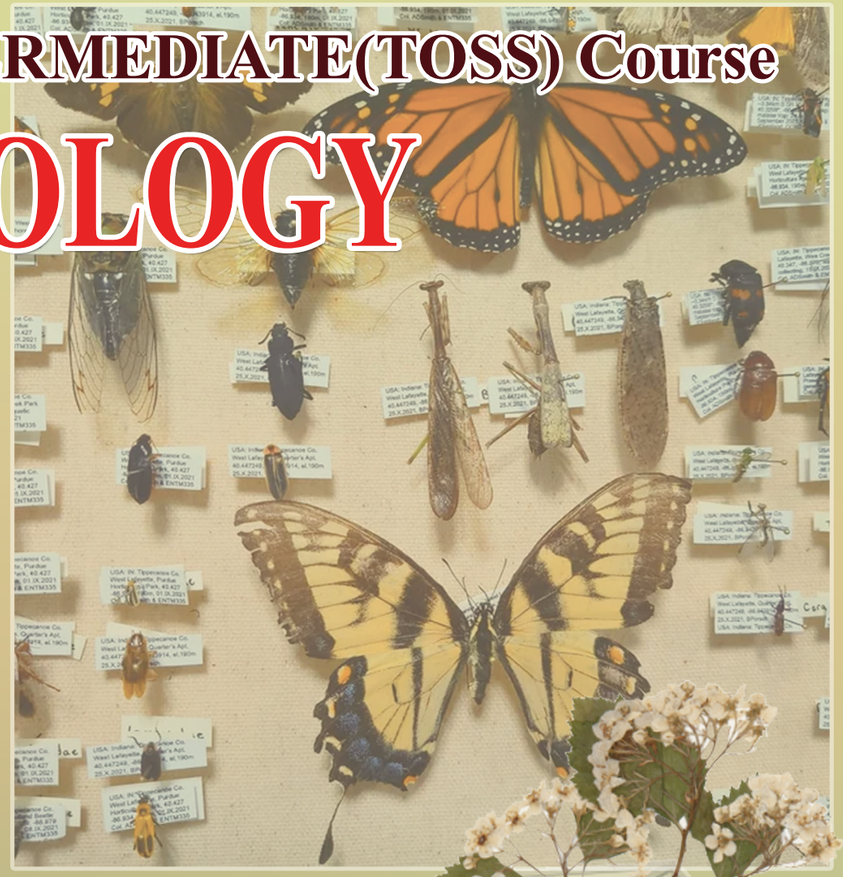
INTERMEDIATE(TOSS) Course

BIOLOGY



Government of Telangana

TELANGANA OPEN SCHOOL SOCIETY YHYDERABAD

INTERMEDIATE (TOSS) COURSE BIOLOGY-3

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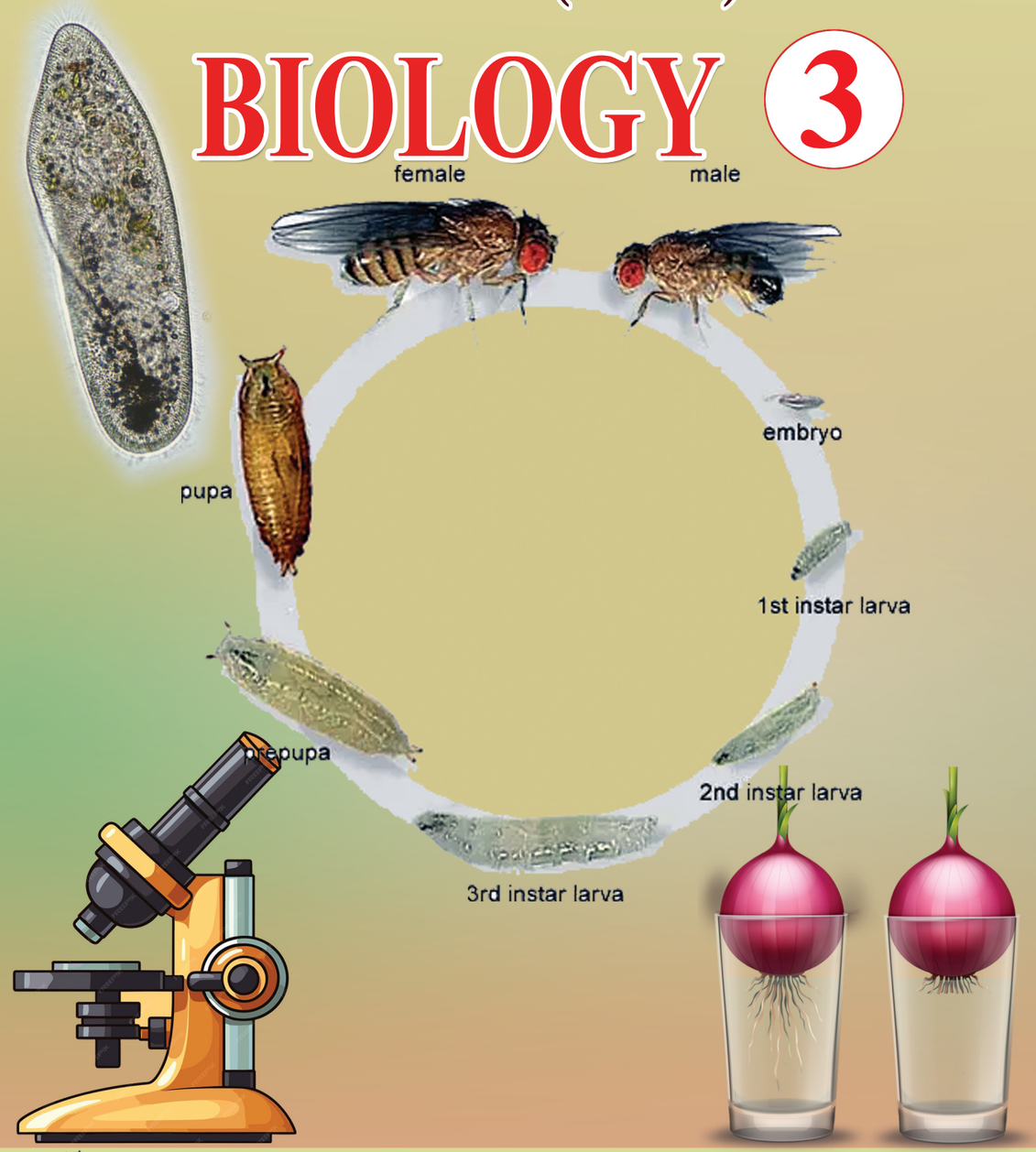
INTERMEDIATE (TOSS) COURSE

BIOLOGY 3



TELANGANA OPEN SCHOOL SOCIETY YHYDERABAD

314

BIOLOGY - 3

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Foreword

Providing education to children is a fundamental right, and it's essential for the overall development of society. The government of Telangana plays a crucial role in ensuring that education is accessible to all, and they often establish institutions like the Telangana Open School Society (TOSS) to cater to children who may be unable to access formal education due to various reasons.

To provide quality education to learners studying Intermediate Education in Telangana Open School Society starting from the 2023 academic year, the textbooks have been revised to align with the changing social situations and incorporate the fundamental principles of the National Education Policy 2020. The guidelines set forth in the policy aim to enhance the overall learning experience and cater to the diverse needs of the learners. Earlier Textbooks were just guides with questions and answers. TOSS has designed the textbook with a student-centric approach, considering the different learning styles and needs of learners. This approach encourages active engagement and participation in the learning process. The textbooks include supplementary teaching materials and resources to support educators in delivering effective and engaging lessons.

Biology plays a valuable part in general education and needless to justify its study in fact directly useful to you in finding employment opportunities as a biology teacher, lecturer, or employment in Pharmaceutical, Animal Biotechnology, Plant Biotechnology and other similar industries. You can be accommodated as a field expert in Agriculture, Horticulture, Forestry and Healthcare sector. Marine and Freshwater Biology Research areas offer plenty of opportunities to young graduates these days. Our Revised Biology Course of Telangana Open School System is based on the National Institute of Open School (NIOS) and the National Common Core Curriculum. It's also worth mentioning that The Revised Curriculum is made very simple and suits exactly to the needs and requirement of the students those who are pursuing. This course is having 3 volumes consisting both theory and practical with special focus on applied biology. I hope you will find the new material interesting and exciting with a lot of activities to do. Further, we also welcome suggestions and inputs for further improvement.

We are indeed very grateful to the Government of Telangana and the Telangana State Board of Intermediate Education. Special thanks to the editor, co-coordinator, teachers, lecturers, and DTP operators who participated and contributed their services tirelessly to write this text book.

Date: 18.11.2023
Place: Hyderabad.

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Index

I. Introduction

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.

Objectives of the Biological 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.
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. **Procedure :** 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.

Read instructions → Follow each → Make carefully step observations →

Get it evaluated → Complete → Note down all worksheet observations →

Prepare a Record Book

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 kept at least 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.

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.

1 TOOLS AND TECHNIQUES USED IN BIOLOGY

Biologists used to be able to learn everything they needed to know about living things just by looking at them. Various types of organisms and their parts were studied in greater detail using new equipment and procedures that were developed. Microscope not only revealed a world of minute organisms but also minute details of internal structure of organisms. In the course of history of biology, various new tools and techniques have developed, like microscopy,Auto radiography, and chromatography, etc. In this lesson you will learn about some of these.

Objectives

After completing this lesson , you will be able to

- Define the terms mineral nutrition, macro and micro nutrients
- Trace the development of microscopes and their working
- List the parts of a Compound microscope; compare the working principle of Compound, Electron and Phase Contrast microscope
- Differentiate between Transmission Electron Microscope (TEM)and Scanning Electron Microscope(SEM)
- Describe the basic aspects of some other techniques like Cytochemistry, Autoradiography, Paper chromatography, Cell fractionation, Ultracentrifugation and Tissue culture.

BRIEF HISTORY OF MICROSCOPES

Microscope is an instrument that help to see minute organisms and their parts . A microscope not only enlarges or magnifies the object but also ‘resolves’ it, that is makes it possible to differentiate between two points present close together in the objects being viewed.

The first microscope was developed by Anton Van Leeuwenhoek (1632-1723). This microscope consisted of a single biconvex lens fitted in a small window of a "board" and the object was viewed through it. This was a simple microscope, next stage was that of a very primitive compound microscope in which two lenses were used. Improvements continued, newer and newer microscopes were designed and are still being improved.

VARIOUS TYPES OF MICROSCOPES

There are different types of microscopes which are used in studying the various structures and activities inside a cell. Some of these are as follows:

1. Simple microscope
2. Compound microscope
3. Phase-Contrast microscope
4. Transmission Electron microscope (TEM)
5. Scanning electron microscope (SEM)

Resolving Power: It is the ability of a microscope to show two closely lying points as two separate points.

Magnification : It is the ratio of the size of the image to that of the object.

1. Simple Microscopes:

These are of two types:

(i) **Hand Lens**: It consists of a biconvex lens, mounted on a handle. The lens is of different sizes and different magnifying powers. It is commonly used to magnify an entire object.

(ii) **Dissecting Microscope** : Dissecting Microscope: It has a biconvex lens that may be adjusted by turning an adjustment screw up or down to focus on an object. A concave mirror installed below helps focus light on the object. A magnified image of the full object can be seen through it.

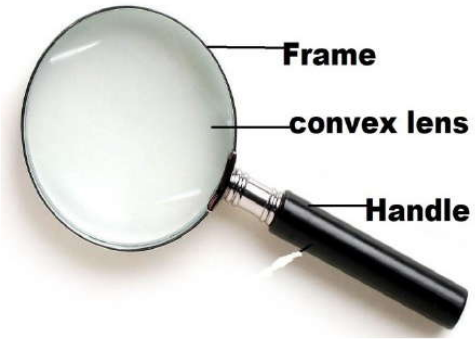


Fig: A Hand Lens

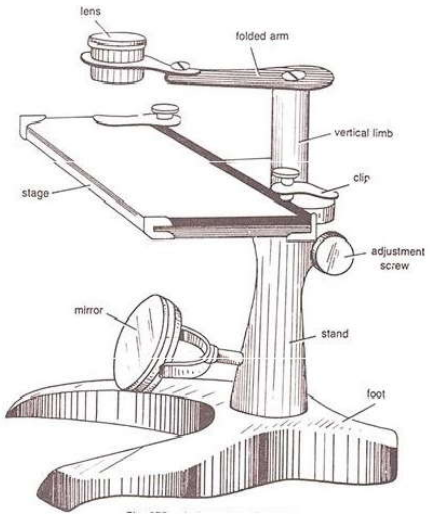


Fig: Dissecting microscope

2. Compound Microscope

It is commonly used in the laboratories to view extremely minute organisms and parts and sections of larger organisms.It has two (2) lenses 1. Occular 2) Object lenses, it also has a condenser, having a simple mirror on one side and concave mirror on the other. The object is placed first below the objective lens over the stage. The objective lens forms an image of the object. This image is further magnified by the eye piece.

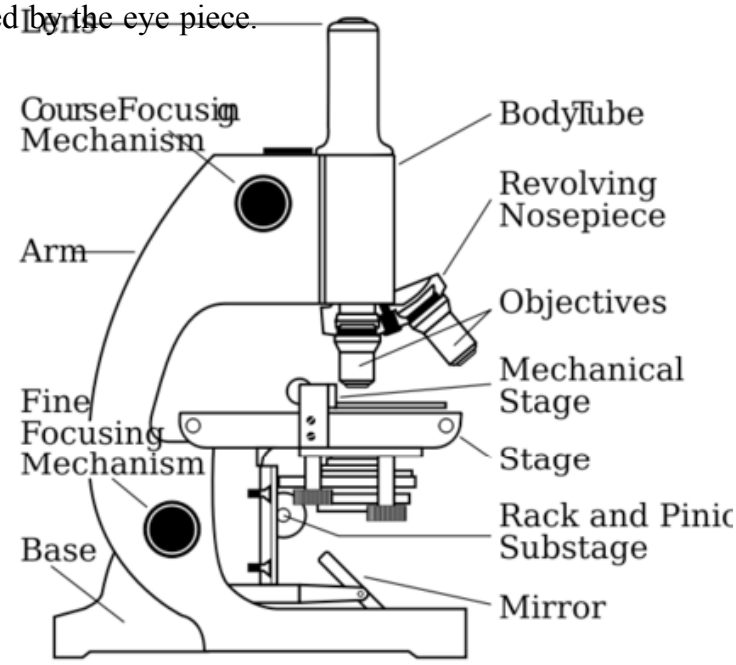


Fig : Compound microscope

Differences between a Simple Microscope and a Compound Microscope	
Simple Microscope	**Compound Microscope**
1. Basically one biconvex lens is used.	1. Basically two lenses are used.
2 The whole object may be seen.	2. Only a part of the object or a thin section can be seen.
3. It uses light which is reflected by the mirror and passes through the object.	3. It uses light which is transmitted through the object.

3. Phase-contrast microscope

It has an annular diaphragm located below the condenser and objective having a phase plate. When light is transmitted throug lenses, some of its rays pass directly while others are diffracted laterally. The diffracted light rays are thus separated from the direct light and an image o strong contrast is produced. It is mainly used in:

(i) Examine living cells.

(ii) Observe the nuclear and cytoplasmic changes taking place during mitosis.

(iii) Study phagocytosis and pinocytosis.

(iv) Observe the effect of different chemicals inside the living cells.

The Electron Microscope: The organelles of the cell became known after the electron microscope was invented. An electron microscope is a powerful instrument that uses a beam of electrons to magnify and study objects at a very high resolution. It allows researchers to investigate the fine details of a specimen that are not visible with traditional light microscopes.Electron miceroscopes are two types1.Transmission Electron Microscope 2. Scanning Electron Microscope

Comparison between the Compound Microscope and an Electron Microscope

Compound Microscope	Electron Microscope
1. It is operated in open condition.	1. It is operated only in vacuum condition.
2. The objective lens is simply a glass lens.	2. The objective lens is electromagnetic lens.
3. The source of illumination is light.	3. The source of illumination is an electron beam
4. The final image of an object is observed through an eye-piece.	4. The final image of an object is projected on a fluorescent screen.
5. It magnifies the object upto 1500 times.	5. It magnifies the object upto 200,000 times.
6. It can be used to see both living and dead cells.	6. It can be used to see only dead cells.+

4. Transmission Electron Microscope(TEM)

In a TEM, a beam of electrons passes through an ultra-thin specimen, which may be stained or chemically treated to enhance contrast. The electrons interact with the specimen, and the resulting image is formed by the transmitted electrons. This image provides detailed information about the internal structure of the specimen, such as the arrangement of atoms in a crystal lattice. TEMs can achieve extremely high magnifications, allowing scientists to observe objects at the atomic scale.

5. Scanning Electron Microscope (SEM)

In an SEM, a focused beam of electrons is scanned across the surface of a specimen, and detectors collect the electrons that are emitted or scattered by the specimen. These signals are used to construct an image of the specimen's surface topography. SEMs provide three-dimensional images with high depth of field and can achieve magnifications ranging from a few times to tens of thousands of times.

Comparison between the Transmission Electron Microscope (TEM) and Scanning Electron Microscope (SEM)

Transmission Electron Microscope	Scanning Electron Microscope
1. Beam of electrons is passed through section of material to produce the image.	1. Whole specimen is scanned by a beam of electrons.
2. Only ultra thin sections or very minute objects can be examined.	2. Larger specimens can be viewed
3. Resolution is very high.	3. Resolution inferior than that in case of Transmission electron microscope.

INTEXT QUESTIONS

1. Name the type of lens used in a simple microscope.
2. How many times can the image of an object be magnified in a compoun microscope?
3. Mention any two differences between a compound microscope and a simpl Dissection microscope.
4. What is the source of illumination in an electron microscope?

SOME OTHER TECHNIQUES

There are other types of tools and techniques that have been developed which helped in the progress of biology as a subject. Some of them are given below

1. Cytochemical Methods

Cytochemical methods are techniques used to study the chemical composition and properties of cells and cellular components. These methods are used to locate specific chemical constituents within the cells by differentiating a particular part from other parts by colouring them with a specific stain or dye. It is done either by the use of certain dyes or by using the substrates of enzymes e.g. Schiff's reagent used in Feulgen staining, is used to localize the presence of DNA in a cell.

2. Autoradiography

This technique is used for study the steps and location, synthesis of molecules and to trace metabolic events in the cells. The radio labelled compounds are injected into the organism. Then various tissues are investigated to find out where the radioactivity is located. This is done by using photosensitive film of silver bromide. Whenever in the cell or tissue or the organism, the radio labelled substance is present, silver gets reduced by radiation and is seen as black patches in the **autoradiographs**.

3. Paper Chromatography

In this method the chemical substances present in a mixture can be separated. A drop of the mixture is put on one end of a long strip of the Whatman filter paper. The filter paper is hung in a manner that the end with the drop of the mixture dips into the solvent mixture kept in the tray/jar. As the liquid is drawn up on the paper, different substances in the mixture begin to separate according to their molecular weight, size and solubility in the solvent and rise up to different heights on the paper. It is then analyses by using certain chemicals for further investigation.

4. Cell fractionation

By this method different organelles of cells such as nucleus, mitochondria, ribosomes etc. having different particle size and weight are separated by rotating them in a centrifuge at different speeds. The cells are first homogenized or broken down by a special method. The homogenate (crushed cells) is then put into tubes and tubes are placed in a centrifuge. The centrifuge is rotated at a high speed. By doing so under the influence of centrifugal force, organelles separate according to their particle density and sizes. The lighter

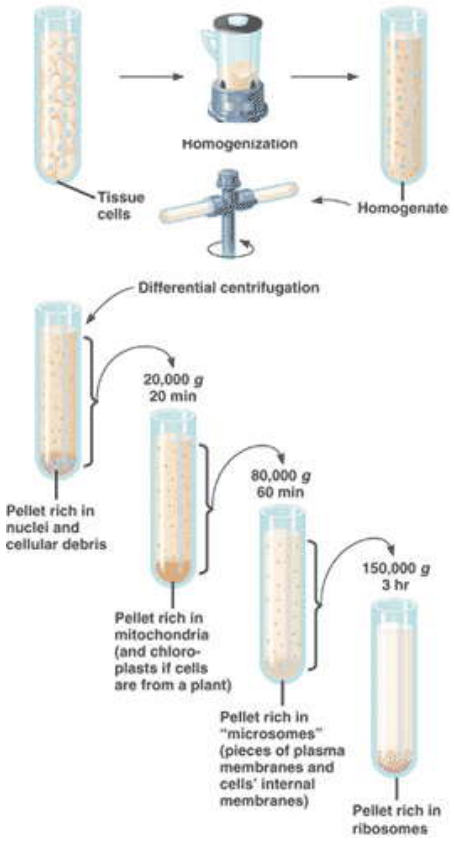


Fig: Technique of Cell fraction

particles settle at the top and the heaviest particle settle at the bottom. The layers are then studied separately and the structure in details gets to be known.

5. Ultracentrifugation

By rotation at a high speed, particles/organelles of different sizes and shape get separated according to their density. Since the rotation is at very high speed, friction with air produces heat, so has to run under refrigeration and vacuum. Nucleus, mitochondria etc. separate out at different speeds.

6. Tissue Culture

This technique involves growing living cells outside the organism by providing all necessary conditions for their survival and growth. The cells from an organism are grown in the laboratory on a nutritive medium at a suitable temperature. Using this technique it has been possible to develo a whole organism from a single cell. Some new fully grown plants have bee developed in this way.

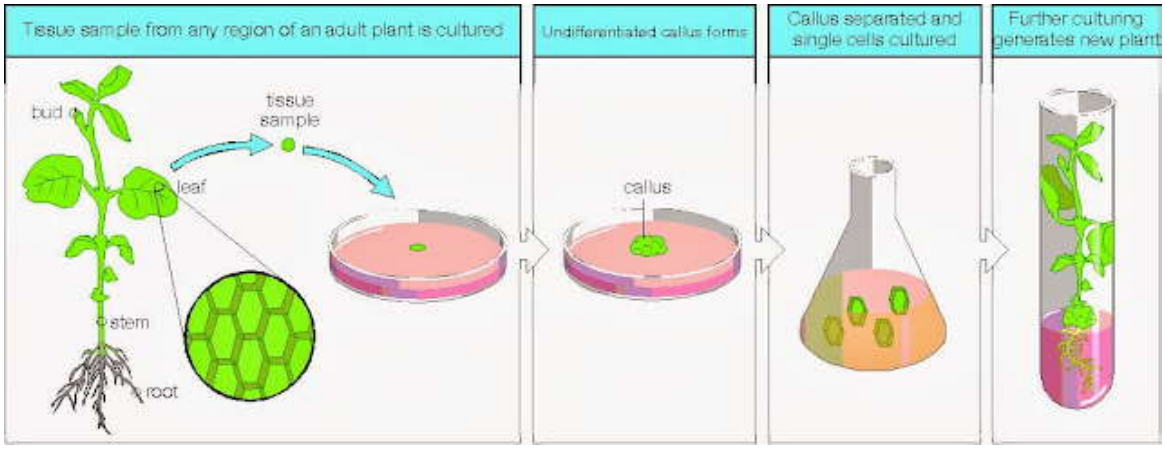


Fig: Steps in tissue culture

Tissue is removed from the plant body and grown in a nutrient medium. The cells divide to form undifferentiated mass of cells called callus which then differentiates into plant. In the diagram leaf tissue culture has been shown but tissue from a part of the plant has the ability to follow the similar path and produce an entire plant. The tissue taken from the plant is called explants. It is now possible to culture a single cell into a whole plant.

INTEXT QUESTIONS

1. What special type of substances are injected in an organism for autoradiography?
2. In which technique is Schiff's reagent used?
3. Name the technique by which the organelles from a cell can be separated.

WHAT YOU HAVE LEARNT

- Biologists depend heavily on a number of tools and techniques for studying organisms.
- Microscopes, such as the simple (dissection) microscope, compound microscope and the electron microscope are used to study organisms.
- Compound microscope uses light and can give magnification up to about 1500 times whereas the electron microscope uses electron beam and magnifies the image upto 2,00,000 times.
- Phase contrast microscope is chiefly used for observing activities inside the living cells.
- Scanning electron microscope is used for introducing three-dimensional images chiefly of the surfaces.
- Cytochemical methods, autoradiography, centrifugation are helpful in studying cell chemistry, synthesis of substances inside the living organism and isolation of cell organelles respectively.
- Paper chromatography is used for separating chemical substances in a mixture.
- Tissue culture involves growing of cells and tissues outside the body of the organism.

TERMINAL QUESTIONS

1. Name the scientist who developed the first microscope?
2. Mention three differences between a compound microscope and an electron microscope?
3. Define the term ultracentrifugation.
4. Name the microscope used in the study of a living cell and instrument used in separating cell organelles.
5. List the main points of the technique of autoradiography
6. Give uses of cytochemical methods and centrifugation.
7. Mention the importance of tissue culture.

2 GENERAL LABORATORY EQUIPMENTS

A biology student has to work with various types of equipment while performing different experiments. It is useful to know the principle behind the working of some of these. One main category out of these you have learnt in the previous lesson i.e. the microscopes. A few others will be explained in this lesson

Objectives

After completing this lesson , you will be able to

- Explain the working of a kymograph and list its uses
- Define pH and state the applications of a pH meter
- Explain the working and mention the uses of autoclave
- Explain the working and mention the uses of colorimeter
- Describe the parts of a distillation unit and mention its applications
- Describe the working and use of spectrophotometer
- List the latest weighting balances used in laboratories and mention their need
- Explain the use of centrifuge and explain the principle of centrifugation
- Explain the working of microtome
- Describe the working and use of sphygmomanometer.

SOME INSTRUMENTS USED IN THE LAB

The following are some of the instruments:

1. Incubator (oven) regulated by a thermostat

(i) Thermostat is an appliance fitted, to regulate the temperature, inside an oven or a refrigerator etc.

Incubator is an appliance shaped like a box which maintains the desired temperature inside it

Structure: (Parts)

A box or container with insulated walls and a door fitted with a latch to close the door firmly.

(ii) A hole in the center of its roof for insertion of a thermometer to read the temperature of the inside chamber.

(iii) Its base contains a heating unit heated through electricity.

(iv) On the front of the base on one side is a knob which can switch-on and switch- off the instrument.

(v) On the backside is fitted a thermostat to regulate the desired temperature

(vi) In the centre of the front or besides the knob, a bulb is fitted to indicat whether the instrument is off or on

(vii) The internal chamber is provided with one or more shelves.

Uses: The incubator is used for the following

i) to keep section cutting material embedded in paraffin wax (at 50-55°)

ii) to study the action of chemicals, enzymes etc. at different temperature

iii) specimens such as pinned and stretched insects can be dried in it, so tha are not spoiled.

2. Autoclave

It is an electrically operated instrument which disinfects the glassware before a research work is started. It works under required pressure. However, pressure cooker can be a substitute for disinfecting the small glassware under pressure for a definite time. The autoclave works on the same principle as the pressure cooker.

3. Kymograph

kymograph is commonly used in different scientific disciplines such as physiology, pharmacology and biomechanics. it can be used to study of muscle contractions, nerve impulses and ventricular contractions etc.

The instrument consists of the following parts:

(1) An electric motor: This motor rotates a drum. The drum can be rotated at different speeds

(2) A muscle or heart mount : The muscle is fixed at one end. The free end of the muscle is connected to a lever, The ventricle of heart is held by a hook for recording the heart beat.

(3) The lever is balanced, to bend up and down freely. A sharp pointer or pen device is fitted to the lever opposite to that connected to the muscle.

(4) Movement of lever due to muscle contraction or heart beat makes the pointer to produce a tracing on a paper which is wrapped on the drum. When the paper is blackened with soot, a white streak is formed on it by the pointer.

(5) On stimulation by an electric current, the muscle contracts and pulls the lever down to make the corresponding dips in the line produced on the recording paper.

(6) As the muscle relaxes the lever moves up to its original position which is again recorded as the continuing straight line.

Uses:

1. Used commonly for recording the reaction of a muscle when its motor nerve is stimulated.
2. Also used for recording the ventricular contraction of perfused heart.

4. Distillation Unit

Distilled water is that water that has been cleared of all salts and other impurities which were dissolved in it. Distilled water is an important requirement in the laboratory.

A distillation unit consists of the following parts

(i) Distilling Flask: The size of flask varies depending on requirement. It is filled with water and heated over flame or hot plate.

(ii) Leibig's Condenser : It consists of an inner glass tube surrounded by a glass jacket through which water is circulated. The steam, passing through inner tube condenses due to cooling effect of cold water flowing in the glass jacket.

(iii) Adapter: It is used to facilitate delivery of distillate into the receiver.

(iv) Receiver: It is a simple conical flask attached to adapter, where distillate is collected. All the connections are done through corks.

5. pH meter

pH stands for "potential of hydrogen" and is a measure of the acidity or alkalinity of

a solution. It quantifies the concentration of hydrogen ions (H+) in a solution and is expressed on a logarithmic scale ranging from 0 to 14.

pH value is a number on a scale 0 to 14 indicating hydrogen ion concentration. If value is below 7, the solution is acidic and if above 7 the solution is alkaline. The pH value at 7 means neutral i.e. neither acidic nor alkaline

How to find pH of a sample: There are two methods: (i) Paper Strip Method (ii) Using pH meter

(i) Paper Strip method: Ready made strips are available which change colour at different pH values. Different strips are dipped in the solution one after another. The change in colour of strips indicates the pH value of the solution. This method gives only a general estimation of pH and not the precise pH.

(ii) pH meter: It gives accurate pH value of the solution. It is in the form of a compact box The material to be examined is placed in one socket with electrodes. The deflection of the needle on the built-in galvanometer gives the pH value of the solution

6. Spectrophotometer

Molecules (eg. DNA, proteins etc.) absorb and emit electromagnetic radiation of a particular wavelength. This property of molecules is used in spectrophotometry. Spectrophotometry is a technique which is widely used to measure the absorption of radiation in the visible and UV regions of the spectrum. Colorimeter also functions on the same principles but it is a simpler instrument in which filters are used

7. Colorimeter

It is an instrument to measure the absorption in the green, blue or red regions of the visible spectrum. There are two type of colorimeter

(i) Visual colour colorimeter

(ii) Photo electric colorimeter

The components in a colorimeter and the spectrophotometer are as follows

1. **A light source**: High intensity tungsten bulb for operation in the visible spectrum (400-700 nm) and Deuterium or Tungsten halogen lamps for UV spectrophotometry. The lamps are fitted with quartz as glass does not transmit UV rays.

2. **Cuvettes** Made of glass or plastic are cleaned before adding the sample solution.
3. **Galvanometer or read out device:** The reading of the standard solution is first taken for comparison with the sample

INTEXT QUESTIONS

1. What is the pH value that indicates that a particular solution is neutral?
2. Name the two main parts of a Kymograph?
3. What is the final product we get from a distillation unit?
4. Mention the use of thermostat in an incubator?
5. What provides the power to the heating unit of incubator?
6. Name the various components of a spectrophotometer?

SOME OTHER INSTRUMENTS

Here you will learn about some other types of instruments.

1. Sphygmomanometer

A sphygmomanometer is a medical device used to measure blood pressure. It consists of three main components: an inflatable cuff, a pressure gauge (manometer), and a bulb or pump for inflating the cuff. By this instrument, blood pressure of a person is measured. They are three types of this instrument which are commonly used.

(i) The old or conventional type using a mercury column.

(ii) Dial type instrument without mercury column. The blood pressure (B.P.) is directly shown on the dial in a gadget attached to a hand pump through a tube.

Stethoscope is also used to listen the throbbing in the artery while measuring B.P.

2. Microtome

A microtome is a laboratory instrument used to cut extremely thin slices of biological or material samples for microscopic examination. It is commonly used in histology, pathology, and materials science research. The main purpose of a microtome is to produce thin, uniform sections of a sample for visualization under a microscope. The cutting mechanism can vary depending on the microtome type. In manual microtomes, a handwheel or lever is used to move the specimen back and forth against the cutting blade. In motorized or automated microtomes, a motor controls the cutting action. Knife Holder: The knife

holder holds the cutting blade or knife securely in position during the cutting process. The knife can be a disposable blade or a glass knife, depending on the application and type of microtome.

***Microtomes can cut thin sections easily upto the thickness of 8-10 microns(1 micron = one thousandth of a millimeter).

3. Centrifuge

A centrifuge is a laboratory instrument used to separate components of a heterogeneous mixture based on their density or particle size. It applies centrifugal force to the sample, causing the denser particles or substances to move away from the center of rotation, while the less dense components remain closer to the center.

The main components of a centrifuge include:

Rotor: The rotor is the rotating part of the centrifuge where the sample tubes or containers are placed. It can have various designs and configurations depending on the specific application.

Motor: The motor provides the rotational force necessary to spin the rotor at high speeds.

Control Panel: The control panel allows the operator to set parameters such as speed, time, and acceleration or deceleration rates.

4. Weighing Balance

There are different types of weighing balances which are used in laboratories. A physical balance is commonly used in the laboratory. However, more accurate weighing is done by microbalances. These balances are covered within a glass cover. Such balances are usually single pan balances and weights of the objects are read on a scale seen from outside. The most convenient balances these days are the digital balances which you might have seen at the jewellary shops.

INTEXT QUESTIONS

1. Mention the chief precaution one should take while using a centrifuge.
2. Give the range of thin sections that can be cut in a microtome.
3. Mention the use of Sphygmomanometer.
4. Why is stethoscope is used while measuring the blood pressure?

WHAT YOU HAVE LEARNT

- Incubator is a chamber in which the temperature is regulated by a thermostat. It is used for incubating eggs and for keeping wax in a liquid condition used for section cutting,
- Autoclave is a device for sterilising glassware etc.
- Kymograph consists of an electric motor and a muscle/heart mount for\ recording muscle contractions.
- Distilled water is obtained by using distillation unit.
- pH can be found by either paper strips that show change in colour or by pH meters that give a direct reading on the built in galvanometer.
- Colorimeter enables to find out the density of colour in a solution.
- There are three kinds of blood pressure instruments, mercury instrument, dial type with hand pump and electronic sphygmomanometer.
- Microtome is used for cutting sections for microscopic examination. There are two kinds of microtomes - rocking and rotor.
- Centrifuge is used for separating cell organelles.
- Microbalances give very fine measurements of weights.

TERMINAL QUESTIONS

1. How can you prepare distilled water in a laboratory?
2. Mention the different parts of a distillation unit.
3. Explain briefly the different parts of a microtome and the use of this gadget.
4. Define pH. Mention the different methods by which pH can be measured.
5. What is the range of pH value of an acidic solution?
6 Mention the uses of an incubator.
7. Why is a thermostat fixed in an incubator?
8. Which of the balance gives the most accurate weight?

3 COMMON PRESERVATIVES, STAINS AND REAGENTS

We collect part of an organism for various studies and keep some for further investigation. In order to study these, they need to be kept in a condition as close to normal as possible or in other words preserved and fixed. In many Biology practicals, for example cytochemistry about which you learnt in previous chapter and many physiology experiments, certian chemicals are required. In this lesson you shall learn about some preservatives, stains and reagents.

Objectives

After completing this lesson , you will be able to;

- Describe methods of staining
- List the commonly used preservatives, stains and reagents
- state the chemical composition of Bouin's fluid, Carnoy mixture, Leishm stain, Safranin, Acetocarmine, Methylene blue, Iodine solution, Bene solution, Fehling's solution, Ringer's solution, FAA (Formalin Acetic Alcohol) solution

PRESERVATIVES

Preservatives are chemicals that are commonly used in laboratories to prevent degradation, contamination, or spoilage of various substances, reagents, and samples. These preservatives help maintain the stability and integrity of the materials, allowing for accurate and reliable results during experimentation or analysis.

Some of the preservatives are given below along with their composition:

1. Bouin's fluid

This preservative is yellow in colour and penetrate rapidly in to the tissues, for making histological preparation.

1. **Composition**

Saturated aqueous picric acid - 70 ml

Formalin (40% Formaldehyde) - 25 ml

Glacial Acetic Acid - 5 ml

2. Carnoy's fluid

It penetrates rapidly and gives excellent nuclear fixation.

Composition:

Absolute Alcohol - 60 ml

Chloroform - 30 ml

Glacial Acetic Acid - 10ml

It is prepared fresh. Care is to be taken as it is highly poisonous and inflammable.

3. Formalin, Acetic acid, Alcohol (F.A.A.)

This is a very good fixative and tissues may be left in it for a long period.

Composition

50% Alcohol - 100 ml

40% Formaldehyde - 6.5 ml

Glacial Acetic Acid - 2.5 ml

INTEXT QUESTIONS

1. Define the term Preservative.
2. State the composition of Carnoy's fluid.
3. How Bouin's fluid is more advantageous than other preservatives?

STAINS

Stains are chemical substances used in laboratories to colour specific components or structures within a sample, They are more visible under a microscope for easier identification.

1. **Single Staining**: In this staining process, a single colour was used on the tissue. e.g. Acetocarmine stains both the nucleus and the cytoplasm pink.
2. **Double Staining:** Where two stains are used, each stains a specific area or the particular cell organelle e.g: Methyl green which stains nucleus green colour is used with Pyronin which stains the cytoplasm (pink in colour)
3. **Multiple Staining:** More than two stains are used in the preparation of slide of tissue or organelle. Each stain will colour only the specific organelle of the cell eg. Triple Mallory stain.
4. **Vital staining:** Such stains which do not kill the cell, do not require prior fixation and impart colour to a specific part are termed vital stains.

   Ex: Janus green B for miochondria stainig

Some of the stains are given below:

1. Leishman's Stain

It is a ready made double stain, used for staining blood films. It gives blue colour to the nucleus and pink to the cytoplasm.

Composition :

Leishman stain powder - 15 g

Ethyl alcohol (solvent) - 100 ml

For good results this stain is kept in dark colored bottle.

2. Safranin

It is used as a general stain for plant tissues. The stain may be prepared both in water as well as in 90% alcohol depending on the requirement.

Composition

Safranin powder - 1g

Distilled water - 100 ml

It is a synthetic dye which gives pink or red colour to the object stained.

3. Acetocarmine

It is mainly used to stain chromosomes in the study of cells.

Composition

Glacial acetic acid - 45 ml

Carmine powder - 2 g

Distilled water - 55 ml

4. Methylene blue

This stain may be used both as aqueous or alcoholic stain. It is a basic stain and so mainly stains acidic parts such as DNA of the nucleus. Methylene blue is a vital stain

Composition

Aqueous Methylene blue:

Methylene blue - 100 mg

Distilled water - 100 ml

The stain dissolved in distilled water

Alcoholic Methylene blue:

Methylene blue - 0.3 g

95% Ethyl alcohol- - 30 ml

Distilled water - 100 ml

This stain is prepared by adding 30 ml of saturated alcoholic solution of methylene blue (0.3 gm of it to 30 ml of 95% ethyl alcohol) in 100 ml of distilled water.

INTEXT QUESTIONS

1. Define term of Stain.
2. State the composition of Alcholocic methyelne blue ?
3. Which stain is useful for observation of Chromosomes.

REAGENTS

Reagent is a substance that takes part of chemical reactions or biological processes. It is used to detect substances present in the cell. Ex: Iodine solution used for detecting starch. There are different reagents which are used to test the different substances present in certain solutions. Some of them commonly used in a biology laboratory are given below:

1. Benedict's Solution

It is used for the test of sugar.

Composition

Copper sulphate - 1.7 g

Sodium citrate - 17.3 g

Sodium carbonate (anhydrous). - 10 ml

Distilled water - 1000 ml

Dissolve 17.3 g sodium citrate and 10 g of anhydrous sodium carbonate in 600 ml of distilled water. Filter the solution. Simultaneously prepare copper sulphate solution. Add this solution slowly to the previous filtered solution, constantly stirring it. Add enough distilled water to make a total of 1 litre. If to a solution containing glucose, Benedict's is added and warmed a brick red precipitate forms.

2. Fehling's Solution A and B

It is also used for testing of sugar. It is commonly purchased ready made from the market.

Composition

Fehling's solution A

Copper sulphate - 34.6 g

Distilled water - 500 ml

Fehling's solution B

Sodium hydroxide - 175 g

Sodium potassium tartarate - 173 g

Distilled water - 500 ml

When testing for sugar, equal amounts of Fehling's solution A and Fehling solution B are added to the solution which is to be tested. Results are the same as that with Benedicts

3. Iodine Solution

It is commonly used for testing starch. As such it is brownish in colour.

Composition

Iodine - 0.3 g

Potassium iodide - 15 g

Distilled water - 100 ml

Iodine added to starch turns the starch grains or starch solution to dark blue.

4. Ringer's Solution

This solution is isotonic to that of tissue that is when tissue is placed in Ringer's no osmotic changes occur. It does not spoil quickly and living material can be placed in it for observation in normal living state.

Composition

Potassium chloride - 0.42 g

Sodium chloride - 9.0 g

Calcium chloride - 24 g

Sodium bicarbonate - 20 g

INTEXT QUESTIONS

1. Mention the use of
   (i) Ringer's solution
   (ii) Leishman's stain.
2. Write the full form of E.A.A.
3. Write the composition of
   (i) Iodine solution.
   (ii) Carnoy's fluid

WHAT YOU HAVE LEARNT

- Preservative is a substance which prevents decay and decomposition of an organism or its parts.
- Stain is a chemical which colours tissue or its parts.
- Different types of preservatives are used for different experimental material and for different purposes.
- Various types of stains are used for various tissues or cellular components.
- Staining may be single, double or multiple. Vital staining stains living organisms and cells.
- Different types of reagents are used for different experiments.

TERMINAL QUESTIONS

1. Define the term reagent
2. What is meant by (i) Double staining and (ii) Multiple staining?
3. Mention the use and the composition of Bouin's fluid.
4. Mention the components of F.A.A.
5. Which tissue is normally stained by Leishman's stain?
6. Name any one stain used generally in biology laboratories.
7. Give the composition of Fehling's Solution A and B. Mention the substance that can be tested by Fehling's reagent.
8. Mention the use of Ringer's solution.

4 ORGANISMS USED IN LABORATORY WORK

Laboratory exercises are an integral part of learning science. For biological sciences, living or preserved organisms have to be provided for the study of anatomy, physiology, histology and animal behaviour. In this lesson, you will learn about methods of culturing organisms in the lab, maintaining an animal house for live animals used in the laboratory and using equipment such as nets and press for collection and preservation of plants and animals required for lab exercises.

OBJECTIVES

After reading this lesson you shall be able to :

- identify and list the organisms which are usually cultured in the laboratory
- list various animals generally needed in a biological laboratory
- list the materials required and describe methods of culturing some common protozoans such as Amoeba and Paramecium, Hydra, Rhizopus, Drosophila
- describe the method of growing root tips of onion in the laboratory
- explain measures for personal hygiene of these handling the animals
- list various equipment required for collection of flora, fauna such as nets vasculum,plant press and mention their uses
- outline the organisation of a typical biology laboratory
- state need for proper ventilation in the lab especially as an outlet for fumes
- list measures to prevent fire hazards.

CULTURING ORGANISMS IN THE LABORATORY

Certain organisms can be collected from nature and then multiplied in the laboratory.

Growing 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 bought from dealers and then maintained and grown and multiplied In the school and college laboratories organisms are cultured on a small scale specifically for laboratory use by individual students.

Preparation for Culturing Organisms

Four points have to be kept in mind while culturing organisms or rearing them for laboratory work.

These are :

(i) knowledge of location or habitat where a particular organism may be found;

(ii) methods of collection;

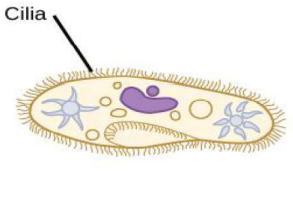
(iii) methods of culture that is kind of vessel to be used to grow them; kind of food to be given to them and ways of protecting them from enemies; (iv) methods of preservation for future **use.**

COMMON ORGANISMS CULTURED IN THE LAB

Organisms are cultured in the lab for morphological, taxonomic cytological, genetic and behavioral studies.

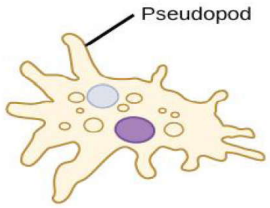
Following are some organisms commonly cultured in the Biology laboratory.

(i) Paramecium and Amoeba belong to the phylum Protozoa. They are obtained from fresh water ponds and easily cultured. Being microscopic in size, stained slides of these protozoans are prepared for observing their structure. Living specimens are studied under the microscope for ciliary and pseudopodial movement.



(a)

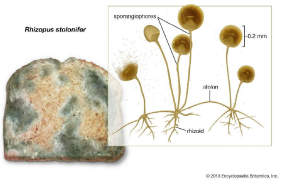
Fig. Paramecium



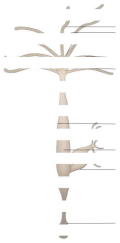
(b)

Fig. Amoeba

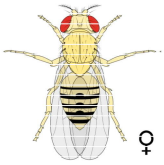
(ii) Rhizopus, the bread mould is a fungus. Its structure and its stages of life cycle can be studied from a lab culture of the bread mould.



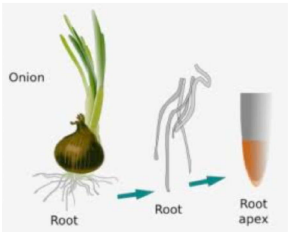
(iii) Hydra is a cnidarian. It is difficult to rear it but can be obtained from the ponds where it sticks to leaves of aquatic plants.



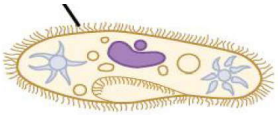
(iv) Drosophila is the fruitfly with which breeding experiments were done by early geneticists and many genetic principles were discovered. In the laboratories, all over the world it is cultured for experiments on Behaviour, Genetics. Cytology and Evolution because of its short life history, easy culture and prolific reproduction rate.



(v) **Onion root tips** are grown especially for the study of mitosis. Onion or Allium cepa has sixteen large chromosomes and slides made from onion root tips clearly show the four phases of mitotic cell division.



Culturing Paramecium



Material required : Vegetable remains from ditches, grass, leaves, jam bottles or any other jars, cotton, glass tube which can be made into a micropipette

Procedure : Half fill jars with grass, leaves and vegetable remains. Add water to almost fill the jars. Leave for a week. If kept at 70° to 80° F, results are better. This is the stock culture.

Pure Culture : Boil grass blades and seeds in water for 20 minutes. Divide the vegetablematter in different bottles and allow them to stand. Bacteria will grow and appear as a scum on the surface. Take a drop on the slide and locate Paramecia. Use micropipette to draw in Paramecia by placing it near Paramecia which will be drawn up the micropipette by capillary action. Add them to other jars in which Paramecia will grow and divide and a pure culture will be obtained

Culturing Amoeba

- *Amoeba proteus* is mostly found in abundance in only those water bodies.where there's already the presence of excessive bacteria and organic substances such as aquatic vegetation, leaves, and twigs. found among other decaying vegetable matters and aquatic plants.,lotus ponds, and also in the artificial water containers intended to provide drinking water to animals, and livestock.

1) Amoebae occur at the bottom of container or on surfaces of leaves and stems when pond water is collected.

2) Collect few *Amoeba proteus* and keep them on the bottom of a clean and sterilized petri dish by a micropipette. Next, add some amount of water to the petri dish. Next, add a few grains of wheat or rice and cover the dish.

3) The petri dish should be kept at a dark place in a cool room with 18–22 °C (64–72 °F) and placed out of direct sunlight for their proper growth as they avoid light due to being negative phototaxic.

4) Observe sample cultures regularly using a dimly lit stereoscope. It's better to place a piece of black paper under the culture dish to make *Amoeba* easier to view.

5) *Amoeba proteus* species start to stick to wheat/rice grains and after sometime multiplies and will give rise to numerous daughter cells.

6) It is usually seen that the Amoeba population will increase to its maximum level in a dish within a period of 20 to 21 days and may then require additional wheat seeds.

7) So, after 21 days, if you want the Amoeba to be cultured for extended period of time, you can split the culture into the other three petri dishes. To do so, stir the media in the dish, and divide the culture evenly into three different clean culture dishes.

8) Next, add enough liquid media solution to each dish to restore the volume to that of the original culture.

Culturing Hydra

Hydra is difficult to rear but can be obtained from fresh water ponds sticking to blades of leaves of aquatic plants. Pick aquatic vegetation and place it in jars of pond water.

Care has to be taken not to let the specimens become too warm. Generally, when hydra float upon surface of water, the amount of oxygen is insufficient. So to dislodge them, leave in the dark overnight. They will float on the surface. Quickly pick up and transfer to new culture dishes equally fast or they will stick to the pipette.

Culturing bread mould

Rhizopus or Mucor often occur on stale bread. It grows rapidly and can be easily cultured.

Material required : Slice of bread, moist chamber made from tin can.

Method : Take a piece of bread, slightly moisten and keep in a closed container for two or three days. The best place would be some warm dark corner. White cottony growth appears with black dots scattered on it. The black dots are sporangia with lots of spores. If a bit of the cottony growth is mounted in a drop of water, the general structure of Rhizopus, its sporangia and spores are visible.

Culturing Drosophila

The fruit fly If an empty jam bottle containing an overripe banana is kept at a fruit shop, very soon tiny red eyed fruit flies will fly into it. These can then be transferred into culture bottles. Jam bottles or milk bottles.

Jam bottles or milk bottles can be cleaned and boiled for use as culture bottles. The culture medium is prepared by heating water and dissolving one gram of agar in it. One gram of yeast, 5 grams of brown sugar and 7.5 grams of cornflour are then added. Heating is continued till the mixture is semi solid and can be poured into the culture bottle. A drop of Propionic acid is added to the medium to inhibit fungal growth.

Flies can be transferred into the culture bottles easily as fruitfly is negatively geotactic (moves upwards against gravity). Thus when an empty bottle is inverted on a jar containing *Drosophila* the flies move into the inverted bottle. A paper strip is inserted between the mouths of the two bottles and the upper bottle with the flies is removed. These flies can then be transferred to a fresh culture bottle The optimal culture temperature for *Drosophila* is 25°C and *Drosophila* culture is kept in a BOD maintained at this temperature. In case the culture has to be maintained at roomtemperature, September to March is the best time.

Growing onion root tips

Material required : Coplin jars, or wide mouth bottles/100 ml beakers, onions, scalpel, water.

Procedure : Take a medium sized onion and scrape off the dry roots from the bulb to expose the disc. Fill a Conical flask/jar with water and place the onion bulb on it such that the disc touches the water. Place this near the window to get enough light for three to four days. Roots will start growing and tips can be clearly seen after 4-5 days.

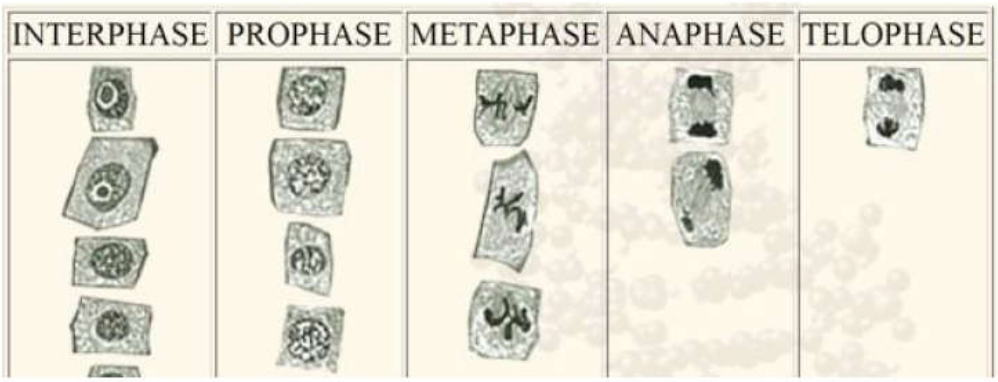
Preparation of slides showing stages of mitosis

To prepare cell division slides a squash preparation of onion root tips is essential.

Material required :

1 : 3 Aceto Alcohol, 1 N Hydrochloric acid, 1% Acetocarmine stain, slides and cover slips.

Procedure: Cut off root tips and fix in 1 : 3 Aceto Alcohol (1 part of glacial acetic acidand 3 parts of Absolute Alcohol) in a watch glass bottle. After five minutes, put the root tips in 1 N HCl in a watch glass and warm them. Remove HCl by washing in water and leave in the stain, 1% Acetocarmine for five to ten minutes. Carmine is a dye obtained from the cochineal bug and the stain is prepared in Acetic Acid. Remove the stained root tip on a clean slide and tease with a needle. Place a cover slip. Put the slide on a filter paper. Fold the filter paper to cover the slide and gently soak the extra stain. Apply pressure with thumb on the cover slip where the teased root tip is. This is called squashing and root tip cells then spread out on the slide and when viewed under the microscope, stages of mitosis can be seen. Care has to be taken not to shake the coverslip.



INTEXT QUESTIONS

1. Name three organisms cultured in the laboratory.

2. Why are root tips grown in the laboratory.

3. How are Drosophila transferred from one cultrue bottle to another?

4. Where is Hydra collected from?

5. On what is Rhizopus grown?

TIPS IN THE BIOLOGY LABORATORY

In the Biology laboratory plants and animals are handled all the time. It becomes absolutely necessary to clean the working tables and wipe with an antiseptic before and after lab work starts.

There should be arrangements for proper disposal of used up animals and plants. This would prevent attack by microorganisms and smell of rotting plants and animals. The fear of spreading infection would also not be there.

An exhaust fan is absolutely essential in a biology lab. It not only removes

(i) Odour of animals

(ii) Fumes of formalin used to preserve certain animals.

(iii) Chemicals are used for certain experiments - their fumes are removed when the air inside the lab is made to circulate with the use of an exhaust fan

(iv) A fire fighting equipment and anti burn ointment such as Burnol should also be kept in the laboratory. Since explosive chemicals and spirit lamps or bunsen burners are required for experiments, it is better to take safety measures.

(v) The biology laboratory needs to be well lit and working table should receive enoughnatural light. The chemicals should be kept on a shelf in one corner of the room.

EQUIPMENT REQUIRED FOR COLLECTION OF FLORA AND FAUNA

A. A few items of equipment have to be carried on collection trips.

For carrying the collected material following vessels would be required

(i) Plastic buckets.

(ii) Small vials with stoppers.

(iii) Plastic bags with rubber bands.

(iv) Vasculum and plant press which are described later.

B. For picking out flora sticking on rocks or ground and aquatic animals sticking to rocks.

(i) Pocket knife for prying sessile plants and animals from rocks or hard substratum. The knife should be oiled before use and also used with care so that it does not injure any part of the collector.

(ii) Geology pick for turning rocks and chipping off specimens.

(iii) Hammer and chisel for collecting lichens and deep rooted plants on rocks.

(iv) Nails

C. Night collection

Nocturnal animals (active during night) and intertidal **specimens** have to be collected at night. For this it is essential to carry

(i) Flash light

D. For culturing bacteria, the following are necessary

(i) Petriplates for keeping the medium

(ii) Culture tubes

(iii) Wire needle and Nicrome loop

E. For trapping insects or other animals

(i) Insect trap or

(ii) Berlese funnel about which you will learn in next lesson .

(iii) Nets are required not only for trapping insects but also various other animals.

Various kinds of nets are available about which you shall learn later in the chapter.

F. Plant collecting tools and equipment

Sufficient tools and equipment are required for collecting and preparing plant samples in the field. A good plant specimen will enable the botanist make an accurate identification on a plant species sampled and therefore maintain the quality of the data. The following tools and equipment are required for field collection and must be available when working in the field.

1. Binoculars
2. Camera
3. GPS
4. Tape measure
5. Dissecting kit
6. Hand lens (X 10 / 12)
7. Field book
8. Pencils

VASCULUM AND PLANT PRESS

Vasculum/bags to place plants collected

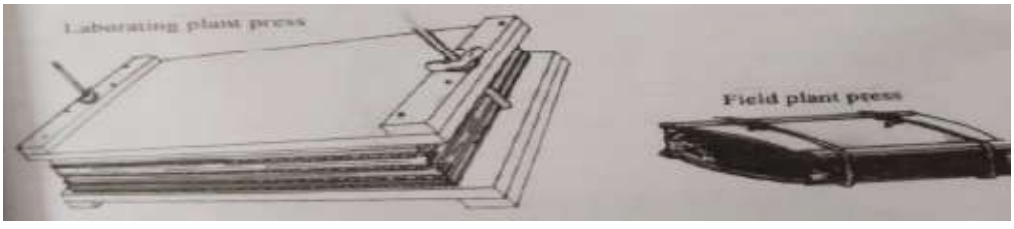
Vasculum is made up of a metal cylinder with a sliding door usually worn on a strap over the collectors shoulder into which plant specimens are placed. Polythene bags and paper bags are also used for putting fruits, seeds and small specimens after collection.

Plant Press

Plant press is an indispensable tool for pressing fresh plant specimens to subsequently dry them and mount permanently. Plant press is made of wood and is of two types.

(i) Lab press : Is heavier than field press.

(ii) Field press : Is lighter in weight A student can make his own plant press from plywood at low cost.



a) Laboratory Plant Process *b) Field Plant Process*

Collecting Fauna

NETS

Several kinds of nets are used for collecting fauna, following are some of them

(i) Biological dredge : A dredge consists of a strong net attached to a heavy frame which is pulled along the substrate in order to obtain plants and animals. It can be used in fresh water and the sea. with boats also.

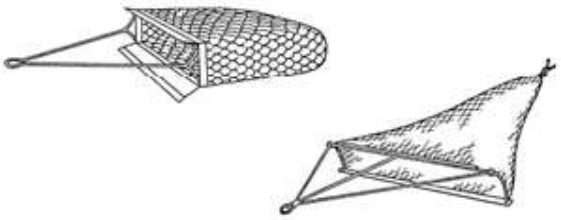
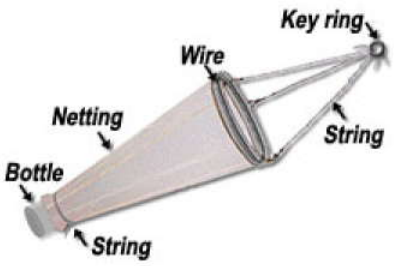


Fig : Biological Dredge

(ii) Plankton nets have fine or coarse mesh with a tapered tip.

(iii) Insect nets are of (a) dredge type (b) aquatic dip type or sweep net.

(iv) Fish nets are of various kinds



Source:bigelow.org

Fig: Hand net

Source: aquaticresearch.com

INTEXT QUESTION

1. How are formalin fumes prevented from collecting in the lab?

2. What are the tools required for preparing herbarium

3. Name the equipment required to release flora or fauna from rocks.

4. What is a vasculum?

5. What is a biological dredge used for?

WHAT YOU HAVE LEARNT

l Certain organisms can be collected from nature andmultiplied in the lab. This is called ‘culturing’. l While preparing cultures, one should know

(i) the location or habitat from which a particular organism can be collected.

(ii) the method of collection

(iii) the method of culture and

(iv) how to preserve organisms for future use.

- l Parameciu m and Amoeba can be cultured after collecting them from pond.
- Parameciam are grown in bottles containing grass, leaves etc. on which bacteria is growing.
- Amoeba is cultured in shallow dish with rice and water mould in it.
- l Hydra can be cultured in a jar with aquatic vegetation.
- l Rhizopus or bread mould is cultured on stale bread.
- l Drosophila or fruit fly are cultured in empty milk bottles containing medium having yeast, brown sugar, and cornflour. They are transferred by placing empty bottle on the medium and the fruit flies fly up.
- l Onion root tips are grown in coplin jars with water and used for the study of cell division by making squashes.
- l Biology lab should have an exhaust fan to remove odour and fumes of Plants can also be kept in cages.

Items of equipment required for collection of fauna and flora are

(a) for keeping collected specimens or

(b) for picking specimens attached to rocks.

(c) for culturing microorganisms and

(d) for trapping insects or other animals.

- l For keeping collected specimens, plastic buckets, vials, plastic bags and vasculum are required.
- l For picking specimens free of substratum, a knife or pick are required. l Flash light is required for night collection. l Insect trap or Berlese funnel is to trap insects.
- l Nets of different kinds are for collecting insects, fish, plankton etc.
- l A vasculum is a metal cylinder with a sliding door carried by the collector on the shoulder.
- l A plant press is used for pressing fresh plant specimens. There are two kinds of plant press - lab press and field press.
- l A dredge is a net attached to a metal frame which can scrape the ground to collect specimens.

TERMINAL QUESTIONS

1. Describe the method of culturing any one protozoan.
2. How can you culture bread mould on a piece of bread?
3. How can you prepare onion root tip squash to study mitosis?
4. Why should there be an exhaust fan in a biology lab?
5. Write a note on Plankton net
6. What all should you carry if you go on an excursion to collect plants?

5 AIDS IN BIOLOGY

Learning and teaching of Biology is complete only when the student is able to see active living and preserved variety of organisms. Learning Biology also becomes easier by observing organisms closely rather than merely reading about them. Preserved animals and plants, duly classified are kept in museums. Charts and models are displayed there. Living animals are kept in animal house, frogs in a specially constructed froggery, fish in aquarium.

Plants are grown in the botanical garden or specially maintained in a green house. Preparation of a herbarium is an integral part of learning Botany.

Some such aids in learning and teaching Biology are outlined in this lesson.

OBJECTIVES

After reading this lesson you will be able to:

- Describe the need for a zoological museum
- Explain the ways in which specimens such as wet, dried specimens, embalmed specimens, models, pictures, photographs and skeletons can be displayed in the zoological museum
- Explain the need for a botanical garden
- List the categories of plants need to be grown in the botanical garden
- Describe a green house
- Explain need for a green house
- Describe herbarium and list the steps followed in making a herbarium
- Explain the steps involved in setting up an aquarium
- List the fishes suitable for an aquariumandl ist different kinds of fish food.

- Explain the need for maintaining suitable temperature, proper light and proper aeration in the aquarium

1. Zoological Museum

The Museum aims to impart awareness on animal fauna, generate curiosity on life forms and evoke interest in animal conservation among the students. The zoological museum has a collection of various specimens of animal kingdom,charts,models which will give an idea of animaldiversity,morphological features etc. It has 1.Preserved animals 2.Skeletons 3.Fossils 4.Models. 5.Photographs. The person in charge of maintaining the museum is called -Museum curator

1. Preservation and display of specimens

(a) Wet Preservation

Invertebrates and small and medium sized vertebrates can be preserved intact in glass or trasnparent plastic jars of appropriate size called specimen jars. The jars have a flat, firm base and a lid. A solution of 10% formalin fills the jar. The specimen is mounted on a glass slab of aprropriate size which is then placed inside the jar and covered with the lid. The lid may then be screwed on to the jar or sealed on it. From time to time fresh formalin has to be added or replaced according to need. The specimen remains intact for years if handled properly.

(b) Dry preservation

Exoskeletons (Skeletons covering the body) such as shell of molluscs, star fish sea urchins, corals, cocoons of insect sloughed off (cast off) skin of snakes or insect (exuviae), feathers and nests of birds, honey combs and wasp or termite nests mammalian skin with furs, dried sponges etc. can be displayed in the museum many years provided they are prevented from breaking or from attack by parasites or microorganisms.

Apart from the above

(i) Vertebrate skeletons and

(ii) Pressed insects also form of dry presentation

(c) Skeleton preparation

Skeletons may be prepared in the following way. Chloroformed vertebrate dissected to remove organs and as much muscle as possible. Boil the animal that muscles become

tender and remove them. When only the skeleton remain dip it in Hydrogen Peroxide for bleaching (optional). Mount on a cardboard wooden board with the help of adhesive like araldite or fevicol and display.

Skull or bones of dead animals collected from the fields may be cleaned with wate disinfected with a disinfectant, dried and displayed in a museum. Stuffed anima are also kept in the museum. Skinning, preserving, stuffing and mountin bry vertebrates is called **Taxidermy**.

(d) Insect collection and preservation

Insects are found everywhere cockroaches abound near the kitchen drain butterflies roam among flowers while grasshoppers hop and crickets chirp in th grass.

Flies are where sweets are and fruit flies hover around vegetables and fruit Insects are the most numerous and diversified group of animals.

Collection of Insects

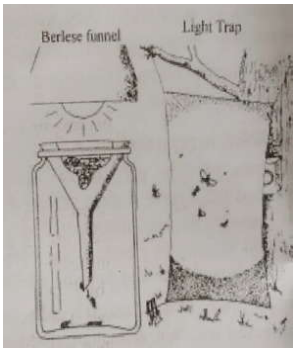
Insect collection is an activity which combines fun and study. The equipment required is

(i) collecting jar, (ii) a net (iii) fine wire sieves (iv) insect trap.

The collecting jar can be of 2 types

(a) Carbon tetrachloride bottle is efficient and harmless. A glass tube is inserted in a small hole bored in the cork of a bottle. A cotton wad is fastened to the cork

Net for catching



Insect Traps

(b) Chloroform bottle has rubber bands placed at the bottom of a bottle and some chloroform put in it. Rubber has the capacity to absorb chloroform. After sometime unabsorbed chloroform is thrown away and a cardboard placed to cover the rubber bands. Fumes of chloroform absorbed by rubber fill the bottle.

A net made of cotton or nylon can be stitched to a handle.

Net for catching The fine wire sieves are required to strain the mud which comes with the collected insects or to wash them. Flying insects or walking and hopping insects can be collected from their natural surrounding. insects may be trapped with the use of Insect traps. A simple trap has a large Tunnel placed on the mouth of a widemouthed jar containing chloroform oralcohol.

Fig: Berlese funnel

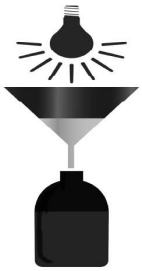


Fig : Light Trap

A Berlese funnel traps small insect. A funnel is soldered at the end of a large can with a hole at its bottom. A false bottom made of wire mesh is placed in the can, filled with leaves and grass and covered with cheese cloth. The stem of the funnel ends in a wide mouthed bottle sealed with cotton plug. This collecting bottle may contain alcohol or chloroform for preserving the insects.

Insect traps

Insects are caught by the net or in the trap and placed in the collecting jar. They have to be preserved.

Different insects tobe collected.

Where to place the insect pin through the body when mounting insects Push through area indicated by the black dot

Fig. :How to spread pinnea butterflies and moths.

Insect preservation

Material required for the preservation of collected insects are

(i) Pins of various sizes

(ii) hard paper

(iii) insect spreading board

(iv) insect collection box

(v) insect cabinet.

Before collected insects dry up, pin has to be thrust through the thorax or wings. Very small insects are mounted on a triangular piece of hard paper Wings of butterflies, dragonflies have to be spread out. Spreading of wings is done by first fixing the pin carrying the insect in the groove of the spreading board, wings spread out and strips of paper pinned across wings of either side. Once such mounted insects are dry, they are removed to the insect collection box. The insects are then classified and arranged in an insect cabinet.

Fig: Standard cardboard insect box

2. Visual aids Charts, models and photographs

Charts and models depicting morphology of organisms, phylogeny show taxonomic relationships, internal structure of plants and animals, life history social insects, evolution of horse and humans etc. should be available for stude.

The advantages of charts and models are

(i) they substitute for live specimens which are not available;

(ii) charts are self explanatory if well prepared and students can revise from the charts

Fig: Model

(iii) the teacher can carry the chart to class while explaining the theory on board.

Good charts prepared by students can also be put up on the wall which not only encourages the student who made it but also other students. Photographs of biologists may also be hung up with their names and contribution written

Visual aids ought to be

(i) accurate

(ii) relevant

(iii) comprehensible

(iv) real

(v) properly labelled and

(vi) title should be clearly written.

The models have a three dimensional effect and the proportions should be correct. Students make models with wood, fibre, thermocole and any other material. Charts pictures should be hung on the wall which is well lit. They should be within level of the eyes of children using the museum.

Maintenance of the Museum

The museum requires constant care. The museum curator has the following duties:

1. to change the charts and pictures from time to time;

2. to make new visual aids:

3. to be available to help students. The curator should have a Biology background
4. to change formalin of preserved specimens; and
5. to be involved in overall maintenance of the museum.

INTEXT QUESTIONS

1. What is the person incharge of museum called?

   _____

2. What is the Berlese funnel used for?

   _____

3. Name a visual aid used in teaching Biology.

   (i) common chemical used for preserving specimens

   _____

   (ii) art and science of skinning, stuffing and preserving animals

   _____

2 BOTANICAL GARDEN

A well maintained garden where plants are classified and grown with care and where plants may even be multiplied for the purposes of observation and research is called a BOTANICAL GARDEN.

A garden full of plants, both flowering and flowering is indeed a treat to see. But a botanical garden is not for entertainment but associated with Botany teaching and research.

Our country we have

1. **The main National botanical garden** in Lucknow and Kolkata and have plants of Uttar Pradesh and those from the hilly regions of Uttaranchal.
2. The Acharya Jagadish Chandra Bose Indian Botanic Garden, previously known as Indian Botanic Garden and the Calcutta Botanic Garden,is in Shibpur near Kolkata. It has more than a hundred year old Banyan tree.The gardens exhibit a wide variety of rare plants and a total collection of over 12,000 specimens spread over 109 hectares. It is under Botanical Survey of India (BSI) of Ministry of Environment and Forests, Government of India.

   School or college botanical garden is, developed on a much smaller scale. The plants grown are mostly the ones which form the study material for Botany. A patch of ground within the school premises where ample sunlight comes is the ideal place where botanical garden may be developed. Plants of different kinds as also those required for practical study need to be grown.

An ideal situation is when

(i) new plants are added from time to time and

(ii) plants are labeled with labels carrying the botanical names as well as common names.

(iii) A catalog has to be prepared giving a number and concise description.

GREEN HOUSE

Fig: A model Green house

A greenhouse is a special enclosure made of glass or plastic in which plants are grown and maintained at a specified temperature and humidity. In countries, where freezing temperature in winter, a green house is made with roof and walls made of glass. Plants get adequate light and they can be watered. At the same time heat trapped by the glass enclosure keeps the greenhouse warm. Temperature, however, is also regulated by a specialised system. Greenhouses are permanent structures.

Temperature of the greenhouse is regulated through an automatically controlled heating and ventilation system. A central coal or oil furnace supplies the heat. More common is a peripheral steam heating system.

In summer, when temperature goes up fan and pad cooling is used to lower temperature. Water is circulated through pipes. Cooling pads draw cooled air across greenhouse. It is more effective when humidity is low.

Ventilation is provided at the sides and top. Instead of glass, plastic films are used to make the wall and roof of glasshouse. Light absorbing qualities of plastic are similar to those of glass. Rigid plastic or ultraviolet resistant polythene isused. During summer a shade made of cloth is to cover the greenhouse.

In an institute where Biology is taught, a greenhouse of smaller dimensions be constructed to house delicate plants. Plants would provide material for botanic studies and students would also be trained in growing, maintaining and propagating plants under controlled conditions.

HERBARIUM

A herbarium is defined as a collection of plants that have been dried, pressed and preserved on sheets of hard paper. The dried plants are classified and arranged for future reference especially for taxonomic studies.

A plant collector needs to have the following

equipment:

(i) a gardener's knife,

(ii) a plant press or vasculum,

(iii) blotting papers to dry plants,

(iv) trowel to dig and uproot the plant,

(v) collecting and mounting sheets,

(vi) gum tape, labels, waterproof ink and pen.

1. Collecting botanical specimens

Fleshy plants lose their diagnostic features when dried so they are preserved in 4% formalin in glass containers. Gymnosperm cones and dry fruits are collected and preserved as such.

Plants should be collected from various localities for the preparation of a herbarium. The herbarium should also have representative specimens from various groups of plants.

(a) Gardener's knife one should carry such knife in field trips

(b) A plant press (Vasculum) with sheets

A complete specimen when collected, should have all the parts including the root system. It is better to collect a plant at its flowering stage. A tag should give the location from where collected. About five or six specimens of each kind of plant should be collected. The collected plant should either be pressed then and there or collected in a vasculum and pressed later. Vasculum is a metal cylinder with a sliding door in which plants are collected.

2. Pressing, Drying and Preserving

The collected plant should be pressed between sheets of blotting paper. One plant is arranged on one sheet so that its parts do not overlap. Specimens longer than the sheets can be folded in the form of 'V' or 'N'.

The plant between the sheets is put in a press for 24 to 48 hours. The press is then opened, blotting sheets changed and plants rearranged again and put back in the press for another 2 or 3 days. The pressed specimen is then dried in sunlight or heat from some other source.

To prevent the abscission layer formation and decay, plants are killed (poisoned) with formalin or Mercuric chloride ($HgCl_2$) or Carbon Tetra chloride an ($CC1_4$). Also dipping in Mercuric chloride ($HgCl_2$) also dipping saves them from attack by museum pests such as beetles.

3. Mounting and Labelling

After drying, specimens are mounted on mounting papers or herbarium sheets which are usually of a standard size of 11.5" x 16.5" and sturdy enough to support the dried plants. Glue or adhesive tape or adhesive paste is used to stick the specimens on to the sheets.

Each sheet should carry a label pasted on the lower right hand corner giving the (i) the site of collection, locality and altitude (ii) name of plant (iii) family (iv) habit (v) date of collection (vi) ecological notes and (vii) name of collector.

Herbarium sheets should be stored in herbarium cases or steel almirahs. They should

be arranged according to the system of classification. Moth balls, naphthalene flakes or 2% of Mercuric chloride should be sprayed to keep away mould, fungi and insects.

INTEXT QUESITONS

1. Where are the national botanical gardens situated in our country?

2. What is a greenhouse?

3. Define herbarium.

4. What is a vasculum?

5. Mention the steps for preparation of a herbarium in a sequence.

AQUARIUM

An aquarium is a glass container in which live fish are kept along with aquatic plants. A well maintained aquarium helps students to learn many biologic principles. Some of these are -

(i) Dependance of animals on green plants for (a) food and (b) oxygen,

(ii) Relationship of carbon-dioxide and light to photosynthesis,

(iii) Food ingestion, storage, respiration, digestion, growth, reproduction and development in plants and animals,

(iv) Relationship of bacteria to Nitrogen, Phosphorus and Sulphur cycle,

(v) Parasitism,

(vi) Food cycles,

(vii) Temperature and water relation,

(viii) Ecological succession.

1. How to prepare a balanced aquarium

Materials required for an aquarium are:

(i) Aquarium tank approximately of five gallon capacity. Aquarium water static and changes its composition due to activities of fish and plants. Hence it has to have enough surface area for adequate gas exchange. It may be madeof plastic or glass with silicon adhesive.

The tank should be placed on firm, level and smooth surface. It is best locate near the window but direct sunlight should be avoided as it leads to excessiv algal growth in summer. The side towards window may be covered with pap or painted. If light is not enough electric light may be used. The situation of the tank should have easy access for maintenance and fpower sockets for heat and light.

(ii) Substratum in the tank can be constructed by putting one inch of sand soil. The substratum

a) forms the source of minerals;

b) plants can anch in the substratum;

c) animals can burrow in it,

d) it forms the spawning of fish;

e) floor bed of the aquarium and

f) a biological filter.

Fig. : An aquarium

Water can be procured from tap, well, spring or pond to fill the tank. The lid of the aquarium prevents excessive evaporation.

2. Temperature of the aquarium

The temperature of the aquarium needs to be maintained at an optimum of 24°C 5°F). To maintain the temperature, a thermostat controlled heating device may used. In case of power failure, tank may be covered by a blanket in winter or uitably hot water added. A floating or adhesive type of thermometer can record me temperature. These days a combined heater and thermostat enclosed in a water ght glass tube is used and kept in place by special clips made of non toxic plastic. Thermostat with microchip (computerised) circuit is fixed for accurate temperature ontrol. All electric connections, however, should be outside the tank.

3. Lighting of the aquarium

Lighting arrangement not only makes the aquarium attractive but it also forms an ssential stimulus to plants for photosynthesis. In nature fish are lit by sunlight. ight in the aquarium may be provided by lamps (tube or bulb of 40 Watts) mounted n aquarium cover called hood or reflector. Tungsten lamps and fluorescent tubes re used for every 30 centimeters (12 inches)length of the tank. Aquarium has to e lit at least for ten hours a day.

4. Biological filtration

The gravel in the substratum acts as a filter bed. Aquarium water passes thro the gravel and bacterial colonies develop on the gravel and convert the waste the fish into ammonia andnitrates by Nitrosomonas bacteria and nitrites into nitr by Nitrobacter. Nitrates are taken up byplants.

5. Aquarium Plants

There are many species of aquatic plants which provide shade, refuge, spawni sites, food, water and source of oxygen for the aquaria fish. Plants may be of t floating type such as Hydrilla, Elodea or rooted such as Vallisneria which g rapidly. To many plants may be avoided.

6. Aquarium Fish

A number of small fish with unique shapes and beautiful designs are appropr for keeping in the aquariums. They are variously coloured. However, care has be taken to assure the absence of predatory varieties in the aquaria. The comm aquaria fish are (i) angel fish (2) molie (3) guppy.

7. Fish Feed

Food of aquaria fish are either live feed such as waterborne insects, wor crustaceans such as water flea. Daphnia, cyclops earthworms. However, if am these are not eaten by the fish, they should be removed and not permitted to incr in number. Lettuce, spinach, peas, wheat grain may be given for herbivorous With progress in technology, a balanced diet with special formula is commerci prepared in the form of flakes, granules, powder or liquid food. Freeze dried food such as Daphnia, Tubifex andother worms are packed. It is convenient to open the packet and sprinkle in the aquarium for fish to eat. But never should much food be put as the left over food may decompose and pollute the aquar For fish to develop best colours, size and a healthy constitution, the diet should be varied. The best food, however, is live food.

INTEXT QUESTION

1. What is an aquarium?

2. Name two plants which are grown in an aquarium

3. What do plants provide the fish in the aquaria?

4. What is biological filtration?

WHAT YOU HAVE LEARNT

- In a Zoology museum preserved animals, skeletons, fossils, charts, models dry specimens are kept.Not
- 10% formalin is used to preserve small animals in glass jars. Mollusc shells, corals, dried sponges, nests, feathers are dry preservations. They are also kept in the museum.
- Skeletons can be prepared and kept in the museum.
- Insect collection requires pinning properly and drying insects after catching them and killing them. They can be trapped in Berlese funnel or simple traps. Charts, models can be made by students or bought from the market and kept in the museum. They should be properly displayed.
- Museum should be looked after by a museum curator.
- A botanical garden should be maintained in the school and plants for study grown there. Plants should be labelled.
- A greenhouse is a special enclosure made of glass or plastic where plants are maintained at a constant temperature and humidity.
- Herbarium is a collection of dried and pressed plants preserved on paper sheets.
- Plants are collected undamaged and then pressed in a press and dried. They are then mounted on herbarium sheets and labelled and classified.
- An aquarium is a glass or plastic container in which fish are grown and maintained. It also has aquatic plants which provide food and Oxygen for the fish.
- An aquarium has to be well lit and temperature has to be maintained. Elodea, Hydrilla, Vallisneria are some aquatic plants kept in the aquarium.
- Substratum of the aquarium is a filter bed in which bacteria can grow and convert waste into nitrates for the use of plants.
- Aquarium fish are of many colours. Some of these are angel fish, black mollie, guppy etc.
- Aquarium fish can be given live food such as worms and crustaceans or dried food.

TERMINAL EXERCISES

1. How is wet preservation done for museum specimens?
2. What are the ways in which skeletons can be prepared for displaying in the museum?
3. Name the equipment items required for insect collection and mention the
4. What is a Berlese trap?
5. Write notes on (a) Botanical garden (b) green house
6. How is a herbarium prepared?
7. Mention three biological principles which can be learnt by maintaining aquarium. How can temperature, light and fish food be arranged for aquarium?

6 LABORATORY EXERCISES

LABORATORY EXERCISES

1 EXERCISE

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.

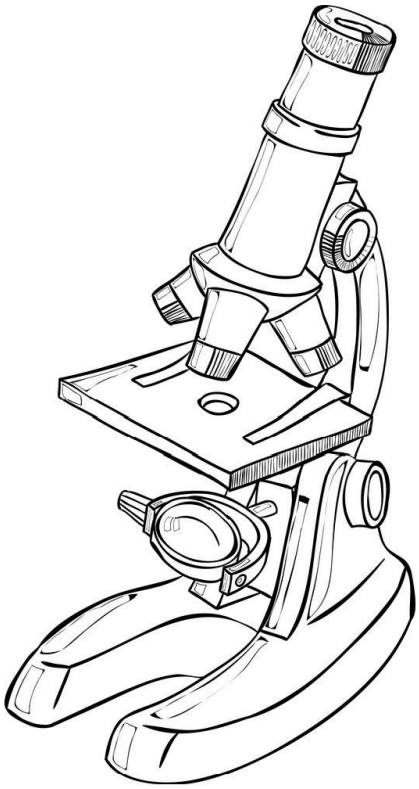
Eye-Piece : Contains lenses to increase magnification.

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.

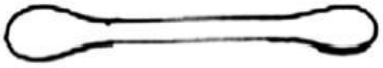
Fine Adjustment : Permits exact focussing by moving stage or body tube up or down very slightly.

Inclination Joint : Permits tilting to adjust the eye

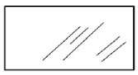
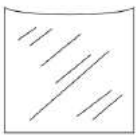
Using the microscope

- 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.

Name of the Laboratory instrument & Usage	Laboratory Instrument
(i) 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	
(ii) Scalpel Works like a knife, used to cut out thin slices and peel.	
(iii) Fine pair of scissors Used for cutting.	
(iv) A pair of forceps Used for picking up very thin slices or material.	
(v) 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.	
(vi) 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 mediumon 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.	

2 EXERCISE

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.

WHAT YOU SHOULD KNOW

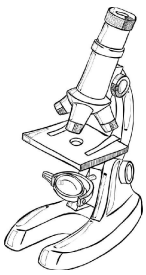
1. A tissue such as that of the peel is made of many cells.
2. A cell has many components, some of which can be seen under the compound microscope.

Materials Required

(i) Onion bulbs (ii) Paper towelling/ Blotting paper (iii) Dropper

(iv) Glycerine (v) Saffranine solution (for staining)

Procedure

PROCEDURE	
(i) Select an onion bulb, discard the brown dry outer scales.	
(ii) Cut the onion into four pieces (quarters) vertically. Remove one fleshy scale.	
(iii) Bend the outer (convex) surface of the fleshy scale towards you with your right hand to break it.	
(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	
(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	
(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. (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 and blot out the excess water.	
(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.

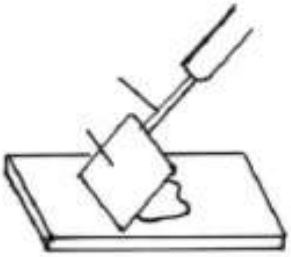
(iii) See the stained material under the microscope to check staining. It should neither be too dark nor to light. If it is light, leave in the stain for some more time.

(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

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

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



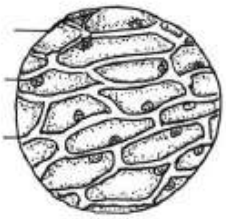


Fig.: *Putting cover slip* ***Fig.:*** *Epidermal cells in onion*

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 slideor 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.

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.

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.

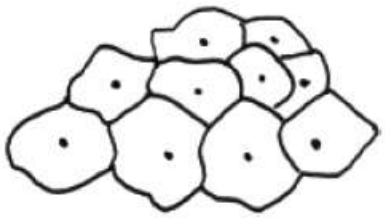
Materials Required

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

Proceedure

(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.

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.

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.

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 two 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

How to Proceed

(i) Take a lily leaf. Cut it into smaller pieces of about 6 cm2.

(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.

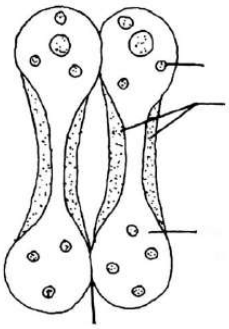


Fig. : *Structure of stomatal apparatus in a monocot leaf*

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

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.

WHAT YOU SHOULD KNOW

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

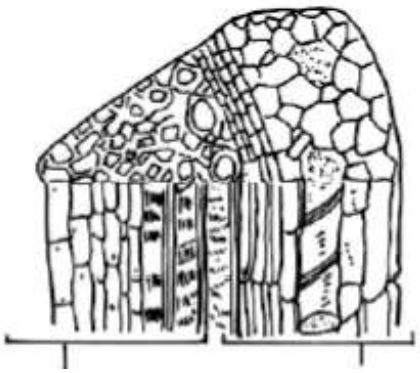


Fig. Xylem and Phloem

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

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 remove the extra stain.

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

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

PRECAUTIONS

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

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;

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

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.

(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.

Fig. : *Striated muscle fibres.*

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

3 EXERCISE

TO STUDY IMPORTANT CHARACTERISTIC FEATURES OFCERTAIN FAMILIES

MALVACEAE AND SOLANACEAE

Bentham and Hooker classified flowering plants on the basis of the arrangement of floral parts,position of thalamus, and the number of cotyledons in the seed etc.

Objectives

After performing this exercise, you should be able to:

- Identify the characters of the families.
- Differentiate between the two families.
- Recognise main features of stem and leaf.
- Identify the non-essential parts of the flowers.

Materials Required :

(i) Twigs with flowers of Malvaceae and Solanaceae families

(ii) Needles (iii) Brushes (o size) (iv) Lens

(v) Watch glass (vi) Glass slide (vii) Dissecting microscope

(viii) Blade

What you should know

1. The stems of Malvaceae and Solanaceae are different.
2. Venation of the leaf and parts of leaf, shape.
3. The arrangement of floral parts on the thalamus.
4. Type of inflorescence.
5. Position of stamens, number unitid or frec.
6. Position of ovary, number of carpels.

A. Vegetative Parts :

(i) Stem : Aerial or underground ot subaerial, errect or not, branched or unbranched, herboceous or woody.

(ii) Leaf : Venation, structure, stipulate or exstipulate, simple or compound.

B. Floral Parts :

i) Inflorescence : Type of inflorescence.

ii) Flower in general : Complete or incomplete, position of the flower, stalked or sessile, bracteate or ebracteate, bracteolate or ebracteolate, symmetry, bisexual or unisexual.

iii) Flower in detail :

a) Calyx : Observe and record the number of sepals, fused or free, aestivation.

b) Corolla : Observe and record the number of petals, united or free, aestivation, whether unitid with stamens or not.

c) Androecium : The number of stamens, fused or united, whether with corolla or not, the height of the filaments, number of lobes in the anther, nature of pollen.

d) Gynoecium : The position of the ovary, number of carpels, height of the style, nature of stigma, number of locules, placentation.

How to proceed :

i) Take the twig and observe the stem, leaves and inflorescence by using needle.

ii) Note down the main features as described.

iii) Remove the sepals and petals in the flower

iv) Draw the diagrams of twig with inflorescence, L.S. of flower,T.S. of ovary, floral digrams.

v) Take L.S. of flower and draw the diagram.

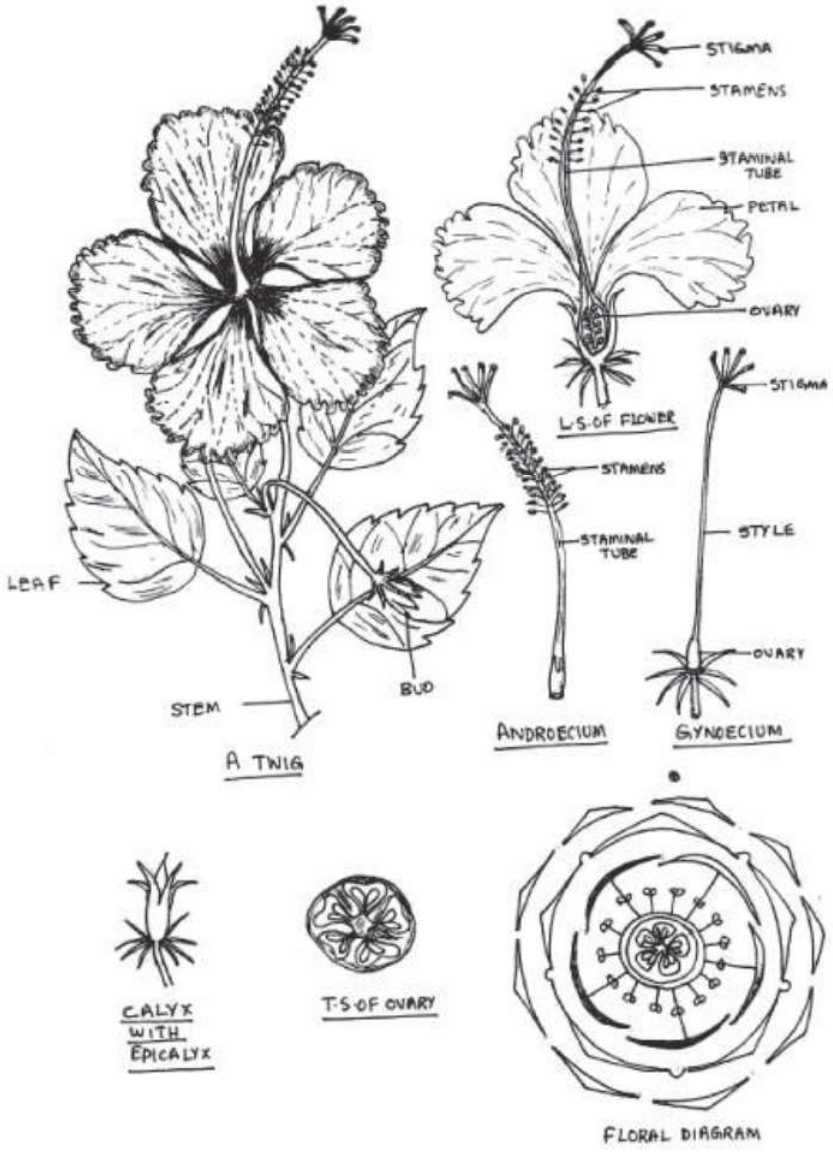
vi) Take the T.S. of ovary.

vii) Observe the fruit

viii) Observe the seeds.

I FAMILY : MALVACEAE

Ex : *Hibiscus rosasinensis* (china rose)



Observe the vegetative characters and floral characters and note the observations.

Observation and Documentation :

Vegetative Characters

1. Stem :

a) aerial or underground ? .....

b) any out growths? .....

c) branched or unbranched .....

d) herbceous or woody .....

2. Leaf :

a) Position .....

b) Stipules present or not .....

c) Petiole .....

d) Simple or compound .....

e) Venation .....

Draw the diagram of the twig with inflorescence. floral characters draw the diagram of flower and lable them.

3. Inflorescence :

a) Type .....

b) Position .....

4. Flower :

a) Number of whorls .....

b) Monochlamydous or dichlamydous .....

c) Complete or incomplete .....

d) Bracts .....

e) Bracteolates .....

f) Symmery .....

g) Number of floral parts .....

Draw the diagram of flower. take L.S. of flower and draw the digram.

5. Calyx :

a) Number of sepals .....

b) Free or fused .....

c) Colour .....

d) Aestivation .....

6. Corolla :

a) Number of petals .....

b) Free of fused.....

c) Aestivation .....

d) Whether united with the staminal tube .....

7. Androecium :

Observe under dissecting microscope.

a) Number .....

b) Whether united, completely united or not .....

c) Whether united with the corolla .....

d) Shape of the pollen grains .....

8. Gynoecium :

TakeT.S. of ovary observe under dissectintg microscope.

a) Position of the ovary .....

b) Number of carpels .....

c) Carpels united or free .....

d) Number of locules .....

e) Placentation .....

9. write the floral formula.

10. Draw the floral diagram.

Identify the family

Identification :

i) ReticulateVenation, Pentamerous flowers.

Class : Dicotyledons.

ii) Dichlamydeous, free corolla.

Subclass : Polypetalae.

iii) Hypogynous flowers, stamens numerous

Series : Thalamiflorae.

iv) Bisexual, actinomorphic. stamens monadelphous, carpels five, axile placentation.

Order : Malvales.

v) Stellate hairs on vegetative parts.

Presence of epicalyx

Twisted acstivation of corolla

Monadelphous, staminal tube

Monothecous, reniform anthers

Pollongrains spinous.

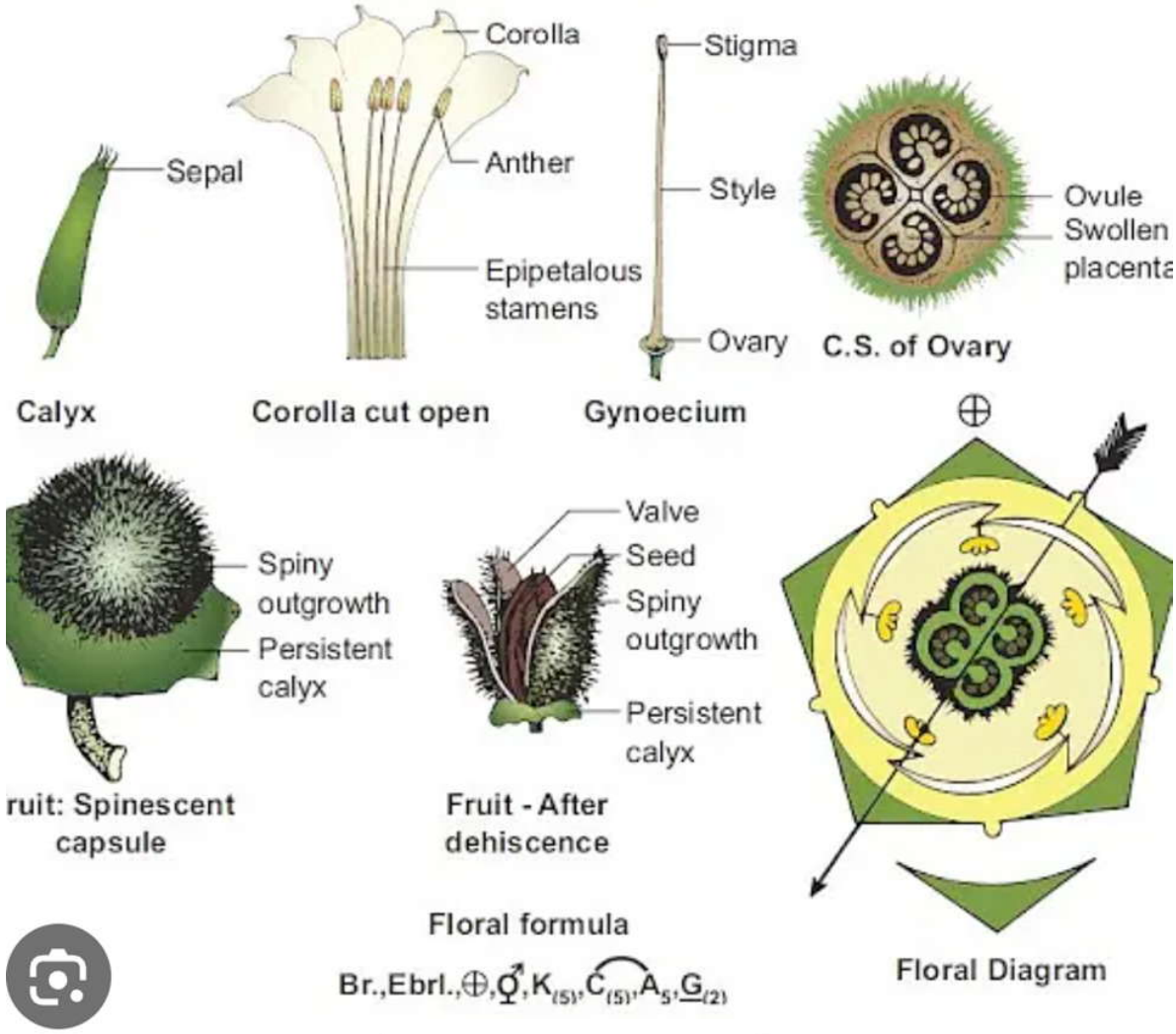
Family-Malvaceae.

RESULT :

Hence the observed twig belongs to the family malvuceae.

II FAMILY : SOLANACEAE

Ex : Datura metel



Draw the diagram of the twig, observe the vegetative and floral characters and record your observation.

Observation and documentation

A. Vegetative Characters

(i) stem :

a) Aerial or other type .....

b) Herbaceous or woody .....

c) Branched or unbranched .....

ii) Leaf :

a) Position .....

b) Stipules .....

c) Petiole .....

d) Leaf base adnation .....

e) Simple or compound .....

f) Venation .....

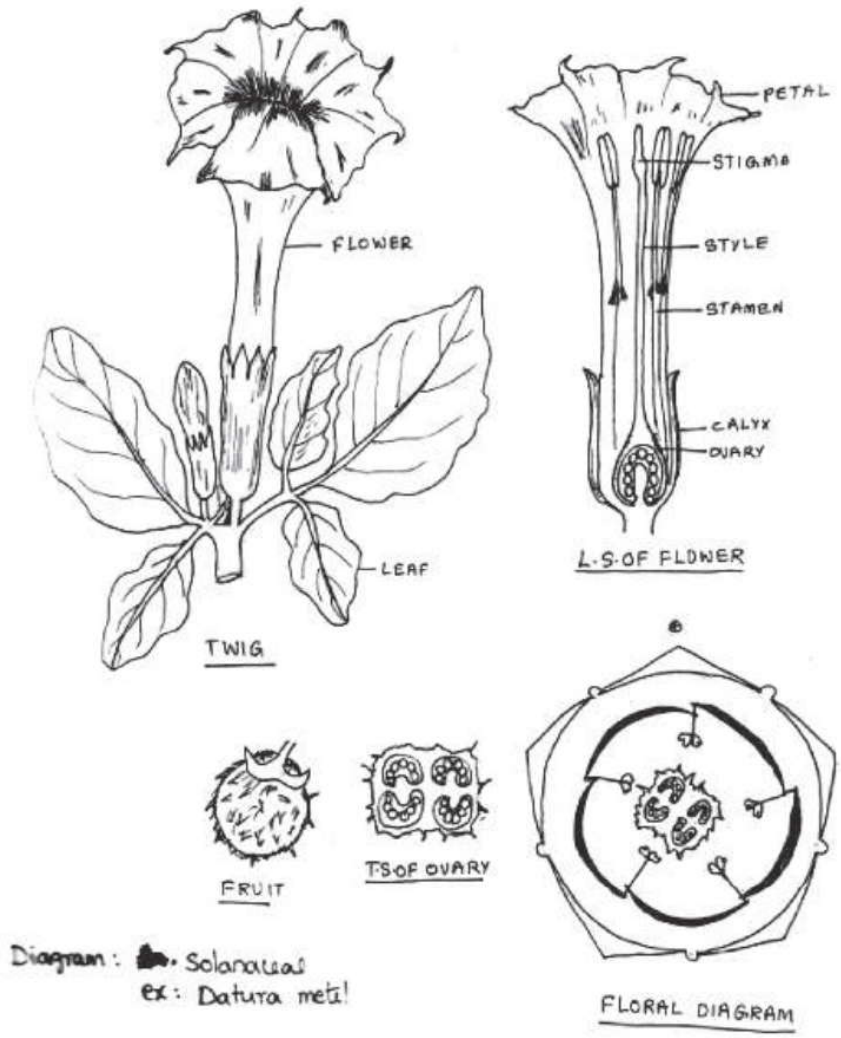


Fig : Floral Digram

B. FLORAL CHARACTERS

Draw the diagram of the flowers, and lable the parts.

3. Inflorescence :

a) Type .....

b) Position .....

4. Flower :

a) Number of whorls .....

b) Monochlamydeous or dichlamydeous .....

c) Complete or incomplete .....

d) Bracts .....

e) Bracteoles .....

f) Symmetry .....

g) Number of floral parts .....

h) Position .....

Take L.S. of flower, observe, draw the diagram.

Take T.S. of ovary and observe under dessecting microscope.

5. Calyx :

a) Number of sepals .....

b) Free or fused .....

c) Aestivation .....

d) Is the calyx persistent ? .....

6. Corolla :

a) Number of petals .....

b) Free or fused .....

c) Aestivation .....

7. Androecium :

a) Number of stamens .....

b) Fused with petals or not .....

8. Gynoecium :

a) Position of the ovary .....

b) Ovary position straight or oblique .....

c) Number of carpels .....

d) Carpels united or free .....

e) Number of locules .....

f) Number of ovules .....

g) Placentation .....

h) Style .....

i) Stigma .....

9. Floral formula

10. Draw the floral diagram.

IDENTIFICATION

1. Reticulate venation, pentamerous flowers.

   Class : Dicotyledonae

2. Dichlamydeous, fused corolla, epipetalous stamens.

   Subclass : Gamopetalae

3. Bicarpellary, hypogynous ovary, number of stamens equal to the number of petals.

   Series : Bicarpellatae.

4. Exstipulate and alternate leaves, bicarpellary, bilocular ovary with many ovules on axile placentation.

   Order : Polymoniales.

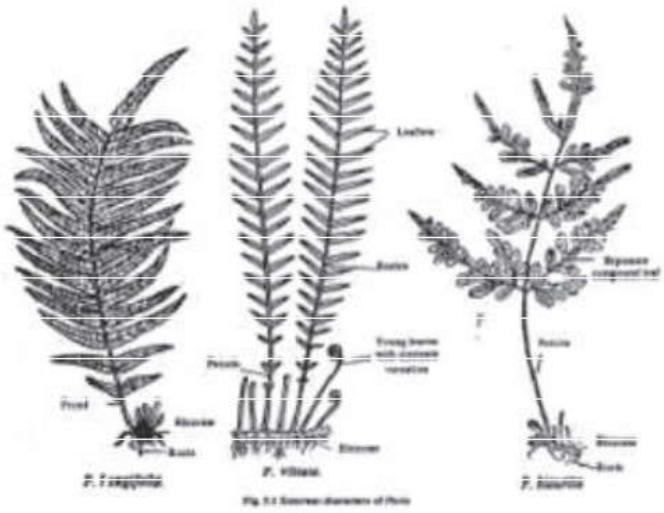
5. Exstipulate leaves, leaf base adnates with the stem, solitary cyme inflorescence, persistent calyx, epipetalous stamens, obliquely arranged carpels, axile placentation.

   Family : Solanaceae

Result : Hence the observed twing belongs to the family solanaceae.

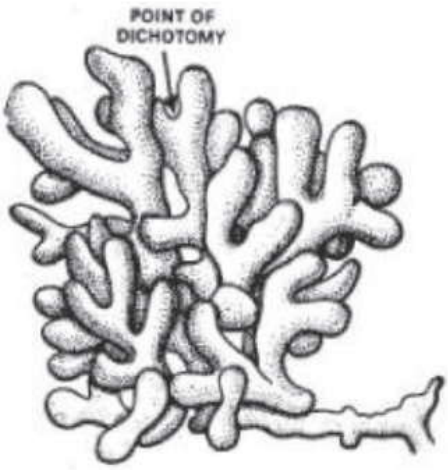
3a. Cycus

1. Adventious roots show dichotomous branching
2. Grow apogeotropically
3. Appear blue green and are coral like
4. The surface show some lenticels



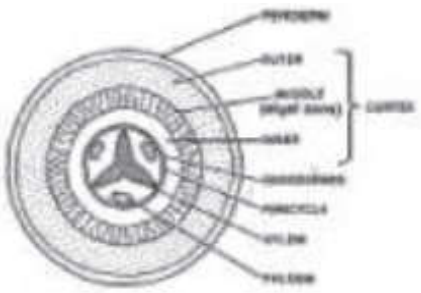
3b. Cycus Coralloid

1. Adventious roots show dichotomous branching
2. Grow apogeotropically
3. Appear blue green and are coral like
4. The surface show some lenticels



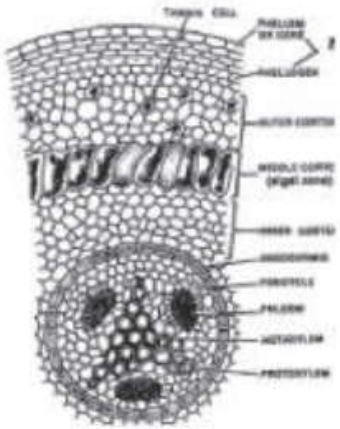
3c. T.S. of Cycus Coralloid root

1. Shows three regions epiermis, cortex and stele
2. Exidermis is single layered with thin walled cells
3. The cortex is massive and is differentiated into three distinct zones such as outer covtex, middle cortex, and inner covtex.
4. In the middle cortex, the cells gets disorganised and are inhabited by symbiotic nitrogen fixing blue-green alge like Anbaena and Nostoc
5. Radial vascular bundles. Xylem is exarch and triarch.



A

Ground plan of Cycus root



B

T.S of Coralloid root

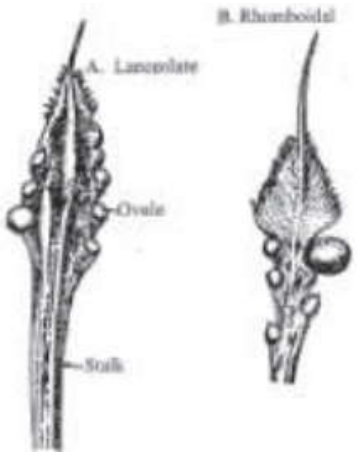
Cycas Male cone

3d. Cycus Male Cone

1. The male cone is shortly stalked, long, compact and fusiform or oval.
2. Mature cones appear woody and about 20 to 60cm. long
3. The male strobilus (=male flower) cousists of number of microsporophylls (=stamens) arranged closely on the centralaxis
4. Some of the microsporophylls situated at the extreme top and at the base maybe sterile

3e. Cycas megasporophyll :

1. Looks like foliage leaf. Borne on the female plant. There is no female cone.
2. Having three well defined parts i) stalk ii) middle fertile portion bearing ovules iii) upper sterile portion.
3. Lanceolate or rhomboidal. Both sides of stalk bears naked ovules
4. Ovules are of the size of hen's egg & browuish in colour
5. The upper portion of the megasporophyll is broad and serrated.



4 EXERCISE

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
- differentiate or identify these modified structures on the basis of their primary characters.

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

Procedure

(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 Root

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.

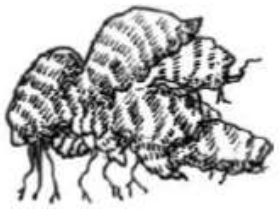
B. Modification of Stem

- 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.

power and then under high power.Look for various types of blood cells.Record your observations and drawRBCs and WBCs.

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

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

d. 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 :

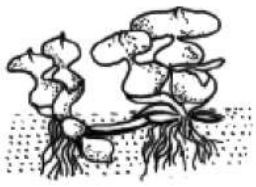
- The delicate branch arising from an axillary bud grows horizontally below the surface of the soil.
- It creeps on the ground with roots at the nodes and is called a **runner**.
- It may break off from the mother plant and can grow independently.

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**

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.

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**.
2. It helps in photosynthesis.

d. Pitcher plant

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

5 EXERCISE

TO STUDY ANATOMY OF DICOT AND MONOCOT STEMS AND ROOTS FROM PERMANENT SLIDES (Anatomy of root and stem)

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.

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

(ii) Permanent slides of dicot and monocot stems

(iii) Dissecting microscope

(iv) Permanent slides of dicot and monocot roots.

Procedure

(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

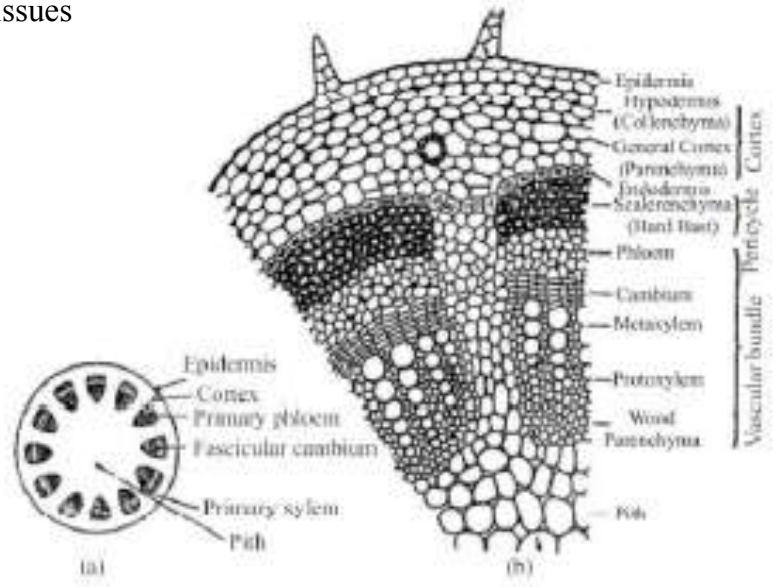


Fig T.S. of Dicot Stem

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

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

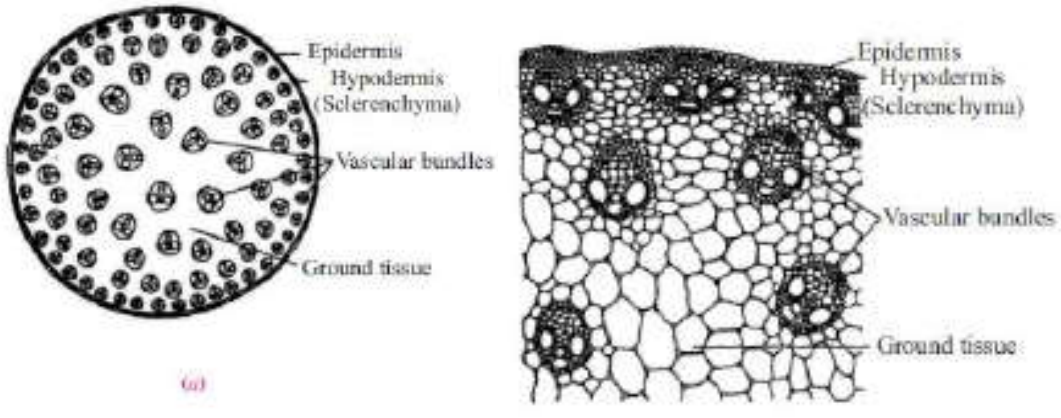
1. Cortex is differentiated into hypodermis (collenchymatous), parenchymatous cortex and innermost layer of endodermis.
2. Note the conjoint, collateral, open, endarch vascular bundles.

(B) T.S. of Monocot Stem

(i) Keep the slide containing T.S. of monocot stem (Maize stem) under a dissecting microscope. 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.



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.

2. Root

(A) T.S. of Dicot Root

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

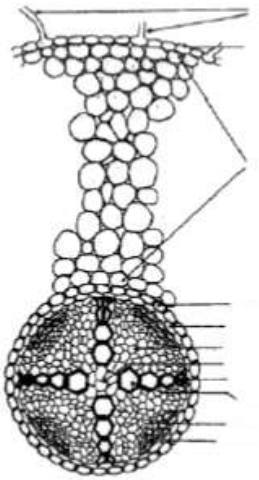
(ii) Observe the single outermost layer–**epiblema** which gives out single celled **hairs**. Inner to this, there is a compact mass of rounded cells with intercellular spaces forming **cortex**.

(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**.



(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.

(B) T.S. Of Monocot Root

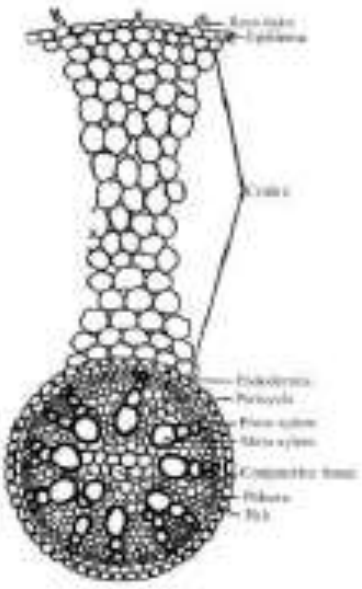
(i) Place the permanent slide of T.S. of monocot root under low power of the microscope.

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)

(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.



6 EXERCISE

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.

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

Procedure

(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

1. It will show the ground substance or **matrix** and cartilage cells termed **chondrocytes** scattered in it.
2. Chondrocytes are present in spaces called lacunae.
3. Now change to high power and by using the fine adjustment only focus a few cells.
4. 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.

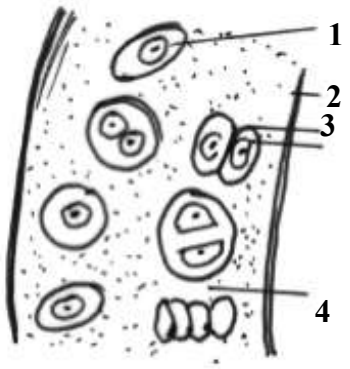


fig T.S. of Catilage
1. Chondroblast 2. Prichondrium 3. Lacunae 4. Matrix

2. To study the structure of T.S. of Bone (long bone such as femur)

Examine the slide under the low power of microscope.

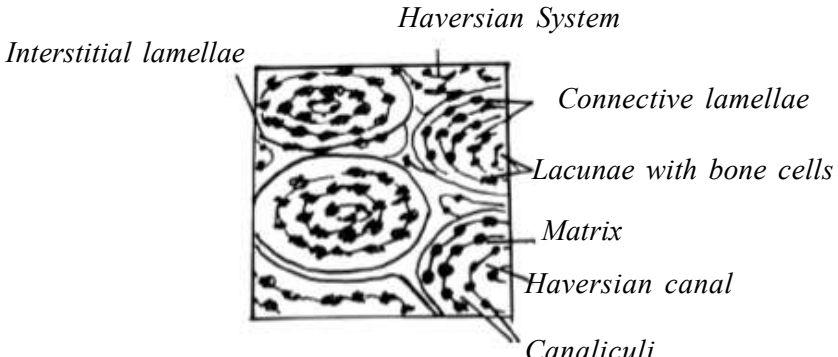


fig T.S. of bone

1. Observe some areas showing concentric rings or lamellae, and each such area having a narrow central canal.
2. The lamellae with their lacunae and central canal form the **Haversian system**. Compare the section in the slide with the provided.
3. Try to locate the central canal, bone lamellae and lacunae (spaces that conained bonecells) arranged in concentric rings.
4. 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.

   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.

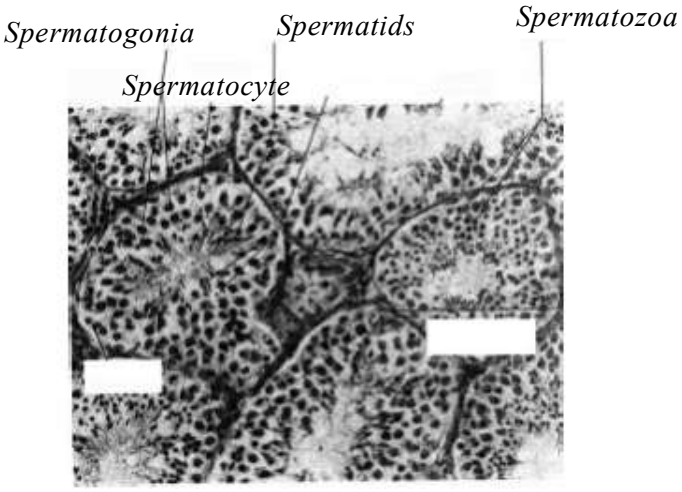


fig T.S. of Testis

1. Do you find any circular, oval compartments?
2. These are **seminiferous tubules**.
3. Can you see some material filling the space between the tubules?
4. 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 ermatozoa. 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.
- 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

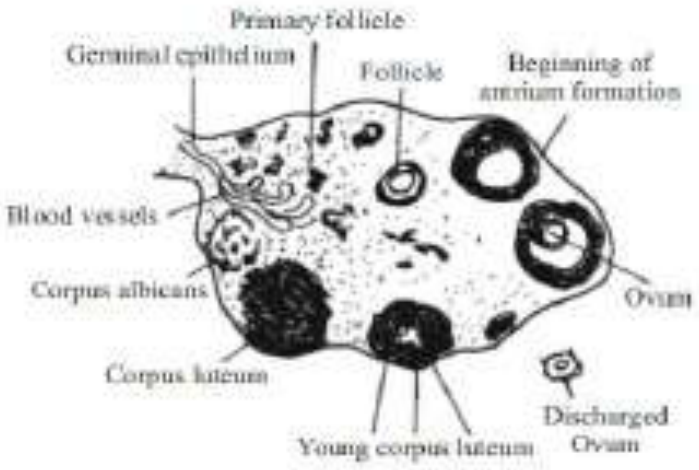
Examine the slide under low magnification moving it in all directions. First of all, observe the general outline of the ovary. Is it plain or uneven with slight bulges here and there?

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

(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**.



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 large number of circular concave disc like structure, which have no nuclei. These are red blood cells, **Red Blood Cells (RBCs).** You should able to see fewer number of stained larger cells (larger than RBC) irregular in shape with a nucleus of various shapes. These are white blood cells (WBCs).

7 EXERCISE

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.

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

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)

1. The number of petals, their colour and shape, whether they are free or fused, their relation with each other (overlapping, twisted, or free etc.)
2. Whether the flower has both male (Androecium) and female (Gynoecium) parts or only one of them.
3. 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).

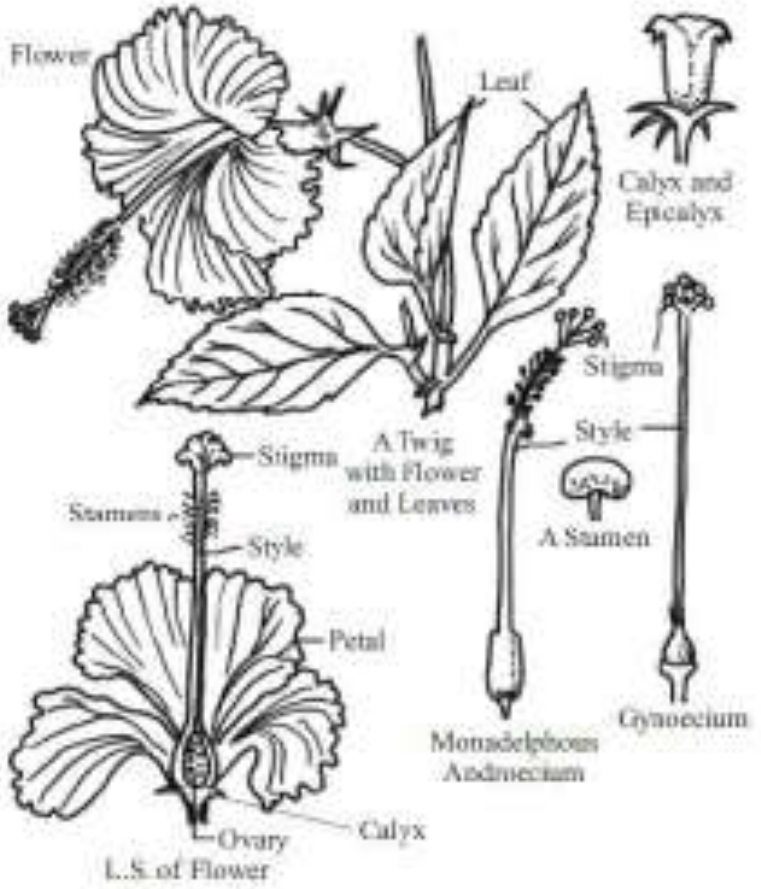


Fig.*Flowering twig, parts of flower of Hibiscus rosa-sinensis* (China rose)

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.

Procedure

(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)

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.

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?

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

(vii) Draw T.S. of ovary.

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

8 EXERCISE

STUDY OF ANIMAL CLASSIFICATION

To identify the Characteristic features of

Invertebrates	Vertebrates
Protozoa	Cartilaginous fish (Dogfish, Scoliodon)
Sponge	Bony fish (Rohu)
Earthworm	Toad
Butterfly	House lizard
Apple snail	Pigeon
Starfish	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.

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.

Study of specimens:

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.

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.

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.

You have read in Biology textbook 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.

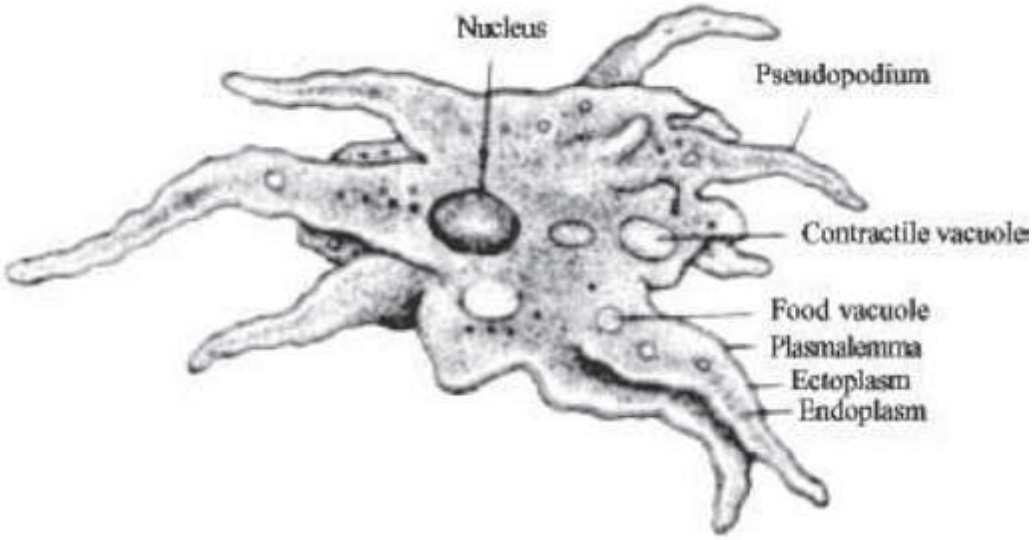
Listed below are the specimens (**invertebrates and vertebrates**) which you are supposed to study in the practicals. Short guide lines have been given wherever desirable.

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.

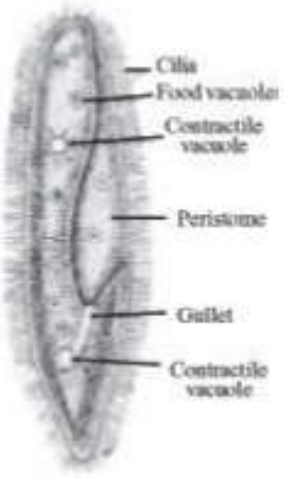
Amoeba Proteus



1. It is an unicellular organism. It lives in fresh water.
2. It has no definite shape. From the body surface, finger like structures are formed called pseudopodia which helps in locomotion and food collection.
3. Body is covered by plasmalemma.
4. Cytoplasm is divided into outer, clear ectoplasm and inner, granular endoplasm.
5. In the centre of the body there is a single and conspicuous nucleus.
6. Contractile vacuoles and food vacuoles are present in the cytoplasm.

Paramecium

1. It is a free swimming protozoan found in fresh water.
2. Body of *Paramoecium* is sole of a slipper shaped and hence it is called as slipper animal cule.
3. Its anterior end is round and posterior end is pointed.
4. Its body covered by pellicle. Entire body is coverd by cilia which help in locomotion and food collection.
5. It possess oral groove and cytopharynx.
6. There are two unequal nuclei - a large marconucleus and small micro nucleus.
7. Two contractile vacuoles are present - one in the anterior part and the other in the posterior.

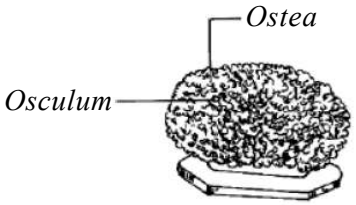


Paramecium

A sample format is given below,which may be suitably modified according to the different specimens.

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. Observe the specimen for the following details:

(Fill up observation 1)

_____ Porous body.

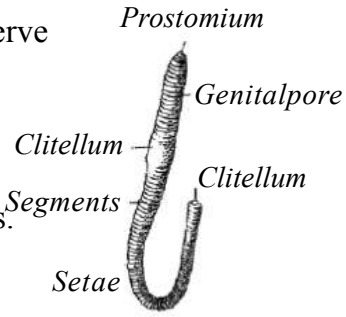
_____ No mouth, but numerous pores (ostia) all over the body.

_____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.

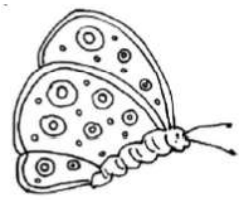
_____ Few setae present on the ventral side of each segment. They help in locomotion.

_____ Sexes not separate.

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

3. Butterfly

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



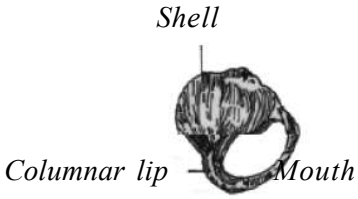
– Two pairs of wings.

Club shaped antennae.

– Powdery scales on wings.

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

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)

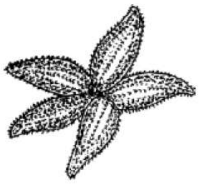
– unsegmented body.

– 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.

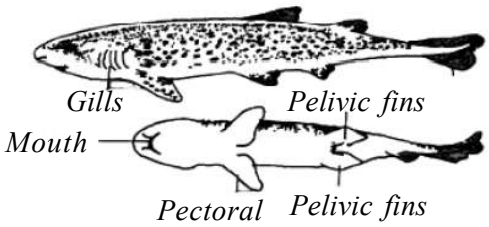
It moves by tube feet. Head is absent.

Observe the animal carefully and fill up observation 5.

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.

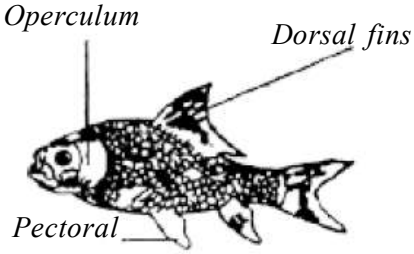
– Paired pectoral and pelvic fins.

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.

7. Rohu

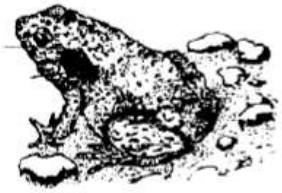


– Large scales cover the body.

– Gills covered by operculum.

– Rohu is a bony fish. i.e. it has a bony skeleton.

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.

9. Wall-lizard (Hamidactyles)

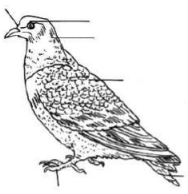
– Dry scaly skin,

– 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.

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.

11. Bat (Pterapus)

– Hair on the body.

– Projecting external ears.

– Forelimbs modified as wings.

Observe the animal carefully and fill up observation 11.

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

9 EXERCISE

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.

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.

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.

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.

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.

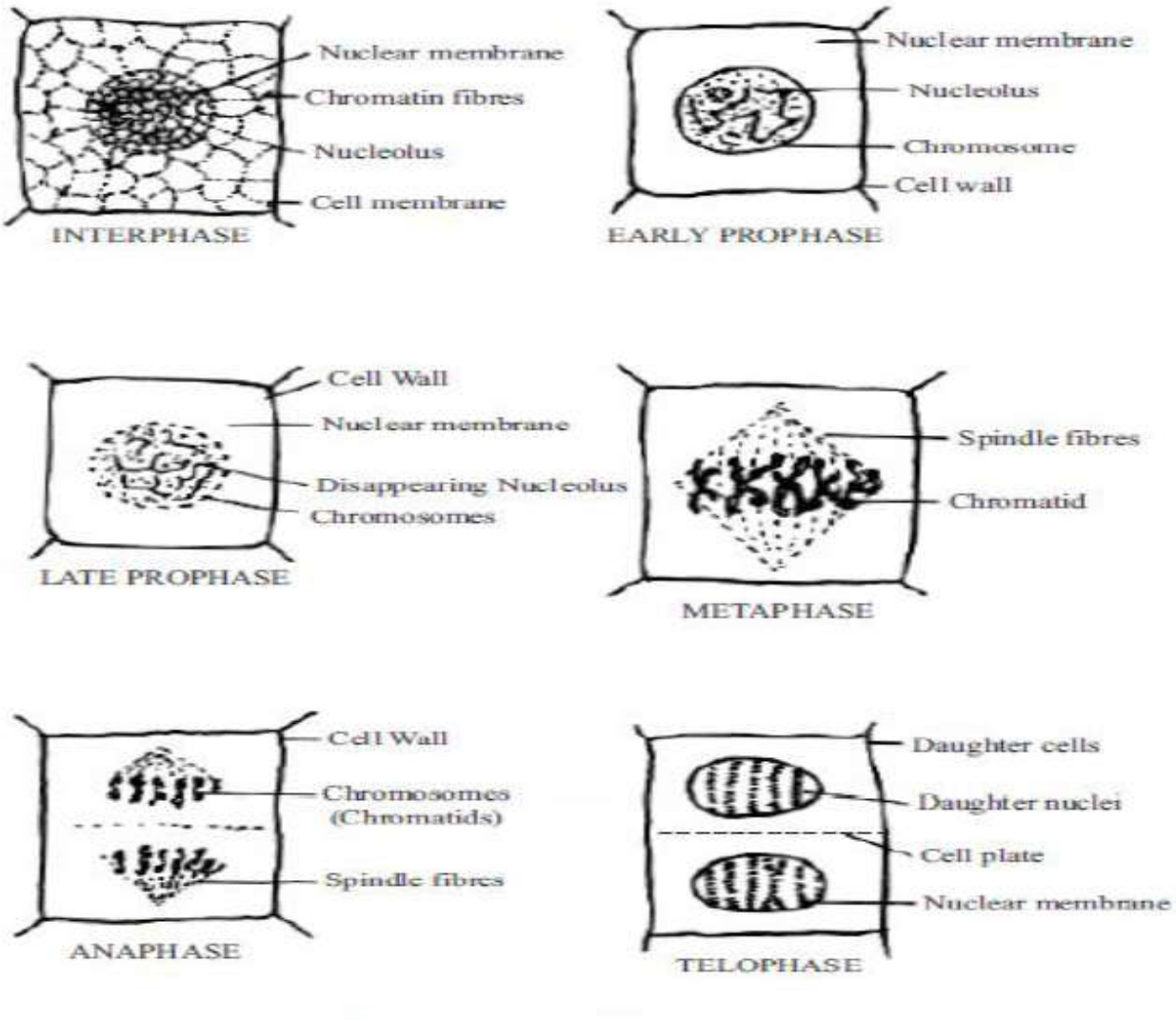


Fig. *Different stages of Mitatic cell division.*

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/	(xiv) 70% Alcohol. container/vial
(v) Coverslips	(x) Beaker	(xv) Blotting paper.

Procedure

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

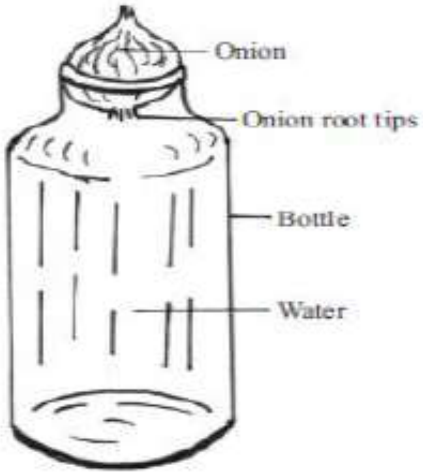
(i) Take a wide-mouthed bottle 3-4 days prior to the day you have fixed for this experiment and fill it with water very close upto the mouth.

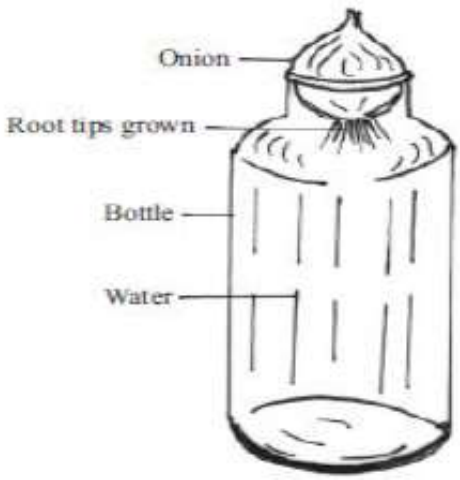
(ii) Take one medium sized onion bulb and remove its dry roots if any.

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

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

(v) When the roots are about 2-3 cms long 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.

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**.

(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?

10 EXERCISE

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.

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.

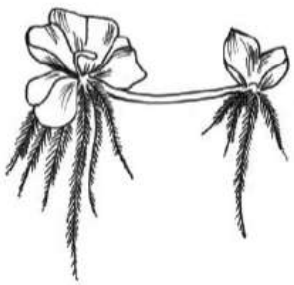
Material Required

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

Procedure

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.

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?

(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?

11A EXERCISE

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.

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 :

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.

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

Material Required

(i) Paper bags for collecting soil samples

(ii) Hand lens (iii) Measuring cylinder (iv) Water (v) Glass rod

Procedure

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.

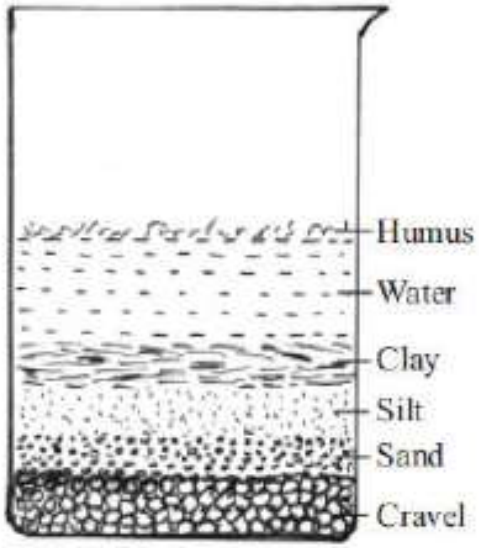


Fig. : *Different layers formed by different types of soil particles in water.*

11B EXERCISE

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.

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

Procedure

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 soft drink 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 x1 andx2.
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.
5. What is the weight of the soil filled boxes? (x1 + 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 y1 and y2 gms respectively.

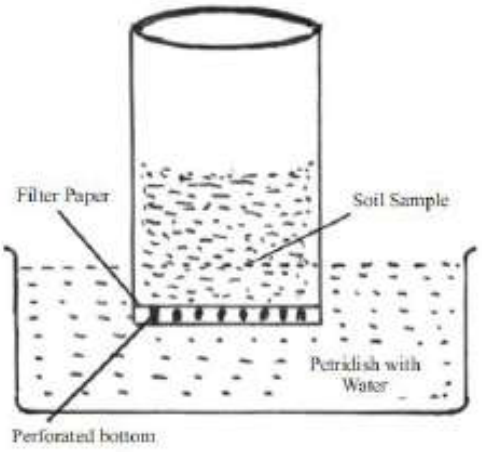


Fig. : *Experimental set-up to determine water holding capacity of soil.*

12 EXERCISE

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.

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

Procedure

1. Select a medium-sized potato.
2. Peel a potato and cut one end of the potato so that it can stand on its base.
3. Make a cavity (2 cm broad × 3 cm long) with the help of a scalpel on the upper portion of the potato.
4. A measured amount of 10% sugar solution is placed in the cavity of the tuber.
5. Mark the initial level of solution in the cavity with the help of a common pin.
6. Place the potato tuber containing sugar solution in a petridish containing water.
7. You can keep the set up for 2-3 hours or even over night.
8. Observe the set up after 2 hours and measure and record the level of solution.
9. Measure the volume of solution after the experiment is over.

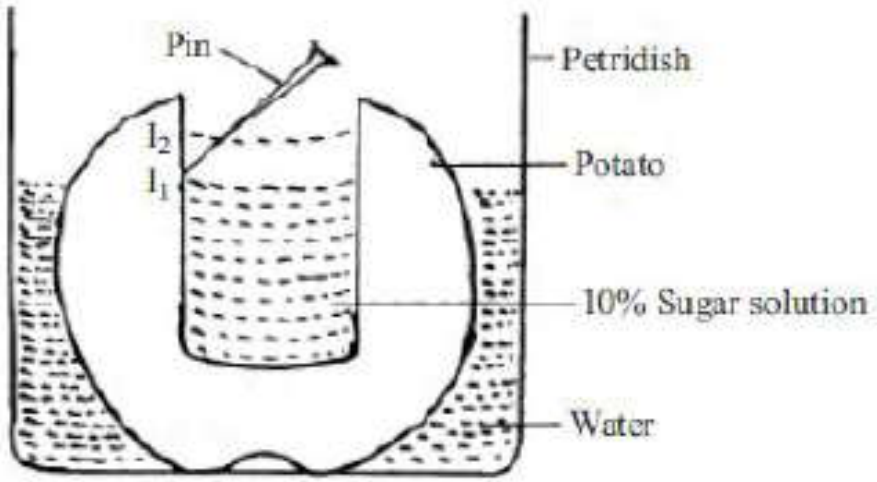


Fig.: *Potato osmometer*

13 EXERCISE

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**. Oxygen 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.

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

Procedure

1. 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..
2. Take a big bucket full of water and leave the Hydrilla plants in it.
3. 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. It must remain inside the water to prevent any air getting into the xylem at the cut ends of the twig.
4. Now introduce the Hydrilla plant which is tied to a rod, inside the jar filled with water.
5. Add a pinch of sodium bicarbonate ($NaHCO_3$) to the water which will provide CO_2 to the plant.
6. What do you observe at the cut end of of Hydrilla twig? You will find tha bubbles are coming out.
7. Keep the set up in full sunlight and five readings by counting the numb bubbles per minute using a stop watc
8. Take the set up in the shade and cour number of bubbles per minute using a watch.

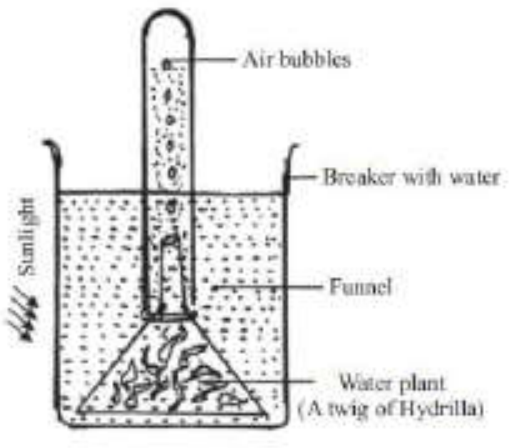


Fig. *Experimental set up to determine the rate of photosynthesis*

14 EXERCISE

STUDY THE STRUCTURE AND GERMINATION IN GRAM AND BEAN SEEDS

(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.

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

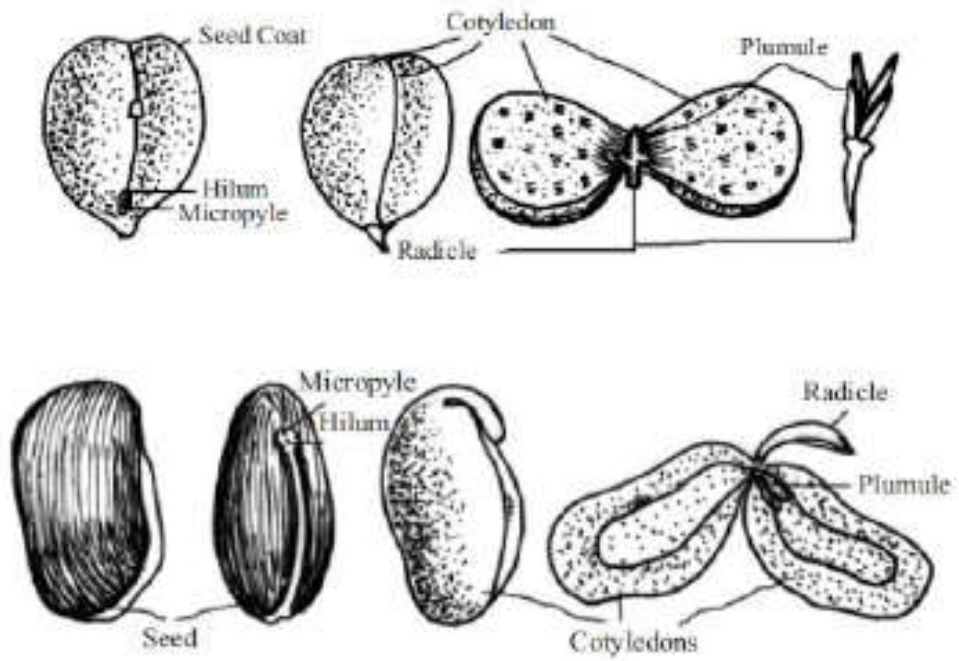
(i) Seeds of gram/bean/castor
(ii) (Dissecting microscope/hand lens
(iii) Watch glass/Petridish
(iv) Needles
(v) Ice cream cups
(vi) Soil

Procedure

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

1. Pick up one large sized soakad seed and place it in a watch glass or on a slide
2. Keep another watch glass ready with some water in it to keep the embryonal axis.
3. 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.
4. Gently open out the two cotyledons from their most convex side taking care. that they do not separate totally.
5. Observe the point of attachment of the two cotyledons with the embryonal axis.
6. With the help of fine needles separate the embryonal axis by breaking the point of attachment with the cotyledons.
7. Place the embryonal axis in the other watch glass containing some water



B 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.

How to Proceed

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

2. Take six dry seeds each of gram and bean and sow them in the soil in the cups.
3. Make sure to keep the soil moist althrough the experiment.
4. Note down the time when the first pair of leaves emerge.
5. In case the cotyledonary leaves do not come out of the soil, dig the seeds out to see the condition of the cotyldedons.
6. Observe and study the structure of the first pair of leaves very carefully

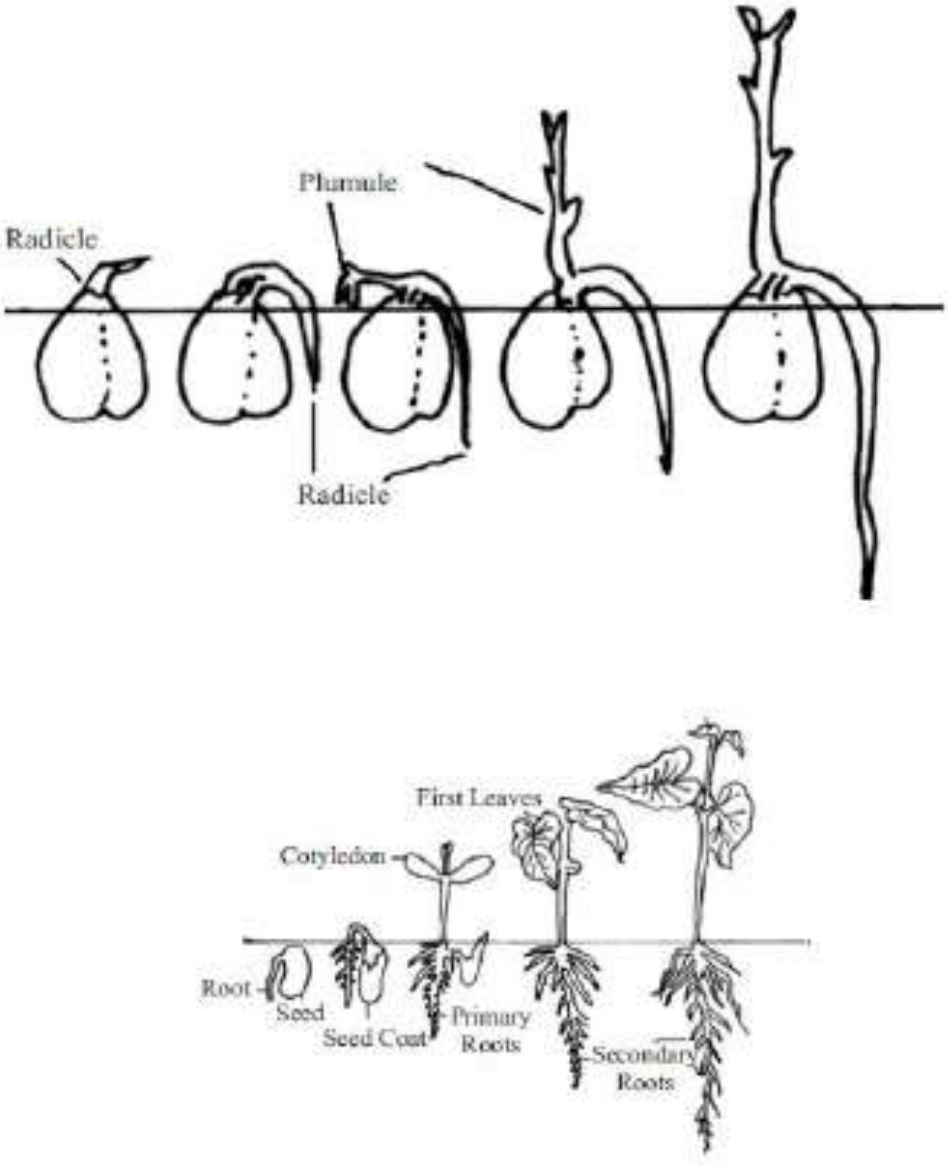


Fig. *Seed germination of bean and gram seeds*

15 EXERCISE

TO DEMONSTRATE THE RELEASE OF CO2 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 nongerminating
- ones, as the rate of growth is faster.

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) KOH-pellets (caustic or potassium hydroxide)

(v) Gram seeds/Moong seeds/Wheat grains

(vi) Small bottle (4 cm × 3/4 cm)

(vii) Thread

(viii) Beaker

Procedure

1. Take about 25 gms of gram seeds and soak them overnight in a beaker half filled with water.
2. Next day decant the water and wrap the seeds in a wet cloth.
3. After one or two days, open the cloth and look at the seeds.
4. The seeds have sprouted or germinated (The radicle and plumule have appeared)
5. You may use the same method to germinate moong seeds and wheat grains and use them in place of gram seeds.
6. 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).
7. Insert a one-holed rubber cork in the mouth of the conical flask.
8. Take a small test-tube and put 5 to 6 pellets of KOH (Potassium hydroxide).
9. Tie the test-tube with a piece of thread and hang it as shown in the diagram.
10. Introduce one end of the bent glass tube into the conical flask through the cork.
11. The end of the tube must be slightly away from the seeds.
12. Dip the other end into a beaker of water coloured with a drop of saffranin.
13. Mark the initial level of water inside the tube.
14. Leave your set-up and observe the level of the water after every half an hour.

Your experimental set-up is now ready for observation

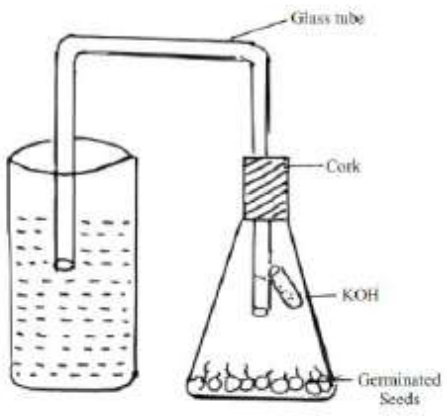


Fig. *Experimental set-up*

16 EXERCISE

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.

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.

Procedure

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.

(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.

(ix) A beaker containing water heated to a temperature of 38°C serves as a waterbath.

(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.

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.

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).

Note the change in colour if any and record it in work-sheet.

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.

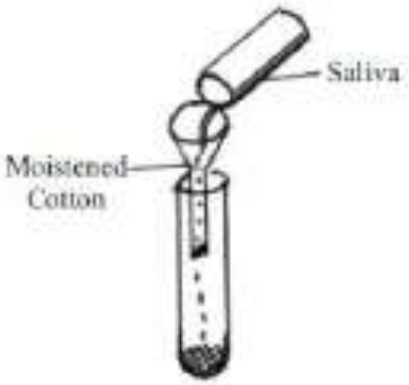


Fig. *Filtering saliva*

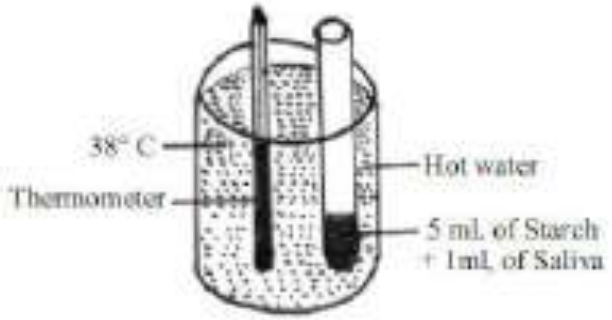


Fig. *Water bath*

(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.

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.

17A EXERCISE

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

★ ***Choose the anyone from Exercise 17 A, 17B, 17C***

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**.

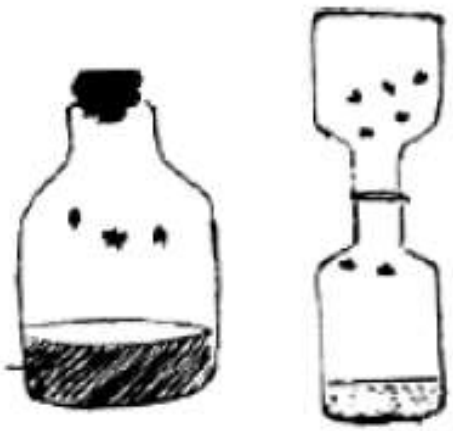
For research work, few organisms are collected from nature or brought from dealer and maintained and grown and multiplied on a large scale.

In school laboratories. Drosophila is cultured on a small scale for laboratory use by the student.

Procedure

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.
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.

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.

17B EXERCISE

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

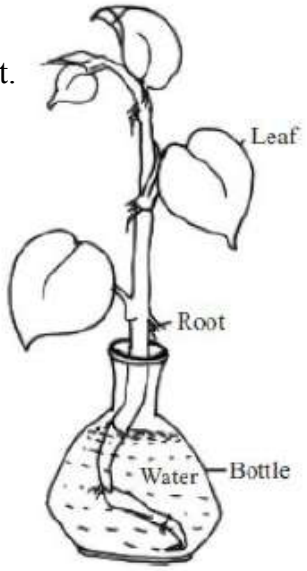
(iv) thread (v) scale (vi) graph paper, pencil

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.

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.



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.

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

17C EXERCISE

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.

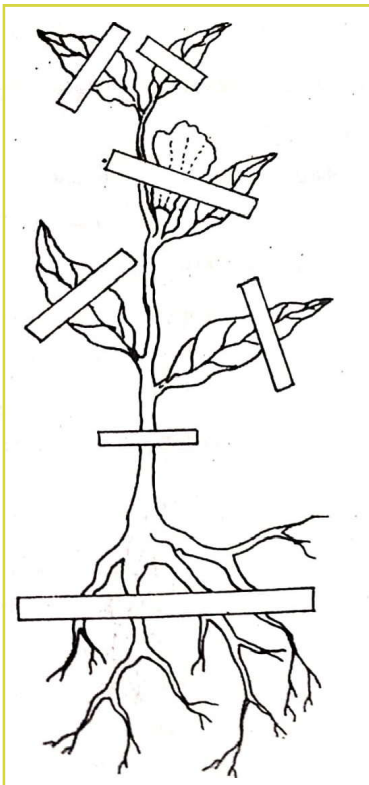
WHAT YOU SHOULD KNOW

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.

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.
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.



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 _____