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مادة علم الانسجة النظري

الكورس الاول
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Theoretical syllabus	
Weeks	Syllabus (theory)
1	Shape of cell
2	Epithelial tissue-Simple epith. T.

3	Epithelial tissue-Stratified epith. T.
4	Connective tissue-Loose CO. T.
5	Connective tissue-dense CO. T.
6	Connective tissue-the blood
7	Connective tissue-Compact bone
8	External feature of digestive system
9	Urogenital system of male & female
10	Liver
11	Spleen
12	Lymph node
13	Circulatory system (Artery)
14	Circulatory system (Vein)
15	Final exam

Shape of cells

Medical Histology is the microscopic study of tissues and organs through sectioning, staining, and examining those sections under a microscope. Often called microscopic anatomy and histochemistry, histology allows for the visualization of tissue structure and characteristic changes the tissue may have undergone.

A cell is a mass of cytoplasm that is bound externally by a cell membrane. Usually microscopic in size, cells are the smallest structural units of living matter and compose all living things. Most cells have one or more nuclei and other organelles that carry out a variety of tasks.

It is the basic structural and functional unit of life and all the organisms are made up of cells. The subcellular structures of the cell comprise of the plasma membrane, organelles and in some cases a nucleus as well. As for the size of the cell, it is variable and maybe anything from 1 to 100 micrometer.

Cell Shape

Usually, the cells are round, elongated or spherical. There are also some cells which are long and pointed on both the ends. Such cells exhibit spindle shape. In some cases, the cells are very long. Some may be branched like the neuron or the nerve cell. The nerve cell transfers and receives messages. It, therefore, helps in coordinating and controlling the working of the different parts of the body. The components of the cell are enclosed in a membrane. This membrane provides shape to the cells of animals and plants. There is a cell wall surrounding them. The cell wall is an additional covering over the cell membrane in the plant cells. It offers rigidity and shape to the cells.

The shape of a cell greatly influences its specific function:

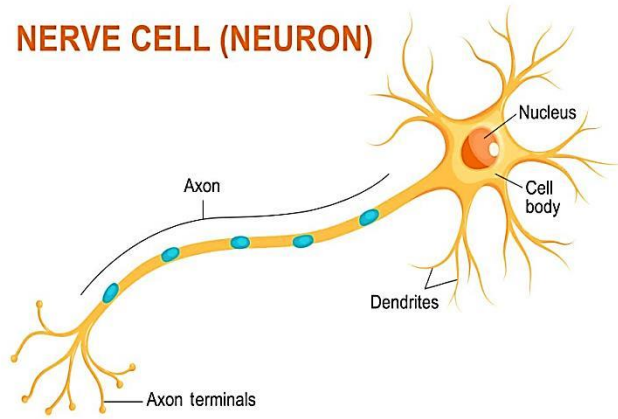
1. RBC's pass through narrow capillaries and transport oxygen. So it has a round Biconcave, discoidal shape to facilitate its function.
2. Muscle cells are elongated for contraction.
3. For motility, sperms have tail.
4. The primary function of the nerve cell is to coordinate and control the different parts of the body. Nerve cells are very long and elongated which facilitate transmitting impulses to distant places from various body parts to the brain and vice-versa,
5. The root hair cells also have prolonged areas that increase "surface area to volume ratio". Plant absorbs water from the soil through osmosis with the help of root hair.
6. The primary role of smooth muscle is to control the diameter, wall movement, and wall stiffness of the hollow organs (such as stomach, small intestine).
7. The function of ovum is to act as a female gamete and share a set of chromosomes in reproduction with a male gamete.
8. Photoreceptor cells (rods and cones) are cells in the eye that detect light. They're actually a very specialized form of neuron. Photoreceptors need to collect light as efficiently as possible, so they have a specialized protrusion from the cell (called the

outer segment) that is full of the molecules that absorb light. Rods, which are especially good at detecting light, have a bigger protrusion. The outer segment is now known to be a highly modified kind.

9. immune cells are cells that respond when the body is infected (by a bacterium, for instance). To do their job, they need to be able to change shape. For instance, lymphocytes may need to move through body tissue to get to the site of infection, so they change their shape to squeeze past tightly packed tissue cells. Some immune cells (such as neutrophils) engulf bacteria and viruses, so they need to change their shape to ‘swallow’ them. You can learn more about the different kinds of immune cells in the context Fighting Infection.

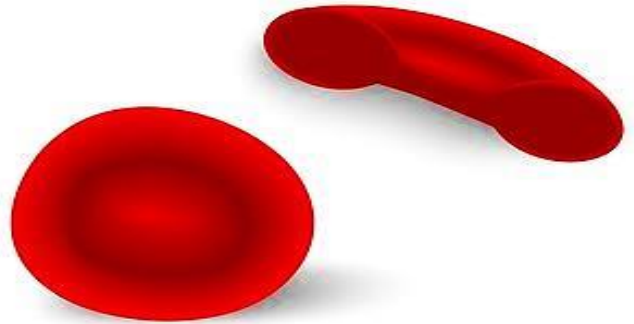
Examples:

NERVE CELL (NEURON)



1

RED BLOOD CELLS



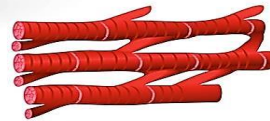
Skeletal muscle



Smooth muscle



Cardiac muscle

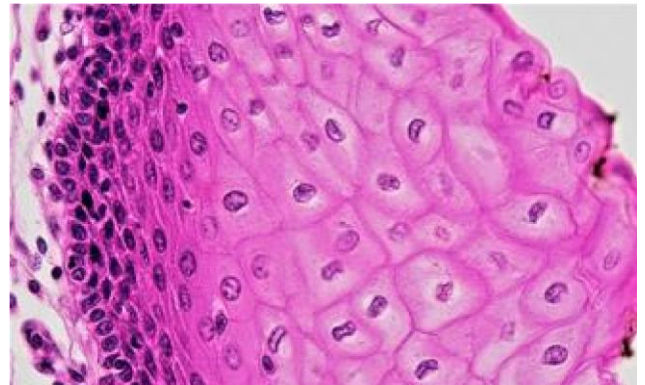
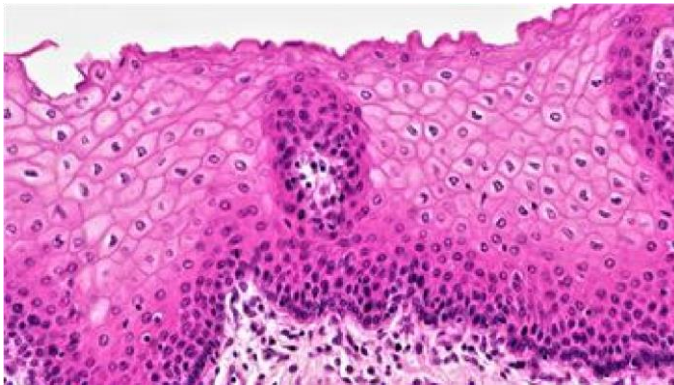


Type of muscles cells

Epithelium tissue

Epithelium or **epithelial tissue** is a thin, continuous, protective layer of compactly packed [cells](#) with a little [intercellular matrix](#). Epithelial tissues line the outer surfaces of [organs](#) and [blood vessels](#) throughout the body, as well as the inner surfaces of [cavities](#) in many internal organs. An example is the [epidermis](#), the outermost layer of the [skin](#). Epithelial tissue is one of the four basic types of [animal tissue](#), along with [connective tissue](#), [muscle tissue](#) and [nervous tissue](#).

Epithelium, a sheet of aggregate cells of a similar type tightly adhered to each other . The external and internal surface of the body . In addition to the surface ,The epithelium is separated from the underlying connective tissue by a basal lamina which is a thin sheet of extracellular material .



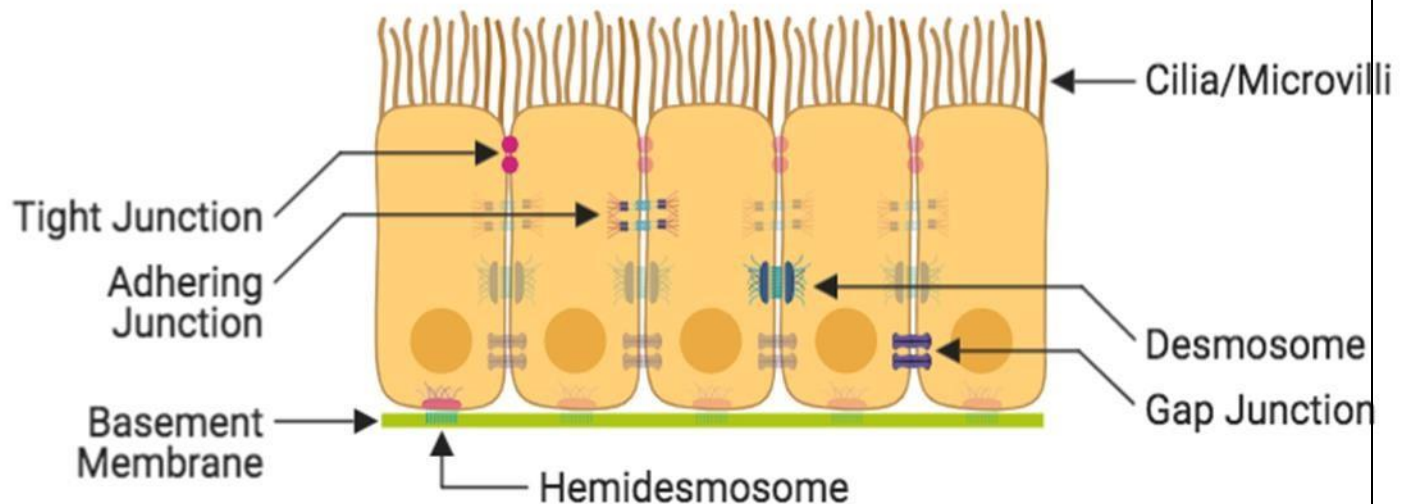
Epithelial Tissue under microscope

There are two functional types of epithelium :

- a. Lining Epithelia: cover the free of the body and its cavities , eg. Epidermis , lining of the gastrointestinal tract and ducts.
- b. Glandular epithelium: represent all the cavities of epithelia that are specialized for secretion which is the process by which cell release specific substance onto their apical surface.

Function of Epithelium tissue

- 1- Covering , lining, and protecting surfaces (eg, epidermis)
- 2- Absorption (eg , the intestinal lining)
- 3- Secretion (eg parenchymal cells of glands)



Number of layers of cells:

1. Simple : one layer.
2. Stratified : more layer.
3. Pseudostratified : appear more than one cell thick since the nuclei lie at different heights, but in fact, all the cells are in contact with the basement membrane.

C-Shape of cells at free surface: e.g. Squamous, Cuboidal, Columnar.

D-Surface specialization (if any) e.g. Keratinised , Ciliated.

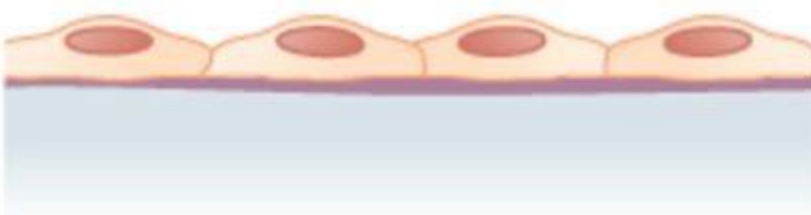
Classification and microscopic structure:

Type of lining epithelium :

1- Simple squamous epithelium

Simple squamous epithelium consist of a single layer of thin, flat, scale like cells . A spherical or oval nucleus , near the center of the cell , gives a slightly elevated appearance to this area. On cross section the cell appears thicker in the area of the nucleus and has thin attenuated strand of cytoplasm on either side.

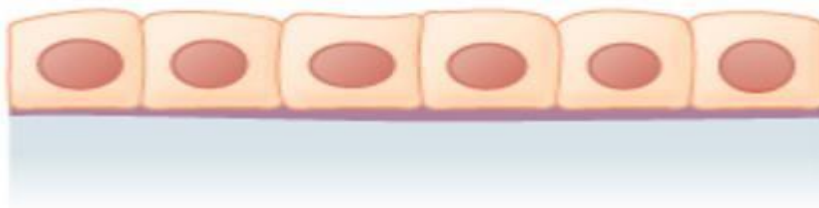
Example of distribution : Lining of vessels (endothelium); serosa lining of cavities : pericardium , pleura , peritoneum (mesothelium)



2-Simple cuboidal epithelium

Simple cuboidal epithelium is a single layer of cells whose width and height are approximately equal . these cells appear as squares in cross sections but are more hexagonal when seen form the surface.

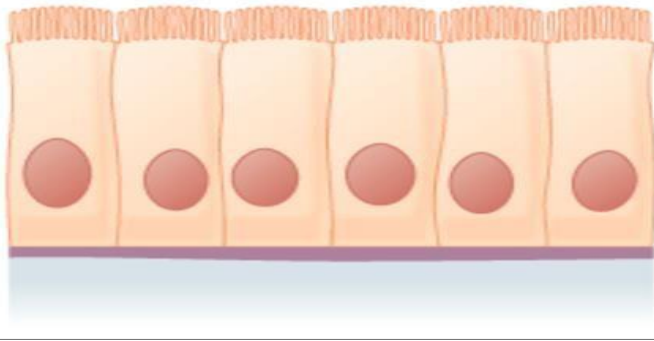
Example of distribution : covering the ovary , thyroid



3-Simple columnar epithelium

Simple columnar epithelium consist of long , narrow cells with height considerably greater than their width usually the nuclei are oval and occur near the base of each cell.

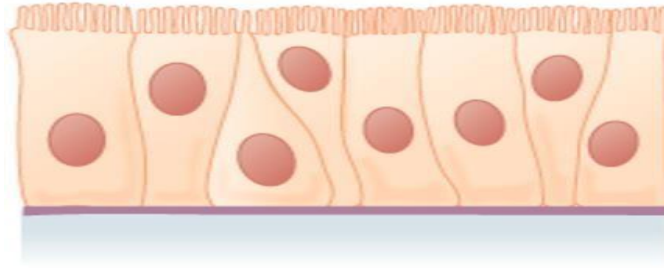
Example of distribution: Lining of intestine, gallbladder



4- Pseudo stratified columnar ciliated epithelium

Pseudo stratified columnar epithelium is composed of a single layer of cells, but because the cells are irregular in shape and size , The nuclei of cells in this type of simple epithelium appear at different levels and therefore give a false impression that the cells are in many layers. In pseudostratified epithelium, all the cells reach the basement membrane even though the nuclei will lie at different levels in the tissue, reflective of the irregular layering of tall and thin cells. However, only the taller cells will reach the free surface

Example of distribution : respiratory and reproductive system



5-Stratified squamous epithelium (Non-keratinised): Many layers of cells; those at the free surface are flattened. Ex.: Lining of mouth, vagina and rectum.

6-Stratified squamous epithelium (keratinised): Many layers of cells; those at the free surface are flattened; the surface cells are dead and filled with an inert protein, keratin, forming flakes or squares. Ex.: Skin.

7-Stratified cuboidal epithelium: Many layers of cells; those at the free surface are cuboidal, Ex.: Sweat gland, Salivary gland and Mammary gland.

8-Stratified columnar epithelium: Many layers of cells; those at the free surface are columnar, Ex.: Male urethra.

9- Transitional epithelium: there are several layers of cells; those at the free or luminal surface are irregularly polyhedral (like squashed bubbles) and it is called transitional. Ex.: Bladder, ureter.

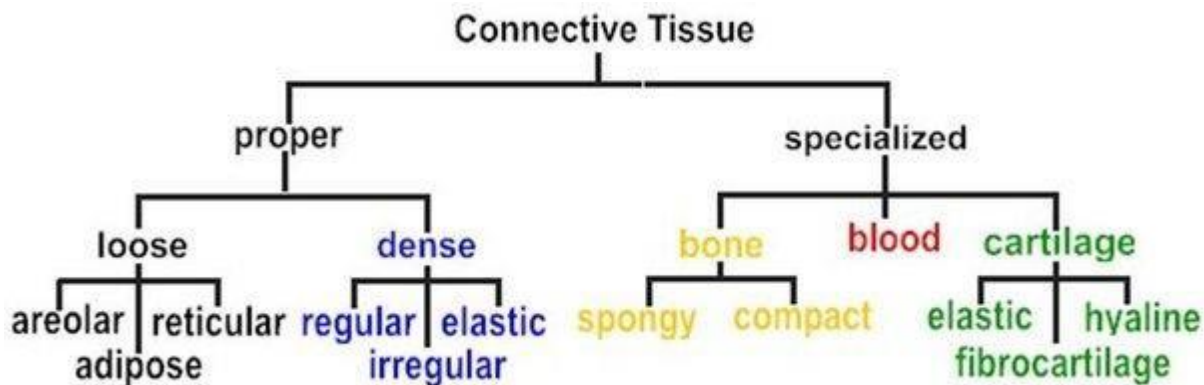
Specific names are given to epithelium in certain locations:

- Endothelium: is the epithelial lining of the blood and lymphatic vessels.
- Endocardium: is the epithelial lining of ventricles and atria of the heart.
- Mesothelium: is the epithelium that lines the walls and covers the contents of the closed cavities of the body. I.e. the abdominal, pericardial, pleural cavities.

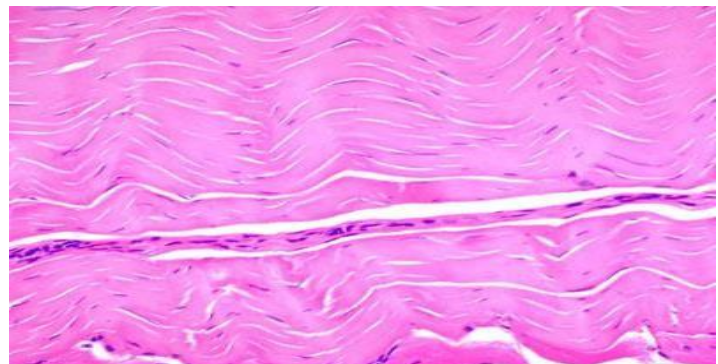
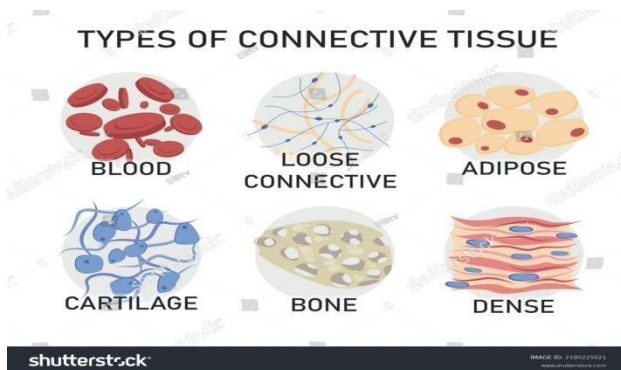
Connective tissue

Connective tissue is one of the four primary types of tissues , along with epithelial tissue, muscle tissue, and nervous tissue. It develops from the mesenchyme, derived from the mesoderm, the middle embryonic germ layer. Connective tissue is found in between other tissues everywhere in the body, including the nervous system.

Most types of connective tissue consists of three main components: elastic and collagen fibers, ground substance, and cells



Blood, and lymph are classed as specialized fluid connective tissues that do not contain fiber. All are immersed in the body water. The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.



Connective Tissue under microscope

Function of connective tissue:-

- A. Providing structure support (bones, cartilage and the ligament)
- B. defense and protection of the body
- C. forming a site for storage of fat
- D. serving as a medium for exchange (metabolic waste, nutrient and oxygen between the blood and many of the cells of the body)

Loose connective tissue

Also known as **areolar tissue** is a cellular connective tissue with thin and relatively sparse collagen fibers. Its ground substance occupies more volume than the fibers do.

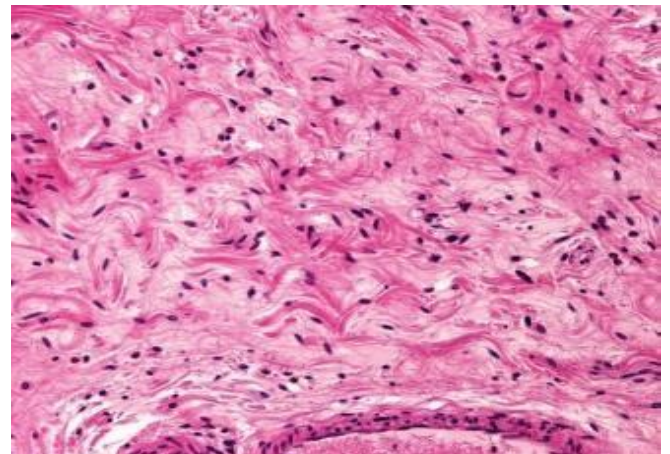
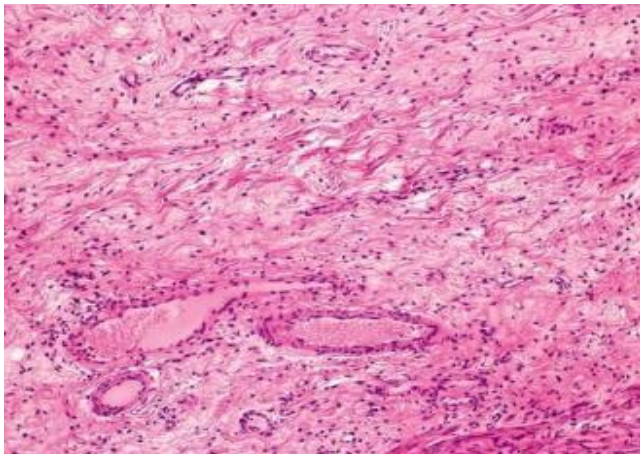
Structure: It is a pliable, mesh-like tissue with a fluid matrix and functions to cushion and protect body organs. Fibroblasts are widely dispersed in this tissue; they are irregular branching cells that secrete strong fibrous proteins and proteoglycans as an extracellular matrix. The cells of this type of tissue are generally connected by a gelatinous substance known as ground substance primarily made up of collagenous and elastic fibers.

Location: It may be found in tissue sections from almost every part of the body. It surrounds blood vessels and nerves and penetrates with them even into the small spaces of muscles, tendons, and other tissues. It may likewise be present in the mediastinal extremities. Nearly every epithelium rests on a layer of areolar tissue, whose blood vessels provide the epithelium with nutrition, waste removal, and a ready supply of infection-fighting leukocytes when needed. Because of the

abundance of open, fluid-filled space, leukocytes can move about freely in areolar tissue and can easily find and destroy pathogens.

The areolar tissue is found beneath the epidermis layer and is also underneath the epithelial tissue of all the body systems that have external openings. it makes the skin elastic and helps it to withstand pulling pain. It is also a component of the lamina propria of the digestive and respiratory tracts, the mucous membranes of reproductive and urinary systems, the stroma of

glands, and the hypodermis of the skin. It is also found in the mesentery which is surrounding the intestine.

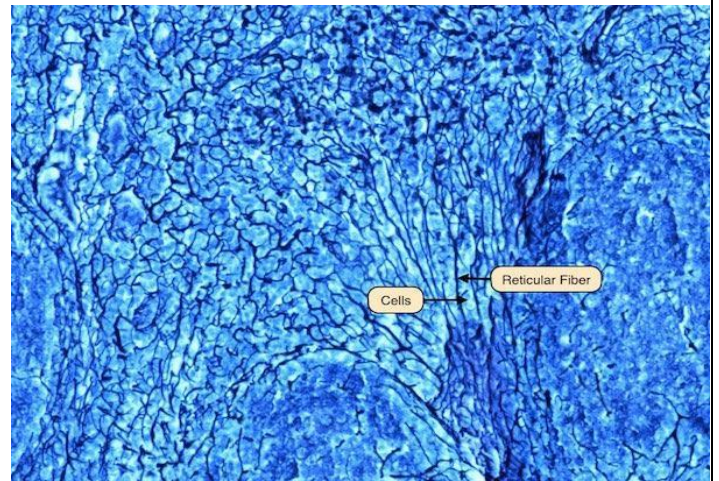
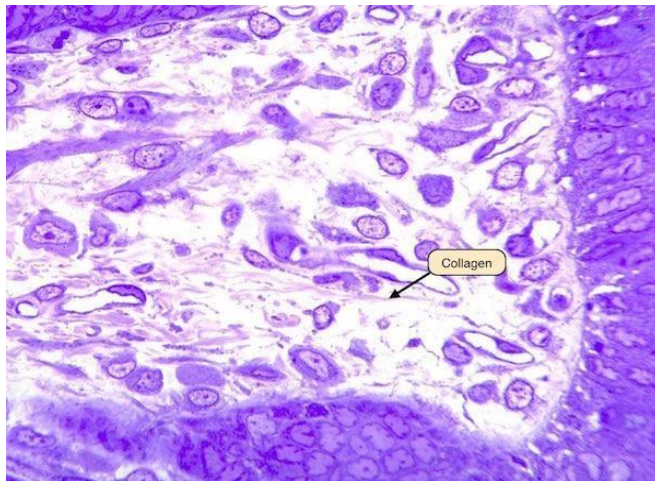
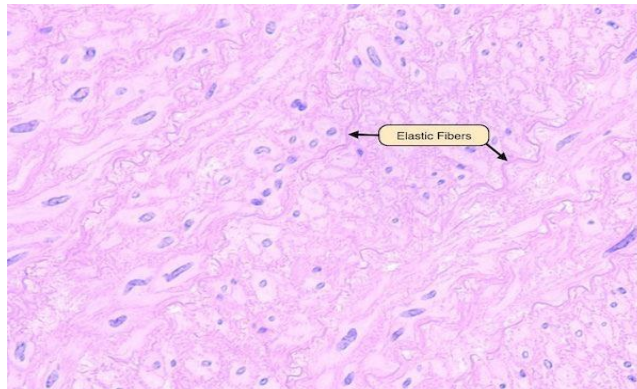


Loose Tissue under microscope

Fibers:- Loose connective tissue is named based on the "weave" and type of its constituent fibers. There are three main types:

- 1) **Collagenous fibers:** collagenous fibers are made of collagen and consist of bundles of fibrils that are coils of collagen molecules.
- 2) **Elastic fibers:** elastic fibers are made of elastin and are "stretchable."
- 3) **Reticular fibers:** reticular fibers consist of one or more types of very thin collagen fibers.

They join connective tissues to other tissues.



Function : Areolar connective tissue holds organs in place and attaches epithelial tissue to other underlying tissues. It also serves as a reservoir of water and salts for surrounding tissues.

Almost all cells obtain their nutrients from and release their wastes into areolar connective tissue

Dense connective tissue

Dense regular connective tissues are connective tissues of a group or bundle of dense, robust, and large collagen fibers that hold the tissue and provide strength to it. Characteristically, in the dense regular tissue the collagen fibers are arranged loosely but in a parallel fashion. This connective tissue can be found in tendons (those that connect cartilage or bone to a muscle) and ligaments (those that connect two bones at the joint). The parallel arrangement of collagen

fibers in dense regular connective tissue provides resilience to axially loaded tension forces.

However, it permits stretching. Thus, these connective tissues are strong as well as flexible.

Cell Types

1-Collagen: The most abundant and important fibers of connective tissue are composed of collagen. Collagen is a protein that is made by specialized cells called fibroblasts. There are different types of collagen that can be found throughout the body, but notably in connective tissue is collagen type I.

2-Fibroblasts : are responsible for the synthesis of collagen and extracellular matrix. They appear as flattened, fusiform or spindle shaped cells. They have large euchromatic nuclei with prominent nucleoli. The cytoplasm of young and active cells are basophilic due to the presence of high concentration of rough endoplasmic reticulum, mitochondria and many sets of Golgi apparatus.

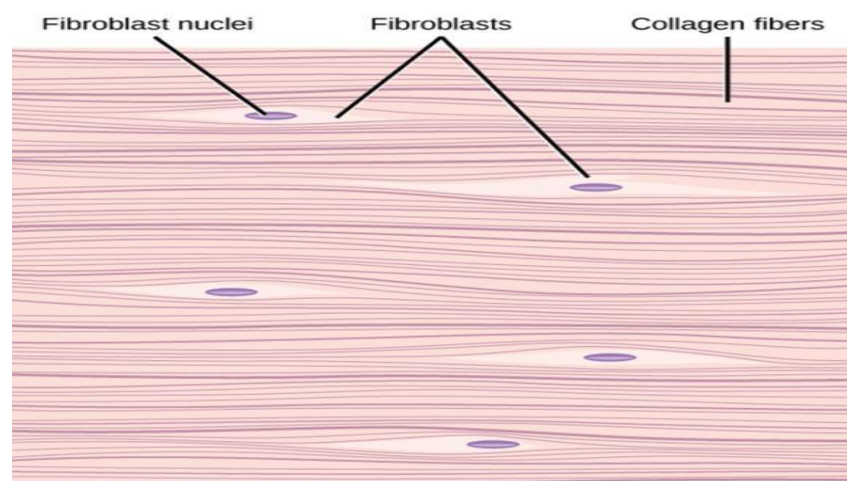
Classification: It is classified as either dense regular connective tissue or dense irregular connective tissue. (1-Dense regular. 2-Dense irregular)

1-Dense regular.

a-Contains closely packed collagen fibers arranged in the same direction

b-Functions of dense regular connective tissue: Attaches muscles to bones or to other muscles; withstands great tensile stress in one direction

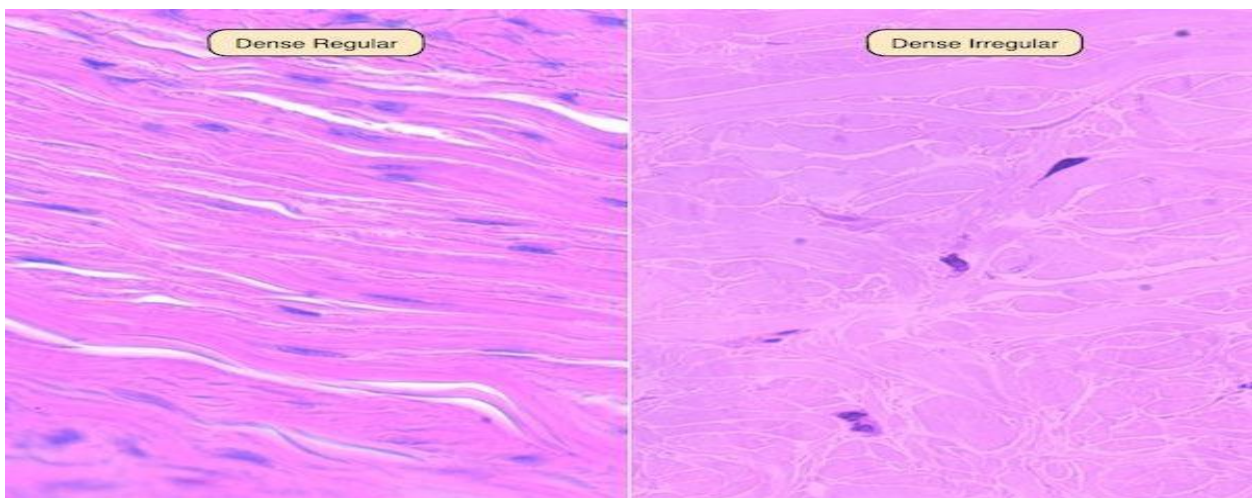
Location - tendons, most ligaments, aponeuroses. Tendon Ligament.



2-Dense irregular: consisting of a fluid containing hyaluronic acid, mixed with many fibers. Examples are dermis and fascia. The fibers are mostly collagen and are irregularly arranged. Provides tensile strength to prevent tearing.

Function : This type of connective tissue is found mostly in the reticular layer (or deep layer) of the dermis , It is also in the sclera and in the deeper skin layers. Due to high portions of collagenous fibers, dense irregular connective tissue provides strength, making the skin resistant to tearing by stretching forces from different directions.

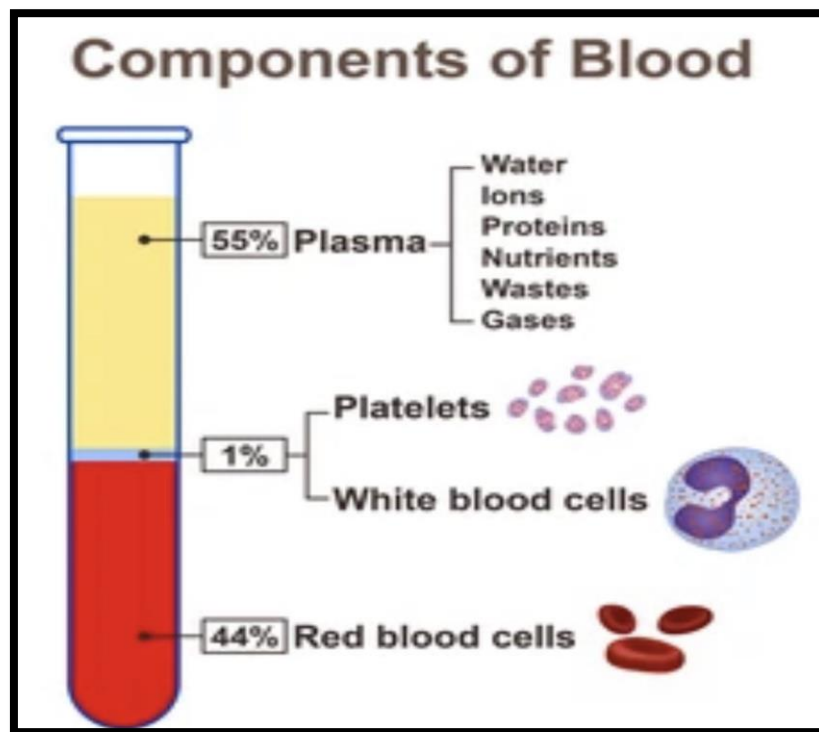
Dense irregular connective tissue also makes up submucosa of the digestive tract, lymph nodes, and some types of fascia. Other examples include periosteum and perichondrium of bones, and the tunica albuginea of testis. In the submucosa layer, the fiber bundles course in varying planes allowing the organ to resist excessive stretching and distension.



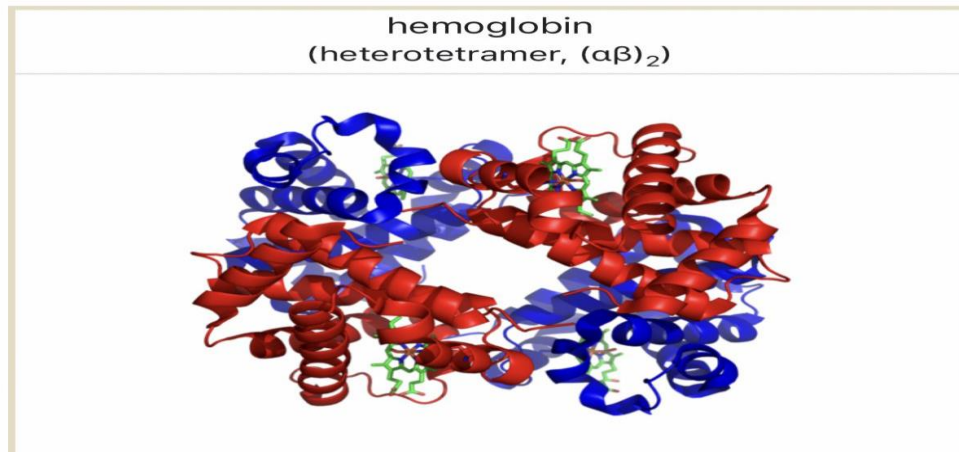
The Blood

Blood is a specialized connective tissue consisting of cells and fluid extracellular material called **Plasma** , propelled mainly by rhythmic contractions of the heart , about 5 L of blood is an average adult moves unidirectional within the closed circulatory system . the so-called formed elements circulating in the plasma are erythrocytes (red blood cells) , leukocytes (white blood cells) , and platelets .when blood leaves the circulatory system , either in a test tube or in the extracellular matrix (ECM) surrounding blood vessels , plasma protein react with one another to produce a clot , which includes formed elements and a pale yellow liquid called serum . serum contains growth factors and other proteins released from platelets during clot formation , which confer biological properties very different from those of plasma .

the straw-colored ,translucent , slightly viscous supernatant comprising 55% at the top half of the centrifugation tube is the plasma . A thin gray-white layer called the **Buffy Coat** between the plasma and the hematocrit , about 1% of the volume , consists of leukocytes and platelets , both less dense than erythrocytes .



An erythrocyte contains hemoglobin consisting of four protein subunits (“globin” molecules), each of which is associated with a non-protein heme group. Heme carries the oxygen, is composed of iron and porphyrin, and is brightly colored (red). Hemoglobin is composed of four globin chains, two alpha and two beta in the adult .



Leukocytes (WBCs)

White blood cells , they leave the body and migrate to the tissues where they become functional and perform various activities related to immunity . Leukocytes are divided into two major groups , granulocytes & granulocytes , based on the density of their cytoplasmic granules.

Types of white blood cells :

1. Monocytes. they are the largest of WBC's ,they travel from the bone marrow to the bone tissue , the nucleus of the monocytes is typically more indented than that in of the lymphocyte .the indentation is the site of the cell center where the well-developed Golgi apparatus and centrioles are located , monocytes are also

contain smooth & rough endoplasmic reticulum and small mitochondria, Although these cells are classified as agranular , they contain small , dense , azurophilic granular , they contain typical lysosomal enzymes similar to those found in the azurophilic granules of neutrophils .

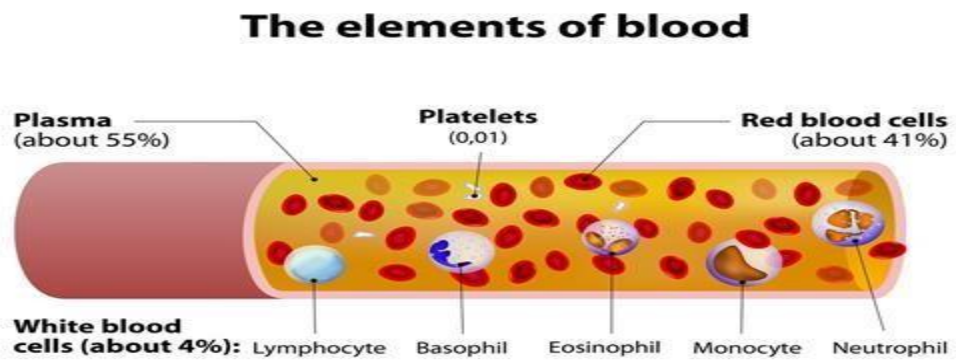
2.Lymphocytes. Are the main functional cells of the lymphatic or immune system , they're about 30% of the total blood leukocytes . Most lymphocytes are small or medium sized , 6 to 15 μm in diameter .they have an intensely staining , slightly indented , spherical nucleus . the cytoplasm appears as a very thin , Pale blue rim surrounding the nucleus . In general , there are no recognizable cytoplasmic organelles other than an occasional fine azurophilic granule . the cytoplasm primarily contains free ribosomes and a few mitochondria .

3.Neutrophils.They are the most numerous WBCs as well as the most common granulocytes , It is measured 10 - 12 μm in diameter and are obviously larger than erythrocytes . Although named for their lack of characteristic cytoplasmic staining , they are also readily identified by their multilobal nucleus , Mature neutrophils possess 2-4 lobes of nuclear material joined by thinner nuclear strands , their cytoplasm contains 3 kinds of granules .

4.Basophils.Are about the same size as Neutrophils and are so named because the numerous large granules in their cytoplasm stain with basic dyes .

5.Eosinophils. About the same size as Neutrophils , and their nuclei are typically bilobed as in neutrophils , the compact heterochromatin of eosinophils is chiefly adjacent to the nuclear envelope , whereas the euchromatin is located in the center of the nucleus.

Platelets : are the smallest of blood cells, being only fragments of megakaryocyte cytoplasm, yet they have a critical role in normal hemostasis. Platelets change from the normal disc shape to a compact sphere with long dendritic extensions facilitating adhesion. The cytoplasm is rich in actin and myosin which bring about the change in shape and retraction of the clot.



The Bone

Bone is a connective tissue characterized by a mineralized extracellular matrix . It is a specialized form of connective tissue that , like other connective tissues , consists of cells and extracellular matrix . the feature that distinguishes bone from other connective tissue is the mineralization of its matrix , which produces an extremely hard tissue capable of providing **support** and **protection** . The major structural component of bone matrix is **type I collagen** , and to lesser extent **type V collagen** . All collagen molecules constitute about **90%** , of the total weight of the bone matrix proteins , the matrix also contains other (non-collagenous) proteins that constitute the **Ground substance** of bone . Bone tissue is classified as either **compact** (dense) or **spongy** (cancellous)

Compact Bone

General Components of Compact Bone :

It forms the shaft of long bones & also presents as a covering plate over the surface of spongy bone . It is formed of :

- 1- Periosteum : It covers the outer surface of bone .
- 2- External Circumferential lamella : they are found under the periosteum . they are formed of Osteocytes within lacunae embedded in between lamellae of calcified collagen bundles which are arranged in layers parallel to the surface of bone .
- 3- Haversian System (Osteon) : they are the structure units of compact bone . they are cylindrical structures which are longitudinally arranged parallel to longitudinal axis of the bone . Each one is formed of

a central canal (Haversian Canal) that contains b.v.s. & nerves embedded in loose C.T. surrounded by 5-20 of concentrically arranged circular bony lamellae & osteocytes within lacunae embedded between them . the lacunae are connected together by canaliculi , through which they get their nutrition . Compact bone has transverse or oblique canals that connect the haversian canals together & with periosteum or bone marrow cavity ,they are called Volkmann's canals.

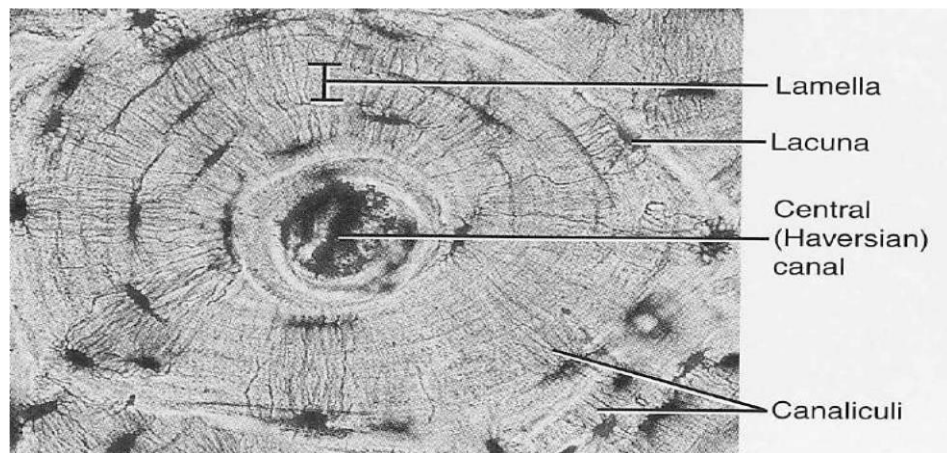
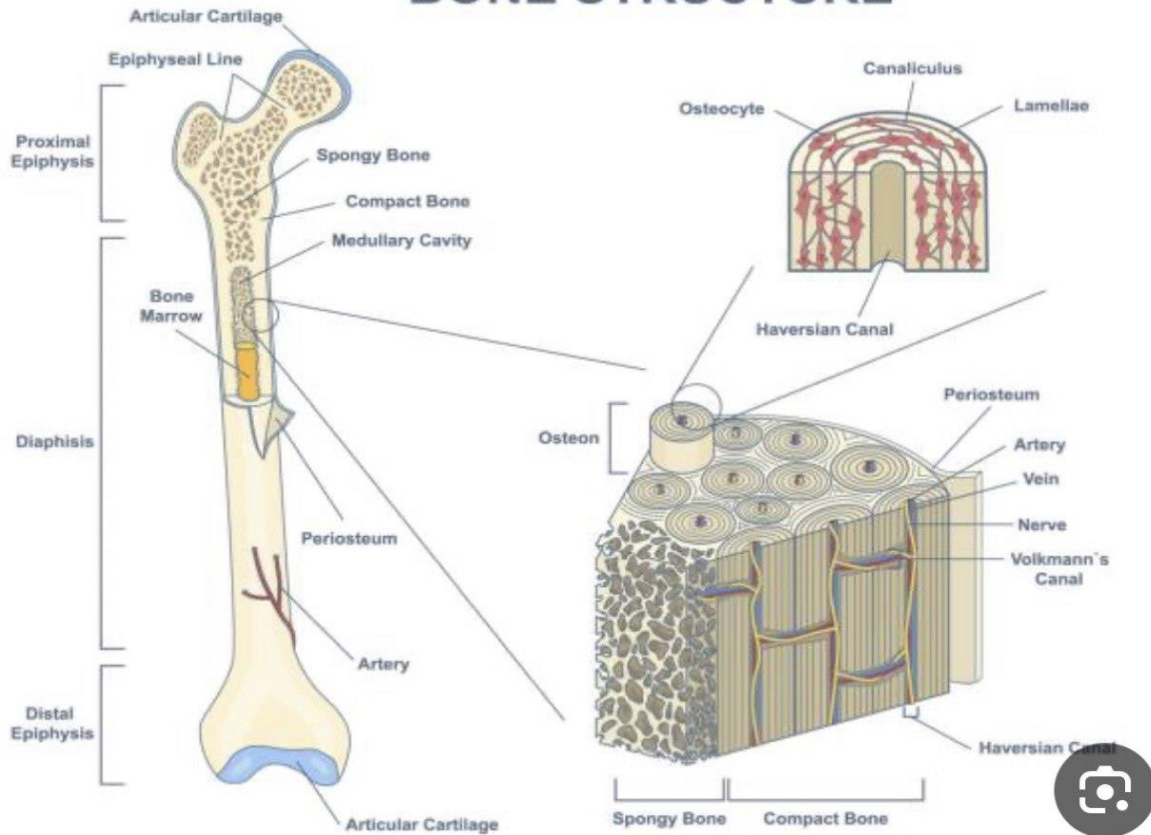
4- Interstitial lamellae : they consist of irregularly arranged bony lamellae & osteocytes in lacunae which are found in between Haversian system .

5- Internal Circumferential lamellae : These are bony lamellae parallel to the inner circumference of bone & they surround the bone marrow cavity .

6- Endosteum : It lines the bone marrow cavity .

Perforating "Fibers of Sharpey" : They are calcified collagen fibers that arise from tendons or ligaments at the site of muscle attachment . they perforate the periosteum at an angle to be

BONE STRUCTURE



External features of Digestive system

The digestive system consists of the digestive tract—oral cavity, esophagus, stomach, small and large intestine, rectum and anus –and its associated glands (salivary glands, liver, and pancreas). Its function is to obtain the molecules necessary for the growth and energy needs of the body

. The **gastrointestinal wall** of the [gastrointestinal tract](#) is made up of four layers of specialized tissue. From the inner cavity of the gut (the [lumen](#)) outwards, these are:

1. [Mucosa](#)
2. [Submucosa](#)
3. [Muscular layer](#)
4. [Serosa](#) or [adventitia](#)

The mucosa is the innermost layer of the gastrointestinal tract. It surrounds the lumen of the tract and comes into direct contact with digested food .The mucosa itself is made up of three layers: the [epithelium](#), where most digestive, absorptive and secretory processes occur; the [lamina propria](#), a layer of [connective tissue](#), and the [muscularis mucosae](#), a thin layer of [smooth muscle](#).

The submucosa contains nerves including the [submucous plexus](#) (also called Meissner's plexus), blood vessels and elastic fibres with collagen, that stretches with increased capacity but maintains the shape of the digestive tract .

The muscular layer surrounds the submucosa. It comprises layers of [smooth muscle](#) in longitudinal and circular orientation that also helps with continued bowel movements ([peristalsis](#))

and the movement of digested material out of and along the gut. In between the two layers of muscle lies the [myenteric plexus](#) (also called Auerbach's plexus).

The [serosa/adventitia](#) are the final layers. These are made up of loose [connective tissue](#) and coated in [mucus](#) so as to prevent any friction damage from the digestive tract rubbing against other tissue. The serosa is present if the tissue is [within the peritoneum](#), and the adventitia if the tissue is [retroperitoneal](#).

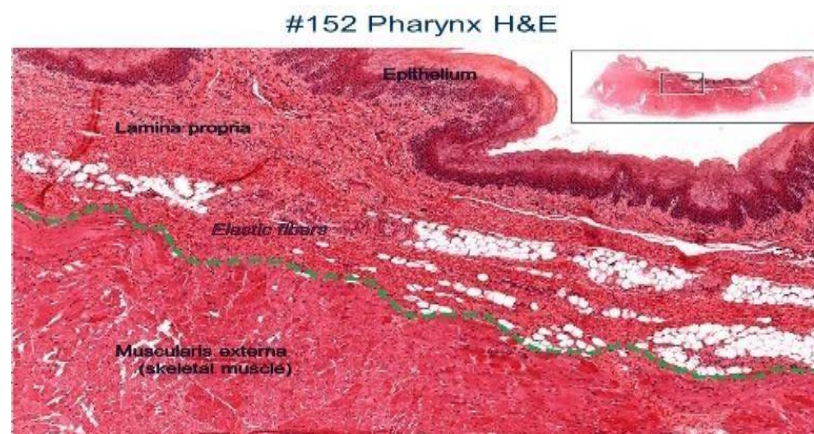
The oral cavity:

This cavity is lined with keratinized or non-keratinized stratified squamous epithelium. The keratin layer found in gum and hard palate,

Tongue : the tongue has a stratified squamous epithelium, seated on an underlying basal lamina over the lingual connective tissue

Pharynx:

The pharynx is a transitional space between the oral cavity and the respiratory and digestive systems. It is lined by non-keratinized stratified squamous epithelial in the region continuous with the esophagus and by ciliated pseudo stratified in the region continuous with the nasal cavity.

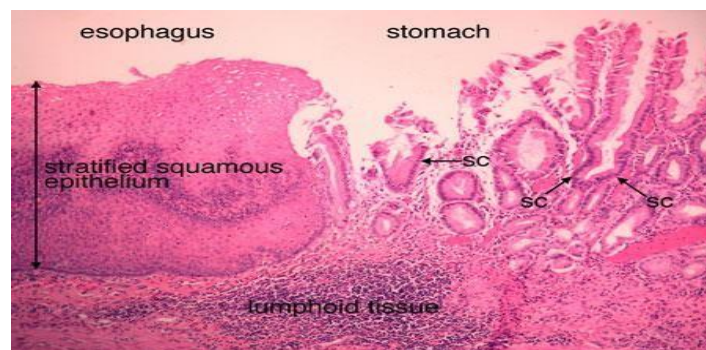


Esophagus:

Is a muscular tube whose function is to transport foods from the mouth to the stomach and to prevent retrograde flow of gastric content. Transport is achieved by esophageal peristalsis with relaxation of sphincters (upper and lower) which controlled by autonomic nervous system. Esophagus is lined by nonkeratinized stratified squamous epithelium, in the submucosa there is mucous gland-the esophageal gland –to facilitate the transport of food and to protect the mucosa. In the LP which is near the stomach is the esophageal cardiac gland which secrete mucous also. At the distal end the smooth muscles of the muscular layer form the lower esophageal sphincter, in the midportion the muscular layer formed by smooth and skeletal muscle, while the upper part composed from skeletal muscle only.

Stomach

The innermost layer of the stomach wall is the gastric mucosa. It is formed by a layer of surface epithelium and an underlying lamina propria and muscularis mucosae. The surface epithelium is a simple columnar epithelium. There are 3 types of glands found in the stomach; cardiac, gastric and pyloric, named after the region in which they are found. These glands produce the digestive enzymes and mucous secretions of the stomach Gastric pits are formed by invaginations of the surface epithelium.

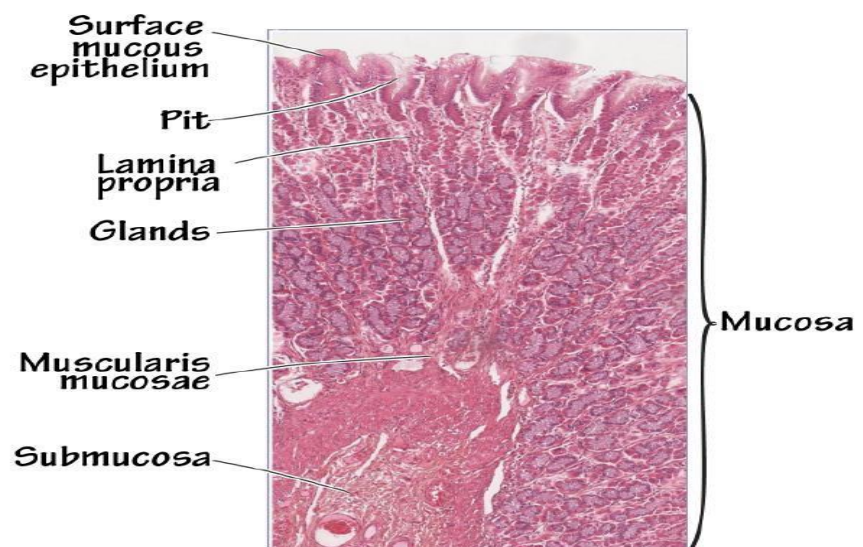


Gastric pits connect to gastric glands and thus allow the glandular products to be delivered into the stomach lumen, Gastric glands open into the base of gastric pits.

The lamina propria is the layer of connective tissue located just deep to the surface epithelium. It contains blood and lymphatic vessels, lymphoid tissue and surrounds the gastric glands.

The muscularis mucosae layer consists of two thin layers of smooth muscle. Deep to the mucosa is a thick layer of connective tissue known as the gastric submucosa. The gastric muscularis externa, also known as tunica muscularis, is the smooth muscle located deep to the submucosa. It is made up of 3 layers: inner oblique, middle circular and outer longitudinal. Gastric serosa is the outermost layer of the stomach wall. It consists of a layer of simple squamous epithelium, known as mesothelium, and a thin layer of underlying connective tissue.

Stomach



Small and Large Intestine

The small intestine is the site of terminal food digestion, nutrient absorption & endocrine secretion. The processes of digestion are completed in the small intestine, where the products

of digestion are absorbed by cells of the epithelial lining. The small intestine is relatively long (5 meters) & consists of 3 segments: Duodenum, Jejunum and Ileum.

1-The intestinal epithelium is simple columnar, composed of intestinal absorptive cells (enterocytes), goblet cells & some enteroendocrine cells. In the ileum there is Mcell. The epithelium of the villi is continuous with that of the intestinal glands

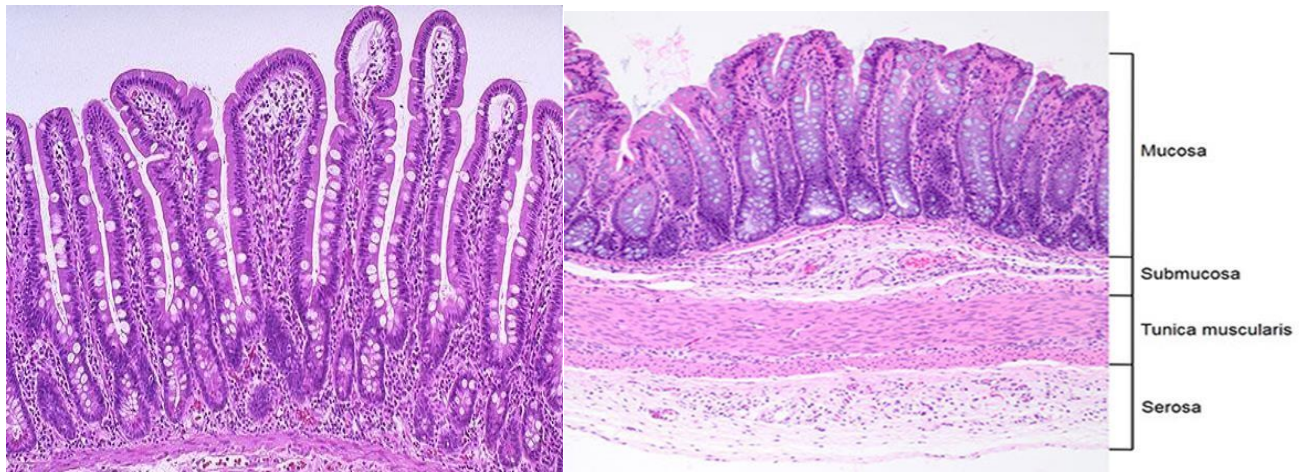
2-The lamina propria of the small intestine:- is composed of loose C.T. with blood & lymph vessels, nerve fibers & smooth m cells

3-The muscularis mucosae of small intestine:- consists of an inner circular & an outer longitudinal layers of smooth muscle

4-Serosa:- covers all of the jejunum & ileum & part of fee duodenum. Adventitia covers the remainder of the duodenum.

Large intestine

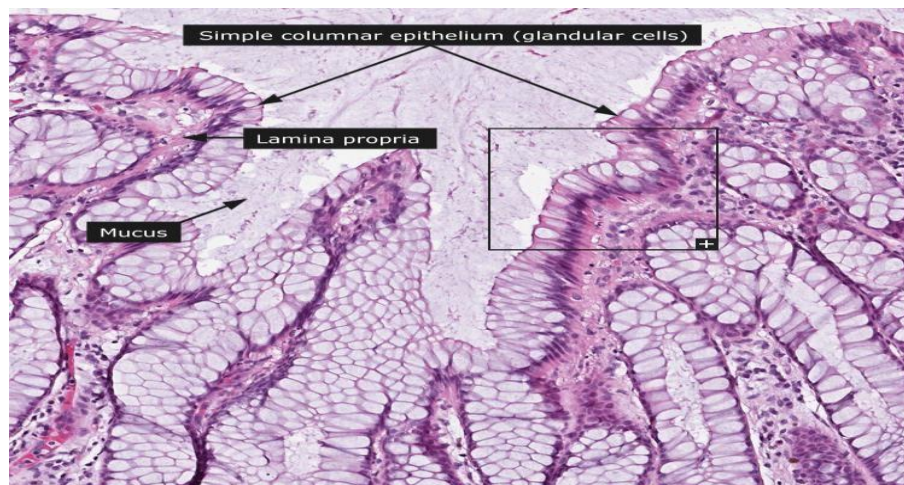
Epithelium:- is simple columnar containing columnar absorptive. cells & goblet cells



Mucosa of intestine

Anus region

The histology of the anal canal, from the anorectal ring down to and including the perianal skin, varies from the columnar epithelium of the intestinal mucosa to the stratified squamous keratinized epithelium of the skin with hair follicles and pigment.



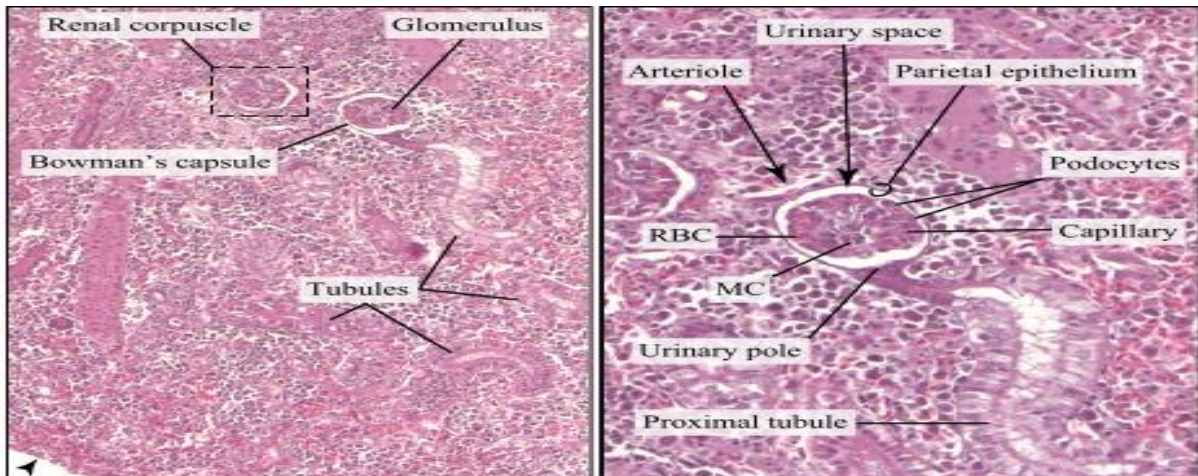
Urogenital system

Also called genitourinary system, in vertebrates, the organs concerned with reproduction and urinary excretion. Although their functions are unrelated, the structures involved in excretion and reproduction are morphologically associated and often use common ducts. The major structures of the urinary system in mammals are the kidneys, ureters, bladder, and urethra. The major structures of the reproductive system in males are the testes, sperm ducts, urethra, and penis; in females, they are the ovaries, fallopian tubes, uterus, and vagina.

Urinary system : Consists of Two Kidneys , Two Ureters , Urinary Bladder and Urethra . **Kidney (corpuscles and tubules)**

the bulk of the kidney consists of *tubules*. The secretory units of the kidney, called renal corpuscles, comprise a relatively small proportion of the organ. Most of the kidney consists of highly specialized renal tubules, which correspond to the duct tree of a typical gland. Together, one renal corpuscle and its associated tubule is called a **nephron**.

- **Nephron :** The nephron loop is the U-shaped bend of a nephron which extends through the medulla of the kidney. Histologically, it consists of two parts; thin descending and thin ascending limbs. Both limbs are composed of simple squamous epithelium.
- **Bowman's Capsule :** Formed of two continuous layers :
 - A. Outer Parietal Layer : Lined by simple squamous epithelium continuous with the simple cuboidal epithelium of the proximal convoluted tubule .
 - B. Inner visceral layer : Formed of modified simple squamous epithelial cells called **podocytes**(Involved of formation of blood renal barrier & Responsible for renewal of basement membrane of glomerular capillaries) .

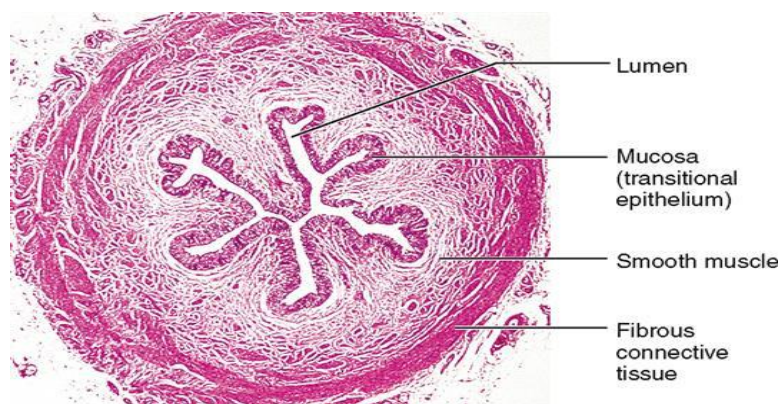


- **Ureters** :They conduct urine from renal pelvis to urinary bladder . The wall of the ureter is formed of :

1-Mucosa : shows prominent longitudinal folds giving the lumen a stellate appearance , Formed of Uroepithelium (Transitional epithelium) and underlying C.T..

2-Musculosa: the upper two thirds of the ureter has an inner longitudinal and an outer circular layer of smooth muscles .the lower third has an additional outer longitudinal layer .contracting of these muscle layers produces peristaltic waves which propel urine along it towards urinary bladder .

3-Adventitia : Formed of fibro-elastic C.T. containing blood vessels , nerves & lymphatics .



Urinary Bladder

1. Mucosa :

- 1 .Epithelium :** Formed of uroepethium in which umbrella cells are well developed and have extensive intercellular junctional complex forming a unique apical membrane as contact with urine is greatest **(lamina propria)** formed of fibro-elastic Connective tissue .
- 2 Musculosa :**Formed of :inner longitudinal , middle circular and outer longitudinal smooth muscle .Distal to the bladder neck , the inner longitudinal layer becomes circular to form the internal urethral sphincter .
- 3 Adventitia :**the urinary bladder is covered by fibro-elastic C.T. except the superior part which is covered by serosa (peritoneum).

Urethra

It is tubular structure that carries urine from the bladder to the exterior . The lining of the urethra is epithelium. The wall of the urethra is smooth muscle. Urine flow is controlled by two urethral sphincters: the internal urethral sphincter and the external urethral sphincter. The internal urethral sphincter is at the start of the urethra.

Collecting system

The collecting system of the kidney is a series of tubes that moves urine from the nephrons into the minor calyces.

- Cortical collecting ducts - **simple cuboidal epithelium**
- Medullary collecting ducts - **simple columnar epithelium**
- Papillary ducts - **simple columnar epithelium**

Male Genital System

1-Primary Sex Organs :Two Testes : mixed compound tubular glands which have an endocrine function (secretion of testosterone hormone) & exocrine function (production of the male gametes : spermatozoa).

2-Secondary Sex Organs .

Testis :Each testis is formed of stroma and parenchyma . Stroma of testis :Inside the scrotum , the testis is covered by three coats (**tunica vaginalis, tunica vasculosa, and tunica albuginea**) Parenchyma of the testis : Exocrine part , Endocrine part .

seminiferous tubules :They are the site of production of spermatozoa , they are lined with a highly specialized stratified epithelium called the spermatogenic epithelium .

Penis:Erectile Tissues : They are interconnecting vascular spaces lined with endothelial cells , they are separated by trabeculae of smooth muscle , collagen and elastic fibers .

Female Genital System

Composed of Primary Sex Organs : Two ovaries which have an endocrine function (secretion of estrogen and progesterone) and an exocrine function (secretion of the female gametes :Oocytes). Secondary Sex Organs :Two fallopian tubes , Uterus , Vagina, External genitalia ,

The Ovary: It consists of :

1. Germinal Epithelium : -It is a single layer of cuboidal epithelium which commonly transforms to flat cells with increasing of age .

-The term germinal is a misnomer as its epithelial cells are not the source of female gametes

2. Tunica Albuginea : It is a layer of dense white fibrous C.T. located between the germinal epithelium and the underlying cortex .
3. Outer Cortex : It is formed of richly cellular supporting stroma (cortical stroma) , and different types of ovarian follicles containing the oocytes .
4. Inner Medulla : It is located in the central portion of the ovary . it is formed of loose highly vascular C.T. lymphatics & nerves.
- 5.

Vagina is a muscular tube. The lining epithelium is **stratified squamous** Underneath the epithelium is a layer of **lamina propria**, which is rich in elastic fibres, and does not have any glands .Under the lamina propria layer is a layer of **smooth muscle**, which has an inner circular and outer longitudinal layer. Finally, there is an adventitial layer, which merges with that of the bladder (anteriorly) and rectum (posteriorly).

Uterus: is the muscular organ that nourishes and supports the growing embryo. the uterus has three layers: mucosa (endometrium), muscularis (myometrium) and serosa/adventitia (perimetrium). The endometrium (uterine mucous membrane) is lined with simple columnar epithelium (lamina epithelialis) and contains numerous tubular glands.

Special connective tissue:

1-Fluid connective tissue

a-Blood b-Lymph

Spleen:

1. Located in the abdomen, directly beneath the diaphragm, and connected to the stomach.
2. Is the body's largest filter of the blood?
3. In essence, the spleen is organized as a 'tree' of branching arterial vessels, in which the smaller arterioles end in a (Venous sinusoidal system).
4. The organ is surrounded by a fibrous capsule of connective tissue, stemming from which are (Trabeculae) that support the larger vasculature.
5. The smaller branches of the arterial supply are sheathed by lymphoid tissue, which forms the (White pulp) of the spleen.
6. The organ parenchyma is divided into two large compartments, the White pulp and the Red pulp, which are distinguished by color in fresh organ sections at low magnification.
7. The white pulp harbors dense and highly organized accumulations of B and T lymphocytes around arterioles.
8. Most of the red pulp consists of blood-filled spaces. These red pulp spaces are composed of two different structures: First, the splenic sinuses represent a specialized part of the vasculature connecting arterioles and veins. Second, the splenic ords are strands of loose connective tissue without endothelium filled with all types of blood cells, macrophages and plasma cells.

Liver

Liver: The liver is the largest solid organ in the body, weighing about 1.5 kg in the adult. Lies in the right upper quadrant of the abdomen and is completely protected by the thoracic rib cage.. Completely surrounded by a peritoneal membrane, known as Glisson'scapsule.

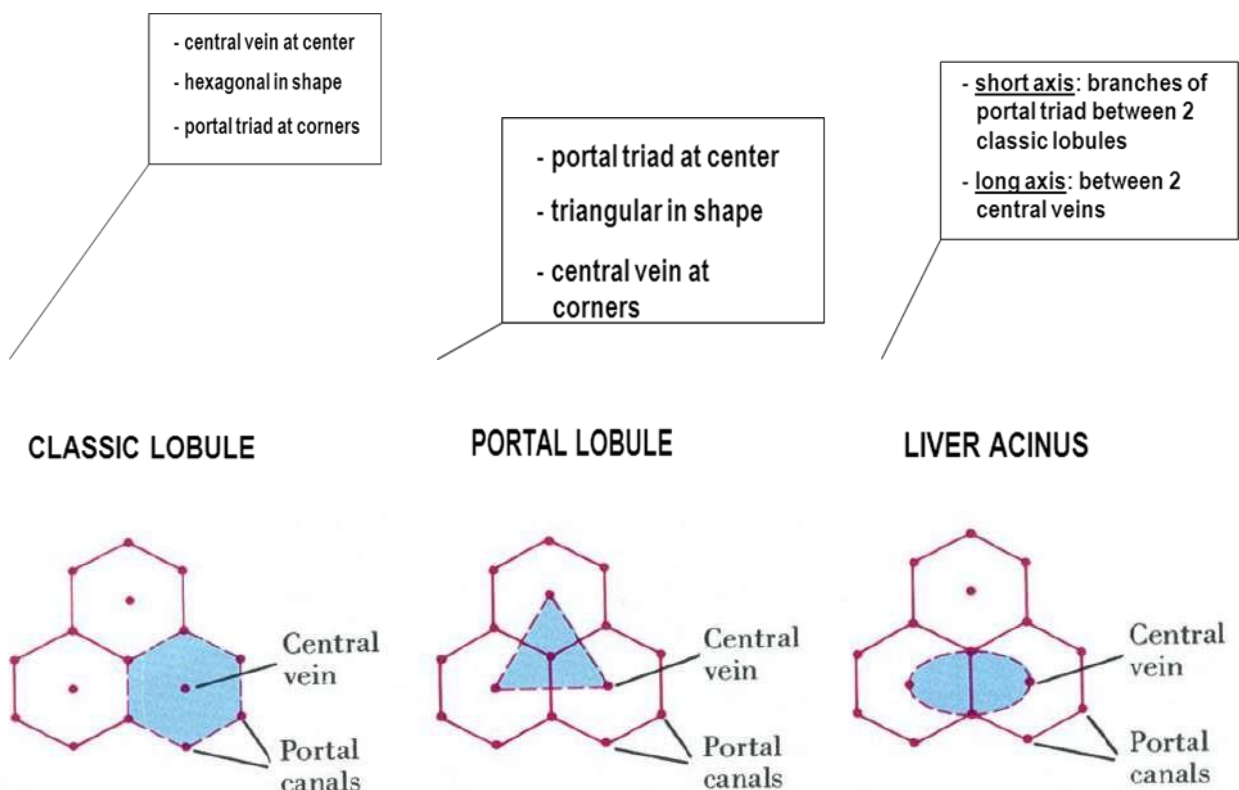
- The liver lobules can be defined in 3 ways:
- 1) **Classic lobule** – centered on the **central vein** with the **portal triads** at each corner. Shown below on the left, the classic lobule may not always be hexagonal in shape.
- 2) **Portal lobule** – centered on the **portal triad**, based on bile secretion, and approximately triangular in shape.
- 3) **Liver acinus of Rappaport** – this is the most functionally important classification. The acinus is roughly oval in shape with 2 central veins and 2 portal triads

on opposite ends. Based on the blood flow within hepatic tissue, the acinus is divided into 3 zones. Cells in different zones are specialized for different activity. Zone 1 cells, being closest to the portal triads and hence most oxygenated blood, have the most drug-metabolizing enzymatic activity. Following that same reasoning, zone 3 hepatocytes near the central veins are most susceptible to ischemia.

- As mentioned earlier, the liver has both endocrine and exocrine functions. The various proteins that hepatocytes secrete enter the bloodstream via the liver sinusoids. The liver also secretes bile in the conventional exocrine fashion. The hepatocytes secrete bile into sealed extracellular spaces called **bile canaliculi**.

EXOCRINE PORTION synthesizes and secretes bile via a system of ducts that is essential for digestion in the intestine

ENDOCRINE PORTION synthesizes and secretes numerous plasma proteins into the bloodstream: (albumin, fibrinogen, prothrombin, lipoproteins, etc.)



❑ Microscopic Anatomy

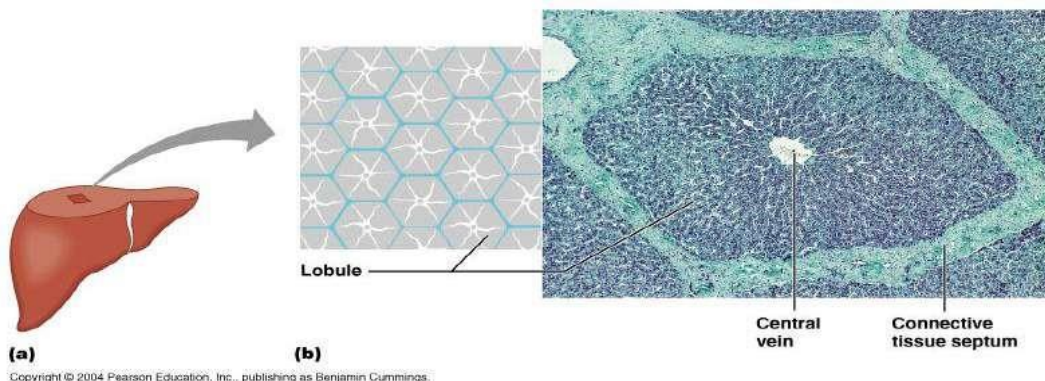
- Liver lobule: hexagonal
- Central vein: drains the lobule
- Hepatocytes form plates that radiate from the central vein

❑ Portal triad at each corner of the hexagonal system. Consists of branches of:

- Hepatic Artery → delivers O_2
- Hepatic portal vein → delivers nutrients from small intestine
- Bile duct → receives bile from the bile canaliculi that lie between layers of hepatocytes

❑ Liver

- Liver sinusoids → Large leaky capillaries conduct blood from the artery & portal vein to the central vein
- Hepatic macrophages → Kupffer cells lie in sinusoid walls
- Central veins flow into hepatic veins then to the inferior vena cava



Lymph nodes

Definition : lymph nodes (or lymph glands) are small lumps of tissue that contain white blood cells, which fight infection. They are part of your body's immune system.

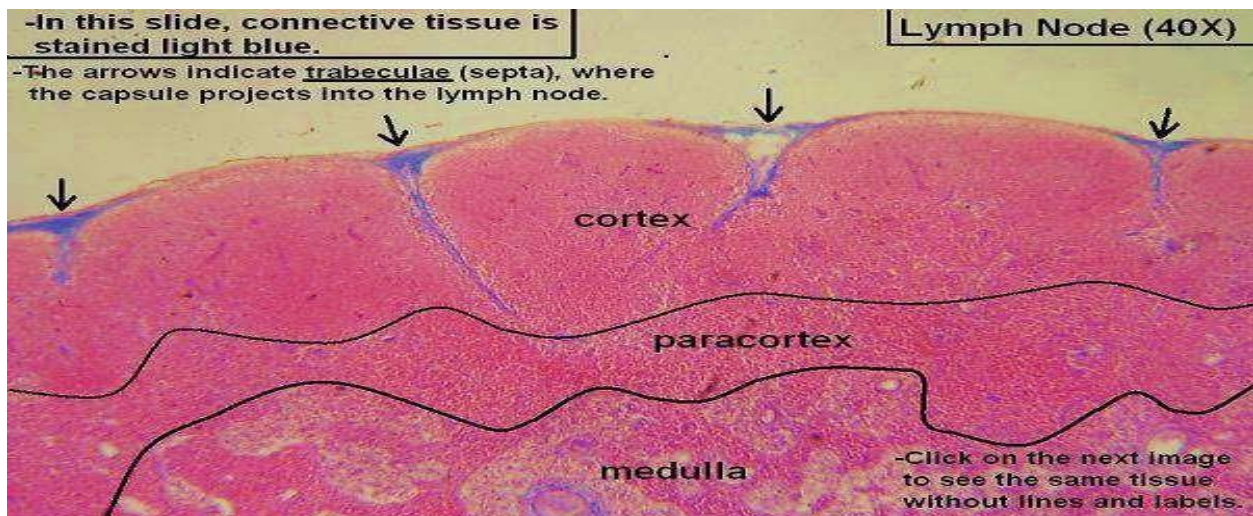
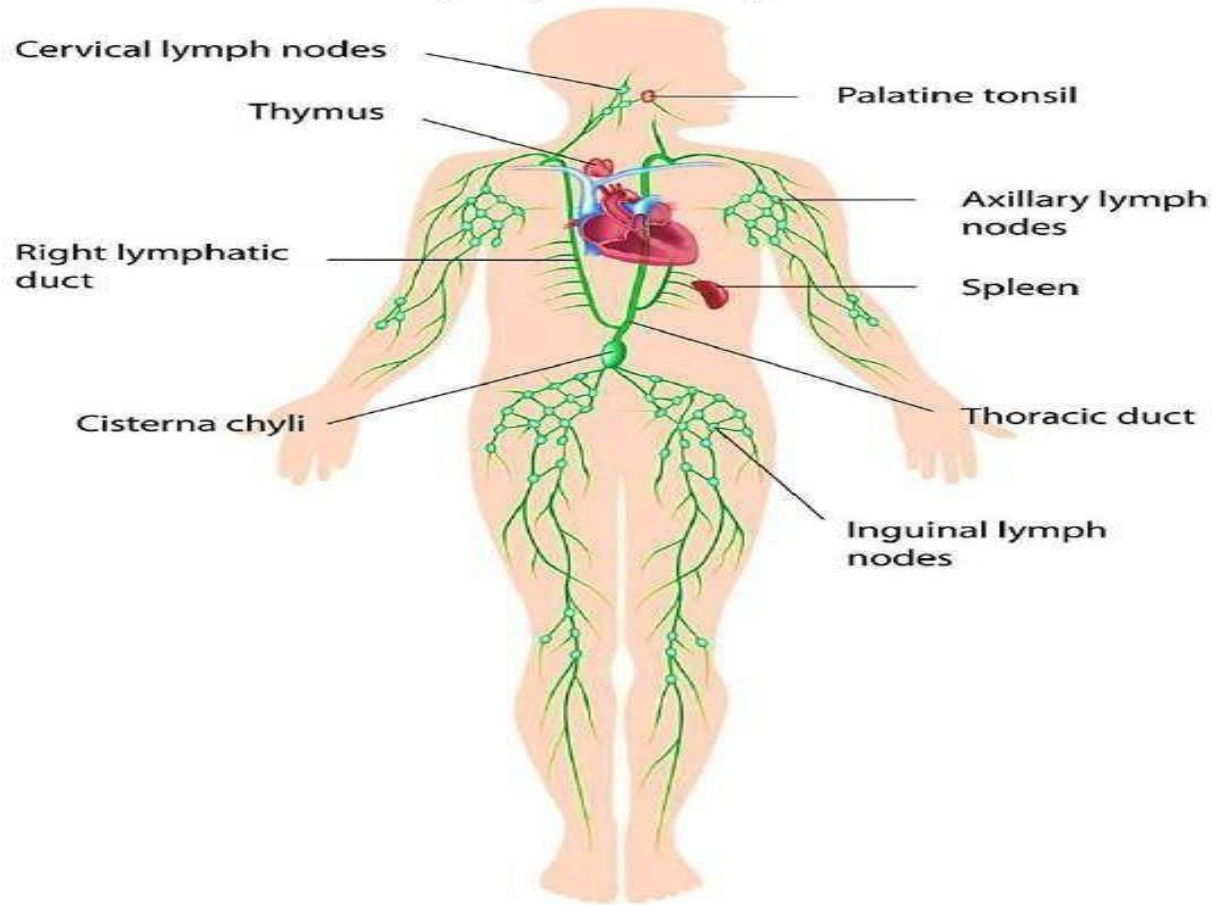
Function : Lymph nodes help to fight infections. The glands near the infection can swell up (lymphadenopathy) . the lymph nodes drain lymph fluid from your nearby organs and areas of your body.

Location : lymph nodes are located throughout your body, including your:

- neck and back (cervical lymph node)
- armpits (axillary lymph nodes)
- groin
- stomach
- chest

Each lymph node is divided into two general regions, the capsule and the cortex. The capsule is an outer layer of connective tissue. Underlying the capsule is the cortex, a region containing mostly inactivated B and T lymphocytes plus numerous accessory cells such as dendritic cells and macrophages. The cortex is further divided into two functional areas: the outer cortex and inner cortex, or paracortex. These regions surround an inner medulla, which consists primarily of activated antibody-secreting plasma cells .

The Lymphatic System



Circulatory system (Arteries)

- transport blood away from the heart to peripheral tissue .
- resist changes in blood pressure in their initial parts by their elastic recoil and regulate blood flow in their terminal parts by their muscular tone.
- the basic structure of arteries is similar in having the three concentric layers clearly differentiated .
- Arteries are classified according to their size & predominant tissue in their media into :
 - 1- large elastic (conducting) arteries : which carry blood from the heart .
 - 2- medium - sized muscular (distributing) arteries : deliver blood to organs .
 - 3-small arteries (arterioles) : regulate the blood flow to capillaries

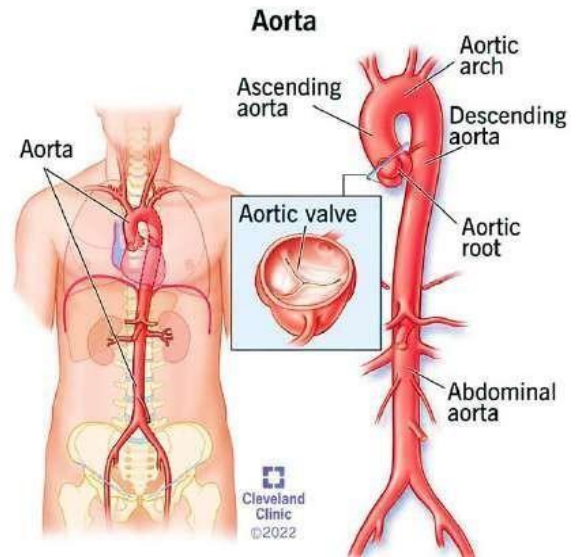
1. large elastic arteries :

- the large elastic arteries in the body are : aorta and its large branches , pulmonary , subclavian and innominate arteries .
- they have thick walls which appear yellowish in fresh conditions as they are mainly formed of elastic fibers , they also have very wide Lumina .
- the walls of large elastic arteries have similar structures . so the aorta will be studied as an example .

THE AORTA

1- Tunica Intima :

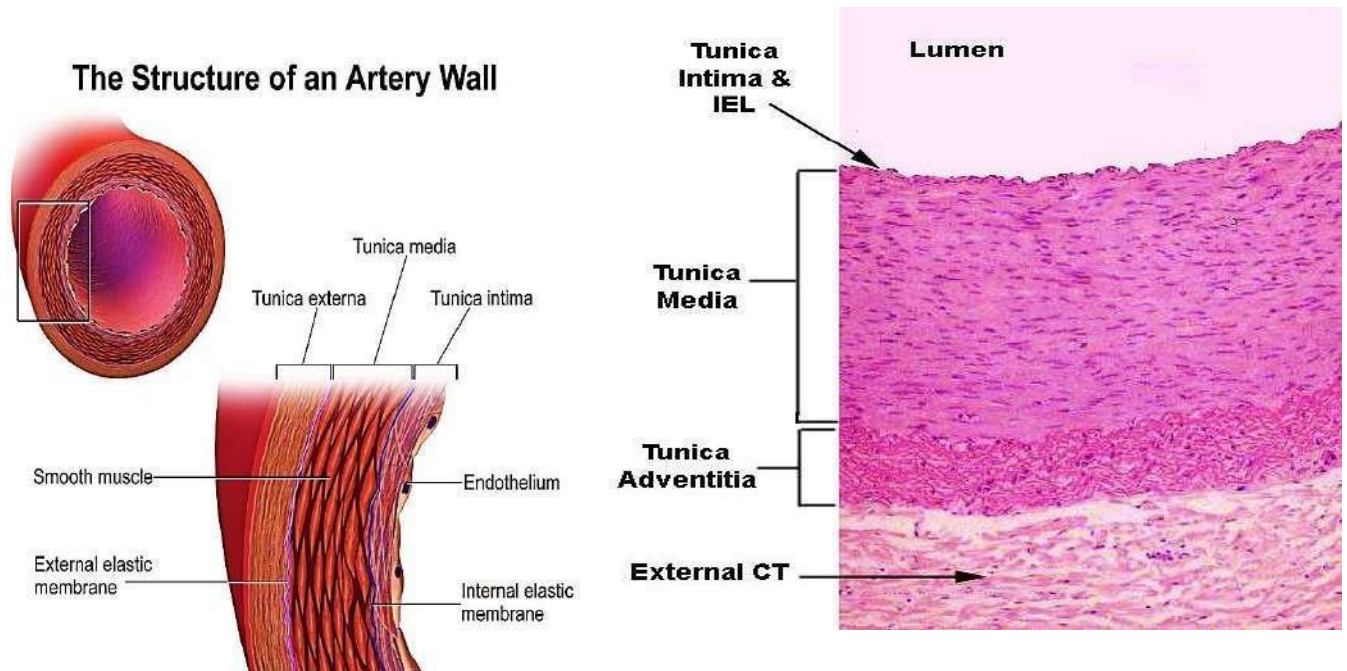
a- endothelium : simple squamous epithelium . b- sub endothelium : thick loose C.T. rich in elastic fibers , collagen fibers which are longitudinal arranged and fibroblasts . c- internal elastic lamina : non-clear , as it is similar to the underling elastic laminae of the media .



2- Tunica Media : the thickest layer , constituting about 70% of the wall , made of :

- concentrically arranged fenestrated elastic membranes (40-70) laminae , which increase with age .
- N.B.: the fenestrae in the elastic laminae are important to facilitate the diffusion of substances through the arterial wall.
- smooth muscle fiber , alternating with the elastic membranes (which is responsible for production of the elastic fibers and ground substance) - collagen fibers are found between elastic laminae .
- ground substance .
- external elastic laminae , cannot be differentiated from those of the media .
- **3- Tunica Adventitia** : thin coat (20% of the thickness), is formed of loose C.T. in which :

- collagen and elastic fibers are found which are longitudinally arranged .
- containing vasa vasorum .



2. Small Arteries (Arterioles):

- the arterioles are responsible for the peripheral resistance of blood vessels they control the blood flow into capillaries .
- they are the smallest branches of muscular arteries , which decrease in diameter gradually , and their walls also decrease in thickness .
- their diameter is less than $100\mu\text{m}$, with narrow lumen . Arterioles less than $50\mu\text{m}$ are called terminal arterioles .

1) Tunica Intima

- Endothelium , resting on thin basal lamina and very thin sub-endothelial layer

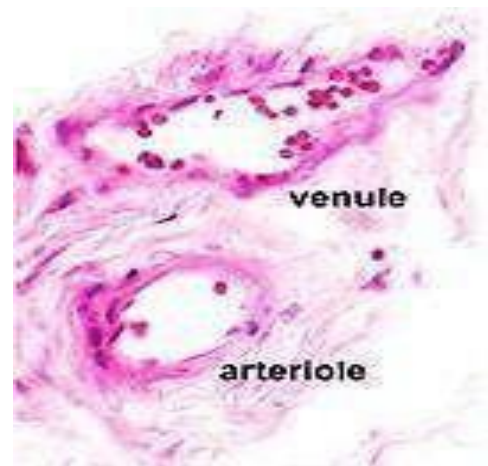
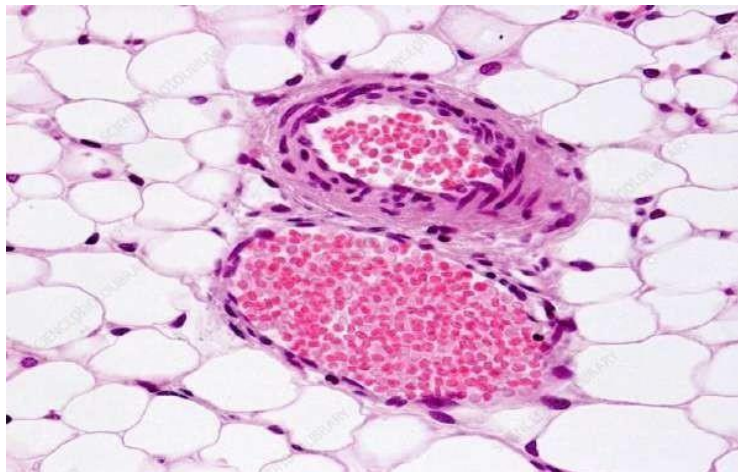
IEL is thin , gradually disappears in smaller arterioles .

2) Tunica Media

One or two layers of smooth muscles , which gradually disappears , and replaced by pericytes in small arterioles .

3) Tunica Adventitia: very thin Met-arterioles :

- they are lateral branches of terminal arterioles , and represent the connection between arterioles and capillaries .
- at their initial segments , they are surrounded by rings of smooth muscle cells that act as sphincters that control the blood flow to capillaries .

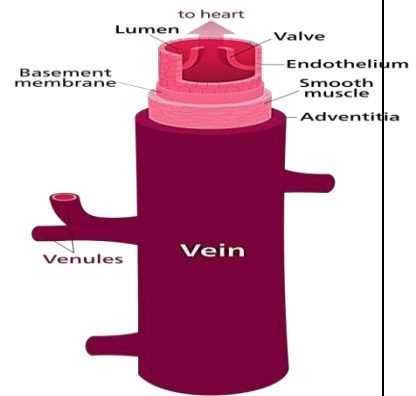


VEINS

- Veins carry venous blood from the tissues and return it back to the heart
- veins start as post capillary venules , muscular , then large veins .

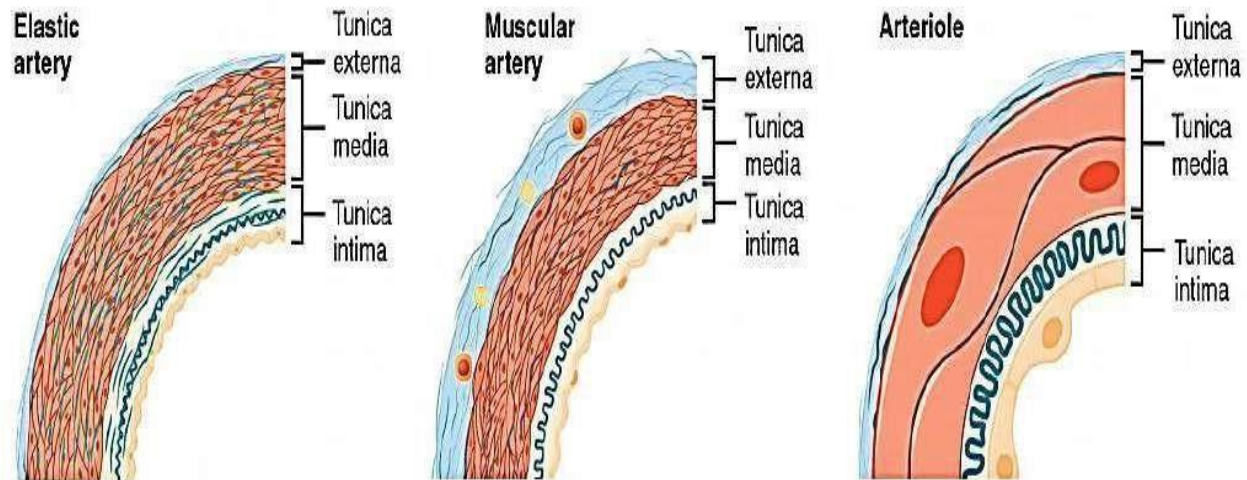
A. Small veins (venules)

B. Medium sized veins



Differences between medium sized artery & medium sized vein

Medium - Sized Artery	Medium - Sized Vein
1. thick wall and narrow lumen	thin wall and wide lumen
2. the lumen is rounded , Doesn't collapse after death .	the lumen collapse after death
3. it has no valves .	it has valves
4. contain no blood after death .	contains blood after death
5. T. Intima is thick , folded , rich in elastic fibers , has a clear internal elastic lamina	T. Intima is thin , not folded , poor in elastic fibers , has no IEL
6. T. media is thick , made of smooth muscles and elastic fibers .	T. media is thin , made of smooth muscles , poor in elastic fibers
7. external elastic lamina may be present between the media & adventitia	it has no external elastic lamina
8. T. Adventitia is thin , rich in elastic fibers .	T. adventitia is thick rich in collagen fibers
9. it has a rapid flow of arterial blood .	it has slow flow of venous blood



Valves : Are semilunar folds that project from the intima into the Lumina of veins , lined from both sides by endothelium .their core is formed of elastic tissue . they allow the passage of blood in one direction (toward the heart) and prevent its return back . Valves are absent in small veins , and large veins .

C. Large veins : have thick wall and a wide lumen -
Inferior vena cava is the best example

-**Tunica Intima** : well developed , No valves .

-**Tunica Media** : thinner than arteries

-**Tunica Adventitia** : the thickest layer . it contains longitudinal bundles of smooth muscle fibers . these fibers facilitate elongation and shorting of the vena cava with respiration .