INSTRUCTIONS

1. Write all provided notes in your biology exercise book
2. Be careful when copying to avoid spelling errors
3. All appeared diagrams in this notes should be drawn neatly using pencil and labeled correctly using blue/black ink
4. The notes should be completed before re-opening of the school JANUARY 2021

NOTE;

The notes should be written with your own hand writing, it is prohibited notes to be written by another person.

MOVEMENT

THE CONCEPT OF MOVEMENT AND LOCOMOTION

Movement refers to change in position or posture by the whole organism or part of the organism.

Movement occurs at various levels like:

(i) **Cellular level:** At this level movement is by cytoplasmic streaming e.g. amoeba and swimming of the male gamete (sperm).

(ii) **Organ level:** In animals movement of organs is brought about by contraction and relaxation of muscles e.g. contraction of the biceps muscles and relaxation of triceps muscles in human arm cause the arm to be raised.

(iii) **Organism level**: At this level the whole organism moves from one place to another.

Movement occurs in both animals and plants.

IMPORTANCE OF MOVEMENT IN ANIMALS AND PLANTS

1. Organisms move in search of food and shelter.
2. Organisms move away (escape) from danger and unfavourable conditions.
   For example:
   - Birds migrate during extreme cold weather
   - Prey move away from predator.
3. Movement enables plants to grow towards positive stimulus and away from negative stimulus.
   For example:
   - Plant shoots bend toward the source of light
   - Roots grow away from the rock
4. Organisms move to find mates so that they reproduce.
5. Locomotion aid in insect pollination as insects carries pollen grains from one flower to another.

TYPES OF MOVEMENT

Living things show one of the following types of movement:

(i) Movement of curvature (growth movement)

(ii) Movement of locomotion

MOVEMENT OF CURVATURE

This refers to the movement of plant organs in response to stimuli.

- Plants remain fixed to the ground hence they are incapable of moving from one point to another. They use their organs such as leaves, stems and roots that show growth responses.
- Movement of curvature enables plants to obtain their requirements inspite of being fixed to one point.

Examples of movement of curvature are

i. Tropic movement
ii. Nastic movement

MOVEMENT OF LOCOMOTION

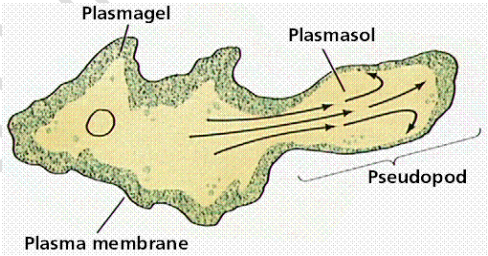
This refers to the change in position of the whole organism from one place to another. This movement is exhibited by all animals and some protoctists.

FORMS OF MOVEMENT OF LOCOMOTION

(i) AMOEBOID MOVEMENT

This is the movement of an organism or part of an organism which is aided by the bodily fluid e.g. in **amoeba** and **white blood cells**. When an organism move in a certain direction, the cytoplasm extends by flowing into that direction. In this way amoeba forms a projection called Pseudopodium (false foot).

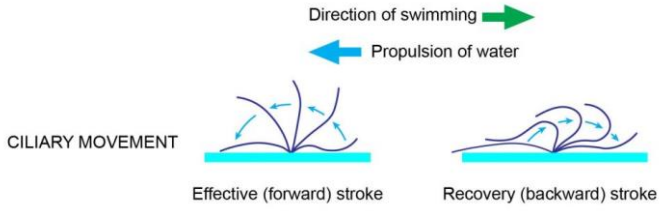
Further extension of pseudopodium in some direction causes some more cytoplasm to flow into it hence amoeba moves in flowing manner.



(ii) CILIARY MOVEMENT

This is the movement using cilia and is exhibited by ciliates like paramecia and larva of some aquatic animals. The bodies of such organisms are covered by thousands of hair like structures called cilia.

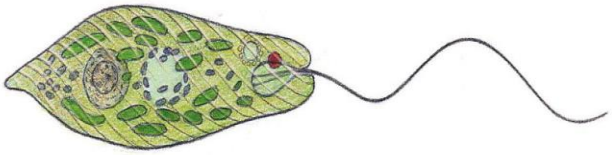
This movement is brought about by backward and forward beating of cilia.



(iii) FLAGELLA MOVEMENT

This is the movement using flagella and it is commonly found in cells or organisms with flagella e.g. Euglena, Trypanosoma, Chlamydomonas and some Bacteria.

- The flagellum beats side to side in a wave like motion that pushes a flagellate forward.
- Sperms move from vagina to the oviduct using its tail (flagellum).



(iv) MUSCULAR MOVEMENT

This is the type of movement found in vertebrates such as mammals, birds, reptiles, amphibians and fish.

- It is brought about by contraction and relaxation of muscles which are attached to the skeleton.

MOVEMENT IN ANIMALS

Animals are capable of moving because of skeleton and muscles present in their bodies.

Locomotion in animals involves locomotory organs such as legs, wings and fins. The following forms of locomotion are exhibited by animals.

(i) **Flying** – This is the action of changing position by using wings e.g. in birds and insects.

(ii) **Hopping** – This is the quick and short jumping shown by grasshoppers and some other insects.

(iii) **Leaping** – This is the action of jumping from one place to another e.g. in frogs and toads.

(iv) **Crawling** – This is the action of changing position by moving the body resting on the ground e.g. in earthworms and snails.

(v) **Swimming** – This is a form of locomotion shown by aquatic animals such as fish and whale. They have fins which help them to swim.

THE SKELETON

This is the rigid framework structure in an animal that provide mechanical support to the body, protect internal organs and provide area for attachment of muscles.

TYPES OF SKELETON

(i) HYDROSTATIC SKELETON

This is the type of skeleton that is made up of a fluid in animals with soft bodies e.g. earthworm and jelly fish.

(ii) EXOSKELETON

This is the hard outer skeleton that covers bodies of arthropods such as crabs, insects, centipedes, millipedes e.t.c.

It is made up of the mixture of chitin and protein and it shed (Moulting) periodically to allow growth to take place.

(iii) ENDOSKELETON

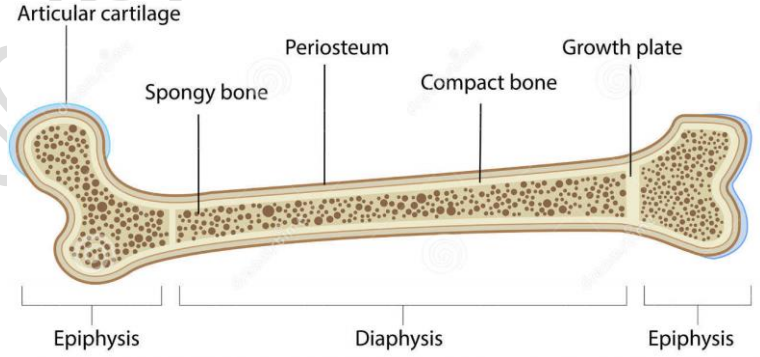
This is made up of bones and cartilage that are found within the bodies of vertebrates (mammals, fish, reptiles, amphibians and birds).

THE MAJOR COMPONENTS OF THE HUMAN SKELETON AND THEIR ADAPTATIONS

1. BONES

Bones are the hardest tissue made up of collagen and large amount of mineral salts e.g. calcium phosphate, calcium carbonate and magnesium salts. They also consist of living cells.

- They are attached together at a joint by fibres called **LIGAMENT**
- The bone has two main parts;
  - **Spongy part** which is the inner porous part of a bone
  - **Compact parts** which is the outer rigid part of the body
- A human being has a total of 206 bones



CLASSIFICATION OF BONES

(i) **Long bones** are strong and hollow and light containing spongy bones at the end. Spongy bones contain open space and holes which contain red marrow

which is where red blood cells are made e.g. humerus, radius, ulna and femur.

(ii) **Short bones** are bones that support weight and allow small movements e.g. bones of human feet (tarsals, carpals and phalanges)

(iii) **Flat bones are bones that support and protect body organs** e.g. ribs, breast bones and scapula.

(iv) **Irregular bones** e.g. vertebrae and ear ossicles

2. CARTILAGE

This is a soft and smooth material made up of elastic protein fibres called collagen and little amount of salts.

- It is found at the end of some bones and joints.
- It is also found in the pinna of ear, larynx, trachea and tip of the nose.
- Cartilage function to cover the end of some bones and keep bones from grinding each other and act as shock absorber between vertebrae.

3. LIGAMENT

This is a fibrous tissue which joins one bone to another. They are elastic to allow movement at the joint.

4. TENDON

This is a tough connective tissue which attaches a muscle to a bone.
They are inelastic to firmly attach a muscle to a bone.

5. JOINT

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

FUNCTION OF SKELETON

1. Support

It provides a rigid framework which supports softer parts of the body (provides attachment for muscles and body organs)

2. Movement

It enables movement of the body caused by contraction and relaxation of muscles attached to it.

3. Protection

It protects delicate internal organs. For example the skull protects the brain, the ribcage protects the heart, lungs and liver and vertebral column protects the spinal cord.

4. Formation of blood cells

Red blood cells and white blood cells are made in the bone marrows.

5. Shape

It gives the animal its definite shape.

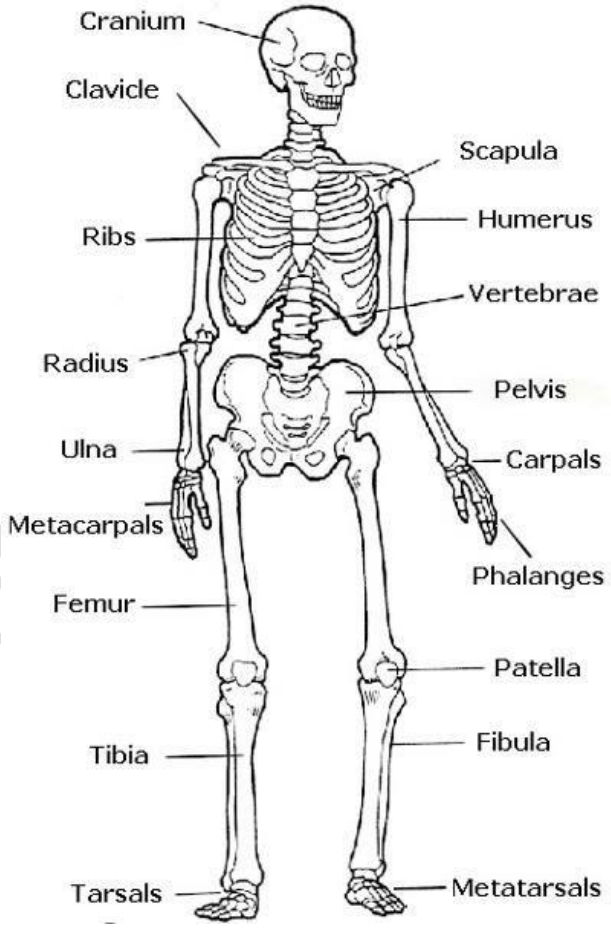
6. Storage of minerals such as calcium and phosphorus.

MOVEMENT OF THE HUMAN BODY

Movement of the human body is made possible by supportive structure like skeleton which provides surface are for attachment of muscles and other body organs. Contraction and relaxation of these muscles cause muscular movement.

THE HUMAN SKELETON

The human skeleton is made up of bones and cartilage that makes a hard framework to which soft tissues, organs and muscles are attached.



The human skeleton

STRUCTURE OF THE HUMAN SKELETON

The human skeleton consists of two main parts:

(i) Axial skeleton

(ii) Appendicular skeleton

AXIAL SKELETON

This refers to bones arranged along the central line of the body. They include the **skull**, **vertebral column**, **sternum** and **ribs**.

1. THE SKULL

This is the bony framework of the head. It is made of 8cranial bones and 14 facial bones which protect brain, olfactory organs, eyes, middle and inner ear.

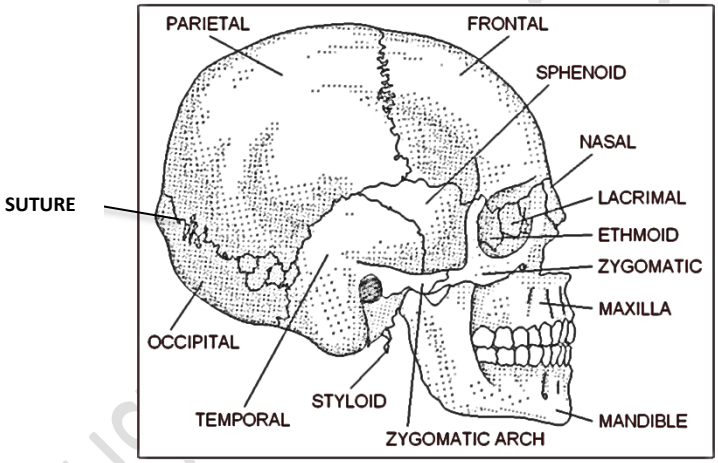
- Cranial bones forms upper part of the skull while facial bones form the lower part of the skull.
- Bones of the skull are joined together by immovable joint known as **SUTURE**

Function of the skull

(i) Protects the brain, olfactory organs, middle and inner ear and the eyeballs against injuries.

(ii) Provides surface for attachment of head muscles.

(iii) Gives the head its shape.



The human skull

2. THE RIBCAGE

It consists of the ribs articulating with the **vertebral column** at the back and the **sternum** (breastbone) at the front.

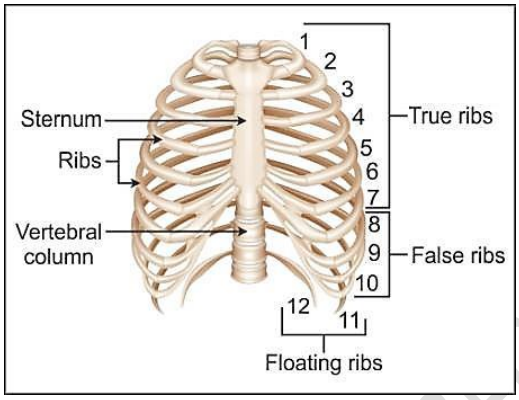
i. The **sternum** is composed of small bones known as **sternebrae** which are fused together. It has a cartilage at its posterior end known as xiphoid cartilage.

ii. The ribs are thin flat curved bones.

iii. There are 12 pairs of ribs in the human body i.e. 24 rib bones in total.

- The first **7** pairs are attached directly to the sternum and are called **True ribs**.

- The next **3** pairs (8th, 9th and 10th) do not join the sternum directly but are connected to the 7th pair by cartilage. They are called **False ribs**.
- The last **2** pairs (11th and 12th) are the smallest of all and do not reach the front of the body i.e are not attached to anything in the front. They are called **Floating ribs**.



The human ribcage

Functions of the ribcage

(i) It encloses and protects delicate internal organs such as the heart, the lungs and the liver.

(ii) It provides surface area for muscle attachments that bring about ventilation of the lungs during breathing.

(iii) It gives the chest its shape.

Adaptations of the ribs

(i) They are curved to provide a long surface area for attachment of intercostal muscles.

(ii) Each rib is forked into tuberculum and capitular that provide points of articulation with the thoracic vertebrae.

(iii) They are hard for support and protection of delicate organs of thoracic cavity.

3. VERTEBRAL COLUMN

This is the main axis of the body.

It is also called the spine or back bone or spinal column.

It consists of 33 bones called **vertebrae** which extend from the base of the skull to the pelvic girdle.

Vertebrae are connected by facet joints at the back of the spine.

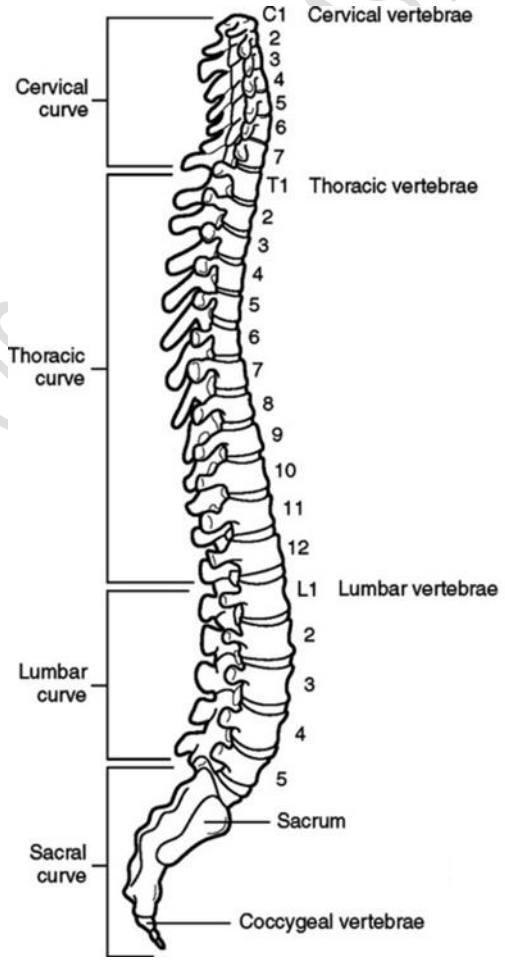
Between two adjacent vertebrae is a cartilage known as **intervertebral disc** which acts as shock absorber, prevent wearing out of vertebrae during locomotion and allows flexibility of the vertebral column.

THE FUNCTION OFTHE VERTEBRAL COLUMN

i. Protection of the spinal cord
ii. Provide area for Attachment of muscles
iii. Allow human being to stand upright and maintain their balance
iv. Their intervertebral disks between the vertebrae act as a shock absorber and allow the back to move.
v. Provide support of the head and arms

Vertebral column is divided into five main regions, which are:

(i) Cervical vertebrae
(ii) Thoracic vertebrae
(iii) Lumbar vertebrae
(iv) Sacral vertebrae
(v) Caudal vertebrae



The human vertebral column

1. CERVICAL VERTEBRAE

There are 7 cervical vertebrae, found in the neck region.

The first is known as the atlas, the second is the axis and the other five are normal vertebrae.

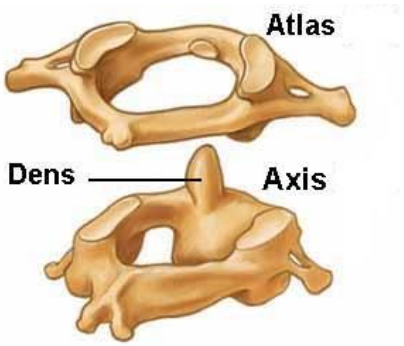
- Atlas and axis are modified to permit movements of the head.
- Between the skull and the atlas there is a joint which allows up and down movements of the head.
- Between the atlas and axis there is another joint which allows turning or sideways movement of the head.

Atlas

- Has a short broad neural spine.
- Has wide transverse processes for attachment of neck muscles.
- Has a wide neural canal to fit the spinal cord and the odontoid process.
- Has vertebraterial canals.
- Has no centrum.

AXIS

- Has a short broad neural spine.
- Has reduced (short broad) transverse processes.
- Has vertebraterial canal.
- Has a centrum that projects to form odontoid process (dens). Odontoid process fits into a cavity in the atlas to form a pivot joint,which allows rotational movement of the head.



Atlas and axis

Features of the other five cervical vertebrae

(i) They have reduced/short neural spines facing upwards.

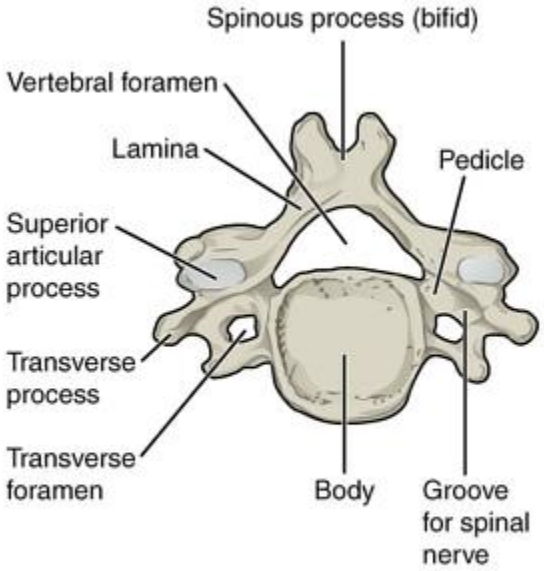
(ii) They have branched transverse processes.

(iii) They have vertebral canal for passage of vertebral artery and vertebral nerves.

(iv) They have large neural canal

(v) They have centrum

(vi) They have both prezygapophysis and postzygapophysis



Structure of a typical cervical vertebra

Functions of cervical vertebrae

(i) They provide support to the skull or weight of the head.

(ii) They allow movement of the head

(iii) They provide attachment of neck muscles

Adaptations of cervical vertebrae

(i) Have wide and large neural canal for passage of spinal cord.

(ii) Transverse processes are branched to provide attachment of neck muscles.

(iii) They have vertebraterial canal to allow passage of blood vessels and vertebral nerves.

(iv) Axis has odontoid process to permit turning of the head.

2. THORACIC VERTEBRAE

They are found in thoracic (chest) region articulating with ribs.

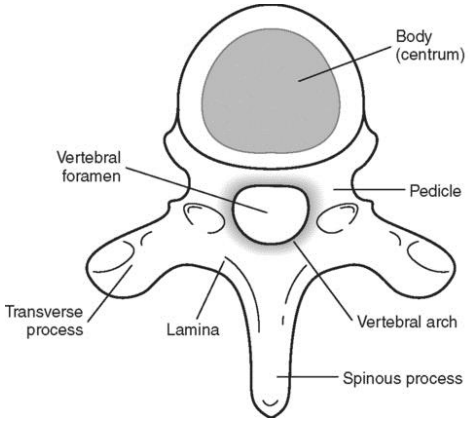
They are 12 in number.

The thoracic vertebrae with the ribs and sternum form ribcage.

Features of thoracic vertebrae

(i) They have long neural spines

(ii) They have short transverse processes
(iii) They have circular neural canal
(iv) They have large centrum for support
(v) Both prezygapophysis and postzygapophysis are present
(vi) They have tubercular facet on the transverse process that articulate with tuberculum of the rib.



Thoracic vertebrae

Functions of thoracic vertebrae

(i) They support the ribs by providing articulation.
(ii) They provide attachment for back muscles

Adaptations of thoracic vertebrae

(i) They have long neural spine that provide a large surface area for attachment of muscles.
(ii) They have facets for articulation with adjacent bones. The demifacets articulate to the capitulum of the rib while the tubercular facets articulate with the tuberculum of the rib.
(iii) They have a wide neural canal for the passage of the spinal cord.
(iv) They have broad centrum for support.

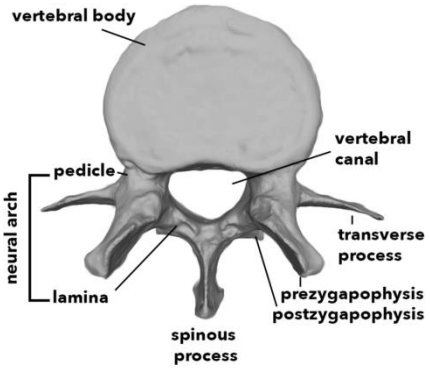
3. LUMBAR VERTEBRAE

They are found in the lumbar region between the end of lower ribs and waist, where large muscles of abdomen are attached.

In humans they are five.

Features of lumbar vertebrae

(i) They have short and broad neural spines.
(ii) They have long transverse process.
(iii) They have large centrum with D shaped neural canal



Lumbar vertebrae

Functions of lumbar vertebrae

(i) Provides surface area for attachment of muscle of the trunk.

(ii) Permits bending, sideways movement and rotation of the trunk.

Adaptations of lumbar vertebrae

(i) They have short and broad neural spines (spinous process) for attachment of muscles.

(ii) They have long transverse processes to increase surface area for attachment of abdominal muscles.

(iii) They have thick and large centrum(body) for support.

(iv) They have extra processes such as metapophysis and anapophysis on the centrum to provide surface for muscle attachment.

(v) They have prezygapophysis and post zygapophysis for articulation between vertebrae.

SACRAL VERTEBRAE

- They are found between waist and tail (sacral region).
- All 5 sacral vertebrae are fused to form the sacrum.
- Sacrum provides a larger surface area for the attachment of muscles of the back.
- Through the sacrum the weight of the body of a stationery animal is passed to the pelvic girdle and the legs.

When an animal moves, the force developed by the hind limb is transmitted via the pelvic girdle through the sacrum to the rest of the vertebral column.

Features of sacral vertebrae

(i) They have short neural spine, processes and short transverse processes.

(ii) The sacrum is broader in front and narrows towards the tail.

(iii) The transverse process of first sacral vertebrae is large and wing like for articulation with pelvic girdle.

(iv) They have pairs of holes (foramens) for passage of spinal nerves.

(v) They have a small neural canal

Functions of sacral vertebrae

- The sacrum provides a large surface area for the attachment of muscles of the back.
- The sacrum transmits the weight of the body to the pelvic girdle and the legs when the animal is stationary.
- The sacrum transmits the force developed by hind limbs through pelvic girdle to the rest of the vertebral column.

Adaptations of sacral vertebrae

(i) They are fused to become strong for support and transmit the weight of stationary animal to the rest of the body.

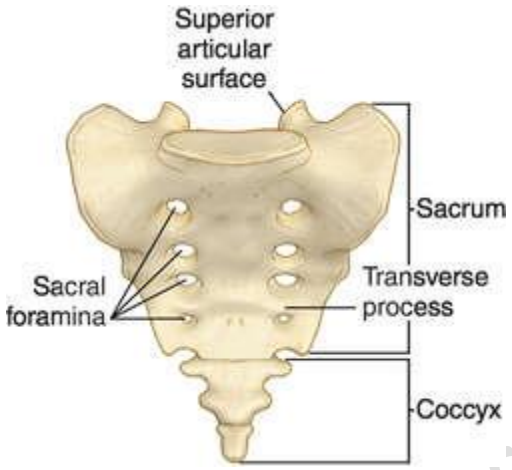
(ii) The sacrum has a broad base and short spines to provide large surface area for attachment of muscles.

(iii) They have numerous posterior foramens (canals) for passage of spinal nerves.

4. CAUDAL VERTEBRAE

- They are found in the tail region.
- The number varies from one animal to another depending on the size of the tail.
- There are four caudal (tail) vertebrae in humans, all fused to form the **coccyx.**
- **Coccyx** is vestigial in human.
- They lack transverse processes, neural spine, neural arch and the zygapophysis but contain the centrum.

- It offers attachment of hip muscles and tail muscles.



Sacral vertebrae

ADAPTATION OF THE VERTEBRAL COLUMN TO ITS FUNCTIONS

i. Have neural spine which provide surface area for attachment of back muscles.
ii. Neural canal allows passage of spinal cord
iii. The centrum supports the body weight
iv. Intervertebral disk provide cushioning between vertebrae to avoid friction and shock (act as shock absorber)
v. Have transverse process for muscle attachment

THE APPENDICULAR SKELETON

This includes the pectoral girdle, limb bones, and pelvic girdle

Mammals have two pairs of pentadactyl limbs.

- Pentadactyl means that each limb ends with five digits (fingers or toes).

PECTORAL GIRDLE (shoulder girdle)

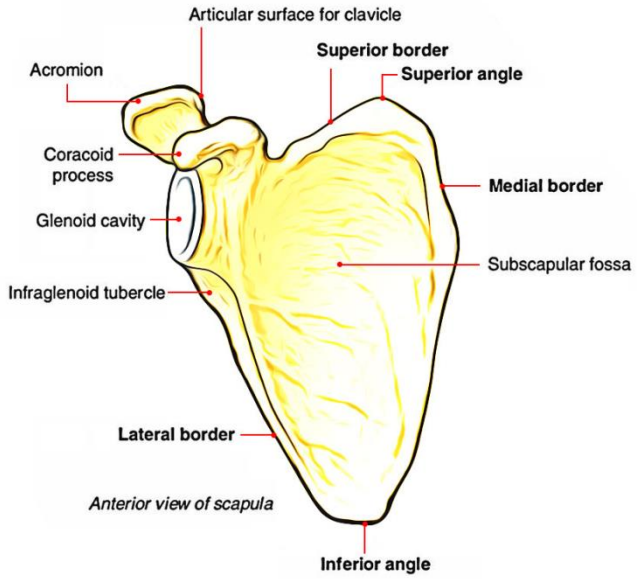
This is made up of two halves each with scapula (shoulder blade), clavicles (collarbone) and coracoids process.

i. **SCAPULA**

It is a triangular bone with a flat and broad blade, which provides a large surface area for the attachment of pectoral muscles. The glenoid cavity, a depression on the scapula articulates with the humerus to form a ball and socket joint.

Function of scapula

Provides site for attachment of muscles that move the arm.



Adaptations of scapula

(i) It has glenoid cavity that provide surface for articulation with the head of humerus to allow movement of the arm.

(ii) It has broad and flattened surface to provide a large surface area for muscle attachment.

(iii) It has projections called acromion and metacromion to increase surface area for muscle attachment.

(iv) It has a long spine to provide large surface area for muscle attachment.

(v) It is bony (hard) to provide support and strength.

(vi) The socket (glenoid cavity) has cartilage to reduce friction.

ii. CLAVICLE (COLLAR BONE)

This is a curved bone that articulates with sternum at one end and with the scapula at the acromion.

Functions of the clavicle

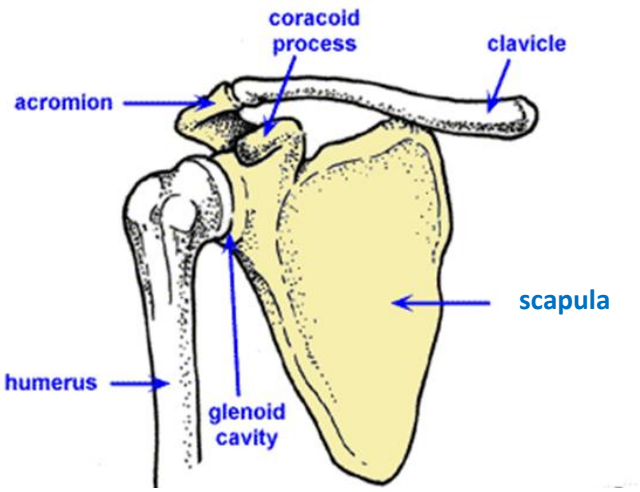
(i) It provides surface for muscle attachment.

(ii) Aids in movement of the arm.

iii. <u>Coracoid process</u>

The coracoids bone is fused onto the scapula to form the coracoids process situated above the glenoid cavity.

- It offers extra surface for muscle attachment.



Pectoral girdle

LIMB BONES

A. FORE LIMB

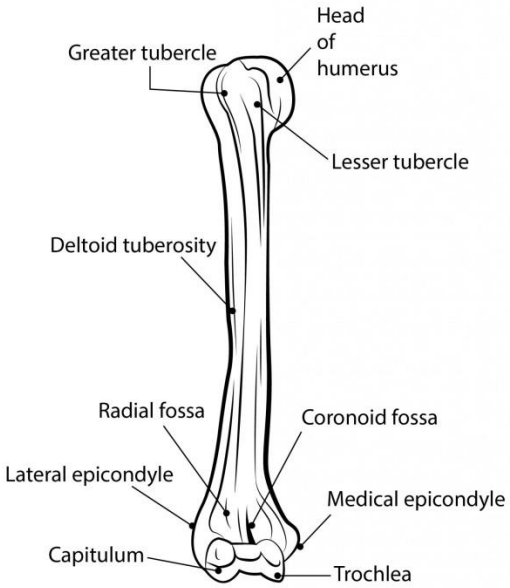
It consists of the humerus, ulna and radius, carpals, metacarpals and the phalanges.

i. **<u>HUMERUS</u>**

This is a single bone found in the upper part of the fore limb. The rounded head articulates with the glanoid cavity of scapula to form a ball and socket joint (shoulder joint). Its lower end articulates with the radius and ulna to form a hinge joint at the elbow.

Functions of humerus

- Provides surface for attachment of biceps and triceps muscles.



ADAPTATIONS OF HUMERUS

(i) It has rounded head that fits into the glenoid cavity of the scapula to allow greater flexibility of the arm.

(ii) It is long to provide a large surface area for attachment of biceps and triceps muscles.

(iii) It has trochlea at the lower end for articulation with forearm to form a hinge joint at the elbow that allows movement in one plane.

(iv) It has bicipital groove through which tendons of the biceps muscles pass.

ii. RADIUS AND ULNA

These are the two bones which form the forearm. The radius is shorter and smaller than the ulna. Radius is slightly curved and it is found on the side where the thumb is located while the ulna is on the side of the small finger.

To the lower end of the forearm, ulna and radius articulate with a number of small bones which form the wrist.

ADAPTATIONS OF RADIUS AND ULNA

i. They are long to provide a large surface area for attachment of muscles of the forearm.

ii. Ulna has olecranon process with a sigmoid notch for articulation with trochlea of the humerus to form a hinge joint at the elbow (allows movement in one plane).

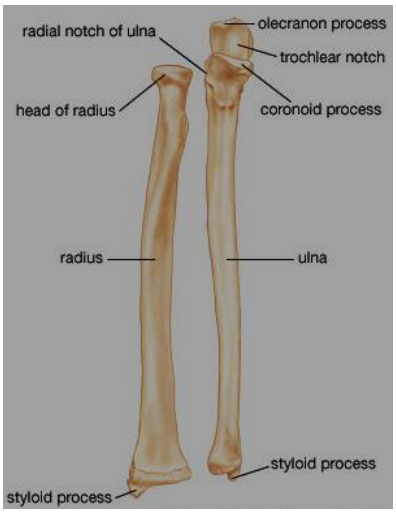
iii. They are bony and strong to provide support.

iv. Distal articulating surface is lined with cartilage for articulation with carpals.

Functions of radius and ulna

(i) They support the carpals, metacarpals and phalanges.

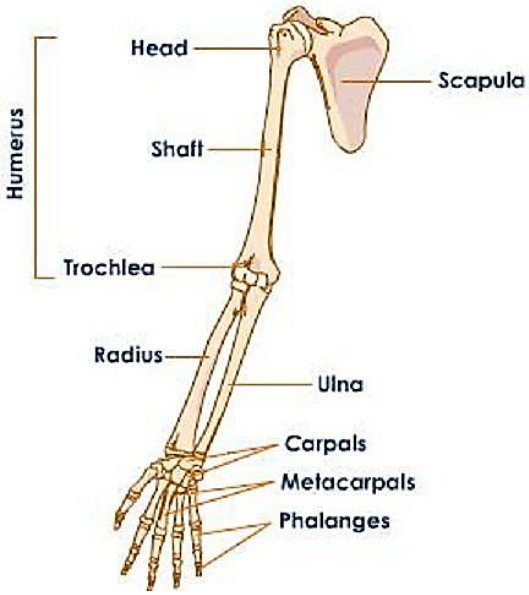
(ii) They provide surface for attachment of muscles of the arm.



iv. CARPALS, METACARPALS AND PHALANGES

Carpals are eight small bones which form the wrist. These small bones articulate with the radius and ulna on the upper end and with metacarpals on the lower end. Metacarpals form the skeleton of the hand and are five in number .

On the lower end metacarpals articulate with phalanges. Phalanges are 14 and form the skeleton of fingers.



Generalised structure of a forelimb

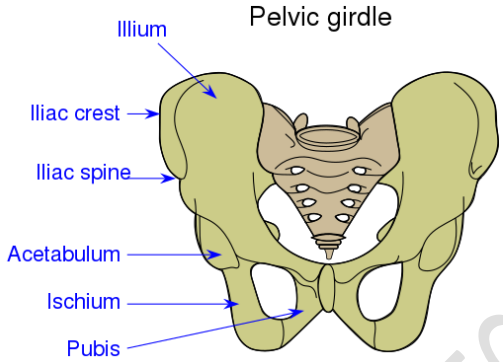
B. HIND LIMBS

Hind limbs are attached to the axial skeleton to the posterior part of the body. Comprises of femur, tibia, fibula, tarsals, metatarsals and phalanges.

PELVIC (HIP) GIRDLE

It comprises of two hip bones known as pubis (pubic bones) connected in front of the pubic symphysis and behind by the sacrum.

- Each pubic bone comprises of three bones; pubis, ischium and ilium which are fused together. It has a depression called acetabulum where it articulates with the femur.It is fused to the sacrum to form a rigid structure, while the two halves are fused at the pubic symphysis (symphysis pubis). The size of pubic cavity is important in female during birth.



Functions of pelvic girdle

i. It supports the weight of the body from the vertebral column.
ii. It protects and supports organs in the lower body such as the urinary bladder and reproductive organs.
iii. It protects the developing foetus in a pregnant woman.
iv. It provides surface for attachment of waist muscles.

Adaptations of the pelvic girdle

(i) It is broad and flattened to provide large surface area for attachment of muscles.
(ii) It is funnel shaped to support the weight of the upper part of the body.
(iii) It has grooves that provide surface for articulation with the head of femur bones to allow movement in all planes.

FEMUR (thigh bone)

i. Is a long bone found in the upper part of hind limb.
ii. On its upper end is a head which articulates with the acetabulum of the pelvic girdle to form a ball and socket joint at the hip.
iii. Slightly below the head of femur are trochanters which provide points of attachment for the thigh muscles. Its lower end has two curved convex surfaces known as condyles which articulate with tibia and fibula to form a hinge joint at the knee.

Functions of femur

i. Supports the upper parts of the body.

ii. Its shaft provides surface for attachment of thigh muscles.

Adaptations of femur

It is long to provide a large surface area for attachment of muscles.

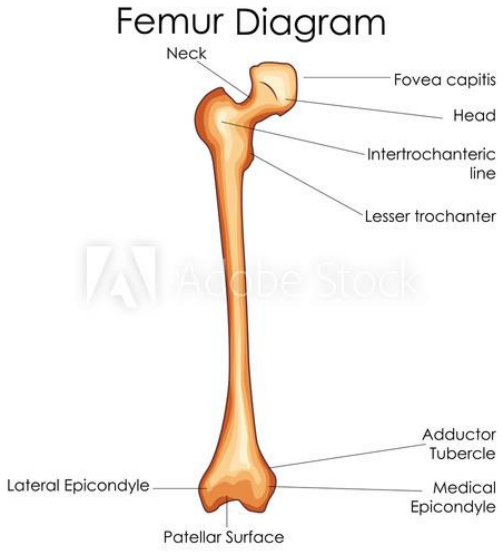
It has a rounded head that articulate with acetabulum of pelvic girdle to form a ball and socket joint which allows flexible movement of the leg.

It has hard and strong shaft for support.

(i) It has condyle for articulation with patella to allow movement in one plane.

Patella (knee cap)

This is a thick circular-triangular bone which articulates with the femur. It covers and protects the anterior articular surface of the knee joint.



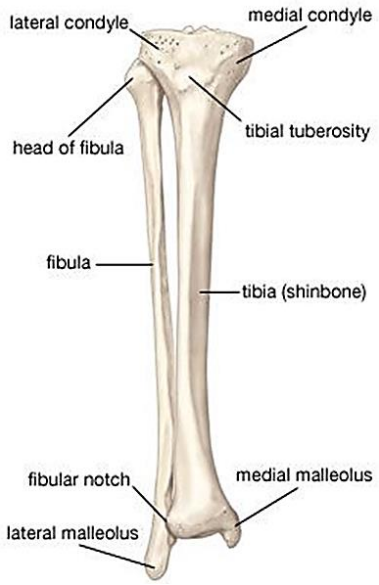
TIBIA AND FIBULA

These are the bones of the lower hind limb.

Tibia is found on the side of the big toe (it is ventral/in front) and is relatively bigger than fibula.

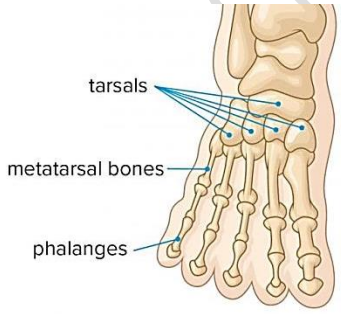
Fibula is dorsal (behind) and is fused to the tibia on the lower part of the leg.

They articulate on the lower end with tarsal bones.



TARSALS, METATARSALS AND PHALANGES

Tarsals articulate with tibia and fibula to form ankle joint. Tarsals articulate with metatarsals to form the foot. Metatarsals articulate with phalanges which form toes.



Tarsals, metatarsals and phalanges

JOINTS

A joint is a point where a bone meets another bone

Is the point where two bones meet.

Is a junction between any two or more bones.

Joints allow free movement.

TYPES OF JOINTS

(i) Immovable (fixed) joint

(ii) Movable (synovial) joint

IMMOVABLE JOINTS

These are joints which do not allow any movement.

They have no cartilage between them.

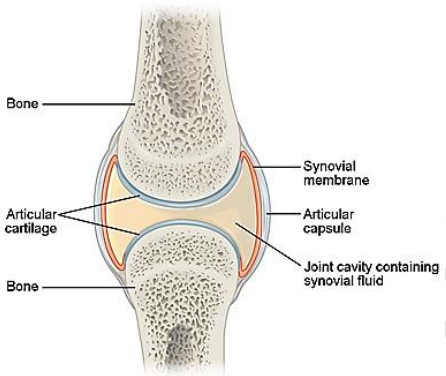
Examples

- **Sutures** – joint between bones of skull which do not allow movement.
- Joint between the two bones of the pelvic girdle (sacrum and the ilium).

MOVABLE JOINTS

They are also referred synovial joints because they contain cavity filled with a fluid called synovial fluid.

- Synovial fluid lubricates the joints and reduces friction between bones during movement



Movable joints can be grouped depending on degree of movement they allow

i. **Slightly movable joints**

This is the type of joint that allow small degree of movement

Examples: - joints found between most of vertebral column and joints between carpals of the palm (wrist) and tarsals of the foot (ankle).

These type of joints are found where two bones surfaces move over each other (sliding/gliding joints)

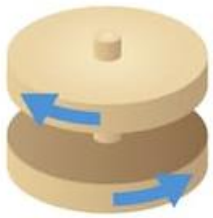
ii. **Freely movable joints**

These are joint that allow high degree of movement. These include:-

i. Pivot joint
ii. Ball and socket joint
iii. Hinge joint

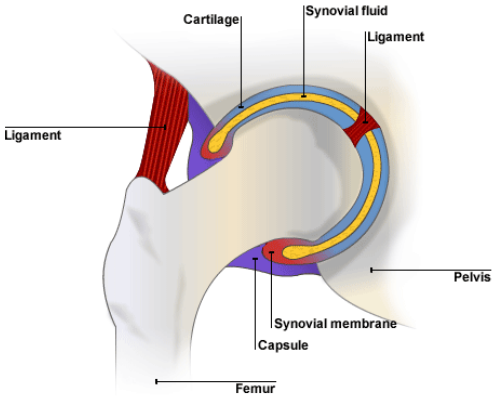
(a) Pivot joint

A pivot joint is type of joint which allow rotation along one axis only. It allows one bone to rotate around another. An example of a pivot joint is the joint between the first two vertebrae in the spine (Atlas and axis). This joint allows the head to rotate from left to right and back again.



(b) Ball and socket

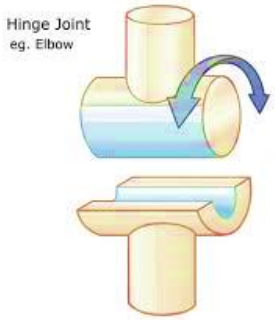
This type of joint allows movement in all directions, it is found at the hip and shoulder. They are called so because the round head of one bone which looks like ball fits into a cavity or socket of another bone.



(c) Hinge joint

This type of joint allows movement in only one plane. Hinge joint is found at the elbow and the knee.

Movement at this joint operates like a hinge of the door.



MUSCLES AND MOVEMENT

A muscle is a tissue consisting of cells that have the capacity to contract and provide movement. All muscles are made up of elongated cells called muscle fibres

Functions of muscles

i. Cover the skeleton
ii. Provide body shape
iii. Contract and relax to enable body to movement

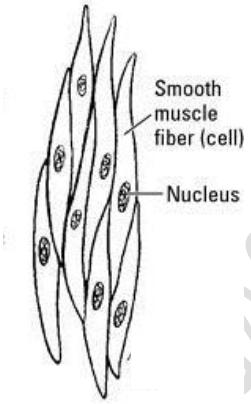
Types of Muscle

i. Smooth (involuntary)
ii. Cardiac muscles.
iii. Skeletal muscles (voluntary)

(i) SMOOTH (involuntary/ unstriated**)**

Muscles which are not controlled by the will, they are controlled by the autonomic nervous system

- They are unstriated, nucleated, short fibred and have cells which taper at both ends (spindle-shaped)
- Are found in alimentary canal, blood vessels, secretory glands, bladder, uterus, urinary tract, reproductive system, respiratory tract, ciliary body etc.



ADAPTATION OF SMOOTH MUSCLES

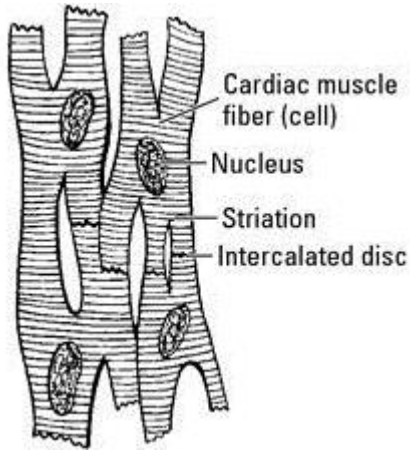
i. Are controlled by autonomic nervous system
ii. Cells have numerous mitochondria to provide ATP energy for contractions
iii. They have spindle-shaped cells to allow smooth contractions

(ii) CARDIAC MUSCLES

Are also called myocardium

They are found in the Walls of the heart and are not under control of the will.

- Composed of long cylindrical cells
- Are myogenic i.e. generate their own contraction without nervous stimulation
- Cardiac muscles never get fatigue



ADAPTATION OF CARDIAC MUSCLES

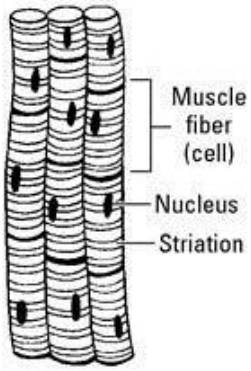
i. Are striated to allow for contraction and relaxations in short intense bursts
ii. Are myogenic to contract and relax without nervous stimulation
iii. Are branched and interconnected to provide large surface area for contractions and relaxation
iv. Have many mitochondria to provide adequate ATP for contraction
v. Are elastic to allow contraction and relaxations

(iii) SKELETAL MUSCLES

Are striated voluntary muscles made up of long fibres that cover the bones or skeleton.

Are controlled by will thus are called voluntary muscles

Are striated and can contract for a certain period of time after which the muscles become fatigue and need to be rested.



ADPTATION OF SKELETAL MUSCLES

i. Are multinucleated to allow better control of contractile activities
ii. Are long to offer a large surface area for contractions and relaxation
iii. Muscles are striated to allow contraction and relaxations on short intense

HOW MUSCLES WORK TO FACILITATE MOVEMENT

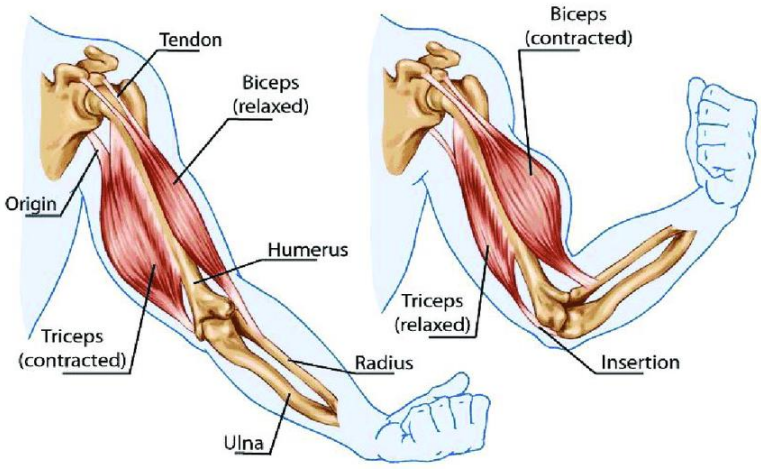
Voluntary muscles usually work across a joint. It is attached to both the bones by tendons.

- Muscles can only contract and relax but do not expand
- When muscle contract it shortens and thickens but when relaxes it lengthen and become thinner.
- Most skeletal muscles act in pairs in such a way that one muscle contract and the other relaxes. This produce movement in opposing action.
- The pair of muscles which work in opposition are called **ANTAGONISTIC MUSCLES.**

Antagonistic muscles

Are muscles that work in opposition to each other. Example biceps (flexor) muscles and triceps (extensor) muscles of the limb

- When the biceps muscle contract the arm bend, at the same time triceps The straighten of the fore arm . W The bending of the fore arm es contract the arm straightens at the same time bice



ADAPTATION OF MUSCLES TO MOVEMENT

i. They are very elastic to facilitate contraction and relaxation (stretching)
ii. Are supplied with blood vessels that supply oxygen and nutrients and take away metabolic wastes from muscles.
iii. They are supplied with nerves that trigger and control muscle contraction
iv. They have many mitochondria for production of ATP energy needed for contraction of muscles.

MUSCLE CRAMP

A muscle cramp is an involuntary and forcibly contracted muscle that does not relax. The cramp may involve a part of muscle, the entire muscle or several muscles that usually act together. Any of the muscles that are not at our voluntary control can cramp.

CAUSES MUSCLE CRAMPS

i. Accumulation of lactic acid during vigorous activities due to inadequate oxygenation of muscles
ii. Lack of salt in the body and body fluid

PREVENTION OF MUSCLE CRAMP

A Cramps from poor breathing (lack of oxygen) can be improved by rapid breathing as well as stretching the muscles A muscle cramp from lack of water or salt can be treated by stretching the muscles and drinking many glasses of water, which contain salts replace the amount of salt lost in the body

Treatment of Muscle Cramps

i. Applying a soft massage on the cramped muscle to relax it
ii. Stretching the muscle and applying oil ointment on the affected area.
iii. If the cramp was caused by loss of fluids, give a plenty of water
iv. Drinking water with salt added can relieve cramp caused by salt loss

MOVEMENT IN PLANTS

Movement in plants occurs by response to particular stimulus .Movement in most plants is very slow thus unnoticeable.

Stimulus refers to the change in the external or internal environment of the body. Example light intensity, water, touch, chemical, gravity.

Movement in plants may involve growth or non-growth movement

WHY PLANTS DO NOT NEED LOCOMOTIVE STRUCTURE

i. They obtain water and nutrients from the soil through the roots
ii. They are capable of manufacturing their own food
iii. Fertilization is aided by pollination through wind or insects

Movement in plants is categorized into

i. Tropic movement
ii. Nastic movement

1. **TROPIC MOVEMENTS:**

Is the growth movement of a plant in the direction of stimulus .In this case a plant grows either toward the stimulus (**positive tropism**) or away from the stimulus **(negative tropism**).

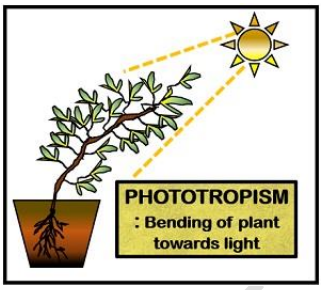
Tropism: - is a movement of a plant part in response to the direction of the stimulus or away from the stimulus.

Types of tropic movement

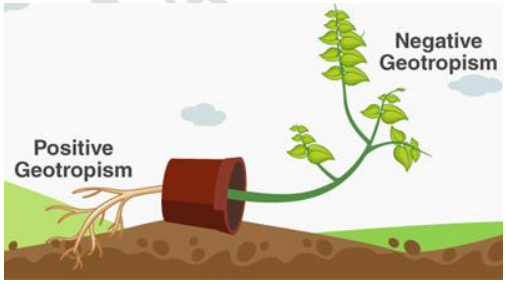
i. Phototropism (light)

ii. Geotropism (gravity)
iii. Hydrotropism (water)
iv. Chemotropism (chemicals)
v. Thigmotropism (touch)

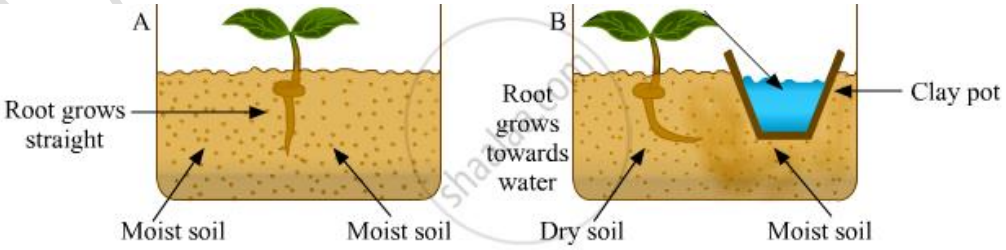
(i) **Phototropism:** It is the movement of plants in response to light. The shoot moves towards the light. The stems usually show positive phototropism, while roots show negative phototropism.



(ii) **Geotropism** – It is the movement of a plant part towards the soil. This is a characteristic of the root system. The roots always move in the direction of the earth's gravity thus show positive geotropism while stem grow away from gravity thus show negative geotropism

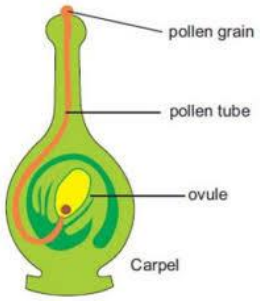


(iii) **Hydrotropism**– It is the movement of a plant towards the water. The stimulus here is water.



(iv) **Chemotropism** – It is the movement of plants in response to a chemical stimulus. A classic example of this type of movement is the growth of the pollen tube

towards the ovule during fertilization in a flower, Plant roots elongate toward a supply of essential mineral nutrients



(v) **Thigmotropism** – It is a directional movement in plants in response to touch. For e.g. the plant tendrils climb around any support which they touch.

2. NASTIC MOVEMENTS

A nastic movement is a non-directional movement which takes place neither towards nor away from the stimulus.

TYPES OF NASTIC MOVEMENT

i. **Photonasty :-**this is the non-directional movement of plant in response to light
   Example maranta plant (prayer plant) which is an ornament house plant, its leaves are horizontal during the day to maximize their use of sunlight. At night the leaves fold vertically and appear like a pair of hands in prayers
ii. **Chemonasty:-** this is the non-directional movement of plant in response to chemicals and disturbance
   Example closing/bending of glandular hairs of Venus fly trap plant in response to nitrogenous compounds from an insect.
iii. **Thigmonasty or haptonasty:-**is the response of plant to contact eg. *Mimosa pudica* respond to touch by folding up its leaves

IMPORTANCE OF TROPIC AND NASTIC RESPONSES

i. Phototropism enable leaves to trap maximum sunlight for photosynthesis
ii. Hydrotropism enables roots of the plant to obtain water

iii. Thigmotropism enables plants with weak stems to obtain mechanical support.
iv. Geotropism enables plant roots of the plant to grow deep in the ground to provide anchorage
v. Chemotropism facilitate fertilization in flowering plants
vi. Photonasty enables flowers of certain plants to open in order to trap sunlight.
vii. Chemonasty enables plant to avoid harmful chemical substances and obtain beneficial chemical substances
viii. Haptonasty enables leaves of *Mimosa pudica* to avoid mechanical damage caused by touch.