PREFACE

Concise Biology Middle School meant for Class VI students is a part of "Integrated Science" with Physics and Chemistry books being brought out separately. The book has been written strictly in accordance with the latest curriculum prescribed by the Council for the ISC Examinations, New Delhi.

In the modern context, science education deals with concepts, processes, applications, attitudes, creativity and world view.

Biology, often described as life science, is perhaps the most fascinating of all the sciences and is very relevant in the lives of pupils — in terms of knowledge about plants and animals, nutrition, diseases, health and hygiene. The author has taken great pains to prepare this book keeping these facts in mind.

Great effort has been made to deal with the different topics of the subject in a clear and interesting manner so that it may elicit among the students a spirit of enquiry and scientific temper, strengthening their power of observation and ability to draw appropriate conclusions from the experiments they perform. Above all, it has been his effort throughout the book that the students develop an appreciation of nature and its mysteries.

The language of the book has been kept simple. Some scientific terms are unavoidable still they have been kept at a minimum level. Each chapter has been greatly enriched with lots of activities to perform, tables to fill up, sketches to draw. Further, important questions related to the chapters have been given at the end of each chapter.

We hope that both the teachers and the students will enjoy learning about science through this series of biology books. Inspite of our best efforts, some shortcomings might have escaped our notice. We shall feel obliged if the same are brought to our attention. Also, we will gratefully acknowledge suggestions and criticisms for improvement of the book.

—Author

CONTENT

UNIT : 1

Plant Life

1 THE LEAF

SYLLABUS

1. External structure (parts of a leaf in detail)
2. Kinds of leaves (simple and compound)
3. Types of venation (reticulate and parallel)
4. Functions of leaf (main functions)
5. Modifications (tendrils, spines, scale leaves)
6. Insectivorous plants. Need for modification with an example
7. Vegetative propagation in leaf (example *Bryophyllum*)

You see a variety of small and large flowering plants in your surroundings such as tulsi, rose, mango, neem, peepal, etc. They have variations in height, shape of leaves, colour of flowers, etc. Despite these variations they have distinct structural similarities. All flowering plants have roots, stems, leaves, and they bear flowers.

PARTS OF A PLANT

Root system | Shoot system

A. THE ROOT SYSTEM

The underground part of plant is called **root**. Its main characteristics are :

1. It grows downward into the soil away from the sunlight and towards the force of gravity.

Activity 1

Carefully dig out a small plant like balsam from the soil. Gently wash the portion which was under the ground, with tap water.

Take a large-sized beaker or tumbler containing some water. Keep the plant in it with its underground parts submerged in water.

Observe the plant carefully and compare its parts. Identify the two main parts of the plant — one which was under the ground known as the **root system**, and the other which was above the soil known as the **shoot system**.

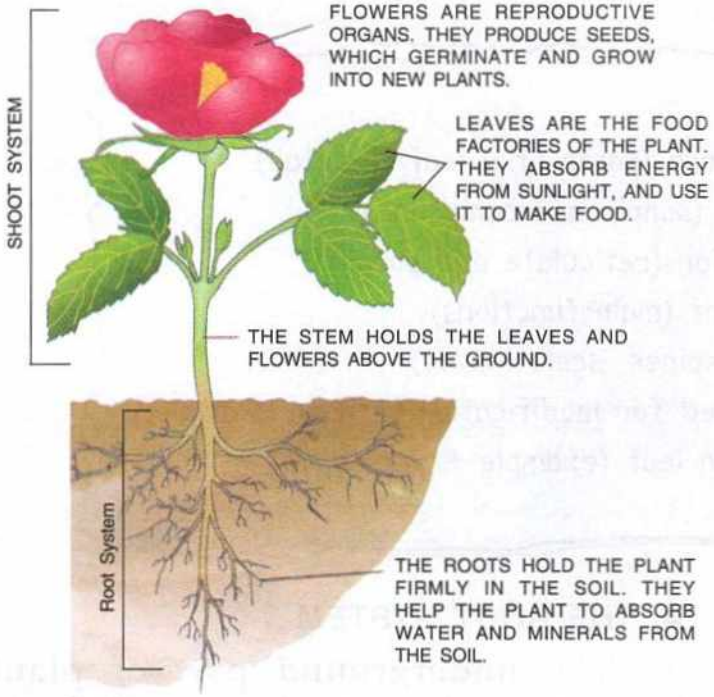


Fig. 1.1 A complete plant showing the root system and the shoot system

2. It has one main, thick **primary root** with many **side branches**. The end parts of the root branches bear fine hair-like projections called **root hairs**. The primary root with all its branches and the root hairs is called the **root system**.

Types of Root System

The root system is of two types —

(i) tap root system

(ii) fibrous root system.

(i) Tap Root System

The tap root system (Fig. 1.2) has a thick main root called **primary root** and bears many side branches called **secondary roots**. Such a root system is found in plants such as gram, pea, etc. (dicot plants).

(ii) Fibrous Root System

The fibrous root system (Fig. 1.3) has a cluster of roots of the same thickness and size arising from the base of the stem. This type of root system is found in plants such as maize, grass, etc. (monocot plants).

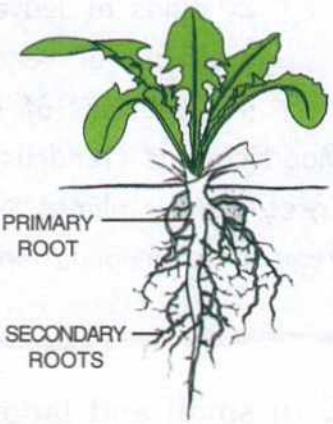


Fig. 1.2 Tap root system

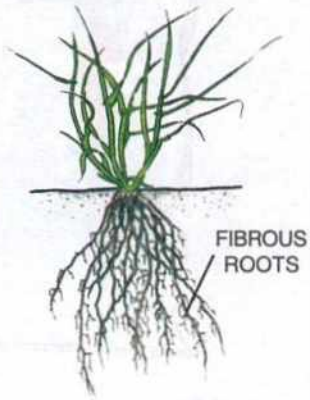


Fig. 1.3 Fibrous root system

Functions of Root system

1. Fixes the plant in the soil.
2. Absorbs water and minerals from the soil for the growth of the entire plant.
3. Binds the soil together so that it does not get washed away during rain or blown away by the wind.

B. THE SHOOT SYSTEM

The part of a plant which grows above the soil forms the **shoot system**.

It is made up of (i) **stem** (ii) **buds** (iii) **leaves** (iv) **flowers** and (v) **fruits**.

THE STEM

Stem is the main aerial part of the shoot system. The points on the stem from where the leaves and branches originate are called **nodes**. The part of the stem between two successive nodes is called an **internode**.

The tip of the shoot has buds called **apical buds** or **terminal buds**. They are responsible for the vertical growth of the stem.

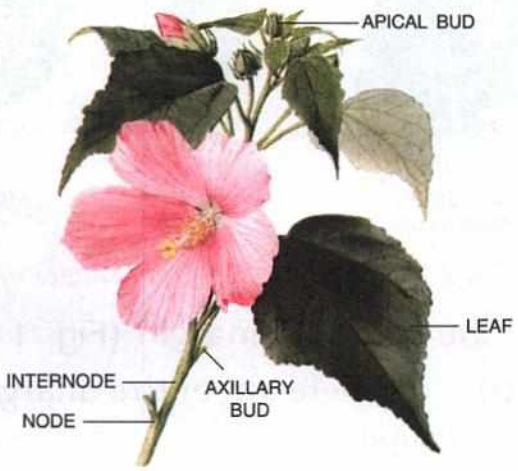


Fig. 1.4 Apical and axillary bud on the stem

The angle between the upper side of a leaf and the stem is the **axil**. Buds found here are called the **axillary buds**. They produce new branches with either leaves or flowers.

Functions of the Stem

1. Stem bears all the aerial parts of the plant—buds, leaves, flowers and fruits.
2. Stem helps in the upward movement of water and minerals absorbed by the roots and transports them upto the leaves, flowers and fruits.
3. Food prepared by the leaves is conducted downwards to the roots and other non-green plant parts by the stem.
4. Stem also manufactures food when green and young.

THE LEAF

The flat and green parts of the shoot that grow laterally from the nodes of the stem, are the 'leaves'. There is always a bud in the axil of a leaf called axillary bud. **Leaves do not continuously grow like the stem but stop growing on attaining full size.**

Structure of a Leaf (Fig. 1.5)

A typical leaf has the following parts:

Petiole : The basal part of a leaf is a stalk called petiole. It is attached to the stem at the node. An axillary bud is present in the axil of the leaf.

Sometimes, leaves are directly attached to the stem without a petiole. Such leaves are called **'sessile'** leaves.

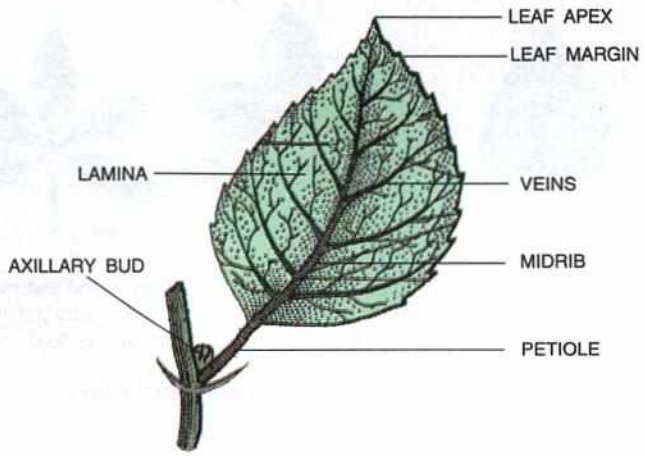


Fig. 1.5 Parts of a leaf

Leaf blade or Lamina : The green, flat and broad part of the leaf is called 'lamina' or 'leaf blade'. Its outer edge is called "leaf margin".

Midrib : Petiole continues into the lamina as the 'midrib'. This laterally gives out fine branches called 'veins'. Petiole, midrib, veins and veinlets (further branches of veins) conduct water and food. Veins also provide a skeleton or a supportive framework to the leaves.

TYPES OF LEAVES

Leaves can be of *two* types — simple leaves and compound leaves.

Simple leaf : In a simple leaf, the lamina is undivided and is a single piece, *e.g.*, mango, banana, banyan, etc. Marginal **incisions**, if present, do not reach upto the midrib or petiole, *e.g.*, prickly poppy (Fig. 1.8).

Compound leaf : In a compound leaf, the leaf blade or lamina is divided into smaller units called leaflets e.g., rose (Fig. 1.6B and 1.6C).

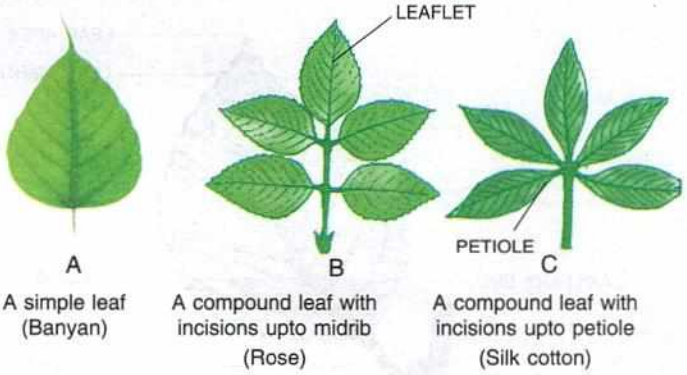


Fig. 1.6 Simple and compound leaves

Leaves can be classified in various ways :

On the Basis of Shape (Fig. 1.7)

(i) Needle shaped, *e.g.*, pine, onion.
(ii) Oval, *e.g.*, guava, apple.
(iii) Heart-shaped, *e.g.*, peepal.
(iv) Oblong, *e.g.*, banana.
(v) Circular, *e.g.*, lotus, nasturtium.
(vi) Tapering, *e.g.*, eucalyptus, ashoka.

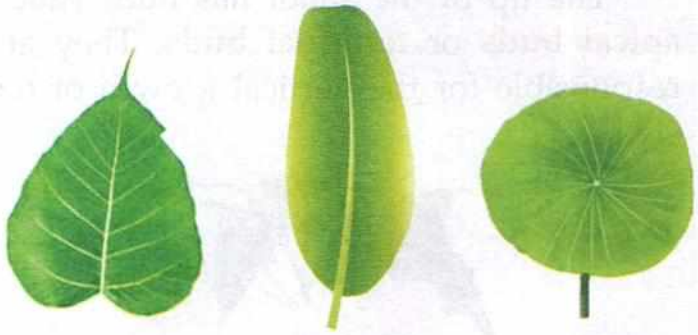


Fig. 1.7 Some of the different shapes of leaves

On the basis of margin (Fig. 1.8)

(i) Complete or entire margin, *e.g.*, peepal.
(ii) Toothed or serrated margin, *e.g.*, china rose, rose.
(iii) Wavy margin, *e.g.*, **ashoka, mango**
(iv) Spinous margin, *e.g.*, prickly poppy.

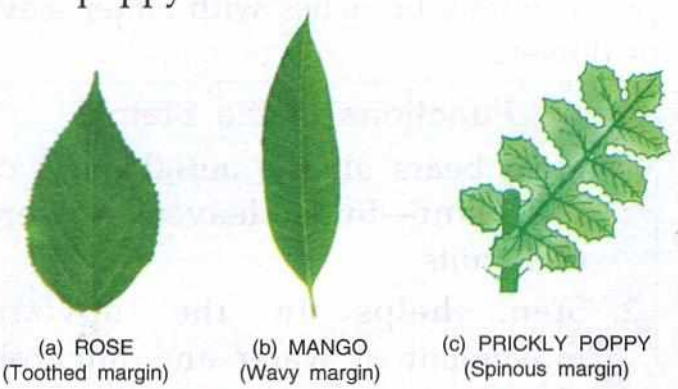


Fig. 1.8 Different margins of leaves

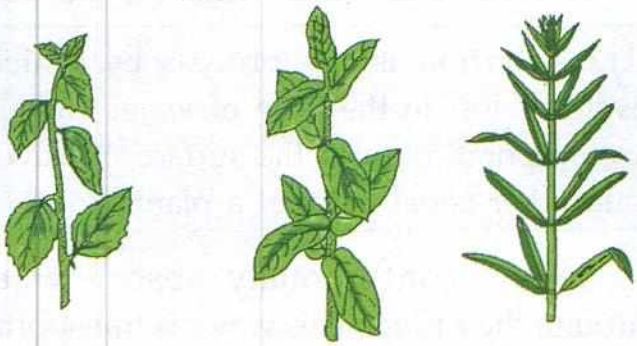
Arrangement of Leaves

The arrangement of leaves on a stem or its branch is called **phyllotaxy**. It can be :

Alternate (Fig. 1.9a) : Only one leaf arises from each node. The next leaf arises from the succesive node in opposite direction. *Examples* : mint, peepal, china rose.

Opposite (Fig. 1.9b) : In plants like jasmine and guava, two leaves arise on each node opposite to each other. This is called opposite arrangement.

Whorled (Fig. 1.9c) : More than two leaves are attached at each node, arranged in a whorl, *e.g.*, oleander (*Nerium*).



(a) ALTERNATE (b) OPPOSITE (c) WHORLED

Fig. 1.9 Types of arrangment of leaves

Activity 2

Take a peepal leaf and soak it in vinegar or water for a few days. Change the water every second day. Rub the leaf with your fingers gently. The green portion of the leaf will come out by rubbing.

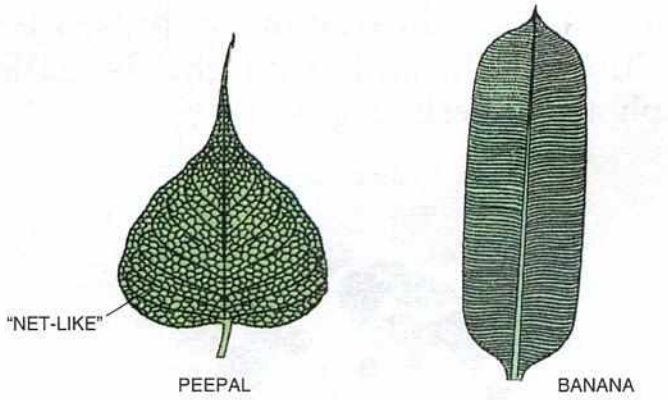
You will observe a very fine network of veins. Dry it as it may contain moisture. You can use this leaf to make a birthday card for your friend.

Venation of Leaves (Fig. 1.10)

Arrangement of veins in a lamina is called **venation**. It is mainly of *two* types.

Reticulate venation : In this type of venation, veins and veinlets are irregularly distributed in the lamina, forming a **network**, *e.g.*, peepal, mango and guava leaves (dicot plants).

Parallel venation : In this type of venation, veins run **parallel** to each other, e.g., banana, grass, maize and wheat leaves (monocot plants).



(a) RETICULATE VENATION (b) PARALLEL VENATION

Fig. 1.10 Types of venation in a leaf

FUNCTIONS OF THE LEAF

Leaves are an important part of a plant. They perform various functions but the two main functions are — **photosynthesis** and **transpiration**.

(1) Photosynthesis (production of food) :

The term photosynthesis means combining by light (*photo* = light; *synthesis* = combining). During photosynthesis, water is combined with carbon dioxide to produce glucose and oxygen.

All green plants have the capability to prepare their own food, and are therefore called *autotrophs* (*auto* = self ; *trophe* = nourishment). This method of nutrition is called **autotrophic nutrition**.

For preparing food, the plants require the following :

1. Water (from soil).
2. Carbon dioxide (from air).
3. Chlorophyll (contained in the leaf).
4. Energy (from sunlight).

The process by which a plant leaf prepares or synthesises food from water and carbon dioxide in the presence of chlorophyll and sunlight is called **photosynthesis** (Fig. 1.11).

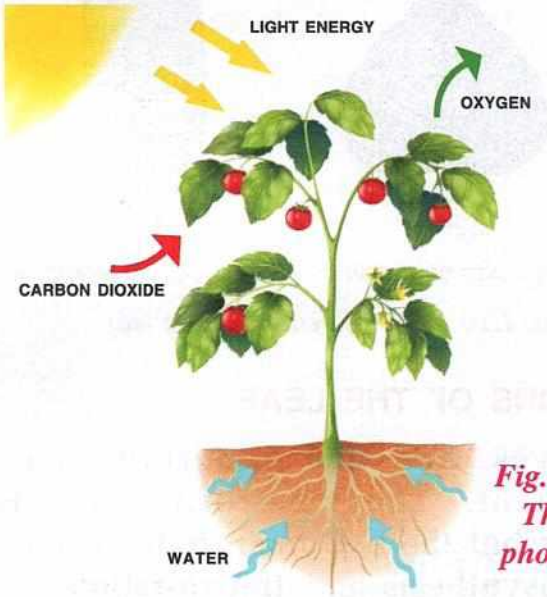


Fig. 1.11 Leaf : The site for photosynthesis

Photosynthesis is represented as follows :

$$\text{carbon dioxide + water} \xrightarrow[\text{sunlight}]{\text{chlorophyll}} \text{glucose + oxygen}$$

There are *two* end-products of photosynthesis :
1. Glucose ($C_6H_{12}O_6$). 2. Oxygen

Significance of Photosynthesis

1. **Food :** During photosynthesis, plants prepare food not only for themselves but also for animals and human beings.
2. **Oxygen :** Leaves give out the oxygen produced as a by-product during photosynthesis, which supports life on earth. Both plants and animals utilise this oxygen for respiration.

(2) Transpiration : This is the process by which water is lost in the form of water vapour by evaporation from the surface of leaves and other aerial parts of a plant. It has a cooling effect and develops a suction force to make roots absorb more water with mineral ions.

Transpiration is the process by which water is lost in the form of water vapour by evaporation from the surface of leaves and other aerial parts of a plant.

Plants continuously absorb water through their roots. This water is transported through the stem to all plant parts including leaves. Only a very little amount of it is retained in the plant or utilised by it during photosynthesis. The rest of it gets evaporated as water vapour into the atmosphere from the surface of leaves.

Significance of Transpiration

1. **Cooling effect :** The water keeps on evaporating from the leaf surface during transpiration. The heat required for evaporation of water is obtained from the plant itself and thus, the plant cools itself when it is hot outside.

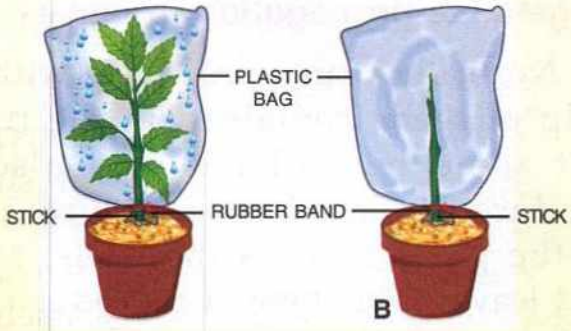
You have experienced that standing under a tree on a hot summer midday, gives a cooling effect. This cooling is not entirely due to shade, but also due to the loss of water from the surface of the leaves by transpiration. Since evaporation leaves a cooling effect, the surrounding air also cools down. Cool air being heavier tends to settle down and as a result you feel cool when you stand under a tree.

2. **Transpirational pull :** As water continually evaporates from the leaf surface, the roots pull up more water from the soil to make up for the water loss during transpiration. As a result, important mineral salts are also brought along with the water from the soil by the roots. These salts are necessary for the growth of the plant.

Activity 3

To demonstrate that a plant loses water by its leaves.

Take two small-sized well-watered potted plants with few branches. Place a polythene bag over the plant as shown in plant (A) and tie it with a rubber band.



The plant loses water by the leaves during transpiration

Remove all the leaves from the other plant (B), cover this plant too with a polythene bag and tie it with a rubber band.

Place the plants in sunlight and observe them after 4-6 hours. You will notice that water drops have appeared on the inner surface of the polythene bag over plant A, while no water drop appears in the polythene bag on plant B.

This set-up indicates that most water from the plant is evaporated from its leaves.

Modifications of Leaf

Sometimes, the complete leaf or a part of the leaf is modified to perform a special function. Some of these modifications include :

Leaf tendril (Fig. 1.12a) **:** In case of certain weak-stemmed plants, leaves or leaflets are modified into wiry, coiled structures called *tendrils*. They are

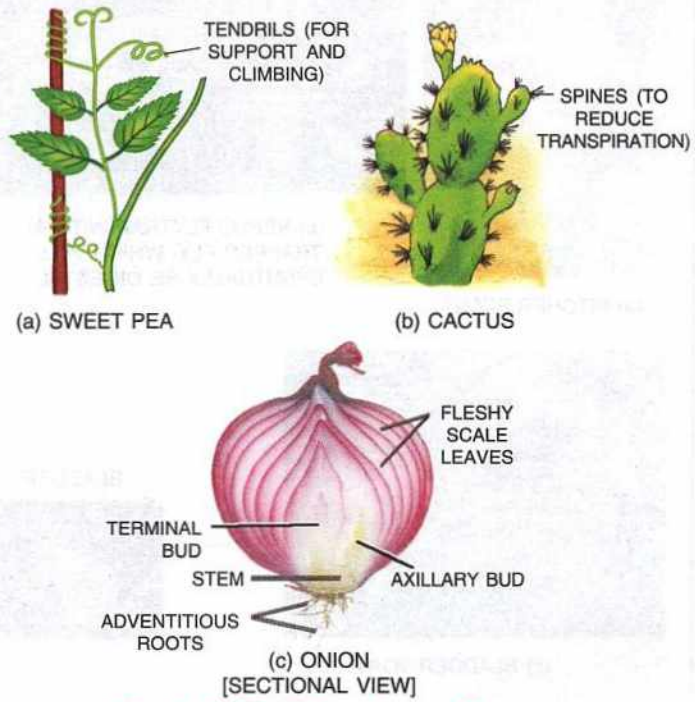


Fig. 1.12 Modifications of Leaves

sensitive to touch. As they touch any object, they coil around it and support the plant to climb up. *Example :* Sweet pea (upper leaflets are modified into tendrils).

Spines (Fig. 1.12b) : Leaves are modified into spines to reduce water loss, like cactus. In prickly poppy, leaves bear spines on the margin.

Scale leaves : In some plants like onion (Fig. 1.12c) and ginger, thick and fleshy or thin and dry scale leaves are present respectively. Their function is to store food and protect the buds.

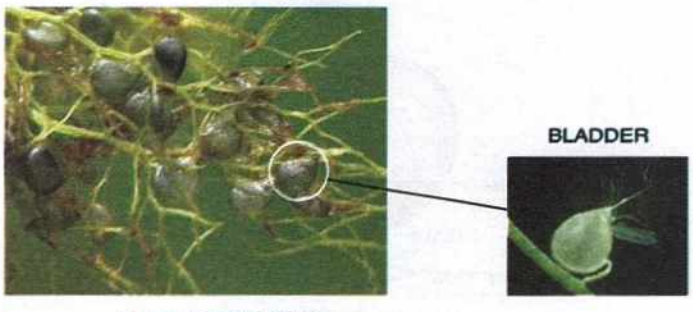
Insectivorous Plants

The plants which trap insects in one way or another to meet their nitrogen demand are called insectivorous plants. These include :

Pitcher plant (Fig. 1.13a) : In pitcher plant, the lamina is modified into a pitcher. Apex of the leaf forms the lid and the petiole becomes leaf-like to manufacture food. Size of a pitcher varies from 10-20 cm. When an insect like an ant, sits on the rim of the pitcher, suddenly the lid closes. At the bottom of the pitcher, enzymatic juices are secreted which digest the animal protein. The pitcher plant is found in Garo and Khasi Hills in Meghalaya. The soil in these areas is deficient in nitrates. The pitcher plant utilises the insect's protein by converting it into nitrates.

(a) PITCHER PLANT

(b) VENUS FLYTRAP WITH A TRAPPED FLY, WHICH WILL EVENTUALLY BE DIGESTED



(c) BLADDERWORT

Fig. 1.13 Insectivorous plants

Venus flytrap (Fig. 1.13b) : The leaves of Venus flytrap have long pointed hair. It is divided into two parts having midrib in between like a hinge. When an insect visits the leaf, it closes its two parts and traps the insect. The insect is then digested by digestive juices secreted by the plant.

Bladderwort (Fig. 1.13c): Bladderwort has highly segmented leaves. Some of the segments of these leaves form small bladder-like structures. The bladder has an entry point which can be closed. The insects enter into it but cannot come out and are digested inside.

Vegetative propagation in leaves

Normally plants propagate with the help of seeds contained in the fruits. But some new plants may also be produced from other (*vegetative*) parts of the plant such as the roots, stems and leaves. This type of reproduction is called **vegetative propagation**.

Plant structures which reproduce vegetatively must have some stored food and a few vegetative buds to form adventitious roots and new shoot leaves.

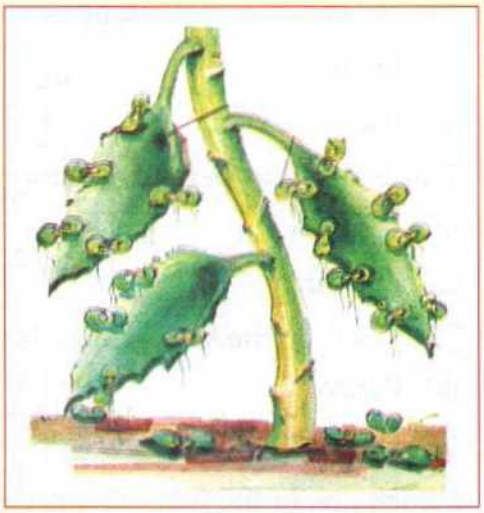
Fig. 1.13 Bryophyllum plant (the buds on the margin of leaves are seen)

Leaves of some plants, such as *Bryophyllum* and *Begonia*, produce buds along their margin. When these buds fall in moist soil, they begin to grow as young tiny plants, *i.e.* plantlets.

Activity 3

To grow bryophyllum by vegetative reproduction :

- Take a full grown leaf of *Bryophyllum* with some adventitious buds growing out from its margin.



A Bryophyllum leaf with growing adventitious buds

- Cut the leaf into bits, each containing a growing adventitious bud.
- Put these bits in a flower pot and cover them under moist soil keeping the emerging buds just projecting out from the surface.
- Observe it after 10–12 days.
- Tiny plantlets grow out from the buds.

Conclusion :

- *Bryophyllum* is a plant whose leaves produce adventitious buds in their margin.
- The adventitious buds grow into new plants when they fall off from the parent plant.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Tick (√) the appropriate answer :

(*i*) Identify the plant which has compound leaves :

(*a*) Banana ☐ (*b*) Banyan ☐

(*c*) Mango ☐ (*d*) Rose ☐

(ii) Which one of the following is not an insectivorous plant :

(a) Pitcher plant ☐ (b) Venus flytrap ☐

(c) Bladderwort ☐ (d) Cactus ☐

(iii) This leaf shows parallel venation :

(a) Banana ☐ (b) Mango ☐

(c) Banyan ☐ (d) Guava ☐

(iv) The point on the stem from where the leaf arises is :

(a) Petiole ☐ (b) Lamina ☐

(c) Node ☐ (d) Trunk ☐

(v) Which one of the following is essential for photosynthesis :

(a) Carbon dioxide ☐ (b) Nitrogen ☐

(c) Oxygen ☐ (d) Soil ☐

Short Answer Questions :

1. Name the following :

(i) The part of the plant which grows under the ground : .....

(ii) The part of the plant which grows above the soil : .....

(iii) The wide flat portion of the leaf : .....

2. What are the *four* functions of roots ?

3. Mention the functions of the following :

(i) Spines (ii) Tendril (iii) Scale leaves

4. Define venation. What are the different types of venation found in the leaves ?

5. Describe the modifications of leaf in any *one* insectivorous plant.

6. Write the *two* main functions of leaves.

7. Define :

(i) Photosynthesis (ii) Transpiration

Long Answer Questions (Write the answers in your notebook)

1. Giving examples, differentiate between the following :

(i) Tap root and fibrous root. (ii) Simple leaf and compound leaf.

(iii) Parallel venation and reticulate venation.

2. What is the modification seen in *Bryophyllum* ? Explain.

3. What purpose is served by the spines borne on the leaves of cactus ?

4. Explain why leaf survival is so important to the plant ?

5. Give an example of the following and draw generalized diagrams for the same :

(i) Simple leaf and compound leaf.

(ii) Parallel venation and reticulate venation.

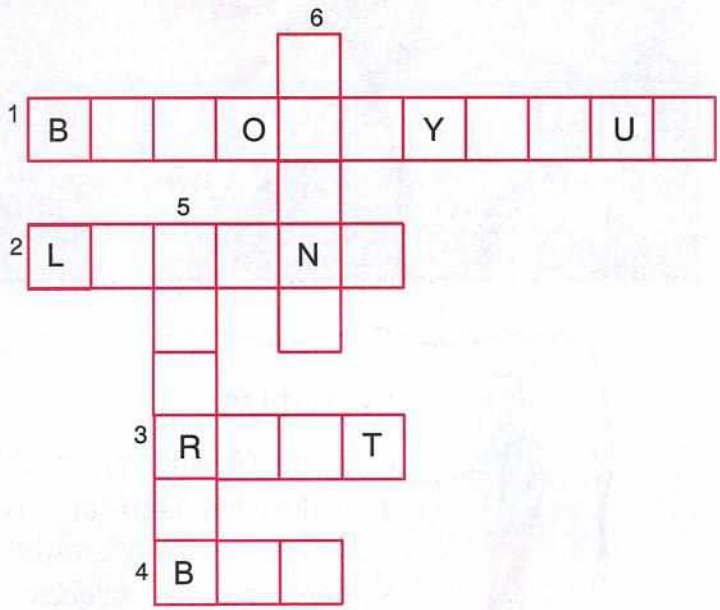
6. Enlist some of the advantages of transpiration to green plants.
7. Why do some plants have to trap insects ?
8. Explain some of the modifications of leaves found in plants.
9. What is a tendril ? Explain its use to the plant.
10. Complete the crossword using the clues given below. Check your performance with the correct solutions given at the end of the chapter.

Clues across :

1. Plant that bears buds in leaves for propagation.
2. The flattened green part of leaf.
3. Underground plant part.
4. Structure that develops into flower.

Clues down :

5. The central big vein of a leaf.
6. A modification seen in cactus.



ANSWERS :
Clues across : 1. Bryophyllum, 2. Lamina, 3. Root, 4. Bud
Clues down : 5. Midrib, 6. Spine

PROJECT

- Visit your school garden or a nearby park and collect the leaves of different plants with the permission of the authorities. Paste the leaves in a file and make a leaf-file.

2

THE FLOWER

SYLLABUS

1. Parts (4 whorls), structure and function of each whorl.
2. Pollination (self and cross) : An idea about agents of cross pollination (wind, water and insects — their examples).
3. Fertilization : process in simple terms.
4. Formation of fruit - fate of each part (whorl) of flower after fertilization.
5. Parts of fruits : dry and fleshy, examples of dry and fleshy parts; parts of the pericarp of fleshy fruits (epicarp, mesocarp, endocarp) and function of each part.
6. Seed — parts (cotyledon, embryo: radicle, plumule) and types (monocot, dicot).
7. Germination — conditions required for germination (moisture, warmth), seed germination of different seeds.

A flower is usually the most beautiful and colourful part of a plant which serves as the reproductive organ. It is attached to the shoot by means of a **stalk** or **pedicel**. The tip of the stalk is enlarged and slightly flattened **(thalamus)** from where the petals and other floral parts arise.

Examine a fully opened flower and note its different parts. You will observe that each part is arranged in such a way that we call them the four **whorls** (rings) of a flower. These are :

Calyx : This is the outermost whorl, made up of tiny green leaf-like structures called **sepals**. During the bud stage, they enclose the inner parts of the flower to provide necessary protection to the growing bud.

Sepals are the green, outermost part of the flower.

Corolla : This forms the second inner whorl. It is made up of structures called **petals**. These are usually coloured or white but never green. The petals make the flower attractive and hence attract insects for pollination.

In some cases, sepals may be absent or are fused with the petals in a flower.

Petals are the large, fragrant and brightly coloured parts of the flower.

Androecium : It is the third whorl of the flower, inner to the petals. This whorl is made up of stamens. Each stamen is made up of a thin, thread-like **filament** which at its tip bears an anther. The anther contains pollen sacs which produce a yellow, powdery material consisting of **pollen grains**. The pollen grains contain the **male gametes.** Hence, the androecium is called the **male reproductive part** of the flower.

Androecium along with anthers and filaments is the male reproductive part of a flower.

Gynoecium : It is the fourth and the innermost whorl of the flower. It is made up of the **carpel** or the **pistil**. The pistil is further made up of three parts — a swollen **ovary** at the base, a tube like **style** arising from the ovary which has an expanded **stigma** at its tip. The stigma receives the pollen grains. The style transfers the male gametes of the pollen grains into the ovary. The ovary contains small, rounded bodies called the **ovules**, which contain the female gamete. For this reason, the gynoecium is called the **female reproductive part** of the flower.

Gynoecium made up of carpel or pistil is the female reproductive part of a flower.

If all the above four whorls viz. calyx, corolla, androecium and gynoecium are present in the same flower, it is known as a **complete** or **bisexual flower**.

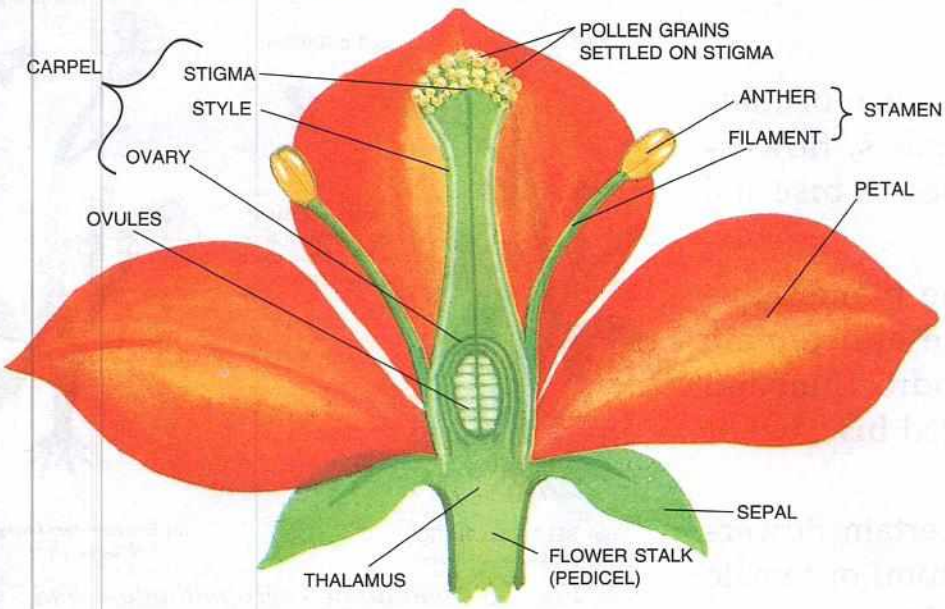


Fig. 2.1 A flower showing its internal parts

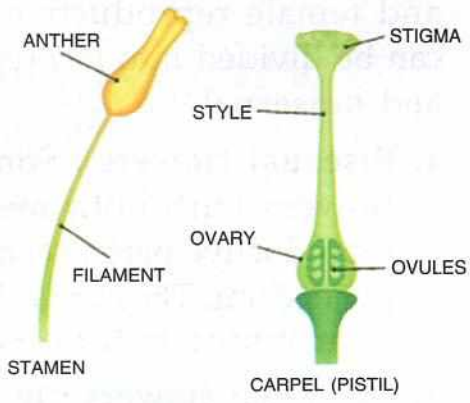
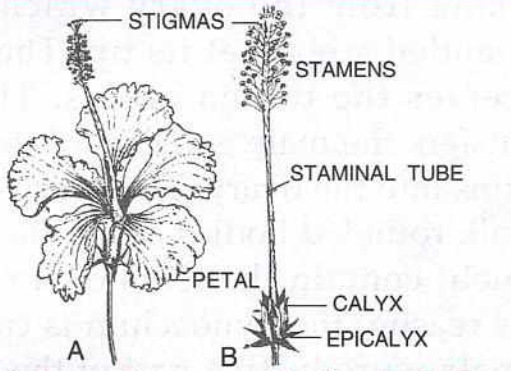


Fig. 2.2 The stamen and carpel (pistil)

Activity 1

Draw the structure of a flower.

Ask your teacher or the 'gardener' of your school to allow you to pluck one flower, such as shoe-flower (*Hibiscus*). Bring this flower to your classroom or laboratory. Draw and describe the flower as given in the text.



(A) A complete flower *(B) Staminal tube with many stamens*

[**Note :** You can describe other flowers on the same pattern].

However, if any one of the four whorls is missing from a flower, the flower is said to be **incomplete**.

Types of Flowers

Depending on the presence of male and female reproductive parts, flowers can be divided into *two* types — **bisexual** and **unisexual**.

1. **Bisexual flowers :** Some plants have flowers with both male and female reproductive parts, i.e. androecium and gynoecium. They are called **bisexual** or **hermaphrodite flowers**.
2. **Unisexual flowers :** In certain flowers either the male (androecium) or female (gynoecium) reproductive parts are found. They are called **unisexual flowers**.

Functions of the Flower

The flower is the reproductive organ of the plant. Its main function is to produce seeds and fruits. The first step for achieving this is through the transfer of pollen grains from the anther to the stigma of a flower.

POLLINATION

Pollination is the transfer of pollen grains from the anthers to the stigma of a flower.

There are *two* types of pollination — self pollination and cross pollination.

1. **Self pollination :** It occurs either within a single flower or between flowers of the same plant. Here, the pollen grains from the anthers fall on the stigma of either the same flower or another flower on the same plant.
2. **Cross pollination :** It occurs in flowers on different plants of the same kind. Here, pollen grains are transferred from

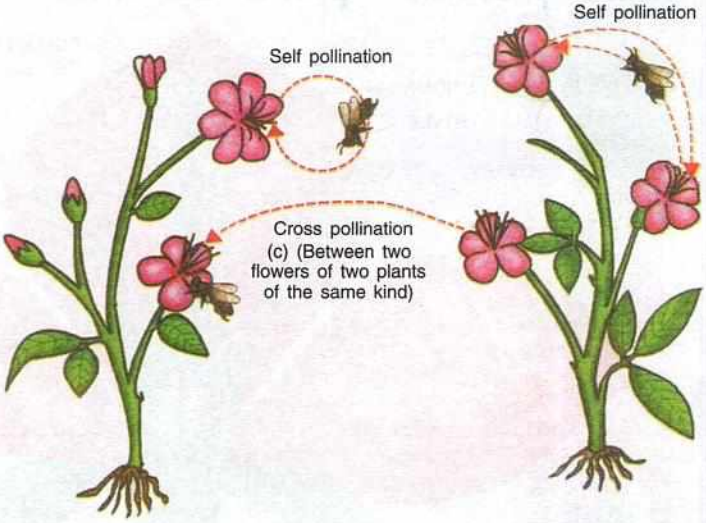


Fig. 2.3 Pollination – self-pollination and cross-pollination

the anther of one flower to the stigma of another flower on another plant of the same kind.

Agents of Pollination

For cross pollination to occur, an agent should be available to transfer the pollen grains. The four common agents for cross pollination are :

(1) **Insects :** Butterflies, bees and other insects visit flowers for collecting nectar (honey). When the insect visits a flower to collect nectar, the pollen grains stick to its mouth-parts, wings, legs, *etc.* When this insect visits another flower of the same kind, the pollen grains from its body may fall on its stigma and bring about fertilization. Transfer of pollen by insects is called **insect-pollination**. Mustard, Marigold, *Dahlia and Salvia* are some of the insect-pollinated flowers.

The insect pollinated flowers are usually large, brightly coloured, fragrant and produce nectar.

Fig. 2.4 A nectar-sucking insect is pollinating a Salvia flower

Activity 2

Visit a garden, especially in the season when flowers of various plants are blossoming. Try to locate plants, such as marigold, mustard, balsam, dahlia, snapdragon, *etc.* and appreciate the variety of colours of the petals of their flowers. You would see a large number of butterflies, bees, *etc.* hovering over the flowers. Insects get attracted towards these flowers because of their bright colours and fragrance.

Given below is a picture of honey bee. In the picture, you can see its entire body covered with pollen grains. We therefore presume that this bee has returned after visiting and alighting over the flowers in a mustard field. When this bee visits other flowers of the same kind, there is every chance that pollens from its body may fall on their stigma. This is exactly what happens in case of insect pollinated flowers.

Honey bee with its body covered with pollen

Apart from the colour, there are other features too, of the flowers, which attract the insects and ensure pollination. Think and record some of them.

Try it yourself

Visit your school garden. With the permission of your school authorities, collect about 10-12 flowers, each of a different kind. Under the guidance of your teacher, examine these flowers carefully. Classify them as flowers of self pollination and cross pollination. In your note book state for each :

(i) kind of pollination,

(ii) agents of pollination, if applicable,

(iii) their specific charactersitics.

Activity 3

To watch the presence of pollen grains.

Hold a flower, such as the shoe flower, in your hand. Gently touch its anthers with one finger of your other hand. Some powdery mass will stick to your finger. This powdery mass is the pollen consisting of fine particles, the **pollen grains**. Now, rub your finger on a sheet of paper. The pollen-grains will be transferred to the paper. This is exactly what happens when an insect visits two flowers, one after the other.

(2) Wind : Some plants like maize, palm, pine, *etc.*, produce dry pollen in large quantity. When these flowers mature, the pollen grains are blown away by the wind. If they happen to fall on the feathery stigma of a flower of the same type, then pollination occurs. Such type of pollination is called **wind pollination**.

(3) Water (Fig. 2.5) **:** The kind of pollination where water acts as an agent to transfer the pollen is known as water pollination. An example of water-pollinated flower is *Vallisneria*. It is an aquatic plant whose male flowers are submerged in water. They later get detached upon maturation, and float on water surface. When these floating male flowers happen to come in contact with a female flower, the pollen grains are transferred to its stigma.

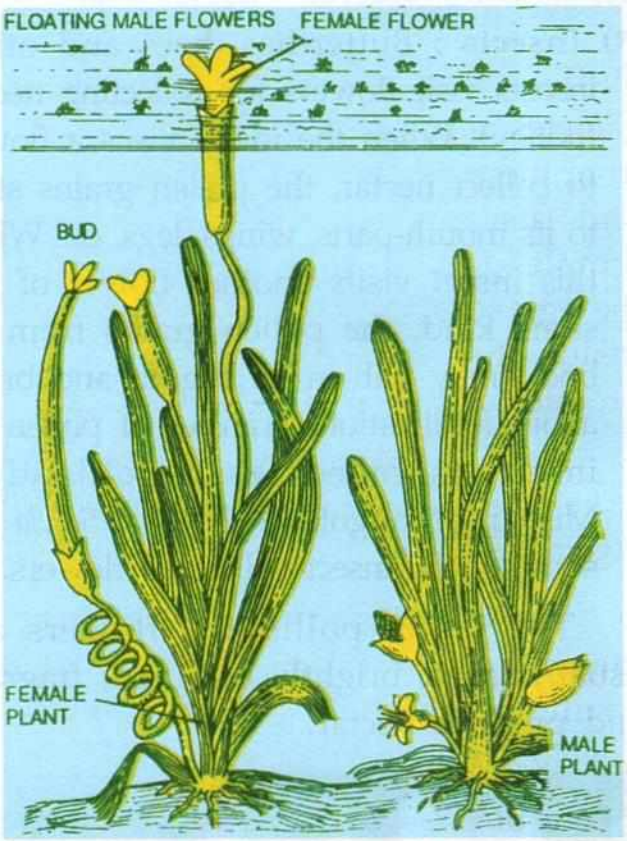


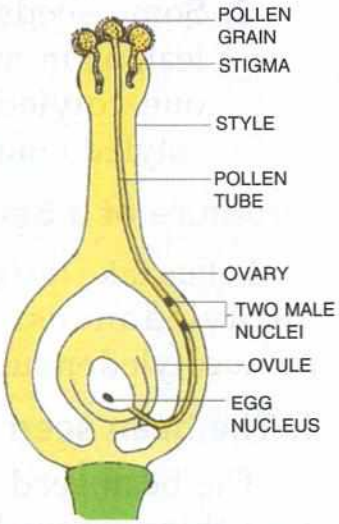
Fig. 2.5 Pollination in Vallisneria

LOTUS AND TRAPA ('Singhara') are water plants, but their flowers are exposed to air and are pollinated by insects.

(4) Animals : Some birds like the humming birds and animals like bats also act as pollinating agents. When they visit various flowers, they carry pollen grains for pollination.

FERTILIZATION

After the pollen grains have landed on the surface of the stigma, they germinate to produce pollen tubes. One of the pollen tubes continue to develop downwards into the style. This pollen tube carries the male gametes. The pollen tube finally reaches the ovary. Further, on reaching the ovule, the male gametes are released from the pollen tube and fuse with the female gamete (or the egg cell) located inside the ovule to produce a **zygote**.



Process of fertilisation

The fusion of male and female sex cells (gametes) is called **fertilization**.

The ovary after fertilization becomes larger and develops into a fruit. The ovule containing the fertilized cell develops into a seed.

Fate of each part of the flower after fertilization. The ovary remains attached to the stalk of the flower and grows into a **fruit**. The ovules inside the ovary develop into seeds. The other parts, like the sepals and petals, fall off.

THE FRUIT

A fruit is the ripened ovary. For most people, a fruit is a sweet, fleshy, edible plant part. Tomato, pea and pumpkin are also fruits of plants although they are commonly called vegetables.

A vegetable is any edible part of a plant — root, stem, leaf or fruit, which can be eaten either raw or cooked.

Apple and pear are different kinds of fruits. In these, the thalamus of the flower (and not the ovary) becomes the main fleshy part of the fruit, which we eat, while the ovary remains a small central part containing seeds. Such fruits are called **"false fruits"** (Fig. 2.6).

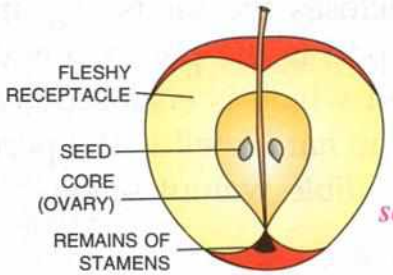


Fig. 2.6 Cut section of an apple (a false fruit)

Parts of a Fruit

A fruit contains *two* parts — a pericarp or fruit wall and the seeds (Fig. 2.7).

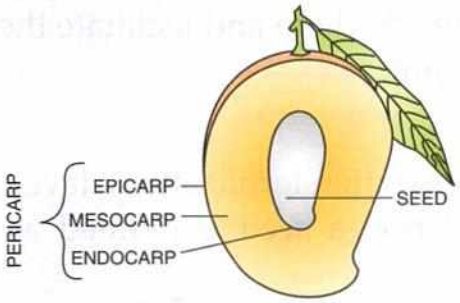


Fig. 2.7 Cut section of a mango

Pericarp

The pericarp or fruit wall develops from the wall of the ovary. It may be thick or thin depending on the kind of fruit. In tomato and papaya, it is soft and fleshy, while in gram, it is dry. The pericarp contains three parts.

Epicarp : The outer, thin protective covering of the fruit is called epicarp.

Mesocarp : It is the sweet, fleshy edible middle layer.

Endocarp : It is the inner hard part, of the fruit that contains seeds.

Fleshy fruits and dry fruits

A **fleshy fruit** is one in which the entire pericarp is soft and fleshy, e.g. grape, tomato, papaya etc. In the case of mango, cherry or plum the epicarp and mesocarp are pulpy, but the endocarp is hard and encloses the seed.

In a **dry fruit**, the pericarp is not pulpy and encloses the seeds, e.g. in the pea pod, the pod is the pericarp and the pea is the seed which is enclosed within. In a walnut, the hard shell is the pericarp enclosing the edible walnut seed.

Functions of a Fruit

1. It protects seeds from the unfavourable environmental conditions.
2. Fruits store food inside them.
3. Fruits help in dispersing the seeds present inside them and facilitate their germination.

THE SEED

The ovules after fertilization develop into seeds. Hence, a seed is defined as a fertilized ovule.

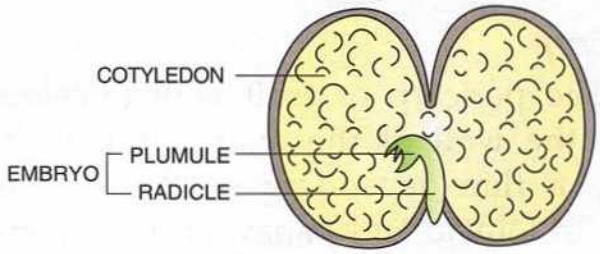


Fig. 2.8 Parts of a germinating bean seed

TYPES OF SEEDS

There are two types of seeds. These are dicotyledonous seeds and monocotyledonous seeds.

1. Some seeds, like those of pea and bean, when opened, show two thick parts or seed leaves known as cotyledons. The seeds with two cotyledons are called **dicotyledonous (*di* : two)**.
2. Some seeds have only one seed leaf, as in maize. Such seeds with one cotyledon are called **monocotyledonous (*mono* : single/one)**.

Structure of a Seed

Let us take *two* examples — bean from dicotyledonous and maize from monocotyledonous seeds.

1. The bean seed (Dicot seed)

The bean seed (Fig. 2.9) is protected by a thin, greenish outermost covering called the **seed coat**. It protects the seed from insects and bacteria as well as from mechanical injury. The seed coat is made up of two parts. The outer exposed part is called the *testa* and the inner part is called the *tegmen*. It is a thin membrane which lies under the testa.

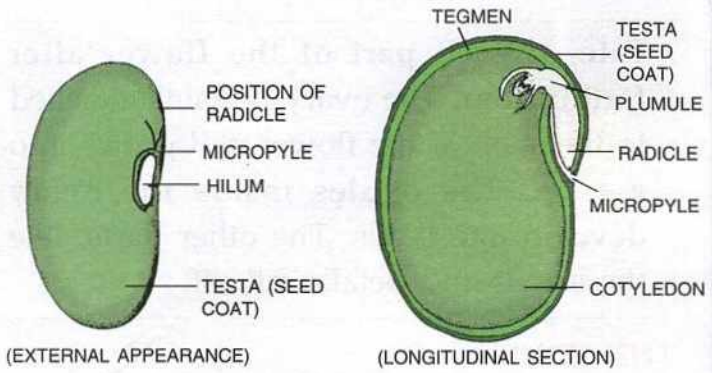


Fig. 2.9 Bean seed

On the inner concave side of the seed, there is a scar called **hilum**, which marks the place where the seed was attached to

the fruit wall. Above the hilum is a small pore called **micropyle (*micro* = small, *pyle* = passage).** The micropyle absorbs and allows the entry of as much water as is required for germination.

On removing the testa and the tegmen from a soaked bean seed, you will find that the seed is made up of two fleshy seed leaves called the **cotyledons.** They contain stored food material which is used by the seedling for growth. We only eat the cotyledons of pulses like pigeon pea and red lentil, as their seed coats have been removed.

In between the two cotyledons is located the delicate embryo which consists of a **radicle** and a **plumule.** The radicle develops into a root, while the plumule develops into a shoot.

2. The maize grain (monocot seed)

The maize grain has only one cotyledon, hence it is said to be monocotyledonous.

Cut open a soaked maize grain through the middle and study its one half as shown in Fig. 2.10.

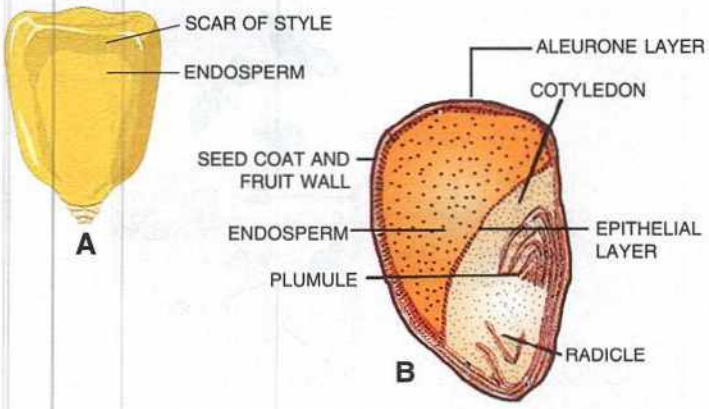


Fig. 2.10 A. Maize grain, B. Its Longitudinal section

The maize grain is almost triangular in shape. The lower narrow end of the grain is yellowish white in colour whereas the upper broad part is dark yellow in colour. The seed coat of the maize grain is fused with the pericarp or fruit wall. This is a thin, membranous layer and forms the outermost part.

The upper larger part of the maize grain is called the **endosperm**. It stores food in the form of starch. Surrounding this is a protein rich layer called the **aleurone layer**.

The lower portion is the **cotyledon**.

The cotyledon contains the embryo which is made up of the radicle and plumule.

> We always use the term 'maize grain' as the seed coat is fused together with the pericarp.

Difference between a bean seed and a maize grain.

Bean seed	Maize grain
1. Dicot seed.	1. Monocot seed.
2. Endosperm absent.	2. Endosperm present.
3. Cotyledons store food.	3. Endosperm stores food.
4. Embryo is large.	4. Embryo is small.
5. Seed is contained separately in a fruit.	5. Seed coat and fruit wall are fused to form a grain.

Germination

The process by which the embryo in the seed becomes active in the presence of water, air and suitable temperature,

and grows into a young plant, is called **germination**.

Most plants grow from seeds. Marigold, mango, apple, wheat, gram plants, *etc*. begin their life from seeds. When a seed is sown, it sprouts and produces a seedling which then grows into a mature plant. This plant again produces flowers, fruits and seeds. Some plants, like wheat and marigold, produce seeds only once in a year and die out, while others continue to produce seeds for many years such as mango, apple, *etc*.

The process by which an embryo within the seed becomes active and grows into a young plant is called germination.

Activity 4

To study the germination of bean seed.

Put some bean seeds in moist cotton placed in a petri dish. Germination occurs slowly, starting with the absorption of water. After about two days, the radicle lengthens and forces out through the seed coat in the region of the micropyle. The radicle grows downward and develops the roots, while the plumule grows upward and develops into the shoot.

It is seen that the cotyledons are pulled above the surface of the ground. The type of germination in which , the cotyledons are pushed above the soil is called epigeal germination (*'epi'* = above, *'geal'* = soil/ ground) . The leaves unfold and start preparing food for the growing plant.

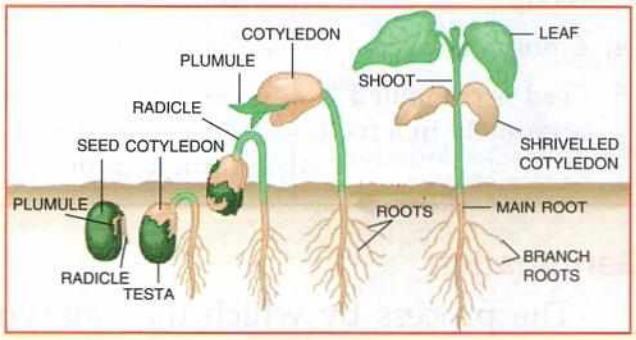


Fig. 2.11 Germination of a bean seed — An example of epigeal germination

Activity 5

To study the germination of pea seed.

Soak some pea seeds, wrap them in moist cotton and keep them overnight. Next morning, try to remove the seed coat from one seed. You will observe that there are two cotyledons inside the pea seed.

Sow the remaining seeds in a pot of moist soil and wait for 2-3 days so as to allow the pea seeds to germinate. It is observed that the cotyledons remain below the ground. This type of germination is called **hypogeal** (*'hypo'* = below; *'geal'* = ground) germination. In this type of germination, the cotyledons remain in the soil.

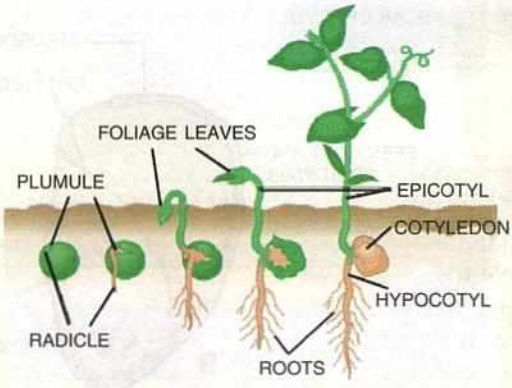


Fig. 2.12 The pea seeds remain in the soil — An example of the hypogeal germination

Activity 6

To study germination using maize grain.

Soak some maize grains in water for about 24 hours. The grains start swelling up with the absorption of water and germination starts slowly. The stored food in the endosperm is used by the plumule and the radicle for their growth.

The radicle lengthens and bursts out. The plumule too emerges out from the grain and forms the first leaf. The radicle grows downward while the plumule grows upward.

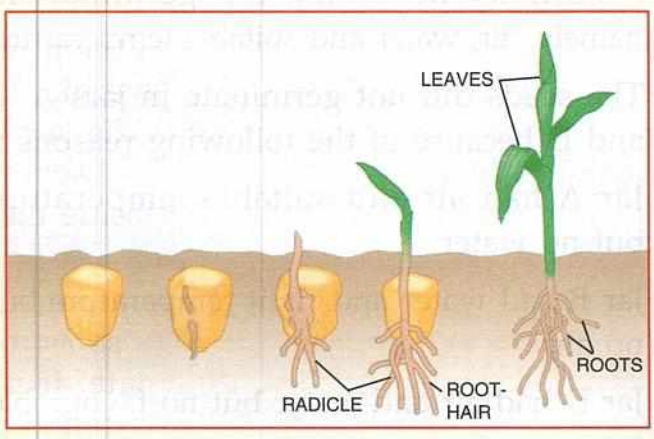


Fig 2.13 Germination in maize grain

This type of germination is called **hypogeal** germination (*'hypo'* means below and *'geal'* means earth), as the cotyledon remains under the soil. The plumule only comes out of the soil to form leaves. (Fig. 2.13).

Difference between epigeal and hypogeal germination

Epigeal germination	Hypogeal germination
1. Cotyledons are pushed above the ground.	1. Cotyledons remain in the ground.
2. Hypocotyl elongates faster than epicotyl, hence cotyledons get pulled above. *Examples :* bean, tamarind, papaya, cucumber.	2. Epicotyl elongates faster than hypocotyl, hence cotyledons remain below. *Examples :* maize, rice, ground nut.

Conditions Necessary for Germination

Water, air, and favourable temperature are the three necessary conditions for the germination of a seed.

We can demonstrate the necessity of these conditions by the following two simple experiments :

Activity 7

To study the conditions necessary for germination.

Take three mature dried bean seeds and tie them on a glass slide at three different positions (Fig 2.14). Place this slide in a beaker containing water in such a way that the lower seed is completely submerged in water, the middle seed is partially submerged inside the water and the top seed is kept above the water level *i.e.* in air only. This set-up is left in a warm place for few days.

It is observed that the middle seed shows germination and gives out a radicle and a shoot with leaves. The top seed shows no growth and the bottom one shows negligible growth.

The middle seed gets fully germinated due to the fact that this seed has all the favourable conditions necessary for

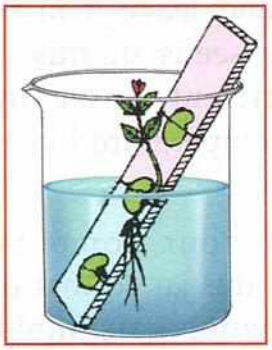


Fig. 2.14 The three-bean experiment to demonstrate germination

germination, *i.e.*, air (oxygen), moisture and warmth (favourable temperature). The seed above the water receives no moisture, hence does not germinate. The seed immersed in water receives too much moisture and very little oxygen, hence it also fails to germinate.

Activity 8

To show that water, air and favourable temperature are necessary for seed germination.

Take four jars and mark them as A, B, C and D. Put some dry cotton wool and a few bean seeds in each jar as described below :

1. **Jar A :** It is kept inside the laboratory. It gets air and right temperature, but no water.
2. **Jar B :** Add water to jar B, which has been boiled and cooled (boiling of water removes all the dissolved air in it), so as to submerge the seeds. Put a few drops of mustard or coconut oil over the surface of water (to prevent the diffusion of atmospheric air into the water), and leave it in the lab. The seeds of this jar get sufficient water and correct temperature but no air.
3. **Jar C :** Pour some tap water in this jar so that the cotton wool gets moist, and leave this jar too in the lab. The seeds of this jar are provided with all the three conditions for germination — air, water and suitable temperature.
4. **Jar D :** Pour some tap water in this jar too, so that the cotton wool gets moist. Put this jar inside a refrigerator. The seeds of this jar get air and water, but not the appropriate temperature.

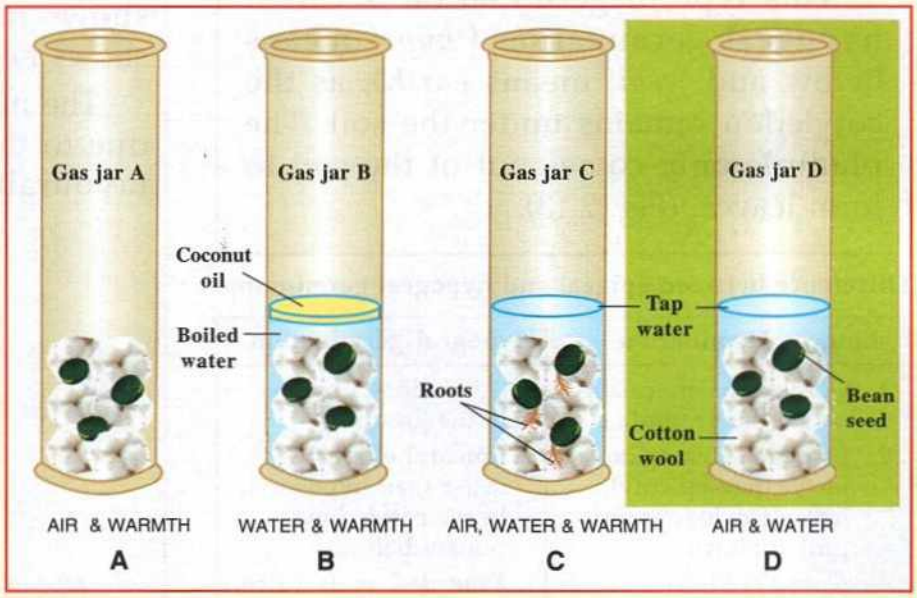
After 2 to 3 days, it was found that only the seeds in jar C got germinated. This is because this jar fulfilled all the three conditions necessary for germination, namely, air, water and suitable temperature.

The seeds did not germinate in jars A, B and D because of the following reasons :

Jar A had air and suitable temperature but no water.

Jar B had water and right temperature but no air.

Jar D had air and water but no favourable temperature.



We observed from the above activities that all living things require **water** to carry out their life processes. Most chemical reactions occur in water. Seeds, like any other living thing, also need water during germination.

Seeds also need air, similar to most of the other living things, for respiration. The oxygen present in the air is used to oxidise the stored food and thus release energy. This energy is required for the the growth of the embryo.

A suitable temperature is necessary for all chemical activities assisted by enzymes. Enzymes are inactive at low temperatures and get destroyed at higher temperatures. They act best at a temperature between 35° and 40°C.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick mark (✓) against the correct alternative in the following statements :

(a) In a germinating seed, the roots develop from :

(i) Radicle ☐ (ii) Plumule ☐

(iii) Tegmen ☐ (iv) Hilum ☐

(b) In a germinating seed, the shoot develops from :

(i) Radicle ☐ (ii) Plumule ☐

(iii) Tegmen ☐ (iv) Hilum ☐

(c) Which one of the following is a monocotyledonous seed ?

(i) Bean ☐ (ii) Pea ☐

(iii) Maize ☐ (iv) Gram ☐

(d) If the cotyledons are pushed above the soil, then such type of germination is called :

(i) Epigeal ☐ (ii) Hypogeal ☐

(iii) Perigeal ☐ (iv) Progeal ☐

(e) If the cotyledons remain under the soil, then such type of germination is called :

(i) Epigeal ☐ (ii) Hypogeal ☐

(iii) Perigeal ☐ (iv) Progeal ☐

(f) Pollen is produced in the :

(i) Filament ☐ (ii) Style ☐

(iii) Pistil ☐ (iv) Anther ☐

(g) Reproductive whorls of a flower are :

(i) Stamens and carpels ☐ (ii) Sepals and petals ☐

(iii) Sepals and stamens ☐ (iv) Petals and carpels ☐

(h) Which one of the following is a false fruit ?

(i) Tomato ☐ (ii) Apple ☐

(iii) Potato ☐ (iv) Pea ☐

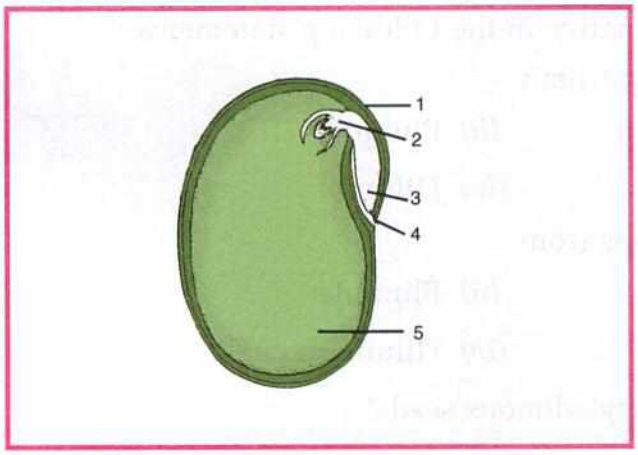
(i) In a seed, food is generally stored in :

(i) Radicle ☐ (ii) Plumule ☐

(iii) Fruit ☐ (iv) Cotyledons or endosperms ☐

Short Answer Questions :

1. Given below is a longitudinal section of a bean seed. Label the parts marked 1 to 5 and write their functions.



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2. Name the following :

(a) A seed which shows hypogeal germination.

.....

(b) A monocot seed.

.....

(c) A dicot seed.

.....

(d) A seed which shows epigeal germination.

.....

3. Differentiate between the following pairs of terms :

(a) Radicle and plumule.

.....

(b) Hilum and micropyle.

.....

(c) Testa and tegmen.

.....

4. Give *two* functions of a fruit.

.....

5. Match the columns:

Column A	Column B
(a) Radicle	(i) Shoot
(b) Plumule	(ii) Store food material
(c) Cotyledon	(iii) Root
(d) Testa	(iv) Absorb water needed for germination
(e) Micropyle	(v) Protection of seed

6. Radicle emerges out of the seed earlier than plumule. State one advantage served by this.

.....

.....

7. State whether the following statements are *True* or *False*.

(a) Some seeds have no cotyledons.

(b) Warmth is necessary for the germination of seeds.

(c) All seeds have two cotyledons.

(d) Oxygen is necessary for the germination of seeds.

8. State one function of the following :

(a) Radicle .....

(b) Cotyledons .....

(c) Endosperm .....

(d) Micropyle .....

9. The *three* conditions necessary for germination of seeds are (tick the correct answer) :

(a) Oxygen, suitable temperature and water.

(b) Good soil, water and air.

(c) Good soil, suitable temperature and light.

(d) Light, oxygen, and temperature.

(e) Oxygen, carbon dioxide, and light.

10. Name the part of the seed from which the following are given out :

(a) Roots : .....

(b) Leaves : .....

11. In the spaces provided below, draw labelled diagrams to show the three stages in the germination of any seed you have observed.

Complete seed	Radicle emerged	Plumule emerged

Long Answer Questions (*Write the answers in your note-book*) :

1. What is meant by pollination ? Name the *two* types of pollination.
2. Imagine all the seeds produced by a plant happen to fall under the same plant and sprout into new plants. Mention any *two* problems that will be faced by the new plants :
3. What is a flower ? Draw a typical flower and label its different parts.
4. With the help of a suitable labelled diagram, describe the structure of a dicot seed.
5. Define germination ? Name the *two* types of germination. Explain with examples.
6. What are the *three* conditions necessary for the germination of seeds.
7. Give the main differences between hypogeal and epigeal germination.
8. State the location of the following in a flower :

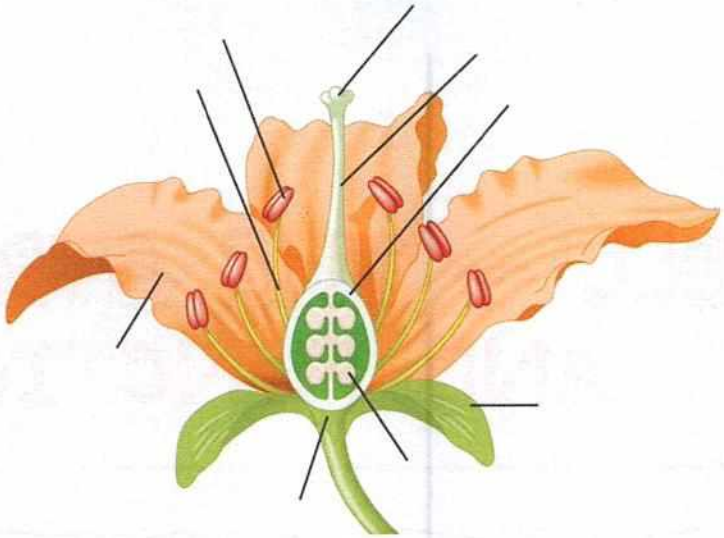
(a) Sepals : .....

(b) Petals : .....

(c) Anthers : .....

(d) Stigma : .....

9. Given below is the diagram of a typical flower. Label the parts marked by guidelines.



10. Give the difference in the function between the following parts :

(a) Ovary and ovule

(b) Petal and sepal

(c) Filament and style

(d) Pollen grains and ovule

PROJECT

- Some seeds called photoblastic seeds need presence of light also for their germination along with water, air and suitable temperature. Try to find out these plants.
- Why are some seeds dry, light with wings while others have structures like hooks ? Find out the reason and examples to support your answer.

UNIT : 2

The Cell

3

CELL – THE STRUCTURE AND FUNCTIONS

SYLLABUS

1. Plant cell : Cell organelles and their functions.
2. Animal cell : Cell organelles and their functions.
3. Diagrams of plant and animal cells.
4. Only the following to be included : Cell wall, Cell membrane, Plastids, Nucleus, Vacuole, Cytoplasm – their structure and functions.
5. Differences between plant and animal cells.

Every organism begins its life as a single cell. Even the largest banyan tree, or an elephant or we humans begin life from a single cell. This single cell undergoes repeated divisions to become a complete living organism. Thus, we say that the cell is the **basic unit of life**. For this reason, cells are also known as the building blocks of life.

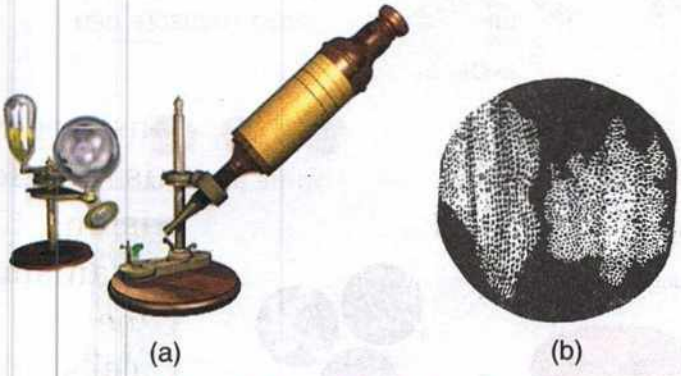
ANTONY VAN LEEUWENHOEK

Fig. 3.1 A simple microscope used by Leeuwenhoek

A **cell** can be defined as the basic structural and functional unit of all living things.

DISCOVERY OF CELL

- **First Discovery :** Antonie Van Leeuwenhoek (1632-1723) developed a **simple microscope** (Fig. 3.1), using only a single biconvex lens. He was the first to see the cells (blood cells in the capillaries of the foot-web of frog) and recognized them as living units of all living beings. However, he did not call them cells.
- **First to coin the term "cell" :** In 1665, Robert Hooke developed a microscope to observe different objects using two lenses [Fig. 3.2(a)]. He examined a very thin slice of a dead cork (the bark of the trees) and observed a cluster of box-like cubicles piled up together [Fig. 3.2(b)]. This reminded him of "cells" of monks living in a monastery. So, he was the first to call them **cells**.



(a) (b)

Fig. 3.2 (a) Robert Hooke's microscope (b) Cork cells : dead and empty

Do You Know ?

The word cell is derived from the latin word cella (compartment).

The branch of biology which deals with the study of cells is called **cytology**.

Robert Hooke had only seen the walls of dead cells. So, when is a cell called a living cell? A cell is said to be living when it contains a jelly-like substance called **"protoplasm"**.

Protoplasm is the living substance of the cell. It is made up of the cytoplasm and nucleus.

The type of microscope that we use in our school laboratories these days is the **compound microscope** (Fig. 3.3).

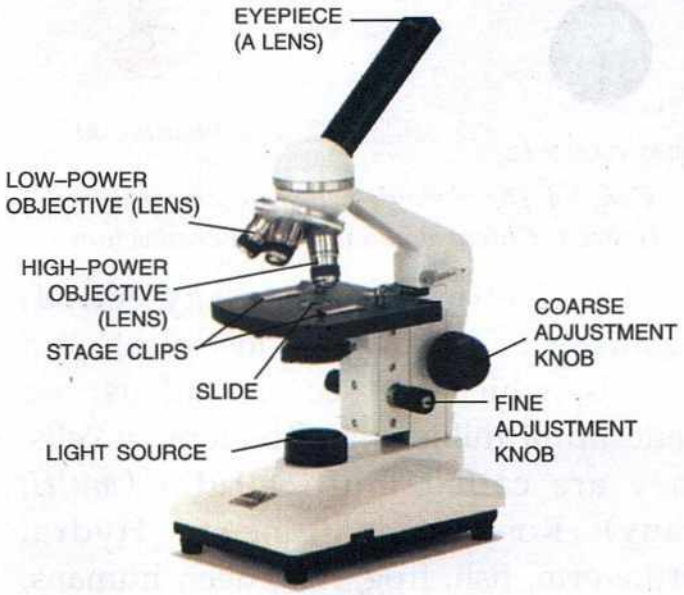


Fig. 3.3 A compound microscope

CELLS — THEIR NUMBERS, SHAPES AND SIZES

Cells — how numerous ? On the basis of the number of cells, the organisms have been categorised as unicellular or multicellular.

Unicellular (single-celled) organisms: The body of many microscopic plants and animals are formed of just one single cell. Such organisms are called **unicellular** (*uni* : single). *Examples* — Bacteria, Yeast, Amoeba, Paramecium, Chlamydomonas (Fig. 3.4).

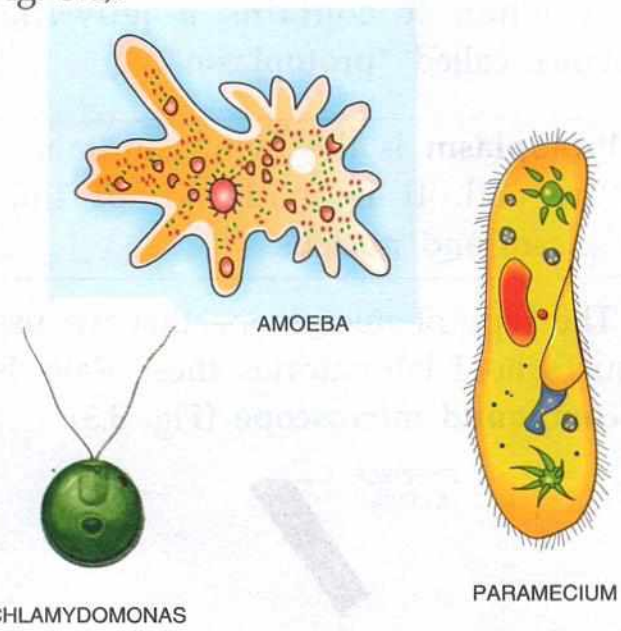


Fig. 3.4 Three single-celled organisms — Amoeba, Chlamydomonas and Paramecium

Multicellular (many-celled) organisms : The body of most plants and animals, which we see around us, are made up of millions and billions of cells. They are called **multicellular** (*multi*: many). Rose, peepal, neem, Hydra, earthworm, fish, frog, lion, deer, humans, etc., are all multicellular organisms.

Cell Shape (Fig. 3.5)

There is a great variety in the shape of cells — oval, spherical, rectangular, irregular, elongated, etc. The cell shape is determined by the function of the cell.

(i) **Spherical shape :** The red blood cells are spherical or disc-shaped structures. Their specific shape enables them to hold more oxygen and easily flow through fine inner lumen of blood capillaries.

(ii) **Oval :** *Chlamydomonas* is a unicellular green algae. Their single-celled body is oval in shape.

(iii) **Cylindrical :** *Spirogyra* is a multicellular green algae. Their cells are cylindrical in shape with spiral ribbon shaped chloroplast.

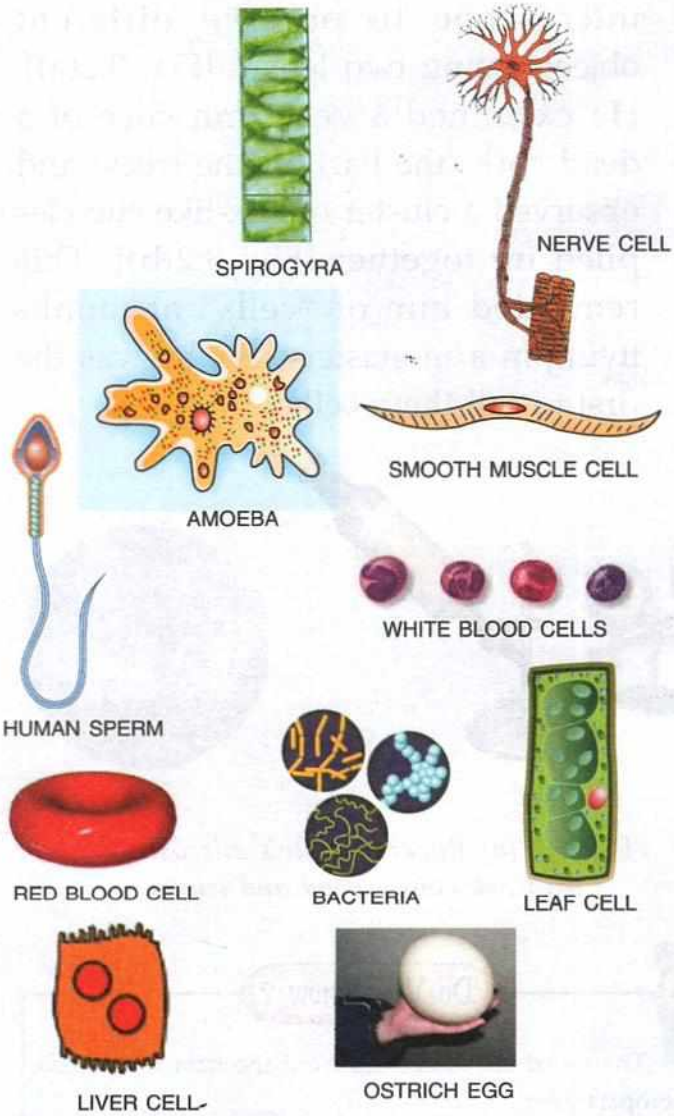


Fig. 3.5 Some examples of different kinds of cell shapes

The cardiac muscles of the heart too are cylindrical in shape for easy contraction and relaxation.

(iv) **Amoeboid :** The single-celled body of the fresh water Amoeba, has no definite shape. Hence, it is said to be irregular in shape. The white blood cells in our body are also amoeboid as they have no definite shape.

(v) **Cubical/rectangular :** The cells of the leaf are cubical or rectangular. In fact, plants also have a variety of cell shapes from cubical to polygonal as well as elongated and tubular.

Some cells are uniquely shaped :

(i) **Slipper-shaped – *Paramecium* :** The body of this single-celled organism is in the shape of a slipper. Hence, it is often called the "slipper-shaped animalcule".

(ii) **Spindle-shaped :** The smooth muscles in our body are thin, long and tapering at the ends, resembling a spindle.

Cell Size

There is a huge variety in the size of the cells. The great majority of cells are very small, and they can be seen only with the help of a microscope. However, there is a great range in their sizes :

(i) The **largest** cells are the ostrich eggs.

(ii) The **longest** cells are the nerve cells (upto 3 metre).

(iii) The **smallest** cells are found among bacteria (0·2–0·5 micrometre). (A micrometre is equivalent to one-thousandth of a millimetre).

Cell Theory

Three scientists, Schleiden, Schwann and Virchow formulated the cell theory as —

1. Every living organism is made up of one or many cells.
2. The cell is the structural unit of all living organisms.
3. The cell is the functional unit of all living organisms.
4. All cells arise from the pre-existing cells.

CELL — THE STRUCTURAL UNIT OF LIFE

Every part of the body of all living organisms (plants and animals) is made up of cells.

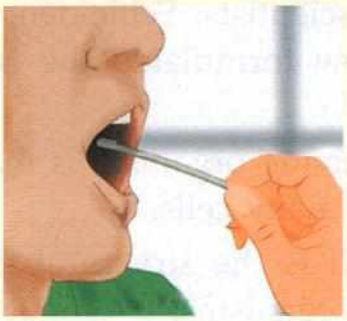
Cells may vary in shape and size but basically, they are just the same in their fundamental structure.

If you examine even a tiny part of a plant's or animal's body under a microscope, irrespective of whether it is the root, stem or leaf of a plant, or the skin, muscle or bone of an animal, you will find that they are all made up of cells.

Activity 1

To study the structure of an animal cell.

1. Take a blunt instrument such as a spatula. It must be **clean.**
2. Gently scrap the inside of your cheek with it.

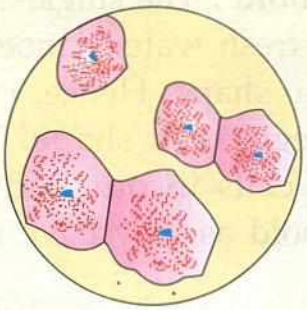


3. Put the scrapings on a glass slide.

4. Add a drop of **methylene blue** stain to the scrapings on the slide. This will stain the cells and help you to clearly see them.

5. Put a coverslip over the material. Lower the cover slip carefully on the slide. The stain will spread out beneath it.

6. Examine the slide under the microscope. First use low power to find some of the scrapings, then look at one of the cells under high power.*



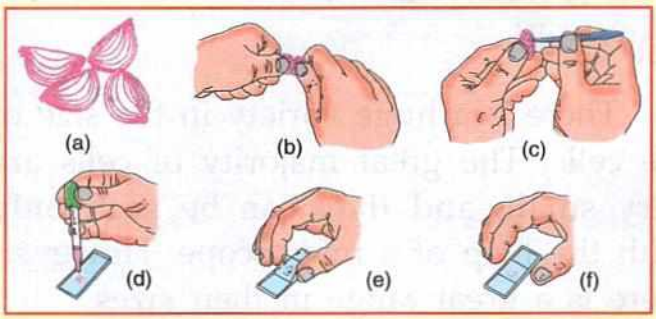
Human cheek cells

Cheek cells are irregular in shape. Similarly, by using different techniques, the skin, muscle, bone or blood of an animal can be studied. You will find that these are all made up of cells, although they may differ in shape and size.

Activity 2

To study the structure of a plant cell.

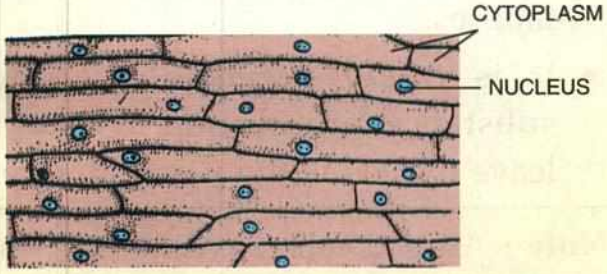
1. Slice an onion into two, lengthwise.
2. Take out one of the thick 'leaves' from inside.
3. With forceps, pull away the thin lining from the inner surface of the 'leaf'. This is the onion peel.



** All activities must be performed under strict supervision of the teacher. This is important for safety reasons, and to avoid any possible injury or infection during the practical exercise.*

4. Cut a small piece of the lining with a pair of scissors, about 5 mm square.
5. Place the piece of lining on a slide and add a drop of dilute iodine solution. (This will stain the cells and make it easier to see their nuclei.)
6. Gently place a coverslip over it.
7. Examine the slide under the microscope, first under low power, and then under high power.

The cells of the **onion peel** have a rectangular shape. Similarly, you can examine thin slices of leaves, stems or roots. You will find that every part is formed of cells, though they may differ in their shapes and sizes.



Cells of the onion peel

CELL — THE FUNCTIONAL UNIT OF LIFE

Every function inside the body of living organisms (plants or animals) is the result of cellular activity.

In Plants

- **Root cells — absorption of water and minerals :** It is the cells of the roots through which plants absorb water and dissolved minerals from the soil. If the root cells die for any reason, the plants will wilt (dry up) and die.
- **Leaf cells —manufacture of food :** It is the chlorophyll (green pigment) containing cells of the leaves which utilise sunlight, carbon dioxide and water to prepare food (glucose) for the plant. This process of preparing food by the plants is known as **photosynthesis**.

In Animals

- **Muscle cells :** Movement of body parts. It is the ability of the **muscle cells** to contract and relax.
- **Nerve cells :** Conduction of messages in the form of impulses.
- **Gland cells :** It is the cells of various glands which secrete enzymes that digest the food.
- **Skin cells :** The skin being the outermost covering of the body protects our body from various external factors such as germs and ultraviolet rays. It also helps in regulating the body temperature.

STRUCTURE OF A CELL (Fig. 3.6)

An animal cell or a plant cell as seen under a compound microscope shows *three* essential parts :

1. The outermost **cell membrane** (also called plasma membrane),
2. The **cytoplasm**, and
3. The **nucleus**.

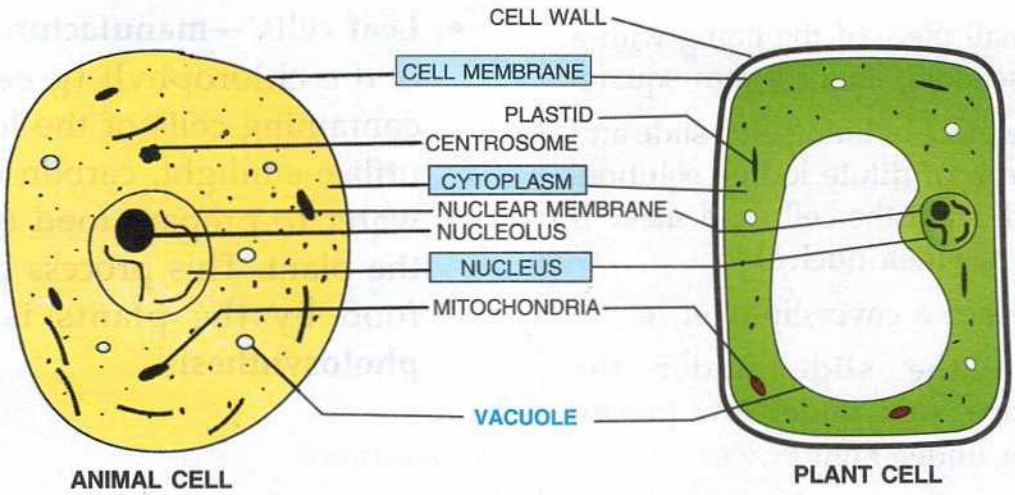


Fig. 3.6 Animal cell and plant cell

The major features of each of these three parts are as follows :

1. Cell Membrane or Plasma Membrane

Each cell is surrounded by a cell membrane, also called **plasma membrane**.

- It is very thin, delicate and flexible.
- It is a living structure present in both plant and animal cells.
- It has fine pores in it, through which only certain substances can pass in and out, while others cannot. Therefore, **the cell membrane is called *selectively permeable*. This allows the entry of certain molecules only, while holding back the others.**

Cell wall

Only the **plant cells** have a cell wall. It lies outside the cell membrane.

- It is made up of ***cellulose***.
- It gives ***shape*** and ***rigidity*** to the plant cell.
- It is a non-living structure.
- It ***protects*** the cell from the entry of disease-causing agents, as well as the underlying plasma membrane and protoplasm against mechanical injuries.
- It is ***freely permeable***, allowing substances in solution to enter and leave the cell without any hindrance.

Note : Animal cells have no cell walls.

2. Cytoplasm

The cytoplasm is a semi-liquid (viscous), colourless and translucent substance. It is found between the nucleus and the cell membrane.

3. Nucleus (Fig. 3.7)

Nucleus is a small spherical mass mostly located towards the centre of the cytoplasm. It is the most important part of the cell.

- It regulates and coordinates various life processes of the cell.
- It plays an important part during cell division.

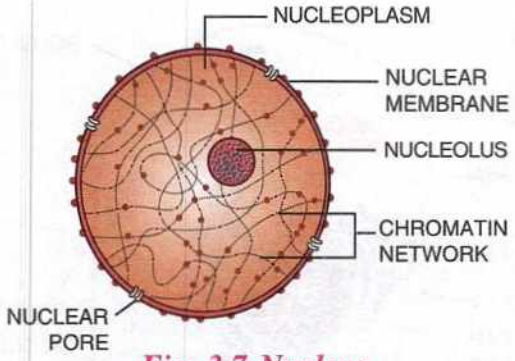


Fig. 3.7 Nucleus

Nucleus has the following parts :

- A delicate, porous **nuclear membrane** which encloses a relatively dense **nucleoplasm**.
- Inside the nucleoplasm is a small darker body called **nucleolus**. The nucleoplasm also contains chromosomes. Chromosomes contain units called **genes**. These genes are responsible for transmiting characterstics from parents to offsprings.

The **number of chromosomes** is definite in each species such as every cell of the human body has 46 chromosomes which occur in 23 pairs, and a cell of pea plant has 14 chromosomes which occur in 7 pairs.

The Cell Organelles (Fig. 3.8 and 3.9)

The development of better microscopes (with higher magnification), specially the electron microscope, revealed that cytoplasm further contains many tiny structures which could not be seen by the ordinary compound microscope. These minute structures are called cell **organelles.** Just as there are organs in an organism for different functions, so are the organelles inside a cell.

The main cell organelles found in the cytoplasm are endoplasmic reticulum, ribosomes, mitochondria, golgi bodies, lysosomes, centrosome and plastids.

Plastids (only in plant cells)

There are mainly three types of plastids depending on the pigment they contain and the colour they impart to plant parts.

(i) **Chloroplasts** are green plastids, that trap the solar energy for photosynthesis.

(ii) **Chromoplasts** contain yellow and red pigments. They impart varied colours to flowers and fruits. In

Table 3.1 : Differences between plant and animal cells

PLANT CELL	ANIMAL CELL
1. Size is usually larger.	1. Size is usually smaller.
2. Plant cell has a definite cell wall.	2. No cell wall.
3. Cytoplasm not so dense. Only a thin layer of cytoplasm.	3. Cytoplasm denser and more granular. It fills almost the entire cell.
4. Vacuoles prominent, fewer in number; concerned with storage of water and nutrients.	4. Vacuoles are small, numerous; concerned with excretion or secretion.
5. Contain plastids.	5. Do not contain plastids.

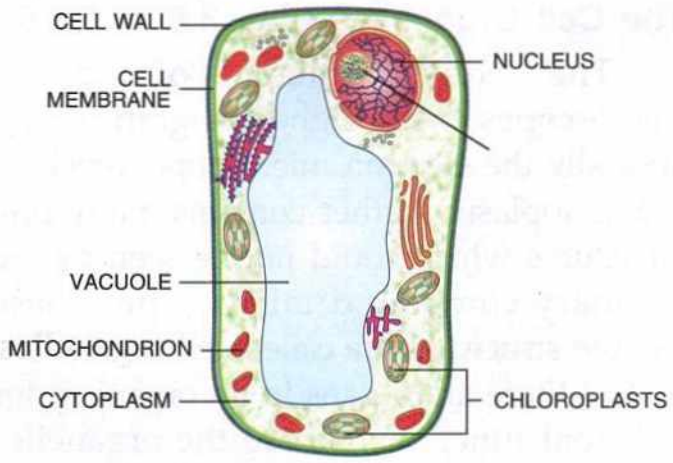


Fig. 3.8 A generalised plant cell (diagrammatic) showing finer details as observed under an electron microscope

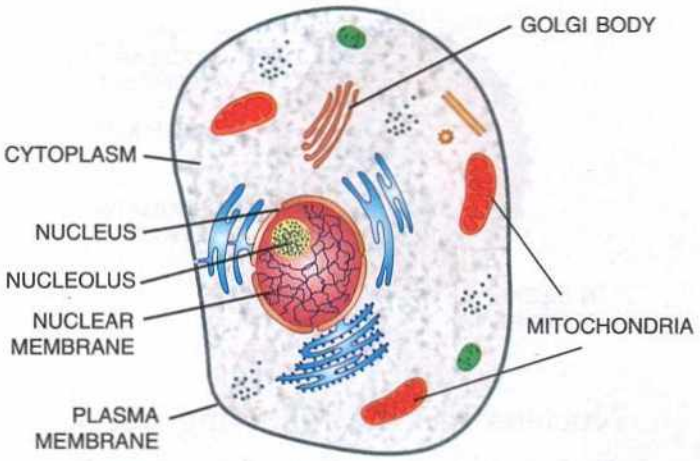


Fig. 3.9 A generalised animal cell showing finer details as observed through an electron microsope

petals of flowers, they attract insects for pollination.

(iii) **Leukoplasts** are colourless plastids which occur in seeds. They store starch, fats and proteins.

Vacuoles

Vacuoles are the non-living inclusions in the cytoplasm bound by a membrane. These are filled with water and various substances in solution form called cell sap.

- In **plant cells**, the vacuoles are fewer but quite large in size.
- In **animal cells**, the vacuoles are larger in number and smaller in size.

Cell Division — A need to produce new cells

New cells need to be produced for (1) *replacement*, (2) *repair*, (3) *reproduction* and (4) *growth*. Thus, cell division is the necessity for the existence of all living organisms, including plants.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick (√) against the most appropriate alternative in the following statements.

(i) Identify the part which contains pigment :

(a) cell membrane ☐ (b) plastid ☐

(c) centrosome ☐ (d) cell wall ☐

(ii) The organelle that controls all activities in a cell :

(a) nucleus ☐ (b) vacuole ☐

(c) plastids ☐ (d) cytoplasm ☐

(iii) A cell that is spherical in shape is :

(a) white blood cell ☐ (b) nerve cell ☐

(c) red blood cell ☐ (d) amoeba ☐

(iv) The vacuole contains :

(a) water ☐ (b) cell sap ☐

(c) salts ☐ (d) food ☐

Short Answer Questions :

1. Name the scientist who invented the first microscope. .....
2. Who coined the term "cell" ? .....
3. Briefly describe the three essential parts of a cell.
4. The cell membrane is called selectively permeable. Why ?
5. State the difference between :
   (i) Nucleus and nucleolus.
   (ii) Cytoplasm and protoplasm.
   (iii) Cell wall and cell membrane.
6. List the major differences between a plant cell and an animal cell.
7. Briefly discuss the importance of chromosomes in an organism.
8. Fill up the blanks with the terms given below in the box.

pigments, wall, pre-existing, cell, vacuoles.

(i) The ..... is the structural unit of all living things.

(ii) All cells arise from ..... cells.

(iii) Animal cells have no cell ..... .

(iv) Plastids contain ..... .

(v) ..... are filled with water and dissolved substance.

9. Try to find the names of four cell organelles hidden in this maze. (Hint : The hidden words can appear horizontally or vertically; forward or backward or even mixed up). Write them in the lines provided. *For example :* "NUCLEUS" in the last row, seven backward letters.

A	J	F	B	H	E	M	O	E	L	O	U	C	A	V
H	V	L	E	U	C	O	P	L	A	S	T	N	O	E
C	H	R	O	M	O	P	L	A	S	T	X	T	E	R
S	U	E	L	C	U	N	W	P	L	A	S	T	I	D

(i) .....

(ii) .....

(iii) .....

(iv) .....

Long answer questions (write the answers in your notebook).

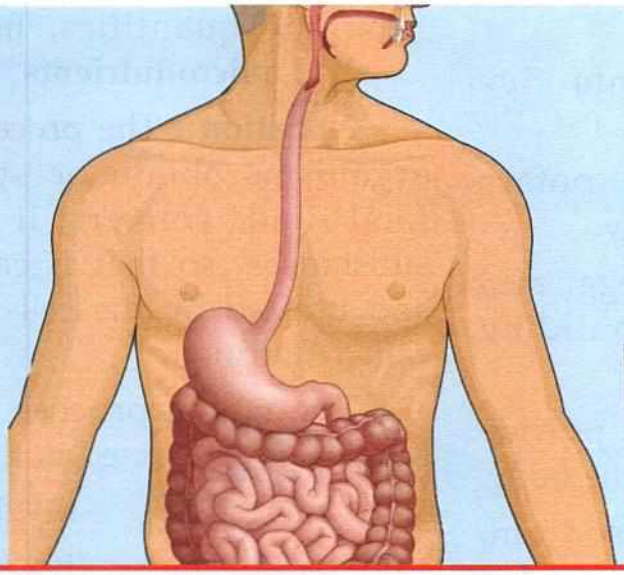
1. Briefly describe the structre of nucleus and mention its any *two* function.
2. Name the scientist who coined the term "cell". How many lenses did he use in his microscope ? What did he observe under his microscope ?
3. Name the *three* essential parts of a cell. Breifly descibe the structure of cell-membrane.

PROJECT

- Collect different types of eggs you find in your surroundings. Measure their length and find out how they are different.
- Collect a fibre from a leather belt or purse. Treat it and watch it under the microscope. Record your observations with diagrams.

UNIT : 3

Human Body



4

DIGESTIVE SYSTEM

SYLLABUS

1. Revisit previous learning.
2. Organs of the digestive system; function of each organ.
3. Process of digestion particularly of carbohydrates, proteins and fats.

FOOD FOR LIFE

You have already learnt that food is a kind of "fuel" as well as a kind of building material for all living organisms. Food contains nutrients — the raw materials our body needs to build everything from muscles and bones to the brain and the heart.

We drink milk and eat different types of food like bread, *chapati*, rice, butter, *ghee*, vegetables, fruits, meat, eggs, pulses, etc. The food provides us with nutritive substances for growth and energy. A good choice of foods gives the body what it needs to grow and do its daily tasks, while choosing the wrong foods deprives the body of some of the nutrients it needs to function properly.

Food provides our body with :

- Energy to do work.
- Nutrients for the growth and repair of damaged cells and tissues.
- Materials for keeping us healthy and disease-free.

The food which provides us with all the necessary substances is known as **nutritious food.** A nutrient can be defined as **"a constituent of food that helps one way or the other in the body's functions".**

Types of Nutrients

Nutrients are classfied into five major groups :

- **Carbohydrates** (like rice, potato and sugarcane) provide energy.
- **Proteins** (like pulses, milk, egg, etc.) provide the body with building material to grow.
- **Fats** (like *ghee*, oil and butter) provide energy and help in insulating the body.
- **Minerals,** such as iron, sodium, calcium, phosphorus, etc., are needed for their specific roles in the body.
- **Vitamins** are needed for the normal functioning of various body processes.
- Carbohydrates, fats and proteins are required in larger quantities, hence, they are called **macronutrients**.
- Minerals and vitamins are required in minute quantities, hence, they are called **micronutrients**.

Nutrition : The process by which all organisms obtain or synthesize their food and convert it into simpler substances, so that it can be absorbed and utilized by the cells of the body is called nutrition.

The whole process of nutrition in humans is conducted in five steps.

(i) ingestion (ii) digestion
(iii) absorption (iv) assimilation and
(v) egestion

DIGESTIVE SYSTEM IN HUMANS

The food we eat passes through the **food canal** or **alimentary canal**. It is a long, muscular and coiled tube. It starts from the **mouth** and ends at the **anus**.

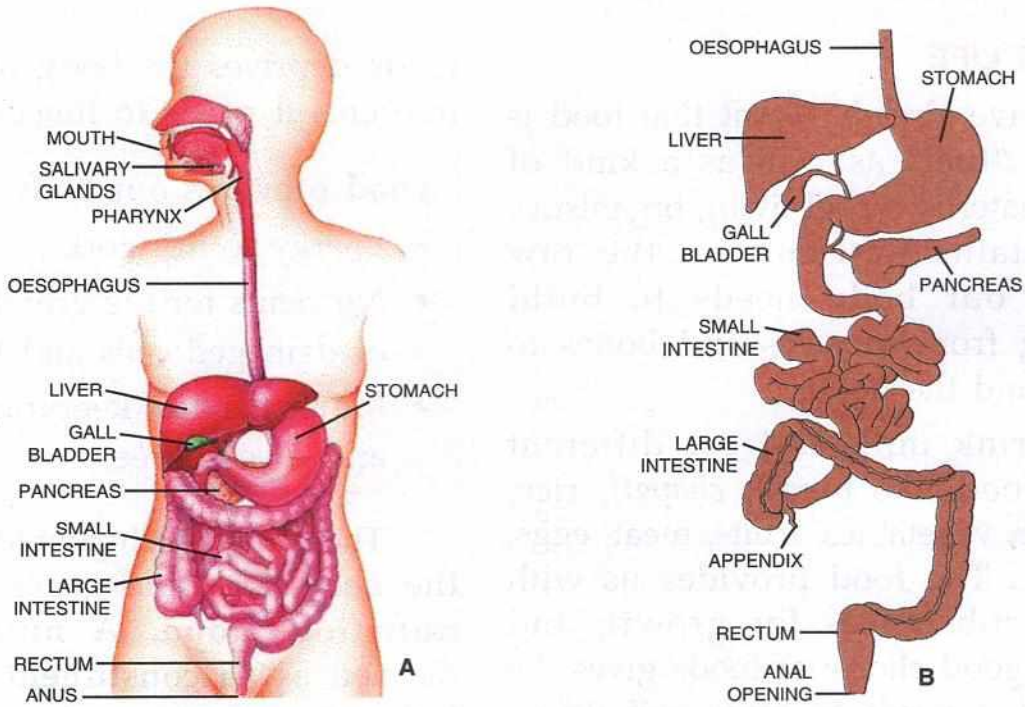


Fig. 4.1 A—Human alimentary canal and associated glands
B—The same diagrammatically stretched out to show the parts more clearly

Glands, such as **liver, salivary glands** and **pancreas** are associated with the food canal. The food canal together with these glands forms the **digestive system**.

The different organs of the digestive system are as follows :

Alimentary Canal consists of mouth (with teeth and tongue), oesophagus, stomach, small intestine, large intestine and rectum.

Digestive glands consist of salivary glands, liver and pancreas.

Digestion is a process by which the complex chemical compounds present in the food are broken down into simpler substances that are readily absorbed and utilized by the body.

1. THE MOUTH

The mouth is bordered by upper and lower lips. The lips help in closing the mouth during swallowing. Inside the mouth are present the teeth and the tongue. Food is taken through the mouth. This is called **ingestion**. The food is broken down into smaller pieces or chewed by the teeth.

Types of Teeth

Based on their different shapes and functions, human teeth are of *four* kinds (Fig. 4.2) :

1. ***Incisors*** are the four front teeth at the middle of each jaw. They are chisel-shaped for **biting** and **cutting**.
2. ***Canines*** are one on either side of the incisors in each jaw. They are pointed for **tearing** the food.
3. ***Premolars*** are two on each side of canines in each jaw. They help in **crushing** and **grinding** the food.
4. ***Molars*** are the last three teeth on each side in each jaw. They have broad uneven surfaces for finer **crushing** and **grinding** of ingested food.

The last molar on each side in each jaw is called the ***Wisdom Tooth***. The wisdom tooth appears at the age of 17-20 years. In some people, however, wisdom teeth may not come out of the gums at all.

The human teeth develop in two sets during the life-time. The first set called the **milk teeth** or the **temporary teeth**, consisting of 20 teeth (8 incisors, 4 canines and 8 molars only), appear in young children. The temporary teeth start falling out around the age of 5-6 years and get replaced with the ***permanent teeth*** by about 12-13 years of age.

An adult human normally has 32 teeth in all, 16 in each jaw. You as a child may have a fewer (usually 28). The ***teeth*** cut and break the food into smaller pieces and also grind the food into a pulp so that it can be swallowed easily. The teeth also help in speaking.

Activity 1

To identify and study different types of teeth in a human jaw.

- Stand against a mirror fitted on a wall. Wide open your mouth, and observe your teeth.
- Observe your teeth in the upper jaw.
- The front four teeth are chisel-shaped. These are the ***incisors*** meant for biting and cutting.
- Look at one tooth on either side of the incisors in each jaw. Observe

their shape and note how they differ from the incisors ? Are they pointed. Yes/No.....

These teeth are known as ***canines***. These are meant for tearing the food.

- Two teeth on either side of canines are the ***premolars*** meant for crushing and grinding the food.
- Observe the teeth behind the premolars. These are again broad in shape with an uneven flat surface. These are also meant for **grinding** and **crushing** the food. These are ***molars.***

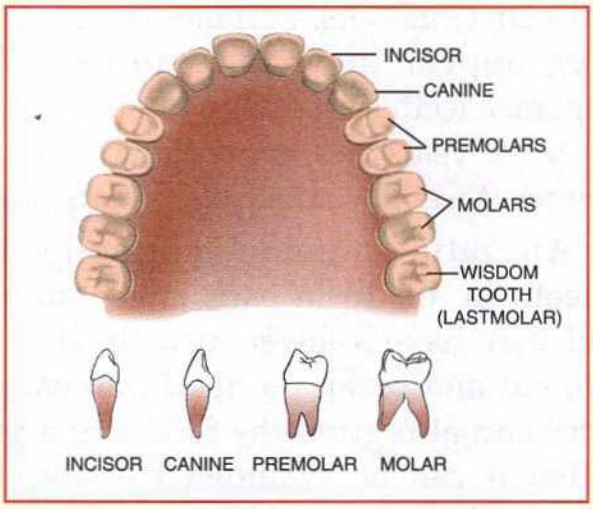


Fig. 4.2 Different kinds of teeth in the upper jaw

- Count the number of teeth in **one half of each jaw** :

Upper jaw Incisors = ...
Canines = ...
Premolars = ...
Molars = ...

Lower jaw Incisors = ...
Canines = ...
Premolars = ...
Molars = ...

Tongue

The tongue is a fleshy muscular organ attached at the back to the floor of the mouth. It helps in several ways :

1. Helps in tasting the food.
2. Helps in mixing the watery secretion (saliva) with the food.
3. Manipulates the food while chewing.
4. Helps in swallowing the food.
5. Helps in cleaning the teeth when food particles are stuck to it.
6. Helps in speaking.

Activity 2

To locate the different types of taste buds on the tongue.

1. Take the following solutions separately in four different test tubes. (a) Sugar solution, (b) salt solution, (c) lemon juice and (d) crushed neem leaf.
2. Blindfold one of your classmates and ask her/him to take out the tongue and keep it in straight and flat position.

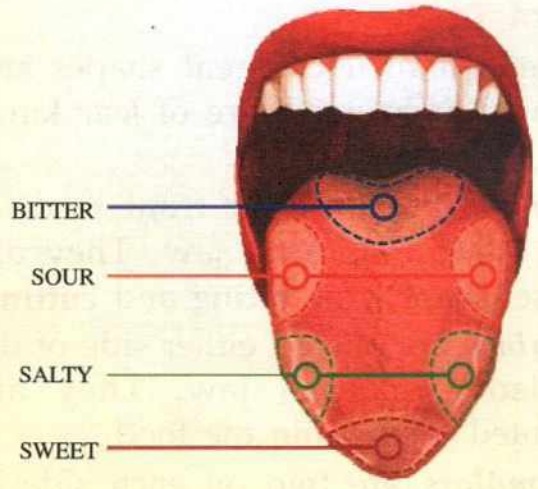


Fig. 4.3 Different taste buds on the tongue

3. Take clean toothpicks to put the above samples one by one on different areas of the tongue as shown in the figure. Use a new toothpick for each sample.
4. Ask the classmate which areas of the tongue could detect the sweet, salty, sour and bitter substances (Fig. 4.3).

The Salivary Glands

What you call the watering of the mouth is actually a secretion of saliva from the salivary glands in your mouth.

The saliva is secreted by three pairs of salivary glands (one below the tongue, second at the base of the ear, and third on the inner side of the angles of the lower jaws) (Fig. 4.4).

Saliva is a fluid containing water, salts and a slimy mucus. It also contains an enzyme called **amylase** which converts starch into maltose.

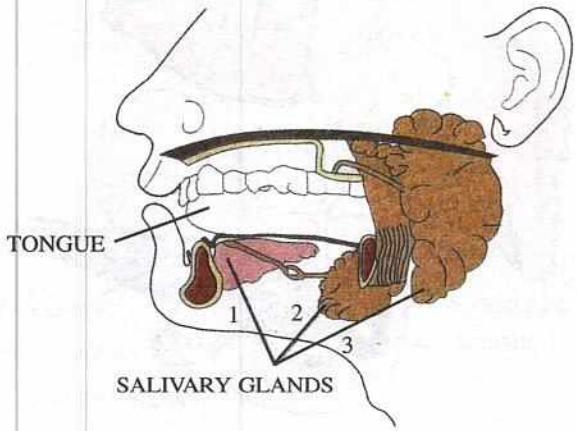


Fig. 4.4 Salivary glands

A piece of bread or boiled rice when chewed thoroughly starts tasting sweet. The tasteless starch changes into sweet maltose (sugar).

$$\text{Starch} \xrightarrow[\text{amylase}]{\text{salivary}} \text{Sugar (maltose)}$$

Activity 3

Stand in front of a mirror. Open your mouth and lift the tongue upwards. Look at the two tiny openings below the tongue. You can see the watery fluid oozing out from these apertures. This is the **saliva.**

Functions of Saliva

1. It moistens and lubricates the mouth cavity and the tongue to make speaking and swallowing easy.
2. It cleans the mouth and destroys germs.
3. The saliva binds the food particles and makes it into a mass called the **bolus**.
4. Digestion begins in the mouth. Saliva contains an enzyme (amylase) which helps in the breakdown of starch to simple sugars (= maltose).

2. THE OESOPHAGUS (FOOD PIPE)

The oesophagus or the food pipe is a long and narrow tube which runs from the back of the throat, down through the chest to open into the stomach. The food moves down the oesophagus by peristalsis. No digestion occurs in the oesophagus.

Peristalsis is the slow wave-like movement seen in the walls of the oesophagus due to the contraction and relaxation of its muscles.

Peristalsis occurs throughout the alimentary canal. This movement enables the food to be pushed downward.

3. THE STOMACH

The stomach is an elastic bag. Its walls are highly muscular. It also contains glands called gastric glands which secrete gastric juice.

The gastric juice given out by the gastric glands contains **water, hydrochloric acid** and an enzyme **pepsin**. The acid kills the germs (which may have entered along with the food), prevents rotting of food during its long stay in stomach, and it activates the enzyme **pepsin**. Pepsin converts proteins into a simpler compound called **peptones**.

Proteins $\xrightarrow{\text{Pepsin}}$ Peptones

The protein **casein** present in the milk is converted into curd by the help of another enzyme, the **rennin**.

Casein $\xrightarrow{\text{Rennin}}$ Curd

The food remains in the stomach for about 3-4 hours or more. During this time stomach also churns the food thoroughly along with the digestive juices and changes it into a pulp-like thick paste called ***chyme***. The chyme moves into the first part of the small intestine.

4. THE SMALL INTESTINE

The small intestine is a long coiled tube of about 7 metres. The food remains in the small intestine for about 3-5 hours for digestion and absorption. The short upper 'U' shaped part of the small intestine, continuing from the stomach, is called **duodenum**. Duodenum receives a common duct that brings secretions from both the liver (called bile juice) and the pancreas (called pancreatic juice).

The Liver

Liver (Fig. 4.5) is reddish brown in colour and is the largest gland in the body. It is situated on the right side of the body, below the chest region. The liver produces a greenish yellow fluid — the ***bile*** which is stored in the **gall bladder**, an organ found just below the liver. The bile juice breaks down fats into tiny droplets and this process is called **emulsification**.

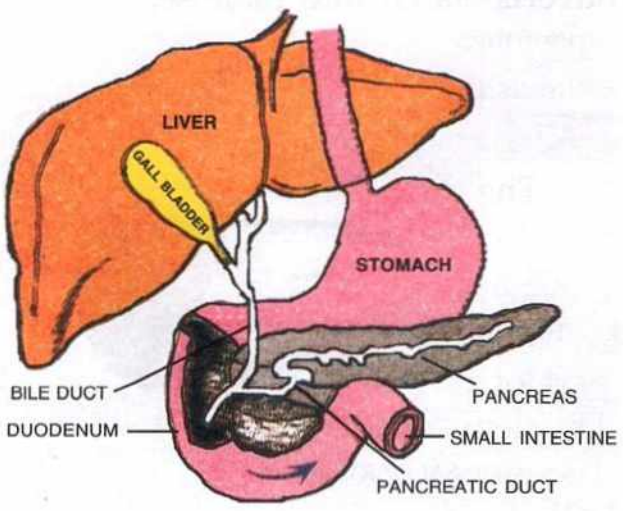


Fig. 4.5 Liver, pancreas and gall bladder

The Pancreas

The pancreas is a large, whitish, leaf-shaped gland situated below the stomach. It secretes pancreatic juice which is poured into the duodenum through the pancreatic duct. The pancreatic duct opens into the duodenum by an aperture common to that of the gall bladder.

The pancreatic juice contains enzymes namely **amylase, trypsin** and **lipase** which help in the digestion of carbohydrates, proteins and fats respectively.

- **Amylase** acts on the starch converting it into maltose.
- **Trypsin** converts proteins and peptones into peptides.
- **Lipase** converts emulsified fats into fatty acids and glycerol.

Starch	Pancreatic Amylase →	Maltose
Proteins + peptones	Trypsin →	Peptides
Emulsified fats	Lipase →	Fatty acids and glycerol

The second part of the small intestine is called **jejunum**. No digestion takes place here.

The semi-digested food enters the last part of the small intestine called **ileum**. The ileum is a long, narrow, coiled tube. The inner lining of ileum contains glands called intestinal glands which produce **"intestinal juice"**. This contains enzymes like **erepsin, maltase, sucrase, lactase** and **lipase**.

Peptides	Erepsin →	Amino acids
Maltose	Maltase →	Glucose
Sucrose	Sucrase →	Glucose and fructose
Lactose	Lactase →	Glucose and galactose
Emulsified fats	Lipase →	Fatty acids and glycerol

As a result of the action of enzymes, food that is ingested through the mouth is completely digested in the ileum.

- Carbohydrates — Glucose
- Protein — Amino acids
- Fats — Fatty acids and glycerol.

Absorption of Digested Food in Small Intestine

The inner lining of the small intestine contains a large number of tiny finger-like projections called **villi** (singular **villus**) (Fig. 4.6). The villi greatly increase the inner surface area for absorption of the digested food. Each villus has a network of thin and small blood vessels close to its surface

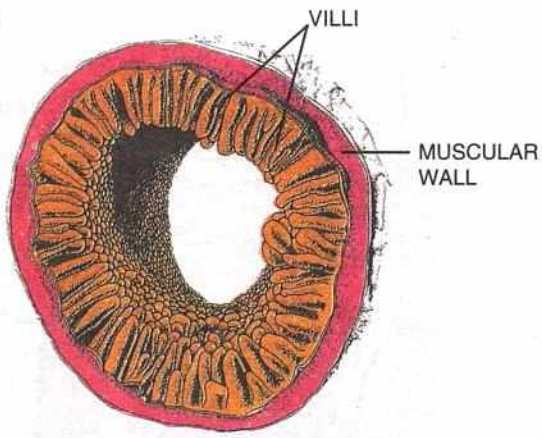


Fig. 4.6 Villi in the wall of the small intestine

The surface of the villi absorbs the amino acids and glucose to pass them into the blood system, whereas the fatty acids pass into special tubes called lymph vessels.

Vitamins and mineral salts are mostly soluble in water and are directly absorbed through the walls of the intestine.

> The ileum of the small intestine serves functions both for the digestion and the absorption of the digested food.

5. THE LARGE INTESTINE

1. The large intestine is about 1.5 metre long and consists of 3 regions : the *caecum*, the *colon* and the *rectum* (Fig. 4.7).
2. The large intestine does not secrete any enzyme. It **mainly absorbs water** from the undigested food. After much water is absorbed, the undigested waste matter that reaches the rectum is semi-solid.
3. The **rectum** is the last part, about 15 cm long. It stores the undigested waste matter called **faeces**. The rectum opens to the outside at the anus. It has a circular muscle **(sphincter)** to keep it closed. When this muscle relaxes, the anus opens to eliminate the **faeces**.
4. The process of eliminating the undigested food through the anus is called **egestion**.

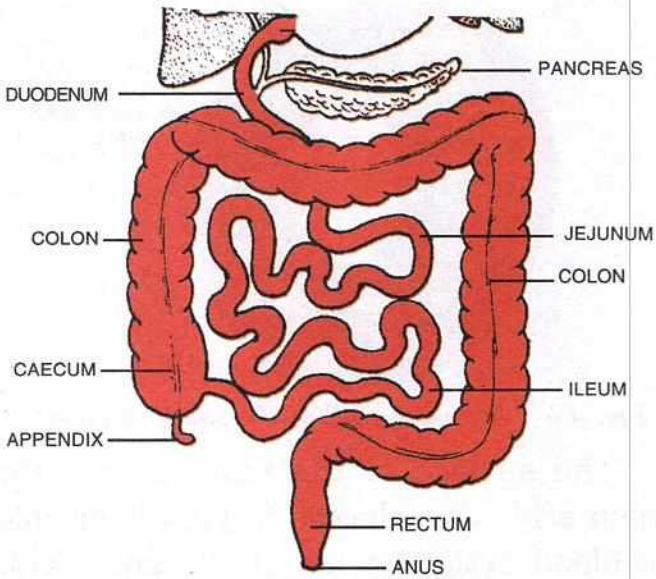


Fig. 4.7 Large intestine in humans

ASSIMILATION

It is the utilization of the digested food or nutrients by the body cells.

The nutrients absorbed into the

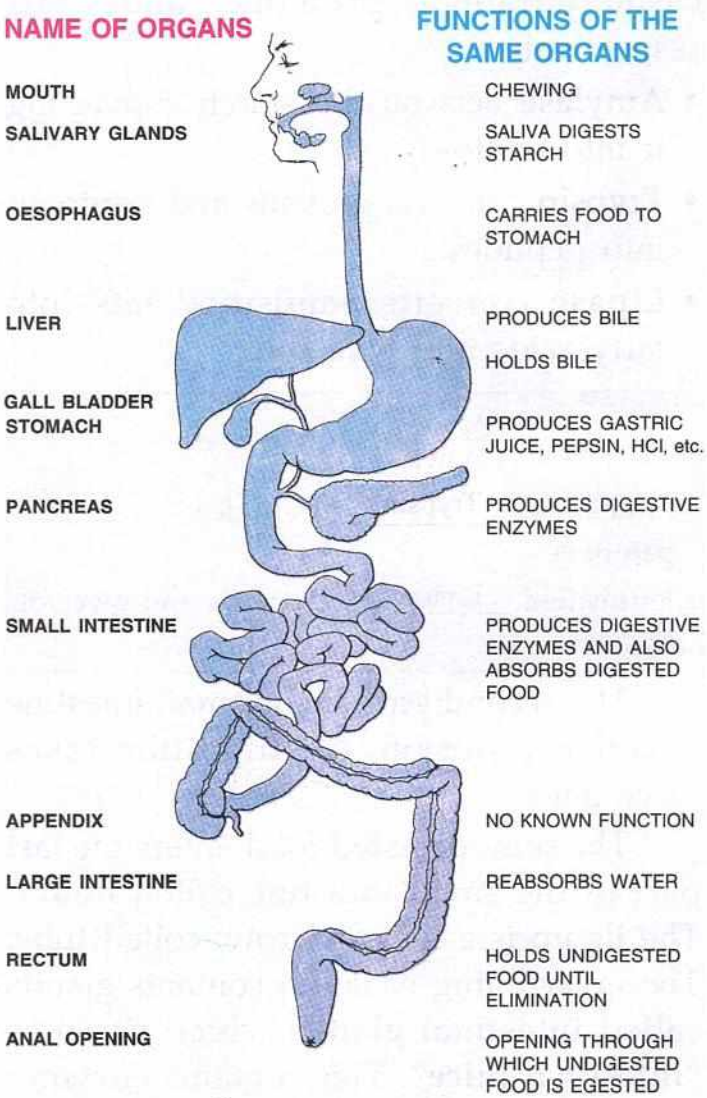


Fig. 4.8 Digestive system : different organs and their functions

blood (or in the villi) are transported to the rest of the body.

- Glucose — (end product of carbohydrate digestion) is required to release energy for cell activities.
- Amino acids — (end products of protein digestion) are used for growth, repairing worn out cells and tissues.
- Fatty acids and glycerol — (end product of fat digestion) act as reserves of energy and are stored for further use.

The various parts of the digestive system and their functions are summarised in the Fig. 4.8.

Structure of a Tooth (Fig. 4.9)

The tooth is formed of three parts — crown, neck and root.

- The top portion of the tooth which can be seen is called the **crown**. The white, hard layer which surrounds the crown is called the **enamel**. Enamel is the hardest substance in the body. **Dentine** is the bone-like hard substance just below the enamel. It supports the tooth. Dentine forms bulk of the tooth and has a hollow space filled with a soft material called the **pulp**. Pulp has nerves and blood vessels.

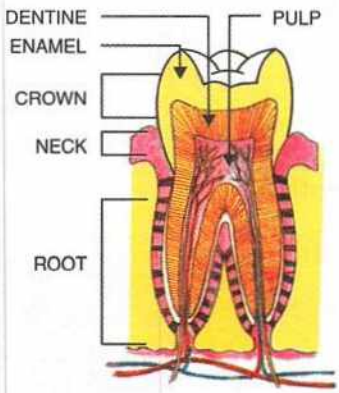


Fig. 4.9 Structure of a grinding tooth

- The **neck** is a single constriction between the root and the crown. Here, the cement that covers the root meets the enamel.
- The **root** is the lower part of the tooth which is fixed in the jaw and is surrounded by **cement**.

The Aching Tooth

Sometimes the sugary or starchy foods that we eat get stuck to the teeth. This along with bacteria on the teeth's surface form a yellow coloured film called **plaque**.

Fig. 4.10 The aching tooth

The acid produced by the bacteria slowly corrodes the enamel of the teeth and forms cavities known as **caries** (Fig. 4.11). The bacteria then enter through these caries and start infecting the tooth pulp. This causes toothache and foul smell too.

Fig. 4.11 Tooth decay

Toothache can be very painful. Sometimes, if the bacteria invade the gums, the tooth has to be pulled out.

If you take good care of your teeth, they can last a life-time. Sparkling white

teeth add charm to your face and your smile.

Care of the Teeth

One should brush one's teeth and gums twice a day – once in the morning and then at night before going to bed (Fig. 4.12).

We eat, drink and speak during the day. This constant movement slows down the growth of bacteria. When you sleep at night, the undisturbed bacteria can damage your teeth. So, it is important to brush your teeth before going to bed everyday.

You must rinse your mouth after each meal. Very hot and very cold things should be avoided.

Chocolates and sweets promote the growth of bacteria in the teeth. Extra care should be taken to rinse the mouth after eating too much of sweets or too many chocolates.

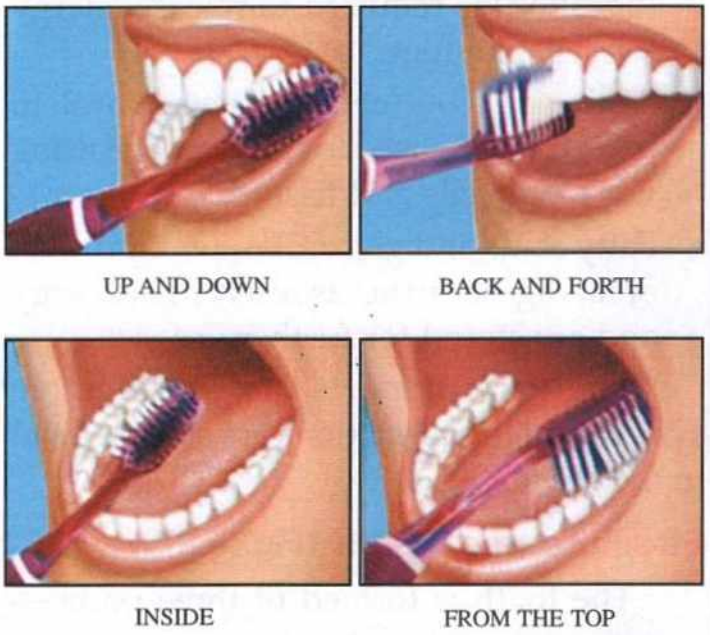


Fig. 4.12 The correct method of brushing the teeth

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick (√) against the most appropriate alternative in the following statements.

(i) The teeth which help in tearing the food are the :

(a) Incisors ☐ *(b)* Canines ☐

(c) Premolars ☐ *(d)* Molars ☐

(ii) Last molar tooth in human beings is called :

(a) Adult tooth ☐ *(b)* Wisdom tooth ☐

(c) Child tooth ☐ *(d)* Elder's tooth ☐

(iii) The hardest substance in your body is :

(a) Dentine ☐ *(b)* Bone ☐

(c) Cement ☐ *(d)* Enamel ☐

(iv) Saliva converts starch into :

(a) Glucose ☐ (b) Sucrose ☐

(c) Maltose ☐ (d) Lactose ☐

(v) Proteins of the milk are converted into curd by the enzyme :

(a) Trypsin ☐ (b) Rennin ☐

(c) Pepsin ☐ (d) Erepsin ☐

(vi) Bile juice is produced by :

(a) Stomach ☐ (b) Liver ☐

(c) Pancreas ☐ (d) Gall bladder ☐

Short Answer Questions :

1. Write *True* or *False* in the following statements.

(i) Molars help in cutting and tearing food.

(ii) Carbohydrates are digested into glucose.

(iii) Proteins are digested into fatty acids.

2. Fill in the blanks :

(i) The teeth called ..... are a total of four in number on the sides of incisors.

(ii) ..... is a common opening of food pipe and wind pipe.

(iii) Molars are meant for ..... the food.

(iv) Incisors are used for ..... and ..... the food.

(v) The ..... are used for tearing the food.

(vi) The ..... and ..... are used for crushing and grinding the food.

(vii) In an adult human, there are a total of ..... teeth.

(viii) The human teeth appear in two sets, the first set is called .....which consists of only ..... teeth.

3. Name the following :

(i) End product of starch after digestion. .....

(ii) The organ where protein digestion begins. .....

(iii) The organ into which the pancreatic juice and the bile juice are poured. .....

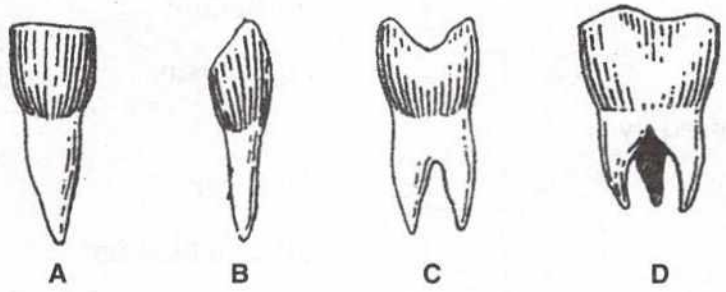
(iv) The enzyme which digests fat in ileum. .....

(v) The simplest form of carbohydrates. .....

(vi) The part of alimentary canal where water from the undigested food is absorbed. .....

(vii) The end-product of protein digestion .....

4. Identify and name the *four* types of teeth shown below and state their functions.



5. State whether the following statements are ***True*** or ***False***.

(i) Wisdom tooth appears at the age of 5-6 years when the child starts going to school.

(ii) The temporary set of teeth includes incisors, canines and premolars only.

(iii) The ducts from the salivary glands open into the duodenum.

(iv) Saliva changes starch into maltose.

6. Fill in the blanks in the table (1-5) by selecting the suitable names of substances from the list given below :
[lipase, peptones, fatty acids, proteoses, protein].

Digestive enzymes	acts on	to form
(i) Pepsin	.....(2).....	.....(3)..... and .....(4).....
(ii) .....(1).....	fats	.....(5).....

7. (i) Name the juice secreted by the liver ..... .

(ii) Name the organ where this juice is temporarily stored ..... .

(iii) What is the main function of this juice ?

8. Name the ***three*** enzymes found in the pancreatic juice and mention their functions.

(i) .....

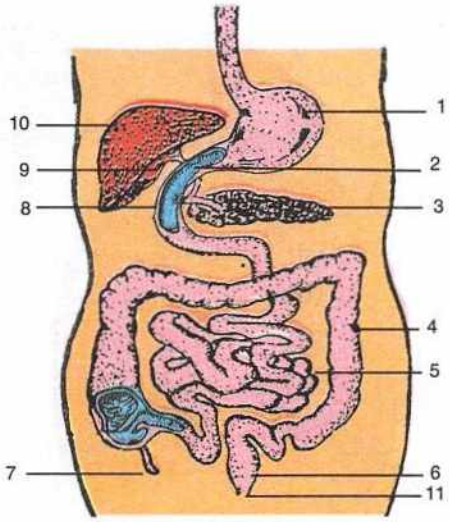
(ii) .....

(iii) .....

9. Name the ***three*** regions of the large intestine.

....

10. Given alongside is the diagram of the human alimentary canal.



(i) Name the parts 1-11 indicated by guidelines.

1. ..... 2. ..... 3. .....

4. ..... 5. ..... 6. .....

7. ..... 8. ..... 9. .....

10. ..... 11. .....

(ii) State the function of the juice secreted by part 1.

.....

.....

.....

(iii) State the function of the ***three*** enzymes found in the juice secreted by part 3.

.....

.....

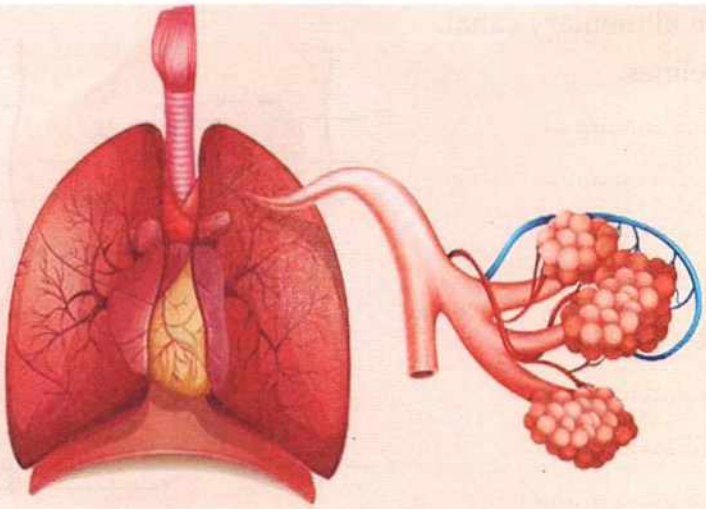
.....

Long Answer Questions (Write the answers in your notebook)

1. Define the term nutrition.
2. What is the role of liver and pancreas respectively in the digestion of food ?
3. Name the digestive juice secreted by the stomach and give its function.
4. Answer the following questions :
   (i) Name the types of teeth present in humans.
   (ii) How is the small intestine best suited for the digestion and absorption of food ?
   (iii) What do you mean by absorption of food ?
5. Define the following terms : Egestion, digestion, assimilation.
6. Rewrite the following parts of the human alimentary canal in their correct sequence :
   Stomach, Oesophagus, Large intestine, Small intestine.
7. What is the fate of excess glucose in our body ?
8. Define the term 'digestion'.
9. State the ***four*** ways in which saliva is useful to us.
10. Foods are classified into three groups on the basis of the functions they perform in our body. Name these three groups, and briefly state their functions. Also give ***two*** sources of each.

PROJECT

- Make a chart of food types you eat at lunch and dinner time during a week.
- Visit a doctor or dietician with your chart and ask if the food you had eaten was good or did it lack something necessary for your growth.



5 RESPIRATORY SYSTEM

SYLLABUS

1. Main parts (nose, pharynx, larynx, trachea, bronchi, lungs); functions of each part of the respiratory system.
2. Difference between respiration and breathing.
3. Mechanism of breathing (physical process with respect to diaphragm and ribs — inhalation and exhalation).
4. Mention of common respiratory diseases : asthma, bronchitis, pneumonia, tuberculosis (T.B.).

Every cell of a plant, an animal or our own body requires energy for various activities. The muscle cells contract for moving a part of our body, the brain cells receive and send messages, the root cells penetrate into the soil and absorb water, minerals, nutrients, and so on. Even when we are sleeping, we need energy. How do we get this energy? We get it through a process called **respiration**.

WHAT IS RESPIRATION ?

Respiration is the process of releasing energy by breaking down food (glucose) needed for various activities of the body.

The breakdown of glucose occurs by utilising oxygen which we breathe in along with air. During this process, the food is oxidised (burnt) to release energy.

Types of Respiration

Depending upon the utilization of oxygen respiration can be of *two* types :

(i) Aerobic respiration that utilizes oxygen.

(ii) Anaerobic respiration that does not utilize oxygen.

RESPIRATORY SYSTEM IN HUMANS (Figs. 5.1 and 5.2)

In humans, the organs of the respiratory system include **nose, pharynx, larynx, trachea, bronchi** and the **lungs**.

Nose

It is the point of entry for air. It has two openings called **nostrils**, each leading into a nasal chamber. The nostrils have a hairy lining to prevent dust particles from reaching into the lungs. The lining of the nasal chamber has mucous (a sticky fluid) which too traps germs and dust. The nasal chamber warms and moistens the air entering into the lungs. One should always breathe through the nose and not through the mouth. The inner lining of nose also has some special cells for smell.

Activity 1

To find if we can smell with closed nostrils.

Take a fresh blossoming red rose flower. Bring it close to nose and smell. It smells sweet. Now close your nostril openings using two fingers of the other hand. Breathe in using mouth. Do you still smell the sweet fragrance of rose flower ? No, the cells for sensing smell are present only on the inside lining of nostrils. Thus, when nostrils are closed, the air cannot pass through them and we cannot smell.

Pharynx

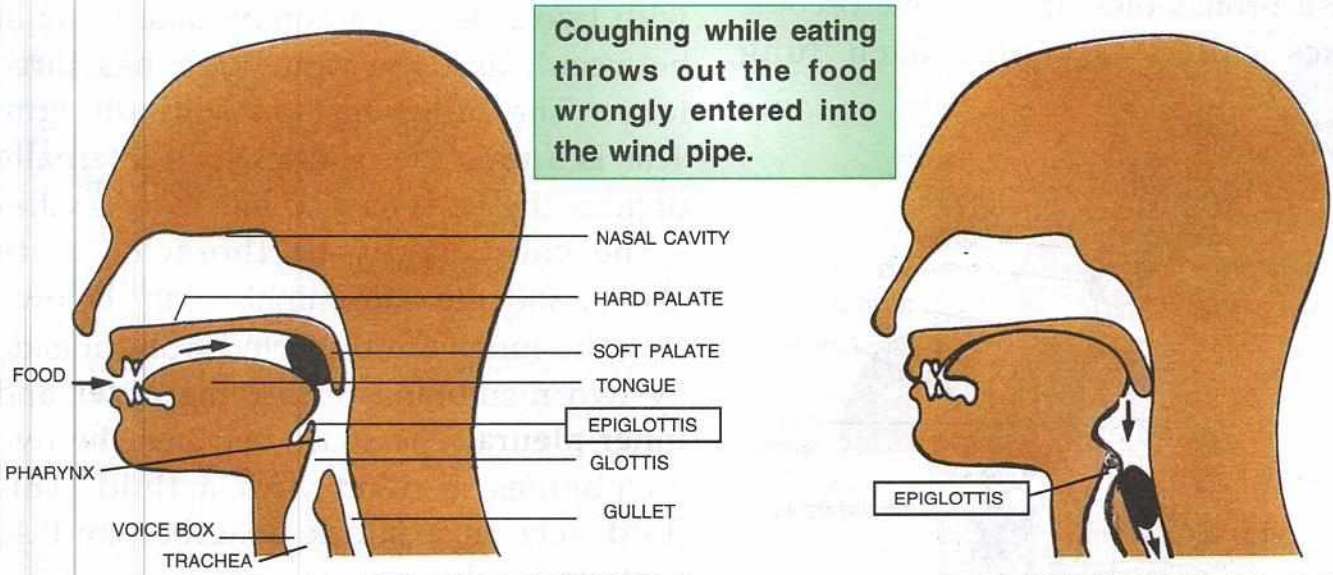
From the nose, the air passes behind the mouth into the **pharynx** or throat which is a common passage for air and the food. It leads into two passages, one the air tube called wind pipe or **trachea** and the other the gullet (food-pipe).

Larynx

At the entrance of the trachea, there is a voice box called **larynx**. It contains two ligamentous folds called **'vocal cords'**. Air expelled forcibly through the vocal cords vibrates them, to produce sound.

The front opening (glottis) of the wind pipe is guarded by a muscular flap called **epiglottis** (Fig. 5.1). The epiglottis closes the wind pipe at the time of swallowing of food. Incomplete closure

Coughing while eating throws out the food wrongly entered into the wind pipe.



A. BOTH PASSAGES – INTO THE WIND PIPE AND INTO THE GULLET OPEN

B. OPENING INTO WIND PIPE CLOSED FOOD ENTERS GULLET.

Fig. 5.1 Epiglottis protects any wrongful entry of food into the wind pipe

by the epiglottis during swallowing causes coughing as the food wrongly enters the wind-pipe (Fig. 5.1).

Trachea (Wind pipe)

The trachea or the wind pipe emerges from the larynx (or voice box) down below in the neck. It runs in the middle of the chest upto a short distance between the two lungs where it divides into two branches called **bronchi** (Fig. 5.2). The wall of the trachea is strengthened by C-shaped rings of cartilage to prevent it from collapsing.

The inner linings of the trachea, bronchi and bronchioles have ciliated epithelium. The continuous movement of the cilia pushes out the unwanted particles that may be present in the inhaled air.

Bronchi (*Singular* : bronchus)

The two bronchi lead into right and left lungs respectively. Each bronchus is further divided into smaller and smaller branches called **'bronchioles'**. At the end of these bronchioles are the microscopic air sacs called **'alveoli'**. Each lung contains millions of alveoli (*singular*: alveolus) (Fig. 5.3). These are richly supplied with blood capillaries covering their walls. The walls of the alveoli are extremely thin and moist for allowing faster diffusion of gases.

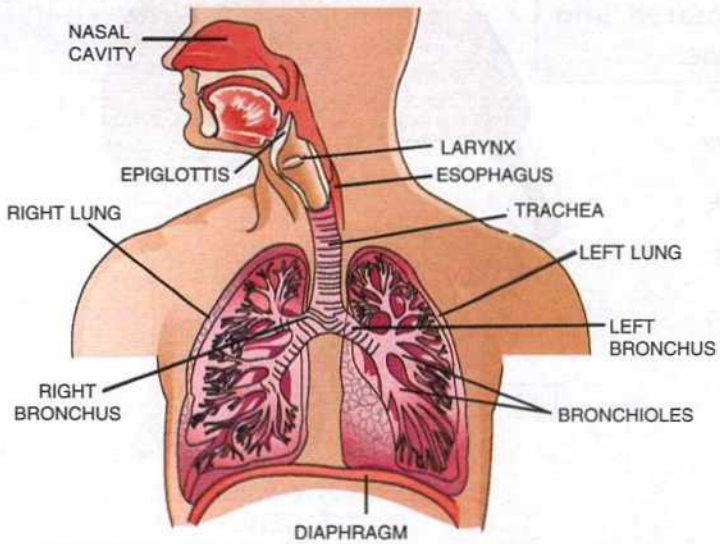


Fig. 5.2 Respiratory system of a human being

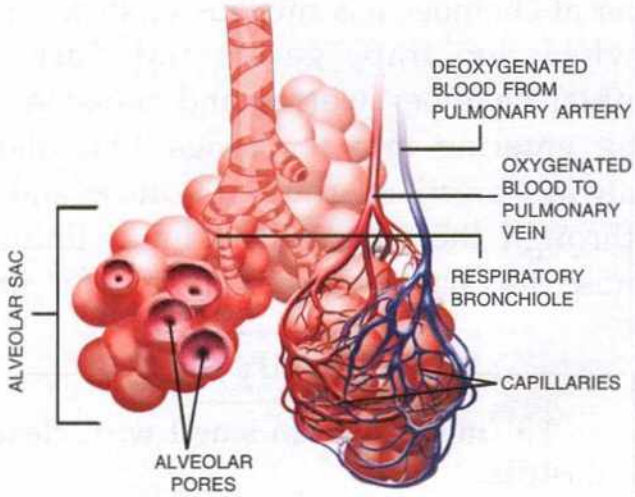


Fig. 5.3 Air sacs with its capillary network (Exchange of O_2 and CO_2 takes place here)

Lungs

The lungs are a pair of pink and spongy, elastic organs protected by the rib cage. The left lung is slightly smaller with two lobes (to accommodate heart in between), and the right lung has three lobes. The lungs rest on a **diaphragm**. This is a muscular sheet which internally divides the body cavity into two cavities – the chest cavity or thoracic cavity above, and the abdominal cavity below.

The lungs are protected from outside by two membranes called the **outer** and **inner pleura**. The space between the two membranes is filled with a fluid. This fluid acts as a shock absorber and so protects the lungs.

Gaseous exchange in lungs. The air which reaches the alveoli through

respiratory passages (nose, pharynx, trachea, bronchi, bronchioles) is rich in oxygen (Fig. 5.4). So, diffusion of gases occur through the blood capillaries surrounding the air sacs. The oxygen from the lungs diffuses into the blood, and is picked up by haemoglobin in red blood cells. Carbon dioxide from the blood diffuses into the lungs and is exhaled out through the same passage.

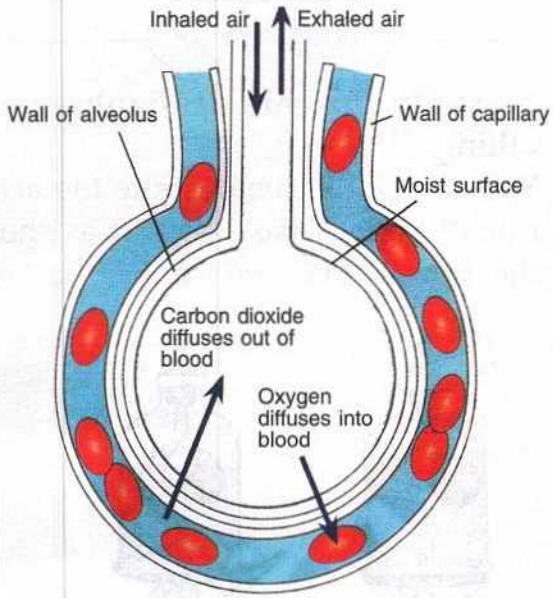


Fig. 5.4 Gaseous exchange in an alveolus

Phases in respiration

Respiration occurs in three phases; (i) Breathing, (ii) Gaseous transport, and (iii) Cellular respiration.

(i) **Breathing** (external respiration) is a physical process. It involves ***inhalation*** (drawing in) of air through the nostrils into the nasal cavity and finally into the lungs, and ***exhalation***, the forcing out of the air from the lungs.

(ii) **Gaseous transport.** Oxygen of the inhaled air is absorbed by the blood in the lungs where it combines with the haemoglobin present in the red blood cells. The oxygen is carried from lungs to the body tissues or cells where the oxygen is utilised and carbon dioxide is released. The released carbon dioxide is transported back to the lungs for its removal (exhalation).

(iii) **Cellular respiration** (internal respiration). It is the process of oxidation of glucose in the cells with the release of energy in the form of adenosine triphosphate or ATP, along with carbon dioxide and water vapour.

Mechanism of Breathing

The process during which the air containing oxygen is drawn into the lungs and the air containing carbon dioxide is forced out from the lungs is called **breathing**. It involves two steps, inspiration and expiration.

Inhalation (Inspiration)	Exhalation (Expiration)
• Ribs move upwards and outward.	• Ribs move downwards and inward.
• Diaphragm is pushed downwards and flattens.	• Diaphragm moves upwards and becomes dome-shaped.
• Volume of chest cavity increases.	• Volume of chest cavity decreases.
• Lungs expand, air pressure becomes low.	• Size of the lungs reduces, air pressure becomes high.
• Atmospheric air at a higher pressure rushes into the lungs.	• Air rushes out of the lungs as atmospheric air pressure is lower.

Why do we sneeze ?

When any foreign particles enter the nasal chamber, the sensitive mucous membrane gets irritated. This results in sneezing, an involuntary action, by which the irritant is removed.

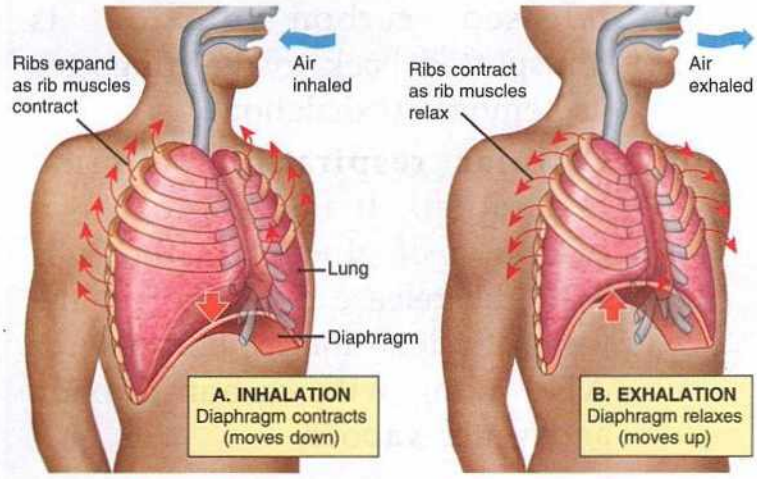


Fig. 5.5 Rib movement during breathing (inhalation and exhalation)

Breathing normally is an involuntary act, which means, it is not under your control. But, breathing can be controlled within certain limits — you can hold your breath for a minute or two, you can have shorter breaths, or you can take deeper breaths.

Activity 2

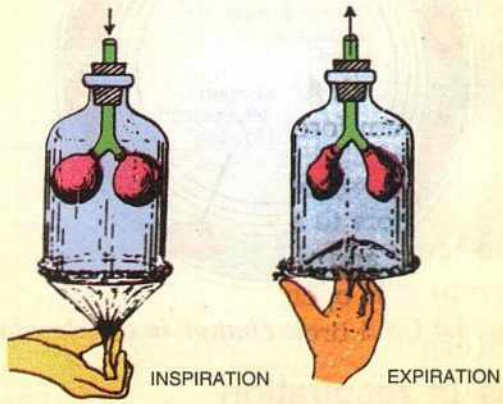
To feel the changes occurring during breathing.

Try it : Put your hands on your chest, and take a gradual deep breath. You can feel the rising of the ribs and bulging of your abdomen. The abdomen bulges due to the lowering of the diaphragm pressing the intestine downwards.

Activity 3

To study the role of diaphragm in breathing.

You can easily demonstrate the action of a diaphragm. Take a bell-jar as shown in the figure. Fix two rubber balloons



Demonstration of breathing process

Table 5.2 : Components of inspired air and the changes taking place upon the exchange

Component	Inspired air	The change	Expired air
Oxygen	21%	Some of it is absorbed into red blood cells.	16%
Carbon dioxide	0.04%	Added from being diffused out of blood.	4%
Nitrogen	Approx. 79%	Unchanged.	Approx. 79%
Water vapour	low	Added from moist lining of respiratory passages.	High

Table 5.3 : Differences between breathing and respiration

Breathing	Respiration
1. It is a physical process.	1. It is a bio-chemical process.
2. Air containing oxygen is taken into the lungs and air loaded with carbon dioxide is given out.	2. Oxygen taken in is used in oxidizing glucose and energy is released.
3. Lungs are mainly involved.	3. Occurs in all living cells of the body.

tied at the ends of two small arms of a Y-shaped glass tube. Insert the long arm of the glass tube through the cork and fix the cork tightly on the mouth of the jar. Tie a sheet of rubber at the wide mouth of the bell-jar. Now pull the rubber sheet downwards. What happens to the balloons ?

Activity 4

To record the breathing rate at different times.

Record your own breathing rate. Take a wrist watch. Lie down on a bed in a relaxed position and count the number of times your chest rises and falls in a minute. Next, record the breathing rate after running for about ten minutes. Do you find any difference? If yes, can you tell the reason for the difference?

Similarly, you can count the breathing rate of a person while he is sleeping, sitting at rest, and after he has climbed stairs. Likewise, you would find some difference in the breathing rate of a young boy and an old person.

COMMON RESPIRATORY DISEASES

1. **Bronchitis** : It is a respiratory infection in which the lining of the bronchi becomes inflamed. As this irritated membrane begins to swell, it narrows or shuts off the bronchial passages, resulting in breathlessness and coughing spells.

   Cause : This respiratory infection is mainly caused by a virus. Air pollution and smoking can also cause bronchitis.

   Treatment : Drinking plenty of fluids, following a well balanced diet, frequent hand washing and adequate rest can prevent and improve bronchitis.

2. **Asthma** — It is a chronic disease that also causes inflammation and swelling in the air passage. But this happens periodically. During an asthmatic attack, a patient experiences tightness in the chest, shortness of breath and wheezing. This condition improves considerably with medication.

   Cause : Air pollutants and allergens can trigger an asthmatic attack.

Treatment : Broncho dilators which are used to inhale medicines containing corticosteroids are commonly prescribed to dilate the airways and give relief.

3. **Pneumonia —** It is a respiratory infection caused by a bacterium. The bacteria enter the air sacs, multiply there and the air sacs may get filled with fluid. This disease causes chest pain, chills and high fever.

   Cause : Mainly caused by bacteria inhaled through air or by contact.

   Treatment : Antibiotic — Penicillin.

4. **Tuberculosis (TB) —** It is also a respiratory infection caused by a bacterium. The bacteria induce continuous coughing. The infected person suffers from continuous cough, low fever, chest pain and weight loss.

   Cause : Caused by bacteria that can spread by air, dust or sputum.

   Treatment : BCG vaccine, antibiotic Streptomycin.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick (√) against the most appropriate alternative in the following statements.

   (i) In humans, taking air through nostrils into the nasal cavity is called

   (a) Inhalation ☐ *(b)* Exhalation ☐

   (c) Cellular respiration ☐ *(d)* Internal respiration ☐

   (ii) The front opening of the wind pipe is guarded by —

   (a) Glottis ☐ *(b)* Exoglottis ☐

   (c) Epiglottis ☐ *(d)* Trachea ☐

   (iii) The process during which food is oxidised and energy is released is called

   (a) Cellular respiration ☐ *(b)* Excretion ☐

   (c) Digestion ☐ *(d)* Transpiration ☐

Short Answer Questions :

1. Answer the following briefly :

   (i) Why do our body cells require oxygen ?

.....

(ii) What is the difference between breathing and respiration ?

.....

(iii) Name the by-products formed during the oxidation of food.

.....

(iv) Name the agent which transports oxygen to all parts of the body.

.....

(v) What is the role of epiglottis during swallowing ?

.....

2. Describe in brief the function of ribs and diaphragm in breathing.

.....

3. Name the gas which is expelled out during expiration. Where is it originally produced in our body ?

.....

4. Name the following.

(i) Respiratory process in which oxygen is not utilized. .....

(ii) Respiratory process in which oxygen is utilized. .....

(iii) The microscopic air-sacs of the lungs. .....

(iv) The *two* membranes which protect the lungs. .....

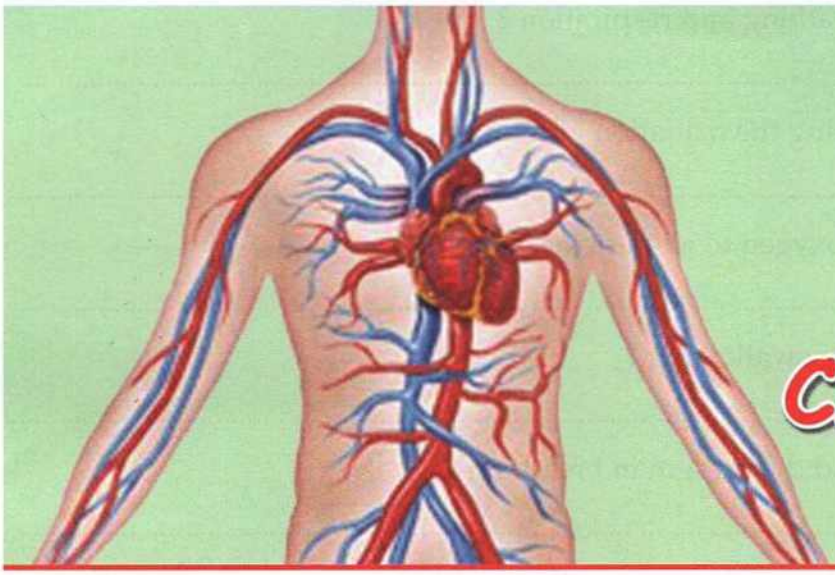
Long Answer Questions :

1. Why is a respiratory system necessary ?
2. What factors are most likely to affect the breathing rate ?
3. What happens to the energy liberated during respiration ?
4. What do you understand by inhalation and exhalation ? How are they different from each other ?
5. What do you understand by the term respiratory diseases ? Name any three common respiratory diseases.
6. State the cause and treatment for the following diseases —

(i) Tuberculosis (ii) Pneumonia (iii) Bronchitis

PROJECT

- Using balloons try to develop a model of breathing system as explained in Activity-3.



6 THE CIRCULATORY SYSTEM

SYLLABUS

1. Main parts of the circulatory system (heart, blood, blood vessels).
2. Process of circulation in the body.
3. Components of blood (plasma and blood cells - RBC, WBC, platelets with their functions only).
4. Types of Blood groups (A, B, AB, O): mention only.
5. Blood pressure (concept only); heartbeat, pulse.
6. Keeping the heart healthy through exercise and good food habits.

HUMAN CIRCULATORY SYSTEM

You have learnt that both human beings and animals need food and oxygen to keep themselves alive. Simultaneously, they give out certain harmful substances like carbon dioxide and metabolic wastes. The intake of nutrients and oxygen along with the removal of the above mentioned wastes are carried out through blood by a transport system also known as **cardiovascular** or **circulatory system**. The transportation is carried out mainly by the blood. The blood is transported to all parts of the body by a pumping organ, *i.e.* heart, and the blood vessels.

Our circulatory system consists of blood, blood vessels and heart. Together, they transport substances to various parts of the body. The blood flows through blood vessels and its flow is regulated by the heart. The heart, acting as a pump, pushes and receives the blood to and from the whole body through the vessels.

THE BLOOD

Blood is a red coloured fluid which consists of two parts :

(1) **Plasma,** the liquid part; and

(2) **Corpuscles,** the cellular part.

- The **plasma** is yellowish in colour. Most of it is water (about 90 per cent), and the remaining (10 per cent) consists of dissolved nutrients, proteins, waste products and hormones.

  Because of the dissolved minerals like sodium chloride in the plasma, blood tastes saltish.

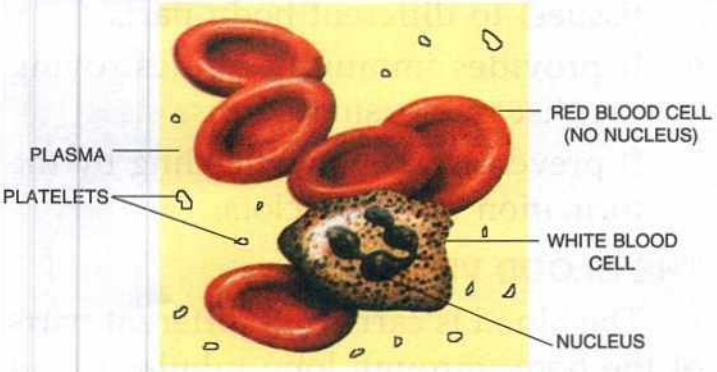


Fig. 6.1 The red blood cells, a white blood cell and platelets

Amazing Fact

In an adult human body, there is about 4·5-5 litres of blood which forms the most amazing transportation system in the body.

- **The corpuscles or the blood cells are of three types :**

Red blood cells (RBCs), White blood cells (WBCs) and Platelets.

1. The **red blood cells** (RBCs) also called erythrocytes are circular or biconcave disc-shaped. A mature RBC lacks a nucleus.

Their red colour is due to the presence of an iron and protein compound called **haemoglobin**. It **acts as the "oxygen–carrier".**

Do You Know ?

In human blood, more than two million red blood cells get destroyed every second but they are replaced immediately by the new ones.

2. The **white blood cells (WBCs)** are also called **leukocytes.** They are colourless and lack haemoglobin. They are larger than the RBCs and have a distinct oval or lobed nucleus. The main function of WBCs is to protect us from disease causing germs *i.e.* provide immunity to the body. This is done in two ways — (a) some WBCs surround the germs and digest them, and (b) some other WBCs produce special chemicals called **antibodies** which destroy the germs.

3. The **platelets**, also called thrombocytes, are somewhat round in shape and the smallest in size. The platelets help in the clotting of blood which prevents excessive blood loss and direct entry of disease causing germs into the blood through cuts and upon wounds.

In certain diseases such as purpura and dengue, the number of platelets get reduced to a great extent.

In dengue fever the number of platelets get reduced to as low as 25-30 thousand per cubic mm of blood and the body shows bleeding symptoms. Delhi and many other parts of the country lose a number of lives because of dengue fever every year.

Activity 1

To observe and identify the blood cell types with the help of prepared slides.

- Place the prepared slide of human blood under the microscope. First, try to focus the slide under low power magnification. Observe the red blood cells and the white blood cells.
- Request your teacher to help you to focus the slide under high power magnification. Examine the slide again. The red and white blood cells will now be more clearly visible.
- The RBCs are comparatively small, disc-shaped and without a nucleus.
- The WBCs are larger with a distinct nucleus.

Conclusion :

Apparently, the blood appears to be a thick "homogenous" fluid, but when observed under the microscope, its two main cellular components, RBCs and WBCs, are distinctly seen.

[**Note :** The platelets are too small to be seen at this magnification].

FUNCTIONS OF THE BLOOD

1. The blood transports the nutrients from the small intestine to the liver where they are either stored or utilised.
2. It carries oxygen from the lungs to the body cells and carbon dioxide produced in them to the lungs from where it is breathed out.
3. It carries the waste products for excretion to the kidneys.
4. It maintains water balance in the tissues.
5. It regulates body temperature by distributing the heat (produced in tissues) to different body parts.
6. It provides immunity by destroying the disease-causing germs.
7. It prevents excessive bleeding by the formation of blood clots.

THE BLOOD VESSELS

The blood is carried to different parts of the body through long tubular **blood vessels**.

Fig. 6.2 Three kinds of blood vessels

The blood vessels are of *three* kinds — **arteries, veins** and **capillaries.**

Artery : It is a vessel which carries the blood away from the heart to other parts of the body. It has thick, elastic and muscular walls, and the

blood in it flows with jerks (as felt in the pulse).

Vein : It is a vessel which takes the blood from an organ towards the heart. It has thin muscular walls with valves. The valves prevent the back flow of blood flowing towards heart.

Differences between arteries and veins :

ARTERIES	VEINS
1. Carry blood away from the heart.	1. Carry blood towards the heart.
2. Have thick elastic and more muscular walls.	2. Have thin and less muscular walls.
3. Carry oxygenated blood (except pulmonary artery which carries deoxygenated blood).	3. Carry deoxygenated blood (except pulmonary vein which carries oxygenated blood).
4. They lack valves (except the pulmonary trunk and the aorta).	4. They possess valves.
5. The blood flows with jerks and under great force.	5. The blood flows smoothly and under little pressure.
6. Usually, deeply placed in the body.	6. Usually placed more superficially.

Capillaries : These are the terminal branches of an artery, which rejoin to form a vein. A **capillary** is a very narrow blood vessel whose walls have a single layer of cells (endothelium). The wall of a capillary is very thin, to enable an exchange of nutrients, waste products and gases between the blood and the body fluids.

HEART — THE PUMPING ORGAN

The human heart is a cone-shaped, muscular organ with the size of a clenched fist. It is located in the chest cavity between the two lungs and is slightly tilted towards the left side. The heart is protected by the rib cage.

The heart is made of specialised muscles called **cardiac muscles**. These muscles show continuous contraction and relaxation without any rest throughout the lifetime of a person. The main function of the heart is to receive and pump blood and keep it circulating throughout the body.

The heart has four chambers. The upper two chambers are smaller and are called the **atria** or **auricles**. The lower two chambers are bigger and are known as the **ventricles**. The auricles are separated from the ventricles by **valves**, known as **atrio-ventricular valves** or **AV valves**. These valves open and close to let the blood pass through them, thereby regulating the blood flow.

The heart is divided into a right side and a left side by a **membrane** or **septum**. The right side of the heart is made up of the right auricle and the right ventricle. Similarly, the left side is made up of the left auricle and the left ventricle.

The **auricles** are the receiving chambers of the heart. They receive blood brought by veins. When auricles contract, they push the blood into the **ventricles** which are the distributing chambers of the heart. Arteries transport the blood that is pumped into them from the ventricles to different parts of the body. The flow of blood from the ventricles into two arteries namely the pulmonary artery and the aorta is also regulated by valves.

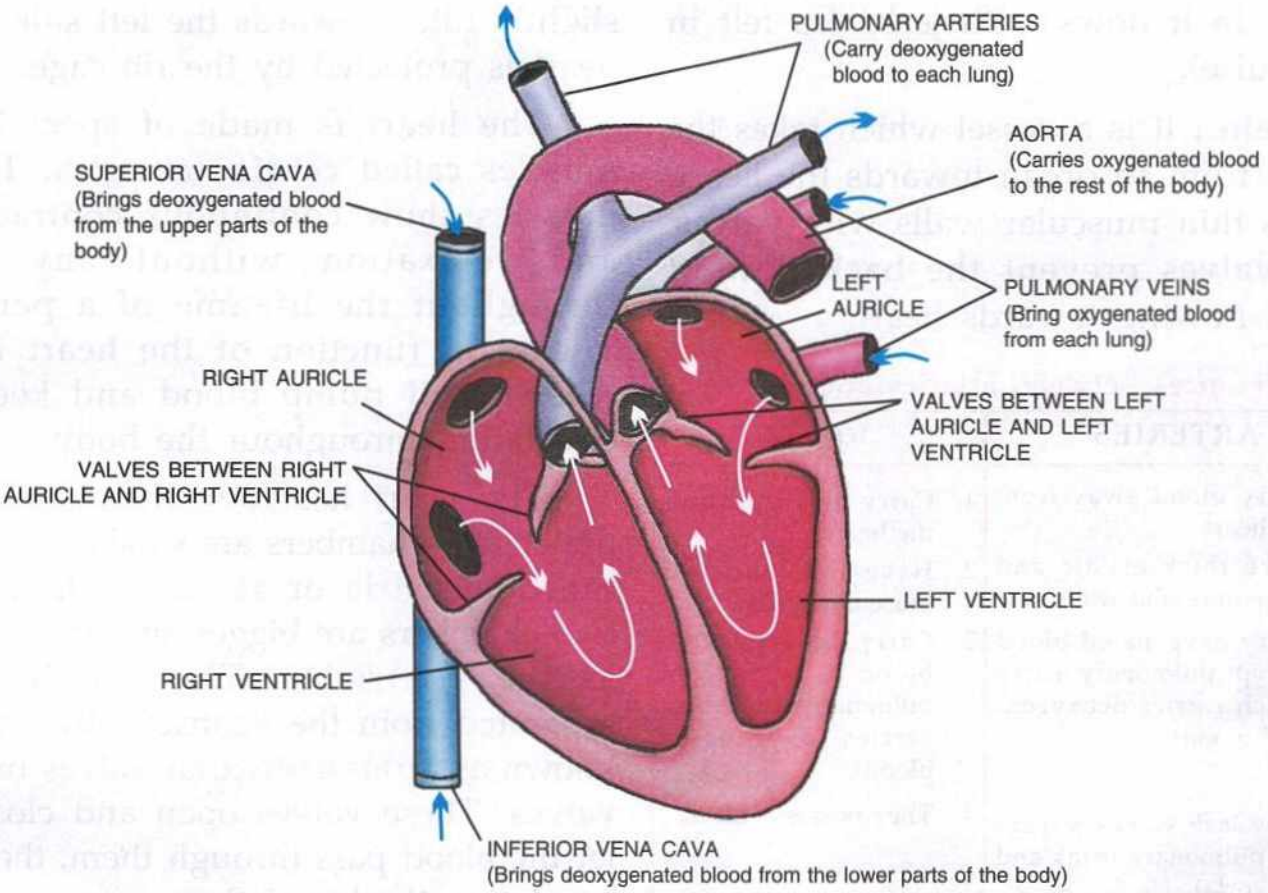


Fig. 6.3 Internal structure of the human heart showing the flow of blood (Diagrammatic)

The right side of the heart receives deoxygenated blood whereas the left side distributes the oxygenated blood. The oxygenated and deoxygenated blood do not intermix at any point of time.

Differences between auricles and ventricles

AURICLES	VENTRICLES
1. The upper, smaller chambers.	1. The lower, larger chambers.
2. They are the receiving chambers of the heart. Receive blood brought in by veins.	2. They are the distributing chambers of the heart. Distribute blood to different parts of the body through arteries.
3. Made up of thin muscular walls.	3. Made up of thick muscular walls.

BLOOD VESSELS OF THE HEART

- **Vena cavae** — The **superior vena cava** is a large vein that brings in deoxygenated blood from the upper parts of the body, such as the head and shoulders.

  The **inferior vena cava** is another large vein that brings in deoxygenated blood from the lower parts of the body, such as the trunk and legs.

  Both of these veins open into the **right auricle**.

- **Pulmonary veins** — They bring in oxygenated blood from the right and left lungs.

These veins open into the **left auricle**.

- **Pulmonary artery** — It leaves the right ventricle carrying the deoxygenated blood to both the lungs for oxygenation.
- **Aorta** — It leaves the **left ventricle** carrying oxygenated blood to all parts of the body through its branches.

BLOOD CIRCULATION

Two types of blood circuits are seen in the human body.

1. In the first type of circuit, blood flows from the right side of the heart to the lungs for oxygenation (addition of oxygen into the blood) and returns to the left side of the heart. This circulation of blood is known as **pulmonary circulation**.
   - The right auricle (RA) receives deoxygenated blood from different parts of the body and sends it to the right ventricle (RV). From the right ventricle, the deoxygenated blood is carried to the lungs for oxygenation by the pulmonary artery.
   - Oxygenated blood from the lungs returns to the left auricle (LA) via the **pulmonary veins**.

> The pulmonary circulation transports blood only between the heart and the lungs.

2. In the second type of circuit, oxygenated blood from the left side of the heart is distributed to all parts of the body. This circulation of blood is known as **systemic circulation**.
   - The oxygenated blood from the left auricle (LA) is pushed into the left ventricle (LV). From the left ventricle, the blood is pumped into the aorta, the largest artery. The branches of this artery then distribute the oxygenated blood to all body parts, including lungs.

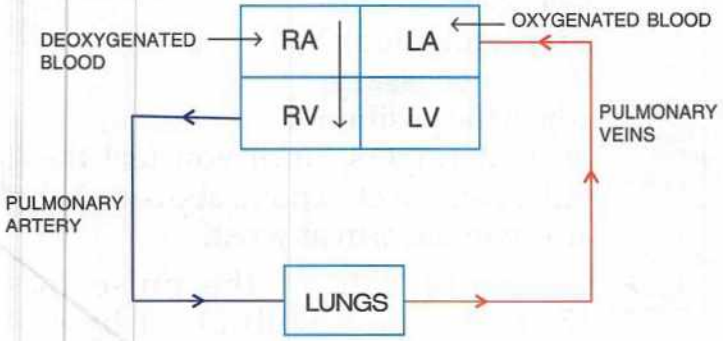


Fig. 6.4 Pulmonary circulation of blood (Red line denotes oxygenated blood and blue line denotes deoxygenated blood)

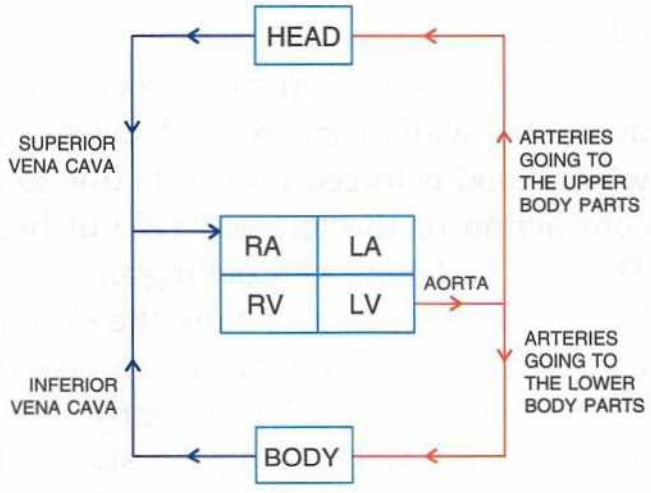


Fig. 6.5 Systemic circulation of blood (Red line denotes oxygenated blood and blue line denotes deoxygenated blood)

- The deoxygenated blood from all parts of the body is collected by two major veins, superior vena cava and inferior vena cava, together they are called **vena cavae**. The deoxygenated blood from vena cavae is then poured into the right auricle and pulmonary circulation of the blood starts again.

The systemic circulation transports blood between the heart and the entire body.

The blood keeps on passing alternatively between these two circuits and this process continues as long as the person lives.

Heart Beat and Pulse

Heart beat : Every time the blood passes through the valves and the valves close, a distinct sound is produced which is called the heartbeat. Normally, the heart beats at an average of 72 times per minute.

Pulse : The arteries have elastic muscular walls that expand every time when blood is forced into aorta due to the contraction of the left ventricle of heart. This can be felt as a throbbing in some of the arteries found just below the skin and is called a **pulse**. This pulse can be easily felt by pressing your finger gently over an artery on the wrist along the side of the thumb. You can also count your heartbeat by feeling your pulse.

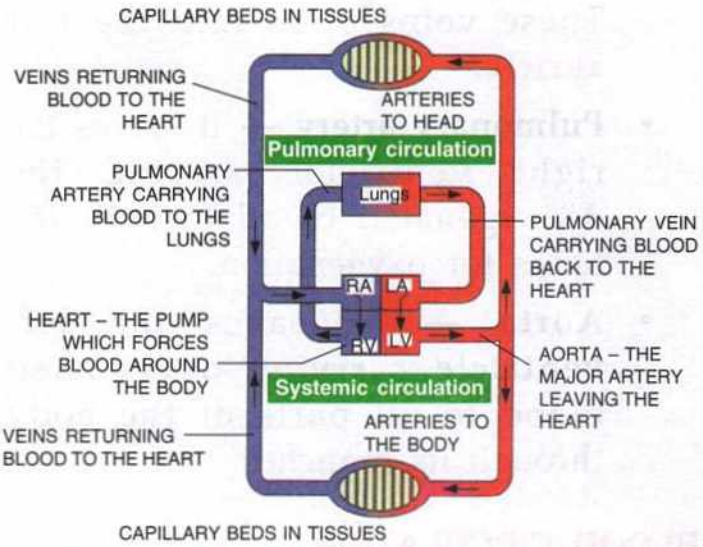


Fig. 6.6 Circulation of blood in the body

Activity 2

To count the pulse, find the average pulse rate, and record the change in the pulse rate after physical exercise and pulse rate at rest.

A. ***For pulse rate at rest***

- Sit down comfortably in a chair with your one palm facing upwards.
- Gently place the first three fingers of your other hand on your wrist as shown in the diagram. Can you feel your pulse as a repeating throb? If necessary, adjust the position of your fingers, until you feel the pulse really well, a point above radial artery in the arm at wrist.

- Count the rate of the pulse in 15 seconds and multiply it by 4. This gives your average pulse rate in one minute.

➢ Similarly, count the pulse rate of five of your classmates, and find out their average pulse rate.

B. ***For pulse rate after physical exercise and again at rest***

➢ Climb fast up and down a staircase 2–3 times, and count your pulse soon after. Record it down.

➢ Sit at rest for about fifteen minutes, and again count your pulse. Record it down. Do you find any difference between the two readings ?

Conclusion :

- The average pulse rate of normal healthy adults while at rest is about 72 times per minute.
- The pulse rate increases after strenuous physical exercise. The rate may reach even 120 or more per minute after an exercise.

The doctor counts the pulse of an ailing person to get an idea about the patient's heart beat.

- **Very low pulse** rate may indicate poor functioning of the heart.
- **Faster heart** beat is usually an indication of hypertension or fever.

A **stethoscope** (Fig. 6.7) is an instrument that amplifies the sound of a heart beat and is used to hear heart beats in the chest, by placing its chest piece at the appropriate place.

Fig. 6.7 Stethoscope

Blood pressure : The pressure exerted by the blood on the walls of the arteries while flowing through them is called **blood pressure**.

The instrument used to find out blood pressure is called **sphygmomanometer.**

The two normal levels of blood pressure of a healthy person are, 120/80 mm/Hg. A rise in blood pressure above 140/90 mm is known as **hypertension** (high blood pressure) and below the normal is called **hypotension** (low blood pressure).

BLOOD GROUPS

Karl Landsteiner in 1900 identified different types of blood groups in humans. These blood groups are differentiated on the basis of proteins (antigens) found on the surface of the RBCs. There are two types of antigens — A and B.

A person's blood group is 'A' if the antigen present on his RBCs is 'A', and 'B', if the antigen is 'B'. The persons whose RBCs have both types of antigens, *i.e.* both A and B, belong to the 'AB' blood group and those persons with no antigens, *i.e.* neither A nor B have the 'O' blood group.

What do you conclude from the above matchings ?

1. A person with AB blood group can receive blood from all types, and is therefore called a **universal recipient.**

2. A person with O blood group can give blood to a person of any blood type and is therefore called a **universal donor.**

BLOOD DONATION AND BLOOD BANKS

Blood donation is a voluntary procedure where blood is drawn from a healthy person called a 'donor', so that it can be given to someone who needs it during a surgery or medical treatment. Normally a pint of blood (420 mL) is withdrawn from a donor at a given time.

Blood bank is a place where blood collected from donors, is stored and preserved to be later given to a recipient.

Keeping the heart healthy

- It is important to take care of one's health to protect one from heart diseases. Eating healthy food and regular exercise should become healthy habits that one should develop early in life.
- Obesity or excessive weight is a very common problem now-a-days and the cause of many diseases, especially heart diseases.
- Playing games is a good form of exercise. It keeps us active and happy.
- Regular walking, jogging, cycling etc. help to keep our body fit and healthy.
- Avoid too much of oily foods and fried foods. They contain fat.
- Excessive eating of fast foods deprives your body of required nutrients. Eat lots of vegetables and fruits.
- Eat plenty of fibre containing foods such as whole grain cereals, oats, etc.
- Avoid eating excessive amount of sweet foods. Too much of sugar in the body is a major cause for obesity.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick mark (√) against the correct alternative in the following statements :

(*a*) Function of WBCs is to

(*i*) transport oxygen ☐ (*ii*) help in clotting of blood ☐

(*iii*) provide immunity ☐ (*iv*) provide storage of food. ☐

(*b*) Blood Capillary is a :

(*i*) Broad tube ☐

(*ii*) Artery with thick wall ☐

(iii) Vein with large lumen ☐

(iv) Narrow tube made up of endothelium only. ☐

(c) Nucleus is absent in :

(i) RBCs ☐ (ii) WBCs ☐

(iii) All blood cells ☐ (iv) Liver cells. ☐

(d) The only artery which carries deoxygenated blood is :

(i) Hepatic artery ☐ (ii) Pulmonary artery ☐

(iii) Aorta ☐ (iv) Renal artery. ☐

(e) Sphygmomanometer measures :

(i) Pulse rate ☐ (ii) Heart beat ☐

(iii) Blood pressure ☐ (iv) Brain activity ☐

(f) Pulmonary vein carries :

(i) Oxygenated blood ☐ (ii) Deoxygenated blood ☐

(iii) Glucose-rich blood ☐ (iv) CO_2 laden blood ☐

(g) The blood tastes saltish due to the presence of dissolved :

(i) Sodium chloride ☐ (ii) Potassium chloride ☐

(iii) Ammonium nitrate ☐ (iv) Sodium nitrate ☐

Short Answer Questions :

1. Differentiate between the following pair of terms :

(a) Platelets and WBC : .....

.....

(b) Pulmonary artery and pulmonary vein : .....

.....

(c) Vena cava and aorta : .....

.....

(d) RBC and WBC : .....

.....

2. Give any *three* differences between an artery and a vein.

.....

.....

.....

3. Blood consists of two parts — a liquid part and a cellular part. Name these parts and briefly describe them.

.....

.....

.....

4. What is the role of haemoglobin in the blood ?

.....

.....

5. Fill in the blanks with suitable words :

(*a*) The colour of a red blood cell is due to .....

(*b*) The two lower chambers of the heart are called .....

(*c*) The blood plasma contains dissolved substances such as ..... and .....

(*d*) The ..... artery takes the blood from the ventricles to the lungs.

(*e*) The instrument used to find out the blood pressure is known as .....

(*f*) The blood loaded with carbon dioxide from the body comes into the ..... of the heart.

(*g*) The oxygen–rich blood from the lungs comes into the ..... of the heart.

(*h*) The oxygen–rich blood is pumped into different parts of the body through ..... .

(*i*) The carbon dioxide loaded blood from the right ventricle is pumped into the lungs through ..... artery.

6. In which organ of our body does blood become oxygenated ?

.....

7. Which side of the heart (left or right) contains oxygenated blood ?

.....

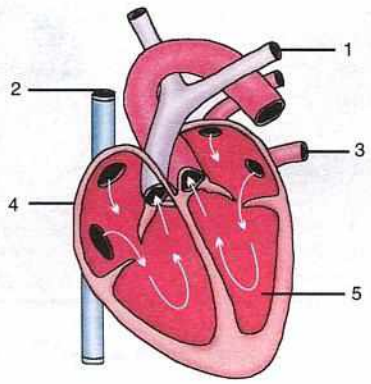
8. Name the disease in which the number of platelets reduces to 25,000-30,000 per cu mm of blood. State its major symptoms.

.....

.....

Long Answer Questions :

1. Name the *three* kinds of blood vessels found in human beings. With the help of suitable diagrams, differentiate between them.
2. State briefly, the difference between white blood cells and the red blood cells.
3. You can see some blood vessels on the outside of the hands specially in older people. Are those veins or arteries ? How can you confirm your answer ?
4. Given alongside is a diagram of human heart showing its internal structure. Label the parts marked 1 to 5, and answer the following questions.
   (a) Which type of blood is carried by the blood vessel marked 2 ?
   (b) Name the main artery which takes the blood from heart to different parts of the body ?
   (c) Which chamber of the heart receives oxygenated blood from the lungs ?

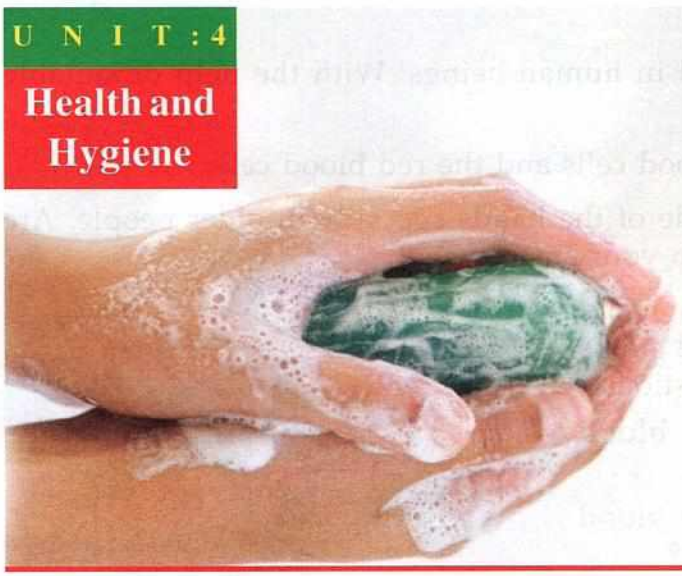


PROJECT

- Using coloured 'Red' and 'Black' tubes develop a model of pulmonary circulation and systemic circulaton with the heart in the middle.

UNIT : 4

Health and Hygiene



7 DISEASE AND HYGIENE

SYLLABUS

1. Types of diseases (communicable and non-communicable).
2. Communicable diseases : bacterial, viral, protozoan, diseases caused by worms (common examples of each).
3. Modes of transmission of diseases (air, water, food, insects).
4. Ways to prevent communicable diseases.
5. Non-communicable diseases : examples, ways to prevent them.
6. Hygiene — ways to keep the surroundings clean, safe disposal of garbage, healthy practices for hygiene.

HEALTH

Normally, a person is said to be healthy, if he or she is not suffering from any disease. When a person can work hard, interact well with people, enjoy leisure and can adapt to the changes and stresses of life, then he or she is in good health, *i.e.* at ease in life.

"Health is defined as a state of complete physical, mental and social well-being, and not merely an absence of disease or infirmity".

A healthy human being has generally the following features :

- a clear skin,
- bright, clear eyes,
- a body neither too fat nor too thin,
- fresh breath,
- good appetite,
- sound sleep,
- regular activity of bladder and bowels,
- coordinated body movements.

WHAT IS A DISEASE

Disease (*dis* + *ease* = not at ease) literally means not being in a comfortable state. Any physical or functional change in the body from a normal state which causes discomfort or disability is called a **disease**.

Diseases can occur due to various factors like :

- living in an unhygienic environment.
- not taking a balanced diet.
- consuming tobacco, alcohol or drugs.
- infection by microbes (disease-causing agents).
- body parts or organs not functioning normally.
- allergic reactions due to certain substances.

Disease is a departure from normal health through structural or functional disorder of the body.

CATEGORIES OF DISEASES

There are *two* major categories of diseases :

1. **Non-communicable or non-infectious diseases.** These diseases are not caused by any germ, therefore these diseases cannot spread from one person to another (*i.e.*, they are non-transmissible). These are caused either due to improper functioning of the body organs or due to the deficiency of certain minerals and vitamins in the body. *Examples*: rickets, diabetes, heart diseases, *etc.*
2. **Communicable or infectious diseases.** These diseases can easily spread from an infected person to a healthy person through disease-causing germs called **pathogens**. These germs are transmitted through various agencies like air, insect bites, contaminated food or water, etc. Some examples of common communicable diseases are cholera, viral fever, chicken pox, malaria, *etc.*

TYPES OF NON-COMMUNICABLE OR NON-INFECTIOUS DISEASES

A simplified classification of non-infectious diseases with some common examples is given below :

1. **Metabolic diseases** – diabetes, kidney stones.
2. **Genetic diseases** – Haemophilia, thalassemia.
3. **Allergies** – Hay fever, asthma.
4. **Dietary deficiency diseases** – Beri-beri, scurvy.
5. **Cancer** – Breast cancer, leukemia.
6. **Degenerative (ageing) diseases** – Arthritis, cataract.
7. **Diseases caused due to physical and chemical agents** – Sunburn, heatstroke, poisoning.
8. **Mental illness** – Depression.

1. Dietary deficiency diseases

(i) **Protein deficiency diseases :** A diet lacking in nutrients, such as proteins, required for the growth and repair of the body, results in degeneration of muscles and loss in body weight.

Fig. 7.1 A child suffering from marasmus

Fig. 7.2 A child suffering from kwashiorkor

One example of protein deficiency disease is kwashiorkor. Another disease, known as marasmus, is caused due to defficiency of proteins, carbohydrates and fats.

(ii) **Vitamin deficiency diseases :** Vitamins in small amounts are required in the body. Lack of any vitamin in sufficient quantity causes a disease (Table 1).

(iii) **Mineral deficiency diseases :** Human body also requires different mineral salts. If the body does not have sufficient quantity of any mineral, it can lead to a disease (Table 2).

Table 1. Some common vitamin deficiency diseases

Vitamin	Deficiency diseases	Source of vitamin
Vitamin A (Retinol)	Nightblindness, drying of cornea.	Carrot, yellow fruits, vegetables, butter, fish, milk.
Vitamin B_1 (Thiamine)	Beri-beri	Whole grains, eggs, nuts, legumes, yeast.
Vitamin B_3 (Niacin)	Pellagra, dermatitis (skin inflammation).	Meat, liver, milk, eggs.
Vitamin C (Ascorbic acid)	Scurvy (bleeding gums).	Citrus fruits, tomatoes, germinating seeds.
Vitamin D (Calciferol)	Rickets (bow-shaped limbs in childhood), bones turn soft.	Egg yolk, fish liver oil, sunlight, milk, butter.

Table 2. Some common mineral deficiency diseases

Mineral	Deficiency diseases	Source of mineral
Calcium	Weak and brittle bones and teeth.	Milk, eggs, green vegetables.
Sodium and potassium	Dehydration, external weakness and pain in muscle contraction.	Fruits, sea food and table salt.
Iron	Anaemia.	Green leafy vegetables, bananas, cereals, egg yolk.
Iodine	Goitre.	Sea food, table salt.

Fig. 7.3 Pellagra. This child is suffering from pellagra caused due to lack of vitamin B_3 (Niacin). Notice the marks on the neck shaped like a necklace

Fig. 7.4 Scurvy, swollen bleeding gums

Fig. 7.6 A person suffering from acute goitre (swelling in the neck)

Fig. 7.5 Child suffering from rickets, a disease in which the bones of growing children do not harden (often bow-legs). It is caused by the lack of vitamin D in the diet

2. **Allergy.** Allergy is an unpredictable reaction of the body to a particular substance called **allergen**. Different people are allergic to different substances. A few common allergens are dust, spores, pollens, certain clothes, particular medicines, cosmetics, *etc*. The common areas of the body parts which are affected by allergies are skin, respiratory and digestive tracts. Asthma, eczema, diarrhoea, vomiting, nausea, *etc*. are some of the common allergic reactions.
3. **Diseases caused due to physical and chemical agents.** Sunburn and heat stroke are examples of some diseases caused by physical agents. Chemical agents which cause diseases are lead, mercury, potassium cyanide, snake bites, poisoning from plants, *etc*.

Activity 1

To play a matching game of some deficiency diseases, the kind of nutrients concerned and rich dietary sources of these nutrients.

- Take eighteen pieces of stiff chart paper of the size of playing cards. Divide them into three sets of six cards each. Write the names of common deficiency diseases on the first set of six cards. On the second set, write names of the nutrients (minerals or vitamins),

whose deficiency causes these diseases. Again, write the name of the natural source of each of these nutrients on the third set.

Here is an example of six such diseases, their nutrients, and one rich source of each.

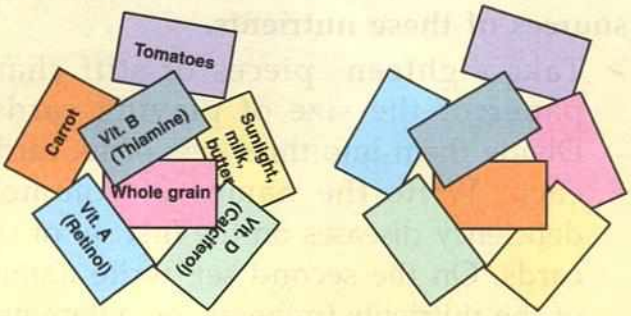
DISEASES	DEFICIENT NUTRIENTS	NATURAL SOURCES
BERI-BERI	THIAMINE	WHOLE GRAINS
RICKETS	VITAMIN D	SUNLIGHT
SCURVY	VITAMIN C	TOMATOES
ANAEMIA	IRON	GREEN VEGETABLES
GOITRE	IODINE	IODIZED SALT
NIGHT-BLINDNESS	VITAMIN A	CARROT

You can paste these on card board pieces or on discarded playing cards.

You can play the game **singly** or in **groups of two** or maximum **three**.

Shuffle the cards, all facing downwards.

- Distribute **three** cards to each of the players and keep the remaining cards facing downwards on the table.
- If by chance, any player gets the set of correct three cards in the first instance itself, he will declare and open his cards. If he is correct, he is the winner.



- If not, the first person will pick up one card from the pack (lying on the table) and see, if it helps him in matching the correct set. If not, discard one card.
- Keep repeating the turn among the players one by one by picking up one card at a time and discarding the non-matching one, until one gets correct matching set.
- In this situation, he will declare, and if found correct, he will be the winner.
- Keep playing the rounds. It will be an attempt of the players to ultimately get a set of three cards bearing the name of the disease, its concerned nutrient and one natural source.

SPREAD OF COMMUNICABLE DISEASES

Communicable or infectious diseases are those diseases which spread from an infected person to a healthy person by the entry of microorganisms.

These diseases are caused due to microorganisms such as viruses, bacteria, fungi and protozoa. The disease-causing germs are called **pathogens**.

Some of the common ways by which the pathogens or disease-causing germs are transmitted include :

- direct contact with an infected person.
- touching and sharing items like towels, handkerchiefs, combs, utensils, etc. of an infected person.
- consuming contaminated food or water.

- sneezing and coughing by people infected with common cold, TB, etc. The droplets coming out transmit germs into the air.
- houseflies, mosquitoes and rodents also carry disease causing germs.

Fig. 7.7 A fly feeding on a lump of food and contaminating it

Houseflies carry germs from garbage and sewage and deposit them on food. A person will get infected if he eats such contaminated food.

A mosquito mostly spreads the disease when it bites a person. At this time, the saliva of the insect along with the pathogens enter into the blood of the person.

Fig. 7.8 A mosquito sucking blood from a person's arm

1. Diseases caused by viruses

Cold is the most common infectious disease. It spreads through water droplets introduced into the air during sneezing and coughing.

Fig. 7.9 Droplet infection : sneezing or coughing may spread certain diseases

Common diseases caused by viruses

Name of disease	Mode of transmission	Symptoms	Prevention/Treatment
1. Mumps	• Droplet infection. • Direct contact from an article used by patient.	• Painful swelling of parotid gland.	• Isolation of patient. • Mumps vaccine.
2. Polio	• Contaminated food and water by flies. • Spread through faeces.	• Limbs and muscles get paralysed.	• Isolation of patient. • Proper disposal of faecal matter. • Salks vaccine.
3. Rabies	• Through saliva by the bite of a mad dog, cat, bat, etc.	• Fear from water — hydrophobia.	• Immunization of dogs and other pet animals. • A series of antirabies injections after a bite.

Mumps develop due to the swelling of parotid glands (one of the three salivary glands) below the ears. These germs spread by contact through handkerchiefs, crockery or utensils used by the patient.

Smallpox is a serious disease which is marked by small pustules all over the body. It spreads by contact and discharge from these pustules.

It has almost been eradicated from India and other parts of the world.

Fig. 7.10 Smallpox is caused by a virus, and is characterised by spots on the skin

Poliomyelitis causes paralysis of the limbs. It spreads by contact through discharge from the nose and throat, and through faecal matter.

Measles spread by contact. Its symptoms are nasal discharge, redness of the eyes and coughing.

Rabies/hydrophobia is a disease caused by the bite of a rabid dog, fox or some other animals. The virus is transmitted through the saliva of a rabid animal. It is a serious disease that affects the central nervous system. Pet dogs must be immunized by a vaccine.

Jaundice / Hepatitis is a disease of the liver. In this disease, the skin, eyes and urine turn yellow. It occurs from eating unhygienic food and drinking contaminated water.

2. Diseases caused by bacteria

Tuberculosis (TB) : It is usually a disease of the lungs, although other parts of the body may also be affected. The bacteria is spread through the sputum of an infected person.

Common diseases caused by bacteria

Name of disease	Mode of transmission	Symptoms	Prevention/Treatment
1. Cholera	• Contaminated food and water.	• Vomiting, watery stools.	• Drinking boiled water. • Proper disposal of waste. • Vaccination.
2. Tetanus	• Entry of the germs into an open wound.	• Jaws lock due to painful contractions of jaw and neck muscles.	• Anti tetanus injection. • Keeping the wound clean and covered.
3. Typhoid	• Contaminated food and water.	• Continuous fever.	• Drinking boiled water. • Ampicillin.

Diphtheria : This is usually a disease of children and affects the throat.

Tetanus : In this disease, the jaws get locked. Germs enter through open and unclean cuts and wounds when exposed to soil carrying cowdung particles.

Whooping cough (Pertussis) : It primarily occurs in children. It spreads through a discharge from the throat of an infected person. The patient coughs with a peculiar sound.

Pneumonia : It is a disease of the lungs caused by a bacteria.

Cholera : It is due to the infection in intestines. Its symptoms are vomiting and whitish rice water colour of loose motions. It spreads through contaminated food and water.

3. Diseases caused by Protozoa

Malaria : It is caused by a protozoan *Plasmodium* which enters the human body through the bite of a female *Anopheles* mosquito. It shows the symptoms of intermittent chills and high fever.

Amoebiasis or amoebic dysentery : It is caused by *Entamoeba* and attacks large intestines. Diarrhoea with gripping pain, along with a discharge of mucus and sometimes blood too is a common symptom. The infection is caused by consuming contaminated food.

Common diseases caused by protozoa

Name of disease	Mode of transmission	Symptoms	Prevention/Treatment
1. Amoebiasis	• Contaminated food and water.	• Diarrhoea, stool mixed with mucus and blood.	• Proper disposal of faeces. • Clean water and food. • Sulfa drugs.
2. Malaria	• Bite of female Anopheles mosquito.	• Chills, high temperature, profuse sweating.	• Elimination of mosquitoes. • Chloroquine.

4. Diseases caused by worms

Elephantiasis : Its symptoms are highly swollen legs. It spreads by the bite of female *Culex* mosquito.

Ascariasis : The parasite of this disease lives in the intestine and absorbs digested food. The eggs of this parasite may be found in the soil, unwashed fruits and vegetables.

Common diseases caused by worms

Name of disease	Mode of transmission	Symptoms	Prevention/Treatment
1. Taeniasis	• By eating undercooked meat.	• Pain in the abdomen.	• Eating properly cooked meat. • Medication to kill worms.
2. Ascariasis	• Contaminated food and water.	• Pain in abdomen, vomiting.	• Clean water and food. • Proper disposal of faeces.
3. Filariasis (Elephantiasis)	• Bite of female Culex mosquito.	• Highly swollen legs.	• Protection from mosquito bite. • Antifilarial drugs.

Taeniasis : The parasite of this disease is found in the intestine from where it absorbs digested food. Infection is caused by eating improperly cooked meat.

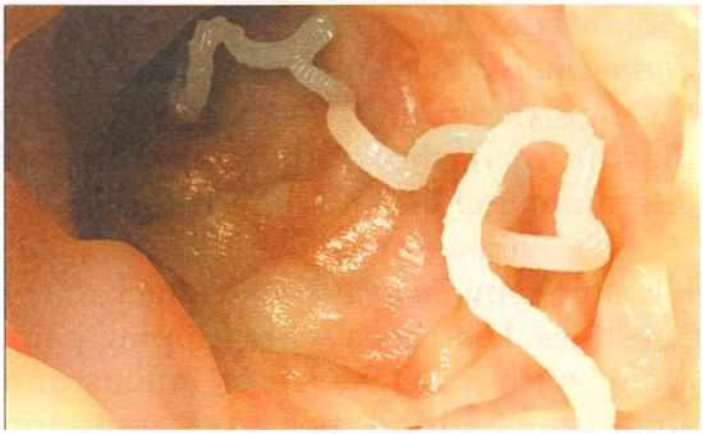


Fig. 7.11 A **tapeworm** *(Taenia) inside the intestine of a human being*

PREVENTIVE MEASURES FOR DISEASES

As is rightly said "prevention is better than cure," we must therefore observe the following preventive measures for our good health.

1. Hygienic food

- Eat healthy food. Consume seasonal fruits and vegetables in proper quantities to develop body's resistance against diseases.
- Cereals should be cooked well.
- Do not leave cut vegetables and fruits in the open as they attract germs.
- Wash vegetables before peeling, and eat whole fruits as far as possible.
- Avoid too much frying of vegetables.
- Food should be properly stored in a refrigerator. Meat and fish should be stored in the deep freezer.
- Drinking water must either be boiled or purified with the help of a filter. It should be stored in clean containers with lids.

2. Cleanliness of Environment :

- Maintain a clean environment to prevent the spreading of diseases due to the breeding of mosquitoes, house flies and pathogens.
- Garbage should be kept in covered bins so that flies do not breed on it.
- Do not allow water to stagnate outside your house and in your neighbourhood. All the drains should also be covered. This will prevent breeding of mosquitoes.
- There should be proper sewer lines connected to sewage treatment plants.
- Contamination of drinking water even with little amount of faeces (human excreta) or dung can cause a number of diseases.

Energy-giving food items

Body-building food items

Protective food items

Fig. 7.12 A balanced diet should include food from all the three groups of food items

3. Personal Hygiene

Hygiene is defined as science and practice of maintaining good health. Taking care of one's own body means personal hygiene. This is important to maintain good health.

Care of the skin : Regular bathing with good soap keeps the skin free from dirt and bad odour.

Hands and nails : Hands should be washed properly before eating food. Nails should be kept short. Nail biting is a bad habit because the dirt goes into the mouth.

Hair : Regular washing of hair should be done with shampoo to remove dirt, dandruff and lice. Combs and hair brushes should not be shared.

Teeth and gums : We should brush our teeth after every meal. Regular brushing and massaging the gums are effective ways to prevent tooth decay and bleeding of gums.

Eye : Wash eyes daily with tap water. There should be good light while reading and avoid too much watching of television and working on computers and playing video games, *etc*. Protect your eyes from direct sunlight. Trachoma and conjunctivitis are common eye infections which spread through contamination by hand, handkerchief, towel, *etc*.

Nose : The nose must be cleaned at regular intervals to remove dirt trapped by the mucus of nasal chamber. Always cover the nose and mouth while sneezing and coughing to avoid droplet infection.

Ear : Never clean the ear with a sharp object. It could damage the delicate ear drum which will cause impaired hearing. Ear is a self-cleaning organ. The wax inside the ear traps dirt and germs. If possible remove it using an ear bud.

4. Physical Exercise : To keep the body muscles active, physical exercise is a must. It helps in the normal functioning of the heart and lungs, and also in the better circulation of blood.

5. Rest : One should take proper rest and sufficient sleep. A normal healthy person requires 6-8 hours of sleep daily.

6. Healthy habits : One should develop healthy habits like taking food at regular hours, going to bed early, but not just after the meals. One should not take stimulants, such as tobacco, alcohol, drugs, *etc*., as they disturb sleep and cause other ailments. Addiction to fast food (burger, pizza, *etc*.) is also bad for health since it causes obesity. Fast foods are deficient in vitamins.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick mark (✓) against the correct alternative in the following statements :

(a) Malaria is caused by

(i) Bacteria ☐ (ii) Protozoan ☐

(iii) Fungi ☐ (iv) Virus ☐

(b) Deficiency of calcium causes

(i) Poor growth of teeth and gums ☐

(ii) Goitre ☐

(iii) Anaemia ☐

(iv) Polio ☐

(c) Hay fever and asthma are

(i) Deficiency diseases ☐ (ii) Genetic diseases ☐

(iii) Organic diseases ☐ (iv) Allergic diseases ☐

(d) Infectious diseases can be prevented by :

(i) Medicines ☐ (ii) Proper food ☐

(iii) Immunisation ☐ (iv) Exercise ☐

(e) Which one of the following is a genetic disease ?

(i) Scurvy ☐ (ii) Leukemia ☐

(iii) Goitre ☐ (iv) Haemophilia ☐

(f) Which one of the following is a degenerative disease ?

(i) Thalassemia ☐ (ii) Beri-beri ☐

(iii) Cataract ☐ (iv) Diabetes ☐

(g) Pellagra is caused by the deficiency of :

(i) Vit. B_3 ☐ (ii) Vit. B_1 ☐

(iii) Vit. C ☐ (iv) Vit. D ☐

(h) Deficiency of Iodine in one's food can cause :

(i) Beri-beri ☐ (ii) Goitre ☐

(iii) Scurvy ☐ (iv) Pellagra ☐

(i) Which one of the following mineral deficiency diseases can be cured by eating a diet which includes green leafy vegetables, banana, cereals, egg-yolk ?

(i) Goitre ☐ (ii) Anaemia ☐

(iii) Brittle bones ☐ (iv) Pain in muscle contraction ☐

(j) Which one of the following vitamin deficiency diseases can be cured by eating a diet which includes carrot, yellow fruits, vegetables, butter, milk, fish ?

(i) Beri-beri ☐ (ii) Dermatitis ☐

(iii) Nightblindness ☐ (iv) Scurvy ☐

(k) Which one of the following is a communicable disease ?

(i) Measles ☐ (ii) Cancer ☐

(iii) Heart stroke ☐ (iv) Allergy ☐

Short Answer Questions :

1. (a) What is a non-communicable disease?

.....

(b) What is a deficiency disease ?

.....

(c) What are communicable diseases?

.....

(d) Biting nails should be strictly avoided. Give reason.

.....

(e) Regular exercise and proper rest is a must. Give reason.

.....

(f) Children eating more fast foods tend to suffer from obesity (overweight). Comment.

.....

(g) How can you control the spreading of diseases by mosquitoes and houseflies ?

.....

(h) Public hygiene is equally important as personal hygiene. Give reasons.

.....

2. Name the following :

(a) A bacterial disease caused due to contaminated water. .....

(b) A disease caused due to *Plasmodium*. .....

(c) A disease caused due to the bite of female *Culex* mosquito. .....

(d) A viral disease spread by the bite of a dog. .....

(e) *Two* diseases caused due to the deficiency of protein in the diet of a child. .....

(f) Any *three* water-borne diseases. .....

3. Write short notes (1-2 sentences) on each of the following :

Disease, pathogen, allergy.

.....

.....

.....

.....

.....

.....

4. Fill in the blanks by selecting suitable words given below :

(goitre, insulin, rickets, iron, proteins)

(a) Anaemia is caused due to the deficiency of .....

(b) Deficiency of Vit. D causes ..... in children.

(c) Deficiency of iodine in the diet may cause .....

(d) Kwashiorkor is caused due to the deficiency of .....

5. Find the odd one out :

(a) Typhoid, cholera, jaundice, tuberculosis, tetanus.

(b) Cold, malaria, measles, mumps.

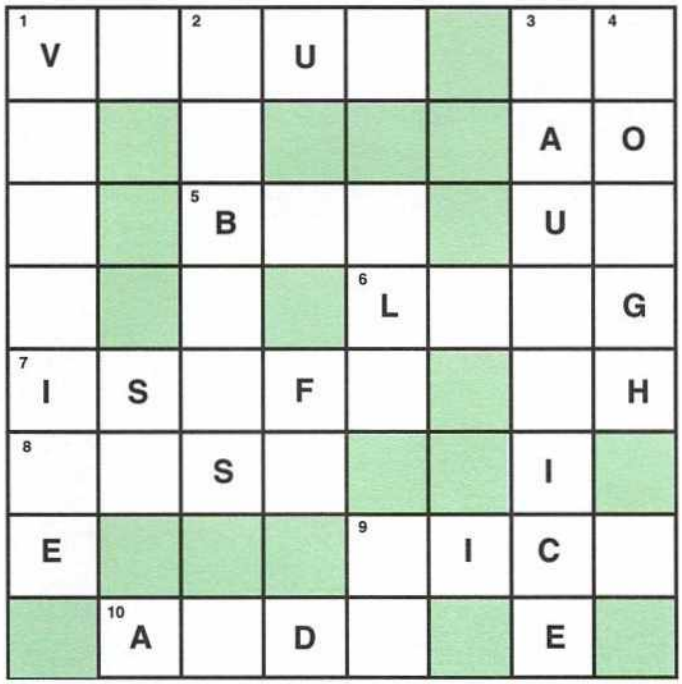
(c) Scurvy, rickets, polio, pellagra, nightblindness.

(d) Proteins, carbohydrates, fats, minerals, cancer.

6. Fill in the blanks in the following table :

	Vitamin	Name of the deficiency diseases	Source of vitamin
(a)	Vitamin A	.....	.....
(b)	.....	Beri-beri	.....
(c)	Ascorbic acid	.....	.....
(d)	.....	Rickets (in childhod) bones turn soft	.....

7. Given below is a crossword puzzle. Read the clues across and clues down, and fill up the blank squares. Check your performance with the correct solutions given at the end of the chapter.



Clues down

1. Germs or germ - substances introduced into the body to prevent occurrence of an infectious disease.
2. A disease caused by an infected dog that affects the central nervous system.
3. A disease in which the eyes, the skin and the urine turn yellow.
4. The disease pertussis is popularly known as whooping .....

Clues across

1. Category of pathogen that causes diseases like common cold and mumps.
5. This is the vaccine for preventing tuberculosis.
6. An organ usually affected by tuberculosis.
7. Jumbled spelling of one of the most common insect which visits our exposed foods and contaminates them.
8. Cover this part of your body by a handkerchief while sneezing to prevent droplet infection to others.
9. These may readily grow in your hair, if you do not wash it regularly.
10. A disease that weakens body's defence system against infections.

Answers :
Clues across : 1. Virus, 5. BCG, 6. Lung, 7. ISEFL *i.e.* Flies, 8. Nose, 9. Lice, 10. AIDS
Clues down : 1. Vaccine, **2.** Rabies, **3.** Jaundice, **4.** Cough

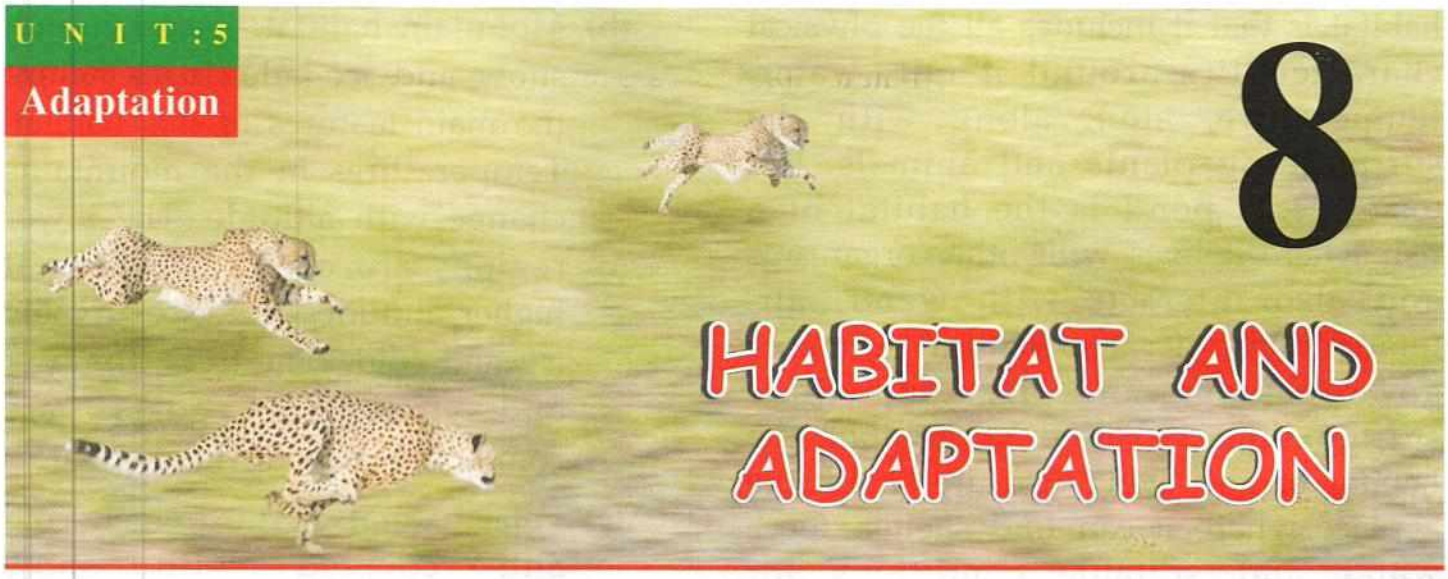
Long Answer Questions (Write the answers in your note-book)

1. Describe the ways in which communicable diseases are transmitted through various indirect methods.
2. List 3 ways by which you should keep your environment clean.

PROJECT

Prepare a chart showing methods of maintaining a good communal hygiene.

UNIT : 5
Adaptation



8 HABITAT AND ADAPTATION

SYLLABUS

1. Habitat — Definition
2. Adaptations of plants and animals to the following habitats along with characteristics and examples :

* Aquatic habitat : floating, submerged and fixed plants; adaptations in fish.
* Desert habitat : adaptations in cactus as desert plant and camel as desert animal.
* Mountain habitat : adaptations in trees like pine and fir; mountain goat.
* Air habitat : adaptations for flight in birds; aerial plants.

The vast surface of the earth presents a huge variety of conditions prevailing in its different parts. The life existing in these parts is also diversified. In this chapter, you will learn about various aspects of the kinds of dwelling places of plants and animals and how they are suited (or adapted) to live in those conditions. Animals and plants have to be well-adapted to survive in their habitat so that they are able to obtain their food, water, a shelter to protect them and to breed. For this purpose, all living organisms have to adjust themselves to their surroundings.

HABITAT

Habitat of an organism in a sense is the environment in which that organism generally lives. The special feature of

habitat is that it includes all the physical characteristics around it (air, water, temperature, etc.), along with the surrounding plants and animals. For example, a pond is the habitat of a fish where it lives with other organisms and also interacts with water, air, temperature, etc. **The natural home of an organism and its immediate surroundings is called its habitat**. The habitat of any living creature should be a place where it can find shelter, food, water and suitable conditions for breeding.

There are different types of habitats in which different varieties of organisms are found. These are —

1. **Aquatic habitat** — rivers, lakes, ponds and seas form this type of habitat. Animals and plants living here have developed distinct features that enable them to survive in water. eg. fish, water lily, lotus, etc.
2. **Terrestrial habitat** — includes plants and animals living on land. Large varieties of organisms are found on land. The terrestrial habitat can be further classified as follows:
   (a) **Desert habitat** — vast regions of sand with high daytime temperatures and low night-time temperatures and very little water are the main environmental factors of this habitat. Cactus, camel, desert fox are a few of the organisms found here.
   (b) **Mountain habitat** — rocky land, snow and ice-laden regions are the main features of this habitat. Temperatures in the mountains change with altitude. The lower regions are cooler whereas at higher altitudes it gets extremely icy and cold. Pine trees, firs, yak and mountain goats are commonly seen in this habitat.
   (c) **Polar habitat** — is extremely cold and covered with snow throughout the year. Polar bears, reindeer, penguins and a very scanty plant growth survive in the cold polar regions.
   (d) **Forests and grasslands** — are the major type of habitats which are abundant in both plant and animal life. The rich vegetation here is home to a diversity of animals.
3. **Aerial habitat** — includes various types of birds, bats, butterflies and other insects. Though no plant is found growing in air, their seeds are carried by the wind from one place to another.

WHAT IS MEANT BY ADAPTATION ?

When we say that an organism is adapted to a habitat, we mean that its appearance, behaviour, structure and mode of life make it well-suited to survive in a particular environment. Observe Fig. 8.1 and try to locate a

Fig. 8.1 A caterpillar adhered to a plant

caterpillar. Can you see it and differentiate it from the twigs of a tree on which it is adhered to ? This is a particularly striking example of adaptation. However, even though all organisms (plants and animals) are adapted to their environment, it may not always be so obvious.

Adaptation is the development of any structure or function in an organism which makes it more efficient for survival in a particular environment or habitat, i.e. adaptations are the changes in the body or behavior of an organism that enables it to survive comfortably and successfully in a habitat.

Organisms adapt themselves to —

- find their food.
- protect themselves from the attack of their enemies (predators).
- find favourable conditions for reproduction.
- protect themselves from the unfavourable effects of the changing environment.

The environment has two types of components — **biotic** and **abiotic**. The living organisms such as plants and animals are the **biotic** components. Various non-living things, such as soil, rocks, air, water, temperature, etc. are the **abiotic** components. The organisms exist in very cold as well as very hot conditions. How do they manage to survive ? That is where adaptation comes to help.

Adaptation does not take place in a day or two. Over thousands of years, the abiotic factors of a region change. Those organisms which cannot adapt to these changes perish, and only the adapted ones survive. Organisms adapt to different abiotic factors in different ways. That is why a diversity of organisms is present in different habitats.

Let us study some varied habitats, and the adaptations of animals and plants to these habitats.

ADAPTATIONS IN AQUATIC HABITAT

Aquatic habitat includes both fresh water bodies (ponds, rivers, lakes) and marine water bodies (seas and oceans). One can find huge variety of plants and animals in aquatic environments. Let us study about some of these aquatic plants.

Vallisneria is an aquatic plant commonly used in setting up an aquarium. The plant remains submerged in the water.

Its roots are small in size. They simply keep the plant fixed in the soil, and have hardly any role in absorbing water and nutrients from the soil. The stem is long, hollow and light, and

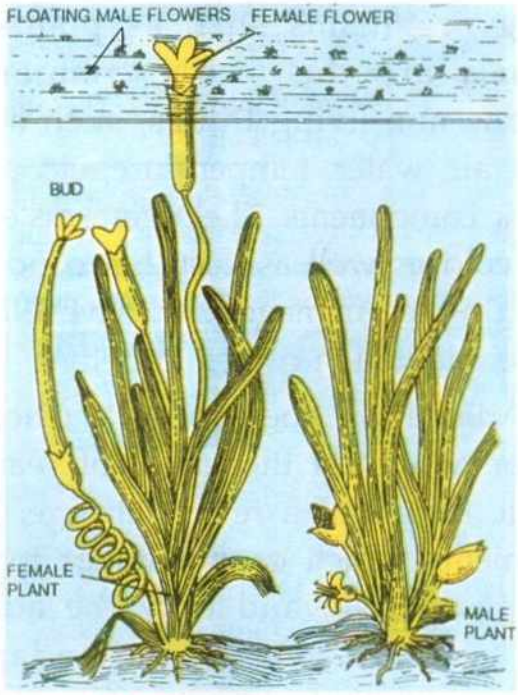


Fig. 8.2 Pollination in Vallisneria

grows well up to the water surface. The leaves are thin, elongated, ribbon-like to expose more surface to the light entering into water. Diffusion of gases between the air dissolved in water and the leaf-tissues, occurs mainly through the thin leaf surfaces.

Vallisneria is well-adapted for cross pollination. It is a dioecious plant where male and female plants are separate. Pollination occurs with the help of water and such flowers are called hydrophilous (*hydro* = water and *phile* = affinity). The male flowers are very small and on maturity, get detached. They float on the surface of water. The female plants bear female flowers that remains afloat on long stalks. Free floating male flowers pollinate the female flowers on the surface of water.

Water lily (Hindi – *Nilofer*) is a partly submerged water plant. Its roots are fixed in the soil at the bottom of the pond and the stems are very small. Leaves have long leaf-stalks filled with air spaces. This

Fig. 8.3 Water lily

adaptation helps the plant to float on water (buoyancy). The leaf-blades are broad with an oily coat (for water proofing) and are spread on water surfaces. Stomata are tiny openings on the leaf which allow diffusion of gases. In water lily, they are present only on the upper surface of the leaves that is exposed to air.

There are many different kinds of animals living in different conditions in water. They include both fresh and marine water forms. Some common actively swimming animals are fishes, frogs, crocodiles, whales, etc.

FROG CROCODILE

Fig. 8.4

Fishes are found both in fresh water and marine water. The most significant adaptations in a fish for aquatic life are as follows :

1. **Streamlined body shape :** The body of a fish is tapering at both ends. Such a body is called a streamlined body. This shape offers least resistance during its forward movement in water.

Fig. 8.5 Streamlined body of a fish

2. **Scales covering the entire body :** The entire body of a fish is covered with water-proof scales which form the exoskeleton of the animal. These scales protect the fish from the ill-effects of water.
3. **Fins :** 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. 8.6).

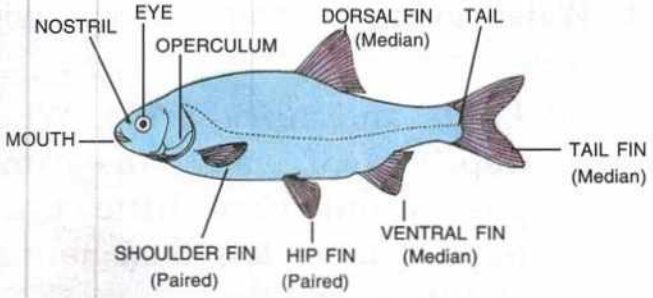


Fig. 8.6 Fins help a fish to swim

4. **Air bladder (or swim bladder)** is an air-filled bladder in some fishes. It helps in maintaining buoyancy and the fish can rise upward or sink downward by increasing or decreasing the amount of gas in the bladder.
5. **Gills :** The gills are the breathing organs effective only in water. These are located on either side of the throat and are covered by an operculum (gill cover). For respiration, the water is taken in through the mouth and expelled out from the gill chambers on either side. As the water flows over the gill filaments, the oxygen of the air dissolved in water is taken up by the blood flowing through gill filaments and carbon dioxide is given out.

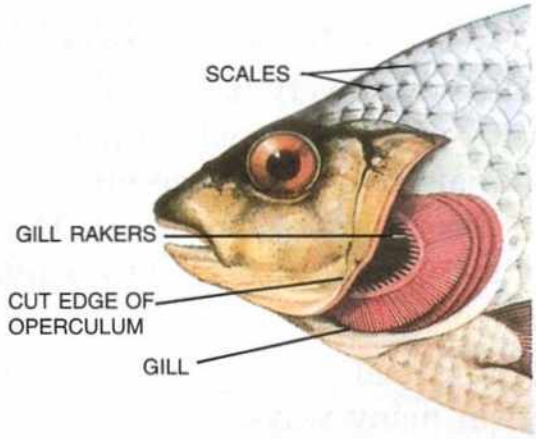


Fig. 8.7 Breathing organs of a fish

Beside fishes, whales and many other animals like crocodiles, turtles, ducks, etc. also swim in water. **Whales** are marine mammals. Its huge body is also spindle-shaped (streamlined). Its front legs are modified into paddles or flippers for kicking water and hind limbs are absent. Whales have to periodically come up to the surface of water to breathe in the atmospheric air into their lungs.

Activity 1

Draw a neat and labelled diagram of a fish and answer the following questions :

1. What name is given to a body which is pointed at both ends ?

2. Name the structures that help in the following :
   (i) Swimming (ii) Breathing
   (iii) Protection
   (iv) Maintaining buoyancy
3. State whether it is an aquatic animal or a terrestrial animal. Why?

ADAPTATIONS IN DESERT HABITAT

Deserts are very hot and dry habitats. Camel is one of the well known examples of animals living in a desert. It is also called the "ship" of the desert. The body structure of a camel helps it to survive in desert conditions.

The camel is adapted to life in the desert in many ways.

1. Physical features :

(i) The foot is large with a pad-like sole which facilitates walking on slippery sand and does not sink into it. The camel has long legs and can run on sand quite fast. Long feet of the camel also keep the body away from the hot sand.

Fig. 8.8 Camel

(ii) The hump of the camel is full of **fat** which serves as the **reserved food**. The camel can remain without food for several days and during that period, the fat in the hump serves as a source of energy. (This is an adaptation of the camel for scanty or no vegetation for long distances at a stretch).

(iii) The eyes of the camel are provided with long eyelashes. This feature protects its eyes from the harsh sun rays and from the sand in the deserts.

(iv) Its nostrils remain closed so that sand cannot enter inside.

(v) It has thick lips which enables it to eat the cacti.

2. Water-saving methods (to cope with water scarcity) :

(i) ***Little*** and ***thick urine***. When deprived of water, the camel passes out very little urine (several times less than normal) and it is quite thick.

(ii) ***Semi-dry faeces***. The dung passed out is quite dry.

(iii) ***Perspires very little***. The camel can tolerate high outside temperature (40°-45°C). Its own body temperature can go up to 41°-42°C and therefore the need to perspire is reduced.

(iv) ***Slow breathing***. Certain amount of moisture is always lost due to evaporation in the respiratory

passages during breathing. Slower the rate of breathing, lesser the loss of water as water vapour in the air breathed out.

(v) ***Water "storage" in muscles.*** The camel's muscles can withstand the shortage of water and can shrink considerably. Once the water is available, the camel can drink sufficient water and the muscles swell up.

(vi) ***Water from the "fat" of the hump.*** While starving, the fat is oxidised to yield energy as well as water.

3. **Heat tolerance :** The camel can raise its body temperature 4°-5°C higher than the normal body temperature when it is hotter outside, with no harmful effect, and in the process saves water that could have been lost.

There are many other desert animals such as desert rat, snakes, etc. Mostly they hide in burrows to avoid the day heat and come out only in the night to search for food.

Cacti (*singular* – "cactus") are known examples of desert plants. Cacti are succulent plants, *i.e.*, they store water in their fleshy tissues and depend on this stored water for photosynthesis. These plants are adapted to hot, dry conditions in several ways. The leaves of cacti are reduced and are in the form of spines. They help in reducing loss of water from the leaves through transpiration. The green leaf-like structure that you see in cactus is, in fact, its stem. Photosynthesis is carried out by the thick green stem. The stem is also covered with a thick waxy layer, which helps to retain water. Cacti have long roots which go deep down into the soil for absorbing water.

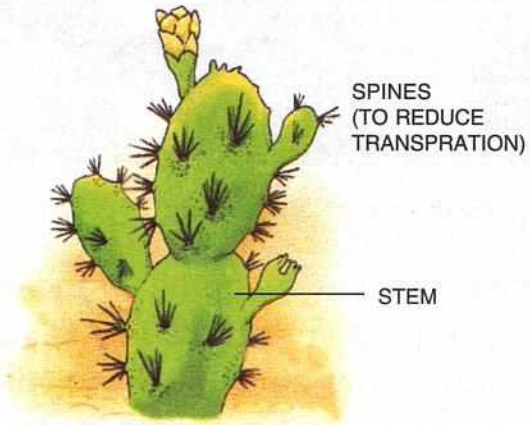


Fig. 8.9 Cactus

Activity 2

Take one green leafy potted plant and one small potted cactus plant. Cover any shoot of each of the plants with a plastic sheet. Secure it with a thread to the base of the shoot. Leave it for an hour or more in the sunlight. Observe and tell which of the plants contain more water droplets on the inner surface of the plastic sheet. Why ? What do you infer from this experiment?

ADAPTATIONS IN MOUNTAIN HABITAT

Mountain habitats are normally very cold and windy, and in certain months they remain snow covered. There are a large variety of plants and animals found in the mountain regions, for example pine, fir, cedar, etc. Pine and fir are big trees. These trees are normally cone

Fig. 8.10 Pine

shaped and have sloping branches. The leaves of pine are needle-like. This helps the rain water and snow to slide off easily and in water conservation as the ground surface is rocky.

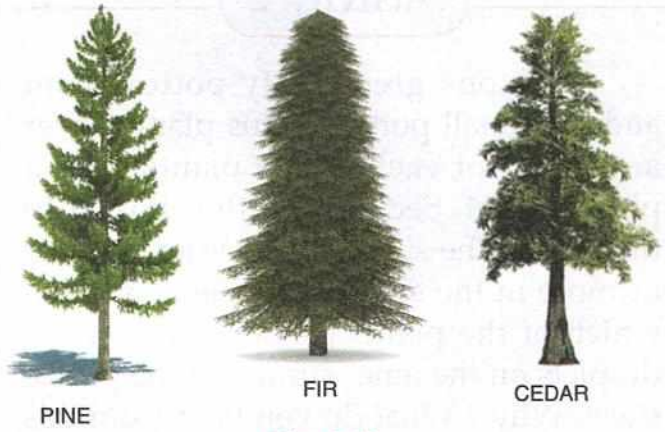


Fig. 8.11

Animals living in the mountain regions show distinct adaptations which are basically to protect them from cold and snow. *For example*, yak has thick skin covered with fur to protect it from cold. The Mountain goat has thick fur on its body including its feet and toes. These animals have strong hooves for running up on rocky slopes of the mountains.

Fig. 8.12 Mountain Goat

- The oxygen content in the mountain air is thin. So the blood of most of these animals contains more red blood cells. This helps them to breathe in sufficient oxygen even when air pressure is low.
- Some animals hibernate or go for a long winter sleep when the temperatures are very low. In this way, they conserve their energy and survive the winter without food. Frogs and hedgehogs are some animals which hibernate.

ADAPTATIONS IN AERIAL HABITAT

Birds, bats and insects fly in the air, *i.e.*, they are fliers. Adaptations for flight are called aerial adaptations.

To be able to fly, the foremost requirement of an organism is to possess some kind of **wings**, their corresponding flight **muscles** and a **streamlined body** to encounter least resistance while flying in the air.

Birds are undoubtedly masters of aerial life. Their body is perfectly adapted for flying. Various aerial adaptations found in birds are :

1. **Body shape :** The body of birds is streamlined. Necks stretched forward with the head pointed in front and a narrowed tail at the end provide them a sleek shape. The body surface is smooth to minimize resistance against air.
2. **Wings :** The forelimbs are modified into wings. The whole length of the forelimb carries long flight feathers.
3. **Steering and brakes :** The feathers on the tail help to slow down the speed and also help in steering (changing direction).

BIRD

FLIGHT FEATHER

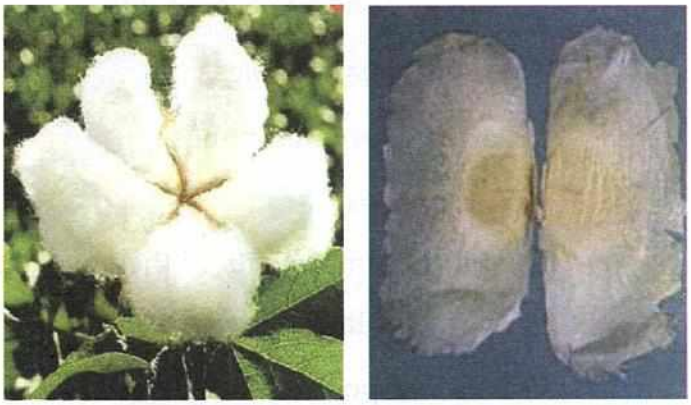
Fig. 8.13

4. **Wing muscles :** They are the strong, active and enlarged breast muscles which support and help in the movement of wings.
5. **Cutting down the body weight :** Except for the most necessary bulky heavy wing muscles, the rest of the bird's body tends to be light to facilitate flight.
   - Bones have air cavities.
   - Much less water is required in the body. The birds excrete solid urine (formed of uric acid instead of urea which otherwise requires much water to be excreted out).

ADAPTATIONS IN SEEDS FOR TRANSPORT THROUGH AIR

You know that new plants grow from the seeds. The seeds are produced in large numbers and they germinate into "baby" plants. These tiny plants gradually grow into full plants. But have you ever thought what will happen if all the seeds produced by a plant are dropped into the soil around the plant ? Only a few of these seeds will germinate, while most of them will die. Do you know the reason for this ? The limited space around the plant has limited amount of water and mineral salts in the soil, which may be enough only for a few seeds. The majority of seeds will be deprived of enough nutrition to germinate and will die. That is where "dispersal" of seeds helps.

Dispersal means the distribution of seeds far away from the parent plant. It is to avoid over-crowding, otherwise the seeds will all fall near the parent



COTTON SEEDS

DRUMSTICK SEEDS

Fig. 8.14 Seeds dispersed by wind

plant and will not germinate because of insufficient space, water and nutrients.

Some seeds are dispersed by wind, for example, *cotton*, *poppy* and *drumstick* seeds. These seeds are not only light in weight but also have silky hair or wings so that they are easily carried away by the wind.

Activity 3

To study different types of the adaptations in seeds for dispersal.

Visit a nearby garden and collect as many different types of seeds or pods lying on the ground as you can. Watch these seeds carefully. If necessary, use a hand lens to identify the possible mode of the dispersal.

Discuss your observations with your friends and teacher in the class.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick mark (✓) against the correct alternative in the following statements :

(a) In a cactus plant, photosynthesis occurs in :

(i) leaves ☐ *(ii)* spines ☐

(iii) modified roots ☐ *(iv)* modified stem ☐

(b) The animals such as birds have :

(i) light bones with air cavities ☐

(ii) solid heavy bones ☐

(iii) heavy pointed bones ☐

(iv) no bones ☐

(c) The biotic components of the environment includes :

(i) green plants ☐ *(ii)* animals ☐

(iii) decomposers ☐ *(iv)* all of these ☐

(d) The presence of hollow plant stems is a characteristic of :

(i) desert plants ☐ (ii) aquatic plants ☐

(iii) mountainous trees ☐ (iv) none of these ☐

(e) Slow breathing is the characteristic of :

(i) desert animals ☐ (ii) aquatic animals ☐

(iii) aerial animals ☐ (iv) land animals ☐

(f) Diversity of organisms is found in different habitats because of different adaptations for :

(i) average temperature ☐ (ii) soil type ☐

(iii) annual precipitation ☐ (iv) all of these ☐

Answer the Questions :

1. List any *four* abiotic factors which affect different living beings.
2. Define the following : habitat, adaptation.
3. Describe any *two* adaptations seen in desert plants.
4. Describe the aerial adaptations in birds.
5. Briefly explain the term "Habitat".
6. Give *two* adaptations in animals found in the mountain habitat.
7. How is a whale similar to a fish in adaptation to life in water ? Explain any *two* features.
8. List the environmental factors that influence a habitat.
9. Differentiate between an aquatic habitat and a terrestrial habitat.
10. Name any three types of terrestrial habitat.
11. Name *two* types of terrestrial habitats with low temperatures.
12. Complete the table given below. Write down *two* points in each given column.

Habitat	Environmental factors	Adaptations	
		Plants	Animals
Aquatic habitat			
Mountain habitat			
Desert habitat			

13. Describe how pollination occurs in *vallismaria* ?
14. State the "water-saving methods" in a camel.

PROJECT

- Collect pictures of different types of animals and plants. Cut and paste them on the "Display Board" of your class room. Write the name of the animal or plant, its habitat and list a few adaptations of the organism you have named.
- Fill in the names of any *two* animals and plants (other than those in the lesson) found in the following habitats :

AQUATIC HABITAT	MOUNTAIN HABITAT	DESERT HABITAT	FOREST HABITAT

- Visit a bird sanctuary or a zoo. Try to find out the names of as many birds as possible. Collect pictures of the birds and paste them in your note book.