

SOUTH END CENTRE (E.M.) SCHOOL

SESSION - 2021-2022

NAME [REDACTED]

CLASS - X

U. I. D. No - [REDACTED]

INDEX No. - [REDACTED]

SUBJECT - BIOLOGY PRACTICAL

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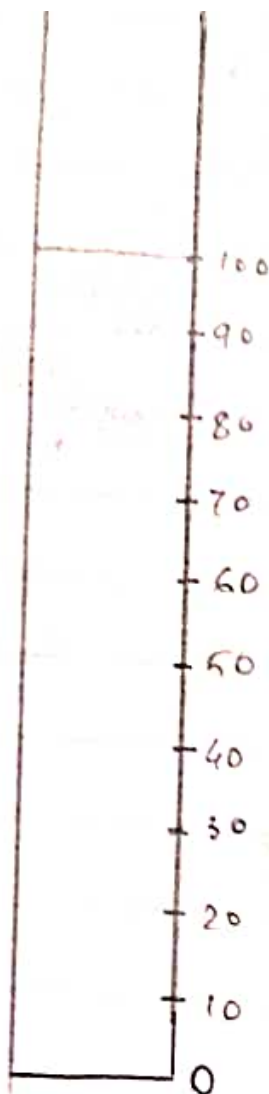
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~~M. H. S.~~
~~21/10/2019~~

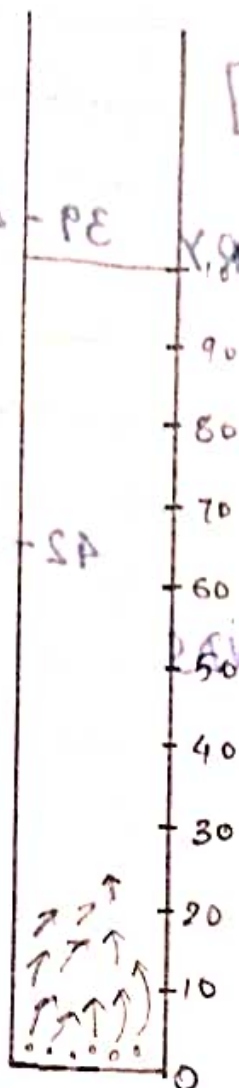
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TRANSPIRATION
[By Coll's paper]

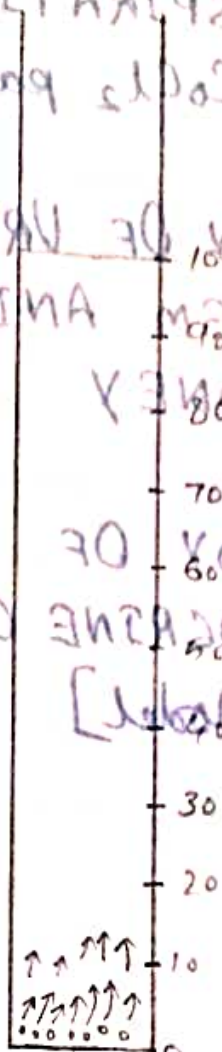
30/11/19 STUDY OF VASCULAR
AND METABOLIC
KIDNEY
30/11/19 STUDY OF
ENDOCRINE GLANDS
[Mayer]



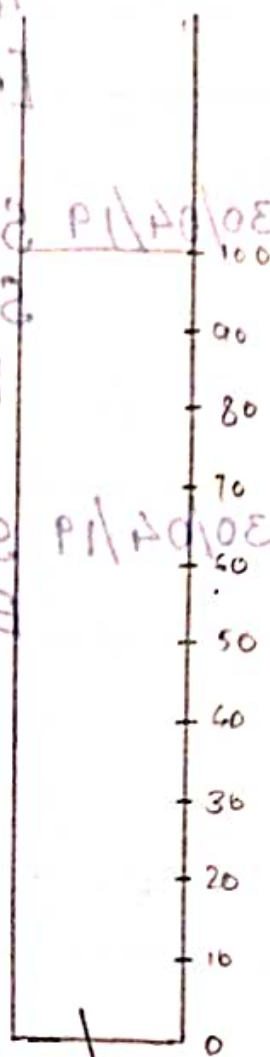
Eosin
(Rapid
diffusion)



Potassium
dichromate
(Moderate
diffusion)



Potassium
permanganate
(Slow
diffusion)



water
(as
control)

Expt no. - 1
Date: 30/4/19

30.04.19

STUDY OF DIFFUSION

Diffusion :- Diffusion is a physical process that refers to the net movement of molecules from a region of higher concentration to a region of lower concentration. The diffusion occurs along the concentration gradient or diffusion gradient and the material which diffuses could be solid, liquid or gas.

OBJECTIVE :- To demonstrate the process of diffusion in liquids.

MATERIALS REQUIRED :-

EOSINE (Dye), distilled water, Potassium dichromate ($K_2Cr_2O_7$), Potassium permanganate ($KMnO_4$) and four measuring cylinders.

PROCEDURE :-

- At first distilled water is filled upto the 100 ml mark of each cylinder.
- Then, Eosin (dye), Potassium dichromate ($K_2Cr_2O_7$), Potassium permanganate ($KMnO_4$) are added in equal amounts in the three measuring cylinders. The fourth measuring cylinder is kept as control setup.

OBSERVATION :-

After sometime, it is observed that :-

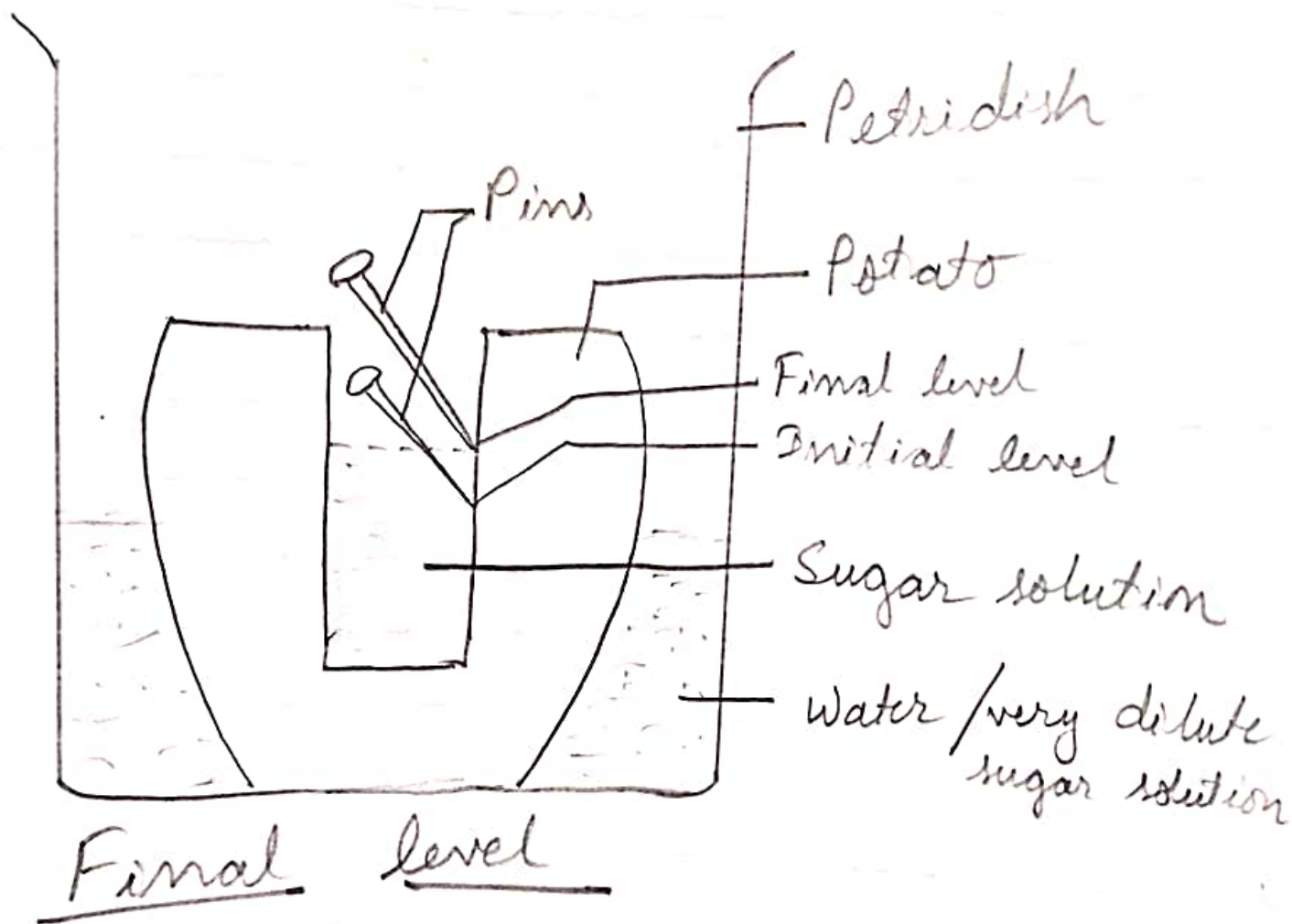
- When Eosin is dropped in the measuring cylinder containing water, it diffuses rapidly and the solution becomes red in colour.
- When potassium dichromate solution is added in the measuring cylinder containing water, it diffuses less rapidly than Eosin but more rapidly than KMnO_4 , and the solution turns orange in colour.
- When potassium permanganate is added in the measuring cylinder containing water, it diffuses less rapidly than potassium dichromate solution and the solution turns pink in colour.

INFERENCE :-

Molecules of Eosine are more concentrated in and around the crystals and they are arranged in decreasing concentration passing from potassium dichromate and potassium permanganate. They keep on moving from the region of higher concentration to the region of lower concentration till the solution is uniformly coloured in all the cylinders. This diffusion is very rapid in case of Eosin and Potassium dichromate and comparatively slower in case of Potassium Permanganate.

SIGNIFICANCE OF DIFFUSION

- Exchange of CO_2 and oxygen between leaves and the outside air takes place by diffusion.
- Movement of sugar, solutes and water between adjacent cells are facilitated by diffusion.
- Loss of water as water vapour from leaves takes place by diffusion.
- Smell of flowers to attract pollinators is due to the diffusion of aromatic compounds.



Expt no. - 2
Date - 30/09/19

STUDY OF OSMOSIS [POTATO OSMOSCOPE]

OSMOSIS - Osmosis is the movement of water molecules from their higher concentration to their lower concentration through a semipermeable membrane without the use of any energy.

A semi-permeable membrane allows only water molecules to pass through it but prevents the passage of the solute molecules (sugar or salt solution).

AIM : To study osmosis using a potato osmoscope

MATERIALS REQUIRED :

Potato tuber, a knife or scalpel, 10% sugar solution, distilled water, beakers, alpins.

PROCEDURE :

- The skin of a medium-sized potato is peeled off. One end of the potato is cut flat and a cavity is carefully made with the help of knife or scalpel in the centre of the potato, opposition to the flat surface.
- A clean small beaker is half filled with water.
- The potato is kept on its flat cut end in the beaker half-filled with water. The cavity of the potato is

half-filled with 10% sugar solution and its level is marked with the help of a pin. It functions as an osmometer.

- The set-up is left for one hour and then again the level of sugar solution is marked in the cavity of potato with another pin.

OBSERVATION :-

The level of sugar solution in the cavity of potato has risen.

INFERENCE :-

The experiment shows that only the living or semi-permeable membrane is responsible for the entry of water into the sugar solution.

EXPLANATION :-

- The potato cavity is surrounded by living cells.
- The plasma membrane of each cell inside the cell wall acts as a semi-permeable membrane.

When potato osmoscope is placed in water, water enters it through cell membrane of potato cells. This phenomenon is called endosmosis, i.e., water from the beaker (from its higher concentration) diffuses into cells (lower concentration). On the other hand, water from potato cells moves into the cavity containing sugar solution by exosmosis. Hence, the level of sugar solution in the cavity has increased.

Expt no. - 3
Date - 30/09/19

CELL DIVISION (MITOSIS) [IN ANIMAL CELL]

Cell Division :- Cell division is the process by which parent cell divides into two identical daughter cells and both the daughter cells have an exact copy of hereditary material present in the parent cell. In unicellular organisms, it is a means of reproduction whereas in multicellular animals, it is a means of growth, repair and reproduction. The phase of cell division involves two major events :-

- i) Division of nucleus is called Karyokinesis.
- ii) Division of cytoplasm is called Cytokinesis.

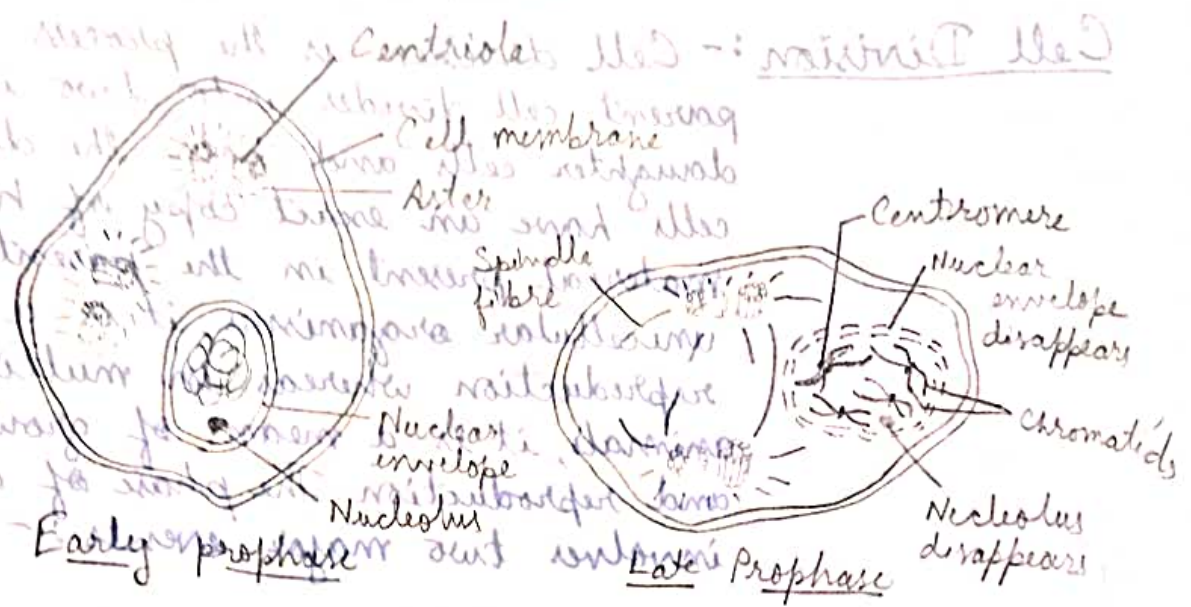
AIM - To identify and draw labelled diagrams of different stages of mitosis from prepared slides.

MATERIALS REQUIRED - Compound microscope, notebook, permanent slides of different stages of mitosis.

PROCEDURE - The slide is focused under low magnification of the compound microscope and then the particular stage of mitosis is focused under high magnification. The different stages are studied and the labelled diagrams are drawn.

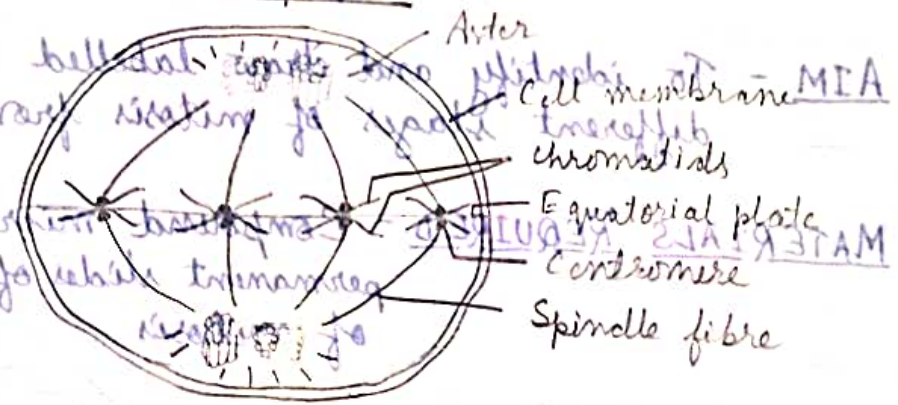
CELL DIVISION (MITOSIS) IN ANIMAL CELL

Prophase



if Division of nucleus is called Karyokinesis
 if Division of cytoplasm is called Cytokinesis

Metaphase



PROCEDURE - The slide is focused under low magnification of the compound microscope and then the particular stage of mitosis is focused under high magnification. The different stages are studied and the labelled diagrams are drawn.

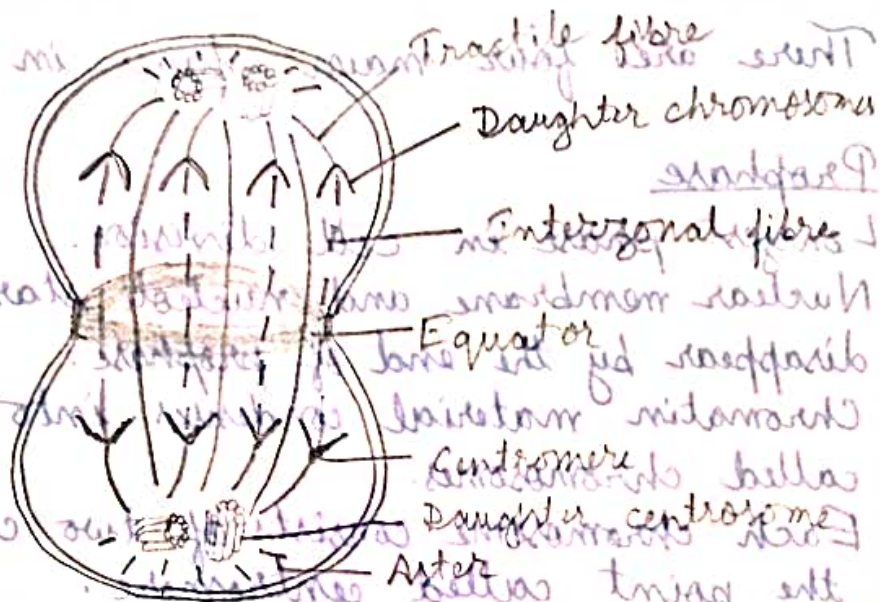
There are four main stages in Karyokinesis :-

i) Prophase

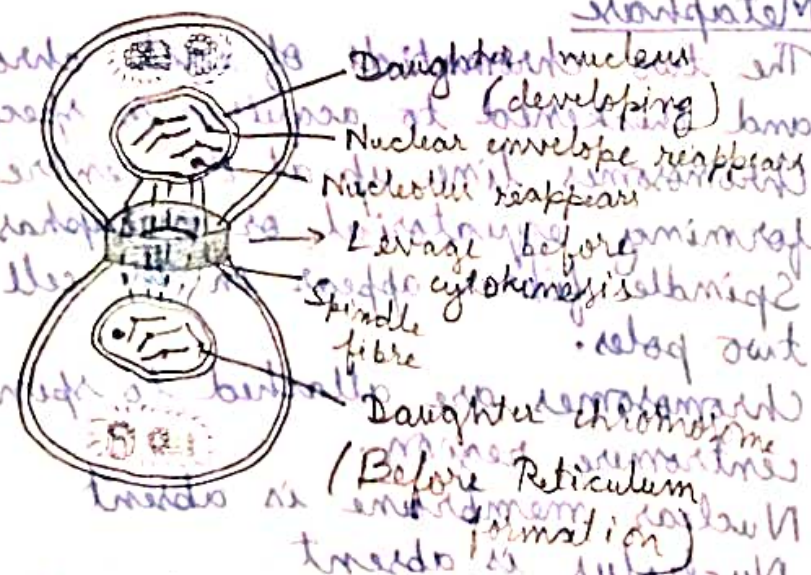
- a) Longest phase in cell division.
- b) Nuclear membrane and nucleoli start disintegrating and disappear by the end of prophase.
- c) Chromatin material condenses into thread-like structures called chromosomes.
- d) Each chromosome consists of two chromatids joined at the point called centromere.
- e) Spindle fibres appear in the cytoplasm.
- f) Spindle fibre formation is completed at the end of prophase.
- g) The centrioles move towards the opposite poles.

ii) Metaphase

- a) The two chromatids of each chromosome become shorter and thickened to acquire a specific shape and size.
- b) Chromosomes line up at the centre of the cell (equator) forming equatorial or metaphasic plate.
- c) Spindle fibres appear in the cell cytoplasm between the two poles.
- d) Chromosomes are attached to spindle fibres at the centromere region.
- e) Nuclear membrane is absent.
- f) Nucleolus is absent.
- g) Centrioles at the opposite poles.



(LATE) ANAPHASE: STAGE OF MITOTIC CELL DIVISION



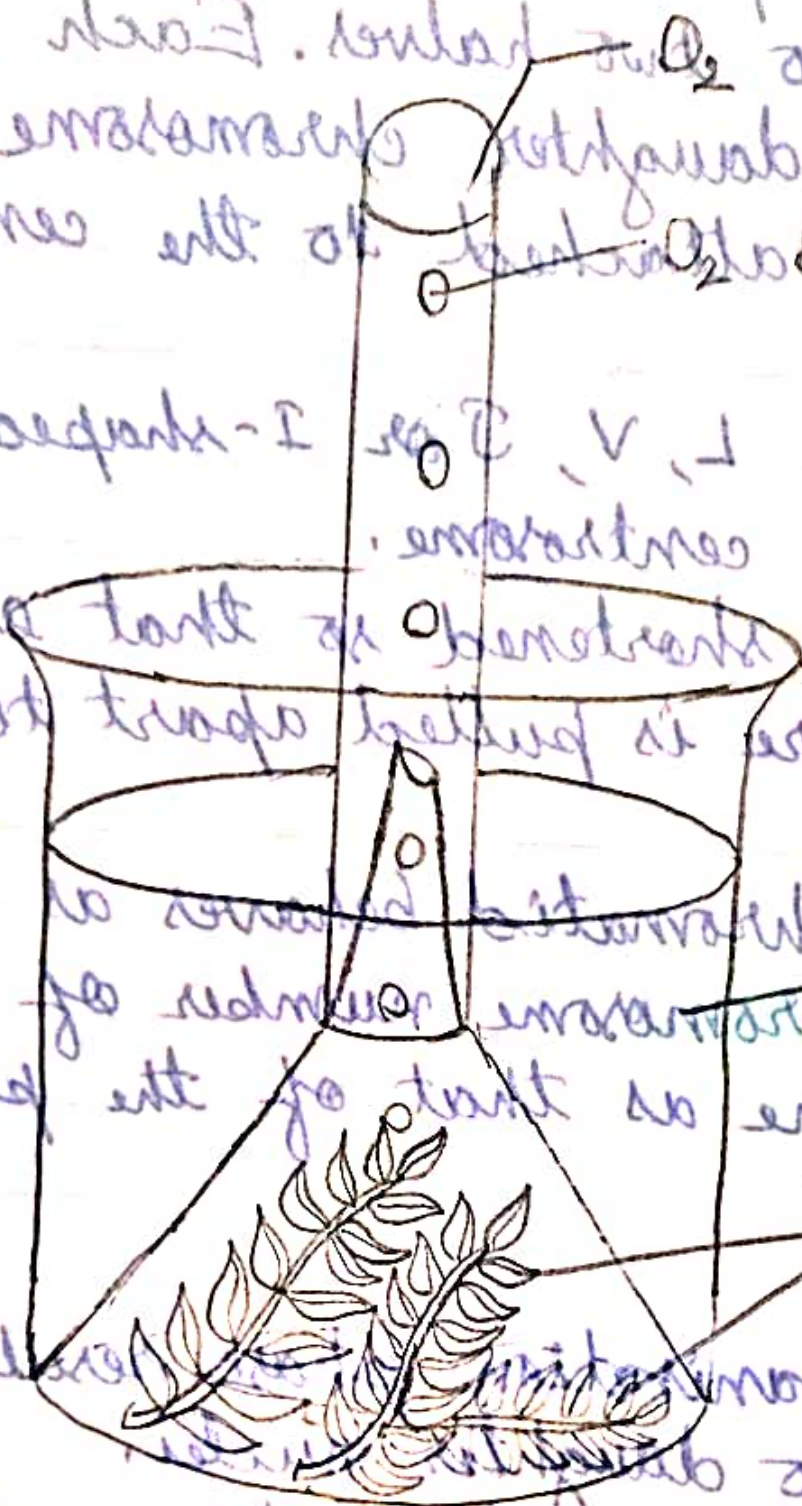
(LATE) TELOPHASE: STAGE OF MITOTIC CELL DIVISION

iii) Anaphase

- a) It is a very rapid stage
- b) Beginning at the centromere, the sister chromatids undergo mutual repulsion and are seen to split longitudinally into two halves. Each sister chromatid is now called a daughter chromosome.
- c) Spindle fibres get attached to the centromere of their side.
- d) Chromosomes become L, V, T or I-shaped depending upon the position of the centrosome.
- e) Spindle fibres get shortened so that each chromatid with the centromere is pulled apart towards its respective pole.
- f) At the poles, each chromatid behaves as an independent chromosome. The chromosome number of daughter nuclei remains the same as that of the parent nucleus.

iv) Telophase

- a) This is the reorganisation phase resulting in the formation of two daughter nuclei.
- b) Chromosomes form the chromatin network.
- c) Nucleolus and nuclear membrane reappear and two daughter nuclei are formed.
- d) The two daughter nuclei formed are identical to the parent nucleus.
- e) Each nucleus is now ready to share its cytoplasm.



Water

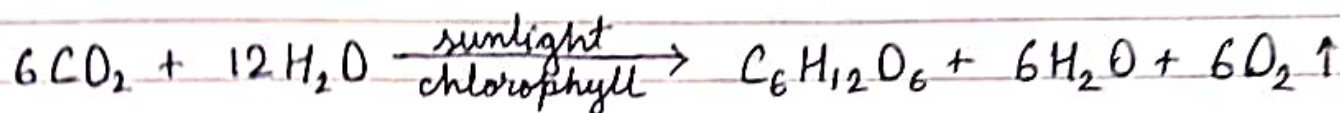
Hydrilla
twigs

experimental set-up to show that oxygen is given out during photosynthesis.

Exp no. 11
Date: 20/6/19

EXPERIMENT ON PHOTOSYNTHESIS [O₂ EVOLUTION]

Photosynthesis :- Photosynthesis is a biochemical process by which green plants and other photosynthetic organisms prepare food like glucose (C₆H₁₂O₆) energised usually by light from CO₂ and water with liberation of oxygen (O₂) and water in the presence of chlorophyll and for other photosynthetic pigments.



AIM :- To demonstrate that oxygen is evolved during photosynthesis.

MATERIALS REQUIRED :- Beaker, Thistle funnel, test tube, water wax, few twigs of Hydrilla plant, pyrogallol solution, Match box.

PROCEDURE :-

- i) A clean beaker is taken and it is filled two-third with tap water.
- ii) The ends of a few Hydrilla twigs are cut obliquely and they are placed in water in the beaker.
- iii) A funnel is taken and it is kept upside down in the beaker in such a way that it covers hydrilla twigs.
- iv) A test tube is filled with water and it is inverted

carefully on the stem of the funnel.
> The apparatus is kept in sunlight.

OBSERVATION:-

After sometime, it is seen that bubbles of gas are given off from the whole of the stem of funnel and are collected in the test tube by displacing water. (Note: We can count the number of bubbles per minute coming out of the hole of cut ends of the hydrilla). When some gas is collected in the test tube, some drops of alkaline pyrogallol solution is added. The gas is absorbed immediately and the solution turns dark brown, thus indicating that it was oxygen gas or bring a burning matchstick near the gas which starts burning more brightly.

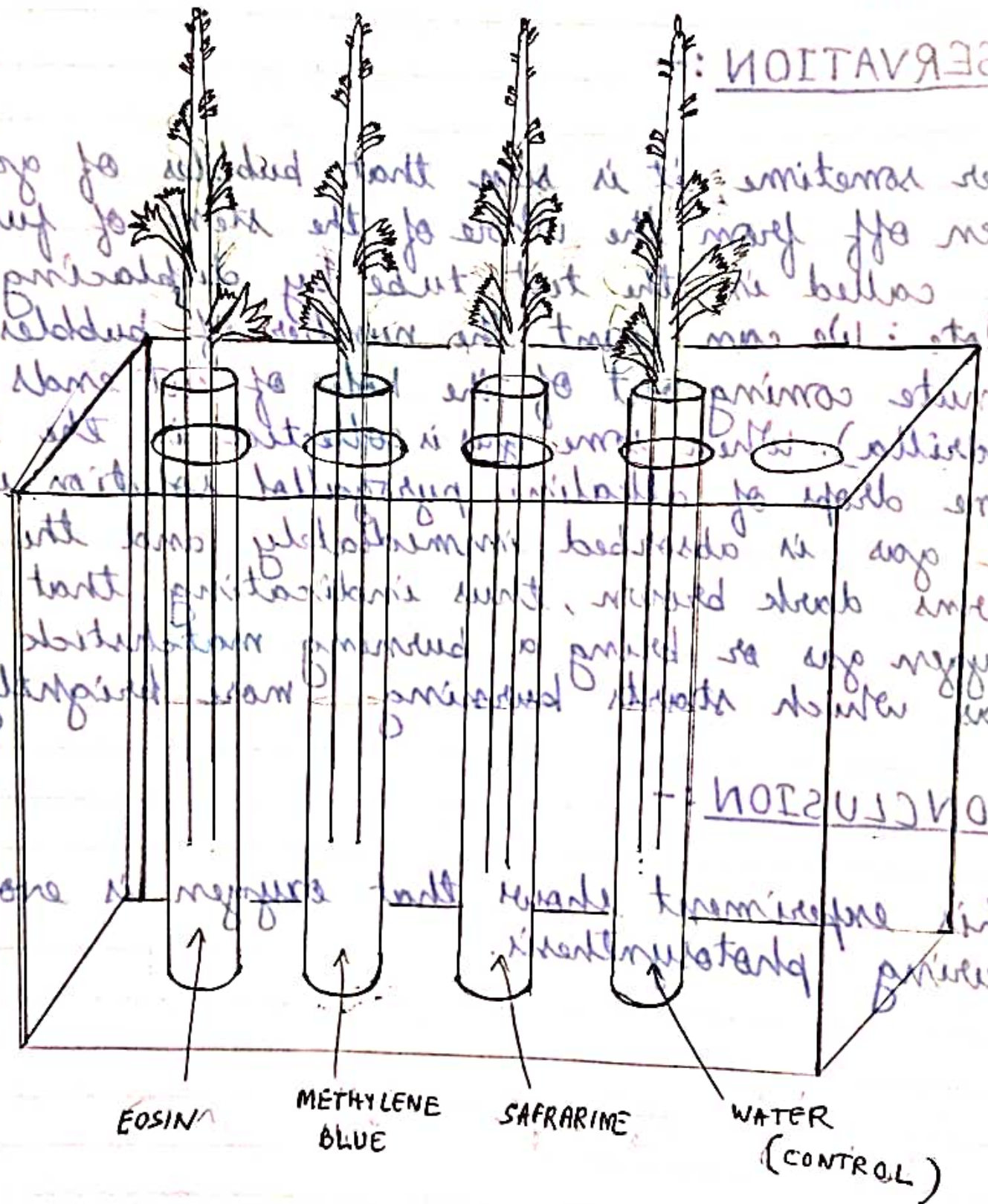
CONCLUSION:-

This experiment shows that oxygen is evolved during photosynthesis.

EXPERIMENT ON CONDUCTION (USING TUBE ROSE STICKS)

The apparatus is kept in sunlight for some time so that the stem of the plant is fully turgid.

OBSERVATION:



10.5
30/04/19

EXPERIMENT ON CONDUCTION [USING TUBEROSE STICK]

OBJECTIVE :- To demonstrate the process of conduction using tuberose sticks.

MATERIALS REQUIRED :- Few tuberose sticks, test tube, Eosin, Methylene, distilled or plain tap water, blade, safranine.

PROCEDURE :-

Three stems of tuberose are cut and made narrow ring using a blade. Eosin, Methylene and water is poured in individual test tubes and three tuberose sticks are inserted, one in each. The test tubes are left in test tube rack and they are kept undisturbed for some time. The test tube containing water is taken as control to check the presence of any other atmospheric condition.

OBSERVATION :-

After sometime, it is observed that the test tube in which Eosin is kept, that specific tuberose becomes red in colour due to rapid conduction of water through the stem. The test tube containing Methylene underwent slow change as well as safranine. As a result the tuberose dipped in Eosin becomes

rapidly red in colour and the tuberose dipped in methylene took a very long time to show a colour change. There was no change in the tuberose dipped in water even after a very long time.

INFERENCE :-

This shows that Ascent of Sap takes place through the xylem vessel. After sometime, when a transverse section of the stem of tuberose dipped in Eosin is made and clearly examined under a magnifying glass. The xylem vessels will appear distinct from the rest.

Vascular bundles in the stem, root, leaf stalks and leaf veins are all continuous and form an unbroken system of tube. Collectively, they form the transport system throughout the entire plant. Water and salt travel upwards mainly in the Xylem and food substances travel up and down in the phloem.

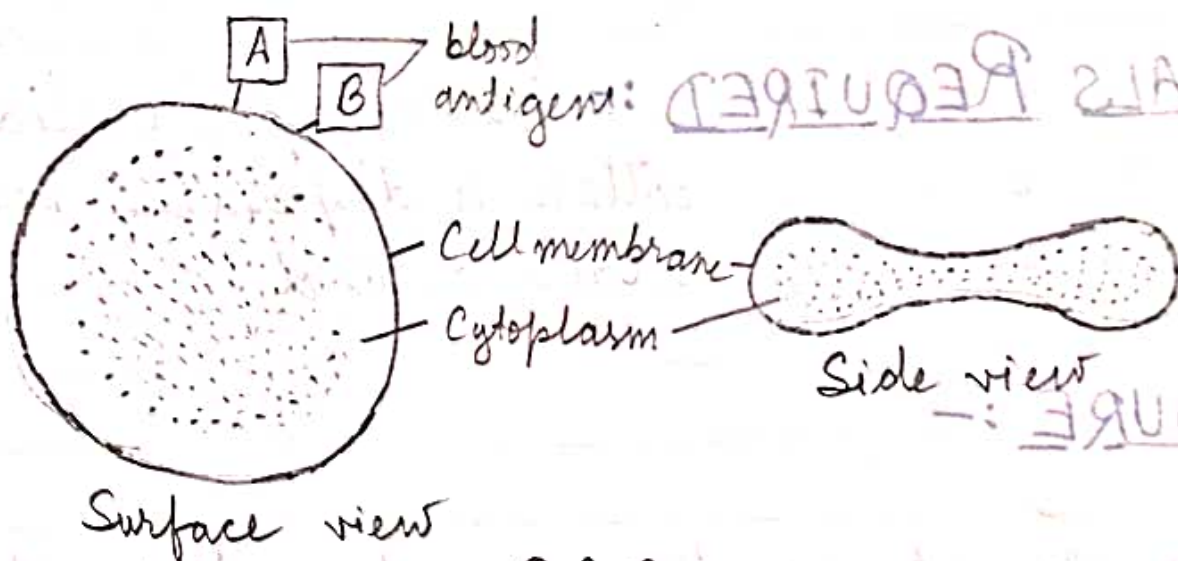
IDENTIFICATION OF BLOOD CELLS [SLIDE]

AIM:- To observe and identify different types of blood cells.

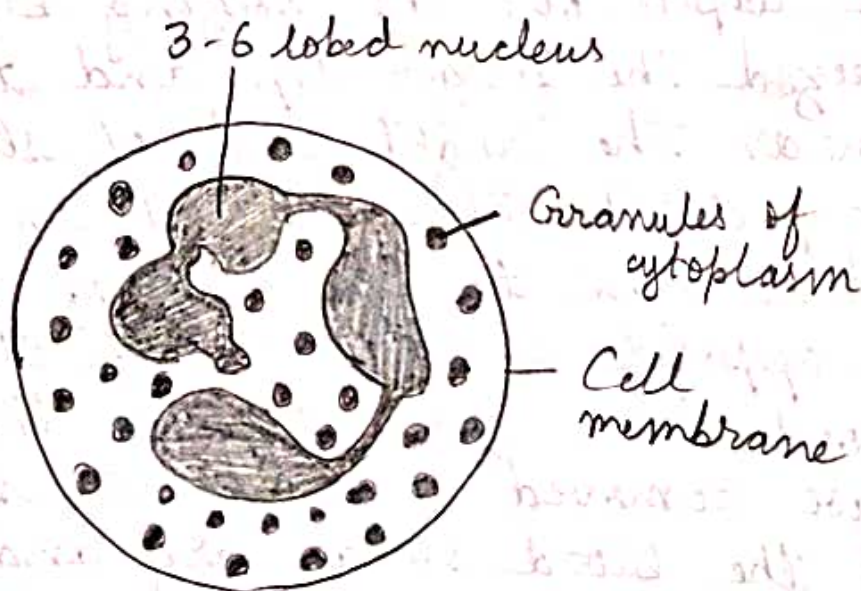
MATERIALS REQUIRED:- Microscope, a slide, coverslip, cotton, a disposable needle, Leishman stain, alcohol.

PROCEDURE:-

- First, we cleaned our finger and a disposable syringe with alcohol.
- Then we pricked our finger tip with the needle.
- Then we wiped out the oozing blood from cotton.
- We squeezed the finger tip and took out a drop of a blood near the right end of slide.
- Then we put the other slide at an angle of 60° over the first slide close to the drop of blood and pulled it to the opposite end of the first slide.
- The blood then gets evenly distributed.
- Then we removed the first slide.
- We let the blood smear dry and stained it with Leishman stain.
- We added distilled water on it.
- Then we kept a cover slip over it.
- We rinsed the slide in tap water.
- Then we examined it under the microscope.



RBC



Neutrophil

OBSERVATION:-

The cellular part of the blood contains:-

1) Red Blood Corpuscles (RBCs) or Erythrocytes

- RBCs appear red in colour due to the presence of haemoglobin which is a respiratory pigment.
- They are biconcave, disc-like and flattened at the centre.
- They are without nucleus or non-nucleated.
- They are 7-8 μm in diameter.
- They do not contain Mitochondria, Endoplasmic Reticulum.
- They are the most numerous cell in human blood.

2) White Blood Cells (WBCs) or Leucocytes

- They do not have haemoglobin, hence called WBCs.
- They possess a prominent nucleus.
- They are larger in size but lesser in number than erythrocytes.

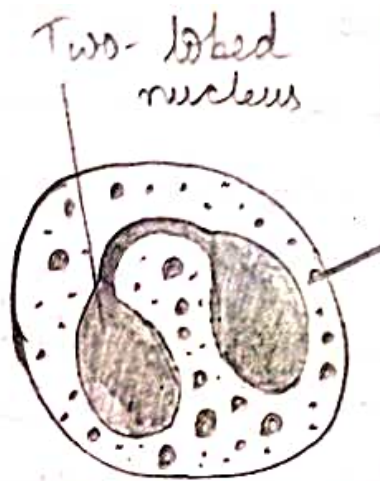
These are of following types:-

a) Granulocytes (Granular Leucocytes): Cytoplasm of granulocytes contains granules and their nucleus is constricted into lobes. They are of three types:-

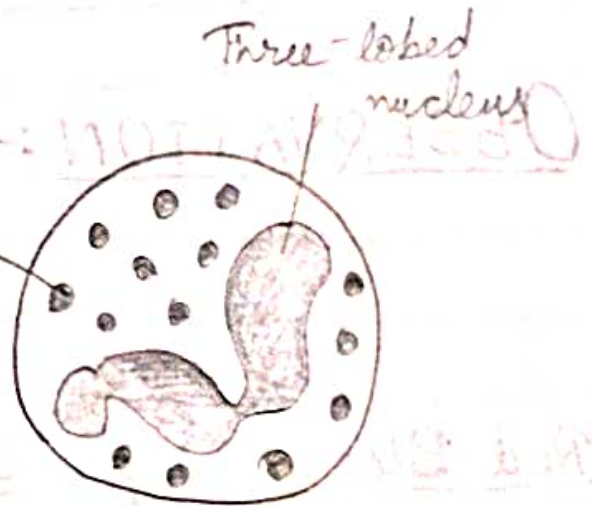
- Neutrophils - Nucleus is 3-5 lobed. The granules stain with neutral dyes. They engulf bacteria.

re ① Part I - 05/09 $\rightarrow$

13/09/2020



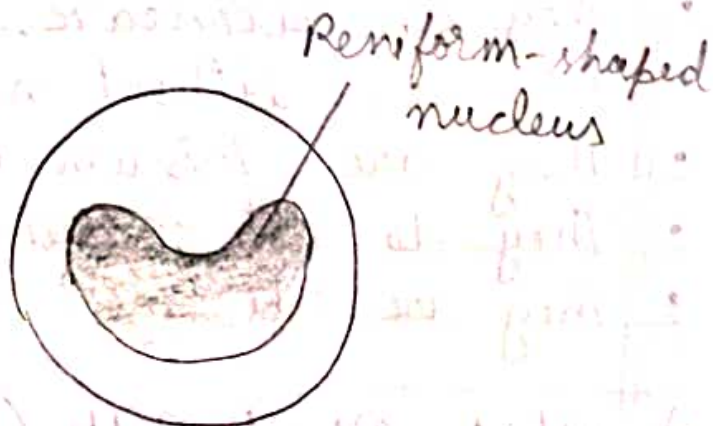
Eosinophil



Basophil



Lymphocyte



Monocyte



Thrombocytes (Platelets)

- Eosinophils : Nucleus is 2-lobed and granules stain with acidic dyes. Their number increases during infection.
- Basophils : Nucleus is S-shaped (3 lobed) and granules stain with basic dyes.
- b) Agranulocytes : Their cytoplasm lacks granules. They are of two types :-
 - Lymphocytes : These are with large rounded nucleus and very little cytoplasm.
 - TYPES OF LYMPHOCYTES :-
 - a) B-cells - Produce Antibodies (Ig A, Ig D, Ig E, Ig G, Ig M)
 - b) T-cells - Produce cell-mediated immunity.
 - Monocytes : These are with large reniform shaped nucleus and enough cytoplasm.

The ratio of RBC : WBC is 600 : 1

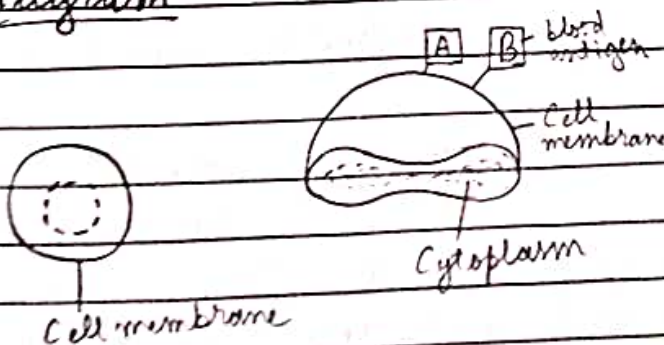
- c) Platelets or Thrombocytes
 - They are fragments of cells.
 - They are oval and much smaller.
 - Distinct nucleus is absent.
 - They help in blood clotting.

Difference between RBC and WBC.

RBC

- 1) They are biconcave disc.
- 2) They contain red haemoglobin.
- 3) They do not contain nucleus.
- 4) They are of one type.
- 5) They carry respiratory gases.
- 6) Their number is 4.5 - 5.5 million per mm^3 of blood.

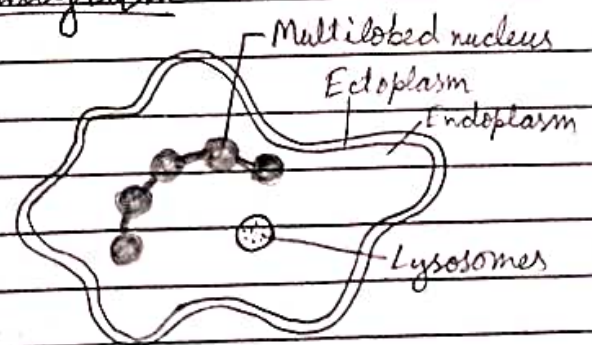
7) Diagram:-



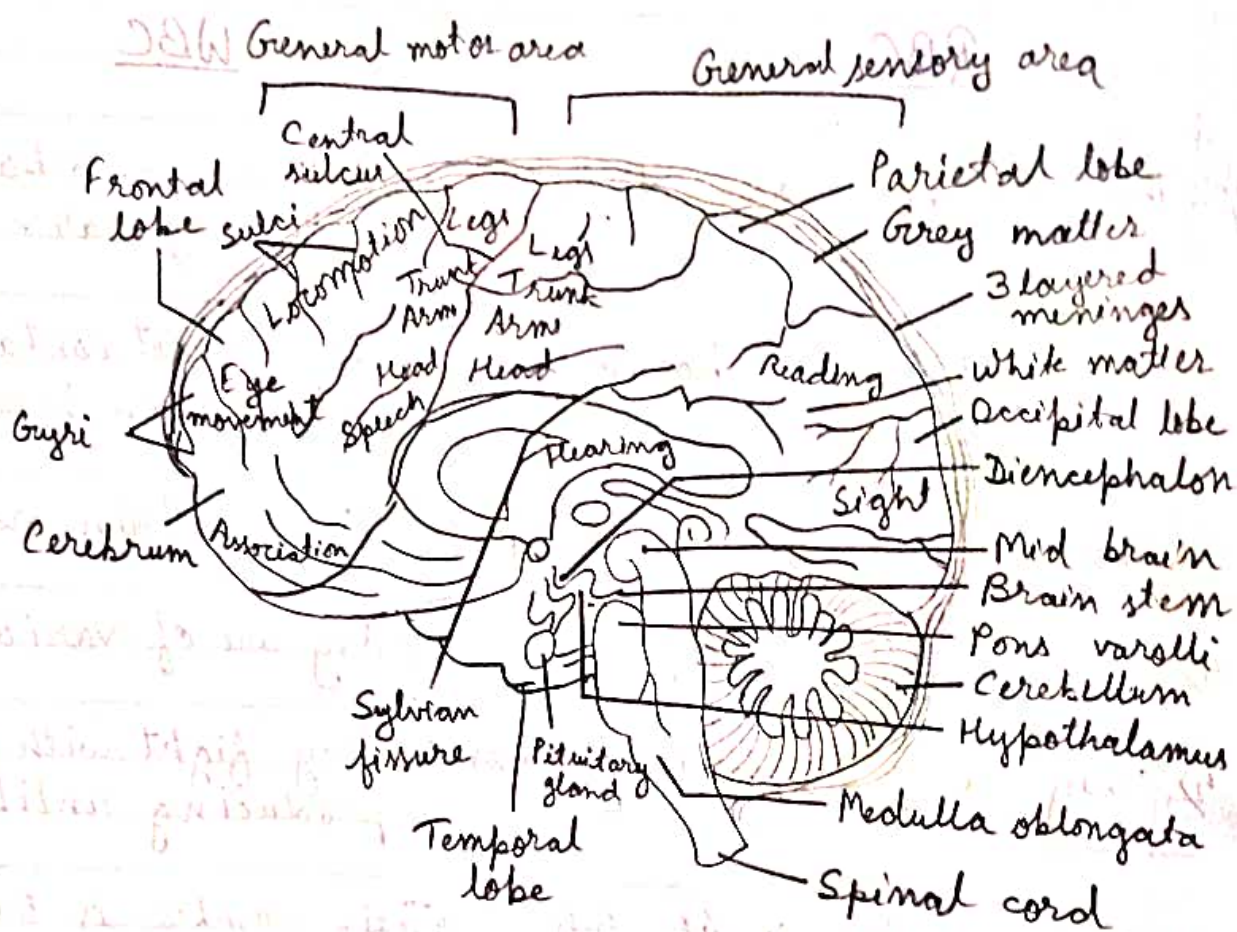
WBC

- 1) They are amoeboid or irregular.
- 2) They do not contain haemoglobin hence colourless.
- 3) They contain nucleus.
- 4) They are of various type.
- 5) They fight with germs by producing antibodies.
- 6) Their number is 5000 - 10000 per mm^3 of blood.

7) Diagram:-



Expt. No. - 7
Date - 30/04/19



Sagittal section of human brain

STUDY OF BRAIN [MODEL AND CHART]

AIM - To identify different parts of a mammalian brain with the help of models and charts.

MATERIALS REQUIRED - Models and charts of human brain.

PROCEDURE - The external view of the brain is studied with the help of models and charts. A neat diagram of the brain is drawn and all its parts are labelled.

OBSERVATION

The brain is protected by ~~ea~~ cranium and Meninges. The meninges consists of three layers - the outermost duramater, the middle Arachnoid and the innermost piamater. The cerebrospinal fluid acts as a shock absorber.

Brain is divisible into three parts :- Forebrain, Midbrain and Hindbrain.

1. Forebrain

It forms the greater part of the brain. It consists of three regions :- olfactory lobes, cerebrum (cerebral hemispheres) and diencephalon.

- Olfactory lobes - These are centres of smell and are poorly developed in human beings. They are visible only in ventral view of the brain.

- Cerebrum (Cerebral Hemispheres) - It is highly developed in man and overshadow all parts of the brain. Cerebrum is divided into right and left cerebral hemispheres by a deep median cerebral fissure. The two cerebral hemispheres are connected ventrally by corpus callosum.

Cerebrum controls mental abilities like thinking, reasoning, learning, memory and intelligence. It also controls will, emotions and speech.

- Diencephalon - It consists of thalamus and hypothalamus. From the roof of diencephalon arises pineal gland and from the floor arises pituitary gland.

- Thalamus - It serves as a relay centre for sensory and motor impulses from spinal cord and medulla to various parts of the cerebrum. It recognises the sensory impulses of heat, cold, pain, light and pressure.

- Hypothalamus - It contains reflex centres of muscular and glandular activities.

- It controls food intake, thirst and body temperature (thermoregulation).
- It regulates hormonal secretions of pituitary gland.
- It controls behavioural patterns of sleep and stress.

2. Midbrain

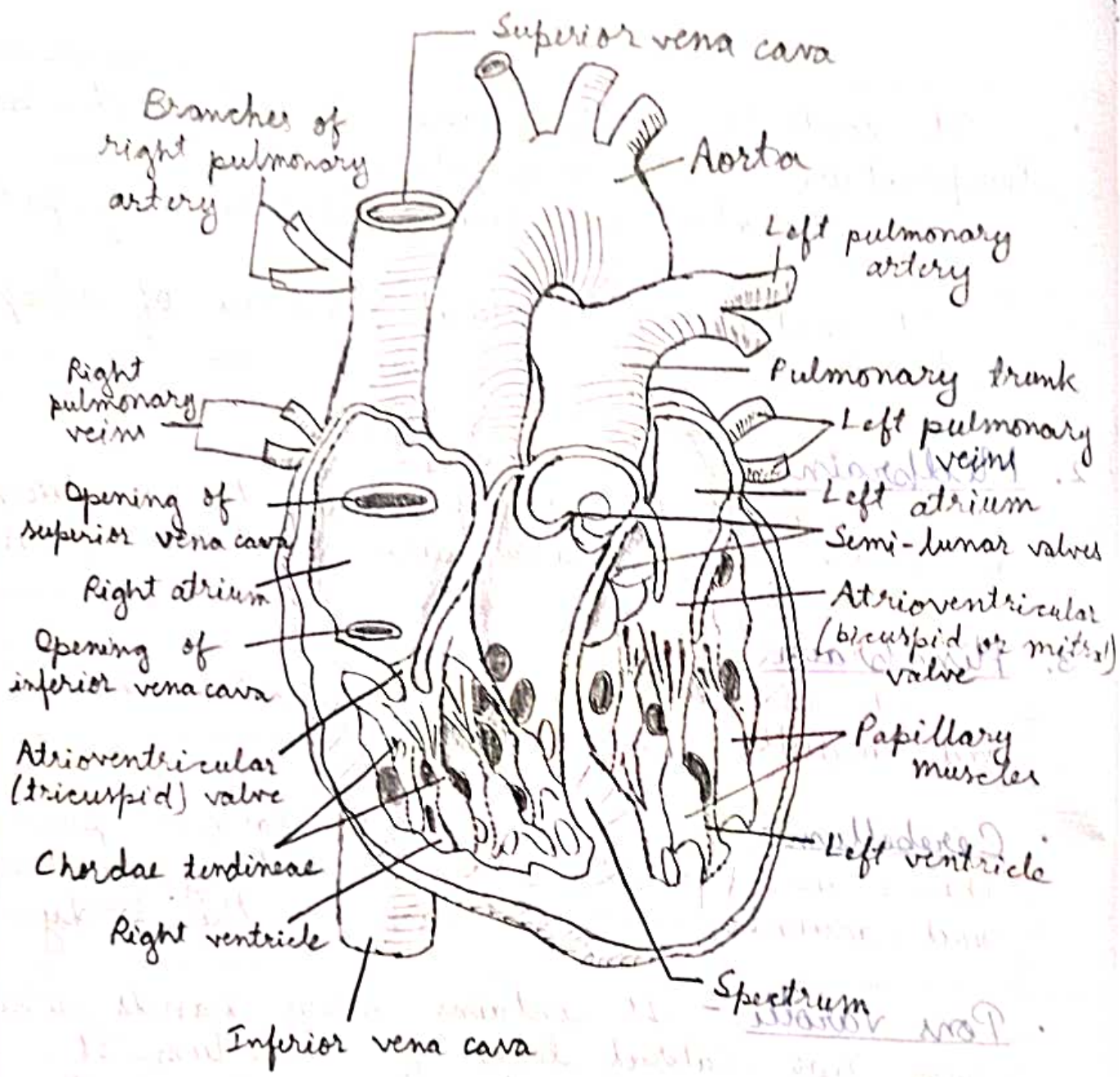
It lies next to diencephalon. It is formed of optic lobes which are centres of vision.

3. Hindbrain

It consists of cerebellum, pons varolli and medulla oblongata.

- Cerebellum - It is the second largest part of the brain. It coordinates voluntary movements and maintains equilibrium of the body.
- Pons varolli - It contains nerve bands which join two lateral lobes of cerebellum. It transmits impulses from one side of the cerebellum to the other.
- Medulla oblongata - It forms the posterior part of the brain and is also called the brain stem. It controls heart beat, breathing movements and swallowing.

Expt. No. - 8
Date - 30/04/19



Longitudinal section of human heart

STUDY OF HEART [MODEL AND CHART]

AIM - To study and identify the internal structure of heart with the help of models and charts.

MATERIALS REQUIRED - Model and chart of human heart.

PROCEDURE - The internal structure of heart is drawn with the help of model and charts. Its figure is drawn and various parts are labelled.

OBSERVATIONS -

- Heart is enclosed in a thin, two-layered sac called pericardium.
- The space between the two layers of pericardium remains filled with pericardial fluid which protects heart from injury and against friction. It also keeps the heart moist.
- Heart is four-chambered. It consists of two atria and two ventricles.
- Atria are two upper, thin-walled chambers of the heart, separated by a thin inter-auricular septum.
- Right atrium receives deoxygenated blood from the body by two large vessels (vena cavae). Left atrium has four openings of four pulmonary veins.
- Two lower, thick-walled chambers of heart are

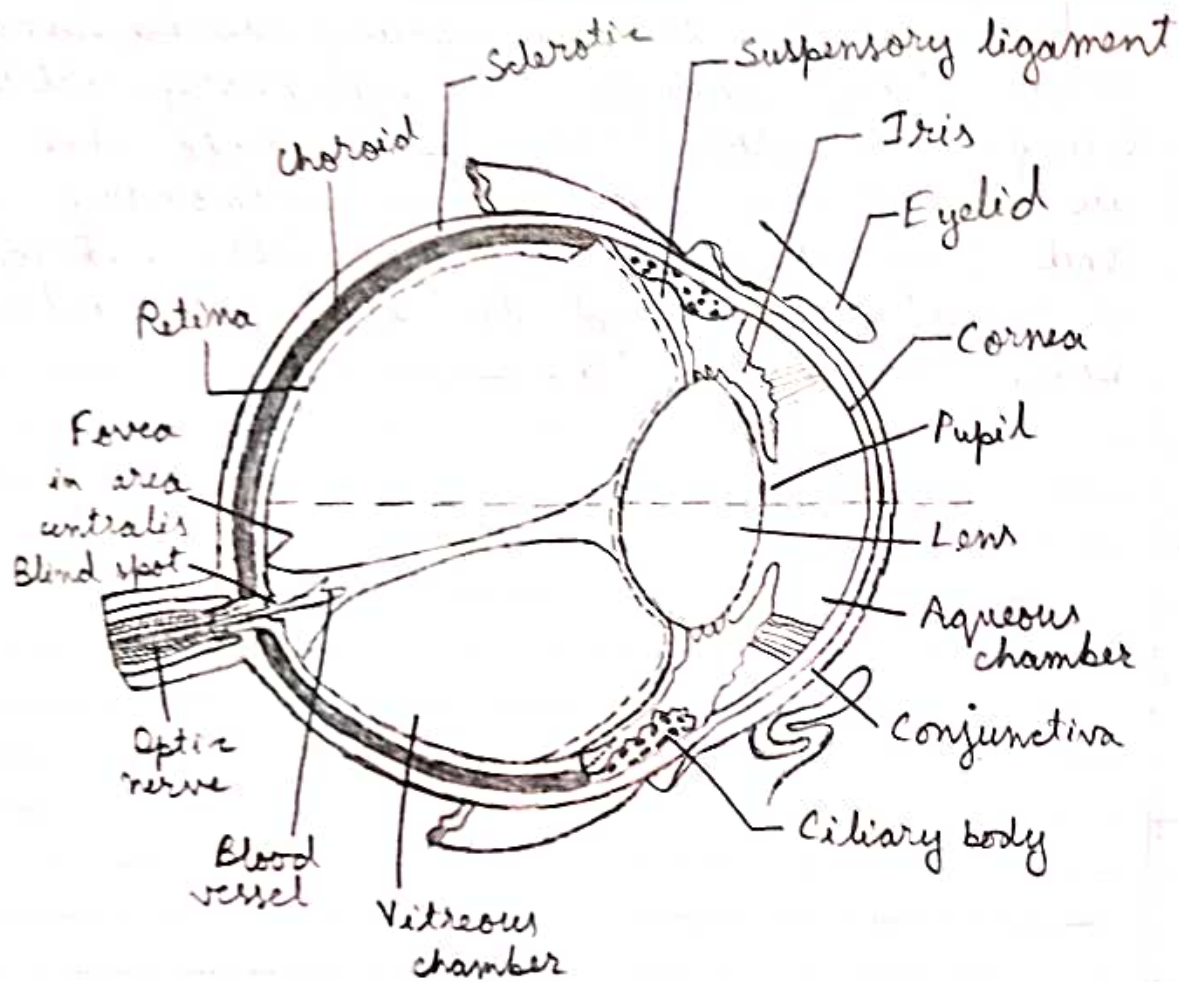
called ventricles. These are separated by a thick, obliquely placed inter-ventricular septum. The left ventricle is larger and its walls are thicker than the right ventricle.

- Right ventricle supplies deoxygenated blood to lungs through pulmonary aorta.
- Various apertures in the heart are guarded by four valves to maintain unidirectional flow of blood inside the heart and into the great blood vessels.
- Each atrium opens into the ventricle of its side through an atrio-ventricular aperture which is guarded by a cuspid valve.
- A bicuspid (mitral) valve guards the left atrio-ventricular aperture. It allows blood to flow from left atrium to left ventricle.
- A tricuspid valve guards the right atrio-ventricular aperture and allows blood from right atrium to right ventricle. It consists of three flaps.
- One set of three pulmonary semilunar valves guards the opening of right ventricle into the pulmonary aorta.
- A set of three aortic semilunar valves guards the point of origin of aorta from the left ventricle.
- Heart receives deoxygenated blood in the right atrium, then pumps it through right

ventricle into the pulmonary ~~aorta~~ lungs for oxygenation through the pulmonary artery.

- Oxygenated blood comes back into the left auricle/atrium through the pulmonary veins, and from there it reaches left ventricle from where it is pumped to all the parts of body through aorta.

Expt. No. - 9
30/04/19



Structure of eyeball

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STUDY OF EYE [MODEL]

AIM - To study the structure of human eye with the help of models and charts.

MATERIALS REQUIRED - Charts and models of human eye.

OBSERVATIONS -

The following structures are seen:-

- 1/ Eyelids - These are protective in function. They also spread the tear evenly over the eyeball, only the upper eyelid is movable.
- 2/ Conjunctiva - It is a thin vascular lining of epithelium inside the eyelid.
- 3/ Sclera - It is the white non-elastic part which covers the eyeball except the front part of eye which is covered by cornea. It protects the eyeball and maintains its shape.
- 4/ Cornea - The exposed one-sixth of the eyeball is in the form of a thin, transparent covering called cornea. Light enters the eye through cornea and it refracts light and the rays are converged.

5) Ciliary body - It is a vascular coat along the peripheral margin of iris. It contains radial and circular muscle which helps to change the focal length of the eye.

6) Choroid - It is the second layer of eyeball and lies in contact with the sclera. It has a rich supply of blood vessels. It is dark-brown in colour to prevent reflection of light in the eyeball.

7) Iris - The vascular coat present between the cornea and the lens is called iris. It has two sets of muscles, the sphincters or circular muscles and dilator or radial muscles. Iris is perforated in the middle by an aperture called pupil.

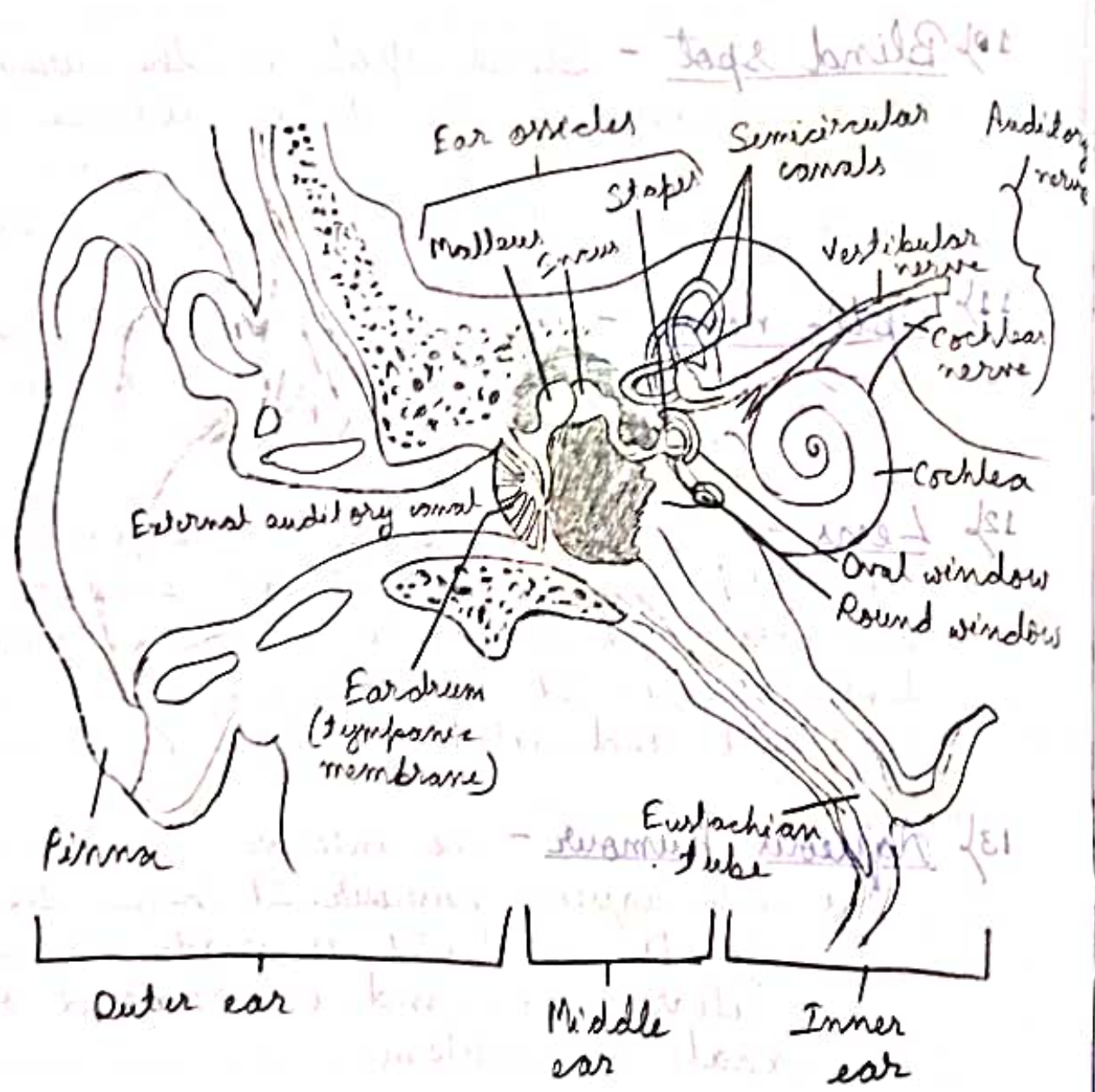
8) Retina - It is the innermost, neurosensory layer of the eyeball. It is formed of rods and cones. Rods and cones contain light sensitive pigment formed from vitamin A. Rods contain pigment rhodopsin and cones contain pigment iodopsin.

9) Yellow spot - Yellow spot is the area of best vision. It is also called area centralis or fovea centralis. It lies in the optical

axis of eye in the retina.

- 10) Blind spot - Blind spot is the area of no vision. Because of the total absence of light sensitive rods and cones, it does not form image. Therefore, it is called blind spot.
- 11) Optic nerve - It is a bundle of nerve fibres to take the message to the visual centre of the brain.
- 12) Lens - It is a transparent, biconvex, crystalline structure. It is present just behind the pupil and iris and is enclosed in a membranous lens capsule. It is suspended by suspensory ligament and ciliary body.
- 13) Aqueous humour - The anterior chamber of eye is filled with aqueous humour. It keeps the lens moist and refracts lights. It is made from fine blood vessels ciliary body and is drained out through the canal of schlem.
- 14) Vitreous humour - It is a jelly-like substance and is present at the back of lens. It provides shape to the eyeball. It is transparent and light passes through it to form an inverted image on the retina.

Expt. No. - 10
30/04/19



Structure of human ear

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Expt. No. - 10
30/04/19

STUDY OF EAR [MODEL]

AIM - To study and identify the structure of human ear with the help of models and charts.

MATERIALS REQUIRED - Charts and models of human ear.

OBSERVATIONS

The human ear consists of three parts :-
Outer ear, middle ear and inner ear.

1) The Outer ear consists of :-

a) Pinna - It is made up of folded cartilage. It collects sound waves from different directions and sends them to the auditory canal.

b) Auditory Canal - It is a long tunnel like structure which contains hairs and wax secreting glands. It carries vibrations to the ear drum.

c) Tympanic Membrane (Ear drum) - It is a thin membrane. It sends the vibrations to the Middle Ear.

2) Middle Ear - It is a small air-filled cavity called tympanic cavity. It is separated from the outer ear by tympanum and from the inner ear by a bony partition. It consists of :-

a) Ear ossicles - They are three small bones. These are malleus, incus and stapes. They amplify and transfer the vibrations from the ear drum to the inner ear.

b) Eustachian tube - Tympanic cavity opens in the pharynx through eustachian tube. This connects middle ear with throat. It equalises pressure on both sides of the ear drum.

3) Inner ear or Membranous Labyrinth :-

Inner ear is situated in a fluid-filled bony cavity. This fluid is called perilymph.

It comprises - cochlea, semi-circular canals and vestibule.

a) Cochlea - It is a spiral-shaped tube, coiled like a snail shell. The cavity of cochlea is divided into three parallel canals separated by two membranes. Outer and inner canals are filled with perilymph and the middle one is filled with endolymph. Basilar membrane

contains organ of corti. Each organ of corti contains sensory cells called hair cells. These cells receive sound vibrations. They are joined with fibres of auditory nerve.

b) Semi-circular Canals - These are a set of three semi-circular canals arranged at right angles to each other but in different planes so that one is horizontal and other two are vertical. One end of each canal is swollen to form an ampulla. Ampulla contains a bunch of sensory cells called cristae. Cristae in semicircular canals are the organs of dynamic equilibrium.

c) Vestibule - It is a short, oval part of membranous labyrinth which joins the semi-circular canals with cochlear. It consists of utricle and saccule.

Utriculus and Sacculus - These are sac-like structures. These contain sensory cells which are associated with static equilibrium.

d) Oval window - It receives vibrations from the middle ear.

e) Endolymph - It is the fluid present in cochlear canal of cochlea in the membranous

labyrinth. It stimulates the organ of corti for hearing.

f) Auditory Nerve - It transmits the impulses to the brain.