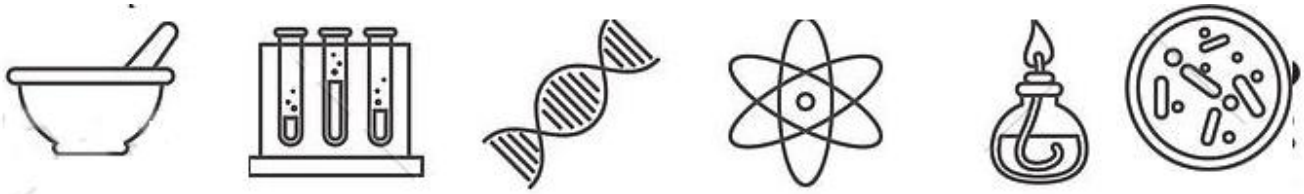
A. List of Experiments

1. Study pollen germination on a slide.
2. Collect and study soil from at least two different sites and study them for texture, moisture content, pH and water holding capacity. Correlate with the kinds of plants found in them.
3. Collect water from two different water bodies around you and study them for pH, clarity and presence of any living organism.
4. Study the presence of suspended particulate matter in air at two widely different sites.
5. Study the plant population density by quadrat method.
6. Study the plant population frequency by quadrat method.
7. Prepare a temporary mount of onion root tip to study mitosis.
8. Study the effect of different temperatures and three different pH on the activity of salivary amylase on starch.
9. Isolate DNA from available plant material such as spinach, green pea seeds, papaya etc.

B. Study/observation of the following (Spotting)

1. Flowers adapted to pollination by different agencies (wind, insects, birds).
2. Pollen germination on stigma through a permanent slide.
3. Identification of stages of gamete development, i.e., T.S. of testis and T.S. of ovary through permanent slides (from grasshopper/mice).
4. Meiosis in onion bud cell or grasshopper testis through permanent slides.
5. T.S. of blastula through permanent slides(Mammalian).
6. Mendelian inheritance using seeds of different colour/sizes of any plant.
7. Prepared pedigree charts of any one of the genetic traits such as rolling of tongue, blood groups, ear lobes, widow's peak and colourblindness.
8. Controlled pollination - emasculation, tagging and bagging.
9. Common disease causing organisms like Ascaris, Entamoeba, Plasmodium, any fungus causing ringworm through permanent slides or specimens. Comment on symptoms of diseases that they cause.
10. Two plants and two animals (models/virtual images) found in xeric conditions. Comment upon their morphological adaptations.
11. Two plants and two animals (models/virtual images) found in aquatic conditions. Comment upon their morphological adaptations.



CORE EXPERIMENTS

CORE EXPERIMENT: 1 (Slide Preparation: Pollen Germination)

Aim:

To study pollen germination on a slide.

Principle:

In nature, pollen grains germinate on the compatible stigmas of the carpel. Pollen grains can also be induced to germinate in a synthetic medium. During germination, intine (inner wall) of pollen grain emerges out as pollen tube through one of the germ pores in exine (outer wall).

Requirements:

Freshly plucked seasonal flowers (*Vinca /Tradescantia/ balsam/ Jasmine/ lily/ pomegranate/ grass/ Petunia*), beaker, boric acid, sucrose, microscope and cavity slide.

Procedure:

The first step involves the preparation of a sugar solution. This is done by dissolving 10g of sucrose 90ml of water.Pour a few drops of this solution onto the cavity slide. Then, use a brush or fingers to gently dust a few pollen grains from the stamen of mature flowers.

Let the slide set for 5 minutes. Then, use the microscope to view the slides in 30-minute intervals.

Observation:

The pollen grains will germinate when submerged in the sugar rich nutrient medium. This is characterized by the enlargement of the vegetative/tube cell. It emerges through one of the germ pores, eventually forming a pollen tube. The generative cell nucleus grows into the pollen tube and makes two male gametes (sperm nuclei). The male gamete is either spherical or lenticular in outline.

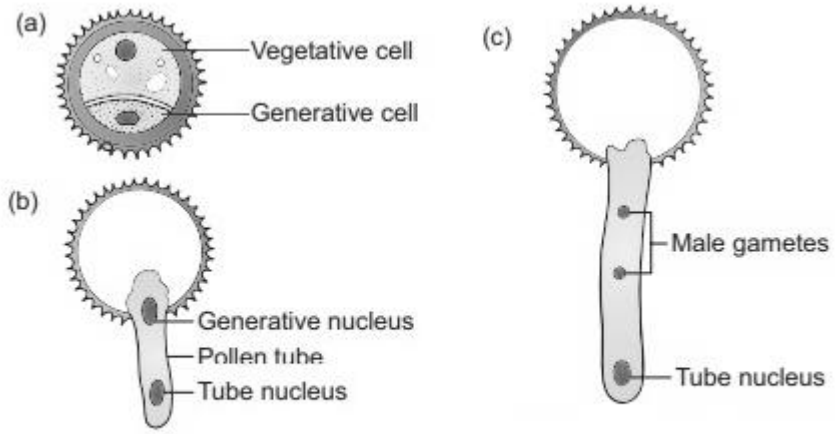


Figure Pollen germination

Inference:

Different stages of germinating pollens are observed. Some pollens are in their initial stage of germination while others have quite long pollen tube containing tube nucleus and two male gametes.

Precautions:

1. Flowers should be freshly plucked.
2. Use clean cavity slide to observe the pollen grains.
3. The slides should not be disturbed, otherwise position of pollen grains will get changed.
4. During observations pollen grains must be properly dipped in nutrient solution.

CORE EXPERIMENT: 2 (Soil Analysis)

Aim:

To study soil samples from two different sites and analyse their properties such as texture, moisture content, pH and water-holding capacity. Also, the study aims to correlate the plants found in such soil.

Requirements:

roadside soil, garden, Dropper, Beaker, Measuring cylinder, Filter Paper, pH paper booklet, Distilled water, Funnel, Universal pH indicator solution, Wire gauze, Burner, Crucibles, Weighing scale/ balance, Mortar and Pestle, Petri dish, Glass rods,

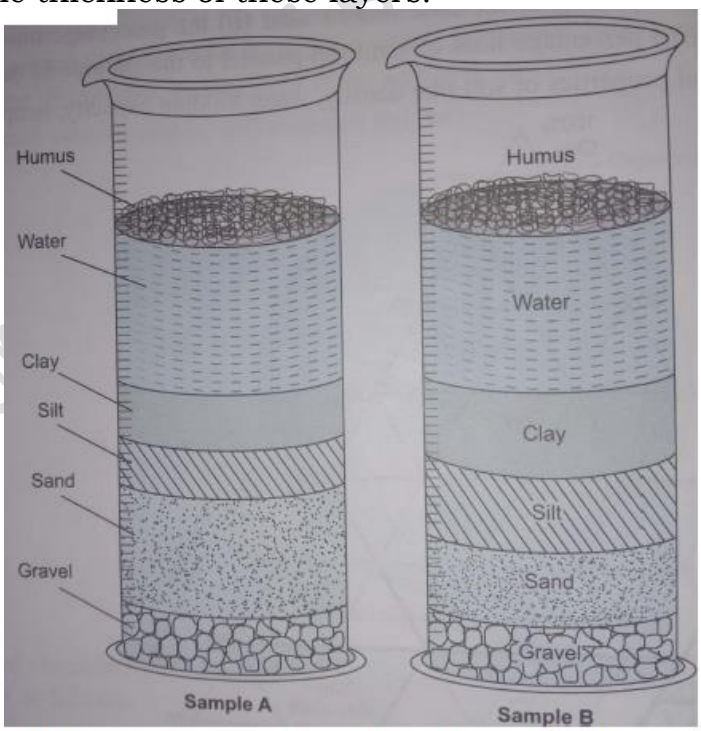
2.1: Texture of Soil

Principle:

Texture is one of the most important physical properties of soil. The soil texture is based upon division of the size of soil particles into three size fractions viz., Sand (2–0.05mm average particle diameter), Silt (0.05–0.002mm) and Clay (less then 0.002mm). If one of these fractions dominates the properties of a soil, the name of that fraction is included in the name of the texture. A soil which has all of these fractions in nearly equal proportion is called a loam soil.

Procedure:

Collect 50 gram of soil in a measuring cylinder. Pour 50 ml water into the measuring cylinder and shake/stir with a glass rod. Wait for the particles to settle down. The particles in the measuring cylinder will start to settle down in layers. Record the thickness of these layers.



Different layers of soil based on particle size

Observation:

Heavy particles settle down first and lighter ones afterwards. Humus floats on the water surface. These layers were observed carefully and observations were recorded in tabular form.

(Draw Observation table as per soil sample taken and fill the readings accordingly. Values/properties given below are for reference only)

S.NO.	Soil samples	Colour	Texture	Relative percentage			Soil class
				Sand	Silt	Clay	
1.	**Soil from a crop field**	Dark brown	Clayey	9%	11%	80%	Fertile
2.	**Garden soil**	Dark Brown	Clayey	22%	40%	38%	Fertile
3.	**Roadside soil**	Pale Brown	Sandy	75%	12%	13%	Infertile
4.	**Soil from a dried pond**	Dark Brown	Clayey	12%	18%	70%	Fertile
5.	**River-bank soil**	Pale Brown	Sandy	2%	28%	70%	Fertile

Inference/Result:
Garden soil is more fertile and beneficial in comparison to road side soil for plants in our locality.

2.2: pH of the Soil

Principle:
The chemical property of the soil depends upon the presence of different types of nutrients and pH of the soil. The soil pH is an indication of acidity or alkalinity of soils. The soil pH is important in determining the availability of soil minerals. Different plants have differing optimum soil pH requirements. The majority of plants prefer a pH of around 6 to 7, which is very slightly acidic.

Procedure:
Take the roadside soil and put it into a beaker containing water. Repeat the same step for the garden soil sample as well. Next, take a test tube and pour the two soil solutions separately through filter papers using a funnel. The collected filtrates in the test tube are now ready for pH testing. Using a dropper, put a few drops of universal indicator solution to the test tube. (Alternate method: When the universal pH indicator is added to the test tube containing the soil solution, the colour changes. These colour changes can be tracked using the pH colour chart. Roadside soil has a pH level of 7 while garden soil has a pH level of 6. Most crops grow between pH levels of 6.0 and 7.0.)

Observation:
(Stick pH paper strips on blank page of file)
The pH different soil samples were recorded in the observation table.

S.No.	Soil samples	pH
1.	Road side soil	8
2.	Garden soil	7
3.	Crop field soil	6.5

Inference:
Garden soil pH is 7 , which is suitable for most of the plants in our locality.

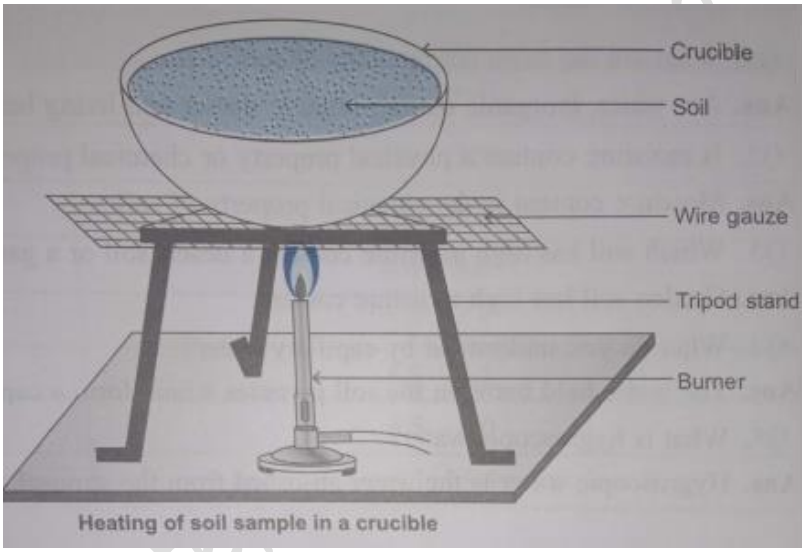
2.3: Moisture Content of the Soil

Principle:

The soil moisture content of soil is the quantity of water it contains. Moisture may be present as adsorbed moisture at internal surfaces and as capillary condensed water in small pores. In agricultural sciences, water content has an important role for groundwater recharge, agriculture and soil chemistry. If the moisture content of a soil is optimum for plant growth, plants can readily absorb soil water. Soil water dissolves salts and makes up the soil solution, which is important as medium for supply of nutrients to growing plants.

Procedure:

Put the two samples of soil in individual crucibles. Weight the soil samples using a weighing balance. Record the weight of each soil sample. Place the crucibles over the Bunsen burner and heat it until it becomes dry , now cool it. Weight the crucibles and record the weight of the dry soil samples. The samples are now ready to be used to determine the moisture content of the soil.



Heating of soil sample in a crucible

Observation:

The initial and final weights were recorded for each sample and the difference between initial and final weights was recorded. Higher difference shows higher moisture content.

(Draw Observation table as per soil sample taken and fill the readings

S.No.	Soil samples	Initial weight (x) gm	Final weight (y) gm	Moisture content (y-x) gm
1.	Soil from a crop field	128.14g	152.25g	24.11
2.	Garden soil	125.23g	145.43g	20.2
3.	Roadside soil	129.02g	137.56g	8.54g
4.	Soil from a dried pond	125.42g	148.29g	22.87g
5.	River bank soil	123.59g	155.67g	32.08g

accordingly. Values/properties given below are for reference only)

Inference/Result:

Garden soil have more moisture content than road side soil, so it is more beneficial for plants in our locality.

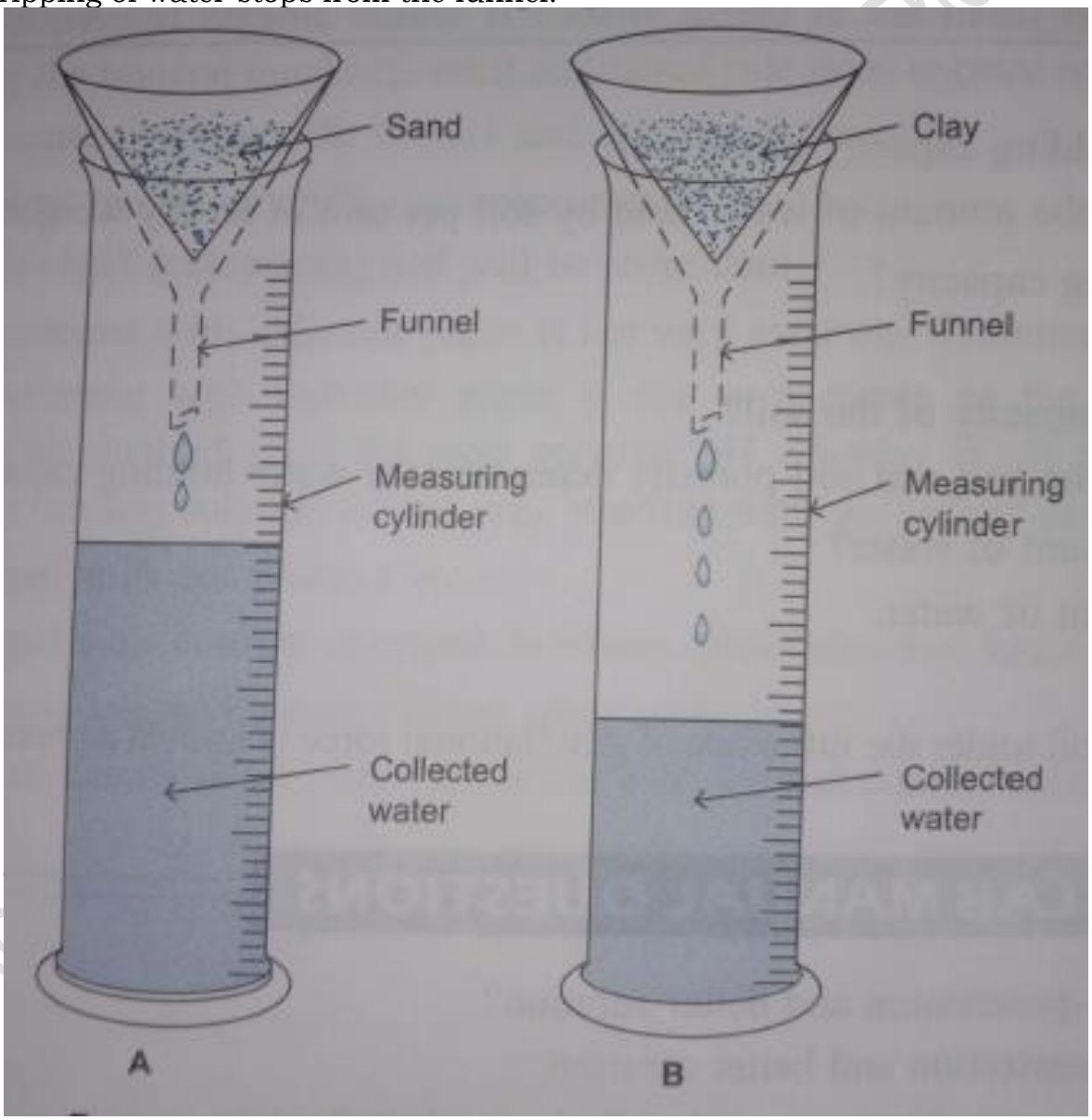
2.4: Water Holding Capacity of Soil

Principle:

Water holding capacity of the soil is the amount of water retained in the capillary spaces of the soil after the percolation of gravitational water into the deeper layers. Water holding capacity depends upon the capillary pore spaces in the soil. Sandy soil has very low water holding capacity, whereas clayey soils have very high water holding capacity.

Procedure:

Take two funnels and line them with filter paper. Label them as A and B. Now place them on two measuring cylinders. Take 30/50/100 gram oven dried sample each of garden soil and roadside soil. Garden soil should be placed in funnel A and roadside soil in funnel B. Pour 100 ml of water in each funnel. Record the volume of filtered out water in the measuring cylinder when the dripping of water stops from the funnel.



Water holding capacity of soil

Observation:

Record all the observations in the observation table and calculate the water holding capacity by given formula:

Water holding capacity of the soil in %=

Vol of water poured - Vol of water collected in measuring cylinder/ Weight of soil * 100

S. No.	Soil types	Weight of soil (X)	Volume of water poured (Y)	Volume of water collected in measuring cylinder(Z)	Volume of water retained the soil (Y-Z)	Water holding capacity of the soil in % (Y-Z)/X*100
1.	Garden soil	50 g	50 ml	26 ml	24 ml	48%
2.	Roadside soil	50g	50 ml	40 ml	10 ml	20 %

Result:
Garden soil has a higher water holding capacity than the roadside soil, because the roadside soil has larger quantities of sand and silt.

Precautions: (for complete soil analysis)

1. Wash the glassware thoroughly and get it oven dried before the experiment.
2. Use standard reagents.
3. Soil samples should be separately packed and brought to the laboratory.
4. The thickness of layers formed by different particles in the cylinder should be carefully measured and their relative percentage should be accurately calculated.
5. Weighing of soil samples should be done accurately.
6. Pour water slowly and gently on the soil in the funnel.
7. Record the volume of collected water in the measuring cylinders carefully.

CORE EXPERIMENT. 3: (Water Analysis)

Aim:
Collect water from two different water bodies around you and study them for pH, clarity and presence of any living organism.

Principle:
Various characters that control the quality of water are taste, smell, colour, amount of dissolved nutrients, dissolved O2 and CO2, pH and different types of plants and animals and their density. Turbidity of the water body determines the depth upto which light can penetrate and thus affects the distribution and photosynthesis of phytoplanktons. More turbid the water body less is the thickness of its photic zone. In polluted water bodies turbidity is due to planktons and effluents formed due to domestic sewage, adjacent agricultural fields and liquid wastes from nearby small and large industries remains turbid.

Requirement:
Water samples from 2/3 different sites, pH paper/ Universal Indicator solution, Dropper, Beaker, Test tube, Coverslips, Filter paper, Glass slides, Needles, Compound microscope, cardboard box/ Tindal effect setup, electric bulb or torch, glass slides, dropper, methylene blue, spirit lamp etc.

3.1 (pH of water):

Procedure:
Obtain water samples from two different sources of water. Dip the individual pH paper strips into the two samples of water. Keep the strips on the tile and wait for them to dry.
Alternatively, pH levels of the water sample can also be found using the universal indicator solution.Use the dropper to pour five drops of this solution into a test tube containing the water samples. Note the change in colour and compare the same with the colour chart.

Observations:
pH of different water samples were recorded in the observation table.

S.No.	Water samples	pH
1	Stagnant water	6
2	Tap water	7.5
3	Distilled Water	7

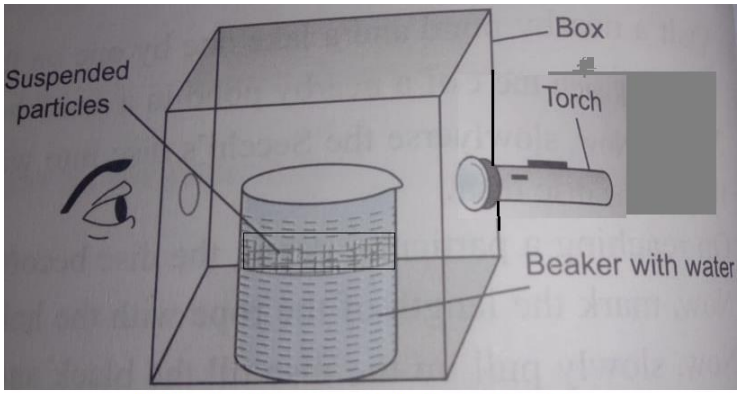
Conclusion: Different types of salts and other chemicals dissolves in water affect the pH of water.

Precautions:
1. Take clean and dried test tubes.
2. Dry the pH papers before comparing the colour with the colour scale.
3. Match the colour carefully and determine pH accurately.

3.2: Clarity of the water sample:

Procedure:
Take a cardboard box and prepared a tyndal set up from it to test turbidity. Tyndal setup can be prepared by making a pencil size hole in the cardboard box and fixing a light source on the other side of the box. We placed the beaker containing the samples of water one by one. Make the laboratory dark and light the bulb or the torch. Now observe the sample of water through the hole and compare the turbidity of different water samples.

Observation: Suspended particulate pollutants such as clay particles, organic matter, bacteria, unicellular organisms etc. are observed.



Tyndal set-up to compare clarity of water samples

Conclusion: Presence of Tyndall effect (more scattering of light) indicates the presence of more suspended particulate matter in stagnant water.

Precautions:

1. The hole in the cardboard box should not be large.
2. The light source should be of sufficient intensity.

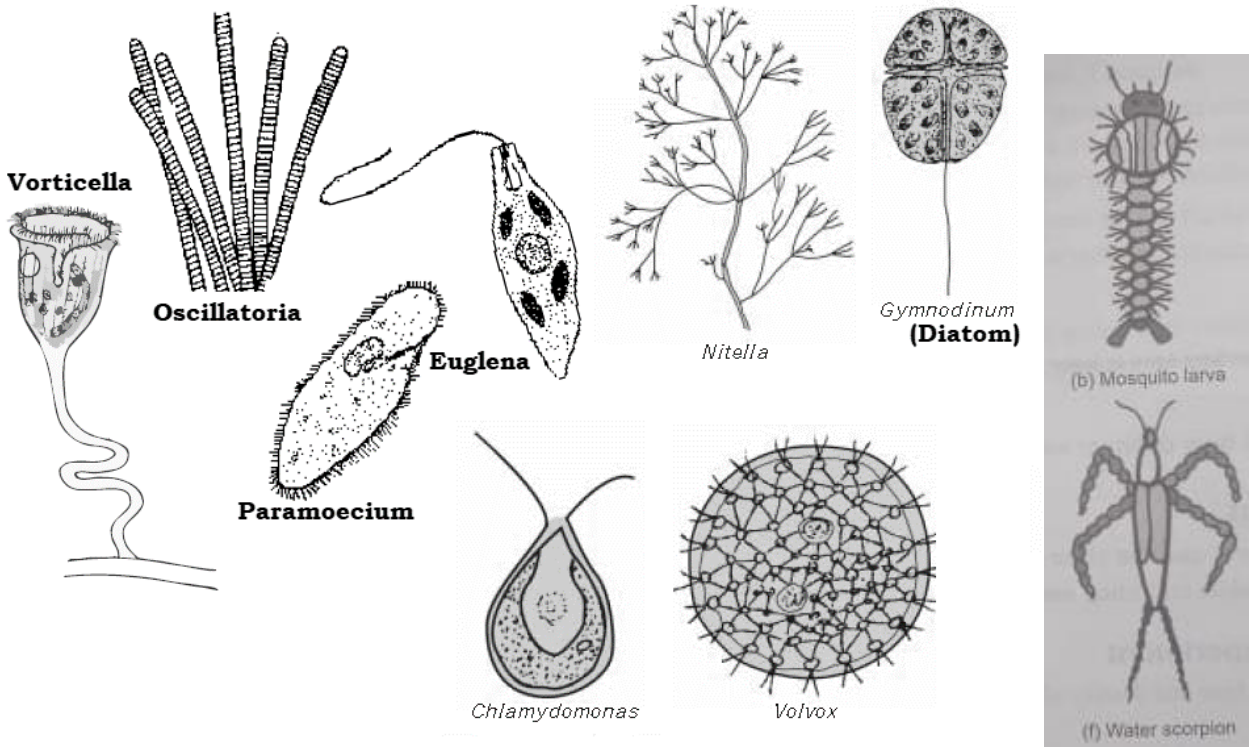
3.3 Study water samples for the presence of living organisms.

Procedure:

Take a clean slide and put a few drop of water separately from different water samples on it and spread it to make a thin film of water on the slide and now allow it to dry. Now pass the lower side of the slide through the flame of spirit lamp 2- 3 times to fix the living organisms present in the water. Now add a few drops of methylene blue on the slide and left it for 2 minutes. Washed the slide and observe the slide under the microscope.

Observations:

A number of types of microorganisms such as bacteria, protozoa, diatoms, some algae, cyanobacteria are observed.



Conclusion: Presence of large number of microorganisms indicates the presence of organic pollutants in water.

CORE EXPERIMENT. 4: (Study of SPM in Air)

Aim:

Study the presence of suspended particulate matter in air at two widely different sites.

Principle:

Environmental pollution is the unfavorable alteration of our surroundings wholly or largely as a by-product of man's action through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitutions of environment and abundance of organisms. Substances that cause pollution to the environment are called pollutants. They are the residues of things that man makes, uses and throws away. These residues pollute soil, water and air. The atmosphere in highly populated area is very rich in dust, smoke and SPM all due to vehicular exhausts and industrial emission.

Requirement: Few freshly cut broad leaves, Vaseline, laboratory balance, weights, brush, paperclips, twine thread, while paper, white handkerchief, brush, Microscope.

Procedure 1:

Apply some Vaseline on two plain white papers and keep/ stick them in a polluted and no polluted area for one whole day.

Observation:

The paper in polluted paper shows more accumulation of pollutants such as dust, pollen grains etc.

(Stick papers in practical file)

Procedure 2:

Pluck leaves from plants growing at two different sites. Put two drops of glycerin on the leaves. With the help of brush take a drop of glycerin from the leaf and put it on a clean slide and observe under microscope.

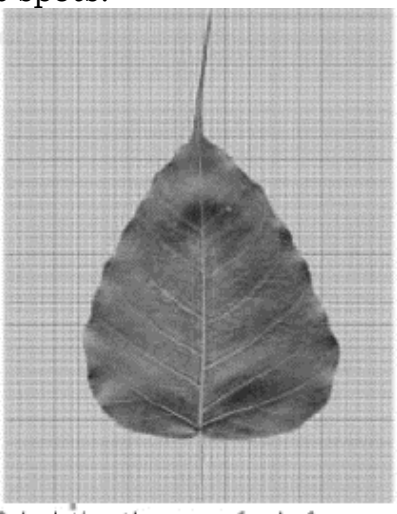
Observation:

Slide prepared from a polluted area shows a number of pollutants such as dust, pollen grains etc.

Procedure 3.

1. Collect a few broad leaves from the nearby plants such as peepal.
2. Wash the leaves to remove any dust particles and dry the surface of the leaves.
3. Trace the outline of the leaves on a graph paper to calculate the area of the leaf.
4. Calculate the total number of full squares, ½ squares, ⅓ squares, ⅔ squares and individual small squares within the traced area.
5. Calculate the total leaf area by adding all the squares.
6. Multiply the obtained value with 2 to obtain the total area of both the surfaces.
7. Take a 10 feet long twine thread and tie five leaves at a foot's distance to each other.
8. A thin layer of vaseline is applied on both the surfaces of the leaves and pack the leaves in polythene bags.
9. Make two such bundles containing five leaves each.
10. Measure the weight of each leaf bundle along with the polythene bags and mark them as A and B.
11. Select any two spots (X and Y) near your area such that spot X has very heavy vehicular traffic and spot Y has very little vehicular traffic.

12. Tie the two ends of the thread containing leaves in bundle A on a tree at a height of about 10 feet from the ground at spot X, such that all the leaves are exposed. Leave the leaves for two hours.
13. After two hours, rebundle the leaves and place then in the polythene bag A. Record the readings in the observation table.
14. Repeat the same process with the bundle B at another spot Y and record the readings.
15. Reweigh each bundle of leaves along with their respective polythene bags.
16. Calculate the amount of suspended particles in mg/cm2 and compare the results of the two different spots.



Calculating the area of a leaf on a graph paper

Observations:

Site	Leaf bundle sample	Weight of leaves (g)		Weight of suspended particle (W_2-W_1)	Total leaf area (cm^2) of five leaves
		Before exposure (W_1)	After exposure (W_2)		
X	'A'				
Y	'B'				

Site	Weight of leaves before exposure (W1)	Weight of leaves after exposure (W2)	Weight of suspended particles (W2-W1)
Little Traffic	20.070	20.100	0.030
Heavy Vehicular Traffic	15.400	15.610	0.201

(Stick graph papers in practical file)

Conclusion

The weight of the suspended particles in the area with heavy vehicular traffic is greater than that in the area with very little traffic. This is because the air in the areas with heavy traffic is rich in smoke, dust and particulate matter when compared to the areas with little traffic.

Precautions

1. Selection of polluted and non polluted area should be done carefully to get appropriate results.
2. Layer of Vaseline should be very thin on the surface.
3. Obsevation should be done first under low magnification of microscope.
4. The outer surface of the polythene bag containing the bundle of leaves should not have any vaseline sticking to it.

CORE EXPERIMENT 5: Population Density

Aim

Study the plant population density by quadrat method.

Principle:

Density represents the numerical strength of a certain plant species in the community per unit area. The number of individuals of the species in any unit area is its density. The unit area may be as small as 5 square cm to as large as 10 square metre depending on the size and nature of the plant community under study. For herbaceous vegetation a metre square quadrat is normally used. Density which gives an idea of degree of competition is calculated as follows.

Density= Total number of individual(s) of the species in all the sampling unit (S) / Total number of sampling units studied (Q)

The value thus obtained is then expressed as number of individuals per unit area. When the measured unit area is divided by the number of individuals the average area occupied by each individual is obtained.

Requirement:

Meter scale, Cotton/nylon thread (five meters), 4 nails and a hammer

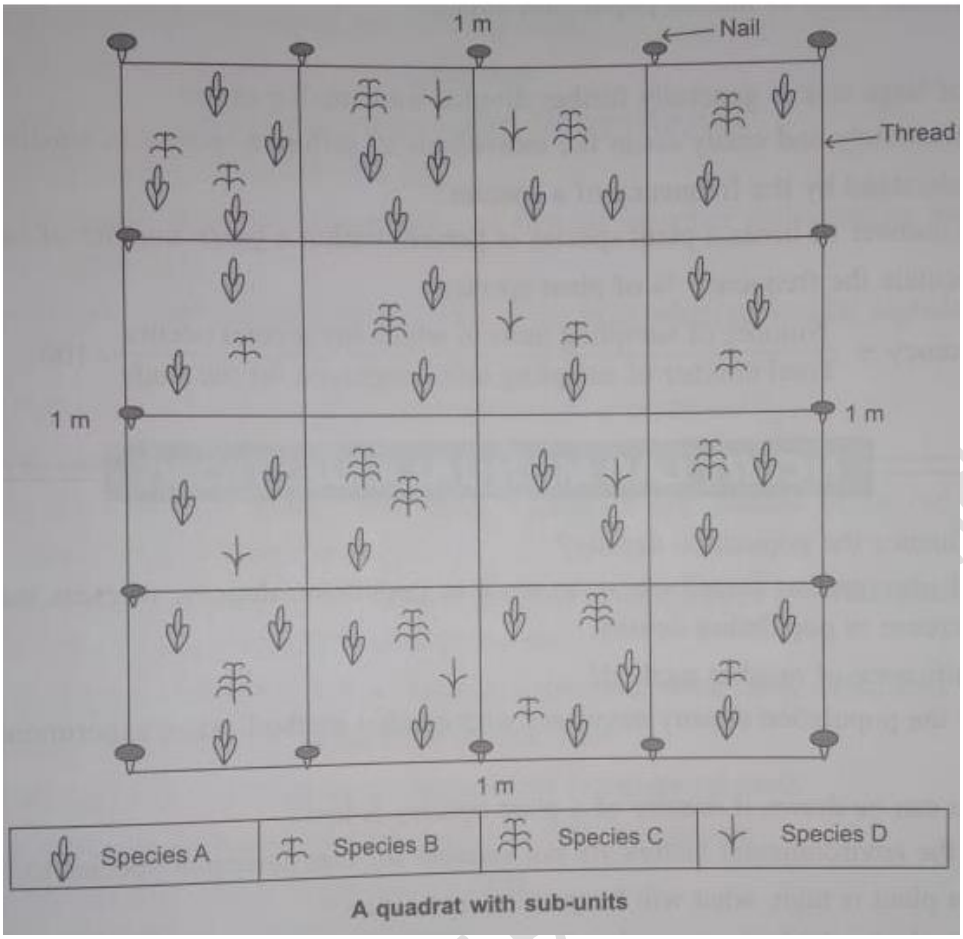
Procedure:

(i) In the selected site of study, make a 1 m X 1 m quadrat with the help of nails and thread. Hammer the nails firmly and make sure that the vegetation is not damaged while laying the quadrat.

(ii) List the names of the plant species seen in the quadrat (if the name is not known mark these as species A or B etc., and the same species if seen in other quadrats assign the same alphabet).

(iii) Count the number of individuals of each species present in the quadrat and record the data as shown in the table.

(iv)Similarly make nine more quadrats randomly in the site of study and record the names and number of individuals of each species.



A quadrat with sub-units

Observations:

Record the total number of species seen in the ten quadrats. This will give an idea about the composition of the vegetation. There will be difference in the species composition in the quadrats made in shady areas, exposed areas with bright sunlight, dry or wet areas etc.

Plant Species	Quadrats employed in study & no. of individuals in each quadrat										Total No. of individuals (S)	Total no. of Quadrats studied (Q)	Density (D)
	I	II	III	IV	V	VI	VII	VIII	IX	X			
A	2			5		7		10		3	27	10	27/10 = 2.7
Z	1	2	4	8	3		2				20	10	20/10 = 2.0

Conclusion

The population density is the highest for species A……. and the lowest for species Z……. The density value is expressed as the number of individuals per unit area.

Precautions:

1. Measure the quadrate accurately.
2. Mark all the quadrates close to each other within one field only.
3. The string/ thread should not be very tick.
4. Every individual of all species should be counted precisely without repetition.
5. The vegetation should not be damaged while laying the quadrates.

CORE EXPERIMENT 6: Population Frequency

Aim:

Study the plant population frequency by quadrat method.

Principle:

Frequency is concerned with the degree of uniformity of the occurrence of individuals of a species within a plant community. It is measured by noting the presence of a species in random sample areas (quadrats) which are distributed as widely as possible throughout the area of study.

Frequency is the number of sampling units (as %) in which a particular species (A) occurs. The frequency of each species (sps. A or sps. B or sps. X etc) is expressed in percentage and is calculated as follows.

% Frequency or Frequency Index = Number of sampling units (quadrats) in which the species occurs /Total number of sampling units (quadrats) employed for the study * 100

Requirements:

Meter scale, Cotton/nylon thread of 5 metres, 4 nails and a hammer

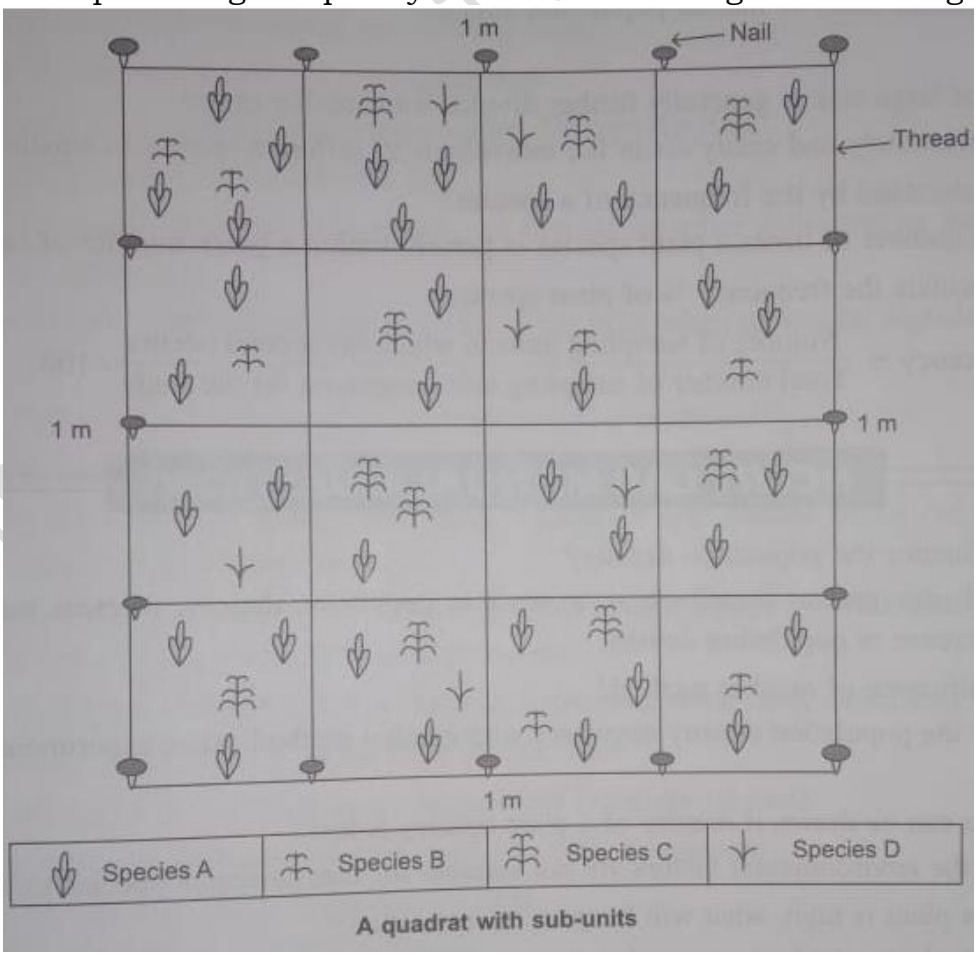
Procedure:

(i) In the selected site of study, make a 1 m X 1 m quadrat with the help of nails and thread. Hammer the nails firmly and make sure that the vegetation is not damaged while laying the quadrat.

(ii) List the names of the plant species seen in the quadrat (if the name is not known mark these as species A or B etc. and if the same species is seen in other quadrats assign the same alphabet)

(iii) Similarly lay nine more quadrats randomly in the site of study and record the names of individuals of each species.

(iv)Calculate the percentage frequency of occurrence using the formula given.



A quadrat with sub-units

Observations:
Record the total number of species seen in the ten quadrats. This will give an idea about the composition of the vegetation. Observe that the frequency of occurrence is not the same for all species.
(There will be difference in the species composition in the quadrats made in shady areas, exposed areas with bright sunlight, dry or wet areas etc.)

Plant Species	Number of quadrats employed in the study (Q)										No. of quadrats in which the species is present (N)	Percentage of frequency F=N/Q X 100
	I	II	III	IV	V	VI	VII	VIII	IX	X		
A	√		√	√			√			√	5	5/10 100 = 50%
B		√									1	1/10 100 = 10%
C					√	√	√		√		4	4/10 100 = 40%

Conclusion
The plant population frequency is the highest in species A..... and the least in species C.....

Precautions:
1. Measure the quadrate accurately.
2. Mark all the quadrates close to each other within one field only.
3. The string/ thread should not be very tick.
4. Every individual of all species should be counted precisely without repetition.
5. The vegetation should not be damaged while laying the quadrates.

CORE EXPERIMENT 7: (Slide Preparation: Mitosis in Onion Root tip)

Aim:
Prepare a temporary mount of onion root tip to study mitosis.
Principle:
Somatic growth in plants and animals takes place by the increase in the number of cells. A cell divides mitotically to form two daughter cells wherein the number of chromosomes remains the same (i.e., unchanged) as in the mother cell. In plants, such divisions rapidly take place in meristem tissues of root and shoot apices, where the stages of mitosis can be easily observed.
Requirement: Onion bulbs, wide mouth glass tubes/jar/bottle, glacial acetic acid, ethanol 2-4% acetocarmine stain, N/10 HCl, spirit lamp, slide, cover slips, blotting paper, molten wax/nail polish and compound microscope
Procedure:
 # Growing of root tips:
Select a few medium-sized onion bulbs. Carefully remove the dry outer scaly leaves and roots present. Grow root tips by placing the bulbs on glass tubes (of about 3–4 cm. diameter) filled with water. Care should be taken so that the stem portion of the bulb (basal part) just touches the water. Replace water in every 2-3 days. New roots may take 3–6 days to grow.

Figure: Growing of roots in Onion

 # Fixation of root tips:
Cut 2–3 cm long freshly grown roots and transfer them to freshly prepared fixative, i.e., aceto-alcohol (1:3:: glacial acetic acid : ethanol). Onion root-tip cells have a cell cycle of approximately 24-hour duration, i.e., they divide once in 24 hours, and this division usually takes place about two hours after sunrise. Therefore, roots grown on water should be cut only at that time to score maximum number of dividing cells.
#Preparation of slide:
Take one or two preserved roots, wash them in water on a clean slide. Place one drop of N/10 HCl on the root tip followed by 2–3 drops of acetocarmine stain on it. Warm slide for 5–10 minutes slightly on spirit lamp). Care should be taken that the stain is not dried up. Carefully blot the excess stain using blotting paper.Now cut the comparatively more stained (2–3 mm) tip portion of the root and retain it on the slide and discard the remaining portion. After (10–20 seconds) put one or two drops of water and blot them carefully using blotting paper. Again put a drop of water on the root tip and mount a cover slip on it avoiding air bubbles. Place the slide in between the folds of blotting paper using the fingers in such a way that the cover slip mounted on the slide is properly held. Now slowly tap the cover slip using the blunt end of a pencil so that the meristematic tissue of the root tip below the cover slip is properly squashed and spread as a thin layer of cells. Carefully seal the margins of the cover slip using molten paraffin wax or nail polish. This preparation of onion root tips cells is now ready for the study of mitosis.

#Study of slide

Place the slide on the stage of a good quality compound microscope. First observe it under the lower magnification (10 X objective) to search for the area having a few dividing cells. Examine the dividing cells under higher magnification of the microscope to observe the detailed features of mitosis.

Observation:

1. Interphase:

The cells are mostly rectangular, oval or even circular in shape, with almost centrally situated densely stained nucleus. The chromatic (coloured) material of the nucleus is homogeneous and looks granular. The boundary of the nucleus is distinct. One or few nucleoli (sing: nucleolus) can also be observed inside the nucleus .

2. Prophase

Intact nuclear outline is seen. The chromatin (seen as a homogeneous material in the nucleus at interphase) appears as a network of fine threads (chromosomes). Nucleoli may or may not be visible.

3. Metaphase

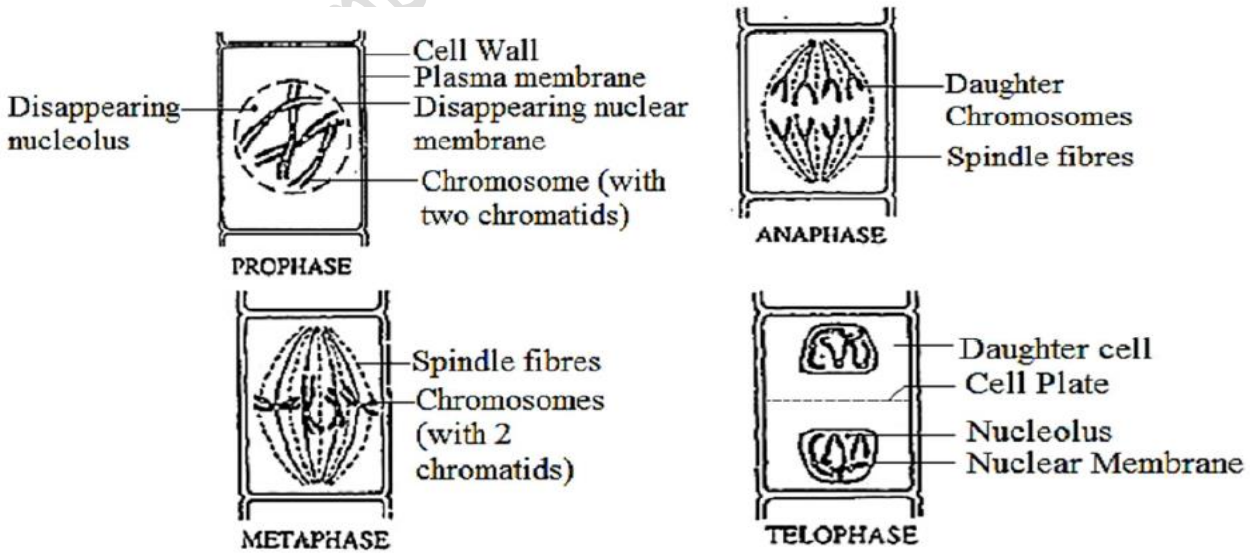
The nuclear membrane disappears. Chromosomes are thick and are seen arranged at the equatorial plane of the cell. Each chromosome at this stage has two chromatids joined together at the centromere. Nucleolus is not observed during metaphase.

4. Anaphase

This stage shows the separation of the chromatids of each chromosome. The chromatids separate due to the splitting of the centromere. Each chromatid now represents a separate chromosome as it has its own centromere. The chromosomes are found as if they have moved towards the two poles of the cell. The chromosomes at this stage may look like the shape of alphabets 'V', 'J' or 'I' depending upon the position of centromere in them. Different anaphase cells show different stages of movement of chromosomes to opposite poles, and they are designated to represent early, mid and late anaphase.

5. Telophase

Chromosomes reach the opposite poles, lose their individuality, and look like a mass of chromatin. Nuclear membrane appears to form the nuclei of the two future daughter cells.

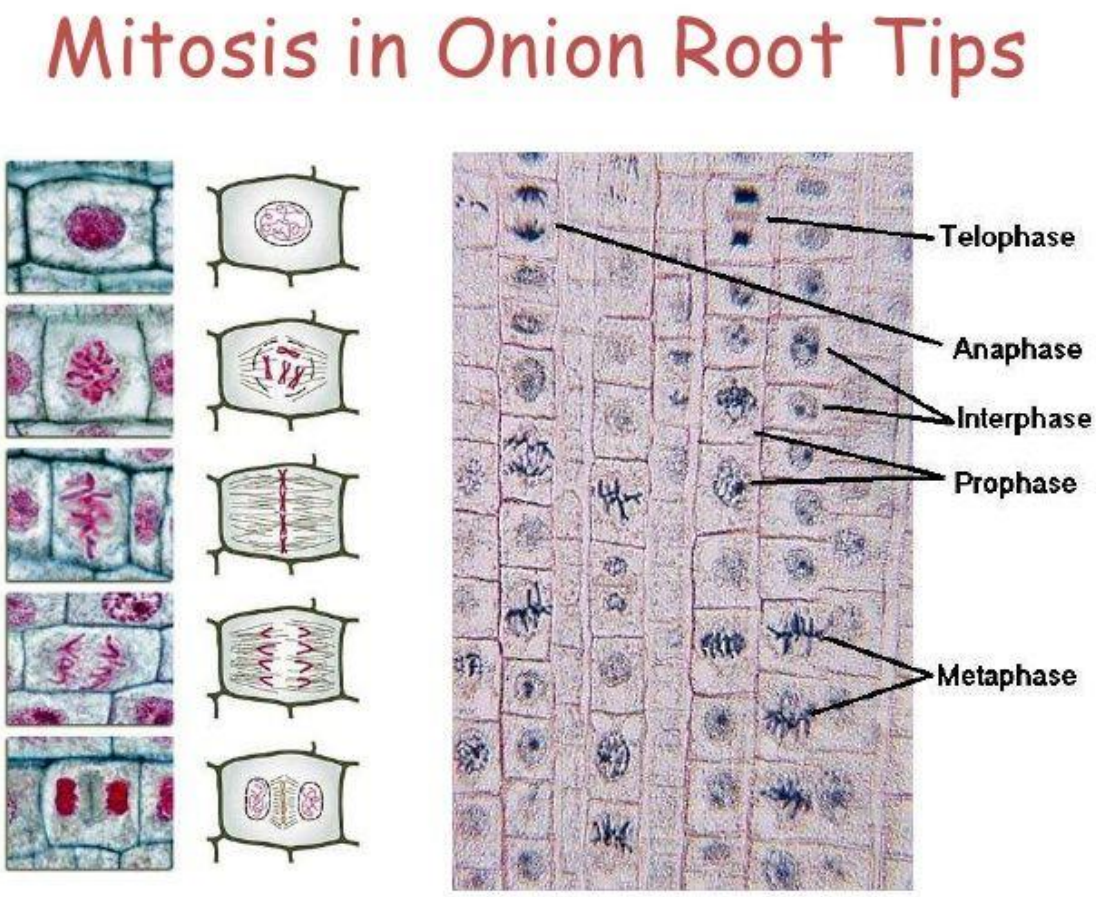


Conclusion

In the prepared temporary mount of onion root tip ..... and ..... Stages of Mitosis are visible clearly.

Precautions:

1. The base of the onion bulb should be n contact with water while growing the roots.
2. Clean the slide and coverslip thoroughly before use.
3. Avoid air bubbles while putting coverslip on the slide.
4. Root tips should be fixed in the morning between 8 to 10 am.
5. The slide should be warmed gently much above the flame of the spirit lamp.



<u>CORE EXPERIMENT 8:</u> (Effect of pH % Temperature on Salivary Amylase)

Aim:
Study the effect of different temperatures and three different pH on the activity of salivary amylase on starch.

Principle:
Chewing of food stimulates the secretion of saliva by salivary gland in our mouth. Saliva mixes up with the food and helps in digestion. The enzyme ptyalin or salivary amylase present in human saliva hydrolyse the big molecules of food into small molecules like maltose. The activity of enzymes is strongly affected by several factors, such as temperature and pH.

Effect of Temperature: All enzymes are protein in nature. At a lower temperature, the enzyme salivary amylase is deactivated and at the higher temperature, the enzyme is denatured. Therefore, more time will be taken by an enzyme to digest the starch at lower and higher temperatures. Optimum temperature for the enzymatic activity of salivary amylase ranges from 32 °C to 37 °C. The optimum temperature means that the temperature at which the enzyme shows the maximum activity. At this optimum temperature, the enzyme is most active and hence, takes less time to digest the starch.

Effect of pH: The optimum pH for the enzymatic activity of salivary amylase ranges from 6 to 7. Above and below this range, the reaction rate reduces as enzymes get denatured. The enzyme salivary amylase is most active at pH 6.8. Our stomach has high level of acidity which causes the salivary amylase to denature and change its shape.

Achromatic Point:
The effect of temperature and pH on the activity of salivary amylase on starch can be studied by using the Iodine test. If we add saliva on starch, the salivary amylase present in saliva gradually acts on starch and converts it into maltose. Starch keeps on giving blue colour with iodine till it is completely digested into maltose. At this point, no blue colour is formed. This is the end point or Achromic point. Hydrolysis of starch can be verified by testing with iodine solution. Starch forms blue colour complex with iodine. If starch is not present in a food, it will not give blue colour with iodine.

Preparation:
Collection of Saliva- Rinse mouth thoroughly with cold water and ensure that it does not contain any food particles. Now take about 20ml of Luke warm water in the mouth and gargle for about three minutes so that saliva mixes up well with it. Spit this into a beaker. Filter, if there is any suspended impurity. Filtrate is saliva solution and contains enzyme ptyalin.
(Alternatively you can use readymade Amylase powder (Fungal diastase). Prepare 1:20 dilution of this enzyme with distilled water as Salivary amylase solution)
Preparation of 1% starch solution - Take about 0.5g of starch in a 100ml beaker and add enough water to make a paste. Dilute the paste by adding 50ml water and boil for about 5 min.
Preparation of 1% NaCl Solution: Dissolve 1g of NaCl in 100ml of distilled water.

Procedure: (Study of effect of temperature on Salivary Amylase)

1. Take three test tubes and label these A, B, C and prepare these in following way:

Set-A: Add 5ml of 1% starch solution + 1 ml of 1% NaCl Solution + 2ml of the saliva solution in test tube A. Now keep this test tube in Ice water bath ($2\,^{o}$C to 4^{o}C)
Set-B: Add 5ml of 1% starch solution + 1 ml of 1% NaCl Solution + 2ml of the saliva solution in test tube B. Now keep this test tube in water bath at room temperature. ($25\,^{o}$C to 30^{o}C).

Set-C: Add 5ml of 1% starch solution + 1 ml of 1% NaCl Solution + 2ml of the saliva solution in test tube C. Now keep this test tube in hot boiling water bath (80 ^{o} C to 100^{o} C)

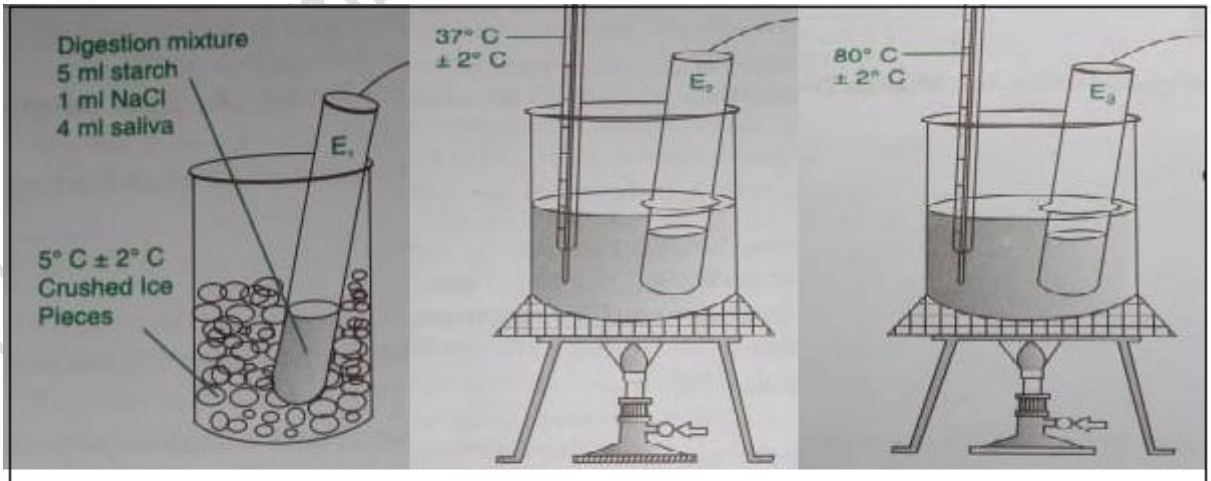
2. Take a white tile and mark it as shown in figure.

Time	Set-A	Set-B	Set-C
2	.	.	.
4	.	.	.
6	.	.	.
8	.	.	.
10	.	.	.
12	.	.	.
14	.	.	.
16	.	.	.

Marking on White Tile

3. After 2 minutes of preparation, take 1-2 drops from each test tube and put it on the tile at respective places. Put one drop of Iodine solution on each spot.
4. Now observe change in colour of Test solution with Iodine (Dark Blue-black to Orange-brown) if any, and note it in the observation table.
5. Repeat the step 3 and 4 after every 2 minutes till achromatic point reached i.e. no Blue-black colour is formed and the colour of Iodine does not changed.

Observation:



Set-A **Set- B** **Set-C**

Effect of Tempeature on action of Salivary Amylase

Time Interval	Colour Intensity of solution after At different temperatures		
	Set-A (~4 ^{0}C)	Set-B (~27 ^{0}C)	Set-C (~80 ^{0}C)
2	Blue	Blue	Blue
4	Blue	Blue	Blue
6	Blue	Blue	Blue
8	Blue	Orange/Brown	Blue
10	Blue	Orange	Blue
12	Blue	Orange	Blue
14	Blue	Orange	Blue
16	Blue	Orange	Blue

It takes …… minutes (less time) to reach achromatic point at 37°C, as the enzyme is maximum active at this temperature, while at higher and lower temperatures ……. Minutes and …..minutes (more time) is taken to reach the achromatic point.

Conclusion

All enzymes are protein in nature. At lower temperatures, the enzyme salivary amylase is deactivated and at higher temperatures, the enzyme is denatured. Therefore, more time will be taken by enzyme to digest the starch at lower and higher temperatures. At 37° C, the enzyme is most active, hence, takes less time to digest the starch.

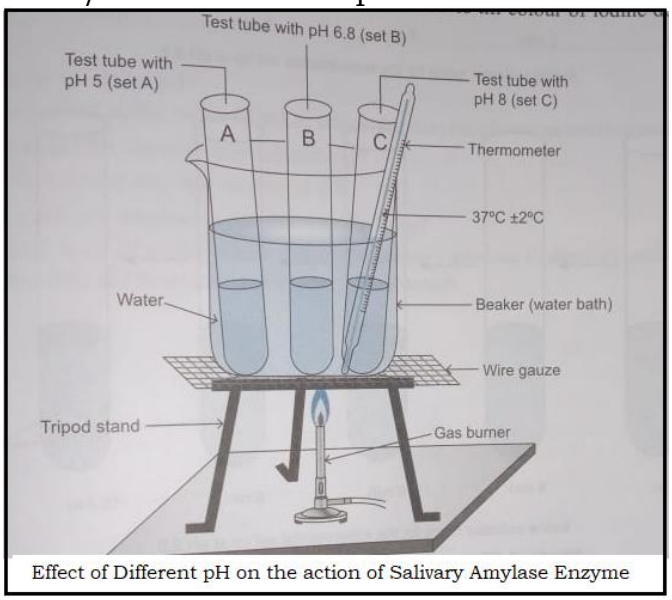
Procedure: (Study of effect of pH on Salivary Amylase)

1. Take three test tubes and label these A, B, C and prepare these in following way:

Set-A: Add 5ml of 1% starch solution + 1 ml of 1% NaCl Solution + 2ml of the saliva solution+ 2 ml of dil HCl/tablet of known pH in test tube A. Now keep this test tube in Ice water bath (2 ^{o} C to 4^o C)

Set-B: Add 5ml of 1% starch solution + 1 ml of 1% NaCl Solution + 2ml of the saliva solution+ tablet of known pH 7 in test tube B.

Set-C: Add 5ml of 1% starch solution + 1 ml of 1% NaCl Solution + 2ml of the saliva solution+2 ml of dil NaOH/tablet of known pH 9 in test tube C.



Effect of Different pH on the action of Salivary Amylase Enzyme

2. Keep all 3 test tubes in a water bath at 37°C for 10 minutes.
3. Take a white tile and mark it as shown in figure.
4. After 2 minutes of preparation, take 1-2 drops from each test tube and put it on the tile at respective places. Put one drop of Iodine solution on each spot.
5. Now observe change in colour of Test solution with Iodine (Dark Blue-black to Orange-brown) if any, and note it in the observation table.
6. Repeat the step 3 and 4 after every 2 minutes till achromatic point reached i.e. no Blue-black colour is formed and the colour of Iodine does not changed.

Observation:

Time Interval	**Colour Intensity of solution after At different pH**		
	Set-A (pH ~4)	**Set-B (pH ~7)**	**Set-C (pH ~ 9)**
2	Blue	Blue	Blue
4	Blue	Blue	Blue
6	Blue	Blue	Blue
8	Blue	Orange/Brown	Blue
10	Blue	Orange	Blue
12	Blue	Orange	Blue
14	Blue	Orange	Blue
16	Blue	Orange	Blue

It takes …… minutes (less time) to reach achromatic point at pH 7, as the enzyme is maximum active at this pH, while at higher and lower pH ……. Minutes and …..minutes (more time) is taken to reach the achromatic point.

Conclusion

pH 4 is acidic and pH 9 is alkaline, therefore salivary amylase did not act in these tubes. Whereas, the enzyme acted in the tube with pH 6.8 (i.e., slightly acidic) and digested the starch.

Precautions:

1. Always use clean and dried glasswares for the experiment.
2. All the measurement must be accurate.
3. Different droppers should be used to pour different solutions.
4. Do not mix the drops on the tile.
5. Maintain uniform temperature throughout the experiment.

CORE EXPERIMENT: 9 (Isolation of DNA)

Aim:

Isolate DNA from available plant material such as spinach, green pea seeds, papaya, banana, Cauliflower etc.

Principle:

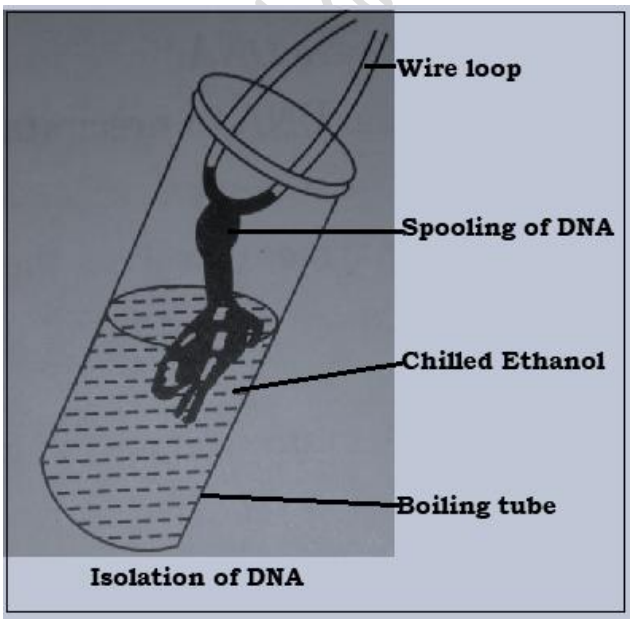
DNA is one of the nucleic acids found in living systems. DNA acts as the genetic material in most of the organisms. Recombinant DNA technology has allowed breeders to introduce foreign DNA in other organisms including bacteria, yeast, plants and animals. Such organisms are called Genetically Modified Organisms (GMOs). Thus rDNA technology involves isolation of DNA from a variety of sources and formation of new combination of DNA.

Requirements:

Plant material (spinach/green pea/papaya/banana/Cauliflower/Tomato/Onion), Water, Pastel and mortal or grater, Chilled Ethanol (Refrigerate it overnight), NaCl, Liquid detergent, Muslin cloth for filtration, tooth pick, Large paper clips/ Wire loop, Beaker, Petri dish, Boiling tube

Procedure:

1. Take the available plant material and grind it in the mortar or grate/mesh it to make paste in a petri dish/beaker.
2. Fill a clean beaker with 25 ml of water, slowly add two teaspoons of liquid detergent and half teaspoon of NaCl. Gently mix tem without making bubbles till the salt dissolves.
3. Add this mixture to meshed plant material and let it undisturbed for 20 minutes to give detergent enough time to react.
4. Place a fine/muslin cloth on a small beaker/boiling tube and carefully pour the mixture here and filter it. Gently squeeze the mixture to get more liquid out. This liquid filtrate contains DNA.
5. Since the DNA is soluble in water so to isolate DNA from this filtrate pour chilled ethanol by side of slightly (45^0) tilted boiling tube.
6. After few minutes DNA will isolate as white precipitates/ fine threads from the watery filtrate at the boundary layer between water and ethanol.
7. Separate DNA by spooling i.e. the winding of the fine threads of DNA on clip or wire loop.



Isolation of DNA

Observation:

DNA appears as white precipitate of very fine threads on the spool.

Inference:

Thus DNA can be isolated from the plant cell nucleus by this technique.

Precautions:

1. All the glass wares must be thoroughly cleaned and dried.
2. The chemicals used for the experiments must be of standard quality.
3. NaCl and Liquid detergent should be to dissolve slowly by stirring without formation of foam or bubbles.
4. Add chilled ethanol to enable the precipitation of the DNA
5. Use wire or blunt forceps for spooling of precipitated DNA.

SPOTTING

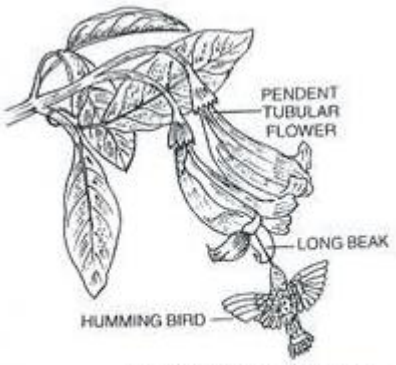
SPOT 1:

Flowers adapted to pollination by different agencies (wind, insects, and birds).

1.1: Flowers adapted to pollination by BIRDS

COMMENTS:

1. Pollination is the process of transferring pollen from the male anther of a flower to the female stigma of the same or different flower.
2. Pollination of flowers by insects is called ornithophily.
3. The flowers pollinated by birds are strong and are adapted to allow the birds to stay near the flowers without their wings getting entangled in them.
4. The flowers are tubular and curved that facilitates nectar-sucking by birds.
5. The flowers are odourless and bright-coloured that attracts the birds. While sucking the nectar, the pollen gets deposited on their beaks and neck and is transferred to the plant they visit next.
6. Few examples of flowers pollinated by birds include: Hibiscus, Bignonia, Verbenas,



A humming bird collecting nectar from *Bignonia capreolata* flowers thereby pollinating them.

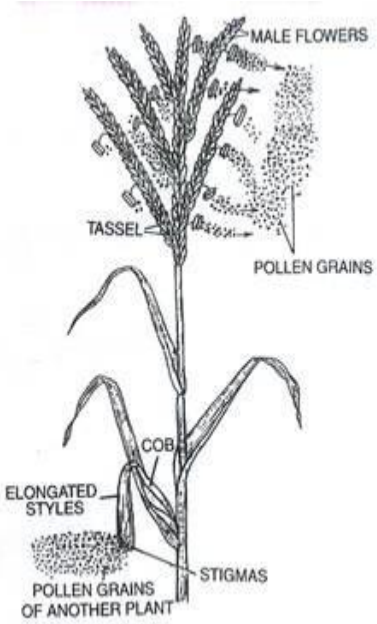


Fig. 2.19. Anemophily in Maize.

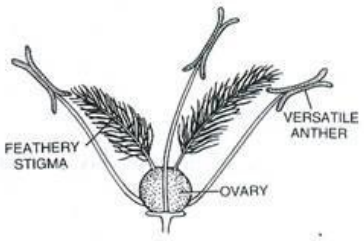


Fig. 2.20. Feathery stigmas and versatile anthers in a flower of Grass.

1.2: Flowers adapted to pollination by WIND

COMMENTS:

1. Pollination is the process of transferring pollen from the male anther of a flower to the female stigma of the same or different flower.
2. Most of the conifers and angiosperms exhibit wind pollination. Pollination of flowers by the wind is called as *anemophily*.
3. Such flowers do not produce nectar and fragrance.
4. In the flowers pollinated by the wind, the microsporangia hang out of the flower. As the wind blows, the light-weight pollen blows with it. The pollen gets accumulated on the feathery stigma of the flower.
5. These flowers appear even before the leaves when the spring commences.
6. Few examples of such flowers include: Rice, Barley, Papaya, Maize,Oats

1.3: Flowers adapted to pollination by INSECTS

COMMENTS:

1. Pollination is the process of transferring pollen from the male anther of a flower to the female stigma of the same or different flower.
2. Pollination of flowers by insects is called entomophily.

3. The flowers pollinated by insects are bright-coloured and produce nectar. Nectar guides are present on the petals.
4. The fragrance of the flowers attracts the insects.
5. The pollen are sticky, large, heavy and rough so that stick to the body of the insects.
6. The stigmas are also sticky so that the pollens depositing are not dispersed.
7. Few examples of the flowers pollinated by insects are: *Salvia, Datura*, Gulmohar, *Calatropis* etc

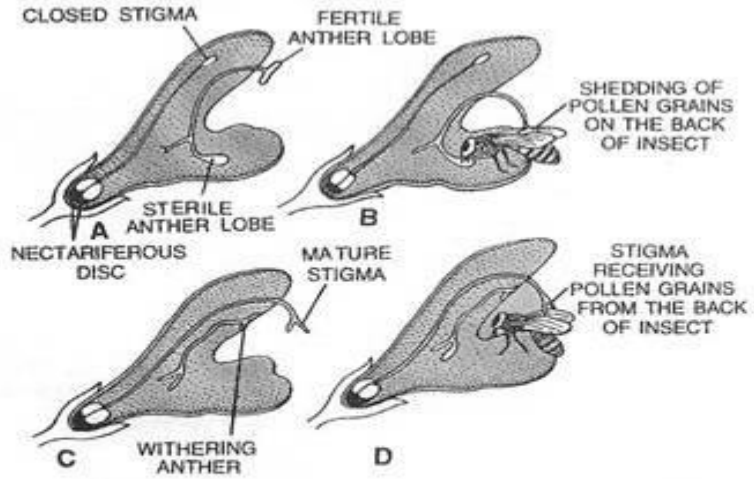
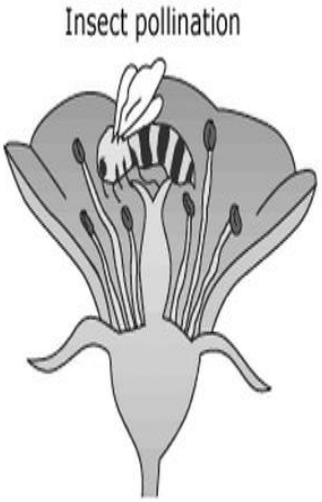
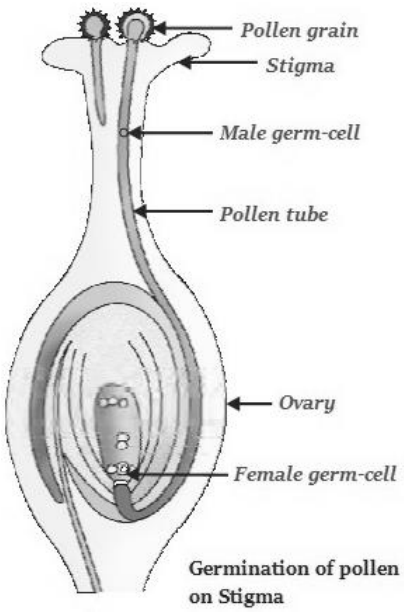


Fig. 2.22. Pollination in *Salvia*. A, flower with mature anthers, closed stigma and short style. B, shedding of pollen grains on the back of entering insect. C, flower with mature stigma and withering anthers. D, stigma receiving pollen grains from the back of entering insect.



SPOT.2:
Pollen germination on stigma through a permanent slide.
COMMENTS:



Germination of pollen on Stigma

1. Pollination refers to the transfer of pollen grains from the anther of a flower to the stigma of the same or different flower through biotic or abiotic means.
2. The pollen are deposited on the stigma. Here, the pollen germination starts with the absorption of nutrients and water.
3. A small pollen tube is produced through the style to the ovary.
4. The tube cell moves out of the pollen grain through one of the germ pores and forms a pollen tube.
5. The nucleus of the tube moves down to the tip of the pollen tube.
6. The generative cells also pass into it and soon divide to form two male gametes.
7. During double fertilization, one of the two sperms fuses with the egg cell of the ovule. This helps in embryo development.
8. The other cell combines with another subsidiary nuclei of the ovule that helps in the formation of endosperm.
9. The growing ovule is transformed into a seed.

SPOT. 3:

Identification of stages of gamete development, i.e., T.S. of testis and T.S. of ovary through permanent slides (from grasshopper/mice).

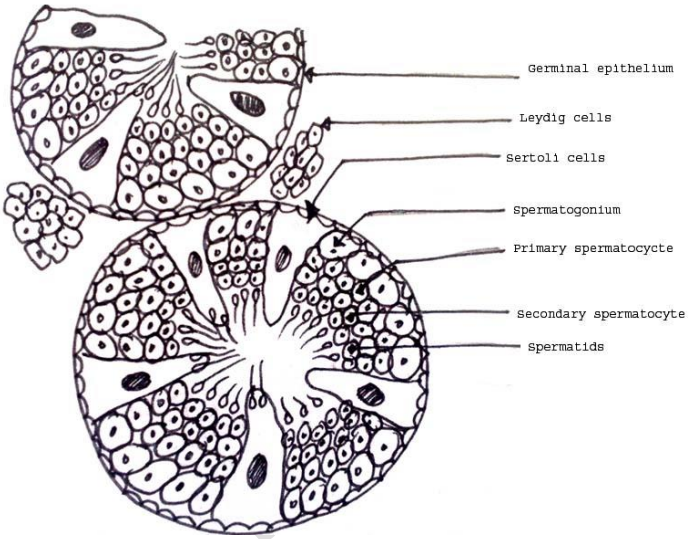
3.1: T.S. OF TESTIS

COMMENTS:

1. The testes comprise several seminiferous tubules embedded in the interstitial tissues.
2. Thick fibrous tissues called tunica albuginea cover the testes.
3. It comprises different types of cells from the outside to the lunar in the manner given below:

Spermatogonia → Spermatocytes → Spermatids → Spermatozoa (sperms)

4. Sertoli cells are located between the germinal cells.
5. The Leydig cells that produce testosterone are present in the interstitial tissues.

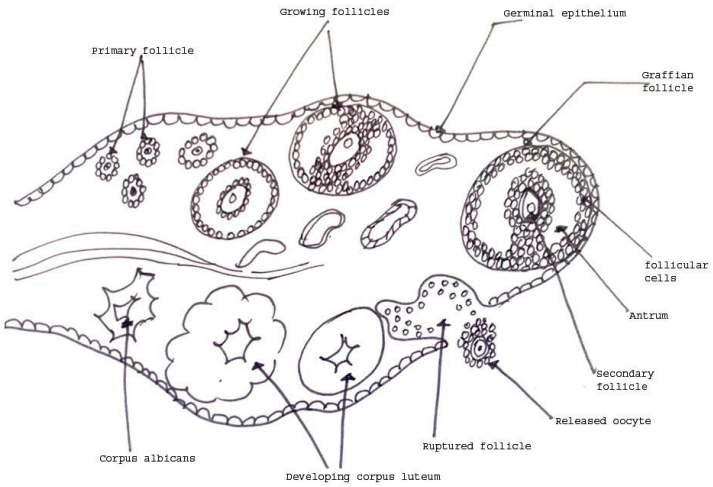


3.2: T.S. OF OVARY

COMMENTS:

1. An ovary is a germinal epithelium bounded by a solid structure covered by a thick layer of fibrous tissue known as tunica albuginea.
2. It consists of an inner medulla and an outer cortex.
3. The medulla comprises several round or oval bodies known as ovarian follicles.
4. Follicle development takes place in the following stages:

   1°follicle → 2°follicle → 3°follicle → Graffian follicle → Corpus luteum
5. Cortex comprises corpus luteum along with mature follicles.



SPOT. 4:

Meiosis in onion bud cell or grasshopper testis through permanent slides.

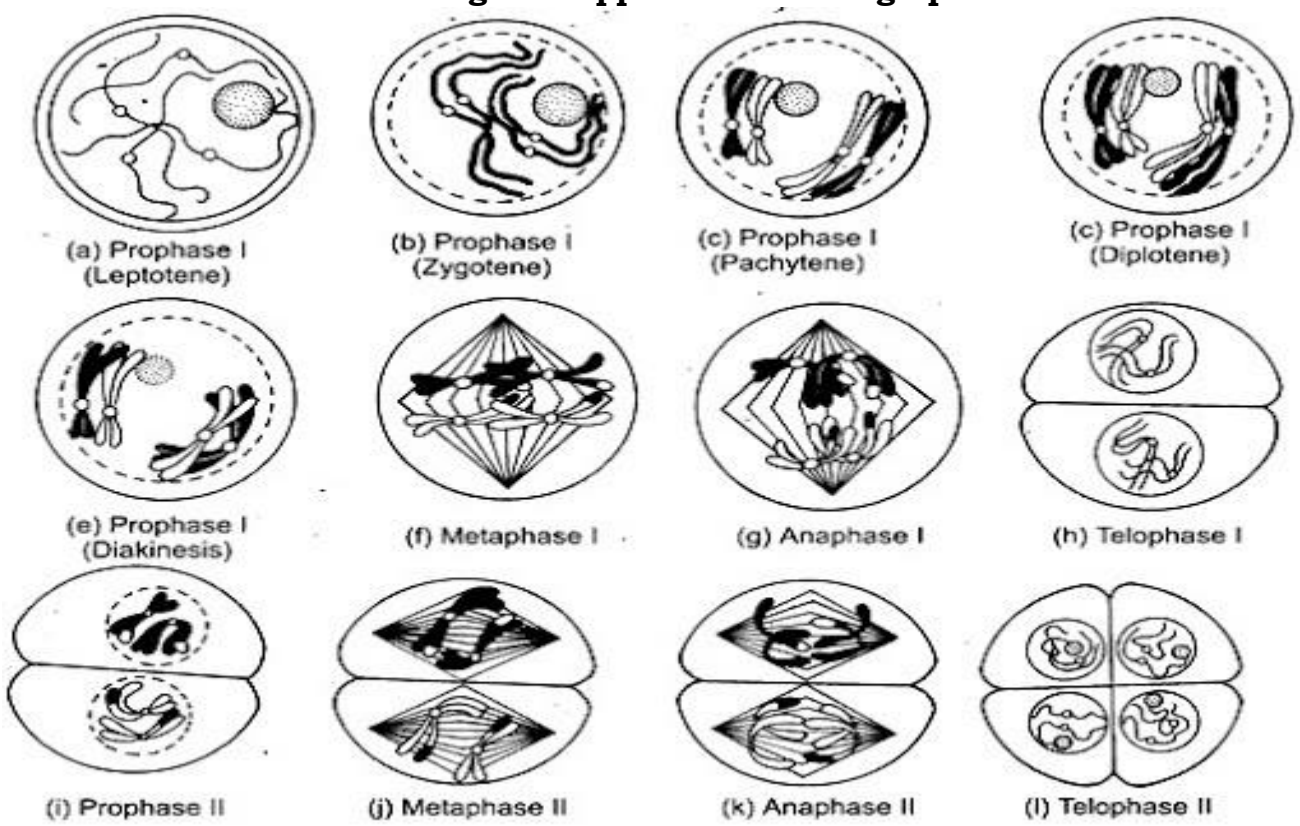


Fig. 5.3A: Different stages of Meiosis (diagrammatic)

COMMENTS:

(1)Prophase I: In this stage, the chromosomes condense and move towards the centre of the cell. It consists of five different sub-phases:

a. Leptotene: The homologous chromosomes replicate.

b. Zygotene: Synapsis between homologous chromosomes start.

c. Pachytene: The sister chromatids separate but the homologous chromosomes remain attached.

d. Diplotene: The two homologous chromosomes migrate apart and disintegrate between the chromosomal arms.

e. Diakinesis: The condensation of chromosomes stop at this stage and the chiasmata is clearly visible under an electron microscope. The nucleolus and the nuclear envelop disappear at this stage and the centrosome moves to the equator.

(2)Metaphase I: The homologous chromosomes that contain two different alleles for each gene, line up on the metaphase plate to be separated.

(3)Anaphase I: The separated chromosomes are pulled towards the centrioles on either side of the cell.

(4)Telophase I: The chromosomes are completely pulled apart and new nuclear envelope forms.

(5) Prophase II: In this stage, the nuclear envelope disintegrates and centrioles develop.

(6)Metaphase II: The chromosomes line up on the metaphase plate and the chromatids are on either side of the metaphase plate.

(7)Anaphase II: The sister chromatids separate and are known as sister chromosomes.

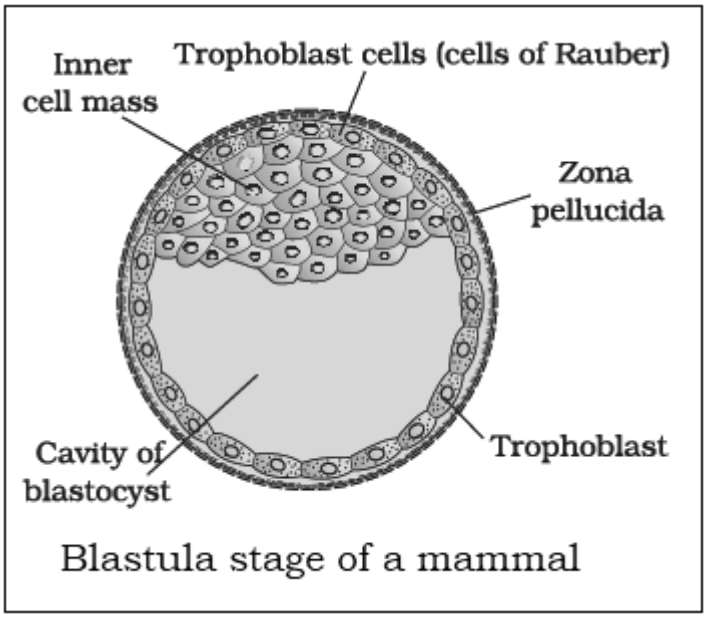
(8)Telophase II: The cell divides into two and new nuclear envelope surrounds the chromosomes.

SPOT.5:

T.S. of blastula through permanent slide (Mammalian).

COMMENTS:

1. The zygote undergoes a few cycles of mitotic divisions to form a solid ball of cells called morula. The cells continue to divide and at a later stage a cavity is formed within it. This stage is blastula.
2. Blastula appears as a sphere with a cavity known as blastocoel.
3. An outer layer of blastomeres known as trophoblasts is observed.
4. One end of the blastula shows a cellular mass adhered to the trophoblast. This is known as the inner cell mass.



Blastula stage of a mammal

SPOT.6:

Mendelian inheritance using beads/seeds of different colour/sizes of any plant.

6.1: Monohybrid cross:

PROCEDURE:-

1. A lot of about 100 pea seeds are taken in an enamel tray.
2. The round and wrinkled seeds are separated out and are put in two different petridishes.
3. The number of the round and wrinkled seeds are noted and their approximate ratio is calculated.
4. The process is repeated for the other contrasting trait of the seed i.e, yellow and green colour.

OBSERVATIONS:- (Enter your own readings)

S.NO	Characters / Traits of seed	Total no. of seeds observed	No. of seeds showing contrasting form of the trait	Approximate Ratio
1.	Seed shape (round/wrinkled)	106	80(R):26 (W)	3.07:1
2.	Seed colour(yellow/green)	110	83(Y): 27(G)	3.07:1

CONCLUSION;-

The contrasting forms in both the traits of the pea seed (i.e, seed shape and seed colour) show an approximate ratio of 3 : 1. The ratio is exactly the same as obtained by Mendel for monohybrid crosses and indicate that the dominant and recessive forms of seed shape and seed colour exist in the ratio 3 : 1 in the population of pea seeds.

6.2: Dihybrid Cross

PROCEDURE:-

1. A lot of about 250 pea seeds are taken in a enamel tray.
2. The yellow round, yellow wrinkled , green round , green wrinkled seeds are separated and put in separate petridishes.
3. The number of seeds in each dish is noted and their approximate ratio is found out.

OBSERVATION:-

Total no. of seeds observed	No. of yellow round seeds	No. of yellow wrinkled seeds	No. of green round seeds	No. of green wrinkled seeds	Approximate Ratio
257	145	48	48	16	9.06:3:3:1

CONCLUSION:-

The ratio of yellow round, yellow wrinkled, green round, green wrinkled approximately 9 : 3 : 3 : 1, which is exactly the same as obtained by Mendel for a Dihybrid cross. This indicates that the contrasting genes for seed colour and seed shape show an independent assortment in the population of pea seeds.

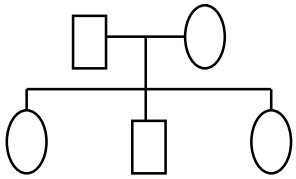
SPOT: 7:

Prepared pedigree charts of any one of the genetic traits such as rolling of tongue, blood groups, ear lobes, widow's peak and colour blindness.

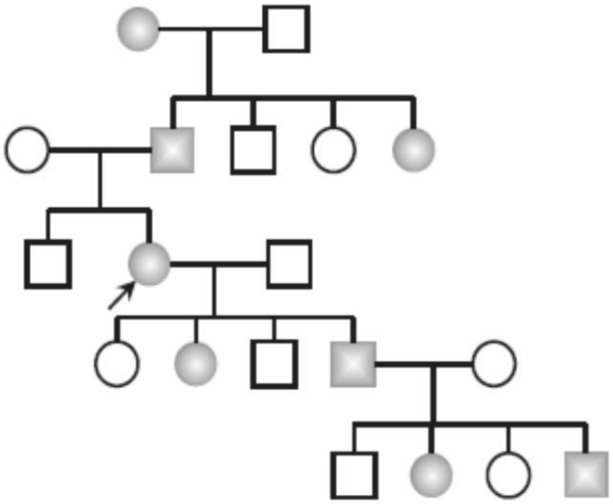
7.1: WIDOW'S PEAK

COMMENTS:

1. A Pedigree is a visual showing the pattern of inheritance for a trait. (Family tree)
2. Symbols and Rules: Unaffected Male = ☐ Unaffected Female = ◯
   Affected Male = ■ Affected Female = ●
3. Link parents together with a line and then make a vertical line to connect to offspring:



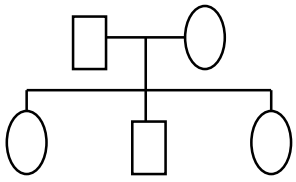
4. Widow's peak is a hairline that forms distinct peak on forehead, it is an Autosome Linked Dominant trait.
5. Transmission of traits occurs from parents of either sex. Males and females are equally affected.
6. The pedigree is vertical, i.e., the trait is marked to be present in each of the generations. Multiple generations are characteristically affected.



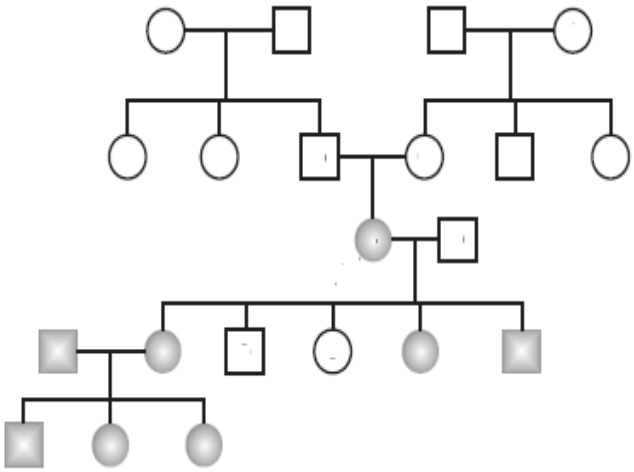
7.2: ROLLING OF TONGUE & FUSED EAR LOBES:

COMMENTS:

1. A Pedigree is a visual showing the pattern of inheritance for a trait. (Family tree)
2. Symbols and Rules: Unaffected Male = ☐ Unaffected Female = ◯
   Affected Male = ■ Affected Female = ●
3. Link parents together with a line and then make a vertical line to connect to offspring:



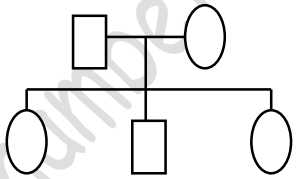
4. Rolling of tongue (Ability to roll tongue in U shape) & fused ear lobes (Ear lobes attached to head) are an Autosome Linked Recessive traits.
5. Occur in equal proportions in multiple male and female siblings, whose parents are normal but carriers;
6. The siblings are homozygous for the defective allele, but their parents, though some may appear normal, are obviously heterozygous, i.e., are merely carriers of the trait.
7. Consanguinity (marriage between man and woman genetically related to each other, such as cousins) occasionally results in the appearance of such traits.



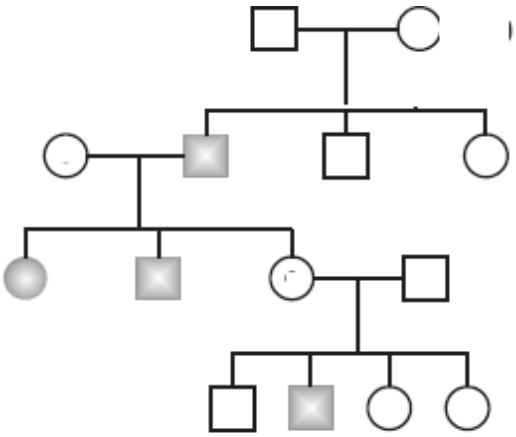
7.3: COLOUR BLINDNESS:

COMMENTS:

1. A Pedigree is a visual showing the pattern of inheritance for a trait. (Family tree)
2. Symbols and Rules: Unaffected Male = □ Unaffected Female = ○
   Affected Male = ■ Affected Female = ●
3. Link parents together with a line and then make a vertical line to connect to offspring:



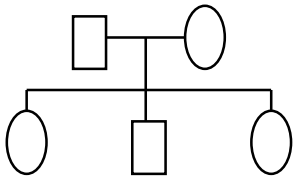
4. Red-green colour blindness is an example of Sex (X- chromosome) linked recessive trait.
5. Females express the trait only when they are homozygous for the mutant allele, whereas the males do so even when they are hemizygous for it.
6. About half of the sons of the carrier (heterozygous for the trait) females are affected. In case of homozygous females showing the trait, fifty percent of her daughters and all of her sons are likely to be affected. Therefore, the males are most affected in the population.
7. This trait shows cris-cross inheritance or skipping of generation.



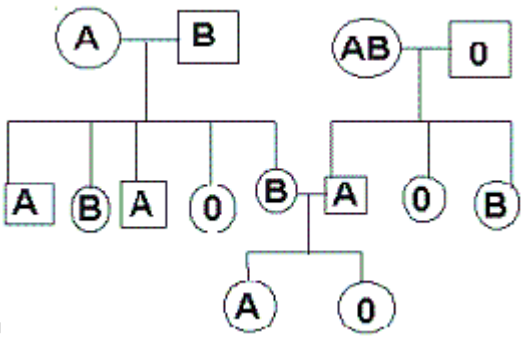
7.4: BLOOD GROUP:

COMMENTS:

1. A Pedigree is a visual showing the pattern of inheritance for a trait. (Family tree)
2. Symbols and Rules: Unaffected Male = □ Unaffected Female = ○
   Affected Male = ■ Affected Female = ●
3. Link parents together with a line and then make a vertical line to connect to offspring:



4. Inheritance of Blood group is an example of Dominance, Multiple allelism and co-dominance.
5. Gene for ABO blood group having 3 alleles: I^A, I^B and o in which I^A and I^B are dominant while o is recessive.
6. It is independent of sex of the organism.



SPOT. 8:

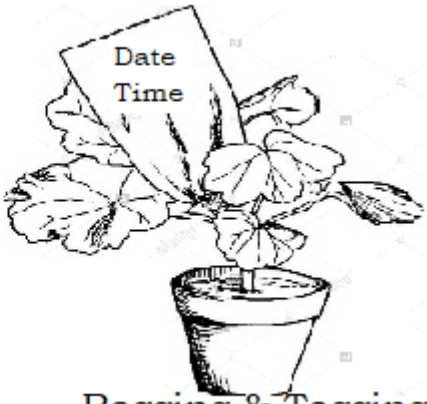
Controlled pollination - emasculation, tagging and bagging.

COMMENTS:

1. Conventional plant breeding programs involve bringing under human control reproductive processes that lead to seed and fruit formation.
2. For this controlled pollination is desirable using male and female parent having desired traits.
3. One of the process that can be easily brought under human control is emasculation in which the stamens are removed from bisexual flowers in order to prevent self-fertilization.
4. The process to cover the emasculated flower with a plastic bag to protect it from undesired pollen is called as Bagging.
5. Just after desired cross pollination the pollinated flower again covered with the bag immediately. Then for identification, labelling of the female parent is called as Tagging.
6. This process helps in the production of flowers with desired characteristics.

Procedure.

Emasculation



Bagging & Tagging

SPOT. 9:

Common disease causing organisms like Ascaris, Entamoeba, Plasmodium, any fungus causing ringworm through permanent slides or specimens. Comment on symptoms of diseases that they cause.

9.1: Ascaris

COMMENTS:

Systematic position:

Phylum – Aschelminthes

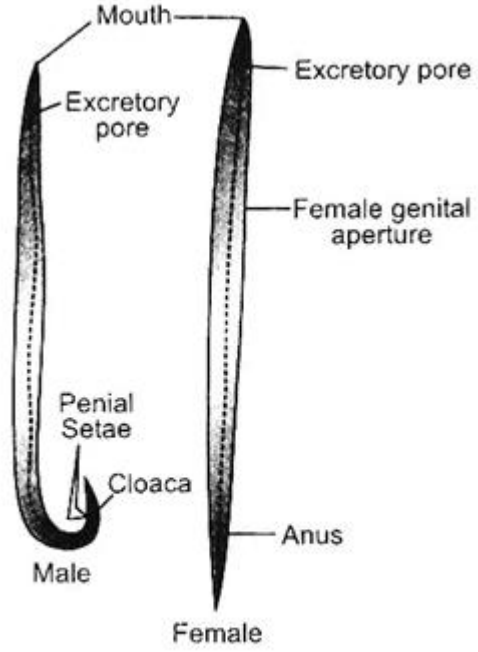
Class – Nematoda

Type – Ascaris lumbricoides

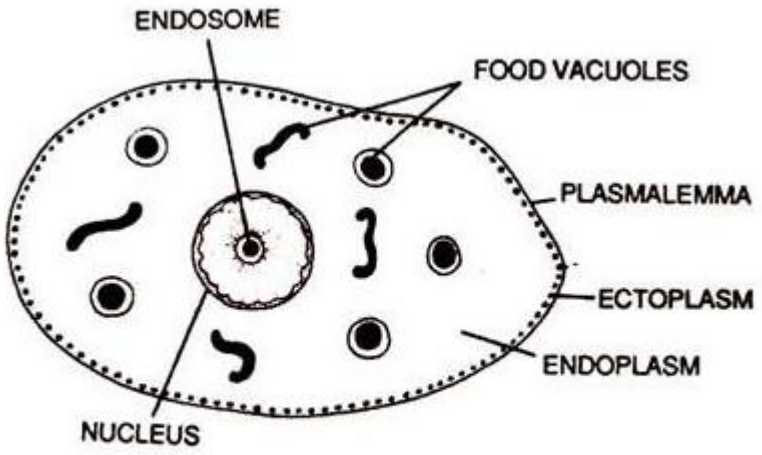
External features:

1. It has a long, cylindrical and un segmented body.
2. The male and female organisms are separate.
3. It bears a mouth at the anterior end surrounded by three lips.
4. There is an excretory pore on the ventral surface slightly behind the anterior end.
5. A pair of penial spicules are present in the male worms close to the cloacal opening.
6. The female genitals are present at about one-third distance from the anterior end.

#Disease: Round worm or Ascaris is one of the common parasite found in the intestine of human beings that causes Ascariasis.
#Symptoms: (a) Irregular bowel, (b) Occasional vomiting, (c) Anaemia (d)Abdominal cramping & swelling (e) Nausea



Ascaris lumbricoides,



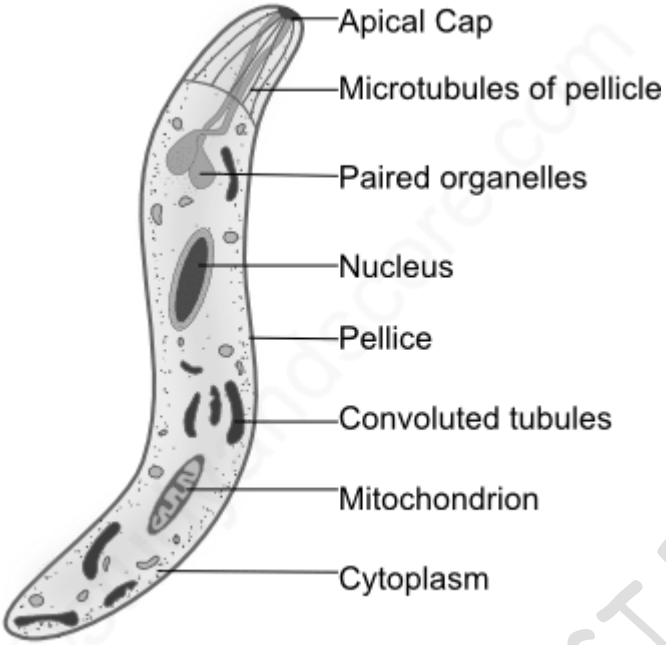
Entamoeba histolytica.

9.2: Entamoeba
COMMENTS:
Systematic position:
Phylum: Protozoa
Class: Rhizopoda
Type: Entamoeba hystolytica
External features:
1. It is a unicellular organism with an irregular shape.
2. It consists of a few food vacuoles. The contractile vacuole is absent.
3. Cysts with four nuclei are present.
4. It consists of a nucleus located eccentrically in the cell.
Disease: Entamoeba histolytica is an organism found in the intestines of humans that is responsible for causing amoebic dysentery.
#Symptoms: Abdominal pain, Watery diarrhea with mucus, blood and pus, Fatigue, Fever, Nausea, Vomiting.

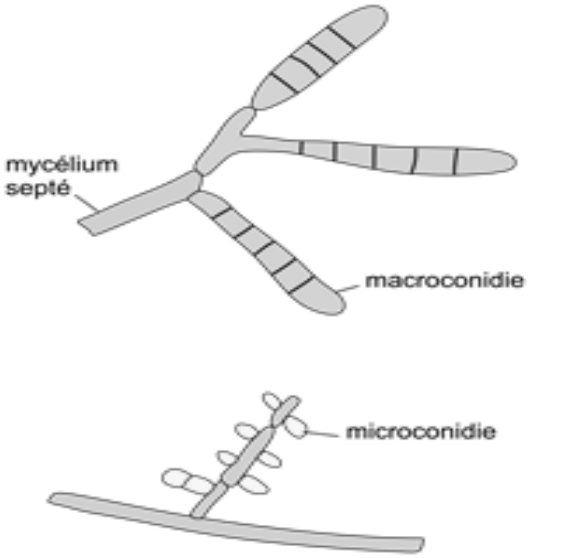
9.3: Plasmodium
COMMENTS:

Systematic position:
Phylum: Protozoa
Class: Sporozoa
Type: Plasmodium vivax
#External Features:
1. It is a unicellular endoparasite found within the red blood cells of the diseased person.
2. The parasite is mostly diagnosed at the “signet ring” stage where the parasite appears as a round body.

3. There is a big vacuole present inside the cell. The cytoplasm is accumulated at one place and contains the nucleus.
4. Plasmodium vivax is a protozoan parasite that causes malaria in humans. The infected female anopheles bites a healthy person and transmits the sporozoite into the peripheral blood vessels of humans.
#Disease: The infective stage sporozoites causes the disease Malaria. This stage undergoes several rounds of multiplication in liver and erythrocytes of Human.
#Symptoms:High fever, Shaking chills, Headache, Vomiting, Nausea



STRUCTURE OF SPOROZOITE



Trichophyton rubrum

9.4: Trychophyton (Ringworm)
COMMENTS:
#Systemic position:
Kingdom: Fungi
Class: Deuteromycetes
Type: Trichophyton rubrum
#External features:
1. This fungus feeds on the keratin of the skin of human beings.
2. The hyphae are waxy and can be smooth or cotton-like.
3. Hyphae that are not stained are yellowish-brown, reddish-brown or white in colour.
#Disease: Ringworm is a communicable fungal infection of the skin.
#Symptoms: Scaly, itchy skin, Red and raised patches, they are redder at the periphery than at the centre and forms a ring-like appearance.

SPOT.10:

Two plants and two animals (models/virtual images) found in xeric conditions. Comment upon their morphological adaptations.

10.1: OPUNTIA DILLENII (NAGPHANI)

COMMENTS:

1. It is a succulent or drought resisting xerophyte, which grows wild in arid areas.
2. The leaves are caduceus. They fall down soon after their formation to reduce transpiration.
3. The stem is jointed, flattened and green phylloclade.
4. The stem becomes fleshy due to storage of water. The stored water is used throughout the unfavorable periods.
5. The stem possesses abundant mucilage, which helps in retaining water.

10.2: CALOTROPIS PROCERA (AK)

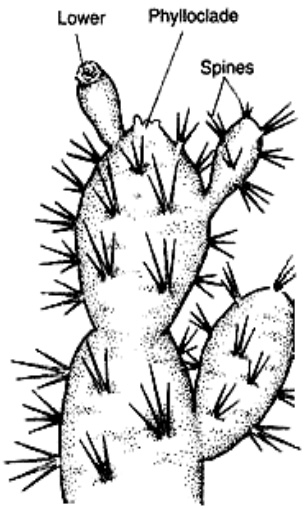
COMMENTS:

1. It is a drought enduring wild shrub of arid, desert & waste lands.
2. The plant has a light grey colour which makes it possible for the plant to absorb less sunlight.
3. The leaves and young branches are covered by a thick cuticle and waxy cover along with hairs for insulation.
4. The leaves are thick and partially leathery so they not wilt easily.
5. The plant possesses milky latex which help in retaining water.

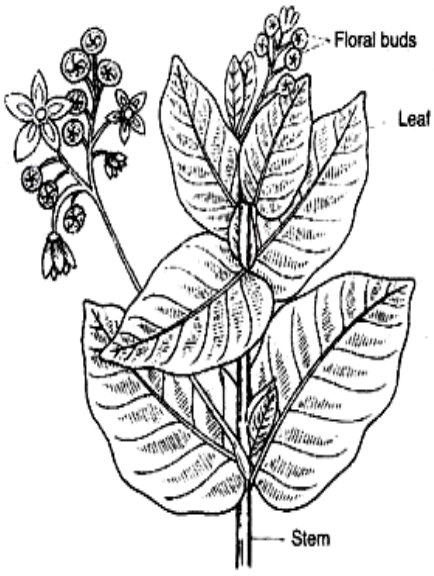
10.3: ACACIA ARABICA (BABOOL)

COMMENTS

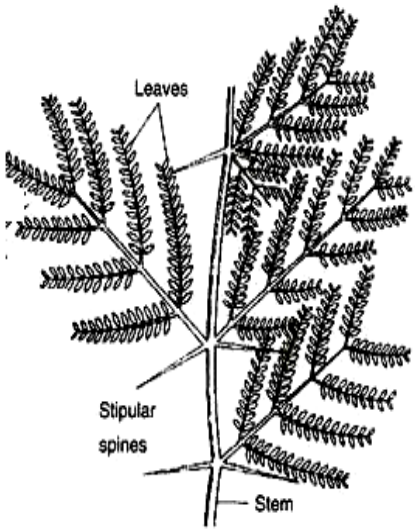
1. It is a drought enduring xerophyte.
2. The older part of the stem are covered by thick brown bark.
3. The leaves are compound bipinnate to reduce transpiration.
4. The stipules are modified into spines to reduce transpiration and prevent grazing.



Opuntia



Calatropis procera



Acacia arabica

10.4: CAMEL

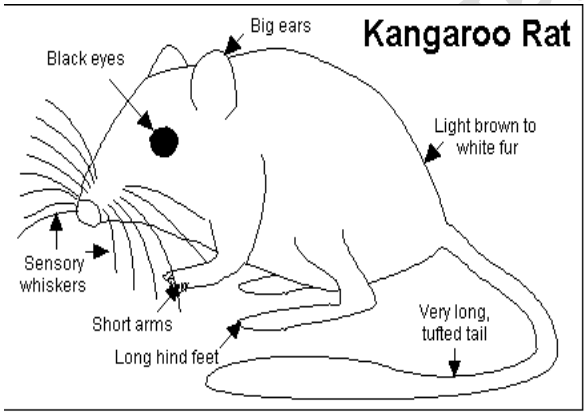
COMMENTS:

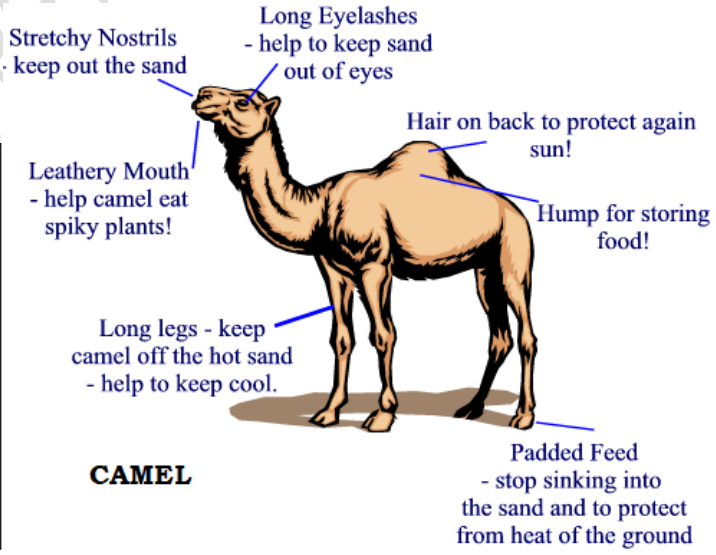
1. It is xerocoles animal adapted to the desert conditions.
2. It is able to tolerate wide range of temperature fluctuations and is able to maintain blood moisture even during hot period.
3. It excretes concentrated urine and can withstand dehydration up to 25% of its body weight.
4. It accumulates its fat in the hump rather than all the body.
5. Its feet has two toes each with fleshy pad below which spread the load on sand enable it to move on hot and slippery sand.
6. Its slender snout bears a cleft upper lip, long eye lashes and muscular nostrils which can be closed for protection from windblown sand.

10.5: KANGAROO RAT

COMMENTS:

1. The kangaroo rat is almost perfectly adapted to life in the desert.
2. They can survive without ever drinking any water, getting needed moisture from their seed diet.
3. They have excellent hearing and can even detect the silent sound of an owl approaching.
4. Kangaroo rats have pouches, but not for carrying their babies. Their pouches are on the outside of their cheeks and are used for carrying seeds back to their burrows.
5. Kangaroo Rats don't sweat or pant like other animals to keep cool because that would cause them to lose water from their bodies.





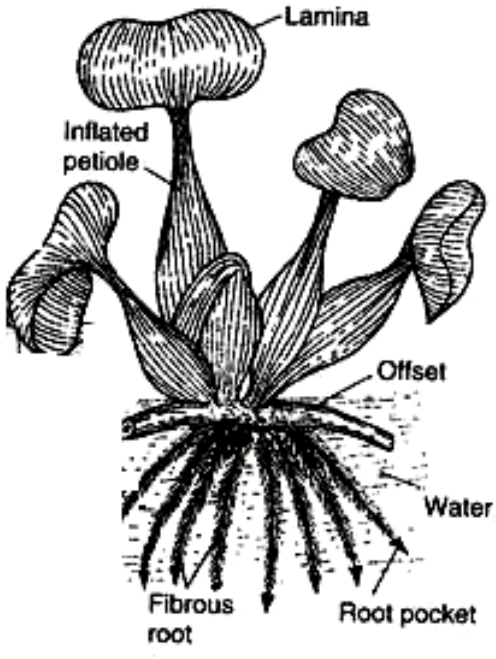
SPOT.11:
Two plants and two animals (models/virtual images) found in aquatic conditions. Comment upon their morphological adaptations.

11.1:EICHHORNIA (WATER HYACINTH)
COMMENTS:

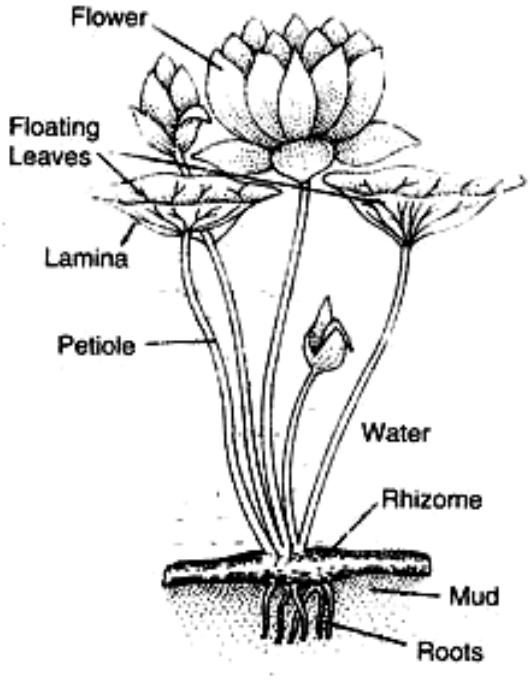
1. It is a free floating hydrophyte that grows in ponds lakes and water bodies containing freshwater.
2. When the level of water is low, the plant gets rooted in the soil.
3. The stem is offset that grows prostrate below the surface of water. It is spongy and stores air.
4. The leaves arise at the nodes in clusters. The petioles of the leaves are inflated that keep the leaves out of water.
5. The emerged leaves have waterproof, waxy and cuticular coating to prevent wetting.

11.2: NELUMBO NUCIFERA (LOTUS)
COMMENTS:

1. It grows in the mud of lagoons, ponds, marshes and waterlogged fields.
2. Leaves of Lotus plant are very wide and disc shaped. This allows them to float on water and absorb large amount of sunlight.
3. The stem and leaf surfaces of Lotus are coated with a wax which is very difficult to wet. Therefore, it keeps the surfaces free from excessive water even in water rich environment.
4. Lotus plants absorb large amounts of heavy metals and have been used to clean industrial pollutants.
5. Lotus flowers have antibacterial properties, an adaptation that protects them from microorganisms and makes them a valuable medicinal plant



Eichhornia



Nelumbo

11.3: LABEO ROHITA (ROHU OR CARP)

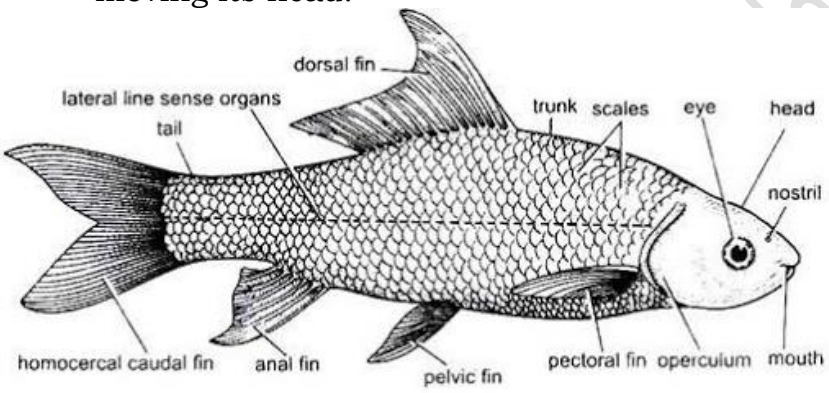
COMMENTS:

1. Its body is compressed laterally to reduce friction and to allow swift passage in water while swimming.
2. It possesses fins that helps in swimming.
3. It has an air bladder or swim bladder which maintains buoyancy.
4. It possesses gills as organs of respiration for the exchange of gasses in water.
5. The body is covered with water impermeable scales to prevent osmotic entry of water in the body.

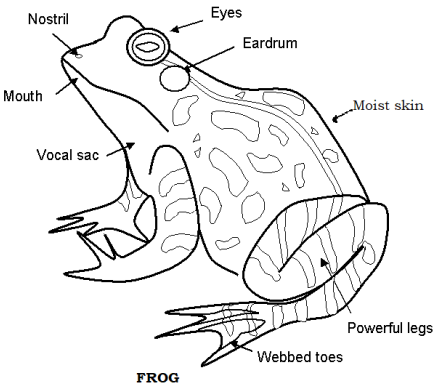
11.4: RANA TIGERINA (INDIAN BULL FROG)

COMMENTS:

1. Frogs have long and powerful legs that allow them to jump and swim for long distances.
2. They also have webbed feet that act as fins to aid in swimming.
3. The shape of the frog's body is streamlined, with a slim body, no neck and a broad head, which allows it to propel itself through water more smoothly.
4. Frog skin is thin and allows for cutaneous respiration. It produce mucous that keeps the skin moist.
5. Frog eyes are large and round, sitting on top of the head. This positioning allows the frog to keep most of its body beneath the water and a wide range of vision. It also allows the frog to look around for predators and prey without moving its head.



Rohu Fish



FROG