

Practical Notebook

Biology

Grade IX

Web Version of PCTB Textbook

giz



**Punjab Curriculum and
Textbook Board, Lahore**

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Certified that:

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Class _____ Roll No. _____

School _____

has completed practical work of Biology 9 for

session _____ as per syllabus.

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General Guidelines

Student Learning Outcomes

Students are required to carry out practical work as an integral part of the course. They are advised to maintain a laboratory practical in which they record, experimental arrangements used, the observations made, the analysis of these observations and the conclusions. Through experimental work the students are expected to develop the following skills:

1. Techniques

- Cutting of longitudinal and cross sections parts of plant.
- Making slides from fresh cultures (stain/glycerin).
- Locate different systems in dissected animals.

2. Information Handling

- Search, select and interpret scientific information from a variety of sources. Display of results in tabular and graphical forms.
- Analyze, interpret and draw inferences from a variety of forms of information including the results of experiments.
- Demonstrate knowledge and understanding of biological facts and principles, practical techniques and safety precautions.

3. Experimental and investigative skills

- Use of microscope and other tools for accurate biological investigations.
- Observe gross features and fine details and find similarities and differences.
- Become acquainted with the use of scientific instruments and equipments.

4. Attitudes

- Display respect for evidence, rationality and intellectual honesty during investigation tasks.
- Support for collaborative activity, active inquiry, problem solving and decision making.
- Demonstrate knowledge and understanding of the personal, social, economic and technological applications of biology in modern society.

Post Lab Activities

Post lab activities / questions have been included in the student laboratory manual. If students do not have their manuals, please provide the questions to them by writing on the board. Do not give the answers. The answers provided in teacher's manual are for guidance. Responses can be handled in many ways:

- Brain storm with the class.
- Divide students into groups of 3-4 and have them work out the responses.

No matter which approach you use, bring the class together to discuss responses as a whole. Let students do the talk and discuss.

Assessment Checklist

1. Procedure followed carefully and exercise completed satisfactorily.
2. Microscope used properly.
3. Clear and large diagram drawn.
4. Diagrams of the structures listed are accurately labeled.
5. Apparatus, materials and chemicals are handled with care.
6. Observations recorded fully and with understanding.
7. Interpreted the structures identified: evidence of ability to relate structure to function.

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General Safety Procedures

Before you begin.....

1. Keep your work table neat and clean. Make sure that has no unnecessary things such as school bag, files, clothes and books etc.
2. Read carefully all the instructions in your practical manual / book before you do anything.
3. Look out for possible safety precautions.
4. Be sure that equipment and glass-ware are clean before use.

While you are doing the experiment....

1. Follow the directions in the practical manual / book precisely.
2. Do not wander around and do not endanger people around you.
3. Wear or use protective devices that are provided to you. These protective devices include goggles, gloves, apron and safety tongs.
4. Use wire gauze or sand bath for heating. Never leave heating apparatus unattended. Turn off Bunsen burner or spirit lamp when you have to leave your work table for a while or when you have finished your experiment.
5. Handle the apparatus and other instruments particularly sharp objects carefully to avoid damage and loss.
6. If you have broken any glassware (beakers, test-tubes and thermometers etc.) or spilt anything, report to your teacher at once. You may have to help in cleaning up.
7. Be aware of where fire extinguishers, fire blankets and first aid box are located in the laboratory.
8. Do not eat or drink in the laboratory.

After you have finished....

1. Turn off water and gas taps, disconnect electrical connections and return your apparatus to Lab Staff.
2. Clean your work table.
3. Do not dispose of material in the sink unless you are instructed to do so.
4. Wash your hands thoroughly.

The best preventive measure is always to be careful and alert. Take care of yourself and people working around you.

Guidelines on Biology Drawing

1. Your drawings should be large, showing details you need to include in the drawing.
2. Draw what you see - not a textbook diagram.
3. The different parts of the specimen should be drawn in the correct proportions.
4. All drawings and labeling (in capital letters) should be done in pencil. Use a sharp 2B lead pencil for clear outlines. Avoid fussy or broken outlines it make difficult for the examiner to assess your drawing.
5. Do not shade with the side of your pencil. do not use crayons or coloured pencils.
6. Leave sufficient space on either side of your drawing for labels. Write a title at the bottom of each drawing.
7. Label neatly and legibly. Write horizontally and space out your labels neatly.
8. Take care of your singulars and plurals, e.g. a line pointing to one seed should not be labeled as 'seeds'.
9. Labeling lines should not be cross each other. Avoid long labeling lines that cut across the whole drawing.

Description of Dissection Box

Dissection box is used for dissection of animals and plants for the laboratory. It contains the following items:

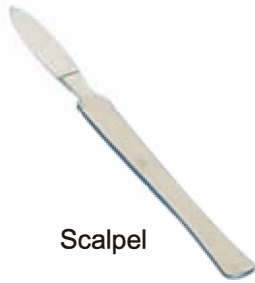
No.	Name of Article	Number in Dissection Box
1	Scalpel	Two
2	Forceps	Two
3	Hooks	Three
4	Dropper	One
5	Blow pipe	One
6	Razor	One
7	Seeker	One
8	Pair of scissors	Two
9	Retractor	One
10	Needle	One
11	Lancet	One



Dissection Box

The uses of items are given below.

- **Scalpel:** It is used to cut different parts of the animal and section of a plant.
- **Forceps:** It is used to hold small tissues or skin of animals.
- **Hooks:** A set of three hooks is used to stretch the tissues of animals during dissection.
- **Scissors:** These small and large scissors are used for cutting purpose.
- **Retractor (lifter):** It is used to retract or lift tissues or other materials.
- **Lancet:** It is used for removing membranes.
- **Needles:** It is used to make holes in certain part of animal or plant. It is also used to separate stretched tissues and blood vessels.
- **Seeker:** It is used to search or trace the hidden parts of dissected animal.
- **Razor:** It is used for sharp cutting, various cross sections of plants and for the preparation of slides.
- **Blow pipe:** It is a hollow curved tipped pipe. It is used for blowing purpose.
- **Dropper:** It is used to put drop of liquid material.



Scalpel



Forceps



Hooks



Scissors

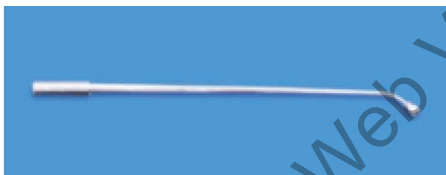


Retractor (Lifter)



Lancet

Needles



Blow pipe

Seeker



Dropper



Razor

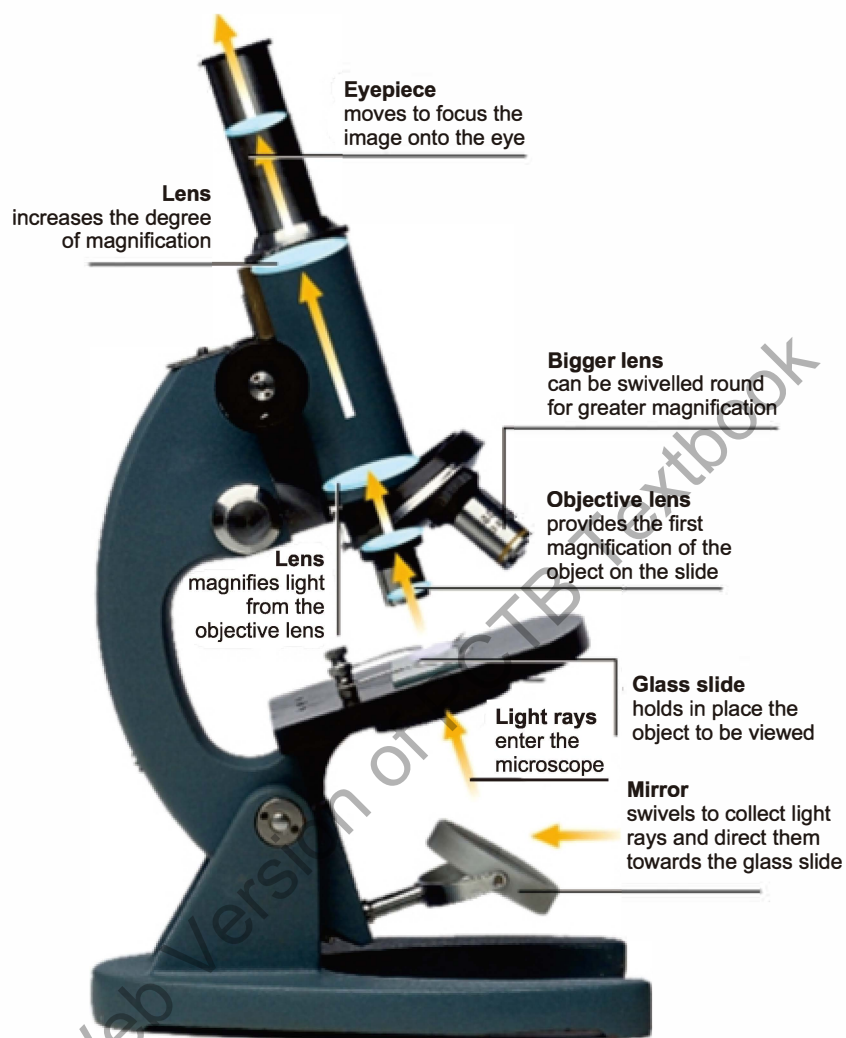


Magnifying lens



Glass slide

Using a Microscope



Compound microscope

Microscope is an expensive instrument that must be given proper care. The following suggestions should be kept in mind.

1. If it is necessary to carry your microscope, always carry it in an upright position. Grasp it firmly with one hand, while supporting the base with the arms towards you. Do not tilt or jar the microscope during transit. Never keep microscope near edge of table.
2. The ocular and objective lenses often require cleaning. These glass lenses are easily scratched and should be cleaned only with lens paper.
3. Learn to keep one hand on the fine focus knob and focus continually up and down while

studying a given object.

4. Do not tilt the microscope while observing any kind of preparation. The microscope is less likely to be knocked off the table when in a vertical position.
5. Adjust the mirror (if present) and iris diaphragm to give a clear but not too bright view through the eye piece.
6. Place the specimen slide on the stage and secure it in place with clips.
7. Using the coarse adjustment, lower the body tube until the objective lens is close to but not touching the slide.
8. Now look through eye piece and use the fine adjustment to raise the body tube until the object on the slide is brought into focus.
9. Always start with low power objective lens to locate the parts of the specimen and then switch to higher power objective lens to observe the details.
10. Always use a cover slip on wet mount preparation.
11. Do not remove any part from the microscope.
12. Clean the microscope and put it back at its proper place after use and be sure that low power objective has been turned in position, the body tube has been moved down, the microscope has been restored to upright position and the clips do not extend beyond the stage.
13. If you find that your instrument is not working properly report it to your teacher.



Dissecting microscope

CHAPTER Introduction To Biology

1

Experiment

1.1

Part 1: Study of different types of bacteria with the help of prepared slides

Date _____

Background Information

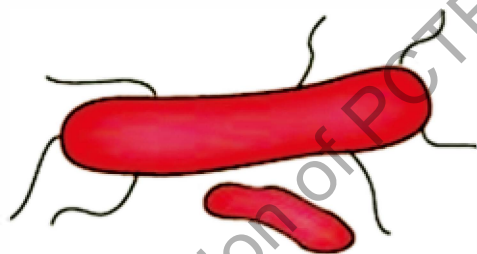
Bacteria are prokaryotes. They differ in size and shape. Bacteria range from 1-10 μm in length and from 0.2-1 μm in width. A bacterium is surrounded by cell wall and cell membrane. A well defined nucleus is absent. The genetic material is in the form of a large coiled chromosome. Bacteria are classified in four types on the basis of shape.

- Cocci (Singular: Coccus) are spherical.
- Bacilli (Singular: Bacillus) are rod shaped.
- Vibrios (Singular: Vibrio) are comma-like.
- Spirilla (Singular: Spirillum) are spiral.



DO YOU KNOW?

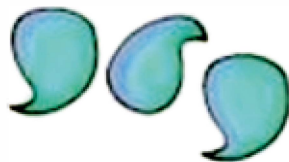
There are more bacteria and microbes in our body than actual cells that make up the body.



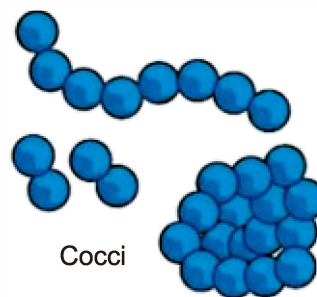
Bacilli



Spirilla



Vibrios



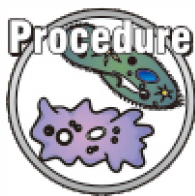
Cocci

Figure 1.1.1: Different types of bacteria

Prepared slides of different bacterial types, microscope

Materials Required

Procedure



1. Observe the prepared slides of bacteria with the help of microscope under low and high powers.



CAUTIONS

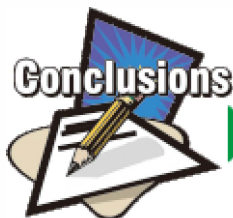
- Handle the slides carefully.
- Clean the slide, ocular lens, and objective of microscope before observing.

Record your observations.



Sr. No.	Shape	Name

Conclusions



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FASCINATING FACT!

A single bacteria cell, given all the food it needs, could divide into a ball of cells to the size of the Earth in 24 hours.



Experiment 1.1

Part 2: Study of *Amoeba*, *Paramecium* and *Volvox* with the help of prepared slides / fresh culture / charts

Date _____



Background Information

(a) Study of *Amoeba*

Amoeba is a unicellular eukaryote. It has an irregular shape, which continuously changes due to thin and flexible cell membrane. It has finger-like projections called pseudopodia (Singular: pseudopodium) which help in movement and intake of food. Cytoplasm is differentiated into outer ectoplasm (non-granular) and inner endoplasm (granular). A well-defined nucleus is present in the endoplasm. Many contractile vacuoles and food vacuoles of different sizes are present in endoplasm. The contractile vacuole performs the function of excretion.

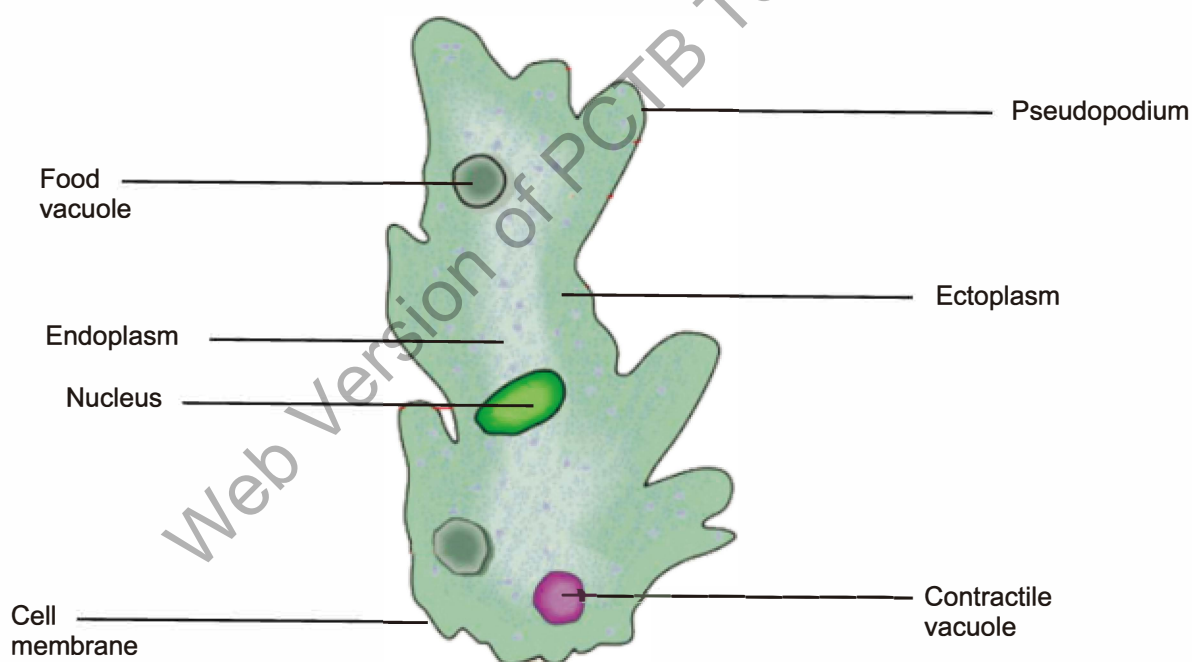


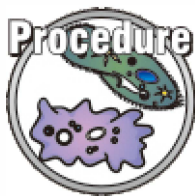
Figure 1.1.2: Structure of *Amoeba*



Materials Required

Prepared slide/ charts, microscope, glass slide, cover slips, dropper, Petri dish, blotting paper, beaker, fresh culture

Procedure



- 1 Observe charts and prepared slide under microscope.
- 2 From fresh culture;
 - Add a drop of water from the fresh culture on the glass slide.
 - Cover it with the cover slip.
 - Observe under low and high powers of microscope.



CAUTIONS

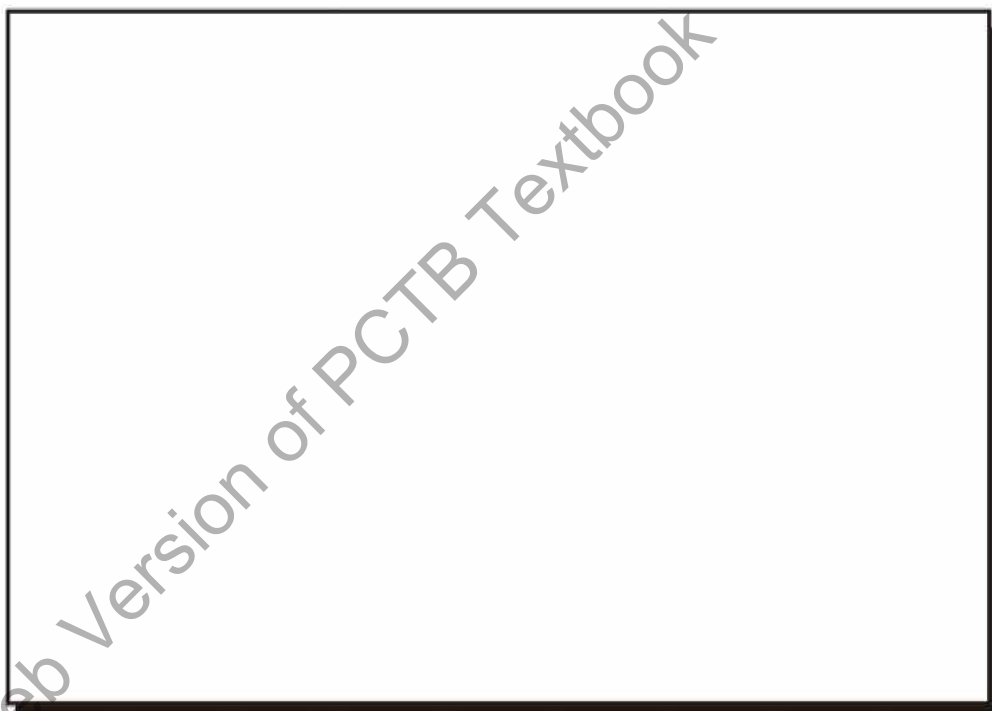
- Never press the cover slip vigorously. It may break or damage the material.
- Remove excess of water around cover slip with blotting paper.



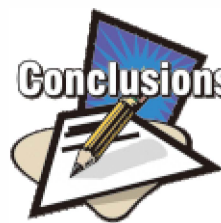
Observations



Draw and label what you have observed under microscope and compare it with prepared slide/chart.



Conclusions



.....
.....
.....
.....

Background Information

(b) Study of *Paramecium*

Paramecium is a unicellular eukaryote. It is slipper shaped i.e. elongated, cylindrical at anterior end, and narrow at posterior end. It moves with the help of hair-like structures called cilia (Singular: cilium) which are present on the entire surface. It possesses two nuclei, large one is called macronucleus and small one is micronucleus. Two contractile vacuoles and many food vacuoles are present. The oral groove leads through a small opening into a narrow tube, the gullet.

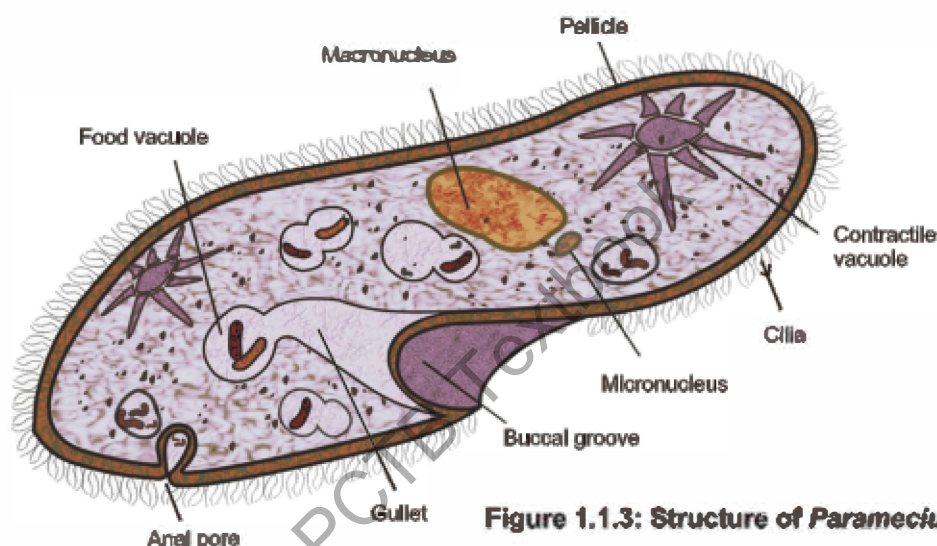


Figure 1.1.3: Structure of *Paramecium*

Materials Required

Prepared slides / fresh culture / charts of *Paramecium*, microscope, glass slides, cover slips, dropper, Petri dish, blotting paper, beaker, glycerine

Procedure

1. Observe charts and prepared slide under microscope;
2. From fresh culture;
 - Put a drop of glycerine on a glass slide to stick the movement of *Paramecium*.
 - Add a drop of water from the fresh culture on it.
 - Cover it with the cover slip.

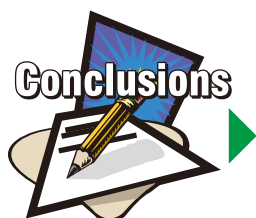


BRAIN TEASERS

Why a *Paramecium* has so many cilia on its surface?



Draw and label what you have observed under microscope and compare it with prepared slide/chart.




(c) Study of *Volvox*

Volvox grows in ponds, pools, ditches and lakes. *Volvox* is not an individual but a colony of a number of similar cells. Many daughter colonies are present in the *Volvox* colony. Each cell of the colony has a pair of flagella at the anterior end that help the colony to move in the water. Each cell has a single eye spot and two to six contractile vacuoles and a single nucleus.

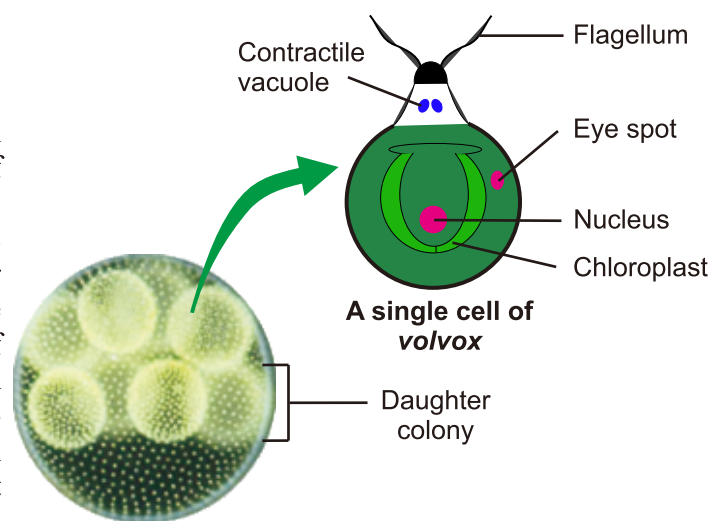


Figure 1.1.4: Structure of single cell of *Volvox* and *Volvox* colony



Prepared slide / fresh culture / charts, microscope, glass slides, cover slips, dropper, petri dish, blotting paper, beaker, glycerine



- ① Observe prepared slide under microscope
- ② From fresh culture;
 - Put a drop of glycerine on a glass slide.
 - Add a drop of water from the fresh culture on it.
 - Cover it with the cover slip.
 - Observe under low and high powers of microscope.



Draw and label what you have observed under microscope and compare it with prepared slide/chart.

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1. **Cut the orange or any other citrus fruit into pieces and put one piece in a Petri dish. Label it as A and leave it on the table. Put another piece in another Petri dish. Label it as B and put it in refrigerator. Observe the pieces after three days. (Same activity may be done with milk).**

I Explain what you observed in Petri dish A and B.

ii What is the effect of cold condition on micro-organisms?

2. **Observe pond water, rain water and tap water under microscope.**

i Which micro-organisms did you observe?

ii In which sample did you observe the maximum number of micro-organisms?

Experiment 1.2

Part 1: Study of external morphology of *Brassica campestris* (mustard plant)

Date _____

Background Information

Brassica campestris (mustard plant) is a dicot angiosperm. Main body of plant is divided into two parts.

1. Vegetative part consists of root, stem and leaves.
2. Reproductive part consists of flowers. Seeds and fruits develop from flower.

Materials Required

Fresh *Brassica* plant, dissecting box, magnifying glass, glass slides or Petri dish

Procedure

1. Take a fresh plant of *Brassica* and observe its root, stem, leaves and flower.
2. Separate the parts by using forceps and observe them under the magnifying glass.

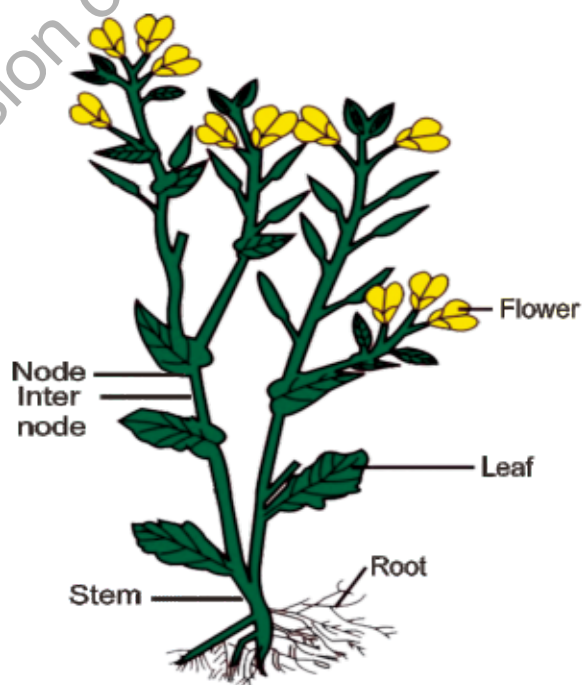


Figure 1.2.1: External morphology of *Brassica*



Note the external morphology of root, stem and leaves.

.....
.....
.....
.....
.....

Draw labeled diagram of each part of the plant.

Root	Stem
Leaf	Flower

Part 2: Microscopic examination of *Brassica* root, stem and leaf

Date _____



(a) Microscopic examination of Root

The root fixes the plant into the soil. It absorbs water and mineral salts from the soil. Its internal structure consists of epidermis, cortex, endodermis, pericycle, vascular bundle (xylem and phloem), cambium and pith. Some cells of epidermis have fine extensions, called root hairs.

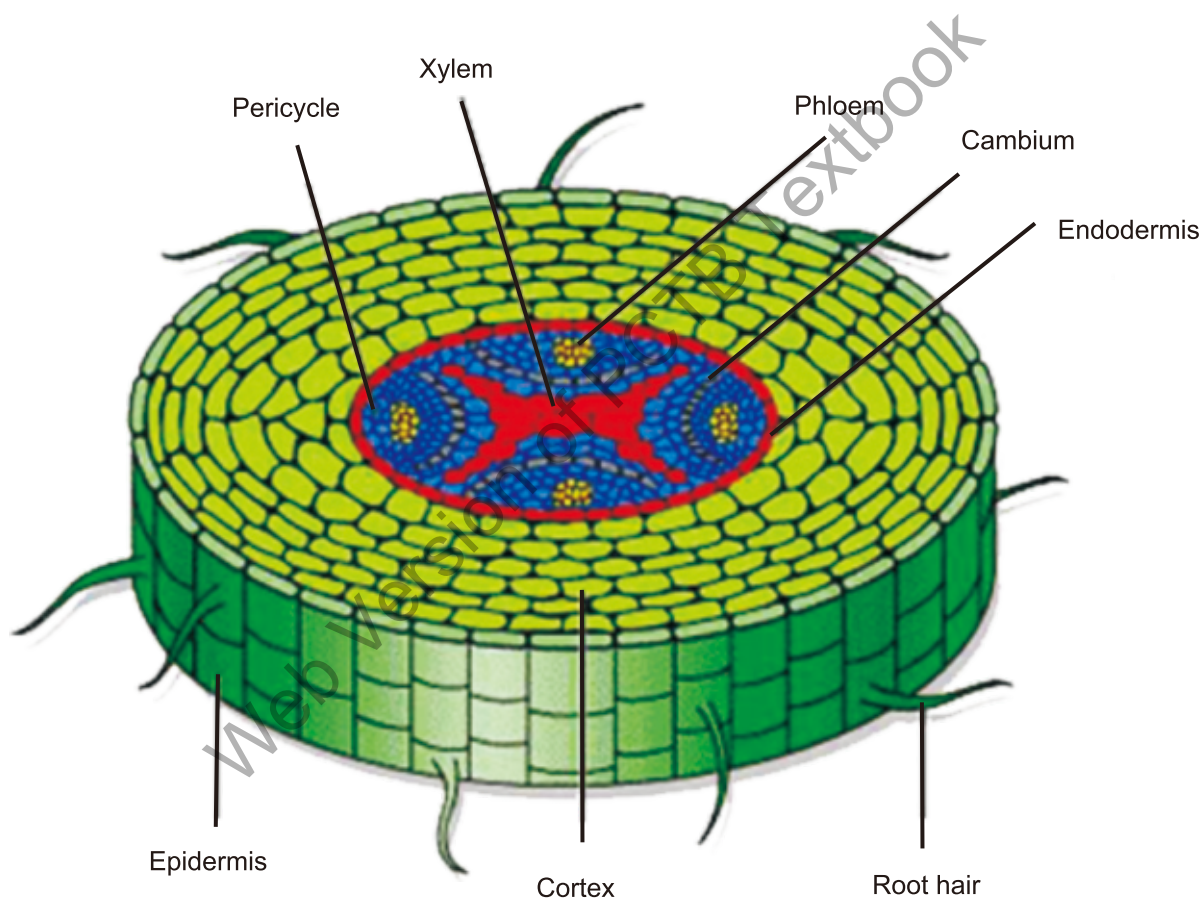


Figure 1.2.2: Transverse Section of a dicot root



Prepared slides of the transverse section of root of *Brassica*, microscope



- 1 Observe the prepared slide of transverse section of root under the low and high powers of microscope.



BRAIN TEASERS

How do you identify that it is a root?



Record your observations.

.....
--

Draw a labeled diagram of what you have observed under microscope.

Background Information

(b) Microscopic examination of Stem

The stem grows upwards from the soil. It bears leaves, flowers and branches. Its internal structure comprises of epidermis, cortex, endodermis, vascular tissues, cambium, medullary rays and pith.

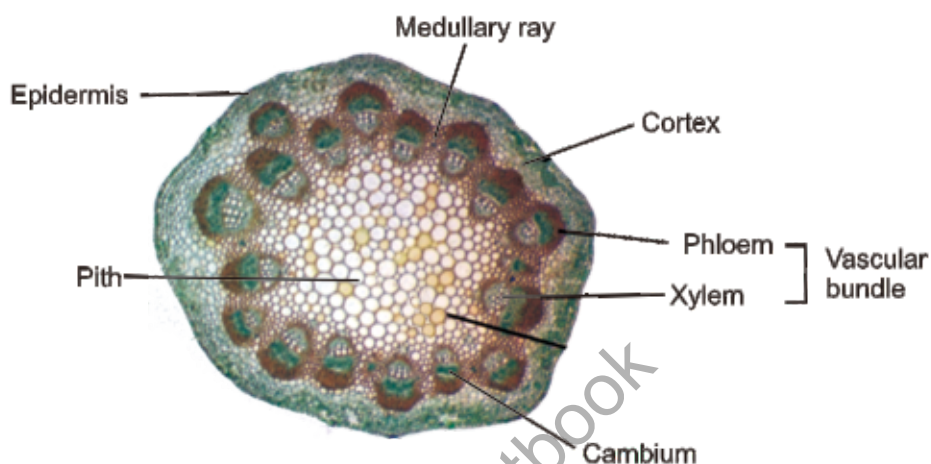


Figure 1.2.3: Transverse Section of a dicot stem

Materials Required

Prepared slides of transverse section of stem of *Brassica*, microscope

Procedure

1. Observe prepared slide of the transverse section of stem under low and high powers of microscope.



BRAIN TEASERS

How do you identify that it is a stem?

Observations

Record your observations.

Draw a labeled diagram of what you have observed under microscope.



(c) Microscopic examination of Leaf

Leaf consists of two parts i.e. petiole and lamina. The internal structure of leaf consists of upper cuticle, epidermis, mesophyll tissue, vascular tissue and lower epidermis (having stomata with guard cells).

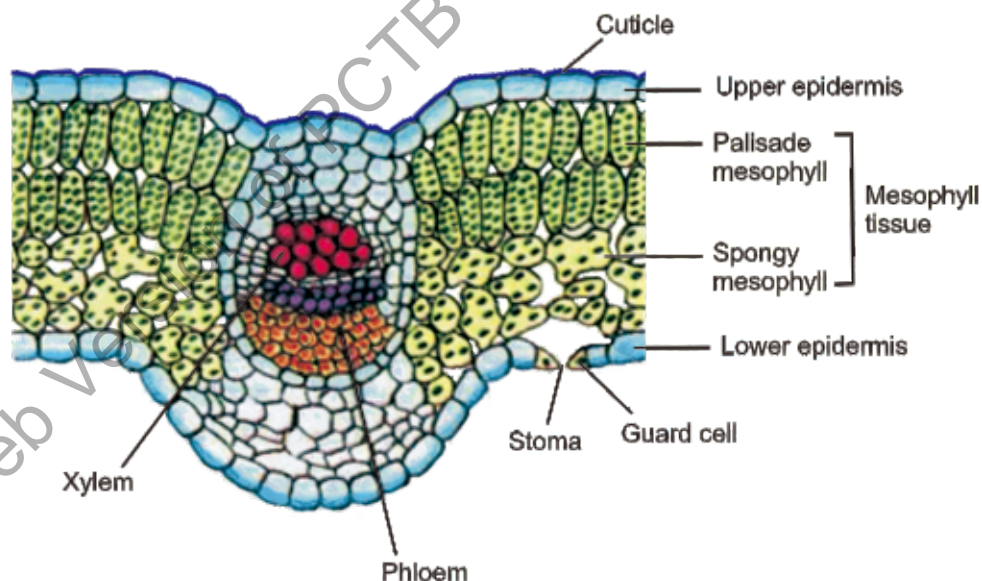


Figure 1.2.4: Transverse section of a dicot leaf



Procedure



Prepared slides of the transverse section of leaf of *Brassica*, microscope

1. Observe prepared slide of transverse section of leaf under low and high powers of microscope.



BRAIN TEASERS

How do you identify that it is a leaf?



Record your observations.

Draw a labeled diagram of what you have observed under microscope.



Part 3: Study of the flower, fruit and seed of *Brassica*

Date _____



Flower is the reproductive part of the plant. A flower consists of four types of floral parts: calyx, corolla, androecium and gynoecium. These parts are arranged in whorls in a definite order.

- The calyx is the outermost whorl and consists of four free sepals. They are usually green. They protect the inner parts of the flower, in bud condition.
- Corolla is the second whorl and composed of four free yellow petals. They help in pollination of flower.
- Androecium is the male reproductive part of the flower. It consists of 6 free stamens. Each stamen has 2 parts i.e. filament and anther. Each anther contains pollen sacs in which numerous pollen grains are produced.
- Gynoecium is the female reproductive part and formed by the union of two carpels. Each carpel consists of stigma, style and ovary.

Mature ripen ovary is called fruit. The fruit of *Brassica* is legume called siliqua (pod). The legume has many seeds. Seeds are small, light in weight, round, blackish and disperse by air.

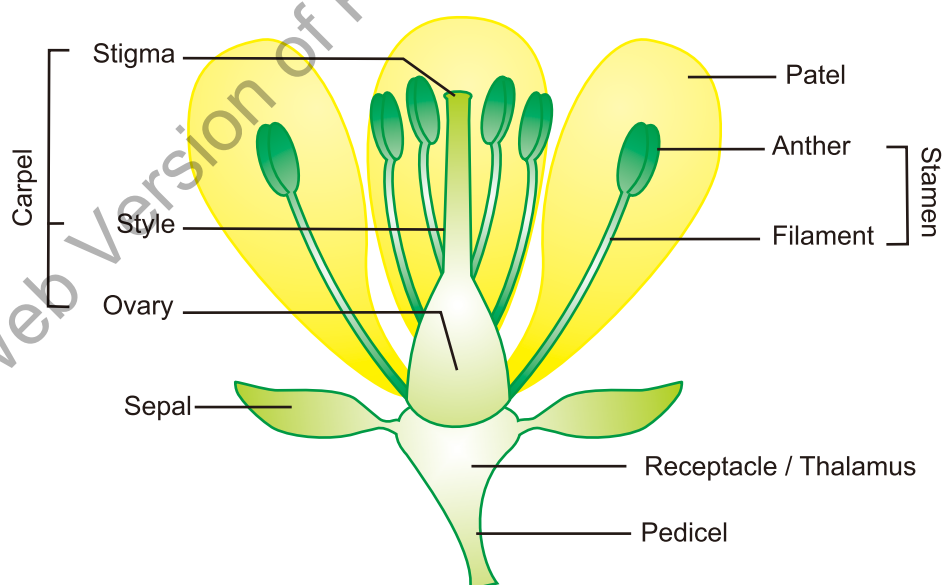


Figure 1.2.5: Structure of a flower



Fresh *Brassica* flower, legume, dissecting box, magnifying glass, Petri dishes or glass slides

- ① Take a fresh flower and observe its parts by magnifying glass.
- ② Remove its parts. Place the parts on glass slide and observe in detail.
- ③ Open a legume and observe the seeds.

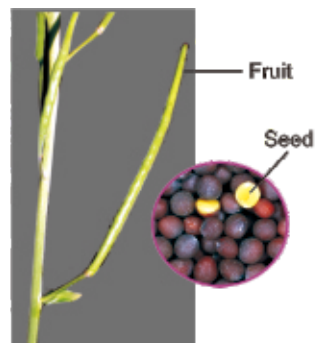


Figure 1.2.6: Fruit (legume) and seeds of *Brassica*

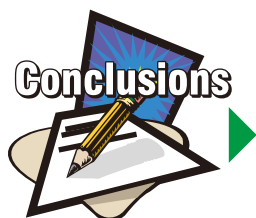
Record your observations.



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Draw labeled diagrams of flower, fruit and seed.

Flower	
Fruit	Seed



Conclusions



Post Lab Activities

1. Give at least two examples of stem, leaves and flowers which we use as vegetables.

2. Make a list of the uses of mustard seeds in your daily life.

3. Leaves are green and they photosynthesize. The outer covering of watermelon is also green. Does photosynthesis also take place in watermelon's outer green covering?



Identification of major organs and organ systems in a dissected frog (dissection by demonstrator/teacher)

Date _____



- On the frog's head there are two external nostrils, two eardrums and two eyes. Each eye has three lids. The third lid is transparent and called the nictitating membrane. Frog has webbed hind feet which help it in swimming. In male frog openings of vocal sacs are present on the floor of buccal cavity.



DO YOU KNOW?

- The largest frog in the world is The Goliath Frog of Gabon in West Africa and can grow as big as 33cm long and up to 3kg heavy.
- The world's smallest frog - The Little Grass Frog - is no bigger than a house fly.

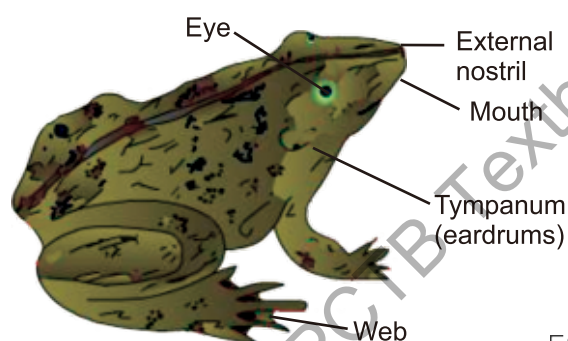


Figure 1.3.1: Frog



Enlarged thumb pad in male frog

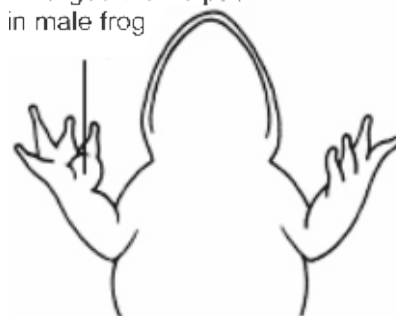


Figure 1.3.2: Distinguishing characters in male frog

- Mouth is bounded by upper and lower jaws. Inside the mouth are two internal nostrils, two vomerine teeth in the middle of the roof of the mouth; and a row of maxillary teeth along the upper jaw. Tongue is very sticky and attached at interior end of buccal cavity.

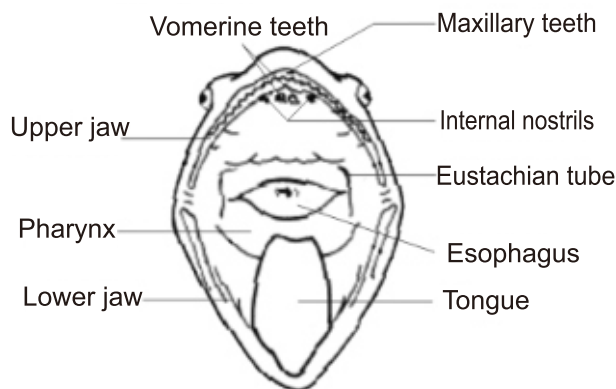
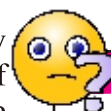


Figure 1.3.3: Structures in the oral cavity of frog

- The digestive system consists of alimentary canal and digestive glands. The cavity of mouth is oral cavity, behind which is the pharynx. There are several openings in pharynx: one for esophagus, one into larynx and two for Eustachian tubes.
- Next to the esophagus there is stomach and a coiled small intestine. Liver and pancreas are also present adjacent to stomach.
- The respiratory system consists of the nostrils, larynx and a trachea which opens into two lungs.



DO YOU KNOW?

- Frog's tongue secretes a sticky substance to capture its preys.
- Male frogs produce croaking sounds to call female frogs for reproduction.

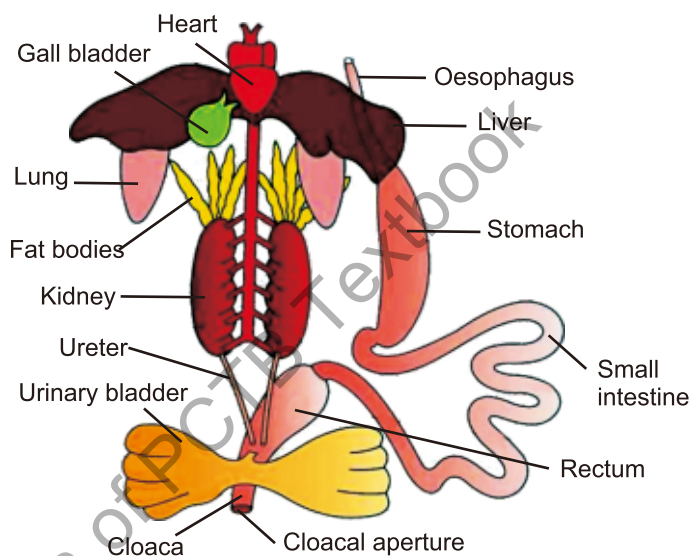


Figure 1.3.4: Different organs in Frog

- The circulatory system consists of the heart, blood vessels, and blood. The heart has two atria and one ventricle. Veins from different parts of the body enter the right atrium, while the veins from lungs enter left atrium. The ventricle pumps the blood out of heart through arteries.
- The urinary (excretory) system consists of two kidneys, two ureters, a bladder, and a cloaca.
- The organs of the male reproductive system are testes, sperm ducts, and cloaca. Those of the female system are the ovaries, oviducts, uteri, and cloaca.
- The central nervous system of frog consists of the brain, which is enclosed in the skull, and the spinal cord, which is enclosed in the backbone. Nerves branch out from brain and spinal cord.
- The frog's skeletal and muscular systems consist of its framework of bones, to which all the skeletal muscles of the body are attached.



Pithed or anaesthetized frog, dissecting tray, paper towels or cotton and dissecting kit



- 1 Identify frog's external morphology.
- 2 In the dissected frog, identify and locate the the organs of the digestive, circulatory, respiratory, urinary and reproductive systems.

CAUTIONS

- Do not cut the organs of the dissected frog unnecessarily.
- Always use hand gloves while probing the hidden structure with hand.

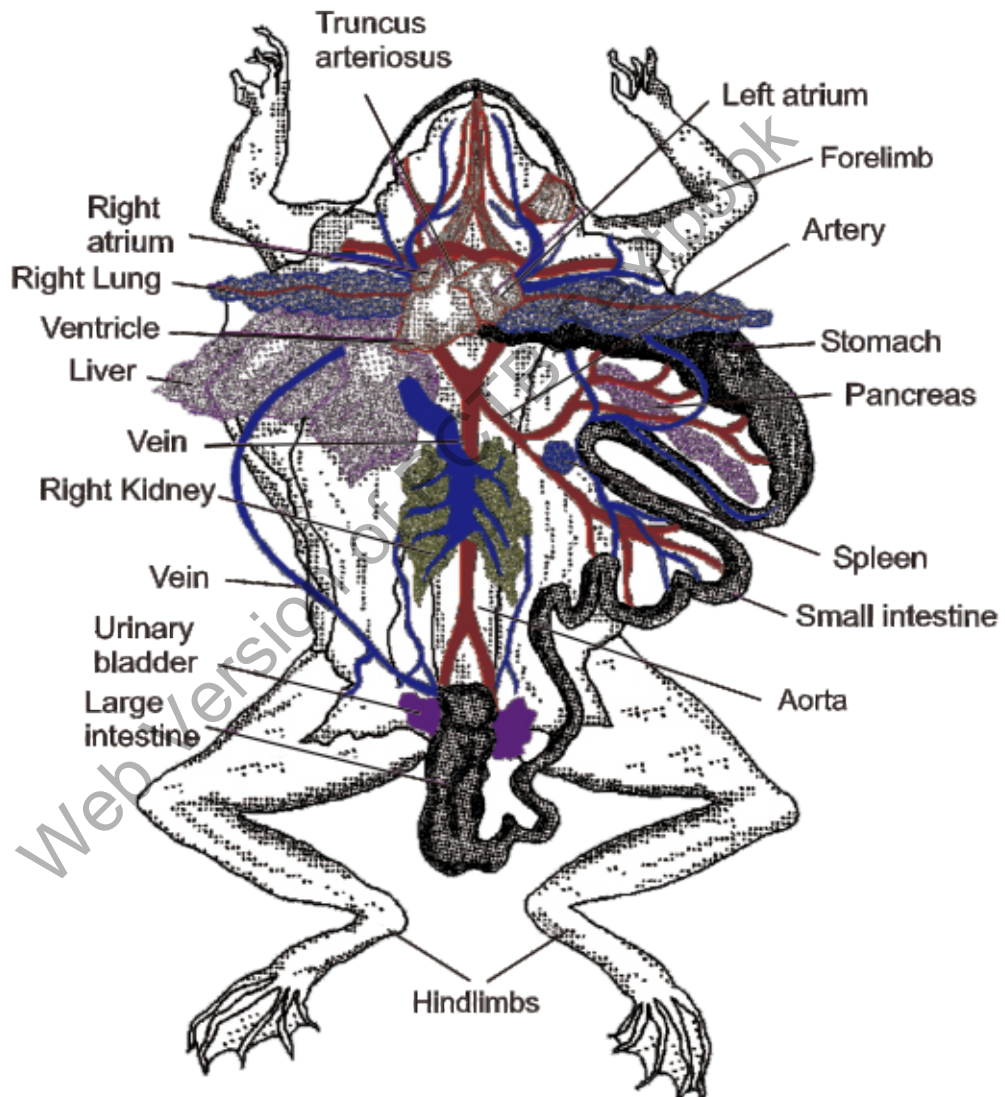


Figure 1.3.5: Internal anatomy of a dissected frog



Draw and label what you have observed.

Digestive system	Respiratory system
Excretory system	

- Describe the appearance of various organs found in a frog.

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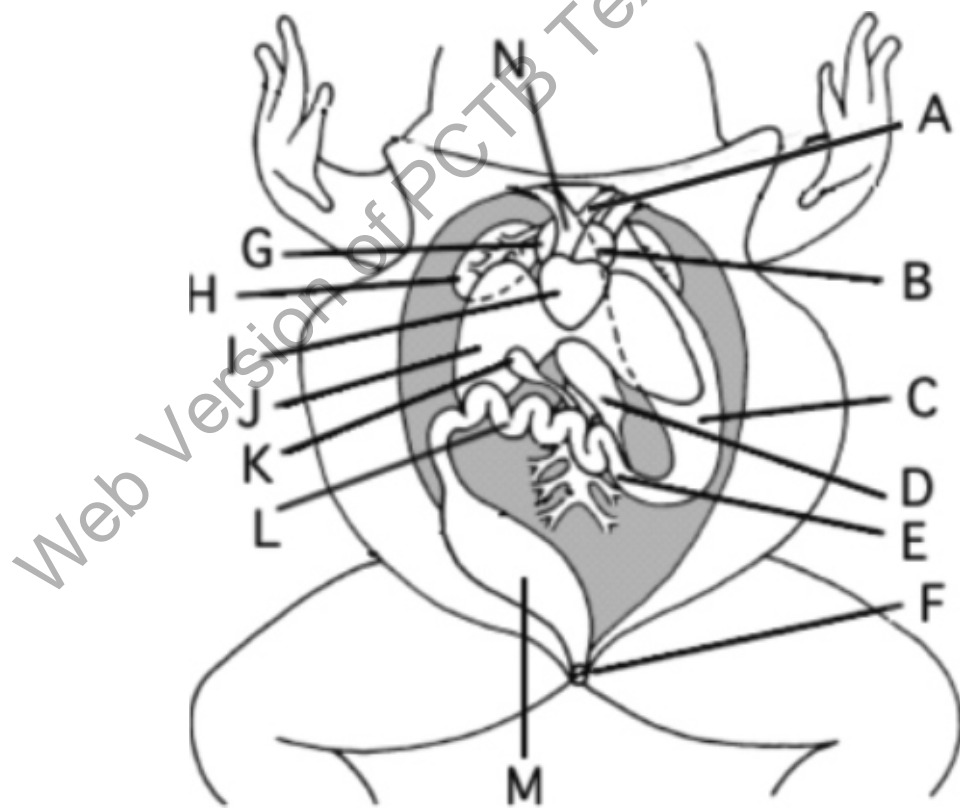
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- Label the diagram.





1. Trace the path taken by a molecule of oxygen from the atmosphere to the blood in the pulmonary vein. What structures play role in the process by which the air is moved?

2. Frog respire through lungs and skin but human respire only through lungs. Do frogs have some advantage, how?

3. How the heart of frog is different from the human heart?

4. Make a table and mention the organs that make digestive, respiratory, reproductive, nervous and circulatory system of a frog.

Organ system	Organs			
Digestive system				
Respiratory system				
Excretory system				
Male Reproductive system				
Female Reproductive system				
Nervous system				
Circulatory system				



Recognition of different animals and plants from fresh and preserved specimens on the basis of apparent distinguishing taxonomic characters

Date _____



Kingdom Animalia

Kingdom animalia is further divided into two main groups i.e. invertebrates (without backbone) and vertebrates (with backbone).



DO YOU KNOW?

There are more insects in a single square mile of fertile soil than there are people on the entire earth.

The characteristics of some important invertebrates are as follows.

Jellyfish

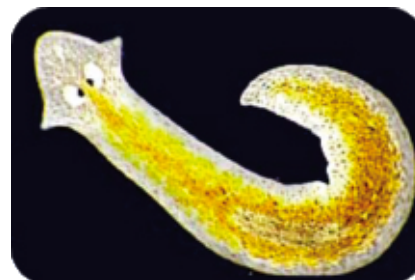
- The body is made of two germ layers i.e. ectoderm and endoderm.
- The digestive cavity has only one opening.
- There is no respiratory or circulatory system.
- There is no central nervous system.
- Jellyfish are found in oceans (some species are also found in freshwater).



Jellyfish

Planaria

- The body is made up of three germ layers i.e. ectoderm, mesoderm and endoderm.
- The digestive cavity has only one opening.
- There is no respiratory or circulatory system.
- They possess a definite head with sense organs.
- Planaria are found in oceans and fresh waters.



Planarian

Ascaris

- It is a human parasite with tubular body form.



Ascaris

- Its digestive tract has two openings i.e. mouth and anus.
- The body is made of three germ layers.

Earthworm

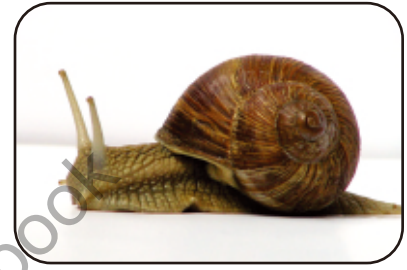
- It possesses segmented body.
- It lives as free-living animal and is found in soil.
- There is a closed blood circulatory system. It respire through skin.



Earthworm

Snail

- Its body possesses a muscular foot
- Its body is enclosed in a coiled shell.
- Head has two tentacles.
- Eyes are located on tentacles.



Snail

Aedes aegypti

- It belongs to the major group of invertebrates i.e. “insects”.
- The body is divided into head, thorax and abdomen.
- They use wings for flight.
- They possess blood circulatory system and respire through special air tubes (tracheal tubes).
- It lives as free-living but the female transmits the virus of dengue fever from one human to the other.
- The mosquito originated in Africa but is now found throughout the world.



Aedes aegypti

Starfish (Sea Star)

- Its body is star shaped and consists of central round disc and five arms.
- Arms have number of tube feet on ventral side.
- It is found only in oceans.



Starfish

The vertebrates are divided into five classes.

1. Class Pisces (Fishes)

Fishes are found in water and are cold blooded (these cannot maintain their body temperature). There are three main groups of fishes.

a. Jawless Fishes

- Jawless fish do not have jaws.
- They have long and eel-like bodies and do not have paired fins.



Jawless Fish

- (iii) Their skeleton is made of cartilage.
 - (iv) They do not have swim-bladder.
- Example: Lamprey and hagfish

b. Cartilaginous Fishes

- (i) Skeleton is made up of cartilage.
 - (ii) Mouth is ventrally located, with upper and lower jaws.
 - (iii) They do not have swim-bladder.
 - (iv) Gills are not covered with operculum.
 - (v) They have tough skin.
- Examples: Shark, ray, and skate



Shark

c. Bony Fishes

- (i) Skeleton is made up of bone.
- (ii) They have terminal mouth.
- (iii) They have swim-bladder.
- (iv) Gills are covered by operculum.
- (v) Skin is usually covered with scales (some do not have scales e.g. trout).



Trout

Example: Trout, perch and tuna

2. Class Amphibia

- (i) They live in both habitats i.e. water and land.
- (ii) They have glandular skin that lack scales.
- (iii) They have bony skeleton.
- (iv) Adult members have lungs. During their developmental stages they have gills (some adult retain gills throughout life).
- (v) They breathe through lungs, gills and skin.
- (vi) They have two pair of limbs.
- (vii) They reproduce in water.
- (viii) They are cold blooded animals.

Example: Frog, toad, salamander and newt



Frog

3. Class Reptilia

- (I) Most are terrestrial and a few live in water.
- (ii) Their skin is hard with scales and scutes and bony plates.
- (iii) They have bony skeleton.
- (iv) They have two pair of limbs (absent in snake).
- (v) They have eggs with leathery shell.
- (vi) Respiration takes place through lungs.
- (vii) They are cold blooded.

Example: Lizard, snake, turtle, crocodile, alligator



FASCINATING FACT!



A crocodile's tongue is attached to the roof of its mouth.

4. Class Aves

- (i) The body is covered with feathers.
 - (ii) Their forelimbs are modified into wings.
 - (iii) All the birds have horny beaks and lay eggs.
 - (iv) They have hollow and light bones.
 - (v) They have air sacs, which assist the lungs for respiration.
 - (vi) They are warm blooded (they can maintain their body temperature).
- Examples: Crow, sparrow, pigeon, parrot



Parrot

5. Class Mammalia

- (i) Body is covered with hairs.
 - (ii) Their skin has sweat glands, scent glands, sebaceous glands and mammary glands.
 - (iii) All the mammals have external ear and moveable eye lid.
 - (iv) They have mammary glands that secrete milk for nourishing the young.
 - (v) They are warm blooded.
- Examples: Cat, cow, goat, rat, human



Cat



DO YOU KNOW?

The giraffe is one of the quietest animals: it has no vocal chords to make any noise.

Kingdom Plantae

Kingdom plantae is divided into two main groups.

1. Non-Vascular Plants

- (I) They do not have vascular bundles.
- Examples: Mosses

2. Vascular Plants

- (I) They have vascular bundles i.e. xylem and phloem.
- (ii) They are further divided into two groups.
 - a. **Seedless plants:** They have vascular bundles but do not produce seeds during their life cycle. *Pteris* and *Adiantum* are common examples of seedless vascular plants.
 - b. **Seed plants:** They produce seeds during their life cycle. Some seed plants do not produce flowers and their seeds are naked (not covered with fruits). Such seed plants are

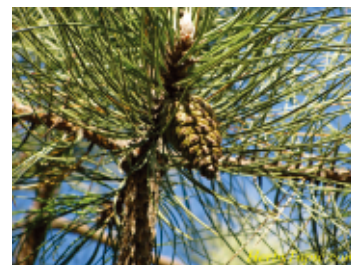


Mosses



Adiantum

called non-flowering plants or gymnosperms (e.g. *Cycas*, *Pinus* etc.). Other seed plants produce flowers and their seeds are covered with fruits. Such plants are called flowering plants or angiosperms (e.g. rose, mango, wheat, *Brassica* etc.). Angiosperms are of two types i.e. monocots (have one cotyledon in seeds e.g. garlic, onion, rice, wheat, grasses) and dicots (have two cotyledons in seeds e.g. potato, tomato, beans, apple, *Brassica*).



Pinus

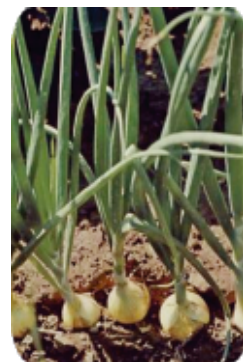


Rice



Wheat

Monocots



Onion

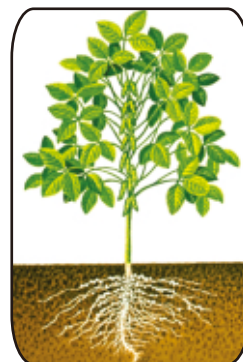


Potato



Apples

Dicots



Soybeans



Preserved and live animals and plants, charts, photographs, hand lens

Procedure



- Observe the specimens provided to you and record the observations.

Specimen	Distinguishing characters
A	
B	
C	
D	
E	
F	

Conclusions



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1. List the ways by which birds are adapted for flight.



BRAIN TEASERS

- Another possible way to classify organisms would be to separate them into unicellular and multicellular organisms. Explain why this is not a useful classification system.
- Why the ventral muscles of the belly are more developed in amphibians than they are in fishes?

2. What type of skeleton is present in Pisces, Amphibians, Reptiles, Birds and Mammals?

3. Identify any two flowering and non-flowering plants present in your surroundings.

4. Draw a table to mention the main differences among the groups of vertebrates.



Evaluation of graphs of a population of an insect (endangered due to excessive use of insecticides) and interpret the reasons for its endangered status

Date _____



Insecticides also kill beneficial insects along with the pest species. An endangered species is a population of organisms which is at the risk of becoming extinct.

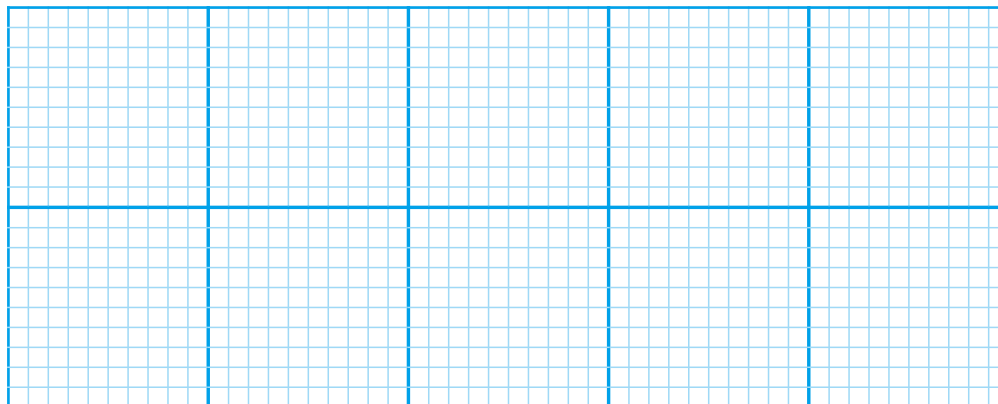
In scientific method, data is collected and organized in the form of tables. The data is also used to make graphs so that scientists can draw conclusions.



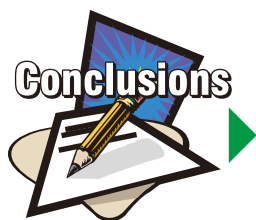
- With the help of the following data, plot a graph showing the insecticide accumulation and number of insects found.

Year of insecticide spray	Insecticide accumulation ($\mu\text{g/square metre of soil}$)	Number of insects (butterflies)/ square metre
1999	200	150
2000	220	120
2001	250	100
2002	260	90
2003	280	85
2004	310	70
2005	325	65
2006	330	60
2007	365	45
2008	375	40
2009	390	20
2010	410	10

Graph



Conclusions



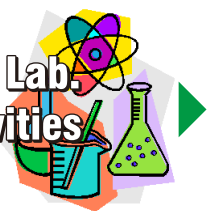
What conclusions can be drawn from the graph?

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Post Lab Activities



1. Is the excessive use of insecticide beneficial or harmful for man?

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2. Make a list of the other factors that may be responsible for the endangered status of the insects.

.....

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3. Should we continue using insecticide or stop its use?

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.....

.....



BRAIN TEASER

Insects that live on land have a coating of wax on the outer surface of their body. What function might the wax serve for these animals?

CHAPTER Cells and Tissues

4



Use of microscope to observe the movement of small objects

Date _____



Microscope is an instrument used to observe small objects.



Pond water, glass slides, microscope, dropper, blotting paper



- Put a drop of water on glass slide and observe under microscope, without placing cover slip.



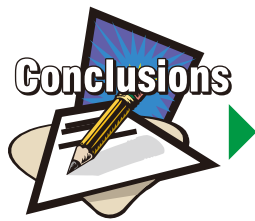
CAUTIONS

- Handle the slides carefully.
- Clean the slide, ocular lens, and objective of microscope before observing.



Draw the diagrams of the organisms you have observed.

Blank area for drawing diagrams of observed organisms.



Conclusions



Post Lab Activities

1. Do all organisms move by the same mechanism?

2. Animals move and plants generally do not move. Can you name some animals that do not move?

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Microscopic examination of an animal cell (e.g. from frog's blood) and a plant cell (e.g. from onion epidermis) using an appropriate temporary techniques such as iodine or methylene blue

Date _____



A cell consists of cytoplasm, nucleus, and cell membrane. Cells are of different shapes and sizes. The red blood cells are spherical and biconvex. They also possess nucleus (The RBCs of mammals do not have nucleus). Unlike the animal cells, plant cells have cell wall, a large vacuole and plastids.

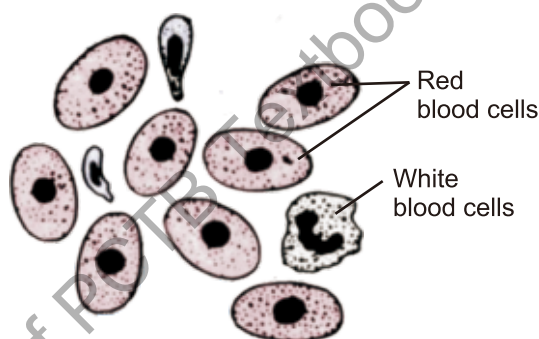


Figure 4.2.1: Blood cells of frog

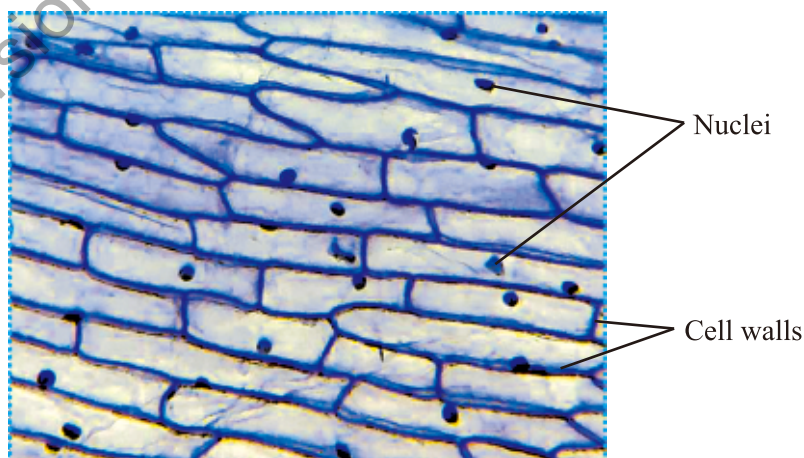


Figure 4.2.2: Onion epidermis as seen under microscope



Part 1: Study of animal cell

Frog, Microscope, glass slide, cover slip, dropper, jar, methylene blue, ethyl alcohol, dissecting box, cotton swab, spirit, syringe



- ① Prepare a smear of frog's blood. For this purpose:
 - Put a small drop of blood of frog on clean glass slide.
 - Place the edge of second slide across the drop at an angle of 45° . The drop of blood will spread along the edge of second slide.
 - Push the second slide in one smooth motion to the opposite end of the first slide. The drop of blood will spread across the slide and a thin smear will form.
- ② Dry the blood smear in the air.
- ③ Fix the smear by dipping the slide in absolute alcohol.
- ④ Add a few drops of methylene blue stain over the smear and leave it for 3-4 minutes.
- ⑤ Add a few drops of distilled water to the stain, and shake the slide gently to mix it thoroughly. Leave it for about 10 minutes.
- ⑥ Wash the slide under the gentle stream of water.

CAUTIONS

- Handle the chemicals carefully.
- Clean the slide, ocular lens, and objective of microscope before observing.

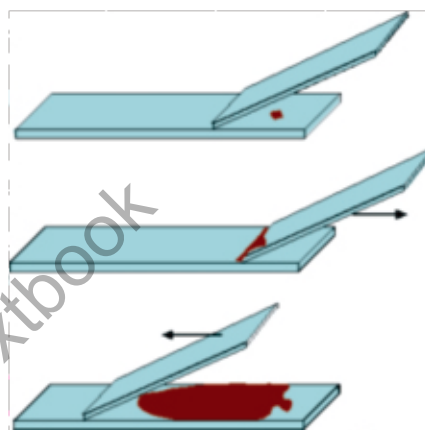
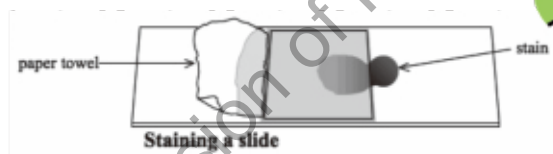


Figure 4.2.3: How to make blood smear



- ⑦ Remove excess liquid with blotting paper and dry the slide in air.
- ⑧ Now observe the slide under low and high powers of microscope.



BRAIN TEASERS

- Why there is no need of cover slip to place on the slide?
- Why an anticoagulant is mixed with blood immediately after taking from the body?

Draw and label what you observe





Part 2: Study of plant cell

Microscope, glass slide, forceps, cover slip, razor blade, scalpel, mounted needle, dropper, dilute iodine or methylene blue, onion, blotting paper



- ① Cut onion bulb into four pieces, vertically.
- ② Hold one of the scale leaves with your fingers and thumb of both hands with the concave side facing you.
- ③ Using fingers of forceps, gently peel off the thin transparent membrane i.e. epidermis from the inner surface of the scale leaf.
- ④ Put the epidermis in a watch glass containing water and cut a small piece of the epidermis.
- ⑤ Place a drop of water in the centre of a clean glass slide and then put the piece of epidermis on it.
- ⑥ Spread the material with the help of needle, so that it should not overlap.
- ⑦ Cover the material with cover slip and remove excess of water around cover slip with blotting paper.
- ⑧ Observe the slide under microscope.
- ⑨ Place a drop of dilute iodine (or methylene blue) solution on one side of cover slip and put blotting paper on the other side.
- ⑩ Examine the slide, first under low power then high power of microscope.

! CAUTIONS

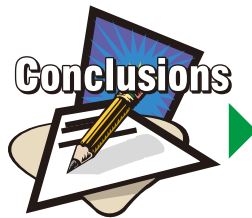
- Remove the wrinkles with the help of needles.
- Cover slip should be placed gently to avoid the air bubbles.



Figure 4.2.4: How to make the slide of onion epidermis



Draw and label what you have observed.



1. Compare the two specimens that you have observed under the microscope.

2. State two ways in which a red blood cell differs from a typical animal cell.

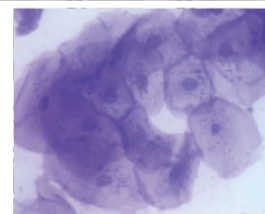
Experiment 4.3

Identification of different parts of the cell from fresh preparations

Date _____

Background Information

Cell wall, plastids and large central vacuoles are present in plant cell and absent in animal cell.



Cheek cells

Materials Required

Onion, knife, microscope, glass slide, cover slip, methylene blue, iodine blue, forceps, tooth picks

Procedure

- ① Study of plant cell
 - Make a slide of onion epidermis as mentioned in the experiment 4.2 and observe it under microscope.
- ② Study of animal cell
 - (i) Place a drop of water on a glass slide.
 - (ii) Gently scrap inside of your cheek, using blunt end of toothpick.
 - (iii) Transfer and mix the material to the drop of water on the slide.
 - (iv) Carefully place cover slip (avoid air bubbles).
 - (v) Put one drop of methylene blue solution on the edge of the cover slip. Touch the other end of the cover slip with the piece of blotting paper. This will spread the stain on the material and will also remove the excess of water.
 - (vi) Observe the slide under lower and higher power of the microscope.

CAUTIONS

- Take cheek cells under teacher's supervision.
- Don't try to explore any part of your skin for taking cells.

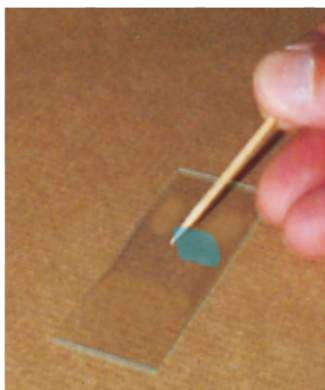
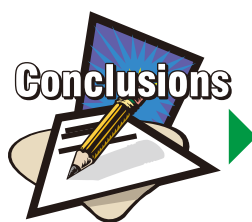


Figure 4.3.1: Taking cheek cells and preparation of slide



Observations

Draw diagrams of what you have observed in onion epidermis and human cheek epithelium slides.



Conclusions

Draw the labeled diagram of an animal and a plant cell, as seen under microscope.



Post Lab Activities

1. The absence of an organelle is responsible for making animals heterotrophs. Which organelle is that?

2. Which is the largest cell in animals?



Preparation of wet mounts of tissue from flowering plants, and study of plant and animal tissues from charts and prepared slides

Date _____



Part 1: Preparation of wet mounts of tissue from flowering plants

Similar cells group together to form a tissue. The dicot stem and the dicot root consist of epidermal tissue, ground tissue and vascular tissue.

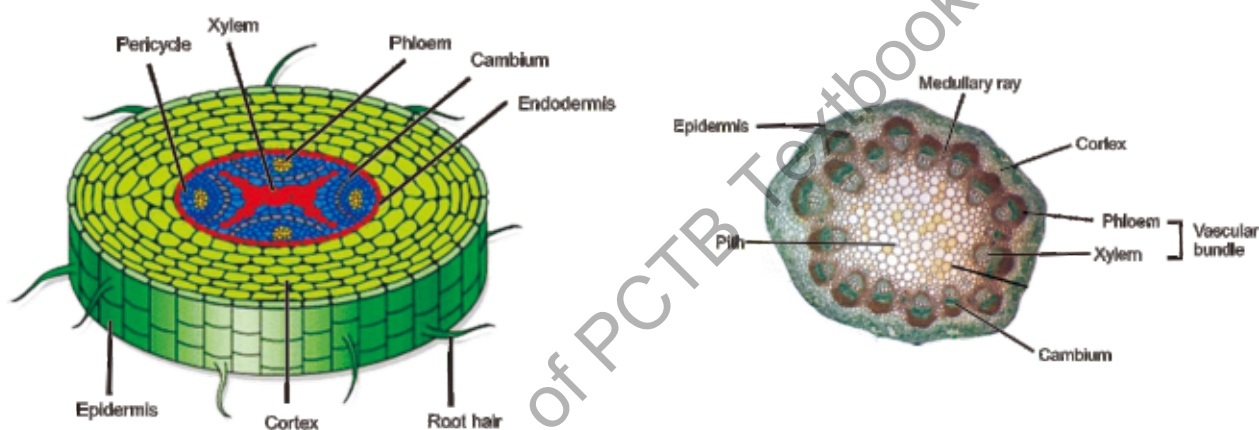


Figure 4.4.1: The internal structures of a dicot root and a dicot stem



Microscope, slides, cover slip, forceps, dicot (*Brassica*) stem and root, Petri dish, distilled water, sharp blade, iodine solution, blotting paper, tissue paper



- ❶ Put a drop of water on a glass slide.
- ❷ Cut very thin transverse section of flowering plant root with the help of sharp blade.
- ❸ Place the section on glass slide and add 2 drops of iodine solution on it.
- ❹ Cover the material with cover slip and observe the slide under low power and then high power of microscope.
- ❺ Repeat the same procedure for the preparation of the slide of stem section.

CAUTIONS

- Select thin section for slide preparation.
- Cover the section very carefully with cover slip and avoid air bubbles.
- Blot the extra stain from the slide.



- Make a diagram to show the distribution of tissues in stem.

- Make a diagram to show the distribution of tissues in the root.



State the difference in these two sections (stem and root).



Part 2: Study of plant and animal tissues from charts and prepared slides

Charts and prepared slide of animal and plant tissues



- 1 Observe the charts and prepared slide of animal and plant tissues.



Animal Tissue

Specimen	Diagram	Main characteristics
Connective Tissue		
Muscular Tissue		
Nerve Tissue		
Epithelial Tissue		

Plant Tissue

Specimen	Diagram	Main characteristics
Epidermal Tissue		
Supporting Tissue		
Vascular Tissue		
Meristematic Tissue		

Conclusions

Write the cellular characteristics and the functions of each of the observed tissue.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There is a faint watermark in the top left corner that reads "Web". The paper is framed by a dark border.



1. What are the three types of muscular tissues in animals?

2. Name the three animal tissues which are functionally equivalent to the epidermal tissue, support tissue and vascular tissue in plants.

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Experiment 4.5

Determination of the effect of tonicity on plasmolysis and deplasmolysis in plant cells or in blood cell

Date _____

Background Information

Tonicity is the term that is used to explain the “concentration” of a solution. A solution is called hypertonic if it is more concentrated than the one being compared with. The hypotonic solution is less concentrated (dilute) than the other. Two solutions having the same concentration are said to be isotonic. When a cell is placed in a hypertonic (concentrated) solution, water leaves the cell i.e. exosmosis of water. The cell in this condition shrinks and this phenomenon is known as plasmolysis. If a plasmolysed cell is placed in a hypotonic (dilute) solution e.g. pure (distilled) water, water moves from the surrounding into the cell (endosmosis) and the cell comes back to its original shape. This phenomenon is known as deplasmolysis. In an isotonic solution, the rate of water entry into cell is equal to the rate of water exit. So there is no change in the shape and size of the cell.

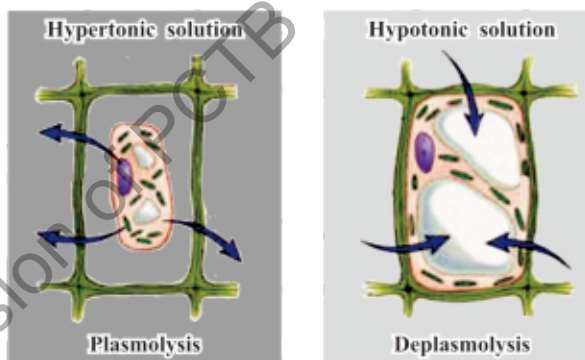


Figure 4.5.1: Plasmolysis and deplasmolysis

Materials Required

Plant cell (onion), 1% and 4% sugar solution, distilled water, microscope, forceps, slides, cover slip, filter/ tissues paper, Petri dish,

Procedure

- 1 Cut onion bulb into four pieces, vertically.
- 2 Hold one of the scale leaves with your fingers and thumb of both hands with the concave side facing you.
- 3 Using fingers of forceps, gently peel off the thin transparent membrane i.e. epidermis from the inner surface of the scale leaf.



CAUTIONS

- Select piece of onion of specific sizes.
- Place the cover slip gently to avoid air bubbles.
- Do not use same dropper for different concentrations of solutions.

- ④ Place two pieces of epidermis (of equal size) on a clean slide and use microscope to observe the sizes of cells. Draw the observed shapes and sizes of cells.
- ⑤ Place one piece of epidermis in Petri dish A, containing 1% sugar solution. Place the second piece in Petri dish B, containing 4% sugar solution. Leave the petri dishes for 15 minutes.
- ⑥ Take the pieces of epidermis out of Petri dishes and place them on separate slides with drops of the same solutions.
- ⑦ Cover the slides with cover slips and observe under microscope.
- ⑧ Record your observations (about the sizes of the cells).
- ⑨ Add distilled water to the piece of epidermis (placed earlier in Petri dish B) and observe under microscope.

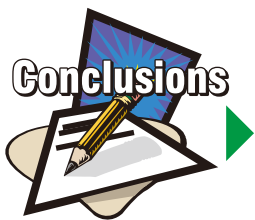


- Record the changes that are observed in the cells of onion epidermis.

	1% sugar solution	4% sugar solution	Distilled water (after 4% sugar solution)
Changes in the cells			

- Draw the diagrams of what you have observed.

Epidermis placed in 1% sugar solution	Epidermis placed in 4% sugar solution	Epidermis placed in 4% sugar solution and then in distilled water
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Conclusions



Post Lab Activities

1. If we place red blood cells in concentrated glucose solution, what will happen?

2. During rainy season, children sprinkle salt on earthworm, so it dies. Salt is not poisonous (we use it daily). Explain why earthworm dies.

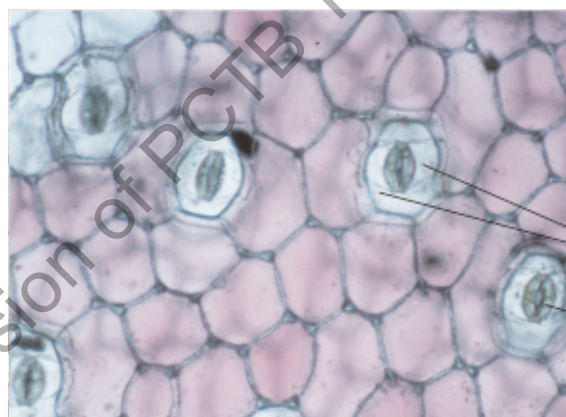


Data collection on the number of stomata per unit area on various plant leaves that grow in areas of differing humidity and compilation of data and graph it to determine the relationship between the variables

Date _____



The upper and lower epidermis of leaves have numerous pores called stomata. From stomata, exchange of gases (CO_2 and O_2) and water vapours takes place between the leaves and environment for photosynthesis, respiration and transpiration. Each stoma is surrounded by a pair of guard cells. The number of stomata (per unit area of leaves) is different in plants of different habitats.



Guard cells

Stoma

Figure 4.6.1: Stomata in the leaf of a mesophyte



Leaves of different plants (mesophyte, hydrophyte, xerophyte), microscope, glass slide, cover slip, forceps



- 1 Take a leaf of mesophyte plant and bend its lamina until it breaks.
- 2 Hold the broken edge with forceps and peel the lower epidermis.
- 3 Put a drop of water on a glass slide.
- 4 Place the epidermis in the drop of water on glass slide.

CAUTIONS

- Epidermis should be smooth, without any folds.

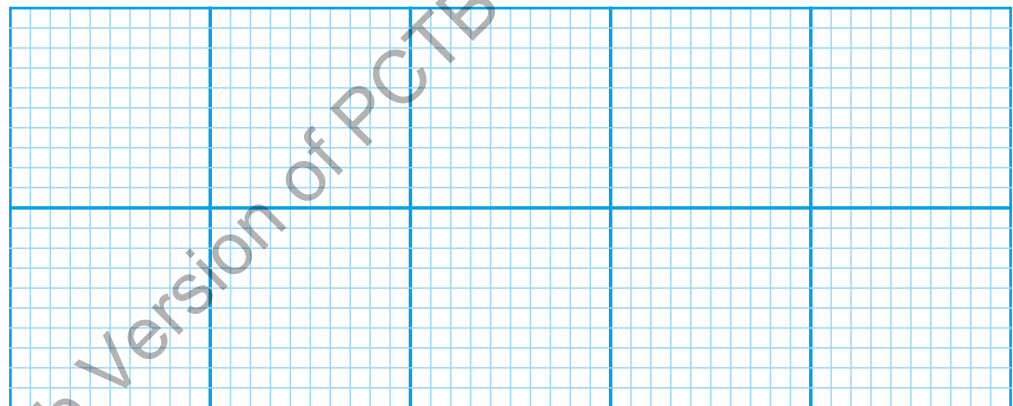
- 5 Cover the epidermis with cover slip (avoid air bubbles) and remove extra water .
- 6 Observe the slide under the low power of microscope and count the number of stomata.
- 7 Repeat the same experiment with xerophyte and hydrophyte leaves.



	Type of Plant	Number of stomata seen under the same power of microscope
1	Hydrophyte	
2	Mesophyte	
3	Xerophyte	

Plot a graph to show the relationship between the number of stomata and the habitats of plants.

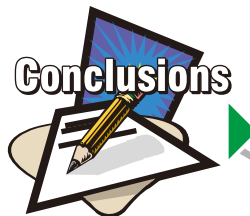
Graph



OBSERVE & TELL

Do all stomata/ guard cells have the same shape and size or they are different?

Conclusions



What do you conclude from the graph? What relationship exists between humidity and number of stomata?

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1. Name the processes in which stomata play role?

2. A plant is growing on a roadside and its leaves are covered with dust. What will be the effect on the rate of photosynthesis? Explain.

3. What other factors determine the number of stomata?

4. If we use upper epidermis, rather than the lower epidermis, what will be the conclusion and why?



BRAIN TEASERS

- Stomata can open and close in response to changes in the CO_2 concentration inside the leaf. Would stomata open or close if the CO_2 concentration decreases?
- Will you observe stomata in onion peel? Why?

Experiment 5.1

Observation of various stages of mitosis and meiosis by slides, models and charts

Date _____

Part 1: Study of mitosis

Background Information

Mitosis is a cell division in which the two daughter cells receive the same number of chromosomes as are present in the parent cell. It is a continuous process in which sequence of events is divided into two major phases: karyokinesis (division of nucleus) and cytokinesis (division of cytoplasm). Karyokinesis is divided into four phases i.e. prophase, metaphase, anaphase and telophase.



Figure 5.1.1: Different stages of mitosis

Materials Required

Models, charts and prepared slides of mitosis, microscope

Procedure

1. Examine the prepared slides showing various stages of cell division (mitosis) through microscope.
2. Observe charts and models of various stages of mitosis.
3. Compare the slides with charts and models.

CAUTIONS

- Handle the slides carefully.
- Clean the slide, ocular lens, and objective of microscope before observing.

BRAIN TEASERS

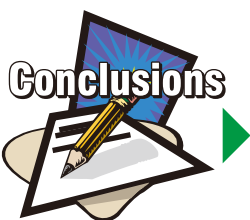
In which kind of cells does mitosis occur?



Observations

Fill the table after observing the slides/charts/models.

Slide	Characteristics of each stage	Diagram



Conclusions

Compare the slides with the charts and models on the basis of position of chromosome and identify the phases of mitosis.

Slide/chart/model	Position of chromosome	Phase of mitosis



Part 2: Study of meiosis

In meiosis, one diploid cell divides to produce four haploid daughter cells. Meiosis consists of two sub-division i.e. meiosis-I and meiosis-II. Each sub-division is further divided into prophase, metaphase, anaphase and telophase.

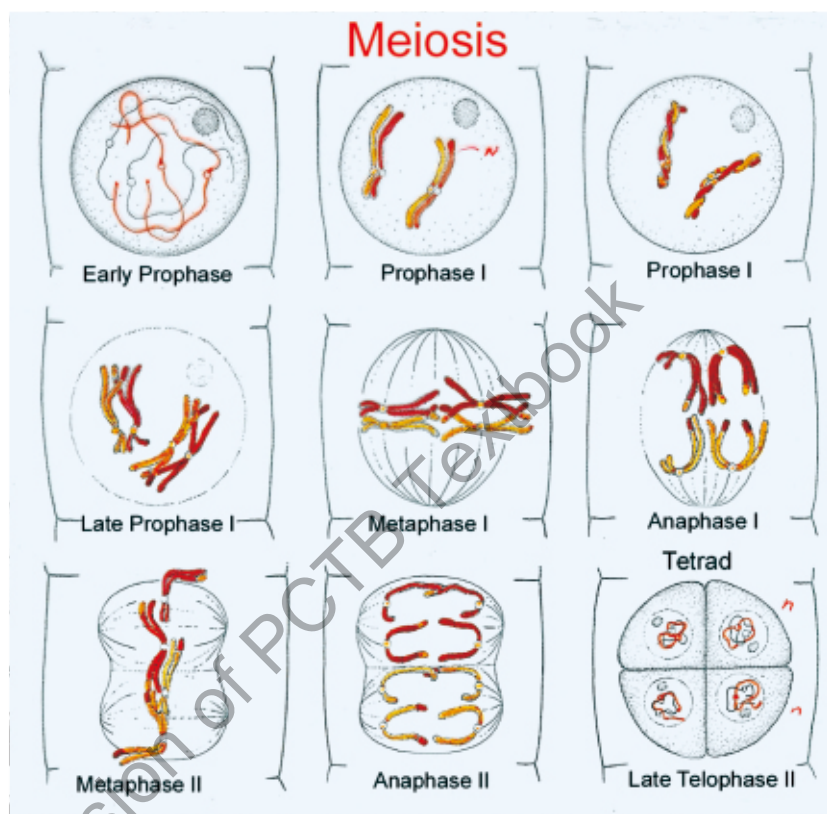


Figure 5.1.2: Different stages of meiosis



Materials Required

Models, charts and prepared slides of meiosis, microscope

Procedure

1. Examine the prepared slides showing various stages of cell division (meiosis) through microscope.
2. Observe charts and models of various stages of the meiosis.
3. Compare the slides with charts and models.



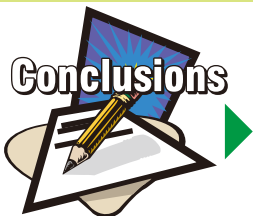
BRAIN TEASERS

- Why meiosis is referred to as reduction division?
- Where in the body does meiosis occur in (i) women (ii) men (iii) plants?



Fill the table after observing the slides/charts/models.

Slide	Characteristics	Diagram



Conclusions

Compare the slides/charts/models and identify the phases of meiosis on the basis of the position of chromosomes.

Slide	Position of chromosome	Phase of meiosis



Post Lab Activities

1. If reduction division does not take place, what will be the consequences?

2. Which type of cell division occurs during healing of wound?



BRAIN TEASERS

- What would happen to a cell if it does not go through the G1 phase of cell cycle? Explain.
- A great deal of the research on the causes and a cure of cancer focuses on the genes that control the cell cycle. Why?

Experiment

5.2

Preparation of root tip squashes and study of the stages of mitosis

Date _____

Background Information

The number of cells within an organism increases by mitosis and this is the basis of growth in multicellular organisms. In plants, the roots continue to grow. The root tips are good for studying the stages of mitosis.



Materials Required

Microscope, slides, root tips provided by teacher, dissecting needle, oceto-orcin, tissue paper

Procedure

- 1 Place each root tip to a clean slide containing water drop.
- 2 Dry it with a piece of soft tissue paper. It is important to remove as much water as possible.
- 3 By using a dissecting needle, chop the root tip thoroughly and spread it on the slide.
- 4 Add 1 drop of oceto-orcin stain on the root tips and stay for 3 minutes.
- 5 Remove the extra stain by filter paper.
- 6 Place a cover slip gently by avoiding air bubbles.
- 7 Observe the slide under the microscope at low and high powers.



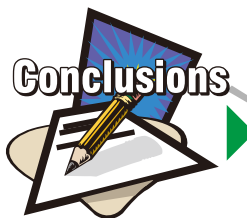
CAUTIONS

Do not place too much material on a slide.



Fill the table after observing the slides.

Slide	Characteristics of each stage	Diagram





1. **Instead of root tip, which other part of plant can be used to study mitosis?**

2. **Do all cells in the human body undergo mitosis? Explain.**

Web Version of PCTB Textbook

CHAPTER Enzymes

6



Experiment 6.1

To demonstrate working of an enzyme in vitro e.g. pepsin working on meat/albumin in test tube

Date _____



Background Information

Enzymes are found in living things and they speed up specific biochemical reactions. Pepsin is an enzyme, which is secreted in the stomach of most animals and helps in the break down of proteins. All the biochemical reactions take place with in the body (in vivo). But these reactions are also possible outside the body (in vitro) e.g. in the laboratory.



DO YOU KNOW?

A single cell contains thousands of enzymes, each with its own function.



Materials Required

Test tube, pipette, beaker, tripod stands, bunsen burner, pieces of meat or albumin, pepsin solution, 10% HCl, Biuret solution, water bath



Procedure

- 1 Take four test tubes and label them A, B, C, and D.
- 2 Add equal pieces of meat or albumin in each test tube.
- 3 Add 2ml of HCl in test tube A.
- 4 Add 2ml of pepsin solution in test tube B.



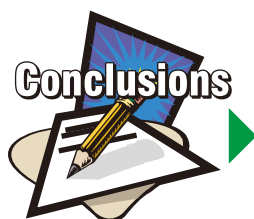
CAUTIONS

- Handle the chemicals carefully.
- Don't try to taste pepsin solution or any other chemical.

- ⑤ Add 2ml HCl and 2 ml pepsin solution in test tube C.
- ⑥ Add 2ml HCl and 2ml boiled pepsin solution (provided) in test tube D.
- ⑦ Place the test tubes at 37°C in water bath.
- ⑧ Add three drops of Biuret solution in each test tube and observe the changes. Purple or pink colour will indicate the presence of proteins.



Test Tube	Changes	Protein present or absent
A		
B		
C		
D		



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1. Name some of the in vivo biochemical reactions (other than digestion) catalyzed by enzymes.

2. Which animal produces less pepsin, a herbivore or a carnivore? Why?



BRAIN TEASERS

- Did pepsin act in the absence of HCl? Why?
- Why the whole of the experiment is performed at 37°C?

Web Version of PCTB Textbook



Experiment to test enzyme action by putting diastase in a starch solution in test tube at 37°C and after fifteen minutes performing iodine test for presence of starch

Date _____



Diastase is a natural group of enzymes (including amylase). It has ability to break down starch into simple sugars (monosaccharide). It is present in saliva, pancreatic juice, plant tissues and seeds. Iodine turns starch solution dark purple / black while disaccharides and monosaccharide do not react with iodine.



DO YOU KNOW?

The average human being produces a quart (about 900 ml) of saliva a day i.e. about 10,000 gallons (37850 litres) in a lifetime.



Amylase solution, starch solution, iodine solution, test tubes, test tube stand

Procedure



- 1 Add 5 ml of starch solution in two test tubes.
- 2 Add two drops of iodine solution in each test tube.
- 3 Add amylase solution in one test tube. Leave the other test tube as such.
- 4 Incubate the test tubes at 37°C for 15 minutes.
- 5 Observe the color change in test tubes.



CAUTIONS

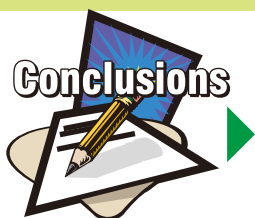
- Handle the chemicals carefully.
- Follow the incubating time strictly.



Why were the test tubes incubated at 37°C?



Test tube	Color change
Test tube without amylase	
Test tube with amylase	



Conclusions



Post Lab Activities

1. What will happen to the rate of reaction if the amount of enzyme is increased?

2. What will happen to the rate of reaction if the amount of substrate (starch) is increased?

3. What will happen to the rate of reaction if the temperature of the reaction is increased?

4. Why washing powders are used to remove starch stains from the clothes?



BRAIN TEASERS

Table sugar (sucrose) can react with water to form two other compounds i.e. glucose and fructose. However, when you add sugar to a glass of water, this reaction proceeds extremely slowly. What else is needed to speed up the reaction?

Experiment 7.1

To demonstrate the process of photosynthesis using aquatic plant like Hydrilla

Date _____

Background Information

Photosynthesis is the process in which green plants, algae and some bacteria prepare their food (carbohydrates) in the presence of sunlight and chlorophyll from carbon dioxide and water and oxygen is released.

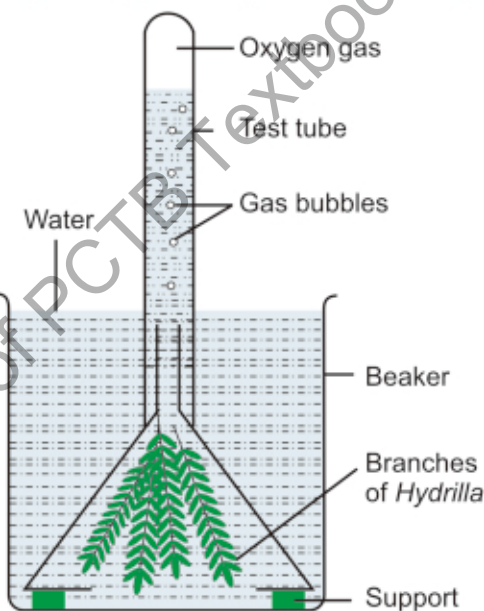


Figure 7.1.1: Experiment setup to demonstrate photosynthesis in an aquatic plant

Materials Required

Beaker, funnel, test tube, sodium bicarbonate, *Hydrilla* or any other aquatic plant shoots, match box

Procedure

- ❶ Fill up 3/4 portion of 500 ml beaker with water.
- ❷ Dissolve little sodium bicarbonate in the water, which provides CO_2 to the plant.
- ❸ Put some *Hydrilla* shoots in beaker and cover it with inverted funnel.



CAUTIONS

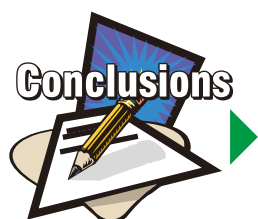
- Air should not enter the test tube while you invert it on the funnel

- ④ Invert a test-tube, filled with water, on the funnel neck.
- ⑤ Place the apparatus in sunlight for few hours for photosynthesis.
- ⑥ Bring out the test tube from funnel (by putting your thumb on its mouth).
- ⑦ Test for the presence of oxygen in the test tube by using a glowing match stick.



Record your observation after the experiment.

S.No.	Change in the inverted test tube
1.	
2.	
3.	



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1. You did not use a control set up for this experiment. If you are asked to do so, what do you think would be an appropriate control?

2. What is the effect of amount of chlorophyll on the rate of photosynthesis?

3. Suggest what will be the rate of photosynthesis in the absence of water/carbon dioxide?



BRAIN TEASERS

- Plants make their own food through photosynthesis. Why is it necessary for plant seeds to contain food reserves?
- The enzymes of light reactions are confined to the thylakoid membrane of chloroplast rather than dissolved in the stroma. What are its advantages?
- Why air should not enter the test tube?



Identification and labeling of the cellular and tissue structures in the cross section (CS) of a leaf through observations under the microscope

Date _____



In cross section of a leaf first layer is upper epidermis, covered with cuticle. Below the upper epidermis is mesophyll tissue, differentiated into palisade and spongy tissues. Vascular bundles are present in spongy tissue. The bottom layer is the lower epidermis which contains most of the stomata.



Prepared slide of the CS of leaves, microscope



- Examine the prepared slide of CS leaf under low and high powers of microscope.

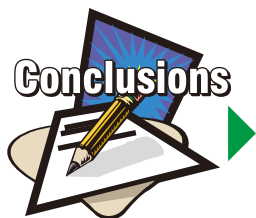


CAUTIONS

- Handle the slides carefully.
- Clean the slide, ocular lens, and objective of microscope before observing.



Draw a diagram of the observed slide.



Conclusions



Post Lab Activities

1. How will you differentiate between spongy cells and palisade cells under microscope?

2. How does the structure of leaf permit gases to diffuse readily between the outside air and the photosynthetic cells?

OBSERVE & TELL



- Why the spongy tissue is called so?
- Which layer of leaf has cylindrical shape of cells?



To investigate the necessity of chlorophyll, sunlight, carbon dioxide using appropriate controls

Date _____



During this process of photosynthesis CO_2 combines with water to form glucose and oxygen is released. Chlorophyll traps sunlight and convert it into chemical energy which is used to synthesize food. Some leaves (e.g. leaves of ivy plant, money plant, hibiscus plant) have yellow areas because of the absence of chlorophyll. Such spotted leaves are called variegated leaves.

Part 1: Investigation of the necessity of chlorophyll

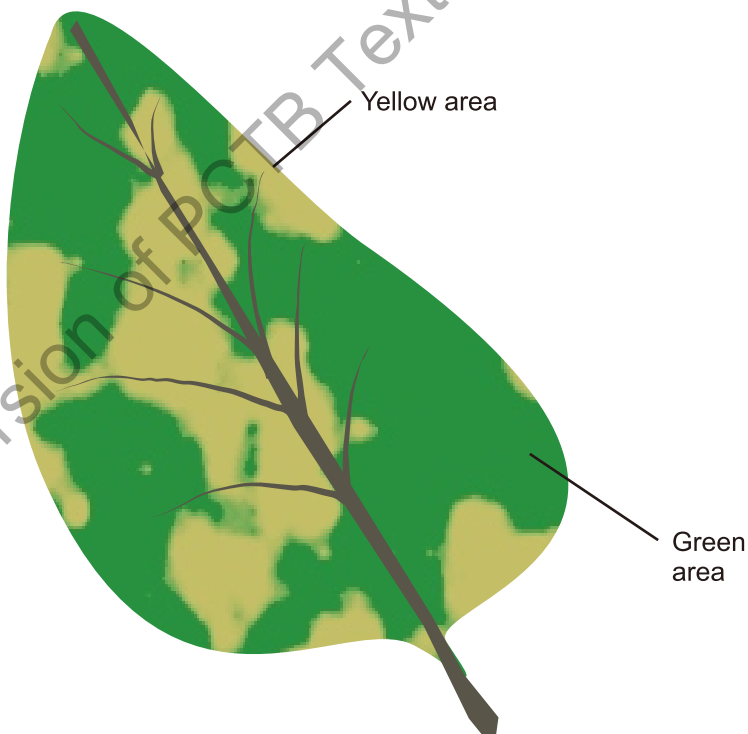


Figure 7.3.1: A Variegated Leaf



Plant with variegated leaves, ethanol, iodine solution, dropper, Petri dish, beaker, test-tube, burner, water bath, tripod stand, match box



- ❶ Take potted plant having variegated leaves.
- ❷ Expose the plant to strong sun light for three to four days.
- ❸ Remove a leaf from the plant. Draw its upper surface making a distinction between green and non-green areas.
- ❹ Perform the starch-test on the whole leaf.

Starch Test

- ❶ Put the detached leaf in boiling water for about half a minute to kill its protoplasm.
- ❷ Put the boiled leaf in a test tube containing ethanol, to remove its chlorophyll.
- ❸ Place test tube in a beaker of water and boil it for 10 minutes till the leaf gets decolorized.
- ❹ Remove the leaf and wash it in water, which will make the leaf soft.
- ❺ Place the leaf in Petri dish and put a few drops of iodine solution on it.
- ❻ Observe colour changes in the upper surface of leaf and make drawing.



CAUTIONS

- Never heat the tube of alcohol directly over the burner flame.

BRAIN TEASERS

- Why did we use variegated leaves?
- Why starch test is applied?



Figure 7.3.2: Experiment setup to investigate the necessity of chlorophyll in photosynthesis

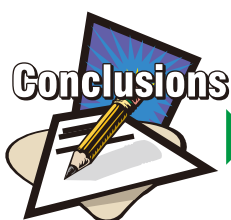


- Record the change in the leaf.

- Make drawings of the leaf before and after the application of starch test.

Drawing (before starch test)

Drawing (after starch test)



- Compare the two drawings.



Materials Required

Part 2: Investigation of the necessity of sunlight

A potted plant with healthy leaves, black paper, paper clips, beaker, forceps, test tube, ethanol, iodine solution, dropper, burner



Procedure

- ❶ De-starch the potted plant by placing it in a dark place for about 2-3 days.
- ❷ Wrap a “leaf A” with black paper as shown in diagram.
- ❸ Cut out a certain pattern on another black paper and wrap “leaf B” with this black paper as shown in diagram (use paper clips to hold the black paper in place).

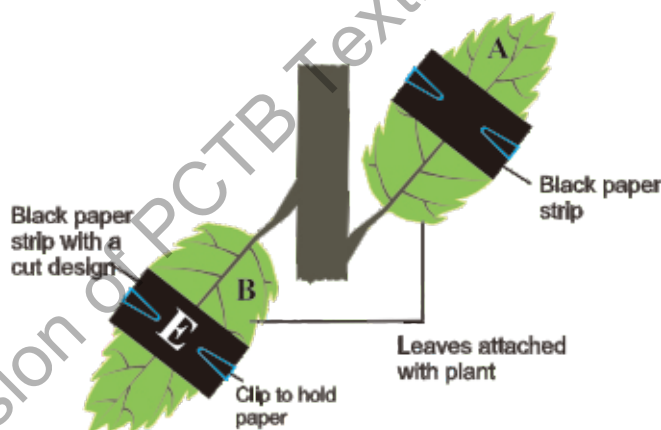


Figure 7.3.3: Experiment setup to investigate the necessity of light in photosynthesis

- ❹ Place the plant in strong sunlight for 4-6 hours.
- ❺ Remove both leaves from the plant and apply starch test on them.
- ❻ Apply starch test to both of the leaves.



BRAIN TEASERS

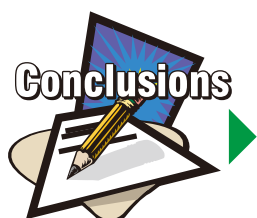
- Why is it needed to de-starch the plant?
- What is the purpose of covering the leaf with black paper?



- Record your observations after applying starch test on leaves.

Leaf A	Leaf B

- Make drawings of the leaves, showing the result.





Part 3: Investigation of the necessity of carbon dioxide

Potted plant, split cork, wide mouth bottle/flask, potassium hydroxide (KOH) solution, beaker, test tube, ethanol, iodine solution, dropper, burner, petri dish, water, vaseline

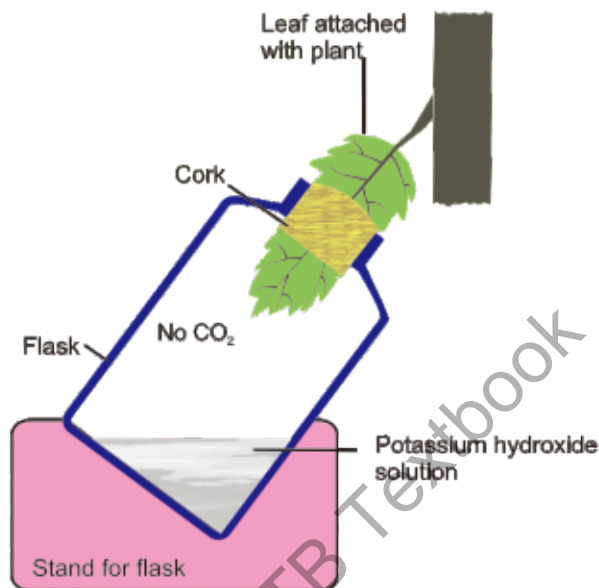


Figure 7.3.4: Experiment setup to investigate the necessity of CO_2 in photosynthesis



- ❶ De-starch the potted plant by placing it in a dark place for about 2-3 days.
- ❷ Add potassium hydroxide solution into the wide mouth bottle (KOH will absorb all the CO_2 present in the bottle).
- ❸ Cut a cork length wise into two pieces.
- ❹ Pass leaf of the potted plant (without detaching) through the cut section of the cork in such a way that half portion of the leaf remains out of the bottle.
- ❺ Make the apparatus airtight by applying vaseline on the cuttings of cork.
- ❻ Place the apparatus in bright sunlight for a few hours for photosynthesis.
- ❼ Remove this leaf from the plant.
- ❽ Apply starch test to the leaf.

! CAUTIONS

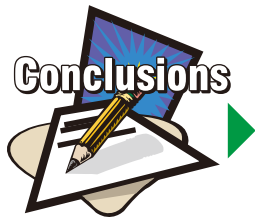
- Don't leave any space between cork sections and the leaf.



- Record your observations after applying starch test on leaf.

Area of leaf outside bottle	Area of leaf inside bottle

- Make a drawing of the leaf showing your observations.





1. In the experiment for the necessity of light, you wrapped a black paper around the leaf. Apart from cutting off the light from part of the leaf, what other effects might the black paper have on the leaf which could influence the results?



BRAIN TEASERS

- Why large quantities of fertilizers should not be added to the soil?

2. What was the relationship between the distribution of chlorophyll in the variegated leaf and the distribution of starch revealed by iodine?
3. Assuming that the accumulation of starch in a leaf is evidence of photosynthesis, make a general statement about photosynthesis and carbon dioxide.

Experiment

7.4

To demonstrate the process of respiration in germinating seeds by using lime water

Date _____

Background Information

During germination, seeds perform respiration for energy. Carbon dioxide is released as a waste product during respiration. Lime water turns milky when it comes in contact with CO_2 .

Materials Required

Conical flask, test tubes, one hole cork, germinating pea seeds, U shaped glass tube, lime water, wax, beaker

Procedure

- 1 Take some germinating seeds and put them in conical flask.
- 2 Place a cork with a hole in its centre on the mouth of the flask.
- 3 Insert one end of U-shaped glass tube into the hole of cork and seal it with wax.
- 4 Dip the other end of the U-shaped tube into the lime water of the beaker.
- 5 Mark this apparatus as 'A'.
- 6 As a control, set the same apparatus with non-germinating seeds as control. Mark it as B.
- 7 Leave the both apparatus for 24 hours.

CAUTIONS

- Don't use seeds which have been soaked for a long time.

Think

Name other seeds which we can use for this experiment?

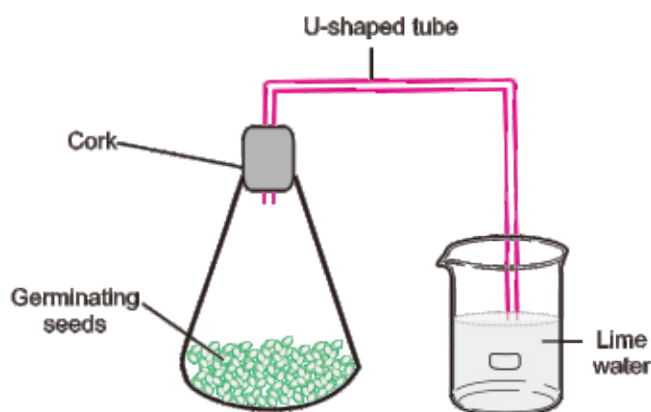


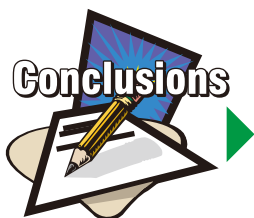
Figure 7.4.1: Experiment setup to demonstrate respiration in germinating seeds



Observations

Record the changes in apparatus A and B.

Apparatus	Changes in lime water
A	
B	



Conclusions



Post Lab Activities

1. Why did the results of experiment take 24 hours?

2. The limewater in the experiment turns milky, why? Which product is formed during this process?

3. If we heat the whole apparatus, what type of results would you expect?



BRAIN TEASERS

- How does the folding of the inner mitochondrial membrane benefit aerobic respiration?
- Living organisms require food as a respiratory substrate. What did the seeds use as a substrate?
- Design without carrying out an investigation to determine whether or not animals release carbon dioxide during respiration.



To investigate the release of heat during aerobic respiration in germinating seeds

Date _____



In aerobic respiration oxygen reacts with glucose and produces carbon dioxide, water and energy. Energy is released in the form of Adenosine Tri-phosphate (ATP) and heat. This heat raises the temperature of germinating seeds.



Pea seeds, two thermos flasks, two thermometers, cotton, iron stand, marker



- 1 Take some germinating seeds.
- 2 Boil some seeds for 10 minutes so that they die.
- 3 Take two thermos flasks and mark them "A" and "B"
- 4 Put the live seeds (un-boiled) in "A" and dead seeds (boiled) in "B"
- 5 Insert a thermometer in each flask and plug it with cotton.



CAUTIONS

- Don't use seeds which have been soaked for a long time.



BRAIN TEASERS

- What are the advantages of inverting the flasks?
- Why germinating seeds were used in flask "A" while killed seeds were used in flask "B"?

- 6 Invert the flasks and set the apparatus as shown in diagram. Flask "A" will serve as experimental and "B" as control
- 7 Keep the apparatus for 24-48 hours.
- 8 Note the reading of thermometers before the start and at the end of experiment.

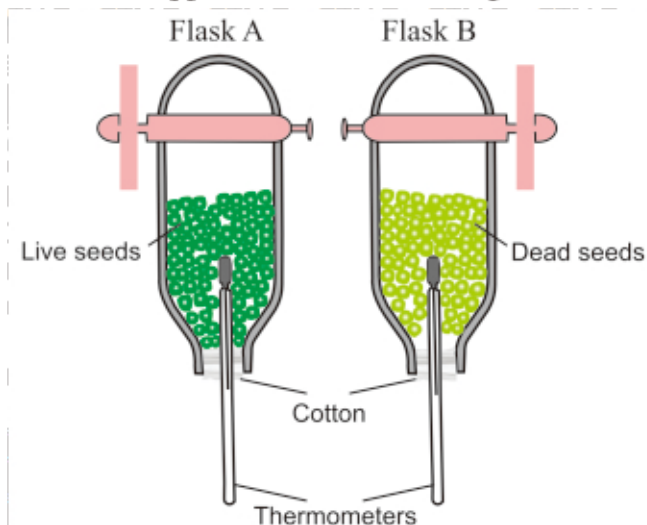
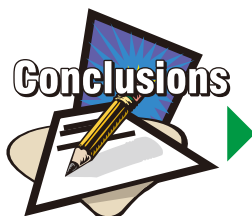


Figure 7.5.1: Experiment setup to investigate the release of heat during aerobic respiration



Observations

Thermos flask	Initial temperature T_1 °C	Final temperature T_2 °C	Difference in temperature $T_3 = T_1 - T_2$ °C
A			
B			



Conclusions



Post Lab. Activities

1. When you do strenuous exercise, your body becomes warm. Relate it with respiration.

2. Repeat this experiment with some other seeds.
3. Can we perform this experiment in a test tube? If not, give reasons.



BRAIN TEASERS

- Give another example of a temperature rise due to respiration.



Experiment 8.1

Food tests: Benedict's test for glucose (reducing sugar), Iodine test for starch (non-reducing sugars), spot test and emulsion test for fats, biuret test for protein

Date _____



Background Information

Carbohydrates, proteins and fats are the major components of food. In carbohydrates, proteins and fats, the main elements are carbon, hydrogen and oxygen. But in proteins nitrogen is also present.



Materials Required

Glucose-solution, Benedict's solution, starch solution, spirit lamp, match box, protein- solution, Biuret reagent, vegetable oil/fat, ethanol, distilled water, test tubes, test tubes rack, test tubes holders, dropper, water bath, pipette



Procedure

Benedict's test for reducing sugars

- ① Take 3 ml of glucose solution in a test tube; add an equal volume of Benedict's solution.
- ② Shake the mixture and heat it for two or three minutes, in a beaker of boiling water.

Iodine test for Starch

- ① Take 2 ml of starch solution in a test tube and pour few drops of Iodine solution to it.

Spot test for fats/ oil

- ① Take a piece of paper and rub a sample food on it. Let the paper dry.
- ② Hold the paper in the front of a light source, so that light shines through it.

Emulsion test for fats/ oil

- ① Add 5 ml of ethanol to 2-3 drops of oil in a test tube. Shake the mixture thoroughly for about 5 minutes.
- ② Add 5 ml of distilled water to this mixture.

Biuret test for protein

- 1 Take 3ml of protein solution in a test tube.
- 2 Add equal quantity of Biuret reagent in it.



CAUTIONS

- Use separate pipettes for measuring different reagents.

All tests of unknown sample

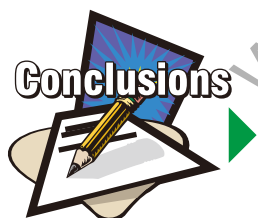
- 1 Apply the same tests to an unknown sample provided to you.



Record your observations about the changes in test tubes.

Sample Solutions	Benedict's Test	Biuret Test	Iodine Test	Emulsion Test / Spot Test
A (Glucose)				
B (Starch)				
C (Oils/Fats)				
D (Proteins)				
E Unknown)				

Conclusions





1. **Your test gives a color change with iodine. Does it indicate that there is no glucose and no protein in the sample? What experiments would you have to carry out to give answer?**

2. **What difficulties can you foresee in using oil test with samples which contain both lipids and water?**

3. **Do your results indicate that any sugar (e.g. sucrose, fructose and maltose) will give the same color as glucose did, when tested with Benedict's solution?**

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Experiment

8.2

Microscopic examination of a transverse section of the small intestine to show villi

Date _____

Background Information

The small intestine comprises of three parts i.e. duodenum, jejunum and ileum. The inner wall of ileum has numerous finger-like projections called villi (singular: villus). Each villus consists of outer epithelium (single cell thick), blood capillaries and lacteal (lymphatic vessel).



DO YOU KNOW?

Honey is easy to digest. The reason is that much of it has already been digested by a honeybee.

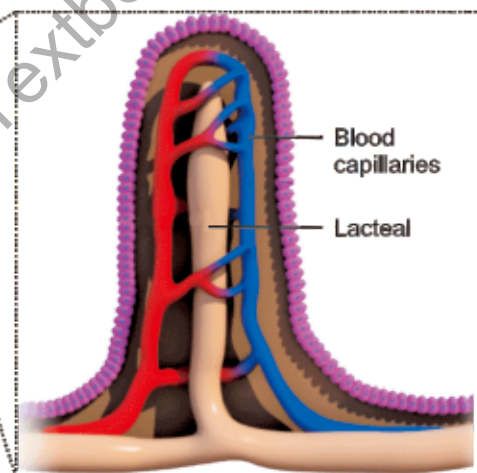
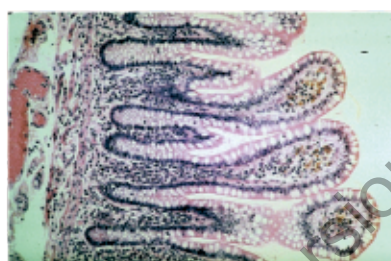
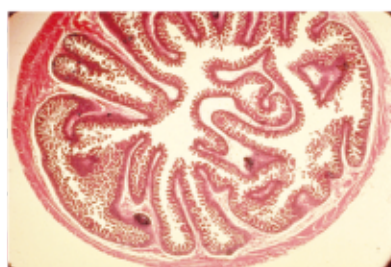


Figure 8.2.1: Slides of the TS of small intestine and an enlarged view of a villus

Materials Required

Prepared slides of transverse section of small intestine (ileum), microscope

Procedure

1

Focus the prepared slide under the low and high powers of microscope and observe.



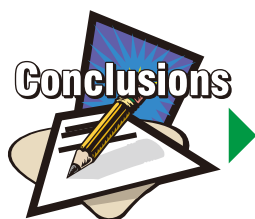
DO YOU KNOW?

Each cm^3 of intestine contains 5000 villi and 3 billion microvilli.



Observations

Draw the labeled diagram of what you have observed.



Conclusions



Post Lab Activities

1. **Why small intestine is efficient for the absorption of digested food?**

2. **How does digested food move from small intestine to blood?**



BRAIN TEASERS

Why is the small intestine so long?



Measurement of difference in length / weight of raw potato strips in salt solutions and in water

Date _____



If we place a cell in hypotonic solution, water will move from outside to the inside. The entry of water in cell causes it to swell and it becomes turgid. This increases the weight and length of the cell. Hypertonic solution causes water to move out from cell. It reduces weight and length of cell. In isotonic solution equal amount of water moves in and out of cell. Thus the cell's weight and length remains same.



Potato, cork borer, knife/blade, test tubes, test tubes stand, 20% salt solution, water, electric balance, scale, pipette



- ❶ Take a large potato and push a cork borer into it.
- ❷ With the other end of the cork borer, push the potato strip out of the cork borer. Cut another strip using the same method.
- ❸ Use knife/blade to cut the equal lengths of strips. Measure the length (should not be not less than 5 cm) and weight of each strip. Both strips should be of equal size and weight.

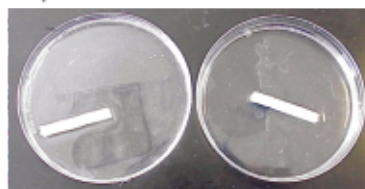
CAUTIONS

- Measure the weight of potato strips carefully.
- Cut the potato strips in equal size.
- Do not use same pipette for different solutions.



Push cork borer in potato

Push potato strip out of cork borer



Potato strips

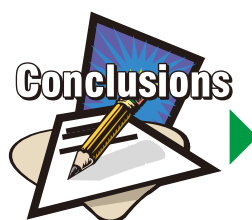
Figure 9.1.1: Cutting and trimming the potato strips

- ④ Place one strip in a test tube of pure water and the other strip in a test tube of 20% salt solution.
- ⑤ Wait for one day and then remove the potato strips from test tubes.
- ⑥ Blot dry and measure the weight and length of both potato strips.



Record the changes in weight and length of potato strips.

	Initial weight	Final weight	Change in weight	Initial length	Final length	Change in length
Potato strip in Pure water						
Potato strip in 20% Salt solution						



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1. What is responsible for the increase in the length of potato strip?



Observation of root hairs on growing roots of onion, carrot etc.

Date _____



In order to absorb more water and minerals and at greater speed, roots increase their surface area by developing root hair. These are hair-like outgrowths of epidermal cells of root.



Figure 9.2.1: Root hairs on different roots



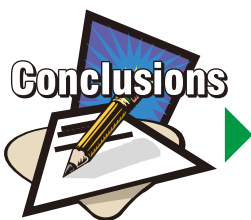
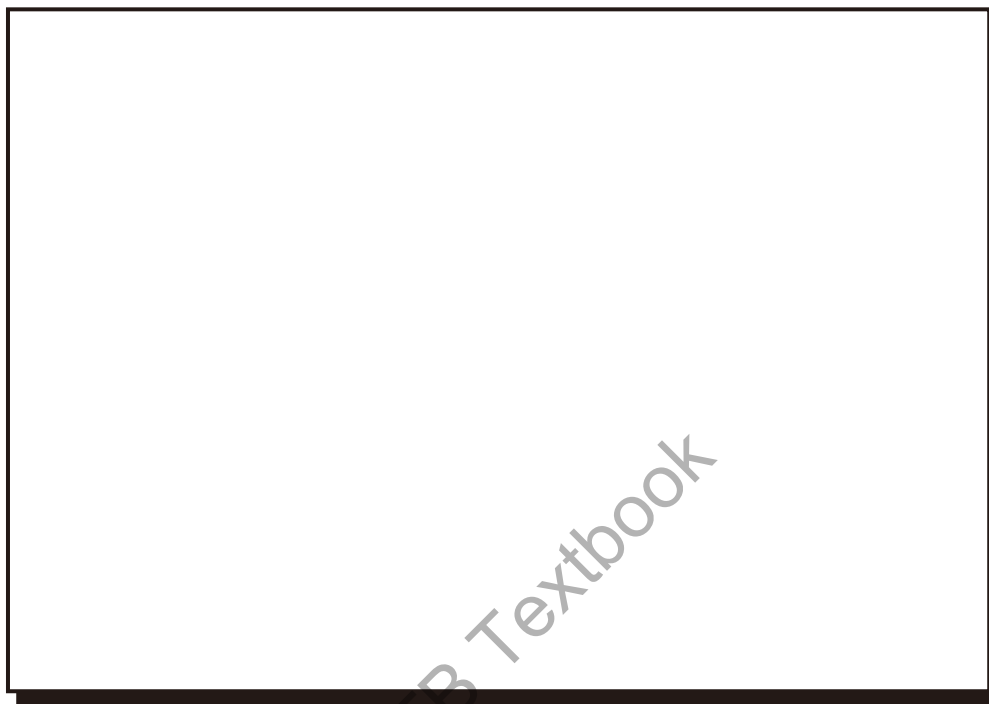
Different roots with root hairs e.g. radish and carrot, hand lens, slides, microscope



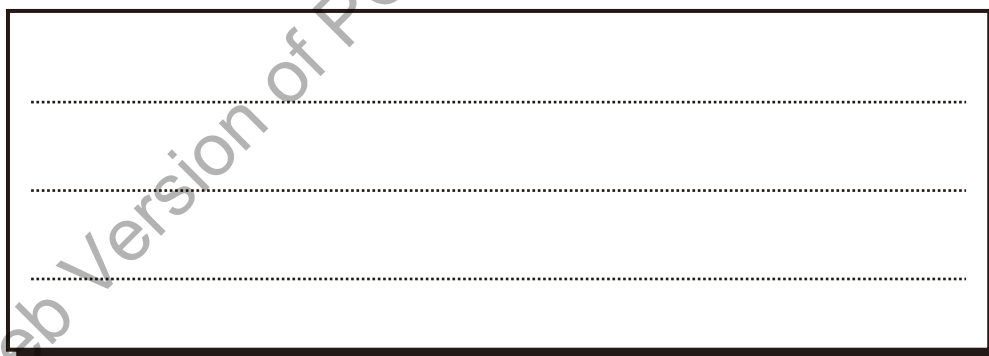
1. Observe the roots of carrot, radish etc. with the help of hand lenses.
2. Study the details of the surface of roots.
3. Try to remove the epidermis along with root hairs and study with the help of microscope.



Draw a diagram of what you have observed.



Conclusions



Post Lab Activities

1. Is “root hair” a cell in plant or not? Describe its structure.

2. What is the function of root hair?

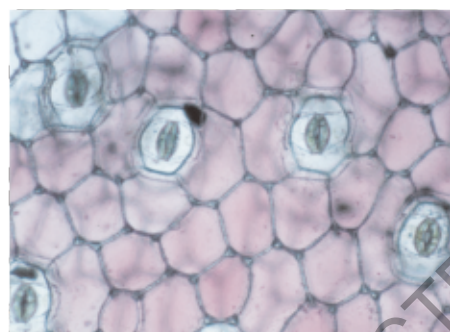


Microscopic observation of the structure and number of stomata in the epidermal peel of a leaf

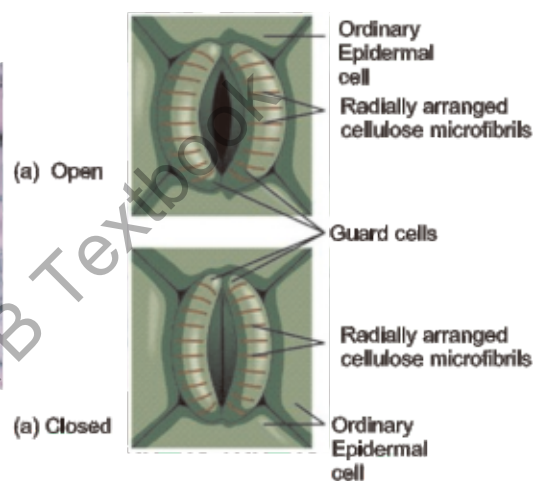
Date _____



The upper and lower surfaces of leaves have stomata for exchange of gases and water vapors. Each stoma is surrounded by pair of small bean shaped guard cells, which control its opening and closing. Guard cells contain chloroplast while epidermal cells are without it.



Lower epidermis with stomata



Stomatal opening and closing



Petri dish, water, glass slides, cover slips, methylene blue, microscope, different leaves



- ➊ Take leaf and peel off a thin layer (lower epidermis) from its surface.
- ➋ Place the thin layer in water in Petri dishes.
- ➌ Cut a piece of the peeled off epidermis and spread it in a drop of water on a glass slide.
- ➍ Pour a drop of methylene blue and place a cover slip on the materials.
- ➎ Observe the slide under low and high powers of microscope keeping in view the structure and number of stomata.

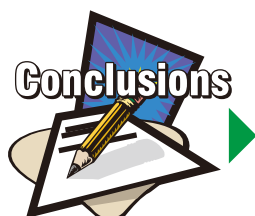
CAUTIONS

- Clean the slide, ocular lens, and objective of microscope before observing.
- Handle the chemicals carefully.



Record your observations and draw figure.

Total number of stomata observed	Number of closed stomata	Number of open stomata



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- Most leaves have many more stomata in the lower epidermis than on the upper epidermis. Suggest the reasons.



BRAIN TEASERS

Stomata in plants are meant for exchange of gases. Which organ of the animal does the same function?

- What other things besides carbon dioxide might pass into or out of the leaf through the stomata?

- Can you find stomata in root and stem of any plant? Give reasons.

- At which time of the day you will find more of the stomata open?

Experiment 9.4

To investigate the rate of water loss at the two surfaces of a leaf by using cobalt chloride paper

Date _____

Background Information

Cobalt chloride paper is blue when dry and it turns pink when it comes in contact with water vapors. The leaves of terrestrial plants have more stomata on their lower surface as compared to the upper ones.

Materials Required

A potted plant, cobalt chloride papers, forceps, glass slides, rubber bands, filter paper

Procedure

1. Take a potted plant. Water the plant and leave it for an hour.
2. Take two equal sized cobalt chloride papers, and with the help of forceps place one piece of cobalt chloride paper on the upper surface and the other paper on the lower surface of a leaf.
3. Place two dry glass slides on the upper and the lower cobalt chloride papers and fix them with a rubber band.
4. Count the time required to turn cobalt chloride papers pink.

CAUTIONS

- Dry hands and leaves before experiment.
- The glass slides should not damage (scratch) the structure of experimental leaves.
- Remove dust from leaves surface before placing cobalt chloride papers on them.

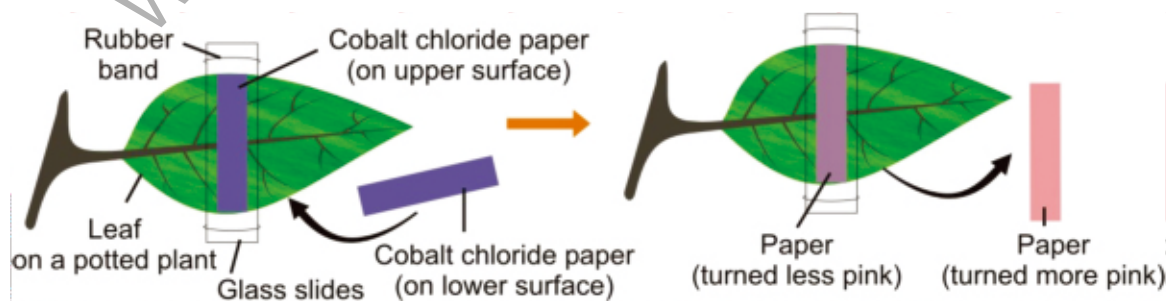
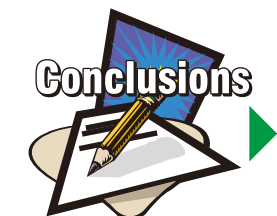


Figure 9.4.1: Experiment setup to investigate the rate of water loss at the two surfaces of a leaf



	Color change	Time taken to change color
Cobalt chloride paper on upper side		
Cobalt chloride paper on lower side		

1. The lower epidermis of leaf generally has more stomata than the upper epidermis. What is the significance of this way of distribution of the stomata?

2. From your experiment, can you tell whether the stomata on both surfaces were open or closed?

3. If all the stomata are closed but the results with cobalt chloride are the same as in your experiment, how would you explain it?



To investigate transpiration in potted plant under a bell jar

Date _____



Transpiration is the loss of water through stomata from plant surface. Transpiration pull brings water and minerals to the aerial parts of the plant. It also helps in cooling plant body under high temperature.



A potted plant, 2 bell-jars, polythene bag, copper sulphate



- 1 Take a potted plant and cover the pot and base of stem with polythene bag.
- 2 Place the potted plant on a glass plate and invert a dry bell jar over it.
- 3 Set up a control without plant.
- 4 Leave both the apparatus in sunlight, minimum for one hour.

CAUTIONS

- Remove moisture from bell jar before experiment (by tissue paper etc.)

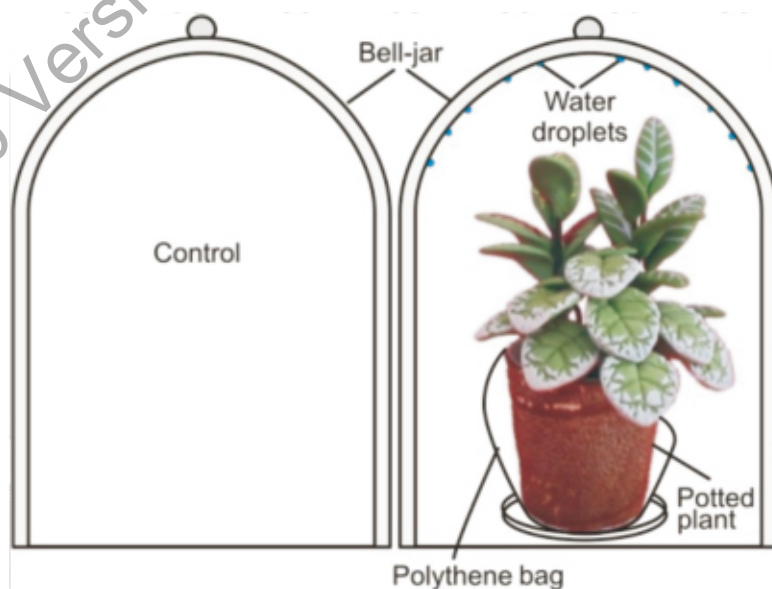
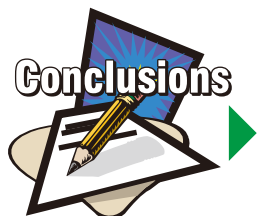


Figure 9.5.1: Experiment setup to investigate transpiration in potted plant under a bell jar



Bell jar without potted plant	Bell jar with potted plant





1. Apply vaseline on the lower surface of the leaf, set up the same apparatus as control, and note the observation.

2. Soil, or leaves or outside; where could the liquid have come from?



BRAIN TEASERS

An agricultural practice reduces transpirational water loss from plants. Why would this practice be disadvantageous for plants?

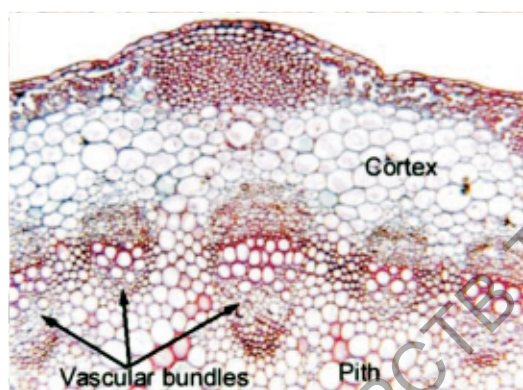


Identification of xylem and phloem tissues in the prepared slides of stem, root and leaf

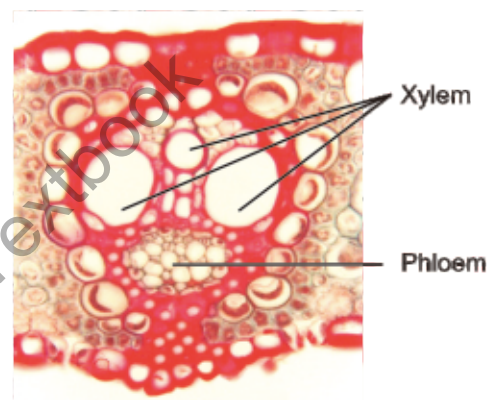
Date _____



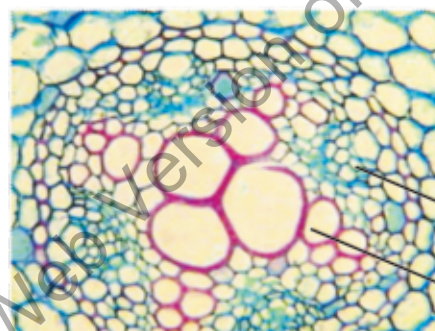
Xylem tissue consists of tracheids and vessel elements. Phloem tissue consists of sieve-tube cells and companion cells. The end walls of sieve tube cells have many small pores. These walls are called sieve plates.



(a)-T.S of castor bean stem



(b)-T.S of sugar cane leaf



(c)- T.S of root of Buttercup plant

Figure 9.6.1: Xylem and phloem tissues – as seen in different slides



Procedure



Prepared slide of T.S of roots and leaf, microscope

- ➊ Observe prepared slide of T.S of root, stem and leaf under low and high power microscop.
- ➋ Identify the xylem and phloem.

CAUTIONS

- Clean the slide, the ocular lens and objective of microscope before observing.
- Handle the slides carefully.



Record your observations.

Root:

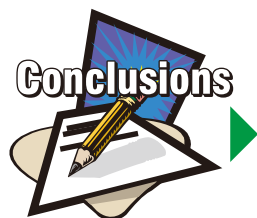
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Stem:

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Leaf:

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1. Is cambium present in the vascular bundles of stems and leaves?

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BRAIN TEASERS

How would you find the age of a tree?

Experiment 9.7

To investigate the pathway of water in parts of plant using a suitable stain and compare sizes of various types of cells.

Date _____

Background Information

Water is absorbed by the root hairs of the plant and reaches the upper part of the plant through xylem tissues. The transport of water and salts from roots to the aerial parts of the plant body is termed as the ascent of sap. Xylem tissue consists of vessel elements and tracheids. Vessel elements are long tubes having short and wide cells while tracheids are long cells with overlapping ends. Transpiration pull is the major force responsible for the ascent of sap.

Materials Required

Eosine solution, beaker, herbaceous plant, dissecting microscope, compound microscope, glass slides, stand, laser

Procedure

1. Fill a beaker with dilute eosine solution.
2. Take an herbaceous plant (e.g. white colored Petunia) with its roots intact.
3. Wash the roots and place the plant inside the beaker in such a way that its roots are completely dipped in coloured water as shown in the figure.
4. Keep the apparatus for a night.
5. Cut the longitudinal sections of stem. (You may also cut the cross section of the stem, to confirm the presence of

CAUTIONS

- Cut longitudinal sections with care.
- Do not use extra amount of eosine dye (the solution should be dilute).

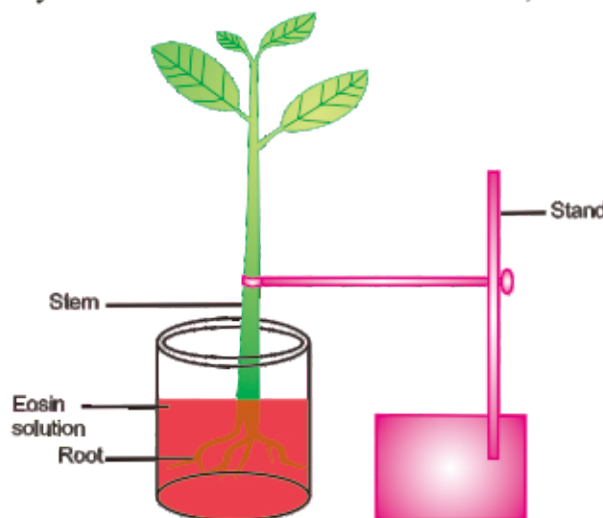


Figure 9.7.1: Experiment setup to investigate the pathway of water in a plant

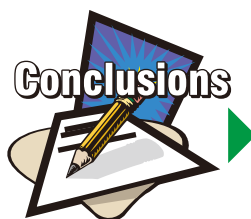
eosine in xylem tissues.)

- ⑥ Examine and observe under dissecting microscope.
- ⑦ Cut transverse section of root and leaf with razor and observe them under the high and low power of microscope
- ⑧ Compare the sizes of various types of cells through which water moves.



Record your observations and draw figures of xylem tissues of root, stem and leaf.

Blank area for drawing figures of xylem tissues of root, stem and leaf.



Blank area for writing conclusions, featuring horizontal dotted lines.



1. Describe the path taken by water through the stem to the leaf as revealed by your experiment.

Blank lines for writing the answer to question 1.

2. We will not observe the movement of water in the stem, if the leaves of plant are covered with cellophane paper. How is that?

Blank lines for writing the answer to question 2.



Identification of red and white blood cells from prepared slides under microscope and in photomicrographs

Date _____



Blood consists of 44 % red blood cells, 1 % white blood cells and platelets and 55% plasma by volume. Red blood cells (erythrocytes) are involved with transportation of oxygen. White blood cells (leukocytes) are of two types i.e. granulocytes and agranulocytes. Granulocytes are further divided into three types i.e. neutrophils (destroy small particles), eosinophils (attack parasites) and basophils (causes inflammation). Agranulocytes consist of monocytes (give rise to macrophages) and lymphocytes (provide immune response).



DO YOU KNOW?

15 million blood cells are produced and destroyed in the human body every second.

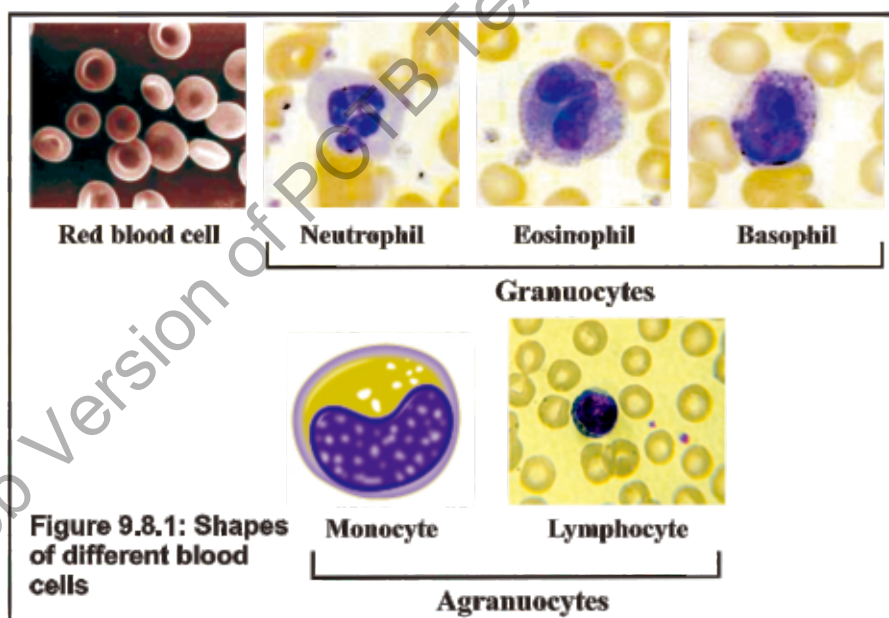


Figure 9.8.1: Shapes of different blood cells



Prepared slides of human blood, microscope, photomicrographs

Procedure



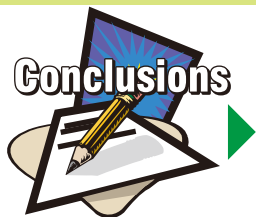
1. Observe the prepared slides of blood cells under low and high powers of the microscope.
2. Observe red blood cells and white blood cells in photomicrographs.



Record your observations regarding the shapes of blood cells. Also draw the different types of blood cells.

Cell type	Description	Drawing

Conclusions



Post Lab Activities



1. What is the relation between the diameters of the red blood cells and the capillaries?

2. Does the red blood cell appear to be a rigid or a flexible structure?

3. A scientist investigated the number of red blood cells possessed by people living at sea level and in the mountainous region at a height of 5860 meters. Here are the results:

Sea level	5.0 million per mm^3
5860 meters	7.4 million per mm^3

Why do they differ? Explain.



BRAIN TEASERS

- How might lack of dietary iron affect the oxygen-carrying capacity of the blood?
- A mature human red blood cell has no nucleus or mitochondria. It consists primarily of membrane, surrounding the hemoglobin. Suggest an advantage of the simple organization of human red blood cells.



To investigate the effect of physical activity on pulse rate

Date _____



As the heart pumps blood through the body, a pulsing can be felt in some of the blood vessels close to the skin's surface. The pulse rate increases when involved in some physical exertion or exercise.



Stop watch / wrist watch



- ❶ Turn the palm side of your hand facing up.
- ❷ Place your index and middle fingers of your opposite hand on your wrist, approximately 1 inch below the base of your hand.
- ❸ Press your fingers down in the groove at this point. You should feel a throbbing - your pulse.
- ❹ Count the number of beats for 1 minute. This will give your pulse rate per minute at resting condition.
- ❺ Do some physical exercise for example running, jumping, or other exercise for one minute. After the exercise, measure your pulse rate by the same method (step 1 to 4).



Figure 9.9.1: Method of taking pulse

CAUTIONS

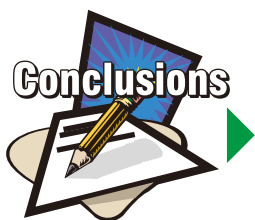
- Physical exercise should not be more strenuous than your age and health allows.

- ❻ Do some exercise for 5 minutes and measure pulse rate.



	Pulse rate per minute			
	1st reading	2nd reading	3rd reading	Average
At rest				
After 1 minute exercise				
After 5 minute exercise				

- Are the pulse rates of all students the same or different?
- What is the average pulse rate of all the students?



Conclusions



Post Lab Activities

1. If a person loses a lot of blood, for example in an accident, the pulse may become very weak. Why?

2. If a bandage was tied tightly round your arm, you would not be able to feel your pulse at all. Why?

3. When the exercise begins, how heart 'knows' that it should beat faster?



BRAIN TEASERS

- A person breathes deeply and rapidly for some time after a period of very strenuous exercise. Explain why strenuous exercise stimulates deep and fast breathing.



Experiment 9.10

To observe the capillary flow in a fish tail or fin or frog's web

Date _____



Background Information

Capillaries are the smallest blood vessels, which are formed by the division of arterioles. Capillaries are involved in the exchange of materials between blood and tissue fluid. Capillaries join to form venules which join to form veins. Fishes possess a rich network of capillaries under their skin.



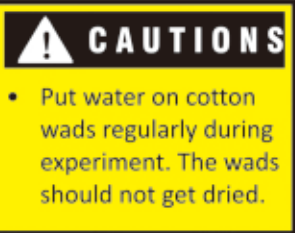
Materials Required

Fish, microscope, glass slides, cotton, Petri dish, dropper



Procedure

- 1 Place a thin wet wad of cotton on the bottom of a Petri dish towards one end.
- 2 Place a slide at the other end, as shown in the figure.
- 3 Remove a fish from the aquarium or jar of water and place it on the Petri dish such that its body lies over the wet cotton and its tail lies over the slide.
- 4 Place a thick wet wad of cotton over the fish and place another slide over the tail. Keep both cotton wads moist by putting water drops over them.
- 5 Remove the clips from the stage of microscope and place the Petri dish on the stage so that the tail of the fish is over the opening of the stage.
- 6 Focus the microscope on the tail and adjust the part of the tail where blood capillaries are observable.



CAUTIONS

- Put water on cotton wads regularly during experiment. The wads should not get dried.

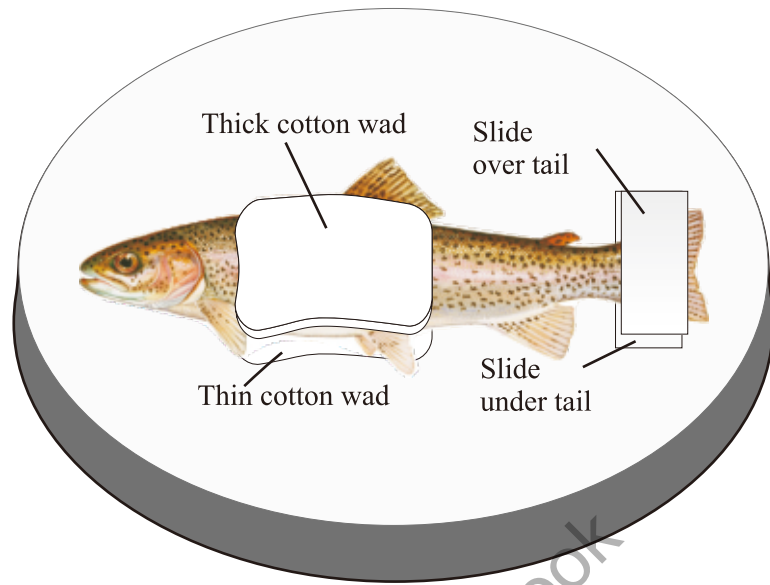
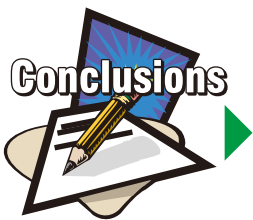


Figure 9.10.1: Experiment setup to observe the capillary flow in a fish tail



Draw the structure of the capillary network seen in the tail of fish.



Conclusions



Post Lab Activities

1. Why is the velocity of blood flow the lowest in capillaries?

2. In the circulatory system, where the blood pressure is lowest?

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