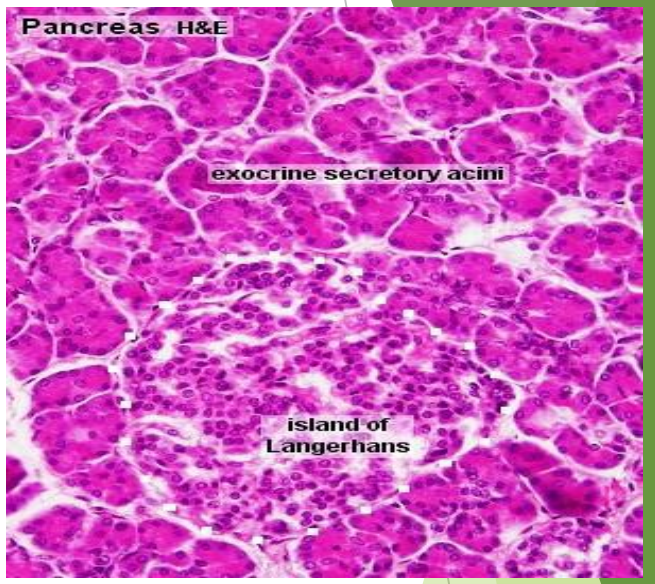
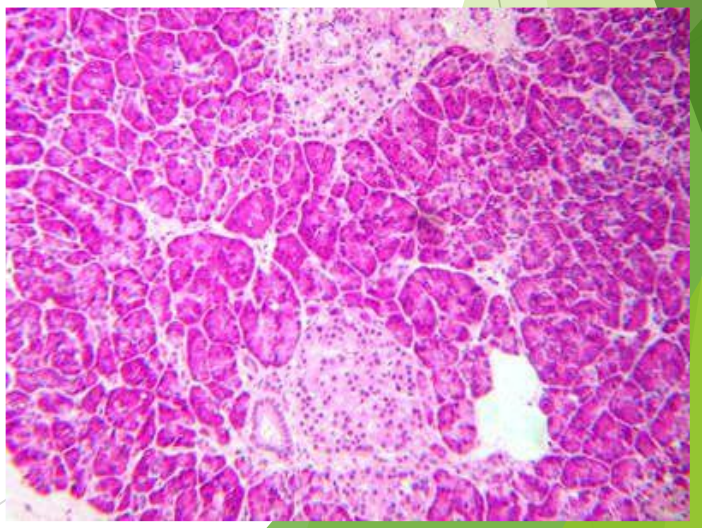
## Associated organ with GIT (part 2)

### Pancreas

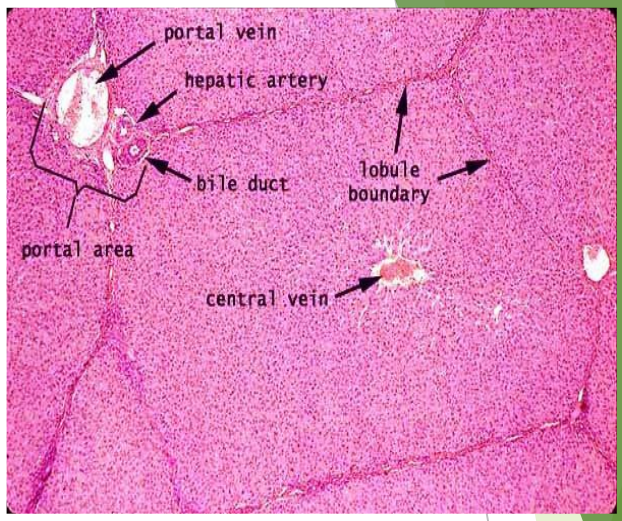
Exocrine and endocrine parts
Exocrine glands-
-Serous acini present
-Acini are compact ,less lumen
-Acini secrete digestive enzyme
-Centroacinar cells continue as intercalated ducts, secrete alkaline fluid
Endocrine glands-
-Island of langerhans
-branching cords like pattern of pale staining cells
Endocrine cells
1.Alpha cells-20%,mainly at periphery, large cells secrete glucagon
2.Beta cells-70%,at centre, small cells, secrete insulin
3.Delta cells-5%, secrete somatostatin
4.F cells-secrete polypeptides

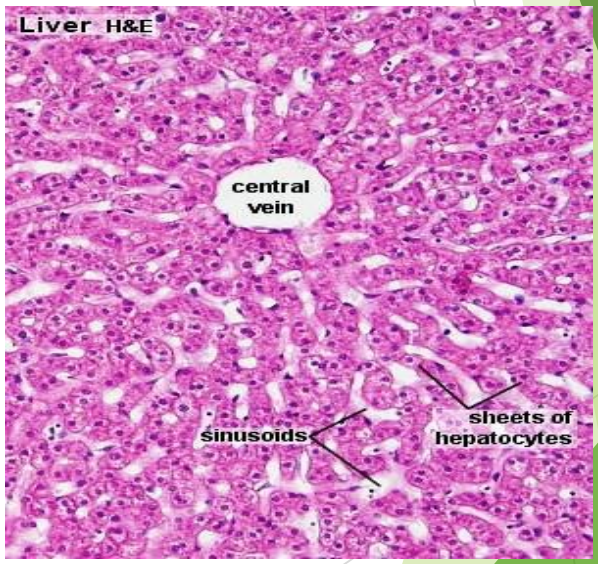


# Liver

- **Glisson capsule- trabeculae**
- **Portal tract-portal triad**
- **-1.Portal venule,2. bile ductule3. hepatic arteriole**
- **-Space of mall**
- **Hepatic lobule- -hexagonal shaped**
- **-Central vein**
- **-heptocytes -hepatic plates**
- **-liver sinusoids -Kuffer cells**
- **-Space of Disse -Bile canaliculi**
- **Portal area consist of bile duct , heparic artery and hepatic vein**
- •Portal lobule- blood supply area
- •Hepatic acinus- area drain by bile duct functiona



# Histology Lectures 1st lab

Dr. Nahidah Ibrahim

College of pharmacy /Dep. Clinical laboratory Science

stage 2nd semester Date: 30/ 4/2021

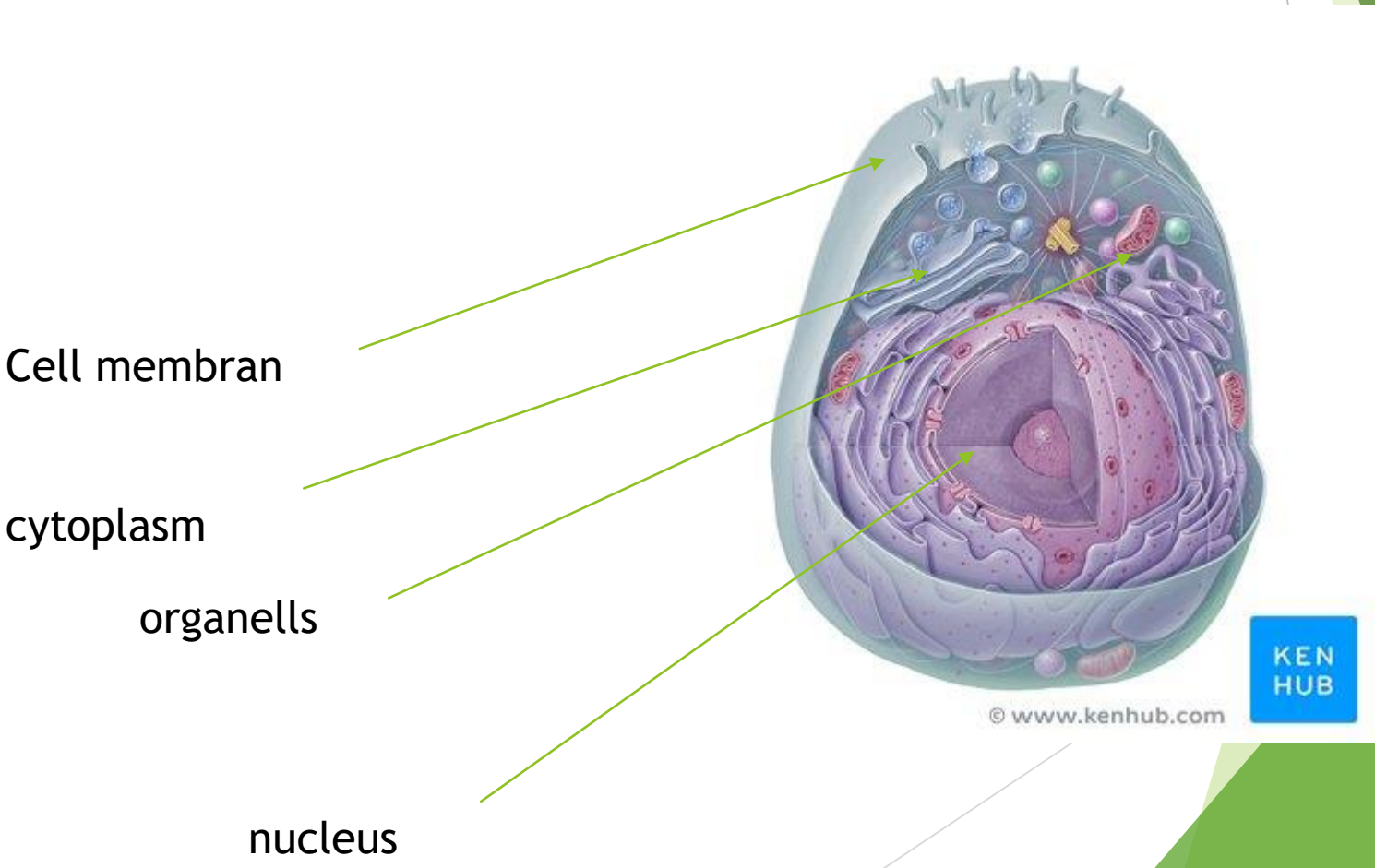
# Histology: An overview: want to learn more about it?

Histology is the science of the microscopic structure of cells, tissues and organs. It also helps us understand the relationship between structure and function

The study of cells and tissues, from their intracellular components to their organization into organs and organ systems.

# Cell structure

- Cellular membrane, cytoplasm, organelles, nucleus



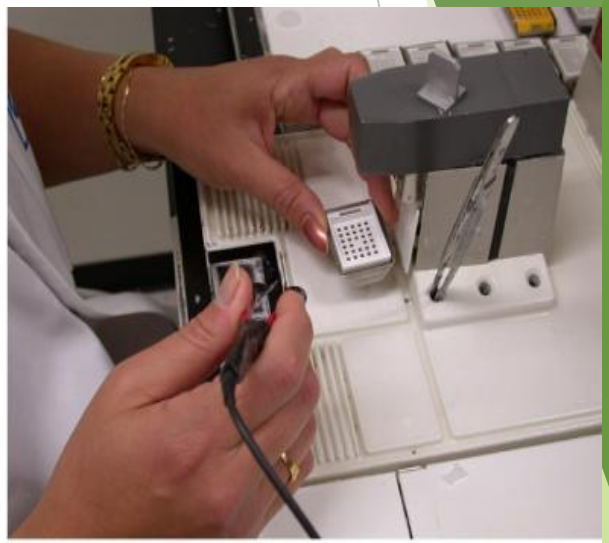
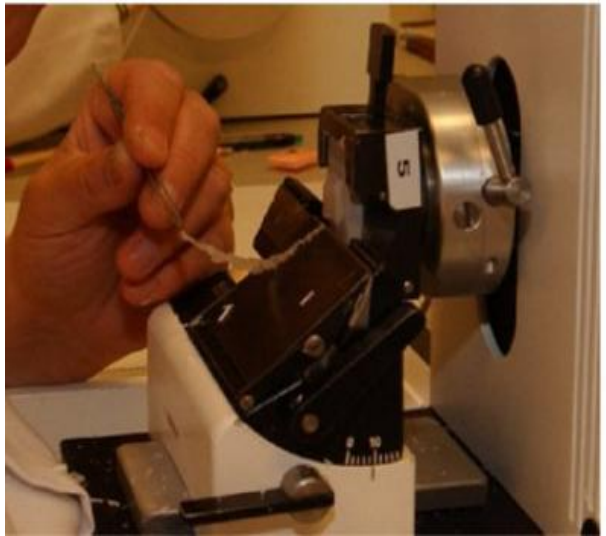
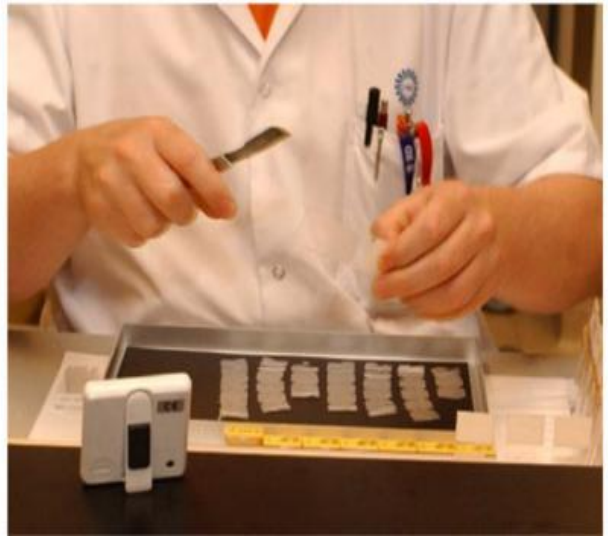
# Tissues

- A unity of cells with a similar structure that as a whole express a definite and unique function.
- Epithelial, connective, muscle, nervous
- Organs
- A unity of tissues with a more complex set of functions, defined by the combination of structure and function of the comprising tissues
- Systems of organs
- A group of organs united by similar functions.
- Cardiovascular, nervous, integumentary, musculoskeletal, respiratory, digestive, excretory, endocrine, lymphatic, reproductive

# Histology techniques

- The Five Steps of Histology Slide Preparation
- 1. Tissue fixation
- 2. Specimen Transfer to Cassettes
- 3. Tissue Processing (Dehydration, Clearing, in which an organic solvent such as xylene , Embedding, )
- 4. Sectioning (Wax is removed , Blocks are chilled on a refrigerated plate , A microtome is used to slice extremely thin tissue )
- 5. Staining (typically hematoxylin and eosin)



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# THE LYMPH VASCULAR SYSTEM :

**by**

**Dr. Nahidah Ibraheim**

**College of pharmacy /Dep. Clinical laboratory Science**

**stage 1**

# Lymphatic system

Lymphatic System consists of:

**A.** Cells

1. Lymphocytes (B,T, natural killer)
2. Antigen-presenting cells (dendritic cells, Langerhans' cells & macrophage

**B.** Lymphatic tissue –diffuse and nodular

**C.** Lymphatic organ ,lymph nodes, spleen, thymus)

**D.** Lymphatic vessels that carry the cells and fluid

The main function of the lymphoid organs is to protect the organism against invading pathogens or antigens (bacteria, parasites, and viruses). The immune response occurs when the organism detects the pathogens, which can enter the organism at any point. For this reason, lymphatic cells, tissues, and organs have wide distribution in the body.

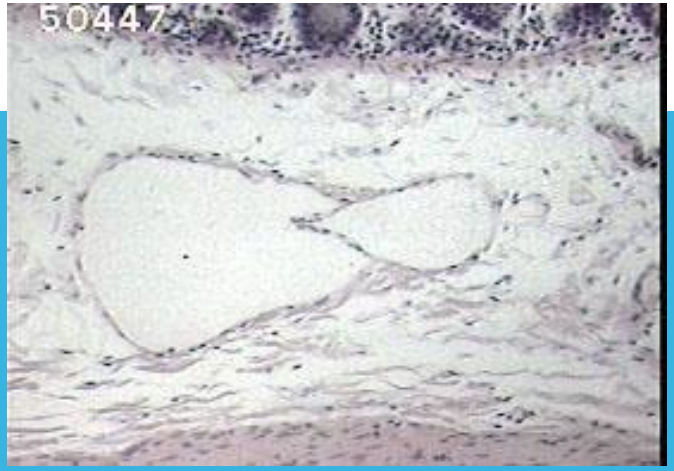
The major lymphoid organs are the

- lymph nodes,
- tonsils,
- thymus, and
- spleen.

# THE LYMPH VASCULAR SYSTEM

The lymphatic system consists of lymph capillaries and lymph vessels. This system starts as blind-ending tubules or lymphatic capillaries in the connective tissue of different organs. These vessels collect the excess interstitial fluid (lymph) from the tissues and return it to the venous blood via the large lymph vessels, the thoracic duct and right lymphatic duct. Also, to allow greater permeability, the endothelium in lymph capillaries and vessels is extremely thin. The structure of larger lymph vessels is similar to that of veins except that their walls are much thinner. Lymph movement in the lymphatic vessels is similar to that of blood movement; that is, the contractions of surrounding skeletal muscles forces the lymph to move forward. Also, the lymph vessels contain more valves to prevent a backflow of collected lymph. Lymph vessels are found in all tissues except the central nervous system, cartilage, bone and bone marrow, thymus, placenta,and teeth.

LYMPHATIC VESSEL WITH A VALVE



## 1- LYMPH CAPILLARIES :

**Lymph capillaries are thin-walled, blind tubes that branch to form a rich network in organs and tissues. They are wider and more irregular than blood capillaries. The wall of a lymph capillary consists only of a thin continuous endothelium and a discontinuous basal lamina that is present only in patches or may even be absent. Externally, the endothelium is surrounded by a small amount of collagenous connective tissue.**

## 2- COLLECTING LYMPH VESSELS

**Collecting lymph vessels differ from lymph capillaries in size and the thickness of their walls. Although three coats - intima, media, and adventitia- are described as in blood vessels, they are not clearly delineated. The tunica intima consists of an endothelium supported by a thin network of elastic fibers. tunica media is composed of smooth muscle cells ,with a few fine elastic fibers.**

**The tunica adventitia is the thickest coat and consists of bundles of collagen fibers, elastic fibers, and some smooth muscle cells.**

**Cells of lymphatic tissue :**

The cells of lymphatic tissue are present as fixed and free cells. **Fixed cells are the reticular cells reticular cells** appear as elongated or stellate elements with round or oval, palely stained nuclei and, lightly basophilic cytoplasm ,esponsible for the formation and maintenance of reticular fibers.

## . lymphocyte:

**Lymphocytes** are the cells that carry out immune responses.

Morphologically, all types of lymphocytes appear very similar, but functionally, they are very different. When lymphocytes are properly stimulated, **B lymphocytes and T lymphocytes** are produced**.**

**T- lymphocytes or T- cells:**

T cells arise from lymphocytes that are carried from the bone marrow to the **thymus gland.**

They mature, differentiate, and acquire surface receptors and before migrating to peripheral lymphoid tissues and organs. The thymus gland produces mature T cells early in life.

T cells carry out immune responses when stimulated. There are four main types of

differentiated T cells:

**-helper T cells,**

**- cytotoxic T cells,**

**-memory T cells,**

**- suppressor T cells**

**1-T- helper cells**

When encountering an antigen, **helper T cells**
assist other lymphocytes by secreting immune chemicals called **cytokines( interleukins).**
**Cytokines** are protein hormones that stimulate proliferation, secretion, differentiation, and maturation of B cells into **plasma cells,** which then produce immune proteins called **antibodies ( immunoglobulins).**

**2- cytotoxic T-cells**:
**Cytotoxic T cells** specifically recognize antigenically different cells such as virus-infected cells, foreign cells, or malignant cells and. These lymphocytes become activated when they combine with antigens that react with their receptors.

**3- Memory T- cells :**
**Memory T cells** are the long-living progeny of T cells. They respond rapidly to the same antigens in the body and stimulate immediate production of cytotoxic T cells.

**4- suppressor T- cells**

**Suppressor T cells** may decrease or inhibit the functions of helper T cells and cytotoxic T cells, and thus modulate the immune response.

# B –lymphocyte or B-cells :

**B cells** mature and become immunocompetent in bone marrow**.** After maturation, blood carries B cells to the non thymic lymphoid tissues such as lymph nodes, spleen, and connective tissue. B cells are able to recognize a particular type of antigen owing to the presence of **antigen receptors** on the surface of their cell membrane.

**Plasma cells** secrete large amounts of antibodies specific to the antigen that triggered plasma cell formation. Antibodies react with the antigens and initiate a complex process that eventually destroys the foreign substance that activated the immune response.

**memory B cells.** These memory cells produce a more rapid immunologic response should the same antigen reappear.

# Lymphatic tissue

Lymphatic tissue divided into

## 1: Diffuse Lymphatic Tissue

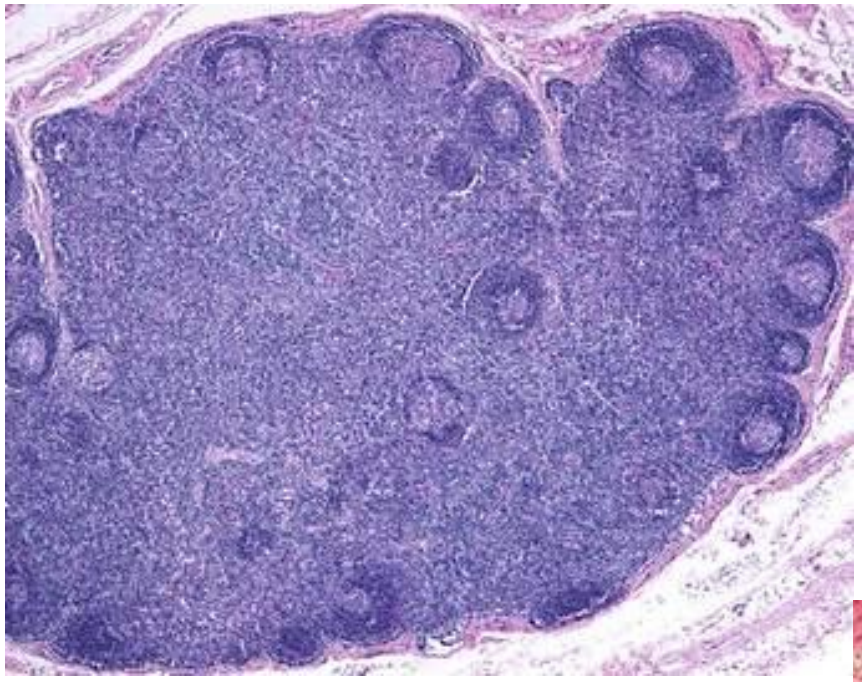
It appears as a loose aggregate of cells with no distinct demarcation from surrounding tissue . Diffuse lymphatic tissue is prominent in the connective tissue that underlies the epithelium of the intestine. Any antigen that does penetrate the epithelial lining induces an immune response in the lymphatic tissue .

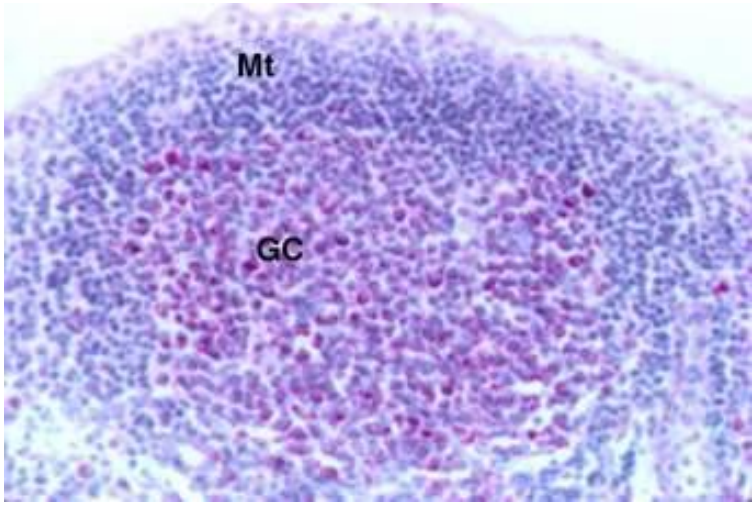
## 2: Nodular Lymphatic Tissue

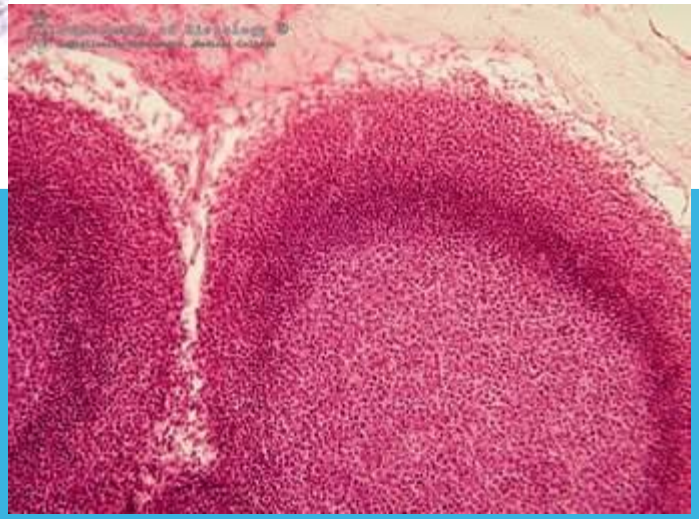
Nodular lymphatic tissue contains the same structural elements as diffuse lymphatic tissue, differing only in that the components are organized into compact, circumscribed structures. Lymphatic nodules (also called **follicles)** may be present as **solitary nodules** , as occur in the appendix and the Peyer's patches of the ileum.

Histologically, some lymphatic nodules appear as rounded collections of densely packed small lymphocytes this nodule is called a **primary nodule.** Other lymphatic nodules contain a lightly staining central area surrounded by a deeply stained cap of closely packed small lymphocytes. The pale region has been called a **germinal center** and the whole structure a **secondary nodule.** Lymphatic nodules are prominent in organs such as the tonsils, lymph nodes, and spleen but are absent from the thymus . *Germinal* centers produce ***B*-cells** that can migrate through the cap to leave the center and eventually pass to other lymphatic tissues.

# PRIMARY LYMPHATIC NODULE/FOLLICLE (LN)
# AGGREGATION OF LYMPHOCYTES IN LAMINA PROPRIA OR SUBMUCOSA



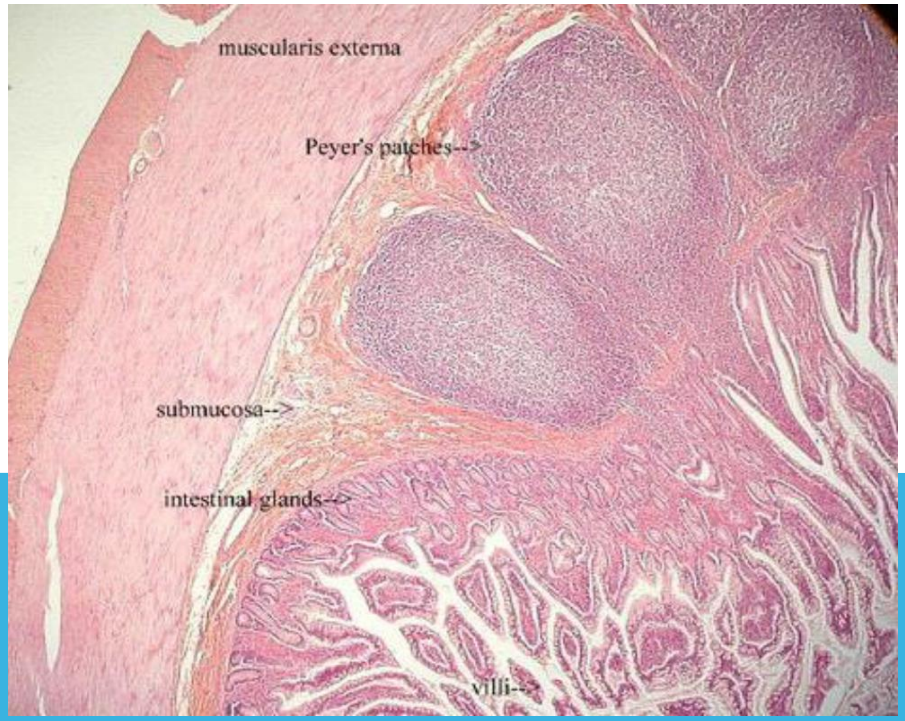


# Peyer’s patches :

Peyer’s patches occur in the wall of the ileum.

Consist of very large spherical aggregates (nodules ) of dense lymphoid tissue which may show germinal centers . most of the mass of each nodule is located in the submucosa ,but the nodule extends into lamina propria and bulges into the lumen of ileum. Their function in screening of the lumen of small intestine, probably to prevent colon bacteria from migrating up into small intestine . IgA antibodies secreted by plasma cells generated by peyer’s Patches seriously impair bacterial motility and inhibit attachment of bacteria to intestinal walls .



# Table Shows Comparative Between Blood Vessles and Lymphatic

| Cardiovascular System | Lymphatic System |
|---|---|
| *Blood* is responsible for collecting and distributing oxygen, nutrients and hormones to the tissues of entire body. | *Lymph* is responsible for collecting and removing waste products left behind in the tissues. |
| *Blood flows* in the arteries, capillaries, and veins. | *Lymph flows* in an open circuit from the tissues into lymphatic vessels. |
| *Blood* flows towards the heart and away from the heart. | *Lymph* flows in one direction only (towards the heart). |
| *Blood* is pumped by the heart to all parts of the body. | *Lymph is not pumped*. It passively flows from the tissues into the lymph capillaries. |
| *Blood* consists of the liquid plasma that transports the red and white blood cells and platelets. | *Lymph* that has been filtered and is ready to return to the cardiovascular system is a clear or milky white fluid. |
| *Blood is visible* and damage to blood vessels causes obvious signs such as bleeding or bruising. | *Lymph is colourless or translucent* and damage to the lymphatic system is difficult to detect until swelling occurs. |
| *Blood is filtered* by the kidneys. | *Lymph is filtered* by lymph nodes located throughout the body. |

# LYMPHATIC ORGANS

by
Dr. Nahidah Ibrahim

College of pharmacy /Dep. Clinical laboratory Science

stage 1

# LYMPHATIC ORGANS :

Lymphatic organs are divided into

1- primary (central) and

2- secondary (peripheral) organs.

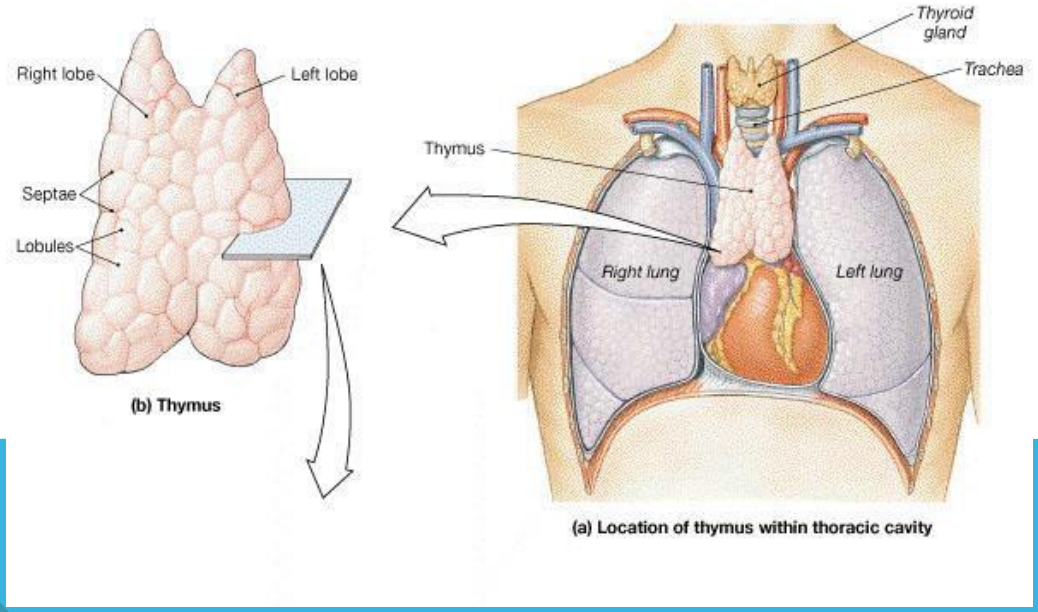
**Primary lymphatic organs** are the first to develop and include the thymus and the bone marrow .

**The secondary lymphatic organs** are the lymph nodes, spleen, tonsils.

# Thymus

The thymus is a bilobed, encapsulated lymphatic organ located in the upper anterior mediastinum and lower part of the neck. . The thymus is the only primary lymphatic organ and is the first organ of the embryo to become lymphoid . Unlike

the spleen and lymph nodes, it is well developed and relatively large at birth, after which the organ undergoes progressive involution and is partially replaced by fat and connective tissue



# Structure:

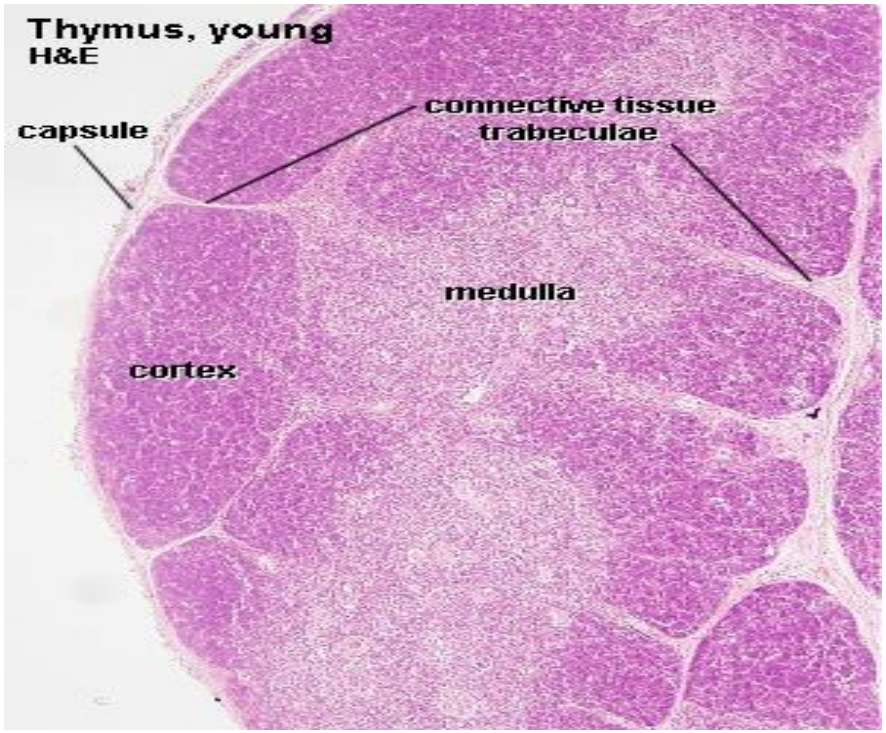
The thymus consists of two **lobes** joined by connective tissue. A thin capsule of loosely connective tissue surrounds each lobe and provides **septa** that extend into the thymus, subdividing each lobe into a number of irregular

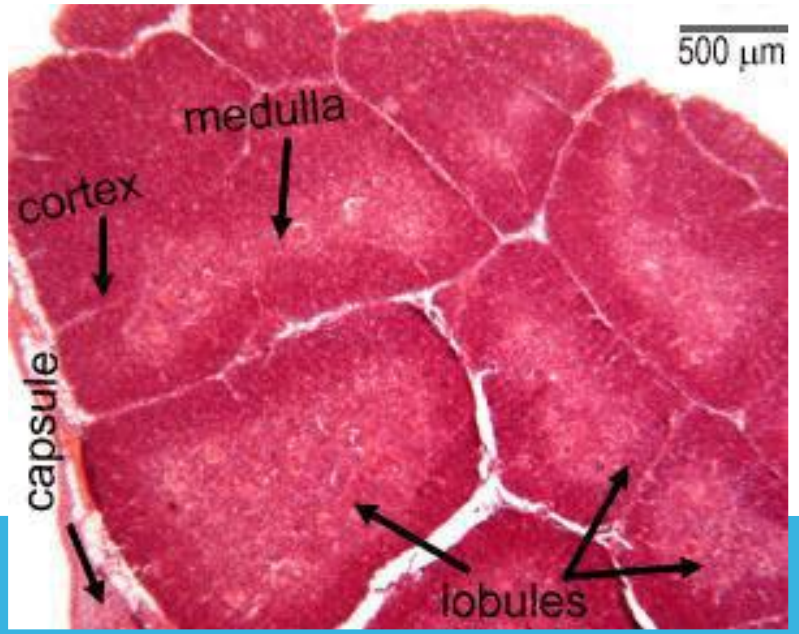
**lobules.**

**Each lobule consists** of :

**-cortex and medulla.**

- **Cortex :**
- under the capsule is a dark-staining cortex with a network of interconnecting spaces. These spaces become colonized by immature lymphocytes that migrate from hemopoietic tissues to undergo maturation and differentiation .
- **Medulla :**
- it appears to be isolated within a lobule, surrounded by a complete layer of cortex. Lymphocytes are less numerous than in the cortex, it appear lighter-staining . The epithelial cells form a coarser framework that contains fewer lymphocytes and epithelial cells that combine to form thymic (Hassall' corpuscles which are the charecteristic feature of medulla of thymus gland.


Thymus, young
H&E
capsule
connective tissue
trabeculae
medulla
cortex

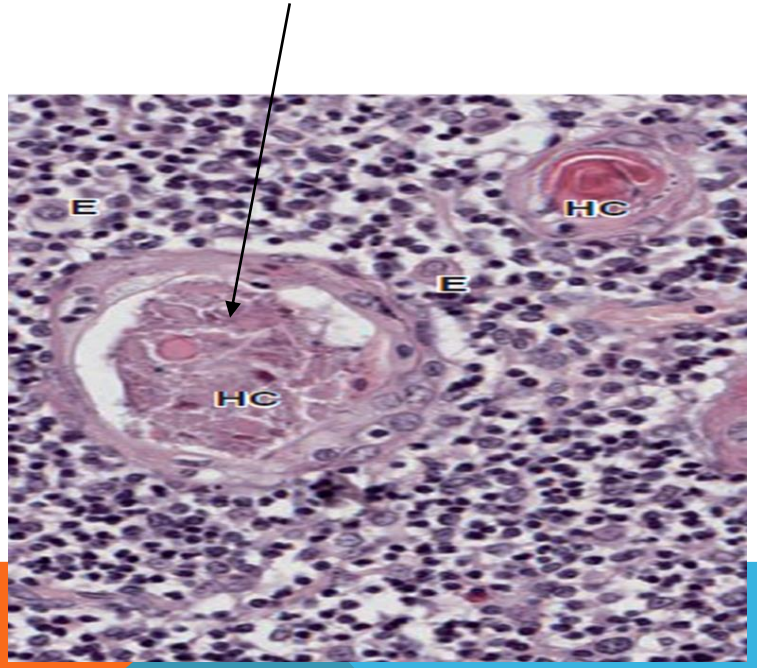

500 µm
medulla
cortex
capsule
lobules

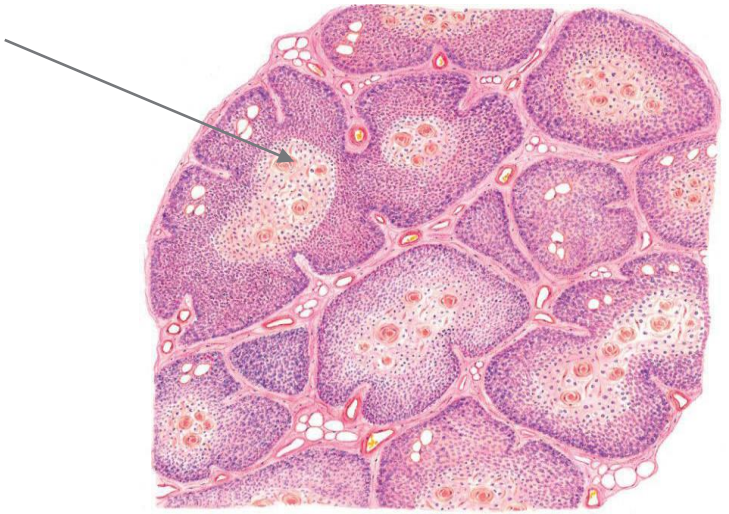
# Thymus

# HASSALL'S CORPUSCLES

The **thymic (Hassall'** corpuscles are oval structures consisting of round or spherical aggregations (whorls) of flattened epithelial cells. The thymic corpuscles also exhibit calcification or degeneration centers that stain pink or eosinophilic**.** The functional significance of these corpuscles remains unknown.

Blood vessels and adipose cells are present in both the thymic lobules and in trabecula .



## LYMPH NODES

Lymph nodes are small encapsulated lymphatic organs set in the course of lymphatic

vessels. They are prominent in the neck, axilla , and mesenteries and along the course of large blood vessels in the thorax and abdomen. They appear as flattened, ovoid or bean shaped structures with a slight indentation at one side, the **hilus,** through which blood and lymphatic vessels enter or leave.

# Structure:

lymph nodes consist of **diffuse** and **nodular lymphatic tissue** enclosed in a capsule that is thick at the hilus. The **capsule** consists of closely packed collagen fibers, with few elastic fibers. From the inner surface of the capsule, **trabeculae** of dense connective tissue extend into the node. Trabeculae subdividing the cortex into several irregular compartments.

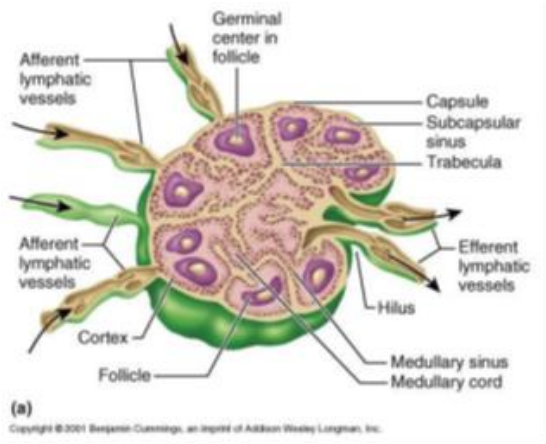
### CORTEX

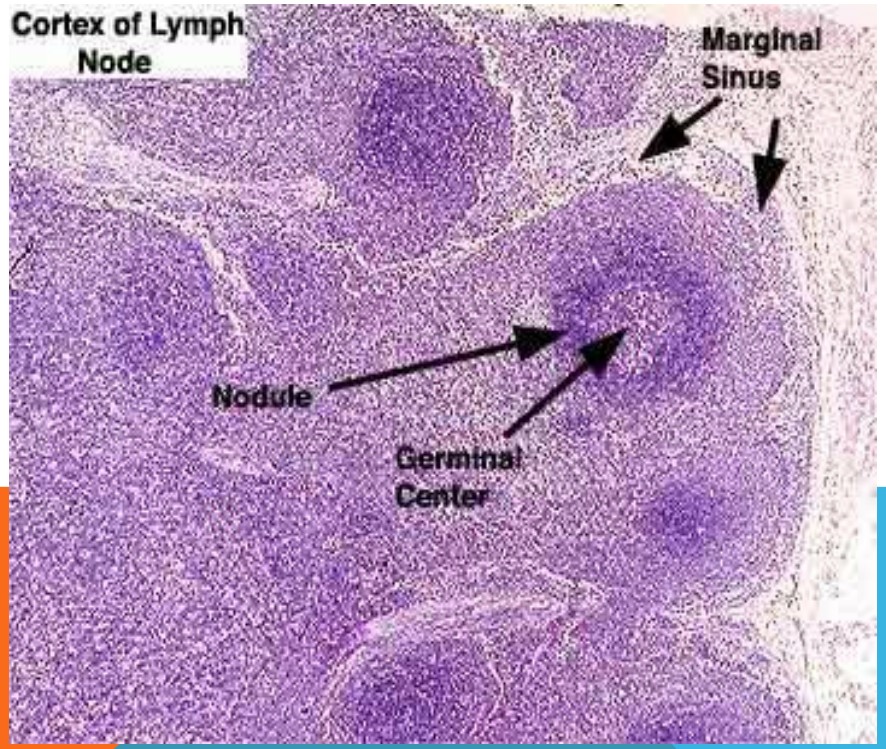
The cortex forms a layer under the capsule. The cortex is divided into an **outer cortex** that lies under the capsule and contains nodular and diffuse lymphatic tissue, and a **deep (inner) cortex** that consists of **diffuse** lymphatic tissue only. A network of reticular fibers and spherical, aggregations of lymphocytes called **lymphoid nodules** characterize the cortex**.** Some of them exhibit **germinal centers.**

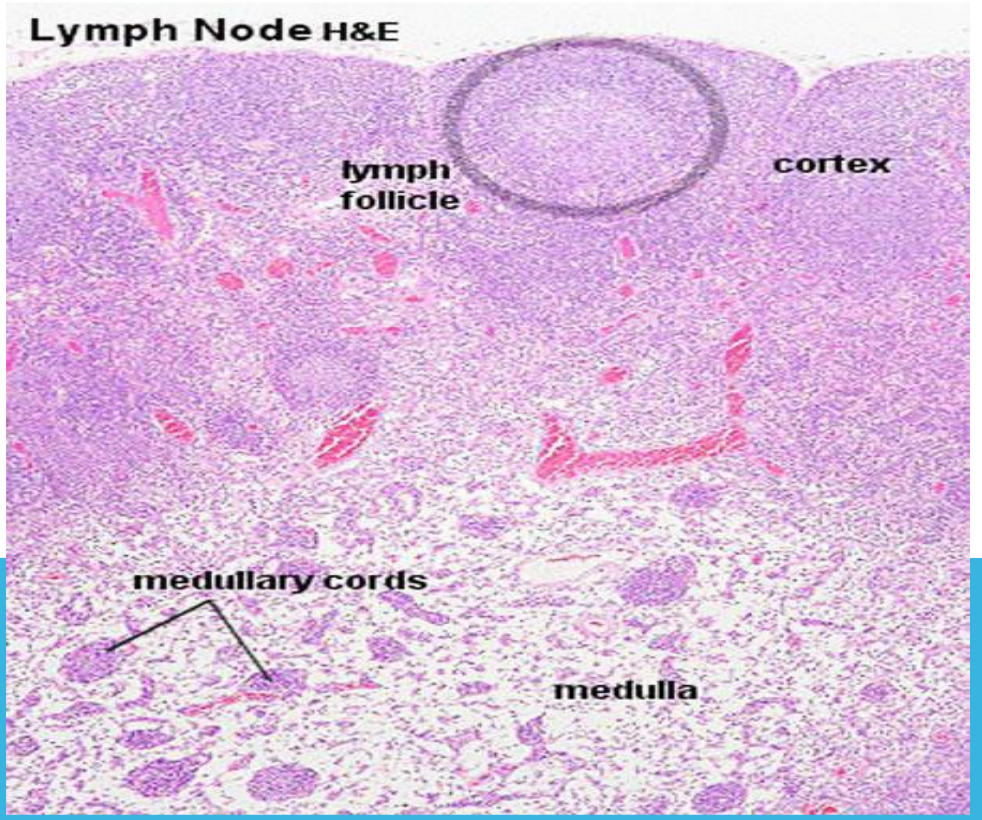
### medulla

The medulla appears as a paler area of variable width, surrounding the hilus . It consists of

diffuse lymphatic tissue arranged as irregular **medullary cords.** Medullary cords are networks o reticular fibers filled with plasma cells, macrophages, and lymphocytes separated by capillary-like channels called **medullary sinuses**

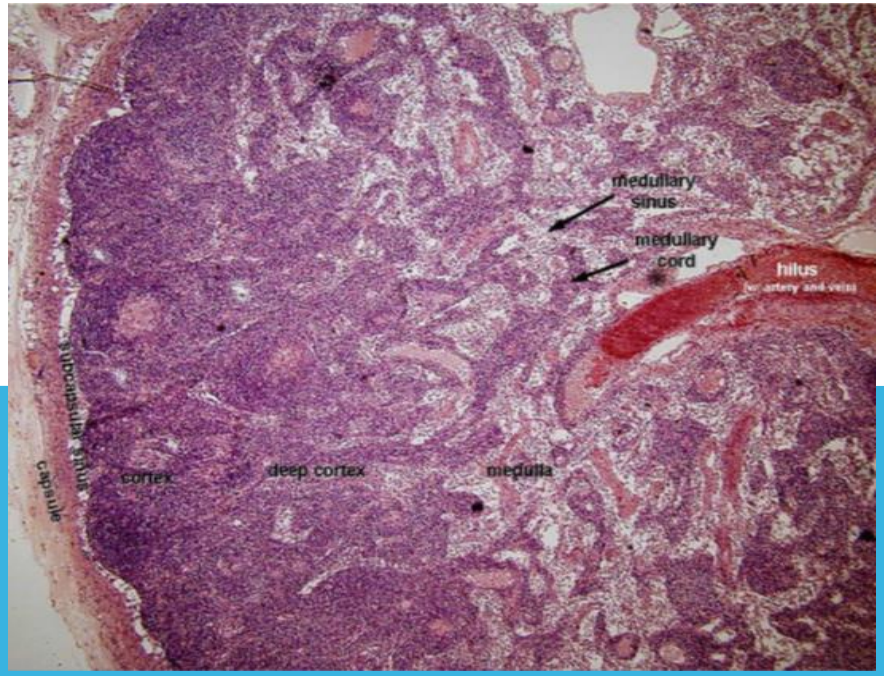

Germinal center in follicle
Afferent lymphatic vessels
Capsule
Subcapsular sinus
Trabecula
Afferent lymphatic vessels
Efferent lymphatic vessels
Hilus
Cortex
Follicle
Medullary sinus
Medullary cord
(a)


Cortex of Lymph Node
Marginal Sinus
Nodule
Germinal Center


Lymph Node H&E
lymph follicle
cortex
medullary cords
medulla

# Lymph Sinuses

Within the lymph node is a system of channellike spaces, the lymph sinuses, through which lymph percolates. Lymph enters the node through afferent lymphatic vessels and empty into the **subcapsular (marginal sinus)** which separates the cortex from the capsule. present as a wide space extending beneath the capsule. It is continuous with the **cortical (trabecular) sinus.** which extend into the cortex, usually along the trabeculae. These become continuous with **medullary sinuses** that run between the medullary cords and trabeculae of the medulla. Sinuses in the cortex are less numerous than in the medulla and narrow . They run in the medullary parenchyma as irregular cordlike arrangement .



# Spleen

The spleen is a large lymphoid organ with a rich blood supply. The spleen is enclosed by a

capsule of dense connective tissue( fibro-elastic connective tissue, some smooth muscle, and an outer covering mesothelium . ). On the medial surface of the spleen, the capsule is form a cleft like hilus through which blood vessels, nerves, and lymphatics enter or leave the spleen. Broad bands of connective tissue, the trabeculae, extend from the inner surface of the capsule, the trabeculae subdivide the organ into compartments. **pulp . the** splenic pulp is consist of : - the light areas form the white pulp and consist of diffuse and nodular lymphatic tissue. - The dark red tissue is the red pulp and consists of diffuse lymphatic tissue**.**

## White pulp

The spleen is characterized by numerous aggregations of **lymphatic nodules ,** they contain mainly **B cells.** The lymphatic nodules also contain **germinal centers** that decrease in number with age**.** Passing through each lymphatic nodule is a blood vessel called a **central artery** that is located in the periphery of the lymphatic nodules . Central arteries are branches of trabecular arteries that become en sheathed with lymphatic tissue as they leave the connective tissue

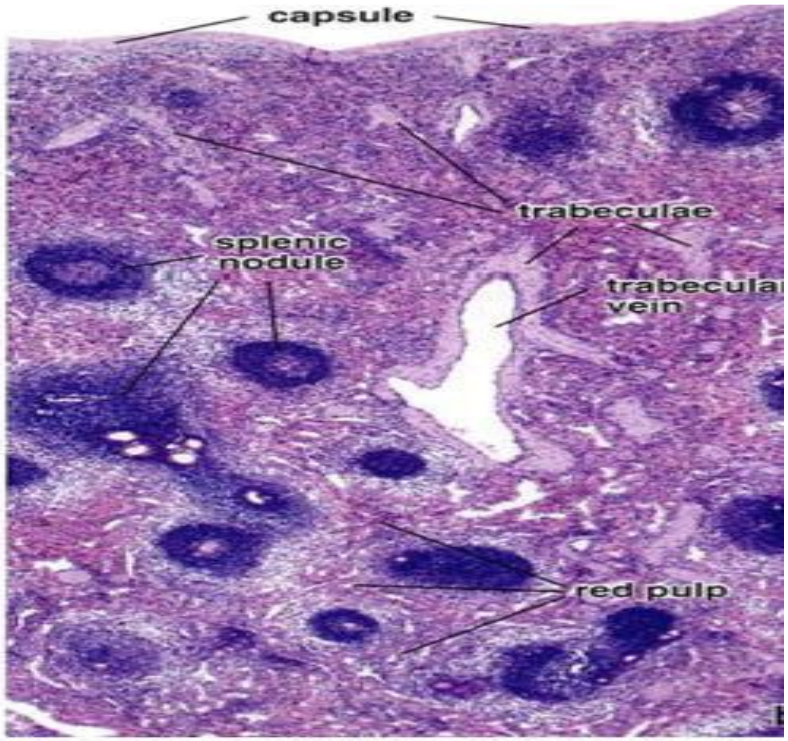
## Red Pulp

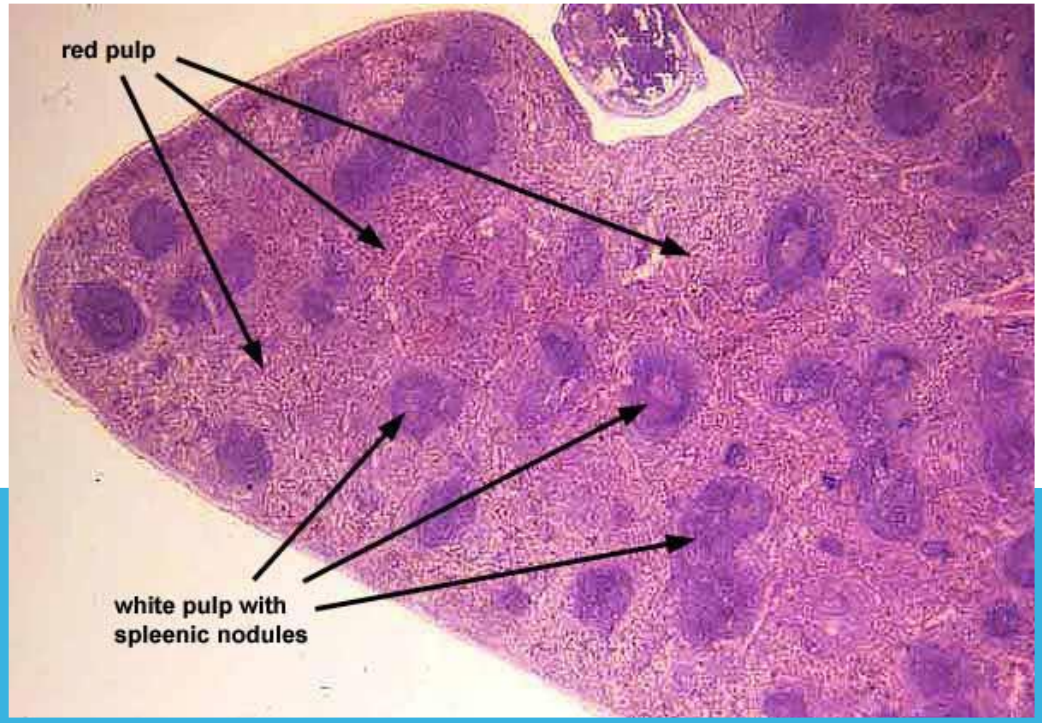
red pulp is red because of its extensive vascular tissue. The red pulp also contains **pulp arteries - venous sinuses , and splenic cords. The splenic cords** appear as diffuse strands of lymphatic tissue between the venous sinuses and form a spongy meshwork of reticular connective tissue. They are thin aggregations of lymphatic tissue containing small lymphocytes, associated cells, and various blood cells.

**Venous sinuses** are dilated vessels lined with modified endothelium of elongated cells .

**pulp arteries** represent the branches of the central artery after it leaves the lymphatic nodule . Capillaries and pulp (venules) are also present .

The main function of the red pulp is to filter the blood. It removes antigens, microorganisms, platelets, and aged or abnormal erythrocytes from the blood. The spleen does not exhibit a distinct cortex and a medulla, as seen in lymph nodes. However, lymphatic nodules are found throughout the spleen. In addition, the spleen contains venous sinuses


capsule
trabeculae
splenic nodule
trabecular vein
red pulp


red pulp
white pulp with spleenic nodules

# Spleen

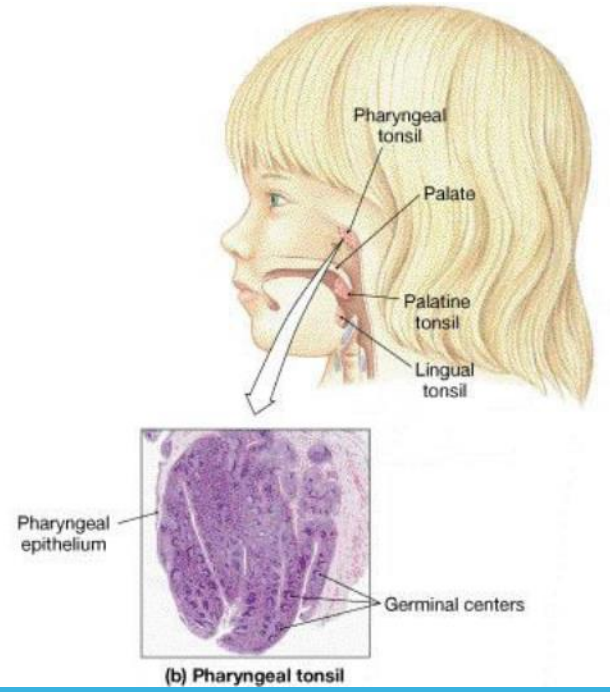
## TONSILS :

Tonsils are aggregates of lymphatic nodules associated with the pharynx and oropharynx. These structures are spread through different areas - oropharynx, nasopharynx, and tongue - and form the

**1- palatine**,

**2- pharyngeal**, and

3- **lingual tonsils** .



# PALATINE TONSILS

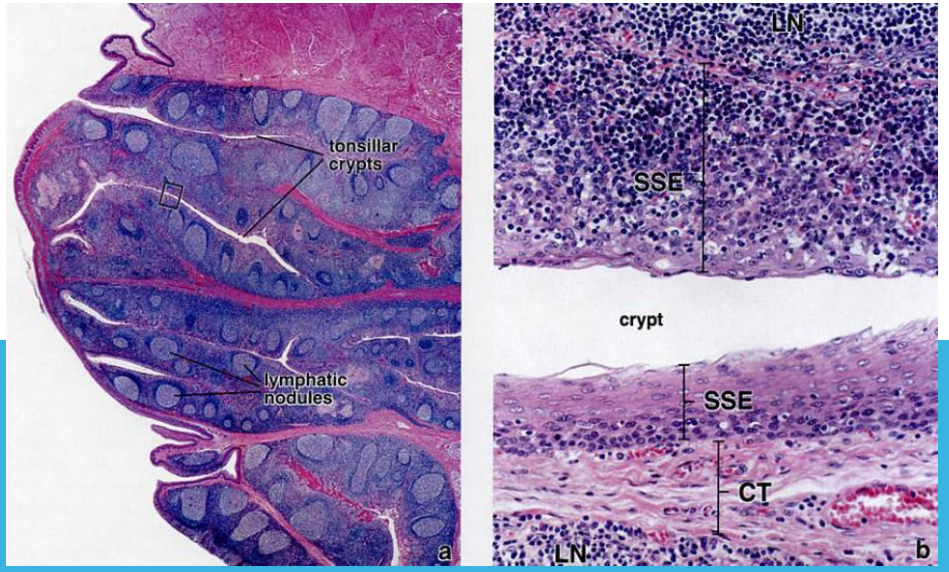
The palatine tonsils are paired, oval lymphatic organs located laterally at the junction of the oral cavity and oropharynx.

A **stratified squamous epithelium** covers the free surface of the tonsil and is very closely

associated with the lymphatic tissue. Deep invaginations of the epithelium form the tonsillar

**crypts** that reach almost to the base of the tonsil Lymphatic nodules, many with germinal

centers, usually are arranged in a single layer beneath the epithelium, embedded in a mass of diffuse lymphatic tissue. A **partial capsule** beneath the basal surface of the tonsil separates it from surrounding structures .



## LINGUAL TONSILS:

The lingual tonsils form nodular bulges in the root of the tongue, and their general structure is similar to that of the palatine tonsil. **Crypts** are deep, and are lined by **stratified squamous epithelium** that invaginates from the surface. The associated lymphatic tissue consists of diffuse and nodular types.

## PHARYNGEAL TONSIL :

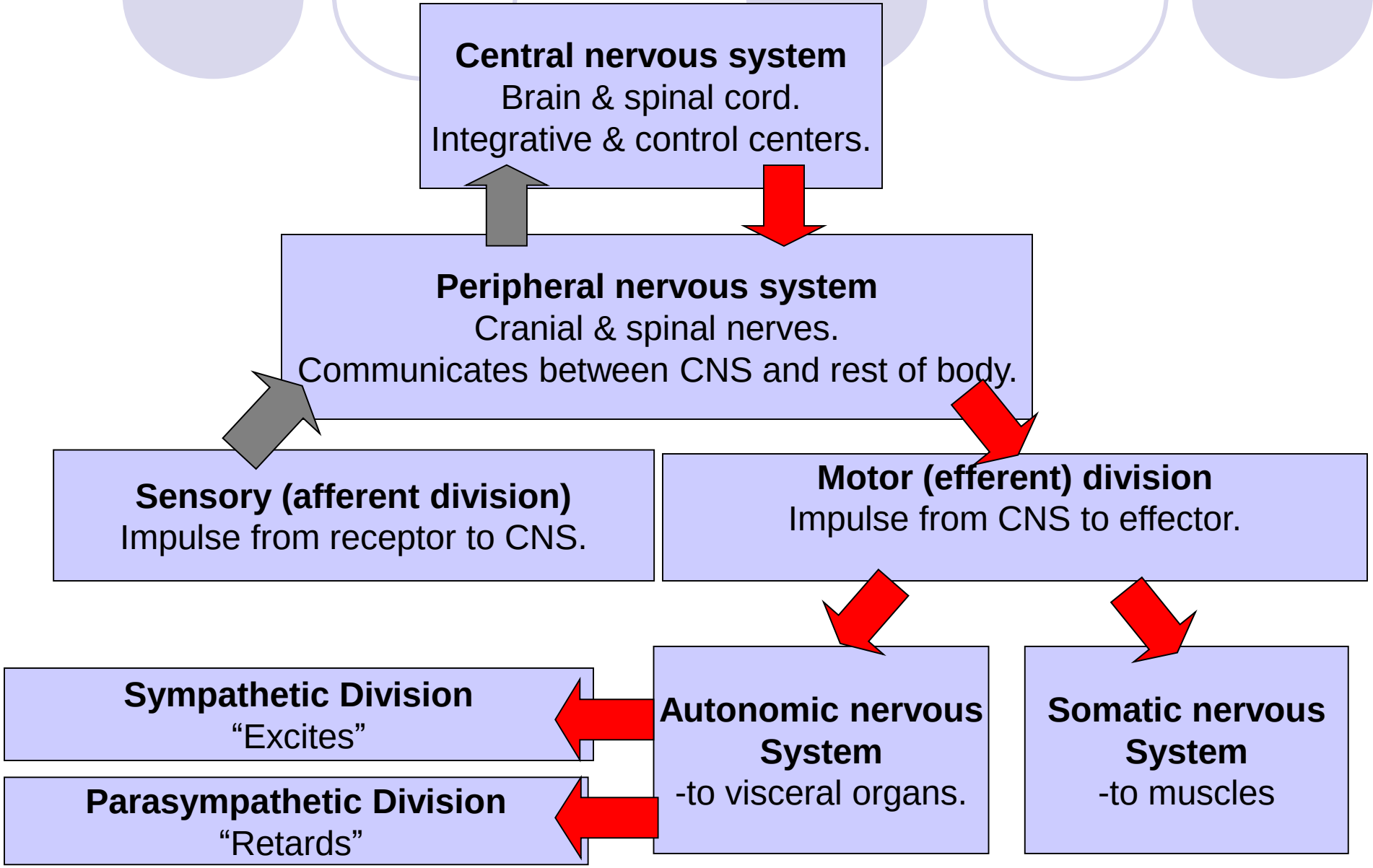
The pharyngeal tonsil is located on the posterior wall of the nasopharynx. Its surface epithelium is a **ciliated pseudostratified columnar epithelium** that contains goblet cells. Patches of stratified squamous epithelium may be present . crypts are not as deep as in the palatine tonsils . A thin capsule separates the pharyngeal tonsil from underlying tissues and provides fine septa that extend into the substance of the tonsil.

Nerve Tissue & the Nervous system I

# Nervous Tissue

- 2 cell types:
  - Nerve cells (neurons)
    - receive or transmit impulses
    - interconnections (at least 1000 each)
  - Neuroglial cells
    - more numerous than neurons
    - support neurons in various ways
- Capillaries
- No lymphatics!

# Organization of the Nervous System



# Introduction:

**The nervous tissue is composed of interconnecting network of specialized cells called *neurons* (nerve cells) supported by *neuroglial cells*. There are about 10 million neurons in human beings. The function of neurons is to receive stimuli and conduct them to a central site, the central nervous system (CNS), where they are analysed and integrated to produce a desired response in the effector organs.**

## Structure of a neuron:

### Cell body/Soma/Perikaryon (5–150 _m):

- **The cell bodies of all neurons are situated in the grey matter of the CNS and in the ganglia of PNS.**
- **The cell body of a neuron contains the nucleus and the following cytoplasmic organelles and inclusions**

- ***Nucleus*—is large, euchromatic, spherical and centrally located.**
- ***Nissl bodies* or *Nissl substance*—are composed of large aggregations of rough endoplasmic reticulum:**

# Table Shows Types Of Glial Cells

| *Glial Cell Type* | *Location* | *Main Functions* |
|---|---|---|
| Oligodendrocyte | Central nervous system | Myelin production, electric insulation. |
| Neurolemmocyte | Peripheral nerves | Myelin production, electric insulation. |
| Astrocyte | Central nervous system | Blood-brain barrier, metabolic exchanges. |
| Ependymal cells | Central nervous system | Lining cavities of central nervous system. |
| Microgl ia | Central nervous system | lmmune-related activity |
| Satellite Cells | Peripheral nerves | Supportive role. |

***Dendrites:*** ***Fig.(2)***

- **Are highly branched, tapering processes of a neuron. So their diameter is not uniform.**
- **Are covered by thorny spines (gemmules) which are sites of synaptic contact.**
- **Receive stimuli from sensory cells and other neurons and transmit them towards the soma. So they can be regarded as major sites of information input into neuron.**

***Axon:*** ***Fig.(2)***

- **Single, long, cylindrical process of a neuron. So its diameter is uniform.**
- **Does not branch profusely; but may give rise to collaterals.**
- **Arises from a cone-shaped portion of the cell body called *axon hillock,* which is devoid of Nissl bodies, but contains bundles of microtubules.**
- **The cytoplasm of the axon is called *axoplasm* and the plasma membrane is called *axolemma.***
- **Terminates by dividing into many small branches, *axon terminals,* ending in small swellings—*terminal buttons.***
- **Conducts impulses away from the cell body to the axon terminals from which impulses are transmitted to another neuron or another target cell.**
- **Axons are commonly referred to as *nerve fibers.***
- **Are often surrounded by *myelin sheath,* which is derived either from Schwann cells (PNS) or oligodendrocytes (CNS).**
- **When an axon is cut, peripheral part degenerates.**
- **Regeneration of the axon is possible only when the cell body of the neuron is intact.**

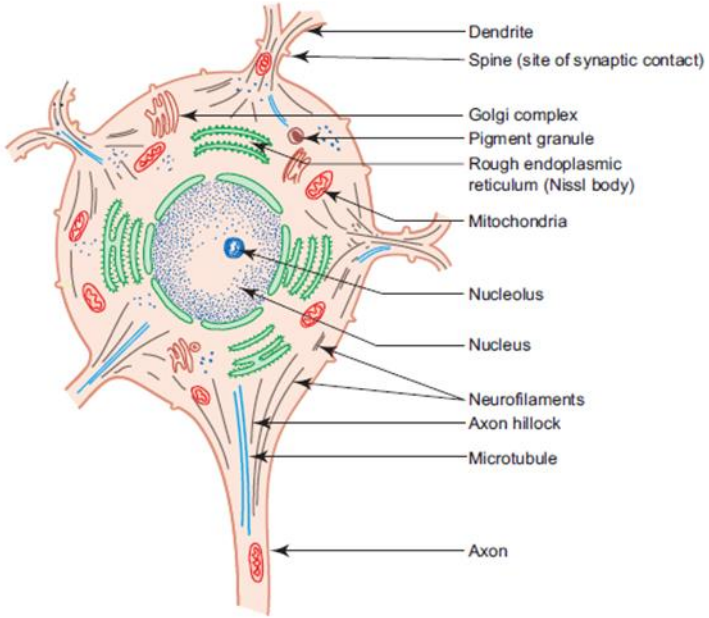



*Fig 1:Ultrastructure of neuron*

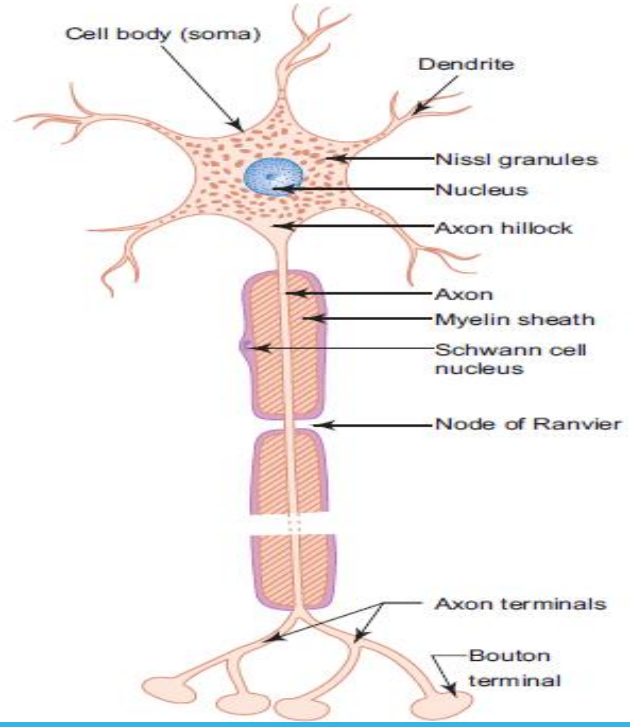



*Fig.(2):Structure of a neuron*

# Classification of Neurons:

## *A. Morphological (based on the number of processes)*

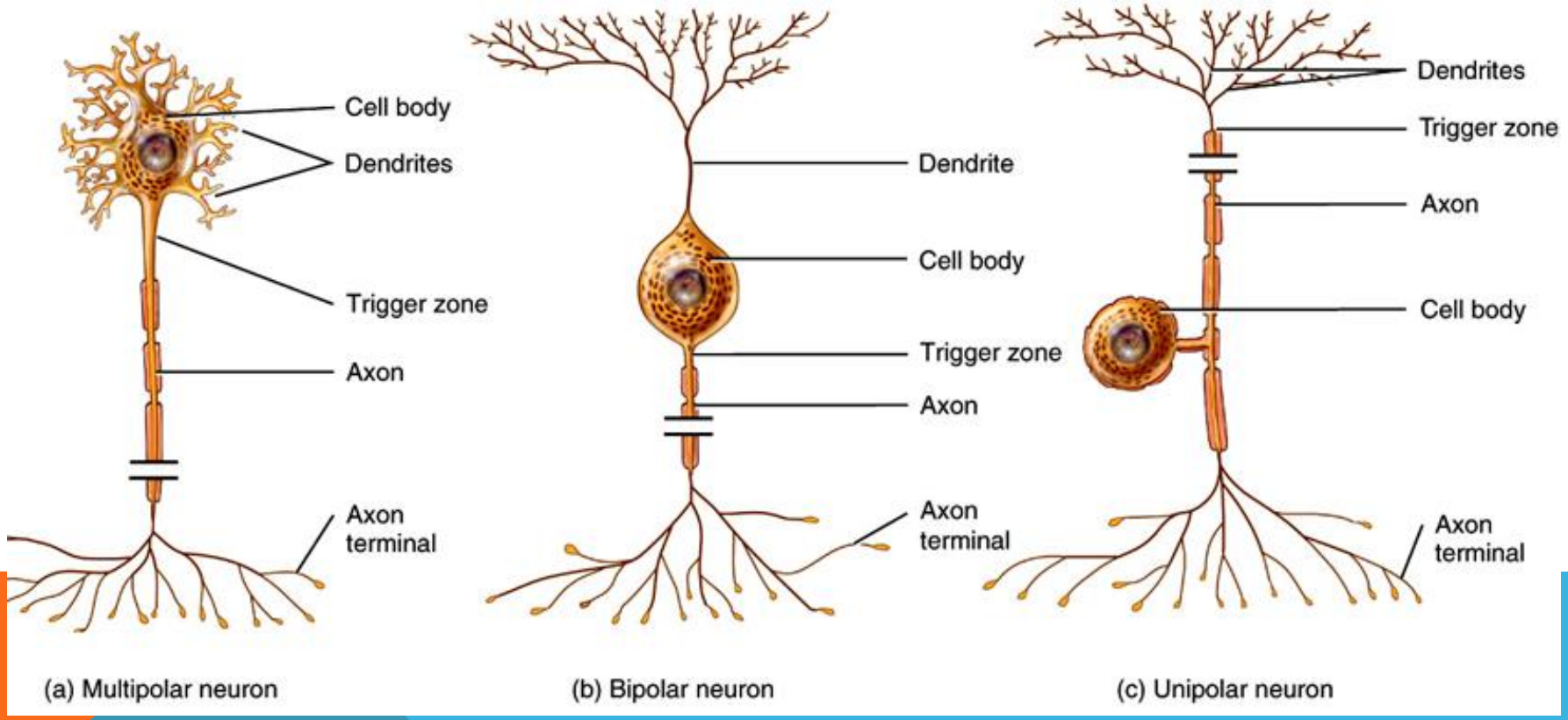
***1. Unipolar neuron***—has a single process (rare), e.g. *mesencephalic nucleus of V cranial nerve*.

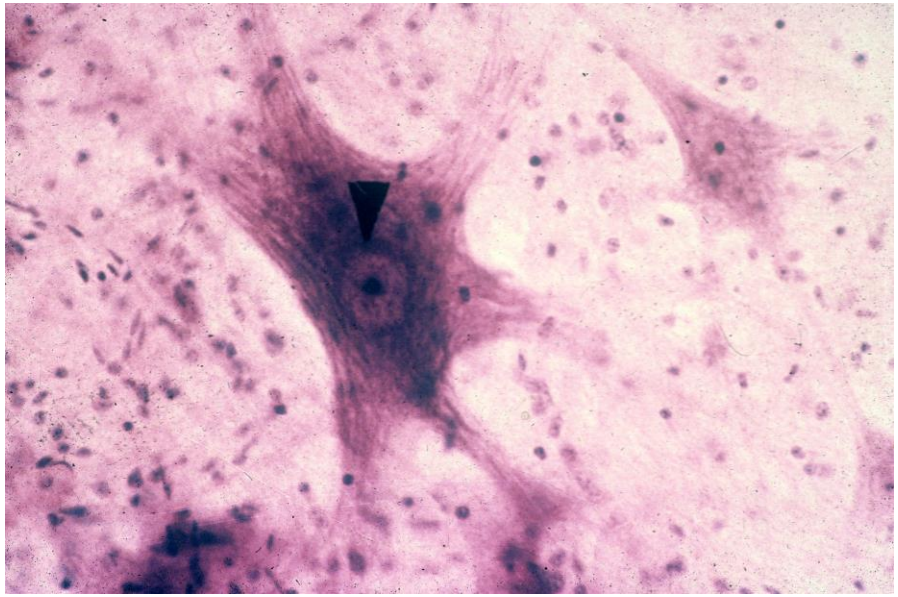
**2. *Bipolar neuron***—has two processes (an axon and a dendrite; fig.(3)), e.g. *spiral ganglion*, bipolar cells in *retina* .

**3. *Multipolar neuron***—has many processes (an axon and many dendrites; Fig. (4)), e.g. *autonomic ganglia motor neurons*

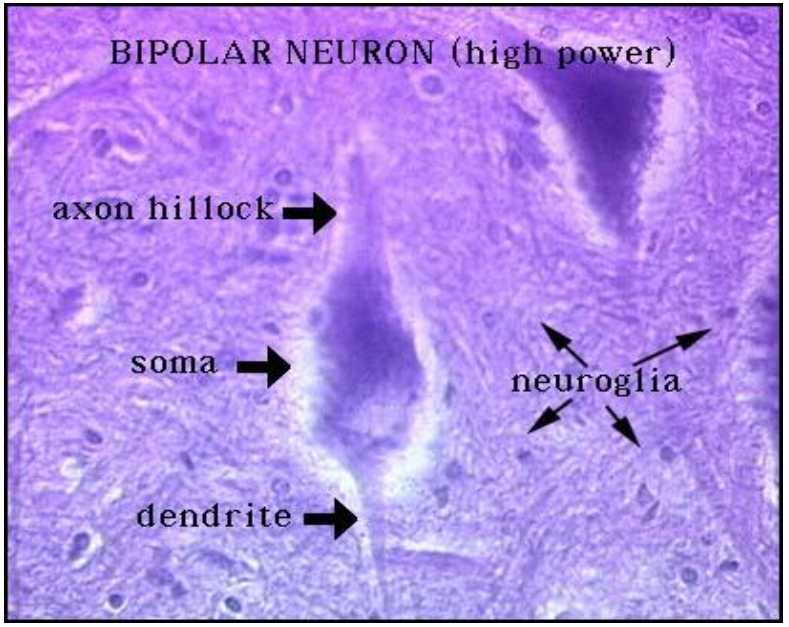
**4. *Pseudo-unipolar neuron***—has a single process that divides into an axon (central process) and a dendrite (peripheral process; Fig. (5)), e.g. *cranial* and *spinal ganglia* (*sensory neurons*

# STRUCTURALCA LSSIFICATION OF NEROUN

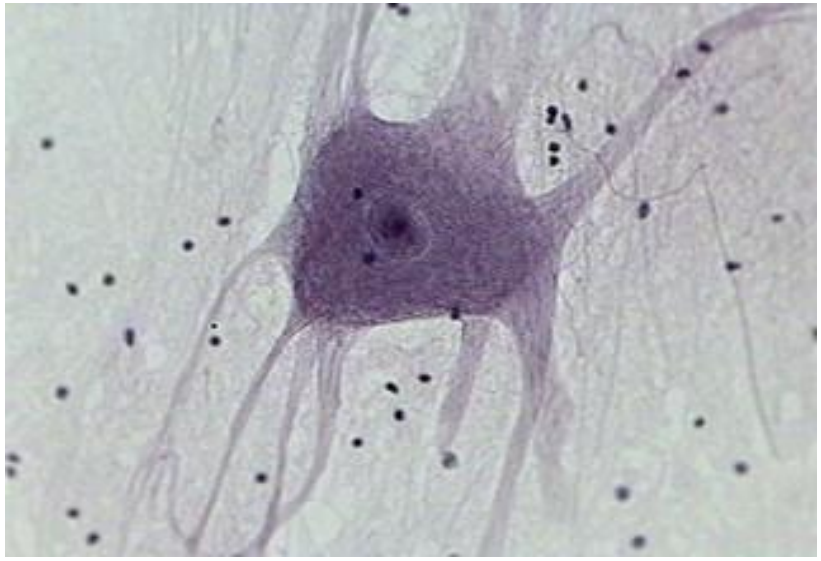




Nerve Cell Body with dark staining Nissl

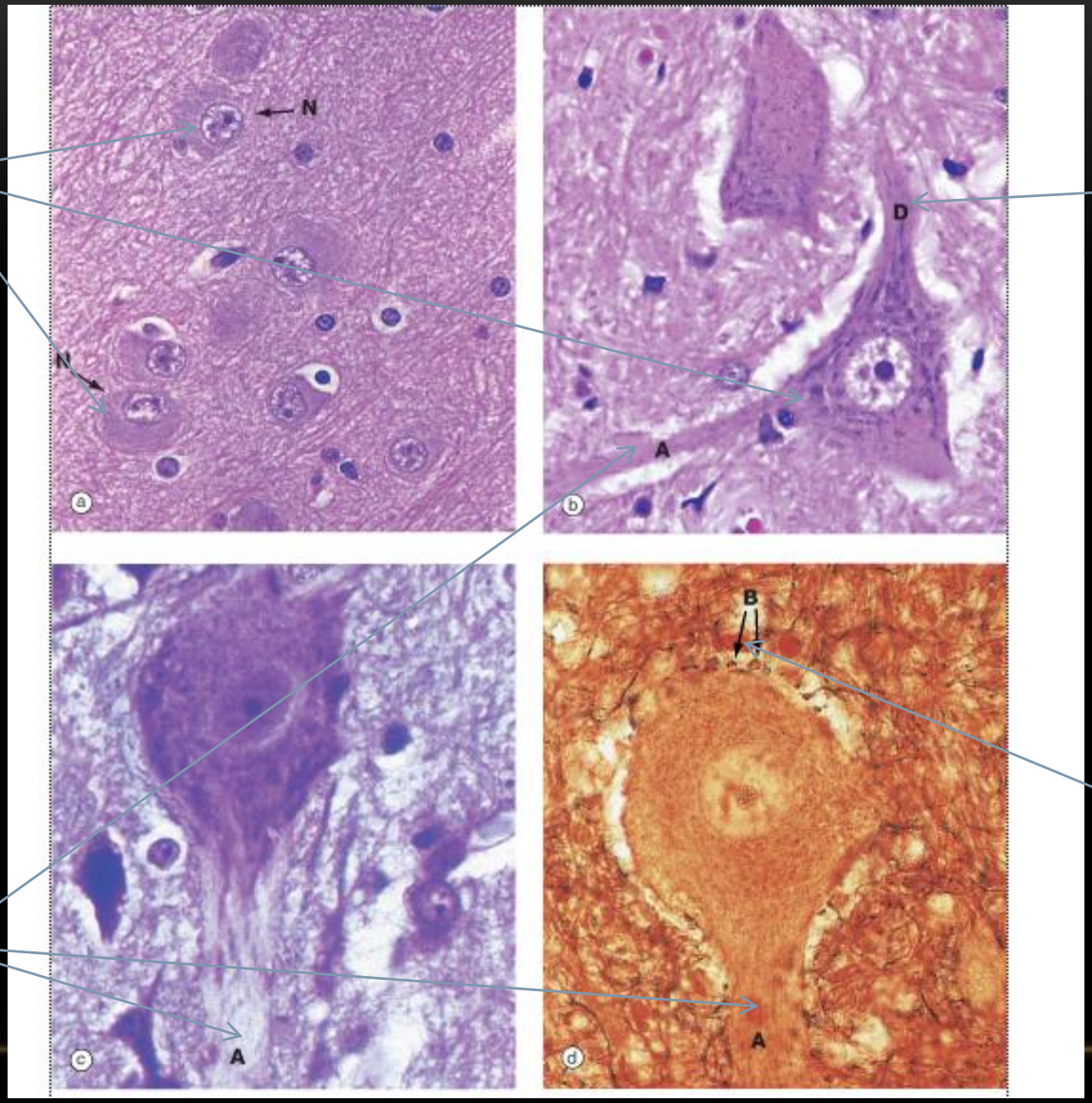



Bipolar Neuron



Multipolar

# Neurons with different staining methods




Neuron N

Dendrite D

Terminal bouton B

Axon A

## *B. Functional (based on the function performed):*

***1. Sensory neuron*—receives stimuli from receptors and conducts impulses to CNS, e.g. *sensory ganglia.***

***2. Motor neuron*—conducts impulses from CNS to effecter organs (muscles), e.g. *ventral horn cells.***

***3. Interneuron*—connects sensory and motor neurons and completes the functional circuit.**

***Synaptic Communication:***

- **The synapse( Gr. Synapsis , union) is responsible for the transmission of nerve impulses from neuron to another cell and insure that transmission is unidirectional.**
- **The function of the synapse is to convert an electrical signal (impulse) from the pre synaptic cell into a chemical signal that acts on the postsynaptic cell. Most synapses transmit information by releasing neurotransmitters.**

***A synapse has the following structure:***

**Presynaptic axon terminal (terminal button) from which neurotransmitter is released,**

- **Postsynaptic cell membrane with receptors for the transmitter and ion channels or other mechanisms to initiate a new impulse.**
- **synapses between neurons may be classified morphologically as:**

- ***axodendritic,* occurring between axons and dendrites;**
- ***axosomatic,* occurring between axons and the cell body**
- ***axoaxonic,* occurring between axons and axons**

*1-Neurons*

*2-Muscle*

*3-Glands*

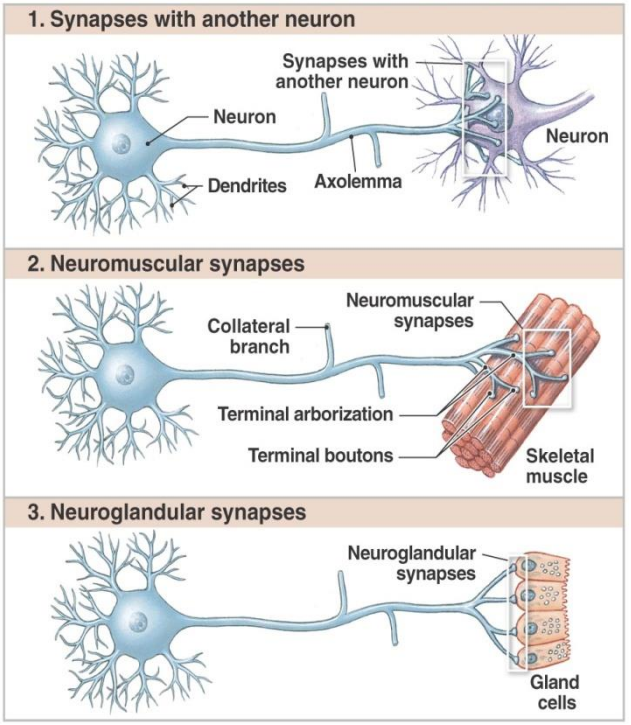



***Fig.( 6)***

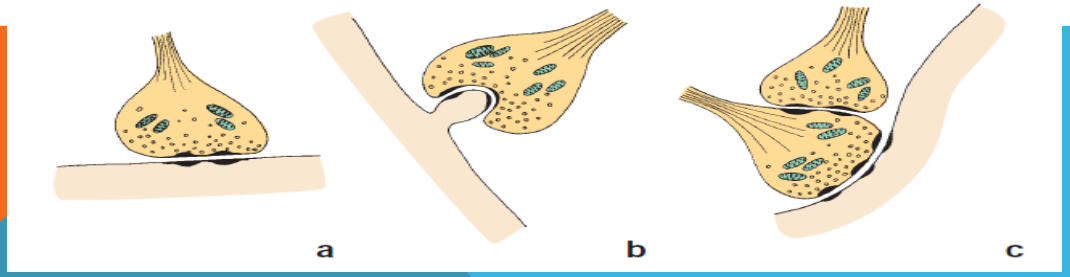



***Fig.(Types of Neuroneural Synapses***

## CONT.

- **The neurotransmitter carries the impulse across the space (the synapse) and onto the next neuron, or onto the organ the impulse is meant to stimulate.**
- **Some examples of neurotransmitters are :**

- **Acetylcholine .**
- **Dopamine , endorphins**
- **Serotonin ,and**
- **Norepinephrine .**

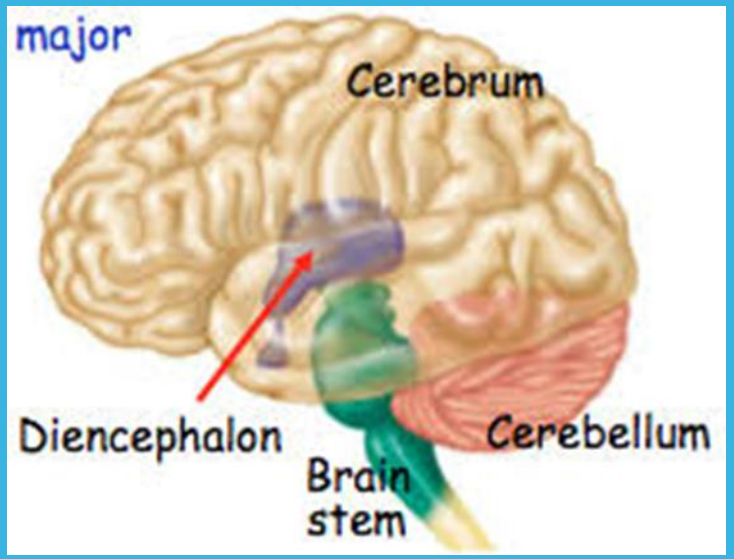
***These neurotransmitters have a variety of functions, including muscle movement, mood, and stress release.***

المشبك العصبي العضلي

# Central Nervous System

- Spinal cord (Medulla Spinalis)
- Brain

–gray matter
–white matter
–no intervening conn. tissue



# CNS

- The principal structures of the CNS are the cerebrum, cerebellum, and spinal cord.
- It has virtually no connective tissue and is therefore a relatively soft, gel-like organ.
- When sectioned ,the cerebrum ,cerebellum, and spinal cord show regions of white (white matter) and gray (gray matter), differences caused by the differential distribution of myelin

**White matter;**

- Myelinated/ few unmyelinated nerve fibers
- Glia
- Capillaries
- White color results from the myelin

**Gray matter;**

- Neuronal cell bodies
- Dendrites
- Initial unmyelinated portions of axons
- Glia
- Capillaries

Neuropil??

- network of the axons, dendrites and neuroglial processes in the gray matter

Nuclei???

- aggregations of neuron cell bodies embedded in white matter
- counterpart of ganglia

# Types of Nerve Cells

## *1. Pyramidal cells*

- **Are the most common type of neurons found in the cerebral cortex.**
- **Are pyramidal in shape.**
- **Their size ranges from 10 µm to 120 µm.**
- **The apices of the neurons give rise to dendritic processes which are directed towards the surface of the cortex, whereas the bases give origin to axons which forms projection fibers of the white matter.**
- **They are distributed in layers, 2–5, and progressively increase in size.**

## *2. Stellate/Granule cells*

- **Small, star-shaped neurons of uniform diameter (8 µm).**
- **Have short axons terminating in nearby neurons.**

## *3. Fusiform cells*

- **Spindle-shaped cells placed at right angles to the surface in the deep layer.**
- **Dendrites arise from each pole of the cell body and axon arises from the cell body just above the**

## •Spinal Cord

•gray matter lies centrally where it forms an H shape in cross-section

•white matter is located in the periphery

•Gray matter

–the butterfly-shaped (H-shaped) area in cross-section

•White matter

•Central canal

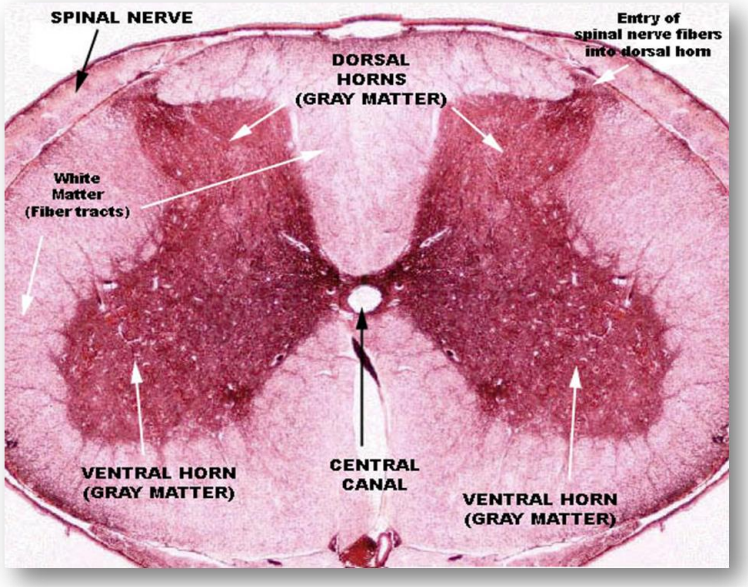
## Brain

•gray matter

–periphery (cortex) of the cerebrum and cerebellum

–basal ganglia

•white matter lies deep to the cortex



•**Dorsal (posterior) horns:**

–the upper vertical bars of the H

–receive central processes of the sensory neurons whose cell bodies lie in the dorsal root ganglion

–contain cell bodies of interneurons

•**Ventral (anterior) horns:**

–the lower vertical bars of the H

–house cell bodies of large multipolar somatomotor neurons whose axons make up the ventral roots of the spinal nerves

•**Intermediary column:** visceromotor neurons

# Central canal

•remnant of the lumen of the embryonic neural tube

•lies in the center of the crossbar of the H

•lined by low columnar- cuboidal cells (ependymal cells)

# CEREBRAL CORTEX

***1. Molecular layer*** **(plexiform layer)—is the most superficial, well defined layer. It consists mainly of nerve fibers and occasional *horizontal cells of Cajal.***

***2. External granular layer*—contains large number of *stellate cells* and *small pyramidal cells.***

***3. External pyramidal layer*—is mainly made of medium sized *pyramidal cells* and also contains few *stellate cells* and *cells of Martinotti.***

***4. Internal granular layer*—is composed of closely packed *stellate cells* and horizontally oriented white fi bre band called *outer band of Baillarger.***

***5. Internal pyramidal layer*** **(ganglionic layer)—consists mainly of *large pyramidal cells* and few *stellate cells* and *cells of Martinotti.* This layer also contains horizontally arranged fi bres that form the *inner band of Baillarger.***

**6. *Multiform layer* (layer of polymorphic cells)—is the deepest layer. It contains predominantly *fusiform cell* and also few *stellate cells* and *cells of Martinotti* intermixed with many nerve fibers entering or leaving the underlying white matter.**

## ***Cerebellar Cortex***

### ***Gneral Cortex:***

- **The cortex of cerebellum is highly folded. The *folds* or *folia* are separated by closely set parallel transverse fissures.**

**Each folium contains a core of white matter covered superficially by grey matter or cortex**

### ***Structure:***

**The cerebellar cortex consists of three layers; an external molecular layer, a middle Purkinje cell layer and an internal granular layer :**

***1. Molecular layer***

- **Is the superfi cial thick layer and is usually lightly stained with eosin.**
- **Mainly made of nerve fi bres and few cells, namely, *stellate cells* in the superfi cial part and *basket cells* in the deeper part.**
- **The axons of these cells run parallel to the long axis of the folia. The axons of basket cells form collaterals which arborize around the Purkinje cells in a 'basket-like' manner.**

***2. Purkinje cell layer***

***Purkinje cells* are large flask-shaped neurons (*Golgi type I*) and are arranged in a single row between *molecular* and *granular* layers.**

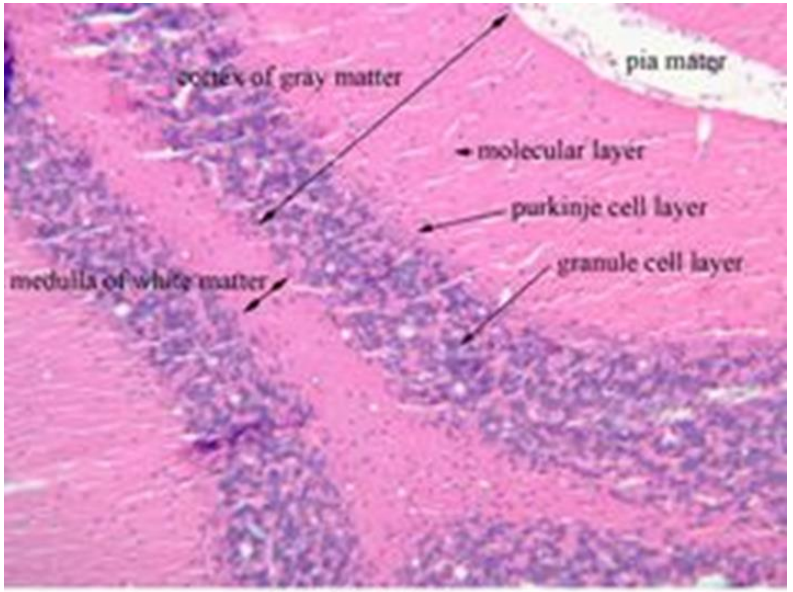
**The dendrites of these cells pass into molecular layer and arborize profusely in a plane transverse to the folium. These dendrites synapse with axons of granular cells**

**The axons of Purkinje cells pass through the granular layer to end in deeper nuclei of cerebellum.**

***3. Granular layer***

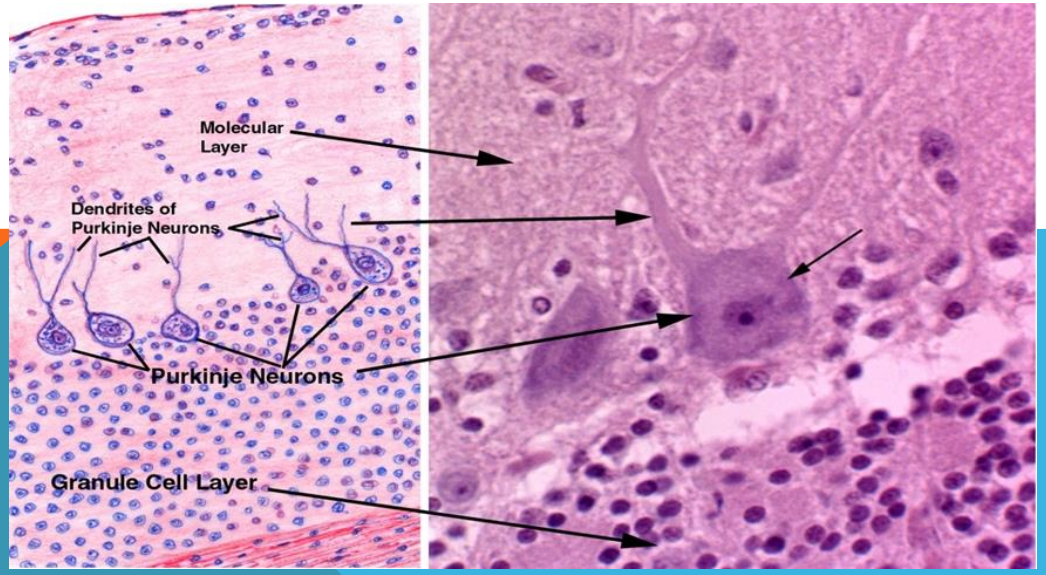
**Is stained deeply with hematoxylin because it is densely packed with very *small granule neurons* . The axons of these granule cells pass into the molecular layer where they bifurcate in a T-shaped manner and run at to the dendritic processes of the Purkinje cells and synapse with them. Few *Golgi cells* (type II) are also present in the granular layer.**

# CEREBELLUM


human cerebellum

***cerebral cortex***



# peripheral nervous system PNS

# PNS

**The peripheral nervous system PNS, consists of nerves, ganglia, and nerve endings. The ganglia are nodular masses of neuronal cell bodies (ganglion cells), together with their supporting peripheral neuroglia, capsule cells or satellite cells. There are two kinds of ganglia in the PNS- sensory ganglia which contain cell bodies of sensory (afferent neuron), and autonomic ganglia, which contain cell bodies of certain efferent neurons of the autonomic nervous system. The sensory ganglia include the cranial ganglia, which are associated with some of the cranial nerves, and the spinal ganglia, known as posterior (dorsal) root ganglia, which are associated with posterior root of the spinal nerves.**

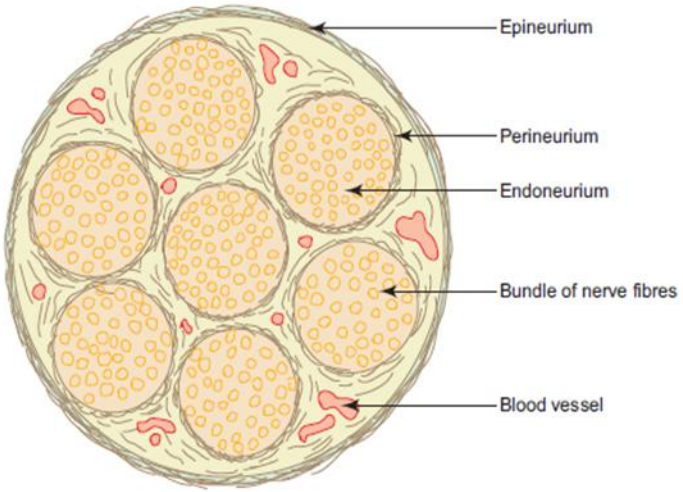
**Peripheral nerves consist of bundles of nerve fibers (myelinated and unmyelinated). Afferent fibers and efferent fibers are both present in most nerves. Afferent nerve endings are a part of sensory receptors, and efferent nerve endings are found on muscle fibers, secretory cells of exocrine glands, and fat cells of adipose tissue**

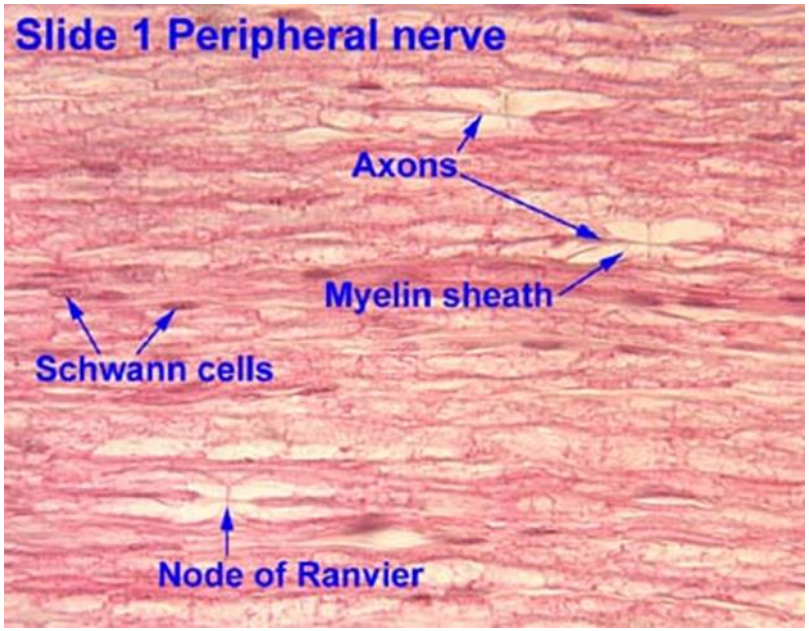
- **In the PNS, all axons are enveloped by Schwann cells which provide both structural and metabolic support.**
- **Many axons with small diameter invaginate into one Schwann cell longitudinally and are simply surrounded by the cytoplasm of Schwann cells. They are called *unmyelinated* nerve fibres.**
- **Myelination begins with the invagination of the axon into the Schwann cell. The invaginated axon is suspended from the periphery of the cell by a fold of fused plasma membrane called *mesaxon***

## Peripheral Nerve:

- **Each peripheral nerve (spinal or cranial) is made of bundles (fascicles) of nerve fibres (axons) which may be myelinated and/or unmyelinated.**
- **The bundles are held together by connective tissue which provides structural support as well as nutritional support by carrying blood vessels to nerve fibres.**
- **The connective tissue framework is well appreciated in cross section of a nerve, where following structures can be observed:**
  - ***Epineurium:*** Dense connective tissue sheath surrounding the entire nerve.
  - ***Perineurium:*** A sleeve of fl attened specialised epithelial cells surrounding the bundles of nerve fibres.
  - ***Endoneurium:*** Loose connective tissue composed of reticular fibers supporting individual nerve fibers.

# *PERIPHERAL NERVE*



# GANGLIA

## *Spinal ganglia*

**Ganglion cells have the typical features of neurons, i.e. large rounded cell body, intense cytoplasmic basophilia with fine Nissl bodies, The nucleus is large spherical pale staining with prominent nucleolus and is centrally located. Lipofuscin pigment may be present in the cytoplasm. A layer of flat capsule cells or satellite cells invest the cell body. The satellite cells are the neuroglial cells in the peripheral nervous system. The ganglion cells and the satellite cells are both derived from the neural crest and are supported by connective tissue framework and a capsule.**

**The ganglion cells are pseudounipolar neurons, therefore in a tissue sections they appear as rounded because the processe was not in the plane of the section.**

## *Autonomic Ganglia*

**Autonimc ganglia are bulbous dilatations appear in the autonomic nerves. Some are located within certain organs, especially in the walls of the digestive tract, where they constitute the intramural ganglia. In autonomic ganglia the margins of the ganglion cells are indistinct because they are multipolar. The cytoplasm is basophilic with fine Nissl granules with eccentrically situated nucleus. The satellite cells are discontinuous unlike their counterpart of the spinal ganglia. The nucleus of the ganglion cell bodies has an eccentric position. The connective tissue capsule is not prominent**

# *NERVE ENDINGS (RECEPTORS)*

**Nerve receptors are distributed throughout the body, mainly in the skin. Two types of nerve endings have been identified**

- ***Free Nerve Endings***
- ***Encapsulated Nerve Endings***

***Free Nerve Endings***

**Free nerve endings are situated in the deeper layer of the epidermis and in the papillary layer of the dermis. They are supplied with afferent nerve endings that are free of investing Schwann cells. They are *sthermoreceptor, nociceptors* and *the mechanoreceptors* that are related to the hair follicles**

**Encapsulated Nerve Endings**

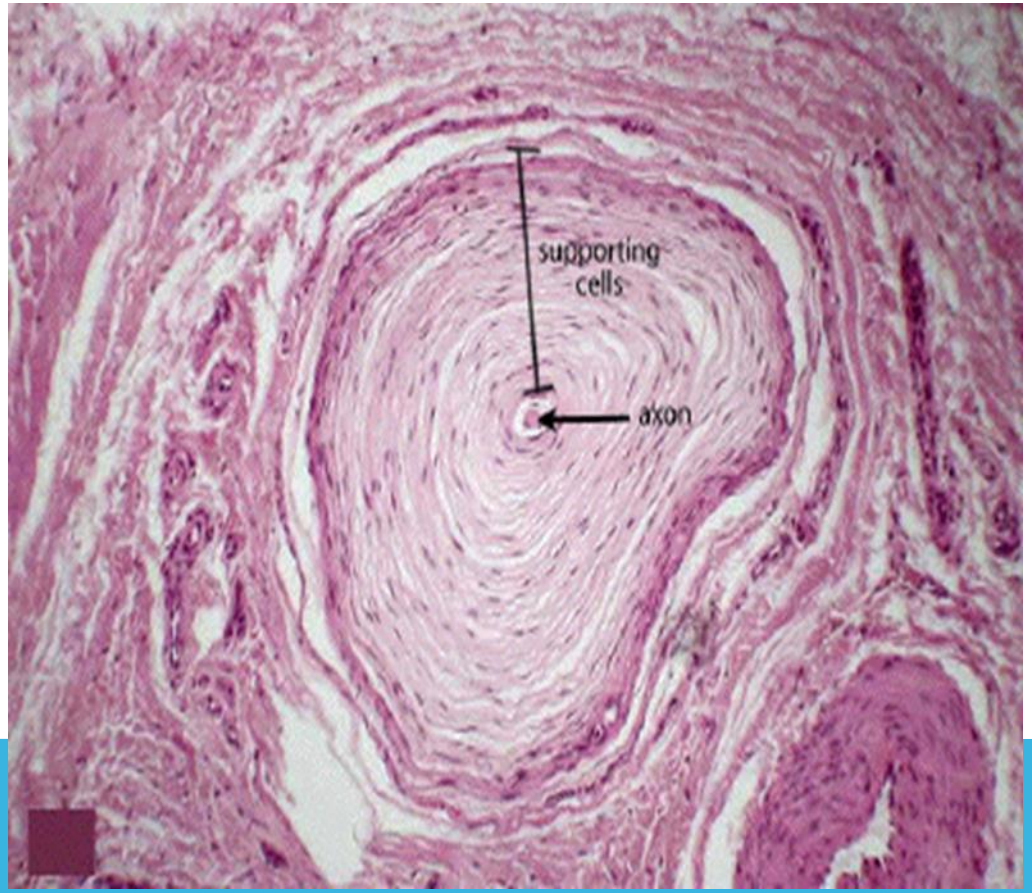
**These are:**

- **Pacinian Corpuscles**
- **Meissners Corpuscles**
- **Ruffini Corpuscle**
- **Krause end bulb**

# *NERVE ENDINGS (RECEPTORS*

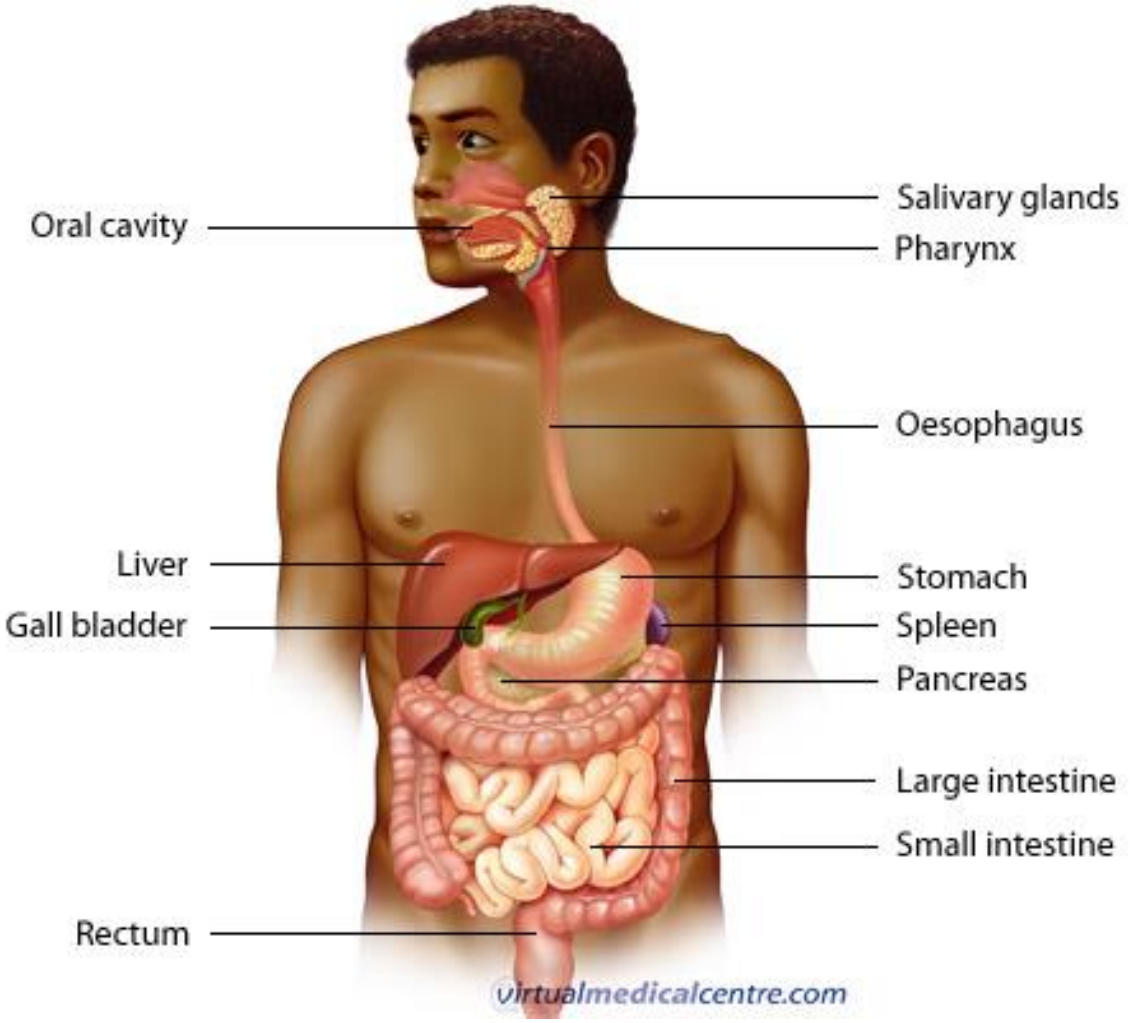
***Meissner's corpuscles***


***Pacinian Corpuscles***

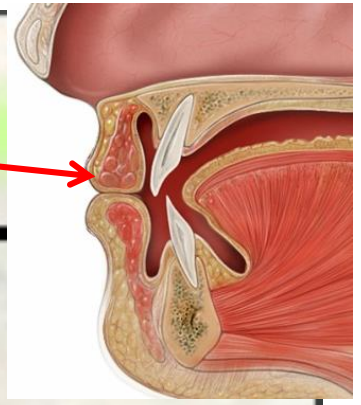


# Digestive Tract

- **Includes:**
  - **Mouth (oral cavity)**
  - **pharynx**
  - **Esophagus**
  - **Stomach**
  - **Small intestine**
  - **Large intestine**



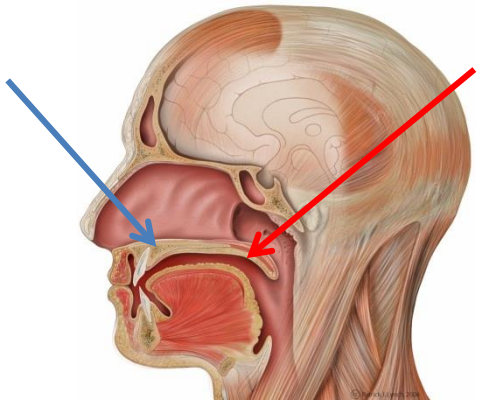
# The Lips

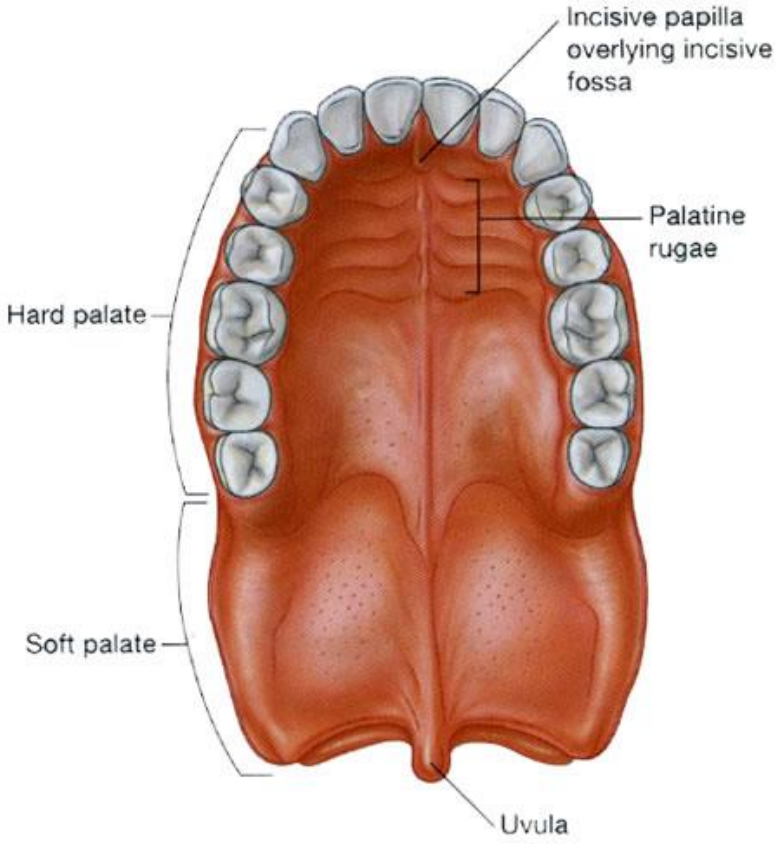


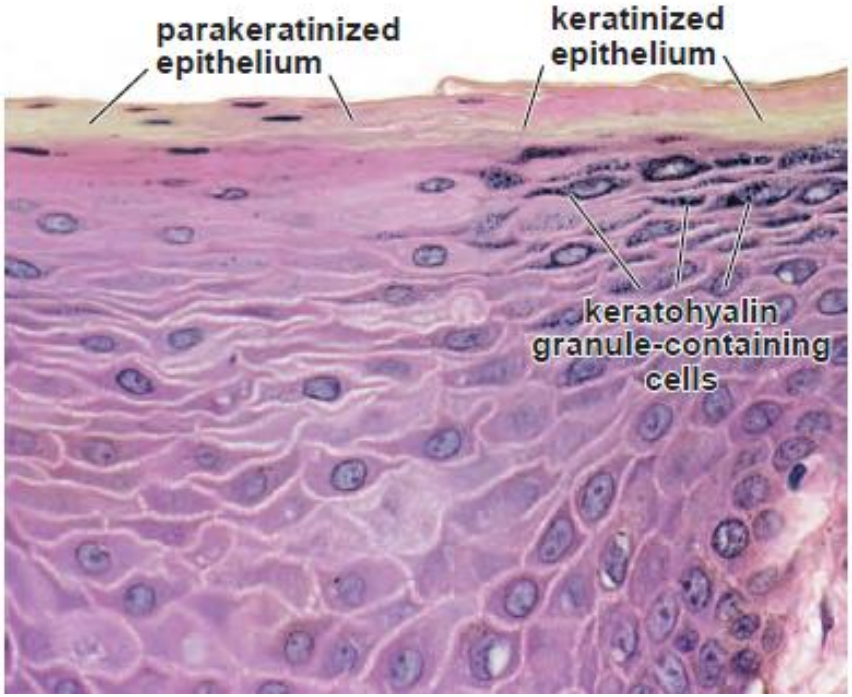
- The lip has 3 surfaces:

1) *External surface:* covered by thin skin.
2) *Internal surface*: stratified squamous non-keratinized epith + thin CT corium.
3) *Free red margin* (vermilion): non-hairy thin skin over a highly vascular area.

# HARD & SOFT PALATE





# Tongue

Fig. 14.8. Tongue (Panoramic view).1-Smooth under surface. 2-Filiform papilla. 3-Fungiform papilla. 4, 5-Skeletal muscle. 6-Serous gland. 7-Mucous gland. 8-Adipose tissue.

- **Mucosa:**
  - Dorsal rough surface → papillae
  - Ventral smooth surface mucosa.
- **Submucosa:** C.T + minor salivary glands.
- **Intrinsic tongue muscles (Skeletal):**
  - arranged in **3** separate planes: horizontal, vertical and longitudinal.

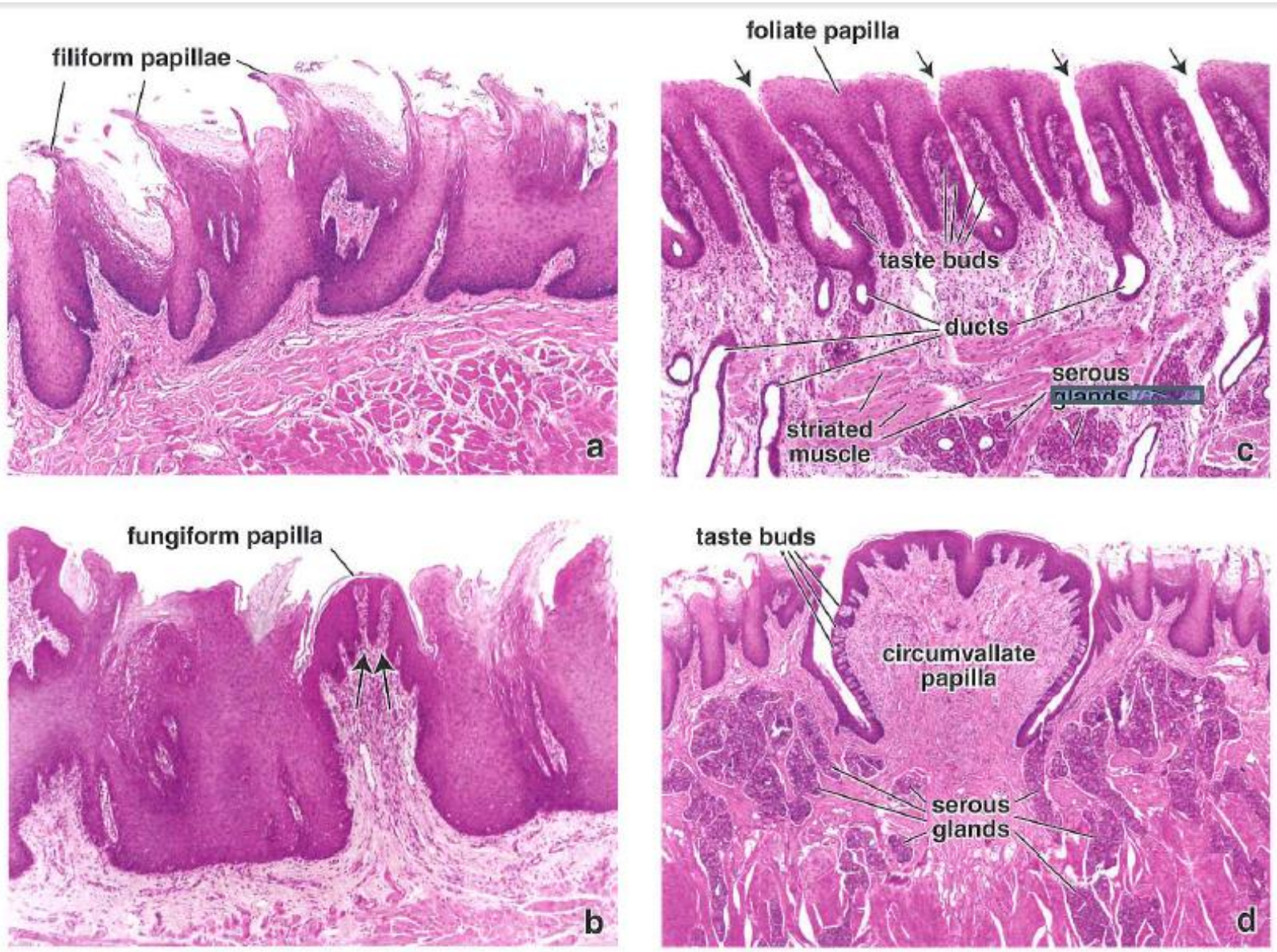



**FIGURE 15.4**

**a.** Structurally, the filiform papillae are posteriorly bent conical pro-

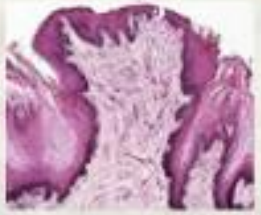
buds on their lateral surfaces. The free surface epithelium of each

# Lingual Papillae

*4 Types:*

*1- Filiform Papillae*

*2- Fungiform Papillae*

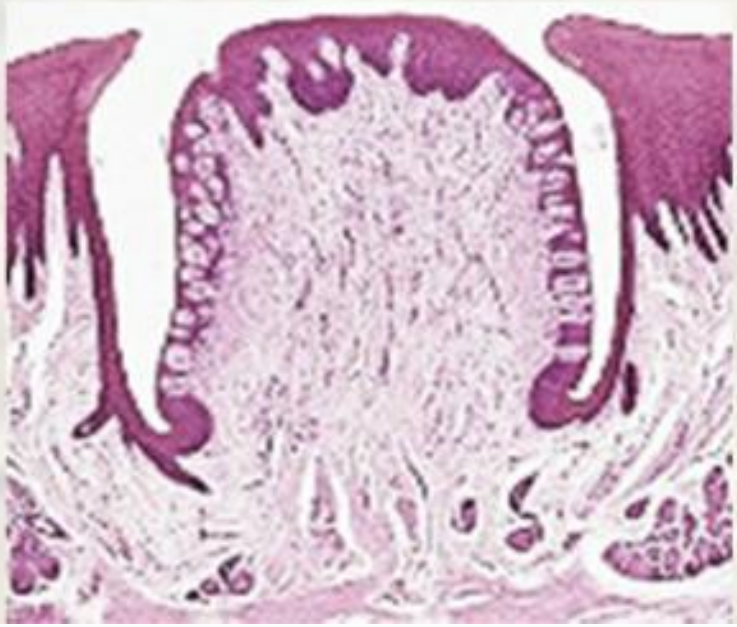


*3- Circumvallate Papillae*

*4- Foliate Papillae*

# Taste buds

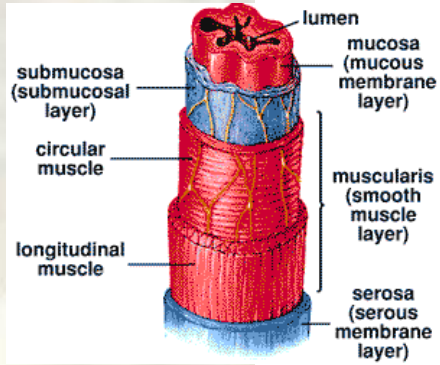
- Onion-shaped structures embedded in the surface of the *fungiform* and *circumvallate* papillae.



# General Structure of the Digestive Tract

The wall of digestive tube is composed of 4 layers *(from inner to outer):*

1) *Mucosa.*
   - epithelium overlying a CT. corium (lamina propria), followed by *muscularis mucosa*
2) *Submucosa.*
   - CT. of variable thickness ± glands
3) *Musculosa (or musculosa externa).*
   - *usually :* inner circular and outer longitudinal layers
4) *Adventitia (or serosa).*
   - outer layer of connective tissue. If it have a peritoneal covering it is called "serosa"



# The Esophagus

- Muscular tube, about 25 cm in length.
- Transports food from the mouth to the stomach and prevent its reflux
- Controlled via reflexes by the autonomic nervous system.
- Consists of the typical 4 layers: mucosa, submucosa, musculosa and adventitia "or serosa".

**1) Mucosa**

- Epithelium: Stratified squamous non-keratinized, contain Langerhans cells (APCs).
- C.T. Corium: contain mucus glands near the stomach called the *cardiac glands*.
- Muscularis Mucosa: longitudinal s. muscles become thicker near the stomach (act as a sphincter).

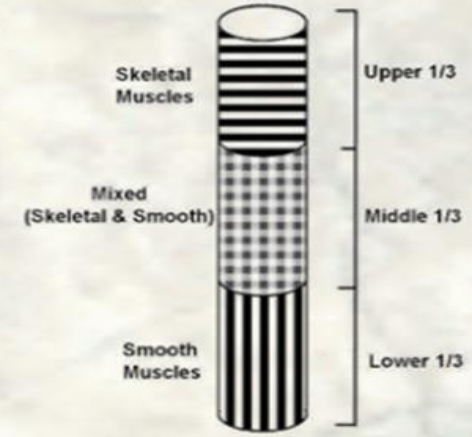
**2) Submucosa**

- Dense fibro elastic C.T.
- Contain *esophageal glands* which facilitate the transport of food and protect the mucosa.

# The Esophagus

## 3) Musculosa

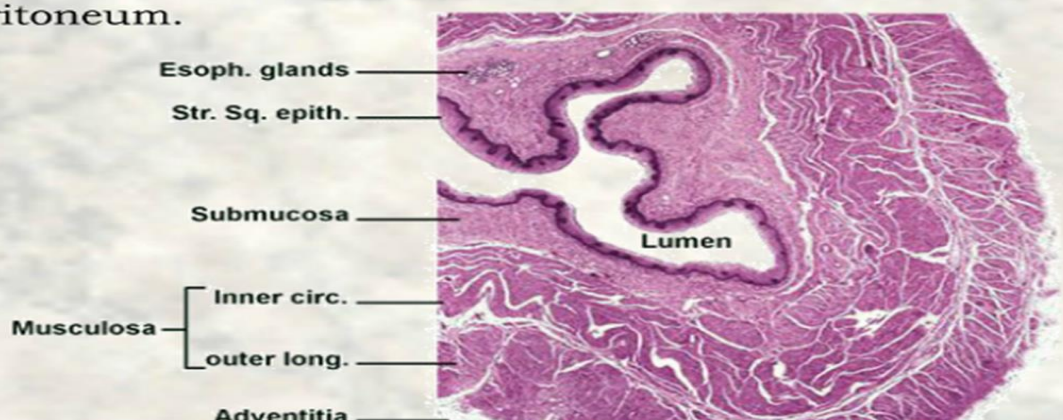
- Consists of inner circular & outer longitudinal layers with Auerbach's plexus in-between them.
- The type of muscle varies according to each region as follows:

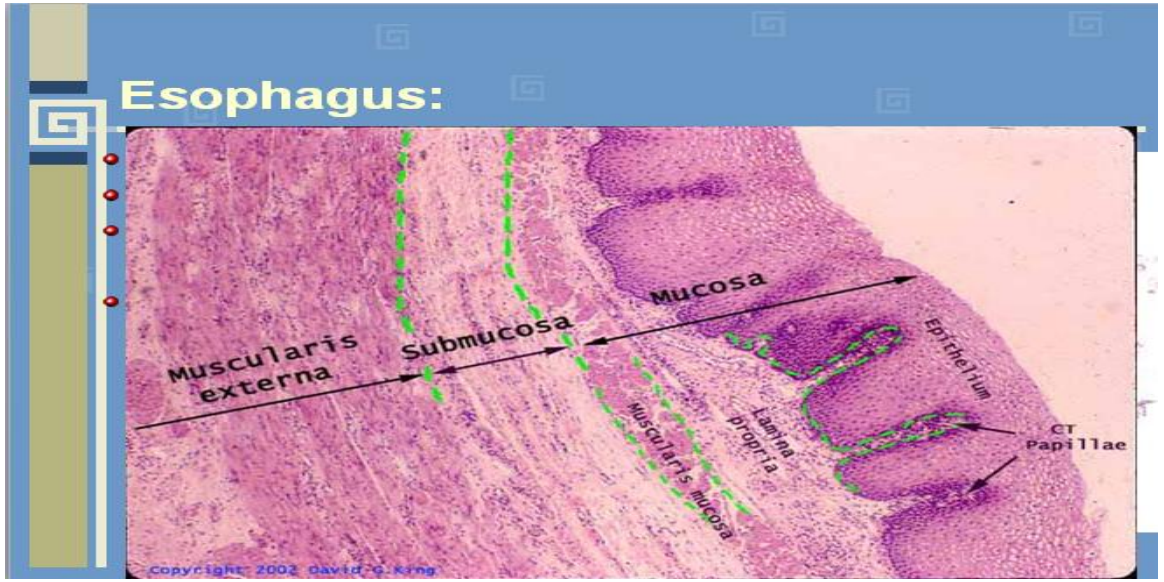
| | |
|---|---|
| **The upper third → skeletal m.** |  |
| **The middle third → mixed (skeletal and smooth m.)** | |
| **The lower third → smooth m.** | |

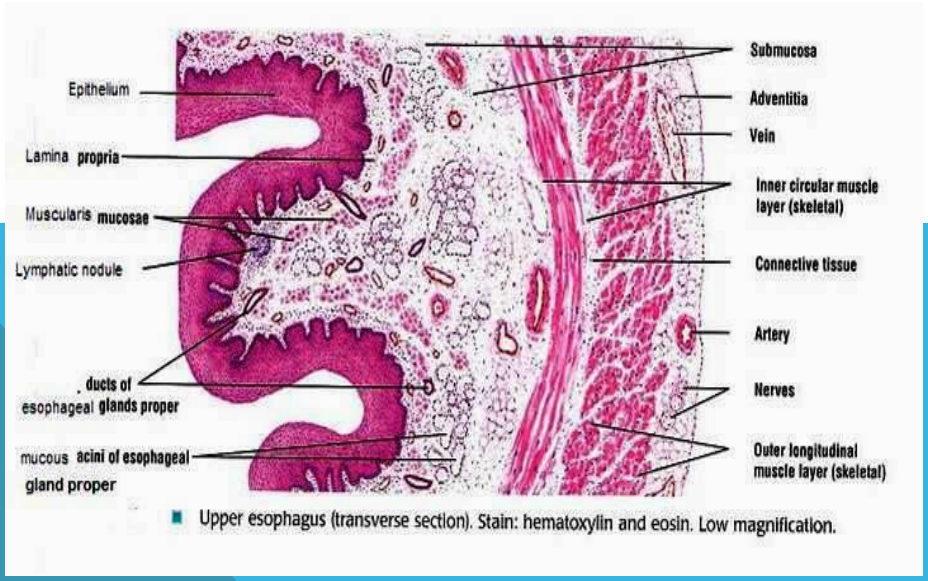


## 4) Adventitia "or Serosa"

- In the thoracic cavity it is the outer layer of connective tissue, below the diaphragm it is called "serosa" being covered by the peritoneum.





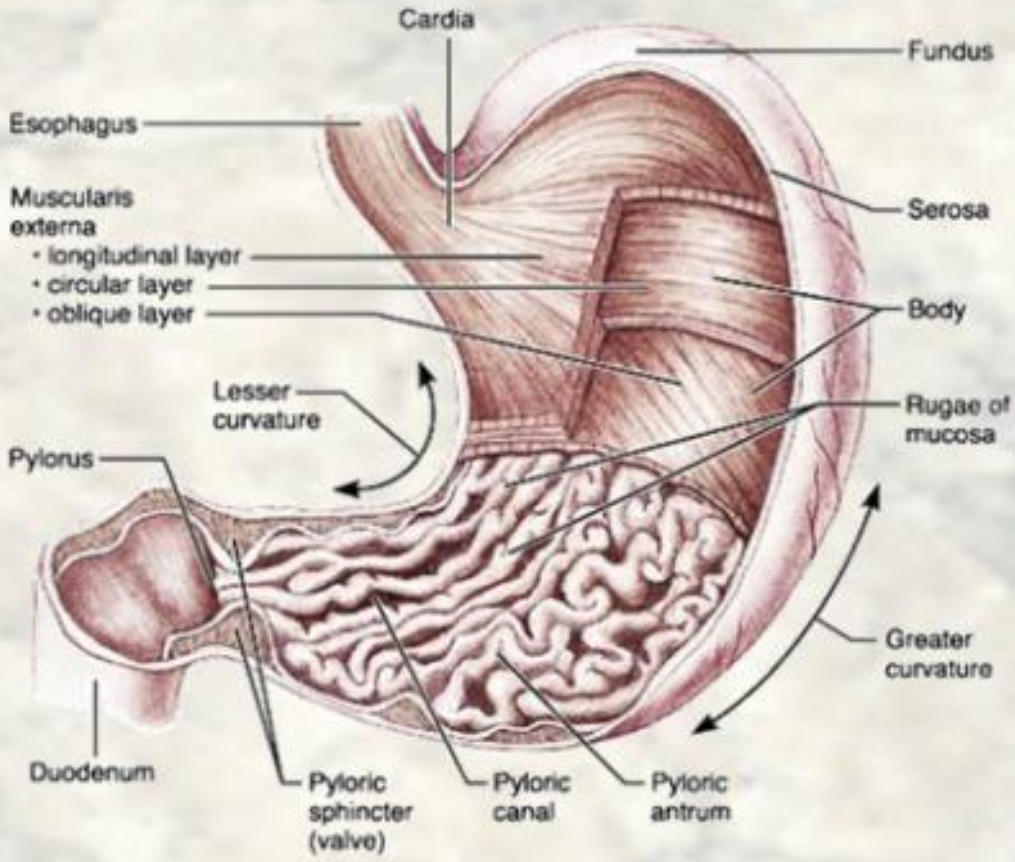

Upper esophagus (transverse section). Stain: hematoxylin and eosin. Low magnification.

# The Gastro-Esophageal Junction

- The stratified squamous epithelium of the esophagus suddenly changes to simple columnar in the stomach.
- The gastric pits start to appear.
- In the submucosa, the esophageal glands disappear.

# The Stomach

- The stomach, is a mixed exocrine & endocrine organ.
- Secretes hormones.
- It digests carbohydrates, proteins and triglycerides.



# The Gastric Mucosa

- It is covered with simple columnar epithelium that reach lamina propria, forming gastric pits.
- The covering epithelium secretes alkaline mucus (protective).
- Gastric glands are simple branched tubular, releasing their secretions into the gastric pits.
- It exhibits structural variation in 3 main regions: cardiac, fundus & body, and pyloric areas.

# The Gastric Mucosa

***1- At the Cardia***

- Narrow transition between the esophagus and the stomach.
- Its mucosa contains simple or branched tubular cardiac glands.
- Most of the secretory cells produce mucus and lysozyme (an enzyme which kills bacteria).
- Contain few parietal cells forming *HCl* in the lumen.

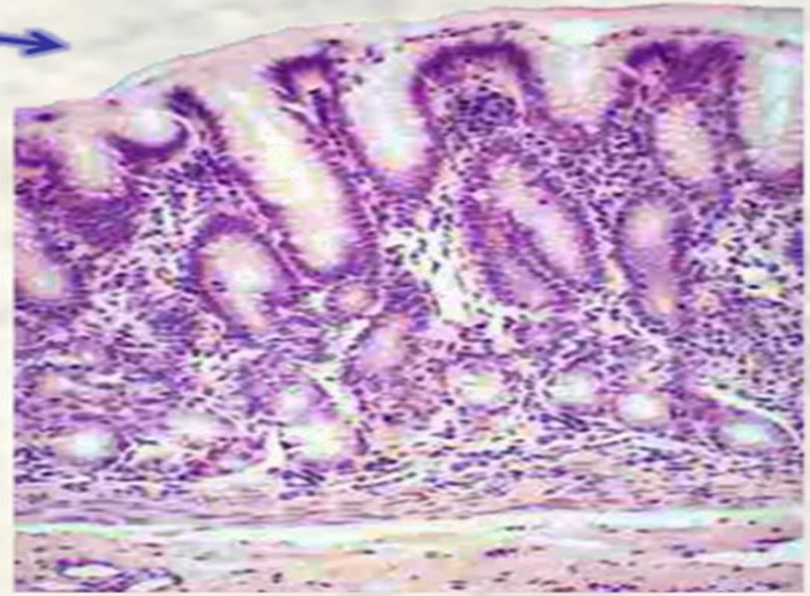
***2- At the Fundus & Body***

- The lamina propria shows branched tubular glands
- The bottom of each pit open into about 3-7 of these glands.
- Each gastric gland has 3 distinct regions: the isthmus, neck, and base

# The Gastric Mucosa

## 3- *The Pylorus*

- It has deeper gastric pits with branched, tubular pyloric glands.
- Glands have longer pits and shorter coiled secretory parts.
- These glands secrete mucus + lysozyme.



- Contains enteroendocrine cells called Gastrin (G) cells found among the mucous cells of pyloric glands.
- Enteroendocrine cells also include the (D cells) which secrete somatostatin
- Somatostatin secretion is stimulated by HCl.

# II- Gastric Submucosa

- The submucosa is composed of dense connective tissue containing blood and lymph vessels; it is infiltrated by lymphoid cells, macrophages, and mast cells.

# Gastric Musculosa & Serosa

## III- Musculosa

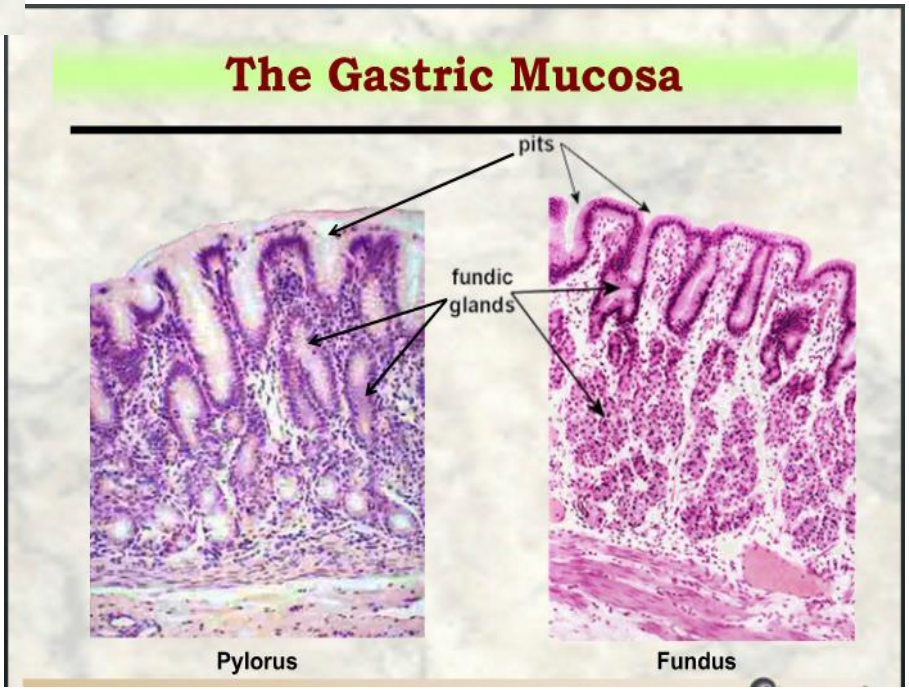
- The musculosa is composed of smooth muscle fibers oriented in three main directions: inner oblique, middle circular and outer longitudinal.
- At the pylorus, the middle layer is greatly thickened to form the pyloric sphincter.

## IV- Serosa

- This is a thin layer of CT protected by peritoneal covering.

## The Gastro-Esophageal Junction


## The Gastric Mucosa



# Small Intestine

The small intestine is a hollow organ of small diameter that is typically 6 to 7 m long. It is the major site for the absorption of nutrients. Important features of the small intestine are villi and microvilli, which increase surface area for absorption.

Each villus has a core of loose connective tissue that extends from the lamina propria and contains fibroblasts, smooth muscle fibers, lymphocytes and plasma cells, fenestrated capillaries, and a central lymphatic called a lacteal. Intestinal glands called glands (crypts) of Lieberkühn are located in the lamina propria of the small intestine. Villi project into the lumen of the intestine; the glands of Lieberkuhn open into the mucosa at the base of the villi.

Epithelial of small intestine are tall columnar cells, each with an oval nucleus located basally. The apical end of each enterocyte displays a prominent ordered region called the striated (or brush) border

Goblet cells are interspersed among the absorptive enterocytes.They secrete glycoprotein mucins that are then hydrated to form mucus, whose main function is to protect and lubricate the lining of the intestine.

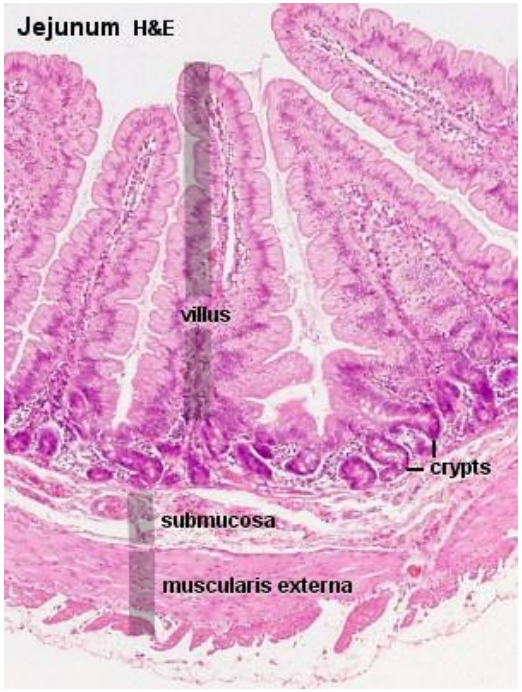
# Parts of small Intestin

**The duodenum** is the shortest segment of the small intestine, about 20 to 25 cm long. It has small openings called **duodenal papillae** , which allow pancreatic juice and bile to enter the digestive tract. It has a similar general structure to other parts of the small intestine . However, the **Brunner glands** (mucus secreting gland) in the submucosa are a unique feature of the duodenum

.

**2. The jejunum** is much longer than the duodenum, about 2.5 m long (two fifths of the rest of the small intestine). It has long villi and a somewhat increased number of goblet cells. It has neither Brunner glands nor Peyer patches.

**3. The ileum** is the longest segment, about 4 m long (three fifths of the rest of the small intestine). It has short villi with signify cantly increased numbers of goblet cells on the surface of the mucosa. There are clusters of lymphatic nodules in the lamina propria of the ileum; sometimes these lymphatic nodules extend into the submucosal layer. These clusters of lymphatic nodules are called **Peyer patches** and are unique to the ileum.


Jejunum H&E
villus
crypts
submucosa
muscularis externa

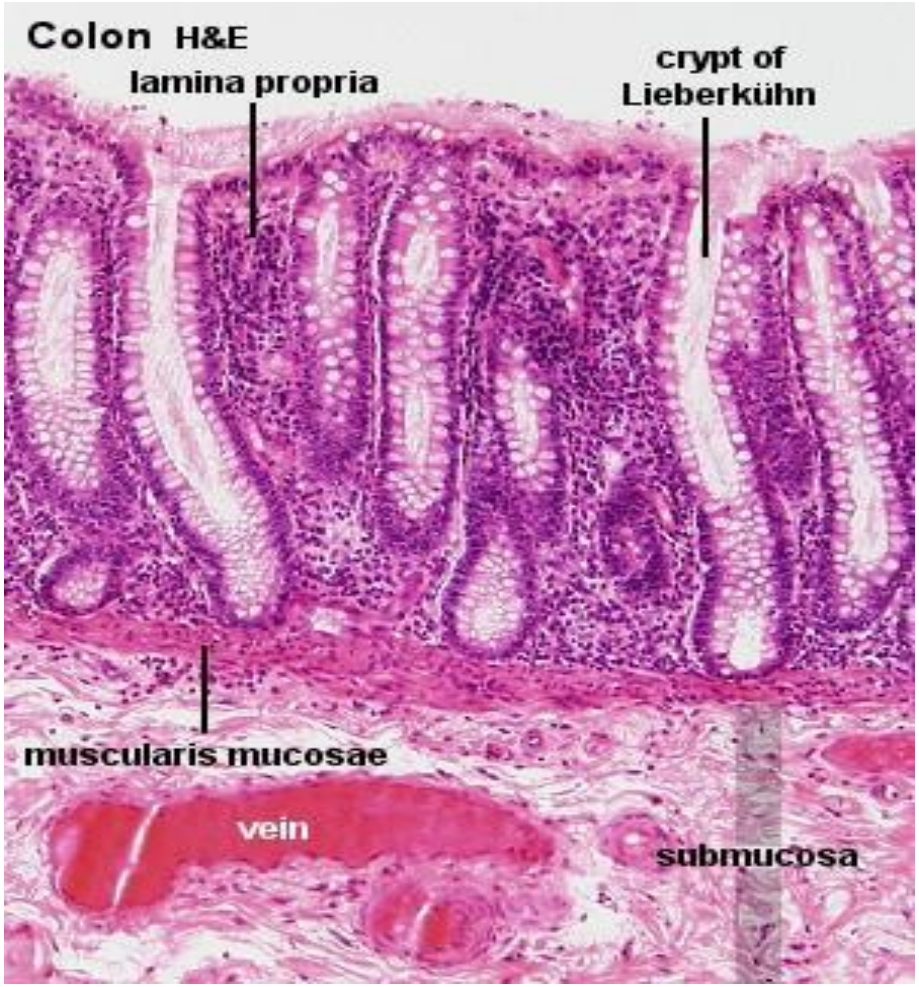

Peyer's Patch H&E
domes
villi
lymph follicle
germinal center
muscularis externa

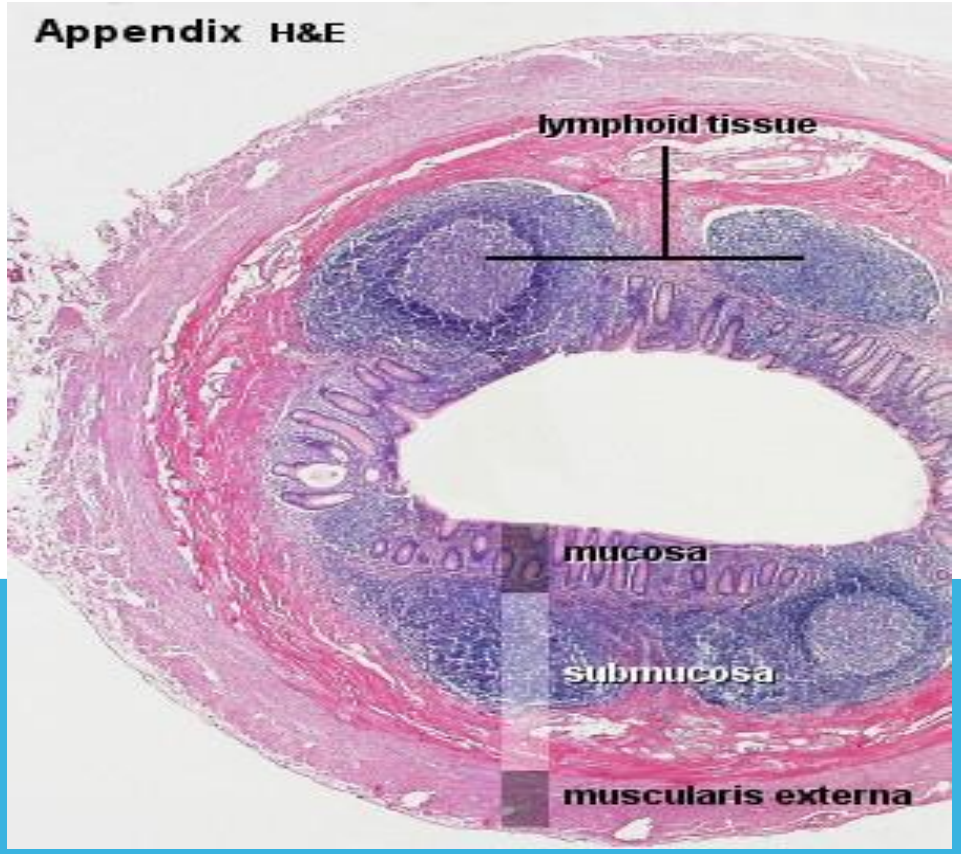
# Large Intestine

The large intestine or bowel, which absorbs water and electrolytes and forms indigestible material into feces, has the following regions: the short cecum, with the ileocecal valve and the appendix; the ascending, transverse, descending, and sigmoid colon; and the rectum, where feces is stored prior to evacuation

The mucosa lacks villi and except in the rectum has no major folds. Less than one-third as long as the small intestine, the large intestine has a greater diameter (6-7 cm). The mucosa of the large bowel is penetrated throughout its length by tubular intestinal glands. These and the intestinal lumen are lined by goblet and absorptive cells, with a small number of enteroendocrine cells . The columnar absorptive cells or colonocytes have irregular microvilli and dilated intercellular spaces indicating active fluid absorption .

Goblet cells producing lubricating mucus become more numerous along the length
The lamina propria is rich in lymphoid cells and in lymphoid nodules that frequently extend into the submucosa
The muscularis of the colon has longitudinal and circular layers but differs from that of the small intestine, with fibers of the outer layer gathered in three separate longitudinal bands called teniae coli . Intraperitoneal portions of the colon are covered by serosa,
The distal end of the GI tract is the anal canal, 3-4 cm long. At the rectoanal junction the simple columnar mucosal lining of the rectum is replaced by stratified squamous epithelium . The mucosa and submucosa of the anal canal form several longitudinal folds, the anal columns , in which the lamina propria and submucosa include sinuses of the rectal venous plexus


Colon H&E
lamina propria
crypt of Lieberkühn
muscularis mucosae
vein
submucosa


Appendix H&E
lymphoid tissue
mucosa
submucosa
muscularis externa

Histology:1st stage
Department of clinical laboratory science
Dr . Nahidah Ibrahim

# *Endocrine System*

The **endocrine system** produces various secretions called **hormones**. to set in motion] that release for delivery to the bloodstream for transport to target cells and organs, serve as effectors to regulate the activities of various cells, tissues, and organs in the body.

## Functions

Its functions are essential in maintaining homeostasis and coordinating body growth and development and are similar to that of the nervous system: Both communicate information to peripheral cells and organs.

- **The endocrine system** including **endocrine Glands (pituitary gland & hypothalamus, thyroid gl., adrenal gl. ,pineal gl. ,parathyroid gl.)**
- as well as **individual cells** within the gonads, liver, pancreas, kidney, and gastrointestinal system.

# *Pituitary Gland(Hypophisis):*

The **pituitary gland** and the **hypothalamus**, the portion of the brain to which the pituitary gland is attached, are morphologically and functionally linked in the endocrine and neuroendocrine control of other endocrine glands.

The **pituitary gland** is a pea-sized, compound endocrine gland .
It is centrally located at the base of the brain, where it lies in a depression of the sphenoid bone .A short stalk, the **infundibulum**, and a vascular network connect the pituitary gland to the hypothalamus.

- **Anterior lobe (adenohypophysis), the glandular epithelial tissue.**
- **• Posterior lobe (neurohypophysis), the neural secretory tissue .**
- **These two portions** are of different embryologic origin.

The anterior lobe of the pituitary gland is derived from an evagination of the **ectoderm of the oropharynx** toward the brain **(Rathke's pouch)**.

- The posterior lobe of the pituitary gland is derived from a downgrowth (the future infundibulum) of **neuroectoderm of the floor of the third ventricle** of the developing brain .
- The **anterior lobe of the pituitary gland** consists of three derivatives of Rathke's pouch:
- **Pars distalis**, which comprises the bulk of the anterior lobe of the pituitary gland and arises from the thickened anterior wall of the pouch .
- **Pars intermedia**, a thin remnant of the posterior wall of the pouch that abuts the pars distalis.
- **Pars tuberalis**, which develops from the thickened lateral walls of the pouch and forms a collar or sheath around the infundibulum.
- The **posterior lobe of the pituitary gland** consists of the following:
- o **Pars nervosa**, which contains neurosecretory axons and their endings.
- o **Infundibulum**, which is continuous with the: **median eminence** and contains the neurosecretory axons forming the **hypothalamohypophyseal tracts .**

# *Structure and Function of the Pituitary Gland*

- ***Anterior Lobe of the Pituitary Gland (Adenohypophysis)***
- **The anterior lobe of the pituitary gland regulates other endocrine glands .**
- Most of the **anterior lobe of the pituitary gland** has the typical organization ofendocrine tissue.
- The cells are organized in clumps and cords separated by fenestrated sinusoidal capillaries of relatively large diameter.
- These cells respond to signals from the hypothalamus and synthesize and secrete
- a number of pituitary hormones .
- Four hormones of the anterior lobe—
- **adrenocorticotropic hormone (ACTH),**
- **thyroidstimulating (thyrotropic) hormone (TSH, thyrotropin),**
- **follicle stimulating**
- **hormone (FSH)**, and **luteinizing hormone (LH)**—because they regulate the activity of cells in other endocrine
- glands throughout the body.
- The two remaining hormones of the anterior lobe, **growth hormone (GH)** and
- **prolactin (PRL)**, are not considered tropic because they act directly on target
- organs that are not endocrine.

***Pars Distalis .***

The cells within the **pars distalis** vary in size, shape, and staining properties.
The cells are arranged in cords and nests with interweaving capillaries.
Histologists identified three types of cells according to their staining reaction, namely, **basophils (10%)**, **acidophils (40%)**, and **chromophobes (50%)**

## Cells of Pars Distalis

| Cell | Staining | % | Hormone | Action |
|---|---|---|---|---|
| ***Somatotrophs*** | Acidophilic | 50 | Somatotropin (growth hormone) | growth of long bones. |
| ***Mammotrophs*** | Acidophilic | 15–20 | Prolactin (PRL) | Promotes milk secretion |
| ***Gonadotrophs*** | Basophilic | 10 | FSH & LH | -FSH promotes ovarian follicle in women and spermatogenesis in men.<br>-LH promotes ovulation in women, interstitial cell androgen secretion in men. |
| ***Thyrotrophs*** | Basophilic | 5 | TSH | thyroid hormone: synthesis, storage & release |
| ***Corticotrophs*** | Basophilic | 15–20 | Adrenal corticotropin (ACTH) | Stimulates the adrenal cortex. |
| | | | Lipotrophins | Lipid metabolism regulation |

***Five functional cell types are identified in the pars distalis on the basis of immunocytochemical reactions***

***Pars Intermedia.***

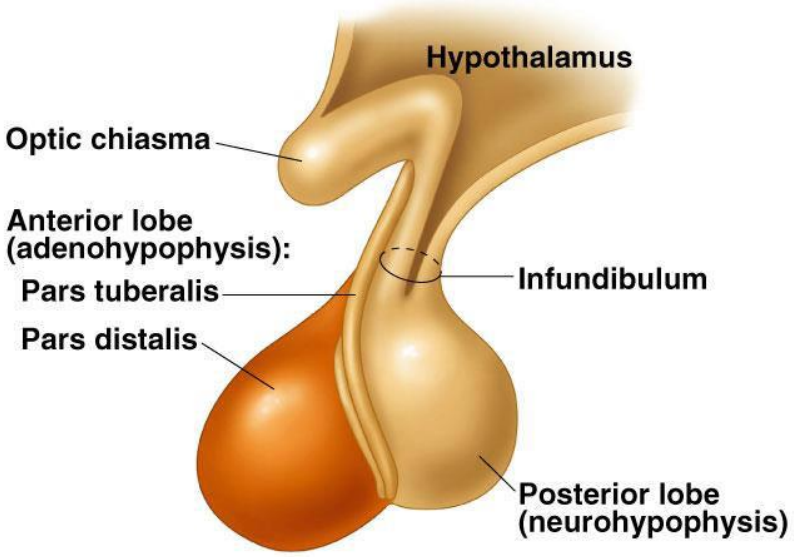
The **pars intermedia** surrounds a series of small cystic cavities that represent the residual lumen of Rathke's pouch .The parenchymal cells of the pars intermedia surround colloid-filled follicles. The cells lining these follicles appear to be derived either from folliculo-stellate cells or various hormone-secreting cells,
pars intermedia have vesicles larger than those found in the pars distalis.. The pars intermedia contains **basophils** and **chromophobes .** Frequently, the basophils and cystic cavities extend into the pars nervosa.

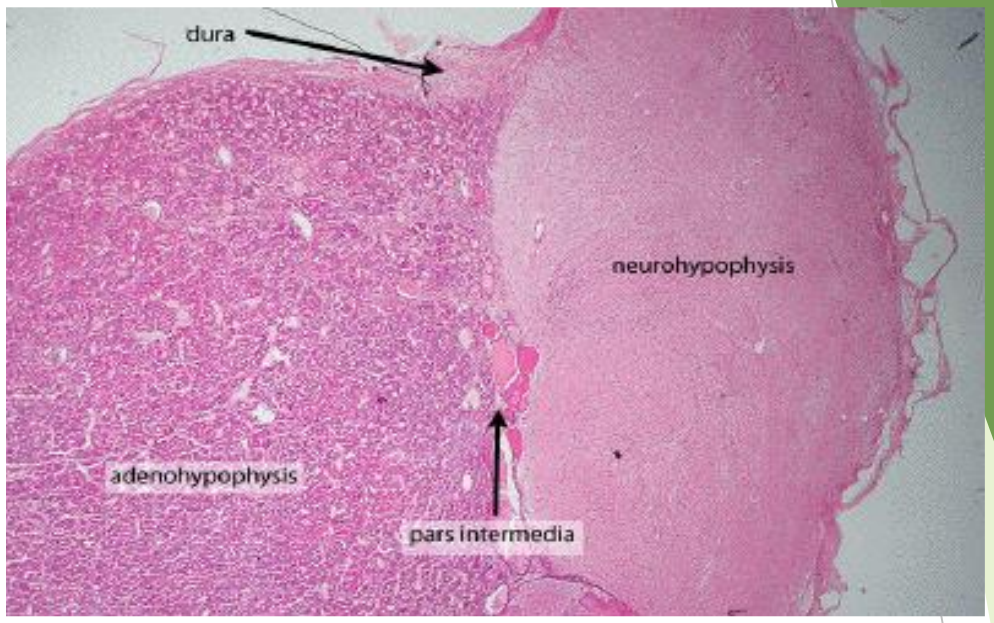
- ***Pars Tuberalis.***
- The **pars tuberalis** is an extension of the anterior lobe along the stalk like infundibulum.
- It is a highly vascular region containing veins of the hypothalamohypophyseal
- system. The parenchymal cells are arranged in small clusters or cords in
- association with the blood vessels.
- Nests of squamous cells and small follicles lined with cuboidal cells are
- scattered in this region. These cells often show immunoreactivity for ACTH,
- FSH, and LH.

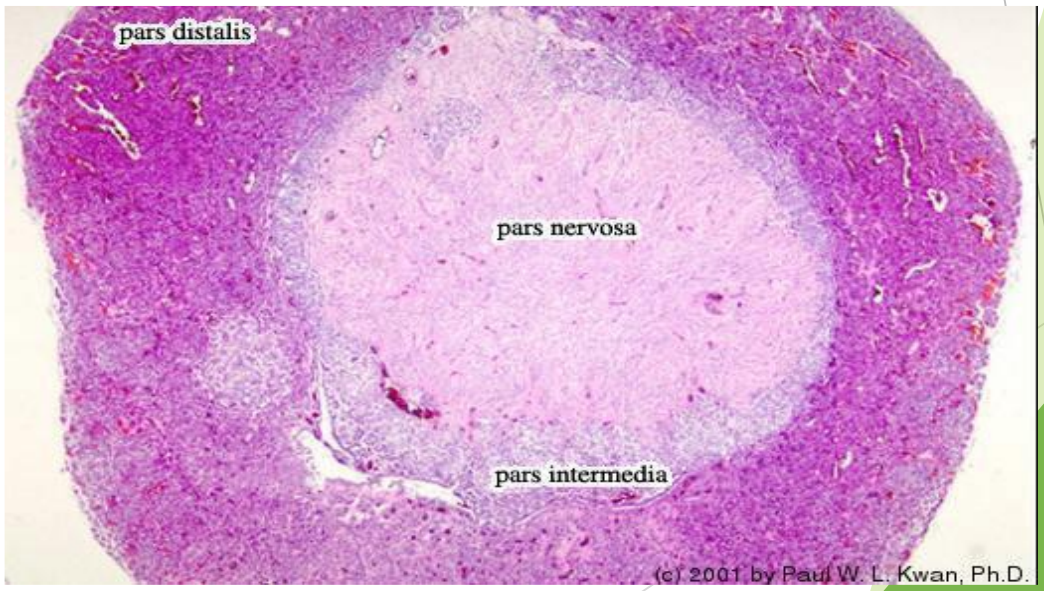
- ***Posterior Lobe of the Pituitary Gland***
- ***(Neurohypophysis)***
- **The posterior lobe of the pituitary gland is an extension of the central**
- **nervous system (CNS) that stores and releases secretory products from the**
- **hypothalamus** , consists of the **pars nervosa** , the **infundibulum& median**
- **eminance** that connects it to the hypothalamus***).***
- The pars nervosa, contains the unmyelinated axons and their nerve endings of
- approximately 100,000 **neurosecretory neurons** whose cell bodies lie in the
- **supraoptic nuclei** and **paraventricular nuclei** of the hypothalamus.
- The axons form the **hypothalamohypophyseal** tract and are unique in two respects:
- ***First,*** they do not terminate on other neurons or target cells but end in close proximity to the fenestrated capillary network of the pars nervosa.
- ***Second***, they contain secretory vesicles in all parts of the cells, i.e., the cell body, axon, and axon terminal.
- There are neurosecretory vesicles in the nerve endings of the pars nervosa, aggregate to form Herring bodies that contain either oxytocin or antidiuretic hormone (ADH; also called vasopressin).
- □ Oxytocin promotes contraction of smooth muscle of the uterus and myoepithelial cells of the breast.
- The pituicyte is the only cell specific to the posterior lobe of the pituitary gland , Because of their many processes and relationships to the blood, the pituicyte serves a supporting role similar to that of astrocytes in the rest of the CNS.

# Pituitary gland





# FUNCTIONAL CORRELATIONS: CELLS AND HORMONES OF THE ADENOHYPOPHYSIS

- 1- Acidophils:
- Somatotrophs secrete somatotropin, also called growth hormone or GH.
- Mammotrophs produce the lactogenic hormone prolactin that stimulates development of mammary glands during pregnancy.
- 2- BASOPHILS
- Thyrotrophs secrete thyroid-stimulating hormone (thyrotropin, or TSH).TSH stimulates synthesis and secretion of the hormones thyroxin an triiodothyronine from the thyroid gland.
- Gonadotrophs secrete follicle-stimulating hormone (FSH) and luteinizing hormone (LH).
- Corticotrophs secrete adrenocorticotropic
- hormone (ACTH). ACTH influences the function of the cells in adrenal cortex.

Hormone of PARS INTERMEDIA

melanocyte-stimulating hormone (MSH). MSH increases skin pigmentation by causing dispersion of melanin granules.

The two hormones, oxytocin and antidiuretic hormone (ADH), that are released from the neurohypophysis are synthesized in the hypothalamus.Release of oxytocin is stimulated by vaginal and cervical distension before birth

# THYROID GLAND

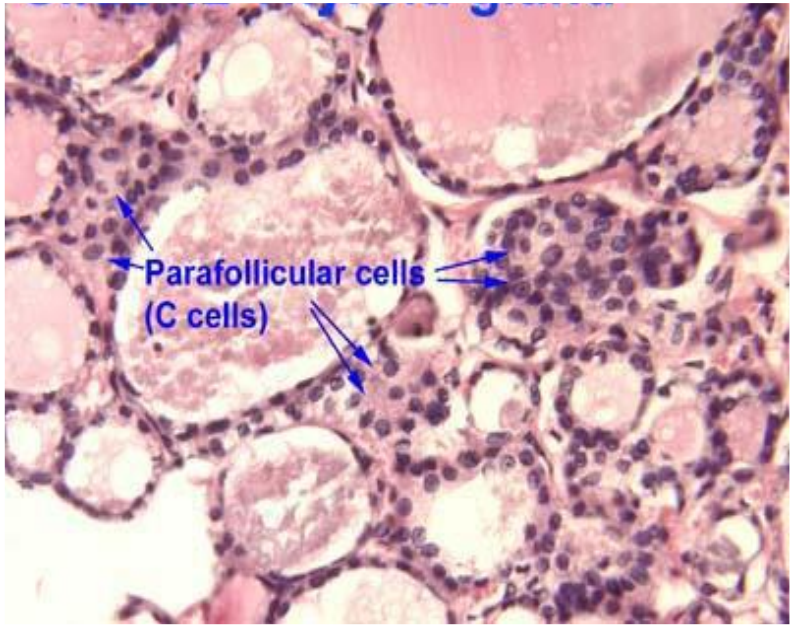
- Is located in the anterior neck inferior to the larynx. It is a single gland that consists of large right and left lobes, connected in the middle by an
- isthmus. Most endocrine cells, tissues, or organs are arranged in cords or clumps, and store their secretory products within their cytoplasm. The
- thyroid gland is a unique endocrine organ in that its cells are arranged into spherical structures, called follicles.

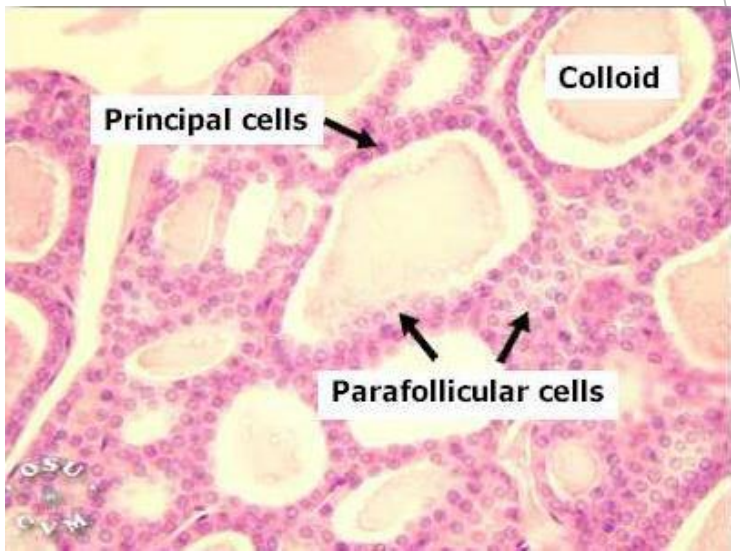
Structure of Adrenal gland

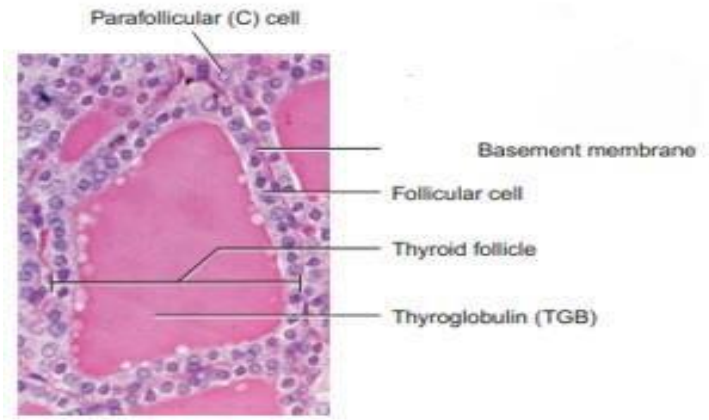
- Each follicle is surrounded by reticular fibers and a network of capillaries that allows for easy entrance of thyroid hormones into the bloodstream. The follicular epithelium can be simple squamous, cuboidal, or low columnar, depending on the state of activity of the thyroid gland. Follicles are the structural and functional units of the thyroid gland. The cells that surround the follicles, the follicular cells, also called principal cells, synthesize, release, and store their product outside of their cytoplasm, or extracellularly, in the lumen of the follicles as a gelatinous substance, called colloid.

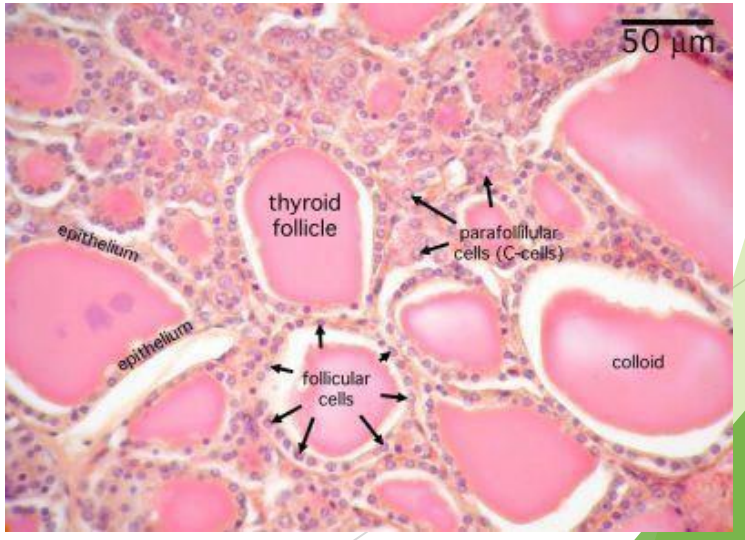
- Colloid is composed of thyroglobulin, an iodinated glycoprotein that is the inactive storage form of the thyroid hormones.
- In addition to follicular cells, the thyroid gland also contains larger, pale-staining parafollicular
- cells. These cells are found either peripherally in the follicular epithelium or within the follicle. When parafollicular cells are located in the confines of a follicle, they are always separated from the follicular lumen by neighboring follicular cells.

# THYROID GLAND



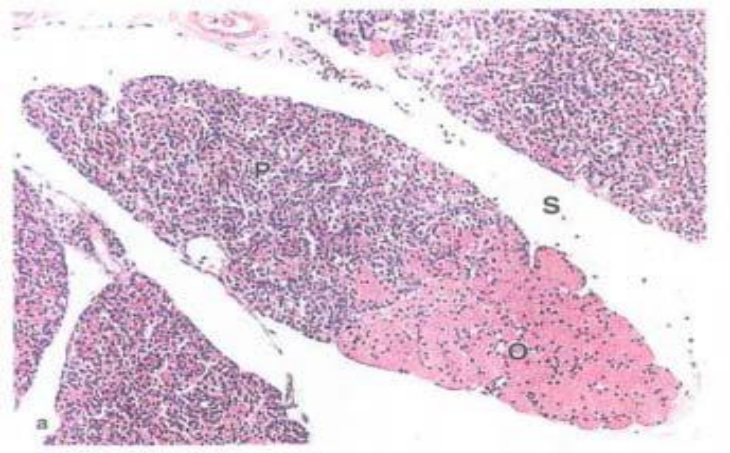



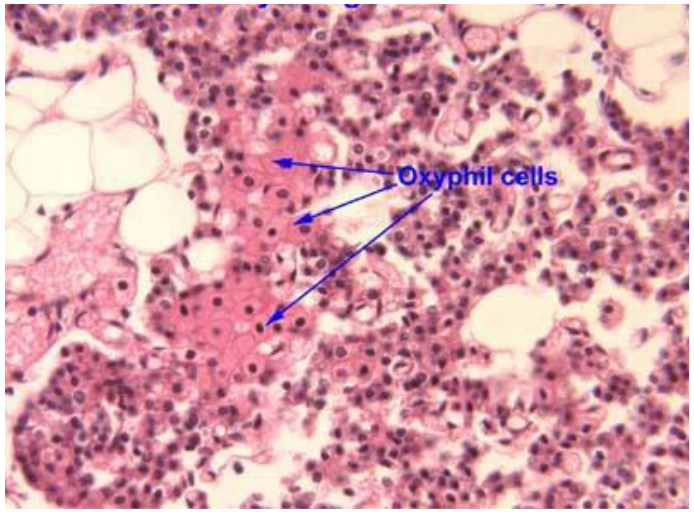
# FORMATION OF THYROID HORMONES

- Thyroid-stimulating hormone (TSH) released from the adenohypophysis. Iodide is an essential element for production of the active thyroid
- hormones triiodothyronine (T3) and tetraiodothyronine or thyroxine (T4) that are
- Relea sed into the bloodstream by the thyroid gland.

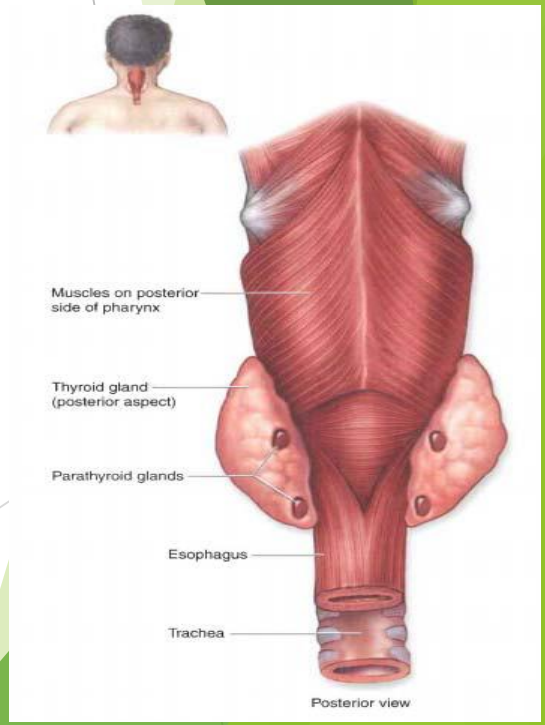
- In response to TSH stimulus, the follicular cells take up iodide from the
- circulation . T3 and T4 remain in thyroid follicles in an inactive form until needed. TSH released from the adenohypophysis stimulates the thyroid
- gland cells to release the thyroid hormones into the bloodstream.

- PARATHYROID GLANDS :
- Mammals generally have four parathyroid glands. These small oval glands are situated on the posterior surface of the thyroid gland, but separated from the thyroid gland by a thin connective tissue capsule. In contrast to the thyroid gland, cells of the parathyroid glands are arranged into cords or clumps, surrounded by arich network of capillaries.
- There are two types of cells in the parathyroid glands: functional principal or chief cells and oxyphil cells. Oxyphil cells are larger, are found singly or in small groups, and are less numerous than the chief cells. In routine histologic sections, these cells stain deeply acidophilic. On rare occasions, small colloid-filled follicles may be seen in the parathyroid glands.



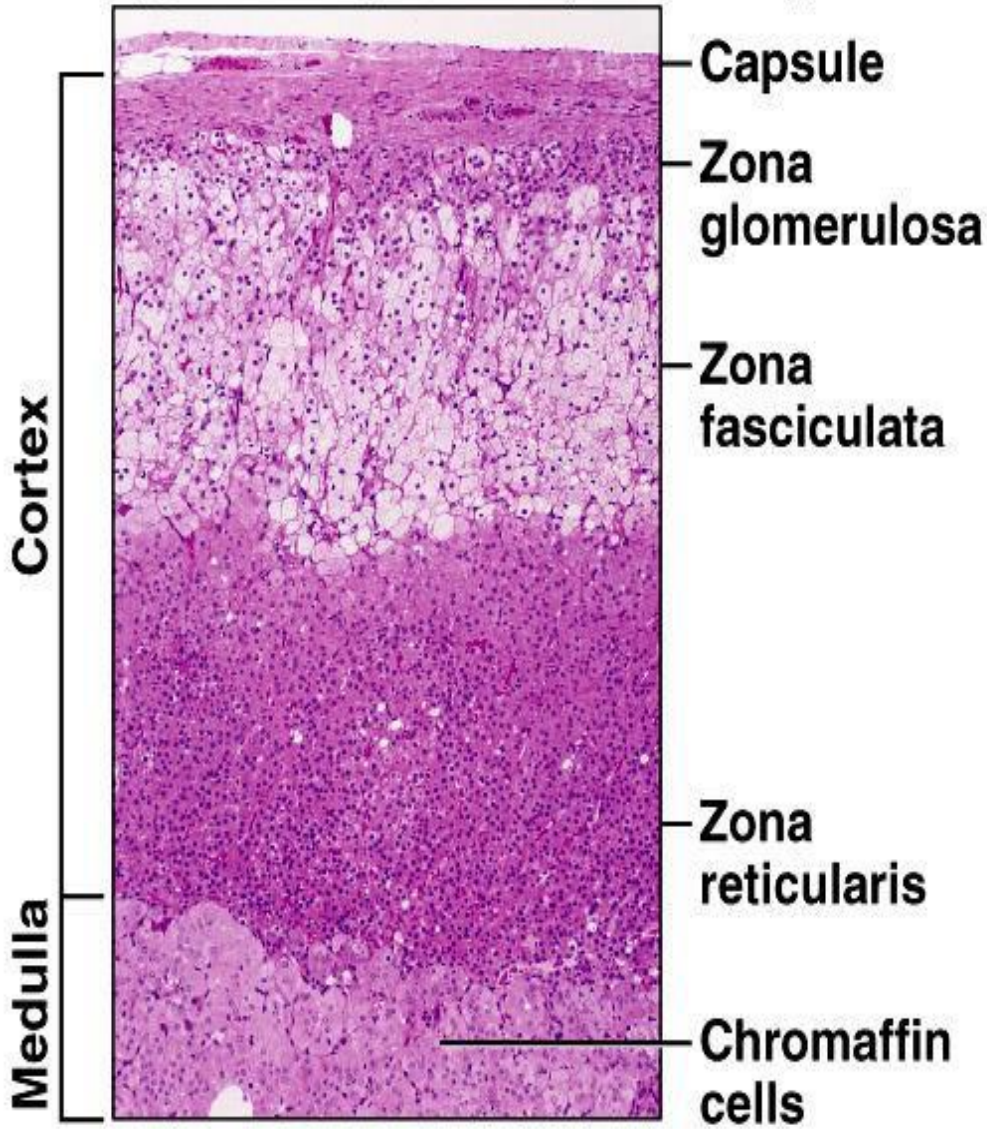




Parathyroid principal cells. (a): A small lobe of parathyroid gland surrounded by connective tissue septa (s), shows mainly densely packed cords of small principal cells (P), also called chief cells, oxyphil cells (O), ( b): The micrograph shows that principal cells are slightly eosinophilic present in cords



# ADRENAL (SUPRARENAL) GLANDS :

- The adrenal glands are endocrine organs  situated near the superior pole of each kidney. Each adrenal gland is surrounded by a dense irregular connective tissue capsule and embedded in the adipose tissue around the kidneys. Each adrenal gland consists of :
- -- outer cortex
- - inner medulla.
- The adrenal cortex exhibits three concentriczones:
- - zona glomerulosa,
- - zona fasciculata,
- - zona reticularis.
- The zona glomerulosa is a thin zone inferior to the adrenal gland capsule. It consists of cells
- arranged in small clumps.
- The zona fasciculata is intermediate and the thickest zone of the adrenal cortex.
- This zone exhibits vertical columns of one cell thickness adjacent to straight capillaries. This layer is characterized by pale-staining cells owing to the increased presence of numerous lipid droplets.
- The zona reticularis is the innermost zone that
- is adjacent to the adrenal medulla. The cells in
- this zone are arranged in cords or clumps.




- CONT
- In all three zones, the secretory cells are adjacent to fenestrated capillaries. The cells of these zones in the adrenal cortex produce
- three classes of steroid hormones:
- mineralocorticoids,
- glucocorticoids,
- sex hormones
- MEDULLA :
- The medulla lies in the center of the adrenal gland. The cells of the adrenal medulla, also
- arranged in small cords, are modified postganglionic sympathetic neurons that have lost their axons and dendrites during development. Instead, they have become secretory cells that synthesize and secrete catecholamines (primarily epinephrine and norepinephrine
- Preganglionic axons of the sympathetic neurons innervate the adrenal medulla cells, which are
- surrounded by an extensive capillary network. As result, the release of epinephrine and norepinephrine from the adrenal medulla is under direct control of the sympathetic division of the
- autonomic nervous system.

# FUNCTIONAL CORRELATIONS ADRENAL GLAND CORTEX AND MEDULLA

- Adrenal Gland Cortex:
- The adrenal gland cortex is under the
- influence of the pituitary gland hormone ACTH
- (adrenocorticotropic hormone). Cells of the
- adrenal gland cortex synthesize and release three
- types of steroids:
- mineralocorticoids,
- glucocorticoids,
- androgens.
- The cells of the zona glomerulosa in the adrenalcortex produce mineralocorticoid hormones,
- primarily aldosterone.
- Aldosterone release is initiated via the reninangiotensin
- pathway in response to decreased arterial blood pressure and low levels of sodium in the plasma.

- CONT.
- Aldosterone has a major influence on fluid and electrolyte balance in the body, with the main target being the distal convoluted tubules in the kidneys. The primary function of aldosterone is to increase sodium reabsorption from the
- glomerular filtrate by cells in the distal convoluted tubules of the kidney and increase potassium excretion into urine
- As water follows sodium, there is an increase in fluid volume in the circulation. The increased volume increases blood pressure and restores
- normal electrolyte balance. The cells of the zona fasciculata—and probably
- those of the zona reticularis—secrete glucocorticoids,of which cortisol and cortisone are
- the most important. Glucocorticoids are released into the circulation in response to stress.
- Although the cells of the zona reticularis are believed to produce sex steroids, they are mainly weak androgens and have little physiologic significance. Glucocorticoid secretion, and the secretory functions of zona fasciculata and zona reticularis, are regulated by feedback control from the pituitary gland and adrenocorticotropic hormone (ACTH).

- ADRENAL GLAND MEDULLA :

- The functions of the adrenal medulla are
- controlled by the hypothalamus through the sympathetic division of the autonomic nervous system. Cells in the adrenal medulla are activated
- in response to fear or acute emotional stress,
- causing them to release the catecholamines
- epinephrine and norepinephrine.

Histology:1st stage
Department of clinical laboratory science Dr . Nahidah Ibrahim

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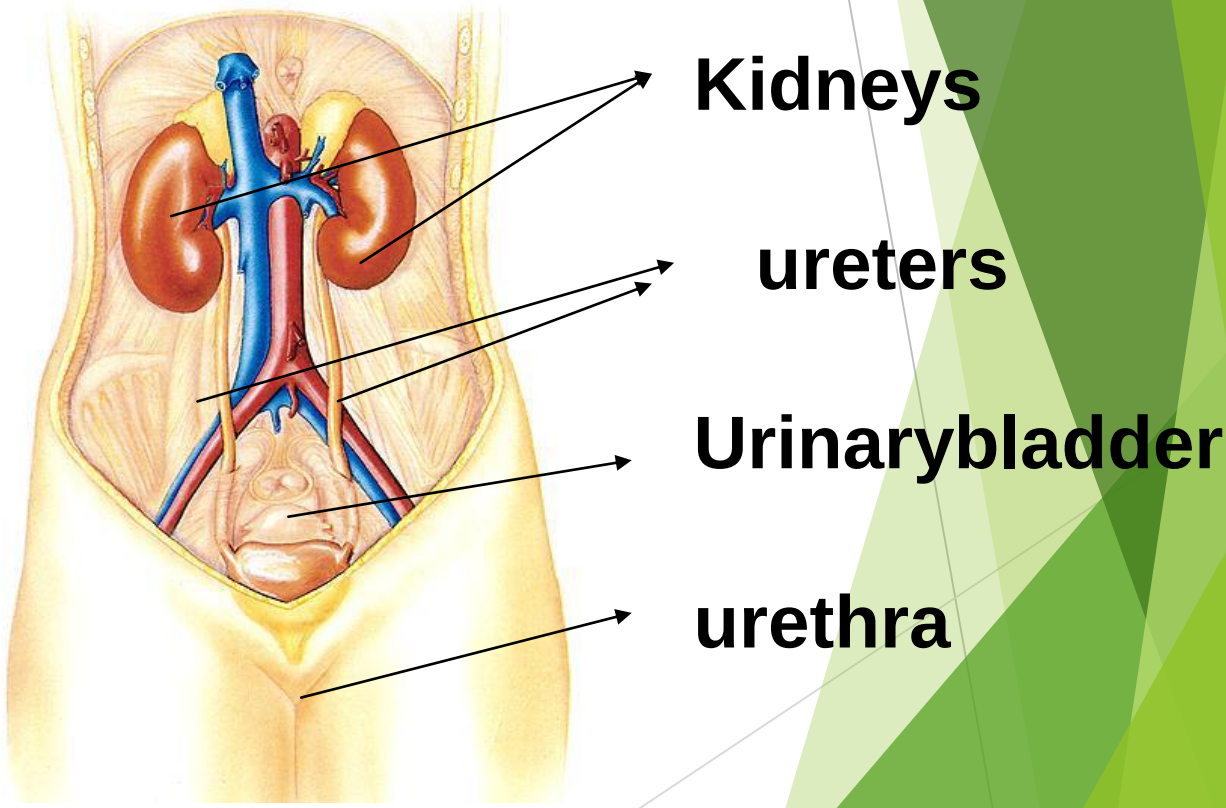
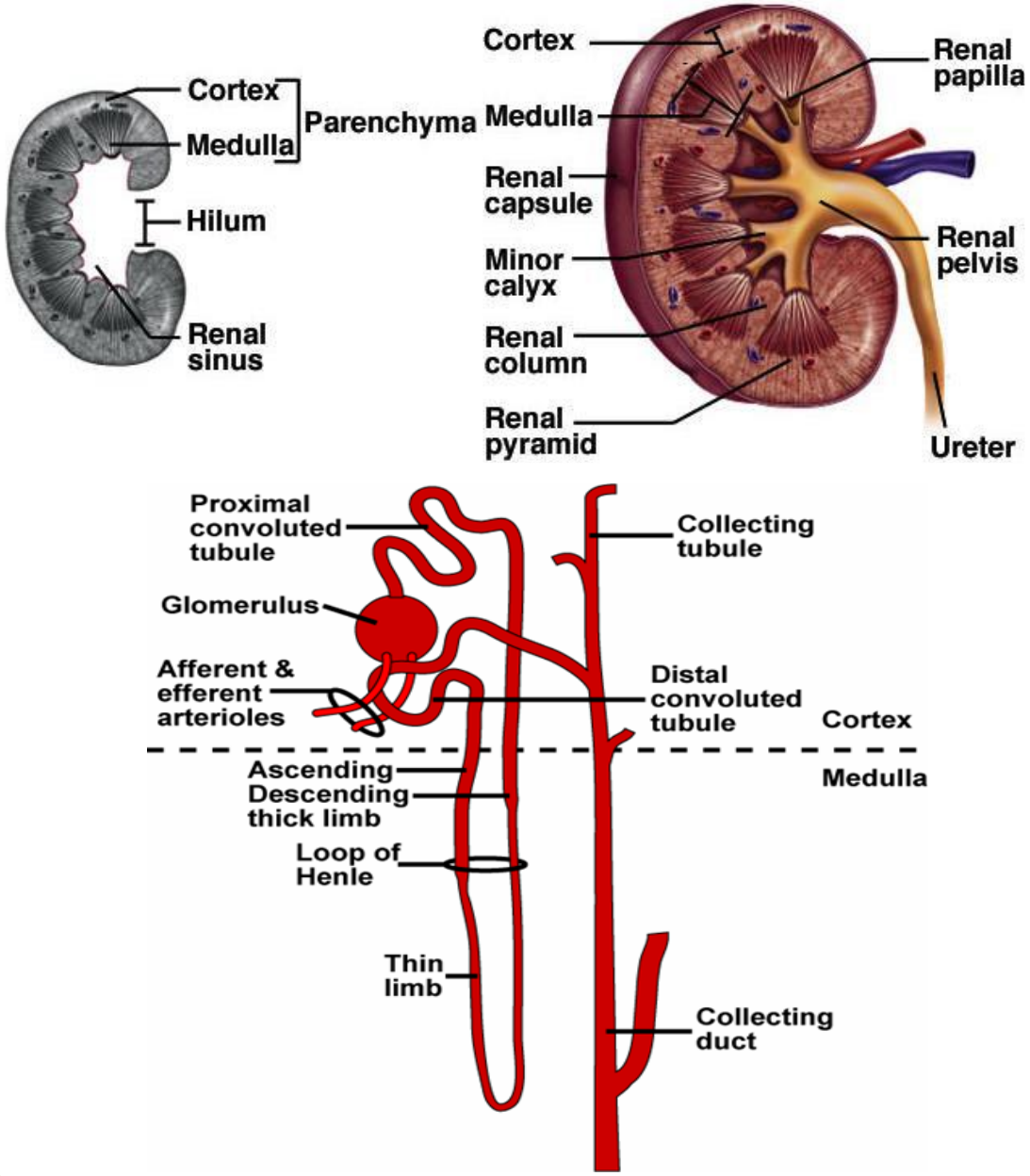
# URINARY SYSTEM

Main components of this system

- 1. Kidneys
- 2. Ureter
- 3.Urinary bladder
- 4. Urethra






# 1. KIDNEY

- Parenchyma organized into cortex and medulla Within parenchyma occur nephrones, collecting ducts, blood vessels, lymphatics and nerves
- Parenchyma organized into lobes and lobules

# Histological aspects of kidneys

- **Position**:

The kidneys located high on the posterior wall of the abdomen behind the peritoneum. The Right kidney is lowered than left due to the presence of liver. The kidneys occasionally congenitally located in the lower part of the abdomen called. Ectopia of the kidneys or Ectopic kidneys.

The size of the kidney is (5 inches) length, (3 inches) width, and (1 inch) thickness. The volume is (130-150 c.c), & the average weight (170 gram).

- **Stroma**
- •connective Tissues  capsule surrounded by fat.& reticular tissue between parenchyma .
- **Parenchyma**
- **Uriniferous tubules**:
- – **Nephron**
- **–Collecting tubule & duct**

# Kidney Functions

- •Filters blood plasma, eliminates waste, returns useful chemicals to blood
- •Regulates blood volume and pressure
- •Regulates osmolarity of body fluids
- •Secretes renin, activates angiotensin, aldosterone
- •Secretes erythropoietin, controls RBC count
- •Regulates PCO2 and acid base balance
- •Detoxifies free radicals and drugs

**Structure :**

The kidneys are solid, bean shaped organs.

The kidneys are surrounded by a “fibrous capsule” that is applied closely to its outer surface.

Outside the capsule is a covering of fat known as the”perinephric fat”.

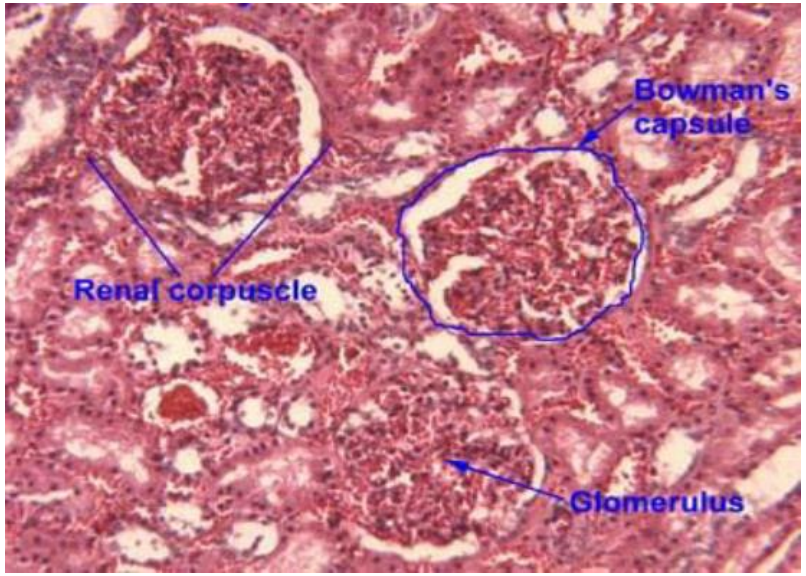
The “perinephric fascia” surrounds the perinephric fat and enclose the kidneys and suprarenal glands.

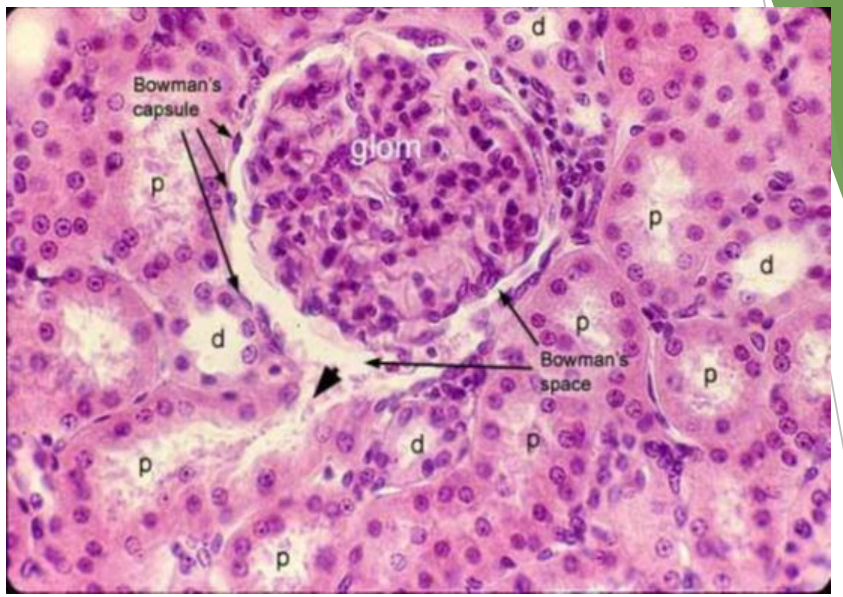
The perinephric fascia is a condensation of areolar tissue. It has a lateral convex border and a medial concave border which face the midline . The concave border show a depression called hilum through which the ureter descend, the renal vein leave, the renal artery, lymphatic vessel and nerve enter.

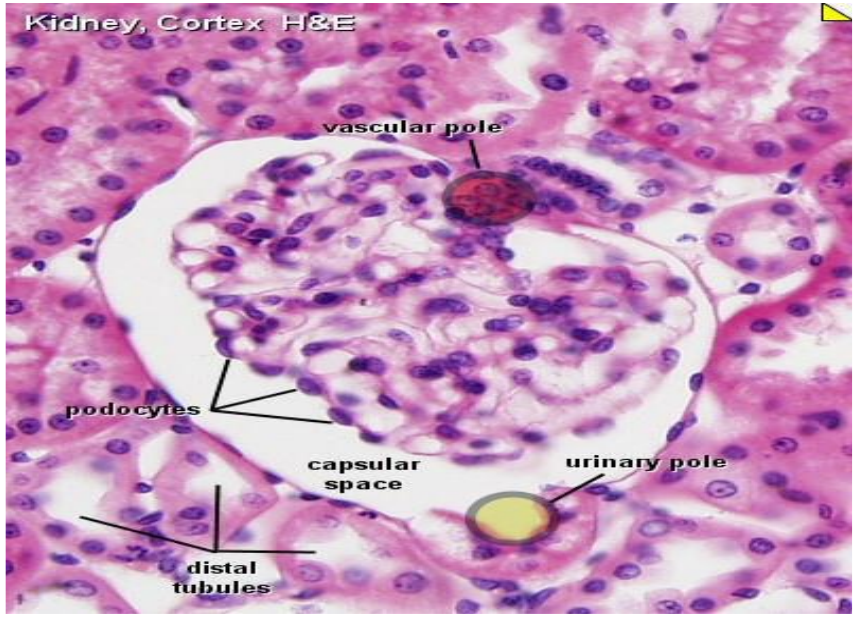
- **Uriniferous Tubules and Nephrons of the Kidney**
- The functional unit of each kidney is the
- microscopic **uriniferous tubule.** It consists of a **nephron** and a **collecting duct** into which empty
- the filtered contents of the nephron.Millions of nephrons are present in each kidney cortex.
- The nephron, is subdivided into two components,
- 1-**renal corpuscle**
- 2- **renal tubules.**
- **There are two types of nephrons.**
- **Cortical nephrons are located in the cortex of kidney .**
- **juxtamedullary nephrons are situated near the junction of the cortex and medulla of the kidney.**

- **1- Renal Corpuscle :**

- The renal corpuscle consists of a tuft of capillaries, called the **glomerulus,** surrounded by a double layer of epithelial cells, called the **glomerular Bowman's capsule.** The inner or visceral layer of the capsule consists of unique and highly modified branching epithelial cells, called **podocytes.** The podocytes are adjacent to and completely invest the glomerular capillaries. The outer layer of the glomerular capsule consists of **simple squamous epithelium.**
- The renal corpuscle is the initial segment of each nephron. Blood is filtered in renal corpuscles through the capillaries of the glomerulus, and the filtrate enters the **capsular**
- **(urinary) space** located between the parietal and visceral cell layers of the glomerular capsule.Each renal corpuscle has a **vascular pole,** where the afferent arteriole enters and the efferentarteriole leaves the corpuscle**.**
- On the opposite end of the renal corpuscle is the urinary pole. Filtrate produced by the glomerulus that enters the capsular space leaves each renal corpuscle at the urinary pole, where the proximal convoluted tubule starts. Filtration of blood in renal corpuscles is facilitated by glomerular endothelium.
- The endothelium in glomerular capillaries is porous (fenestrated) and highly permeable to many substances in the blood, except to the formed blood elements or plasma proteins. Thus, glomerular filtrate that enters the capsular space is not urine. Instead, it is an ultrafiltrate that is similar to plasma, except for the absence of proteins.


Bowman's capsule
Renal corpuscle
Glomerulus


Bowman's capsule
glom
Bowman's space
p
d


Kidney, Cortex H&E
vascular pole
podocytes
capsular space
urinary pole
distal tubules

## 2- Renal Tubules :

As the glomerular filtrate leaves the renal corpuscle at the urinary pole, it flows through different parts of the nephron before reaching the renal tubules called **the collecting tubules** and **collecting ducts**. The glomerular filtrate first enters the renal tubule**,** which extends from the glomerular capsule to the collecting tubule. This renal tubule has several distinct histologic and functional regions. The portion of the renal tubule that begins at the renal corpuscle is highly twisted or tortuous and is therefore called the **proximal convoluted tubule.** Initially, this tubule is located in the cortex but then descends into the medulla to become continuous with the **loop of Henle**.

Proximal convoluted tubule

- Reabsorption of water, nutrients and solids (obligatory) Lined by simple
- cuboidal epithithelium resting on a thin b. lamina Tubule cells have
- microvilli on their luminal surfaces (typical brush border)Tubule cells
- appear striated due to numerous basal infoldings & plenty of mitochondria


**Functions of proximal convoluted tubule**

1. Reabsorption of 85%of Na, Cl &water. Na is reabsorbed by active process. Cl, & water reabsorbed by passive process.

2. Reabsorption of glucose. When the amount of glucose exceeds the absorbing capacity of the proximal tubule it appears in urine as in case of diabetes

.

3. Reabsorption of protein & amino acid

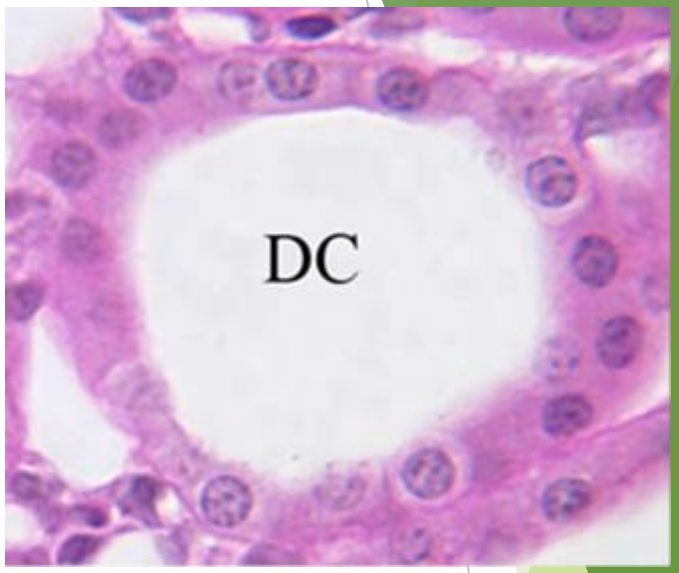
.

4. Excretion of foreign substances

## Distal convoluted tubule:

Reabsorbs most of substances contained in ultrafiltrate especially glucosa and amino acids (mainly facultative) Reabsorption regulated by ADH and aldosteroneContinues from the m. loop and extends to collecting tubule within cortex Lined by low simple cuboidal epithelium resting on a thin BL The cells lack microvilli but are striated, with basal infoldings and but less mitochondria

Its epithelial cells stain less osmophilic compared to those of PCT



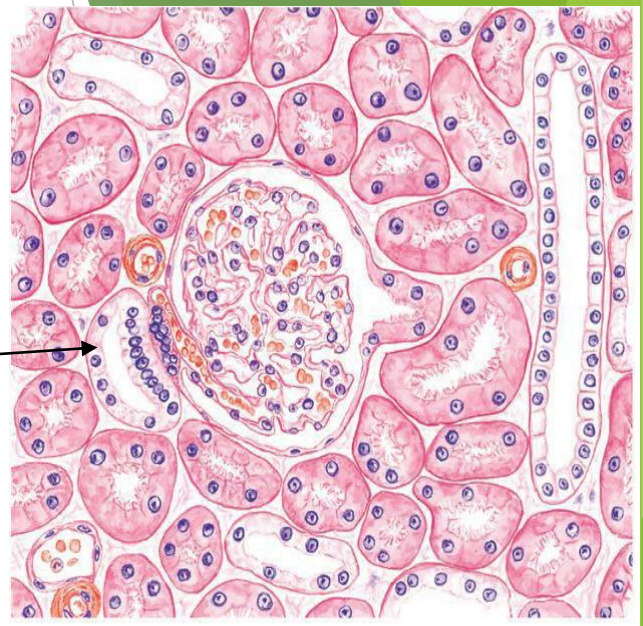

Functions:

1. Maintain acid - base balance.
2. Important in urine concentration.
3. Reabsorption of Na ions from the lumen of the distal convoluted tubules to the blood while K is excreted in the urine.
4. Bicarbonate ions are reabsorbed back to the blood & hydrogen ions are excreted so the urine is acidic.
5. Its function is under the effect of aldosterone secreted by the adrenal cortex.
6. ADH (antidiuretic hormone) secreted by the posterior lobe of pituitary gland acts on the last part of the distal convoluted tubules & increases the permeability of the tubule to water rendering the urine more concentrated. ADH also act on the collecting duct in a similar way.

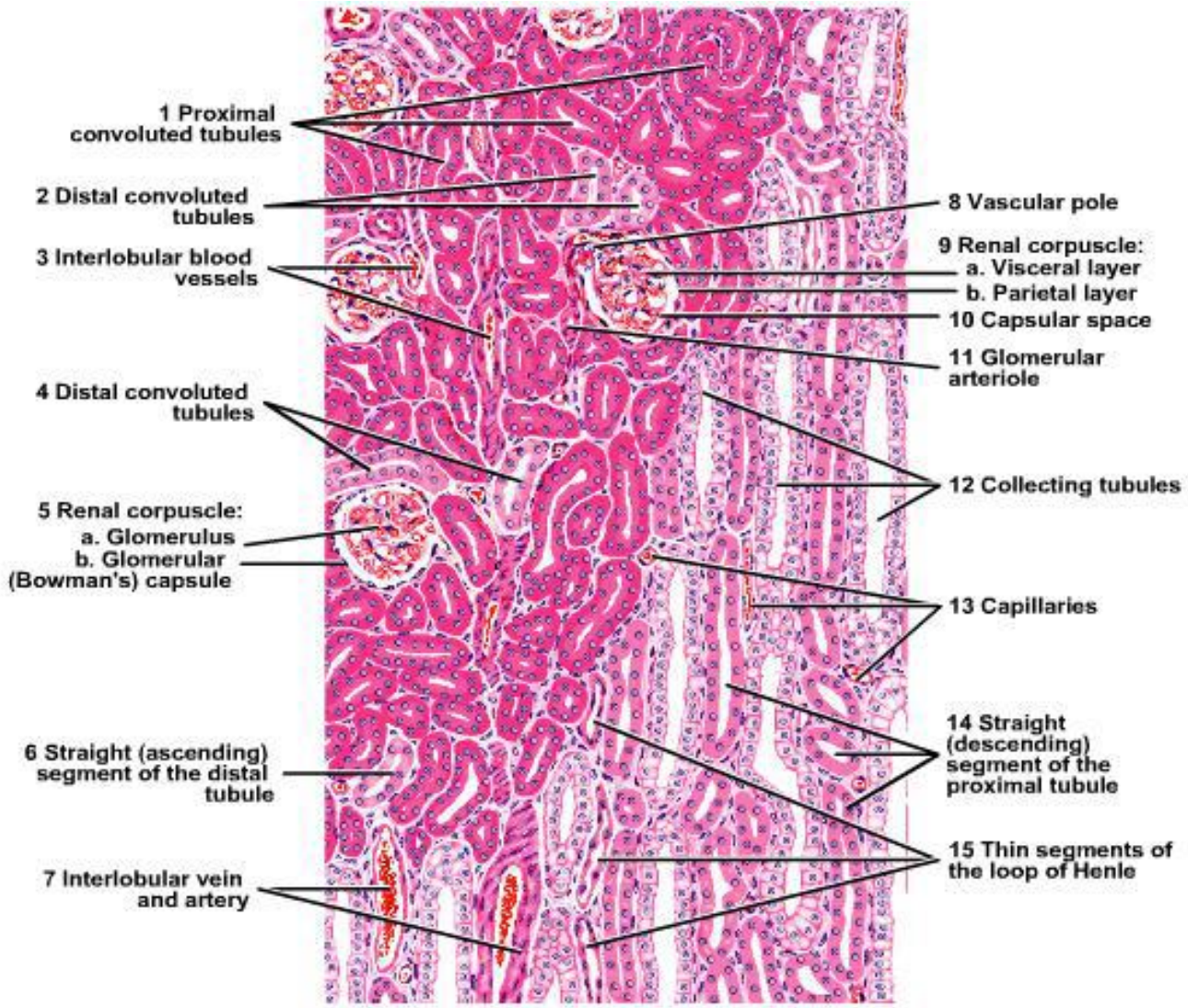
- **Loop of Henle :**
- The **loop of Henle** consists of several parts**: -** a thick, descending portion of the proximal convoluted tubule; a thin descending and a thick, ascending portion called the **distal convoluted tubule.** The distal convoluted tubule is shorter and less convoluted than the proximal convoluted tubule, and it ascends into the kidney cortex. Because the proximal convoluted tubule is longer than the distal convoluted tubule, it is more frequently observed near the renal corpuscles and in the renal cortex.
- Glomerular filtrate then flows from the distal convoluted tubule to the **collecting tubule.** In juxtamedullary nephrons, the loop of Henle is very long; it descends from the kidney
- cortex deep into the medulla and then loops back to ascend into the cortex . The collecting tubule is not part of the nephron . A number of short collecting tubules join to form several larger **collecting ducts.**
- **papillary ducts.** Smaller collecting ducts are lined by light-staining cuboidal
- epithelium. Deeper in the medulla, the epithelium in these ducts changes to columnar . At the tip of each papilla, the papillary ducts empty their contents into the minor calyx

- **Function of Henle loop :** the descending part is quite permeable. Permitting free passage of water & Na. since the interstitial fluid of the kidney medulla is hypertonic, Na enters and water leaves the glomerular filtrate in the descending part of the loop

- **Juxtaglomerular Apparatus**
- Adjacent to the renal corpuscles and distalconvoluted tubules lies a special group of cellscalled **juxtaglomerular apparatus.** This apparatus consists of two components,
- **- the juxtaglomerular cells**
- **-the macula densa**.
- Juxtaglomerular cells are a group of modified smooth muscle cells located in the wall of the afferent arteriole just before it enters the glomerular capsule to form the glomerulus .
- The main function of the juxtaglomerular apparatus is to maintain the necessary blood pressure in the kidney for glomerular filtration

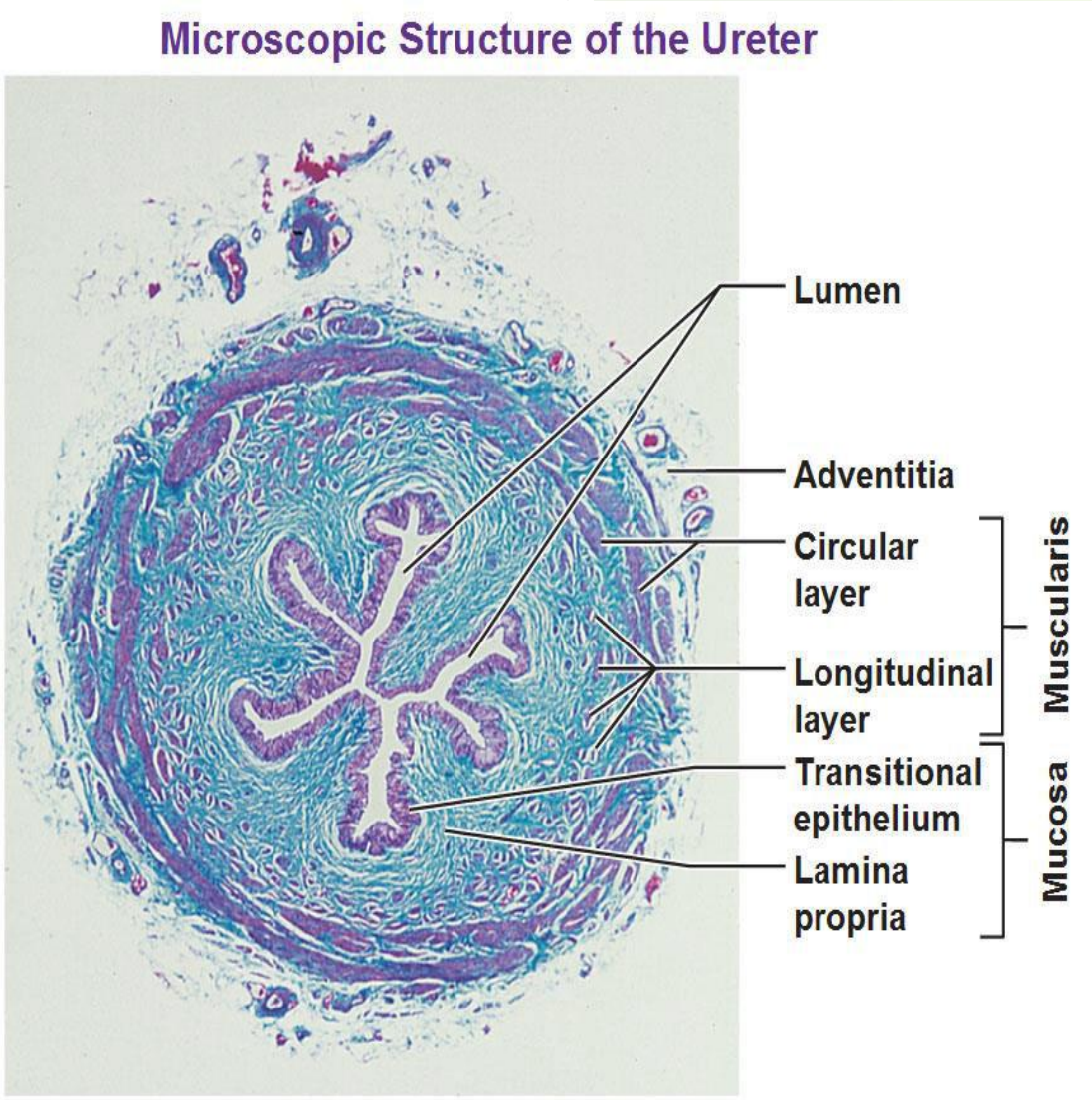


# Kidney view


1 Proximal convoluted tubules
2 Distal convoluted tubules
3 Interlobular blood vessels
4 Distal convoluted tubules
5 Renal corpuscle:
a. Glomerulus
b. Glomerular (Bowman's) capsule
6 Straight (ascending) segment of the distal tubule
7 Interlobular vein and artery
8 Vascular pole
9 Renal corpuscle:
a. Visceral layer
b. Parietal layer
10 Capsular space
11 Glomerular arteriole
12 Collecting tubules
13 Capillaries
14 Straight (descending) segment of the proximal tubule
15 Thin segments of the loop of Henle

# Ureter

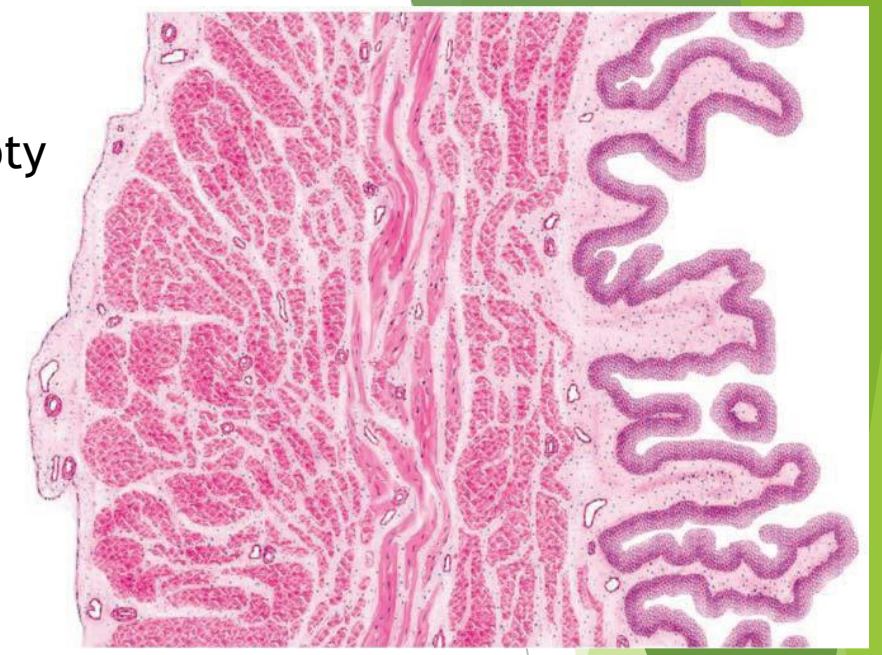
- The ureter is a muscular tube that conveys urine from the kidneys to the bladder by the contractions of the thick, smooth muscle layersfound in its wall.
- The mucosa of the ureter is highly folded and lined by a thick **transitional epithelium .** Below the transitional epithelium is the connective tissue **lamina propria .**
- The muscularis of the ureter contains smoothmuscle layers, an
- **-inner longitudinal layer**
- **- a middle circular muscle layer .**
- **- A third outer longitudinal layer**
- A connective tissue **adventitia ,** with blood
- vessels and adipose tissue **,** surrounds the ureter.



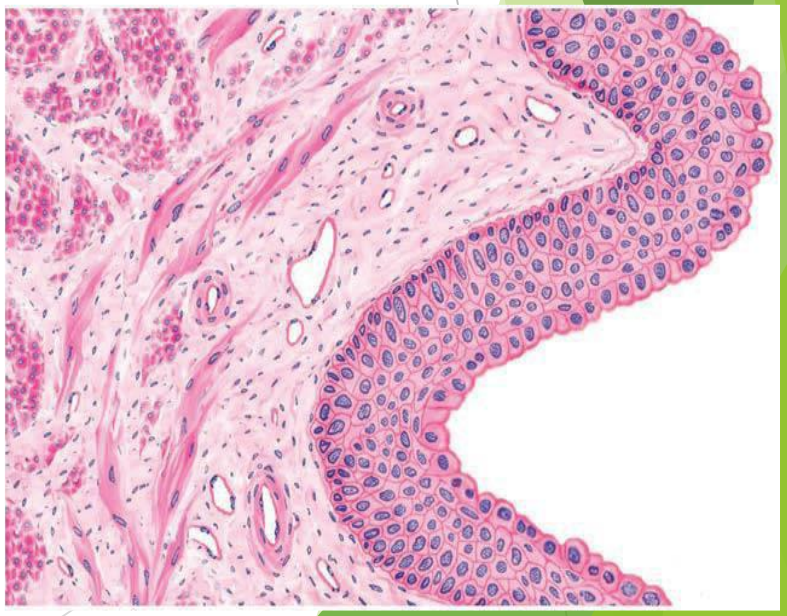
# Urinary Bladder:

- The bladder has a thick muscular wall. The
- wall is similar to that of the lower third of the
- ureter, except for its thickness. In the wall are
- found three loosely arranged layers of smooth
- muscle,
- -the inner longitudinal,
- -middle circular, and - outer longitudinal layers.
- The three layers are arranged inanastomosing smooth muscle bundles
- between which is found the interstitial connective tissue . The interstitial
- connective tissue merges with the connective tissue of the serosa .Mesothelium covers the connective tissue of serosa and is the outermost layer.
- Serosa lines the superior surface of the bladder,whereas its inferior surface is covered by the connective tissue adventitia, which merges with the connective tissue of adjacent structures

Empty



Full



# Urethra

- Its wall has 4 tissue layers

1- Tunica mucosa;

epith transitional but changes to stratified squamous at external urethra orifice

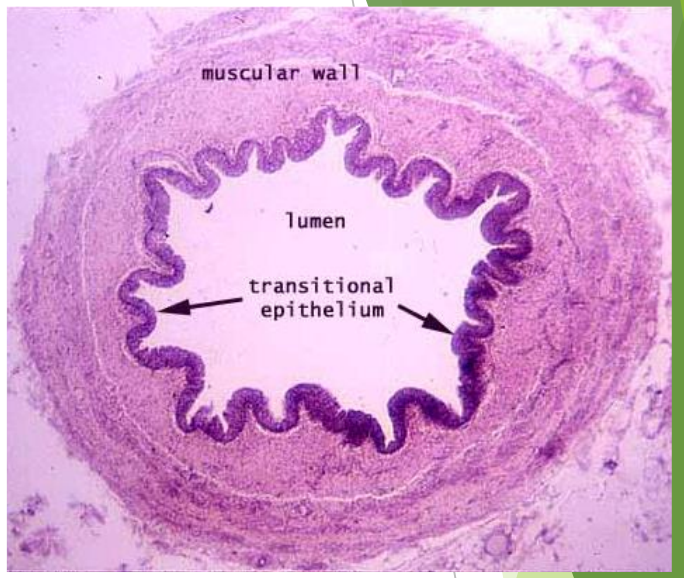
2- Tunica submucosa;

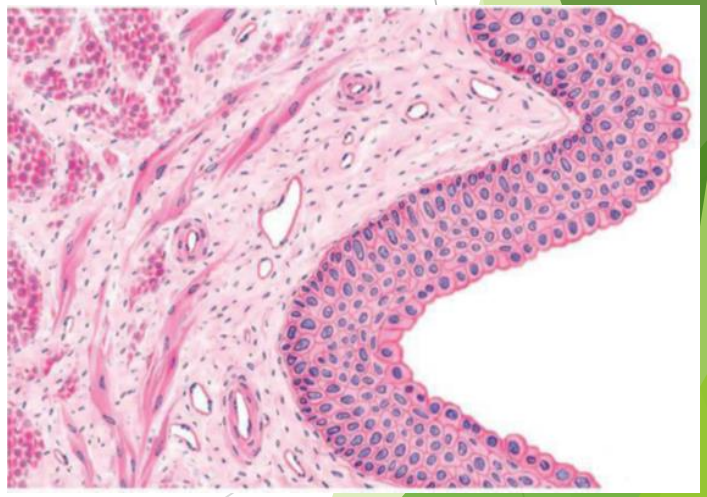
has cavernous tissue spaces that are typical of erectile tissue

3- Tunica muscularis;

Has inner and outer longi and middle layer of smooth muscles as in bladder but towards external urethral orifice, it acquires an external layer of skeletal muscle called striated urethralis muscle

4- Tunica serosa/Adventitia:

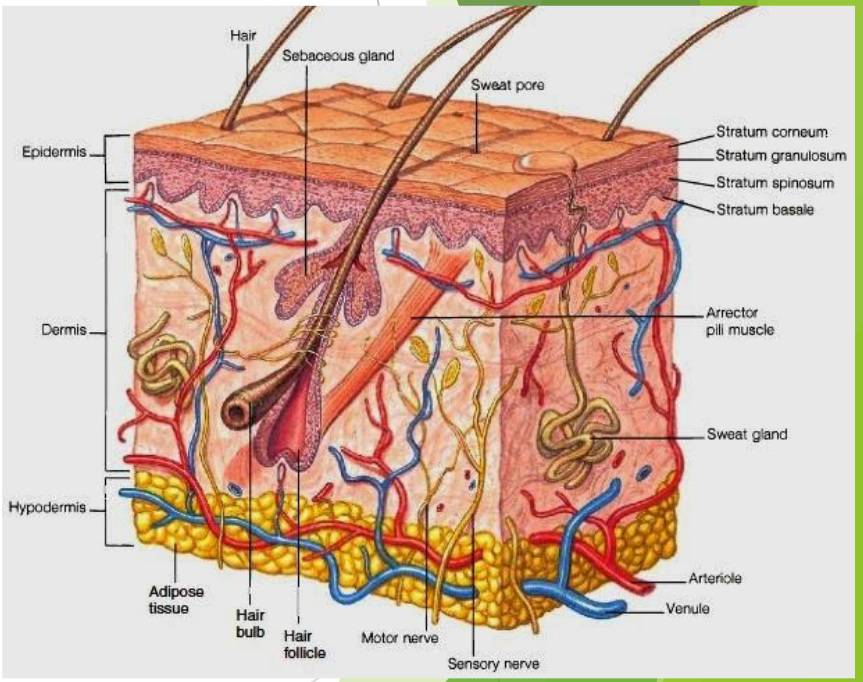


Dr . Nahidah Ibrahim

# The skin

- The skin covers the exterior of the body and constitutes a large organ with several functions.
- It protects the body from mechanical injury and loss of fluid, acts as a barrier against noxious agents, temperature regulation, excretes various waste products, and through its receptors for sensations of heat, cold,touch, and pain, provides information about the external environment.
- Skin and its derivatives and appendages form the integumentary system.
- In humans, skin derivatives include :
- nails, hair, and several types of sweat and sebaceous glands.
- skin consists of two distinct regions :
- - superficial epidermis
- - deep dermis

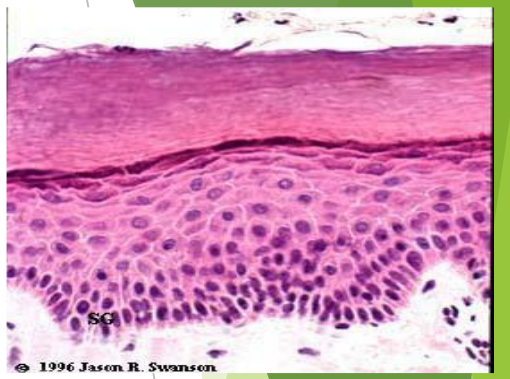


- Types of skin
- **Thick skin**. Thick skin also contains numerous sweat glands, but lacks hair follicles ,sebaceous glands, and smooth muscle fibers and consist of five layers
- The remainder of the body is covered by
- **thin skin**.
- In these regions, the epidermis is thinner and it's cellular composition simpler
- than that of thick skin. It consist of 3 layers

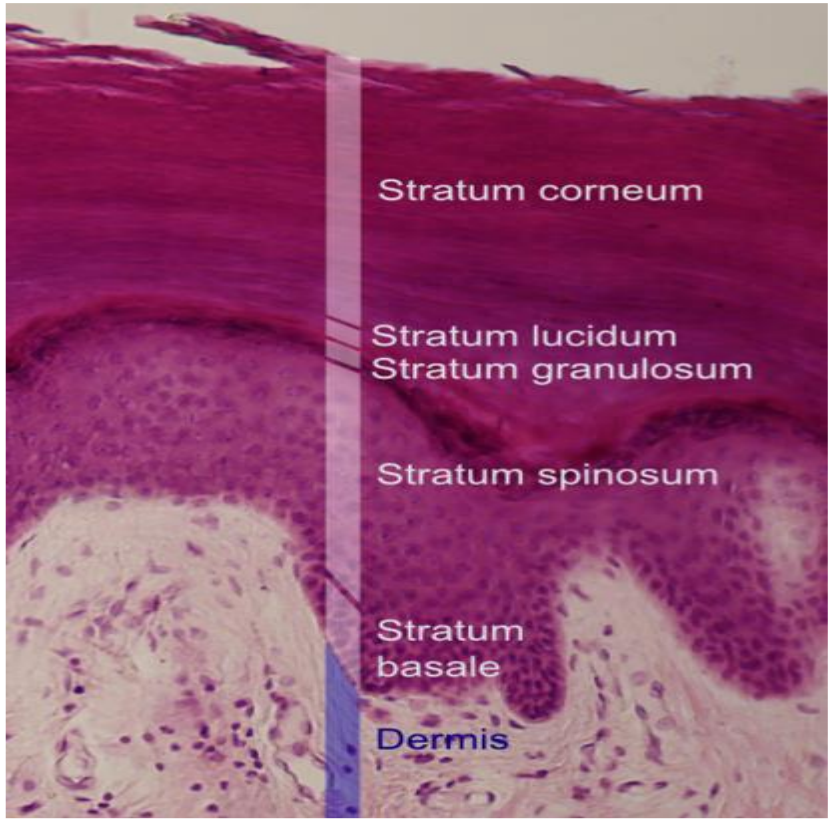
- **1- The superficial epidermis :**
- is nonvascular and lined by keratinized
- stratified squamous epithelium with distinct
- cell types and cell layers.
- Inferior to the epidermis is the vascular
- **2- dermis,** characterized by dense irregular
- connective tissue. Beneath the dermis is hypodermis
- **3- hypodermis** or a subcutaneous layer of
- connective tissue and adipose tissue that forms
- the superficial fascia seen in gross anatomy.

# The superficial epidermis layers

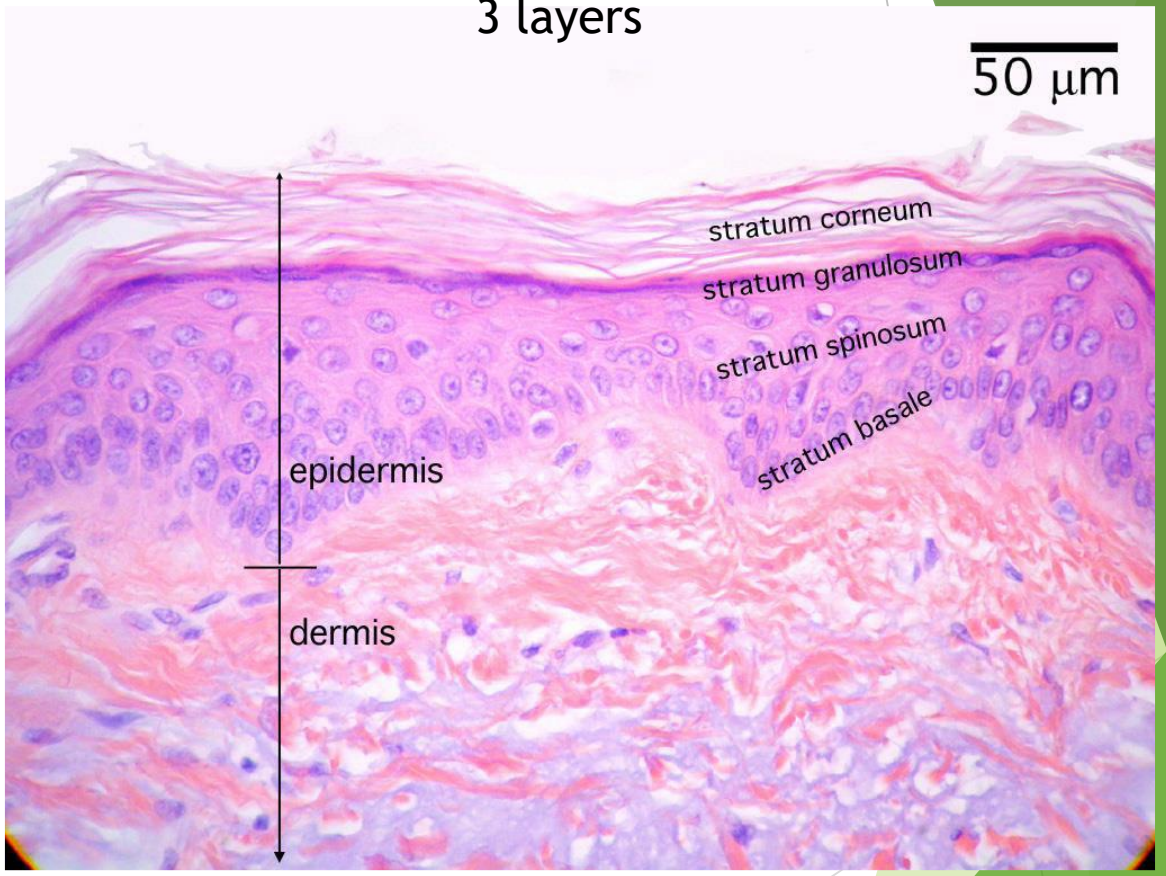
- **1- Stratum Basale (Germinativum)**
- The stratum basale is the deepest. It consists of asingle layer of columnar to cuboidal cells that rest on a membrane
- separating the dermis from the epidermis .
- **2- Stratum Spinosum :**
- , a second cell layer, or stratum spinosum, forms. This layer consists of four to six rows of cells
- **3- Stratum Granulosum**
- The third layer ,stratum granulosum .Three to five layers of flattened cells form
- **4- Stratum Lucidum :**
- In thick skin only, the stratum lucidum is translucent and barely visible; it lies just
- superior to stratum granulosum and inferiorto the stratum corneum.
- The tightly packed cells lack nuclei or organelles and are dead.
- **5- Stratum Corneum** :
- Stratum corneum primarily consists of flattened, dead cells filled with soft keratin filaments . The keratinized, superficial cells from this layer are continually shed or desqumated and are replaced by new cells arising from the deep stratum basale.




Thick skin
5 layers



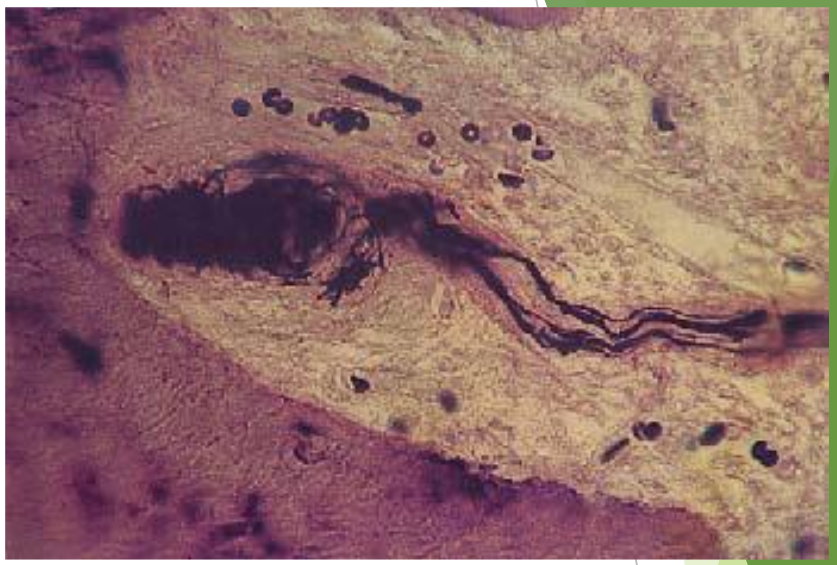

Thin skin
3 layers



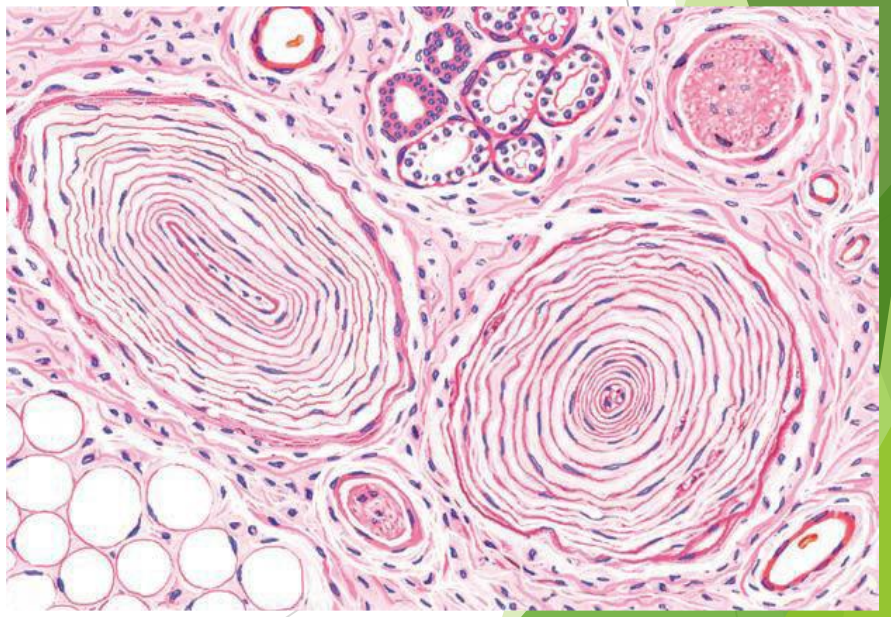
## Dermis: Papillary and Reticular Layers

- Dermis is the connective tissue layer that binds to epidermis. A distinct basement membrane separates the epidermis from the dermis. In addition, dermis also contains derivatives such as sweat glands , sebaceous glands, and hair follicles.
- The junction of the dermis with the epidermis is irregular. The superficial layer of the dermis forms numerous raised projections called dermal papillae, that evaginations of epidermis, called epidermal ridges This region of skin is the papillary layer of the dermis. This layer is filled with loose irregular connective tissue fibers, capillaries, blood vessels, fibroblasts , macrophages , and other loose connective tissue cells > The deeper layer of dermis is called the reticular layer. This layer is thicker and is characterized by dense irregular connective tissue fibers

- Sensory receptors :



- Two types of encapsulated touch/pressure
- receptors are commonly found in the dermis.
- Relatively small Meissner's corpuscles are
- located near the crests of the dermal papillae.

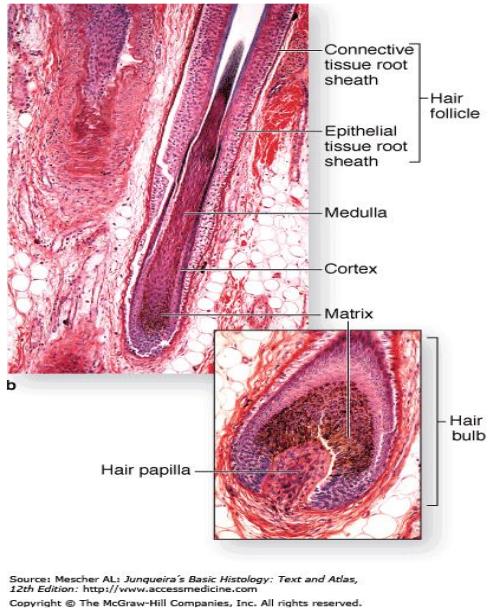


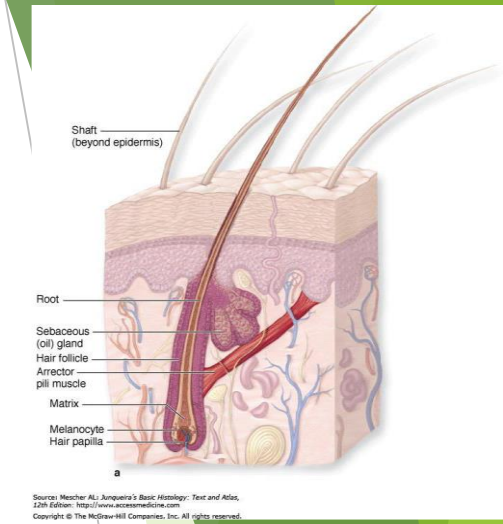
- Larger Pacinian corpuscles are encapsulated
- pressure receptors located deep in the reticular
- layer.

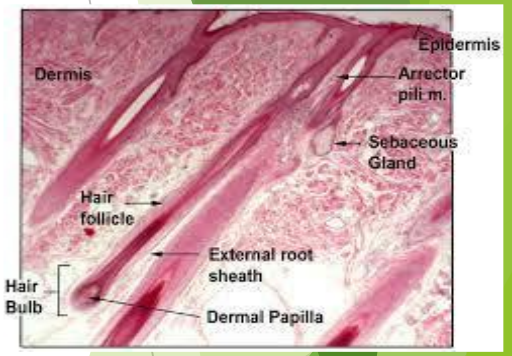
# Skin appendage

## Hair follicle :

- Hairs are the hard, cornified, cylindrical
- structures that arise from hair follicles in the
- skin. One portion of the hair projects through
- the epithelium of the skin to the exterior
- surface; the other portion remains embedded in
- the dermis. Hair grows in the expanded portion
- at the base of the hair follicle called the hair
- bulb. Associated with each hair follicle are one or
- more sebaceous glands that produce an
- oily secretion called sebum.Sebum forms when cells die in sebaceous
- glands. Also, extending from the connectivetissue around the hair follicle to the papillarylayer of the dermis are bundles of smooth
- muscle called arrector pili. The sebaceous glands are located between the arrector pili
- muscle and the hair follicle.



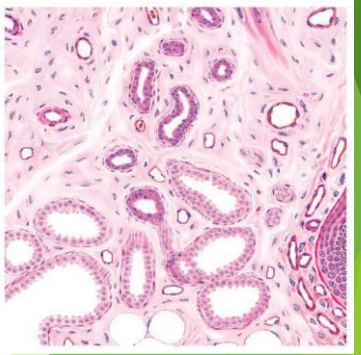



- Sweat glands :
- Sweat glands are widely distributed in skin ,and are of two types :
- 1- eccrine (merocrine) are most numerous
- in the skin of the palms and soles. The eccrinesweat glands assist in
- temperature regulation.Sweat glands also excrete water, sodiumsalts,
- ammonia, uric acid, and urea

- 2- apocrine :Apocrine sweat glands are also found in the dermis and are
- primarily limited to theaxilla ,anus , and areolar regions of thebreast.
- These sweat glands are larger than eccrine
- sweat glands, and their ducts open into thehair follicle.

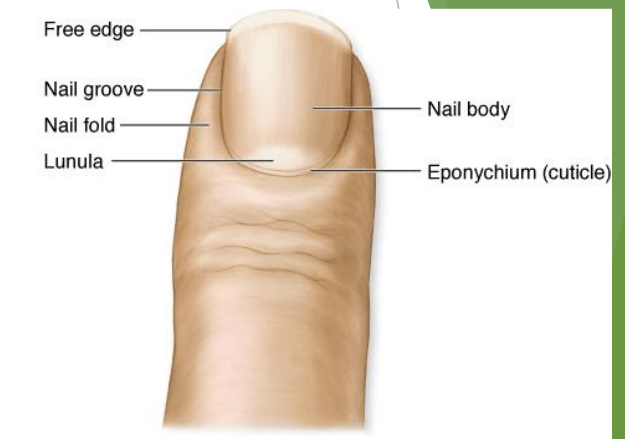
Secretory portion of eccrine gland


Apocrine gland

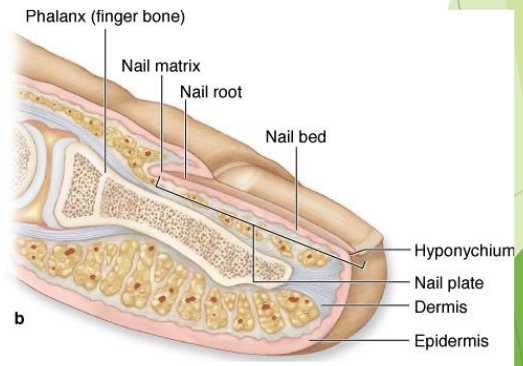


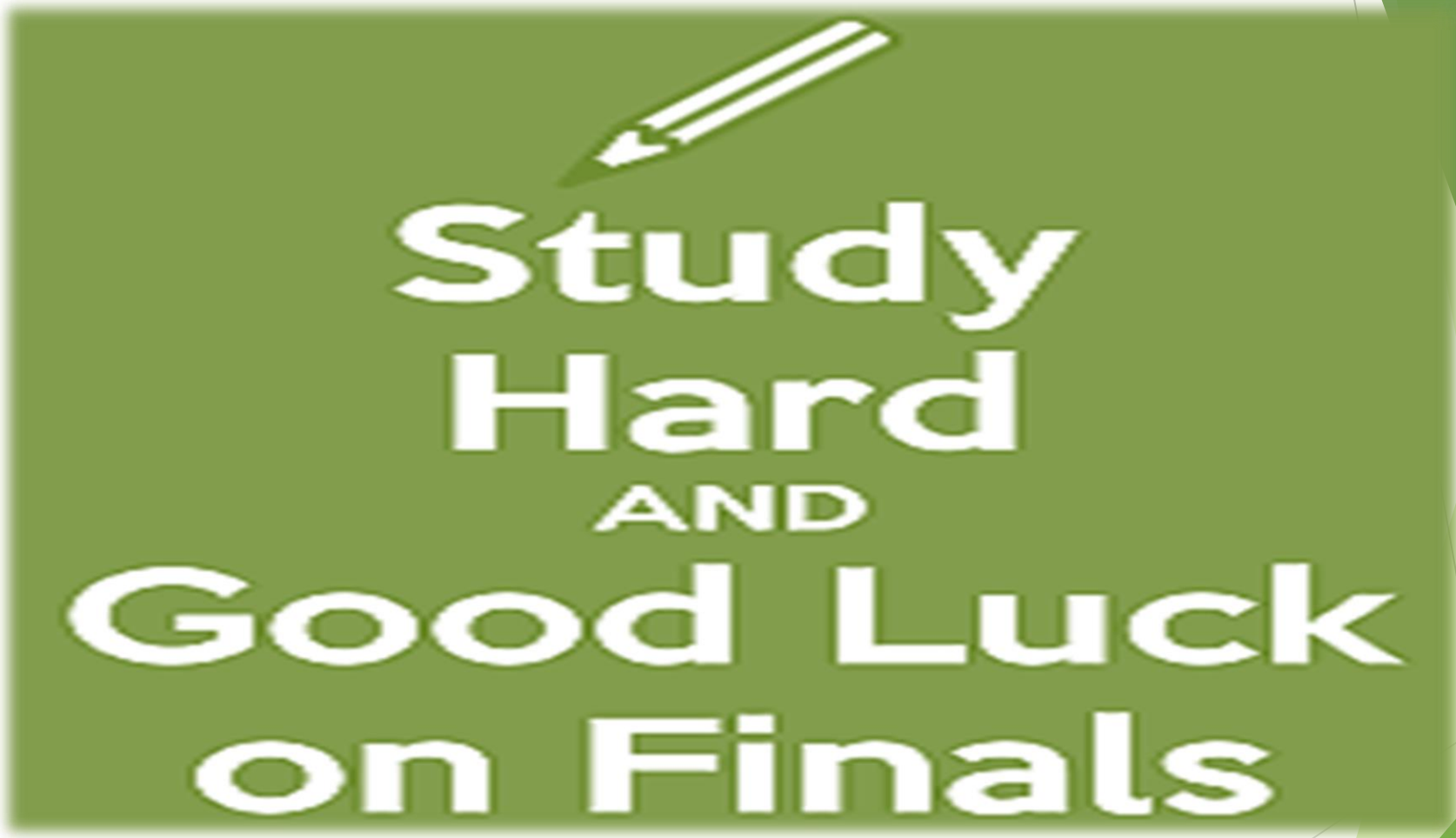
# Nails

- The nails are hard, keratinized structures
- that cover the dorsal surfaces of the tips of the
- fingers and toes. Each nail consists of a visible
- body (nail plate) and a proximal part, the
- root, which is implanted into a groove in the
- skin. The root is overlapped by the proximal
- nail fold, a fold of skin that continues along
- the lateral borders of the nail, where it forms
- the lateral nail folds.





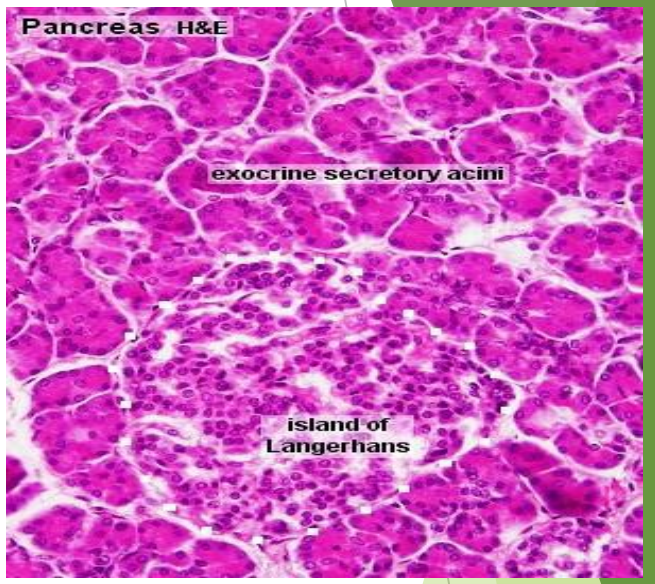


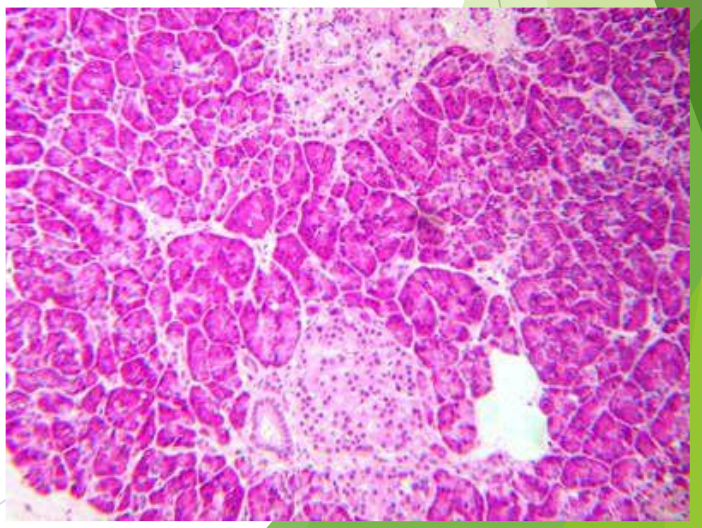

Study
Hard
AND
Good Luck
on Finals

## Associated organ with GIT (part 2)

### Pancreas

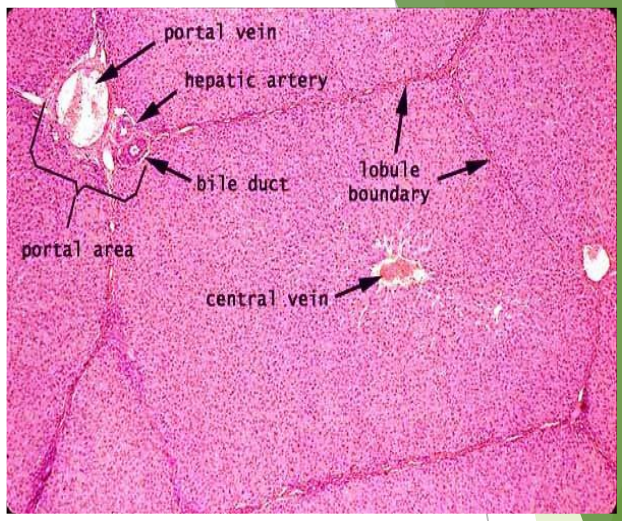
Exocrine and endocrine parts
Exocrine glands-
-Serous acini present
-Acini are compact ,less lumen
-Acini secrete digestive enzyme
-Centroacinar cells continue as intercalated ducts, secrete alkaline fluid
Endocrine glands-
-Island of langerhans
-branching cords like pattern of pale staining cells
Endocrine cells
1.Alpha cells-20%,mainly at periphery, large cells secrete glucagon
2.Beta cells-70%,at centre, small cells, secrete insulin
3.Delta cells-5%, secrete somatostatin
4.F cells-secrete polypeptides

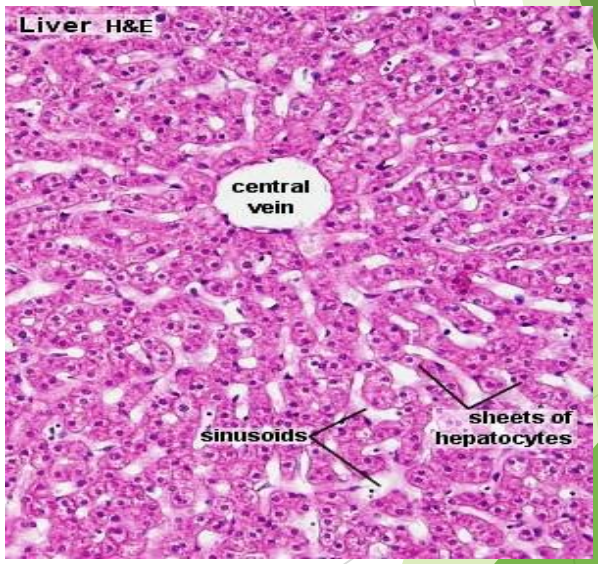


# Liver

- **Glisson capsule- trabeculae**
- **Portal tract-portal triad**
- **-1.Portal venule,2. bile ductule3. hepatic arteriole**
- **-Space of mall**
- **Hepatic lobule- -hexagonal shaped**
- **-Central vein**
- **-heptocytes -hepatic plates**
- **-liver sinusoids -Kuffer cells**
- **-Space of Disse -Bile canaliculi**
- **Portal area consist of bile duct , heparic artery and hepatic vein**
- •Portal lobule- blood supply area
- •Hepatic acinus- area drain by bile duct functiona



Histology:1st stage
Department of clinical laboratory science
Dr . Nahidah Ibrahim

# *Endocrine System*

The **endocrine system** produces various secretions called **hormones**. to set in motion] that release for delivery to the bloodstream for transport to target cells and organs, serve as effectors to regulate the activities of various cells, tissues, and organs in the body.

## Functions

Its functions are essential in maintaining homeostasis and coordinating body growth and development and are similar to that of the nervous system: Both communicate information to peripheral cells and organs.

- **The endocrine system** including **endocrine Glands (pituitary gland & hypothalamus, thyroid gl., adrenal gl. ,pineal gl. ,parathyroid gl.)**
- as well as **individual cells** within the gonads, liver, pancreas, kidney, and gastrointestinal system.

# *Pituitary Gland(Hypophisis):*

The **pituitary gland** and the **hypothalamus**, the portion of the brain to which the pituitary gland is attached, are morphologically and functionally linked in the endocrine and neuroendocrine control of other endocrine glands.

The **pituitary gland** is a pea-sized, compound endocrine gland .
It is centrally located at the base of the brain, where it lies in a depression of the sphenoid bone .A short stalk, the **infundibulum**, and a vascular network connect the pituitary gland to the hypothalamus.

- **Anterior lobe (adenohypophysis), the glandular epithelial tissue.**
- **• Posterior lobe (neurohypophysis), the neural secretory tissue .**
- **These two portions** are of different embryologic origin.

The anterior lobe of the pituitary gland is derived from an evagination of the **ectoderm of the oropharynx** toward the brain **(Rathke's pouch)**.

- The posterior lobe of the pituitary gland is derived from a downgrowth (the future infundibulum) of **neuroectoderm of the floor of the third ventricle** of the developing brain .
- The **anterior lobe of the pituitary gland** consists of three derivatives of Rathke's pouch:
- **Pars distalis**, which comprises the bulk of the anterior lobe of the pituitary gland and arises from the thickened anterior wall of the pouch .
- **Pars intermedia**, a thin remnant of the posterior wall of the pouch that abuts the pars distalis.
- **Pars tuberalis**, which develops from the thickened lateral walls of the pouch and forms a collar or sheath around the infundibulum.
- The **posterior lobe of the pituitary gland** consists of the following:
- o **Pars nervosa**, which contains neurosecretory axons and their endings.
- o **Infundibulum**, which is continuous with the: **median eminence** and contains the neurosecretory axons forming the **hypothalamohypophyseal tracts .**

# *Structure and Function of the Pituitary Gland*

- ***Anterior Lobe of the Pituitary Gland (Adenohypophysis)***
- **The anterior lobe of the pituitary gland regulates other endocrine glands .**
- Most of the **anterior lobe of the pituitary gland** has the typical organization ofendocrine tissue.
- The cells are organized in clumps and cords separated by fenestrated sinusoidal capillaries of relatively large diameter.
- These cells respond to signals from the hypothalamus and synthesize and secrete
- a number of pituitary hormones .
- Four hormones of the anterior lobe—
- **adrenocorticotropic hormone (ACTH),**
- **thyroidstimulating (thyrotropic) hormone (TSH, thyrotropin),**
- **follicle stimulating**
- **hormone (FSH)**, and **luteinizing hormone (LH)**—because they regulate the activity of cells in other endocrine
- glands throughout the body.
- The two remaining hormones of the anterior lobe, **growth hormone (GH)** and
- **prolactin (PRL)**, are not considered tropic because they act directly on target
- organs that are not endocrine.

***Pars Distalis .***

The cells within the **pars distalis** vary in size, shape, and staining properties.
The cells are arranged in cords and nests with interweaving capillaries.
Histologists identified three types of cells according to their staining reaction, namely, **basophils (10%)**, **acidophils (40%)**, and **chromophobes (50%)**

## Cells of Pars Distalis

| Cell | Staining | % | Hormone | Action |
|---|---|---|---|---|
| ***Somatotrophs*** | Acidophilic | 50 | Somatotropin (growth hormone) | growth of long bones. |
| ***Mammotrophs*** | Acidophilic | 15–20 | Prolactin (PRL) | Promotes milk secretion |
| ***Gonadotrophs*** | Basophilic | 10 | FSH & LH | -FSH promotes ovarian follicle in women and spermatogenesis in men.<br>-LH promotes ovulation in women, interstitial cell androgen secretion in men. |
| ***Thyrotrophs*** | Basophilic | 5 | TSH | thyroid hormone: synthesis, storage & release |
| ***Corticotrophs*** | Basophilic | 15–20 | Adrenal corticotropin (ACTH) | Stimulates the adrenal cortex. |
| | | | Lipotrophins | Lipid metabolism regulation |

***Five functional cell types are identified in the pars distalis on the basis of immunocytochemical reactions***

***Pars Intermedia.***

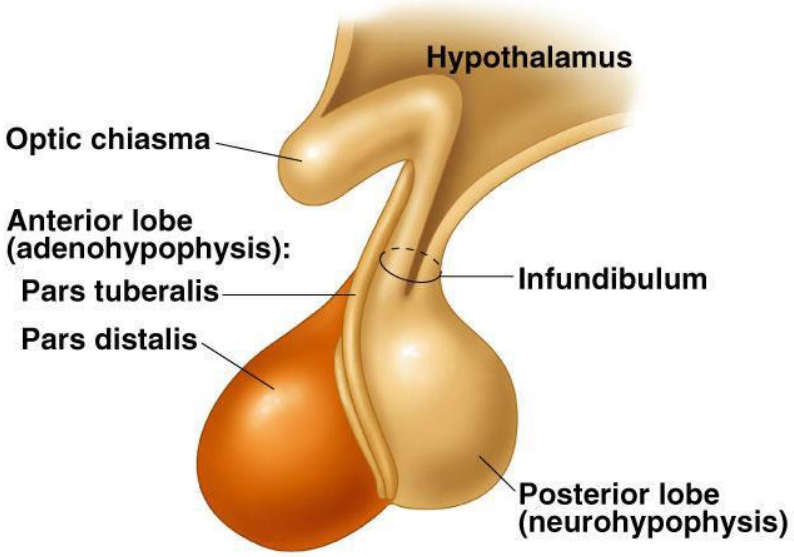
The **pars intermedia** surrounds a series of small cystic cavities that represent the residual lumen of Rathke's pouch .The parenchymal cells of the pars intermedia surround colloid-filled follicles. The cells lining these follicles appear to be derived either from folliculo-stellate cells or various hormone-secreting cells,
pars intermedia have vesicles larger than those found in the pars distalis.. The pars intermedia contains **basophils** and **chromophobes .** Frequently, the basophils and cystic cavities extend into the pars nervosa.

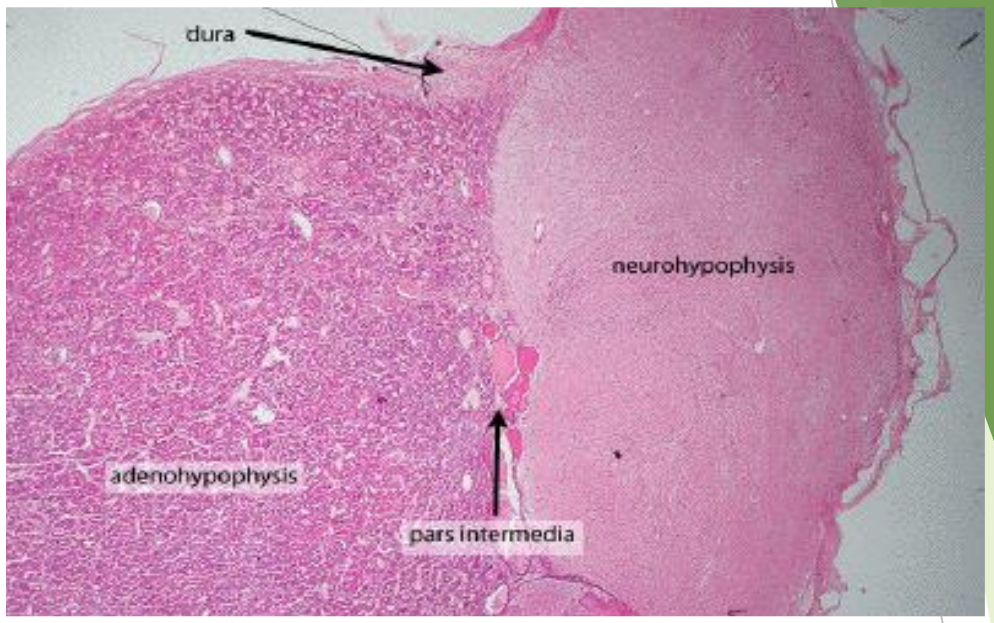
- ***Pars Tuberalis.***
- The **pars tuberalis** is an extension of the anterior lobe along the stalk like infundibulum.
- It is a highly vascular region containing veins of the hypothalamohypophyseal
- system. The parenchymal cells are arranged in small clusters or cords in
- association with the blood vessels.
- Nests of squamous cells and small follicles lined with cuboidal cells are
- scattered in this region. These cells often show immunoreactivity for ACTH,
- FSH, and LH.

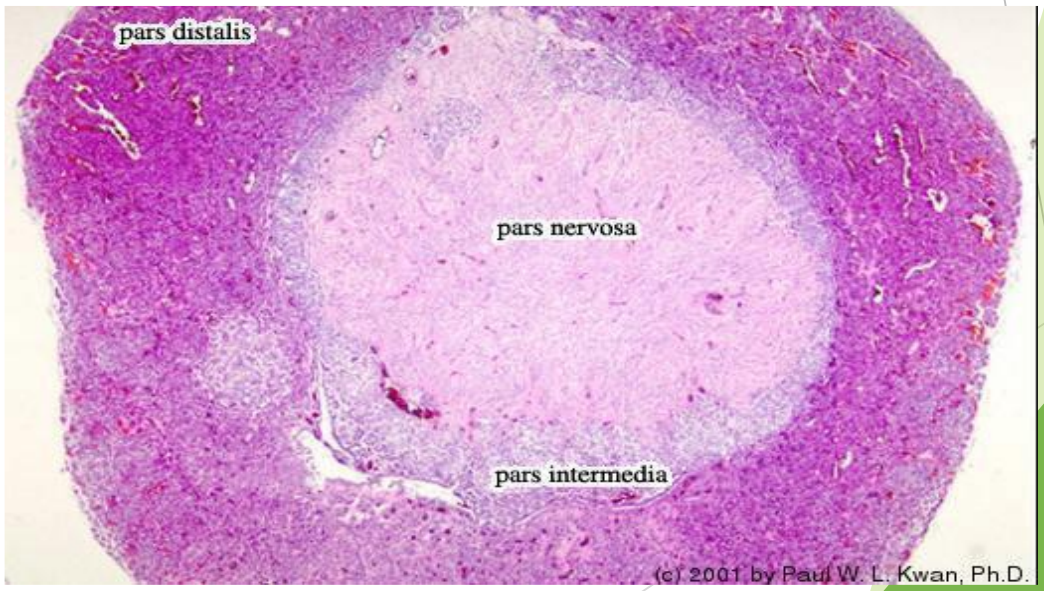
- ***Posterior Lobe of the Pituitary Gland***
- ***(Neurohypophysis)***
- **The posterior lobe of the pituitary gland is an extension of the central**
- **nervous system (CNS) that stores and releases secretory products from the**
- **hypothalamus** , consists of the **pars nervosa** , the **infundibulum& median**
- **eminance** that connects it to the hypothalamus***).***
- The pars nervosa, contains the unmyelinated axons and their nerve endings of
- approximately 100,000 **neurosecretory neurons** whose cell bodies lie in the
- **supraoptic nuclei** and **paraventricular nuclei** of the hypothalamus.
- The axons form the **hypothalamohypophyseal** tract and are unique in two respects:
- ***First,*** they do not terminate on other neurons or target cells but end in close proximity to the fenestrated capillary network of the pars nervosa.
- ***Second***, they contain secretory vesicles in all parts of the cells, i.e., the cell body, axon, and axon terminal.
- There are neurosecretory vesicles in the nerve endings of the pars nervosa, aggregate to form Herring bodies that contain either oxytocin or antidiuretic hormone (ADH; also called vasopressin).
- □ Oxytocin promotes contraction of smooth muscle of the uterus and myoepithelial cells of the breast.
- The pituicyte is the only cell specific to the posterior lobe of the pituitary gland , Because of their many processes and relationships to the blood, the pituicyte serves a supporting role similar to that of astrocytes in the rest of the CNS.

# Pituitary gland





# FUNCTIONAL CORRELATIONS: CELLS AND HORMONES OF THE ADENOHYPOPHYSIS

- 1- Acidophils:
- Somatotrophs secrete somatotropin, also called growth hormone or GH.
- Mammotrophs produce the lactogenic hormone prolactin that stimulates development of mammary glands during pregnancy.
- 2- BASOPHILS
- Thyrotrophs secrete thyroid-stimulating hormone (thyrotropin, or TSH).TSH stimulates synthesis and secretion of the hormones thyroxin an triiodothyronine from the thyroid gland.
- Gonadotrophs secrete follicle-stimulating hormone (FSH) and luteinizing hormone (LH).
- Corticotrophs secrete adrenocorticotropic
- hormone (ACTH). ACTH influences the function of the cells in adrenal cortex.

Hormone of PARS INTERMEDIA

melanocyte-stimulating hormone (MSH). MSH increases skin pigmentation by causing dispersion of melanin granules.

The two hormones, oxytocin and antidiuretic hormone (ADH), that are released from the neurohypophysis are synthesized in the hypothalamus.Release of oxytocin is stimulated by vaginal and cervical distension before birth

# THYROID GLAND

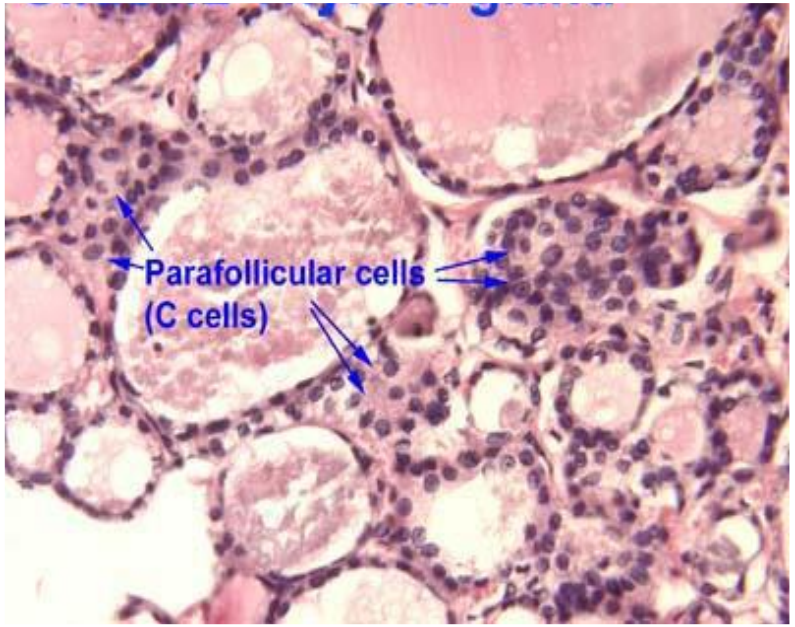
- Is located in the anterior neck inferior to the larynx. It is a single gland that consists of large right and left lobes, connected in the middle by an
- isthmus. Most endocrine cells, tissues, or organs are arranged in cords or clumps, and store their secretory products within their cytoplasm. The
- thyroid gland is a unique endocrine organ in that its cells are arranged into spherical structures, called follicles.

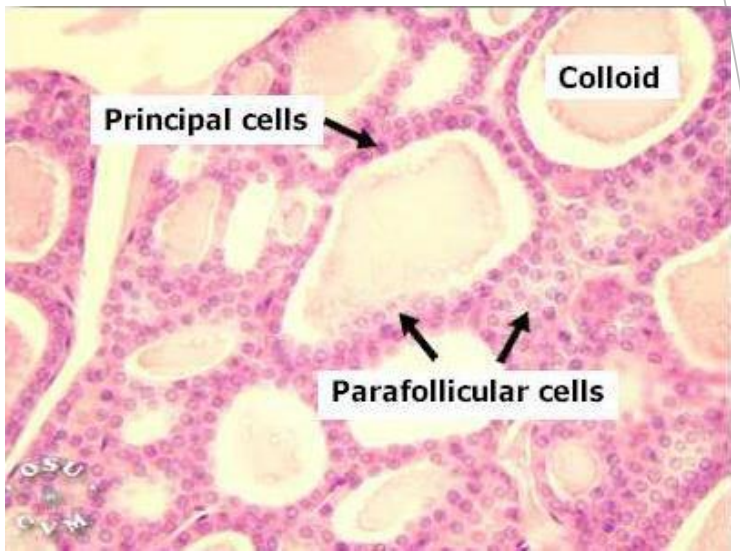
Structure of Adrenal gland

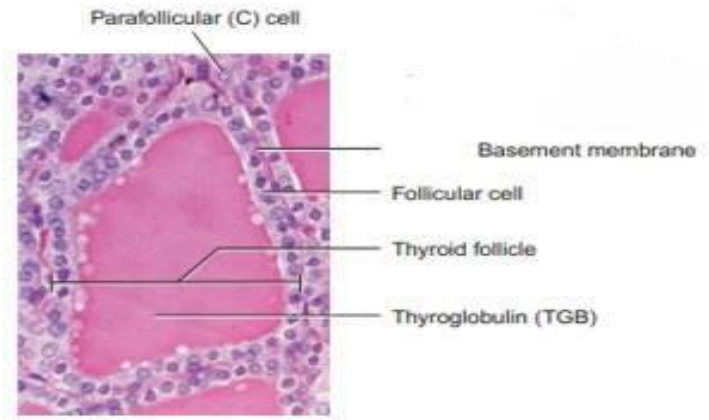
- Each follicle is surrounded by reticular fibers and a network of capillaries that allows for easy entrance of thyroid hormones into the bloodstream. The follicular epithelium can be simple squamous, cuboidal, or low columnar, depending on the state of activity of the thyroid gland. Follicles are the structural and functional units of the thyroid gland. The cells that surround the follicles, the follicular cells, also called principal cells, synthesize, release, and store their product outside of their cytoplasm, or extracellularly, in the lumen of the follicles as a gelatinous substance, called colloid.

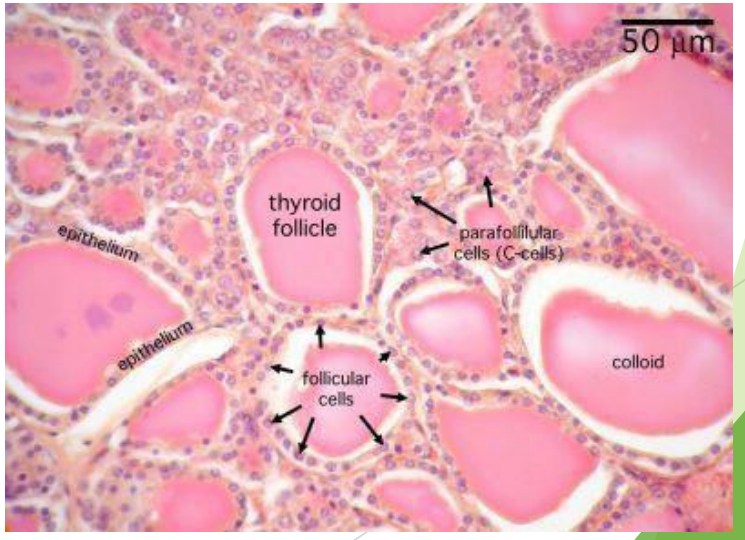
- Colloid is composed of thyroglobulin, an iodinated glycoprotein that is the inactive storage form of the thyroid hormones.
- In addition to follicular cells, the thyroid gland also contains larger, pale-staining parafollicular
- cells. These cells are found either peripherally in the follicular epithelium or within the follicle. When parafollicular cells are located in the confines of a follicle, they are always separated from the follicular lumen by neighboring follicular cells.

# THYROID GLAND



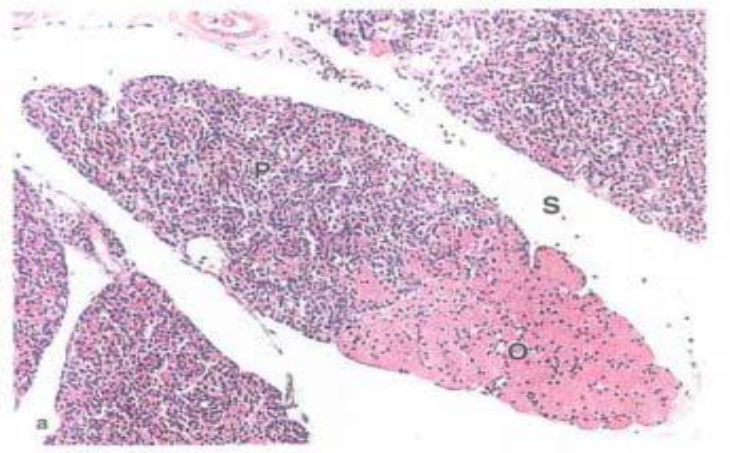



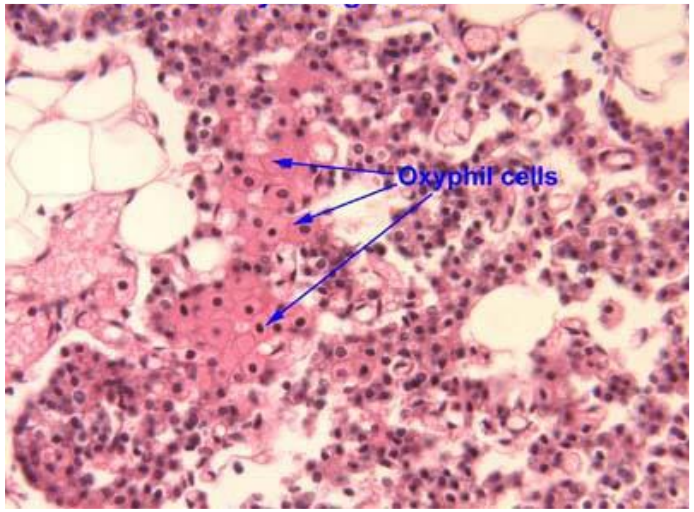
# FORMATION OF THYROID HORMONES

- Thyroid-stimulating hormone (TSH) released from the adenohypophysis. Iodide is an essential element for production of the active thyroid
- hormones triiodothyronine (T3) and tetraiodothyronine or thyroxine (T4) that are
- Relea sed into the bloodstream by the thyroid gland.

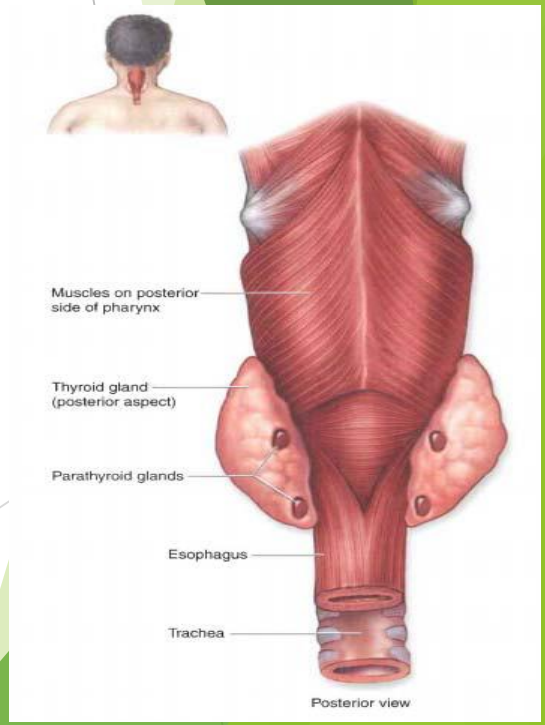
- In response to TSH stimulus, the follicular cells take up iodide from the
- circulation . T3 and T4 remain in thyroid follicles in an inactive form until needed. TSH released from the adenohypophysis stimulates the thyroid
- gland cells to release the thyroid hormones into the bloodstream.

- PARATHYROID GLANDS :
- Mammals generally have four parathyroid glands. These small oval glands are situated on the posterior surface of the thyroid gland, but separated from the thyroid gland by a thin connective tissue capsule. In contrast to the thyroid gland, cells of the parathyroid glands are arranged into cords or clumps, surrounded by arich network of capillaries.
- There are two types of cells in the parathyroid glands: functional principal or chief cells and oxyphil cells. Oxyphil cells are larger, are found singly or in small groups, and are less numerous than the chief cells. In routine histologic sections, these cells stain deeply acidophilic. On rare occasions, small colloid-filled follicles may be seen in the parathyroid glands.



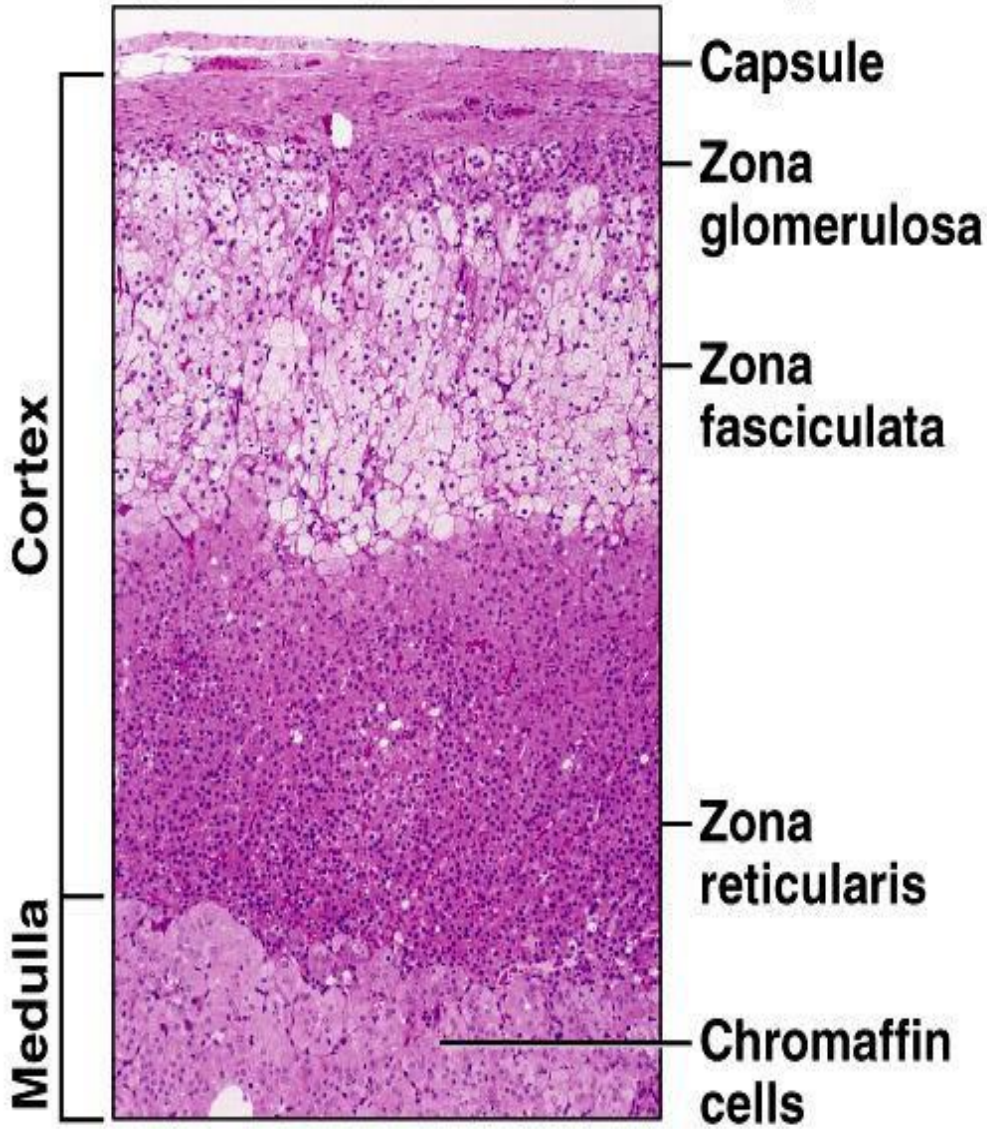




Parathyroid principal cells. (a): A small lobe of parathyroid gland surrounded by connective tissue septa (s), shows mainly densely packed cords of small principal cells (P), also called chief cells, oxyphil cells (O), ( b): The micrograph shows that principal cells are slightly eosinophilic present in cords



# ADRENAL (SUPRARENAL) GLANDS :

- The adrenal glands are endocrine organs  situated near the superior pole of each kidney. Each adrenal gland is surrounded by a dense irregular connective tissue capsule and embedded in the adipose tissue around the kidneys. Each adrenal gland consists of :
- -- outer cortex
- - inner medulla.
- The adrenal cortex exhibits three concentriczones:
- - zona glomerulosa,
- - zona fasciculata,
- - zona reticularis.
- The zona glomerulosa is a thin zone inferior to the adrenal gland capsule. It consists of cells
- arranged in small clumps.
- The zona fasciculata is intermediate and the thickest zone of the adrenal cortex.
- This zone exhibits vertical columns of one cell thickness adjacent to straight capillaries. This layer is characterized by pale-staining cells owing to the increased presence of numerous lipid droplets.
- The zona reticularis is the innermost zone that
- is adjacent to the adrenal medulla. The cells in
- this zone are arranged in cords or clumps.




- CONT
- In all three zones, the secretory cells are adjacent to fenestrated capillaries. The cells of these zones in the adrenal cortex produce
- three classes of steroid hormones:
- mineralocorticoids,
- glucocorticoids,
- sex hormones
- MEDULLA :
- The medulla lies in the center of the adrenal gland. The cells of the adrenal medulla, also
- arranged in small cords, are modified postganglionic sympathetic neurons that have lost their axons and dendrites during development. Instead, they have become secretory cells that synthesize and secrete catecholamines (primarily epinephrine and norepinephrine
- Preganglionic axons of the sympathetic neurons innervate the adrenal medulla cells, which are
- surrounded by an extensive capillary network. As result, the release of epinephrine and norepinephrine from the adrenal medulla is under direct control of the sympathetic division of the
- autonomic nervous system.

# FUNCTIONAL CORRELATIONS ADRENAL GLAND CORTEX AND MEDULLA

- Adrenal Gland Cortex:
- The adrenal gland cortex is under the
- influence of the pituitary gland hormone ACTH
- (adrenocorticotropic hormone). Cells of the
- adrenal gland cortex synthesize and release three
- types of steroids:
- mineralocorticoids,
- glucocorticoids,
- androgens.
- The cells of the zona glomerulosa in the adrenalcortex produce mineralocorticoid hormones,
- primarily aldosterone.
- Aldosterone release is initiated via the reninangiotensin
- pathway in response to decreased arterial blood pressure and low levels of sodium in the plasma.

- CONT.
- Aldosterone has a major influence on fluid and electrolyte balance in the body, with the main target being the distal convoluted tubules in the kidneys. The primary function of aldosterone is to increase sodium reabsorption from the
- glomerular filtrate by cells in the distal convoluted tubules of the kidney and increase potassium excretion into urine
- As water follows sodium, there is an increase in fluid volume in the circulation. The increased volume increases blood pressure and restores
- normal electrolyte balance. The cells of the zona fasciculata—and probably
- those of the zona reticularis—secrete glucocorticoids,of which cortisol and cortisone are
- the most important. Glucocorticoids are released into the circulation in response to stress.
- Although the cells of the zona reticularis are believed to produce sex steroids, they are mainly weak androgens and have little physiologic significance. Glucocorticoid secretion, and the secretory functions of zona fasciculata and zona reticularis, are regulated by feedback control from the pituitary gland and adrenocorticotropic hormone (ACTH).

- ADRENAL GLAND MEDULLA :

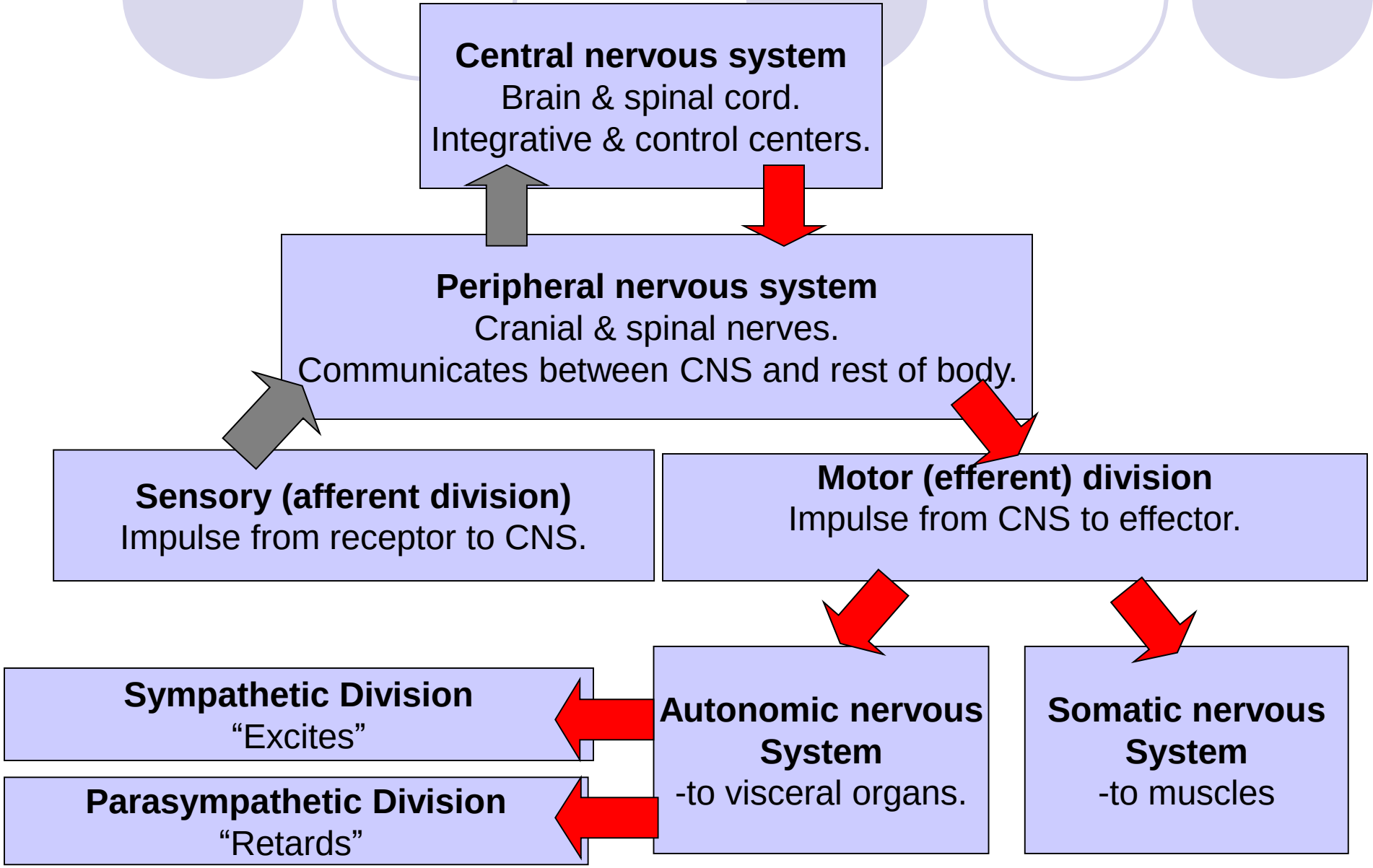
- The functions of the adrenal medulla are
- controlled by the hypothalamus through the sympathetic division of the autonomic nervous system. Cells in the adrenal medulla are activated
- in response to fear or acute emotional stress,
- causing them to release the catecholamines
- epinephrine and norepinephrine.

Nerve Tissue & the Nervous system I

# Nervous Tissue

- 2 cell types:
  - Nerve cells (neurons)
    - receive or transmit impulses
    - interconnections (at least 1000 each)
  - Neuroglial cells
    - more numerous than neurons
    - support neurons in various ways
- Capillaries
- No lymphatics!

# Organization of the Nervous System



# Introduction:

**The nervous tissue is composed of interconnecting network of specialized cells called *neurons* (nerve cells) supported by *neuroglial cells*. There are about 10 million neurons in human beings. The function of neurons is to receive stimuli and conduct them to a central site, the central nervous system (CNS), where they are analysed and integrated to produce a desired response in the effector organs.**

## Structure of a neuron:

### Cell body/Soma/Perikaryon (5–150 _m):

- **The cell bodies of all neurons are situated in the grey matter of the CNS and in the ganglia of PNS.**
- **The cell body of a neuron contains the nucleus and the following cytoplasmic organelles and inclusions**

- ***Nucleus*—is large, euchromatic, spherical and centrally located.**
- ***Nissl bodies* or *Nissl substance*—are composed of large aggregations of rough endoplasmic reticulum:**

# Table Shows Types Of Glial Cells

| *Glial Cell Type* | *Location* | *Main Functions* |
|---|---|---|
| Oligodendrocyte | Central nervous system | Myelin production, electric insulation. |
| Neurolemmocyte | Peripheral nerves | Myelin production, electric insulation. |
| Astrocyte | Central nervous system | Blood-brain barrier, metabolic exchanges. |
| Ependymal cells | Central nervous system | Lining cavities of central nervous system. |
| Microgl ia | Central nervous system | lmmune-related activity |
| Satellite Cells | Peripheral nerves | Supportive role. |

***Dendrites:*** ***Fig.(2)***

- **Are highly branched, tapering processes of a neuron. So their diameter is not uniform.**
- **Are covered by thorny spines (gemmules) which are sites of synaptic contact.**
- **Receive stimuli from sensory cells and other neurons and transmit them towards the soma. So they can be regarded as major sites of information input into neuron.**

***Axon:*** ***Fig.(2)***

- **Single, long, cylindrical process of a neuron. So its diameter is uniform.**
- **Does not branch profusely; but may give rise to collaterals.**
- **Arises from a cone-shaped portion of the cell body called *axon hillock,* which is devoid of Nissl bodies, but contains bundles of microtubules.**
- **The cytoplasm of the axon is called *axoplasm* and the plasma membrane is called *axolemma.***
- **Terminates by dividing into many small branches, *axon terminals,* ending in small swellings—*terminal buttons.***
- **Conducts impulses away from the cell body to the axon terminals from which impulses are transmitted to another neuron or another target cell.**
- **Axons are commonly referred to as *nerve fibers.***
- **Are often surrounded by *myelin sheath,* which is derived either from Schwann cells (PNS) or oligodendrocytes (CNS).**
- **When an axon is cut, peripheral part degenerates.**
- **Regeneration of the axon is possible only when the cell body of the neuron is intact.**

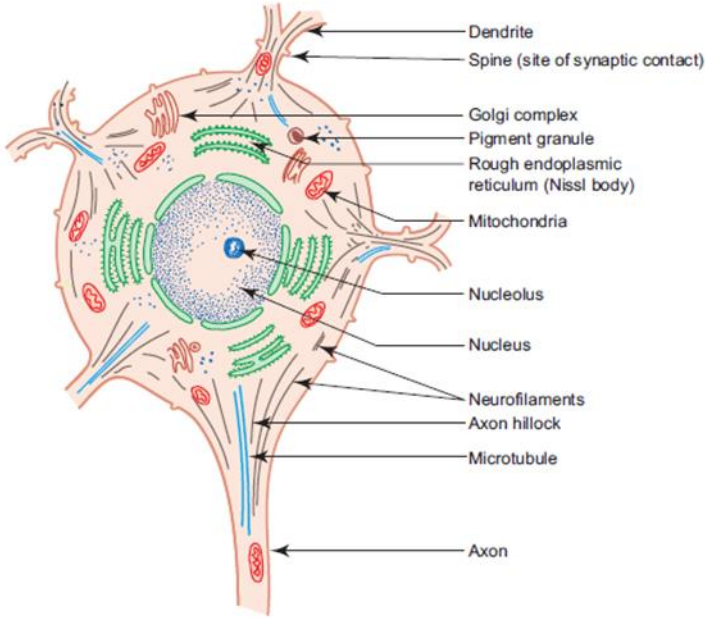



*Fig 1:Ultrastructure of neuron*

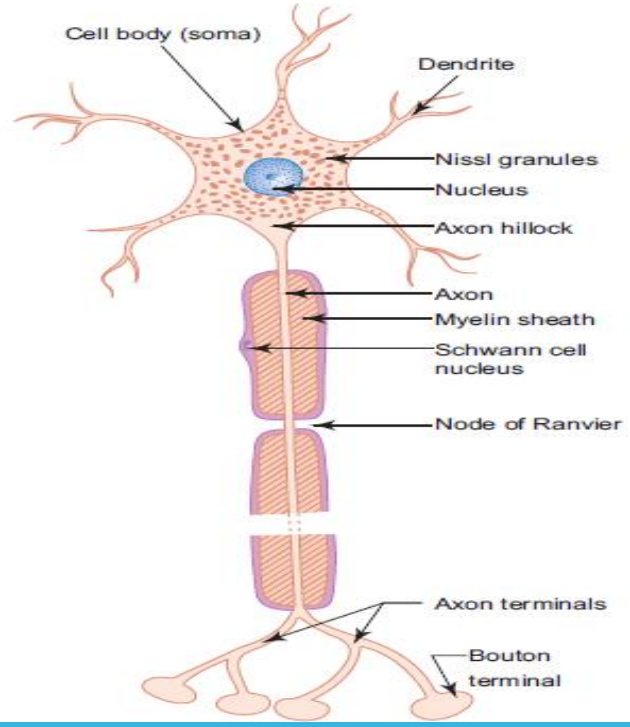



*Fig.(2):Structure of a neuron*

# Classification of Neurons:

## *A. Morphological (based on the number of processes)*

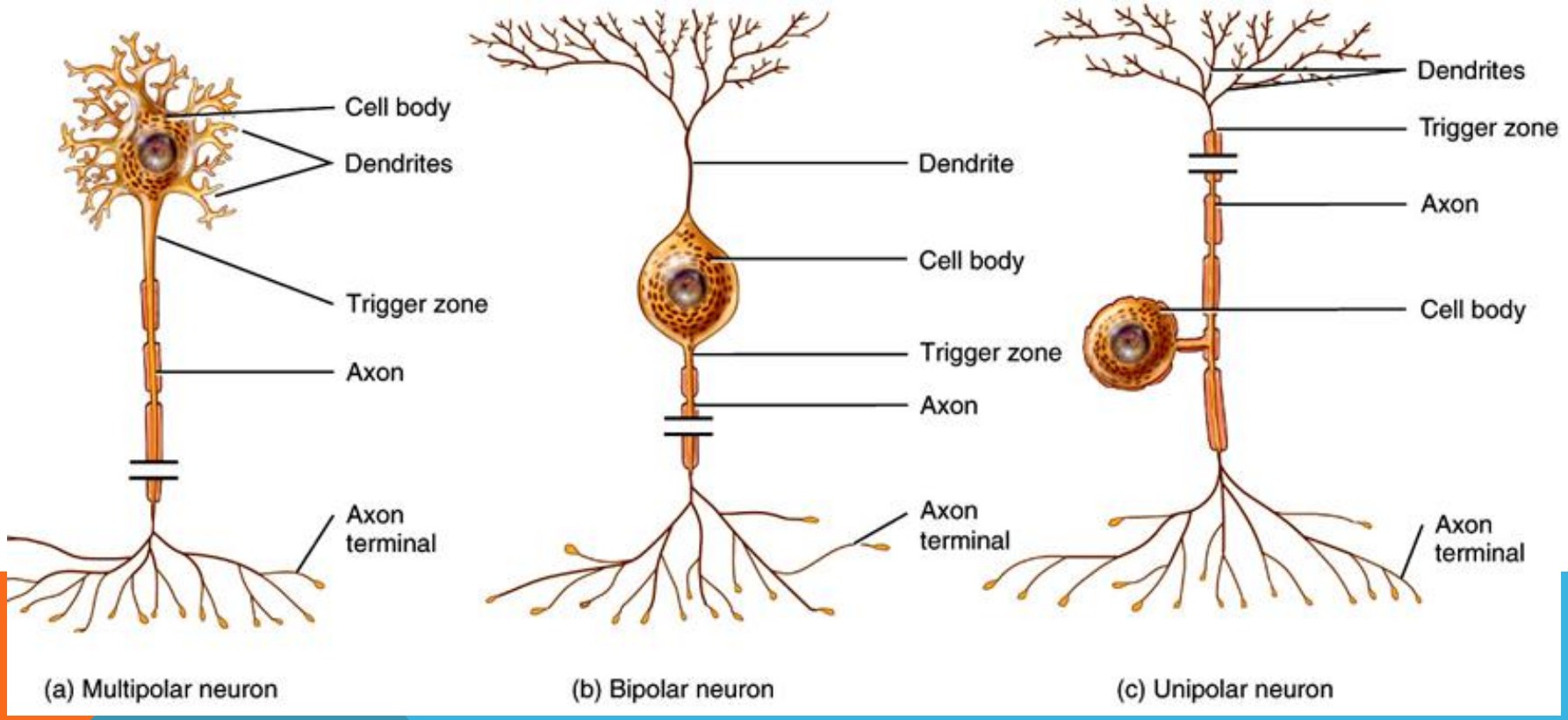
***1. Unipolar neuron***—has a single process (rare), e.g. *mesencephalic nucleus of V cranial nerve*.

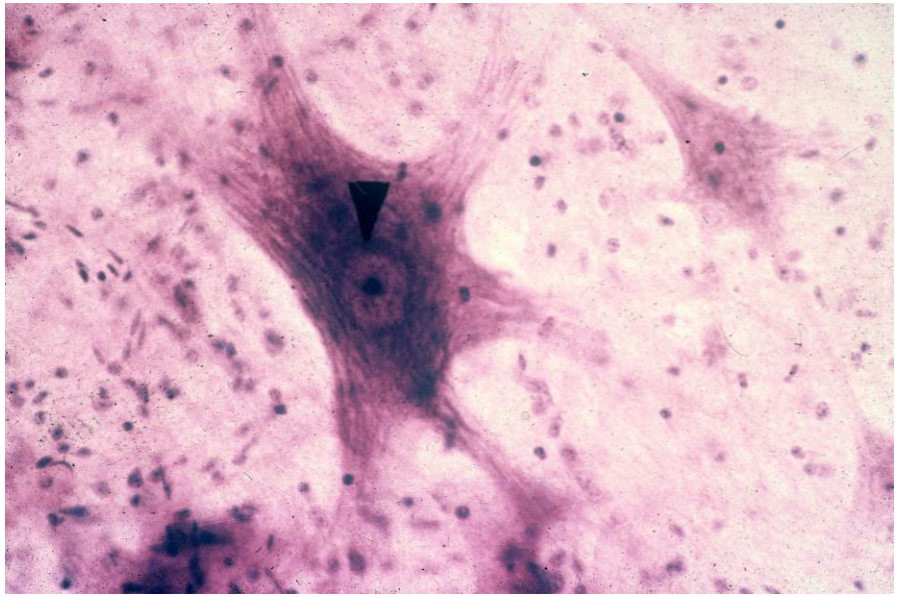
**2. *Bipolar neuron***—has two processes (an axon and a dendrite; fig.(3)), e.g. *spiral ganglion*, bipolar cells in *retina* .

**3. *Multipolar neuron***—has many processes (an axon and many dendrites; Fig. (4)), e.g. *autonomic ganglia motor neurons*

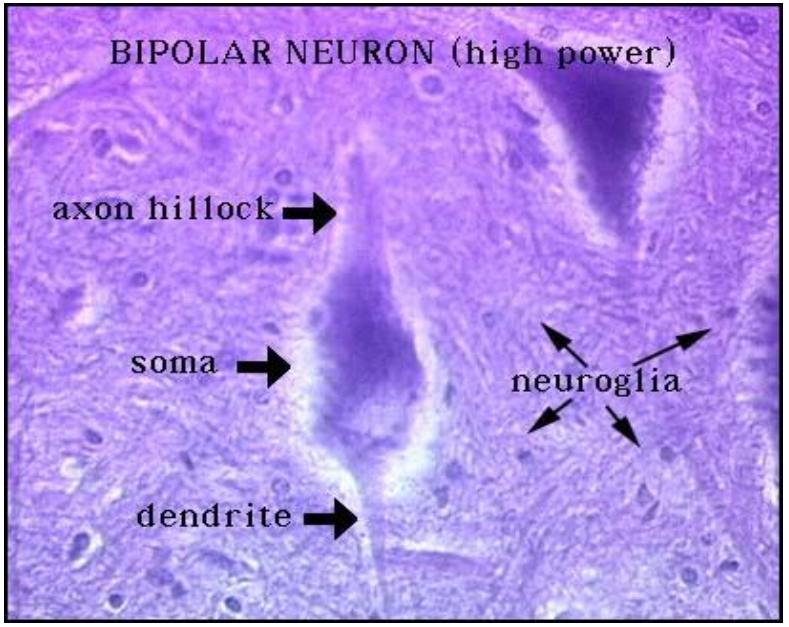
**4. *Pseudo-unipolar neuron***—has a single process that divides into an axon (central process) and a dendrite (peripheral process; Fig. (5)), e.g. *cranial* and *spinal ganglia* (*sensory neurons*

# STRUCTURALCA LSSIFICATION OF NEROUN

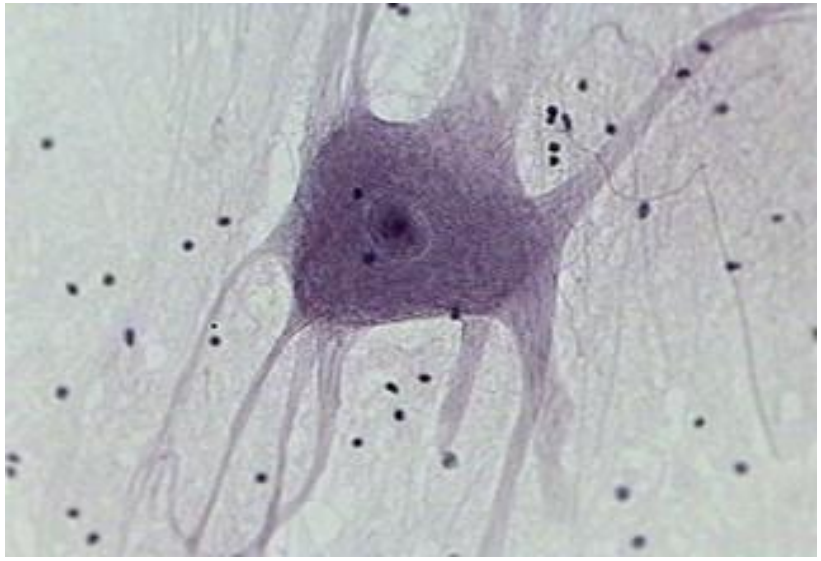




Nerve Cell Body with dark staining Nissl

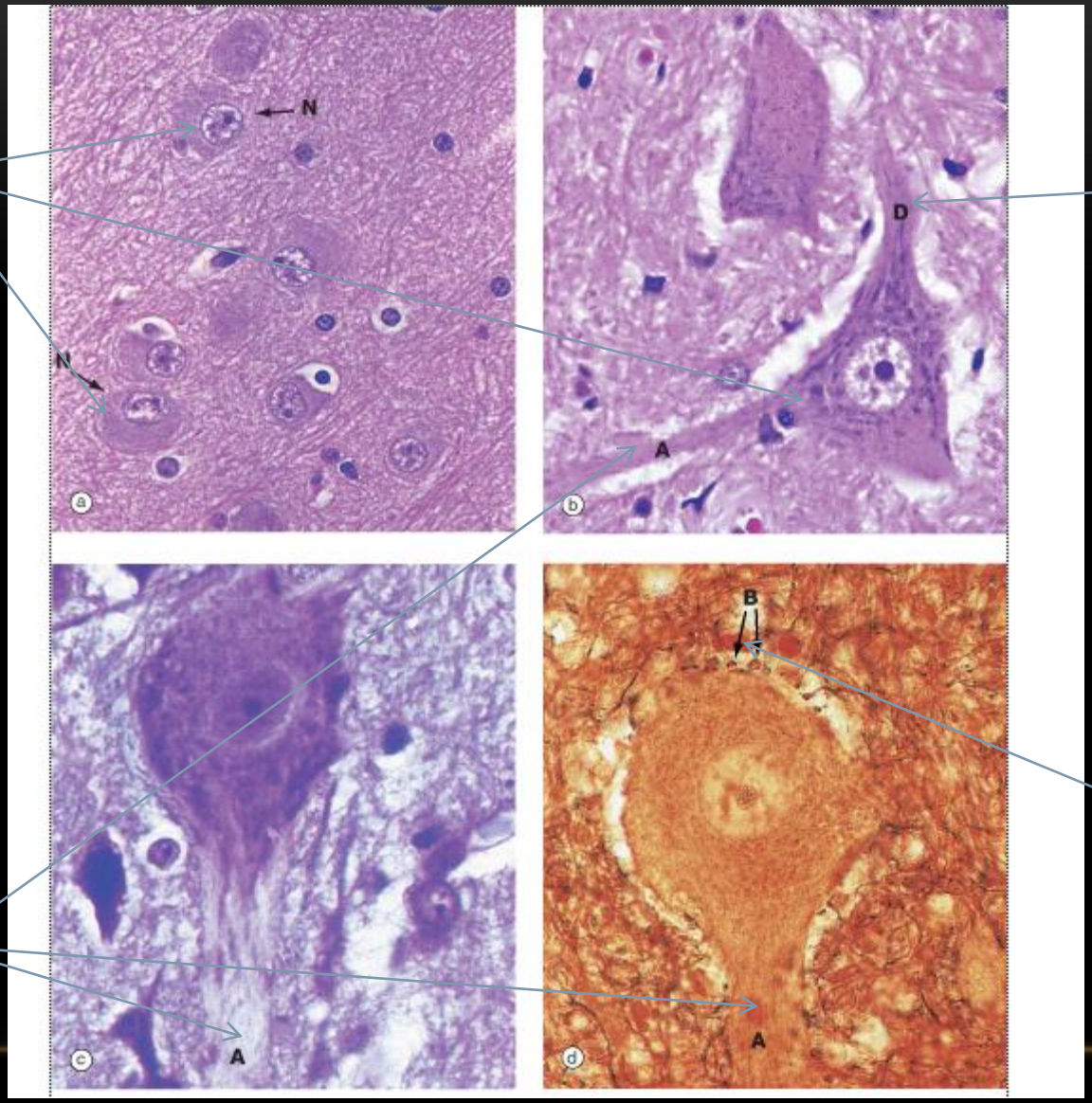



Bipolar Neuron



Multipolar

# Neurons with different staining methods




Neuron N

Dendrite D

Terminal bouton B

Axon A

## *B. Functional (based on the function performed):*

***1. Sensory neuron*—receives stimuli from receptors and conducts impulses to CNS, e.g. *sensory ganglia.***

***2. Motor neuron*—conducts impulses from CNS to effecter organs (muscles), e.g. *ventral horn cells.***

***3. Interneuron*—connects sensory and motor neurons and completes the functional circuit.**

***Synaptic Communication:***

- **The synapse( Gr. Synapsis , union) is responsible for the transmission of nerve impulses from neuron to another cell and insure that transmission is unidirectional.**
- **The function of the synapse is to convert an electrical signal (impulse) from the pre synaptic cell into a chemical signal that acts on the postsynaptic cell. Most synapses transmit information by releasing neurotransmitters.**

***A synapse has the following structure:***

**Presynaptic axon terminal (terminal button) from which neurotransmitter is released,**

- **Postsynaptic cell membrane with receptors for the transmitter and ion channels or other mechanisms to initiate a new impulse.**
- **synapses between neurons may be classified morphologically as:**

- ***axodendritic,* occurring between axons and dendrites;**
- ***axosomatic,* occurring between axons and the cell body**
- ***axoaxonic,* occurring between axons and axons**

*1-Neurons*

*2-Muscle*

*3-Glands*

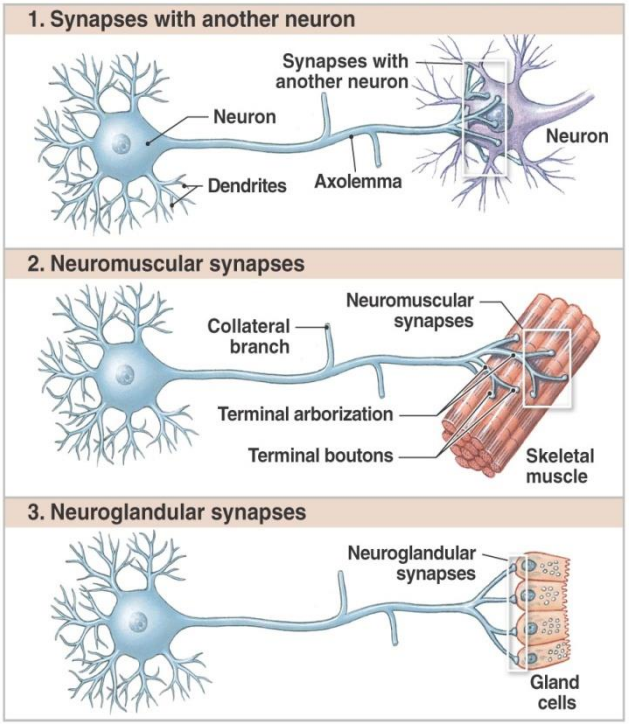



***Fig.( 6)***

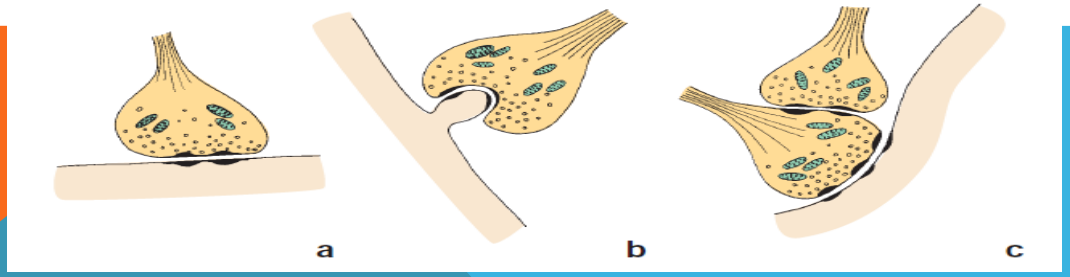



***Fig.(Types of Neuroneural Synapses***

## CONT.

- **The neurotransmitter carries the impulse across the space (the synapse) and onto the next neuron, or onto the organ the impulse is meant to stimulate.**
- **Some examples of neurotransmitters are :**

- **Acetylcholine .**
- **Dopamine , endorphins**
- **Serotonin ,and**
- **Norepinephrine .**

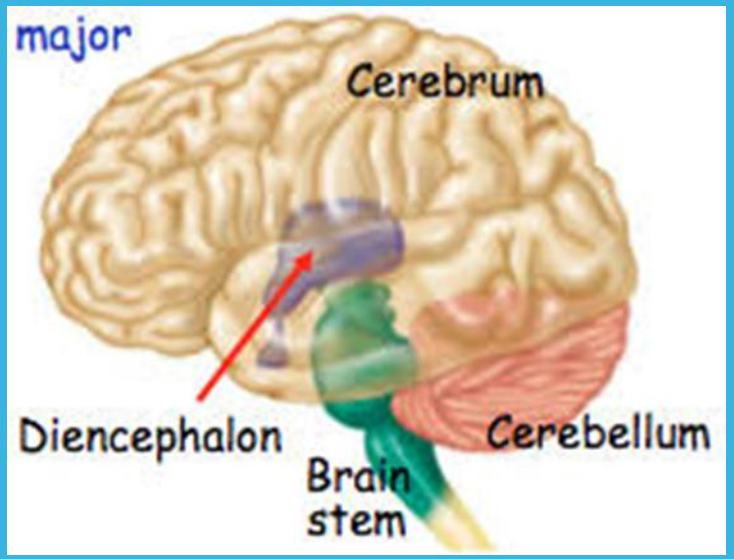
***These neurotransmitters have a variety of functions, including muscle movement, mood, and stress release.***

المشبك العصبي العضلي

# Central Nervous System

- Spinal cord (Medulla Spinalis)
- Brain

–gray matter
–white matter
–no intervening conn. tissue



# CNS

- The principal structures of the CNS are the cerebrum, cerebellum, and spinal cord.
- It has virtually no connective tissue and is therefore a relatively soft, gel-like organ.
- When sectioned ,the cerebrum ,cerebellum, and spinal cord show regions of white (white matter) and gray (gray matter), differences caused by the differential distribution of myelin

**White matter;**

- Myelinated/ few unmyelinated nerve fibers
- Glia
- Capillaries
- White color results from the myelin

**Gray matter;**

- Neuronal cell bodies
- Dendrites
- Initial unmyelinated portions of axons
- Glia
- Capillaries

Neuropil??

- network of the axons, dendrites and neuroglial processes in the gray matter

Nuclei???

- aggregations of neuron cell bodies embedded in white matter
- counterpart of ganglia

# Types of Nerve Cells

## *1. Pyramidal cells*

- **Are the most common type of neurons found in the cerebral cortex.**
- **Are pyramidal in shape.**
- **Their size ranges from 10 µm to 120 µm.**
- **The apices of the neurons give rise to dendritic processes which are directed towards the surface of the cortex, whereas the bases give origin to axons which forms projection fibers of the white matter.**
- **They are distributed in layers, 2–5, and progressively increase in size.**

## *2. Stellate/Granule cells*

- **Small, star-shaped neurons of uniform diameter (8 µm).**
- **Have short axons terminating in nearby neurons.**

## *3. Fusiform cells*

- **Spindle-shaped cells placed at right angles to the surface in the deep layer.**
- **Dendrites arise from each pole of the cell body and axon arises from the cell body just above the**

## •Spinal Cord

•gray matter lies centrally where it forms an H shape in cross-section

•white matter is located in the periphery

•Gray matter

–the butterfly-shaped (H-shaped) area in cross-section

•White matter

•Central canal

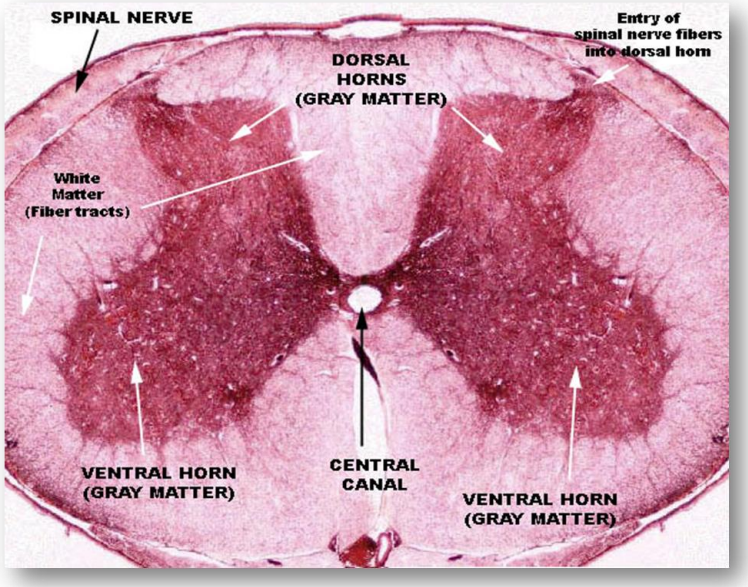
## Brain

•gray matter

–periphery (cortex) of the cerebrum and cerebellum

–basal ganglia

•white matter lies deep to the cortex



•**Dorsal (posterior) horns:**

–the upper vertical bars of the H

–receive central processes of the sensory neurons whose cell bodies lie in the dorsal root ganglion

–contain cell bodies of interneurons

•**Ventral (anterior) horns:**

–the lower vertical bars of the H

–house cell bodies of large multipolar somatomotor neurons whose axons make up the ventral roots of the spinal nerves

•**Intermediary column:** visceromotor neurons

# Central canal

•remnant of the lumen of the embryonic neural tube

•lies in the center of the crossbar of the H

•lined by low columnar- cuboidal cells (ependymal cells)

# CEREBRAL CORTEX

***1. Molecular layer*** **(plexiform layer)—is the most superficial, well defined layer. It consists mainly of nerve fibers and occasional *horizontal cells of Cajal.***

***2. External granular layer*—contains large number of *stellate cells* and *small pyramidal cells.***

***3. External pyramidal layer*—is mainly made of medium sized *pyramidal cells* and also contains few *stellate cells* and *cells of Martinotti.***

***4. Internal granular layer*—is composed of closely packed *stellate cells* and horizontally oriented white fi bre band called *outer band of Baillarger.***

***5. Internal pyramidal layer*** **(ganglionic layer)—consists mainly of *large pyramidal cells* and few *stellate cells* and *cells of Martinotti.* This layer also contains horizontally arranged fi bres that form the *inner band of Baillarger.***

**6. *Multiform layer* (layer of polymorphic cells)—is the deepest layer. It contains predominantly *fusiform cell* and also few *stellate cells* and *cells of Martinotti* intermixed with many nerve fibers entering or leaving the underlying white matter.**

## ***Cerebellar Cortex***

### ***Gneral Cortex:***

- **The cortex of cerebellum is highly folded. The *folds* or *folia* are separated by closely set parallel transverse fissures.**

**Each folium contains a core of white matter covered superficially by grey matter or cortex**

### ***Structure:***

**The cerebellar cortex consists of three layers; an external molecular layer, a middle Purkinje cell layer and an internal granular layer :**

***1. Molecular layer***

- **Is the superfi cial thick layer and is usually lightly stained with eosin.**
- **Mainly made of nerve fi bres and few cells, namely, *stellate cells* in the superfi cial part and *basket cells* in the deeper part.**
- **The axons of these cells run parallel to the long axis of the folia. The axons of basket cells form collaterals which arborize around the Purkinje cells in a 'basket-like' manner.**

***2. Purkinje cell layer***

***Purkinje cells* are large flask-shaped neurons (*Golgi type I*) and are arranged in a single row between *molecular* and *granular* layers.**

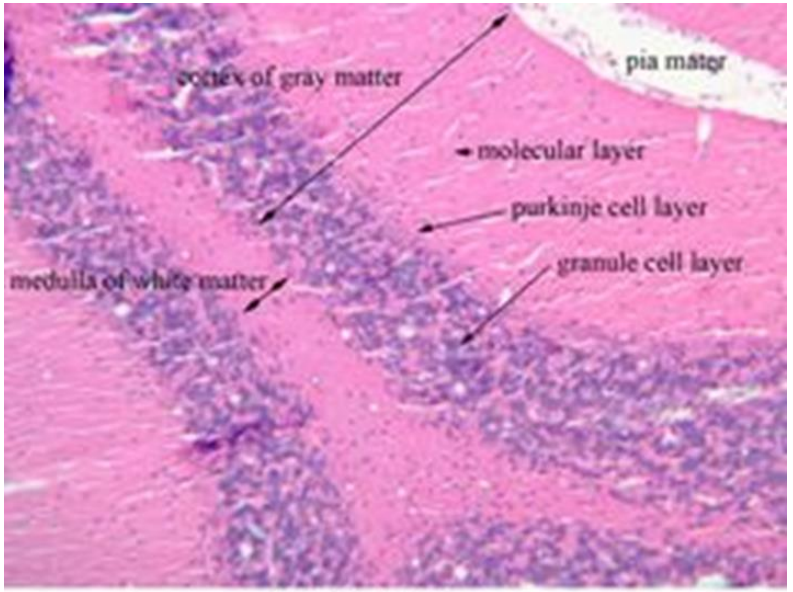
**The dendrites of these cells pass into molecular layer and arborize profusely in a plane transverse to the folium. These dendrites synapse with axons of granular cells**

**The axons of Purkinje cells pass through the granular layer to end in deeper nuclei of cerebellum.**

***3. Granular layer***

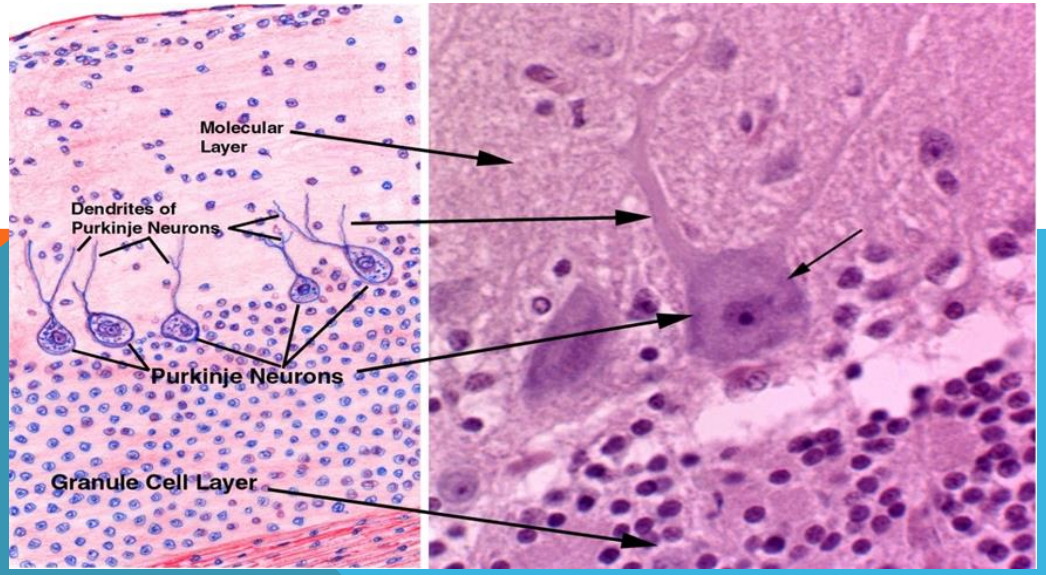
**Is stained deeply with hematoxylin because it is densely packed with very *small granule neurons* . The axons of these granule cells pass into the molecular layer where they bifurcate in a T-shaped manner and run at to the dendritic processes of the Purkinje cells and synapse with them. Few *Golgi cells* (type II) are also present in the granular layer.**

# CEREBELLUM


human cerebellum

***cerebral cortex***



# peripheral nervous system PNS

# PNS

**The peripheral nervous system PNS, consists of nerves, ganglia, and nerve endings. The ganglia are nodular masses of neuronal cell bodies (ganglion cells), together with their supporting peripheral neuroglia, capsule cells or satellite cells. There are two kinds of ganglia in the PNS- sensory ganglia which contain cell bodies of sensory (afferent neuron), and autonomic ganglia, which contain cell bodies of certain efferent neurons of the autonomic nervous system. The sensory ganglia include the cranial ganglia, which are associated with some of the cranial nerves, and the spinal ganglia, known as posterior (dorsal) root ganglia, which are associated with posterior root of the spinal nerves.**

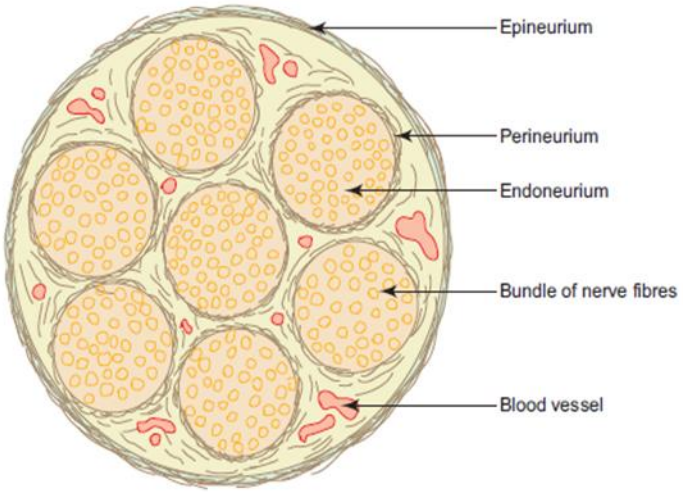
**Peripheral nerves consist of bundles of nerve fibers (myelinated and unmyelinated). Afferent fibers and efferent fibers are both present in most nerves. Afferent nerve endings are a part of sensory receptors, and efferent nerve endings are found on muscle fibers, secretory cells of exocrine glands, and fat cells of adipose tissue**

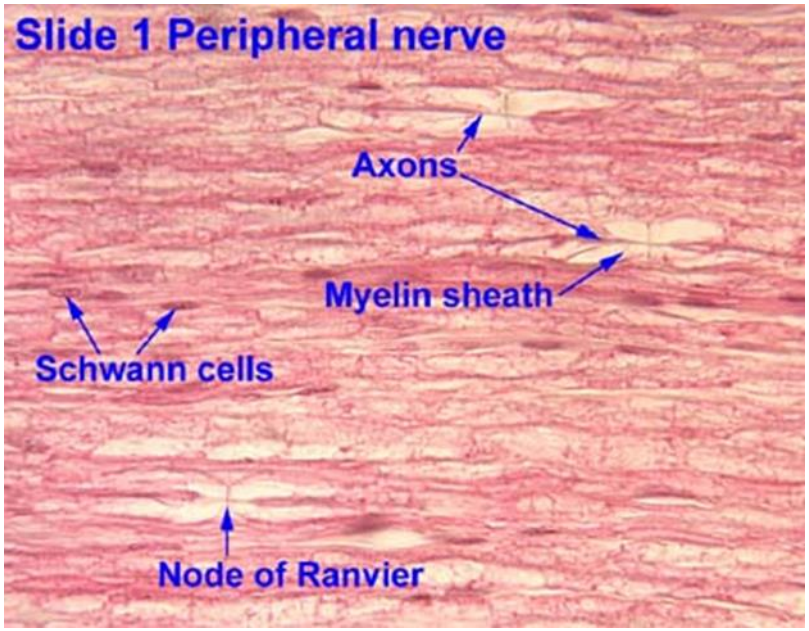
- **In the PNS, all axons are enveloped by Schwann cells which provide both structural and metabolic support.**
- **Many axons with small diameter invaginate into one Schwann cell longitudinally and are simply surrounded by the cytoplasm of Schwann cells. They are called *unmyelinated* nerve fibres.**
- **Myelination begins with the invagination of the axon into the Schwann cell. The invaginated axon is suspended from the periphery of the cell by a fold of fused plasma membrane called *mesaxon***

## Peripheral Nerve:

- **Each peripheral nerve (spinal or cranial) is made of bundles (fascicles) of nerve fibres (axons) which may be myelinated and/or unmyelinated.**
- **The bundles are held together by connective tissue which provides structural support as well as nutritional support by carrying blood vessels to nerve fibres.**
- **The connective tissue framework is well appreciated in cross section of a nerve, where following structures can be observed:**
  - ***Epineurium:*** Dense connective tissue sheath surrounding the entire nerve.
  - ***Perineurium:*** A sleeve of fl attened specialised epithelial cells surrounding the bundles of nerve fibres.
  - ***Endoneurium:*** Loose connective tissue composed of reticular fibers supporting individual nerve fibers.

# *PERIPHERAL NERVE*



# GANGLIA

## *Spinal ganglia*

**Ganglion cells have the typical features of neurons, i.e. large rounded cell body, intense cytoplasmic basophilia with fine Nissl bodies, The nucleus is large spherical pale staining with prominent nucleolus and is centrally located. Lipofuscin pigment may be present in the cytoplasm. A layer of flat capsule cells or satellite cells invest the cell body. The satellite cells are the neuroglial cells in the peripheral nervous system. The ganglion cells and the satellite cells are both derived from the neural crest and are supported by connective tissue framework and a capsule.**

**The ganglion cells are pseudounipolar neurons, therefore in a tissue sections they appear as rounded because the processe was not in the plane of the section.**

## *Autonomic Ganglia*

**Autonimc ganglia are bulbous dilatations appear in the autonomic nerves. Some are located within certain organs, especially in the walls of the digestive tract, where they constitute the intramural ganglia. In autonomic ganglia the margins of the ganglion cells are indistinct because they are multipolar. The cytoplasm is basophilic with fine Nissl granules with eccentrically situated nucleus. The satellite cells are discontinuous unlike their counterpart of the spinal ganglia. The nucleus of the ganglion cell bodies has an eccentric position. The connective tissue capsule is not prominent**

# *NERVE ENDINGS (RECEPTORS)*

**Nerve receptors are distributed throughout the body, mainly in the skin. Two types of nerve endings have been identified**

- ***Free Nerve Endings***
- ***Encapsulated Nerve Endings***

***Free Nerve Endings***

**Free nerve endings are situated in the deeper layer of the epidermis and in the papillary layer of the dermis. They are supplied with afferent nerve endings that are free of investing Schwann cells. They are *sthermoreceptor, nociceptors* and *the mechanoreceptors* that are related to the hair follicles**

**Encapsulated Nerve Endings**

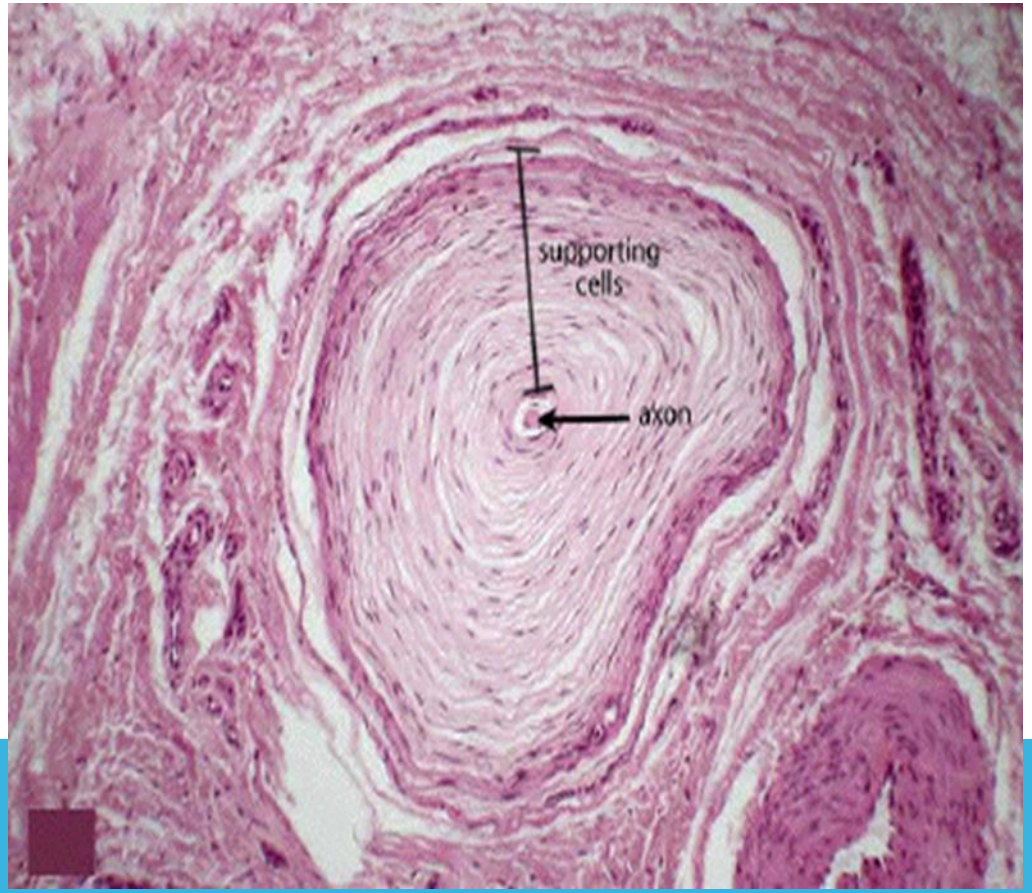
**These are:**

- **Pacinian Corpuscles**
- **Meissners Corpuscles**
- **Ruffini Corpuscle**
- **Krause end bulb**

# *NERVE ENDINGS (RECEPTORS*

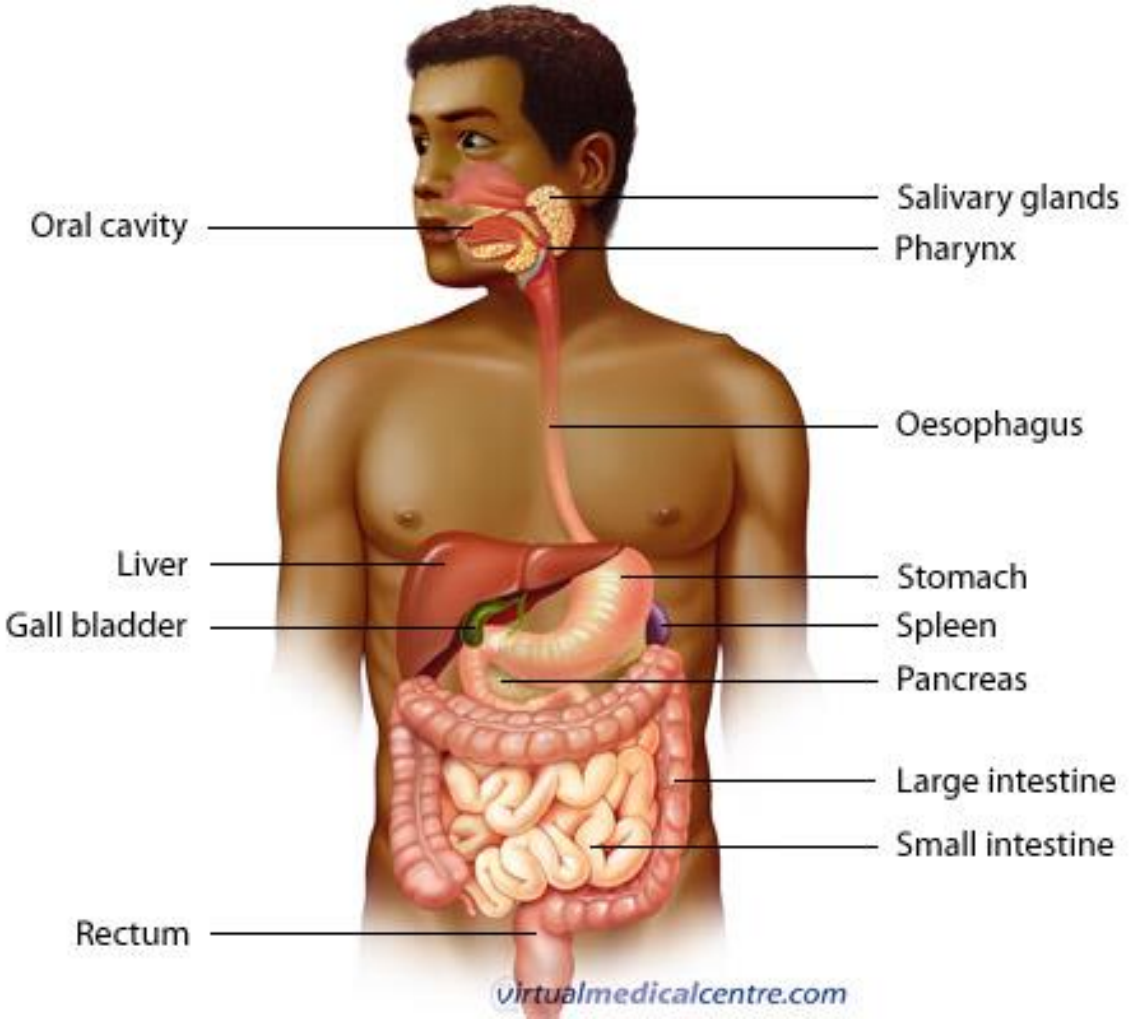
***Meissner's corpuscles***


***Pacinian Corpuscles***

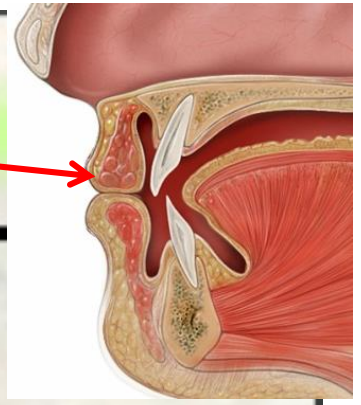


# Digestive Tract

- **Includes:**
  - **Mouth (oral cavity)**
  - **pharynx**
  - **Esophagus**
  - **Stomach**
  - **Small intestine**
  - **Large intestine**



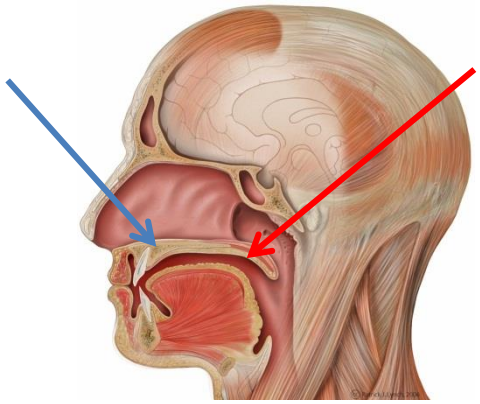
# The Lips

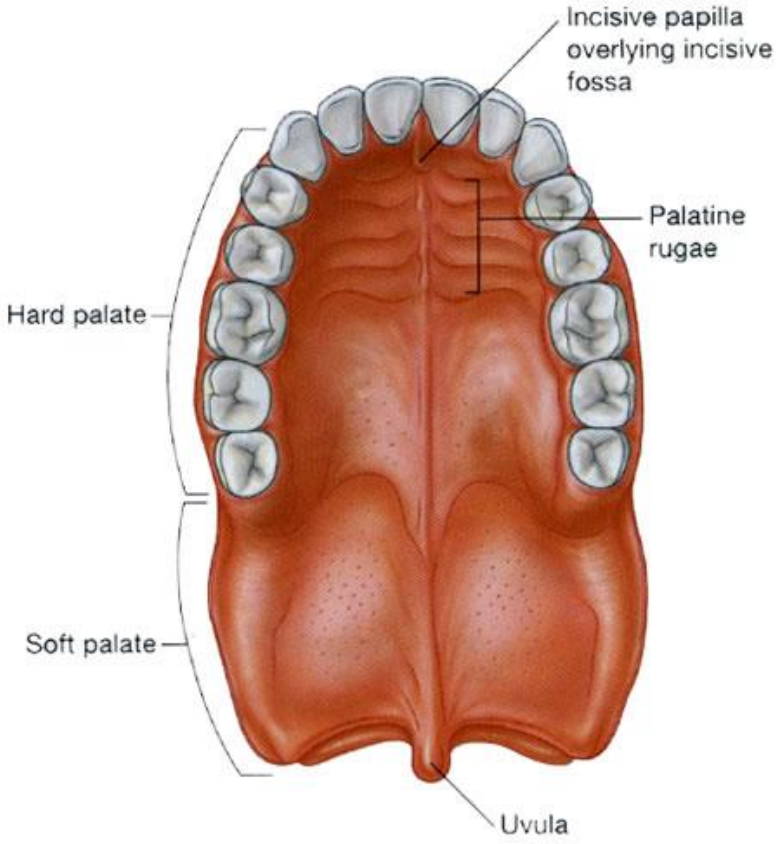


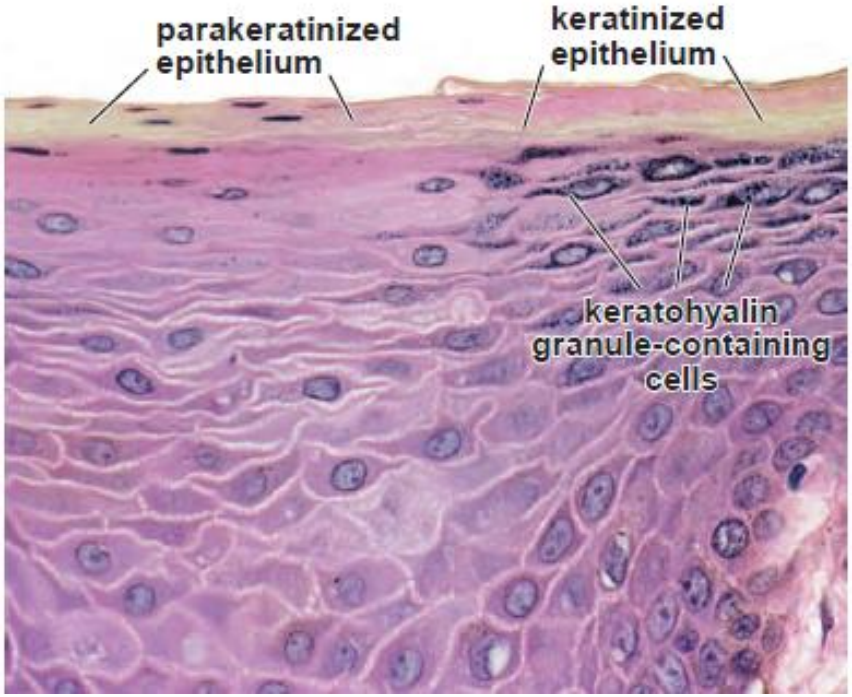
- The lip has 3 surfaces:

1) *External surface:* covered by thin skin.
2) *Internal surface*: stratified squamous non-keratinized epith + thin CT corium.
3) *Free red margin* (vermilion): non-hairy thin skin over a highly vascular area.

# HARD & SOFT PALATE





# Tongue

Fig. 14.8. Tongue (Panoramic view).1-Smooth under surface. 2-Filiform papilla. 3-Fungiform papilla. 4, 5-Skeletal muscle. 6-Serous gland. 7-Mucous gland. 8-Adipose tissue.

- **Mucosa:**
  - Dorsal rough surface → papillae
  - Ventral smooth surface mucosa.
- **Submucosa:** C.T + minor salivary glands.
- **Intrinsic tongue muscles (Skeletal):**
  - arranged in **3** separate planes: horizontal, vertical and longitudinal.

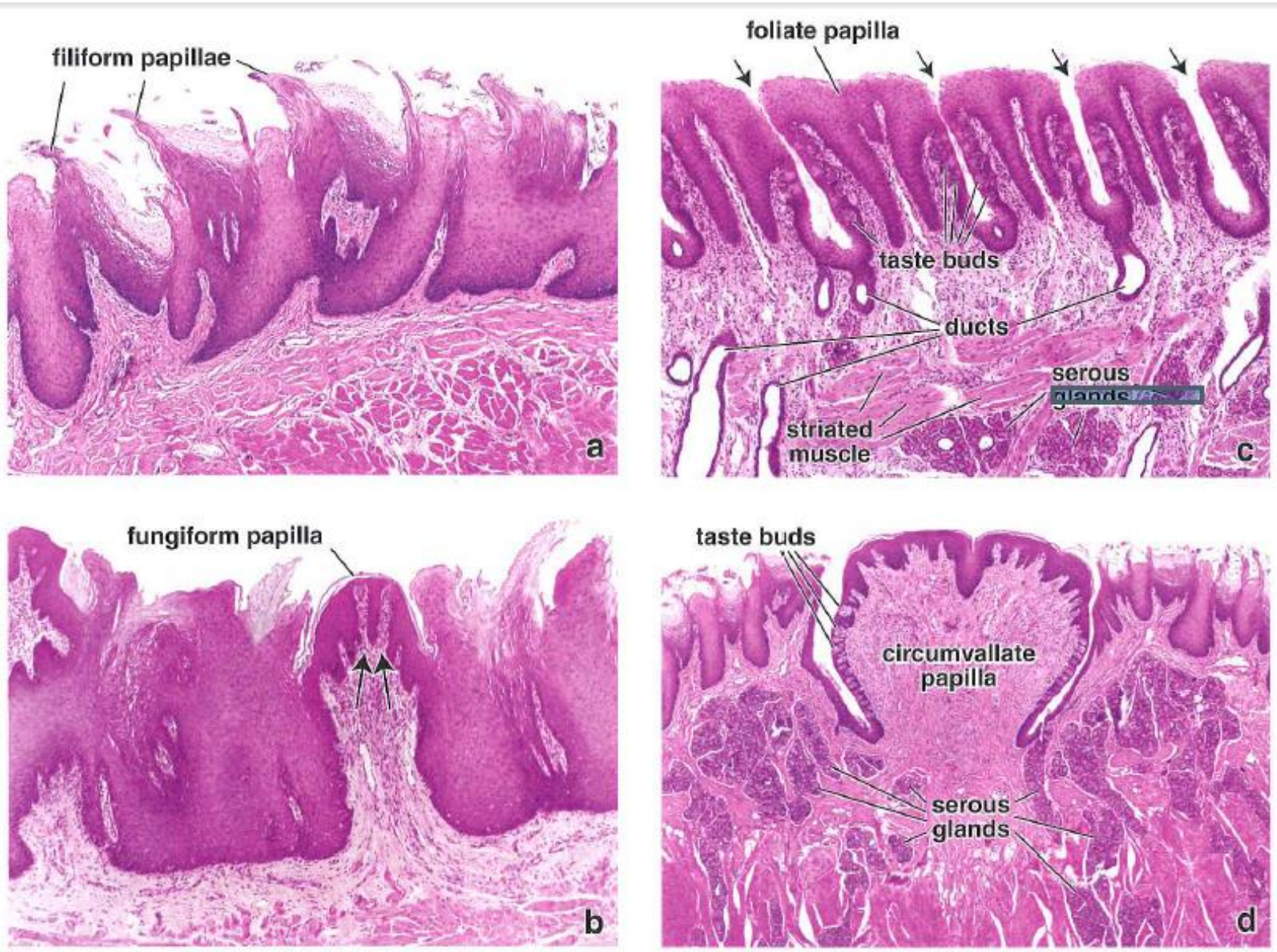



**FIGURE 15.4**

**a.** Structurally, the filiform papillae are posteriorly bent conical pro-

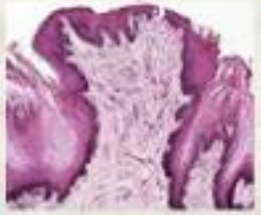
buds on their lateral surfaces. The free surface epithelium of each

# Lingual Papillae

*4 Types:*

*1- Filiform Papillae*

*2- Fungiform Papillae*

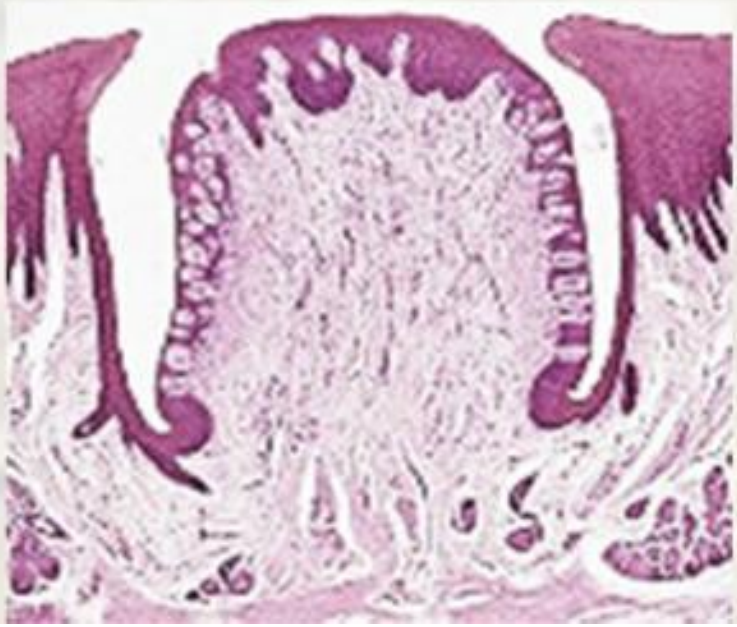


*3- Circumvallate Papillae*

*4- Foliate Papillae*

# Taste buds

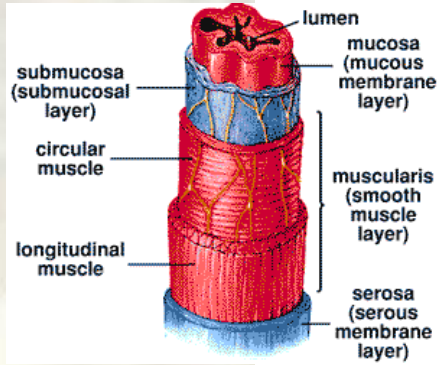
- Onion-shaped structures embedded in the surface of the *fungiform* and *circumvallate* papillae.



# General Structure of the Digestive Tract

The wall of digestive tube is composed of 4 layers *(from inner to outer):*

1) *Mucosa.*
   - epithelium overlying a CT. corium (lamina propria), followed by *muscularis mucosa*
2) *Submucosa.*
   - CT. of variable thickness ± glands
3) *Musculosa (or musculosa externa).*
   - *usually :* inner circular and outer longitudinal layers
4) *Adventitia (or serosa).*
   - outer layer of connective tissue. If it have a peritoneal covering it is called "serosa"



# The Esophagus

- Muscular tube, about 25 cm in length.
- Transports food from the mouth to the stomach and prevent its reflux
- Controlled via reflexes by the autonomic nervous system.
- Consists of the typical 4 layers: mucosa, submucosa, musculosa and adventitia "or serosa".

**1) Mucosa**

- Epithelium: Stratified squamous non-keratinized, contain Langerhans cells (APCs).
- C.T. Corium: contain mucus glands near the stomach called the *cardiac glands*.
- Muscularis Mucosa: longitudinal s. muscles become thicker near the stomach (act as a sphincter).

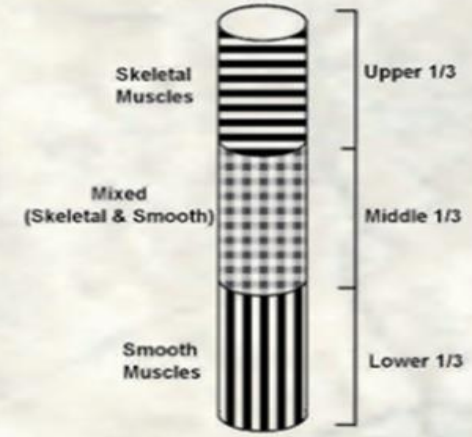
**2) Submucosa**

- Dense fibro elastic C.T.
- Contain *esophageal glands* which facilitate the transport of food and protect the mucosa.

# The Esophagus

## 3) Musculosa

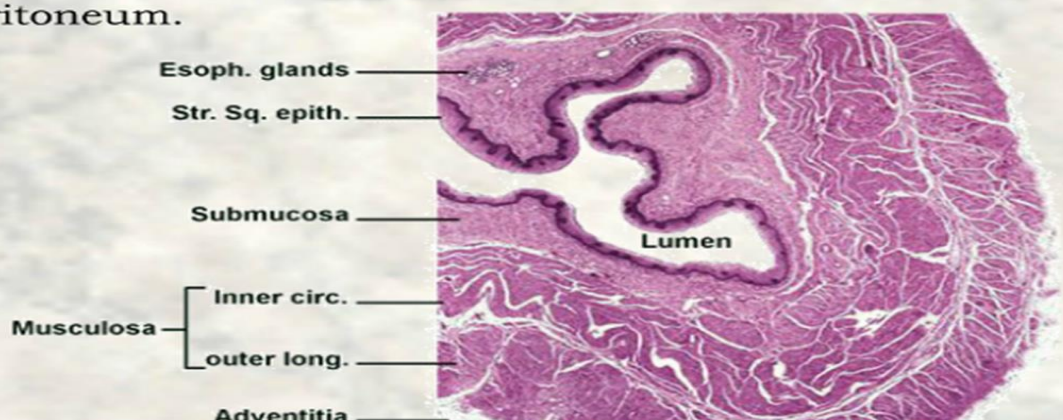
- Consists of inner circular & outer longitudinal layers with Auerbach's plexus in-between them.
- The type of muscle varies according to each region as follows:

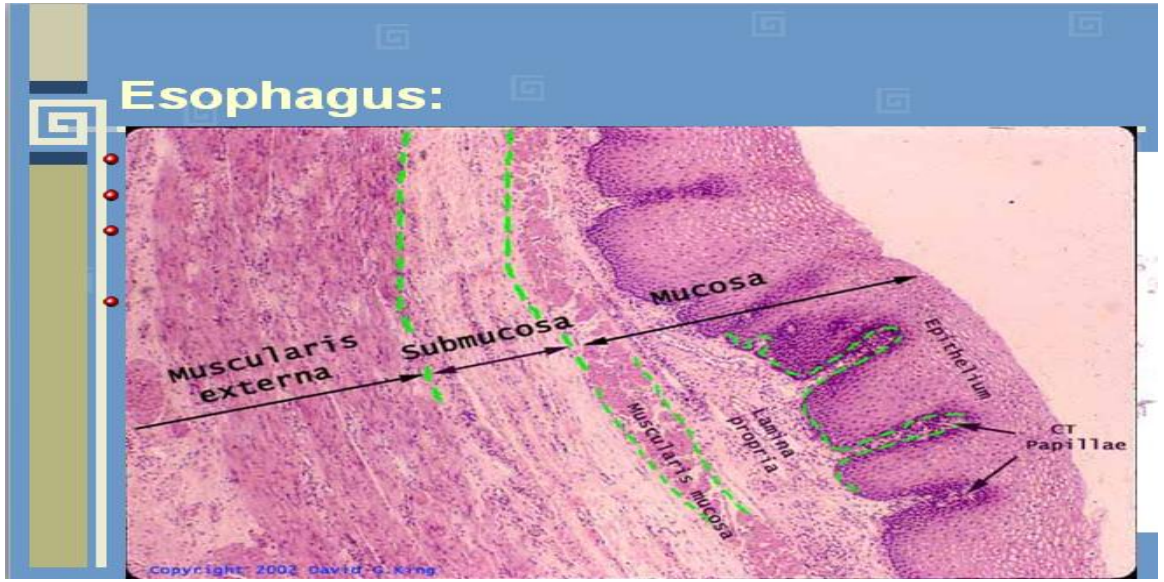
| | |
|---|---|
| **The upper third → skeletal m.** |  |
| **The middle third → mixed (skeletal and smooth m.)** | |
| **The lower third → smooth m.** | |

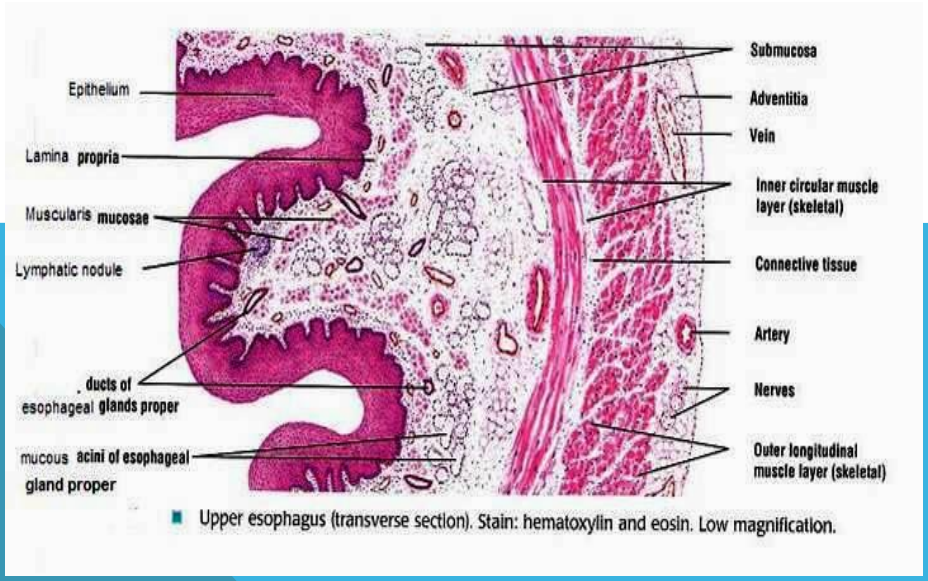


## 4) Adventitia "or Serosa"

- In the thoracic cavity it is the outer layer of connective tissue, below the diaphragm it is called "serosa" being covered by the peritoneum.





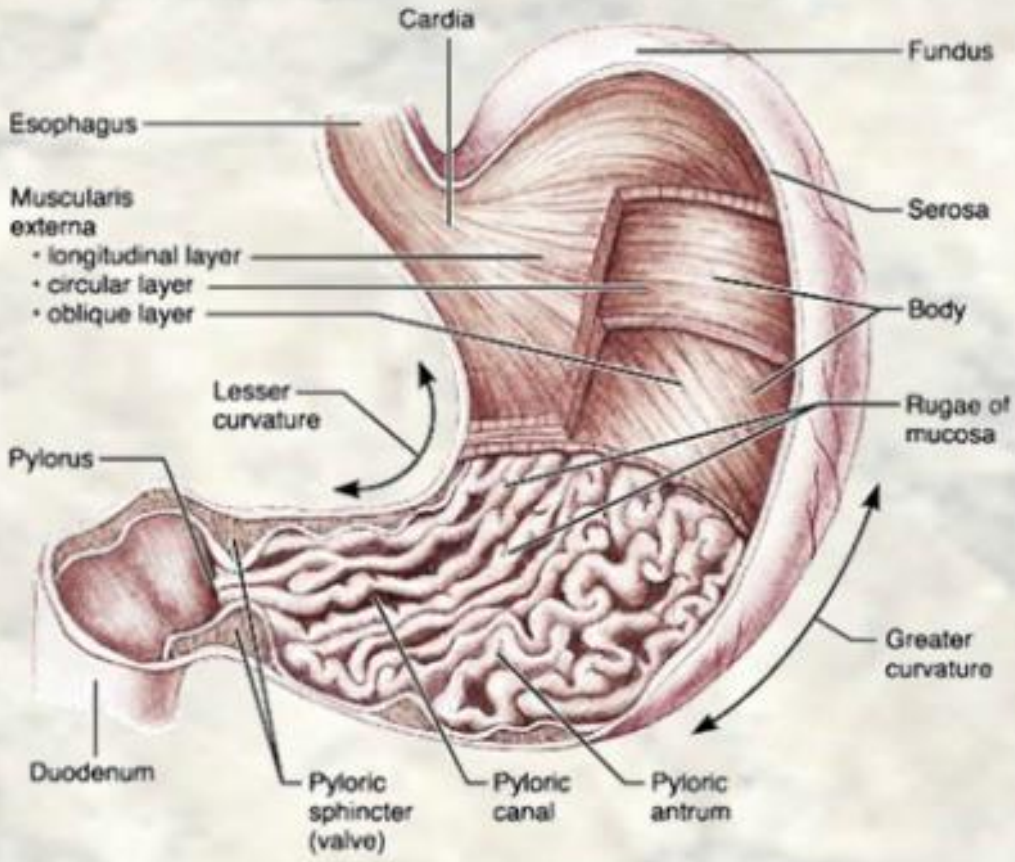

Upper esophagus (transverse section). Stain: hematoxylin and eosin. Low magnification.

# The Gastro-Esophageal Junction

- The stratified squamous epithelium of the esophagus suddenly changes to simple columnar in the stomach.
- The gastric pits start to appear.
- In the submucosa, the esophageal glands disappear.

# The Stomach

- The stomach, is a mixed exocrine & endocrine organ.
- Secretes hormones.
- It digests carbohydrates, proteins and triglycerides.



# The Gastric Mucosa

- It is covered with simple columnar epithelium that reach lamina propria, forming gastric pits.
- The covering epithelium secretes alkaline mucus (protective).
- Gastric glands are simple branched tubular, releasing their secretions into the gastric pits.
- It exhibits structural variation in 3 main regions: cardiac, fundus & body, and pyloric areas.

# The Gastric Mucosa

***1- At the Cardia***

- Narrow transition between the esophagus and the stomach.
- Its mucosa contains simple or branched tubular cardiac glands.
- Most of the secretory cells produce mucus and lysozyme (an enzyme which kills bacteria).
- Contain few parietal cells forming *HCl* in the lumen.

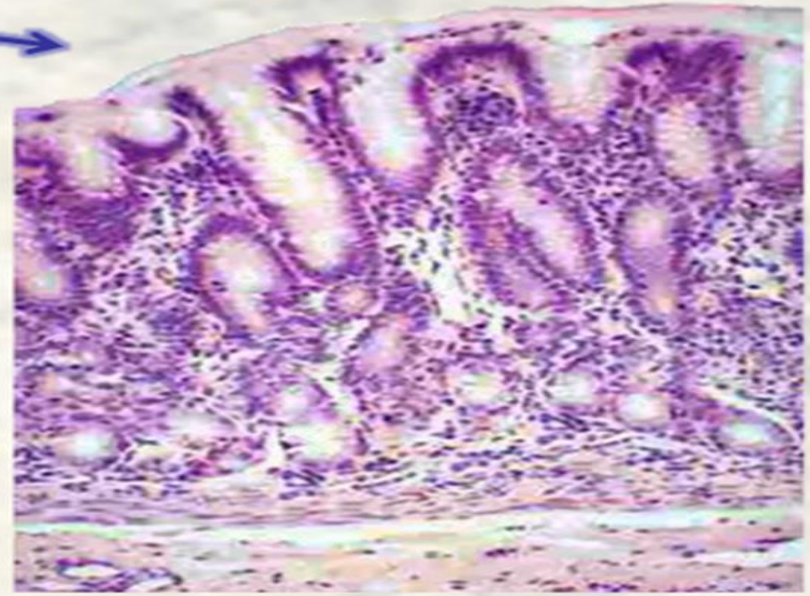
***2- At the Fundus & Body***

- The lamina propria shows branched tubular glands
- The bottom of each pit open into about 3-7 of these glands.
- Each gastric gland has 3 distinct regions: the isthmus, neck, and base

# The Gastric Mucosa

## 3- *The Pylorus*

- It has deeper gastric pits with branched, tubular pyloric glands.
- Glands have longer pits and shorter coiled secretory parts.
- These glands secrete mucus + lysozyme.



- Contains enteroendocrine cells called Gastrin (G) cells found among the mucous cells of pyloric glands.
- Enteroendocrine cells also include the (D cells) which secrete somatostatin
- Somatostatin secretion is stimulated by HCl.

# II- Gastric Submucosa

- The submucosa is composed of dense connective tissue containing blood and lymph vessels; it is infiltrated by lymphoid cells, macrophages, and mast cells.

# Gastric Musculosa & Serosa

## III- Musculosa

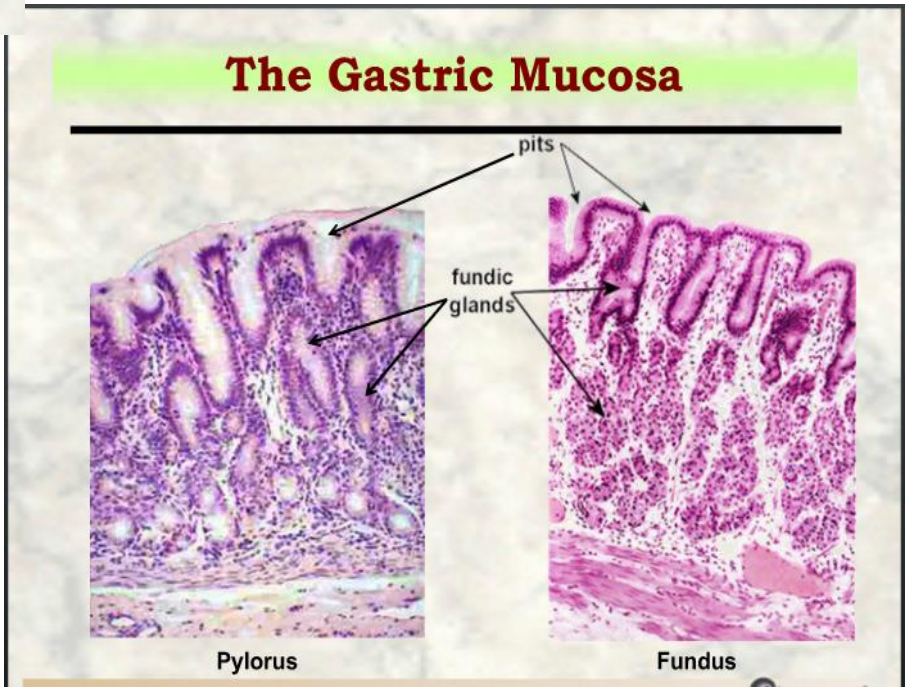
- The musculosa is composed of smooth muscle fibers oriented in three main directions: inner oblique, middle circular and outer longitudinal.
- At the pylorus, the middle layer is greatly thickened to form the pyloric sphincter.

## IV- Serosa

- This is a thin layer of CT protected by peritoneal covering.

## The Gastro-Esophageal Junction


## The Gastric Mucosa



# Small Intestine

The small intestine is a hollow organ of small diameter that is typically 6 to 7 m long. It is the major site for the absorption of nutrients. Important features of the small intestine are villi and microvilli, which increase surface area for absorption.

Each villus has a core of loose connective tissue that extends from the lamina propria and contains fibroblasts, smooth muscle fibers, lymphocytes and plasma cells, fenestrated capillaries, and a central lymphatic called a lacteal. Intestinal glands called glands (crypts) of Lieberkühn are located in the lamina propria of the small intestine. Villi project into the lumen of the intestine; the glands of Lieberkuhn open into the mucosa at the base of the villi.

Epithelial of small intestine are tall columnar cells, each with an oval nucleus located basally. The apical end of each enterocyte displays a prominent ordered region called the striated (or brush) border

Goblet cells are interspersed among the absorptive enterocytes.They secrete glycoprotein mucins that are then hydrated to form mucus, whose main function is to protect and lubricate the lining of the intestine.

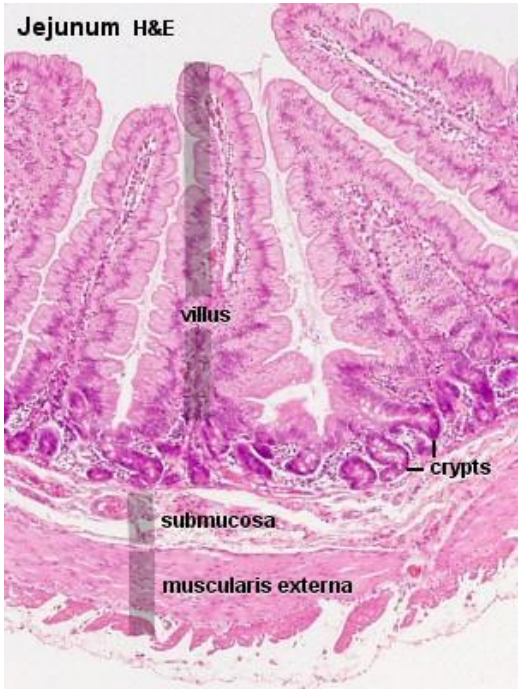
# Parts of small Intestin

**The duodenum** is the shortest segment of the small intestine, about 20 to 25 cm long. It has small openings called **duodenal papillae** , which allow pancreatic juice and bile to enter the digestive tract. It has a similar general structure to other parts of the small intestine . However, the **Brunner glands** (mucus secreting gland) in the submucosa are a unique feature of the duodenum

.

**2. The jejunum** is much longer than the duodenum, about 2.5 m long (two fifths of the rest of the small intestine). It has long villi and a somewhat increased number of goblet cells. It has neither Brunner glands nor Peyer patches.

**3. The ileum** is the longest segment, about 4 m long (three fifths of the rest of the small intestine). It has short villi with signify cantly increased numbers of goblet cells on the surface of the mucosa. There are clusters of lymphatic nodules in the lamina propria of the ileum; sometimes these lymphatic nodules extend into the submucosal layer. These clusters of lymphatic nodules are called **Peyer patches** and are unique to the ileum.


Jejunum H&E
villus
crypts
submucosa
muscularis externa

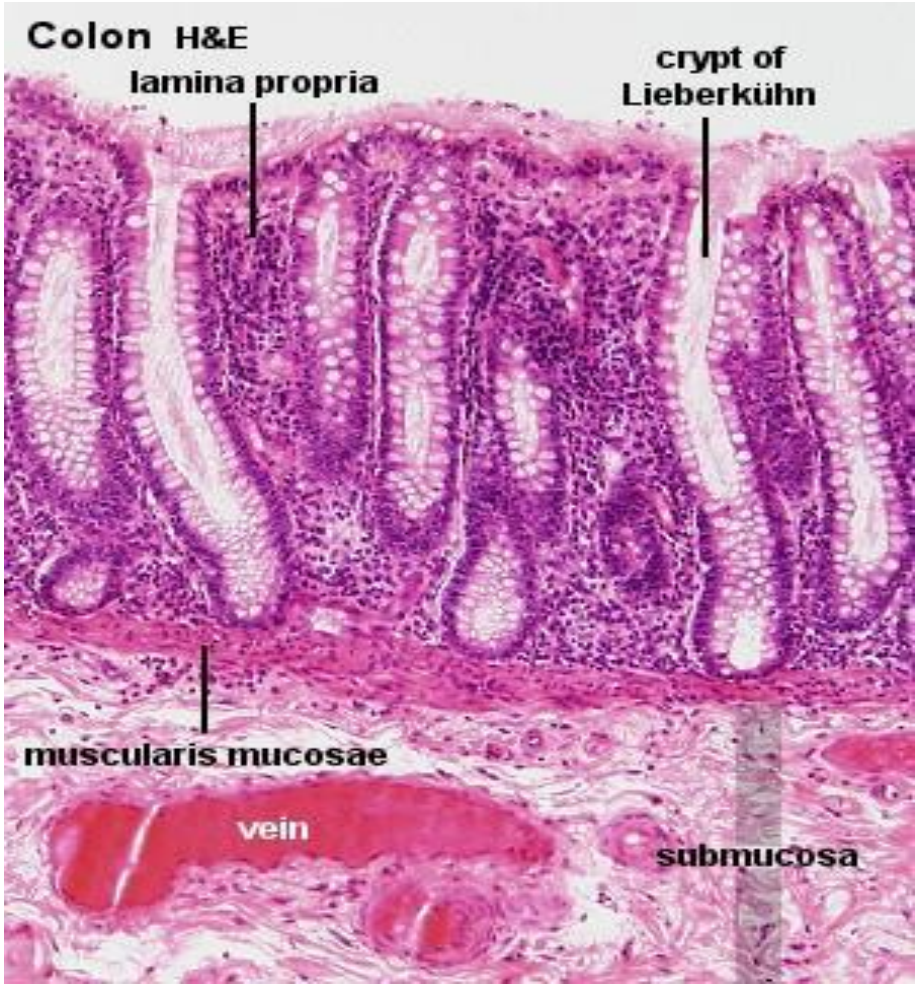

Peyer's Patch H&E
domes
villi
lymph follicle
germinal center
muscularis externa

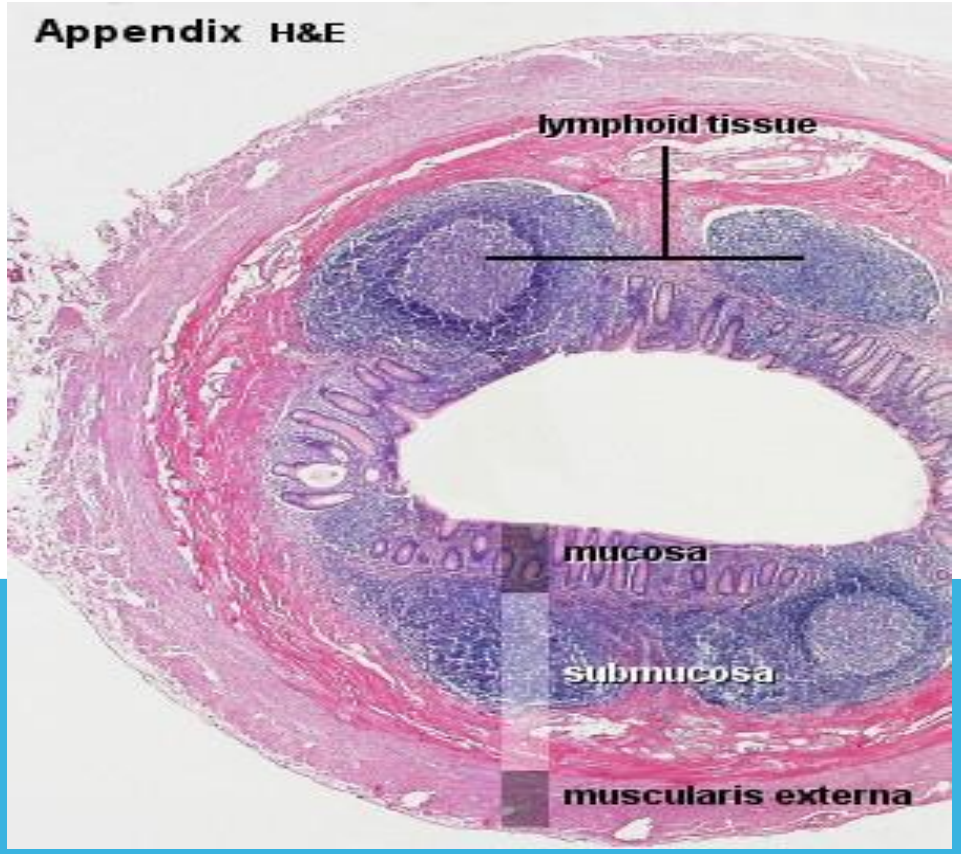
# Large Intestine

The large intestine or bowel, which absorbs water and electrolytes and forms indigestible material into feces, has the following regions: the short cecum, with the ileocecal valve and the appendix; the ascending, transverse, descending, and sigmoid colon; and the rectum, where feces is stored prior to evacuation

The mucosa lacks villi and except in the rectum has no major folds. Less than one-third as long as the small intestine, the large intestine has a greater diameter (6-7 cm). The mucosa of the large bowel is penetrated throughout its length by tubular intestinal glands. These and the intestinal lumen are lined by goblet and absorptive cells, with a small number of enteroendocrine cells . The columnar absorptive cells or colonocytes have irregular microvilli and dilated intercellular spaces indicating active fluid absorption .

Goblet cells producing lubricating mucus become more numerous along the length
The lamina propria is rich in lymphoid cells and in lymphoid nodules that frequently extend into the submucosa
The muscularis of the colon has longitudinal and circular layers but differs from that of the small intestine, with fibers of the outer layer gathered in three separate longitudinal bands called teniae coli . Intraperitoneal portions of the colon are covered by serosa,
The distal end of the GI tract is the anal canal, 3-4 cm long. At the rectoanal junction the simple columnar mucosal lining of the rectum is replaced by stratified squamous epithelium . The mucosa and submucosa of the anal canal form several longitudinal folds, the anal columns , in which the lamina propria and submucosa include sinuses of the rectal venous plexus


Colon H&E
lamina propria
crypt of Lieberkühn
muscularis mucosae
vein
submucosa


Appendix H&E
lymphoid tissue
mucosa
submucosa
muscularis externa

# Histology Lectures 1st lab

Dr. Nahidah Ibrahim

College of pharmacy /Dep. Clinical laboratory Science

stage 2nd semester Date: 30/ 4/2021

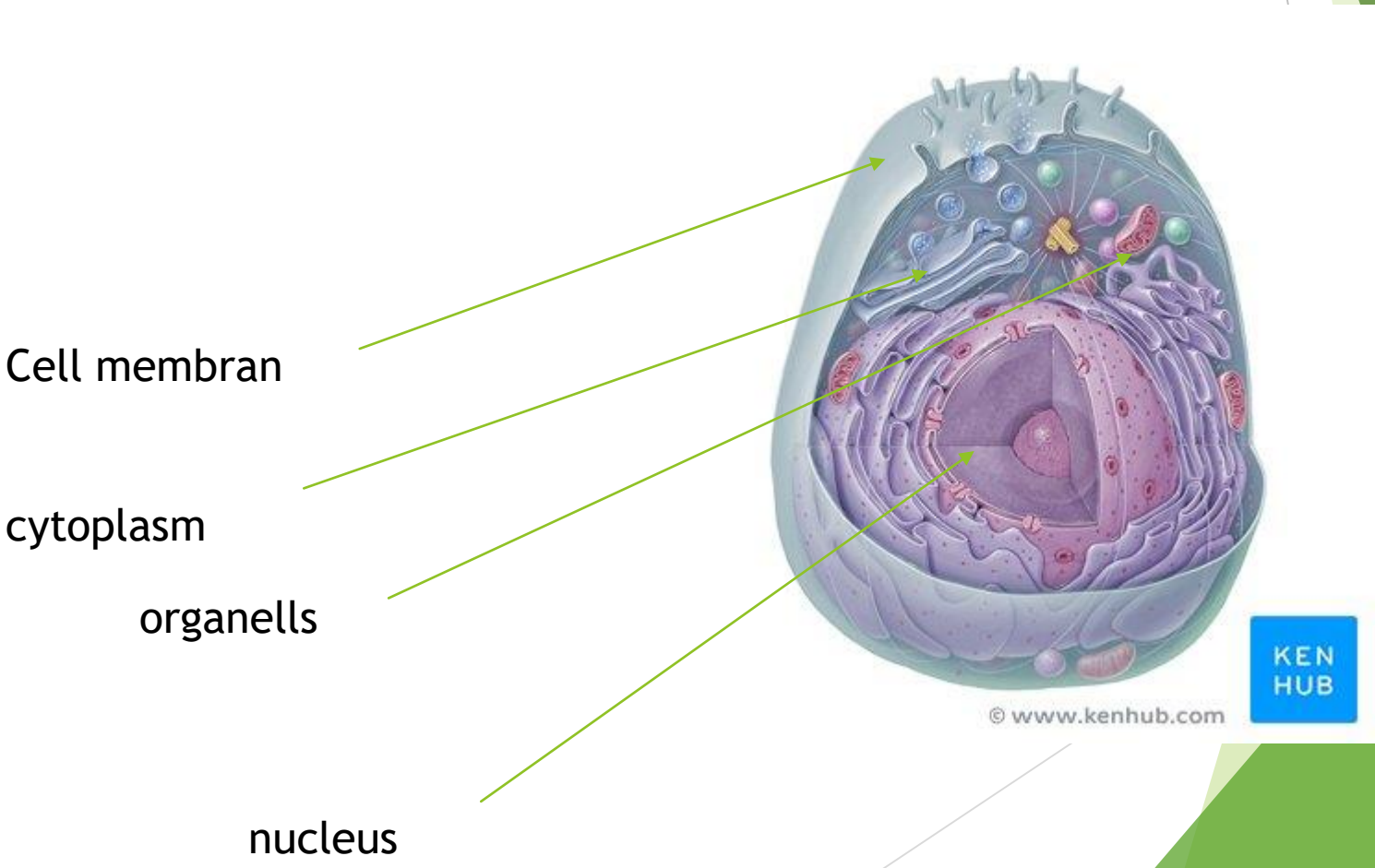
# Histology: An overview: want to learn more about it?

Histology is the science of the microscopic structure of cells, tissues and organs. It also helps us understand the relationship between structure and function

The study of cells and tissues, from their intracellular components to their organization into organs and organ systems.

# Cell structure

- Cellular membrane, cytoplasm, organelles, nucleus



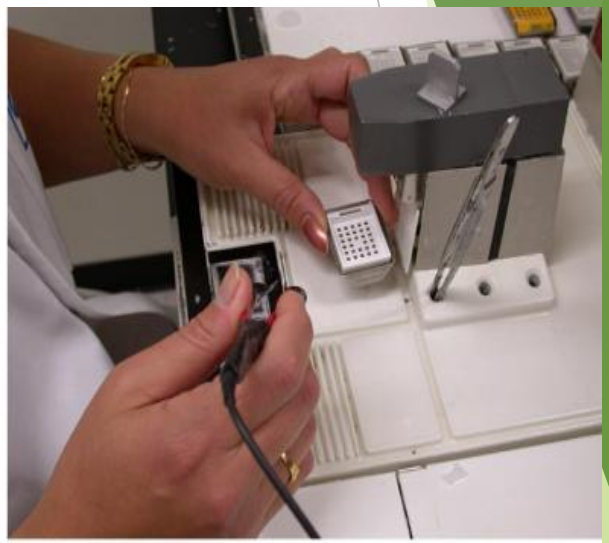
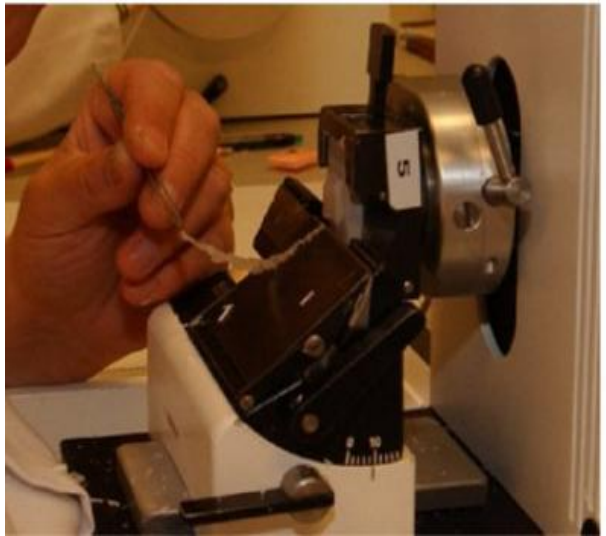
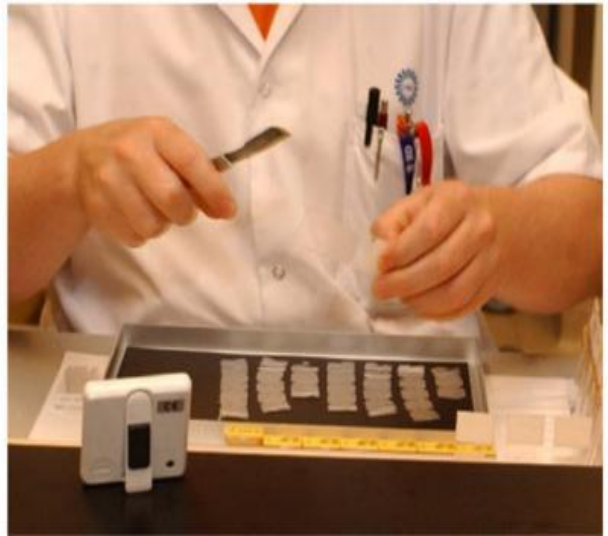
# Tissues

- A unity of cells with a similar structure that as a whole express a definite and unique function.
- Epithelial, connective, muscle, nervous
- Organs
- A unity of tissues with a more complex set of functions, defined by the combination of structure and function of the comprising tissues
- Systems of organs
- A group of organs united by similar functions.
- Cardiovascular, nervous, integumentary, musculoskeletal, respiratory, digestive, excretory, endocrine, lymphatic, reproductive

# Histology techniques

- The Five Steps of Histology Slide Preparation
- 1. Tissue fixation
- 2. Specimen Transfer to Cassettes
- 3. Tissue Processing (Dehydration, Clearing, in which an organic solvent such as xylene , Embedding, )
- 4. Sectioning (Wax is removed , Blocks are chilled on a refrigerated plate , A microtome is used to slice extremely thin tissue )
- 5. Staining (typically hematoxylin and eosin)



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# THE LYMPH VASCULAR SYSTEM :

**by**

**Dr. Nahidah Ibraheim**

**College of pharmacy /Dep. Clinical laboratory Science**

**stage 1**

# Lymphatic system

Lymphatic System consists of:

**A.** Cells

1. Lymphocytes (B,T, natural killer)
2. Antigen-presenting cells (dendritic cells, Langerhans' cells & macrophage

**B.** Lymphatic tissue –diffuse and nodular

**C.** Lymphatic organ ,lymph nodes, spleen, thymus)

**D.** Lymphatic vessels that carry the cells and fluid

The main function of the lymphoid organs is to protect the organism against invading pathogens or antigens (bacteria, parasites, and viruses). The immune response occurs when the organism detects the pathogens, which can enter the organism at any point. For this reason, lymphatic cells, tissues, and organs have wide distribution in the body.

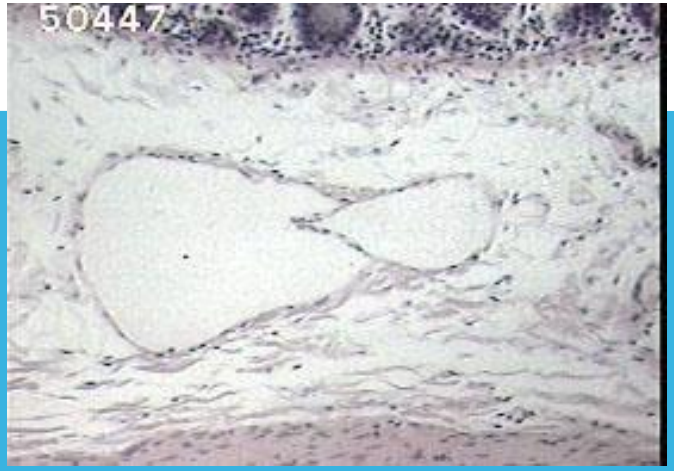
The major lymphoid organs are the

- lymph nodes,
- tonsils,
- thymus, and
- spleen.

# THE LYMPH VASCULAR SYSTEM

The lymphatic system consists of lymph capillaries and lymph vessels. This system starts as blind-ending tubules or lymphatic capillaries in the connective tissue of different organs. These vessels collect the excess interstitial fluid (lymph) from the tissues and return it to the venous blood via the large lymph vessels, the thoracic duct and right lymphatic duct. Also, to allow greater permeability, the endothelium in lymph capillaries and vessels is extremely thin. The structure of larger lymph vessels is similar to that of veins except that their walls are much thinner. Lymph movement in the lymphatic vessels is similar to that of blood movement; that is, the contractions of surrounding skeletal muscles forces the lymph to move forward. Also, the lymph vessels contain more valves to prevent a backflow of collected lymph. Lymph vessels are found in all tissues except the central nervous system, cartilage, bone and bone marrow, thymus, placenta,and teeth.

LYMPHATIC VESSEL WITH A VALVE



## 1- LYMPH CAPILLARIES :

**Lymph capillaries are thin-walled, blind tubes that branch to form a rich network in organs and tissues. They are wider and more irregular than blood capillaries. The wall of a lymph capillary consists only of a thin continuous endothelium and a discontinuous basal lamina that is present only in patches or may even be absent. Externally, the endothelium is surrounded by a small amount of collagenous connective tissue.**

## 2- COLLECTING LYMPH VESSELS

**Collecting lymph vessels differ from lymph capillaries in size and the thickness of their walls. Although three coats - intima, media, and adventitia- are described as in blood vessels, they are not clearly delineated. The tunica intima consists of an endothelium supported by a thin network of elastic fibers. tunica media is composed of smooth muscle cells ,with a few fine elastic fibers.**

**The tunica adventitia is the thickest coat and consists of bundles of collagen fibers, elastic fibers, and some smooth muscle cells.**

**Cells of lymphatic tissue :**

The cells of lymphatic tissue are present as fixed and free cells. **Fixed cells are the reticular cells reticular cells** appear as elongated or stellate elements with round or oval, palely stained nuclei and, lightly basophilic cytoplasm ,esponsible for the formation and maintenance of reticular fibers.

## . lymphocyte:

**Lymphocytes** are the cells that carry out immune responses.

Morphologically, all types of lymphocytes appear very similar, but functionally, they are very different. When lymphocytes are properly stimulated, **B lymphocytes and T lymphocytes** are produced**.**

**T- lymphocytes or T- cells:**

T cells arise from lymphocytes that are carried from the bone marrow to the **thymus gland.**

They mature, differentiate, and acquire surface receptors and before migrating to peripheral lymphoid tissues and organs. The thymus gland produces mature T cells early in life.

T cells carry out immune responses when stimulated. There are four main types of

differentiated T cells:

**-helper T cells,**

**- cytotoxic T cells,**

**-memory T cells,**

**- suppressor T cells**

**1-T- helper cells**

When encountering an antigen, **helper T cells**
assist other lymphocytes by secreting immune chemicals called **cytokines( interleukins).**
**Cytokines** are protein hormones that stimulate proliferation, secretion, differentiation, and maturation of B cells into **plasma cells,** which then produce immune proteins called **antibodies ( immunoglobulins).**

**2- cytotoxic T-cells**:
**Cytotoxic T cells** specifically recognize antigenically different cells such as virus-infected cells, foreign cells, or malignant cells and. These lymphocytes become activated when they combine with antigens that react with their receptors.

**3- Memory T- cells :**
**Memory T cells** are the long-living progeny of T cells. They respond rapidly to the same antigens in the body and stimulate immediate production of cytotoxic T cells.

**4- suppressor T- cells**

**Suppressor T cells** may decrease or inhibit the functions of helper T cells and cytotoxic T cells, and thus modulate the immune response.

# B –lymphocyte or B-cells :

**B cells** mature and become immunocompetent in bone marrow**.** After maturation, blood carries B cells to the non thymic lymphoid tissues such as lymph nodes, spleen, and connective tissue. B cells are able to recognize a particular type of antigen owing to the presence of **antigen receptors** on the surface of their cell membrane.

**Plasma cells** secrete large amounts of antibodies specific to the antigen that triggered plasma cell formation. Antibodies react with the antigens and initiate a complex process that eventually destroys the foreign substance that activated the immune response.

**memory B cells.** These memory cells produce a more rapid immunologic response should the same antigen reappear.

# Lymphatic tissue

Lymphatic tissue divided into

## 1: Diffuse Lymphatic Tissue

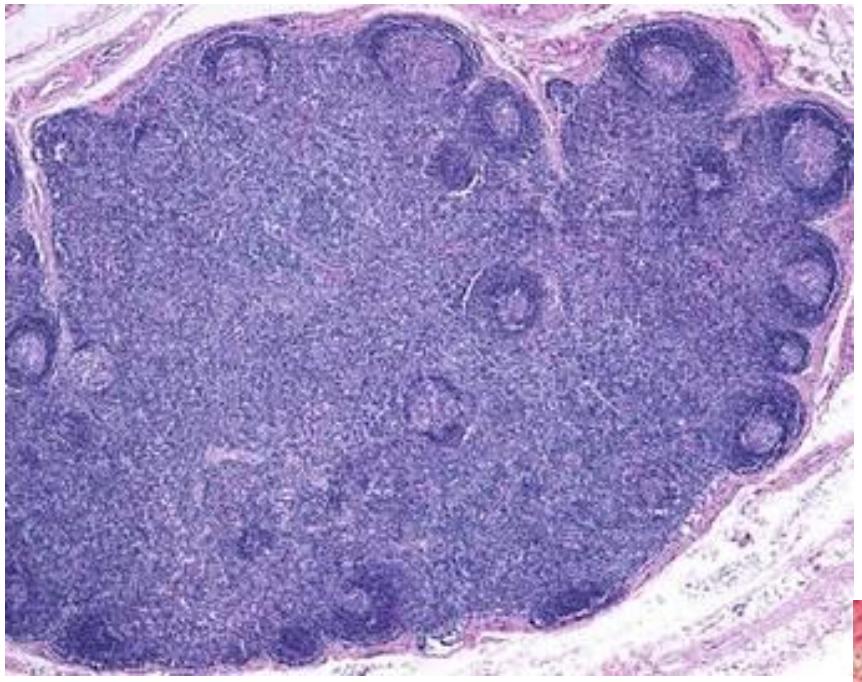
It appears as a loose aggregate of cells with no distinct demarcation from surrounding tissue . Diffuse lymphatic tissue is prominent in the connective tissue that underlies the epithelium of the intestine. Any antigen that does penetrate the epithelial lining induces an immune response in the lymphatic tissue .

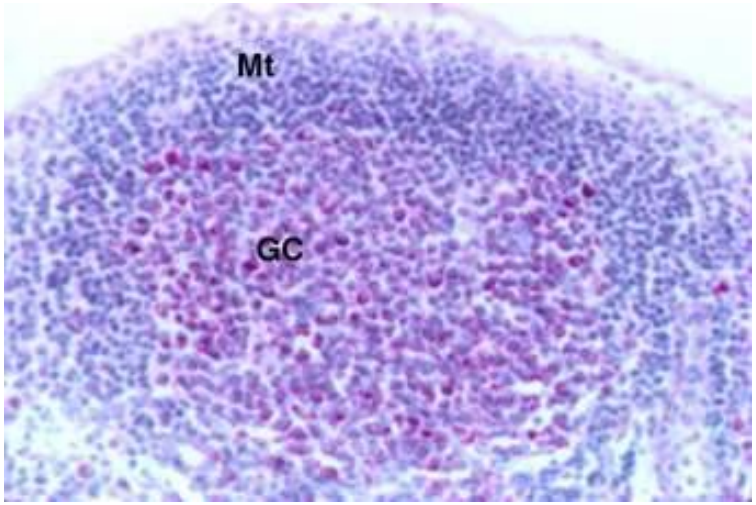
## 2: Nodular Lymphatic Tissue

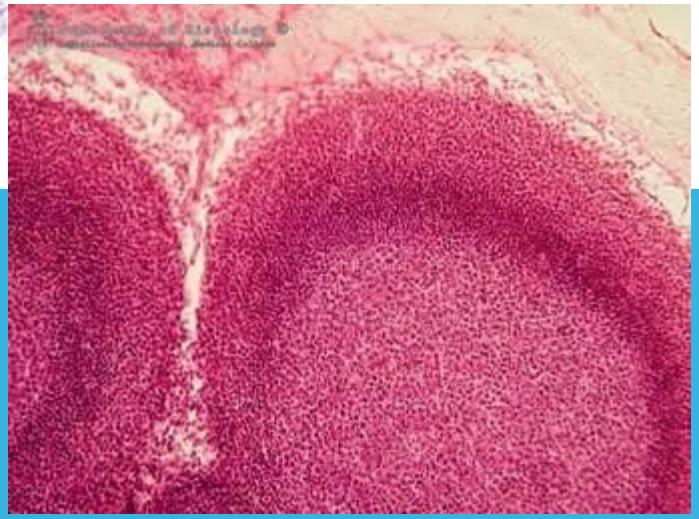
Nodular lymphatic tissue contains the same structural elements as diffuse lymphatic tissue, differing only in that the components are organized into compact, circumscribed structures. Lymphatic nodules (also called **follicles)** may be present as **solitary nodules** , as occur in the appendix and the Peyer's patches of the ileum.

Histologically, some lymphatic nodules appear as rounded collections of densely packed small lymphocytes this nodule is called a **primary nodule.** Other lymphatic nodules contain a lightly staining central area surrounded by a deeply stained cap of closely packed small lymphocytes. The pale region has been called a **germinal center** and the whole structure a **secondary nodule.** Lymphatic nodules are prominent in organs such as the tonsils, lymph nodes, and spleen but are absent from the thymus . *Germinal* centers produce ***B*-cells** that can migrate through the cap to leave the center and eventually pass to other lymphatic tissues.

# PRIMARY LYMPHATIC NODULE/FOLLICLE (LN)
# AGGREGATION OF LYMPHOCYTES IN LAMINA PROPRIA OR SUBMUCOSA



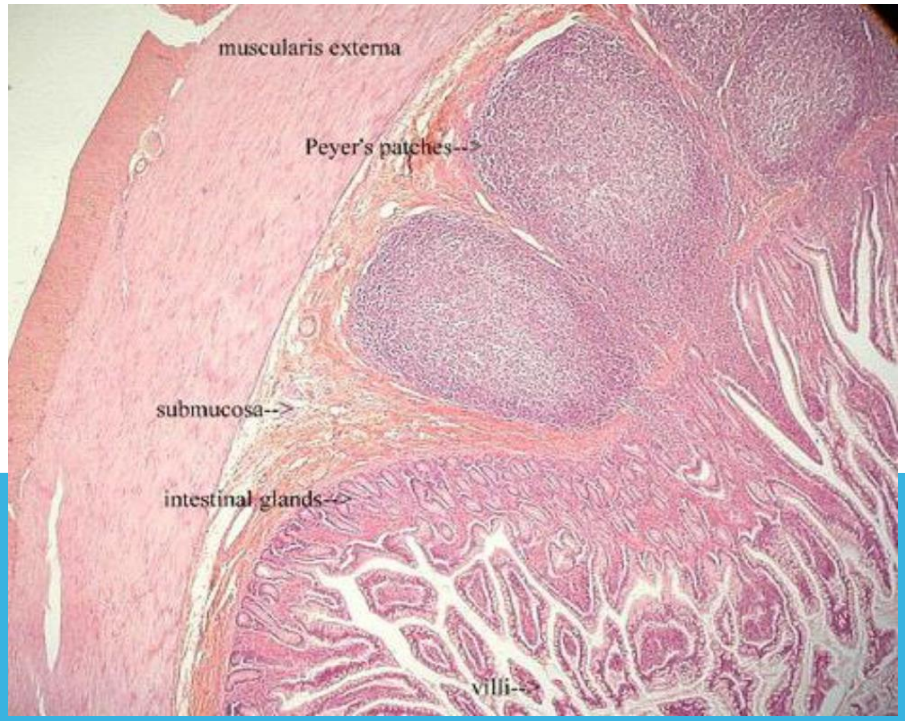


# Peyer’s patches :

Peyer’s patches occur in the wall of the ileum.

Consist of very large spherical aggregates (nodules ) of dense lymphoid tissue which may show germinal centers . most of the mass of each nodule is located in the submucosa ,but the nodule extends into lamina propria and bulges into the lumen of ileum. Their function in screening of the lumen of small intestine, probably to prevent colon bacteria from migrating up into small intestine . IgA antibodies secreted by plasma cells generated by peyer’s Patches seriously impair bacterial motility and inhibit attachment of bacteria to intestinal walls .



# Table Shows Comparative Between Blood Vessles and Lymphatic

| Cardiovascular System | Lymphatic System |
|---|---|
| *Blood* is responsible for collecting and distributing oxygen, nutrients and hormones to the tissues of entire body. | *Lymph* is responsible for collecting and removing waste products left behind in the tissues. |
| *Blood flows* in the arteries, capillaries, and veins. | *Lymph flows* in an open circuit from the tissues into lymphatic vessels. |
| *Blood* flows towards the heart and away from the heart. | *Lymph* flows in one direction only (towards the heart). |
| *Blood* is pumped by the heart to all parts of the body. | *Lymph is not pumped*. It passively flows from the tissues into the lymph capillaries. |
| *Blood* consists of the liquid plasma that transports the red and white blood cells and platelets. | *Lymph* that has been filtered and is ready to return to the cardiovascular system is a clear or milky white fluid. |
| *Blood is visible* and damage to blood vessels causes obvious signs such as bleeding or bruising. | *Lymph is colourless or translucent* and damage to the lymphatic system is difficult to detect until swelling occurs. |
| *Blood is filtered* by the kidneys. | *Lymph is filtered* by lymph nodes located throughout the body. |

Histology:1st stage
Department of clinical laboratory science Dr . Nahidah Ibrahim

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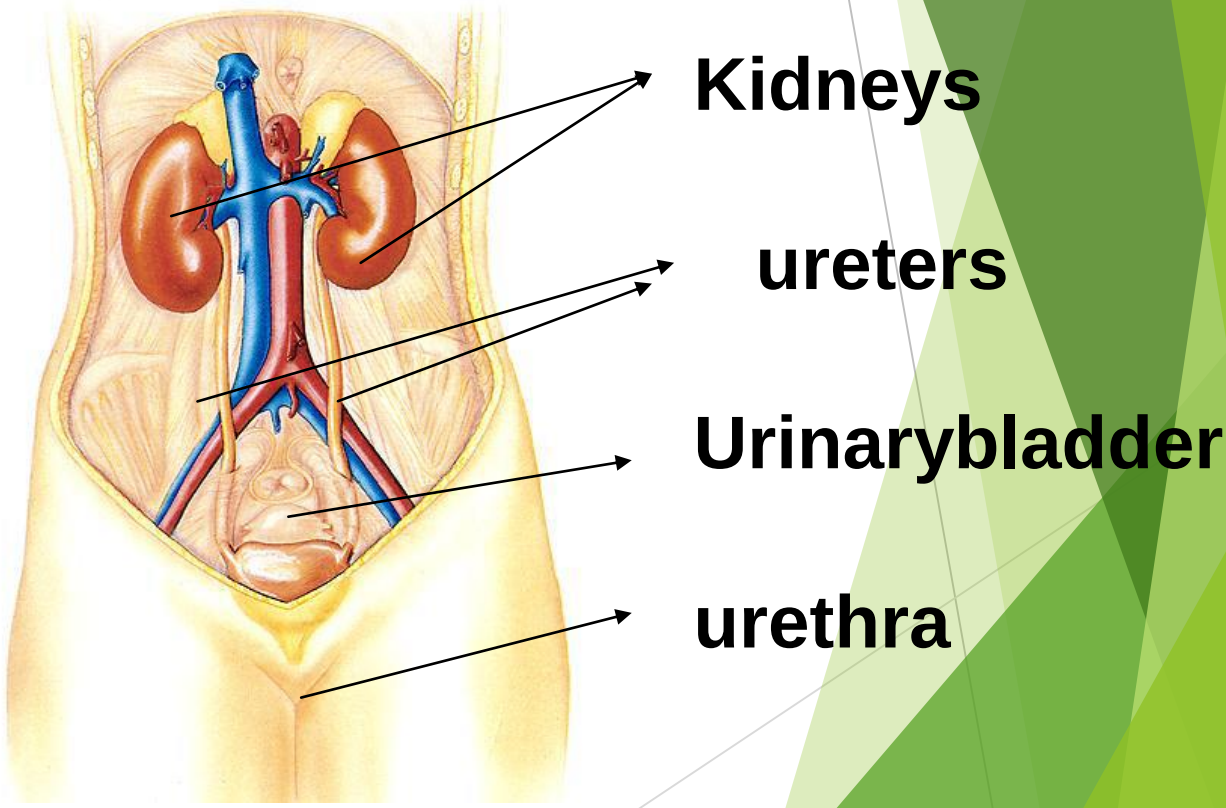
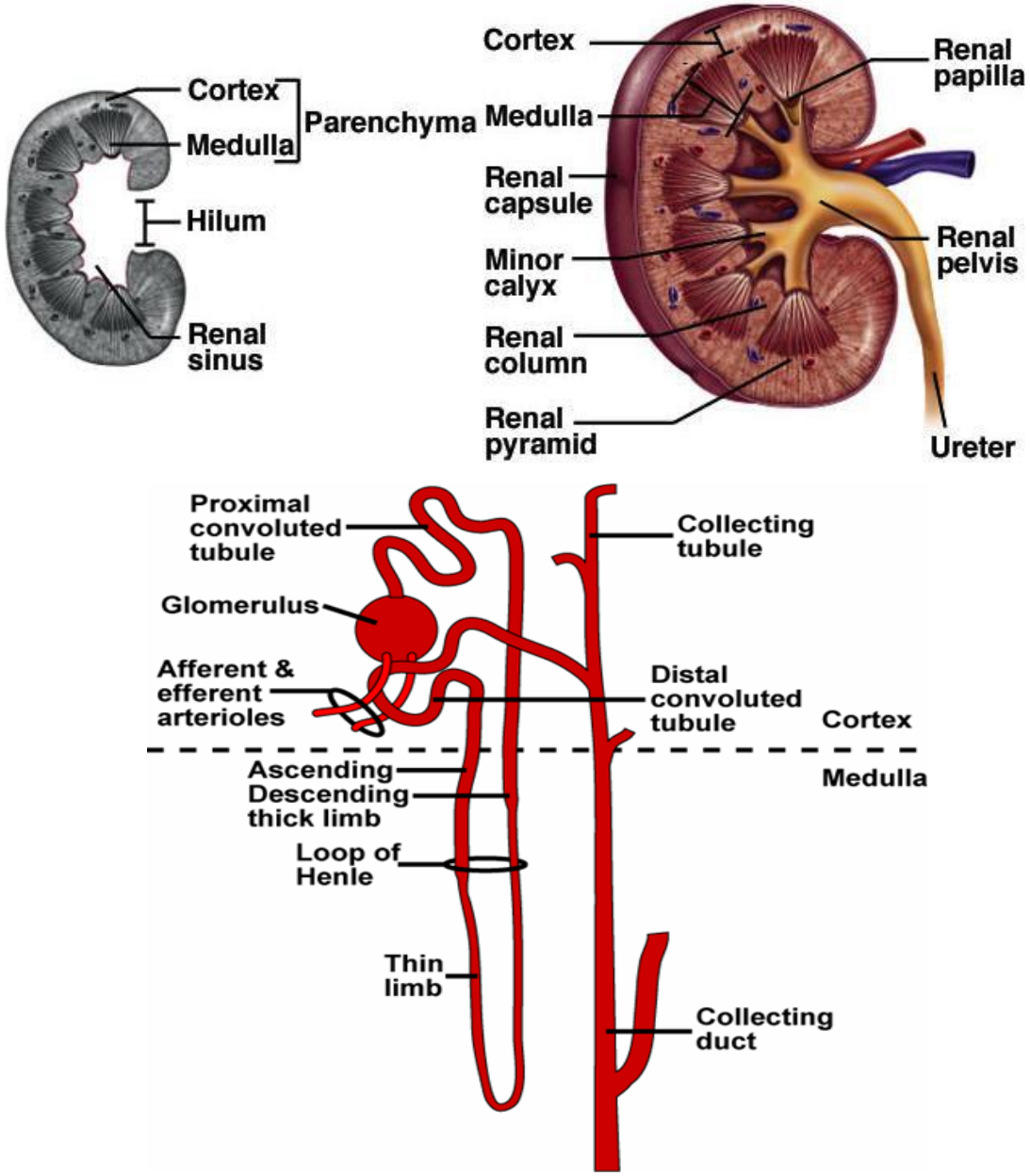
# URINARY SYSTEM

Main components of this system

- 1. Kidneys
- 2. Ureter
- 3.Urinary bladder
- 4. Urethra






# 1. KIDNEY

- Parenchyma organized into cortex and medulla Within parenchyma occur nephrones, collecting ducts, blood vessels, lymphatics and nerves
- Parenchyma organized into lobes and lobules

# Histological aspects of kidneys

- **Position**:

The kidneys located high on the posterior wall of the abdomen behind the peritoneum. The Right kidney is lowered than left due to the presence of liver. The kidneys occasionally congenitally located in the lower part of the abdomen called. Ectopia of the kidneys or Ectopic kidneys.

The size of the kidney is (5 inches) length, (3 inches) width, and (1 inch) thickness. The volume is (130-150 c.c), & the average weight (170 gram).

- **Stroma**
- •connective Tissues  capsule surrounded by fat.& reticular tissue between parenchyma .
- **Parenchyma**
- **Uriniferous tubules**:
- – **Nephron**
- **–Collecting tubule & duct**

# Kidney Functions

- •Filters blood plasma, eliminates waste, returns useful chemicals to blood
- •Regulates blood volume and pressure
- •Regulates osmolarity of body fluids
- •Secretes renin, activates angiotensin, aldosterone
- •Secretes erythropoietin, controls RBC count
- •Regulates PCO2 and acid base balance
- •Detoxifies free radicals and drugs

**Structure :**

The kidneys are solid, bean shaped organs.

The kidneys are surrounded by a “fibrous capsule” that is applied closely to its outer surface.

Outside the capsule is a covering of fat known as the”perinephric fat”.

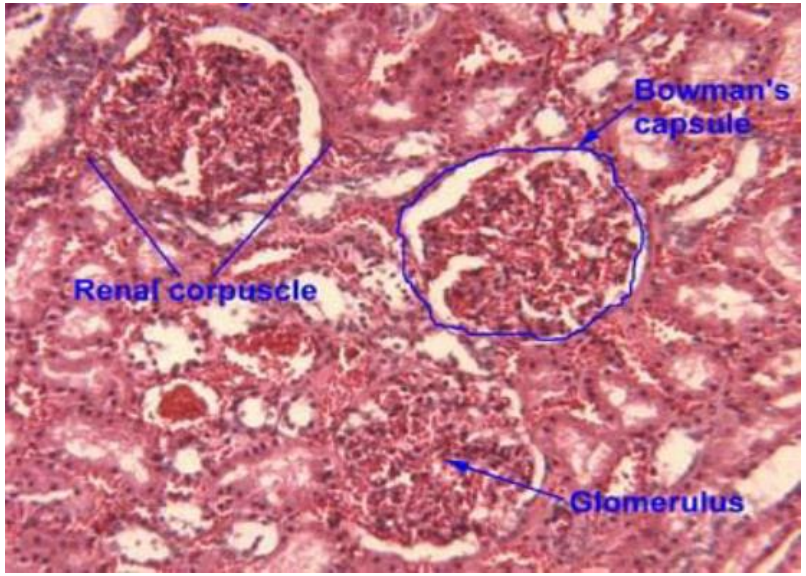
The “perinephric fascia” surrounds the perinephric fat and enclose the kidneys and suprarenal glands.

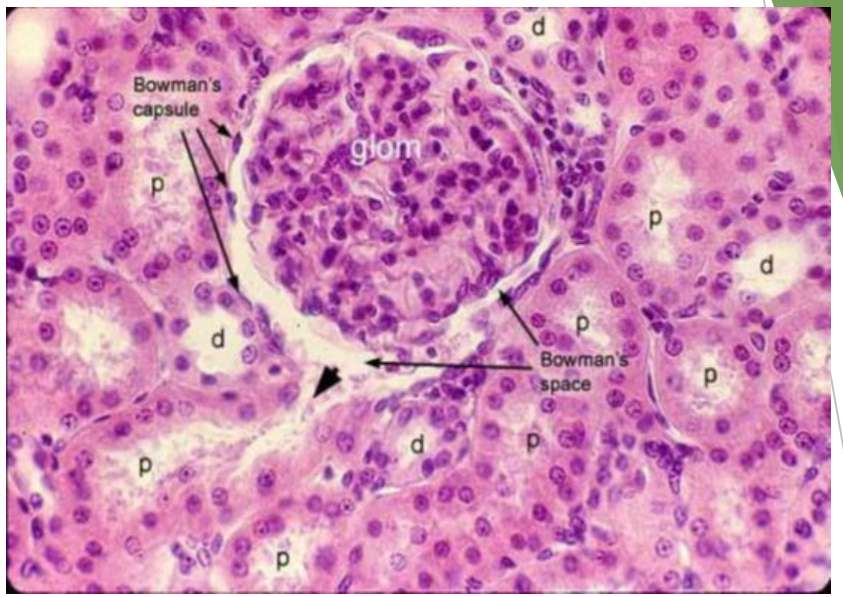
The perinephric fascia is a condensation of areolar tissue. It has a lateral convex border and a medial concave border which face the midline . The concave border show a depression called hilum through which the ureter descend, the renal vein leave, the renal artery, lymphatic vessel and nerve enter.

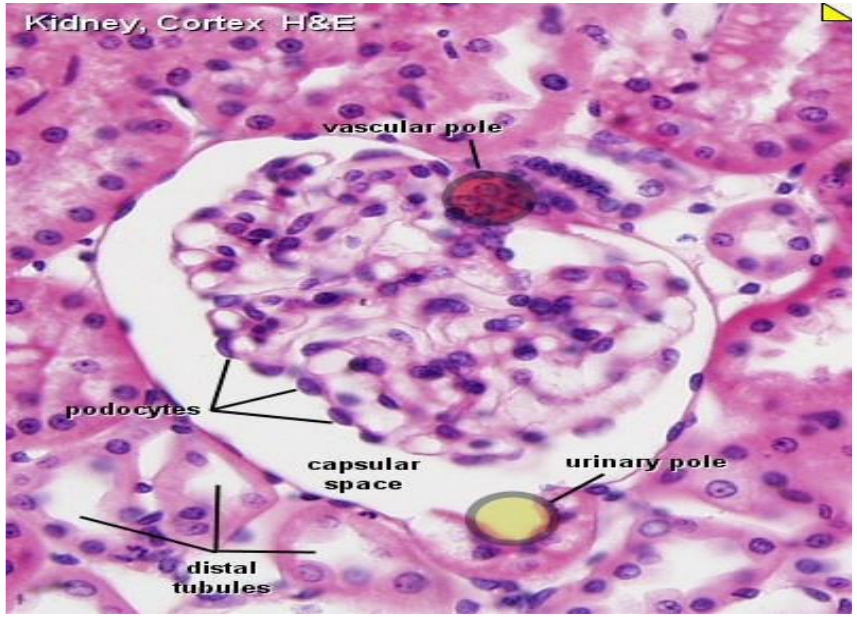
- **Uriniferous Tubules and Nephrons of the Kidney**
- The functional unit of each kidney is the
- microscopic **uriniferous tubule.** It consists of a **nephron** and a **collecting duct** into which empty
- the filtered contents of the nephron.Millions of nephrons are present in each kidney cortex.
- The nephron, is subdivided into two components,
- 1-**renal corpuscle**
- 2- **renal tubules.**
- **There are two types of nephrons.**
- **Cortical nephrons are located in the cortex of kidney .**
- **juxtamedullary nephrons are situated near the junction of the cortex and medulla of the kidney.**

- **1- Renal Corpuscle :**

- The renal corpuscle consists of a tuft of capillaries, called the **glomerulus,** surrounded by a double layer of epithelial cells, called the **glomerular Bowman's capsule.** The inner or visceral layer of the capsule consists of unique and highly modified branching epithelial cells, called **podocytes.** The podocytes are adjacent to and completely invest the glomerular capillaries. The outer layer of the glomerular capsule consists of **simple squamous epithelium.**
- The renal corpuscle is the initial segment of each nephron. Blood is filtered in renal corpuscles through the capillaries of the glomerulus, and the filtrate enters the **capsular**
- **(urinary) space** located between the parietal and visceral cell layers of the glomerular capsule.Each renal corpuscle has a **vascular pole,** where the afferent arteriole enters and the efferentarteriole leaves the corpuscle**.**
- On the opposite end of the renal corpuscle is the urinary pole. Filtrate produced by the glomerulus that enters the capsular space leaves each renal corpuscle at the urinary pole, where the proximal convoluted tubule starts. Filtration of blood in renal corpuscles is facilitated by glomerular endothelium.
- The endothelium in glomerular capillaries is porous (fenestrated) and highly permeable to many substances in the blood, except to the formed blood elements or plasma proteins. Thus, glomerular filtrate that enters the capsular space is not urine. Instead, it is an ultrafiltrate that is similar to plasma, except for the absence of proteins.


Bowman's capsule
Renal corpuscle
Glomerulus


Bowman's capsule
glom
Bowman's space
p
d


Kidney, Cortex H&E
vascular pole
podocytes
capsular space
urinary pole
distal tubules

## 2- Renal Tubules :

As the glomerular filtrate leaves the renal corpuscle at the urinary pole, it flows through different parts of the nephron before reaching the renal tubules called **the collecting tubules** and **collecting ducts**. The glomerular filtrate first enters the renal tubule**,** which extends from the glomerular capsule to the collecting tubule. This renal tubule has several distinct histologic and functional regions. The portion of the renal tubule that begins at the renal corpuscle is highly twisted or tortuous and is therefore called the **proximal convoluted tubule.** Initially, this tubule is located in the cortex but then descends into the medulla to become continuous with the **loop of Henle**.

Proximal convoluted tubule

- Reabsorption of water, nutrients and solids (obligatory) Lined by simple
- cuboidal epithithelium resting on a thin b. lamina Tubule cells have
- microvilli on their luminal surfaces (typical brush border)Tubule cells
- appear striated due to numerous basal infoldings & plenty of mitochondria


**Functions of proximal convoluted tubule**

1. Reabsorption of 85%of Na, Cl &water. Na is reabsorbed by active process. Cl, & water reabsorbed by passive process.

2. Reabsorption of glucose. When the amount of glucose exceeds the absorbing capacity of the proximal tubule it appears in urine as in case of diabetes

.

3. Reabsorption of protein & amino acid

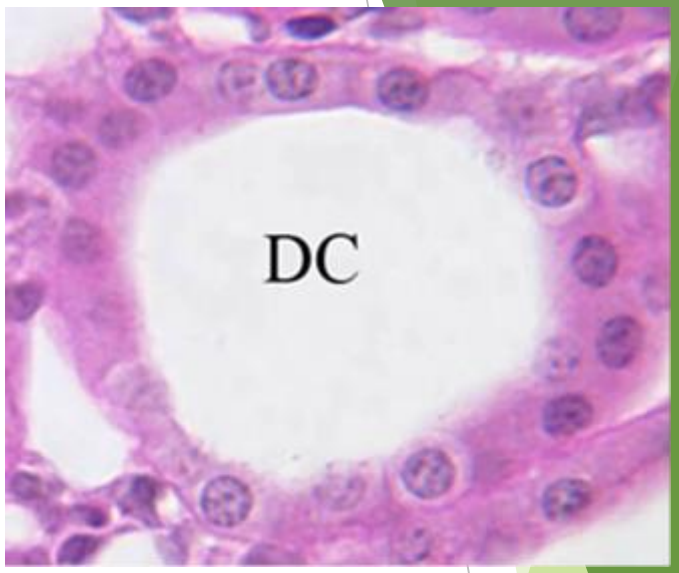
.

4. Excretion of foreign substances

## Distal convoluted tubule:

Reabsorbs most of substances contained in ultrafiltrate especially glucosa and amino acids (mainly facultative) Reabsorption regulated by ADH and aldosteroneContinues from the m. loop and extends to collecting tubule within cortex Lined by low simple cuboidal epithelium resting on a thin BL The cells lack microvilli but are striated, with basal infoldings and but less mitochondria

Its epithelial cells stain less osmophilic compared to those of PCT



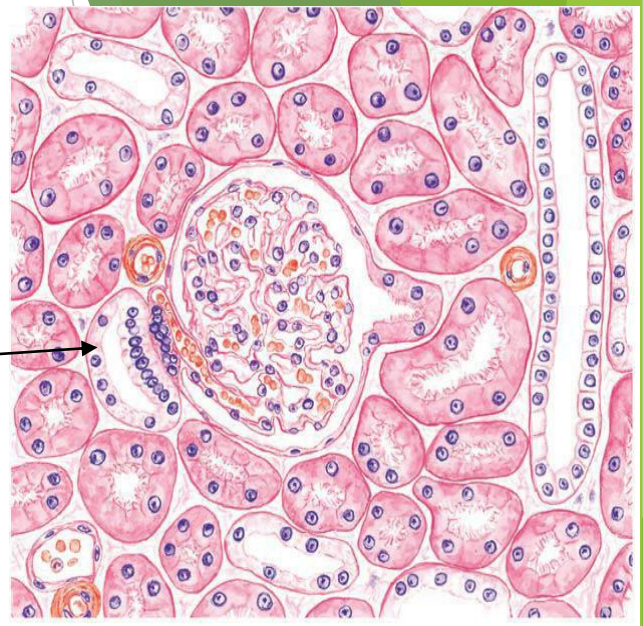

Functions:

1. Maintain acid - base balance.
2. Important in urine concentration.
3. Reabsorption of Na ions from the lumen of the distal convoluted tubules to the blood while K is excreted in the urine.
4. Bicarbonate ions are reabsorbed back to the blood & hydrogen ions are excreted so the urine is acidic.
5. Its function is under the effect of aldosterone secreted by the adrenal cortex.
6. ADH (antidiuretic hormone) secreted by the posterior lobe of pituitary gland acts on the last part of the distal convoluted tubules & increases the permeability of the tubule to water rendering the urine more concentrated. ADH also act on the collecting duct in a similar way.

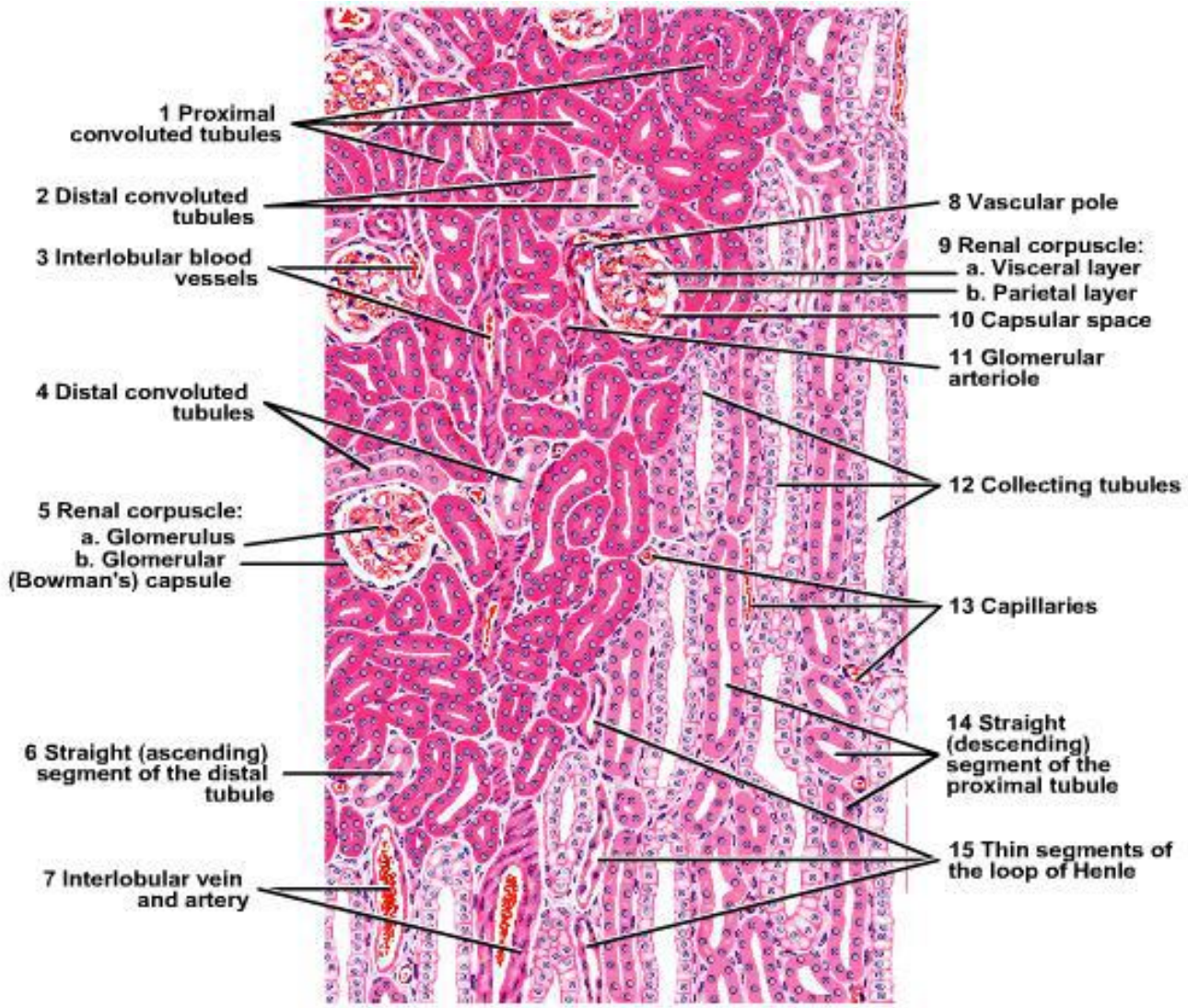
- **Loop of Henle :**
- The **loop of Henle** consists of several parts**: -** a thick, descending portion of the proximal convoluted tubule; a thin descending and a thick, ascending portion called the **distal convoluted tubule.** The distal convoluted tubule is shorter and less convoluted than the proximal convoluted tubule, and it ascends into the kidney cortex. Because the proximal convoluted tubule is longer than the distal convoluted tubule, it is more frequently observed near the renal corpuscles and in the renal cortex.
- Glomerular filtrate then flows from the distal convoluted tubule to the **collecting tubule.** In juxtamedullary nephrons, the loop of Henle is very long; it descends from the kidney
- cortex deep into the medulla and then loops back to ascend into the cortex . The collecting tubule is not part of the nephron . A number of short collecting tubules join to form several larger **collecting ducts.**
- **papillary ducts.** Smaller collecting ducts are lined by light-staining cuboidal
- epithelium. Deeper in the medulla, the epithelium in these ducts changes to columnar . At the tip of each papilla, the papillary ducts empty their contents into the minor calyx

- **Function of Henle loop :** the descending part is quite permeable. Permitting free passage of water & Na. since the interstitial fluid of the kidney medulla is hypertonic, Na enters and water leaves the glomerular filtrate in the descending part of the loop

- **Juxtaglomerular Apparatus**
- Adjacent to the renal corpuscles and distalconvoluted tubules lies a special group of cellscalled **juxtaglomerular apparatus.** This apparatus consists of two components,
- **- the juxtaglomerular cells**
- **-the macula densa**.
- Juxtaglomerular cells are a group of modified smooth muscle cells located in the wall of the afferent arteriole just before it enters the glomerular capsule to form the glomerulus .
- The main function of the juxtaglomerular apparatus is to maintain the necessary blood pressure in the kidney for glomerular filtration

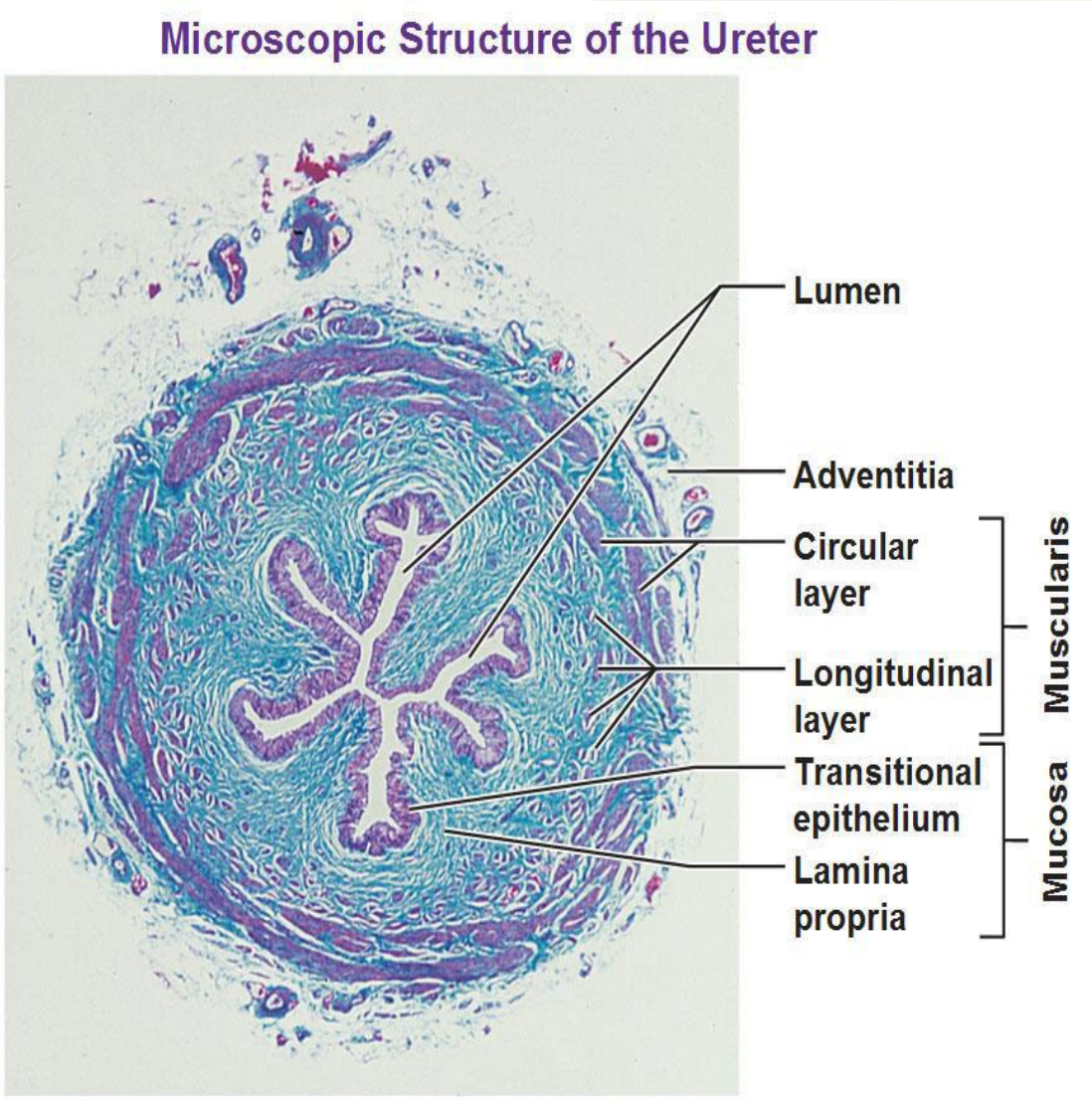


# Kidney view


1 Proximal convoluted tubules
2 Distal convoluted tubules
3 Interlobular blood vessels
4 Distal convoluted tubules
5 Renal corpuscle:
a. Glomerulus
b. Glomerular (Bowman's) capsule
6 Straight (ascending) segment of the distal tubule
7 Interlobular vein and artery
8 Vascular pole
9 Renal corpuscle:
a. Visceral layer
b. Parietal layer
10 Capsular space
11 Glomerular arteriole
12 Collecting tubules
13 Capillaries
14 Straight (descending) segment of the proximal tubule
15 Thin segments of the loop of Henle

# Ureter

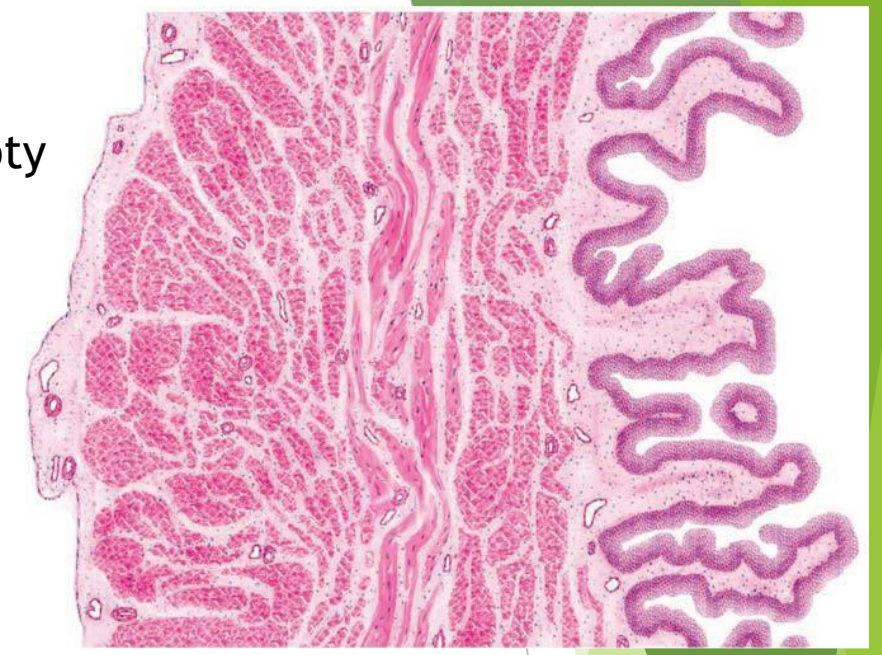
- The ureter is a muscular tube that conveys urine from the kidneys to the bladder by the contractions of the thick, smooth muscle layersfound in its wall.
- The mucosa of the ureter is highly folded and lined by a thick **transitional epithelium .** Below the transitional epithelium is the connective tissue **lamina propria .**
- The muscularis of the ureter contains smoothmuscle layers, an
- **-inner longitudinal layer**
- **- a middle circular muscle layer .**
- **- A third outer longitudinal layer**
- A connective tissue **adventitia ,** with blood
- vessels and adipose tissue **,** surrounds the ureter.



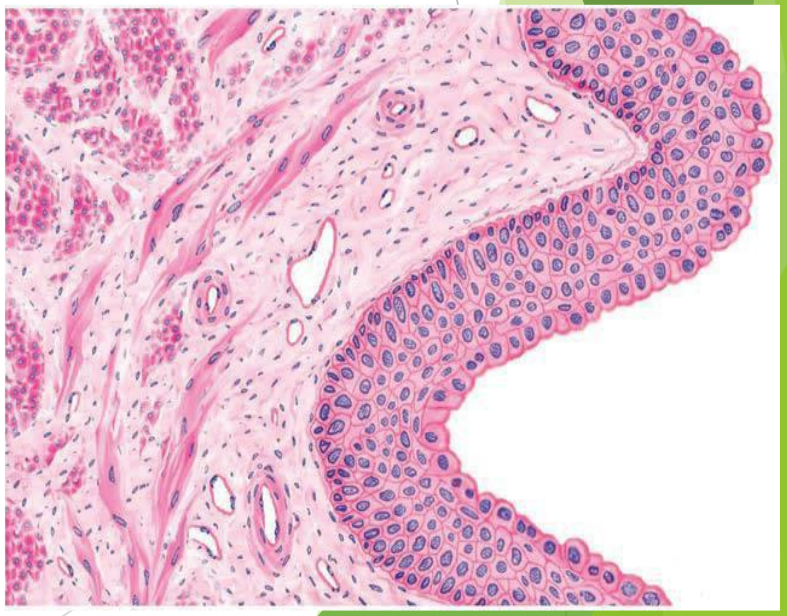
# Urinary Bladder:

- The bladder has a thick muscular wall. The
- wall is similar to that of the lower third of the
- ureter, except for its thickness. In the wall are
- found three loosely arranged layers of smooth
- muscle,
- -the inner longitudinal,
- -middle circular, and - outer longitudinal layers.
- The three layers are arranged inanastomosing smooth muscle bundles
- between which is found the interstitial connective tissue . The interstitial
- connective tissue merges with the connective tissue of the serosa .Mesothelium covers the connective tissue of serosa and is the outermost layer.
- Serosa lines the superior surface of the bladder,whereas its inferior surface is covered by the connective tissue adventitia, which merges with the connective tissue of adjacent structures

Empty



Full



# Urethra

- Its wall has 4 tissue layers

1- Tunica mucosa;

epith transitional but changes to stratified squamous at external urethra orifice

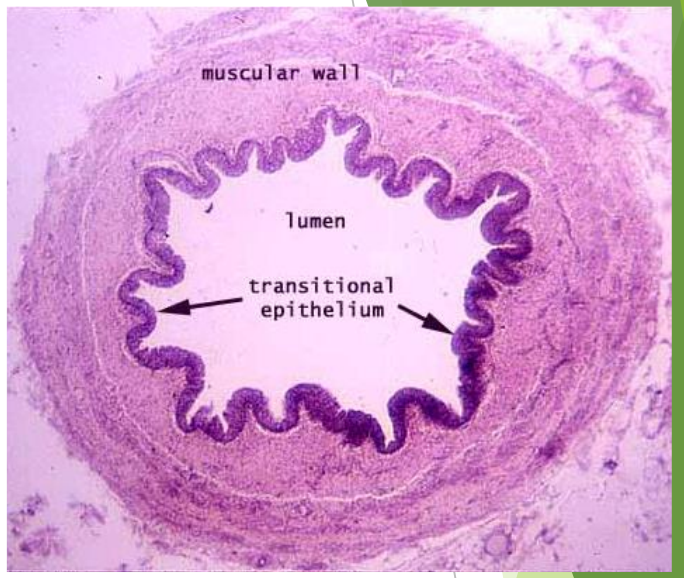
2- Tunica submucosa;

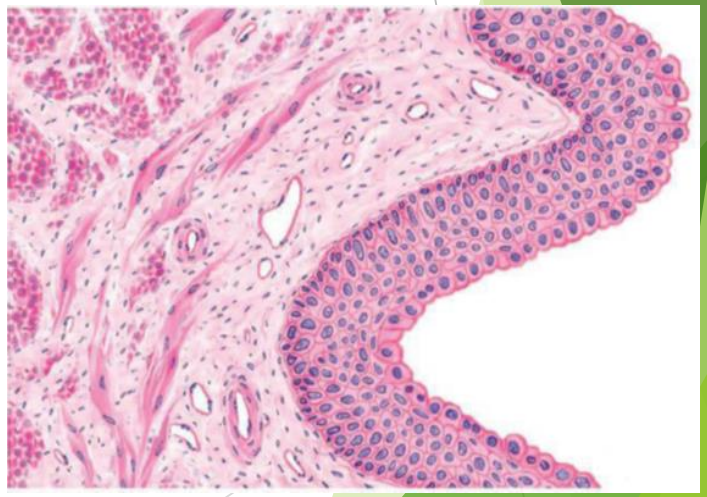
has cavernous tissue spaces that are typical of erectile tissue

3- Tunica muscularis;

Has inner and outer longi and middle layer of smooth muscles as in bladder but towards external urethral orifice, it acquires an external layer of skeletal muscle called striated urethralis muscle

4- Tunica serosa/Adventitia:

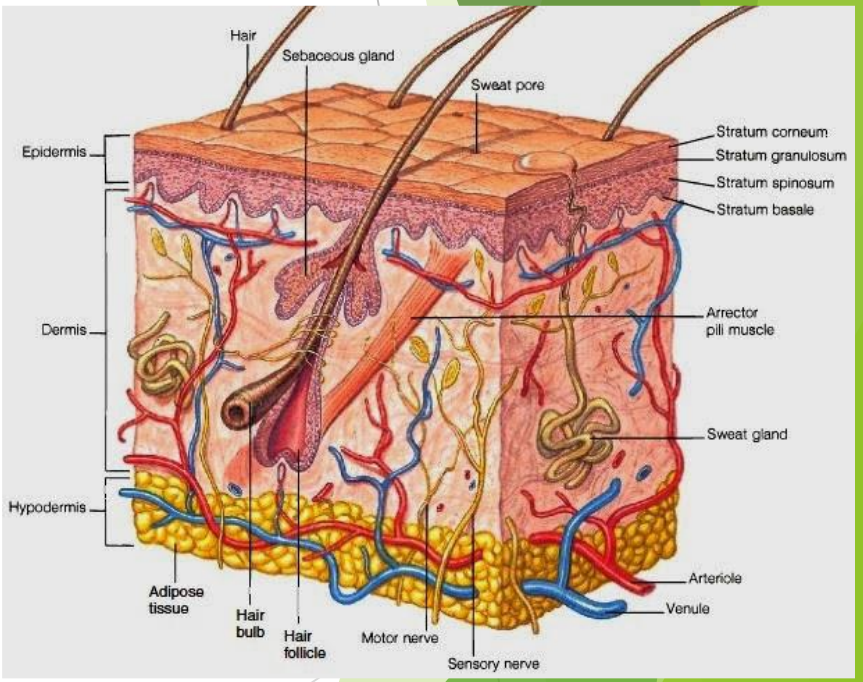


Dr . Nahidah Ibrahim

# The skin

- The skin covers the exterior of the body and constitutes a large organ with several functions.
- It protects the body from mechanical injury and loss of fluid, acts as a barrier against noxious agents, temperature regulation, excretes various waste products, and through its receptors for sensations of heat, cold,touch, and pain, provides information about the external environment.
- Skin and its derivatives and appendages form the integumentary system.
- In humans, skin derivatives include :
- nails, hair, and several types of sweat and sebaceous glands.
- skin consists of two distinct regions :
- - superficial epidermis
- - deep dermis

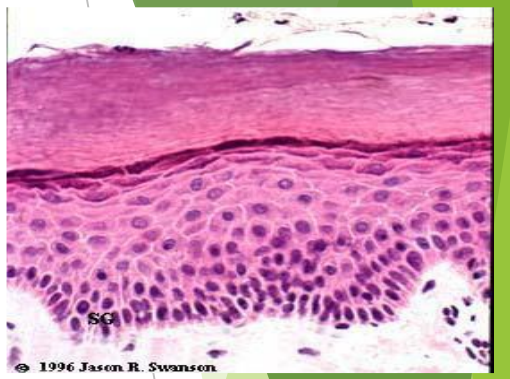


- Types of skin
- **Thick skin**. Thick skin also contains numerous sweat glands, but lacks hair follicles ,sebaceous glands, and smooth muscle fibers and consist of five layers
- The remainder of the body is covered by
- **thin skin**.
- In these regions, the epidermis is thinner and it's cellular composition simpler
- than that of thick skin. It consist of 3 layers

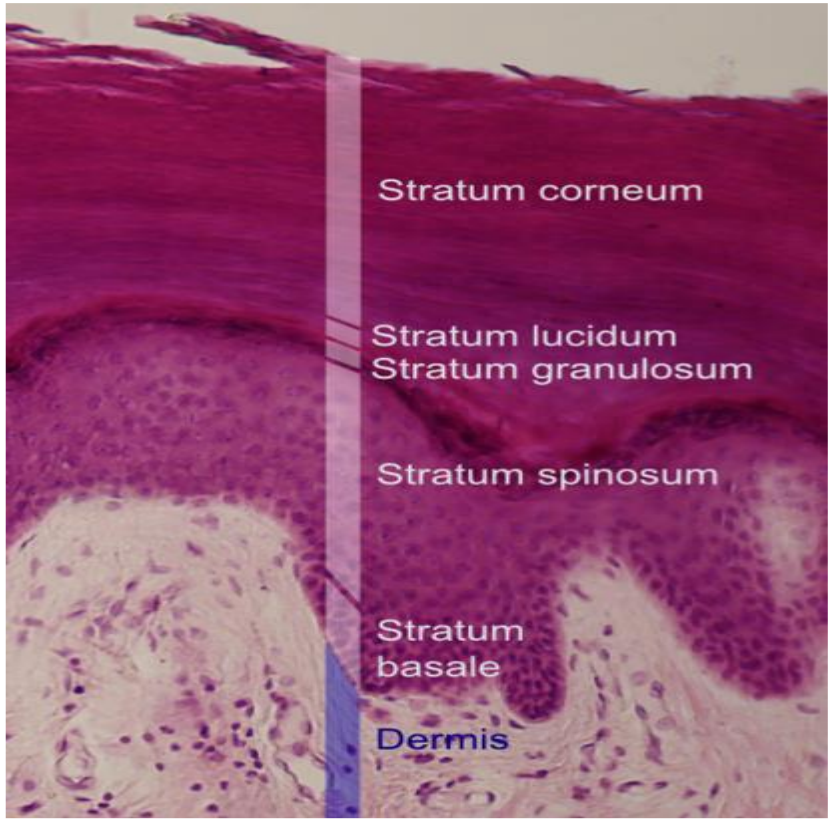
- **1- The superficial epidermis :**
- is nonvascular and lined by keratinized
- stratified squamous epithelium with distinct
- cell types and cell layers.
- Inferior to the epidermis is the vascular
- **2- dermis,** characterized by dense irregular
- connective tissue. Beneath the dermis is hypodermis
- **3- hypodermis** or a subcutaneous layer of
- connective tissue and adipose tissue that forms
- the superficial fascia seen in gross anatomy.

# The superficial epidermis layers

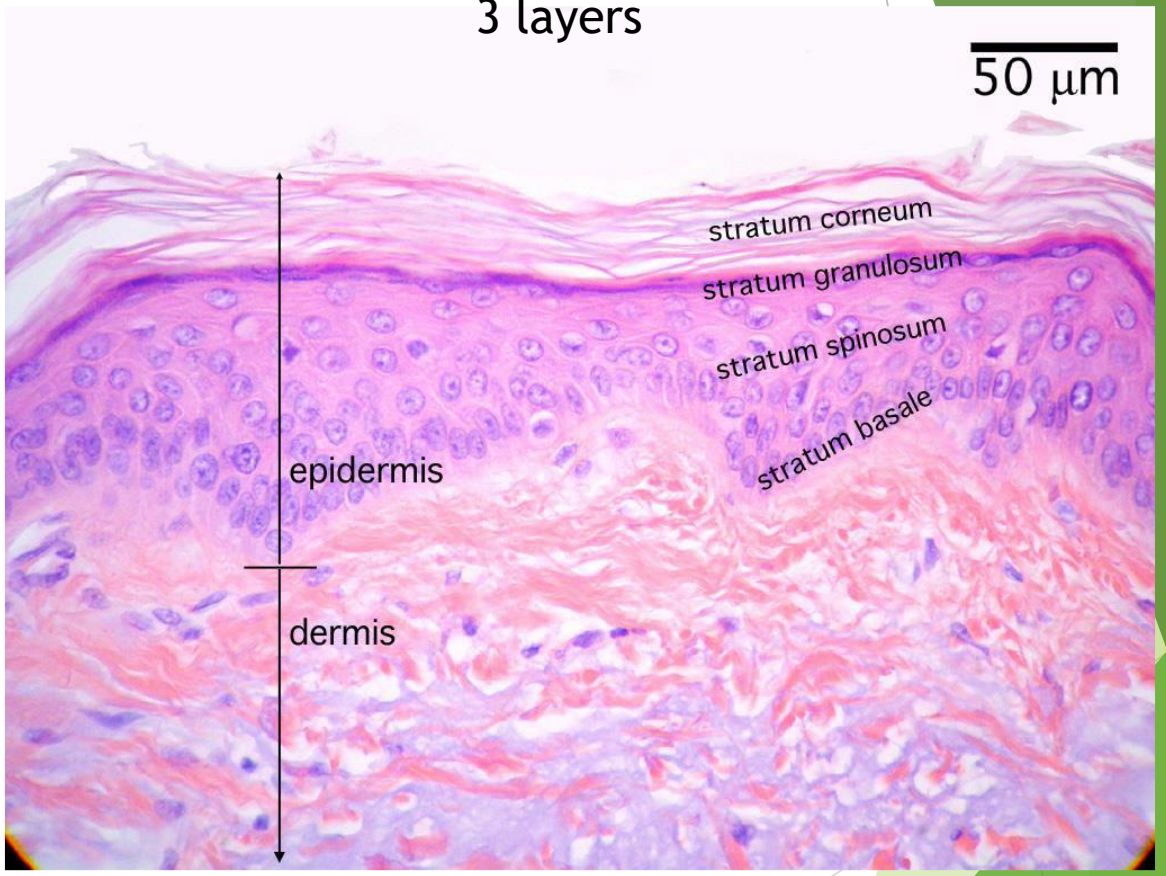
- **1- Stratum Basale (Germinativum)**
- The stratum basale is the deepest. It consists of asingle layer of columnar to cuboidal cells that rest on a membrane
- separating the dermis from the epidermis .
- **2- Stratum Spinosum :**
- , a second cell layer, or stratum spinosum, forms. This layer consists of four to six rows of cells
- **3- Stratum Granulosum**
- The third layer ,stratum granulosum .Three to five layers of flattened cells form
- **4- Stratum Lucidum :**
- In thick skin only, the stratum lucidum is translucent and barely visible; it lies just
- superior to stratum granulosum and inferiorto the stratum corneum.
- The tightly packed cells lack nuclei or organelles and are dead.
- **5- Stratum Corneum** :
- Stratum corneum primarily consists of flattened, dead cells filled with soft keratin filaments . The keratinized, superficial cells from this layer are continually shed or desqumated and are replaced by new cells arising from the deep stratum basale.




Thick skin
5 layers



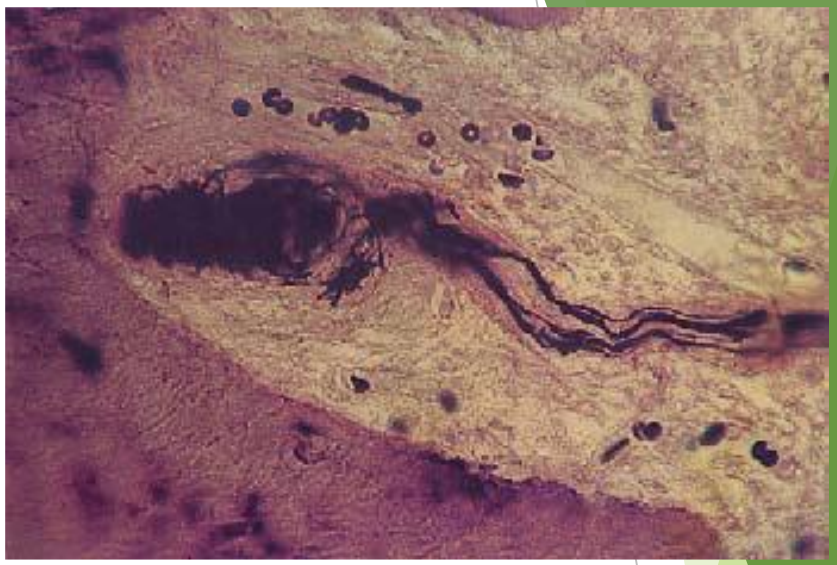

Thin skin
3 layers



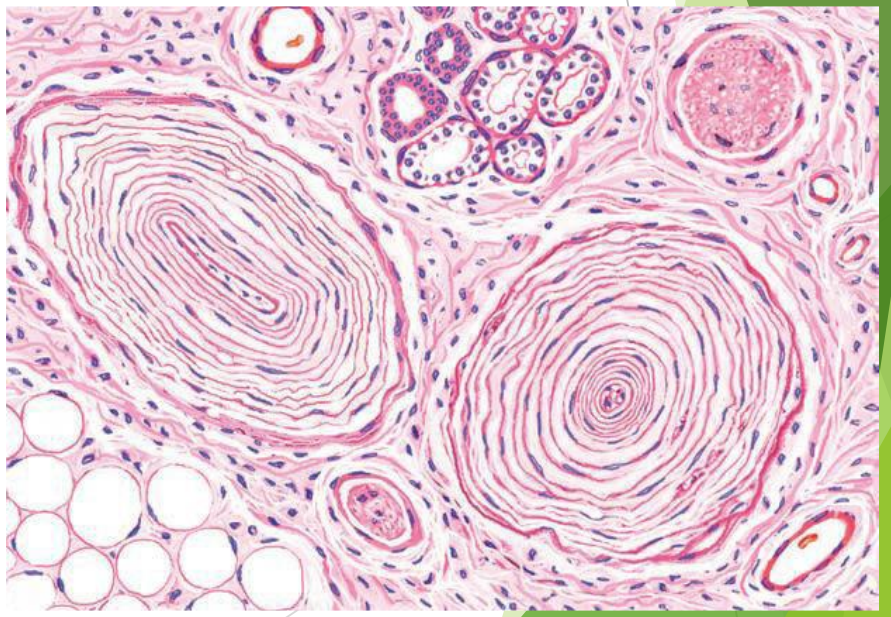
## Dermis: Papillary and Reticular Layers

- Dermis is the connective tissue layer that binds to epidermis. A distinct basement membrane separates the epidermis from the dermis. In addition, dermis also contains derivatives such as sweat glands , sebaceous glands, and hair follicles.
- The junction of the dermis with the epidermis is irregular. The superficial layer of the dermis forms numerous raised projections called dermal papillae, that evaginations of epidermis, called epidermal ridges This region of skin is the papillary layer of the dermis. This layer is filled with loose irregular connective tissue fibers, capillaries, blood vessels, fibroblasts , macrophages , and other loose connective tissue cells > The deeper layer of dermis is called the reticular layer. This layer is thicker and is characterized by dense irregular connective tissue fibers

- Sensory receptors :



- Two types of encapsulated touch/pressure
- receptors are commonly found in the dermis.
- Relatively small Meissner's corpuscles are
- located near the crests of the dermal papillae.

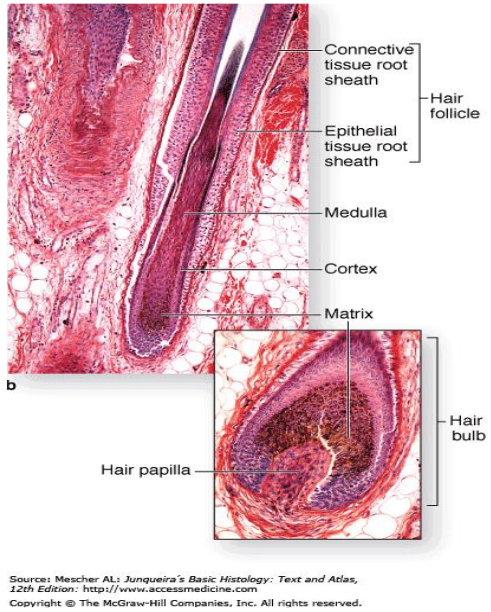


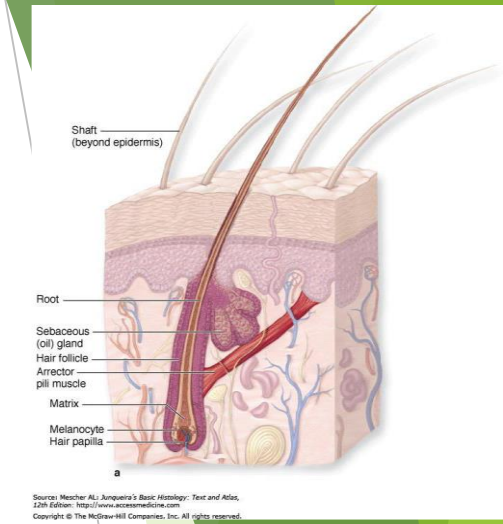
- Larger Pacinian corpuscles are encapsulated
- pressure receptors located deep in the reticular
- layer.

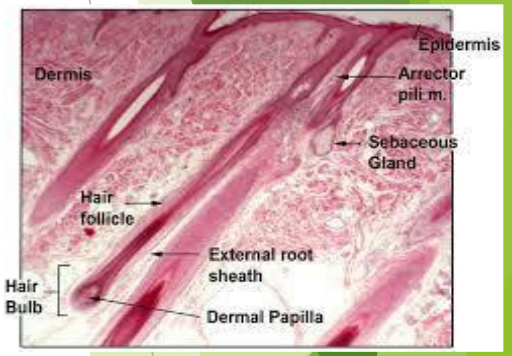
# Skin appendage

## Hair follicle :

- Hairs are the hard, cornified, cylindrical
- structures that arise from hair follicles in the
- skin. One portion of the hair projects through
- the epithelium of the skin to the exterior
- surface; the other portion remains embedded in
- the dermis. Hair grows in the expanded portion
- at the base of the hair follicle called the hair
- bulb. Associated with each hair follicle are one or
- more sebaceous glands that produce an
- oily secretion called sebum.Sebum forms when cells die in sebaceous
- glands. Also, extending from the connectivetissue around the hair follicle to the papillarylayer of the dermis are bundles of smooth
- muscle called arrector pili. The sebaceous glands are located between the arrector pili
- muscle and the hair follicle.



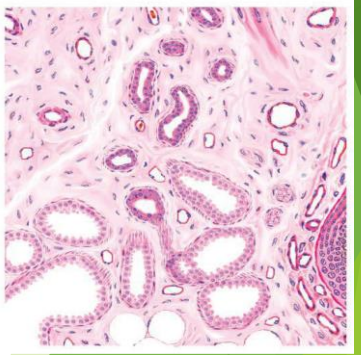



- Sweat glands :
- Sweat glands are widely distributed in skin ,and are of two types :
- 1- eccrine (merocrine) are most numerous
- in the skin of the palms and soles. The eccrinesweat glands assist in
- temperature regulation.Sweat glands also excrete water, sodiumsalts,
- ammonia, uric acid, and urea

- 2- apocrine :Apocrine sweat glands are also found in the dermis and are
- primarily limited to theaxilla ,anus , and areolar regions of thebreast.
- These sweat glands are larger than eccrine
- sweat glands, and their ducts open into thehair follicle.

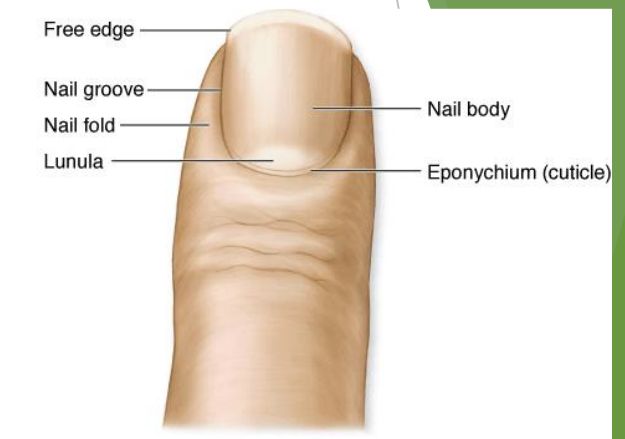
Secretory portion of eccrine gland


Apocrine gland

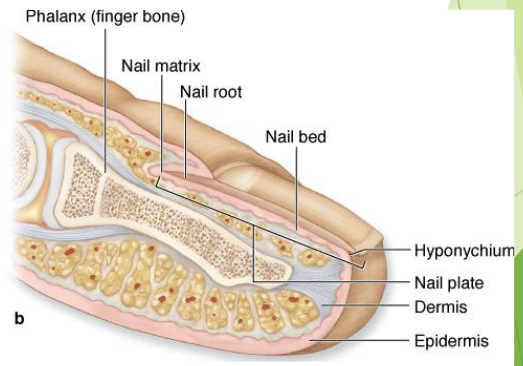


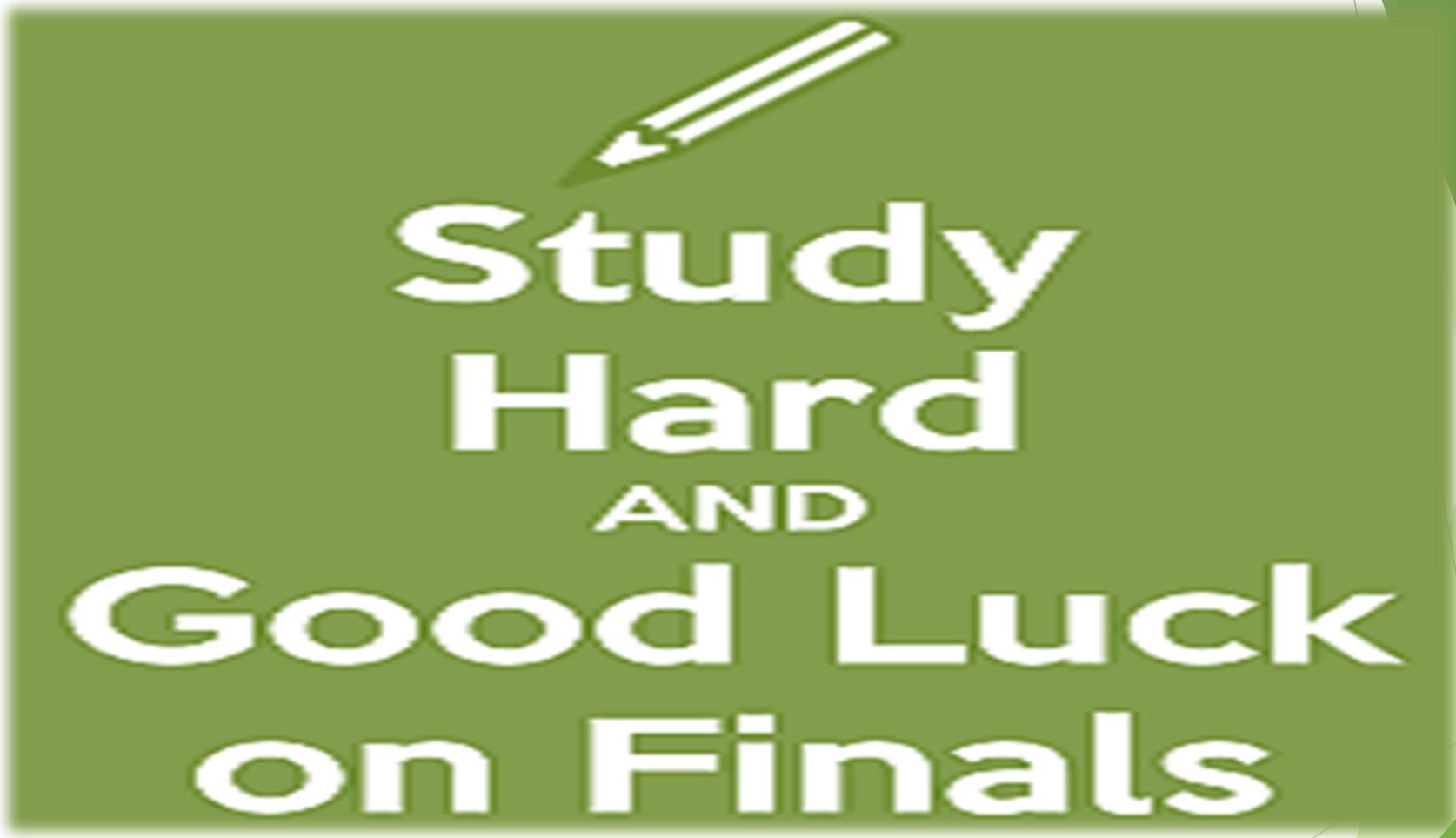
# Nails

- The nails are hard, keratinized structures
- that cover the dorsal surfaces of the tips of the
- fingers and toes. Each nail consists of a visible
- body (nail plate) and a proximal part, the
- root, which is implanted into a groove in the
- skin. The root is overlapped by the proximal
- nail fold, a fold of skin that continues along
- the lateral borders of the nail, where it forms
- the lateral nail folds.








Study
Hard
AND
Good Luck
on Finals

# LYMPHATIC ORGANS

by
Dr. Nahidah Ibrahim

College of pharmacy /Dep. Clinical laboratory Science

stage 1

# LYMPHATIC ORGANS :

Lymphatic organs are divided into

1- primary (central) and

2- secondary (peripheral) organs.

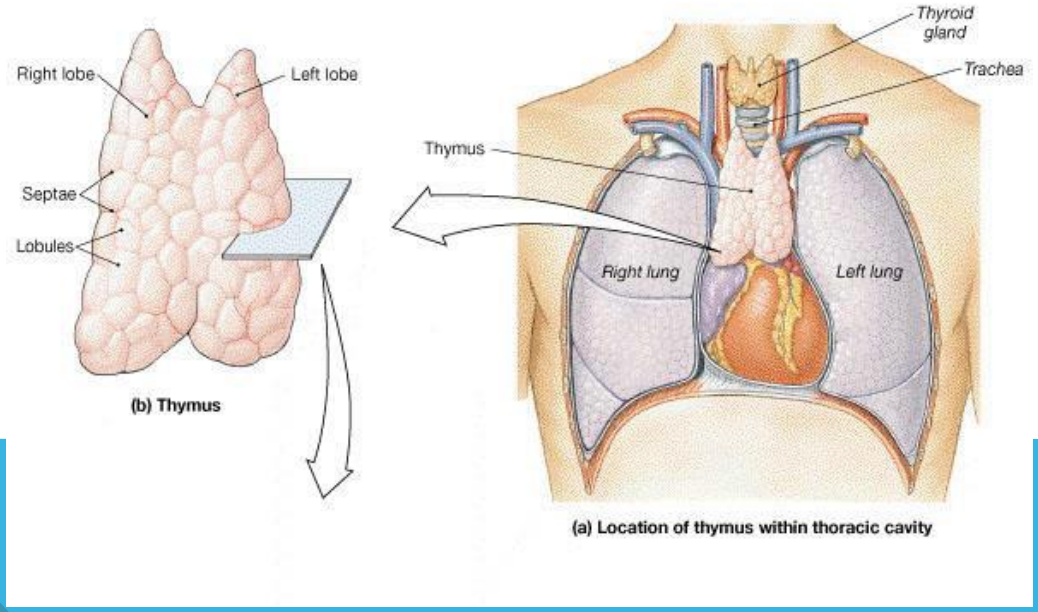
**Primary lymphatic organs** are the first to develop and include the thymus and the bone marrow .

**The secondary lymphatic organs** are the lymph nodes, spleen, tonsils.

# Thymus

The thymus is a bilobed, encapsulated lymphatic organ located in the upper anterior mediastinum and lower part of the neck. . The thymus is the only primary lymphatic organ and is the first organ of the embryo to become lymphoid . Unlike

the spleen and lymph nodes, it is well developed and relatively large at birth, after which the organ undergoes progressive involution and is partially replaced by fat and connective tissue



# Structure:

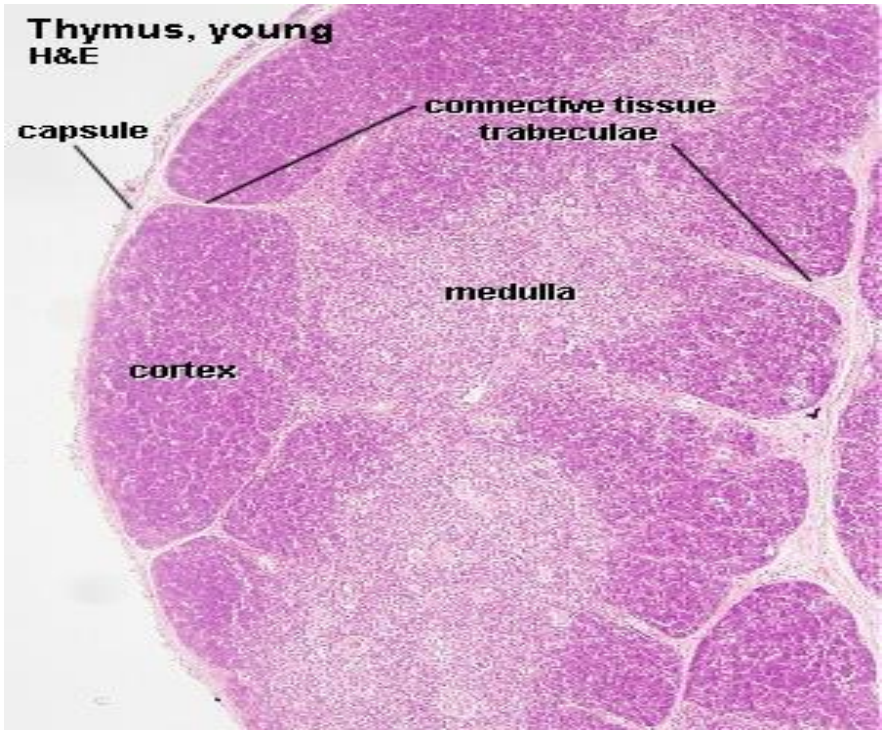
The thymus consists of two **lobes** joined by connective tissue. A thin capsule of loosely connective tissue surrounds each lobe and provides **septa** that extend into the thymus, subdividing each lobe into a number of irregular

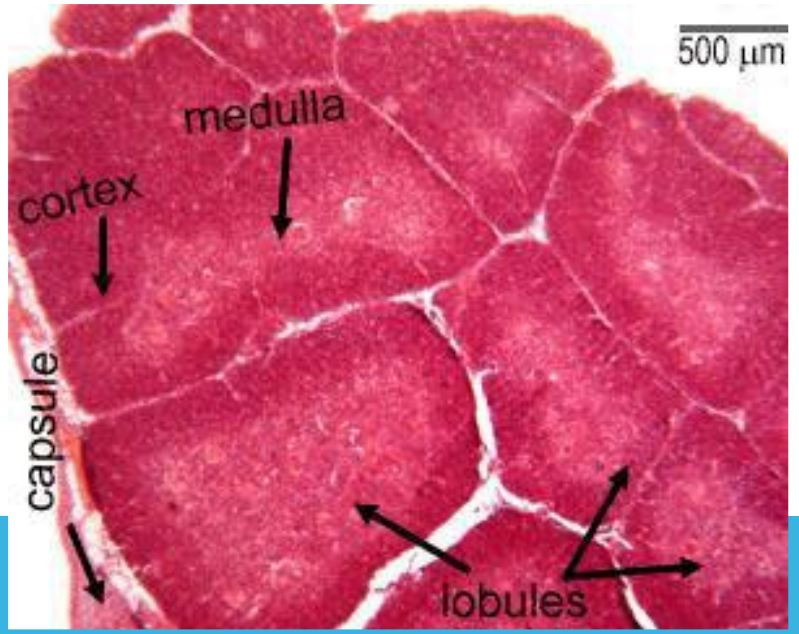
**lobules.**

**Each lobule consists** of :

**-cortex and medulla.**

- **Cortex :**
- under the capsule is a dark-staining cortex with a network of interconnecting spaces. These spaces become colonized by immature lymphocytes that migrate from hemopoietic tissues to undergo maturation and differentiation .
- **Medulla :**
- it appears to be isolated within a lobule, surrounded by a complete layer of cortex. Lymphocytes are less numerous than in the cortex, it appear lighter-staining . The epithelial cells form a coarser framework that contains fewer lymphocytes and epithelial cells that combine to form thymic (Hassall' corpuscles which are the charecteristic feature of medulla of thymus gland.


Thymus, young
H&E
capsule
connective tissue
trabeculae
medulla
cortex

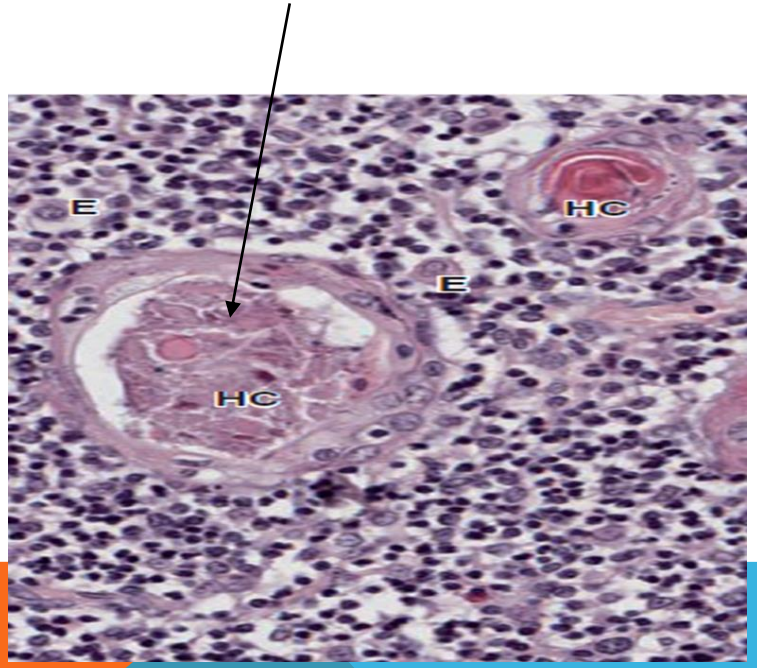

500 µm
medulla
cortex
capsule
lobules

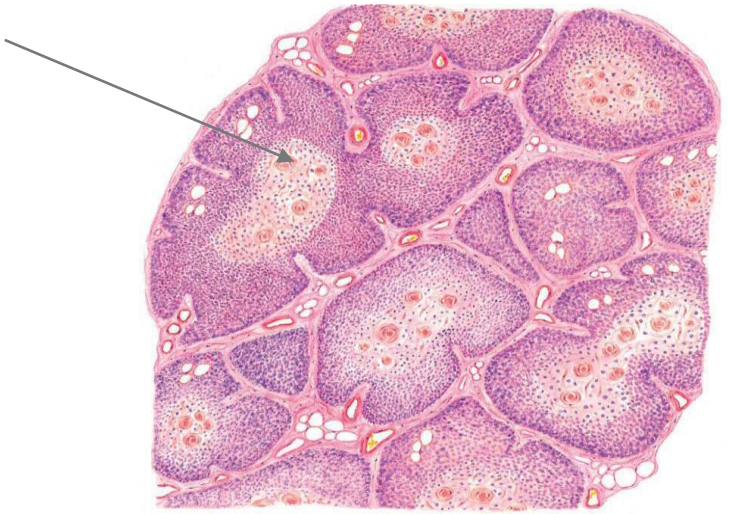
# Thymus

# HASSALL'S CORPUSCLES

The **thymic (Hassall'** corpuscles are oval structures consisting of round or spherical aggregations (whorls) of flattened epithelial cells. The thymic corpuscles also exhibit calcification or degeneration centers that stain pink or eosinophilic**.** The functional significance of these corpuscles remains unknown.

Blood vessels and adipose cells are present in both the thymic lobules and in trabecula .



## LYMPH NODES

Lymph nodes are small encapsulated lymphatic organs set in the course of lymphatic

vessels. They are prominent in the neck, axilla , and mesenteries and along the course of large blood vessels in the thorax and abdomen. They appear as flattened, ovoid or bean shaped structures with a slight indentation at one side, the **hilus,** through which blood and lymphatic vessels enter or leave.

# Structure:

lymph nodes consist of **diffuse** and **nodular lymphatic tissue** enclosed in a capsule that is thick at the hilus. The **capsule** consists of closely packed collagen fibers, with few elastic fibers. From the inner surface of the capsule, **trabeculae** of dense connective tissue extend into the node. Trabeculae subdividing the cortex into several irregular compartments.

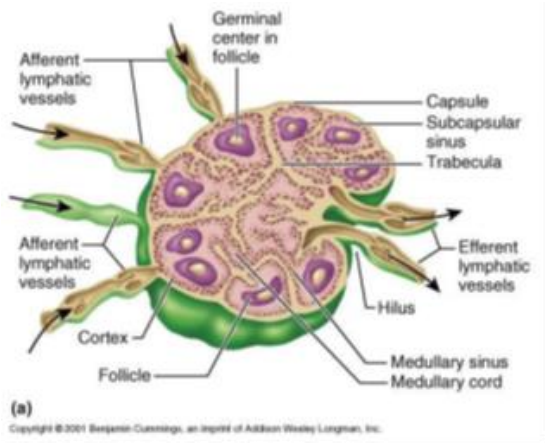
### CORTEX

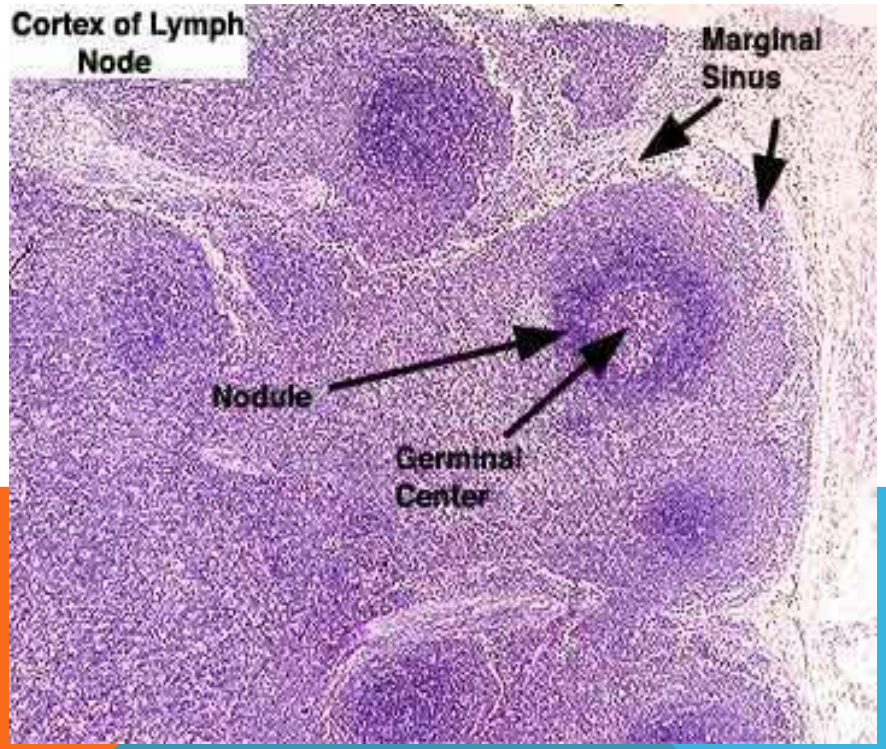
The cortex forms a layer under the capsule. The cortex is divided into an **outer cortex** that lies under the capsule and contains nodular and diffuse lymphatic tissue, and a **deep (inner) cortex** that consists of **diffuse** lymphatic tissue only. A network of reticular fibers and spherical, aggregations of lymphocytes called **lymphoid nodules** characterize the cortex**.** Some of them exhibit **germinal centers.**

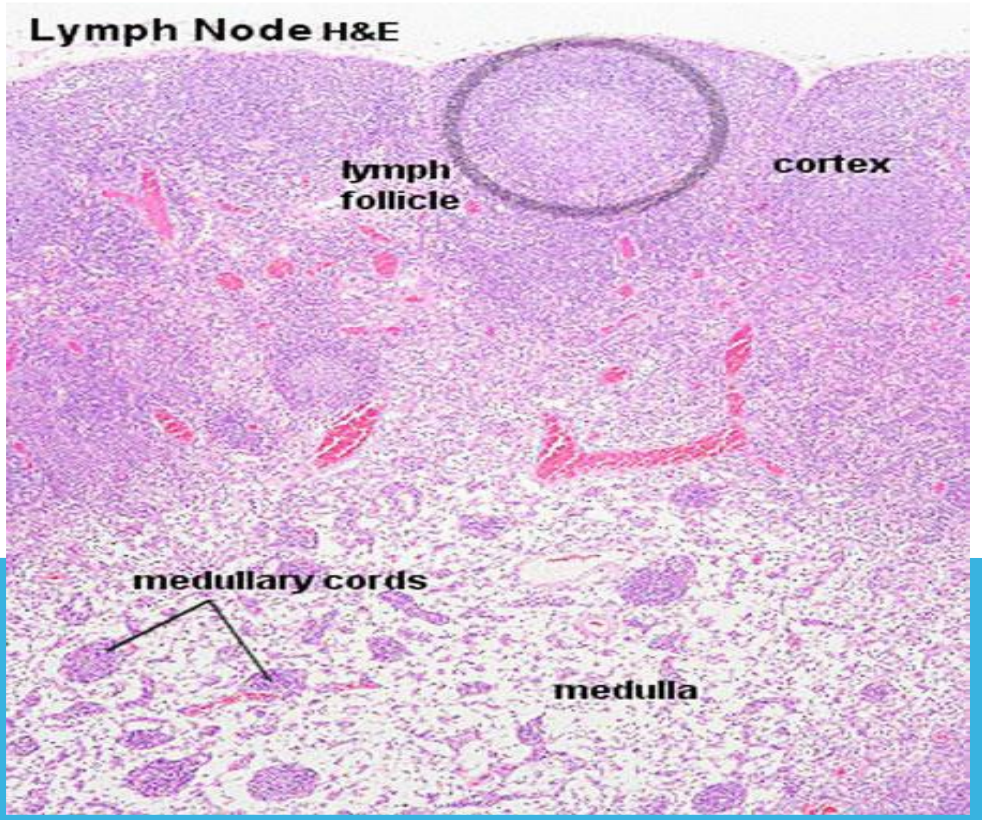
### medulla

The medulla appears as a paler area of variable width, surrounding the hilus . It consists of

diffuse lymphatic tissue arranged as irregular **medullary cords.** Medullary cords are networks o reticular fibers filled with plasma cells, macrophages, and lymphocytes separated by capillary-like channels called **medullary sinuses**

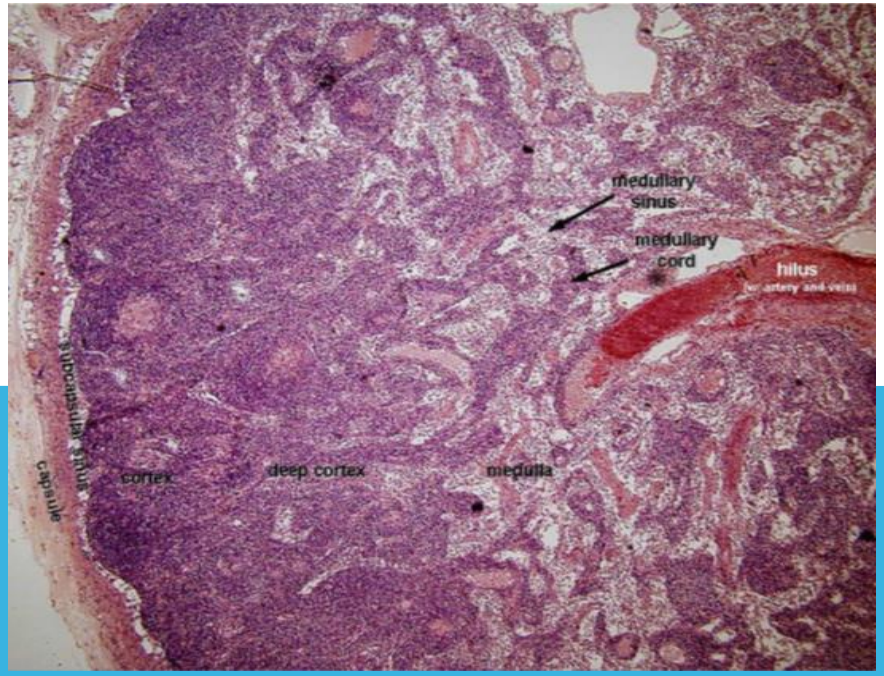

Germinal center in follicle
Afferent lymphatic vessels
Capsule
Subcapsular sinus
Trabecula
Afferent lymphatic vessels
Efferent lymphatic vessels
Hilus
Cortex
Follicle
Medullary sinus
Medullary cord
(a)


Cortex of Lymph Node
Marginal Sinus
Nodule
Germinal Center


Lymph Node H&E
lymph follicle
cortex
medullary cords
medulla

# Lymph Sinuses

Within the lymph node is a system of channellike spaces, the lymph sinuses, through which lymph percolates. Lymph enters the node through afferent lymphatic vessels and empty into the **subcapsular (marginal sinus)** which separates the cortex from the capsule. present as a wide space extending beneath the capsule. It is continuous with the **cortical (trabecular) sinus.** which extend into the cortex, usually along the trabeculae. These become continuous with **medullary sinuses** that run between the medullary cords and trabeculae of the medulla. Sinuses in the cortex are less numerous than in the medulla and narrow . They run in the medullary parenchyma as irregular cordlike arrangement .



# Spleen

The spleen is a large lymphoid organ with a rich blood supply. The spleen is enclosed by a

capsule of dense connective tissue( fibro-elastic connective tissue, some smooth muscle, and an outer covering mesothelium . ). On the medial surface of the spleen, the capsule is form a cleft like hilus through which blood vessels, nerves, and lymphatics enter or leave the spleen. Broad bands of connective tissue, the trabeculae, extend from the inner surface of the capsule, the trabeculae subdivide the organ into compartments. **pulp . the** splenic pulp is consist of : - the light areas form the white pulp and consist of diffuse and nodular lymphatic tissue. - The dark red tissue is the red pulp and consists of diffuse lymphatic tissue**.**

## White pulp

The spleen is characterized by numerous aggregations of **lymphatic nodules ,** they contain mainly **B cells.** The lymphatic nodules also contain **germinal centers** that decrease in number with age**.** Passing through each lymphatic nodule is a blood vessel called a **central artery** that is located in the periphery of the lymphatic nodules . Central arteries are branches of trabecular arteries that become en sheathed with lymphatic tissue as they leave the connective tissue

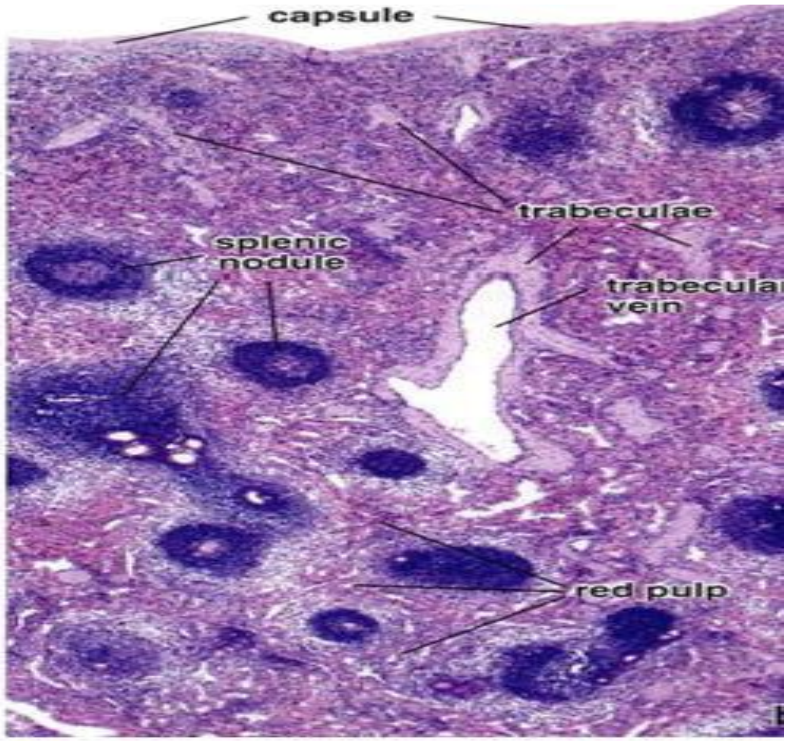
## Red Pulp

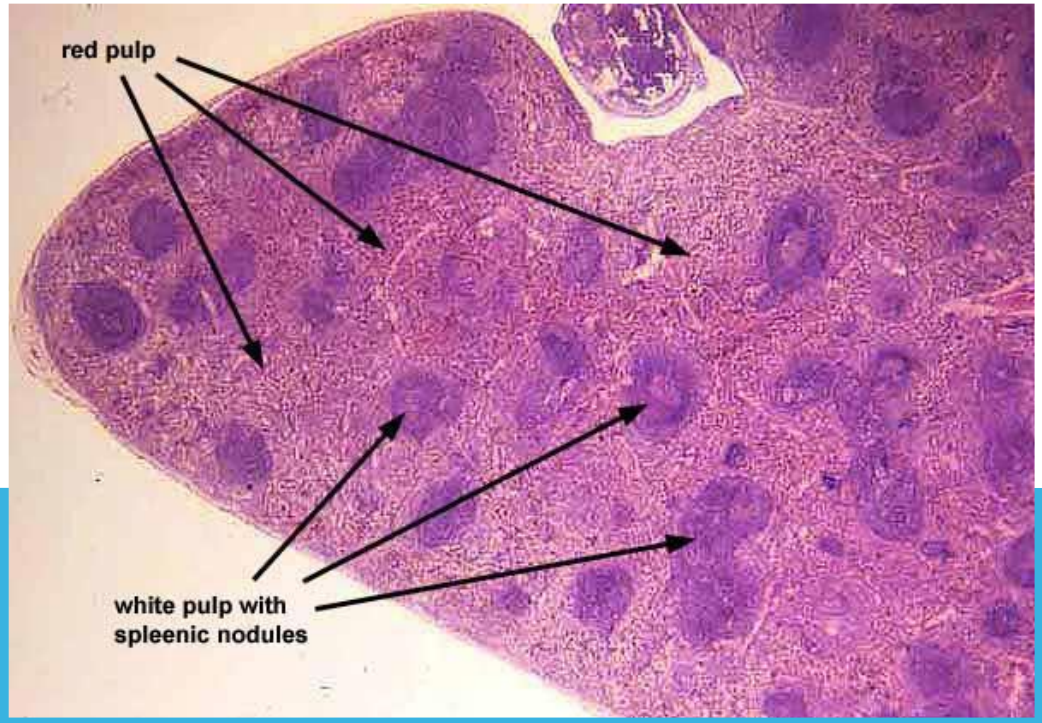
red pulp is red because of its extensive vascular tissue. The red pulp also contains **pulp arteries - venous sinuses , and splenic cords. The splenic cords** appear as diffuse strands of lymphatic tissue between the venous sinuses and form a spongy meshwork of reticular connective tissue. They are thin aggregations of lymphatic tissue containing small lymphocytes, associated cells, and various blood cells.

**Venous sinuses** are dilated vessels lined with modified endothelium of elongated cells .

**pulp arteries** represent the branches of the central artery after it leaves the lymphatic nodule . Capillaries and pulp (venules) are also present .

The main function of the red pulp is to filter the blood. It removes antigens, microorganisms, platelets, and aged or abnormal erythrocytes from the blood. The spleen does not exhibit a distinct cortex and a medulla, as seen in lymph nodes. However, lymphatic nodules are found throughout the spleen. In addition, the spleen contains venous sinuses


capsule
trabeculae
splenic nodule
trabecular vein
red pulp


red pulp
white pulp with spleenic nodules

# Spleen

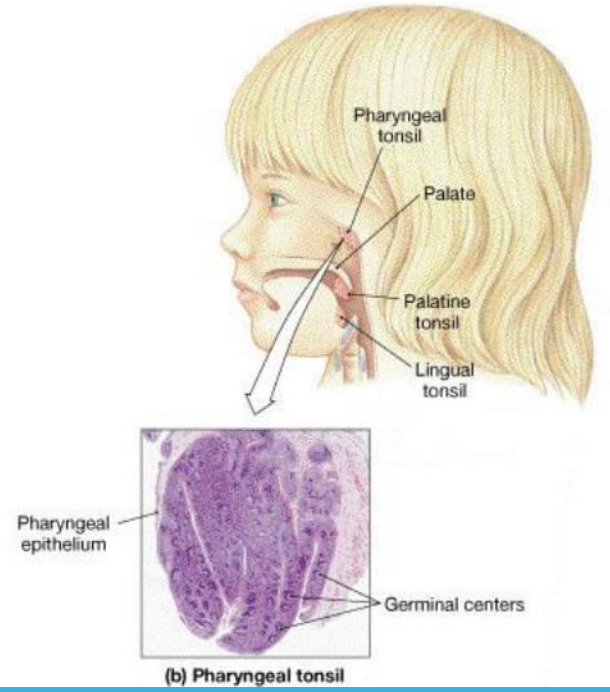
## TONSILS :

Tonsils are aggregates of lymphatic nodules associated with the pharynx and oropharynx. These structures are spread through different areas - oropharynx, nasopharynx, and tongue - and form the

**1- palatine**,

**2- pharyngeal**, and

3- **lingual tonsils** .



# PALATINE TONSILS

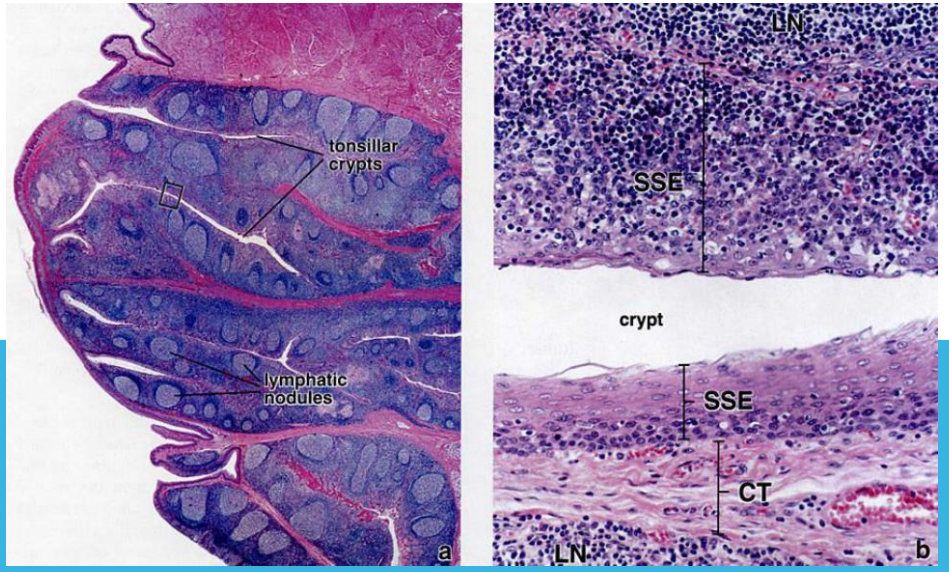
The palatine tonsils are paired, oval lymphatic organs located laterally at the junction of the oral cavity and oropharynx.

A **stratified squamous epithelium** covers the free surface of the tonsil and is very closely

associated with the lymphatic tissue. Deep invaginations of the epithelium form the tonsillar

**crypts** that reach almost to the base of the tonsil Lymphatic nodules, many with germinal

centers, usually are arranged in a single layer beneath the epithelium, embedded in a mass of diffuse lymphatic tissue. A **partial capsule** beneath the basal surface of the tonsil separates it from surrounding structures .



## LINGUAL TONSILS:

The lingual tonsils form nodular bulges in the root of the tongue, and their general structure is similar to that of the palatine tonsil. **Crypts** are deep, and are lined by **stratified squamous epithelium** that invaginates from the surface. The associated lymphatic tissue consists of diffuse and nodular types.

## PHARYNGEAL TONSIL :

The pharyngeal tonsil is located on the posterior wall of the nasopharynx. Its surface epithelium is a **ciliated pseudostratified columnar epithelium** that contains goblet cells. Patches of stratified squamous epithelium may be present . crypts are not as deep as in the palatine tonsils . A thin capsule separates the pharyngeal tonsil from underlying tissues and provides fine septa that extend into the substance of the tonsil.