UNIT II

The World of Living

Experiment 18

Aim

To prepare a stained, temporary mount of onion peel and to study its cells.

Theory

All living organisms are composed of cells. New cells arise by the division of pre-existing cells. Cell is the structural and functional unit of life. In plants, cells have an outermost rigid cell wall beneath which is a cell membrane. The cell membrane encloses cytoplasm, cell organelles, and a nucleus.

Materials Required

An onion bulb, slides, cover slips, two watch glasses, needle, brush, forceps, razor blade, compound microscope, blotting paper, methylene blue (or safranin) solution, glycerine, and water.

Procedure

1. Take one fleshy scale leaf of an onion. Break it into two and using a forcep pull out a thin membranous peel adhering to the inner surface of the leaf. This is the epidermal peel.
2. Place the peel in a watch glass containing water and cut it into small rectangular pieces.

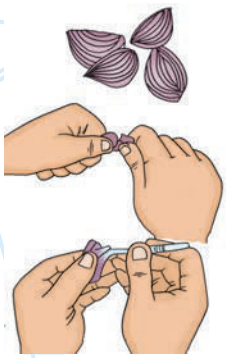


Fig. 18.1 : *(a) Method of removing an epidermal peel from onion leaf*

3. Mix 1 or 2 drops of methylene blue or safrarin in a small quantity of water taken in another watch glass and transfer the peels into it. Leave the peels for about 3 minutes. Dip the peel in water to remove excess stain.
4. Take a clean slide with a drop of glycerine in the middle and using a brush transfer the washed and stained peel on to it.
5. Place a cover slip over it by slowly lowering it with a needle. Avoid entry of air bubbles.
6. Remove excess glycerine from the edges of cover slip with the help of a piece of blotting paper.
7. Observe the slide under the microscope, first in low power and then in high power.
8. Draw a labelled diagram of the cells as seen under microscope.
9. Note the features listed in the observation table.

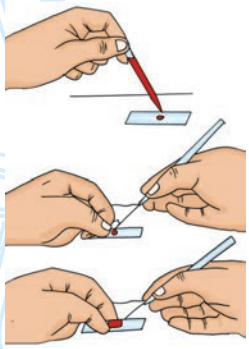


Fig. 18.1 : *(b) Staining and mounting the onion peel*

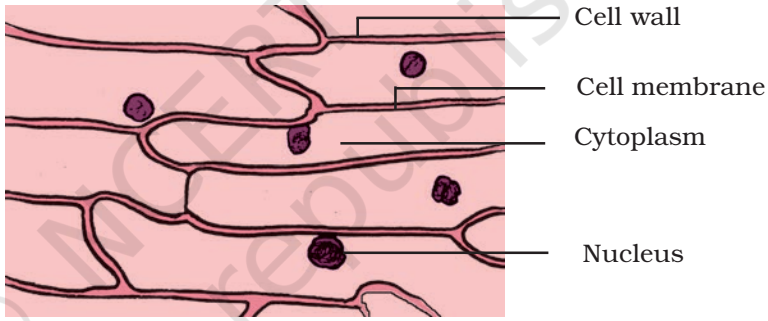


Fig. 18.2 : *Epidermal cells of an onion peel*

OBSERVATION TABLE

Sl.No.	Feature	Observation
1.	Shape of cells	spherical/oval/rectangular/square
2.	Arrangement of cells	compact/loose
3.	Inter-cellular spaces	present/absent
4.	Nucleus	present/absent
5.	Cell wall	present/absent
6.	Stained portions of cell	cell wall/cytoplasm/nucleus
7.	Unstained portions of cell	cell wall/cytoplasm/vacuole

Results and Discussion

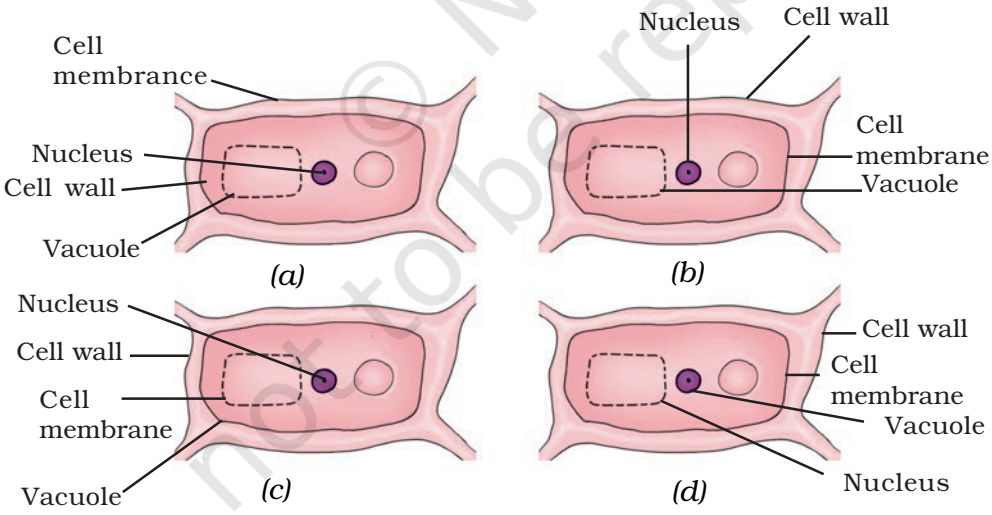
The cells that form the peel are rectangular in shape, compactly arranged and without any intercellular spaces. Each cell has a distinct cell wall, a prominent nucleus and a vacuole. The cells form the outer layer of the leaf known as epidermis.

Precautions

- Staining of the peel must be appropriate. Excess stain can be removed by rinsing the peel with water taken in a watch glass.
- Use a brush to transfer the peel on to the slide.
- While placing the cover slip care should be taken to avoid air bubbles.

Questions

- What is the size of nucleus in relation to size of cell?
- Name the stained parts of the cell.
- Pick the odd one out. (a) plastids, (b) large vacuoles, (c) cell wall, (d) centrioles.
- Which of the following is a correctly labeled cell of an onion peel?



Experiment 19

Aim

To prepare a temporary mount of human cheek epithelial cells, and to study its characteristics.

Theory

Like plants, the body of all animals including humans is composed of cells. Unlike plant cells, animal cells do not have cell wall. The outermost covering of an animal cell is a cell membrane. The cytoplasm, nucleus and other cell organelles are enclosed in it. Epithelial tissue is the outermost covering of most organs and cavities of an animal body.

Materials Required

Methylene blue stain, glycerine, a compound microscope, slide, cover slip, a clean spatula or a toothpick, a brush, a needle, and a piece of blotting paper.

Procedure

1. Rinse your mouth with fresh water.
2. With the help of a clean spatula or a toothpick, gently scrap the inner side of your cheek.
3. Transfer the scrapped material into a drop of water taken on a clean slide.

4. With the help of a needle spread the material uniformly.
5. Add a drop of methylene blue stain. After about 3 minutes put a drop of glycerine over it.
6. Place a clean cover slip over the glycerine. Remove the excess glycerine from the edges of cover slip with the help of a piece of blotting paper.
7. Examine the slide under microscope, first under low power and then under high power.
8. Draw diagrams of cells as seen under the microscope. Observe and record the features.

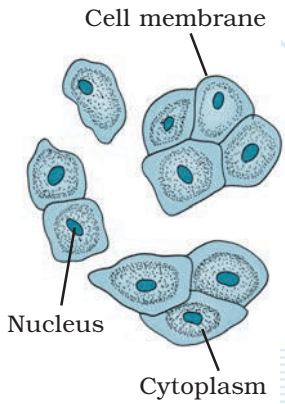


Fig. 19.1 : *A few Cheek cells*

Observations

Sl.No.	Feature	Observation
1.	Shape of cells	
2.	Arrangement	
3.	Intercellular space	
4.	Cell wall	present/absent
5.	Cell membrane	present/absent
6.	Cell contents	
7.	Vacuoles	

Results and Discussion

Epithelial cells are small, polygonal in shape and compactly arranged to form a continuous layer. The cells are without cell wall. Cell membrane encloses a distinct nucleus and a vacuole. Epithelial tissue forms the outermost covering of almost all the organs and various cavities of animals and human.

Precautions

- Cheeks should be scrapped gently to prevent injury.
- Spread the material on the slide so that it forms a thin uniform layer.
- Avoid over staining (or understaining) of the material.
- While mounting the cover slip, avoid entry of air bubbles.

Note for the Teacher

In such temporary preparations, cytoplasmic organelles are not visible because they are too small and are not stained by methylene blue.

Questions

- Arrange the following steps in correct sequence–
  (i) Putting a drop of glycerine on the cheek cells on a slide,
  (ii) Scrapping the inner side of cheek,
  (iii) Adding methylene blue stain, and
  (iv) Placing the cover slip over the material.
  (a) i, ii, iii, iv; (b) ii, i, iv, iii; (c) iv, ii, iii, i; (d) ii, iii, i, iv.
- Which one of the following is absent in animal cells–
  (a) Cell membrane, (b) Nucleolus, (c) Cell wall, (d) Cytoplasm
- Cheek epithelial cells are an example of
  (a) squamous epithelial cells, (b) cuboidal epithelial cells,
  (b) columnar epithelial cells, (d) all of these.
- Why are cheek epithelial cells always moist?
- Name two structures which you would see in cheek cells if you were using a very high magnifying power of microscope?

Experiment 20

Aim

To study the phenomenon of osmosis.

Theory

Every living cell has an extremely thin, elastic cell membrane, also called plasma membrane, which separates cell contents from the external environment. It is the outermost covering of animal cells. In plant cells, the membrane is present below the cell wall. It is selectively permeable as it allows solvent molecules and only selected solute molecules to pass through it. It differs from a permeable membrane which allows all types of molecules to pass through it. Movement of molecules of water or solvent from a region of its higher concentration to the region of its lower concentration across a selectively permeable membrane is called *osmosis*. It is of two types – endosmosis and exosmosis. Endosmosis is the entry of water into the cell while exosmosis is the movement of water out of the cell into the external solution. Endosmosis takes place, when the cell is placed in a hypotonic solution. Exosmosis takes place when the cell is placed in a hypertonic solution.

Materials Required

Two raw eggs, dil. hydrochloric acid, a salt (or sugar) solution of about 25% concentration in water (dissolve about 25 g salt in 100 mL water), beakers and petri dishes.

PROCEDURE 

1. Dissolve the shells of two eggs by placing them in two separate beakers containing dil. HCl. Hydrochloric acid dissolves the calcium chloride of the egg shells. The eggs will become de-shelled.
2. Carefully drain off the acid from the beakers and wash the eggs thoroughly with water while they are still in the beakers. Repeat this process several times till all traces of acid are completely removed.
3. Observe the de-shelled eggs.
4. Fill one beaker containing one de-shelled egg with water and the other beaker with another de-shelled egg with the concentrated salt (or sugar) solution.
5. Leave the set up for about four hours and observe the two de-shelled eggs.

OBSERVATIONS 

Observe the de-shelled eggs before and after placing them in water and concentrated salt (or sugar) solution respectively. And answer the following–

(i) What has happened to the de-shelled egg placed in water?

(ii) What has happened to the de-shelled egg placed in salt (or sugar) solution?

RESULTS AND DISCUSSION 

The de-shelled egg when placed in water swells because the concentration of water molecules outside the egg is much higher than the concentration of water molecules inside the egg, as a result of which endosmosis takes place and water from the beaker enters into the egg. Exosmosis takes place when the de-shelled egg is placed in a sugar (or salt) solution. The water comes out from the de-shelled egg into the (or salt) sugar solution. The loss of water results in the shrinkage of the egg.

PRECAUTIONS 

- While washing the de-shelled eggs, care should be taken to prevent the damage of egg membrane.
- Use dil. hydrochloric acid only lest the egg membrane gets damaged.

QUESTIONS

- What is the difference between endosmosis and exosmosis?
- What will happen if a de-shelled egg is placed in a solution with the same osmotic concentration as in the egg?
- Why did the egg swell when placed in water?
- Movement of water during osmosis takes place across–
  (a) cell wall, (b) cell membrane, (c) cytoplasm, (d) protoplasm.
- The plasma membrane which selectively allows solvent molecules and solute molecules to pass through it is–
  (a) a permeable membrane, (b) a selectively permeable membrane, (c) an impermeable membrane, (d) a semi-permeable membrane.

Experiment 21

Aim

To study plasmolysis in leaf epidermal peels of *Rhoeo* or *Tradescantia*.

Theory

Living cells generally contain plenty of water due to which they are turgid. Turgidity is an important attribute of cells as it gives shape to cells. When turgid cell is placed in salt (or sugar) solution, water moves out of the cell across its membrane into the external solution. As a result, the volume of protoplast decreases and the cell membrane withdraws from the cell wall creating an apparent colourless space within the cell. This shrinkage of protoplast inside a cell is termed plasmolysis.

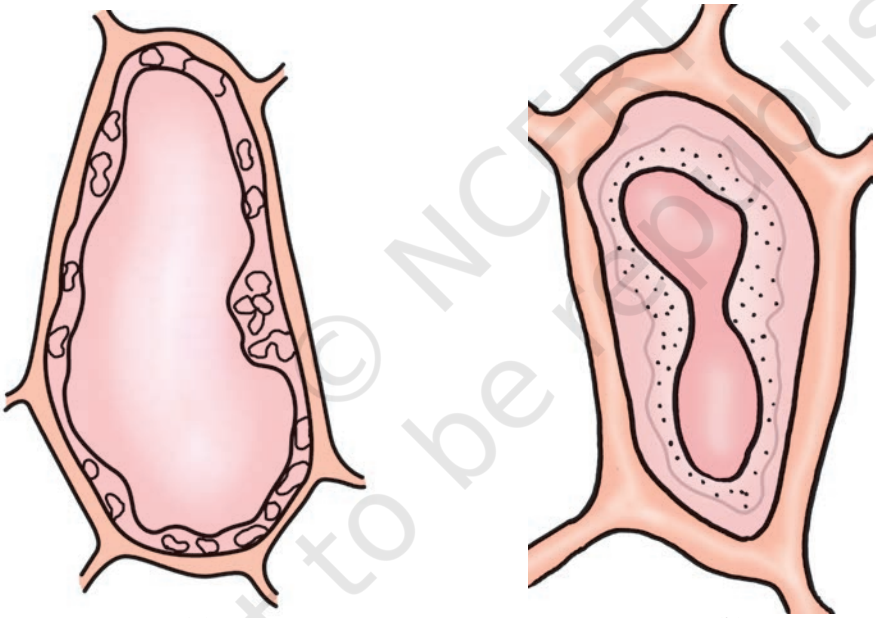
Materials Required

Compound microscope, fresh leaves of *Rhoeo* or *Tradescantia*, a sugar (or salt) solution of about 10 per cent concentration in water (dissolve about 10 g sugar in 100 mL water), a new razor blade, slide, cover slip, needle, forceps, brush, and a piece of blotting paper.

Procedure

1. Using a new razor blade, take out three or four small peels from the lower epidermis of leaf of *Rhoeo* or *Tradescantia.*

2. Mount one peel in a drop of water taken on a slide. Place a cover slip and observe under the low power of microscope. Notice the compact arrangement of polygonal cells. Each cell contains pink coloured protoplast. Draw a neat diagram of few cells in your notebook and shade the regions covered by the protoplast.
3. Count about 25 cells and note down how many of them are turgid and how many are plasmolysed.
4. Remove the cover slip. Add about five drops of sugar (or salt) solution on the peel.
5. After five minutes place a cover slip on the peel, blot out the excess solution from the sides of the cover slip. Focus the cells under the low power of microscope and observe.
6. Note down your observations. Draw some cells and shade the extent of pink coloured region in them.
7. Again count about 25 cells and note down how many of them are turgid and how many are plasmolysed.



(a) *(b)*

Fig. 21.1 : *(a) A normal cell and (b) a plasmolysed cell*

OBSERVATIONS

	No. of cells counted	Number of turgid cells	Number of plasmolysed cells
Peel in water			
Peel kept in salt (or sugar) solution			

Results and Discussion 

Based on the observations, analyse and reason out the causes for plasmolysis.

Precautions 

- Perform the experiment using coloured leaf samples like those of *Rhoeo*, *Tradescantia*, *Coleus*, etc.
- Use concentrated sugar (or salt) solution.
- Ensure complete immersion of peels in the solution.

Note for the Teacher

In the experimental peel, water from the cells moves out into the external solution by a process called exosmosis. This happens due to the fact that the cell sap is a weaker solution as compared to the external (salt or sugar) solution. Consequently, it has more water molecules than that in external solution. Due to this difference in the concentration of water inside the cell and the external solution, a concentration gradient is established. Due to this gradient, water moves out of the cell into the external solution. This results in a reduction in volume of protoplasm inside the cell hence the pink region appears shrunk in these cells. The phenomenon of losing water from cells leading to shrinkage of protoplast is called plasmolysis.

Questions

- What moves out from the cells in this experiment? Why?
- Why pigments and other cell contents do not move out of the cells?
- Why are living cells always turgid?
- What will happen if the cells are kept for a very long time in the salt (or sugar) solution? Explain.
- Between the cell sap and solution (salt or sugar) in the experiment, which is the hypertonic solution?
- Will plasmolysis occur when cells are placed in isotonic solution?

Experiment 22

Aim

To test the presence of starch in a given food sample and metanil yellow in pigeon pea.

Theory

The presence of starch in a given food sample (say in potato) can be determined using iodine solution. Starch is a carbohydrate that produces blue colour when brought in contact with the iodine solution.

Food products are often adulterated for economic gains. For example, metanil yellow is used to adulterate pigeon pea (arhar dal). Metanil yellow turns into pink colour when it reacts with the concentrated hydrochloric acid. Whereas the pieces of unadultrated sample does not exhibit such a change.

Materials Required

Potato, pieces of pigeon pea (arhar dal), iodine solution, concentrated hydrochloric acid, petridish, test tube, knife, and a dropper.

Procedure

A. To test the presence of starch in potato–

1. Wash a potato alongwith its skin.
2. Take a thin slice of potato in a petridish.

3. Add a few drops of iodine solution on the surface of the thin potato slice.
4. Observe the change in colour in the area of slice where iodine soluton was added.

B. To test the presence of metanil yellow in pigeon pea–

1. Take a few dry pieces of pigeon pea sample in a dry test tube.
2. Add a few drops of conc. HCl to these dry pieces.
3. Does the colour of the reaction mixture change?
4. Conclude whether the sample under test is adulterated or not?

Observations

(a) The colour of potato slice changes into _____ on addition of iodine solution.

(b) The colour of reaction mixture of pigeon pea sample when reacted with conc. HCl changes into _____ .

Results and Discussion

On the basis of observations comment on (a) presence of starch in potato and (b) whether the pigeon pea sample is adulterated with metanil yellow or not.

Note for the Teacher

- The starch test may also be performed on samples of rice, wheat flour etc.
- The presence of metanil yellow can also be detected in other food samples such as turmeric powder.

Questions

- In what form the food is stored in plants?
- Which is the common adulterant of arhar dal?
- What are the efects of adulteration of food items.
- Why do the old stock of potato taste sweet?
- What are the different adulterants commonly used in foods?

Experiment 23

Aim

To study parenchyma and sclerenchyma tissues in plants by preparing temporary slides.

Theory

Flowering plants are structurally complex as they are made up of different parts like roots, stem, leaves, flowers, fruits, etc. Each part is in turn an assembly of different types of tissues. Each tissue type has specific structure and performs a particular function. Plant tissues are broadly classified into meristematic and permanent tissues. Permanent tissues may be simple, permanent tissues like parenchyma, collenchyma and sclerenchyma. Complex permanent tissues are xylem and phloem. The structural features of tissues like wall characteristics, cell size, lumen size, and cytoplasmic contents are different in different tissues.

Materials Required

Tender stem of a herb (balsam/*Tridax*/*Petunia*/any cultivated ornamental herb or wild plant), safranin stain solution, dilute glycerine, chart of transverse section of stem, compound microscope, razor blade, slide, cover slip, brush, petri dish, and a piece of blotting paper.

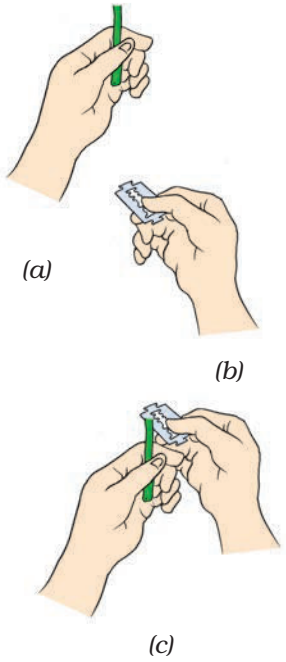


Fig. 23.1 : *(a) Correct way of holding the material;*
(b) Correct way of holding the razor blade; and
(c) cutting the section

PROCEDURE

A. Making a temporary slide

1. Cut a tender stem of any of the above-mentioned plants into bits of about 3 cm length and place them in water.
2. Hold a piece between the thumb and forefinger in your left hand as shown in Fig. 23.1 (a).
3. Pass a wet blade across the stem in quick motion so as to get a thin, unbroken, circular cross section of the material [Fig. 23.1 (b) and (c)].
4. Repeat the process to get about fifteen transverse sections of the material.
5. Transfer the sections to a petri dish containing water. Select a thin, transparent section and with a brush transfer it to a drop of water taken on a slide. Add three drops of dilute safranin stain solution to the section and leave it for about five minutes.
6. Blot the excess stain. Add three drops of dilute glycerine on the stained section. Place a cover slip on it. Focus it under the low power of microscope and observe the section.
7. Now focus the section under high power and observe again. Note and record your observations.
8. Starting from the outermost layer, locate the epidermis, cortex and vascular tissues [Fig. 23.2(a) and (b)]. compare the layers with the diagram in the chart.
9. In the layers of cells beginning from epidermis, observe the following features–

a.	Cell wall	thin/thick;
b.	Arrangement	compact/loose;
c.	Shape of cell	circular/oval/rectangular/polygonal;
d.	Intercellular spaces	present/absent;
e.	Lumen (cell cavity)	small/large;
f.	Nucleus	present/absent;
g.	Staining of cell wall	deeply stained/mildly stained/no stain; and
h.	Cytoplasm:	present/absent

10. Record your observations in the given tabular column.

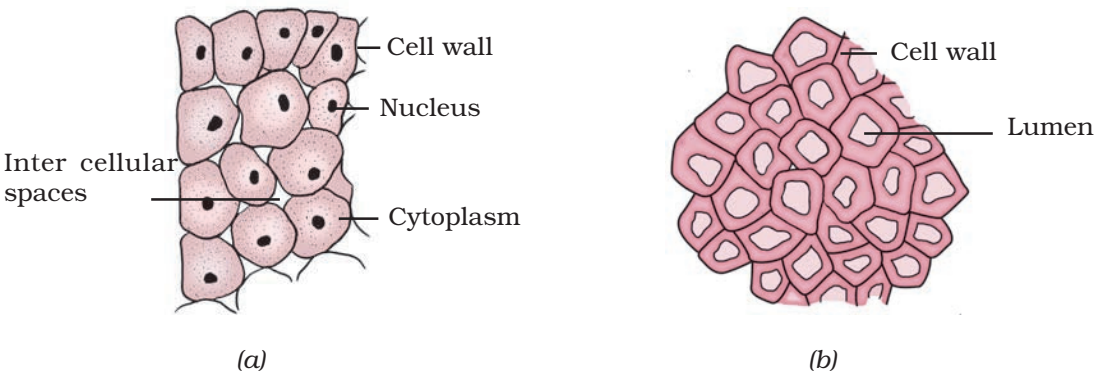


Fig. 23.2 : *(a) Parenchyma; and (b) sclerenchyma*

OBSERVATIONS

	Features	Parenchyma	Sclerenchyma
a.	Cell wall		
b.	Arrangement		
c.	Shape of cell		
d.	Intercellular spaces		
e.	Lumen		
f.	Nucleus		
g.	Staining of wall		
h.	Cytoplasm		

RESULTS AND DISCUSSION

Parenchyma tissue is the most abundant type of tissue in plants. It forms the major bulk of stem, roots, leaves, fruits and seeds. The tissue is composed of living cells, with various shapes, sizes and functions. The cells provide mechanical support to the plant body. The parenchyma also acts as a storage tissue for food, air and water. Cells of sclerenchyma tissue are higly lignified with very thick cell walls and obliterated lumen. Cells are usually elongated and polygonal in shape in cross-section. The tissue provides the mechanical support and is found below the epidermis and around the vascular bundles.

PRECAUTIONS

- For sectioning, select soft, tender herbaceous stem only. Avoid stems that are hard and woody.
- Take care not to injure your finger while sectioning.
- Always keep the plant materials and sections in water.
- Use dilute safranin stain solution.
- The trachea and tracheids of xylem tissue appear to be very much similar to sclerenchyma and may be erroneously identified as sclerenchyma tissue. Xylem is always confined to the vascular bundle and is generally not seen in the cortex or pith.

NOTE FOR THE TEACHER

- Features of parenchyma and sclerenchyma are given below for purpose of their identification

Parenchyma

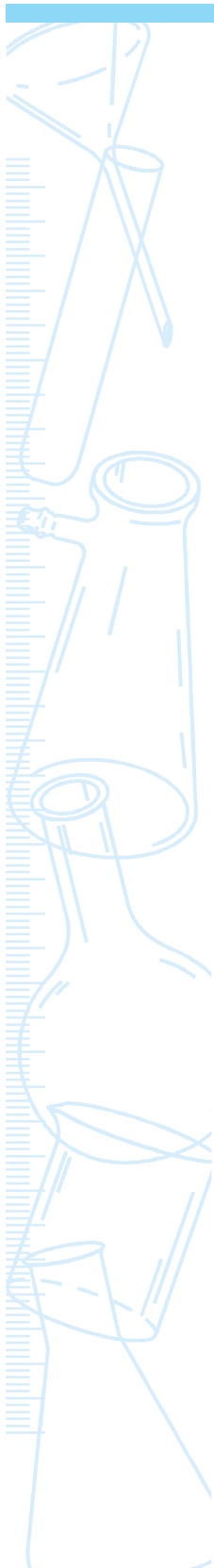
- Parenchyma constitutes the major type of tissue in plants.
- Parenchyma cells have very thin walls, may be circular, rectangular, oval or polygonal in shape, loosely arranged in most cases with intercellular spaces between cells. In some plants intercellular spaces are absent and the cells are compactly arranged.
- Parenchyma is composed of living cells with large internal space (lumen). Under the high power of microscope nucleus may be visible.
- Epidermis, cortex and pith are essentially composed of parenchyma tissue.

Sclerenchyma

- Sclerenchyma cells are generally found below the epidermis or just above the vascular bundles.
- The cells have very thick walls and they stain deep red when stained with safranin.
- Lumen is reduced and there is no nucleus [Fig. 25.3(b)].
- Cells are generally elongated in vertical section and polygonal in cross section; compactly arranged without any intercellular spaces.

QUESTIONS

- In the transverse section of stem which tissue occupies larger space-parenchyma or sclerenchyma?
- Draw an outline of the section of stem and indicate the regions where parenchyma and sclerenchyma are situated.
- Which tissue, when matured, has dead cells?
- Mention the main function of sclerenchyma tissue?
- You can bite fruits like guava, grapes, banana etc. but not a piece of wood. Why?



Experiment 24

Aim

To identify and study striated muscle fibre and nerve fibre in animals.

Theory

Animal body is made up of groups of similar cells which perform specific function. Such groups of identical cells are called tissues. There are four basic types of tissues: epithelial, connective, muscular, and neural. These tissues vary from each other not only in their structure but also in their functions.

Materials Required

Permanent slides of striated muscle fibre and nerve fibre, charts of animal tissues with straited muscle fibre and nerve cell (neuron), and compound microscope.

Procedure

1. Place a permanent slide of straited muscle fibre under a compound microscope.
2. Observe it first under low power and then under high power. Do you see an alternate arrangement of dark and light bands? Do you also find some nuclei along the fibre?

3. Identify the tissues with the help of charts. Draw diagrams of the tissues as seen under the microscope.
4. Replace the permanent slide of straited muscle fibre by the permanent slide of a nerve fibre. Identify different parts of a cell with the help of charts. Draw diagrams.

Observations

Striated Muscle Fibre – Under high magnification, the elongated fibre shows the presence of alternate arrangement of dark and light bands (Fig. 24.1). The dark bands represent thick filaments and the light bands represent thin filaments. Many nuclei are also observed along the fibre resulting from the fusion of many muscle cells. Such a condition is called syncytium. Cells of the tissue are long, cylindrical, non-tapering and unbranched.

Nerve Fibres – Under high magnification, the nerve fibre shows nerve cells which have three parts: a cell body, dendrites, and axon, The axon may or may not be surrounded by myelin sheath (Fig. 24.2).

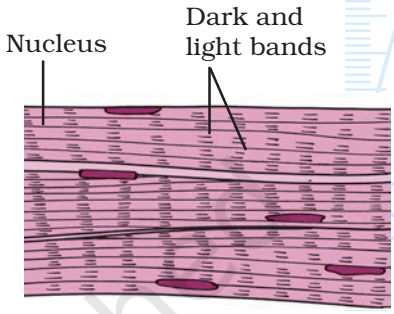


Fig 24.1 : *A striated muscle fibre*

Results and Discussion

Tissues are organised in a specific proportion and pattern to form different organs. Muscular tissue plays an important role in all the movements of body parts and also in locomotion. It consists of different types of muscle fibres, such as (i) striated, (ii) smooth, and (iii) cardiac muscle fibres. The striated muscle fibres work according to our will (voluntary) and get tired (fatigued) when overworked. The functioning of smooth and cardiac muscle fibres are not under our control (involuntary).

Neural tissue controls the body's responsiveness to changing conditions within and outside the body. The function of neural tissue is to allow communication between different parts of the body. It is composed of neurons, which transmit impulses. The neural tissues of an organism form its nervous system. The nervous system includes the brain, spinal cord, and nerves. Neural tissue is made of nerve cells which are distinctly characterised by the axon of the cell that sends nerve impulse to the next cell.

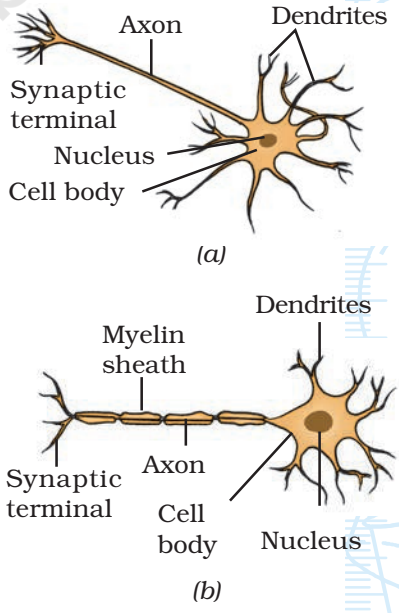


Fig. 24.2 : *(a) Non-myelinated nerve fibre; and (b) Myelinated nerve fibre*

QUESTIONS

- What are the features of striated muscle fibre? Where do we find these in our body?
- Mention the function of skeletal muscles in our body.
- What are the features observed in a neuron?

Experiment 25

Aim

To study the characteristics of *Spirogyra*, *Agaricus*, moss, fern, *Pinus* and an angiosperm plant.

Theory

We know that plants of different groups exhibit different characteristics. Thallophytes, bryophytes, pteridophytes, gymnosperms, and angiosperms are the five major groups of plants. This classification is essentially based on the structure of their bodies and methods of reproduction. Thallophytes have the simplest structure. The plant body becomes more complex from bryophytes onwards, and reaches its highest complexity in angiosperms.

Materials Required

Permanent slides of *Spirogyra*, specimen of *Agaricus*, moss, fern, *Pinus*, and an angiosperm such as *Petunia*, balsam, *Amaranthus*, *Chenopodium*, *Tridax* or other locally available plants, compound microscope.

Procedure

1. Observe the permanent slide of *Spirogyra* under low power of microscope and record your observations. Draw the diagram of *Spirogyra* and label the parts.
2. Likewise, observe and record the characters of *Agaricus*, moss, fern, *Pinus* and an angiosperm plant. Draw their diagrams.

OBSERVATIONS

Observe and record the features of *Spirogyra* and *Agaricus* in Table 1. For other materials (that is Moss, fern, *Pinus*, and angiosperm) record you observations in Table 2.

Table 1: Observations of the general features of *Spirogyra* and *Agarius* (edible mushroom)

Sl.No.	Feature	*Spirogyra*	*Agaricus*
1.	Size of the plant body: microscopic/macroscopic		
2.	Nature of the plant body: thallus/differentiated into root, stem and leaves		
3.	Thallus: filamentous; branched/ unbranched		
4.	Stem: present/absent		
5.	Roots: present/absent		
6.	Leaf: present/absent		
7.	Rhizoids: present/absent		
8.	Fruiting body with spores: present/absent		

Table 2: Observations of the general features of moss, fern, *Pinus*, and angiosperm

Sl.No.	Feature	Moss	Fern	*Pinus*	Angiosperm
1.	Size of the plant body: microscopic/macroscopic				
2.	Nature of the plant body: thallus/differentiated				
3.	Stem: (i) present/absent (ii) branched/unbranched				
4.	Rhizoids/roots: present/absent				
5.	Leaf: (i) simple/compound/needle-like (ii) midrib: present/absent (iii) Sori/Sporangia: present/absent				
6.	Cones: present/absent				
7.	Flower: present/absent				
8.	Fruits: present/absent				
9.	Seeds: present/absent				

General characteristics of all the specimens are given below for the purpose of identification.

Spirogyra (Fig. 25.1)

- The plant body is filamentous, unbranched and made up of cylindrical cells placed one above the other.
- Cells are longer with one or two spiral ribbon shaped chloroplasts.
- Each cell has a single large nucleus and a vacuole.

Agaricus (Fig. 25.2)

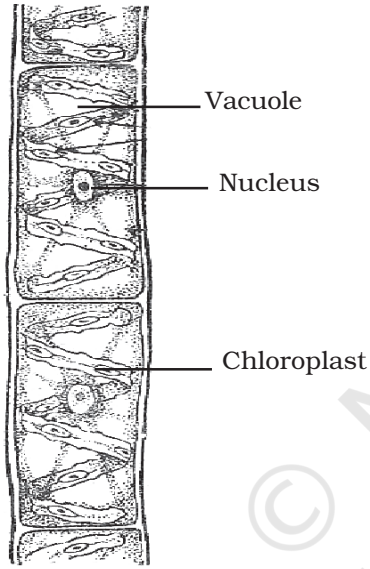


Fig. 25.1 : *Spirogyra*

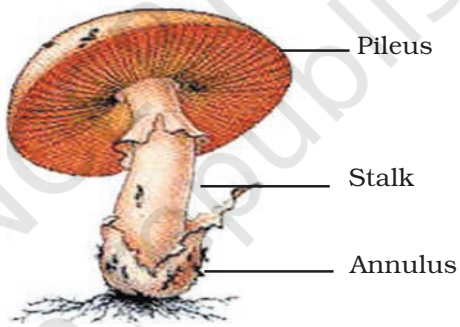


Fig. 25.2 : *Agaricus*

- We generally see a fruiting body of *Agaricus*.
- It is macroscopic and fleshy.
- A mature fruiting body is divided into a stalk and an umbrella like cap called pileus.
- A ring like membranous structure (annulus) is attached at the base of the stalk.
- The cap on its lower side has gills which bear spores.

Moss (Fig. 25.3)

- The thallus is about three to five cm long, differentiated into central axis, leaves, and root-like structures (called rhizoids).
- The central axis is erect, branched or unbranched.
- Tiny flat green leaves are arranged spirally on the stem.
- Rhizoids are long and multiseptate and are present at the base of the central axis.

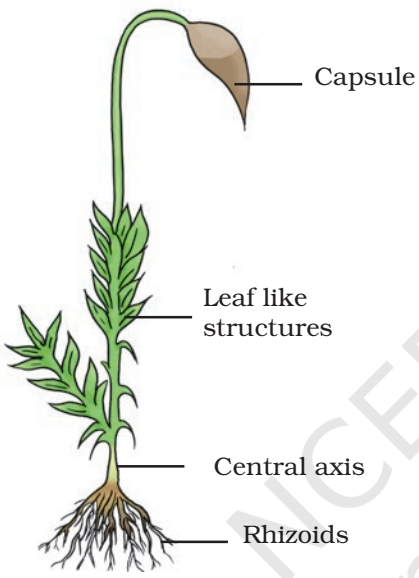


Fig. 25.3 : *Moss*

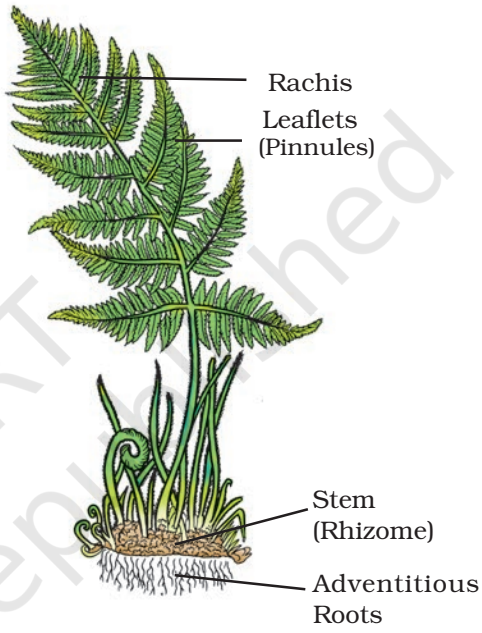


Fig. 25.4 : *Fern*

Fern (Fig. 25.4)

- The plant body is well differentiated into root, stem and leaves.
- Stem is short, stout and underground.
- From the adventitous buds on the stem arise large, compound leaves. Leaflets are small and arranged on either side of the rachis.
- Clusters of adventitous roots arise from the underside of the stem near each node.

Pinus (Fig. 25.5)

- Pinus is a tree with stem, leaves and roots.
- Stem is hard, woody and has branches bearing scaly and needle-like leaves and cones.
- Male and female cones are the reproductive organs.

- Male cones are small and tender; female cones are large and woody when mature.

Angiospermic Plant (Fig. 25.6)

- The plant body is divided into roots, stem, and leaves.
- Stem bears distinct nodes and internodes.
- Leaves arise from nodes.
- Plants bear flowers and fruits.
- Roots may be of fibrous (monocot plants) or tap-roots (dicot plants).

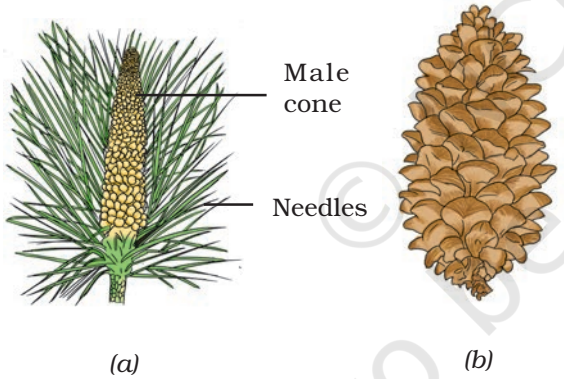


Fig. 25.5 : *(a) Male cone of Pinus; (b) Female cone of Pinus* (not to the scale)

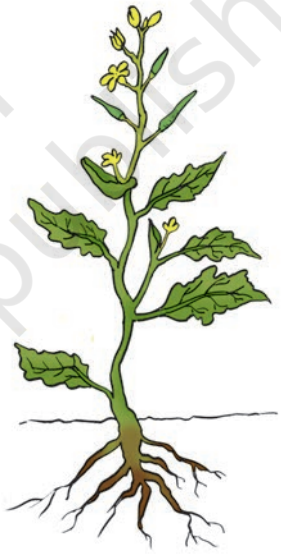


Fig. 25.6 : *An Angiosperm*

QUESTIONS

- Why is a *Spirogyra* plant green in colour?
- Name two functions that are common to roots and rhizoids?
- What do the cones in pine represent?

Experiment 26

Aim

To prepare herbarium sheet of a flowering plant.

Theory

Herbarium sheets are generally prepared by botanists and stored systematically in a laboratory for an immediate reference. It consists of a thick white sheet of a specific dimension on which a dried plant specimen is mounted. The mounted specimen must have leaves, flowers and fruits (optional). Only one plant specimen is mounted on a herbarium sheet. Herbarium sheets have to be carefully preserved to prevent insect infestation. The term Herbarium refers to the place (such as a laboratory) where herbarium sheets are preserved systematicly and are made available for reference.

Materials Required

Plant specimen or a twig of a plant (20 – 25 cm long) with leaves and flowers, a thick white sheet (card sheet) of dimension 40 × 28 cm, old news papers or blotting sheets, adhesive, field press with a long rope or a heavy mass (such as a brick or a book), sewing needle, and thread.

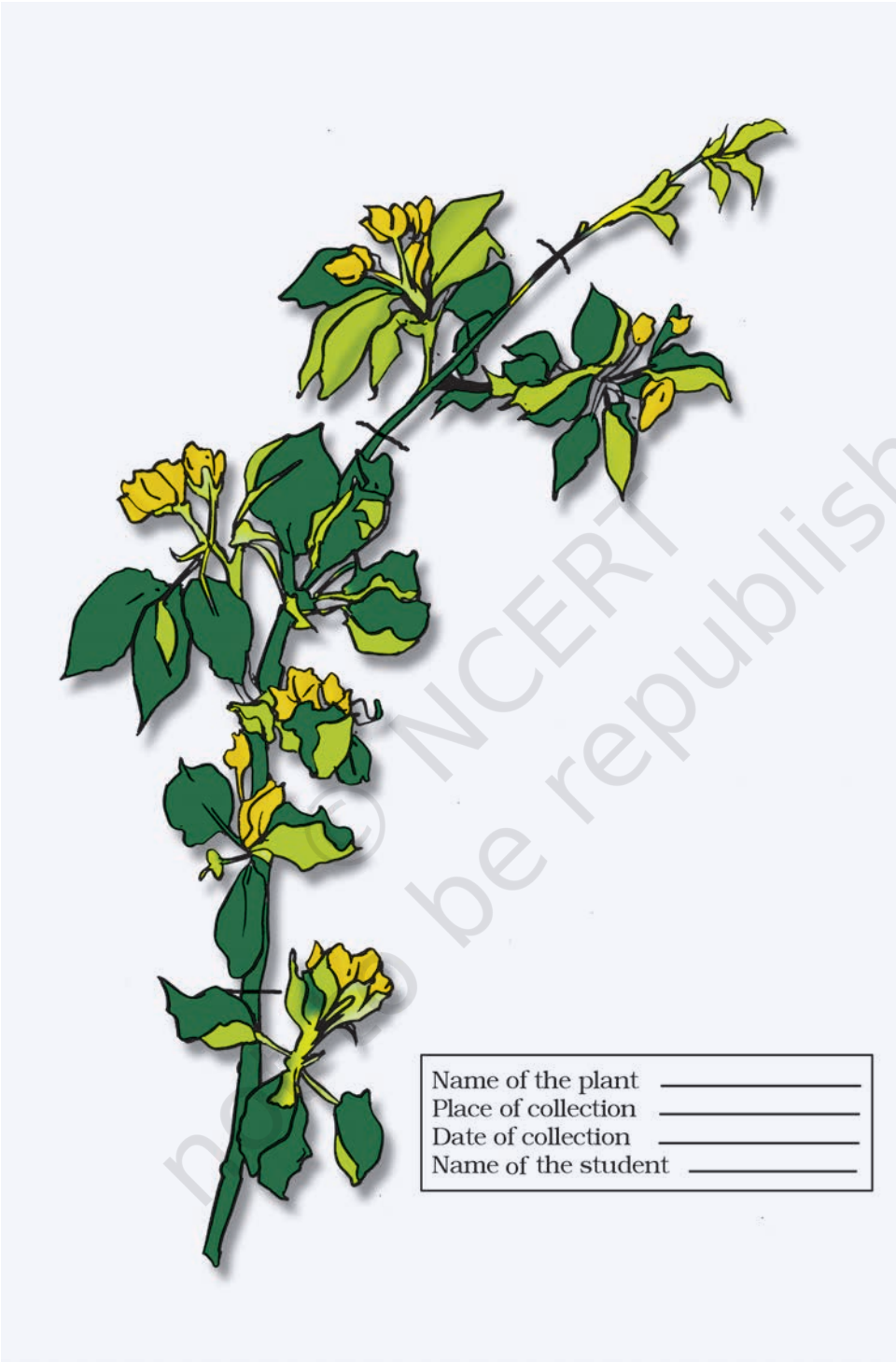


Fig. 26.1 : *A sample herbarium sheet*

PROCEDURE

1. Collect a plant or a twig with leaves and flowers.
2. Place it inside the folds of a newspaper (or a blotting sheet) and spread the leaves and flowers gently without damaging them.
3. Turn one of the leaves so that its ventral surface faces upwards.
4. Cover the plant with the other half of the newspaper; place a few more sheets containing plants and a few newspaper sheets one above the other and keep a heavy mass (such as a brick or a book) on the pile. If a field press is available, the sheets of newspaper containing plant specimen may be stacked one above the other and the field press should be tied tightly using a long rope.
5. Next day, transfer the plant to a fresh set of dry newspapers and repeat step 4.
6. Repeat this process for four to five days till the plant becomes dry.
7. Smear a small quantity of adhesive at a few places on the stem or branches and leaves. Mount the plant on the card sheet as shown in Fig. 26.1.
8. Stich the twig or stem at a few places using a sewing needle and thread.
9. Keep this sheet in a dry newspaper (or a blotting sheet). Keep the heavy mass on the newspaper for two to three hours to allow the dried plant to stick to the card sheet.
10. At the bottom right corner, write your name, name of plant, place and date of collection. Now the herbarium sheet is ready (Fig. 26.1).

PRECAUTIONS

- Do not prepare herbarium sheets of aquatic plants, succulents and plants with thorns. (Why?)
- Select plants with small leaves and flowers as they are easier to handle.
- Spreading the differernt parts of plant on newspaper sheet has to be done very carefully before pressing them using a heavy mass.
- Mount the plant specimen after all the moisture and water has been completely removed from the plant.
- Apply a small quantity of the adhesive only at a few places on the herbarium sheet. Use of cellophane adhesive tape to stick the plant on the herbarium sheet must be avoided.

NOTE FOR THE TEACHER

- Professional herbarium keepers treat plants with 1 per cent mercuric chloride or 4 per cent formalin before mounting them on the

herbarium sheet. This process is called poisoning the specimen. As these chemicals are dangerous, and keeping in mind the age of students, this step has not been mentioned in the procedure here. Fumigants and naphthalene balls are placed in the cupboards where herbarium sheets are stored to prevent insect attack.

- Students may also be advised to find information about any five important international and national herbaria. They may also be encouraged to use internet or magazines or other information sources for this purpose.

QUESTIONS

- What are the advantages of a herbarium sheet?
- Why are water plants not suitable for preparing herbarium sheets?
- Why are plants treated with mercuric chloride or formalin before mounting on the herbarium sheet?
- What is the difference between a Herbarium and a herbarium sheet?

Experiment 27

Aim

To study the features and draw diagrams of earthworm, cockroach, bony fish and bird.

Theory

Animals are variously adapted to different kinds of habitat and environment. Adaptation is an inherent quality of living organisms which enable them to survive in specific habitats. Adaptation of organisms are due to certain modifications that are observed in the organisms at the morphological, anatomical as well as physiological levels. In this experiment, four organisms are considered for the study. For each organism, characteristics of the phylum to which it belongs to and a few adaptive features are studied and correlated with the habitat (or environment) in which they live.

Materials Required

Preserved specimens of earthworm, cockroach, bony fish, a stuffed bird, charts showing detailed diagrams of animals under study, and a hand lens.

Procedure

1. Observe the given specimens and for each specimen, record one specific feature of the group (phylum/class) to which it belongs.

2. Write down one adaptive feature of each specimen with reference to its habitat.
3. Draw diagrams of the specimens, using the chart(s). Identify the various parts of organisms observed.

OBSERVATIONS

Table 1

Sl. No.	Organism	Phylum/Class	Features of the phylum observed	Adaptive Features observed	Habitat
1.	Earthworm				
2.	Cockroach				
3.	Bony fish				
4.	Bird				

Based on your observations, record some more features of the specimens (at least five for each specimen).

Table 2

Sl.No.	Earthworm	Cockroach	Bony Fish	Bird
1.				
2.				
3.				
4.				
5.				

NOTE FOR THE TEACHER

Some characteristic features of the phylum (or class) and adaptive features of organisms are given for easy identification.

- **Earthworm (Phylum: Annelida)**

  Specific feature of the phylum – Body surface is characterised by distinct annular segments or metameres; body is not differentiated.

  Adaptive features – Moist and slimy skin, presence of clitellum (merger of 14 - 17 metameric segments).

- **Cockroach (Phylum: Arthropoda; Class: Insecta)**

  Specific feature of the class – Segmented body; jointed appendages with three pairs of legs.

  Adaptive feature – Nocturnal habit; body is covered by chitinous cuticle which is impervious to water; spiracles are present on the lateral sides of body for respiration.

- **Bony fish (Phylum: Chordata; Class: Pisces)**

  Specific feature of the phylum – Presence of notochord.

  Specific feature of the class – Presence of four pairs of gills covered by an operculum; and presence of fins.

  Adaptive feature – They possess a streamlined body for minimum resistance to water while swimming. Presence of air bladder helps in their buoyancy.

- **Bird (Phylum: Chordata; Class: Aves)**

  Specific feature of the phylum – Presence of notochord.

  Specific feature of the class – Forelimbs are modified into wings.

  Adaptive feature – Boat shaped body; presence of feathers; bones are hollow with air cavities (to reduce the mass).

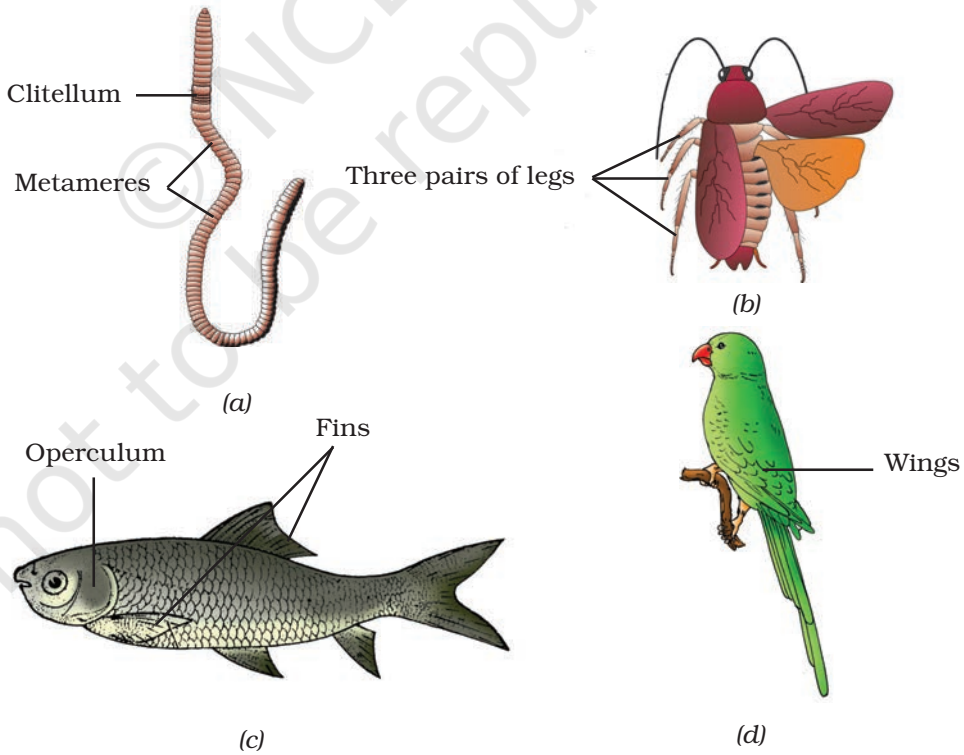


Fig. 27.1 : *(a) An earthworm, (b) A cockroach; (c) A bony fish; and (d) A bird*

APPLICATIONS

- Earthworms are known as 'Farmer's Friend' because of their role in enhancing the fertility of soil. As they burrow into the soil, they ingest soil along with the organic matter present in it. They excrete the same soil and bring it on the top as casts. This way, it is able to loosen the soil. Earthworms are also used to prepare vermicompost that is used as manure to enhance the fertility of soil.

QUESTIONS

- Name the phyla to which earthworm, cockroach, bony fish, and bird belong.
- What is an adaptation?
- In which body segments of an earthworm is the clitellum found?
- How does a cockroach adapt itself to a wide range of habitats?
- Mention two adaptive characters of a bony fish besides the possession of a streamlined body and air bladder.
- Feathers are an adaptive feature of birds. How are they helpful to them?

Experiment 28

Aim

To compare the external features of monocot and dicot plants.

Theory

Angiosperms or flowering plants are the most dominant plants on the earth. They are divided into two major groups, namely monocots and dicots. Seeds of monocots, as the name suggests, have one cotyledon and those of dicots have two. Besides this major difference, there are many other distinct differences in their morphological and anatomical features. Such features enable us to differentiate between monocots and dicots even when their seeds are not available to check the number of cotyledons. In this experiment, we intend to make a comparison of external features of monocot and dicot plants.

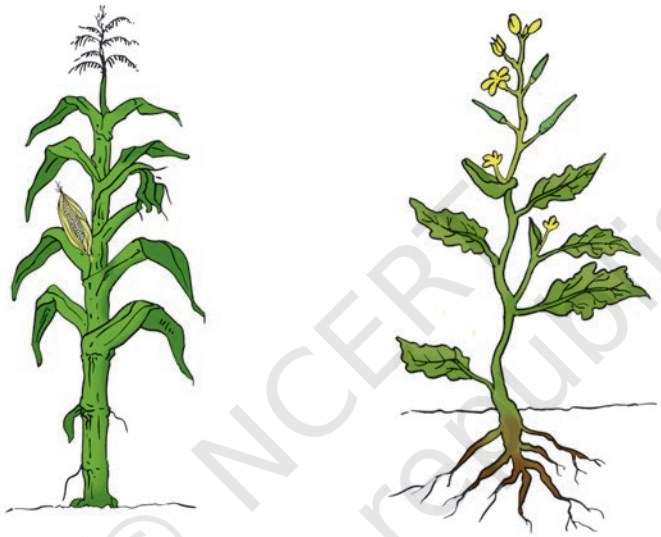
Materials Required

Plants of *Hibiscus*/rose/*Petunia*/pea and grass/maize/bamboo/lily/*Chlorophytum*/any other ornamental herb with flowers and fruits, simple or dissecting microscope, a hand lens, slide, cover slip, and a razor blade.

Procedure

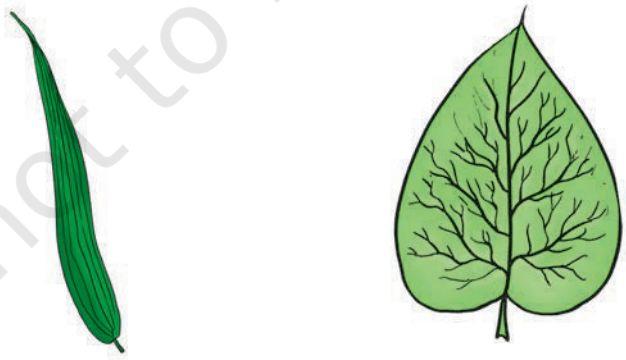
1. From the list given above, select a dicot and a monocot plant with roots, leaves, flowers, and fruits.

2. Observe the differences in the external features of stem, leaf, roots, flowers, and seeds. To study the root system, wash the roots carefully and spread them on a sheet of paper and study their nature.
3. Study the leaves for their shape and venation.
4. Carefully observe the flower and identify the different floral parts. Count the number of sepals, petals and stamens in the flower. Take a transverse section of ovary and count the number of carpels.
5. Remove the seed coat and count the number of cotyledons.
6. Note down your observations; draw diagrams of all the parts you have studied.



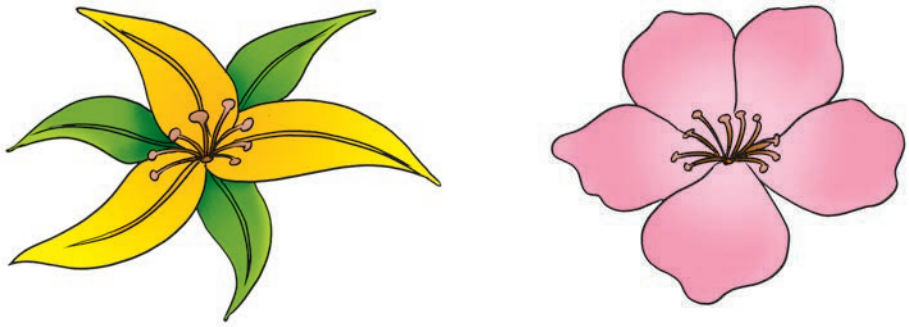
(a) (b)

Fig. 28.1 : *(a) A monocot plant; and (b) a dicot plant*



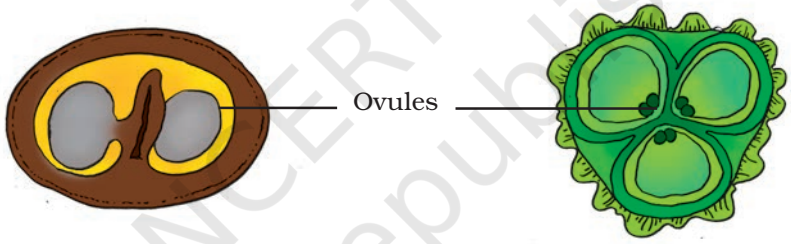
(a) (b)

Fig. 28.2 : *(a) A monocot leaf showing parallel venation; and (b) A dicot leaf showing reticulate venation*



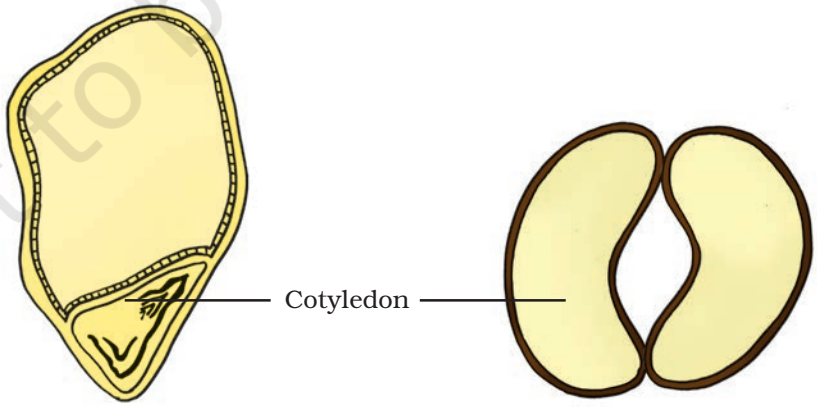
(a) (b)

Fig. 28.3 : *(a) A monocot flower and (b) A dicot flower*



(a) (b)

Fig. 28.4 : *Transverse section of ovary (a) bicarpellary and (b) tricarpellary*



(a) (b)

Fig. 28.5 : *(a) A seed with one cotyledon and (b) a seed with two cotyledons*

Observations

Some important features that distinguish a monocot and a dicot plant are listed in the table given below. You may observe some more features of difference between them. Record your observations.

Sl.No.	Feature	Monocot	Dicot
1.	Roots: fibrous/tap root		
2.	Leaf shape: broad/narrow		
3.	Leaf venation: parallel/reticulate		
4.	Floral parts: multiple of 3 or 5		
5.	Sepals: number and colour		
6.	Petals: number and colour		
7.	Stamen: number		
8.	Pistil: number of carpels		
9.	Cotyledon: one or two		

Results and Discussion

- The study reveals many differences between dicot and monocot plants. The distinctive features are consistently seen in most other plants belonging to these groups.

Questions

- How do we differentiate betwen fibrous root system and tap-root system?
- A plant has leaves with reticulate venation and floral parts consisting of 5 sepals, 5 petals, 5 stamens, and 5 carpels. In which group of angiosperms would you place this plant? Give reasons.
- In a plant, name two features which you would examine to categorise it into a monocot or a dicot plant.
- Do all flowers have all the floral parts? Explore.

Experiment 29

Aim

To study the life cycle of a mosquito.

Theory

Life cycle of a mosquito passes through several stages. Each stage is morphologically distinct. Even their habitat differs with the adult being aerial and the earlier stages being aquatic. Though there are many species of mosquitoes, their life cycles, more or less, exhibit common features.

Materials Required

Chart showing the life cycle of a mosquito and/or museum specimen of stages in the life cycle, permanent slides, and compound microscope.

Procedure

1. Observe the chart carefully and note the different stages in the life cycle.
2. Recall/discuss the characteristics of each stage.
3. Draw diagrams of all the stages.
4. Observe the preserved speciemen and name the stages.

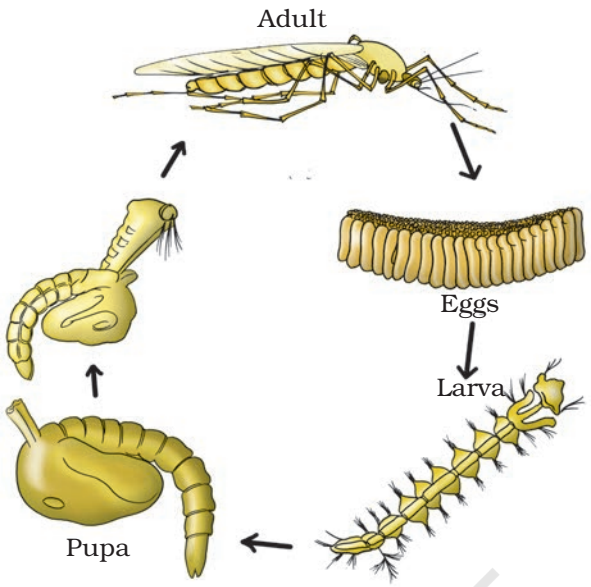


Fig. 29.1 : *Stages in the life cycle of a mosquito*

Discussion

The eggs of various species of mosquito are deposited on stagnant water bodies like ponds, ditches, cess pools, lakes etc. Any container with stagnant water is a potential breeding place for mosquitoes.

The larvae hatch out from the eggs within a few hours and begin feeding on decaying plant matter. They float on the surface of water and breath through a specialised siphon tube. The larval stage lasts for a few days during which several layers of skin are shed. This stage lasts for a few days to a few weeks. The larval stage is followed by the pupal stage.

Pupae do not feed but gradually metamorphose or change into adults. Pupal stage lasts for a few days. From the pupa an adult mosquito emerges. Before the adult starts flying it rests for a few days during which its outer cuticle hardens.

After about a week, adult female mosquito begins searching for a host. It generally feeds on blood, which is a rich source of protein that is helpful to make a fresh batch of eggs, Eggs are deposited on or near water. The male mosquito does not seek a blood meal, but prefers a sugar meal which it obtains by feeding on the nectar of flowers. The female adults also feed on nectar in between blood meals. Adult mosquitoes live for several weeks.

Note for the Teacher

- The mosquito goes through four distinct stages during its life cycle (Fig. 29.1)–
  - (i) egg: deposited in water; hatches in water;
  - (ii) larva (plural; larvae): lives on the surface of water; moults several times;
  - (iii) pupa (plural; pupae): A stage just prior to the adult stage; pupae do not feed; and
  - (iv) adult emerges from the pupae, body parts harden and starts flying.
- Permanent slides of different stages in the life cycle of a mosquito may be focussed under a compound microscope and shown to the students. This will enable students to have a better understanding of life cycle of a mosquito.

Questions

- Why is it important to study the life cycle of mosquito?
- At which stage in the life cycle of a mosquito, moulting takes place?
- Why does only the female mosquito require a blood meal?
- What are the conditions that are helpful for breeding of mosquitoes?
- Suggest three measures to check the breeding of mosquitoes.

Experiment 30

Aim

To study the life cycle of malarial parasite.

Theory

Plasmodium is commonly called the malarial parasite. The life cycle of *Plasmodium* is complex and involves two hosts, human being and a mosquito. *Plasmodium* completes its sexual cycle in mosquito and asexual cycle in human being. When female *Anopheles* mosquito infected with the parasite bites a healthy human, infective sporozoites are injected into the human blood stream causing the dreaded disease malaria. The mosquito which transmits the malarial parasite is called the vector.

Materials Required

A chart showing the life cycle of malarial parasite, permanent slides of malarial parasite, and compound microscope.

Procedure

1. Study the chart and carefully note down the different stages of the life cycle of *Plasmodium* beginning with the mosquito bite.
2. Draw a flow chart of different stages of life cycle.

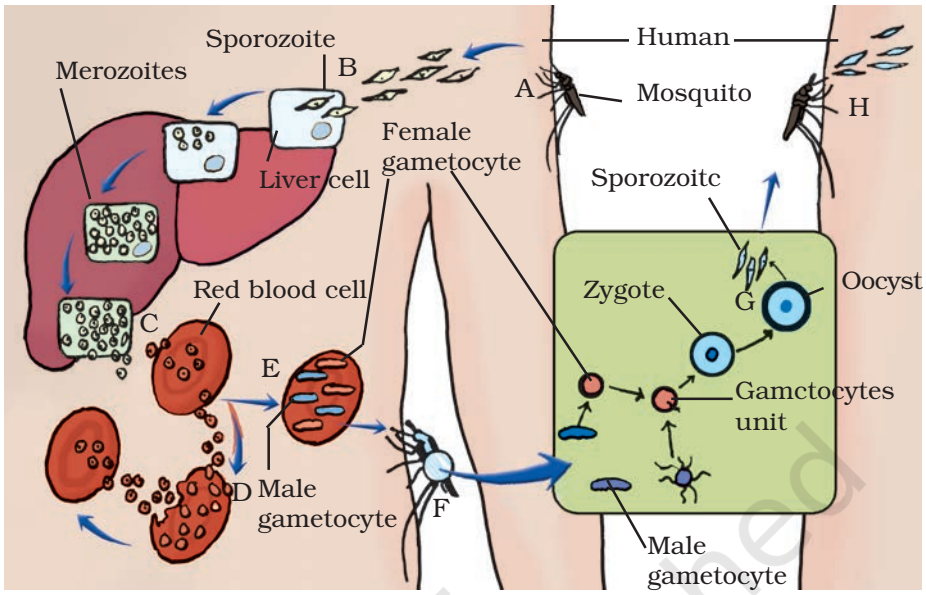


Fig. 30.1 : *Life cycle of malarial parasite*

Discussion

- There are about four hundred and thrity five known species of *Anopheles*. About thirty to forty of them are vectors of malarial parasite. The species of *Plasmodium* which are known to cause malaria are *Plasmodium vivax*, *P. falciparum*, *P. malariae* and *P. ovale.* Of these, *P. falciparum* is considered the most deadly species.
- Symptoms of malarial infection include chills, fever, sweats, headaches, nausea, vomiting, weakness and body aches. Symptoms specific to *Plasmodium falciparum* are jaundice, swollen liver and very rapid breathing. Complications that may accompany severity of disease are irregular breathing, accumulation of fluid in lungs, anaemia, behavioural abnormalities if infection reaches the brain, abnormalities in blood coagulation and cardiac problems.
- The infection can be confirmed by pathological tests that involve microscopic examination of blood smears, RDT (Rapid Dignostic Test) and other tests.
- Drugs administered to treat patients with malaria invariably contain quinine as the active ingredient.

Note for the Teacher

The life cycle of malarial parasite is completed through the following stages–

- When a mosquito infected with the malarial parasite bites a healthy human, the slender malarial parasitic cells (sporozoites) are injected into the human bloodstream (see A in Fig. 30.1).

- Within thirty minutes, the parasite invades the human liver through the blood and lymphatic system. It infects the liver cells (hepatocytes), where it multiplies producing thousands of parasitic cells within a week (See B in Fig. 30.1).
- The parasitic cells re-enter the blood stream and infect red blood cells (see C in Fig. 30.1).
- They grow in the red blood cells and undergo another phase of multiplication, eventually causing rupture of red blood cells and releasing more parasitic cells along with their toxins. This leads to manifestation of symptoms of malaria like chills and fever (see D in Fig. 30.1).
- Some parasitic cells form gametocytes (sex cells). These are of two types: (i) male gametocytes and (ii) female gametocytes (see E in Fig. 30.1).
- When another mosquito bites the infected human, it ingests the sporozoites along with blood (see F in Fig. 30.1).
- In the stomach of mosquito (midgut), the gametocytes mature and fertilization occurs resulting in the formation of zygote. Zygote develops an outer covering and becomes the oocyst. Within the oocyst thousands of sporozoites are formed. The oocysts rupture and release the sporozoites into the body cavity from where they migrate to the salivary glands of mosquito (see G in Fig. 30.1).
- When this mosquito bites another human, along with the saliva the parasites are injected and the life cycle continues.
- Permanent slide of blood smear of persons suffering from malaria can be shown to the students.

QUESTIONS

- What are the different species of malarial parasite that cause malaria?
- When do the symptoms of malaria such as fever and chills appear?
- When a mosquito bites a person infected with *Plasmodium*, which stage of the parasite will the mosquito ingest?
- How does the malarial parasite reproduce in the red blood cells?
- Why are people suffering from malaria anaemic?

Experiment 31

Aim 

To collect and study symptoms of diseases in locally available crop plants.

Theory 

Microbes like fungi, bacteria and virus are capable of causing serious diseases in plants. Such parasitic microbes affect many of our commercial crops like cereals, pulses, vegetables, fruits etc. Generally a parasitic infection is specific, that is, it infects a specific plant. Some microbes are capable of infecting plant species belonging to a particular group. The infected plant is called the host and the infecting organism is called the parasite. Parasitic microbes require a living host for completing their life cycle. They absorb nutrients from the host plants and may even kill the host. If the disease is not checked, it is capable of spreading rapidly to other plants causing severe loss. Bacterial blights, smuts, white rust, black rust, tobacco mosaic are a few common diseases of crop plants in our country.

Materials Required 

Two or three diseased crop plants or ornamental plants or weeds, compound microscope, permanent slides of some diseased plants, a hand lens, slides, cover slips, needle, and a brush,

P

2. Carefully observe each plant part for visible disease symptoms such as decolouration, infection spots, coloured patches, soft and decaying parts.
3. Observe if the entire plant is infected or only some parts like leaves, flowers or stem are infected.
4. Observe the infected parts and the physical characteristics of infection and record in the observations table.
5. Scrape the infected spot with a needle/blade and transfer it to a drop of water on a slide. Place a cover slip and observe under the microscope.
6. Under the low power of microscope, observe the presence of spores/ hyphae and damage caused to plant tissues (or cells).
7. Draw a diagram of the infected part and show the disease symptoms.

Observations

Sl.No.	Observation	Plant 1	Plant 2
1.	Infected part is: Stem Root Leaf Flower Fruit	(Yes/No)	(Yes/No)
2.	Extent of infection: Localised Enitre plant		
3.	Infection spot Soft patch Dry patch		
4.	Are spores visible?		
5.	Are hyphae visible?		

Results and Discussion

Draw the diagrams of the infected parts and label the diseased parts. Also draw diagrams of spore and hyphae.