पुष्पना International School

Shree Swaminarayan Gurukul, Zundal

Class – XI **Subject: Biology** **Experiment (2021_22)**

Exp. No	Aim
	Term -1
1	Study and describe a locally available common flowering plant, from any one family: Solanaceae or Liliaceae (Poaceae, Asteraceae or Brassicaceae can be substituted in case of particular geographical location) including dissection and display of floral whorls, anther and ovary to show number of chambers (floral formulae and floral diagrams).
2	Study of osmosis by Potato osmometer
	Term -2
3	Separation of plant pigments through paper chromatography
4	Study of distribution of stomata in the upper and lower surfaces of leaves.
5	Study of the rate of respiration in flower buds/leaf tissue and germinating seeds
6	Test for presence of sugar in urine
7	Test for presence of albumin in urine
	B. Study/observation of the following (Spotting) Term :1
B1	Parts of a compound microscope.
B2	Specimens/slides/models and identification with reasons - Bacteria, Oscillatoria, Spirogyra, Rhizopus, mushroom, yeast, liverwort, moss, fern, pine, one monocotyledonous plant, one dicotyledonous plant and one lichen.
B3	Virtual specimens/slides/models and identifying features of - Amoeba, Hydra, liverfluke, Ascaris, leech, earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit.
	Term 2
B 4	Tissues and diversity in shape and size of animal cells (squamous epithelium, smooth, skeletal and cardiac muscle fibers and mammalian blood smear) through temporary/permanent slides
B 5	Mitosis in onion root tip cells and animal cells (grasshopper) from permanent slides

Experiment 1

Aim Of The Experiment

To study and describe the three locally available common flowering plants one from each of the families Solanaceae, Fabaceae, Liliaceae(Poaceae, Asteraceae or Brassicaceae can be substituted for specific geographical location) along with dissection and exhibition of floral whorls, anther and ovary to show the number of chambers through floral whorls and diagrams, types of roots (tap and adventitious), stem(woods and herbaceous) and leaf(shape, arrangement, venation, compound and shape).

Family – Solanaceae

This family is referred to as the Nightshade family.

Petunia nyctanginifolia

Habitat	Grown an ornamental herb, Annual.
Root	The root is branched. Tap-root system is observed
Stem	Branched, aerial, solid, green, erect, herbaceous, cylindrical, hairy
Leaf	Consecutive in basal part and opposing decussate in the upper part, simple, cauline and Ramal, sessile, stipulate, acute, ovate, hairy, entire, unicostate, reticulate.
Inflorescence	Axillary dichasial cyme, Cymose.
Flower	Hypogynous, pedicellate, bracteate, hermaphrodite, actinomorphic, regular, pentamerous, complete, cyclic, white or light violet in colour.
Calyx	5 sepals, deeply lobes, green, gamosepalous, inferior, hairy, persistent
Corolla	5 petals, white or light violet in colour, infundibuliform, valvate, gamopetalous, induplicate, inferior, pentafid
Gynoecium	2 carpels (bicarpellary), superior, many ovules in each locule, stigma capitate, placenta swollen, syncarpous, bilocular, style long

Androecium	5 stamens, epipetalous, polyandrous, filaments unequal, basifixed, introse
Fruit	Capsule
Floral formula	**Br, ⊕♀ K(5),C(5A)‾‾‾‾‾‾‾‾5, G(2)**

https://youtu.be/ER2LLfCjXc8

Family – Papilionaceae (Fabaceae) Pea family

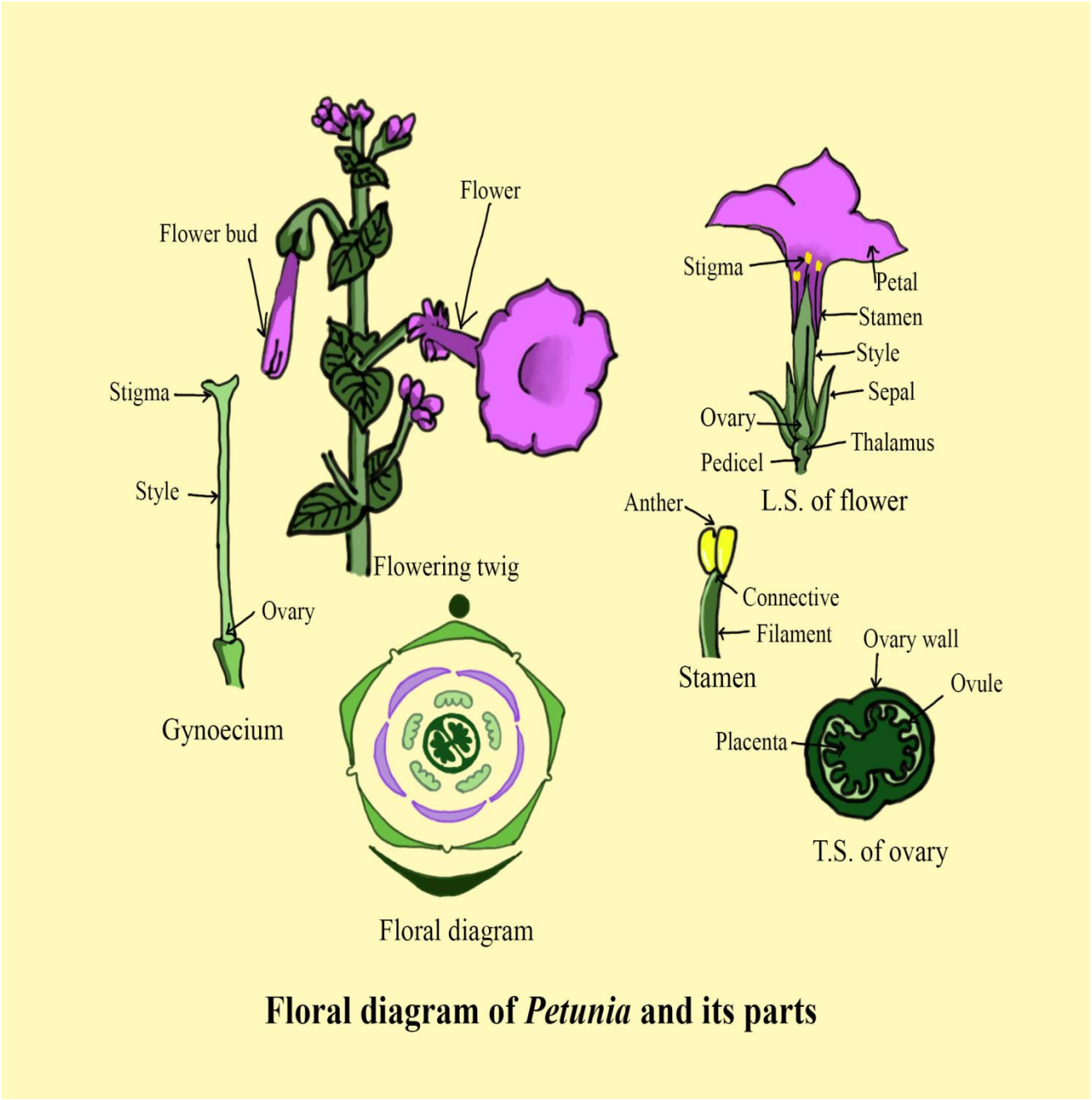
Pisum sativum

Habitat	Cultivated, annual herb
Root	Presence of root nodules, branched, tap.
Stem	Smooth, glaucous, cylindrical, weak, herbaceous, branched, climb with the help of leaf tendrils.
Leaf	Compound, Cauline and Ramal, alternate, stipulate, imparipinnate, terminal leaflet forms a tendril, leaflets 4 to 6.
Inflorescence	Solitary arrangement of flowers or axillary racemes, racemose
Flower	White or pink, complete, zygomorphic, irregular, bracteate, pedicellate, hermaphrodite, papilionaceous, hypogynous
Calyx	Imbricate, 5 sepals, campanulate, gamosepalous
Corolla	White/pink, 5 petals (1 standard, 2 wings, 2 keels united, keels shorter than wings), Corolla papilionaceous, enclosed pistil and stamens, imbricate.
Gynoecium	1 carpel, ovary superior, ovules many style bent and long, terminal, ovary hairy, stigma simple, unilocular, marginal placentation
Androecium	10 stamens in 2 bundles (diadelphous–9+1–9 mixed at the base for the formation of a tube around the ovary, 1 is free), basifixed, dehiscence by longitudinal cleave, anthers bilobed
Seeds	Ground, uniform
Fruit	A legume (pod)
Floral formula	% ⊕♀ K(5),C1 +2 +(2), A(9) +1, G1 https://youtu.be/EmXcslWpKxE https://youtu.be/zEGtC0G4_UU

Family – Liliaceae (Lily family)

Allium cepa

Habitat	Cultivated, Herbs.
Root	The root is fibrous.
Stem	The stem is underground. Altered to disc-like and found enclosed by scale leaves to form a bulb.
Leaf	The leaves are simple.
Inflorescence	leaflets scape or Terminal umbel (The young inflorescence can be surrounded by 2-3 membranous bract)
Flower	White in colour, complete, pedicellate, actinomorphic, bracteate, hermaphrodite, hypogynous
Perianths	Imbricate, gamophyllous, 6 lobed, arranged in 2 whorls of 3 each
Gynoecium	Style short, tricarpellary, axile plantation, Superior ovary, stigma small, trilocular, 2 ovules/locule, syncarpous
Androecium	Polyandrous, anthers, 6 stamens arranged in 2 whorls of 3 each, epiphyllous, long, dorsifixed, introse
Seeds	Seeds are albuminous.
Fruit	Capsule/Berry/
Floral formula	$\oplus ♀♂ P_{3+3}A_{3+3}G(3)$ or P(3+3) https://youtu.be/s_x_f68e27U



Floral diagram of *Petunia* and its parts

Experiment No.2

Aim ; Study of osmosis by Potato osmometer.

Requirements: Fresh large sized potato tuber , beaker ,20% sucrose solution , water, petridish , knife , bell pin needle marked with water proof ink.

Theory/principle Osmosis is a common physical process in living cells and tissues of all organisms. It is defined as the movement of molecules of solvent from a region of its higher concentration to a region of its lower concentration across a selectively permeable membrane such as plasma membrane

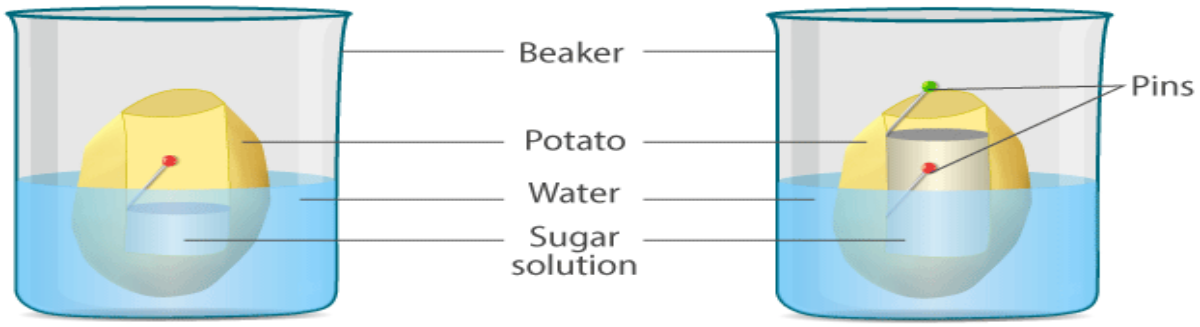
Procedure ; Cut the potato in to two equal halves with a knife. Peel of the outer skin .As the shape of the tuber is irregular in shape the two halves in squares

Scoop from the center of the tuber the soft parenchyma to make a small cavity of circular or square shape. The cavity prepared by scooping should have minimum thickness at the bottom.

Fill the half the cavity with 20% sugar solution. Fix a pin to the cavity in such a way that the mark is in line with the sucrose solution layer as shown.

Place the osmometer in a beaker/ petridish filled with water in such a way that 2/3rd of the potato osmometer is dipped in water.

Leave the set up undisturbed for about an hour .



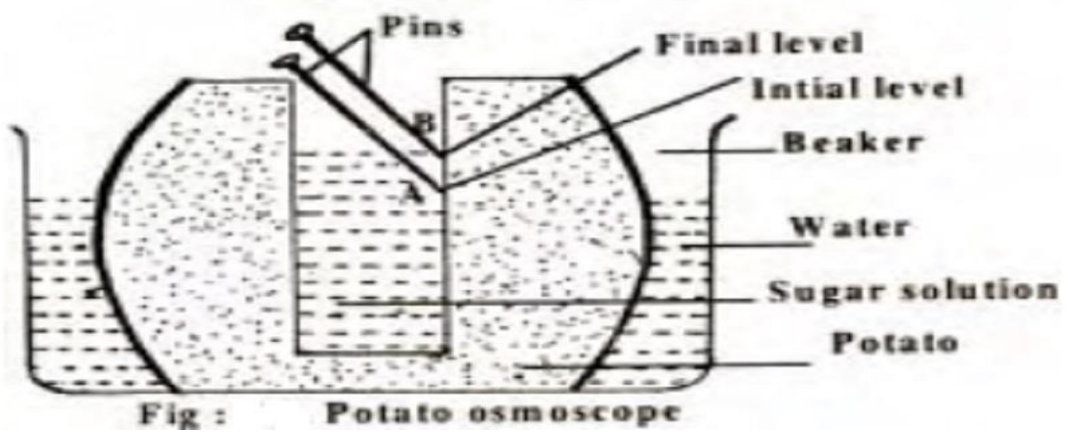


Fig : Potato osmoscope

Observe the level of sugar solution in the osmometer at the end of experiment
Repeat the experiment using water in the tuber cavity and sucrose solution in beaker/ petridish.

Conclusion ; The volume of sucrose solution inside the osmometer increases
Due to entry of water from the beaker as a result of endosmosis .
A water potential gradient is established between the sucrose solution present in the osmometer and the external water. Although the living cells of potato tuber separate these two liquids. They permit entry of water in to sugar solution.
Interpret the result you observed when water has been used in place of sucrose solution in the osmometer

Video link https://youtu.be/_mMnbO31g3U

Experiment 3

Aim

To distinguish and study the various pigments present in plants through the process of paper chromatography.

Theory

Plants carry out the process of photosynthesis, during which light energy from the sun is converted into chemical energy (food). The capturing of light energy is carried out by molecules known as pigments, which are present within the plant cells.

What are Pigments?

Pigments are chemical compounds, which are able to reflect only a particular range of wavelengths of visible light. Leaves of plants primarily contain different types of pigments within their tissues. The four different types of pigments are listed below in a tabular column along with their colours

Pigment	Colour
Chlorophyll A	Dark green
Chlorophyll B	Yellowish-green
Xanthophylls	Yellow

Carotenoids	Orange

In order to view and distinguish the primary four plant pigments, a simple technique known as chromatography can be used

What is Chromatography?

It is a technique that is used to distinguish between different molecules. This differentiation is based on these attributes-shape, size, charge, mass, adsorption and solubility.

Types of chromatography:

- Column chromatography
- Paper chromatography
- Partition chromatography
- Thin-layer chromatography

Mechanism of Paper Chromatography

In this technique, the interaction between three components is involved – solid phase, separation of a mixture and a solvent.

1. At first, the mixture is spotted onto the paper and is dried.
2. The solvent is made to flow through the capillary attraction.
3. While the solvent moves through the paper, the various components of the mixture differentiate into varied coloured spots.
4. Later the paper is allowed to dry and the position of various compounds is viewed.
5. The substance, which is the most soluble moves further on the paper as compared to the other substances that are less soluble.

Material Required

- Chromatography chamber
- Spinach leaves
- Mortar and pestle
- Scissors
- Ether acetone solvent
- Acetone
- Capillary tube
- Pencil
- Spatula
- Scale
- Filter paper strips
- Stapler
- Thread

- Watch glass

Procedure

- In this experiment, spinach leaves are used to separate different pigments.
- Pick a few fresh and green leaves of spinach and wash it.
- Cut out small pieces of spinach using scissors. Add them to the mortar.
- Accurately measure 5ml acetone using a measuring cylinder and add it into the mortar.
- With the help of mortar and pestle, grind the spinach leaves into a smooth paste.
- Shift the prepared paste of spinach into the watch glass with the help of a spatula.
- Place a filter paper strip with a tapering notch towards one ending of the strip.
- Horizontally trace a line with a scale and a pencil that is 2 to 3 cm apart from the notch's tip.
- Using a capillary tube, add 1 drop of the extract of the pigment in the midsection of the line.
- Let the drop dry. Repeat the same process of adding a drop and allowing it to dry for 4-5 times.
- In the chromatographic chamber, pour the ether acetone solvent.
- Make sure to folded and stapled an end side of the paper.
- Suspend the strip in the chamber.

- The loading spot remains about 1 cm above the level of the solvent.
- Let the chamber remain uninterrupted for a while.
- We can notice that the solvent passes along the paper scattering various pigments of the blend to different distances.
- Once the solvent reaches 3/4th of the strip, carefully take the strip off.
- Allow the strip to dry.

Observation

The dried paper strip displays four different bands. Discrete pigments can be distinguished with the help of colours.

Conclusion

1. The Carotene pigment is observed at the topmost as an orange-yellow band of pigments distinctively.
2. Just below this band, a yellowish band appears which indicates the pigment xanthophyll.
3. The third band appearing dark green indicates chlorophyll-a pigment.
4. The yellowish-green band present at the bottom is the chlorophyll b pigment.

Precautions

- The leaves that are selected should be green and fresh spinach leaves

- From the tip of the notch, the loading spot needs to be 2 to 3 cm apart
- While suspending the filter paper strips in the chamber, one need to ensure that the loading spot needs to be set up above 1 cm from the level of solvent.

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Expt 4

Aim

To study the pattern and distribution of stomata in both the upper and lower leaf surfaces.

Theory

Stomata are tiny openings that are located in the young shoots of plants and epidermis of the leaves. They govern the gas exchange process in plants. The structure of the stomata includes a pair of specialized cells that are found girdling around the opening. These cells are termed as guard cells and are responsible to check and regulate the size of the closing and opening of the stomata.

Through the process of transpiration, water escapes from the stomata into the atmosphere in the form of water vapor. Along with this, carbon dioxide and oxygen too are exchanged in the leaf through these openings.

Stomata are distributed differently between dicots and monocots, between the top side and underside of leaves, between different plant species, etc.

Mostly, stomata are found on surfaces of plants that flourish under greater availability of light, lesser carbon dioxide levels in the atmosphere and also in moist environments.

In a dicot leaf, in comparison with the upper surface, the lower surface has a higher distribution of stomata whereas in a monocot leaf, usually, the upper and the lower surfaces usually see an equal distribution of stomata.

Material Required

- Blade
- Forceps
- Dropper

- Glycerine
- Cover slip
- Watch glass
- Glass Slide
- Distilled water
- Needle and brush
- Safranin solution
- Four O’clock plant
- Compound microscope

Procedure

- One fresh leaf from a four-o’clock plant is used in this experiment
- On two watch glasses, add some distilled water
- Slit the leaf in an oblique manner
- With the help of forceps, peel a section from the upper surface of the leaf
- Set this section into one of the watch glass holding water
- With the help of forceps, peel another section from the lower surface of the leaf
- Set this section on another watch glass which is also holding water
- With the help of a dropper, add few drops of safranin solution into both the watch glasses
- Now place cleared glass slides on each of the peels one at a time with the help of a brush
- From each of the peels, cut a square or a rectangular piece with the help of a blade
- With the help of a dropper, add one drop of glycerine on each of the slides
- With the help of a needle, gently place a cover slip on the peel
- Examine each of the glass slides under the microscope
- Notice and count the occurrence of stomata in each of the peels of both the lower and upper epidermis of the four-o’clock leaf.

Observation And Conclusion

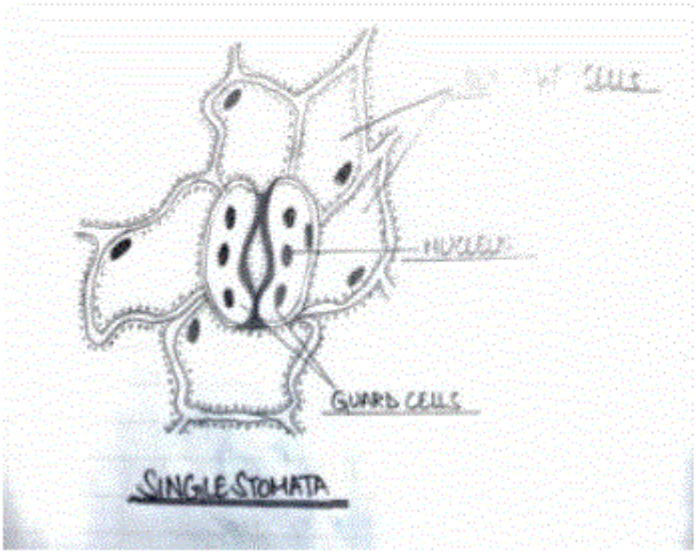
The section of leaf plucked from the four-o’clock plant shows that the number of stomata is much more in the lower epidermis while a few are found in the upper epidermis of the leaf.

Precautions

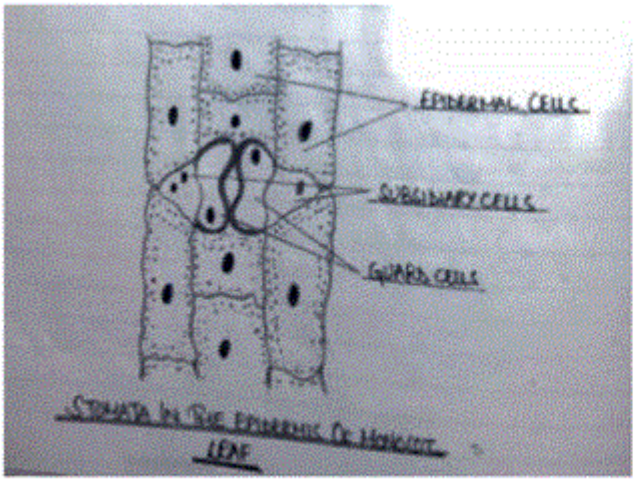
- Avoid leaf curling
- Gently place the cover slip on the slide to avoid air bubbles
- Transferring peel to the slide from the watch glass should always be done using a brush

PRECAUTIONS:

- The cutting of peel should be avoided.
- Always use filter paper to remove the excess of methylene blue.
- Use the brush to transfer the pills from water glass to the slide.
- Air bubbles must be avoided.



Single Stomata



Stomata in the epidermis of monocot leaf.

https://youtu.be/v53Zf2MhrwE

https://youtu.be/7q5HDMXSdtU

EXPERIMENT 5

Aim

To study and demonstrate the rate at which respiration takes place in flowering buds or in leaf tissue or in germinating seeds.

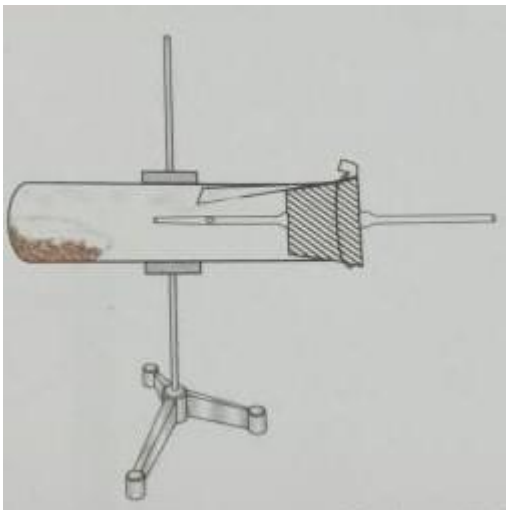
Theory

Respiration is a vital process in living organisms and generates energy through break down

Of food materials in presence / absence of O_2 .The released energy is used for all life processes of .Rate of respiration depends internal and external factors (age , physiological status and type of cell, temperature and availability of $O_{2)}$

Materials Required

- 10% KOH solution.
- Flower buds/ germinating seeds, boiling tube, single bore rubber cork fitted with a pipette, cotton , stand with burrette clamp ,black paper and filter paper
- Germinating seeds or Flower petals or a Leaf Tissue.



Procedure

- Take about 10-15 buds or 10-15 g germinating seeds in a boiling tube or wide mouth test tube. Introduce a swab of cotton. Dip a 2× 1 cm strip of filter paper in

KOH solution and place it in the tube ensuring that it does not touch the cotton swab or seeds

- Dip the pipette in water and slowly suck in water in such a manner that a small air bubble is trapped in it. Now insert the attached rubber cork into the tube. The test tube should be fixed in horizontal position with burette clamp.

- Note the position of air bubble in the pipette .

- Record the distance travelled by the bubble at 2 minute intervals for a period of time.

- Now shift the set up to bright sunlight outside the laboratory . After a few minutes note the distance travelled by the bubble at 2 minutes intervals for the same period

Observation

Compare the two sets of values obtained in the experiments. It is likely that in the experiment conducted in bright sunlight the bubble moves much faster indicating higher rate of respiration. One of the factors that is responsible for increase in rate of respiration is temperature. Can you think of a reason

Inference:

- Notice the rates of respiration are not the same in different materials and undr different condition.
- Respiration is an enzymatic processes where food materials are broken down to release energy
- Light and temperature affect the process.Young meristematic cells show high rate of respiration

- https://youtu.be/xtZhgu2EDGA
- https://youtu.be/k1CTrQy8fEU

Experiment 6

Aim

Sugar presence in a sample of urine can be detected by performing the following two tests:

1. Benedict's test
2. Fehling's test

What is Benedict's Test?

A Benedict's solution serves as a reagent in this test. The reagent is a blend of copper, sodium citrate and sodium carbonate and copper II sulphate pent hydrate ($CuSO_4.5H_2O$)

What is Fehling's test?

In this test, the two different types of Fehling's solution are used:

1. Fehling's solution – A: Aqueous solution of copper II sulphate – Blue colour solution.
2. Fehling's solution – B: Aqueous solution of sodium potassium tartrate – Clear and Colourless solution.

When the urine sample is boiled with the two different reagents, the $CuSO_4$ found in Benedict's and Fehling's solution is reduced by the reducing agent, glucose for the formation of a coloured cuprous oxide precipitate. Depending on the glucose concentration, a yellow, green and brick-red formation of precipitates of oxides take place.

The table below depicts the colour sequence on the basis of glucose level concentration.

Precipitate colour	Sugar level (Percentage)
Blue	Absence of sugar
Green	0.5%-1%
Yellow	1%-2%
Brick red	2% or higher

1. Benedict’s Test

Material Required

- Burner.
- Test tube.
- Urine sample.
- Test tube holder.
- Benedict’s solution.
- Measuring cylinders.

Procedure

- Take a clean and dried test tube.
- Using the measuring cylinder, accurately measure 2ml of the given urine sample.
- Pour the measured urine sample into the test tube.
- Add accurately 5ml of Benedict’s reagent into the test tube containing the urine sample.
- Now fix the test tube holder, bring the test tube near the bunsen burner and allow it to heat for 2 minutes.
- While it is heating, keep stirring the tube continuously.
- Observe the changes.

Observation And Conclusion

Upon heating the sample, gradually, a yellow precipitate is formed in the test tube, which indicates the presence of sugar in the given urine sample. Different precipitates are formed depending upon the sugar concentration in urine, which can be yellow, green, or brick red.

2. Fehling’s Test

Material Required

- Burner.
- Test tube.
- Urine sample.
- Test tube holder.
- Measuring cylinder.
- Fehling’s solution A.
- Fehling’s solution B.

Procedure

- Take a clean and dried test tube.
- Using the measuring cylinder, accurately measure 2ml of the given urine sample.
- Pour the measured urine sample into the test tube.
- Add accurately 2ml of Fehling’s solution A into the tube containing urine sample and shake well.
- Add accurately 2ml of Fehling’s solution B into the same test tube and mix all the solution slowly.
- Now fix the test tube holder, bring the test tube near the bunsen burner and allow it to heat for 2 minutes.
- While it is heating, keep stirring the tube continuously
- Notice the changes

Observation And Conclusion

Upon heating the sample, gradually, a green precipitate is formed in the test tube, which indicates the presence of sugar in the given urine sample. Different precipitates are formed depending upon the sugar concentration in urine which can be yellow, green, brick red.

https://youtu.be/-eg-MHdoJ_Q

Experiment 6

Aim

To perform a test detecting the presence of albumin in the given sample of urine.

Theory

What is albumin?

Albumin is a protein that is produced by the liver. It is a typical constituent of blood that is filtered by the kidney.

What is the significance of albumin?

- It maintains the intravascular oncotic pressure thereby checking the stability of the fluid pressure inside the blood vessels.
- It acts as a carrier proteins for fatty acids, thyroid hormones, steroids in the blood

About Albuminuria

A normally functioning kidney has very less to no traces of albumin in the urine, about 250mg in normal urine in a day. Any damage to the kidney causes an unusual range of albumin, way above the normal level to enter into the urine. This condition is known as albuminuria. If the albumin level is very little and persists to stay abnormal, then the condition is referred to as microalbuminuria.

Causes:

- Can be caused due to the kidney damage from the condition of diabetes
- Albuminuria can also be caused by kidney damage caused by heart failure, high blood pressure, lupus and cirrhosis

Tests that can be carried out to detect the presence of albumin in urine are:

- Heller's Test – A white ring is caused due to albumin precipitation
- Sulphosalicylic acid Test – Coagulation resulting in white cloudiness in the solution

1. Heller's Test

Material Required

- Concentrated nitric acid
- Urine sample
- Test tube
- Measuring cylinder
- Dropper
- Test tube holder

Procedure

- From the reagent bottle, add 5ml concentrated nitric acid accurately using a measuring cylinder, pour it into a test tube
- From the sample urine bottle, add some drops of the urine sample with the help of a dropper

- Pour some sample of urine along the inner side of the test tube with the help of a dropper and by inclining the tube.
- The above step is performed so as to form a covering on the nitric acid
- Notice the changes taking place in the test tube.

Observation And Conclusion

The changes taking place in the test tube is observed. At the intersection of the two layers, a white ring appears which indicates that albumin is present in the given sample of urine.

2. Sulphosalicylic Acid Test

Material Required

- 30% Sulphosalicylic acid
- Urine sample
- Measuring cylinder
- Burner
- Test tube
- Test tube holder
- Dropper

Procedure

- From the sample urine bottle, add 2ml sample of the urine accurately using a measuring cylinder, pour it into a test tube
- Add some drops of the sulphosalicylic acid with the help of a dropper into the tube holding the urine sample
- The solution in the tube turns into a white color
- Securely hold the tube with the help of a holder to heat upon the burner gently.
- Make note of the changes observed

Observation And Conclusion

The given sample of urine appears as a cloudy turbid solution or whitish which indicates that albumin is present in the sample.

https://youtu.be/i7dZBzhQCaI

Term 1

B 1 Study / observation of the following (spotting)

Aim

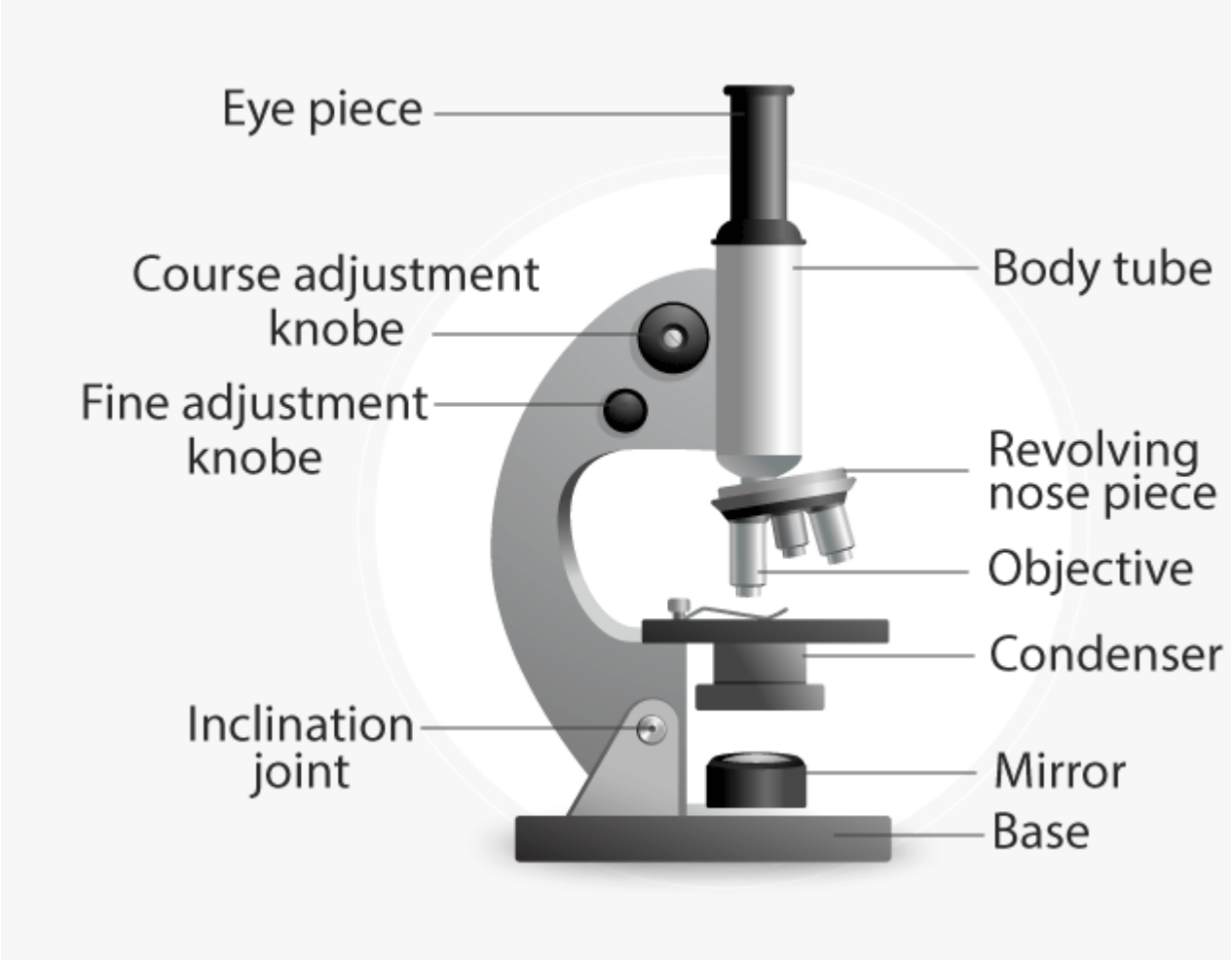
To study different parts of a compound microscope.

Theory

What is a compound microscope?

Real and magnified images of minuscule particles or objects can be achieved using a combination of lenses. A compound microscope is an intricate gathering of a combination of lenses that renders a highly maximized and magnified image of microscopic living entities and other complex details or tissues and cells.

Diagram



Parts of the Compound Microscope

Parts Of Compound Microscope

The parts of the compound microscope can be categorized into:

- Mechanical parts
- Optical parts

(A) Mechanical Parts of a Compound Microscope

1. Foot or base

It is a U-shaped structure and supports the entire weight of the compound microscope.

2. Pillar

It is a vertical projection. This stands by resting on the base and supports the stage.

3. Arm

The entire microscope is handled by a strong and curved structure known as the arm.

4. Stage

The flat and rectangular plate that is connected to the arm's lower end is called the stage. The specimen is placed on the stage for studying and examining the various features. The centre of the stage has a hole through which light can pass.

5. Inclination joint

It is a joint, wherein the arm is fastened to the compound microscope's pillar. The microscope can be tilted using the inclination joint.

6. Clips

The upper part of the stage is connected to two clips. The slide can be held in its position with the help of the clips.

7. Diaphragm

The diaphragm is fastened below the stage. It controls and adjusts the intensity of light that passes into the microscope. The diaphragm can be of two types:

- Disc diaphragm
- Iris diaphragm

8. Nose piece

The nose piece is circular and a rotating metal part that is connected to the body tube's lower end. The nose piece has three holes wherein the objective lenses are embedded.

9. Body tube

The upper part of the arm of the microscope comprises a hollow and tubular structure known as the body tube. The body tube can be shifted down and up using the adjustment knobs.

10. Fine adjustment knob

It is the smaller knob, which is used for sharp and fine focusing of the object. For accurate and sharp focusing, this knob can be used.

11. Coarse adjustment knob

It is a large knob that is used for moving the body tube down and up for bringing the object to be examined under exact focus.

(B) Optical Parts of Compound Microscope

1. Eyepiece lens or Ocular

At the top of the body tube, a lens is planted which is known as the eyepiece. On the rim of the eyepiece, there are certain markings such as 5X, 10X, 15X, etc. Which indicates the magnification power. The object's magnified image can be observed with the help of an eyepiece.

2. Mirror

A mirror is found attached wither to the pillar or the lower end of the arm. It consists of a concave mirror on one side and a plain mirror on the other side. It can be used for reflection of light rays into the microscope.

3. Objective lenses

At the bottom of the body tube, there are two objective lenses, which are connected to the revolving nose piece. The three objective lenses are as follows:

- Oil immersion objective – 100X
- High power objective – 45X
- Low power objective – 10X

Working Mechanism Of The Compound Microscope

- View into the eyepiece. Rearrange the mirror such that adequate light passes into the microscope
- The mirror, lenses, stage, and slides should be cleared of dust and be clean.
- Place the slide in the middle of the stage
- Firmly secure the slide with clips at two edges of the slide to ensure that the slide cannot move
- The nose piece is adjusted in such a way that the low power objective is aligned with the object of focus placed on the slide.
- The coarse adjustment knob can be shifted upwards or downwards such that the slide is well under focus
- Turn the fine adjustment knob by moving upwards or downwards to get a clear and sharp image of the object under focus.
- All minute details of the object are observed under low power objective. Necessary diagrams are sketched.
- The nose piece is now turned to bring the high power objective aligning with the object. The fine adjustment knob is tuned as much as possible to get a bright and precise view of the object.
- In high power, the details of the object are observed. Draw the necessary diagrams. The coarse adjustment knob should not be used when the object is being examined in high power as it can crush the slide.
- **https://youtu.be/hMncjPw6MPo**

B 2

Aim :

1. Study the characteristics of spirogyra, agaricus, moss, fern, pinus (either with male or female cones) and an angiosperm (White Orchid-tree).
2. Identify two features that indicate the group they belong to.

Theory:

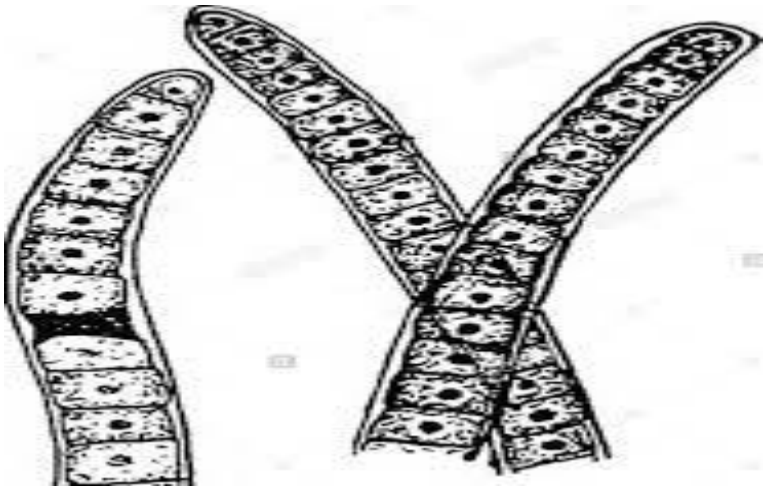
The kingdom Plantae consists of different types of plants that are eukaryotic, multicellular organisms having photosynthetic pigments and cell walls.

Plants are classified in several different ways based on various external and internal characteristics. Based on these characteristics, plants are classified into multicellular groups such as thalophytes, bryophytes, pteridophytes, gymnosperms and angiosperms. We will look at spirogyra, agaricus, moss, fern, pinus and an angiosperm (White Orchid-tree), to identify their characteristics and classify them into the respective groups.

1.Oscillatoria

Kingdom : Monera

Class : Eubacteria



i) It is a blue green algae of fresh water bodies .

ii) Thallus is filamentous, un-branched, multicellular.

iii) The cells are arranged one above the other like a pack of cards

iv) Each cell has a definite cell wall,

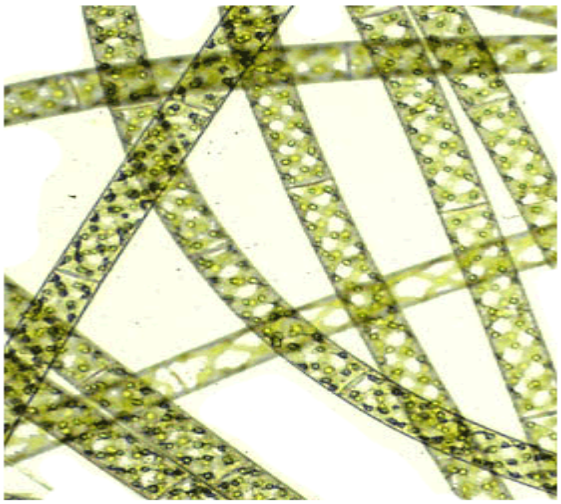
v) Some cells of the filament may be dead and appear as blank spaces in the filament.

vi) Fresh specimen shows oscillatory movements and hence the name

Oscillatoria.

2. Spirogyra (Pond Silk)

Sub-kingdom: Cryptogamae; Division: Thallophyta; Group: Chlorophyta



Thalophytes are the simplest plants and do not have a well-differentiated body design. The body design is called 'thallus' as it is unicellular and non-jacketed. The vascular system and embryo stage is absent in their life cycle.

The plants included in this group are commonly known as **algae,** usually found in water or in moist regions. **The plants in this group do not bear flowers, but they contain chlorophyll and prepare their own food.**

3 Characteristics of Spirogyra

Spirogyra is a filamentous green algae that is seen in fresh water bodies such as ditches, ponds and lakes. It is commonly called water silk. Spirogyra measures approximately 10 to 100μm in width and may stretch centimetres long.

Each filament is unbranched and consists of cylindrical cells placed end to end. These cells have one or more beautiful spiral chloroplasts, so they appears dark green.

The cell wall is two layered and made up of cellulose and pectin. Pectin dissolves in water and makes the filament slimy to touch.

The cytoplasm lies in the periphery of the cell enclosing a vacuole at the centre. The nucleus is located at the centre of the cell and is suspended from strands of cytoplasm from the cell periphery.

Identifying features:

1. Contains chlorophyll in quantities that are as high as those found in plants.

2. Grows mostly in fresh water bodies.

3 Rhizopus

Kingdom :Plantae

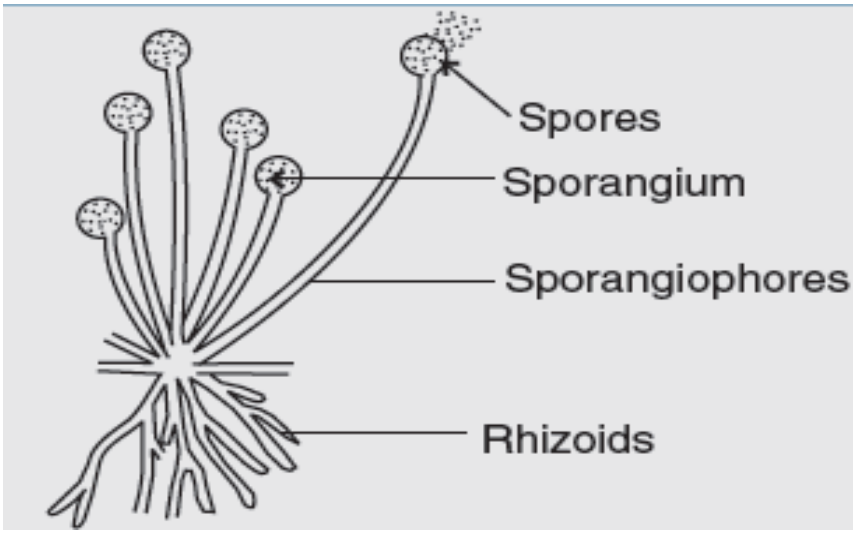
Division : Thallophyta

Class : Chlorophyceae

Observation : Following features are observed

i) Thallus is an interwoven mass of hyphae called mycelium,

ii) Hyphae are tubular multinucleate and without any septa.



iii) Some hyphae are horizontal and grow parallel on the surface of the substratum. These are called stoloniferous hyphae

Some hyphae grow down the stratum and are called rhizoidal hyphae.

Erect vertically growing hyphae are called sporangiophores.

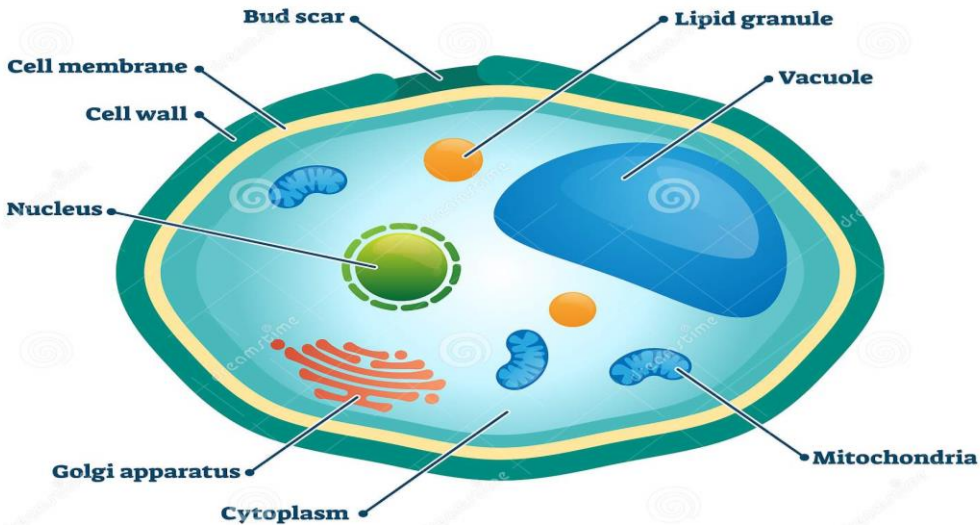
- Sporangiophores bear the capsule or sporangium
- A domed shaped columella is found inside the cavity of sporangium .
- Numerous black spores fill the cavity

4.Yeast

Kingdom : Fungi

Division : Eumycota

Class; Basidiomycetes



i) Cells are oval or spherical in shape
ii) Cells form chain of buds that help in propogation.
iii) Each cell has one vacuole
iv) Single nucleus is present in each cell.

5. Agaricus (Mushroom)

Sub-kingdom: Cryptogamae; Division: Thallophyta; Group: Fungi

Fungus is a eukaryotic organism classified as a separate kingdom and is not grouped under plants, animals and bacteria. This kingdom includes microorganisms such as yeasts, moulds and mushrooms. Fungal cells have cell walls that contain chitin, unlike the cell walls of plants, which contain cellulose.

Fungi lack chloroplasts and are heterotrophic organisms, and so require preformed (previously formed) organic compounds as energy sources. These organic compounds have already been made by plants, bacteria, fungi, or other animals; they are 'preformed', so to speak, by those other organisms.

Characteristics of Agaricus sp. (Mushroom)

Agaricus is a fleshy saprophytic fungus with over 300 species and contains both edible and poisonous species. It is found in wet and damp climates. It grows on wood and in humus-rich soil.

The upper part which is visible above ground is called basidiocarp. It consists of a fleshy cap called pileus. Horizontal groove-like structures called gills or lamellae are present on the lower surface of the cap. The gills bear club shaped basidia on either side, which contain spores called basidiospores. Below the cap is a stalk or stipe (stem) which has a ring-like structure called annulus. This gets cut off from the margin of the cap during its development.

Identifying features:

1. Agaricus does not possess chlorophyll pigment.
2. It is saprophytic in nutrition, which means that it obtains its nutrients from non-living organic matter.

6. Moss (Funaria)

Sub-kingdom: Cryptogamae; Division: Bryophyta

Bryophytes do not have true vascular tissues and are therefore called 'non-vascular plants'. They, however, have the embryo stage present in their life cycle. Bryophytes do not have flowers or seeds and reproduce through spores.

Plants in this group have stems and leaves, but no roots. They have root like structures called ‘rhizoids’. Rhizoids help the

lant to anchor itself to a surface, but they do not absorb nutrients from the soil as roots do in other plants.

Characteristics of Mosses

Moss grows on moist brick walls, on sidewalks, and as thick mats on forest floors. It is green, erect and is differentiated into leaves, axis and rhizoids. The main body of an adult plant is called a gametophyte. The rhizoids that anchor the plant are multicellular and branched with oblique septa.

Mosses are bisexual. The same plant bears the female reproductive organ (archegonia) and male reproductive organ (antheridia). Mosses reproduce in a unique way. The first generation moss, the gametophyte, produces a sperm and an egg that come together and grow into the next generation sporophyte. The female branch of the older moss plants bears the sporophyte that has no chlorophyll and lives on a gametophyte.

The sporophyte dries and releases spores that grow into a new generation of gametophytes. The sporophyte is the organ for asexual reproduction and consists of a foot, seta and capsule. The capsule is a beak like structure found on top of a thin stalk and produces the spores. Mosses show alternation of generation between gametophytic and sporophytic generations though the plant has a gametophyte dominant cycle.

Identifying features:

1. Funaria is a non- vascular plant.
2. It bears male and female, as well as asexual organs, on the same plant.

7 Fern (Dryopteris)

Sub-kingdom: Cryptogamae; Division: Pteridophyta

Pteridophytes are vascular plants. The plants in this group contain roots, stems and leaves, but do not produce flowers and seeds. The adult plant body is a saprophyte. It shows differentiation into true roots, stems and leaves. The stem is mostly herbaceous. Leaves may be small or large. Vascular tissues are present in all the vegetative parts of the plant body. Reproduction involves production of spores inside special structures called sporangia that can be found on the ventral surface of fertile leaves called sporophylls. Sporangia may sometimes be found in groups called sori.

Characteristics of Fern (Dryopteris)

Ferns are found in humid and shady places, both in tropical and subtropical climates. They can also be found in aquatic habitats. Ferns are vascular plants having xylem and phloem. Like all vascular plants, they have stems, leaves and roots.

The stem is short, stout and mostly an underground creeping rhizome. In some species the stem is above the ground and is erect and woody. From the adventitious buds on the stem arise large, compound leaves called fronds. Leaves are of three types:

1. **Trophophyll** - A leaf that does not produce spores, but produces only sugars by photosynthesis.
2. **Sporophyll** - A leaf that produces spores and also sugars by photosynthesis. The leaves are similar to the scales of pine cones or to stamens and pistil in angiosperms.
3. **Brophophyll** - A leaf that produces very large amounts of spores. These leaves are larger than other leaves and resemble trophophylls.

Clusters of adventitious roots arise from the underside of the stem near each node. Ferns reproduce through spores, and have neither seeds nor flowers. Like all vascular plants, ferns have a life cycle that sees alternation of generations, although the plant has a sporophyte dominant cycle.

Identifying features

1. Ferns are vascular plants having xylem and phloem for conduction of food and water.
2. They have stems, leaves and roots, and the adult plant is sporophytic dominant.

8 Pinus (Pine)

Sub-kingdom: Phanerogamae; Division: Gymnospermae

Gymnosperms are seed producing plants. The word gymnosperm comes from the Latin word ‘gymnospermos’ meaning ‘naked seeds’, which means the plants bear naked seeds which are exposed to the environment.Gymnosperm seeds develop either on the surface of scale or leaf-like appendages of cones, or at the end of short stalks. The cones are the reproductive organs of the plants. Gymnosperms do not have the ability to make flowers.

Characteristics of Pinus (Pine)

The Pine is a tall evergreen tree found mostly in hilly areas in tropical and temperate climates. It is a vascular plant having well developed xylem and phloem.

The stem is covered with bark, is thick and bears long and short branches. The long branches arise from the main stem and have unlimited growth and bear scale leaves. The short branches arise from the scale leaves of the long branches and have limited growth. They bear needle like leaves.

The adult pine has two types of leaves:

1. The scale leaves, that are small, brown and are non-photosynthetic. They are arranged spirally.
2. The adult needle-like leaves are green and photosynthetic. These needle-like leaves are bundled in clusters of 1 to 6 or 2 to 5, called fascicles. Each fascicle is produced from a small bud on a short branch in the axil of a scale leaf.

The pine tree has taproots. It is monoecious, which means the tree bears both the male and female cones. It produces naked seeds that are not enclosed in a fruit. A pine tree produces two types of spores- the microspores seen on male cones and megaspores seen on female cones. Hence, they are heterosporic.

Male Cones

Male cones are borne in clusters in the axil of the scale leaves of the long branches. A mature cone is dark brown in colour and ovoid in shape. A male cone consists of numerous spore bearing leaves, the microsporophylls, that are arranged spirally on the central axis.

Each microsporophyll has a stalk, a broad lamina and a tip curved upwards to fit over the microsporophyll above it. It bears two sporangia on its lower surface. The sporangia are filled with numerous winged microspores. The wings help the pollen grains to be carried by the wind that reach the ovules (megasporangia) in the female cones.

Female cones

A female cone is brown in colour, woody in structure and found in groups of 2 to 4 in the axil of the scale leaves of the long branches. Branches that bear male cones do not bear female cones. It contains 80-90 bract scales arranged spirally on the central axis. In the axils of each bract scale an ovuliferous scale is present, called the microsporophyll. It bears two ovules on the upper surface. The ovules contain eggs that are fertilised by the winged pollen grains released by the microsporangia of the male cone.

Identifying features:

1. he seeds are naked, which means they are not enclosed in an ovary or fruit.
2. The reproductive organs are the cones.

White Orchid-tree (Bauhinia acuminata)

Sub-kingdom: Phanerogamae; Division: Angiospermae; Class: Dicotyledonae

Angiosperms are flowering plants and are the most diverse group of land plants, with a vascular system. Angiosperms have stems, roots, and leaves. They produce seeds that are enclosed within a fruit. Angiosperms bear flowers that are reproductive organs. Flowering plants are divided into two major groups, or classes on the basis of the number of cotyledons present in the seed, the Monocots and Dicots. Monocot seeds have one cotyledon and dicot seeds having two cotyledons. The cotyledons are enclosed in an embryo.

Characteristics of White Orchid-tree (Bauhinia acuminata)

Bauhinia acuminata is a species of flowering plant native to tropical south eastern Asia. It grows two to three meters tall and is a semi-deciduous large shrub or small tree with white butterfly-like flowers. This shrub is drought tolerant. Bauhinia acuminata is very sensitive to cold winds.

Like the other Bauhinia species, the leaves are bilobed and shaped like an ox's hoof. Its leaves are sessile and have a reticulate venation.

The flowers have five petals and so are pentamerous.

The seeds are enclosed inside the fruit. A member of the bean family, the orchid tree produces flattened brown woody legumes (pea shaped pods) with 4 to 6 seeds in each pod.

The root system is a tap root system with a number of root hairs emerging from it.

Identifying features

1. The leaves of Bauhinia acuminata are bilobed and shared like an ox's hoof.
2. It produces flattened pea shaped pods with seeds in them.

Learning Outcomes:

1. Students understand terms like thalophytes, bryophytes, pteridophytes, gymnosperms, angiosperms.
2. Students will be able to identify the features of the different divisions of the kingdom Plantae.
3. Students understand the characteristics of spirogyra, agaricus, moss, fern, pinus and angiospermic plants.

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Identifying features

3. The leaves of Bauhinia acuminata are bilobed and shared like an ox's hoof.
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4. Students understand terms like thalophytes, bryophytes, pteridophytes, gymnosperms, angiosperms.
5. Students will be able to identify the features of the different divisions of the kingdom Plantae.
6. Students understand the characteristics of spirogyra, agaricus, moss, fern, pinus and angiospermic plants.

B 4

Aim: Virtual specimens/slides/models and identifying features of - Amoeba, Hydra, liverfluke, Ascaris, leech, earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit

Materials Required

- Freshly prepared animal specimens
- Pencil
- Record file
- Eraser
- Sharpener
- Rules
- Practical guide/A laboratory guide

Amoeba Proteus

Classification

Kingdom	Phylum	Class	Order	Genus	Species
Protista	Protozoa	Sarcodine	Amoebida	Amoeba	Proteus

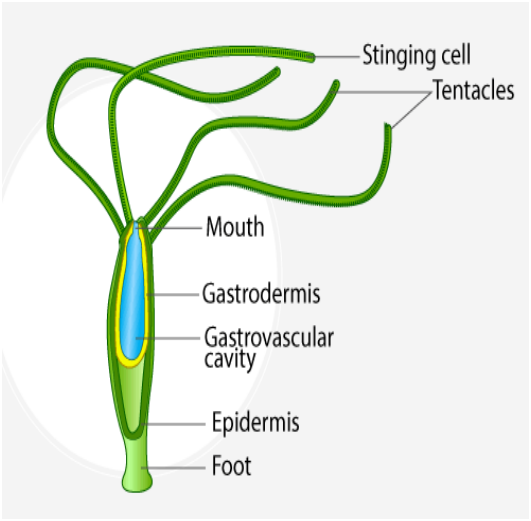
Discussion

- It is a microscopic, unicellular entity with a diameter of 0.2-0.5mm, appearing greyish in colour.
- The amoeba is usually found in ditches, ponds, lakes or rivers that contain adequate decomposed organic matter.
- When observed under a microscope, amoeba seems to be like a jelly that has an irregular shape containing a little mass of hyaline protoplasm. This protoplasm can be classified into a notable inner endoplasm and outer octoplasm.

Characteristic Features

- Irregular shape
- Unicellular
- Exhibit pseudopodia – They are blunt and finger-like projections that are used in locomotion and phagocytosis
- They exhibit contractile vacuole

Hydra



Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Cnidaria	Hydrozoa	Hydrozoida	Hydra	Vulgaris

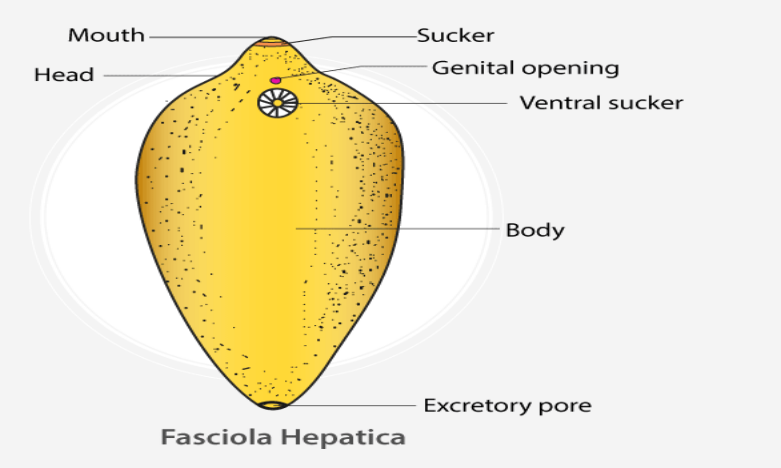
Discussion

- They are solitary and freshwater forms that are found attached to rocks, stones and weeds
- The body resembles a cylindrical and an elongated tube wherein the posterior end is attached to the substratum by a basal disc and the anterior end is free
- The body wall of hydra is made up of two cell layers referred to as diploblastic
- The epidermis consists of cnidocytes or stinging cells that serve as defensive and offensive organs

Characteristic Features

- Possess a soft body and are diploblastic
- The free end exhibits an inverted funnel-like structure known as hypostome which is the mouth
- The mouth is girdled with a circlet of around 5 to 10 long and hollow structures known as tentacles. These tentacles help in capturing prey as these structures contain cnidoblasts which assist in the killing of the prey.
- The gastrovascular cavity is present which opens to the mouth

Liver Fluke (Fasciola herpatica) present, which



Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Platyhelminthes	Trematoda	Echinostoma	Fasciola	Hepatica

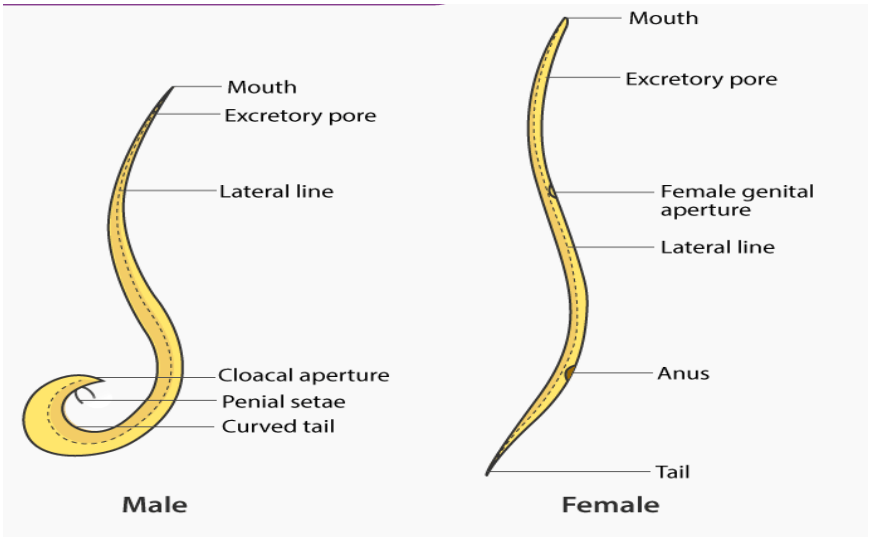
Discussion

- Usually found in internal organs such as bile ducts of goats, sheep, and cattle as it is an endoparasite. It is sometimes also found in a few vertebrates but not in humans.
- They are known to cause liver rot – a disease of the liver
- It resembles a triangular shape that is flat and leaf-like parasite approximately 25mm long. It possesses a ventral an oval sucker known as the acetabulum which adheres to the bile duct.
- The body of the liver fluke is covered with cuticle with spinules.

Characteristic Features

- Leaf-like body resembling a triangular shape
- The body of the liver fluke is covered with cuticles
- Exhibits two suckers

Roundworm (Ascaris lumbricoides)



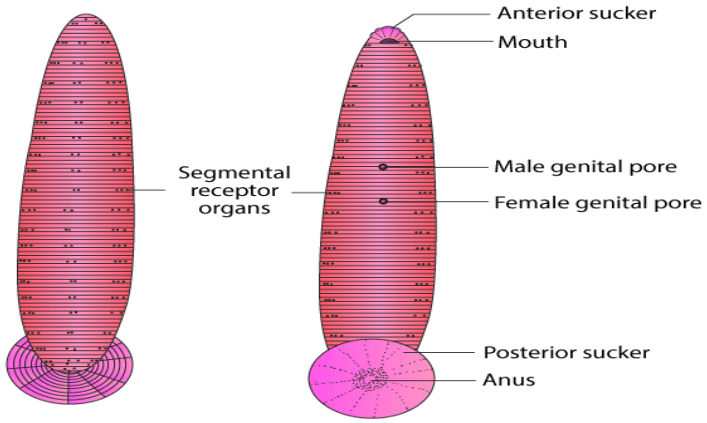
Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Nemanthelminthes	Nematoda	Ascaroidea	Ascaris	Lumbrecoides

Features

- It is an endoparasite found in the intestine of man.
- It can cause weakness, anaemia, laziness and adverse abdominal discomfort
- The body is long, cylindrical and unsegmented with pointed edges.
- The body is covered by a soft and thin cuticle that is marked with fine striations.
- The body shows four longitudinal ridges throughout the body
- The anterior end of the body possesses a mouth.
- On the ventral surface, the excretory pore is located just a little behind the mouth.
- They are unisexual, exhibiting a well-defined sexual dimorphism.

Leech (Hirudinaria granulosa)



Classification

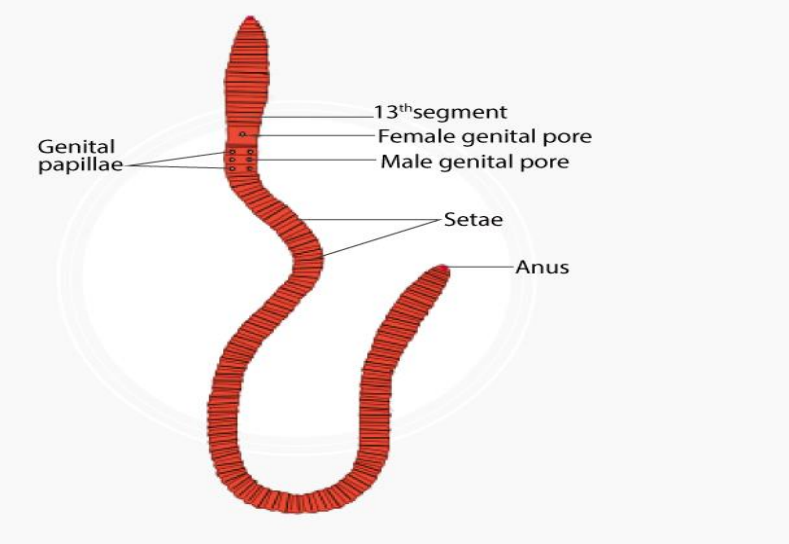
Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Annelida	Hirudinaria	Gnathobdellida	Hirudinaria	Granulosa

Features

- It is found in freshwater ponds and sluggish streams.
- Commonly known as Indian cattle leech, it is a temporary ectoparasite that feeds on cattle and blood.
- The body is elongated, dorsoventrally flattened and metamerically segmented. The body has 33 segments.
- Exhibits powerful organ attachments and locomotion.

- There are five pairs of small eyes situated dorsally in the first five segments.
- The anus is present at the base of the posterior sucker dorsally.
- The anterior end has an anterior sucker which is cup-shaped, turned downwards and ventral, wherein the mouth is centrally located. The posterior end has a posterior sucker, which is circular and is highly muscular. It is formed as a result of the fusion of the last 7 segments.
- Leech is bisexual.

Earthworm (Pheretima Posthuma)



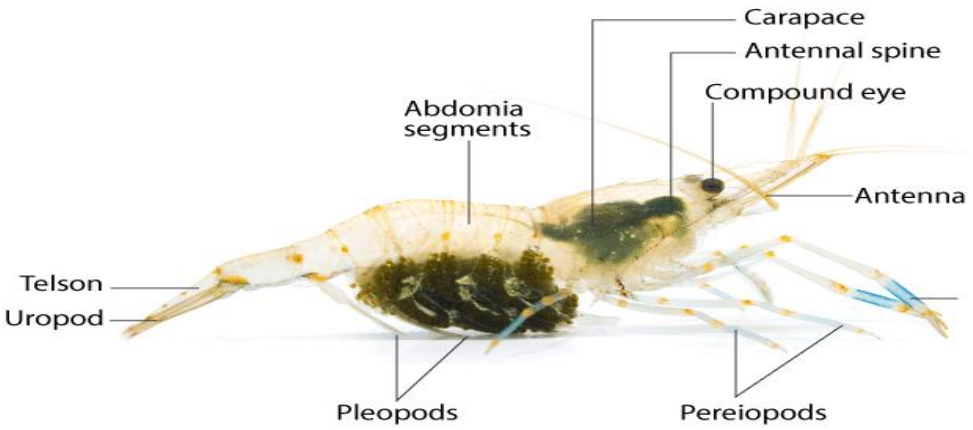
Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Annelida	Oligochaeta	Terricelae	Pheretima	Posthuma

Features

- Commonly found in moist soil.
- The body is long, triploblastic, cylindrical, eucoelomate and metamerically segmented.
- The mouth is at the anterior end and anus at the posterior end.
- The clitellum (a circular band of glandular tissue) is located at the 14th, 15th, and 16th segments
- Earthworms are hermaphrodites.
- Presence of a single female genital aperture mid-ventrally in the 14th segment.
- Presence of a pair of male genital apertures ventrolaterally in the 18th segment.
- A pair of genital papillae are located ventrolaterally in the 17th and the 19th segment
- The anus is present in the last segment.
- Setae are the locomotory structures that are located on all segments except the first and the last.

Prawn (Palaemon)



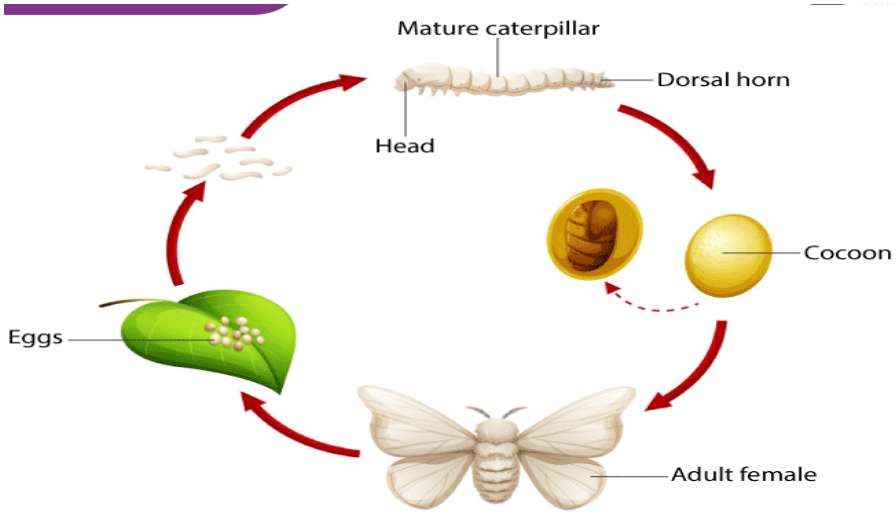
Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Arthropoda	Crustaceae	Decapoda	Palaemon	Malcolmsonii

Features

- It is a freshwater entity that is found in ponds, lakes and rivers.
- The body is laterally compressed and protected by a chitinous exoskeleton. The body exhibits an anterior cephalothorax and a posterior abdomen
- The cephalothorax is formed by the fusion of 5 segments that constitute the head and the thorax is composed of 8 segments.
- The carapace is an exoskeleton shield that protects the cephalothorax. Anteriorly, it is produced into a serrated median process known as the rostrum.
- Pair of stalked eyes at the base of the rostrum.
- There is one pair of appendage at each segment of the cephalothorax. 5 pairs in the head region, 8 pairs of the thoracic region. The last 5 pairs are for walking known as pereopods.
- The abdomen has 6 segments followed by a telson which is a conical flat piece.
- A pair of abdominal segments at the ventral side known as pleopods or swimmers are present.
- Uropods are the last pair of abdominal appendages.

Silkworm (Bombyx Mori)



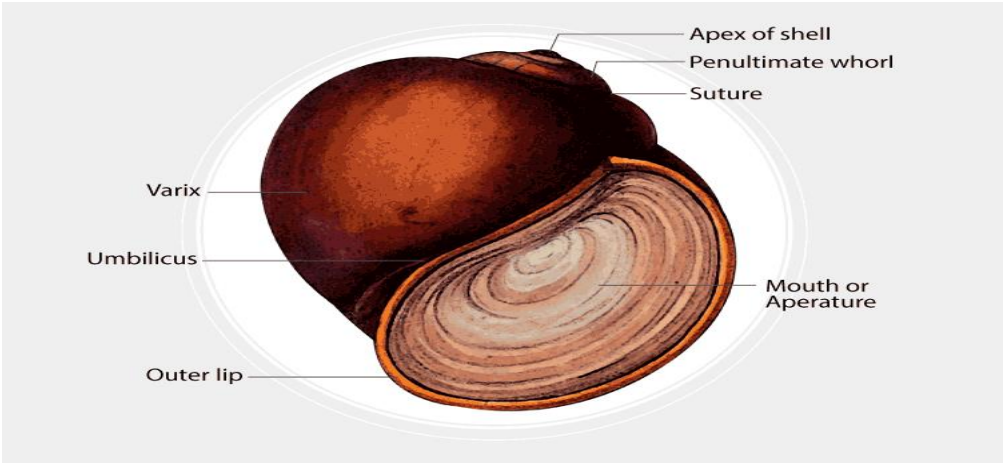
Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Arthropoda	Insecta	Lepidoptera	Bombyx	Mori

Features

- An adult silk moth has a creamy white colour and is about 3 inches in length having two wings.
- The body can be distinguished into the head, thorax, and abdomen and is covered with tiny scales.
- The larvae undergo a metamorphosis for four months post which they stop feeding. Through its spinnerets, they secrete a slimy fluid. This liquid, when it comes in contact with air turns into silk thread and stays coiled and wrapped around its body to form the pupa.
- Larva from the cocoon.
- Two pairs of wings are present along with three pairs of legs.

Apple Snail (Pila Globosa)



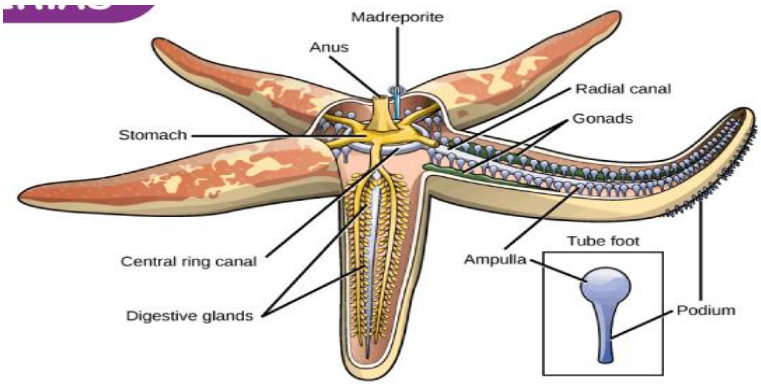
Classification

Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Mollusca	Gastropoda	Prosobranchiata	Pila	Globosa

Features

- It has a slim and soft body that is enveloped in a coiled calcareous shell.
- The shell opening is sealed by an operculum – thick plated.
- The body can be distinguished into the head, foot, visceral mass and mantle.
- There is a slight sexual dimorphism with separation of the sexes.
- The shell is coiled and univalved.
- The foot is broad and muscular.
- The head is distinct from tentacles and eyes.

StarFish (Asterias)



Classification

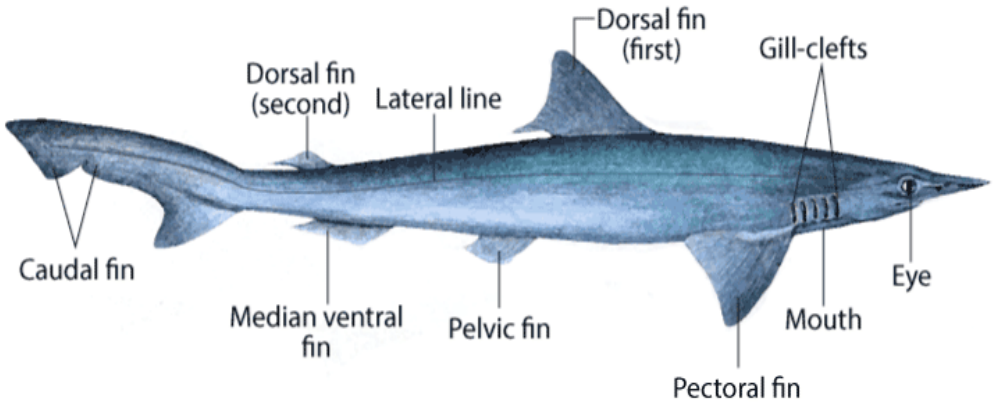
Kingdom	Phylum	Class	Order	Genus	Species
Animalia	Echinodermata	Asterioda	Forcipulata	Asterias	Rubers

Features

- It is a marine form found in the rocky and sandy parts of the sea
- A star-shaped body consisting of a central disc with 5 radiating arms. Broad at the base and taper towards the extremities
- The body can be distinguished into an oral surface directed downwards and aboral surface directed upwards
- On the oral surface at the centre of the disc, a pentagonal mouth is present. 5 narrow ambulacral grooves emerge from the 5 corners of the mouth, which extend along the middle of the oral surface of 5 arms up to their margins
- Each of this groove has 2 double rows of tube feet helping in locomotion

- The aboral surface has many spines and the anus is located at the centre of the disc on the same surface
- The madreporite is a perforated calcareous plate located between the bases of two arms on the aboral surface

Shark (Scolidon Sorrakowah)



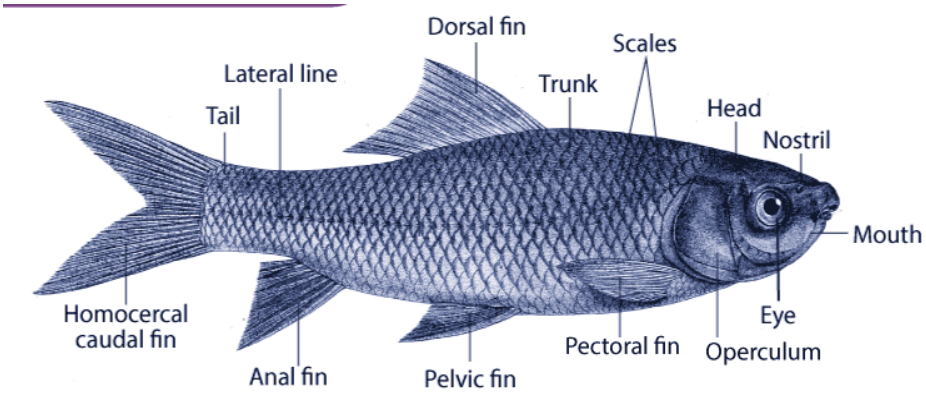
Classification

Kingdom	Phylum	Subphylum	Class	Genus
Animalia	Chordata	Vertebrata	Chondrichthyes	Scoliodon sp.

Features

- It is widely distributed in marine waters. It is precious and attacks the preys with powerful jaws.
- The body is long, laterally compressed and spindle-shaped that tapers at both ends.
- It can be distinguished into the head, trunk, and tail.
- The ventral surface is pale in colour while the lateral and dorsal body surface is dark grey.
- The skin is covered by an exoskeleton of dermal scales, placoid scales. The head is dorsoventrally flattened, which is produced to form a snout.
- The head has a large pair of circular eyes at the sides, the mouth is wise crescentic present ventrally. A pair of nostrils is present in the front.
- 5 pairs of naked gill slits are present behind the eyes.
- The trunk has two types of fins – lateral fins and median fins.
- Between the bases of the pelvic fins, a cloacal aperture is present
- Male sharks have a pair of claspers.

Carp (Labeo Rohita or Rohu)



Classification

Kingdom	Phylum	Subphylum	Class	Genus	Species
Animalia	Chordata	Vertebrata	Osteichthyes	Labeo	Rohita

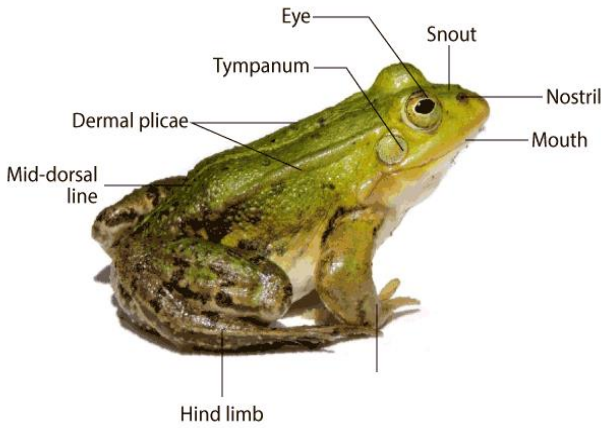
Features

- It is a freshwater bony fish that is found in rivers and ponds. It is a source of food
- The body is compressed, fusiform and matures up to 1m in length. The body is distinguished into the head, trunk, and tail and is covered by a large overlapping cycloid scales
- Head is depressed to form a blunt snout and has a subterminal fringe lipped mouth with no teeth, a pair of eyes and nostrils
- Four pairs of gill slits on the lateral side of the body behind the eyes. The gill slits are covered by an operculum. The lateral line is clear and distinct.
- The trunk comprises of a pair of pectoral fins, a pair of pelvic fins, a dorsal fin a ventral or anal fin and a homocercal caudal fin.

Frog(Rana Tigrina)

Classification

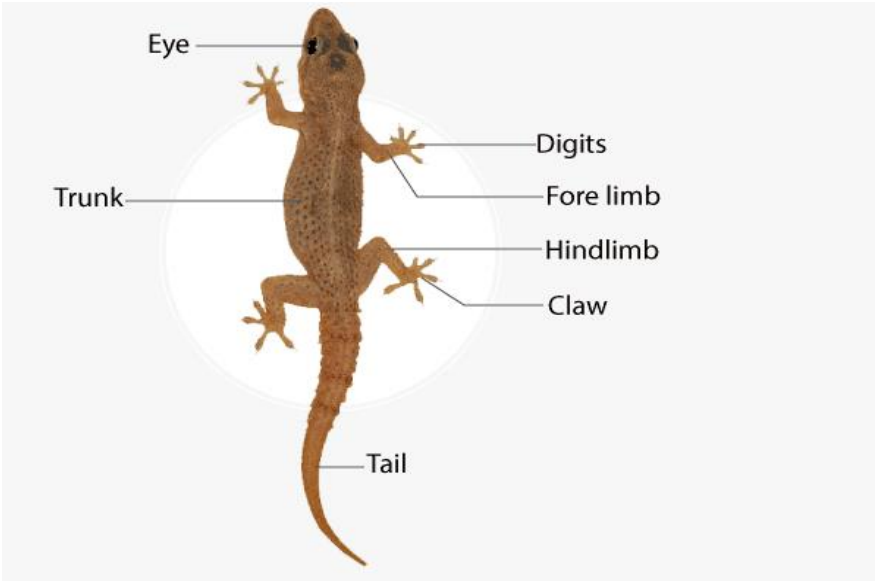
Kingdom	Phylum	Subphylum	Class	Order	Genus	Species
Animalia	Chordata	Vertebrata	Amphibia	Anura	Rana	Tigrina



Features

- It is terrestrial and nocturnal.
- The body is distinguished into the head and the trunk.
- The skin is warty and dry.
- The head has a pair of eyes, nostrils, tympanum, parotid glands and a mouth.
- The mouth is large with no teeth.
- The tympanum is well developed and the eyes are large.
- Behind the tympanum, the parotid glands are present, which secretes a poisonous fluid that has an irritating effect.
- The trunk has a pair of hind limbs, forelimbs, and at the posterior end there is a cloaca.
- Shorter forelimbs wherein each one has 3 webless fingers and a thumbpad.
- The hind-limbs are longer wherein each one has 3 toes with a highly reduced web.

Lizard (Hemidactylus)



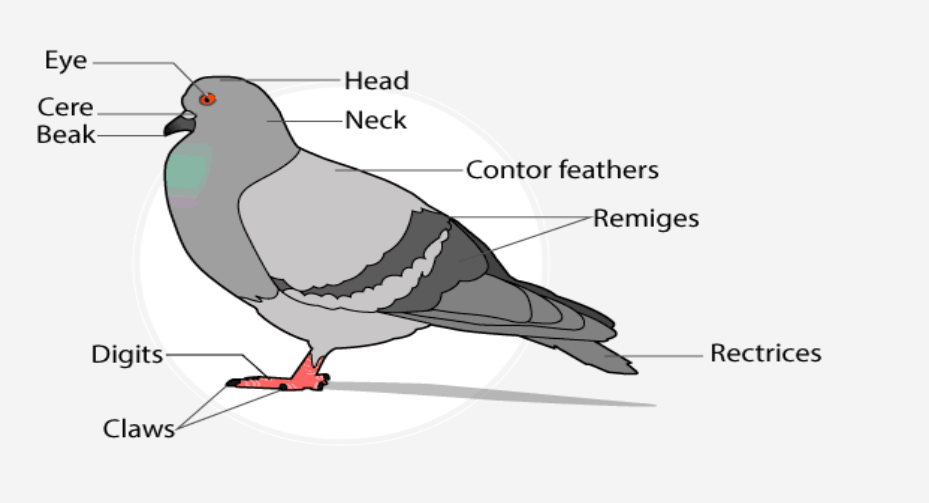
Classification

Kingdom	Phylum	Subphylum	Order	Genus
Animalia	Chordata	Reptilia	Lacertilia	Hemidactylus sp.

Features

- It is typically brown in colour and is 8-14cm in length.
- The body can be distinguished into the head that is thick and flattered, the neck is short, the trunk is large with a tapering tail.
- The head has a pair of eyes having movable eyelids, ear openings and nostrils.
- The skin is covered with tiny scales and is dry.
- The tail has annular pores of scales. These scales can be broken.
- They have four limbs, each having five clawed digits.

Pigeon (Columba Livia)



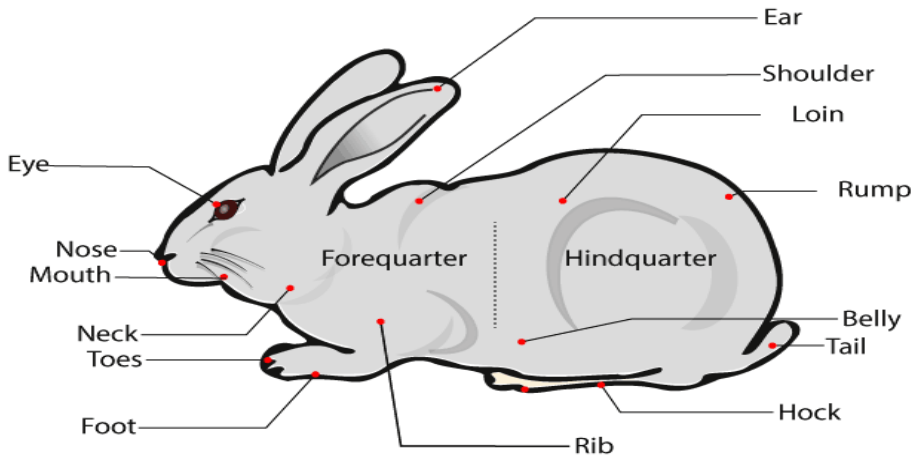
Classification

Kingdom	Phylum	Subphylum	Class	Genus	Species
Animalia	Chordata	Vertebrata	Aves	Columba	Livia

Features

- It is adapted for an aerial or volant mode of life and is a common domesticated bird.
- The body is boat-shaped and can be distinguished into the head, trunk and tail.
- The entire body surface except the feet is covered by feathers. The feet are covered by epidermal scutes
- The head has a pair of eyes, a pair of slit-like nostrils and a short beak.
- Eyes are large, rounded with movable eyelids and a nictitating membrane that is well developed.
- The forelimbs are modified into wings to take a flight.
- The hind limbs are pushed forward for bipedal locomotion. The digits end in claws.
- They have pneumatic bones. Teeth are absent and the skull is monocondylar.

Rabbit (Oryctolagus cuniculus)



Classification

Kingdom	Phylum	Subphylum	Class	Order	Genus	Species
Animalia	Chordata	Vertebrata	Mammalia	Lagomorpha	Oryctolagus	Cuniculus

Features

- The body can be distinguished into a head, trunk, neck and a small bushy tail.
- The entire body is covered with hair of black or brown colour
- The presence of two largely movable pinned behind the eyes. The colour of the eyes is pink.
- The mouth appears to have fleshy and soft lower and upper lips
- Sexual dimorphism is observed. Sexes are distinct and separate
- They possess the characteristic mammary glands, which end in nipples, located in the abdominal region.

B :4

Tissues and diversity in shape and size of animal cells (squamous epithelium, smooth, skeletal and cardiac muscle fibers and mammalian blood smear) through temporary/permanent slides

This topic gives an overview of;

- Animal Tissues
- Epithelial Tissue
- Connective Tissue
- Muscular Tissue
- Nervous Tissue

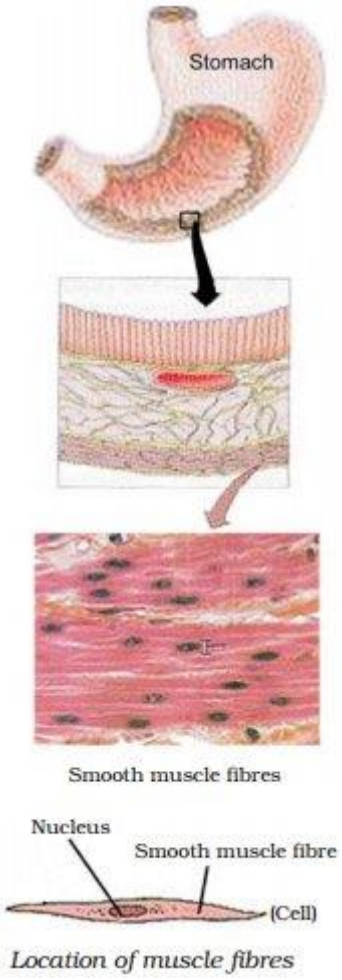
Animal Tissues

When we breathe we can actually feel the movement of our chest. How do these body parts move? For this we have specialised cells called **muscle cells** . The **contraction and relaxation** of these cells result in movement.

During breathing we inhale **oxygen**. Where does this oxygen go? It is absorbed in the lungs and then is transported to all the body cells through blood. The functions of mitochondria we studied earlier provide a clue to this question. Blood flows and carries various substances from one part of the body to the other. For example, it **carries oxygen and food** to all cells. It also collects wastes from all parts of the body and carries them to the liver and kidney for disposal.

Blood and muscles are both examples of **tissues** found in our body. On the basis of the functions they perform we can think of different types of animal tissues, such

as **epithelial tissue, connective tissue, muscular tissue and nervous tissue**. Blood is a type of **connective tissue**, and muscle forms muscular tissue.



Location of muscle fibres

Epithelial Tissue

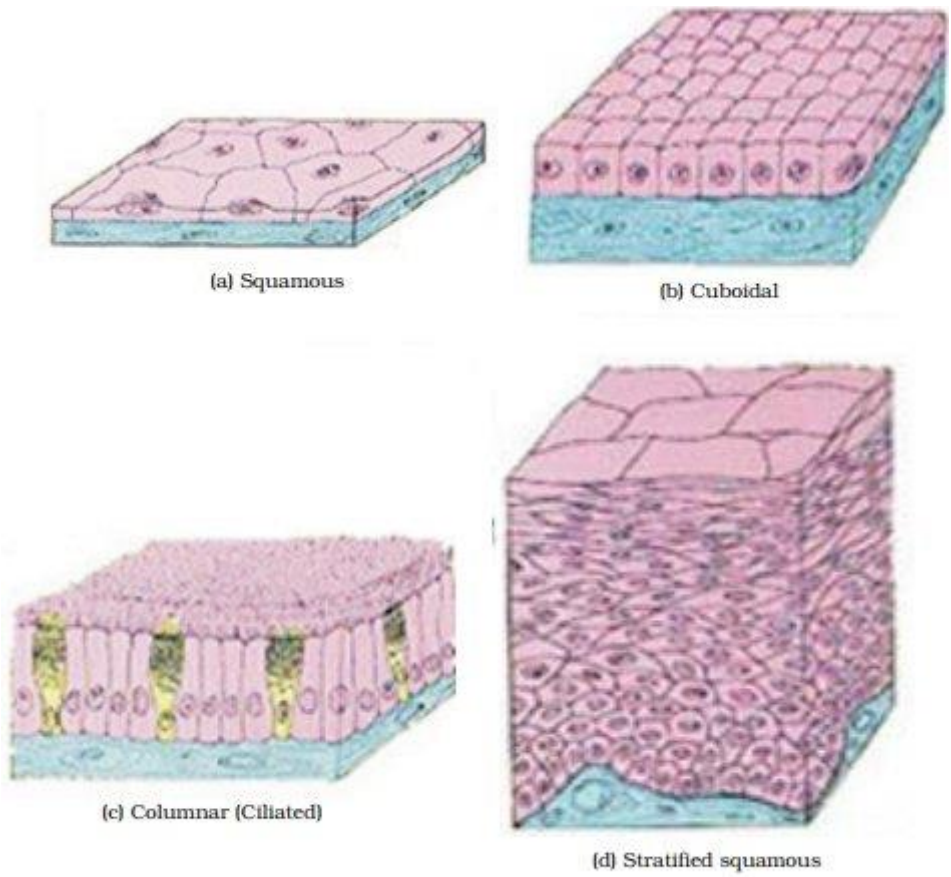
The **covering or protective tissues** in the animal body are epithelial tissues. **Epithelium** covers most organs and cavities within the body. It also forms a barrier to keep different body systems separate. The skin, the lining of the mouth, the lining of blood vessels, lung alveoli and kidney tubules are all made of epithelial tissue.

Epithelial tissue cells are tightly packed and form a continuous sheet. They have only a small amount of cementing material between them and almost no intercellular spaces. Obviously, anything entering or leaving the body must cross at least one layer of epithelium. As a result, the **permeability of the cells** of various epithelia play an important role in regulating the exchange of materials between the body and the external environment and also between different parts of the body. Regardless of the type, all **epithelium** is usually separated from the underlying tissue by an extracellular fibrous basement membrane.

Different epithelia show differing structures that correlate with their unique functions. For example, in cells **lining blood vessels** or **lung alveoli**, where transportation of substances occurs through a selectively permeable surface, there is a simple flat kind of epithelium. This is called the simple **squamous epithelium**. Simple squamous epithelial cells are extremely thin and flat and form a delicate lining. The oesophagus and the lining of the mouth are also covered with squamous epithelium. The skin, which protects the body, is also made of squamous epithelium. **Skin epithelial cells** are arranged in many layers to prevent wear and tear. Since they are arranged in a pattern of layers, the epithelium is called **stratified squamous epithelium**.

Where absorption and secretion occur, as in the inner lining of the intestine, **tall epithelial cells** are present. This **columnar** (meaning "pillar-like") **epithelium** facilitates movement across the epithelial barrier. In the respiratory tract, the **columnar epithelial tissue** also has **cilia,** which are hair-like projections on the outer surfaces of epithelial cells. These cilia can move, and their movement pushes the mucus forward to clear it. This type of epithelium is thus **ciliated columnar epithelium**.

Cuboidal epithelium (with cube-shaped cells) forms the lining of kidney tubules and ducts of salivary glands, where it provides mechanical support. Epithelial cells often acquire additional specialisation as gland cells, which can secrete substances at the epithelial surface. Sometimes a portion of the epithelial tissue folds inward, and a **multicellular gland** is formed. This is **glandular epithelium**.



Different types of epithelial tissues

Connective Tissue

Blood is a type of **connective tissue**. Now, let us look at this type of tissue in some more detail. The cells of connective tissue are **loosely spaced** and embedded in an **intercellular matrix**. The matrix may be jelly like, fluid, dense or rigid. The nature of matrix differs in concordance with the function of the particular connective tissue.

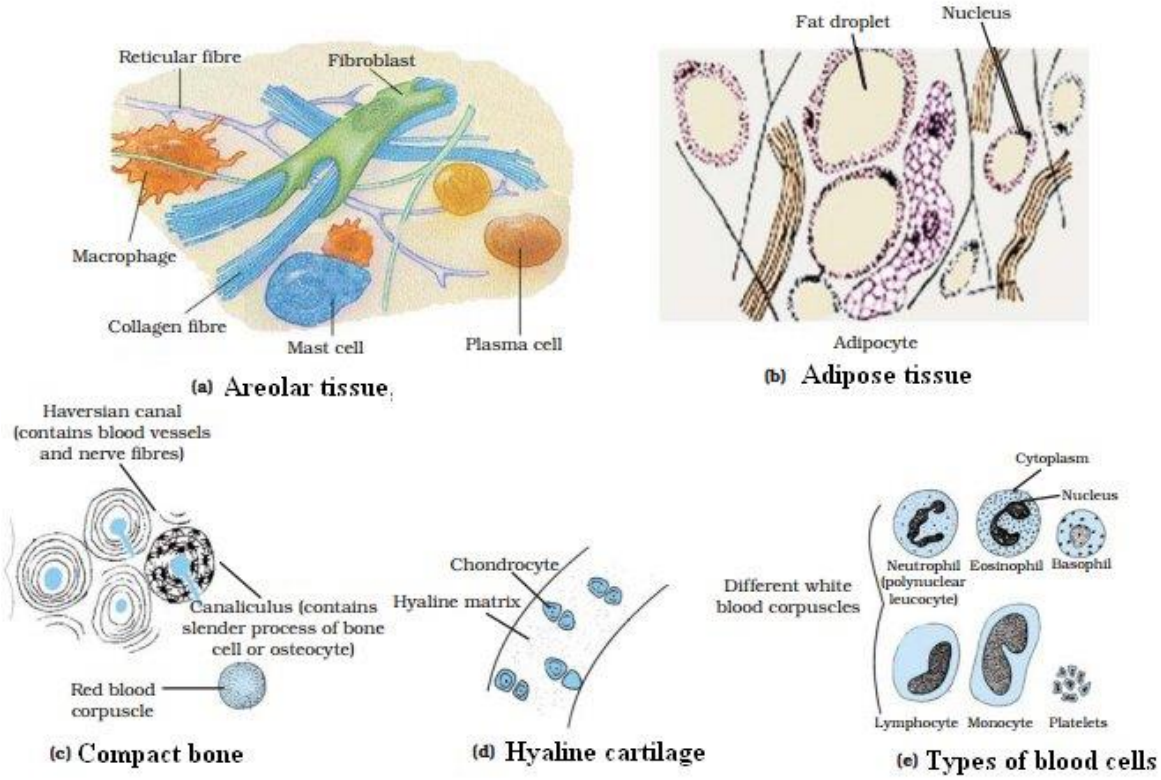
Take a drop of blood on a slide and observe different cells present in it under a microscope Blood has a fluid (liquid) matrix called **plasma**, in which red blood cells (RBCs), white blood cells (WBCs) and platelets are suspended. The plasma contains proteins, salts and hormones. Blood flows and transports gases, digested food, hormones and waste materials to different parts of the body.

Bone is another example of a **connective tissue**. It forms the framework that supports the body. It also anchors the muscles and supports the main organs of the body. It is a strong and nonflexible tissue. Bone cells are embedded in a hard matrix that is composed of **calcium and phosphorus compounds.**

Two bones can be connected to each other by another type of connective tissue called the **ligament**. This tissue is very elastic. It has considerable strength. Ligaments contain very l**ittle matrix**. **Tendons** connect muscles to bones and are another type of connective tissue. Tendons are **fibrous tissue** with great strength but limited flexibility.

Another type of connective tissue, **cartilage**, has widely spaced cells. The **solid matrix** is composed of proteins and sugars.Cartilage smoothens bone surfaces at joints and is also present in the nose, ear, trachea and larynx. We can fold the cartilage of the ears, but we cannot bend the bones in our arms. Think of how the two tissues are different !

Areolar connective tissue is found between the skin and muscles, around blood vessels and nerves and in the bone marrow. It fills the space inside the organs, supports internal organs and helps in repair of tissues.



Fat- storing adipose tissue is found below the skin and between internal organs. The cells of this tissue are filled with fat **globules**. Storage of fats also lets it act as an insulator.

Muscular Tissue

Muscular tissue consists of elongated cells, also called muscle fibres. This tissue is responsible for movement in our body.Muscles contain special proteins called **contractile proteins**, which contract and relax to cause movement.

We can move some muscles by conscious will. Muscles present in our limbs move when we want them to, and stop when we so decide. Such muscles are called **voluntary muscles**. These muscles are also called **skeletal muscles** as they are mostly attached to bones and help in body

movement. Under the microscope, these muscles show alternate light and dark bands or striations when stained appropriately. As a result, they are also called **striated muscles**. The cells of this tissue are long, cylindrical, unbranched and multinucleate (having many nuclei).

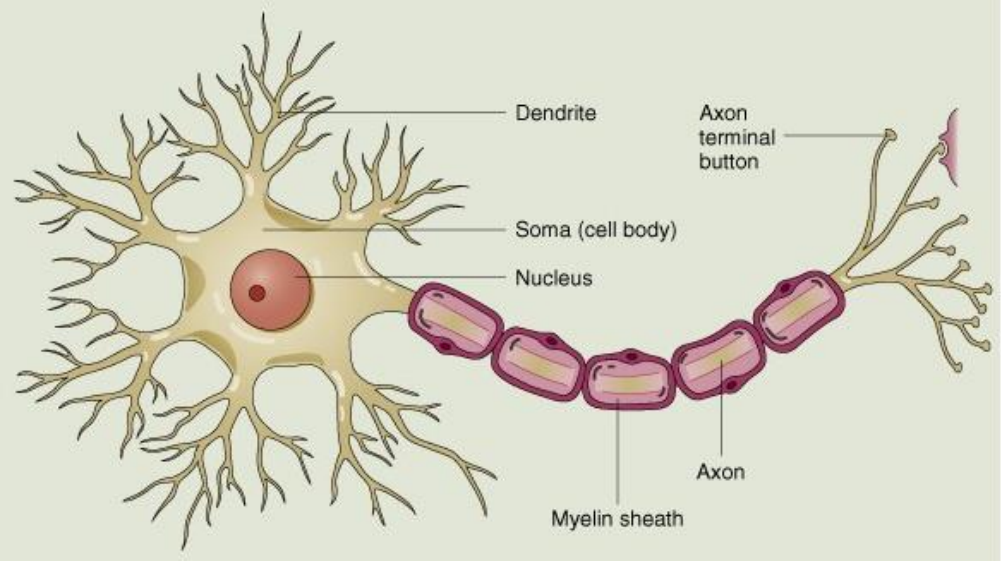
The movement of food in the alimentary canal or the contraction and relaxation of blood vessels are **involuntary movements**. We cannot really start them or stop them simply by wanting to do so! Smooth muscles or involuntary muscles control such movements. They are also found in the iris of the eye, in ureters and in the bronchi of the lungs. The cells are **long with pointed ends** (spindle-shaped) and uninucleate (having a single nucleus). They are also called **unstriated muscles.**

The muscles of the heart show rhythmic contraction and relaxation throughout life. These involuntary muscles are called **cardiac muscles**. Heart muscle cells are cylindrical, branched and uninucleate.

Compare the structures of different types of muscular tissues. Note their shape, number of nuclei and position of nuclei within the cell.

Nervous Tissue

All cells possess the ability to respond to **stimuli**. However, cells of the nervous tissue are highly specialised for being stimulated and then transmitting the stimulus very rapidly from one place to another within the body. The brain, spinal cord and nerves are all composed of the **nervous tissue**. The cells of this tissue are called nerve cells or **neurons**. A neuron consists of a cell body with a nucleus and cytoplasm, from which long thin hair-like parts arise. Usually each neuron has a single long part, called the axon, and many short, branched parts called **dendrites**. An individual nerve cell may be up to a metre long. Many nerve fibres bound together by connective tissue make up a nerve.



Nerve impulses allow us to move our muscles when we want to. The functional combination of nerve and muscle tissue is fundamental to most animals. This combination enables animals to move rapidly in response to stimuli.

Summary

- Animal tissues can be epithelial, connective, muscular and nervous tissue.

- Depending on shape and function, epithelial tissue is classified as squamous, cuboidal, columnar, ciliated and glandular.
- The different types of connective tissues in our body include areolar tissue, adipose tissue, bone, tendon, ligament, cartilage and blood.
- Striated, unstriated and cardiac are three types of muscle tissues.
- Nervous tissue is made of neurons that receive and conduct impulses.

B 5

Aim: Mitosis in onion root tip cells and animal cells (grasshopper) from permanent slides

Theory

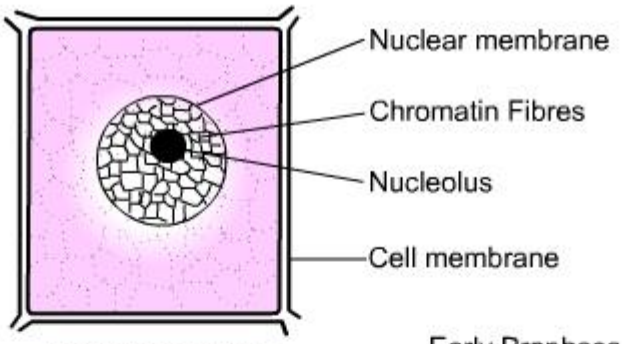
All organisms are made of cells. For an organism to grow, mature and maintain tissue, new cells must be made. All cells are produced by division of pre-existing cells. Continuity of life depends on cell division. There are two main methods of cell division: mitosis and meiosis. In this tutorial we will learn about mitosis.

What is Mitosis?

Mitosis is very important to life because it provides new cells for growth and replaces dead cells. Mitosis is the process in which a eukaryotic cell nucleus splits in two, followed by division of the parent cell into two daughter cells. Each cell division consists of two events: cytokinesis and karyokinesis. Karyokinesis is the process of division of the nucleus and cytokinesis is the process of division of cytoplasm.

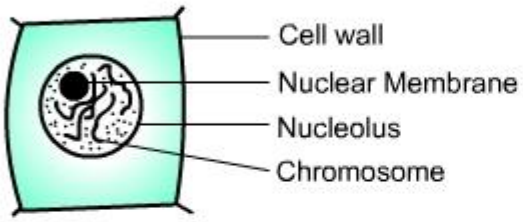
Events during Mitosis

1. Prophase:
    1. Mitosis begins at prophase with the thickening and coiling of the chromosomes.
    2. The nuclear membrane and nucleolus shrinks and disappears.
    3. The end of prophase is marked by the beginning of the organization of a group of fibres to form a spindle.
2. Metaphase
    1. The chromosome become thick and two chromatids of each chromosome become clear.
    2. Each chromosome attaches to spindle fibres at its centromere.
    3. The chromosomes are arranged at the midline of the cell.
3. Anaphase
    1. In anaphase each chromatid pair separates from the centromere and move towards the opposite ends of the cell by the spindle fibres.
    2. The cell membrane begins to pinch at the centre.
4. Telophase
    1. Chromatids arrive at opposite poles of cell.
    2. The spindle disappears and the daughter chromosome uncoils to form chromatin fibres.
    3. The nuclear membranes and nucleolus re-form and two daughter nuclei appear at opposite poles.
    4. Cytokinesis or the partitioning of the cell may also begin during this stage.

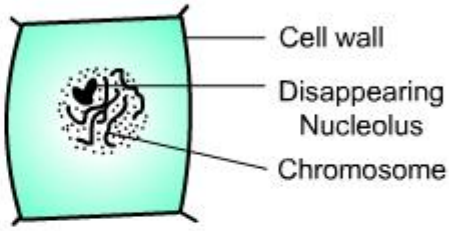


Interphase Stage

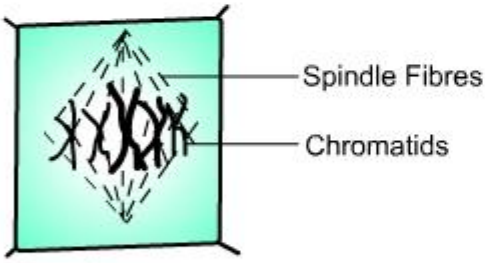
Early Prophase



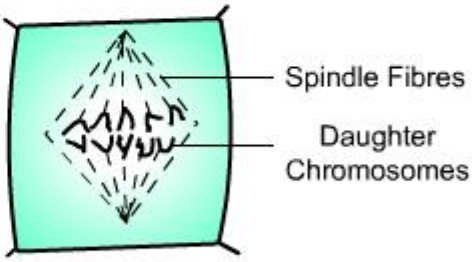
Early Prophase



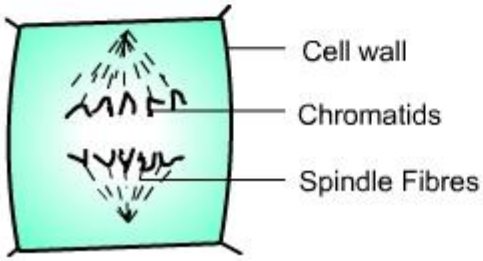
Late Prophase



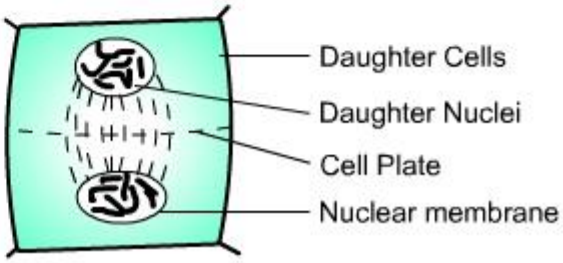
Metaphase Stage



Early Anaphase



Late Anaphase



Telophase Stage

The stage, or phase, after the completion of mitosis is called interphase. It is the non dividing phase of the cell cycle between two successive cell divisions. Mitosis is only one part of the cell cycle. Most of the life of a cell is spent in interphase. Interphase consist of three stages call G1, S and G2.

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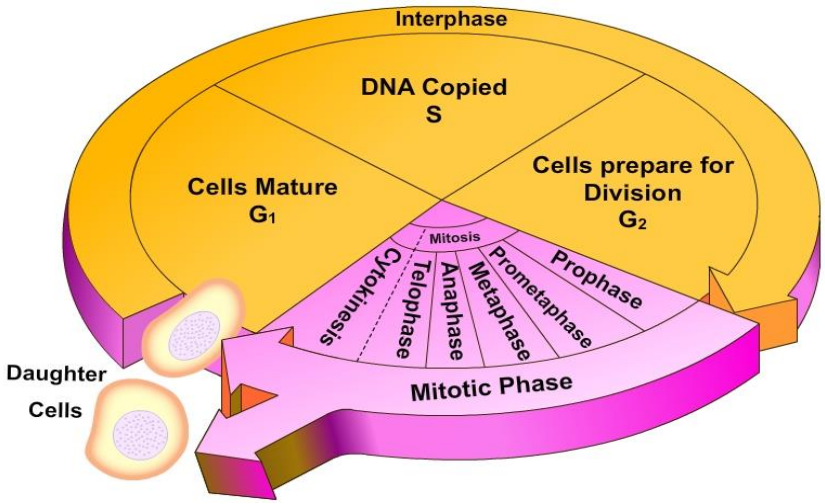
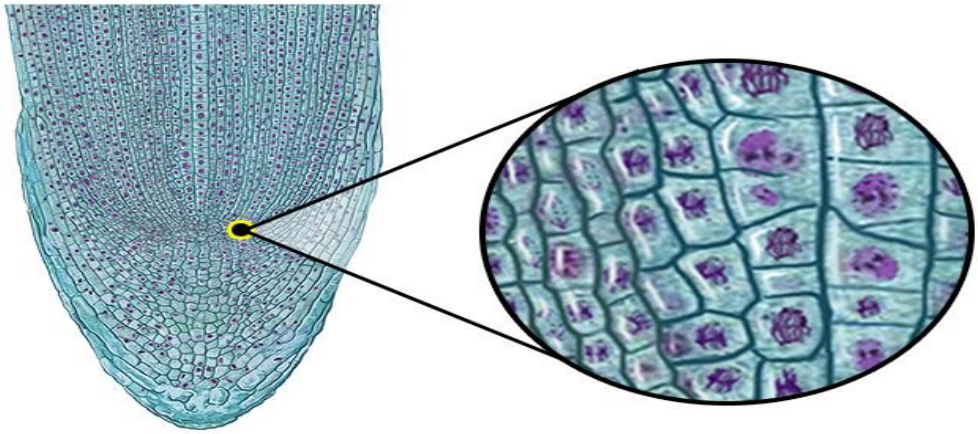


Mitosis in Onion Root Tip

The meristamatic cells located in the root tips provide the most suitable material for the study of mitosis. The chromosome of monocotyledonous plants is large and more visible, therefore, onion root tips are used to study mitosis. Based on the kind of cells and species of organism, the time taken for mitosis may vary. Mitosis is influenced by factors like temperature and time



Mitosis in Onion Root Tip

Learning Outcomes:

- Students understand the term mitosis.
- Students understand the different events during mitosis.
- Students do the experiment better in the real lab having gone through the animation and simulation.