D. PHARM 1ST YEAR

SUBJECT: HUMAN ANATOMY AND PHYSIOLOGY

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PRACTICAL JOURNAL

Name: _____

Subject: _____

Class: _____

Roll No: _____ **Batch:** _____

University Seat/Enrollment No.: _____

CERTIFICATE

This is to certify that Mr./Miss. _____

of D. Pharm 1st Year at _____,

Seat/Enrollment No. _____ & Roll No. _____ has satisfactory completed his/her _____ out of _____ Experiments/Practical of the Subject Human Anatomy and Physiology, Subject Code – DP104TP for the academic year 20 __ to 20 __.

Signed by:

_____	_____	_____
Head of Department	**External Examiner**	**Subject Teacher**

Date of certified:

D. PH 1ST YEAR: HUMAN ANATOMY AND PHYSIOLOGY – PRACTICAL

INDEX

D. PH 1ST YEAR: HUMAN ANATOMY AND PHYSIOLOGY – PRACTICAL

Basic Requirements for the practical

1. Apron
2. Cap & Mask
3. Record Book
4. Thomas Cover slip
5. Glass Slide
6. Dissection Box
7. Napkin
8. Wrist watch
9. Calculator
10. Permanent Marker, Pen, Pencil, Eraser and Sharpener
11. Nail Cutter
12. Cellotape
13. Water Bottle
14. Journal
15. Hand Sanitizer
16. Sticky Label or White Small Square Sticker

Instruction for the student

1. Entre in laboratory with neat and clean formal clothes.
2. Do not entre in laboratory with wearing of short, track, and sleeveless kind of dresses.
3. Enter in laboratory with wearing of shoe. (Girls can wear formal sandal)
4. Long hair must be tied back to avoid catching fire and contamination of sample.
5. Keep solids out of the sink.
6. Leave your work station clean and in good order before leaving the laboratory.
7. Wear apron before entering into the laboratory.
8. Remove apron outside the laboratory after completion of experiment
9. Use apparatus or instrument with care
10. Seat in laboratory at your allocated place
11. Ask laboratory assistant, Peon, Teacher or your colleague in emergency.

EXPERIMENT NO.: 1 **DATE:**

AIM: TO STUDY THE USE AND CARE OF MICROSCOPE.

INTRODUCTION:

Types of microscope:

1. Microscopes used in clinical practice are **light microscopes**. They are called light microscopes because they use a beam of light to view specimens.
2. A **compound light microscope** is the most common microscope used in microbiology. It consists of two lens systems (combination of lenses) to magnify the image. Each lens has a different magnifying power. A compound light microscope with a single eye-piece is called monocular; one with two eye-pieces is said to be binocular.
3. Microscopes that use a beam of electrons (instead of a beam of light) and electromagnets (instead of glass lenses) for focusing are called **electron microscopes**. These microscopes provide a higher magnification and are used for observing extremely small microorganisms such as viruses.

PARTS OF MICROSCOPE:

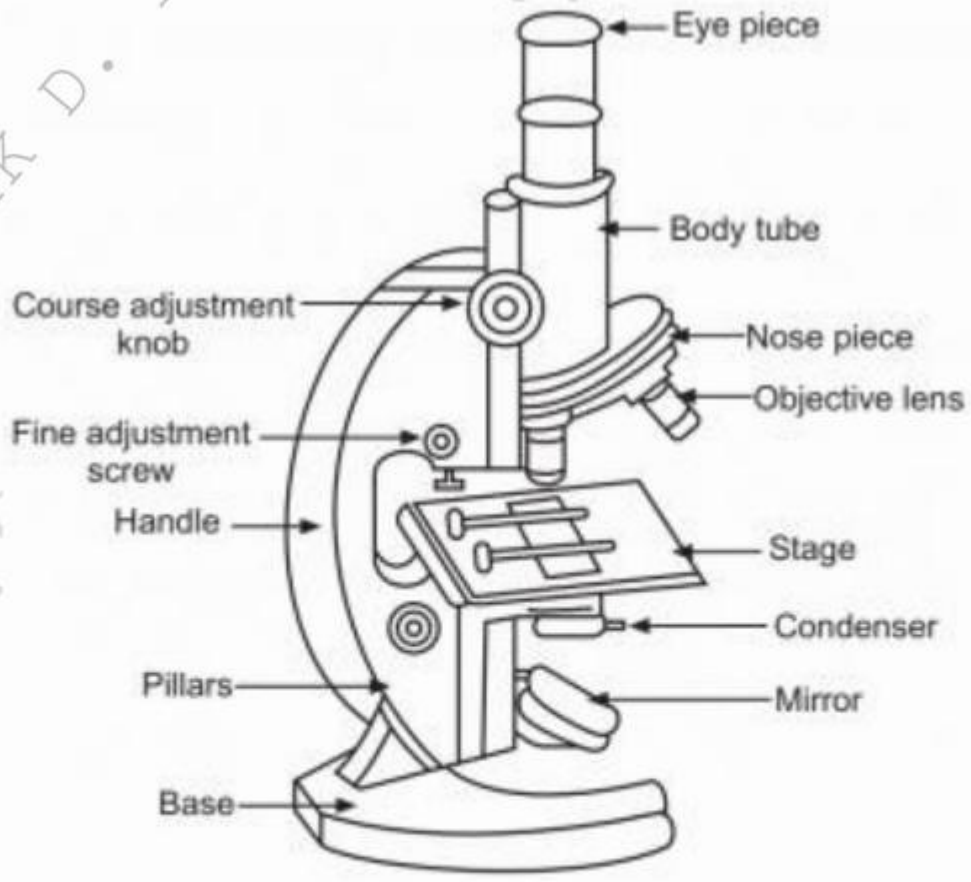


Figure: Compound Microscope

The main parts of the microscope are the eye-pieces, microscope tube, nosepiece, objective, mechanical stage, condenser, coarse and fine focusing knobs, and light source.

COMPOUND MICROSCOPE PARTS

- A high power or compound microscope achieves higher levels of magnification than a stereo or low power microscope. It is used to view smaller specimens such as cell structures which cannot be seen at lower levels of magnification. These key microscope parts are illustrated and explained below.

A. STRUCTURAL COMPONENTS

1. **Base (foot):** It is U or horseshoe-shaped metallic structure that supports the whole microscope.
2. **Pillar:** It is a short upright part that connects to base as well as arm.
3. **Arm (Limb):** It is a curved metallic handle that connects with the arm by inclination joint. It supports stage and body tube.
4. **Inclination Joint:** It is used for tilting the microscope if required for observation in sitting position.
5. **Stage:** It is a metallic platform with a central hole fitted to the lower part of the arm. Microscopic slides held on the stage by either simple side clips or by a mechanical stage clip.
6. **Body tube:** It is meant for holding ocular and objective lenses at its two ends. The end holding ocular lens is called head while the end containing 3-4 objective lens is called nose piece. The body tube has an internal pathway for the passage of light rays which form the enlarged image or microscopic objects.
7. **Draw tube:** It is a small tube that remains fixed at the upper end of the body tube. It holds eyepiece or ocular lens.
8. **Rack and pinion:** The microscope has a rack and pinion attached either to body tube or the stage for bringing the object under focus.
9. **Adjustment screws:** There are two pairs of screws for moving the body tube in relation to stage, larger for coarse adjustment and smaller for fine adjustment. In fine adjustment the body tube or stages moves for extremely short distances. In coarse adjustment the body tube or stage can move up and distance. In coarse adjustment is meant for briefly objective lens at a proper distance from the object so as to form image of the same at the ocular end. Fine adjustment is required to obtain sharp image.
10. **Automatic Stop:** It is a small screw fitted at lower end or rack and pinion. It is meant for stopping the downward sliding of the body tube so as to prevent the damage of objective lens and the slide.

B. OPTICAL COMPONENTS

1. **Diaphragm:** It is flitted just below the stage for regulating the amount of light failing on the object. Diaphragm is of two types, disc and iris.

2. **Condenser:** It is attached below the diaphragm. Condenser can be moved up and down to focus light on the object.
3. **Reflector (Mirror):** It is attached just above the base. Both its surface bear mirrors, plane on one side and concave on other side. Plane side is used in strong light and concave side in weak light. Reflector directs the light on the object through the condenser and diaphragm system.
4. **Objective Lenses:** They are fitted over the nose piece. Objective lenses are of three types – low power (commonly 10X or 5X), high power (commonly 45X) and oil immersion (commonly 100X, can be more).
5. **Ocular Lens or Eyepiece:** It is lens through which image of the microscopic object is observed. It also takes part in magnification. Depending upon magnification, the eye piece is of four types-5X, 10X, 15X, and 20 X.

USE AND CARE OF THE MICROSCOPE

- Always keep the microscope clean, dust free and covered. Clear space on the bench before getting the microscope from the cabinet
- Grasp the microscope with two hands – one on the arm and the other under the base
- When you remove the microscope from the cabinet, do it slowly and carefully
- Remove the dust cover and store it in the scope cabinet
- Verify that the MIRROR is set for minimum light. Concave mirror is used while using low power lens and the plane mirror is used while using high power or oil immersion lens. Adjust the mirror such that the maximum and even illumination is obtained.
- Lower the stage (or raise head)
- Check that the **CONDENSER** is flush with the stage and the iris diaphragm is open
- Using the knurled nose ring, rotate and click the shortest.
- Load a slide, being sure it sits flat on the stage, held by the spring clip
- While looking into the eyepieces, slowly turn the coarse knob, moving lens closer to stage. As soon as you see a hint of color, switch to the small, fine focus knob and focus the object. Close one eye at a time to compare images.
- Once the slide is perfectly focused and the image is centered on low power, use the knurled nosepiece to click the next larger lens into place. **DO NOT USE THE COARSE FOCUS KNOB** after increasing magnification. Only use the fine focus knob to focus with a higher power lens.
- If you cannot find the image when you increase the magnification, go back to 4X and start again.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 2 **DATE:**

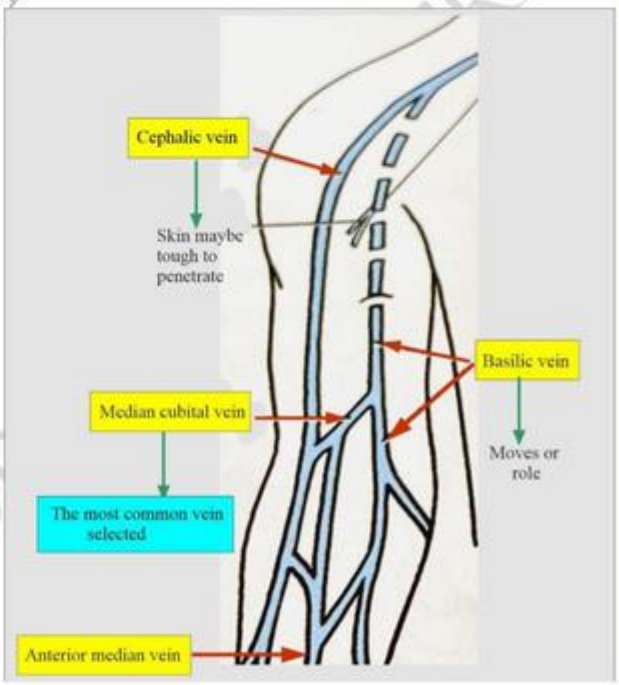
AIM: GENERAL TECHNIQUES FOR THE COLLECTION OF BLOOD.

INTRODUCTION:

Blood is collected for the various hematological investigations to obtain accurate and precise results in the laboratory which will to identify a correct diagnosis of the patient's disease.

Three popular methods of blood collection or sampling are:

1. Venipuncture Sampling
2. Arterial Sampling
3. Capillary Sampling



1. Venipuncture Sampling

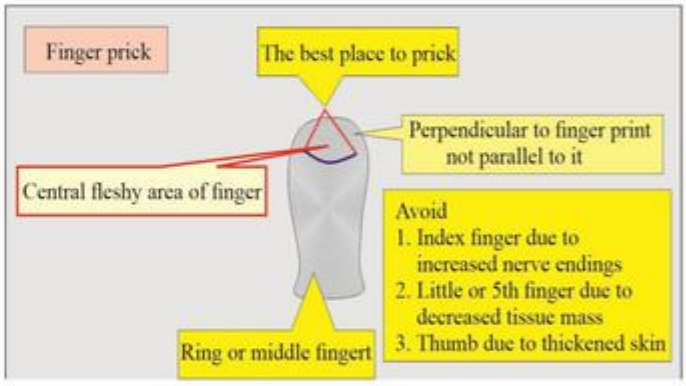
- This is the easiest way to collect the blood sample.
- It is free of complications.
- Blood is taken from the superficial veins.
- The commonest site is the antecubital fossa because of the presence of basilic vein, cephalic vein, median cubital veins are the commonest veins.
- Veins of the wrist or hand may be used and another site is the femoral vein.

2. Arterial blood:

- Arterial blood is used to measure arterial blood gases, like oxygen, CO_2, and pH.
- Arterial puncture is more difficult than the venous sample.
- The Brachial and radial arteries are often used; the femoral artery is usually avoided because of bleeding.

3. Capillary blood:

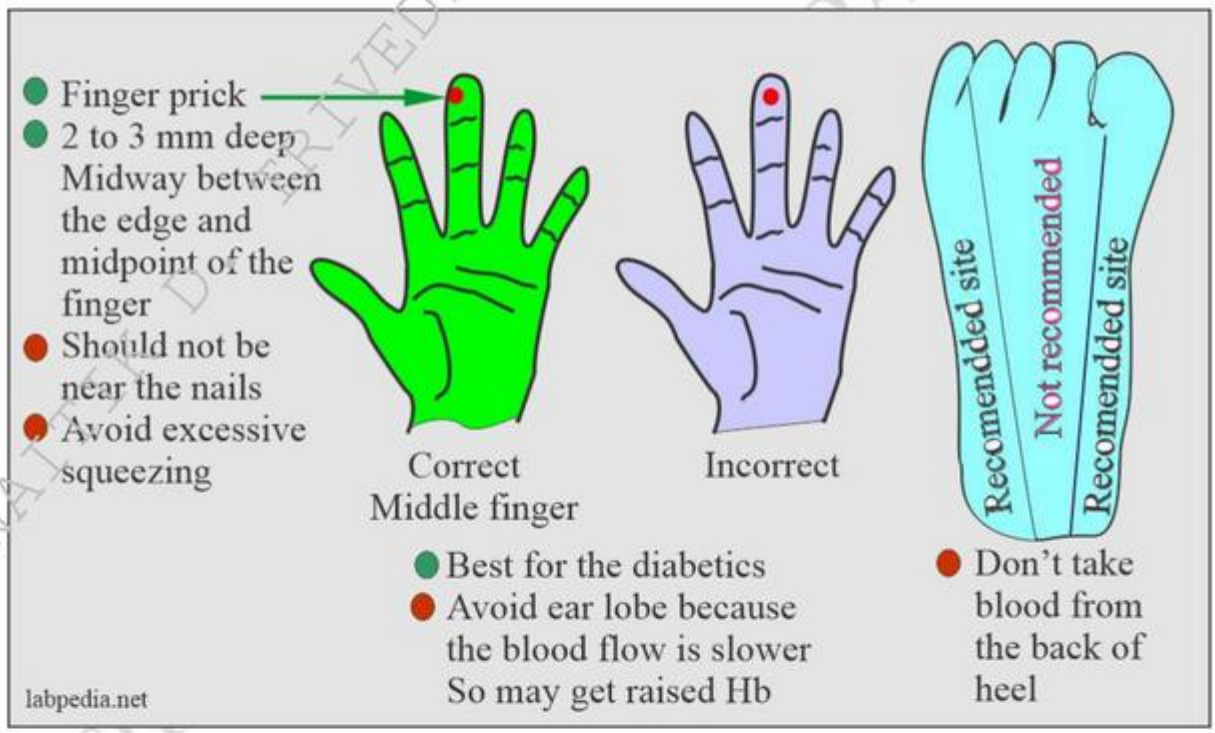
- It is mostly used in the pediatric patient's group where there is no need for a large amount of blood.
- The common sites are the fingertips, heel, and ear lobe. The heel is most commonly used in infants.
- The middle or ring finger is preferred as having the greatest depth of tissue beneath the skin and hence offering the least chances of injury.
- The thumb or index finger may be more likely to be calloused or scarred, as well as being much more sensitive, making the procedure more painful.



- Repeated punctures should not be made on the same site to avoid pain and dilution of the blood with extracellular fluid.

PROCEDURE OF FINGER PRICK:

- First warm the finger or hand to increase the blood flow for that shake the two hand or you can put the hand or finger in warm water also.
- After then gently apply the 70 % of alcohol on the correct finger.
- Then rub middle or ring finger of non-dominant hand from top to bottom by your thumb of dominant hand.
- Hold the finger and prick the finger by newly fresh and sterile lancet or by using pen device.
- Collect sufficient quantities of blood if possible then discard the first drop of blood due to contamination of protein and skin material.
- After collection of blood again sterilize the finger using 70 % of methylated alcohol or proof spirit using cotton wool.



Note:

- Discard the used needle and syringe or blood-sampling device into a puncture resistant sharps container.
- Do not use someone else used lancet or pricking niddle.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 3 **DATE:**

AIM: TO STUDY THE MICROSCOPIC EXAMINATION OF EPITHELIAL TISSUE, CARDIAC MUSCLE, SMOOTH MUSCLE, SKELETAL MUSCLE, CONNECTIVE TISSUE, AND NERVOUS TISSUE OF READY / PRE-PREPARED SLIDES.

DEFINITION: "It is a group of cells that usually have common embryonic origin and function together for special activities."

INTRODUCTION:

Body tissues can be classified in to four principal types according to their function and structure:

1) Epithelia tissue:
- It cover body surface, lines hollow organs, body cavity and ducts.
- It also forms glands.

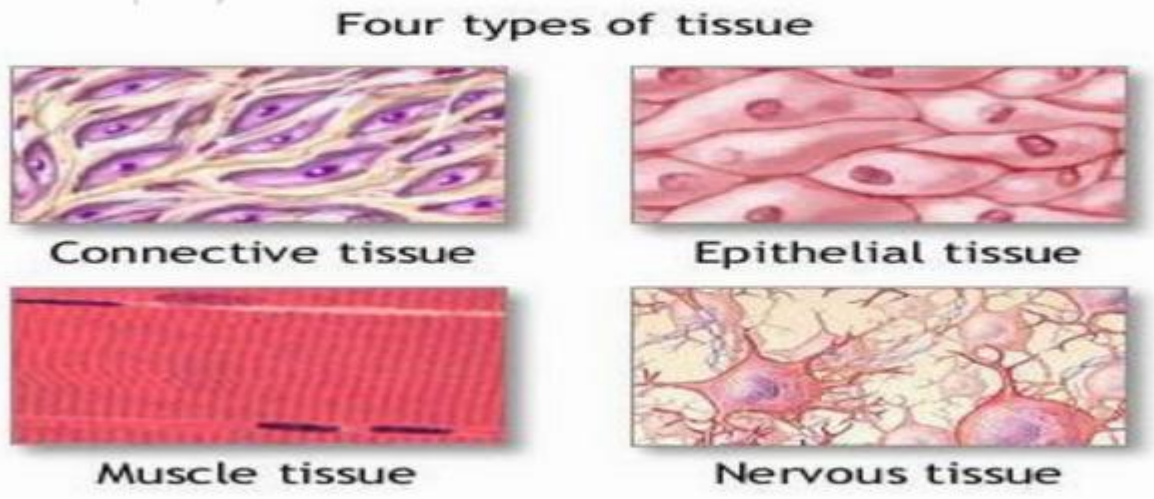
2) Connective tissue:
- It provides the supports and protects the body and its organs.
- It binds organs together.
- It store energy as reserved fat.
- It provides immunity.

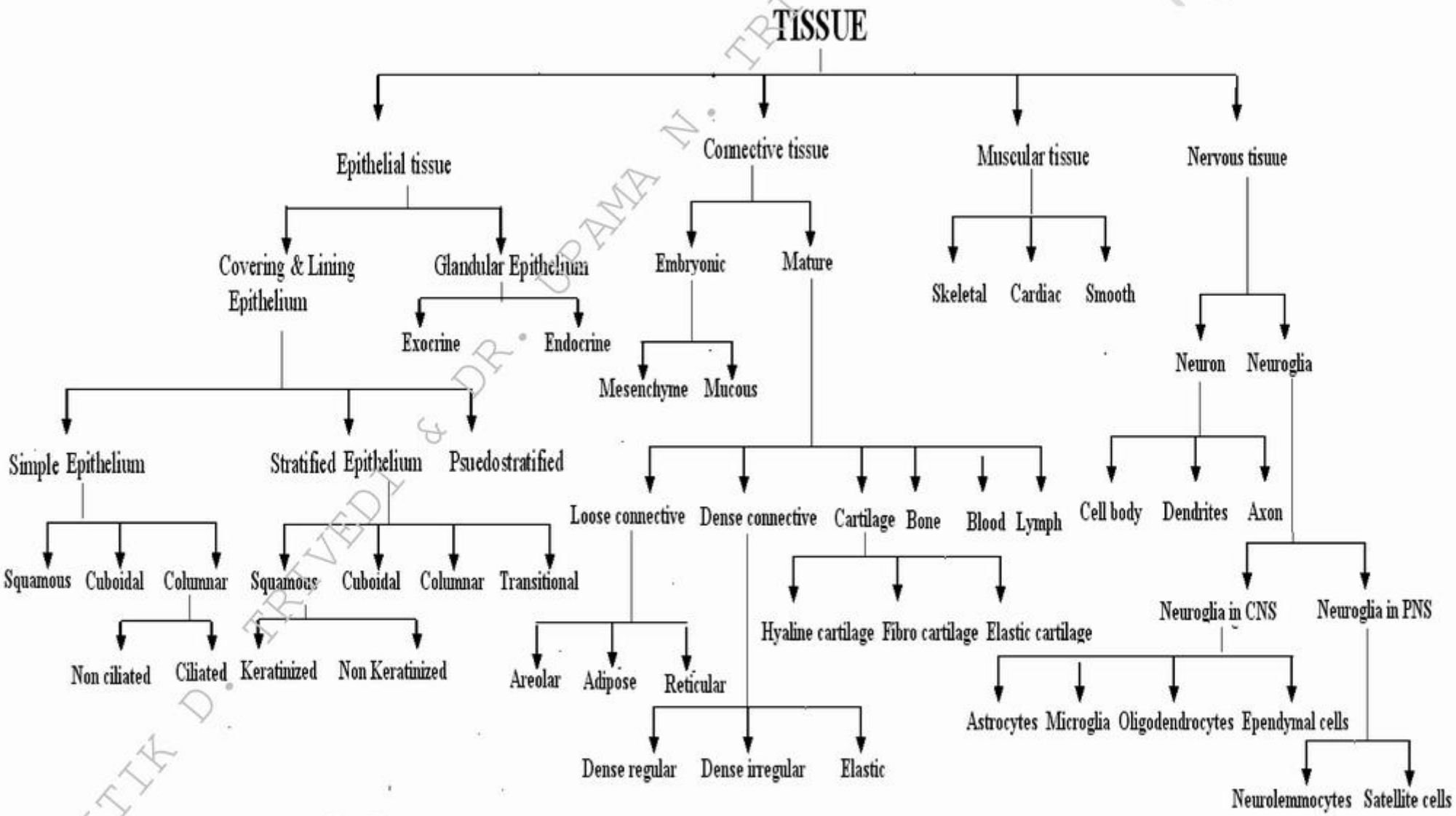
3) Muscle tissue:
- It is responsible for movements and generation of force.

4) Nervous tissue:
- It initiates and transmits action potential (Nerves Impulse) that helps coordinate body activities.

During the embryonic developments zygote produces three germ layers:
a) Ectoderm
b) Endoderm and
c) Mesoderm.

These three are embryonic tissue from which all tissues and organs of the body develop.
- Epithelium tissue derived from all three layers.
- Connective tissue and most muscles tissue derived from mesoderm.
- Nervous tissue derived from ectoderm





► EPITHELIAL TISSUE ◄

General future of epithelial tissue:

- It consist large and closely packed cells with little extracellular material between adjacent cells.
- It's arrangement produce continues sheet which is either single layer or multi layers.
- Epithelial cells have an apical (free) surface, which produce the lining of internal organ so it exposed in to a body cavity.
- The basal surface of the epithelial cells attached with the basement membrane.
- Epithelial cells are avascular so the blood vessels that supply to nutrients and move wastes are located in adjacent connective tissue.
- The material exchanges take place in epithelium by the diffusion process.
- Epithelium cells are adheres to connective tissue which holds the epithelium in their position.
- The junction between the epithelium and connective tissue is known as basement membrane which consist two layers.

    1) **Basal lamina:** contain collagen, laminin and proteoglycan secret by epithelium.
    2) **Reticular lamina:** This contains reticular fibers, fibronectin and glycoproteins.

- The main function of epithelium is protection, filtration, lubrication, secretion, digestion, absorption, transportation, sensory reception and reproduction.

➢ CLASSIFICATION OF EPITHELIAL TISSUE:

1) Covering and lining epithelium:

- It forms the superficial layer of the skin and some internal organ.
- It forms the inner lining of blood vessels, ducts, body cavities and the interior of the respiratory, digestive, urinary and reproductive systems.

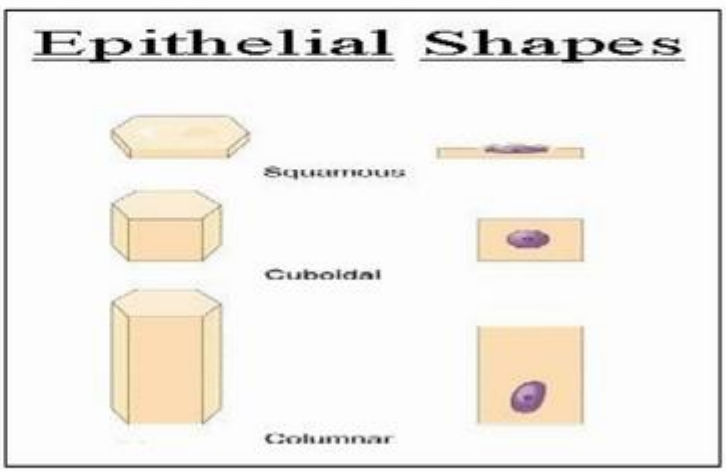
➢ According to **arrangements of layer** it is classified in to three types:

I) Simple epithelium:

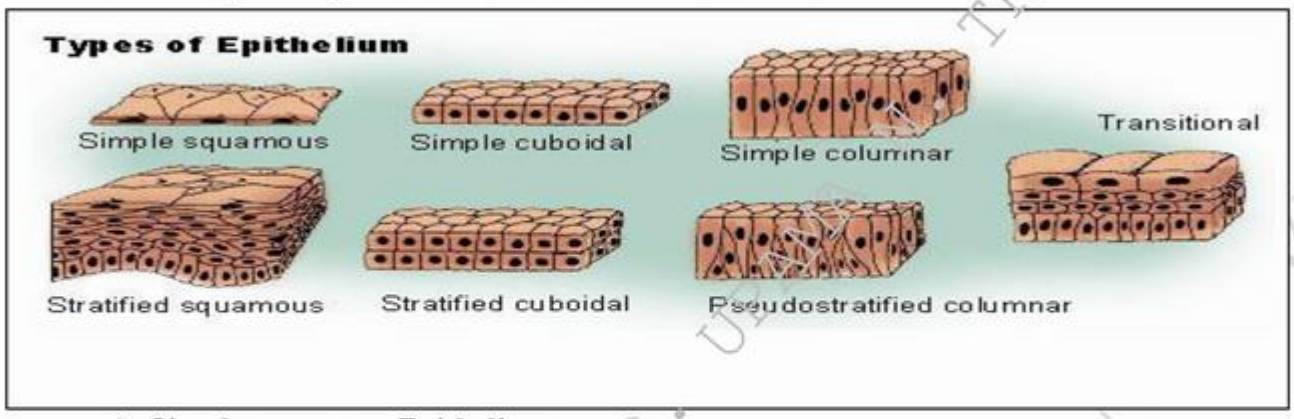
- It is a single layer of cells.
- It founds where activities such as diffusion, osmosis, filtration, secretion and absorption occurs.

Epithelium is named according to shape, structure, and arrangement of cells.

- •squamous - thin and flat cells
- •cuboidal - cube shaped cells
- •columnar - column shaped cells
- •simple - single layer of cells
- •stratified - multilayered cells
- •pseudostratified - false stratified
- •transitional - stretchable
- •ciliated - cells possess cilia



✓ **According to shape of the cells it is further divided in to:**



a) Simple squamous Epithelium:

- It is a flat in shape.
- This consists of a single layer of flat cells.
- Their surfaces look like as tiles floor.
- The nucleolus of each cell is oval or spherical shape.
- It follows the osmosis or diffusion process.
- It found in the body where the little wear and tear is found.
- It lines the hearts, blood vessels and lymphatic vessels and also forms the wall of capillary known as endothelium.
- The cells which form the epithelial layer of serous membrane are known as mesothelium.

b) Simple cuboidal epithelium:

- It is cuboidal in shape.
- The nucleus of the cell is round.
- The main function of this tissue is absorption and secretion.

c) Simple columnar epithelium:

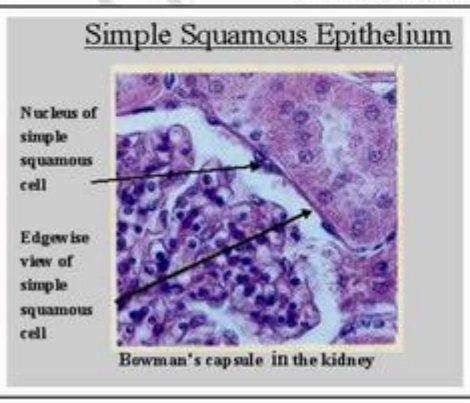
- It is rectangular in shape.
- It consist oval nuclei.
- It mainly produces two forms:

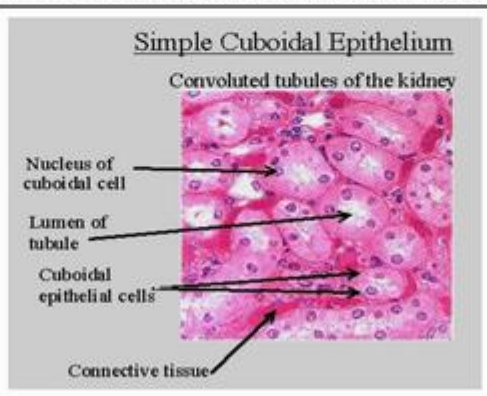
i) Nonciliated simple columnar epithelium:

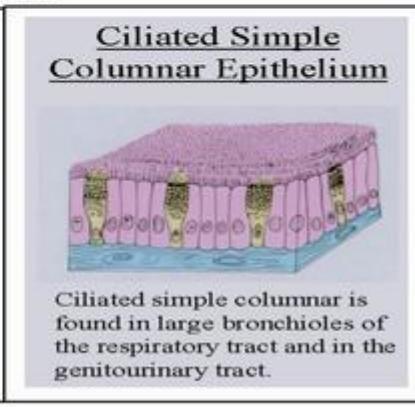
- It contains microvilli and goblet cells.
- Microvilli produce the microscopic fingerlike structure which increases the surface area of plasma membrane.
- Goblet cells secret mucus which is slightly sticky fluid.

ii) Celiated simple columnar cells:

- Celia produces the hairlike processes means it's movement gives the motion.
- Eg.: Secondary oocyte moves toward fallopian tube for fertilization by or fertile ovum down the uterin tube to the uterus help of celia.







II) Stratified Epithelium:

- It contains two or more layers.
- It protects the underline tissues from where there is considerable tear and wear.

➢ According **to shape it can** be further classified as under:

a) Stratified squemous epithelium:

- In the superficial layer this type of cells are flat whereas in the deep layers cells vary in shape from cuboidal to columnar.
- Here, the basal cells continuously replicate by cell division and produce new cells which shift upward toward the surface.
- So, they loss their blood supply from the connective tissue so they become dehydrated, shrunken and harder.
- These processes replace old cells by new cells.

✓ **Stratified squemous epithelium exists in two forms:**

i) Keratinized stratified squemous epithelium:

- It consist tough layer of keratin.
- It is a protein which is water proof and prevents us from several bacterial attacks.

ii) Non keratinized stratified squemous epithelium:

- It does not contain keratin and remains moist.

b) Stratified cuboidal epithelium:

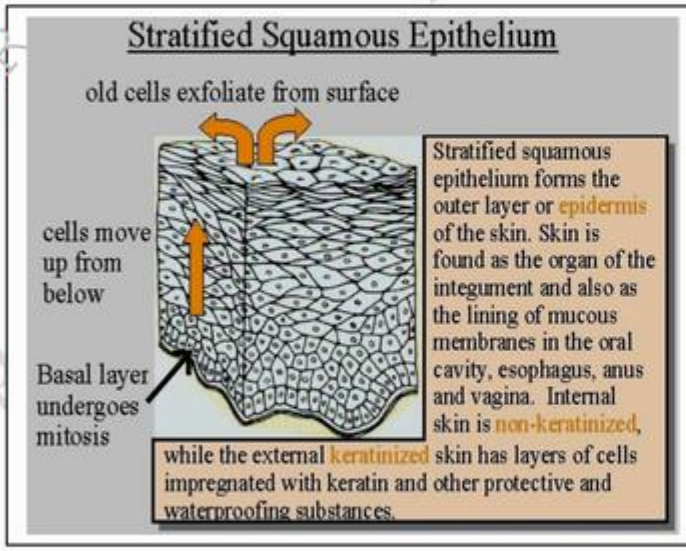
- It consist two or more layer of cells in which superficial cells are cube-shaped.
- Duct of adult sweat glands and part of male urethra consist these cells.
- The main function is to give protection.

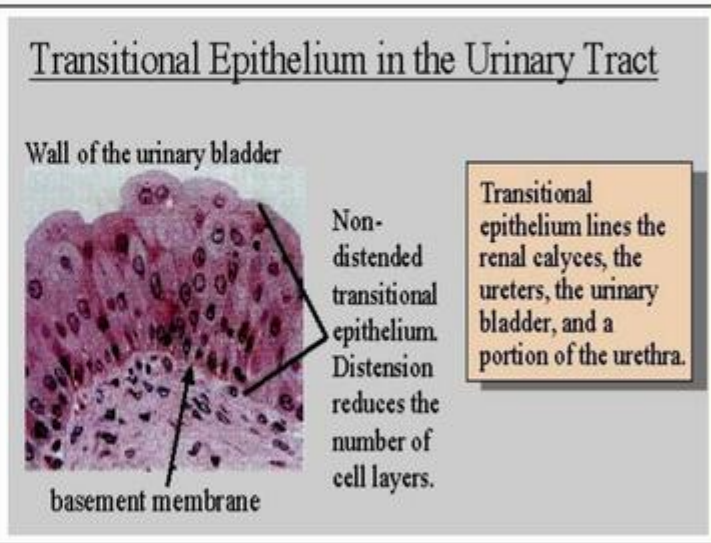
c) Stratified columnar epithelium:

- It consist several layer of polyhedral cells.
- Only the superficial cells are columnar.
- Conjunctiva of eye, anal mucous membrane, urethra consist these cells.
- It gives protection and secretion.

c) Transitional epithelium:

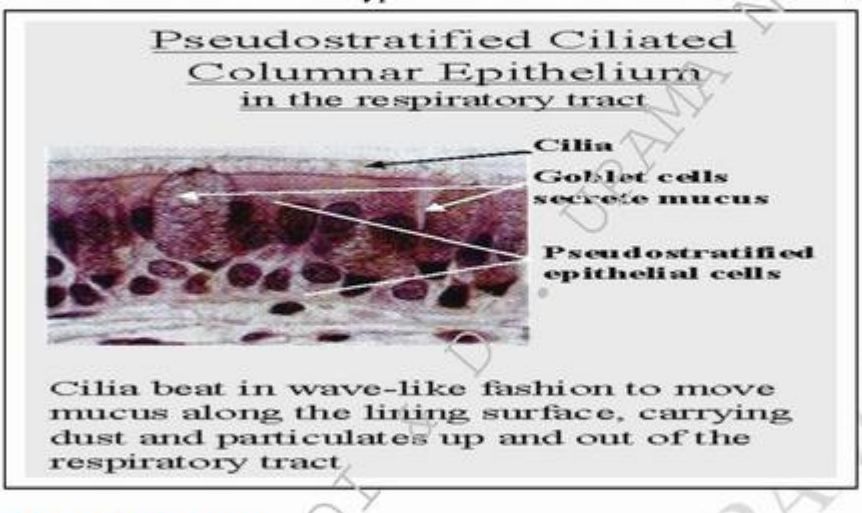
- Its appearance is variable mainly it depends either it is stretched or relaxed.
- Its line the urinary bladder and portion of ureters and urethra.





III) Pseudostratified epithelium:

- It contains mixture of cells in one layer.
- It produces multilayered tissue like appearance because all cells nuclei not reach to the surface of cells. These type of cells either ciliated or secrete mucus.



2) Glandular epithelium:

- These types of cells are mainly present in gland the main function of these cells is secretion.

➢ **There are two types of secretary gland:**

a) exocrine:

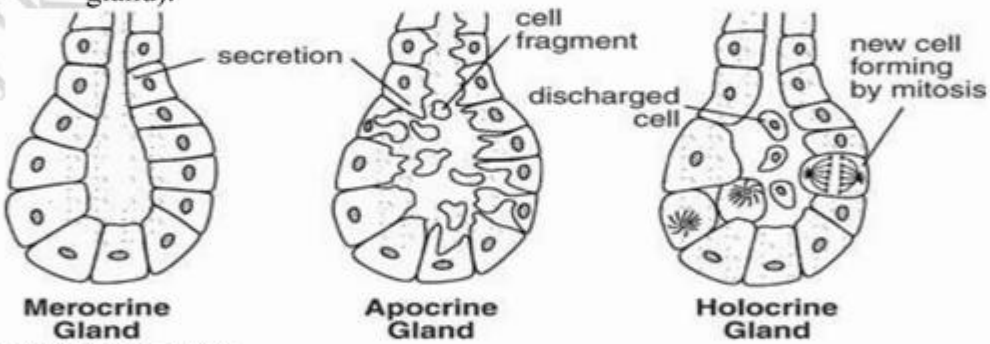
- It secret their product in to duct.
- The secretion includes mucus, perspiration, skin oil, ear wax and digestive enzymes.
- Eg.: Sweat glands, Salivary glands.

✓ **According to structure it is divided into two classes:**

i) unicellular
ii) multi cellular

✓ **According to function it is divided in to:**

i) **Merocrine glands:** it forms the secretary product and discharge it. (salivary glands)
ii) **Apocrine glands:** accumulate their secretary product on their apical surface. (mammary glands).
iii) **Halocrine glands:** accumulate secretary product in cytosol. (Sebaceous gland).



b) endocrine glands:

- Secret product in to blood.
- Eg.: endocrine glands, pituitary glands, thyroid gland.

► CONNECTIVE TISUUE ◄

"It is the tissue which provide supports and strength of the other body tissues, protect and insults internal organs also it binds the other cells or tissue together.

1) Embryonic Connective Tissue:

- It is primarily present in the embryo or fetus.
- The term embryo used for developing human from fertilization through the first two months of pregnancy.
- The term Fetus used for developing human from the third month of pregnancy to birth.

➢ **It is mainly divided in to two types:**

a) Mesenchyme:

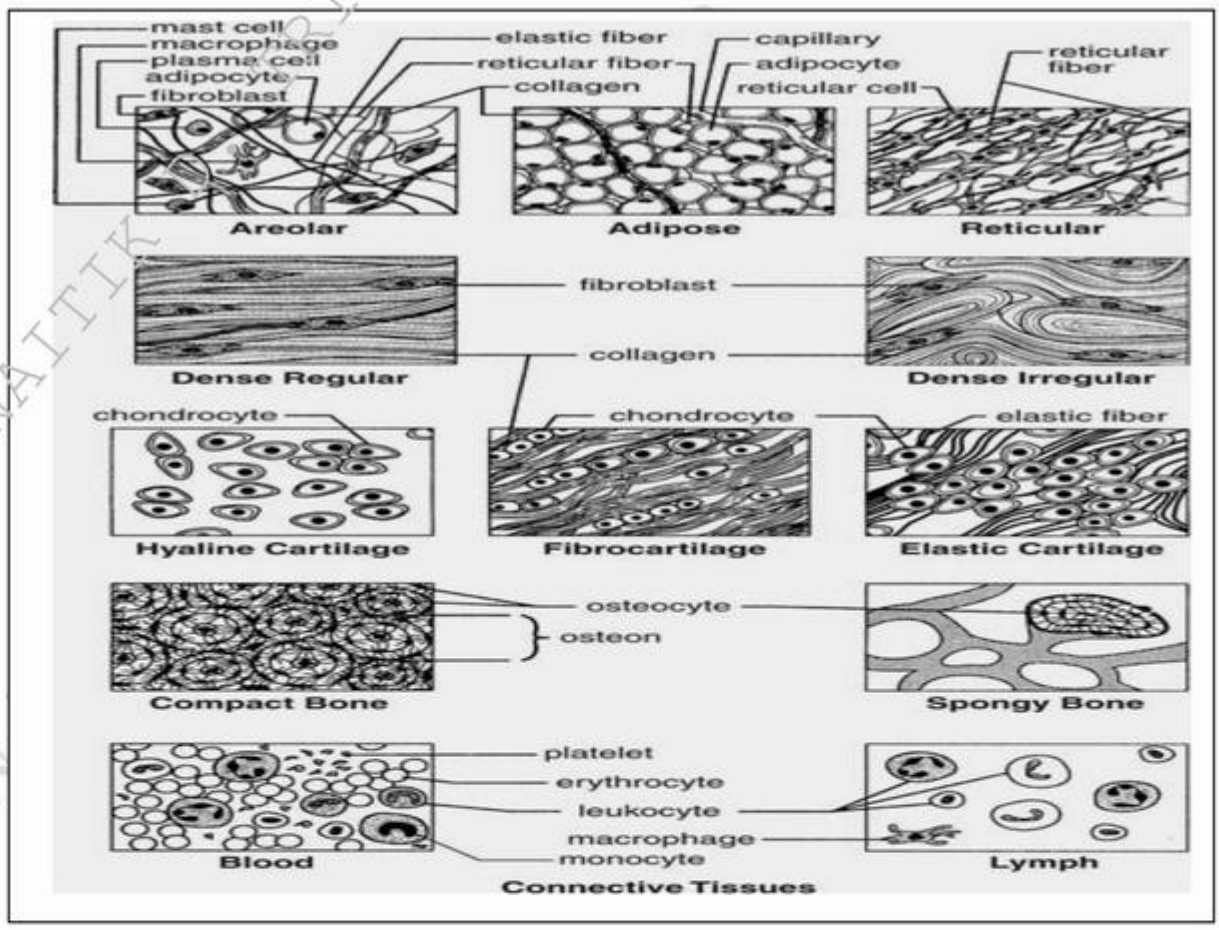
- It forms all kind of connective tissue.
- It is composed by irregularly shaped mesenchymal cells, a semisolid ground substance and delicate reticular fibers.

b) Mucous connective tissue:

- It is primarily found in umbilical cord of the fetus.
- It also forms from the Mesenchyme.
- It contains star shaped cells, a more viscous and jelly like ground substance and collagen fibers.

2) Mature connective tissue:

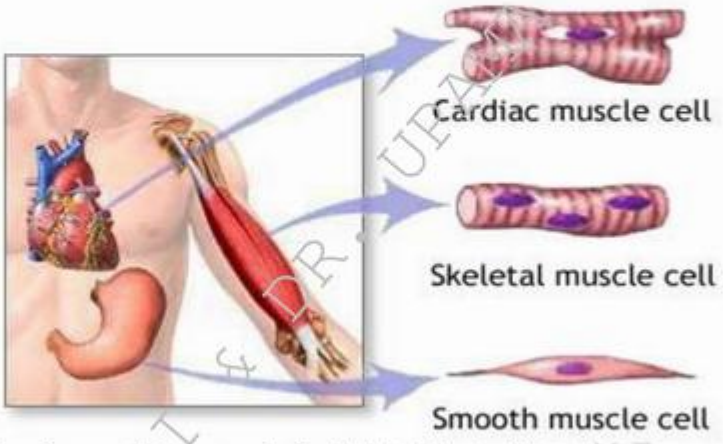
- It exists in new born baby.
- It, form from Mesenchyme and does not change after the birth.



CONNECTIVE TISSUE			
Tissue Type	**Cells Present**	**Fibers Present**	**Matrix Characteristics**
Loose Connective Tissue:			
Areolar	Fibroblasts macrophages adipocytes mast cells plasma cells	Collagen elastic reticular	Loosely arranged fibers in gelatinous ground substance
Adipose	Adipocytes	Reticular collagen	Closely packed cells with a small amount of gelatinous ground substance; stores fat
Reticular	Reticular cells	Reticular	Loosely arranged fibers in gelatinous ground substance
Dense Connective Tissue:			
Dense regular	Fibroblasts	Collagen (some elastic)	Parallel-arranged bundles of fibers with few cells and little ground substance; great tensile strength
Dense regular	Fibroblasts	Collagen (some elastic)	Irregularly arranged bundles of fibers with few cells and little ground substance; high tensile strength
Cartilage:			
Hyaline (gristle)	Chondrocytes	Collagen (some elastic)	Limited ground substance; dense, semisolid matrix
Fibrocartilage	Chondrocytes	Collagen (some elastic)	Limited ground intermediate between hyaline cartilage and dense connective tissue
Elastic	Chondrocytes	Elastic	Limited ground substance; flexible but firm matrix
Bone (osseous tissue):			
Compact (dense)	Osteoblasts osteocytes	Collagen	Rigid, calcified ground substance with (canal systems)
Spongy (cancellous)	Osteoblasts osteocytes	Collagen	Rigid, calcified ground substance (no osteons)
Blood & Lymph (vascular tissue):			
Blood	Erythrocytes leukocytes thrombocytes	"Fibers" are soluble proteins that form during clotting	"Matrix" is liquid blood plasma
Lymph	Leukocytes	"Fibers" are soluble liquid proteins that form during clotting	"Matrix" is blood plasma

► MUSCLES TISSUE ◄

- Muscles cells consist fibers that are beautifully constructed and generate force for constriction.
- As a result of constriction power it provides motion, maintains posture and generates heat.



➢ Based on location, function and structure it is **divided in to three types**:

1) Skeletal muscles tissue:

- Its name shows its location means attached to bone.
- It is strait in nature, fiber contain light and dark band which is known as striation which are visible in microscope.
- A single skeletal muscles fiber is very long, roughly cylindrical in shape and has more than one nuclei which are periphery of the cells.
- Skeletal muscles are voluntary in nature because it can be contracted and relaxed below the conscious level.

2) Cardiac muscles tissue:

- They are in bulk form and produce wall of the heart.
- Like skeletal muscles it is striated but it is involuntary in nature means constriction in not under the control of conscious level.
- The fibers are branched and cross sections are squares in shape.
- Centrally it contain one nuclei and cardiac muscles fibers attached end to end by one another and the joint is known as intercalated disc which form welding like spot between cells.

3) smooth muscles tissue:

- It is located in the wall of hollow internal structures such as blood vessels, air ways to the lungs, intestines, gallbladders and urinary bladders.
- It provides help in break down of foods, elimination of wastage and move fluid and food through out body.
- It is involuntary in control.

►NERVOUS TISSUE◄

➢ **It consist of the two principle kinds of cells**

1) Neurons:

✓ The neurons consists of **three basic portion :**

a) Cell body:

- Cell body contains a nucleolus surrounded by cytoplasm that includes typical organelles such as lysosomes, mitochondria and Golgi complex.
- In the cytoplasm it also contains the **Chromatophilic substance (Nissl bodies)** which is ordinary arrangement of endoplasmic reticulum, the site of protein synthesis and it also contain **neurofibrils** which forms the cytoskeleton and provide the support and shape of the cells.

b) Dendrites:

- Dendrites are the receiving or input portion of the neurons.
- They are usually short, tapering and highly branched.
- Usually dendrites are not mylinated.
- Their cytoplasm contains chromatophilic substance, mitochondria and other organelles.

c) Axon:

- It is a long, thin and cylindrical in shape.
- It is joined with cell body by axon hillock.
- The first portion of axon is known as initial segment where the nerves impulse are arise.
- It also contains mitochondria, microtubules and neurofbrils but no rough endoplasmic reticulum so it does not synthesize protein.
- its cytoplasm known as axoplasm which is surrounded by membrane known as axolema.
- The side branch of axon is known as axon collaterals.
- At the end of axon it divides branch like structure known as axon terminals.
- The tip of some axon terminals swell in to bulb shaped known as synaptic end bulbs.

According to structural it can be classified in to:

i) Multi polar neurons:

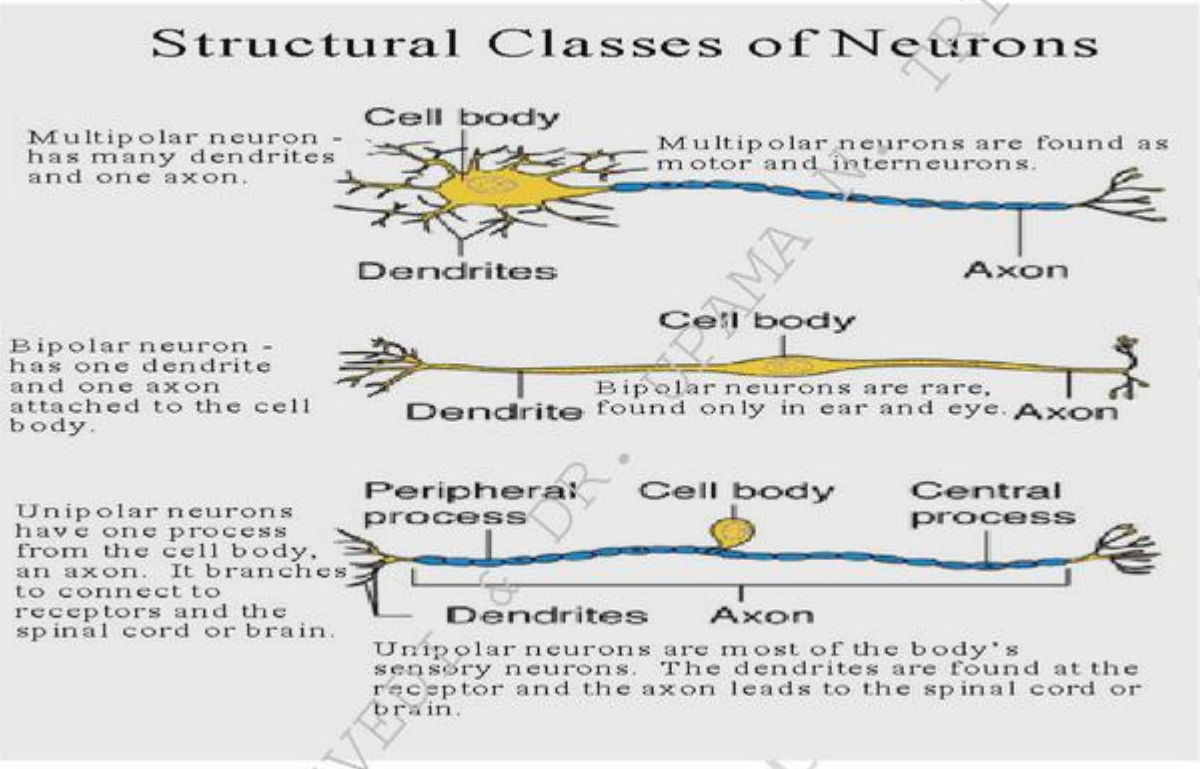
- It has several dendrites and one axon.
- Most neurons of brain and spinal cord are of this type.

ii) Bipolar neurons:

- It has one main dendrites and one axon.
- It is found in the eye, inner ear and olfactory areas of the brain.

iii) Unipolar neurons:

- It's originated as bipolar neurons in the embryo but during the development axon and body get fuse into a single process that divides in to two branch and consist one cell body.
- It is always sensory neurons.



2) Neuralgia:

- Neuroglia or glia fills about half of the CNS.
- Its have the glue like characteristics so it held nervous tissue together.
- Neuroglias are generally smaller than neurons.
- Neuroglia can multiply and divide in the mature nervous systems.

➢ **Classification of Neuroglia:**

- There are mainly six types of Neuroglia in which four astrocytes, olegodendrocytes, microglia and ependymal cells are **found in the CNS.**
- While neurolemmocytes (schwann cells) and satellite cells **found in peripheral nervous system.**

a) Neuroglia found in CNS:

i) Astrocytes:

- They are star shaped.
- It produces the metabolism of neurotransmitters, maintain the proper balance of K^+ for generation of nerves impulse, and participate in brain development.
- It forms the blood brain barrier which regulates entry of substance in to the brain.

ii) Olegodendrocytes:

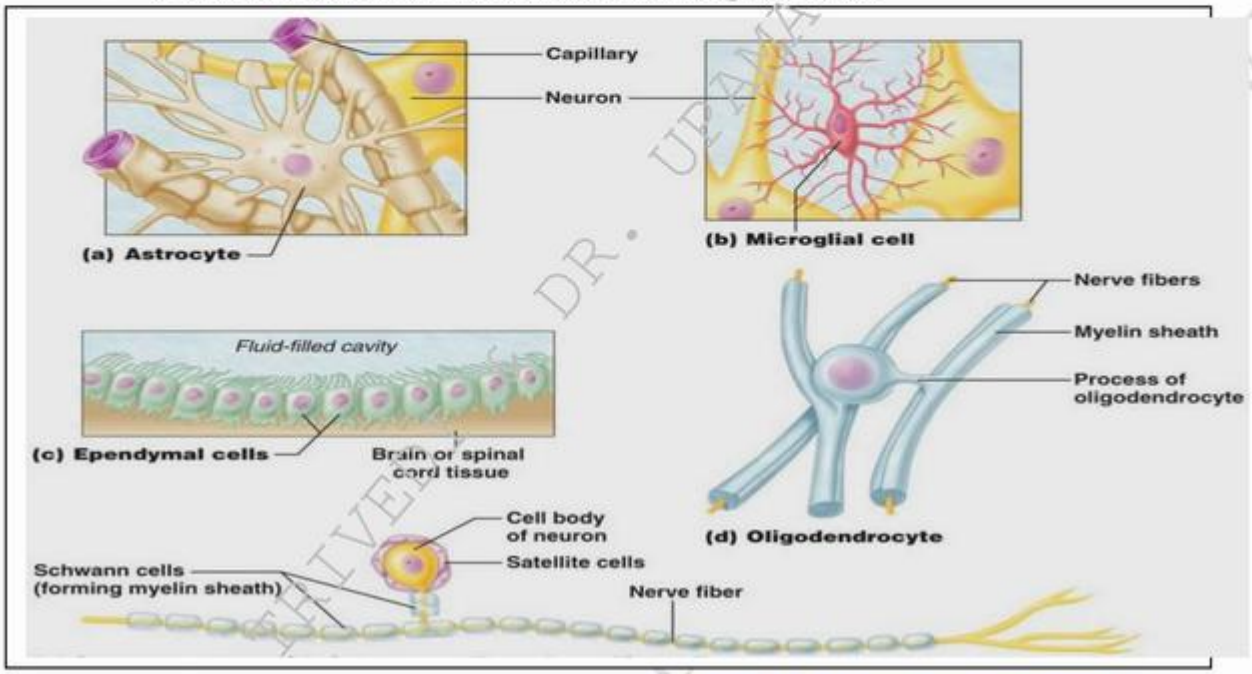
- It is the most common glial Cells in the CNS.
- It is smaller than astrocytes.
- They coil around neurons and produce supporting structure to the neurons.
- It produces protein and lipid covering known as myelin sheath.

iii) Microglia:

- It is the small and phagocytic Neuroglia derived from monocytes.
- They protect the CNS from the disease by engulfing invading microbes and clearing away debris from dead cells.

iv) Ependymal:

- It is the epithelial cells.
- The cells have different shaped from cuboidal to columnar and many are ciliated.
- Ependymal cells line the fluid filled ventricles, cavity within the brain and central canal means a narrow passage from spinal cord.
- It forms the fluid which is known as cerebrospinal fluids.



b) Neuroglia found in peripheral nervous system:

i) Neurolemmocytes (schwann cells):

- Each cell produces myelin sheath around PNS Neurons.

ii) Satellite cells:

- Which supports neurons in ganglia in PNS.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 4 **DATE:**

AIM: TO STUDY AND INTRODUCTION OF AXIAL AND APPENDICULAR SKELETON/BONES

INTRODUCTION:

Skeletal System

The skeletal system includes all of the bones and joints in the body. Each bone is a complex living organ that is made up of many cells, protein fibers, and minerals.

Babies have more bones than adults because as they grow up, some of the bones fuse together to form one bone. This is because babies have more cartilage than bone. New born babies have around 300 bones. As a person grows up, most of this cartilage turns into bone in a process called ossification.

Components of Human Skeleton:

- Bones: Bone is a tough and rigid form of connective tissue. It is the weight bearing organ of human body and it is responsible for almost all strength of human skeleton.
- Cartilages: Cartilage is also a form of connective tissue but is not as tough and rigid as bone. The main difference in the cartilage and bone is the mineralization factor. Bones are highly mineralized with calcium salts while cartilages are not.
- Joints: Joints are important components of human skeleton because they make the human skeleton mobile. A joint occurs between "two or more bones", "bone and cartilage" and "cartilage and cartilage".

Divisions of human skeleton: (206 Bone)

Axial skeleton - The axial skeleton (80 bones) is formed by the vertebral column (32–34 bones; the number of the vertebrae differs from human to human as the lower 2 parts, sacral and coccygeal bone may vary in length), a part of the rib cage (12 pairs of ribs and the sternum), and the skull (22 bones and 7 associated bones).

Appendicular skeleton - The appendicular skeleton (126 bones) is formed by the pectoral girdles, the upper limbs, the pelvic girdle or pelvis, and the lower limbs. Their functions are to make locomotion possible and to protect the major organs of digestion, excretion and reproduction.

Functions of bone and skeletal system

1. Support: The skeletal system is the structural framework of the body as well as for muscles and skin.

2. Protection: The skeletons protect the internal organs from any kind of external injury.

3. Movement: The skeletal system along with the muscular system and central nervous system helps the locomotion of the body as well as the purposeful movement of the body parts.

4. Blood cell formation: The blood cells are formed in the red bone marrow (connective tissue) within certain bones from the pluripotent stem cells.

5. Triglyceride storage: Triglycerides are stored as chemical energy reserve in the yellow bone marrow, present in the bone.

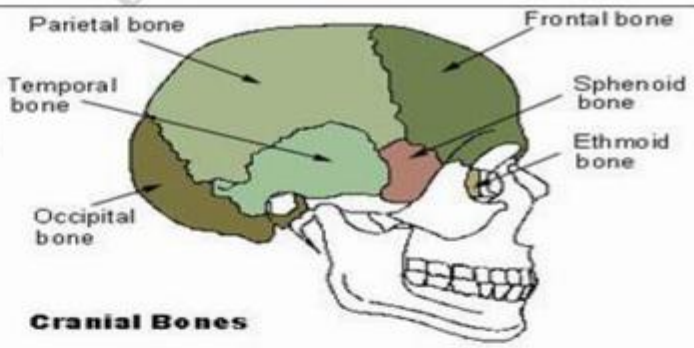
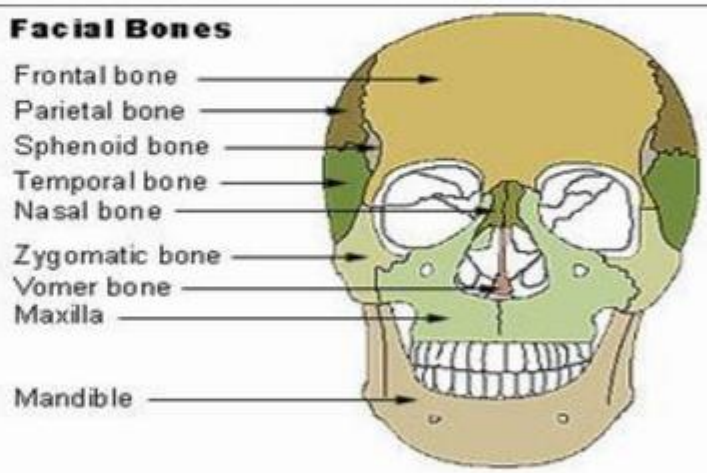
6. Bones provide attachment points to the muscles for smooth performing their activities like movements, contraction and relaxation of muscles.

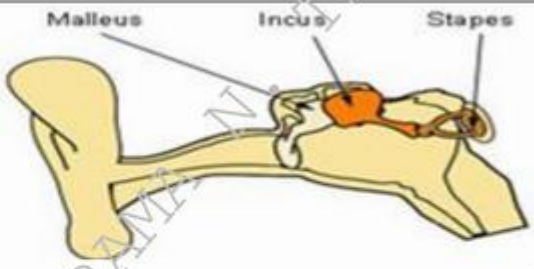
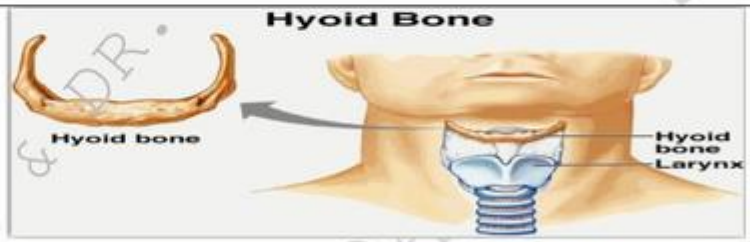
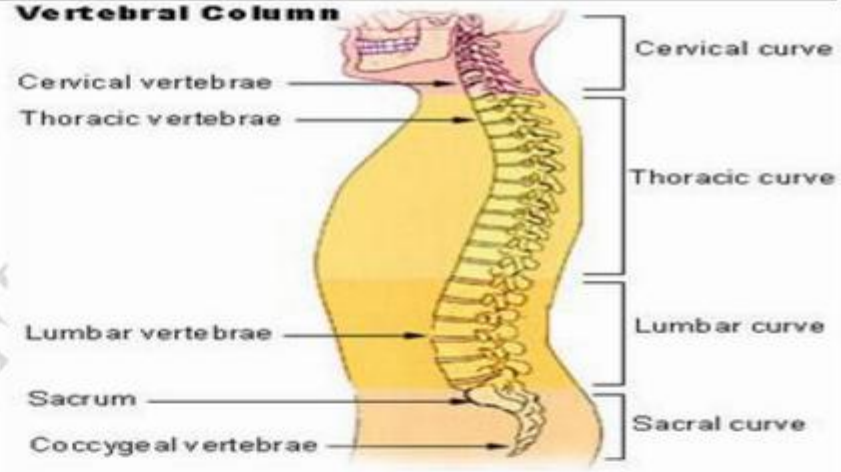
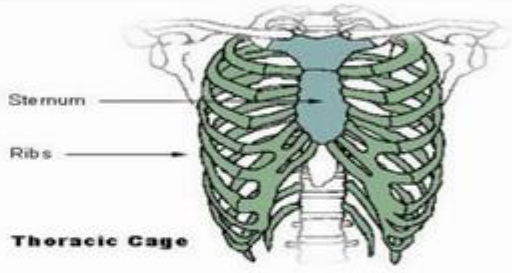
7. Axial skeleton of thorax assists in breathing.

8. Teeth help to disintegrate the foods.

9. Mineral homeostasis: Bone is the reservoir of calcium (Ca++). 99% of body calcium is stored in the bone and released in the plasma when required.

AXIAL SKELETON: 80 BONES

SR. NO	BONES	NUMBERS	DAIGRAM
CRANIAL BONES (8)			
1	Parietal	2	
2	Temporal	2	
3	Frontal	1	
4	Occipital	1	
5	Ethmoid	1	
6	Sphenoid	1	
FACIAL BONES (14)			
1	Maxilla	2	
2	Zygomatic	2	
3	Mandible	1	
4	Nasal	2	
5	Platine	2	
6	Inferior nasal concha	2	
7	Lacrimal	2	
8	Vomer	1	

AUDITORY OSSICLES (6)			
1	Malleus	2	
2	Incus	2	
3	Stapes	2	
HYOID (1)			
1	Hyoid	1	
VERTEBRAL COLUMN (26)			
1	Cervical vertebrae	7	
2	Thoracic vertebrae	12	
3	Lumbar vertebrae	5	
4	Sacrum	1	
5	Coccyx	1	
THORACIC CAGE (25)			
1	Sternum	1	
2	Ribs	24	
Total axial bones		80	

The table below lists the location and function of the major bones of the axial skeleton:

Bone(s)	Location	Function	Major grouping of axial skeleton
Cranium	Head	Supports facial structures, encloses and protects the brain, provides muscle attachments for chewing and moving the head	Skull
Mandible	Lower jaw	Permits chewing	Skull
Vertebrae	Spine	Permit mechanical stability for the body and protect the spinal cord	Vertebral column
Ribs	Chest wall	Provide protection for the organs of the upper body	Thoracic cage
Sternum	Center of the chest	Provides attachment for many (not all) ribs	Thoracic cage

The skeletal system in an adult body is made up of 206 individual bones. These bones are arranged into two major divisions: the axial skeleton and the appendicular skeleton. The axial skeleton runs along the body's midline axis and is made up of 80 bones in the following regions: Skull, Hyoid, Auditory ossicles. Ribs, Sternum, Vertebral column

❖ **SKULL**

- The skull is composed of 22 bones that are fused together except for the mandible.
- The bones of the superior portion of the skull are known as the cranium and protect the brain from damage.
- The bones of the inferior and anterior portion of the skull are known as facial bones and support the eyes, nose, and mouth.

❖ **HYOID AND AUDITORY OSSICLES**

- The hyoid is a small, U-shaped bone found just inferior to the mandible. The hyoid is the only bone in the body that does not form a joint with any other bone—it is a floating bone.
- The hyoid's function is to help hold the trachea open and to form a bony connection for the tongue muscles.
- The malleus, incus, and stapes—known collectively as the auditory ossicles—are the smallest bones in the body.
- Found in a small cavity inside of the temporal bone, they serve to transmit and amplify sound from the eardrum to the inner ear.

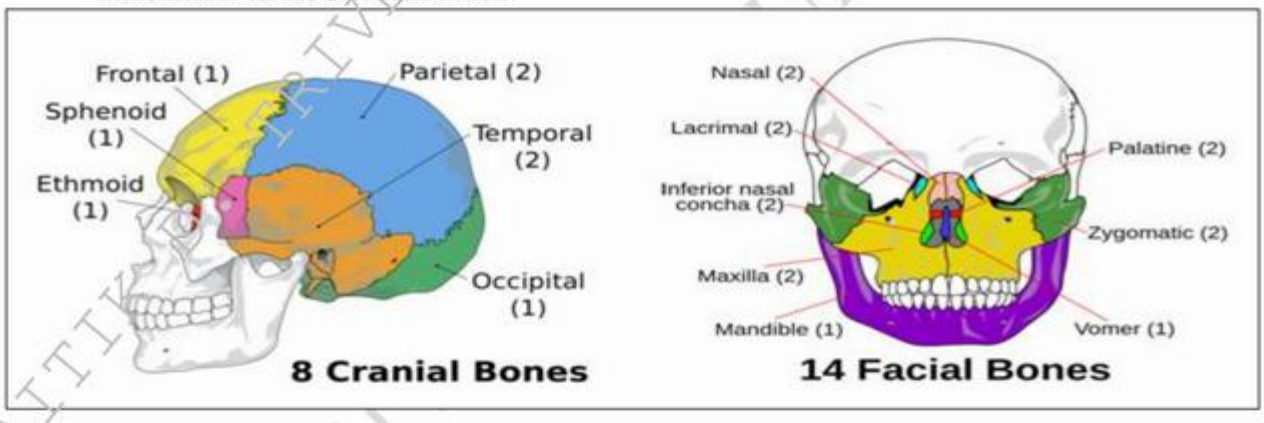
VERTEBRAE

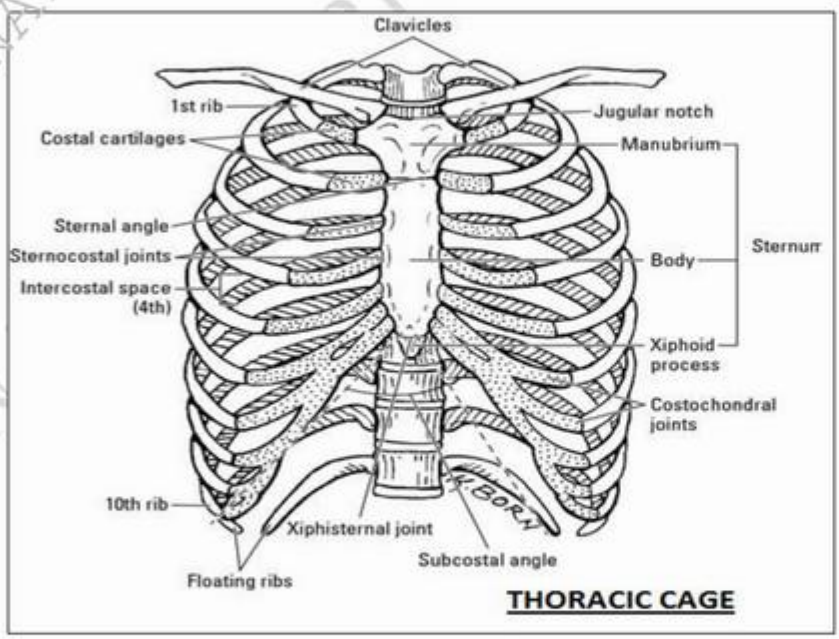
Twenty-six vertebrae form the vertebral column of the human body.

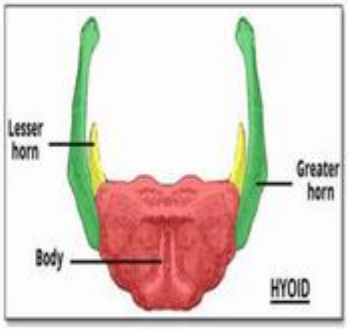
- Cervical (neck) - 7 vertebrae
- Thoracic (chest) - 12 vertebrae
- Lumbar (lower back) - 5 vertebrae
- Sacrum - 1 vertebra
- Coccyx (tailbone) - 1 vertebra
- With the exception of the singular sacrum and coccyx, each vertebra is named for the first letter of its region and its position along the superior-inferior axis.

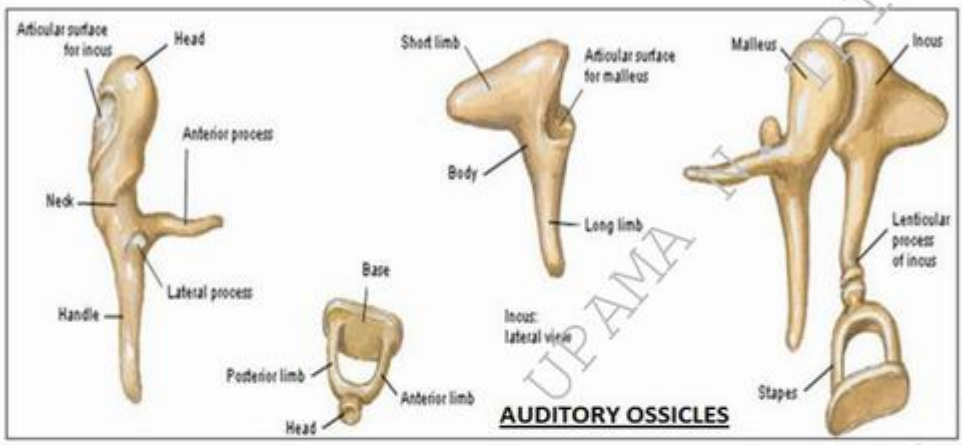
RIBS AND STERNUM

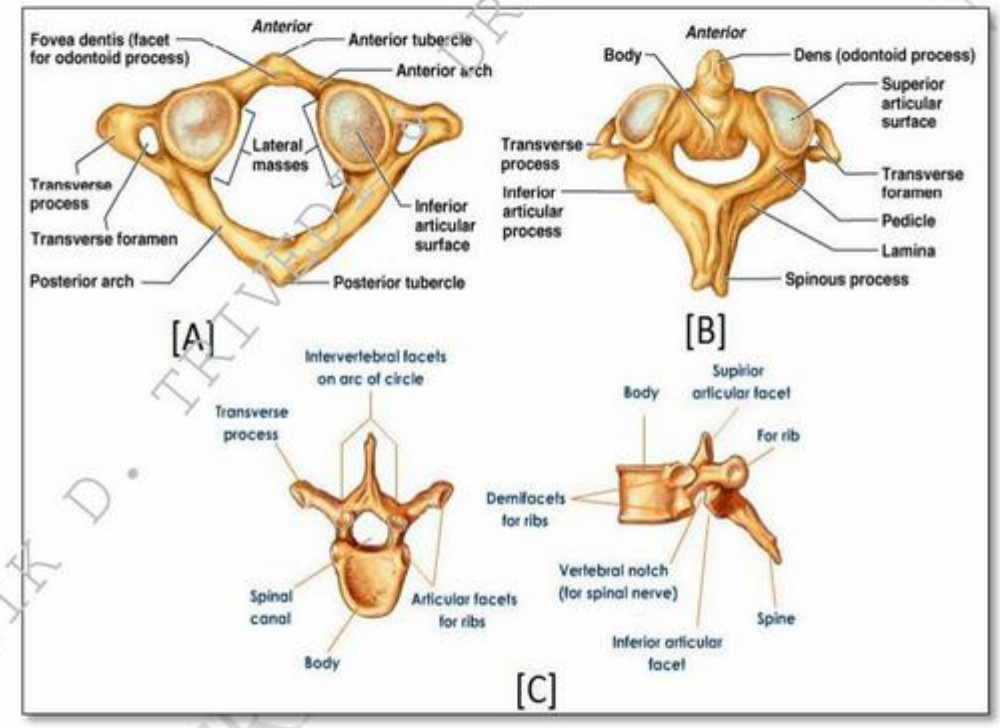
- The sternum, or breastbone, is a thin, knife-shaped bone located along the midline of the anterior side of the thoracic region of the skeleton. The sternum connects to the ribs by thin bands of cartilage called the costal cartilage.
- There are 12 pairs of ribs that together with the sternum form the ribcage of the thoracic region. The first seven ribs are known as "true ribs" because they connect the thoracic vertebrae directly to the sternum through their own band of costal cartilage. Ribs 8, 9, and 10 all connect to the sternum through cartilage that is connected to the cartilage of the seventh rib, so we consider these to be "false ribs." Ribs 11 and 12 are also false ribs, but are also considered to be "floating ribs" because they do not have any cartilage attachment to the sternum at all.











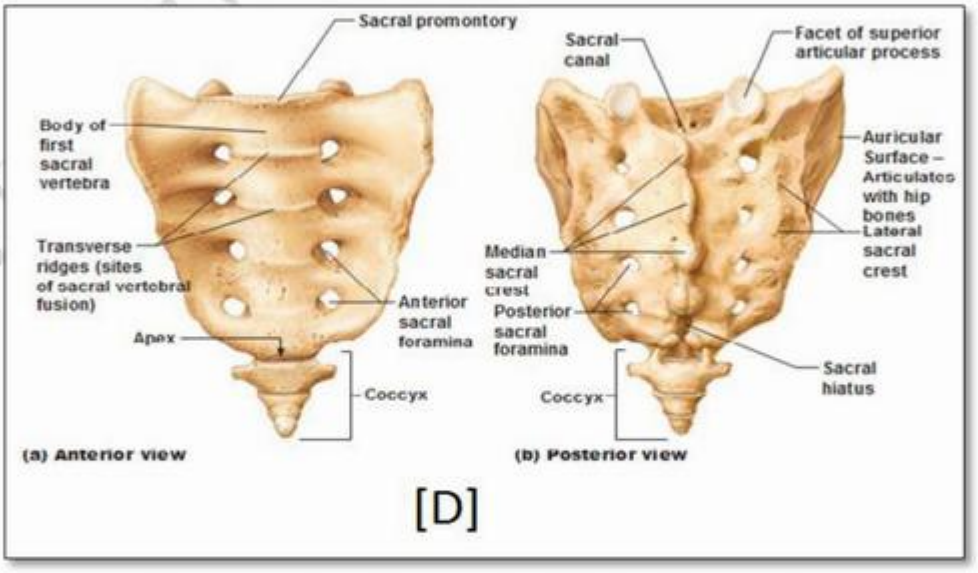
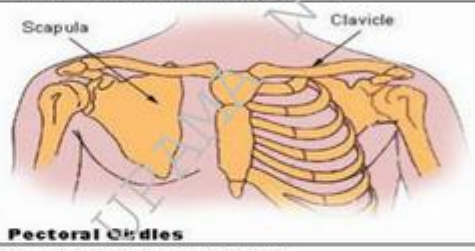
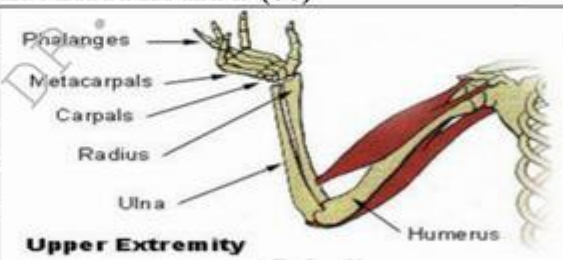
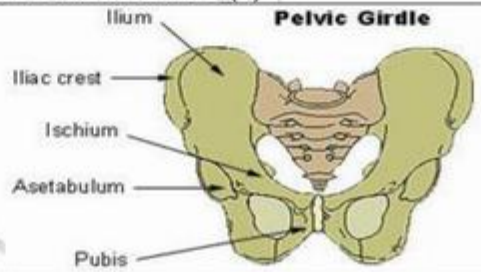
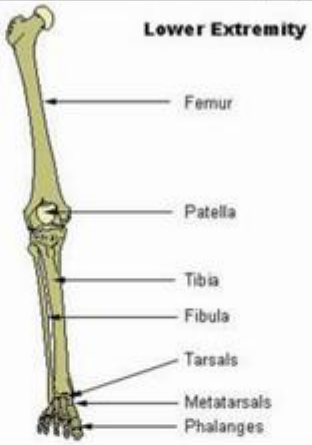


Fig: A) ATLAS B) AXIS C) THORACIC D) SACRUM

APPENDICULAR SKELETAL: 126 BONES

SR. NO	BONES	NUMBERS	DAIGRAM
		PECTORAL GIRDLES (4)	
1	Clavicle	2	
2	Scapula	2	
		UPPER EXTREMITY (60)	
1	Humerus	2	
2	Radius	2	
3	Ulna	2	
4	Carpals	16	
5	Metacarpals	10	
6	Phalanges	28	
		PELVIC GIRDLE (2)	
1	Coxal or innominate, or hip bones	2	
		LOWER EXTREMITY (60)	
1	Femur	2	
2	Tibia	2	
3	Fibula	2	
4	Patella	2	
5	Tarsals	14	
6	Metatarsals	10	
7	Phalanges	28	
Total bones		126	

APPENDICULAR SKELETON

The appendicular skeleton is composed of the 126 bones of the appendages and the pectoral and pelvic girdles, which attach the limbs to the axial skeleton.

A] UPPER LIMB

Thirty-two (32) separate bones form the bony framework of each upper limb.

PECTORAL (Shoulder)

- The paired pectoral girdles each consist of two bones, the anterior clavicle and the posterior scapula. The shoulder girdles function to attach the upper limbs to the axial skeleton.
- The pectoral girdle is exceptionally light and allows the upper limb a degree of mobility not seen anywhere else in the body. This is due to multiple factors including:
  - ✓ The sternoclavicular joints are the only site of attachment of the shoulder girls to the axial skeleton.

1. **Clavicle**: A slender, doubly-curved bone that joins the sternum to the scapula.
   - **Sternal end**: Rounded terminus; articulates with the sternal manubrium.
   - **Acromial end**: Flattened terminus articulates with the scapula to form part of the shoulder joint.
2. **Scapula**: Thin, triangular flat bone; lies on the dorsal surface of the rib cage serves as the attachment point for the arm.
   - **Superior border**: Short, sharp border that forms the upper margin of the scapula.
   - **Medial (vertebral) border**: Border which parallels the vertebral column when articulated with the axial skeleton.
   - **Lateral (axillary) border**: The thick border that abuts the armpit when articulated with the axial skeleton.
   - **Glenoid cavity (fossa)**: Small, shallow depression superior to the lateral border, articulates with humerus of the arm.
   - **Spine**: The upper posterior surface of the scapula; site of muscle attachment.
   - **Acromion**: Enlarged, roughened triangular structure of the lateral end of the scapular spine; articulates with the acromial end of the clavicle.
   - **Coracoid process**: Beak-like structure projecting anteriorly from the superior scapular border; site of muscle attachment.
   - **Suprascapular notch**: Shallow groove in the superior border of the scapula at the base of the coracoid process; passageway for nerves.

- **Supraspinous fossa**: Deep depression superior to the spine on the posterior surface of the scapula; site of muscle attachment.
- **Infraspinous fossa**: Shallow depression inferior to the spine on the posterior surface of the scapula; site of muscle attachment.
- **Subscapular fossa**: Shallow depression formed by the entire anterior scapular surface; site of muscle attachment.

ARM

The arm consists of a single bone, the humerus. The largest and longest bone of the upper limb, it articulates with the scapula at the shoulder and with the radius and ulna (forearm bones) at the elbow.

1. **Humerus**:
   - **Head**: Smooth, hemispherical projection at the proximal end of the humerus; articulates with glenoid cavity of scapula.
   - **Anatomical neck**: Slight constriction just distal to the head of the humerus.
   - **Greater Tubercle** [lateral surface] and **Lesser Tubercle** [medial surface] sites of muscle attachment.
   - **Intertubercular sulcus**: Shallow groove between lesser and greater tubercles; guides tendon.
   - **Surgical neck**: Constricted region of the humerus; common site of bone fracture.
   - **Deltoid tuberosity**: V-shaped rough region; site of muscle attachment.
   - **Radial groove**: nerve passageway.
   - **Trochlea**: Medial spool-shaped structure; articulates with ulna of the forearm.
   - **Capitulum**: Lateral ball-like structure; articulates with radius of the forearm.
   - **Medial epicondyle and Lateral epicondyle:** site of muscle attachment.
   - **Coronoid fossa**: receives process from ulna when elbow flexes / extends.
   - **Radial fossa**: receives head of radius when elbow flexes.
   - **Olecranon fossa**: receive process from ulna to form elbow joint.

FOREARM

Two parallel bones, the radius and the ulna, form the forearm.

1. **Ulna**: Long, slender bone with a hook at the proximal end that forms the elbow joint with the humerus; lies medially in the forearm when the body is in anatomical position.
   - **Olecranon process**: On the proximal end of the ulna; forms the upper portion of the hook that articulates with the trochlea of the humerus.

- **Coronoid process**: forms the lower portion of the hook that articulates with the trochlea of the humerus.
- **Trochlear notch**: Deep concavity found between the olecranon process and coronoid process; 'grips' trochlea to form elbow joint.
- **Radial notch**: Small depression of the coronoid process; articulates with head of radius.
- **Head**: Knob-like structure and the distal end of the ulna; articulates with wrist bone.
- **Styloid process**: Pointed process medial to the head of the ulna; site of ligament attachment.

2. **Radius**: Long bone that is thin at its proximal end and wide at its distal end; lies laterally in the forearm when the body is in anatomical position.
   - **Head**: Wheel-shaped proximal end of radius; articulates with capitulum of humerus and radial notch of ulna.
   - **Radial tuberosity**: Rough projection just inferior to the head of the radius; site of muscle attachment.
   - **Ulnar notch**: Medial shallow depression on the distal end of the radius; articulates with the ulna.
   - **Styloid process**: Pointed process lateral to the ulnar notch; site of ligament attachment.

HAND

- The skeleton of the hand includes the bones of the carpus (wrist); the bones of the metacarpus (palm), and the bones of the phalanges
- **Carpals (wrist):** Eight (8) marble-size short bones closely united by ligaments; quite flexible due to gliding movements between bones.
- **Metacarpals:** Five (5) small long bones radiating from the wrist like spokes; numbered 1 – 5 from the thumb to the little finger.
- **Phalanges:** Fourteen (14) miniature long bones that form the fingers; numbered 1 – 5 from the thumb (pollex) to the little finger.
- Proximal phalange (1 – 5), Middle phalange (2 – 5), Distal phalange (1 – 5)

B] LOWER LIMB

Like the upper limb, the lower limb is divided into three regions. The **thigh, leg** and **foot**. The lower limb contains 30 bones.

FEMUR

- The femur, or thigh bone, is the single bone of the thigh region. It is the longest and strongest bone of the body, and accounts for approximately one-quarter of a person's total height.
- The head of the femur, which articulates with the hip bone to form the hip joint. The fovea capitis is the site of attachment for the ligament of the head of the femur.
- The greater trochanter [the large, upward, bony] and lesser trochanter [is a small,] are the bony prominence.
- The trochanters are also connected on the posterior side of the femur by the larger intertrochanteric crest.
- The roughened area on the outer, lateral side of the condyle is the lateral epicondyle of the femur. The adductor tubercle is a small bump located at the superior margin of the medial epicondyle.

PATELLA

- The patella (kneecap) is largest sesamoid bone of the body. A sesamoid bone is a bone that is incorporated into the tendon of a muscle where that tendon crosses a joint.
- The patella is found in the tendon of the quadriceps femoris muscle.
- The patella articulates with the patellar surface of the femur and thus prevents rubbing of the muscle tendon against the distal femur.The patella does not articulate with the tibia.

TIBIA

- The tibia (shin bone) is the medial bone of the leg and is larger than the fibula, with which it is paired.
- The tibia is the main weight-bearing bone of the lower leg and the second longest bone of the body, after the femur
- The proximal end of the tibia is greatly expanded. The two sides of this expansion form the medial condyle of the tibia and the lateral condyle of the tibia. These areas articulate with the medial and lateral condyles of the femur to form the knee joint. The shaft of the tibia becomes triangular in shape. The anterior apex of this triangle forms the anterior border of the tibia.
- The large expansion found on the medial side of the distal tibia is the medial malleolus ("little hammer").
- On the lateral side of the distal tibia is a wide groove called the fibular notch, forming the distal tibiofibular joint.

FIBULA

- The fibula is the slender bone located on the lateral side of the leg. The fibula does not bear weight.
- The head of the fibula is the small, knob-like, proximal end of the fibula. It articulates with the inferior aspect of the lateral tibial condyle, forming the proximal tibiofibular joint. The distal fibula also articulates with the fibular notch of the tibia. The distal end form ankle joint with tallus

FOOT

1. **TARSAL BONES**

- The posterior half of the foot is formed by seven tarsal bones. The most superior bone is the talus.
- This has a relatively square-shaped, upper surface that articulates with the tibia and fibula to form the ankle joint. The cuboid bone and metatarsal Bones

2. **METATARSAL**

- The anterior half of the foot is formed by the five metatarsal bones, which are located between the tarsal bones of the posterior foot and the phalanges of the toes.
- These elongated bones are numbered 1–5, starting with the medial side of the foot. The first metatarsal bone is shorter and thicker than the others. The second metatarsal is the longest.
- Each metatarsal bone articulates with the proximal phalanx of a toe to form a metatarsophalangeal joint.

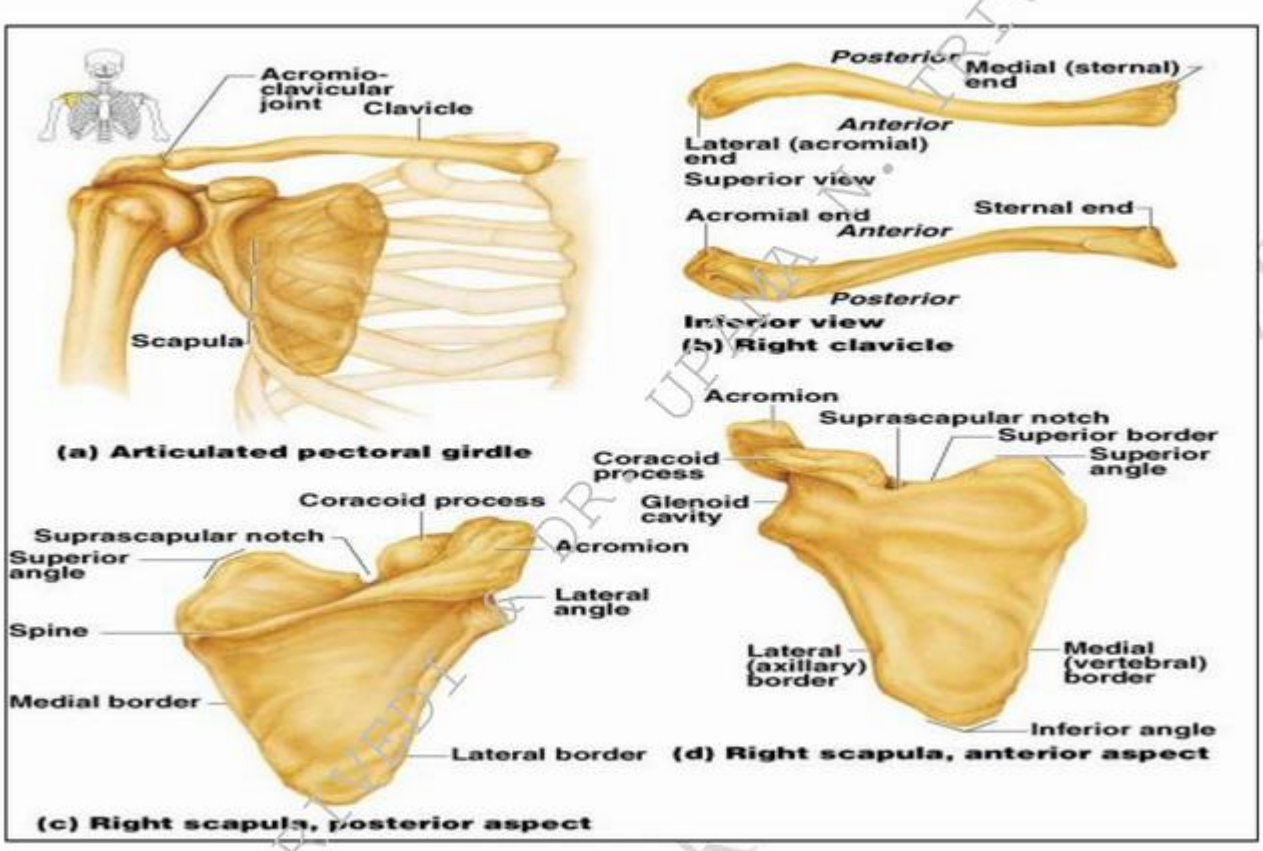
3. PHALANGES

- The toes contain a total of 14 phalanx bones (phalanges), arranged in a similar manner as the phalanges of the fingers.
- A joint between adjacent phalanx bones is called an interphalangeal joint.

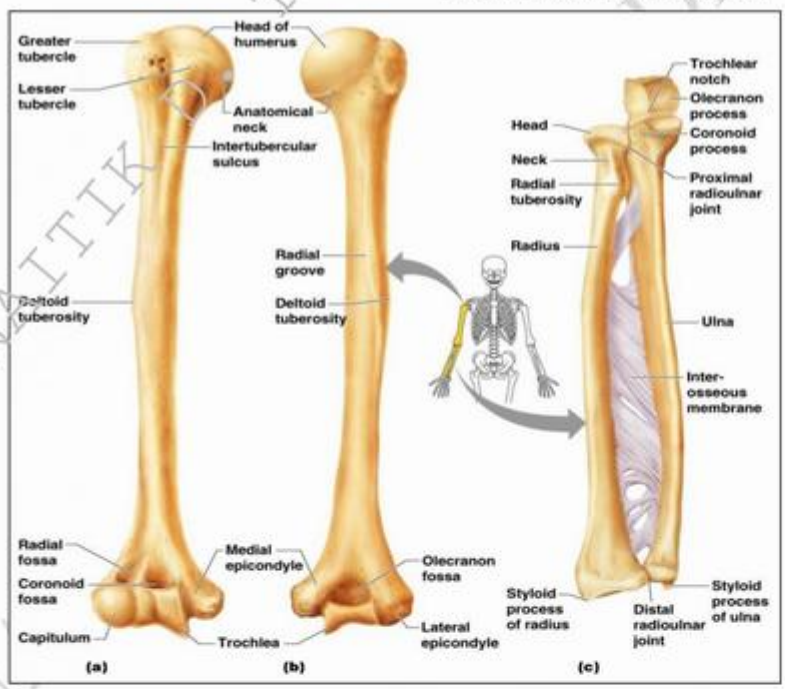
The table below lists the location and function of the major bones of the appendicular skeleton:

Bone(s)	Location	Function	Grouping
Scapula	Flat, triangular bone located on the posterior side of each shoulder	Articulates with the clavicle and humerus	Pectoral girdle
Clavicle	Located in each shoulder at the base of the neck	Helps to keep the shoulders in place; connects upper arm to the body	Pectoral girdle
Humerus	Extends from the scapula to the elbow	Provides attachments for muscles that move the shoulder and upper	Upper limbs

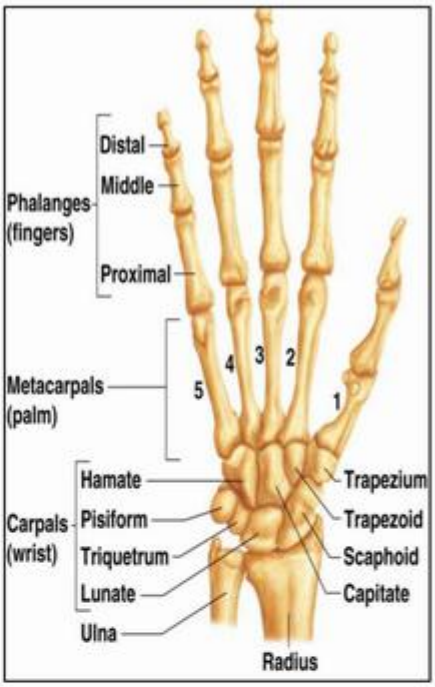
Bone(s)	Location	Function	Grouping
		arm at the proximal end; articulates with the radius and ulna at the distal end	
Radius	Located on the lateral side of the forearm between the elbow and wrist	Provides attachment for muscles that bend the arm at the elbow and muscles that allow movement of the wrist	Upper limbs
Ulna	Located on the medial side of the forearm between the elbow and wrist	Provides attachment for muscles that bend and straighten the arm at the elbow and muscles that allow movement of the wrist	Upper limbs
Ilium	Located on the superior portion of the coxal bone	Connects the bones of the lower limbs to the axial skeleton	Pelvic girdle
Femur	Extends from the hip to the knee	Provides attachment for muscles of the lower limbs and buttocks; distal end articulates with the tibia and patella	Lower limbs
Tibia	Located on the medial side of the leg between the knee and the ankle	Articulates with the femur, on its superior side, to form the knee joint; articulates with the fibula on the lateral side; articulates with the patella on the anterior side; and the tarsels to form the ankle joint	Lower limbs
Fibula	Located on the lateral side of the tibia between the knee and ankle	Forms the lateral part of the ankle joint	Lower limbs
Patella	Located on the anterior surface of the articulation between the femur and tibia	Supports movement of the knee joint	



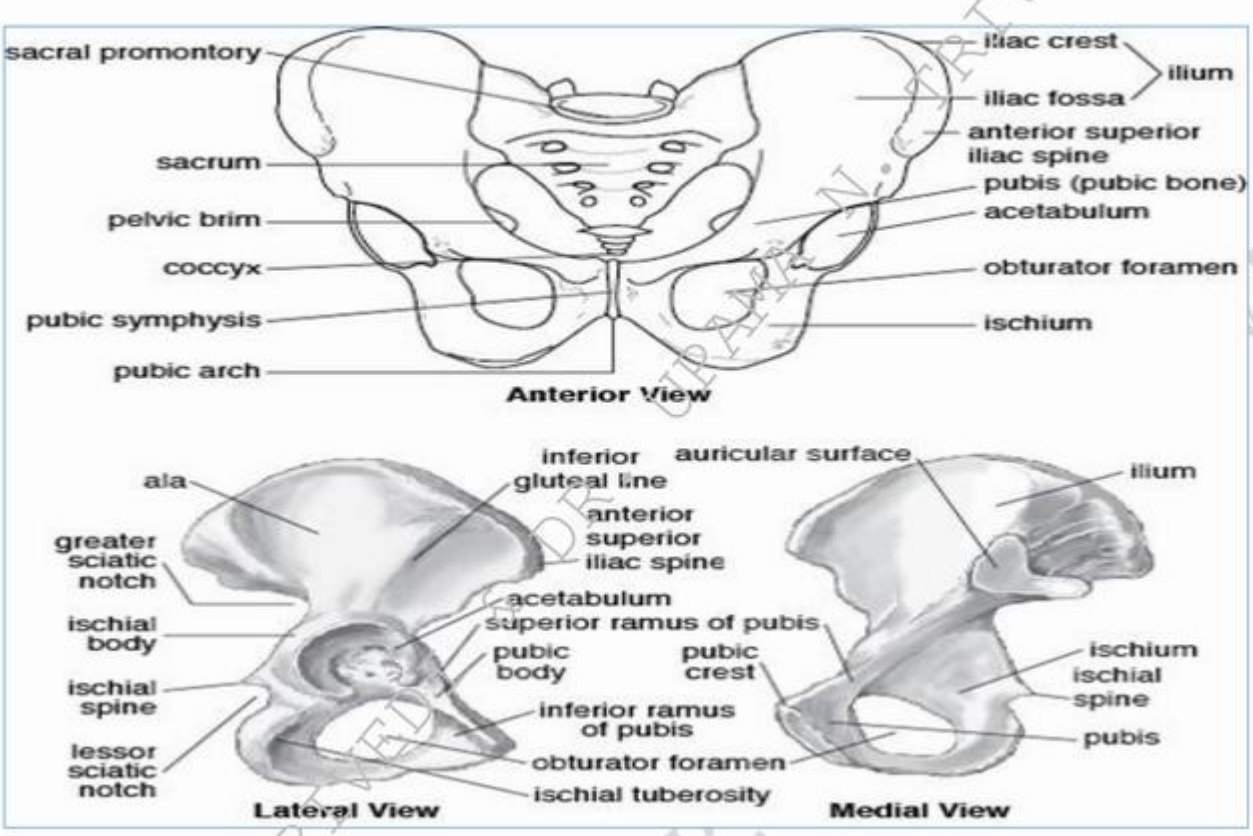
PECTORIAL GIRDLE



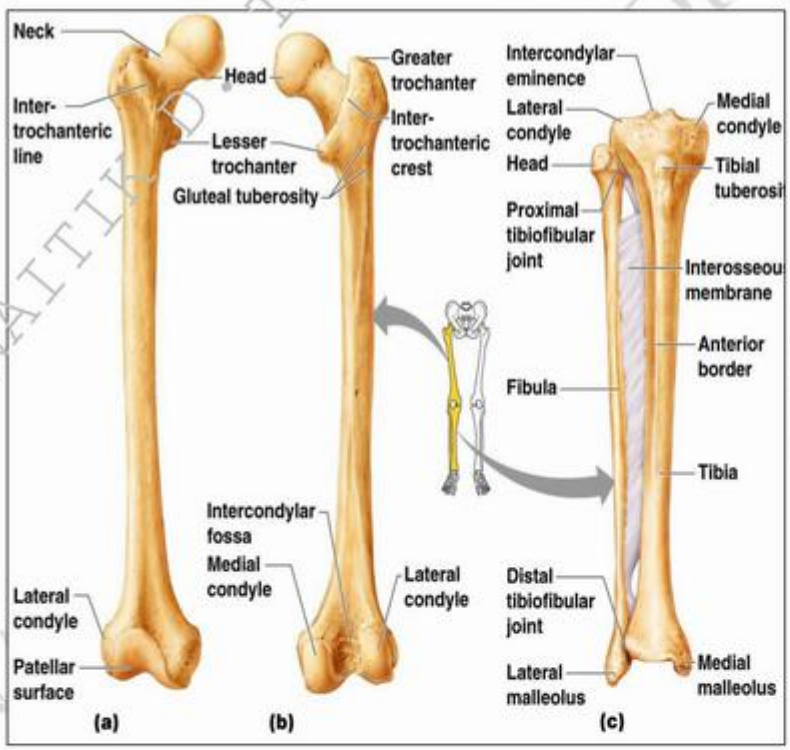
RADIOUS AND ULNA



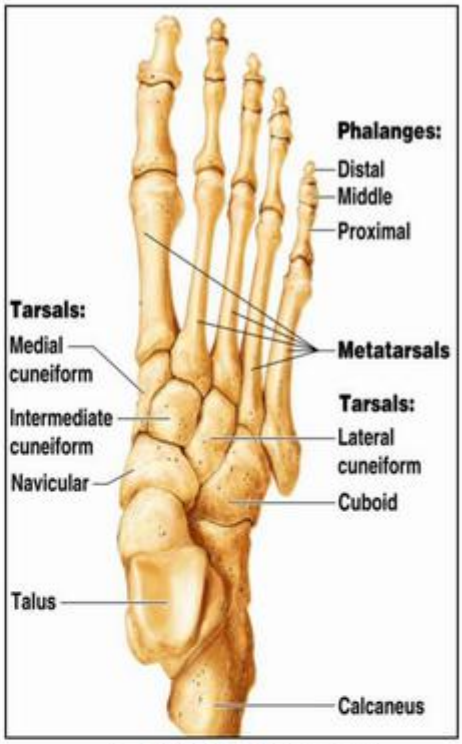
BONES OF HAND



PELVIC GIRDLE



TIBIA AND FIBULA



BONES OF FOOT

SIGNATURE OF TEACHER

EXPERIMENT NO.: 5. A **DATE:**

AIM: TO FIND OUT BLOOD GROUP OF OWN BLOOD SAMPLE.

REQUIRMENT: Blood group detection kit [antisera kit], glass slides, Permanent Marker Pen, 70% alcohol, Cotton swabs.

PRINCIPLE

Compatibility between the blood groups of donor and recipient determines the success of a blood transfusion. The AB0 and Rh blood groups are looked at while conducting the test. In a diagnostic lab, Monoclonal antibodies are available for A, B and Rh antigen. Monoclonal antibody against Antigen A (also called Anti-A), comes in a small bottles with droppers; the monoclonal suspension being **BLUE** in color. Anti-B comes in **YELLOW** colour. Anti-D (monoclonal antibody against Rh) is **COLORLESS**. All the colour codes are universal standards. When the monoclonal antibodies are added one by one to wells that contain the test sample (blood from patient), if the RBCs in that particular sample carry the corresponding Antigen, clumps can be observed in the corresponding wells. A drop of blood is left without adding any of the antibodies; it is used as a control in the experiment. The monoclonal antibody bottles should be stored in a refrigerator.

THEORY

- The surface of the erythrocyte contains some glycoprotein and glycolipids that can act as antigen. These antigens are known as isoantigens or agglutinogens.
- Based on the presence or absence of various isoantigens blood is categorized in to different blood groups. The two most important ones are: ABO and the RhD antigen; they determine someone's blood type (A, B, AB and O, with +, − or Null denoting RhD status).

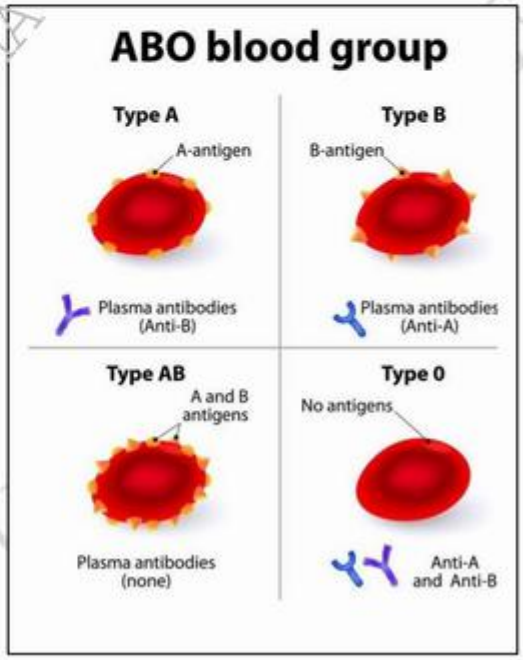
➢ ABO blood groups:

- The ABO blood groups is based on two glycolipids isoantigens called A and B.

Child blood type estimate table

		Father's Blood Type			
		A	**B**	**AB**	**O**
Mother's Blood Type	**A**	A/O	A/B/AB/O	A/B/AB	A/O
	B	A/B/AB/O	B/O	A/B/AB	B/O
	AB	A/B/AB	A/B/AB	A/B/AB	A/B
	O	A/O	B/O	A/B	O

Blood Group	Antigens present	Antibodies present
A	A Antigen	Anti-B
B	B Antigen	Anti-A
AB	A and B Antigens	No antibodies
O	Neither Antigens	Anti-A and Anti-B



➢ Rh Blood groups:

- Rh antigen first find out in to Rhesus monkey so it is known as Rh blood groups.
- People whose blood have Rh antigen is known as Rh positive (+).
- People whose blood have not Rh antigen is known as Rh negative (-).
- According to Rh positive and Rh negative ABO blood group further divided in to eight types:

1. A+ve blood group
2. B+ve blood group
3. AB+ve blood group
4. O+ve blood group
5. A-ve blood group
6. B-ve blood group
7. AB-ve blood group
8. O-ve blood group

- If Rh- person receive Rh+ blood, their immune system start to make anti-Rh antibodies that will remains in the blood and during the second transfusion the previous formed anti-Rh antibodies will cause hemolysis of donated blood and cause severe reaction. Example:

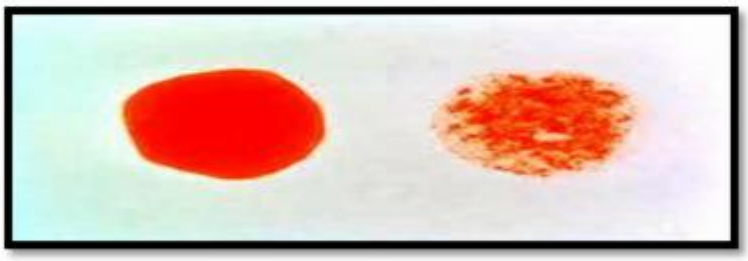
BLOOD TYPE COMPATIBILITY:

		Donor Blood Type							
		A+	**A-**	**B+**	**B-**	**AB+**	**AB-**	**O+**	**O-**
Recipient Blood Type	**A+**	√	√	X	X	X	X	√	√
	A-	X	√	X	X	X	X	X	√
	B+	X	X	√	√	X	X	√	√
	B-	X	X	X	√	X	X	X	√
	AB+	√	√	√	√	√	√	√	√
	AB-	X	√	X	√	X	√	X	√
	O+	X	X	X	X	X	X	√	√
	O-	X	X	X	X	X	X	X	√

PROCEDURE

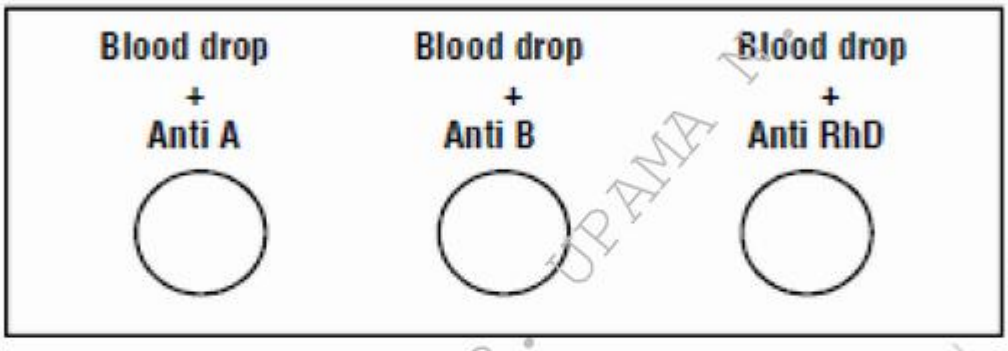
1. Take neat and clean four glass slides, Mark A, B, and D on three slide top middle part respectively. Use fourth slide to mix the blood withantisera.
2. Sterilize the ring finger with spirit using cotton swab.
3. Prick the finger using lancet/pricking needle.
4. Discard the first drop of blood.
5. Put blood drop on Slide A, Slide B and Slide D at the center.
6. Take the Anti-A (blue) bottle, re-suspend the content and use the dropper to place a drop of the Anti-A in the Slide A. Place the bottle back in ice.
7. Take the Anti-B (yellow) bottle, re-suspend the content and use the dropper to place a drop of the Anti-B in the Slide B. Place the bottle back in ice.
8. Take the Anti-D (colorless) bottle, re-suspend the content and use the dropper to place a drop of the Anti-D in the Slide D. Place the bottle back in ice.
9. Take a fourth slide, mix the Slide A, Slide B and Slide D blood drops with Anti-A, Anti-B and Anti-D solution respectively using alternate corner of the fourth slide. So, it prevent the mixing of one slide solution with the other slide solution.
10. After mixing, wait for a while to observe clumps.

DIAGRAM



No clumping Clumping

OBSERVATION



Tick (√) appropriate box.

Slide No. A: **Blood + Anti serum A** **Clump [ ] / No Clump [ ]**

Slide No. B: **Blood + Anti serum B** **Clump [ ] / No Clump [ ]**

Slide No. D: **Blood + Anti serum D (Rh Factor)** **Clump [ ] / No Clump [ ]**

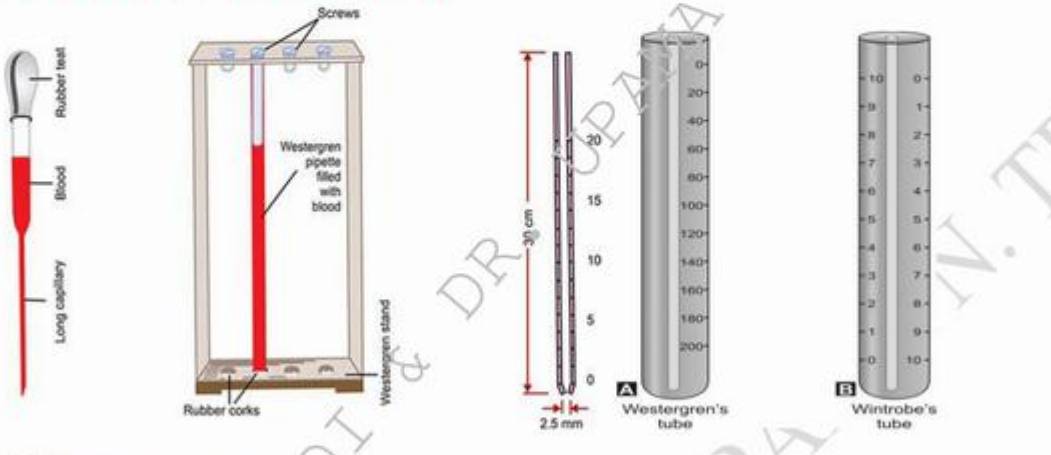
RESULT

Blood group of own blood sample is _____

SIGNATURE OF TEACHER

EXPERIMENT NO.: 5. b **DATE:**

AIM: TO DETERMINE ERYTHROCYTE SEDIMENTATION RATE BY WESTERGREN'S METHOD



Westergren

Wintrobe

WORKING PRINCIPLE:

When anticoagulated blood is allowed to stand in a narrow vertical glass tube, undisturbed for a period of time, the RBCs – under the influence of gravity- settle out from the plasma. The rate at which they settle is measured as the number of millimeters of clear plasma present at the top of the column after one hour (mm/hr). This mechanism involves three stages:

1. **Stage of aggregation:** It is the initial stage in which piling up of RBCs takes place. The phenomenon is known as Rouleaux formation. It occurs in the first 10-15 minutes.
2. **Stage of sedimentation:** It is the stage of actual falling of RBCs in which sedimentation occurs at constant rate. This occurs in 30-40 minutes out of 1 hour, depending upon the length of the tube used.

3. **Stage of packing:** This is the final stage and is also known as stationary phase. In this, there is a slower rate of falling during which packing of sedimented RBCs in column occurs due to overcrowding. It occurs in final 10 minutes in 1 hour.

THEORY:

- The erythrocyte sedimentation rate (ESR) is a common hematological test for nonspecific detection of inflammation that may be caused by infection, some cancers and certain autoimmune diseases. It can be defined as the rate at which Red Blood Cells (RBCs) sediment in a period of one hour.
- When anticoagulated blood is allowed to stand undisturbed for a period of time, the erythrocytes tend to sink to the bottom.
- Two layers are formed, the upper plasma layer and the lower one of red blood cells.
- The rate at which the red cells fall is known as the erythrocyte sedimentation rate.
- The first is the stage of aggregation when the red cells form rouleaux (RBCs cling together like coins in pile).
- This is followed by the stage of sedimentation in which the falling of the red cells takes place.
- The rate of falling of erythrocyte is directly proportional to the aggregation in first stage.

Clinical significance

- ESR is increased in all conditions where there is tissue breakdown or where there is entry of foreign proteins in the blood, except for localized mild infections.
- The determination is useful to check the progress of the infectious disease. If the patient is improving the ESR tends to fall.
- If the patient's condition is getting worse the ESR tends to rise. The ESR increases high in some chronic bacterial diseases like tuberculosis, typhoid, rheumatic diseases etc.

NORMAL RANGE:

- **Male:** 0-15 mm after 1st hour.
- **Female:** 0-20 mm after 1st hour.

FACTORS AFFECTING ESR:

i. The changed levels of plasma proteins such as fibrinogen and globulins tend to increase rouleaux formation. ESR is therefore increased in any condition causing an increase in fibrinogen (any cause of tissue breakdown such as tuberculosis and other chronic infections) or globulins (rheumatic fever, myeloma, kala-azar, etc.)

ii. Albumin retards sedimentation.

iii. High blood count however, tend to lower the sedimentation rate, while low blood counts tend to accelerate the rate of fall.

iv. ESR is greater in women than in men.

v. During pregnancy ESR gradually increases after 3rd month and returns to normal in about 3 to 4 weeks after delivery.

vi. ESR is low in infants and gradually increases up to puberty.

The Laboratory factors which influence ESR are as follows:

- **Time:** The test should be performed as early as possible after the collection of fasting specimen. There is progressive decrease in sedimentation in first four hours and after that there is a rapid decrease in sedimentation.
- **The length of the ESR tube:** ESR is greater with longer tubes (Westergren's tube) than with shorter tube (Wintrobe's tube). To ensure reliable results the column of blood should be as high as possible. The internal diameter of the tube should be more than 2.5 mm. The tubes should be kept in vertical position. Deviation of the tubes from the vertical position increases the ESR.
- **Temperature:** The red cell sedimentation is increased at higher temperature.

METHODS FOR ESR DETERMINATION:

There are two main methods to determine ESR :

1. Wintrobe's method
2. Westergren's method

Each method produces slightly different results. Mosely and Bull (1991) concluded that Wintrobe's method is more sensitive when the ESR is low, whereas, when the ESR is high, the Westergren's method is preferably an indication of patient's clinical state.

PROCEDURE

1. Westergren's method

Requirements:

- Anticoagulated blood (0.4 ml of 3.13% trisodium citrate solution + 1.6 ml blood)
- Westergren tube
- Westergren stand
- Rubber bulb (sucker)

It is better method than Wintrobe's method. The reading obtain is magnified as the column is lengtheir. The Westregren tube is open at both ends. It is 30 cm in length and 2.5 mm in diameter. The lower 20 cm are marked with 0 at the top and 200 at the buttom. It contains about 2 ml of blood.

1. Fill the Westergren's tube exactly up to zero mark by means of a rubber bulb (avoid air bubbles).
2. Place the tube upright in the stand. It should fit evenly into the groove of the stand.
3. Note the time. Allow the tube to stand for exactly one hour.
4. Exactly after one hour, note the level to which the red cell column has fallen.
5. Report the result in terms of mm/after 1st hour.

Normal values

For males: 0-10 mm/hr

For females: 0-15 mm/hr

2. Wintrobe method:

Requirements:

- Anticoagulated blood (EDTA, double oxalate)
- Pasteur pipette
- Timer
- Wintrobe's tube
- Wintrobe's stand

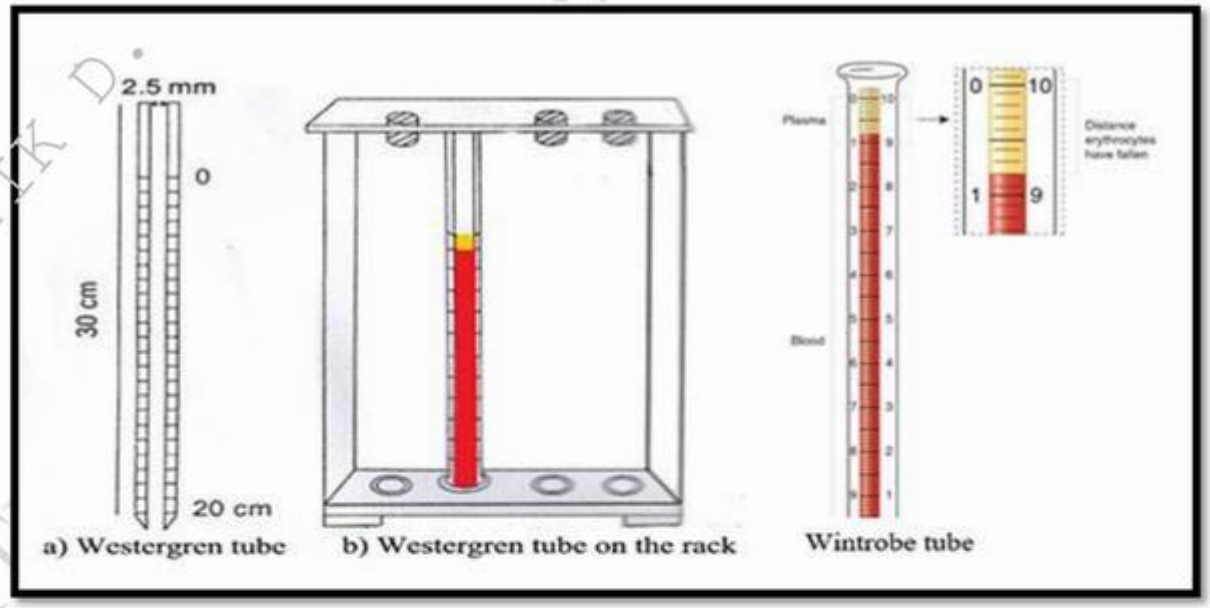
This method uses Wintrobe's tube, a narrow glass tube closed at the lower end only. The Wintrobe's tube has a length of 11 cm and internal diameter of 2.5 mm. It contains 0.7-1 ml of blood. The lower 10 cm are in cm and mm. The marking is 0 at the top and 10 at the bottom for ESR

1. The Wintrobe method is performed similarly except that the Wintrobe tube is smaller in diameter than the Westergren tube and only 100 mm long.
2. EDTA anticoagulated blood without extra diluent is drawn into the tube, and the rate of fall of red blood cells is measured in millimeters after 1 hour.
3. The shorter column makes this method less sensitive than the Westergren method because the maximal possible abnormal value is lower.
4. Fill the Wintrobe tube exactly up to zero mark by means of a rubber bulb (avoid air bubbles).
3. Place the tube upright in the stand. It should fit evenly into the groove of the stand.
4. Note the time. Allow the tube to stand for exactly one hour.
5. Exactly after one hour, note the level to which the red cell column has fallen.
6. Report the result in terms of mm/after 1st hour.

Normal values :

For males: 0-9 mm/hr

For females: 0-20 mm/hr



CLINICAL SIGNIFICANCE OF ESR

The erythrocyte sedimentation rate (ESR) is a non-specific test. It is raised in a wide range of infectious, inflammatory, degenerative, and malignant conditions associated with changes in plasma proteins, particularly increases in fibrinogen, immunoglobulins, and C-reactive protein. The ESR is also affected by many other factors including anaemia, pregnancy, haemoglobinopathies, haemoconcentration and treatment with anti-inflammatory drugs.

CAUSES OF A SIGNIFICANTLY RAISED ESR :

- All types of anemias except sickle cell anemia
- Acute and chronic inflammatory conditions and infections including:
  - HIV disease
  - Tuberculosis
  - Acute viral hepatitis
  - Arthritis
  - Bacterial endocarditis
  - Pelvic inflammatory disease
  - Ruptured ectopic pregnancy
  - Systemic lupus erythematosus
- African trypanosomiasis (rises rapidly)
- Visceral leishmaniasis
- Myelomatosis, lymphoma, Hodgkins disease, some tumours
- Drugs, including oral contraceptives

CAUSES OF REDUCED ESR :

- Polycythaemia
- Poikilocytosis
- Newborn infants
- Dehydration
- Dengue haemorrhagic fever
- Other conditions associated with haemoconcentration

OBSERVATION TABLE

Method	At the end of one hr		At the end of two hr	
	Male	Female	Male	Female
Westerngren				
Wintrobe				

CONCLUSION

- The ESR of the given sample is normal / abnormal
- If abnormal then is it higher/lower than normal.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 5. c **DATE:**

AIM: TO ESTIMATE HAEMOGLOBIN WITH THE HELP OF SAHLI'S HAEMOGLOBINOMETER AND COLOR INDEX

REQUIREMENTS: Sahli's hemoglobinometer, Hydrochloric acid, Distilled Water.

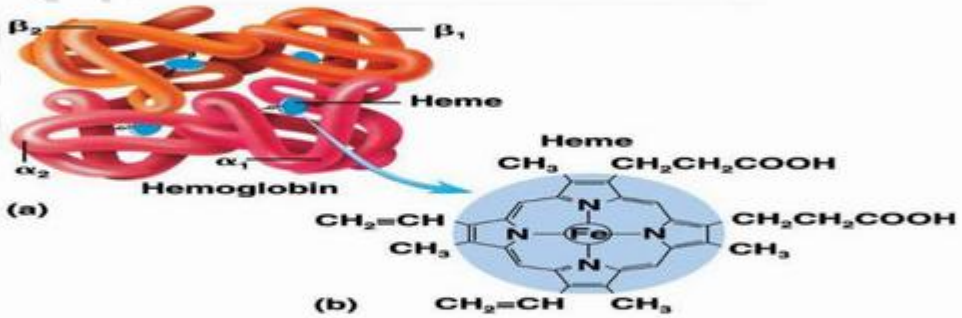
L-R:
Pipette
Sahli's Standard
Hemometer Tub
Stirring Rod
Dropper

THEORY

- Hemoglobin is the molecules which are present in to the RBC.
- In Hemoglobin protein part is known as globin and non-protein part is known as heme.

  Globin molecules: Transport carbon dioxide and nitric oxide

  Heme molecules: Transport oxygen.
- Globin composed by four polypeptide chain 2α and 2β.
- Each hemes are associated with one polypeptide chain and iron ion (Fe^{+2}) that can combine reversibly with oxygen.



- Each hemoglobin has the capacity to carry four molecules of O_2 which release in to interstitial fluid from there in to cells.
- Each (RBC) one contains about 280 million hemoglobin molecules.
- It has no nucleolus because all space is available for oxygen transport.

- As well as RBC has no mitochondria so it generates ATP by anaerobically so they do not use O_2 which they transport.

NORMAL RANGE OF HAEMOGLOBIN:

- **At birth –** 13.5 to 19.5 gm/dl
- **Children (2-5 yrs)** – 11 to 14 gm/dl
- **Children (6 – 12 yrs)** – 11.5 to 15.5 gm/dl
- **Adult female** – 13 to 15 gm/dl
- **Adult male** – 14 to 17 gm/dl

CLINICAL SIGNIFICANCE OF HEMOGLOBIN ESTIMATION

1. **Anemia:**

Hemoglobin estimation below normal level indicates that the patient is anemic. In this condition there is not enough Hb available to carry sufficient oxygen from the lungs to tissue.

Types of anemia:

A. **Based on hemoglobin estimation**: if hemoglobin level is below 10gms/dl it is called mild anemia. If hemoglobin level goes below 8gms/dl, and 6gms/dl, the conditions are called moderate and severe anemia respectively.

B. **Based on etiology of anemia:** Deficiency of iron in diet (iron deficiency anemia), Vitamin B12 and Folic acid are deficient in diet or folic acid is destroyed due to drug's action (Megaloblastic anemia), Due to impaired absorption of Vitamin B12 from the small intestine, as the intrinsic factor is not synthesized by stomach or destroyed due to gastric surgery (Pernicious anemia), Synthesis of Hb is impaired due to bone marrow failure (Hypoplastic or aplastic anemia), destruction of Hb in circulation due to effect of drugs, free radicals or other toxic chemicals (Hemolytic anemia). Hemoglobin A is replaced by Hb S, Hb C, Hb D, and Hb E (hereditary haemoglobinopathies, Sickle cell anemia etc.), Hemoglobin Batrs (consists of four gamma chains) is present instead of normal Hemoglobin (Thalassemia).

2. **Polycythemia:**

When RBC count is elevated sometimes in disease condition like haemoconcentration due to burns, cholera, chronic heart disease, conditions of decreased lung function such as emphysema or due to climbing (as the oxygen level is less in the high altitude).

METHODS OF HAEMOGLOBIN COUNT:

1. Visual colour comparison method

i. Sahil's method
ii. Dares method
iii. Hadens method
iv. Wintrobes method
v. Haldanes method
vi. Tallquists method

2. Gasometric method

- Van Slyke method

3. Spectrophotometric method

i. Oxyhaemoglobin method
ii. Cyanmethemoblobin method

4. Automated haemoglobinometry

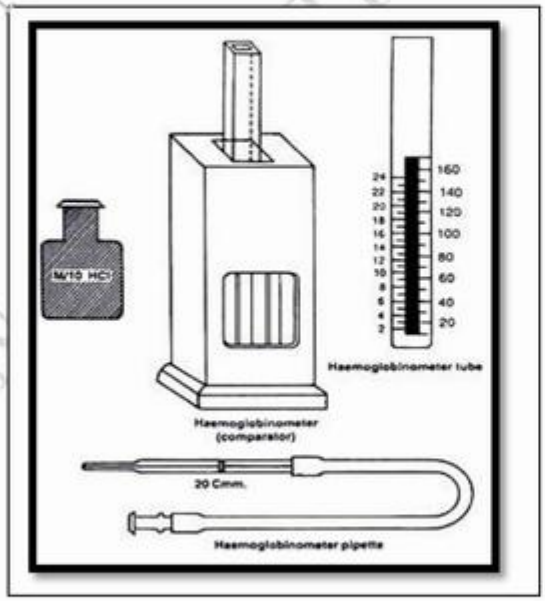
5. Non-automated haemoglobinometry

6. Other methods:

i. Alkaline-hematin method
ii. Specific gravity method
iii. Comparator method.

HB COUNT BY SAHLI'S HAEMOGLOBINOMETER (ACID HAEMATIN METHOD):

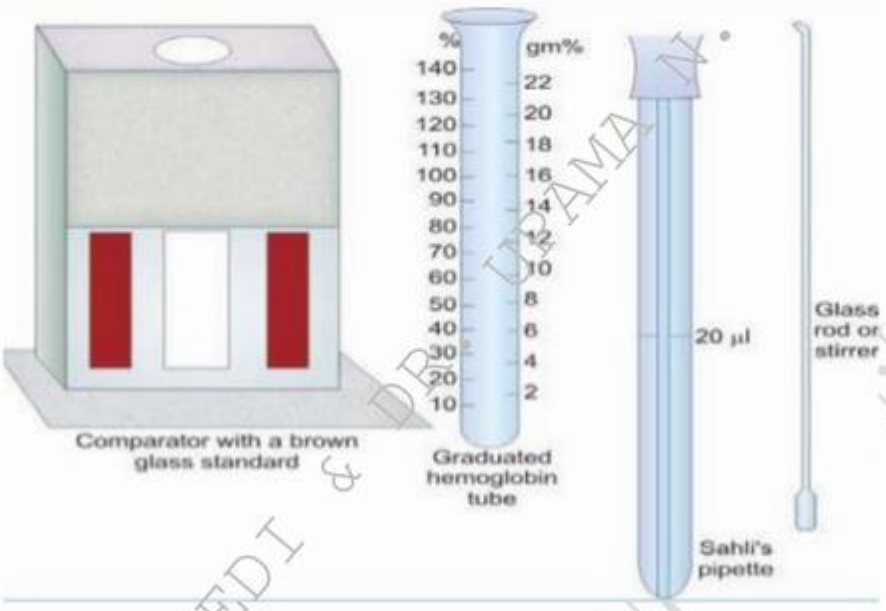
PRINCIPLE:



Anticoagulated blood is added to the 0.1 N HCl and kept for 5-7 minutes to form acid hematin, which give red color to the solution. The color of this acid hematin should be matched with the solution, present in the calibration tube (Reference Solution). Distilled water is added drop by drop to the acid hematin until the color matches and the final reading is directly noted from the graduation in the calibration tube. [Please note that 100 percent on the scale corresponds to 14.5gm % to 15gm %].

SAHLI'S HAEMOCYTOMETER

PROCEDURE:



- The graduated diluted tube and micropipette are clean thoroughly and dried.
- Place N/10 HCL (0.1 N HCL) in diluting tube up to the mark 2gm mark.
- Ring finger is sterilized with 70% alcohol and pricked boldly with the help of pricking needle.
- 1st drop discarded, then suck the blood from pricking site by the help of hemoglobin pipette up to 20-cubic-mm-mark.
- Transfer or blow it into diluting tube and rinse/stir well.
- To clean the pipette rinse it with HCl 2-3 times.
- The blood is immediately deposited at the bottom of graduated tube.
- The blood and HCL mixed properly by glass rod/Stirred and solution allowed to stand for 10-15 mins so all Hb converted into hematin.
- After 10 minutes add distilled water by using the dropper and mix the tube until it has exactly the same color as the reference solution.
- Note down the reading in G% and % of hemoglobin. (It is your observed Hb result)

CALCULATIONS

International value of Hb is 14.5 gm % = 100%

So _____ (Your Hb gm %) = ?

Calculated Hb% = (Your Hb gm % X 100) /14.5 gm %

Oxygen carrying capacity

Amount of oxygen in cc. carried by 100mL of blood during one pulmonary circulation.

Hb% X 1.34 cc oxygen

1gm of Hb contains 1.34 cc oxygen

Therefor, N gm of Hb contains= N X 1.34 cc oxygen (N = Your Hb gm% Value)

Color index

The relative amount of Hb present in single RBC. It can be determine by finding ratio of Hb% and RBC%

Color index = Hb% / RBC%

14.5 gm % = 100 % (Hb%) **5 million/cmm = 100 % (RBC)**

Calculate according to your obtained value.

(Normal color index reside between 0.85 to 1.15)

RESULT

Observed:

My own blood observed Hb gm%=_____ gm%

My own blood observed Hb %=_____%

Calculated:

My own blood calculated Hb %=_____%

Color Index

The Color index of the own sample is_____.

CONCLUSION

My own blood hemoglobin G% and % value is in normal / abnormal range.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 5. d **DATE:**

AIM: TO STUDY AND DETERMINATION OF THE BLEEDING TIME OF OWN BLOOD SAMPLE.

REQUIRMENTS:

PRINCIPLE:

- A bleeding time test determines how quickly your blood clots to stop bleeding. The test involves making small punctures in your ring finger.
- The test is a basic assessment of how well your blood platelets work to form clots.
- Platelets are tiny cell fragments that circulate in your blood. They're the first cells to react to a blood vessel injury. They seal off the wound to prevent more blood from escaping.
- Abnormal results from a bleeding time test can be a sign platelet function defect.

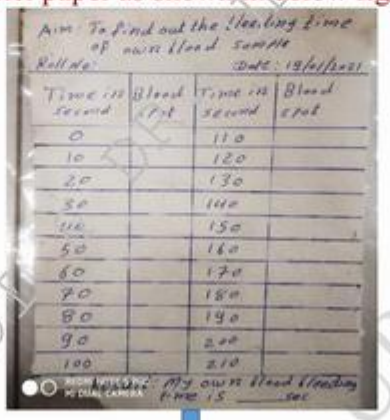
THEORY

- The time required for complete stopping of blood flow from the punctured blood vessels called the **bleeding time.**
- Normally it is 1-3 minutes for a normal human's blood.
- Normal clotting time and bleeding time values differ because bleeding time is the time for stopping bleeding by the formation of fibrin network on the surface of punctured skin known as surface phenomenon.

- But the clotting time is the time for clotting the whole blood, collected in the capillary tube; therefore it is a volume phenomenon.
- For this reason clotting time is more than the bleeding time, when determining by conventional methods.

PROCEDURE:

Write the aim, date and roll number on piece of filter paper and draw the pattern to take result on filter paper as shown in below figure



↓

Take a new or unused Lancet/Pricking Needle and Sterilize it with 70 % of alcohol

↓

Sterilize the tip of ring finger with 70% of alcohol

↓

Rub the finger to increase the blood circulation then hold the finger using your thumb

↓

Give the sharp Prick by the lancet on the tip of ring finger

↓

Star to take result on filter paper at 10 sec interval, Take first result at 0 Second time means immediately after pricking, then at 10 Sec, 20 Sec, 30 Sec …..

↓

Take the response till no blot appears on filter paper

↓

Time from first appearance of the blood spot to no blot appears is your bleeding time

↓

Normal Bleeding time of healthy person is 1-3 Minutes

Why We Use Left Hand Ring Finger ????

- It is least used as compared to other finger
- Synovial sheath of ring finger short of the hand and due to this infection do not spread exceed to their limit.

RESULTS

Bleeding time of my own blood is _____ minute _____ Seconds.

PRECAUTION

Following precautions should be enforced

i) Needle should be sterilized.

ii) A faint stain of blood should not be avoided.

iii) Time should be noted properly.

iv) Use fresh needle every time for the practical

CONCLUSION

My own blood bleeding time is _____ which lie in normal/abnormal range.

CLINICAL SIGNIFICANCE

- To study the hemorrhagic disorders.
- To study the coagulation defects
- To have an idea about the platelets count of the patient.
- Bleeding time is prolonged in few disorders like: vascular lesions, platelet defect, severe liver disease, uremia and anti-coagulant drug administration.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 5. d **DATE:**

AIM: TO DETERMINE THE CLOTTING TIME OF OWN BLOOD SAMPLE.

PRINCIPLE:

- Clotting prevents excessive bleeding during the time of injury. Coagulation/Clotting tests measure your blood's ability to clot, and how long it takes to clot.
- During coagulation solution/liquid form of the blood convert in to the gel/semisolid form.
- Note down the time required for this physical change.

THEORY

- **Clotting time** is the time taken to coagulate the blood after rupture of blood vessels. Normally it is **4-10 minutes** for a normal human's blood depending upon platelets count and other clotting factors inside the plasma.

▪ Clotting process is well described by three main pathways which are:
a) Extrinsic pathway b) Intrinsic pathway and c) Common pathways

a) Extrinsic pathways:

▪ It has fewer steps than the intrinsic pathway.
▪ It is a fast process than the intrinsic pathway usually takes few seconds.

During the injury
↓
Endothelial cells which lines the blood capillary get damaged
↓
So Factor VII leaves the circulation and comes into contact with tissue factor (TF)
↓
It activate the clotting factor VII
↓
Which combine with the factor X and activate factor X
↓
It combines with factor V in the presence of Ca++
↓
Which form the active enzyme prothrombinase

▪ Tissue factor (TF) is a complex mixture of lipoprotein and phospholipids, It release from the surface of damaged cells.

b) Intrinsic pathways:

▪ It is a more complex process than the extrinsic pathway.
▪ It is a slow process than the extrinsic pathway usually required several minutes

During the injury
↓
Endothelial cells which lines the blood capillary get damaged
↓
Blood come with contact of collagen in the surrounding basal lamina (Junction between Endothelial tissue and Connective tissue)
↓
Activate the clotting factor XII
↓

Clotting factor XII activates factor XI

↓

Factor XI activates the factor IX which is also activate by extrinsic pathway factor VII

↓

Factor IX by the help of factor VIII and platelet phospholipids activate factor X

↓

Activated factor X combine with factor V and Ca++ (same as extrinsic pathway processes)

↓

Which form the active enzyme prothrombinase

c) Common pathway:

- Once prothrombinase is form it start the common pathway.
- It this pathway:

Prothrombinase convert in to thrombin by the help of Ca++

↓

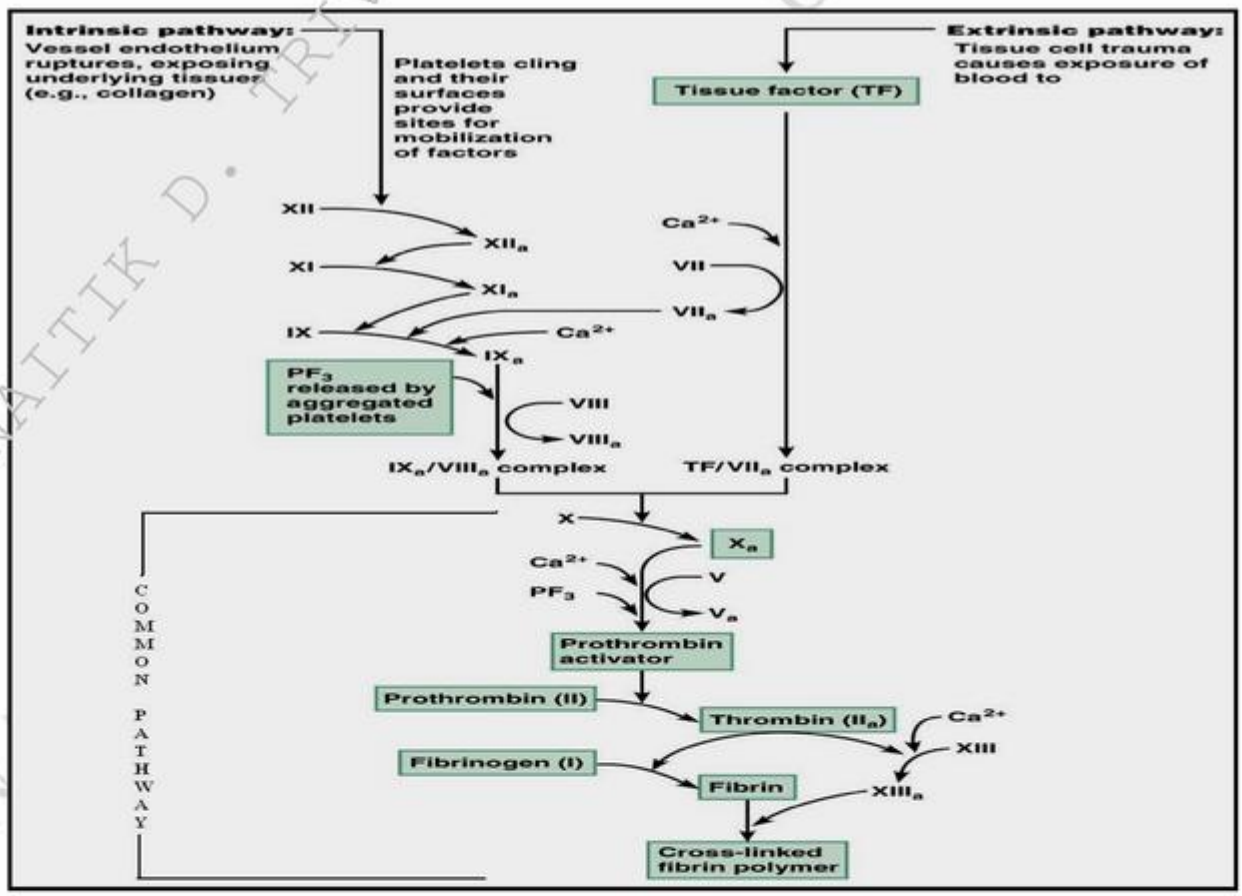
Thrombin activate factor XIII as well as convert in to Fibrinogen in the presence of Ca++

↓

Fibrinogen converts into soluble fibrin

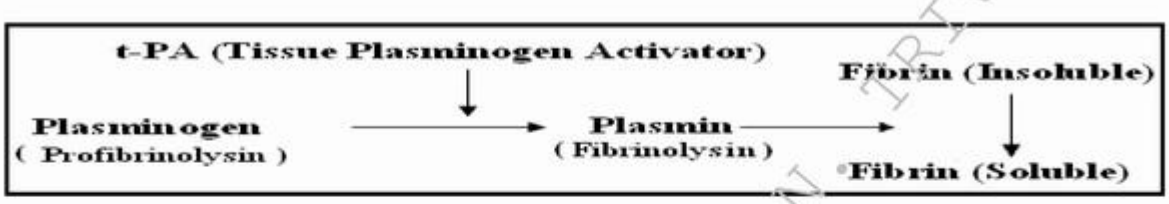
↓

Soluble fibrin converts in to insoluble fibrin by the help of activated factor XIII



Fibrinolysis:

- Once repair s over, the fibrinolysis system is activate. This process inhibit the clot formation in blood because in clot formation soluble fibrin is convert in insoluble while in fibrinolysis insoluble fibrin convert in to soluble fibrin.



Factor	Name(s)
Prekallikrein (PK)	Fletcher factor
High molecular weight kininogen (HMWK)	contact activation cofactor; Fitzgerald, Flaujeac Williams factor
I	Fibrinogen
II	Prothrombin
III	Tissue Factor
IV	Calcium
V	Proaccelerin, labile factor, accelerator (Ac-) globulin
VI (same as Va)	Accelerin
VII	Proconvertin, serum prothrombin conversion accelerator (SPCA), cothromboplastin
VIII	Antihaemophiliac factor A, antihemophilic globulin (AHG)
IX	Christmas Factor, antihemophilic factor B,plasma thromboplastin component (PTC)
X	Stuart-Prower Factor
XI	Plasma thromboplastin antecedent (PTA)
XII	Hageman Factor
XIII	Protransglutaminase, fibrin stabilizing factor (FSF), fibrinoligase

Hemorrhageic condition:

If there is hemorrhage we can guess few possibilities:

- **Thrombocytopenia** Blood platelets count is below 150000/ cubic mm of blood.
- **Vitamin K deficiency** Vitamin K is essential for synthesis of factor II, VII, IX, and X. Syntheses of these factors are impaired and hemorrhagic disease is progressed due to Vit K deficiency.
- **Hamophilia** Bleeding disease that causes excessive bleeding especially in men.
- **Hemophilia A:** Factor VIII is abnormal **Hemophilia B or Christmas disease:** Factor IX is deficient.
- **Von Willebrand's disease** Factor VIII has two parts, a large component and a small component. The smaller component is more important in intrinsic pathway of blood clotting and loss of this component causes the classical haemophilia. Sometimes haemophilia is seen due to deficiency of the large component, called Von Willebrand's disease.

Thromboembolic condition

When the clotting time is lower than the normal range we can guess there might be **thromboembolic condition** inside the tissue:

- **Thrombus:** An abnormal blood clot developed inside the blood vessels.
- **Emboli:** Tiny parts of breakdown thrombi are called emboli.
- **Causes of thromboembolic condition:** i. Rough endothelial surface caused due to atherosclerosis, infection or trauma. ii. Slow blood flow.

PROCEDURE

There are mainly three methods to find out the Clotting time of own blood sample

1. Lee and White's method
2. Wright's Method
3. Duke's Method

1. Wright's Method:

PROCEDURE

Take a new or unused Lancet/Pricking Needle and Sterilize it with 70 % of alcohol

↓

Sterilize the tip of ring finger with 70% of alcohol using cotton swab

↓

Rub the finger to increase the blood circulation then hold the finger using your thumb

↓

Give the sharp Prick by the lancet on the tip of ring finger

↓

Place Capillary Tube in vertical position at pricking site of finger from where blood comes out (Blood move from higher pressure to lower pressure and entre in to the Capillary Tube)

↓

Fill the blood capillary at the 80-90 % of total volume

↓

After every 30 second. Cut/break about 1/10 portion of capillary tube until to get thread like structure (Coagulum) between two broken part of capillary tube

↓

Note down this time and write in to the result.

Correction factor: If you take more than 10 sec to fill the capillary tube then add this time in result.

2. Lee and White's method

REQUIREMENTS:


Standard Size Test Tube


Watch


Cotton Swab


Plastic Sheets


Syringe

70 % Methylated Alcohol/Spirits


Water Bath, Test tube Holder, Thermometer


Pen/Pencil


Gloves

2. Lee and White's method

PROCEDURE

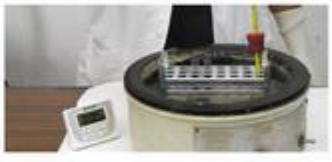
Collect the blood through the venepuncture / Venous Blood

↓

Pour the collected blood (Approximate 1mL) into the Standard Size Test tube.

↓

Start the stopwatch and keep Test Tube in water bath at 37^{O}C Temp.



↓

After 2 Min. tilt the tube for blood clot, Check for clotting in both tubes at every 30 sec. & Note the result

Note: Take the average time for clotting in both the tubes – Clotting Time

3. Duke's Method:
REQUIREMENTS:

Pricking needle/Lancet

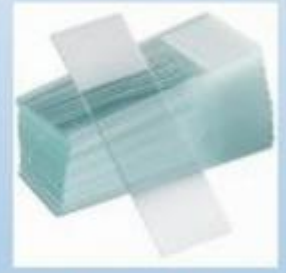
Watch

Plastic Sheets

Pen/Pencil

Cotton Swab

70 % Methylated Alcohol/Spirits



Glass slide

3. Duke's Method:

PROCEDURE

Take a new or unused Lancet/Pricking Needle and Sterilize it with 70 % of alcohol

↓

Sterilize the tip of ring finger with 70% of alcohol using cotton swab

↓

Rub the finger to increase the blood circulation then hold the finger using your thumb

↓

Give the sharp Prick by the lancet on the tip of ring finger

↓

Place the blood drop on the Glass Slide, approximate which produce 5 mm diameter

↓

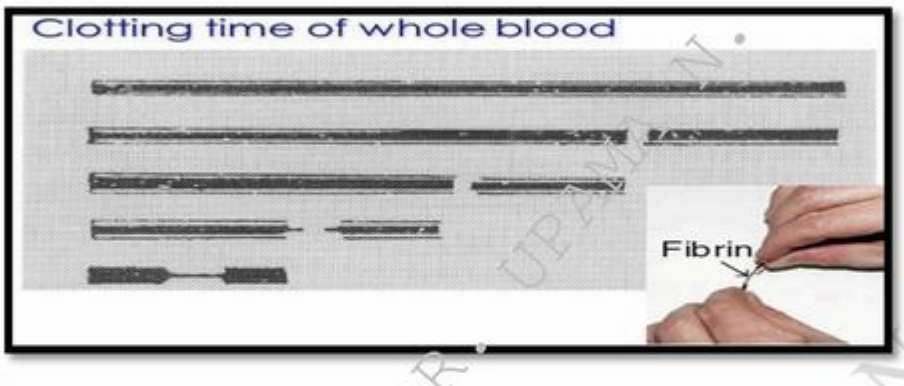
Move the slide vertical at every 30 sec. to observe the movement of blood drop

↓

Note down the time when no movement/change in shape observe in the blood drop. This is your clotting time

OBSRVATION

The fibrin thread is formed at the breaking point after clot is formed



RESULTS

Clotting time of my own blood is _____ min_____seconds.

PRECAUTION

Following precautions should be enforced

i) Needle should be sterilized.

ii) A fain stain of blood should not be avoided.

iii) Time should be noted properly.

CONCLUSION

Clotting time of my own blood is _____ in normal/abnormal range.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 6 **DATE:**

AIM: TO ESTIMATION TOTAL WBC (LEUCOCYTE) COUNT OF OWN BLOOD SAMPLE

REQUIREMENTS:

Microscope, Haemocytometer, Thomas coverslip, WBC diluting fluid, Cotton swab, Pricking Needle/Lancet, Napkin, Plastic Sheet

PRINCIPLE:

The blood specimen is diluted 1:20 in a WBC pipette with the diluting fluid (water: glacial acetic acid: gentian violet = 97:2:1) and the cells are counted under low power of the microscope (10X) by using a counting chamber. The glacial acetic acid lyses the red cells while the gentian violet slightly stains the nuclei of the leukocytes to locate the WBC under microscope.

THEORY:

- White blood cells, present in plasma take part in body defense against invading micro-organisms.
- They are produced from the pluripotent stem cell in the bone marrow in adults. In case of foetus haemopoiesis occurs in liver and spleen.

Clinical Significances of total leukocyte count:

- Increase in total leukocyte count of more than 10,000/cu mm (µl) is known as leukocytosis and decrease of less than 4 000 cu mm (µl) as leukopenia.

Causes of leukocytosis:

- It is common for a transient period in infections (bacterial, protozoal (malaria), or parasitic),
- Leukocytosis is also observed in severe hemorrhage and in leukemia ii. High temperature
- Severe pain iv. Accidental brain damage.

Causes of Leucopenia:

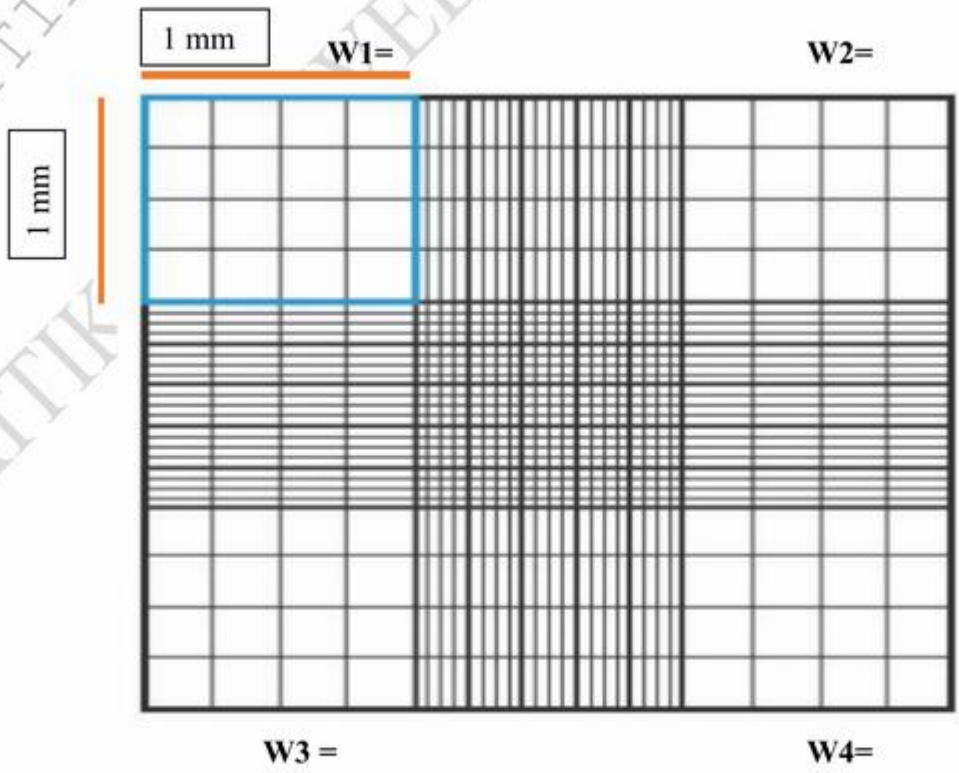
- Certain viral (hepatitis, influenza, measles, etc.), and bacterial (typhoid, paratyphoid, tuberculosis, etc) infections
- Primary bone marrow depression (aplastic anaemia)
- Secondary bone marrow depression (due to drugs, radiation, etc.) Iv. Anaemia (iron deficiency megaloblastic etc).

NORMAL RANGES:

About 4,000 to 11,000 per µl or cubic mm of blood

PROCEDURE:

- Clean microscope, neubauer counting chamber and Thomas cover slip,
- Place the Thomas cover lip on Neubauer counting chamber and adjust the Neubauer counting chamber under low power objective lens i. e 10X.
- Make ready neat and cleaned WBC pipette to collect blood from the ring finger
- Sterilize the ring finger with 70% of alcohol and pricked boldly with the help of pricking needle.
- 1st drop discarded, then hold the WBC pipette slightly down position like tip of the Pipette touch the pricking site.
- Take the WBC pipette tube of the next end in the mouth and try to pull blood in capillary without AIR bubble till the making of 0.5.
- Then pill WBC dilution fluid upto the mark 11.
- Make a 1:20 Dilution.
- Give a node to the WBC pipette tube and mix the fluid gently for 1-2 minutes.
- Open the node of WBC Pipette and place the tip of WBC pipette like that the fluid portion enter between the gap of Thomas cover slip and Neubauer counting chamber.
- Allowed the fluid to spread on the counting.
- Try to count WBC as shown in below figure.



CALCULATIONS:

- Total Number of white blood cells in 16 small square[64 smallest square] = N

  N means = W1+W2+W3+W4 =
- Length (L) of 1 small WBC square = 1mm
- Width (W) of 1 small WBC square= 1mm

  So area of 1 small square (L X W) = 1 mm X 1 mm= 1 mm^2 or 1 sq. mm
- Height (Thickness) of the counting chamber 1/10 mm = 0.1 mm
- Volume of fluid in 1 small square (L X W X H) = 1 mm X 1 mm X 0.1 mm = 0.1 mm^3
- So, Volume of fluid in 4 small square = 0.1 X 4 = 0.4 cmm or 0.4 mm^3

  If,

  0.4 cmm or (4/10) cmm, of diluted fluid contains N WBC

  So, 4 cmm (4 X 1 cmm) of diluted fluid contains = N X 10 WBC

  1 cmm of diluted fluid contains = N/4 X 10 WBC
- Dilution factor is 0.5 in 10 or 1 in 20

  Therefore total number of WBC in undiluted fluid = N/4 X 10 X 20 (Dilution Factor)

  = N X 50 /cmm

  =

  =

RESULT: Total WBC count of my own blood is _____/cmms

(Normal WBC count 4000 to 11,000/cmm of blood)

CONCLUSION: Therefore, my blood is in **normal/ abnormal**

CLINICAL SIGNIFICANCES OF DIFFERENTIAL LEUKOCYTE COUNT:

Types of WBC, elevated in plasma	Significances
Neutrophils	Acute bacterial infections, hemorrhage, diabetic acidosis
Basophils	Increase in types of blood dyscrasias
Eosinophils	Increase in parasitic and allergic conditions, pernicious anemia
Monocyte	Hodgkin's disease, lipid storage disease, recovery from severe infections, monocytic leukemia
Lymphocyte	Viral and chronic bacterial infections, acute and chronic lymphocytic leukemia, antigen reaction

Increased WBC Count (Leukocytosis):

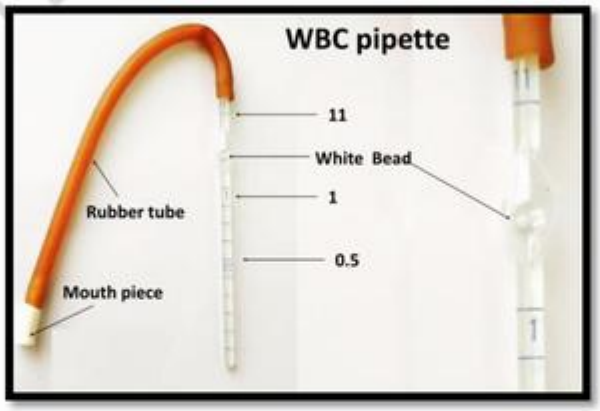
The count is more than 11,000/cmm.

1. Infections mostly acute bacterial give rise to an increase in the WBC count.
2. Trauma and stress.
3. Hemorrhage.
4. Dehydration.
5. Steroid therapy.
6. Inflammations.
7. Thyroid hormone increases.
8. Leukaemias or another myeloproliferative process.
9. Other malignancies may increase WBC count.

Decreased WBC Count (Leukopenia):

The count is less than 4000/cmm.

1. Drug toxicity causing bone marrow depression.
2. Cytotoxic drugs.
3. Bone marrow failure.
4. Severe infections.
5. Bone marrow infiltration by the tumors or myelofibrosis.
6. Dietary deficiency like vitamin B12 and iron deficiency.
7. Hypersplenism.
8. Autoimmune diseases.
9. Low TLC may be seen in typhoid fever.



SIGNATURE OF TEACHER

EXPERIMENT NO.: 7 **DATE:**

AIM: TO ESTIMATE TOTAL RBC (ERYTHROCYTE) COUNT OF OWN BLOOD SAMPLE

REQUIRMENT:

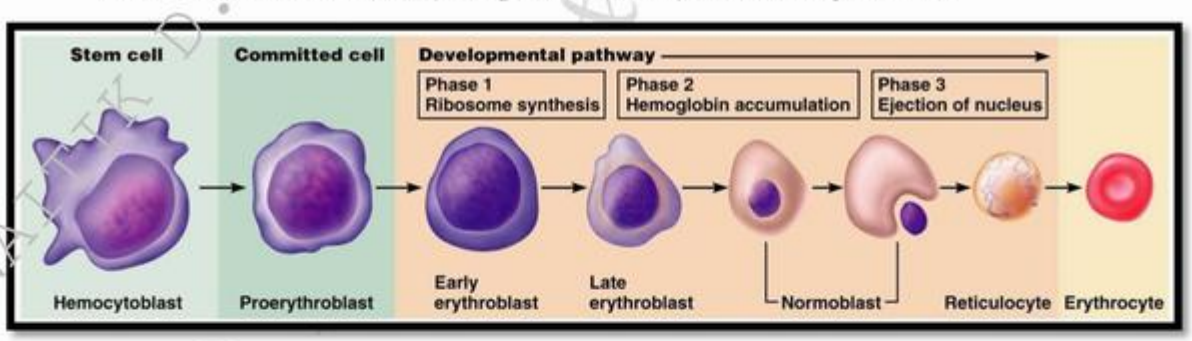
Microscope, Neubauer Chamber, Thomas Coverslip, Microscope, RBC Diluting Fluid, Cotton swab, Pricking Needle/Lancet, 70 % Methylated Alcohol (Spirit)

PRINCIPLE:

The blood specimen is diluted 1:200 in a RBC pipette with the Haymen's RBC diluting fluid and the cells are counted under high power of the microscope (40X or 45X) by using a counting chamber.

THEORY:

- Erythrocytes, also known as red blood corpuscles, contain the hemoglobin (Hb) which carries the oxygen to cells and tissues, is responsible for the red colour of blood. The life span of normal RBC is 120 days. The RBC is produced in red bone marrow in adult.
- The agents, required for the synthesis of blood cells are called hematinic agents (iron, folic acid, vitamin B12, erythropoietin, colony stimulating factors).



Steps of Erythropoiesis

Functions of RBC

1. Transport of oxygen and carbon dioxide.
2. Maintains of acid base balance, ionic balance and viscosity of blood.
3. Formation bile pigment as result of destruction of RBC.

Clinical significances:

- The decreased count of RBC indicates several conditions like iron deficiency anemia, megaloblastic anaemia, pernicious anemia, thalassemia, sickle cell anemia, aplastic anemia, chronic renal failure etc.

- ❖ Increased RBC production (Polycythemia vera) occurs in burn, lack of oxygen during rock climbing, bone marrow cancer, respiratory disorders etc., when the viscosity of the blood increases.

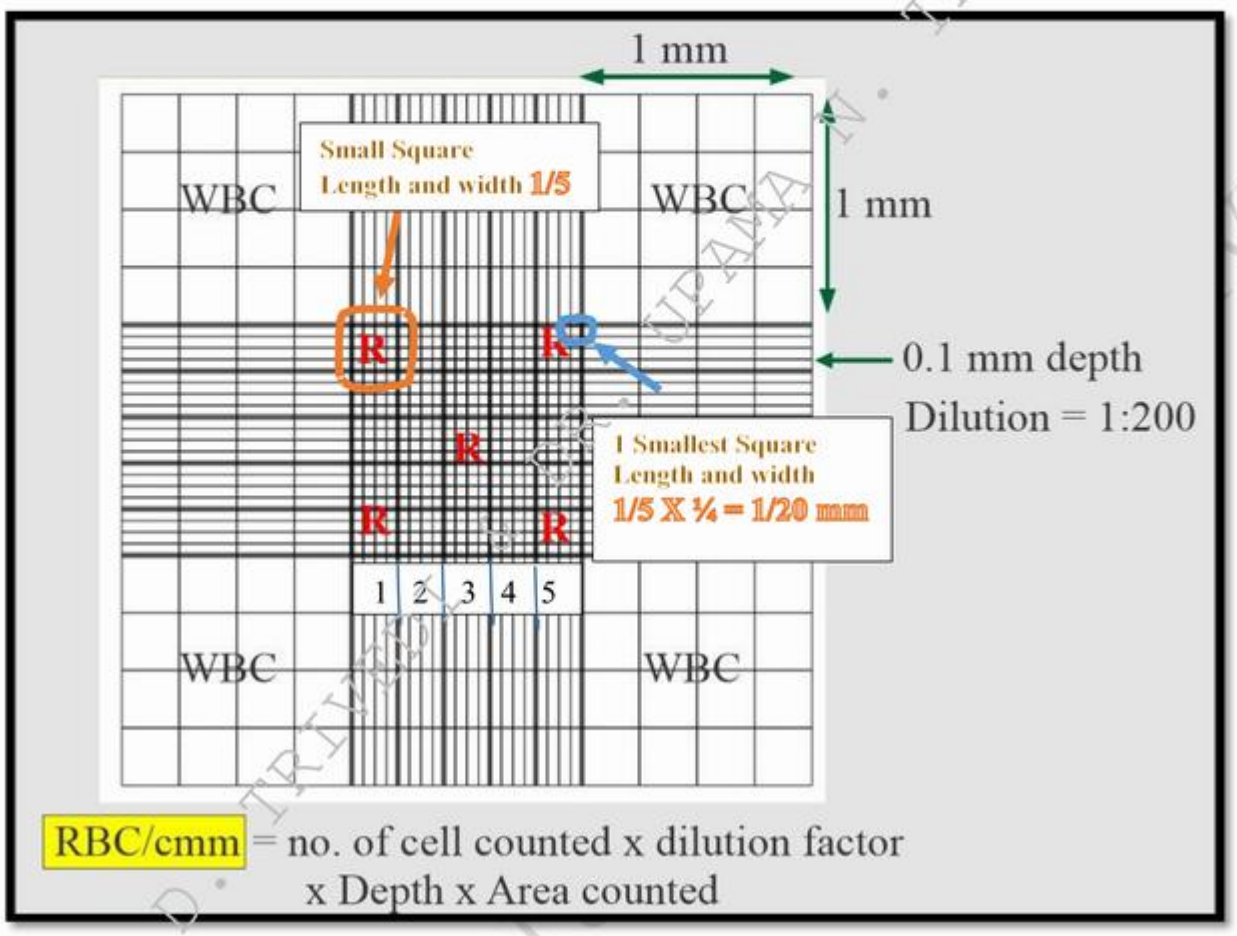
NORMAL RANGES:

- ❖ **Male:** about 5-6 million per µl or cubic mm of blood
- ❖ **Female:** about 4-5 million per µl or cubic mm of blood
- ❖ Cord blood = 3.9 to 5.5 million/cmm
- ❖ Adult = 18 to 44 years :
  - o Male = 4.7 to 6.1 million/cmm.
  - o Female = 3.8 to 5.4 million/cmm
- ❖ 45 to 64 years :
  - o Male = 4.2 to 5.6 million/cmm.
  - o Female = 3.8 to 5.0 million/cmm
- ❖ 65 to 74 years :
  - o Male = 3.8 to 5.8 million/cmm.
  - o Female = 3.8 to 5.2 million/cmm

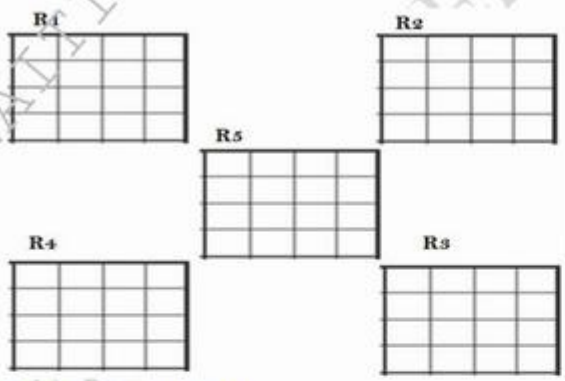
PROCEDURE:

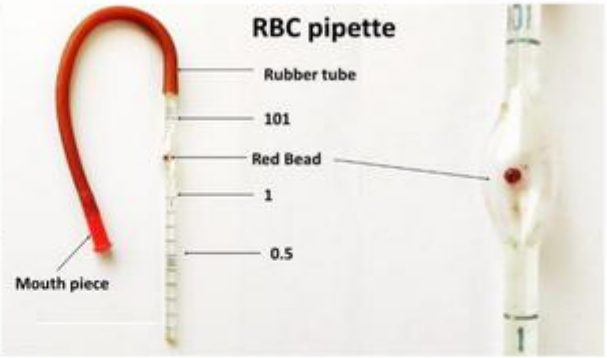
- Clean microscope, neubauer counting chamber and Thomas cover slip,
- Place the Thomas cover lip on Neubauer counting chamber and adjust the Neubauer counting chamber under high power objective lens i. e 45X.
- Make ready neat and cleaned RBC pipette to collect blood from the ring finger
- Sterilize the ring finger with 70% of alcohol and pricked boldly with the help of pricking needle.
- 1st drop discarded, then hold the RBC pipette slightly down position like tip of the Pipette touch the pricking site.
- Take the RBC pipette tube of the next end in the mouth and try to pull blood in capillary without AIR bubble till the making of 0.5.
- Then pill WBC dilution fluid upto the mark 101.
- Make a 1:200 Dilution.
- Give a node to the RC pipette tube and mix the fluid gently for 1-2 minutes.
- Open the node of RBC Pipette and place the tip of RBC pipette like that the fluid portion enter between the gap of Thomas cover slip and Neubauer counting chamber.
- Allowed the fluid to spread on the counting.

- Try to count RBC as shown in below figure.



OBESRVATION TABLE





CALCULATION:

- Total Number of red blood cells in 5 small square (N= R1+R2+R3+R4+R5) is 80 smallest square
- Length (L) of 1 small sq. RBC is 1/5 mm part of the RBC counting chamber.
- So length of 1 smallest sq. RBC is 1/5 X 1/4 = 1/20 mm part of the RBC counting chamber.
- Width (W) of 1 small sq. RBC is 1/5 mm part of the RBC counting chamber.

- So width of 1 smallest sq. RBC is 1/5 X 1/4 = 1/20 mm part of the RBC counting chamber.
- Area of 1 smallest square = Length X Width = 1/20 mm X 1/20 mm = 1/400 sq. mm
- Height (Thickness) of the RBC counting chamber is 1/10 mm.
- So, Volume of fluid in:

  1 smallest square = Length X Width X Height

  = 1/20 mm X 1/20 mm X 1/10 mm

  = 1/4000 cmm

  We need to count RBC in R1+R2+R3+R4+R5 box so it consist total 80 smallest square.

  Consider 80 Smallest square consist = N RBCs

  If we wright 80 X 1 Smallest square consist = N RBCs

  Therefore 1 smallest square contain = N/80 RBCs
- 1/4000 cmm contain = N/80 RBCs (Put value of 1 smallest square is 1/4000 cmm)
- 1 cmm contains (N/80) X 4000 RBCs
- 1 cmm contains (N/80) X 4000 X 200 RBCs (200 is dilution factor)

  =_____RBCs/cmm (N = R1+R2+R3+R4+R5)

RESULT: Total RBC count of my own blood is _____millions/cmms

CONCLUSION: Therefore, my blood RBC is in **normal / abnormal** range.

Calculate color index: Hb% / RBC % (Color index normal range is 0.85 - 1.15)

Increased RBC Count Is Seen In:

1. Primary Erythrocytosis.
2. Polycythemia.
3. Erythremia (Erythrocytosis).
4. Secondary Erythrocytosis.
5. Vigorous exercise.
6. Hemoconcentration.
7. High Altitude.
8. Chronic obstructive pulmonary disease (COPD).
9. Severe dehydration.
10. Thalassemia trait.
11. Hemoglobinopathies.
12. Congenital heart disease.
13. Extra-renal tumors.
14. Tobacco use.

Decreased RBC Count is Seen In:

- Anaemias.
- Drugs that cause aplastic anemia.
- G-6 PD deficiency.
- Immune mechanism.
- Malignancy like Hodgkin's disease, lymphomas.
- Acute and chronic hemorrhage.
- Autoimmune diseases like SLE and rheumatoid arthritis.
- A chronic infection like subacute endocarditis.
- Cirrhosis.
- Dietary deficiency of iron, and vit B12.
- Pregnancy.
- Marrow failure, e.g., Bone Marrow fibrosis, leukemia infiltration, chemotherapy, and antiepileptic drugs.
- Drugs leading to bone marrow failures like quinidine, chloramphenicol, and hydantoin.
- Hemolysis is seen in spherocytosis, G6PD deficiency, and splenomegaly.
- The genetic abnormality is seen in thalassemia and sickle cell anemia.
- Hemorrhage, e.g., in GI tract or trauma.
- Chronic illness due to infections or malignancies.
- Organ failure as seen in renal diseases.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 8 **DATE:**

AIM: TO ESTIMATE DIFFERENTIAL WBC (LEUKOCYTE) COUNT OF OWN BLOOD SAMPLE

REQUIRMENT:

Microscope, Thomas Coverslip, Microscope, Cotton swab, Pricking Needle/Lancet, 70 % Methylated Alcohol (Spirit), Giemza or Leishman stain.

THEORY:

White blood cells (leukocytes) have two types:

a. **Granulocytes (BEN):**
- 0.5-1.0% Basophils
- 2-4% Eosinophils
- 60-70% Neutrophils

b. **Agranulocytes (LM):**
- 20-25% Lymphocytes
- 3-8% Monocytes

Granular leukocyte:

- It develops from myeloblast.
- It contains protein which is known as major histocompatiblity (MHC) antigen.
- It contains the clear granules in cytoplasm that can be seen under light microscope.
- It s further divided in to three types:

a) Eosinophils:
- It is 10-14 µm in diameter.
- Its granules produce red or orange stain with acidic dyes.
- The nucleus of eosinophils has two lobes connected by thin or thick fiber.
- The granules are large and uniform in size that are present in group in cytoplasm but do not cover the nucleus.

b) Basophils:
- It is 8-10 µm in diameter.
- Its granules give Blue-purple stain with basic dyes.
- Its nucleus is in irregular shape often in form of letter S.
- The cytoplasmic granules are round and variable in size.

c) Neutrophils:
- It is 10-12 µm in diameter.
- Its granules known as neutral because it produces pale lilac stain with mixture of acidic and basic dye.
- Their nucleuses contain two to five lobes connected by very thin fibers of chromatin.
- Older neutrophils known as polymorphonuclear leukocytes (PMNs), polymorphs or polys because it has many different shaped nuclei.
- Younger neutrophils are known as bands because their nucleus is rod shaped.

2) Agranular leukocyte:

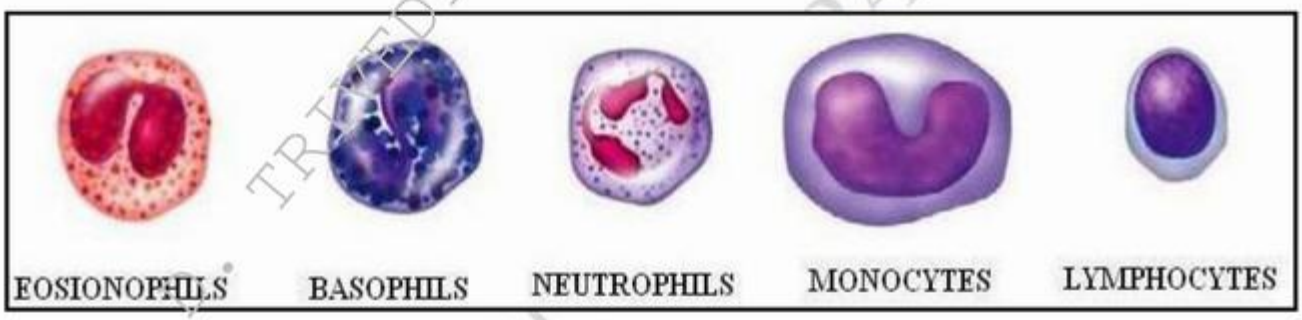
- It has the granules but do not seen under the light microscope because of their small size so it is known as agranular.
- It is further classified in to two types:

a) Lymphocytes:

- Small lymphocytes are 6-9 µm in diameter and large lymphocytes are 10-14 µm in diameter.
- It is devolve from lymphoblast.
- Their nucleus is in round shaped and produce dark stain.
- The cytoplasm produce border around the nucleus and it produce sky blue stain.

b) Monocytes:

- It is 12-20 µm in diameter.
- It is develop from monoblast.
- Their nucleus is in kidney shaped.
- Its cytoplasm has foamy appearance and produce blue grey stain.
- Monocytes migrate from blood to tissue where they enlarge their size and differentiated in to macrophages.
- Some are known as fixed macrophages because they are fixed on particular tissue such as alveolar macrophages, spleen macrophages etc.
- Other are known as free or wandering macrophages which travel tissue to tissue at inflammation or infection site for to repair it.



PROCEDURE:

- Place drop of blood on dried slide.
- Spreading it with another slide (blood film method).
- Add Giemza or Leishman stain or Field Stain or Wright Stain (Any One) on to the blood film.
- Allow to stain for 2-3 min.
- Wash gently in a stream of buffered water until it has acquired a pinkish tinge (up to 2 min).
- Observe the different types of WBC in Microscop first in 40X or 45X then by oil immersion lens – 100X) and record the number of all WBC types that observed.

N	L	M	L	E					

Symbols to be used:
'M' for Monocyte
'L' for Lymphocyte
'E' for Eosinophil
'B' for Basophil
'N' for Neutrophil
Fill these Symbols accordingly in the 100 squares on the left

-

OBESRVATION TABLE

Result:

Types of Cell	Total Number of Cell	Amount of Cell in %
Basophil		
Eosinophil		
Neutrophil		
Lymphocyte		
Monocyte		

CONCLUSION: My different types of WBCs are in **normal / abnormal** range.

DISCUSSION:

Type of white blood cell	Function
neutrophil	helps stop microorganisms in infections by eating them and destroying them with enzymes
lymphocyte	–uses antibodies to stop bacteria or viruses from entering the body (B-cell lymphocyte) –kills off the body's cells if they've been compromised by a virus or cancer cells (T-cell lymphocyte)
monocyte	becomes a macrophage in the body's tissues, eating microorganisms and getting rid of dead cells while increasing immune system strength
eosinophil	helps control inflammation, especially active during parasite infections and allergic reactions, stops substances or other foreign materials from harming the body
basophil	produces enzymes during asthma attacks and allergic reactions

INTERPRETATION:

An **increased percentage of neutrophils** in your blood can mean that you have:

- Neutrophilia, a white blood cell disorder that can be caused by an infection, steroids, smoking, or rigorous exercise
- an acute infection, especially a bacterial infection
- acute stress
- pregnancy
- inflammation, such as inflammatory bowel disease or rheumatoid arthritis
- tissue injury due to trauma
- chronic leukemia

A **decreased percentage of neutrophils** in your blood can indicate:

- neutropenia, a white blood cell disorder that can be caused by a lack of neutrophil production in the bone marrow
- aplastic anemia, a decrease in the number of blood cells produced by your bone marrow
- a severe or widespread bacterial or viral infection
- recent chemotherapy or radiation therapy treatments

An **increased percentage of lymphocytes** in your blood may be due to:

- lymphoma, a white blood cell cancer that starts in your lymph nodes
- a chronic bacterial infection
- hepatitis
- multiple myeloma, a cancer of the cells in your bone marrow
- a viral infection, such as mononucleosis, mumps, or measles
- lymphocytic leukemia

A **decreased percentage of lymphocytes** in your blood can be a result of:

- bone marrow damage due to chemotherapy or radiation treatments
- HIV, tuberculosis, or hepatitis infection
- leukemia
- a severe infection, such as sepsis
- an autoimmune disorder, such as lupus or rheumatoid arthritis

A **heightened percentage of monocytes** in your blood can be caused by:

- chronic inflammatory disease, such as inflammatory bowel disease
- a parasitic or viral infection
- a bacterial infection in your heart

- a collagen vascular disease, such as lupus, vasculitis, or rheumatoid arthritis
- certain types of leukemia

An **increased percentage of eosinophils** in your blood can indicate:

- eosinophilia, which can be caused by allergic disorders, parasites, tumors, or gastrointestinal (GI) disorders
- an allergic reaction
- skin inflammation, such as eczema or dermatitis
- a parasitic infection
- an inflammatory disorder, such as inflammatory bowel disease or celiac disease
- certain cancers

An **increased percentage of basophils** in your blood might be caused by:

- a serious food allergy
- inflammation
- leukemia

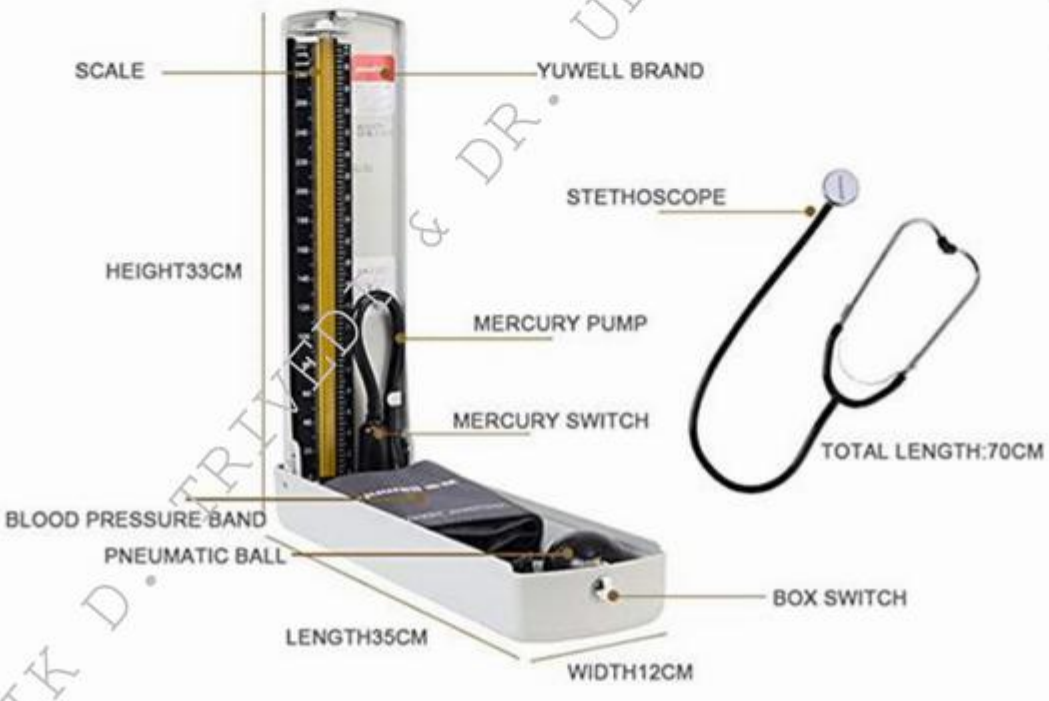
SIGNATURE OF TEACHER

EXPERIMENT NO.: 9 **DATE:**

AIM: TO RECORDING OF BLOOD PRESSURE IN VARIOUS POSTURES, DIFFERENT ARMS, BEFORE AND AFTER EXERTION AND INTERPRETING THE RESULTS

REQUIRMENTS

Sphygmomanometer and stethoscope.



THEORY

Blood Pressure (BP) is the force or pressure which the blood exerts on the wall of blood vessels. When the left ventricle contracts and pushes blood into the aorta the pressure produced within the arterial system is called systolic blood pressure and in the complete cardiac diastole stage, the heart is resting following the ejection of blood, the pressure within the arteries is called diastolic blood pressure. In adult normal systolic BP ranges about 110-130 mm Hg and the diastolic BP ranges about 70-85 mm Hg in adult.

Clinical significance:

Blood pressure, more than the normal range is called hypertension and blood pressure less than the normal is called hypotension.

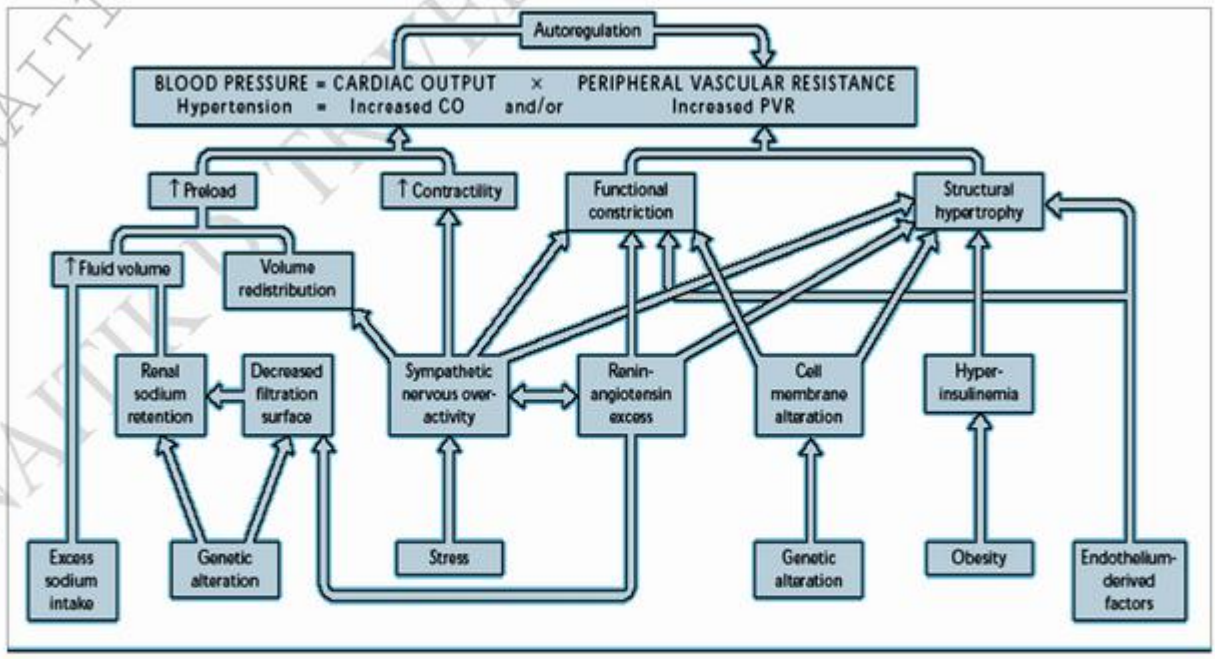
Classification of hypertension in adults

Category	Systolic BP	Diastolic BP
Optimal	<120	<80
Normal	120–129	80–84
High Normal	130–139	85–89
Hypertension grade I (Mild)	140–159	90–99
Hypertension grade II (Moderate)	160–179	100–109
Hypertension grade III (Severe)	≥180	≥110
Isolated systolic hypertension	≥140	<90

CAUSES OF HYPERTENSION:

1. Genetic variation (overexpressed or underexpressed genes)
2. Hypertensinogenics (high alcohol intake, high salt intake, obesity, insulin resistance)
3. aging and perhaps
4. sedentary lifestyle
5. Stress
6. low potassium intake
7. low calcium intake. explain
8. Coarctation of aorta explain
9. Diabetes mellitus
10. Hypercholestrolemia

PATHOGENESIS OF HYPERTENSION:



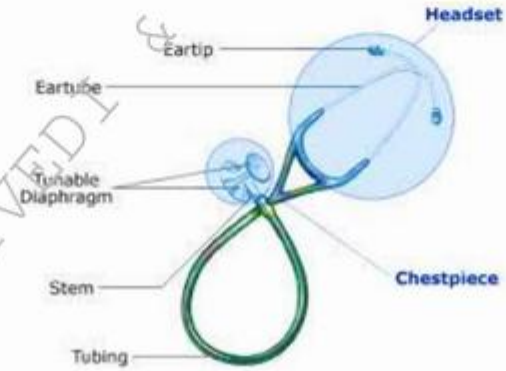
SPHYGMOMANOMETER

A **sphygmomanometer**, is a device used to measure blood pressure. It is consist an inflatable cuff to collapse and then release the artery under the cuff in a controlled manner, and a mercury or mechanical manometer to measure the pressure.

It is an instrument for measuring blood pressure, typically consisting of an inflatable rubber cuff which is applied to the arm and connected to a column of mercury next to a graduated scale, enabling the determination of systolic and diastolic blood pressure by increasing and gradually releasing the pressure in the cuff.

STETHOSCOPE

It amplify the sound and it is made up by 7 parts:



1. **Chestpiece**

   "Stethos" means "chest," so this is the logical place to start. The chestpiece is the part of the instrument that you hold against the body of the patient.

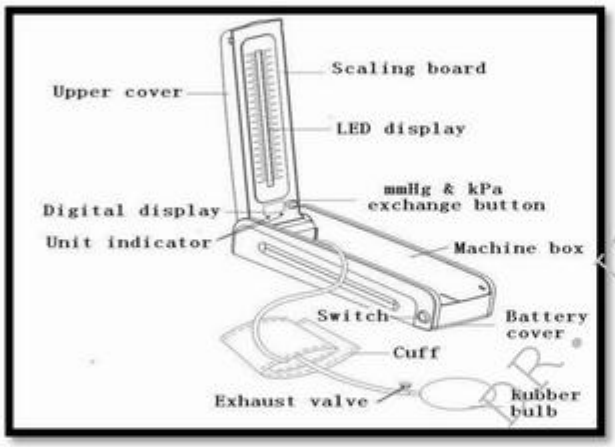
2. **Diaphragm**

   It may be single-sided or double-sided.

   - A two-sided chestpiece will typically have a diaphragm on one side and a deep cup-shaped side called the bell.
   - Both single-sided and double-sided pieces will usually have a flexible ring called a chill ring encircling them, which helps to make an airtight seal and buffer the patient against the coldness of the part.

3. **The stem** is what connects the chestpiece to the tubing.
4. **Acoustic tubes:** The acoustic tubes are the hollow rubber-like tubes that connect the chestpiece to the ear tubes.
5. **Headset:** This is typically the metal portion of the stethoscope.
6. **Ear tubes:** The ear tubes are hollow metal tubes that connect to the acoustic tubes on one end and the earpieces on the other.

7. **Earpieces:** Earpieces are the small tips on the ends of the ear tubes that fit into your ears. Some stethoscopes may have a choice of hard plastic or soft silicone earpieces.



A] Manual sphygmomanometer

B] Digital sphygmomanometer

C] Aneroid sphygmomanometer

PRINCIPLE OF SPHYGMOMANOMETER

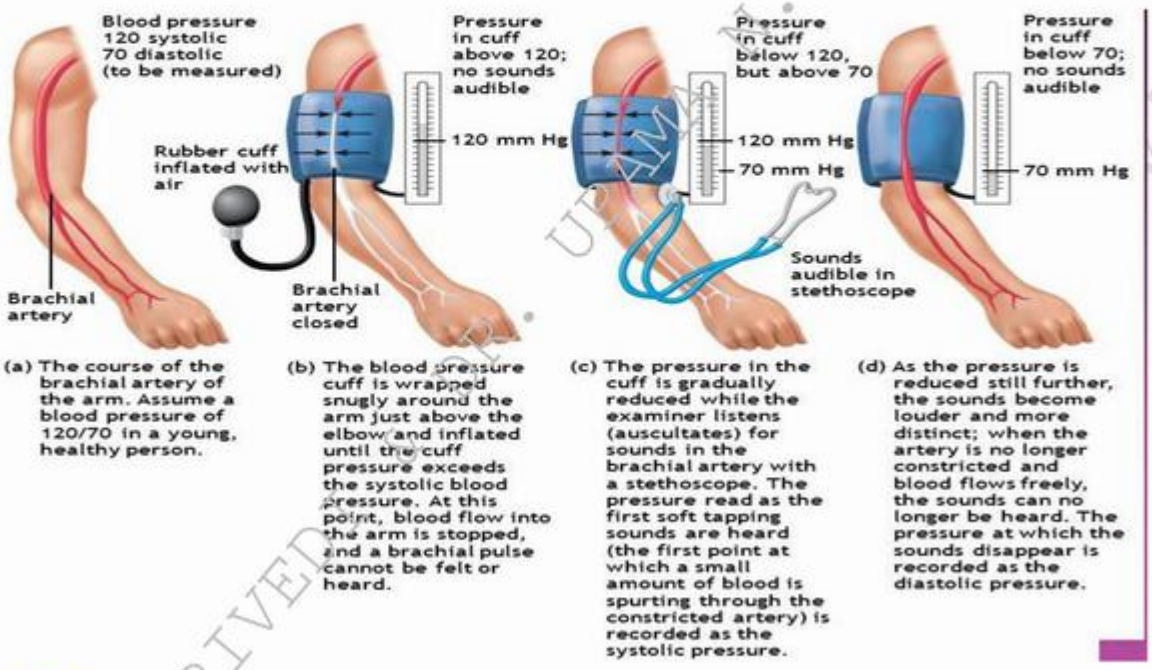
The flow through a large size artery is obstructed by means of air pressure exerted through a rubber bag wrapped around the limb.

The pressure is slowly released and the entry of the blood through the obstruction is studied by three methods:

1. Feeling of the pulse **(palpatory method)**
2. Observation of oscillations of the mercury level **(oscillatory methods)**
3. Hearing with the stethoscope the sound produced in the segment of the artery distal obstruction **(auscultatory method).**

The blood flow stops when pressure transmitted to the artery through the rubber bag is equal to or more the blood pressure. The first entry of blood through an obstruction indicates the blood pressure.

Usually arm or thigh is used because there is used because there is only one big blood vessel runs superficially in each of these parts.



PROCEDURE

Note: Follow the same procedure before and after exercise.

- Place the Sphygmomanometer on a desk
- Ask the subject to seat calm on a table or chair and place lower hand on the desk with closed fist and uppersame line with the heart.
- Cuff is wrapped around the upper arm just above the elbow.
- The chest piece of the stethoscope is placed upon the brachial artery.
- The other ends of the stethoscope are connected with two ears.
- The bag of the cuff is filled by the pump up to 240 mm Hg. pressure.
- The pressure inside the cuff is released slowly by losing the air with the air adjustment screw. As the pressure is released sudden appearance and disappearance of a sound is heard and recorded. Also observe the movement of mercury inside the tube of sphygmomanometer.
- Sudden onset of trapping sound is systolic blood pressure and the sudden disappearance of sound is diastolic pressure.

MTHODS OD RECORDING OF BLOOD PRESSURE

1. **Palpatory method**

   During the release of sphygmomanometer pressure fix eye at mercury level and finger at the pulse (At the start it is disappeared). When the pulses reappear gives the systolic

pressure. This is palpalatory method. This method does not give any idea about diastolic pressure. The systolic pressure measure by this method is about 5-10 mm lower than actual systolic pressure.

2. **Oscillatory methods**

When the pulse appears, it is also noted that mercury stars oscillating. The first oscillation gives systolic pressure read within 15 secs. On continuation of deflation the oscillation start increasing in magnitude and then slowly diminish. The level at which the oscillations are maximum is taken as the diastolic pressure which read within 30 secs. This is called oscillatory methods

3. **Auscultatory method**

After inflation of cuff, the chest piece of stethoscope placed over the brachial artery in the cubical fossa and deflation is started by slowly releasing the pressure. The level at which a sudden tap sound is heard is the systolic pressure. The sound suddenly gets muffled and disappears is the diastolic pressure. The sound heard are Korokorr's sound. These are due to interrupted flow of blood.

OBSERVATION TABLE AND RESULT:

1. **Blood Pressure by right arm**

Before Exercise		After Exercise	
Systolic BP mmHg	**Diastolic BP mmHg**	**Systolic BP mmHg**	**Diastolic BP mmHg**

2. **Blood Pressure by left arm**

Before Exercise		After Exercise	
Systolic BP mmHg	**Diastolic BP mmHg**	**Systolic BP mmHg**	**Diastolic BP mmHg**

PRECAUTIONS

The cuff should be wrapped tightly, the cuff bag should be air free, the apparatus should be kept at the level of heart, pumping and measuring should be done carefully.

CONCLUSION

- From the result my blood pressure is in normal/abnormal range.
- It Indicates person is normal/hypertensive/hypotensive.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 10 **DATE:**

AIM: RECORDING OF BODY TEMPERATURE (USING MERCURY, DIGITAL AND IR THERMOMETERS AT VARIOUS LOCATIONS), PULSE RATE/ HEART RATE (AT VARIOUS LOCATIONS IN THE BODY, BEFORE AND AFTER EXERTION), RESPIRATORY RATE

1. RECORDING OF BODY TEMPERATURE:

REQUIREMENT: Clinical Thermometer, Digital Thermometer, IR Thermometer

THEORY:-

What is body temperature?

- Body temperature is a measure of the body's ability to generate and get rid of heat.
- The body is very good at keeping its temperature within a narrow, safe range in spite of large variations in temperatures outside the body.
- When you are too hot, the blood vessels in your skin expand (dilate) to carry the excess heat to your skin's surface.
- You may begin to sweat, and as the sweat evaporates, it helps cool your body.
- When you are too cold, your blood vessels narrow (contract) so that blood flow to your skin is reduced to conserve body heat.
- You may start shivering, which is an involuntary, rapid contraction of the muscles.
- This extra muscle activity helps generate more heat.
- Under normal conditions, this keeps your body temperature within a narrow, safe range.

Where is body temperature measured?

- Your body temperature can be measured in many locations on your body.
- The mouth, ear, armpit, and rectum are the most commonly used places.
- Temperature can also be measured on your forehead.

METHOD (SITE)	NORMAL TEMPERATURE RANGE	METHOD (SITE)	NORMAL TEMPERATURE RANGE
ORAL (MOUTH)	36.4–37.2°C 97.6–99.6°F	RECTAL (RECTUM)	37.0–38.1°C 98.6–100.6°F
TYMPANIC (EAR)	35.9–37.6°C 96.6–99.7°F	TEMPORAL (FORHEAD)	35.8–36.9°C 96.5–99.6°F
AXILLARY (ARMPIT)	35.2–36.9°C 95.3–98.4°F		

What are Fahrenheit and Celsius?

Thermometers are calibrated in either degrees Fahrenheit (ºF) or degrees Celsius (ºC), depending on the custom of the region. Temperatures in the United States are often measured in degrees Fahrenheit, but the standard in most other countries is degrees Celsius.

If you'd like to convert a temperature reading in Fahrenheit to Celsius:

1. Start with the temperature in Fahrenheit (e.g., 100 degrees).
2. Subtract 32 from this figure (e.g., 100 - 32 = 68).
3. Divide your answer by 1.8 (e.g., 68 / 1.8 = 37.78)

What is a fever?

- In most adults, an oral temperature above 100ºF (37.8ºC) or a rectal or ear temperature above 101ºF (38.3ºC) is considered as a fever.

BODY TEMPERATURE CHART

Condition	Child		Adult	
Hypothermia	<35°C	<95°F	<35°C	<95°F
Normal	35.8°C - 37.5°C	96.4°F - 99.5°F	36.5°C - 37.5°C	97.7°F - 99.5°F
Low Fever (Hyperthermia)	>38.3°C	>100.4°F	>38.3°C	>100.9°F
High Fever (Hyperpyrexia)	>40°C	>104.0°F	>41.5°C	>106.7°F

SEVERAL DIFFERENT TYPES OF THERMOMETERS ARE AVAILABLE:

Thermometer Figure	Types and Description
	**Electronic thermometers** are plastic and shaped like a pencil, with a display window at one end and the temperature probe at the other end. They work by measuring how well electricity travels through a wire. Electronic thermometers are used in the mouth, rectum, or armpit. They are easy to use and easy to read. If you buy an electronic thermometer, check the package for information about its accuracy.
	**Ear thermometers** are plastic and come in different shapes. They use infrared energy to measure body temperature. The small cone-shaped end of the thermometer is placed in the ear, and body temperature shown on a digital display. The results appear within seconds. Some models also show the corresponding oral and rectal readings. See a picture of an ear thermometer.

	**Disposable thermometers** are thin flat pieces of plastic with colored dots and temperature markings on one end. The color of the dots shows the temperature. Disposable thermometers can be used in the mouth or rectum. A patch form can be used on a baby's skin to measure temperature continuously for 48 hours. These thermometers are safe, but they are not as accurate as electronic or ear thermometers. They do not contain glass, latex, or mercury. You can reuse the thermometer during an illness and then throw it away.
	**Forehead (temporal) thermometers** use skin temperature to determine body temperature. Some have a soft disc that are pressed against the forehead and show the temperature on a digital display. Other types are thin pieces of plastic with numbers on them. You press the strip against a person's forehead, and the temperature makes some numbers change colors or light up. These thermometers are not as accurate as electronic and ear thermometers.
	**Pacifier thermometers** are shaped like a baby's pacifier but have a display that shows the temperature. You place the pacifier in your child's mouth to measure temperature. These thermometers may take longer to get a reading and are not as accurate as other types.

How to take an oral temperature

Oral is the most common method of taking a temperature.

1. Place the digital or disposable thermometer under the tongue, just to one side of the center, and close the lips tightly around it.
2. Leave the thermometer in place for the required amount of time. Time yourself with a clock or watch. Some digital thermometers give a series of short beeps when the reading is done.
3. Remove the thermometer and read it.
4. Clean a digital thermometer with cool, soapy water and rinse it off before putting it away.

How to take an armpit (axillaries) temperature

Taking a temperature in the armpit may not be as accurate as taking an oral or rectal temperature.

1. Place the thermometer under the arm with the bulb in the center of the armpit.
2. Press the arm against the body and leave the thermometer in place for the required amount of time. Time yourself with a watch or clock.
3. Remove the thermometer and read it. An armpit temperature reading may be as much as 1ºF (0.6ºC) lower than an oral temperature reading.
4. Clean a digital thermometer with cool, soapy water and rinse it off before putting it away.

Body temperature	
Normal:	The average normal temperature is 98.6ºF (37ºC). But "normal" varies from person to person. Your temperature will also vary throughout the day, usually being lowest in the early morning and rising as much as 1ºF (0.6ºC) in the early evening. Your temperature may also rise by 1ºF (0.6ºC) or more if you exercise on a hot day. A woman's body temperature typically varies by 1ºF (0.6ºC) or more through her menstrual cycle, peaking around the time of ovulation.
Abnormal:	**Oral, ear (tympanic), or rectal temperature** • Fever: 100.4ºF (38ºC) to 103.9ºF (39.9ºC) • High fever: 104ºF (40ºC) and higher
	Armpit (axillary) temperature • Fever: 99.4ºF (37.4ºC) to 102.9ºF (39.4ºC) • High fever: 103ºF (39.5ºC) and higher
	A rectal or ear temperature of less than 97ºF (36.1ºC) means a low body temperature (hypothermia).

RESULT:

My Body temperature is …….

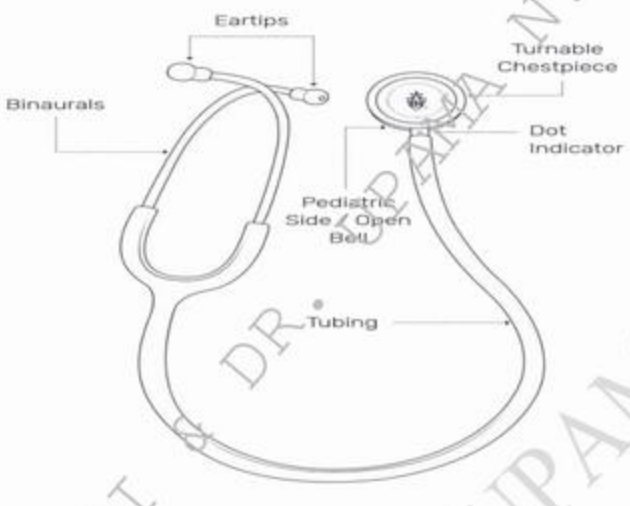
Conclusion

My body temperature is in normal / abnormal range.

2. DETERMINATION OF HEART RATE AND PULSE RATE

REQUIRMENTS

Stethoscope



THEORY

Heart rate and pulse rate are different because a heart rate measures the heartbeats of the heart, whereas a pulse rate measures the rate of blood pressure. A heartbeat pushes the blood through the body.

A normal resting heart rate for adults ranges from 60 to 100 beats per minute.

There are different techniques to measure the pulse rate and heart rate.

There are a few places on your body where it's easier to take your pulse:

- The insides of your wrists
- The insides of your elbows
- The sides of your neck
- The tops of your feet

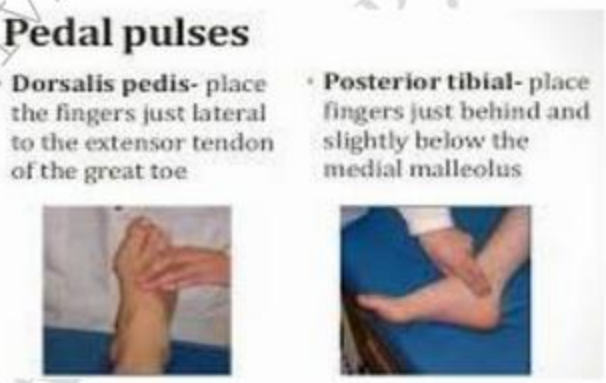
Put the tips of your index and middle fingers on your skin. Press lightly until you feel the blood pulsing beneath your fingers. You may need to move your fingers around until you feel it.

Count the beats you feel for 15 seconds. Multiply this number by four to get your pulse per minute

PROCEDURE:

For Pulse rate:

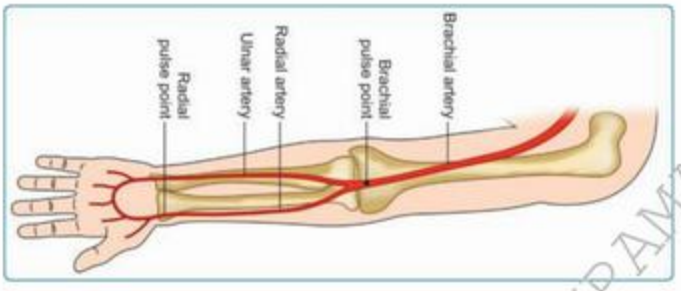
1. **Radial Pulse Method:**
   - It check your pulse through wrist.
   - At your wrist, place two fingers between the bone and the tendon over your radial artery — which is located on the thumb side of your wrist.
2. **Carotid Pulse Method:**
   - It check pulse rate through windpipe.
   - Place your index and third fingers on your neck to the side of your windpipe.
3. Pedal pulse Method



You can also find your pulse on the top of your foot. This is called the pedal pulse.

- Place your index and middle fingers above the highest point of the bone that runs along the top of your foot. You may have to move your fingers along the bone or slightly to either side to feel the pulse.
- Once you have found your pulse, count the beats for 15 seconds.
- Multiply by 4 to obtain your heart rate.

4. **Brachial pulse Method**



Another location for checking your pulse is the brachial artery. This method is used most commonly in young children.

- Turn your arm so it's slightly bent and your inner arm is facing up toward the ceiling.
- Place your index and middle fingers along the side of your arm between the crook of your elbow on the top and the pointy part of your elbow bone on the bottom. Then move your fingers an inch up your arm. You may have to press quite firmly to feel your pulse.
- Once you can feel the pulse, count how many beats occur in 15 seconds.
- Multiply this number by 4 to obtain your heart rate.

For Heart Rate:

- A stethoscope is a medical instrument which is useful to hear sounds made by the heart, lungs, and intestines. Using a stethoscope to hear sounds is called auscultation
- Procedure:
- Get a high-quality stethoscope.
- Adjust your stethoscope's earpieces.
- On the chest piece of stethoscope before use.
- Hold the diaphragm over the subject's heart. Position the diaphragm on the left upper part of the chest where the 4th to 6th ribs meet, almost directly under the breast. Hold the stethoscope between your pointer and middle fingers and apply enough gentle pressure so that you don't hear your fingers rubbing together.
- Listen to the heart for a full minute. Ask the subject to relax and breathe normally. You should hear the normal sounds of the human heart, which sound like "lub-dub." These

sounds are also called systolic and diastolic. Systolic is the "lub" sound and diastolic is the "dub" sound.

- The "lub," or systolic, sound happens when the mitral and tricuspid valves of the heart close.
- The "dub," or diastolic, sound happens when the aortic and pulmonic valves close.

- Count the number of heartbeats you hear in a minute. The normal resting heart rate for adults and children over 10 years old is between 60-100 beats per minute. For well-trained athletes, the normal resting heart rate may only be between 40-60 beats per minute.
- Listen for abnormal heart sounds. As you count the heartbeats, you should also listen for any abnormal sounds. Anything that does not sound like lub-dub may be considered abnormal. If you hear anything abnormal, your subject may need further evaluation by a doctor.

RESULT:

1. My Pulse Rate is _____ Pulse/Min before exercise
2. My Pulse Rate is _____ Pulse/Min after exercise
3. My Heart Rate is _____ beats/min before exercise
4. My Heart Rate is _____ beats/min after exercise

DISCUSSION:

To measure your heart rate, simply check your pulse. When you feel your pulse, count the number of beats in 15 seconds. Multiply this number by four to calculate your beats per minute.

Normal heart rates and pulse rate at rest:

Age	Pulse rate (beats per minute)
Newborn (resting)	100-180
Infant (resting)	80-150
Child up to 6 years	75-120
Child 6-12 years	70-110
Adolescent-adult	60-90

Above 100 beats a minute indicate as tachycardia and resting heart rate is below 60 beats a minute indicate bradycardia.

3. DETERMINATION OF RESPIRATORY RATE

REQUIRMENTS: Stop watch

Theory:

Respiratory rate is also known as breathing rate. This is the number of breaths person take per minute. Person can measure their breathing rate by counting the number of breaths they take over the course of one minute while they are at rest.

We are doing 12 breaths (Inspiration and Expiration) in each minute so the minute ventilation (MV) is the the total volume of air inhaled and exhaled in each minute.

Minute Ventilation (MV) = Tidal volume (VT) x 12
= 500 mL/ breath x 12 breaths/min = 6 litres/min

Principle:

Healthy adult doing 12 breaths in each minute and with each inhalation and exhalation moving about 500 mL of air into and out of the lungs. The volume of one breath is called the tidal volume (VT).

Procedure:

- Sit down and try to relax.
- It's best to take your respiratory rate while sitting up in a chair or in bed.
- Measure your breathing rate by counting the number of times your chest or abdomen rises over the course of one minute.
- Record this number.

Result:

I have taken _____ respiration per minute.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 11 **DATE:**

AIM: RECORDING PULSE OXYGEN (BEFORE AND AFTER EXERTION)

REQUIREMENT: Clinical Thermometer, Digital Thermometer, IR Thermometer

PRINCIPLE:

Peripheral capillary oxygen saturation (SpO2) is commonly measured by pulse oximetry, which provides an indirect measurement of arterial oxygenation (SaO2) based on the differential absorption of light by oxygenated and deoxygenated blood during pulsatile blood flow

THEORY:

Pulse Oximetry is the process to measure the oxygen saturation by pulse oximetry which is handheld clip device. Person can easily use this device at rest, and can also be used during exercise.

Figure: Pulse Oximeter

PROCEDURE:

- Remove any nail polish/false nails & warm your hand if cold.
- Rest for at least 5 minutes before taking your measurement.
- Rest your hand on your chest at heart level & hold it still.
- Switch on the oximeter & place it on your middle or index finger.
- The reading takes time to steady, Keep the oximeter in place for at least a minute or longer if the reading is not stable.
- Record the highest result once it has not changed for 5 seconds.

- Identify each reading carefully and note it as a before exercise reading.
- Repeat above procedure after doing the 10 to 15 minutes of normal exercise and again note the reading which is the after exercise reading.
- Now compare both the reading.

Result:

1. My before exercise pulse oxygen is _____
2. My after exercise pulse oxygen is _____

Interpretation:

- Normal oxygen saturation (SpO2) levels for healthy individuals should be between 95% - 100%.
- SpO2 values below 95% (90.1%-94.9%) are considered to be abnormal, and caution should be taken at these values.
- Patients with an SpO2 reading of less than 90% are said to be hypoxemic.
- Patients with an SpO2 reading of less than 85%would be severely hypoxemic. These patients would most likely need an external oxygen supply.
- Note that oxygen saturation levels can be slightly lower for individuals at higher altitudes.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 12 **DATE:**

AIM: TO RECORDING FORCE OF AIR EXPELLED USING PEAK FLOW METER

REQUIRMENT: Peak flow meter, graph paper

THEORY:

Peak flow is a simple measurement of how quickly you can blow air out of your lungs. It's often used to help diagnose and monitor asthma. A peak flow test involves blowing as hard as you can into a small handheld device called a peak flow meter.

Principle Peak flow meter

- ✓ The peak expiratory flow (PEF), also called peak expiratory flow rate (PEFR), is a person's maximum speed of expiration, as measured with a peak flow meter, a small, hand-held device used to monitor a person's ability to breathe out air.
- ✓ It measures the airflow through the bronchi and thus the degree of obstruction in the airways.
- ✓ Peak expiratory flow is typically measured in units of liters per minute (L/min).

Peak Flow Meter

Procedure:

- Move the marker to the bottom of the numbered scale.
- Stand up straight.
- Take a deep breath. Fill your lungs all the way.
- Hold your breath while you place the mouthpiece in your mouth, between your teeth. Close your lips around it. Do not put your tongue against or inside the hole.
- Blow out as hard and fast as you can in a single blow. Your first burst of air is the most important. So blowing for a longer time will not affect your result.
- Write down the number you get.
- Move the marker back to the bottom and repeat all these steps 2 more times.
- The highest of the 3 numbers is your peak flow number.
- Write it down in your log chart.

Observation table:

Trial	Peak Expiratory Flow Rate (L/Min)
1	
2	
3	

Result:

My peak expiratory flow rate is _____ L/Min.

Interpretation of result:

An important part of peak flow measurement is noting peak flow zones. Peak flow zones are areas of measurement on a peak flow meter. The goal of the peak flow zones is to show early symptoms of uncontrolled asthma. Peak flow zones are set differently for each person. Your healthcare provider will help determine your peak flow zones. The 3 peak flow zones are noted by color and include:

- **Green**: This means "go." The green zone is 80% to 100% of your highest peak flow reading, or personal best. This is the zone you should be in every day. When your

measurements are in this zone, air is moving well through the large airways in your lungs. It means that you can do your usual activities and go to sleep without trouble.

- **Yellow:** This means "caution" or "slow down." The yellow zone is 50% to 80% of your personal best. Measurements in this zone are a sign that your large airways are starting to narrow. You may start to have mild symptoms, such as coughing, feeling tired, feeling short of breath, or feeling like your chest is tightening. These symptoms may keep you from your usual activities or from sleeping well.
- **Red:** This means "stop." The red zone is less than 50% of your personal best. Readings in this zone mean you have severe narrowing of your large airways. This is a medical emergency. You should get help right away. You may be coughing, very short of breath, wheezing while breathing in and out, or having retractions (the muscles between the ribs are working hard to help you breathe). You may also have trouble walking and talking.

SIGNATURE OF TEACHER

EXPERIMENT NO.: 13 **DATE:**

AIM: MEASUREMENT OF HEIGHT, WEIGHT AND BMI

REQUIRMENT: Weighing machine, height measurement chart or tape, Volunteers.

PRINCIPLE:

Basal or Body Mass Index (BMI) is an internationally accepted measure of the weight status of an individual. It is based on the differences in weights according to heights. BMI is calculated by dividing a person's weight in kilograms (kg) by the square of their height in meters (m) i.e. body weight (kg)/height $(m)^2$. World Health Organisation (WHO) has classified categories as underweight, normal, overweight, or obese based on BMI values.

THEORY:-

- Body Mass Index: a measure of body fat that is the ratio of the weight of the body in kilograms to the square of its height in meters.
- BMI is recommended as a practical approach for assessing body fat in the clinical setting.
- It provides a more accurate measure of total body fat compared with the assessment of body weight alone.
- Measurement of BMI is used as one of the diagnostic tests for overweight and obesity.

INTRODUCTION:

Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters. BMI is an inexpensive and easy screening method for weight category—underweight, healthy weight, overweight, and obesity.

Category	BMI range*	Risk of developing health problems
Underweight	<18.5	Increased
Normal weight	18.5–24.9	Least
Overweight	25.0–29.9	Increased
Obese class I	30.0–34.9	High
Obese class II	35.0–39.9	Very high
Obese class III	≥40.0	Extremely high

*BMI is calculated as follows: metric: BMI = weight (kg)/height $(m)^2$;

PROCEDURE:

Measure Weight in Kg or Pound:

1. First set the weigh machine on scale zero.
2. Ask the subject to remove apron, shoe and any heavy items from their pockets like key's, wallets etc.
3. Ask subject to stand on weigh machine straight position
4. Wait for the needle/digital screen to settle before recording the measurement.
5. Note down the weight in pound or kilogram

Measure Height in meter or inches:

1. Remove your shoes or Cap, Hat etc..
2. Hang the BMI scale tape (Ruler)and adjust or Set the BMI Scale tap at 0 point.
3. Stand below the BMI Scale tape with your feet flat on the floor with your heels against the corner where the wall and floor meet.
4. Make sure your head, shoulders, and buttocks are touching the wall.
5. Stand up straight with your eyes looking straight ahead.
6. Your line of sight and chin should be parallel to the floor.
7. Now lower the BMI Scale till touch to your head.
8. Note down the height in meter or inches.

Observation Table:

Weight in Kg/Pound	Height in Meter/Inches

Calculation:

$$BMI = \frac{weight\ (kg)}{height^2\ (m^2)} \quad \text{or} \quad BMI = \frac{weight\ (lb) * 703}{height^2\ (in^2)}$$

Result:

My own Body mass index (BMI) is _____

Conclusion:

My Body mass index (BMI) is in the range of _____.

It indicate I am in the category of _____

SIGNATURE OF TEACHER

EXPERIMENT NO.: 14. a **DATE:**

AIM: STUDY OF CARDIOVASCULAR SYSTEM WITH THE HELP OF CHART AND MODELS.

REQUIREMENTS: Models, charts and specimens of cardiovascular system

THEORY:

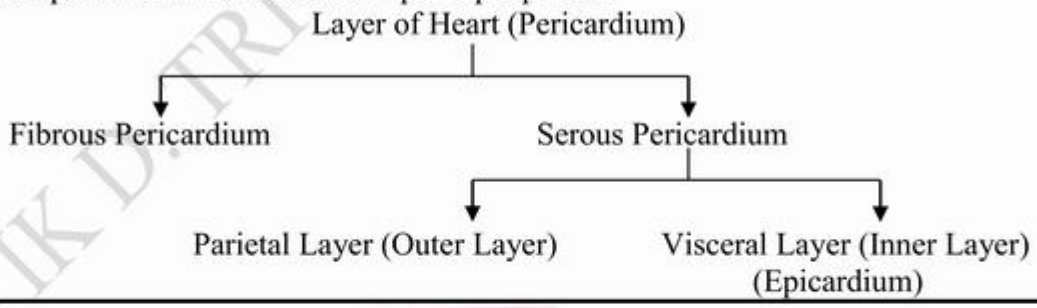
Cardiovascular is the system which includes the study of the heart, blood vessels and blood. These system is some time known as circularly system because it circulate or transport the nutrients, oxygen, carbon dioxide and essential molecules from environment to cells and cells to environment. It is involuntary in nature and gives continuous work. The heart propelling or impelling blood around 100,000 km of blood vessels and it pumps 14000 liters blood in day and 10 million liters in year.

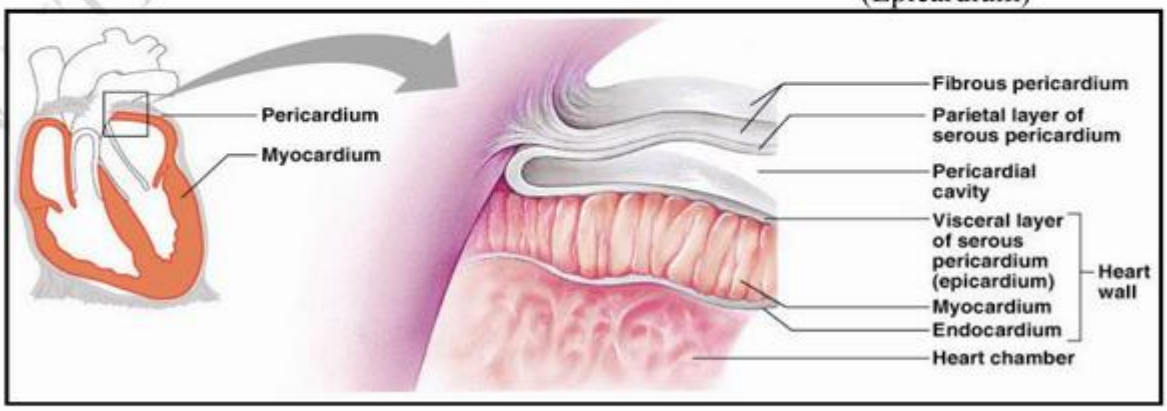
LOCATION OF HEART:

- Cone shaped heart is relatively small, about the same size of closed fist of person.
- It is 12 cm (5 in.) long, 9 cm (3.5 in.) wide and 6 cm (2.5 in.) thick.
- In an adult, average weight of heart is 300gm.
- The heart consist four chambers:
  - **a)** Two atria or atrium
  - **b)** Two ventricles
- It is located near to the middle of thoracic cavity in the mediastinum (the space between the lungs) and it rest on to the diaphragm.
- About two third of the mass of the heart lies to the left of the body's midline.
- Pointed end portion which is formed by the tip of left ventricle is known as apex and opposite to apex the wide superior and posterior margin is known as base.

LAYER OF THE HEART:

- Heart layer is formed by pericardium ("around the heart") which is triple-layered fluid-filled sac that surrounds and protects the heart.
- The pericardium consist of two principle portion





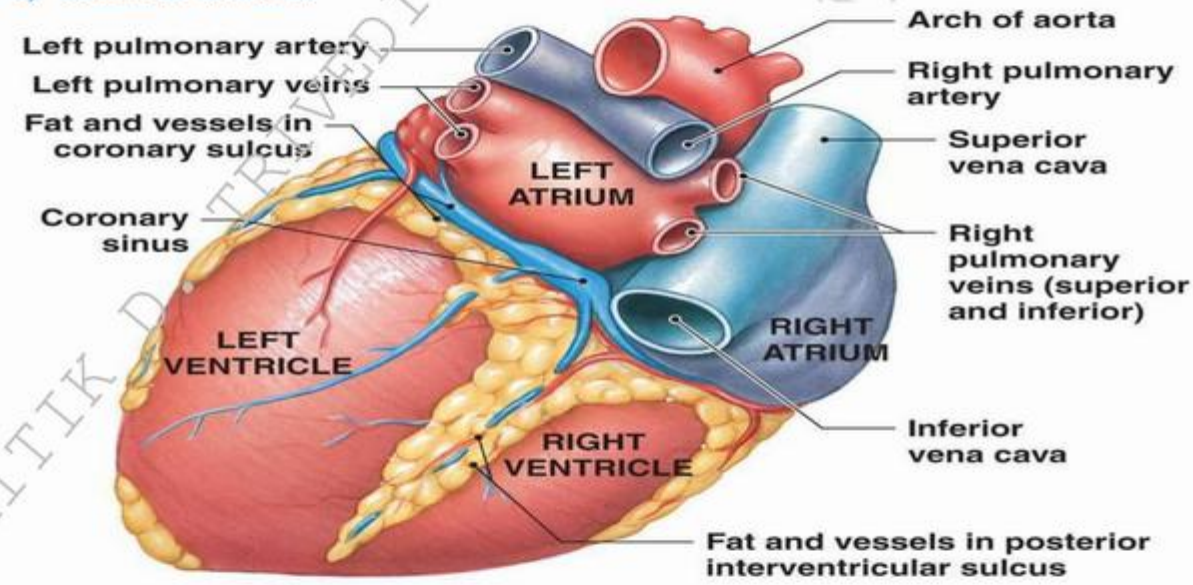
WALL OF THE HEART:

- The wall of the heart is formed by three layers:
  - **a) Epicardium (External layer):**
    - It is also known as the visceral layer of the serous pericardium.
    - It is composed of mesothelium and delicated connective tissue.
    - It is the outer or external wall of the heart.
  - **b) Myocardium (Middle layer):**
    - Myo means muscles so it is made up by cardiac muscles tissue.
    - It provides the bulkiness to the heart and it is responsible for the pumping action of heart.
  - **c) Endocardium (Inner layer):**
    - The endocardium is an innermost, thin, smooth layer of epithelial tissue that lines the inner surface of the heart chambers and valves.

INTERIOR OF THE HEART:

- The heart is divided in to right and left side by partition known as the septum which is made up by myocardium covered by epithelium

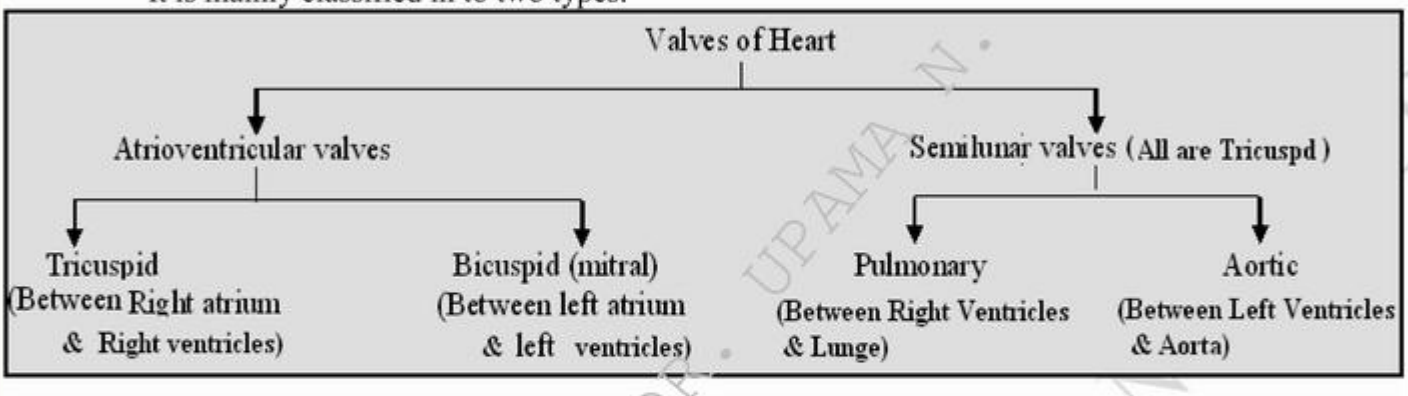
a) Chamber of heart:



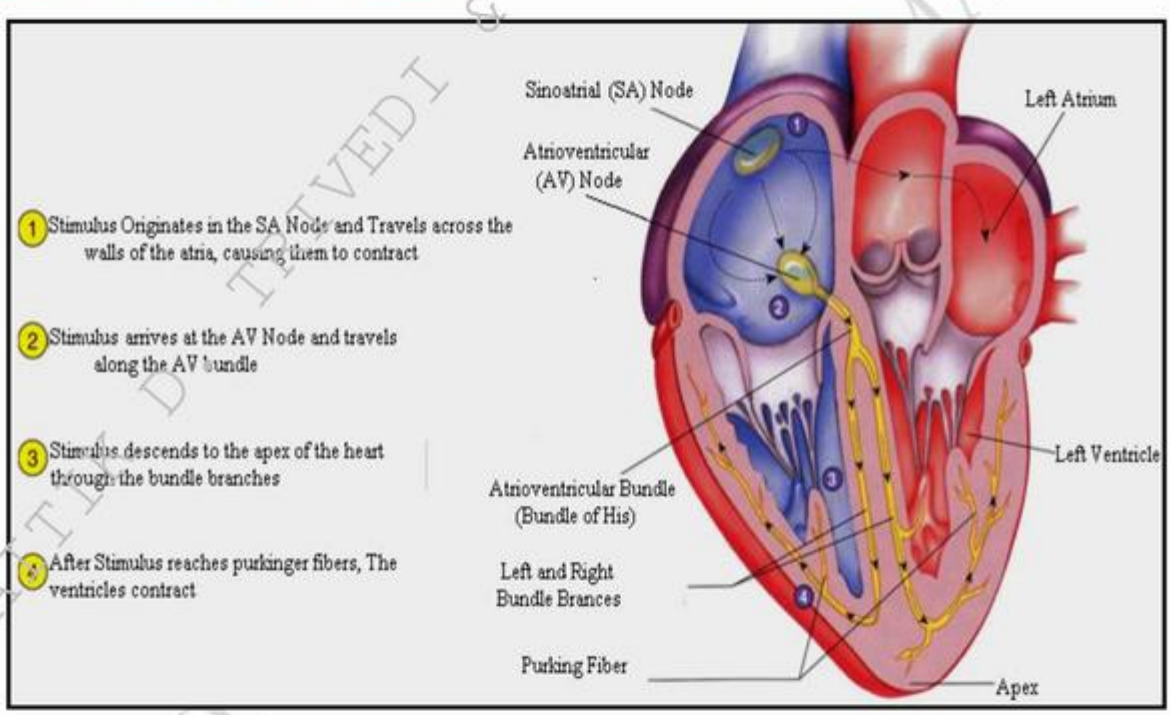
- Heart consists of four chambers;
  - **i) Two atria:**
    - The two superior chambers are known as right atrium and left atrium.
    - The posterior wall of the atrium is smooth surface while the anterior wall of the atrium is rough surface.
    - On the surface of the atrium is wrinkle pouch like structure is known as auricle because it resemble like dog ear.
  - **ii) Two ventricles**
    - The two inferior are known as right ventricle and left ventricles.
- On the surface of heart grooves like structures known as coronary sulcus which separate the atria to ventricle.
- The thickness of the wall of the four chambers varies according to their function.
- **Example:** The wall of the atria is thin and it pumps blood in to ventricles & the ventricle wall is thick in which right ventricle pumps blood in to lungs and left ventricle pumps blood in to aorta so the work load on left ventricle is high because of that the wall of left ventricle is two to four times thicker than right ventricle.

b) Valve of the heart:

It is mainly classified in to two types:



HEART CONDUCTION SYSTEM:



SA-node➔ AV-node➔ AV bundle➔ Right & Left Bundle braches➔ Purkinje fibers

CARDIAC CYCLES:

"A cardiac cycle include all the events associated within one heart beat"

- The normal heart beats in healthy adult is 75 beats/min and cardiac cycle last for 0.8 sec.
- Cardiac cycle is described by the following phase:
  1. Atrial systole
  2. Ventricular systole:
  3. Ventricular Diastole or Relaxation period:

Time	*Atria*	*Ventricles*	*Atrioventricular Valves (tricuspid, bicuspid)*	*Semilunar Valves (pulmonary, aortic)*
0.15 sec	Systole	Diastole	open	closed
0.30 sec	Diastole	Systole	closed	open
0.40 sec	Diastole	Diastole	open	closed

CARDIAC OUTPUT:

- Cardiac output is the amount of blood ejected from the left ventricle (or the right ventricle) in to the aorta (or pulmonary trunk) each minute and it is equal to the product of stroke volume and heart rate.

Thus,

Cardiac Output = Stroke volume (ml/beat) * Heart rate (beats/min)
= 70 ml/beat * 75 beats/min
= 5250 ml/min or 5.25 liters/min.

Note: Stroke volume = EDV – ESV = 130 ml/beat – 60 ml/beat = 70 ml/beat

SIGNATURE OF TEACHER

PRACTICAL NO.: 14. b **DATE:**

AIM: STUDY OF RESPIRATORY SYSTEM WITH THE HELP OF CHART AND MODELS.

REQUIREMENT: Models, charts and specimens of respiratory system

THEORY

Respiration:

Respiration means exchange of gases—oxygen and carbon dioxide—between the atmospheric air, blood, and tissue cells. Inhalation and exaltation, inspiration and expiration, breathing in and breathing out known as respiration.

The respiratory system consists of the nose, pharynx (throat), larynx (voice box), trachea, windpipe), bronchi, and lungs.

Its parts can be classified according to either structure or function.

Structurally, the respiratory system consists of two parts:

1. **The upper respiratory system:** It includes the nose, pharynx, and associated structures.
2. **The lower respiratory system:** It includes the larynx, trachea, bronchi, and lungs.

Types of respiration:

There are 3 types of respiration:

1. **Pulmonary Ventilation:** Exchange of Oxygen and Carbon Dioxide between air and lungs known as pulmonary ventilation.
2. **External respiration:** Exchange of Oxygen and Carbon Dioxide between lungs and blood known as external respiration.
3. **Internal Respiration:** Exchange of Oxygen and Carbon Dioxide between blood and cell known as internal respiration.

1. NOSE:

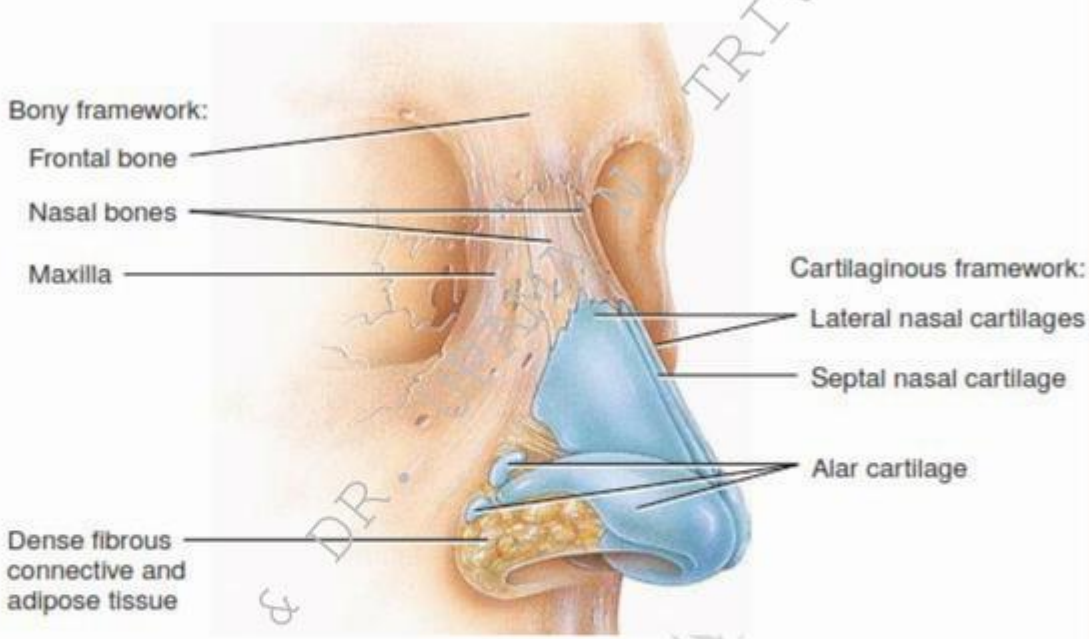
Nose is made up by two kind of frame work:

i. Bony frame work:

It is made up by Frontal bone, Nasal Bone and Maxilla

ii. Cartilage Frame Work:

It is made up by Lateral Nasal Cartilage, Septal Nasal Cartilage and Alar Cartilage

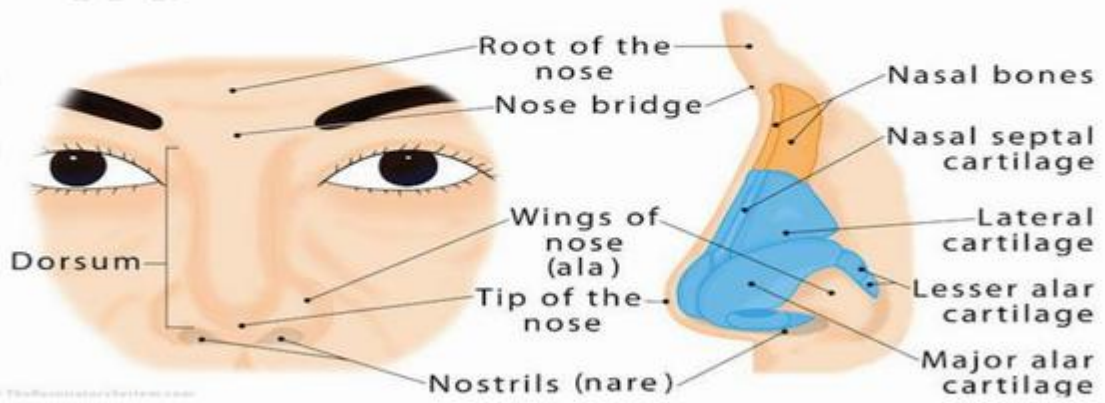


The nose can be divided into external and internal portions.

The external nose:

- It is the portion of the nose visible on the face and consists of a supporting framework of bone and hyaline cartilage covered with muscle and skin and lined by a mucous membrane.
- The external nose is somewhat flexible because it consist hyaline cartilage.
- External nose consist two opening which is known as external nares or nostrils divided by vertical septum.
- External nose also consist of hair inside the nostril.
- The external nose have three functions:
  i. Warming, moistening, and filtering incoming air;
  ii. Detecting olfactory stimuli or identify the smell
  iii. Modifying speech

The internal nose:



- Anteriorly, the internal nose merges with the external nose, and posteriorly it communicates with the pharynx through two openings called the internal nares or choanae.
- The space within the internal nose is called the nasal cavity.
- The anterior portion of the nasal cavity just inside the nostrils, called the nasal vestibule, is surrounded by cartilage.
- The superior part of the nasal cavity is surrounded by bone.
- A vertical partition, the nasal septum, divides the nasal cavity into right and left sides.
- Superior attachment of the nose to the frontal bone is known as Root.
- Tip of nose known as Apex.

2. PHARYNX (THROAT)

- It is a funnel-shaped tube about 13 cm (5 in.) long
- It starts from the internal nares and extends to the level of the cricoid cartilage, the most inferior cartilage of the larynx (voice box)
- Its wall is composed of skeletal muscles and is lined with a mucous membrane.
- Contraction of the skeletal muscles assists in deglutition (swallowing).
- The pharynx functions as a passageway for air and food.
- It provides a resonating chamber for speech sounds, and houses the tonsils, which participate in immunological reactions against foreign invaders.
- The pharynx can be divided into three anatomical regions:

i. Nasopharynx:

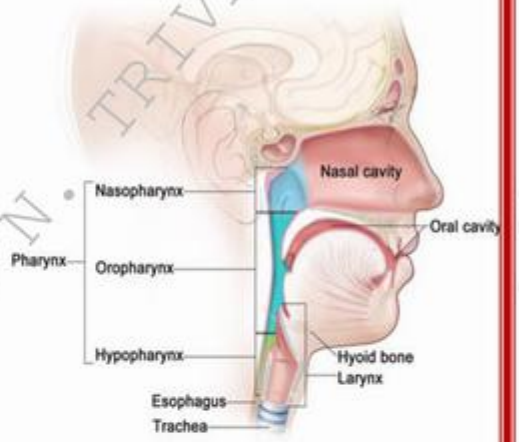
- It is the superior portion of the pharynx.
- It lies posterior to the nasal cavity and extends to the soft palate.
- There are five openings in its wall: two internal nares, two openings that lead into the auditory tubes (commonly known as the Eustachian tubes), and the opening into the oropharynx.

ii. Oropharynx:

- It extend behind mouth from soft palate to level of hyoid bone.
- This portion of the pharynx has both respiratory and digestive functions, serving as a common passageway for air, food, and drink. Because the oropharynx is subject to abrasion by food particles, it is lined with nonkeratinized stratified squamous epithelium.
- Oropharynx consist, the palatine and lingual tonsils.

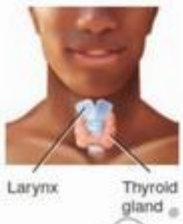
iii. **Laryngopharynx:**

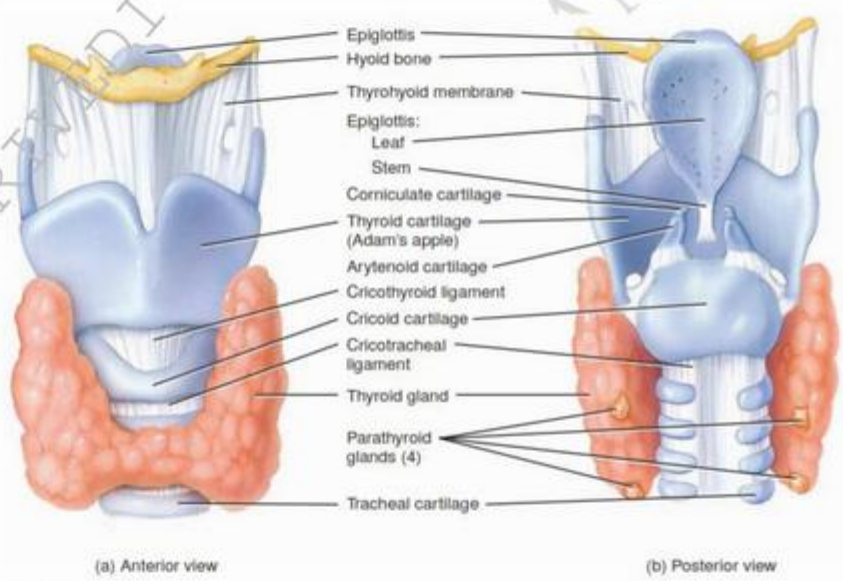
Its end portion open in to the esophagus (food tube) and the larynx (voice box).



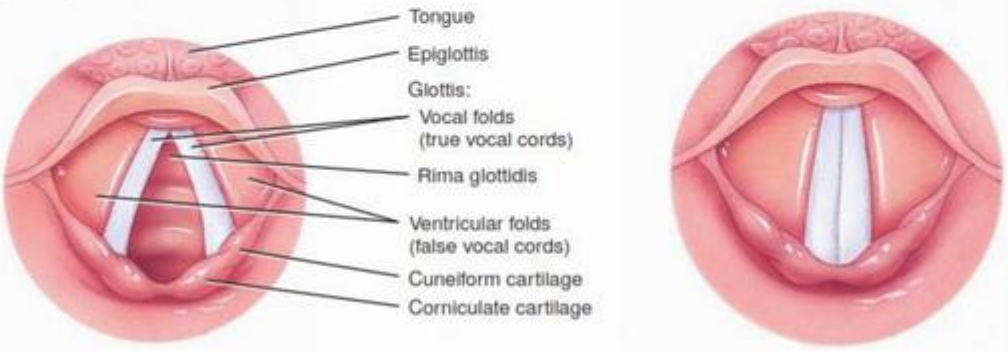
3. LARYNX (VOICE BOX)

- The larynx is known as voice box.
- It connects the laryngopharynx with the trachea.
- The wall of the larynx is composed of nine pieces of cartilage:
  - Three occur singly (thyroid cartilage, epiglottis, and cricoid cartilage), and
  - Three occur in pairs (arytenoid, cuneiform, and corniculate cartilages).
- During swallowing, larynx move down the the epiglottis so food not enter into the wind pipes.

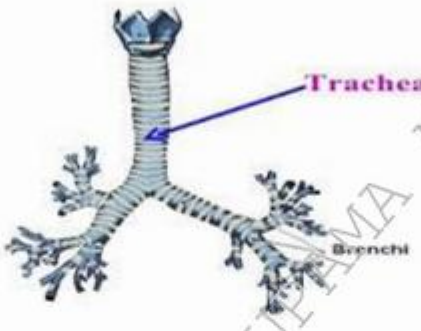




- The mucous membrane of the larynx forms two pairs of folds a superior pair called the ventricular folds (false vocal cords) and an inferior pair called the vocal folds (true vocal cords).



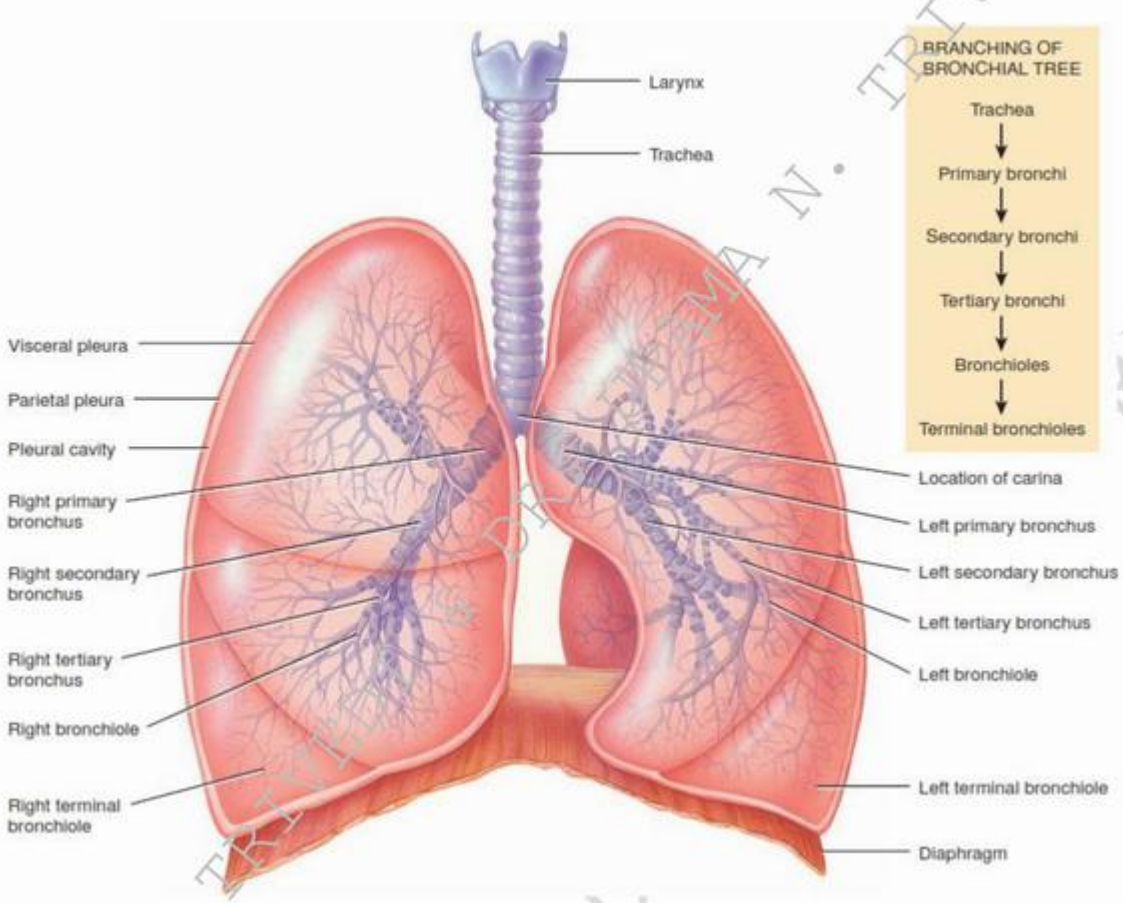
4. TRACHEA



- Trachea is also known as windpipe.
- It is a tubular passageway for air.
- It is about 12 cm (5 in.) long and 2.5 cm (1 in.) in diameter.
- It is extends from the larynx bronchi.
- Trachea consist 16–20 incomplete, horizontal rings of hyaline cartilage resemble the letter C.
- The open part of each C-shaped cartilage ring faces posteriorly toward the esophagus.

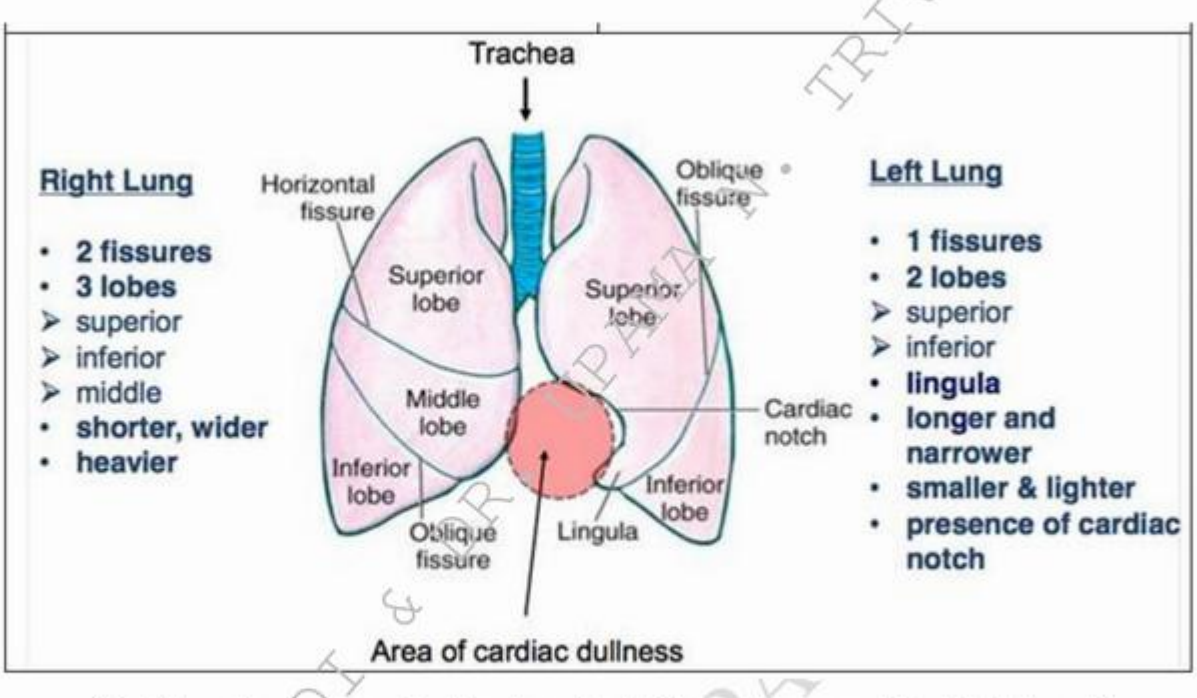
5. BRONCHI

- The trachea divides into a right and left primary bronchi.
- Right primary bronchi goes into the right lung, and a left primary windpipe bronchi, which goes into the left lung.
- The right primary bronchi is more vertical, shorter, and wider than the left.
- As a result, an aspirated object is more likely to enter and lodge in the right primary bronchus than the left.
- The primary bronchi contain incomplete rings of cartilage like trachea.
- The primary bronchi in to the lungs divide to form smaller bronchi known as the secondary (lobar) bronchi, one for each lobe of the lung. (The right lung has three lobes; the left lung has two.)
- The secondary bronchi branches known as tertiary (segmental) bronchi it further divide in to bronchioles.
- Bronchioles further divide in to smaller branches known as terminal bronchioles.
- This branch like structure resembles an inverted tree and is commonly referred to as the bronchial tree.



6. LUNGS

- There are two lungs in human body.
- It is cone-shaped organs reside in the thoracic cavity.
- Lungs are separated from each other by the heart and other structures in the mediastinum.
- Each lung is enclosed and protected by a double-layered serous membrane known as the pleural membrane.
- The superficial layer is parietal pleura and the deep layer is the visceral pleura.
- Between the visceral and parietal pleurae there is a small space which is known as the pleural cavity, which contains a small amount of lubricating fluid secreted by the membranes.
- This pleural fluid reduces friction between the membrane of lungs and allowing them to slide easily over one another during breathing.
- The broad inferior portion of the lung is known as the base and narrow superior portion of the lung is the apex.



- Right lung is shorter and wider than the left lungs because right side lobes of liver occupy more space than the left lobes.
- Left lung is long and narrow and it has lingula portion because left side of lung consist cardiac notch.
- Right lung capsular layer is thicker than the left lung.
- Right side of lung consist horizontal and oblique fissure so it divide in to three lobes, 1. Superior lobe 2. Middle lobe 3. Inferior lobe
- Left side of lung consist only oblique fissure so it divide in to two lobes, 1. Superior lobe and 2. Inferior lobe

7. BRONCHIOLES

- It is a smallest branches of respiratory tree having <1mm diameter.
- It do not consist cartilage rings but larger branches may have small patches of cartilage
- Asthma like disease condition affects the smallest terminal bronchioles

8. ALVEOLI

- Smallest bronchioles have clusters of tiny sacs branching off known as alveoli which produce "grapelike clusters."
- Each lung consist 300-500 million alveoli.
- It is made up by Single cell layer of thick squamous epithelium.
- Alveoli are the "functional units" of the respiratory system
- It is the actual site of gas exchange with blood.

- Alveoli increase in number and size until adolescence after adolescence, can increase in size only and if damaged, it has limited ability to repair themselves

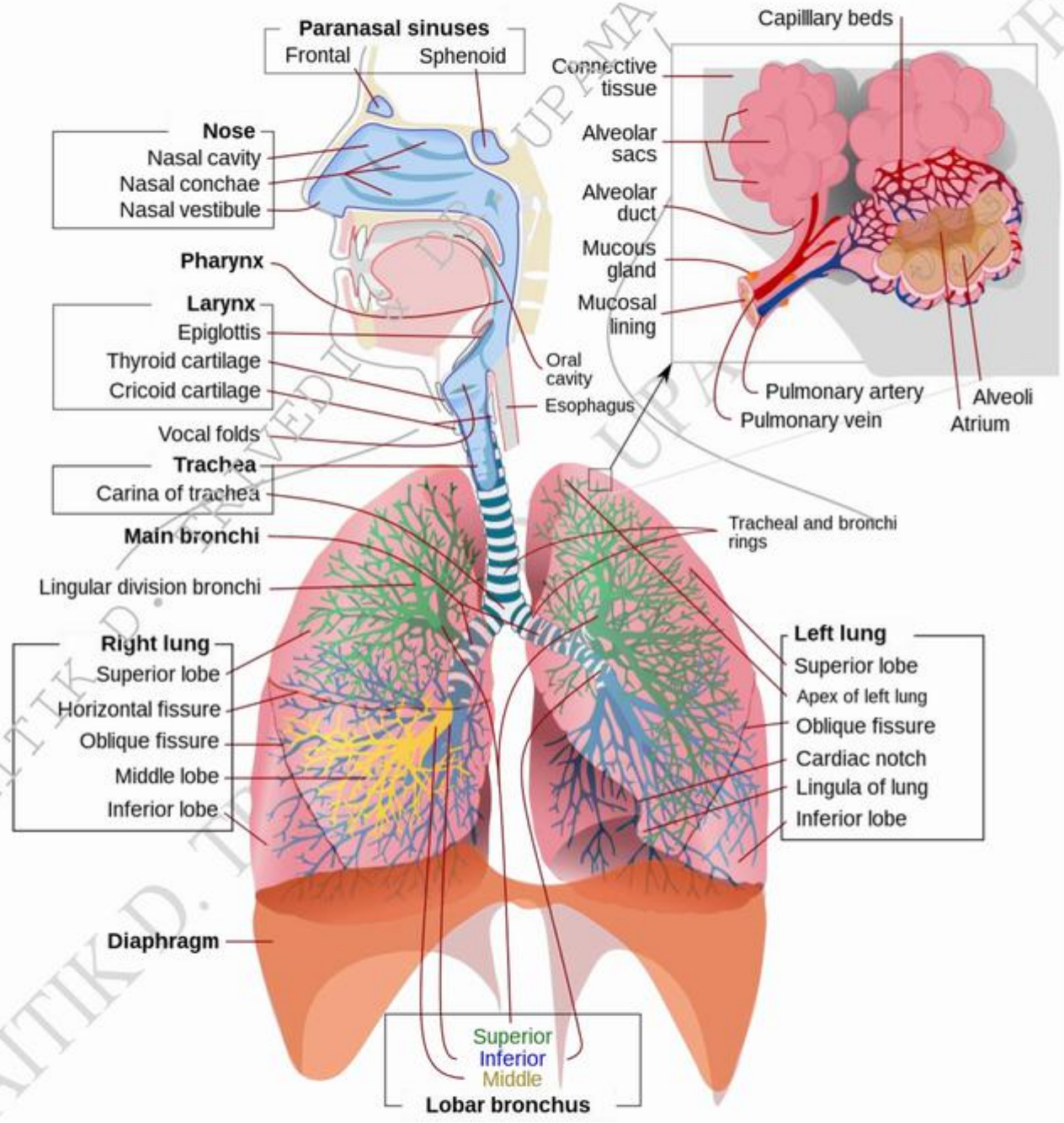


DIAGRAM OF RESPIRATORY SYTEM

SIGNATURE OF TEACHER

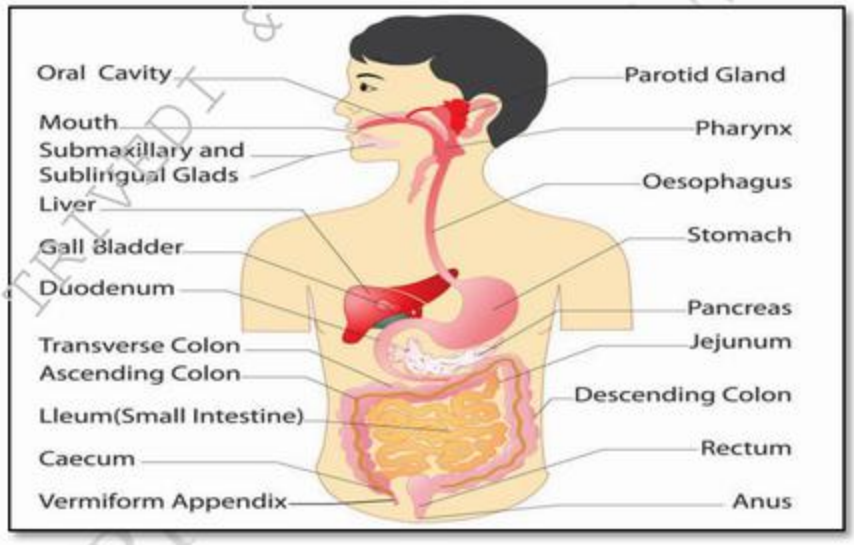
EXPERIMENT NO.: 14. c **DATE:**

AIM: TO STUDY OF DIGESTIVE SYSTEMS WITH THE HELP OF MODELS, CHARTS AND SPECIMENS.

REQUIRMENT: - Models, charts and specimens of digestive systems.

THEORY:-

- The system by which ingested food is acted upon by physical and chemical means to provide the body with absorbable nutrients and to excrete waste products is called digestive system.
- The organs involved in the breakdown of food—collectively called the digestive system.



The digestive system is divided into two groups of organs

The Gastrointestinal Tract (GIT)

- ✓ Mouth
- ✓ Oropharynx
- ✓ Esophagus
- ✓ Stomach
- ✓ Small Intestine
- ✓ Large Intestine
- ✓ Rectum
- ✓ Anus

The Accessory Digestive Organs

- ✓ Teeth
- ✓ Tongue
- ✓ Salivary Glands
- ✓ Liver
- ✓ Gallbladder
- ✓ Pancreas

The Gastrointestinal Tract (GIT)

- The gastrointestinal (GI) tract, or alimentary canal, is a continuous tube that extends from the mouth to the anus through the thoracic and abdominopelvic cavities. The length of the GI tract is about 5–7 meters.

The Accessory Digestive Organs

- The other accessory digestive organs are not come in direct contact with food.
- They produce or store secretions that flows into the GI tract through ducts; the secretions aid in the chemical breakdown of food.

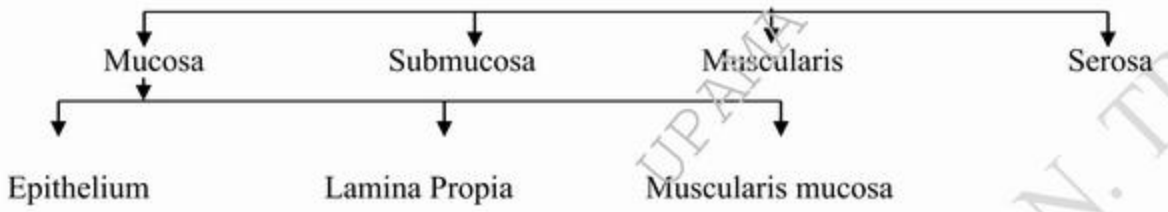
SIX BASIC PROCESSES OF THE DIGESTIVE SYSTEM

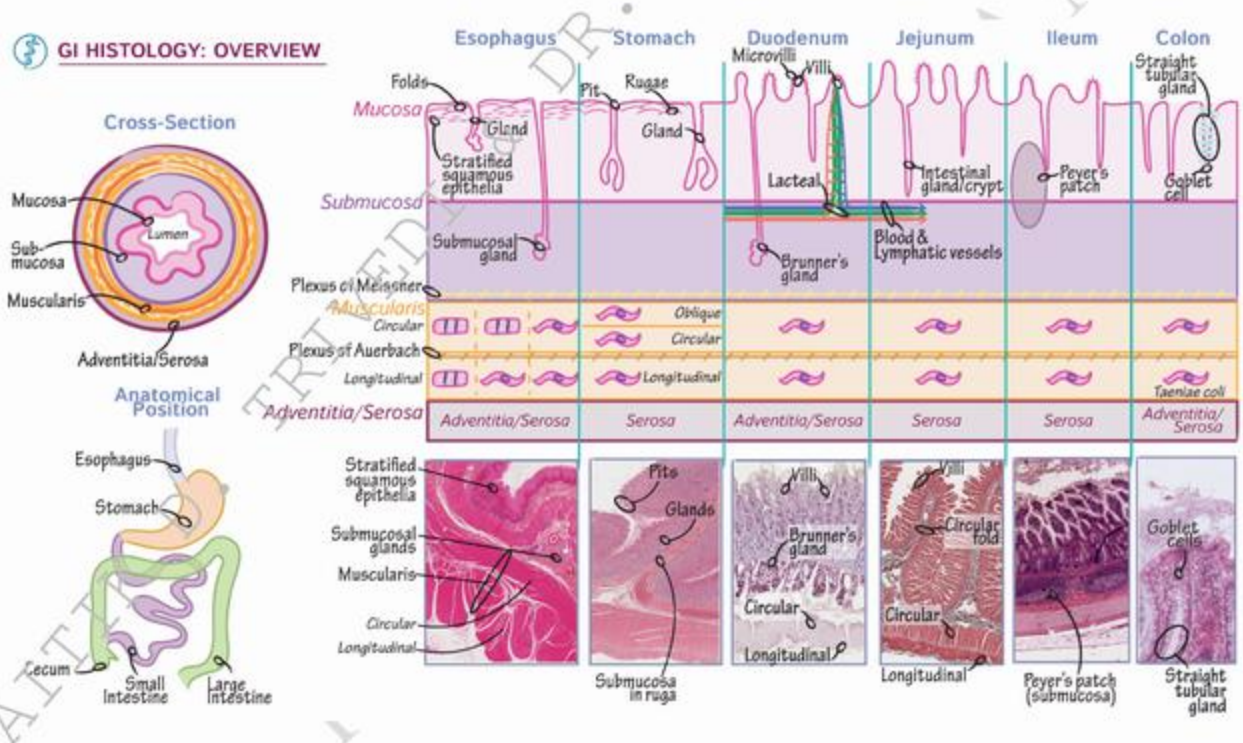
<table>
<tr><td>1</td><td>Ingestion</td><td colspan="2">✓ This is an eating process in which foods & liquids take into the mouth.</td></tr>
<tr><td>2</td><td>Secretion</td><td colspan="2">✓ In one day the secretary cells of the walls of the GI tract and accessory digestive organs secrete a total of about 7 liters of water, acid, buffers, and enzymes into the lumen of the tract.</td></tr>
<tr><td>3</td><td>Mixing & propulsion</td><td colspan="2">✓ Alternate contractions and relaxations of smooth muscle in the walls of the GI tract mix food & secretions & propel them toward the anus.
✓ This capability of the GI tract to mix and move material along its length is called motility or peristalsis movement.</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Digestion</td><td colspan="2">There are two processes of break down ingested food into small molecules</td></tr>
<tr><td>Mechanical digestion
▪ teeth cut and grind food &
▪ then smooth muscles of the stomach and small intestine churn the food
▪ food molecules become dissolved & thoroughly mixed with digestive enzymes</td><td>Chemical digestion
▪ The large carbohydrate, lipid, protein, and nucleic acid molecules in food are split into smaller molecules by hydrolysis
▪ Digestive enzymes catalyzed the catabolic reactions</td></tr>
<tr><td>5</td><td>Absorption</td><td colspan="2">✓ The transfer of ingested and secreted fluids, ions, and the products of digestion into the epithelial cells lining the lumen of the GI tract is called absorption.
✓ The absorbed substances pass into blood or lymph and circulate to cells throughout the body.</td></tr>
<tr><td>6</td><td>Defecation</td><td colspan="2">✓ Wastes, indigestible substances, bacteria, cells sloughed from the lining of the GI tract, and digested materials that were not absorbed in their journey through the digestive tract leave the body through the anus in a process called defecation.
✓ The eliminated material is termed feces.</td></tr>
</table>

THE LAYERS OF THE GIT

- The wall of the GIT having same basic, four-layered arrangement of tissues.
- The four layers of the tract, from deep to superficial, are the

The layers of the GIT





1. MUCOSA

- The mucosa is the innermost layer of the GI tract. The mucosa surrounds the lumen, or open space within the digestive tube. This layer comes in direct contact with digested food (chyme). It is absorptive & secretary layer of GIT.
- The epithelium of the mucosa is particularly specialized, depending on the portion of the digestive system.
- It is made up of three layers:
  - i. The epithelium
    - ✓ A layer of epithelium in direct contact with the contents of the GI tract
    - ✓ It is the innermost layer and it is responsible for most digestive, absorptive, and secretory processes.
  - ii. The lamina propria

- ✓ It is a layer of connective tissue that is unusually cellular compared to most connective tissue.

iii. The muscularis mucosae

- ✓ It is a thin layer of smooth muscle.

- In the esophagus, the epithelium is stratified, squamous, and non-keratinizing, for protective purposes.
- In the stomach. the epithelium is simple columnar, and is organized into gastric pits and glands to deal with secretion.
- In the small intestine, the epithelium (particularly the ileum) is specialized for absorption, with villi and microvilli increasing surface area.

2. SUBMUCOSA

- The submucosa consists of areolar connective tissue that binds the mucosa to the muscularis.
- The submucosa is relatively thick, highly vascular, and serves the mucosa.
- The absorbed elements that pass through the mucosa are picked up from the blood vessels of the submucosa.
- It also contains that receive absorbed food molecules.
- Also located in the submucosa is an extensive network of neurons known as the submucosal plexus.
- The submucosa may also contain glands, lymphatic vessels & lymphatic tissue.

3. MUSCULARIS

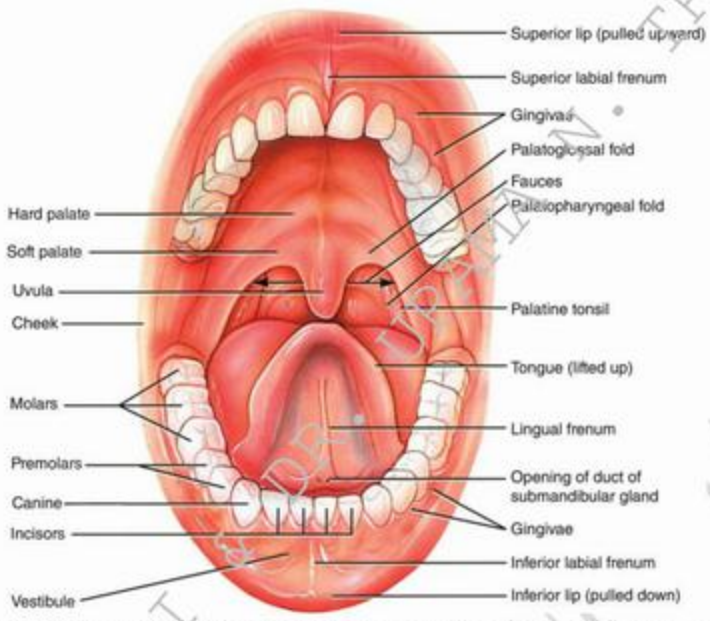
- The third layer of the alimentary canal is the **muscalaris** also called the **muscularis externa**.
- The muscularis in the small intestine is made up of a double layer of smooth muscle:
  - inner circular layer
  - outer longitudinal layer.
- The contractions of these layers promote mechanical digestion, expose more of the food to digestive chemicals, and move the food along the GI tract.
- The stomach is prepared for its churning function by the addition of a third layer, the oblique muscle.

4. SEROSA

- Those portions of the GI tract that are suspended in the abdominopelvic cavity have a superficial layer called the serosa.
- Instead of serosa, the mouth, pharynx, and esophagus have a dense sheath of collagen fibers called the adventitia.
- These tissues serve to hold the alimentary canal in place near the ventral surface of the vertebral column.

PARTS OF DIGESTIVE SYSTEM

1. **Mouth**



- Food begins its journey through the digestive system in the mouth, also known as the oral cavity.
- Inside the mouth are many accessory organs that aid in the digestion of food the tongue, teeth, and salivary glands.
- The set of 32 **teeth** chop food into small pieces, which are moistened by saliva before the tongue and other muscles push the food into the pharynx.
- The **tongue** is a small organ made up of several pairs of muscles covered in a thin, bumpy, skin-like layer. The taste buds on the surface of the tongue detect taste molecules in food and connect to nerves in the tongue to send taste information to the brain. The tongue also helps to push food toward the posterior part of the mouth for swallowing.
- **Salivary Glands**. Surrounding the mouth are 3 sets of salivary glands. The salivary glands are accessory organs that produce a watery secretion known as saliva. Saliva helps to moisten food and begins the digestion of carbohydrates. The body also uses saliva to lubricate food as it passes through the mouth, pharynx, and esophagus.

2. Pharynx

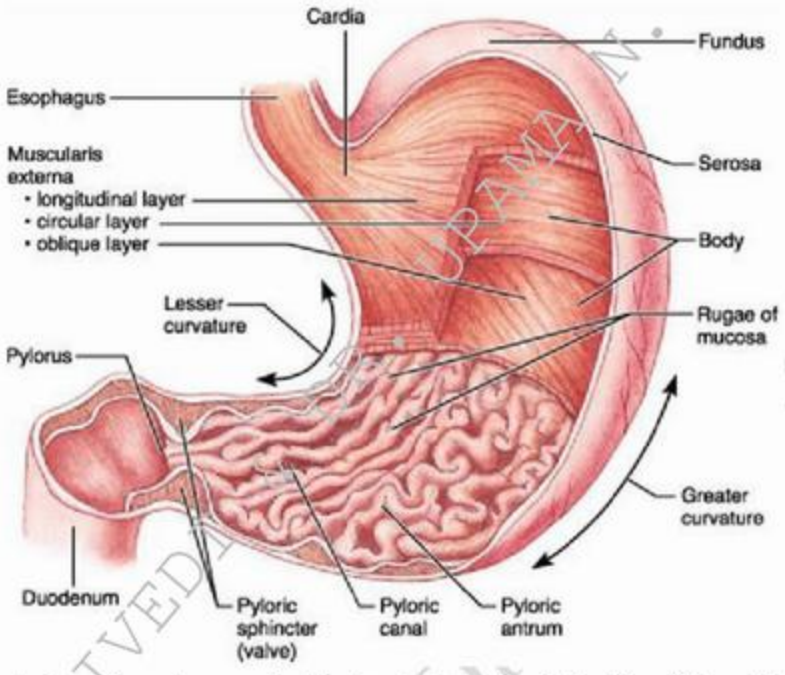
- The pharynx, or throat, is a funnel-shaped tube connected to the posterior end of the mouth. The pharynx is responsible for the passing of masses of chewed food from the mouth to the esophagus.
- The pharynx also plays an important role in the respiratory system, as air from the nasal cavity passes through the pharynx on its way to the larynx and eventually the lungs.
- Because the pharynx serves two different functions, it contains a flap of tissue known as the epiglottis that acts as a switch to route food to the esophagus and air to the larynx.

3. Esophagus

- Esophagus, the fibromuscular tube that food passes through aided by peristaltic contractions the pharynx to the stomach.
- It carries swallowed masses of chewed food along its length.
- At the inferior end of the esophagus is a muscular ring called the lower esophageal sphincter or cardiac sphincter.

- The function of this sphincter is to close of the end of the esophagus and trap food in the stomach.

4. Stomach



- The stomach is a muscular sac that is located on the left side of the abdominal cavity, just inferior to the diaphragm.
- In an average person, the stomach is about the size of their two fists placed next to each other. This major organ acts as a storage tank for food so that the body has time to digest large meals properly.
- The stomach also contains hydrochloric acid and digestive enzymes that continue the digestion of food that began in the mouth.

5. Small Intestine

- The small intestine is a long, thin tube about 1 inch in diameter and about 10 feet long.
- It is located just inferior to the stomach and takes up most of the space in the abdominal cavity.
- The entire small intestine is coiled like a hose and the inside surface is full of many ridges and folds. These folds are used to maximize the digestion of food and absorption of nutrients. By the time food leaves the small intestine, around 90% of all nutrients have been extracted from the food that entered it.
- Parts of small intestine
  - ✓ Duodenum: Here the digestive juices from the pancreas and the gallbladder (bile) mix together. The digestive enzymes break down proteins and bile and emulsify fats into micelles. The duodenum contains Brunner's glands that produce bicarbonate, and pancreatic juice that contains bicarbonate to neutralize hydrochloric acid in the stomach.
  - ✓ Jejunum: This is the midsection of the intestine, connecting the duodenum to the ileum. It contains the plicae circulares and villi to increase the surface area of that part of the GI tract.
  - ✓ Ileum: This has villi, where all soluble molecules are absorbed into the

6. Liver & Gallbladder

- The liver is a roughly triangular accessory organ of the digestive system located to the right of the stomach, just inferior to the diaphragm and superior to the small intestine.
- The liver weighs about 3 pounds and is the second largest organ in the body.
- The liver has many different functions in the body, but the main function of the liver in digestion is the production of bile and its secretion into the small intestine.
- The gallbladder is a small, pear-shaped organ located just posterior to the liver. The gallbladder is used to store and recycle excess bile from the small intestine so that it can be reused for the digestion of subsequent meals.

7. Pancreas

- The pancreas is a large gland located just inferior and posterior to the stomach. It is about 6 inches long and shaped like short, lumpy snake with its "head" connected to the duodenum and its "tail" pointing to the left wall of the abdominal cavity.
- The pancreas secretes digestive enzymes into the small intestine to complete the chemical digestion of foods.

9. Large Intestine

- The large intestine is a long, thick tube about 2 ½ inches in diameter and about 5 feet long. It is located just inferior to the stomach and wraps around the superior and lateral border of the small intestine.
- The large intestine absorbs water and contains many symbiotic bacteria that aid in the breaking down of wastes to extract some small amounts of nutrients. Feces in the large intestine exit the body through the anal canal.
- The large intestine has four parts:
  - ✓ Cecum, the vermiform appendix that is attached to the cecum.
  - ✓ Colon, which includes the ascending colon, transverse colon, descending colon, and sigmoid flexure. The main function of the colon is to absorb water, but it also contains bacteria that produce beneficial vitamins like vitamin K.
  - ✓ Rectum
  - ✓ Anus

SIGNATURE OF TEACHER

EXPERIMENT NO.: 14. d **DATE:**

AIM: STUDY OF URINARY SYSTEM WITH THE HELP OF CHART AND MODELS.

REQUIREMENTS: Models, charts and specimens of urinary system

THEORY:

Urinary system is also known as the excretory system.

The organs of the urinary system include the kidneys, renal pelvis, ureters, bladder and urethra.

The purpose of the urinary system is to filtration of blood and eliminate waste from the body, regulate blood volume and blood pressure, control levels of electrolytes and metabolites, and regulate blood pH.

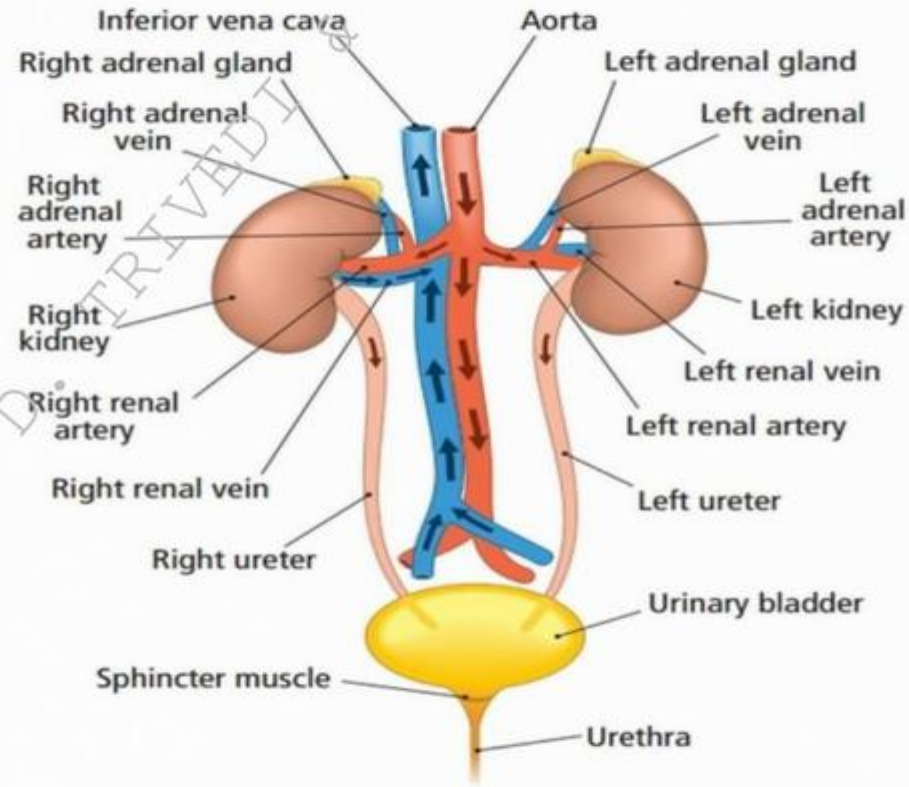


Diagram of Urinary System

FUNCTIONS OF URINARY SYSTEM:

1. Removal of waste product:
2. Reabsorption of electrolytes and nutrients:
3. Maintaining pH
4. Maintain blood pressure and volume:
5. Control the erythropoiesis (Formation of RBCs):
6. Maintain the calcium level:
7. Provide the glucose during the fasting stage

LAYERS OF KIDNEYS:

Kidney is surrounded by three layers.

1. **Renal Capsule:** It is the inner and deep layer of the kidney. It is transparent, fibrous membrane. It continue with the outer layer of the ureters. This layer maintain the shape of the kidney.
2. **Adipose capsule:** It is the middle layer of the kidney. It is made up by the fatty mass, it protect kidney from the trauma and it holds the kidney in its position.
3. **Renal fascia:** It is the outer layer of the kidney. It is made up by the dense irregular connective tissue.

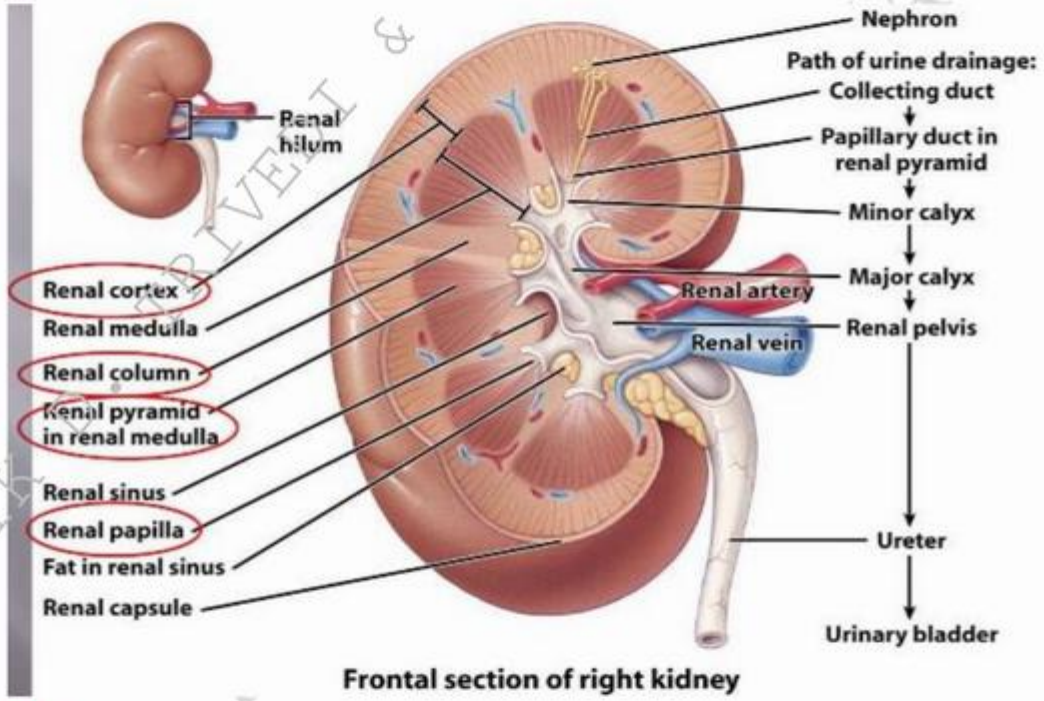
ANATOMY OF KIDNEY: (EXTERNAL ANATOMY)

- The paired kidneys are reddish (purplish-brown organs) in color and it is bean shaped.
- They are located just above the waist between the peritoneum and posterior wall of the abdominal cavity so it is also known as retroperitoneal organs.
- It is located at the level of last thoracic and third vertebrae as well as it is partially protected by the eleventh and twelfth pair of ribs.
- Right kidney is slightly lower than the left kidney because right lobes of the kidney occupied more space than the left lobes.
- Adult kidney is 9-12 cm long, 6-9 cm wide and 3 cm thick.
- Each kidney weighs about 125–175 g in males and 115–155 g in females.
- The medial surface of the kidney is concave with a deep vertical fissure known as hilum through which ureters leaves kidney as well as blood, lymphatic vessels and nerves exit and entre the kidney through the renal hilus.

HISTOLOGY OF KIDNEY: (INTERNAL ANATOMY)

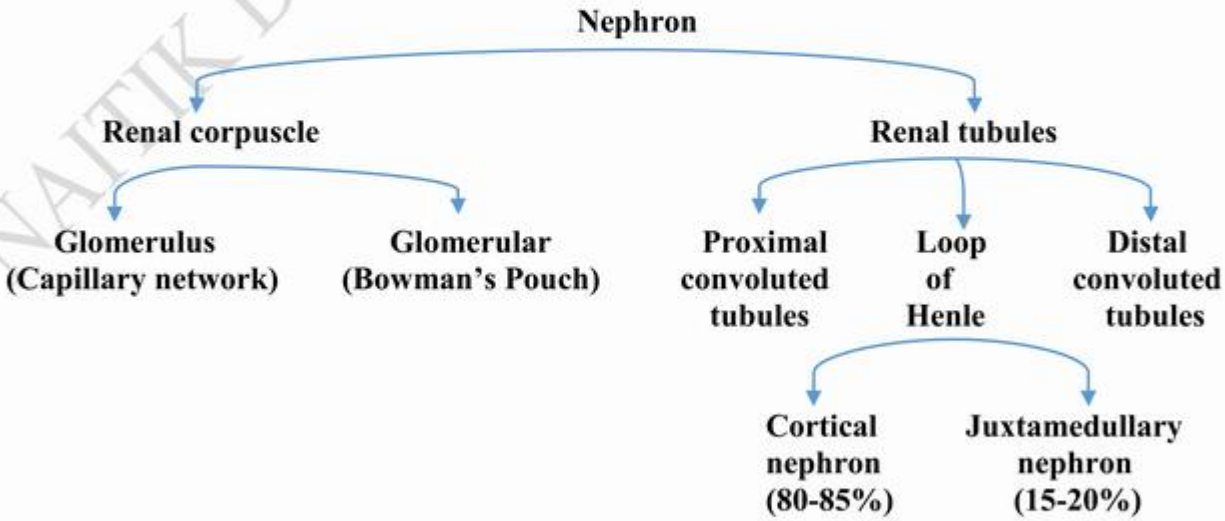
- Frontal section of the kidney shows two main region: a) renal cortex b) renal medulla
- Renal cortex is a superficial region and it is reddish in color.
- Renal medulla is a deep region and it is reddish brown in color.
- Renal medulla consist 8-18 cone shaped structure which is known as renal pyramid. Base of the renal pyramid faces towards the renal cortex side and apex of the renal pyramid towards centre of kidney side known as renal papilla.
- Between two pyramids there is a gap like portion is known as renal column.
- Renal pyramids and the portion of renal cortex combine together known as renal parenchyma where the functional units of kidney reside that is nephron.
- Each kidney's renal parenchyma consist about 1 million number of nephrons.

- The number of nephrons are constant from the birth, if nephrons are died due to injury or infection new nephron cannot form.
- Each kidney filtered blood at 50% rate, but if one kidney get failed other kidney compensate 80 % blood filtration rate.
- Urine formed by the nephron drains into papillary ducts, below that there is a cup like structure known as major and minor calyces.
- Each kidney consist 8-18 minor calyces and 2-3 major calyces.
- Formed urine pass from renal papillae to minor calyces to major calyces, then it flow in to renal pelvis to ureters and it finally drains in to urinary bladder.

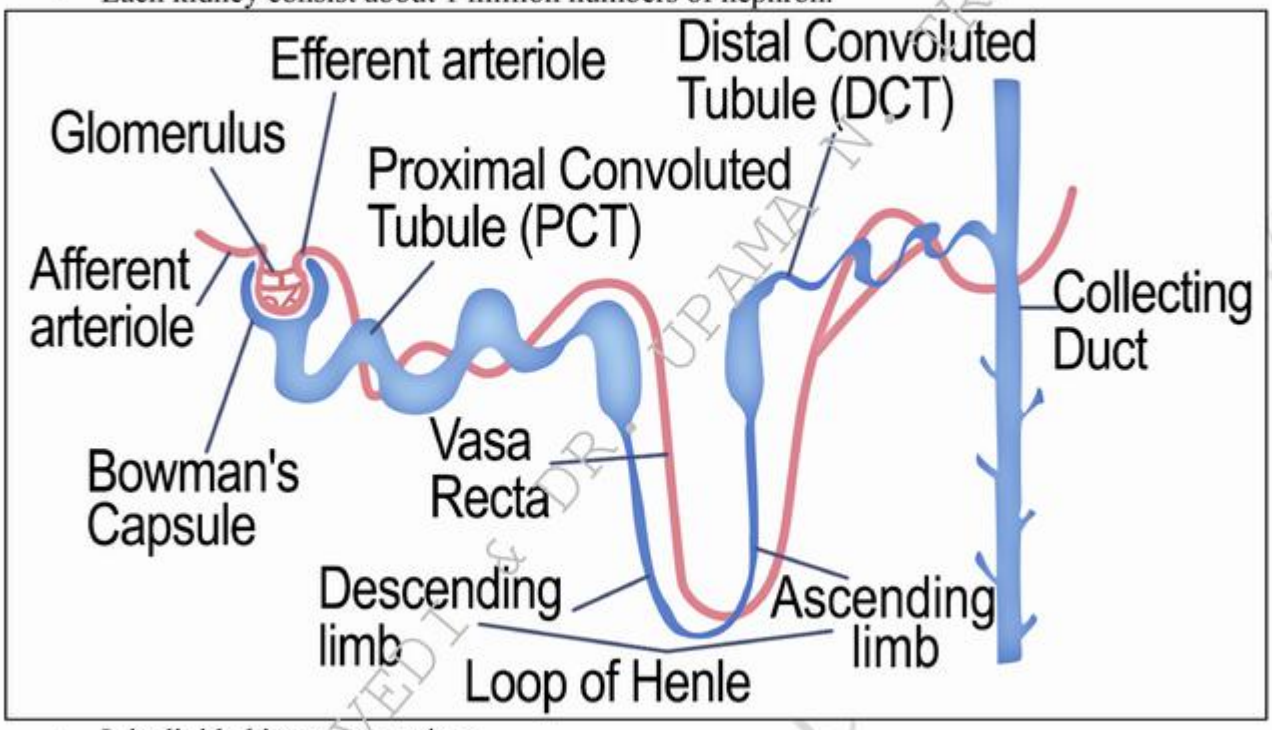


Frontal section of right kidney

NEPHRON:



- Each kidney consist about 1 million numbers of nephron.



- It is divided into two portion:

i. Renal corpuscle:

- ✓ Renal corpuscle is lie into the cortex region of kidney, It is also known as Malpighian body.
- ✓ It consist two portion:

a) **Glomerulus** - This is a cluster of capillaries that absorb protein from blood traveling through the renal corpuscle.

b) **Glomerular (The Bowman capsule) –** It is double layered walled that surround the glomerulus. The remaining fluid, called capsular urine, passes through the Bowman capsule into the renal tubules.

ii. Renal tubules:

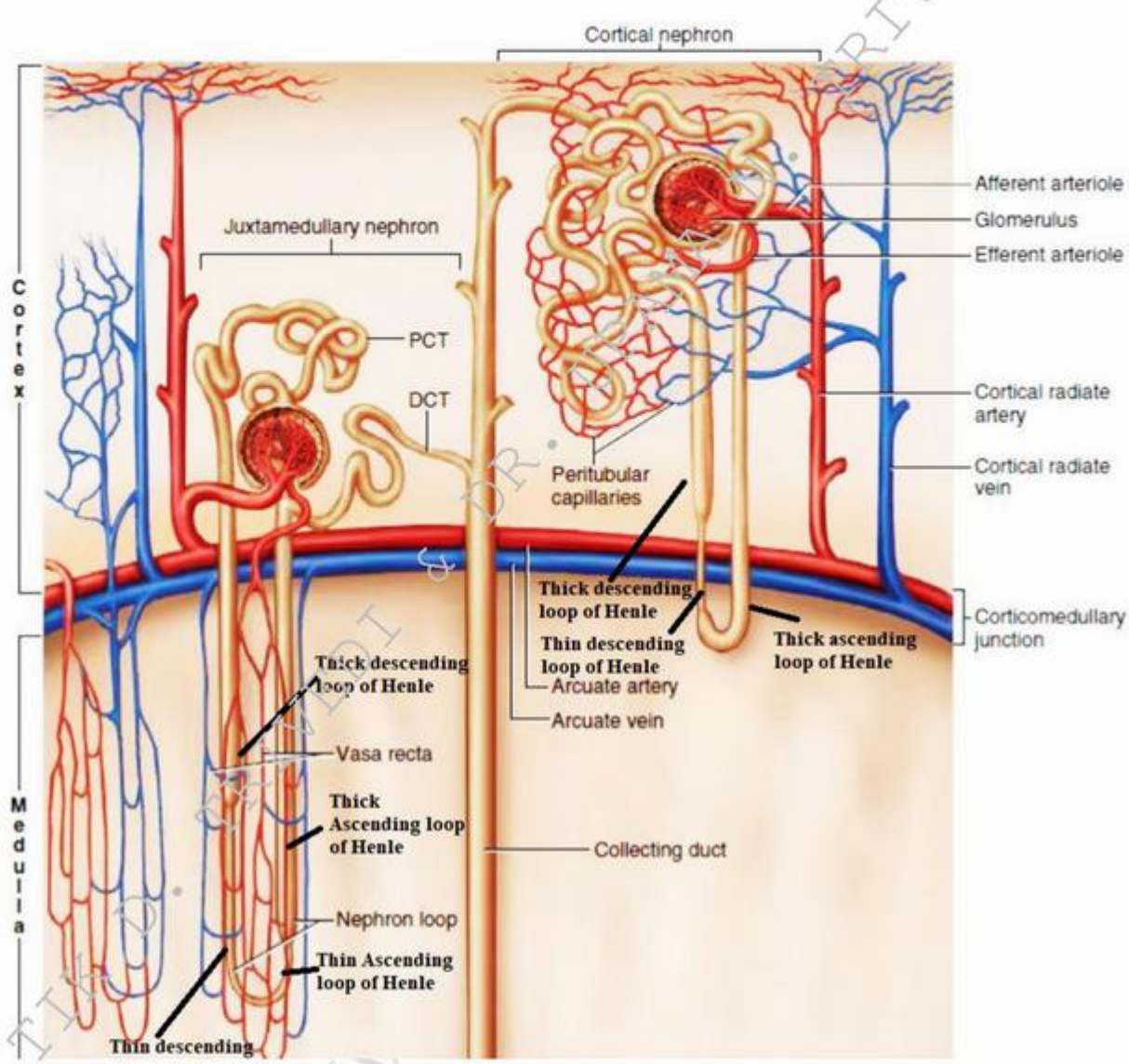
- Filtered fluid from the capsular space enter into the renal tubules, which has three main section.

a. Proximal Convoluted tubules b) Loop of Henle c) Distal convoluted tubules

- According to loop of Henle, nephron is divided into two main types:

a. Cortical nephron:
It is about 80 to 85 % of the total nephron.
It mainly located in the superficial region of the kidney that is known as cortex.
It consist short loop of Henle.
Loop of Henle consists, thick and thin descending portion and thick ascending portion but no thin ascending portion.

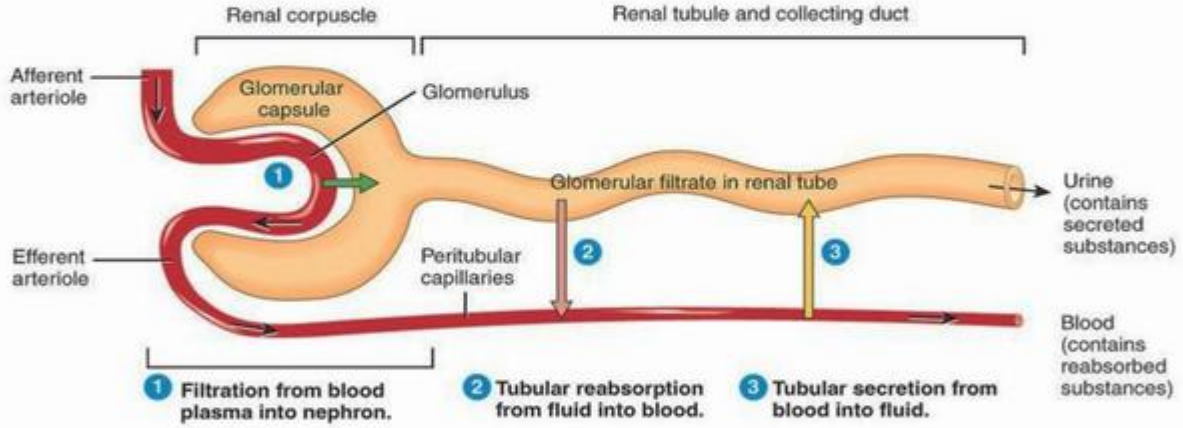
b. Juxtamedullary nephron:
It is about 15 to 20 % of the total nephron.
It mainly located in the deep region of the kidney that is known as medulla.
It consist long loop of Henle.
Loop of Henle consists, thick and thin descending portion as well as thin and thick ascending portion.
It excreted very dilute or very concentrated urine.



PHYSIOLOGY OF URINE FORMATION:

Urine is formed by mainly three process:

1. Glomerular filtration, 2. Tubular reabsorption and 3. Tubular secretion.



1. Glomerular filtration:

- Afferent arteries have larger diameter than the efferent arteries so pressure is created into the glomerulus. Due to this about 180 liters/day of filtrate entre into the capsular space, with respect to the glomerular filtration rate (GFR) 125 mL/min for an adult male. This represent is 65 times the entire blood plasma volume.
- Out of 180 liters of filtrate 178-179 liters of filtrates get reabsorbed so finally 1-2 liters of urine excreted each day.
- Glomerular filtration is depend on net filtration pressure (NFP) created into the glomerulus.
- The net filtration pressure (NFP) is mainly describe by following three mechanism, in which one process promote the filtration and two oppose the filtration process.

i. **Glomerular Blood Hydrostatic Pressure (GBHP):**

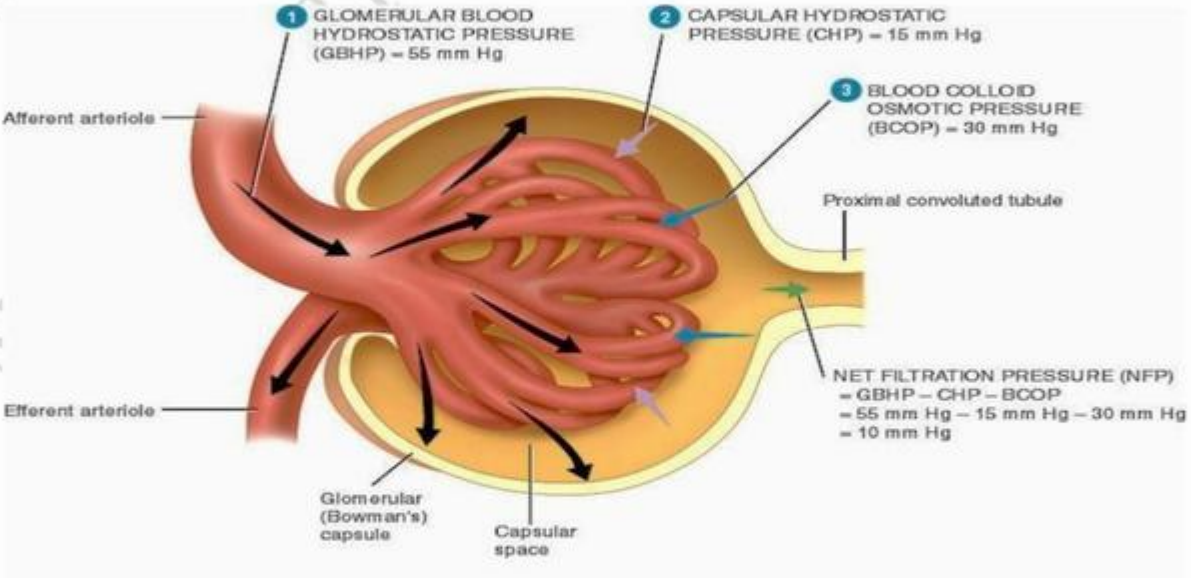
Afferent arteries have the larger diameter and efferent arteries have smaller diameter so large amount of blood comes into the glomerulus and small amount of blood out from the glomerulus it create pressure into the glomerulus that is 55 MmHg. Which is positive and it promote the filtration.

ii. **Capsular Hydrostatic Pressure (CHP):**

The wall of the capsule where there is no pores as well as the fluid filled into the capsule oppose the filtrate for filtration. This is the negative pressure which oppose the filtration rate that is 15 MmHg.

iii. **Blood Colloidal Osmotic Pressure (BCOP):**

Some of the protein of blood plasma cannot pass through the endothelial capsular membrane and it block the pore for filtration site, so it oppose the filtration rate and the pressure created by this oppose is 30 MmHg which is also the negative pressure.



2. Tubular reabsorption:

About 99% of Water and other useful small molecules in the filtrate are normally reabsorbed back into plasma by renal tubules.

In tubular reabsorption, water and solute moves from the tubuler lumen back into the blood with in a peritubular capillary or vasa recta.

Here, solutes like glucose, amino acids, urea, anions (Cl^-, HCO_3^-, HPO_4^{2-} etc) and cations (Ca^+, K^+, Na^+ etc) are reabsorbed by both the process active and passive mechanism.

3. Tubular Secretion:

- ✓ Some of the substances which not filtered through the PCT get directly secreted from blood capillary to tubules.
- ✓ Tubular secretion removes Hydrogen ions (H+), Potassium ions (K+), Ammonium ions (NH_4+), creatinine and some drugs like penicillin.
- ✓ Tubular secretion of Hydrogen ions (H+) helps to maintain blood pH and secretion of other substances helps eliminate them from the body.

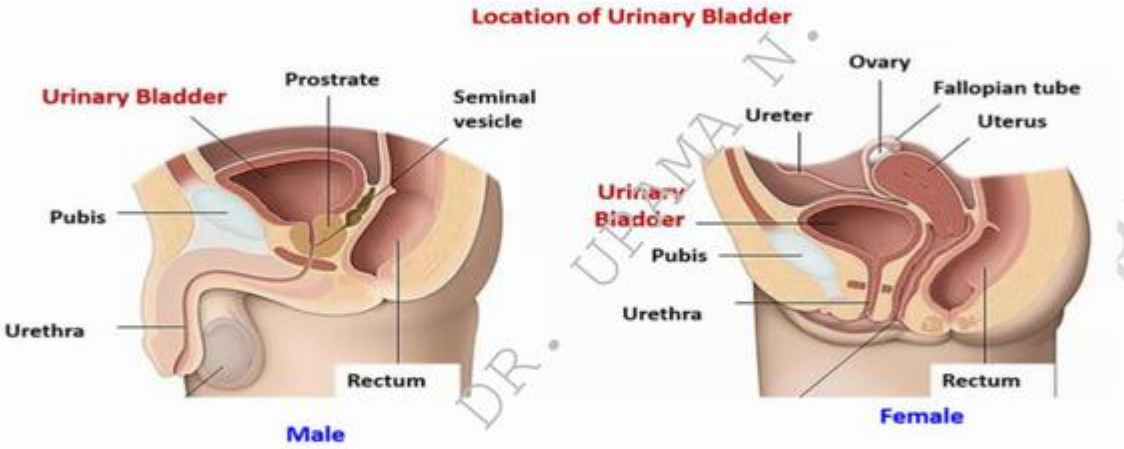
URETERS:

- The ureters are a pair of tubes that carry urine from the kidneys to the urinary bladder.
- The ureters are about 10 to 12 inches long and run on the left and right sides of the body parallel to the vertebral column.
- Gravity and peristalsis of smooth muscle tissue in the walls of the ureters move urine toward the urinary bladder. The ends of the ureters extend slightly into the urinary bladder and are sealed at the point of entry to the bladder by the ureterovesical valves.
- These valves prevent urine from flowing back towards the kidneys.
- About every 10 to 15 seconds, small amounts of urine are emptied into the bladder from the ureters.

URINARY BLADDERS:

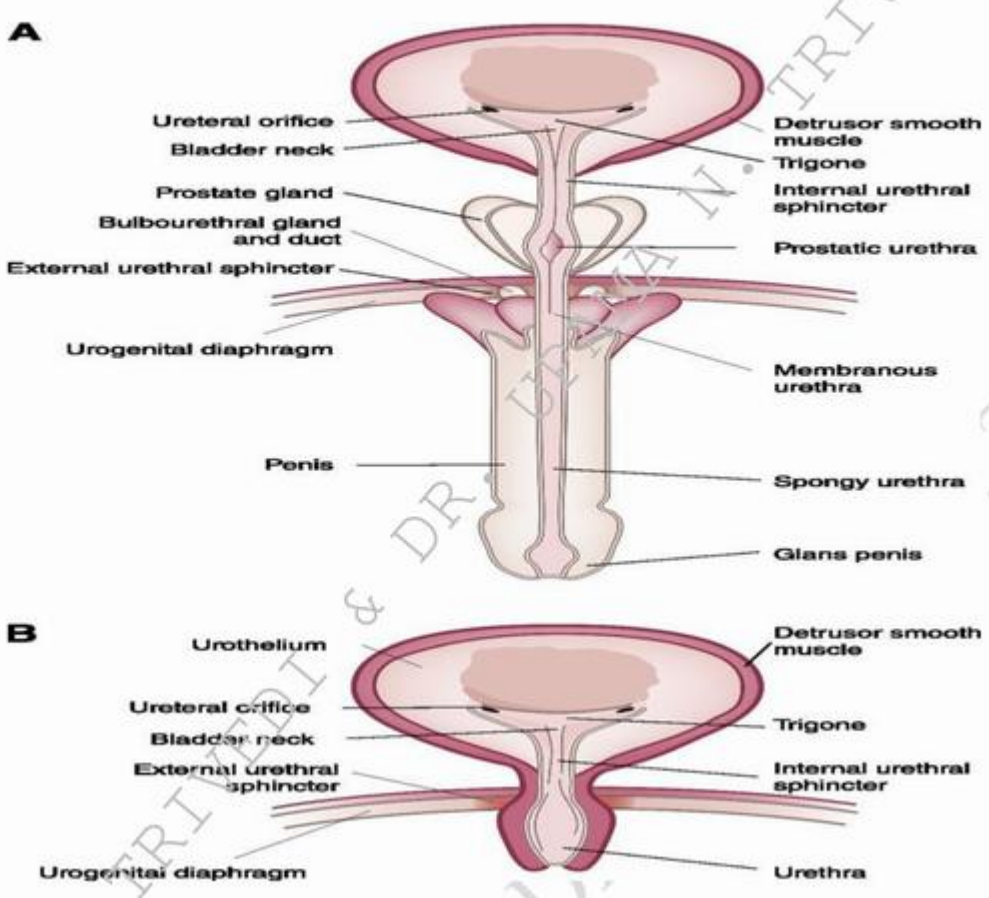
- This triangle-shaped, hollow organ is located in the lower abdomen.
- In the male it is directly anterior to the rectum and in the female it is directly anterior to the vagina and inferior to the uterus.
- In general urinary bladder have less capacity to store urine in female than male because in female uterus occupies the space just above the bladder in female.
- Expulsion of urine from urinary bladder is known as micturition, commonly known as urination.
- The average capacity of urinary bladder to store urine is 600-700 mL, but when the urine reached near the volume of 200-300 mL in urinary bladder, the stretch receptors in the wall of bladder send message/impulse via sensory response to spinal cord that response analyze

by the integrated centre of CNS and generate the reflex action to expel urine known as micturition.



URETHRA:

- The urethra is the tube through which urine passes from the bladder to the exterior of the body.
- The female urethra is around 2 inches long and ends inferior to the clitoris and superior to the vaginal opening.
- In males, the urethra is around 8 to 10 inches long and ends at the tip of the penis. The urethra is also an organ of the male reproductive system as it carries sperm out of the body through the penis.
- The male urethra has three regions: 1. prostatic urethra 2. Membranous urethra 3. Penile urethra.
- The flow of urine through the urethra is controlled by the internal and external urethral sphincter muscles.
- The internal urethral sphincter is made of smooth muscle and opens involuntarily when the bladder reaches a certain set level of distention.
- The opening of the internal sphincter results in the sensation of needing to urinate.
- The external urethral sphincter is made of skeletal muscle and may be opened to allow urine to pass through the urethra or may be held closed to delay urination.



A. **Male Urethra** **B. Female Urethra**

SIGNATURE OF TEACHER

EXPERIMENT NO.: 14. e **DATE:**

AIM: TO STUDY THE ENDOCRINE SYSTEM USING CHARTS & SPECIMENS.

REQUIRMENT: - Human endocrine system chart & model.

THEORY:

- The nervous and endocrine systems act together to coordinate functions of all body systems.
- The endocrine system also controls body activities by releasing mediators, called hormones, but the means of control of the two systems are very different.
- A hormone is a mediator molecule that is released in one part of the body but regulates the activity of cells in other parts of the body.
- Most hormones enter in interstitial fluid and then the bloodstream.
- The circulating blood delivers hormones to cells throughout the body.
- Both neurotransmitters and hormones exert their effects by binding to receptors on or in their "target" cells.
- Several mediators act as both neurotransmitters and hormones.
- One familiar example is norepinephrine, which is released as a neurotransmitter by sympathetic postganglionic neurons and as a hormone by chromaffin cells of the adrenal medullae.

The body contains two kinds of glands:

1. Exocrine glands &
2. Endocrine glands

Sr. no	Exocrine glands	Endocrine glands.
1	Exocrine glands (exo- _ outside) secrete their products into ducts that carry the secretions into body cavities, into the lumen of an organ, or to the outer surface of the body.	Endocrine glands (endo- _ within) secrete their products (hormones) into the interstitial fluid surrounding the secretory cells rather than into ducts.
2	Exocrine glands include sudoriferous (sweat), sebaceous (oil), mucous, and digestive glands.	From the interstitial fluid, hormones diffuse into blood capillaries and blood carries them to target cells throughout the body.

- The endocrine glands include:
  - ✓ 1- The Pituitary,
  - ✓ 1- Thyroid,
  - ✓ 4- Parathyroid,
  - ✓ 2- Adrenal
  - ✓ 1-Pineal glands
  - ✓ 1- Pancreatic gland
  - ✓ 2- Ovaries
  - ✓ 2- Testis
  - ✓ 1- Thymus

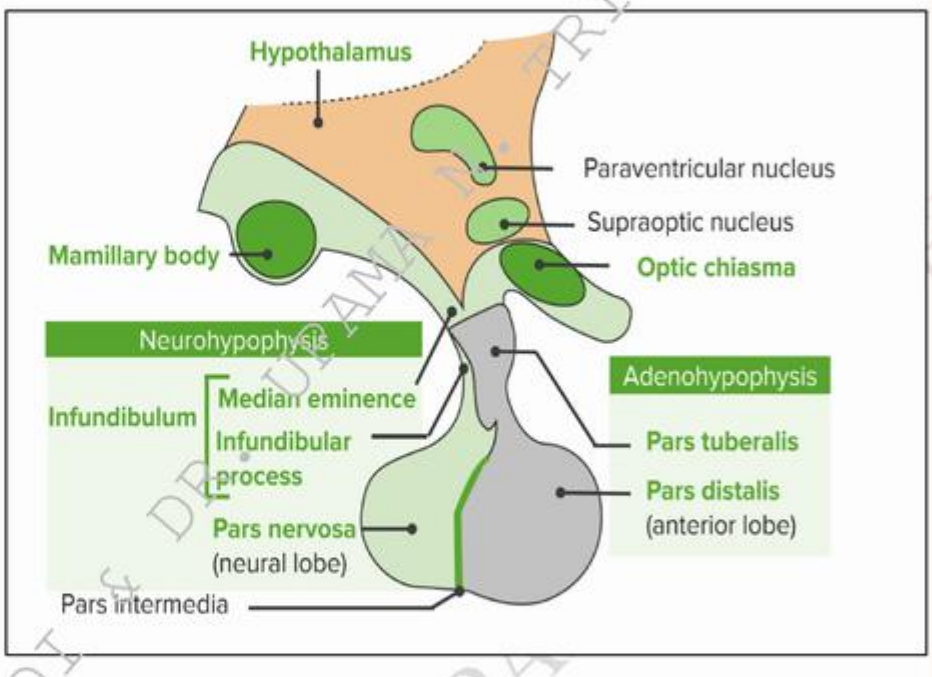
HYPOTHALAMUS AND PITUITARY GLAND

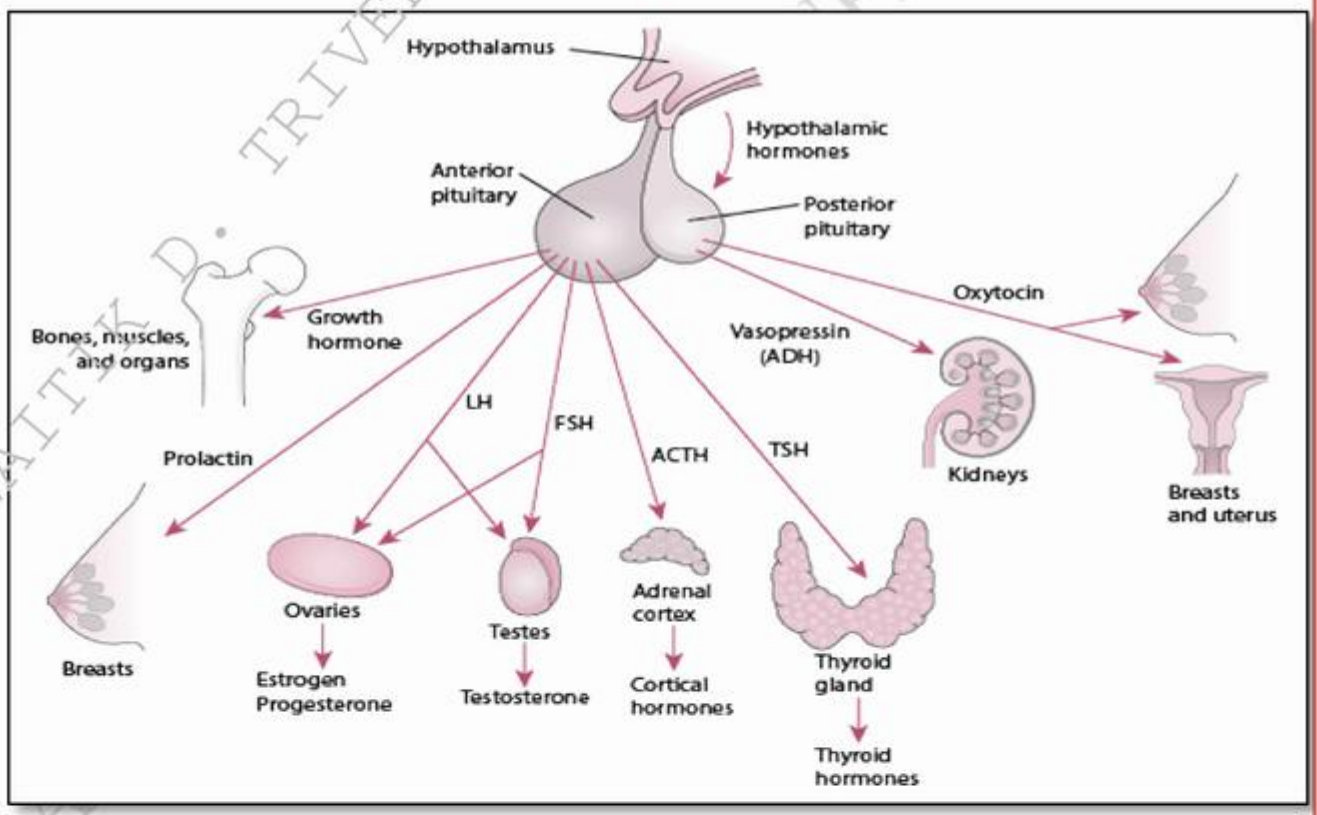
- The pituitary gland (or hypophysis) was called the "master" endocrine gland because it secretes several hormones that control other endocrine glands.
- The pituitary gland itself has a master—the hypothalamus.
- This small region of the brain below the thalamus is the major link between the nervous and endocrine systems.
- Cells in the hypothalamus synthesize at least nine different hormones, and the pituitary gland secretes seven.
- Together, these 16 hormones play important roles in the regulation of virtually all aspects of growth, development, metabolism, and homeostasis.
- Hypothalamus secreting 9 hormones
    1. Thyrotropin-releasing hormone (TRH)
        - Stimulates release of TSH (thyrotropin) and Prolactin
    2. Corticotropin-releasing hormone (CRH)
        - Stimulates release of ACTH (corticotropin)
    3. Gonadrotropin-releasing hormone (GnRH)
        - Stimulates release of FSH and LH (gonadotropins)
    4. Growth hormone-releasing hormone (GHRH)
        - Stimulates release of growth hormone
    5. Growth hormone release inhibiting hormone (GHRIH)
        - Inhibits release of growth hormone
    6. Prolactin-releasing hormone (PRH)
        - Stimulates release of prolactin
    7. Prolactin release inhibitory hormone (PRIH)
        - Inhibits release of prolactin
    8. Dopamine
- Pituitary glands secreting-
    1. Growth hormone (GH)
    2. Prolactin
    3. Adrenocorticotropic hormone (ACTH, Corticotrophin)
    4. Thyroid stimulating hormones (TSH, Thyrotrophin)
    5. Gonadotrophins- Follicle stimulating hormone (FSH)
    6. Luteinizing hormone (LH)
    7. Oxytocin
    8. Antidiuretic hormone (ADH, Vasopressin)

Structure of pituitary gland

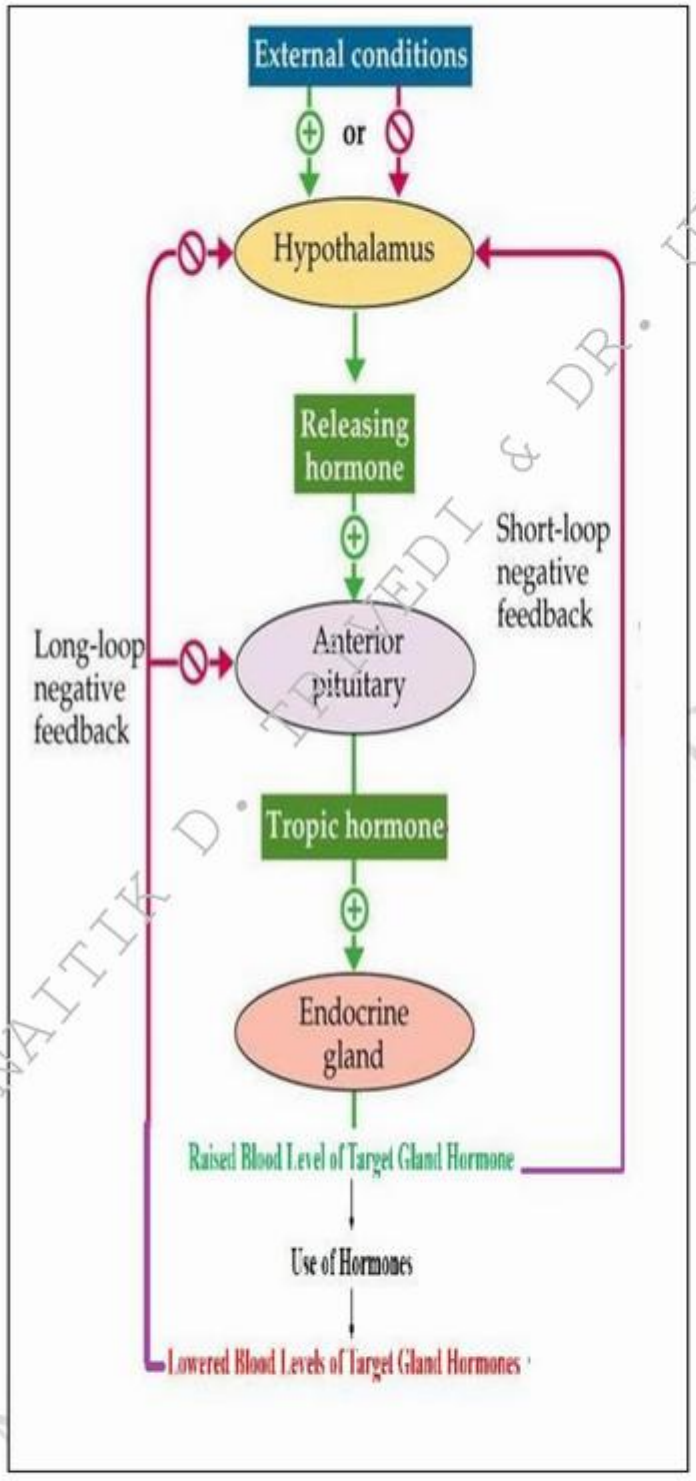
- The pituitary gland is a pea-shaped structure that measures 1–1.5 cm (0.5 in.) in diameter
- It lies in the hypophyseal fossa of the sphenoid bone.
- It attaches to the hypothalamus by a stalk, the infundibulum.
- It has two anatomically and functionally separate portions:
    - ✓ Anterior pituitary
    - ✓ Posterior pituitary

- The anterior pituitary (anterior lobe), also called the adenohypophysis, accounts for about 75% of the total weight of the gland.
- The posterior pituitary (posterior lobe), also called the neurohypophysis.
- A third region of the pituitary gland called the pars intermedia.





FEEDBACK MECHANISM OF ENDOCRINE HORMONE SECRETION



- The neurosecretory cells synthesize the hypothalamic releasing and inhibiting hormones in their cell bodies and package the hormones inside vesicles, which reach the axon terminals by axonal transport.
- Nerve impulses [external stimuli] stimulate the vesicles to undergo exocytosis.
- The hormones then diffuse into the primary plexus of the hypophyseal portal system.
- The hypothalamic hormones flow with the blood through the portal veins and into the secondary plexus.
- Hypothalamic hormones then act on anterior pituitary cells.
- Hormones secreted by anterior pituitary cells pass into the secondary plexus capillaries, which drain into the anterior hypophyseal veins and out into the general circulation.
- Anterior pituitary hormones then travel to target tissues throughout the body.
- Those anterior pituitary hormones that act on other endocrine glands are called tropic hormones

ENDOCRINE GLANDS AND THEIR SECRETIONS

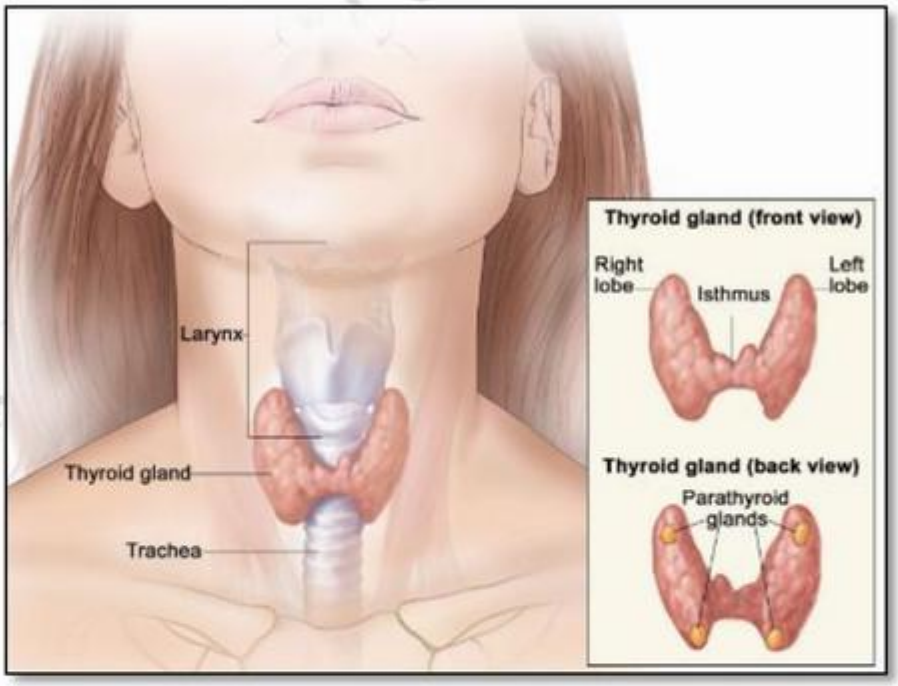
Sr. No	Endocrine Gland	Hormone	Function
1	Anterior Pituitary Gland	Growth Hormone [Gh]	Promotes growth of cells
		Prolactin	Promotes breast-milk production
		Thyrotrophic Hormone [TSH]	Stimulating thyroid gland
		Follicle Stimulating Hormone [FSH]	Controls the production of eggs and sperm
		Luteinizing Hormone [LH]	Controls oestrogen and testosterone production as well as ovulation
	Intermediate	Melanocyte Stimulating Hormone [MSH]	Stimulates melanin in skin
	Posterior Pituitary Gland	Oxytocin	Helps with lactation, childbirth, and mother-child bonding
		Vasopressin	Promote the retention of water by the kidneys and increase blood pressure.
2	Thyroid Gland	Thyroid Hormone [T_3 & T_4]	Helps control several body functions, including the rate of metabolism and energy levels
3	Parathyroid Gland	Parathyroid Hormone [PTH]	Regulation of blood level of Calcium, Magnesium & Hypophosphate Controls calcium levels in bones and blood
4	Adrenal Gland	Adrenaline	Increases blood pressure, heart rate, and metabolism in reaction to stress
		Aldosterone	Controls the body's salt and water balance
		Cortisol	Plays a role in stress response
		Dehydroepiandrosterone Sulfate (DHEA-S)	Aids in production of body odor and growth of body hair during puberty
5	Pancreas	Glucagon	Helps increase levels of blood glucose (blood sugar)
		Insulin	Helps reduce your blood glucose levels
6	Pineal Gland	Melatonin	Controls sleep-wake cycles

7	Ovary	Progesterone	Helps prepare the body for pregnancy when an egg is fertilized
		Estrogen	Works to regulate the menstrual cycle, maintain pregnancy, and develop female sex characteristics; aids in sperm production
8	Ovary, Testes, Adrenal	Testosterone	Contributes to sex drive and body density in males and females as well as development of male sex characteristics

NOTE: Key to remember name of Pituitary hormones-------"GOAT FLAP"
GH, Oxytocin, ACTH, TSH, FSH, LH, ADH, Prolactin.

THYROID GLAND

- The butterfly-shaped thyroid gland is located just inferior to the larynx (voice box).
- It is composed of right and left lateral lobes, one on either side of the trachea.
- The normal mass of the thyroid is about 30 g. It is highly vascularized and receives 80–120 mL of blood per minute.
- Microscopic spherical sacs called thyroid follicles make up most of the thyroid gland.
- The follicular cells produce two hormones: thyroxine which is also called tetraiodothyronine because it contains four atoms of iodine, and triiodothyronine, which contains three atoms of iodine.
- T3and T4 together are also known as thyroid hormones.
- A few cells called parafollicular
- cells or C cells lie between follicles. They produce the hormone calcitonin homeostasis, which helps regulate calcium.

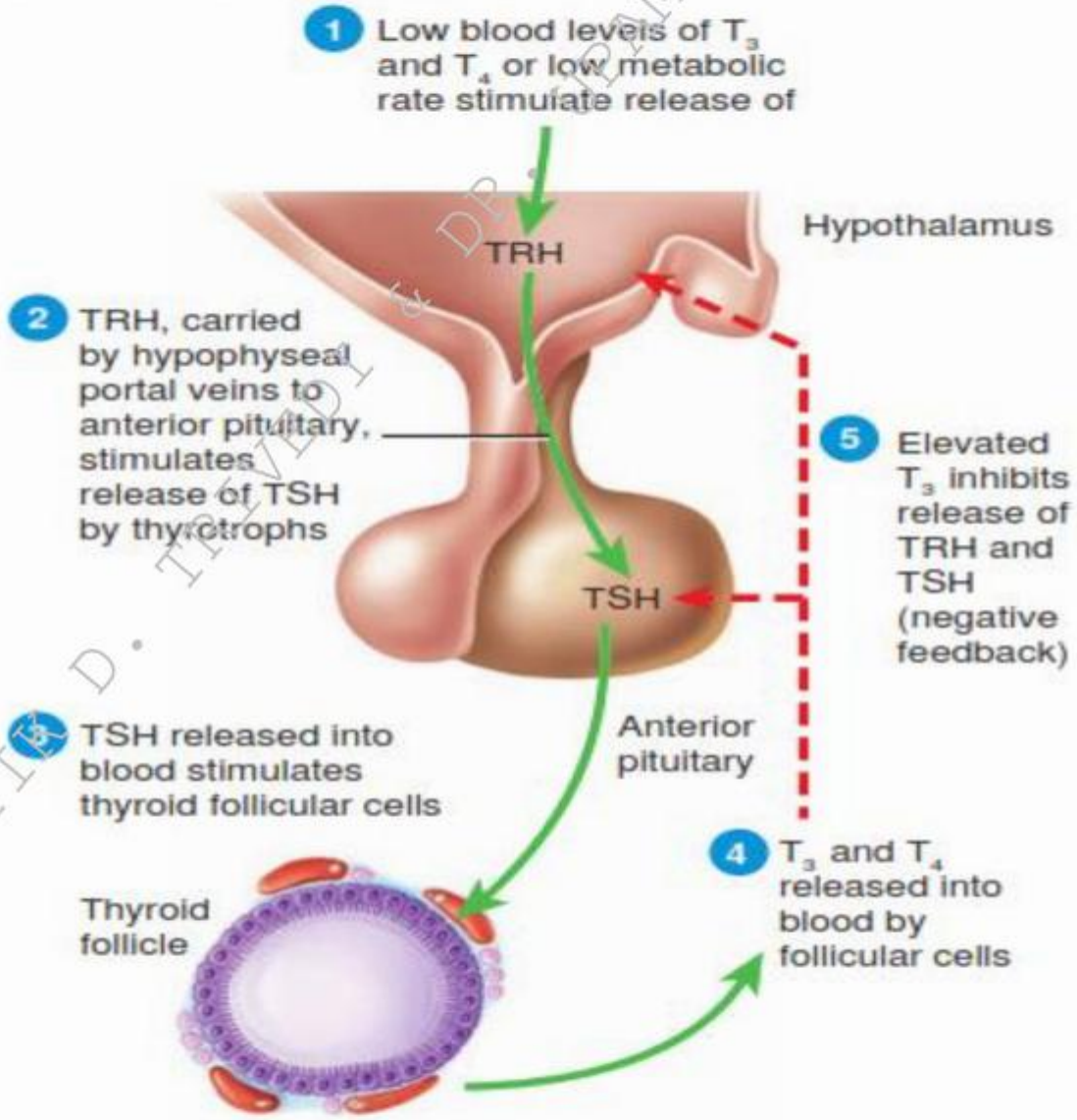


Actions of Thyroid Hormones:

- Increase basal metabolic rate
- Stimulate protein synthesis

- Increase body temperature (calorigenic effect)
- Stimulate synthesis of Na/K+ ATPase
- Increase the use of glucose and fatty acids for ATP production
- Regulate development and growth of nervous tissue and bones
- Enhance some actions of catecholamines
- Stimulate lipolysis

REGULATION OF THYROID HORMONE



PARATHYRIOD GLAND

- Partially embedded in the posterior surface of the lateral lobes of the thyroid gland are several small, round masses of tissue called the parathyroid glands.
- Each has a mass of about 40 mg.
- Microscopically, the parathyroid glands contain two kinds of epithelial cells.
- The more numerous cells, called chief (principal) cells, produce parathyroid hormone PTH), also called parathormone.
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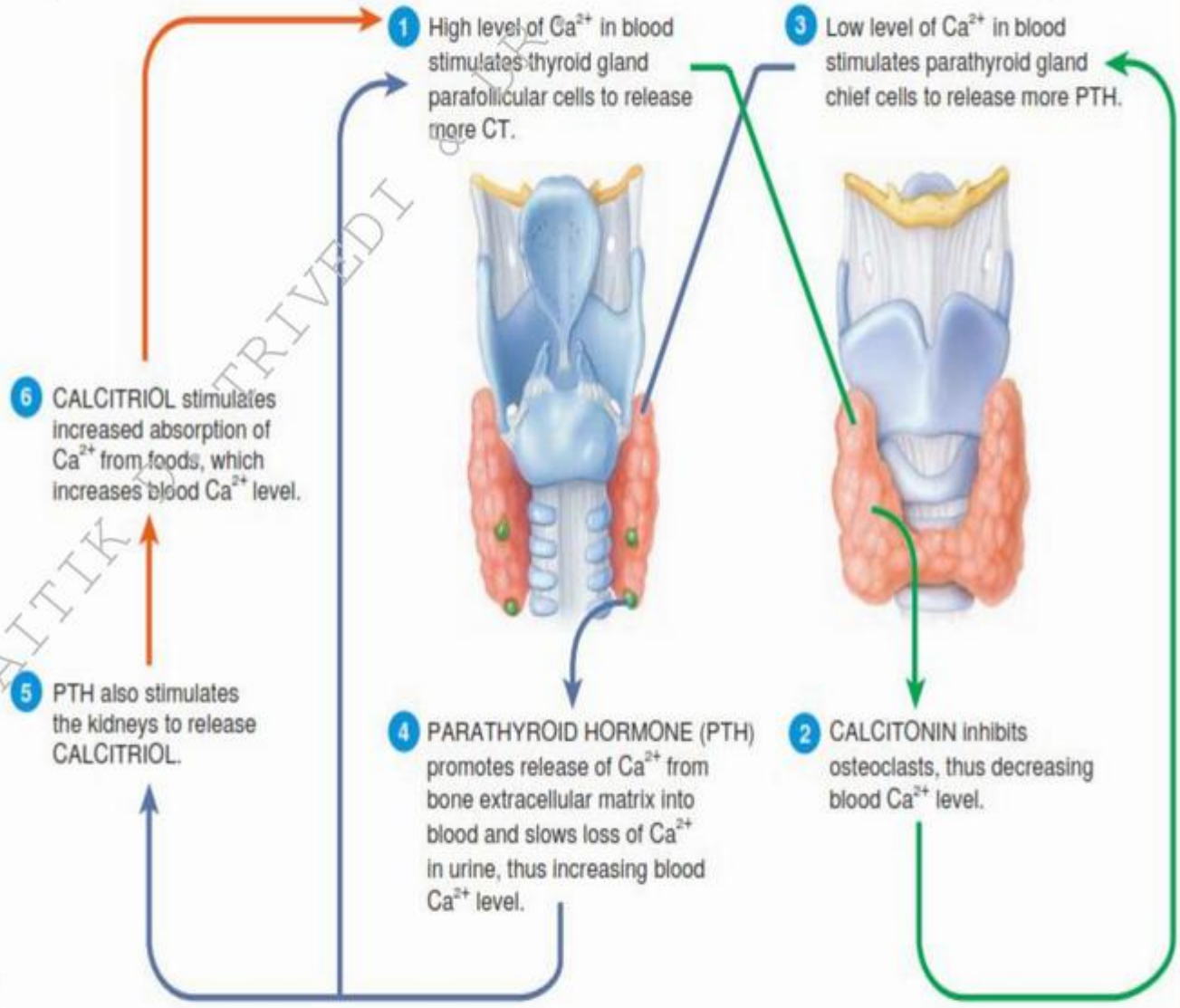


ADRENAL GLANDS

- The paired adrenal (suprarenal) glands, one of which lies superior to each kidney in the retroperitoneal space, have a flattened pyramidal shape.

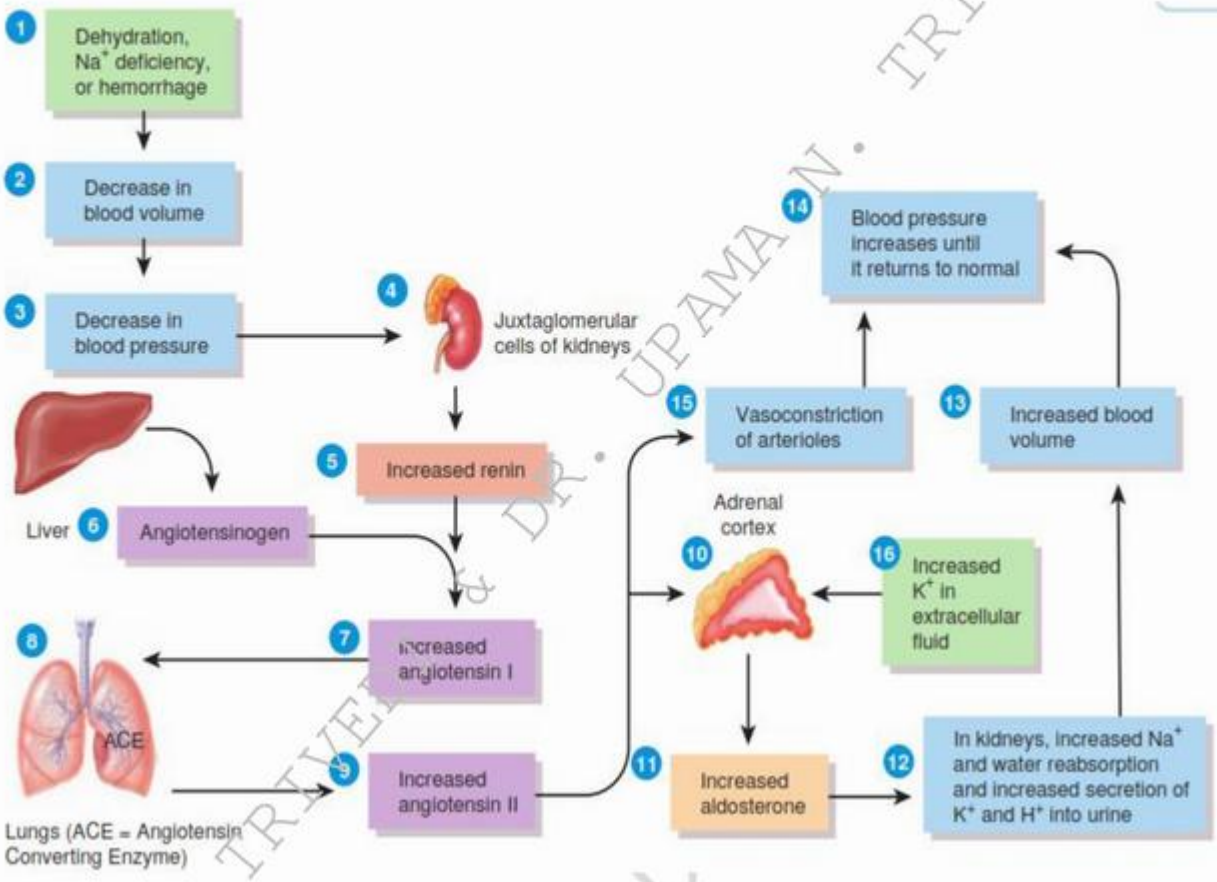
- Each adrenal gland is 3–5 cm in height, 2–3 cm in width, and a little less than 1 cm thick, with a mass of 3.5–5 g.
- During embryonic development, the adrenal glands differentiate into two structurally and functionally distinct regions:
    1. A large, peripherally located adrenal cortex, comprising 80–90% of the gland, and
    2. A small, centrally located adrenal medulla
- A connective tissue capsule covers the gland.
- The adrenal glands, like the thyroid gland, are highly vascularized.
- The adrenal cortex produces steroid hormones that are essential for life.
- Complete loss of adrenocortical hormones leads to death due to dehydration and electrolyte imbalances in a few days to a week, unless hormone replacement therapy begins promptly.
- The adrenal medulla produces three catecholamine hormones—norepinephrine, epinephrine, and a small amount of dopamine.

Adrenal gland:

- Medulla: MEN –Medulla, Epinephrine, Norepinephrine.
- Cortex: has 3 layers: GFR- Glomerulosa, Fasiculata, Reticularis
- their hormones are: Make Good Sweets
- Mineralocorticoids, (aldosterone) , Glucocorticoids, (cortisol) , Sex hormone, (androgen) .
- All adrenal gland hormones together: "CANES"
- Cortisol, Aldosterone, Norepinephrine, Epinephrine, Sex hormone.

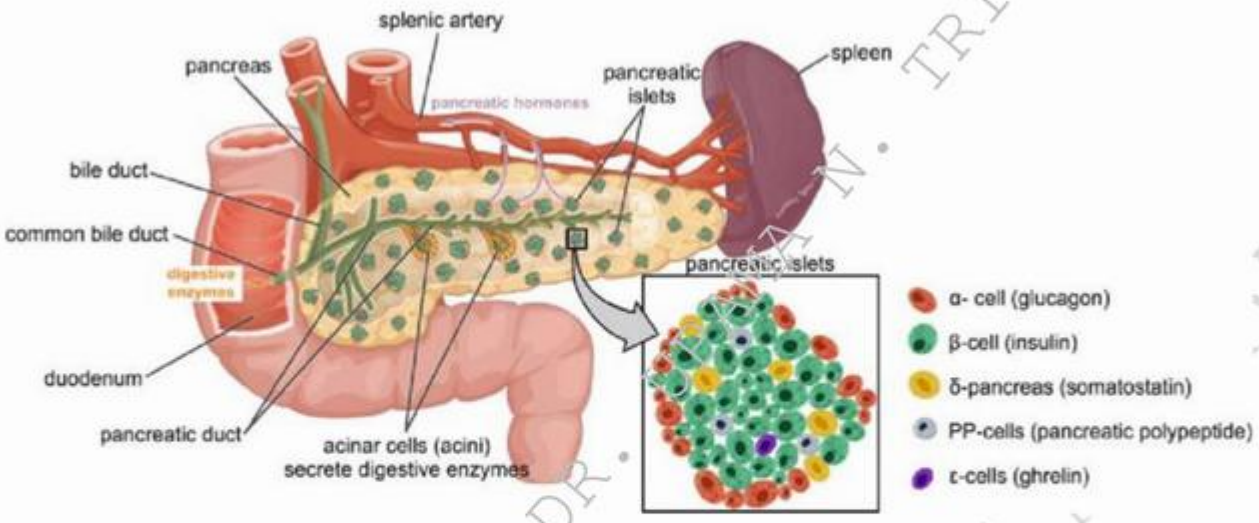
Aldosterone

- Regulation of aldosterone secretion by the renin–angiotensin–aldosterone (RAA) pathway.
- Aldosterone helps regulate blood volume, blood pressure, and levels of Na, K, and H in the blood.



PANCREAS

- The pancreas is both an endocrine gland and an exocrine gland.
- A flattened organ that measures about 1 2. 5–15 cm (4.5–6 in.) in length, the pancreas is located in the curve of the duodenum, the first part of the small intestine, and consists of a head, a body, and a tail.
- Roughly 99% of the cells of the pancreas are arranged in clusters called acini.
- The acini produce digestive enzymes, which flow into the gastrointestinal tract through a network of ducts.
- Scattered among the exocrine acini are 1–2 million tiny clusters of endocrine tissue called pancreatic islets or islets of Langerhans.
- Abundant capillaries serve both the exocrine and endocrine portions of the pancreas.

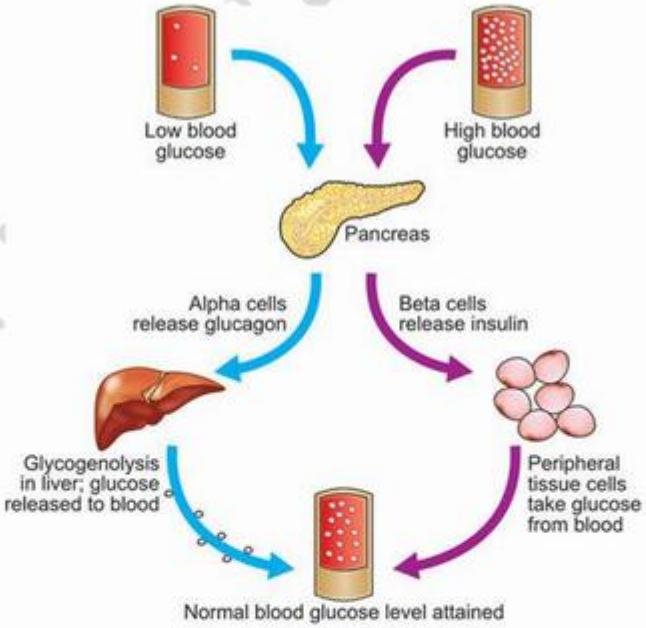


Cell Types in the Pancreatic Islets

Each pancreatic islet includes four types of hormone-secreting cells:

1. Alpha or A cells constitute about 17% of pancreatic islet cells and secrete glucagon.
2. Beta or B cells constitute about 70% of pancreatic islet cells and secrete insulin.
3. Delta or D cells constitute about 7% of pancreatic islet cells and secrete somatostatin.
4. F cells constitute the remainder of pancreatic islet cells and secrete pancreatic polypeptide.

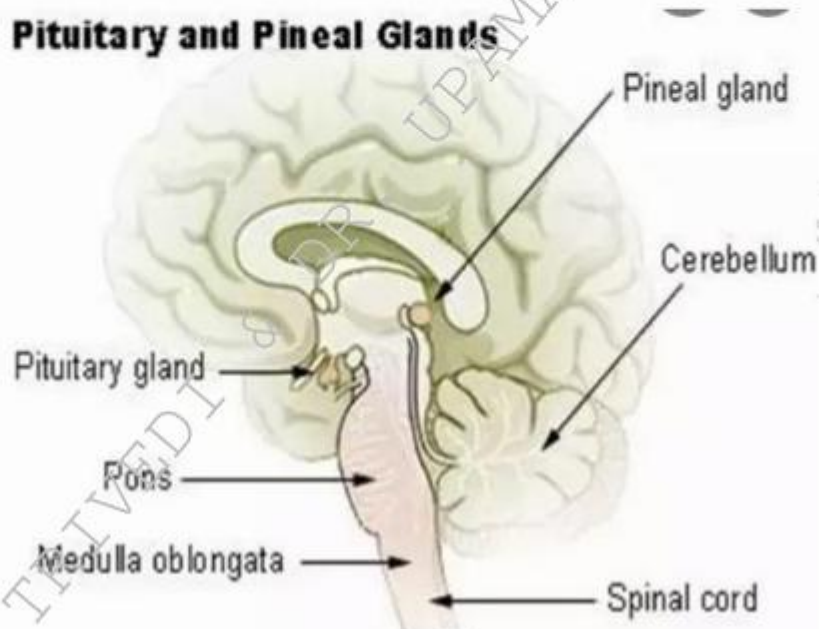
Low blood glucose stimulates release of glucagon; high blood glucose stimulates secretion of insulin.



PINEAL GLAND

- The pineal gland is a small endocrine gland attached to the roof of the third ventricle of the brain at the midline.

- Part of the epithalamus, it is positioned between the two superior colliculi, has a mass of 0. 1–0.2 g, and is covered by a capsule formed by the pia mater.
- The gland consists of masses of neuroglia and secretory cells called pinealocytes.
- The pineal gland secretes melatonin, an amine hormone derived from serotonin.
- Melatonin appears to contribute to the setting of the body's biological clock and maintain sleep.



SIGNATURE OF TEACHER

EXPERIMENT NO.: 14. f **DATE:**

AIM: STUDY OF REPRODUCTIVE SYSTEM WITH THE HELP OF CHART AND MODELS.

REQUIREMENTS: Models, charts and specimens of urinary system

THEORY:

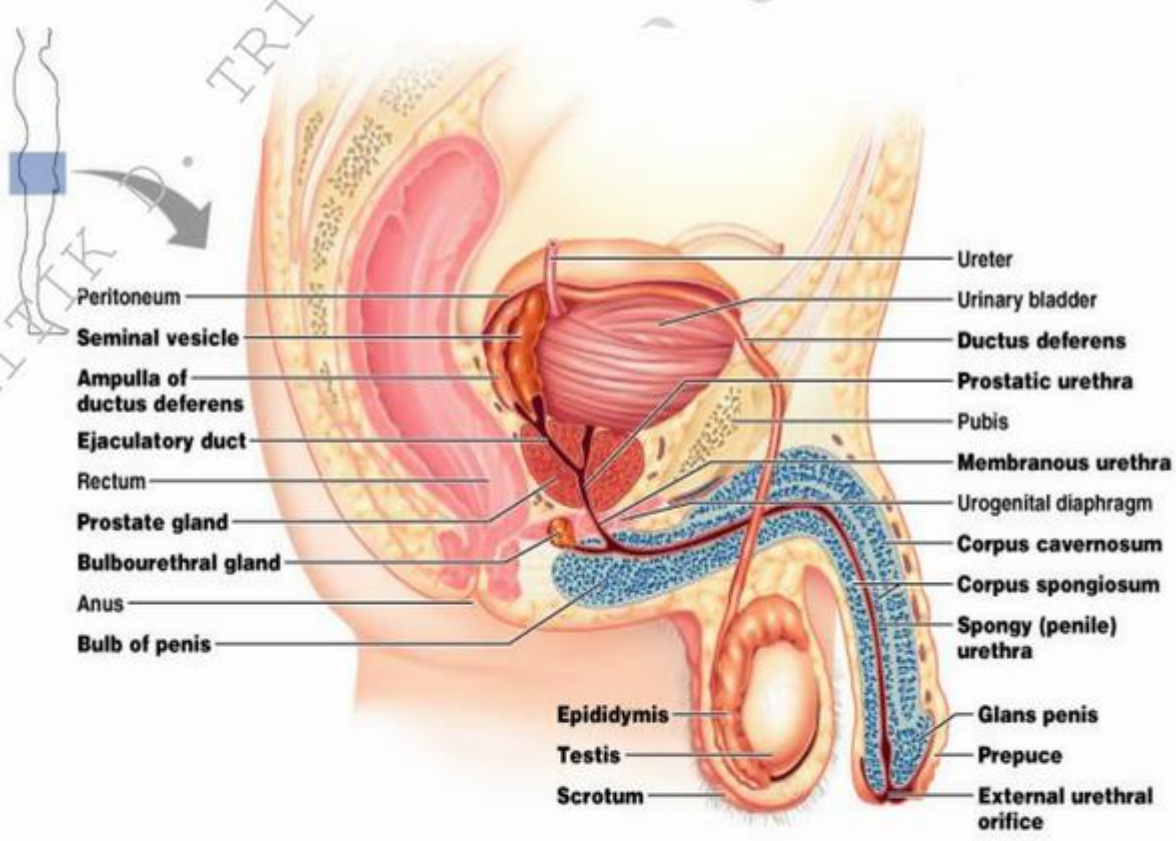
The **reproductive system** or **genital system** is a system of organs within an organism which work together for the purpose of reproduction.

Reproduction is the process by which new individuals of species are produced via which genetic material pass from generation to generation.

According to function, the male and female reproductive organ grouped as under

1. **Gonads (Seeds):** it includes testes and ovaries, the main function of testes are production of gametes and secretion of hormones.
   Male gametes known as sperm
   Female gametes known as oocytes
2. **The ducts:** It transport and store the gametes.
3. **Accessory sec gland:** It produces materials that support gametes.
4. **Supporting Structures:** It includes penis that have important role in reproduction.

MALE REPRODUCTIVE SYSTEM:



External Structures

- **Penis:** External male sex organ
- **Scrotum:** Sac of skin and muscle containing testicles

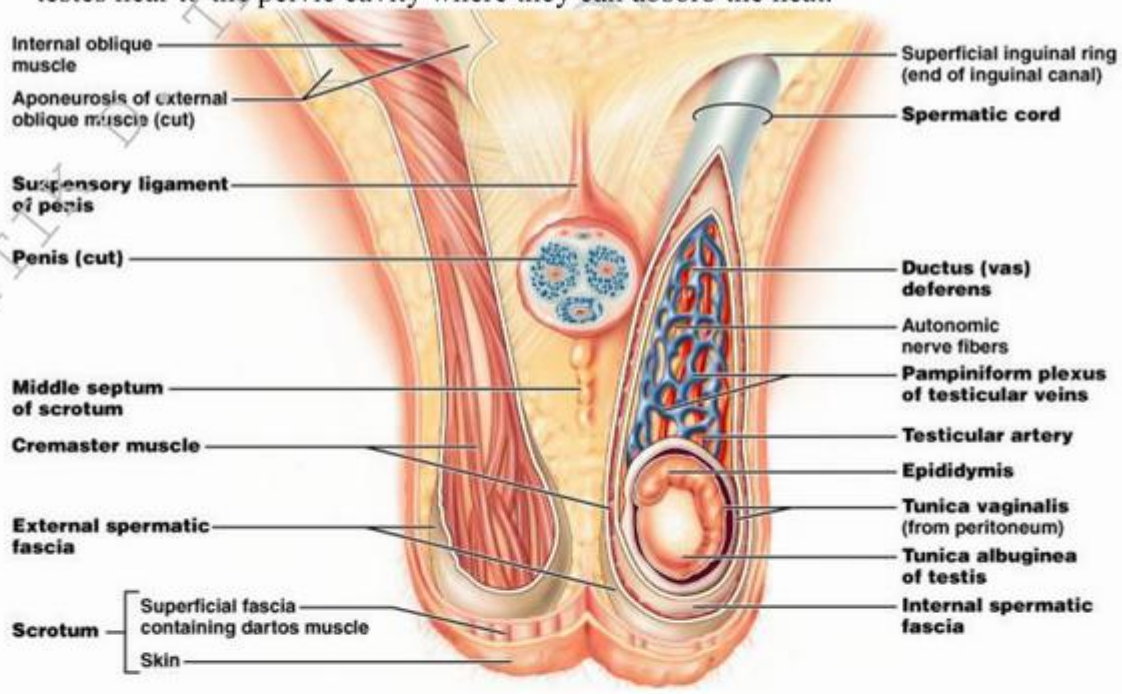
Internal Structures

- **Prostate:** Exocrine gland of male reproductive system

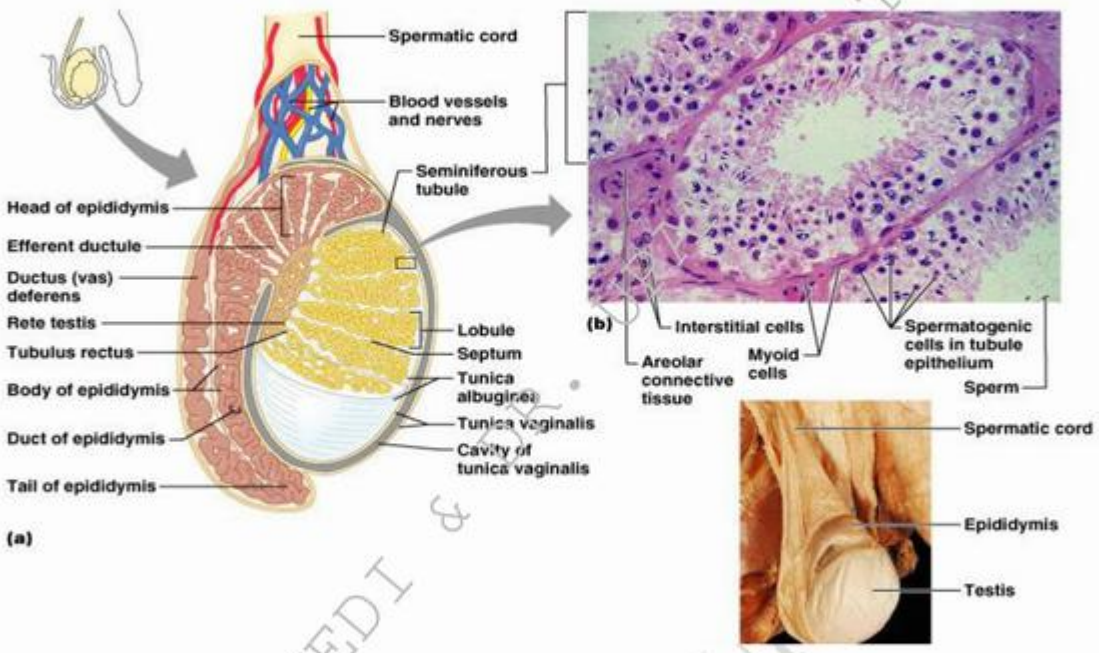
- **Vas Deferens:** Tubes connecting epididymis to ejaculatory ducts
- **Epididymis:** Organ where sperm matures
- **Testicles:** Organ where sperm is created
- **Urethra:** Tube that connects bladder to outside of body

1. Scrotum:

- Scrotum is a sac that hangs from the root of the penis and consists of loose skin and super fasia.
- It is a supportive structure of the penis.
- Internally scrotum consist vertical septum which divide it in to the two sacs.
- Each sec consist a single testes.
- Septum is covered by superficial fascia and muscle tissue known as dartos which consist smooth muscles fibers.
- When dartos muscle contracts it produce wrinkle in the skin of scrotum.
- The location of the scrotum and contraction of its muscle fiber regulate the temperature of testes.
- Both production and survival of sperm required a temperature that is about 3°C lower than the normal body temperature.
- The cremaster muscles is a small band of skeletal muscle present in to the spermatic cord, during the cold and sexual arousal it elevate the testes and this action moves the testes near to the pelvic cavity where they can absorb the heat.



2. Testes:

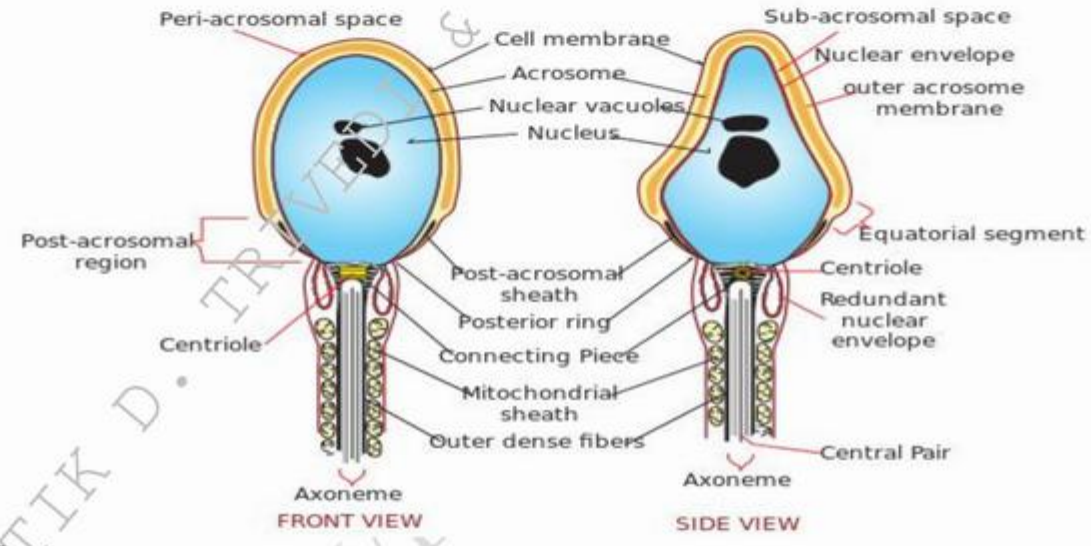


- Testes are formed in abdomen and descend into scrotum at 7th month of development.
- The testes are paired oval glands.
- It is 5 cm length, 2.5 cm in diameter and 10-15 grams of weight of each testis.
- The outer covering of testes is known as tunica vaginalis made up from serous membrane.
- Internal to the tunica vaginalis dense white fibrous capsule known as tunica albuginea.
- Inside extending portion of the tunica albuginea produce lobules. There are 200 – 300 lobules present in each testis.
- Each lobule consist one to three tightly coiled tubules known as semniferous tubules.
- Seminiferous tubule consist spermatogenic cell is taking part in the production of sperm cell, the process is known as spermatogenesis.
- There many sustentacular cells lie between the spermatogenic cell which produce the tight junction known as blood testes barrier.
- These barriers prevent the activation of immune system against the sperm because spermatogenic cell (sperm) consist surface antigen that are recognize as foreign particle by the immune system.
- The sustentacular cells also secret the fluid for the sperm transport as well as it secret the hormone inhibin which regulate the sperm production by inhibiting the secretion of FSH.

3. Sperm:

- The mammalian sperm cell consists of a head, a midpiece and a tail. The head contains the nucleus with densely coiled chromatin fibres, surrounded anteriorly by an acrosome, which contains enzymes (hyaluronidase and proteinases) used for penetrating the female egg.

- The midpiece has a central filamentous core with many mitochondria spiralled around it, used for ATP production for the journey through the female cervix, uterus and uterine tubes.
- The tail or "flagellum" executes the lashing movements that propel the spermatocyte.
- Human sperm cells can survive within the female reproductive tract for more than 5 days post coitus. Semen is produced in the seminal vesicles, prostate gland and urethral glands.
- Sperm mature at the rate of about 300 million per day.



4. Ducts:

A. Ducts of testis:

- After the production of sperm from the somniferous tubules, release in to the lumen and goes in to straight tubules.
- Newly forming fluid produce by the sustentacular (sertoli) cells produce pressure that moves the sperm ahead.
- These fluids contain potassium ions (K^+), glutamic acid and antigen binding protein (ABP).
- From the straight tubules, fluid moves with sperm in to rate testis, which leads toward an epididymis.
- Epididymis is a comma shaped organ about 4 cm long.
- Next to epididymis is ductus epididymis (Sperm get mature here in 10 – 14 days) is a straight coiled structure 6 m in length continue with the tail epididymis.
- Within the tail of the epididymis, the ductus epididymis becomes less convoluted and its diameter increases. After this point, the duct is referred to as the ductus deference, vas deference or seminal duct.
- The ductus deference (vas deference) or seminal duct is 48 cm long, it store sperm. The dilated terminal portion of this vas deference is known as the ampulla.

B. Ejaculatory ducts:

- Posterior to the urinary bladder are the ejaculatory ducts.
- Each ejaculatory duct is about 2 cm long and is formed by the union of the seminal vesicle and the ampulla.
- The ejaculatory duct ejects the sperm in to the urethra just before ejaculation.

C. Urethra:

- In the male, Urethra is the shared terminal duct of the reproductive and urinary systems.
- It serves as a passageway for both semen and urine.
- The urethra passes through the prostate gland, the urogenital diaphragm and the penis.
- Its measure about 20 cm in length, divided in to three parts:
  - **The prostate urethra:** 2 – 3 cm long, passage from prostate gland.
  - **The membranous urethra:** 1 cm in length
  - **Spongy urethra:** 15-20 cm long
- Spongy urethral end consist external urethral orifice.

5. Accessory sex gland:

The ducts of male reproductive system store and transport sperm cells while the accessory sex gland secret most of the liquid portion of semen.

A. The paired seminal vesicles:

- It is a convoluted pouch like structure, about 5 cm in length and lying posterior to the urinary bladder and anterior to the rectum.
- It secrete:
  - An alkaline,
  - Viscous fluid that contains fructose, prostaglandins and clotting protein (semenogelin) (differ than the blood clotting protein).
- The alkaline nature of the fluid neutralizes the acid in the female reproductive tract.
- The fructose is used for ATP production by sperm.
- Prostaglandin is useful for the sperm motility and viability also stimulate the muscular contraction in the female reproductive system.
- Seminogelin is the protein that causes the coagulation of semen after ejaculation.
- Seminal vesicle adds 60 % of fluid of the total volume of semen.

B. The prostate gland:

- It is a doughnut shaped gland.
- It is inferior to the urinary bladder and surrounds the prostate urethra.
- The prostate secrete milky and slightly acidic fluid which contains:
  - Citrate: Useful for the ATP production by the sperm.
  - Acid phosphate: Functions are not known
  - Proteolytic enzymes like Prostate specific antigen (PSA) – liquefy the coagulated semen, pepsinogen, lysozyme, amylase and hyaluronidase.
- The secretion of the prostate gland enters the prostatic urethra through many prostatic ducts.
- The secretion of the prostate gland adds 25 % of fluid out of total volume of semen.

C: The bulbourethral or Cowper's gland:

- It is about the size of pea and It lie inferior to the prostate gland.
- During sexual arousal, bulbourethral gland secrete alkaline substance that protect sperm by neutralizing acid in the urethra.
- It also secretes mucus that lubricates the end of penis and the lining of urethra.

6. Semen:

- Semen is the mixture of sperm and seminal fluid.
- The average volume of semen in each ejaculation is 2.5 – 5 mL.
- There are 50 – 150 million sperm present per milliliter (mL).
- When the sperm fall below the 20 million/mL, the male is likely to be infertile.
- The pH of semen is in the range of 7.2 – 7.7.

7. Penis:

- The penis contains the urethra, a passage for ejaculation of semen and for excretion of urine.
- It is cylindrical in shape and consist body, root and gland penis.
- The consensus is that the average erect human penis is approximately 12.9–15 cm (5.1–5.9 in) in length with 95% of adult males falling within the interval 10.7–19.1 cm (4.2–7.5 in). Neither age nor size of the flaccid penis accurately predicts erectile length.

A. Body of penis:

- It is composed by the three cylindrical masses of tissue:
  - — Tunica albuginea
  - — Corpora cavernosa penis (Paired dorsolateral masses)
- Tunica albuginea consist corpus spongy penis at the middle part and spongy urethra.
- All the three masses are covered by the facia and skin with the erectile tissue permeated by blood sinuses.
- During the sexual stimulation, which may be:
  - — Visual,
  - — Tactile,
  - — Auditory,
  - — Olfactory,
  - — Or Imagination large quantities of blood enter in to the penis due to the dilation of arteries (effect of nitric oxide).
- These vascular effects produce erection in penis.
- Ejaculation is the sympathetic reflex. As a part of reflex the smooth muscle spincter at the base of urinary bladder close.
- Thus urine is not expelled during ejaculation.

B. Root of penis:

- It is the attached part, consisting of the bulb of penis in the middle and the crus of penis, one on either side of the bulb. It lies within the superficial perineal pouch.

C. Gland penis:

- The distal end of the corpus spongiosum penis is slightly enlarged, acorn shaped region known as gland penis.
- The margin of gland penis is known as corona.
- Gland penis consist the external urethral orifice.

THE FEMALE REPRODUCTIVE SYSTEM:

The female reproductive system include

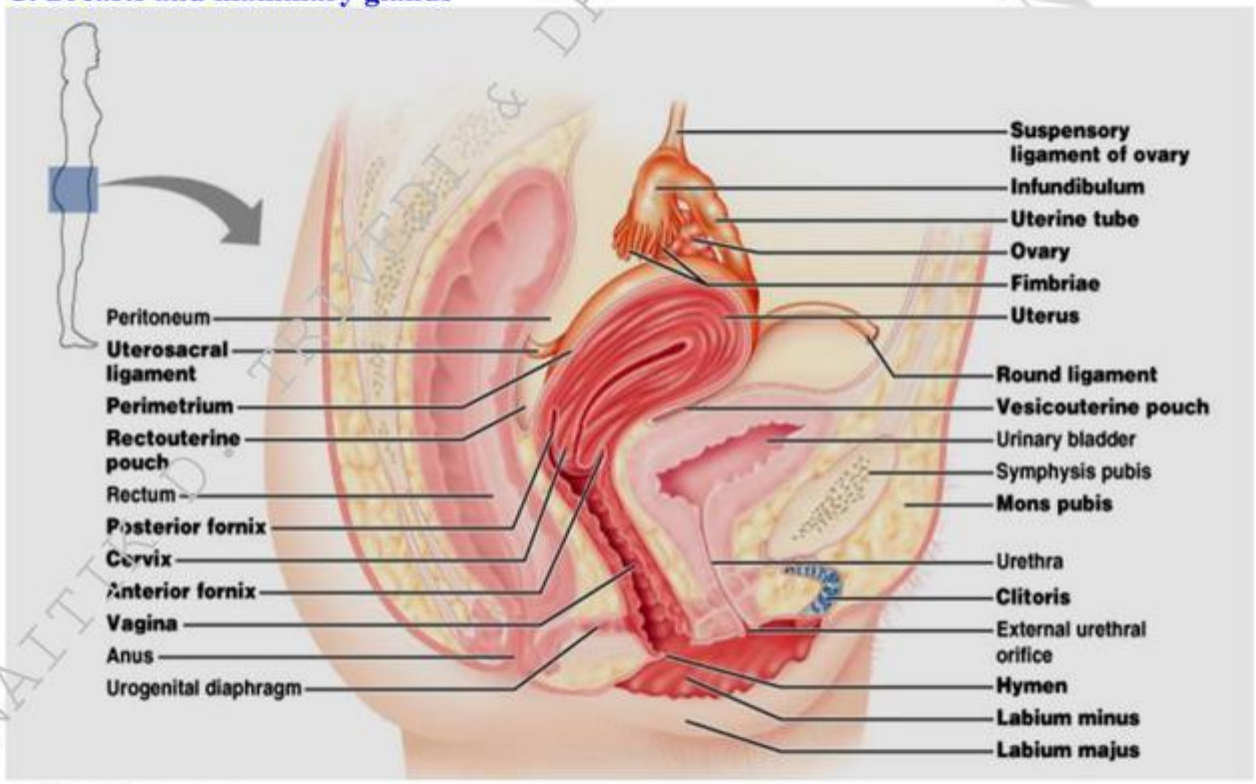
A. Internal genitalia:

— 2 ovaries
— 2 oviducts (uterine or Fallopian tubes)
— Uterus
— vagina

B. External genitalia

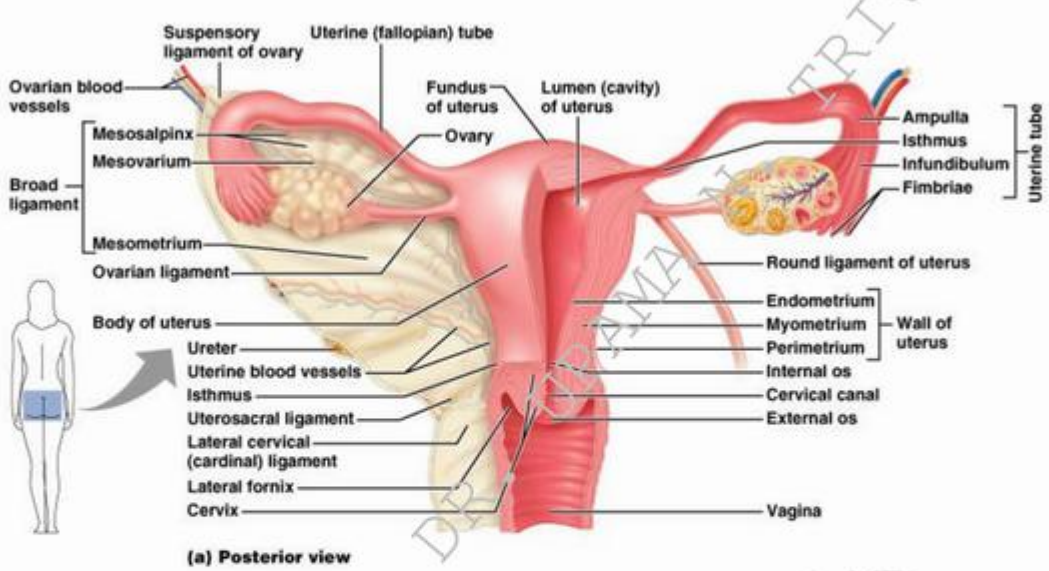
— clitoris
— labia minora
— labia majora

C. Breasts and mammary glands

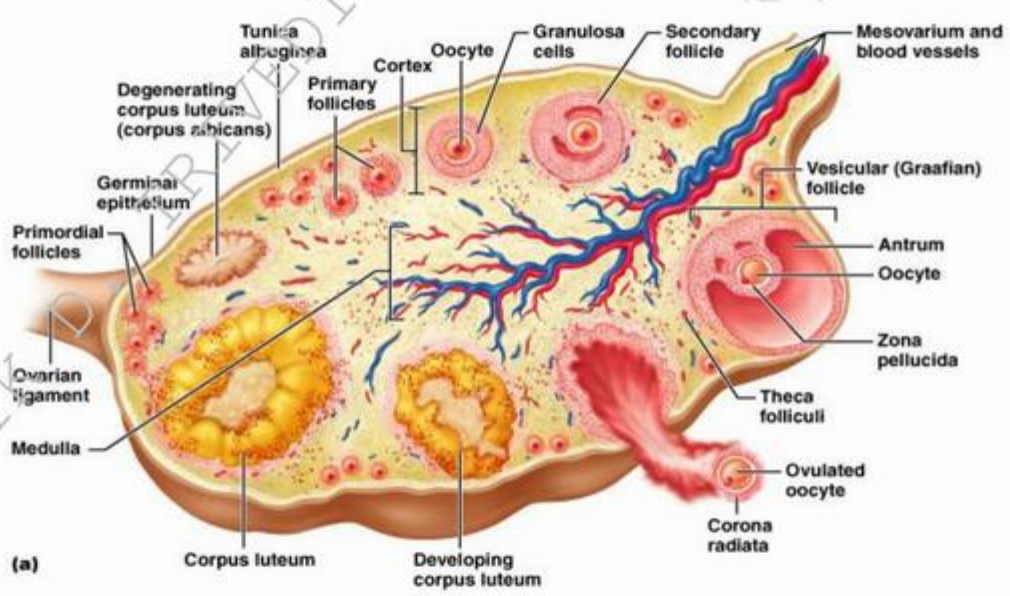


1. Ovaries:

- The paired ovaries are paired glands that resemble unshelled almonds in shape and size.
- Because of the same origins ovaries are homologues to testis.
- The broad ligament of uterus, which is the part of partial peritoneum, attaché to ovaries by double layer fold of peritoneum known as mesovarium.
- The ovarian ligament anchors the ovaries to uterus and the suspensory ligament attach them to the pelvic wall.



A. Structure of ovary:



i) Germinal epithelium:
- — It covers the surface of the ovary and it continues with the mesothelium that cover the mesovarium.

ii) Tunica albuginea:
- — It is a whitish capsule of dense irregular connective tissue extended deep to germinal epithelium.

iii) Stoma:
- — Deep to the tunica albuginea known as stroma.
- — It divided in to the two portions, superficial portion known as cortex and deep portion known as medulla.

iv) Ovarian follicle:
- — It is lie in to the cortex region of stoma.
- — Here the oocytes pass from the various steps of their development with their surrounding cells.
- — The surrounding cells produce single layer known as follicular cells.

— Later in developing stage of oocyte, it produces several layers known as granulose.
— These surrounding cells secret estrogen and other fluid so follicle grow larger.

v) Mature (Graafian) follicle:

It is a large fluid filled follicle after the rupturation of this follicle secondary oocyte get expel out.

vi) Corpus luteum:

— It is the remnant of an ovulated mature follicle.

B. The Ovarian Cycle

i) Follicular phase

— 1st approx 14 days but variable
— Egg develops in a follicle
— Stimulated by FSH

Estrogen produced

ii) Ovulation

— Egg released from follicle (LH surge)
— Egg in abdominal cavity
— Picked up by fimbria of fallopian tube
— Not necessarily halfway point

iii) Luteal phase

— Postovulatory phase 14 days (more constant)
— Corpus luteum develops from exploded follicle
— Produces progesterone as well as estrogen
— Progesterone stimulates uterus to be ready for baby
— If no pregnancy, corpus luteum degenerates into corpus albicans

2. Uterine (Fallopian) Tubes:

- Female have two fallopian tubes. It stretches from the uterus to the ovaries and measure about 8 to 13 cm in length. It transport the secondary oocytes to the uterus.
- The open, funnel shaped portion of each tube is known as infundibulum, close to the ovary.
- At the end portion of infundibulum has finger like projection known as fimbria, which hold the ovary.
- Widest and longest portion of the uterine tube is known as ampulla and short, narrow, thick walled portion known as isthmus that join the uterus.

3. Uterus:

- The uterus is located inside the pelvis immediately dorsal (and usually somewhat rostral) to the urinary bladder and ventral to the rectum.
- The human uterus is pear-shaped and about 3 in. (7.6 cm) long, 4.5 cm broad (side to side) and 3.0 cm thick (anteroposterior).
- A nonpregnant adult uterus weighs about 60 grams.
- Layers of the uterus:
  - **Perimetrium:** it is the outer layer of the uterus.
  - **Myometrium:** It is the middle layer of the uterus.
  - **Endometrium:** The lining of the uterine cavity is called the "endometrium".
- Parts of uterus:
  - **Fundus:** The dome shaped portion superior to the uterine tube known as fundus.
  - **Body:** The major tapering central portion is known as body.

- **Cervix:** The inferior narrow portion opens in to the vagina known as cervix

4. Vagina:

- Vagina is the passage for the menstrual flow and child birth.
- It also receives semen from the penis during the sexual intercourse.
- It is 10 cm in length, situated between the urinary bladder and the rectum.
- The vaginal mucosa secret the acidic fluid as well as the mucosal cells of vagina has the antigen presenting cells (APCs) from where the HIV (AIDS) virus gets transmitted.
- The next layer is muscularis is composed of an outer circular layer and inner longitudinal layer of smooth muscle that can stretch considerably to receive the penis during sexual intercourse and allow for birth of a fetus.
- The adventitia is the superficial layer of the vagina.
- At the end of vagina there is vaginal orifice covered by the mucosal membrane known as hymen.
- Sometimes the hymen completely covers the orifice, a condition known as imperforated hymen, which may require surgery to open the orifice and permit the discharge of the menstrual flow.

5. Vulva:

It is known as the external genital organ of the female reproductive system.

i) **Mons pubis:**
Anterior to the vaginal and urethral opening portion is known as mons pubis. It is an elevation of adipose tissue covered by the skin and hair.

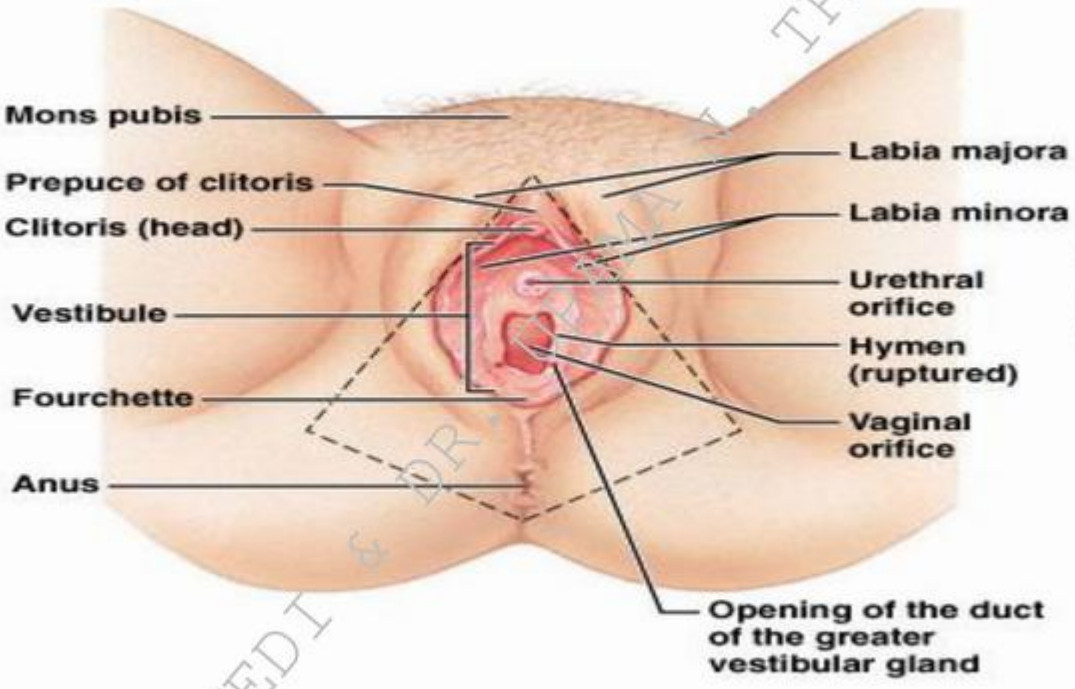
ii) **Labia majora:**
From the mons pubis, two longitudinal folds of skin known as labia majora. It is homologues to the scrotum and are covered by the pubic hair.

iii) **Labia minora:**
Middle to the labia majora is to smaller folds of skin called the labia minora. But it not consist the hair and fat. They have few sudoriferous (sweat) glands and sebaceous (oil) gland.

iv) **Clitoris:**
It is the small, cylindrical mass of erectile tissue and nerve. It is located at the anterior junction of the labia minora. It is homologues to the penis and capable of enlargement upon tactile stimulation and it play important role in sexual excitement of the female.

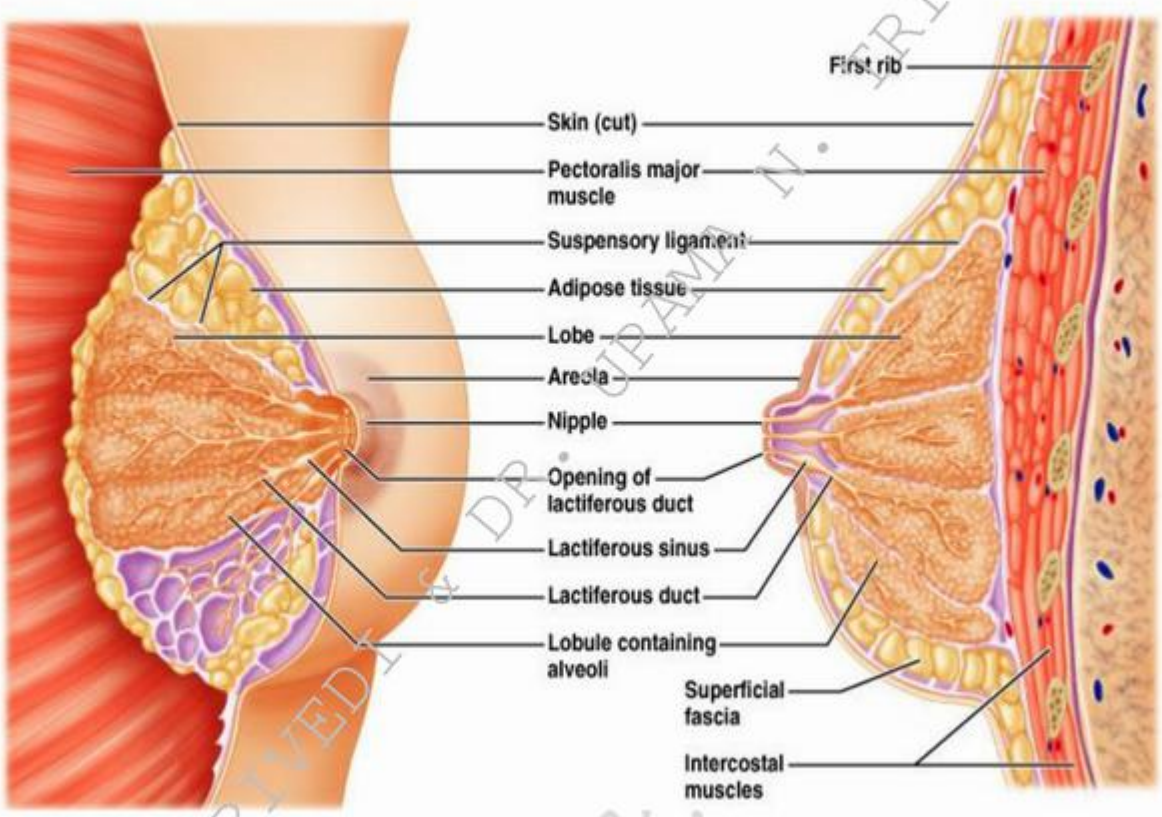
v) **Vestibules:**
The region between labia minora is known as the vestibules. Hymen, Vaginal orifice, external vaginal orifice are located between the vestibules. The bulb of the vestibules consists of two elongated masses of erectile tissue, during the sexual intercourse it narrowing the vaginal orifice and placing pressure on the penis. Anterior to the vaginal orifice and posterior to the clitoris is the external urethral orifice.

v) **Perineum:**
It is the diamond shaped area medial to the thigh and buttocks of both males and females. That contains the external genital and anus.



6. Mammary glands:

- Mammary gland is an organ in female mammals that produces milk to feed baby located in to the breast.
- Each breast has one pigmented projection known as nipple, it have closely spaced opening known as lactiferous ducts from where milk emerges.
- The circular pigmented area of the skin surrounding the nipple known as areola. It appears rough because it contains modified sebaceous (oil) glands.
- Within each breast the memory glands consists 15 – 20 lobes separated by adipose tissue.
- Each lobe have smaller compartment known as lobules composed of grapelike clusters of milk secreting glands known as alveoli.
- Surrounding the alveoli are spindle shaped cells known as myoepithelial cells, whose contraction helps to propel milk towards the nipple.
- Milk path: alveoli – secondary tubules – mammary ducts – lactiferous sinus – lactiferous duct.
- Milk secretion is stimulated by the hormone prolactin as well as with the contribution of estrogen and progesterone.



MENSTRUAL CYCLE:

- The duration of the female reproductive cycle is 24 – 35 days.
- Menstrual cycle is divided in to three phases:

i) Menstrual Phase ii) Preovulatory Phase iii) Postovulatory Phase

i) Menstrual Phase:

This phase is also known as menstruation or menses phase, takes first 5 days of the cycle.

a. Events in the ovaries:

- During the menstruation phase, about 20 so small secondary follicles try to being enlarge.
- In this phase, follicular fluid secret from the granulose cells and oozing from blood capillaries and oocyte remain near the edge of the follicle.

b. Event in the uterus:

- In this phase, decrease the hormone level of estrogen and progesterone. Because of this reason, produce contraction of uterine spiral arteries.
- So the blood supply of the Endometrium cell gets interrupt and start to die. It start the menstruation flow consists about the volume of 50 – 150 ml of blood, tissue fluid, mucus and epithelial cells derived from the Endometrium.

ii) Preovulatory Phase:

It is the second phase of the female reproductive cycle. It is the phase between the menstruation and ovulation phase.

If we consider 28 days menstrual cycle, it takes 6 to 13 days of period.

a) **Events in the ovaries:**
   - In this phase, the secretion of FSH produces effects on 20 secondary follicle and its grow secret estrogen and inhibin.
   - Out of 20 secondary follicles, one follicle in one ovary has outgrown all others so it is known as the dominant follicle.
   - Estrogen and inhibin secretion by the dominant follicle cell decrease the secretion of FSH and this effect stop the development of other follicle cells.
   - Dominant follicle cell produce the mature follicle about the size of 20 mm in diameter and ready for the ovulation.
   - In this phase the secretion of LH also increase the secretion of estrogen and start the secretion of progesterone also.

b) **Events in the uterus:**
   - In this phase, estrogen liberate in to the blood by growing ovarian follicle cell.
   - It stimulates the repair of endometrium damage. It produces the neovascularization, cell proliferation and differentiation so increase the thickness of endometrium, this phase is also known as the proliferative phase.

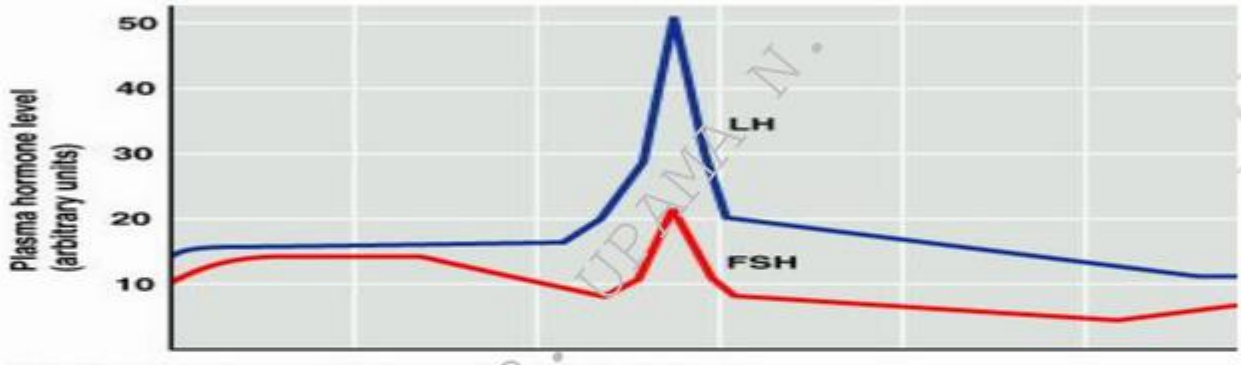
Ovulation:
   - In this phase, the mature follicle cell gets rupture and releases the secondary oocyte in to the pelvic cavity, usually occur in the day 14 of 28 dyas cycle.
   - It generally takes 20 days (last 6 days of the previous cycle and first 14 days of the current cycle).
   - During this phase, primary oocyte complete the meiosis – I and enter in to the meiosis – II.

iii) Post ovulation phase:

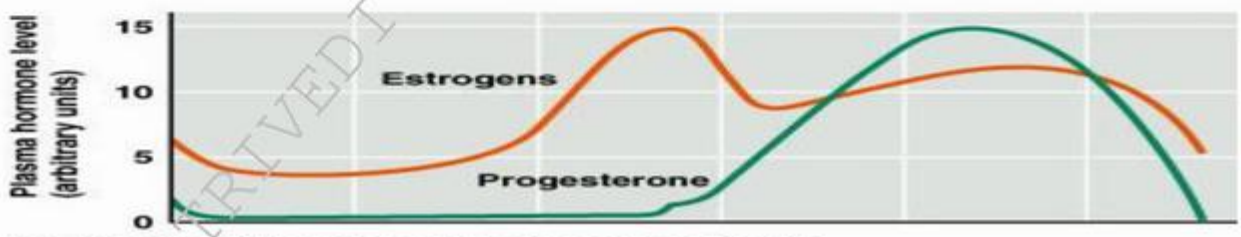
It takes last 14 days, from days 15 to 28. It represent the time between ovulation and the onset of the next menses. Corpus luteum formed in this phase and it increases the secretion of estrogen and progesterone.

a) **Events in the ovary:**
   - In this phase if the secondary oocyte get fertilize and begins to divide, the corpus luteum persists past its normal 2 week life span and it is maintained by the human chronic gonadotropin (hCG).
   - This hormone is produce by the chorion of the embryo after 8 – 12 days of fertilization.
   - The hCG level in to the blood or urine confirm the pregnancy.
   - If the hCG will not release (because of no fertilization) than corpus letuem decrease their secretion and produce scar known as corpus albican.
   - Decrease level of estrogen and progesterone again start the menstruation.

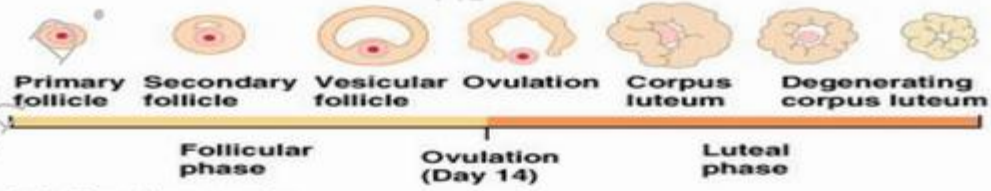
b) **Event in the uterus:**
   - Progesterone and estrogen secretion produce by the corpus luteum promote the growth and coiling of the endometrium gland, which begins to secret glycogen, vascularization of the superficial endometrium, thickening of the endometrium and increase the amount of tissue fluid.



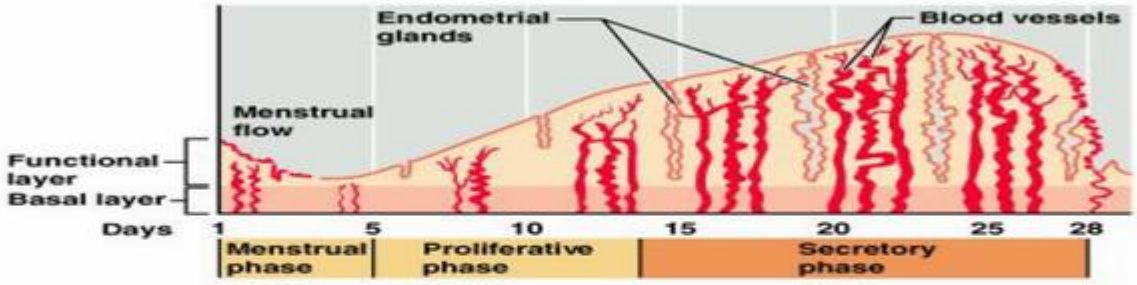
(a) Fluctuation of gonadotropin levels



(b) Fluctuation of ovarian hormone levels



(c) Ovarian cycle

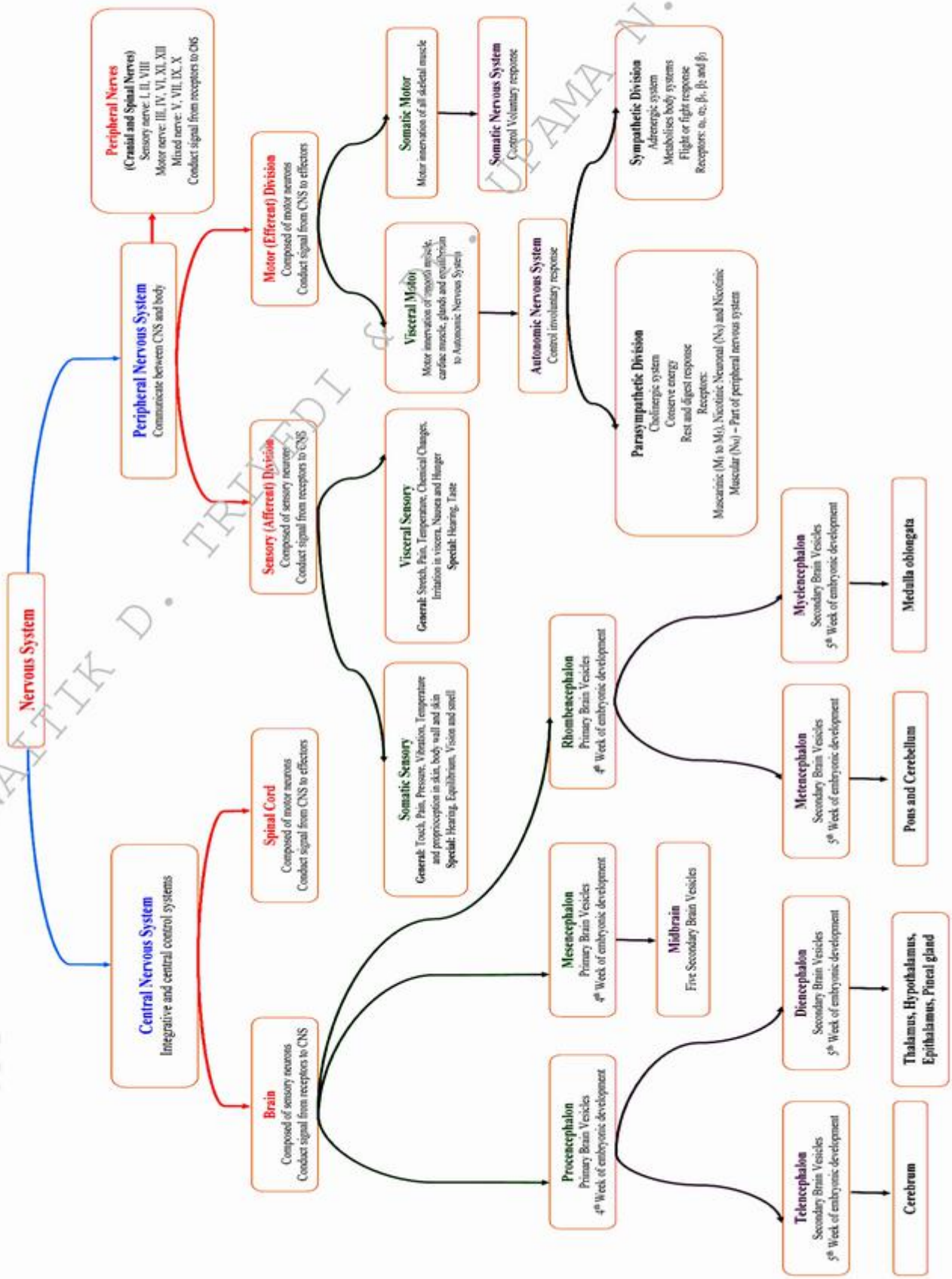


(d) Uterine cycle

SIGNATURE OF TEACHER

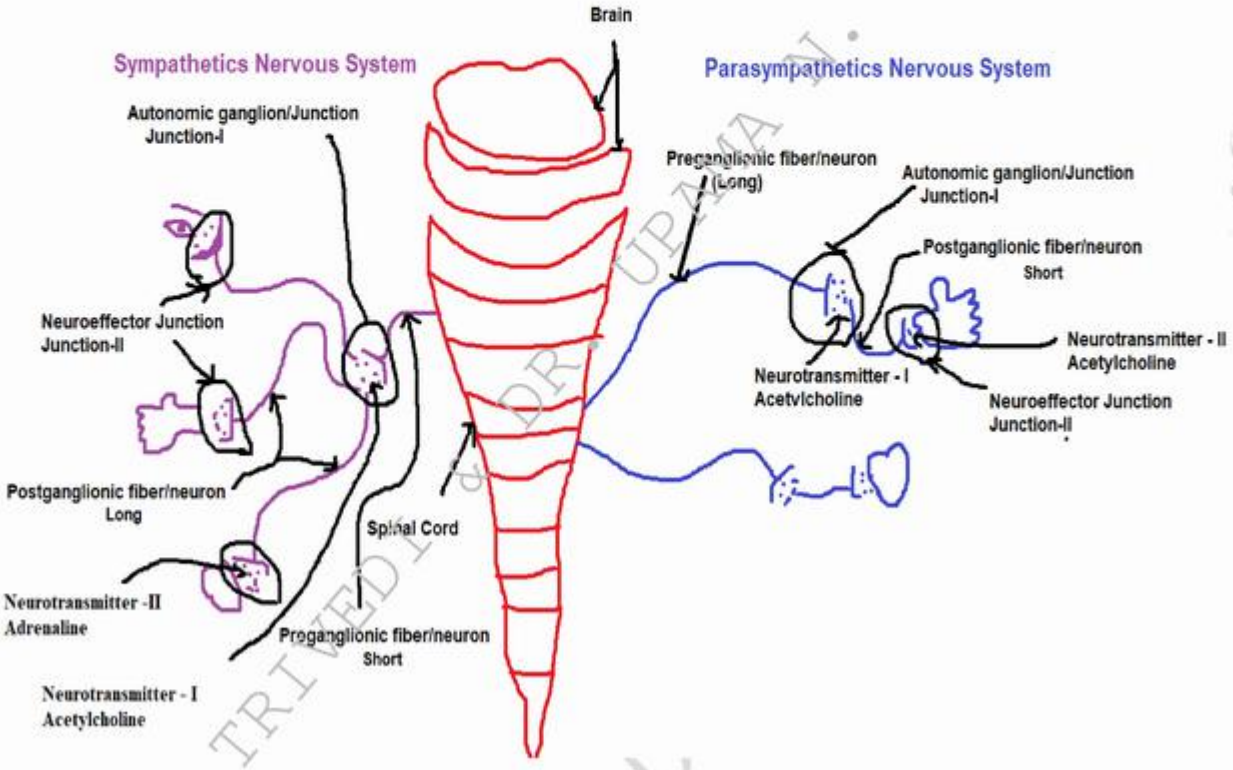
EXPERIMENT NO.: 14. g **DATE:**

AIM: TO STUDY THE NERVOUS SYSTEM USING SPECIMEN AND MODELS



REQUIREMENTS: Charts and Models of Human Brain, Spinal Cord, Autonomic Nervous system

AUTONOMIC NERVOUS SYSTEM



THEORY

Introduction of Autonomic Nervous System (ANS):

It is the part of nervous system that deals with the involuntary movements. It is also known as visceral nervous systems. It works under the conscious and unconscious conditions and maintain the involuntary functions. It control automatically, pumping of blood, beating of heart, contraction of blood vessel, lungs and GI tract, secretion of saliva, lacrimal fluid etc….

Anatomy of Autonomic Nervous System (ANS):

Hypothalamus

↓ Coordinate with

Midbrain/Spinal Cord

↓

Stimulate Preganglionic Neuron/Fiber

↓ Release Neurotransmitter – I at Autonomic Ganglion

Stimulate Postganglionic Neuron/Fiber

↓ Release Neurotransmitter – II at Neuron Effector Junction

It stimulate various receptors of respective organs

↓

Produce various autonomic action

Autonomic nervous system is subdivided into the two portion:

1. Parasympathetic Nervous System (Cholinergic Nervous System)
2. Sympathetic Nervous Systems (Adrenergic Nervous System)

1. PARASYMPATHETIC NERVOUS SYSTEM (CHOLINERGIC NERVOUS SYSTEM):

Anatomy of Parasympathetic Nervous System (Cholinergic Nervous System)

Superior control by anterior and middle part of hypothalamus

↓

Centre of III, VII, IX and X cranial nerve and sacral part of spinal cord

↓

Activate preganglionic neuron/fiber (Long)

↓

Release neurotransmitter-I (Ach) in Autonomic Ganglion/Junction (Junction-I)

↓ Stimulate (N_N) or (M_1) receptor

Activate postganglionic neuron/fiber (Short) after that Ach is destruct by Acetylcholine Esterase

↓

Release neurotransmitter-II (Ach) in Neuron Effector Junction (Junction-II)

↓ Stimulate (M_1), (M_2), (M_3) or (N_N) receptor

Produce various action after that Ach is destruct by Acetylcholine Esterase (AchE)

*Preganglionic neuron/fibers are long and post ganglionic neuron/fibers are short in parasympathetic nervous system.

* One preganglionic neuron/fiber, one or two post ganglionic neuron/fiber are originated except Auorbach's plexus - inner circular and outer longitudinal layers of the muscularis externa).

* Acetylcholine esterase (AchE) is the enzyme which destruct the Acetyl Choline (Ach) after their action.

* Parasympathetic system consist two types of receptors: 1) Muscarinic (M_1, M_2, M_3, M_4, M_5) and Nicotinic (N_N – Nicotinic Neuronal, N_M – Nicotinic Muscular).

Location of parasympathetic receptors and their functions:

Parasympathetic receptors

↓

Muscarinic → **M_1** **M_2** **M_3** **M_4** **M_5**

Nicotinic → **Nicotinic Neuronal (N_N)** **Nicotinic Muscular (N_M)**

- **M_1 receptors:**

Location	Function
Autonomic ganglion/junction (Junction – I)	Activation of post ganglionic neuron/fiber

- **M_2 receptors:**

Location	Function
Heart	Decrease force of contraction (Negative Inotropic) Decrease heart rate (Negative Chronotropic) Decrease conduction (Negative dromotropic)

- **M_3 receptors:**

Location	Function
GI smooth muscle	Contraction of GI smooth muscle
Bronchial smooth muscle	Contraction of bronchial smooth muscle (Lungs contraction)
Urinary tract	Contract detrusor – urinary bladder muscle which relax trigon of urinary bladder and produce micturition.
Salivary secretion	increase secretion of saliva
Lacrimal secretion	Increase secretion of tear/lachrymal fluid
Gastric secretion	Increase secretion of HCl in GI tract
Eye	Produce meiosis (Contraction of pupils) Iris consist two types of smooth muscles 1) Sphincter pupillae 2) Dilator pupillae (Radial Muscle). Contraction of sphincter pupillae constrict pupil known as meiosis and contraction of dilator pupillae produce dilation of pupil known as mydriasis.

N_N receptors:

Location	Function
Autonomic ganglion/junction (Junction – I)	Activation of post ganglionic neuron/fiber
Adrenal medulla	Release of adrenalin and some nor adrenalin
CNS	Complex undefined action but inhibitory

N_M receptors:

Location	Function
Neuromuscular Junction	Contraction of skeletal muscle

Synthesis, storage, release and hydrolysis of Ach

Choline + Acetyl Co-A

↓ Choline acetylase

Ach (Store in vesicle)

↓ Release of Ach when needed

Ach produce various action through receptors

↓ Acetylcholine Esterase (AchE) destruct Ach

Ach convert in acetate and choline

2. SYMPATHETIC NERVOUS SYSTEMS (ADRENERGIC NERVOUS SYSTEM)

Anatomy of sympathetic nervous system (Adrenergic System)

Superior control by posterior and lateral part of hypothalamus

↓

Preganglionic fibers origenate from Thoracic 1 to Lumber 3 segments

↓

Activate preganglionic neuron/fiber (Short)

↓

Release neurotransmitter-I (Ach) in Autonomic Ganglion/Junction (Junction-I)

↓ Stimulate (N_N) or (M_1) receptor

Activate postganglionic neuron/fiber (Long) after that Ach is destruct by Acetylcholine Esterase

↓ Release neurotransmitter-II (Adr)

Stimulate (α_1), (α_2), (β_1), (β_2) or (β_3) receptor in Neuron Effector Junction (Junction-II)

↓

Produce various action

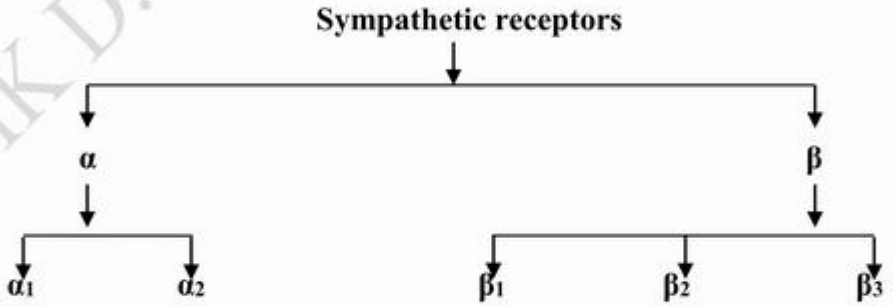
*Preganglionic neuron/fibers are short and post ganglionic neuron/fibers are long in sympathetic nervous system.

* One preganglionic neuron/fiber emerge out 20 to 100 post ganglionic neuron/fiber.

* Sympathetic nervous system consist both the neurotransmitter that is acetylcholine in autonomic ganglion/junction and noradrenalin in neuron effector junction.

* Parasympathetic system consist two types of receptors: α (α_1, α_2) and β (β_1, β_2, β_3)

Location of sympathetic receptors and their functions:



- **α_1 receptors:**

Location	Function
Blood vessels	Produce vasoconstriction
Iris	It contract radial muscles and dilate the pupil known as mydriasis
GI tract	Contract the GI sphincter and relax the the GI muscle
Urinary bladder	Contract the trigon and relax the urinary bladder
Glands	Increase the secretion of glands
Uterus	It produce contraction in nonpregnant uterus
Heart	Weak action on heart
Male sex organ	Penile erection and ejaculation
Skin	Contraction of pilomotor muscles.

- **α_2 receptors:**

Location	Function
Presynaptic nerve ending	It reduce release of noradrenalin
Blood vessels	Produce constriction of blood vessels
CNS	Reduction in central sympathetic flow due to decrease of Noradrenalin level
Pancreas	Reduce insulin level so increase blood sugar level
Platelets	Aggregate platelets
GI muscle	Relaxation of GI muscle

- **β_1 receptors:**

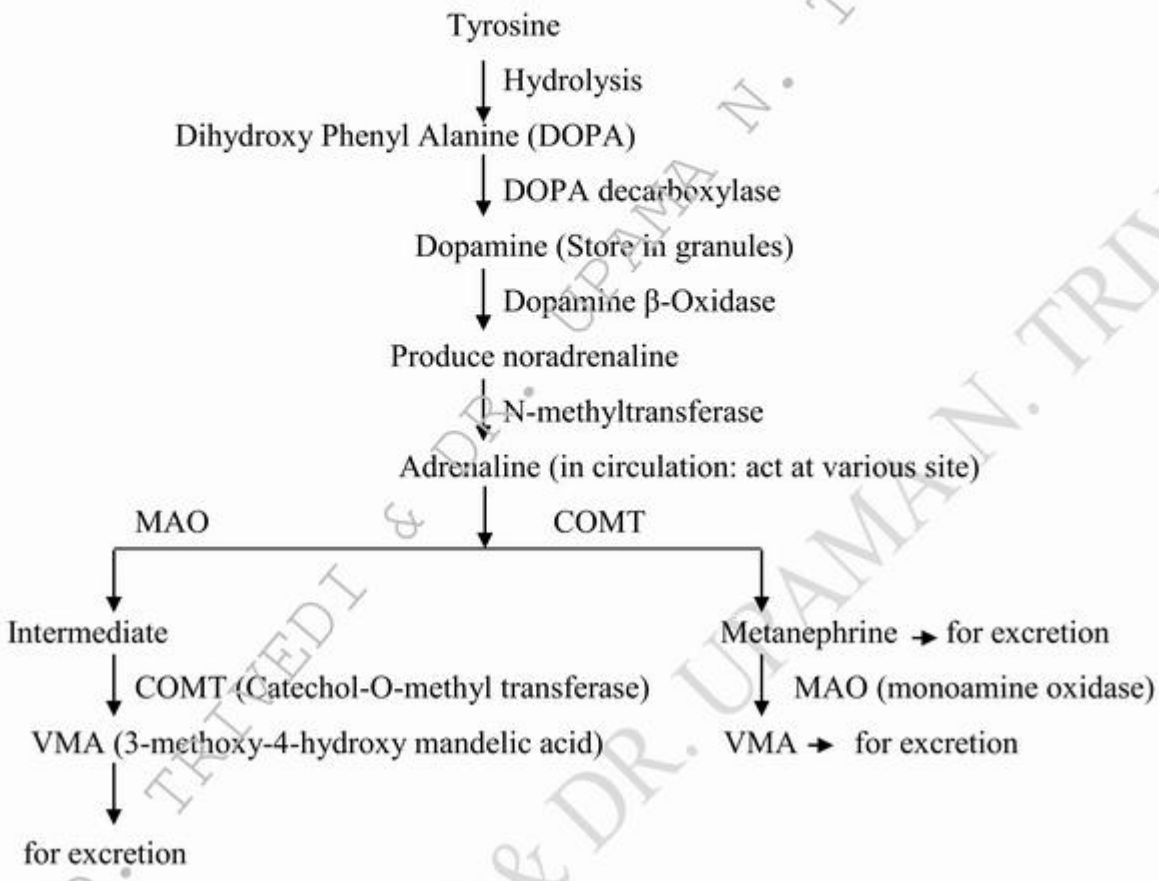
Location	Function
Heart	Increase force of contraction (Positive Inotropic) Increase heart rate (Positive Chronotropic) Increase conduction (Positive dromotropic)
Kidney	Release of renin, so renin activate angiotensinogen I which convert in angiotensinogen II by the help of angiotensinogen converting enzyme (ACE) and activate the aldosterone. Which retain the Na^+ and water and increase the blood volume as well as angiotensinogen act on AT-I and AT-II receptor and contract the blood vessels.

- **β_2 receptors:**

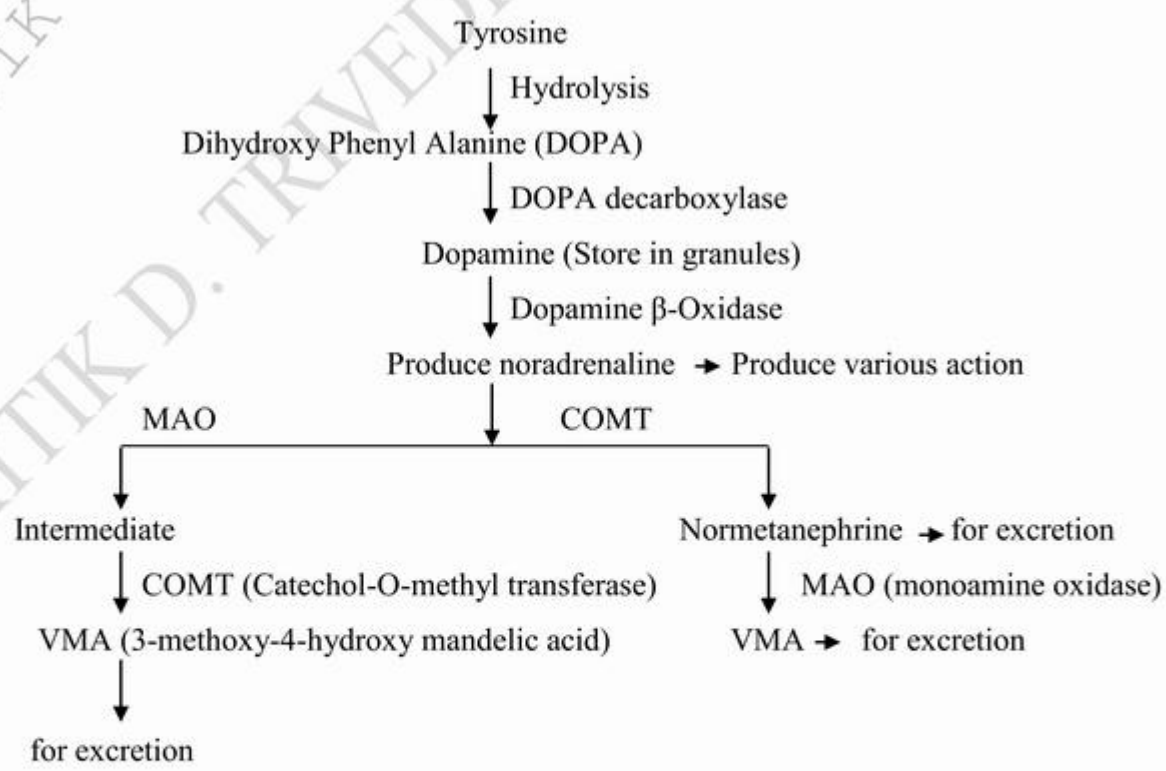
Location	Function
Blood vessels	Dilation of blood vessels
Lungs	Dilation of bronchial smooth muscles and lungs
GI muscle	Relaxation of GI muscle
Bladder	Relaxation of detrusor produce relaxation in urinary bladder (contract the trigon)
Liver	Produce glycogenolysis means conversion of glycogen to glucose and increase blood sugar level
Pancreas	Increase glucagon secretion which increase blood sugar level
Adipose tissue	Lipolysis (Break down of fats)
Uterus	Produce relaxation in pregnant uterus

- **β_3 receptors:** Role and functions of β_3 receptors are not clearly defined.

Synthesis, storage, release and hydrolysis of adrenaline

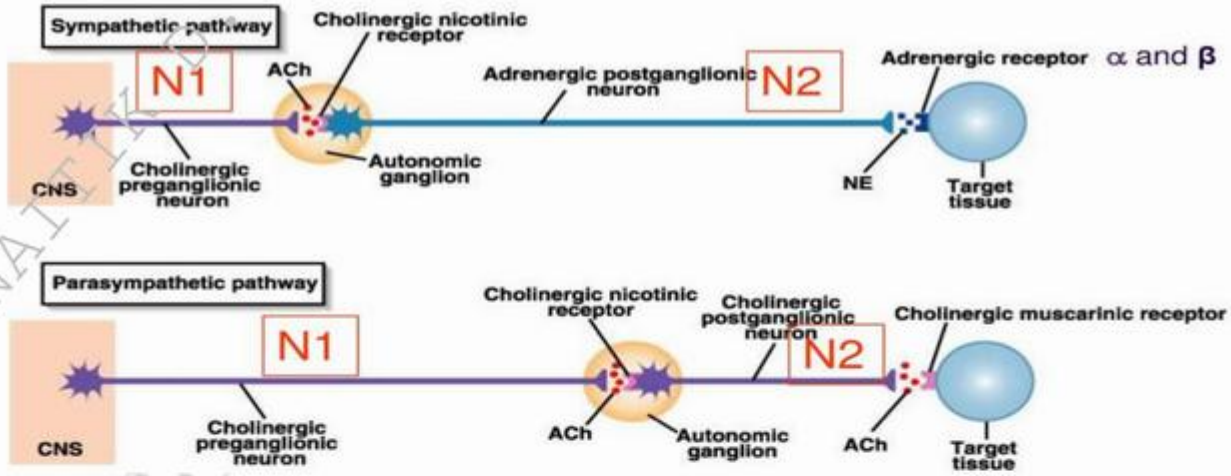


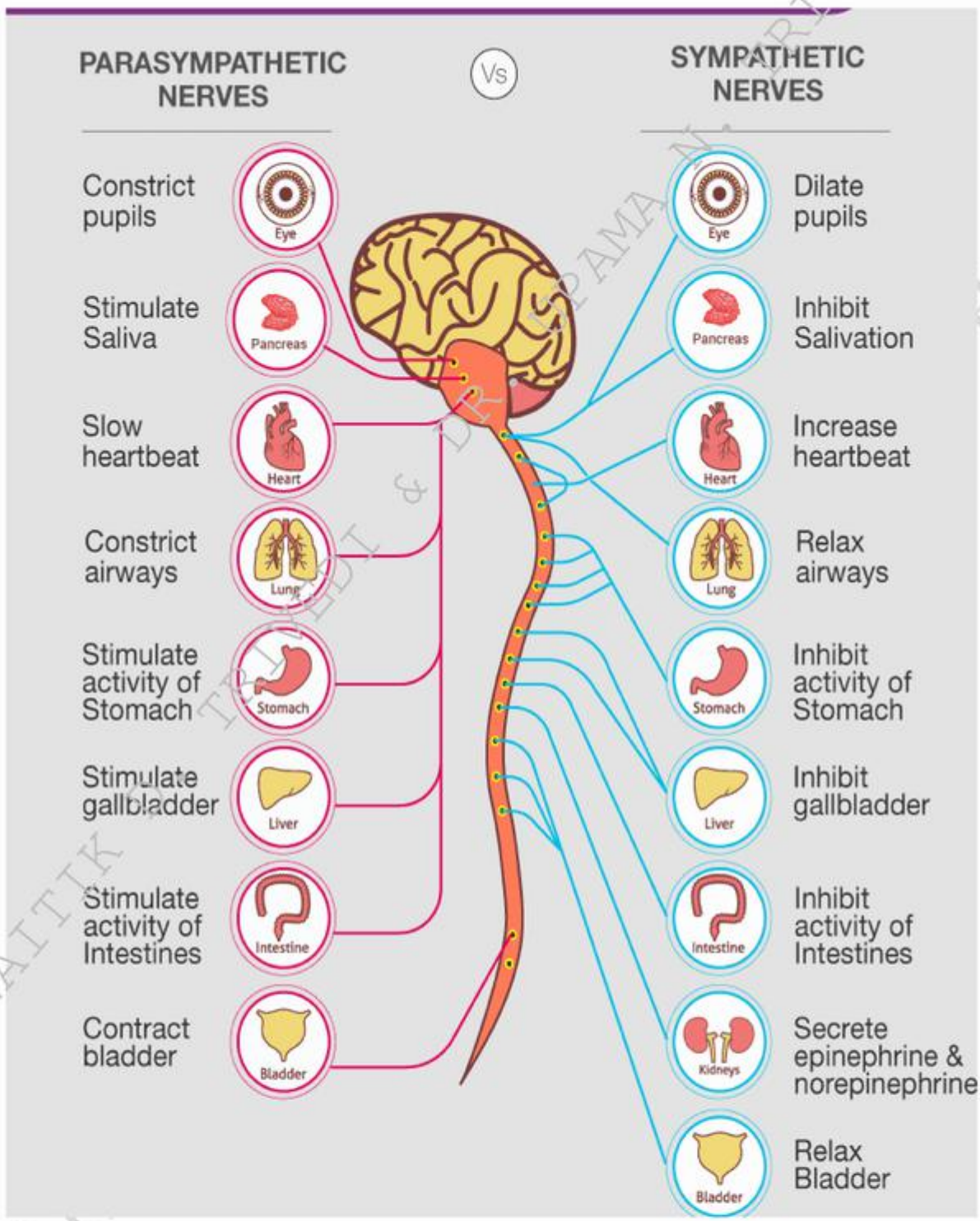
Synthesis, storage, release and hydrolysis of noradrenaline

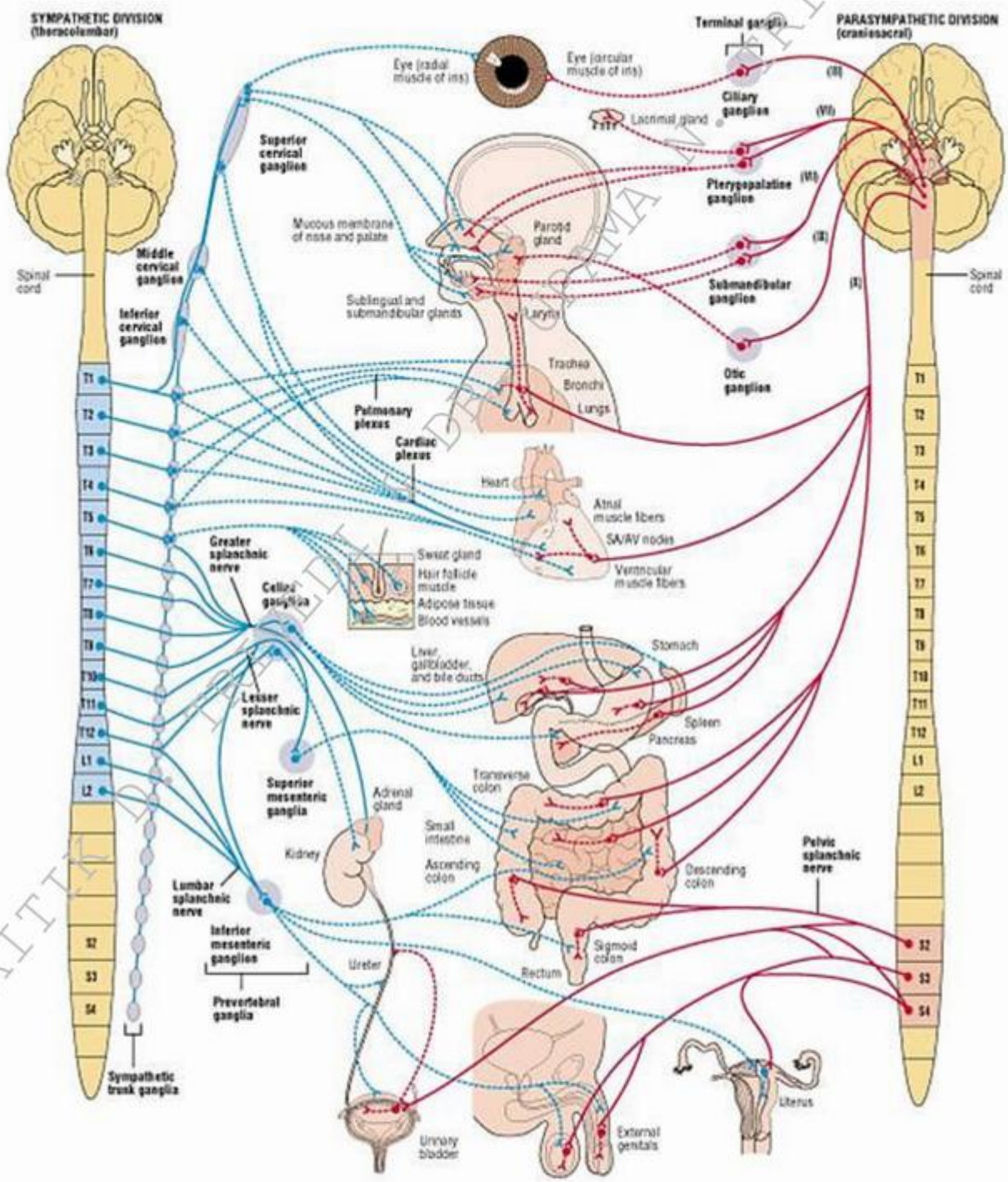


Sympathetic and Parasympathetic Effects		
Structure	**Sympathetic**	**Parasympathetic**
Eye (pupil)	Dilation	Constriction
Nasal Mucosa	Mucus reduction	Mucus increased
Salivary Gland	Saliva reduction	Saliva increased
Heart	Rate increased	Rate decreased
Arteries	Constriction	Dilation
Lung	Bronchial muscle relaxation	Bronchial muscle contraction
Gastrointestinal Tract	Decreased motility	Increased motility
Liver	Conversion of glycogen to glucose increased	Glycogen synthesis
Kidney	Decreased urine	Increased urine
Bladder	Contraction of sphincter	Relaxation of sphincter
Sweat Glands	↑Sweating	No change

Neurotransmitter	Neurotransmitter – I is acetylcholine and Neurotransmitter – II is Adrenalin	Neurotransmitter – I and II both are acetylcholine
Preganglionic fiber	Short	Long
Postganglionic fiber	Long	Short
Receptor	α and β	Muscarinic (M) and Nicotinic (N)




PARASYMPATHETIC NERVES
Vs
SYMPATHETIC NERVES
Constrict pupils
Eye
Dilate pupils
Stimulate Saliva
Pancreas
Inhibit Salivation
Slow heartbeat
Heart
Increase heartbeat
Constrict airways
Lung
Relax airways
Stimulate activity of Stomach
Stomach
Inhibit activity of Stomach
Stimulate gallbladder
Liver
Inhibit gallbladder
Stimulate activity of Intestines
Intestine
Inhibit activity of Intestines
Contract bladder
Bladder
Kidneys
Secrete epinephrine & norepinephrine
Relax Bladder



Sympathetic and parasympathetic nervous system (Ref: Tortora)

CENTRAL NERVOUS SYSTEM

THE BRAIN

Anatomy of Brain:

Adult brain consist average 100 billion neurons and 1000 billion neuroglia. Weight of the adult brain is approximately 1.3-1.5 kg in human. Brain mainly divided into four parts:

1. Brain Stem: It is the superior portion and continuous with the spinal cord consist medulla oblongata, pons and midbrain.
2. Cerebellum: It located posterior to the brain stem.
3. Diencephalon: It is located superior to the brain stem. It consist thalamus, epithalamus, subthalamus, hypothalamus and pineal gland.
4. Cerebrum: It look like cap of mushroom. It occupies the most of the part of cranium and it is divided into right and left halves known as cerebral hemispheres.

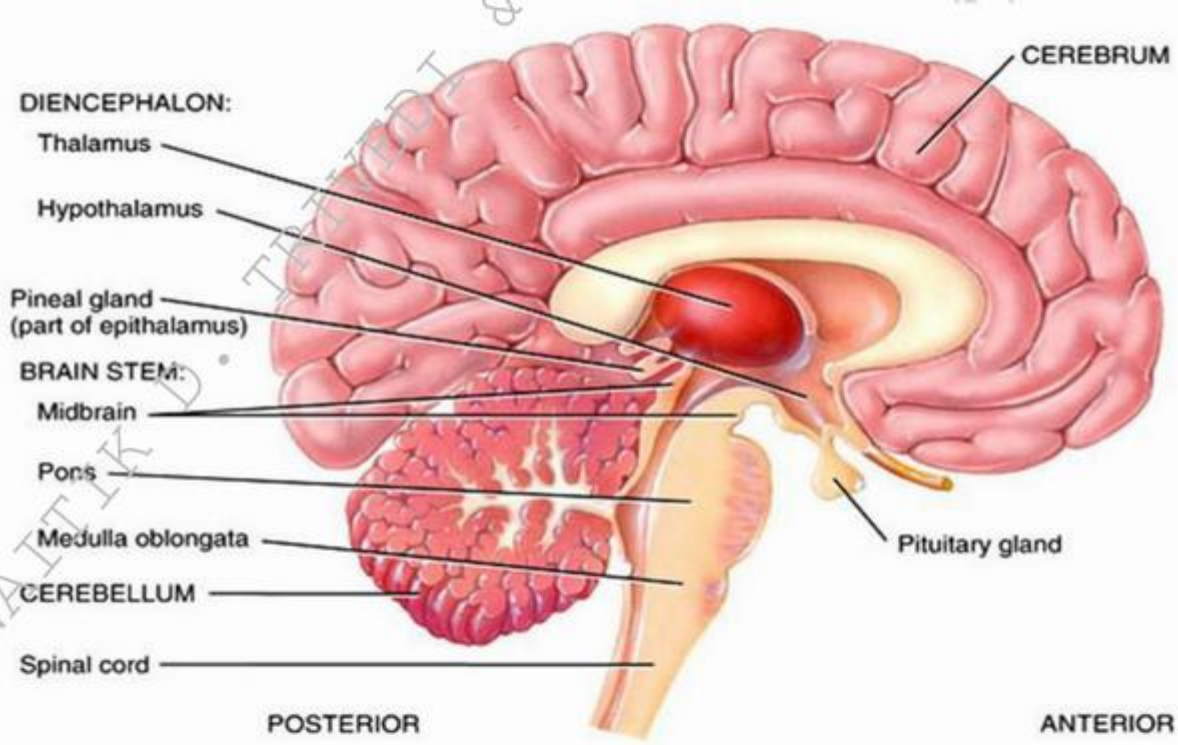


Diagram of brain

According to the embryonic development brain is divided mainly into the three parts at the third weeks of embryonic development which is also known as primary brain vesicles:

1. Prosencephalon – Forebrain
2. Mesencephalon – Midbrain
3. Rhombencephalon – Hindbrain

During the further development of the embryo primary vesicles is divided and form secondary vesicles at the 5th weeks of embryonic development.

- Procencephalon develop telencephalon and diencephalon

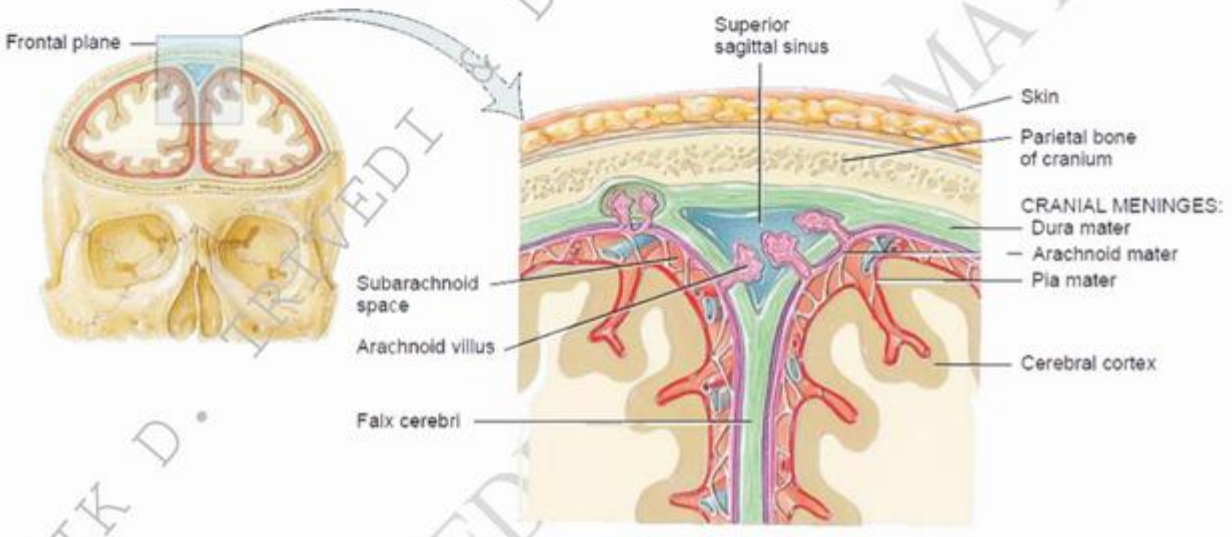
- Mesencephalon develop midbrain
- Rhombencephalon develop metencephalon and myelencephalon

At the final stage of embryonic development:

- Telencephalon forms cerebrum
- Diencephalon forms epithalamus, hypothalamus, subthalamus, thalamus and pineal gland
- Metencephalon forms pons and cerebellum
- Myelencephalon forms medulla oblongata

The brain grow rapidly during the first few years of life (between the ages of 1-12 years).

PROTECTION AND COVERING OF THE BRAIN:

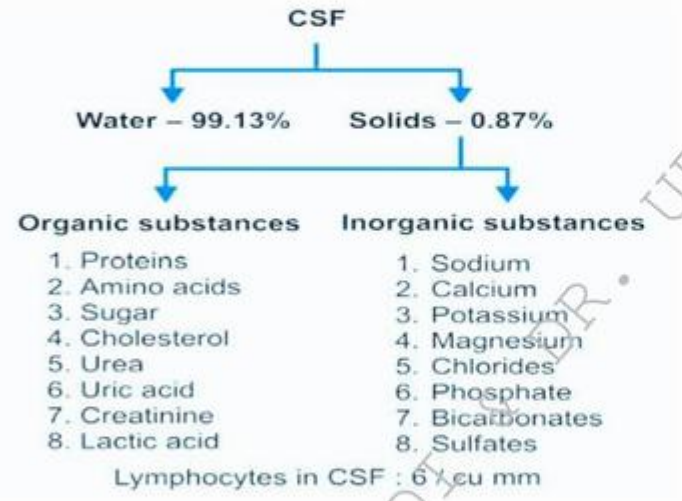


- Cranial bones and cranial meninges mainly protect the brain.
- Cranial bones produce the superficial layer of the brain.
- Cranial meninges surrounds the brain and continuous towards the spinal cord and known as spinal meninges.
- In the brain, outer portion of the cranial manages known as dura meter, middle portion known as arachnoid and inner portion is known pia meter.

CEREBROSPINAL FLUID (CSF):

The entire central nervous system contains between 80 – 150 mL of CSF, and about 500 mL is generated every day.

Compositions of cerebrospinal fluid:

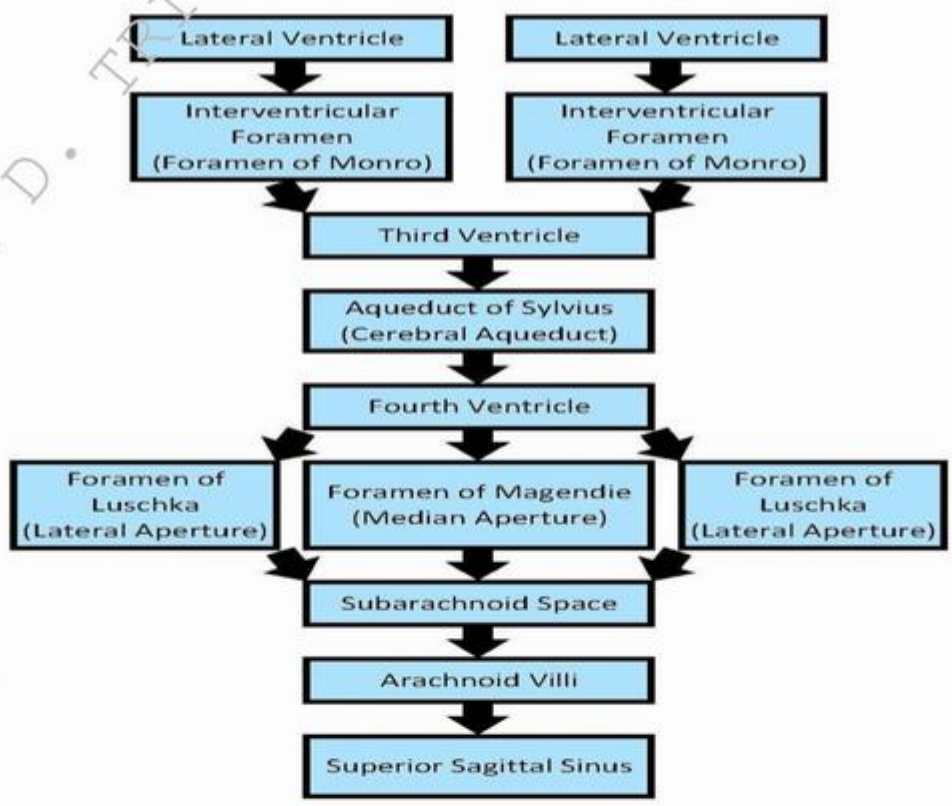


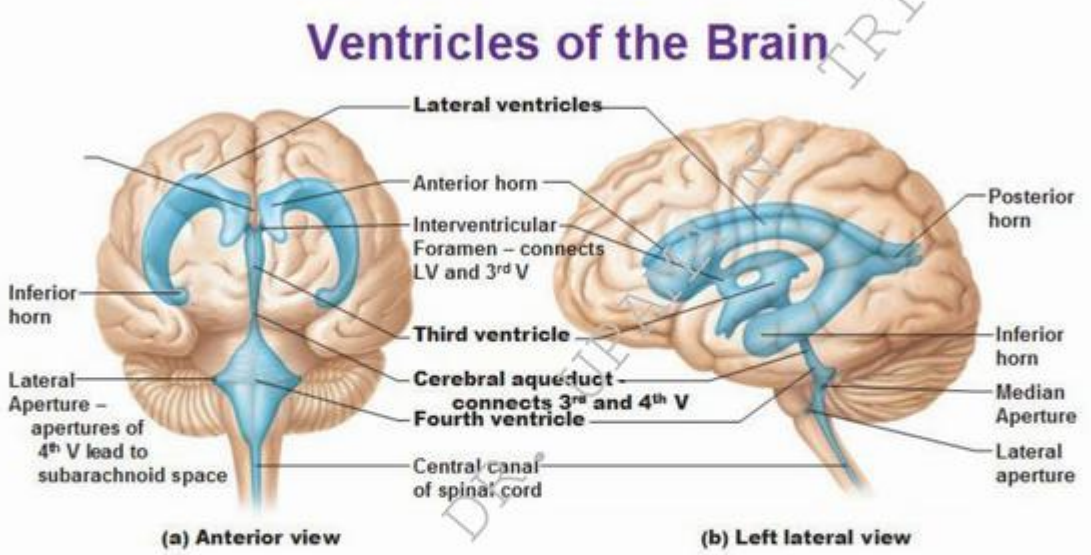
Composition of CSF

Substance	Plasma	CSF
Na^+ (mEq/l)	145.0	150.0
K^+	4.8	2.9
Ca^{++}	5.2	2.3
Mg^{++}	1.7	2.3
Cl^-	108.0	130.0
HCO_3^-	27.4	21.0
Lactate	7.9	2.6
PO_4^{---}	1.8	0.5
Protein	7000.0	20.0
Glucose	95.0	60.0

(protein and glucose expressed as mg/100 ml)

Flow/circulation of cerebrospinal fluid:

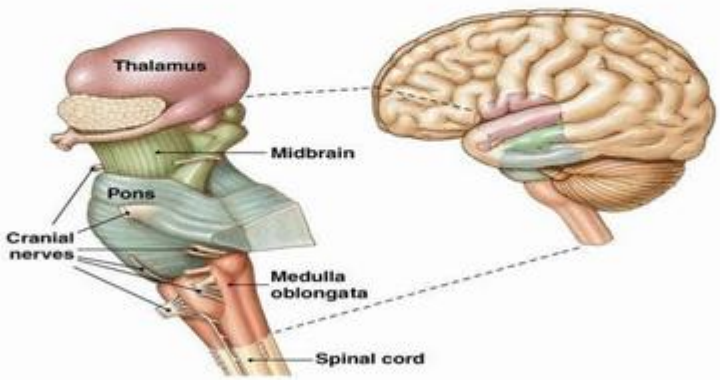




Functions of cerebrospinal fluid (CSF):

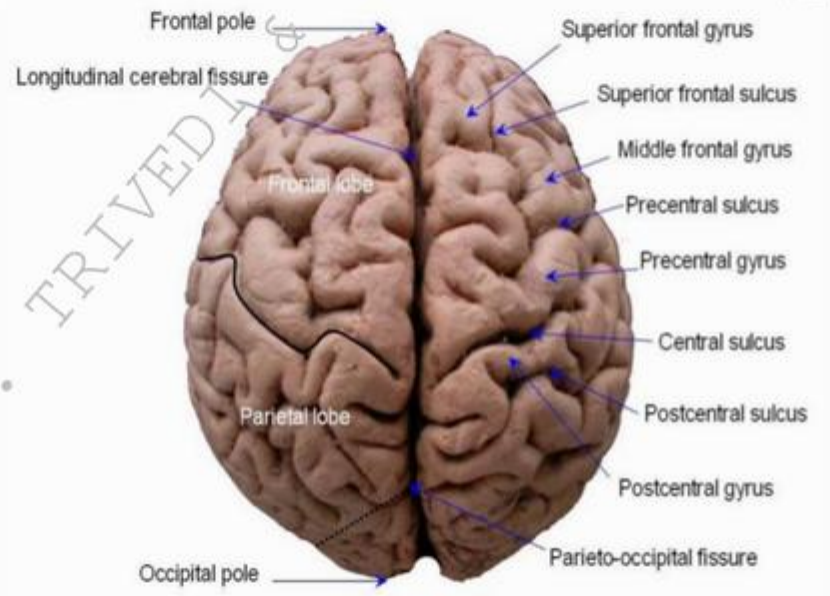
1. Mechanical Protection:
   - Cerebrospinal fluid absorb the shock and protect the delicate tissue of the brain and spinal cord.
   - It also act as a lubricating fluid and reduce the friction during the movement.
2. Chemical Protection:
   - It maintain the electrolytes and chemical balance which is required for regulation of post synaptic potential and action potential.
3. Provide nutrients:
   - It provide the essential nutrient through the circulation in brain and spinal cord.
4. Provide immunity:
   - It consist some amount of the WBCs which can fight against the harmful bacteria and virus.
5. Remove the toxin:
   - CSFs remove the metabolites, waste products and toxin from the brain and spinal cord through the circulation.

BRAIN STEM:



- The midbrain, pons and medulla oblongata of the hindbrain are collectively referred to as the "brain stem". These structures connects brain to the spinal cord.
- The midbrain coordinates sensory representations of the visual, auditory and somatosensory perceptual spaces.
- The pons is the main connection with the cerebellum. The pons and the medulla regulate several crucial functions, including the cardiovascular and respiratory systems.
- The cranial nerves connect through the brain stem and provide the brain with the sensory input and motor output associated with the head and neck, including most of the special senses.
- The major ascending and descending pathways between the spinal cord and brain, specifically the cerebrum, pass through the brain stem.

CEREBRUM:



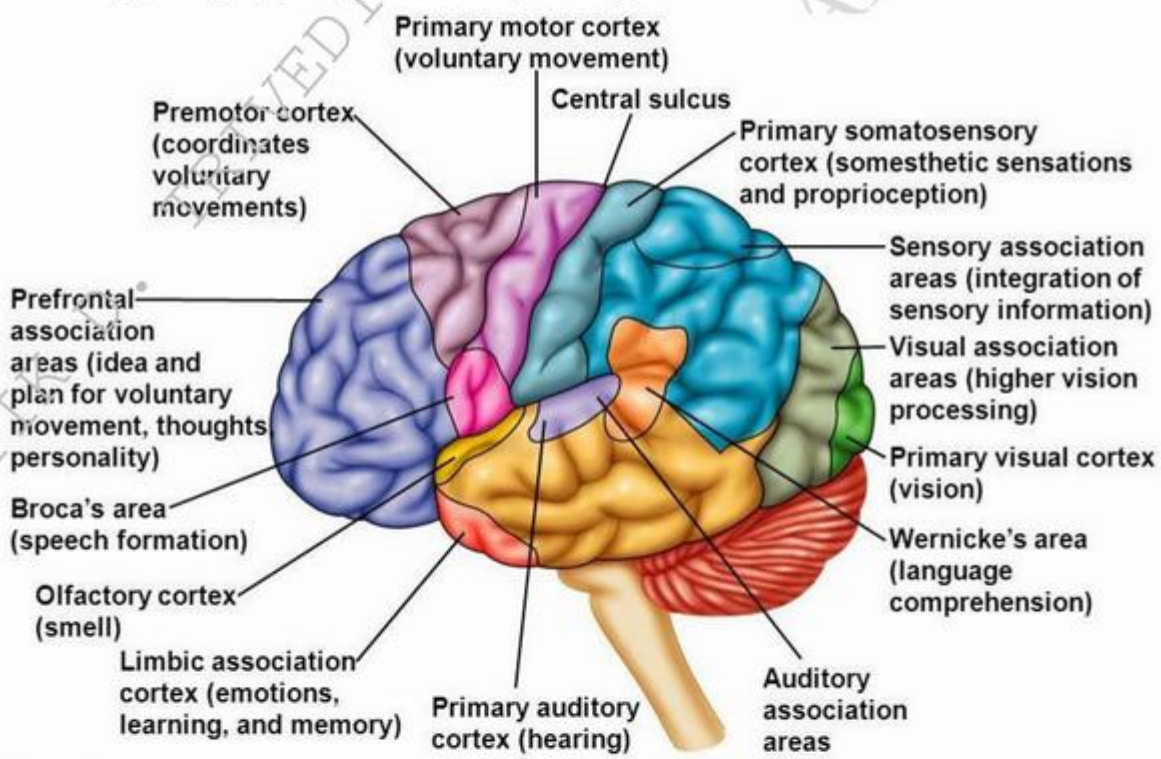
- Cerebrum support diencephalon and brainstem. It develop from the telencephalon.
- The superficial layer of the cerebrum is gray matter which is known as cerebral cortex.
- Cerebral cortex is 2-4 mm thick and consists billion of neurons.
- Deep to the cerebral cortex consist white matter.
- During the embryonic development when brain size increase rapidly the gray matter of the cortex enlarge much faster than the white matter so cortical region rolls and folds itself. The folds are known as gyri.
- The deepest grooves between folds are known as fissures and the narrower grooves between folds are known as sulci.
- The most prominent fissure is longitudinal fissure which separates cerebral in right and left hemispheres. These hemispheres are joined internally by the white matters.

- Each hemisphere controls the opposite side of the body. If a stroke occurs on the right side of the brain, your left arm or leg may be weak or paralyzed.
- Not all functions of the hemispheres are shared. In general, the left hemisphere controls speech, comprehension, arithmetic, and writing. The right hemisphere controls creativity, spatial ability, artistic, and musical skills. The left hemisphere is dominant in hand use and language in about 92% of people.

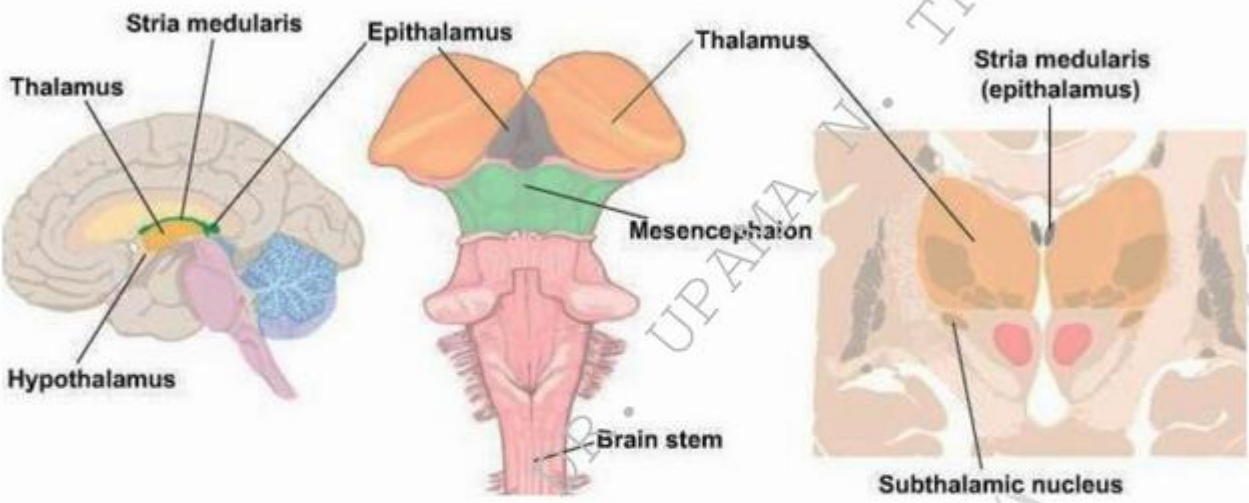
Functional area of the cerebral cortex:

Cerebral cortex consist mainly three kinds of functional areas.

1. Sensory areas: receives and interpret sensory impulses.
2. Motor areas: control muscular movements
3. Association areas: deals with more complex integrative functions such as memory, emotion, reasoning, will, judgment, personalities, intelligence etc.

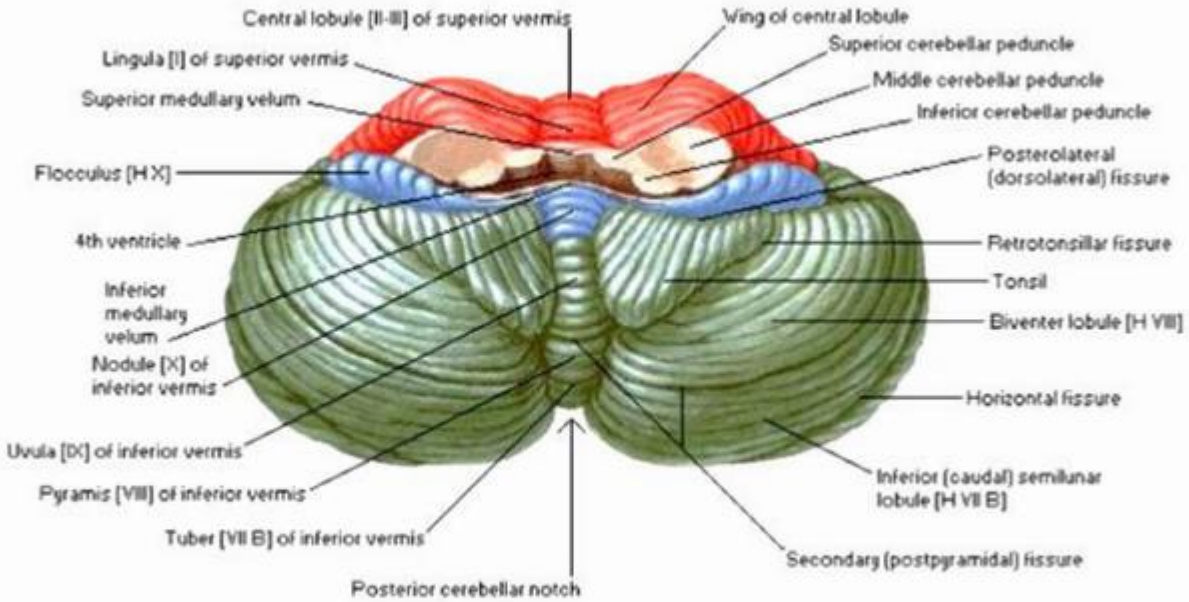


DIENCEPHALON:



- The diencephalon is the connection between the cerebrum and the rest of the nervous system, with one exception.
- The rest of the brain, the spinal cord, and the PNS all send information to the cerebrum through the diencephalon.
- Output from the cerebrum passes through the diencephalon. The single exception is the system associated with olfaction, or the sense of smell, which connects directly with the cerebrum.
- The diencephalon is deep beneath the cerebrum and constitutes the walls of the third ventricle. The diencephalon consists thalamus, hypothalamus, epithalamus, subthalamus and pineal gland.

CEREBELLUM:



Anatomy of Cerebellum:

- The cerebellum, which stands for "little brain", is a structure of the central nervous system. It has an important role in motor control.
- In particular, it is active in the coordination, precision and timing of movements, as well as in motor learning.
- The cerebellum is located at the back of the brain, immediately inferior to the occipital and temporal lobes, and within the posterior cranial fossa. It is separated from these lobes by the tentorium cerebelli, a tough layer of dura mater.
- It lies at the same level of and posterior to the pons, from which it is separated by the fourth ventricle.
- The cerebellum consists of two hemispheres which are connected by the vermis, a narrow midline area. Like other structures in the central nervous system, the cerebellum consists of grey matter and white matter:
- Grey matter – located on the surface of the cerebellum. It is tightly folded, forming the cerebellar cortex.
- White matter – located underneath the cerebellar cortex. Embedded in the white matter are the four cerebellar nuclei (the dentate, emboliform, globose, and fastigi nuclei).
- There are three ways that the cerebellum can be subdivided – anatomical lobes, zones and functional divisions
- There are three cerebellar zones. In the midline of the cerebellum is the vermis. Either side of the vermis is the intermediate zone. Lateral to the intermediate zone are the lateral hemispheres. There is no difference in gross structure between the lateral hemispheres and intermediate zones

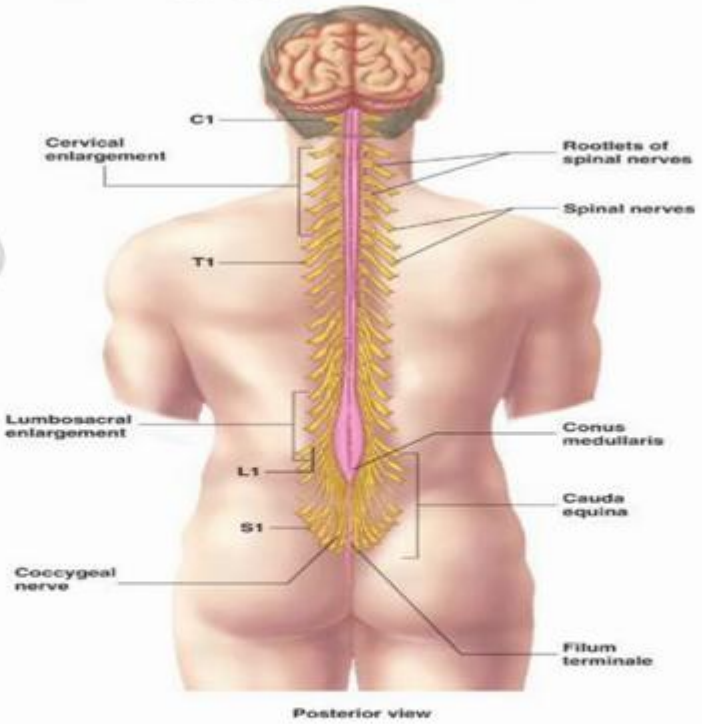
THE SPINAL CORD

FUNCTIONS:

- The spinal cord with its 31 pairs of *spinal nerves* serves two important functions.
- It is the connecting link between the brain and most of the body.
- It is involved in spinal reflex actions, both somatic and visceral.

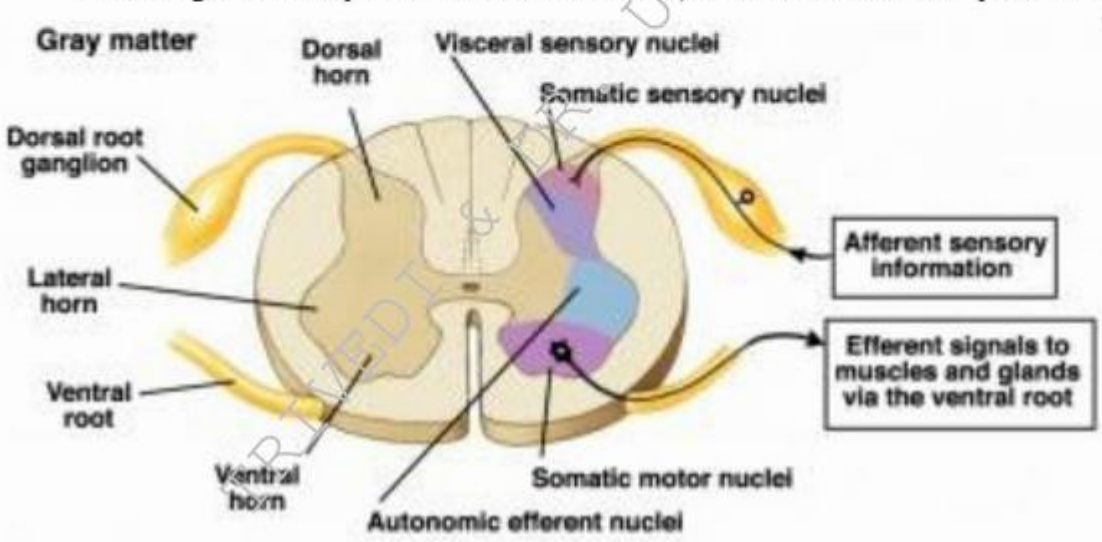
BASIC EXTERNAL ANATOMY OF THE SPINAL CORD:

- The spinal cord extends caudally from the brain for about 45 cm and has a width of ~14 mm. Its upper end is continuous with the brain (medulla oblongata). The cord is slightly thicker than a pencil.
- There are 31 pairs of spinal nerves: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and coccygeal. The roots of the lumbar and sacral are called *cauda equina*.
- Surrounding and protecting the spinal cord is the vertebral column.
- The spinal cord is slightly flattened dorsally and ventrally, with two enlargements-cervical and lumbosacral from which the spinal nerves emerge that innervate the upper and lower limbs.
- The cervical enlargement supplies nerves to the pectoral girdle and upper limbs.
- The lumbar enlargement supplies nerves to the pelvis and lower limbs.
- Inferior to the lumbar enlargement, the spinal cord becomes tapered and conical-conus medullaris.
- Filum terminale-slender strand of fibrous tissue that extends from conus medullaris.



Basic Internal Anatomy of Spinal Cord:

- If the spinal cord is cut in X.S., a tiny central canal is observed, which contains CSF.
- There is a dark portion of H-shaped or butterfly shaped "gray matter", surrounded by a larger area of "white matter".
- The spinal cord is divided into more or less symmetrical halves by a deep groove called the anterior (ventral) median fissure and a median septum called posterior (dorsal) median sulcus.
- Extending from the spinal cord are the ventral and dorsal roots of the spinal nerves.



GRAY MATTER:

- The gray matter of the spinal cord consists of nerve cell bodies, dendrites and axon terminals (unmyelinated) and neuroglia. It is pinkish-gray color because of a rich network of blood vessels.
- The gray matter forms an H shape and is composed of three columns of neurons-posterior, anterior and lateral horns. The projections of gray matter toward the outer surface of spinal cord are called horns.
- The two that run dorsally-posterior horns which function in afferent input. The two that run ventrally-anterior horns which function in efferent somatic output. The two that extend laterally-lateral horns.
- The nerve fibers that form the cross of the H are known as gray commisure-functions in cross reflexes.

WHITE MATTER:

- The white matter gets its name because it is mainly composed of myelinated nerve fibers, and myelin has a whitish color.

- The white matter is divided into three pairs of columns or funiculi of myelinated fibers- anterior, posterior, lateral and a commisure area.
- The bundles of fibers within each funiculus are divided into tracts called fasciculi.
- Ascending tracts-sensory fibers carry impulse up the spinal cord to the brain.
- Descending tracts-motor neurons transmit impulse from the brain down the spinal cord.

CRANIAL NERVES

- The brain communicates with the body through the spinal cord and twelve pairs of cranial nerves.
- Ten of the twelve pairs of cranial nerves that control hearing, eye movement, facial sensations, taste, swallowing and movement of the face, neck, shoulder and tongue muscles originate in the brainstem. The cranial nerves for smell and vision originate in the cerebrum.
- The Roman numeral, name, and main function of the twelve cranial nerves:

Number	Name	Function
I	Olfactory	Smell
II	Optic	Sight
III	Oculomotor	Moves eye, pupil
IV	Trochlear	Moves eye
V	Trigeminal	Face sensation
VI	Abducens	Moves eye
VII	Facial	Moves face, salivate
VIII	Vestibulocochlear	Hearing, balance
IX	Glossopharyngeal	Taste, swallow
X	Vagus	Heart rate, digestion
XI	Accessory	Moves head
XII	Hypoglossal	Moves tongue

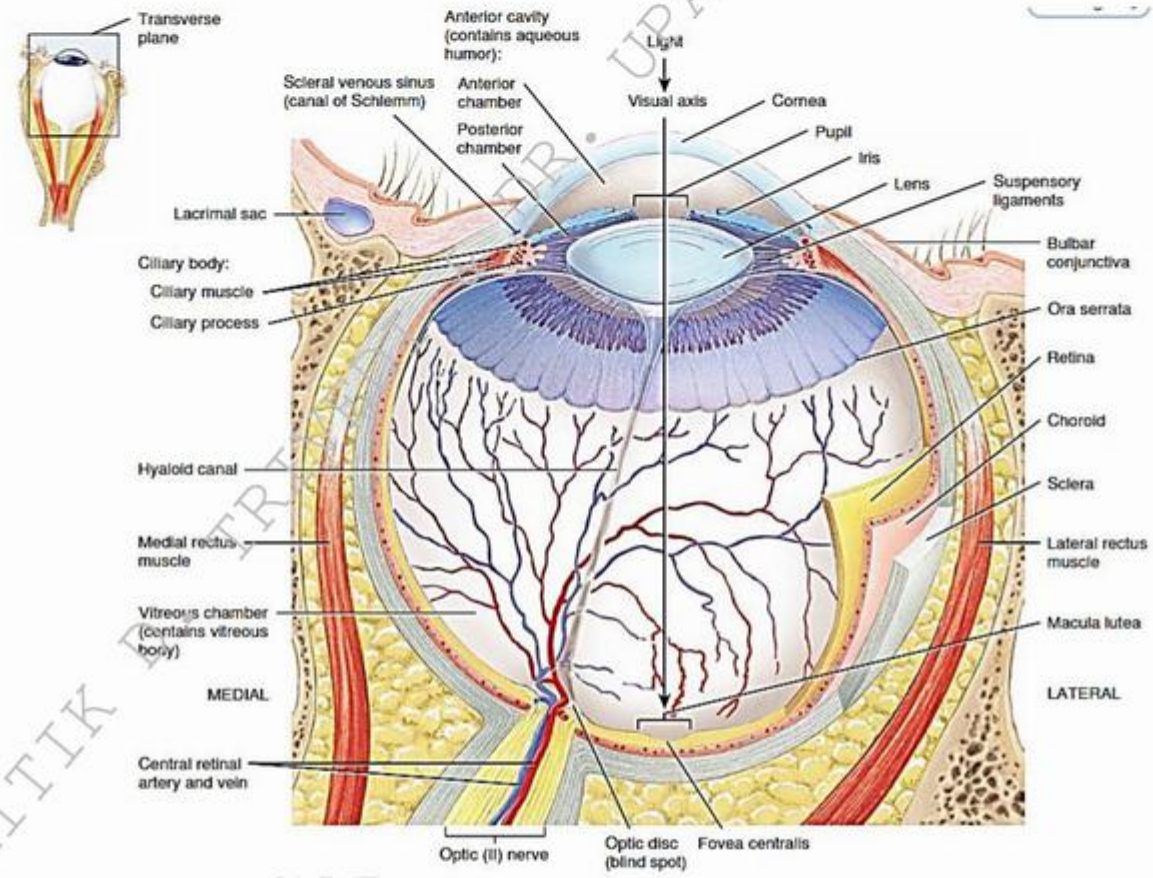
SIGNATURE OF TEACHER

EXPERIMENT NO.: 14. h **DATE:**

AIM: TO STUDY THE HUMAN EYE USING SPECIMEN AND MODELS

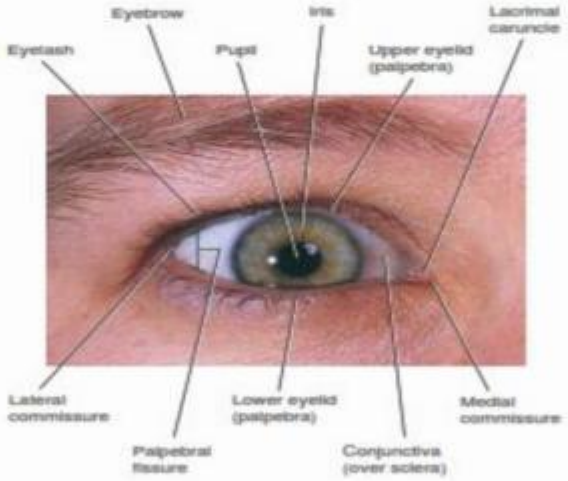
THEORY:

The eyes are responsible for the detection of visible light, the part of the electromagnetic spectrum with wavelengths ranging from about 400 to 700 nm.



Accessory Structure of Eye:

The accessory structures of the eye include the eyelids, eyelashes, eyebrows, the lacrimal (tearing) apparatus, and extrinsic eye muscles.



Eyelids

- The upper and lower eyelids shade the eyes during sleep, protect the eyes from excessive light and foreign objects, and spread lubricating secretions over the eyeballs.
- The upper eyelid is more movable than the lower.

Eyelashes and Eyebrows

- The eyelashes from the border of each eyelid and the eyebrows which located transversely above the upper eyelids.
- It helps to protect the eyeballs from foreign objects, perspiration, and the direct rays of the sun.

The Lacrimal Apparatus

- The lacrimal apparatus is a group of structures that produces and drains lacrimal fluid or tears.
- The lacrimal glands, each about the size and shape of an almond, secrete lacrimal fluid, which drains into 6–12 excretory lacrimal ducts that empty tears onto the surface of the conjunctiva of the upper lid.
- From here the tears pass medially over the anterior surface of the eyeball to enter two small openings called lacrimal puncta.
- Tears then pass into two ducts, the lacrimal canals, which lead into the lacrimal sac and then into the nasolacrimal duct.

Anatomy of the Eye Ball:

The adult eyeball size is about 2.5 cm (1 in.) in diameter. Out of total surface area, only the anterior one-sixth is exposed and the remaining part is protected by the orbit in to which it fits.

The wall of the eyeball consists of three layers:

i. Fibrous tunic:

- The fibrous tunic is the superficial layer of the eyeball and consists of the anterior cornea and posterior sclera.
- The cornea is a transparent coat that covers the colored iris. Because it is curved, the cornea helps focus light onto the retina.
- The sclera is the white portion of the eye.
- The sclera covers the entire eyeball except the cornea.

ii. Vascular tunic:

- The vascular tunic also known as uvea. It is the middle layer of the eyeball.
- It is composed of three parts: **choroid, ciliary body, and Iris.**

Choroid

- It is the posterior portion of the vascular tunic and its lines most of the internal surface of the sclera.
- The choroid also contains melanocytes that produce the pigment melanin, which causes this layer to appear dark brown in color.

Ciliary processes

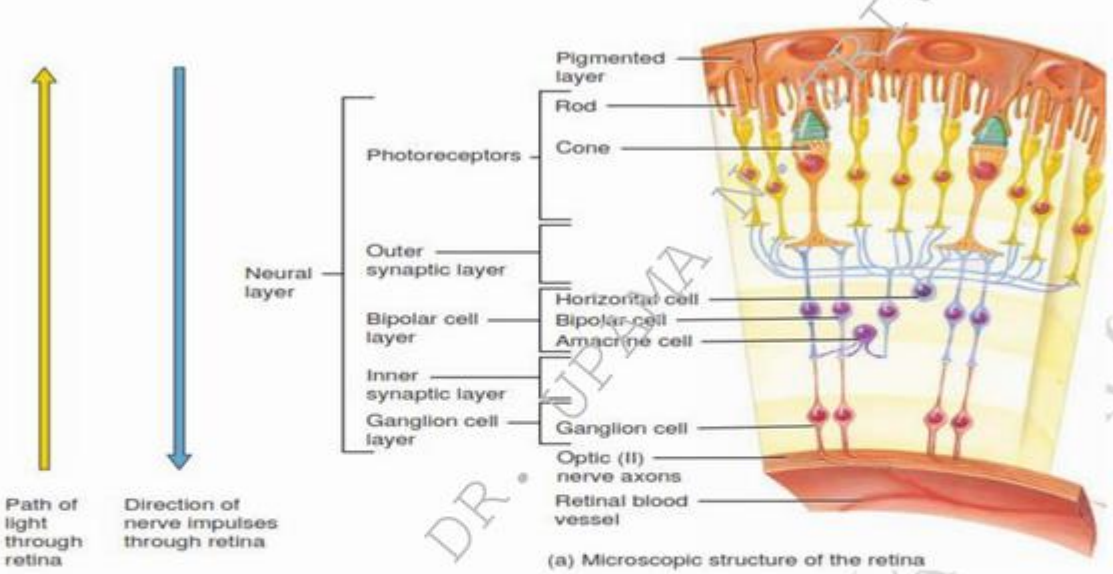
- These are protrusions or folds on the internal surface of the ciliary body.
- They contain blood capillaries that secrete aqueous humor.

Iris

- It is the colored portion of the eyeball.
- It is located between the cornea and the lens and is attached at its outer margin to the ciliary processes.

iii. Retina.

- It is the third and inner layer of the eyeball.
- The retina, lines the posterior three-quarters of the eyeball and is the beginning of the visual pathway.
- The retina consists of a **pigmented layer and a neural layer.**
- The pigmented layer is a sheet of melanin-containing epithelial cells located between the choroid and the neural part of the retina.
- The neural (sensory) layer of the retina is a multilayered outgrowth of the brain that processes visual data extensively before sending nerve impulses into axons that form the optic nerve.
- Three distinct layers of retinal neurons are: The photoreceptor layer, The bipolar cell layer and The ganglion cell layer which are separated by two zones, the outer and inner synaptic layers



- Photoreceptors are specialized cells that begin the process by which light rays are ultimately converted to nerve impulses.
- There are two types of photoreceptors: rods and cones.
- Each retina has about 6 million cones and 120 million rods.
- Rods allow us to see in dim light, such as moonlight. Because rods do not provide color vision, in dim light we can see only black, white, and all shades of gray in between.
- Brighter lights stimulate cones, which produce color vision. Three types of cones are present in the retina: (1) blue cones, which are sensitive to blue light, (2) green cones, which are sensitive to green light, and (3) red cones, which are sensitive to red light
- From photoreceptors, information flows through the outer synaptic layer to bipolar cells and then from bipolar cells through the inner synaptic layer to ganglion cells.
- The axons of ganglion cells extend posteriorly to the optic disc and exit the eyeball as the optic (II) nerve.
- The optic disc is also called the blind spot.
- Because it contains no rods or cones, we cannot see an image that strikes the blind spot.
- Normally, we are not aware of having a blind spot, but we can easily demonstrate its presence.
- Hold this page about 20 in. from your face with the cross shown below directly in front of your right eye. You should be able to see the cross and the square when you close your left eye.
- Now, keeping the left eye closed, slowly bring the page closer to your face while keeping the right eye on the cross.
- At a certain distance the square will disappear from your field of vision because its image falls on the blind spot.

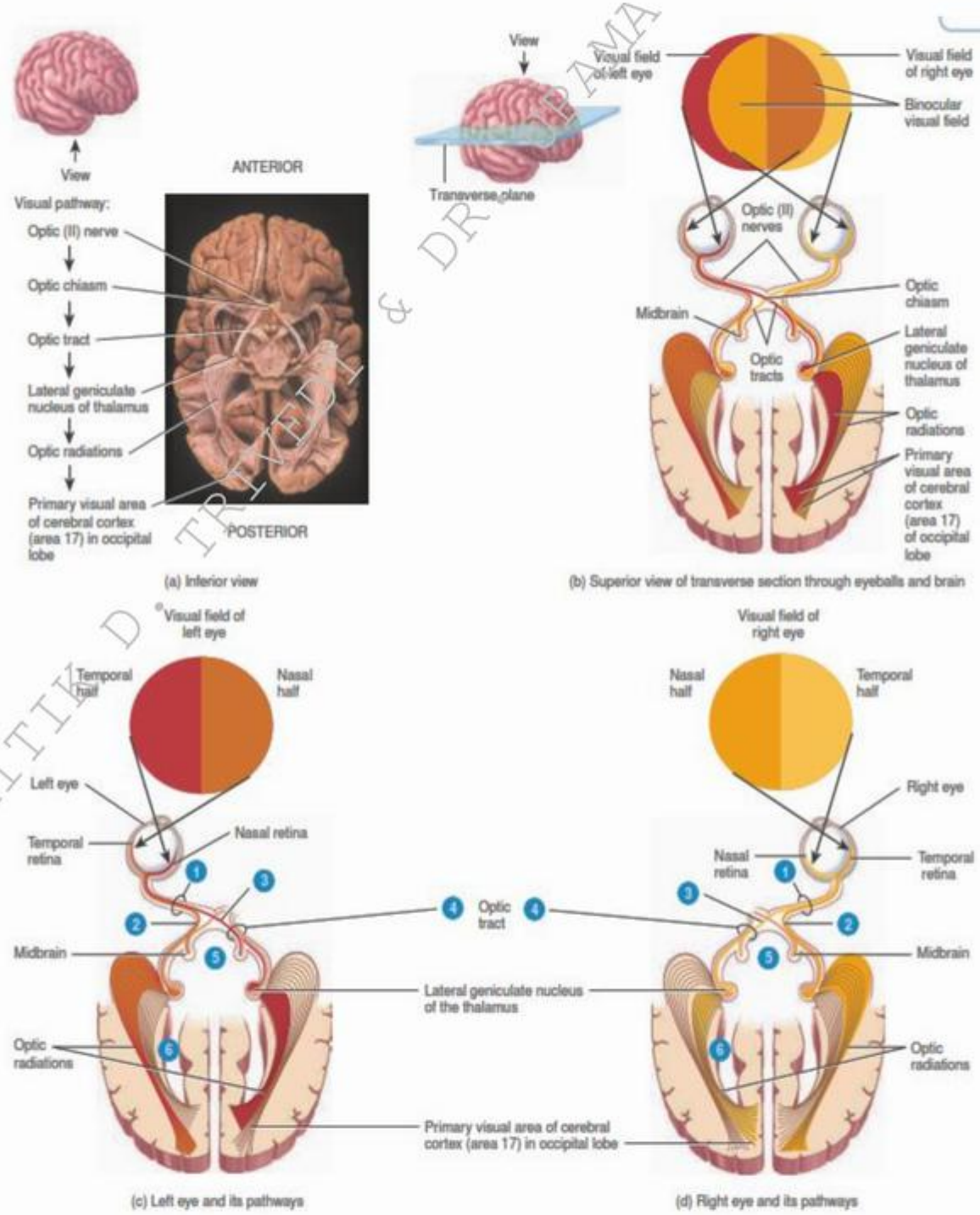
+ ■

- The macula lutea is in the exact center of the posterior portion of the retina, at the visual axis of the eye.
- The fovea centralis a small depression in the center of the macula lutea, contains only cones.

Lens

- It is located behind the pupil and iris, within the cavity of the eyeball.
- It is made up by proteins called crystallins.

Visual Pathway:



SIGNATURE OF TEACHER

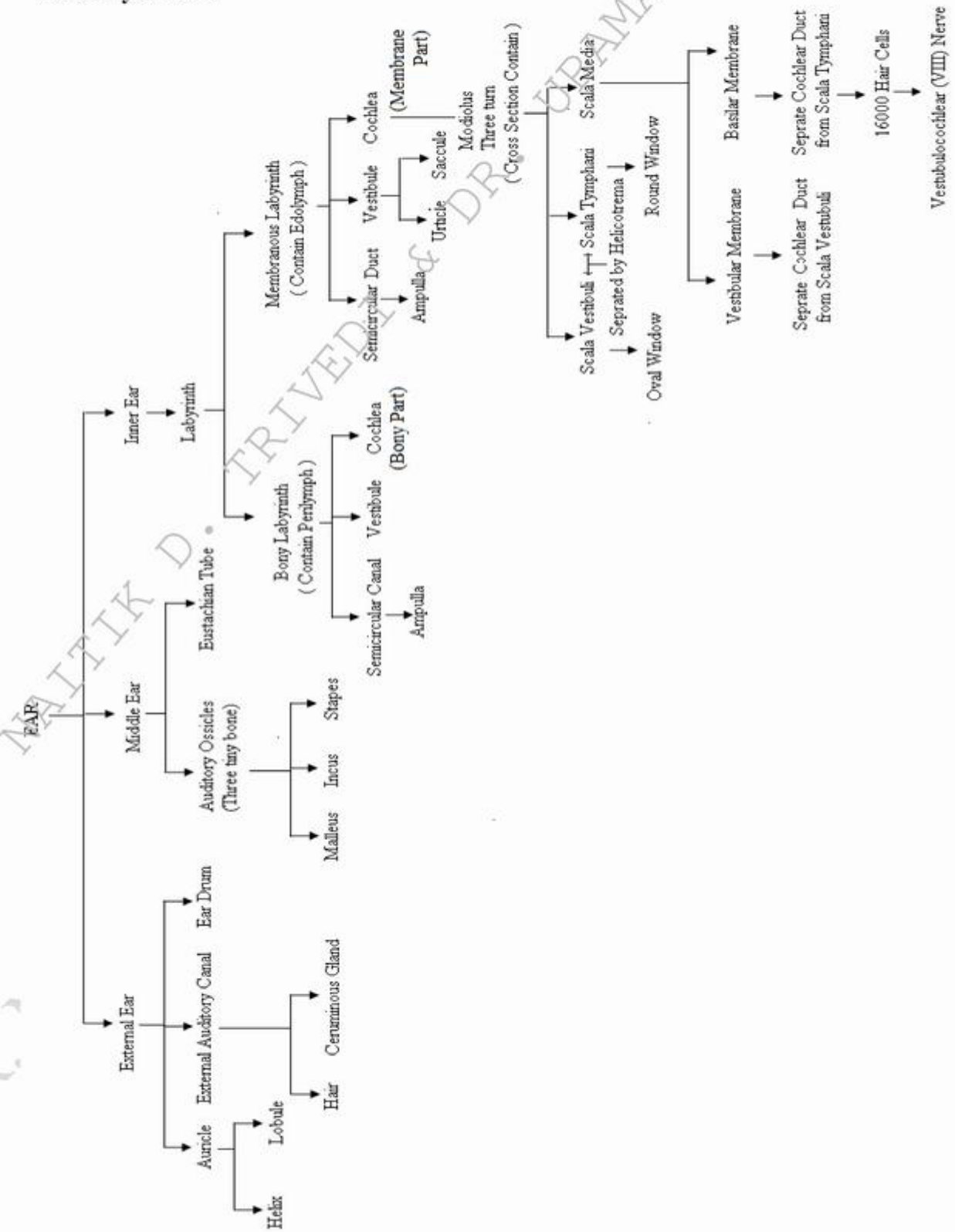
EXPERIMENT NO.: 14. i **DATE:**

AIM: TO STUDY THE HUMAN EAR USING SPECIMEN AND MODELS

THEORY:

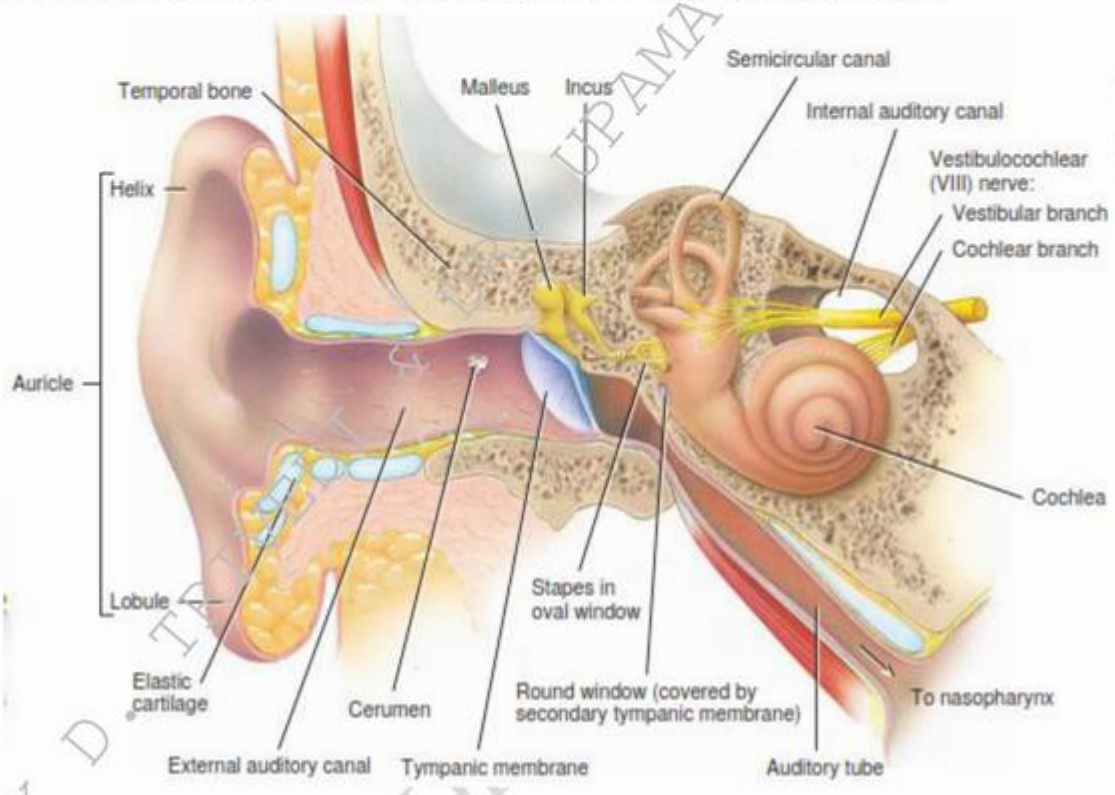
Hearing or audition is the sense of detecting sound through the ear.

Anatomy of Ear:



The ear is divided into three main regions:

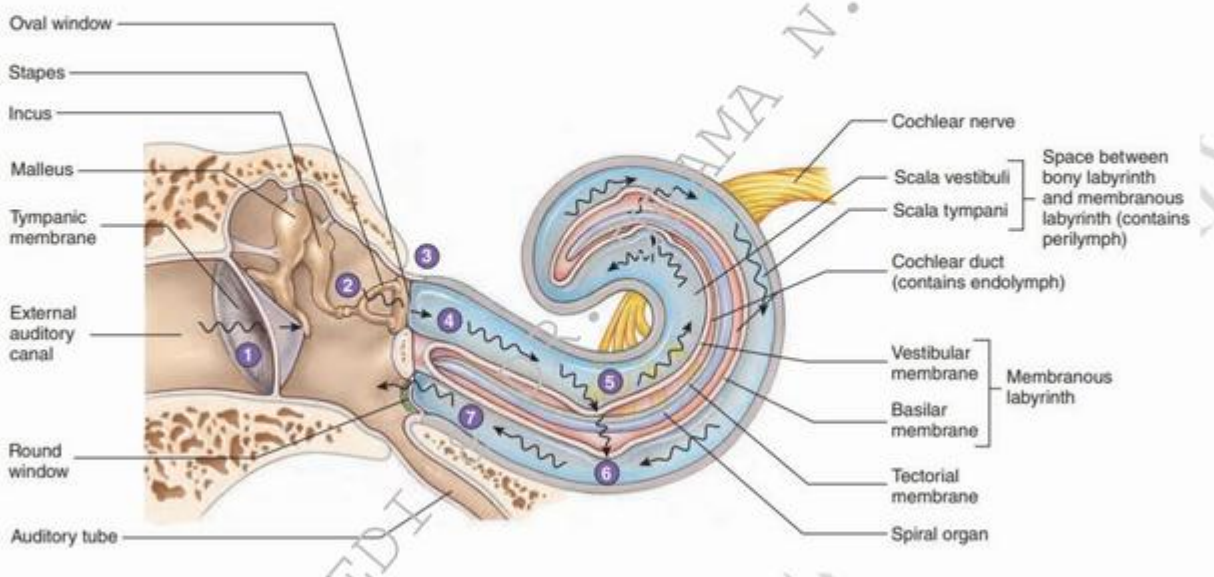
1. The external ear, which collects sound waves and channels them inward;
2. The middle ear, which conveys sound vibrations to the oval window and
3. The internal ear, which houses the receptors for hearing and equilibrium.



External (Outer) Ear:

- The external (outer) ear consists of the auricle, external auditory canal, and eardrum.
- The auricle is made up by helix and lobule.
- The external auditory canal is a curved tube about 2.5 cm (1 in.) long that lies in the temporal bone and leads to the eardrum.
- The tympanic membrane or eardrum is a thin, semitransparent partition between the external auditory canal and middle ear.
- Near the exterior opening, the external auditory canal contains a few hairs and specialized sweat glands called ceruminous glands that secrete earwax or cerumen.
- Both hairs and cerumen prevent the entry of dust and foreign objects in the ear.
- Cerumen helps to protect the delicate skin of the external ear canal by water and insects. Cerumen usually dries up and falls out of the ear canal automatically.
- In, some people ceruminous glands secret large amount of cerumen, that produce disturbance in hearing. So it is essential to remove cerumen regularly.

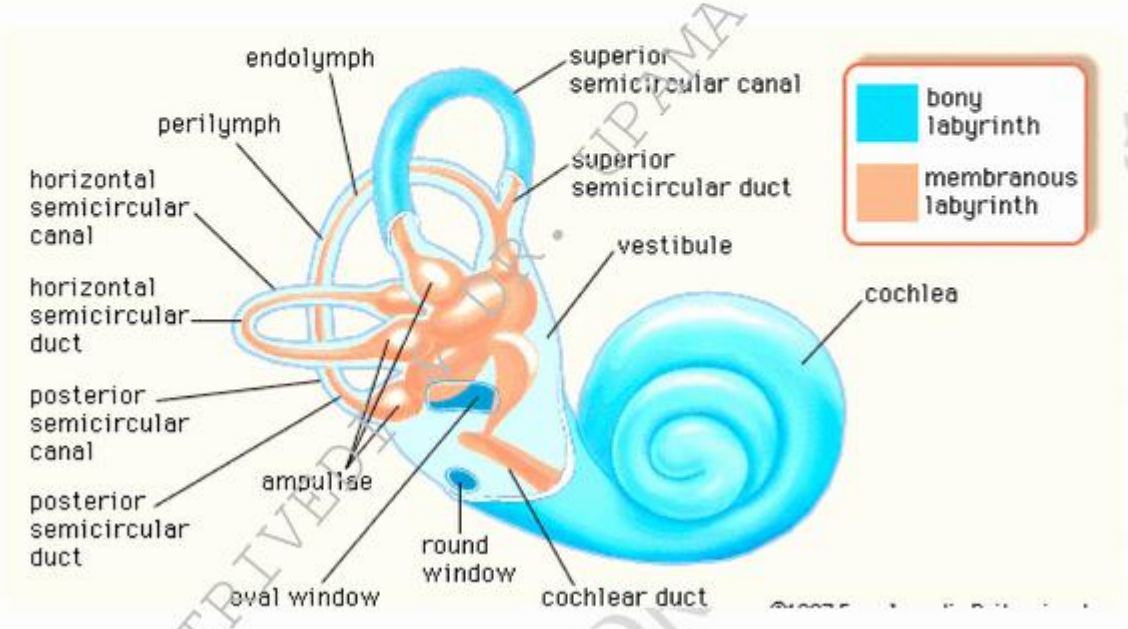
Middle Ear:



- It is a small, air-filled cavity.
- It is separated from the external ear by the ear drum and from the internal ear by a thin bony partition that contains two small membrane-covered openings: the oval window and the round window.
- Middle ear consist three bones.
    i. Malleus – Hammer Shape
    ii. Incus – Anvil Shape
    iii. Stapes – Stirrup Shape (Smallest Bone of the Body)
- The "handle" of the malleus attaches to the internal surface of the tympanic membrane or ear drum and the head of the malleus articulates with the body of the incus.
- The incus attached with the head of the stapes.
- The base or footplate of the stapes fits into the oval window.
- Below the oval window there is another opening known as the round window, which is enclosed by a membrane called the secondary tympanic membrane.
- The anterior wall of the middle ear contains an opening known as the eustachian tube or auditory tubes.
- It connects the middle ear with the nasopharynx and its main function is modifying the sound.

Internal (Inner) Ear

- The internal or inner ear is also called the labyrinth because it consist complicated series of canals.



- There are two main divisions of the inner ears:

i. Outer bony labyrinth :

- The bony labyrinth contains fluid known as perilymph. This fluid, which is chemically similar to cerebrospinal fluid.
- The bony labyrinth is divided into three areas:

a) **The semicircular canals:** Three bony semicircular canals, known as anterior, posterior, and lateral semicircular canals out from the vestibule.

b) **The vestibule:** The vestibule is the oval central portion of the bony labyrinth its end portion is swallow and known as amulla.

c) **The cochlea:** Anterior to the vestibule there is snail shaped structure known as the cochlea which having three snail shell like turn known as modiolus.

ii. Membranous labyrinth:

- The membranous labyrinth contains fluid known as endolymph.
- The membranous labyrinth in the vestibule consists of two sacs called the utricle and the saccule which are connected by a small duct.

- **The cochlea** is divided into three channels:

i. Cochlear duct: It is a continuation of the membranous labyrinth into the cochlea; and it consist endolymph.

ii. Scala vestibule: It located above the cochlear duct which ends at the oval window. It is the part of bony labyrinth and it consist perilymph.

- Scala tympani: It located below the cochlear duct which ends at the round window. It is the part of bony labyrinth and it consist perilymph.
- The scala vestibuli and scala tympani are completely separated by the cochlear duct.
- The vestibular membrane separates the cochlear duct from the scala vestibuli, and the basilar membrane separates the cochlear duct from the scala tympani.
- Basilar membrane is the spiral organ consist coiled sheet of epithelial cells consist 16,000 hair cells, which are the receptors for hearing.
- At the apical surface of hair consist microvilli and at their basal ends, inner and outer hair cells synapse both with first-order sensory neurons and with motor neurons from the cochlear branch of the vestibulocochlear (VIII) nerve.

Physiology of hearing:

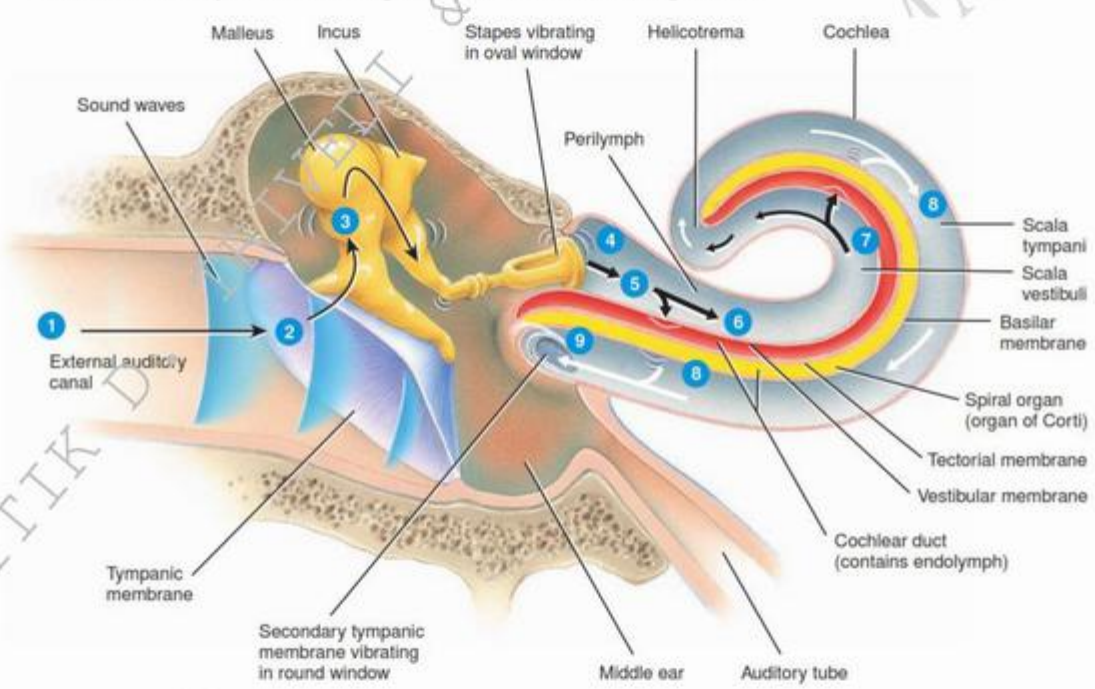
Hearing involved following steps:

- The auricle of outer ear send sound waves into the external auditory canal to ear drum.
- When sound waves strike the tympanic membrane or ear drum, the alternating high- and low-pressure of the air causes the tympanic membrane to vibrate back and forth.
- The eardrum vibrates slowly in response to low-frequency (low-pitched) sounds and rapidly in response to high-frequency (high-pitched) sounds.
- The central area of the eardrum connects to the malleus, which also starts to vibrate. The vibration is transmitted from the malleus to the incus and then to the stapes.
- As the stapes moves back and forth, it pushes the membrane of the oval window in and out.
- The oval window vibrates about 20 times more vigorously than the eardrum because vibrations spread over a large surface area (eardrum) into a smaller surface (oval window).
- The movement of the oval window sets up fluid pressure waves in the perilymph of the scala vestibule of cochlea.
- Pressure waves are transmitted from the scala vestibuli to the scala tympani and eventually to the round window, causing it to bulge outward into the middle ear.

- As the pressure waves deform the walls of the scala vestibuli and scala tympani, they also push the vestibular membrane back and forth, creating pressure waves in the endolymph inside the cochlear duct.

- The pressure waves in the endolymph cause the basilar membrane to vibrate, which moves the hair cells of the spiral organ against the tectorial membrane.

- This leads to bending of the hair cell stereocilia or villi, which produces receptor potentials that ultimately lead to the generation of nerve impulses.



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EXPERIMENT NO.: 14. j **DATE:**

AIM: TO STUDY THE HUMAN SKIN USING SPECIMEN AND MODELS

THEORY:

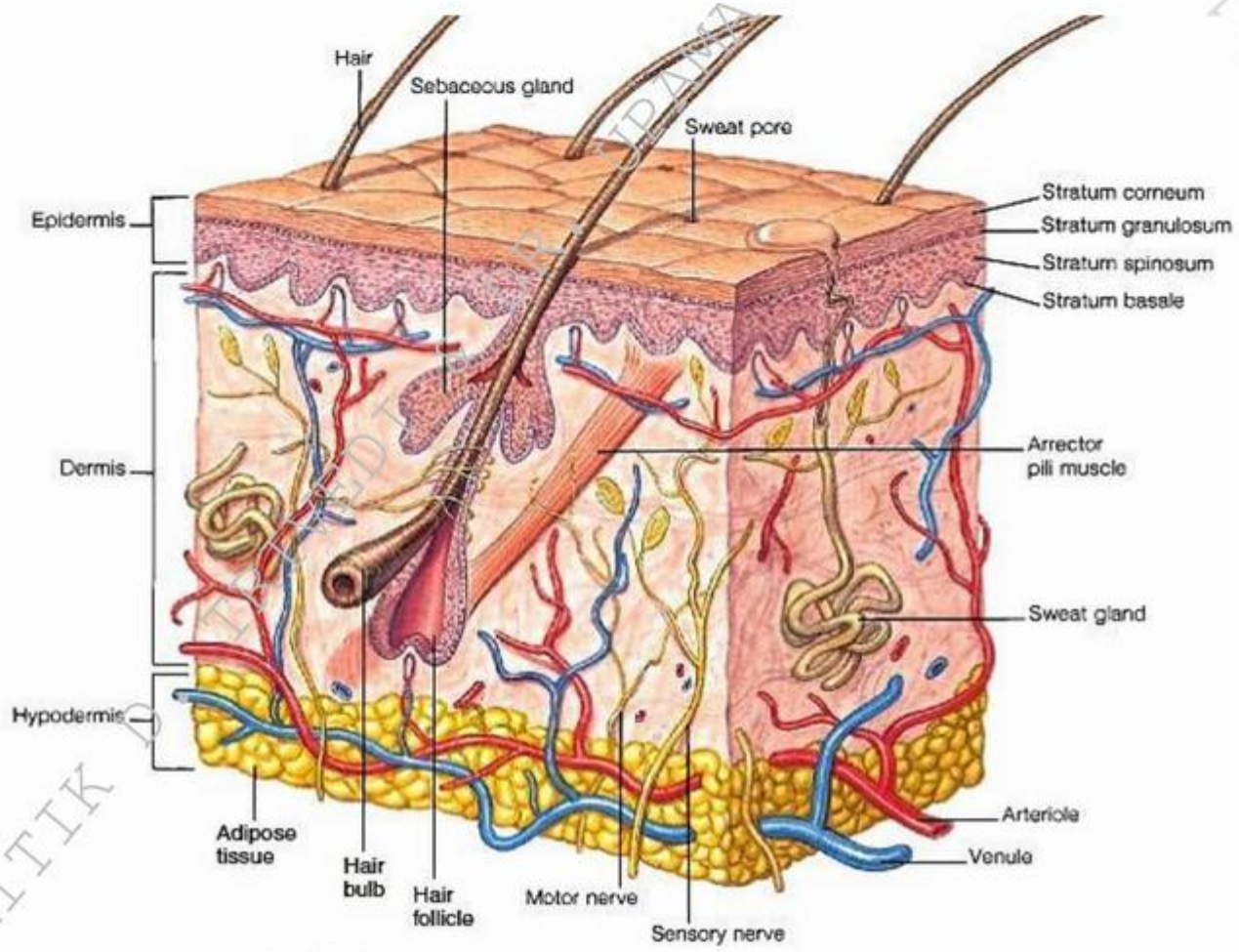


Diagram of Skin

- Skin occupy 16% of our total body weight
- Skin is made up by two layers:

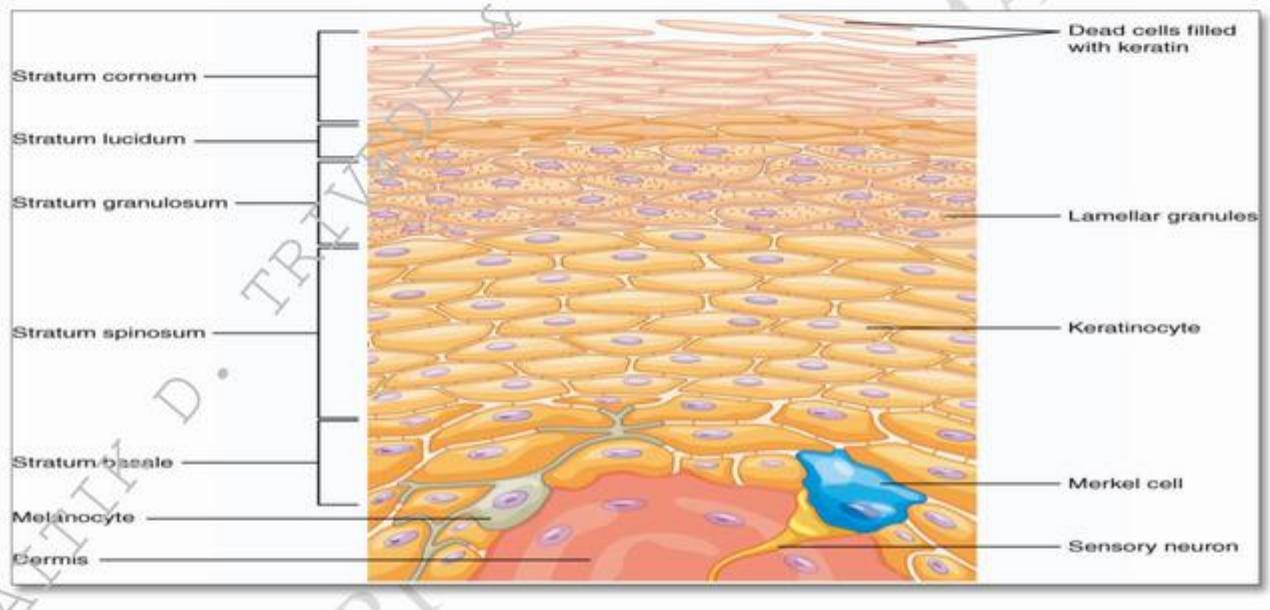
i. EPIDERMIS:

- It is a superficial layer of the skin
- It contains four principal types of cells: **keratinocytes, melanocytes, Langerhans cells, and Merkel cells.**
- About 90% of epidermal cells are **keratinocytes** which are arranged in four or five layers and produce the protein keratin, tough layer.
- About 8% of the epidermal cells are **melanocytes** which produce pigment melanin. Melanin is a yellow-red or brown-black pigment that contributes to skin color and absorbs damaging ultraviolet (UV) light.

- **Langerhans cells** develop from red bone marrow and migrate to the epidermis. They protect us from microbes.
- **Merkel cells** located in the deepest layer of the epidermis, it detect touch sensations.

Layers of Epidermis: (from deep to superficial):

a. Stratum basale or germinatum – single row of cells attached to dermis; youngest cells
b. Stratum spinosum – Made up of bundles of protein resist tension
c. Stratum granulosum – layers of flattened keratinocytes producing keratin.
d. Stratum lucidum- (only found in thick skin – that is, the palms of the hands, the soles of the feet and the digits)
e. Stratum corneum – horn cornified superficial layer



Layers of epidermis

ii. DERMIS:

- It is a deep layer of skin made up by fibre and it having good tensile strength.
- It is divided in papillary and reticular region.

a) **The Papillary Dermis**: The papillary dermis is the more superficial of the two, and lies just beneath the epidermal junction. It is relatively thin and is made up of loose connective tissue, which includes:
   - Capillaries
   - Elastic fibers
   - Reticular fibers
   - Collagen

b) **The Reticular dermis**: The reticular dermis is the deeper and thicker layer of the dermis, which lies above the subcutaneous layer of the skin. It contains dense connective tissue, which includes:

- Blood vessels
- Elastic fibers (interlaced)
- Collagen fibers (in parallel layers)
- Fibroblasts
- Mast cells
- Nerve endings
- Lymphatics

iii. HYPODERMIS:

- The hypodermis lies between the dermis and underlying organs.
- It is also known as subcutaneous layer.
- It is composed of loose areolar tissue and adipose tissue.
- This layer provides additional cushion and insulation through its fat storage function and connects the skin to underlying structures such as muscle.

iv. ASSOCIATED GLANDS:

- Integumentary system has four types of exocrine glands, which secrete their product or substance outside the cells and body.

i. Sudoriferous glands:

- Sweat glands excrete sweat via very small openings at the skin's surface.
- The purpose of sudoriferous glands is to emit perspiration to help cool the body off when the body temperature rises.

ii. Sebaceous glands:

- It is responsible for releasing oil into the hair follicle to help lubricate and protect the hair shaft, keeping it from becoming hard and brittle.

iii. Ceruminous glands:

- Located in the ear canal. It produce ear wax known as cerumen.
- Cerumen prevent entry of dust, bacteria and harmful agent in the ear.

iv. Mammary glands:

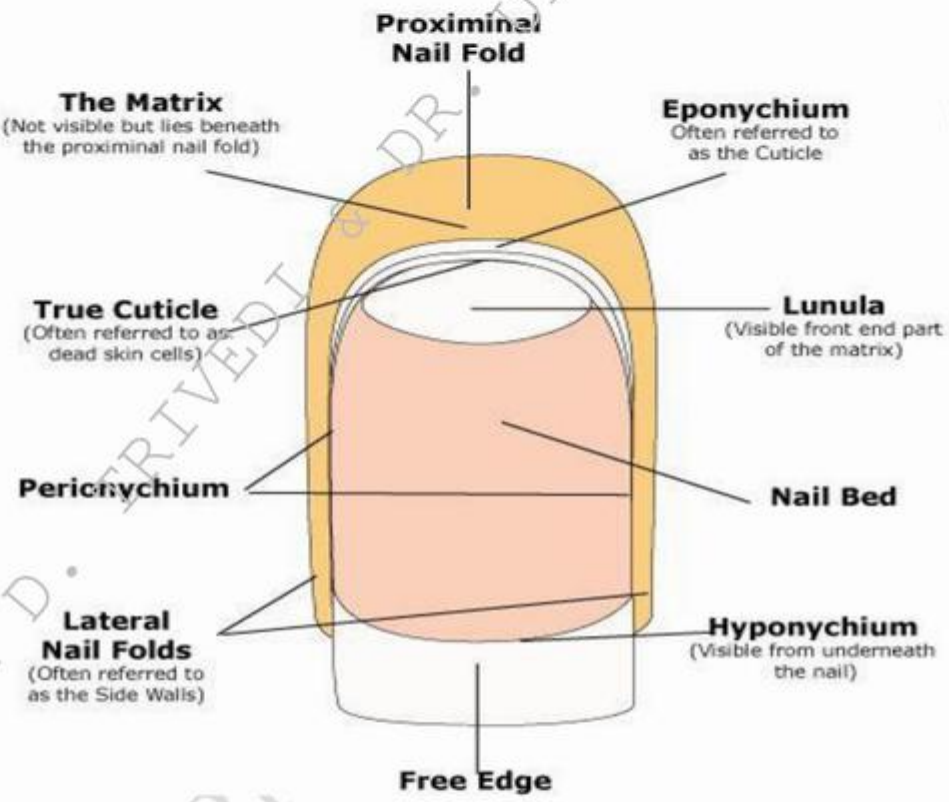
- There are two mammary glands located one at each side of the front of the chest wall.
- Both men and women have mammary glands, but in men, these glands are underdeveloped. In females, the glands function to produce breast milk after giving birth.

v. HAIR:

- Hair is derived from the epidermis but grows its roots deep into the dermis.

- Its structure divides into the externally visible hair shaft and the hair follicle within the skin.
- Hair is primarily comprised of a fibrous protein and contains a very small amount of lipids (fats) and water.
- Hair comes from follicles, which are simple organs made up of cells called epithelial cells

vi. NAIL:



- Nails consist of several segments, including:
  i. **The nail plate:** The part of the nail that is visible.
  ii. **The nail bed:** The skin that lies beneath the nail plate.
  iii. **The cuticle:** The thin line of tissue that is located at the base of the nail and overlaps the nail plate.
  iv. **The nail folds:** The folds of the skin located on the sides of the nail plate.
  v. **The lunula:** The white-colored half-moon-shaped area located at the base of the nail plate.
  vi. **The matrix:** Part of the nail that is not visible, located underneath the cuticle, this is the area responsible for the growth of the fingernail.

Functions of integumentary system:

- It act as barrier so it provides physical protection against bacteria and germs.
- It heal abrasions, cuts and other injuries.
- It protect us from the sun's ultraviolet (UV) rays and sunburn.
- It remove waste by excreting sebum, sweat and other waste from our body.
- It maintain our body temperature by heat evaporating and absorbing as needed.
- It give us sensation for heat, cold and detect other sensations.
- It helps to synthesizes vitamin D.
- It Stores fat for a source of energy
- It Keeps the body from becoming dehydrated

SIGNATURE OF TEACHER

MULTIPLE CHOICE QUESTION AND ANSWER

NOTE: BOLD MARK INDICATE THE RIGHT ANSWER

1. _____ is the largest organelles of the cell.

   a) Nucleus b) Mitochondria c) Golgi Apparatus d) Ribosomes

2. _____ is the largest organelles of the cytoplasm.

   a) Nucleus **b) Mitochondria** c) Golgi Apparatus d) Ribosomes

3. Plasma membrane consist _____ amount of phospholipids.

   a) 30 % b) 10 % **c) 75 %** d) 100 %

4. _____ is known as power house of cell.

   a) Lysosomes **b) Mitochondria** c) Nucleus d) Ribosomes

5. _____ bind to amino acid during translation

   a) **t-RNA** b) r-RNA c) m-RNA d) DNA

6. In Cell division Cytoplasmic division known as

   a) Mitosis b) Telophase c) Metaphase **d) Cytokinesis**

7. _____ tissue cover the body surface and line the internal organs.

   a) Muscular **b) Epithelial** c) Nervous d) Connective

8. _____ gland produce the milk.

   a) Mammary b) Thyroid c) Pituitary d) Adrenal

9. In ear wax type of secretion produce by _____ gland

   a) Mammary b) Thyroid c) Pituitary **d) Ceruminous**

10. _____ is the area of highest visual activity or resolution.

    a) Central fovea b) Blind spot c) Lens d) Rods receptors.

11. _____ receptor is useful for color vision

    a) Rod **b) Cone** d) Muscarinic d) Nicotinic

12. _____ muscles contraction produce dilation of pupils (Mydriasis).

    a) Circulatory muscles b) Spinctor papillae

    c) Constrictor papillae **d) Radial muscles**

13. _____ muscles contraction produce constriction of pupils (Meiosis).

    b) Skeletal muscles **b) Spinctor papillae**

    c) Cardiac muscle d) Radial muscles

14. Intraocular tension normally stay about _____

    a) **10 mmhg** b) 16 mmhg c) 25 mmhg d) 100 mmhg

15. In the middle ear, hammer shaped bone is known as _____.

a) Incus **b) Malleus** c) Stapes d) Temporal bone

16. In the middle ear, Anvil shaped bone is known as _____.

a) Incus b) Malleus c) Stapes d) Temporal bone

17. In the middle ear, Stirrup shaped bone is known as _____.

a) Incus b) Malleus **c) Stapes** d) Temporal bone

18. Smallest bone of the body is

a) Malleus b) Incus **c) Stapes** d) Femur

19. Human body consist _____ number of bones.

a) 208 b) 204 **c) 206** d) 210

20. How many numbers of bones are present in vertebral column?

a) 26 b) 24 d) 28 d) 12

21. Lumbar vertebrae consist how many numbers of vertebrae

a) 5 b) 7 d) 31 d) 12

22. Thoracic vertebrae consist how many numbers of vertebrae

a) 5 b) 7 d) 31 **d) 12**

23. Cervical vertebrae consist how many numbers of vertebrae

a) 5 **b) 7** d) 31 d) 12

24. Which numbers of ribs are known as floating ribs?

a) 1-7 b) 8-9 c) 9-11 **d) 11-12**

25. Longest bone of the body is

a) Tibia b) Fibula c) Humerus d) Femur

26. Pons is the parts of _____

a) Brain stem b) Diencephalon c) Cerebellum d) Cerebrum.

27. During the embryonic development midbrain is developed from ?

a) Rhombencephalon **b) Mesencephalon** c) Procencephelon d) Telencephelon

28. Brain consist _____ amount of neuron.

a) 1 million **b) 100 billion** c) 1000 billion d) 10 million

29. Spinal cord consist _____ amount of neurons.

a) 1 million b) 100 billion c) 1000 billion **d) 100 million**

30. Entire nervous system consist how much amount of Cerebrospinal Fluid?

a) 10 mL **b) 80 - 150 mL** c) 300 mL d) 5 Liters

31. Select the correct name for the cranial nerve - I

a) Olfactory b) Optic c) Facial d) Vagus

32. Select the correct name for the cranial nerve - II

a) Olfactory **b) Optic** c) Facial d) Vagus

33. Select the correct name for the cranial nerve - VII

a) Olfactory b) Optic **c) Facial** d) Vagus

34. Select the correct name for the cranial nerve - X

a) Olfactory b) Optic c) Facial **d) Vagus**

35. Which part of the brain is the largest part?

a) Cerebrum b) Cerebellum c) Hypothalamus d) Thalamus

36. Select the correct number for spinal nerve

a) 31 b) 100 c) 17 d) 11

37. Ach produce meiosis in eye by acting on _____ receptor

a) M_3 b) M_2 c) β_2 d) α_1

38. Ach produce decrease in heart beat by acting on _____ receptor

a) M_3 **b) M_2** c) β_2 d) β_1

39. Adrenalin produce increase in heart beat by acting on _____ receptor

a) M_3 b) M_2 c) β_2 **d) β_1**

40. _____ % of blood present in human body of the total body weight

a) 8 b) 72 c) 108 d) 90

41. _____ % of plasma present in total amount of blood

a) 55 b) 45 c) 72 d) 90

42. In blood _____ cell nucleus is look like kidney shaped

a) Monocyte b) Lymphocyte c) Basophil d) Neutrophil

43. _____ blood group is known as universal donor according to Rh factor.

a) **O^{-ve}** b) O^{+ve} c) AB^{+ve} d) AB^{-ve}

44. _____ blood group is known as universal acceptor according to Rh factor.

a) O^{-ve} b) O^{+ve} **c) AB^{+ve}** d) AB^{-ve}

45. Blood consist _____ amount of platletes

a) 250,000 – 400,00 mm^3 b) 4000 – 11000 mm^3 c) 11000 mm^3 d) 250 mm^3

46. _____ process in hemopoiesis produce platelets.

a) Megakaryoblasts b) Myeoblasts c) Lymphoblasts d) Monoblasts

47. _____ amount of neutrophils present in

a) 20 – 25 % **b) 60 – 70 %** c) 3 – 8 % d) 2 – 4 %

48. In human body O_2 is transported by _____

a) Heme b) Globin c) Platelets d) WBCs

49. In human body CO_2 is transported by _____

a) Heme **b) Globin** c) Iron d) WBCs

50. In human body Nitric Oxide is transported by _____

a) Heme **b) Globin** c) Iron d) WBCs

51. Globin is made up by _____ amount of polypeptides chain.

a) Two b) Three **c) Four** d) One

52. Platelets lives for how many number of days _____

a) 4-9 b) 1 c) 72 d) 120

53. RBC lives for how many number of days _____

a) 120 b) 1 – 3 c) 72 d) 1000

54. RBCs and WBCs are measured by _____

a) Neubars chamber b) Statoscope c) Thermometer d) Spirometer

55. Normal amount of WBC in healthy human is

a) 4-11000/Cmm **b) 4000-11000/Cmm** c) 4.5 million/Cmm d) 500/Cmm

56. Normal amount of RBC in healthy human is

a) 4-11000/Cmm b) 4000-11000/Cmm **c) 4.5 million/Cmm** d) 500/Cmm

57. Normal amount of Platelets in healthy human is

a) 2,50,000-4,00,000/Cmm b) 4000-11000/Cmm c) 4to6 million/Cmm d) 500/Cmm

58. Normal Bleeding time of blood is

a) 1-3 minutes b) 4-10 minutes c) 72 minutes d) 100 minutes

59. Normal Clotting time of blood is

a) 1-3 minutes **b) 4-10 minutes** c) 72 minutes d) 100 minutes

60. Color index =

a) Hb%/RBC% b) RBC%/Hb% c) HbG%/RBC% d)RBC%/HbG%

61. Normal color index is between

a) 0.85-1.15 b) 1.85-2.15 c) 10-11 d)14.5-17.5

62. 1 gm of Hb carries _____ of O_2

a) 1.34 cc b) 72 cc c) 108 cc d) 2.34 cc

63. Chief cell of stomach secret

a) HCL b) Histamine **c) Pepsin** d) Gastrin

64. Ph of saliva is

a) 3-4 b) 7.2 - 7.7 **c) 6.2 – 7.2** d) 10 - 11

65. Nasopharynx consist how many number of opening in their wall

a) 5 b) 6 c) 11 d) 2

66. Larynx consist how many number of cartilage

a) 7 b) 6 **c) 9** d) 2

67. Each minute adult human doing how many number of respiration?

a) 7 **b) 12** c) 9 d) 2

68. What is tidal volume?

a) 500 mL b) 6000 mL c) 1200 mL d) 3600 mL

69. Right lung is _____ than left lungs.

a) Thicker and broader b) Thinner and narrow

c) Thicker and narrow d) Thinner and broader

70. _____ is minute volume of respiration.

a) 1200 mL **b) 6000 mL** c) 2400 mL d) 500 mL

71. In the calculation of total lungs volume capacity, Inspiratory capacity occupy _____ amount of air.

a) 1200ml **b) 3600ml** c) 2400ml d) 4800ml

72. Active form of Vitamin D3 produce by kidney is

a) Calcium **b) Calcitriol** c) Acetylcholine d) Adrenalin

73. Each kidney consist how many number of nephron

a) 100 million b) 10 billion **c) 1 million** d)10 million

74. Normal capacity of urinary bladder to store urine is

a) 400 - 600 mL b) 100 mL c) 6000 mL d) 1000 mL

75. What is net filtration pressure of kidney?

a) 10 MmHg b) 110 MmHg c) 45 MmHg d) 30 MmHg

76. How much amount of urine is filtered by kidney in each day?

a) 180 mL **b) 180 Liters** c) 1000 mL d) 10 Liters

77. Name the fat soluble hormone

a) Dopamine b) Thyroid c) Adrenalin d) Nor adrenalin

78. Name the protein hormone.

a) Dopamine **b) Thyroid** c) Insulin d) Nor adrenalin

79. Which muscles produce wrinkle like structure on scrotum ?

a) Dartos muscle b) Skeletal Muscle c) Cardiac Muscle d) Adipose muscle

80. What is the Ph of semen? *

a) 7.2 - 7.7 b) 3-6 c) 10-11 d) 1-3

81. Ejaculated sperm most probably do not survive more than ___ out of vagina.

a) 1 months **b) 2 hrs** c) 48hrs d) 120 days

82. Each day healthy male produce how many number of sperm ?

a) 300 million b) 1000 billion c) 20 million d) 1 million

83. When the number of sperm falls below _____, the male is likely to be infertile.

a) 20 million/ml b) 200 million/ml c) 50-150 million/ml d) 100 million/ml

84. Ph of female vagina is

a) Acidic b) Basic c) Neutral d) None of these

85. Pregnancy is confirmed by which enzyme in urine or blood

a) Human chorionic gonadotropin (hCG) b) Adrenaline

c) Testosterone d) Progesterone

86. In the Net Filtration Pressure, Blood Colloidal Osmotic Pressure is _____.

a) **30 MmHg** b) 10 MmHg c) 55 MmHg d) 15 MmHg

87. Kidney consist _____ amounts of juxtamedullary nephrons.

a) 25- 30 % **b) 15 – 20 %** c) 80 – 85 % d) 5 – 10%

88. Kidney consist _____ amounts of cortical nephrons.

a) 25- 30 % b) 15 – 20 % **c) 80 – 85 %** d) 5 – 10%

89. Aqueous humor is completely replaced about every _____.

a) 90 minutes b) 15 minutes c) 10 minutes d) 1minutes

90. Partial pressure of carbon dioxide in alveoli is _____.

a) 160 mmhg b) 105 mmhg **c) 40 mmhg** d) 45 mmhg

91. Each kidney consist _____amount of minor calyces.

a) 4-6 b) 2-3 c) 21- 30 **d) 8 – 18**

92. Each lacrimal gland produce about _____ amount per day of lacrimal secration.

b) 10 ml b) 20ml c) 90 ml **d) 1ml**

93. In the ECG, P – wave indicates.

a) Atrial depolarization b) Ventricle Depolarization

c) Ventricle repolarization d) Atrial depolarization.

94. In the ECG, T – wave indicates.

a) Atrial depolarization b) Ventricle Depolarization

c) Ventricle repolarization d) Atrial depolarization.

95. In the ECG, QRS complex wave indicates.

a) Atrial depolarization **b) Ventricle Depolarization**

c) Ventricle repolarization d) Atrial depolarization.

96. _____ valves consist two cups in heart

a) Mitral b) Pulmonary Semilunar c) Aortic Semilunar d) Right AV

97. Stroke volume eject _____ amount of blood

a) 70 mL b) 130 mL c) 10 mL d) 15 mL

98. Normal Pulse rate of healthy human is

a) 72 - 75 b) 100 c) 12 d) 120

99. Normal beat of heart per minute is

a) 72 b) 100 c) 12 d) 120

100. Normal blood pressure of the body is

a) Systolic 120 & diastolic 80 mmhg b) Diastolic 80 & systolic 120 mmhg

c) Systolic 80 & diastolic 120 mmhg b) Diastolic 120 & systolic 80 mmhg