Lec 1: Cell structure

Cells

Cells are the tiny living units that form the tissues, organs and structures within the body. In turn, the body is composed of different types and varieties of cells to carry out specific functions, but they all have the same basic structure. All cells contain cytoplasm and are surrounded by a membrane, and contain the following structures of organelles:

1. Cell membrane

Also known as the plasma membrane, the cell membrane is a bi-lipid membrane layer (it is a double membranous structure) that is also composed of proteins and carbohydrates.

It is also selectively permeable, which means that it only allows certain materials (nutrients and minerals etc) to pass through to sustain the cell. The cell membrane also functions to protect the cell and ensure stability.

2.The Nucleus

The nucleus may be described as the largest organelle of a cell. The nucleus is itself surrounded by a double membrane (nuclear envelope) and contains genetic information (genes) making it the control center of a cell. As such, it controls such activities cell metabolism and reproduction.

3.The Cytoplasm

The cytoplasm is the fluid matrix (jelly-like) found inside the cell (but it is outside the nucleus). Various types of organelles and minerals (salts) are suspended in this constantly streaming fluid. Apart from containing all the cell organelles, the cytoplasm also helps maintain the shape of a cell.

Cell Organelles

Cell organelles may be described as cell subunits specialized to carry out given functions within the cell. There are different types of organelles in cells that carry out given functions.

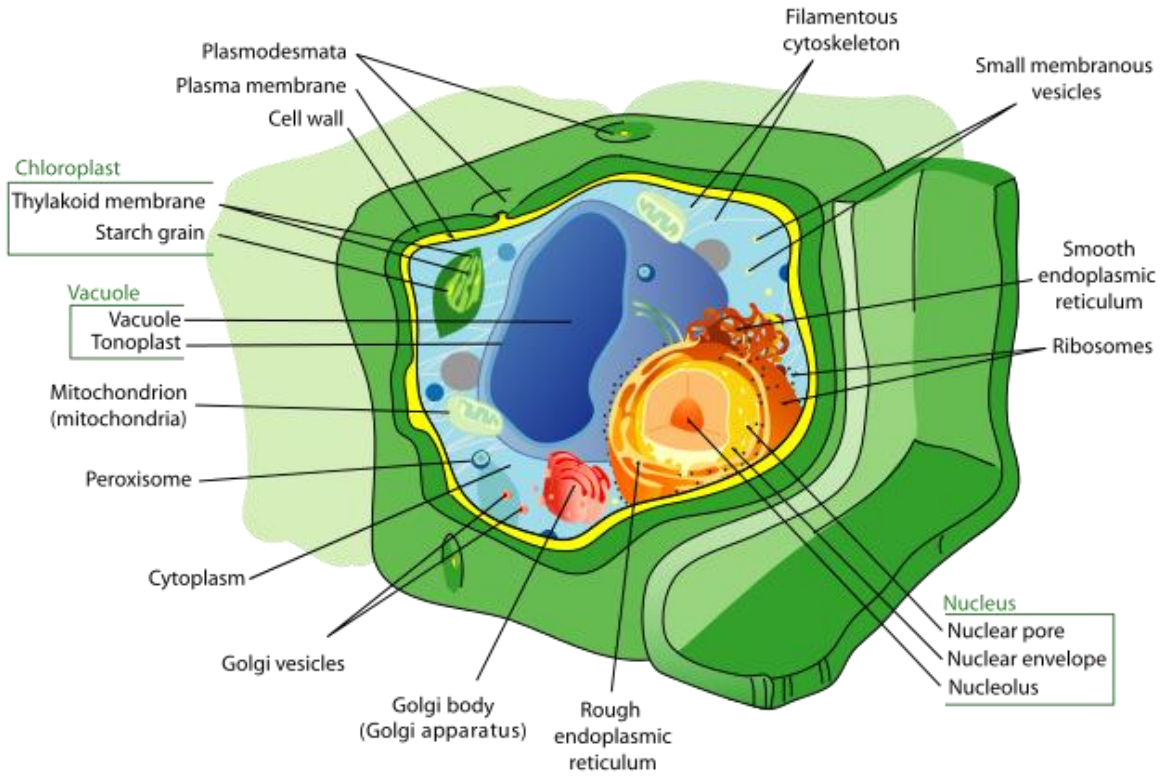
The following are some of organelles that can be found in a cell

Mitochondria : The mitochondria are rod-shaped organelles and sites of ATP synthesis. The mitochondria is also surrounded by a double membrane. This organelle is commonly referred to as a power- generator given that it converts oxygen and nutrients into a chemical energy known as ATP (adenosine triphosphate) which provides the energy required for activities of the cell. the mitochondrion is also involved in the self-destruction of a cell in a process known as apoptosis.

Ribosomes : Found in the cytoplasm and the surface of the rough endoplasmic reticulum, ribosomes are composed of RNA and proteins. They may be described as the "cell factories" given that they are responsible for the synthesis of protein molecules.

Lysosomes - These are sac-like structures that are surrounded by a membrane (a single membrane). Lysosomes contain digestive enzymes, which are responsible for breaking down proteins, lipids and nucleic acids. In addition, lysosomes are also involved in the removal of waste molecules as well as recycling of molecular subunits.

Golgi body - These are flattened structures in a cell responsible for temporary storage of protein in the cell.



Histology is a branch of microscopic anatomy and deals only with the microscopic structure of tissues. Different tissues combine to form and organ and organs are the units of organs systems.

Tissues

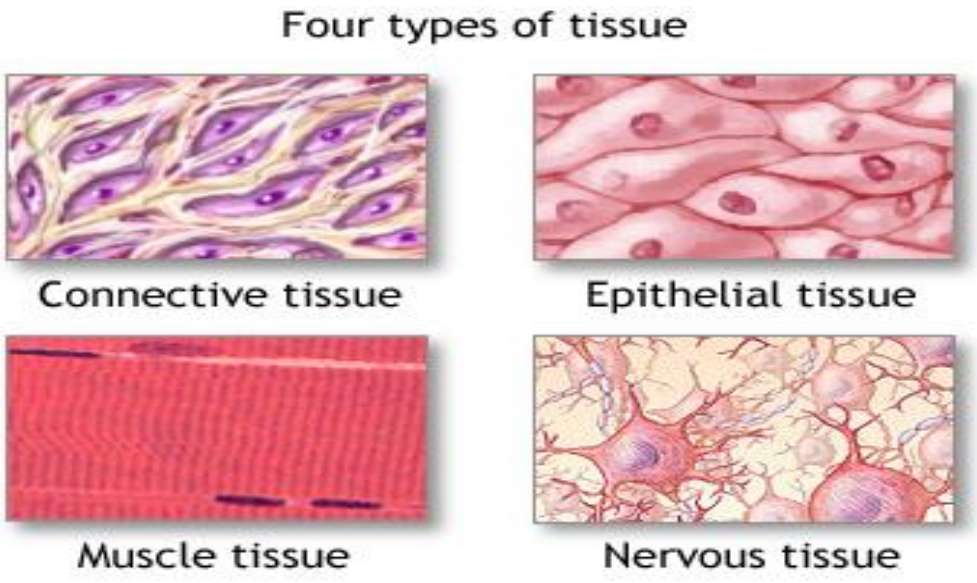
Body tissues : are collections of cells, grouped in the body according to structure and function. In histology, human tissues are separated into four distinct categories:

Muscular: Muscle tissue is made up of long thin muscle cells called myocytes. Their structure and arrangement allows for muscular contraction.

Nervous: Nervous tissue forms the nervous system, and is made up of specialized cells called neurons and neuroglial cells. Neurons conduct nerve signals from one to another in the form of electrical impulses.

Epithelial: Epithelial tissue comprises epithelial cells arranged together in sheets. These sheets serve as protective layers, forming coverings like the skin, and the lining of the small intestine.

Connective: Connective tissue forms a connective web throughout the body. It fills gaps and connects different organs and body parts, so that the carefully arranged structure of the body can be maintained.



Lec 2: Epithelial tissue

Epithelial tissue: layers of cells that covers the whole surface of the body.

- It is made up of cells closely packed and ranged in one or more layers.
- tissue is specialized to form the covering or lining of all internal and external body surfaces.
- Epithelial tissue that occurs on surfaces on the interior of the body is known as endothelium.
- Epithelial cells are packed tightly together with almost no intercellular spaces and only a small amount of intercellular substance.
- Epithelial tissue, regardless of the type is usually, separated from the underlying tissue by a sheet of connective tissue; basement membrane. The basement membrane provides structural support for the epithelium and acts as a selectively permeable membrane that determines which substances will be able to enter the Epithelium.
- Glandular epithelium: this type of epithelium lining gland.

Free surface

a. Ciliated epithelium. Cilia are present at the cell surface.

b. Moist or non-keratinized epithelium The cells at free surface are not certified.

c. Dry or keratinized epithelium. Cells at free surface are certified.

Calcification of epithelium tissue

Based on:
1) type of cell in which the tissue is made of
2) shape
3) number of layers of cells

1.Type of cell in which the tissue is made of

A. Covering and lining epithelium: from the outer layers of the skin; lines open cavities of the digestive and respiratory systems; covers the walls of organs of the closed ventral body cavity.

B. Glandular epithelium: surrounds glands within the body.

Number of layers of cells

A. Simple epithelial tissues: consist of a single layer of cell.

B. Stratified epithelial tissues**:** consist of multilayer of cells only the bottom layer touches the basement**.**

Shape of cell: (when viewed in profile)

A. squamous epithelium. Cells appear flattened scale-like.

B. Cuboidal epithelium. Cell height is same as cell width.

C. Columnar epithelium. Cell height is greater than cell width.

Simple epithelium

can be subdivided according to the shape and function of its cells.

1. Simple squamous epithelium: consist of a single layer of flattened cells with disc shape central nuclei, is found lining sacs of lung and wall of blood vessels, its shape and arrangement permit the exchanges of substance in these locations.

2. Simple cuboidal epithelium: consist of single layer of cube like cell with large spherical nuclei, this type is found in glands as salivary gland, or in kidney tubule, its function secretion and absorption.

3. Simple columnar epithelium: consist of single layer of tall cells with round to oval nuclei located near the bottom of each cell, this type of epithelium is found digestive tract as stomach.

4. Pseudostratified ciliated columnar epithelium: one layer of cells, but appears stratified because cells are off different heights. all cells are in contact with the basement membrane.

Stratified epithelium

- ❖ Stratified epithelium differs from simple epithelium in that it is multilayered.
- ❖ The most basal layers the cells can be squamous, cuboidal or columnar.
- ❖ This type of epithelium can be classified into four types.

1. Stratified squamous: has multiple layers of cells, the basal cells are cuboidal or columnar are metabolically active, the surface layer are flattened (**squamous**) there are two type

nonkeratinized (e.g. lining of oesophagus)

keratinized (e.g. skin).

2. Stratified cuboidal: usually has two or three layers of cuboidal cells. This type of epithelium is largely confined to the lining of large ducts (sweat gland).

3. Stratified columnar: has several cell layers, the outermost of which contains **columnar** cell. This type of epithelium is relatively rare found in male urethra.

4. Transitional epithelium: Is similar to Stratified squamous epithelium except that the outermost cell layer consists of large Rounded cells (dome- like) This type of tissue changes in response to tension. found in urinary bladder.

2.Glandular epithelium: Consist of one or more cells that produce and secrete a specific product. there are two types of glands:

a. Exocrine gland: are gland with ducts that secrete their product onto the outer surface (sweat gland) or into body cavities (pancreas).

b. Endocrine gland: are gland without duct secrete hormones internally so they are transported by blood stream (thyroid gland) .

Glandular epithelium : are classified by the following morphological characteristic to:

1. **Unicellular glands:** consisting of only one glandular epithelium cell e.g. goblet cell of digestive system.
2. **Multicellular glands**: multiple cell make up one gland; e.g salivary glands

Glands are divided according to type of secretion:

1. **Serous glands:**

A. Secret watery solution of enzyme

B. Have small lumen

C. Have round nucleus located in the basal of the cell

D. Have well stained cytoplasm

E. The secretory units composed of pyramidal cells with unclear border

F. e.g parotid gland

2.Mucous glands :

A. produce mucous secretion

B. have large lumen

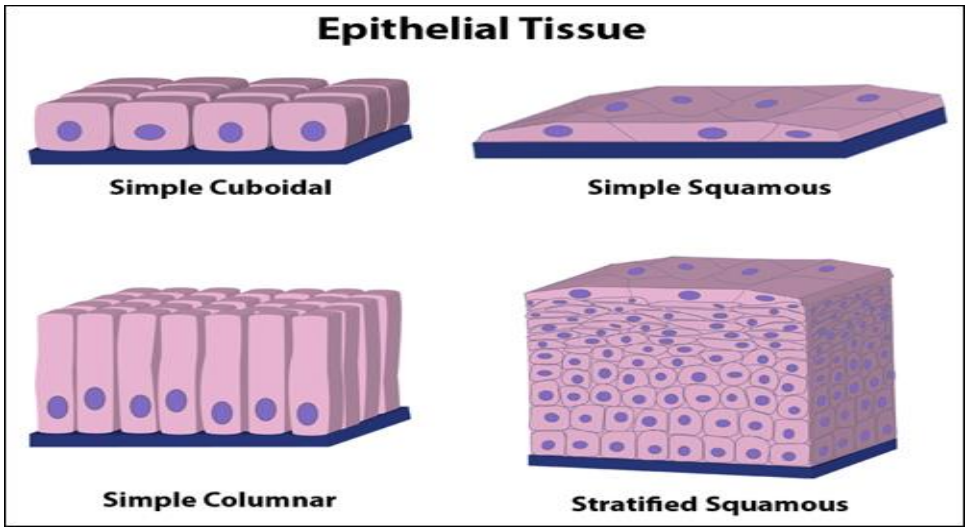
C. have pressed flattened nucleus in the basal limit of the cell

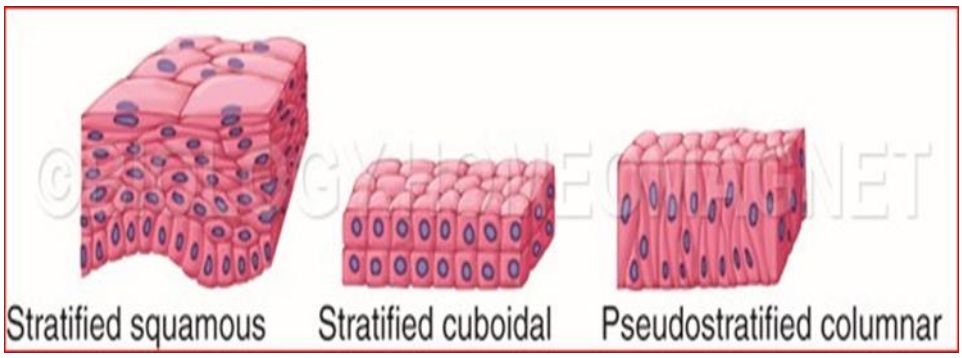
D. have poorly stained cytoplasm

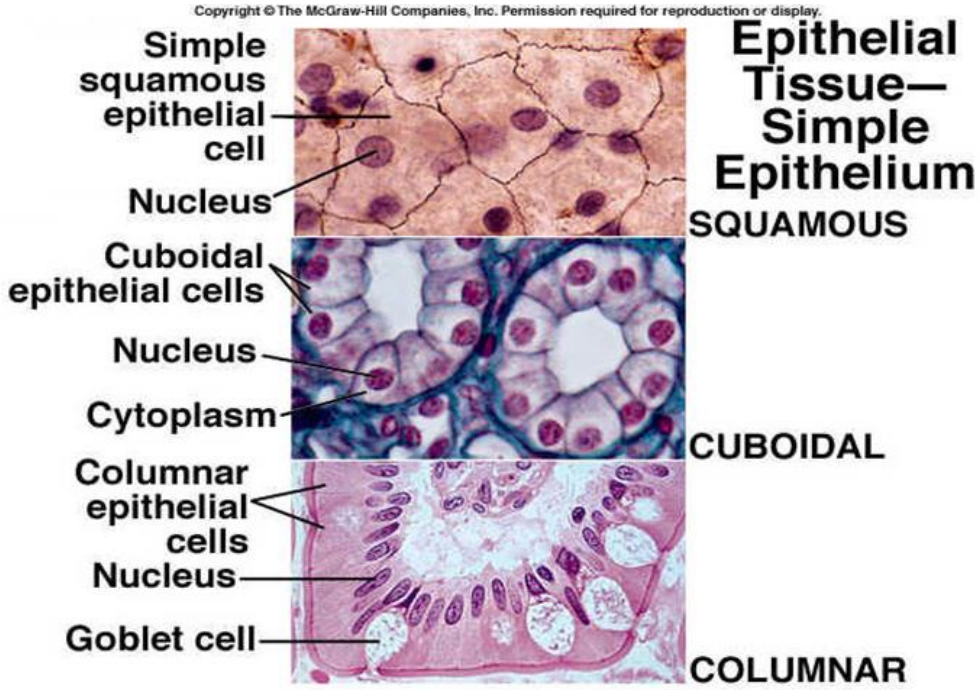
E. the secretory units composed of pyramidal cells with clear border

F. palatine gland

3. Mixed or seromucous glands : a gland in which some secretory cells are serous and some mucous (salivary glands)




Stratified squamous
Stratified cuboidal
Pseudostratified columnar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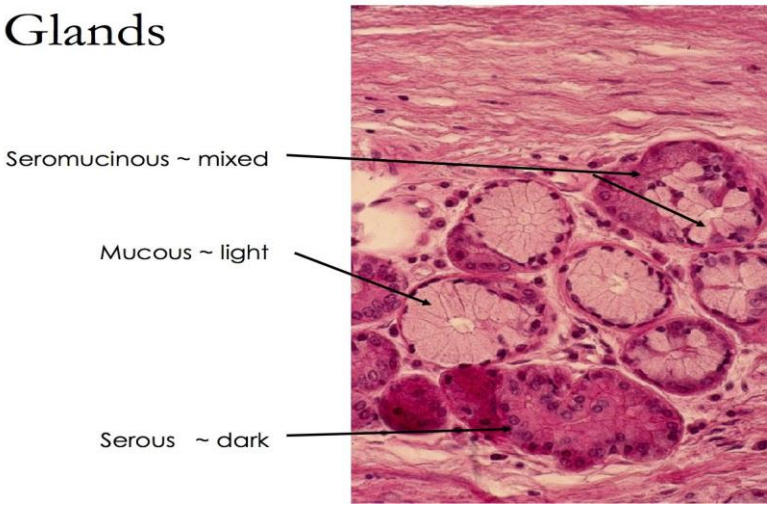
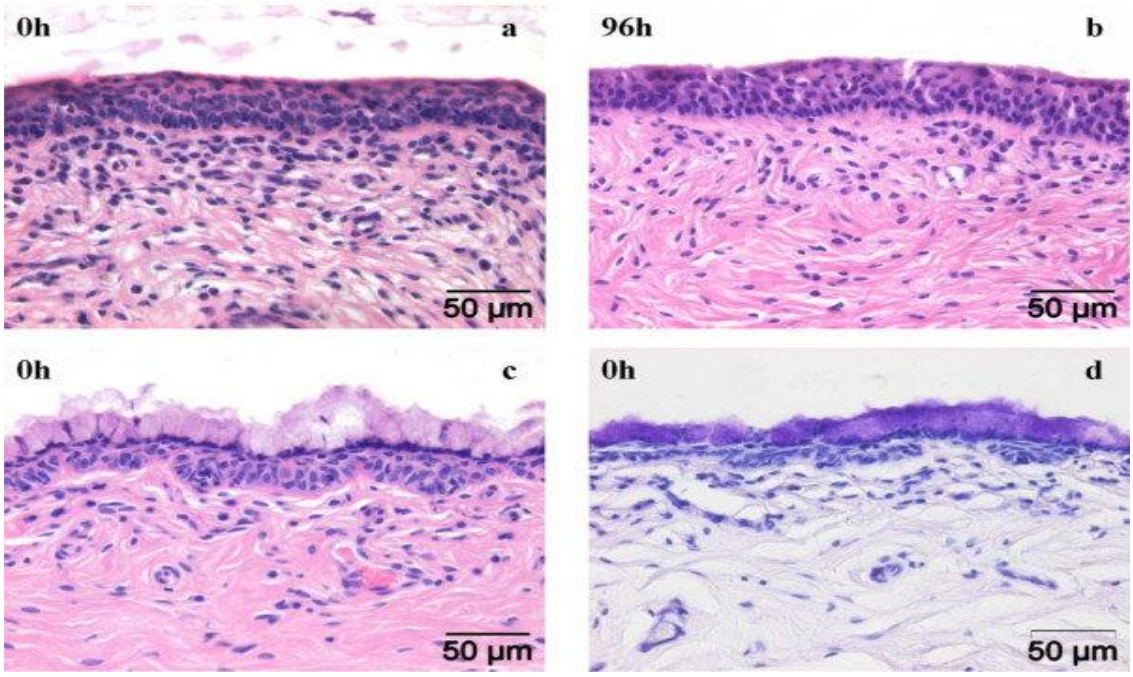
Simple squamous epithelial cell
Nucleus
Epithelial Tissue— Simple Epithelium
SQUAMOUS
Cuboidal epithelial cells
Nucleus
Cytoplasm
CUBOIDAL
Columnar epithelial cells
Nucleus
Goblet cell
COLUMNAR


Glands
Seromucinous ~ mixed
Mucous ~ light
Serous ~ dark



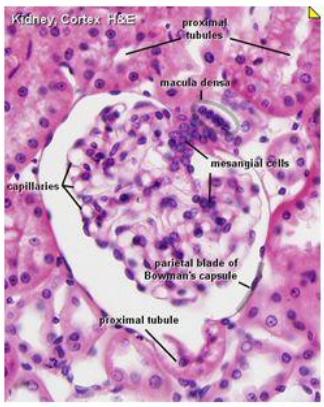
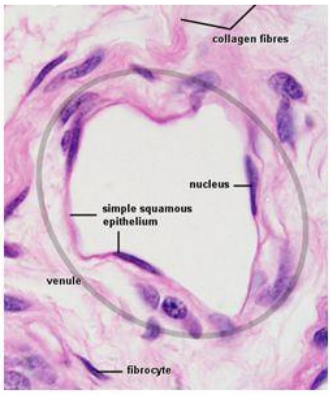
Stratified squamous epithelium lining the vestibulum vaginae

Epithelial tissues

Classification of epithelial tissues

A. Simple epithelia

1. Simple squamous epithelium:

	
Simple squamous epithelium in a Bowman's capsule in kidney.	Simple squamous epithelium in a blood capillary.

7

Lec 3 : connective tissues

Connective tissues: are group of tissues in the body that maintains the form of the body. Found throughout the body, most abundant and widely distributed in primary tissues.

All forms of connective tissue share some common structural features and a common embryonic origin.

Structure of Connective Tissue

Connective tissue has three main components:

1.Ground substance (extracellular matrix)
2.Fibers
3.Cells

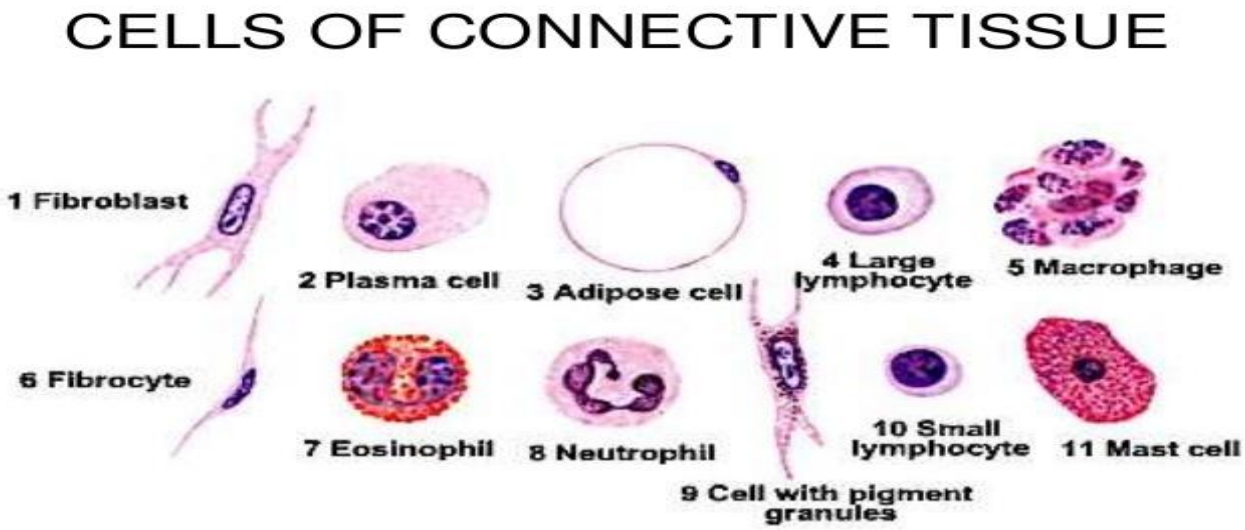
Cells of the connective tissue include:

1. **Fibroblasts:**
   - ❖ are the most common cells in proper connective tissue.
   - ❖ Fibroblasts are responsible for secreting collagen and other elements of the extracellular matrix of connective tissue.
   - ❖ are elongated cell with cytoplasmic projections, an ovoid nucleus and one or two nucleoli.
2. **Mast cells**
   - ❖ Synthesize and release histamine when exposed to allergic
   - ❖ Cytoplasm is filled with regular basophilic secretory granules.
   - ❖ Closely associated with blood vessel.
   - ❖ Release heparin that act locally as an anti-coagulant.
   - ❖ Are oval irregular shaped cell with centrally nuclei.
   - ❖ Found in skin, respiratory system.

3. **Macrophages** (histocytes)
   - ❖ remove and digest the by-products of both bacteria and normal growth and degeneration.

- ❖ They are irregular cells larger than fibroblasts, with more cytoplasm, the nucleus is smaller and darker than fibroblast nucleus, the nucleus eccentric in position.
- ❖ Macrophages contain numerous lysosomes which are used for breaking down ingested material.

4. **Plasma cells**
   - ❖ Small round cells with large eccentric nucleus, the nucleus characterized by the big dark masses of chromatin which arranged radically.
5. **Fat cells (Adipocytes)**
   - ❖ Round cell with packed nucleus in the side of the cell and large droplet of fat, this droplet looks as large cavity occupied the cell.
6. **Reticular cells**
   - ❖ The cell has large nucleus and processes attached with the processes of the adjacent cells.
7. **Leucocytes**
   - ❖ including the eosinophils, neutrophils, and lymphocytes, this found in the connective tissue of the intestine.



Connective Tissue Fibers

There are three main types of connective tissue fibers:

Type	Characters	Component	Location
1.White collagen fibers	• Is the main type found in most supporting tissues. •they are seen as wavy bundles of various thickness	Alpha , polypeptide chain	Tendon, skin, blood vessel, cartilage ,ligaments
2.Yellow (elastic) fiber.	these are usually single thin and branched .they can be stretched	Elastic ,micro fibril, and elastin	Elastic ligaments, large arteries
3.Reticular fibers	They are arranged in a mesh-like pattern form a delicate supporting network around cells	Type III collagen	Liver, bone marrow ,lymphatic organs.

Ground substance

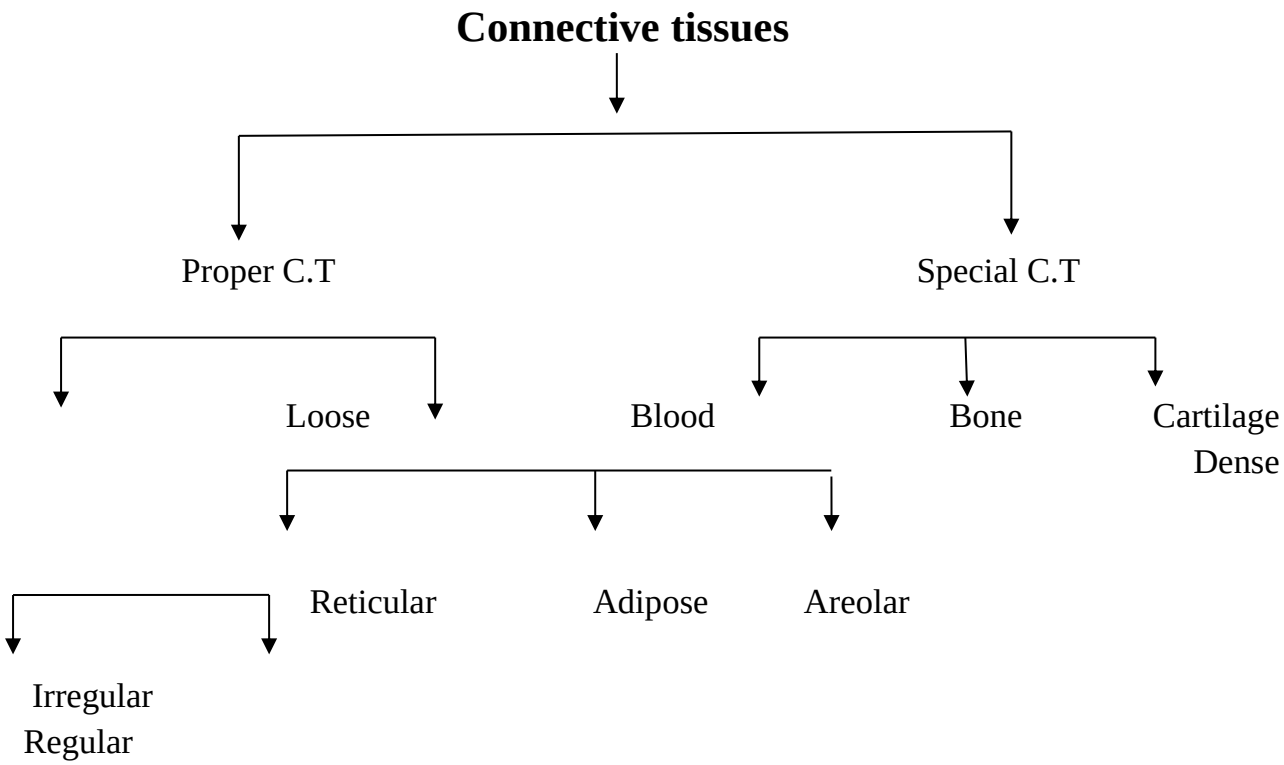
Ground substance: is the background material within which all other connective tissue elements are embedded. In proper connective tissue, the ground substance consists mainly of water whose major role is to provide a route for communication and transport (by diffusion) between tissues. This water is stabilized by a complex of glycosaminoglycans (GAGs), proteoglycans, and glycoproteins, all of which comprise only a small fraction of the weight of the ground substance.

Ground substance may be highly modified in the special forms of connective tissue.

- In blood, the ground substance lacks stabilizing macromolecules. We call this free-flowing ground substance plasma.
- In skeletal tissue, the ground substance may become mineralized by deposition of calcium salts. We call this rigid ground substance bone.

- In cartilage, the ground substance is much more solid than in proper connective tissue but still retains more resiliency than bone

Classification of connective tissues



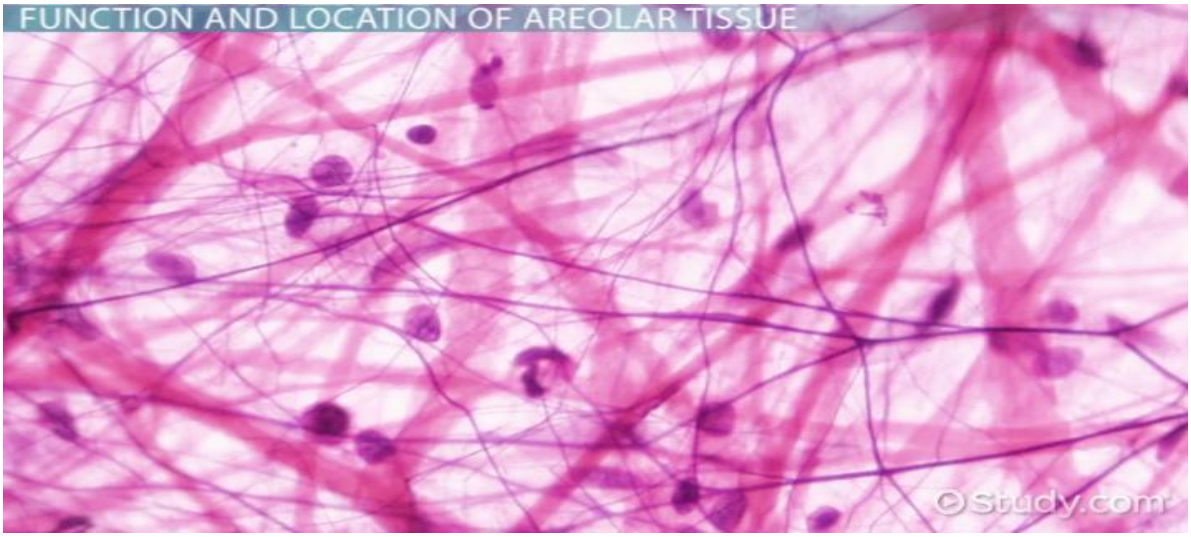
Loose connective tissue

The loose connective tissue contains cells, fibers, and ground substance in roughly equal parts. Among the cells, the fibroblasts are the predominant cells; other types of connective tissue cells are also present, along with nerves and blood vessels. Collagen fibers predominate, but elastic and reticular fibers are also present. The loose connective tissue has moderate amount of ground substance. The combination of these components gives a delicate consistency to the loose connective tissue making it flexible and not very resistant to stress.

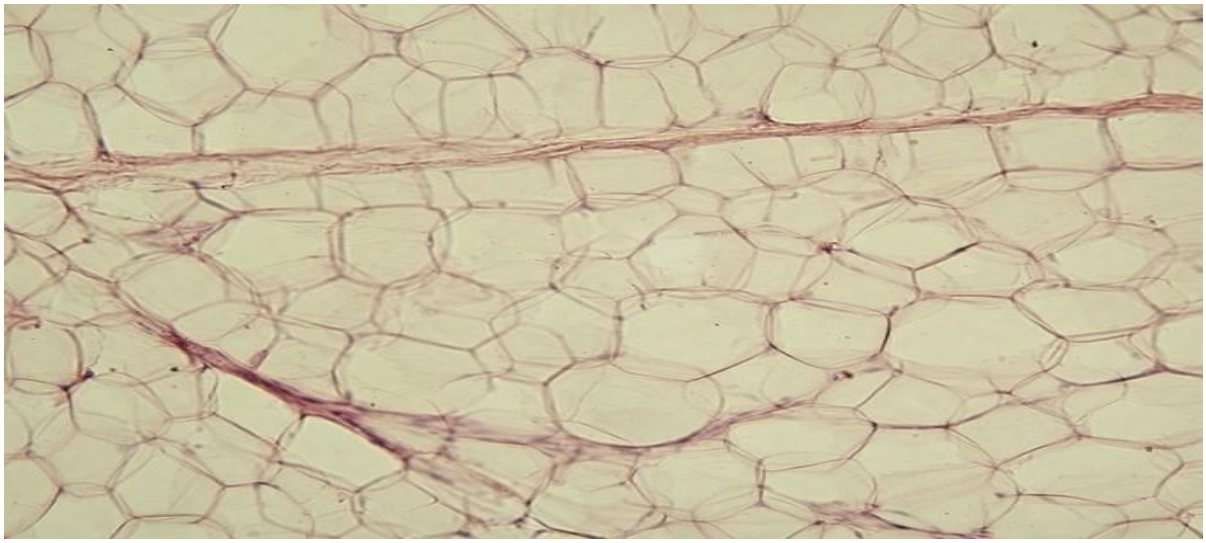
1. Areolar Connective Tissue

These tissues are widely distributed and serve as a universal packing material between other tissues. The functions of areolar connective tissue include the support and binding of other tissues. It also helps in defending against infection.

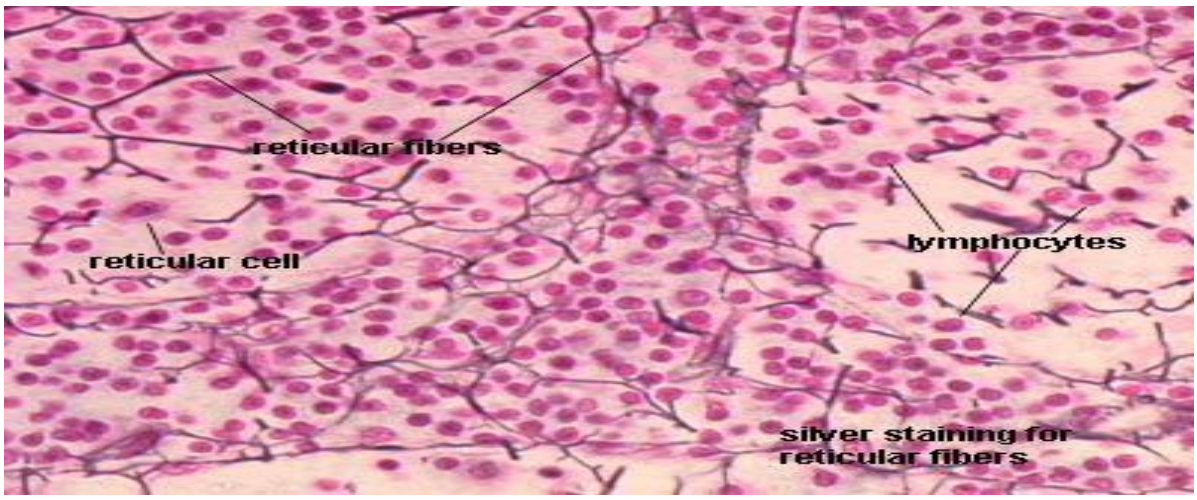
Is a loosely arranged connective tissue that is widely distributed in the body such as in gastrointestinal tract, blood vessels and ducts of glands. The areolar tissue contains collagen fibers, reticular fibers and a few elastic fibers embedded in a thin and almost fluid-like ground substance.



2.Adipose Tissue: this type of tissue differs from other connective tissues in two respects it contains more of fat cells and not the intercellular substances and secondly, each fat cell is surrounded by its own basal lamina**.**

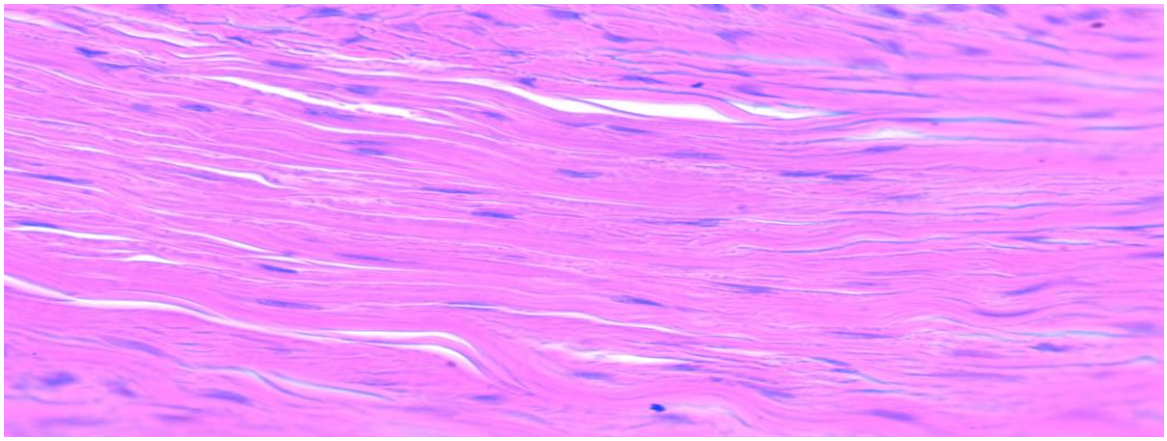


3.Reticular Connective Tissue: The reticular connective tissue is predominantly made up of reticular fibers and characterized by a cellular framework as seen in lymphatic tissues and bone marrow.



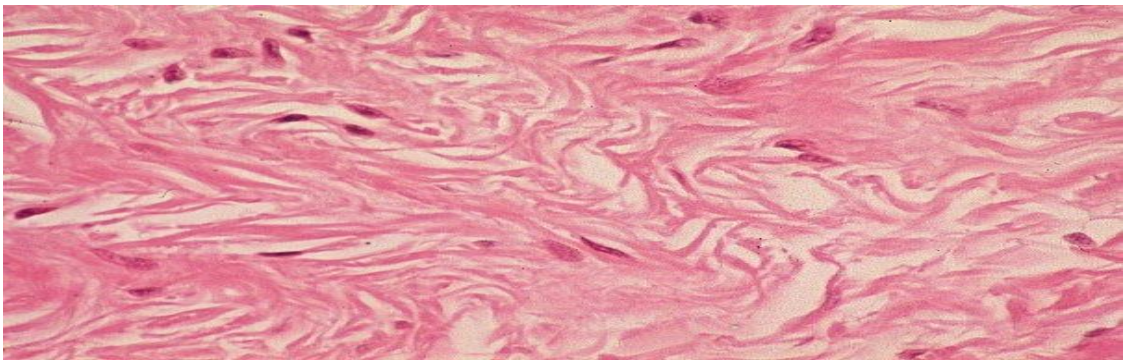
Dense connective tissue: This type of tissue is characterized by an abundance of fibers with fewer cells, as compared to the loose connective tissue.

a. Regular connective tissue: It is made primarily of parallel collagen fibers, a few elastic fibers and the major cell type is the fibroblast. found in tendons.



Dense connective tissue (regular)

b.Irregular connective tissue : It is made primarily of irregularly arranged collagen fibers , some elastic and the major cell type is the fibroblast . found in skin.



Lec 4: Specialized Connective Tissue: (Cartilage)

Is a form of fibrous connective tissue that is composed of closely packed collagenous fibers in a rubbery gelatinous substance called chondrin.

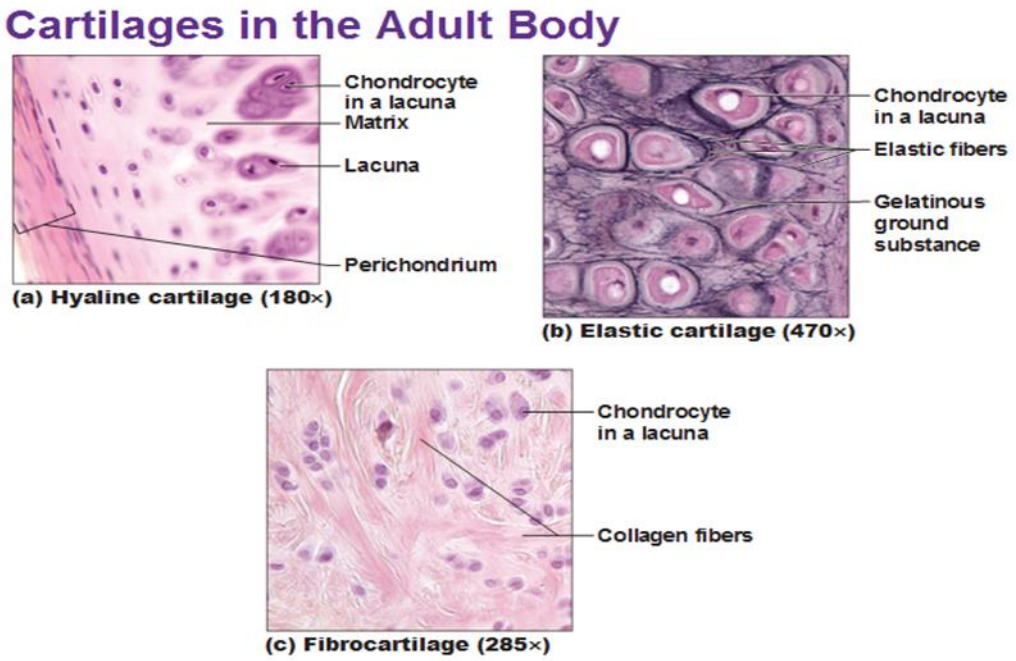
The skeletons of sharks and human embryos are composed of cartilage. Cartilage also provides flexible support for certain structures in adult humans including the nose, trachea, and ears.

There are three different types of cartilage, each with different characteristics.

1. Hyaline cartilage: is the most common type and is found in areas such as the trachea, ribs, and nose. Hyaline cartilage is flexible, elastic, and surrounded by a dense membrane called perichondrium.

2. Fibrocartilage: is the strongest type of cartilage and composed of hyaline and dense collagen fibers. It is inflexible, tough, and located in areas such as between vertebrae, in some joints, and in heart valves. Fibrocartilage does not have perichondrium.

3.Elastic cartilage: contains elastic fibers and is the most flexible type of cartilage. It is found in locations such as the ear and larynx (voice box).



Lec 5: Specialized Connective Tissue: (Bone)

Is a type of mineralized connective tissue that contains collagen and calcium phosphate, a mineral crystal Calcium phosphate gives bone its firmness. There are three types of cells:

1. **Osteoblasts**: are responsible for the synthesis of the organic components bone matrix, consisting of type I collagen fibers and osteonectin.
2. **Osteocytes**: Individual osteoblasts are gradually surrounded by their own secretion and become osteocytes enclosed singly within spaces called lacunae.
3. **Osteoclasts:** which are multi-nucleated giant cells involved in the resorption and remodeling of bone tissue.

There are two types of bone tissue: spongy and compact.

1. **Spongy bone** also called **cancellous** bone: gets its name because of its spongy appearance. The large spaces, or vascular cavities, in this type of bone tissue contain blood vessels and bone marrow. Spongy bone is the first bone type formed during bone formation and is surrounded by compact bone, found at the end of long bones.
2. **Compact bone** or **cortical** bone: is strong, dense, and forms the hard outer bone surface. Small canals within the tissue allow for the passage of blood vessels and nerves **(Haversian canal).**

Lamellae: are concentric rings of a strong matrix

Lacunae: are the small space between the lamella in which the osteocytes

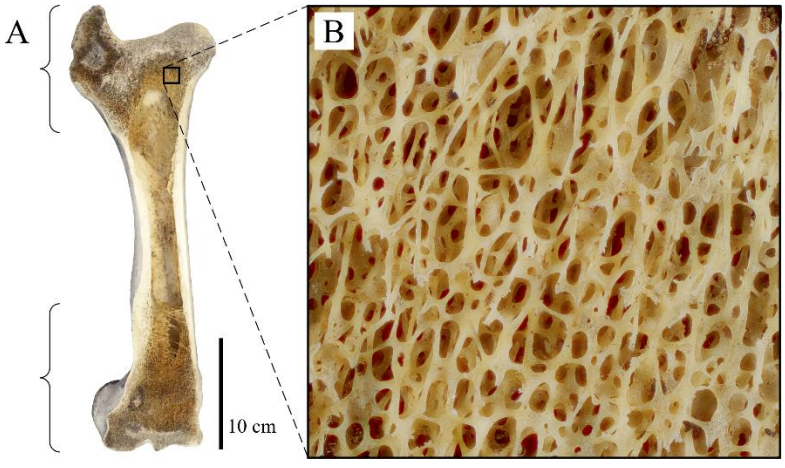
Canaliculi: a minute channels that linked the lacuna together which provide routes for pass the nutrients and waste product for osteocytes.

- The bulbous ends of each long bone, known as the **epiphyses** (or singularly as an *epiphysis*), are made up of spongy, or **cancellous,** bone tissue covered by a thin layer of compact bone. The **diaphysis,** or shaft, contains the **medullary cavity** and blood cell–producing **marrow.** A membrane called the **periosteum** covers the

outer bone to provide nutrients and oxygen, remove waste, and connect with ligaments and tendons.

Compact Bone, Dried: An Osteon (transverse section). High magnification.

Compact Bone (100x)



Spongy bone

Bone matrix

Bone matrix contains organic components (osteoid), and inorganic components (bone mineral). The organic components constitute about 50% of bone volume and 25% of bone weight. It is composed of type I collagen fibers and unmineralized ground substance, which is composed of proteins. Carbohydrates, and small amounts of proteoglycans and lipids. The inorganic components (bone 13 mineral) makes up about 50% of bone volume and 75% of bone weight. It is composed of calcium and phosphate, with some bicarbonate, citrate, magnesium and potassium and trace amounts of other metals.

Ossification of Bone

Ossification: is the process of the synthesis of bone from cartilage. There are two types of ossification- intramembranous and endochondral ossification.

1. Intramembranous ossification:

Most flat bones are produced by this types of ossification it takes place within condensations of embryonic mesenchymal tissue such as the frontal and parietal bones of the skull, temporal bones and the mandible and maxilla.

2.Endochondral Ossification

In **endochondral ossification**, bone develops by replacing hyaline cartilage. Cartilage does not become bone. Instead, cartilage serves as a template to be completely replaced by new bone. Endochondral ossification takes much longer than intramembranous ossification. Bones at the base of the skull and long bones form via endochondral ossification. This type of ossification is responsible for the formation of short and long bones.

Zone of reserve cells: A thin layer (3 – 6 cells wide) of small, randomly oriented chondrocytes adjacent to the bony trabeculae on the articular side of the growth plate.

Zone of prolifrration : Chrondrocytes are stacked in prominent rows and the cartilage matrix becomes more basophilic in this zone. Mitotc figures are present

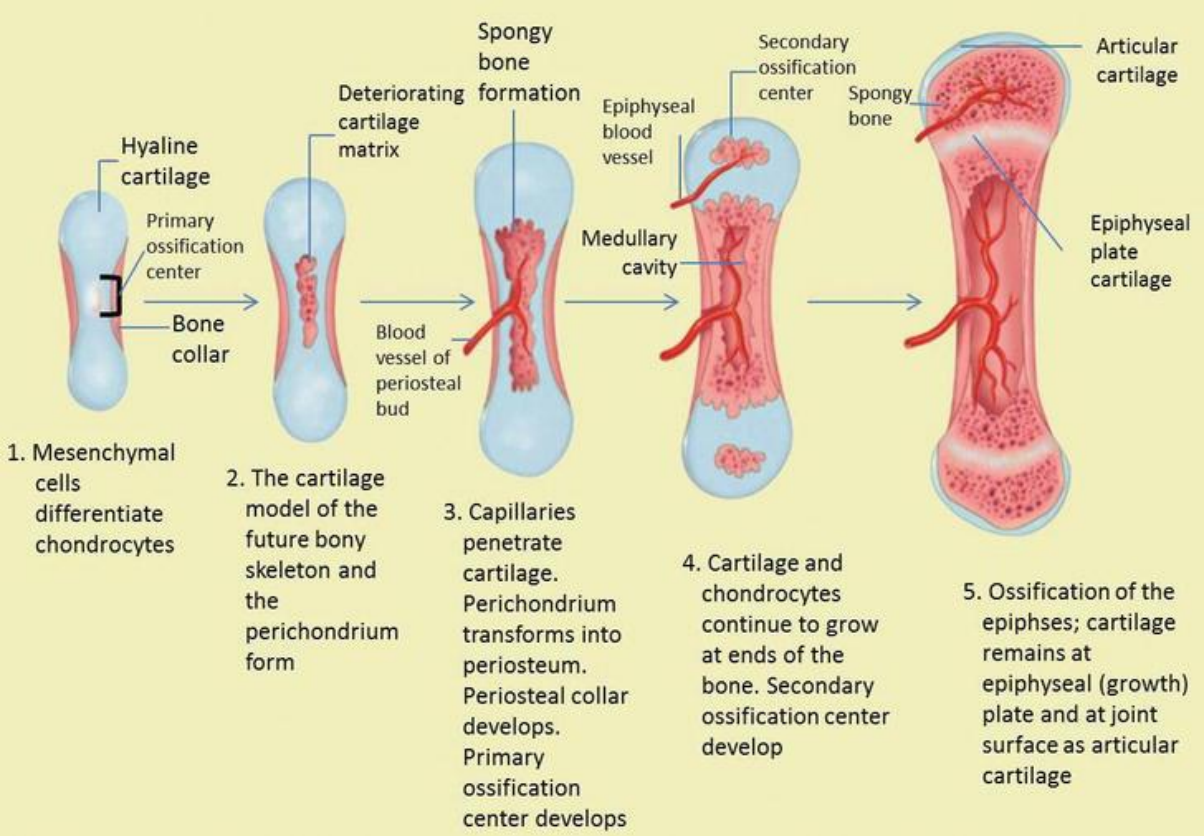
and the axis of the mitotic figure usually is perpendicular to that of the row of chondrocytes.

Zone of hypertrophy : Chrondrocytes and their lacunae increase in size

Zone of calcification : Deposition of minerals in the matrix surrounding the enlarged lacunae causing cell death.

Zone of ossification : Osteoblasts deposal bone matrix on the exposed plates of calcified cartilage.

Zone of resorption : Osteoclasts absorb the oldest ends of the bone spicules.



Lec 6: Specialized connective tissues: (Blood)

Blood: is considered to be a type of connective tissue. Like other connective tissue types, blood is derived from mesoderm, the middle germ layer of developing embryos.

- The blood is composed of elements or cells suspended in a fluid matrix called plasma. the volume of blood in healthy adult human is about 5 liters.

The cellular element composed of

a. Erythrocyte **(Red blood cell**)

b. Leucocytes **(White blood cell)**

c. Platelets or **Thrombocytes**

Blood functions involved:

1. Transport of oxygen, carbon dioxide and hormones.

2. Maintenance of acid - base balance.

3. Removal of waste products of cell metabolism

4. Temperature control of the body

5. Defense against infections.

Plasma is the extracellular matrix of blood with red blood cells white blood cells, and platelets suspended in the plasma.

1.water (90%)

2. Proteins (7%)

3. Organic salt (1%)

4. organic compound (2%) such as amino acids, lipid and vitamins.

1. Leukocytes (WBC)

- Leukocytes are colorless because they do not have hemoglobin however each cell has a nucleus.
- In the blood stream leukocyte are spherical in shape and capable of amoeboid movement.

*** WBCs fight infection in two ways**

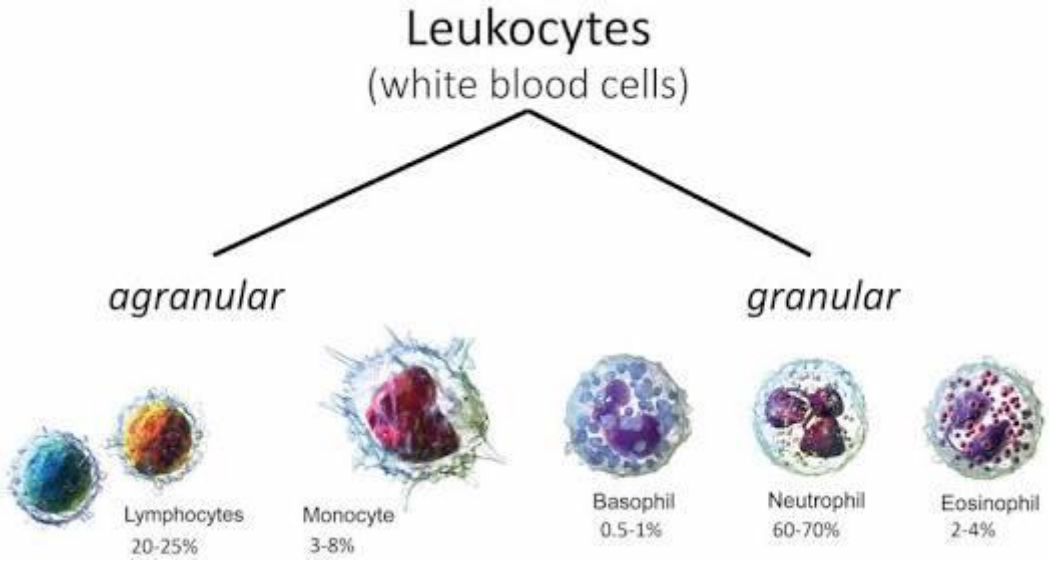
1. Some white blood cells are phagocytic and engulf pathogens.

2. Other white blood cells either produce antibodies, molecules that combine with foreign substances to inactivate them or they kill cells outright.

❖ According to the type of cytoplasmic granules and the shape of nuclei Leukocyte are classified into:

a. granular leukocytes.

b. A granular leukocyte.



a. granular leukocytes

They contain specific granular and lobulated nuclei. this type of leukocytes involved:

1. Neutrophils

❖ Compose 60 to 70% of the blood leukocytes.

❖ Nuclei have 3-5 lobes, which are connected together by thin strands of chromatin.

Bar body: is a drumstick chromosome or condensed chromatin visible in neutrophils contain all the organelles that make up a typical cell

The neutrophil cytoplasm contains fine violet or pink granules that are difficult to see with a light microscope. as result, the cytoplasm appears clear or neutral.

- First line of cellular defense against microorganism, especially bacteria phagocyte small particles and microorganisms.

2. Eosinophils

- Compose 2 to 4% of the blood leukocytes.
- Eosinophils are identified in a blood smear by their cytoplasm, which is filled with distinct, large esoinophilic (bright pink) granular.
- Nucleus: is bi-lobed but a small third lobe may be present.
- The cytoplasm granules are stained red or pink with eosin or other similar dyes.
- Recognize and phagocytosis antigen-antibody complexes, and particle that are associated with these complexes that are found during an immune response.

3. Basophils

- The nucleus is bi-lobed which hidden by the large cytoplasmic granules.
- The granules are basophil are not as numerous as in eosinophil; however, they are more variable in size, less densely packed, and stain dark blue or brown.
- These cell carry histamine, heparin and various mediators of inflammation and other protein .

b. Non Granular Leukocytes

They do not have specific granule with non-lobulated nuclei. this type can be sub divided into:

1. Lymphocytes

- Lymphocytes represent 20 to 40 % of the differential white cell count
- There are two structure types:

a. Small lymphocytes: ~5µm in diameter, and represent 3% of lymphocytes in peripheral blood. Most small lymphocytes in the blood stream belong to either the group or B- lymphocytes (~5%)

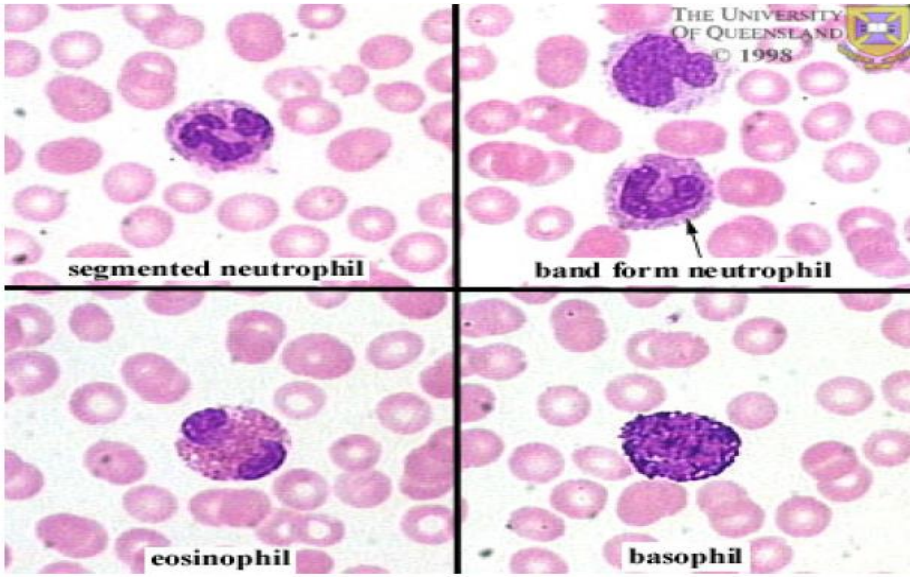
Or the group of T- lymphocytes (~90%).

b. Large lymphocytes: 9 to 15µm in diameter, possibly natural killer cells; possibly dividing lymphocytes the cell is rounded with densely stained nucleus, small amount of pale basophilic cytoplasm with free ribosomes; short microvilli more numerous on B lymphocytes than T lymphocytes, Only blood lymphocyte capable of division outside of bone marrow.

2. Monocytes

- ❖ Monocytes are large cells, 12-18µm in diameter; represent 2 to 10% of the differential white cell count.
- ❖ Monocytes are highly motile and phagocytic cells; i.e. they are the precursor of tissue phagocytes that migrate into tissues; engulf and destroy tissue debris & foreign material.
- ❖ Their nucleus less dense than lymphocytes; deeply indented, C-shaped or kidney shaped.
- ❖ Their cytoplasm is pale grayish blue with small pink to purple stained lysosomal granules, and contain cytoplasmic vacuoles (frosted glass).
- ❖ Monocytes contain granules (visible in the EM) which are similar to the primary granules of neutrophils, i.e. Lysosomes containing acid phosphatase, aryl granules.

❖ They contain also secondary granules of unknown function.



3. Erythrocytes (RBCs)

- In the normal male the average number of (RBC) is about 5-6 million/cubic millimeter, in the female it is about 4.5-5 million /cubic millimeter
- The life span of RBC is 4moths .
- Mature RBCs are flexible and oval biconcave disk.
- They lack a cell nucleus and most organelles, in order to accommodate maximum space for hemoglobin .

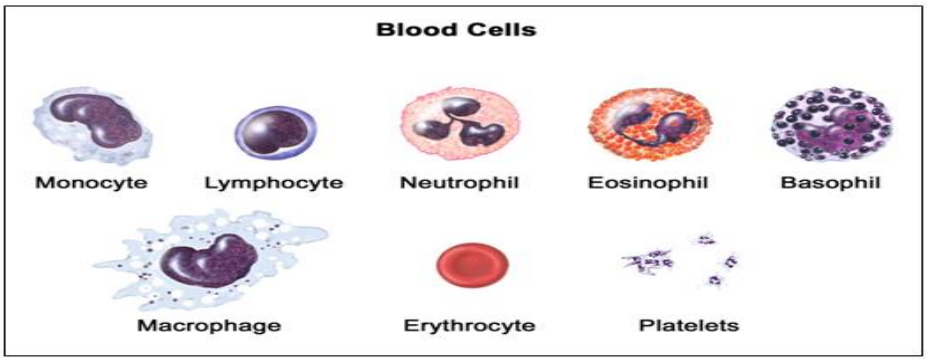
Erythrocytes function involved:

1. Transport oxygen from the lungs to the tissues.

2. Transport carbon dioxide from the tissue to the lungs.

3. Blood platelets or thrombocytes

- Platelets or thrombocytes are small fragments of cytoplasm measuring about 2-5 µm in diameter.
- Blood platelets do not contain nucleus, they are cytoplasmic fragments of very large thrombocyte (megakaryocytes) that are found in the bone marrow.
- Their number is 150,000-400,000/mm3.
- They are rounded or oval, biconvex discs.
- The cytoplasm is divided into two zones: an outer **hyalomere**, and an inner **granulomere**, which contains bluish staining granules.
- The hyalomere contains **cytoskeletal fibers,** which include actin and myosin.
- Their cytoplasm is purple-staining, granular, organelles concentrated toward center; granules constitute about 20% volume.



Lec 7: Muscular tissues

General characteristics of muscles:

1. The structural and functional units of muscles are formed of special elongated cells known as muscle fibers.

2. A muscle fiber is enclosed by plasma membrane called the sarcolemma.

3.The cytoplasm of these muscle fibers is known as sarcoplasm.

4.Within the sarcoplasm. the T- tubules allow transport of substances throughout the muscle fiber and sarcoplasmic reticulum stores calcium.

5.The structure and functional subunits are myofibrils which found in sarcoplasm.

6. Two types of myofilaments, thin (protein actin) and thick (protein myosin), associated with muscle contraction.

7. This tissue is responsible for:

a. Movement of the body and its parts.

b. Changes the size and shape of internal organs.

8. The fibers rest on the basement membrane.

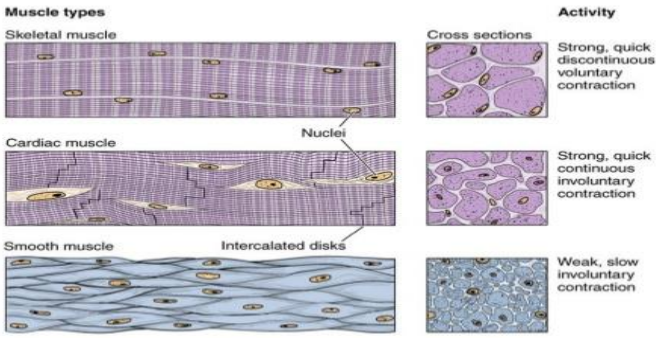
There are three types of muscle tissue:

♣ **Skeletal muscle**—Skeletal muscle tissue moves the body by pulling on bones of the skeleton.

♣ **Cardiac muscle**—Cardiac muscle tissue pushes blood through the arteries and veins of the circulatory system.

♣ **Smooth muscle**—Smooth muscle tissues push fluids and solids along the digestive tract and perform varied functions in other systems.

MUSCLE TISSUE



1. Skeletal muscle:

- It acquires its name because most of the muscles involved are attached to skeleton, and make it move.
- Also known as **Striated** muscle -because it cell (fiber) are composed of alternating **light** and **dark band (stripe).**
- Also known as **voluntary muscle**.

Structure:

1. Composed of **muscle fibers.** Each muscle fiber is long, cylindrical shaped with multinucleate with peripheral location immediately beneath the sarcolemma.

3. Each fiber contains numerous **myofibrils**, which are made up of thick and thin threads.

4. found: attached to the bones and in some visceral organs.

5. voluntary contraction.

6. The fibers held together by sheaths (**a. Endomysium b. Perimysiumc. Epimysium) .**

a. Endomysium: is a delicate layer that immediately surround the individual fibers.

b. Perimysium: is a thick layer of connective tissue, surround group of fibers that form fascicle.

c. Epimysium: is the sheath of dense connective tissue that surround a collection of fascicle.

Structure of skeletal fibers

1. Under light microscope the skeletal muscle showed light bands **(I- band)** and dark bands **(A-band)**.

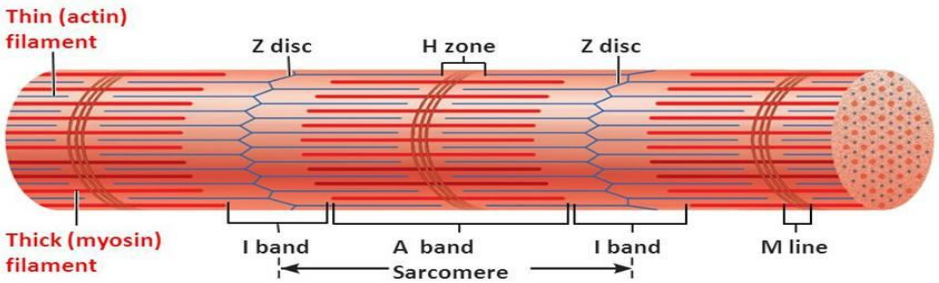
2. each **I-band** is bisected by transverse line called **Z-line**

3. The area between two Z line is known as **sarcomere,** which is the **fundamental contractile unit of myofibril.**

4. The **A-band** has a lighter zone in center called (**H-zone**) which bisected by **M –line**.

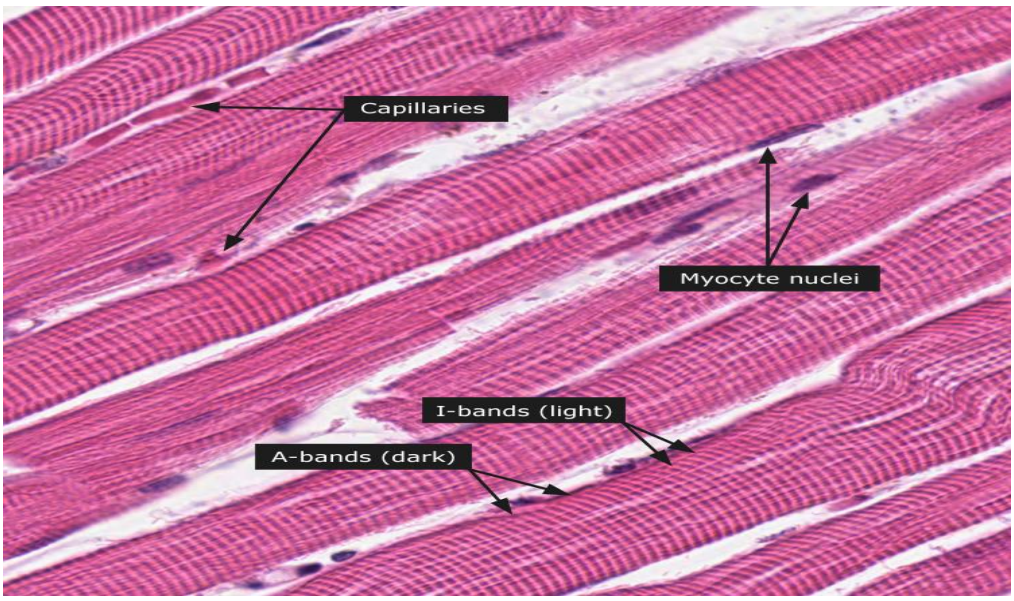
- **light I band** = (isotropic band); allow light to pass.
- **dark A band** = (anisotropic band) ; doesn't allow light to pass.

Figure 9.2c Microscopic anatomy of a skeletal muscle fiber.



(c) Small part of one **myofibril enlarged to show the myofilaments** responsible for the banding pattern. Each **sarcomere** extends from one Z disc to the next.

Pg 280



Skeletal muscle under microscope

2. Smooth muscle

- It get its name because it is **not striated**, and appear smooth under microscope.

Structure

1. Muscle fiber: is long (but not nearly as long as skeletal muscle fiber, spindle shaped and slender. Contain only one nucleus, situated at the center of the fiber at the broadest part.

2. Smooth muscle fiber is enclosed by sarcolemma, and contain numerous longitudinal myofibrils.

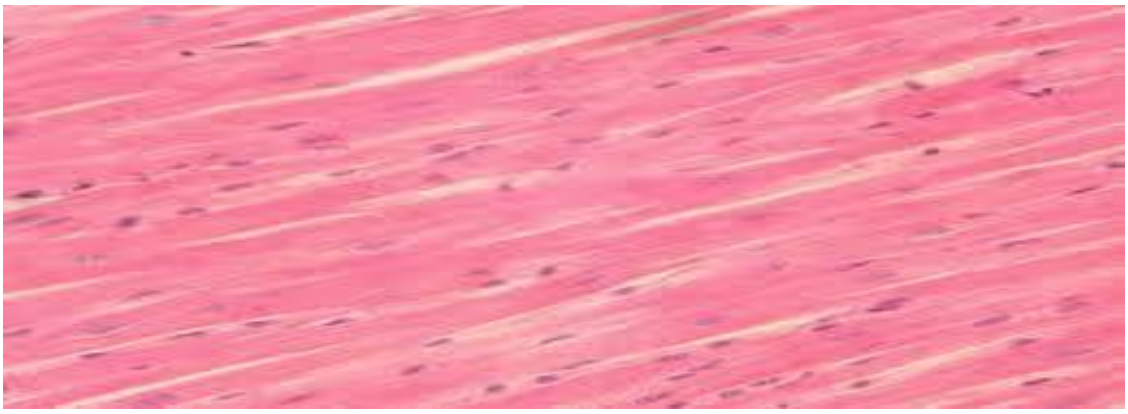
3. Actin and myosin myofilaments within myofibrils are **very thin** and are **arranged more randomly** than in skeletal muscle, so there is no stripes.

4. found: in vessels and visceral organs as bundles or sheets.

5. involuntary muscle.

6. Endomysium Sheath is present.

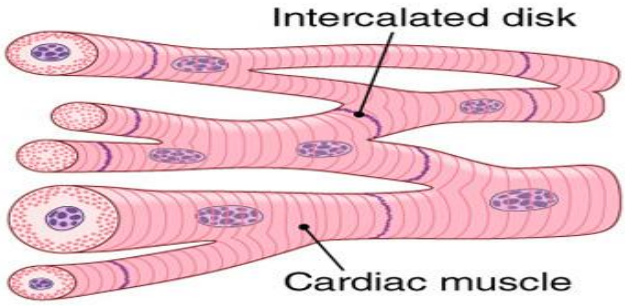
7. The cross striation is none.



Smooth muscle

3. Cardiac muscle:

It is present only in **heart**



Structure

1. Under microscope, they have similar striation as skeletal muscle

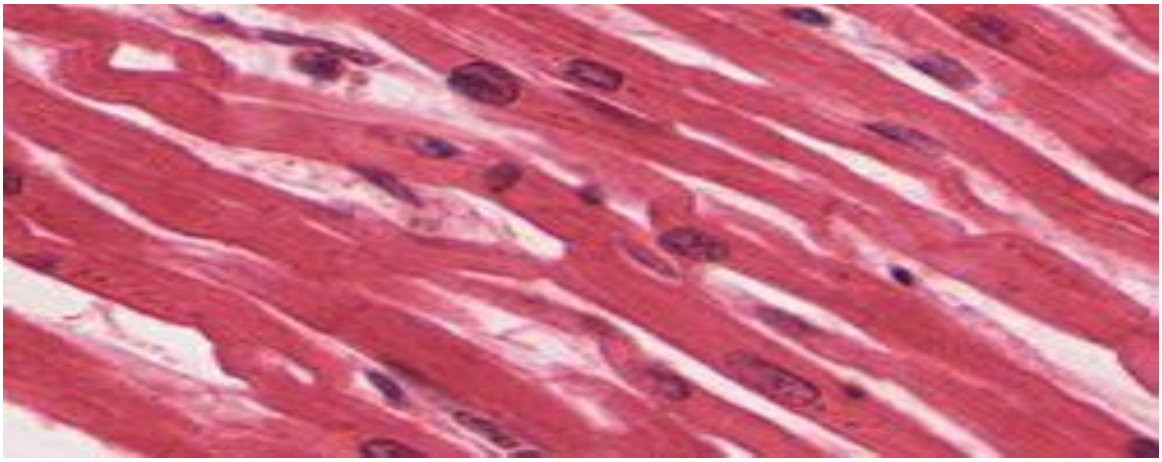
2. Cardiac muscle cells are closely packed but each cell are nucleated and separated from each other

3.The cells are joined end to end by the specialized cell junctions called **(intercalated disks)** that attach one cell to another with **desmosomes,** connect the myofibril filaments of adjacent cells and contain gap junctions that help to syncronise the contraction of cardiac muscle, by allowing impulse transmission from one cell to another.

4. They contain **light I** and **dark A band,** the **intercalated disk** always occur at the **location of Z-line**

5. Purkinje fibers: are specialized and modified cardiac muscle fibers which found in the heart . cardiac muscle has spontaneous rhythmic contraction .

6. Involuntary muscle.



Cardiac muscle

Comparison of Structure and Properties of Muscle Tissue Types

Skeletal muscle fibers	Smooth muscle fibers
The muscle fibers are long cylindrical in shape	The muscle fibers are spindle in shape
Multinucleated cells with spherical nuclei.	Mono-nucleated with central location.
Striated muscles	Non-striated muscles
Voluntary muscles	Involuntary muscles
Conjunction with skeletal bone	Lining of visceral hollow organs and blood vessels

Cardiac muscle fiber	Skeletal muscle fibers
Located in the walls and septa of the heart	Conjunction with skeletal bone
Shorter and branched	Longer and unbranched
Striated muscles	Striated muscles
Contain intercalated discs	Un contain intercalated discs
Contain one or two central nuclei	Contain multinucleated cells with peripheral nuclei
Involuntary muscles	Voluntary muscles

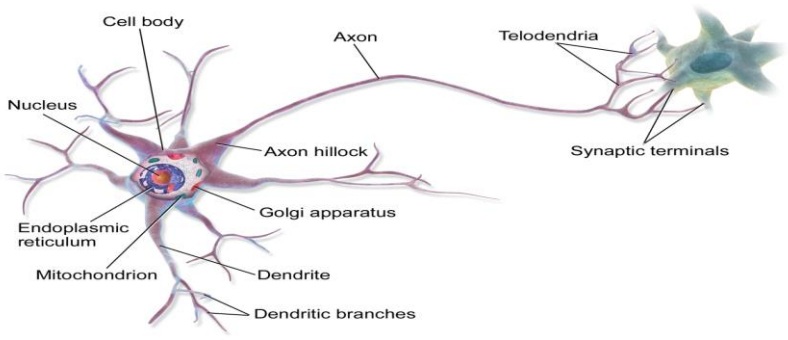
Lec 8: Nervous tissue:

Is one of four major classes of tissues. It is specialized tissue found in the central nervous system and the peripheral nervous system. It consists of neurons and supporting cells called neuroglia.

The nervous system is responsible for the control of the body and the communication among its parts. Nervous tissue contains two categories of cells—neurons and neuroglia.

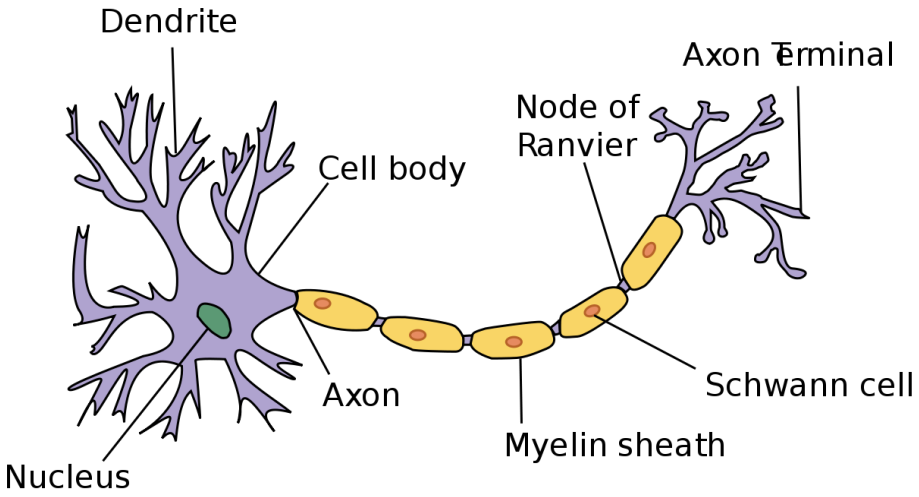
1. Central nervous system (CNS): Composed of the brain and spinal cord. Its major functions are to integrate sensory information, and to initiate and co-ordinate efferent responses.

2. Peripheral nervous system (PNS): Composed of all nervous tissue outside the CNS. The PNS is represent by cranial nerves from the brain, spinal nerves from the spinal cord, and nodules known as ganglia, that contain the neural cell bodies.



Neurons (Nerves cell)

Neurons are highly specialized nerve cells that generate and conduct nerve impulses. A typical neuron consists of dendrites, the cell body, and an axon.



Dendrites:

- Numerous short –branched structures emerging from the soma are called Dendrites they are often covered with small, branched projections known as dendritic spines.
- The function of dendrites are receptor of a neuron that receive electrical signals from other neurons.
- The function of dendritic spines involved to increase the surface area of the dendrite vastly, thus helping in receiving impulses from other axon.

2. Cell body (perikaryon)

Cell body- central unit of neuron. Contains nucleus, cytoplasm, etc.

- The nucleus is central, large, single.
- The cytoplasm has granules called (**Nissl bodies**) which are distributed In the cytoplasm of the cell body except in the region close to the axon called axon hillock.
- Mitochondria,Golgi complex, lysosomes and other cell organelles are present.

3. Axon

Process (a single nerve fiber) that takes impulses away from the cell body. Neurons have at least 1 axon.

- The cytoplasm of the axon is termed axoplasm.
- The plasma membrane bounding the axon is called axolemma.
- The axon is covered with a white fatty layer known as the myelin sheath , this sheath serves two major functions protecting and insulating the axon and accelerating the electrical signals during transmission.
- The myelin sheath layer has a cellular covering known as the neurilemma or the Schwann cell sheath. this sheath is essential for regeneration of nerves. It is present only in the peripheral nervous system. in the central nervous system, nerurilemma is absent, thus nerves here are incapable of regeneration
- The medullary sheath is not continuous layer on the axon; it has joints or node – type interruptions known as the **nodes of Ranvier**

Classifications of neuron:

A. according to the number of processes

1. Pesudounipolar neuron

These neurons consist of one dendrite and one axon.

The nerve cell body has two processes which are adherent to each other forming one pole.

- It is seen in spinal sensory ganglia.

2. Biopolar neurons

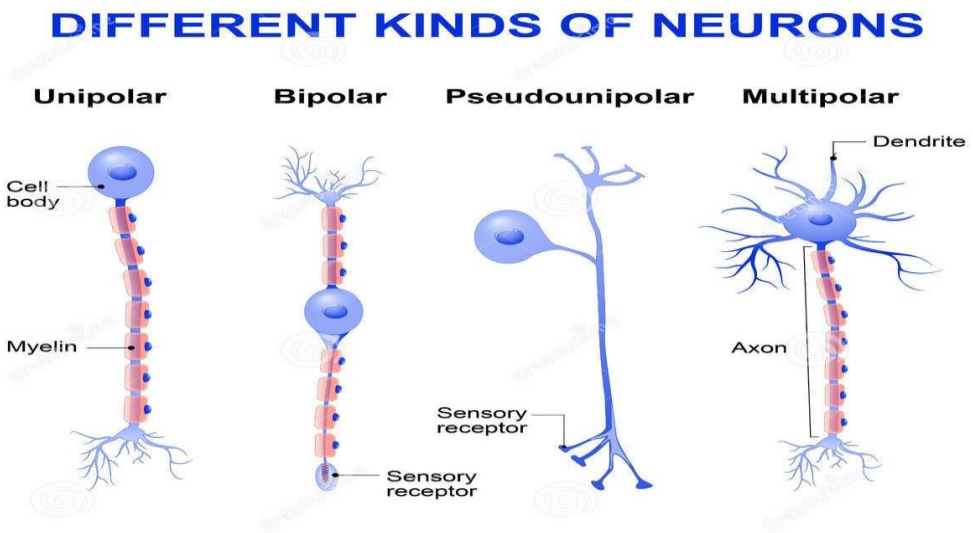
The nerve cell body has spindle shape and has two processes from the two pols, a short dendrite and a long axon.

- It is seen in the olfactory epithelium of the nasal cavity.

3. Multipolar neurons

The nerve cell has a single long axon and many short dendrites.

They represented most of the neuron in the brain and spinal cord.



B. according the functions

1. Motor (Efferent) neurons

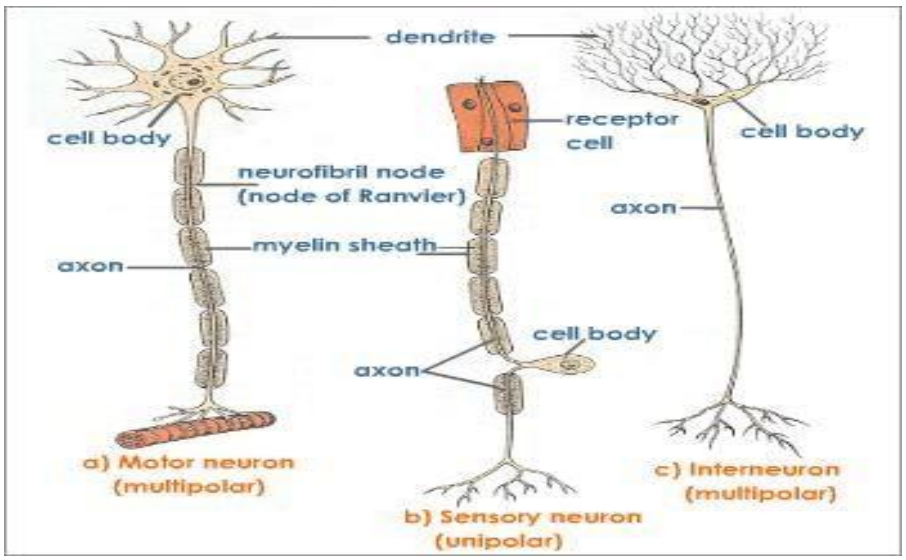
- This type carries motor impulses from central nervous system (CNS) to peripheral end organ.
- The site of this type is a motor nucleus in anterior horn cell of spinal cord.

2. Sensory (Afferent) neurons

- This type receives impulses from peripheral sensory cells and organ and then carry them toward CNS.
- The site of this type is sensory spinal ganglia.

3. Interneurons

This type have short neurons that connect a sensory and motor neuron, The site of this type is spinal cord in reflex arc .



Neuroglia

- ❖ Neuroglia or glial cells are protective and support structure of the nervous tissue.
- ❖ They are found in bunches surrounding the neurons and have the ability to regenerate in case of injury.
- ❖ They are located in both peripheral ad central nervous system .

Neruroglia of peripheral nervous system (PNS) include:

1. Schwann cell
2. Satellite cell

Neruroglia of central nervous system (CNS)

1. Astrocytes

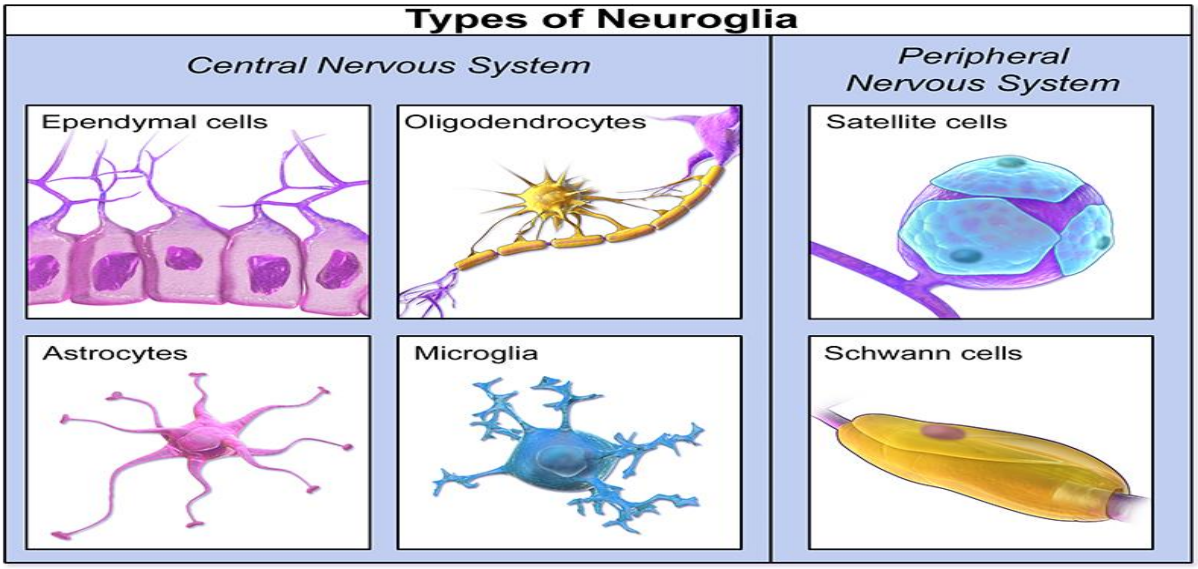
a. fibrous astrocytes.

b. protoplasmic astrocytes.

2. Oligodendroglia

3. Microglia

4. Ependymal cells.



Synapse

❖ Any two neurons are connected together at the site called synapse.

❖ Information from one neuron flows to another neuron across a synapse.

according to the site, synapse are classified into;

1. Axo-dendritic between axon and dendrite.

2.Axo-somatic between axon cell body (soma)

3. Axo-axonic between axon and another axon.

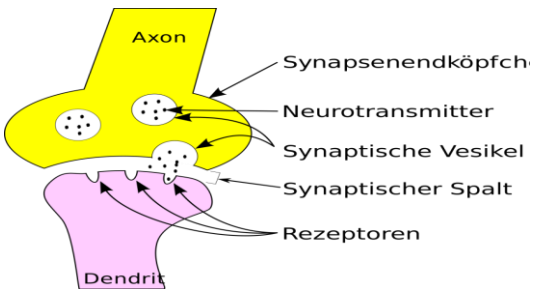
Synapses have 4 main functions

a. They transmit information between neurons.

b. They filter out low frequency impulses.

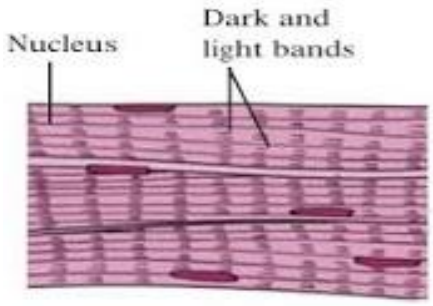
c. They act as valves to ensure that impulses pass across then in one direction only

d. they also act as junctions allowing impulses to be divided up along many neuron or merge into one.

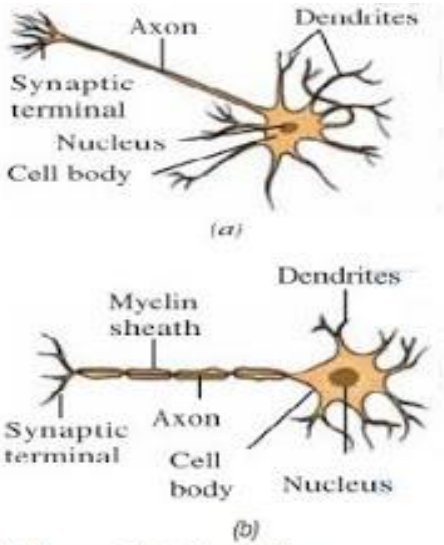


Nerve fibers:

- A nerve fiber is an axon and its sheath.
- Long, peripheral axons are surrounded by a multi-layered with Phospholipid , segmented covering called myelin sheath .
- Axons with the covering are known as myelinated fibers and those without are unmyelinated fibers.
- The functions of the myelin sheath are to increase the speed of nerve impulse conduction.
- Myelin sheaths in the PNS are formed by multiple layers of wrapped Schwann cells.
- The outer surface of the Schwann cells is the neurilemma or sheath of Schwann and is located just beneath the plasma membrane of the cell.



A strained muscle fibre



(a) Non-myelinated nerve fibre
(b) Myelinated nerve fibre