Introduction

As in any other science subject, practicals have an important role in Biology too. The purpose of teaching biology is not only to acquaint the learner with biological terms, facts, concepts and principles but also to prepare him/her to understand these concepts by doing exercises relating to them. Self experience not only eliminates doubts and misbeliefs in one's mind but also generates an interest in the subject. The present practical course thus considers practical work as an integral part of the biology curriculum at Senior Secondary stage.

1. THE OBJECTIVES OF BIOLOGY PRACTICALS

The objectives of biology practicals are to :

- develop practical skill for better understanding through first hand experience;
- demonstrate the principles covered in the theory;
- develop observational skill in the form of identifying and locating desired parts in specimen;
- develop manipulative skills in arranging and handling the apparatus and instruments and taking readings on them;
- collect material and to mount it and to develop skill in preserving biological material and specimens;
- draw, label and record experimental results and interpret them;

Through practical work, not only the theoretical concepts are tested but also it trains you in the scientific method.

2. THE FORMAT OF THIS MANUAL

The exercises presented in this manual are in the form of self-instructional material. Each exercise in the manual has the following format:

1. ***Aim*** **:** It defines the scope of the exercise.
2. ***Introduction*** **:** It describes the purpose of the experiment.
3. ***Objectives*** **:** The objective of an experiment gives you an idea about the skills and knowledge to be developed after performing that experiment.

Notes

4. ***What you should know*** **:** It highlights the concepts and background knowledge relating to the experiment, which should be known to you in order to perform the experiment in a meaningful manner.

5. ***Materials required:*** Listed various materials, apparatus etc. required to carry out the exercise.

6. ***How to proceed :*** It includes the steps to perform an experiment in a sequential manner.

7. ***Precautions :*** The precautions to be taken in carrying out the exercise are listed here. Any specific precaution wherever necessary is listed at the relevant step of the exercise.

8. ***Observation and Documentation*** : A detailed format of observations, step by step and their recording is given in observation and documentation. An effort has been made to adopt a self-interactive method of recording these observations.

9. Diagrams, wherever necessary, are given in each exercise and it is advisable that the students should compare the diagrams with the actual one as seen in the slide/ specimen etc.

10. ***For the teacher*** : The teacher will help you to perform an experiment.

3. HOW TO USE THIS MANUAL

This manual consists of the following parts :

– Illustrative step-by-step instructions for doing the practical.

– Worksheets for recording observations and answering related questions.

Use the manual in the following way for performing the practicals.

1. Read the aim of the experiment carefully. Try to understand what is required to be done.

2. Get ready by collecting all materials required for the.exercise.

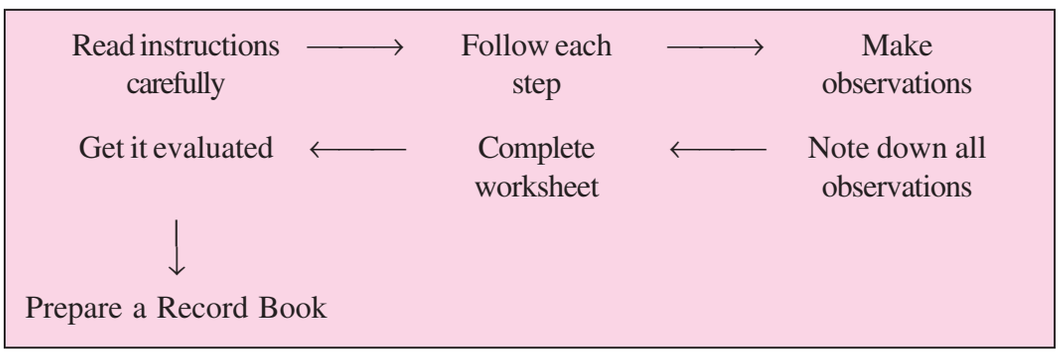
3. Read the instructions given in the procedure step by step and keep following the instructions.

4. Wherever "observe" comes, carry out the observation and fill up the observations in the space provided for observations and documentation or in your notebook. The sequence of different observations is indicated by numbers 1,2,3 etc. Record observations in the correct sequence. Try noting down the observations then and there instead of doing it later. Draw the diagrams as you actually see them. Only the part of the specimen should be drawn which is asked for.

5. Apart from the general precautions to be taken while working in a laboratory also follow the precautions given either at the end or in between the instruction steps for each practical within box. Do not avoid these precautions if you want better results as they are very specific for the particular experiment.

6. Complete the worksheet for each experiment. You will find that the worksheet is based on your observations and also on the theoretical knowledge which you have studied in the study material.
7. Reference of the books has been given wherever necessary. After doing the practicals you may go back and study the book once again for better understanding.
8. Keep your record book neat and clean as it is an important material for practical examination. Three marks are allocated for keeping proper records of practicals.
9. Do not forget to carry your manual with you when you go for the practical work.

   Once again the steps involved in performing a practical are listed below in the chart to help you do the practicals.



4. SAFETY IN THE LABORATORY (DO'S AND DON'TS)

The following precautions and care should be taken while working in the biology laboratory :

(i) The students should be well aware of the exercise they are going to perform in the laboratory.

(ii) The instruments, glassware and any other equipment should be kept clean at its proper place before and after its use.

(iii) The microscope and other delicate instruments should be handled gently and properly and should be atleast 5 inches from the edge of the table to avoid its knocking off accidently.

(iv) Do not throw any broken glassware in the sink. It should be thrown in the dust bin.

(v) Whenever working with the sharp instrument as blade/scalpel etc, be careful not to cut or puncture your skin.

(vi) Do not inhale, never taste or apply stain or any chemical as it may harm.

(vii) Never eat in the laboratory to avoid infection.

Notes

5. MAINTENANCE OF RECORD BOOK

We hope you will follow the instructions listed in each experiment while performing it and record your observations in your notebook. You may use following style for writing the exercise in your record book.

- Aim of the exercise.
- Materials and method used for performing the exercise.
- Procedure followed.
- Observations which you made during performing the exercise and diagram wherever asked.
- Precautions taken during experimentation.

6. SCHEME OF PRACTICAL EXAMINATION

There will be a practical examination of three hours duration carrying 20 marks. The distribution of marks is as follows:

(i)	Performing an experiment	4 marks
(ii)	Submitting a project report	3 marks
(iii)	Identification of given samples (4 samples)	4 marks
(iv)	Preparing mounts	3 marks
(v)	Maintenance of Record Book	3 marks
(vi)	Viva Voce	3 marks
	Total	20 marks

Exercise 1

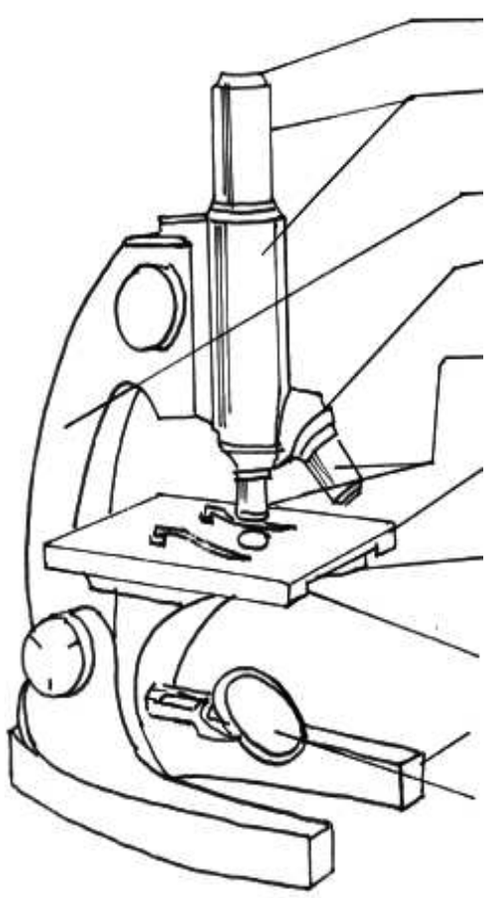
SOME COMMON INSTRUMENTS

There are some instruments,which you will use frequently while working in the laboratory. One of these is the compound microscope.

(i) Compound Microscope

Know your microscope

It is an indispensable instrument in a Biology laboratory. Study the diagram of the microscope and compare it with an actual one in the laboratory.



Eye-Piece : Contains lenses to increase magnification.

Body Tube : Holds lenses of eyepiece and objectives at proper working distance from each other.

Arm : Supports body tube and coarse adjustment.

Nose-Piece : Permits interchange of low and high powered objectives.

Coarse Adjustment : Moves body tube up and down to the correct distance from the specimen for focussing the object.

Objective : Contains lenses of different magnification as 10X, 40X etc.

Stage : Supports slide over hole that admits light from mirror below.

Diaphragm : Regulates amount of light passing through the specimen.

Stage Clips : Hold slide firmly in place.

Base : Firm support bearing weight of microscope.

Mirror : Reflects light upward through diaphragm and hole in stage.

Fine Adjustment : Permits exact focussing by moving stage or body tube up or down very slightly.

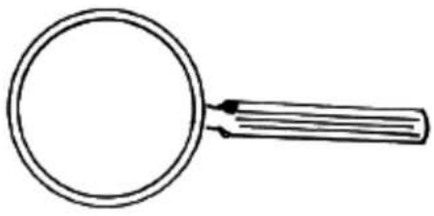
Inclination Joint : Permits tilting to adjust the eye level.

Using the microscope

- Always use both hands when carrying the microscope, one hand beneath the base and the other holding the arm of the microscope in an upright position to be check. Walk, holding the microscope close to your body.
- Set the microscope at least 5 inches from the edge of the table to avoid its knocking off accidently.
- Always clean the lenses and mirror of the microscope with the lens paper/ cloth. Otherwise there might be scratches on them.
- Adjust the mirror by slightly tilting it and by seeing through the eye piece so that sufficient light enters the microscope when you view under low magnification objectives.
- Place the prepared slide directly over the hole in the stage.
- Secure the slide on the stage with the stage clips to prevent accidental movement of the slide.
- Look through the eye piece and slowly bring the low magnification objective towards the material by using the coarse adjustment until the specimen comes into view.
- To change to high power, rotate the nose-piece to bring the high power objective in position (taking precaution that the body tube does not move up or down).
- Look through the eye piece, if the light is insufficient, open out the diaphragm slightly.
- Gently raise the objective by using fine adjustment. If the image worsens without improving, start lowering the objective by the same fine adjustment. **(Do not use coarse adjustment while viewing under high power)**. By gently moving up and down you will be able to get a clear focus.
- While removing the slide from the stage release the spring clips. Do not allow the stage clips to extend out of the stage.
- When work gets over, rotate nose piece such that the objective lens is not over the hole in the stage.
- When not in use keep it covered by a polythene cover and/or lock it in its box.

(ii) A simple hand lens

- Contains a single double convex lens mounted on a handle.
- Can magnify things four to five times.
- Used for smaller magnification.



(iii) Scalpel

- Works like a knife, used to cut out thin slices and peel.

(iv) Fine pair of scissors

- Used for cutting.

(v) A pair of forceps

- Used for picking up very thin slices or material.

(vi) Fine needles

- Used for (i) adjusting sample/ teasing any biological material on a glass slide without touching it, (ii) placing the cover slip on the slide.

(vii) Fine hair brush

- Mainly used for transferring material for mounting on the slides.

(vii) Spatula

- Used to pick up solid chemicals.

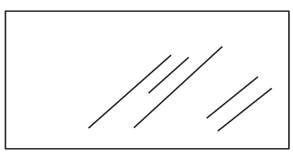
GLASSWARE

(i) A dropper

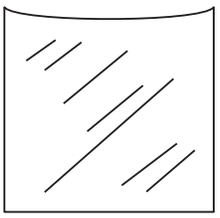
- Used for (i) putting a drop of liquid on the slide.

(ii) Plain glass slides

- Used for preparing temporary or permanent mounts.



(iii) Cover slips (Very thin glass cover)



- Used for covering the material placed on glass slide to be observed under the microscope. This protects the objective lens.

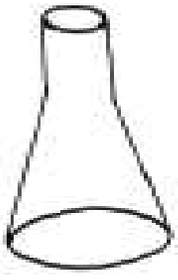
(iv) Petridish

- Is a shallow dish often with a cover.
- Used for soaking specimen for the purpose of preservation, staining etc. Also used to keep a medium on which bacteria or small organisms may be cultured.

(v) Beaker

- Available in various sizes like 100 ml and 250 ml etc.
- Used for preparing and storing chemicals and performing experiments.

(vi) Flask



- A bottle with a narrow neck used in the laboratory for performing experiments (keeping solution, for heating solution etc).

(vii) Funnel

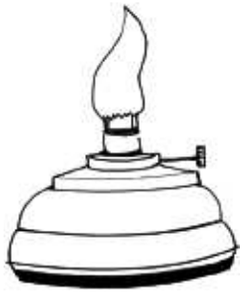
- Available in various sizes i.e. in different diameter of the mouth of the funnel.
- Used during filtration of solutions.

(viii) Pipette

- A slender graduated glass tube for measuring and transferring known volume of liquid.

(ix) Spirit lamp or Bunsen burner

- Used for heating. It should be extinguished immediately after use.



Exercise 2

Preparing Stained Glycerine Mounts

2.1 Epidermal peel of onion

2.2 Squamous epithelium from human cheek cells.

2.3 Epidermal peel of leaf to observe stomata

2.4 Xylem and phloem from cucurbita stem

2.5 Striated muscle fibres (cockroach)

Exercise 2

2.1 PREPARATION OF TEMPORARY MOUNT OF ONION PEEL TO OBSERVE AND STUDY EPIDERMAL CELLS

An onion peel is a very suitable material for observing a cell and its parts. The components such as cell wall, cytoplasm, nucleus and vacuoles can be easily observed through this exercise.

OBJECTIVES

After performing this exercise, you should be able to:

- acquire the skill of removing thin outer layers from plant material;
- prepare a temporary stained mount without trapping air bubbles;
- learn to handle and use the microscope such that its light is adjusted and material focussed to clarity;
- observe a typical plant cell and tally with your theoretical knowledge about the cell and its components;
- distinguish between some components of a plant cell such as the cell wall, cytoplasm, nucleus and vacuole.

2.1.1 WHAT YOU SHOULD KNOW

1. A tissue such as that of the peel is made of many cells.
2. A cell has many components, some of which can be seen under the compound microscope.

Materials Required

(i) Onion bulbs
(ii) Paper towelling/ Blotting paper
(iii) Dropper
(iv) Glycerine.
(v) Saffranine solution (for staining)

2.1.2 HOW TO PROCEED

(i) Select an onion bulb, discard the brown dry outer scales.

Notes

(ii) Cut the onion into four pieces (quarters) vertically. (See Fig. 2.1.1). Remove one fleshy scale.

Fig. 2.1.1

(iii) Bend the outer (convex) surface of the fleshy scale towards you with your right hand to break it. (Fig. 2.1.2)

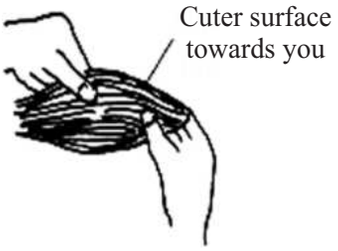


Fig. 2.1.2

(iv) It forms a neat break yet it remains attached to the other end of the scale that you are holding with your left hand (See Fig. 2.1.3).

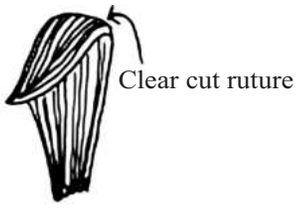


Fig. 2.1.3

(v) Gently pull the broken end. You will find that from other half of the scale held in your left hand, a thin transparent layer of epidermis is peeling off easily (See Fig. 2.1.4).

(vi) If the peel is large, use a fine pair of scissors or a blade to cut a small piece of about 2 mm. To do this place the peel in a drop of water on a clean slide and trim it.

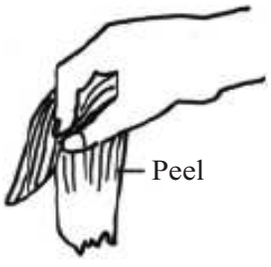


Fig. 2.1.4

(vii) If there are any wrinkles in the peel, stretch it with the help of dissecting needle.

(viii) Place this neatly cut peel in the centre of a clean slide in a fresh drop of water (Fig. 2.1.5) and blot out the excess water.

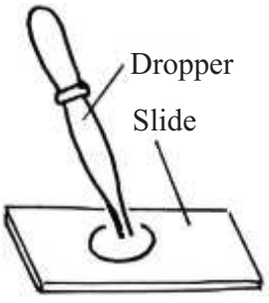


Fig. 2.1.5

(ix) Examine the slide under low power of the microscope (fill up observation 1).

Staining

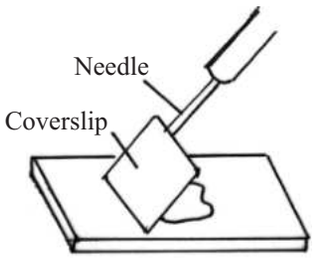
(i) When you are able to see the epidermal cells clearly in your peel, remove the slide from the microscope.

(ii) Drain off water and then add a very small drop of Saffranine to the peel on the slide and leave the material in the stain for about two minutes.

(iii) See the stained material under the microscope to check staining. It should neither be too dark nor to light. If it is light, leave in the stain for some more time.

(iv) Pick up the stained material from the slide, wash it and place it in a drop of glycerine on a fresh slide.

(v) Hold the coverslip with your left hand at 45° (as shown in the diagram) on the slide in such a way that the lower edge of the coverslip touches the glycerine. Now using the needle, gradually lower the coverslip so that no air bubble gets trapped in the material. Excess glycerine should be removed with the help of a blotting paper.



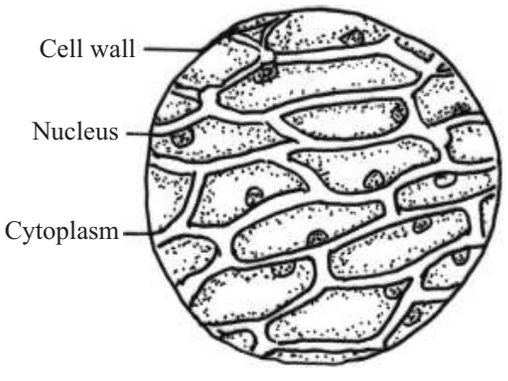


Fig. 2.1.6 Putting coverslip

Fig. 2.1.7 Epidermal cells in onion

The slide is now ready for further observation (fill up observation 2).

(vi) Observe under the microscope and compare the diagram provided (Fig. 2.1.7) with the slide as seen under the microscope.

2.1.3 PRECAUTIONS

1. Do not leave the peel too long in air, otherwise it will dry and show air bubbles in it.
2. The peel should be mounted in the centre of the slide.
3. Always use a brush (not a needle) to transfer the peel from petridish to the slide or from one slide to another. Otherwise, the peel will tear off.
4. Avoid the entry of any air-bubble in the mount.
5. Use clean slides and cover slips for mounting.

Notes

2.1.4 RECORDING OF OBSERVATION

Observation 1

Under low power of the microscope

(i) What can you see ? (long rows of rectangular cells in the unstained onion peel)

.....

(ii) Which structures of the cell can you see ? Do you see the cell wall, the nucleus and a large vacuole contained in the cytoplasm?

.....

Observation 2

After staining the onion peel

(i) Do you see large number of cells in the peel or only one? What is the general shape of these cells (rectangular, circular, triangular, polygonal etc)?

.....

(ii) What is the darkly stained body in each cell?

.....

(iii) Can you see any vacuole in the cell cytoplasm?

.....

(iv) Does the nucleus become more conspicuous after staining?

.....

(v) What is the position of the cytoplasm in the cell? (central or peripheral)

.....

(vi) What is the shape of the nucleus? (spherical, oval, irregular etc.)

.....

(vii) Sketch the onion peel cell as seen under the microscope. Label the parts such as the cell wall, cytoplasm, vacuole and the nucleus.

.....

(viii) Record all the observations in your record book.

.....

Notes

2.1.5 FOR THE TEACHER

Please ensure that

1. slides and coverslips are cleaned before use.
2. microscope is handled properly.
3. staining is properly done as staining helps to highlight certain cell components.
4. the students are to be told that cell has other components also but they can not be seen under compound microscope.
5. and that staining is important.

Exercise 2

2.2 PREPARATION OF TEMPORARY STAINED MOUNT OF HUMAN CHEEK CELLS

The slide of human cheek cells is easy to prepare and gives a view of an animal cell and also how the cells of squamous epithelium are arranged.

OBJECTIVES

After performing this exercise, you should be able to:

- acquire the skill of taking out human cheek cells;
- learn to prepare a uniform smear;
- observe the special features of squamous epithelium.

2.2.1 WHAT YOU SHOULD KNOW

1. Animal cell lacks the cell wall and large vacuoles.
2. Epithelial tissue forms covering of organs and is of various types.
3. Inner lining of the cheek is made of squamous epithelium where cells are (a) flat (b) closely packed and (c) have central nucleus.

Materials Required

(i) Slides	(ii) Coverslips	(iii) Filter-papers
(iv) Needles	(v) Methylene blue	(vi) Brush
(vii) Tooth pick.		

2.2.2 HOW TO PROCEED

(i) Take a washed tooth pick and gently slide its tip over the inner lining of your cheek. Its tip would collect some viscous transparent substance. Smear this substance on a slide. (Instead of tooth pick, you can use the uncoated end of a matchstick).

(ii) Add a drop of water to the smear and also a drop of Methylene blue stain.

(iii) Leave for about one minute.

(iv) Tilt the slide to let the extra stain drain off. wash gently with water.

(v) Put a coverslip gently over the material with the help of a needle avoiding entry of any air bubbles.

(vi) Press it gently with a needle to make the cells under the coverslip uniform.

(vii) Soak away extra stain by placing the slide within a folded filter paper, taking care not to move the coverslip.

(viii) Observe under a microscope and find out the structural details of cheek cells and answer the questions given in observation 1.

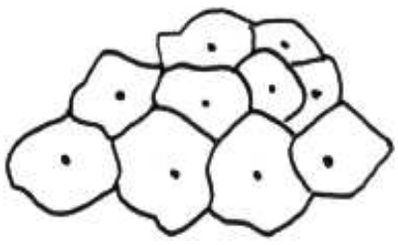


Fig. 2.2.1 Cheek cells

2.2.3 PRECAUTIONS

1. Scrape the inner surface of the cheek gently to avoid any damage or bleeding.
2. See that you, do not break the coverslip.
3. While removing the extra stain, make sure you do not move the coverslip and the material under it.

2.2.4 RECORDING OF OBSERVATION

Observation 1

Cheek cells under the microscope :

(i) Draw a few cells in your record book as you see them.

.....

(ii) What is the shape of cheek cells?

.....

(iii) What is the location of nucleus in a cheek cell?

.....

(iv) List the differences between the cells you see in this exercise (cheek cells) and the cells you saw in onion peel with respect to the following :

(a) Presence or absence of cell wall :

.....

(b) Presence or absence of large vacuole:

.....

(c) Difference in shape :

.....

(v) Is there any cell wall in the cheek cells?

.....

Notes

(vi) Cheek cells are epithelial cells. What is the name of this kind of epithelium?

.....

2.2.5 FOR THE TEACHER

Please ensure that the student

1. does not get hurt while removing the cheek cells.
2. is able to identify the differences between a plant cell (onion peel) and an animal cell (human cheek cells).

Exercise 2

2.3 PREPARATION OF TEMPORARY MOUNT OF LEAF EPIDERMIS TO STUDY THE STRUCTURE OF STOMATA

The slide gives a view of (i) leaf epidermal cells and (ii) stoma enclosed by made of two guard cells. The guard cells contain prominent nucleus and chloroplasts. In contrast, the epidermal cells other than the guard cells, lack chloroplasts.

OBJECTIVES

After performing this exercise, you should be able to :

- acquire the skill of taking out the epidermal peel from a leaf;
- prepare a stained mount of leaf peel without trapping air bubbles;
- observe the special features of the leaf epidermis and compare it with that of onion peel.

2.3.1 WHAT YOU SHOULD KNOW

(i) Leaf epidermis is made up of tightly fitted cells. These cells show cell wall, nucleus and cytoplasm.

(ii) In between the epidermal cells are present small pores called stomata (singular - stoma). In dicot leaves, each of these pores is enclosed by two large bean shaped cells called **guard cells**. In monocot leaves, the guard cells are dumb-bell shaed. Each of the guard cells is in hysical contact with an elongated epidermal cell, called the subsidiary cell. Thus, there are only two subsidiary cells external to the guard cells in monocot leaves. In dicot leaves, the two guard cells are surrounded by 2 more subsidiary cells. The guard cells are responsible for opening and closing of stomata. They contain chloroplasts in addition to cell wall, nucleus and cytoplasm.

(iii) The inner walls of guard cells are thicker than the outer walls.

Materials Required

(i) Slide (ii) Filter paper (iii) Brush

(iv) Coverslip (v) Needles (vi) Water

(vii) Lily leaf/any other leaf from which a peel can be obtained easily

2.3.2 HOW TO PROCEED

(i) Take a lily leaf. Cut it into smaller pieces of about 6 cm^2.

(ii) Wash it with water

(iii) Fold the leaf on its upper surface to break it such that it still remains attached.

(iv) Gently pull the broken end apart.

(v) You will find the lower epidermis separating from the rest of the leaf.

(vi) Take a fine pair of scissors and cut a small regular piece of the peel and transfer it in water into a petridish.

(vii) Take a clean slide. Put a drop of water in its centre and transfer the peel from the petridish to the slide with the help of a brush. Place the coverslip.

(viii) Remove the extra water by placing the slide within a folded filter paper.

(ix) Examine the slide first under low power and then under high power.

(x) Record your observations.

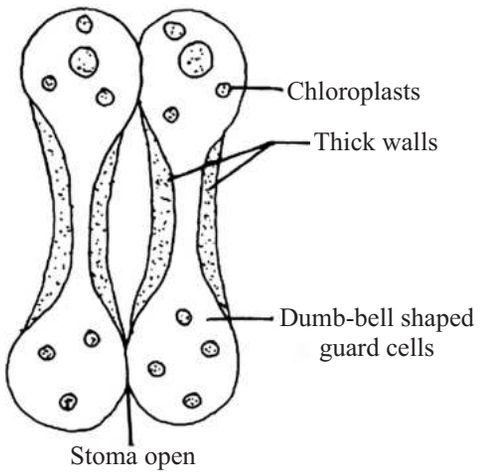


Fig. 2.5.1 Structure of stomatal apparatus in a monocot leaf

2.3.3 PRECAUTIONS

1. Do not let the peel dry up.
2. Mount the peel in the centre of the slide.
3. Use a brush to transfer the peel.
4. There should be no air bubbles.
5. Slides and coverslips should be very clean.

2.3.4 RECORDING OF OBSERVATIONS

Observe under low power of the microscope:

(i) How many different types of cells can you see in the leaf epidermis?

.....

(ii) How do the guard cells differ from the other epidermal cells. Mention three differences.

(a) .....

(b) .....

(c) .....

(iii) Is the cell wall of guard cells uniformly thick? If not describe the cell wall.

.....

(iv) How will you differentiate between the epidermal cells and guard cells on the basis of their shape.

(v) Draw a labelled diagram of the leaf peel showing stomata.

2.3.5 FOR THE TEACHER

Please emphasize that

1. the lower surface has more stomata than the upper surface in most dicot of leaves.
2. In monocot leaves, the distribution of stomata, on both the surfaces is similar.
3. the same technique is applicable for viewing stomata in the leaf of any other plant.
4. the guard cells are epidermal cells specialised for a particular function, as they have chloroplats, and control opening and closing of stomatal pores.

Exercise 2

2.4 PREPARATION AND STUDY OF XYLEM AND PHLOEM FROM CUCURBITA STEM

Xylem and phloem are complex tissues present in plants. They constitute the vascular bundles in leaf, stem and root. Xylem consists of vessels, tracheids, parenchyma and fibres. Phloem consists of phloem tubes (sieve-tubes), companion cells, parenchyma and fibres.

OBJECTIVES

After completing this exercise, you should be able to:

- identify xylem and phloem under a microscope;
- locate and differentiate between xylem and phloem.

2.4.1 WHAT YOU SHOULD KNOW

1. Xylem and Phloem are the constituents of a vascular bundle.
2. These are present in roots, stem and leaves.

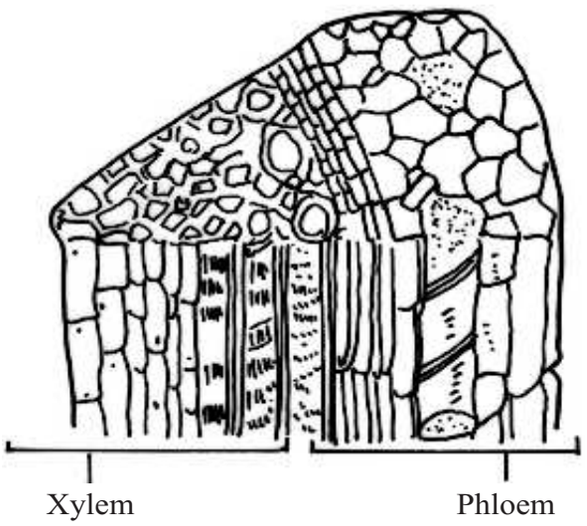


Fig. 2.4.1 Xylem and Phloem

Materials Required

(i) Cucurbita stem	(ii) Sharp blade/razor
(iii) Slides	(iv) Thin brush
(v) Water	(vi) Cover slip
(vii) Glycerine	(viii) Saffranin stain
(ix) Compound microscope	

2.4.2 HOW TO PROCEED

(i) Cut a T.S. of cucurbita stem.

(ii) Select a thin section and stain in Saffranin.

(iii) Wash the section with fresh water to remove the extra stain.

(iv) Put the stained section in a drop of glycerine on the centre of a slide.

(v) Put a cover slip over it and see the vascular bundle under the microscope.

2.4.3 PRECAUTIONS

1. Thin uniform section should be cut.
2. A good section is cut in a straight, transverse or longitudinal plane and should not be oblique.
3. Observe under the microscope before it dries up.

2.4.4 RECORDING OF OBSERVATIONS

(i) Do you see thick walled more or less circular cells stained red?

If yes ..... These cells constitute xylem.

(ii) Do all the vessels appear of same diameter in cross section?

Yes/No .....

(iii) Do you find some thin walled cells unstained, just external to the xylem.

Yes/No ..... If yes, These cells represent phloem.

(iv) Draw a few cells of xylem and phloem in your record book.

2.4.5 FOR THE TEACHER

1. The teacher to help the students to :
   (i) locate vascular bundle in the section and
   (ii) identify xylem and phloem.

Exercise 2

2.5 TEMPORARY STAINED PREPARATION AND STUDY STRIATED MUSCLE FIBRES IN COCKROACH

Muscle fibres are cells which are responsible for motility of an animal or that of the parts of its body. Limb muscles have muscle cells which are called striped or striated muscles and these are under voluntary control. You will study their structure by making a slide from the leg of a cockroach. Unstriated muscle cells are involuntary and found in muscles of various internal organs such as those of the digestive system.

OBJECTIVES

After performing this exercise, you should be able to:

- acquire the skill to handle live cockroach and remove its legs;
- acquire the skill of making a stained preparation of striated muscle fibres;
- identify, draw and label striated muscle fibres;

2.5.1 WHAT YOU SHOULD KNOW

1. Muscle fibre is a muscle cell.
2. Contractility is its special property.
3. Muscle fibres form the muscle tissue.
4. Muscles are of three types - striated, unstriated and cardiac, which differ from each other in their structural details and mode of functioning. Revise these differences from the theory text book.

Materials Required

(i) Cockroach (live) (Try to collect one yourself).

(ii) Glass slides	(iii) Cover slips	(iv) Forceps
(v) Needles	(vi) Brush	(vii) Watch glass
(viii) Methylene blue	(ix) Glycerine	(x) Compound Microscope

2.5.2 HOW TO PROCEED

(i) Remove one of the legs of a cockroach.

(ii) Locate its coxa (the broadest first segment of the leg). See Fig. 2.5.1

(iii) Slit open the leg (longitudinally) with the help of fine scissors.

(iv) Whitish fibrous tissue represents the striated muscles.

(v) Add 2-3 drops of methylene blue to stain it.

(vi) Place the muscle in a watch glass in water.

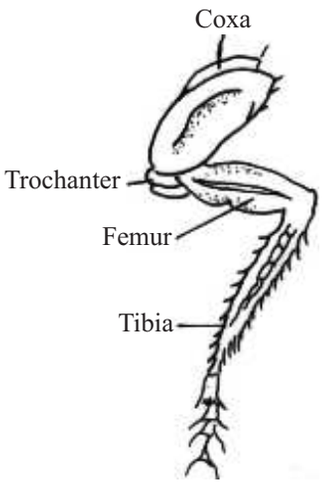


Fig. 2.5.1 Leg of a Cockroach

(vii) Using a forceps pull a few fibres from the stained muscle and place these fibres in another watch glass.

(viii) Put the stained muscle fibres on a clean slide.

(ix) Blot out excess stain surrounding the tissue with the help of a filter paper.

(x) Tease the muscle with a needle.

(xi) Add a drop of glycerine on the slide and gently put the coverslip. Avoid air bubbles. Mount the material in the centre of the slide.

(xii) After putting the coverslip press it gently with the back of a needle or pencil to spread out the glycerine and the muscle fibrs under the coverslip.

(xiii) Examine the slide under the microscope and note the following points. (Fill up observation 1)

- The plasma membrane of a muscle fibre is called **Sarcolemma**.
- The muscle fibres (muscle cells) show alternate light and dark bands or striations and hence the name **striated muscles**.
- Each muscle fibre is long and cylindrical.
- Many nuclei can be seen in the muscle fibre at the periphery.

Sometimes in your slide you may come across striated (striped) silvery shining cylindrical structure. They are not striated muscle fibres. They are tracheal tubes and can be distinguished from muscle fibres by (a) their broader diameter and (b) absence of nucleus.

Notes

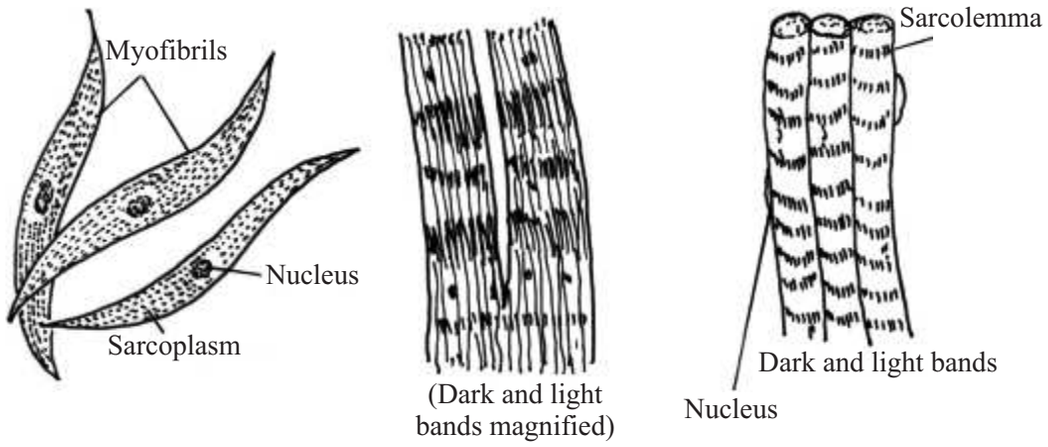


Fig. 2.5.2 Striated muscle fibres.

2.5.3 PRECAUTIONS

1. Use clean slides and coverslips.
2. Use adequate amount of stain.
3. Do not let the slide dry.
4. Manipulate such that the material is neither too darkly stained nor very lightly stained.

2.5.4 RECORDING OF OBSERVATIONS

Observation

(i) In which kind of muscle fibre do you see light and dark bands? Striated or unstriated.

.....

(ii) Are these fibres uninucleate or multinucleate?

.....

(iii) What is the shape of the muscle fibres?

.....

2.5.5 FOR THE TEACHER

Please ensure that :

1. the microscope is adjusted and the slide properly focussed.
2. the student identifies the striated muscle fibre and observes its muclei and does not mistake the trachea for striated muscle fibre as trachea also shows striations.

Exercise 3

STUDY OF MORPHOLOGICAL MODIFICATIONS OF PLANT PARTS LIKE ROOT, STEM AND LEAF

The practical exercise has been planned to give an idea that plant parts like root, stem and leaf in certain plants can get modified structurally to perform functions which are very different from their normal functions.

OBJECTIVES

After performing this exercise, you should be able to :

- identify the root, stem and leaf in their modified form in plants other than what you will be observing in this exercise.
- differentiate or identify these modified structures on the basis of their primary characters.

3.1 WHAT YOU SHOULD KNOW

1. Recapitulate what you have learnt about modification of various plant parts like root, stem and leaf.
2. The modified structure or parts may look very different from the normal structure, that is a stem may look like a root or a leaf and the leaf may take the shape of a thorn or a tendril.
3. In their modified form, they perform very different functions from what they normally do. The modified roots do the job of storage and support, the stem may take up the job of photosynthesis and multiplication; the leaf may do the function of protection and support.

Material Required

(i) Fresh or museum specimens

(ii) Models of specimens

(iii) Photographs or pictures of specimens of carrot, radish, beet, ginger, potato, zamikand, onion, grass, Eichhornia, strawberry, lemon and grape twigs, pea leaf, Opuntia, pitcher plant, Australian acacia

3.2 HOW TO PROCEED

(i) Observe the specimens from different sides.

(ii) In most cases, you will know what you are looking at, in your first glance only.

(iii) You can use a hand lens, if need be.

(iv) Draw labelled diagram of the specimens provided, write their salient features of identification.

(v) A short guideline of diagram with points of identification has been given for each specimen. You observe the specimens carefully and record your observation on the basis of what you actually observe.

A. Modifications of Roots

a. Radish

1. The tap root is swollen in the middle and tapers towards apex and base
2. It is known as **fusiform** root and it stores excess food.

b. Beet

1. It is swollen at the upper part almost becoming spherical and abruptly tapering at the lower point.
2. It is known as **napiform** root.
3. It is a storage root and a commercial source of sugar.

c. Carrot

1. It is broad at the base and tapers gradually towards the apex.
2. This is known as **conical** root.
3. Function is storage of food.

d. Banyan Tree

1. Roots are produced from main stem branches for mechanical support.
2. These roots grow downwards and penetrate the soil and act as supporting pillars.
3. These roots are known as **prop** root.

e. Sugarcane

1. From the lower portions of the main stem large number of strong roots are produced to provide support.
2. These roots are known as **stilt** roots.

f. Rhizophora

1. These plants grow in marshy places.
2. Large number of conical structures, which are roots, grow vertically upwards.
3. These roots being aerial perform the function of respiration and are known as **pneumatophores** or breathing roots.

3.3(a) RECORDING OF OBSERVATION

1. Do you find hair like structures coming out from carrot and radish? What are these?

   .....

2. What kind of function these roots perform?

   .....

3. Have you been able to locate the stem in these plants?

.....

4. Where do you find the leaves in these plants?

.....

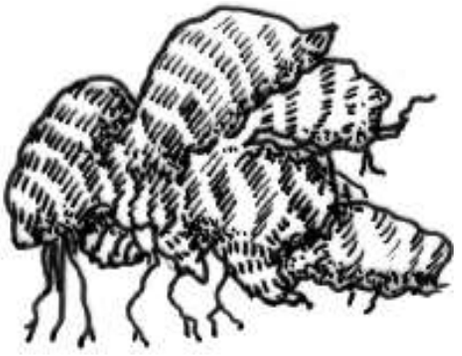
B. Modification of Stems :

- Stems get modified in various ways
- These modified sturctures help the plant to survive during unfavourable seasons by storing food, help in vegetative multiplication of the plant and provide mechanical support and protection.
- They can be studied by grouping them into underground, subaerial and aerial.

(i) Underground modifications

a. Ginger

1. It has an irregularly branched prostrate structure.
2. There are nodes, internodes, buds and scale leaves.
3. It is known as **rhizome**.



b. Zamikand

1. It is a condensed form of rhizome growing more or less in vertical direction and known as **corm**.
2. Axillary buds and scale leaves are present.

c. Potato

1. The smooth brown, swollen structure is known as **tuber**.
2. There are a number of axillary buds known as **eyes** located on one side of the tuber.
3. The axillary buds give rise to new plants.

Onion

1. The bases of the **bulb** as it is termed has a convex, compressed stem which produces cluster of firbrous roots at its base.
2. There are many scale leaves which are fleshy and store food.
3. Buds are present in the axil of scale leaves.
4. The complete shoot is modified.

(ii) Subaerial modifications

In some plants the stem is partly aerial and partly underground. The underground part is not very deep and lies horizontally underground. It has nodes and internodes. The nodes give out leaves which grow above the soil surface and roots below :

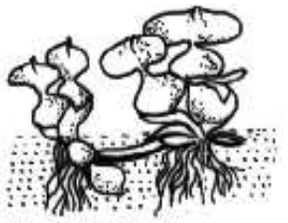
- The delicate branch arising from an axillary bud grows horizontally below the surface of the soil.
- It creeps on the ground with roots at the nodes and is called a **runner**.
- It may break off from the mother plant and can grow independently.

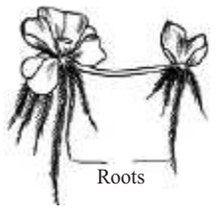
a. Strawberry

1. Branches originate from the base of the stem which grow obliquely and are known as **stolons.**
2. You have studied potato which is actually a stolon.

b. Eichhornia and Pistia

1. Short, thick, horizontal branch originates in the axil of a leaf.
2. It elongates to produce a tuft of leaves above and clusters of small roots below.
3. This is known as **offset**.





(iii) Aerial modifications

a. Grape-vine

1. From the axil of leaves arise **tendrils** which are wiry, coiled structures.
2. Tendrils help the climber in clinging to support.

b. Lemon and Karonda

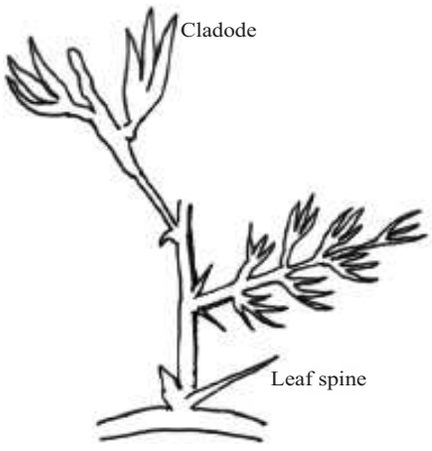
1. The axillary or terminal buds of the stem are modified into **thorns**, which are hard pointed structures.
2. Thorns provide protection to the plant.

c. Opuntia

1. Green, flat, fleshy, thick branches have unlimited growth.
2. Leaves are modified into spines.
3. The modified structure is known as **phylloclade.**

d. Asparagus

1. There are branches of limited growth which become green and look like a leaf.
2. These are called **cladodes**.



3.3(b) RECORDING OF OBSERVATION

1. Can you name the three structures you observe on the rhizome of ginger?

   .....

2. Which sturcture of the potato tuber can give to new plants?

   .....

3. Can you locate the axillary bud on the runner of grass?

   .....

4. Can you see the stem of grass in your lawns?

   .....

5. What causes fast rate of growth in Eichhornia?

   .....

6. Why are the tendrils in grape-wine stem and thorns of karonda or lemon called modified stems?

   .....

7. Give reason why phylloclade and cladode are considered modified stems of xerophytes.

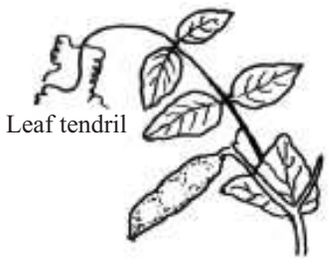
   .....

C. Modification of Leaf

Although the main function of leaf is to synthesize food for the plant, in some plants they get modified to perform functions of support and protection for the plant.

a. Pea

1. Upper leaflets of compound leaves (a portion) are modified into slender, wiry, closely coiled structures called **tendrils**.
2. These are climbing organs for the plant.



Notes

b. Opuntia

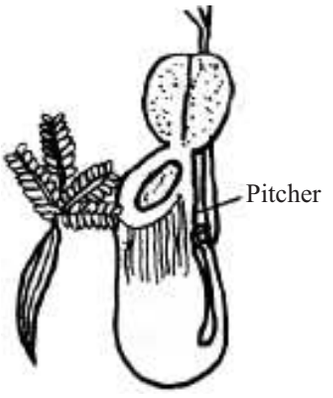
1. Leaves are modified into sharp, pointed spines for defensive purpose.
2. These spines also help for reducing transpiration.

c. Australian acacia

1. The petiole of mature leaves becomes flat, green leaf like called **phyllode**.
1. It helps in photosynthesis.

d. Pitcher plant

1. Leaf is modified into a pitcher and the leaf tip into a lid to trap insects.
2. It is an **insectivorous** plant.



3.3(c) RECORDING OF OBSERVATIONS

1. Observe the tendril of pea carefully. Why do you call them modified leaves?

   .....

2. Which portion of the leaf is modified in pea?

   .....

3. Which part of opuntia plant prepares food?

.....

4. Can you observe the modified leaves, where are they located?

.....

3.4 FOR THE TEACHER

Teacher may help the students to identify or locate the modified structures like axillary bunds, scale leaves, root hairs, spines and thorns on various specimens.

Exercise 4

TO STUDY THE T.S. OF DICOT AND MONOCOT STEMS AND ROOTS FROM PERMANENT SLIDES

Stem and root are made up of different types of tissues. These tissues form different layers in the composition of stem and root. This exercise is intended to study the structural details (anatomical details) of these tissues.

OBJECTIVES

After performing this exercise, you should be able to:

- identify the sections of dicot and monocot stem;
- identify the sections of dicot and monocot root;
- identify location of various layers in the stem and root, formed by different tissues;
- differentiate anatomically between the various sections of stem and root.

4.1 WHAT YOU SHOULD KNOW

1. Different layers are made up of different types of tissues.
2. The layers are present in a definite sequence.
3. Anatomically the monocot and dicot stems differ significantly in the arrangement of various tissues.
4. Anatomical differences between monocot and dicot roots exist in the vascular zone.

Materials Required

(i) Compound microscope (iii) Dissecting microscope

(ii) Permanent slides of dicot and monocot stems

(iv) Permanent slides of dicot and monocot roots.

4.2 HOW TO PROCEED

(i) Take permanent slides of T.S. of the dicot and monocot stem and root.

(ii) Adjust the slides under the microscope.

(iii) Note the outline of the sections, and the main tissues and their arrangement inside.

(iv) Select a part of the slide as viewed under the microscope and draw a labelled diagram.

1. Stem

(A) T.S. of Dicot Stem

Observation

From the permanent slide of the T.S. of dicot stem (sunflower plant), try to locate the following tissues (Fig. 4.1)

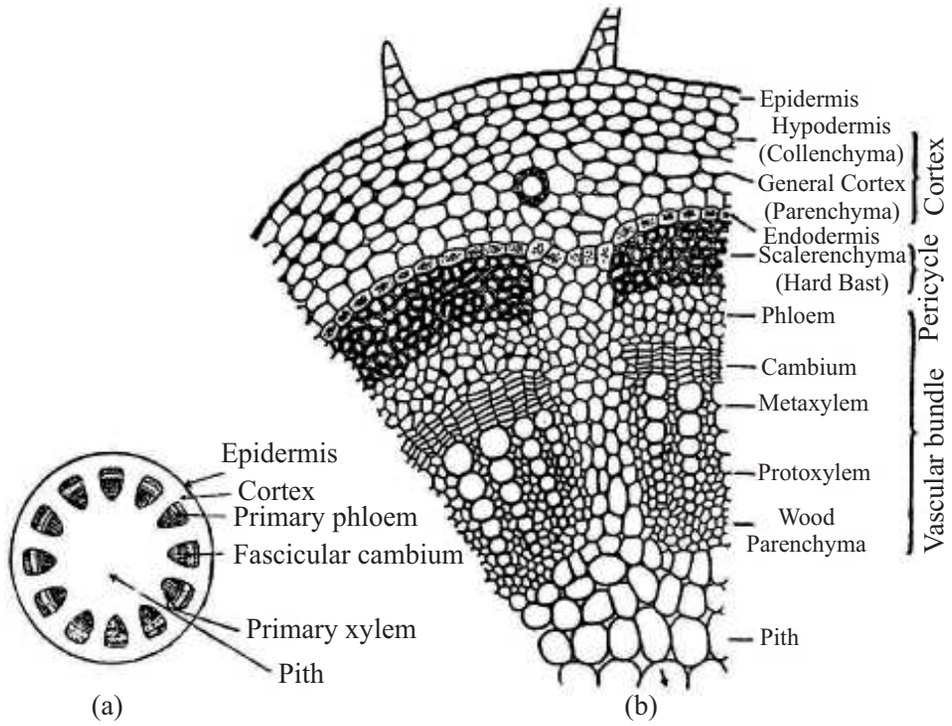


Fig. 4.1 T.S. of Dicot stem

- Outermost layer of single row of cells–**epidermis**.
  It bears some multicellular hairs.
- Immediately below the epidermis is two–three layers of collenchymatous **hypodermis**.
- Inner to the hypodermis are few layers of thin walled cells**–cortex**.
- Innermost layer of cortex forms a distinct layer**–endodermis**
- Inner to endodermis lies a layer of cells**–pericycle**
- The pericycle encloses **vascular bundle** and **pith** in the centre
- Each vascular bundle consists of phloem towards outside and xylem toward inside. Thus the vascular bundles are **conjoint** and **collateral**.
- Xylem and phloem are separated by cambium thus these vascular bundles are open. Thus the vascular bundles are **conjoint, collateral and open**.

Notes

- Parenchyma tissue separating the vascular bundles is termed **medullary rays**.

Main points of identificaiton of T.S. of dicot stem are :

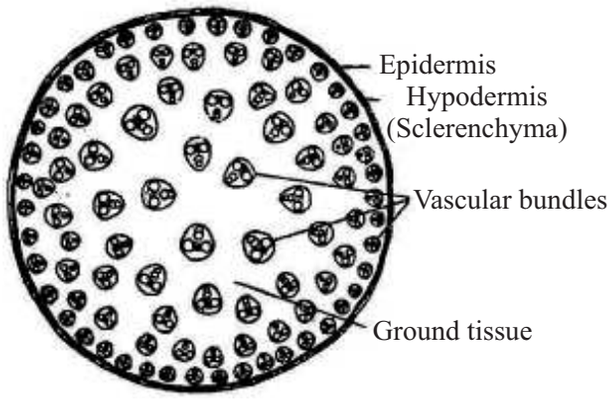
1. Cortex is differentiated into hypodermis (collenchymatous), parenchymatous cortex and innermost layer of endodermis.
2. Note the conjoint, collateral, open, endarch vascular bundles.

(B) T.S. of Monocot Stem

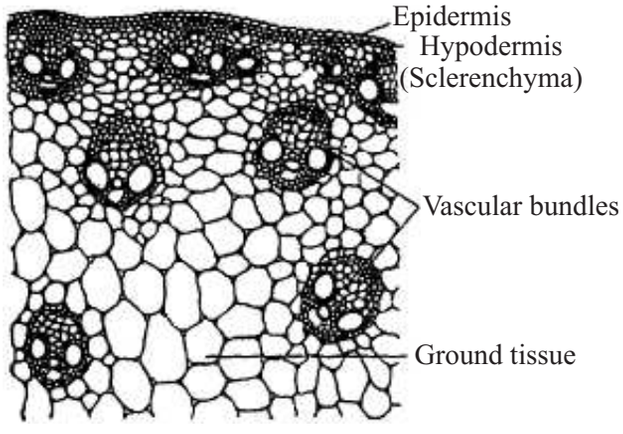
(i) Keep the slide containing T.S. of monocot stem (Maize stem) under a dissecting microscope (Fig. 4.2). Do you observe scattered vascular bundles?

(ii) Now place the slide under low power of the microscope and focus only a portion of the section in a view for greater details.

(iii) Start observing from the periphery.



(*a*)



(*b*)

Fig. 4.2 T.S. of monocot stem

Observations

Do you notice a large difference between the section of maize (monocot) stem and that of dicot stem?

Note these differences.

Important distinguishing characters of monocot stem are:

1. Single layer of **epidermis** covered with thick **cuticle**.
2. Narrow zone of sclerenchymatous **hypodermis**.
3. A mass of thin walled parenchyma tissue known as **ground tissue** below the hypodermis.
4. Scattered **vascular bundles** in the ground tissue.
5. Have you observed four distinct vessels stained red and arranged in the form of letter 'Y'. Two large ones are **metaxylem** and two smaller inner ones are **protoxylem**.
6. Observe the thin walled small cells towards outside which form the phloem.

4.3 RECORDING OF OBSERVATIONS

Observation 1

T.S. of dicot stem

(i) How many layers are there in the epidermis? Draw few cells of epidermis as seen under the microscope.

.....

(ii) Is there any outgrowth or structure visible on the epidermis. If yes what are these called?

.....

(iii) What is pericycle? See in your slide and draw it.

.....

(iv) Can you locate the vascular bundle. Draw a few xylem and phloem cells as you see them in a vascular bundle.

.....

Observation 2

T.S. of Monocot stem

(i) Observe the outermost epidermis. Can you see some 'holes' scattered all around in the cortex?

(ii) Can you make out any difference in the position of vascular bundles in monocot and dicot stem?

(iii) Are the vascular bundles separated from one another by the intervening ground tissue? Yes/No .....

(iv) What is the differece between the hypodermis that you have seen in sunflower stem (dicot stem) and the hypodermis that you are seeing here in the maize stem (monocot stem)?

Sunflower (dicot)	Maize (monocot)
.....	.....
.....	.....
.....	.....

Observation 3

Differences between Dicot and Monocot Stem

Structures	Dicot stem	Monocot stem
1. Epidermis	.....	.....
2. Hypodermis	.....	.....
3. Cortex	.....	.....
4. Endodermis	.....	.....
5. Pericycle	.....	.....
6. General cortex	.....	.....
7. Medullary rays	.....	.....
8. Vascular bundles	.....	.....
9. Pith	.....	.....

2. Root

(A) T.S. of Dicot Root

(i) Place the slide under the dissecting microscope and observe its structure.

(ii) Observe the single outermost layer–**epiblema** which gives out single celled **hairs**. Inner to this, there is a compact mass of rounded cells with intercellular spaces forming **cortex**.

(iii) The central cylinder constitutes, the vascular **bundle**, or the **stele**.

(iv) Do you find that inner cylinder is also surrounded by two definite layers of cells? Name the two layers from the diagram.

(v) Semi-circular patch of thin walled cells with blue stain constitute **phloem**.

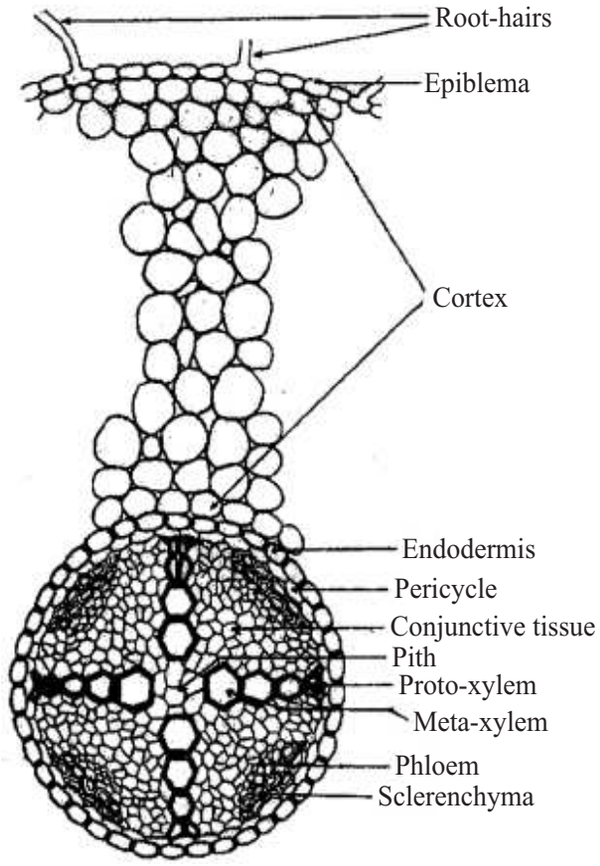


Fig. 4.3 T.S. of Dicot root

(vi) This alternates with group of thick walled cells which have taken up red stain.

(vii) Both these structures constitute vascular bundle.

Note : **In Root, the xylem and phloem are in separate bundles and are at different radii.**

(viii) Do you observe that protoxylem is placed towards pericycle and the metaxylem towards centre. It is one of the characteristic points to identify root. It is known as **exarch condition**.

(ix) Do you find any projections coming out from the epiblema? These are called root hairs.

(xi) Count the number of vascular bundles present. You will note that they are in the numbers of 2 to 6.

Notes

(B) T.S. Of Monocot Root

(i) Place the permanent slide of T.S. of monocot root under low power of the microscope.

The outline of monocot root is much bigger in T.S., so you will not be able to see it as an entire section under the microscopic field as in case of dicot root. So to find out the general outline view the slide under dissecting microscope (Fill up observation) (Fig. 4.4)

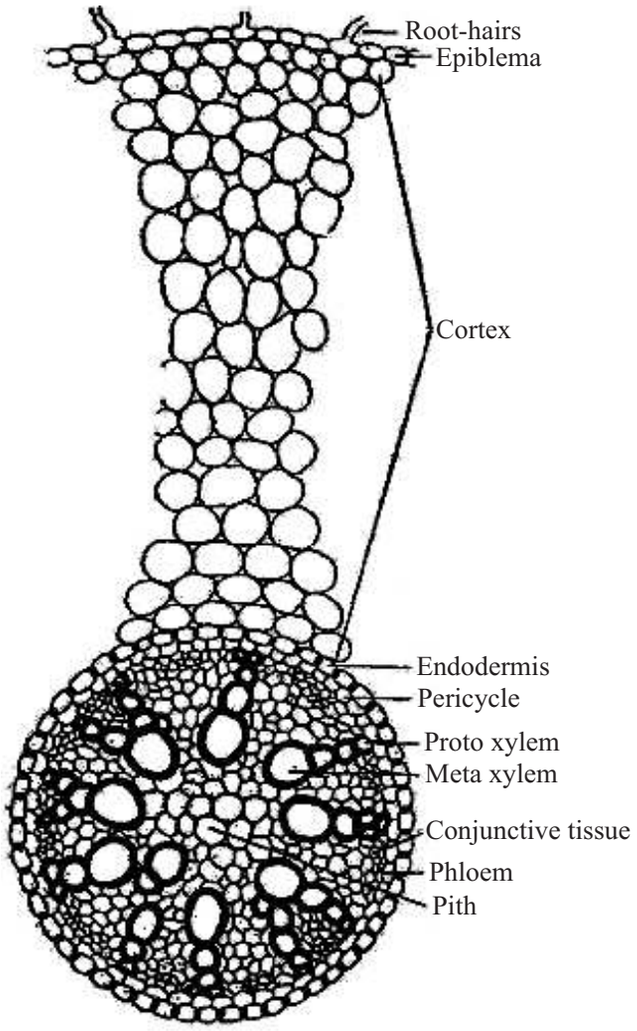


Fig. 4.4 T.S. of Monocot Root

(ii) Do you observe the difference in the number of vascular bundles? If yes, what is their approximate number?

(iii) Do you see the large pith? Yes/No

(iv) Tabulate the difference between dicot root and monocot root.

	Dicot Root	Monocot Root
1.	.....	.....
2	.....	.....

4.4 RECORDING OF OBSERVATIONS

Observation 1

T.S. of Dicot Root

(i) Is it circular in outline? Can you view the entire section in the microscopic field?

.....

(ii) Can you distinguish two distinct zones in the section?

.....

(iii) Is the peripheral outermost layer epiblema, single layered or multilayered?

.....

(iv) Is there any outgrowth or projections or any structures on this epiblema? If so, what are they?

.....

(v) Look at the epiblema.

Can you see multilayered loosely packed thin walled parenchymatous cells with intercellular spaces?

Yes/No .....

Is this ground tissue or cortex?

.....

(vi) Can you differentiate the central cylinder from the cortex by any complete layer of cells? Yes/No .....

If yes, how many layers of cells are there.

.....

(vii) Look at between xylem and phloem bundles. Can you see thin walled parenchyma cells? Yes/No .....

What are these called? .....

(viii) Draw a simple sketch of T.S. of dicot root in your record book.

Observation 2

T.S. of Monocot Root

(i) Is it circular in outline? Yes/No .....

(ii) Are there root hairs? Yes/No .....

(iii) Does the endodermis have its radial walls thickened? Yes/No .....

(iv) Is the pericycle thin walled or thick walled?

.....

(v) Are xylem and phloem in separate bundles? Yes/No .....

(vi) How many bundles are there?

.....

(vii) Is there a pith? Is it large and well developed or small in size?

.....

(viii) Write the difference between a dicot and monocot root?

Dicot root	Monocot root
.....	.....
.....	.....
.....	.....
.....	.....

(ix) Draw a simple sketch of T.S. of monocot root in your record book.

4.5 FOR THE TEACHER

Please ensure that

1. the microscope is adjusted and the slide properly focused.
2. the student identifies the various tissues in both dicot and monocot roots and stems.
3. the students get a clear concept regarding the structure and conditions of the vascular bundles.

   The teacher may kindly inform the students that the red and blue colours of cells maintained inside are not their natural colours, but colours taken up during staining of the slide.

Exercise 5

STUDY OF THE MICROSCOPIC ANATOMY (HISTOLOGY) OF MAMMALIAN TISSUES AND ORGANS

Every tissue has a special structure suited to its function. In this exercise you will study the histological features of some of the major tissues and organs of mammals.

OBJECTIVES

After performing this exercise, you should be able to :

- identify and differentiate between various kinds of mammalian tissues and organs based on their shape, size and structural details;
- differentiate between different types of blood cells.

5.1 WHAT YOU SHOULD KNOW

1. Animals have different types of tissues and organs which perform specific functions.
2. Each organ is different histologically.
   - Cartilage and bone represent supportive connective tissue where matrix is solid.
3. Blood is another type of connective tissue composed of plasma and cells. Matrix is fluid.
4. Testis and ovary produce male and female gametes respectively. They also secrete sex hormones.

Aim : To study the histology of mammalian tissues and organs from permanent slides. (cartilage, bone, blood, testis and ovary)

Material required

(i) Compound microscope

(ii) Dissection microscope

(iii) Permanent slides of tissue or organ namely

(a) Cartilage (b) Bone (c) Blood

(d) Mammalian testis and (e) Ovary

5.2 HOW TO PROCEED

(i) Gently wipe the prepared slide with a soft tissue paper in order to clean the dust particles if any on the slide.

(ii) First examine the slide under low power of the microscope.

(iii) Move the slide to get a general view of the entire section.

(iv) Select a region where individual cells are seen.

(v) Change to high power if required, by using fine adjustment only.

(vi) Record your observations and repeat the same procedure for all the slides.

1 To study the microscopic structure of cartilage

– Examine the T.S. of cartilage under low power of microscope (refer to Fig. 5.l).

– It will show the ground substance or **matrix** and cartilage cells termed **chondrocytes** scattered in it.

– Chondrocytes are present in spaces called lacunae.

– Now change to high power and by using the fine adjustment only focus a few cells. (Record observation 1)

– Given below is a sketch showing T.S. of cartilage. Compare your slide with it and label the parts - matrix, lacunae and chondrocytes or cartilage cells.

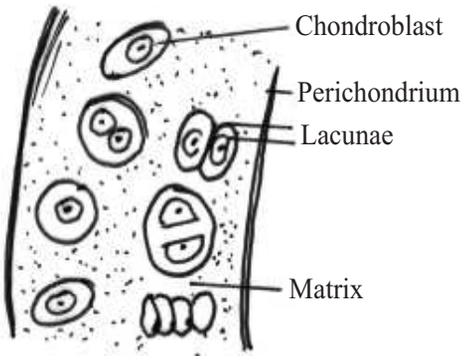


Fig. 5.1 T.S: of Cartilage

2. To study the microscopic structure of bone

T.S. of Bone (long bone such as femur)

– Examine the slide under the low power of microscope.

– Observe some areas showing concentric rings or lamellae, and each such area having a narrow central canal. The lamellae with their lacunae and central canal form the **Haversian system**.

– Compare the section in the slide with the figure (Fig. 5.2) provided.

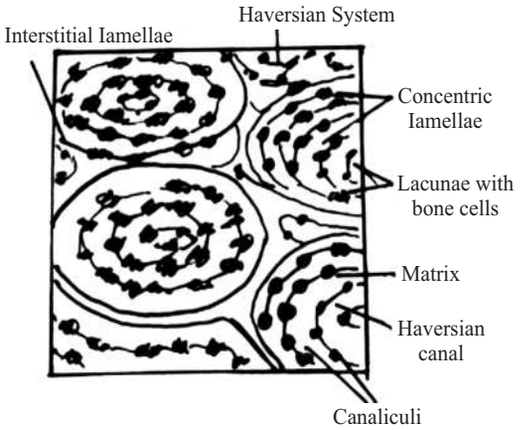


Fig. 5.2 T.S: of bone

– Try to locate the central canal, bone lamellae and lacunae (spaces that conained bone cells) arranged in concentric rings.

– Lying in the bone lamellae are empty lacunae (spaces) which in natural condition contain bone cells (osteocytes). Some fine canals (canaliculi) radiate out from these lacunae. (Fill up observation 2)

  You may not see the osteocytes within the lacunae as they get removed while processing the bone for slide preparation.

– (If the section passes obliquely or longitudinally, you will not find the Haversian systems so perfectly and the central canals may become oblong or even longitudinal).

3. To study the microscopic structure of mammalian testis (T.S.)

Place the slide under the microscope under low magnification and observe. (Fig. 5.3)

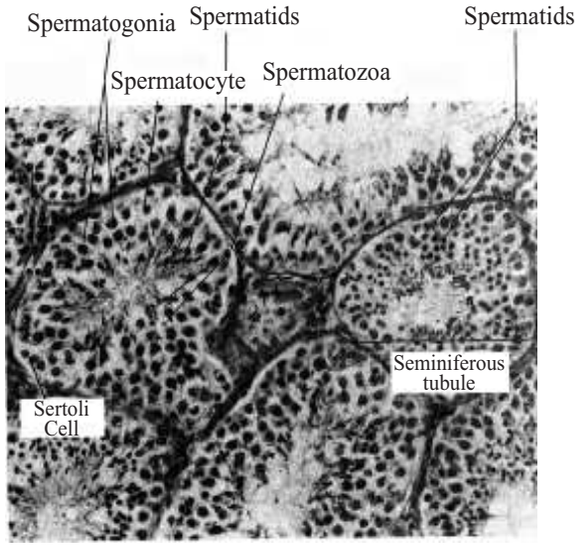


Fig. 5.3 T.S: of Testis

– Do you find any circular, oval compartments? These are **seminiferous tubules**.

– Can you see some material filling the space between the tubules? This is connective tissue **matrix**.

– Record the shape of the seminiferous tubule.

– Locate the germinal epithelium which is first layer of cells lining each seminiferous tubule. It is interrupted in between by vertical row of cells which proceed from the surface towards the interior of the tubule.

– Inner to the germinal epithelium lie, spermatogonia, spermatocytes, spermatids and spermatozoa.

– Can you also see in the centre of the tubules the cluster of spermatozoa in seminiferous fluid. Observe their tail ends which are clustered together towards the centre.

Notes

– Between the seminiferous tubules are interlobular spaces containing Leydig cells. Can you locate them?

– Draw a labelled diagram of T.S. of testis.

4. To study the microscopic structure of mammalian ovary

Examine the slide under low magnification moving it in all directions. First of all, observe the general outline of the ovary. Is it plain or uneven with slight bulges here and there?

Then study part by part all the structures contained in it. Compare the slide with the diagram provided (Fig. 5.4).

(i) Observe cells contained in the outermost lining of the ovary. They constitute the **germinal epithelium**.

(ii) Observe the developing primary follicles.

(iii) Observe the multilayered (graffian follicle) and the ruptured follicle which forms **corpus luteum**. (Fill up observation 4).

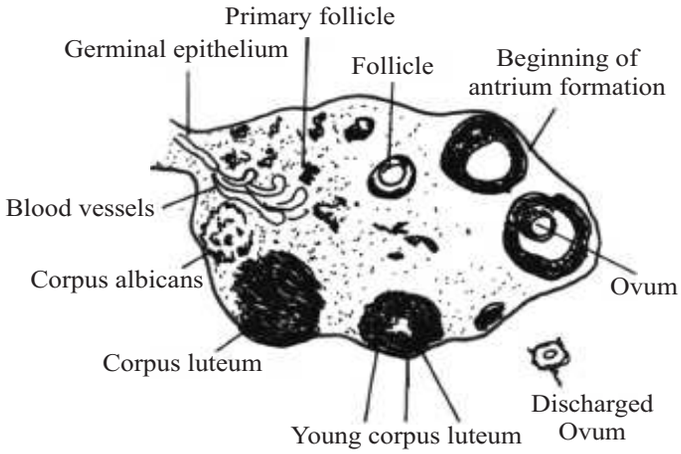


Fig. 5.4 T.S. of Mammalian Ovary

5. To study human blood smear and identify the different types of blood cells.

Examine the slide of human blood smear under the microscope, first under low power and then under high power. Look for various types of blood cells. Record your observations and draw RBCs and WBCs.

You will see a large number of circular concave disc like structure, which have no nuclei. These are **red blood cells (RBCs)**.

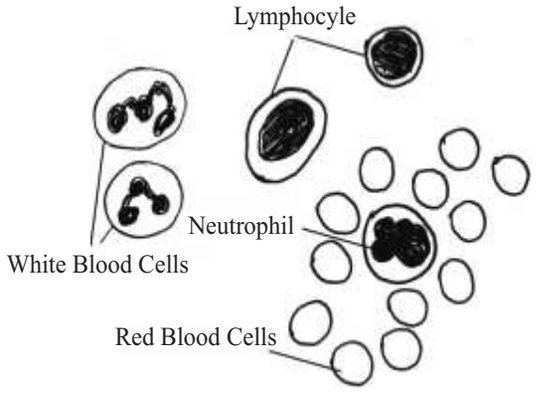


Fig. 5.5 Different types of human blood cells.

You should be able to see a fewer number of stained larger cells (larger than RBC) irregular in shape, with a nucleus of various shapes. (Fig. 5.5). These are **white blood cells (WBCs)**.

(Fill up observation 5)

How many WBCs are you able to see in a single focal field?

5.4 RECORDING OF OBSERVATIONS

Observation 1

Cartilage under high power of the microscope :

(i) What is the shape of the cartilage cells?
(square, hexagonal, spherical, or hemispherical)

.....

(ii) Does each cell lie in a cavity? If so, what is the name of this cavity?

.....

(iii) Is the nucleus of the cells oblong, oval or round?

.....

(iv) Note that most cells are in groups. Are they mostly in groups of two's, three's or four's?

.....

(v) What is the term for the ground substance in which the cell clusters lie?

.....

(vi) Draw a labelled diagram of T.S. of cartilage.

Observation 2

T.S. of Bone under high power of the microscope :

(i)) Draw at least three adjacent Haversian systems as you see them and label the parts.

.....

(ii) Mention any two differences between bone and cartilage.

(a) Arrangement of cells : in lamellae or single or in clusters?

.....

(b) Central canal : present or absent

.....

(iii) Draw a labelled diagram of T.S. of bone.

Observation 3

Mammalian testis under low power of microscope :

(i) Are there prominently large tubules of uniform size and shape?

.....

(ii) What are these tubules called?

.....

(iii) Is there any space between tubules or are they tightly arranged? What is this space called? What can you see in the space?

.....

(iv) Name the structures present in the interior of each seminiferous tubule?

.....

(v) How does a spermatozoon look, as you see it in the slide? Draw it as you see it.

.....

(vi) Draw a labelled diagram of T.S. of testis.

Observation 4

Mammalian ovary under low power of microscope :

(i) Can you see several follicles? Are they similar with respect to size and structure?

.....

(ii) Count the number of follicles.

.....

(iii) Draw a diagram of a portion of your slide showing a primary follicle and the Graafian follicte.

.....

(iv) Can you see the corpus luteum? Label it in the diagram.

.....

(v) Draw a labelled diagram of section of ovary.

Observation 5

Human blood cells under low power of Microscope

(i) (a) Draw ten RBCs as you see them in the slide.

.....

(b) Draw two or three different types of white blood cells and label them.

.....

(ii) What are the different types of WBCs present in human blood? Name them.

.....

(iii) List any two differences between RBC and WBC.

.....

5.6 FOR THE TEACHER

Please ensure that the student

1. handles the permanent slides with much care while focussing it, especially under high power.
2. can identify the various types of cells (eg. chondrocytes, WBC, RBC etc) in the different tissues and
3. also identify the various parts seen in the sections of mammalian testis and ovary which they need to label in their drawings.

Exercise 6

TO STUDY THE STRUCTURE AND FUNCTION OF DIFFERENT PARTS OF FLOWERS (PETUNIA AND CHINA ROSE)

Flowering plants are classified on the basis of the structure and arrangement of floral parts on and around the receptacle or thalamus (the swollen end part of the flower stalk) in concentric whorls.

OBJECTIVES

After performing this exercise, you should be able to:

- identify different parts of the flower;
- recognise main features of the flowers of petunia and china rose;
- explain the structure of any type of flower.

6.1 WHAT YOU SHOULD KNOW

1. The flowering plants are classified on the basis of the structure of flowers and arrangement of floral parts around the receptacle or thalamus.
2. This arrangement is specific for a specific family.
3. Flowers have parts such as sepals, petals, androecium, gynoecium etc.

Materials Required

(i) Flowers of china rose/hollyhock and petunia

(ii) Dissecting microscope

A. Floral Parts

Main points to be noted in these two (or in any other) flowers as follows :

(a) The size and nature of flower whether the flowers are large and showy or inconspicuous.

(b) The origin of flower whether they are borne on the flowering twig singly/in clusters or serially along the twig etc. (i.e. the kind of inflorescence).

Inflorscence

(i) Main axis does not terminate in a flower-Recemose

(ii) Main axis terminates in a flower-cymose

Size of the stalk whether the flowers have a long stalk (pedicellate) or they have no stalk (sessile).

Floral parts

Each flower has to be observed starting from outermost whorl (calyx/sepals) or epicalyx and to proceed to the inward whorls (corolla, stamens, pistils, etc.)

(a) Calyx (Sepals)

Observe and record the number of sepals, their colour and whether they are free or united. Consult your Biology text book-1 lesson 7 and find out the function of the calyx.

(b) Corolla (Petals)

- The number of petals, their colour and shape, whether they are free or fused, their relation with each other (overlapping, twisted, or free etc.)
- Whether the flower has both male (Androecium) and female (Gynoecium) parts or only one of them. Thus whether the flower is bisexual or unisexual.
- Find out the function of the corolla from your text book.

(c) Androecium:

- The number of stamens, whether fused or free.
- Each stamen has an anther attached to a long filament.
- Whether the filaments are free or attached to the corolla.
- It is the male part of the flower and has pollen grains in the anther.

(d) Gynoecium (Carpels)

The gynoecium consists of carpels. One or more carpels give rise to a pistil which has three parts-ovary, style and stigma.

- The position of the ovary on the thalamus with respect to the position of other parts—whether above, at the same level or below i.e. inferior ovary or superior ovary.
- Number of Carpels.
- Whether the style is short or protruding out.
- The stigma, whether simple or divided into lobes or branches.

In order to find out the number of ovary chambers (locules) and the number of ovules in each chamber, cut T.S. of ovary. In such sections you can also observe the attachment of ovules to the ovary wall (i.e. placentation).

Notes

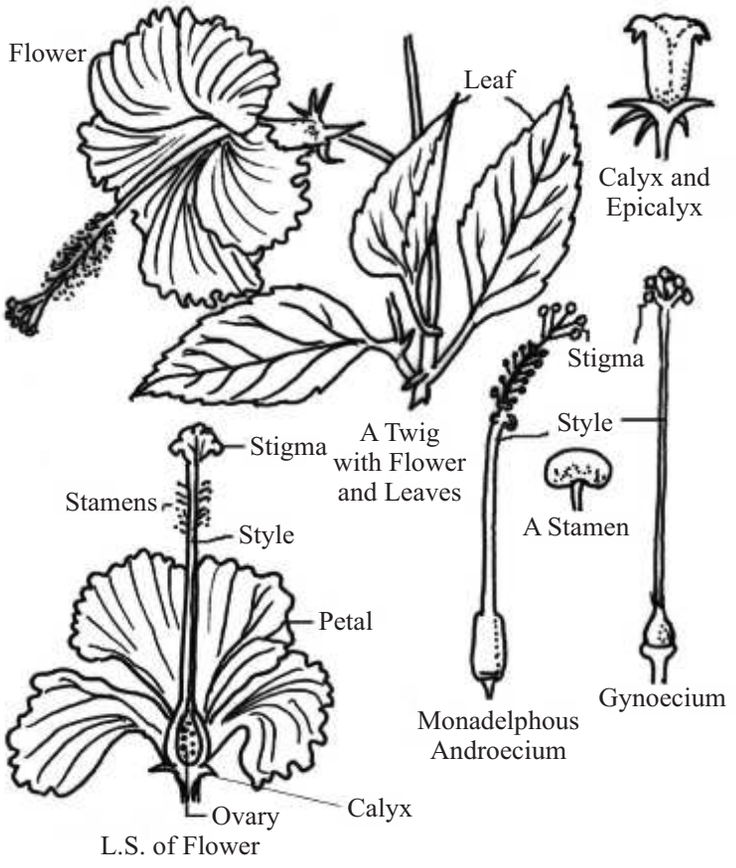


Fig. 6.1 Flowering twig, parts of flower of Hibiscus rosa-sinensis (China rose)

B. Symmetry

Actinomorphic

symmetrical, can be cut along more than one plane into two similar halves.

Zygomorphic

Bilaterally symmetrical can be cut into two similar halves along only one plane.

C. Aestivation

The arrangement of sepals and petals in a floral bud with respect to the members of the same whorl.

6.2 HOW TO PROCEED

(i) Take the flower and observe the different floral parts by using hand lens/ dissecting microscope, needles and forceps.

(ii) Note down the main features as described.

(iii) Remove the sepals one by one. Draw one of them, or the entire calyx if fused, in your notebook.

(iv) Remove the petals. If all are similar, draw one of them otherwise each one of them separately.

(v) Observe the stamens and ovary. Locate their position/attachment/inter-relationship among themselves and with other floral members.

(vi) Cut transverse sections of ovary to observe placentation and draw it in your record book.

(i) China rose

Observe the different parts of the flower carefully (Fill up observation 1)

(ii) Petunia

Observe the different parts of flower carefully (Fill up observation 2)

6.3 OBSERVATION AND DOCUMENTATION

Observation 1

(A) China-rose (*Hibiscus rosasinensis*)

1. Inflorescence .....

   Draw the inflorescence

2. Pedicellate/sessile .....
3. Sepals (Calyx)
   - (i) Shape .....
   - (ii) Number .....
   - (iii) Free/fused .....
   - (iv) Colour .....
   - (v) Do the sepal-lobes face each other (valvate) or do they overlap (twisted)?

     .....
   - (vi) Draw one sepal as you see it in your flower.
4. Petals (Corolla)
   - (i) Size .....
   - (ii) Colour .....
   - (iii) Number .....
   - (iv) Free/fused .....
   - (v) Do the petals face each other (valvate) or do they overlap (twisted) one above the other by their edges?

     .....
   - (vi) Draw a figure to show aestivation in corolla.

Notes

5. Stamens (Androecium)

(i) Position (whether attached to corolla or not)

.....

(ii) Number .....

(iii) Free/Fused .....

(iv) Are the anthers free/united .....

(v) Does the staminal tube protrude out of the flower?

.....

(vi) Is the anther one-lobed or four lobed?

.....

6. Carpels (Gynoecium)

(i) Position of ovary on the thalamus (superior/Inferior)

.....

(ii) Style : Is it exposed or enclosd in a tube?

.....

(iii) Stigma : Is it branched?

.....

(iv) If so, how many branches?

.....

(v) Take T.S. of ovary and examine and draw the diagram as you see in the section under a dissecting microscope.

.....

(vi) How many chambers are there in the ovary?

.....

(vii) How many ovules are there inside each chamber?

.....

(B) Petunia

1. Draw the flower of Petunia.
2. Pedicellate/sessile

.....

3. Sepal (Calyx)

(i) Number : .....

(ii) Free/Fused : .....

(iii) Colour : .....

(iv) Do the sepals face each other (valvate) or do they overlap (twisted)?

.....

(v) Draw one sepal.

4. Petals (Corolla)

(i) Number .....

(ii) Colour .....

(iii) Free/fused .....

(iv) Valvate or twisted? .....

(v) Draw one corolla.

5. Stamens (Androecium)

(i) Number .....

(ii) Position (whether attached to corolla or not) .....

(iii) Free/united .....

(iv) How many lobes in each anther : .....

(v) Draw a stamen indicating the filament, connective and anther lobe.

7. Carpels (Gynoecium)

(i) Position of ovary on the thalamus (Superior/inferior)

.....

(ii) Is the style protruding out?

.....

(iii) Is the style longer than the stamens?

.....

(iv) What is the type of placentation?

..... (Observe T.S. of ovary under a dissection microscope)

(v) How many chambers are there in the ovary?

.....

Notes

(vi) How many ovules are there in each chamber?

.....

(vii) Draw T.S. of ovary.

6.4 PRECAUTIONS

1. Use the needle carefully so that the floral parts are not damaged.
2. The flowers must be kept fresh by dipping the stalks in water.

6.5 FOR THE TEACHER

1. Teacher may help the students to separate out various floral parts
2. The function of flowers may be emphasised as a reproductive organ of a plant.

Study of Animal Specimens and their Classification

Invertebrates	Vertebrates
Sponge	Dogfish
Earthworm	Rohu
Butterfly	Toad
Apple Snail	Wall lizard
Starfish	Pigeon
	Bat

Exercise 7

STUDY OF ANIMAL SPECIMENS CLASSIFICATION

To identify the Characteristic features of Sponge, Earthworm, Butterfly, Apple snail, Starfish, Cartilaginous fish (Dogfish, Scoliodon), Bony fish (Rohu), Toad, House lizard, Pigeon and Bat.

The animal world is a group of large variety of animals which can be subgrouped on the basis of differences in their specific body forms and morphological features. The study of the animal specimen helps us in understanding relationship with other animals belonging to its own subgroup and to the others.

OBJECTIVES

After performing this exercise, you should be able to:

- identify the given animal specimens;
- identify even those animals which are closely similar to the ones prescribed;
- point out the important features of the specimens, especially those that form the basis of their classification;
- assign the organisms to their systematic position, i.e. Phylum, Sub-phylum (if any), and Class;
- list the general distinguishing features of the specimens;
- mention any specific feature/s (if present) of the specimen as different from others of the same class.

7.1 WHAT YOU SHOULD KNOW

1. The name of all the Phyla, Subphyla (if any), and the Classes under each phylum.
2. The distinctive features of the above mentioned categories.
3. The common names of the specimens recommended.
4. One or more special features (if any) of the given specimens.

5. The manner in which scientific names are written, i.e. genus name to start with capital, species name to start with small letter, and the entire name to be underlined when written or to be in italics when printed.

6. Revise the lesson on classification of animals in Biology text book-1.

Materials Required

(i) Museum specimens mentained for study.

(ii) Dry or stuffed specimens for study.

If specimens are not available then the study may be conducted with.

(iii) Models of specimens, photographs/pictures.

7.2 HOW TO PROCEED

A. Specimens in Museum jars/stuffed specimens

(i) Observe the specimens from different sides.

(ii) In most cases you will know what you are looking at in your first glance.

(iii) You can use handlens in some cases, if need be.

B. Dry and stuffed specimens and models of specimens-proceed in the same way as in A (Museum jars).

C. Models and pictures of specimens provide only limited scope of observation, and can be used only when actual specimens are either not available or are somewhat broken.

7.3 OBSERVATIONS

(i) Observe the specimens. Locate the characteristics required for classifying them, for example, the kind of body covering (hairs, feathers, scales, etc), the appendages - their number, arrangement and other structural characteristics.

(ii) Note down these observations in your record book.

(iii) Make labelled diagrams of the specimens provided.

7.4 PRECAUTIONS

1. Do not take out the specimens from the jars. Do not tilt the jars.

2. Handle the stuffed specimens and the models carefully.

3. Do not write or move-your pen/pencil on the specimens or on their labels.

Notes

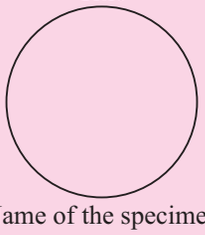
7.5 HOW TO PROCEED

You have read in Biology text book No. 1 about the general classification of animals. The set of observation exercises in this practical are intended to see with your own eyes. The main points in the body features of some representative examples of the vast variety of animals. Some of the animals included are microscopic (mounted on slides), others are large wet-preserved or dry preserved. Here we have included only the common representative examples of the different phyla and some classes. These are some invertebrates (1-5) and some vertebrates (6-11).

Almost all these animals should be available in your laboratory centre. In case you do not find any one as a specimen, look up its diagram or photograph in any book on animals.

Listed below are the specimens (invertebrates and vertebrates) which you are supposed to study in the practicals. Short guide lines have been given wherever desirable. Having read about each specimen, turn to the exercise sheets entitled OBSERVATION. Perform the observation sequentially as listed under each exercise and write the responses according to what you actually observe (and not from your theoretical knowledge). In your notebook, draw the diagram/s of the specimens, label their parts and write the classification (Phylum, Subphylum (if any) and Class at the bottom of the sheet, as well as write a few very significant features of the specimen. A sample format is given below, which may be suitably modified according to the different specimens.

Title



Name of the specimen

CLASSIFICATION

PHYLUM

CLASS

Main characterstics

1. .....

2. .....

3. .....

We shall broadly group the specimens under invertebrates (1-5) and vertebrates (6-11)

1. Sponge

Find out the type of sponges you have in your laboratory.

(a) Is it a Bath sponge or

(b) Colony of *Leucosolenia* or

(c) Dried sponge of *Scypha* or any other sponge.

Take help of your teacher and find out the name of the sponge you have been given for observation and study.

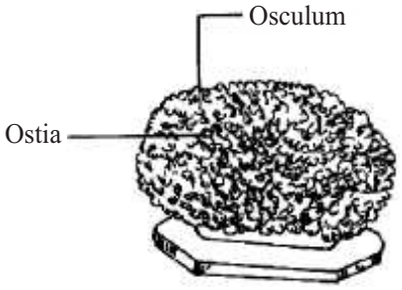


Fig. 7.1 Sponge

Observe the specimen for the following details:

(Fill up observation 1)

– Porous body.

– No mouth, but numerous pores (ostia) all over the body.

– One large opening (osculum) at the top.

– Spongy body strengthened by a skeleton of elastic spongin fibres.

2. Earthworm

A terrestrial animal commonly found in moist soil. Observe the specimen for the following details : (Fill up observation 2)

– Cylindrical body with tapering ends.

– Body is segmented.

– Head is not distinct, mouth is terminal.

– A thick band called clitellum present towards the anterior half of the body.

– Few setae present on the ventral side of each segment. They help in locomotion.

– Sexes not separate.

– Use a hand lens to observe the setae. Also try to observe if any pores are present on the body.

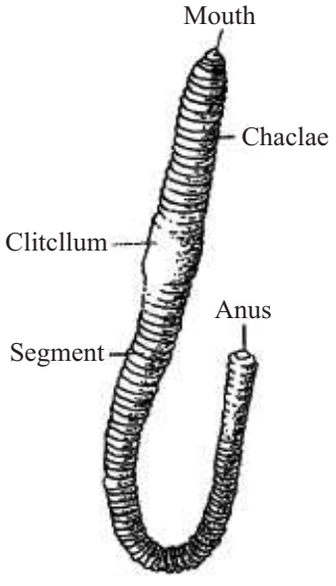


Fig. 7.2 Earthwarm

3. Butterfly

The specimens provided are usually dried ones and mounted on pins. A butterfly has:

– Two pairs of wings.

– Club shaped antennae.

– Powdery scales on wings.

– Observe the butterfly carefully and answer the questions given in observation 3.

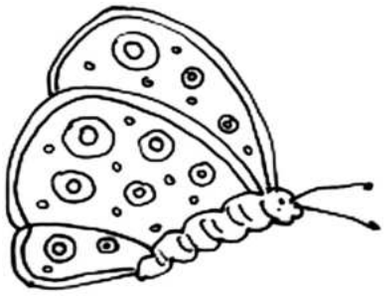


Fig. 7.3 Butterfly

4. Apple snail (*pila*)

Observe the specimen (fill up observation 4).

It is a mollusc.

Observe the "mouth" of the shell. In preserved specimens it is firmly closed by a "door" - the lid.

If ever you get a spare specimen break open the shell and look for the animal contained inside. (You may sometimes find only the empty shells)

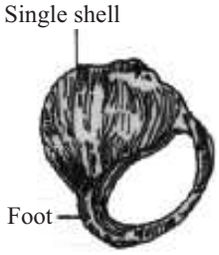


Fig. 7.4 Apple snail

– unsegmented body.

– Body is soft and encosed in a calcareous shell.

– Head bears eyes and tentacles.

Observe carefully and fill up observatin 4.

5. Starfish

Starfish is an Echinoderm. It is an unsegmented marine animal, showing radial symmetry. It has a spiny body surface. It moves by tube feet. Head is absent.

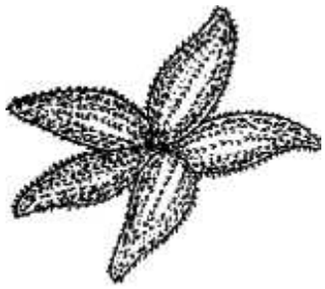


Fig. 7.5 Starfish

Observe the animal carefully and fill up observation 5.

7.6 RECORDING OF OBSERVATION

Observation 1

A. Outward appearance of sponge

(i) Looking at it what do you think-is it unicellular or multicellular?

.....

(ii) Is it a single lump or branched?

.....

(iii) What is its shape?

Vase-shaped/cup-shaped/bottle-shaped or irregular mass.

.....

B. Finer structure

Look at the surface of the main body.

(v) Do you find pores? .....

(These pores are called ostia, and serve as the entrances for water into the body).

You may also find a large hole osculum. It is for exit of water from the body.

If the specimen is a dried one, you may not see the pores. The dried material is the skeleton made of spongin fibres.

C. Classification

Why are sponges placed in phylum Porifera? Give one reason.

.....

Can you assign the particular specimen given to you to its class - Calcarea, Hexactinellida, or Demospongiae?

.....

Observation 2

Earthworm (*Pheretima*)

A. External features

(i) Is the animal (a) long and dorso-ventrally flattened or (b) cylindrical and contracted?

.....

(ii) What is the colour of the animal?

.....

(iii) What is the shape of the animal?

.....

(iv) Is the body even or segmented?

.....

(v) How does the clitellum differ from the skin over the rest of the body?

.....

(vi) What is the shape of the part of organ present at the upper (anterior) end?

.....

(vii) Where is the mouth present?

.....

(viii) Look for the anal aperture. Where is it present?

.....

(ix) Do you observe any setae? On which surface are they present, dorsal or ventral or on both?

B. Classification

(i) Why does the earthworm belong to the phylum Annelida? Give one reason?

.....

(ii) In which class will you place Pheretima in Polychaeta, Oligochaeta or Hirudinea?

.....

Observation 3

Butterfly (Danaus)

A. External Features

(i) Is the animal bilaterally symmetrical or radially symmetrical?

.....

(ii) Into how many parts or regions is the body divisible?

.....

Name the regions .....

(iii) How many pairs of eyes do you see? (Use a hand lens)

.....

(iv) Are these simple eyes or compound eyes?

.....

(v) How many pairs of antennae do you see?

.....

(vi) What is the shape of the antennae?

.....

(vii) Are they long and swollen at tip?

.....

The scientific term for this type of antennae is clavate (club-shaped).

(viii) Mention the type of mouth parts. (sucking/piercing/biting).

.....

(ix) Do you see a coiled (spring-like) part located on the lower side of the head? ..... It is the proboscis.

(x) What does the butterfly feed upon?

.....

(xi) How many pairs of wings are there?

.....

(xii) Describe the pattern of colouration in the body?

.....

In case you ever catch a butterfly then only try the following:

- Gently move your finger on the wings. Do you find something powdery coming on to your finger?
- Spread this powdery material on a clean slide and examine under microscope. (These are the scales).

(xiii) How many pairs of legs do you see?

.....

(xv) Are the legs jointed?

.....

(xv) From which region of body do they originate?

.....

(xvi) How many joints are there in each leg?

.....

(xvii) Are the legs hairy or smooth?

.....

(xviii) What are the legs used for (resting/walking)?

.....

B. Classification

(i) Why is butterfly classified as an Arthropod? Give one character.

.....

(ii) Give two characters that justify that butterfly is an insect.

(1) .....

(2) .....

Observation 4

4. Apple snail (*Pila*)

A. External Features

(i) Is the body of the animal enclosed in a shell?

.....

(ii) Is the shell made up of one piece (univalve) or of two pieces (bivalve)?

.....

(iii) Is the shell plain or spirally coiled?

.....

(iv) Locate the position of the opening of the shell. Is it open or closed?

.....

B. Classification

Let us try to classify *pila*:

(i) Why is *Pila* placed in phylum Mollusca?

Give one suitable reason

.....

(ii) Mention the class of *Pila*. Give one reason.

.....

(Bivalvia, Gastropoda or Cephalopoda)

Observation 5

Starfish

A. External features

(i) Is the animal radially symmetrical or bilaterally symmetrical?

.....

(ii) How many arms does it have?

.....

(iii) Can you make out any central region i.e. the central disc?(Yes/No)

.....

(iv) Locate the mouth on the lower (lighter coloured) side of the body. Is it located in the centre?

.....

(v) Do you observe any plates and spines on the surface of the body?

.....

Examine the lower surface of the arm

(vi) Do you find a groove running through the middle?

.....

(vii) Do you observe any fleshy structures along the sides of the groove?

These are tube feet. .....

(viii) What is the natural habitat of starfish?

.....

(ix) Why is it called starfish?

.....

Classification

(Echinodermata : echinos = spiny, derma = skin).

(i) Why is the starfish placed in the phylum Echinodermata? Give one reason?

.....

(ii) In which class will you place starfish - Asteroidea, Ophiuroidea, Echinoidea Holothuroidea or Crinoidea? Give reason.

.....

B. Vertebrata

Animals observed and studied upto this point were all invertebrates (without backbone). We will now take up **Vertebrates**.

6. Dogfish

– Scales embedded in skin.

– Paired pectoral and pelvic fins.

– Unpaired dorsal, caudal and ventral fins.
– Five Gill slits.

Dog fish has a cartilagenous skeleton. Refresh your memory about cartilage. Observe the animal carefully and fill up observation 6.

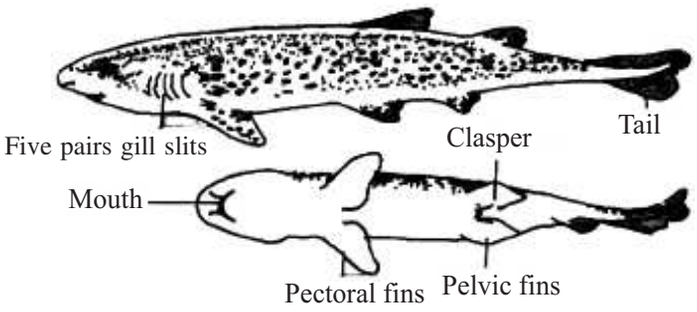


Fig. 7.6 Dogfish

7. Rohu

– Large scales cover the body.
– Gills covered by operculum.
– Rohu is a bony fish. i.e. it has a bony skeleton.

Observe the animal carefully and fill up observation 7.

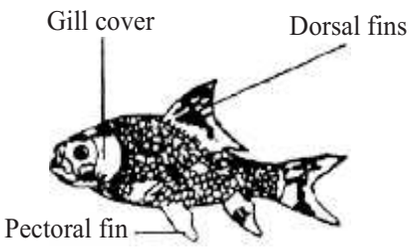


Fig. 7.7 Rohu

8. Toad (*Bufo*)

– Dry skin.
– Parotid glands.
– Toad has much in common with frog, but it has some of its own characteristics.
– Count the number of toes in fore and hind limbs.

Observe the specimen carefully and fill up observation 8.

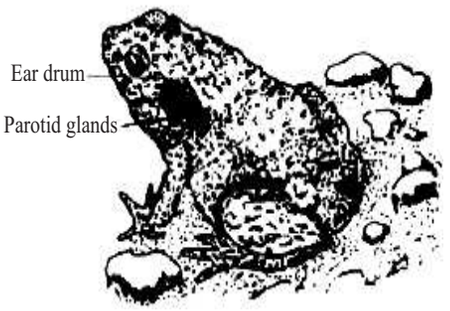


Fig. 7.8 Toad

9. Wall-lizard (Hamidactyles)

– Dry scaly skin,

– Hands and feet with flat expanded digits for clasping.

– Wall lizard is the most familiar repitle.

Observe the specimen carefully and fill up the observation 9.

Fig. 7.9 Wall lizard

10. Pigeon (Columba)

– Has feather.

– Wings (modified forelimbs).

– Beak but no teeth.

Pigeon or any other bird have the same general features of class Aves.

Observe the specimen carefully. Fill up observation 10.

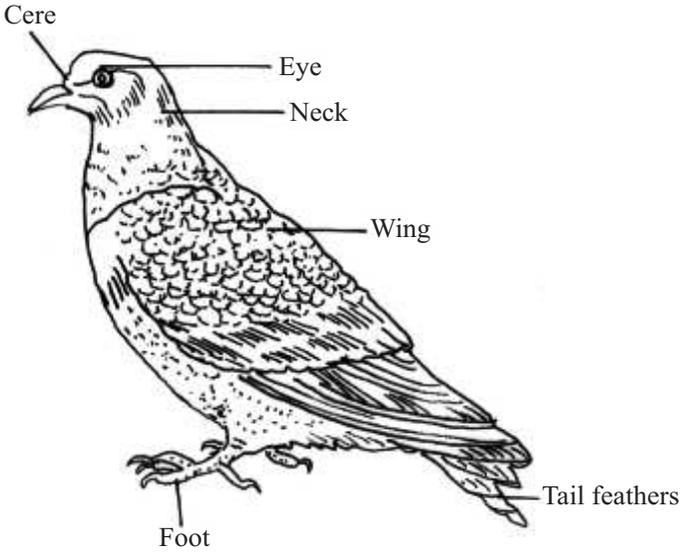


Fig. 7.10 Pigeon

11. Bat (Pterapus)

– Hair on the body.

– Projecting external ears.

– Forelimbs modified as wings.

Observe the animal carefully and fill up observation 11.

Fig. 7.11 Bat

Bat flies like a bird but it is not a bird. What is it then? Exercise under the observation no. 11 to find out.

Notes

7.7 RECORDING OF OBSERVATIONS

Observation 6

Dogfish

A. External features

(i) What is the shape of the body? boat shaped/spindle shaped or any other shape.

.....

(ii) How many distinct regions are there in the body?

.....

(iii) Is the surface of the body smooth or covered by any distinct scales?

.....

(iv) How many fins do you find in the trunk?

.....

(v) Tick (√) mark those fins which you observe in the specimen.

(1) Paired pectoral fins ( ) (2) Dorsal fins ( )

(3) Paired pelvic fins ( ) (4) Ventral fins ( )

(5) Anal fin ( )

(vi) Where is the mouth located- on the front tip or on the dorsal or on the ventral side of the head?

.....

(vii) Does the head bear a pair of nostrils?

.....

(viii) What are the nostrils used for in a fish?

.....

(ix) Where are the eyes located?

.....

Observe the gill-slits behind and slightly below the eyes.

(x) How many gill-slits do you find on each side?

.....

(xi) Are the gill slits covered by any flap?

.....

(xii) Do you see a "line" extending all along from head to tail on each side?

.....

(xiii) What is this line called?

.....

(xiv) Does the fish possess an internal skeleton or an external skeleton?

.....

B. Classification

(i) Why the dogfish has been placed in Phylum Chordata? Give one suitable reason for it.

.....

(ii) Why is dogfish also a vertebrate?

.....

(iii) Mention three features in this animal which shows that it lives in water?

(1) .....

(2) .....

(3) .....

Observation 7

Rohu (Bony fish)

A. External features

(i) Find out the shape of the body-fusiform/spindle shaped/boat shaped (mark √ on the right answer)

(ii) How many distinct regions are there in the animal?

.....

(iii) Does the head possess any scales? Yes-or No.

.....

(iv) Where is the mouth located? (Terminal/sub-terminal/dorsal/ventral)

.....

(v) What other parts do you observe on the head?

.....

(vi) Are the gill-slits naked or covered by a flap?

.....

The flap is called *operculum*.

(vii) Does the dogfish possess *Operculum*?

.....

(viii) Is the trunk of Rohu covered by hair or by scales?

.....

(ix) Observe the fins and fill in the blanks below :

Name the unpaired fins	Name the paired fins.
1	1 .....
2	2 .....
3	

(x) Is the lateral line distinct or indistinct?

.....

(xi) List any two features by which you can differentiate a cartilaginous fish from bony fish.

(i) ..... (ii) .....

B. Classification

(i) Why is Rohu placed in the Sub phylum Vertebrata?

Give one reason

.....

(ii) Mention three features of this animal which show that it lives in water.

1. .....

2. .....

3. .....

Observation 8

Toad (*Bufo*)

A. External features

(i) Name the regions into which the body is divided.

(Head, neck and trunk/head and trunk) (mark √)

(ii) Is there a neck?

.....

(iii) What type of skin do you observe? Tick (√) mark the appropriate one.

Smooth/dry/warty/rough/scaly.

(iv) Is the snout pointed or semicircular?

.....

(v) Name the structures present on the head.

.....

(vi) Are the eyes large and bulging? Yes/No

.....

(vii) Is there a dark patch seen behind the eye?

Yes/No .....

Behind each tympanum, you observe an oval shaped area which is different from the rest of the skin. It is the **parotid gland**.

(viii) What is its function?

.....

(ix) How many appendages (limbs) do you observe?

.....

(x) Which limb is longer? (fore limb/hind limb)

.....

(xi) How many digits do you observe in the fore-limb?

.....

(xii) How many digits do you observe in the hind-limb?

.....

(xiii) How do these differ from the digits of the fore limbs? Give two differences.

1. .....

2. .....

(xiv) Does the skin of the toad serve as an organ for respiration or for protection or for both?

.....

(xv) From the external features that you have observed, point out whether this animal is (a) aquatic (b) terrestrial or (c) both. Tick (√) mark.

B. Classification

(i) Why has toad been included in the phylum Chordata?

Give one reason .....

(ii) Why is it grouped in the class Amphibia?

Mention a suitable explanation. (Amphi=both; bios=life).

Observation 9

Wall lizard

A. External features

(i) In how many regions can you divide the body of a lizard. Name them.

.....

(ii) Is the surface of the body covered by hairs/warts/horny scales?

.....

(iii) What is the shape of the head?

.....

(iv) How does the tympanum (ear-drum) of lizard differ from that of a toad?

.....

(v) How many limbs are there?

.....

(vi) How many digits does each limb have?

.....

These limbs are called **pentadactyl limbs**.

(vii) Do the digits have claws? Yes or No .....

(viii) What do you observe on the ventral side of the digit?

.....

(ix) Why does the wall lizard not fall when it creeps on the ceiling or the wall? (Co-relate it with the structure of the digit).

(x) Why is it known as wall-lizard?

.....

(xi) Does this animal walk/creep/run?

.....

Reptiles are **creeping animals**.

B. Classification

(i) Why is it placed in phylum Chordata?

Give one reason .....

(ii) Why is it grouped in class Reptilia?

Give one reason .....

(iii) Give the scientific name of the wall lizard.

Observation 10

Pigeon

A. External features

(i) What is the shape of the body?

.....

(ii) What is the body covered with?

.....

(iii) Do you find the same type of structures covering on the head?

Yes/No .....

(iv) If they are different, in what way do they differ?

.....

(v) How is its beak ? (Short and pointed, short and curved).

.....

(vi) From the shape of the beak, suggest the-type of food it feeds on.

.....

(vii) Can you locate the nostrils? Yes/No.

.....

(viii) Are the nostrils slit-like or oval?

.....

(ix) How many eyes are there?

.....

(x) How many wings does it have?

.....

Fore-limbs are modified into **wings.**

(xi) Do you see the digits at the tip of the wings?

Yes/No .....

Pigeon has a pair of hind limbs.

(xii) Are they covered with hairs/scales or are smooth?

.....

(xiii) How many digits do you observe in "each hind limb?

.....

(xiv) Are they clawed?

.....

(xv) How do they make use of their feet?

.....

(xvi) What is the tail made up of?

.....

(xvii) How is it useful?

.....

B. Classification

(i) Enumerate any three external features of pigeon that suggests that it has aerial mode of life.

(1) .....

(2) .....

(3) .....

(ii) Why is the pigeon placed in phylum chordata? .

Give one reason .....

Birds are grouped under the class Aves. List any two characteristic features.

.....

Observation 11

Bat

A. External features

(i) Body is divisible into ....., ... and tail. (Mention the regions)

1. ..... 2. .....

(ii) What structures are located on the head? Tick (J) mark the ones you observe. eyes/nostrils/tympanum/external ear (pinna).

(iii) Is the snout long or short?

.....

(iv) How many limbs do you observe?

.....

(v) Fore-limbs are in the form of wings.

Does the fore limb possess the skin/feathers?

Examine the folds of skin

The wing skin called patagium begins from shoulder, extends along the upper margin of the arm to the base of the thumb, between the finger (digits) and along the sides of the body to the hind legs. It helps in flying.

(vi) Which digits support the wings? (Second to fifth/first to fifth)

.....

(vii) Which digits are clawed?

.....

(viii) Which digit is free?

.....

(ix) Are the hind limbs small/large?

.....

(x) How many digits are there in each hind limb?

.....

(xi) Are the digits clawed?

.....

B. Classification

(i) Why is bat included in chordata?

Give one reason .....

Notes

(ii) It is grouped in class **Mammalia** why?

Tick (√) mark those external features which show mammalian characters.

1. Presence of hair
2. Presence of external ear (pinna)
3. Mammary glands in female.
4. Presence of limbs.

(iii) Is it justified to call bat as a flying mammal?

Yes/No .....

7.8 PRECAUTION

Handle the specimens carefully so that they are not damaged.

7.9 FOR THE TEACHER

Please ensure that the student

(i) learns the scientific name of the animals studied in the laboratory and spells and writes.

(ii) relate the features with the classification.

Exercise 8

PREPARATION OF A SLIDE OF ONION ROOT TIP FOR OBSERVATION OF STAGES OF MITOSIS

Growth and repair of any part of an organism takes place through mitotic division of cells of that part. The growing tip of onion roots forms an excellent material to study various stages of mitosis.

OBJECTIVES

After performing this exercise, you should be able to:

- acquire the skill of making a root tip squash preparation;
- distinguish between dividing and non-dividing cells;
- identify different stages of mitotic cell division;
- differentiate between different stages of mitosis.

8.1 WHAT YOU SHOULD KNOW

1. Cells follow a cell cycle in which there is a phase termed interphase in which cells do not divide and another phase termed mitosis in which one cell divides to produce two identical cells.
2. In non-dividing cells, nucleus is seen to contain a chromatin network.
3. Mitosis can be divided into four phases (stages) Prophase, Metaphase, Anaphase and Telophase (Fig. 8.1)
4. At **Prophase**
   (a) Nuclear membrane remains intact.
   (b) Chromatin is resolved into thread like chromosomes.

   At **Metaphase**
   (a) Nuclear membrane disappears.
   (b) Spindle forms (may not be seen in the slides).
   (c) Chromosomes arrange at the equator.
   (d) Each chromosome has two chromatids joined by a centromere.

Notes

At **Anaphase**

(a) Centromere splits.

(b) Each chromatid now has its own centromere and so it becomes a chromosome.

(c) Equal number of chromosomes move to opposite poles.

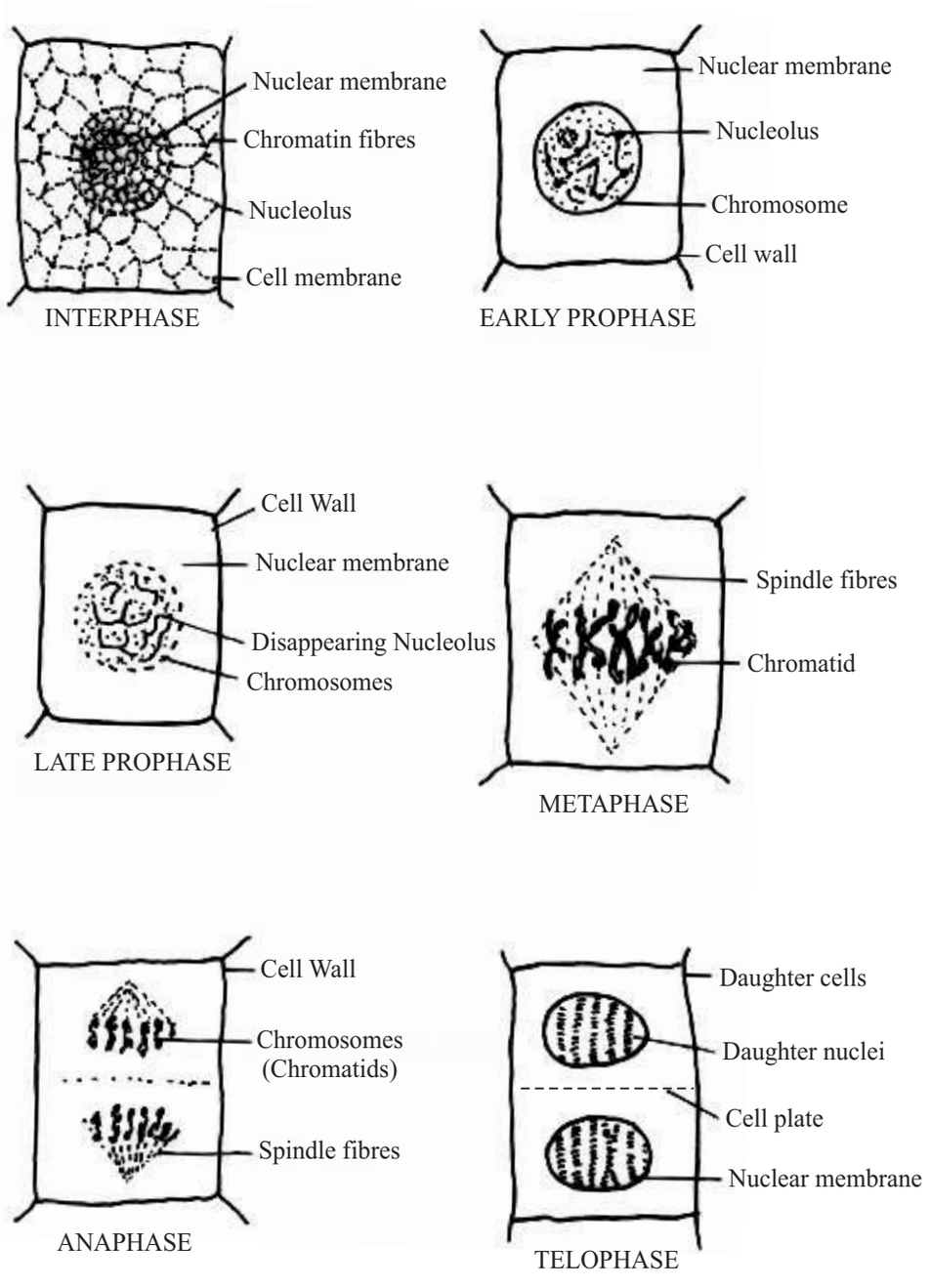


Fig. 8.1 Different stages of Mitatic cell division.

At **Telophase**

(a) Two groups of chromosomes lie at two poles and nuclear membranes form around them.

(b) Chromosomes uncoil, become long and thin, and lose their identity and once again form chromatin network.

(c) Thus two nuclei are formed in the cell containing the same number and types of chromosome.

(d) A partition wall (cell plate) begins to form in the centre of the cell.

4. **Cytokinesis**

(a) Cell plate formed in the middle extends centrifugally, and divides the cell into two daughter cells.

(b) Each daughter cell now contains a single nucleus.

Materials Required

(i) Onion bulb	(vi) Microscope	(xi) Match-stick
(ii) Needles	(vii) Acetocarmine	(xii) Scalpel
(iii) Brush	(viii) Dilute HCl	(xiii) A pair of Scissors
(iv) Slides	(ix) Wide-mouthed bottle/ container/vial	(xiv) 70% Alcohol.
(v) Coverslips	(x) Beaker	(xv) Blotting paper.

8.1 HOW TO PROCEED

This exercise has to be done in three phases:

1. Growing an onion for 3 to 5 days till roots emerge.
2. Fixing the root-tips.
3. Preparing a microscopic slide.

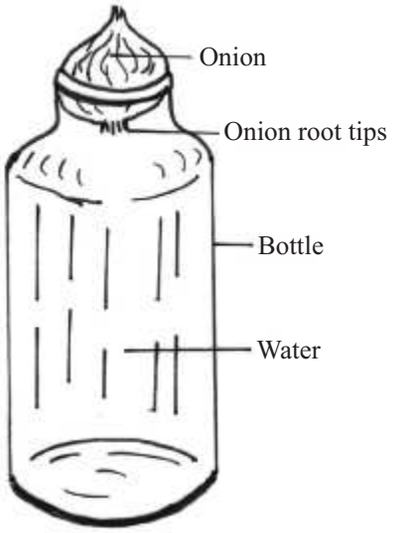
Phase 1. Growing onion for root-tips

(i) Take a wide-mouthed bottle 3-4 days prior to the day you have fixed for this experiment and fill it with water very close upto the mouth.

(ii) Take one medium sized onion bulb and remove its dry roots if any.

(iii) Place the onion at the mouth of the bottle so that only the base (disc) of the onion touches the water (Fig. 8.2a).

Notes



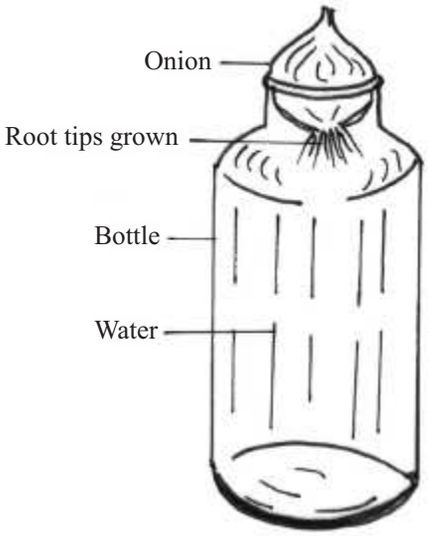


Fig. 8.2(a) Placing onion at the mouth of bottle

Fig. 8.2(b) Growing root tips

(iv) In 3-4 days new roots will appear (Keep watching everyday).

(v) When the roots are about 2-3 cms long (Fig. 8.2b) you can start with the next phase (2) of the exercise.

Phase 2. Fixing the root-tips

(i) Remember you have to cut the root-tips only in early morning (around 9 A.M.) (Generally mitotic activity is the highest at this time).

(ii) Remove the onion bulb from water. Using a pair of scissors, cut only the root tips (about 0.5 cm long from their ends from the cluster of white slender thread-like roots).

(iii) Put them in 1 : 3 Acetic Alcohol for 10 minutes. Remove from fixative and put the cut root tips in 70% Alcohol. (This is permanent preservation for any length of time).

(iv) The root-tips are ready for use after 24 hours.

Phase 3. Preparing a microscopic slide

(i) Take one root tip on a clean slide.

(ii) Add a few drops of dilute HCl just for 1 or 2 seconds. (This will soften the root tips).

(iii) Immediately add a few drops of ordinary water to this material to wash off the acid,

(iv) Decant the water by holding the slide tilted over a watch glass with one hand and holding the material on the slide with a brush by the other hand,

(v) Shift the material to a cavity block/watch glass. Add a few drops of acetocarnine stain, cover it with a lid. Wait for 5-8 minutes. The root tips become deep red.

(vi) Now take a clean slide. Place 3-4 drops of acetocarmine stain on the slide and transfer the material from the watch glass to the stain on the slide.

(vii) Gently warm the slide and then place on a square piece of paper towel / blotting paper. Take care that the slide is not overheated.

(viii) Squash the stained root tip and then place a coverslip over the material.

(ix) Place the slide between folded filter paper or blotting paper and blot gently without moving the coverslip, to remove excess stain.

(x) Take a pencil and using its blunt end gently tap over the cover-slip (cells of the root tip will spread out.

(This will crush the root-tips and the cells lying deepest which may not have picked up the stain earlier would now do so, as they are again submerged in the stain).

(xi) If the material is soft, a few tappings will be enough for the material to be squashed (squash means crushing to release contents).

Note : Do not crush the coverslip while tapping the material below it.

Always use glass-rod, brush, or needles, and forceps for handling the material in this exercise.

Metallic contact with the stained material causes a dark-brown precipitate in the material.

(xii) Observe the slide under the microscope first under the low power.

(xiii) Locate a specific good area on the slide and then observe under the high power.

(xiv) Move your slide gradually to observe different areas for various stages of mitosis.

8.3 YOU WILL OBSERVE

(i) Cells in onion are rectangular. Do you see any circular or oval cells? Check.

(ii) Acetocarmine stains the chromosomes, that is why you do not observe spindle fibres.

(iii) Look for a cell with distinct nucleus (no separate chromosomes). Such cells are in **Interphase stage**.

(iv) Look for cells where the chromosomes are thick, deeply stained and easily visible. They are arranged in the middle (equator) of the cell, arranged in a circle or in a row etc. These cells are in **Metaphase stage**.

(v) Look for some cells in your slide in which the chromosomes are away from the middle and in two groups, each such group lying at the opposite ends. These cells are in the **Anaphase stage**.

Notes

(vi) You may also see cells where the chromosomes form a cluster at extreme opposite ends. These cells are in the **Telophase stage**. You may also see beginning of cell plate formation.

(vii) You may see cells where cell plate formation is completed and cell is divided into two daughter cells. These cells are in the **Cytokinesis stage**.

(viii) In case you are unable to see all the stages of mitosis in your slide try to see them, in the preparation of other students.

Why should you cut only the tips for this exercise and not any other region of the root?

8.4 RECORDING OF OBSERVATIONS

Observation 1

(i) Name the stage at which a cell is in the non-dividing phase. Interphase/ Telophase/ or Amitosis.

.....

(ii) (a) Look for a stage where the chromosomes are arranged in the middle of a cell. What is this stage known as?

.....

(b) Is there a nuclear membrane at this stage?

.....

(iii) Can you count the number of chromosomes in the above mentioned stage?

.....

(iv) Can you see two chromatids of each chromosome?

.....

(v) Look for a stage where you see the chromosomes in two groups moving towards the two opposite ends.

.....

(a) Are they slightly away from the middle? At this stage the cell is said to be at early Anaphase.

.....

(b) Have they reached the opposite ends of a cell? Then it would be late Anaphase.

.....

(vii) Look for a cell with two nuclei which have a partition between them.

.....

(viii) What is this stage of cell division called?

.....

(ix) In some cells the partition will be incomplete, what is this partition called?

.....

(x) Draw the following in your record book.

1. An interphase cell
2. A cell at prophase
3. A cell at metaphase
4. A cell at anaphase
5. A cell at telophase
6. A cell showing cell plate formation (cytokinesis)

8.5 PRECAUTIONS

1. Use clean slides and coverslips.
2. While fixing the tissues do not leave it in acid for more than the required time.
3. Do not heat the slide. It is only to be warmed.
4. After putting coverslip over stained material, blot off excess stain.
5. Do not allow the slide to dry up.

8.6 FOR THE TEACHER

1. This is a comparatively difficult exercise as students have to be trained to locate particular stages of cell division in the microscopic field under observation.
2. It will be of immense help if a squash preparation is first demonstrated by the teacher.
3. An interphase cell may then be shown under the microscope. The student may then be asked to focus an interphase cell in the slide prepared by the student. Dividing cells can then be distinguished from the non dividing cells lying in the same field.
4. In this way, demonstration of a particular mitotic stage followed by its identification, in the students own slide, may be carried out for each of the different stages of mitosis.

Exercise 9

TO STUDY THE SPECIAL ADAPTIVE FEATURES IN SOME PLANTS AND ANIMALS

Animals and plants have evolved special features in order to live successfully in a particular habitat. These features known as adaptive features, help the organisms to adjust to their habitats.

You will study the adaptive features in a hydrophyte (Water hyacinth), xerophyte (Opuntia) and a parasitic animal (Tapeworm).

OBJECTIVES

After completeing this exercise, you should be able to :

- identify the specimen and know its habitat;
- list the general features as well as the special adaptive features of these organisms;
- mention the role played by the adaptive features;
- identify and relate the habitat of other organisms showing similar adaptive features.

9.1 WHAT YOU SHOULD KNOW

1. Diverse habitats in which plants and animals live are (i) terrestrial (ii) aquatic (iii) aerial.
2. Depending upon the availability of water, the habitat can be xeric, mesic or aquatic.
3. Name some plants and animals belonging to the above categories.
4. The term adaption can be defined as the modifications of characteristics which have evolved over a period of time in the living organisms. These modifications help the organisms to adjust in a particular environment.
5. Some of the adaptive features in aquatic plants are presence of air cavities in stem or leaf for buoyancy; presence of waxy coating on leaves to protect them from damage due to continuous flow of water on them; roots are partly developed as water is present in abundance.
6. Some of the xeric plants show adaptation which help them to conserve water.

7. Some parasitic worms have thick cuticle which protects them from the action of digestive enzymes of the host.

Material Required

1. Fresh or preserved specimens of (a) water Hyacinth (b) Opuntia (c) preserved specimen of tapeworm and a slide of head of tapeworm (scolex)
2. Hand lens

How to proceed

1. Water Hyacinth, a Free floating aquatic plant :

Take a fresh or preserved specimen and observe its parts carefully. Take special note of the following :

(a) Roots - Its type, growth pattern and any special feature that comes to your notice.

(b) Stem - Its nature, length etc.

(c) Leaves - Observe the petiole, the protective coating on the leaves and the texture of the leaves.

Fig. 9.1

Note down the special features that help it to survive in aquatic habitat. Record your observations.

2. Opuntia are xeric plants so observe a fresh or preserved specimen with special attention to

(a) Root - Its type, length etc.

(b) Stem - If it is modified then the type of modifications it shows. Observe its colour. Does it suggest any special function that it perform?

(c) Leaves - are present ? If not, then what are they modified into. What is the significance of this modification?

Fig. 9.2

Fill up observation

3. Tapeworm (Taenia) = A human intestinal parasite

(a) Observe the entire specimen from the head up to the last segment or the widest end and identify the following parts :

(i) Scolex or the head

(ii) Neck

(iii) Proglottides forming the strobila

(b) Observe the slide of the scolex under a dissection microscope or the low power of a compound microscope and identify

(i) the hooks in the form of a circlet on the top of the head.

(ii) Four suckers present on four different sides of the scolex.

The parasite attaches itself to the wall of the human instestine with the help of its scolex.

(c) Observe that there is no mouth and anus in the parasite because it absorbs digested food surrounding it

(d) How do you think it respires inside the human intestine?

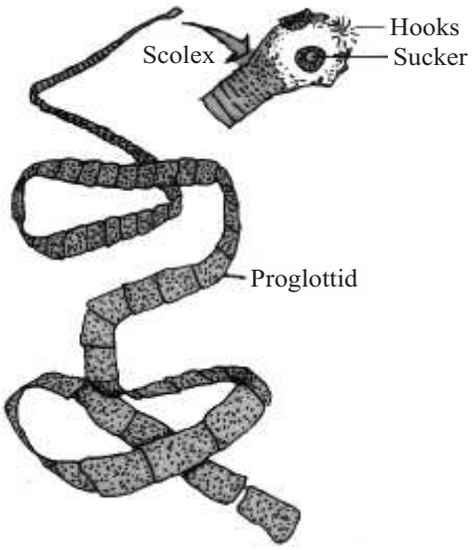


Fig. 9.3

RECORDING OF OBSERVATIONS

Observation 1

(i) Are the aquatic plants rooted or freely floating?

.....

(ii) Is the roots system poorly developed or well developed?

.....

(iii) Are root hairs present or absent?

.....

(iv) Does Water hyacinth have fibrous root system or tap root system?

.....

(v) What is the significance of these types of roots?

.....

(vi) What is the nature of the petiole of the leaf?

.....

(vii) What role do the air cavities in the stem or petiole play in life of plant in aquatic habitat?

.....

(viii) What is the nature of special coating on the leaves? How is it useful?

.....

(ix) List the special adaptive features in water hyacinth for aquatic life

(i) ..... (ii) ..... (iii) .....

(x) Draw a labelled diagram of the specimen.

Observation 2 (Related to Opuntia)

(i) What is the nature of the stem? Is it fleshy or dry?

.....

(ii) Are there any leaves present? What are they reduced to ? What is the significance?

.....

(iii) What is the term used to describe such a stem?

.....

(iv) How have such plants reduced the loss of water?

.....

(v) Draw a labelled diagram of specimen.

Observation 3 (Related to Tapeworm)

(i) Draw a labelled diagram showing

(a) Scolex with hooks and suckers

(b) Neck

(c) Proglottides

(ii) What is the use of the hooks and suckers in the scolex?

(a) .....

(b) .....

(iii) Comment upon the digestive system of *Taenia*.

(a) Does it have a well developed digestive system?

.....

(b) How does it obtain its food?

.....

(iv) List at least three parasitic adaptations in *Taenia*.

(a) .....

(b) .....

(c) .....

(v) How does it protect itself from the action of the digestive enzymes present in the intestine?

PRECAUTIONS

1. Carefully handle the opuntia plant with fine spines, if it is fresh specimen.

FOR THE TEACHER

Please ensure that student is able to

1. correlate special adaptive features with the habitat
2. identify the spines and suckers on the scolex of ***Taenia*.**

Exercise 10(a)

TO STUDY THE PHYSICAL PROPERTIES OF DIFFERENT SOIL SAMPLES

Soil is the uppermost layer of the earth. It is formed by disintegration and decomposition of rocks. Soil is a mixture of mineral particles of varying sizes and decaying organic matter called **humus**. Numerous organisms live in soil and soil sustains plant life. On the nature of soil depends the type of plants or crops that can be grown on it.

OBJECTIVES

After performing the exercise, you should be able to :

- acquire the skill of setting up the experiment;
- identify different layers or components of the soil;
- compare the physical properties of different soil samples.

Fig. 10.1 Soil sample

10.1(a) WHAT YOU SHOULD KNOW

Soil is a mixture of mineral particles of different sizes and decaying organic matter. The different sized soil particles are classified as follows :

S.No	Diameter of particles	Name of the soil particles
1.	more than 2.00 mm	gravel
2.	2.00 mm to 0.2 mm	Coarse sand
3.	0.2 mm to 0.02 mm	Fine sand
4.	0.02 mm to 0.002 mm	Silt
5.	below 0.002 mm	Clay

The varying percentage of different particles in the soil are responsible for the difference in soil texture. According to the texture characteristics of soil, it may be named as :

1. Sandy soil - When soil consists of 60% of sand, 10% clay and 10% silt.
2. Loamy soil - When soil has 30-50% silt, 5-20% clay and rest sand.
3. Clay soil - When soil contains 50% of clay particles or more, rest as silt and sand.

Notes

Material Required

(i) Paper bags for collecting soil samples
(ii) Hand lens
(iii) Measuring cylinder
(iv) Water
(v) Glass rod

10.2(a) HOW TO PROCEED

1. Collect soil samples from different places in different paper bags and label the place and date of collection. Bring them to the laboratory.
2. Examine the soil samples by a hand lens and feel its texture and note down in the observation table given below.
3. Take about 50 gm of soil from a sample in a 250 ml measuring cylinder.
4. Add 150 ml of water and stir it well with a glass rod.
5. Allow it to settle down.
6. Record the thickness of the layers formed by different types of particles Calculate their relative percentage and note down your observations in the table given below.
7. Similarly record the relative percentage of different types of particles in different soil samples.

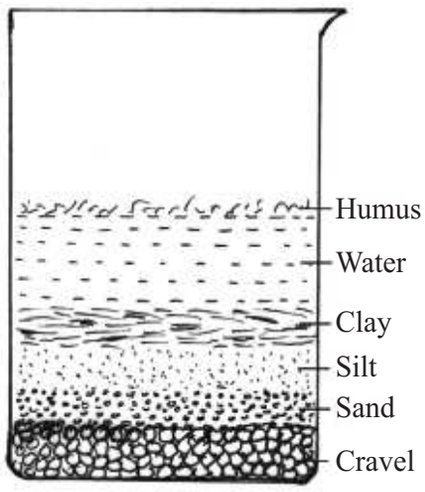


Fig. 10(a) Different layers formed by different types of soil particles in water.

10.3(a) RECORDING OF OBSERVATIONS

1. Name the layer that settles at the bottom and the layer that floats on water.

(a) ..... (b) .....

2. How many layers are formed by the soil samples

   (a) .....

   (b) .....

   (c) .....

3. What is the colour and texture of the soil sample A, B and C in the table given below

S.No.	Soil sample	Colour	Texture	Relative percentage		
				Sand	Silt	Clay
1.	Soil from a crop land					
2.	Soil from road side					
3.	Soil from river or any other source					

10.4(a) PRECAUTIONS

1. Soil samples should be collected in separate bag labelled and brought to the laboratory.
2. The thickness of the layers formed in water should be carefully measured.

10.5(a) FOR THE TEACHER

The teacher may help the students to

1. identify the different layers formed by the soil in water.
2. identify the sample/type of soil sample A, B and C.

Notes

Exercise 10(b)

TO STUDY THE WATER HOLDING CAPACITY OF DIFFERENT SOIL SAMPLES

Soil water is one of the most important ecological factors. Soil water is derived either from rain or from irrigation. All the water falling on soil in an area is not retaind by it. Most of it is lost as **gravitational water**, the rest of it is retained as **capillary water** and **hygroscopic water**. The amount of water retained by the soil depends upon its particle size.

OBJECTIVES

After performing the exercise, you should be able to :

- acquire the skill of weighing soil samples by using physical balance;
- develop the skill to set up an apparatus to perform this exercise;
- explain that water rises up in soil by capillarity;
- explain why different soil samples have different water holding capacities.

10.1(b) WHAT YOU SHOULD KNOW

1. The maximum amount of water retained by a unit mass of dry soil after the water loss due to gravitational flow is called its **water holding capacity**.
2. It varies in different types of soils.
3. Soil is a complex mixture of mineral particles, humus, water and air.
4. The texture of the soil depends upon its particle size.
5. The soil particles may be classified into (a) coarse sand (b) fine sand (c) silt and (d) clay depending upon the particle size (0.2 mm-0.002 mm)

Material Required

(i) Garden soil sample
(ii) Small tin cans with perforated bottom
(iii) Road side soil sample
(iv) Petridish
(v) Filter papers
(vi) Water
(vii) Weighing balance

10.2(b) HOW TO PROCEED

1. Take the soil samples, one from garden and the other from the road side. Allow them to dry. Crush the lumps if any.
2. Take two tin boxes of the same dimensions (empty cans of softdrink or preserved food. The tins should be narrow and long). Make 15 holes of uniform size at the bottom of these two boxes.
3. Place filter paper at the bottom of each tin and weigh them separately say x_1 and x_2.
4. Now fill 50 gms of garden soil in one box and 50 gms of roadside soil in the other box and gently tap to ensure uniform filling.

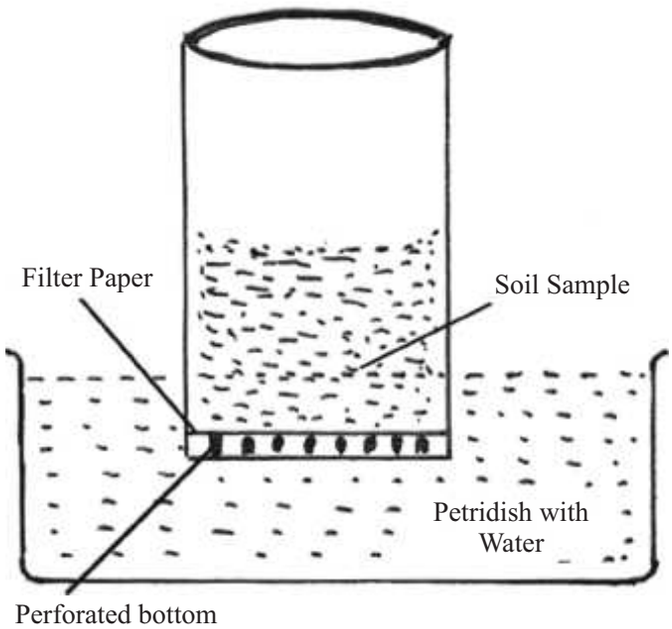


Fig. 10(b) Experimental set-up to determine water holding capacity of soil.

5. What is the weight of the soil filled boxes? (x_1 + 50 gms).
6. Place the soil filled tins in petridishes containing water and allow them to take up water till the upper surfaces of the soils become wet. Note down the time taken.
7. Now take out the tins from the petridishes and hold them slightly tilted so that the extra water drips down. Can you explain why this is important?
8. Now weigh the tins again say it weighs y_1 and y_2 gms respectively.
9. Now complete the following table and record it in your recod book.

1	2	3	4	5
Soil sample	Wt of the empty can (x)	Wt of the can after filling soil x + 50 gm	Wt of the can after removing it from petridish y gm	Wt of water retained by soil y – (x + 50) = z
Garden soil	.....	.....	.....	.....
Road side soil	.....	.....	.....	.....

Water holding capacity of soil Z/50 × 100

10.3(b) RECORDING OF OBSERVATION

1. In which of the soil samples did the water reach the top layer earlier?

   .....

2. How much time did the water take to rise to the top in the two samples?

   .....

3. What was the final weight of the soils after the completion of the experiment?

   Sample A ..... gm

   Sample B ..... gm

4. How much of water was gained by

   Sample A ..... gm

   Sample B ..... gm

5. Which of the two samples has a higher water holding capacity, sample A or sample B?

   .....

6. What is the nature of soil in the samples? Coarse/fine?

   Sample A .....

   Sample B .....

7. How do you corelate the water holding capacity with the texture of the soil?

   Did the sample with finer texture of soil show higher water holding capacity?

10.4(b) PRECAUTIONS

1. The tins should be weighed accurately.
2. Weighing of the cans after taking out of the petridishes should be done only after dripning of water has stopped.

10.5(b) FOR THE TEACHER

1. Collection of soil sample be done under the guidance of the teacher.
2. Significance of water holding capacity may be emphasized by the teacher.

Exercise 11

DEMONSTRATION OF OSMOSIS BY POTATO OSMOMETER

Materials move in and out of the cells by different cell processes. Water moves in and out of the cells by **osmosis** through the cell membrane. This exercise aims at studying the osmosis in detail.

OBJECTIVES

After performing this exercise, you should be able to:

- develop a skill to make an osmometer with some plant material such as carrot, potato;
- reason out that cell membrane of the potato cells acts as semipermeable membrane.

11.1 WHAT YOU SHOULD KNOW

An osmometer is used to see the movement of water molecules from the region of higher water concentration to the region of lower water concentration through the semipermeable membrane of the cells.

Materials Required

(i) Potato	(ii) Sugar Solution	(iii) Stand
(iv) Petridish	(v) Water	(vi) Scalpel

11.2 HOW TO PROCEED

(i) Select a medium-sized potato.

(ii) Peel a potato and cut one end of the potato so that it can stand on its base. Make a cavity (2 cm broad × 3 cm long) with the help of a scalpel on the upper portion of the potato.

(iv) A measured amount of 10% sugar solution is placed in the cavity of the tuber.

(v) Mark the initial level of solution in the cavity with the help of a common pin.

(vi) Place the potato tuber containing sugar solution in a petridish containing water.

(vii) You can keep the set up for 2-3 hours or even over night.

(viii) Observe the set up after 2 hours and measure and record the level of solution.

(ix) Measure the volume of solution after the experiment is over.

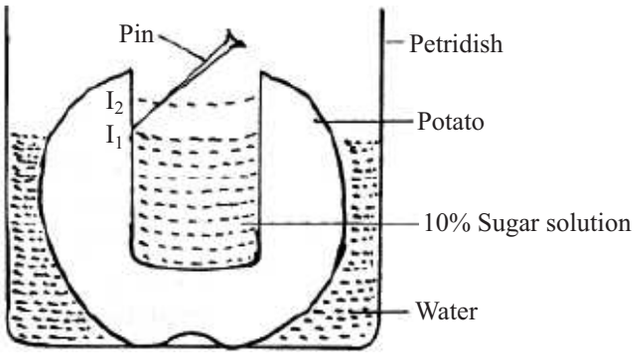


Fig. 11.1 Potato osmometer.

11.3 RECORDING OF OBSERVATIONS

(i) Has the level in the potato cavity (a) remained same, (b) risen, or (c) fallen?

.....

(ii) Explain the reason for your observation made in observation no.(i)

.....

(iii) Name the processes involved in this experiment. (diffusion, osmosis, imbibition, absorption)

.....

(iv) Define or explain the phenomenon concerned with the change of the level of sugar solution in the cavity of potato stated above.

.....

(v) What will happen if sugar solution is kept in the petridish and water in the potato cavity?

.....

11.4 PRECAUTIONS

1. Make a cavity carefully in the potato so that it should be deep enough.
2. Initial level of water should be carefully marked.

11.5 FOR THE TEACHER

1. The teacher may demonstrate to students, how to make cavity in the potato tuber.
2. Make sure that the sugar is properly dissolved while preparing its solution before pouring it in the potato cavity.
3. Mark the initial level of solution in the cavity.

Exercise 12

DETERMINING THE RATE OF PHOTOSYNTHESIS IN AN AQUATIC PLANT (HYDRILLA OR ELODEA)

Plants take CO_2 and water to produce food in the presence of sunlight. The process is referred to as **photosynthesis**. O_2 is one of the end products during photosynthesis.

In the present exercise you will study the rate of photosynthesis in an aquatic plant **Hydrilla**. Rate of photosynthesis will be measured by counting the number of bubbles evolved per minute from the cut end of the plant.

OBJECTIVES

After performing this exercise, you should be able to:

- explain that different wave lengths of light affect the rate of photosynthesis;
- explain that release of O_2 during the day indicates that photosynthesis is taking place,
- argue that it is therefore one of the reasons to suggest that during night one should not sleep under the trees because at night there is no photosynthesis and therefore, no O_2 is evolved but only CO_2 is released in respiration;
- explain giving one reason why during the day, one feels fresh under the tree; (that is because of oxygen given out by the trees)
- give reason why aquatic plants are best suited for such experiments.

12.1 WHAT YOU SHOULD KNOW

1. In the presence of light, green plants take in CO_2 and water and synthesize sugar and liberate O_2 in the process of photosynthesis.
2. Light and carbon dioxide are two important factors which control the rate of photosynthesis.

Materials Required

(i) Water (ii) Sodium bicarbonate (iii) Glass rod (v) Hydrilla plants

(vi) Glass jar (12'' by 5'') or wide-mouth bottle

(vii) Stop watch with seconds hand

12.3 HOW TO PROCEED

(i) Collect some Hydrilla plants from a nearby pond. May be your school centre has an aquarium containing Hydrilla. It is a free floating green plant with several leaves arising in whorls at the nodes..

(ii) Take a big bucket full of water and leave the Hydrilla plants in it.

(iii) Select a healthy twig and tie it to a glass rod in such a way that the cut end of the stem is facing upwards as shown in the Fig. 12.1. It must remain inside the water to prevent any air getting into the xylem at the cut ends of the twig.

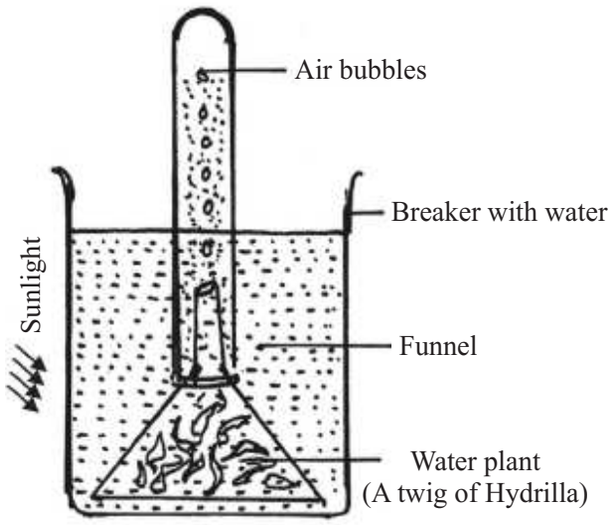


Fig. 12.1 Experimental set up to determine the rate of photosynthesis.

(v) Now introduce the Hydrilla plant which is tied to a rod, inside the jar filled with water.

IMPORTANT

The Hydrilla plant must always remain submerged in water.

(vii) Add a pinch of sodium bicarbonate ($NaHCO_3$) to the water which will provide CO_2 to the plant.

(viii) What do you observe at the cut end of stem of Hydrilla twig? You will find that air bubbles are coming out.

(ix) Keep the set up in full sunlight and take five readings by counting the number of bubbles per minute using a stop watch.

(x) Take the set up in the shade and count the number of bubbles per minute using a stop watch.

Notes

12.4 OBSERVATION AND DOCUMENTATION

Observation

No. of observation	No of bubbles given out/minute		
	Full sunlight	Under the shade of a tree	Mean
1			
2			
3			
4			
5			

(i) In which light the number of bubbles evolved is more?

.....

(ii) Why is it that under the shade of tree there is less number of bubbles per minute?

.....

(iii) Name the gas which is evolved in the form of bubbles.

.....

(iv) What is the source of the gas mentioned in item no. (iii) above

.....

(v) Name the process involved in this experiment.

.....

(vi) What does the rate of bubbles given out indicate?

.....

(vii) Can we replace Hydrilla by any grass or any common plant like balsam or rose? Yes/No ..... and why?

12.5 PRECAUTIONS

1. Set up the apparatus very carefully.
2. Never permit air bubbles to enter the xylem vessels of Hydrilla. Therefore always keep the twigs submerged in water.
3. Do not damage the plant while tying it to the glass rod.

12.6 FOR THE TEACHER

1. Teacher may help the student to select a healthy twig of Hydrilla.
2. Student be helped in recording the observation and counting of bubbles.

Exercise 13

STUDY THE STRUCTURE AND GERMINATION IN GRAM AND BEAN SEEDS

13(A) STRUCTURE

All seeds have the same function i.e. to produce a new plant. For this they have an embryo, but they also have some other parts. This exercise is intended to make you study by yourself the detailed structure of the two common seeds gram and bean. In the dry condition they are available throughout the year.

OBJECTIVES

After performing this exercise you should be able to :

- identify the different parts of the seed;
- highlight the characteristics of each component of the seed;
- justify the classification of the two prescribed seeds as dicotyledonous;
- make a temporary mount of the embryonal axis;
- identify the embryonal axis and its parts such as epicotyl and hypocotyl regions;
- identify two basic patterns of germination like epigeal and hypogeal.

13.1 WHAT YOU SHOULD KNOW

1. Seed is a reproductive part.
2. Seed contains an embryo consisting of plumule and radicle.
3. Cotyledons usually store food, and act as the first leaves after seed germination.
4. Seeds are classified as monocotyledonous (single cotyledon) and dicotyledonous (two cotyledons).

Material Required

(i)	Seeds of gram/bean/castor	(iii)	Watch glass/Petridish
(ii)	Dissecting microscope/hand lens	(iv)	Needles
(v)	Ice cream cups	(vi)	Soil

Notes

13.2 HOW TO PROCEED

Place the seeds in water in a petridish and leave them as such for about 24 hours. You will find that the seeds are somewhat swollen and that their coverings have become soft.

A. Gram and Bean

(i) Pick up one large sized soakad seed and place it in a watch glass or on a slide (Fill up observation No. 1)

(ii) Keep another watch glass ready with some water in it to keep the embryonal axis.

(iii) Remove the outermost covering of the seed, i.e the seed coat, with the help of fine needles taking care that the underlying parts are not damaged, and the cotyledons are intact (Fill up Observation No. 2).

(iv) Gently open out the two cotyledons from their most convex side taking care. that they do not separate totally (Fill up Observation No. 3).

(v) Observe the point of attachment of the two cotyledons with the embryonal axis.

(vi) With the help of fine needles separate the embryonal axis by breaking the point of attachment with the cotyledons.

(vii) Place the embryonal axis in the other watch glass containing some water (Fill up Observation No. 4).

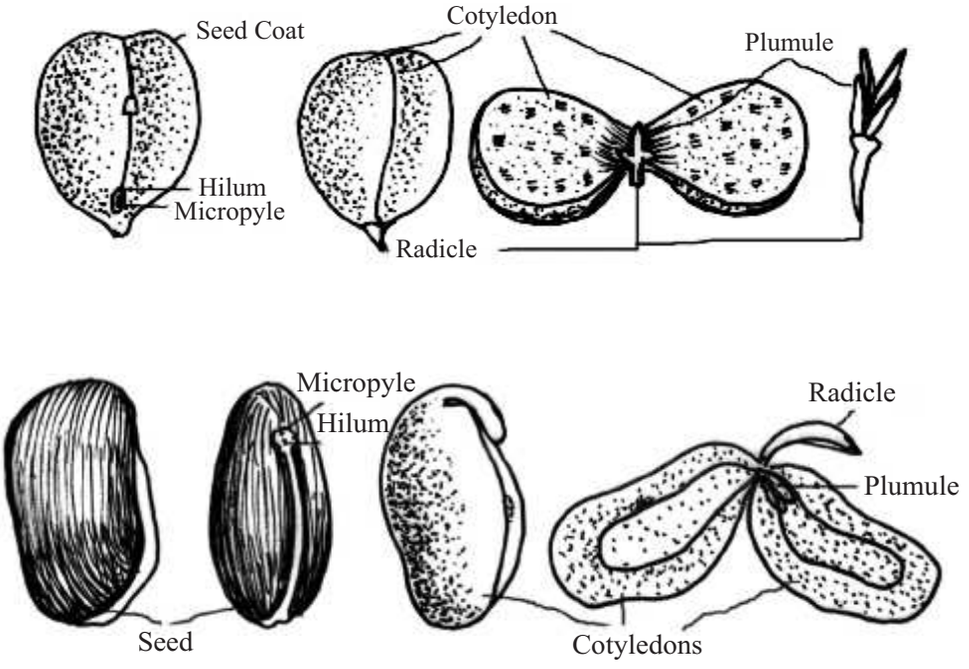


Fig. 13.1 Structure of gram and bean seeds

13.3 RECORDING OF OBSERVATION

Observation No. 1

(i) What is the shape of the seed (somewhat conical, rounded or kidney shaped)

.....

(ii) Do you find any markings on the surface? Yes/No .....:

(iii) If yes, describe the markings.

.....

(iv) Can you make out the point by which the seed was attached to the parent fruit? Yes/No....: .....

If yes, what is its name

.....

Observation No. 2

(i) How many cotyledons are there?

.....

(ii) What is the colour of the cotyledons?

.....

Observation No. 3

(i) What is nature of the outer surface of the cotyledons? (Convex, concave or flat)

.....

(ii) What is the shape of the inner surface of the cotyledons? (Convex, concave or flat)

.....

Observation No. 4

(i) How many distinct parts do you see in the embryonal axis? (One, two, three or more)

(ii) Which parts of the embryonal axis will form

(a) Shoot .....

(b) Root .....

13B GERMINATION

Embryo lies dormant in the seed but when supplied with moisture and optimum temperature, the embryo becomes active and grows and develops into a small seedling. The process by which the dormant embryo becomes active and grows out of the seed coat and establishes itself as a seedling is called **germination**.

OBJECTIVES

After performing this exercise, you should be able to :

- develop the skill of germinating the seeds under optimum conditions;
- identify the two basic patterns of germination : epigeal and hypogeal;
- identify the embryonal axis and its parts such as epicotyl and hypocotyl regions.

13.4 HOW TO PROCEED

(i) Take two clean and empty ice cream cups of about 6 cm diameter and fill them with soil.

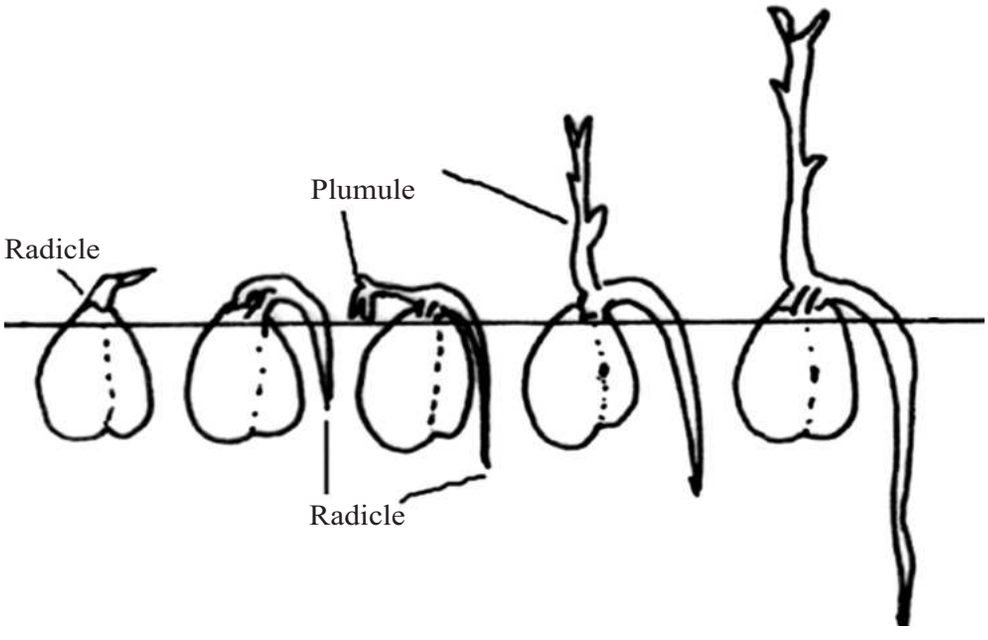
(ii) Take six dry seeds each of gram and bean and sow them in the soil in the cups.

(iii) Make sure to keep the soil moist althrough the experiment.

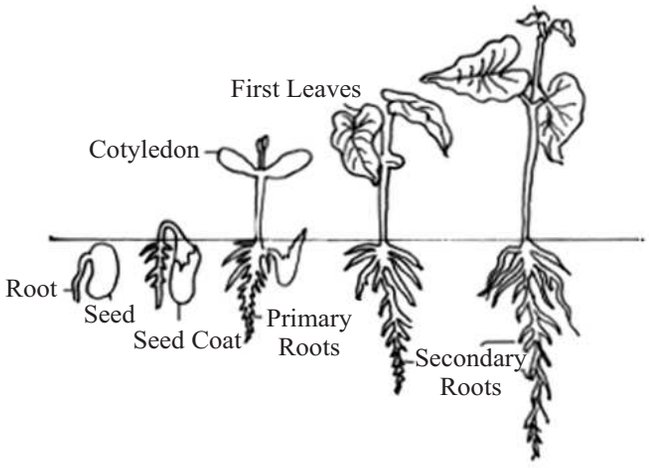
(iv) Note down the time when the first pair of leaves emerge.

(v) In case the cotyledonary leaves do not come out of the soil, dig the seeds out to see the condition of the cotyldedons.

(vi) Observe and study the structure of the first pair of leaves very carefully.



(a)



(b)

Fig. 13.2 Seed germination of bean and gram seeds

13.5 RECORDING OF OBSERVATIONS

1 Bean as well as in gram seeds which part emerged first from the soil, radical/plumule/ cotyledons?

.....

2. What was the nature of the first leaf formed in (a) gram and (b) bean?

.....

3. What happens to the cotyledons in the (a) gram seeds and (b) bean seeds. You may dig out the germinating seeds to see the condition of the cotyledons.

.....

4. Which portion of the embryonal axis grows faster epicotyl/hypocotyl in (a) and (b)?

.....

5. What type of germination is found in (a) and in (b)?

.....

6. What is the major difference you find in the first pair of leave in the two types of seedlings and why?

.....

Notes

13.6 PRECAUTIONS

1. Make sure to keep the soil wet through out the duration of experiment.
2. While digging the soil to examine the condition of the cotyledons, do not damage the seeds.

13.7 FOR THE TEACHER

1. Student should take help of the teacher to identify different parts of a seed.
2. Students may take help from the teacher to select out right kind of seeds to study epigeal and hypogeal germination.
3. Teacher may kindly emphasize the significance of seed as a reproductive unit or a propagative body.

Exercise 14

TO DEMONSTRATE THE RELEASE OF CO_2 DURING GERMINATION OF SEEDS

All living beings respire whether it is a developing baby plant (germinating seeds) or a developing human foetus, or a single cell. During respiration oxygen is taken in while carbon dioxide is liberated which can be demonstrated by the present exercise.

OBJECTIVES

After performing this exercise you should be able to:

- develop a skill to set up an apparatus to perform this exercise;
- reason out why germinating seeds and not dry seeds are selected;
- explain that the rate of respiration is higher in germinating seeds than in non-germinating ones, as the rate of growth is faster.

14.1 WHAT YOU SHOULD KNOW

1. All living beings respire and take O_2, from the inspired air and give out CO_2 in the expired air.
2. Inspiration and expiration together constitute breathing.
3. O_2 taken in is used for oxidation of food to release energy representing Cellular respiration.

Materials Required

(i) Conical flask-250 ml, capacity
(ii) One holed rubber cork
(iii) Glass-tube bent twice at right angles
(iv) Beaker
(v) Small bottle (4 cm × 3/4 cm)
(vi) Thread
(vii) KOH-pellets (caustic or potassium hydroxide)
(viii) Gram seeds/Moong seeds/Wheat grains

14.2 HOW TO PROCEED

(i) Take about 25 gms of gram seeds and soak them overnight in a beaker half filled with water.

(ii) Next day decant the water and wrap the seeds in a wet cloth.

(iii) After one or two days, open the cloth and look at the seeds.

(iv) The seeds have sprouted or germinated (The radicle and plumule have appeared)

(v) You may use the same method to germinate moong seeds and wheat grains and use them in place of gram seeds.

Material is now ready to proceed further

(vi) Take a dry conical flask and put sufficient number of germinated seeds into it, so as to cover the base of the flask. (Two to three layers of germinated seeds).

(vii) Insert a one-holed rubber cork in the mouth of the conical flask.

(viii) Take a small test-tube and put 5 to 6 pellets of KOH (Potassium hydroxide).

(ix) Tie the test-tube with a piece of thread and hang it as shown in the diagram.

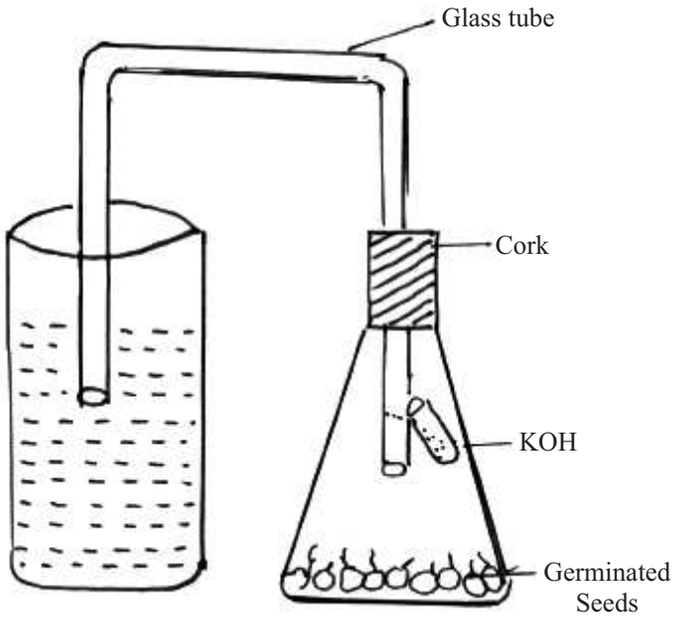


Fig. 14.1 Experimental set-up

(x) Introduce one end of the bent glass tube into the conical flask through the cork.

(xi) The end of the tube must be slightly away from the seeds.

(xii) Dip the other end into a beaker of water coloured with a drop of saffranin.

(xiii) Mark the initial level of water inside the tube.

Your experimental set-up is now ready for observation

(xiv) Leave your set-up and observe the level of the water after every half an hour. Now turn to your work-sheet and fill up observation 1.

14.3 RECORDING OF OBSERVATION

Observation 1

(i) Why do we take germinating seeds for this experiment and not the dry seeds?

.....

(ii) Can we take young floral buds instead of germinating seeds? Yes/No

.....

(iii) If your answer is 'Yes' what precaution should be taken?

.....

(iv) Why do we take KOH pellets inside the conical flask?

.....

(v) Why is the other end of the tube dipped in beaker of water?

.....

(vi) Does the level of water in the tube (a) remains same, (b) rises or (c) falls?

.....

(vii) State a suitable reason for your answer in Q. No. (vi)

.....

(viii) Name the process that this experiment has demonstrated.

.....

(ix) Define or explain the process, mentioned in answer no. (viii)

.....

(x) Can you perfom the experiment with boiled seeds? If not why not?

.....

14.4 PRECAUTIONS

(i) The cork of the flask should remain air tight.

(ii) The KOH pellets should not come in contact with the germinating seeds.

14.5 FOR THE TEACHER

1. Students may be explained the significance of the process of respiration.
2. Students should be explained the nature of metabolites present in the seeds and grains in this experiment.
3. Teacher may explain the significance of oxygen in the process of respiration.

Exercise 15

TO STUDY ABOUT THE ACTION OF SALIVARY AMYLASE ON STARCH

Enzymes are involved in major physiological processes and biochemical reactions in the living body systems such as **digestion, cellular respiration, biosynthesis** etc. Salivary amylase is present in our saliva and is an important enzyme for digestion in the mouth.

OBJECTIVES

After performing this exercise, you should be able to:

- reason out that
  - (i) enzymes are specific for specific biochemical reactions;
  - (ii) act best at optimum temperature and pH;
- develop skill to prepare different solutions of specific concentration;
- show that salivary amylase acts best on cooked starch.

15.1 WHAT YOU SHOULD KNOW

1. Saliva is the secretion of three pairs of salivary glands opening into the buccal cavity of humans.
2. Saliva is a mixture of salivary amylase, mucin, minerals and water.
3. Salivary amylase is the first digestive enzyme acting on starch.

Materials Required

(i)	Test-tubes	(vii)	Starch powder
(ii)	Test-tube stand	(viii)	Iodine
(iii)	Beakers	(ix)	Benedicts reagent
(iv)	Burner	(x)	Pipette
(v)	Measuring cylinder.	(xi)	Water bath
(vi)	Physical balance	(xii)	Thermometer

Note : Starch solution and iodine solution to be prepared one day before the experiment.

15.2 HOW TO PROCEED

A. Preparation of Starch Solution

Note : Starch is soluble only in hot water.

(i) Weigh one gram of starch and dissolve it in 10 ml hot (boiling) distilled water.

(ii) Keep it aside.

(iii) Heat 90 ml of distilled water in a conical flask (85°C-95°C).

(iv) When the air bubbles form, remove the flask from the source of heat.

(v) Gradually transfer the prepared starch to this hot water.

(vi) Shake it thoroughly and leave it overnight.

(vii) Cork the conical flask containing starch solution.

This is 1% starch solution

B. Preparation of Iodine solution

(i) Dissolve 1 gm. of iodine and 2 gms. of potassium iodide in 100 ml of water in a beaker.

(ii) Pour it in a bottle and cork it.

Action of salivary amylase on starch

(i) Rinse your mouth with warm water. Make sure that no particle is sticking in your teeth.

(ii) Chew a piece of paraffin wax, to get saliva collected in your mouth. Chewing enhances secretion of saliva.

(iii) Collect your saliva in a test-tube (spit it into a test-tube).

(iv) Filter the saliva through a thin layer of moistened cotton to collect frothless, clear saliva in another test-tube (Fig. 15.1)

(v) Take two test-tubes A and B. Pour 1 ml. of 1% starch solution in both A and B. Add a drop of iodine in A.

(vi) Pour 1 ml of saliva in B and add one drop of iodine solution to it.

(vii) Observe any colour change in both A and B

Iodine gives blue-black colour only with starch.

(viii) Get a water-bath. If you do not have one, make one as given below (Fig. 15.2).

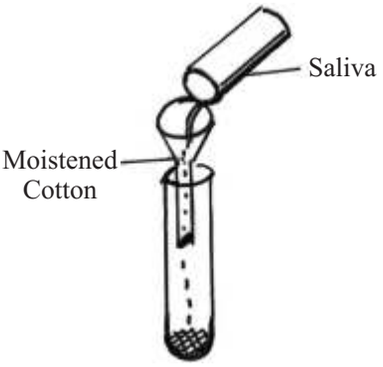


Fig. 15.1 Filtering saliva

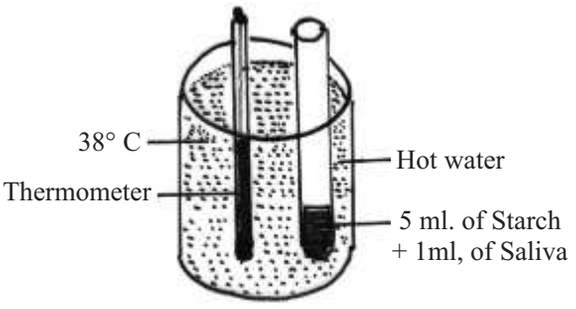


Fig. 15.2 Water bath

A beaker containing water heated to a temperature of 38°C serves as a water-bath.

(x) Prepare a series of three test-tubes (D,E,F) each containing 2 ml. of iodine solution.

(xi) Pipette out 5 ml. of 1% starch solution into another test-tube 'D, E, F ?

(xii) Add 1 ml of saliva to the above starch solution in C. Mix the contents well and record the exact time of addition of saliva.

(xiii) The mixture of 1% starch solution with saliva is called digestion mixture.

(xiv) Keep the test-tube containing digestion mixture into the water-bath. Temperature of water bath must be 38°C-39°C.

Suppose, the temperature of the water in the water bath falls below 34°C, add hot water to it. Stir it and take the temperature reading.

Do you know your normal body, temperature. It is 38°C.
Salivary amylase acts best at 38°C.

Why do we maintain the temperature of 38°C? Salivary amylase becomes inactive at lower temperature and gets destroyed at higher temperature.

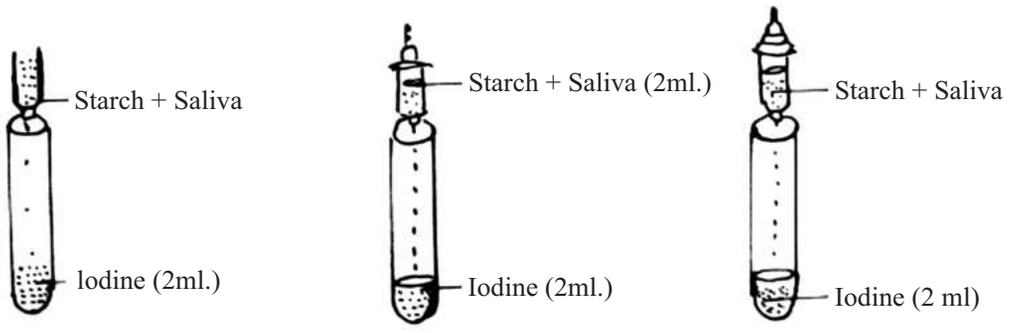
(xv) Immediately take out 2 drops of digestion mixture and add it into the test-tube D containing iodine. (Fig.19.3a)

Note the change in colour of the iodine and record in work-sheet.

(xvi) After 5 minutes repeat the previous step. This time use test-tube-E. (Fig. 19.3b) Note the change in colour if any and record it in work-sheet.

(xvii) After 5 minutes again repeat the earlier step. This time use test-tube (F). (Fig. 15.3c)

Note the change in colour if any and record it in work-sheet.



(a) Addition of digestion mixture immediately after keeping in water bath

(b) Addition of digestion mixture after 5 minutes

(c) Addition of digestion mixture after 10 minutes.

Fig. 15.3

Clue : Some chemical reaction must have taken place during this time.

(xviii) Keep all the three test-tubes (D,E and F) and compare the colours and fill up Observation 1.

15.3 CONCLUSION

Salivary amylase of saliva acts on starch and converts it into sugar. During this chemical action some intermediate substances like dextrins are formed. Dextrins give reddish brown colour with iodine.

15.4 RECORDING OF OBSERVATION

Observation 1

(i) Why do you rinse your mouth before collecting saliva in a test tube?

.....

(ii) Did you find any change in colour in test-tube A?

If yes, what was the colour?

.....

(iii) Did you find any change in colour in test- Tube B? Yes/No

.....

(iv) What was the significance of keeping the digestion mixture in water-bath at a temperature of 38°C.

.....

(v) Mention the change in colour of the contents in test-tubes - D,E,F,

.....

Change in colour

(i) Test-tube D ..... Why/ .....

(ii) Test-tube E ..... Why/ .....

(iii) Test-tube F ..... Why/ .....

(**Hint** :- Starch may be undigested, partially digested, completely digested)

(vi) How much time has your saliva taken to convert starch into sugar?

.....

15.5 PRECAUTIONS

1. Rinse your mouth before collecting saliva.
2. Prepare the solutions carefully.
3. Make sure the required temperature is maintained in the water bath.

15.6 FOR THE TEACHER

Please ensure that the student observes and records correct timings for changes in the various test tubes.

Execise 16
(Optional Module)

TO STUDY THE DEVELOPMENTAL STAGES IN THE LIFE CYCLE OF DROSOPHILA BY PREPARING A CULTURE

The progress in genetics has been largely due to experiments with common red-eyed fruit fly (Drosophilla) hovering over fruits. It is easily available and easily cultured. The generation time (time to complete development from egg-stage to adult) of fruitfully is short. It has conspicuous stages carvae and pupa. Observing the eggs hatch into larvae and then into adults through pupal stage is a delight to watch.

OBJECTIVES

After preparing a culture of Drosophila, you should be able to :

- prepare the culture medium;
- crop this from the fruit shop;
- transfer flies from one bottle to another;
- identify the various stages of life history.

Materials Required

(i) Empty jam bottle or milk bottle	(ii) agar	(iii) yeast
(iv) sugar,	(v) corn flour,	(vi) propionic acid,
(vii) banana	(viii) water	(ix) brush

16.1 WHAT YOU SHOULD KNOW

- Culturing of an organism in laboratory is required to study the behaviour, genetics cytology and evolution purpose.
- Raising large population of organisms in the laboratory by providing space and **nutrition** is termed **culturing**.
- For research work, few organisms are collected from nature or brought from dealer and maintained and grown and multiplied on a large scale.

Notes

- In school laboratories. Drosophila is cultured on a small scale for laboratory use by the student.

16.2 HOW TO PROCEED

Drosophila, the fruit fly can be cultured by the following method :

1. Clean the empty jam bottle or milk bottle and keep in boiling water for 4-5 minutes.
2. Dissolve one gram of agar in 100 ml of water.

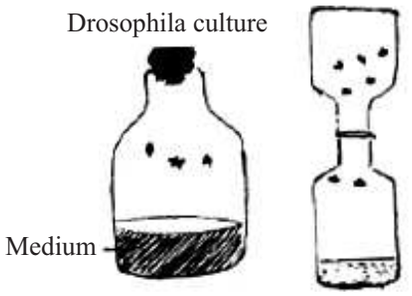


Fig. 16.1a Drosophila culture

3. Add one gram of yeast, 5 grams of sugar and 7.5 grams of cornflour to the above solution.
4. Heat the mixture till it is semi solid.
5. Transfer it into the empty and clean jam bottle.
6. Add a drop of propionic acid to it. The culture bottle is ready.
7. Put one overripe banana in an empty and clean bottle. Place it at a fruit shop. Soon red eyed fruit flies will come into the bottle.
8. Bring the bottle containing fruit flies to your place and transfer the fruit flies into the culture bottle. Note the date and time.
9. Observe the tiny, red eyed fruit flies daily and record your observations.
10. Note the changes they undergo from egg to larva, larva to pupa and pupa to adult.
11. Draw diagrams of each stage.
12. Do not forget to write the date and time of each observation.

16.3 RECORDING OBSERVATIONS

Write the procedure of making the culture and obtaining fruit flies to lay eggs.

Draw labelled diagrams of the stages of life history that is adult male and female *Drosophila*, eggs, larvae or pupae in bottle.

Note : *Drosophila* flies move up into the empty bottle if you place it upside down above the culture bottle

16.4 PRECAUTIONS

1. The nutrient medium should not become hard
2. Care should be taken while transferring flies
3. Close observation is needed to see the various larval stages or larval instars as they grow in size.

16.5 FOR THE TEACHER

The students might need help in transferring the flies. If an inverted jam bottle of same size is kept over culture bottle. The fruitflies easily fly into the upper bottle.

Notes

Execise 16(b)

A PROJECT TO STUDY THE GROWTH PATTERN OF MONEY PLANT

Growth is an essential character of life or living organisms. Growth may be defined as a permanent change in size. When growth occurs in plants, its organs increase in number and size. Thus in a growing plant, its organs increase in number and size. Thus growth is a vital process which brings about a permanent change in any plant or its part in respect to size, form, weight linear dimensions and volume.

OBJECTIVES

After completing this project, you should be able to

- know and differentiate between temporary increase due to water absorption and permanent increase in size and number of plant organs.
- develop the skill of using methods to measure length and size of roots, stems and leaves.
- learn the technique of measuring number and size of leaves.
- learn to draw a graph to show the growth pattern of various organs of the plant.

Material Required

(i) Discarded bulb or jam bottle	(ii) money plant	(iii) water
(iv) thread	(v) scale	(vi) graph paper, pencil

16.1 WHAT YOU SHOULD KNOW

1. Growth is a permanent change in size and weight of any organism.
2. The growth of a whole organism or a part of an organism, like the twig of a money plant can be measured by vaious methods.
3. Measurement of length of the internodes and the size and number of leaves can be recorded every day, at the same time, to determine the growth pattern of money plant.

16.2 PROCEDURE

1. Take a neat and clean empty bulb or jam bottle.
2. Fill three-fourth of it with fresh water.
3. Collect a piece of money plant with one or two leaves and grow it in the bulb/bottle at a place with sufficient light.
4. Change the water twice a day.
5. Observe and record the growth pattern of the money plant.
6. continue collecting the data for 15 days.
7. Draw conclusions about
   - (i) Time taken by roots to appear
   - (ii) Time taken by new leaves to appear
   - (iii) Growth rate of roots
   - (iv) Growth rate of stem
   - (v) Growth rate of leaves
   - (vi) Draw the diagram of each stage.

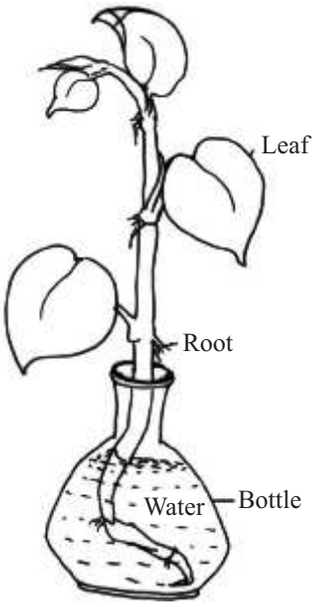


Fig. 16.2 Growth pattern of money plant

8. Plot a graph to represent growth patterns of roots, stem and leaves. In such growth curves, take time along x-axis and length along y-axis.
9. Present your record in the form of a project report.

16.3 RECORDING OF OBSERVATION

Suggested observation variables are

Date	Time	Length of root	Length of stem	Number of leaves

16.4 PRECAUTIONS

1. Observation be recorded for the same set of organs during the experiment
2. Mark the roots, leaves and stem portion with the help of tags

16.5 FOR THE TEACHER

1. Teacher may explain to the students that temporary increase in size or volume of certain organ due to absorption of water should not be confused with real growth.
2. Students should be helped while recording the length with the help of thread.

Notes

Execise 16(c)

TO MAKE A HERBARIUM

The books are kept in the libraries in a classified manner, so that it becomes easier for us to find a specific book when we need it. The same idea applies to systems guiding us about living world. Plants are kept in dry conditions mounted on hard sheets of paper, in a classified manner in a herbarium. Preparation of a plant to be kept in a herbarium is an important technique.

OBJECTIVES

After performing the exercise, you should be able to :

- develop the skill of collecting plants for their study;
- prepare a plant for mounting on herbarium sheets;
- learn the technique of classifying plants.

Material Required

(i) A gardener's knife	(ii) a plant press blotting papers or news papers
(iii) trowel	(iv) herbarium sheets
(v) tape	(vi) pen
(vii) plastic bags	(viii) water
(ix) tags	(x) labels.

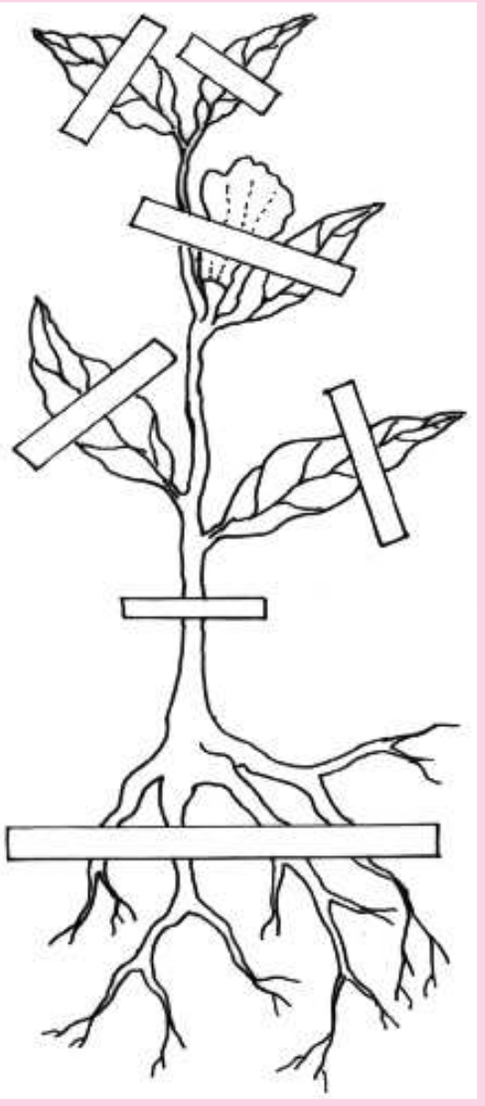
16.1 WHAT YOU SHOULD KNOW

1. A herbarium is defined as a collection of plants that have been dried pressed and preserved on sheets.
2. Dried plants are classified and arranged for future reference in taxonomic studies.
3. Plants should be collected from various localities for preparation of herbarium.

16.2 PROCEDURE

1. Collect 10 to 15 plants of different types from various localities with the help of knife and trowel.
2. The plants should be from at least five different groups.
3. The plants should be moistened with water and kept in the plastic bags during collection.
4. At the time of collection, the plant specimen should have all the parts such as stem, root and leaf.
5. Name of location, from where the specimen has been collected, should be tagged with it.
6. The collected plant should be spread evenly between the sheets of blotting paper or newspapers.
7. Then the plant should be pressed with the help of a plant press. If the plant press is not available, then some other heavy objects having plane surface can be used for the purpose.
8. While pressing, care must be taken that the parts of the plant do not overlap and the pressure is applied uniformly on the entire plant
9. The plant should be kept under some heavy weight for about three days.
10. The plant is taken out of the sheets, that is the sheets should be blotting paper or newspapers that should be changed successively for about three days. The same procedure is followed with other plant specimens simultaneously.
11. Now, the dried specimens are mounted on the herbarium sheets/big drawing sheets with the help of tape.
12. Only one specimen should be mounted on one herbarium sheet.
13. On each sheet the following detail should be given on the lower right hand corner.
    - (i) The site of collection
    - (ii) Date of collection
    - (iii) Name of the plant
    - (iv) Family
    - (v) Ecological and morphological note
    - (vi) Habitat
    - (vii) Name of the collector
14. Herbarium sheets should be preserved safely with moth balls/naphthalene balls etc.
15. These sheets should be presented in the form of a file.

Notes



1. The site of collection .....
2. Date of collection .....
3. Name of the plant .....
4. Family .....
5. Ecological and morphological note .....
6. Habitat .....
7. Name of the collector .....

16.3 PRECAUTIONS

1. If a plant is too large then a 12 inch long flowering twig can be collected and identified
2. The leaves must be pressed in a manner that they do not overlap and doe not get crinkled.
3. make sure that the plants or twig bear flowers

16.4 FOR THE TEACHER

1. Learners should be helped in identifying plants
2. Significance of taxonomic classification be explained.