UNIT 1

Plant Life : Leaf and Flower

Learning Outcomes

Children will be able to :

- *distinguish between leaves (reticulate vs parallel venation/simple vs compound leaves);*
- *recognize, identify and draw figures of leaf modifications for support, protection, reduction in water loss and vegetative propagation in leaf;*
- *recognize that flowers are of various shapes, sizes and colours and are an important part of the plant;*
- *collect and preserve various types of flowers;*
- *explain the structure and function of each whorl of flower (complete flower);*
- *list the agents of cross pollination;*
- *learn the process of seed germination and list the conditions required for germination;*
- *list common names of locally available plants;*
- *list the various types of modifications for special functions such as vegetative propagation and storage;*

Chapter Outlines

- Introduction
- The Leaf
- The Flower
- Pollination
- Fertilization
- Formation of Fruit and Seed
- Seed Germination

INTRODUCTION

Plants play an important role in our lives. When we move around different places we find different types of plants. Some of them are very small such as grasses, jasmine, rose, dahlia, etc., while many of them are very big such as banyan, mango, neem, etc. Most of the tall trees belong to higher plants. As you have already learnt in the previous classes, the body of a flowering plant can be divided into two fundamental parts : (i) an underground root system, and (ii) an aboveground shoot system *(Fig. 1)*. The root system grows downwards into the soil and anchors the plant firmly in the soil and absorbs water and various minerals from it. The shoot comprising of stem, and its lateral organs, the leaves, grows upwards into the air. Leaves are highly specialised organs, designed to manufacture carbohydrate food by green cells. In previous classes, children have already been familiarised with parts of a plant body (root, stem, leaf, flower, fruit and seed). The contents of the present chapter aims at enabling children to know and learn more about the leaf, flower, fruit and seed.

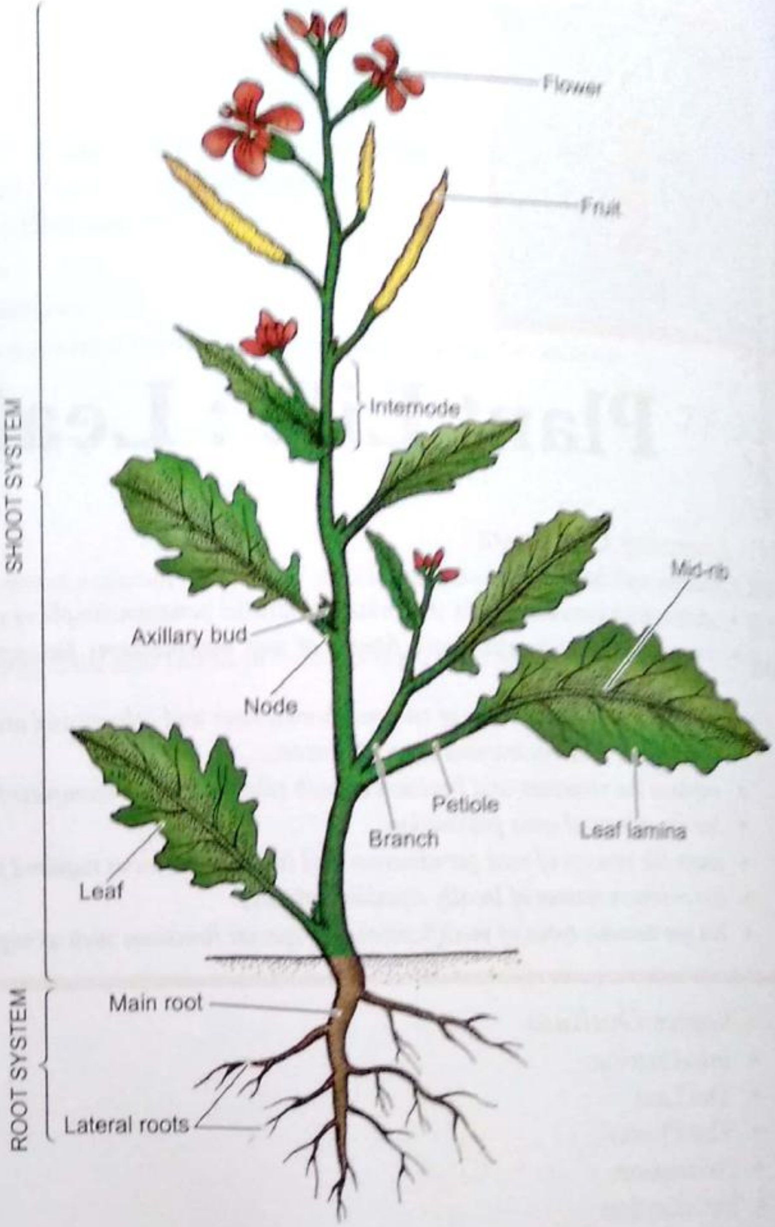


Fig. 1. Fundamental parts of a flowering plant.

THE LEAF

The leaf is a flattened, lateral outgrowth of the stem developing from a node and having a bud in its axil. It is normally green in colour and is the food manufacturing organ of the plant.

Characteristics of the Leaf

The following are distinctive characteristics of leaves.

1. They are lateral outgrowths of the stem.
2. They arise at the nodes of the stem.
3. They have limited growth.
4. They bear buds in their axils.

Activity 1

Aim : To study structure, kinds and venation of different kinds of leaves.

Visit a nearby garden/park or forest area with your teachers/parents. Collect the specimens of different types of leaves (including specimens of leaf modifications). Draw the different types of leaves, their structure and kinds and types of venation and modifications (if any).

Activity 2

Aim : To demonstrate that water is given off during transpiration.

The loss of water in the form of vapours from the aerial parts of plants (especially leaves) is known as transpiration. It can be easily demonstrated in laboratory. A well-watered potted plant is taken, the soil surface is covered properly with a sheet of oil paper, and then it is placed in a bell jar. After some time water droplets are noticed on the inner surface of the bell jar *(Fig. 2)*. Explain the presence of water drops inside the bell jar. This water has come from the aerial parts of the plant due to transpiration.

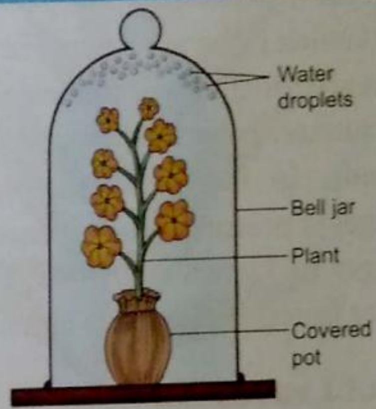


Fig. 2. Demonstration of transpiration.

Parts of a Leaf

A typical leaf has three main parts : Leaf base, petiole and lamina *(Fig. 3)*.

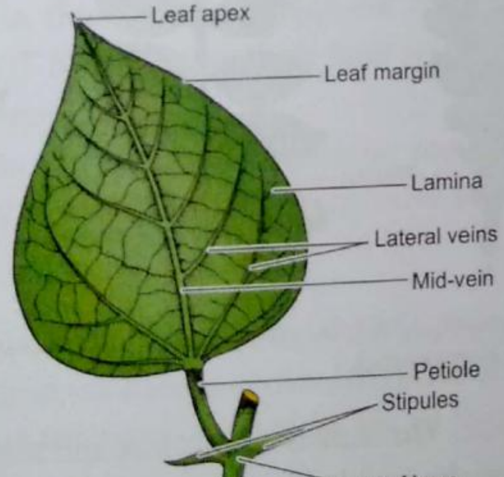


Fig. 3. Parts of a leaf.

Fig. 4. Pulvinus leaf base.

Leaf base. The part of the leaf attached to the stem is known as leaf base. It protects a bud in its axil. In some plants like pea, the leaf base is swollen and then it is known as pulvinus *(Fig. 4)*.

Petiole (or leaf stalk). It is the part of the leaf that connects the lamina with the stem. The petiole is usually cylindrical. It pushes out the lamina high and thus helps it to secure more sunlight. In some plants, the petioles are short, in some others they are quite long. In some leaves, petiole is absent.

Such leaves are called sessile. In water hyacinth, the petiole swells up into a spongy bulb–like structure which helps the plant in floating (*Fig. 5*).

Lamina. It is the flat, thin, broad, green and expanded portion of the leaf. A conspicuous system of veins and veinlets forms the external framework of the lamina. In most dicotyledons, a strong vein, known as the mid-vein (mid-rib), runs centrally through the leaf blade from its base to the apex. It gives off thinner lateral veins which produce into still thinner veins to form a net-like pattern (*Fig. 3*).

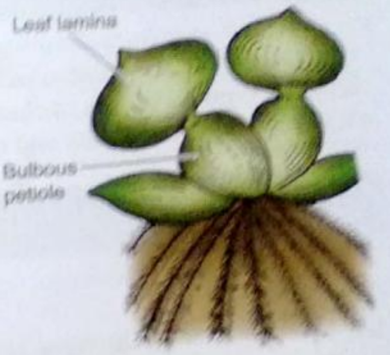


Fig. 5. Bulbous floating petiole in water hyacinth.

The lamina is the most important part of the leaf since it is the seat of food manufacture for the entire plant. It shows great variation in its shape, margin, surface, texture, colour, venation, incision, etc.

Stipule. In many dicotyledonous plants, a pair of small lateral appendages is present at the juncture of the petiole with the stem. These appendages are known as stipules (*Fig. 3*). Stipules protect the young leaf in the bud. When stipules are green they function like leaves and help in the manufacture of food material.

Kinds of Leaves

Depending upon the incision of the lamina, leaves may be simple or compound.

Simple leaves. In simple leaves, there is a single undivided lamina (*Fig. 6A, B*). It has an axillary bud in its axil. For example, banyan, guava, mango and papaya leaves are simple leaves.

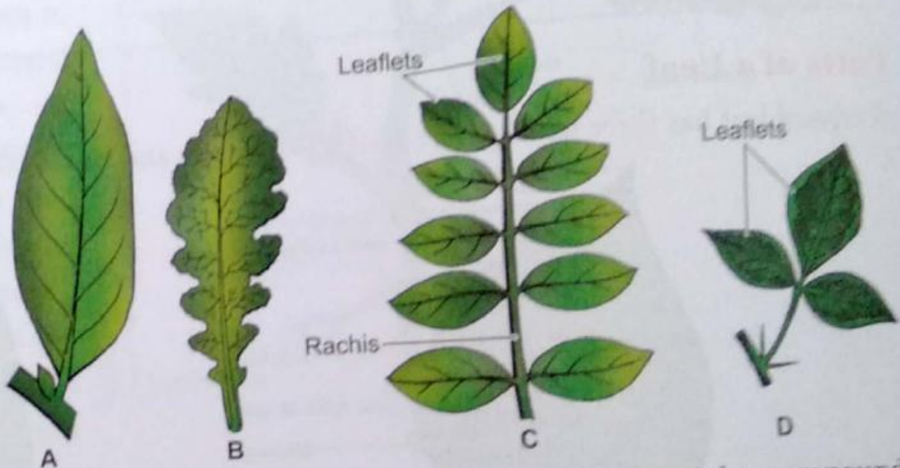


Fig. 6 A-D. Leaves : A. B. simple; C. pinnately compound; D. palmately compound.

Compound leaves. In compound leaves, the incisions of the lamina reach up to the mid-rib (rachis) and the lamina is divided into several small segments, known as leaflets or pinnae. The leaflets are distinct and remain free from one another but are jointed with the rachis or the tip of the petiole. Rose, neem and gulmohar leaves are compound leaves. You can easily differentiate these leaves from simple leaves by the absence of buds in their axils.

Compound leaves are of the following two types :

1. Pinnately compound leaf. In this type, incisions of the lamina are directed towards the mid-rib, known as rachis. Leaflets are arranged on both sides of the rachis (*Fig. 6C*). Rose leaf is an example of pinnately compound leaf.

2. Palmately compound leaf. In this type, all leaflets seem to be jointed at the tip of the petiole, like fingers of a hand (*Fig. 6D*). *Oxalis* leaf is an example of palmately compound leaf.

Phyllotaxy

Phyllotaxy is the mode of arrangement of leaves on the stem and its branches.

The green leaves of the plant prepare food in the presence of sunlight. Therefore, they are arranged on the stem or branch in such a way so that their maximum surface is exposed to sunlight. Leaves may arrange themselves on the stem or branch in three different ways :

Fig. 7 A-D. Phyllotaxy : A. alternate; B-C. opposite; D. whorled.

Alternate. In alternate phyllotaxy, only one leaf is present at each node *(Fig. 7A)*. Most of the plants (*e.g.*, china rose, mustard, sunflower, etc.) possess this type of leaf arrangement.

Opposite. In this type of arrangement two leaves are present at each node, standing opposite to each other *(Fig. 7 B, C)*. Jamun, holy basil (tulsi), etc., are common examples where such type of leaf arrangement is seen.

Whorled. In this type of arrangement, more than two leaves are present at each node forming a whorl *(Fig. 7 D)*. Such type of leaf arrangement is seen in oleander, devil tree, etc.

Venation

The arrangement of veins and veinlets in the leaf lamina is called venation. Besides providing strength and rigidity, veins distribute water and dissolved mineral salts to the lamina and carry away the prepared food from it. There are two types of venation, *viz.* (i) Reticulate, and (ii) Parallel.

Reticulate venation. When veins are irregularly distributed to form a network, it is known as reticulate venation *(Fig. 8A)*. This type of venation is a characteristic feature of dicotyledon leaves.

Parallel venation. When veins run parallel to each other and do not form a reticulum , it is known as parallel venation *(Fig. 8B)*. It is a characteristic feature of monocot leaves.

ACTIVITY 3

Aim : To identify difference in venation of monocots and dicots.

Collect the leaves of some monocot and dicot plants. Then, observe the type of venation in them. You will find that parallel type of venation is a characteristic feature of monocots whereas reticulate type of venation is a characteristic feature of dicots.

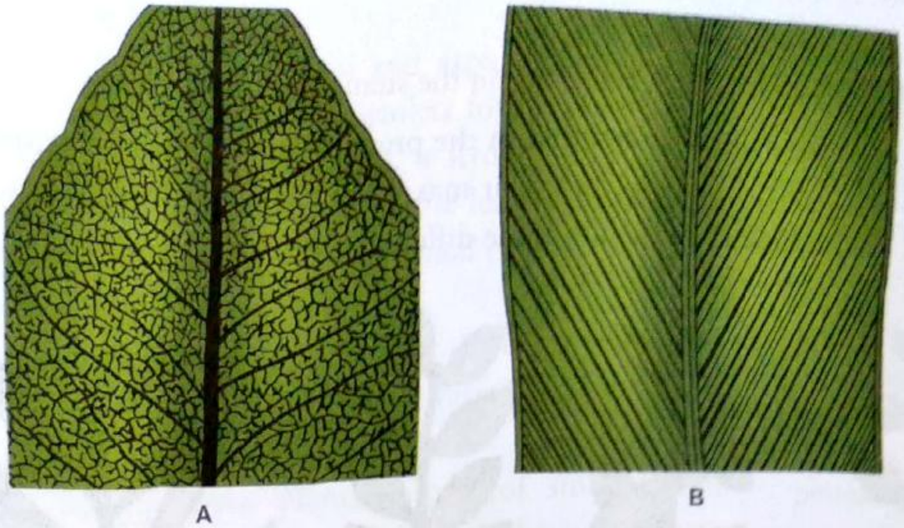


Fig. 8 A-B. Venation : A. reticulate; B. parallel.

Functions of Leaf

There are two main functions of leaves—photosynthesis and transpiration.

1. Photosynthesis. All green plants prepare their own food in their leaves. The leaves contain chlorophyll which absorbs the energy of the sun. They have a large surface area exposed to the sun. They get water and minerals from the roots and carbon dioxide from the atmosphere. Water, carbon dioxide and energy of the sun combine to produce glucose and oxygen. Plants use glucose for their growth and various processes. They also use a part of oxygen for respiration. Leaves give out the oxygen which is used by animals for breathing and respiration. Animals also use the food stored by the plants in leaves and fruits.

2. Transpiration. Leaves lose extra water in the form of water vapour by evaporation from the surface of leaves. The heat required for evaporation of water is obtained from the plant itself and thus the plant cools itself when it is hot outside. Continuous evaporation from the surface of the leaves create a pull which forces the roots to pull up more water from the soil. The water also contains minerals necessary for the growth of the plant.

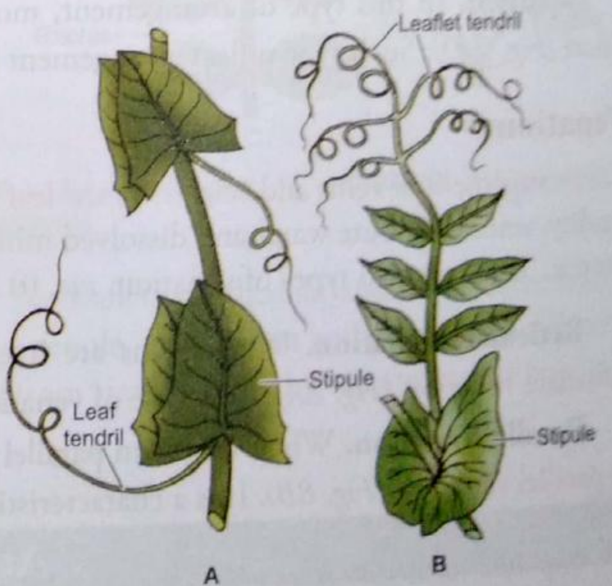


Fig. 9 A-B. Leaf tendrils : A. wild pea; B. sweet pea.

Modification of Leaves

The main function of the leaf is to synthesize food by the process of photosynthesis but in some plants they are modified to perform some specialized functions. Some important modifications of the leaves are as follows :

Leaf tendrils. In some plants, leaves are modified into thin, thread-like structures, called tendrils. They coil around the support and help the plant in climbing. The leaf may be partially or wholly modified into tendril. In wild pea, the whole leaf is modified into a tendril and the leaf-like stipules carry out the function of photosynthesis *(Fig. 9A)*. However, in sweet pea, only the upper leaflets of a compound leaf are modified into tendrils *(Fig. 9B)*.

Leaf spines. Leaves of certain plants, such as prickly pear, are modified into sharp, pointed structures known as spines *(Fig. 10)*. They protect the plant from grazing animals and also help to check transpiration by reducing the leaf area.

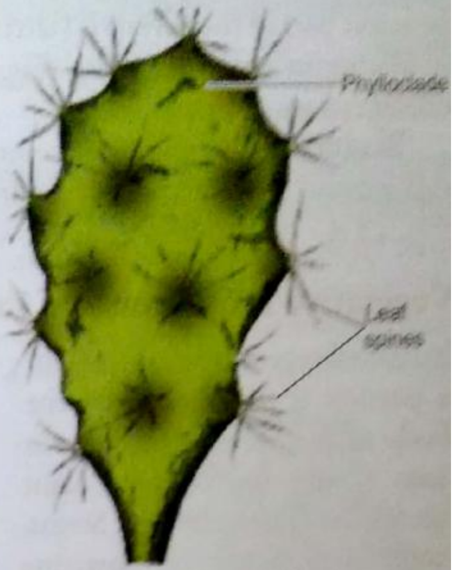


Fig. 10. Leaf spines in prickly pear.

Scale leaves. They are thin, dry, papery membranous structures, commonly found on underground stems *(Fig. 11A)*. They protect the axillary buds. In onion, they become thick and fleshy and store water and food materials *(Fig. 11B)*.

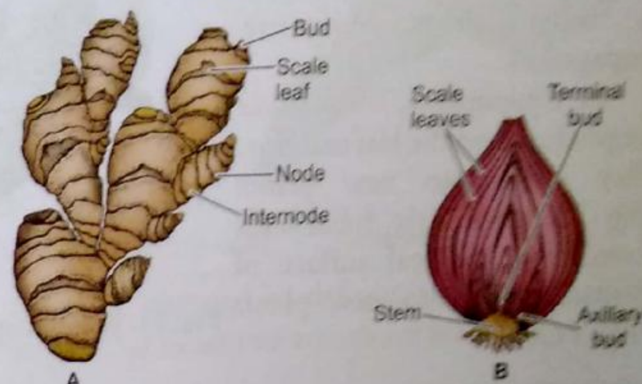


Fig. 11 A-B. Scale leaves : A. on rhizome of ginger; B. onion bulb.

Pitcher. Insectivorous plants grow in nitrogen-deficient soils and hence they trap insects to fulfill their nitrogen requirements. Hence, leaves of some insectivorous plants like *Nepenthes* (pitcher plant) are modified into pitcher-like structures to trap insects.

In *Nepenthes*, the lamina is modified into a pitcher-like structure, the distal part of the lamina forms a lid which covers the mouth of the pitcher.

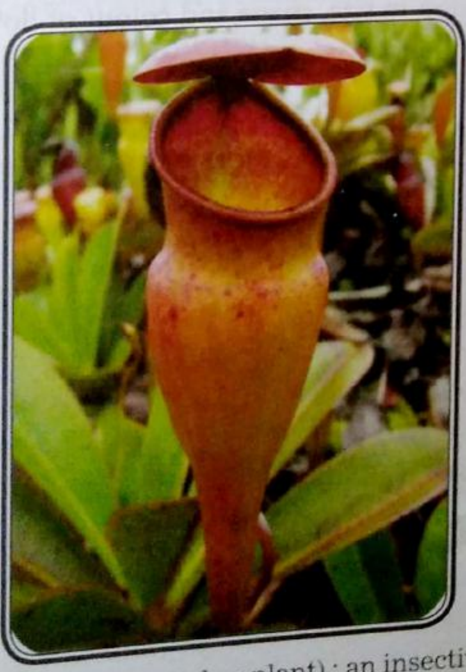


Fig. 12. *Nepenthes* (pitcher plant) : an insectivorous plant.

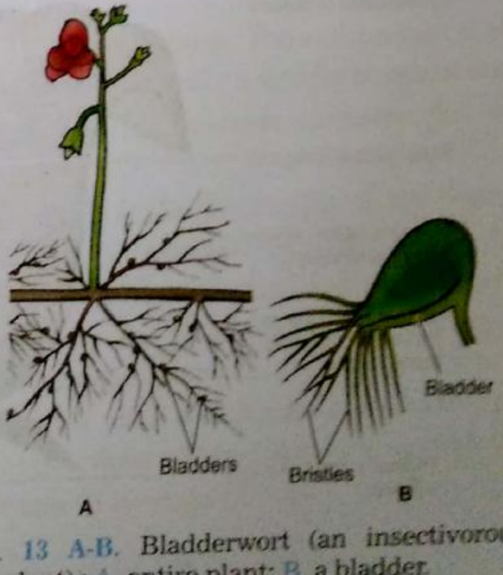


Fig. 13 A-B. Bladderwort (an insectivorous plant) : A. entire plant; B. a bladder.

The lower part of the petiole is flattened like a leaf, whereas the upper part is coiled like a tendril and keeps the pitcher in vertical position *(Fig. 12)*. The pitcher contains water and digestive juices, and it captures and digests small insects.

Bladder. Bladderwort, an another insectivorous plant, has much dissected leaves. Some of the leaf segments are modified into bladder-like structures. The bladder has a hollow cavity with a trap-door *(Fig. 13 A - B)*. The trap door allows minute water flies to pass in but they cannot come out.

Vegetative Propagation in Leaf

In natural vegetative propagation, a portion is detached from the body of mother plant and grows into a new independent plant under suitable conditions. Stems, roots and leaves of flowering plants are variously modified to bring about vegetative propagation.

In *Bryophyllum*, foliar buds are produced on the leaf margins. They grow into new plants *(Fig. 14A)*. Similarly, foliar buds formed on the leaf surface of *Begonia* grow into new plants *(Fig. 14B)*.

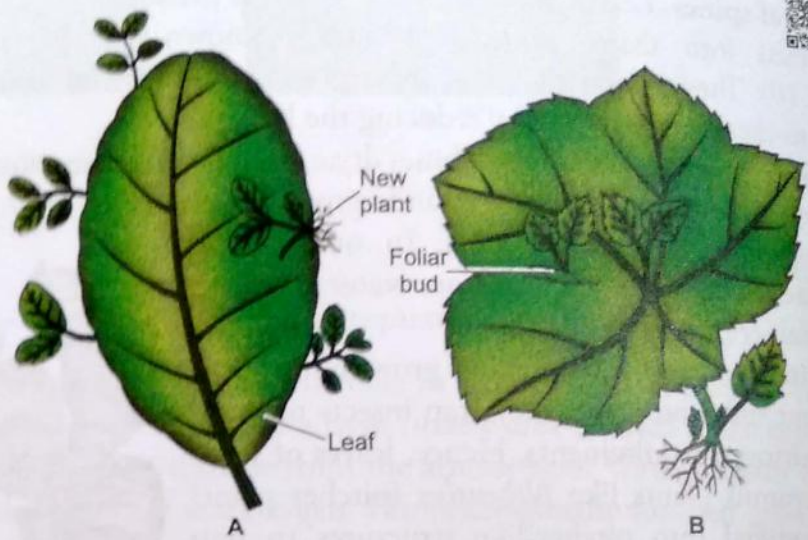


Fig. 14. Vegetative propagation by leaves : A. *Bryophyllum*; B. *Begonia*.

THE FLOWER

Flowers are the most beautiful manifestations of biological world. The reproductive parts of a flowering plant are located in the flower. There is considerable variation in size, shape and colour of flowers.

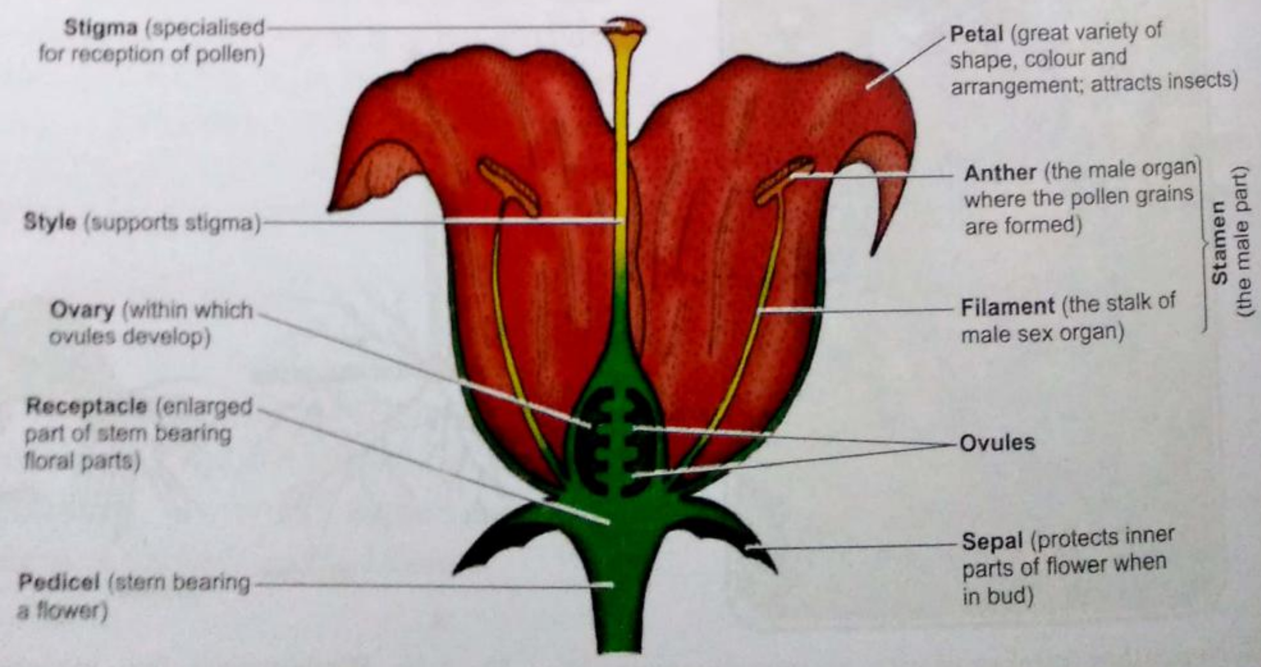


Fig. 15. Longitudinal section of a typical flower.

Activity 4

Aim : To draw well labelled diagram of complete flower.

Draw a neat, well labelled diagram of a complete flower. Give sufficient information about this plant. Display this picture in your study room.

Activity 5

Collect the various types of flowers and preserve them. Write their common names in the notebook. Then make a list of plants(a) flowering in summer, and (b) flowering in winter. Examine the flowers by carefully removing and counting the number of sepals, petals, stamens and carpels. Draw diagram of each flower in your notebook. Label the different parts. Note your observations in the form of a table.

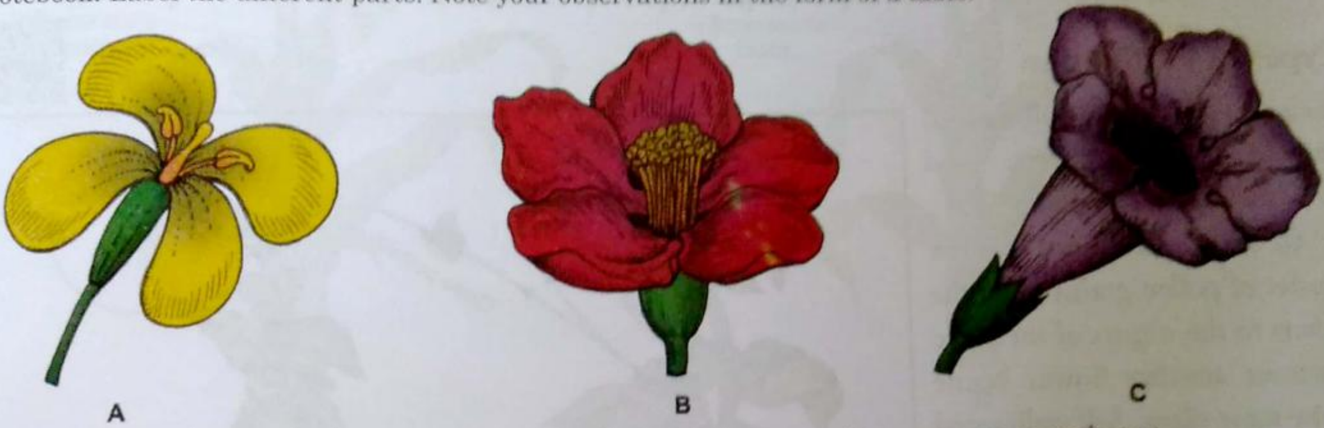


Fig. 16 A-C. Different types of flowers : A. mustard; B. rose; C. gooseberry.

A typical flower has four sets of appendages which are arranged in definite whorls on a flat or cup-shaped structure called receptacle or thalamus *(Fig. 15)*. The outer two whorls are known as accessory whorls and the inner two whorls are essential whorls.

The accessory whorls are calyx and corolla. The calyx forms the outermost whorl; it is usually made up of green coloured leafy structures called sepals. The sepals protect the inner organs of the flower. Corolla is the second whorl of the flower . The individual members of the corolla are called petals. The petals are generally large and brightly coloured leafy structures of various shapes. The function of the petals is to attract insects and / or birds for pollination.

The inner two whorls of floral organs are androecium and gynoecium. The androecium is the male part of the flower and consists of one or more stamens. A stamen is typically a slender structure consisting of two distinct parts : (i) the filament, and (ii) the anther. The anther produces numerous pollen grains. Each pollen grain forms two male gametes.

The gynoecium forms the innermost whorl of the flower. It is the female part of the flower made up of one or more carpels. The gynoecium is differentiated into a basal swollen ovule bearing part, the ovary; a terminal pollen receptive part, the stigma, and a middle elongated cylindrical part, the style. The ovary has one or more chambers, known as locules, and bears ovules. Each ovule has an egg cell, which functions as female gamete. After maturation, ovules develop into seeds and the ovary matures into a fruit.

Bisexual and unisexual flowers. Some flowers have both male and female reproductive parts—androecium and gynoecium. They are called bisexual flowers. Some flowers have either the male (androecium) or female (gynoecium) reproductive parts. Such flowers are called Unisexual flowers.

POLLINATION

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 pollination.

Pollination is the transfer of the pollen grains from the anther of a flower to the stigma of the same flower or of another flower. At the maturity of the pollen grains, the anther wall ruptures and the pollen grains are released. They are transferred by various agencies like wind, water, insects, animals, etc., and some of them finally reach stigma of the same or of another flower. This process, known as pollination, is an essential step in sexual reproduction and a pre-requisite for seed selfing.

Types of Pollination

There are two kinds of pollination, *viz.* (i) self-pollination, and (ii) cross-pollination *(Fig. 17)*.

(i) Self-pollination. It is the transfer of pollen grains from the anthers to the stigma of the same flower or another flower borne by the same plant. Self pollinated flowers show several adaptations which favour self-pollination.

(ii) Cross-pollination. Transfer of pollen grains from the anther of a flower from one plant to the stigma of the flower on another plant is called cross-pollination.

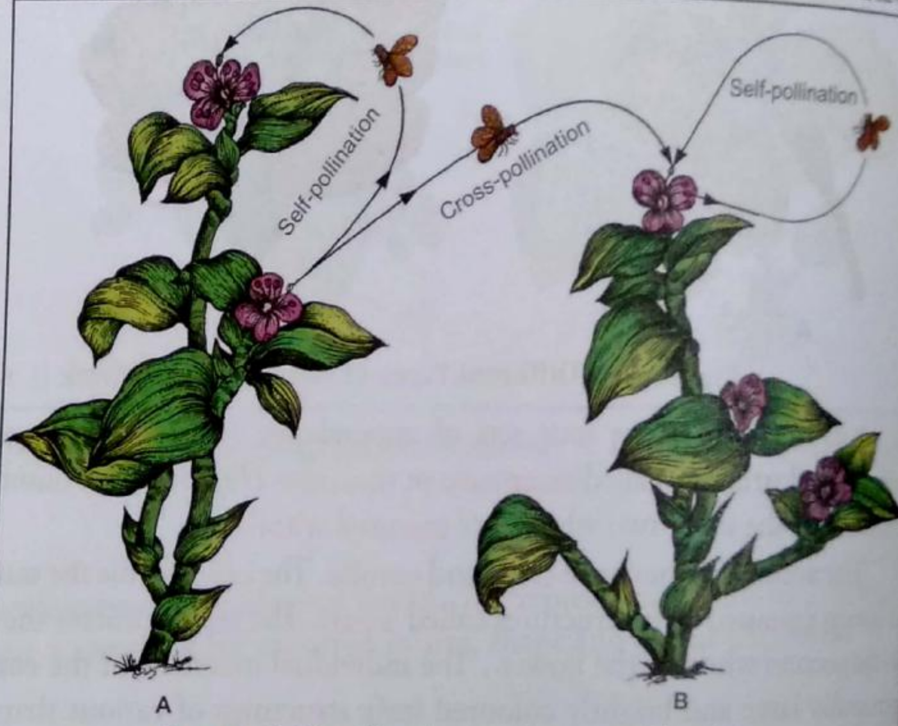


Fig. 17. Self-pollination and cross-pollination.

Agents of Pollination

Wind, water, insects, birds, bats, etc., are the various agencies which help in cross-pollination. Some of these are described here briefly.

1. Pollination by wind. Some plants like maize and wheat have smooth-walled relatively light, small and dry pollen grains which are produced in large quantities. The stigmas of wind-pollinated flowers are comparatively large and protruding; they are often feathery.

In maize plant, clusters of male flowers (tassel) are borne terminally and the female inflorescences (cobs) occur laterally at lower nodes. As anthers burst, a cloud of dust-like pollen grains floats in the air. Some of these pollens are caught by protruding stigmas and thus pollination is brought about *(Fig. 18)*. Such type of pollination is called wind-pollination or anemophily.

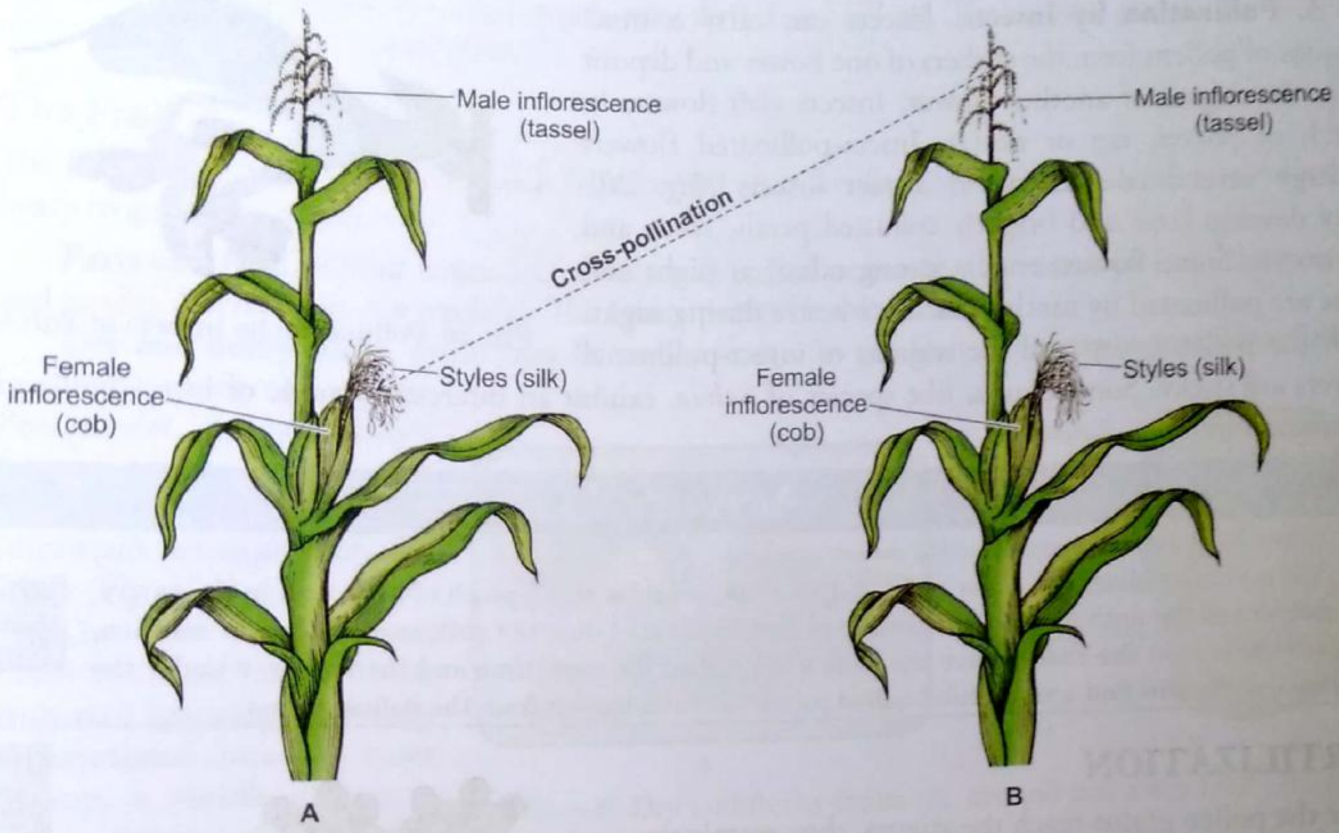


Fig. 18. Maize plant showing pollination by wind.

2. Pollination by water. Aquatic plants like *Vallisneria* (ribbon weed) make excellent use of water for pollination. Its flowers remain submerged in water. The male flowers break away and float on the surface of water. The female flowers on maturity are raised to the surface of water by the long spiral stalk. Free-floating male flowers get lodged on the female flower bringing open anthers in contact with the stigma *(Fig. 19)*.

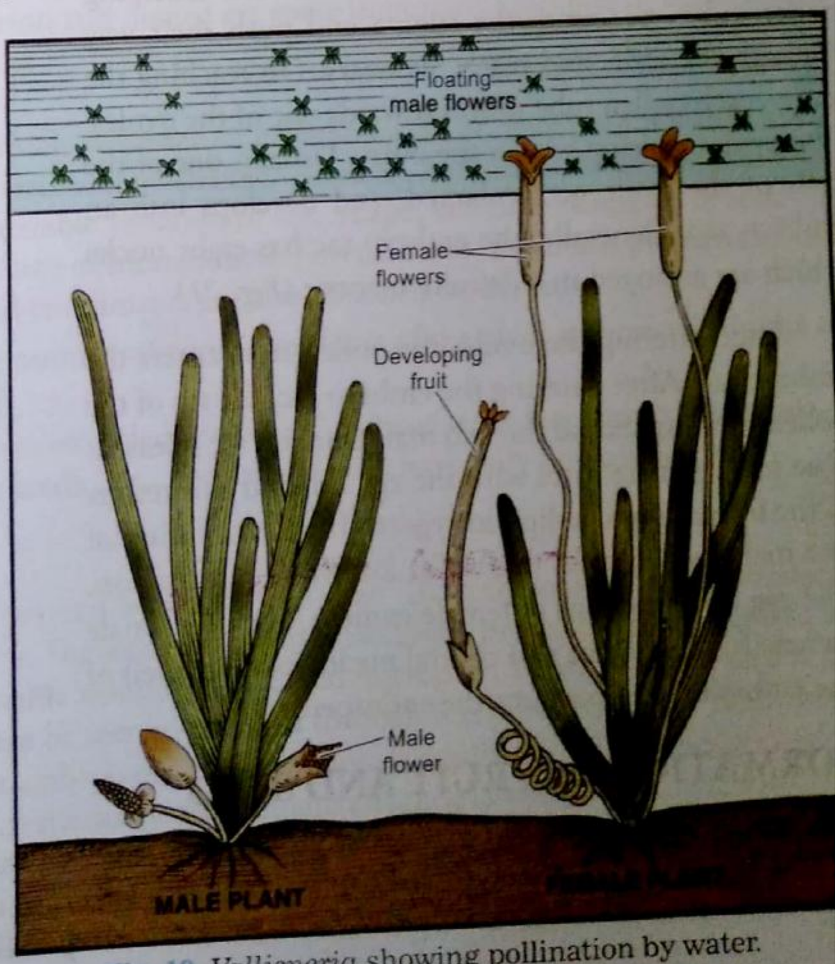


Fig. 19. *Vallisneria* showing pollination by water.

3. Pollination by insects. Insects can carry a small amount of pollens from the anthers of one flower and deposit it on the stigma of another flower. Insects visit flowers in search of pollen, sap or nectar. Insect-pollinated flowers undergo several adaptations to attract insects *(Fig. 20)*. They develop large and brightly coloured petals, scent and /or nectar. Some flowers emit a strong odour at night and these are pollinated by moths which are active during night. Both the pollen grains and the stigmas of insect-pollinated flowers are sticky. Some plants, like species of *Salvia*, exhibit an interesting mode of insect-pollination (entamophilly).

Fig. 20. Pollination by insects in *Salvia*.

ACTIVITY 6

Aim : To observe the germinating pollen grains.

Take a cavity slide. Put a few drops of 10% sugar solution and a pinch of boric acid in the cavity. Thereafter tap the anthers from the freshly picked flower and dust the pollens on the sugar solution. Put a cover slip on the slide. Leave the slide undisturbed for some time and then observe under the microscope. We will find a small tube, called pollen tube coming out from the pollen grains.

FERTILIZATION

Once the pollen grains reach the stigma, they germinate and produce a long slender pollen tube. The emerging pollen tubes penetrate the stigma and push their way through the style, and reach the ovary. On reaching the ovary, each pollen tube moves towards one of the ovules. The ovules develop within the ovary. Usually, one of the cells of the ovule gets enlarged, and develops into an embryo sac. Generally, the embryo sac has eight nuclei which are arranged in a definite manner *(Fig. 21)*.

After entering the ovule, the pollen tube enters the embryo sac. After entering the embryo sac, the tip of the pollen tube bursts and the two male gametes are released. One male gamete fuses with the egg cell and this results in the formation of a diploid zygote. This act of fusion of one male gamete with egg cell is known as fertilization. The egg cell functions as female gamete. The other male gamete fuses with the two central nuclei (polar nuclei) of the embryo sac to produce the endosperm.

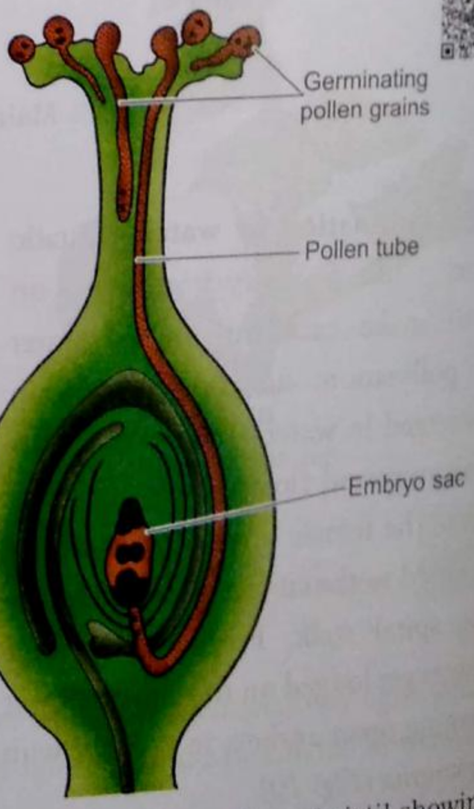


Fig. 21. Longitudinal section of pistil showing growth of pollen tube towards embryo sac.

FORMATION OF FRUIT AND SEED

After fertilization, most of the parts of the flower wither off and significant changes occur inside the ovary. Ultimately the fertilized egg (zygote) develops into a multicellular embryo, the ovules develop into seeds, and the ovary develops into fruit, and the ovary wall becomes the wall of the fruit. Meanwhile, the sepals, petals, stamens, style and stigma may shrivel and fall off. The embryo present inside the seed represents the dormant future plant.

The Fruit

The fruit is a mature or ripened ovary. It is formed after fertilization, which provides a stimulus to the ovary to grow into a fruit.

Parts of a fruit. A fruit consists of a fruit wall (called pericarp), that develops from the ovary wall, and seed(s) derived from the ovule(s). The pericarp may be thin or thick.

Dry and fleshy fruits. Fruits may be dry or fleshy. In dry fruits, pericarp is undifferentiated and is usually papery or woody. Pea, madar, mustard, lady's finger, wheat, cashew nut and groundnut are some important examples of dry fruits *(Fig. 22A)*.

On the other hand, fleshy fruits are juicy and the fruit wall (pericarp) is usually differentiated into an outer epicarp, a middle mesocarp, and an inner endocarp *(Fig. 22B)*. Mango, coconut, banana, grapes, tomato, apple, watermelon and orange are some important examples of fleshy fruits.

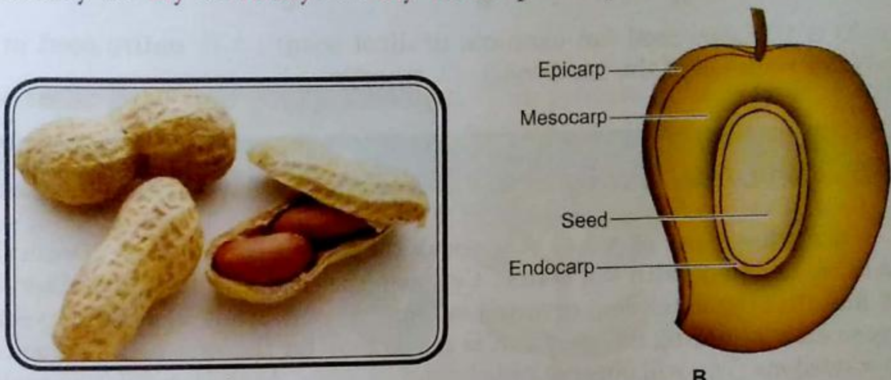


Fig. 22 A-B. Dry and fleshy fruits : A. ground nut-a dry fruit ; B. mango-a fleshy fruit.

The Seed

The seed is a fertilized mature ovule which possesses an embryonic plant, usually stored food material and a protective coat. After fertilization changes occur in various parts of the ovule and it transforms into a seed. There is a considerable variation in size, shape, colour and surface of seeds. Seeds of cereals and legumes are the major source of human food. Several other important products of human use like fibres, oils, beverages, spices and condiments are also obtained from seeds.

Types of seeds. On the basis of the number of cotyledons (part of the plant embryo within the seed), seeds are classified into :

(i) dicotyledonous seeds, and (ii) monocotyledonous seeds. Dicot seeds (*e.g.*, gram, bean, pea, etc.) have two cotyledons, whereas monocot seeds (*e.g.*, rice, maize, etc.) have only one cotyledon.

Structure of Seed : Dicot Seed

A typical dicot seed (*e.g.*, bean seed) is covered by a hard seed coat. The seed coat has two coverings—an outer thick testa and an inner thin tegmen. The seed coat provides necessary protection to the embryo which lies within. At one end of the seed, there is a minute pore, called micropyle. When a soaked seed is gently pressed, water and minute air bubbles can be seen to ooze out through this pore. The entire fleshy body, as seen after removing the seed coat, is the embryo or the baby plant. It consists of (a) two fleshy cotyledons (seed leaves), and (b) a short axis to which the cotyledons remain attached laterally. The cotyledons store its reserve food which provide nourishment to the developing embryonal axis. The part of the embryonal axis lying towards the micropyle is called radicle, and the one in between the two cotyledons is known as plumule *(Fig. 23 A-D)*.

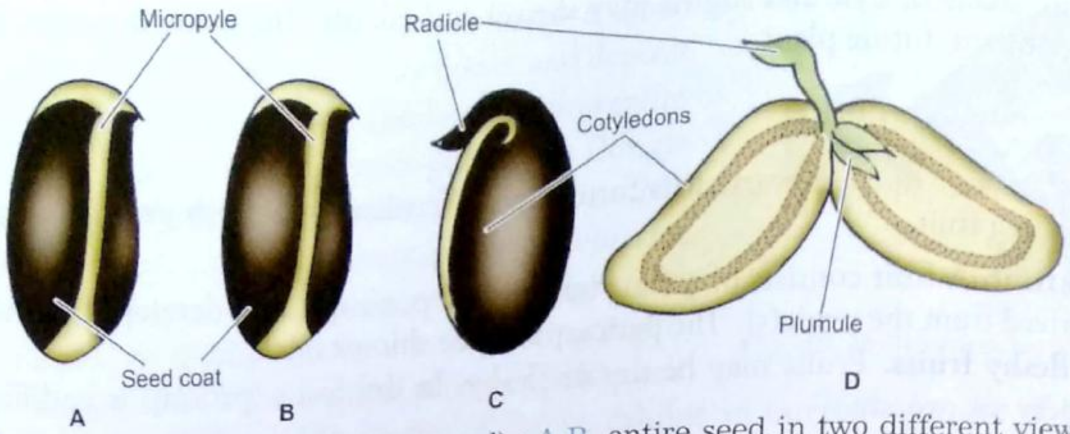


Fig. 23 A-D. Bean seed (an example of dicot seed) : A-B. entire seed in two different views; C. embryo (after removal of the seed coat) : D. embryo.

ACTIVITY 7

Aim : To study the structure of seeds.

Take a few seeds of pea or bean. Soak them overnight in water. Drain the excess water next day and cover the seeds with wet cotton. Cut open the seeds carefully and observe the different parts. You will find that the outermost covering is the seed coat, made up of two layers. The entire fleshy body, as seen after removing the seed coat is the embryo (or the baby plant). It consists of two thick cotyledons. Open the cotyledons. You will observe radicle and plumule. At the time of germination, the radicle forms the root and plumule gives rise to shoot.

Monocot Seed (Maize Grain as an Example)

The maize grain remains attached to the cob by its pointed end *(Fig. 24A)*. The following structures can be seen in the grain.

1. Seed coat. It is represented by a thin layer which surrounds the grain *(Fig. 24B)*.

2. Endosperm. The seed is divided internally into two unequal portions, endosperm and embryo by a layer. The endosperm contains the reserve food material for the nourishment of embryo.

3. Embryo. It consists of (a) a single cotyledon, and (b) a short axis. The cotyledon is shield shaped and supplies food material to the growing embryo. The upper part of the axis with minute leaves is known as plumule, and the lower part is called radicle. The plumule and radicle are surrounded by separate protective sheaths *(Fig. 24C)*.

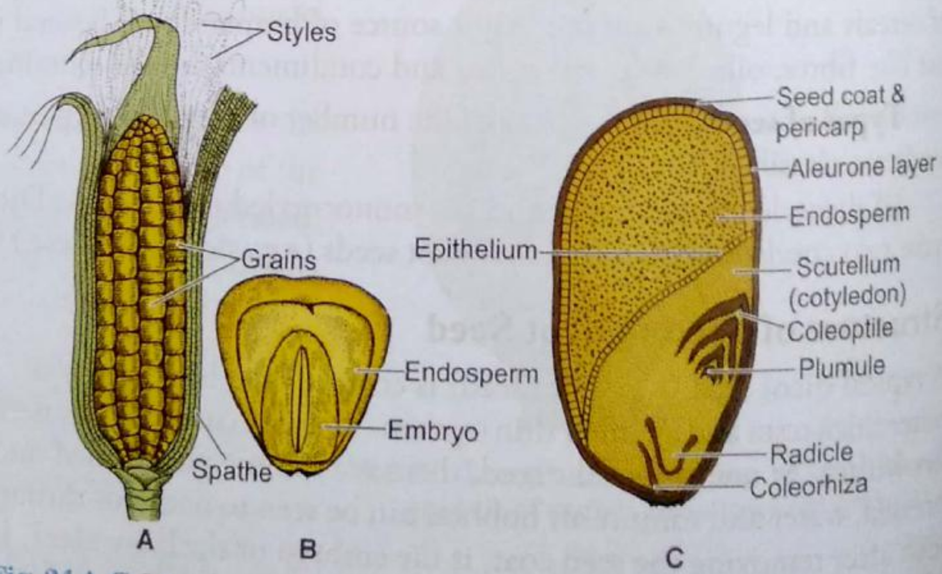


Fig. 24 A-C. Maize grain : A. cob; B. entire grain; C. grain in longitudinal section.

Table 1. Differences between a bean seed and a maize grain

S. No.	Bean seed	Maize grain
1.	Bean seed is dicot.	Maize seed is monocot.
2.	Seed is contained separately in a fruit grain.	Seed coat is fused with fruit wall to form a grain.
3.	Embryo is large.	Embryo is small.
4.	The cotyledons store reserve food which provide nourishment to the developing embryo.	The endosperm contains the reserve food for the nourishment of the developing embryo.

SEED GERMINATION

Under favourable conditions, the seeds grow into young seedlings. This process is known as germination. During germination, the embryo forms root and shoot. Several metabolic processes

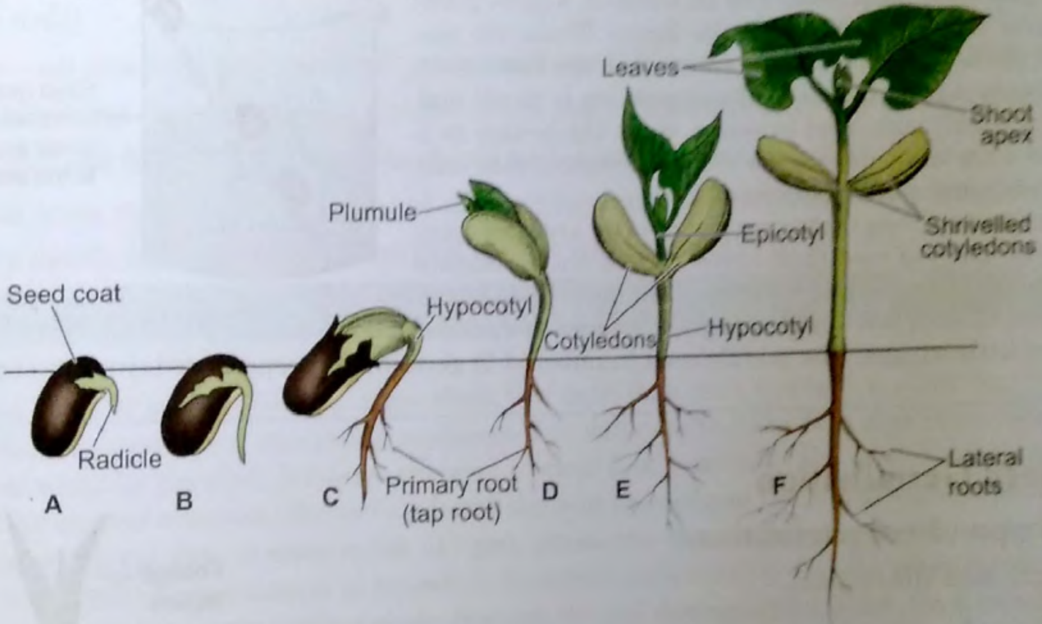


Fig. 25 A-F. Successive stages of the germination of bean seed (showing epigeal germination).

occur during the process of germination. The first step in germination is the uptake of water by the seed. It causes the seed to swell and eventually the seed coat ruptures. With this, the growth of the embryo resumes. The radicle forms the root system and the plumule grows into shoot. The young seedling utilizes the food stored in the cotyledons or in the endosperm until it becomes independent *(Fig. 25 A-F, 26 A-D).*

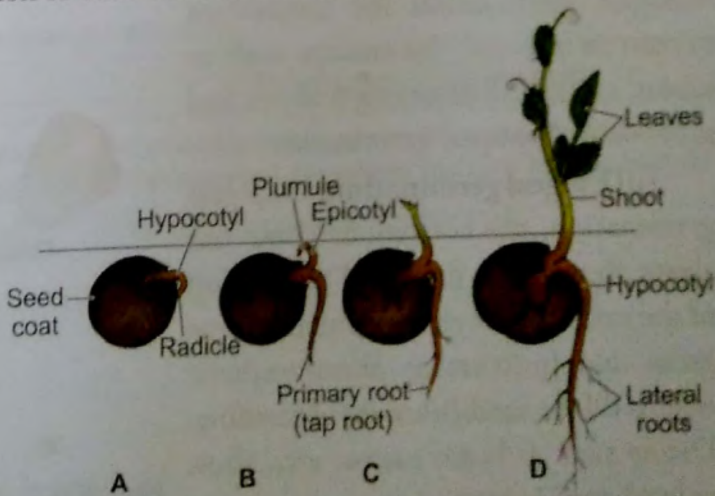


Fig. 26 A-D. Successive stages of the germination of pea seed (showing hypogeal germination).

Conditions Required for Germination

The most important factor which determines

Scanned with CamScanner

germination of the seed is its own viability. Suitable moisture (water), warmth (temperature) and oxygen are three important external conditions that affect seed germination. Uptake of water is the first step in seed germination. It causes the seed to swell and eventually the seed coat ruptures. With this, the growth of the embryo resumes. Suitable temperature is necessary for the physiological processes going on within the seed during germination. The optimum temperature is 25°-35°C for most seeds. In most cases, seeds fail to germinate at lower temperature. Oxygen (air) is necessary for germination, since energy released by the process of respiration is required for germination.

ACTIVITY 8

Aim : To show that oxygen and water are necessary for seed germination.

Necessity for oxygen and water for seed germination can be demonstrated easily by 'three bean seeds experiment' *(Fig. 27)*. For conducting the experiment, take a beaker and fill it 3/4 th with water. Take three bean seeds and tie them on a glsss plate with the help of thread as shown in the figure. Then, dip the glass plate in the beaker in such a manner that the lowermost seed is completely dipped in water, the upper one is in air and the middle one is half immersed in water. Keep the beaker in a warm place for a few days. After a few days, we observe that only the middle seed (numbered 2) germinates.

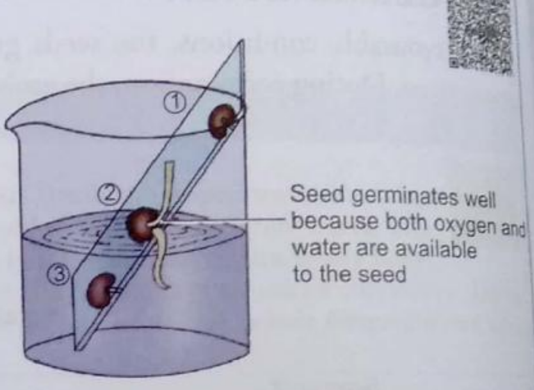


Fig. 27. Three bean seeds experiment.

This experiment shows that oxygen and water are necessary for germination. The top seed (numbered 1) does not germinate because it gets only oxygen and no water. Similarly the bottom seed (numbered 3) does not germinate well because it receives water but very little oxygen. The middle seed (numbered 2) germinates properly as it receives both oxygen and water.

Types of Seed Germination

There are two types of seed germination, *viz.*(i) hypogeal, and (ii) epigeal.

(i) Hypogeal germination. In hypogeal germination the cotyledons remain in the soil. Monocots such as wheat, maize and dicots such as pea and gram show hypogeal germination.

(ii) Epigeal germination. In epigeal germination, the cotyledons come out above the soil by the rapid elongation of the axis. The cotyledons then become green and function as photosynthetic organs till the establishment of seedling. Dicots such as bean, castor, etc., show epigeal germination.

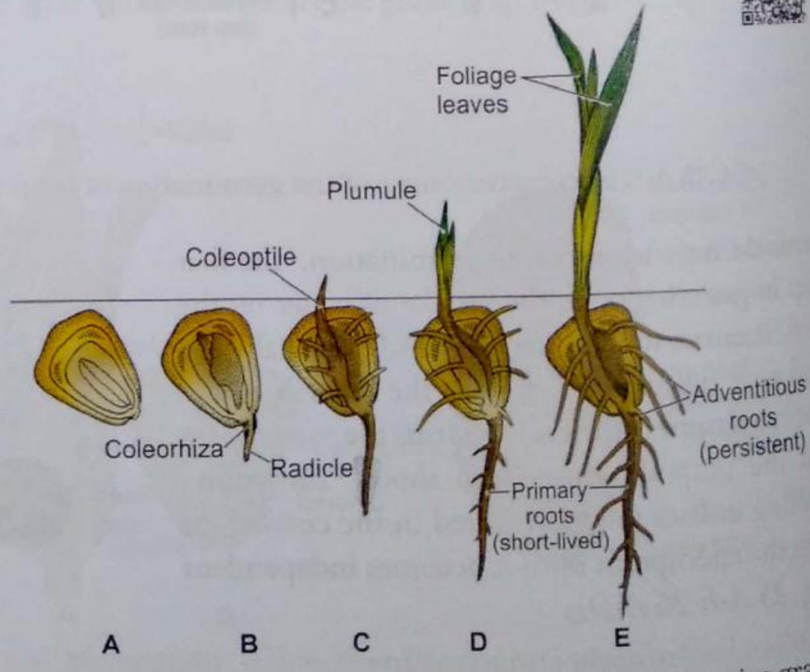


Fig. 28 A-E. Successive stages of the germination of maize grain.

Germination of Some Common Seeds

1. Bean—an example of epigeal germination. The seed swells up by absorbing water and as a result, the seed coat bursts. The radicle comes out first and forms the tap root. Then the axis (hypocotyl) grows quickly and forms a loop which comes out of the soil and pulls out the rest of the seed. The seed coat is cast off and the cotyledons come up above the soil, open out like two leaves and become green. As cotyledons unfold, plumule begins to grow and forms young foliage leaves. The food material stored in the cotyledons is used up by the developing plant and the cotyledons gradually shrivel up *(Fig. 25 A-F)*.

2. Pea—an example of hypogeal germination. First of all, the pea seed swells up considerably by absorbing water. As a result, the seed coat bursts. The radicle comes out first through the micropyle and forms the root system. Thereafter, the epicotyl(axis) elongates and pushes the plumule upwards which forms the shoot system. The cotyledons, however, remain under the soil and gradually dry up and wither away *(Fig. 26 A-D)*.

3. Maize—an example of hypogeal germination. The maize seed is endospermic and during its germination cotyledon and endosperm remain in the soil. First of all the seed absorbs water. Thereafter, the radicle comes out from its sheath (coleorhiza) and develops into a primary root. The primary root is short-lived and soon replaced by a cluster of adventitious roots. Thereafter, the plumule grows upward, by breaking its sheath (coleoptile), and the first foliage leaf emerges *(Fig. 28 A-E)*.

Activity 9

Aim : To study the germination of seeds.

Take a few seeds of pea or bean and place them in a petri dish with wet cotton. After 3 or 4 days you will find that the seeds grow into young seedlings. You will note that the first step in germination is the uptake of water by the seed. It causes the seed to swell and eventually the seed coat ruptures. With this, the growth of the embryo resumes. The radicle forms the root system and the plumule grows into the shoot.

You will also observe that in some seeds like pea, gram, etc. the cotyledons remain inside the soil during germination. Such type of germination is known as hypogeal germination. On the other hand, in some other seeds like bean, the cotyledons are pushed above through the soil during germination. Such type of germination is called epigeal germination.

Table 2. Differences between epigeal and hypogeal germination

S. No.	Epigeal germination	Hypogeal germination
1.	Cotyledons get pulled above because the hypocotyl elongates faster than epicotyl.	Cotyledons remain under the soil because the epicotyl elongates faster than hypocotyl.
2.	Cotyledons are pushed out above the soil.	Cotyledons remain in the soil.
3.	Example : bean, castor.	Example : pea, maize.

SUMMARY

- The body of a flowering plant can be divided into two fundamental parts : (i) an underground root system, and (ii) an above ground shoot system.
- The root system grows downwards into the soil and anchors the plant firmly in the soil and absorbs water and various minerals from it.
- The shoot comprising of stem and its lateral organs, the leaves, grows upwards into the air.
- Leaves are highly specialised organs, designed to manufacture carbohydrate food by green cells.
- The leaf is a flattened, lateral outgrowth of the stem developing from a node and having a bud in its axil.
- A typical leaf has three main parts : Leaf base, petiole and lamina.
- Depending upon the incision of the lamina, leaves may be simple or compound.
- Phyllotaxy is the mode of arrangement of the leaves on the stem and its branches.
- Leaves may arrange themselves on the stem or branch in three different ways, *viz*., alternate, opposite, and whorled.
- The arrangement of veins and veinlets in the leaf lamina is called venation.
- There are two types of venation, *viz*., (i) reticulate, (ii) parallel.
- In some plants, leaves are modified to perform some specialized function. Leaf tendrils, leaf spines, scale leaves, pitcher and bladder are some important modifications of the leaves.
- Stems, roots and leaves of flowering plants are variously modified to bring about vegetative propagation.
- Flowers are the most beautiful manifestations of biological world. There is a considerable variation in size, shape and colour of flowers.
- The reproductive parts of a flowering plant are located in the flower.
- A typical flower has four sets of appendages which are arranged in definite whorls on a flat or cup-shaped structure called receptacle or thalamus. The outer two whorls are known as accessory whorls and the inner two whorls are essential whorls.
- The accessory whorls are calyx and corolla. The calyx forms the outermost whorl, usually made up of green coloured leafy structures called sepals. Corolla is the second whorl of the flower, usually made up of large and brightly coloured leafy structures called petals.
- The inner two whorls of floral organs are androecium and gynoecium. The androecium is the male part of the flower and consists of one or more stamens. The gynoecium is the female part of the flower made up of one or more carpels. The gynoecium is differentiated into ovary, style and stigma.
- The ovary has one or more chambers, known as locules, and bears ovules.
- Each ovule has an egg cell, which functions as female gamete.
- Pollination is the transfer of the pollen grains from the anther of a flower to the stigma of the same flower or of another flower.
- There are two kinds of pollination, *viz*., (i) self-pollination, and (ii) cross-pollination.
- Wind, water, insects, birds, bats, etc., are the various agencies which help in cross-pollination.
- The act of fusion of one male gamete with egg cell is known as fertilization.
- Ultimately the fertilized egg (zygote) develops into a multicellular embryo, the ovules develop into seeds, and the ovary develops into fruit, and the ovary wall becomes the wall of the fruit.
- After fertilization, most of the parts of the flower wither off and significant changes occur inside the ovary.
- The fruit is a mature or ripened ovary. Fruits may be dry or fleshy.
- The seed is a fertilized mature ovule which possesses an embryonic plant, usually stored food material and a protective coat.
- On the basis of the number of cotyledons, seeds are classified into (i) dicotyledonous seeds, and (ii) monocotyledonous seeds.
- Under favourable conditions, the seeds grow into young seedlings. This process is known as germination.
- The most important factor which determines germination of the seed is its own viability. Suitable moisture (water), warmth (temperature) and oxygen are three important external conditions that affect seed germination.
- There are two types of seed germination, *viz*., (i) hypogeal, and (ii) epigeal. In hypogeal germination, the cotyledons remain in the soil, whereas in epigeal germination, the cotyledons come out above the soil by the rapid elongation of the axis.

EXERCISE

[A] Long answer based questions

1. Describe various modifications of the leaf.
2. Explain with suitable examples the different types of phyllotaxy.
3. How do the various leaf modifications help plants?
4. Describe the structure of bean seed.
5. What is a flower? Describe the parts of a typical flower.
6. What is pollination? Describe the characteristic feature of the flowers where pollination is brought through the agency of insects.
7. With the help of neatly labelled sketches, briefly outline the stages in the germination of a bean seed.
8. Briefly explain the factors that are necessary for germination.

[B] Short answer based questions

1. How would you distinguish a dicot leaf from a monocot leaf by external observations only?
2. How is a pinnately compound leaf different from a palmately compound leaf?
3. How is the process of pollination different from fertilization?
4. Draw a labelled diagram of the longitudinal section of a flower.
5. Differentiate between wind- and insect-pollinated flowers.
6. Enumerate the various agents of cross-pollination.
7. What is a fruit? State the significance of fruits.
8. State the fate of each of the following after fertilization has been affected :

(a) ovule	(b) ovary wall
(c) calyx	(d) corolla
(e) stamens	(f) stigma and style.

[C] Very short questions with answers

1. Name a plant where leaf is modified into a tendril.

   Ans. Wild pea.
2. What term is given to the arrangement of leaves on the stem?

   Ans. Phyllotaxy.
3. Name two different types of compound leaves.

   Ans. Pinnately and palmately compound leaves.
4. What is pulvinus?

   Ans. Swollen leaf base is known as pulvinus.
5. Name two plants that show alternate phyllotaxy.

   Ans. China rose, mustard.
6. Name two essential whorls of a flower.

   Ans. Androecium and gynoecium.
7. What is vegetative propagation?

   Ans. Regeneration of new plants from the vegetative parts of the parent plant is known as vegetative propagation.
8. In a fertilized ovule, which tissue provides nutrition to the developing embryo?

   Ans. Endosperm.
9. What is pollination?

   Ans. Pollination is the transfer of pollen grains from the anther of a flower to the stigma of the same flower or another flower of the same species.
10. Which type of pollination occurs in maize?

    Ans. Cross-pollination; by wind.

11. What technical term is used for the group of sepals in a flower?

Ans. Calyx.

12. Name the male and female reproductive organs of flower.

Ans. Androecium and gynoecium respectively.

13. Name a plant in which vegetative propagation takes place by means of leaves.

Ans. *Bryophyllum*.

14. Name the two types of leaves.

Ans. Simple and Compound.

15. What is the main function of leaves?

Ans. To carry out photosynthesis.

16. How many kinds of arrangement of leaves are found in plants? Name them.

Ans. Three types; alternate, opposite and whorled.

17. Define venation. Name its two major types.

Ans. The arrangement of veins and veinlets in the leaf lamina is called venation; Reticulate and paralle are two major types of venation.

18. What type of pollination occurs in ribbon weed?

Ans. Cross-pollination; by water.

19. Tell three important external conditions that affect seed germination.

Ans. Suitable moisture, warmth (temperature) and oxygen.

20. Name the two types of seed germination.

Ans. Hypogeal and epigeal.

[D] True or false statements

1. The leaf of *Citrus* is a simple leaf.
2. In maize grain, the fruit wall remains fused with testa.
3. A dry pea seed will have more dry weight than a germinated one.
4. Oxygen is not necessary for seed germination.
5. The male reproductive part of the flower is called gynoecium.
6. Botanically, the tomato is a fruit.
7. Dicots such as pea show epigeal germination.
8. A typical leaf has three main parts : leaf base, petiole and lamina.
9. In simple leaves, the incisions of the lamina reach up to the mid-rib (rachis) and the lamina is divided in several small segments, known as leaflets.
10. Venation is the mode of arrangement of leaves on the stem and its branches.

Answers

1. False 2. True 3. True 4. False 5. False 6. True 7. False 8. True
9. False 10. False.

[E] Fill in the blanks

1. A carpel is composed of three parts : ________, ________ and ________.
2. The part of the embryo above the cotyledons is called ________ .
3. Seed is a fertilized ________.
4. A fertilized egg is known as ________.
5. The male and female reproductive organs of a flower are respectively ________ and ________.
6. In self-pollination, the pollen grains of a flower are transferred to the ________ of the same flower.
7. Reticulate venation is a characteristic feature of ________ plants.
8. The point of attachment of a leaf to the stem is known as ________ .

9. ___________ is the male reproductive organ of a flower.
10. ___________ is the outermost whorl of a flower.
11. ___________ is the process of fusion of male gamete with female gamete.
12. In cactus, leaves are modified into ___________.
13. In pitcher plant, ___________ are modified for trapping insects.
14. ___________ pigment imparts green colour to a leaf.
15. Ovules grow into ___________ and ovaries into ___________ after fertilization.
16. Three conditions necessary for seed germination are ___________, ___________ and ___________.

Answers

1. stigma, style, ovary	2. epicotyl	3. ovule	4. zygote
5. androecium, gynoecium	6. stigma	7. dicot	8. leaf base
9. androecium	10. calyx	11. fertilization	12. spines
13. leaves	14. chlorophyll	15. seeds, fruits	16. oxygen, water, suitable temperature.

[F] Match the following

Plant structure	Their relative functions
1. Leaf	(i) It nourishes the plant embryo
2. Ovary	(ii) It became seed after fertilization
3. Flower	(iii) It provides the site for food production
4. Stamen	(iv) Reproductive part of the plant and help in plant maturation
5. Ovule	(v) It becomes fruit after fertilization
6. Endosperm	(vi) Helps in production of pollen grains for fertilization

Answers

1. (iii) 2. (v) 3. (iv) 4. (vi) 5. (ii) 6. (i).

[G] Differentiate between

1. Alternate and whorled phyllotaxy
2. Reticulate and parallel venation
3. Compound leaf and a branch
4. Self and cross-pollination
5. Dry and fleshy fruits
6. Pollination and fertilization
7. Hypogeal and epigeal germination
8. Radicle and plumule

[H] Give one term for the following

1. A flower in which all the four whorls are present.
2. Flowers having both the essential whorls.
3. The male and female flowers are borne on separate plants.
4. A ripened ovary.
5. Pollination brought about by wind.
6. Flat, thin, broad, extended portion of the leaf.
7. Stalk of the leaf.

8. Arrangement of veins and veinlets in leaf is known as.
9. Male reproductive part of flower.
10. Female reproductive part of flower.
11. Fertilised mature ovule, which possess future embryonic plant and storage of food material.
12. Reproductive part of plant.
13. Pollination by insects.

Answers

1. complete	2. bisexual	3. dioecious	4. fruit
5. anemophily	6. lamina	7. petiole	8. venation
9. androecium (stamen)	10. gynoecium (carpel)	11. seed	12. flower
13. entamophilly.			

[I] Objective type questions

1. A flower with sepals, petals, stamens and carpels is said to be :
   - a. complete
   - b. incomplete
   - c. unisexual
   - d. imperfect
2. Which of the following is mismatched?
   - a. Anther — Produces pollen grains
   - b. Gynoecium — Produces pollen
   - c. Ovary — Becomes fruit
   - d. Ovule — Becomes seed
3. A fruit is :
   - a. a ripened ovary
   - b. an enlarged ovule
   - c. a mature pollen
   - d. a mature female gametophyte
4. The anther contains :
   - a. carpels
   - b. ovules
   - c. pollen grains
   - d. fruits
5. After fertilization, fruit is derived from :
   - a. stamen
   - b. endosperm
   - c. ovule
   - d. ovary
6. The part of a flower that bears ovules is :
   - a. sepal
   - b. petal
   - c. stamen
   - d. carpel
7. The female part of the flower is :
   - a. calyx
   - b. corolla
   - c. androecium
   - d. gynoecium
8. The fusion of a male and a female gamete results in the formation of :
   - a. egg
   - b. sperm
   - c. spore
   - d. zygote
9. Conditions necessary for seed germination are :
   - a. water and oxygen
   - b. water and suitable temperature
   - c. oxygen and suitable temperature
   - d. water, oxygen and suitable temperature
10. How many leaves are present at each node in alternate phyllotaxy?
    - a. Nil
    - b. Only one
    - c. Two
    - d. More than two

Answers

1. (a) 2. (b) 3. (a) 4. (c) 5. (d) 6. (d) 7. (d) 8. (d) 9. (d) 10. (b)

UNIT 2

The Cell

Learning Outcomes

Children will be able to :

- *identify difference in unicellular and multicellular organisms and cite examples;*
- *observe cell (plant and animal) under microscope and discuss in class;*
- *identify the different cell organelles (cell wall, cell membrane, nucleus, chloroplast, vacuole) and learn about their primary functions;*
- *distinguish and draw diagrams of a plant cell and an animal cell.*

Chapter Outlines

- Introduction
- Plant Cell and Animal Cell
- Structure of Plant Cell
- Structure of Animal Cell
- Cell Shape and Size
- Cell Organelles
- Facts about Cell

INTRODUCTION

The cell is the fundamental structural and functional unit of all living beings. In unicellular organisms where a single cell represents the whole body, it carries out all vital functions of the body. But in multicellular organisms where the body is made up of many types of cells, the cells undergo differentiation and specialize to perform a specific function.

KNOW MORE

The study of cell in all aspects of life is called Cell Biology or Cytology.

ACTIVITY 1

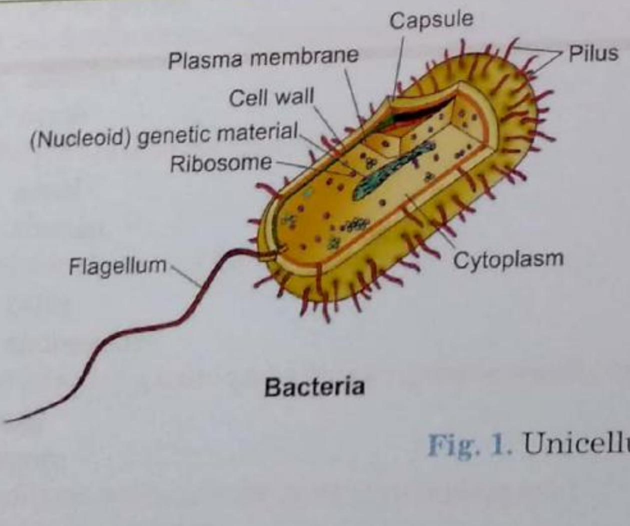
Aim : Study unicellular organisms such as *Amoeba* and *Chlamydomonas* with the help of their permanent slides or charts or photographs.

Observation : *Amoeba* does not possess cell wall. It does not have well defined shape. There is presence of false feet called pseudopodia.

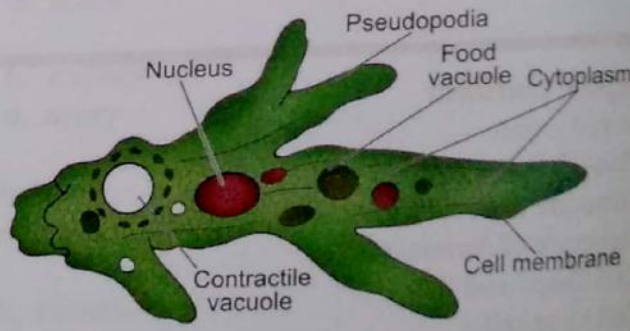
Chlamydomonas is green algae oval in shape. It is biflagellated. There is presence of eyespot and contractile vacuole.

Table 1. Some unicellular and multicellular organisms

S. No.	Unicellular Organisms (single celled)	Multicellular Organisms (many celled)
1.	*Amoeba*	Human beings
2.	*Paramecium*	Lion
3.	Yeast	Monkey
4.	Bacteria	Mango tree
5.	*Chlamydomonas*	Holy basil plant



Bacteria



Amoeba

Fig. 1. Unicellular organisms.

Lion

Tree

Fig. 2. Multicellular organisms.

Cells are very-very small objects and thus we can not see them with the naked eyes. To study these small objects, we need certain instruments, called microscopes. Microscopes can magnify the image of an object. These help us in observing fine details of every minute object. Simple magnifying glass and the compound microscope (or light microscope) are the two common types of magnifying instruments used in biological laboratories *(Figs. 3, 4, 5)*.

Activity 2

Aim : To study different types of microscopes.

Visit a biological laboratory with your teacher. See the various instruments present in the laboratory. You will find microscope as an indispensable instrument in a biology laboratory. As we are unable to see the objects smaller than 0.1 mm by our naked eyes, to study micro-organisms and other smaller objects we need microscope which provides a magnifying view of the object. You will find several types of microscopes in the school laboratory, which are used for different purposes. However, hand lens and simple dissecting and compound microscopes are commonly used. With the help of your teacher, study the different parts of various types of microscopes. Also draw the outline diagram of the microscope.

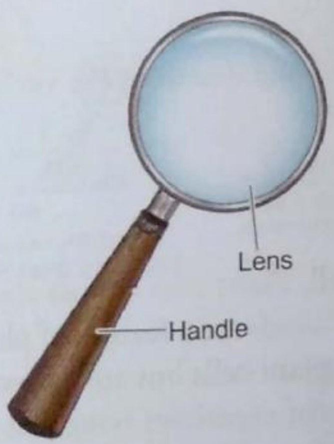


Fig. 3. A hand lens.

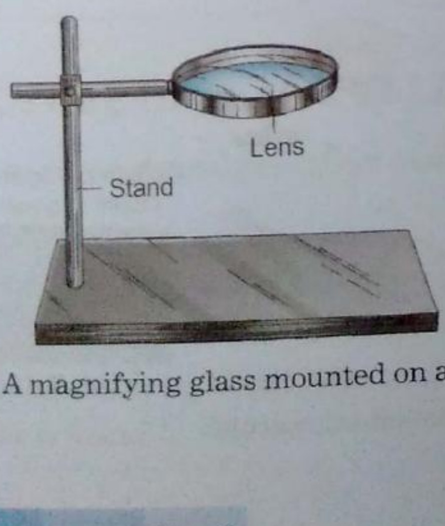


Fig. 4. A magnifying glass mounted on a stand.

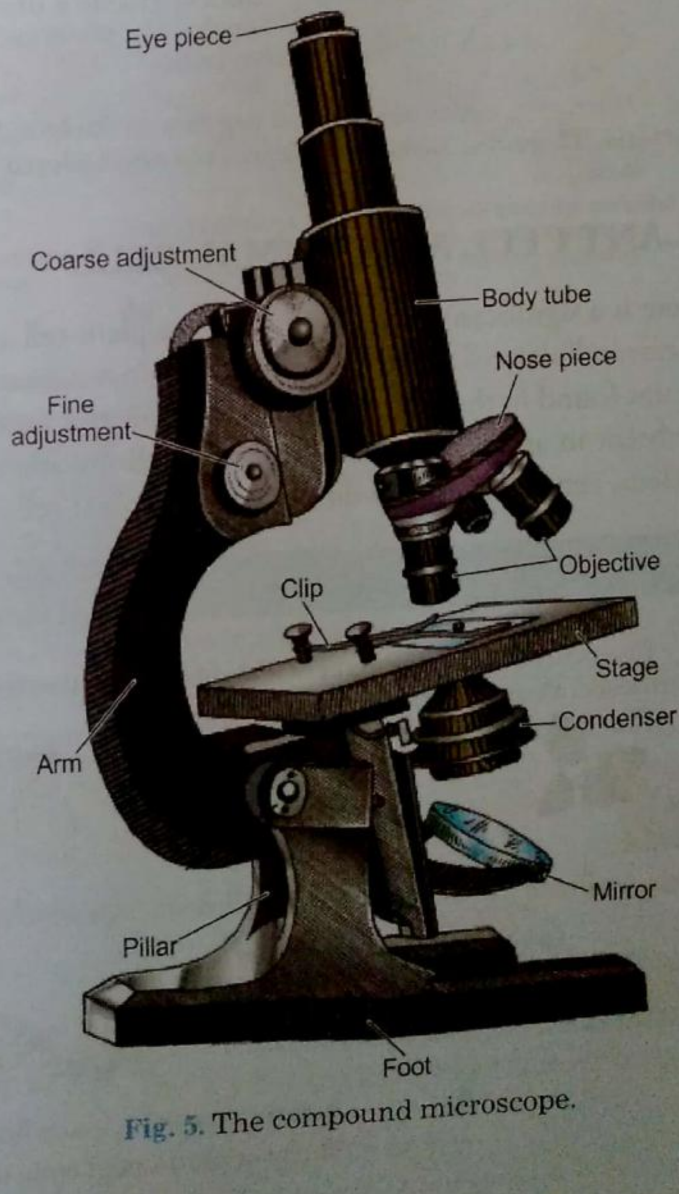


Fig. 5. The compound microscope.

2. Cytoplasm. It is the jelly-like fluid protoplasmic matrix which surrounds the nucleus and constitutes the true internal milieu of the cell. It contains several organelles, such as mitochondria, plastids, etc.

3. Nucleus. The nucleus is generally spherical in shape and controls all the processes of a cell.

STRUCTURE OF ANIMAL CELL

On looking human check cells under compound microscope (*Fig. 10, fig 12*). It is observed that cell wall is absent in animal cell. There is presence of small vacuole and intense network of endoplasmic reticulum. Plastids are absent in animal cells.

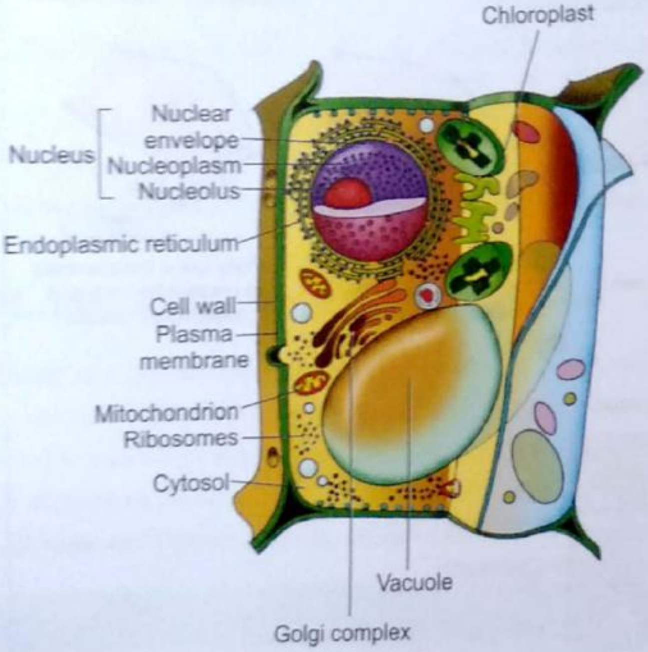


Fig. 11. Plant cell.

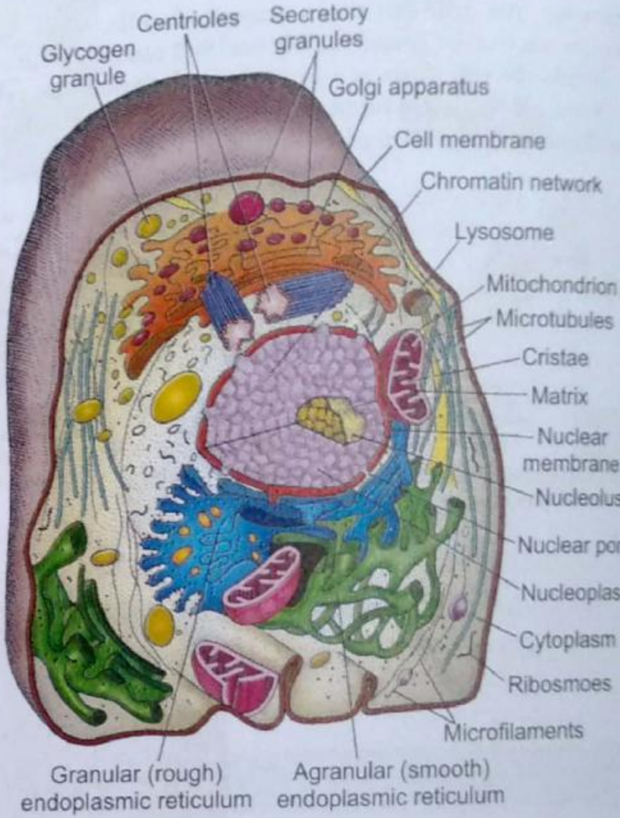


Fig. 12. Animal cell.

Table 2. Comparison in animal and plant cells

S. No.	Plant Cell	Animal Cell
1.	Plant cells are large in size and rectangular or cubical in shape.	Animal cells are small in size and irregular in shape.
2.	Plant cells have cell wall around the cell membrane or plasma membrane.	Animal cells have no cell wall.
3.	Plastids are present.	Plastids are absent in animal cells.
4.	Plant cells do not have centriole.	Animal cells contain centriole to help in cell division.
5.	Vacuole is well developed.	Vacuole is absent or less developed.

CELL SHAPE AND SIZE

There is a great variety in size, form, structure and functions of cells *(Fig. 13 A-G)*. They range in size from several centimetres in diameter (*e.g.*, ostrich egg cell) to 0.0001 millimetre (*e.g.*, some minute bacteria). The nerve cells found in mammals may attain a length of more than a metre.

> **KNOW MORE**
>
> Ostrich egg cell is about 176 mm in diameter.

The shape of the cells is also much variable. They may be of any form and may change their shapes according to their position and functional adaptations.

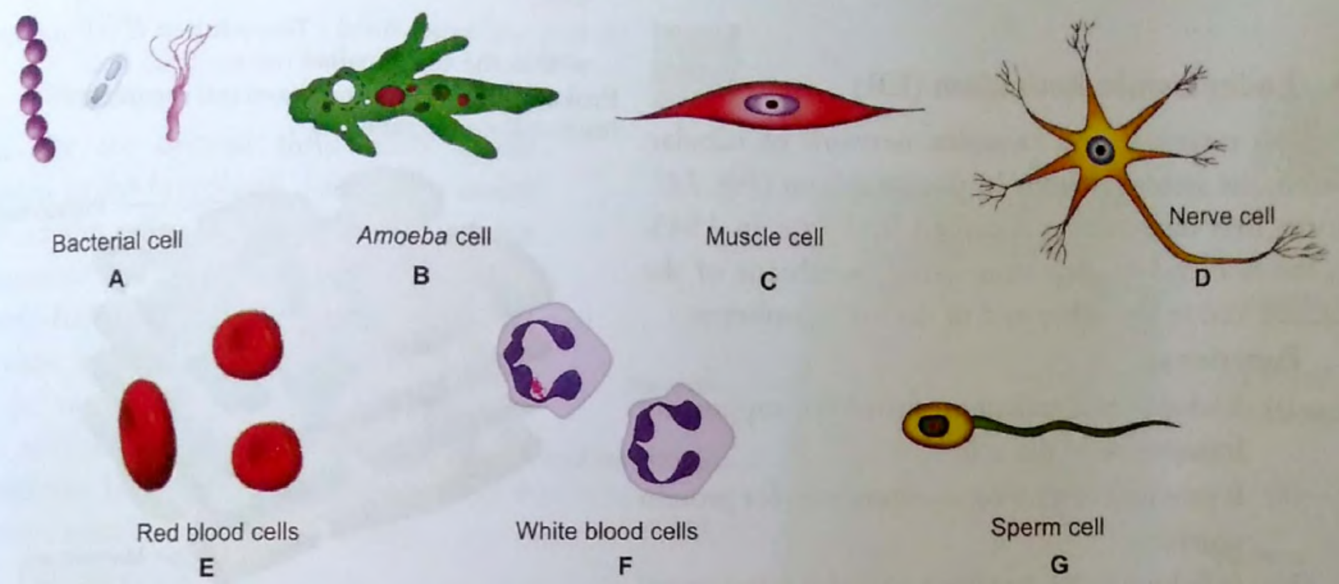


Fig. 13 A-G. Various types of cells.

CELL ORGANELLES

On the basis of presence or absence of membrane, cell organelles are classified into two categories :

(a) Membranous (b) Non-membranous

Cell Organelles

- Membranous
  - Single membranous
    1. Endoplasmic reticulum
    2. Golgi body
    3. Lysosome
    4. Vacuole
  - Double membranous
    1. Mitochondria
    2. Nucleus
    3. Plastids
- Non-membranous
  1. Ribosome
  2. Centrosome

ACTIVITY 5

Study various cell organelles of a plant/animal cell with the help of charts or electron micrographs. Study the various cell organelles, such as mitochondria, chloroplast, nucleus, Golgi apparatus and lysosomes. Draw diagrams and write the important features and functions of them.

Each organelle has a definite shape, structure and function. Structure and functions of some of the cell organelles is given below :

KNOW MORE

1. **Extracellular fluid** : The solution of cell which occurred outside the cell is called extracellular fluid.
2. **Intracellular fluid** : The solution of cell matrix within the cell is called intracellular fluid.

Prokaryotic cell does not have cell organelles (intracellular organelles).

✦ Endoplasmic Reticulum (ER)

It is an extensive and complex network of tubular membrane system present in the cytoplasm *(Fig. 14)*. It was first observed and named by Porter in 1945. At the one end it joins from outer membrane of the nucleus and at the other end to the cell membrane.

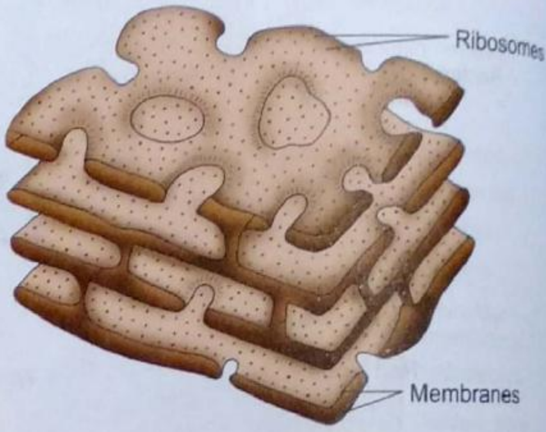


Fig. 14. Endoplasmic reticulum.

Functions :

(i) Endoplasmic reticulum forms the supporting framework of the cell.

(ii) It provides surface to the ribosomes for protein synthesis.

(iii) It helps in the synthesis of lipids, cholesterol and intracellular transport.

✦ Golgi Body

It is single membrane organelle *(Fig. 15)* named after Camillo Golgi; who was first to report this structure in 1898. It is found in all the eukaryotic cells. In the plant cells they are called dictyosomes. The shape, size and number of Golgi bodies vary considerably in different types of cells. It arises from the membrane of endoplasmic reticulum.

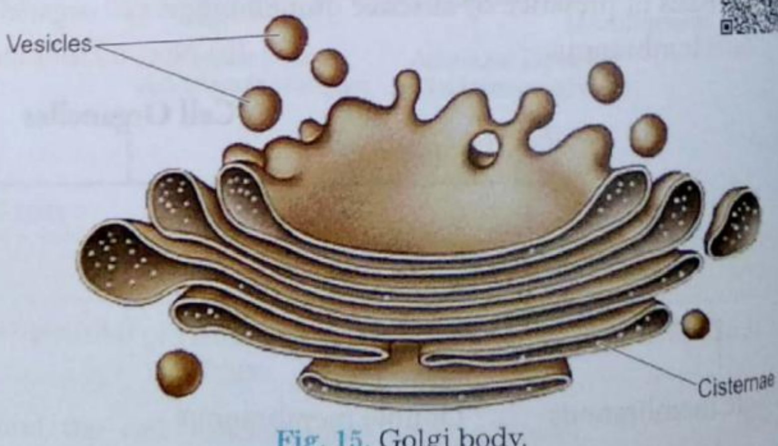


Fig. 15. Golgi body.

Functions :

(i) Golgi body is primarily associated with the secretion of polysaccharides, proteins, enzymes and lipids.

(ii) In plant cells, Golgi body is involved in the formation of cell wall material.

✦ Lysosome

Lysosomes are tiny spherical sac-like structures, commonly called suicidal bags.

Lysosomes are common in animal cells. Lysosomes are single membrane organelle and contain hydrolytic enzymes that can digest all the cell material.

Functions :

(i) The main function of lysosome is protection from the foreign invaders such as bacteria, viruses, etc.

(ii) Under certain conditions, it may digest its own cell. Therefore, they are also called as suicidal bags.

✦ Vacuole

Vacuoles are distinct fluid filled spaces present in the cytoplasm. In plants a major part of the cell is occupied by single large vacuole *(Fig. 16)*. Animal cells on the other hand, have either several small vacuoles or these may be absent. The fluid present in the vacuole is termed as cell sap. Cell sap is comparatively less dense than the cytoplasm. Each vacuole is surrounded by a delicate membrane called tonoplast.

Functions :

(i) Vacuoles help the cells in maintaining rigidity and turgidity.

(ii) Cell sap stores minerals and other solutes.

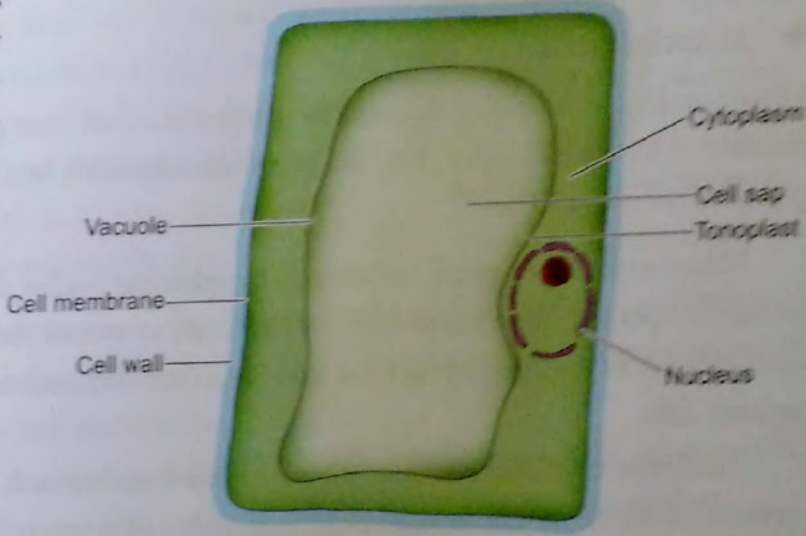


Fig. 16. Plant cell showing vacuole.

✦ Plastids

Plastids are membrane bound organelles present only in plant cells. They are involved in the synthesis and storage of food substances.

On the basis of their colour, plastids are of three types :

1. **Chloroplast :** Green coloured plastids.
2. **Chromoplast :** All coloured plastids (other than green).
3. **Leucoplast :** Colourless plastids.

Functions :

(i) Chloroplasts play an important role in photosynthesis from which food products are formed.

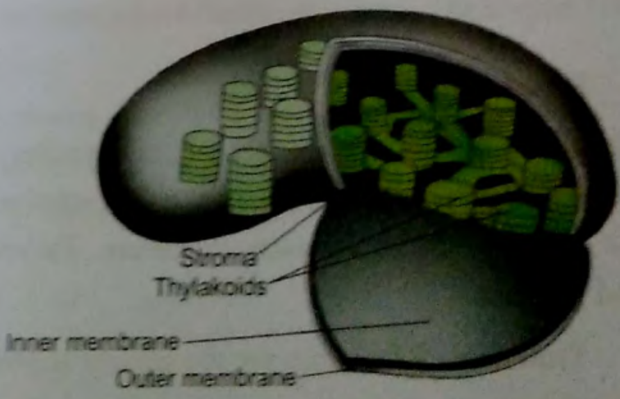


Fig. 17. Structure of chloroplast in 3-dimensional view.

(ii) Chromoplasts are responsible for bright colour of fruit and flowers in plants.

(iii) Leucoplasts are responsible for the storage of food.

Chloroplasts. Chloroplasts are disc-shaped structures present in all green plants. These plastids contai the photosynthetic pigment-the chlorophyll. Each chloroplast is enclosed by a double membrane. The spac enclosed by the double-membraned envelope is stroma. Embedded in the stroma (matrix) are several stacks o disc-shaped membrane layers, called grana. The membranes forming the grana are known as thylakoid *(Fig. 17).*

Functions :

(i) Chloroplast provides green colour to plant body.

(ii) It helps in the preparation of food by the plant during photosynthesis.

✦ Mitochondria

Mitochondria, commonly known as powerhouse of the cell, were discovered by Kolliker in 1880. The term mitochondria was, however, given by Benda (1897).

Mitochondria are small rod-shaped or spherical bodies distributed in the cytoplasm. Their number varies from one to several thousands in each cell. Plant cells in general have lesser number of mitochondria than animal cells.

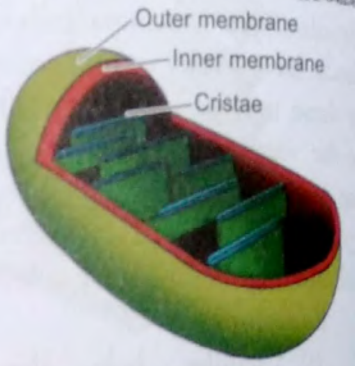


Fig. 18. Mitochondrion.

Each mitochondrion is bound by a double membrane. It has a large central cavity filled with a semi-fluid material, called matrix. The outer membrane of mitochondrion is smooth whereas the inner membrane has many infolds which extend into the matrix. These infoldings are known as cristae *(Fig. 18).*

Functions : Mitochondria are often described as powerhouse of the cell. They generate energy from food materials in the form of ATP. They are the sites for aerobic respiration in the cell. ATP is the energy rich compound commonly called energy currency of the cell.

✦ Ribosome

Ribosomes are the non-membranous organelles of the cell *(Fig. 19).* They are present freely distributed in the cytoplasm or are attached on the surface of the endoplasmic reticulum. They are made up of RNA and proteins.

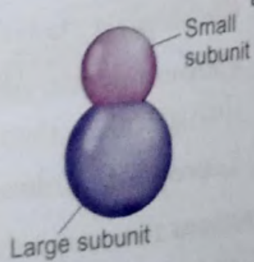


Fig. 19. Structure of ribosome.

Function : Ribosomes are the centres of protein synthesis.

✦ Centrosome

Centrosome is a small body situated above the nucleus in animal cells. Each centrosome consists of a pair of cylindrical structures called centrioles. Centrioles are the non-membranous organelle of the cell *(Fig. 20)*.

Function : Centrosome helps in the formation of spindle fibres during cell division.

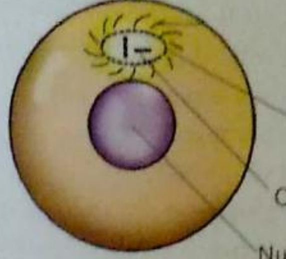


Fig. 20. Centriole : general view.

✦ Nucleus

Nucleus is the largest and distinct cell organelle which controls all the activities of the cell. The credit for the discovery of nucleus goes to Robert Brown (1831). Generally there is one nucleus in each cell but this number may vary in different types of cells. The shape and size of the nucleus varies with the type and functions of the cell. Typically, nucleus has the four parts, *viz.* 1. Nuclear membrane, 2. Nucleoplasm, 3. Nucleolus, and 4. Chromatin *(Fig. 21)*.

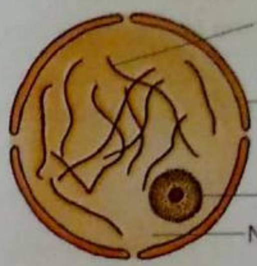


Fig. 21. Nucleus.

1. Nuclear membrane. The nuclear membrane is the outer envelope of the nucleus. It is made up of two unit layers. The membrane has numerous small pores, called nuclear pores. Nuclear pores allow the movement of materials between cytoplasm and nucleoplasm.

2. Nucleoplasm(Nuclear sap). The nucleus is filled with a transparent granular matter called nucleoplasm or nuclear sap. Nucleolus and chromatin material remain present in the nucleoplasm.

3. Nucleolus. The nucleolus usually appears as a spherical body and is not bounded by a membranous envelope. It is the site of ribosome formation.

4. Chromatin. The chromatin is the genetic material, found in the form of intertwined mass of thread like structures called chromatin threads. The chromatin is composed of deoxyribose nucleic acid (DNA) and proteins. DNA has all the information necessary for the cell functions. Small segments of DNA which control a particular character are called genes.

When a cell prepares itself for division, the chromatin material gets condensed into thick thread like structures, called chromosomes. Chromosome number is constant for a particular organism. All the chromosomes present in a normal cell are in pairs. For instance, human beings have 46 chromosomes (present in 23 pairs) in each cell.

Functions :

(i) Nucleus controls all the activities of the cell.

(ii) Nucleus contains hereditary (genetic) information. The hereditary information is transferred to the offsprings.

FACTS ABOUT CELL

- Smallest cell → Mycoplasma
- Largest cell → Ostrich egg
- Longest animal cell → Nerve cell
- Largest plant cell → *Acetabularia* (Algae)
- Longest plant cell → Phloem fibre
- Smallest virus → Foot and mouth disease virus
- Largest virus → Influenza virus
- Smallest cell organelle → Ribosome
- Largest plant cell organelle → Vacuole
- Largest animal cell organelle → Nucleus
- Busiest cell organelle → Mitochondria
- Maximum surface area occupied by any organelle → Endoplasmic reticulum

SUMMARY

- Because of their small size, cells can only be observed with the aid of microscope.
- The discovery of cells is credited to an English microscopist Robert Hooke in 1665. He observed cork cells of bark (tree) and named these hollow spaces as cells.
- The cell is the structural and functional unit of life.
- The body of unicellular organism (*e.g.*, *Amoeba*, *Chlamydomonas*) is made up of single cell.
- Multicellular organisms are composed of more than one cell.
- Golgi complex is primarily associated with the secretion of polysaccharides, proteins, enzymes and lipids.
- The mitochondria are the centre for energy generation.
- The cellular fluid is referred to as cytosol.
- Nucleus controls all the activities of the cell; Besides, it contains hereditary (genetic) information.
- Both plants and animals have the same fundamental cell structure but differ in few characters.
- The cell, when seen under light microscope, shows following structures—(i) Cell wall (absent in animals), (ii) Plasma membrane, (iii) Cytoplasm, and (iv) Nucleus.
- The cell wall is hard and rigid, hence provides shape and mechanical support to the cell.
- The plasma membrane (cell membrane) is living membrane. It is composed of lipid and protein molecules.
- Endoplasmic reticulum forms the supporting framework of the cell. It also provides surface for the ribosomes for protein synthesis.
- Ribosomes are the centres of protein synthesis.
- Lysosomes, commonly called suicidal bags, contain hydrolytic enzymes.
- Chloroplast contains a green pigment known as chlorophyll, which plays an important role in photosynthesis.

EXERCISE

[A] Long answer based questions

1. Describe the structure of a plant cell. In which respect it differs from that of an animal cell.
2. Write short notes on :
   (a) Cell wall
   (b) Cell membrane
   (c) Lysosome
   (d) Mitochondria
3. Draw diagram of an animal cell and label its various parts.
4. What are plastids? Name different types of plastids and their functions.
5. Describe the structure and functions of Golgi apparatus.
6. Describe the structure and functions of nucleus.

[B] Short answer based questions

1. Briefly explain the functions of cell membrane.
2. What are the functions of nucleolus?
3. Write short notes on:
   (a) Centriole
   (b) Vacuole
   (c) Ribosome
4. Draw a labelled diagram of mitochondrion. Why is it called 'power house of the cell'?
5. Why do we call lysosomes as suicidal bags?

[C] Very short questions with answers

1. What is cell?

   Ans. Cell is fundamental structural and functional unit of life.
2. What is the main function of chloroplast?

   Ans. Chloroplast contains a green pigment, the chlorophyll which plays a significant role in photosynthesis.
3. What is ATP?

   Ans. ATP (adenosine triphosphate) is the energy rich compound and called energy currency of the cell
4. What is the composition of cell membrane?

   Ans. The cell membrane or biomembrane is composed of the lipid and protein molecules.
5. What is the principal function of leucoplast?

   Ans. Leucoplast is responsible for the storage of starch, fats and proteins.
6. Name the cell organelle responsible for photosynthesis.

   Ans. Chloroplast.
7. Name the cell organelle that have digestive enzymes to degrade foreign material.

   Ans. Lysosome.
8. Who coined the term 'cell'?

   Ans. Robert Hooke.
9. Name the outermost covering of a plant cell.

   Ans. Cell wall.
10. Name two unicellular organisms.

    Ans. *Amoeba*, *Chlamydomonas*.

11. Name the plastids which store starch.

Ans. Leucoplasts.

12. What is the name of the green pigment present in chloroplast?

Ans. Chlorophyll.

13. Which cell organelle synthesizes ATP?

Ans. Mitochondria.

14. Name the site of ribosome synthesis in a cell.

Ans. Nucleolus.

15. Which cell organelle is known as "Power house of the cell"?

Ans. Mitochondrion.

[D] True or false statements

1. Cell is the fundamental unit of life.
2. First living cell was observed by Robert Hooke.
3. What Robert Hooke saw were actually the suberised walls of the dead cork cells?
4. Cell wall is found only in animal cells.
5. Cell membrane is found in plant cells only.
6. Lysosomes degrade foreign material by the digestive enzymes (hydrolytic enzymes).
7. Nucleus controls all the activities of the cell.
8. Nucleolus are the site for protein synthesis.
9. Endoplasmic reticulum provides the site for lipid synthesis.
10. DNA is the genetic material of the life.
11. Plastids occur only in plant cells.
12. An ostrich egg is the largest animal cell.
13. Most part of a plant cell is occupied by a vacuole.
14. Plasma membrane is found in plant cells only.
15. Ribosomes are concerned with the synthesis of proteins.

Answers

1.	True	2.	False	3.	True	4.	False	5.	False	6.	True	7.	True	8.	False
9.	True	10.	True	11.	True	12.	True	13.	True	14.	False	15.	True.		

[E] Fill in the blanks

1. Cell is the __________ and __________ unit of life.
2. The term 'protoplasm' was proposed by __________.
3. Cell wall is made up of __________.
4. Cell organelle called __________ is often referred to as suicidal bag.
5. Lysosome is found only in __________.
6. In 1665 cells were discovered by __________.
7. Ribosomes are synthesized in __________.
8. Mitochondria release energy in the form of __________.

9. Cell membrane is mainly composed of __________ and __________.

10. Animal cells contain __________ to help in cell division.

Answers

1. structural, functional
2. J.E. Purkinje
3. cellulose (polysaccharide)
4. lysosome
5. animal cells
6. Robert Hooke
7. nucleolus
8. ATP
9. lipids, proteins
10. centrioles.

[F] Match the following

Organelles	Functions
1. Plasma membrane	(i) Carry the information of a character in the form of genes.
2. Ribosome	(ii) Site for protein synthesis
3. Endoplasmic reticulum	(iii) Give colours to plant
4. Chromosome	(iv) Generate energy
5. Mitochondria	(v) Regulate the activities of the cell
6. Plastid	(vi) Help in proteins and lipids synthesis
7. Nucleus	(vii) Regulate the movement of molecules or ions into the cell

Answers

1. (vii) 2. (ii) 3. (vi) 4. (i) 5. (iv) 6. (iii) 7. (v).

[G] Differentiate between

1. Cell membrane and cell wall
2. Plant cell and animal cell
3. Endoplasmic reticulum and Golgi body
4. Nucleus and nucleolus

[H] Give one term for the following

1. The study of cell.
2. The powerhouse of cell.
3. Cell organelle that helps in cell division.
4. Outermost part of the plant cell.
5. The important tool for the study of cells.

Answers

1. cytology
2. mitochondria
3. centriole
4. cell wall
5. microscope.

[I] Objective type questions

1. The term cell was proposed by :
   a. Robert Brown
   b. J.E. Purkinje
   c. Robert Hooke
   d. Leeuwenhoek
2. The fundamental unit of life is :
   a. cell
   b. cytosol
   c. cell skeleton
   d. cell organelles
3. Tonoplast is the outer covering membrane of :
   a. golgi complex
   b. mitochondria
   c. vacuole
   d. lysosome
4. Mechanical strength of the plant cell is provided by :
   a. cell wall
   b. plasma membrane
   c. cytoskeleton
   d. nucleus
5. Lysosomes arise from the :
   a. vacuoles
   b. mitochondria
   c. golgi complex
   d. ribosome
6. Which organelle release energy (ATP)?
   a. Chloroplast
   b. Mitochondria
   c. Golgi complex
   d. ER
7. Cell wall is composed of :
   a. DNA and RNA
   b. cellulose
   c. lipid and protein
   d. protein
8. Which organelle is not found in animal cells?
   a. Lysosome
   b. Chloroplast
   c. Mitochondria
   d. Golgi complex
9. Centrioles are found in :
   a. plant cells
   b. animal cells
   c. both of them
   d. none of these
10. Chromosomes are located in :
    a. ER
    b. golgi complex
    c. nucleus
    d. vacuole
11. Which of the organelle is responsible for the cell division?
    a. Golgi complex
    b. Nuclear membrane
    c. Centrioles
    d. Nucleolus
12. How many membranes are found in nuclear membrane?
    a. Three
    b. Four
    c. Two
    d. One
13. Which of the plant cell structure provides the mechanical strength to the cell and composed of cellulose fibres?
    a. Chloroplast
    b. Cell wall
    c. Biomembrane
    d. Vacuole

14. Animal cell differs from the plant cell in the presence of :

a. cell wall
b. plastids
c. centrioles
d. cell membrane

15. An organelle which occupies the maximum surface area :

a. endoplasmic reticulum
b. ribosome
c. mitochondrion
d. lysosome

Answers

1.	(c)	2.	(a)	3.	(c)	4.	(a)	5.	(c)	6.	(b)	7.	(b)	8.	(b)	9.	[illegible]	10.	[illegible]
11.	(c)	12.	(c)	13.	(b)	14.	(c)	15.	(a).										