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Introductory Biology
Practical Manual
Course No, SE-AGP101
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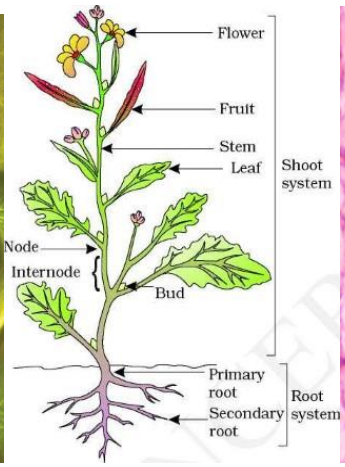

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CONTENTS

Practical 1: Morphology of Root

https://www.youtube.com/watch?v=Ra021LvCiZM

Definition: Radicle comes out or arise from the seed coat in the form of soft structure and move toward the soil. It develops and forms primary root.

General Characters:

1.

2.

3.

4.

5.

Types of Roots:

1. Tap root,
2. Adventitious root

Tap root: It develops from radicle and made up of one main branch and other sub branches. The primary roots and its branches constitute tap root system. e.g. Dicot roots.

Adventitious root: It arise from an organ other than the **root**—usually a stem, sometimes a leaf. They are especially numerous on underground stems, such as rhizomes, corms, and tubers, and make it possible to vegetative propagate many plants from stem or leaf cuttings.

Function of Roots:

1.

2.

3.

4.

Draw a neat diagram of typical Root with label:

Sample Name:

Type:

Draw a neat diagram of a storage Root with label:

Sample Name:

Type:

Practical 2: Modification of Root

https://www.youtube.com/watch?v=yIag_TPs6lw

1. **Adventitious roots**
   - ✧ **Tuberous root:** When food is stored in these roots, they become swollen and form a bunch. eg. **Sweet potato (*Ipomea batata*)**
   - ✧ **Fasciculated:** Roots arise in **bunch** (cluster) from lower node of the stem and become fleshy eg. ***Dahlia, Asparagus***.
   - ✧ **Nodulose:** In this type, tips of roots swell up. **eg. *Melilotus, Curcuma amoda.***
   - ✧ **Beaded or moniliform:** When root swells up like a bead at different places after a regular interval.

     eg. *Vitis, Momordica* (Bitter gourd), Portulaca.
   - ✧ **Annulated:** Roots having series of ring like swellings **eg. *Psychrotia***
2. **Stilt roots or brace roots:** When root arises from lower nodes and enter in soil obliquely, known as stilt roots **eg. Maize, Sugarcane, *Pandanus* (screwpine)**
3. **Prop root or pillar root:** when root arises from branches of plant and grows downward towards soil. It function as supporting stem for the plant. **eg. Banyan**.
3. **Butteress root:** Such roots appear from the basal part of stem and spread in different directions in the soil. **eg. *Ficus, Bombax , Terminalia*.** It is a characteristic feature of tropical rain forest.
4. **Climbing roots:** These roots arise from nodes and helps the plant in climbing. **eg. Money plant (*Pothos*), Betel, Black pepper, *Techoma*.**
5. **Foliar roots or Epiphyllous roots:** When roots arise from leaf they are called as foliar roots. **eg. *Bryophyllum, Bignonia*.**
6. **Sucking or haustorial roots or Parasitic roots:** In parasitic plant roots enter in the stem of host plant to absorbed nutrition from host. **eg. *Dendrophthoe, Cuscuta, Viscum*.**
7. **Assimilatory roots:** The aerial roots of ***Tinospora*** and submerged roots of ***Trapa*** (Water chestnut) become green and synthesize food. ***Podostemon*** also has green assimilatory roots.

8. **Hygroscopic roots:** These are found in epiphytes, specially in orchids and help in absorption of moisture from the atmosphere using special tissue called **velamen**. **eg. *Orchids, Banda***
9. **Contractile roots:** They shrink 60 – 70% of the original length and bring underground organ at proper depth in the soil e.g., corm of ***Crocus*** (saffron), ***Fresia***.
10. **Root thorns:** These are hard, thick and pointed thorns e.g. ***Pothos armatus***.
11. **Reproductive roots:** These are fleshy, adventitious roots used for vegetative reproduction e.g., sweet potato (*Ipomea batata*), Dahlia.
12. **Leaf roots:** In Salvinia, one leaf of each node modifies into root like structure for balancing the plant in water.

Modification of Roots:

1.

2.

3.

4.

Include a Campus tour to collect Sample:

Collect Sample and draw

Specimen1:

Specimen2:

Practical 3: Morphology of Stem

https://www.youtube.com/watch?v=ilHuGaB9oDU

Definition: Stem is a part of plant which lies above from surface of soil i.e. it shows negative geotropic growth. It has nodes and internodes. Branches, leaf, flower bud and bracts are developed from nodes. Stem arises from plumule.

General Characters:

1.

2.

3.

4.

5.

Types of Stem:

Caudex : It is unbranched, erect, cylindrical stout stem and marked with scars of fallen leaves. Crown of leaves are present at the top of plant. eg.: Palm

Culm : Stem is jointed with solid nodes & hollow internodes. eg. Bamboo (Graminae)

Excurrent : The branches arise from the main stem in acropetal succession and the tree assumes a cone like appearance e.g. ***Pinus, Eucalyptus, Casuarina,*** etc.

Decurrent (Deliquescent) : The lateral branches grow more vigorously and outcompetes the main trunk, giving a dome-shaped appearance, e.g., mango (***Mangifera indica***), shishem (***Dalbergia sissoo***) and banyan (***Ficus bengalensis***).

Draw a neat diagram of typical Stem and label it:

Sample Name:

Type: Dicot

Draw a neat diagram of typical Stem and label it:

Sample Name:

Type: Monocot

Functions of Stem:

1.

2.

3.

4.

Include a Campus tour to collect Sample:

Collect Sample and draw

Specimen1:

Specimen2:

Practical 4: Modification of Stem

https://www.youtube.com/watch?v=yIag_TPs6lw

Underground Modification:

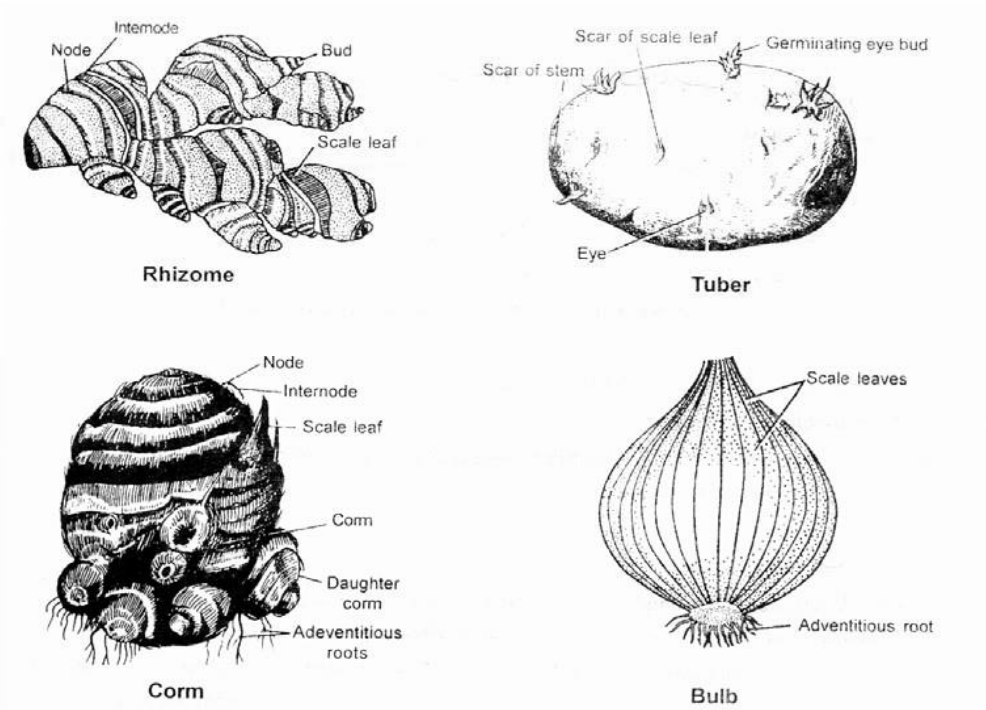
This type of modification occurs generally for food storage and vegetative propagation.

Tuber – The tips of underground branches become swollen in the soil. Eyes are found on then which are axillary buds and covered with scaly leaves. eg. **Potato, *Helianthus tuberosus***

Rhizome – It is fleshy and horizontally stem found below in soil. Small nodes and internodes are found which are covered by scaly leaves. eg. **Ginger, Turmeric, Canna, Water lily, Banana.**

Corm – It is condensed structure which grow vertically under the soil surface. They are having spherical node and inter node eg. ***Colocasia, Alocasia,* Zaminkand, Saffron, *Gladiolus, Colchicum***

Bulb – This stem is reduced and has disc like structure and surrounds with numerous fleshly scaly leaves, many roots arise from its base, Foods are stored in fleshy leaves, they show apical growth eg. Onion. Garlic.



Draw a neat diagram of storage Stem and label it:

Sample Name: **Family:**

Type: Dicot

Draw a neat diagram of typical Storage Stem and label it:

Sample Name: **Family:**

Type: Monocot

Practical 5: Morphology of Leaf

https://www.youtube.com/watch?v=-_xboflKxLY

Definition: The leaf is a lateral generally flattened structure borne on the stem. The leaves develop from the nodes. Their main function is photosynthesis and food making, axillary buds are found in its axil. All the leaves of a plant is known as phyllome. Axillary bud later develops into a branch. Leaves originated from shoot apical meristem and are arranged in acropetal order.

General Characters:

1.

2.

3.

4.

5.

Describe the parts of a typical leaf:

Leaf base:

Lamina:

Stipules:

Describe different types of leaves after field survey:

Foliage:

Cotyledonary:

Scaly:

Bract:

Floral:

Perianth:

Functions of leaf:

1.

2.

3.

4.

5.

Draw a neat diagram of a typical leaf and label different parts:

Venation of Leaves: arrangement of veins and veinlets in leaves (Lamina) is known as venation. It is of 2 types, **Reticulate :** It is found in dicots. Exception – ***Calophyllum***, ***Eryngium.*** It has parallel venation.

Parallel : It is found in monocots. Exception – ***Smilax***, ***Dioscorea, Alocasia, Colocasia***. It has reticulate venation.
Reticulate: In it main vein divided into various branches (veinlets) and form a net like structure. Reticulate venation is of 2-types. Pinnate and Palmate

Draw a neat diagram of a Simple Dicot leaf with label:

Specimen: **Family:**

Draw a neat diagram of a Simple Monocot leaf with label:

Specimen: **Family:**

Draw a neat diagram of a Pinnate Compound leaf with label:

Specimen: **Family:**

Draw a neat diagram of a Palmate Compound leaf with label:

Specimen: **Family:**

Draw a neat diagram of a leaf with reticulate venation and label:

Specimen: **Family:**

Draw a neat diagram of a leaf with parallel venation and label:

Specimen: **Family:**

Practical 6: Modification of Leaf

https://www.youtube.com/watch?v=OuBDV_pZmXM

Leaf tendril – In it, whole leaf is modified into thin thread like structure which is called leaf tendril eg. ***Lathyrus aphaca*** **(wild pea).**

Leaflet tendril – When leaflet is modified into tendril like structure than it is called leaflet tendril. eg. ***Pisum sativum*** (Garden pea), ***Lathyrus odoratus*** (sweet pea)

Leaf spine – Leaves or any part of leaflet are modified into pointed spine. eg. ***Asparagus, Opuntia, Aloe, Argemone.***

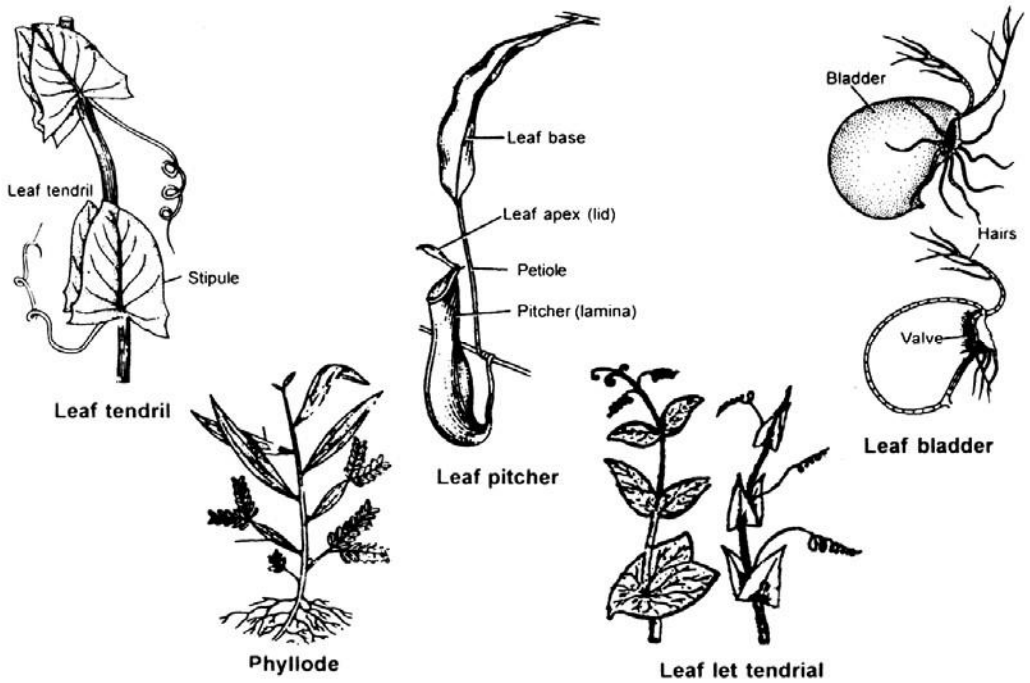
Leaf scale – In it, leaves become thin, dry and form a membrane or paper like structure and serve to protect axillary buds as in ***Ficus*** and ***Tamarix, Ruscus***, ***Casurina***.

Leaf pitcher – Leaves of some plants are modified to pitcher shape. eg. ***Nepenthes, Dischidia.***

Leaf bladder – In some plant, leaves are modified into bladder like structure eg. ***Utricularia.***

Leaf Hooks – In some plants terminal leaflets are modified into curved hooks for helping the plant in climbing. eg. ***Argemone, Opuntia, Aloe,*** **Cat's nail (*Bignonia unguis – cati*)**

Phyllode – In its, petiole becomes flat structure and function as normal leaf. eg. ***Australian acacia.***



Draw a neat diagram of a modified leaf and label:

Specimen: **Family:**

Function:

Draw a neat diagram of a modified leaf and label:

Specimen: **Family:**

Function:

Practical 7: Morphology of Flower

https://www.youtube.com/watch?v=oZyMVoOIYJY

Definition: Flower is defined as highly condensed and modified reproductive shoot. The part from where flower arise is called bract. Flower has short or long flower stalk which is called pedicel. The upper part of pedicel is swollen, spherical shaped or conical which is called thalamus / Receptacle.

Commonly four parts are present in a flower but others may have excess parts

Describe different parts of flower after a field visit:

Perianth:

Calyx:

Epicalyx:

Corolla:

Androecium:

Gynoecium:

Pedicel:

Draw a neat diagram of a Dicot flower and label:

Specimen: **Family:**

Draw a neat diagram of a monocot flower and label:

Specimen: **Family:**

Write down different Functions of a Flower:

1.

2.

3.

4.

Draw the diagram of a unisexual flower and label:

Specimen: **Family:**

Practical 8: Modification of Flower

https://www.youtube.com/watch?v=oZyMVoOIYJY

Description: The flower is generally defined as a highly specialized reproductive shoot, comparable to leaves- bearing shoot. The sepals and petals may be regarded as modified leaves. Stamens and carpels also show some resemblance to leaves in position, arrangement, internal structure and development. Based on these similarities, they are comparable with leaves which bear reproductive organs.

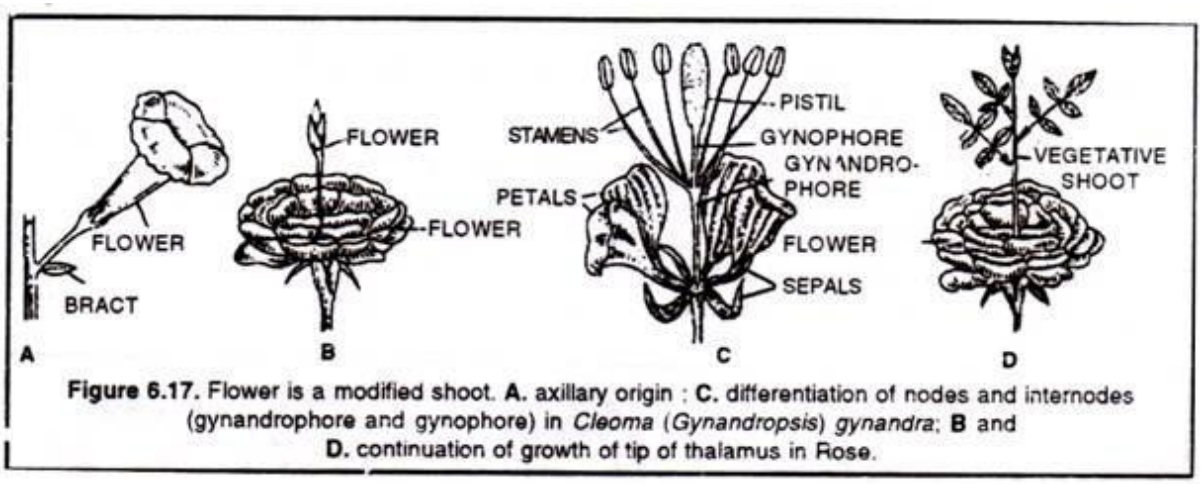


Figure 6.17. Flower is a modified shoot. **A.** axillary origin : **C.** differentiation of nodes and internodes (gynandrophore and gynophore) in *Cleoma* (*Gynandropsis*) *gynandra*; **B** and **D.** continuation of growth of tip of thalamus in Rose.

Describe the statement on the basis of below mentioned points

(I) Homology of the floral bud:

(II) Axis nature of receptacle:

(III) Foliage nature of floral appendages:

Draw a Modified Flower and label different floral parts:

Specimen Name:

Practical 9: Different Types of Inflorescence

https://www.youtube.com/watch?v=OU4_7DKmVCk

Definition: Arrangement of flower on floral axis is called inflorescence.

Racemose – In this type of inflorescence the main axis continues to grow and does not terminate in a flower and give off flower laterally in acropetal manner where old flowers are arranged toward base and young flowers are at tip. When peduncle is broad then flowers are centripetally arranged.

Briefly describe different types of racemose inflorescence:

1. **Raceme –**

2. **Spike –**

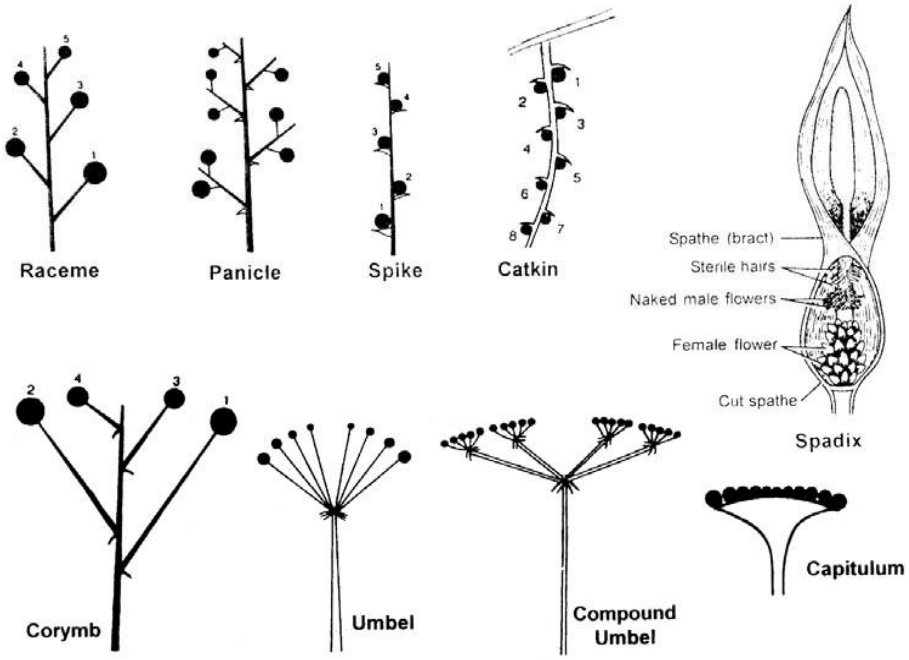
3. **Catkin –**

4. **Spadix –**

5. **Corymb –**

6. **Umbel -**

7. **Capitulum -**



Cymose: In this type of inflorescence, the peduncle terminate in a flower. In it the older flowers are present at tip and young buds are arranged towards base. This arrangement is called basipetal succession.

Briefly describe different types of cymose inflorescence:

1. **Uniparous cyme / Monochasial cyme –**

2. **Dichasial or biparous cyme –**

3. **Multiparous cyme / polychasial –**

Describe different types of Special Inflorescence:

Cyathium:

Verticillaster:

Hypanthodium:

Coenanthium:

Mixed inflorescence:

Diagram of a racemose inflorescence and label:

Specimen: **Family:**

Diagram of a cymose inflorescence and label:

Specimen: **Family:**

Diagram of a mixed inflorescence and label:

Specimen: **Family:**

Diagram of a special inflorescence and label:

Specimen: **Family:**

Practical 10: Morphology of Seed

https://www.youtube.com/watch?v=sWRWZkcIs4U

Definition: A seed is an important part of a flowering plant. They give rise to a new plant. They may be of different shapes, colours and sizes. They may be round, wrinkled, winged or hairy. They are in a dormant condition until they receive adequate sunlight, water, and soil. The growth of the plant from a seed is known as germination. A seed has three parts:

1. **Seed Coat:**

2. **Endosperm:**

3. **Embryo:**

4. **Epicotyl:**

5. **Hypocotyl:**

6. **Radicle:**

7. **Cotyledon:**

Types of Seeds

There are two types of seeds:

- Monocotyledonous seeds
- Dicotyledonous seeds

1. Monocotyledonous Seeds

These comprise of a single cotyledon emerging from the seeds on germination. For eg., rice, wheat, barley, mango, lilies, etc.

2. Dicotyledonous Seeds

These comprise of two cotyledons emerging from the seeds on germination. For eg., corn, sugarcane, bamboo, etc.

Draw a neat diagram of a dicot seed and label:

Specimen: **Family:**

Draw a neat diagram of a monocot seed and label:

Specimen: **Family:**

Perform Seed Germination Experiment

Specimen 1:

Time taken for Germination:

Germination Percentage:

Type:

Special feature:

Specimen 2:

Time taken for Germination:

Germination Percentage:

Type

Special feature:

Specimen 3:

Time taken for Germination:

Germination Percentage:

Type:

Special feature:

Practical 11: Cell Division Slide, stages

https://www.youtube.com/watch?v=DwAFZb8juMQ

Procedure: will place some permanent slides on the stage of compound microscope and observe and identify the stages of mitosis.

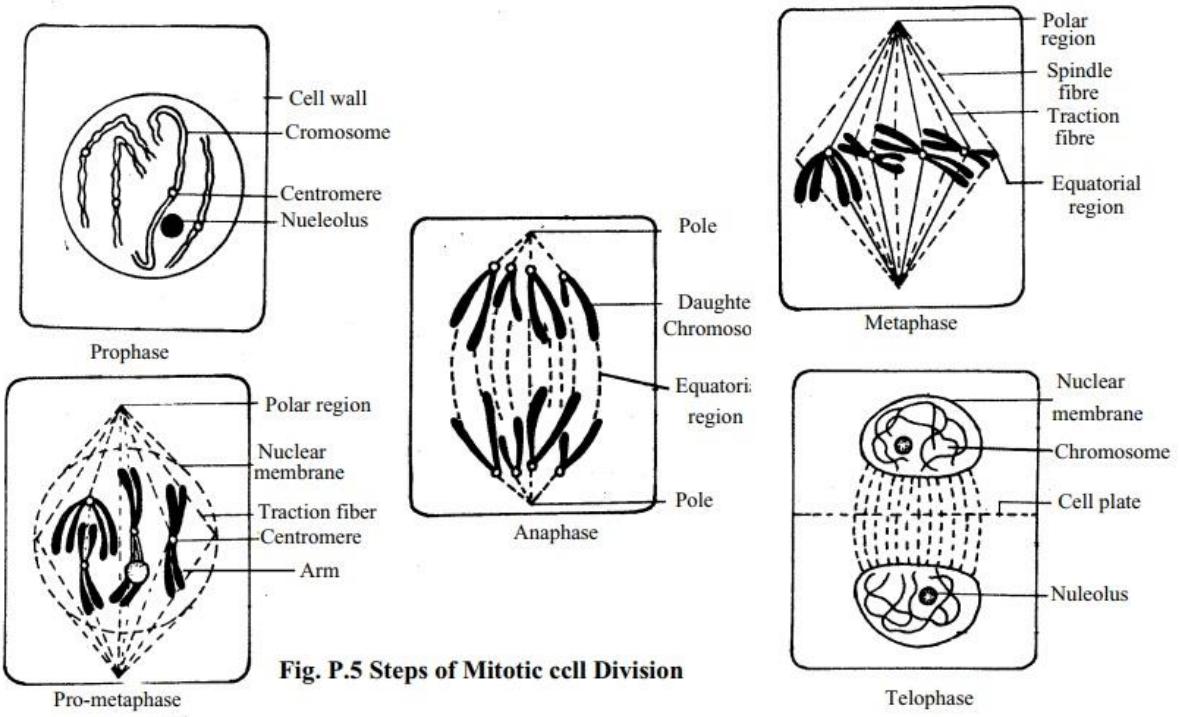


Fig. P.5 Steps of Mitotic ccll Division

Describe the Stages:

Interphase:

Prophase:

Metaphase:

Anaphase:

Telophase:

Cytokinesis:

Draw Different Stages of Mitosis with Label:

Specimen Name:

Practical 12: Cell Division Slide with Meiosis

https://www.youtube.com/watch?v=MNq015d03MU

Specimen:

Procedure: will place some permanent slides on the stage of compound microscope and observe and identify the stages of mitosis.

Description (will be explained in class):

Specimen 1:

Draw: Different stages of Meiosis

Comment:

Practical 13: Study of Tissue Specimen

https://www.youtube.com/watch?v=lLnjo4Pf2JM

Requirement: Safranine Stain, Watch glass, dropper, forcep, brush, slide, coverslip, glycerine, needle

Instrument: Compound Microscope

Specimen1:

Draw:

Observation:

Function of the tissue:

Specimen 2:

Draw:

Observation:

Function of the tissue:

Specimen3:

Draw:

Observation:

Function of the tissue:

Specimen 4:

Draw:

Observation:

Function of the tissue:

Practical 14: Important Plant Family Study - seasonally available

https://www.youtube.com/watch?v=1YXp_uBdyG0
(plant family may change according to availability of plant sample)

Specimen1

Common Name:

Scientific Name:

Type:

Family:

Characters:

1.

2.

3.

4.

5.

Importance:

Draw Different parts with taxonomic significance:

Specimen2:

Common Name:

Scientific Name:

Type:

Family:

Characters:

1.

2.

3.

4.

5.

Importance:

Draw Different parts with taxonomic significance:

Practical 15: Important Plant Family Study – Economically Important

https://www.youtube.com/watch?v=FKoD6ZXIIe4

(plant family may change according to availability of plant sample)

Specimen1:

Common Name:

Scientific Name:

Type:

Family:

Characters:

1.

2.

3.

4.

5.

Importance:

Draw Different parts with taxonomic significance:

Specimen 2:

Common Name:

Scientific Name:

Type:

Family:

Characters:

1.

2.

3.

4.

5.

Importance:

Draw Different parts with taxonomic significance:

Practical 16: Method of preparation of Herbarium

https://www.youtube.com/watch?v=Ka3vRaUOnfw

Herbarium: It is the collection of plant specimens arranged in the sequence of an accepted classification. Plant specimens are dried, pressed and mounted on sheets. Fleshy parts of plants are collected in 4% formalin solution

Objectives: The main objectives of herbaria making are:

- To preserve plant specimens for reference.
- To identify plants on the basis of herbarium specimens.
- To study the vegetation different localities at of various times intervals.

Requirement: Office file (1.5 inch), Card Board (32 cm X 22 cm), Herbarium Press, Scissors, One sharp knife, one pair of forceps, Hand lens and pocket lens, pocket diary, Collection bag/sack, label, thread, marking pen

Collection: Angiosperms are normally preserved as dried and pressed specimens on herbarium sheets. Intact flowers and fruits should be taken while collecting Angiosperms, because without flowers and fruits identification of plants will be difficult. Therefore, 3 to 4 specimens of the same pants from different localities and different seasons are collected.

Pressing: Fresh materials are pressed in plant press in herbarium press. Three to four specimens of the same plant should be pressed. If the specimens is large then it should be pressed in "V" or "N" manner. If leaves and flower are crowded on the stem, then flowers and leaves can be detached and pressed on sheet in their natural arrangement. Underground parts should be made dust free before preserving. Aquatic plants should be properly spread in water and then uplifted and pressed carefully. To press fleshy organs, sponge pads should be used.

Drying: For drying of specimens, following two methods are used:

Drying of specimens without artificial heat : In this process plants are kept in herbarium press for 24 hours. Blotting paper will absorb moisture. Again this process is repeated with fresh blotting pater for 24 to 72 hours. Specimens become dry after such process but remain vulnerable to infection of mould and pests.

Drying of specimens with the help of artificial heat:
This is slightly different from previous method, here previously pressed and dried specimens are kept in drying press at adequate temperature ,water vapourizes and materials gets dried in short duration. Temperature management is important in this method because plants turn brown and brittle at high temperature.

Mounting of specimens on herbarium sheets:
Well pressed and dried specimens are mounted on 12" X 18" herbariums sheets with the help

of gum or fevicol containing 1% $HgCl_2$. Sometimes mixture of ethylcellulose and resin or cello-tape is used as mounting media. Holland cloth is also used for fixing specimens. In certain museums specimens are tagged to herbarium sheets with the help of needle and thread. Labeling is done after mounting.

Labeling of specimens: After fixing specimens on herbarium sheet the following information is entered at right side of the lower corner of herbarium sheet.

- Serial number : -------
- Botanical name : -------
- Family : ---------
- Genus : -------
- Species : -------
- Local name : --------
- Place : --------
- Habit : ---------
- Date of collection : ----------
- Place of collection : ---------
- Collected by : ---------

Storage: Properly mounted and labeled herbarium sheets are preserved for future records. Specimens are arranged according to recognized system of classification, i.e. Bentham and Hooker's, Engler and Prantl's system of classification. Indexing should be done for easy operation of herbarium.

Protection: The specimens mounted on sheets may be destroyed by beetles, booklouse, drugstore beetles and other insects during storage. This problem may be overcome by fumigation with suitable insecticides. DDT, Lauryl phenyl chlorophenate, carbon tetrachloride and other insecticides may also be sprayed on specimen. Naphthalene balls may also be used as repellent.

Conclusion: By following above methods and steps you would be able to prepare a good herbarium yourselves without any doubt. Please follow above procedure step by step to prepare a good herbarium.

Work to be done: Students will visit nearby locality, study vegetation and will prepare at least one herbarium specimen as per instructor's guidance:

Date of Visit	**Common Name of Collected Plant**	**Type (Agricultural Importance)**	**Date of Submission of Herbarium**	**Instructors' Remark & Signature**

Additional Sheets

Additional Sheets

Additional Sheets

Additional Sheets