UNIT : Life Processes

MOVEMENT IN ANIMALS AND PLANTS

[A PRIMARY DISTINCTION OF LIFE]

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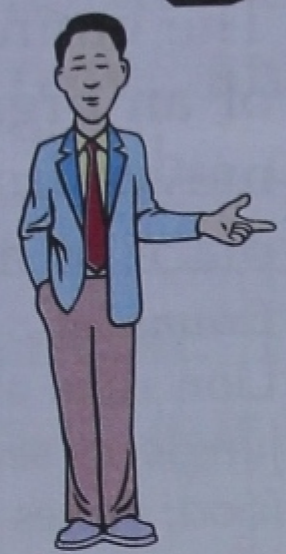

SYLLABUS

1. Locomotion in animals : organs which help movement in common animals — mammals, insects, birds, fish, earthworm, etc. — different kinds of movement.
2. Movement in human beings — muscles, joints, ligaments, tendons, cartilage.

Movement occurs at joints — locating the joints in the human body — different kinds of joints and examples of these (fixed and slightly moveable joints, freely moveable joints — hinge joints, pivot joints, ball and socket joints).

Muscles work in pairs to produce movement — e.g. arm.

(**Note** : Technical names of all bones need not be introduced. Drawings of joints, skeleton etc. are not required).

3. The difference between movement and locomotion.
4. Movement in plants : phototropism, geotropism, hydrotropism — positive and negative responses to the stimuli of light, gravity and water. Simple drawings of experiments, set-up to show such movements. Thigmotropism.

   Tropic and nastic movements.
5. Movement of microscopic living things — *Amoeba, Paramecium, Euglena.*

   * Locating joints in the human body and exploring the range of movements they allow (E).
   * Observing a skeleton (or models), if available, and observing the various bones and joints (D).
   * Observing the actions of voluntary muscles in the body (e.g. neck, arm, leg, abdomen) (E).
   * Observing the movement of pets/other animals seen at home, birds in flight etc. — recording these in words — sharing these observations in class (E).
   * Simple experiments to show the different kinds of tropic movements in plants — and drawing the changes observed (D/E).

Movement is a characteristic feature of all living beings. Though, plants are fixed to the ground, they too show movement. The sunflower bends towards the sun. If you touch the leaf of a sensitive plant *Mimosa* (in Hindi, it is called *Lajwanti*), it droops and after a few minutes, the wilted leaf recovers and stands erect. There are many plants which fold their leaves or close the petals of their flowers at night and reopen next morning.

Similarly, animals move their body parts or the body as a whole for various purposes and in different ways. For example, animals walk or run, fishes swim, birds fly, humans hold objects, bend their arms, blink the eyelids, etc.

Thus, overall there are two main types of movements in the living beings : movements only of body parts and locomotory movements (from one place to another).

- **In the movement of body parts, only the parts of the body move :** For example, the bending and relaxing movements of limbs, the blinking of the eyelids, the wilting (drooping down) movements of the leaves of a plant or the closing or opening movements of petals of a flower.
- **In locomotory movements,** ***the organism moves from one place to another as a whole***. It occurs mainly to collect food, to avoid enemies, and in search of shelter, etc. For example, cows move about in search of food. Frogs, when disturbed, jump into water for safety.

Table 3.1 : Main differences between movement and locomotion

Movement	Locomotion
1. It takes place even in fixed organisms, like plants. 2. Only the body parts move. *Examples :* Movement of joints, bending of sunflower towards the sun, drooping of the leaf of a sensitive plant mimosa (*Lajwanti*) when touched and coming back to its original position after a few minutes.	1. It takes place in free living organisms. 2. The entire body of an organism moves from one place to another. *Examples :* Lion runs about in the jungle in search of its food; fishes swim all around in water in ponds and rivers; snakes crawl here and there to find their prey.

MOVEMENTS IN MICROSCOPIC ORGANISMS

Microscopic organisms, such as ***Amoeba, Paramecium, Euglena, Hydra,*** are very simple and show creeping, swimming or bending type of movements.

Creeping Movement (as in *Amoeba*)

Amoeba is a very simple unicellular organism found in fresh water, such as ponds. It moves by protruding its body in the desired direction. The finger-like projections of its body are called *pseudopodia* (*Singular* : pseudopodium, meaning-false foot). Many pseudopodia

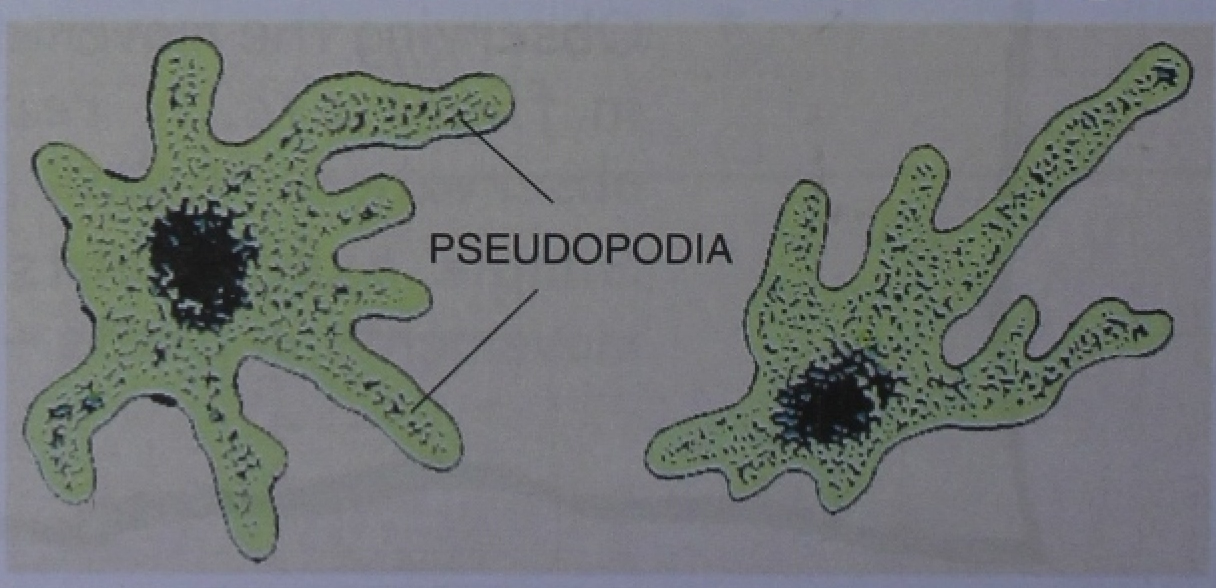

Fig. 3.1 Movement by pseudopodia in **Amoeba**

may project out from the body of an amoeba at a time (Fig. 3.1). One of these continues to grow in the direction in which it wants to move. Amoeba may change its direction of movement. In such a situation, the earlier pseudopodium stop to grow, and another one starts extending in the desired direction. Such movement is called **amoeboid** (amoeba like) **movement**. This type of **movement** also occurs in our white blood cells.

Swimming (as in *Euglena* and *Paramecium*)

Euglena (a unicellular organism) moves with the help of a long, threadlike structure called *flagellum*. The flagellum extends out through the front end of *Euglena*. During movement, the flagellum beats back and forth and thus draws the organism forward through water. It also rotates spirally (Fig. 3.2). Movement with the help of flagellum is called **flagellar movement**.

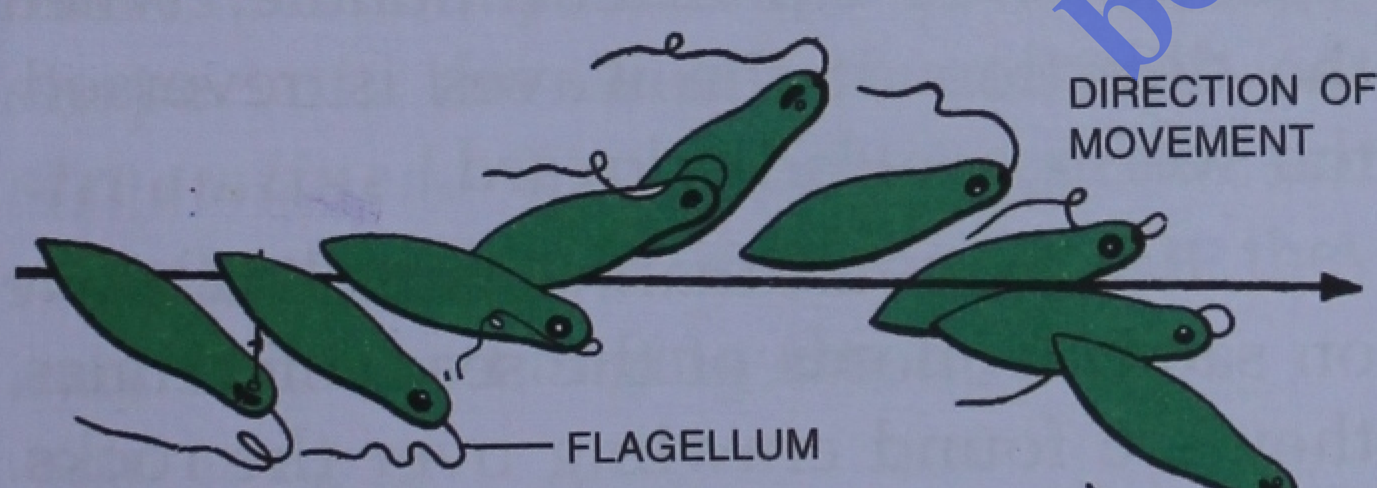

Fig. 3.2 **Euglena** *: Successive stages of locomotion in a spiral path by flagellum*

In *Paramecium* (another unicellular organism), the entire body is covered with tiny, delicate, "hair-like" outgrowths called *cilia* (*singular* : cilium). The cilia beat water **backward** to carry the *Paramecium* forward. The ciliary stroke is oblique, therefore the organism also rotates on its longitudinal axis. To swim backward, the cilia beat in the **forward** direction. Movement with the help of cilia is called **ciliary movement** (Fig. 3.3).

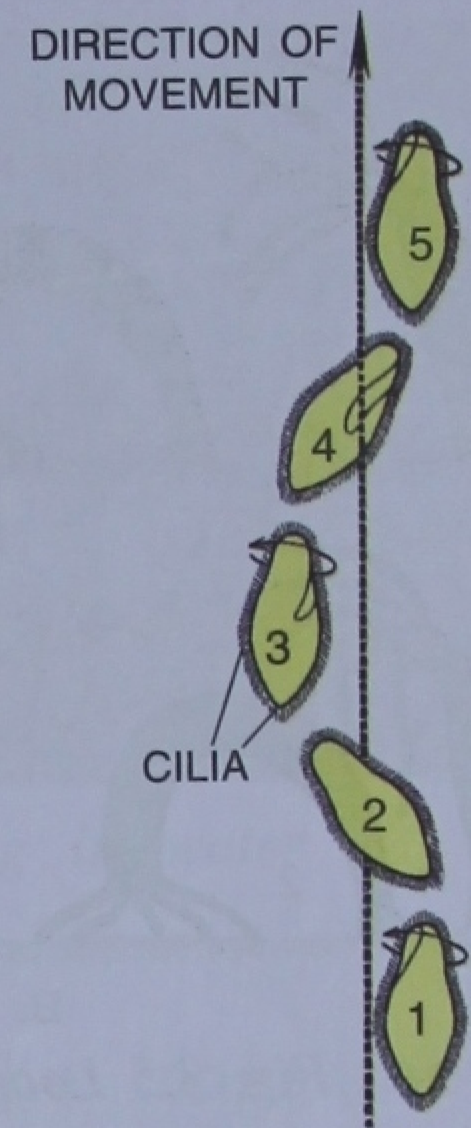

Fig. 3.3 Spiral path followed by a swimming **Paramecium.** *The movement is caused by cilia present all over the surface*

Bending Movements (as in Hydra)

Hydra is a fixed aquatic animal, found in ponds and lakes. It is attached to submerged stones, aquatic plants, etc. It bears many flexible and delicate tentacles at its free end (Fig. 3.4). The tentacles help in feeding. They catch tiny prey and bend over the mouth to push it in. Keeping its basal end fixed, the hydra can bend in different directions.

Fig. 3.4 Bending movement in **Hydra**

Hydra shows two types of locomotory movements for changing its position, *i.e.*, looping and somersaulting.

In **looping**, hydra bends its body and fixes the tentacles to the substratum (resting surface). It then frees its fixed end and draws it near the tentacles and then straightens up again (Fig. 3.5A).

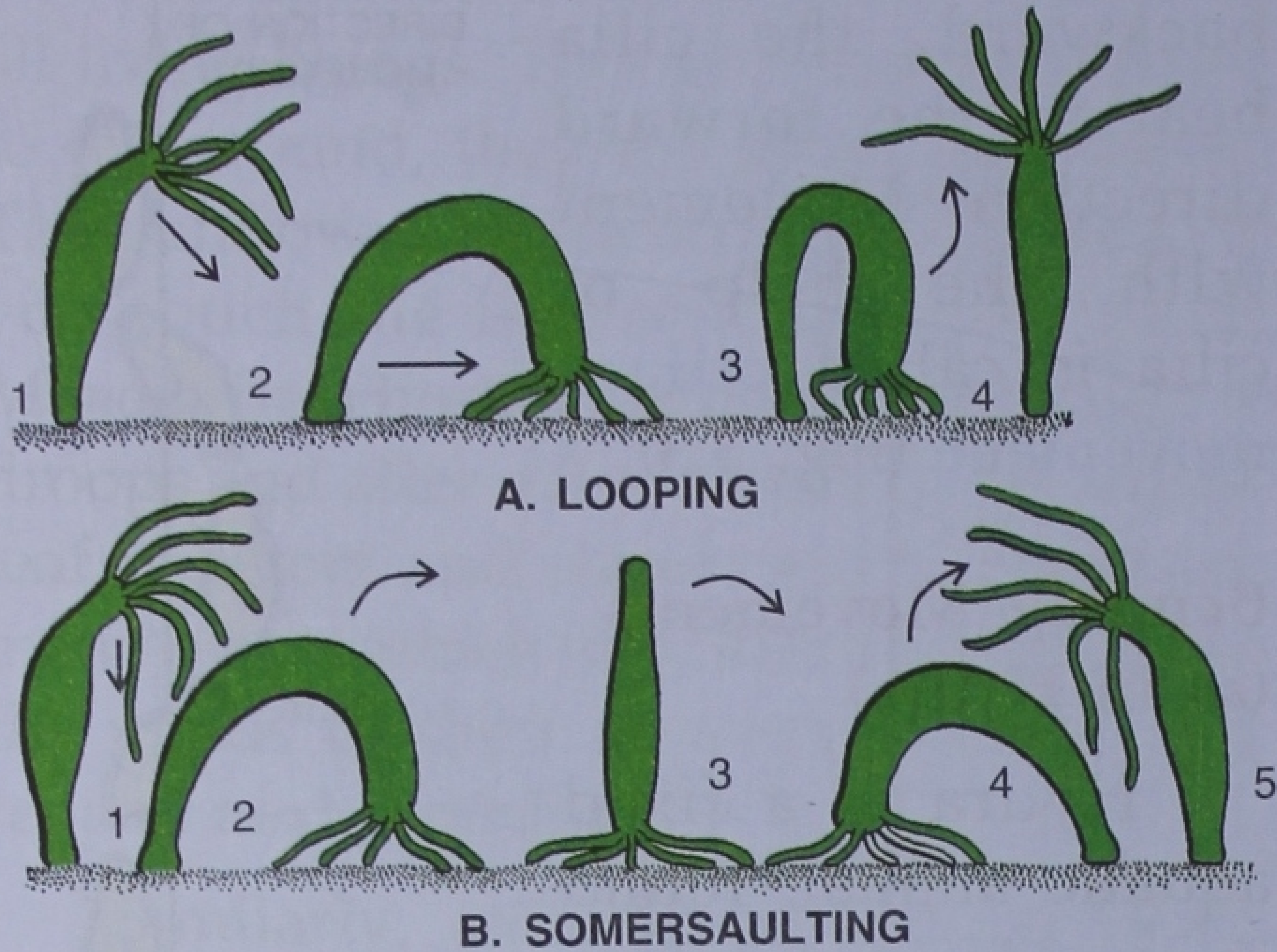

Fig. 3.5 Looping and somersaulting movements in **Hydra**

In **somersaulting**, it bends the body by making the tentacles touch the substratum. It releases its base and straightens it up to make the body stand upside down. It again bends it forward till it touches the substratum. It then releases the tentacles to make the body straight (Fig. 3.5B).

CAN YOU RECOLLECT ?

You must have visited a circus show. There, the joker displays spectacular somersault type of movements. The spectators are amused by his acts. Try to recollect any such more movements. Record your observations in the space given below.

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CRAWLING MOVEMENTS

An **earthworm** moves with the help of muscles. Its tiny curved hard bristles called **setae** are embedded in its body wall. Its muscles are of two types — longitudinal muscles which run lengthwise, and circular muscles which form a ring. During locomotion, the circular muscles contract, making the body thinner and thus extending the body forward. This is followed by the contraction of the longitudinal muscles, causing the thickening and shortening of the body (Fig. 3.6). This is again followed by the wave of thinning and the process is repeated. Each wave of circular contraction causes the affected portion of the body to move forward. But the portion in the state of longitudinal contraction, does not move as it is anchored to the ground by the protruded setae. Thus, setae always protrude during longitudinal contraction and retreat during circular contraction.

Fig. 3.6 Crawling movements in earthworm

An earthworm can crawl upto a distance of 25 cm in one minute. When the direction of the waves is reversed, the worm crawls backward.

Star-fishes are marine animals that live on sandy bottoms of the sea. Sometimes, they are found crawling over the rocks. They have thousands of tiny, tubular, retractile structures, called the *tube feet.* Each tube foot ends in a sucker. It is with the help of these tube feet that the star-fish moves on rocks by sticking and pulling them (Fig. 3.7).

Fig. 3.7 A Star-fish

FLOATING, SWIMMING AND LEAPING MOVEMENTS (IN FROG)

Floating

Frogs are familiar floating animals. While floating, the tip of their snout (bearing nostrils) and the two bulging eyes project above the water surface. The rest of the body hangs downward with both pairs of legs fully stretched. The bulging eyes are watchful for any enemy and the nostrils keep open into the air for breathing (Fig. 3.8). Lungs filled with air and fully stretched legs give it the upward thrust to float.

Swimming

Frogs swim very efficiently. Their powerful hind legs act like oars. The webbed feet (Fig. 3.9 E) provide a large surface for kicking the water. The rigid body with a forwardly pointed head moves smoothly, through water. Such a shape of the body is termed as ***streamlined***. The front legs do not contribute much in swimming, but they only help in changing the direction.

Fig. 3.8 **Frog,** *floating in water*

Leaping

On the ground, the frogs move mainly with the help of two pairs of legs by leaping, and at times, they also crawl.

In leaping, the frog uses its hind legs in pushing the body forward and the front legs to support the falling body (Fig. 3.9). The hind legs are much longer and are folded in "Z" shaped manner while sitting (position A). Sudden straightening of the hind legs, throws the body forward and upward (position B). The frog lands on the ground at some distance, when the front legs give the support (position C), and finally, the frog comes at rest (position D).

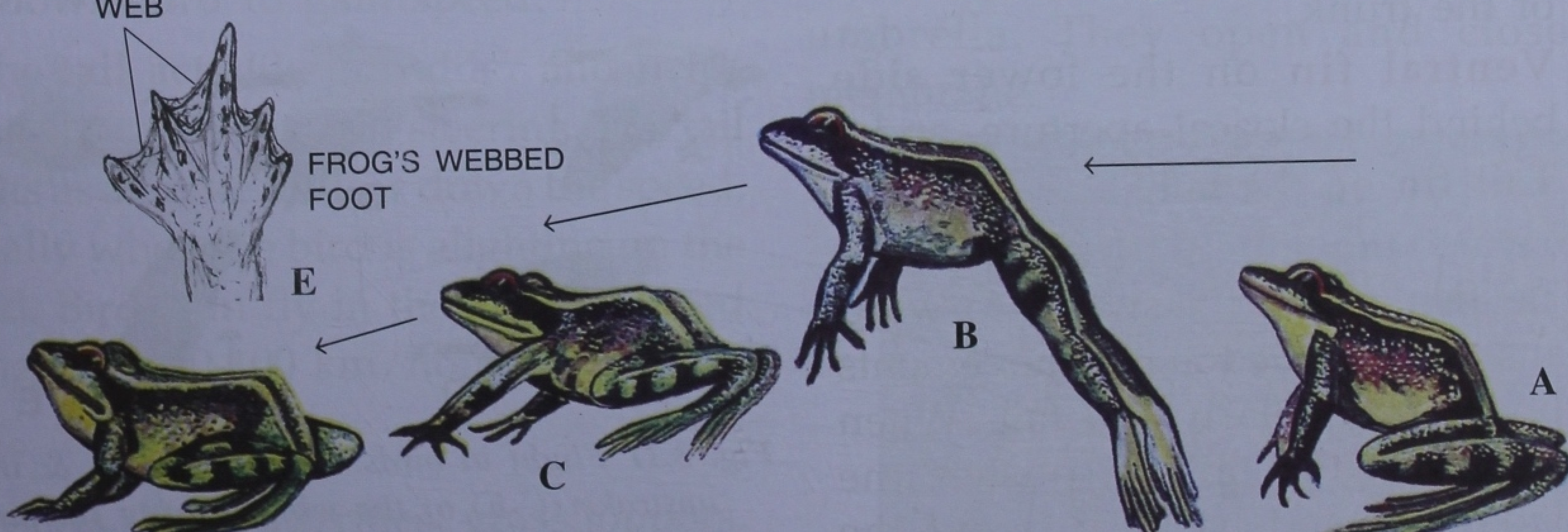

Fig. 3.9 Leaping movement of a **frog**

SWIMMING MOVEMENTS IN A FISH

A fish swims with the help of fins and a tail. It bears two types of fins : paired fins (on the right and left sides) and unpaired (median) fins (Fig. 3.10A).

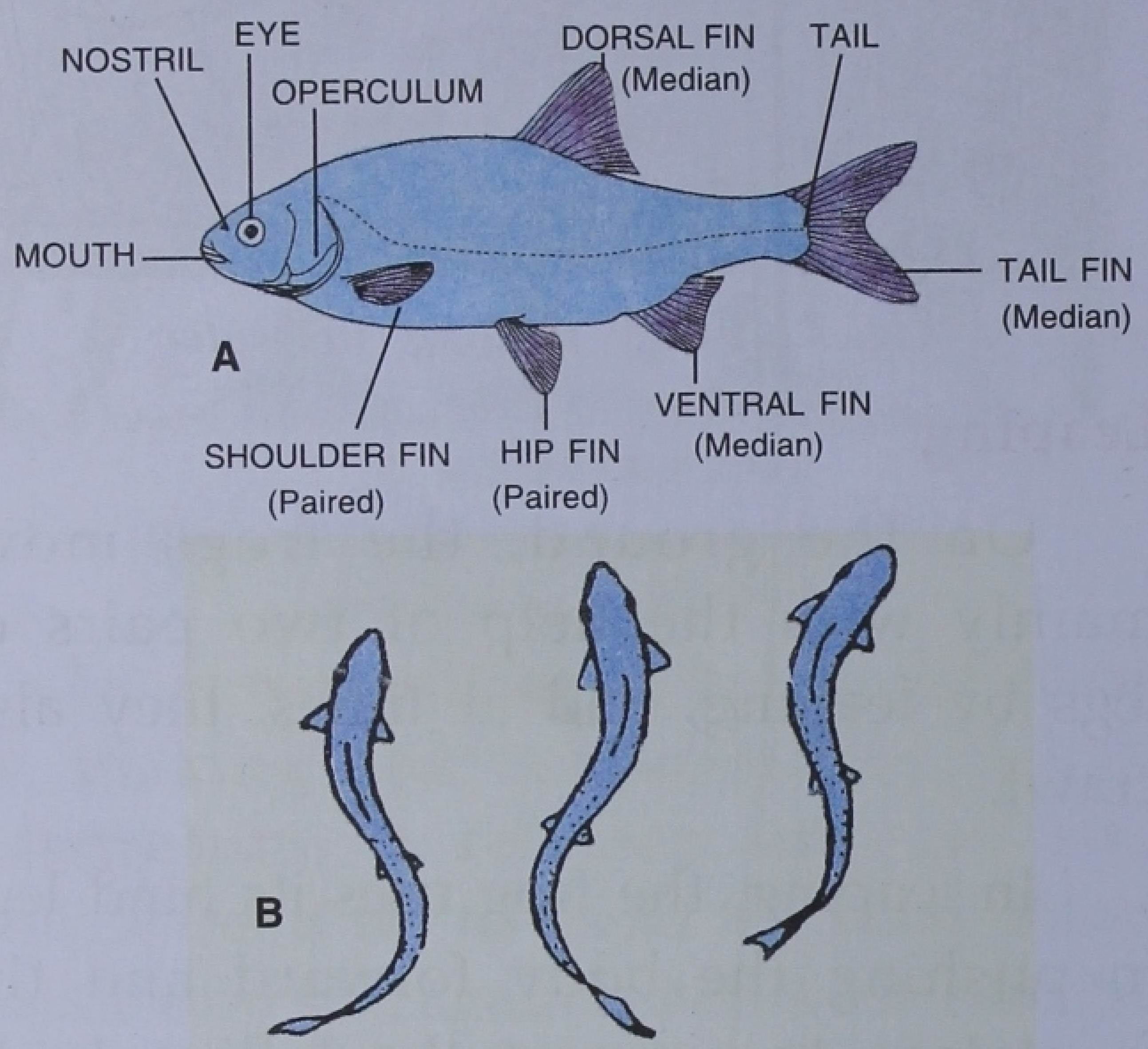

Fig. 3.10 (A) Fish , (B) Fish swims with the help of fins and tail

The *paired fins* are :

(i) A pair of **shoulder** (*pectoral*) **fins** located close to the head,

(ii) A pair of **hip** (*pelvic*) **fins**.

The *unpaired* or single fins also called the *median fins* are :

(i) **Dorsal fin** on the top middle line of the trunk,

(ii) **Ventral fin** on the lower side behind the cloacal aperture, and

(iii) **Tail fin** on the tail.

Forward movement (by body and tail). The fish primarily swims forward by means of the side-to-side movements of its body, particularly the tail. When the tail moves, the tail fin pushes the water sideward and backward, and the fish moves forward (Fig. 3.10B).

- The median fins help in **balancing** the body.
- The paired fins help the fish in three ways :
  - ➢ To swim downward or upward.
  - ➢ To maintain the body at rest at any depth.
  - ➢ To act as **brakes** to slow down or stop.

Steering : The change in direction results due to the combined effect of the tail and the paired fins.

> Beside fishes, whales and many other animals like crocodiles, turtles, ducks, etc. also swim in water. Whales are marine mammals. They have fin-like *flippers* (modified limbs), with the help of which they swim in water.

FLYING MOVEMENTS

Birds

Most birds *fly* in the air with the help of their wings. Some birds, like ducks, can also *swim* in water with the help of their webbed feet, and some, like ostrich can *run* very fast by their long legs.

Flying : There are two principal types of flight in birds: **flapping**, in

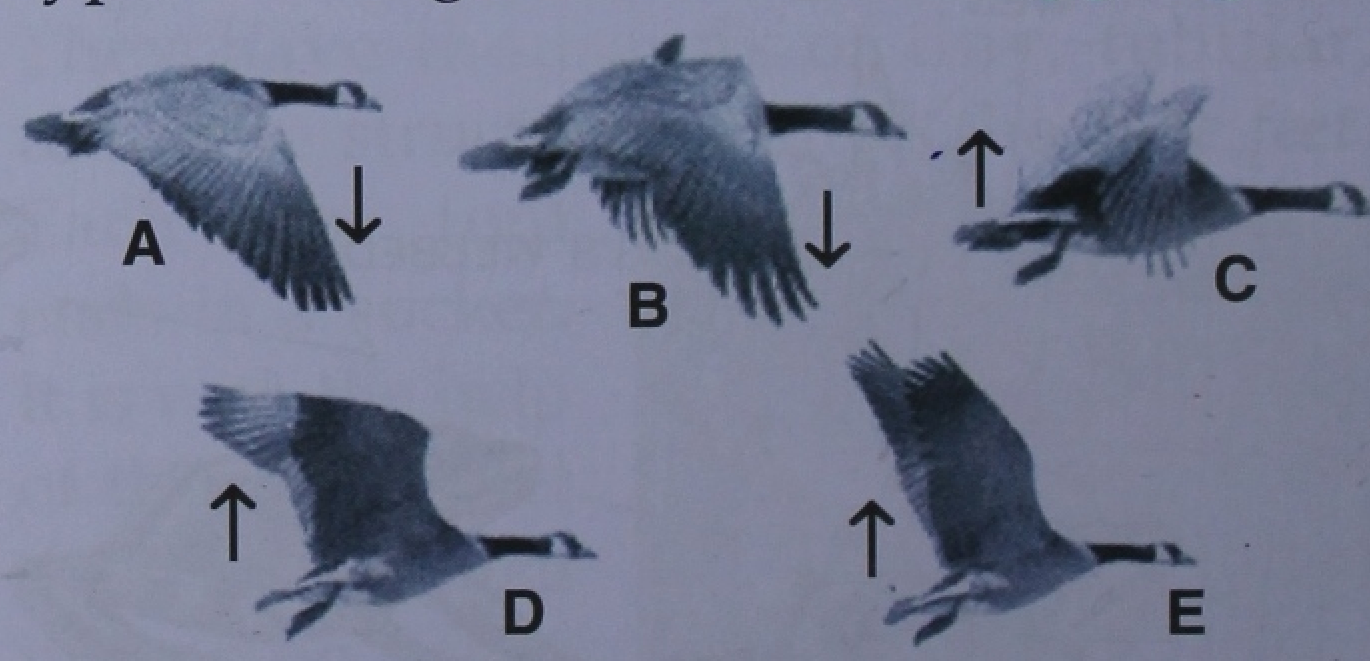

Fig. 3.11 Flight in birds. Downstroke (A & B) and upstroke (C-E) of the wings during flapping movement; start of upstroke (C), upstroke completed (E)

which wings move up and down, and **gliding**, in which the wings are held stretched in a motionless state.

In **flapping flight,** there are two principal movements of the wings — the downstroke and the upstroke (Fig. 3.11).

- The **downstroke** is more powerful, pushing the air downward and backward as a result of which the bird moves upward and forward. The upstroke is much more rapid than the downstroke.
- In **upstroke,** the wing is slightly rotated on the long axis and slightly bent at the "wrist" to reduce resistance against air. Flapping movements of the wings are brought about by the strong breast muscles.

In **gliding**, the wings are held and stretched sideward without flapping. In simple gliding, in still air, the path of the flight is downward to some degrees. Sometimes, as in **soaring** kites (kites rising high in the air), the birds take advantage of air currents in gaining heights. The soaring birds now and then glide downward to gain speed.

The **tail** acts like a **rudder** and helps the bird in stabilising and steering. The tail also acts as a **brake** to slow down the speed, especially when the bird is alighting on the ground. Birds can fly in the air at a speed ranging from 50-100 km/hour.

Insects

Insects, like butterflies, grasshoppers, etc., also fly in the air with the help of their wings (Fig. 3.12). Most insects have two pairs of wings — the forewings and hindwings. Some insects, like the houseflies and mosquitoes, have only one pair of wings — the forewings. There are some insects such as silverfish, head lice, etc., which have no wings and cannot fly. Such insects simply move with the help of legs.

Fig. 3.12 A Butterfly

Bats

Bats are the only mammals, which can fly. Their forelimbs are modified as wings. Their arms and hands form a framework. The skin stretches like a membranous sheet between the elongated fingers and even the hindlegs and tail (Fig. 3.13). The fingers support the wing, somewhat like the ribs of an umbrella. They open and close the membrane.

Fig. 3.13 A Bat

ACTIVITY 1

1. Dog :

- Watch a dog walking gently in a relaxed manner, and look at its legs.
- Is it lifting one or more legs at a time ?

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- If it is lifting two legs at a time, are these of the same side (left or right) or alternate ones i.e. one of the left side and the other of the right side ?

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- Watch the legs of a dog while it is running. Write below, the manner in which the legs are being lifted and placed forward.

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Repeat similar observations on the following animals and write them for each.

2. Cow :

....

....

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3. Pigeon :

Observe a pigeon while it is walking on land on its two legs. Are the legs being lifted and placed forward alternately ?

Yes/No..........

Is the pigeon at any time jumping ?

Yes/No..........

Are the two legs held together while jumping ? Yes/No..........

Observe a flying pigeon. Note the flapping of the wings. Are both the wings moved up or down together simultaneously or one after another alternately ?

MOVEMENTS IN HUMANS

Humans show various types of locomotory movements, e.g., walking, running, swimming, etc. These are brought about by the combined action of bones and muscles.

When you press at some parts of your body, as on the forehead or on your chest, you feel certain hard structures inside. These are the bones. Various bones together form our **skeleton system**.

The bones not only provide a definite shape to our body, but also enable us to stand erect and help in our movements.

HUMAN SKELETON

The human skeleton (Fig. 3.14) shows various bones in their normal position. Following are the important bones in the human body.

1. **Skull** in the head,
2. **Vertebrae** of the backbone, and
3. **Rib-cage** of the chest.

Collectively, all the above mentioned bones form the **axial skeleton.**

Then, there are bones which project outward from the axial skeleton. These are the bones of the *shoulder* and the *hip girdles* and those of the *fore* and the *hind*

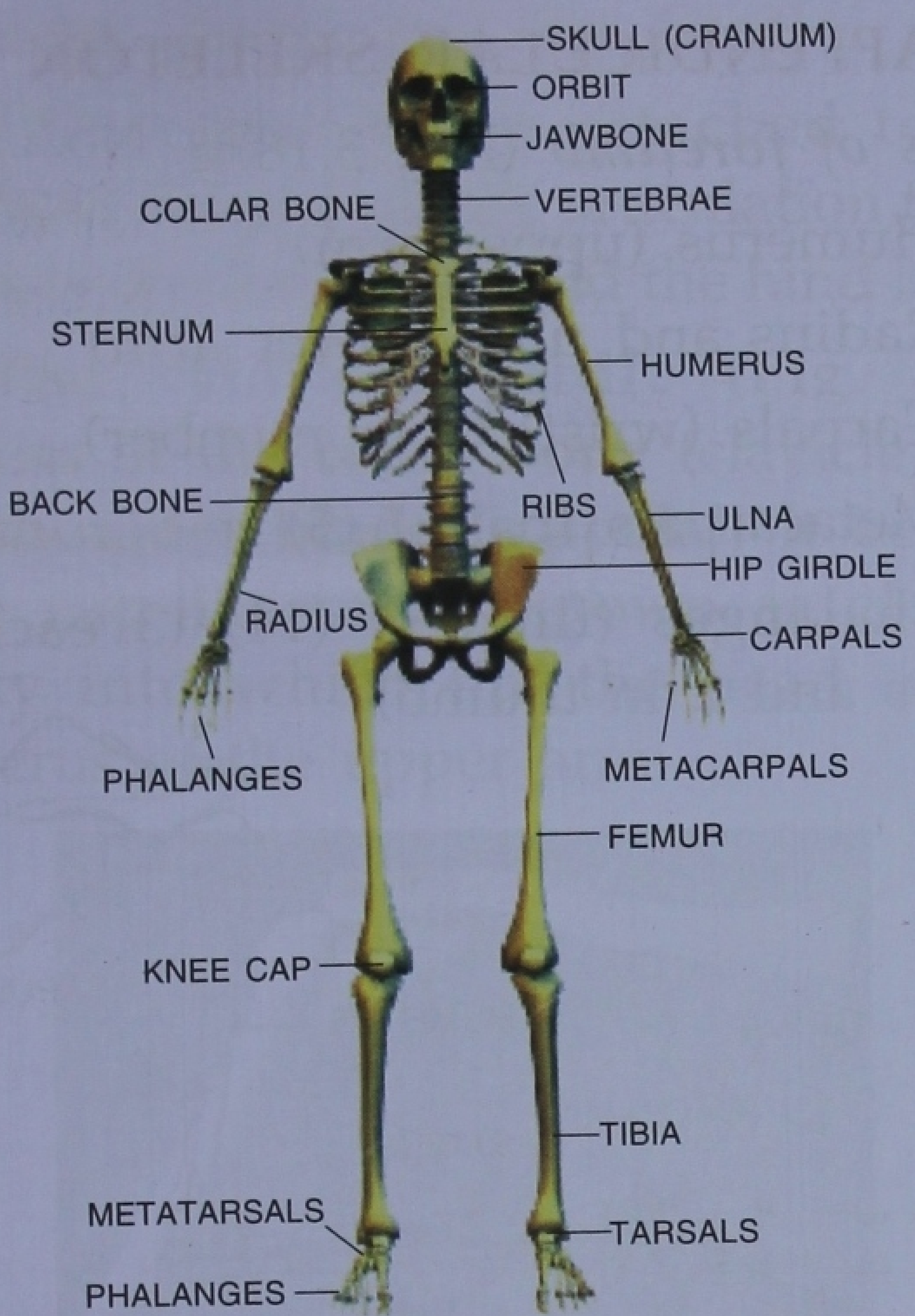


Fig. 3.14 Human Skeleton

limbs. Together, these constitute the **appendicular skeleton.**

SKELETON
- Axial skeleton
- Appendicular skeleton

A. AXIAL SKELETON

The axial skeleton contains the skull, the backbone, the ribs and the sternum.

Skull

The skull is formed of an upper part forming the brain box and a lower part forming the jaws (Fig. 3.15). The **brain box (cranium)** is made of many bones which are immovably joined with each other. Observe the zigzag lines on the cranium where the adjacent bones are joined. Out of the two jaws, the upper one is immovably fused with the brain box while the lower jaw is movably

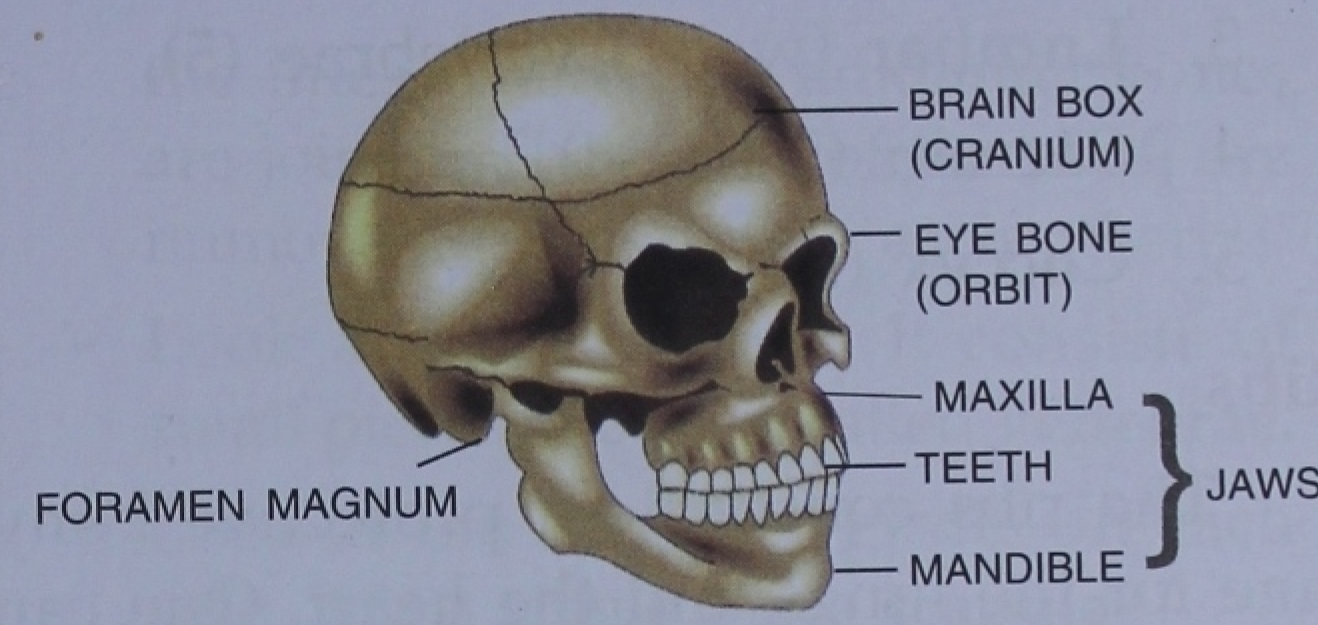


Fig. 3.15 The Skull

joined. The jaw bones have deep pits (sockets) for lodging the teeth.

On the back of the skull is a large hole called ***foramen magnum*** (meaning the big hole). This hole provides passage for the spinal cord which comes out from the brain and is continued inside the backbone.

Backbone

Move your finger along the middle of your back, and feel the presence of a chain of small bony pieces. This is your ***backbone*** (the ***vertebral column***) (Fig. 3.16). It consists of 33 small ring-like **vertebrae** (*singular* = vertebra) arranged in five groups :

1. **Cervical** (neck) vertebrae (7),
2. **Thoracic** (chest) vertebrae (12),

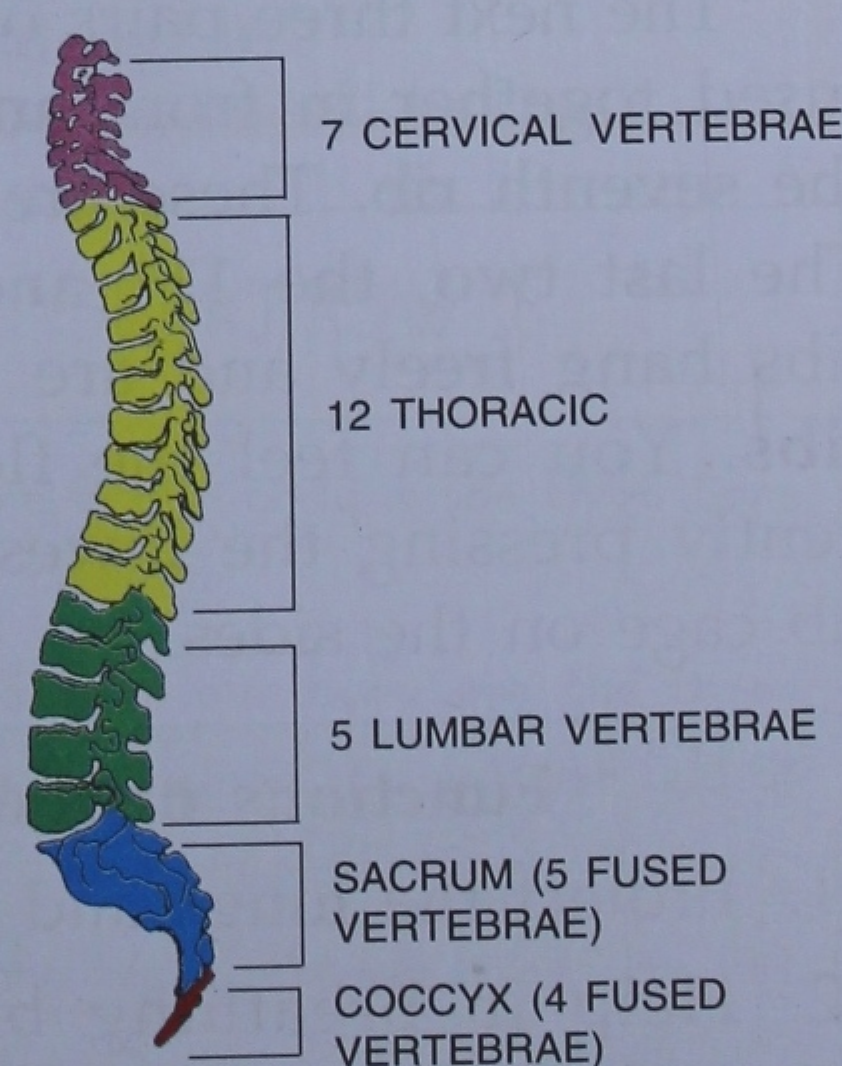


Fig. 3.16 The vertebral column

3. **Lumbar** (waist) vertebrae (5),
4. **Sacrum** (5 fused), and
5. **Coccyx** (tail) (4 fused).

Ribs

The ribs constitute a protective bony cage for the lungs and the heart. One can feel the ribs by moving his fingers up and down his chest (Fig. 3.17).

There are twelve pairs of ribs. The first seven (1-7) are attached to the thoracic vertebrae at the back and to the **breast-bone** (sternum) on the front. These are the **true ribs.**

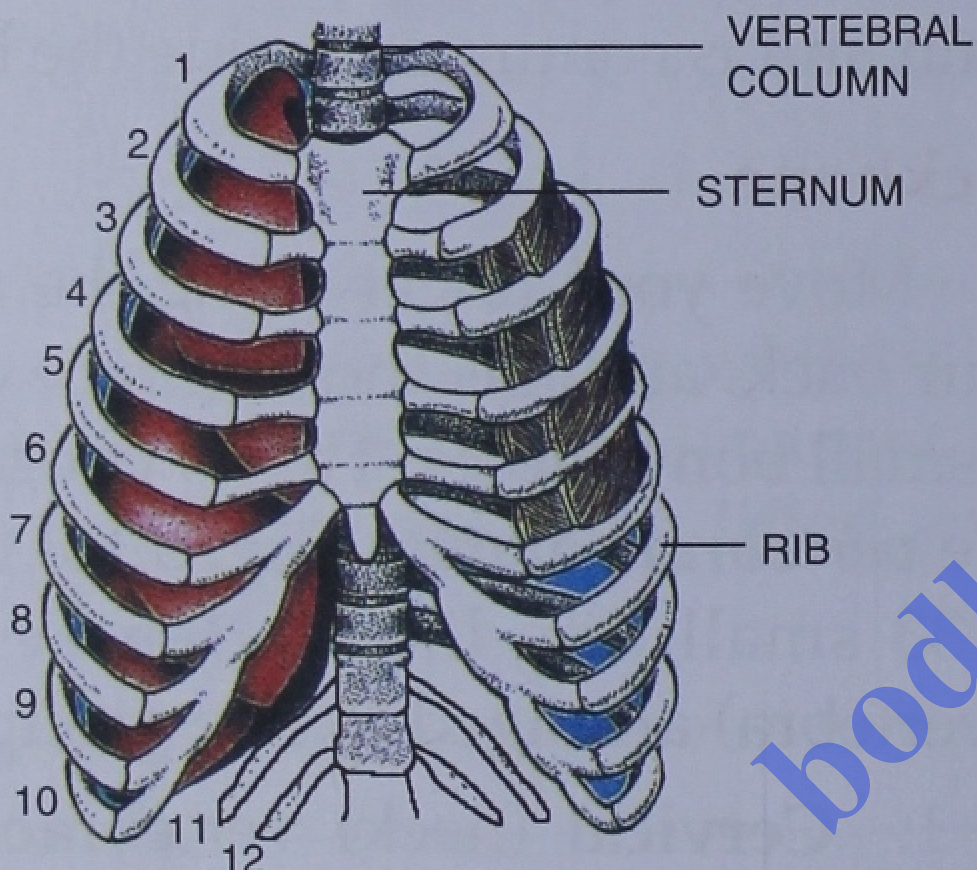


Fig. 3.17 The Rib cage

The next three pairs of ribs (8-10) are fused together in front and in turn, join the seventh rib. These are the **false ribs.** The last two, the 11th and 12th pairs of ribs hang freely and are called **floating ribs**. You can feel the floating ribs by gently pressing the lowest part of your rib cage on the sides.

Functions of the ribs
1. Protect the lungs and the heart.
2. Help in breathing by expanding and contracting the chest cavity.

B. APPENDICULAR SKELETON

Bones of forelimb (Fig. 3.18) :

Humerus (upper arm)

Radius and ulna (lower arm)

Carpals (wrist) (8 in number)

Metacarpals (palm) (5)

Phalanges (fingers) (14) (3 each in fingers and 2 in thumb)

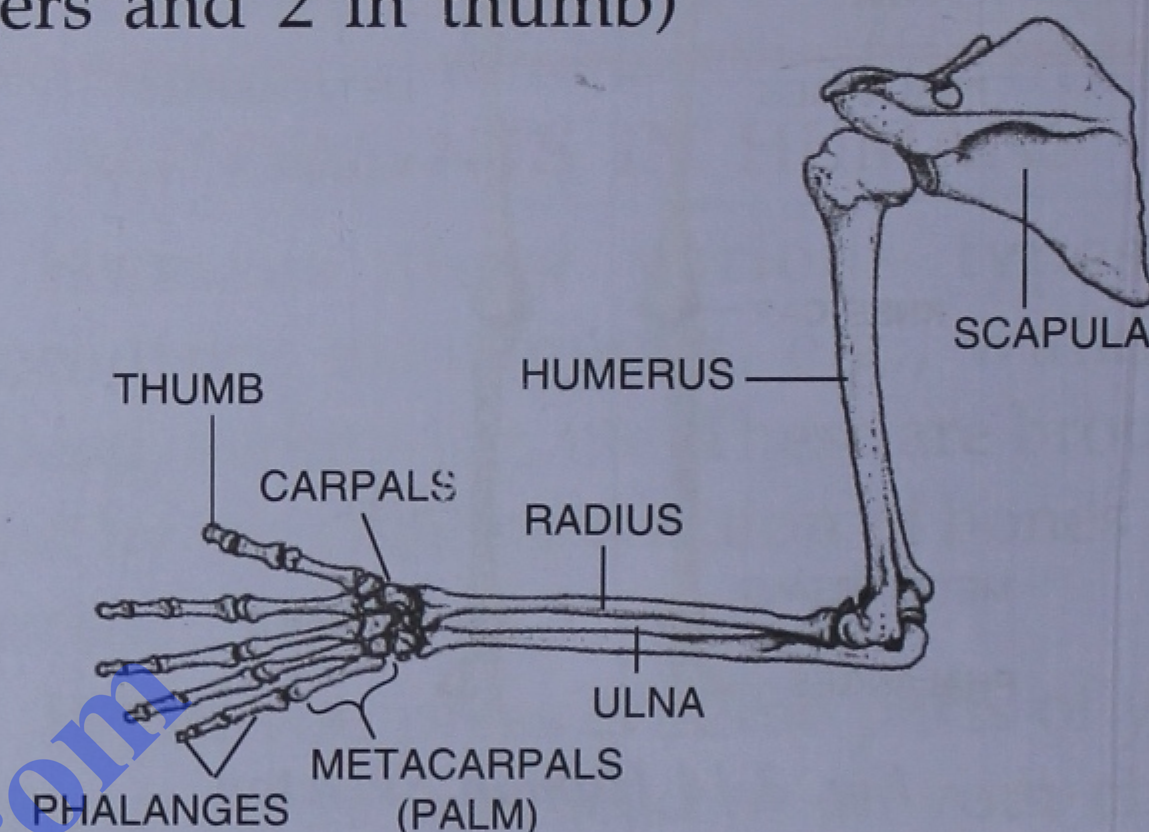


Fig. 3.18 The shoulder girdle and arm bones

Bones of hind limb (Fig. 3.19) :

Femur (thigh)

Tibia and fibula (shank)

Tarsals (ankle) (7 in number)

Metatarsals (middle of the foot) (5)

Phalanges (toes) (14)

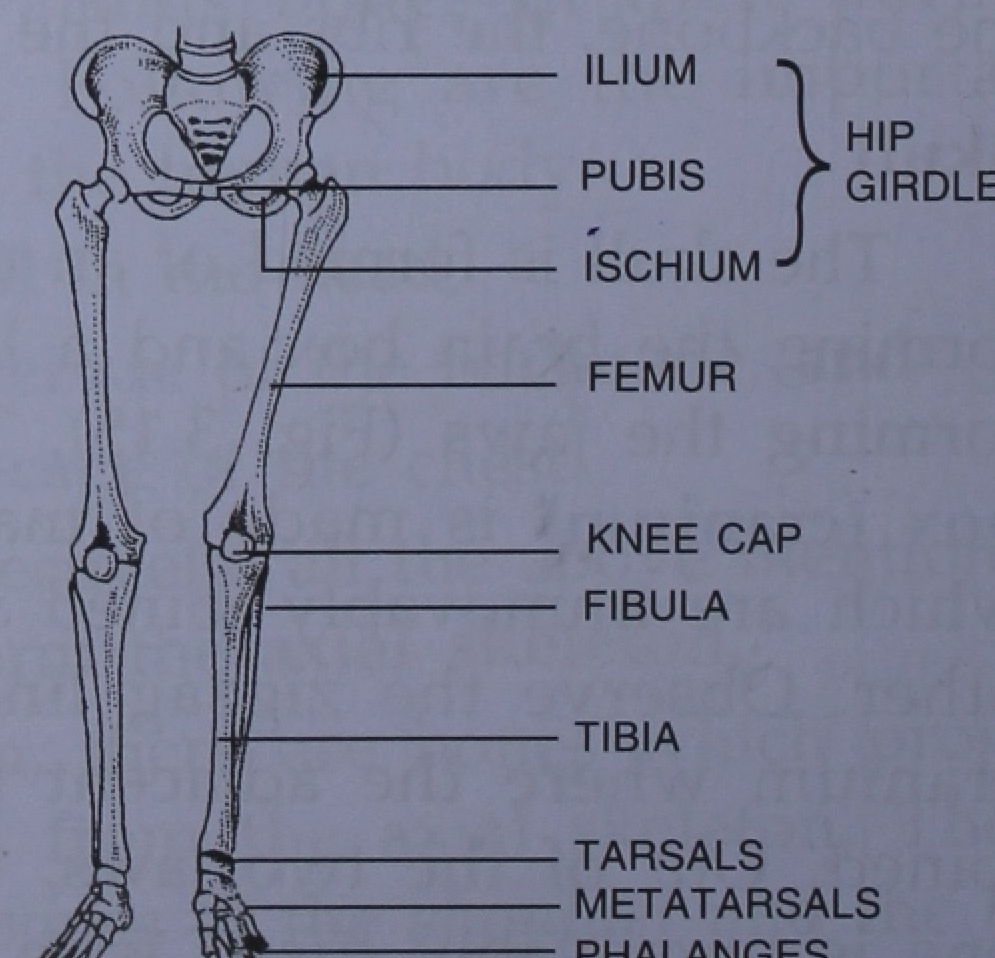


Fig. 3.19 The hip girdle and hindlimbs

Shoulder Girdle and Hip Girdle

These girdles are attached to the backbone. They provide articulation to the bones of the fore limbs and the hind limbs.

The **shoulder girdle** (Fig. 3.20) consists of the **collar bone** (clavicle) and the **shoulder blade** (scapula). It bears a large cup-like cavity known as glenoid cavity into which fits the head of the humerus of the upper arm.

Fig. 3.20 Shoulder girdle

The hip girdle is joined medially to the sacrum of the backbone. Each half of the hip girdle consists of an **ilium**, a **pubis** and an **ischium**. The pelvic girdle bears a large cup-like cavity known as acetabulum on either side to lodge the head of the thigh bone (Femur). The trough-like hip girdle holds and supports various organs like the intestines.

ACTIVITY 2

An actual human skeleton kept in the school, or a good plastic model of the same is needed for this activity.

- Look at the **skull**. You will see some zig-zag lines (sutures) on it. These are the lines where two adjoining bones are joined. The bones of the skull are immovably joined with each other.
- Look at the backbone. It consists of small pieces of bones, called **vertebrae**.
- Look at the shoulder girdle on each side. It is a single piece **scapula**.
- Locate the arm bones — long single **humerus** in the upper arm, two bones (**radius** towards thumb side and **ulna** towards little finger side in the lower arm), three bones of each finger and two of thumb **(phalanges)**.
- Locate the **hip girdle**. Observe its shape. It is somewhat trough-like and is called pelvis.
- Look at the bones of the legs and note the following :
  - Single long **thigh bone** (femur). It is the longest bone in the body ?
  - The **knee joint**. It has a small disc-like **knee cap** (patella).
  - Locate the two bones (**tibia** and **fibula**) of the shank.
  - In the foot, locate the small toe bones **(phalanges)**.

DO YOU KNOW ?

- The longest bone in our body is the thigh bone (femur).
- The smallest bones in our body are the three tiny bones in the ear, joined to the inner side of the ear drum in the form of a chain.
- The nails and the teeth, though hard, are not bones.

JOINTS

The point at which two separate bones meet is called a **joint.** There are several kinds of joints in our body.

Immovable Joint (Fig. 3.21, A)

In this type of joint, no movement is possible between the two bones. The sutures between the bones of the brain box are examples of immovable joint.

Partially Movable Joint (Fig. 3.21, B)

Here, only very little (partial) movement occurs between the two bones. For example, the joint between a rib and the breast-bone or between the vertebrae.

Movable Joints :

In this type, varying degrees of movements are possible between the two bones forming the joint and accordingly, the movable joints are as follows :

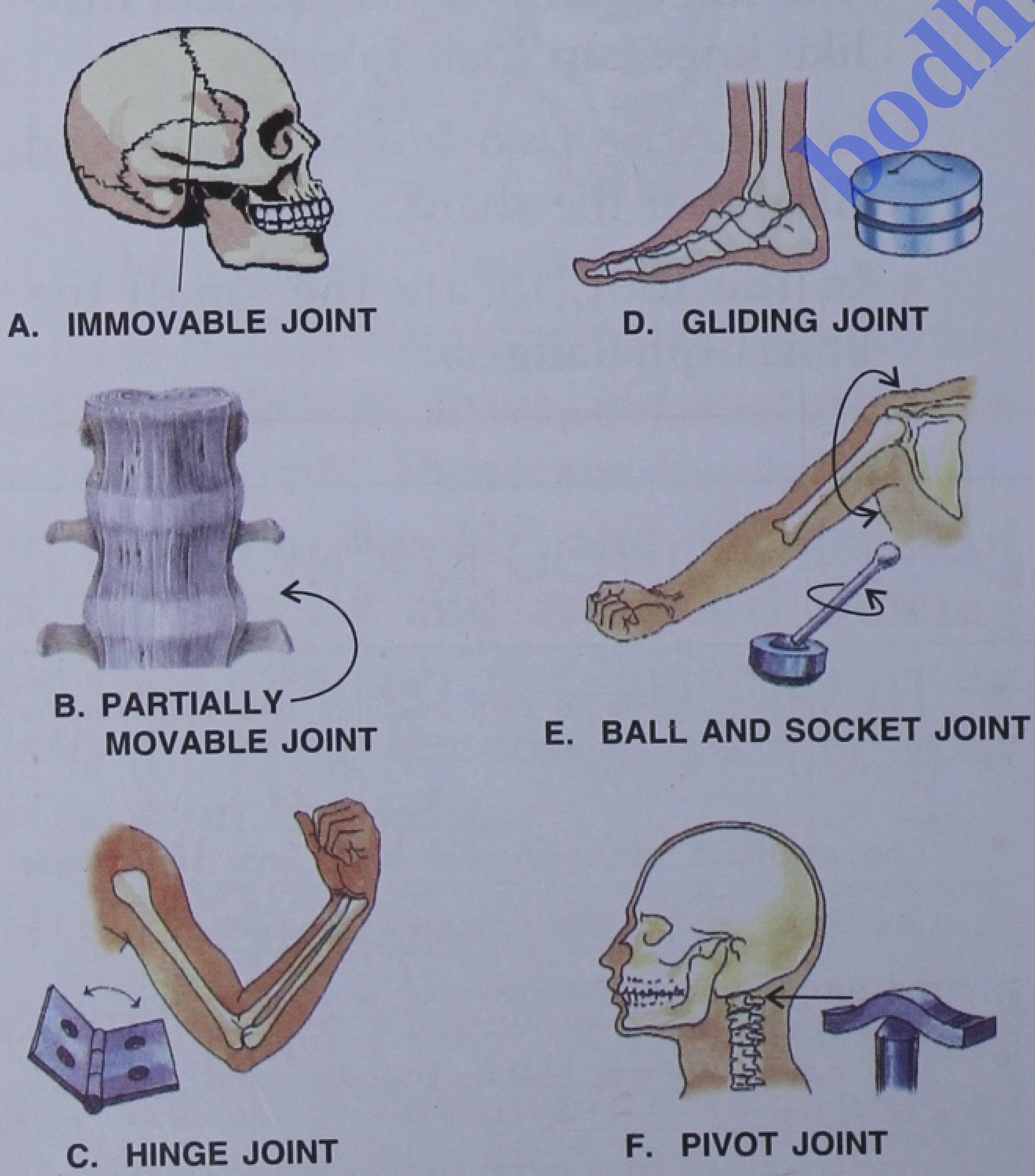


Fig. 3.21 Different kinds of joints

(i) Hinge Joint (Fig. 3.21, C)

This joint moves like a hinge in one plane only, just like the hinge of a door. Example : Elbow joint between the humerus and ulna, joints between the bones of fingers and toes, and less perfectly, the knee joint. The hinge joints usually give sufficient power because at the joint, there is less danger of twisting.

(ii) Gliding Joint (Fig. 3.21, D)

It occurs between the bones of the wrist and also between the bones of the ankle. The joint between the two adjacent vertebrae is also a kind of gliding joint.

(iii) Ball and Socket Joint (Fig. 3.21, E)

Here, one end of a bone which is rounded and ball-like fits into a cup-like depression of another bone. This joint provides movement in any direction. Two best examples are shoulder joint, and the hip joint. In shoulder joint, the head of humerus fits into a socket (glenoid cavity) of the shoulder girdle, and in hip joint, the large ball-like head of femur fits in the deep socket of the hip girdle (acetabulum cavity).

(iv) Pivot Joint (Fig. 3.21 F)

In such joints, one bone is rotated over a pivot-like end of another bone. For example, the skull is rotated on the upper end of the backbone.

Synovial Joints

Some of the joints like the shoulder joint and the knee joint (Fig. 3.22 & 3.23), allow considerable degree of movement. These joints have two special requirements—firstly, they should be held firmly in position and secondly, the surfaces coming in contact should be well lubricated to remove friction. This lubricating fluid wherever it occurs, is called the **synovial fluid** and hence the name synovial joint. The knee joint, for example, is a synovial joint. It is held in position by strong ligaments and is well protected by an outer fibrous layer (capsule). The ligaments prevent dislocation in normal movement. The synovial fluid is contained in a "sac" formed of very thin synovial membrane and this sac serves as a cushion between the bones.

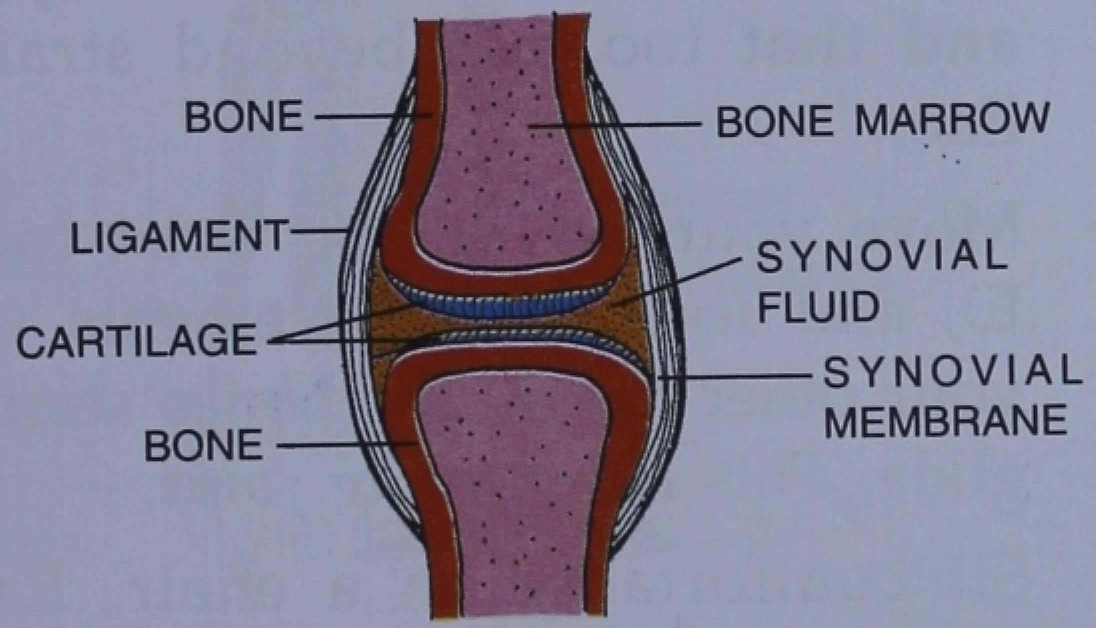


Fig. 3.22 Internal structure of a typical movable joint (diagrammatic)

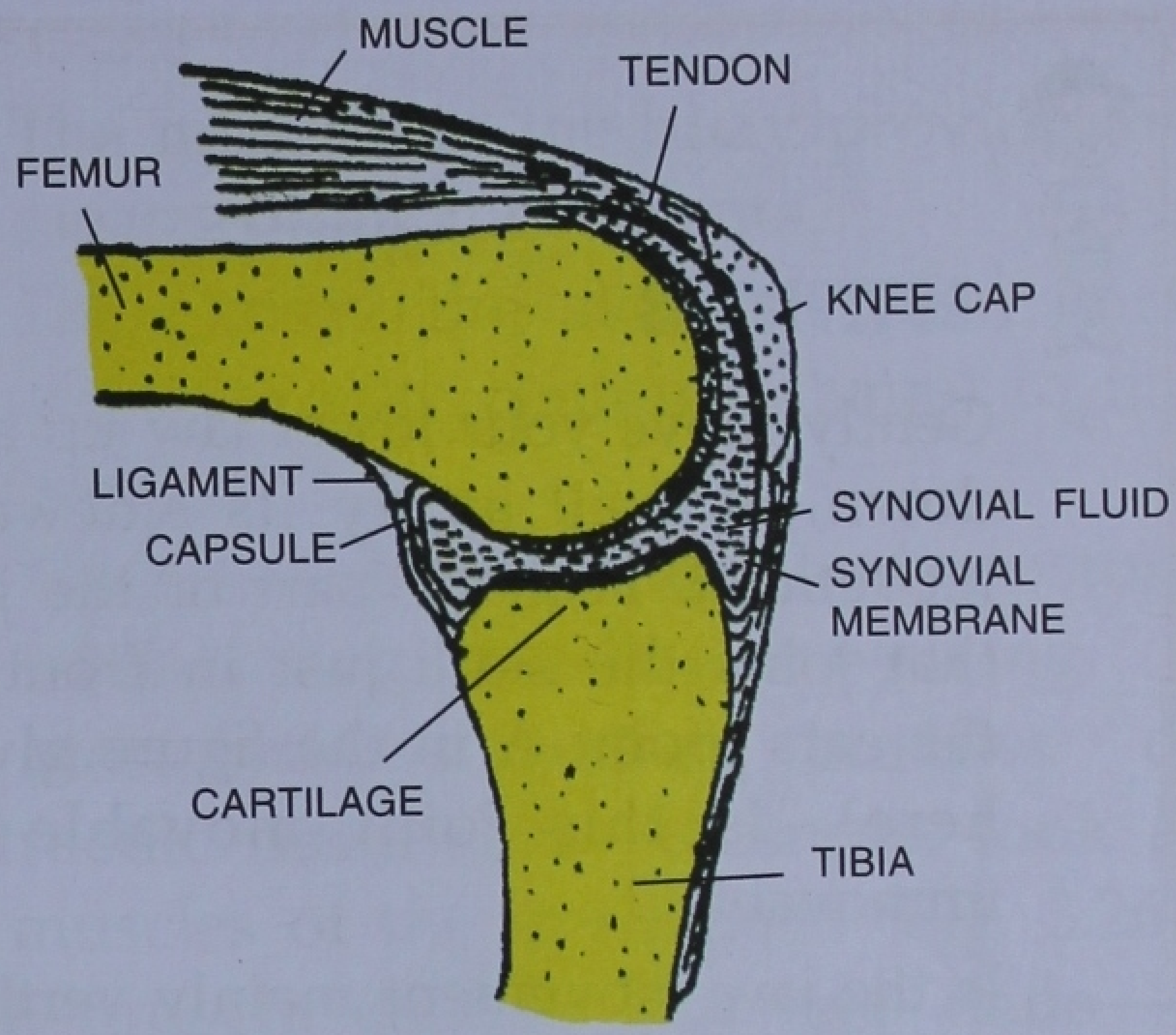


Fig. 3.23 Knee joint (diagrammatic)

JOINTS

Immovable Joints
Joints are a fixed type. Bones are jointed by a fibrous connective tissue very tightly, e.g. *skull bone.*

Partially Movable Joints
Joints allow little movement. Bones are jointed by cartilage which allows little movement. For example, *joint between sternum* and *ribs, joints between vertebrae.*

Freely Movable Joints
There is synovial cavity present between the two ends of a bone. Filled with synovial fluid, joints are capable of free movement. For example, *elbow joint, hip joint.*

Gliding Joint
Bones glide over each other to some extent e.g. *wrist bones, ankle bones.*

Pivot Joint
Joints allow rotation about an axis (the pivot) e.g. joint *between atlas* and *axis vertebrae.*

Ball and Socket Joint
Most movable joints, ball like end of one bone, articulate into cup-shaped depression of another bone so that the structure could move in all planes. e.g. *shoulder* and *hip joint.*

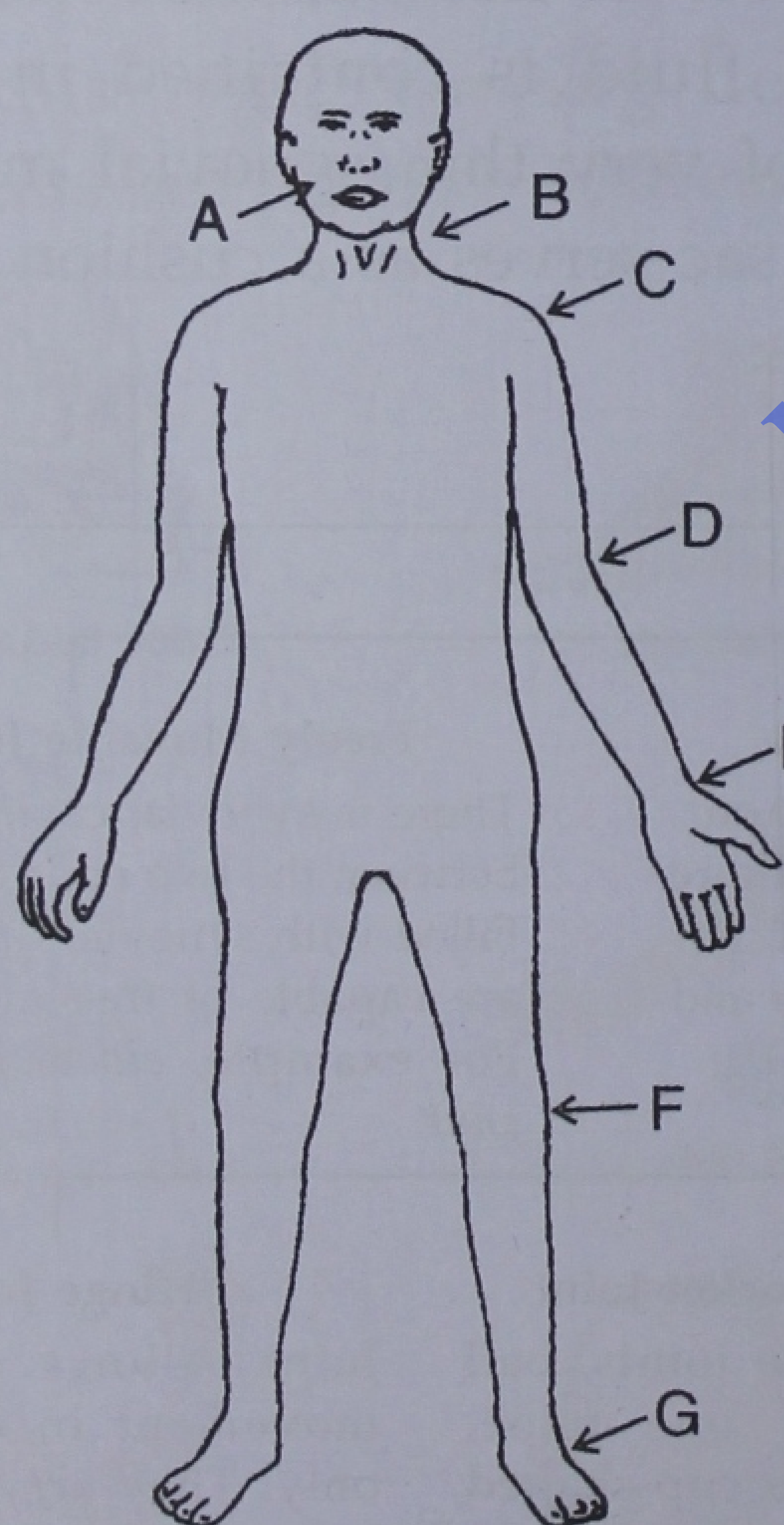
Hinge Joint
Joint allows restricted movement in one plane only. They are capable of bearing heavy load. e.g., *elbow, knee.*

ACTIVITY 3

- Gently move your lower jaw up and down, as well as try its sideward movement. Feel the part of the jaw that joins the skull just in front of the ears (point A in the figure given here). Is this joint movable or immovable ?

  Is the jaw movement mainly vertical or horizontal ?

- Keeping your neck steady, move your head upward and downward. Feel the uppermost point at the back of the neck where the head moves. This is a *pivot joint* (marked B).



Position of some of the main joints in human body

- Touch the top of your shoulder at point C. Move your arm forward, backward, sideward, upward and downward. Can you do so in all directions ? Yes/No

  This is ***ball and socket joint***.

- Straighten your one arm and place the palm of the other hand below its elbow (point D). Bend and straighten the arm, a number of times. Can you feel the movement of a bone at the elbow ? Yes/No

  This is the elbow joint (***hinge joint***) which can move only in one plane and that too, not beyond straight line.

- Move your fist on the wrist (point E), and feel these movements with your other hand. The bones seem to glide. This is a ***gliding joint***.

- Sit comfortably on a chair. Raise your one leg and try to bend it at the knee in different directions (point F). Can you do so in all directions ? Yes/No

  (The knee joint is a ***hinge joint*** just like the one at the elbow).

- Feel the movement at the ankle (point G). Are these movements similar to those at the wrist ?

  Yes/No

  (This is a ***gliding joint*** similar to the one on the wrist).

- Bend your toes in various directions. Do these show movements like those in your fingers ? Yes/No

  (The bones in the toes have ***hinge joints*** like those in the fingers).

Tendons : These are in the form of tough parallel fibres of connective tissues which *join muscles to the bones* (Fig. 3.24). As the bones move with the contraction and relaxation of muscles, tendons do not allow bones to move away from their normal location. Thus, they play an important role in locomotion.

Ligaments (Fig. 3.24) **:** Ligaments consist of strong and elastic bands of connective tissues. These bands *hold two or more bones together at joints*. They help the bones move by contraction and relaxing.

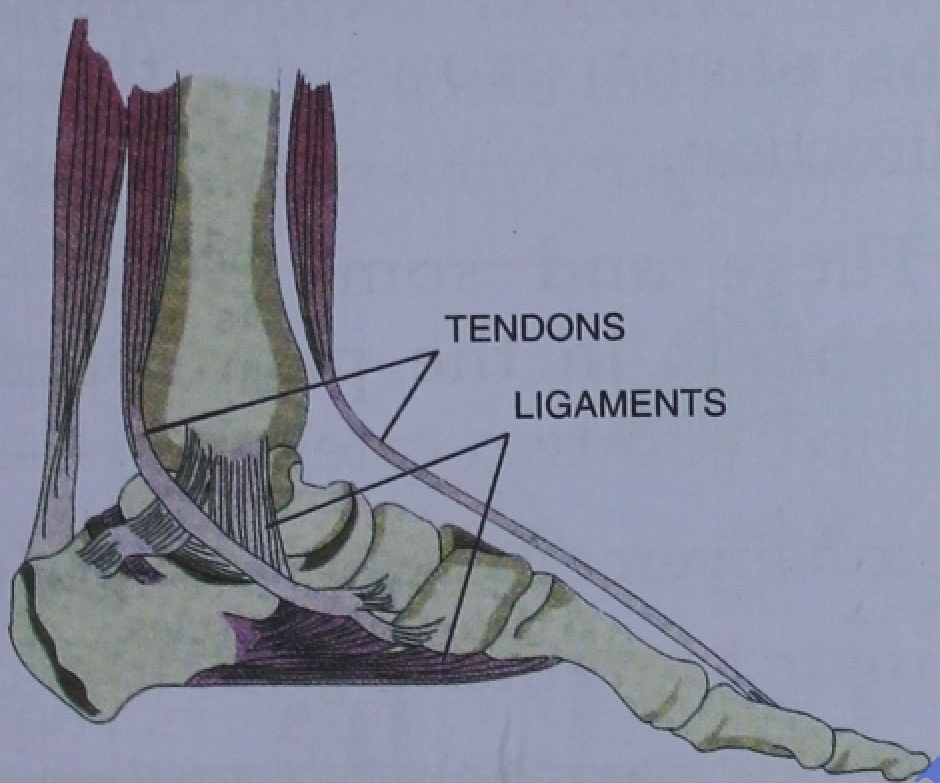


Fig. 3.24 Tendons and ligaments of foot

Cartilages (Fig. 3.25) **:** Cartilages are found between two or more bones. They behave as cushions to the bones and prevent them from rubbing together. Thus, they act as cushions or, shock absorbing pads.

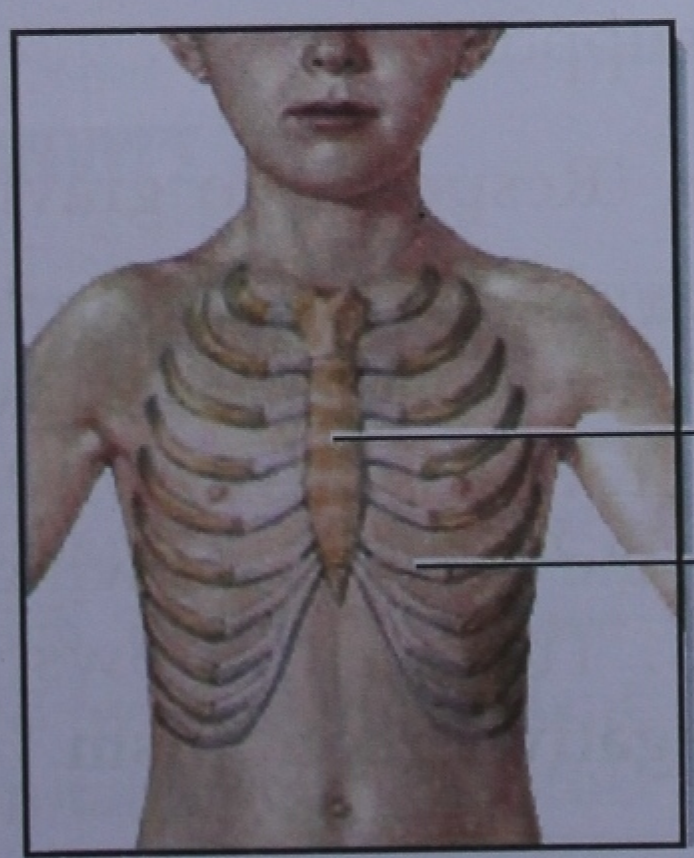


Fig. 3.25 Cartilages

MUSCLES

- The muscles in the body provide the means of all movements.
- They cover the skeletal framework and also give contour (shape) to the body.
- Muscles help to maintain body posture while sitting, standing or walking.

Most muscles are long bundles of contractile tissues. For example, look at the muscles of the upper arm (Fig. 3.26). Each muscle usually has two ends—a **fixed end** where the muscle originates and a **movable end** which pulls some other part. This movable end is drawn out to form a tough structure, the **tendon**, which is attached to the bone. Can you make out these parts in Fig. 3.26.

When stimulated by a nerve, the muscle contracts to become shorter and thicker and thus, it pulls the bone at the movable end.

Muscles can only get stretched, contract and relax, but they cannot lengthen.

Antagonistic or Opposing Muscles (Fig. 3.26)

A structure which has been moved by a muscle cannot return to its original position without the action of another muscle. Such muscles causing opposing movements are called **antagonistic muscles.** For example, the biceps (flexor) muscle of the upper arm flexes, *i.e.* bends the lower arm over the upper arm. Straightening (extension) of the lower arm is brought about by triceps (extensor). Therefore, these two muscles are antagonistic.

Coordination of Muscles

Most actions in our body, like standing, walking, running, playing tennis, etc., require combined action of several muscles. To a great extent, the muscles have to be coordinated for a particular kind of movement.

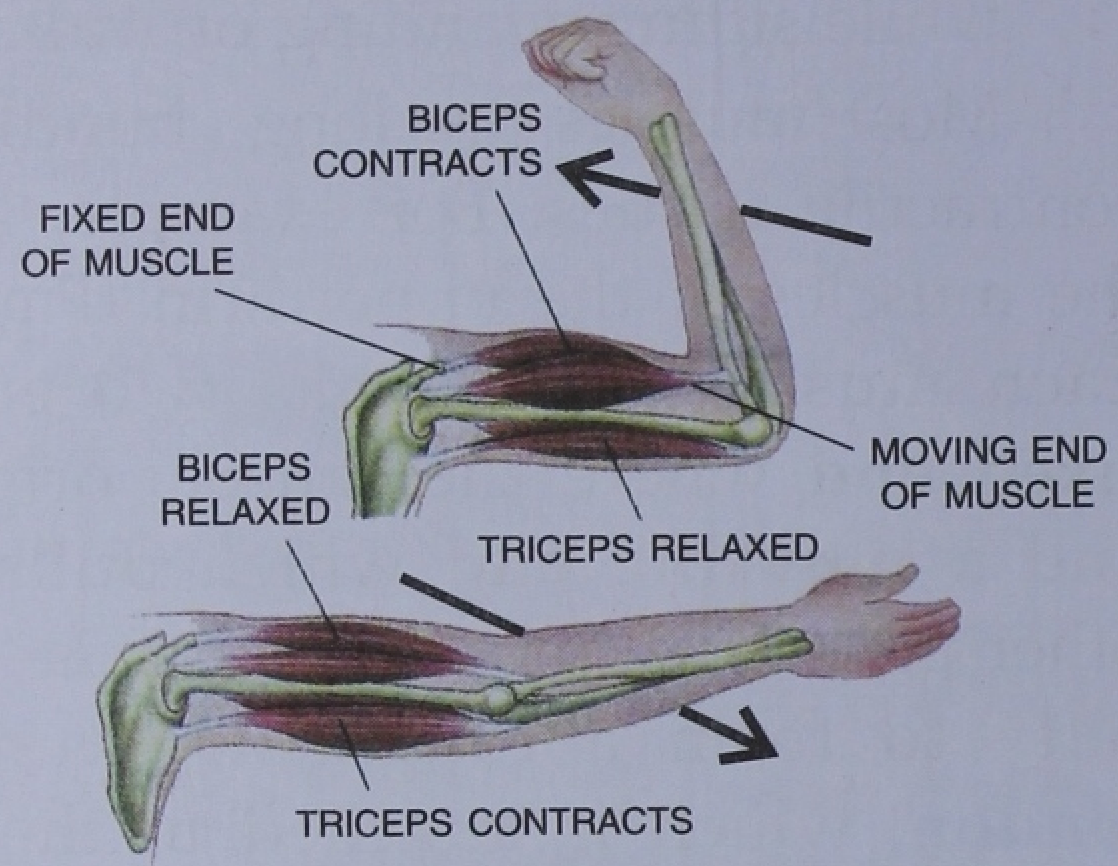


Fig. 3.26 Antagonistic muscles of arm

DO YOU KNOW ?

- Most muscles are attached to bones, but some are not. For example, the muscles which move our eyelids, or the muscles that push the food along the food canal are not attached to bones.
- Some muscles in our body are vestigial (non-functional) such as the muscles of the ears. Other animals like the cow or horse can move their ears. Some persons also, with some effort, can learn to move their ears slightly.

MOVEMENTS IN PLANTS

Unlike animals, plants remain fixed in the soil and do not move from one place to another. However, certain, unicellular plants, like algae, swim in water with the help of hair - like structures called flagella. But, in most plants, movements are very slow and are not visible. Such movements are mostly limited to changes in the position of their parts.

You must have observed the following movements in plants :

- The flowers close their petals during night time and open them the next morning.
- The sunflower turns towards the sun.
- The root grows towards the soil while the shoot grows in the opposite direction.

These and some other types of movements in the plant parts can be classified into two categories —

Tropic Movements and **Nastic Movements**

A. Tropic Movements (Gk. tropicos : turn)

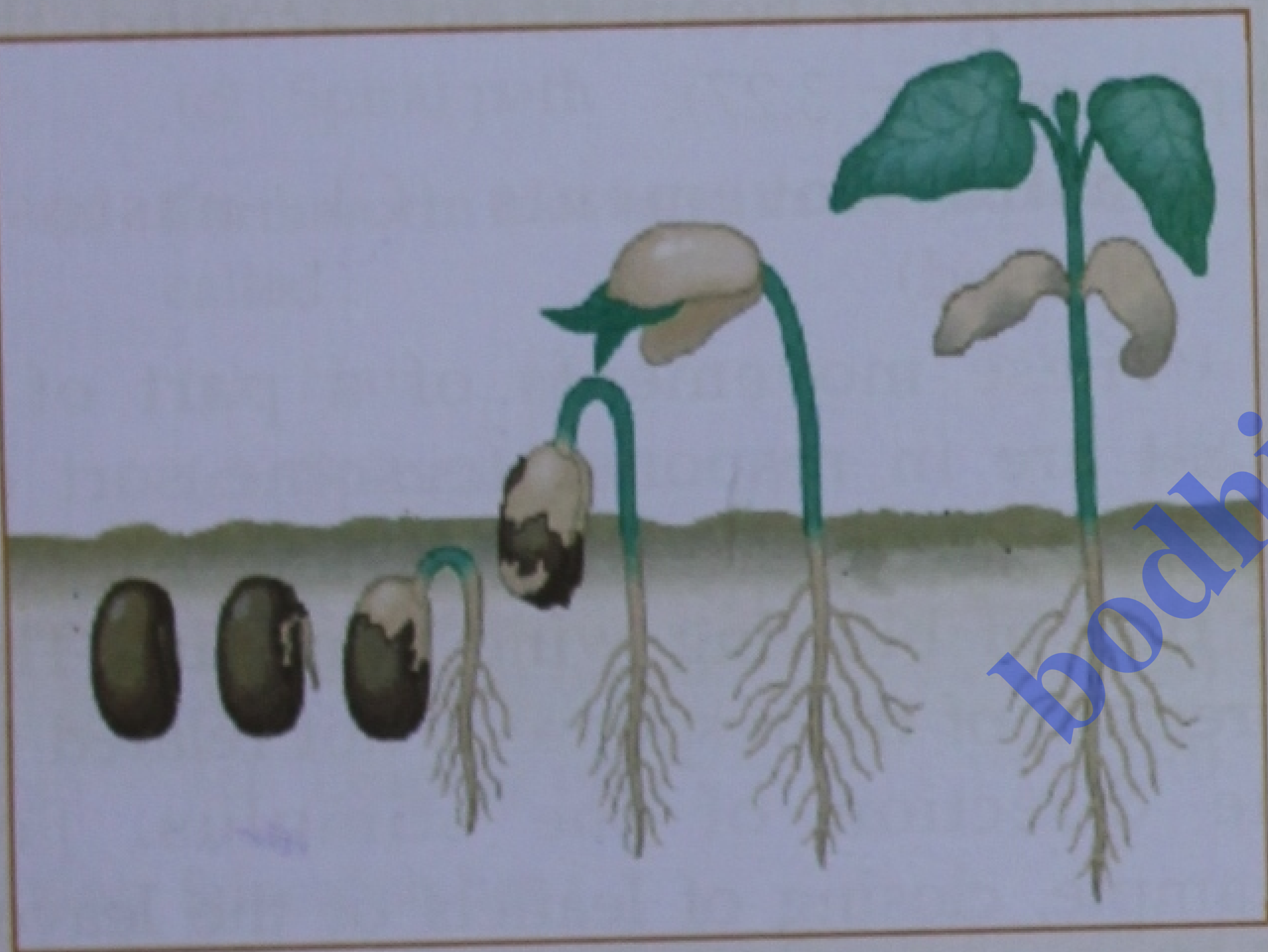
These are the turning growth movements of a plant part, in response to a directional stimulus. The direction of the response is related to the direction of the stimulus. For example, bending of the shoot towards the source of light, growth of the roots towards the force of gravity, growth of the tendril of a climber around the touch, support, etc.

Geotropism (Response to gravity)

Growth movements induced by gravity are called **geotropism**. Roots grow downwards towards the gravity to absorb water from the ground showing **positive geotropism**. The stem grows upwards showing **negative geotropism**.

ACTIVITY 4

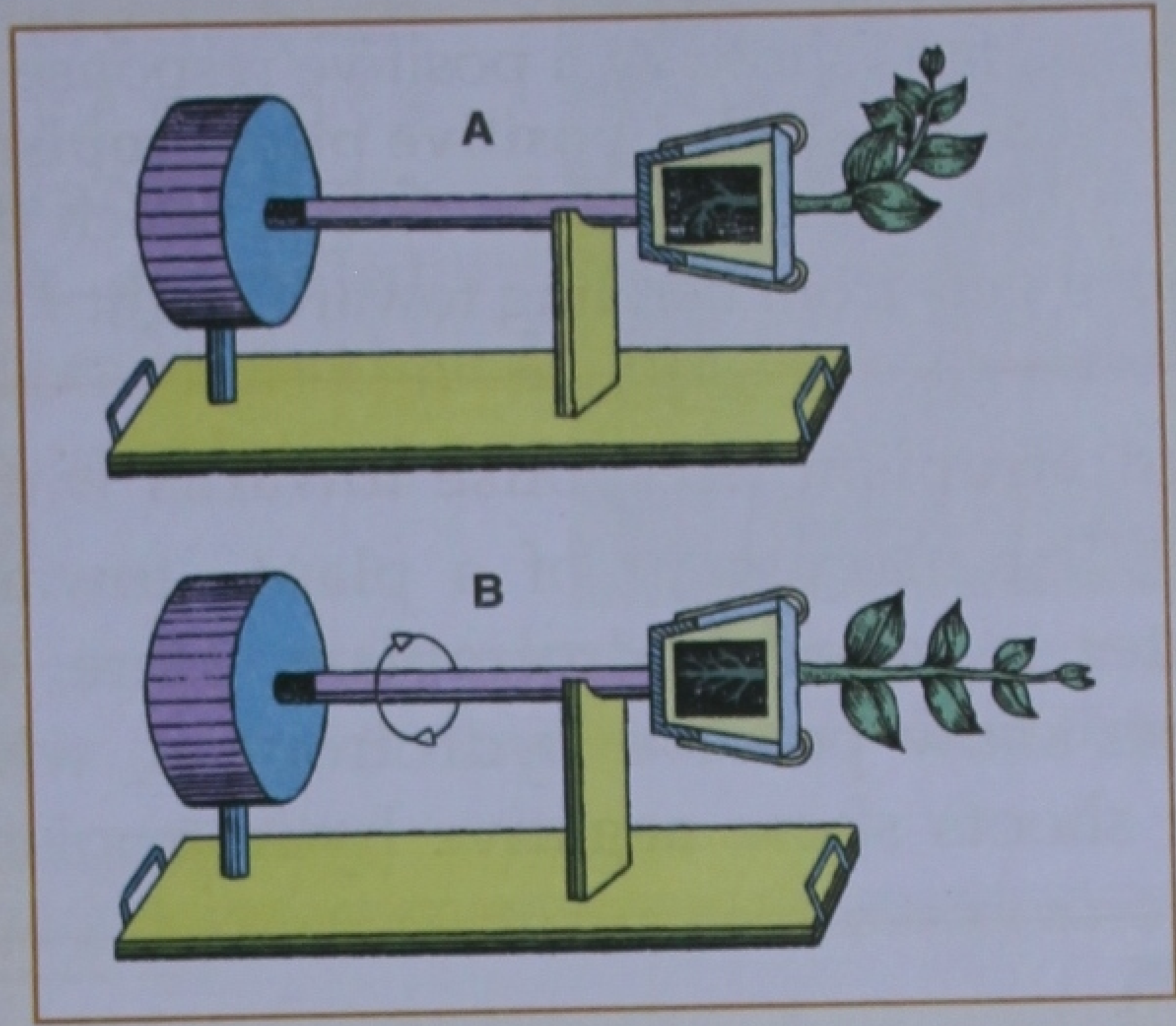
Take a few seeds of bean or gram, and sow them in moist soil in a glass beaker. In three or four days, the seeds will sprout. Each seed will give rise to a tiny seedling. Observe the growth of the seedling for 8-9 days. Water the plants regularly. Observe the increase in the length of stem growing opposite the force of gravity, and that by the roots growing towards the force of gravity. The growth in the stem shows negative (away) response to gravity, while the root shows positive (towards gravity) response.



Geotropism

ACTIVITY 5

Geotropism can be demonstrated in the laboratory with the help of an instrument called *klinostat*. It can allow a potted plant to rotate at a slow speed. Two such instruments are taken which are fixed with potted plant horizontally. One is rotated and the other is not. After



Demonstration of geotropism : A. Klinostat stationary; B. Klinostat rotating (note that no geotropic response is seen in it)

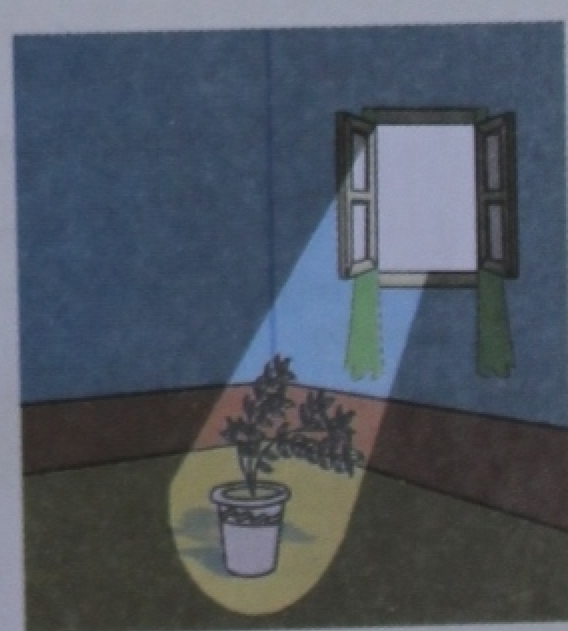
sometime, you will see that the shoot of stationary klinostat shows negative geotropism and roots show positive geotropism. The other potted plant does not show any bending. This is due to the fact that all parts are equally exposed to the gravitational force during rotation.

Phototropism

The bending of a plant towards light shows phototropism.

ACTIVITY 6

Take a healthy potted croton plant. Keep this pot inside a dark room by the side of an open window. After a few days, you will notice that the plant bends towards the open window (that is, towards light). Here,



This potted house plant is growing towards light the plant is showing a positive response to light. This is called **positive phototropism**. Can you think of the advantage which the plant gets from bending towards light ?

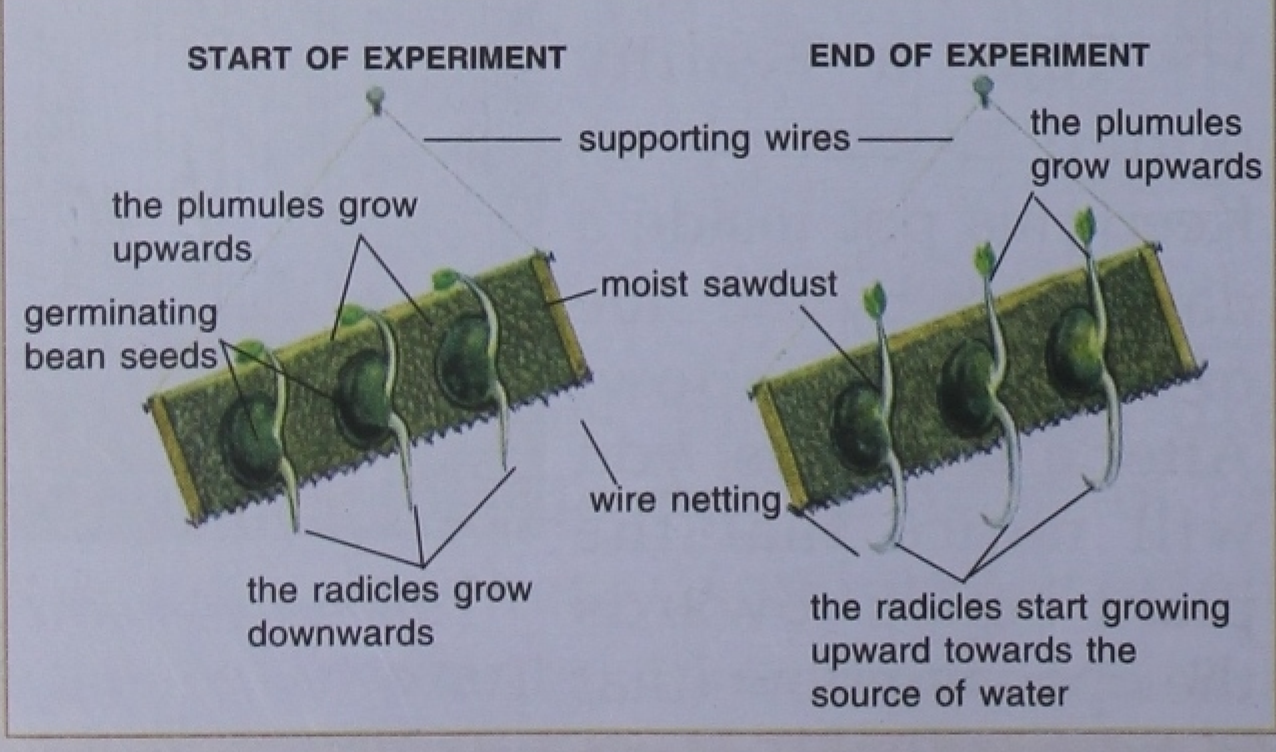
Hydrotropism (Response towards water)

The movement of a plant towards water is called **hydrotropism**. Here, the roots show positive hydrotropism, while the shoots show negative hydrotropism.

ACTIVITY 7

To investigate the effects of water on the growth of roots and shoots. Take a piece of wire netting or gauze, suspended by means of wires. Moist sawdust (around one inch) is placed on the wire netting and some germinating bean seeds are embedded in the sawdust.

As the seeds germinate, the radicles initially grow downwards through the wire netting under the influence of gravity. But soon, they start growing upwards, towards the moist sawdust, which is the only source of water. In doing so, they grow against the force of gravity. The shoots grow upwards all the time.



Hydrotropism

This experiment shows that the roots grow towards water and shoots do not. In the roots, water is more effective stimulus than gravity.

Thigmotropism (Response to touch)

A part of plant which shows response due to stimulus of **touch**, is called thigmo-tropism. For example, twining of pea tendrils around the support and spiralling of bean shoot around the supports (Fig. 3.27).

Fig. 3.27 Thigmotropism movement in a tendril of a climber

B. Nastic Movements (Gk. nastos : pressed)

These movements of a part of a plant are in response to some sort of pressure even as gentle as finger-touch or that of blowing wind stimulus. The direction of the response is not related to the direction of the stimulus. For example, closing of leaflets of the leaves of the sensitive plant *(Lajwanti)*, when touched by finger (Fig. 3.28).

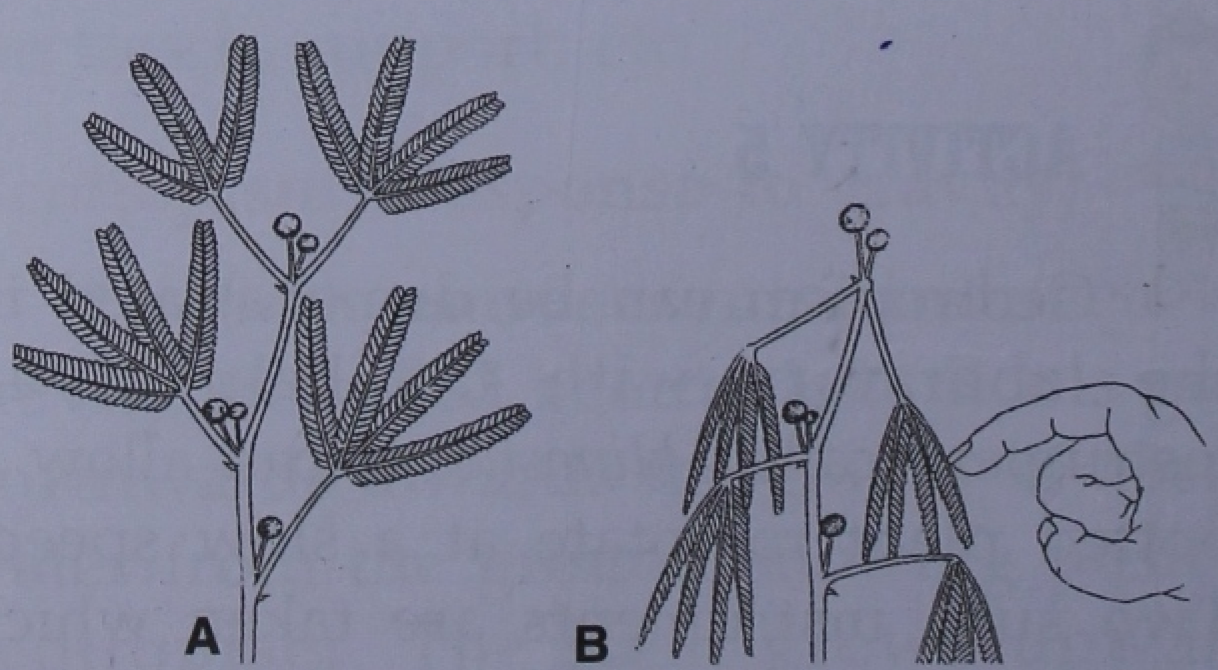


Fig. 3.28 Sensitive plant showing nastic movement. A. Normal; B. After touch

What is Stimulus ?

A *stimulus* is a sudden change in the environment, which in turn brings about change in the activity of an organism. The stimulus could be light, water, gravity or touch. Plant parts which grow towards the stimulus show *positive tropism* and those against the stimulus show *negative tropism.*

In venus fly trap, leaves close together rapidly when touched by an insect. Such movements produced by a touch, are called **thigmonastic movements** (Fig. 3.29).

Fig. 3.29 Thigmonastic movement in Venus flytrap

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Choose the correct option :

(i) During locomotion, *Euglena* moves in :
   (a) Oblique path (b) Straight path
   (c) Spiral path (d) Backward path

(ii) Earthworm moves with the help of muscles present in its body wall, and the tiny hard structures called :
   (a) Hair (b) Setae
   (c) Spines (d) Spicules

(iii) Frogs show which type of movements :
   (a) Floating only (b) Swimming only
   (c) Leaping only (d) All the three

(iv) Silverfish has :
   (a) One pair of wings (b) Two pairs of wings
   (c) Three pairs of wings (d) No wings

(v) In humans, the 11th and 12th pairs of ribs hang freely and are called :
   (a) Free ribs (b) Floating ribs
   (c) Hanging ribs (d) Movable ribs

(vi) Shoulder joint is an example of :
   (a) Hinge joint (b) Gliding joint
   (c) Pivot joint (d) Ball and socket joint

(vii) Which one of the following joints allows movements in almost all directions ?
   (a) Pivot joint (b) Hinge joint
   (c) Ball and socket joint (d) Gliding joint

(viii) The movement of plant roots in search of moisture is called :

(a) Geotropism (b) Hydrotropism

(c) Thigmotropism (d) Phototropism

(ix) The growth movements of a plant part in response to a directional stimulus are called :

(a) Nastic movements (b) Tropic movements

(c) Photonastic movements (d) All the three

(x) The movements of a plant part in response to an external stimulus but unrelated to the direction of the stimulus are called :

(a) Nastic movements (b) Tropic movements

(c) Static movements (d) All the three

SHORT ANSWER QUESTIONS

1. Name the type of locomotion found in the following animals :

Euglena : ____________________

Amoeba : ____________________

Paramecium : ____________________

Hydra : ____________________

2. Name the bones of our fore-limbs and hind-limbs respectively.

(i) Fore-limbs : ____________________

(ii) Hand-limbs : ____________________

3. Where are the following found in the human skeleton ?

(i) Glenoid cavity ____________________

(ii) Radius and ulna ____________________

(iii) Metacarpals ____________________

(iv) Sternum ____________________

(v) Humerus ____________________

4. Fill in the blanks :

(i) Spinal cord is protected inside the ....

(ii) .... is an example of movable joint.

(iii) .... is the hole found on the back of the skull.

(iv) .... is the muscle which bends the forearm.

(v) Carpals have .... type of joint.

(vi) .... are retractile organs of star-fishes for locomotion.

(vii) The shape of the body of a frog is .... to facilitate in swimming.

5. Write *True* (T) or *False* (F). Correct the false statement(s) without changing the first part of the statement.

(i) The hip bone is also called pectoral girdle.

(ii) Ribs are attached to the vertebrae and the breast bone.

(iii) The humerus (bone of the upper arm) fits into the glemoid cavity.

(iv) Tarsals form the wrist bone.

(v) Femur forms the bone of the upper arm.

6. Name the organ(s)/structure(s) of locomotion in the following animals :

(i) Butterfly ________________

(ii) Birds ________________

(iii) Snake ________________

(iv) Star-fish ________________

(v) Hydra ________________

(vi) Earthworm ________________

(vii) Paramecium ________________

(viii) Amoeba ________________

LONG ANSWER QUESTIONS (Write the answers in your notebook)

1. What is the importance of a skeleton system in our body ?
2. Differentiate between exoskeleton and endoskeleton.
3. How many bones are there in our backbone? What is the function of the backbone?
4. What is rib cage? Name the organs it protects.
5. Name the bones which form the rib cage.
6. Briefly describe the different types of joints.
7. What are the characteristics of muscles?
8. Differentiate between movement and locomotion.
9. Define the following terms :

   (i) Nastic movement : ________________

   (ii) Tropic movements : ________________

   (iii) Stimulus : ________________

   (iv) Response : ________________

10. Suggest an experiment to show positive geotropism in roots and negative geotropism in shoots.
11. Certain plants show locomotion. With the help of an example, explain how do they move about?
12. Name the respective stimulus which causes the following response movements in plants : Twining, phototropism, hydrotropism, thigmotropism, geotropism, opening and closing of sunflowers.