

HISTOLOGY

M56BOOKSTORE

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❖ HISTOLOGY OF TISSUE

- Human body made up of 04 basic tissues

1. Epithelial tissue
2. Connective tissue
3. Muscular tissue
4. Nervous tissue

❖ Epithelial tissue (02)

SIMPLE EPITHELIUM	STRATIFIED EPITHELIUM
- Squamous - Cuboidal - Columnar - Pseudostratified	- Transitional - Stratified squamous non keratinized - Stratified squamous keratinized

❖ Connective tissue (02)

CELLS	FIBRES
- Fibroblast/ fibrocyte - Adipose/ fat cells - Plasma cells - Mast cells - Macrophages - Leucocytes - Pigment cells - Mesenchymal cells	- Collagen fibre - Elastic fibre - Reticular fibre

❖ Muscular tissue

- Skeletal muscle
- Smooth muscle
- Cardiac muscle

❖ **Nervous tissue**

- Central nervous system
- Peripheral nervous system
- Autonomic nervous system

❖ **EPITHELIAL TISSUE :**

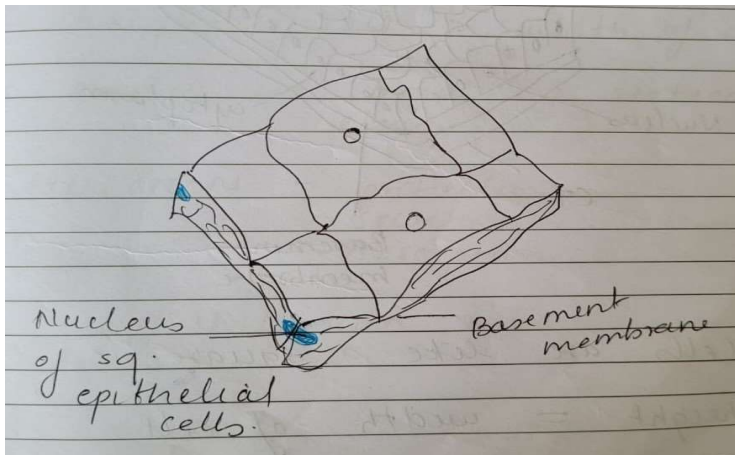
- Lines the internal and external surface of the body
- It can be : ECTODERMAL
MESODERMAL
ECTODERMAL
- **FUNCTION :** - Protection
 - secretion
 - absorption
 - forms gland and duct
- Epithelium can be simple or stratified

(A)SIMPLE EPITHELIUM :

- Simple when all the cells rest on the basement membrane

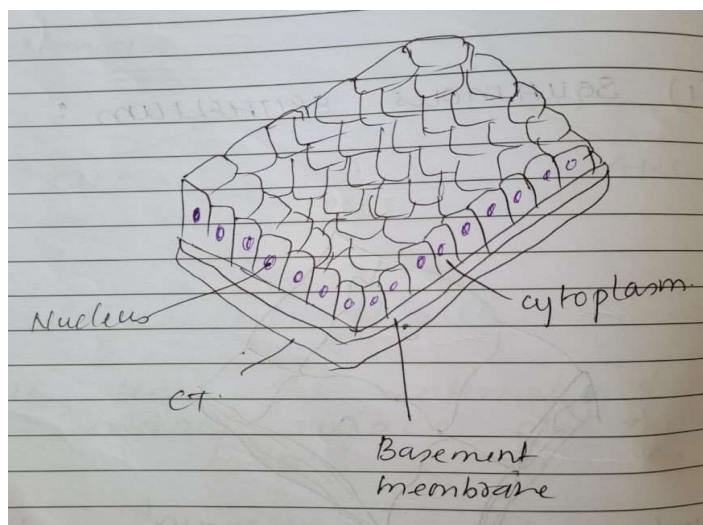
1. Squamous epithelium

- Cells are flattened
- Nuclei present with bulge in the cell
- Allows rapid exchange of substance
- Eg: lining of alveoli



2. Cuboidal epithelium

- Cells are like a square
- Height = width of cell
- Nucleus : present in centre
: round in shape
- FUNCTION : absorption
: secretion



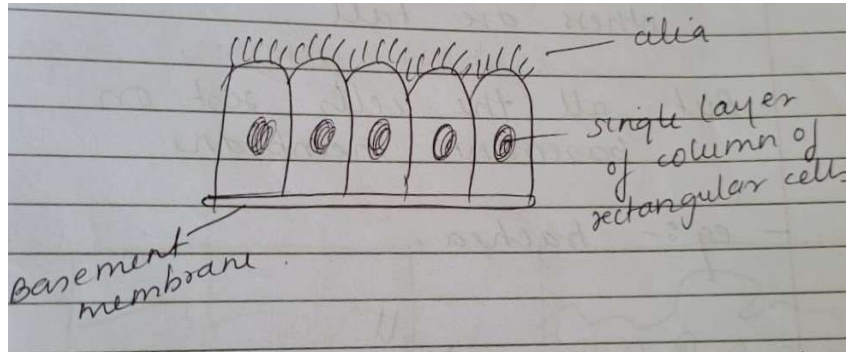
3. Columnar epithelium

- Height > width of cell
- Nuclei is basal and vertically elongated

FUNCTION : protection

: secretion and absorption

- Eg: fallopian tube

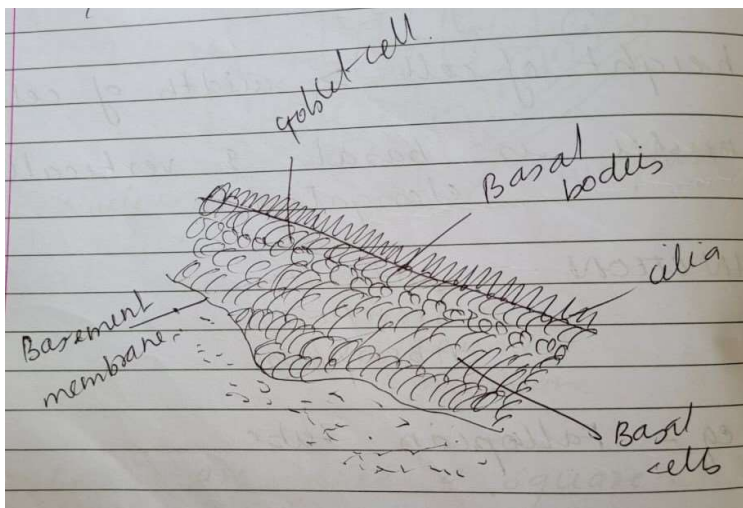


4. Pseudostratified epithelium

Pseudo = false

Stratified = multilayer

- False appearance
- Epithelium is multilayered
- Some cells are short while others are tall
- But all the cells rest on the basement membrane
- Eg: trachea



❖ STRATIFIED EPITHELIUM

- Multilayer epithelium is known as stratified epithelium

1. Transitional epithelium

- It is kind of epithelium line an organ which is distensible (ability to stretch)
- Eg: urinary bladder

2. Stratified squamous non keratinized

- Multilayer epithelium
- Basal cells are columnar
- Eg: lining of oesophagus

3. Stratified squamous keratinized

- Multilayered epithelium
- Top most layer consist keratin
- Water can neither be evaporated from the body
- As in standing in sun nor can be absorbed into body while swimming
- Eg : epidermis of skin

❖ CONNECTIVE TISSUE

- Connects different component of the body
- Made up of : cells
 - : fibres
 - : matrix
- Eg: fibroblast , fibrocyte , macrophages
- Matrix is composed of ground substance and fibre
- **FUNCTION:**
 1. Providing support to different part of body
 2. Connects different component of our body
 3. It is a medium for exchange of nutrients , metabolites and oxygen between blood and cells

CELLS:

1. Fibroblast:

- Cells synthesize collagen fibre, elastin fibre and lays down matrix

2. Fibrocyte:

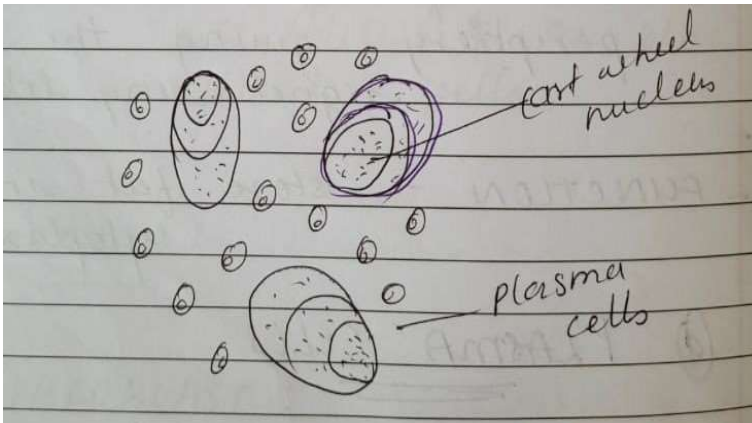
When fibroblast gets mature they are known as fibrocyte

3. Adipose/ fat cell:

- Rounded cell
- Present in groups
- Usually compressed
- Variable in shape
- Fat globule in their cytoplasm which pushes the nuclei to periphery giving the cell signet like structure
- FUNCTION : store fat in their cytoplasm

4. Plasma cells:

- Rounded to avoid basophilic cells with cart wheel nucleus
- Rich in rough endoplasmic reticulum



- FUNCTION: synthesize immunoglobulin

5. Mast cells:

- Involved in inflammatory reaction

6. Macrophages:

- Function is to engulf various foreign particles

7. Leucocyte:

- Wbc are known as leucocytes
They are :
 - Neutrophils
 - Lymphocytes

- - Eosinophils
 - Basophils
 - Monocyte
- Have defensive action

8. Pigment cell:

- Import brown colour to skin
- Offers protection against ultraviolet rays of sunlight

9. Mesenchymal cells

- Are undifferentiated cells
- Can differentiate into a variety of cell type

FIBRES:

1. Collagen fibre

- Flexible but offer great tensile strength
- Found in tendon, ligament , all kind of connective tissue

2. Elastic fibre

- Can stretch and come back to their normal size when stretching force is released
- Found in ligamentum nuchae , ligamentum flava and wall of large arteries

3. Reticular fibre

- They are special type of collagen fibres and can be seen only by special stain
- They are seen in connective tissue framework of spleen , liver, lymph nodes

GENERAL CONNECTIVE TISSUE:

- Loose connective tissue
- Dense connective tissue
- Muroid tissue
- Adipose tissue

-

SPECIALIZED CONNECTIVE TISSUE :

- This compresses the bones, cartilage, hemolymphoid tissue

(a) Cartilage :

- Hyaline cartilage
- Elastin cartilage
- Fibrocartilage

(b) Bone:

- Made up of organic and inorganic substance

(c) Hemolymphoid tissue :

- Blood and lymphatics

❖ MUSCULAR TISSUE :

1. SKELETAL MUSCLE

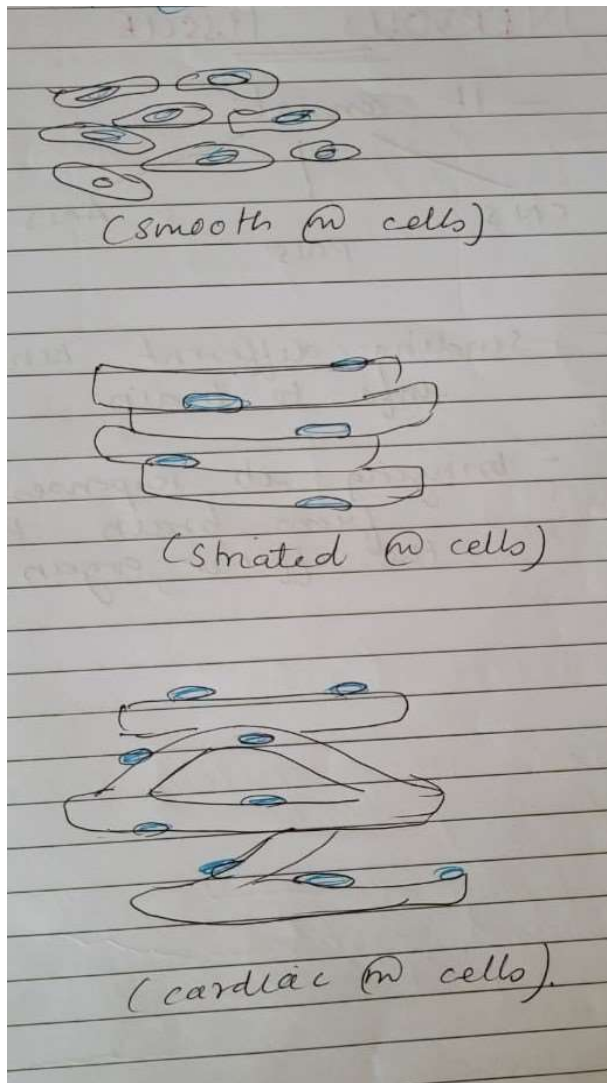
- Helps in locomotion
- Eg: biceps femoris

2. SMOOTH MUSCLE

- Present in viscera of our body
- Eg: wall of stomach

3. CARDIAC MUSCLE

- Seen only in heart
- Contraction of this muscle helps in pumping of blood throughout the body



❖ **NERVOUS TISSUE**

- CONSIST: CNS , PNS , ANS
- Sending defferent kinds of information to brain
- Bringing its response back from brain to the effector organ



HISTOLOGY OF LUNGS:

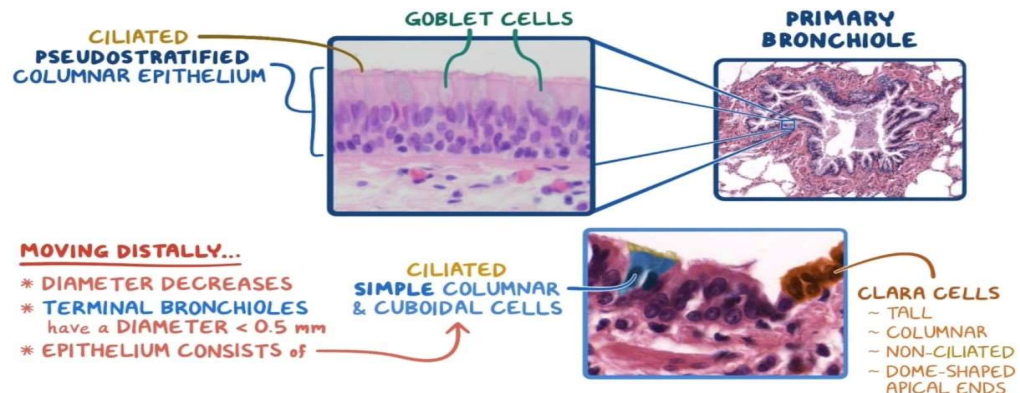
- Presence of numerous thin walled alveoli
- Mostly lined by : Squamous cells single layer
- These cells are also called as :
- SQUAMOUS CELLS : Type I pneumocytes
- CUBOIDAL CELLS : Type II pneumocytes
(type II pneumocyte – responsible for **SURFACTANT**)
- Between the alveoli fine capillaries are present
- CAPILLARIES : Responsible for gaseous exchange
- Besides alveoli and capillaries → Bronchi and bronchioles are present

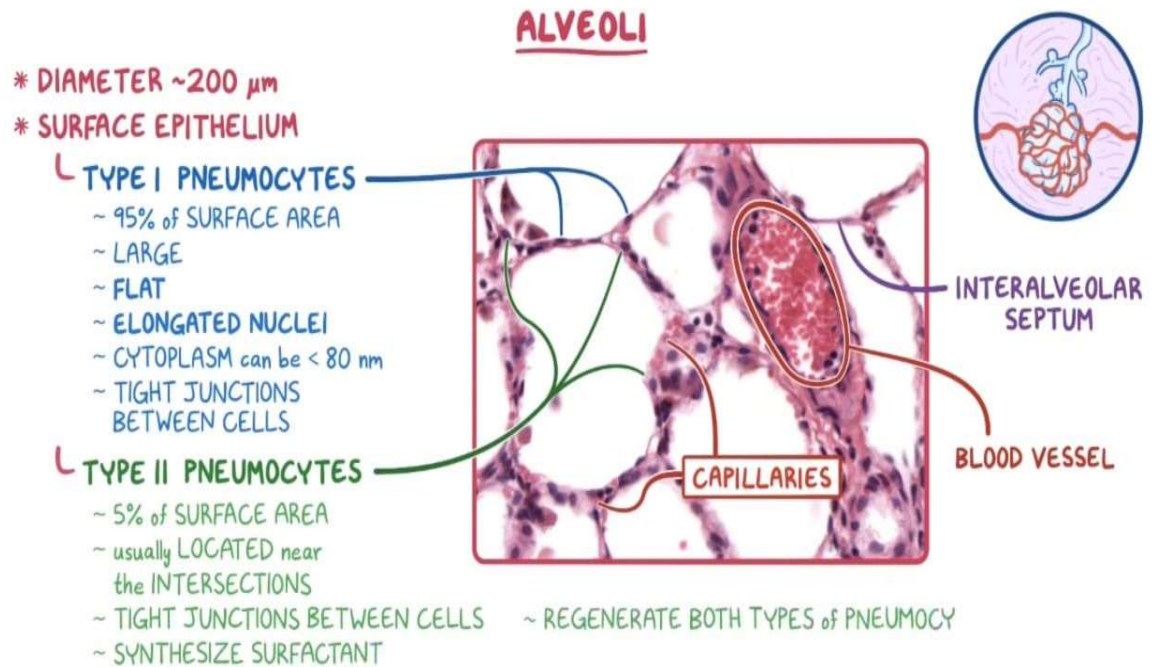
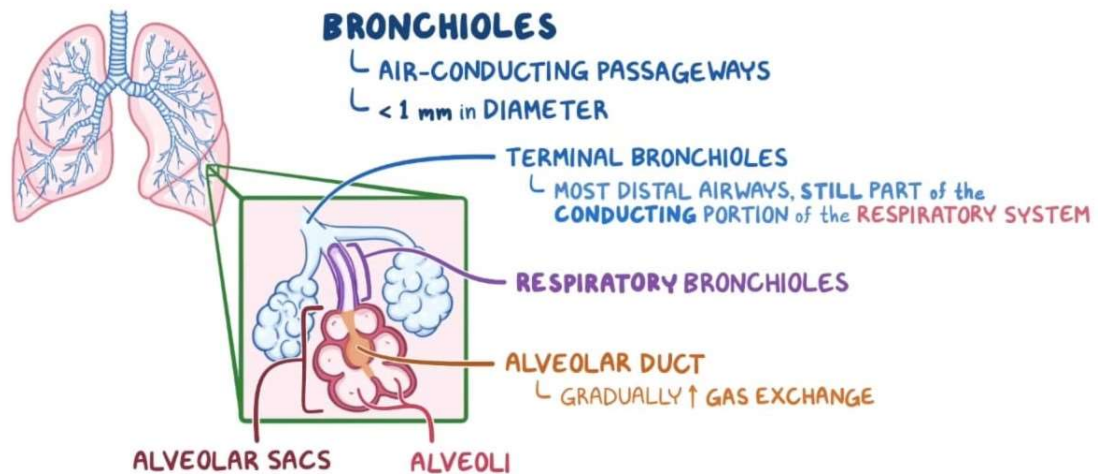
BRONCHI :

- Lined by pseudostratified ciliated columnar cells
- Cartilage seen
- Smooth muscles present

BRONCHIOLES:

- Dilated space
- Lined by columnar epithelium
- No cartilage present
- Smooth muscle present
- No glands present
- Arteriole seen adjacent to bronchiole





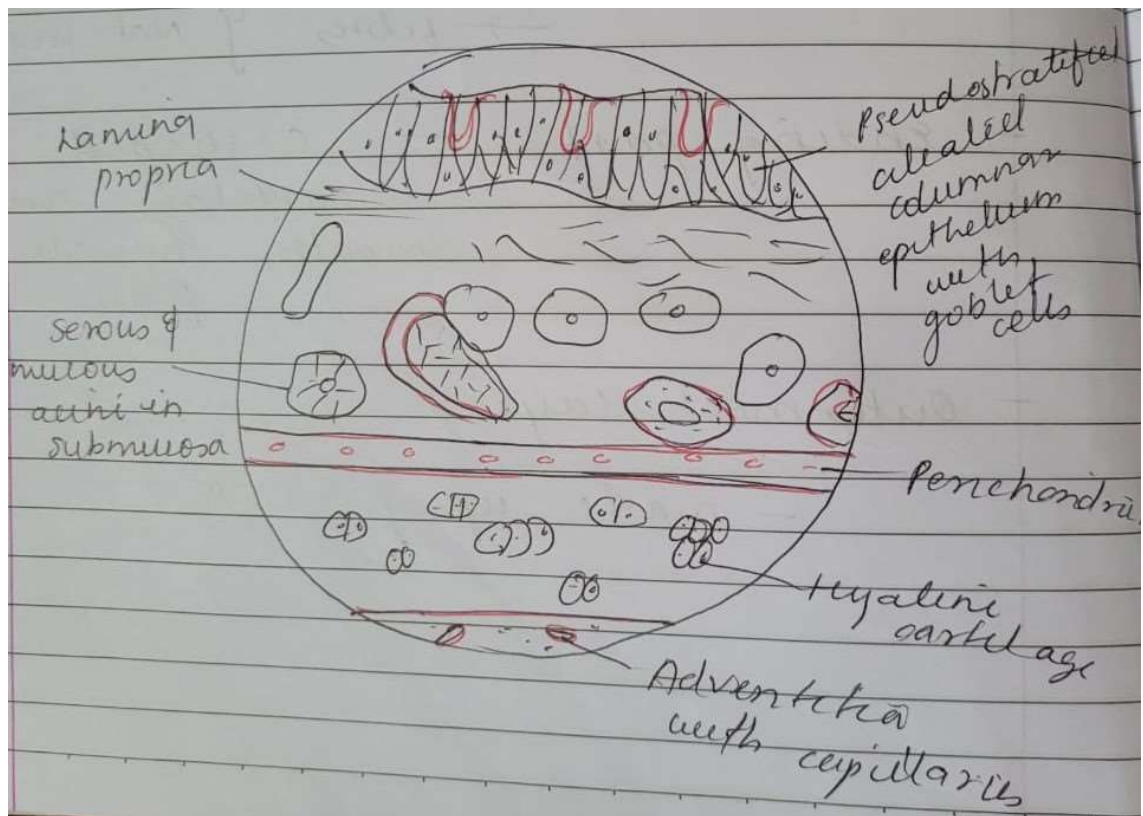


HISTOLOGY OF TRACHEA

- Trachea is lined by : PSUEDOSTRATIFIED CILIATED COLUMNAR EPITHELIUM
- Cells varying : Height
 - False apparence
 - More than one layer of cells
- Deep to epithelium : MUCUS GLAND
SEROUS GLAND
- Main part : 'C' shaped
 - Hyaline cartilage
- Cartilage cells lie in group of 02 or 04 each with in: Matrix
 - Fibre
- Ending part : C shaped
 - Cartilage are smooth muscle fibre
- Outermost layer: made up of **connective tissue**

IMPORTANT POINTS TO REMEMBER

1. Psuedostratified
2. Lamina propia – connective tissue found in thin layer of tissues covers by muscous membrane
3. Perichondrium :
 - Connective tissue envelops cartilage
 - Protect bone from injury and damage
 - Nourish cartilage through blood vessels
 - Facilitate cartilage growth
4. Hyaline cartilage
5. Adventitia with capillaries





HISTOLOGY OF CARTILAGES

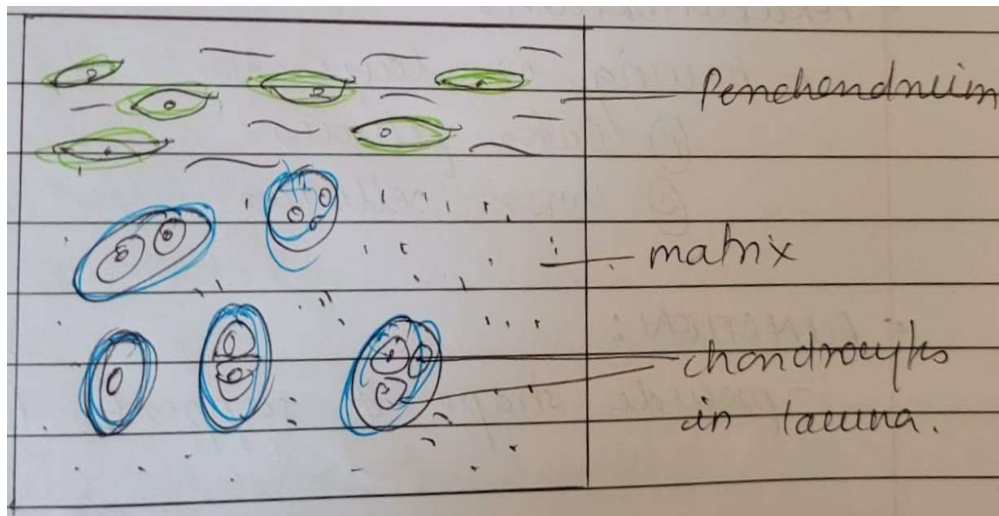
- It is a type of connective tissue
- Composed of cells and fibres
- Embedded in firm gel like structure matrix which is rich in mucopolysacchride

CLASSIFICATION:

1. HYALINE CARTILAGE
2. FIBROCARILAGE
3. ELASTIN CARTILAGE

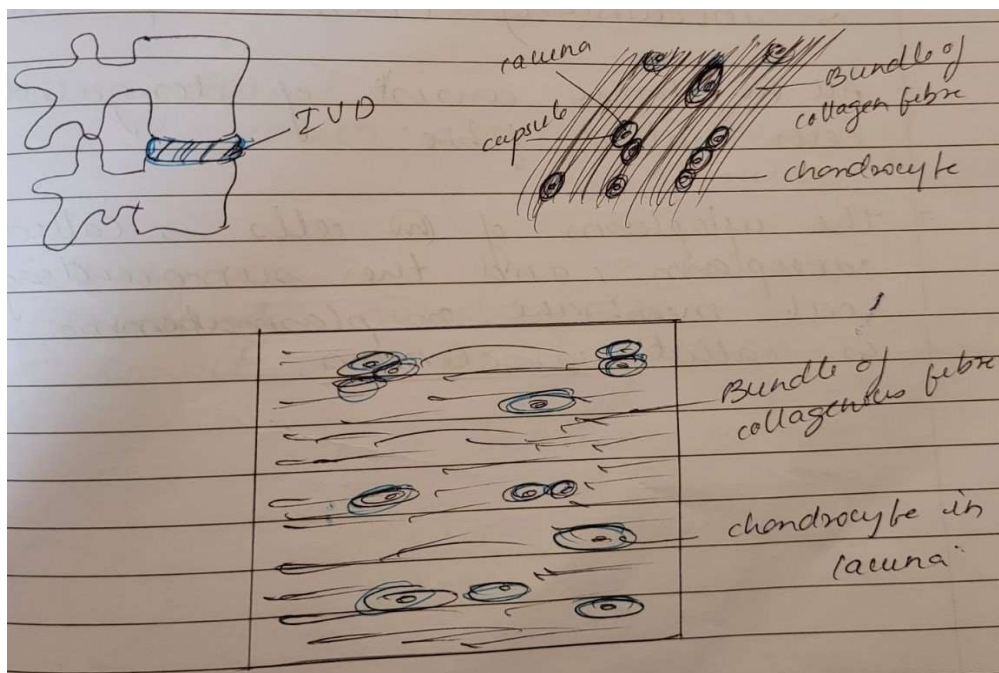
1. HYALINE CARTILAGE

- Located in articular cartilage of long bones
- Epiphyseal lplates
- Nasal cartilage
- Thyroid
- Trachea
- Bronchi
- Costal cartilage
- Bluish white in coulour
- Shiny and translucent
- Very thin fibre
- Flexible
- Perichondrium is present



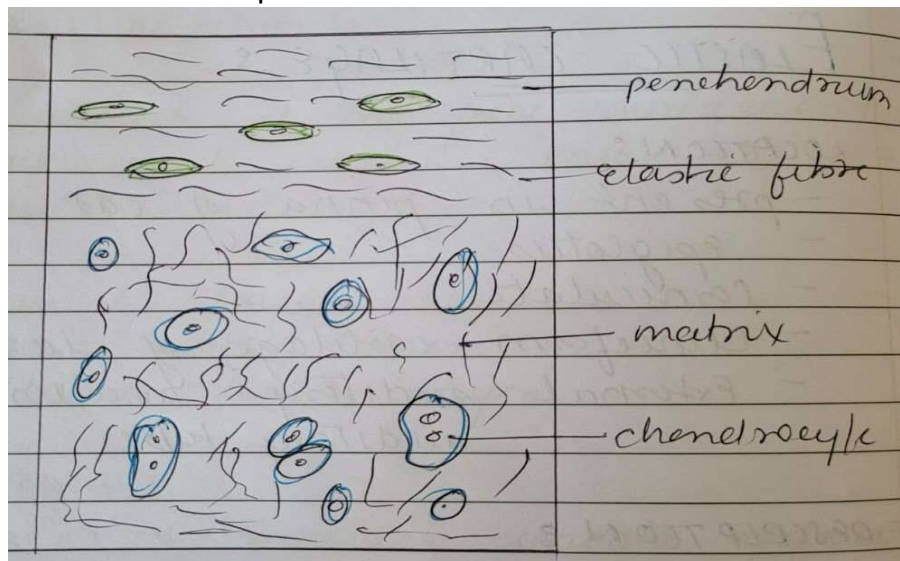
2. FIBROCARILAGE

- Located in : intervertebral disc , temporomandibular joint, sternoclavicular joint
- White in colour
- Opaque appearance
- Numerous white fibre
- Perichondrium is absent



3. ELASTIC CARTILAGE

- Located in : pinna , external auditory meatus, Eustachian tube, epiglottis
- Yellowish in colour
- Opaque appearance
- Numerous yellow fibre
- Most flexible
- Perichondrium is present



❖ HISTOLOGY OF BONE

- Bone tissue contains an abundant matrix
- **MATRIX CONTAINS :**
 1. Water – 25%
 2. Collagen fibre – 25%
 3. Crystallized inorganic mineral salts – 50%
- **Matrix is made up of :**
 1. Calcium phosphate
 2. Calcium carbonate
- This mineral salts are deposited in framework which is formed by collagen fibre of matrix

04 types of cells present in bone tissue :
- Osteogenic cells - Osteoblast cells - Osteocyte cells - Osteoclast cells

1. OSTEOGENIC CELLS :

- Stem cells
- Bone cells are formed
- Later, cells are developed into osteoblast cell

Found in :

- Periosteum
- Endosteum
- Blood vessels

2. OSTEOBLAST CELLS :

- Bone building cells
- Synthesis and secret collagen fibre and organic components
- Initiation of ossification
- Finally converted into osteocyte

3. OSTEOCYTE CELLS:

- Mature bone cells
- They are main cells in bone tissue
- Maintain daily metabolism of bone tissue

4. OSTEOCLAST CELLS:

- They are large cells
- Present in endosteum
- Cause and breakdown of bone matrix
- Normal development
- Growth maintenance
- Repair of bone

BONE :

- **COMPACT BONE**
- **SPONGE BONE**

1. COMPACT BONE

- Compact bone contains few spaces
- Forms external layer of all bones
- Make a bulk of shaft of long bones
- Eg: femur, humerus
- Provides protection and support
- Resist the stress produced by weight and movement

❖ UNIT OF COMPACT BONE :

- Osteon / Haversian system
 1. Blood vessels
 2. Lymphatics
 3. Nerves(form periosteum penetrate the compact bone through transverse perforating canal)
- CANAL NAME – **Volkman's canal**
- This vessels and nerve of volkmann's canal connects with periosteum and haversian canal

- Around central canal – concentric lamellae present called as **ring of heart**
- Ring of heart is calcified matrix
- Between lamellae small spaces called as **lacunae**

❖ LACUNAE:

- contains osteocytes
- from lacunae **canaliculi** radiate in all direction

❖ CANALICULI:

- Link the lacunae with each other with harvesian canal
- Areas between osteon contains **interstitial lamellae**

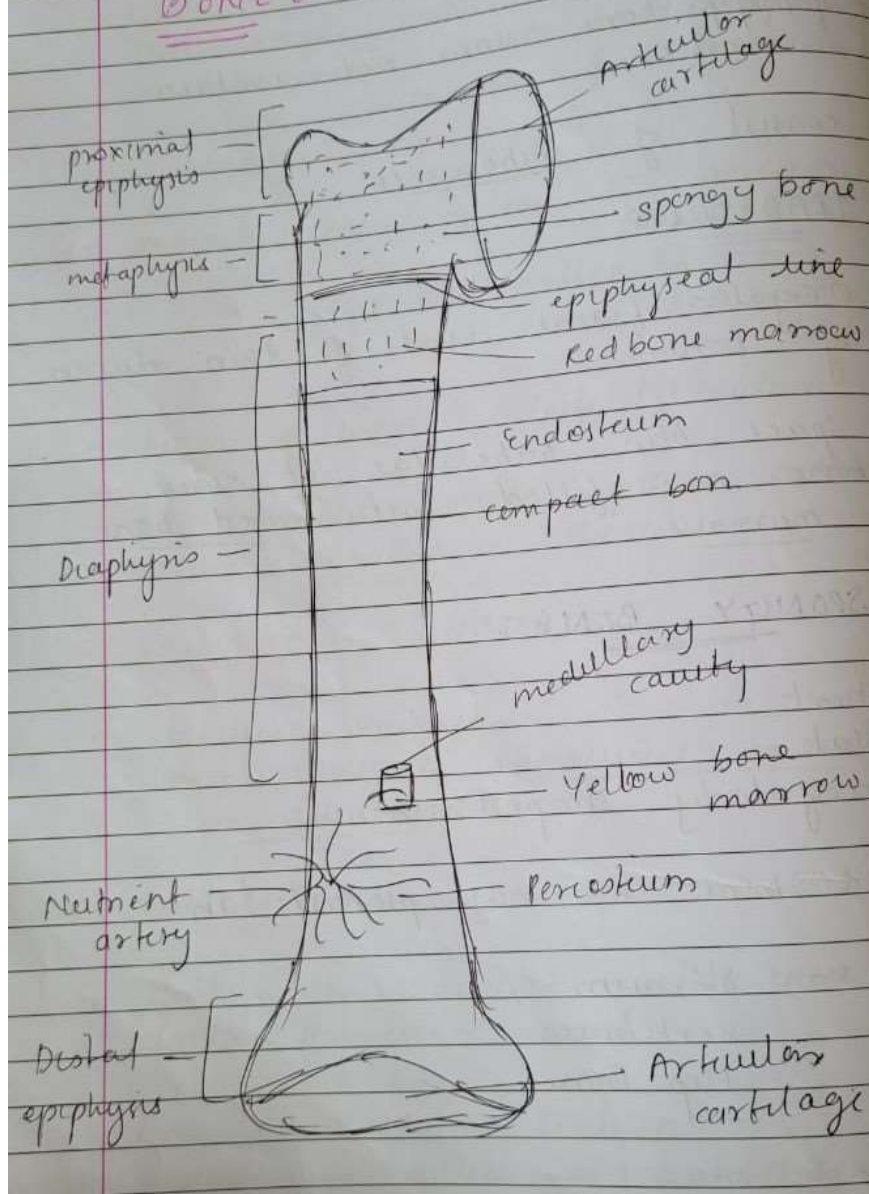
❖ SPONGE BONE :

- Sponge bone does not contain osteon
- Short
- Flat
- Red bone marrow present
- Irregular shape
- Consist of trabeculae
- Eg: sternum, vertebrae, hip bone

❖ TRABECULAE:

- Irregular frame work of thin column of bones
- Spaces between trabeculae of some bone are filled with **red bone marrow**

BONE :-



❖ Histology of stomach

- it is a J shaped organ
- hollow organ
- present between esophagus and duodenum

❖ 4 Layers:

- mucosa
- submucosa
- muscularis
- serosa

1. MUCOSA

- simple columnar epithelium
(Gastric pits present)

2. Lamina propria

- (Pyloric gland present)

3. Muscularis mucosa

- (Smooth layer present)

#SUBMUCOSA

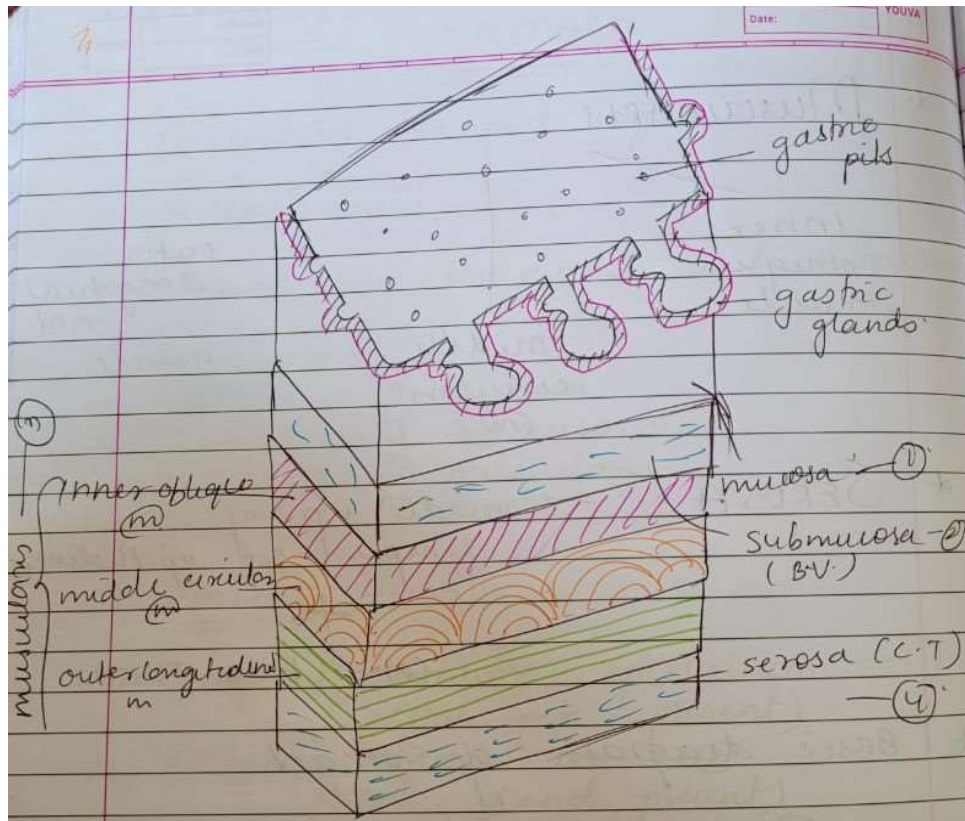
1. Connective tissue
2. Blood vessels

#MUSCULARIS

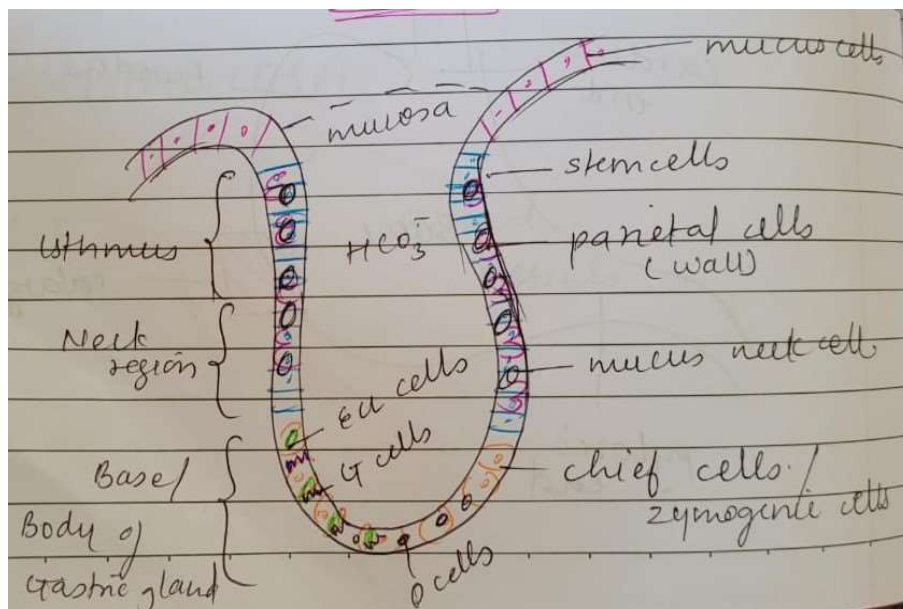
- Inner oblique muscle
- Middle circular muscle
- Outer longitudinal muscle

#Serosa

- made up of simple squamous epithelium and connective tissue



❖ CELLS PRESENT IN GASTRIC GLAND



1.MUCUS CELLS

- mucus to protect stomach from acid
- outer or pit region of gastric gland

2.STEM CELLS

- totipotent and differentiate new cells
- present in isthmus and neck region

3. PARIETAL CELLS

- also called as oxyntic cells secrete HCL
- present in the wall of isthmus and neck region

4. MUCUS NECK CELLS

- secreting mucus
- present in neck region of gastric gland

5. CHIEF CELLS

- secrete pepsinogen
- weak lypase
- present in the base region

6. ECL CELLS

- entero chromaffin like cells
- release histamine
(Stimulate parietal cells to release HCL)
- Present in near parietal cells

7. G - CELLS

- release gastrin
- present in base region

8. D - CELLS

- somatostatin hormone
- present in the base region



HISTOLOGY OF KIDNEY

- covered by capsule

❖ CORTEX :

- present deep to capsule
- consist of renal corpuscles
- tubules in various shapes

CORTEX COVERS 02 SECTIONS

- PCT
- DCT

1. PCT - Proximal convoluted tubule

- Dark pink tubule
- lumen is small and distinct
- lined by cuboidal epithelium with brush border
- more in number than DCT

2. DCT - Distal convoluted tubule

- lighter staining tubule
- distinct lumen
- lined by simple cuboidal epithelium

❖ MEDULLA

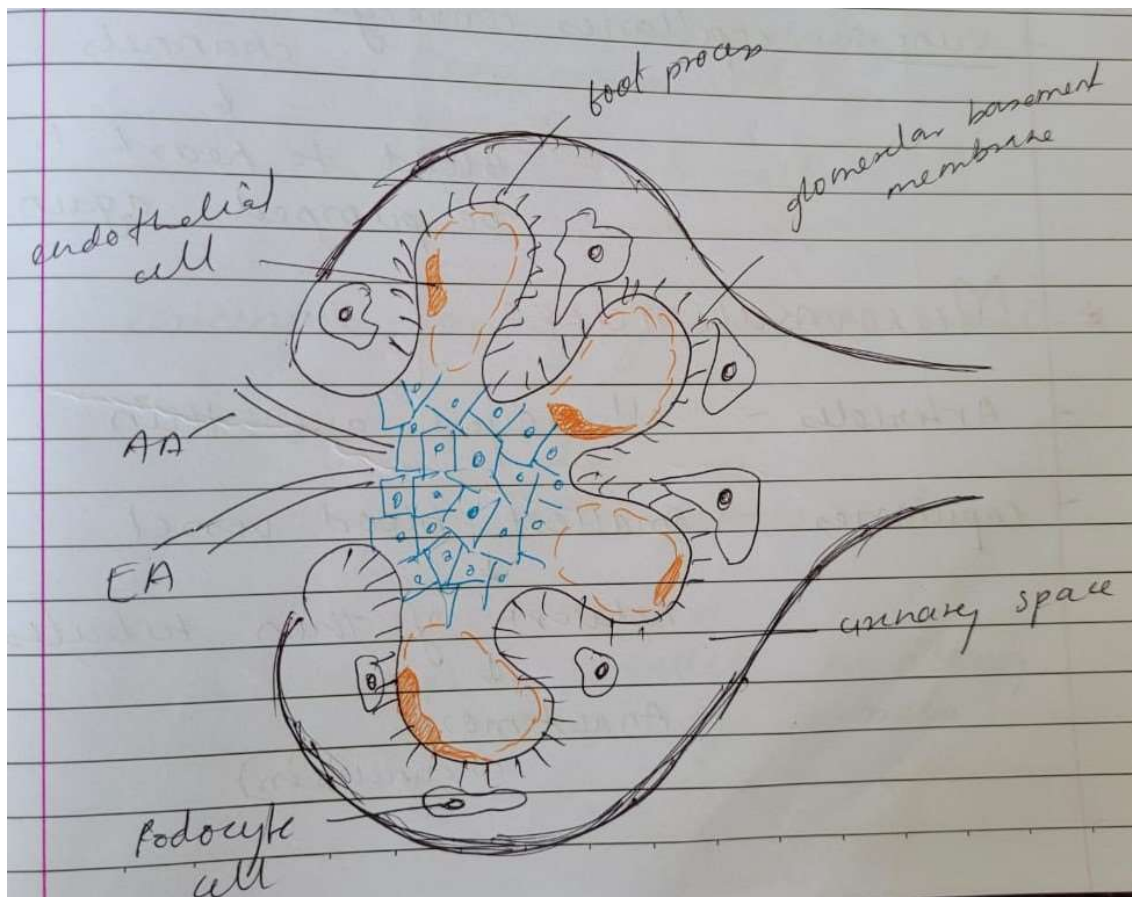
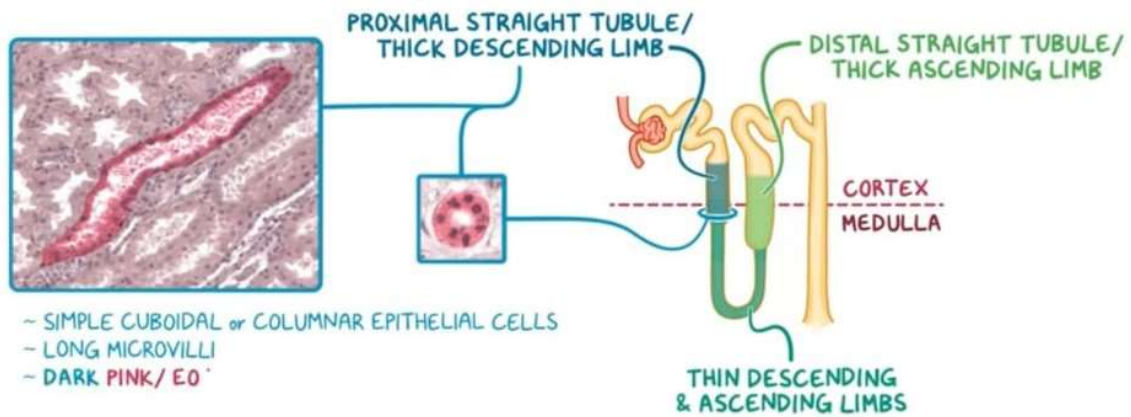
- deep to cortex
- very light staining , elongated , parallel running tubules - collecting duct and henle's loop
- some of them extended into cortex

❖ COLLECTING DUCT

- simple cuboidal epithelium

❖ HENLE'S LOOP

- thin segment
- simple squamous epithelium





HISTOLOGY OF URETER

- ureter is a tube with star shaped lumen inside
- it conducts urine from renal pelvis to urinary bladder
- its structure containing 03 walls
(Submucosa absent)

1. MUCOSA

- irregular shaped
- made up of transitional epithelium
 - i. Simple squamous
 - ii. Simple columnar
 - iii. Simple cuboidal
 - iv. Pseudostratified
- thick layers

2.LAMINA PROPRIA

- made up of loose connective tissue
- contains blood vessels and lymphatics

3.MUSCULAR LAYER

- inner longitudinal and outer circular layer of smooth muscle

4.ADVENTITIA

- outer most layer of ureter made up of loose connective tissue

❖ CLINICAL

- ureter stone
- Size of stone <10mm then easily passout through urine
- it causes severe pain radiating from back to front side at lower abdomen



HISTOLOGY OF URINARY BLADDER

❖ 03 LAYERS

- inner mucosa
- middle muscularis
- outer adventitia

❖ STRUCTURE:

- muscular organ
- temporary reservoir of urine
- located on anterior part of pelvic cavity
- **SHAPE** : empty - tetrahedral
- full - oval shape

1. MUCOSA

- mucosal fold
- transitional epithelium
- lamina propria

2. MUSCULARIS

- Inner longitudinal
- middle circular
- outer longitudinal

3. ADVENTITIA

- made up of : loose CT
 - nerve
 - Blood vessels
 - Lymphatics

❖ HISTOLOGY OF ADRENAL GLAND

❖ Suprarenal gland / Adrenal gland cell divide into:

1. stroma
2. parenchyma

#CAPSULE: - dense fibrous connective tissue

#SEPTA: - from the deep surface of capsule

- extend in the cortex
- carry blood vessel

❖ **Reticular Fibrous**

- support the sinusoidal capillaries and parenchyma cell

❖ **Cortex zones :**

- 1) zona glomerulosa → secrete mineral corticoides
- 2) zona fasciculata → secrete glucocorticoides
- 3) zona reticularis → secrete sex hormones

❖ **ZONA GLOMERULOSA**

- narrow zona under the capsule
- cell are arranged into round and oval groups (glomeruli)
- A rich network capillaries surrounds the glomeruli
- CELLS → columnar cell
- spherical shape

❖ **ZONA FASCICULATA**

- Broadest zone
- composed straight parallel cords of cell
- The cord : usually one or two cell in width
- surrounded by a longitudinally arranged fenestrated sinusoidal capillaries.
- cells shape : polyhedral
- Nucleus - Binucleated

❖ **ZONA RETICULARIS**

- thin zone
- composed of branching and anastomosing cord of cells separated by fenestrated Blood sinusoidal capillaries,
- CELLS: - small
 - polyhedral shape with few lipid droplet
 - some cells are darker as the contain lipofuscin pigment

❖ HISTOLOGY OF TESTIS

- Changes taking place in the spermatids during spermatogenesis
- Formation of acrosomal cap from golgi apparatus
- condensation and elongation of nucleus
- formation of flagellum from centrioles
- formation of mitochondrial sheath
- casting of excess cytoplasm

❖ FUNCTION OF SERTOLLI CELLS

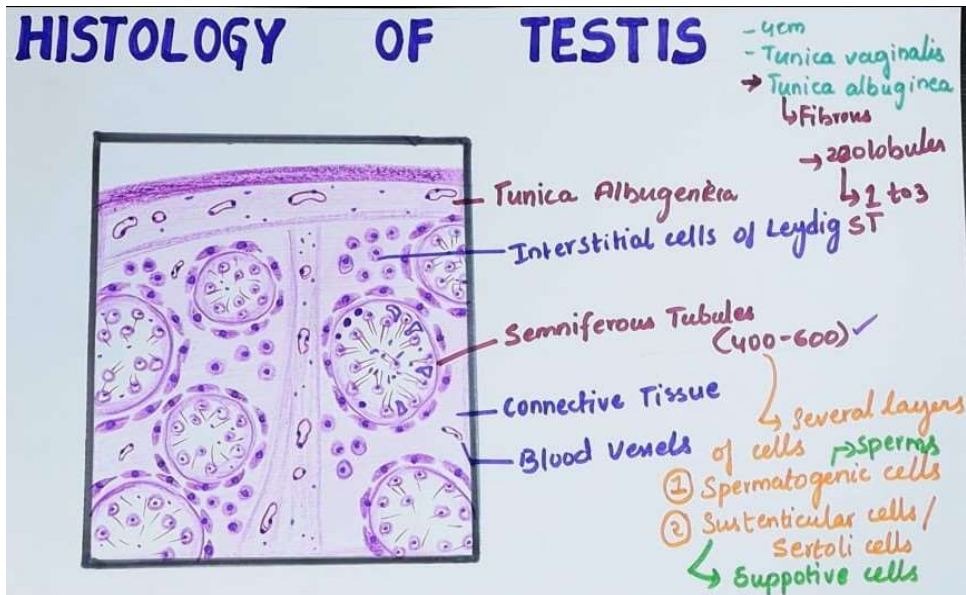
- supports
- protection and nutrition
- phagocytosis
- secretion
- blood test barrier

❖ CELLS OF SEMINIFEROUS EPITHELIUM

- outer fibrous layer : tunica albugenia
- seminiferous tubules cut in various direction
- tubules are separated by connective tissue containing blood vessels and group of interstitial or leydig cells
- seminiferous tubule lined by several layers of cell

❖ CELLS:

1. Spermatogenic cells - produce spermatozoa
2. Sertoli cells - supportive function



❖ HISTOLOGY OF FALLOPIAN TUBE

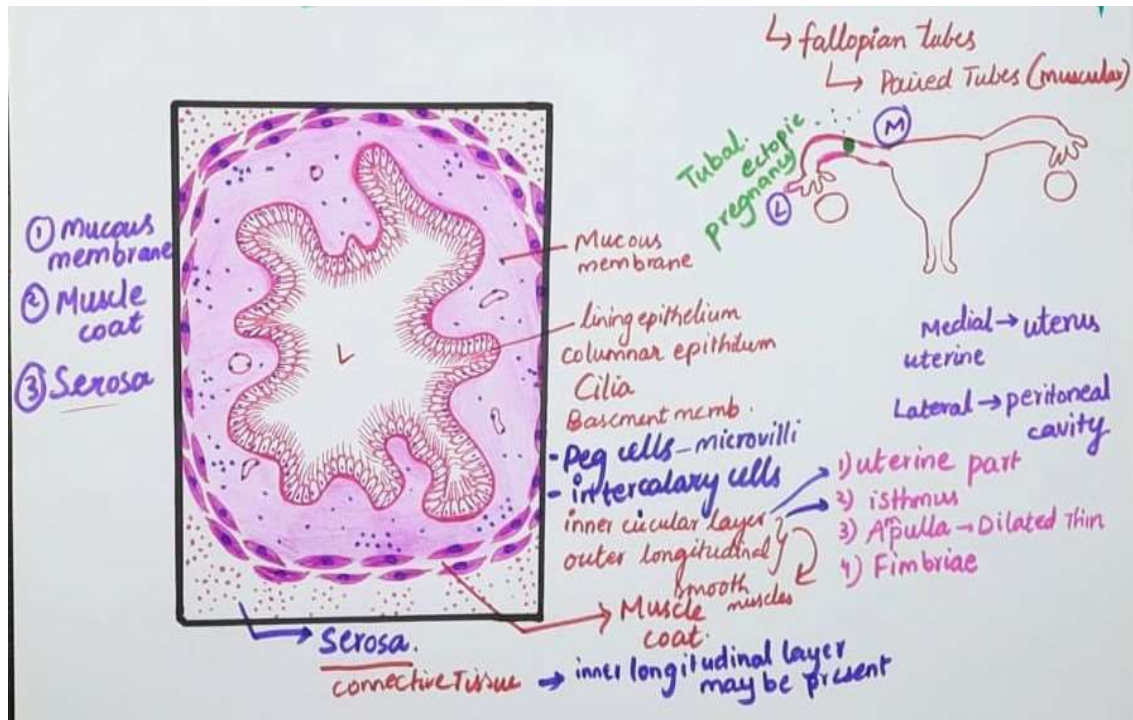
- paired tube
- medial part : uterine part
- lateral part : peritoneal cavity

❖ PARTS:

1. Infundibulum
2. Ampulla
3. Isthmus
4. Uterine

❖ LAYERS

- Mucus membrane
- Muscle coat
- serosa

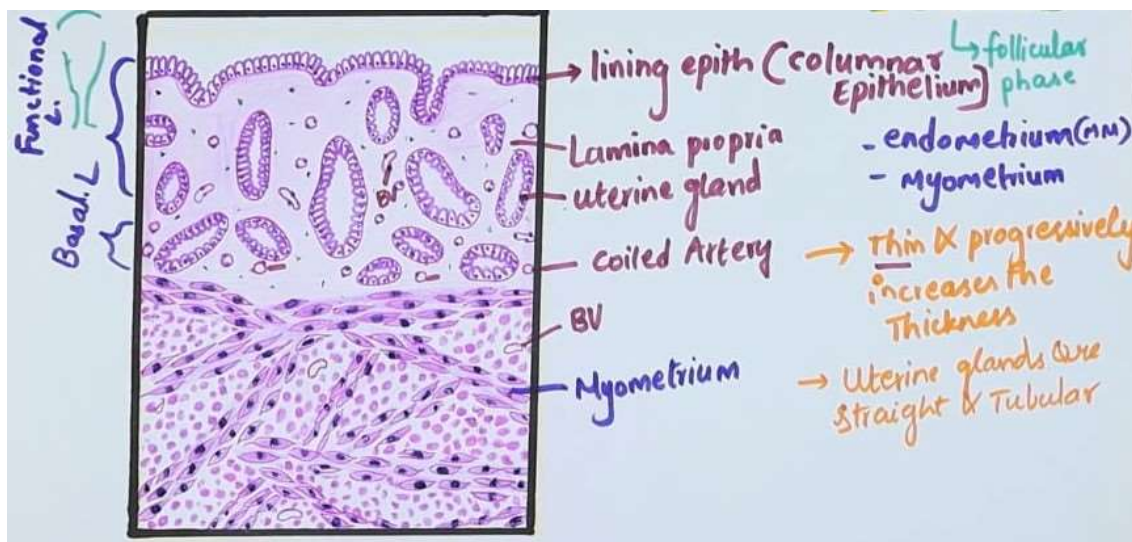


❖ HISTOLOGY OF UTERUS

- also called as secretory phase / luteal phase
- occurs in 14-20 days

❖ LAYERS

- Endometrium
- Myometrium
- Serosa



❖ HISTOLOGY OF SPLEEN

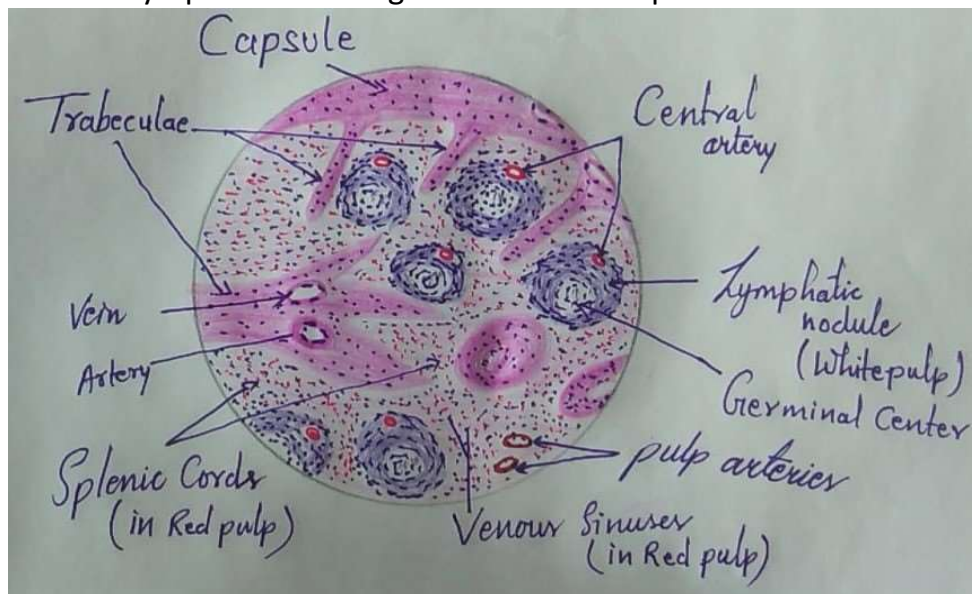
- The whole surface of organ is covered with the the peritoneum and refers as serous coat
- The deep to the peritoneum or serous coat the organ is completely covered with capsule
- capsule extended downward and forms a trabeculae

#TRABECULAE :

- it is extension from the capsule to the organ
- Trabeculae divided into smaller divisions and totally they form network
- Also contains arteries and venuoles

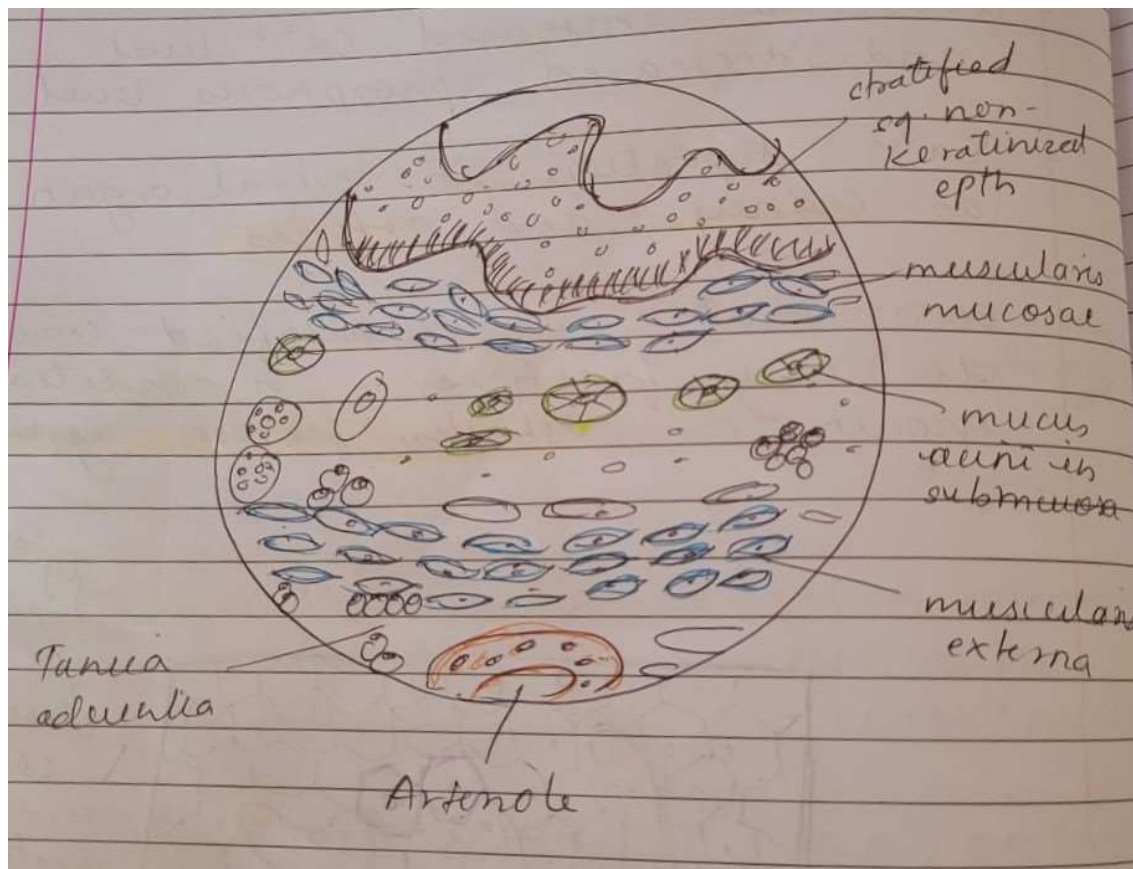
❖ CENTRAL ARTERY

- Located in the periphery of lymphatic nodules
- lymphatic nodules contain white pulp and remaining portion is called red pulp
- In the red pulp - pulp artery. is present as well as splenic cord
- in lymphatic nodule germinal centre is present



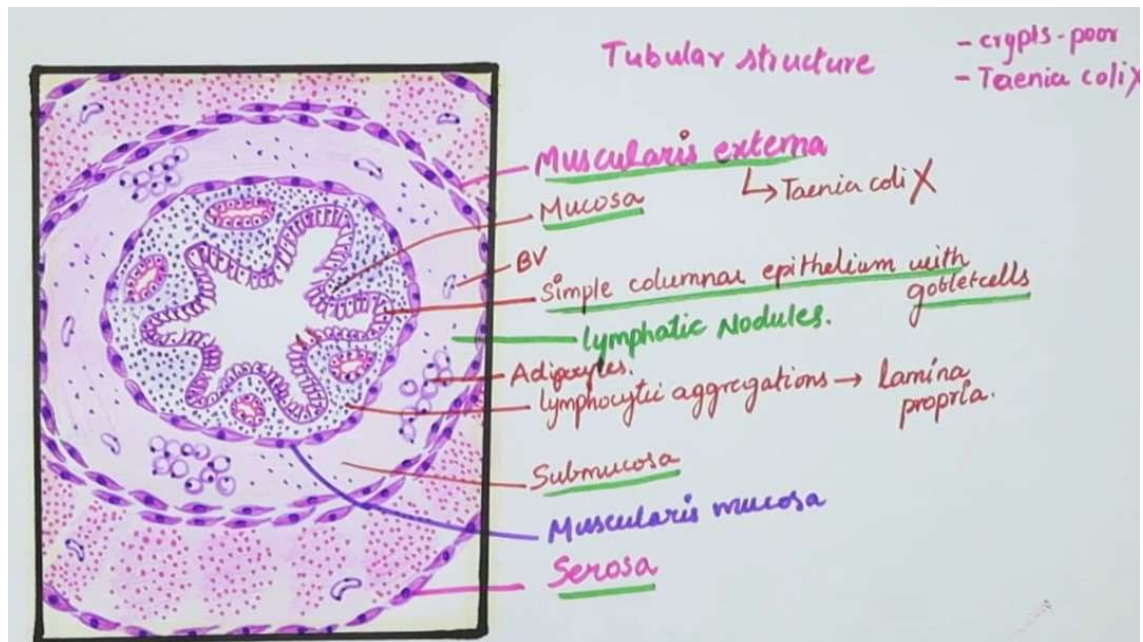
❖ HISTOLOGY OF OESOPHAGUS

- Epithelium is stratified squamous non keratinized
- esophageal mucus gland in submucosa
- Lower 1/3rd shows smooth muscle in muscularis externa



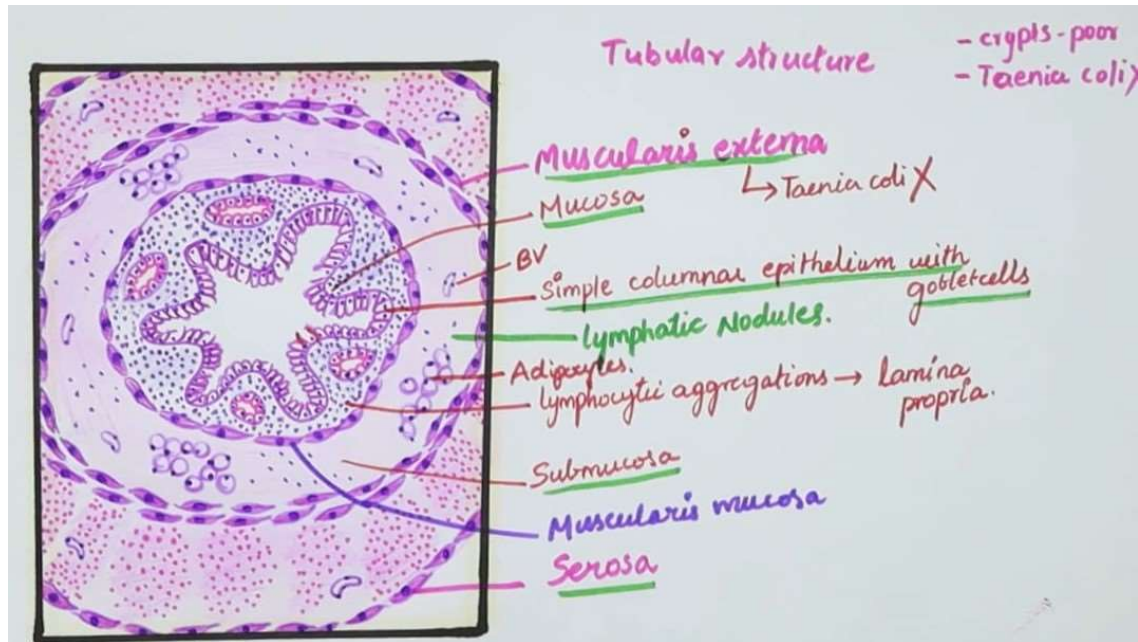
❖ HISTOLOGY OF VERMIFORM APPENDIX

- Tubular structure
- Tenia colica absent



❖ HISTOLOGY OF VAS DEFERENS

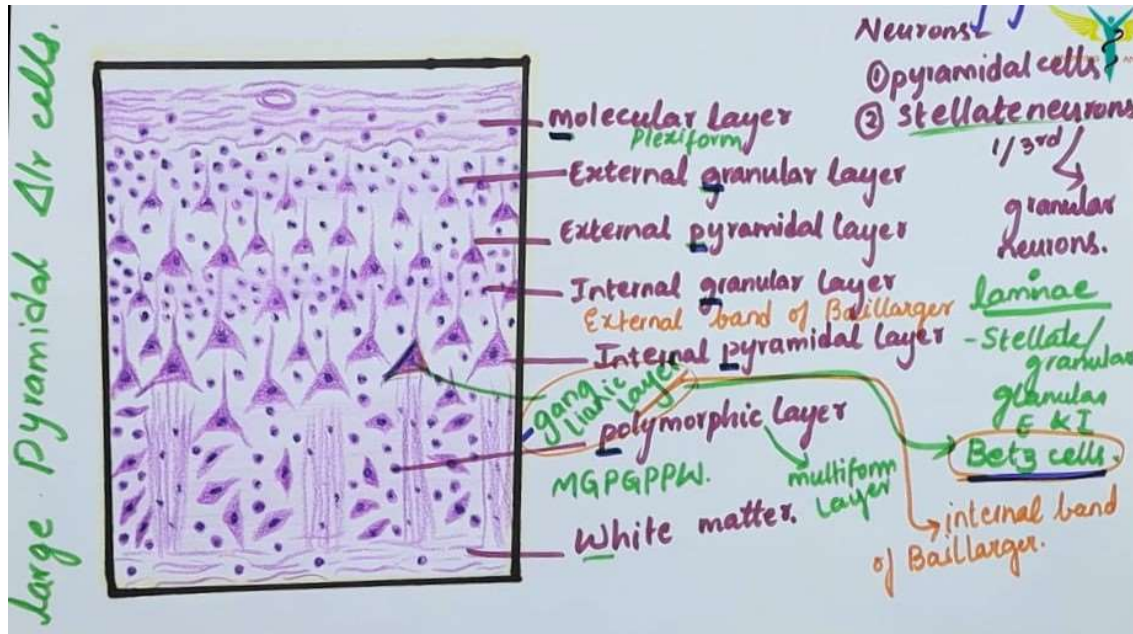
- Also called as ductus deferens



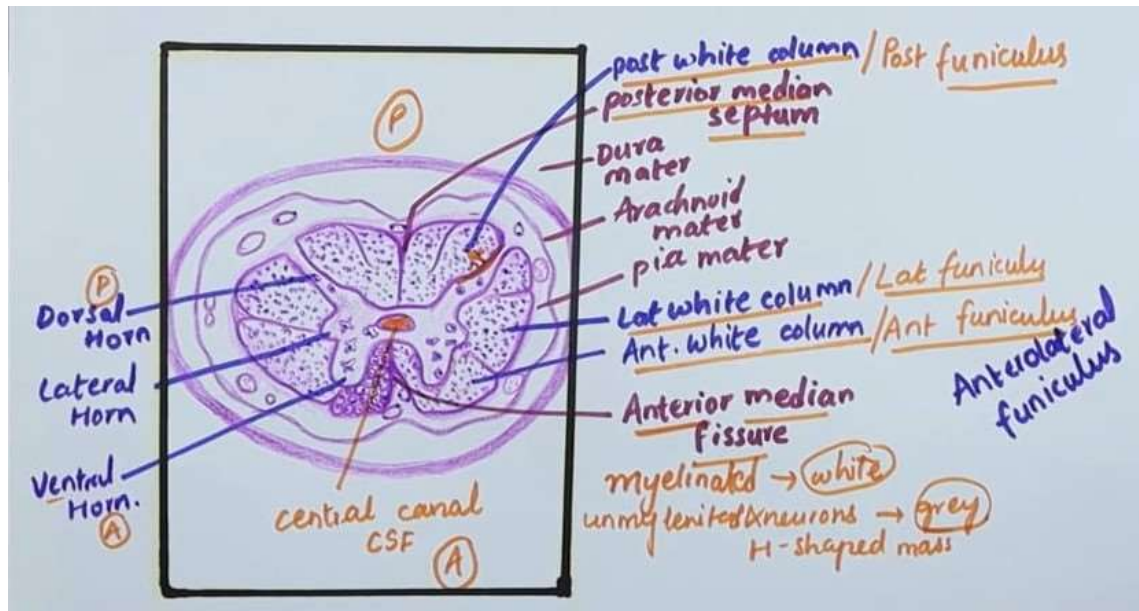
❖ HISTOLOGY OF CEREBRAL CORTEX

NEURONS

- Pyramidal cells
- Stellate neuron



❖ HISTOLOGY OF SPINAL CORD



- H – shaped mass
- Myelinated → white
- Unmyelinated → grey

❖ HISTOLOGY OF PITUITARY GLAND

ADENOHYPHYSIS (ANTERIOR PITUITARY)	NEUROHYPHYSIS (POSTERIOR PITUITARY)
CONSIST 03 TYPES OF CELLS: - Acidophill cells - Basophil cells - Chromophole cells Secrete 06 major hormone	CONSIST : - Unmyelinated neurons Secrete 02 hormones

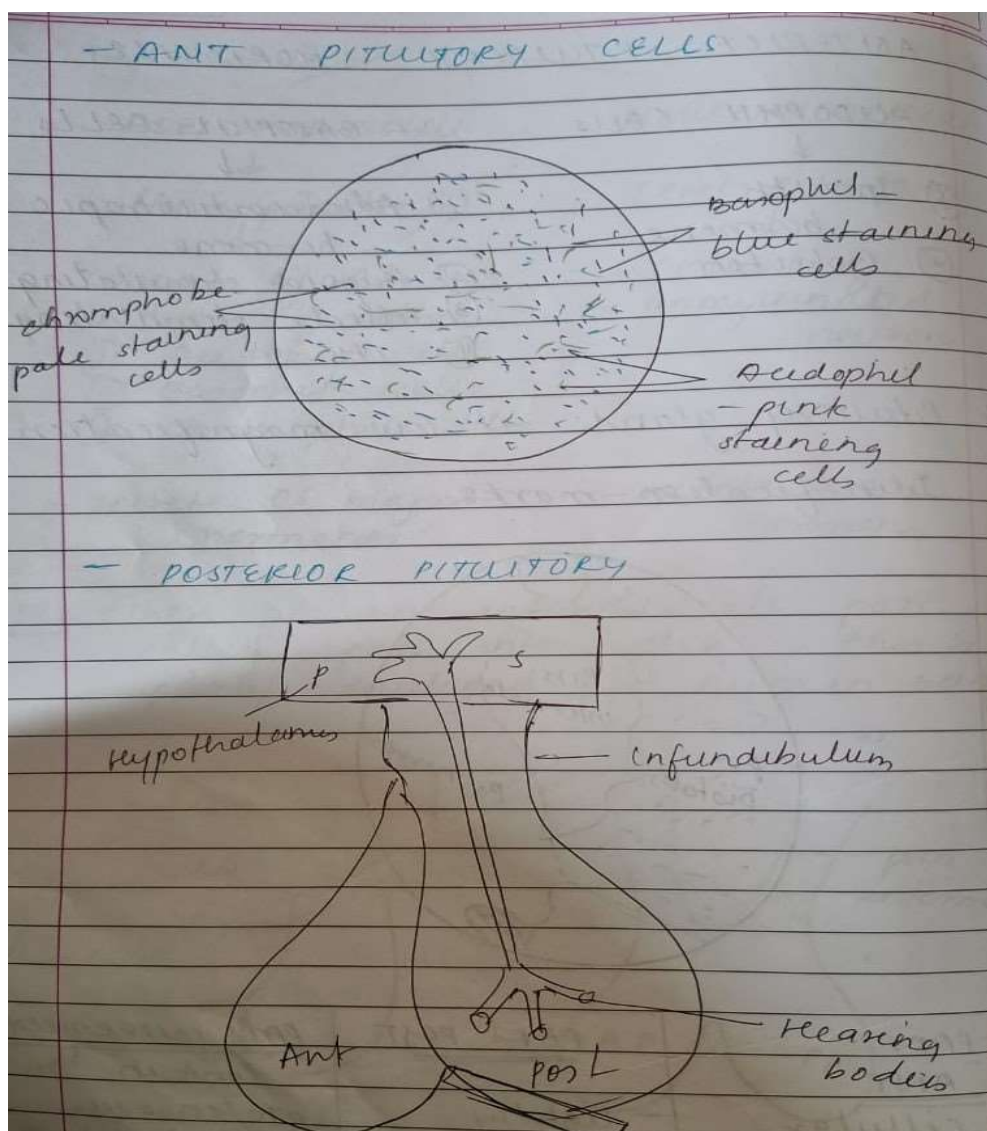
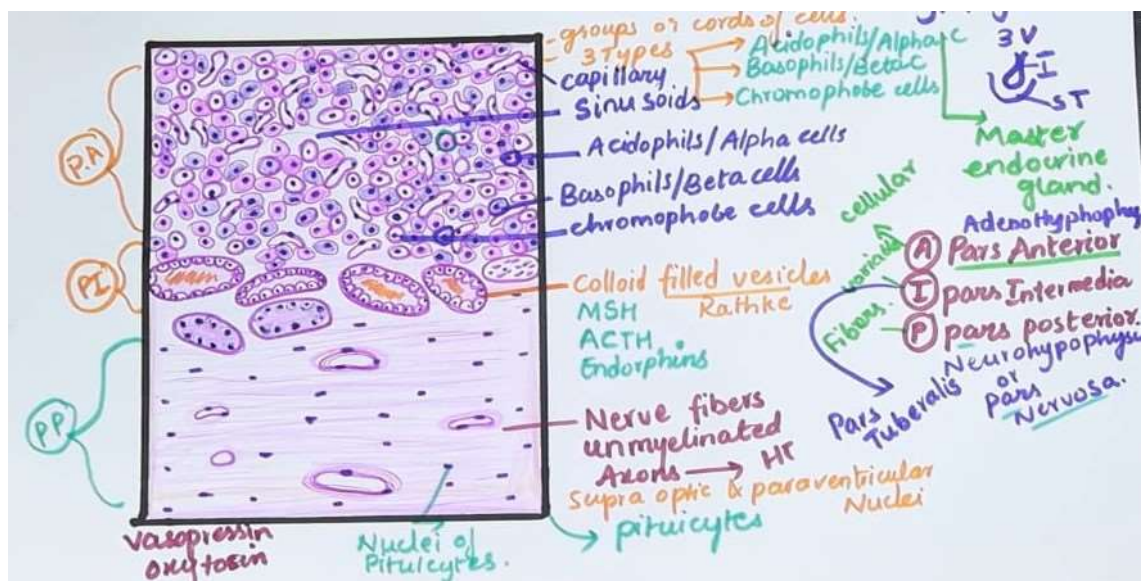
❖ **NOTE:** there is an intermediate part called **PARS INTERMEDIA** , this is poorly developed in human beings

❖ ANTERIOR PITUITARY HORMONES :

ACIDOPHIL CELLS	BASOPHIL CELLS
1. Growth hormone 2. Prolactin	1. Adrenocorticotrophic hormone 2. Thyroid stimulating hormone 3. Follicle stimulating hormone 4. Leutinizing hormone

• PITUITARY GLAND AT LOW MAGNIFICATION

PARS ANTERIOR	PARS POSTERIOR	PARS INTERMEDIA
- cellular - dark stained	- lightly stained - contain fibres	- contains proteneous coiled like material



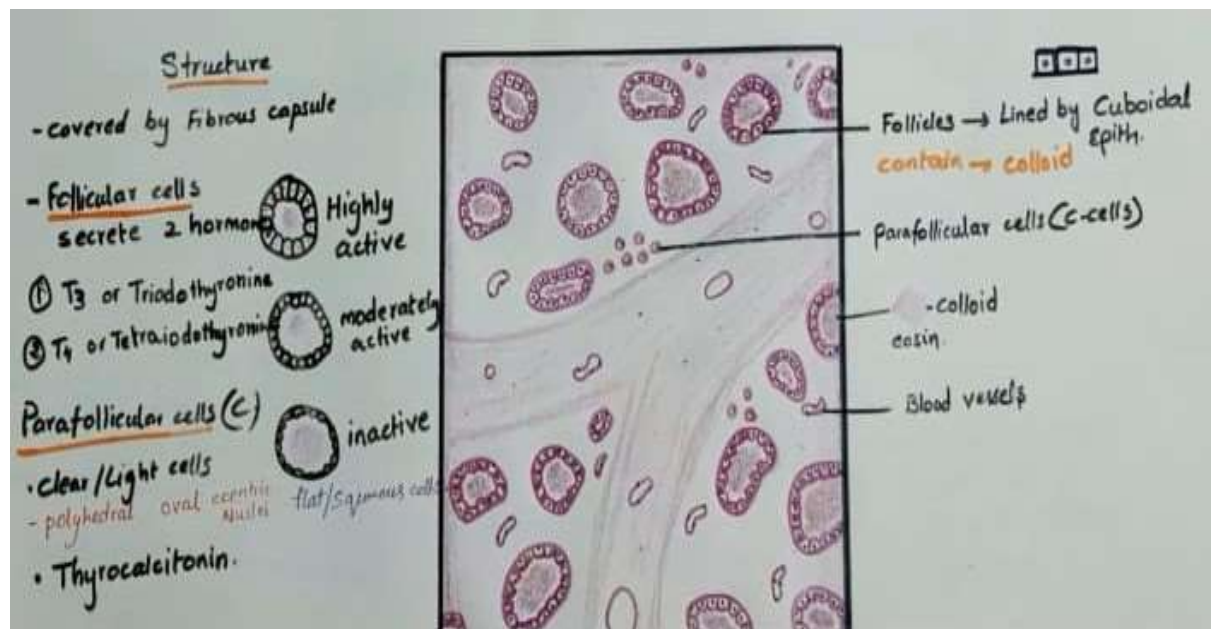
❖ HISTOLOGY OF THYROID GLAND

- Unique endocrine gland
- Bilobed gland

LOCATION : each lobe situated either side of trachea

- **HISTOLOGY :**

- Covered by fibrous capsule
- FOLLICULAR CELLS :
 1. HIGHLY ACTIVE FOLLICULAR CELLS
 2. MODERATE ACTIVE
 3. INACTIVE FOLLICULAR CELLS



❖ HISTOLOGY OF OVARY

- female reproductive system
- **LOCATION** : lower abdominal region
- **Shape** : oval shape and 01 pair
- **RELEASE** : Ovum and hormones
- **HISTOLOGY** : outer to inner

#GERMINAL EPITHELIUM

lined by simple cuboidal epithelium

#TUNICA ALBUGENIA

fibro connective tissue

- **CORTEX**

- Ovarian follicle : development stage

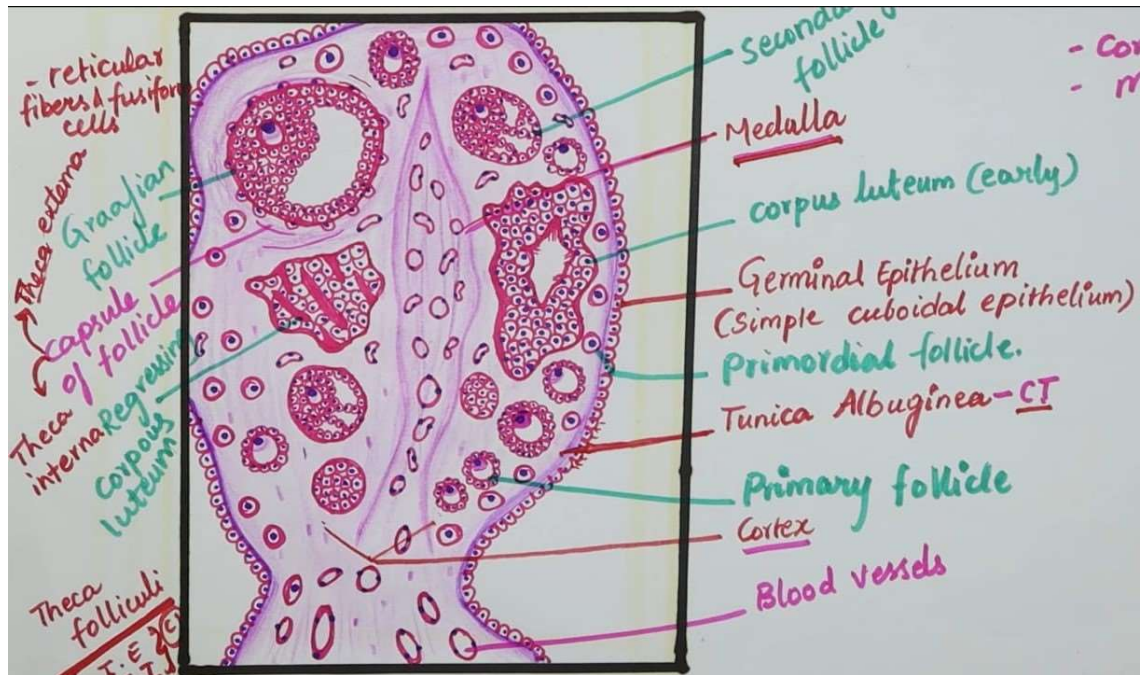
- **STAGES :**

Primordial follicle
Primary follicle
Secondary follicle
Graafian follicle
Corpus luteum
Corpus albicans

#Arteric follicle : follicle after menopause

- **MEDULLA**

- connective tissue
- highly blood vessels





HISTOLOGY OF PARATHYROID GLAND

- Number of glands : 04
- Located on posterior surface of thyroid glands

- **PARATHYROID GLAND**

STROMA	PARENCHYMA
1. CAPSULE 2. SEPTA 3. RETICULAR CONNECTIVE TISSUE	

- CHIEF CELLS
- OXYPHIL CELLS
- RBC

COMPONENTS	CHIEF CELLS	OXYPHIL CELLS
NUMBER	More numerous	Less numerous
SIZE	small	Larger
SHAPE	Polygonal cells with central rounded nuclei	Oval or rounded cells with central nuclei
CYTOPLASM	Have basophilic cytoplasm and vesicular nuclei	Deeply acidophilic cytoplasm and dark nuclei
FUNCTION	Secrete parathyrohormone	Degenerating chief cells

#CLINICALS:

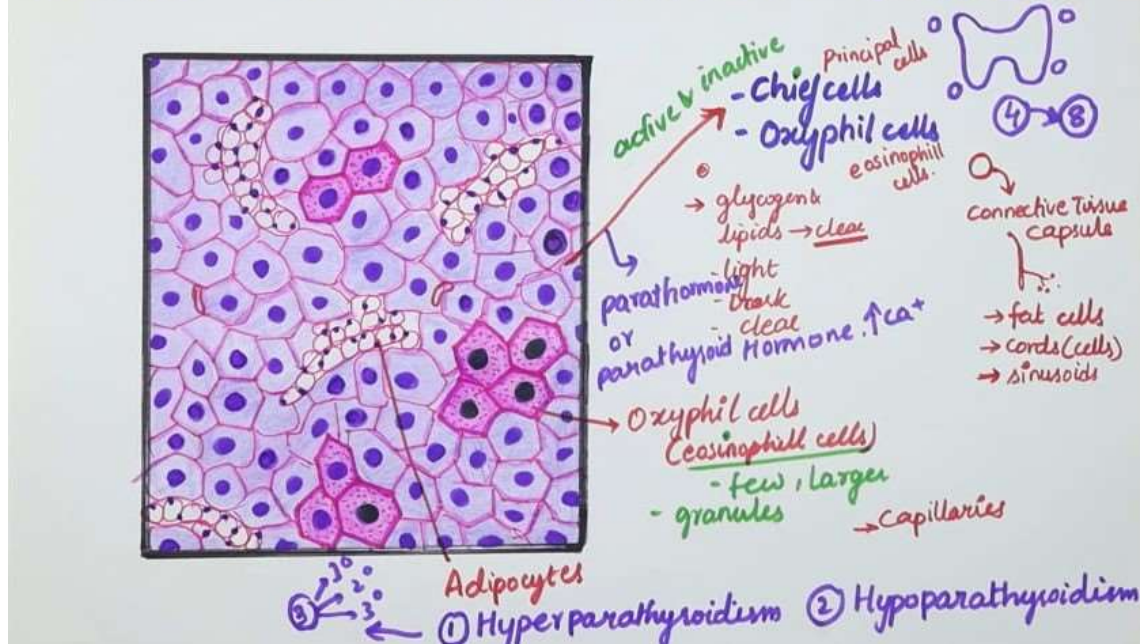
- **HYPO FUNCTION OF PARATHYROID GLAND**

- Or removal of parathyroid glands lead to tetany and death due to decreased calcium level

- **HYPER FUNCTION OF PARATHYROID GLAND**

- Leads to increased calcium level and decreased phosphorus level
- Calcium deposition in several organs as kidney and arteries

HISTO OF PARATHYROID GLAND.



- Bone matrix is decalcified leading to easy fractures , a condition known as osteosites fibrosa cystica



HISTOLOGY OF MUSCLES

- **Termed used :-**

- Muscle fibre - Muscle Cell
- Sarcolemma - Cell membrane of muscle cell
- Sarcoplasmic – reticulum (SER)
- Sarcosomes – mitochondria
- Sarcoplasm - cytoplasm

- **Muscles :-**

- Classified into :- smooth
Skeletal
cardiac
- Muscle cells possess contractile filament containing actin and myosin
- Contraction may be voluntary (skeletal muscle)
Or involuntary (cardiac and smooth muscle)
- All muscle tissue consist of elongated cells called fibre.
- The cytoplasm of muscle cell is called sarcoplasm
- And the surrounding cell membrane or plasmalemma is called sarcolemma

- **Skeletal :-**

- Compressed all voluntary muscles in the body.
- Most originated/inserted in the bone.

- **Cardiac:-**

United to heart and large blood vessels attached to heart

- **Smooth**

Present in walls and parenchyma of most visceral organs ,walls of blood vessels and skins.

- **Skeletal Muscles :-**

1. **Epimysium:**

- Connective tissue which envelops muscles

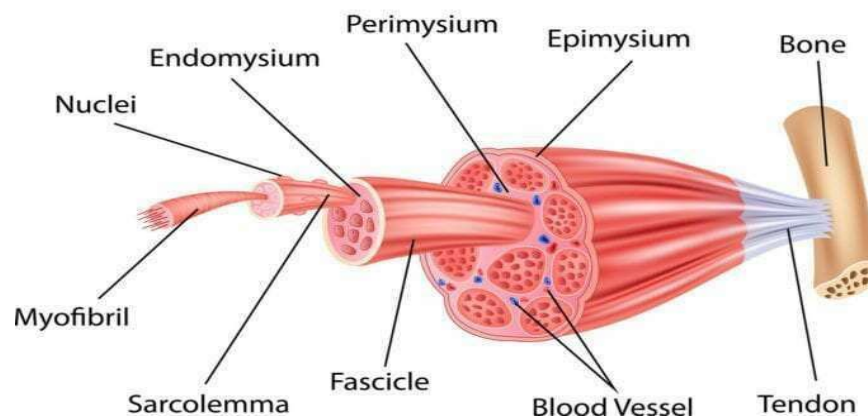
2. **Perimysium :-**

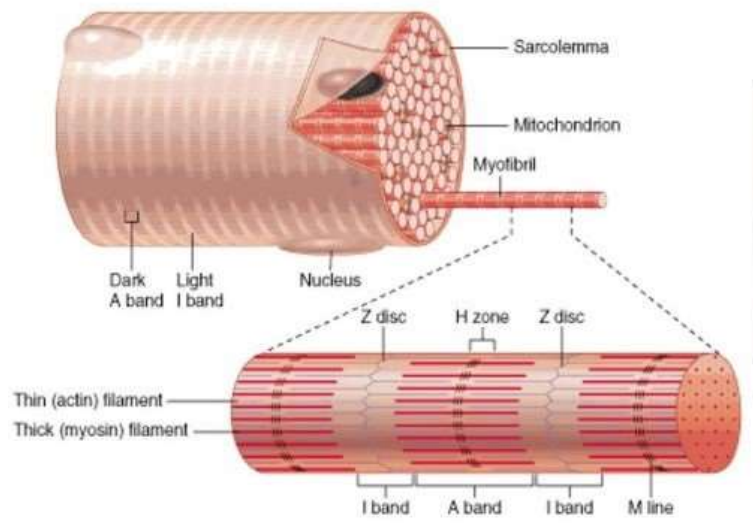
- Connective tissue which envelops muscle bundles.

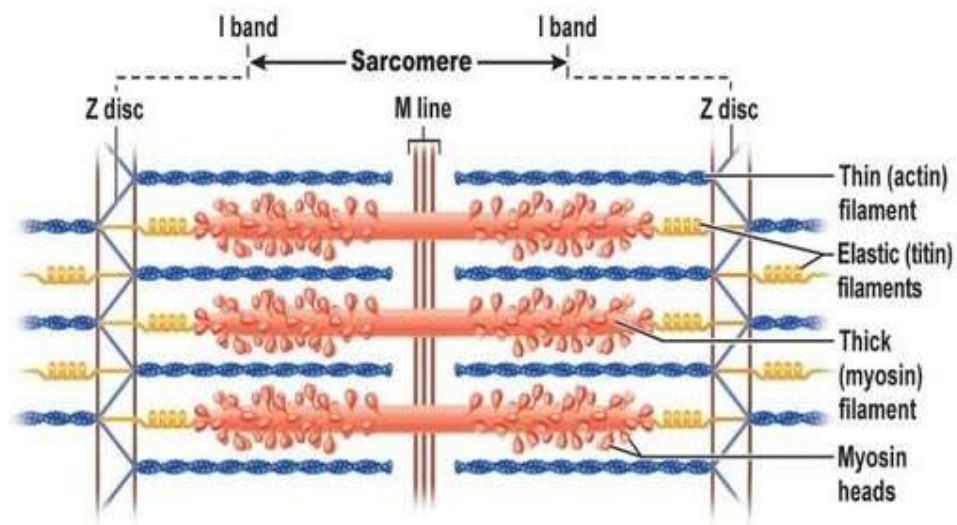
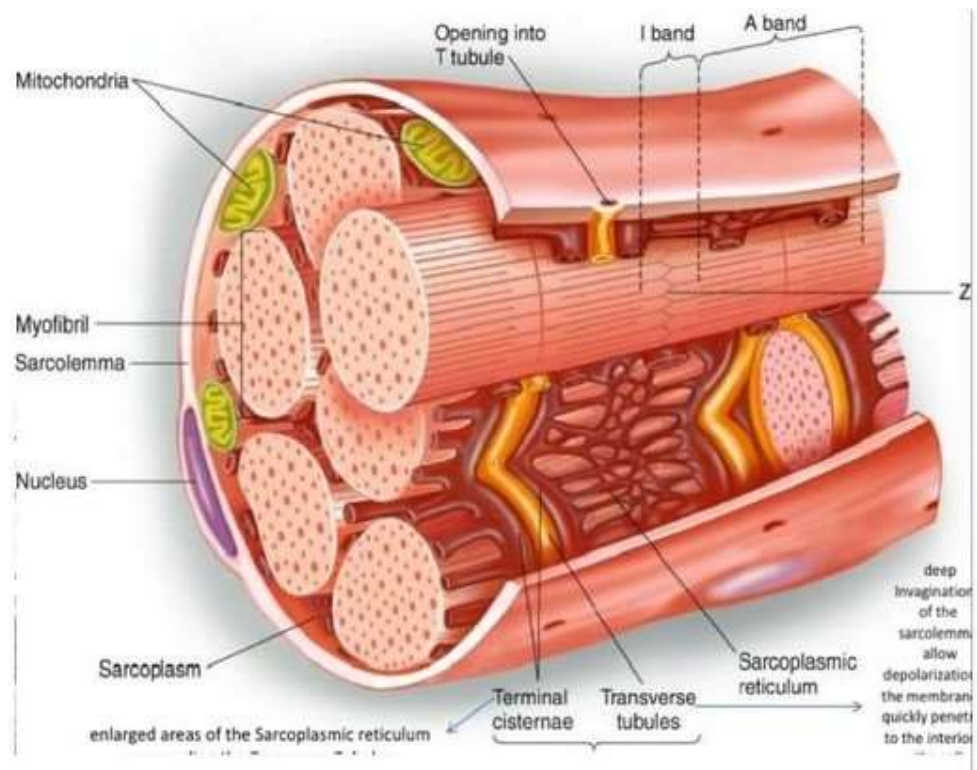
3. **Endomysium :**

- Surround muscle fibre
- Consist of basal lamina + free reticular fibre + Connective tissue element.

Structure of Skeletal Muscle





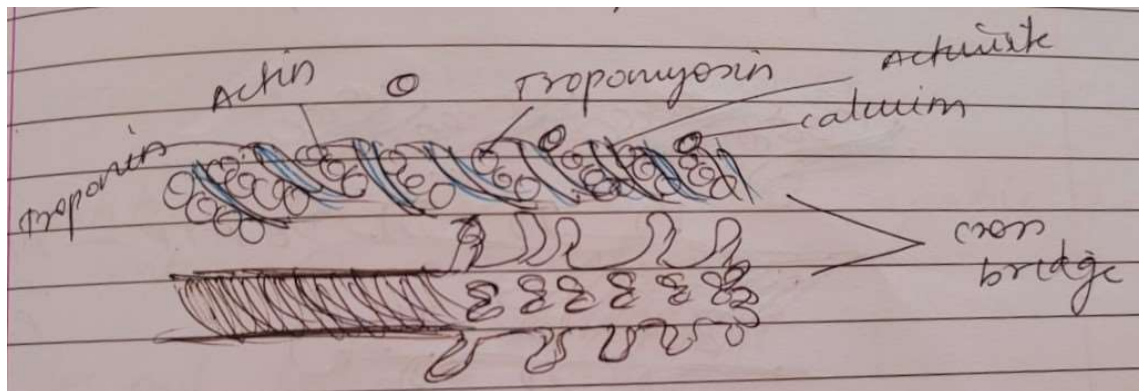


(d) Enlargement of one sarcomere
(sectioned lengthwise). Notice the
myosin heads on the thick filaments.

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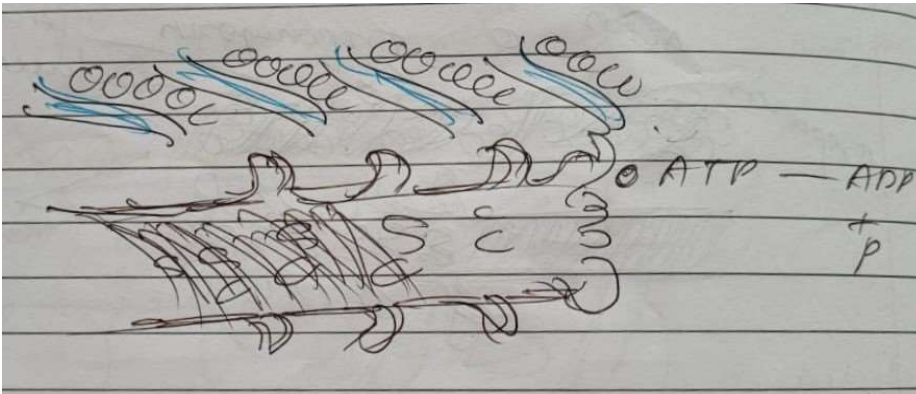
- **NEUROMUSCULAR JUNCTION**

1. A nerve impulse trigger release of ACH from the synaptic knob into the synaptic cleft.
 - ACH binds to ACH receptors in the motor end plate of the Neuro muscle junction initiating a muscle impulse in the sarcolemma of the muscle fibre
2. As the muscle impulse spreads quickly from the sarcolemma along T-tubules , calcium ions are released from terminal cisternae into the sarcoplasm.



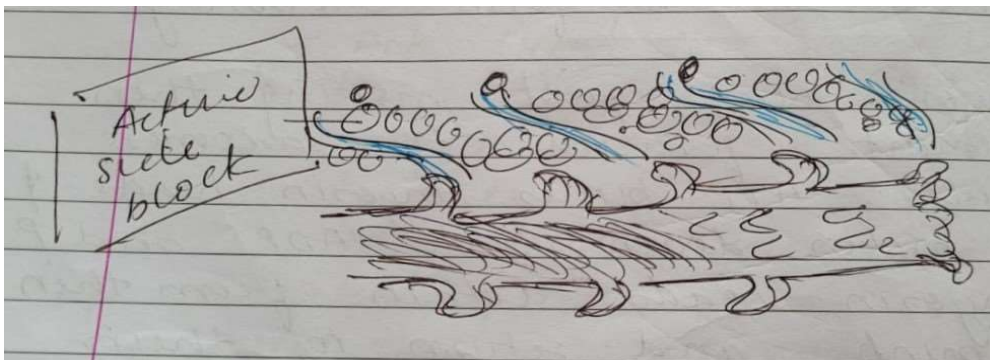
3. Calcium ions binds to troponin. Troponin changes shape, moving tropomyosin on the actin to expose active sites on actin molecules of thin filament. Myosin head of thick filament attach to exposed active sites to form crossbridge
4. Myosin heads pivot, moving thin filament forward the sarcomere centre. ATP binds the myosin head and it is broken down into ADP and P
 - myosin head detach from thin filament and return to their pre pivot position.
 - The repeating cycle of attach-pivot- detach - return slides thick and thin filaments part one another
 - The sarcromes shorten and the muscle contracts
 - The cycle continues as long as calcium ions remains bound to troponin to keep active site exposed
5. When the impulse stops, Ca ions are actively transported into the sarcoplasmic reticulum.

- tropomyosin recovers active sites and filament passively slides back to then relaxed state



• **SKELETAL MUSCLE:**

RED TWITCH MUSCLE	WHITE TWITCH MUSCLE
- contract slower rate but capable of continuous contraction - do not fatigue easily - richer blood supply than white - high content of red pigments - many mitochondria, smaller in diameter - eg: long muscle of the back	- contracts rapidly but briefly - fatigues fast - low myoglobin content - fewer mitochondria, large in diameter than red - eg: extraocular matrix



#CARDIAC MUSCLE

INTERCALATED DISC

- unique in cardiac muscle
- cross chain of cardiac cells at irregular interval
- represent junctional complex of muscle cells
- anchor myofibrils
- allows for instantaneous spread of contractile stimulus

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HISTOLOGY OF RETINA

- **COMPONENT OF RETINA:**

- Photoreceptor cell : Rods and Cones
- Conducting neuron : bipolar neuron
Ganglion cell
- Association neuron : horizontal neuron
Amacrine neuron
- Supporting neuroglial cell : miller cell
Microglial cell
Astrocytes

- **LAYER'S OF RETINA:**

- 1) Pigmented epithelium
- 2) Layer of rode & cones
- 3) outer limiting membrane
- 4) Outer nuclear layer
- 5) Outer plexiform layer
- 6) Inner nuclear layer
- 7) Inner plexiform layer
- 8) Ganglion cell layer
- 9) Nerve fiber layer
- 10) Inner limiting membrane

- **COMPONENTS:**

- 1) pigment
- 2) Cones
- 3) Rods
- 4) Horizontal cell
- 5) Bipolar neuron
- 6) Amacrine cell
- 7) Muller cell
- 8) Ganglion cell
- 9) Axons at surface of retina

❖ **HISTOLOGY OF EYELID**

- Eyelid consist following layer from outside to inside :

- 1) Skin
- 2) Subcutaneous loose C .T
- 3) Orbicularis oculi muscle
- 4) Tarsal plate
- 5) Palpebral conjunctiva

• **GLANDS OF EYELID:**

1. Meibomian gland/ tarsal gland

- 20-25 long sebaceous gland embedded in tarsal plate
- produce oily secretion that retards evaporation of tears

2. Gland of zesis (in eyelash)

- small modified sebaceous gland connected with root of eyelash

3. Gland of moll/ ciliary gland

- Apocrine gland of eyelash
- modified sweat gland present near free edges of eyelid

4. Glands of wolfring and gland of krause

- Accessory lacrimal gland
- Compound tubulo - alveolar sebaceous gland
- glands of wolfring are located in inner surface of upper eyelid
- glands of krause present near superior conjunctival fornix & open into fornix of lacrimal sac

Histology of the

CONJUNCTIVA

→ Transperant membrane that covers the inner surface of eyelid → palpebral.c and the anterior part of sclera → ocular.c

- cells ✓ in Epith
- Goblet cells
 - Melanocytes
 - Langerhans cells
 - CAIT
 - MALT



columnar cells
Epithelium
Flattened cells

polygonal cells

Adenoid layer (Lymphoid layer)

Substantia propria

Fibrous layer

collagen + Elastic fibres
contains vessels & Nerves

→ changes into stratified squamous Epith at Scleroconjunct junction

Conjunctival Glands

main G

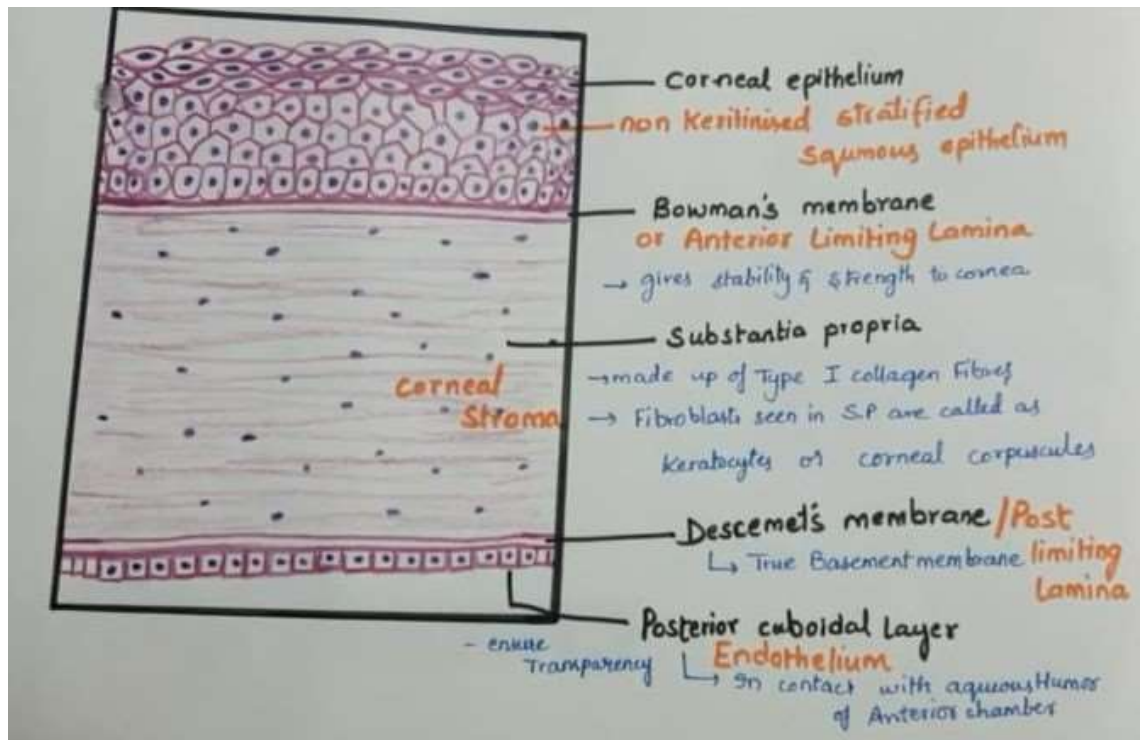
- Goblet.c
- Henle's.c
- Glands of Manz

Accessory lacrimal G

- Glands of Krause
- Glands of Wolfring

❖ HISTOLOGY OF CORNEA

- **CORNEAL EPITHELIUM** :stratified squamous epithelium
- **BOWMAN'S MEMBRANE** :basal lamina of corneal epithelium.
- **CORNEAL STROMA** : orthogonal array of collagen fibrils few fibroblast
- **DESCEMENT MEMBRANE**:Thick basal lamina of corneal endothelium
- **.CORNEAL ENDOTHELIUM**: Simple squamous or low cuboidal epithelium
- **CORNEAL EPITHELIUM :**
 - stratified squamous hemidesmosomes connect corneal epithelium to Bowman's layer.
 - microvilli of superficial cells are covered with mucus coating
- **BOWMAN'S LAYER :**
 - Acellular layer .
 - Doesn't regenerate after injury.
 - thickness is 8 micron & contain type 2 collagen fibril.
- **STROMA:**
 - fibroblasts(keratinocyte) are present between type 3 collagen lamellae.
 - extra cellular matrix unmyelinated nerve fibers no blood vessels.
- **DESCEMENT MEMBRANE:**
 - it has thick basal lamina secreted by corneal epithelium.
 - it can regenerate after injury.
- **CORNEAL EPITHELIUM:**
 - simple squamous transport nutrient from aqueous humor to stroma.
 - contains numerous mitochondria



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❖ HISTOLOGY OF LIVER

- Largest endocrine gland covered by connective tissue

1. Hepatic lobules (hexagonal)

- functional unit

2. Central venule (centre)

3. Portal triad

- hepatic artery
- portal vein
- bile duct

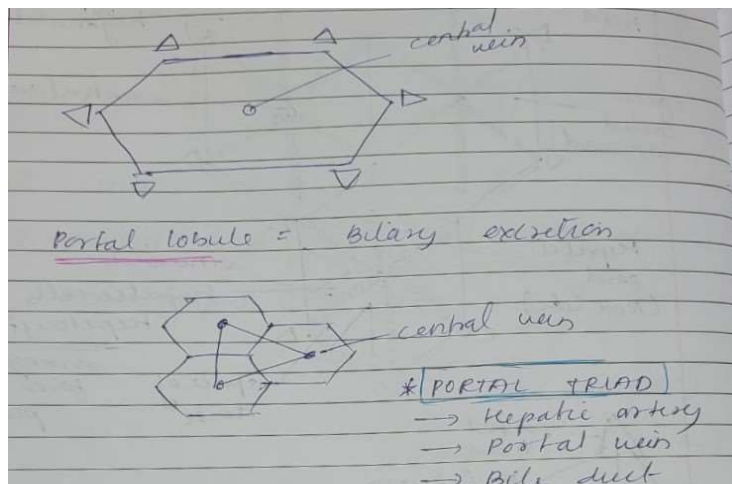
4. Hepatocytes / Hepatic cells

5. Hepatic cord

6. Sinusoids (space between two hepatic cord)

- Liver sinusoids lined by **kuffer cells** (macrophages)
 - engulf the foreign particles

- the space between hepatocytes as well as sinusoids called as **SPACE OF DISSE**



- **HEPATIC ACINUS**

- #ZONE 1**

- richest blood flow
 - also called as preportal zone

- #ZONE 02**

- intermediate zone

- #ZONE 03**

- pericentral zone

• Histology of Arteries, Veins and Capillaries

- **Divisions of circulatory system:**

- 1) Macrovasculature
- 2) Microvasculature

- **Macrovasculature :**

- 1) Vessels > 0.1 mm diameter
- 2) Larger arterioles, muscular and elastic arteries and muscular veins
- 3) Arteries: Carries oxygenated blood with nutrients - Tissues
- 4) Veins: Capillaries coverage - channels - blood to heart to be pumped again

- **Microvasculature:**

- 1) Arterioles: All layers are thin
- 2) Capillaries: Smallest blood vessel - network of thin tubules - anastomosis (connection) - interchanged between blood vessels and tissues

- **Basic Structure of Blood Vessels :**

- 1) Tunica Media (Inner Coat)
- 2) Tunica Intima (Middle Coat)
- 3) Tunica Adventitia (Outer Coat)

1. Tunica Intima:

Single layer of endothelium
Squamous cells + Subendothelial cells

2. Tunica Media:

Concentric layers of smooth muscles + elastic + reticular fibres

3. Tunica Adventitia:

C.T. arranged parallel to along axis of lumen of vessels

- **Combination:**

- 1) Tunica intima**

- endothelium simple squamous epithelium
 - basal lamina
 - Subendothelial
 - internal elastic lamina (permits diffusion)

- 2)Tunica media**

- thickest
 - concentric layer of smooth muscle cells
 - + Elastic + reticular fibres
 - + External elastic lamina

- 3) Tunica adventia**

- strong layer formed mainly of collagen fibres
 - longitudinally -blends with surrounding fibroareolar
 - + Sheath for vessels

- **Endothelium**

- single layer of flattened polygonal cells resting on basement
 - secret type 2,4,5 collagen endothelium
 - stores enzymes like angiotensin converting enzyme
 - ↓
 - Regulate BP

- **Subendothelial**

- Thin
- also called as lamina propria

- **Smooth muscle cells**

- spindle shaped with elongated nuclei
- contraction decreases lumen
↓
Increase pressure

#LARGE SIZE ARTERIES:

- called as elastic / conducting arteries
- eg : aorta , pulmonary trunk
- Diameter : > 1cm

1. TUNICA INTIMA

- thicker than medium size arteries
- internal elastic lamina not prominent

2. TUNICA MEDIA

- thickest
- made up of elastic fibre + type III collagen

3. TUNICA ADVENTITIA

- poorly developed
- has vasa vasorum

#MEDIUM SIZE ARTERIES :

- Distributing arteries
- size decreases
- diameter : 2-10cm
- regulate flow of blood to an organ

Eg : brachial artery
Femoral artery
Renal artery

1. TUNICA INTIMA

- thinner sub endothelial layer
- elastic lamina more prominent

2. TUNICA MEDIA

- gradual production of elastic fiber
- has upto 40 layer of smooth muscle cells

3. TUNICA ADVENTITIA

- Vasa vasorum + connective tissue + nerve

#SMALL SIZE ARTERIES :

- diameter: 100-50mm

1. TUNICA INTIMA

- endothelium + thin internal lamina

2. TUNICA MEDIA

- It has 1 -2 layer of smooth muscle cells
- no external elastic lamina

3. TUNICA ADVENTITIA

- very thin (if seen)

CAPILLARIES

- Small blood vessels
- diameter : 7 - 9 mm
- total length = 96000km in the body
- FUNCTION : exchange of material between blood and tissue
- nucleus of cells bulges in lumen
- pericyte cells are present

- adventitial cells with contractile filaments supports wall and control lumen size

#TYPES OF CAPILLARIES

- Continous
- Fenestrated
- Discontinous

1. CONTINUOUS CAPILLARIES(somatic capillaries)

- end of cells fuse and form continous capillaries tube cells held by tight junction
- exchange is through cytoplasm
- found in : skin
Muscle
Lungs
Brain
Exocrine glands

2. FENESTRATED CAPILLARIES (visceral capillaries)

- have circular fenestrated covered by a thin diaphragm
- found in tissue for rapid exchange
- eg : intestinal villi
Endocrine gland
Pancreas

#Fenestrated with no diaphragm found in glomerulus of kidney

3. DISCONTINUOUS CAPILLARIES(sinusoidal)

- special kind of capillaries
- large diameter
- diameter : 30 - 40mm
- irregular shape

- shows gap between the neighbouring endothelial cells without diaphragm
- suggest blood flow
- allows good exchange for substance
- basal lamina may be absent
- found in spleen , liver, bone marrow, anterior pituitory, parathyroid

#VEINS :

- blood flow more slowly
- at lower pressure
- lumen is larger
- walls are thinner
- collapse when empty

#VEINS WALL:

- less muscular elastic tissue
- more fibrous
- has 03 coat but not well distinguished from each other
- wall easily collapsed

#LARGE SIZED VEINS:

- Well developed tunica intima
- their tunica media
- tunica adventitia is thickest
- has longitudinal bundles of smooth muscle
- valve consist of 02 semilunar folds of tunica intima that project into the lumen

- **SMALL SIZE VEIN**

Small medium size

D= 1.9mm

- Tunica intima sub endothelial layer can be absent has valves

- VALVES - Allow blood flow towards the heart and prevent regulation

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- Valves are made up of two semilunar cups - endothelium and connective tissue with elastic fibre
- Adventetia is well developed and thicker than media

- **VENULES**

- Smallest veins into which capillaries drain
- D=20 - 30mm
- Wall have endothelium + BL + thin Adventetia
- Pericytes I post capillary venules
- Muscle in layer muscular venule
- Walls are permeable for exchange

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