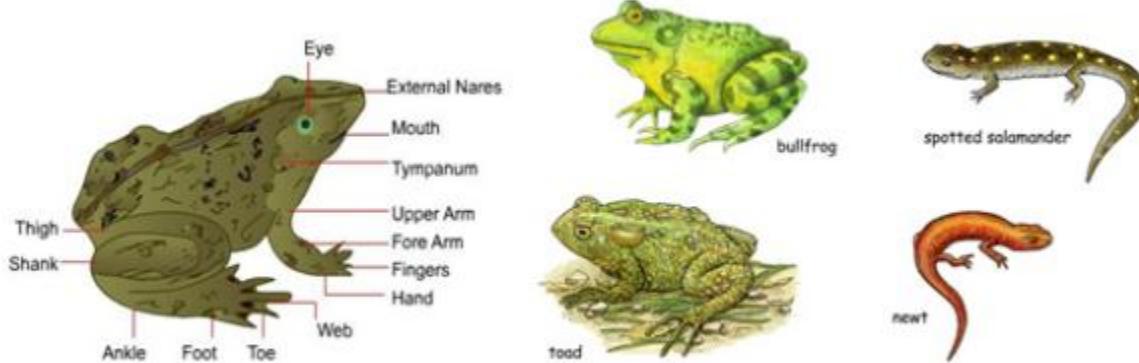
1. Skin is always moist and without scales.
2. Life cycle involves larval form called **Tadpole**
3. External and internal gills are present in larval stages.
4. Have a heart with three chambers (two-atria and one ventricle).
5. Gaseous exchange is by gills in tadpoles and by lungs/ skin and mouth lining by adults.
6. Eggs are covered with a jelly like substance and laid in water.
7. Body temperature varies with that of environment (i.e. they are ectotherms /poikilothermic).

NB: -

- Amphibians vary greatly in size body form and habitat. Some are large (toads) others are small (tree frog).
- Most have limbs, few do not and look like snake or worms
- Some amphibians have webbed toes, another do not
- Amphibians are never found in salty water.

Advantage:

Some feed on insects and pests which would otherwise destroy crops.



4. CLASS REPTILIA

Reptilia are thought to have evolved from Amphibians. Four main groups of reptiles are snakes, lizards, turtles and crocodiles.

Distinguishing characteristics

1. Have dry skin covered with horny scales
2. Have a heart divided into two atria and partially divided ventricles. But in crocodile the heart has four chambers separately.
3. Body temperature varies with that of environment (ectothermic /poikilothermic)
4. They lay eggs on land covered with soft shells

NB: -

- They vary greatly in size form and habitat.
- Some are limbless (snakes) others have limbs (Lizard and crocodile).
- Some have protective shells (tortoise and turtles).
- Some are aquatic and others are terrestrials

- Other representatives of Reptiles are tortoise, chameleon

Disadvantages

- Some reptiles are poisonous and they attack and kill humans on occasion (snakes and crocodiles)



5. CLASS AVES

Most birds are distinguished by their ability to fly although some are flightless (e.g. ostrich and penguin)

Distinguishing features/characteristics

1. Body is covered with feathers
2. The anterior of limb is modified into wings
3. The mouth is modified into a beak which varies according to feeding habits
4. They lay hard - shelled eggs
5. They maintain temperature at a constant level (homoeothermic/ warm blooded)

NB:-

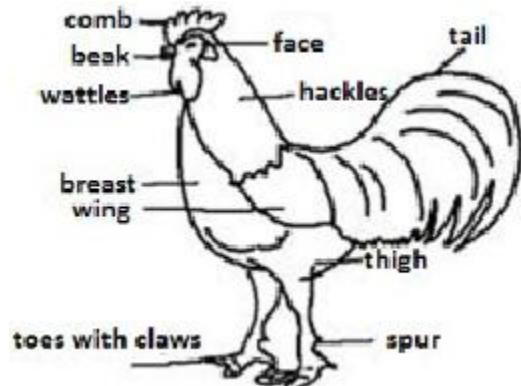
Birds vary in size form and habitat

- Some are large (ostrich) others are small (Sunbird)
- The body is spindle- shaped and streamlined
- Most birds have hollow' bones to reduce weight and aid flight
- Birds with webbed feet can swim in water (ducks)

Advantages

1. Source of food to human by eggs and meat from domestic fowl and other birds
2. Provide stuffs for cushions and pillow's from feathers of fowl.

6. CLASS MAMMALIA



- It includes bat, rat, cow, mouse, man. All mammals have a highly developed brain

Distinguishing characteristics

1. Have hair of fur on all or part of their body.
2. Have mammary glands.
3. Have teeth of different types and shapes (heterodont dentition).
4. Have a diaphragm.
5. Their red blood cells have no nucleus.
6. They are viviparous (zygote develops and get requirement internally).
7. Have sweat glands in the skin.
8. They maintain their body temperature at constant level (homoeothermic/warm - blooded).

NB:

- They vary greatly in size form and habitat
- Some are very large (elephant) others are very small (mouse and rat)
- Some have wings (bats)
- Many have pinna (outer opening of the ear)
- May have either horns, hooves, claws or nails
- The heart has four chambers
- Most live on land while others live on water

Advantages

1. Food sources (cattle, sheep, goats, rabbits)
2. Sources of materials(skin for leather, and feces for manure)
3. Eco -tourism (wildlife park and game reserves)

Disadvantages

1. Predation of humans and livestock
2. Crop damage

10. ORGANIC EVOLUTION

CONCEPT OF ORGANIC EVOLUTION

Organic evolution

Is the gradual development of organisms from simple life forms to more complex life forms over the course of time. Evolution answers the question why do organisms show such great diversity/ difference. Also evolution is the process of change by which new species are formed from pre-existing species.

The main theory idea of evolution is that population of living things do undergo changes over generation. According to this theory some organism resembles each other hence they have a common ancestor e.g. Human being and Primates, Donkeys and Zebra.

Importance of organic Evolution

1. Results to the emergence of new species from pre-existing ones (the new species are able to adapt to the changing environmental factors as climate and food)
2. Organic evolution can modify some of the body structures of the organisms to match the need of the environment
3. Organic evolution can modify immunity system to increase the survival value

ORIGIN OF LIFE

It is believed that Earth formed around 4.54 billion (4.54×10^9) years ago by accretion from the solar nebula. Volcanic out gassing probably created the primordial atmosphere, but it contained almost no oxygen and would have been toxic to humans and most modern life. Much of the Earth was molten because of extreme volcanism and frequent collisions with other bodies. One very large collision is thought to have been responsible for tilting the Earth at an angle and forming the Moon. Over time, the planet cooled and formed a solid crust, allowing liquid water to exist on the surface. The first life forms appeared between 3.8 and 3.5 billion years ago. The earliest evidences for life on Earth are graphite found to be biogenic in 3.7 billion-year-old meta-sedimentary rocks discovered in Western Greenland and microbial mat fossils found in 3.48 billion-year-old sandstone discovered in Western Australia. Photosynthetic life appeared around 2 billion years ago enriching the atmosphere with oxygen. Life remained mostly small and microscopic until about 580 million years ago. When complex multicellular life arose, During the Cambrian period it experienced a rapid diversification into most major phyla.

THEORIES OF THE ORIGIN OF LIFE

There are four theory of origin of life which are the following

1. Special creation
2. Spontaneous generation
3. Steady state
4. Organic evolution (scientific evolution)

1. Theory of special creation

According to this theory life was nonexistent before a particular time then the supreme being super natural father created all living things and there was life on earth. These theories are found in holly books.

2. Theory of spontaneous generation

Scientists believed that from non living matter living matter developed

Example; Worms and frogs could have come from mud, dust or rotten food. This theory was applied up to the 19th century but no longer applied

3. Steady theory

These theory they don't explain the origin of the planet, earth and all organisms. Say people found life with no source.

4. Organic evolution (scientific theory of evolution)

It states that life probably started by a catalytic effect that made free elements to combine to form molecules. Elements combined by a catalytic effect probably lightning, ultra violet radiation or possibly gamma rays. The first four gases to form were ammonia, hydrogen, water vapour and methane.

This theory was supported by Stanley Miller who used an electric spark to synthesize amino acids from the above four mentioned gases

These molecules further combine to form a stable system capable of releasing energy and replicating its self these were the first living organisms resembling the present day viruses and bacteria more complex organs develop later.

Origin of species

It is the process by which new species were formed from pre existing ones

Causes of origin of species

i. Isolation of mechanisms

The demes of the organisms were not distributed evenly on the land they were isolated due to natural disasters or behavior changes these isolations were the causes of origin of new species.

ii. Reproductive isolation

This is caused by such changes that bring about barriers to successful mating between individuals of the same species

iii. Ecological isolation

These are environmental barriers that keep population or demes apart. These barriers make demes occupy different types of habitat from the original type

iv. Geographical isolation

These are physical barriers such as ocean, seas, mountains, ice valleys etc. These geographical barriers prevent the organisms from exchanging their genes

v. Behavioural isolation

This is the change in the behavior before matting period i.e. Courtship or nesting. The prospective changes take place if fertilization occurs

Evidence of origin of evolution

1. Fossil records
2. Cell biology comparative embryology
3. Comparative anatomy
4. Comparative physiology
5. Comparative embryology

1. FOSSIL RECORD

Fossil are remains of the organisms that lived in ancient times. The age of a specimen can be determined by the weight of the carbon in that specimen e.g.

A fossil containing 5g of carbon showing the organism had been 5600 years old. Archeological discovery showed that homonidae family which humans belong. The pongitae family to which appears like chimpanzees and the gorilla belong arose from primate stock called **proconsul** as per archeologist evidence the earliest hominids appeared about four million years ago. They were not having culture of tools making and fire making. From the same family genus homo are some development and changes to homo habilis.

Homo habilis used tools and became extinct about 1.5 million years ago.

The next species emerged were homo erectus the organism which was able to stand in an erect position homo erectus was showing communal life and work fire and toll making.

The present day's species are homo sapiens or rationalizing man which was behaving high intellectual capacity ability to communicate through languages ability to show many skills

2. CELL BIOLOGY

All the cells of higher organisms show basic similarities in their structure and function i.e. all cells have DNA as carrier of genetic information. All use roughly the 20 amino acids to synthesis protein and all use the ATP as energy carrier the fact that all cells have the cell membrane, ribosome and mitochondria etc which perform similar functions indicate that all organisms had a common ancient origin.

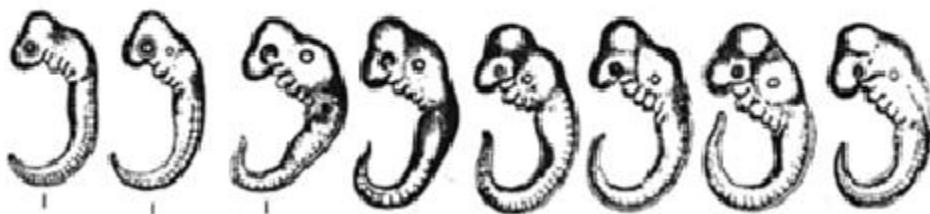
These are other structures and chemical substances that are confined to specific groups of organisms. Organisms sharing the same chemical characteristics are considered to be more closely related this principle has been recently used to confirm phylogenetic relationship this principle is known as **biochemical homology**

E.g. of biochemical homology

- most plants contain chlorophyll, cellulose and starch which are absent in animal tissues
- vertebrates are the only animals that posses adrenaline and thyroxine
- only algae posses orange pigment called fucoxanthin

3. COMPARATIVE EMBRYOLOGY

This is the branch of embryology that contract and relate the embryo of the different species. It helps to show how all organisms relate. Many living thing are compared. Whether or not organisms have a notochord or not it has gill arches. Many things go into comparative embryology and many things can be included



Comparative anatomy

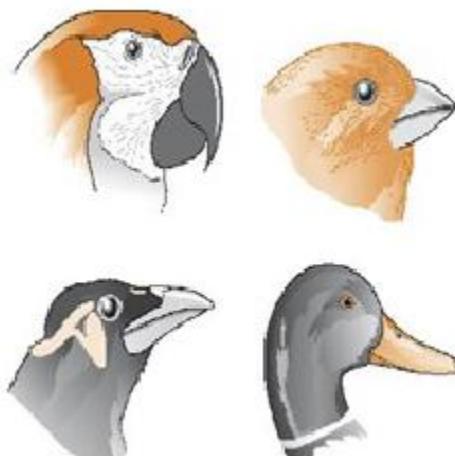
Organisms with basic structural similarities have a common related ancestral. Based on the structural similarity their functions anatomical studies are divided into:

1. Homologous structures

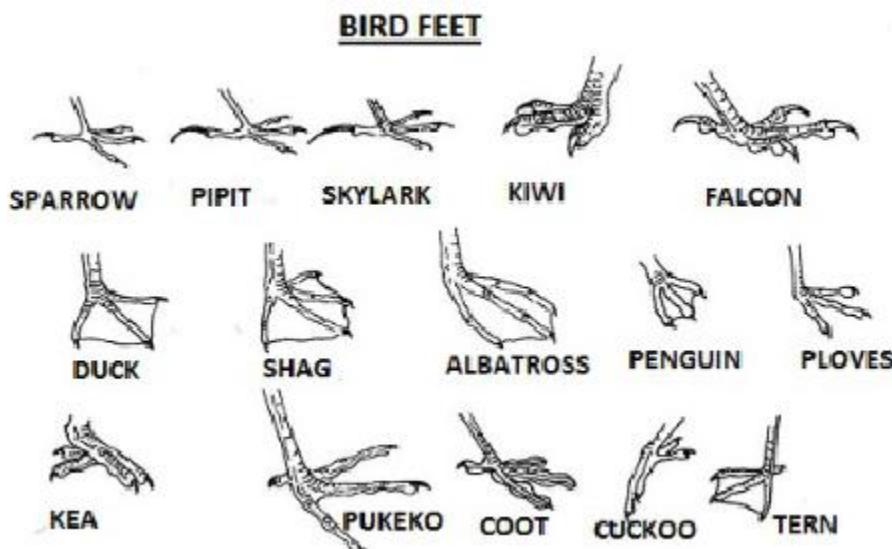
These are structures that perform different functions though they have similar ancestral origin

Examples:

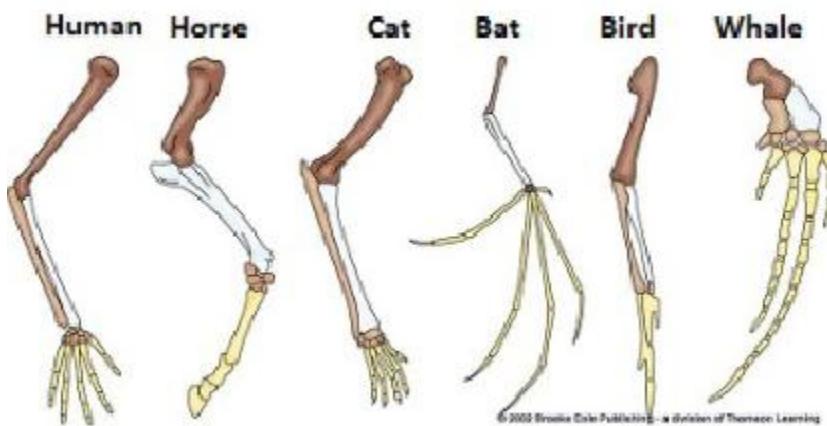
Beak structures in birds



Feet structures in birds



Limb structure in vertebrates



The type of evolution where by organisms with similar ancestral origin develops structures that form different functions is **called divergent evolution**.

2. Analogous structures

These are structures that perform similar functions though they have different ancestral origin

Examples: Wings in birds and insects. Eyes of the human and octopus

3. Convergent evolution

This is the type of evolution where by organisms with different ancestral origins develop structures which appear similar in the form and structure Vestigial structures

These are structures which are developing from generation to the next but they serve no use.

Example: appendix in humans, wings on flightless birds like the ostrich

4. Comparative physiology

Due to continental drifting organisms with a common ancestral origin became isolated and hence evolved into different species examples; monkeys with long tails found in the Amazon while monkeys with short tails found in the African continent.

MECHANISM OF EVOLUTION

These are many theories to explain possible mechanism of evolution

1. Lamarck's theory
2. Darwin's theory
3. Neo Darwin's theory
4. Punctuated equilibrium theory

1. Lamarck's theory

Lamarck led to the principle of natural use and disuse of structure. He observed that the more an individual used a part of his body the more developed that part became

If an individual failed to use a particular part that part became weak and finally disappeared Lamarck concluded that the giraffe developed a long neck due to its use while the flight less birds had their wings reduced and function less due to their disuse

Lamarck proposed that these changes of structure acquired during the life time of an individual were transmitted to their off springs which resulted into the emergence of new species

Merits in Lamarck's theory

According to Lamarck an individual is able to develop structures to suit the need of the environment it increases the organism survival in the diverse environment

Demerits in Lamarck's theory

Modern genetics tells that the phenotypically acquired characteristics cannot inherit therefore Lamarck cannot explain the emergence of the new species

2. Darwin of the theory

Charles Darwin proposed three theories

1. Natural selection.

Some individual posse's particular variation in a population which are the key factor in determining survival and adaptation to the environment. These variations are selecting advantages given to one organism over another organism.

2. Struggle for existence.

As the population increases, causes competition between individuals for environmental resources as a result creates struggle for existence.

3. The survival for the fittest.

Organism with favourable variations will be selected by the environment and the unfavorable variations unfit characters will be eliminated.

Merits of Darwin's theory

According to Darwin a number of species tend to remain constant all the time due to the regulating factors such as food, disease and predation etc.

Demerits

- Darin theory did not explain how changes occurred by chance.
- He was not able to explain how transmission of the traits occurs

3. Neo Darwin theory

These are theories that arose after Darwin theories. It said the processes of evolution can be traced to changes that take place due to mutation.

Mutation brings changes which can pass to the next generation which leads to the emergence of new species

4. Punctuated equilibrium theory

This theory was put forward by Stephen Gould and the Niles Eldredge they proposed a specie remain stable for long time [equilibrium] but often sudden and unpredictable changes spring up punctuated giving rise to new structures and new species

EFFECT OF ORGANIC EVOLUTION

1. Sickle cells anemia

Is the hereditary disorder in which the red blood cells assume a sickle crescent shape making them less efficient in the transportation of oxygen. People with sickle cell traits are more resistant to malaria than normal people

2. Resistance to insecticides and drugs

There are some organisms that develop resistance to chemicals such as insecticides and antibiotics in continued use.

Examples; DDt mosquitoes, penicillin and bacteria

Melanin pigment

There are some organisms that occur in two or more distinct forms which is known as polymorphism.

Examples of polymorphism is prepared moth which occurs in white form and melamine form or dark form

The moths are normally found on the trunks of branches of the trees where they camouflage against predators. In the population of the melanin due to the environmental pollution subject to predation population because of the darkened tree trunks and branches which makes them less white moths are decreasing

Factors that bring about evolution

Evolution on living organism are brought about by various things such as:

1. Mutation
2. Migration
3. Environmental changes
4. Crossing over
5. Artificial selection

11. HIV, AIDS AND STD's

HIV

HIV stands for human immunity deficiency virus. HIV weakens the body immune system by entering into white blood cell (lymphocytes) and binds itself to chromosome and integrates into the genetic material. The virus now multiplies very fast using genetic materials of White Blood Cells. The daughter virus invades White Blood Cells destroy and kill them. As more White Blood Cells are killed the body becomes less and less fight against disease. Patient with aids are prone to opportunistic infection caused by fungi, bacteria and protozoa.

In nutshell people with AIDS die with disease their body cannot resist. These diseases are referred to as **opportunistic infection**.

E.g. tuberculosis, severe diarrhea, skin cancer and pneumonia.

AIDS

AIDS stand for: *Acquire Immune Deficiency Syndrome*. For someone with AIDS T-helper fall below.

The T-helper count for health person range between 450 and 1200

CAUSES

AIDS is viral infection caused by a strain of a virus called **HIV**.

HIV means *Human Immunodeficiency Virus*.

HIV mainly found in body fluids such as blood, semen and vaginal secretion. Also traces of **HIV** found on saliva, tear and sweat

1. Primary stage (window stage) : It does not show any symptoms except for slight flu HIV test result is negative
2. A-symptomatic stage : Has no symptoms but the HIV test is positive
3. Full blown aids : Where by one gets various opportunistic infections and diseases

SEXUALLY TRANSMITED INFECTION

These are infection, which are transmitted through sexually contact during sexually intercourse. Sexually transmitted disease are also referred to as *venereal disease*

RELATIONSHIP BETWEEN HIV, AIDS AND STD's

- HIV is sexually transmitted. Having STD's can increase risk of acquiring and transmitting HIV.
- Some STI's such as Chlamydia cause open sores in the skin and become exit point into and from the blood stream of HIV.
- Studies show that infected people to be affected with other STIs are three to five times more likely to transmit the virus through sexually contact.

SYMPTOMS OF HIV/AIDS

- Loss of body weight
- Diarrhea for longer than a month
- Shortness of breath
- White layer in the mouth and in the throat
- Swollen glands especially in the neck

TRANSMISSION OF HIV

HIV is transmitted via body fluids such as blood, breast milk, vaginal secretions, sweat, saliva, tears. The most common ways of HIV transmission are:

1. Sexual intercourse with an infected person
2. Blood transmission from a infected donor
3. Organ transplants from an infected donor
4. An infected mother to her child during pregnancy birth or breast feeding
5. Using unsterilized surgical or skin piercing instruments, such as scalpels, needles and circumcision blades that have been used on an affected person
6. Sharing toothbrushes, shaving blades or nail cutter with infected person.

NOTE: HIV is not spread by casual contact such as hugging, shaking hands, or touching unless both people have bleeding wounds

Effects:

- They causes death
- Increase a poverty
- Increase the problems of orphans and street children
- It led to stigmatization among society member
- People with HIV and AIDS get opportunistic infections and disease,

For example: -

- Chest infections e.g. pneumonia. TB

- Brain infections leading to mental confusion, severe headache and fits
- Stomach or gut infections leading to severe diarrhea
- Skin cancer i.e. Kaposi sarcoma

PREVENTION AND CONTROL OF HIV/ AIDS

1. Avoid promiscuous sex partner prostitutes, commercial sex workers (avoid irresponsible sexual behavior abstain from sexual intercourse (if not marriage) be faithful to one sexual partner, use condom during sexual intercourse
2. Wear disposable gloves when touching peoples body fluid
3. Use sterilized instruments during surgery, circumcision and delivery
4. Only screened blood and organs should be used for transfusion and transplants
5. Go for HIV test in order to know your status
6. Do not share tooth brushes and shaving blades
7. People with HIV and AIDS should be given Anti—retrovirus drugs (ARV'S) which help them to show down infections.
8. Pregnant women should attend pre-natal clinic where they can be treated to prevent mother to child transmission.
9. HIV positive mothers should not breast feed their new born babies.
10. Follow the ABC rule. (Abstain. Be faithful and use Condom).

CARE AND SUPPORT FOR PEOPLE LIVING WITH HIV AND AIDS (PLWHA)

People living with HIV and AIDS can live health live for a long time if they get proper care and support we can care for them and supported them in the following ways:

- Give them well balanced meals in adequate quantities.
- Allow them to rest when they feel unwell.
- Taking them to a health center as soon as they start developing signs of illness.
- Provide them with ARV'S allow them to work.
- Behaving in a loving way towards them and listen them.
- Counseling them to stop behavior that worsen
- Not discriminating against them or stigmatizing
- Hiding them from the public, denying them education or health services
- Chasing them away from home
- Refuse to share utensils or rooms with them
- Care and support gives People Living with HIV and AIDS (PLWHA) hope, good health piece of mind, long life strength to work and comfort.
- Discrimination led to depression, loneliness, loss performance at work and school.

IMPORTANCE OF HEALTH CARE FOR STI's, STD's AND OPPORTUNISTIC DISEASES

- Early testing and treatment will help to treat or slow down the development of the infection or disease in its early stage
- Proper treatment can save life and prevent long term effects such as infertility
- Healthcare professionals can give appropriate counseling on how to manage the infections
- Testing gives peace of mind
- Proper health care reduces the chance of infecting other people.

VOLUNTARY COUNSELING AND TESTING (VCT)

It is a process that is undertaken when a person wants to find out if they are infected with HIV. Because it is voluntary, a person who thinks they might have HIV decides on their own whether they want to have the test done. If the individual decides to go ahead with the testing they will have the opportunity to discuss the test with a trained counselor.

Most clinic use a rapid accurate scientific test that makes the results available, usually within twenty minutes after the test has been performed.

Voluntary Counseling and Testing (VCT) for HIV is an efficient internationally recognized approach for people to find out their HIV status at VCT centers. It has become one of the most effective and popular ways of diagnosing people who may have been exposed to the virus or who have been infected.

VCT is an important tool for preventing the spread of HIV—especially in communities where the epidemic is widespread. It allows for adolescents to find out their own HIV status in order to evaluate their behavior and its consequences.

VCT clinics usually have 45 minutes counseling sessions that provide information about HIV and AIDS and the testing process. VCT provides a confidential and non-judgmental environment for people who want to know their HIV status. VCT can help to improve advocacy and reduce stigma by giving people the opportunity to talk anonymously and confidentially with counselors about their HIV status. Voluntary counseling and test involve pre testing counseling and post testing counseling.

Pre testing counseling is done in advance before HIV test Post testing counseling is done after HIV test if it is positive.

There are Three Main Steps in VCT:

First, there is a session of pre test counseling where questions about HIV/AIDS and the test are discussed and answered by a counselor. The counselor will help the individual determine whether testing is appropriate given the information that is shared with them about the reasons the individual wanted to be tested. Sharing information about their past sexual behavior will help the counselor determine whether testing is appropriate. After making their assessment, if the counselor deems it appropriate for the person to take the test they should

1. Describe the test and how it is performed
2. Explain AIDS and the way HIV infection is spread
3. Discuss ways to prevent the spread of HIV
4. Explain the confidentiality of the test results
5. Discuss the meaning of the possible test result
6. Ask what impact you think the results of the test will have on you
7. Discuss whom you might tell your results to
8. Discuss the importance of telling your sex and or drug-using partner(s) if the results come back positive

Second, when the person decides to have the HIV test they must sign a consent form before the test can be administered. Informed consent is a crucial part of the VCT process and it is important that the individual is aware of their right to refuse any medical procedure, to be informed about it and to agree to it. There is a statement which they should be asked to read beforehand stating that they have been informed about the HIV-antibody testing procedure, that they understand, and have given their consent to have the test performed.

Finally, after the test has been done the counselor gives the results to the person in the post-test counseling session (it usually takes around fifteen to twenty minutes after the test has been administered for the results to come back. If they are found to be HIV-positive (meaning that they have HIV) then they are referred to medical specialists and other counselors in order to aid them in receiving treatment and support.

WHO SHOULD SEEK VCT SERVICES

- i. Anyone who has been exposed to the risk of sexual behavior.
- ii. Anyone who is seriously considering changing his / her sexual partner.
- iii. Anyone who is diagnosed with sexually transmitted infections.
- iv. Anyone who has had more than one sexual partner.
- v. People who are sharing sharp instruments.
- vi. Commercial sex workers.
- vii. Refugees and migrant workers.
- viii. Anyone who wishes to find out his /her sexual partner.

SIGNIFICANCE OR IMPORTANCE OF VCT

- i. It is a way to find out about HIV and AIDS status so that a person can plan for the future.
- ii. It is an effective way of preventing HIV and AIDS because it promotes sexual behavior change and helps people to make wise decisions.
- iii. It is a means of HIV and AIDS treatment and care.
- iv. It helps people to get useful and right information about HIV and AIDS.
- v. It provides psychological support for people living with HIV and AIDS thus helping them to lead a normal life.
- vi. It helps the government in planning for care and treatment by knowing the number of infected people.
- vii. Testing negative is a strong motivation for one to reduce sexual behavior.
- viii. Testing positive gives one an opportunity to find out how he / she can live longer and a more productive life.
- ix. It gives confidence to the people that are planning marriage or pregnancy.
- x. It helps to prevent mother to child transmission.

Some barriers to VCT for young people

- i. Some of the barriers to VCT for young people include limited availability, legal issues and accessibility of VCT services.
- ii. Waiting times and costs.
- iii. Pressure by health staff to notify partners.
- iv. Worries about confidentiality and fear that the results of HIV tests would be shared with partner(s) and/or parent(s) without their consent.
- v. Fear of being stigmatized and labeled by their friends, families and communities.
- vi. Inadequate prevention, care and support from health care providers (i.e. counselors, doctors, nurses etc.) to effectively meet the needs of youth.

PROCEDURE AND TECHNIQUES OF VCT

- i. Counseling and testing must be truly voluntary.
- ii. The counselor should cross check code numbers on all forms against the client codes.

- iii. The results should be provided to a person in person to ensure that the correct person receives the results this also helps to maintain confidentiality.
- iv. The counselor should ensure the person has enough understanding of the results.
- v. The result should be provided in the manner that it is easily understood by the client if the result is positive the counselor should be gentle and provide emotional support so as to help the client cope with the situation.
- vi. When the client is negative the counselor should provide information on how to remain negative
- vii. It is better to provide pre testing counseling and guiding.
- viii. The counselor should be aware in the manner he /she calls clients from the waiting area to avoid verbal or non verbal behavior that might disclose the status of the client and he can be mentally distressed.
- ix. Unless it is very necessary result should not be provided in written form.
- x. The results should not be given if the client is not ready to accept them.

XX

******Prepared by Sr. Donny******

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