Homeostasis

Experiment 1

INVESTIGATION OF ADAPTIVE FEATURES OF HYDROPHYTES, HALOPHYTES, MESOPHYTES AND XEROPHYTES FROM FRESH MATERIAL

ECOLOGICAL ADAPTATIONS IN PLANTS:

Modification in Morphological, anatomical, physiological and reproductive characters of plants that help them in surviving in their particular habitat successfully are termed ecological adaptations.

Most important, factor in the habitat that forces modifications in characters of plants is availability of water. Thus plants are classified into following ecological groups.

(a) Hydrophytes (b) Halophytes (c) Mesophytes (d) Xerophytes

(a) Hydrophytes:

Hydrophytes are the plants which grow in water reservoirs, like ponds lakes streams or rivers.

Materials:

Beaker, Microscope, Hand lens, Forceps, Prepared slides, Fresh plants or preserved plants.

Examples of Hydrophytes:

Hydrilla, Vallisnera — Potamogeton

Nymphaea lotus (water lily) — Nelermbium Speciosum (Kanwal)

Trapa bispinosa, Azolla — Isoetes, (Sanghara), Saliva Typha

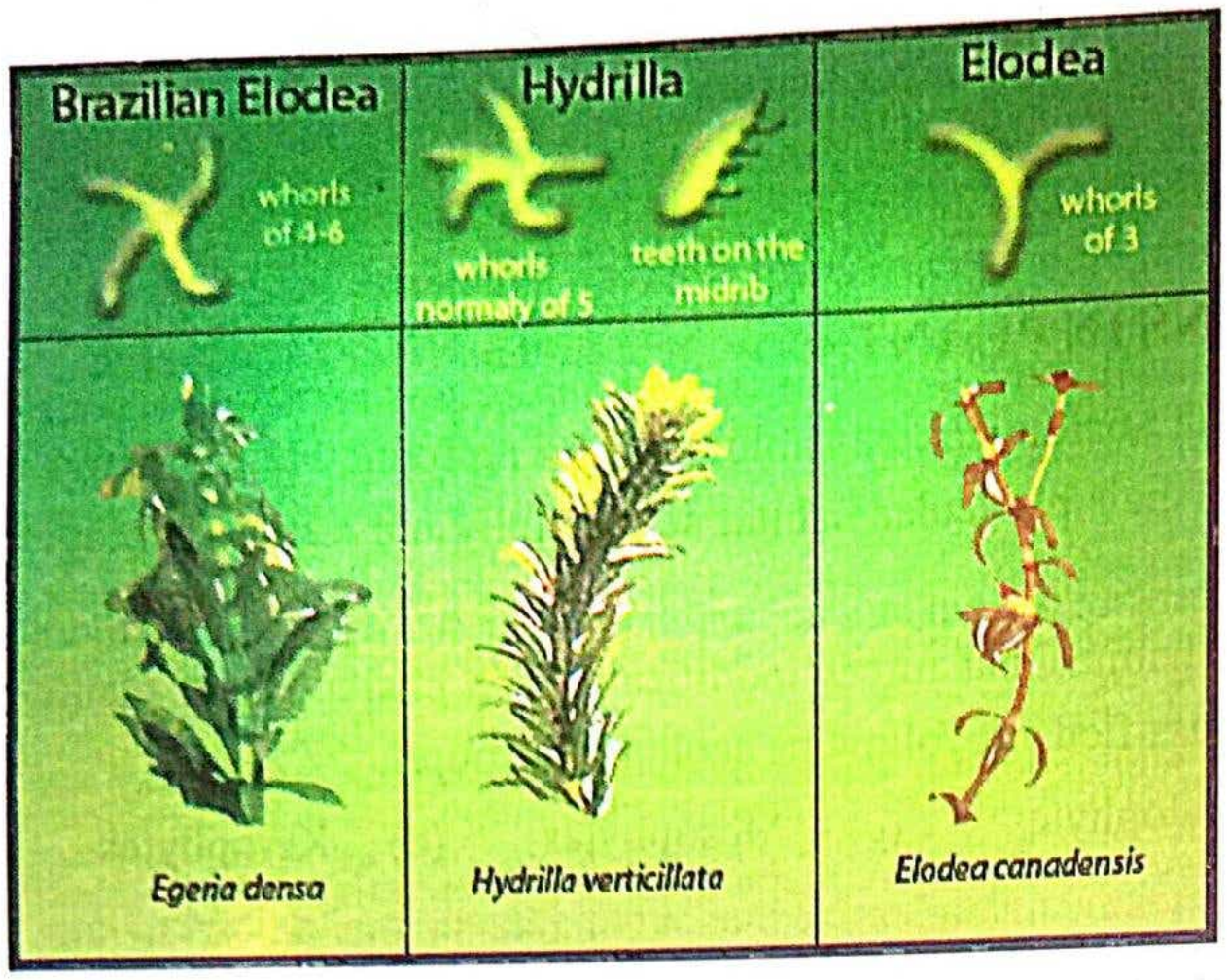
Habitat and Habit:

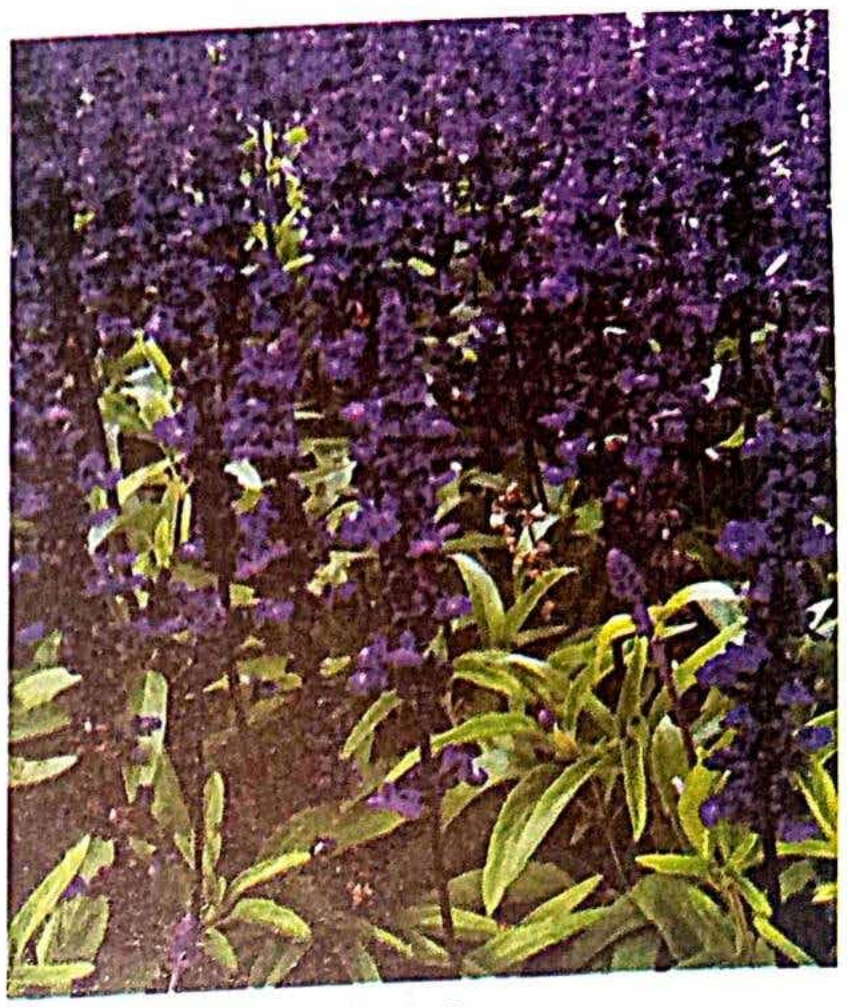
Hydrophytes grow inside water, moist and swampy banks photosynthetic, green, weak stem plants.

Hydrophytic Adaptations:

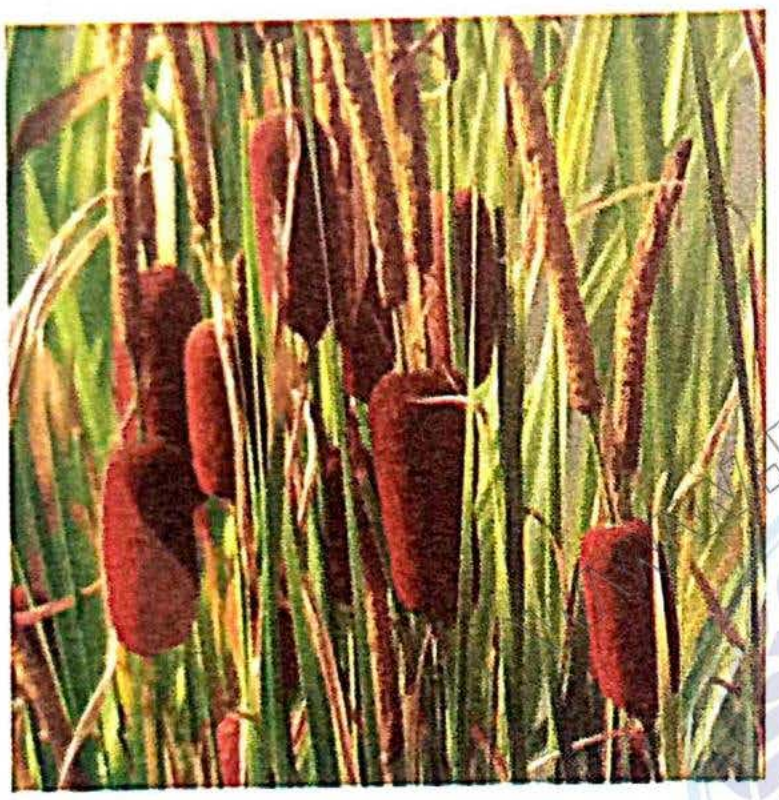
There are modifications in morphological, anatomical, physiological and reproductive characters of plants that help them in surviving successfully in habitat having excess of water.

1. Bark cuticle or periderm is absent because plant parts are not exposed to high temperature or hard soil.
2. Stem is modified into rhizome, stolen etc. because long, hard, erect stem is not needed to keep leaves in the atmosphere.
3. Roots are absent or poorly developed in varying degrees. Lamina is reduced, ribbon like, petioles absent.
4. Mechanical tissues are absent or highly reduced.





Salvia



Typha

Azolla

Lotus

Trapa

5. Solute potential of cells is quite high to reduce excess absorption of water.
6. Photosynthesis is limited by poor light, poor gaseous exchange and poor nutrient availability.
7. Fruits and seed are usually covered with waxy, gelatinuous or mucilagenous covering to protect them from rot in water.
8. Fruits and seed are quite light in weight. So that they can float and be distributed by water.
9. Seeds are produce in very large numbers to ensure enough survival in hydric conditions.

(b) Halophytes:

Halophytes are plants which grow in localities (Area) with high concentration of salts like. NaCl, $MgCl_2$, $MgSO_4$ and abundance of water in the soil. Halophytes cannot use this water due to high salinity.

Materials:

Halophytes plants, slides, compound microscope, beakers, lens, dissecting box.

Examples:

Phizophora, portulaca chenopodium album (Bathu, goosefoot), suaeda fruiticosa (saloonak buti) suaeda monoica, salsola foetida (Lana or saltwort).

Habitat and Habit:

Plants are grow in water logged and saline area (water and salt rich). Plants are shurbs photosynthetic stems, leaves are reduced.

Ecological Adaptations:

1. Root system is extensive, usually shallow due to water logging of soil. Root have much lateral branching.
2. Pneumatophores (Breathing roots) are common. These roots grow upward in the air, they have pores at their tips and special absorbing tissue. These roots helps in gaseous exchanges and water absorptions.
3. Stem are generally succulent due to water storage tissues in cortex. Very thick cuticle waxy covering and thick walled epidermis reduces transpiration.
4. Much water storage tissue is presents in leaves between outer epidermis and mesophyll.
5. Stomata generally present on the lower surface only are sunken into urn-shaped chambers.
6. Much aerenchymatous tissue develops in Cortex and Mesophyll to increase gaseous exchange in the condition of water excess in the habitat.
7. Solute potential is very low in cells and plants protoplasm is highly salt-tolerant in general.
8. Salt excretion through salt glands is also general salt regulating mechanism in halophytes.
9. Air spaces or protective covering over fruits and seeds make them tolerant to salt water for long periods.

Suaeda Fruticosa

Chenopodium

Suaeda Vera

Suaeda-monoica

Portulaca

(c) Mesophyte:

These are the land plants which grow in habitats which are neither dry nor wet and the temperature of the air is neither too high nor too low. Mesophyte are the plants which intermediate between xerophytes and hydrophyte.

Material:

Microscope, slides of stem, root, leaves, plants, lens, dissecting box, beaker.

Examples:

Many of our cultivated crops, ornamental plants and evergreen forest belong to this group, rose, mango, jasmine, sheeshem, peepal etc.

Habitat and Habit:

Mesophyte love to live in habitats which are in between two extremes i.e., scarcity of water and abundance of water. Plants are herbs shurb, woody trees.

Ecological Adaptation:

1. Mesophyte have well developed branched, tap roots in dicot and adventitious, fibrous roots are present in Monocots. Root hairs are captiously developed for the absorption of water from the soil.
2. The stem is usually erect, solid and branched.
3. The leaves are richly developed and are large with waxy coating over upper surface of leaf.
4. Stomata are present mainly on the lower surface of the leaves.

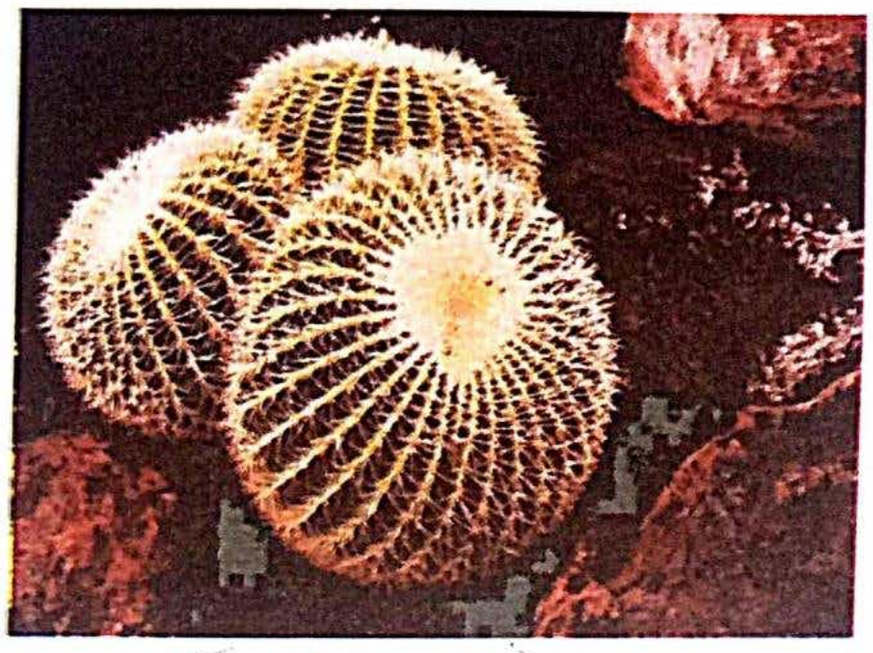
Maize

Rice

Rose

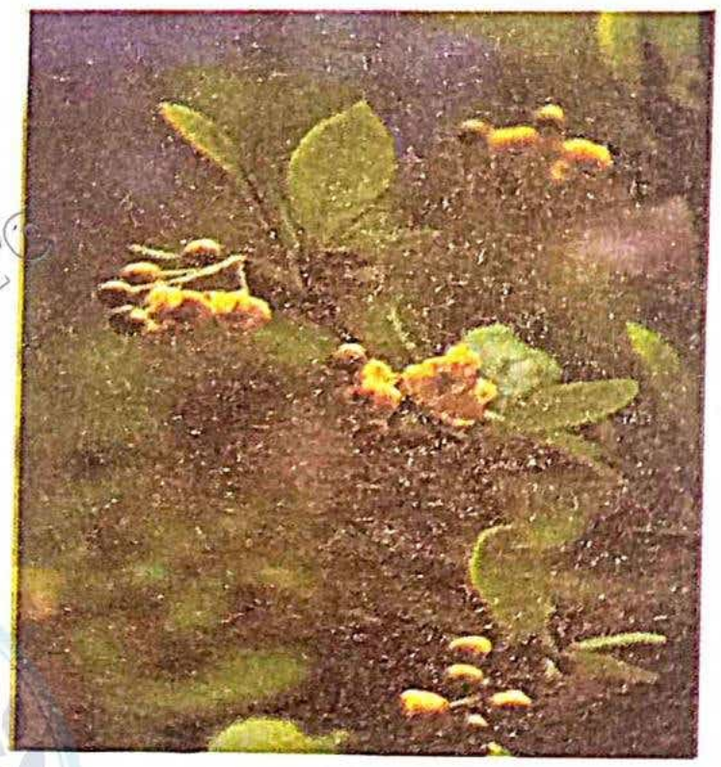
5. The epidermis is thin and the chlorplast are abundance in cortex tissues.
6. Mechanical tissues are well developed.
7. Vascular bundles are well developed and well organized in the root, stem, leaves.
8. Some trees and shurbs with deciduous leaves show marked seasonal variations.
9. There is no device for protecting the plants against transpiration.

Tribulus



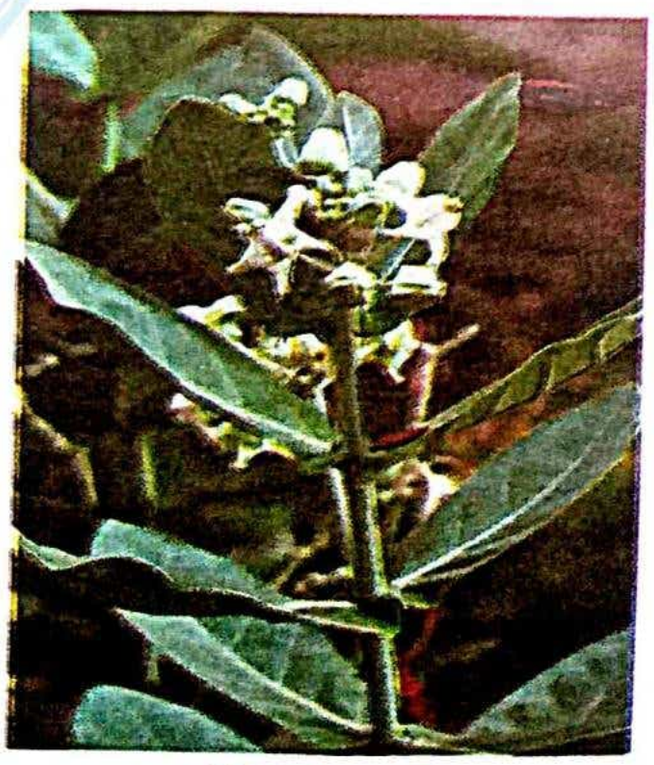
Cactus Seats

Tamarix



Berberis

Euphorbia



Calotropis

(d) Xerophytes:

Xerophytes are the plants living in xeric habitat. Xeric habitat is an area with inadequate water. (Dry condition)

Material:

Plants, microscope, prepared slides, lens, beakers, dissecting box.

Examples:

Tribulus, Ak, Euphorbia, pinus, cactus, Opuntia, aloe. (Kawar gandal) Alhaji Maurorum, Tamarix, Ruscus, Acacia.

Habitat of Habit:

Xeric habitat, physically dry habitat, intense heat, high wind velocity. Plants are mostly small, herbaceous, may be shrubs with small shoot system.

Ecological Adaptation:

1. Plants body is small and herbaceous with small shoot system as plants do not get much time for vegetative growth in short rainy season.
2. Xerophytes are mainly stem, leaf, root succulent plants which absorb much water in rainy season, check its loss, store in their water storage tissues of roots, leaves or stem and use the stored water.
3. Root system is extensive with much lateral branching well developed.
4. Root hairs and root caps. It spreads both horizontally and deep into the soil to absorb water from surface as well as deeper layers.
5. In succulents stomata remain closed during day and open during night when humidity increase due to fall in temperature.
6. Solute potential of cells is quite low to keep water within the cells.
7. Stem and leaves are covered with numerous hairs or waxy coating to protect underlying tissue from excessive heat and to reduce cuticular transpiration.
8. Stem is hard, wood, and stunted. It has thick bark, palisade and stomata for gaseous exchange and to increase photosynthesis.
9. Vegetative reproduction is quite common and age of sexual reproduction is delayed due to little energy available to plant and unfavourable habitat.
10. Covering is resistant to high temperature and desiccation even for long time.
11. Conducting tissue xylem is highly developed to distribute small amount of water available to plant properly amongst tissues.

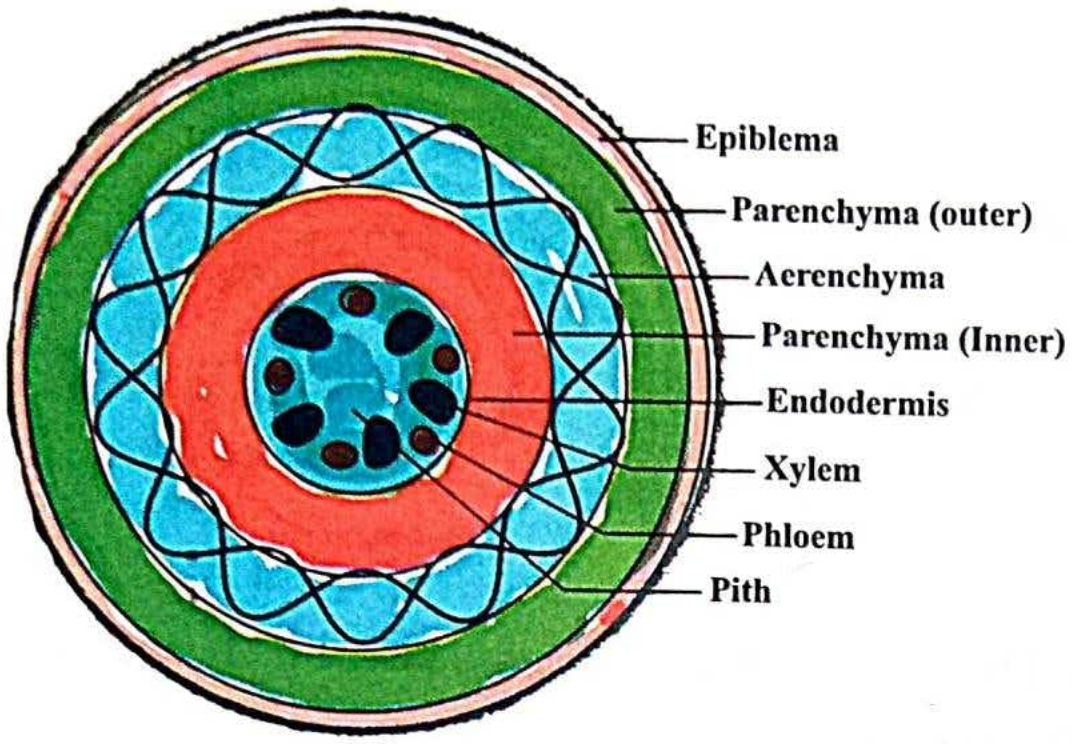


Fig. T.S. of *root* (outline) of totally submerged hydrophyte

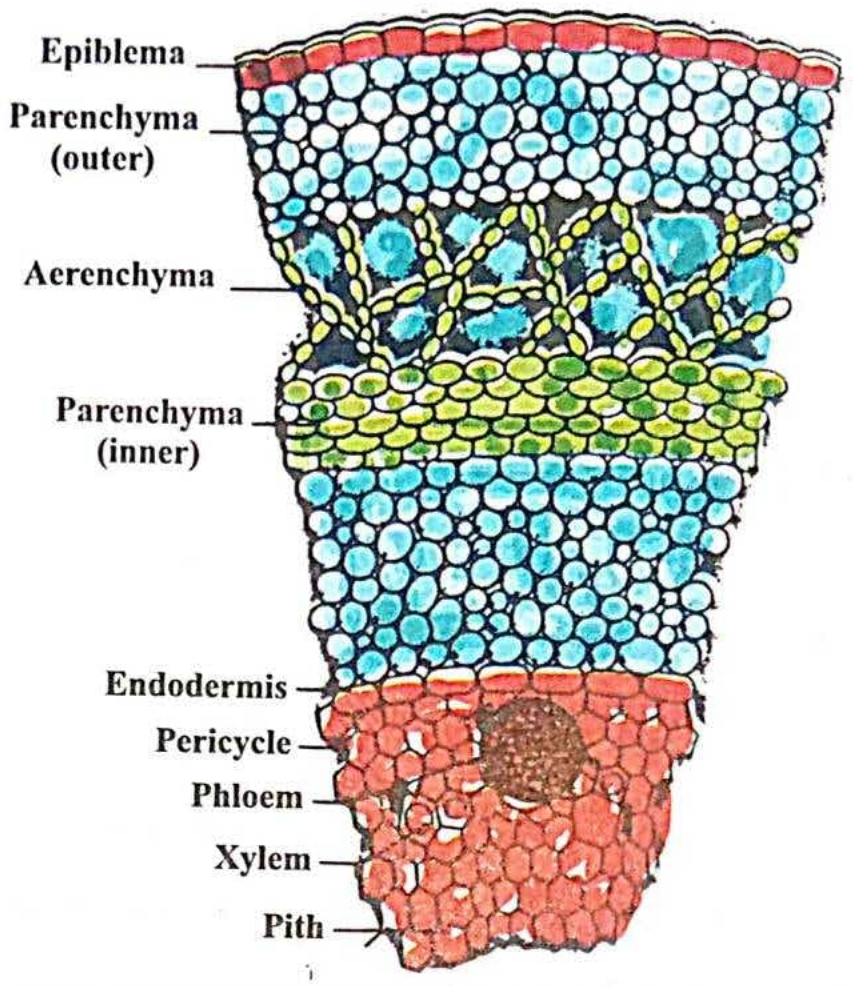


Fig. A part of T.S. of *root* of totally submerged hydrophyte

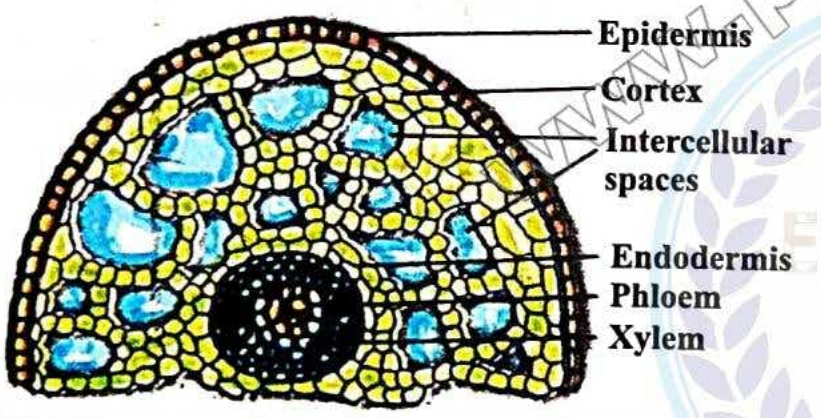


Fig. Transverse section of the stem of *Potamogeton*

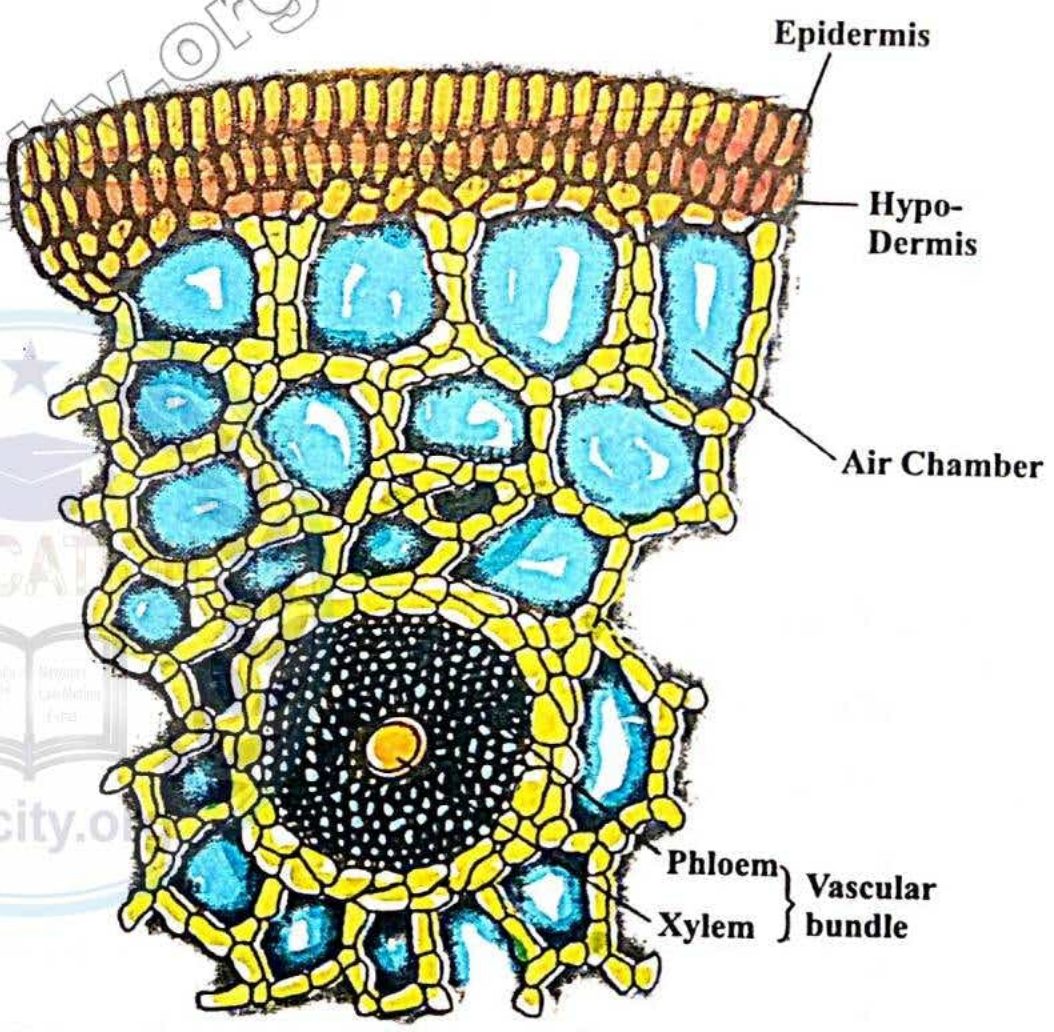


Fig. A part of T.S. of *stem* of *Hydrilla*

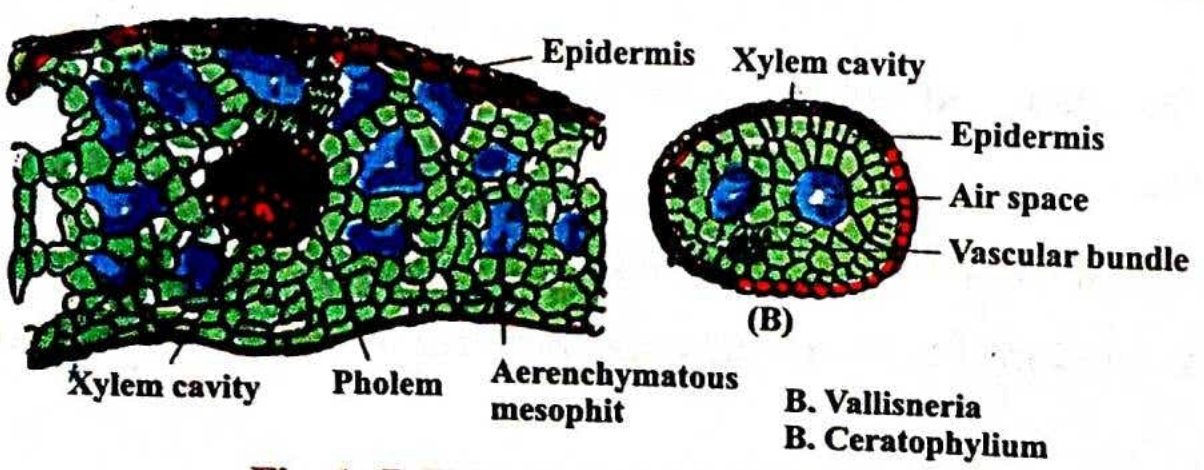


Fig. A, B-T.S. of submerged *leaves*

(i) INTERNAL STRUCTURES OF TOTALLY SUBMERGED PLANTS:

Study the prepared slides of the T.S. of root, stem and leaf of totally submerged plants under the compound microscope and observe the following histological characteristics.

ROOT (T.S.):

(i) The epiblema (piliferous layer) lacks cuticle.

(ii) The cortex is parenchymatous containing large, well-developed, intercellular air-spaces (*aerenchyma*). The aerenchyma gives buoyancy to the plants and helps store air for respiration.

(iii) The mechanical tissue is absent.

(iv) The vascular tissue is poorly developed. The xylem is centrally placed. It is reduced and may be represented by a few or a single vessel.

(v) The phloem is comparatively well-developed, consisting of a few sieve-tubes.

STEM (T.S.):

(i) The cuticle is absent.

(ii) The epidermis is thin and its cells very frequently contain chloroplasts.

(iii) The cortex is large, undifferentiated and mostly parenchymatous. A few outer layers may possess chlorplasts. The mechanical tissue is absent. There are big and well-developed air cavities (aerenchyma).

(iv) There is usually a single vascular bundle. Xylem is poorly developed. It is sometimes represented by a single xylem and vessel as in *Hydrilla*.

(v) Phloem is comparatively well-developed. It consists of few sieve-tubes.

LEAF (T.S. / V.S.):

(i) The cuticle is absent.

(ii) The palisade parenchyma is absent. The spongy parenchyma is few cells deep containing a large number of air cavities consistuting the aerenchyma.

(iii) The mechanical tissue is absent.

Now examine the morphology of the partly submerged lrophytes. Study water lily, kanwal and sanghara plants, one by one and note their fol' daptations:

(i) The root system is poorly developed in kanwal and san . well-developed in water lily for the purpose of attachment.

(ii) The stem is delicate and flexible. It can sway with wate ents to and fro.

(iii) The petioles of the leaves are long and delicate.

(iv) The floating leaves are large, entire as in kanwal and sanghara or slightly lobed as in water lily. They are thick and tough and their margins are turned upwards so as to present the upper surface from being wetted.

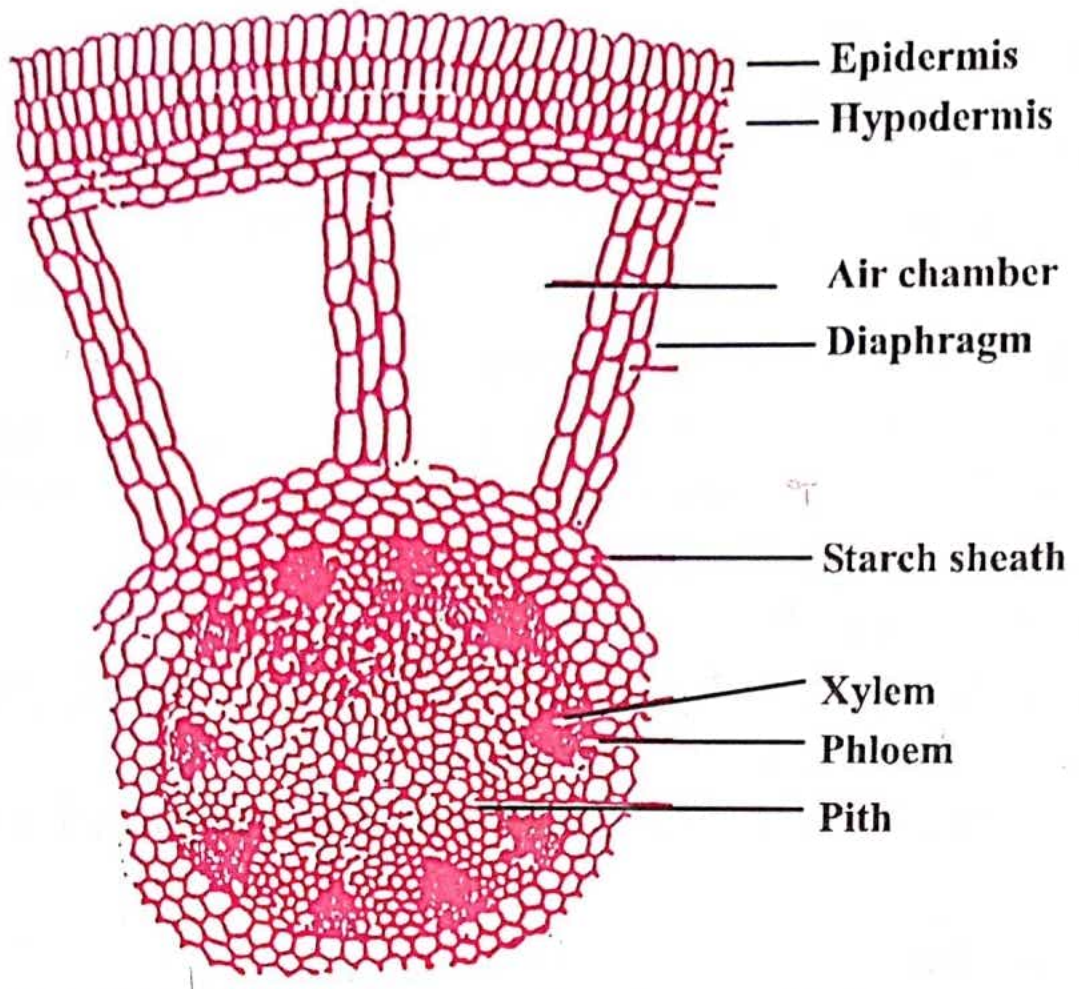


Fig. A part of T.S. Of stem of a partly submerged plant

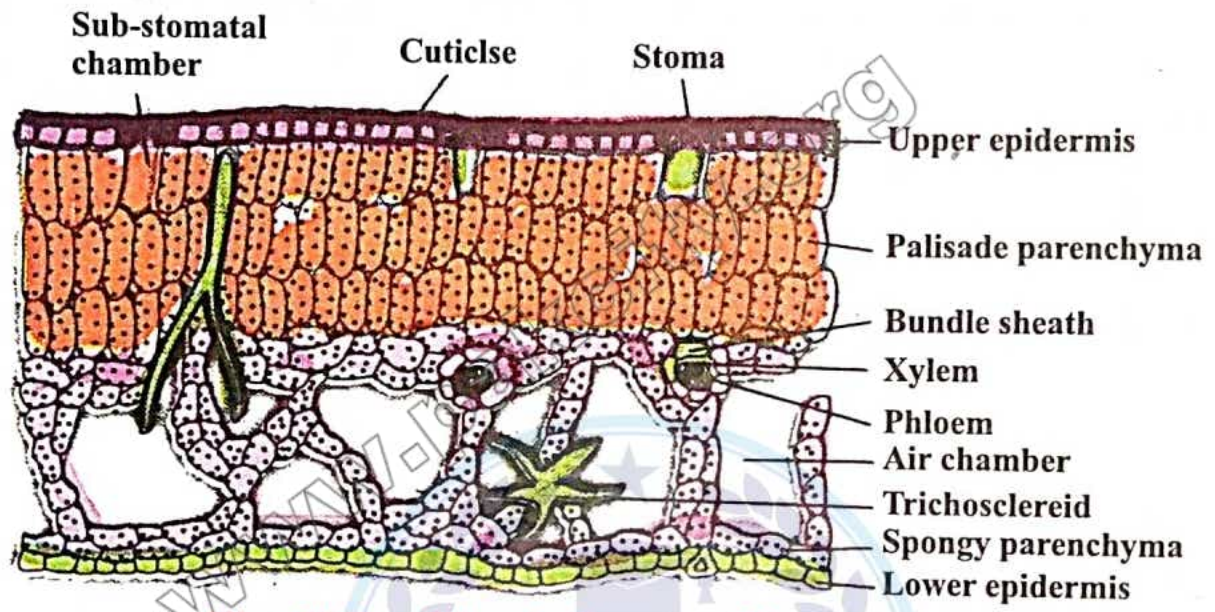


Fig. V.S. of *leaf* of water lily

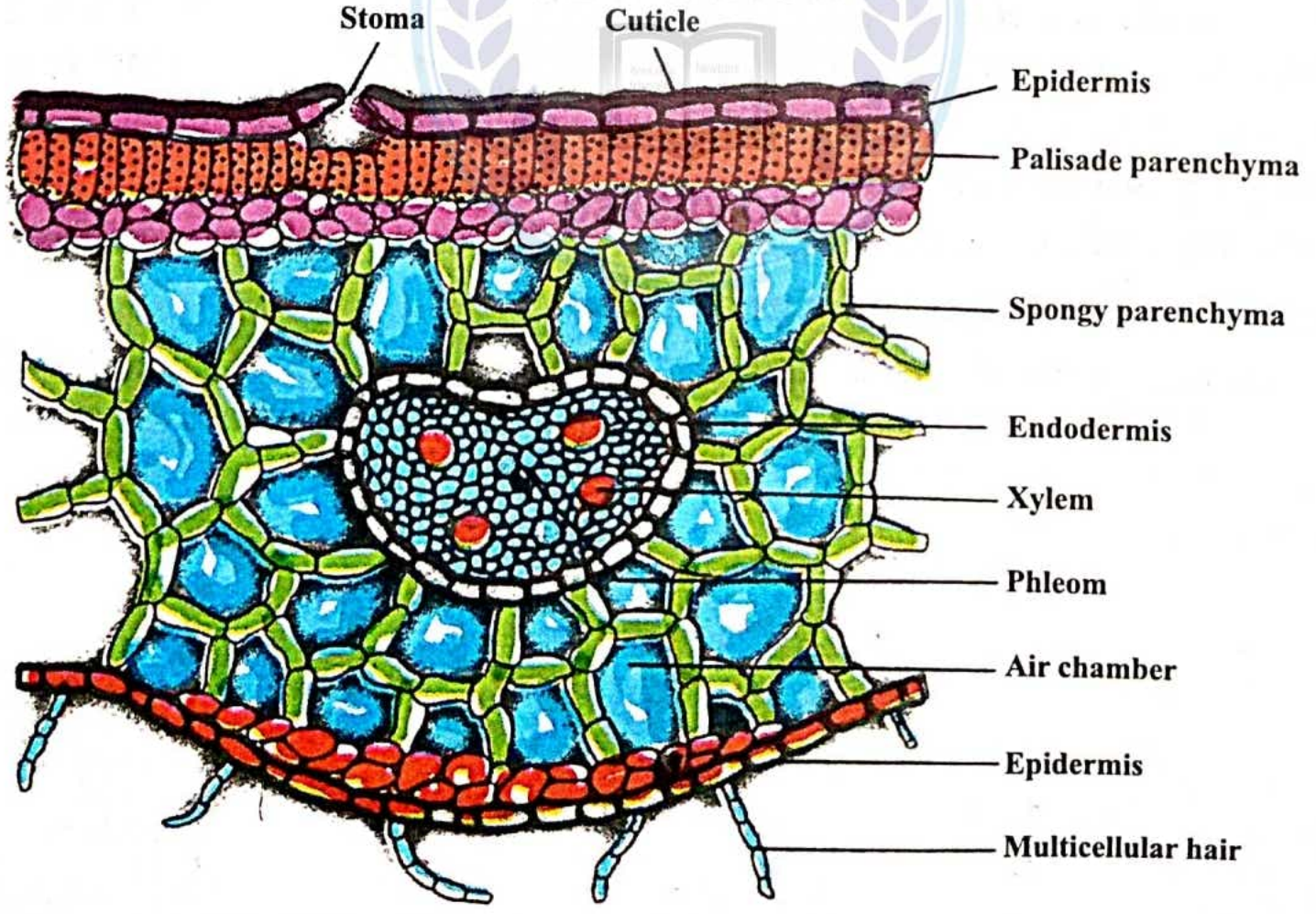


Fig. V.S. of *leaf* to Trapa (Sanghara)

(ii) INTERNAL STRUCTURES OF PARTLY SUBMERGED PLANTS:

Now study the prepared slides of the transverse sections (T.S.) of the root, stem and leaf of partly submerged plants under the compound microscope and note the following anatomical characters.

ROOT:

The internal structure of the root is just the same as in totally submerged plants.

STEM (T.S.):

(i) The cuticle is absent.

(ii) The epidermis is thin and single-layered, having compactly arranged cells.

(iii) The cortex is large, undifferentiated and mostly parenchymatous. The mechanical tissue is absent. A large number of air cavities (aerenchymatous cavities) are present.

(iv) A few vascular bundles occur arranged in a ring. Vascular tissue is poorly developed.

(v) Xylem elements (vessels and tracheids) lack characteristic thickenings (are thin-walled).

(vi) Phloem is less-developed.

LEAF (T.S./V.S.):

(i) The upper or exposed surface of the leaves is covered with thick, waxy cuticle.

(ii) Upper and lower epidermal layers are present. The stomata are present only on the upper surface.

Note: *The presence of stomata and cuticle on the upper epidermis indicates that upper surface is exposed to air and is not in contact with water. On the other hand, absence of cuticle and stomata from the lower epidermis shows that surface is in contact with water. It means that the leaves float on the surface of the water.*

(iii) The palisade tissue is well-developed in the mesophyll of the leaf.

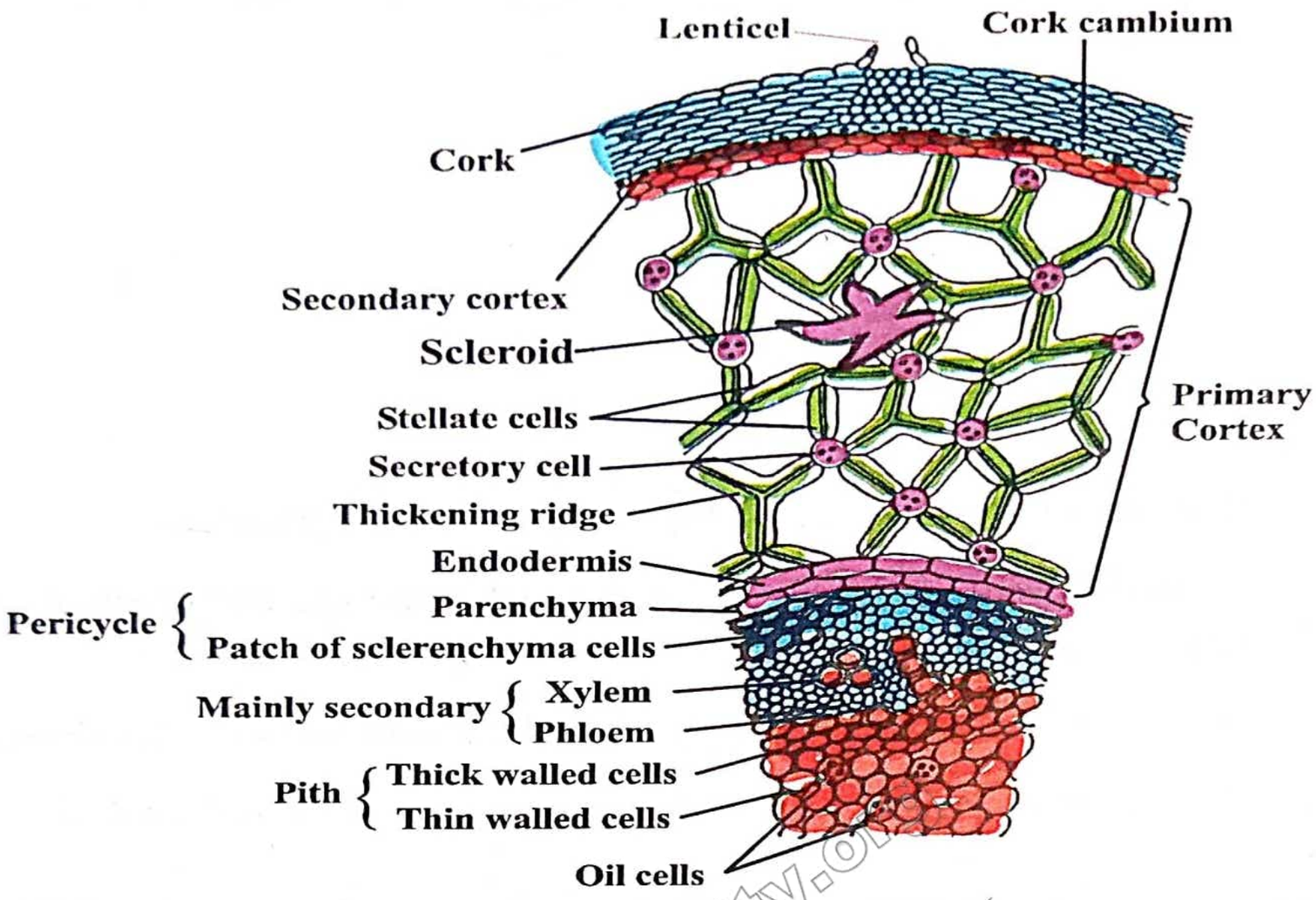
(iv) A large number of air cavities (air chambers) are present which constituent aerenchyma.

(v) The mechanical tissue is completely absent.

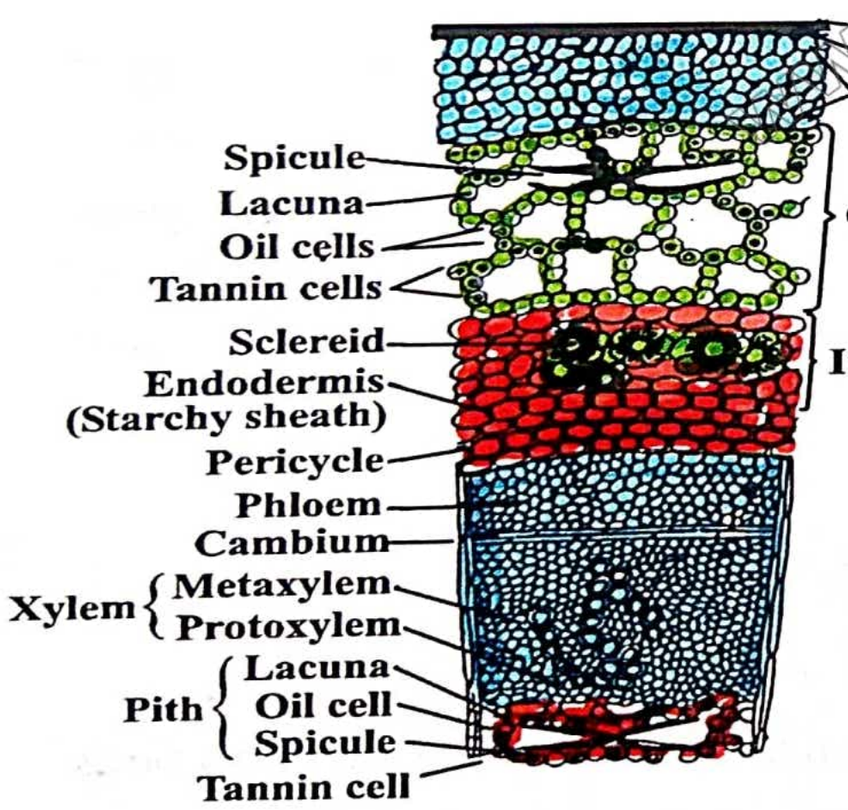
(vi) The vascular bundles are reduced and small. They may be many as in water lily or only one as in Trapa.

(vii) The xylem is represented by only a few elements as in water lily or by lacunae as in Trapa. True vessels are absent.

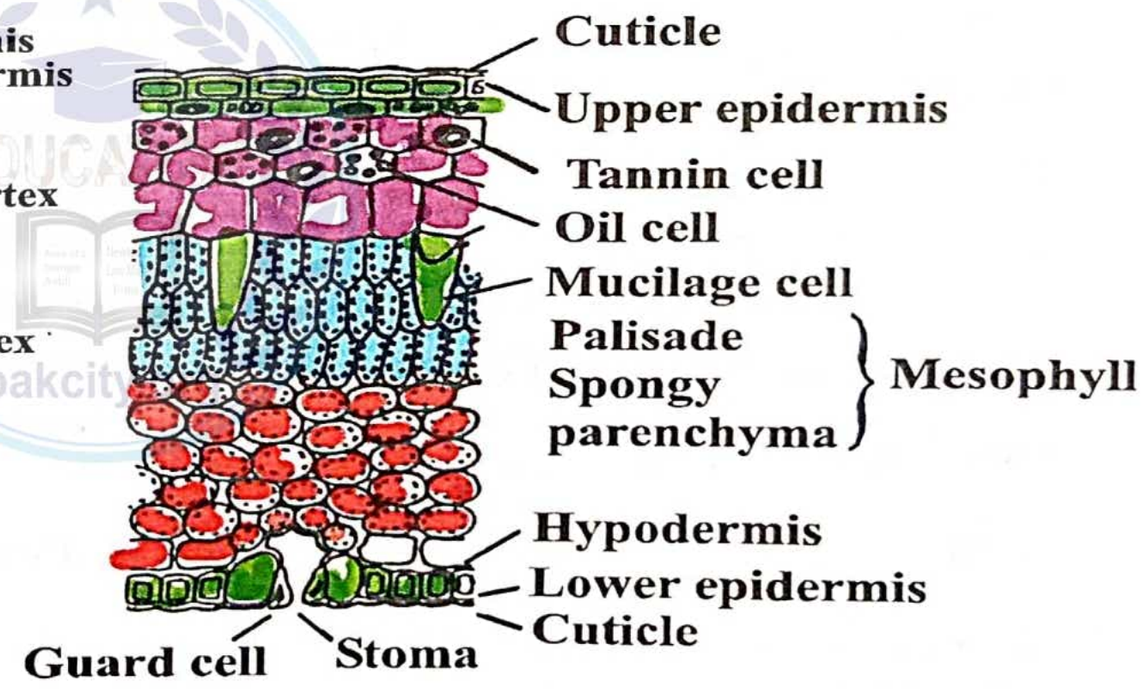
(viii) Phloem is well-developed as compared to xylem.



T.S. Old subterra neam portion of stilt root of Rhizophora mucronata



T.S. Young stem of Rhizophora mucronata



T.S. Leaf (Lateral Portion) of Rhizophora mucronata

(B) INTERNAL STRUCTURE OF HALOPHYTES

Examples:

Suaeda frticosa,Salsola, foetida, chenopodium album.

Root:

The internal structure of the roots of halophytes have followring characters.

(i) Primary and secondary cortex is present.

(Ii) Highly thick walled cells are present.

(iii) Mechinical and vascalar tissue is well developed.

(iv) Well developed cork cambuim is present.

STEM.

Stem of halophytes have following internal featuers.

(i) A thik cuticle is present.

(Ii) Epidermis is well developed.

(iii) Well developed conducting tissue is present

(iv) Xylem is divided into proto and metaxylem.

(v) Cells are thick walled.

LEAVES.

Leaves of the halophytes have followng internal featuers.

(i) Cuticle is well developed.

(ii) Upper and lower epiderimis consist of thick walled cells.

(iii) Sunken stomata are present.

(iv) Stomata are present in lower epidemis.

(v) Palisade and spongy mesophyll is present.

(vi) Vascular bundle is well developed.

(C) INTERNAL STRUCTURE OF MESOPHYTES

To study the internal structure of root, stain and leaves see the Page No. 128 to 133

(D) INTERNAL STRUCTURE OF XEROPHYTES

They grow in dry habitats e.g. deserts and high mountains etc. All plants of arid zone which are not confined to the margins of streams or lakes are considered as Xerophytes.

Internal Structure Of Xerophytes:

ROOT:

The roots of xerophytes have following features.

(i) Well developed cuticle is present.

(ii) Thick walled cells are present.

(iii) Extensively developed pith is present.

(iv) Extensively developed aerenchyma enclosing large air chambers.

(v) Well developed vascular and supporting tissue is present.

STEM:

The stem of xerophytes have following internal features.

(i) Cutical is well developed.

(ii) Epidermis consist of thick walled cells.

(iii) Vascular tissue is well developed.

(iv) Large central pith is present.

LEAF:

The leaf of the xerophytes have following internal structure.

(i) The cutical is thick.

(ii) The epidermis is thick walled.

(iii) Below epidermis, there is sclerenchymatous hypodermis.

(iv) There is waxy coating on the leaves.

(v) Leaves have sunken stomata.

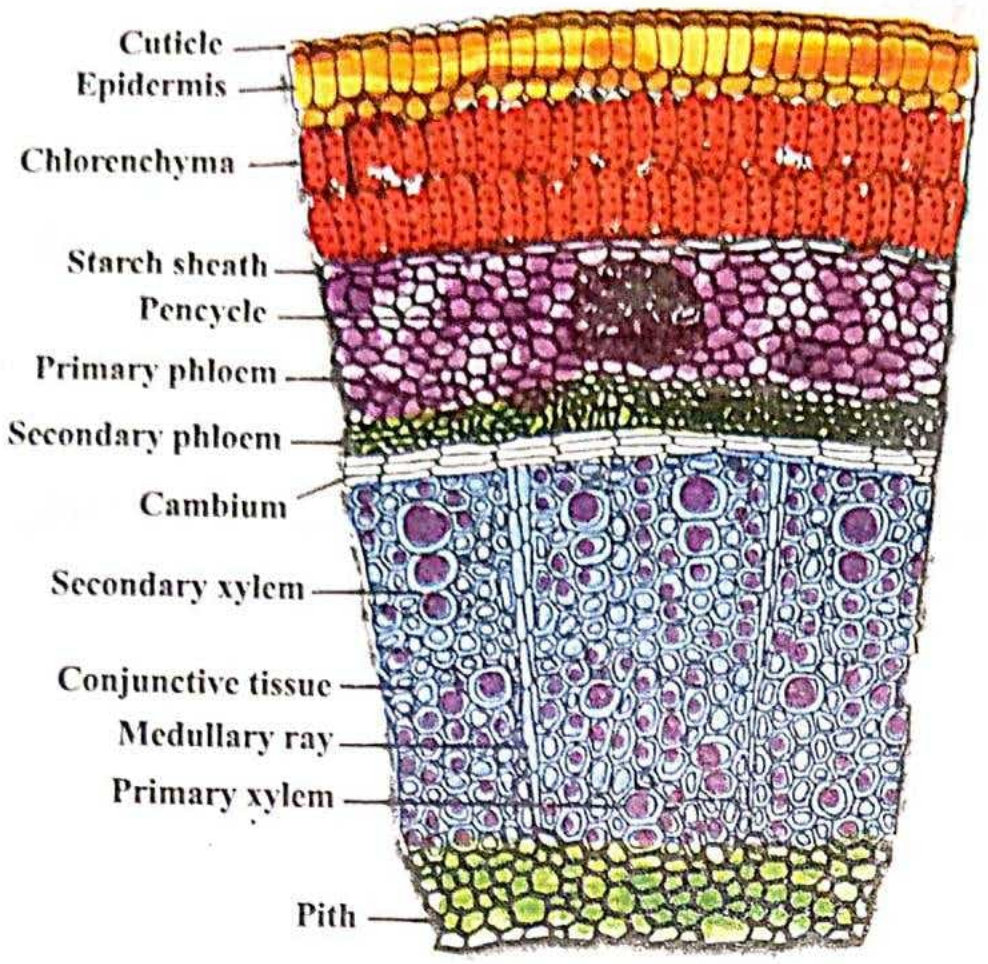


Fig. A part of T.S. of *stem* of *Copparis*

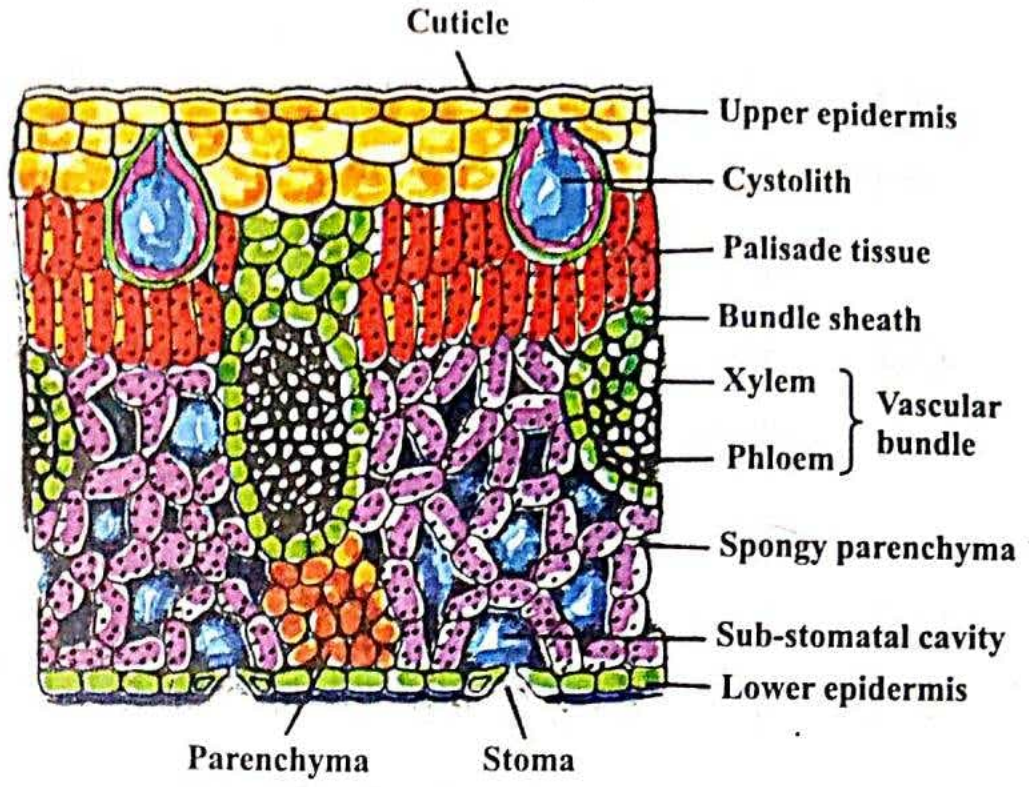


Fig. A part of V.S. of *leaf* of *Ficus*

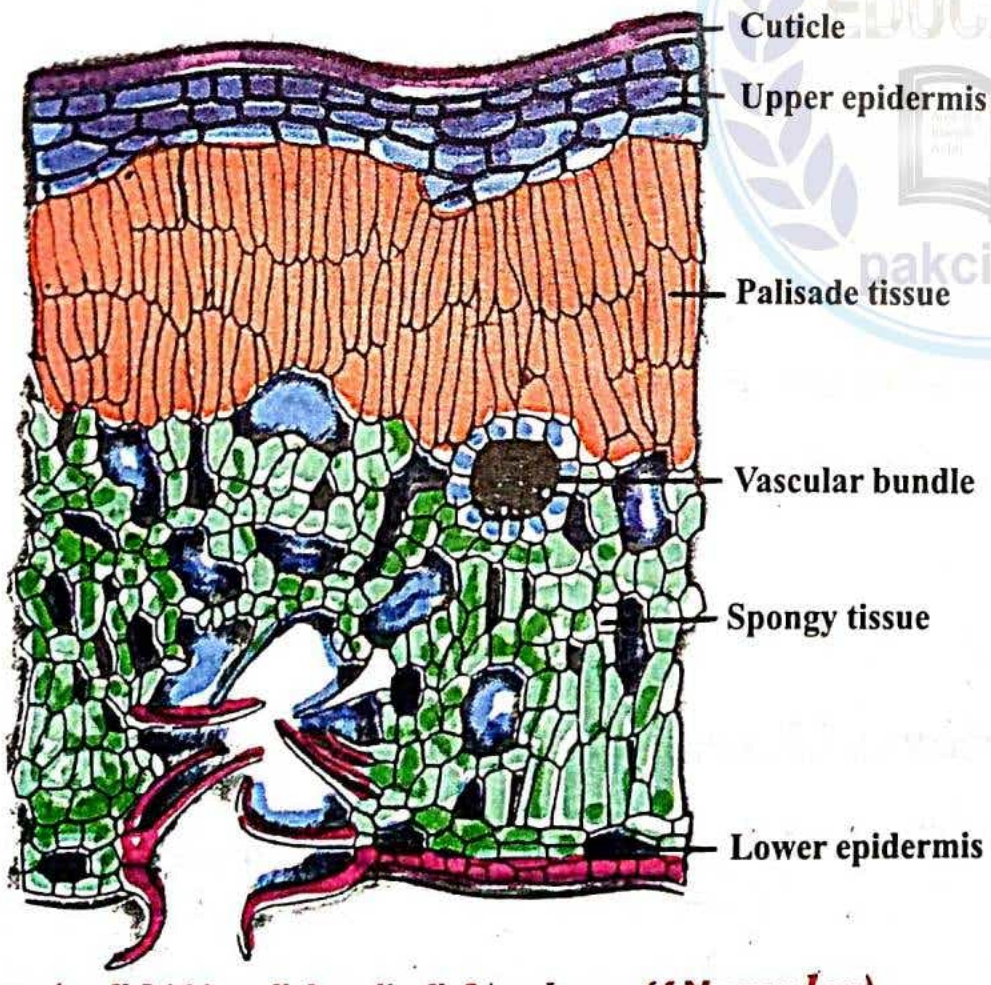


Fig. A part of V.S. of *leaf* of *Nerium (Oleander)*

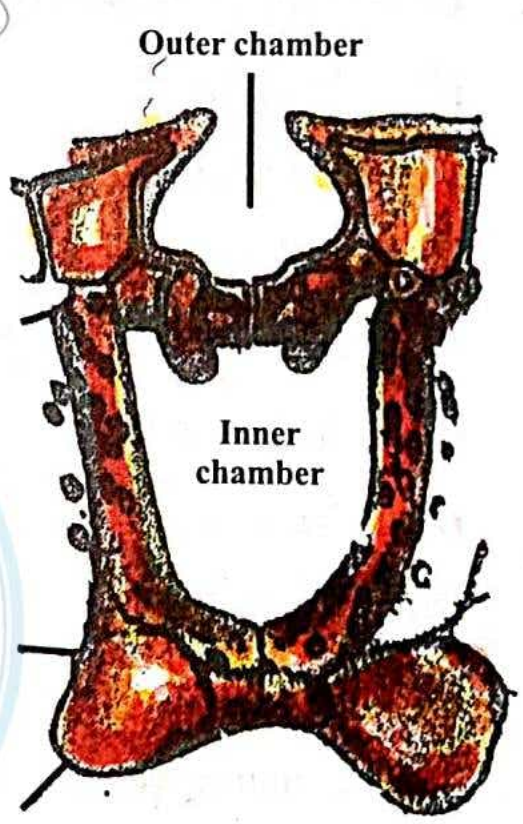


Fig. A magnified sunken *stoma*

VIVA VOCE

Q.1 *Why are root hairs very scanty or absent in hydrophytes?*

Ans. *This is because absorption of water, dissolved salts and gases takes place over the whole surface of the roots.*

Q.2 *What are hydrophytes?*

Ans. *Hydrophytes are the plants which grow in or near water,they may be partly or totally submerged.*

Q.3 *What are the types of hydrophytes.*

Ans. *(i) Free floating*
(ii) Rooted with floating leaves
(iii) Submerged floating
(iv) Rooted emergent

Q.4 *Give three examples of free floating hydrophytes?*

Ans. *(i) Wolffia*
(ii) Eichhornia
(iii) Salvinia

Q.5 *Give three examples of hydrophytes which are rooted with floating leaves.*

Ans. *(i) Nymphaea*
(ii) Nelumbo
(iii) Marsilea

Q.6 *Give three examples of submerged floating hydrophytes.*

Ans. *(i) Ceratophyllum (ii) Najas (iii) Utricularia*

Q.7 *What is the function of mucilage cells and mucilage canals in hydrophytes?*

Ans. *They secrete mucilage to protect the plant from decay under water.*

Q.8 *Is transpiration absent in submerged plants?*

Ans. *Yes.*

Q.9 *What are halophytes?*

Ans. *They are special type of xerophytic plants which grow on dry soils such as saline Soils with high concentration of salts like Sodium chloride, Magnesium chloride, Magnesium chloride and Magnesium sulphate.*

Q.10 *Give examples of halophytes.*

Ans. *(i) Suaeda fruticosa*

(ii) Salsola foetida

(Iii) Chenopodium album

Q.11 *What are the types of halophytes?*

Ans.

(i)	*Lithophilous*	:	*They grow on rock and stones.*
(ii)	*Psammophilous*	:	*They grow on sand.*
(iii)	*Pelophilous*	:	*They grow on mud.*
(iv)	*Helophilous*	:	*They grow on marshes.*

Q.12 *What are xerophytes?*

Ans. *Xerophytes are the plants which grow in dry habitats like deserts, high mountains etc.*

Q.13 *What are the types of xeropytes?*

Ans. *(i) Ephermerals*

(ii) Succulents

(iii) True xeropytes

Q.14 *What are ephemerals?*

Ans. *They are short lived annual xerophytes which complete their life cycle within a short of water availability. e.g. Solanum xanthocarpum*

Q.15 *What are succulents?*

Ans. *The xerophytes which have succulent fleshy stems, leaves or roots are called succulent. e.g. Opuntia, Cacti, Euphorbia.*

Q.16 *What are true xerophytes? Give examples.*

Ans. *They are drought resistants, they maintain growth under critical dry conditions and temperature.e.g. Acacia nelotica, Ziziphus jujuba, Calatropis procera etc.*

Q.17 *What are mesophytes?*

Ans. *Mesophytes are the plants which grow in moderately moist habitats and need well areated soils.*

Q.18 *Give examples of mesophytes.*

Ans. *Sunflower, Rose, Oat, Mango, Neem, etc.*

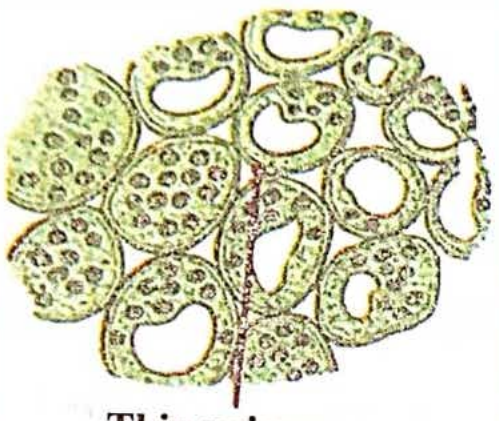
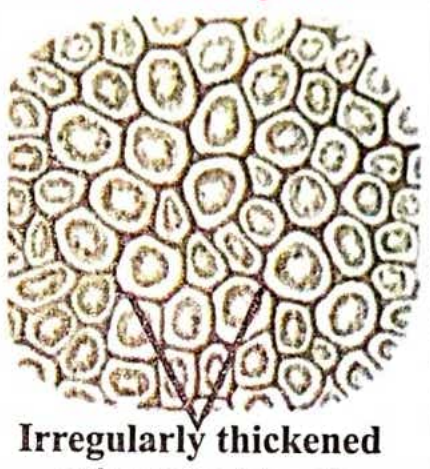
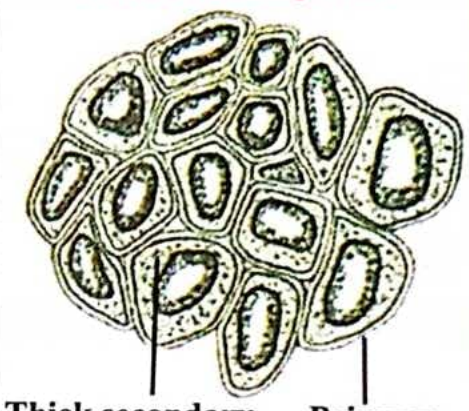
SUPPORT AND MOVEMENT

2 Experiment

STUDY OF SUPPORTIVE TISSUES OF PLANT

SUPPORT PROVIDING TISSUES OF THE PLANTS

Supportive tissue of plants are selerenchyma cells and collenchyma cells.

Features	Parenchyma	Collenchyma	Sclerenchyma
	 Thin primary cell wall	 Irregularly thickened primary cell wall	 Thick secondary cell wall; Primary cell wall
1. Cell Shape	Isodiametric cells which are oval, spherical or polygonal in shape	Circular, oval or polyhedral	Variable in shape. Fibres and sclereids
2. Cell wall	Thin cellulosic cell wall	Uneven thickening on their cell wall.	Lignified secondary cell wall present
3. Cytoplasm	Abundant	Present	Absent
4. Nucleus	Present, (Living tissue)	Present, (Living tissue)	Absent
5. Vacuoles	Large vacuole	Vacuolated	Absent
6. Intercellular Spaces	Present	Absent	Absent
7. Occurrence	Basically packing tissue, All soft part of plant, Pith, cortex, medullary rays	Dicot stems, petiole and beneath the epidermis. Absent in monocot and roots	Dicot hypodermis bundle sheath, pericycle, seed, pulp of fruits.
8. Functions	Food storage, Photosynthesis	Provide tensile strength, Mechanical support, Phostosynthesis	Protection from stress and strain, Mechanical strength

VIVA VOCE

Q.1 *Name the support providing tissues of plants.*

Ans. *The tissues which provide support to the plants are:*

(a) Sclerenchyma (b) Collenchyma

Q.2 *What are sclerenchyma cells?*

Ans. *They have thick secondary cell walls usually impregnated with lignin, an organic substance that makes the walls tough and hard. Most of the sclerenchyma cells are non-living.*

Q.3 *What is the function of sclerenchyma cells?*

Ans. *Their primary function is to provide support to the plant parts.*

Q.4 *What are different types of sclerenchymatous cells?*

Ans. *There are three types of sclerenchymatous cells:*

(i) fibers or tracheids, (ii) sclereids or stone cells and (iii) vessels or trachea.

Q.5 *What are fibers or tracheids?*

Ans. *These are long and cylindrical and they may exist in solid bundles in xylem or as bundle caps.*

Q.6 *What are sclereids?*

Ans. *These are shorter than fibers and are found in seed coats and nutshells and provide protection.*

Q.7 *What are Vessels (Trachea)?*

Ans. *Long tubular structures, join end to end to form long water conducting pipe in Xylem.*

Q.8 *What are collenchyma cells?*

Ans. *Collenchyma cells have protoplasts and usually lack secondary walls. They have angular thickening in their primary walls. They are usually grouped in strands or cylinders. Collenchyma cells provide support to young herbaceous parts of the plant.*

Q.9 *What are simple tissues?*

Ans. *These are homogenous in nature and are composed of structurally and functionally similar cells. These include parenchyma, collenchyma and sclerenchyma.*

Q.10 *What are complex tissues?*

Ans. *These are heterogenous in nature, i.e., these are composed of structurally and functionally different cells. These include xylem and phloem.*

Q.11 *What are secretory tissues?*

Ans. *These are structurally modified and organized to perform secretory functions. These tissues may occur as a single cell, in isolated groups, or in masses. These may be external or internal in position. Tese include trichomes and glands, hairs, hydathodes, oil glands, secretory cells, and laticiferous tissues.*

Q.12 *What is a tissue?*

Ans. *A group of more or less similar cells performing same function is called a tissue.*

Q.13 *What are the two major types of tissues?*

Ans. *(i) Meristematic tissues (ii) Mature tissues*

Q.14 *What are the types of mature tissues?*

Ans. *(i) Simple tissues (ii) Complex tissues (iii) Secretory tissues*

Q.15 *Give examples of simple tissues.*

Ans. *(i) Parenchyma (ii) Collenchyma (iii) Sclerenchyma*

Q.16 *How would you differentiate between collenchyma and sclerenchyma?*

Ans.

Collenchyma	Sclerenchyma
(i) Living cells	(i) Non living cells
(ii) Non lignified walls	(ii) Lignified walls
(iii) Pits absent	(iii) Pits present

Q.17 *What is the main function of collecncyma and sclerencyma cells?*

Ans. *Support*

Q.18 *What are the types of sclerencyma cells?*

Ans. *(i) Fibres (long cells) (ii) Sclereids (short cells)*

Q.19 *What are stone cells?*

Ans. *Sclereids are called stone cells. They are more or less isodiametric in form.*

Q.20 *Name the plants which yield fibres.*

Ans. *Flax, Ramie, Jute, Hemp, Cotton etc.*

Q.21 *Where do fibres occur in plants?*

Ans. *They are found in both xylary and extra xylary regions.*

Q.22 *Where do sclereids occur in plants?*

Ans. *They are found in cortex, in the phloem, in the pith of stems, in flesh of fruits (pears) and in testa of seeds (family leguminosae).*

Q.23 *What are pits?*

Ans. *These are depressions or cavities in secondary walls e.g. sclerenchyma fibres and sclereids.*

3 Experiment

INVESTIGATION OF PLANT MOVEMENTS (PHOTOTROPISM AND GEOTROPISM)

TROPISM

Response of plant to some directional stimulus is called Tropism.

OR

Change in the direction of growth of a part of plant due to some directional stimulus is called Tropism e.g. Phototropism, Geotropism. It may be positive when growth is towards the stimulus and negative when away from stimulus.

PHOTOTROPISM (Heliotropism):

Response of plant towards light is called Heliotropism or Phototropism.

OR

It is the movement of part of plant in response to stimulus of light and it is caused by differential growth of that part of plant.

GEOTROPISM:

Response of plant towards gravity is called geotropism.

PART - A

PHOTOTROPISM (HELIOTROPISM)

The growth movement in plants in response to light is called phototropism.

APPARATUS

A small flower pot planted with pea seeds or Radish seeds. Heliotropic or Phototropic chamber.

PROCEDURE

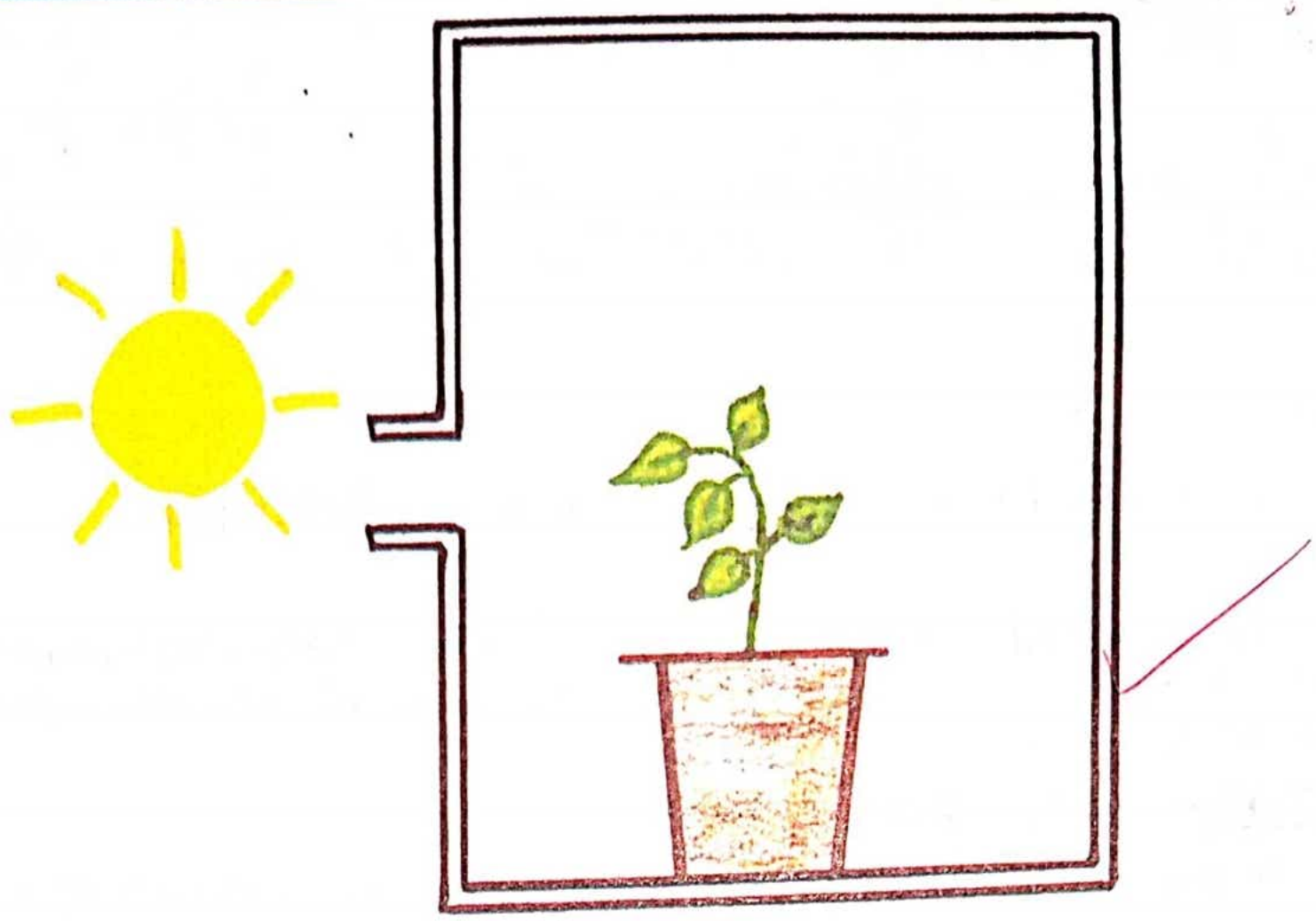
(1) Take a heliotropic chamber and place the potted growing seedlings in the chamber.

(2) Place the set up in a window with the hole of the chamber facing light or on a table and hang lighted electric bulb in front of the hole.

(3) Keep this set up in this condition for 4 - 5 days and then observe it.

OBSERVATIONS

The shoots of the plants are bent towards the hole i.e. towards the source of light, so the shoot is positively phototropic. Gently expose the roots, the main root is bent in a Direction away from the source of light. So the root is negatively phototropic.



Heliotropic chamber to demonstrate phototropism

CONCLUSION

The shoots show positive phototropism while the roots show negative phototropism

PART-B

GEOTROPISM

ACTIVITY - I

The growth movement in plants in response to gravity is called geotropism.

APPARATUS

A pair of petridishes, Soaked corn grains, Blotting paper or Filter paper, Cellophane tape Water proof ink marker, Cotton

PROCEDURE

(1) Take a petridish and an ink marker.

(2) Draw two intersecting lines on the bottom of the petridish.

(3) Place four soaked corn grains, one on each radius of the petridish, with their pointed ends directed towards the center and the broader ends towards outside as Shown in the figure.

(4) Cover the grains with the filter paper, keeping in mind that the paper should fit tightly in petridish.

(5) Place cotton on the paper and sprinkle a little water on it and cotton.

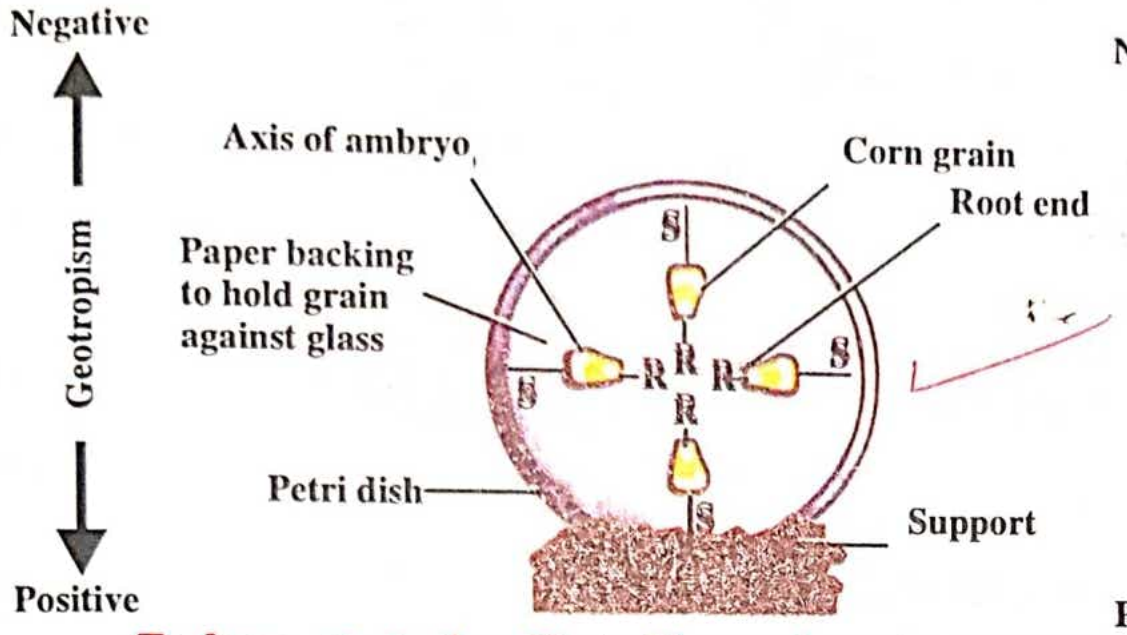
(6) Close the dish and seal it with the strips of cellophane tape.

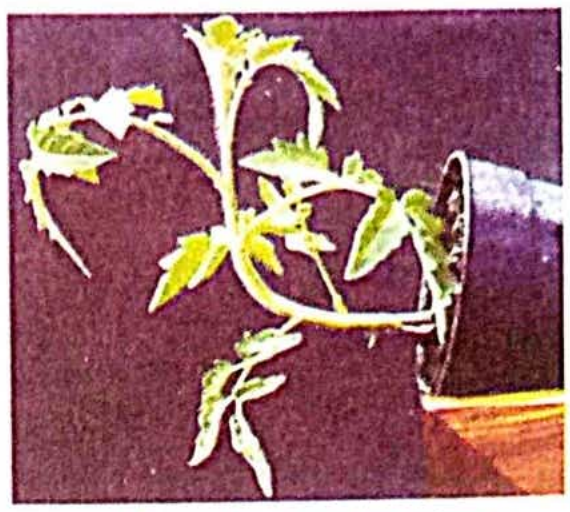
(7) Make the dish to stand on its edge with the help of clay in such a way that one grain lies above, one lies below and two lie at the sides.

(8) Place this set up in the laboratory for 3 - 4 days.

OBSERVATIONS

After 3 - 4 days, the shoot of all the seedlings have grown upwards and the roots downwards.





To demonstrate the effect of force of gravity on germinating Seedlings

Negative geotropism

CONCLUSION

The shoot is negatively geotropic and root is positively geotropic.

ACTIVITY-II

CLINOSTAT

It is an apparatus which rotates plants to make the effects of light and gravity equal on all sides. It consists of a rod with a disc mounted on it. It shows a clockwise mechanism for rotating the rod and the disc. It makes only four turns or rotations per hour.

PROCEDURE

(1) Place the clinostat in a horizontal position.

(2) Fix a potted plant horizontally to the disc of the clinostat.

(3) Keep the apparatus in a dark room for a few days.

(4) Spray water regularly on the soil of plant.

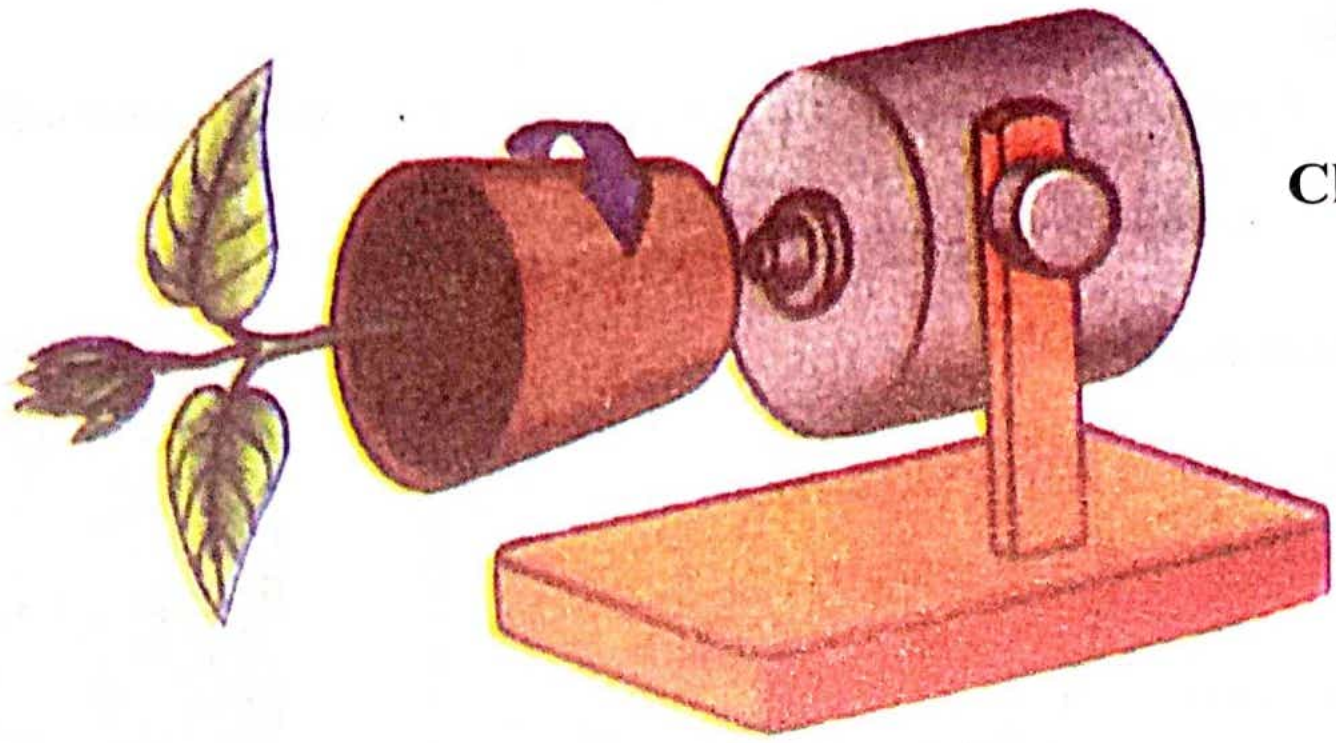
(5) The roots and stem will grow horizontally instead of roots growing downwards and stem upwards.

(6) All the sides of the plant axis, i.e. root and stem are in turn directed upwards and downwards and are equally exposed to the effect of gravity. So the effect of gravity on the plant axis is eliminated and stem and root do not bend.

(7) Stop clinostat and observe the plant after 3 - 4 days.

OBSERVATIONS

The shoot curves upwards and the roots downwards.



Clinostat

Geotroptism in shoots

CONCLUSION

The shoot is negatively geotropic and root is positively geotropic.

VIVA VOCE

Q.1 Define tropism?

Ans. The response to external stimulus that come chiefly or wholly from one direction is called tropism.

Q.2 Name various types of tropism?

Ans. (1) Geotropism (2) Phototropism (3) Thigmotroprism
(4) Chemotropism (5) Hydrotropism

Q.3 Define geotropism?

Ans. The growth movement in plants in response to gravity is called geotropism.

Q.4 Define phototropism?

Ans. The growth movement in plants in response to light is called phototropism.

Q.5 Briefly define thigmotropism, Chemotropism and Hydrotropism?

Ans. Thigmotropsim ..... Response to contact
Chemotropsim ..... Response to chemicals
Hydrotropism ..... Response to water

Q.6 Why is it necessary to soak the grains before placing them in the petridish?

Ans. Grains are soaked so that they can get water required for germination.

Q.7 Why are the grains placed next to a wet blotting paper?

Ans. It is necessary so that grain get moisture during germination.

Q.8 In what direction do the root and shoot grow out of each grain?

Ans. The roots of all the grains grow towards the earth, while shoots grow away from the earth.

Q.9 To which factor in the environment are the root and shoot responding.

Ans. They are responding to force of gravity.

Q.11 What is coleoptile?

Ans. The first leaf in some grasses (Grass family - Gramineae or Poaceae)

Q.12 What is agar?

Ans. Agar is a product of seaweeds. It dissolves in hot water. When agar cools in solution, it resembles gelatin.

Q.13 What are auxins?

Ans. These are Indole Acetic Acid (IAA) or their variants.

Q.14 What are the characteristics of auxins?

Ans. Auxins influence cell elongation; inhibit growth of lateral buds; promote the initiation of roots; and in a few plants, regulate the differentiation of flower buds.

Q.15 Does the coleoptile tip elongate above the cut or below the cut?

Ans. The coleptile tip elongates below the cut.

Q.16 What is the evidence that some stimulation from the tip is necessary for elongation of the coleoptile?

Ans. Plant provides evidence that some stimulation from the tip is necessary for elongation of the coleoptile.

Q.17 What type of response to gravity is shown by roots and the shoots?

Ans. The roots show positive geotropism and the shoots show negative geotropism.

Q.18 Why were the grains placed next to a wet filter paper?

Ans. It is necessary so that grains get moisture required for germination.

Q.19 Why do we soak the seeds before putting them in petridish?

Ans. The seeds are soaked before putting them in petridish in order to provide moisture for the germination of seeds.

Q.20 For which purpose can the clinostat be used?

Ans. It can be used to eliminate the influence of gravity on root or stem.

4 Experiment

STUDY OF SKELETON OF FROG

Taxonomic Position

Phylum	Chordata
Sub-phylum	Vertebrata
Sub-class	Lissampbibia
Order	Anura
Sub-order	Phaneroglossa
Species	Rana Tigrina (Frog)

MATERIALS

Articulated and disarticulated skeleton of frog.

PRODUCDURE

Study articulated and disarticulated skeleton of frog. Draw and label different parts.

SKELETON

In frog skeleton consists partly of bone and partly of cartilage. The skeleton provides support and rigidity to the body. It protects the delicate parts and helps in locomotion. Frog possesses endoskeleton as it is lying inside the muscles.

The skeleton can be divided into two parts:

1- **an Axial skeleton** consisting of skull and vertebral column.

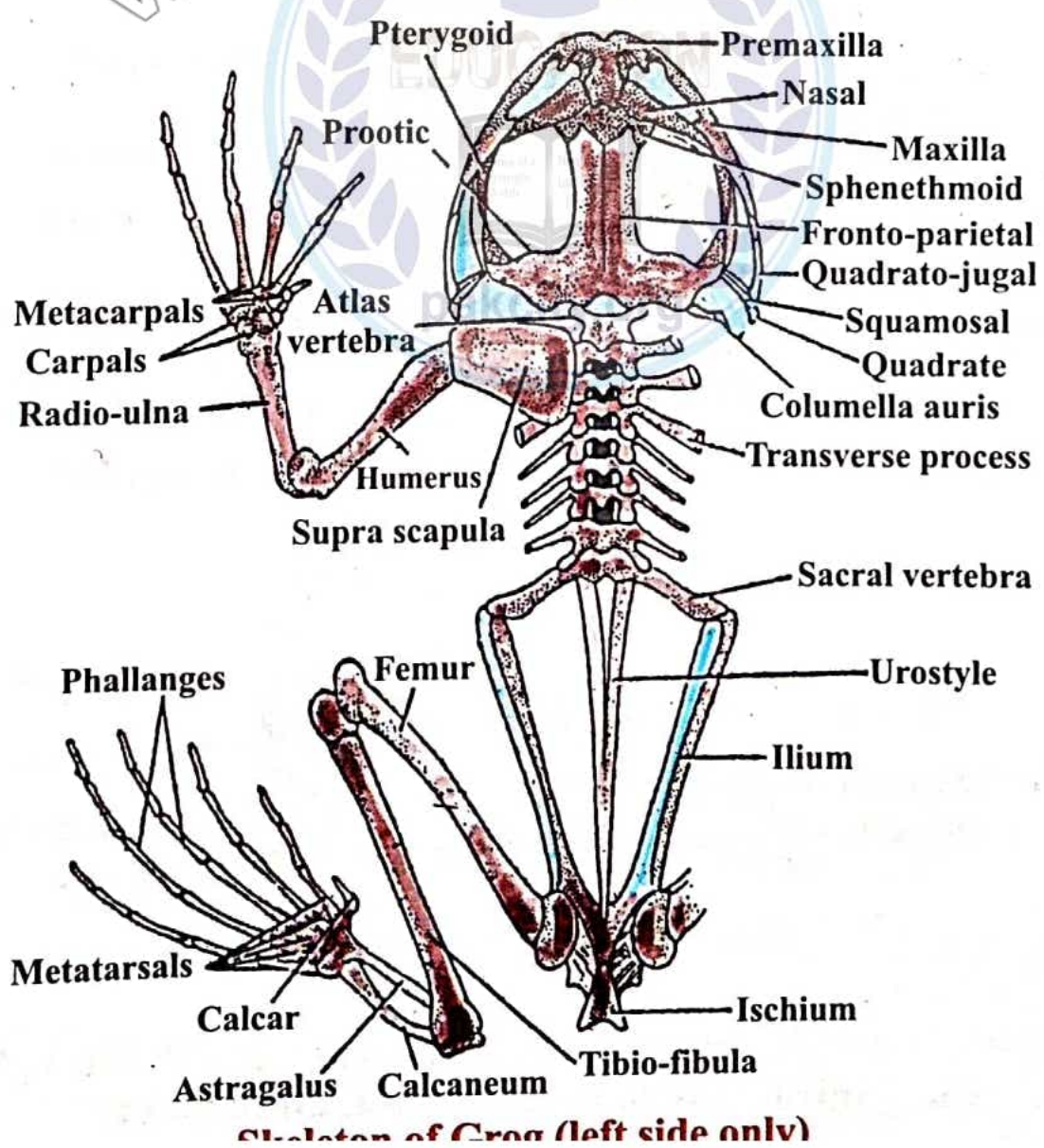
2- **an appendicular skeleton** consisting of limbs and girdles.

SKULL

The skull of frog consists of following parts:

i) Cranium ii) auditory capsules iii) Olfactory capsules

iv) Upper and Lower jaws v) Hyoid apparatus.



Skeleton of Frog (left side only)

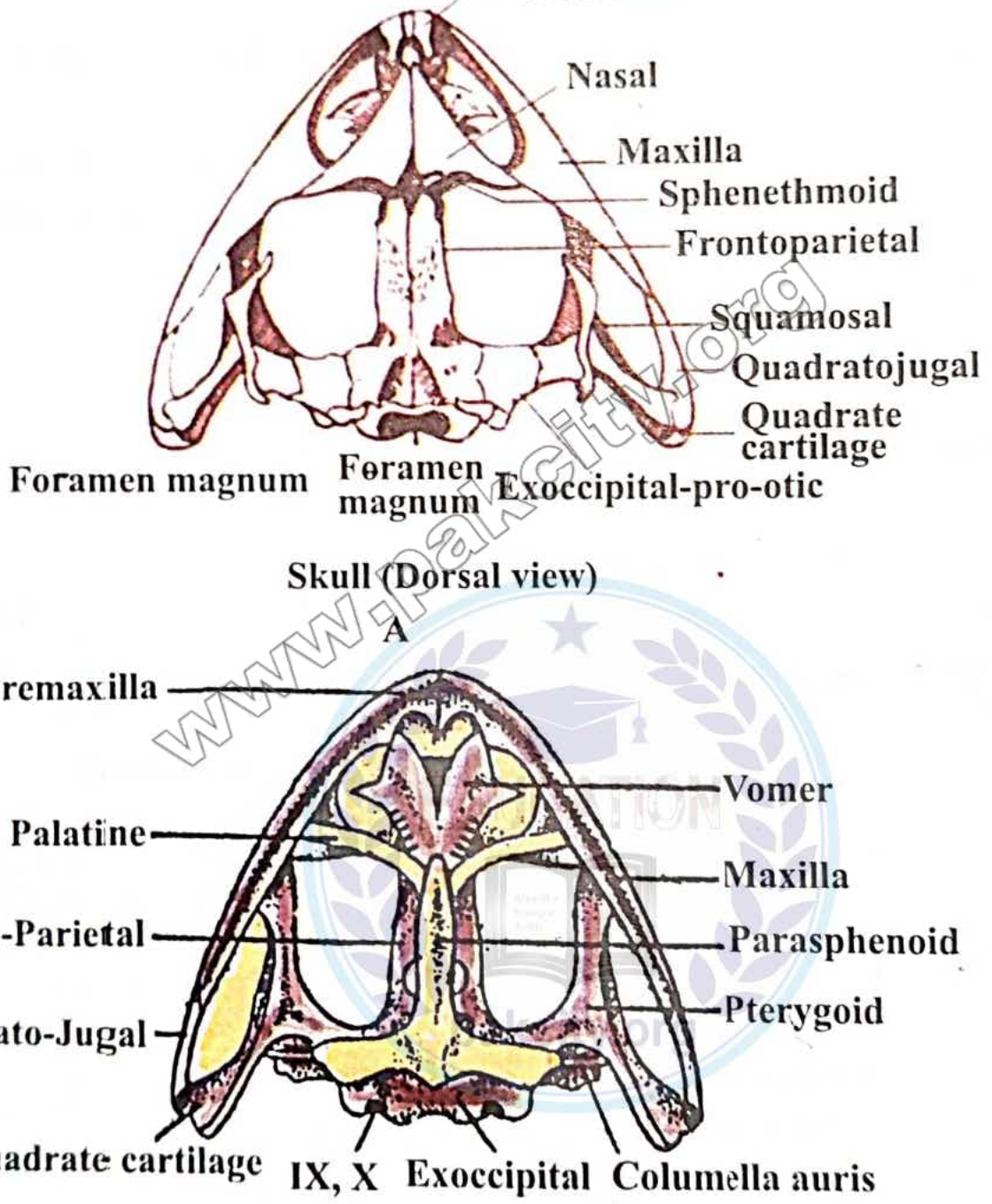
i) Cranium

The cranium (brain case) is an oblong middle portion of the skill and encloses the brain. It has an orbit on either side. The roof of the cranium is formed by two long gflat bones, the **fronto-parietals** which partially cover a tube like cartilage bone, the **sphenethmoid.** The sephenethmoid forms the anterior part of the cranium, but a small diamond shaped area of this bone is visible on the dorsal surface in front of the fronto-parentals.

Behind the fronto- parietals are the two **exoccipitals** which surround a large hole, the **foramen magnum** and form posterior part of cranium. The spinal cord passes through this **occipital condyles** which articulate with the first vertebra. The floor of the cranium is formed by a T-shaped bone, the **parasphenoid.**

ii) Auditory Capsules

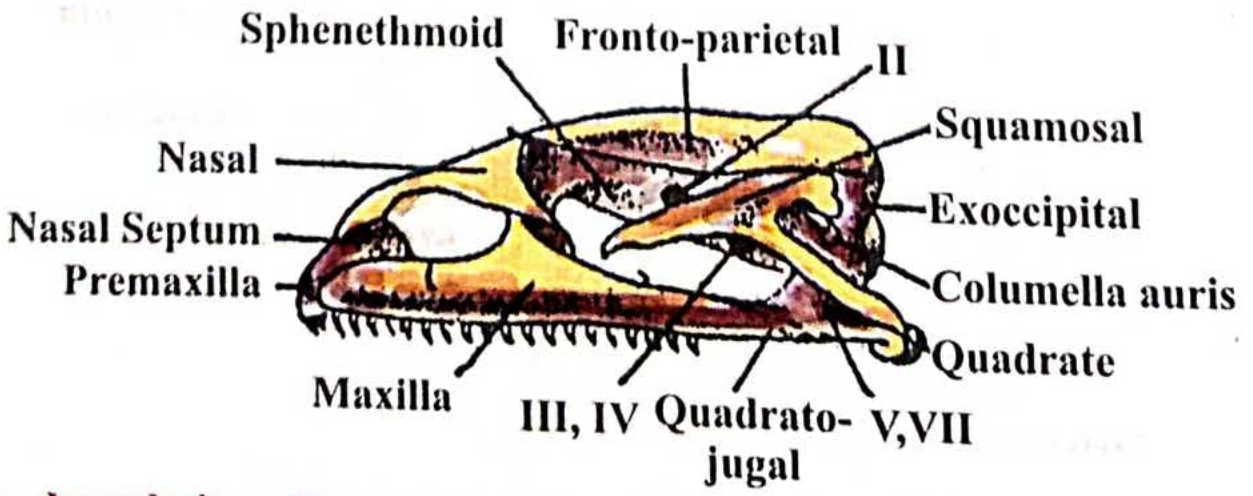
They enclose the auditory organs. They are cartilaginous and are fused with the sides of the posterior ends of the cranium. The anterior wall and surface of each capsule is formed of an irregular bond, the **pro-otic.**



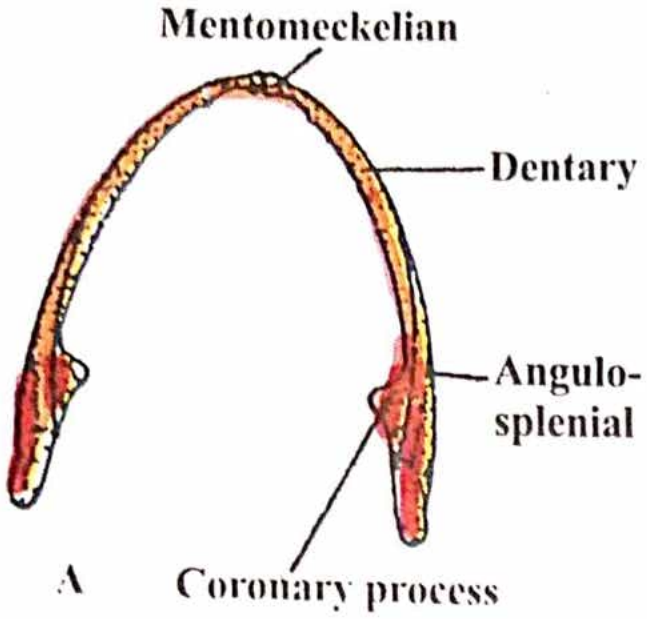
Skull (Dorsal view)

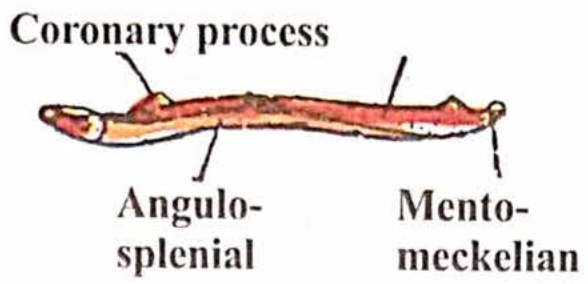
A

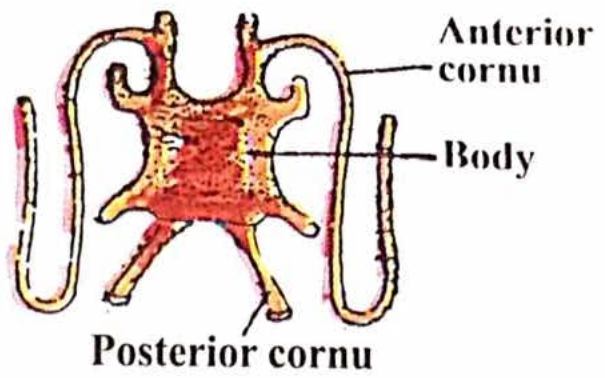
B



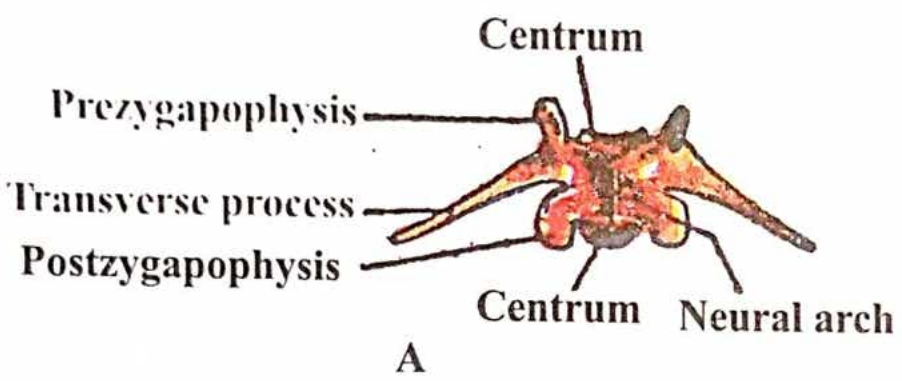
Skull of frog: A. dorsal view; B. ventral view; C. lateral view. II, III, V, VII, IX, X opening for the exit of second, third, fourth, fifth, seventh, ninth and tenth cranial nerves.

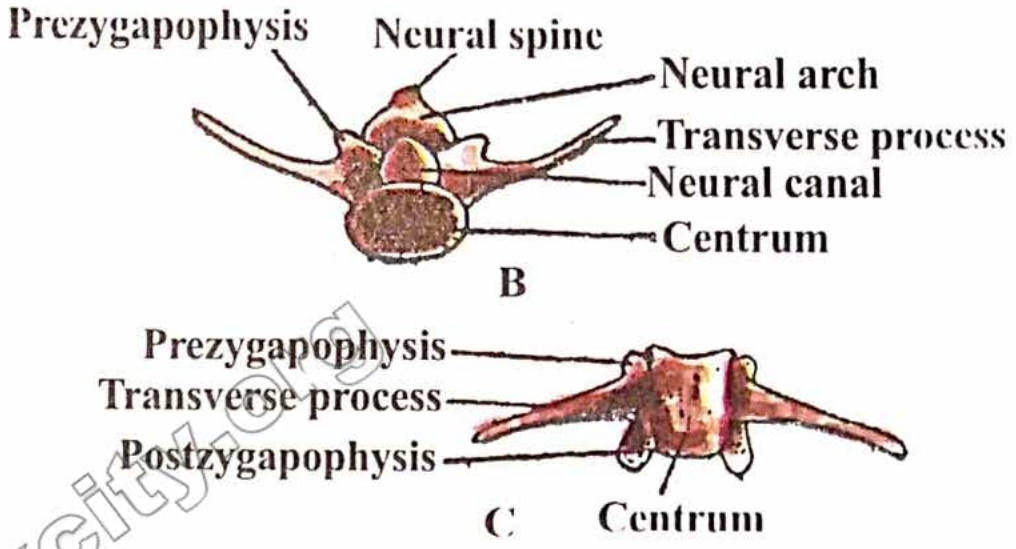




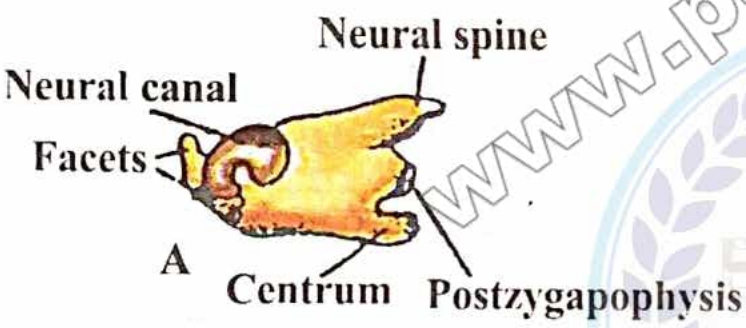


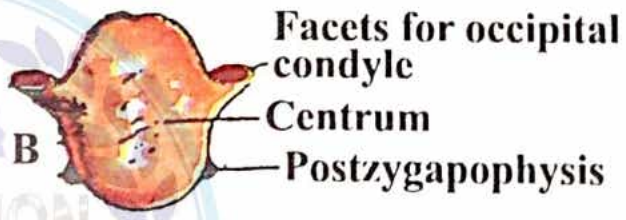
Lower jaw of the frog. A, dorsal view; B, right ramus seen from outside



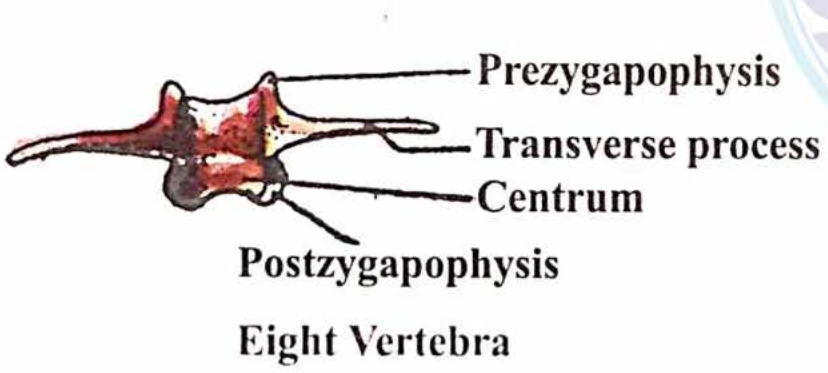


Typical (fifth) vertebra of frog. A, doral aspect, B, anterior aspect; C, ventral aspect.

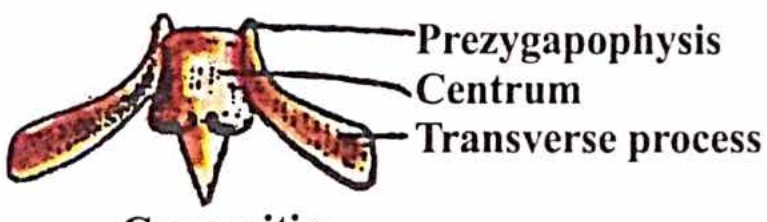




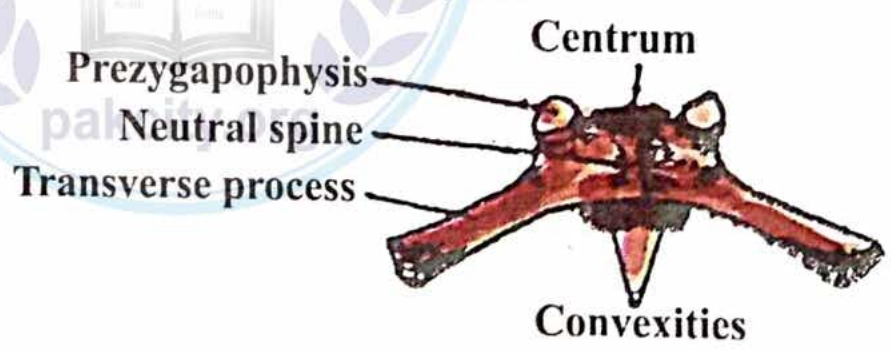
First Vertebra (atlas) of frog. A, antero-lateral view; B, ventral view.



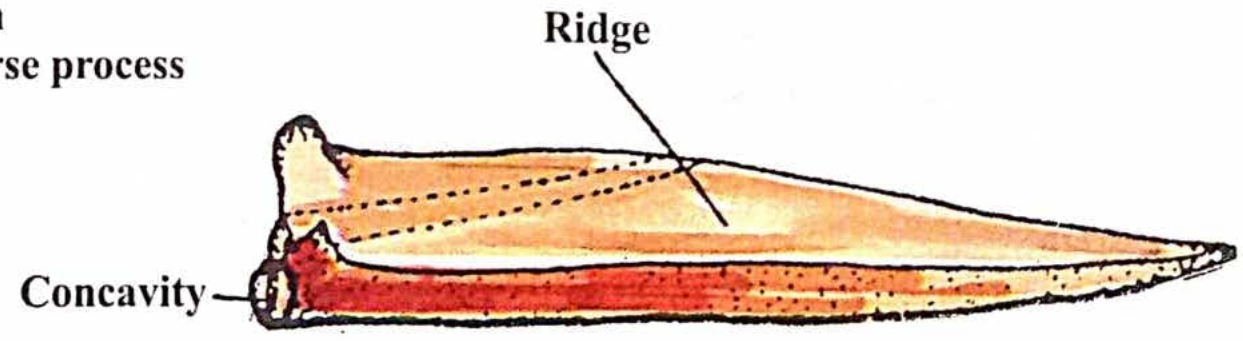
Eight Vertebra



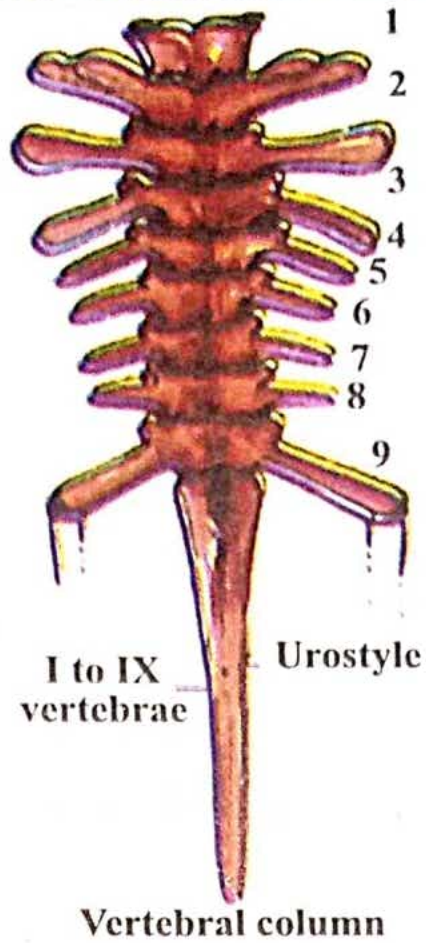
9th Vertebra
(ventral view)



9th Vertebra
(Dorsal view)



Urostyle of frog.



Vertebral column

Urostyle

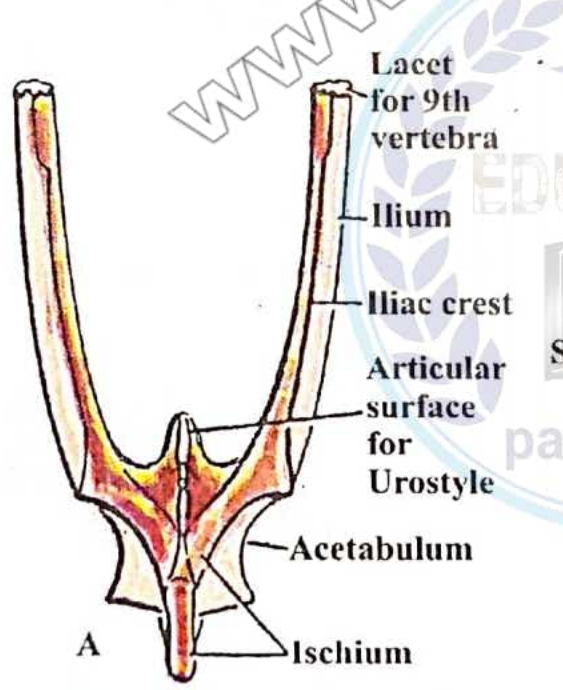
It is a long rod-like bone tapering from anterior to posterior end. It has two concavities at its anterior end which articulate with convexities of the 9th vertebra. A prominent ridge or blade is present at its dorsal surface which gradually diminishes posteriorly. Neural canal is present at the anterior end.

PECTORAL GIRDLE

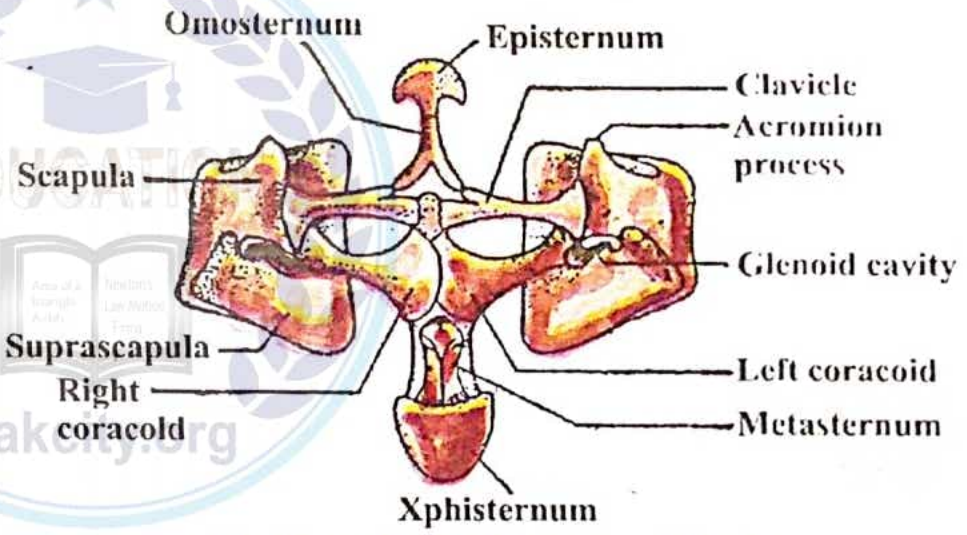
The pectoral girdle looks like an inverted arch consisting of two similar halves of bones and cartilage, and a central part called **sternum.** Each half is formed of a dorsal scapular region and a ventral coracoid region.

Scapular Region

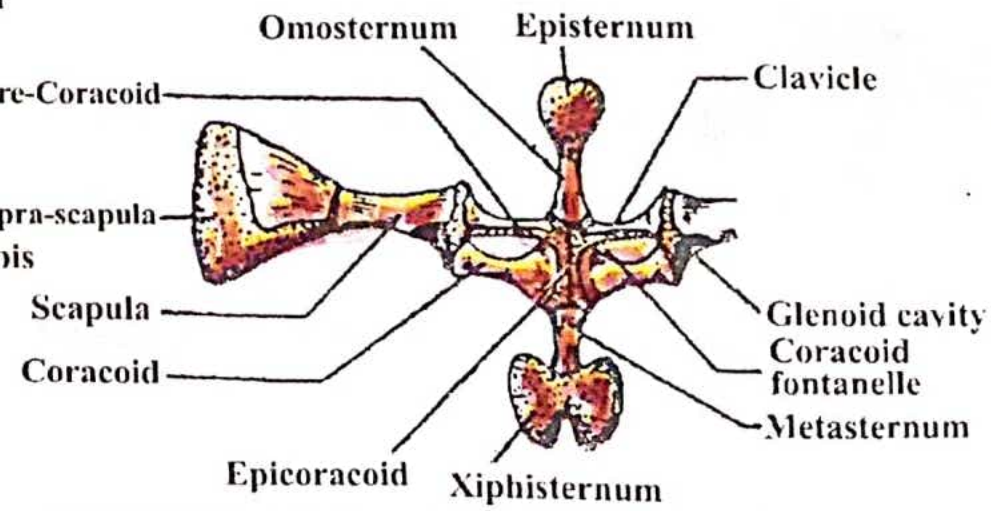
The scapular region consists of the scapula below and supra-scapula above. The scapula is a flat long plate which is broader at both ends and gives rise to a prominent forward process called **acromian process.** The supra-scapula is a flat plate of cartilage which overlaps the first four vertebra.



Frog. Pelvic gridle. A – Dorsal view.
B – One half (os innominatum) in lateral view.



Shoulder-gridle and sternum of the frog.



– Pectoral girdle and sternum of the frog with the right supr

Coracoid Region

The coracoid region is composed of **pre-coracoid** in front and **coracoid** behind. The precoracoid is a slender bar of cartilage which is covered antero-dorsally by a thin bone, the clavicle. The coracoid is a stout long rod expended at both ends. Two strips of cartilage, the epicoracoids lie between the ends of both the coracoids. The space between the coracoid and the clavicle is called **coracoid foremen** or **fontanelle.** The coracoid along with scapula form the **glenoid cavity** in each half, where head of the humerus (fore-limb) articulates.

Sternum

It is attached to the mid-ventral portion of the pectoral girdle. It is composed of two bony rods. The anterior rod consists of **episternum** and **omosternum** and runs forwards from clavicles. The episternum is round cartilage present at anterior and while omosternum lies below it and bifurcates at its posterior end. The posterior rod of sternum extendds backwards from the coracoids. It consists of **mesosternum** (metasternum) and **xiphisternum** or **xiphoid cartilage.** The mesosternum lies below coracoid while xiphisternum is expanded cartilaginous part lying posterior to mesosternum.

PELVIC GIRDLE

The pelvic girdle consists of two curved halves which are attached posteriorly in the form of an irregular disc of bone and cartilage but free anteriorly. Pelvic girdle gives V-shaped appearance. The disc has a cavity on each side which is called **acetabulum.** The head of femur (hind limb) fits into the acetabulum. The disc is composed of three bones: i) the **ilium,** ii) the **ischium** and iii) the **pubis.**

Ilium

The ilium forms the anterior and dorsal part of the disc and acetabulum and extends forwards as an elongated arm which has a prominent **iliac crest** on its dorsal side.

Ischium

The ischium is lying on the posterior part of the disc and also forms posterior part of acetabulum. Ilium and Ischium are bony parts.

Pubis

It forms the ventral part of the disc and rest of the acetabulum. It is carilaginous.

Above mentioned three bones are separate in young frog but in the adult the two ilia unite posteriorly while ischia and pubis of the two sides become completely fused together.

FORE-LIMB

The fore-limb (arm) can be divided into four parts:

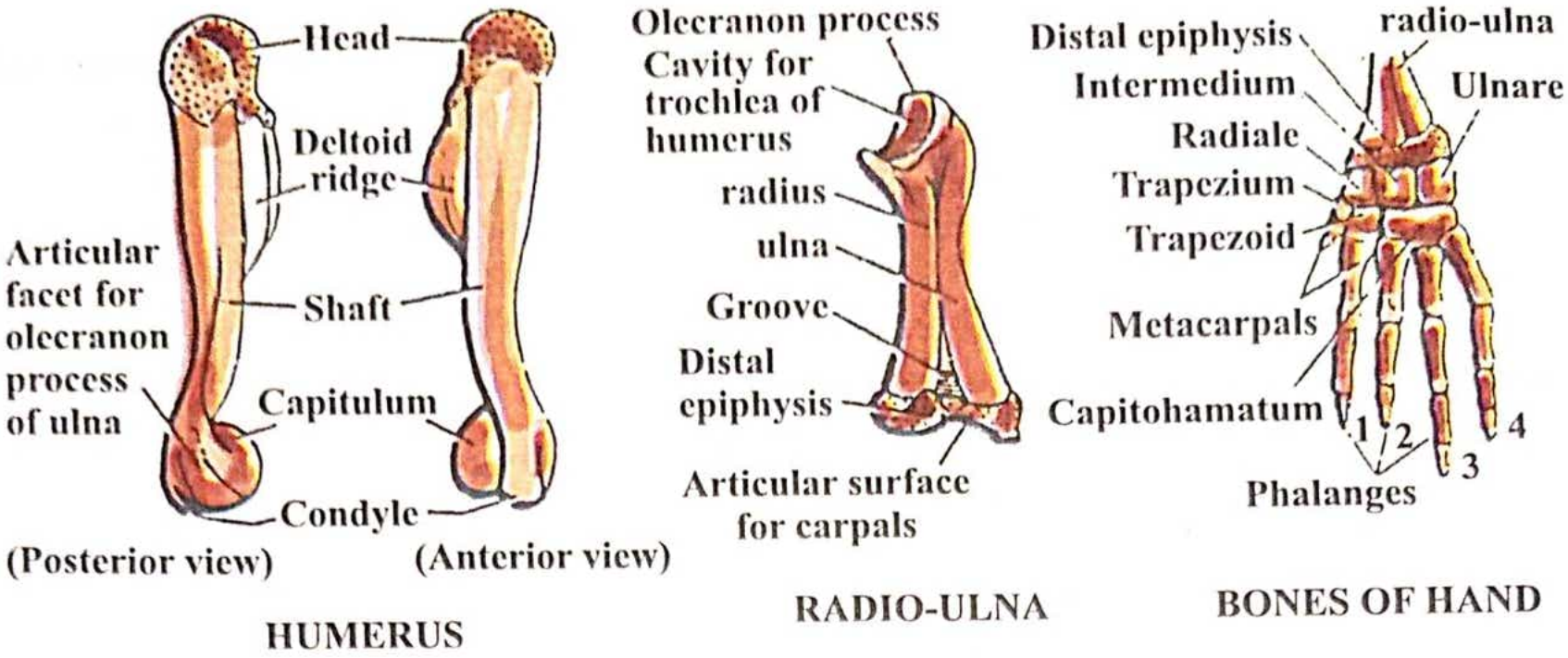
i) upper arm, ii) fore arm, iii) wrist, iv) hand.

i) Upper arm

The upper arm has a single long bone called humerus which has a rounded upper and called head. This head fits into the glenoid cavity of the pectoral girdle. A crest called **deltoid ridge** is present on the inner surface of the humerus, extending below the hand to middle of the bone. A rounded projection, the **trochlea,** with two lateral outgrowths is present at the lower end of the humerus.

ii) For-arm

The fore-arm ahs a single bone called radio-ulna formed by the fusion of radius and ulna. The proximal end of radio-ulna has a pit into which trochlea of the humerus articulates. The ulna forms a short process, the **olecranon process** or **elbow,** towards the outer edge of the pit.



Bones of the for-limb of the Frog

iii) Wrist or Carpus

The wrist or carpus is formed of six small irregular bones, the **Carpals,** arranged in two rows; three in each. The carpals of proximal row are named according to their location e.g., the carpal below the ulna is called **ulnare,** that below the radius is called **radiale** where as middle one is the **intermedium.** The carpals of the distal row are called distal carpals.

iv) Hand

The hand has tow parts i) palm or metacarpus and ii) Fingers (digits) having phalanges.

The palm or metacarpus consists of five rod like bones called **metacarpals** but first one is rudimentary. So there are four well developed fingers. The second and third fingers have two phalanges each while fourth and fifth have three each.

HIND LIMB

Teh hind-limb (leg) can be divided into four parts:-

i) thigh ii) shank iii) ankle iv) foot.

i) Thigh

The tigh has a single long slightly curved bone, the **femur,** which bears a rounded head at tits proximal end for articulation with acetabulum. Its distal end is laterally expanded and has articular surface.

ii) Shank

The shank possesses a single log bone, the **tibio-fibula** which is formed by the union of tibia and fibula. It is expanded at both ends and articulates anteriorly with femur and posteriorly with ankle bones.

iii) Ankle

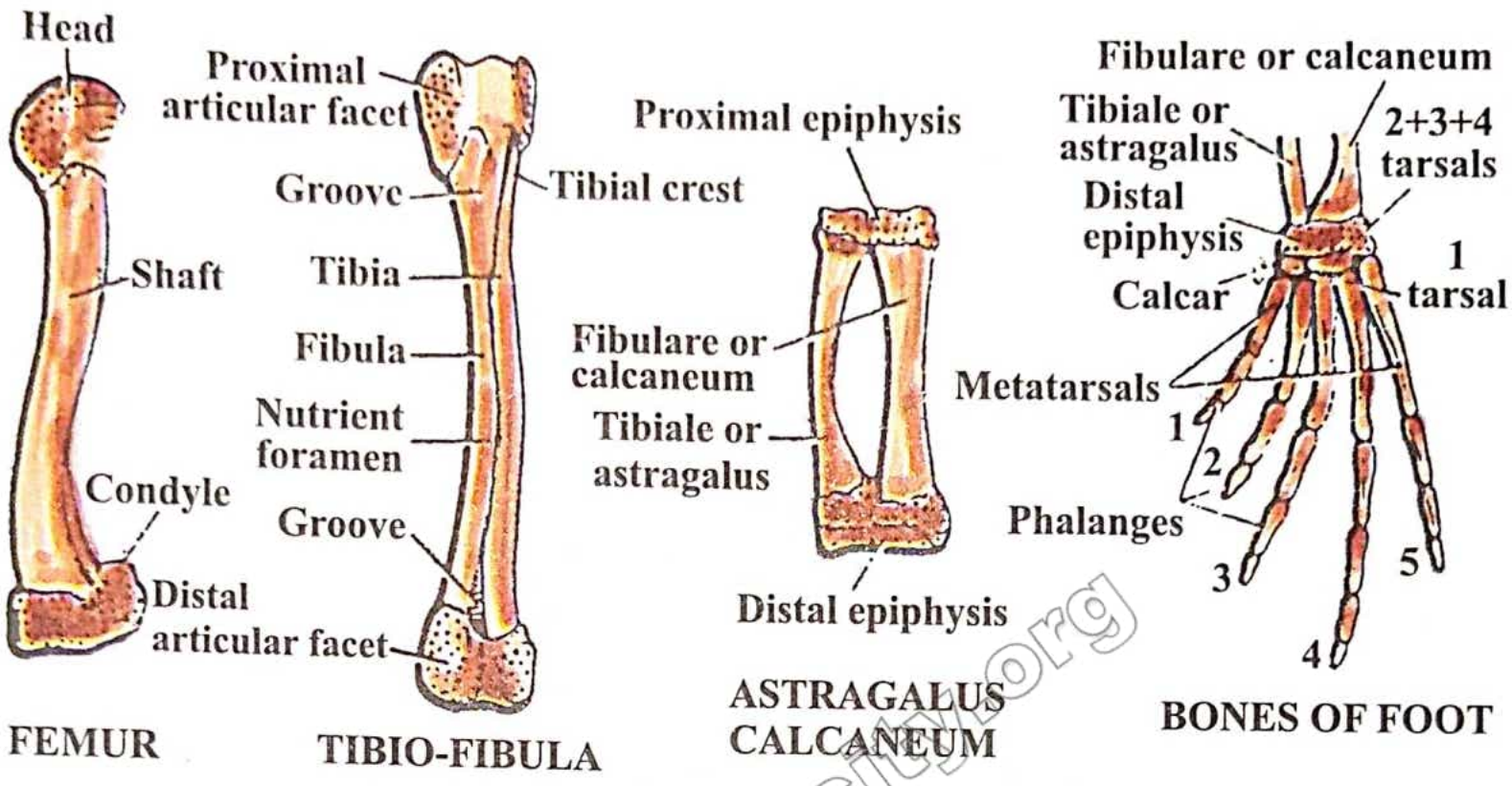
The ankle or tarsus is made up to two rows of bones called tarsals. There are two long tarsals in the proximal tow which are called **Astragulus** and **Calcaneum.** The astragalus is thin, curved and present on the inner side while calcaneum is thick, straight and present on the outer side. The distal row has two very small tarsals.

iv) Foot

The foot has two parts:

i) mid-foot (sole) or metatarsus ii) Digits or **toes**

The mid-foot consists of five long bones called metatarsals. There are five toes which are provided with varying number of phalanges. The first and second digits have two phalanges each, the third and fifth digits, three phalanges each, and fourth has four phalanges. A small claw like structure called **calcar** is attached to the inner side of the tarsus. The calcar is made up of two or three small bones.



Bones of the hind-limb of the Frog

VIVA EXAMINATION QUESTIONS

Q.1 *How many kinds of Skeleton are found in animals?*

Ans. *There are two kinds of skeleton viz. The exoskeleton and the endoskeleton. The former is outside the body where as the latter is found within the body.*

Q.2 *Differentiate between the axial and the appendicular skeletons.*

Ans. *The part of the skeleton such as the skull and the vertebral column (and ribs in mammals), which lies in the axis of the body is called as the axial skeleton whereas the one, like bones of limbs and girdles, which is present in the appendages is known as the appendicular skeleton.*

Q.3 *What is a vertebrate animal?*

Ans. *An animal possessing a vertebral column (backbone) is said to be a vertebrate.*

Q.4 *Write down the names and numbers of the bones of skull of frog which constitute the cranium (brainbox).*

Ans. *There are two fronto-parietals, one parasphenoid, one sphenethmoid and two ex-occipitals.*

Q.5 *Is the skelten of frog cartilaginous or bony?*

Ans. *The skeleton of frog is party cartilaginous and partly bony.*

Q.6 *What is foramen magnum in the skull?*

Ans. *The foramen magnum is a large hole at the posterior end of the cranium through which brain extends in the vertebral column as the spinal cord.*

Q.7 *What do you mean by skeleton?*

Ans. *All the hard parts of the body of an animal, both external and internal, are collectively known as the skeleton.*

Q.8 *What are auditory and olfactory capsules in the skull?*

Ans. *These are the spaces in the skull which lodge sense organs of sound and smell respectively.*

Q.9 *Name the bones which form olfactory capsules of frog.*

Ans. *These are nasals, sphenethmoid and vomers.*

Q.10 *What bones and cartilages form each half of the upper jaw of frog?*

Ans. *These bones are pre-maxilla, maxilla, quadrato-jugal, palatine, ptergoid and squamosal while the only cartilage is the quadrate.*

Q.11 *How many ribs are found in frog?*

Ans. *The frog lacks ribs.*

Q.12 *Which bones comprise each half of the lower jaw of frog?*

Ans. *These bones are mento-meckelian, dentary and angulo-splenial.*

Q.13 *What does vertebral column of frog consist of?*

Ans. *The vertebral column of frog consists of nine vertebrae and a long bony rod, the urostyle.*

Q.14 *What is the body of a vertebrae known as?*

Ans. *The body of a vertebrae is known as the centrum.*

Q.15 *Where does the head of femur articulate?*

Ans. *In the actabular cavity it-articalation in pelvic girdle.*

Q.16 *Where the head of Humerus articulate?*

Ans. *It articulates in the glenoid cavity of scapula.*

Q.17 *Distinguish between procoelous and amphicoelous centra.*

Ans. *The centrum which is concave at the anterior end but convex at the posterior is called procoelous whereas the one which is concave at both ends is known as amphicoelous.*

Q.18 *Where are pectoral and pelvic girdles found in the body of frog (or any other vertebrate)?*

Ans. *The pectoral girdle is found at the anterior end and the pelvic girdle at the posterior end of the trunk.*

Q.19 *Name the bones of the pelvic girdle of frog.*

Ans. *These are ilium, ischium and pubis.*

Q.20 *What are the functions of pectoral and pelvic girdles?*

Ans. *They provide support for the fore and hind limbs respectively.*

Q.21 *Name the thigh bone.*

Ans. *It is called femur.*

Q.22 *In which parts can the fore-limb of frog be distinguished?*

Ans. *The fore-limb of frog can be distinguished into the upper arm, fore-arm, wrist and hand.*

Q.23 *In which parts can the hind-limb of frog be distinguished?*

Ans. *The hind-limb of frog can be distinguished into thigh, shank, ankle and foot.*

Q.24 *What are the kinds of elbow, knee, shoulder and hip joints.*

Ans. *The elbow and knee and hinge joints allowing movements of bones only in two directions whereas shoulder are hip are ball and socket joints allowing movement in all directions.*

Q.25 *What is the first vertebrae of frog known as? How does it differ from the typical vertebrae?*

Ans. *The first vertebra of frog is known as the atlas. It differs from the typical vertebra in the following respects:*

(i) Its centrum is smaller.

(ii) It lacks transverse processes and the prezygapophyses.

(iii) It has two oval concavities at its anterior end into which fit occipital condyles of the skull.

Q.26 *Which vertebrae of frog are atypical?*

Ans. *These are the first, eighth and ninth vertebrae.*

Q.27 *What is the function of the pre-and postzygapophyses of the vertebrae in frog?*

Ans. *The pre and postzygapophyses serve to articulate the vertebrae together.*

Q.28 *Why does the first vertebrae (atlas) lack prezygapophyses?*

Ans. *It is because there is no vertebra ahead of the first with which it may articulate.*

Q.29 *How does the 9th (sacral) vertebrae of frog differ from the typical one?*

Ans. *The 9th vertebrae differs from the typical one in the following respects:*

(i) Its centrum is convex at the anterior end and bears two convexities at the posterior end.

(ii) Its transverse processes are stout and are directed obliquely backwards.

(iii) It lacks postzygapophyses.

Q.30 *Name the bones of wrist, ankle and fingers (or toes).*

Ans. *These bones are respectively called as the carpals, tarsals and phalanges.*

Q.31 *How do the thumb and the great toe of frog look like?*

Ans. *Frog does not have the thumb and the great toe.*

Q.32 *What does proximal and distal end of a bone mean?*

Ans. *The end of the bone which is closer to the central axis of the body is called proximal end while the other distant one is termed as the distal end.*

Q.33 *What are the other names for palm and sole?*

Ans. *These are metacarpus and metatarsus.*

5 Experiment

STUDY OF SKELETAL, SMOOTH AND CARDIAC MUSCLES FROM PREPARED SLIDE AND PREPARATION OF SLIDE OF STRIATED MUSCLES OF COCKROACH

MATERIAL

Compound microscope; Dissection box; Watch glass; Slide; Cover slip; Dropper; Leg of cockroach.

(Fresh or preserved); Prepared and stained slides of skeletal; smooth and cardiac muscles of a vertebrate

Camel hair brush; Filter paper; Glycerine.

PROCEDURE

Examine the prepared and stained slide of the skeletal (striped) muscle fibers under The low and high powers of the microscope.

STUDY OF MUSCLES

PART I

STUDY OF PREPARED SLIDES OF SKELETAL, SMOOTH AND CARDIAC MUSCLES

MATERIAL

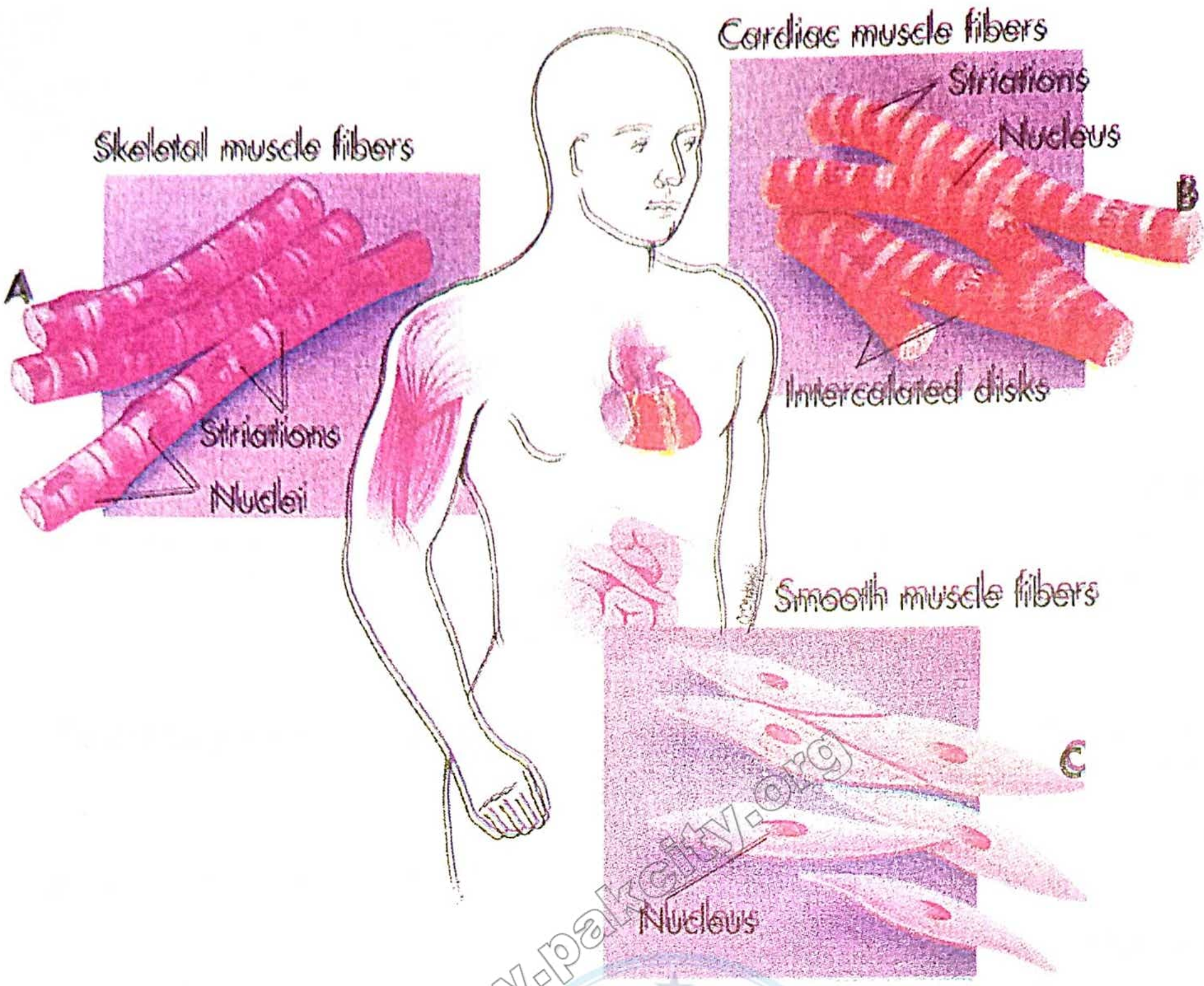
Prepared slides of skeletal, smooth and cardiac muscles of frog and skeletal muscle of cockroach.

PROCEDURE

Observe under the microscope prepared slides of skeletal, smooth and cardiac muscles of frog.

Also observe the prepared slide of skeletal muscle of cockroach.

Property	Smooth	Cardiac	Skeletal
(1) Muscle appearance	Un-striped	Irregular stripes	Regular stripes
(2) Cell shape	Spindle	Branched	Elongated cylindrical,
(3) Number of nuclei	One per cell	One per cell	Many per cell
(4) Speed of contraction	Slow	Intermediate	Slow to rapid
(5) Contraction caused by	Spontaneous, stretch, nervous system, hormones	Spontaneous	Nervous system
(6) Function	Controls movement of substances through hollow organs	Pumps blood	Moves the skeleton
(7) Voluntary control	Usually no	Usually no	Yes



POINTS OF IDENTIFICATION:

Skeletal muscle

(1) Skeletal muscle fiber is elongated, unbranched, cylindrical cell.

(2) Multi-nucleated.

Smooth muscle

(1) The fiber is sipindle-shaped cell i.e. thick in middle and gradually tapering towards the ends.

(2) Uni-nucleated.

Cardiac muscle

(1) Muscle fiber is short, branched, placed end to end with intercalated disc.

(2) Uni-nucleated.

6 Experiment

PREPARATION OF SLIDE OF STRIATED MUSCLES OF COCKROACH

MATERIAL

Muscles of legs of cockroach, compound microscope, Dissection box, slide, cover slips, watch glasses, Dropper, 0.75% NaCl, Acetic acid, glycerine.

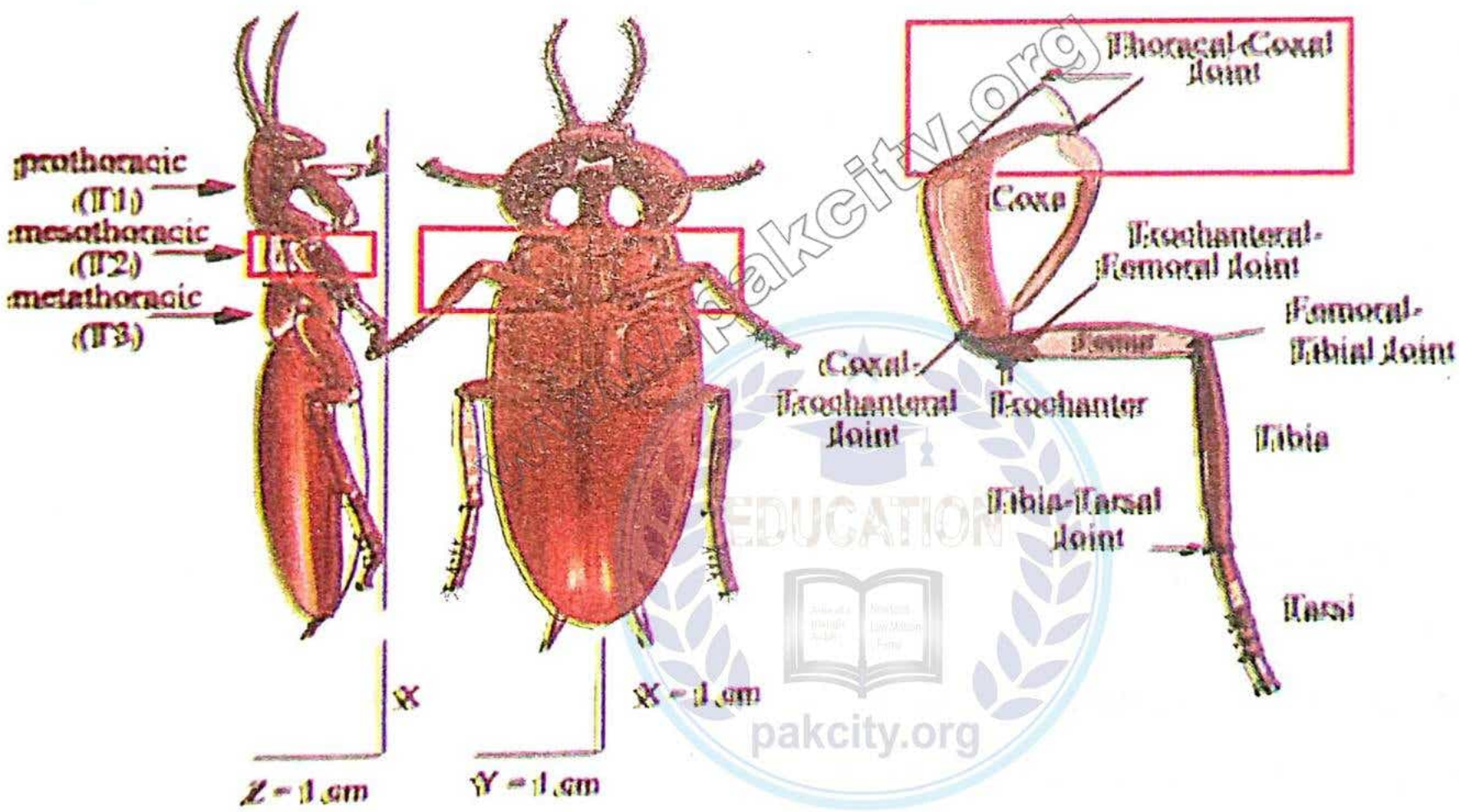
PROCEDURE

TEASING:

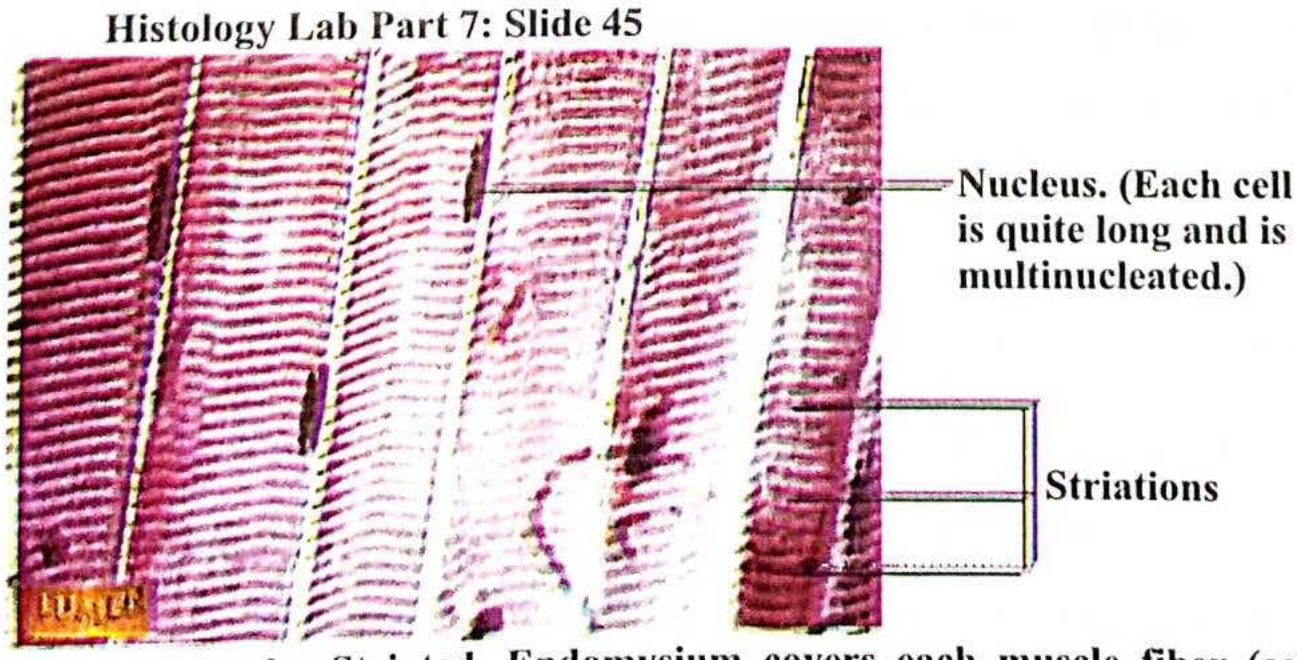
Take a small piece of the muscles of leg of cockroach in a watch glass having saline water. If the muscles are kept in Ranvier's alcohol (2 part of water + 1 part of methylated spirit) for twenty four hours, the fibers can be teased or separated easily. Tease the muscles length wise with a pair of dissecting needles so that fibers can be separated. (0.75% NaCl solution makes the striation and sarcolemma clear).

MOUNTING

Take a drop of glycerine on a clean glass slide. Transfer one or two muscle fibers from the watch glass to glycerine drop, with a camel-hair brush. Cover the slide with a cover slip. Remove extra glycerine with blotting paper or filter paper. Add a few drops Of 1% acetic acid to make nuclei more prominent.



Histology Lab Part 7: Slide 45



Skeletal Muscle: Striated. Endomysium covers each muscle fiber (cell). Perimysium covers bundles of fibers and Epimysium is a connective sheath that surrounds an entire muscle.

OBSERVATIONS:

(1) The leg muscles of cockroach are striated muscles.

(2) The fibers lie parallel to one another.

(3) They are unbranched.

(4) Each fiber is enclosed in sarcolemma membrane.

(5) Multi nucleated.

(6) Transverse light and dark bands are wider in cockroach as compared To vertebrates.

VIVA VOCE

Q.1 *How do unstriped and striped muscles of vertebrates differ in shape?*

Ans. *The unstriped muscles are spindle-shaped while the striped muscles are cylindrical in shape.*

Q.2 *What is meant by the term "contractile"?*

Ans. *It means "which can contract and relax".*

Q.3 *How do the striped muscles of frog and cockroach differ?*

Ans. *The transverse bands of striped muscles fibres of frog are narrower while those of cockroach are wider.*

Q.4 *What is the difference in the structures of striped and cardiac muscles?*

Ans. *The cardiac muscles unlike the striped muscles, are uninucleate, without sarcolemma and form a network.*

Q.5 *What do you mean by voluntary and involuntary muscles? Quote their examples.*

Ans. *Those muscles whose contraction and relaxation is under the control of the will of the animal are called voluntary e.g., striped muscles. On the other hand, the muscles whose contraction is not under the control of the will of the animal are known as involuntary e.g. smooth and cardiac muscles.*

Q.6 *Define muscle.*

Ans. *Muscle is a tissue consisting of cells which are highly contractile.*

Q.7 *Why are the striped muscles of the vertebrates also called skeletal muscles?*

Ans. *The striped muscles of the vertebrates are also called skeletal muscles because they are attached to the skeleton and are associated with the movement of the bones.*

Q.8 *What are the special names given to the cell membrane and cytoplasm of the striped muscle cells?*

Ans. *These are sarcolemma and sarcoplasm respectively.*

Q.9 *Where are the smooth muscles found in the body of the vertebrates?*

Ans. *They are found in the walls of blood vessels, urinary bladder and digestive tract.*

Q.10 *Which muscle cells lack sarcolemma?*

Ans. *Smooth and cardiac muscle cells lack sarcolemma.*

7A Experiment

STUDY OF SIMPLE MUSCLE TWITCH USING FROG'S MUSCLE

MUSLCE TWITCH

The response of the muscle with respect to a stimulus is known as muscle twitch.

Muscle cells differ only in degree of response to a stimulus. Cells that are specialized to perform other function may respond to the same forms of stimulation as muscle cells but in a different way.

A nerve cell (neuron) will transmit an impulse in response to an adequate stimulus.

If nerve is physiologically connected with an excitable muscle, the muscle will contract on receiving that stimulus.

PROCEDURE

Muscle twitch can be studied by

(1) Applying Electrical stimululation.

MATERIAL

(i) Frog *(ii) Chloroform* *(iii) Battery 6 volt*

(iv) Two pieces of insulated wires each about 50 cm long *(v) Ringer's solution*

(vi) Methylene blue *(vii) Dissecting box*

METHOD

Muscle Nerve preparation / Preparation of Gastroenemius (calf) muscle of frog.

(1) Place freshly pithed or chloroformed frog on a dissecting board.

(2) Remove the skin from the leg. This can be done easily if the skin is cut completely around the thigh of the frog leg. The entire skin of leg can then be pulled off in the same way that you would strip a glove from your hand.

(3) Place the frog dorsal side up on moist filter paper.

(4) Keep the frog moist with physiological saline.

(5) Search the large calf muscle (Gastrocnemius muscle) of lower leg.

(6) Run a blunt probe or the end of a forceps, between gastrocnemius muscle and the long bone of leg.

(7) Notice the well marked groove running along the upper leg. This grove marks the location of the sciatic nerve. This nerve innervates the gastrocnemius muscle.

(8) Separate the muscles on either side of groove using a pair of forceps.

(9) Expose the faintly yellowish sciatic nerve and reddish blood vessels.

(10) Without touching or pulling the nerve, pull the muscles aside so that the nerve is exposed from a point near the knee up to the hip.

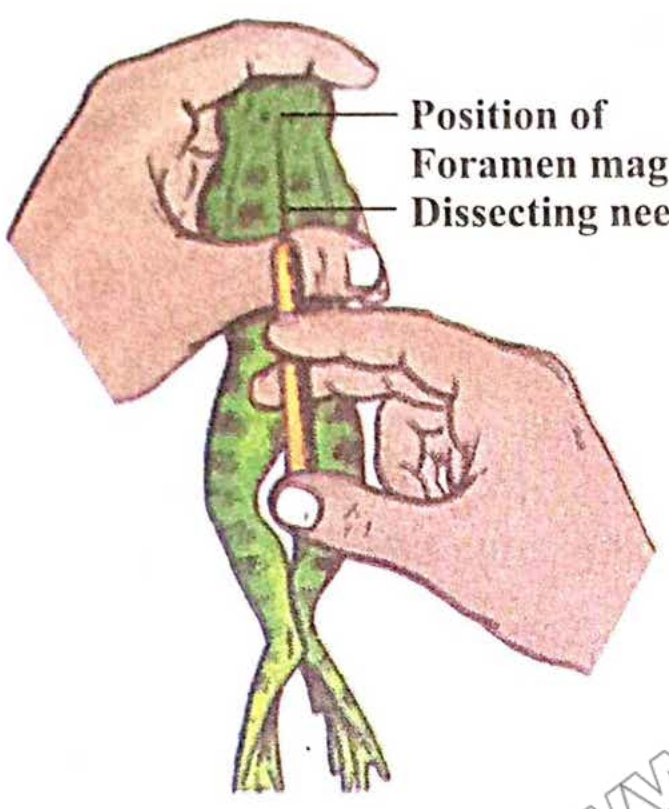
(11) Using forceps, grasp the hip end of the nerve, and cutting across the nerve on the hip side of the forceps, gradually free the nerve down to a point near the knee joint.

(12) Lay the free nerve on top of lower leg.

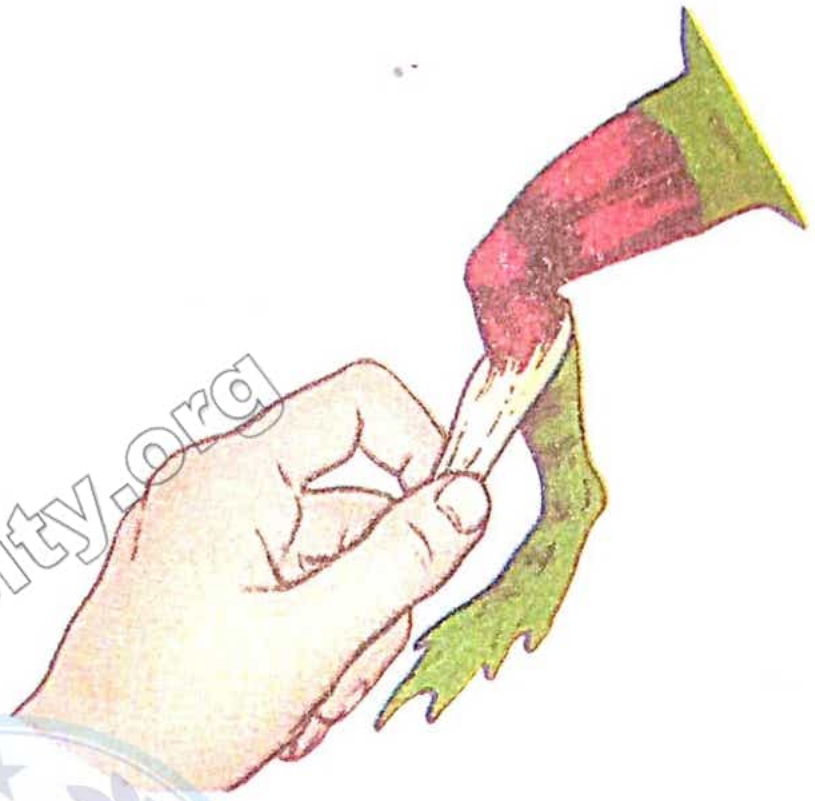
(13) Using scissors, cut through the middle of the upper leg. Cut through everything, including bone and muscle, but be sure that the nerve is laid back so that you do not cut through it.

(14) Separate the tendon at lower end of the gastrocnemius muscle where it is attached to the foot.

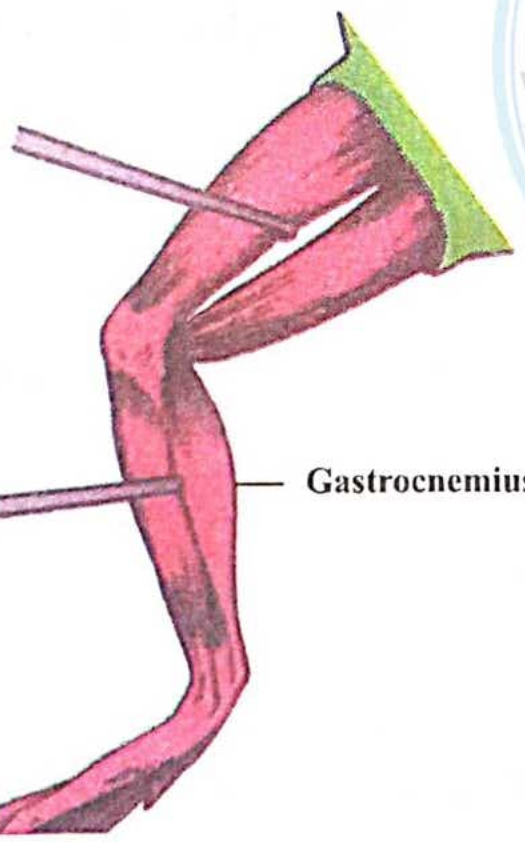
(15) Cut the lower leg bone near the knee.



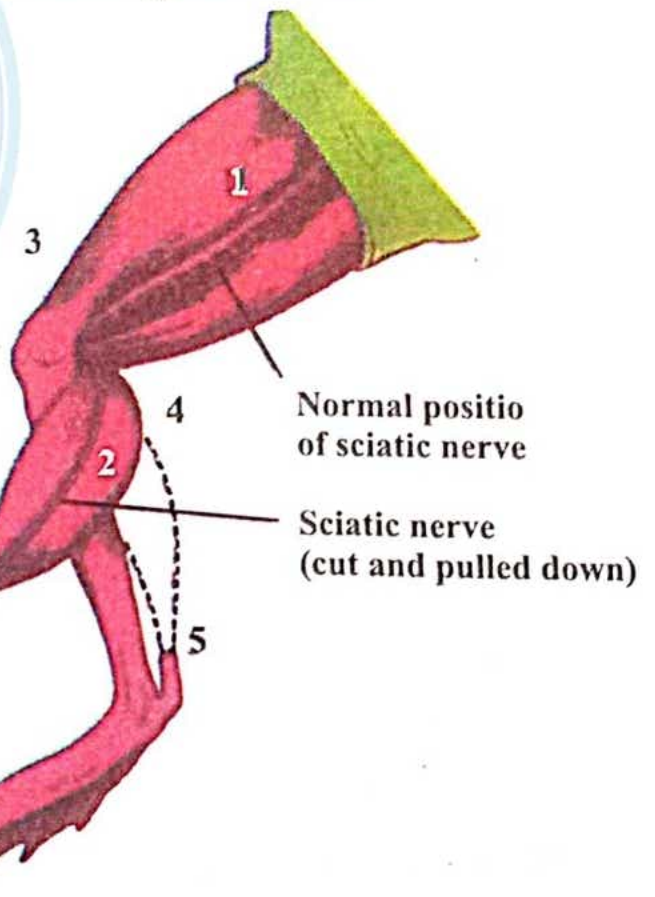
A. Pith the frog



B. Cut skin completely around the upper part of the leg. Then pull the skin off over the toes.



C. Care fully separate the gastrcnemius muscle from the adjacent muscles by running a probe between them. Separate the muscles of the upper leg in the same



D. Cut the nerve at (1) and pull it down over the lower leg at (2). Cut the upper leg through (3)-(4) and then cut the gastrocnemius muscle (5)-(6) This is your muscle-nerve preparation.

7B Experiment

NOW MUSCLE NERVE PREPARATION IS READY TO USE. PLACE IT ON FILTER PAPER MOISTENED WITH PHYSIOLOGICAL SALINE OR RINGER'S SOLUTION

Study of muscle twitch by electrical stimulation

(i) *Fill a large petridish with Ringer's solution.*

(ii) *Add to it several drops of methylene blue solution. Methylene blue acts as an indicator. In oxidized form it is blue, as it gets reduced it will decolorize.*

(iii) *Attach an electrode (wire) to each end of the muscle.*

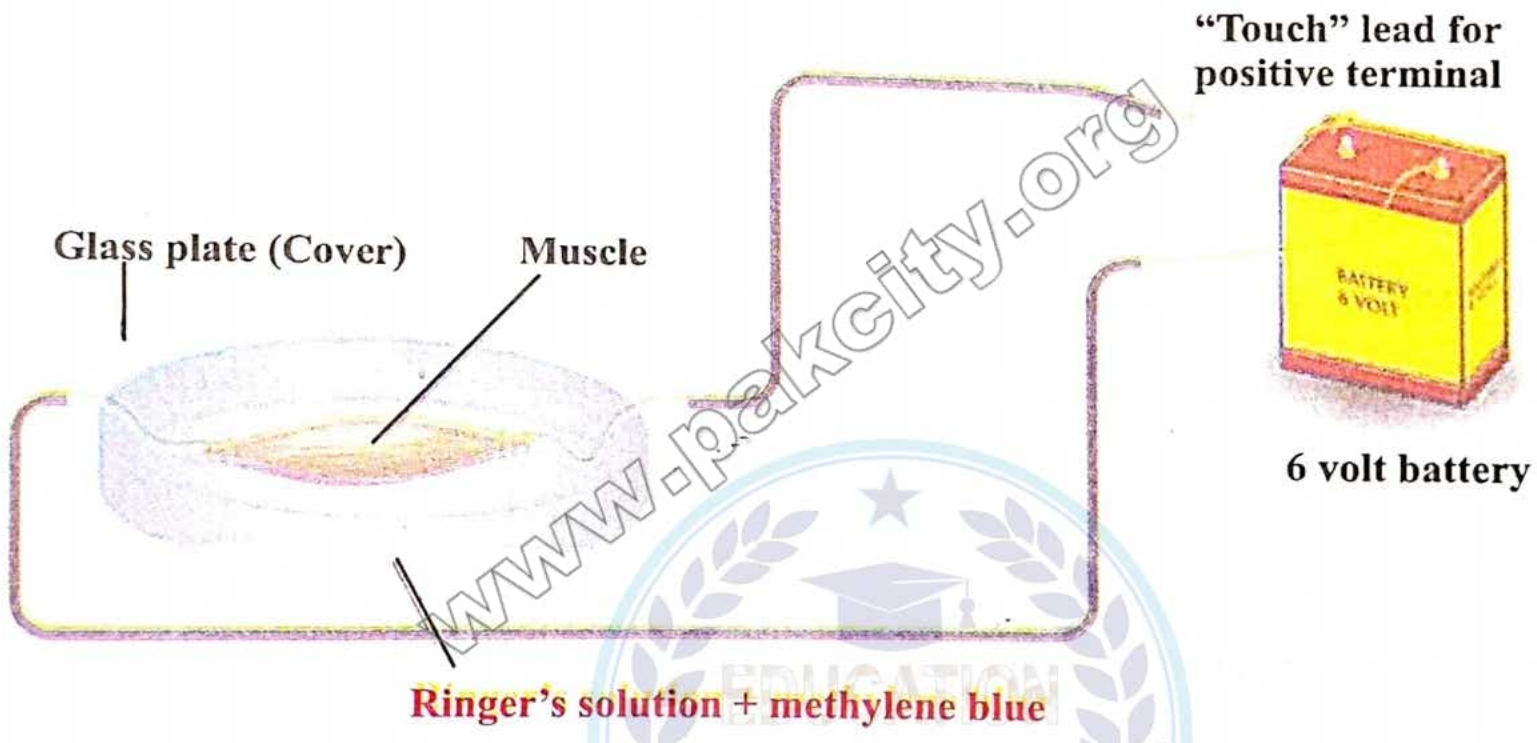
(iv) *Now place this muscle in the petridish.*

(v) *Cover the petridish with other petridish or a glass plate and air tight the setup by using Vaseline.*

(vi) *Connect one wire to negative terminal of 6 volt battery.*

(vii) *Repeatedly touch and remove other wire from the positive terminal of 6 volt battery.*

(viii) *Observe the twitch of muscle.*



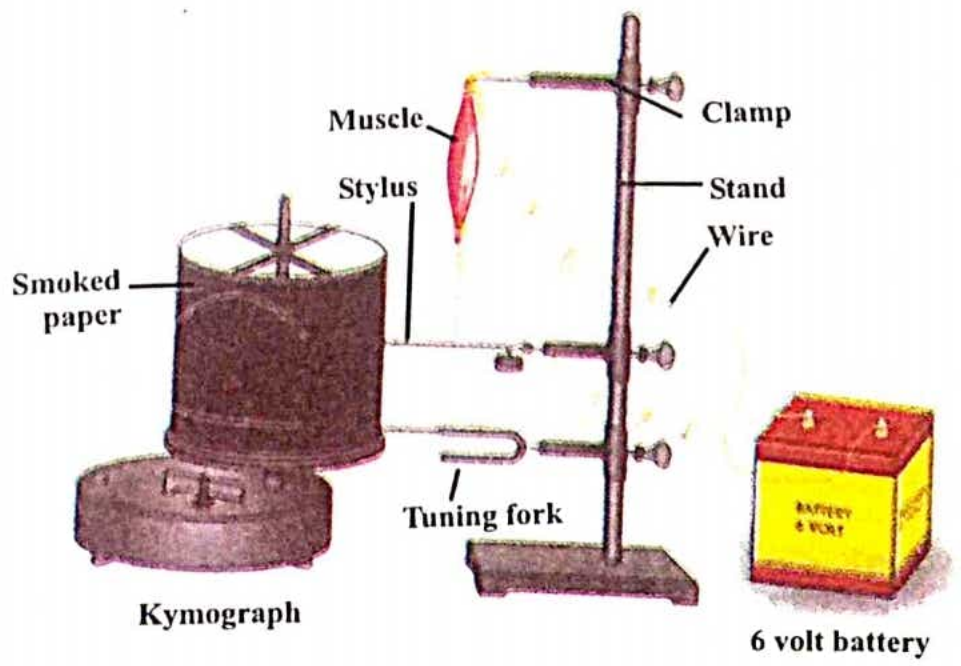
Activity II

MATERIAL

(i) *Vasline* *(ii)* *6 Volt battery* *(iii)* *Methylene blue*

(iv) *Gastrocenemius muscle* *(v)* *Ringer's solution for frog* *(vi)* *Connecting wires*

(vii) *Petridesh*



VIVA VOCE

Q.1 *What is muscle twitch?*

Ans. *The response of the muscle with respect to a stimulus (electric shock) is called muscle twitch.*

Q.2 *What is a gastrocnemius muscle.*

Ans. *The large two-headed muscle of the calf, associated with the tibia bone is called gastrocenemius muscle. It is also called calf muscle.*

Q.3 *What is the nature of the gastrocenemius muscle, voluntary or involuntary?*

Ans. *Gastrocenemius muscle is voluntary in nature.*

Q.4 *Does the gastrocenemius muscle of frog remain alive after its removal from the body?*

Ans. *After its removal from the body, the gastrocnemius muscle of the frog can remain alive for hours, if it is kept moist.*

Q.5 *What is a kymograph?*

Ans. *Kymograph is an apparatus used for recording muscle contraction. It can also be used for recording heart beat of an animal because the wall of the heart is made up of cardiac muscles.*

Q.6 *What is the duration of a single muscle twitch?*

Ans. *A single muscle twitch lasts for only 0.1 second.*

Q.7 *Name the three phases comprising a single twitch of the muscle?*

Ans. *These phases are the latent period, contraction period and the relaxation period.*

Q.8 *What is the duration of latent period of a muscle twitch?*

Ans. *It is less than 0.005 second (actually varying between 0.0025 and 0.004 second).*

Q.9 *Write down the durations of contraction and relaxation phases of a muscle twitch.*

Ans. *These are 0.045 second and 0.05 second respectively.*

Q.10 *What is the effect of repeated stimulation on the muscle contraction?*

Ans. *Muscle fatigue is caused after about fifteen rapid stimuli and consequently the Contraction decreases with further stimuli.*

Co-ordination and Control

8 Experiment

INVESTIGATION OF NERVOUS SYSTEM OF COCKROACH

MATERIAL

Living cockroach; Chloroform; Dissecting box; Hand lens, Dissecting dish; Pins.

PROCEDURE

Cockroach can be made available for dissection / investigation by:

(1) Killing by dipping in chloroform. *(2) Killing by dipping in foam.*

(1) Take a dissecting dish having a thick layer of wax fixed at its bottom.

(2) Partially melt a little of the wax in the center of the dish by plying a Bunsen flame, on the surface.

(3) Place the blank paper on the upper surface of tray and fix it through pin.

(4) Place the dorsal side of insect upward on the paper.

(5) The cockroach may be fixed with small pins, one through the femur (first part) of each leg, one through the posterior end and one through the straightened head.

(6) Pour water into the dish. Remove the wings.

(7) Then carefully remove first the abdominal and then the thoracic terga, one at a time,working forwards by lifting with forceps and cutting around the edge with small scissors.

(8) Remove the fat bodies with the help of forceps and by blowing off with the blow pipe.

(9) Deflect and pin the alimentary canal on one side so as to observe the underlying Nervous system.

(10) Now gently and carefully scratch away the chitinous covering of the head, between the compound eyes, with fine foceps and sharp scalpel so as to expose the part of the nervous system lying in this region. Study with hand lens.

Observations:

(1) The nervous system of cockroach consists of following parts:

- *(a) Bilobed supra oesophageal ganglion (brain)*
- *(b) Bilobed sub oesophageal ganglion.*
- *(c) Pair of circum oesophageal connectives.*
- *(d) Double ventral nerve cord.*

(2) Brain is a bilobed mass present above the oesophagus in the head reion. It is also called supra-oesophageal ganglion or cerebral ganglion. It receives nerves from the eys and antennae.

(3) A bilobed sub-oesophageal ganlion is present below the oesophagus in the head Region.

(4) *A pair of short cords, the circum-oesophageal connectives arise from brain and form a ring around the oesophagus. They unite below in a double suboesophageal ganglion.*

(5) *A double ventral nerve cord arises from the suboesophageal ganglion. It runs posteriorly below alimentary canal along mid-ventral line of the thorax and abdomen.*

(6) *The nerve cord gives off nine ganglia, three in the thoracic segments and six in the abdominal segments.*

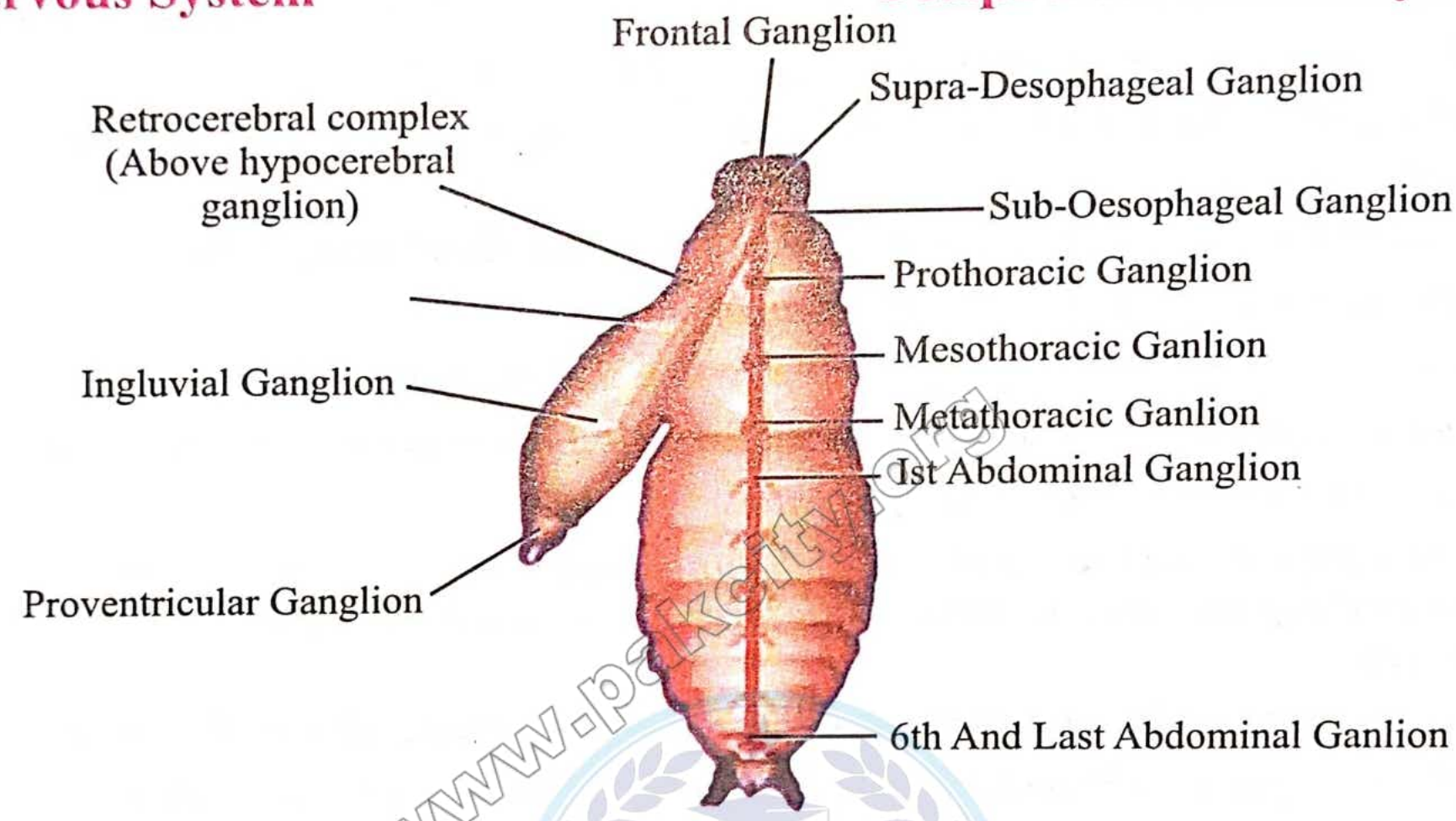
(7) *The thoracic ganglia are called prothoracic, mesothoracic and metathoracic ganglia respectively.*

(8) *The sixth abdominal ganglion is larger.*

(9) *The ganglia give off nerves to the structures of their own segments.*

Nervous System

Peripheral Nervous System



VIVA VOCE

Q.1 *Write down the scientific (biological) names of the two species of cockroach.*

Ans. *The scientific names of the species of cockroach are Periplaneta orientalis and Periplaneta americana.*

Q.2 *To which phylum and class does cockroach belong?*

Ans. *Cockroach belongs to phylum Arthropoda and class Insecta.*

Q.3 *What is a ganglion?*

Ans. *Ganglion is a collection of nerve cell bodies (neurons), usually bounded by a sheath or capsule.*

Q.4 *Does cockroach possess a brain? If so, what is it known as?*

Ans. *The cockroach possesses a brain which is known as the supra-oesophageal ganglion or cerebral ganglion.*

Q.5 *What is nerve ring in cockroach? Which structures contribute to its formation?*

Ans. *A ring of nervous tissue surrounding the anterior end of the oesophagus in the head of cockroach is called nerve ring. It is formed by a supra-oesophageal ganglion, two circum-oesophageal connectives and a sub-oesophageal ganglion.*

Q.6 *How many ganglia arise from ventral nerve cord in cockroach?*

Ans. *Nine*

Q.7 *How many thoracic ganglia arise from ventral nerve cord in cockroach?*

Ans. *Three*

Q.8 *How many abdominal ganglia arise from ventral nerve cord in cockroach?*

Ans. *Six*

Q.9 *What structures constitute the central nervous system of cockroach?*

Ans. (a) *Brain* (b) *Suboesophageal connectives*
(c) *Circumoesophageal connectives* (d) *Ventral nerve cord*

Q.10 *What is the function of antennae of cockroach?*

Ans. *They are organs of touch and smell.*

Q.11 *Why are the eyes of cockroach called compound eyes?*

Ans. *Each eye of cockroach is really made up of thousands of simple eyes and is therefore called compound eye.*

Q.12 *Differentiate between terga and sterna?*

Ans. *Each thoracic and abdominal segment is covered dorsally by a chitinons plate called tergum and ventrally by a similar plate called sternum.*

Q.13 *How would you recognize a male cockroach?*

Ans. *In male cockroach, the ninth sternum has a pair of slender, unjointed anal styles. These are absent in female cockroach.*

Q.14 *Which ganglion in cockroach is largestone?*

Ans. *Sixth abdominal ganglion.*

9 Experiment

STUDY OF DUCTLESS GLANDS (PANCREAS, THYROID) USING MICROSCOPIC SECTIONS

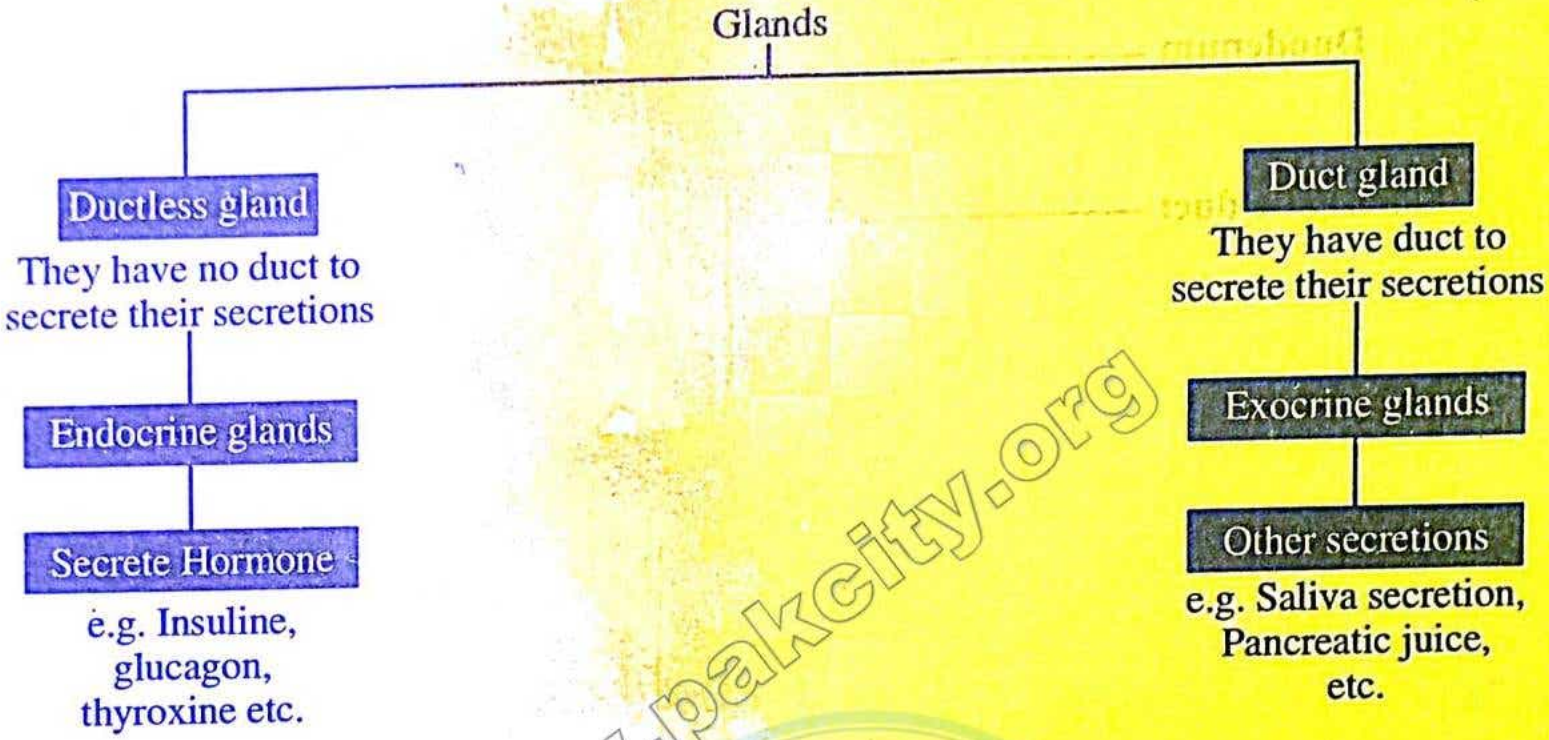
MATERIAL

Compound microscope: Prepared and stained slides of the T.S. of pancreas and Thyroid of a mammal.

PROCEDURE

Examine the prepared and stained slide of the T.S.of pancreas under the low and high magnification of the microscope and note the following details.

There are two types of glands in human body.

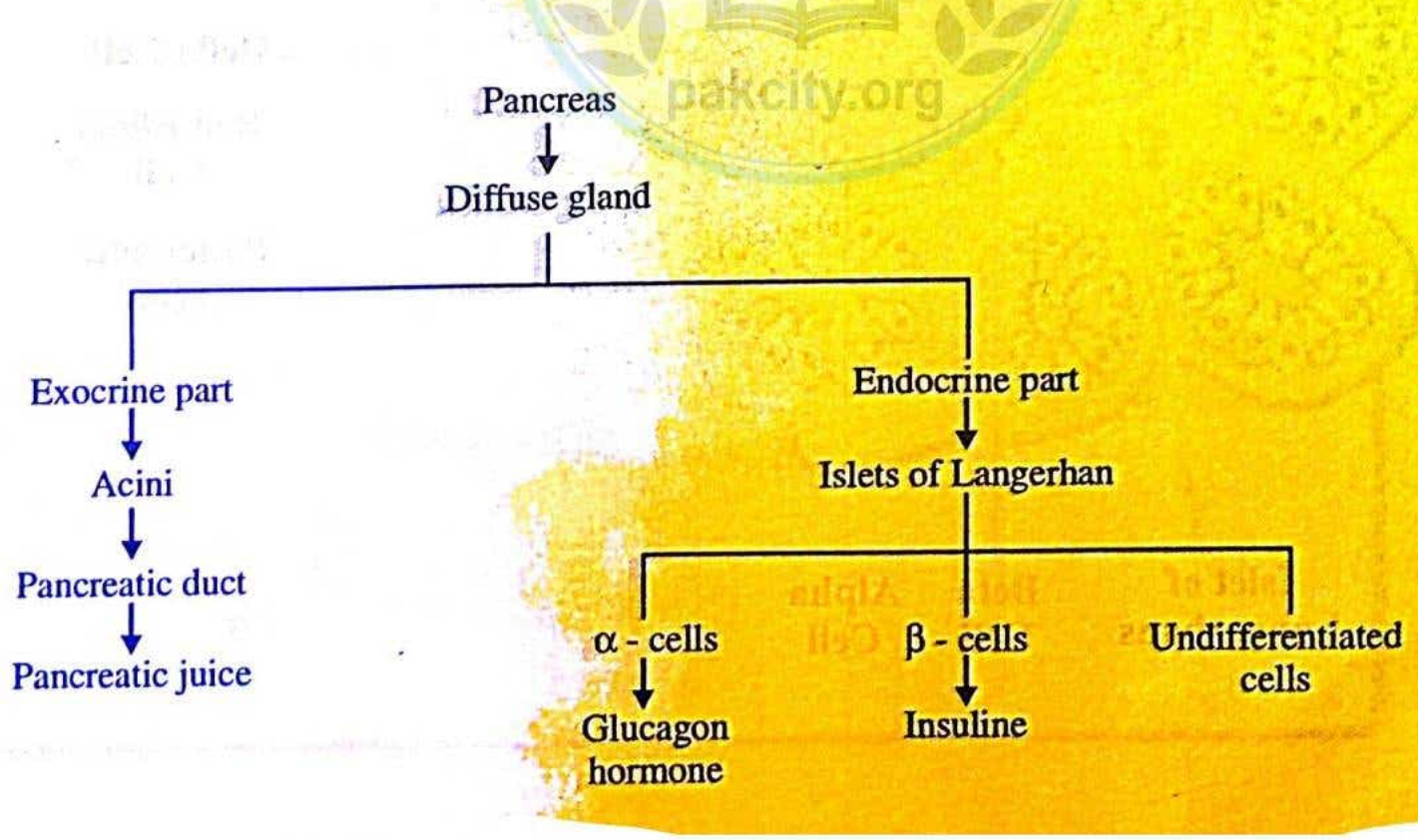


PART I

PANCREAS

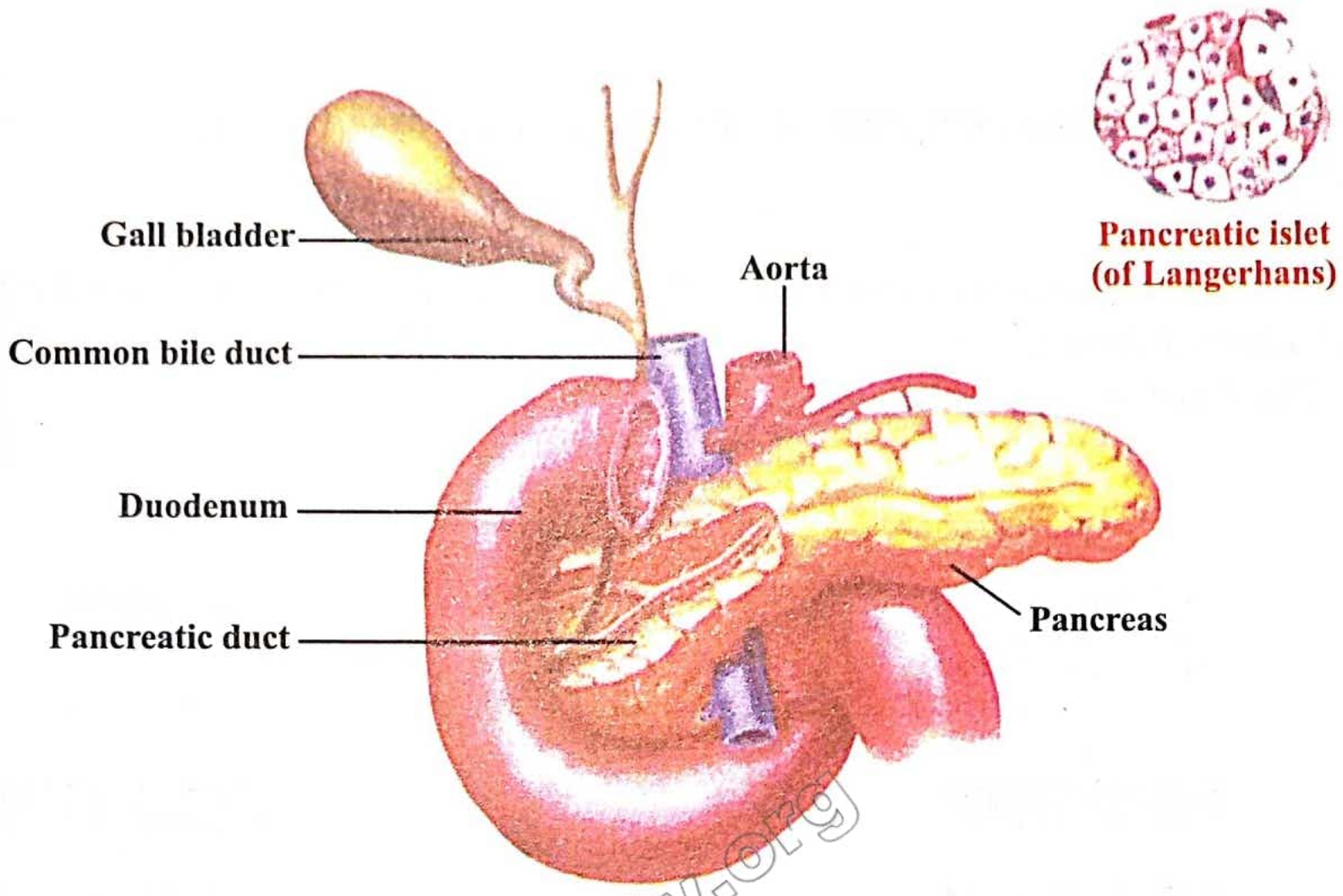
The pancreas is a diffuse gland consisting of both exocrine and endocrine parts

NATURE:



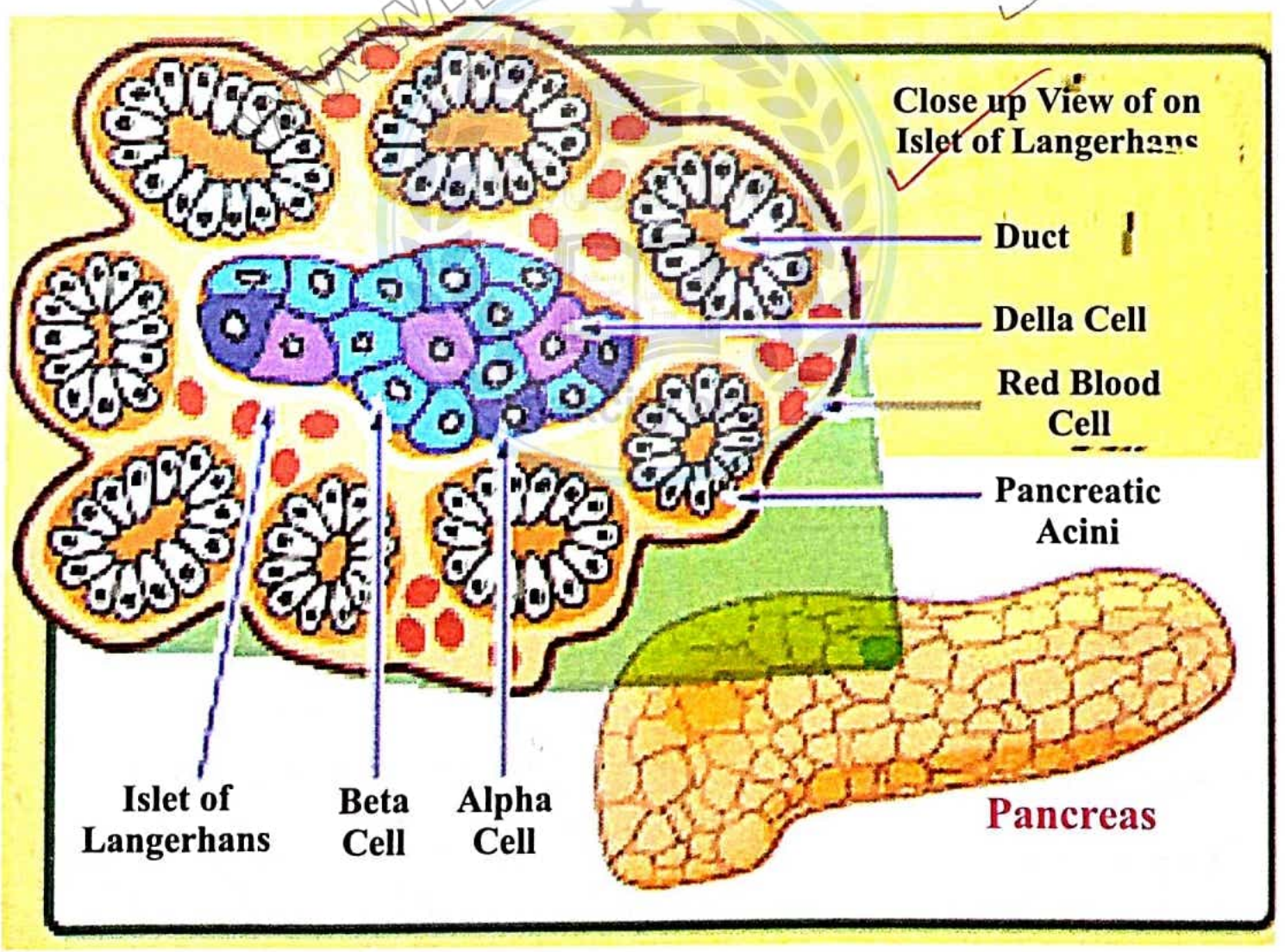
EXTERNAL STRUCTURE

It is held in the mesentery in the U-shaped loop of the duodenum.



Anatomy of parncreas and associated ducts

(1) PANCREAS



INTERNAL STRUCTURE:

The pancreas is covered with coelomic epithelium.

Acini

The bulk of the gland is differentiated into distinct clusters of cells and rounded alveoli or acini. Each acinus has a wide lumen surrounded by the wall made up of columnar pyramidal cells.

The cells of pancreatic acini secrete pancreatic juice containing several enzymes.

Islets of Langerhans.

In the connective tissue between acini are present clusters of cells arranged in elliptical areas. These clusters are known as the islets of Langerhans which secrete hormones. The region of islets reveals three kinds of cells:

(a) Alpha cells (α-cells) which secrete the hormone, glucagons.

(b) Beta cells (β-cells) which secrete the hormone, insulin.

(c) Undifferentiate cells.

The pancreatic duct. artery. vein and blood capillaries are also seen in the section.

PART - II

THYROID

PROCEDURE

Study the prepared and stained slide of the T.S. of thyroid under the low and high power of the microscope.

NATURE

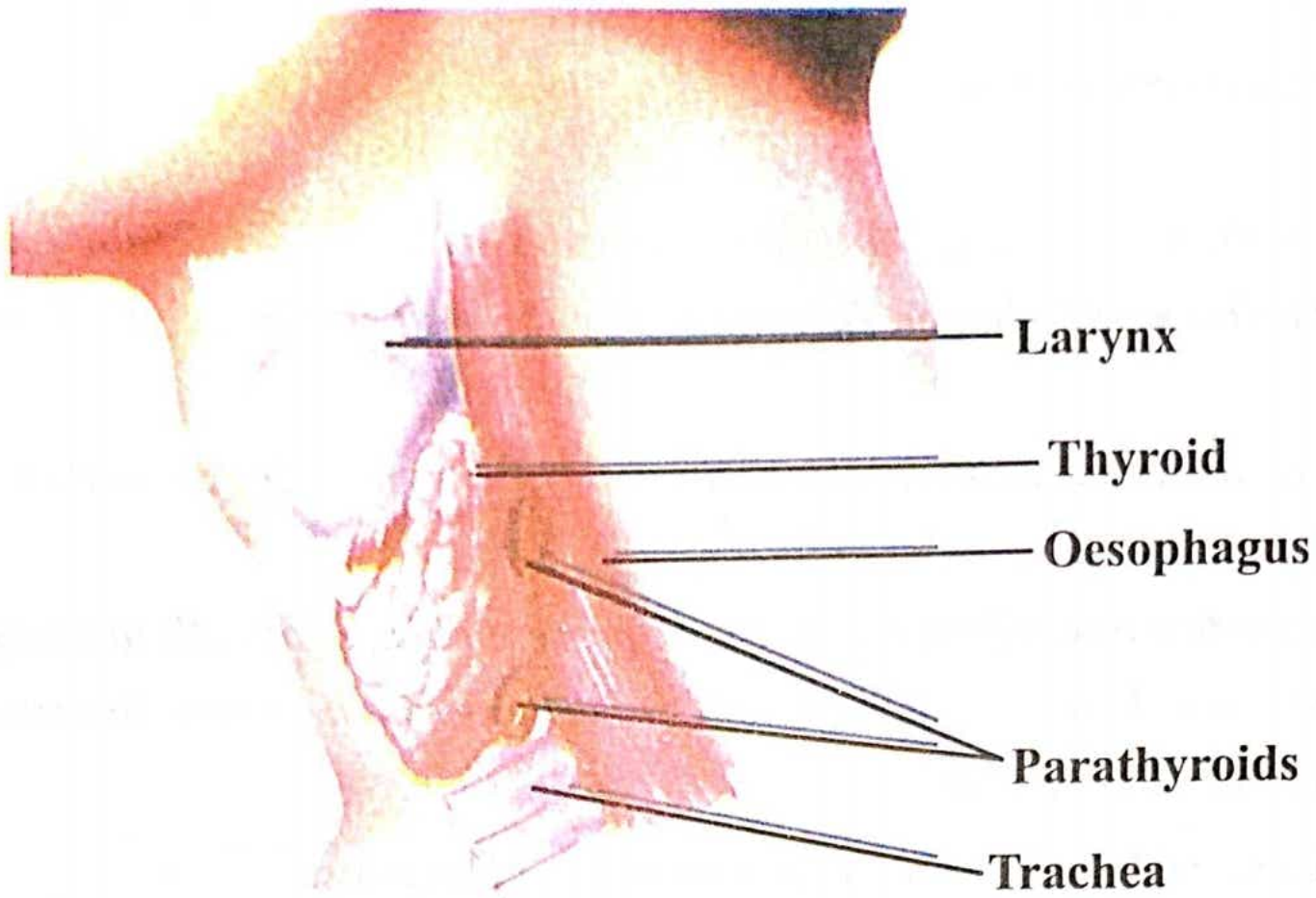
Thyroid gland is an endocrine gland found in almost all vertebrate animals and so called because it is located in front of and on each side of the thyroid cartilage of the larynx.

EXTERNAL STRUCTURE

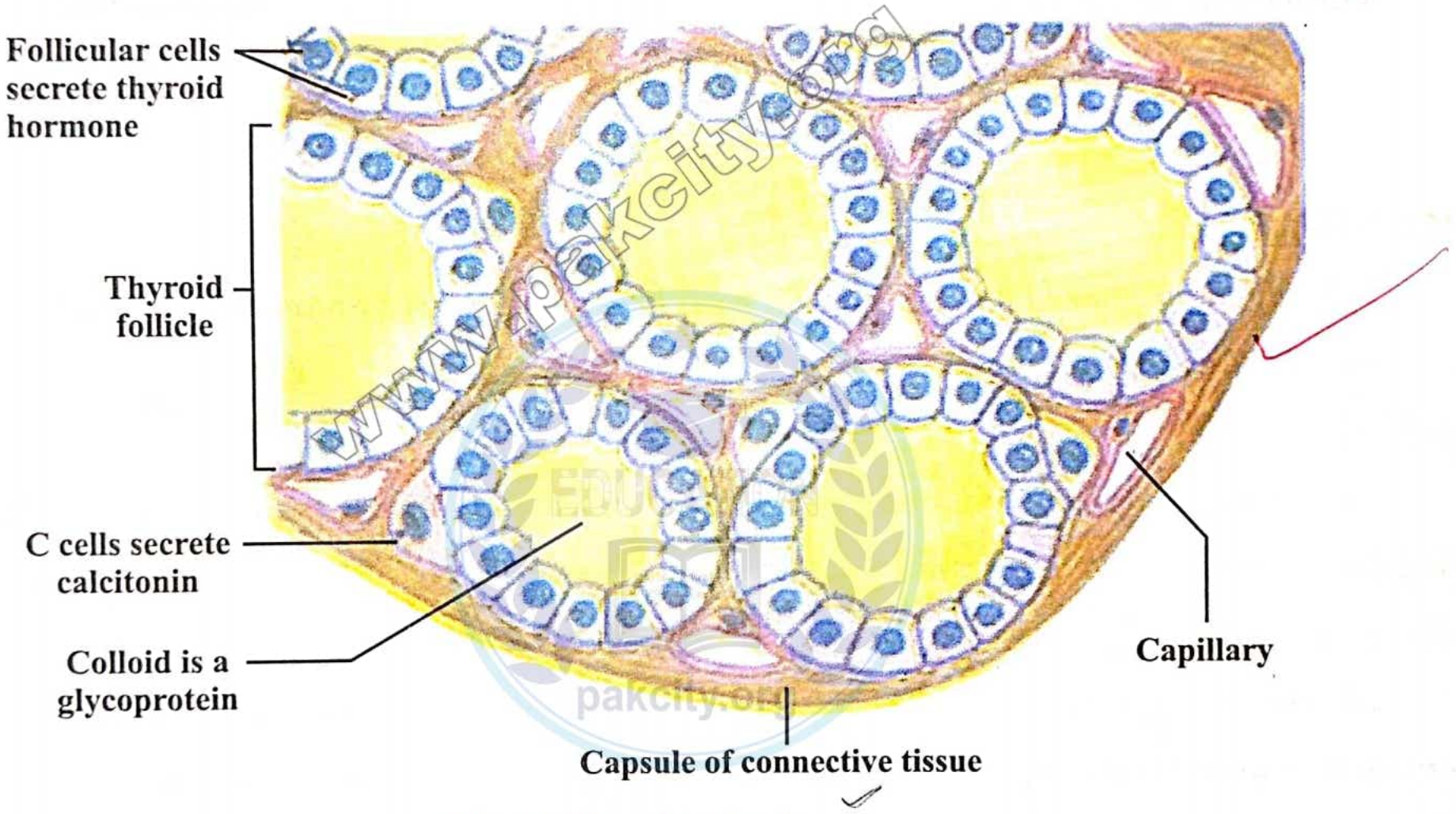
The thryroid gland in human beings is a brownish-red organ having two lobes connected by an isthmus; it normally weigs about 28 g (about 1 oz) and consists of right and left lobes, joined by an "isthmus".

INTERNAL STRUCTURE

Cuboidal epithelial cells arranged to form small sacs known as vesicles or follicles. The vesicles are supported by connective tissue that forms a framework for the entire gland. In the normal thyroid gland, the vesicles are usually filled with a colloid substance containing the protein thyroglobulin in combination with the two thyroid hormones thyroxine, also called tetraiodothyronine (T4), and triiodothyronine (T3). These hormones are composed of the amino acid tyrosine, containing four and three iodine atoms, respectively.



The thyroid and parathyroid glands



T.S. Of thyroid gland

VIVA VOCE

Q.1 *Why endocrine glands are known as ductless glands?*

Ans. *Endocine glands are called ductless glands because they have no ducts conncting them to specific body parts.*

Q.2 *What is the difference between endocrine and exocrine glands?*

Ans. *The endocrine glands are ductless glands so their hormones are released directly into the bloodstream. In contrast the exocrine glands, such as the sweat glands or the salivary glands, release their secretions directly to target areas via ducts.*

Q.3 *How many types of cells, each lobule of pancrease is composed of?*

Ans. *Each lobule consists mainly of two types of cells.*

(i) Cells of Islets of Langerharns.

(ii) Acini cells

Q.4 *What is the secretion of Islets of Langerhans?*

Ans. *The cells of Islets of of Langerhans secrete insulin and glucagon.*

Q.5 *What do the acini cells secret?*

Ans. *Acini cells secrete pancreatic juice.*

Q.6 *Why thyroid gland is called thyroid gland?*

Ans. *It is so called because it is located in front of and on each side of the thyroid cartilage of the larynx.*

Q.7 *What is the colour of thyroid gland of human beings?*

Ans. *The thyroid gland in human beings is brownish-red in colom.*

Q.8 *How many lobes does thyroid gland consist of?*

Ans. *Thyroid gland consists of two lobes connected by an isthmus*

Q.9 *What is filled in the vesicles of thyroid glands?*

Ans. *In the normal thyroid gland, the vesicles are usually filled with a colloid substance containing the protein thyroglobulin in combination with the two thyroid hormones thyroxine, also called tetra lodothyronine (T4), and triiodothyronine (T3).*

Q.10 *How would you distinguish between alpha cells and beta cells?*

Ans. *(i) The cytoplasm of alpha cells stain pink while the cytoplasm of beta cells stain blue.*

(ii) The alpha cells are situated more peripherally in the islet and the beta cells deeper or more in center of islet.

Q.11 *What is the endocrine part of the pancreas called?*

Ans. *Islets of Langerhans (pancreatic islets)*

Q.12 *What is the exocrine part of the pancreas called?*

Ans. *Seroud acini.*

Q.13 *What are the secretory cells of dserous acini called?*

Ans. *They are called Zymogenic cells.*

Q.14 *Where is thyroid gland of man situated?*

Ans. *It is situated in front of neck and on each side of thyroid cartilage of the larynx.*

Q.15 *Name the hormones secreted by thyroid gland.*

Ans. *(i) Thyroxine (T_4) (ii) Tri-iodothyronine (T_3)*
(iii) Calcitonin

Q.16 *What are the major components of thyroid gland?*

Ans. *(i) Follicles (ii) Follicular cells*
(iii) Parafollicular cells (iv) Interfollicular connective tissue

Q.17 *What is colloid?*

Ans. *It is composed of thyroglobulin. It is glycoprotein which contains several iodinated aminoacids.*

Q.18 *What is site of storage of thyroid hormones?*

Ans. *It is follicle.*

Q.19 *What is role of follicular cells?*

Ans. *They synthesize and secrete thyroid hormones, T_3 and T_4.*

Q.20 *What is the role of parafollicular cells?*

Ans. *They synthesize and secrete the calcitonin*

Reproduction

10 Experiment

EXPOSURE OF URINOGENITAL SYSTEM OF FROG

Like other vertebrates, amphibians (e.g, Frog) possess a well developed urinary (excretory) and reproductive systems. Both urinary and reproductive systems are collectively known as urinogenital system.

The urinary system of frog (male or female) consists of a pair of kidneys and a pair of ureters. The basic function of this system is the elimination of cellular waste products such as urea and regulation of ions concentration and water content of the blood. Thus, urinary system plays a basic role in homeostasis.

The frog is dioecious i.e., male and female individuals are separate. Male reproductive system consists of a pair of testes and duct system. The female reproductive system consists of a pair of ovaries and duct system.

The male's thumb (first finger) has nuptial pad in the form of swelling on the ventral side. This pad is absent in female. Fertilization is external. Larval stage is present. The larva of frog is called tad pole and it changes into adult by metamorphosis. Reproduction is necessary for the survival of a species.

MATERIAL

(i)	Frog Dissection box	(ii)	Dissecting Board	(iii)	Chloroform
(iv)	Hand lens	(v)	Hammer	(vi)	Nails
(vii)	A tin can or large glas jar	(viii)	Cotton	(ix)	Water

METHOD

(1) Place a frog in a tin can or large glass jar and pour some chloroform in it.

(2) Cover the can or glass jar tightly.

(3) After few minutes, the frog will be senseless.

(4) Remove the frog from can or glass jar and wash with water and then place it on a dissecting wooden board keeping ventral side facing you.

(5) Fix it by nailing its limbs. Use hammer for this purpose.

(6) Carefully lift up the skin of frog's belly with the help of forceps.

(7) Give a cut with a scissor in the middle. Through this incision (cut, pass the pointed end of scissor lifting the skin up and cut through the chest to the chin and backwards up to the cloacal aperture.

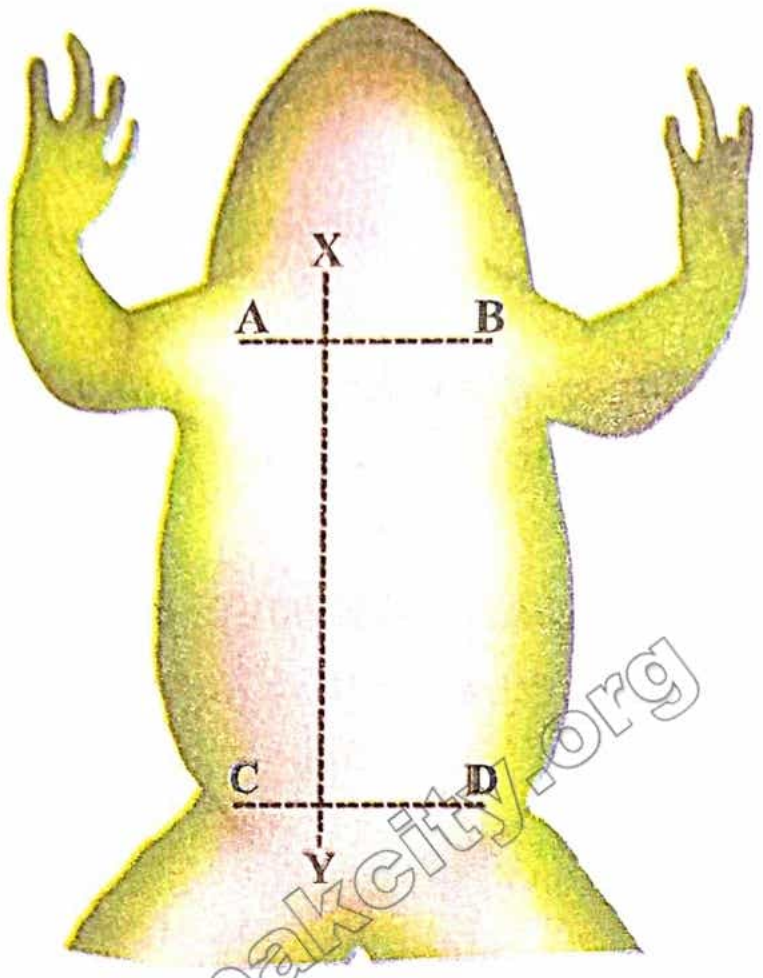
(8) Give few cross cuts and separate the skin from the muscles with the help of scalpel. Now stretch the skin to the sides and nail it so that body will become clear.

(9) Cut down the muscle right up to the lower jaw through shoulder bone.

(10) Cut the muscular strips sideways and stretch the body wall on its sides and nail them.

(11) Now coelom (body cavity) is open, see and locate various organs (viscera) Constituting the urinogenital system of frog.

(12) Sketch neat and labelled diagram of dissected frog.



OBSERVATIONS:

URINOGENITAL SYSTEM OF FROG CONSISTS OF FOLLOWING:

(i) Urinary (Excretory) system (ii) Reproductive system.

(I) URINARY SYSTEM

It consists of following organs:

(a) Kidneys

The kidneys are the excretory organs of frog. These are two elongated, reddish brown bodies attached to dorsal body wall by a fold of peritoneum. They are located on each side just below the vertebral column. They are present in both male and female frogs.

(b) Ureters

These are two long ducts which arise from posterior end of each kidney and open into dorsal wall of the cloaca. The ureters bring the urine from kidneys into cloaca.

(c) Urinary bladder

It is a thin bilobed sac which opens into the ventral wall of cloaca.

(d) Adrenal glands

These are two in number. Each adrenal gland is a yellow or orange stripe running along ventral side of each kidney. It secretes adrenaline into the blood which increases the heart rate. It results in rise of blood sugar level and makes the body react to stresses.

(II) REPRODUCTIVE SYSTEM

(A) MALE REPRODUCTIVE SYSTEM

(a) Testis (Plural Testes)

The testes are two oval yellowish bodies which are attached to kidneys by a fold of peritoneum. Each testis is located on the anteroventral surface of the respective kidney. Nearby are bright yellow finger like fat bodies. Testes produce male gametes (sperms).

(b) Vasa Efferentia

These are six white ducts arising from the inner margin of each testis. They connect the testis to the kidney. They bring sperms from the testis into the kidney.

(c) Urinogenital ducts (Ureters)

Since ureters in male frog carry both urine and spermatic fluid to the cloaca, they are called urinogenital ducts. These are two in number. Each ureter arises from the kidney and opens into the cloaca.

(B) FEMALE REPRODUCTIVE SYSTEM

It consists of following organs:

(a) Ovary (plural ovaries)

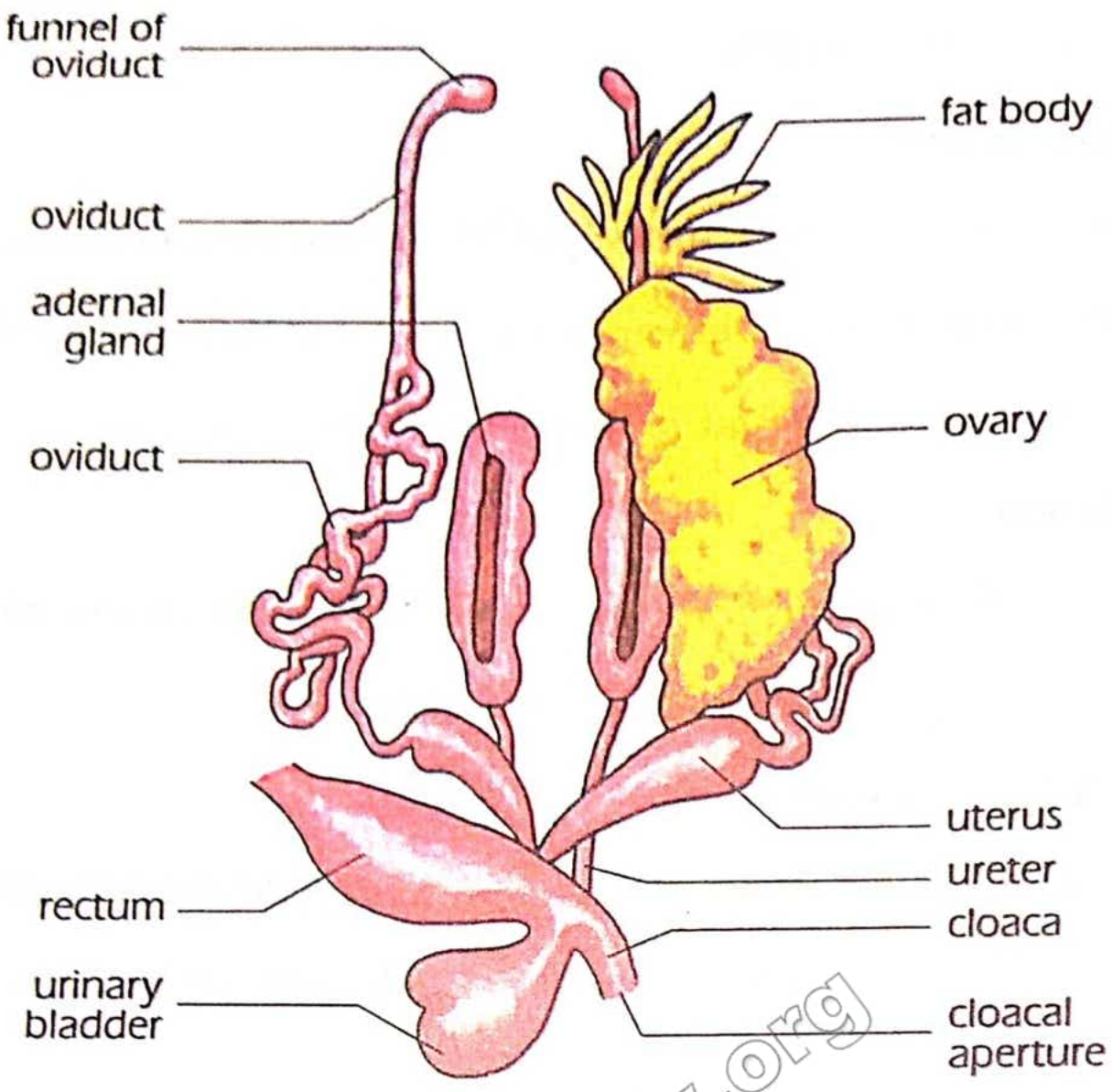
The ovaries are a pair of highly folded sacs. They are largest during fall and winter when they are filled with thousands of ripe eggs and smallest after ovulation in spring.

(b) Oviducts

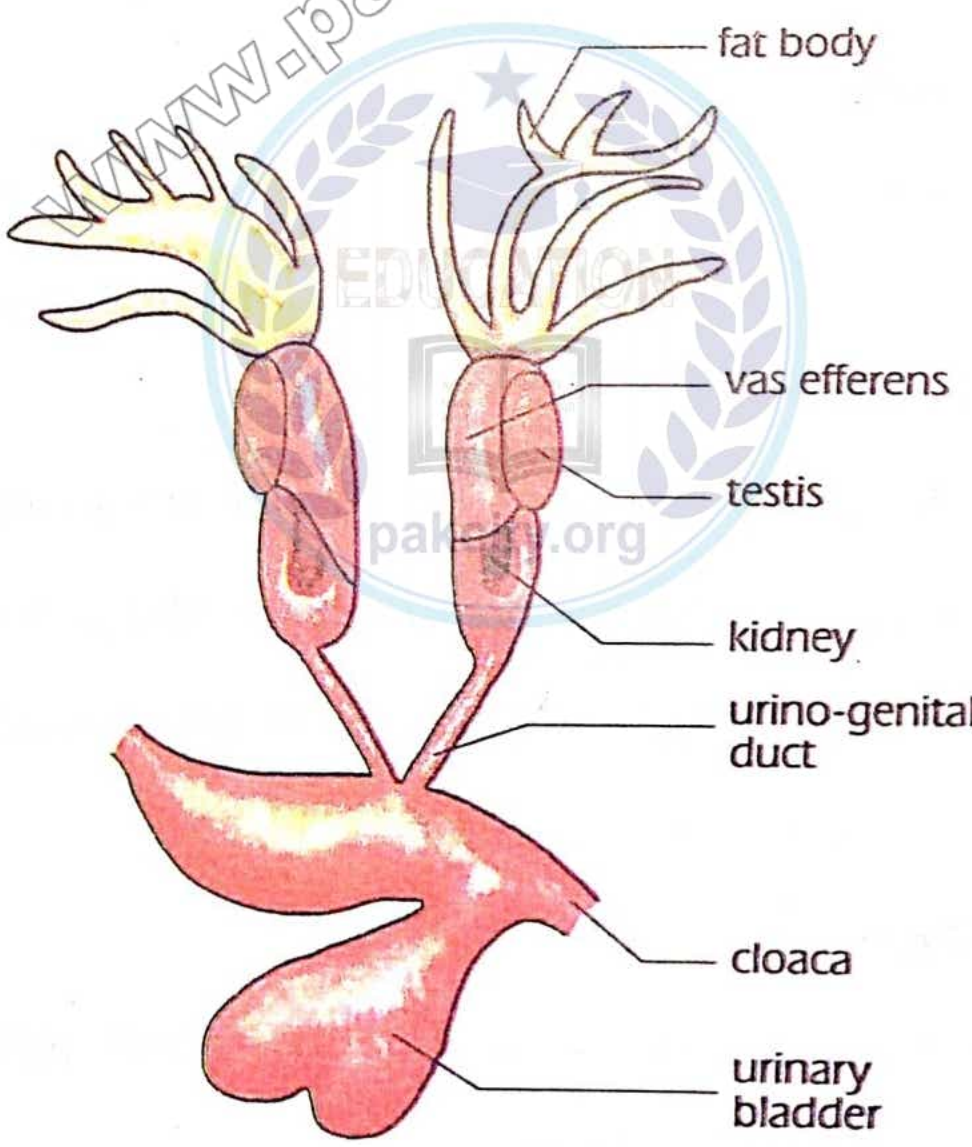
These are two long, white coiled tubes attached to the dorsal body wall one on each side of midline. Each oviduct is a highly coiled duct extending forward to anterior end of body cavity. At end of each oviduct, there is a funnel shaped ostium. Ovary releases eggs in the body cavity which then enter the oviduct through ostium.

(c) Uterus (Plural Uteri)

The posterior enlarged part of oviduct is called uterus. It stores eggs for sometime. It opens into the cloaca. Thus, eggs reach the cloaca through uterus.



Female urino genital system



Male urino genital system

VIVA VOCE

pakcity.org

Q.1 *What is the scientific name of frog.*

Ans. *Rana tigerina.*

Q.2 *What is Anatomical position of Kidney.*

Ans. *They are attached to the body wall by mesenteries.*

Q.3 *What functions are performed by the kidneys?*

Ans. *The kidneys perform excretory (elimination of nitrogenous wastes) as well as osmoregulatory (removal of excess water) functions.*

Q.4 *What is the function of ureter in male as well as in female frog?*

Ans. *In the male frog, the ureter serves to convey both the urine as well as the male genital elements (sperms) i.e. it acts as the urinogenital duct. In the female frog it carries only the Urine it acts as the urinary duct only.*

Q.5 *What are vasa efferentia in frog and what are these meant for?*

Ans. *The vasa efferentia are the six pairs of fine ducts which connect the testes with their corresponding kidneys. These carry sperms from the testes into the kidneys.*

Q.6 *What is mesentery?*

Ans. *Mesentery is a thin transparent membrane that supports various organs in the abdominal cavity of vertebrates.*

Q.7 *Describe the path through which sperms pass out of the body of the frog.*

Ans. *The path of the sperms of frog is from the testes to vasa efferentia, to kidneys, to ureters, to cloaca and out through the cloacal aperture.*

Q.8 *What is the path of the outgoing eggs of the frog?*

Ans. *It is from the ovaries to body cavity, to oviducts, to uterus, to cloaca, to the outside through the cloacal aperture.*

Q.9 *What are other names for the reproductive organs?*

Ans. *The reproductive organs can also be called genital organs or sex organs.*

Q.10 *What is the kind of fertilization in frog?*

Ans. *In frog, fertilization is external e.g. it takes place in water, outside the body of the female.*

Q.11 *What is the path of the urine in frog.*

Ans. *Kidney Ureter Cloaca Cloacal aperture*

Q.12 ***What is the function of the fat bodies?***

Ans. ***The fat bodies store food in the form of fat.***

Q.13 ***What is the singular of vasa efferentia?***

Ans. ***It is vas efference.***

Q.14 ***Where are testes found in frog?***

Ans. ***The testes of frog are found on the antero-ventral surfaces of the corresponding kidneys.***

Q.15 ***Where are ovaries of frog located?***

Ans. ***The ovaries of frog are located on the ventral surfaces of the corresponding kidneys.***

Q.16 ***What is the shape, size and colour of each mature egg of frog?***

Ans. ***Each mature egg of frog is spherical, 1.5 mm in diameter and half black and half white or yellow.***

Growth and Development

11 Experiment

INVESTIGATION OF EFFECTS OF INDOLE ACETIC ACID (IAA) ON GROWTH OF OAT COLEOPTILE OR ON THE GROWTH OF GERMINATED BARLEY SEEDS

PLANT HORMONES

All communications in the plants are done by specific chemical messengers, such chemical messengers are called growth hormone e.g. Auxins,Gibberellins,cytokinins etc.

AUXINS

It is produced in the meristematic tissues of buds, leaves, seeds, fruits and embryos.Most common is indole acetic acid (IAA).

COLEOPTILE

It is protective cellular sheath that surrounds embryonic leaves of the developing seedling. When the shoot reaches a length of 5 to 8 cm, the coleoptile stops to grow. The enclosed leaves split through the coleoptile and continue their growth upward.

The aim of the experiment is to investigate the effect of various concentrations of IAA (natural (auxin) on the growth of oat coleoptiles. Growth is affected by white light and, therefore, cutting and transferring of coleoptiles during the experiment should be carried out under red light or in the minimum possible amount of light . Sucrose solution is used in the experiment as energy will be required for growth, and sucrose is an energy source. The apical tip (3 mm) of each coleoptile is removed in order to prevent natural auxins produced by the coleoptile from having an effect on growth.

APPARATUS

(i) Germinating oat or Barley (ii) Seedlings with at least 1.5 cm long coleoptiles
(iii) Test tube rack (iv) Test tubes (six in number)
(v) Beaker (1000 ml) (vi) Petridishes (six pairs)
(vii) Graduated pipettes (viii) Measuring cylinders
(ix) Incubator (x) Filter paper
(xi) Stock IAA solution (xii) Distilled water
(xiii) Double bladed cutter with blades held exactly 10 mm apart a series of washers
(xiv) Camel hair brush (xv) A nut and a bolt
(xvi) Sucrose solution (2%)

PREPARATION OF GERMINATING OAT (OR BARLEY) SEEDLINGS

(i) Place about 100 grains in a 1000 ml beaker containing water and retain them overnight.
(ii) Place these soaked seeds on damp damp filter paper in a dish.
(iii) Cover the dish with aluminum foil.
(iv) Place this dish in dark for 5 days or in incubator at.

PREPARATION OF STOCK IAA SOLUTION

(I) Take one gram of IAA and dissolve it in 2 ml of ethyl alcohol in a test tube.

(ii) Dilute this solution to 900 ml with distilled water.

(iii) Warm the diluted solution to 80C, and keep at this temperature for 5 minutes. Make the solution up to 1000 ml with distilled water.

PROCEDURE

(1) Take six test tubes and six petridishes and label them A, B, C, D, E, F and a, b, c, d, e, f respectively.

(2) Add 18 ml of 2% sucrose solution to each test tube.

(3) Add 2 ml of 1AA solution to tube A with the help of a pipette. Mix the two solutions thoroughly.

(4) Transfer 2 ml of solution from tube A to tube B and mix the contents of tube B thoroughly. This transfer is done by a fresh pipette.

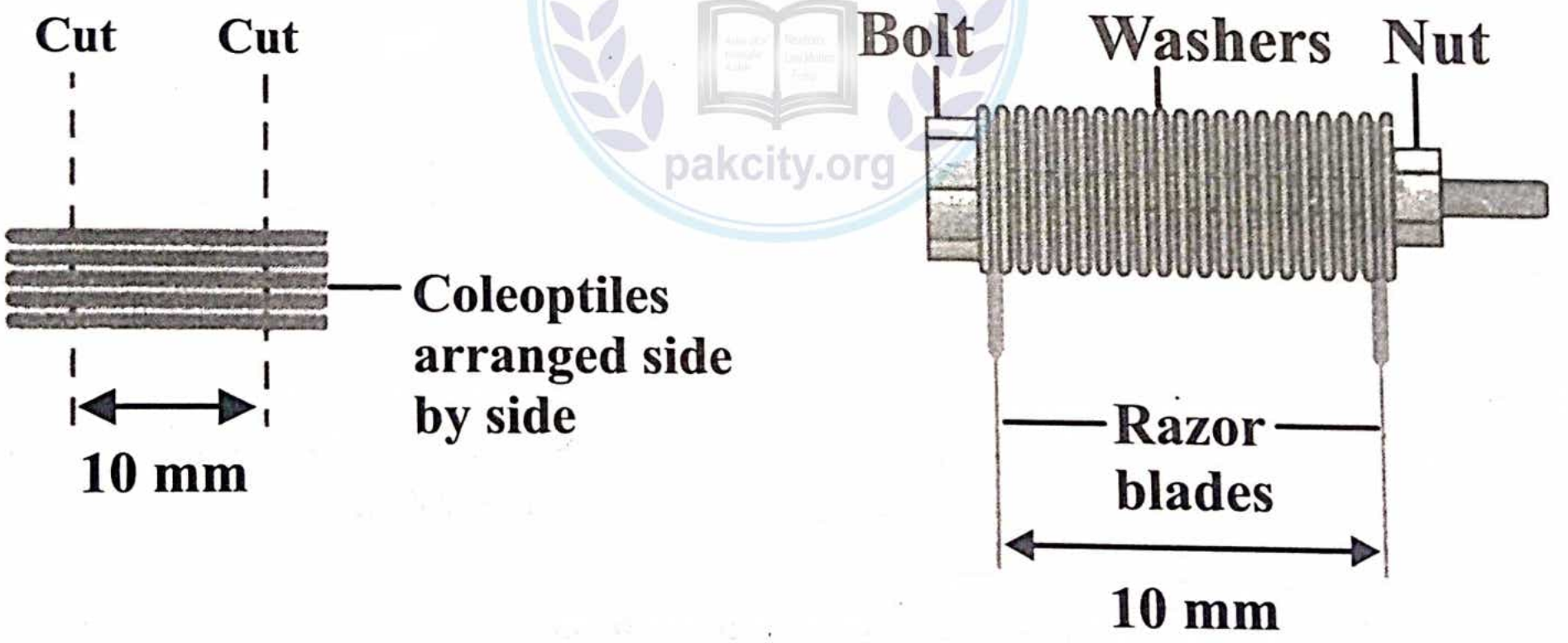
(5) Using fresh pipette each time, transfer 2 ml of solution from the tube B to tube C, mix thoroughly, then transfer 2ml of solution from tube C to tube D, mix thoroughly, then transfer 2ml of solution from tube D to the tube E, mix thoroughly.

(6) Add 2ml of distilled water to tube F.

(7) Pour the solutions from test tubes A-F to petridishes a-f respectively.

(8) Take 60 out of 100 germinated oat seedlings.

(9) Cut the 10 mm lengths of coleoptiles, starting about 3 mm back from the tips by using the double bladed cutter as shown in figure.

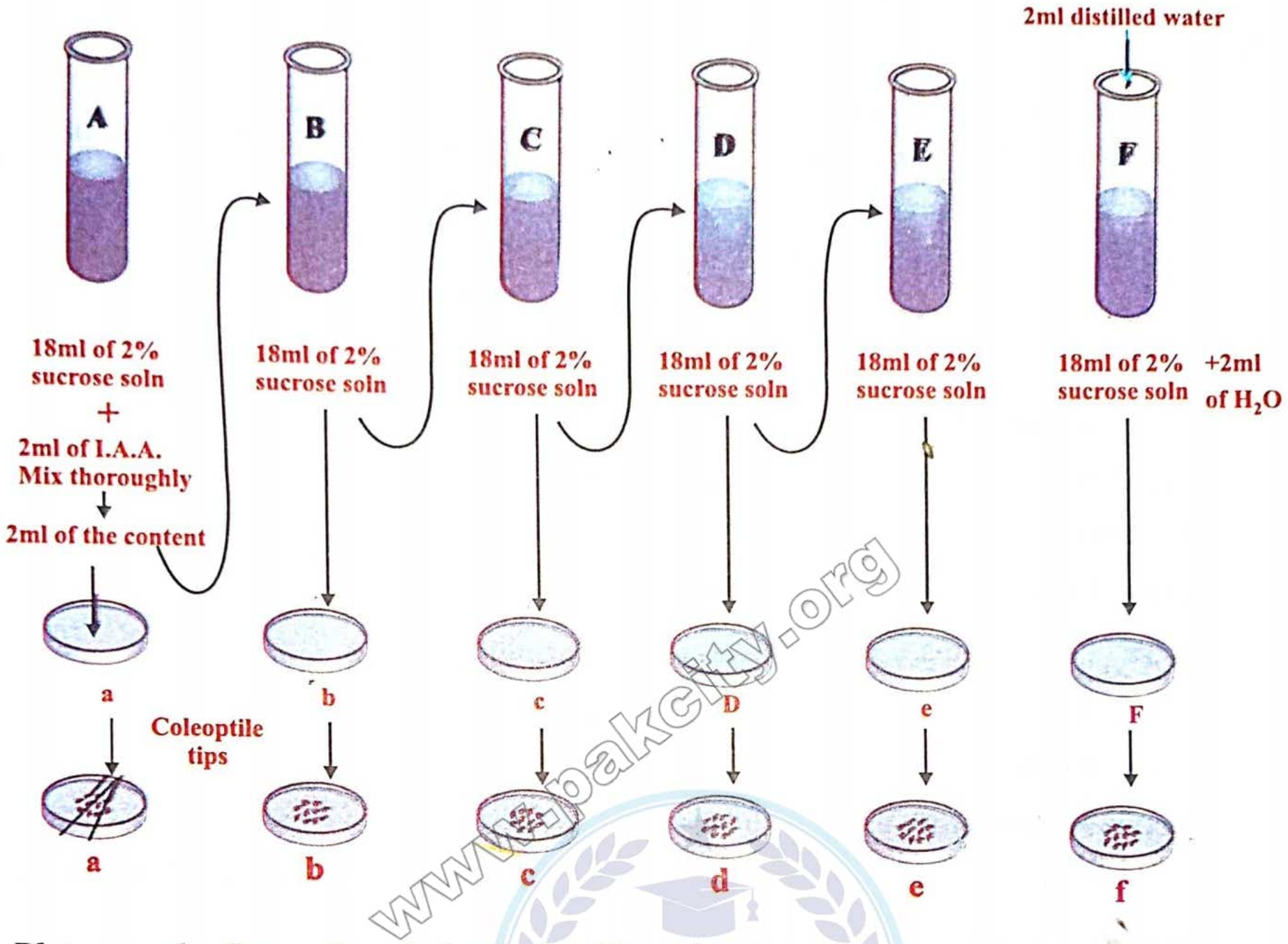


Cutting 10 mm lengths of coleoptiles

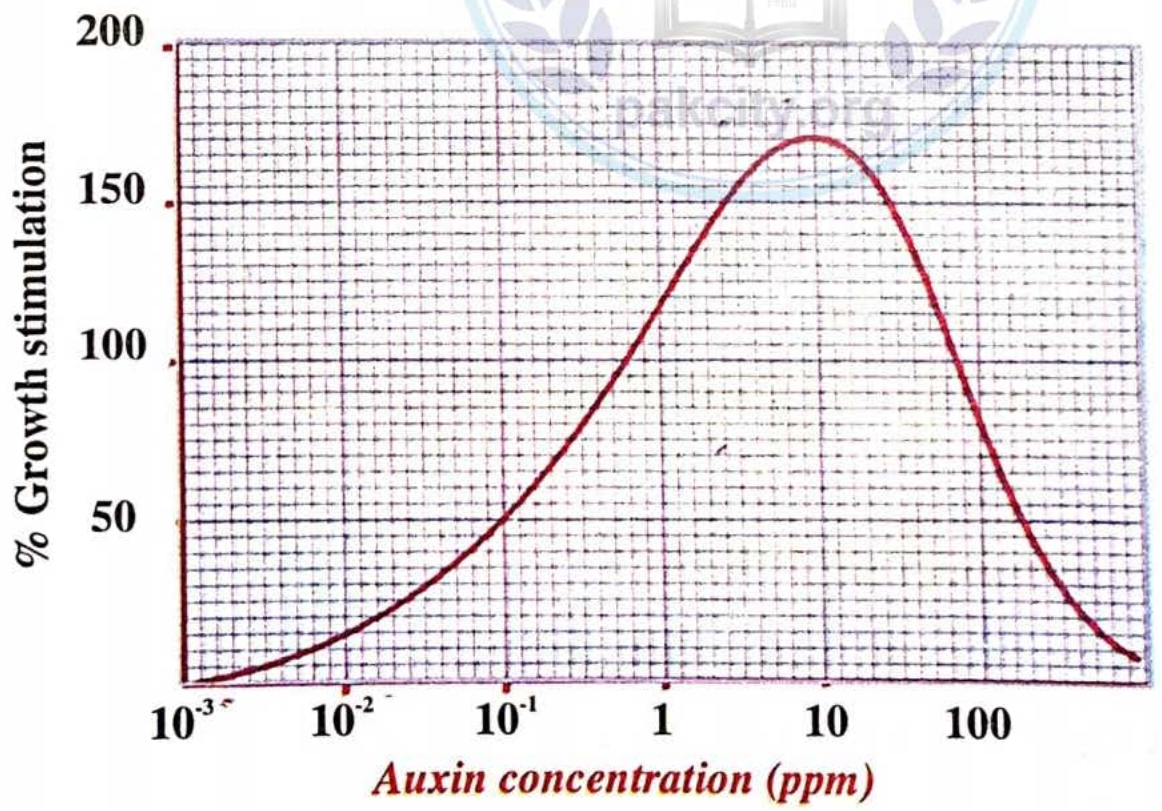
(10) ***Transfer 10 coleoptile tips to each petridish by using fine camel hair brush and then place a lid on each dish.***

(11) ***Now incubate these dishes at 25°C for three days in the dark.***

(12) ***Remeasure the lengths of coleoptiles and calculate the average length for each dish.***



(13) ***Plot a graph of mean length (vertical axis) against IAA concentration in parts per million (horizontal axis) as shown below:***



OBSERVATIONS

(1) A maximum increase in the average length of the coleoptiles takes place in petridish **b** *(10 ppm) and petridish* **c** *(1ppm).*

(2) A lesser increase in the average length of the coleoptiles takes place in petridish **b** *and pteridish, still lesser in* **e** *and no increase in* **f**.

RESULT

(1) The maximum rate of growth of coleoptile occurs at 1 - 10 ppm of IAA.
(2) An increase or decrease in concentration of IAA inhibits / retards the Growth of shoot

VIVA VOCE

Q.1 What are growth hormones?

Ans. These are the chemical messengers produced in very low concentrations and active in another parts of plant body.

Q.2 Give examples of growth hormones?

Ans. Auxins, Gibberellins, Cytokinins.

Q.3 What is most common naturally occurring auxin?

Ans. Indoleacetic acid.

Q.4 What are the sites of production of auxins?

Ans. Auxins are produced in meristematic tissues of buds, leaves, embryos, seeds and fruits.

Q.5 What is coleoptile?

Ans. It is a protective cellular sheath that surrounds embryonic leaves of the Developing seedling.

Q.6 Why is sucrose solution used in this experiment?

Ans. It is used as an energy source for growth.

Q.7 What will be the effect of concentration of IAA above 10 ppm on coleoptile growth?

Ans. It causes an inhibitory effect on the growth of coleoptile. At concentration of IAA around about 1000 ppm, growth is ceased.

Q.8 What is the optimum auxin concentration for coleoptile of oat?

Ans. 1 - 10 ppm.

Q.9 Name other naturally occurring auxins.

Ans. These are indole acetonitrite and indole pyruvic acid.

Q.10 Where is auxin synthesized in the body of the living plant?

Ans. The auxin is synthesized in the meristematic regions of the stem tips.

Q.11 Give examples of synthetic auxins.

Ans. The synthetic auxins are the naphthalene acetic acid (NAA) and 2,4-dichlorophenoxy acetic acid (2, 4-D).

Q.12 The growth of which parts of the body of the plant is influenced by the auxins?

Ans. The auxins influence the growth of root, stem and buds of the plant.

Q.13 How do different concentrations of auxin affect growth of shoot and root?

Ans. The concentrations of auxin which stimulate shoot growth inhibit root growth.

Q.14 What is the optimum auxin concentration for the coleoptile of oat?

Ans. The optimum auxin concentration for the coleoptile of oat lies between one to ten parts per million (p.p.m) of IAA.

Q.15 Why high concentrations of auxins can be used as herbicides?

Ans. The high concentrations of auxins kill the herbs (weeds) by inhibiting and stopping their growth.

Q.16 How does auxin promote plant elongation and growth?

Ans. The auxin promotes plant elongation by softening the rigid cell walls so as to allow the water to enter the cells and make them turgid. The growth is thus brought about by cell enlargement rather then by cell division.

Q.17 Enlist various functions of auxins, besides plant elongation?

Ans. The various functions of auxins, besides plant elongation are:

(i) Stimulation of the formation of roots in cuttings.

(ii) Prevention of leaf abscission and fruit drop.

(iii) Role in fruit development.

(iv) Control of bud growth.

(v) Role in phototropic and geotropic responses.

Q.18 What is auxin?

Ans. Auxin is a plant growth substance (growth hormone) which promotes the elongation of shoot and root when present in low concentration.

12 Experiment

STUDY OF STRUCTURE OF HEN'S EGG

The chick egg (called the yolk) is surrounded by various accessory coverings secreted by the female reproductive tract. Fertilization is internal and normally takes place just as ovum is entering the oviduct. The shell is secreted as the egg passes through the shell gland (the uterus). When an egg has been laid, the development ceases unless the temperature of egg is kept nearly up to the body temperature of the mother.

MATERIALS

Fresh fertilized hen's egg (unincubated), Shallow dish of water or warm chick Ringer's solution.

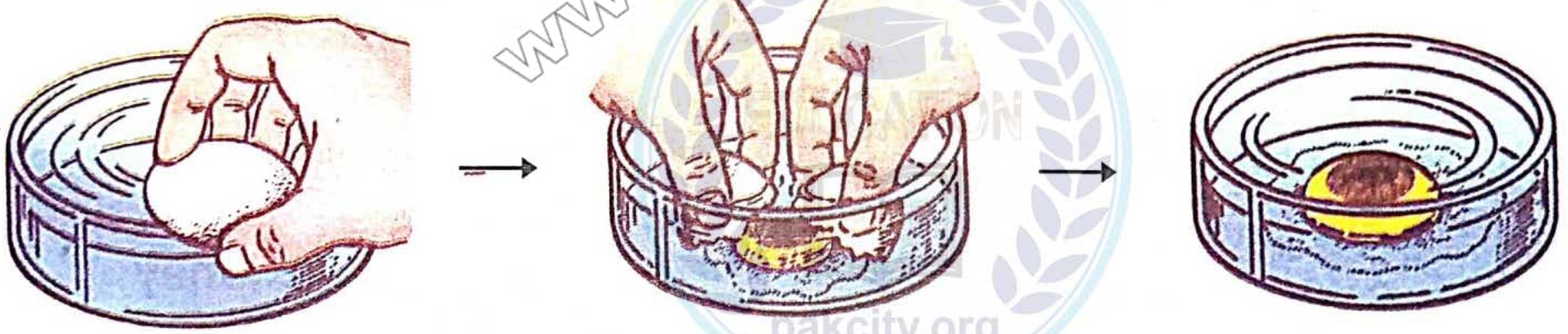
PROCEDURE

(1) Crack a fresh, fertilized hen's egg without breaking the yolk.

(2) Carefully put the contents in a dish or bowl containing water or warm chick Ringer's solution.

(3) The yolk with its developing embryo will float (If you find only a white spot On the surface of the yolk, the egg has failed to develop so use another egg.)

(4) The embryo at this stage is very small, but can be seen as a whitish spot, called the blastoderm (blastodisc), on the upper surface of they yolk.



Structure of Hen's Egg

EXTERNAL STRUCTURES

(1) Shape and size:

Generally the eggs are laid at the rate of one egg per day. A fully formed and newly laid egg is large and elliptical with one end broader than the other. It is about 3 cm broad and 5 cm long. By the time it is laid, the embryo is in the blastula stage or undergoing gastrulation.

(2) Egg Shell:

The egg is externally protected by a firm white or brown Shell, at least 97 per cent, of which is calcium carbonate. The shell is porous and allowes diffusion of O_2 and CO_2 through it. The shell is soft and flexible in a freshly-laid egg but soon becomes hard and brittle. The shelled-egg, shut off from its surrounding, is termed cleidoic.

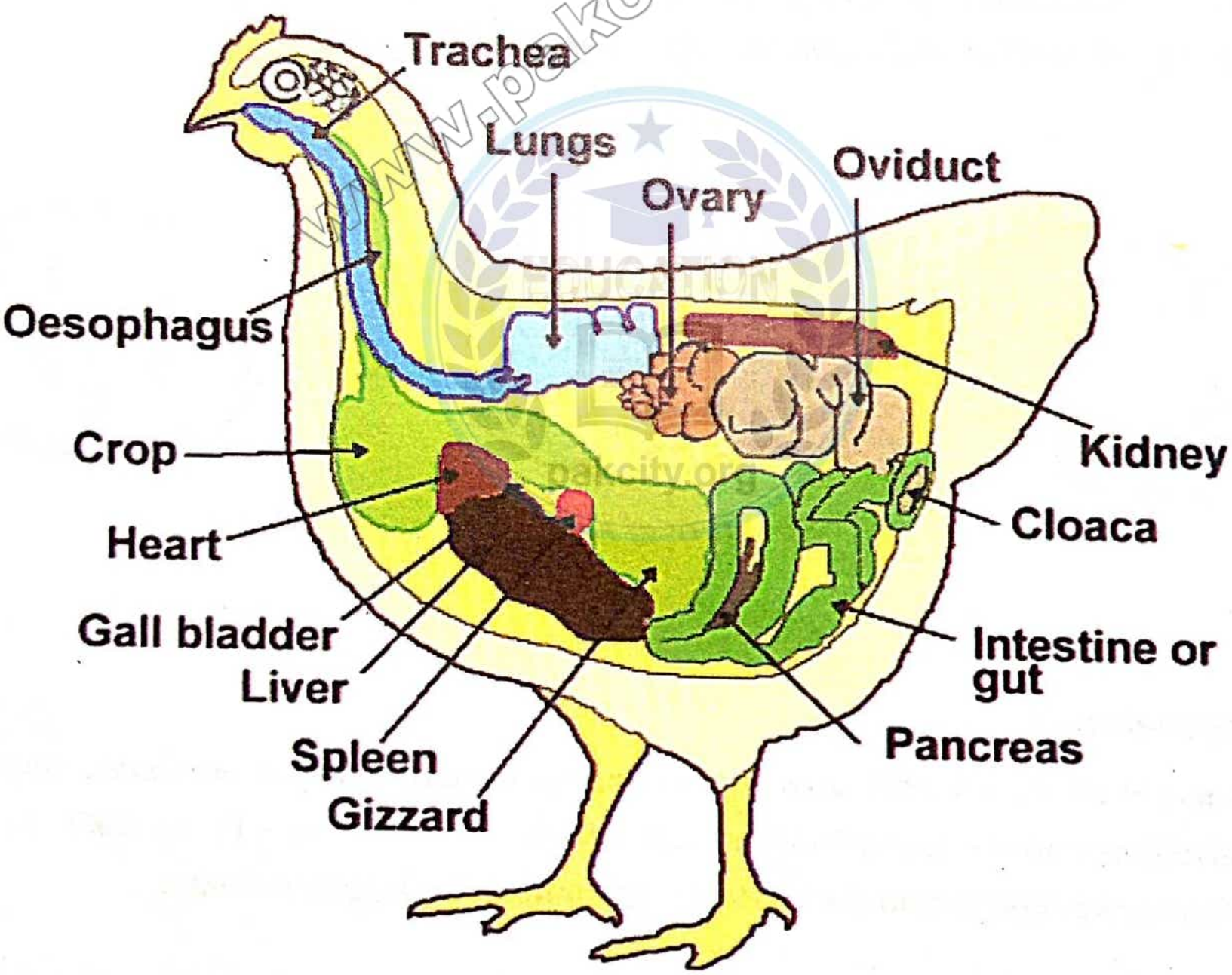
INTERNAL STRUCTURE

(1) Shell membrane:

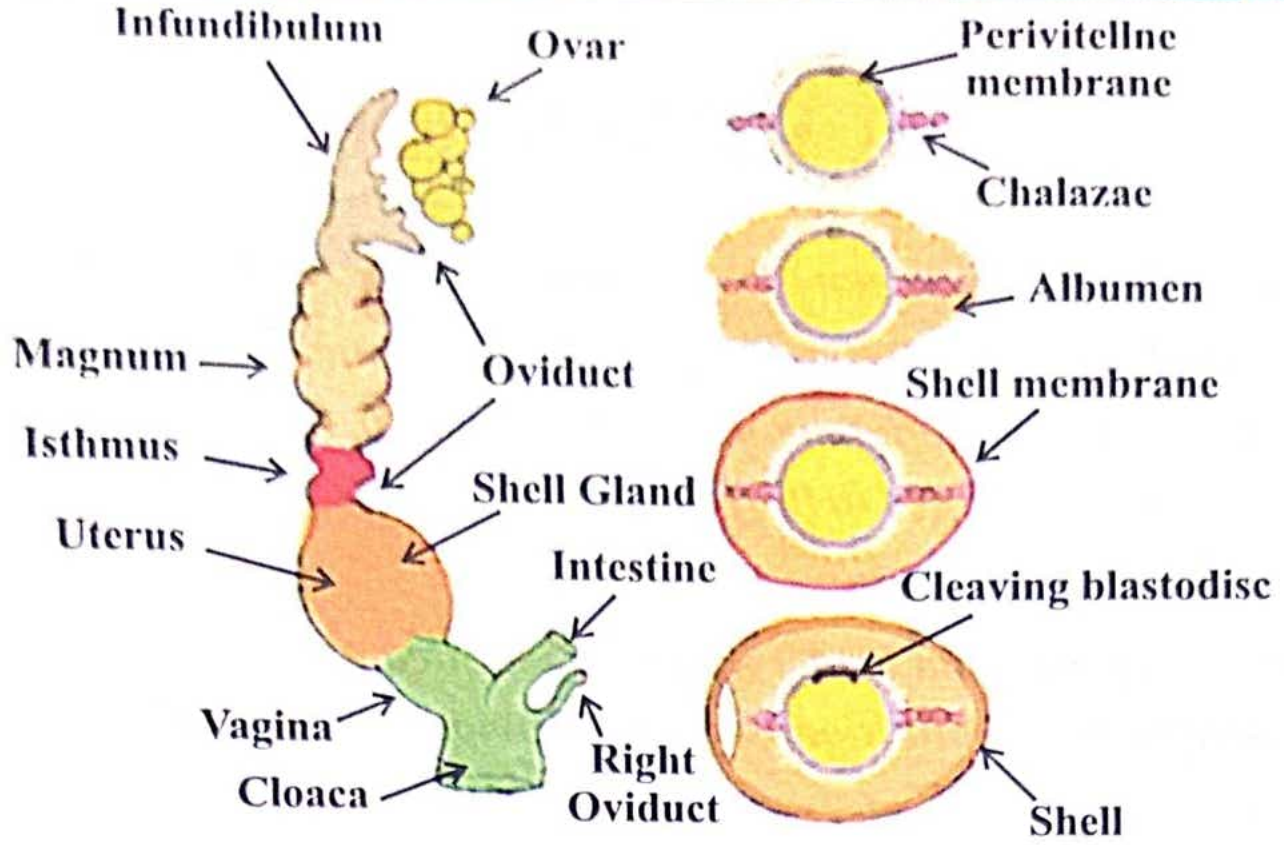
Immediately underneath the shell is a thin but tough, white shell membrane consisting mostly of keratin. It is made of two layers which are mostly in close contact with each other but are separated at the broad end of the egg to enclose an air space. As development proceeds, the air space grows larger, and just before hatching the young chicken pierces the air space with its break and takes its first breath of air, inflating its lungs.

(2) Albumen:

Beneath the shell membrane lies the albumen or white of egg, surrounding a central mass of yolk. The albumen consists chiefly of water (85 per cent) and protein.



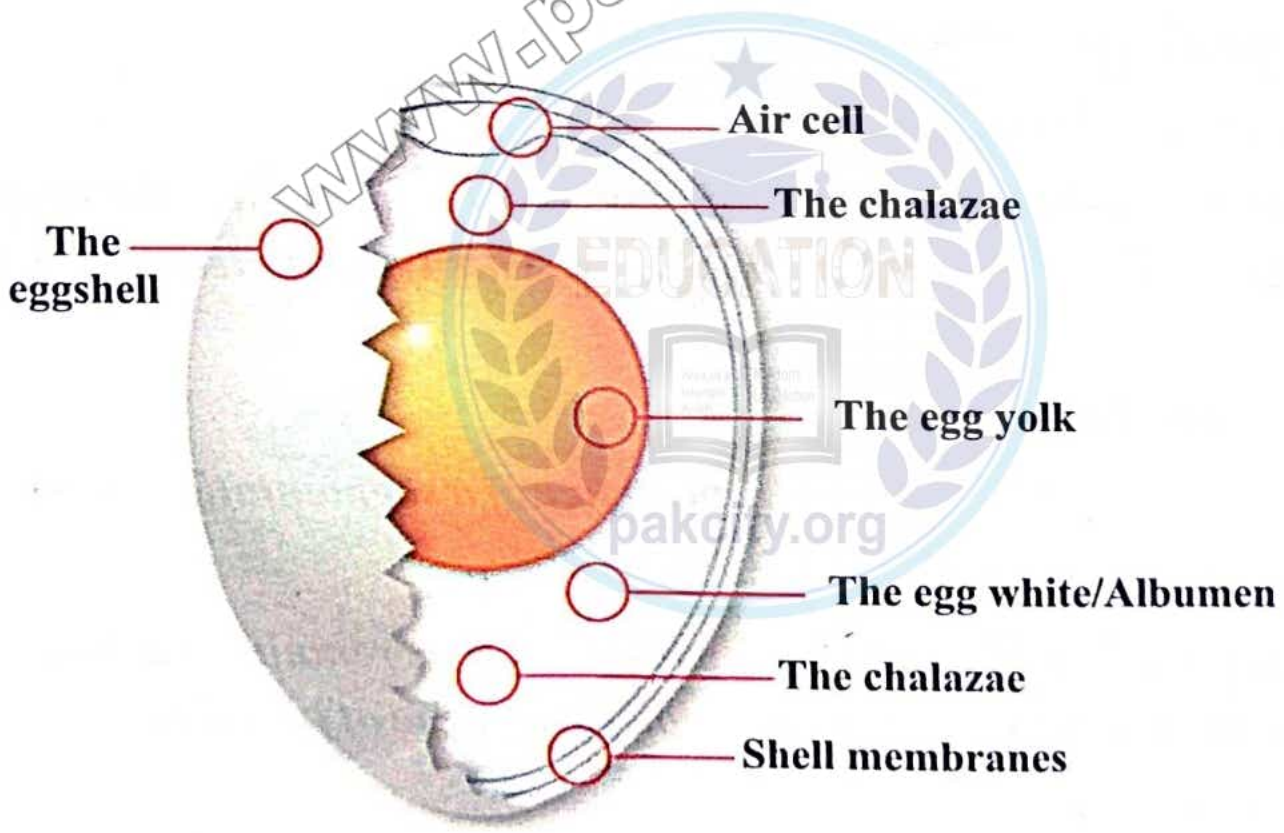
Eggs is in gastrula stage when laid



Other proteins are also present. The albumen is deposited in several layers. The outermost albumen is more water-like and known as the fluid, liquid, watery or thin albumen. The middle layer of albumen is thick and viscous and known as the dense albumen. The innermost layer is made of very viscous albumen called the chalaziferous layer, which surrounds the yolk. It forms the pair of spirally twisted ropes or cords, the

calazae, one towards each end of the egg.

The granules of yolk, being slightly denser than cytoplasm, sink to the bottom of the ovum, towards its vegetal pole. Due to the large yolk contents, the egg of fowl is an extreme example of macrolecithal and telolecithal egg.



Internal structure of hen's egg

NUCLEUS

The ovum contains a nucleus surrounded by a negligible amount of yolk free cytoplasm forming the germinal disc or blastodisc. It always floats on the upper surface of yolk and represents the animal pole of the ovum.

VIVA VOCE

Q.1 *What is the difference between internal and external fertilization?*

Ans. *External fertilization occurs in aquatic environment where male gametes can swim towards the female gametes in water medium. In terrestrial conditions fertilization is internal. Sperms are lodged in the female body where fertilization occurs.*

Q.2 *What are Oviparous animals?*

Ans. *The animals (reptiles and birds) which lay shelled eggs to protect the developing embryo from harsh terrestrial conditions are called oviparous animals.*

Q.3 *What are Viviparous animals?*

Ans. *In mammals, internal fertilization leads to internal development and development of embryo is accomplished inside the female body, which gives birth to young one. Such animals are called viviparous animals.*

Q.4 *Which stage the embryo is in when hen egg is laid?*

Ans. *When hen's egg is laid it is in blastula stage or undergoing gastrulation.*

Q.5 *Define cleavage.*

Ans. *The fertilizad egg undergoes a series of mitotic divisions, called cleavage.*

Q.6 *What is morula?*

Ans. *Cleavage results in the formation of a rounded closely packed solid mass of blastomeres this called is morula.*

Q.7 *Define discoidal cleavage.*

Ans. *In bird's egg the process of cell division is confined to the small disc of protoplasm lying on the surface of the yolk at the animal pole. This type of cleavage is referred as discoidal cleavage.*

Q.8 *What is the blastocoele?*

Ans. *The blastula is characterized by the presence of a segmentation cavity or blastocoele.*

Q.9 *What is zone of junction?*

Ans. *Marginal area of the blastoderm in which the cells remain undetached from the yolk and closely adherent (supporting) to it, is called the zone of junction.*

Q.10 *What is blastoderm?*

Ans. *It is a layer of cells arising from the repeated division of a fertilizaed egg (reptiles, birds and mammals) that develops into an embryo. Or The discoidal cap of cells above the blastocoele is called blastoderm.*

Q.11 *What is fertilization?*

Ans. *The fusion of male and female gametes (sperm and egg) is called fertilization.*

Q.12 *Is it internal or external fertilization that occurs in hen?*

Ans. *The fusion of male and female gametes (sperm and egg) is called fertilization. Does internal or external fertilization occur in hen. Internal fertilization occurs in hen.*

Q.13 *What is the shape of hen's egg?*

Ans. *Hen's egg is oval in shape.*

Q.14 *What is the function of egg shell?*

Ans. *(i) It protects the egg and later embryo.*

(ii) It is responsible for exchange of gases between embryo and atmosphere.

Q.15 *What is the shape of hen's egg?*

Ans. *Hen's egg is oval in shape.*

Q.16 *What is the egg shell chemically made of?*

Ans. *The egg shell is chemically made up of calcium carbonate.*

Q.17 *What is the blastodrm?*

Ans. *It is a layer of cells arising from the repeated divisions of fertilized egg that develops into an embryo.*

Q.18 *What is vitelline membrane?*

Ans. *It is thin transparent membrane which separates yolk from albumen.*

Q.19 *Which part of the reproductive tract does secrete the shell around yolk.*

Ans. *Shell gland (uterus).*

Q.20 *What is latebra?*

Ans. *It is central flask shaped area in the yolk.*

Q.21 *What is nucleus of pander?*

Ans. *The latebra extends towards the blastodisc and flares out under it in a mass called Nucleus of pander.*

Q.22 *Why air space is formed between the two membranes of egg?*

Ans. *The air space is formed because the egg contracts as it cools after being laid and because of evaporation of water.*

Q.23 *In which form is the stored food present in egg of the hen?*

Ans. *It is stored in the form of albumen and yolk.*

Q.24 *What are chalazae? What is their function?*

Ans. *They are two spirally twisted bands within albumen. They serve to hold the yolk in the centre of albumen and subsequently protect the embryo from vibration.*

Q.25 *What is the chemical nature of yolk?*

Ans. *Protein and fat.*

Q.26 *What is the chemical nature of albumen?*

Ans. *Protein.*

Q.27 *What are the different regions of albumen?*

Ans. *It is differentiated into two parts, outer less dense albumen and inner dense Albumen.*

13 Experiment

STUDY OF DEVELOPMENT OF CHICK EMBRYO 48/72 HOURS AFTER INCUBATION

Part I Study of 48 Hours Embryo

Part II Study of 72 Hours Embryo

MATERIAL

Fertilized egg incubated for 48 hours; Fertilized egg incubated for 72 hours; Fine, sharp-pointed scissors; Filter paper; Physiological saline solution, warmed to about 38°C, Petri dish; Fine, sharp-pointed forceps; Paper towels; Medicine dropper or pipette; Small specimen jar; 70% ethyl alcohol; Dissecting microscope; Ink marker.

PROCEDURE

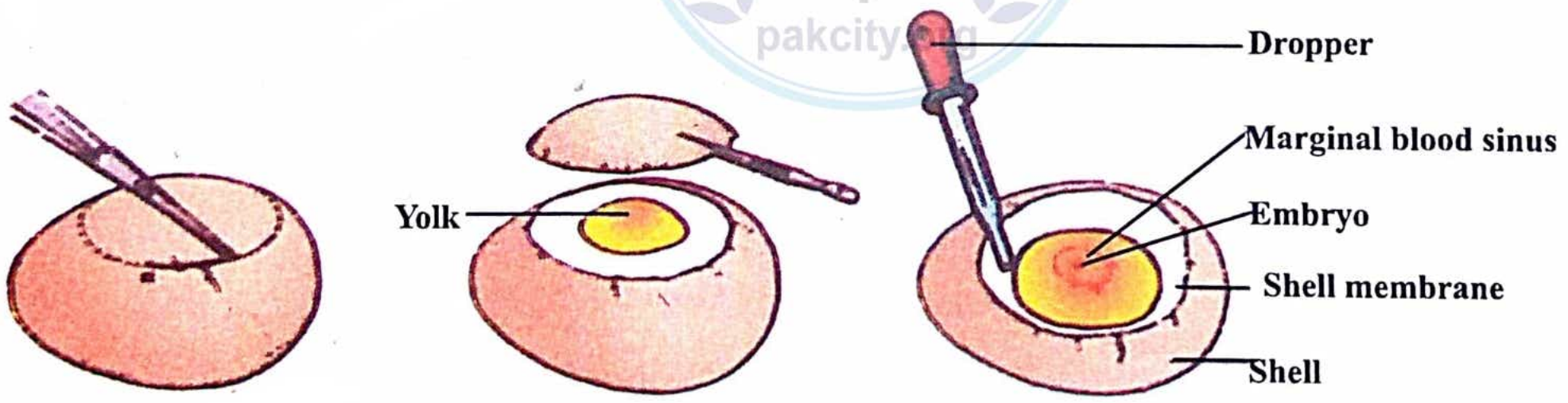
Opening the incubated egg

(i) ***Insert point of scissors barely through shell and gently clip large opening.***

(ii) ***With the forceps carefully lift the loose piece of shell and discard it.***

(iii) ***Draw off albumen with medicine dropper until yolk surface is uncovered.***

An alternative method is to break the egg into a dish of a warm saline solution (Just as you break an egg into a frying pan). Locate the embryo and observe it.



Method of opening an egg

Removing the embryo by paper ring method

Use the paper ring method to remove the embryo from the yolk.

(i) ***Cut and place filter-paper ring of inside diameter barely smaller than the***

(ii) ***Grasp edge of paper ring and adhering membrane with forceps, and clip the***

(iii) ***Lift the filter-paper ring with adhering membranes and embryo, and transfer to***

(Iv) ***Physiological saline solution.***

OBSERVATIONS

Place the petri dish with floating embryo on the stage a stereoscopic dissecting microscope and observe it under different powers. While you are observing the embryo, note carefully its stage of development. You can see the head and neck at this stage.

(a) Cut and place filter-paper ring of inside diameter barely smaller than the diameter of the marginal blood sinus.

(b) Grasp edge of paper ring and adhering membrane with **forceps** and clip the membrane completely around the paper ring.

(c) Lift the filter-paper ring with adhering membranes and embryo, and transfer to physiological saline.

A procedure for removing an embryo from the yolk

PART - I

The following structures are visible in 48 hours embryo:

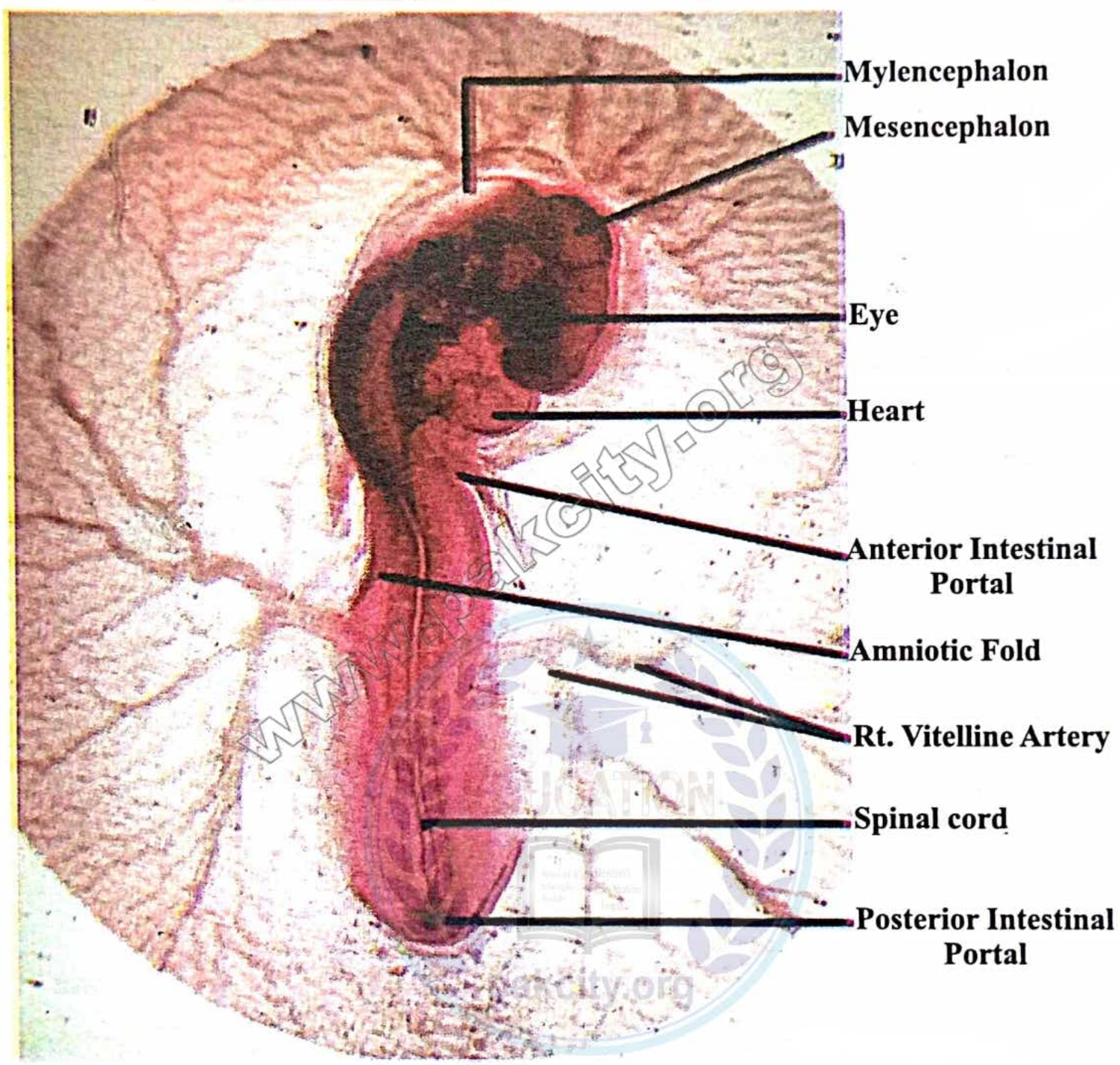
(i) *the head and neck are most prominent.*

(ii) *the two bulges on each side of the front of the brain.*

(iii) *Nineteen paired blocks, called somites, to the rear of the head will develop into the backbone and the muscles of the back.*

(iv) *The brain and the nervous system develop from embryonic ectoderm.*

(v) *Heart is present on the right side.*



48 hours embryo

POINTS OF IDENTIFICATIONS

48 hr. Embryo

(i) *Head and neck is prominent.*

(ii) *19 pairs of somites are present.*

(iii) *Heart is present on the right side.*

PART - II

The following structures are visible in 72 hours embryo:

(i) *Three pairs of gill slits and the blood vessels (aortic arches).*

(ii) *The neural tube has become a five-part brain anteriorly and spinal cord posteriorly.*

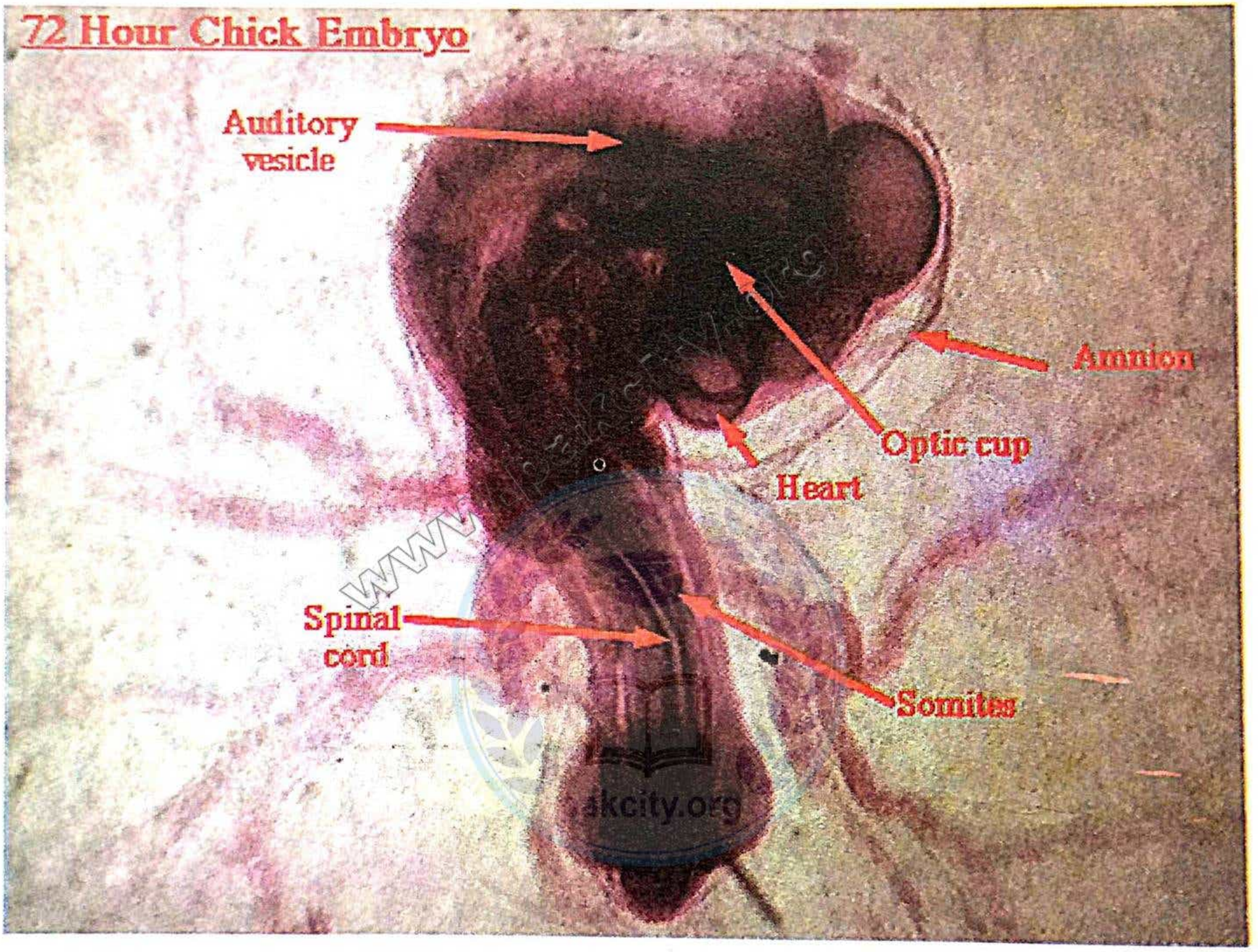
(iii) *The optic vesicles have greatly enlarged.*

(iv) *Dorsal to the gill slits on each side is an invaginated thickening of the ectoderm forming the auditory vesicle (ear).*

(v) *The heart has become twisted and transformed into a two-chambered structure consisting of an auricle and a ventricle.*

(vi) *Vitelline arteries enter the yolk sac and vitelline veins enter the auricle.*

(vii) *Truncus arteriosus arises from the ventricle and branches into aortic arches.*



POINTS OF IDENTIFICATIONS:

72-hr. Embryo

(i) *Optic vesicles greatly enlarged.*

(ii) *36 pairs of somites are present.*

(iii) *The heart becomes twisted.*

VIVA VOCE

Q.1 Why chick embryo is used in development studies?

Ans. It is used because its early embryonic development is markedly similar to that of the mammalian embryo.

Q.2 Why the process of cleavage in chick is called the partial or discoidal cleavage?

Ans. The cleavage in chick is called partial or discoidal cleavage because the irregular cleavage divisions, restricted to blastodisc are incomplete and large mass of yolk does not divide.

Q.3 At what temperature the eggs are incubated artificially?

Ans. 36-38°C

Q.4 From which germinal layer the nervous system develops?

Ans. Ectoderm.

Q.5 From which part the backbone develops?

Ans. Somites

Q.6 From which layers the somites develops?

Ans. Mesoderm.

Q.7 How many somite pairs are seen in 48 hour embryo?

Ans. 19 pairs.

Q.8 How many somite pairs are seen in 72 hour embryo?

Ans. 36 pairs

Q.9 When does the chick embryo differentiate into the head and neck parts?

Ans. At 48 hour embryonic stage.

Q.10 Name the germinal layers from which all body parts of chick will develop.

Ans. (i) Ectoderm (ii) Mesoderm (iii) Endoderm

Q.11 From which germinal layer the circulatory system develops?

Ans. Mesoderm.

Q.12 What structures are more prominent in 48 hour embryo?

Ans. (i) Head and neck parts (ii) Developing brain
(iii) Optic vesicles and auditory vesicles (iv) Twisted heart
(v) Somites

Q.13 What structures are more prominent in 72 hour embryo?

Ans. (i) Three pairs of gill slits and aortic arches
(ii) Neural tube developing into brain and spinal cord.
(iii) Optic cups, optic lenses and auditory vesicles.
(iv) Two chambered heart
(v) Vitelline arteries.

Q.14 Define neurulation.

Ans. The whole process of formation of nervous system is called neurulation.

Q.15 What is gastrulation?

Ans. It is the process of cellular movements whereby future endoderm, mesoderm and notochord cells of the blastula migrate to the interior, thereby generating three germinal layers.

Q.16 What is area pellucida?

Ans. The central part of blastoderm where cells can be separated from the yolk, giving the area a translucent appearance is called the area pellucida.

Q.17 What is area opaca?

Ans. The peripheral part of the blastoderm where the cells lie unseparated from the yolk is termed as area opaca. i.e., the white area that transmits light.

Q.18 What is primitive streak?

Ans. In the chick the mesodermal cells do not invaginate as in amphibians, but migrate medially and caudally from both sides and create a mid line thickening called primitive streak.

Q.19 What is primitive node?

Ans. The anterior end of the primitive streak is occupied by an aggregation the primitive node or notochordal cells while rest of cells are mesodermal cells.

Q.20 What is Hensen's node?

Ans. At the cephalic end of primitive streak, closely packed cells form a local thickening known as Hensen's node.

Cell Cycle

14 Experiment

PREPARATION OF ROOT TIP SQUASHES TO STUDY STAGES OF MITOSIS

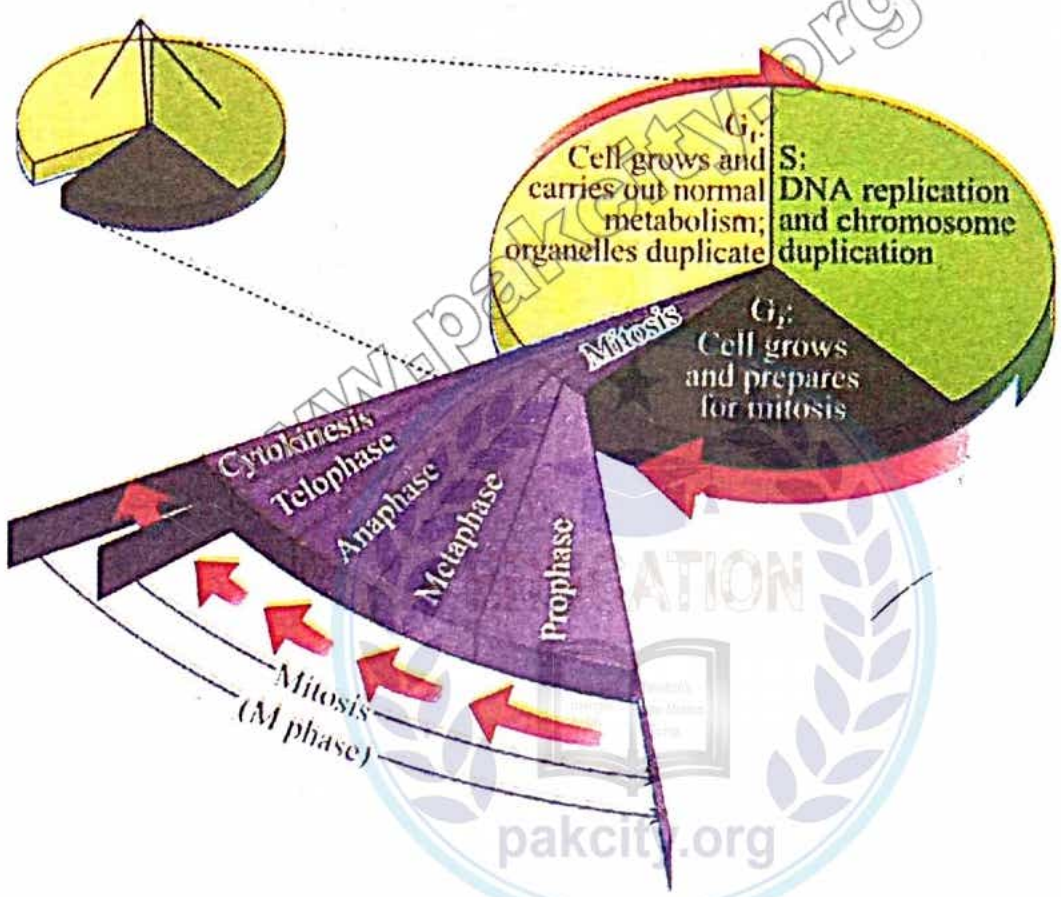
MITOSIS:

Definition:

It is the type of cell division in which number of chromosomes in the daughter cells remain same as in the parent cell.

"Mitosis" is derived from the Greek word mitosis, meaning "thread". Mitosis is a process of nuclear division in which duplicated chromosomes are separated from each other, producing two nuclei, each with one copy of each chromosome.

Mitosis is usually accompanied by cytokinesis which is a process by which cells split into two, partitioning the cytoplasm into two roughly equal packages. The two daughter cells formed by mitosis.



Eukaryotic cell cycle

A gap (Interval) of cell growth before the onset of DNA **replication**

S : A time of "synthesis" (DNA replication).

PHASES OF MITOSIS

The process of mitosis is generally divided into prophase, metaphase, anaphase and telophase.

STUDY OF MITOSIS IN ONION ROOT TIP

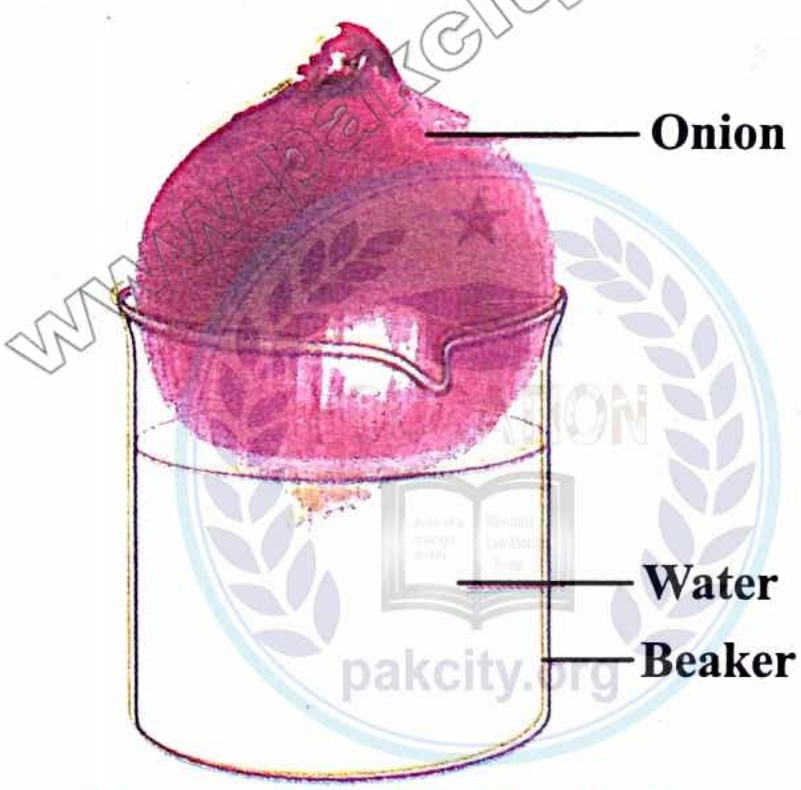
The oninon root tip is one of the most widely used materials for the study of mitosis because it is readily available, preparation of the dividing cells is easy, and the chromosomes are large and few in number. Root tips are regions of active cell divisions, therefore, chances are good that in a specimen of such tissues, one can find every stage of mitosis.

MATERIALS

(i) Compound microscope
(ii) Onion root tips
(iii) 1% Hydrochloric acid
(iv) 2% aceto-orcein stain
(v) Glass slide
(vi) Cover slip
(vii) Filter paper
(viii) Blotting paper
(ix) Watch glass
(x) Dropper

PREPARATION OF ONION ROOT TIPS

(1) Take an onion bulb and place it on a beaker full of water.
(2) The base of bulb must touch the water in beaker.
(3) After a few days, the roots will become prominent.
(4) When roots become 5-6 cm long, their tips (1- 2 mm) are cut.
(5) When root tips are not immediately needed, they should be fix in carnoy's solution.
(6) After two hours, the root tips are removed from carnoy's solution and should be preserved in 70% alcohol until the time of use.



Preparation of Onion Root

METHOD

(1) Fresh root tips or preserved tips are placed in 1% HCl solution for 30 minutes to hydrolyse the cell wall.
(2) Put the root tip on a glass slide.
(3) Remove the acid from root tip by adding water and then remove the water with a filter paper or blotting paper.

(4) *Crush the root tip with a clean spatula or with a razor blade or a sharp scalpel.*

(5) *Blot dry the slide.*

(6) *Add a drop of acetoiorcein stain to the root tip on the slide;. Allow to stain for 5 to 10 minutes.*

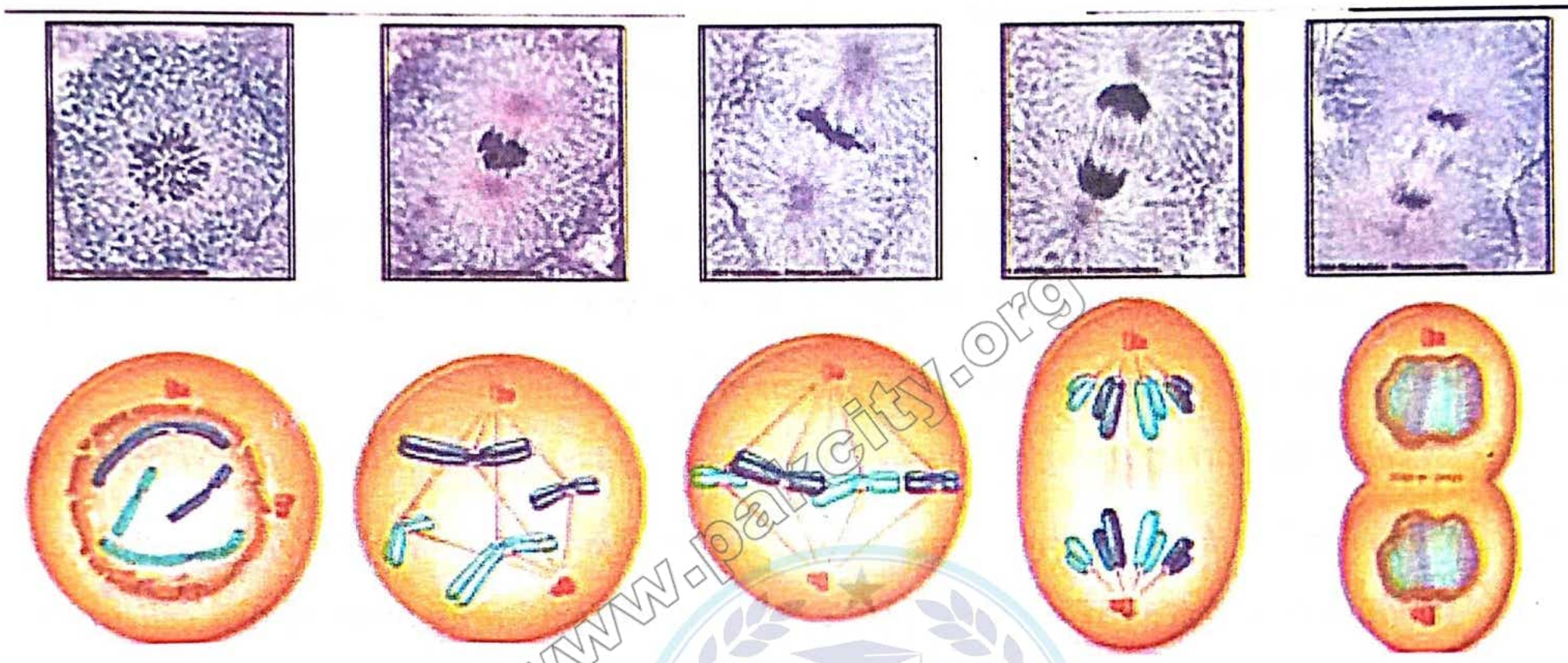
(7) *Place a cover slip over it and gently press with thumb to spread the material.*

(8) *Remove the excess stain from the slide with blotting paper.*

(9) *Heat the slide gently over the spirit lamp.*

(10) *Observe the slide under low and high powers of the microscope and study different stages of mitosis.*

OBSERVATIONS



Prophase:

(i) *Chromosomal material condenses to form compact mitotic chromosomes.*

(ii) *Chromosomes are composed of two chromatids attached together at the centromere.*

(iii) *Mitotic spindle is assembled.*

(iv) *Cytoskeletion and nuclear envelope disappear.*

Metaphase:

(i) *Chromosomal microtubules attach to the kinetochores of chromosomes.*

(ii) *Chromosomes move to the spindle equator.*

(iii) *Chromosomes are aligned along metaphase plate, attached by chromosomal microtubules to both poles.*

ANAPHASE

(i) Centromere splits and chromatids separate.

(ii) Chromosomes (chromatids) move to opposite poles.

(iii) Spindle poles move farther apart.

TELOPHASE

(i) Chromosomes cluster at opposite spindle poles.

(ii) Chromosomes become dispersed.

(iii) Nuclear envelope assembles around each chromosome cluster.

(iv) Golgi complex and ER reform.

(v) After telophase the division of cytoplasm (cytokinesis) starts.

CYTOKINESIS

It is the process of division of cytoplasm and it involves cell plate formation.

(i) As mitosis ends, vesicles converge at the spindle equator. They contain cementing materials and structural materials for a new primary cell wall.

(ii) A cell plate starts forming as membranes of vesicles fuse. Materials inside the vesicles get sand witched between two new membranes that elongate along the plane of the cell plate.

(iii) Cellulose is deposited on the inside of the "sandwitch" thus forming two cell walls. Other deposits will form a middle lamella and cement the wall together.

(iv) A cell plate grows at its margins untill it fuses with the parent cell's plasma membrane. During plant growth when cells expand and their walls are still thin, new materials get deposited on the old primary wall.

VIVA VOCE

Q.1 *Define Mitosis.*

Ans. *It is a process of cell division in which number of chromosomes in the doughter cells remains same as in the parent call..*

Q.2 *What is meant by cytokinesis?*

Ans. *Cytokinesis is a process by which cell splits into two, partitioning the cytoplasm into roughly equal packages.*

Q.3 *What is the significance of mitosis?*

Ans. *It maintains the chromosomal number and generates new cells for growth, maintenance and repair of an organism.*

Q.4 *Define cell cycle.*

Ans. *The series of changes which involve period of growth, replication of DNA followed by cell division are called as cell cycle.*

Q.5 *What are the substages of mitosis.*

Ans. *(i) Prophase (ii) Metaphase (iii) Anaphase (iv) Telophase*

Q.6 *Which phase is the reverse of telophase?*

Ans. *Prophase.*

Q.7 *Why onion root tip is used for study of mitosis?*

Ans. *It is readily available, preparation of the dividing cells is easy, and the chromosomes are large and few in number.*

Q.8 *Which solution is used to preserve root tips?*

Ans. *Carnoy's solution.*

Q.9 *Which acid is used to hydrolyse the cell walls?*

Ans. *Hydrochloric acid (1%)*

Q.10 *What is the longest phase of cell cycle?*

Ans. *Interphase.*

Q.11 *Name three stages of interphase.*

Ans. *G_1, S and G_2 phases.*

Q.12 *What is meant by G_1?*

Ans. *It means a gap (interval) of cell growth before the onset of DNA replication.*

Q.13 *What is meant by S?*

Ans. *It means a time of synthesis (DNA replication).*

Q.14 *What is meant by G_2?*

Ans. *It means a second gap following DNA replication when the cell prepares for division.*

Q.15 *What is meant by M?*

Ans. *It means nuclear division only, mitosis or meosis, usually followed by cytoplasmic division (Cytokinesis).*

Q.16 *Which stain is usually used to study mitosis in onion root tip?*

Ans. *Aceto orcein stain.*

Q.17 *What is metaphase plate or equatorial plate?*

Ans. *During metaphase, the chromosomes become arranged in the middle of spindle. This arrangement is called equatorial plate.*

Q.18 *How many chromosomes are found in cells of onion root tip?*

Ans. *16 or 8 pairs.*

Q.19 *Where do you observe cells dividing in the onion root?*

Ans. *In root apical meristem present at the root tip.*

Q.20 *What has happened to nucleoli during prophase?*

Ans. *Nucleoli disappear.*

15 Experiment

PREPARATION OF SQUASHES OF RHOEO DISCOLOR FLORAL BUDS TO STUDY MEIOSIS AND OBSERVATION OF STAGES OF MEIOSIS FROM PREPARED SLIDES AND STUDY OF POLYTENE CHROMOSOMES

MEIOSIS:

Definition:

It is the type of cell division in which number of chromosomes become half (n) in the daughter cells as compared to the parent cells (2n)

TIME OF MEIOSIS

(i) In Plants: In plants during spore formation.

(ii) In Animals: During gametes formation.

Meiosis maintains the chromosome number constant for most species of plants and animals and provides a means of genetic variability because of crossing over and the subsequent exchange of genetic material. Meiosis is subdivided into following two step or stages.

(i) Meiosis I or First meiotic division

(ii) Meiosis II or Second meiotic division

METHOD 1

Preparation of squashes of Rhoeo discolor floral buds to study meiosis

MATERIAL

(i) Stereomicroscope (ii) Spirit lamp (iii) Watch glass

(iv) aceto-orcein stain (2%) (v) Dissecting box

(vi) Fresh or preserved floral buds of Rhoeo discolor

(vii) Cover slips (viii) Carnoy's solution (ix) Slides

(x) Refrigerator (xi) 70% ethanol (xii) Razor blade

(xiii) Forceps (xiv) Blotting paper (xv) Specimen jar

(xvi) Compound microscope

PRESERVATION OF FLORAL BUDS

The floral buds of Rhoeo discolor can be collected early enough in growing season (March to April) when meiosis is taking place. These buds are fixed in carnoy's solution. After 18-24 hours, these buds are, preserved in a specimen jar containing 70% ethanol. The preserved buds are then placed in refrigerator.

METHOD

(1) Take a fresh or preserved floral bud of Rhoeo discolor in a watch glass containing 70% ethanol.

(2) *Place the watch glass containing floral bud on the stage of stereo microscope and separate the anthers from other parts.*

(3) *Take a clean glass slide containing a drop of acheta orcein stain and place one or two anthers on it.*

(4) *Cover it with cover slip and then press the cover slip gently by a pad of filter paper with tumb.*

(5) *Remove the excess out flowing stain with blotting paper.*

(6) *Heat the slide gently over the flame.*

(7) *Study the slide under low and high powers of the compound microscope.*

METHOD 2

Observation of stages of meiosis from prepared slides

MATERIAL

(i) *Prepared slides of meiosis* (ii) *Microscope*

METHOD

(1) *Study the prepared slides of meiosis one by one under low and high powers of microscope.*

(2) *Sketch neat and labeled diagrams.*

OBSERVATIONS:

(I) *Meiosis I*

(2) *Prophase I*

(a) Leptotene *(Points of Identification)*

(i) *Nucleus increases in size.*

(ii) *Chromosomes become visible.*

(iii) *Each chromosome appears to be consisting of two chromatids held together by a centromere.*

(b) Zygotene *(Points of Identification)*

(I) *Lengthwise pairing of homoglous chromosomes occurs. This is called synapsis.*

(ii) *Chromosoems continue to condense.*

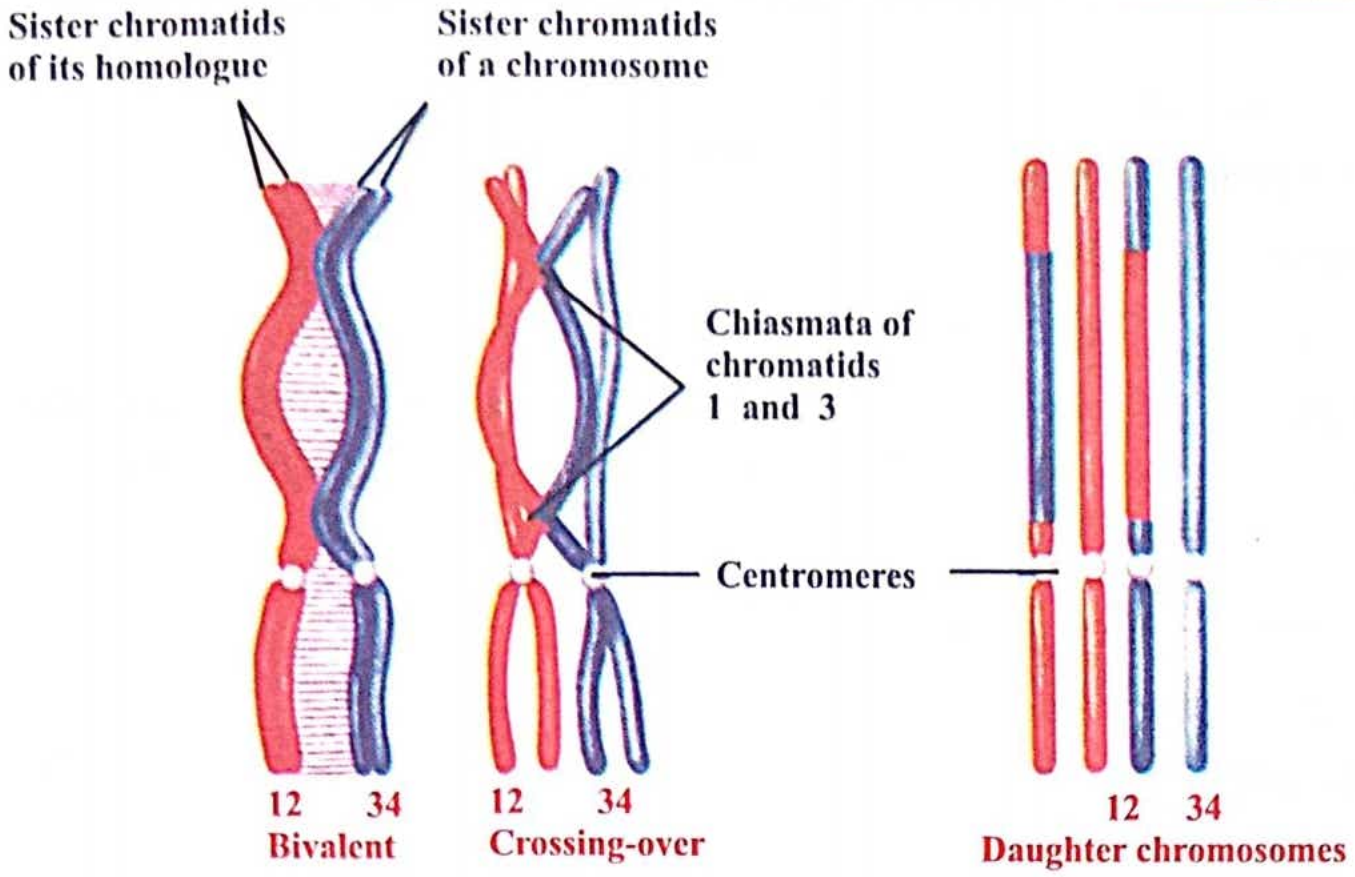
(c) Pachytene *(Points of Identification)*

(i) *Synapsis completes.*

(ii) *At this stage, pairs of homologous chromosomes are called bivalents.*

(iii) *Each bivalent is made up of four chromatids therefore it is also called tetrad.*

(iv) *Chromosomes continue to condense.*



(d) Diplotene ***(Points of Identification)***

(i) After further condensation, the paired chromosomes repel each other and begin to separate.

(ii) Separation however is not completed, because homologous chromosomes remain united by their points of interchange (Chiasmata).

(iii) Each bivalent has at least one such point od contact, the cromatids otherwise are separated.

(e) Diakinesis ***(Points of Identification)***

(i) During this phase the condensation of chromosome almost reaches to its maximum.

(ii) At the same time separation of the homologous chromosomes (started during diplotene) is completed but still they are united at one point, more oftenly at ends.

(iii) Nucleoli disappear.

(iv) Nucleoli disappear.

(v) Chromosomes prepare for attachment to meiotic spindle fibres.

(2) Metaphase: ***(Points of Identification)***

(i) Nuclear membrane disorganizes at beginning of this phase.

(ii) Spindle fibres originate and the kinetochore fibres attach to the kinetochores of homologous chromosomes from each pole.

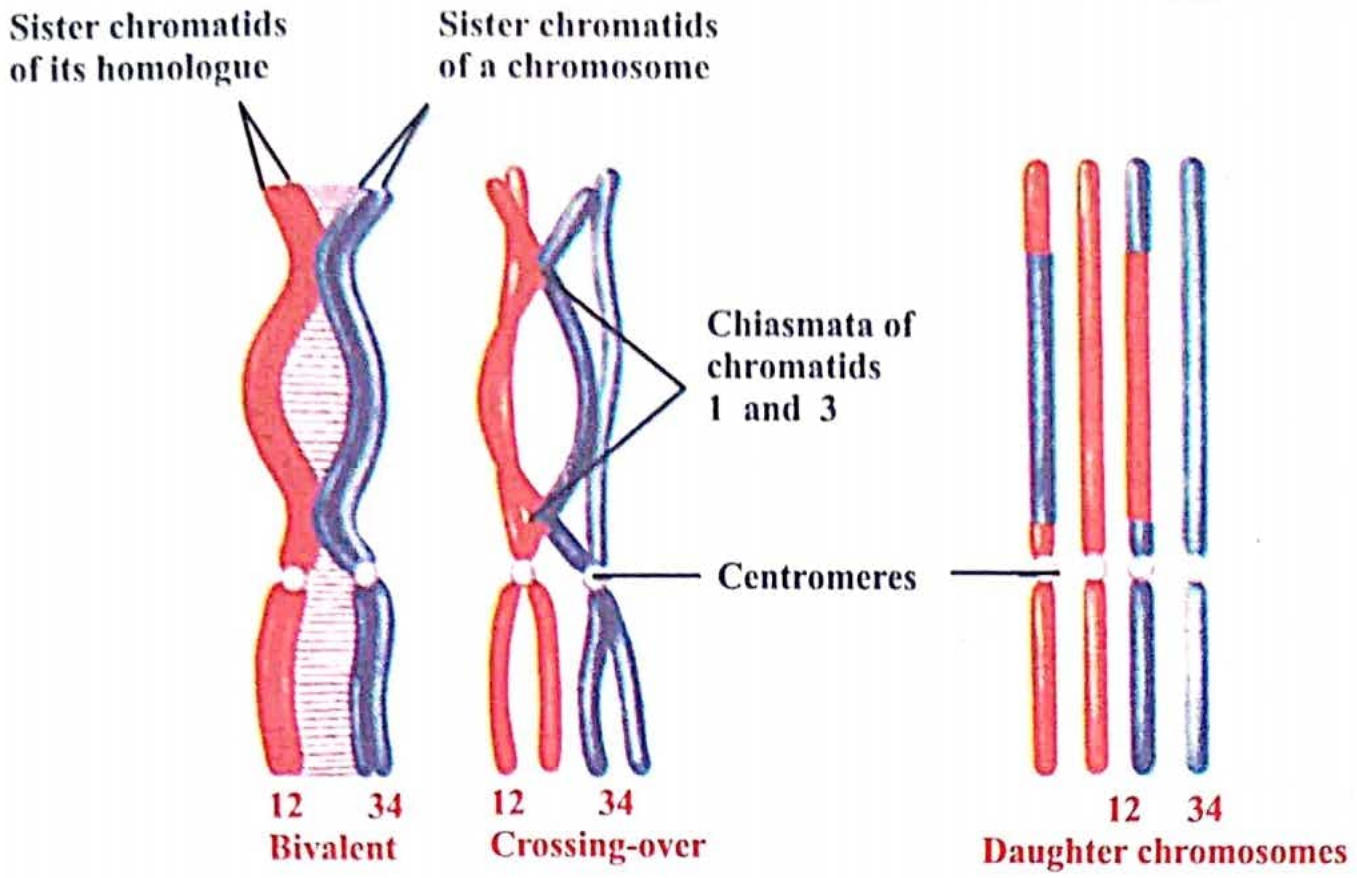
(iii) Bivalents are arranged at equator to form equatorial plate.

(3) Anaphase: ***(Points of Identification)***

(i) Kinetochore fibres contract and spindle fibres elongate.

(ii) Homologous chromosomes of each bivalent separate and move towards their respective poles.

(iii) Each pole receives half of the total number of cnromosomes.



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(v) Chromosomes prepare for attachment to meiotic spindle fibres.

(2) Metaphase: *(Points of Identification)*

(i) Nuclear membrane disorganizes at beginning of this phase.

(ii) Spindle fibres originate and the kinetochore fibres attach to the kinetochores of homologous chromosomes from each pole.

(iii) Bivalents are arranged at equator to form equatorial plate.

(3) Anaphase: *(Points of Identification)*

(i) Kinetochore fibres contract and spindle fibres elongate.

(ii) Homologous chromosomes of each bivalent separate and move towards their respective poles.

(iii) Each pole receives half of the total number of chromosomes.

METHOD 3

STUDY OF POLYTENE CHROMOSOME

Polytene chromosomes are special large sized chromosomes found in the cells of larval salivary gland of Drosophila.

OTHER SITES

Large, multistranded or polytene chromosomes are not confined to the salivary gland cells but are also present in cells of the gut epithelium, in the malpighian tubules of the larva and in the foot pads of adult flies.

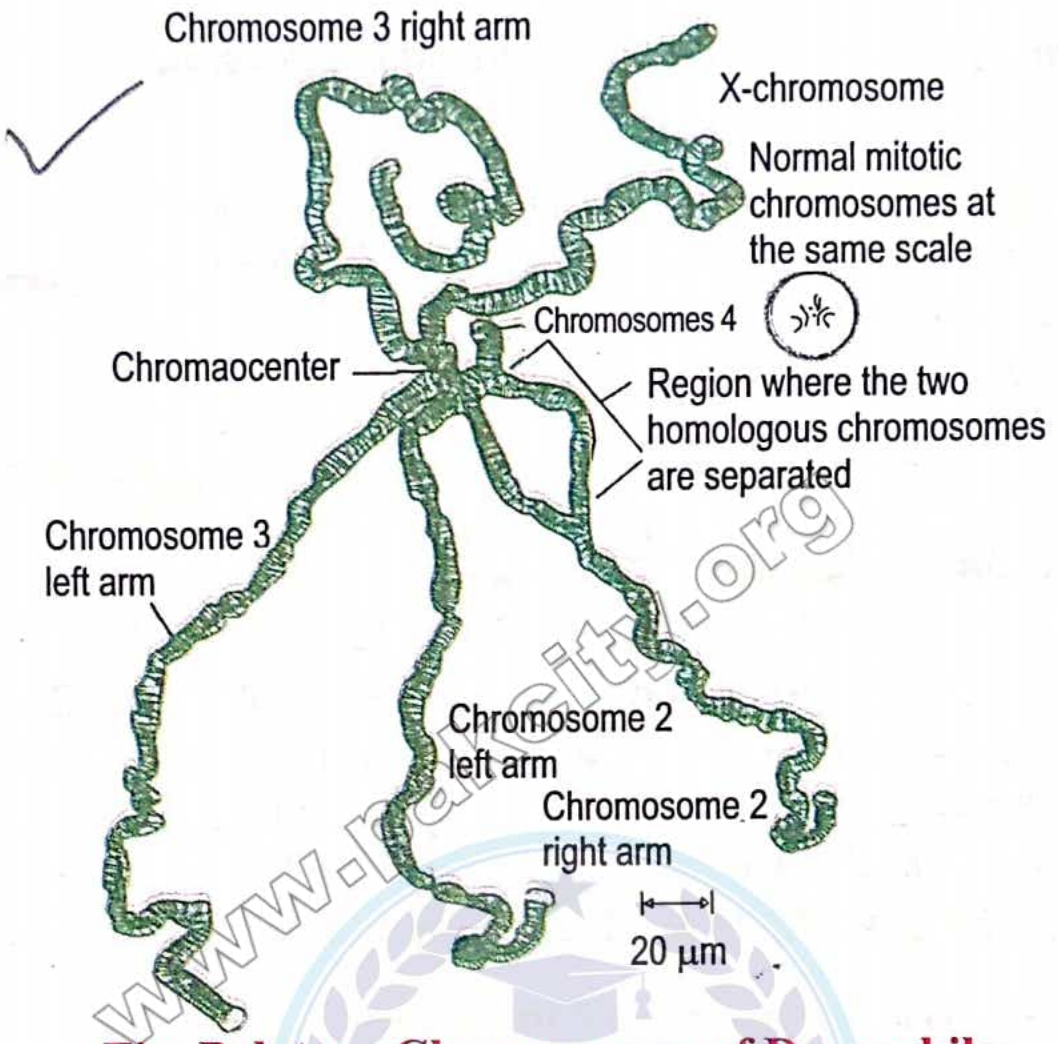


Fig. Polytene Chromosomes of Drosophila

MATERIAL

(I) Compound microscope (ii) Prepared and stained slide of polytene chromosome.

METHOD

(i)Study the slide under low and high powers of microscope.

(ii)Sketch neat and labelled diagram.

OBSERVATIONS:

(1) The giant polytene chromosomes from the salivary gland of a larval fruit fly show thousands of distinct darkly staining bands.

(2) Many of these bands are loci of particular genes.

(3) Polytene chromosome consists of a number of individual DNA strands.

(4) The bands on the chromosomes correspond to sites where the DNA is more tightly compacted.

(5) Specific sites of chromosomes are expanded to form "Puffs".

(6) Chromosome puffs are sites where DNA is being transcribed.

VIVA VOCE

Q.1 *What is alternation of generations?*

Ans. *The alternate occurrence of sporophyte (2n) and gametophyte generation. (n) is called alternation of generatins.*

Q.2 *What is sporophyte?*

Ans. *It is spore producing generation.*

Q.3 *Define sporogenesis.*

Ans. *The formation of spores by meiosis is called sporogenesis.*

Q.4 *Give significance of meiosis.*

Ans. *It maintains the chromosome number constant for most species of plants and animals and provides a means of genetics variability because of crossing over and subsequent exchange of genetic material.*

Q.5 *What is the difference between mitosis and meiosis?*

Serial No.	Mitosis	Meiosis
1.	Chromosome number remains constant.	Chromosome number is reduced to half.
2.	One cells gets divided into two.	One cell gets divided into four.
3.	There is no pairing of homologous chromosomes.	Homologous chromosomes form pairs (synapsis).
4.	Somatic cells(e.g. skin cells, blood cells, bone cells etc) formed by mitosis	Sex cells (gametes or spores) formed by meiosis

Q.6 *When does meiosis occur in animals and plants?*

Ans. *Meiosis occurs in animals at the time of gamete formation (gametogenesis) and in plants a the time of spore formation (sporogenesis).*

Q.7 *Name of types of spores produced in angiosperms (flowering plants) and gymnosperms?*

Ans. *(i) The microspores (pollen grains)*

(ii) The megaspores

Q.8 *Where are the microspores and megaspores of flowering plants produced?*

Ans. *In angiosperms, the microspores are produced within the pollen sacs or microsporangia of the anthers whereas the megaspores are produced within the megasporangia contained within the ovules.*

Q.9 *What are such angiosperms which produce two (different) types of spores?*

Ans. *Such plants are called heterosporous. The production of two types of spores is called heterospory.*

Q.10 *What is the squash preparation?*

Ans. *It is a microscopic preparation in which plant material is flattened before examination.*

Q.11 *Why are living plant materials fixed prior to squash preparation for the study of cell division?*

Ans. *The fixation stops the cells divisions and preserves the chromosomes in their normal form and position.*

Q.12 *How is living material fixed before squash preparation?*

Ans. *It is fixed by putting in proper chemicals called fixatives such as Carnoy's solution or Harmer's fixative.*

Q.13 *What are homologous chromosomes (homologues)?*

Ans. *The chromosomes always occur in pairs in almost all the species. The two similar chromosomes of each pair are known as the homologous chromosomes.*

Q.14 *What is synapsis?*

Ans. *The pairing of homologous chromosomes during prophase I is called synapsis.*

Q.15 *In which stage does synapsis occurs?*

Ans. *The synapsis occurs in zygotene of prophase I.*

Q.16 *What are chiasmata?*

Ans. *The points of attachment of non sister chromatids of homologous chromosomes are called chiasmata.*

Q.17 *In what stage of meiosis does the crossing over take place?*

Ans. *The crossing over takes place during pachytene of prophase I.*

Q.18 *What is crossing over?*

Ans. *The exchange of segments between non sister chromatids of homologous chromosomes is called crossing over.*

Q.19 *What is bivalent or tetrad?*

Ans. *A structure consisting of two homologous chromosomes or four chromatids is called a bivalent or tetrad respectively or each paired but not fused, complex structure is called as bivalent or tetrad.*

Variation and Genetics

16 Experiment

STUDY OF CONTINUOUS VARIATIONS IN THE HEIGHT IN MAN AND DISCONTINUOUS VARIATION IN TONGUE ROLLING IN MAN AND RECORDING THE RESULT AS HISTOGRAMS

Continuous variations:

Quantitative variations are small and less striking. Many traits like height, weight and skin colour in humans exhibit continuous variations over a range of many phenotypes.

Discontinuous variations:

Qualitative differences are large and more obvious. Some traits like pea seed shape show discontinuous variations with two sharply distinct phenotypes. Some people can roll their tongue into a distinct U shape when they extend it out of their mouth. This ability is due to a single dominant gene. It is a discontinuous variation.

Histogram:

Frequency Histogram illustrates variations. A frequency histogram is a simple graph. The horizontal or X-axis indicates the range of different phenotypes of a trait within a population. The vertical or Y-axis indicates the number of individuals or their percentage in a population. Study of continuous variation in the Height in human.

STUDY OF CONTINUOUS VARIATION IN THE HEIGHT IN MAN

APPARATUS

Measuring tape or rod, Rectangular plate, Graph paper, Note book, A sharp pencil, tudents of biology second year class,

PROCEDURE

(1) Arrange this activity in biology laboratory.

(2) Ask the students to take off their shoes.

(3) Call the students one by one according to their roll numbers or names as in their Attendance register.

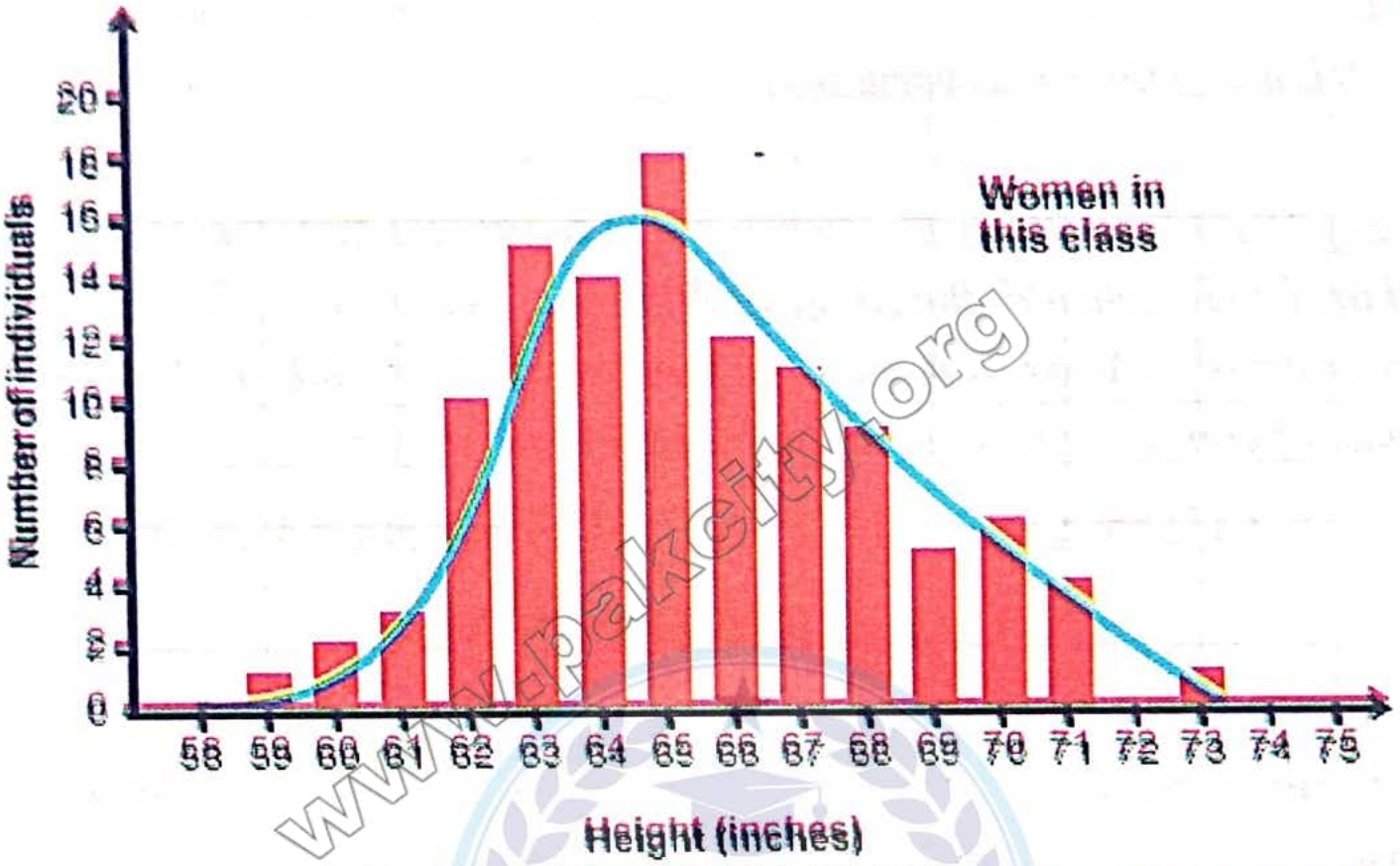
(4) Stand the student along the wall with hanging measuring tape or rod.

(5) Place the rectangular plate on the head in horizontal fashion. One end of the tape must touch the rectangular plate and other to the floor of laboratory.

(6) Measure and record the heights of all students in centimeters.

(7) Now arrange the heights in order of magnitude and make a frequency table.

S. No	No. Of Individuals	Height (inches)
1	01	59
2	02	60
3	03	61
4	10	62
5	14	63
6	15	64
7	18	65
8	12	66
9	11	67
10	09	68
11	05	69
12	06	70
13	04	71
14	01	73



STUDY OF TONGUE ROLLING IN MAN

APPARATUS

Note book, Students of biology second year class

PROCEDURE

(1) Arrange this activity in biology laboratory.

(2) Ask the students to be silent during this activity.

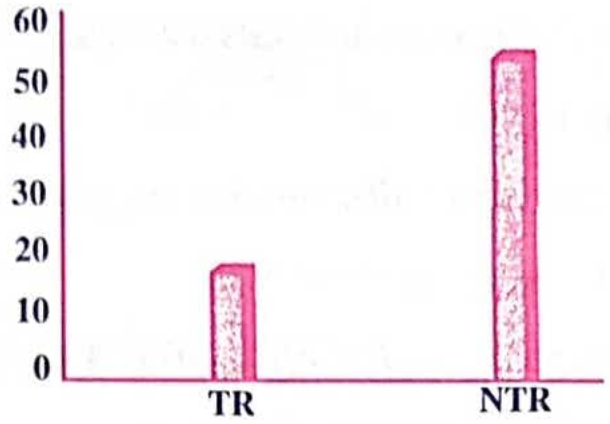
(3) Call the students one by one according to their names or roll numbers.

(4) Ask each student to try to roll his tongue.

(5) Count the number of tongue rollers and nonrollers.

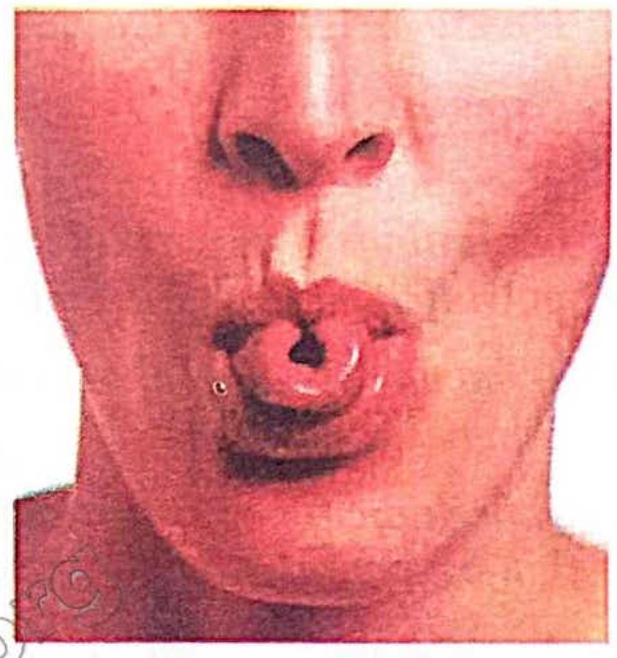
(6) Tabulate the data in the form of table

Total no. Of students	Tongue – roller (TR)	Non – Tongue roller (NTR)
75	20	55



	R	r
R	RR	Rr
r	Rr	rr

RR= roller
Rr= roller
rr= non-roller



Tongue Roller

VIVA VOCE

Q.1. ***What are continuous variations?***

Ans. ***Some traits show more than two qualitatively different phenotypes, this is called continuous variations e.g., wheat grain colour, human height; skin colour and intelligence.***

Q.2. ***What are discontinuous or non-continuous variations?***

Ans. ***There are many traits which have only two sharply defined phenotypes, this is called discontinuous variation e.g., height, colour, shape etc., in pea plant as studied by Mendel.***

Q.3. ***What is polygenic inheritance?***

Ans. ***A trait which is encoded by alleles of two or more different gene pairs found at different loci, all influencing the same trait in an additive way is called polygenic. Trait or continuously varying trait and its inheritance is called polygenic inheritance.***

Q.4. ***What are tongue rollers?***

Ans. ***Some people can roll their tongue into a distinct U shape when they extend it out of their mouth. They are called tongue rollers.***

Q.5. ***Whether tongue rolling is dominant or recessive trait?***

Ans. ***Tongue rolling is dominant trait.***

Q.6. ***Is human height a continuously or discontinuously varying trait?***

Ans. ***Human height is a continuously varying trait.***

Q.7. ***Is tongue rolling a continuously or discontinuously varying trait?***

Ans. ***Tongue rolling is a discontinuously varying trait.***

Q.8. ***What kind of trait is the human height?***

Ans. ***Human height is a continuously varying trait.***

Q.9. ***Explain continuously varying traits and quote their examples in living beings.***

Ans. ***The characters which have several degrees of continuous variations are known as the continuously varying traits. Their examples are kernel color in maize, height, skin colour and intelligence etc, in man.***

Q.10. ***What do you know about the inheritance of continuously varying traits and what is their inheritance known as?***

Ans. ***Inheritance of each of such trait it affected by more than one genes quantitatively. Such an inheritance is known as the quantitative or polygenic inheritance.***

Q.11. ***Explain tongue rolling as a hereditary trait in man.***

Ans. ***Some people can roll the edges of the tongue to form a tube, when it is Extended out from the mouth. This hereditary trait (ability) is called tongue rolling and the people as tongue-rollers. This trait is thought to be due to a single dominant gene.***

Q.12. ***What is a histogram?***

Ans. ***The graphic representation of the frequency distribution of a hereditary trait is known as the histogram.***

Ecosystem

17 Experiment

INVESTIGATION OF FOOD CHAIN AND FOOD WEB OF A POND ECOSYSTEM

FOOD CHAIN

It is the series of various organism, through which food energy moves, with repeated stages of eating and being eaten. It consists of following components.

(1) Producer

These are photosynthetic organism, autotrophs and are capable to fix light energy and manufacture organic food from inorganic substances i.e. $CO_2 + H_2O$.

(2) Consumers

They do not produce their own food, they depend upon other autotrophic organisms for the food.

OR

Organisms which directly or indirectly depend upon the producer for the food.
Consumers are of following types.

(a) Primary consumer

They directly depend upon the producers for the food e.g. grasshopper and zooplankton.

(Note: Tsetse flies suck the blood of zebras.)

(b) Secondary consumer

They feed on primary consumers e.g. Small fish feed on Zooplankton.

(c) Tertiary consumer

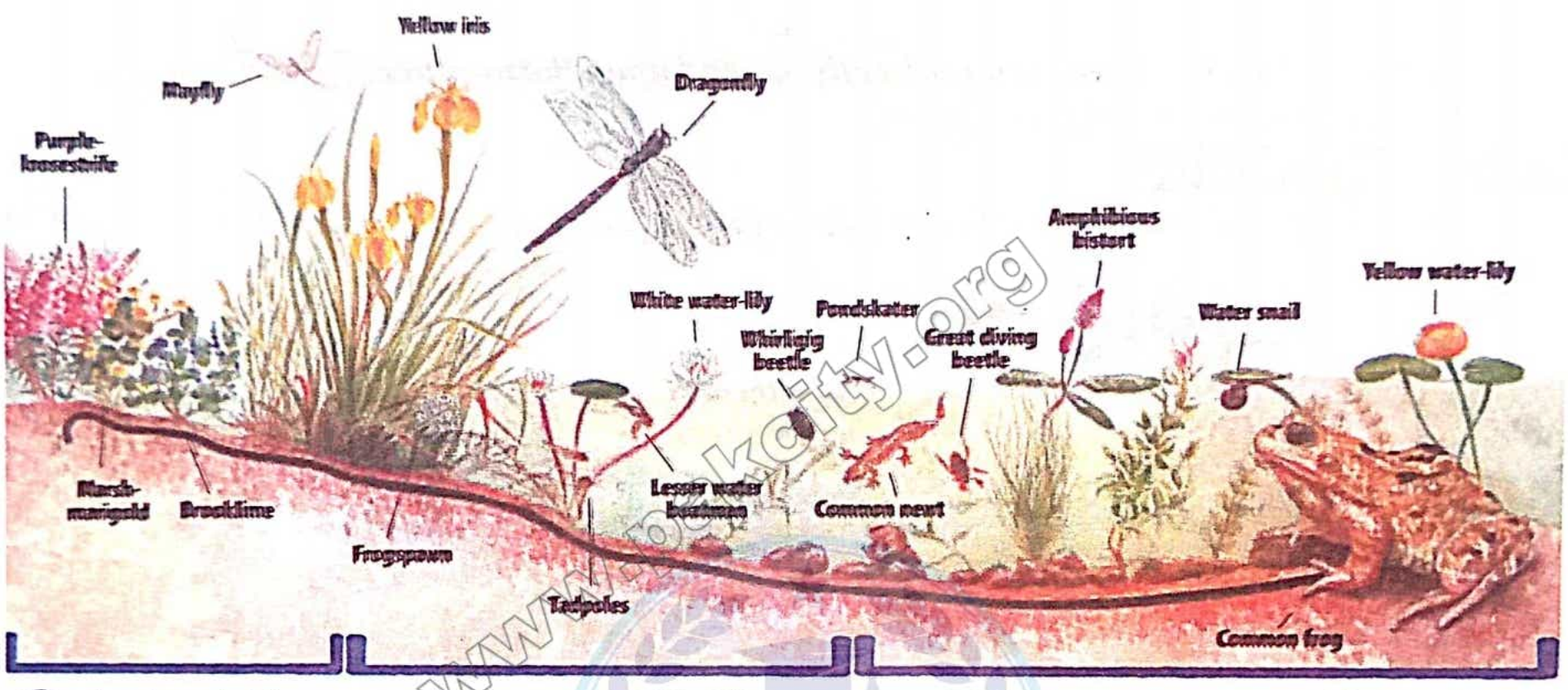
They feed on secondary consumer e.g. large fish.

(d) Quaternary Consumer

They feed on tertiary consumer e.g. man.

Decomposers:

When any of the above organisms die, bacteria and fungi decompose them back to inorganic materials these are called micro consumers or micro organism .



(1)Abiotic substances(2)Producers-phytoplankton

(3)Producers-rooted vegetation(4)Primary consumers

(5)Secondary consumers (carnivores)(6)Tertiary consumers (secondary carnivores)

Pond Ecosystem

A pond serves as a good example of a fresh water ecosystem. It exhibits a self-sufficient regulating system. Basic biotic components of the pond ecosystem are as follows:-

(i) Producers:

These are autotrophic green plants which fix radiant energy With the help of chlorophyll, water and minerals,they manufacture complex organic substances such as carbohydrates, proteins, lipids etc. Producers are of the following types:

(a) ***Macrophytes:***

These are mainly rooted larger plants, growing in shallow water. They also include partly or completely submereged, floating or emergent hydrophytes, such as Kanwal. Typha, Hydrilla, Vallisneria, Potamogenton etc.

(b) ***Phytoplankton:***

It mainly consists of floating and suspended algae like Euglena, Volvox, Chlamydomonas. Diatoms. Spirogyra and Chara etc. They are considered as more important producers than the larger plants.

There are the basic components (biotic and abiotic) of an ecosystem. Where you want it place them?

(ii) Consumers:

They are the heterotrophs, which depend upon the producers for their food. They consists of Primary Consumers which feed directly on living plants or plant remains such as nymphs and larvae of insects, water fleas, tadpoles and zooplanktons; Secondary Consumers which may be beetles, rotifers, crustaceans, frog and fishes. Beetles feed upon some Zooplanktons; and fishes live upon other small animals as well as on herbivorous fishes; Tertiary Consumers consist of carnivorous animals like predatory birds (stock, heron, ducks etc.) and large fishes that feed on the smaller ones.

(iii) Decompoers:

The decomposers consist of bacteria and fungi.

Practical Work:

Material:

Paper, Pencil, Alcohol, Tag, plastic bags, Hand net.

Procedure:

Note down the time and locality of visit of a pond or a forest ecosystem. Make the collection with hand net. Preserve the material collected in separate plastic bags. Bring them in the lab. Study them and make a list of the organisms. Build food chain and food web of these organisms.

Sr. No.	Producers		Consumers		Decomposers	
	NAME	No.	NAME	No.	NAME	No.
1 2 3 4 5						

Note :the food web of pond ecosystem is shown in the diagram below.

VIVA VOCE

Q.1 *What is meant by food web?*

Ans. *Food web is a complex pattern of several interlocking food chains in a complex community or between several communities.*

Q.2 *What are producers?*

Ans. *Producers in an ecosystem are represented primarily by green plants which are capable of producing their own food.*

Q.3 *What are herbivores (primary consumers)?*

Ans. *Hebrivores or primary consumers are the animals that feed directly on green plants.*

Q.4 *What are the principal primary consumers of the terrestrial and the aquatic habitats?*

Ans. *The principal primary consumers in the terrestrial habitats are insects, rodents and ruminants while in aquatic habitats are small crustaceans, mollusks and some fishes.*

Q.5 *What are primary carnivores (Secondary consumers)?*

Ans. *The animals which feed on herbivores or primary consumers are called primary carnivores or secondary consumers.*

Q.6 *What are secondary carnivores (Tertiary consumers)?*

Ans. *The animal which feed on primary carnivores or secondary consumers are called secondary carnivores or tertiary consumers.*

Q.7 *What is food cycle?*

Ans. *A food cycle consists of all the food chains in a particular community.*

Q.8 *Define food chain?*

Ans. *The transfer of food energy from the source in plants through a series of organisms with repeated stages of eating and being eaten is known as food chain.*

Q.9 *Give names of certain natural food cycles.*

Ans. *(1) Nitrogen cycle (2) Carbon-Hydrogen-Oxygen cycle*

Q.10 *What are biogeochemical cycles?*

Ans. *The back and forth movements of chemical substances between organisms and environment along characteristic circular paths are known as biogeochemical cycles.*

Q.11 *What is the difference between atmospheric and sedimentary reservoir cycle?*

Ans. *Biogeochemical cycles that have dominant atmoshpheric phases are called atmospheric reservoir cycles, while those whose sedimentary phase is dominant are called sedimentary reservoir cycles.*

Q.12 *What are predators?*

Ans. *Predators are the animals which capture and readily kill living animals for their food.*

Q.13 *What is prey?*

Ans. *The animal which is killed and eaten by the predator is called prey.*

Q.14 *What is parasitism?*

Ans. *An association between organisms of different species in which one individual is benefited (parasite) and the other though harmed (host) is not killed until the parasite has completed its reproductive cycle.*

Q.15 *Define Symbiosis.*

Ans. *An association between organisms of different species which live together for mutual benefit or one partner gets benefit and the other is neither benefited nor harmed.*

18 Experiment

Estimation of pyramids of numbers using simple techniques

DEFINITION

The relationship between the number of producers, consumers of primary, secondary and tertiary levels constitutes the pyramid of numbers."

In an ecosystem, the producers are always maximum in number. As we move up towards the apex of the pyramid, the number of organisms of successive levels such as primary, secondary and tertiary consumers goes on decreasing. Thus, the pyramid becomes upright.

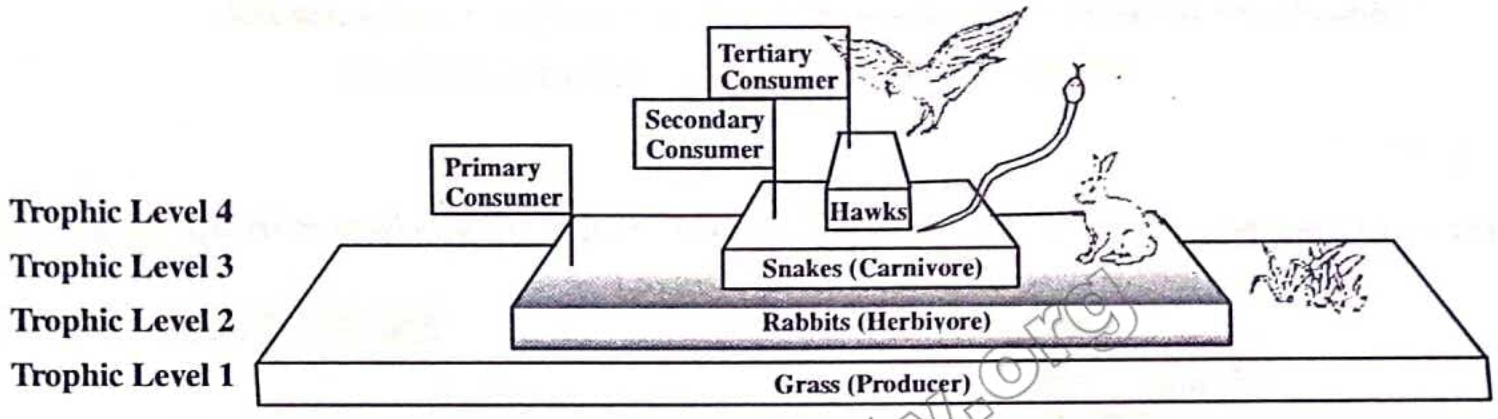


Diagram of Pyramid

MATERIALS:

(i) Measuring tape (100 meter)	*(ii) Rope*	*(iii) Steel or wooden rods*
(iv) Forceps	*(vi) Notebook*	*(v) Pencil*
(viii) Nets	*(ix) Plastic bags*	*(x) Specimen jars*

PROCEDURE

(1) Arrange a field trip to nearby terrestrial or aquatic ecosystem.

(2) Select a plot for sampling in the undisturbed area of ecosystem.

(3) Use quadrat method.

(4) Collect the data.

PYRAMID OF GRASSLAND ECOSYSTEM

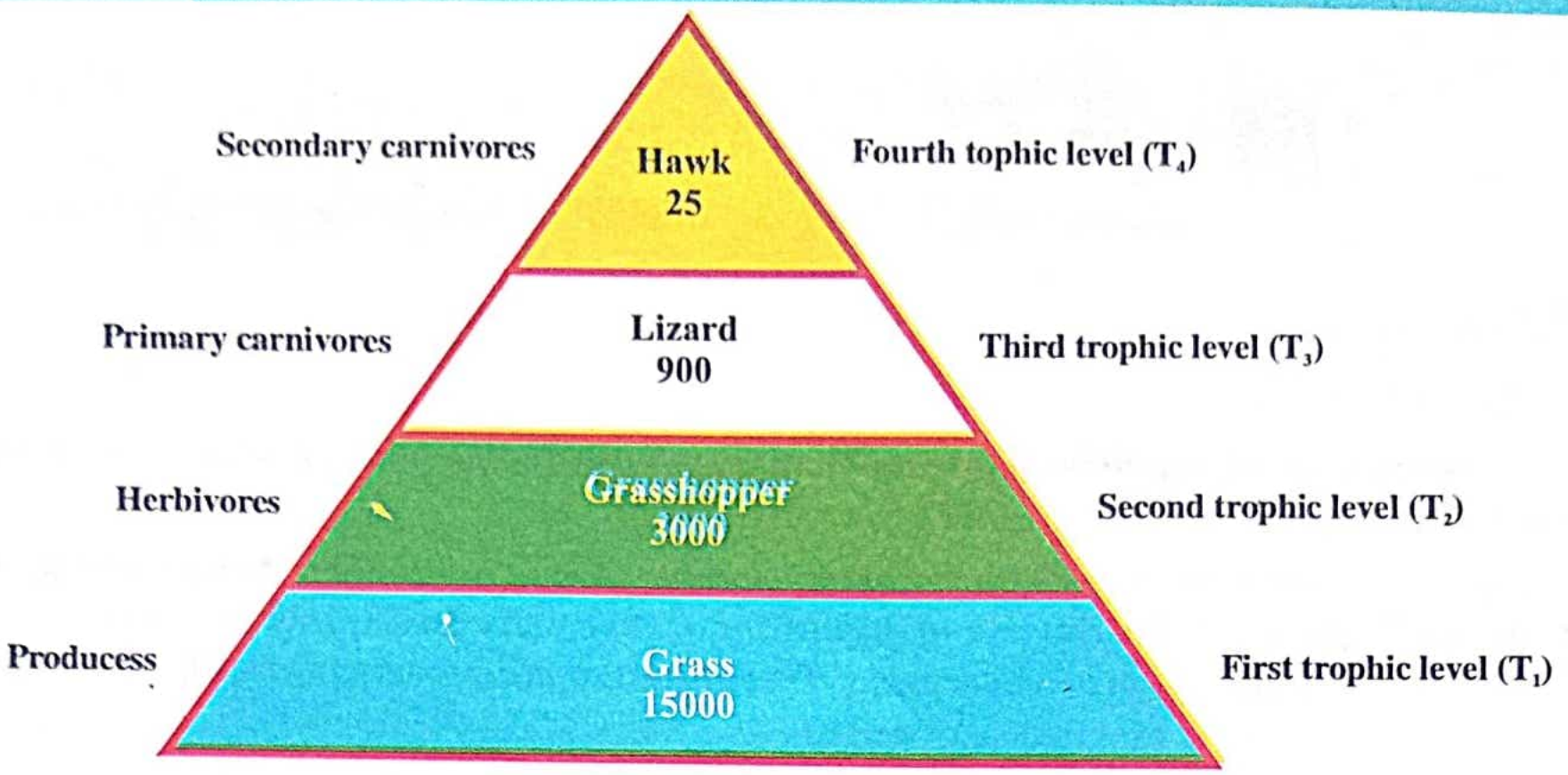
(1) Producers (grasses, herbs, forbs) are largest in number

(2) Primary consumers or herbivores (grasshopper, rabbits) are less in number than producers.

(3) Secondary consumers or primary carnivores (snakes, lizards) are further less in number than primary consumers.

(4) Tertiary consumers or secondary carnivores (hawks) are smallest in number.

(5) The number of organisms decreases from base of pyramid to apex.



Pyramid of numbers (grassland ecosystem)

OBSERVATIONS:

Construct a pyramid of numbers of forest organisms as shown in the figure below.

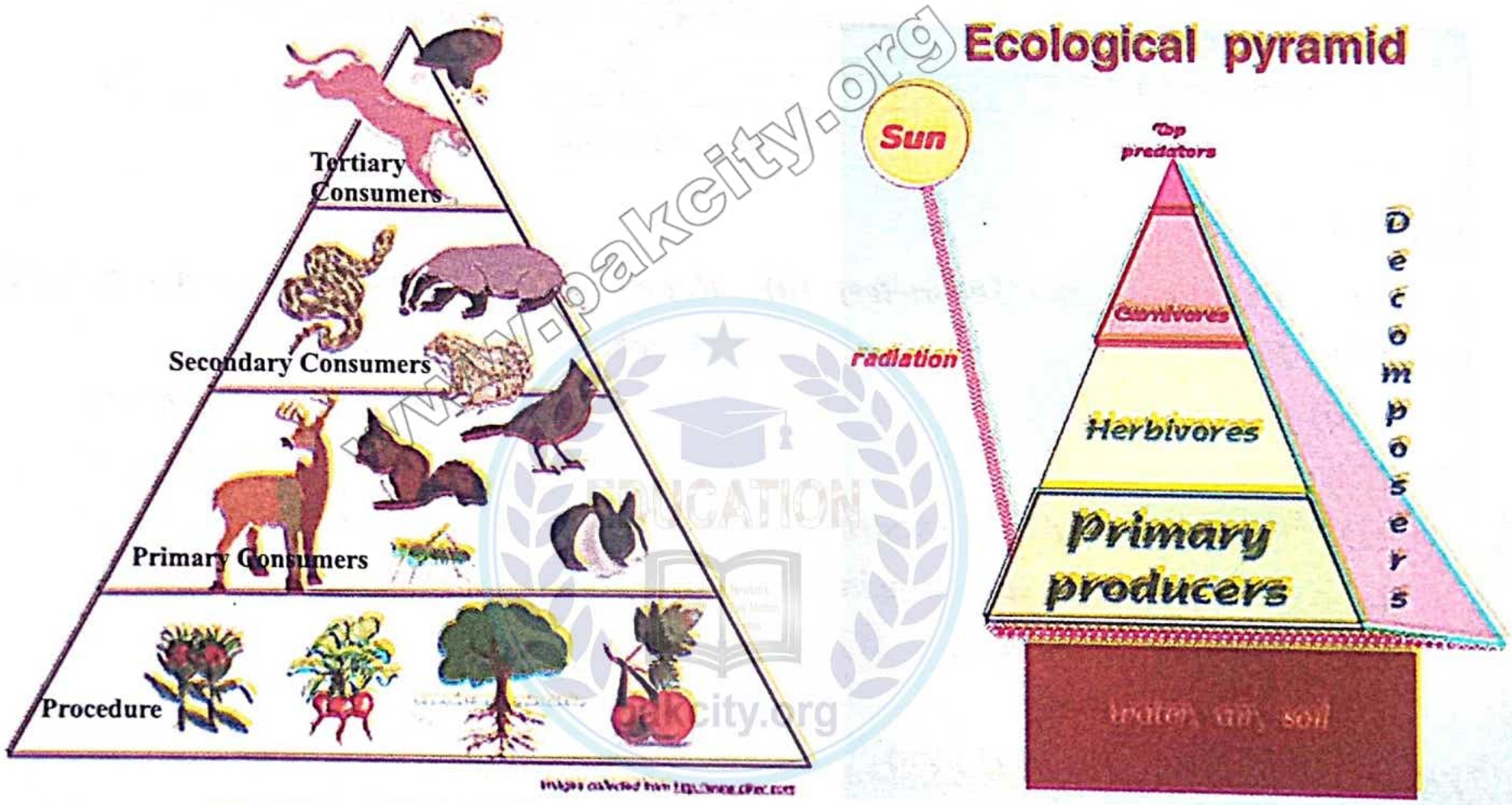


Fig. Pyramid of numbers – A forest ecosystem (individuals per unit area).

PYRAMID OF POND OR LAKE ECOSYSTEM

(1) Producers (phytoplanktons and other hydrophytes) are largest in number.
(2) Herbivores (zooplanktons, rotifers and small fish) are less in number than producers.
(3) Carnivores (large fish) are even less in number than herbivores.
(4) The number of organisms decreases from base of the pyramid to apex.

OBSERVATIONS:

The tropic level goes on decreasing. (T_1 T_4) from producer to consumer.

VIVA VOCE

Q.1 *What is an ecological pyramid?*

Ans. *The trophic structure of an ecosystem expressed in a pyramid is called as the ecological pyramid.*

Q.2 *What are different types of ecological pyramids?*

Ans. *The different types of ecological pyramids are the pyramid of numbers, pyramid of biomass, and pyramid of energy.*

Q.3 *Which type of plants are dominant in the forest ecosystem?*

Ans. *These are the trees.*

Q.4 *What are the components of an ecosystem?*

Ans. *Abiotic (non-living) and biotic (living) are the two components of an ecosystem.*

Q.5 *What is meant by balanced ecosystem?*

Ans. *A self sustainable ecosystem in which producers and consumers reach at a balance within their physical environment is called as a balanced ecosystem.*

Q.6 *What is trophic level?*

Ans. *The food link of an organism in a food chain or food web is called trophic level. e.g. producers represent the first trophic level (T_1) and herbivores represent the second trophic level (T_2).*

Q.7 *In which type of ecosystem, the pyramid of number is best studied?*

Ans. *Lake ecosystem.*

Q.8 *What is the position of producers in the pyramid of number?*

Ans. *At base (first trophic level)*

Q.9 *Explain pyramid of numbers.*

Ans. *The pyramid depicting the relative number of different trophic levels, starting from the highest of the producers at the base, leading to the lowest of tertiary consumers at the top is called pyramid of numbers.*

Q.10 *Which of the biotic component is in largest number in an ecosystem?*

Ans. *The producers are in largest number in the ecosystem.*

Q.11 *How do the successive groups of consumer animals appear in size and numbers in a food chain?*

Ans. *In a food chain, the successive groups of consumer animals often appear to be larger in size but fewer in numbers.*

19 Experiment

SAMPLING OF A GRASSLAND COMMUNITY BY QUADRAT METHOD

QUADRATS SAMPLING:

A quadrat is a square sample area, usually 0.5 or 1.0 square metre, marked out with a wooden frame or thick wire, that can be used in an ecological survey to study in detail the distribution and abundance of different species i.e. random sampling within an area.

The main quadrat frame may sometimes be divided by strings or fine wires into smaller convenient areas,

The bitotic components of grassland community consist o the following categories of organisms.

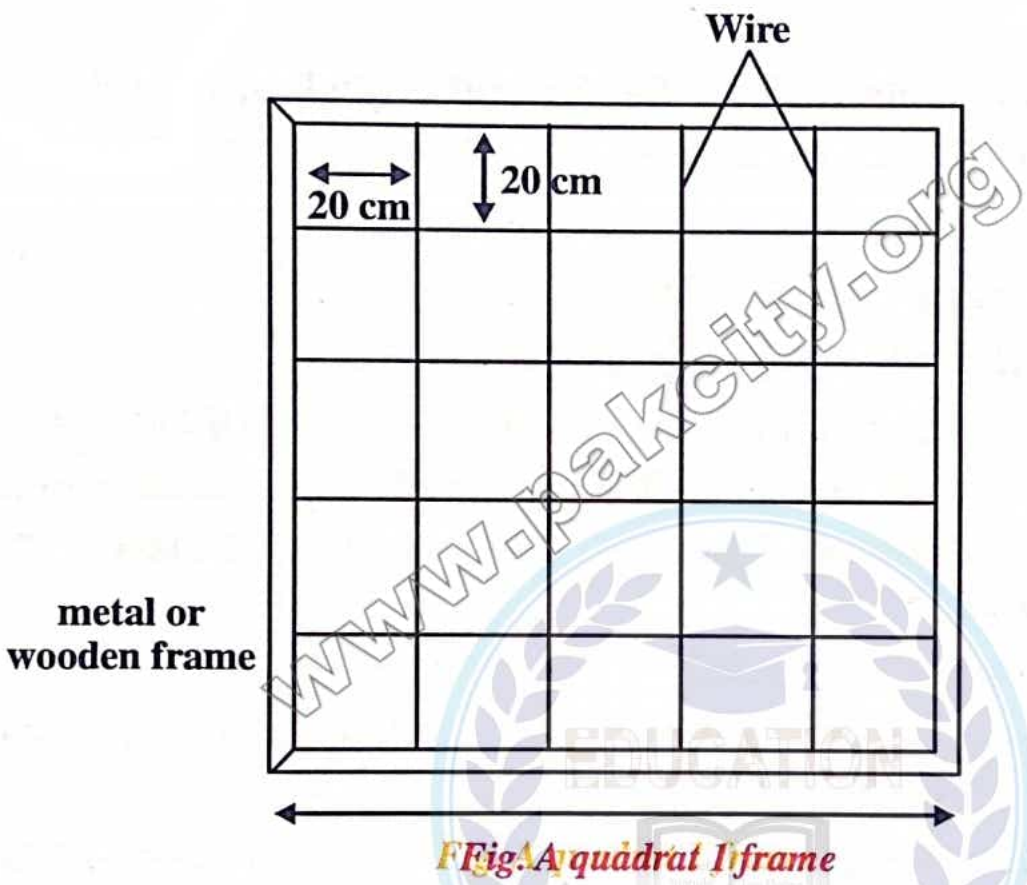


Fig. A quadrat frame

GRASSLAND ECOSYSTEM

Location:

Grassland ecosystems are found in Gilgit, Kashmir, Waziristan, lower Chitral and North Kallat. In world you can see large grassland in the center of Eurasian continents.

Prairies

Grasslands present in temperate climates are also called Prairies, such as Prairies of North, America, pampas of Argentina. These grasslands do not have woody plants so they are known as praisries.

Savanna

The grasslands in tropic climates have woody trees and are called Savanna.

Rain fall

Annual rainfall is about 250 to 750 mm (10 30 inches). The grasslands usually face severe rains, which in tropical and subtropical grassland, reaches about 1500 mm.

(i) PRODUCERS:

They mainly consists of grasses and small herbs.

(ii) CONSUMERS:

Herbivores: Dominant species are herbivores; invertebrates including insects are very numerous, grasshoppers become so numerous that they can compete with other herbivores for plant fliage.

Predators: The predators are reptiles, amphibians and mammals, such as Lizards, toads and turtles prey on insects. Foxes and wolves among mammals are very common.

Large animals: Large animals like Zebra, wild horses and bison are important.

DECOMPOSERS:

They are microscopic organisms, responsible for attacking the dead end decaying remains of plants and animals. During this process of decomposition, the microorganisms get energy and liberate minerals which are once again used by the producers. The decomposers in grassland are the fungi and the bacteria.

MATERIAL

A quadrate frame; Microscope; slides; Beakers; Petridishes; Insect net; Box for insects; Bottles 250 ml; Formaline; Fungicide; Insecticides; Plastic bags; Rubber bands; Forceps.

PROCEDURE

(1) Arrange a field trip to study grassland ecosystem.

(2) Select a plot in the undisturbed area of grassland.

(3) Throw a quadrat of one square metre at random in any part of the plot.

(4) Using hand lens, if needed, collect different visible organisms and preserve them in labeled plastic bags and bottles containing formaline, fungicides and insecticides, for studying them later on.

(5) Also collect the loose soil from a small area in a plastic shopper.

(6) Repeat the throwing of quadrat and collection of specimens in the same way for at least three times at three different places in the plot.

(7) On returning to the laboratory, note the numbers and kinds of producers, consumers and decomposers of all the three quadrat sites.

(8) Put the specimen of loose soil in water in a backer and shake.

(9) Now place a drop of water from the beaker on the slide.

(10) Examine under the lowe and high powers of the microscope and count the number of becteria and fungi, if any.

(11) Calculate and make a rough estimate of the total number of bacteria (or fungi) found in the soil of the whole quadrat.

(12) Record the data in the form of the following table:

Record the data in the form of the following table:

QUADRAT NO.	PRODUCERS		CONSUMERS		DECOMPOSERS	
	NAME	No.	NAME	No.	NAME	No.
1						
2						
3 etc.						

CALCULATIONS

(1) No. of plants (say grasses) of one species.

(2) No. of plants (say grasses) of second species.

And so on.

Collect the animals of the area.

Different aspect of community e.g. Density cover can be calculated. make the list of most dense areas and least dense area of plants.

$$\textit{Density} = \frac{\text{Total No. of individuals of species in all quadrate}}{\text{No. of Quadrate Area}}$$

$$\textit{Relative Density} = \frac{\text{Total No. of individuals of species}}{\text{Total No. of Individual in a Quadrate}} \times 100$$

$$\textit{Relative Cover of One species} = \frac{\text{Sum of cover of one species in all quadrate}}{\text{Sum of cover of all species in all Quadrate}}$$

VIVA VOCE

Q.1 *What are abiotic components of grassland ecosystems?*

Ans. *Light, Temperature, Atmosphere and Wind, Water, Soil, Topography, Inorganic and Organic nutrients.*

Q.2 *What are biotic components of grassland ecosystems?*

Ans. *(i) producers. (all green plants) (ii) Consumers (all animals) (iii) Decomposers (bacteria and fungi)*

Q.3 *Define quadrat.*

Ans. *It is simply a square area of desired size, marked off from vegetation under investigation. Its size ranges from $1dm^2$ to $100m^2$.*

Q.4 *What is best size of quadrat for studying grassland community?*

Ans. *$1ft^2$ or $1m^2$.*

Q.5 *Define frequency?*

Ans. *It is the number of sampling units in which the species occurred, divided by total number of sampling units studied and multiplied by hundred.*

Q.6 *Define density?*

Ans. *It is the total number of individuals of the species in all the sampling units divided by total number of sampling units studied.*

Q.7 *Define abundance?*

Ans. *It is the total number of individuals of the species in all the sampling units divided by number of sampling units in which species has occurred.*

Q.9 *What are grassland ecosystems or communities?*

Ans. *The grassland communities are open land communities with limited moisture conditions, irregular rainfall, sharp seasonal and diurnal variations and very high radiation. They have continuous cover of grasses.*

Q.10 *What is the mean annual rainfall in a grass land?*

Ans. *250 750 mm.*

Q.11 *Where are located grasslands in Pakistan?*

Ans. *Gilgit, Kashmir, Waziristan, Lower Chitral and North Kallat.*

Q.12 *Where are located grass lands in the world?*

Ans. *They are located in the interiors of continents.*

Q.13 *Name carnivores of grasslands.*

Ans. *Coyotes, badgers, foxes, owls, rattle snake.*

Q.14 *Name different birds found in grasslands.*

Ans. *Prairie chickens, meadow larks, rodent hawks.*

Q.15 *Name common insects found in steppes?*

Ans. *Locusts, bees, wasps, termites.*

Q.16 *Which reptiles are most common in grasslands?*

Ans. *Snakes and lizards.*

Q.17 *Name decomposers of grasslands?*

Ans. *Bacteria, fungi.*

Q.18 *Define community?*

Ans. *It is a group of different organisms (palnts, animals and microscopic organisms) living together in a certain physical environment and interacting with each other and with the.*

Q.19 *Give examples of some of the famous grasslands of the world.*

Ans. *(i) Prairies of North America (ii) Steppes of Eurasia*
(iii) Veldt of Africa (iv) Pampas of Argentina

Q.20 *What is savanna?*

Ans. *The grasslands in tropic climates have clumps of woody trees and are called savanna.*

Q.21 *What are the dominant plants of grasslands?*

Ans. *Grasses and small sized forbs.*

Q.22 *Name large sized animals of grasslands.*

Ans. *Bison, wild horse, ass, zebra, antelopes.*

20A
Experiment

Investigation of Water Content of Soil Sample

The water content of the soil is naturally very fluctuating, but an average estimate may be sought by taking a sample about twenty four hours after rain has fallen. More scientific and more instructive, however, is the construction of a graph, based on a number of estimates at different times and seasons, to show the range of natural variation in this respect, of the soil examined.

Following four kinds of uncombined soil water have been differentiated on the basis of their tendency to be retained in the soil.

(1) Gravitational water *(2) Capillary water*

(3) Hygroscopic water *(4) Water vapours*

(1) Gravitational water

The extra amount of water displaces air from the pore spaces between soil particles and percolates downwardly under gravitational influence. This water is called gravitational water. When this water percolates down and reaches to the level of parent rock, it is called ground water.

(2) Capillary water

The water held by capillary forces in smaller soil channels when the gravitational and ground water are drained, is called capillary water. This water is found in the form of thin film around soil particles in the capillary spaces.

(3) Hygroscopic water

It is held very tightly by small soil particles. plants are unable to absorb it.

(4) Water vapours

Some uncombined water occurs as moisture or water vapours in the soil atmosphere.

Field Capacity

The amount of water retained in soil by capillary attraction when it is free to percolate under the influence of gravity is called field capacity.

Hygroscopic coefficient

If soil is dried out, as all capillary water is lost, even from smallest pores. The hygroscopic water is left. The amount of this water is called hygroscopic coefficient.

MATERIALL

Aluminum foil dish or evaporating basin (or crucible); Balance with weight box; Oven; Water bath; Beakers; Desiccator; Bunsen burner or spirit lamp; Tripod stand; Wire gauze; Tongs.

METHODS

(1) Take an evaporating dish or tray and weigh it (a).

(2) Place the soil sample in the tray and reweigh it (b).

(3) Now place the tray containing wet soil sample in oven at 100°C for about 24 hours.

(4) Remove the sample from the oven and cool in a desicator.

(5) Re weight the oven dried soil along with tray (c).

(6) The percentage of moisture or water in the soil sample is calculated.

Observations and Calculation

Weight of tray	= a gm	10 gm
Weight of tray + wet soil	= b gm	50gm
Weight of tray + oven dried soil	= c gm	46gm
Weight of wet soil	= b a = d gm	40gm
Weight of dry soil	= c a = e gm	46-10 = 36gm
Amount of moisture	= d e = f gm	40-36 = 4gm

% age of moisture in the soil sample = 100 × 4/40 × 100

VIVA VOCE

Q.1 *What is soil water?*

Ans. *The water present in the soil is called soil water.*

Q.2 *What is the significance of soil water?*

Ans. *(i) It acts as a solvent* *(ii) It maintains soil texture*
(iii) It enables the soil to support life.

Q.3 *What is the source of soil water?*

Ans. *It comes in the soil through infiltration of precipitated water (dew, rain, hail).*

Q.4 *What is the source of soil water?*

Ans. *It comes in the soil through infiltration of precipitated water (dew, rain, hail).*

Q.5 *What factors are responsible for the loss of soil water?*

Ans. *These are the movement of water down to water bed, stream flow, evaporation and transpiration.*

Q.6 *Which factors influence the movement and retention of soil water?*

Ans. *Soil water movement and retention are greatly influenced by the texture and structure of soil, quality and quantity of organic and inorganic materials present and the nature and volume of pore space.*

Q.7 *What are pore spaces in the soil?*

Ans. *These are the spaces existing between the differently sized and irregularly shaped soil particles as well as those left behind by the burrowing animals and decaying roots.*

Q.8 *What is the importance of the water in the soil?*

Ans. *The plants absorb soil water for photosynthesis and transpiration. Furthermore, the physical, chemical and biological activities in the soil are largely regulated by the soil water.*

Q.9 *What is water bed (water table)?*

Ans. *The level of water below the earth to which drains the gravitational water is called water table.*

Q.10 *Define field capacity.*

Ans. *The amount of water retained in the soil by capillary attraction when it is free to percolate under the influence of gravity is called field capacity.*

Q.11 *What is meant by hygroscopic coefficient?*

Ans. *If soil is dried out, as all capillary water is lost, even from smallest pores. The hygroscopic water is left. The amount of this water is called hygroscopic coefficient.*

Q.12 *What are the factors influencing the movement and retention of soil water?*

Ans. *(i) Soil texture* *(ii) Soil structure*
(iii) Nature of organic and inorganic material present in the soil.
(iv) Volume of pore space *(v) Vegetation*

20B Experiment

INVESTIGATION OF APPROXIMATE SOIL TEXTURE OR ROUGH ESTIMATE OF PROPORTION OF PARTICLES OF DIFFERENT SIZES IN A SOIL SAMPLE

Measuring Soil Texture in the Laboratory

Key points

- Particle size analysis breaks a soil into texture classes – sand, silt or clay.
- Soil texture influences nutrient retention, water storage and drainage.
- Particles greater than 2 mm are removed before analysis.
- The soil textural triangle is used to determine soil type based on sand, silt and clay percentages.

Mineral components of soil

Coarse fragments

Greater than 2 mm and include coarse quartz, rock fragments and cemented material. This is commonly called the 'gravel fraction'.

Sand

Comprise quartz and resistant primary minerals such as mica. Sand particles are between 2 mm and 20 microns in size (Note: there are 1000 microns in 1 mm).

Silt

Silts are typically composed of quartz and small mineral particles such as feldspars and mica, and are between 2 and 20 microns in diameter.

Clay

Clays are made up of secondary clay minerals and oxides/oxyhydroxides of iron and aluminium, and are less than 2 microns in diameter.

The amount of sand, silt, and clay ultimately makes up the class of the soil. To determine the class type of an unknown soil we will have to determine the ratio of sand, silt, and clay particles in a specific volume of soil. Soil particles are categorized into groups according to size.

Clay = less than 0.002 mm, **Silt** = 0.002 to 0.06 mm,
Sand = 0.06 to 2.0 mm, **Gravel** = greater than 2.0 mm.

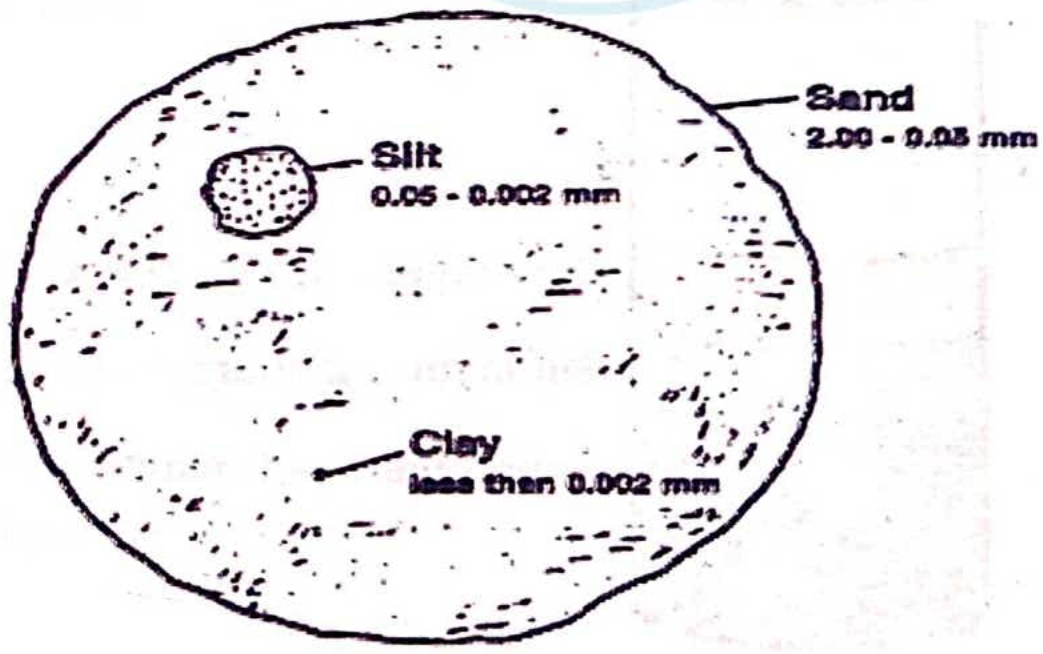


Figure. Relative size of soil separates.

We will be using comparative volumes to determine the ratio of these particles, based upon the fact that different sizes of particles will fall out of solution at different rates

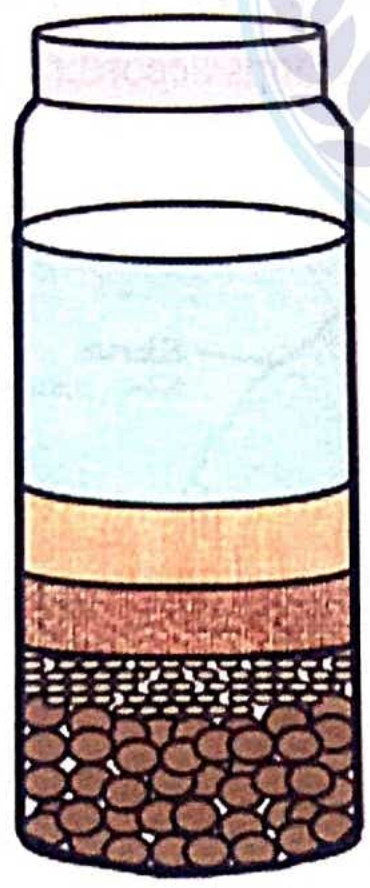
Method I:

Materials:

- Plastic stand
- 3 - 50ml graduated centrifuge tubes
- Tube rack
- Stopper to fit the centrifuge tube
- Soil dispersing agent - Calgon
- Soil samples

Procedure:

1. Label the centrifuge tubes **A**, **B**, and **C**.
2. Break up the soil into individual particles and add soil to the level of the line marked **15 ml** in centrifuge tube **A**. Tap the bottom of the tube gently against the table to pack the soil and eliminate any large air pockets. Add more soil, if necessary, to the 15 ml mark.
3. Add **1 ml** of the soil dispersing agent (Calgon) to the soil, and add tap water to the level of **45 ml**.
4. Place the stopper firmly in the tube. Holding the stopper, Shake the tube for two to 5 minutes. Make sure all the soil is mixed with the water.
5. Remove the stopper and place the centrifuge tube in the stand for **30 seconds**. The time is critical. If you allow more than 30 seconds to pass, shake the tube again and allow the tube to stand for another 30 seconds.
6. Carefully pour all the solution from the centrifuge tube **A** into centrifuge tube **B** (leaving the soil particles that settled out). Gently tap tube **A** on the table to level the soil left in the tube and return to the stand.
7. Allow tube **B** to stand undisturbed for **30 minutes.** At the end of the 30 minute standing time, carefully pour the solution from centrifuge tube **B** into centrifuge tube **C** (again leaving the particles that settled).
8. Read the volume of soil particles, as accurately as possible, for tubes **A** and **B**. Record the data.



Data:

Volume of soil sample: 15.0 ml

Particles in tube

A: _____ ml

Particles in tube

B: _____ ml

Calculations:

The mineral particles in separation tube **A** are sand. They are the largest and heaviest particles. Therefore, they settle out first. The particles in separation tube **B** are silt. Since they are lighter than sand, they take longer to settle out.

The particles remaining in the final tube are clay. Clay particles swell when placed in water, and they tend to remain in water. This tube is not an accurate indication of the amount of clay in the sample. The amount of clay is more accurately determined mathematically.

9. Calculate the Percent of Sand in your soil sample:

   Volume in tube **A** (sand) divided by 15 ml (total sample) times 100 = _____ **% Sand.**

10. Calculate the Percent of Silt in your soil sample:

    Volume in tube **B** (silt) divided by 15 ml (total sample) times 100 = _____ **% Silt.**

11. Calculate the Percent of Clay in your soil sample:

    Add the volumes of tubes **A** and **B** then subtract that answer from 15 ml (total sample). This is the volume of clay.

    Volume of clay divided by 15 ml times 100 = _____ **% Clay.**

12. Now determine the soil type for your sample by comparing your answers in steps 9, 10, and 11, to the following table.

Soil Types:

Sands:

Soil that contains 85% to 90% or higher sand, with no more than 10% clay and with the rest silt.

Loamy Sands:

Soil that contains between 70% to 85% sand and with clay being 14% or below.

Sandy Loams:

Soil with 52% or more sand and 20% or less clay.

Loam:

Soil with 7% to 27% clay, 28% to 50% silt, and less than 52% sand.

Silt Loam:

Soil that contains 50% or more silt and 12% to 27% clay, or 50% to 80% silt and less than 12% clay.

Clay Loam:

Soil that contains 27% to 40% clay and 20% to 45% sand.

Clay:

Soil that contains 27% to 40% or more clay, and less than 45% sand and less than 40% silt.

Soil type for sample =

Method II:

Materials:

- 100ml graduated cylinder
- Rubber stopper that fits the cylinder
- 5% Calgon solution
- Soil samples

Procedure:

1. Add approximately **50 ml** of soil to the graduated cylinder, and fill with Calgon solution to the 100 ml mark. Mix well and allow to stand for **15 minutes**.
2. Secure the stopper in the graduated cylinder and holding a finger over the stopper, shake by inverting, for **5** to **10 minutes**. Allow to stand undisturbed for **24 hours**.
3. You will be able to see the lines that divide the sand, silt, and clay columns. The sand will be on the bottom, the silt in the middle, and the clay on top. Read and record as data: the top of the sand column (also the bottom of the silt column), the top of the silt column (also the bottom of the clay column), and the top of the clay column (also the total volume).

Data:

Volume at top of sand column: _____ ml

(also represents the bottom of the silt column)

Volume at top of silt column: _____ ml

(also represents the bottom of the clay column)

Volume at top of clay column: _____ ml

(also represents the **total volume of sample**)

Calculations:

4. Calculate the Percent of Sand in the sample.

   Volume of sand divided by the total volume times 100 = **% Sand**.

   Percent Sand = _____ %

5. Calculate the Percent of Silt in the sample.

   Volume at top of silt column minus volume of sand = volume of silt.

   Volume of silt divided by total volume times 100 = **% Silt**

   Percent Silt = _____ %

6. Calculate the Percent of Clay in the sample.

   Volume at top of clay column minus volume at top of silt column = volume of clay.

   Volume of clay divided by total volume times 100 = **% Clay**.

   Percent Clay = _____ %

7. Use the soil type table from method 1 to determine the texture of your soil sample.

   Soil type for sample = _____

The most common **method** for **determining soil texture** is the hydrometer **method**. In this **method** the **soil** particles are dispersed with a sodium metaphosphate (calgon) and then agitated. After dispersion, the amount of each particle group (sand, silt, clay) are determined by using a hydrometer (see picture).

Method III:

Soil Texture by the Bonyoucos Hydrometer Method

Materials:

1. Sieved soil (50g dry weight equivalent if fine textured, 100g if sandy).
2. Bouyoucos hydrometer
3. Sedimentation cylinder
4. Thermometer
5. 1 500 ml beaker (or16 ounce cup)
6. Glass stirring rod (or a pencil)
7. 1 100ml graduated cylinder
8. 1 10ml Graduated cylinder
9. 1 Liter (1000 ml) Graduated cylinder
10. Stop watch
11. Clock

Reagents:

1. I/V Sodium hexametaphosphate
2. Tap water (use distilled water if tap water is too "hard")

Procedures:

NOTE: If the soil is not oven dried, take a sub sample for water content determination.

1. Place 50 or 100 g of soil (dry weight equivalent) in the 16 ounce cup.
2. Fill the cup with ml of water.
3. Add 5 ml of I/V Sodium hexametaphosphate.
4. Mix thoroughtly:
   a. For high clay soils-allow to slake (soak) for 15 minutes
   b. For sandy soild-mix for 5 minutes
   c. For finely textured soils-mix for 15 minutes
5. Transfer soil suspension to the sedimentation cylinder, use water to remove the entire sample from the cup.
6. Fill the sedimentation cylinder with 1 liter of water.
7. Carefully remove the hydrometer.
8. Fill the sedimentation cylinder to the 1150 mark.
9. Carefully remove the hydrometer.
10. Wrap the top of the sedimentation cylinder in parafilm. Make sure the seal is secure.
11. Gently tilt the cylinder back and forth for through mixing, several times.
12. Carefully set the cylinder on a stable surface and remove the parafilm.
13. Return the hydrometer to the cylinder and begin the 40 second timing immediately. This 40 second reading can be repeated several times to improve accuracy.
14. After the final 40 second reading, remove the hydrometer and allow the cylinder to stand undisturbed. Begin to record the time in which you will start the 2 hour settling period.

15. Record the temperature, by lowering a thermometer into the suspension and record the temperature (in °C).
16. Take a hydrometer reading at 2 hours.
17. Make up a blank cylinder with water and 5 ml of I/V Sodium hexametaphosphate. Record the blank hydrometer reading.

Calculations:

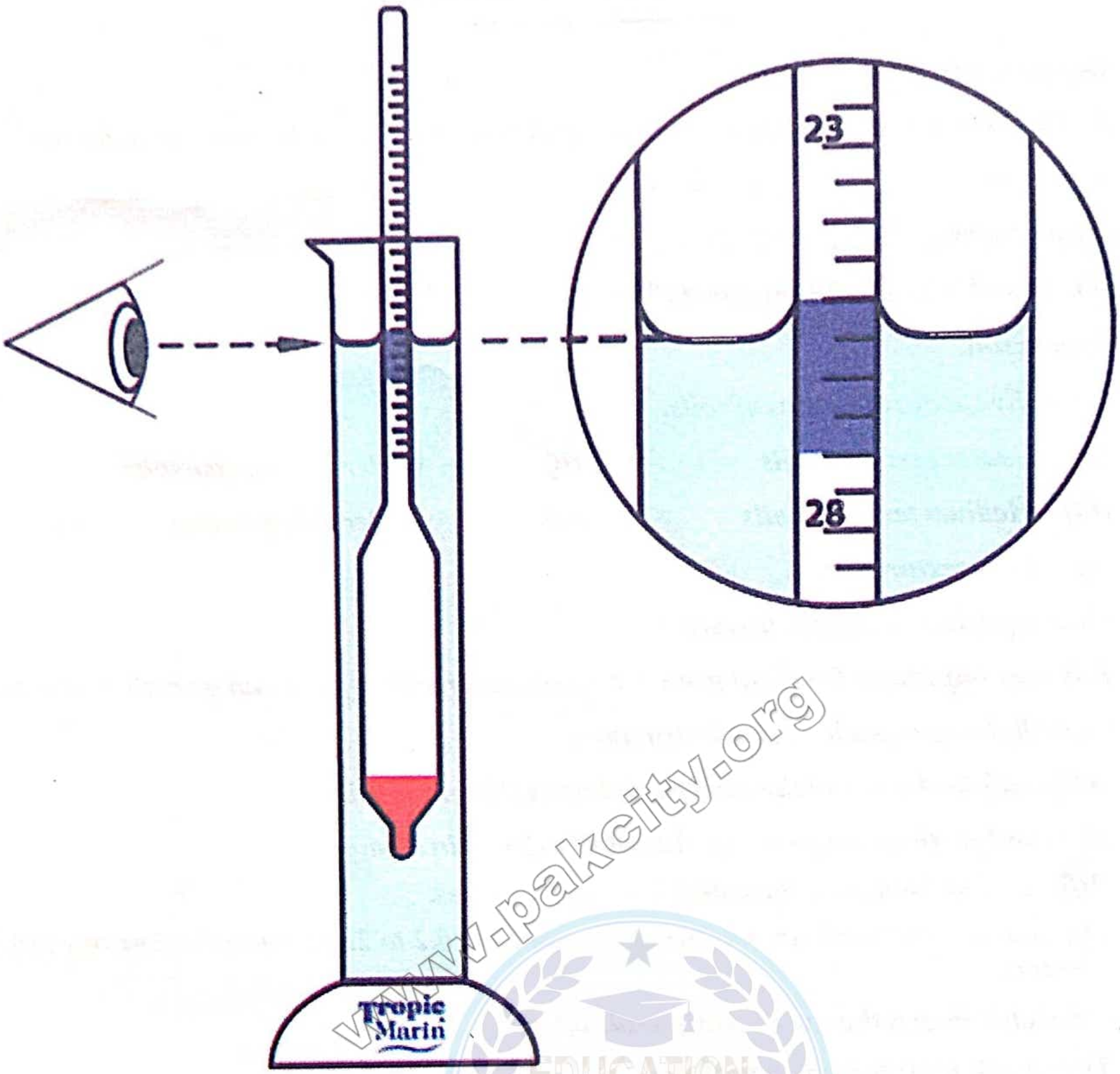
1. Temperature Correction Factor:
   a. $T = (\text{observed temperature} - 20°C) \times 0.03$
2. Corrected 40 second reading:
   a. 40 second (corrected 'c') = 40 second reading– Blank reading + T
3. Corrected 2 hours reading:
   a. 2 hour (corrected 'c') = 2 hour reading– Blank reading + T
4. Particle Percentages
   a. % sand (2 – 0.05 mm)
   = [oven dry soil weight– 40 second reading (c)] ÷ [oven dry soil weight] x 100
   b. % clay (<0.002 mm)
   = [2 hour reading (c)] ÷ [oven dry soil weight} x 100
   c. % silt (0.05 – 0.002 mm)
   = 100 – (% sand + % clay)
5. Determine the textural class of the soil sample by using the textural triangle.

Hydrometer Method Data Collection Sheet

SOIL SAMPLE	0 to 15 cm	15 to 30 cm
Sample weight	grams	grams
40 second Hydrometer reading	g/L	g/L
Temperature of suspension	°Celsius	°Celsius
Corrected 40 second Hydrometer reading	g/L	g/L
% sand		
% silt and clay		
2 hour Hydrometer reading	g/L	g/L
(Blank Temperature liquid	°Celsius	°Celsius
Corrected 2 hours Hydrometer reading	g/L	g/L
% clay		
SUMMARY		
% sand		
% silt		
% clay		

Using the soil particle percent data, determine the textural class for the soil samples.

HORIZON	SAND	SILT	CLAY	TEXTURAL CLASS
0 to 15 cm				
15 to 30 cm				



VIVA VOCE

Q.1 *Define soil texture.*

Ans. *Soil texture is defined as the percentage of different soil particles present in the soil.*

Q.2 *Name the instrument used for the determination of the amount of soil particles.*

Ans. *Hydrometer.*

Q.3 *Which soil is best for plant growth?*

Ans. *Loamy soil.*

Q.4 *Name five textural groups of soils.*

Ans. *(i) Coarse textured soils (ii) Moderately coarse soils*
(iii) Medium textured soils (iv) Moderately fine textured soils
(v) Fine textured soils

Q.5 *Give significance of soils texture.*

Ans. *It is very important for plant growth because it directly affects root growth, soil aeration, water holding capacity and soil structure.*

Q.6 *What may be the size of the sand particles in different soils?*

Ans. *The sand particles range in size from 0.02 to 2 mm in diameter.*

Q.7 *Differentiate between coarse and fine sand particles.*

Ans. *The coarse sand particles are larger in diameter (0.2 to 2mm) than the fine ones (0.02 to 0.2 mm).*

Q.8 *What chemical is the sand mainly made up of?*

Ans. *The sand is mainly made up of silica.*

Q.9 *Write down the size in diameter of the silt and clay particles of the soil.*

Ans. *The silt particles range in diameter from 0.002 to 0.02 mm whereas those of clay are smaller than 0.002 mm.*

Q.10 *What is the organic matter found in the soil generally called?*

Ans. *The organic matter found in the soil is generally called humus.*

Q.11 *How can the humus be removed from the soil sample?*

Ans. *This can be done by treating the soil with Hydrogen peroxide (H_2O_2) or Potassium permanganate ($KmnO_4$).*

Q.12 *The texture of the soil may be light or heavy. Explain.*

Ans. *The light-textured soils have coarse particles and are easy to dig or cultivate whereas heavy vois have fine, compacted particles and are, therefore, difficult to dig or plough. Light soils contain more than 80% sand while heavy soils contain large amounts of silt and clay.*