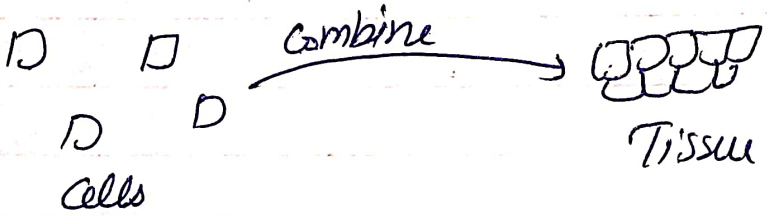
TISSUE LEVEL OF ORGANIZATION

A tissue is a group of cells that usually have a common origin in different specialized activities.

→ The structure and properties of a specific tissue are carried by different factors like extracellular fluid etc.



→ The science deals with the study of tissue is known as histology.

Types of Tissues

- **Epithelial Tissue** → Cover body surfaces and lines hollow organs, body cavities, and ducts, also form glands.
- **Connective Tissue** → Protect and support body and its organs. Store fat energy, Provide immunity
- **Muscular Tissue** → Composed of cells specialized for contraction and generation of force.
- **Nervous Tissue** → detect changes in a variety of conditions inside and outside the body and respond by generating electrical signals called nerve impulses

☆ Epithelial Tissue :

It consist of cell arrangement in continuous sheets, in either single or multiple layers Because cells are closely packed and hold one another by the cell Junctions.

Functions

→ Selective Barries that permits few substances to transfer inside and outside

→ a protective surface that resists the factors affected by Environment.

☆ Epithelia Tissue have different structures that perform different functions -

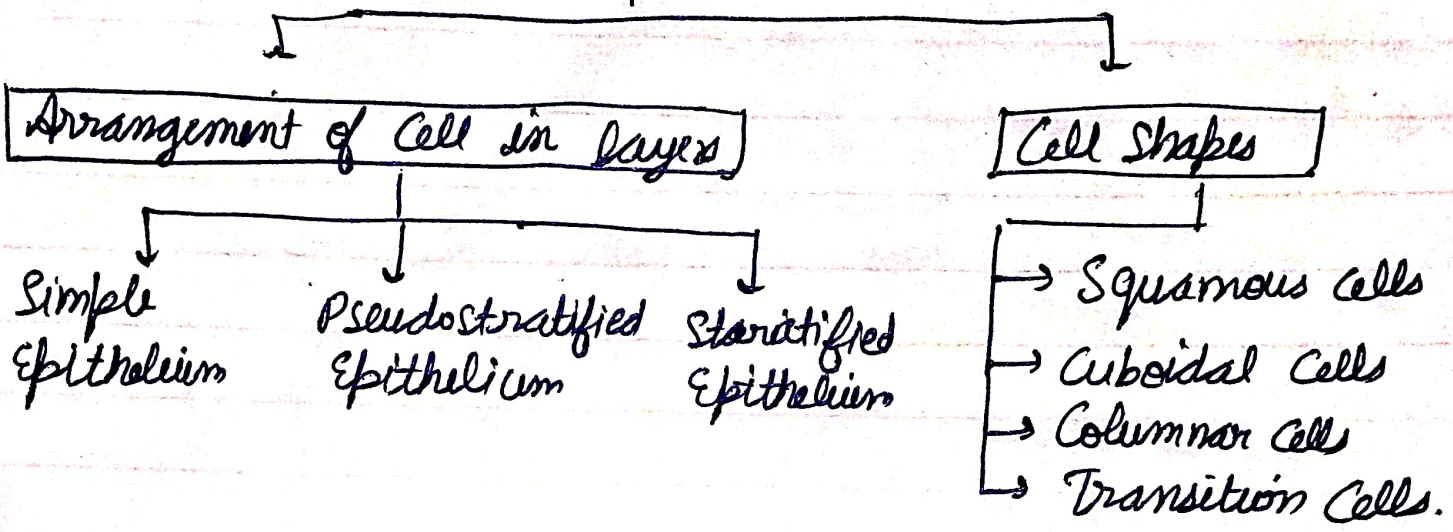
→ The apical (free) surface of cell faces body surfaces, a body cavity, the lumen (inner surface) or space) of internal organs

→ The lateral surfaces of cell faces the adjacent cells on either sides, may contain tight Junctions, adhere Junctions or gap Junctions

→ Basal surface of cell is opposite to its apical surface. It is deepest layer of epithelial cells adhere to extracellular material such as Basement membrane

☆ Basement membrane is a thin layer (extracellular or outer) that consist of 2 layers, the Basal lamina and reticular lamina.

Classification of Epithelial Tissue



✡ Arrangement of Cell in layers :

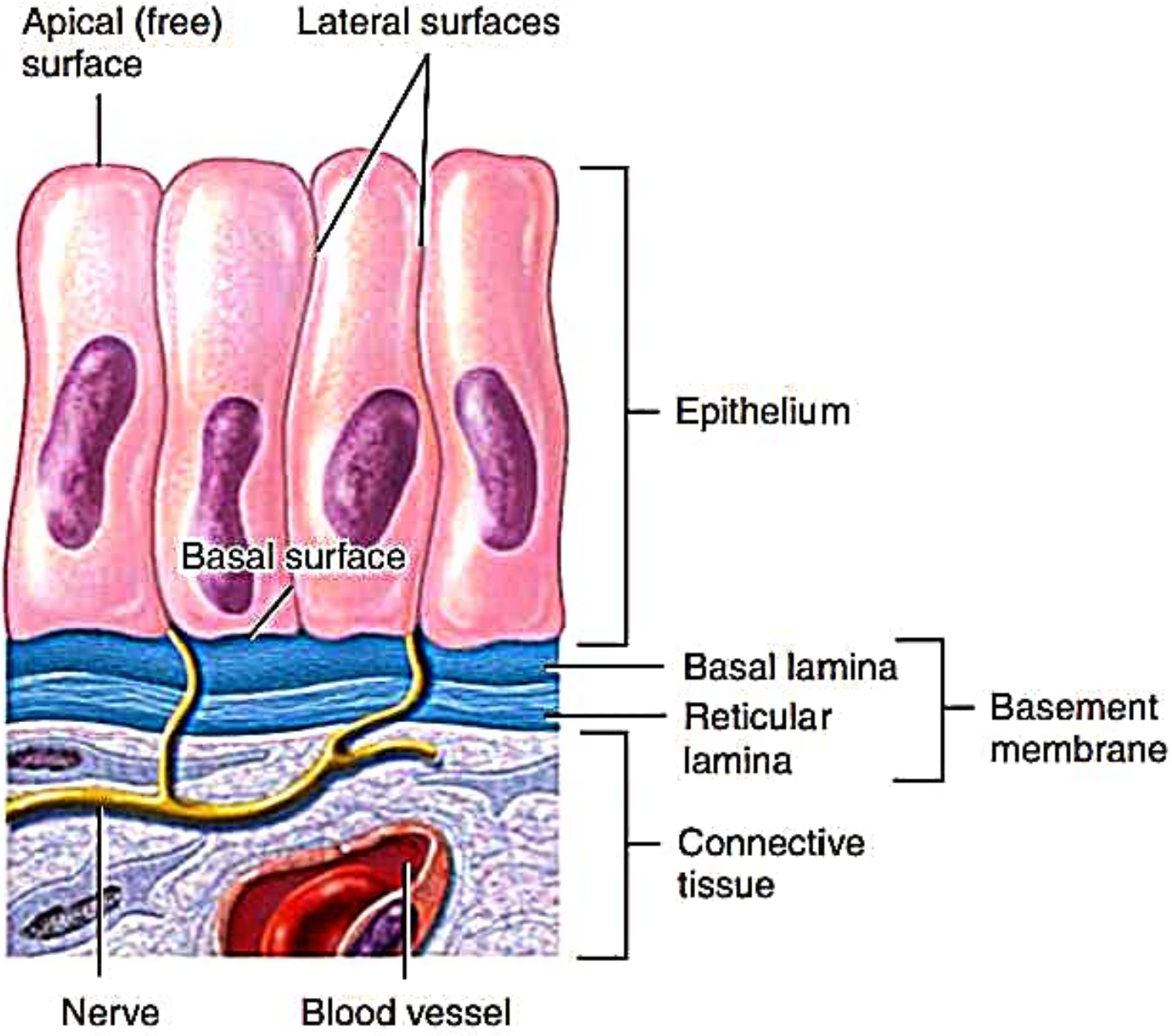
① **Simple Epithelium** :- It is a single layer of cells that functions in diffusion, osmosis, Secretion or absorption.

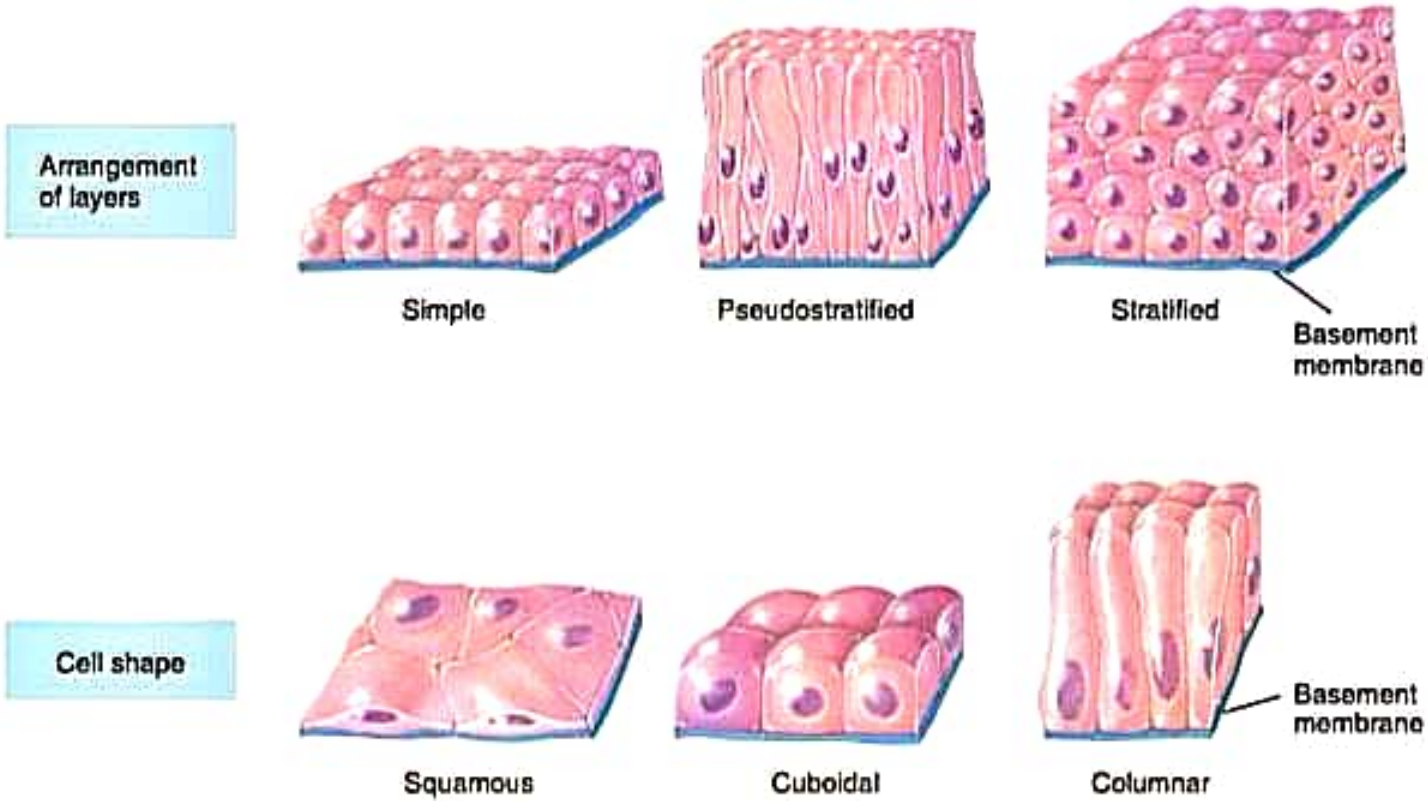
→ Absorption is the intake of fluids or other substances such as digested food from Intestinal Tract.

② **Pseudostratified Epithelium** :- These are multiple layers of Epithelial Cells and not all cells reach the apical surface.

→ Apical surface may contain cilia, other Secrete mucus.

③ **Stratified Epithelium** :- It consist of 2 or more layers of cells that protect underlying tissue in location where there is considerable wear and tear.


Apical (free) surface
Lateral surfaces
Epithelium
Basal surface
Basal lamina
Reticular lamina
Basement membrane
Connective tissue
Nerve
Blood vessel


Arrangement of layers
Simple
Pseudostratified
Stratified
Basement membrane
Cell shape
Squamous
Cuboidal
Columnar
Basement membrane

☆ Cell Shapes :

① Squamous Cells : these are thin, which allow rapid (fast) passage of substances through them.

② Cuboidal Cells : they are wide and shaped like cubes or hexagons.
→ They may have microvilli at their apical surface.

③ Columnar Cells : these are much taller than they are wide, like columns and protect underlying tissues.

④ Transitional Cells : They changes shape, from squamous to cuboidal and back, as organs such as the urinary bladder stretch to larger size and then collapse to smaller size.

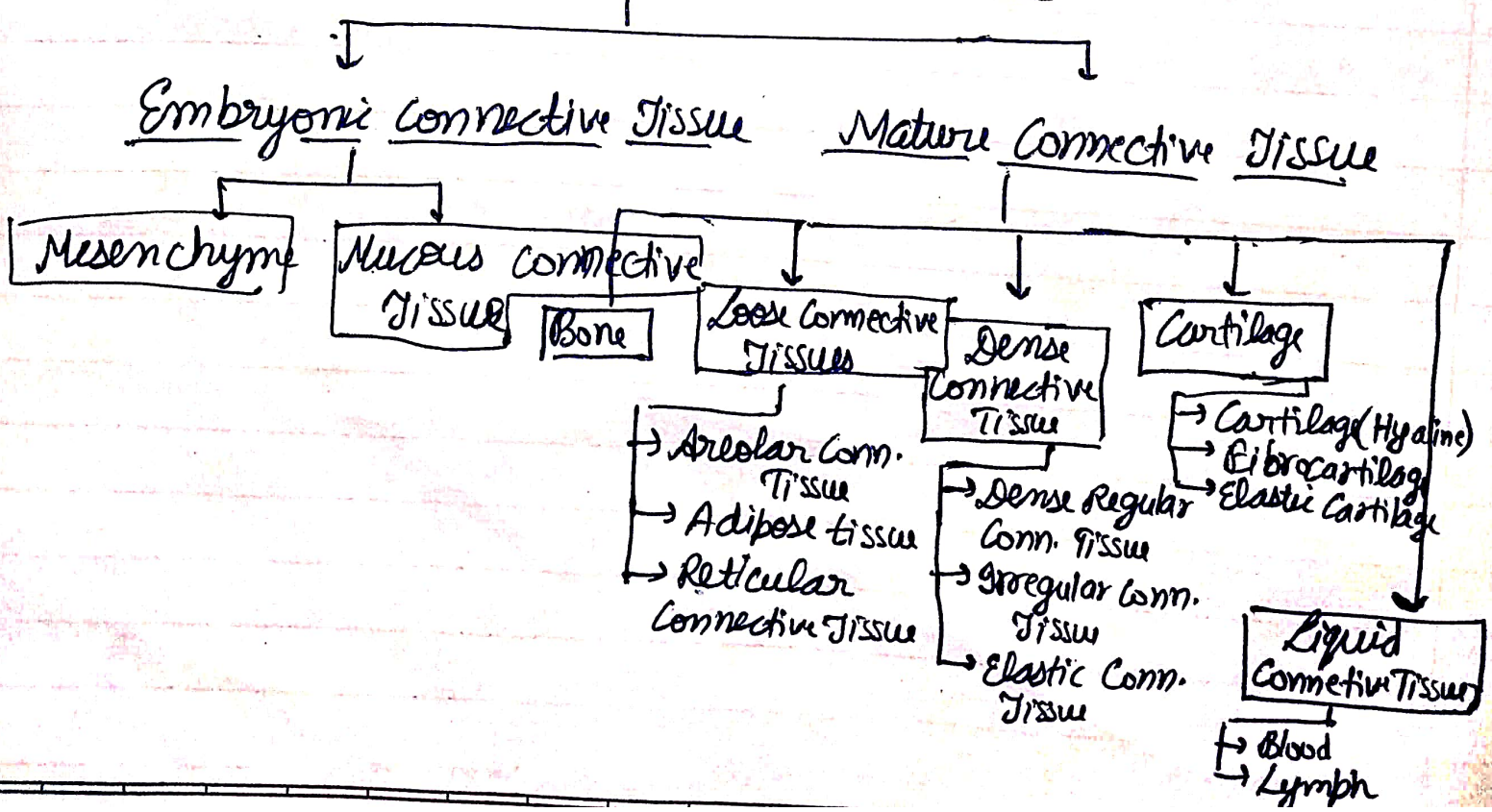
Connective Tissue

Connective tissue is one of the most abundant and widely distributed tissue in the body. In different form, connective tissue has a variety of functions.
→ It binds together, support, and strengthens other body tissues.

→ Connective tissue consists of 2 basic elements :-
- Extracellular matrix
- Cells.

* Extracellular matrix is the material located between its widely spaced cells.
* Extracellular matrix consists of protein fibers and ground substance, the material between the cells and the fibers.
* Connective Tissue Cells
  - Fibroblasts
  - Macrophages
  - Plasma cells
  - Mast Cells
  - Adipocytes
  - Leukocytes

Classifications of Connective Tissues



Embryonic Connective Tissue

① Mesenchyme - Mesenchyme is present primarily in the Embryo, developing human from fertilization through the first one month of pregnancy and in fetus, the developing human from the 3rd month of pregnancy to birth.

→ found Exclusively under skin and along developing bones of Embryo.

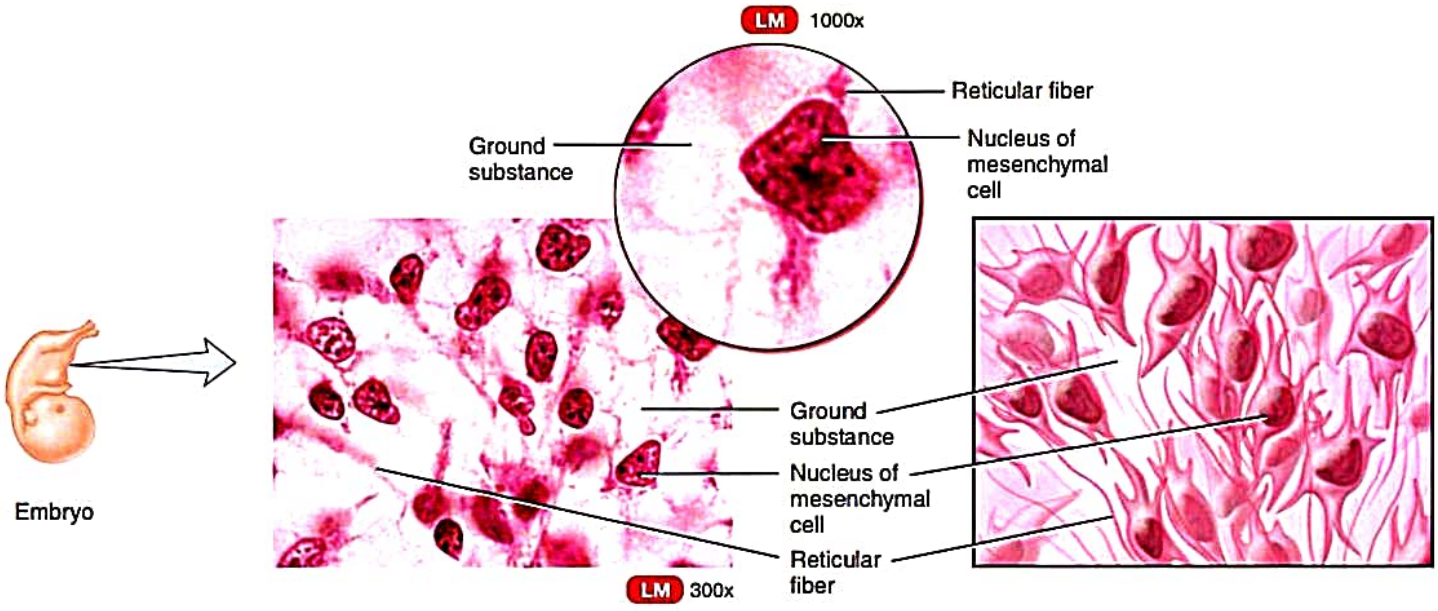
→ It forms almost all other types of connective tissue.

② Mucous Connective Tissue :-

Mucous connective Tissue has widely Scattered fibroblasts embedded in Viscous, Jelly like Substance that contain collagen fibres.

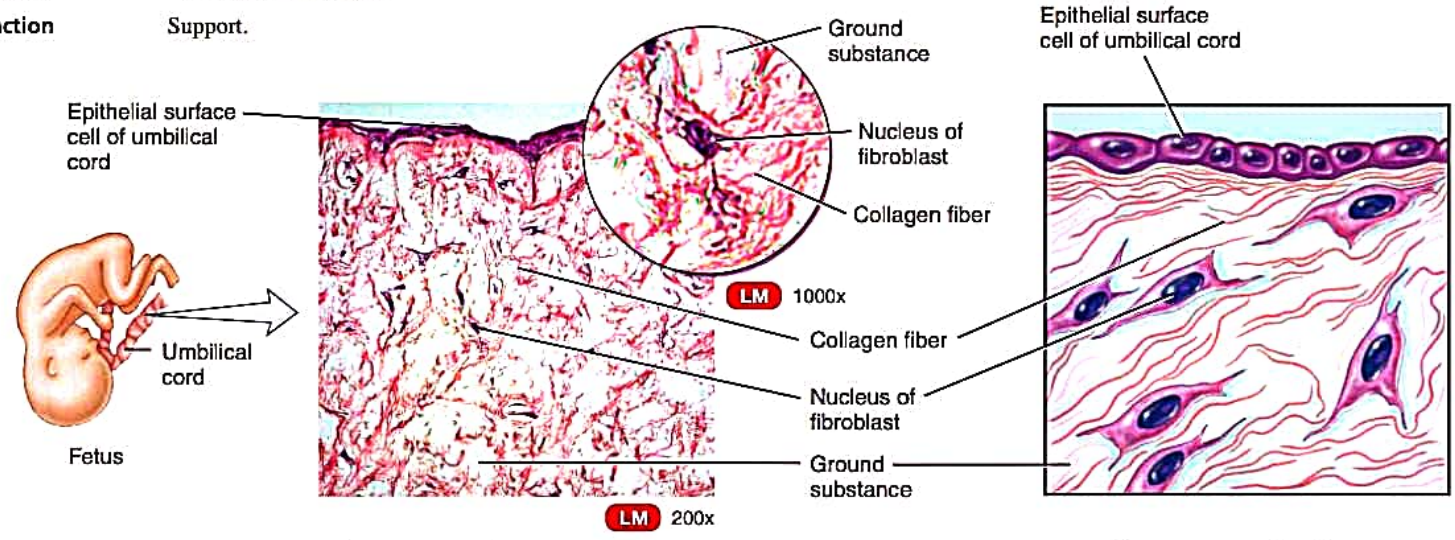
Location - umbilical cord of fetus.

Function - Support.


LM 1000x
Reticular fiber
Ground substance
Nucleus of mesenchymal cell
Ground substance
Nucleus of mesenchymal cell
Reticular fiber
LM 300x
Embryo
Sectional view of mesenchyme of a developing embryo
Mesenchyme

Location Umbilical cord of fetus.

Function Support.



Sectional view of mucous connective tissue of the umbilical cord

Mucous connective tissue

Mature Connective Tissue

The second major subclass of connective tissue, mature connective tissue, is present in newborn.

→ Its cells arise primarily from mesenchyma.

→ There are 5 types of Mature Connective Tissue :-

① Loose Connective Tissue :-

Types → Areolar Connective Tissue
→ Adipose Connective Tissue
→ Reticular Connective Tissue

* Areolar Connective Tissue - It is widely distributed tissue consist of fibres like collagen, elastic, reticular and cells like fibroblast, plasma cells, mast cells, WBC etc embedded in ground substances.

Location - In subcutaneous layer deep to skin, dermis of skin, mucous membrane, blood vessels, nerves and body organs

Function Strength, Elasticity, support.

* Adipose Connective Tissue :- (Fat Tissue) It is specialized for storage of triglycerides as a large centrally located droplet.

→ Most adipose tissue in adults is white adipose tissue, Brown adipose tissue (BAT) is darker due to rich Blood Supply

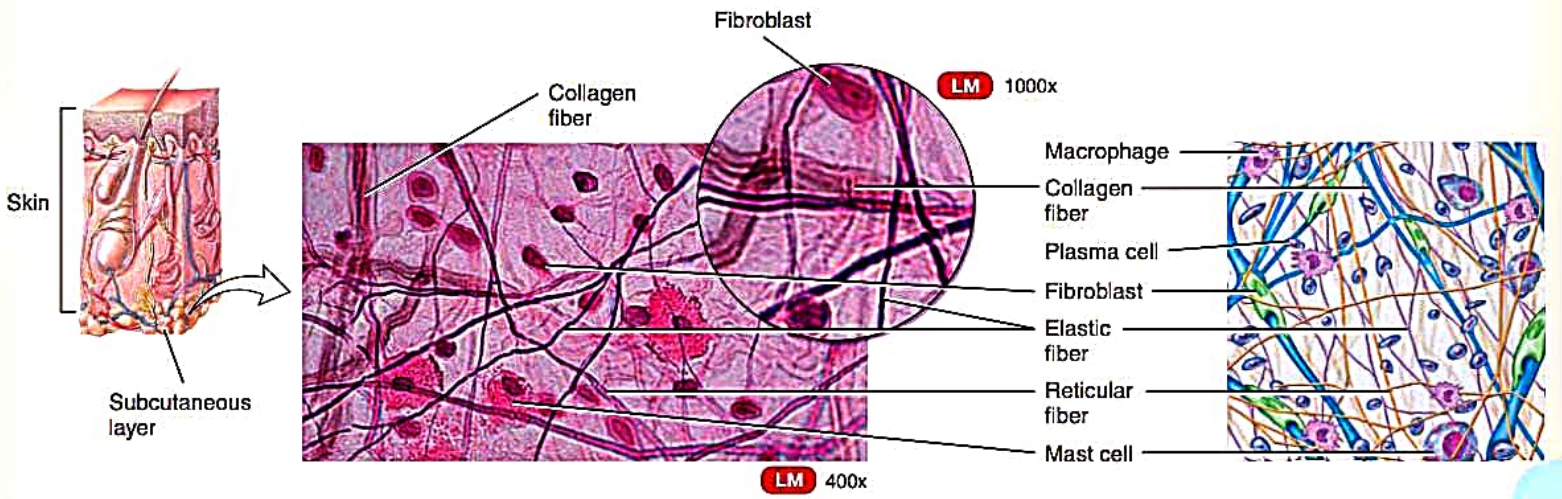
Location – Subcutaneous layer deep to skin, around ♡ and kidneys, yellow bone marrow

Function: Support and protect organs. Reduces heat loss through skin.

★ Reticular Connective Tissue: These are fine network of Collagen fibres and reticular cells.

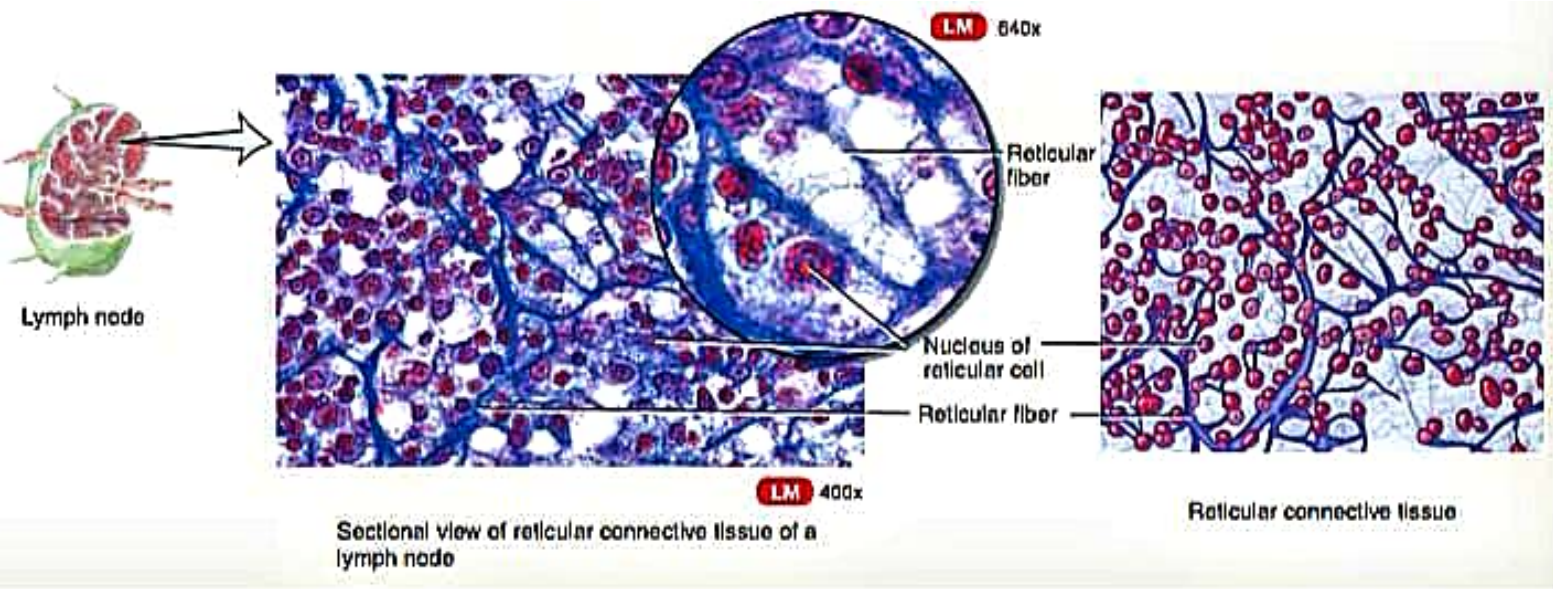
Location - liver, Spleen, lymph nodes, Red bone marrow

Function - Binds smooth tissue cells, filters and removes worn-out blood cells in Spleen.



Sectional view of subcutaneous areolar connective tissue

Areolar connective tissu


LM 640x
Reticular fiber
Nucleus of reticular cell
Reticular fiber
LM 400x
Lymph node
Sectional view of reticular connective tissue of a lymph node
Reticular connective tissue

(2) Dense Connective Tissue

★ Dense regular connective Tissue:

mainly fibres regularly arranged in bundles with fibroblasts in rows between them.

Location: Form tendons (attach muscle to Bone), most ligaments (attach bone to Bone).

Function: Provide Strong attachment between Various structures

★ Dense irregular connective Tissue:

made up of Collagen fibres, usually irregularly arranged with a few ~~of~~ fibroblasts.

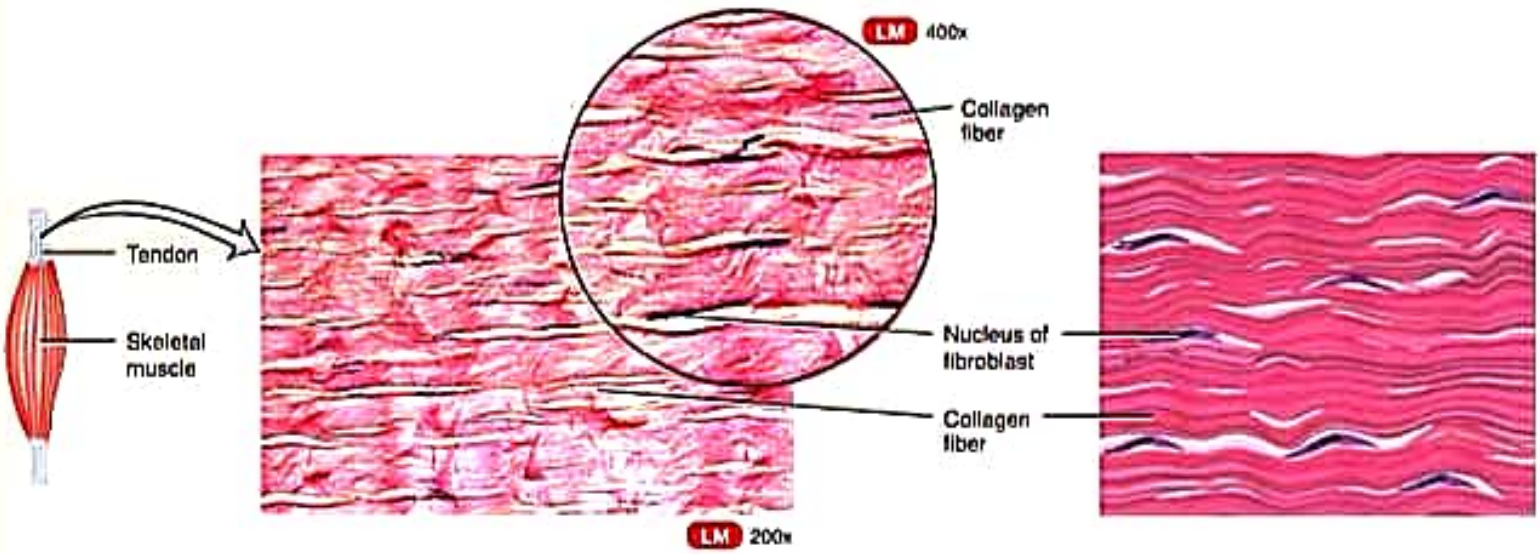
Location: occurs in Sheets, such as fascia (tissue in skin and muscles), ♡, Periosteum of bone, Joint Capsules, membrane capsules around different organs (Kidney, Liver, testis, lymph nodes).

★ Elastic connective Tissue:

Contain Elastic fibers with fibroblasts between them.

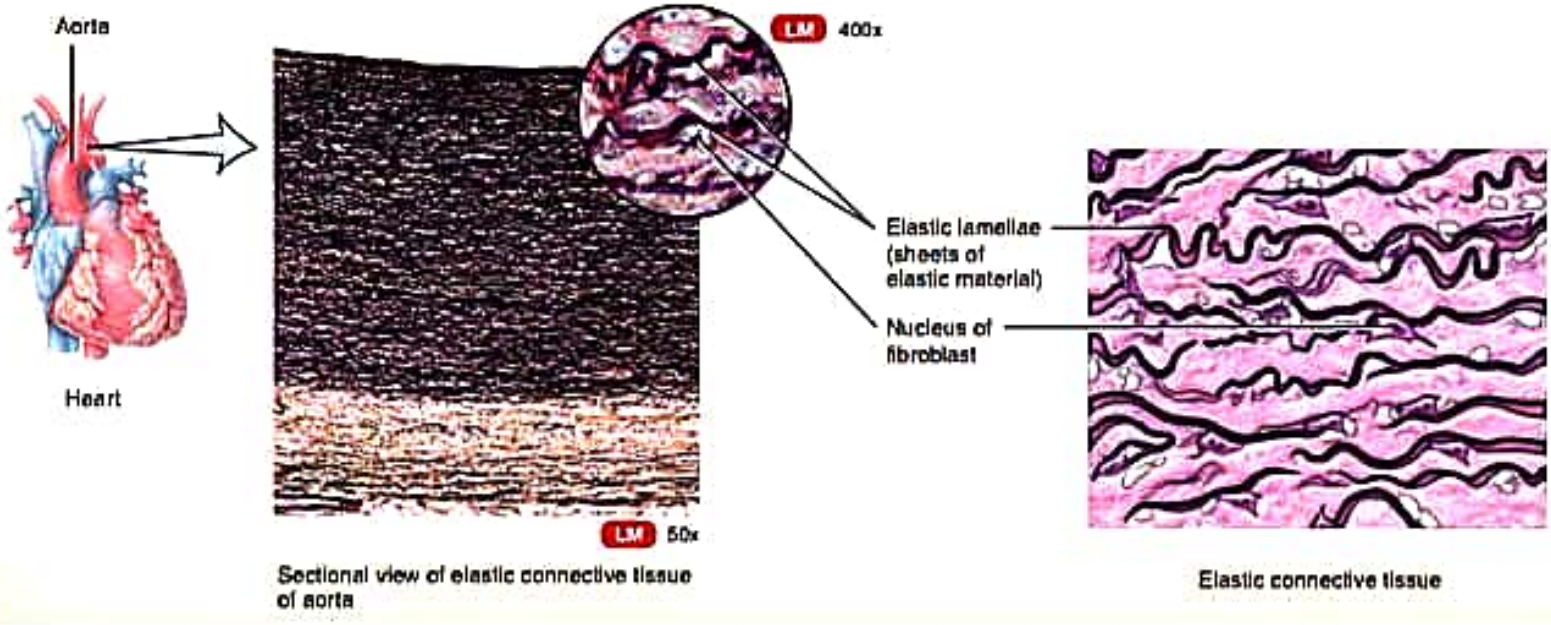
Location: Lung tissue, walls of elastic arteries, trachea, bronchial tubes etc

Function:- allow stretching of Various organs, is Strong and can recoil to original stretched. Important to normal functioning of lung tissue et



Sectional view of dense regular connective tissue of a tendon

Dense regular connective tissue



Sectional view of elastic connective tissue of aorta

Elastic connective tissue

(3) Cartilage :- It consists of dense network of collagen fibers and elastic fibers embedded in gel like component of ground substance.

→ Like other connective Tissue, cartilage has few cells and large extracellular matrix.

→ Cells of mature cartilage called as chondrocytes, occur singly or in groups within spaces called lacunae.

* Hyaline Cartilage :- (Hyalinos - glassy)
contain gel like substance and appears in body as a bluish-white, shiny substance.
Location: Most abundant Cartilage in body, at end of long bones, anterior ends of ribs, nose, parts of Larynx, trachea, bronchi etc
Function :- provide smooth surfaces for movement of Joints, flexibility and support.

* Fibrocartilage: Clearly visible thick bundles of Collagen fibers within extracellular matrix.
Location:- Intervertebral discs, cartilage pads of knee.
Functions:- Support and Joining Structures together, Strength and rigidity make it the Strongest type of cartilage

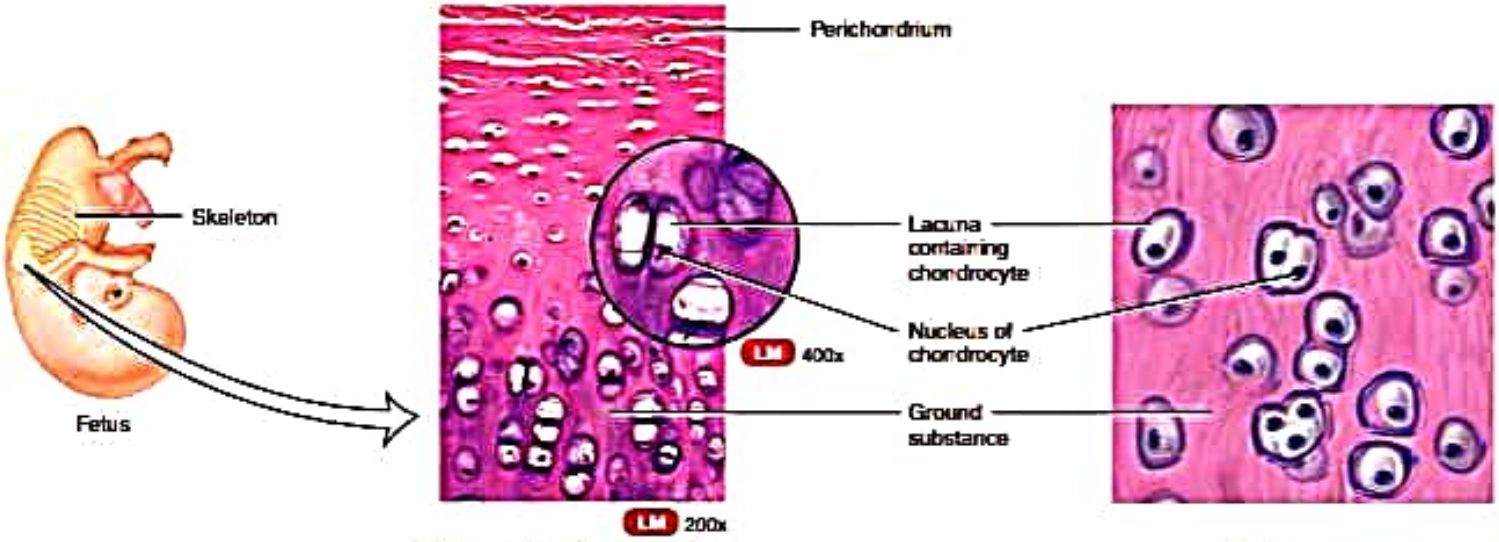
* Elastic Cartilage :- Threadlike network of Elastic fibres within extracellular matrix
Location :- Lid on top of Larynx (epiglottis), part of External Ear.
Fuction:- Provide Strength and Elasticity, maintain Shape of Certain Structures.

A. HYALINE CARTILAGE

Description — **Hyaline cartilage** (*hyalinos* = glassy) contains a resilient gel as ground substance and appears in the body as a bluish-white, shiny substance (can stain pink or purple when prepared for microscopic examination; fine collagen fibers are not visible with ordinary staining techniques); prominent chondrocytes are found in lacunae surrounded by perichondrium (exceptions: articular cartilage in joints and cartilage of epiphyseal plates, where bones lengthen during growth).

Location — Most abundant cartilage in body; at ends of long bones, anterior ends of ribs, nose, parts of larynx, trachea, bronchi, bronchial tubes, embryonic and fetal skeleton.

Function — Provides smooth surfaces for movement at joints, flexibility, and support; weakest type of cartilage and can be fractured.



Sectional view of hyaline cartilage of a developing fetal bone

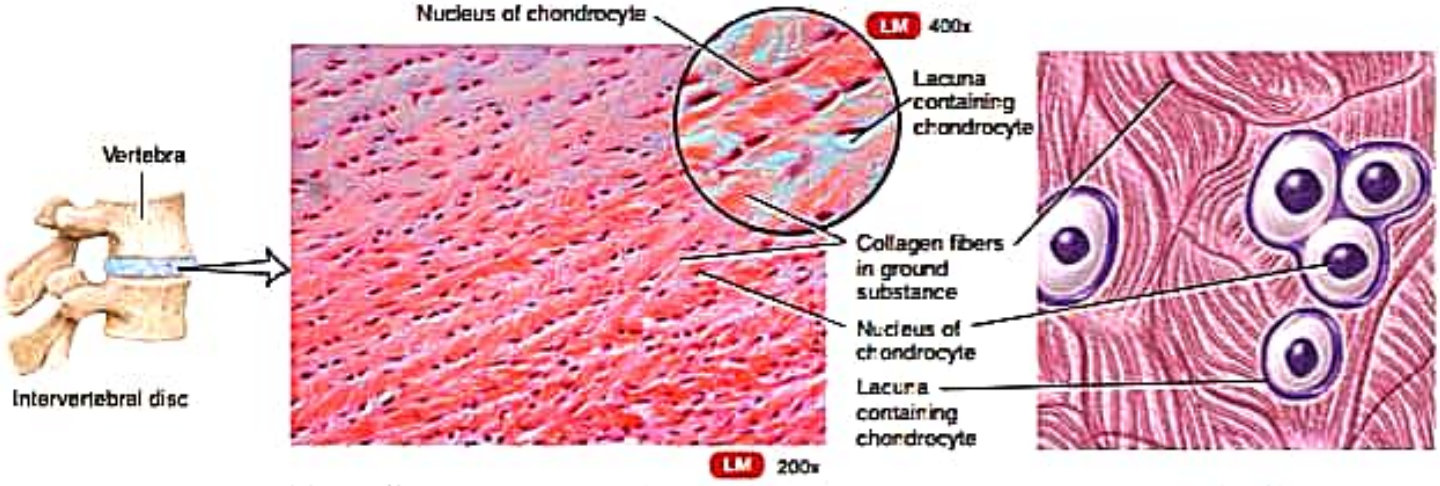
Hyaline cartilage

B. FIBROCARTILAGE

Description **Fibrocartilage** has chondrocytes among clearly visible thick bundles of collagen fibers within extracellular matrix; lacks perichondrium.

Location Pubic symphysis (where hip bones join anteriorly), intervertebral discs, menisci (cartilage pads) of knee, portions of tendons that insert into cartilage.

Function Support and joining structures together. Strength and rigidity make it the strongest type of cartilage.



Sectional view of fibrocartilage of intervertebral disc

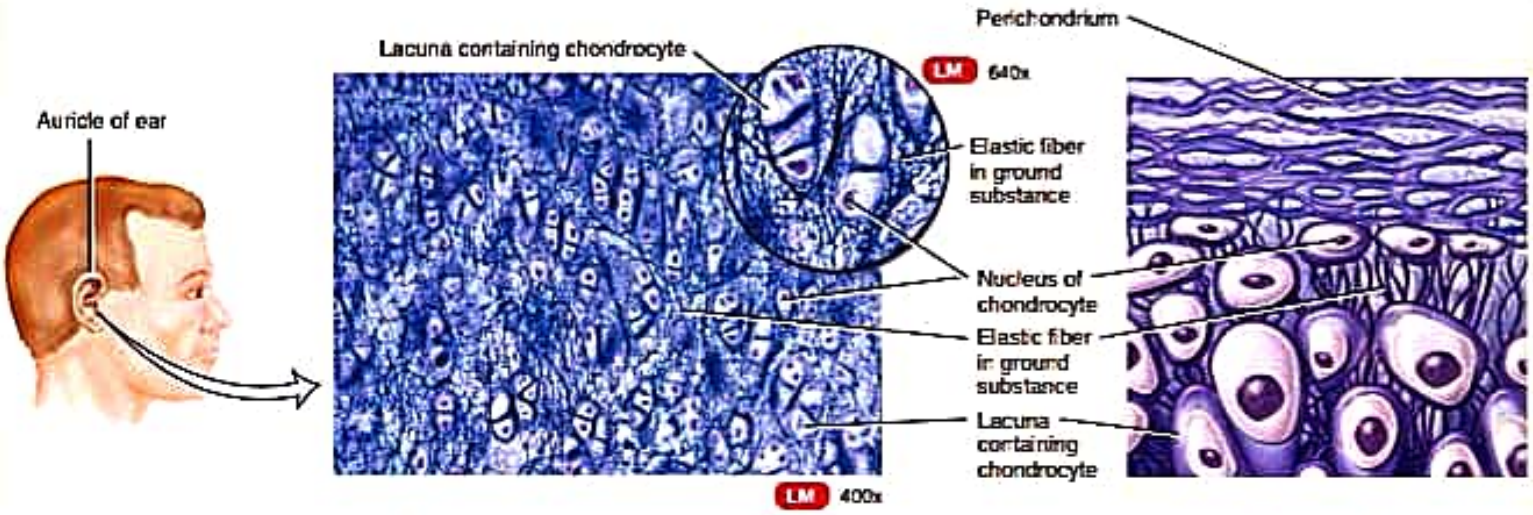
Fibrocartilage

C. ELASTIC CARTILAGE

Description **Elastic cartilage** has chondrocytes in threadlike network of elastic fibers within extracellular matrix; perichondrium present.

Location Lid on top of larynx (epiglottis), part of external ear (auricle), auditory (eustachian) tubes.

Function Provides strength and elasticity; maintains shape of certain structures.



Sectional view of elastic cartilage of auricle of ear

Elastic cartilage

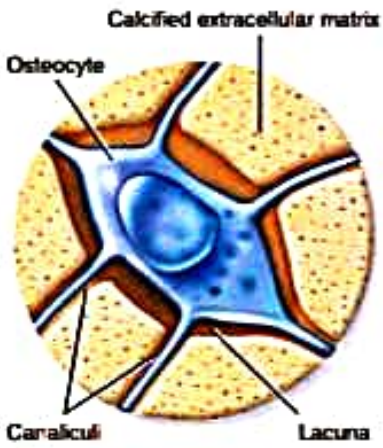
Mature Connective Tissue: Bone Tissue

Description Compact bone tissue consists of osteons (haversian systems) that contain lamellae, lacunae, osteocytes, canaliculi, and central (haversian) canals. By contrast, spongy bone tissue (see Figure 6.3) consists of thin columns called trabeculae; spaces between trabeculae are filled with red bone marrow.

Location Both compact and spongy bone tissue make up the various parts of bones of the body.

Function Support, protection, storage; houses blood-forming tissue; serves as levers that act with muscle tissue to enable movement.

Sectional view of several osteons (haversian systems) of femur (thigh bone)

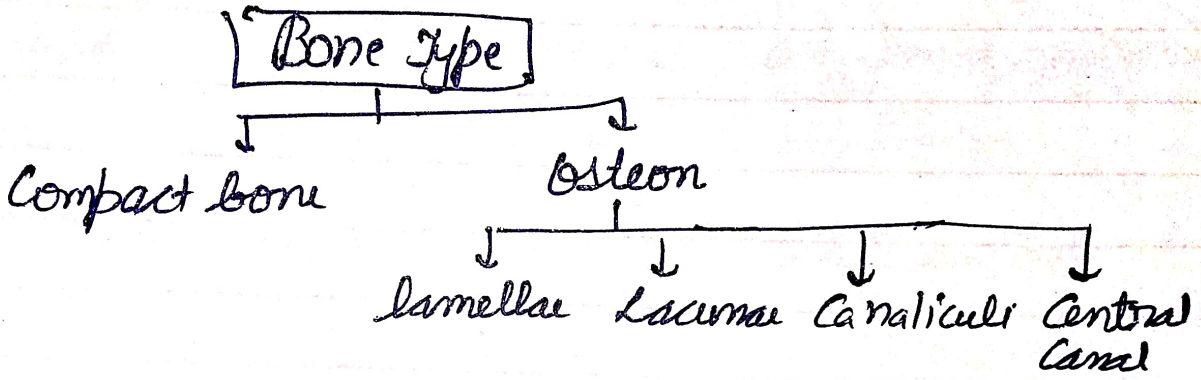


Details of an osteocyte

④ Bone Tissue :-

Bones are organs composed of several different connective tissues.

→ Include Bone, red and yellow bone marrow, etc.



→ Compact Bone tissue consists of osteons that contain lamellae, lacunae, osteocytes, canaliculi and central canals.

Location – Both compact and spongy bone tissue make up various parts of bones of body.

Function :- Support, protection, storage, houses blood forming tissues.

⑤ Liquid Connective Tissue :-

* Blood Tissue :- A liquid connective tissue has a liquid as its extracellular matrix.

* Blood is one of the connective tissues. has a liquid extracellular matrix called Blood Plasma and formed elements.

* Blood Plasma is a Pale yellow fluid that consists mostly of water with variety of dissolved substances - nutrients, wastes, enzymes, plasma proteins, hormones and ions.

* In Blood Plasma, RBC, WBC, Platelets are suspended.

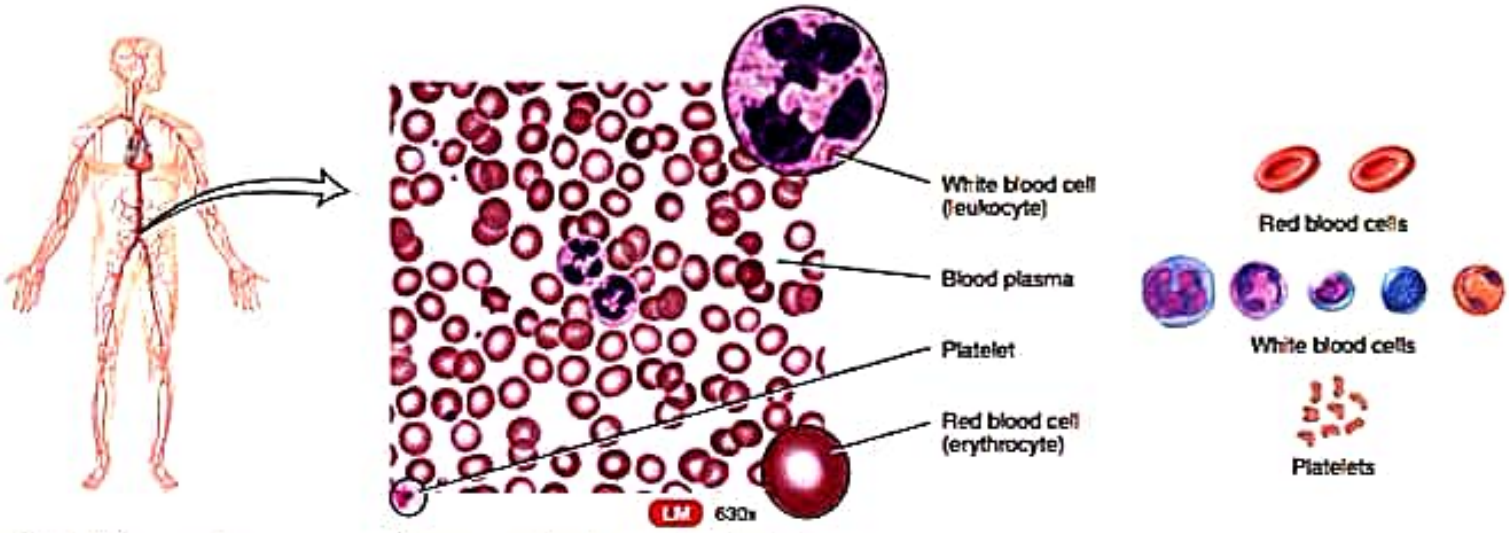
* Lymph:- Extracellular fluid that flows in lymphatic vessels.
→ It consists several types of cells in a clear liquid Extracellular matrix that is similar to blood plasma but with much less protein.

Location - within Blood Vessels, within Chambers of ♡.

Functions:- RBC, transport oxygen and CO_2, WBC, carry on Phagocytosis and mediate allergic reactions.

Mature Connective Tissue: Blood

Description	Blood plasma and formed elements: red blood cells (erythrocytes), white blood cells (leukocytes), platelets (thrombocytes).
Location	Within blood vessels (arteries, arterioles, capillaries, venules, veins), within chambers of heart.
Function	Red blood cells: transport oxygen and some carbon dioxide; white blood cells: carry on phagocytosis and mediate allergic reactions and immune system responses; platelets: essential for blood clotting.



Blood in blood vessels

Blood smear (all enlargements are 1500x)

Muscular Tissue

Muscular tissue consists of Elongated cells called muscle fibers or myocytes that can use ATP to generate force.

→ Muscular tissue produces body movements, maintain posture and generates heat.

→ It provide protection. Based on location and certain structural and functional features, muscular tissue is classified into 3 types.

1. Skeletal muscle
2. Cardiac muscle
3. Smooth muscle

☆ Skeletal Muscle Tissue :

It consist of long, cylindrical, striated fibers, Skeletal muscle fibers vary greatly in length, from a few centimeters in short muscles to 30-40 cm in longest muscles.

Location - Usually attached to bones by tendons.

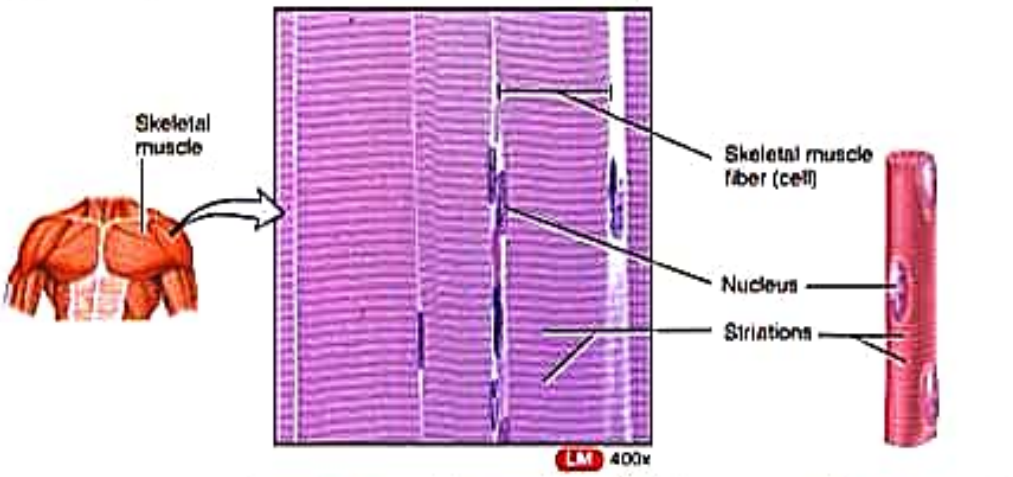
Function - Motion, posture, heat production, protection

A. SKELETAL MUSCLE TISSUE

Description **Skeletal muscle tissue** consists of long, cylindrical, striated fibers (*striations* are alternating light and dark bands within fibers that are visible under a light microscope). Skeletal muscle fibers vary greatly in length, from a few centimeters in short muscles to 30–40 cm (about 12–16 in.) in the longest muscles. A muscle fiber is a roughly cylindrical, multinucleated cell with nuclei at the periphery. Skeletal muscle is considered *voluntary* because it can be made to contract or relax by conscious control.

Location Usually attached to bones by tendons.

Function Motion, posture, heat production, protection.



Longitudinal section of skeletal muscle tissue

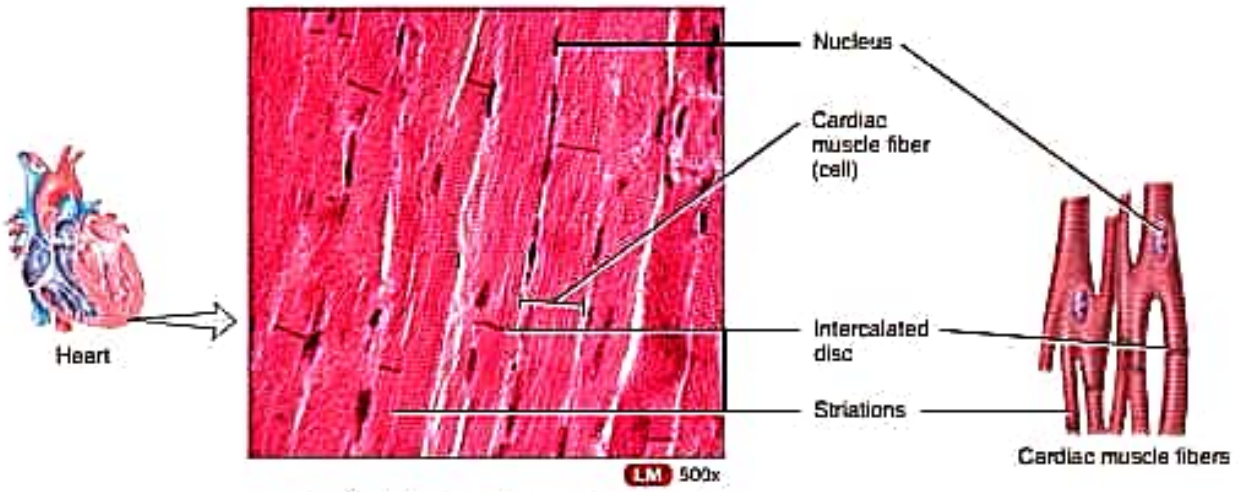
Skeletal muscle fiber

B. CARDIAC MUSCLE TISSUE

Description **Cardiac muscle tissue** consists of branched, striated fibers with usually only one centrally located nucleus (occasionally two). Attach end to end by transverse thickenings of plasma membrane called *intercalated discs* (in-TER-ka-lāt-ed; *intercalate* = to insert between), which contain desmosomes and gap junctions. Desmosomes strengthen tissue and hold fibers together during vigorous contractions. Gap junctions provide route for quick conduction of electrical signals (muscle action potentials) throughout heart. *Involuntary* (not conscious) control.

Location Heart wall.

Function Pumps blood to all parts of body.



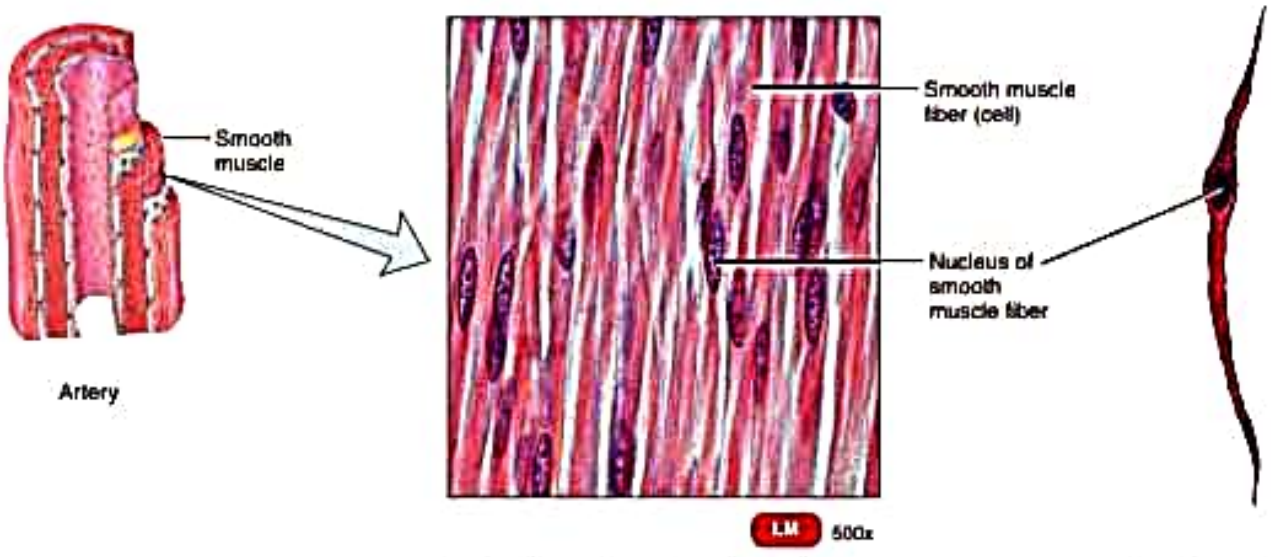
Longitudinal section of cardiac muscle tissue

C. SMOOTH MUSCLE TISSUE

Description **Smooth muscle tissue** consists of fibers usually *involuntary*, nonstriated (lack striations, hence the term *smooth*). Smooth muscle fiber is a small spindle-shaped cell thickest in middle, tapering at each end, and containing a single, centrally located nucleus. Gap junctions connect many individual fibers in some smooth muscle tissue (for example, in wall of intestines). Can produce powerful contractions as many muscle fibers contract in unison. Where gap junctions are absent, such as iris of eye, smooth muscle fibers contract individually, like skeletal muscle fibers.

Location Iris of eyes; walls of hollow internal structures such as blood vessels, airways to lungs, stomach, intestines, gallbladder, urinary bladder, and uterus.

Function Motion (constriction of blood vessels and airways, propulsion of foods through gastrointestinal tract, contraction of urinary bladder and gallbladder).



✡ Cardiac Muscular Tissue:

It is consist of branched, Striated fibers with usually only one centrally located nucleus.

Location - Heart wall

Function - Pumps blood to all the parts of Body.

✡ Smooth Muscle Tissue:

Consists of fibers usually involuntary, nonstriated. Smooth muscle ~~fiber~~ ~~fibre~~ fiber is a small-spindle shaped cell thickest in middle, tapering at each end and containing a single, centrally located nucleus.

Located:- Iris of Eyes, walls of hollow internal structures suchas blood vessels, airways of lungs, Stomach, intestines, gall bladder, urinary bladder and uterus.

Function: Motion.

Nervous Tissue

Nervous tissue consist of only 2 principal types of Cells. → Neurons
→ Neuroglia

→ Neurons or nerve cells are sensitive to various stimuli.

→ The convert stimuli into electrical signals called nerve action Potentials. and conduct these action potentials to other neurons, to muscle tissue, or to glands..

☆ Most neurons Consist of 3 Basics parts:.

- Cell Body
- Dendrites
- axons

→ Cell body contains the nucleus and other organelles.

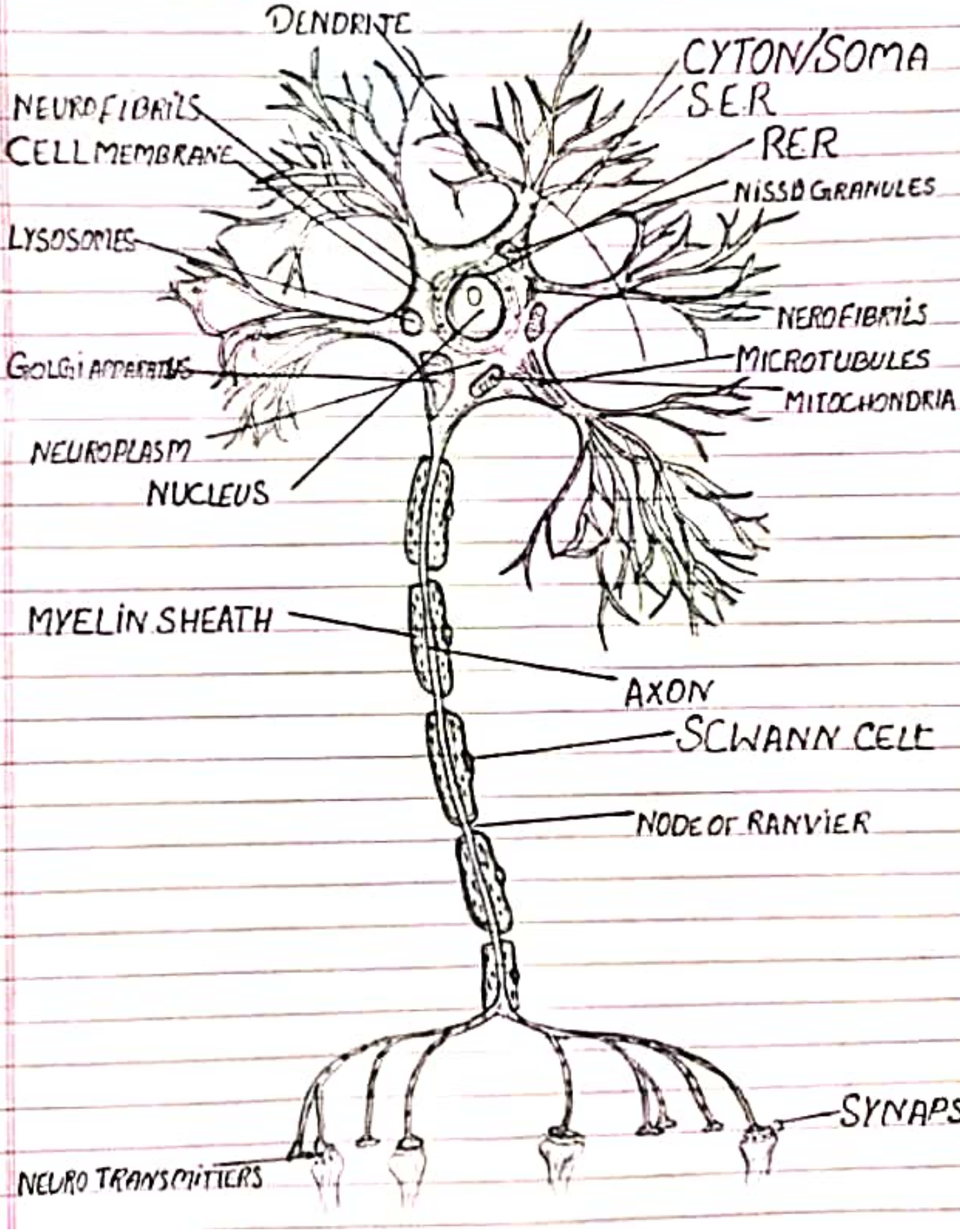
→ Dendrites - are highly Branched and usually short Cell processes.

↳ They are major recieving or input portions of neuron.

→ Axon - , It is a single, thin, cylindrical process that may be very long.. It is the output portion of neuron.

☆ Neuroglia - It do not generate or conduct nerve Impulses, these cells do have many important supportive functions.

NEURON

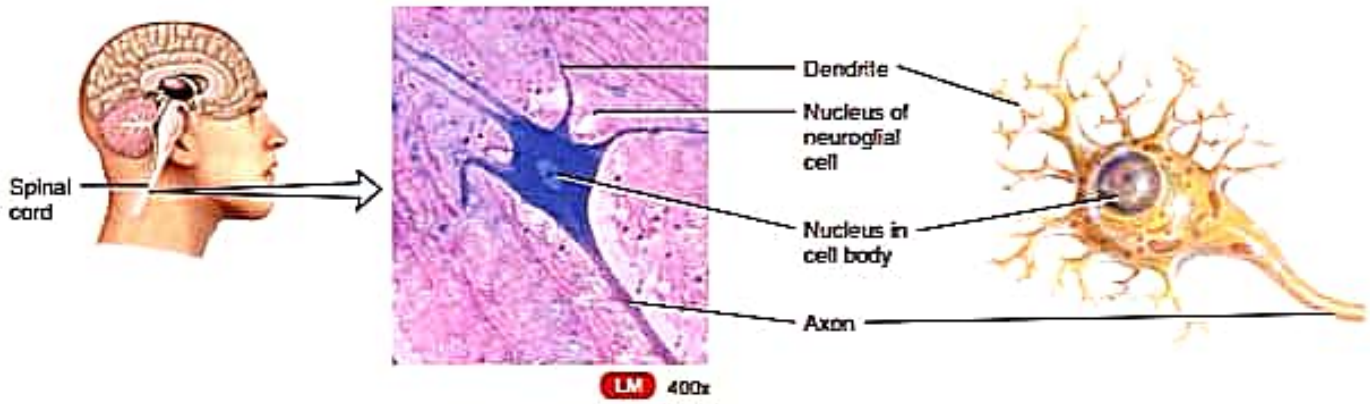

DENDRITE
CYTON/SOMA
S.E.R
RER
NISSB GRANULES
NEUROFIBRILS
CELL MEMBRANE
LYSOSOMES
NEROFIBRILS
MICROTUBULES
MITOCHONDRIA
GOLGI APPARATUS
NEUROPLASM
NUCLEUS
MYELIN SHEATH
AXON
SCWANN CELL
NODE OF RANVIER
SYNAPSE
NEURO TRANSMITTERS

Nervous Tissue

Description **Nervous tissue** consists of (1) Neurons (nerve cells), which consist of cell body and processes extending from cell body (one to multiple dendrites and a single axon); and (2) neuroglia, which do not generate or conduct nerve impulses but have other important supporting functions.

Location Nervous system.

Function Exhibits sensitivity to various types of stimuli; converts stimuli into nerve impulses (action potentials); conducts nerve impulses to other neurons, muscle fibers, or glands.



Neuron of spinal cord