STUDY OF DIFFERENT TYPES OF PLANT TISSUES.

Comments

Objectives:

1. To study and identify different types of plant tissues.
2. To know types, shape and size of cells.
3. To know arrangement of cells.
4. To know functions of cells

Requirements:

Material: Permanent slides of plant tissues.

Apparatus: Compound Microscope.

Observations : The following observations are made under 10x and 40x power of microscope.

Parenchyma :

1. Parenchyma are simple permanent living tissue with uniformly thicken thin cellulosic cell wall.
2. They are arranged with or without intercellular space.
3. They are found in different shapes like oval, spherical, polygonal, rectangular, irregular.
4. They contain centrally located large size vacuole because of which cytoplasm and nucleus are found in peripheral side.
5. They are most abundant tissue present in almost all parts of the plant like ground tissue, vascular bundle of stem, root, leaves and also in flower, fruit.
6. There are different types of parenchyma tissue according to their function like aerenchyma, epidermal parenchyma, xylem and phloem parenchyma, prosenchyma, chlorenchyma, idioblast etc.
7. All types of parenchyma helps in storage of food matter where as prosenchyma helps in mechanical support, chlorenchyma helps in photosynthesis, phloem and xylem parenchyma help in lateral conduction of food and mineral respectively, aerenchyma helps in providing buoyancy .

Mesophyll tissue

1. Chlorenchyma cells, the chloroplast containing parenchyma are lying in between the upper and lower surface ofleaf is called mesophyll tissue.
2. In dicot leaf, Mesophyll tissue consists of upper palisade tissue and lower spongy tissue where as in monocot leaf, mesophyll tissue is not differentiated as in dicot leaf.

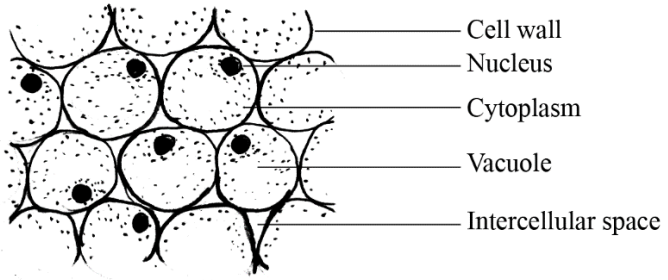
Palisade tissues:

1. They are the parenchyma tissue present in upper surface of dicot leaf just below the epidermis.
2. They consist of 1-3 layers of radially elongated, parallel and closely packed cells.
3. They consist of more number of chloroplasts so they are main photosynthetic tissue.

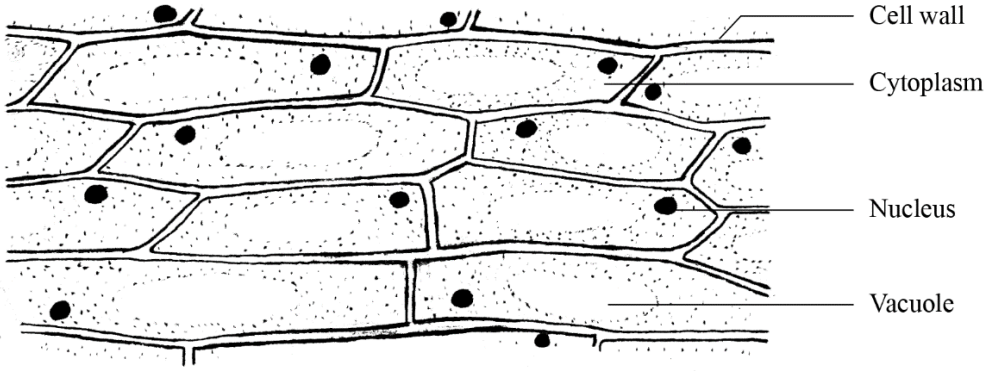
Spongy tissue:

1. They are the parenchyma tissue present in lower surface of dicot leaf just lie inner to lower epidermis.
2. The cells are oval, spherical or irregular in shape.
3. The spongy tissues are loosely arranged with large intercellular space.
4. They consist of large intercellular space just inner to stomata called stomatal cavity which helps in exchange gases.

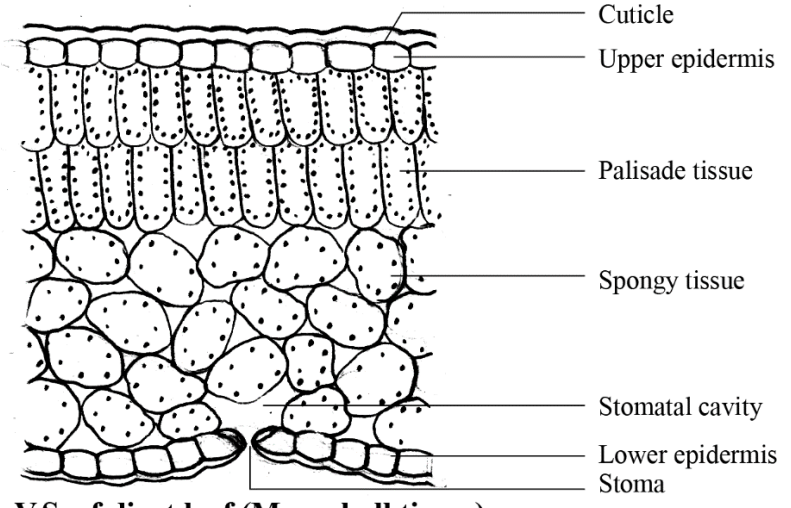
STUDY OF DIFFERENT TYPES OF PLANT TISSUES



Parenchyma (T.S.)



Epidermal parenchhyma cell (Onion scale leaf)



V.S. of dicot leaf (Mesophyll tissue)

Different types of plant tissue

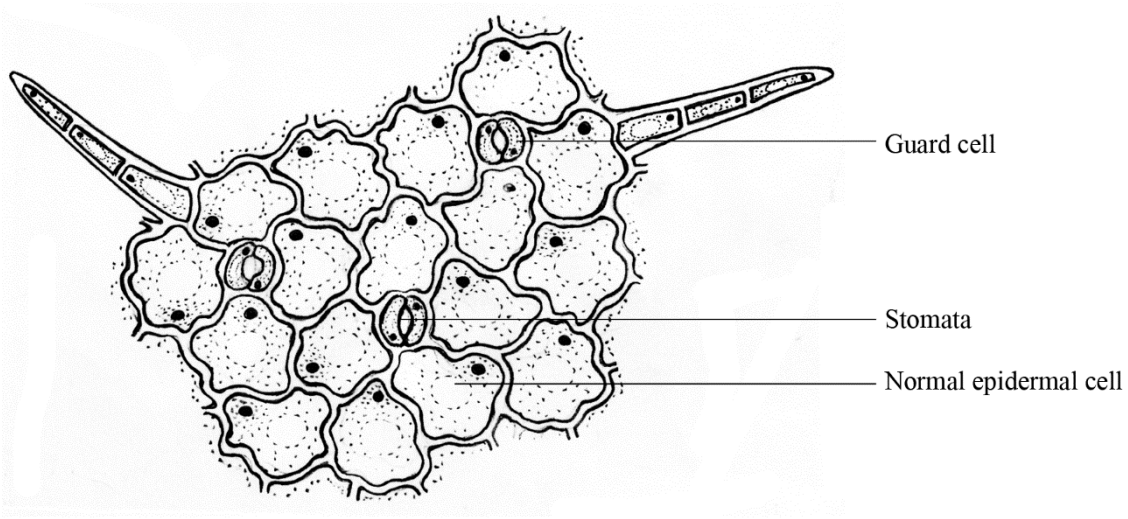
Comments

Guard cells

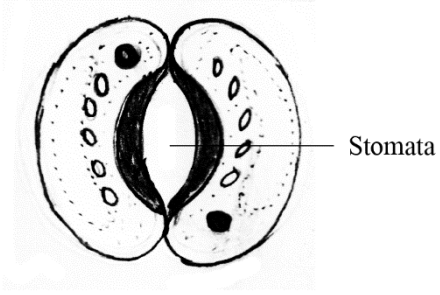
1. Guard cells are specialized parenchyma cells found in the epidermis in aerial parts of plants like leaves, stems, flowers etc.
2. They always occur in pair with or without subsidiary cells that forms the gap between them called stoma or stomatal pore.
3. Guard cells are bean or kidney shaped in dicot plant while dumb bell shape in monocot plants.
4. Their cell walls are thick around the pore i.e., the inner wall is thick, so they are inelastic in nature where as other wall are thin and elastic in nature.
5. Each guard cell consists of vacuole, single nucleus, mitochondria and cytoplasm etc. It also consists of large number of chloroplasts that helps in photosynthesis.

Guard cells help in regulating the opening and closing of stomata and supports in exchange of gases during photosynthesis and respiration. It also supports in controlling transpiration

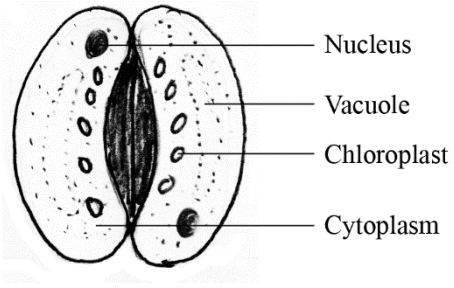
STUDY OF DIFFERENT TYPES OF PLANT TISSUES



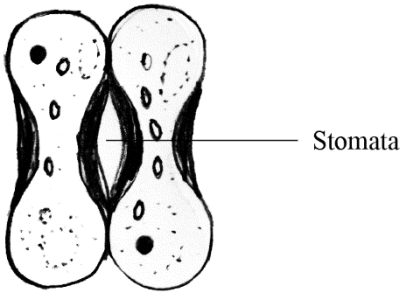
Epidermis showing guard cells



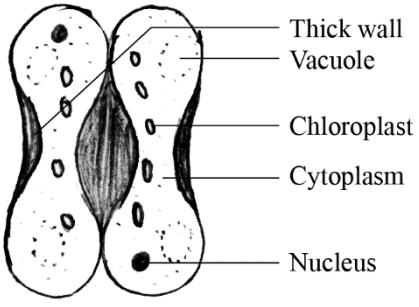
Stoma open



Stoma Closed



Stoma open



Stoma Closed

Stomata of monocot leaf (T.S.)

Collenchyma:

1. Collenchyma cells are simple permanent living tissues with unevenly thickened wall due to deposition of cellulose and pectin.
2. They are living cells with or without intercellular space.
3. Due to living nature, they have centrally located large vacuole with nucleus and cytoplasm at peripheral side.
4. On the basis of thickening, collenchyma may be angular, lamellar and lacunate.
5. Some of the parenchyma cells consist of chloroplast and support in photosynthesis.
6. They are found in upper and lower surface of vascular bundle of dicot leaf and hypodermis of dicot stem and may be in petiole of leaf.
7. The function of collenchyma is storage of food as well as provides mechanical support.
8. Collenchyma present in the margin of leaf protects the leaf from tearing.

Sclerenchyma:

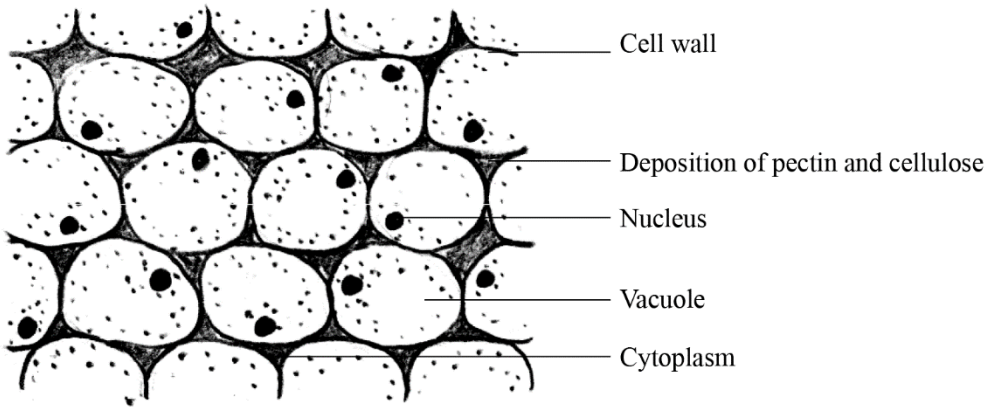
1. Sclerenchyma tissue are simple permanent dead tissue with uniformly thicken cells with the deposition of lignin in their wall. So, the cells are called lignified cells.
2. They are elongated or isodiametric cells without intercellular space.
3. Each cell is empty with a cavity called lumen.
4. They have distinct middle lamella.
5. Their cell wall possesses pits.
6. They help in mechanical support and protect the inner soft parts.
7. On the basis of structure and function, they are fibres and sclereids.

Fibre sclerenchyma

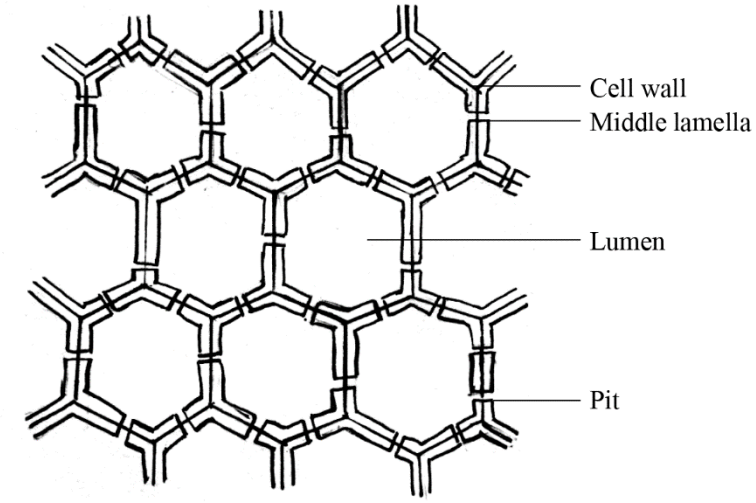
1. They are highly elongated, narrow with tapering end in L.S. and hexagonal in T.S.
2. They are found all those parts which required mechanical supports like leaves, petiole, hypodermis of monocot stem, pericycle, vascular bundle and around the vascular bundle of monocot stem.
3. They help in mechanical support.

Sclereid sclerenchyma

1. They are highly thickened dead cells with very narrow lumen.
2. They are present in the pericarp of fruits like pyrus, testa of seed, pulp of apple, pear etc.
3. They protect the inner soft parts of the plants like almond, walnut, coconut etc.



Collenchyma (T.S.)



Sclerenchyma (T.S)

STUDY OF DIFFERENT TYPES OF COMPLEX PERMANENT TISSUES

Objective: To study and identify different types of complex permanent tissues.

Requirements:

Material: Permanent slides of tissues

Apparatus: Compound microscope

Observations: The following observations are made under 10x and 40x power of microscope

Phloem:

It is the complex tissue that helps to distribute prepared food from photosynthetic area to required places of the plant. It consists of the following four types of cells – sieve tubes, companion cells, phloem parenchyma and phloem fibres.

Sieve tubes: Sieve tube is elongated tube-like structure made up of thin-walled living cells joined end to end. The end wall of sieve tube is perforated and is called sieve plate. Each sieve tube is associated with elongated thin walled densely filled parenchyma which is called companion cell as it doesn't consist of nucleus. It is polygonal in structure in transverse section. It is the main component that transfers food matter.

Companion cells: These are narrow, elongated and thin-walled parenchyma cells that is always associated with sieve tubes. It is polygonal in T.S. They have dense cytoplasm with distinct nucleus. It is replaced by albuminous cell in gymnosperms. It helps in conduction of food matter along with sieve tube cells.

Phloem Parenchyma: They are normal parenchyma cells with thin wall associated with phloem. It helps in storage of food matter and lateral conduction of food.

Phloem fibres: They are sclerenchyma cells associated with phloem. They have lignified uniformly thick wall with narrow lumen with simple pit. It provides mechanical support.

Xylem:

It is the complex tissue that helps to distribute water and mineral from root to upper parts of the plant. It consists of following four types of cells – vessel, tracheid's, xylem fibres and xylem parenchyma.

Vessels: Vessels are elongated nonliving tube-like cells with lignified cell wall which are placed end to end with wide opening and empty lumen. In T.S., they are polygonal in dicot and circular in monocot. Their walls maybe thickened with various types of thickenings like annular, spiral, reticulate, scalariform and pitted. It is the main conducting tissue in case of angiosperms. The main function of vessel is conduction of water and minerals.

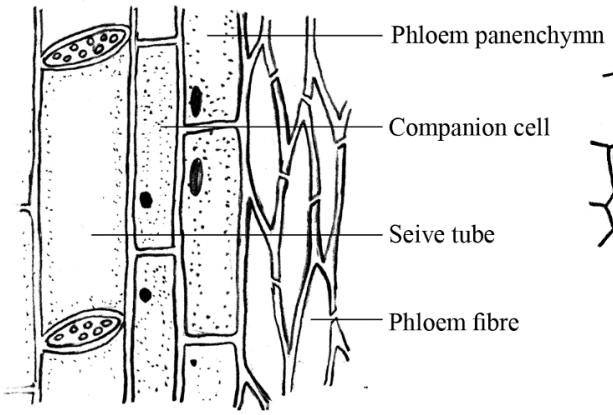
Tracheids: Tracheids are elongated, lignified thick walled, nonliving cells with tapering ends. They have thickening material in their walls as in vessels. They are main conducting tissue in gymnosperm and pteridophyte. The main function of tracheids are conduction and provide mechanical support.

Xylem Parenchyma: They are normal parenchyma cells with thin wall associated with xylem. It helps in storage of food matter and lateral conduction of food.

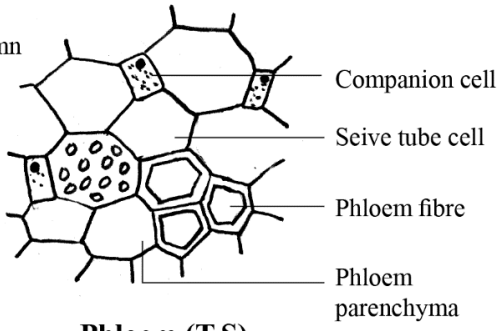
Xylem fibres: They are elongated sclerenchyma cells associated with xylem. They have lignified uniformly thick cell wall with simple pits and narrow lumen. It provides mechanical support.

Conclusion:

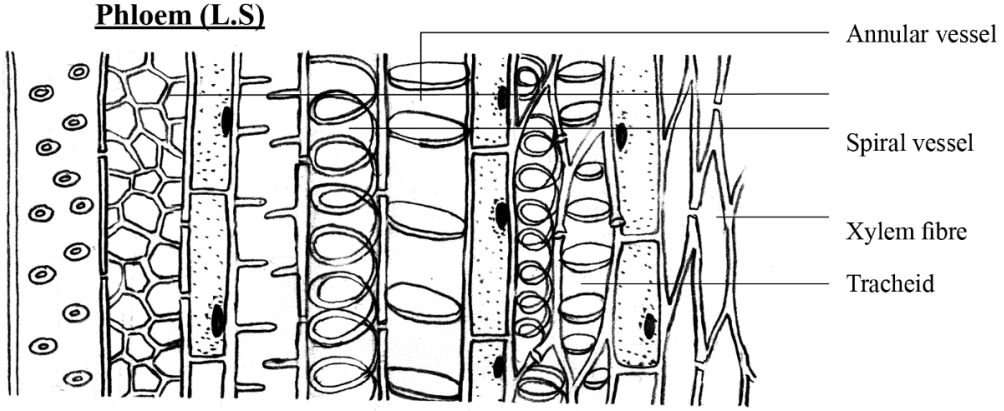
The tissues are composed of different types of cells forming a heterogeneous mass and have lost the power of division. So, the tissue is known as complex permanent tissue. Phloem helps in conduction of food and xylem helps in conduction of water and minerals. They also help in providing mechanical support.



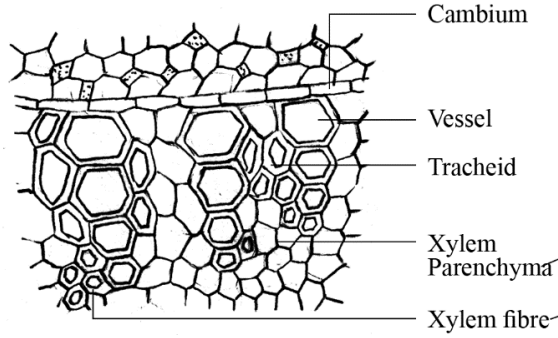
Phloem (L.S)



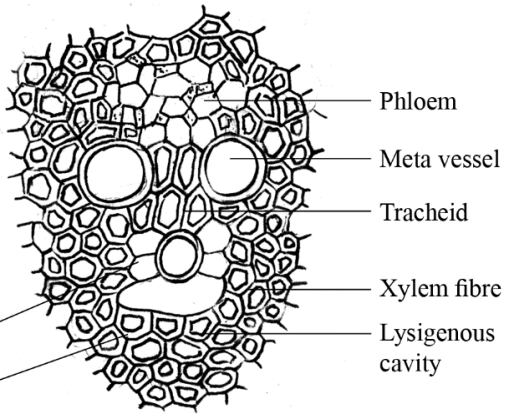
Phloem (T.S)



Xylem (L.S)



Xylem (Dicot)



Xylem (Monocot)

Description of a given unknown plant

For describing any unknown flowering plant, the external morphological description should be given in a systematic way beginning from the habitat up to the floral diagram and floral formula, The given unknown plant can be described and identified with the help of following outline scheme

Habitat: Cultivated (food crops ……/ornamental)/wild

Habit: Herbs/shrubs/tree Annual/biennial/perennial

Root: Tap (Any special modification like fusiform/napiform/tuberous/climbing/nodulated) /Adventitious

Stem: Nature: erect/prostrate/climbing/twinning

Branching: Branched/unbranched

Texture: Herbaceous/woody

Form: Solid/hollow(Fistular)

Type: Cylindrical/angular/flattened/reduced

Surface: Hairy/glabrous/waxy/spiny/thorny

Any modification: Rhizome/tuber/bulb

Leaf: Position: Radical/cauline/ramal

Phyllotaxy: alternate/Opposite/ whorled

Leaf structure: Petiolate/sessile/sub- sessile

stipulate(Foliaceous/spinous)/ exstipulate

Type: dorsiventral/isobilateral

Kind: simple (Pinnatifid/pinnatipartite/pinnatisect)/compound {Pinnate

(paripinnate/ imparipinnate)/palmate}

Surface: Glabrous/pubescent/glaucous

Venation: Reticulate /parallel (Unicostate/ multicostate)

Margin of lamina: entire/dentate/ serrate/wavy

Leaf apex: Acute/Obtuse/mucronate

Leaf shape: Ovate/Elliptical/lyrate/linear

Any modification: Tendril/spine/scale

Inflorescence: Racemose (spike/spikelet/corymb/head or capitulum)/ cymose(monochasial /dichasial/polychasial)/any other special type

Flower: Bract: Bracteate(Foliaceous/ spinous) / ebrateate /Bracteolate/ebracteolate

Stalk: Pedicellate/ sessile/sub-sessile

Type: Complete/ incomplete/ Achlamydous/ haplochlamydous/ trimerous/ tetramerous/ pentamerous

Nature: Regular/irregular/ tetracyclic/ pentacyclic

Sex : Unisexual/bisexual

Symmetry: Actinomorphic/zygomorphic

Position of floral whorl: Hypogynous/ epigynous/Any other type

Form of flower: Rotate/campanulate/papilionaceous/cruciform/tubular/Ligulate

Colour, size, special structure as nectar glands/ disc etc

Calyx: Number of sepals

Fusion: Polysepalous/ gamosepalous

Colour: Green/ petalloid/Any other colour

Caducous/ deciduous/ persistent

Aestivation: Valvate/ twisted/ imbricate/ quincuncial/ vexillary

Forms of calyx: Tubular/ companulate/ infundibulum/ pappus

Incision: Toothed/ Fid/ partite/connate Regular/ irregular Superior/ inferior

Corolla: Number of pepals

Fusion: Polypetalous/ gamopetalous

Colour: sepaloid/ other colour

Aestivation: Valvate/ twisted/ imbricate/ quincuncial/ vexillary

Shape: Cruciform/papilionaceous

Forms of corolla: Tubular/ companulate/ infundibulum/ rotate

Incision: Toothed/ Fid/ partate/connate

Regular/ irregular

Superior/ inferior

Perianth: Number of tepals

Fusion: Polyphyllous/ gamophyllous

Colour: Sepaloid/ petalloid/ other colour

Caducous/ deciduous/ persistent

Aestivation: Valvate/ twisted/ imbricate/ quincuncial/ vexillary

Forms of perainth: Tubular/ companulate/ infundibulum/ pappus

Incision: Toothed/ Fid/ partite/connate Regular/ irregular Superior/ inferior

Androecium: Number of stamens

Sterile- staminode

Cohesion: polyandrous/ adelphous (monoadelphous/ diadelphpus/polyadelphous/ syngenesis/ synandrous)

Adhesion: Epipetalous/ Epiphyllous

Length of stamens: Didynamous/ tetradynamous Inserted/ exserted Introse/ entrose

Fixation of anther: Basifixed/ dorsifixed/ adnate/ versatile

Number of anther: Monothecous/ diethecous

Gynoecium: No. of carpel: Mono/Bi/tri/polycarpellary

Fusion: Apocarpous/syncarpous

Stigma: Capitate/bifurcate/hairy/Bifid

Form of style: long/short/filiform/ terminal/lateral

Position of ovary: Superior/inferior

Number of locules: uni/bi/tri/tetra/penta /multilocular

Number of ovary: one/two/many

Placentation: Axile/marginal/parietal/basal

Fruit: Siliqua/berry/pod/ cypsela/ caryopsis/capsule/lomentum/ Capsule

Sequence and symbols for floral formula

i. Br/Brl

ii Brl/Ebrl

iii ⊕/%/⊕/

iv ♀/♂/☿

v. K (No)/ Kno/ Kpappus

vi. C (No)/ C_n

vii. A (No)/ A_n

viii. $\overset{\frown}{C\ \ A}$ if epipetalous

ix. G (No)/Gn If superior $\underline{G}$ and if inferior $\overline{G}$

DESCRIPTION OF ANGIOSPERMIC PLANT IN SEMITECHNICAL TERMS

Objective:

To describe the given plant in semi-technical terms

Description of plant:

Habitat: Grows wild in shady terrestrial places

Habit: Annual, under shrub

Root: Tap root , branched

Stem: Aerial, erect, branched, woody, cylindrical, slightly ridged, solid, hairy, green

Leaves: Cauline, ramal ,simple, alternate, petiolate, exstipulate, unicostate reticulate venation, wavy margin, acute apex

Inflorescence: Cymose, extra-axillary scorpioid cyme (Rhipidium)

Flower: Ebracteate, ebracteolate, pedicellate, complete, small, white coloured, diplochlamydous, pentamerous, regular, tetracyclic, bisexual, hypogynous, actinomorphic but slightly zygomorphic due to oblique placement of ovary

Calyx: Sepals 5, gamosepalous, campanulate, valvate aestivation, persistent, green, inferior,

Corolla: Petals 5, gamopetalous, white, rotate, valvete, regular, inferior

Androecium: Stamen 5, polyandrous , epipetalous, anther bilobed , basifixed, inserted, introrse, connivent, filaments short, pubescent, isostemonous, porous dehiscence.

Gynoecium: Bicarpellary syncarpous, ovary superior, bilocular, many ovules inside the locule, axile placentation with swollen placenta, long style, hairy at the base, capitate stigma

Fruit: Berry with persistent calyx

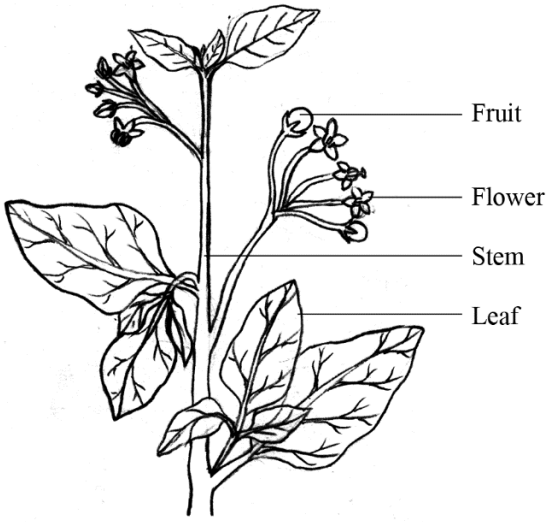
Floral formula: Ebr. $\oplus$ ♀ $K_{(5)}$ $\overset{\frown}{C_{(5)}}$ A_5 $\underline{G}_{(2)}$

Diagonostic characters:

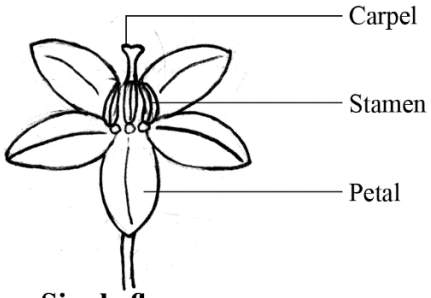
1. Leaves simple, exstipulate, alternate
2. Inflorescence extra-axillary cyme.
3. Flowers actinomorphic but slightly zygomorphic
4. Sepals 5, gamosepalous, valvate
5. Petals 5, gamopetalous, valvate, rotate
6. Stamens 5, epipetalous, connivent anther, porous dehiscence
7. Carpel 2, syncarpous, obliquely placed ovary, axile placentation with swollen placenta, many ovules in locule,
8. Fruit berry with persistent calyx

CLASSIFICATION :

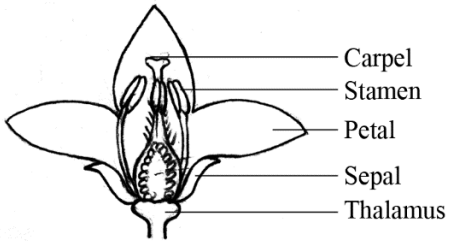
Kingdom: Plantae
Class: Dicotyledonae
Series: Bicarpellatae
Order: Polymoniales
Family: Solanaceae
Genus: *Solanum*
Species*: S. nigrum*
Common name: Black night shade
Local name: Kali gedi



A flowering branch

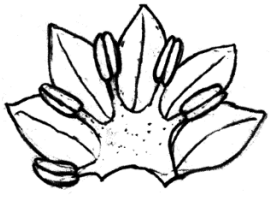


Single flower

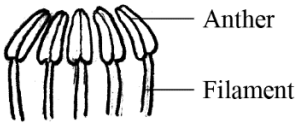


L.S. single flower

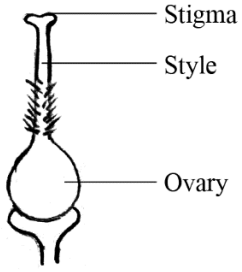
Calyx



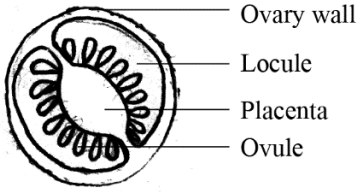
Corolla and androecium



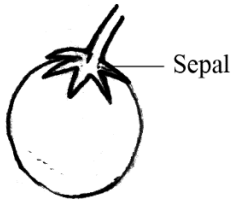
Androecium



Gynoecium

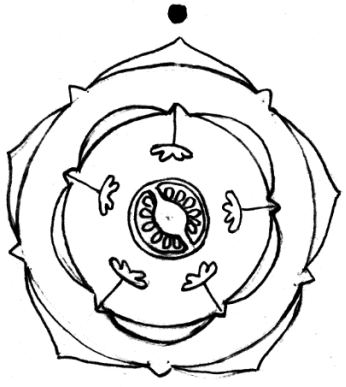


TS ovary



Fruit

Solanum nigrum



Floral diagram

DESCRIPTION OF ANGIOSPERMIC PLANTS IN SEMITECHNICAL TERMS

Objectives: To describe the given plant in semitechnical terms

Material: flowering branch

Description of the plant:

Habitat: Cultivated for vegetables

Habit: Annual, herb

Root: Tap root, branched with prominent root nodule containing nitrogen fixing bacteria Rhizobium

Stem: Erect, branched, herbaceous, glabrous, fistular, quadrangular

Leaf: Cauline, ramal, alternate, petiolate, unipinnatly compound, stipulate, foliaceous stipule, ovate, multicostate leaflet, apex mucronate

Inflorescence: Racemose, axillary raceme

Flower: Bracteate, bract rudimentary, pedicellate, papilionaceous, complete, bisexual, zygomorphic, pentamerous, regular, tetracyclic, hypogynous

Calyx: 5 sepals, gamosepalous, campanulate, irregular, inferior, imbricate aestivation, persistent

Corolla: 5 petals, polypetalous, papilionaceous ,larger petal is standerd or vexillum, medium sized wings or alae and anterior fused smallest keel or carina, descending imbricate or vexillum, inferior

Androecium: 10 stamens, diadelphous, 9 + 1arrangement, 9 stamens fused forming a sheat around the ovary and 1stamen free, anther bithecous, basifixed, introrse

Gynoecium: Monocarpellary, unilocular, marginal placentation, hypogynous, ovary elongated, style short, stigma simple hairy, superior

Fruit: Legume or pod

Floral formula: Br. ⚥ $K_{(5)}\ C_{1+2+(2)}\ A_{(9)+1}\ \underline{G}_{1}$

Diagonostic characters:

1. Root nodulated
2. Stem quadrangular, fistulular
3. Leaf compound with foliaceous stipule
4. Flower papilionaceous,: zygomorphic
5. Calyx with 5sepals, odd sepal anterior, imbricate aestivation
6. Corolla with 5petals in vexillary or descending imbricate aestivation
7. Androecium diadelphous, (9) +1 arrangement
8. Gynoecium monocarpellary, marginal placentation
9. Fruit legume or pod
8. Fruit capsule with persistent calyx

Classification

Kingdom: Plantae

Class: Dicotyledonae

Sub class: Polypetalae

Series: Calyciflorae

Order: Rosales

Family: Leguminosae

Sub family:Papilionoideae

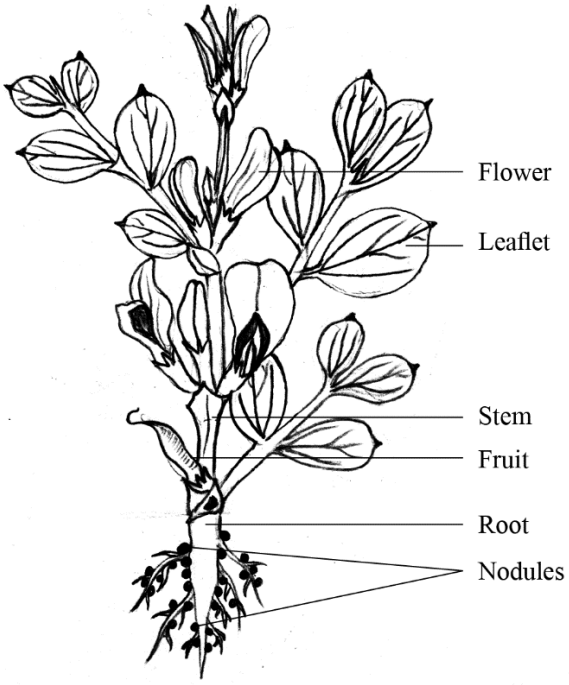
Genus: *Vicia*

Species: *V. faba*

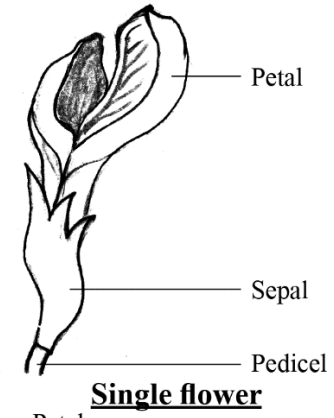
Common name: Broad bean

Local name: Bakula

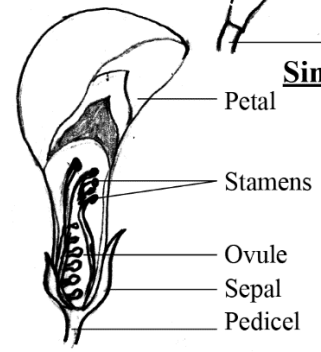
FAMILY: FABACEAE



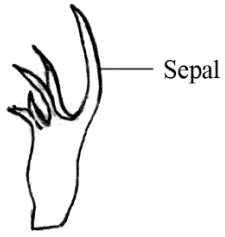
An entire plant



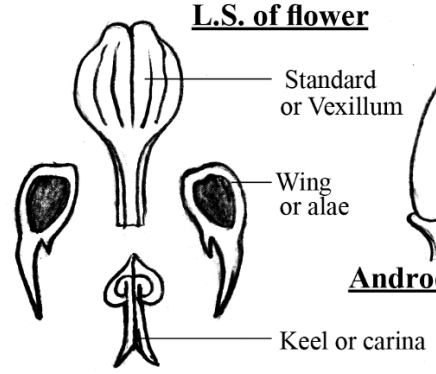
Single flower



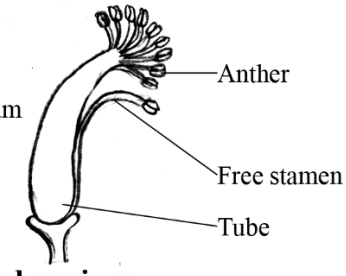
L.S. of flower



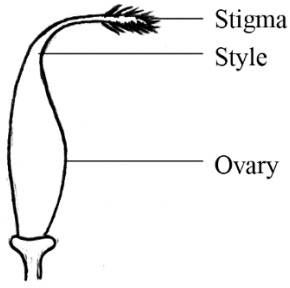
Calyx



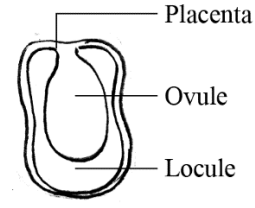
Corolla



Androecium

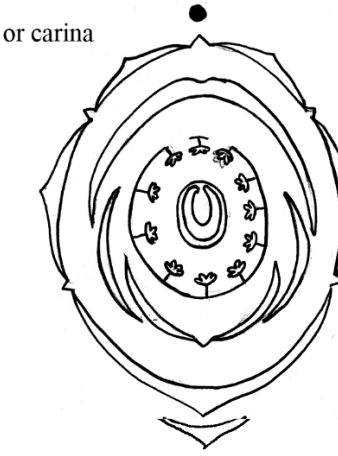


Gynoecium



T.S. of ovary

Vicia faba



Floral diagram

MEASUREMENT OF TEXTURE OF SOIL SAMPLES

Objectives: To know the methods of measuring soil texture.]

To know the concept of soil texture.

Requirements Soil samples, petridish, beaker, glass rod, Oven, Mechanical sieve at having meshes of different pore size, Weighing machine, Plotting paper. 10

Theory

Soil texture is one of the most important physical properties of soil. Soil texture refers to the relative proportion of various size groups of individual soil particles. It is determined by the relative proportion of soil particles of different sizes present in the soil. The soil particles are categorized as gravel, course and, fine sand, silt and clay. These soil particles are gravel (more than 2mm average particle diameter) course sand (2 – 0.2mm average particle diameter), fine sand (0.02 – 0.2 2mm average particle diameter) Silt (0.002 – 0.02 mm 2mm average particle diameter) and clay (less than 0.002 mm average particle diameter) Depending on the percentage of sand, silt, clay in the soil sample, soil has been divided into 12 different textural classes as given in the soil textural triangle. Soil texture determines' the density, water holding capacity, soil temperature, soil aeration, root penetration properties of soil. This in turn determines the vegetation type in the area.

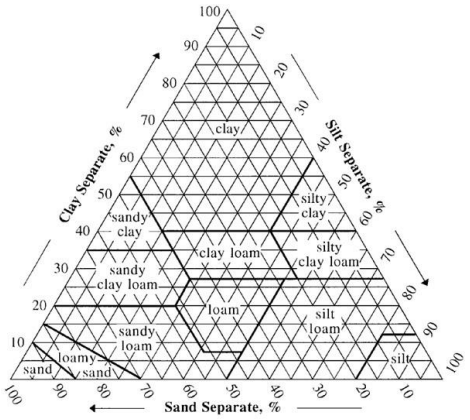


Fig. Soil Texture Triangle Heritage (95)

Procedure

Sieve method.

1. Collect about 500 gm soil from two different location and label them as sample A and sample B.
2. Dry the soil sample in an oven so as to remove the soil moisture.
3. Place exactly 200 gm of dried soil sample in mechanical sieve set having sieves of 3 different mesh sizes (2 mm, 0.05 mm and 0.002 mm).

4. Sieve the soil sample by shaking the sieve set for about 5-10 minutes and collect the soil retained in each sieve.
5. Weigh the soil viz. sand, silt and clay retained by each sieve plate. The total weight of these three soil fraction must be equal to the weight of the sample taken.
6. Calculate the percentage of each particle size of your sample.

Percentage of clay= Wt of clay / Wt of soil sample X 100%

S.N	soil sample	Sand (%)	Silt %	Clay %	Soil texture class (%)
1	sample A				
2	sample B				

II. Suspension method

1. Take 500 /500 gm soil sample from two different areas and keep them in the two measuring cylinder
2. Then add the water in the cylinder so that all soil sample remain below the water level.
3. Stir the mixture uniformly and leave the beaker for 24 hrs undisturb
4. Measure the volume of different soil particles by the help of measuring scale.
5. Determine the percent of clay, sand, silt in the soil using the given formula % of fraction (sand or clay or sit) = volume of fraction (sand or clay or silt)/ volume of soil x 100%

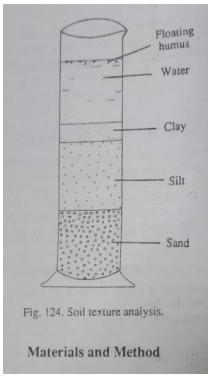


Figure of soil profile

Result

Take the soil size record of all the experimental spots and estimate the approximate size of soil with the help of observation base on table and formula. Compare the soil sample A and B with the plants growing in the area and discuss how soil texture affects the affects the plant growth. The texture of the given sample is ……..

Precuations

1. Soil samples should be dried and grinded well before sieving.
2. Weight should be taken carefully
3. Apparatus should be handled carefully.

MEASUREMENT OF WATER HOLDING CAPACITY (WHC) OF SOIL SAMPLES

Objective: To know the concept of calculating water holding capacity

Requirements: Soil sample A and A, Gooch crucible, Blotting paper, Pestle and mortar, Weighing machine, Petri dish and Newspapers,

Theory:

Water holding capacity of soil is the amount of water retained in the capillary space of the soil after the gravitational water has percolated, Water holding capacity depends upon the texture of soil which determines the capillary pore space in soil, humus content in soil etc. The sandy soil has very low water holding capacity, whereas clay soil has very high water holding capacity as sandy soil has more space between the soil where as clay soil has very less space between them. Loam soil has value in between those of sandy and clay soil. The water holding capacity of soil is calculated using the formula as follows:

(%) Percentage Water-holding capacity of soil = Weight of water retained by soil x 100/ Weight of dry soll

Procedure (Weighing method)

1. Collect soil samples from two different places garden and crop land and label it as Soil sample A and B.
2. Remove large stones, pebbles, debris of plants and animals and any other matter from the soil samples.
3. Spread the soil sample into a thin layer on to a newspaper and dry it under the shade
4. Grind the dried soil sample into fine powder using pestle and mortar.
5. Place some blotting papers at the base of Gooch crucible and measure the weight of crucible alongwith the blotting paper.
6. Put the soil sample | into the above crucible and let the soil pack compactly by gently tapping thesides of crucible.
7. Now, measure the weight of soil along with the crucible and note down the weight.
8. Place the crucible in a petri dish containing water and let the soil absorb water from the petri dish.
9. Leave the set up undisturbed until entire soil becomes wet.
10. Now, remove the crucible from the petri dish and allow all the gravitational water to percolate.
11. When no more water percolates from the crucible, weight the crucible and note down its weight.
12. Repeat the above steps for sample 2 too and note down the data in the table given below.

Sample No.	Wt of crucible + blotting paper (A)	A+ Dry soil sample (B)	Wt of dry soil sample (B-A) = (C)	A + soil (D)	Wt of wet soil (D-A) = E	Amount of water retained by soil (E-C) = F	% water holding capacity = F/C x 100
1							

2							

By pouring method

1. Collect soil samples from two different places garden and crop land and label it as Soil sample A and B.
2. Remove large stones, pebbles, debris of plants and animals and any other matter from the soil samples.
3. Spread the soil sample into a thin layer on to a newspaper and dry it under the shade
4. Grind the dried soil sample into fine powder using pestle and mortar.
5. Weigh 10 gram soil.
6. Then wet the circular filter paper perfectly so that no more water remaining for percolate.
7. Keep the filter paper in the glass funnel and then keep 10 gram soil sample to the funnel containing filter paper.
8. The hold the funnel containing soil sample with stand can clamp
9. Drop all the water in the funnel containing soil sample slowly slowly with the help of pipette of fixed amount (suppose 50 mi)
10. Collect the water that is percolate down from the funnel containing soil sample
11. Same process is repeated to the next soil sample too.

Observation

S.No	Soil sample	Wt of dry soil taken (A)	Initial water poor (B) ml	Amount of water percolate from funnel (c) ml	Amount of water hold by soil (B-C) = D ml	% water holding capacity = D/A x 100
1	A					
2	B					

Result, Discussion and Conclusion

Percentage water holding capacity of given soil sample list ___and that of soil sample --- is

This difference in percentage water holding capacity of the two soil is due to the varying proportion of sand, silt and clay in the soil. Soil rich in sand is highly aerated but has poor water holding capacity. On the other hand, soil rich in clay has very poor aeration but has high water holding capacity amount of humus contain, organism etc. The other factors that affect the water holding capacity is the Loam soil having equal proportion of sand and clay, has optimum aeration and water holding capacity for proper growth of plants. So, Loam soil is the best soil for growth of plant.

Precautions

1. Proper weighing and calculation should be done.
2. Use gloves while collecting soil or wash hand properly after handling soil.

MEASUREMENT OF pH OF SOIL SAMPLES

Objective: To get the concept of measuring pH of soil.

Requirements:

Soil samples, Distilled water, Beaker, Buffer tablets (pH 4, 9), pH meter, Magnetic stirrer or glass god, Weighing machine

Theory

Soil is determined as acidic or alkalinity or neutral with the measurement of pH of the soil. Its pH value varies from 0-14. If the pH is less than 7 considered as acidic soil or if the pH is more than 7 considered as basic or if its value is 7 considered as neutral soil.

pH stands for potential hydrogen and represents the measure of Hydrogen ions in soils. Hydrogen is positive charged atom. Therefore, soil pH is defined as the decimal logarithm of reciprocal o the hydrogen ion activity. pH test of soil is the measurement of concentration of hydrogen ton in the soil solution.

It is considered as a master variable in soil and it affects many chemical processes. It affects mainly plant nutrient availability by controlling the chemical forms of nutrients. pH of soil also affects plant growth by its effect on the activity of beneficial micro-organisms. Bacteria that decompose soil organic matter are hindered in strong or basic acidic soil. Nutrient availability to plants, preferences of plants to pH requirement and as a whole plants growth and development, which is directly or indirectly affected by pH variation.

Procedure(By using pH meter)

1. Take soil samples from two different place and label it as soil sample A and B.
2. Mix soil sample with distilled water (1:1 ratio, e.g. 25gm of soil with 25 ml of distilled water) in a beaker.
3. Stir mixture with the help of magnetic stirrer or glass rod for about 5 minutes.
4. Prepare standard buffer solution of pH 4 and 9
5. Calibrate pH meter with buffer solution
6. Now, Measure pH of prepared soil solution

Observation

Record pH of different soil samples in the following format.

S.No	Soil Sample	pH	Average	Remark
1	A(name of place or land use type)			
2	B(name of place or land use type			

Procedure (By Using pH paper)

1. Take soil samples from two different place and label it as soil sample A and B.
2. Mix soil sample with distilled water (1:1 ratio, e.g. 25gm of soil with 25 ml of distillede water) in a beaker.
3. Stir mixture with the help of magnetic stirrer or glass rod for about 5 min.
4. Take a broad range pH paper and dip it in above soil-water suspension and observe thechange in colour of pH paper.
5. Match the colour with the colour scale given in the booklet.
6. Determine pH value of prepared soil solution

Observation

Record pH of different soil samples in the following format.

S.No	Soil Sample	pH	Average	Remark
1	A(name of place or land use type)			
2	B(name of place or land use type			

Result Discussion and conclusion

pH of given soil sample is ..... . Compare soil sample A and B having acidic and basic properties with possible reason.

Inherent factors that affect soil pH include climate, mineral content, and soil texture. Natural soil pH reflects the combined effects of the soil-forming factors . Temperature and rainfall affect the intensity of leaching and the weathering of soil minerals. In warm, humid environments, soil pH decreases over time through acidification due to leaching from high amounts of rainfall. In dry environments where weathering and leaching are less intense, soil pH may be neutral or alkaline. Soils that have a high content of clay and organic matter are more resistant to changes in pH (higher buffering capacity) than are sandy soils. Sandy soils commonly have a low content of organic matter, resulting in a low buffering capacity and a high rate of water percolation and infiltration.

Precautions

1. Apparatus should be clean with distilled water and handle carefully
2. Soil water suspension should be shaken well intermittently for 30 minutes.
3. The glass and reference electrode of pH meter should always remain dipped in water.
4. Buffer solutions should be prepared accurately and stored well in glass container.
5. It is desirable to prepare fresh buffer solutions after few days.
6. Connect the pH meters to the stabilizer to avoid the fluctuations in pH readings
7. Adjust the temperature knob of pH meter at room temperature for correct pH determination.
8. Broad range of pH value paper should be used for more accuracy.
9. After dipping the pH paper, do not let the pH paper dry before comparing to the colour chart.

Comments:

Distribution: Bacteria are cosmopolitan in distribution and found all types of habitat such as water, air, land, fruit stuffs, vegetables, in living organisms etc

Body structure

1. They are the most primitive, microscopic, unicellular prokaryotes.
2. Membrane bound cell organelles are absent.
3. Cell wall is made up of murein.
4. They are the decomposer of the ecosystem.
5. DNA is circular in nature without histone protein.
6. They may be found in different shapes spherical, rod shaped, helical, comma shaped etc.

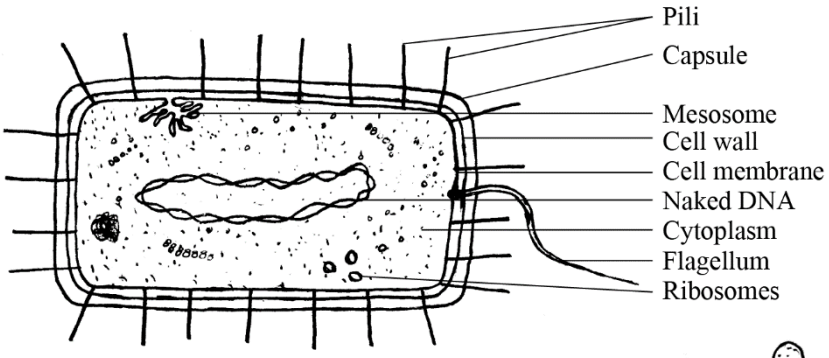
On the basis of shape, bacteria are classified into the following types –

- Coccus- spherical: They are spherical in shape bacteria. They are non motile as they lack flagella. They may be monococcus (they occur singly), diplococcus (they occur in group of two cells), tetracoccus (found four cells) streptococcus (found in chain) or staphylococcus (found as groups as grapes).
- Bacillus: They are rod shape bacteria. They may be flagellate or non flagellate. They may be monobacillus (they occur singly), diplobacillus (found two cells), streptobacillus(present in chain like structure) may be palisade (found to attach side by side to make a columnar form).
- Spirillum-They are helical or spiral shape. They occurs singly. They always have flagella at one or both ends.
- Vibrio- They are comma- shaped bacteria. They are also present singly. They always bear flagella at one end.
- Bacteriods- They are X or Y shaped bacteria. They are also present singly. They don't bear flagella.

Reproduction

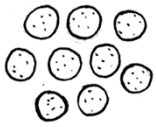
1. They do reproduction mainly by binary fission.
2. Sexual reproduction is parasexual type done by either conjugation, transformation and transduction.

STUDY OF MUSEUM SPECIMENS- BACTERIA

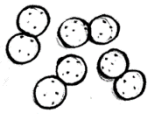


Classification

Kingdom : Monera
Division : Eubacteria
Example : Bacteria

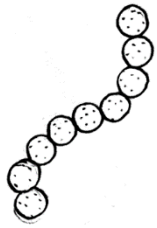


Monococci

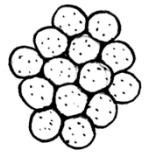


Diplococci

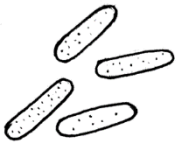
Tetracoccus



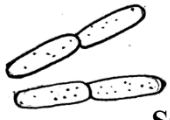
Streptococcus



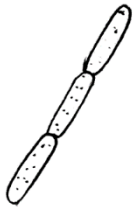
Staphylloceccus



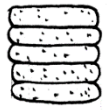
Monobacilli



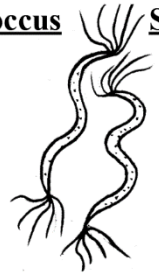
Diplobacilli



Streptobacillus



Palisade



Spirilla

Vibrios

Nodulated root

Bacteriods

Comments:

Distribution: Rhizopus is cosmopolitan in distribution. Rhizopus is a saprophytic fungus which grows commonly in breads, fruits, vegetables.

Body structure

1. It is achlorophyllous and appears as cottony mass in young and turns dark brown at maturity.
2. The mycelium is highly branched and contains three types of coenocytic hyphae- rhizoidal, prostate and aerial which form sporangium at the top after maturation.
3. All the hyphae contain outer cell wall formed by fungal cellulose (chitin) and cytoplasm withmany nuclei, various cell organelles, many large vacuoles and reserve food material (in the form of glycogen). As the aerial hyphae at maturity has dark coloured pin like head, this fungus is also called as black mould.

Reproduction

1. They reproduces by three methods they are Vegetative, Asexual, sexual.-
2. Vegetative It takes place by fragmentation
3. Asexual – It reproduces asexually in favourable condition with the help of spores produced in sporangium. The sporangium is borne at the tip of aerial hyphae, the sporangiophore .
4. Sexual – *Rhizopus* is commonly heterothallic and reproduces sexually in unfavourable condition by gametangial conjugation.

Comments:

Distribution : It is a fleshy saprophytic fungus grown on wet damp places with rich organic matter such as rotton log, tree trunk decaying material and manure piles.

Body structure

a. The vegetative fungal body is an underground mycelium.

b. The portion of the fungus present above the soil is called fruiting body called basiodiocarp.

Basidiocarp is fleshy and edible.

1. A mature fruiting body is divided into a stout, fleshy, cylindrical and upright stalk called stipe and an umbrella like cap called pileus.
2. There is a ring like membranous structure around the stipe below the pileus called annulus.
3. The upper surface of pileus is creamy and smooth.
4. The under surface of pileus bears a number of vertical plate like structure called gills or lamellae radiating outwards from the stipe to the margin.
5. The gills bear basidium .

Reproduction

a. It reproduces asexually or sexually

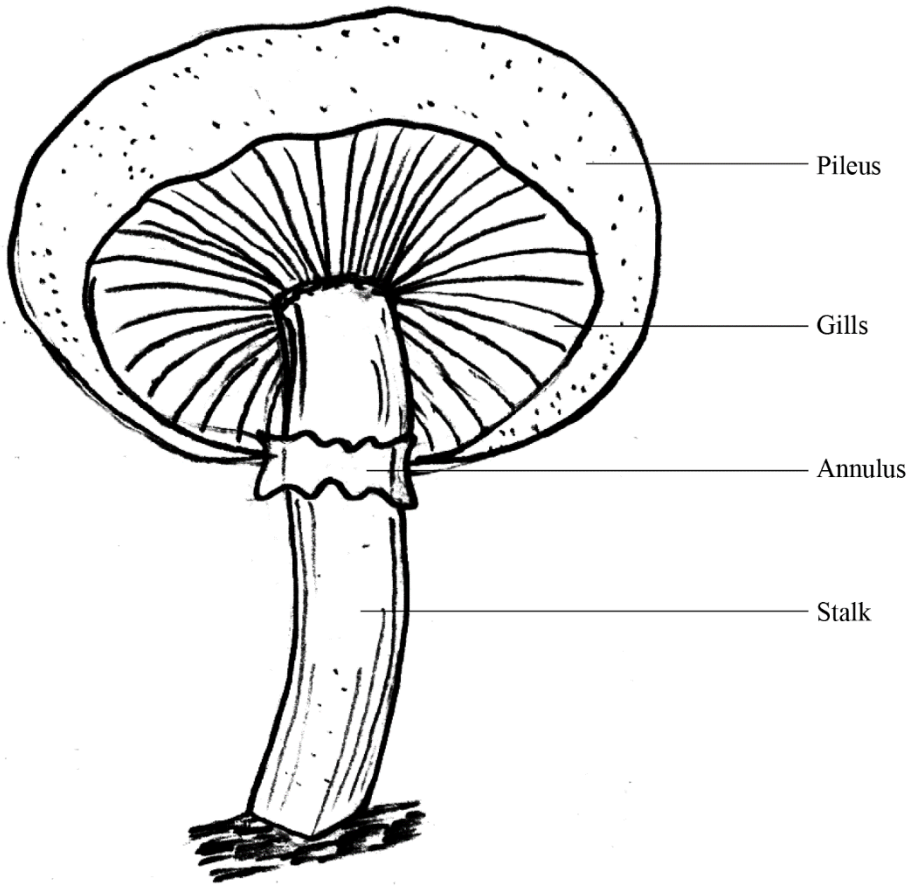
b. Asexual reproduction is done by basiodiospores from in each basidium.

c. Sexual reproduction is done by fusion of the hyphae of two different mating types fuse before forming a new fruiting body

STUDY OF MUSEUM SPECIMEN - *Agaricus campestris*

Classification

Kingdom	:	Mycota
Class	:	Basidionycetes
Order	:	Agaricates
Family	:	Agaricaceae
Genus	:	*Agaricus*
Species	:	*campestris*
C.N.	:	Mushroom



Agaricus campestris **(Basidiocarp)**

Comments:

Distribution: *Spirogyra* is a free floating, fresh water green alga found in ponds, pools, lakes, ditches and slow running water etc.

Body structure

a. It is also called as water silk, pond scum or pond silk.
b. It is multicellular, unbranched, silky filamentous plant
c. It is covered by mucilage and mostly consists of all alike, cylindrical cells.
d. Each cell contains bilayer cell wall (outer pectinised and inner cellulosic) .
e. The cell has a large central vacuole, a conspicuous central nucleus suspended in amass of cytoplasmic strands developed from the peripheral cytoplasm (primordial utricle).
f. It has long ribbon shaped chloroplast arranged spirally. The chloroplast contains pyrenoids.

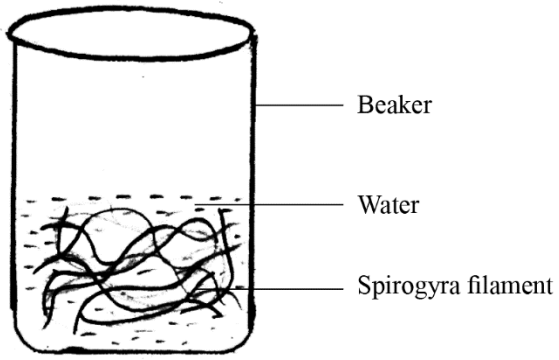
Reproduction:

a. Spirogyra reproduces by three methods vegetative, asexual and sexual.
b. Vegetative reproduction is done by by fragmentation.
c. Asexual reproduction is done by spores- akinetes (thick walled) and aplanospores (thin walled).
d. Sexual reproduction is isogamous type. It is commonly occur by conjugation process.
e. Conjugation are of two types they are scalariform conjugation and lateral conjugation.

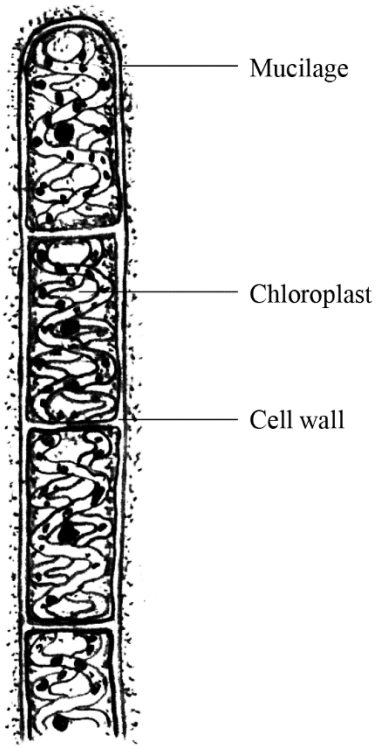
STUDY OF MUSEUM SPECIMENs - *Spirogyra*

Classification

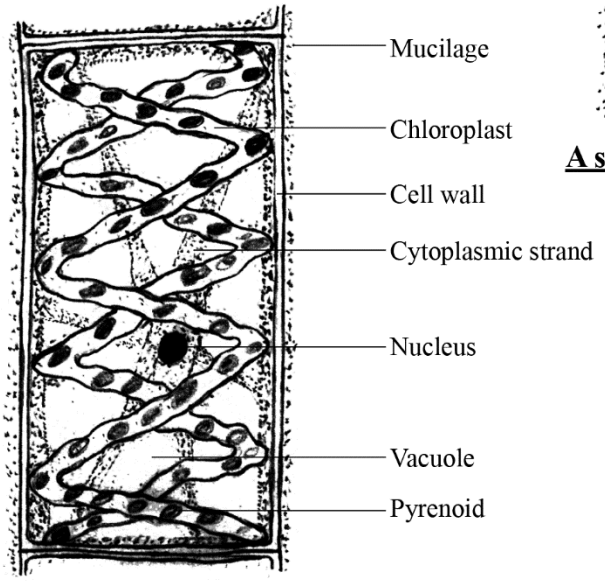
Kingdom : Plantae
Division : Algae
Class : Chlorophyceae
Order : Conjugales
Family : Zygnemaceae
Genus : *Spirogyra*



Habit sketch (*Spirogyra*)



A single filament



A single cell

Comments:

Distribution: Marchantia is commonly grown in moist and shady places.

Body structure

a. It is gametophyte with green, dorsiventrally flattened, dichotomously branched and the tip of each thallus bears an apical notch which represents the growing point.
b. The dorsal surface contains a prominent midrib which is furnished with many gemma cups.
c. Ventral surface contains unicellular rhizoids and multicellular scales.
d. The rhizoids are of two types – smooth walled (wide with smooth inner wall which helps in anchorage and absorption) and tuberculated (narrow with peg like tubercles in the inner wall which helps in conduction).
e. Scales, which help in the retention of water, are also of two types – ligulate (tongue shaped) and appendiculate (with an appendage on the tip).

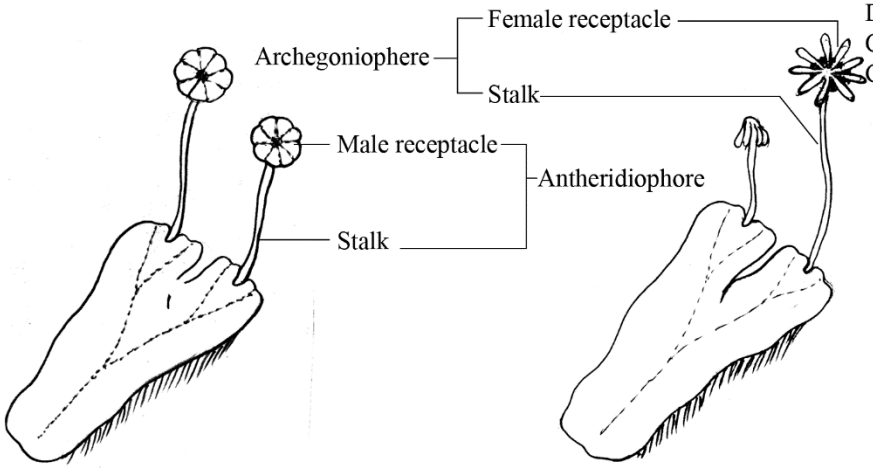
Asexual

a. It reproduces by vegetative, asexually and sexually.
b. Vegetative reproduction is done by progressive death and decay.
c. Asexual reproduction is done place by gemmae present inside gemma cups. Each gemmae is 8-shaped, green, multicellular structure attached on the floor of gemma cup by unicellular stalk.
d. Sexual reproduction is oogamous type. Marchantia is dioecious ie male and female reproductive structure are produce in different thalli.
e. Male thallus produces male reproductive structure called antheridiophore containing stalk and receptacle on the tip of the stalk. The receptacle is like structure composed of eight lobes that are fused together.
f. Female thallus produces female reproductive structure called archegoniophore containing stalk and receptable on the tip of the stalk. The receptacle is umbrella like structure with eight lobes and rays.
g. After fertilization they produce saprophyte which is divided in foot, seta and capsule.

STUDY OF MESEUM SPECIMENS - *Marchantia*

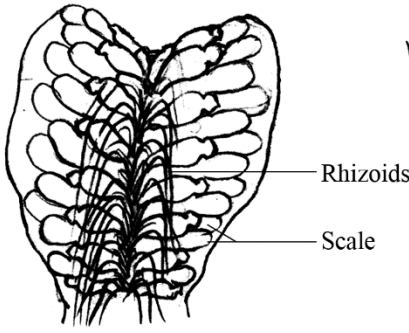
Classification

Kingdom : Plantae
Division :Bryophyta
Class : Hepaticopsida
Genus : *Marchantia*

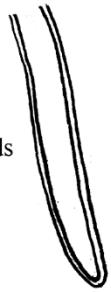


Male thallus

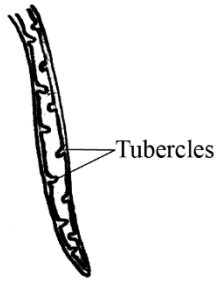
Female thallus



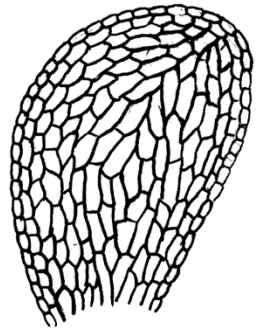
Ventral view



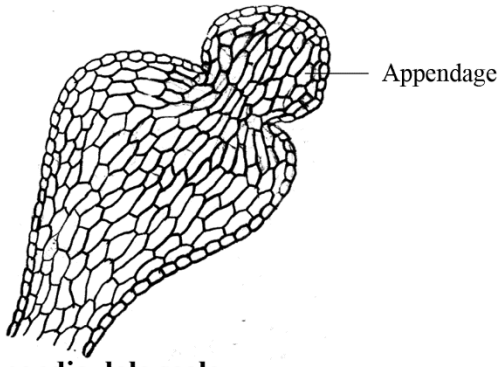
Smooth wall rhizoid



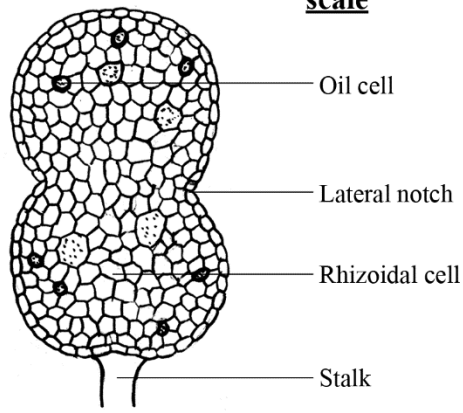
Tuberuclated rhizoid



Ligulate scale



Appendiculale scale



Gemma

Comments:

Distribution: Fern plant is a perennial plant found abundantly in moist and shady places.

Body structure:

1. The plant body is sporophyte and consists of true root, stem and leaves.
2. The root is adventitious and arises from rhizome
3. The stem is dichotomously branched, modified, underground, perennial stem called rhizome that contain many brown scales known as ramenta.
4. It has large pinnately compound leaves (front) on the upper side. The leaf contains a long petiole which grows upward in the form of rachis. The rachis contains many leaflets, the pinna divided into many pinnules.
5. Young circinately coiled leaves and the rhizome.

Reproduction

1. It does both asexual and sexual reproduction.
2. Asexual reproduction is done with the spores produced in sporangium born on the ventral surface of the matured leaf (sporophyte). Such group of sporangia is known as sorus. Each sorus is protected by kidney

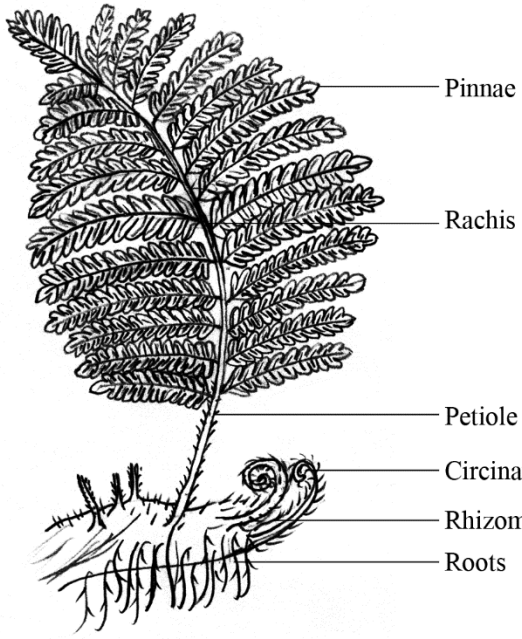
shaped indusium.

1. At maturity of spores, the capsule wall of sporangium brusts at stomium and release spores.
2. When spores fall insuitable substratum germinates into a green dorsiventrally flattened gametophytic plant, the prothallus.
3. Prothallus is monoecious and has unicellular rhizoids and reproductive structures on the ventral surface.

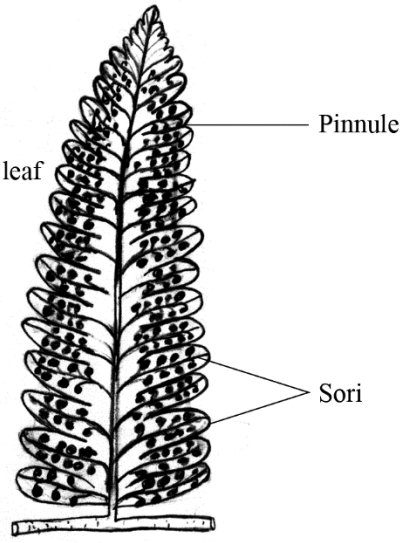
STUDY OF MUSEUM SPECIMENS - *Dryopteris*

Classification

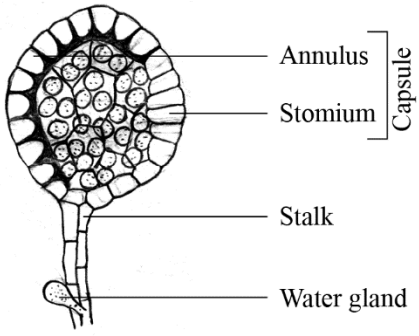
Kingdom	:	Plantae
Division	:	Tracheophyta
Class	:	Leptosporangiopsida
Order	:	Filicales
Family	:	Polypodiaceae
Genus	:	*Dryopteris*



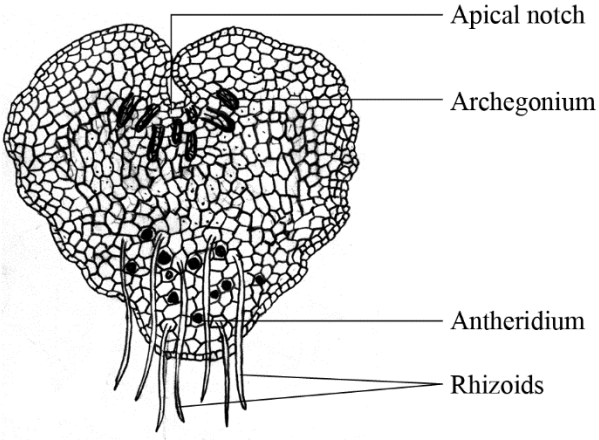
Plant body (Sporophyte)



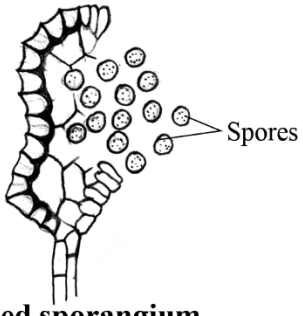
A single pinna Showing sori (sporophyll)



A Single sporangium



Prothallus (Gametophyte)



Dehisced sporangium

Comments:

Distribution: Pinus is an evergreen, pyramidal , xerophytic plant found in arid, dry and slopy places.

Body structure

1. The plant body is differentiated into root, stem and leaves.
2. It has two types of root system- tap root and mycorrhizal root. In mycorrhizal roots there is an association of fungal hyphae for absorption of water and mineral.
3. The stem is tall, erect, branched, cylindrical and woody consisting of two types of branches – branch of unlimited growth or long shoot and branch of limited growth or dwarf shoot.The long shoot of unlimited growth possesses apical bud and grows indefinitely. Thesebranches spread out horizontally and bear only scale leaf.The dwarf shoot of limited growth borne in the axil of scale leaves bear cluster of needle like foliage leaves.
4. Leaves are also of two types – scale leaf and foliage leaf small, brown, thin, flattened leaves occurring on long shoot as well as dwarf shoot are called as scale leaves. Green, needle like photosynthetic leaves found at the apex of dwarf shoot are called as foliage leaves.
5. Pinus is monoecious while the branches are dioecious ie male and female cones are borne in different branches of the same plant.
6. Male cones, borne in cluster, are comparatively smaller in size than female cone. It consists of a slender axis which bears numerous spirally arranged microsporophylls. Each microsporophyll bears two microsporangia on its lower surface. Inside the microsporangium microspores or pollen grains are developed.
7. Female cone, borne singly, is comparatively larger than male cone. It consists of a central axis which bears a number of spirally arranged, tough woody megasporophylls. Each megasporophyll has an ovuliferous scale which bears a bract at its base. The anatropous ovule or megasporangia are borne on the ovuliferous scale on the upper surface of its base.

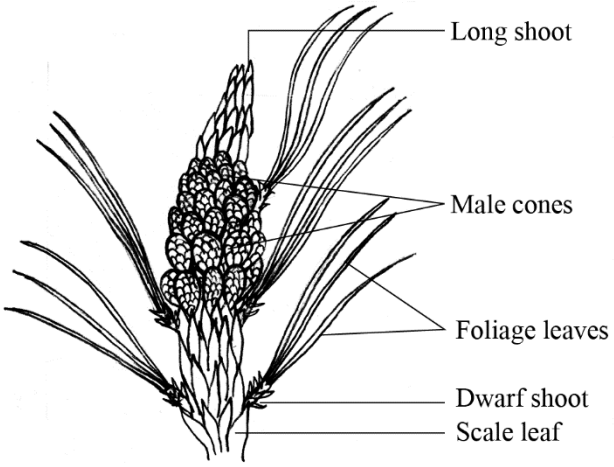
Reproduction:

It does sexual reproduction by fusion of gametes.

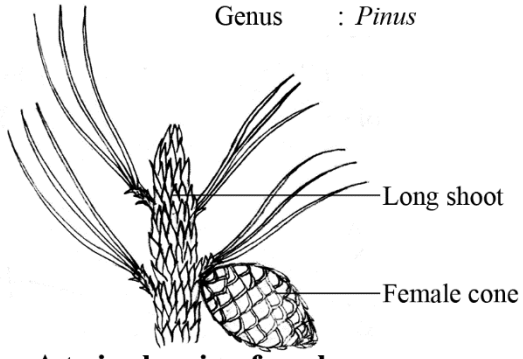
STUDY OF MUSEUM SPECIMENS- *Pinus*

Classification

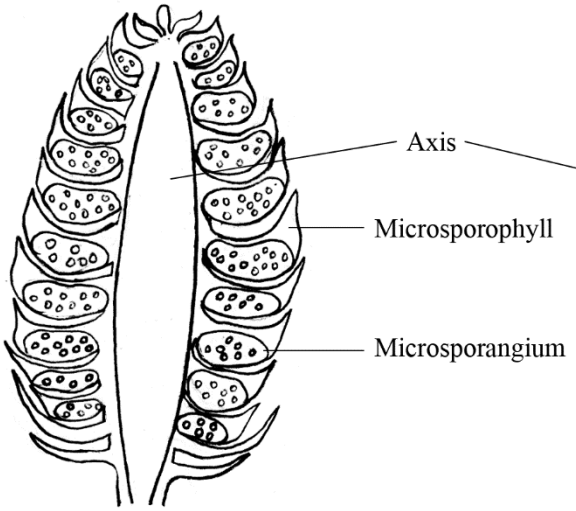
Kingdom : Plantar
Division : Tracheophyta
Class : Coniferopside
Order : Coniferales
Family : Pinaceae
Genus : *Pinus*



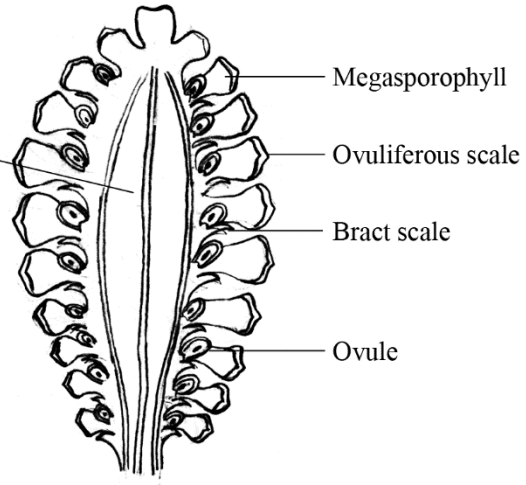
A twig showing male cone



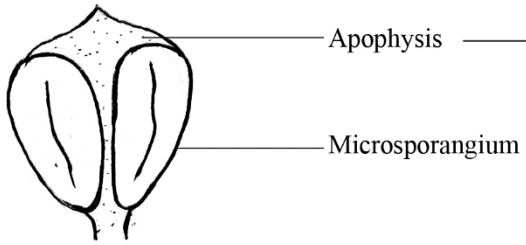
A twig showing female cone



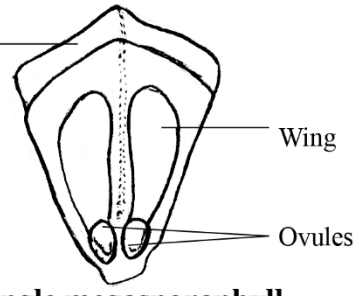
L.S. of male cone



L.S. of female cone



Single microsporophyll



Single megasporaphyll

Comments:

Distribution: Mustard plant is a cultivated annual herb and are mesophytic in nature.

Body structure

Root: It has well developed tap root system with branched.

Stem: The stem is erect, branched, herbaceous, solid, cylindrical, with node and internode.

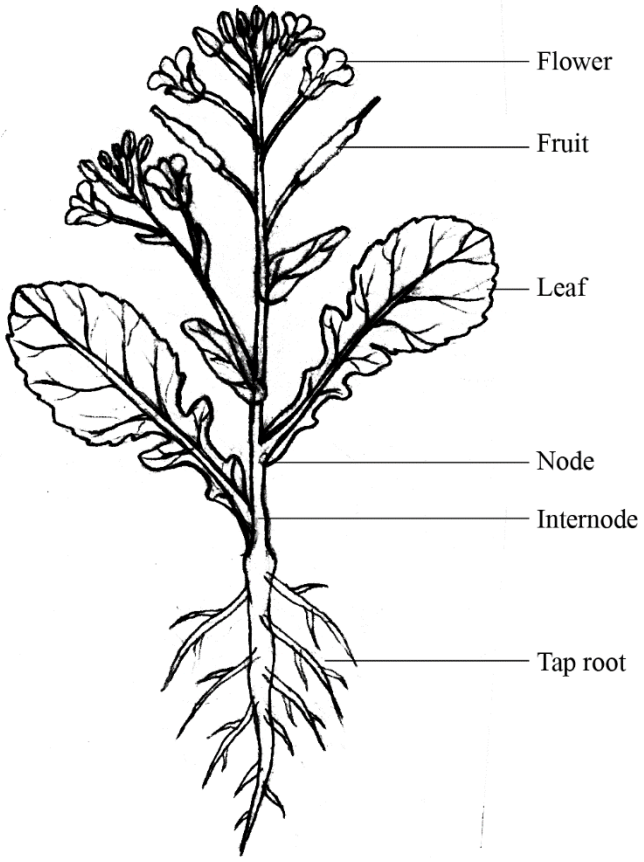
Leaf: Leaves arises from the main stem and branches which are arranged in alternate fashion. Leaf is simple dorsiventral flatten with unicostate reticulate venation. Leaves are exstipulate with petiole at lower surface and sessile at upper surface..

Flower: Flowers are developed from the reproductive buds either at the stem apex or at the axil of leaves. They are ebracteate, pedicellate, complete, tetradynamous, regular, actinomorphic, with mustard yellow.

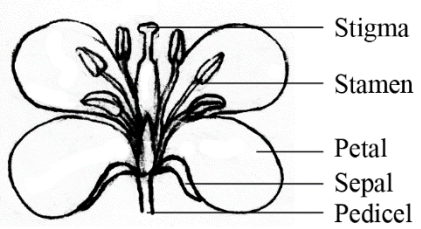
Reproduction: It is done by sexual reproduction(oogamous) by fusion of gametes

Classification

Kingdom	:	Plantae
Division	:	Spermatophyta
Class	:	Dicotyledonae
Order	:	Parietales
Family	:	Brassucaceae
Genus	:	*Brassuca*
Species	:	*campestris*



Mustard (Dicot plant)



Single flower

Comments:

Habitat: Terrestrial, cultivated annual food crop and is mesophyte in habitat

Root: Adventitous unbranched root system

Stem: Aerial, erect, nodes and internodes, node slightly swollen and solid internode fistular, cylindrical, tillering, glabrous, partially covered by sheathing leaf base, green

Leaf:Simple, cauline, exstipulate, alternate, isobilateral, distichous, linear, entire, acute, rough, ligule at the junction of blade and leaf sheath, unicostate, parallel venation

Inflorescence: Spike of spikelets. Each spikelet is short stalked and consists of a pair of

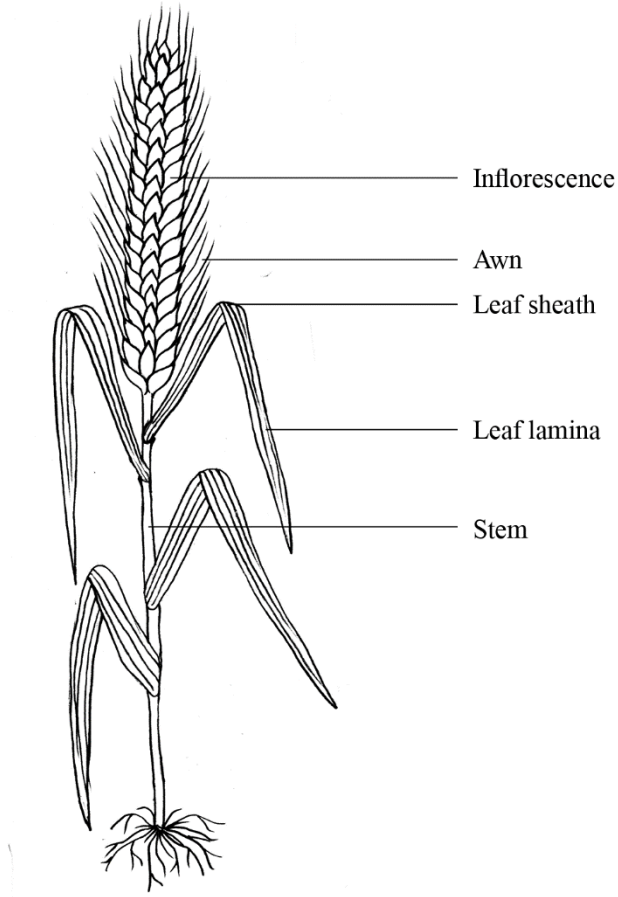
empty glumes- glume 1 and glume 2 enclosing three or four flowers

Flower: Bracteate (by lemma), bracteolate (by palea), a lemma with slender bristle like awn and palea, sessile, zygomorphic, bisexual, incomplete, hypogynous, trimerous

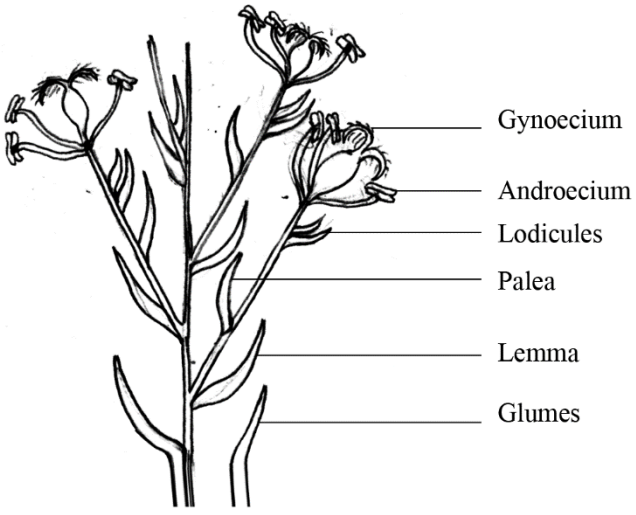
STUDY OF MUSEUM SPECIMENS - MONOCOT PLANT

Classification

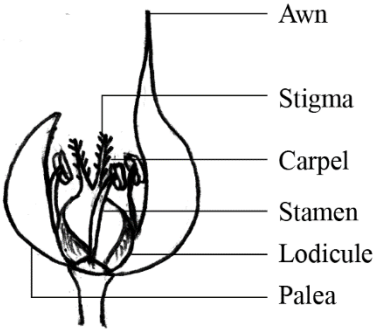
Kingdom	:	Plantae
Division	:	Spermatophyta
Class	:	Monocotyledonous
Family	:	Gramineae
Genus	:	*Triticum*
C.N	:	Wheat



Wheat plant (Monocot)



Single Inflorescence



Single flower

Comments:

Distribution: Lichens are cosmopolitan, widely distributed from sea-shore to high mountain in any climatic range on various substratum such as base of rocks, stones, walls, tree trucks and even soil. They have special capability to invade and grow where the normal plants cannot grow. Some lichens may be epiphytic in nature

General body features

Lichens are dual organisms which content permanent association of a fungus and an alga. The body of lichen is called thallus as their body cannot differentiated as angiospermic plants. They are called air pollution indicator as they don't grow in such area where SO_2 are found. There are three types of lichen on the basis of growth form they are crustose, foliose and fruticose.

Crustose lichen–

1. The thallus of crustose lichen is poorly developed.
2. It penetrates the substratum by the whole of its lower surface forming incrustations.
3. It is partly or wholly embedded inthe substratum.
4. Superficially, it appears as an ashy and whitish crust marked by black, linear and Thallus of Graphis

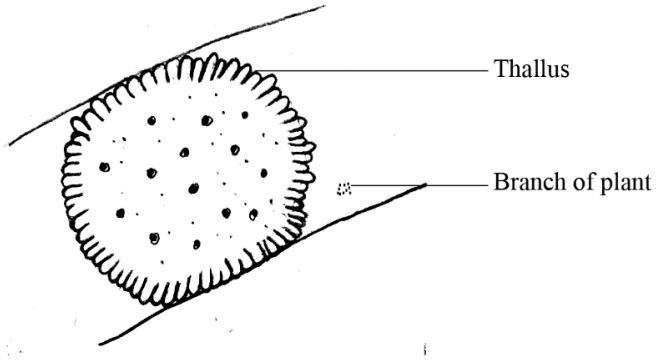
Foliose lichen –

1. The thallus is flat, broad much lobed with usually curled up irregular margins.
2. It is dorsiventral with whitish or shooty lower surface that gives rise central rhizoid-like strands called rhizinae for anchorage.
3. The upper surface bears a number of small cup-like fruiting bodies called apothecia. eg. Physcia, Parmelia.

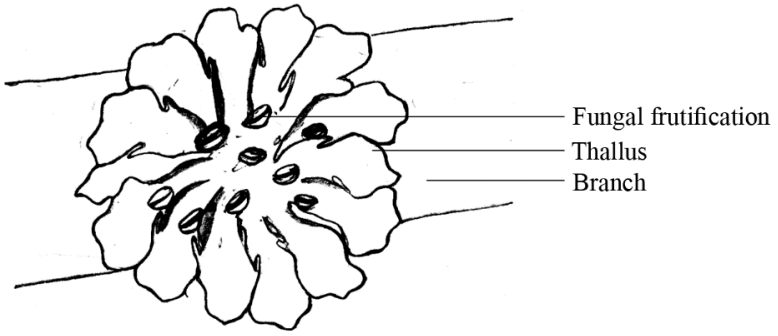
Fructicose lichen –

1. The thallus is complex, composed of slender cylindrical or flattened free bushy or erect or pendent branches.
2. The thallus shows no differentiation between upper and lower surface.
3. It gets attached to substratum by a strand of basal hyphae.
4. The tip of the thallus branch bear large, plate like apothecia that produces ascospores within ascus.
   eg. Usnea, Cladonia, Ramalina etc.

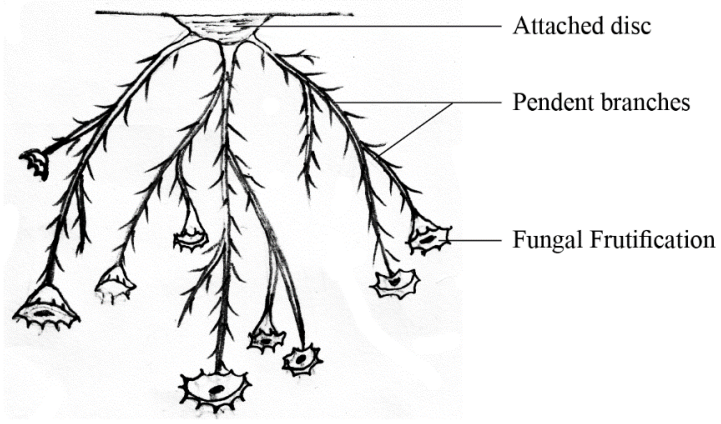
Reproduction: Lichens reproduce by vegetative, asexual and sexual methods



Crustose Lichen



Foliose Lichen



Fructiose Lichen (*Usnea*)