HISTOLOGY

Basic tissues

Living organisms can be classified into tow organisms the unicellular and multicellular and the multicellular regarded as complex group composed of variable cells and organs collected together to form the systems with different functions and multicellular(large)organisms function more efficiently if cells become specialized for specific functions.

A tissue is composed of cells or a group of cells that function together in a specialized activity for the performance of a common function Histology (Gr. *histo,* web or tissue, + *logos,* study) is the study of the tissues of the body and of how these tissues are arranged to constitute organs. Four fundamental tissues are recognized: epithelial tissue, connective tissue, muscular tissue, and nervous tissue.

Tissues are made of cells and extracellular matrix, two components that were formerly considered separate entities. The main functions formerly attributed to the extracellular matrix were to furnish mechanical support for the cells, to transport nutrients to the cells, and to carry away catabolites and secretory products.

There are four types of tissues found in a multicellular animal.

Table 4–1. Main Characteristics of the Four Basic Types of Tissues.

Tissue	Cells	Extracellular Matrix	Main Functions
Nervous	Intertwining elongated processes	None	Transmission of nervous impulses
Epithelial	Aggregated polyhedral cells	Very small amount	Lining of surface or body cavities, glandular secretion
Muscle	Elongated contractile cells	Moderate amount	Movement
Connective	Several types of fixed and wandering cells	Abundant amount	Support and protection

1. Epithelial tissues:

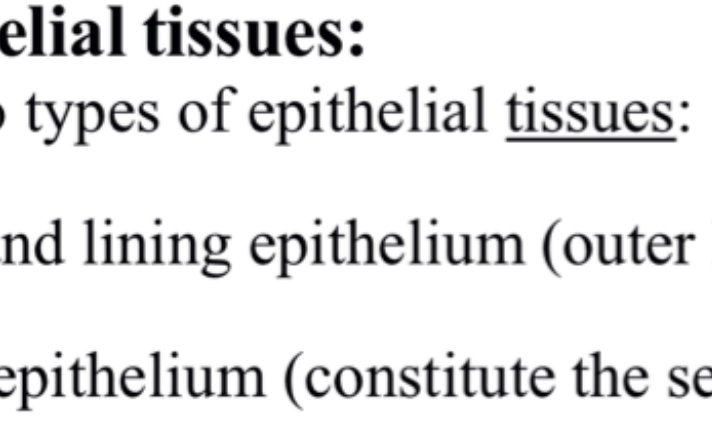
There are two types of epithelial tissues:

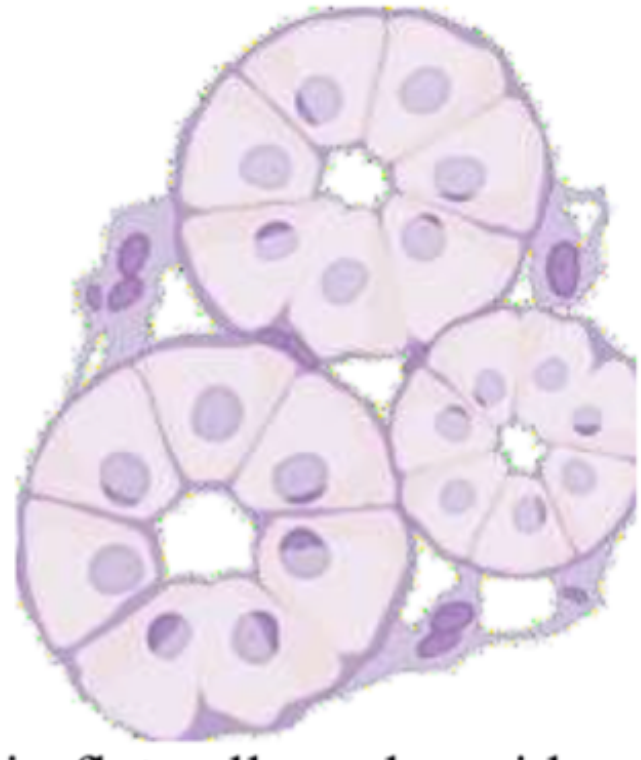
1. Covering and lining epithelium (outer layer of the skin and some organs) .

2. Glandular epithelium (constitute the secreting portion of glands) .

There are two types of epithelial tissues according to the number of layers:

1- Simple epithelial tissues and this classified according to cell shape to:



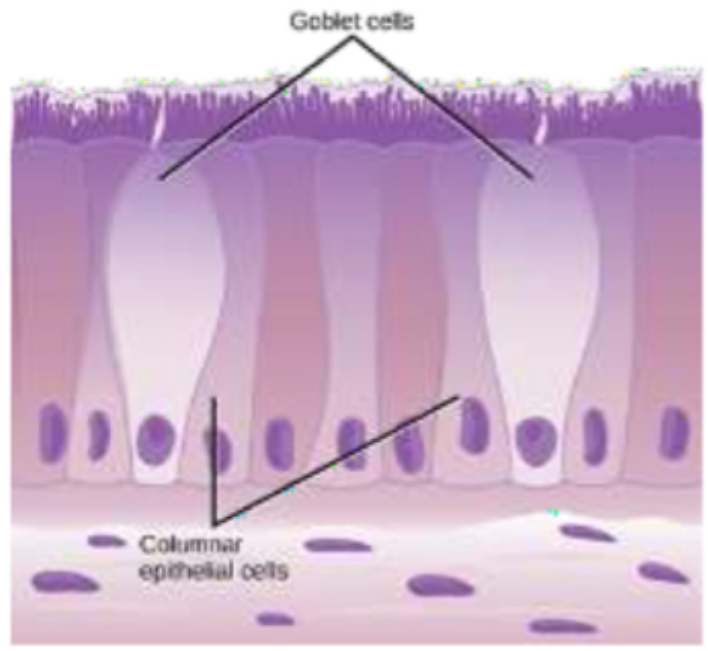


a- Simple Squamous epithelial tissue with thin flat cells and ovoid nucleus.

b- Simple Cuboidal epithelial tissues ,cells are roughly square ,spherical nucleus

c- Simple columnar epithelial , elongated ,tall cells,with elongated nucleus .

The goblet cells distribute between the columnar cells. Each cell in this tissue end with cilia on free surface.



The following types of **epithelial tissues** are covered in this activity:

1. Simple squamous epithelial tissue (lungs)
2. Simple cuboidal epithelial tissue (kidneys)
3. Simple columnar epithelial tissue
   a. Ciliated (bronchioles)
   b. Non Ciliated (digestive tract)
4. Pseudostratified columnar epithelial tissue
   a. Ciliated (trachea lining)
   b. Non Ciliated (male reproductive tract)
5. Stratified squamous epithelial tissue
   a. Keritinized (skin)
   b. Non Keritinized (oral cavity)
6. Stratified cuboidal epithelial tissue (salivary glands, sweat glands)
7. Stratified columnar epithelial tissue (male reproductive tract)

8 Transitional epithelial tissue (bladder)

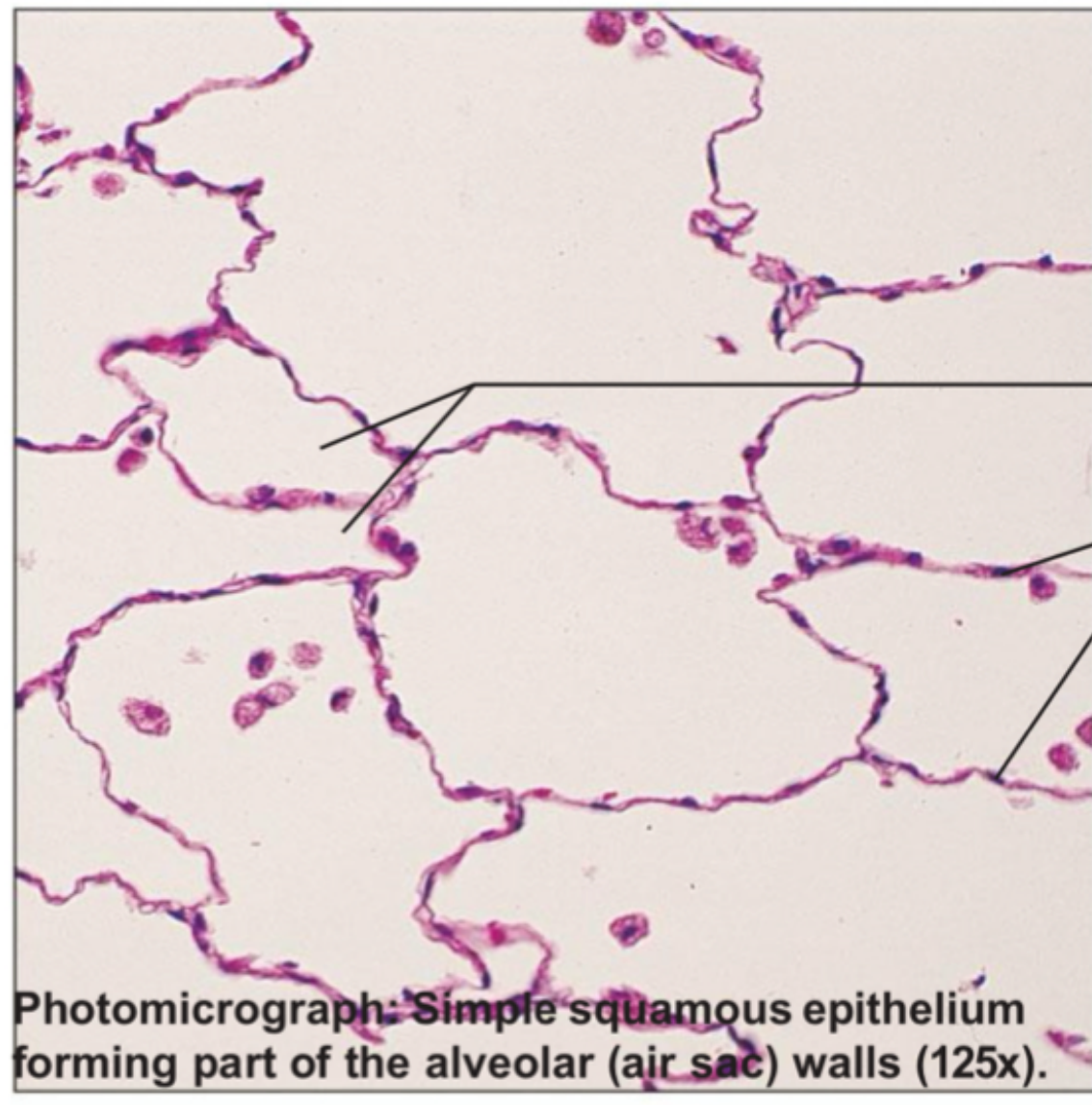
   a. Relaxed (empty bladder)
   b. Stretched (full bladder)

(a) Simple squamous epithelium

Description: Single layer of flattened cells with disc-shaped central nuclei

Function: diffusion and filtration in sites where protection is not important;

Location: Kidney glomeruli; air sacs of lungs; lining of heart, blood vessels, and lymphatic vessels; lining of ventral body cavity (.



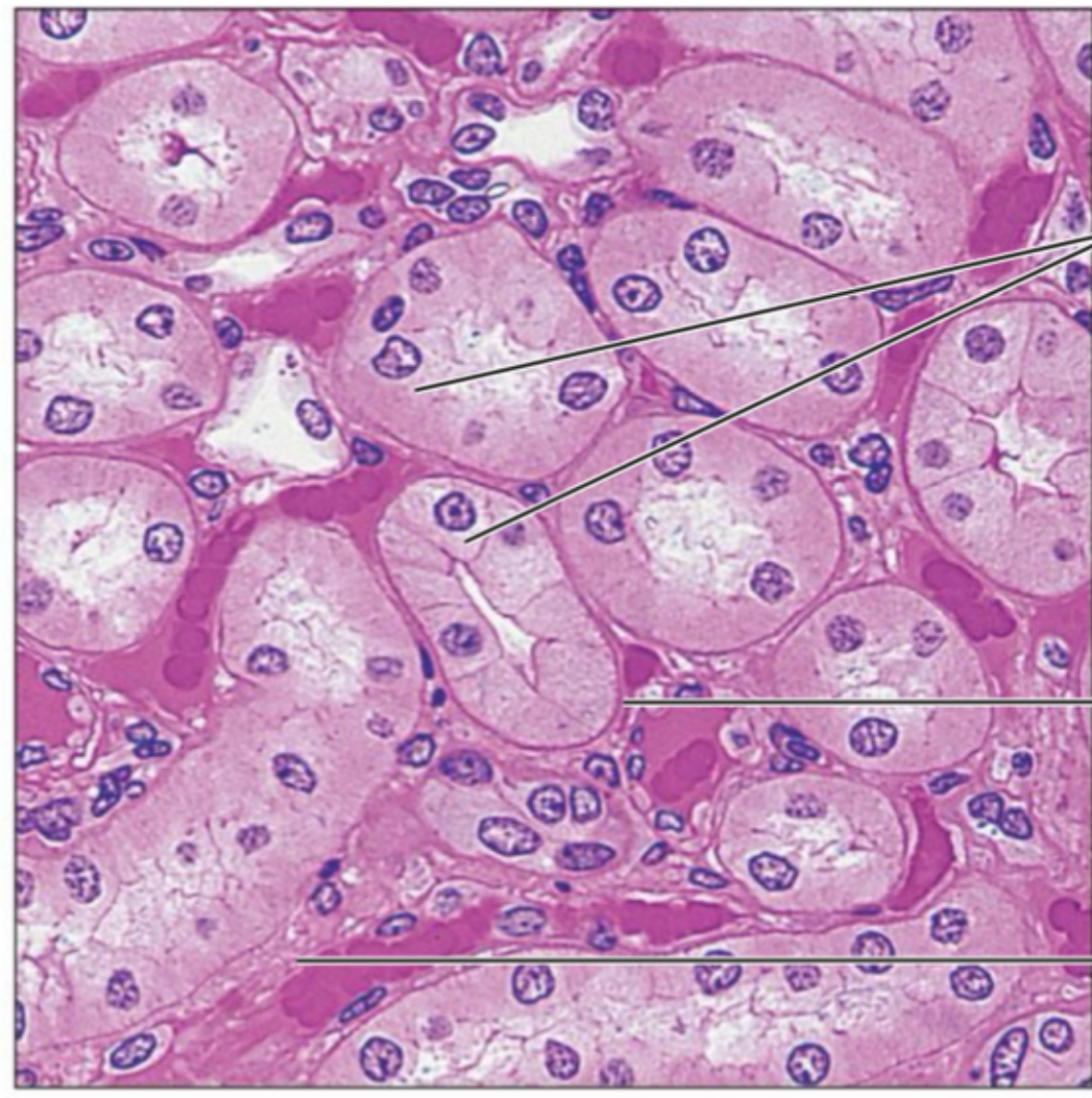
Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (125x).

(b) Simple cuboidal epithelium

Description: Single layer of cubelike cells with large, spherical central nuclei.

Function: Secretion and absorption.

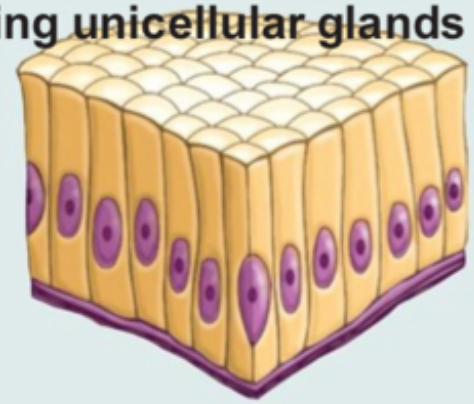
Location: Kidney tubules; ducts and secretory portions of small glands; ovary surface.



Photomicrograph: Simple cuboidal epithelium in kidney tubules (430x).

(c) Simple columnar epithelium

Description: Single layer of tall cells with *round* to *oval* nuclei; some cells bear cilia; layer may contain mucus-secreting unicellular glands (goblet cells).

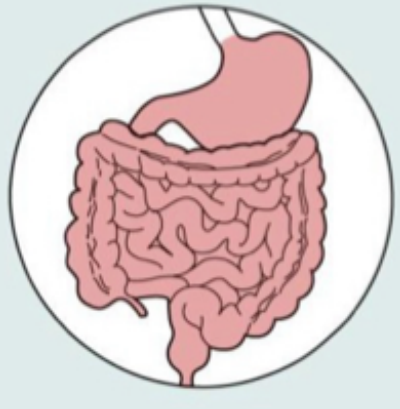


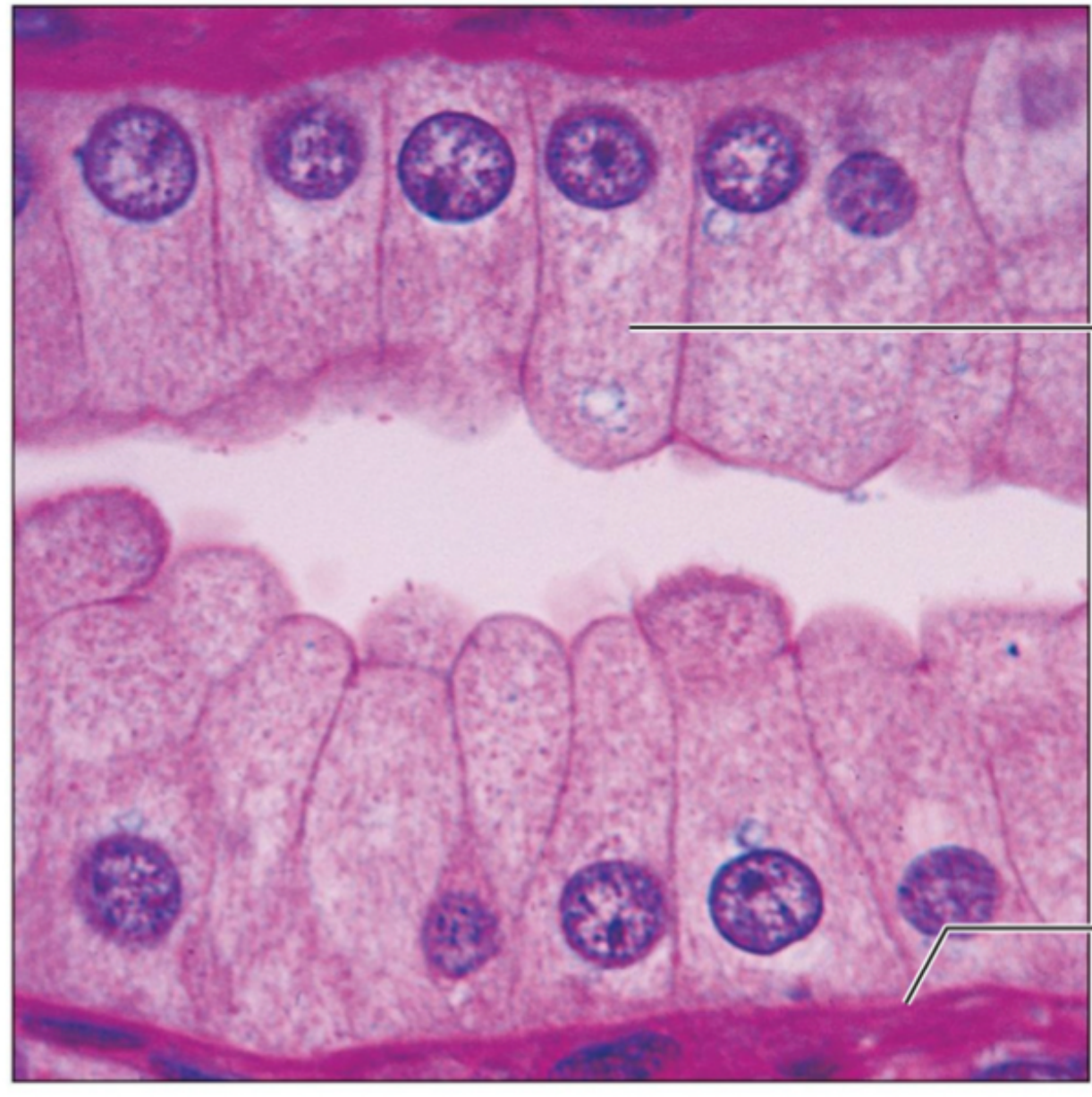
Function: Absorption; secretion of mucus, enzymes, and other substances;

Location: Nonciliated type lines most of the digestive tract

ciliated variety lines small bronchi, Fallopian tube

uterine tubes, and some regions of the uterus.

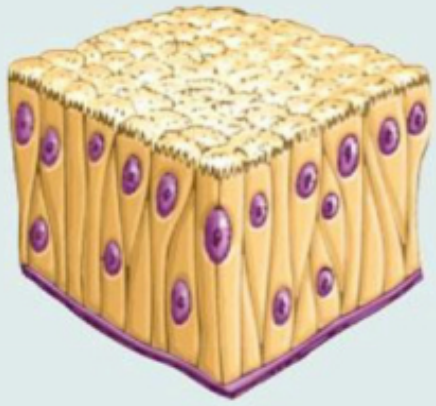




Photomicrograph: Simple columnar epithelium of the stomach mucosa (860X).

(d) Pseudostratified columnar epithelium

Description: Single layer of cells of differing heights, some not reaching the free surface; nuclei seen at different levels; may contain mucus-secreting cells and bear cilia.

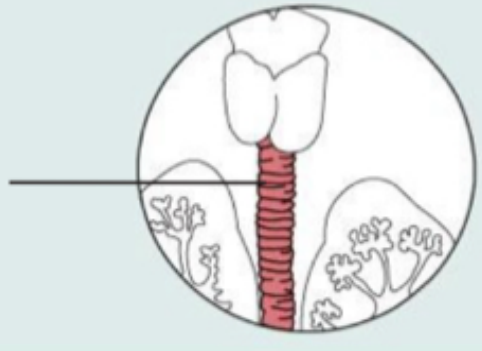


Function: Secretion,

Location: Nonciliated type in ducts of large glands;

ciliated variety lines the trachea, most of the upper respiratory tract.

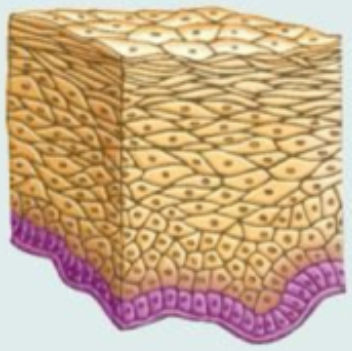
Trache a



Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (570x).

(e) Stratified squamous epithelium

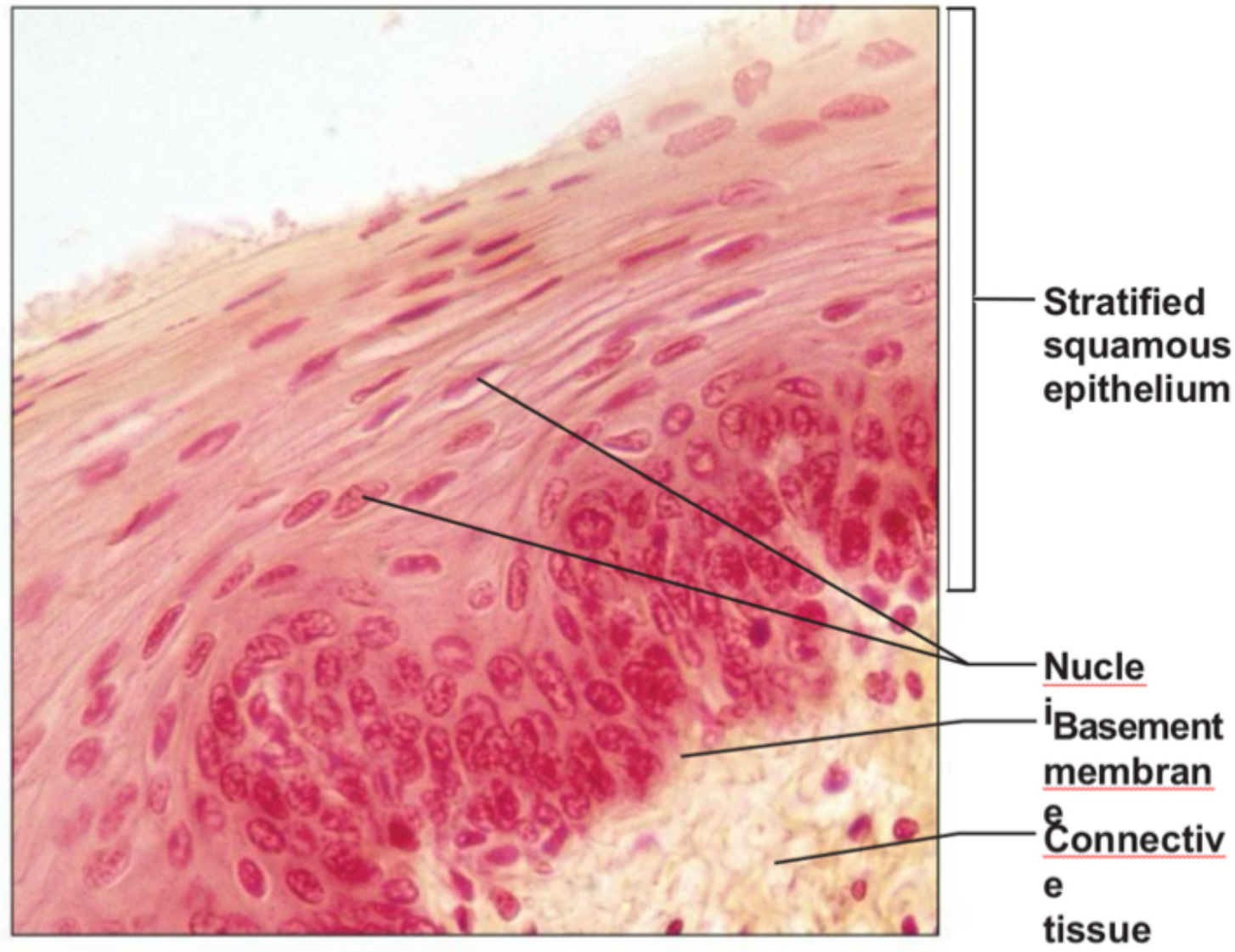
Description: Thick membrane composed of several cell layers; basal cells are cuboidal or columnar surface cells are flattened (squamous);



Function: Protects underlying tissues in areas subjected to abrasion.

Location: Nonkeratinized type forms the moist linings of the esophagus, mouth, and vagina;

keratinized variety forms the epidermis of the skin



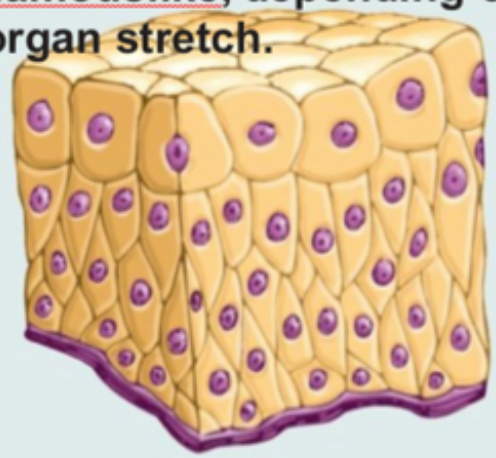
Photomicrograph: Stratified squamous epithelium lining the esophagus (285x).

(f) Transitional epithelium

Description: is similar to

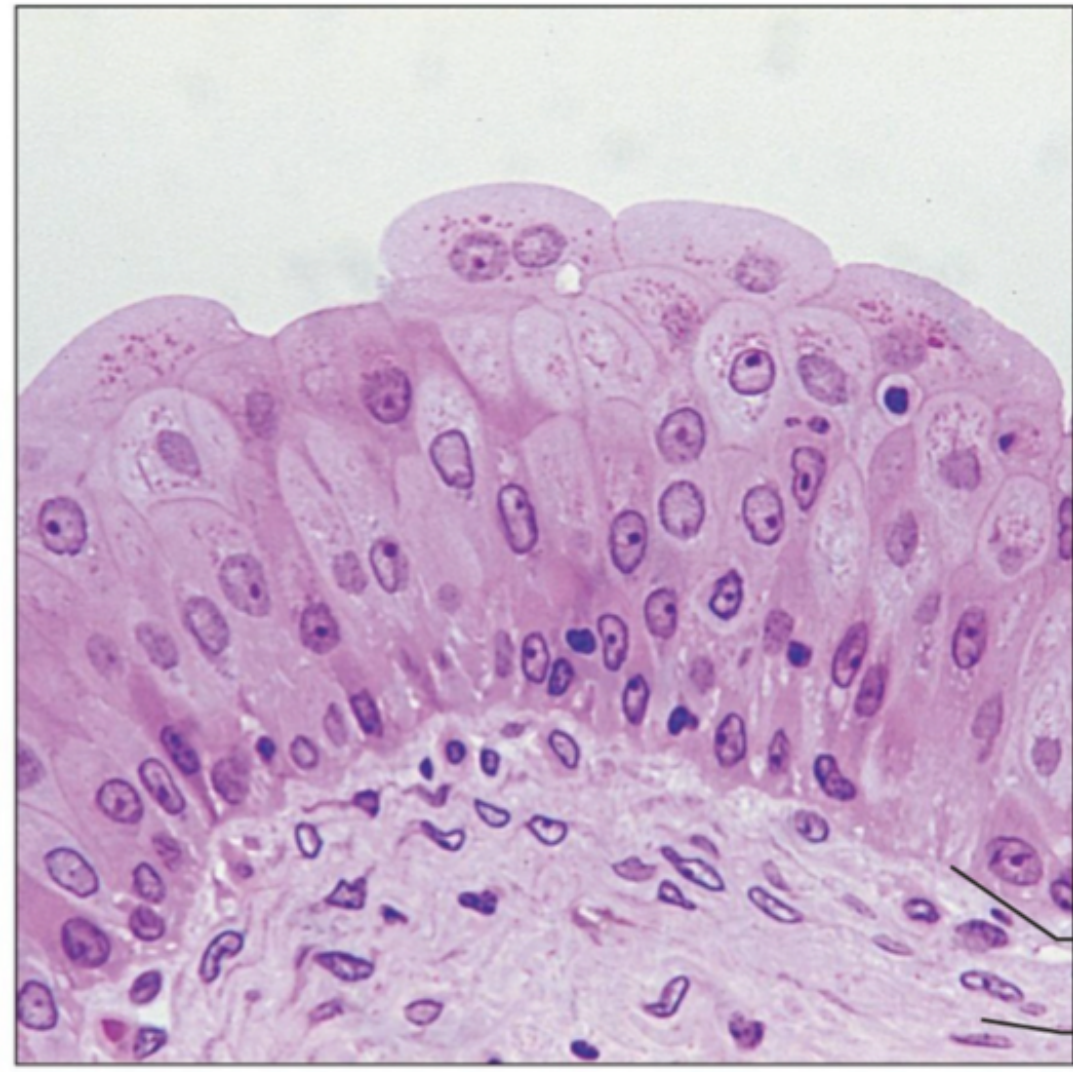
both stratified squamous and stratified cuboidal;

basal cells cuboidal or columnar; surface cells dome shaped or squamouslike, depending on degree of organ stretch.



Function: Stretches readily and permits distension of urinary organ by contained urine.

Location: Lines the ureters, urinary bladder, and part of the urethra.

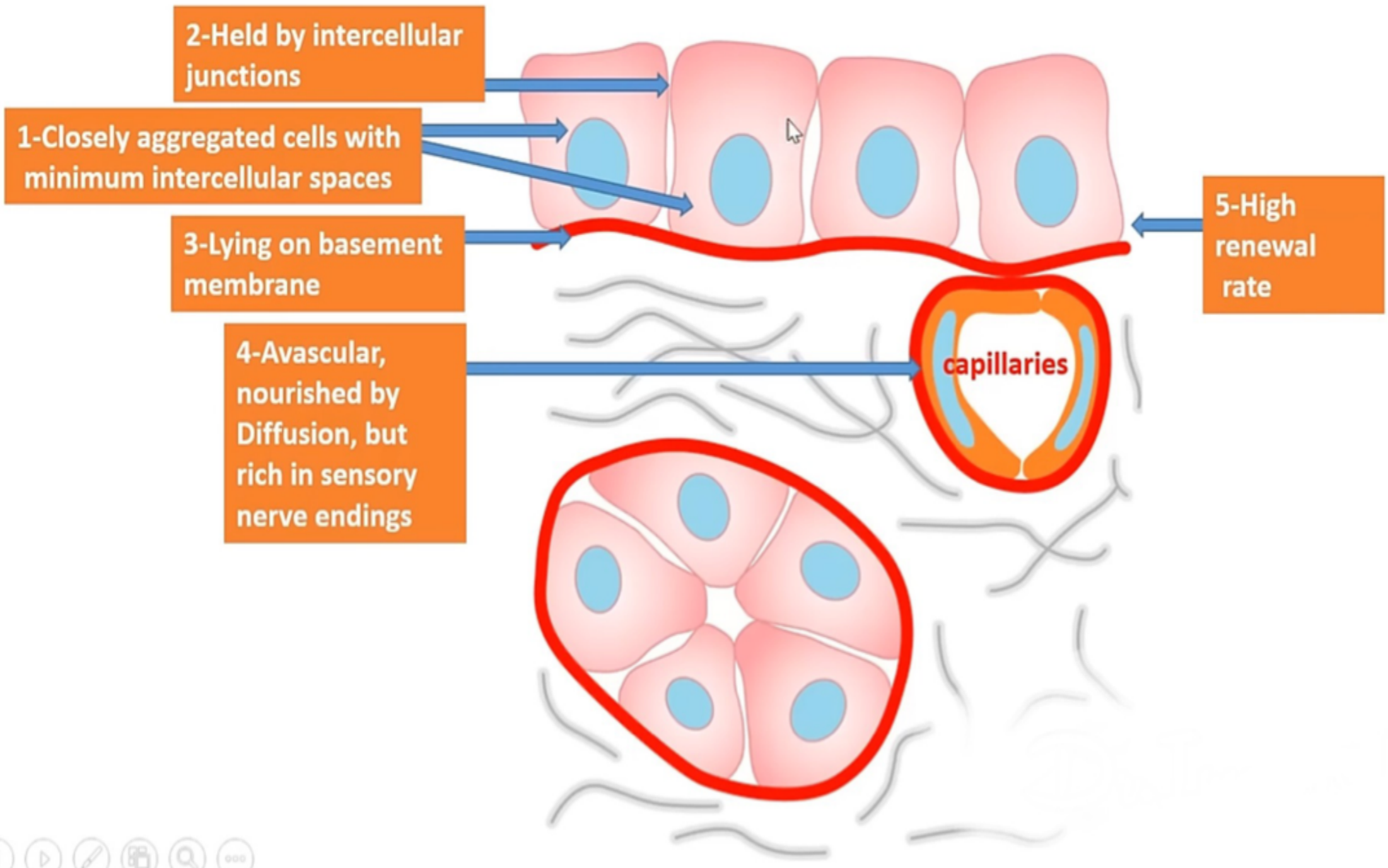


Photomicrograph: Transitional epithelium lining the urinary bladder, relaxed state (360X); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine

Functions of Epithelial Tissue

- **Protection**
  - Skin protects from sunlight & bacteria & physical damage.
- **Absorption**
  - Lining of small intestine, absorbing nutrients into blood
- **Filtration**
  - Lining of Kidney tubules filtering wastes from blood plasma
- **Secretion**
  - Different glands produce perspiration, oil, digestive enzymes an

Characteristics of epithelium



- 1. Microvilli:
- Finger-like projections of the apical plasma membrane found in epithelial cells, especially in the small intestine and kidneys. Their main function is to increase surface area to enhance absorption or secretion of small molecules.

- 2. Cilia:
- Whip-like, motile extensions of the apical surface of epithelial cells. They move in coordinated wave-like motions to help transport substances (like mucus) across the epithelial surface, such as in the respiratory tract.

The Basal Lamina

- Noncellular supporting sheet between the epithelium and the connective tissue deep to it

- Consists of proteins secreted by the epithelial cells

- Functions:

- Acts as a selective filter, determining which molecules from capillaries enter the epithelium

- Basal lamina and reticular layers of the underlying connective tissue deep to it form the basement membrane

- Glandular epithelium is a specialized epithelial tissue composed of cells that produce and release secretions. These secretions are usually stored in membrane-bound vesicles called secretory granules before being released.

Functions of glandular epithelial cells:

: Synthesize → Store → Secrete

- Secretions of Glandular Epithelia
- • Proteins (e.g., pancreas)
- • Lipids (e.g., adrenal, sebaceous glands)
- • Complexes of carbohydrates and proteins (e.g., salivary glands)
- • All three substances (mammary glands)
- • Low synthesizing activity cells (e.g., sweat glands)
  → secrete mostly substances transferred from the blood to the lumen of the gland

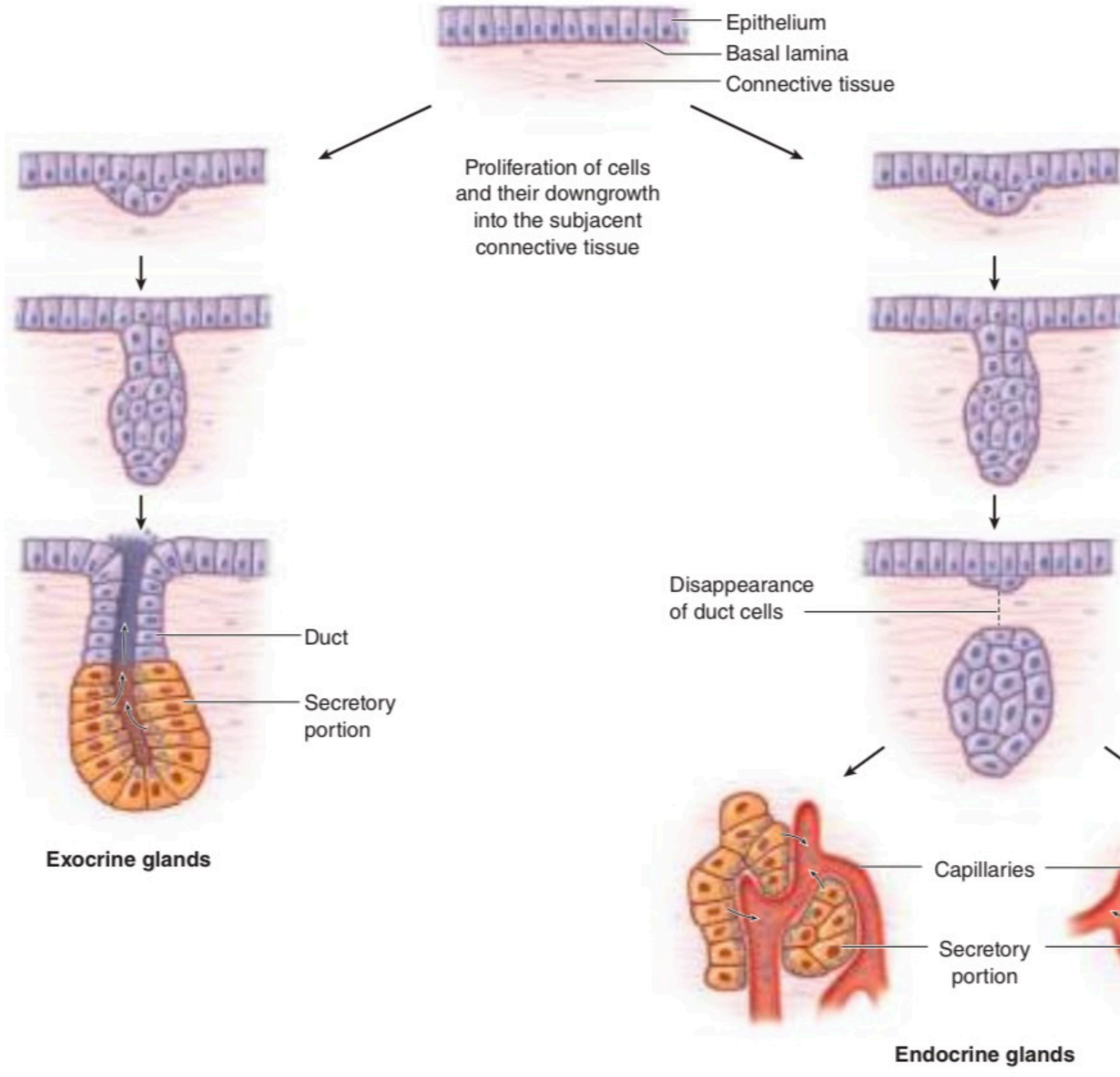
- Classification of Glandular Epithelium
- 1. Unicellular glands
- • Example: Goblet cell
- 2. Multicellular glands
- • Examples: Salivary glands, Pancreas

- Exocrine glands
- Have ducts connecting to surface.
- Secrete substances through ducts.
- Example: Salivary glands, Sweat glands, Exocrine pancreas
- Endocrine glands
- Ductless (lose connection to surface).
- Secrete hormones directly into bloodstream.
- Example: Thyroid, Adrenal glands, Pituitary

Key point:

- Exocrine → ducts → surface
- Endocrine → no ducts → blood

FIGURE **4–19** **Formation of glands from covering epithelia.**



CONNECTIVE TISSUE

INTRODUCTION

Connective tissue is one which gives structural and metabolic support to the organ and other tissue of the body

CONNECTIVE TISSUE

- ***GENERAL FEATURES***

- **1. Cells**
  2. Matrix
  -Fibers
  -Ground substance

Cells of Connective Tissue

- **A. Fixed cells (intrinsic cells)**
  1. **Fibroblast**
  2. **Mesenchymal cells**
  3 **Macrophage(histiocyte)**
  4. **Adipocyte**
- **B. Free cells (extrinsic cells)**
  5. **Mast cell**
  6. **Plasma cells**
  7. **Leucocytes**

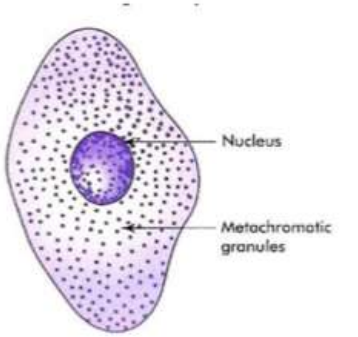


Fig. 4.6 Mast cell

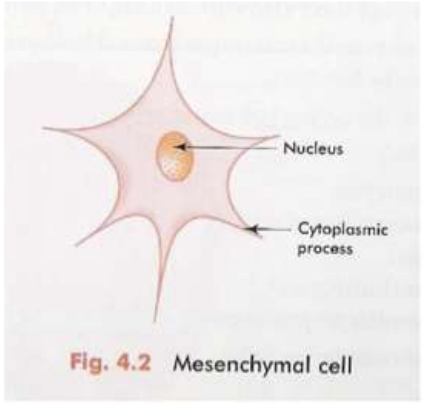


Fig. 4.2 Mesenchymal cell

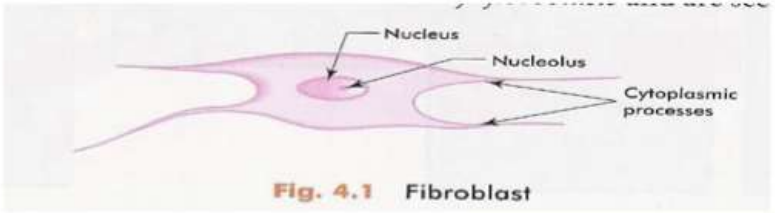
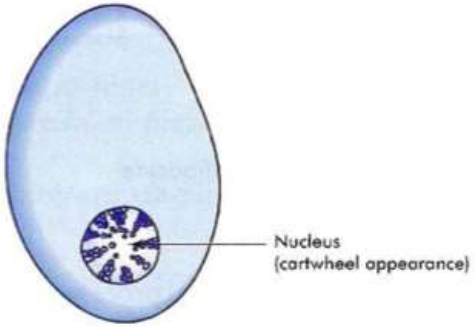
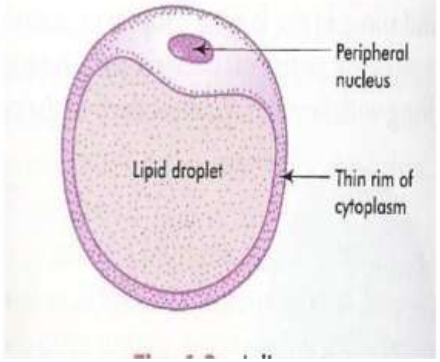


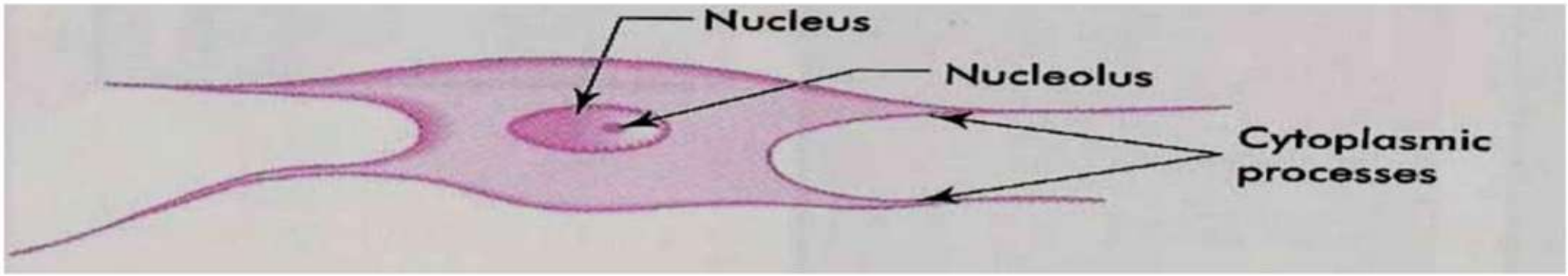
Fig. 4.1 Fibroblast

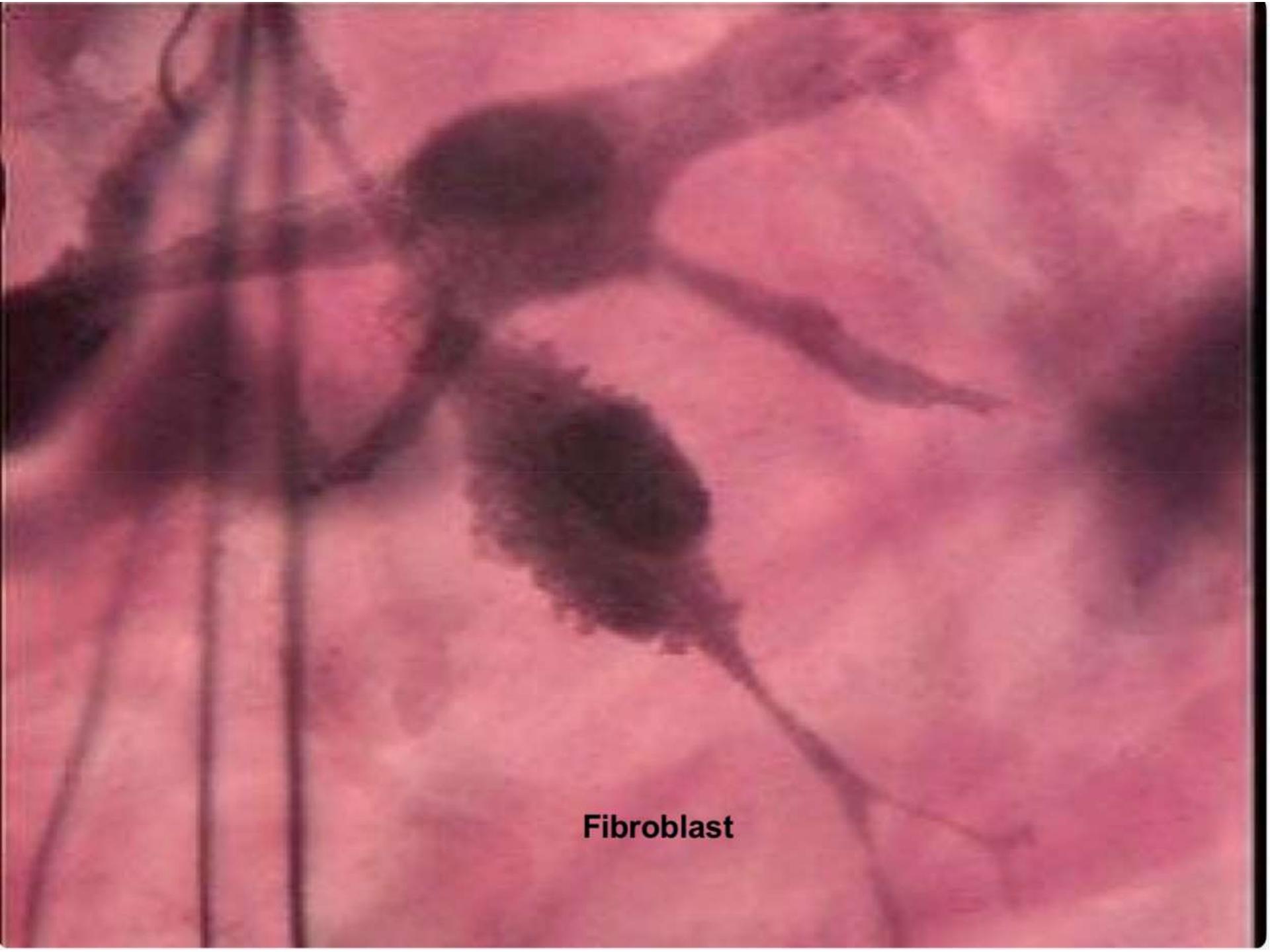




Fibroblast

- Most commonly seen
- Fusiform with slender cytoplasmic process
- Large oval nucleus,
- Responsible for production of fiber production
- Old cells are fibrocyte,
- Contractile Cells are myofibroblast




Fibroblast

Mesenchymal cells

- Undifferentiated cells
- Stellate in shape,
- Cytoplasmic process,
- Near blood vessels as Advential cell

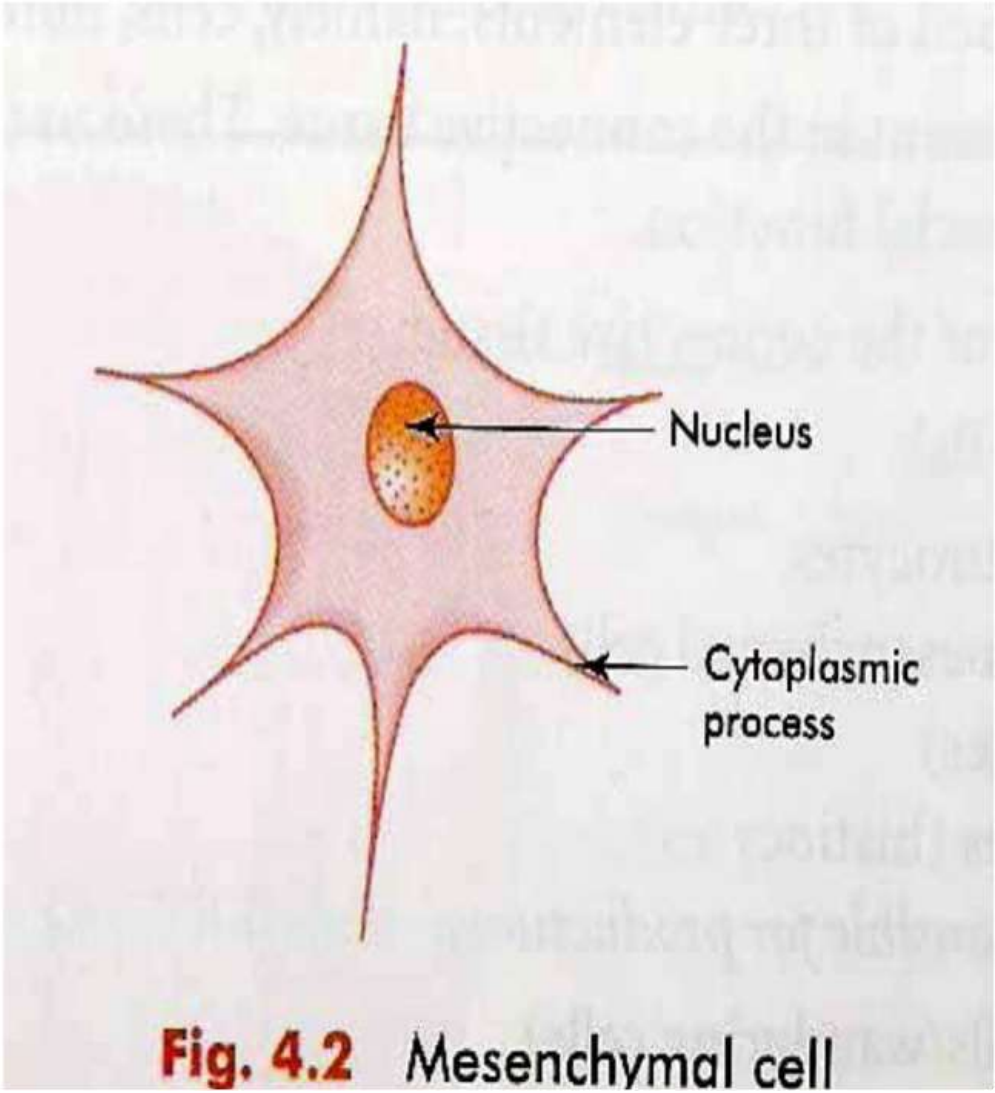


Fig. 4.2 Mesenchymal cell

Macrophages (Histiocytes)

- Free and Fixed type,
- Fixed Cells-
- Irregular Shape
- filopodia process,
- Derived from monocyte
- Involved in phagocytosis
- Fused to form giant cell.
- Free Cells- rounded, no filopodia

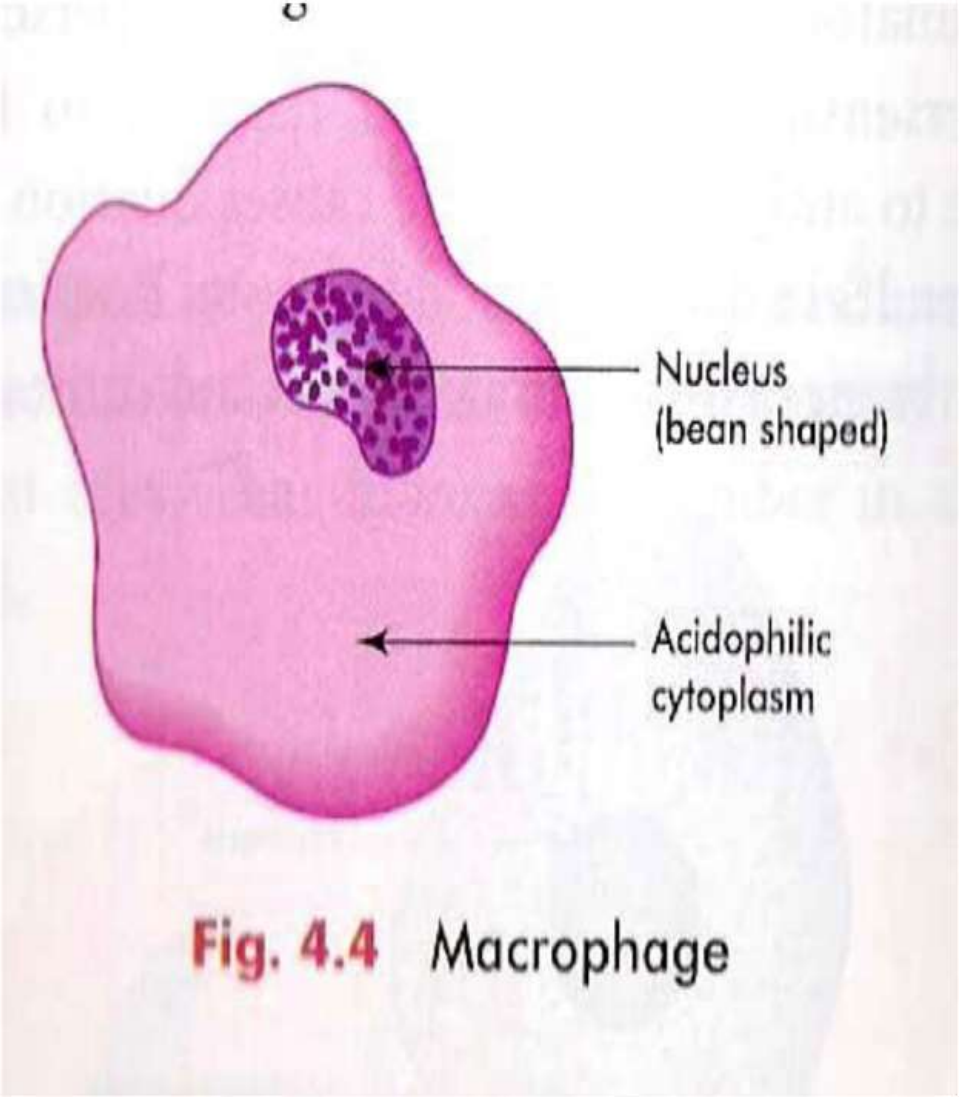
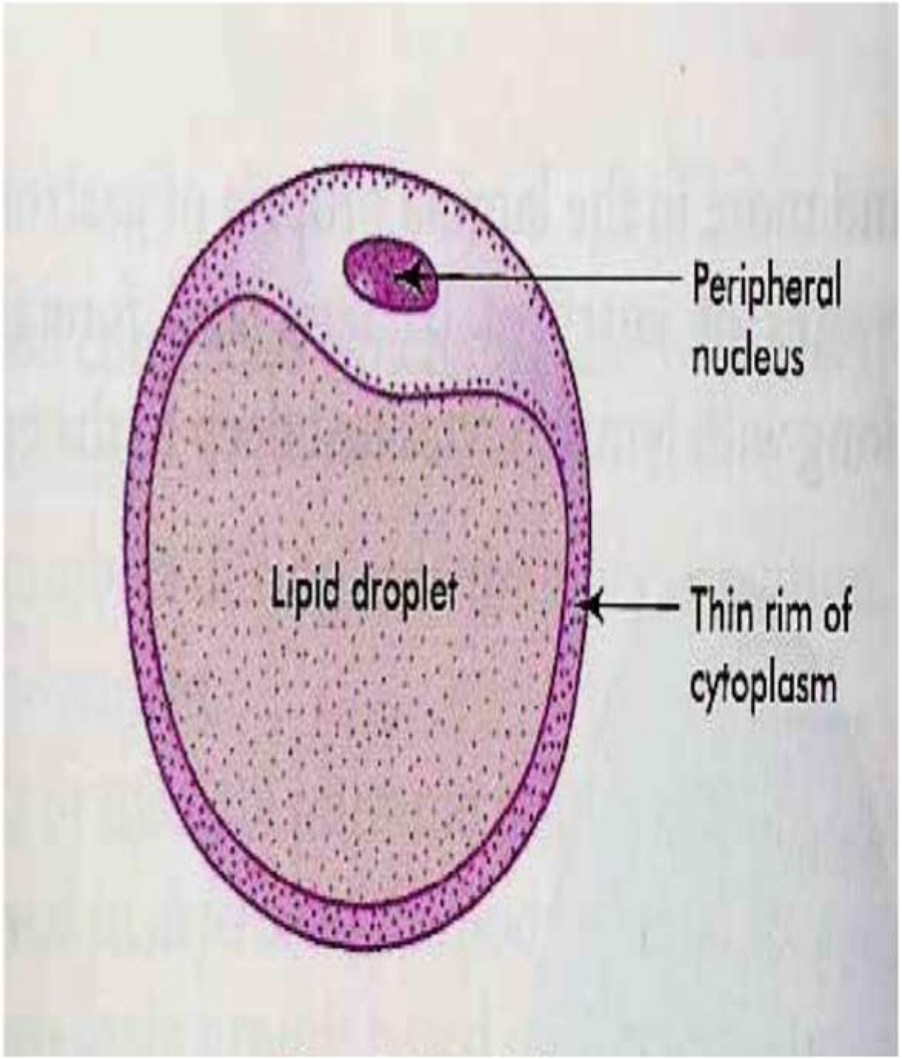


Fig. 4.4 Macrophage

Adipocytes

- Store lipid
- Appears as empty space
- Incapable to division
- Aggregate in adipose tissue with reticular fibre



Leucocytes-

. **Granulocytes-**
  Neutrophils,
  Esinophils,
  Basophiles

. **Agranulocytes**
  Lymphocytes,
  Monocytes

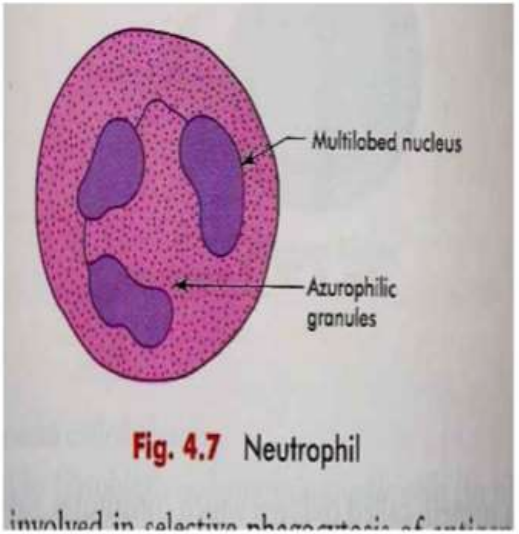


Fig. 4.7 Neutrophil

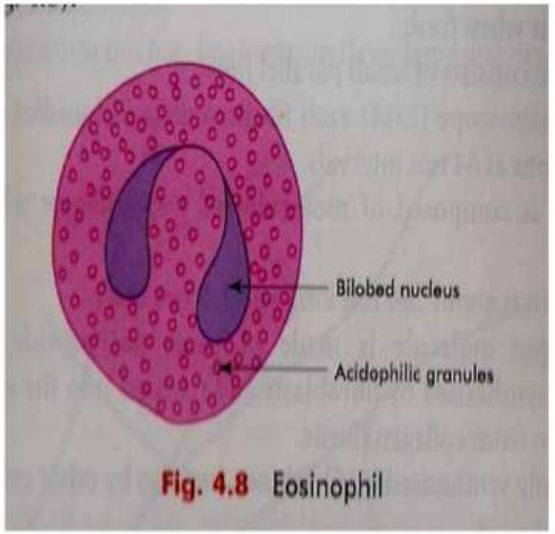


Fig. 4.8 Eosinophil

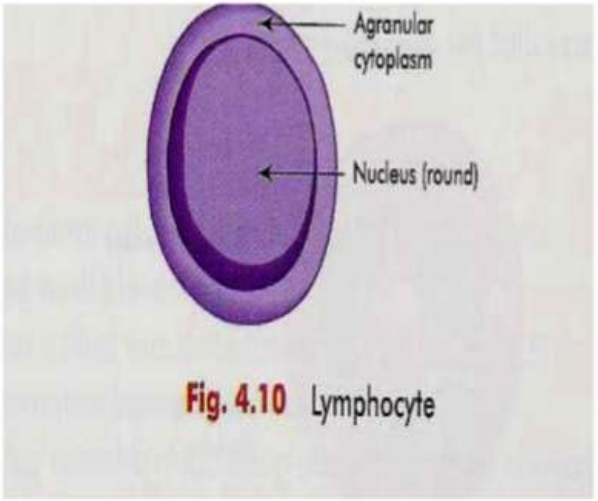


Fig. 4.10 Lymphocyte

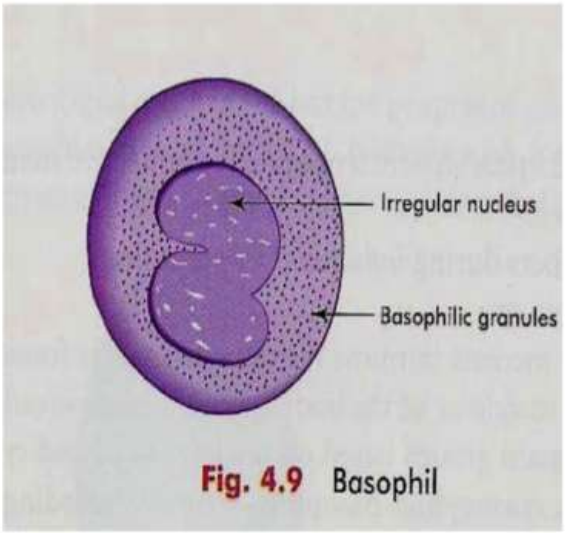


Fig. 4.9 Basophil

Collagen Fibre

- *White* colour when fresh
- Do not branch,
- present in bundle
- *Collagen protein* forms Fibres
- Synthesized by *fibroblast*

Fig. 4.11 Collagen fibres

Elastic fibre

- Composed of elastin protein
- Singly present
- Branched and anastomose
- Can be stretched
- Synthesized by fibroblast

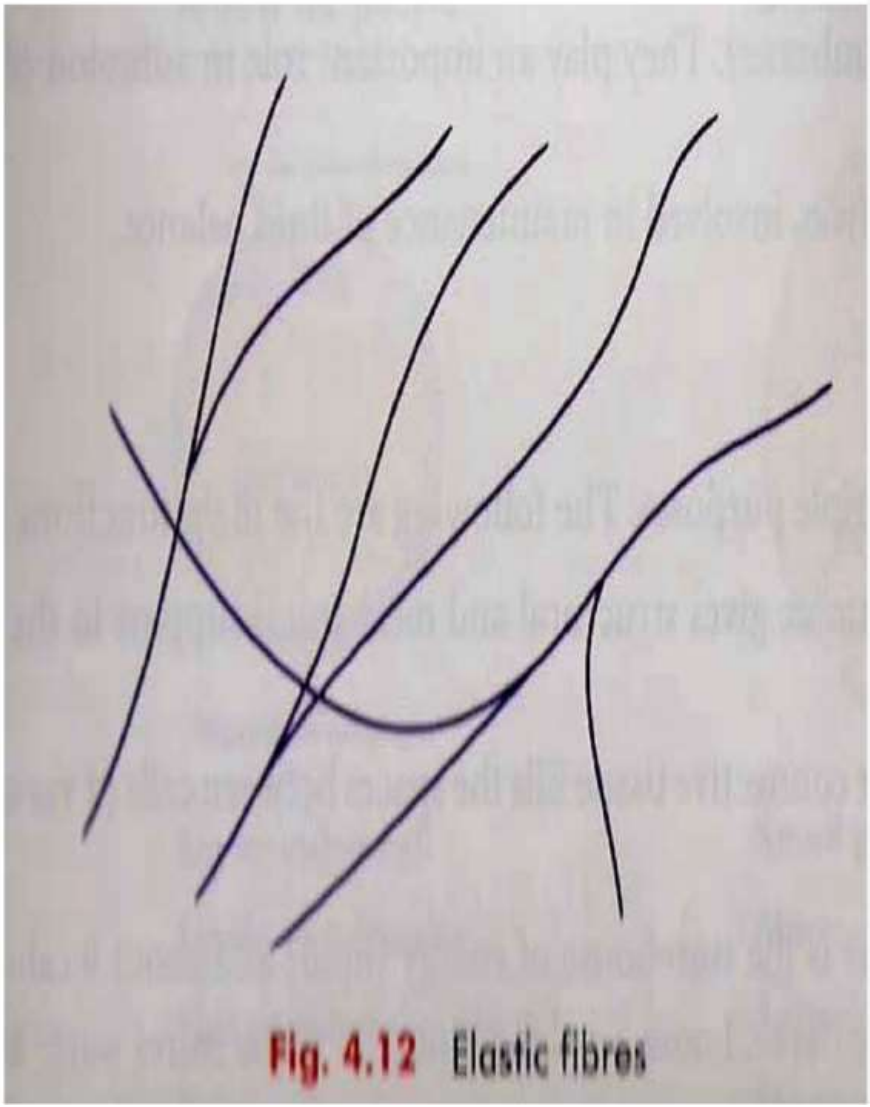


Fig. 4.12 Elastic fibres

Reticular fibre

- **Immature collagen fibre (type -3)**
- **Framework of lymphoid tissue**

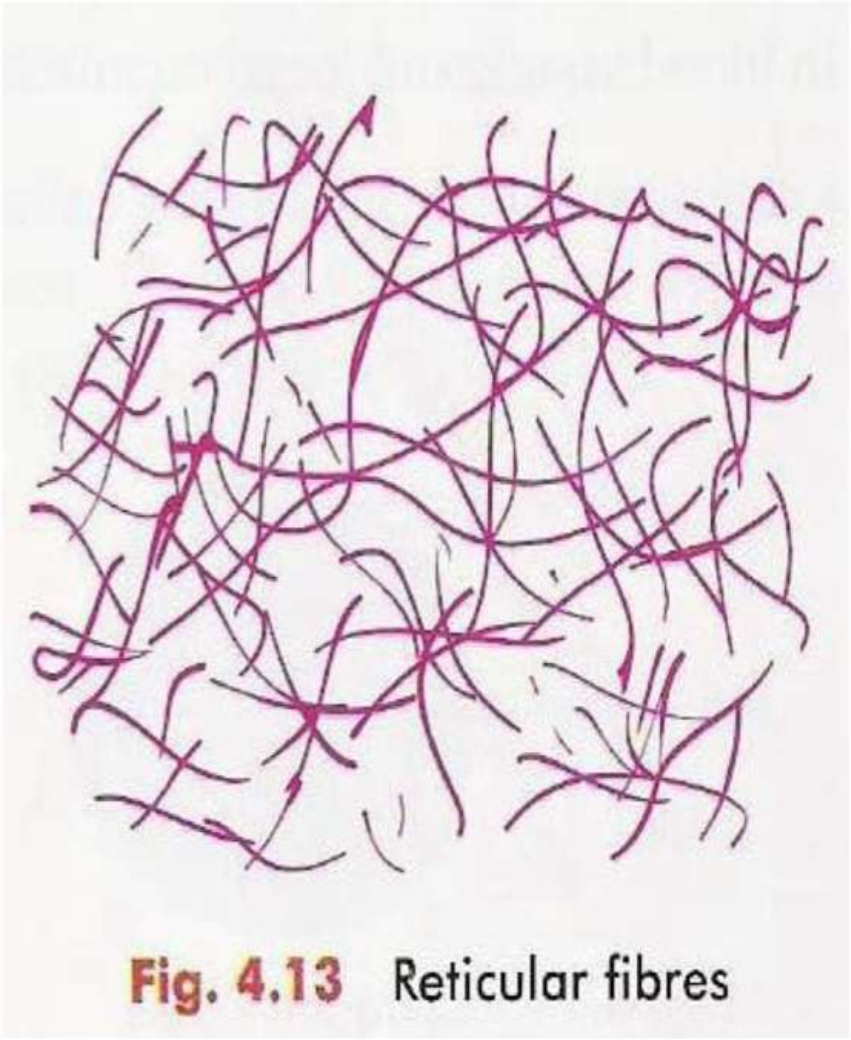


Fig. 4.13 Reticular fibres

Connective Tissue

M.SC.Mariam Issam

⬙ Definition & Functions

- Connective tissue is responsible for supporting and maintaining the shape of organs in the body.
- It provides a matrix that binds tissues and cells,
- acts as a medium for nutrient and waste exchange.

📌Major Components of Connective Tissue

1. Cells
2. Fibers
3. Ground substance

Other tissues (Epithelium, Muscle, Nerve) are mainly composed of cells.

In contrast, a major component of connective tissue is the Extracellular Matrix (ECM).

Extracellular Matrix (ECM)

📌Composition

- The ECM consists of:

1. Protein fibers → collagen, reticular, and elastic fibers.
2. Ground substance → a viscous, hydrophilic complex of:

- Glycosaminoglycans (GAGs)
- Proteoglycans
- Multiadhesive glycoproteins (e.g., laminin, fibronectin)

📌 Functions of Connective Tissue Components

- Structural: stabilize ECM by binding to integrins & other matrix parts.
- Biological: act as a reservoir of growth & differentiation factors.

Due to its viscous nature, it acts as:

- A lubricant to facilitate movement of cells and fibers.
- A barrier to invasion by pathogens.

The connective tissues originate from the mesenchyme, an embryonic tissue formed by elongated undifferentiated cells, the mesenchymal cells

Tissue Cells of Connective Tissue

Fibroblasts:

Origin: locally from undifferentiated mesenchymal cells.

Lifespan: remain in connective tissue throughout their life.

Other cells (Mast cells, Macrophages, Plasma cells):

Origin: hematopoietic stem cells in bone marrow.

First circulate in the blood, then migrate to connective tissue to perform their functions.

White Blood Cells (Leukocytes)

Transient cells in most connective tissues.

Origin: bone marrow.

Migrate to connective tissue, stay for a few days, then usually die via apoptosis (programmed cell death).

Function and Characteristics of Fibroblasts

Fibroblasts synthesize

- Collagen fibers
- Elastic fibers
- Reticular fibers

•components of the extracellular matrix (ECM):

Glycosaminoglycans, Proteoglycans, Glycoproteins

- Play an active role in wound healing.
- In adults, fibroblasts rarely divide unless needed, e.g., during tissue repair.

Comparison: Active Fibroblast vs Quiescent Fibroblast (Fibrocyte)

Quiescent Fibroblast (Fibrocyte)	Active Fibroblast	Feature
Smaller, spindle-shaped	Larger, irregularly branched cytoplasm	**Shape / Size**
Smaller, elongated, darker	Large, ovoid, pale-staining, prominent nucleolus	**Nucleus**
Less cytoplasm, more acidophilic, less RER	Abundant, metabolically active, rich in Rough ER & Golgi	**Cytoplasm**
Low activity → maintains ECM	High synthetic activity → produces ECM components	**Activity**
Maintains ECM, preserves tissue structure	Builds ECM, active in tissue repair	**Role**

Adipocytes (Fat Cells)

- Specialized connective tissue cells for:
- Storage of neutral fats (energy reservoir)
- Heat production (thermogenesis)
- Have considerable metabolic significance.

Macrophages & Mononuclear Phagocyte System

Wide morphological variation depending on tissue type and activity.

Electron microscope features: irregular surface, folds, protrusions → reflect active phagocytosis and pinocytosis.

Rich in Golgi apparatus, lysosomes, and rough ER.

Origin and Development

Derived from bone marrow precursor cells → produce monocytes.

• Monocytes circulate in blood → cross venule and capillary walls → enter connective tissue → mature into macrophages.

• Monocytes and macrophages = same cell at different maturation stages. Also called histiocytes.

- Present in most organs.
- Long-living cells, may survive months in tissue.
- uptake, processing, and presentation of antigens → activates lymphocytes.

Organ-Specific Macrophages

- Kupffer cells → liver
- Microglial cells → CNS
- Langerhans cells → skin
- Osteoclasts → bone
- All derived from monocytes.

Transformation from Monocyte to Macrophage

- Increase in cell size
- Increased protein synthesis
- Increase in Golgi complexes and lysosomes
- Typical macrophage: 10–30 µm, oval or kidney-shaped nucleus (eccentric).

Mast Cells

- Large connective tissue cells, oval or round, 20–30 μm in diameter.
- Cytoplasm filled with basophilic secretory granules.
- Nucleus is small, spherical, centrally located, often obscured by granules.

Mast cell cytoplasmic granules may obscure the nucleus because they are rich in acidic radicals from sulfated glycosaminoglycans.

These granules show metachromasia, meaning they can change the color of some basic dyes (e.g., toluidine blue) from blue to purple or red.

• Important molecules in granules include:

1. Heparin → local anticoagulant.

2. Histamine → increases vascular permeability, contracts smooth muscle.

3. Serine proteases → activate inflammatory mediators.

4. Eosinophil & neutrophil chemotactic factors → attract leukocytes.

Origin /

• Derived from bone marrow precuesor cells.

• Circulate as immature cells in blood → migrate to connective tissue → mature into mast cells.

plasma cell

Large, ovoid cells.

- Basophilic cytoplasm → rich in rough ER.
- Juxtanuclear Golgi apparatus
- Nucleus: spherical but eccentrically placed.
- Alternating regions of heterochromatin (dense, peripheral) and euchromatin (lighter, internal).
- Nucleus shows a clock-face appearance.

Lifespan:

- Short-lived, approximately 10–20 days.

Fibers in Connective Tissue

General Formation

Formed by proteins that polymerize into elongated structures.

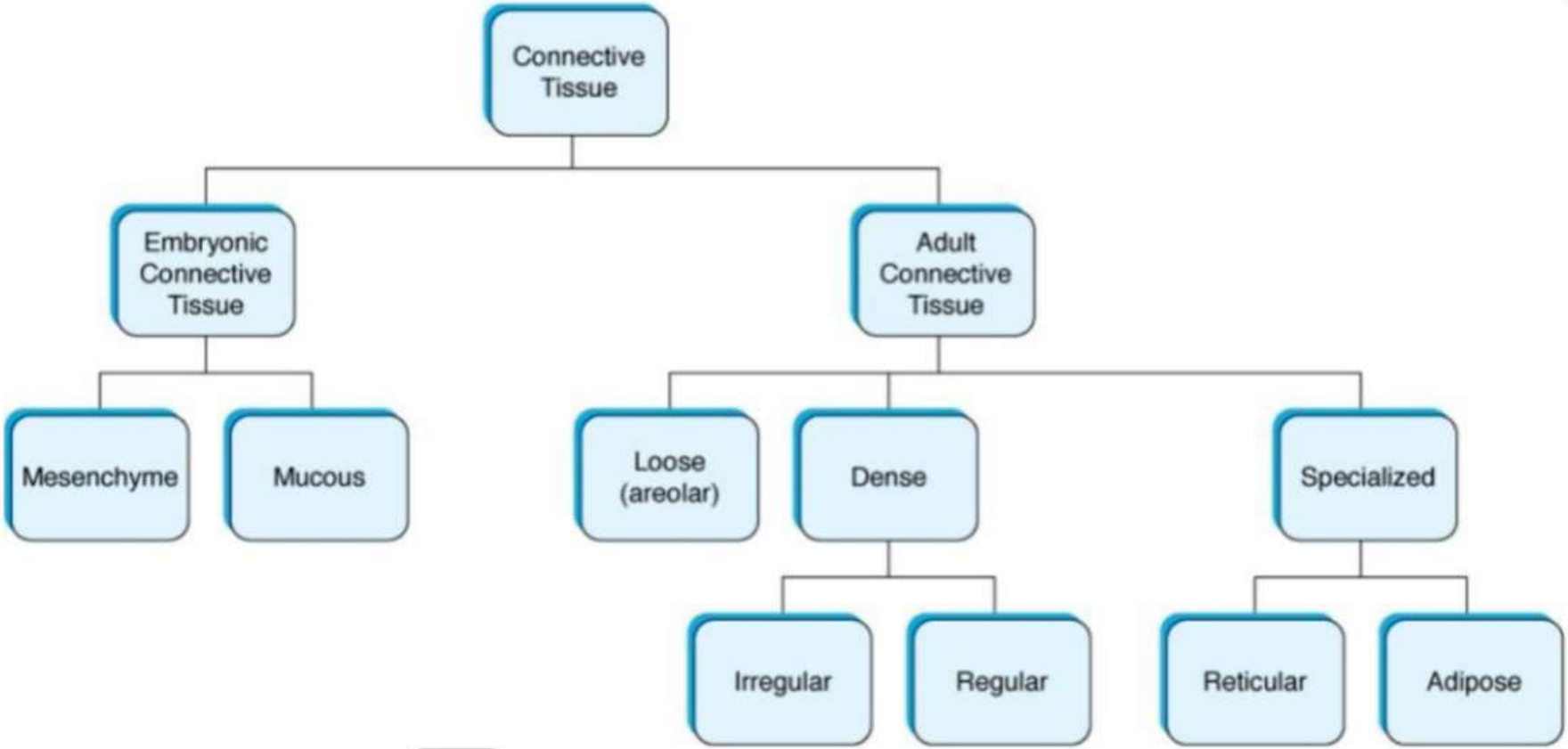
Function: provide support, strength, and elasticity.

Main Types

- Collagen fibers
- Reticular fibers
- Elastic fibers

Function	Location	Composition	Fiber Type
Strength, rigidity, resistance to tension	Skin, bone, cartilage, smooth muscle, basal lamina	Protein: Collagen	**Collagen fibers**
Form flexible networks to support organs	Organs that change shape or volume (arteries, uterus, intestinal muscle layers)	Type III collagen, very thin, heavily glycosylated	**Reticular fibers**
Elasticity, stretch and recoil	Organs subjected to stretching/bending (large artery walls)	Protein: Elastin	**Elastic fibers**

Table 5–6. Types of connective tissue.



Loose Connective Tissue (Areolar)

Very common; contains cells, fibers, and ground substance in nearly equal parts.

Main cells: fibroblasts, macrophages.

Location: supports epithelia, around blood & lymphatic vessels, between muscles and nerves, dermis, hypodermis, glands, mucous membranes.

Function: support for structures under low pressure and friction.

Dense Connective Tissue

- Description: Less flexible, stronger than loose CT.
- Composition: fewer cells, predominance of collagen fibers.

Dense Regular Connective Tissue	Dense Irregular Connective Tissue	Feature
Parallel / organized	Random / irregular	**Collagen fiber arrangement**
Mainly in one direction	From many directions	**Resistance to stress**
Very strong, unidirectional	Moderate, multidirectional	**Strength**
Tendons, ligaments	Dermis of skin, organ capsules	**Example locations**

Reticular Tissue

Description: delicate 3D network of type III collage

Function: provides structural framework for hematopoietic & lymphoid organs (bone marrow, lymph nodes, spleen).

Special feature: spongelike structure where cells and fluids move freely.

Mucous Tissue

Description: rich in hyaluronic acid, jelly-like ground substance, very few collagen fibers, scattered fibroblasts

Location: umbilical cord , fetal tissues, pulp cavity of young teeth.

Function: flexible support and protection.

RESPIRATORY SYSTEM

The system is divided into:

1. The conducting portion: nose, pharynx, larynx, trachea, bronchi, and large bronchioles.

2. The respiratory portion: respiratory bronchioles, alveolar ducts and sacs, and alveoli, in which gaseous exchange occurs.

Respiratory epithelium:

- It lines most of the conducting portion.
- It is a ciliated pseudostratified columnar epithelium rich in goblet cells.
- It is pink in color.
- It contains five types of cells.

Cells of the respiratory epithelium

1-Ciliated columnar cells:

Constitute the most abundant type, each cell with an apical 300 cilia several microns in length, beneath which are numerous basal bodies, small mitochondria that supply the cilia with ATP. They move in a coordinated fashion, sweeping mucus up the bronchus.

The fragile cilia are particularly vulnerable to damage and destruction by inhaled toxic chemicals (cigarette smoke, car exhaust fumes) and by bacterial and viral infections

2-Mucous goblet cells:

- The second abundant cell type with an expanded apical portion rich in mucous droplets and basal-located nuclei.

- 3-Brush cells:

- contain numerous microvilli on their apical surface, they have different nerve endings(considered as sensory receptors)

4-Small granule cells:

These cells resemble basal cells and contain numerous granules, each 100–300 μm in diameter with dense cores. They constitute a population of the neuroendocrine system, secreting several peptide hormones, including serotonin and bombesin, which help regulate muscle tone in the bronchial and vessel walls

.5-Basal (short) cells:

These are small, rounded cells that lie on the basal lamina and do not extend to the luminal surface of the epithelium.

The Nose:

- The nose is divided by a midline into right and left nasal cavities.
- It opens to the outside through the anterior nares (nostrils) and posteriorly communicates with the nasopharynx.

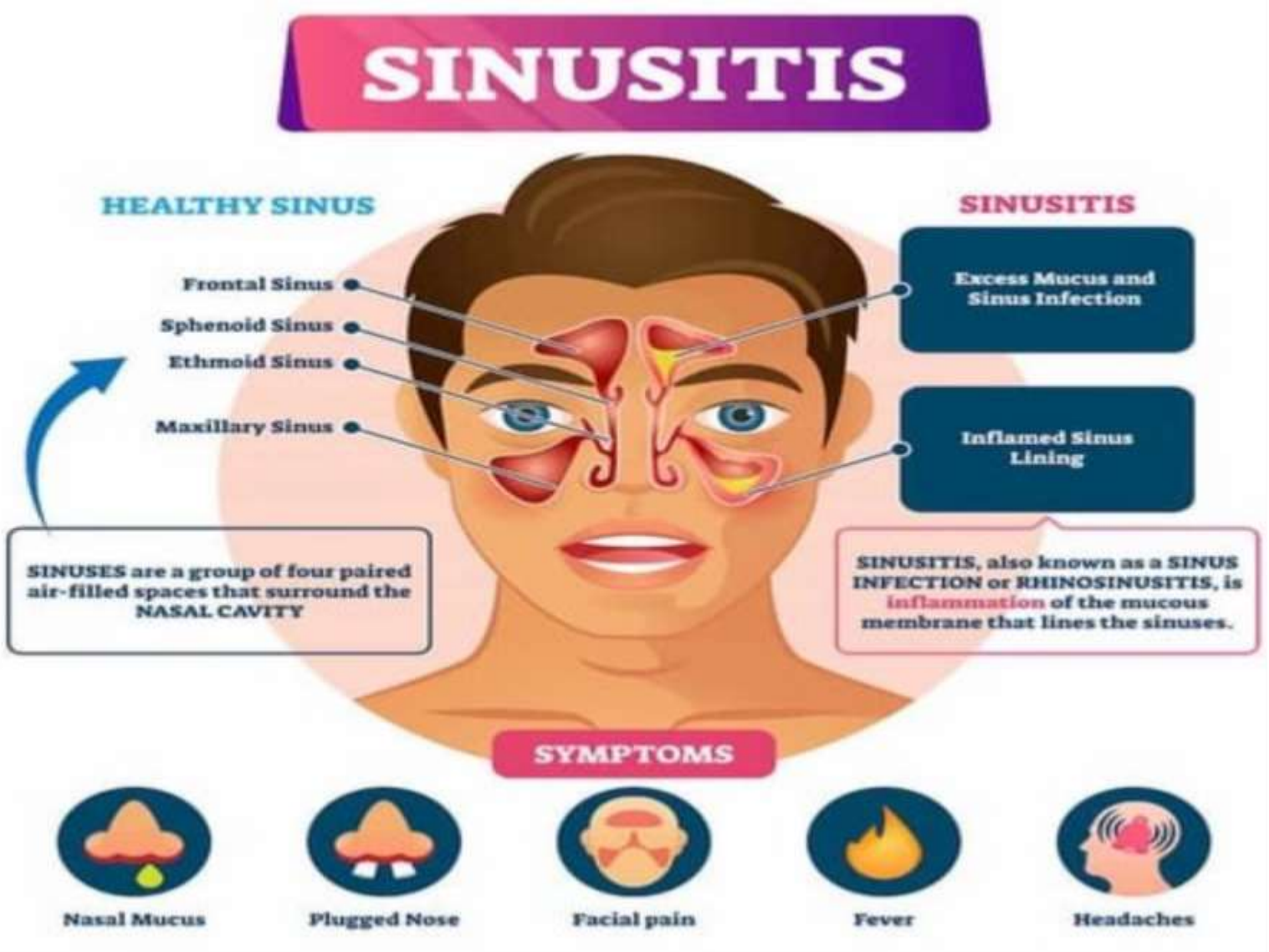
Paranasal Sinuses

- Small hollow cavities located within the bones surrounding the nose.

They serve several functions, such as reducing the weight of the head, humidifying and warming inhaled air, and enhancing the resonance of the voice.

Sinusitis

Inflammation of the sinuses, most often caused by an infection.



Pharynx

The pharynx is a muscular tube located behind the nasal cavity and the oral cavity. It serves as a common passageway for both air and food.

It is divided into three main regions:

1. Nasopharynx – located behind the nasal cavity.
2. Oropharynx – located behind the oral cavity.
3. Laryngopharynx – located above the larynx.

Larynx

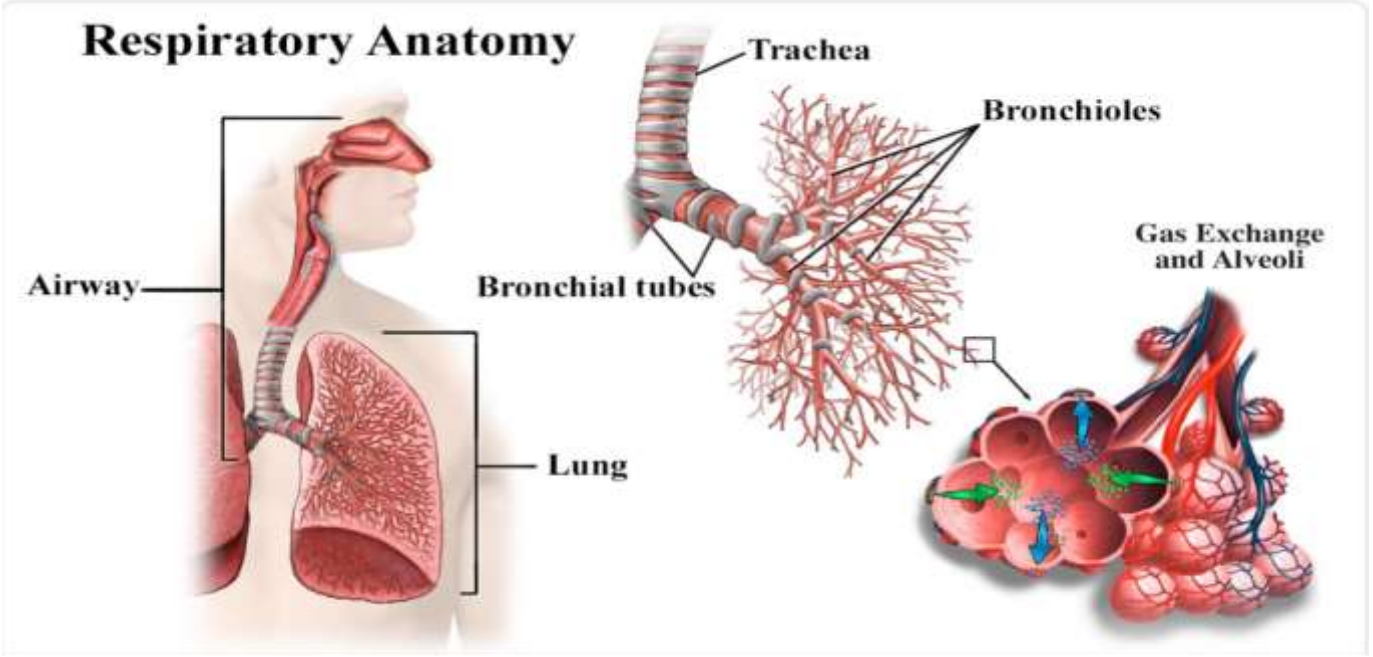
The larynx is a cartilaginous structure known as the voice box. It connects the pharynx to the trachea and contains the vocal cords.

It plays an essential role in respiration and sound production

Functions

The pharynx and larynx work together to perform several important functions:

- Maintaining an open airway for breathing.
- Preventing food and liquids from entering the trachea through the action of the epiglottis.
- Producing sound (phonation) through vibration of the vocal cords in the larynx.



Trachea:

The trachea is a semi-rigid, flexible tube that transports air to the lungs.

Structure: It is supported by incomplete C-shaped cartilaginous rings that prevent it from collapsing during breathing.

Bronchi:

The bronchi are tubular branches that arise from the lower end of the trachea, They conduct air into the lungs and further divide into smaller branches.(bronchioles)

Bronchioles:

The bronchioles are small air passages that lack cartilaginous support.They are composed mainly of smooth muscle, which allows them to change their diameter during breathi

Alveoli:

The alveoli are small sac-like structures that represent the actual site of gas exchange between the air and the blood.

At the ends of the alveolar ducts are the alveolar sacs, which contain clusters of alveoli.

The Lung:

The lung is a sponge-like organ located within the thoracic cavity, with one lung on the right and one on the left.

Main function:

The lungs contain and protect the bronchi, bronchioles, and alveoli, which work together to accomplish the process of respiration (taking oxygen from the air and delivering it to the blood, and removing carbon dioxide from the blood and releasing it into the air).

Histology

Histology (Gr. histo, web or tissue, + logos, study) is the study of the tissues of the body and of how these tissues are arranged to constitute organs.

Basic tissues: A group of similar cells specialized to perform a common function. These tissues exist in associations forming body organs.

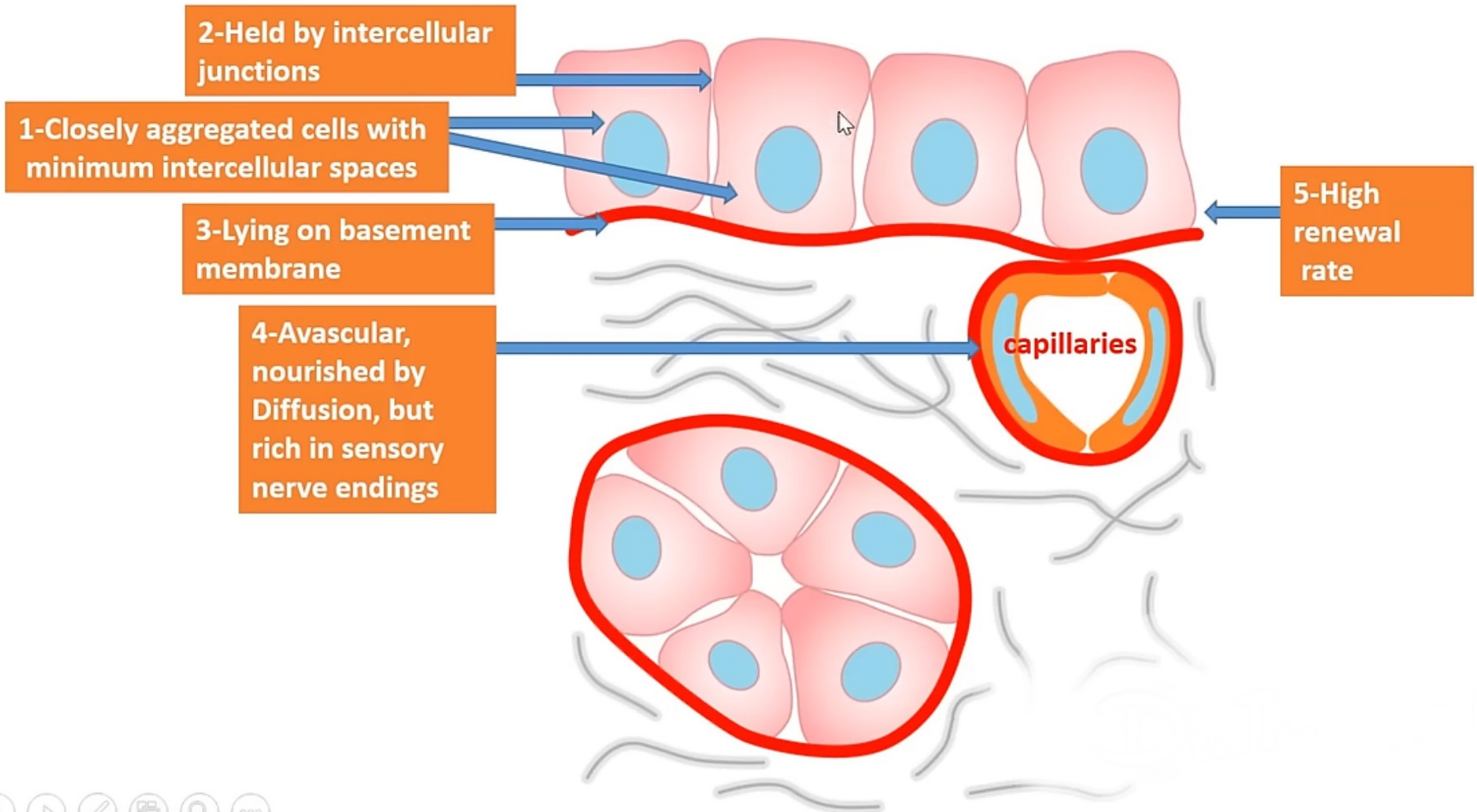
Connective tissue

Muscular tissue

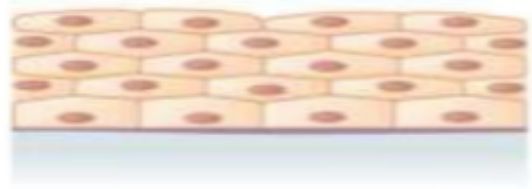
Epithelial tissue

Nervous tissue

Characteristics of epithelium



- 1.Epithelial tissues:
- There are two types of epithelial tissues:
- 1.Covering and lining epithelium (outer layer of the skin and some organs) .
- Glandular epithelium (constitute the secreting portion of glands) .

	Simple	Stratified	Pseudostratified
Squamous	 Simple squamous epithelium	 Stratified squamous epithelium	
Cuboidal	 Simple cuboidal epithelium	 Stratified cuboidal epithelium	
Columnar	 Simple columnar epithelium	 Stratified columnar epithelium	 Pseudostratified columnar epithelium

Terms that help us understand what kinds of tissues we are identifying:

Terms referring to the layers

Simple = one layer

Stratified = more than one layer

Pseudostratified = false layered (appears to be more than one layer, but only one); *ciliated* = with cilia

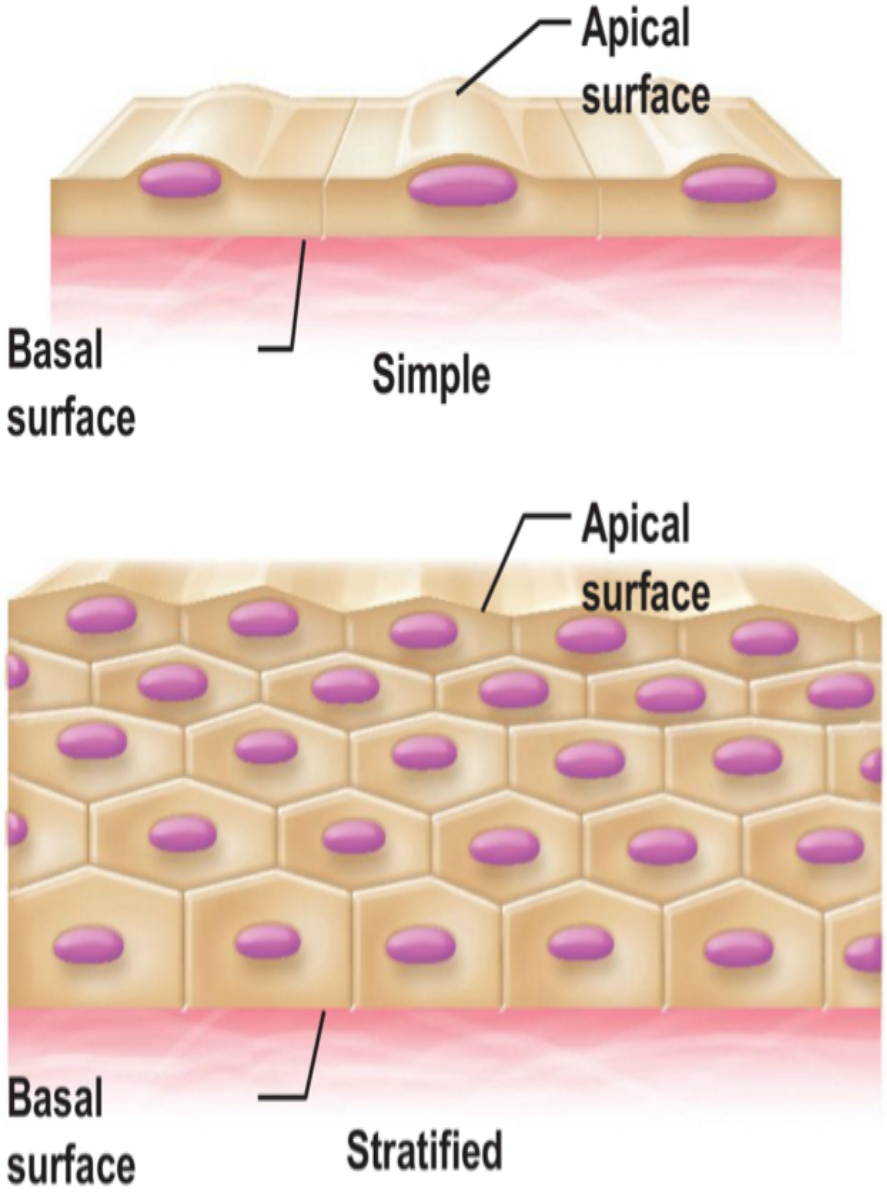
Terms referring to the cell shapes

Squamous = flat

Cuboidal = cube

Columnar = rectangular (column)

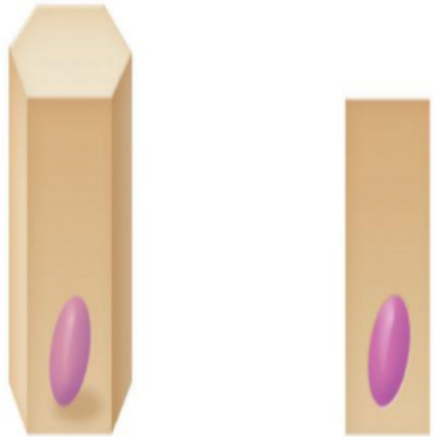
Transitional = ability to change shape



Classification based on number of cell layers.

Squamous

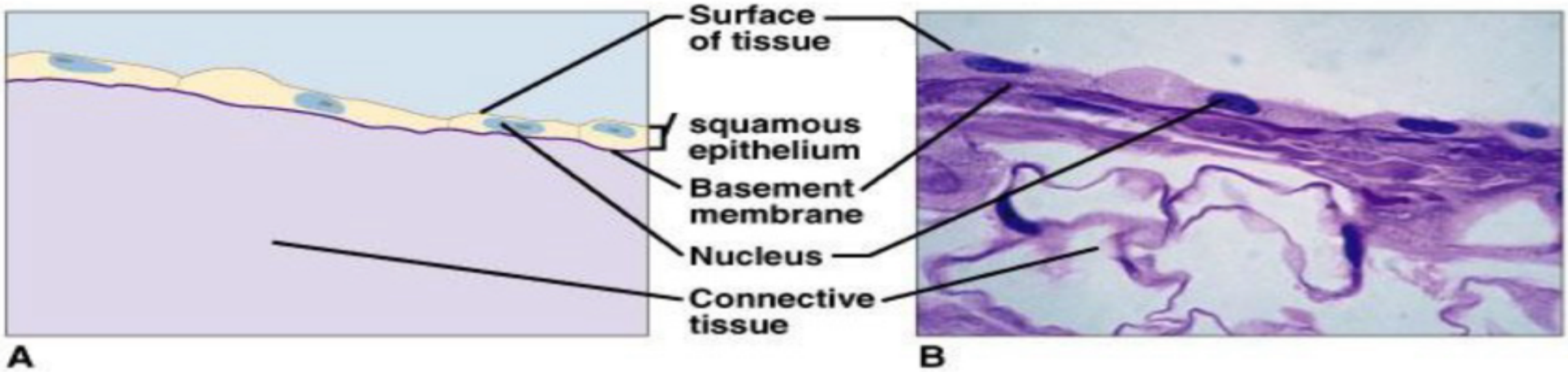
Cuboidal



Columnar

Classification based on cell shape.

Simple squamous epithelial tissue



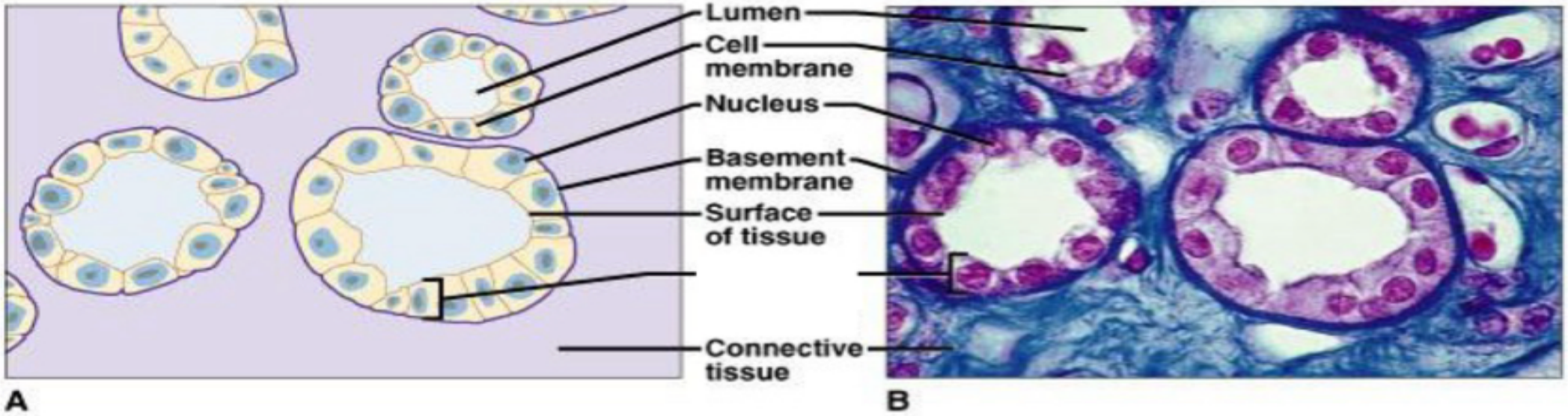
Single layer of flattened cells with disc-shaped central nuclei

diffusion and filtration in sites where protection is not important;

Bowman's capsule

- Endothelium
- Endocardium

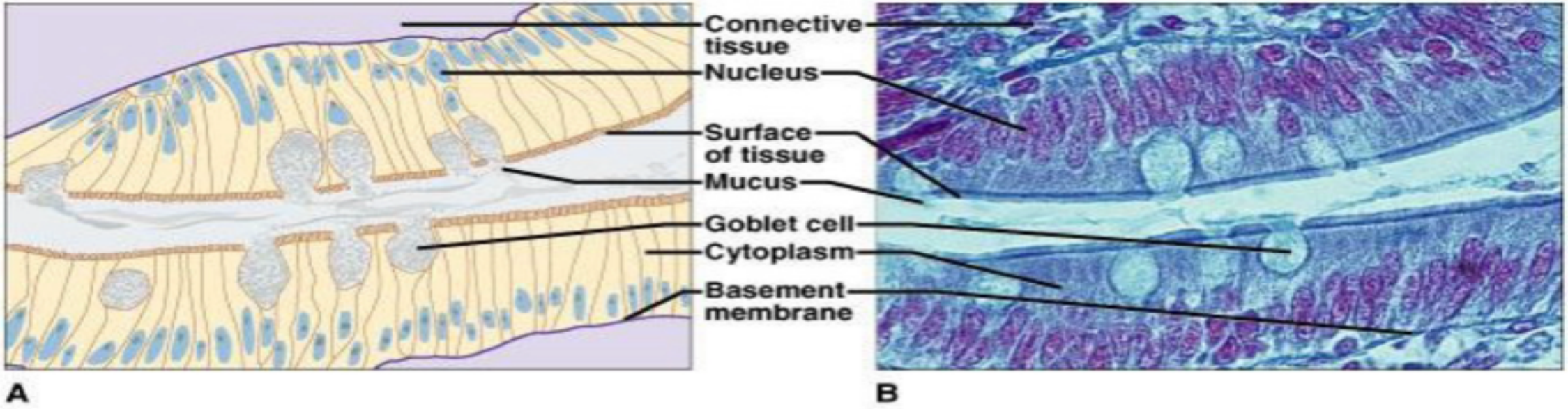
Simple cuboidal epithelial tissue



Single layer of cubelike cells with large, spherical central nuclei.

Secretion and absorption.

Kidney tubules;



Simple columnar epithelial tissue

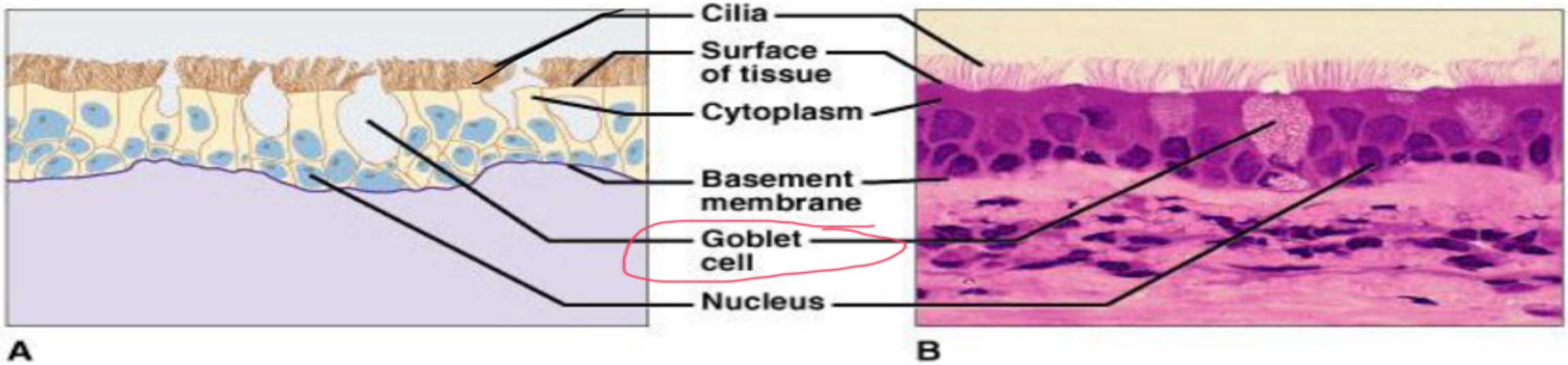
Single layer of tall cells with round to oval nuclei.

Absorption; secretion of mucus, enzymes.

Ciliated type propels mucus or ova by ciliary action (e.g., lines the Fallopian tube / Oviduct).

Nonciliated type lines most of the digestive tract (stomach to anal canal) and gallbladder."

Pseudostratified (ciliated) columnar epithelial tissue

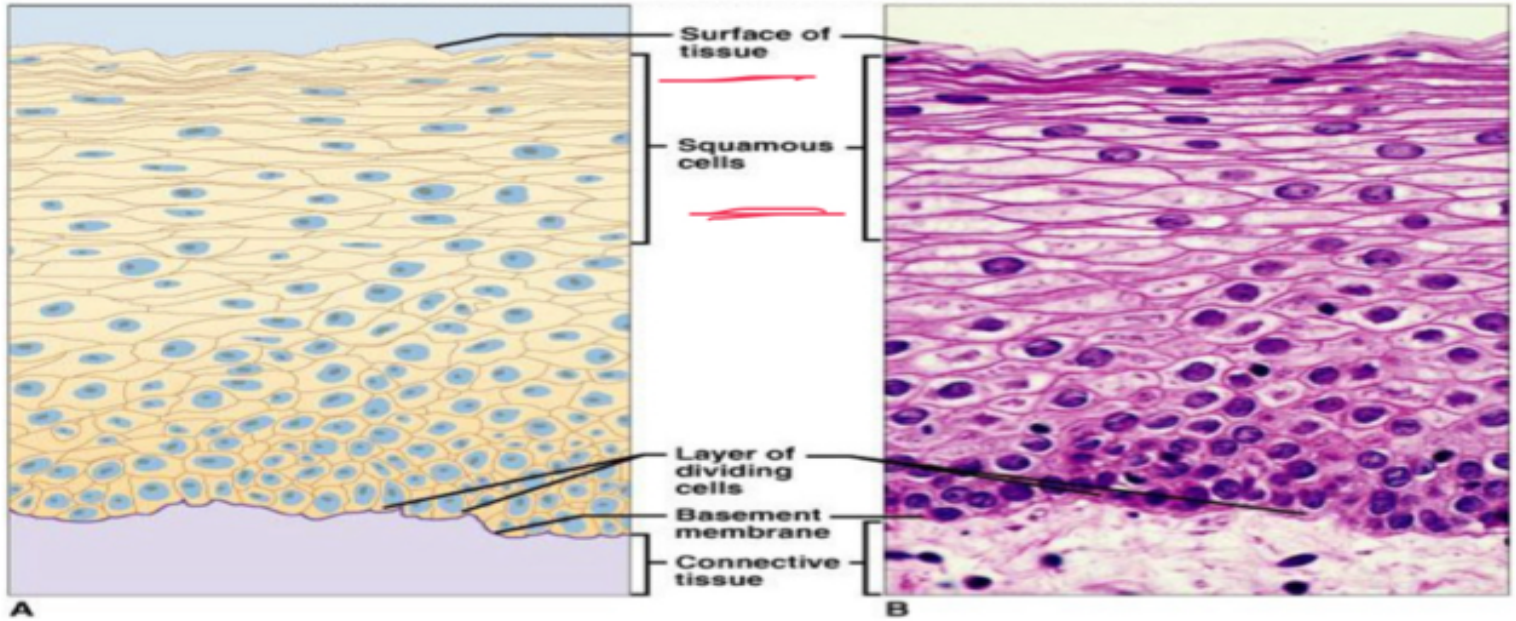


Single layer of cells of differing heights,some not reaching the free surface nuclei seen at different levels;

Secretion and protection

Nasal cavit

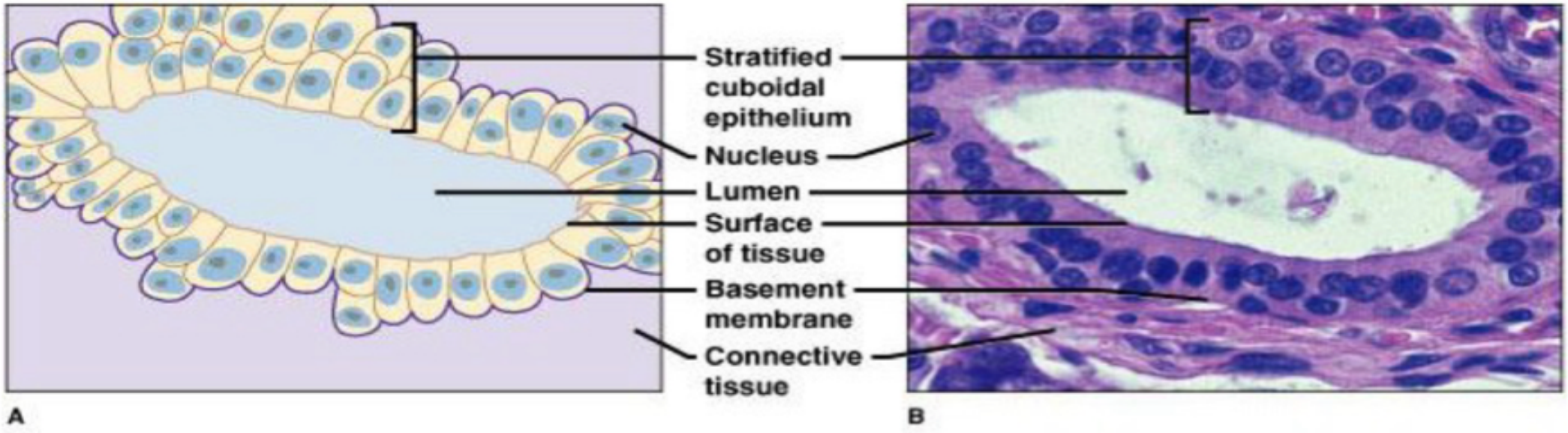
Stratified squamous epithelial tissue.



consists of multiple layers of cells, with basal cells columnar and surface cells (squamous).

protection n. Keratinized type is(skin)for while non-keratinized type the oral cavity,,.

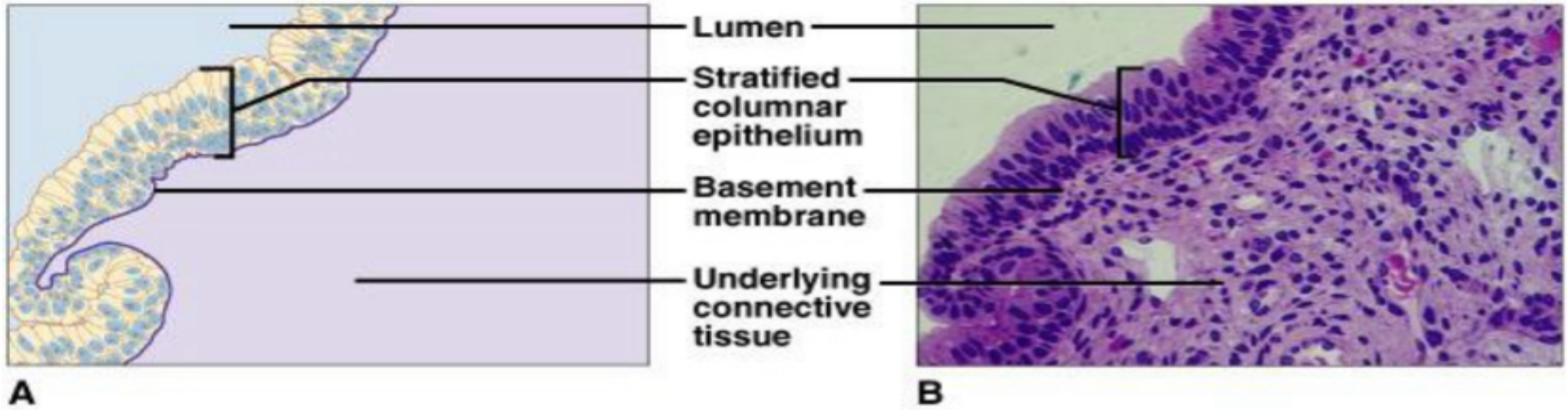
Stratified cuboidal epithelial tissue



salivary glands, sweat glands

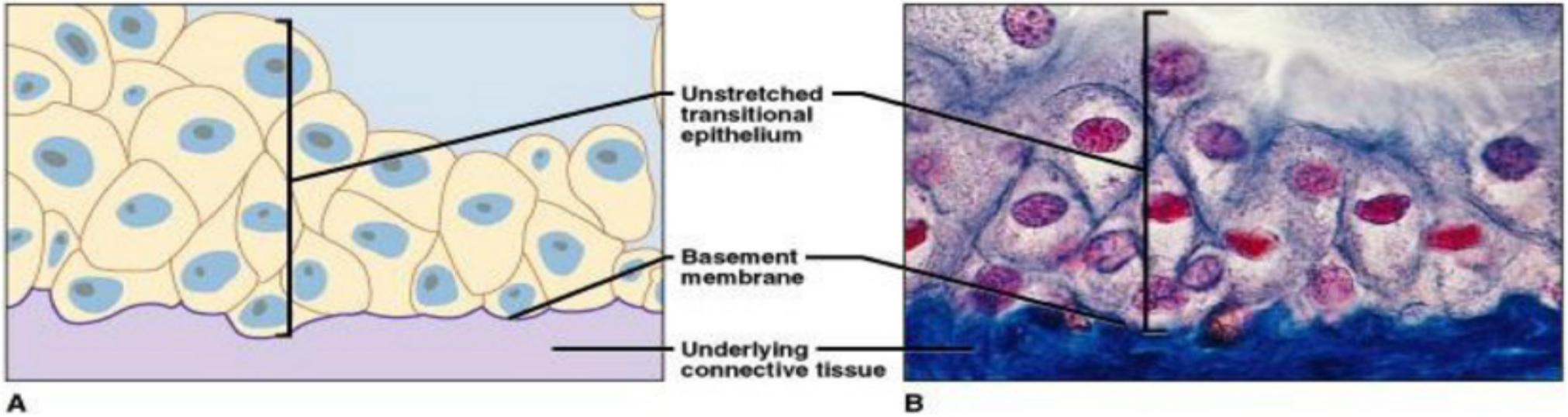
Secretion

Stratified columnar epithelial tissue

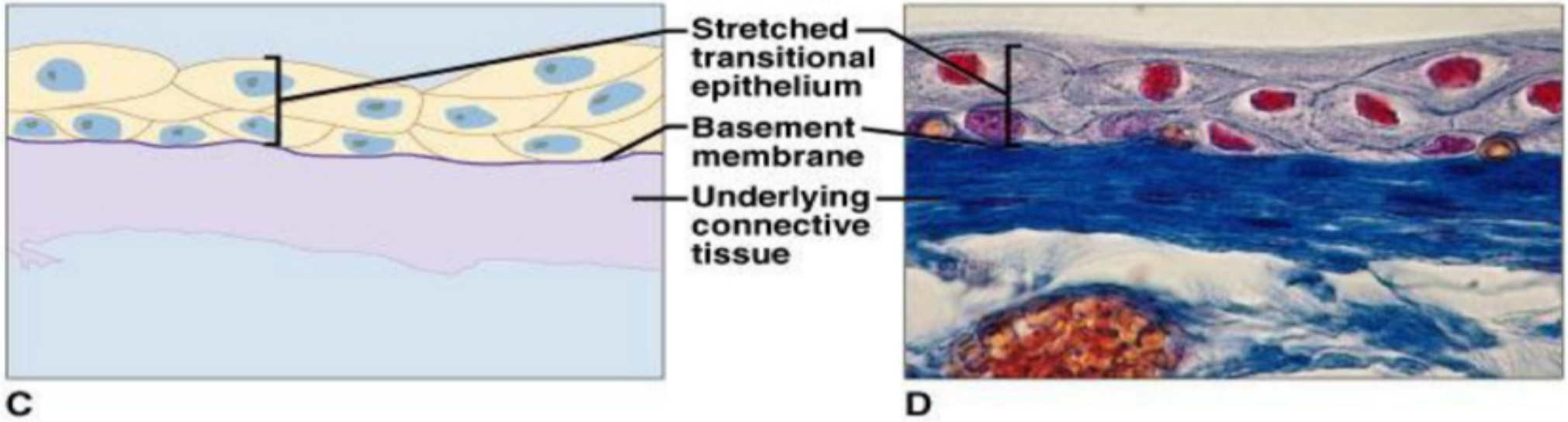


protection

Transitional epithelial tissue



empty bladder



Nervous tissue

- The nervous tissue develops from the ectodermal layer of the embryo, the same layer that forms the skin and nervous system.

- The nervous system :
- regulates the functions of most body organs
- respond to internal and external stimuli rapidly and precisely.

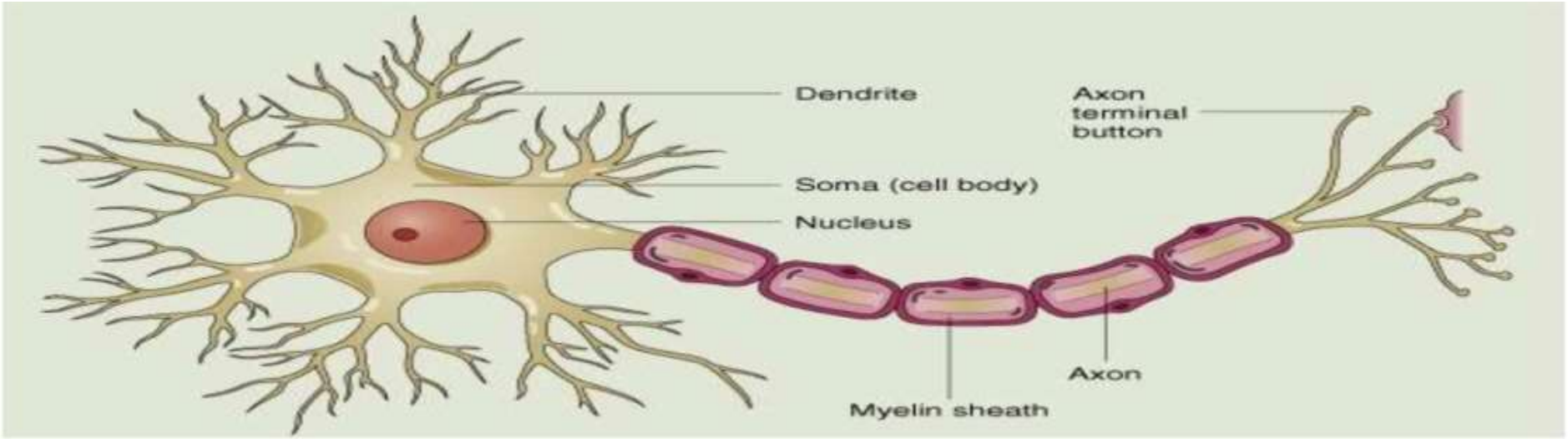
- The Neuron (Nerve Cell)

is the basic structural and functional unit of the nervous system.

- function is to receive stimuli and transmit nerve impulses to other neurons or to effector organs such as muscles

- Parts of the Neuron

✓ (Cell Body / Soma)
✓ Dendrites
✓ Axon



- ✓ cell body /It contains a large, centrally located nucleus, and the cytoplasm has special structures called Nissl bodies, for protein synthesis.

- ✓ Dendrites/ are short, highly branched cytoplasmic processes that receive nerve impulses from other neurons and carry them toward the cell body.

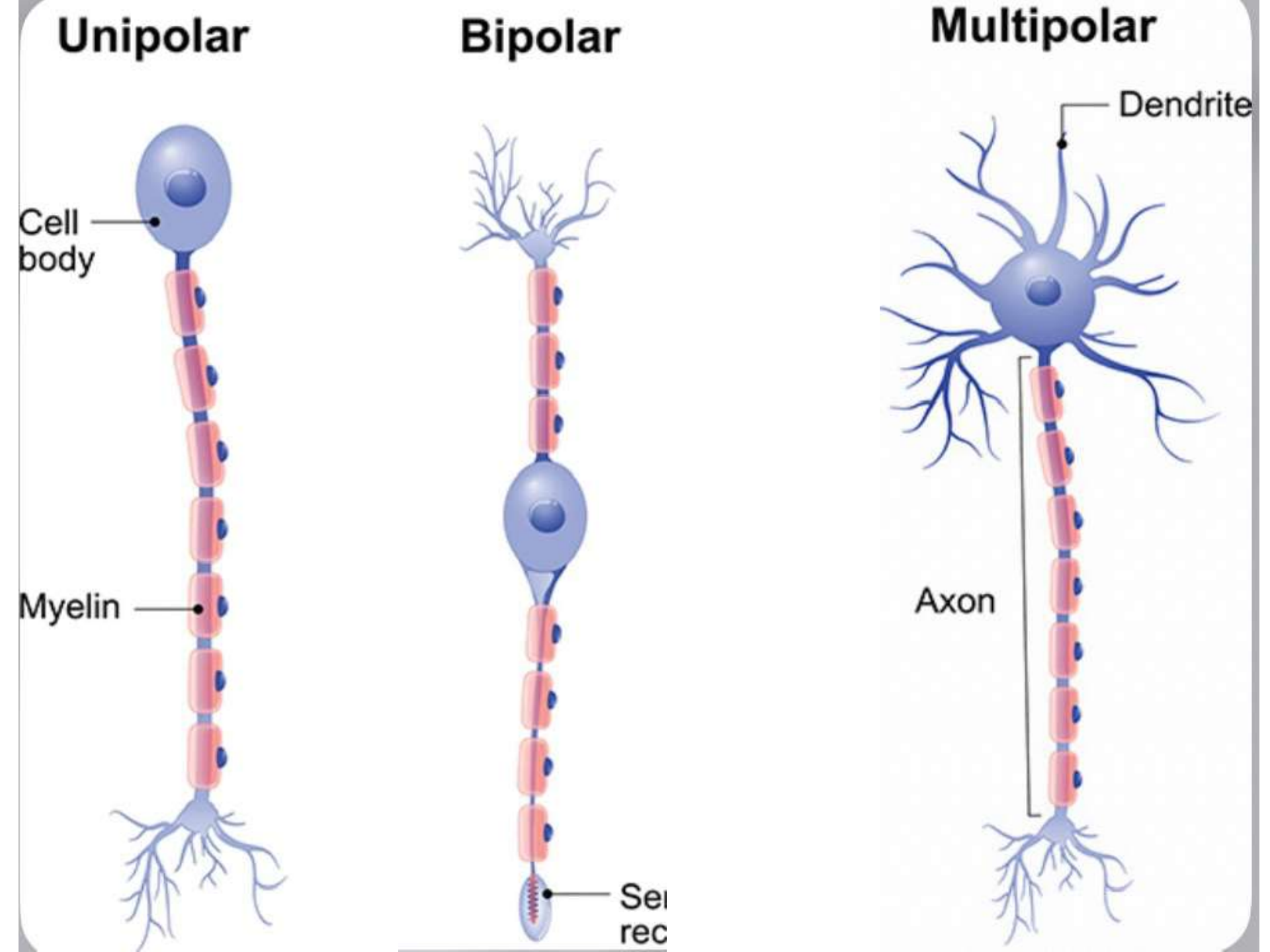
- ✓ The axon / is a single, long cytoplasmic process that carries impulses away from the cell body to other neurons or effector organs.

Classification of Neurons According to Processes

- Unipolar neurons have a single process, (axon)

- Bipolar Neuron has a cell body with two processes: one is the axon, and the other is a dendrite extending toward the free surface of the tissue to receive impulses.

- Multipolar Neuron They have a large cell body giving rise to several processes; the longest one is the axon, and the others are dendrites.
- These neurons are found in the gray matter of the spinal cord and the brain.


Unipolar
Bipolar
Multipolar
Cell body
Myelin
Dendrite
Axon

Muscle tissue

MSC.Mariam Issam

responsible for the movement of different parts of the body.

It has the property of contractility and relaxation.

It is composed of elongated cells called muscle fibers the intercellular substance is very minimal.

Based on structure and function, muscles are classified into three types:

1. Smooth muscles
2. Skeletal muscles
3. Cardiac muscles

1. Smooth Muscles

Found in the walls of the intestine and other internal organs, so they are also called visceral muscles.

Composed of long, spindle-shaped cells has a single, centrally located nucleus (oval or rod-shap

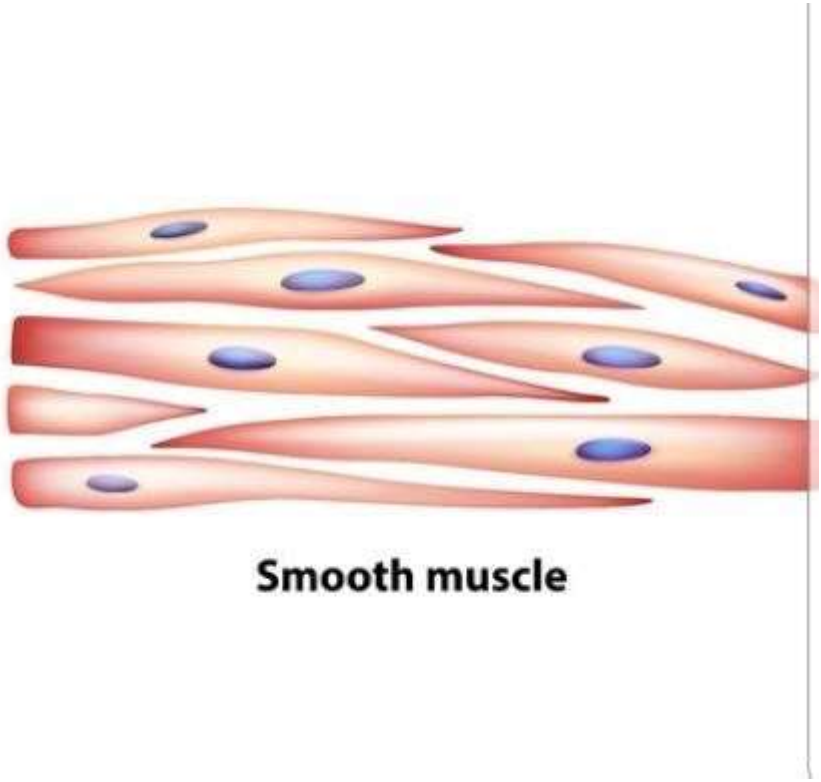
The cytoplasm is called sarcoplasm.

In cross section, they may appear round .

Their contraction is not under voluntary control, so they are called involuntary muscles.

Each fiber is made up of fine myofibrils that are non-striated .

Muscle fibers are arranged in an almost regular pattern.



Smooth muscle

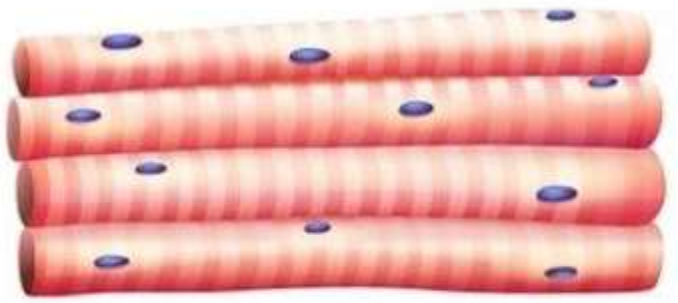
2.Skeletal Muscles

Found attached to bones, responsible for body movements.

Long, cylindrical, multinucleated fibers.Nuclei are located at the periphery of the cell.

Capable of powerful and quick contractions, but they fatigue easily.

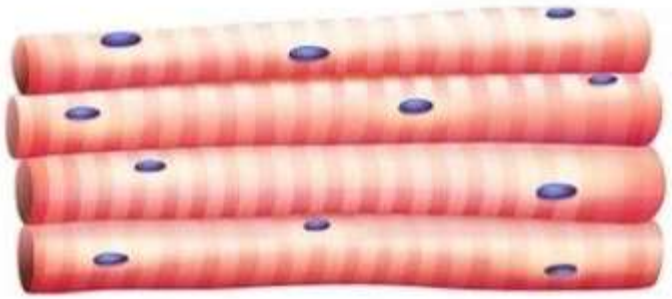
Each fiber is composed of myofibrils arranged in a regular pattern (actin & myosin filaments).



Skeletal muscle

Also called striated muscles because they show alternating dark and light bands under the microscope.

Called voluntary muscles because their contraction is under the control of will.



Skeletal muscle

3.Cardiac Muscles

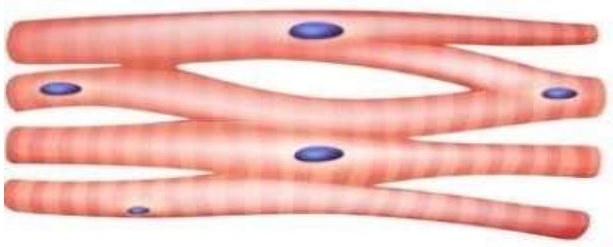
Found only in the heart wall (myocardium).

Fibers are branched and connected by special junctions called intercalated discs.

Usually one centrally located nucleus per cell (sometimes two).

Contraction is involuntary .

Like skeletal muscles, they are striated .



Contractions are rhythmic, strong, and continuous.

Do not fatigue easily (adapted for lifelong pumping function).

Digestive system

MSC.MARIAM ISSAM

Components of the Digestive System:

- Digestive tract: oral cavity, esophagus, stomach, small intestine, large intestine, rectum, and anus.
- Accessory glands: salivary glands, liver, and pancreas.

Major Processes:

- Digestion: breakdown of large molecules (proteins, fats, complex carbohydrates,) into smaller absorbable units.
- Absorption: uptake of small molecules—such as amino acids, monosaccharides, fatty acids, and monoglycerides—mainly in the small intestine

General Wall Structure of the Digestive Tract:

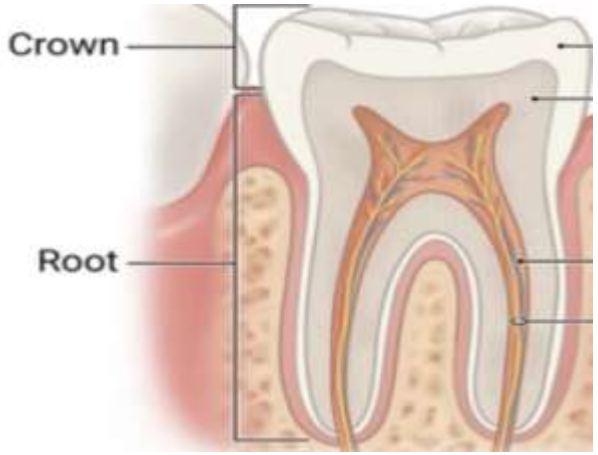
1. Mucosa
2. Submucosa
3. Muscularis
4. Serosa

- Oral Cavity
- The oral cavity is lined by stratified squamous epithelium

- Tongue: Composed of striated (skeletal) muscle fibers arranged in three planes (multidirectional).

- Teeth
- In the adult human there are normally 32 permanent teeth, arranged in two bilaterally symmetric arches in the maxillary and mandibular bones.

- Crown_Neck_Root



- Esophagus
- The part of the gastrointestinal tract called the esophagus is a muscular tube whose function is to transport food from the mouth to the stomach. It is lined by non keratinized stratified squamous epithelium with stem cells scattered throughout the basal layer
- Stomach
- The stomach is a dilated part of the digestive tract, and its main functions are:

1. To continue the digestion of carbohydrates that started in the mouth.
2. To add acidic fluid to the ingested food.
3. To transform food into a viscous mass (chyme) by muscular activity.
4. To initiate the digestion of proteins with the enzyme pepsin.

- The small intestine is the site of final digestion of food, nutrient absorption, and endocrine secretion.
- Intestinal villi are mucosal projections measuring 0.5–1.5 mm in length.
- The villi are covered by a simple columnar epithelium containing absorptive cells and goblet cells

- .The large intestine is the last part of the digestive tract, approximately 1.5 meters long.
- • Its main functions are:
- 1. Absorption of water and minerals from the contents of the small intestine.
- 2. Formation of feces from undigested materials.
- 3. Temporary storage of feces until elimination from the body.

Nervous Tissue

- Nerve tissue is a specialized tissue composed of neurons, which transmit nerve impulses, and glial cells, which support, protect, and nourish neurons.

- The nervous system is the most complex system in the human body.

It is divided into two main parts:

Central Nervous System (CNS) – includes the brain and spinal cord, responsible for processing information and generating responses

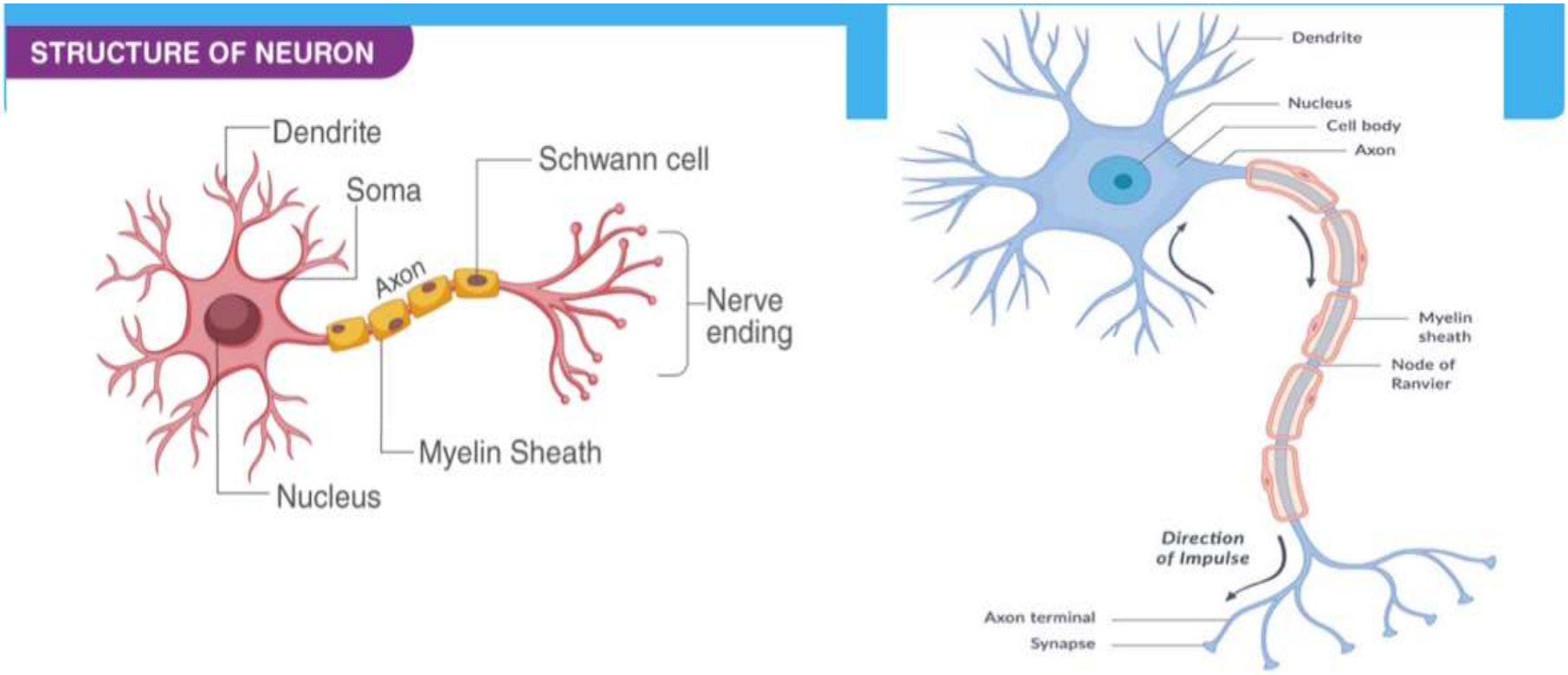
Peripheral Nervous System (PNS) – consists of cranial, spinal, and peripheral nerves that carry impulses to and from the CNS, as well as ganglia, which are small groups of nerve cells outside the CNS

The neuron is the functional unit of the nervous system.

It consists of a cell body the dendrites, and the axon,

The distal end of the axon branches (terminal arborizations,) and each branch ends in an end bulb (bouton).

These endings form synapses with other neurons or non-nerve cells, through which the nerve impulse is transmitted to the next cell in the neural pathway.



The cell body, (soma), is the part of the neuron that contains the nucleus and surrounding cytoplasm .It is primarily a trophic center, although most neurons perikarya also receive a great number of nerve endings that convey excitatory or inhibitory stimuli generated in other nerve cells.

Dendrites

are usually short and divide like the branches of a tree.

They are often covered with many synapses and are the principal signal reception and processing sites on neurons.

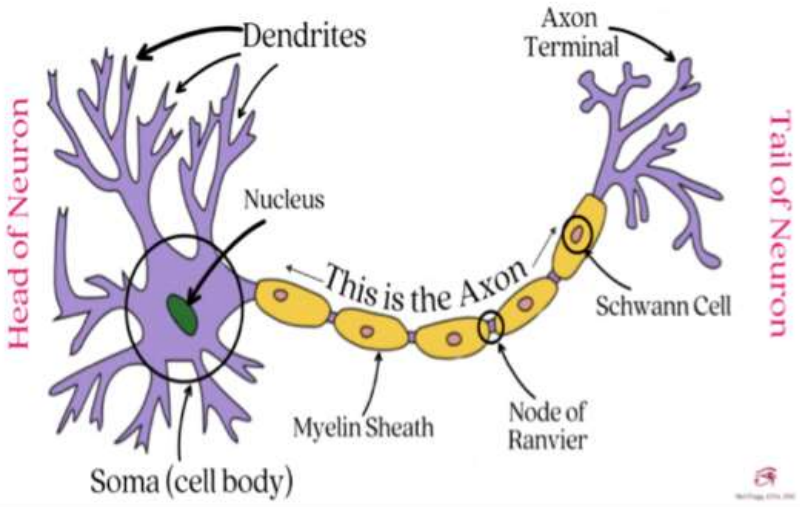
- Axons

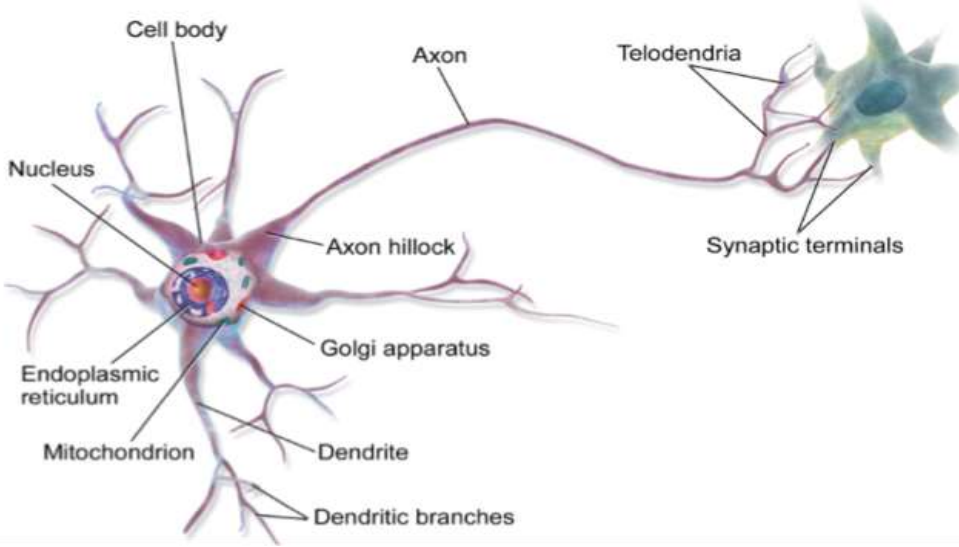
a cylindrical process that varies in length and diameter according to the type of neuron.

originate from a pyramid-shaped region, the axon hillock, arising from the soma .

Just beyond the axon hillock, at an area called the initial segment, where excitatory and inhibitory signals are integrated to trigger an action potential.

The plasma membrane of the axon is often called the axolemma and its contents are known as axoplasm.





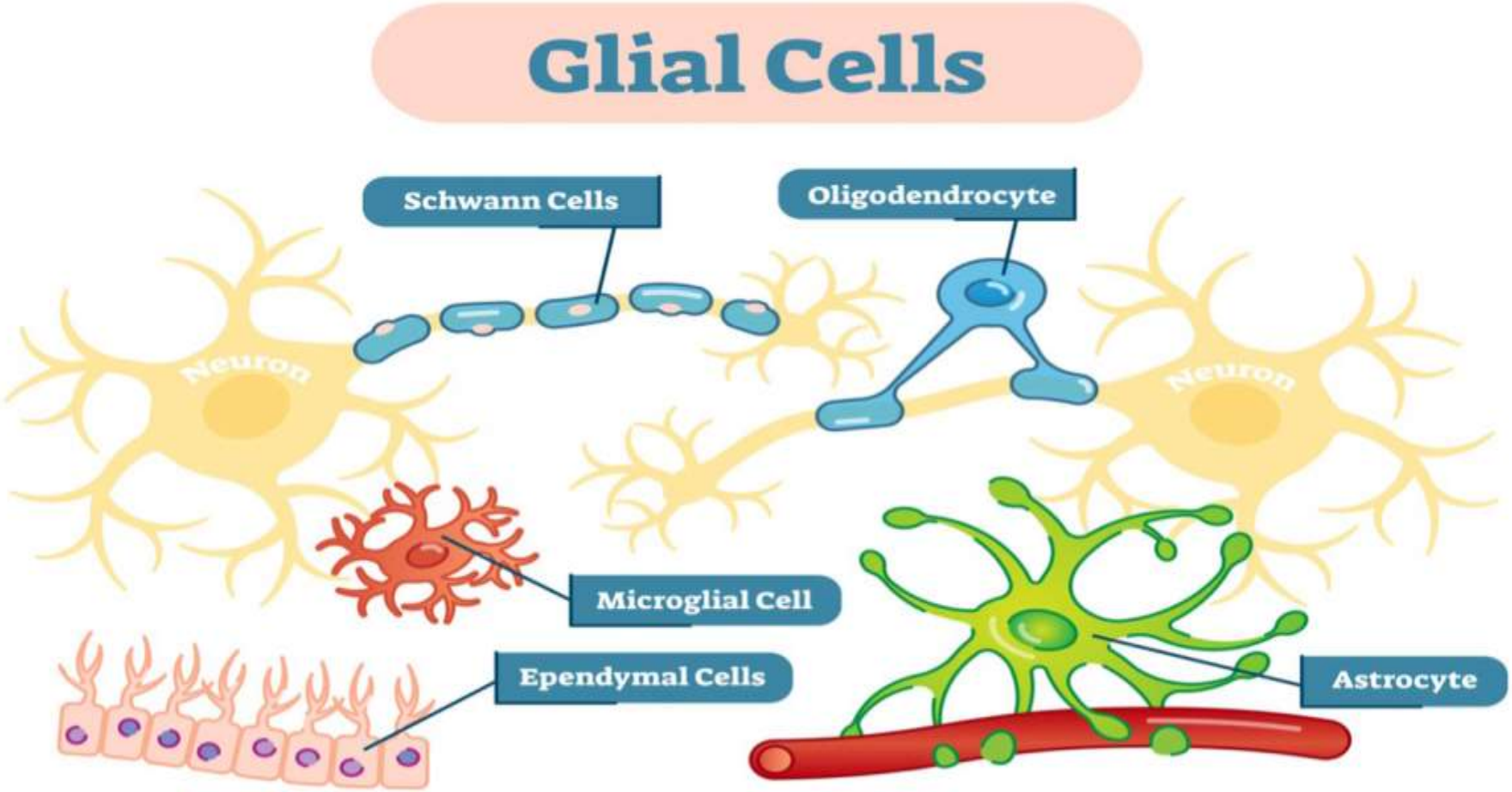
Glial cells are supporting cells in the nervous system, about ten times more numerous than neurons.

- Their functions include support, protection, nutrition, insulation, and regulation of the neuronal microenvironment.

Main types:

In CNS: Astrocytes, Oligodendrocytes, Microglia, Ependymal cells.

In PNS: Schwann cells, Satellite cells, Enteric glial cells.

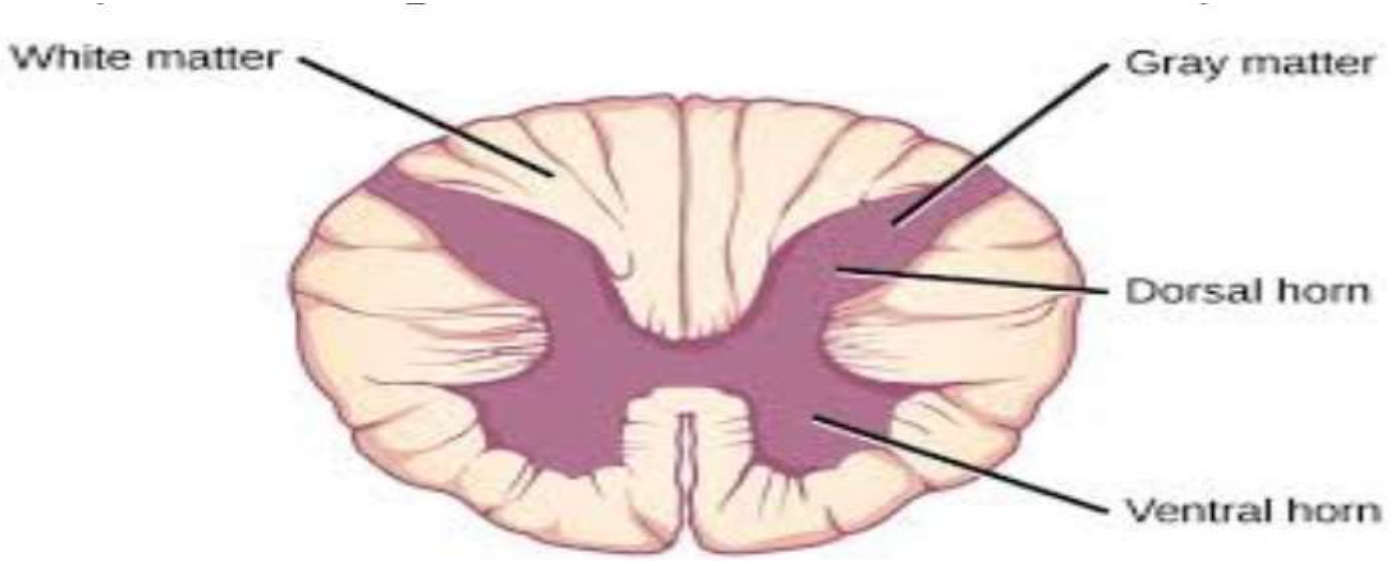


The principal structures of the CNS are the cerebrum, cerebellum, and spinal cord.

It has virtually no connective tissue and is therefore a relatively soft, gel-like organ.

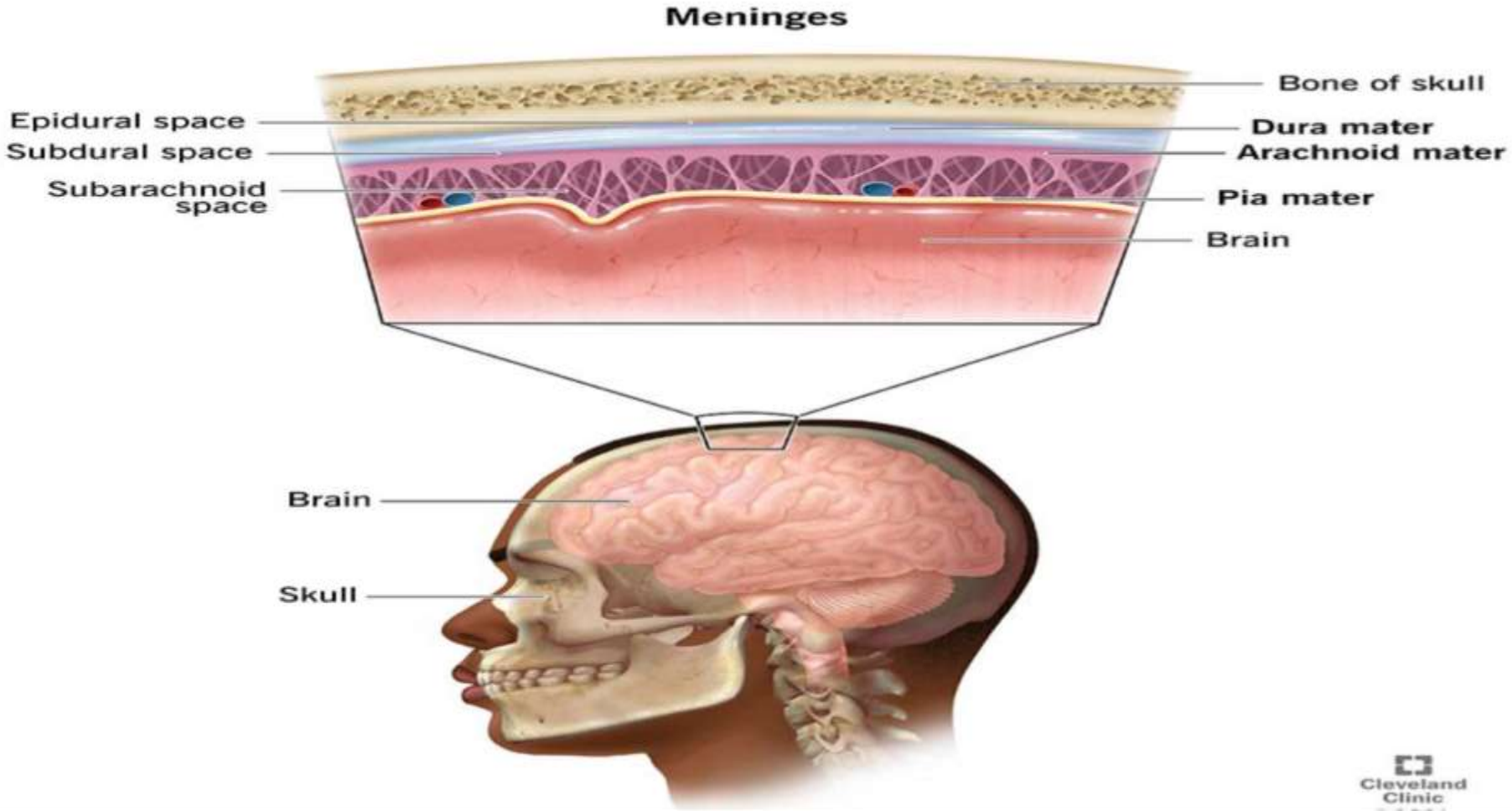
When sectioned, the cerebrum, cerebellum, and spinal cord show regions of white (white matter) and gray (gray matter), differences caused by the differential distribution of myelin.

white matter is peripheral and gray matter is internal and has the general shape of an H.



Between the bone and nervous tissue are membranes of connective tissue called the meninges

1. Dura mater:
2. Arachnoid:
3. Pia mater:



Peripheral Nervous System (PNS)

Main components: Nerves, ganglia, nerve endings.

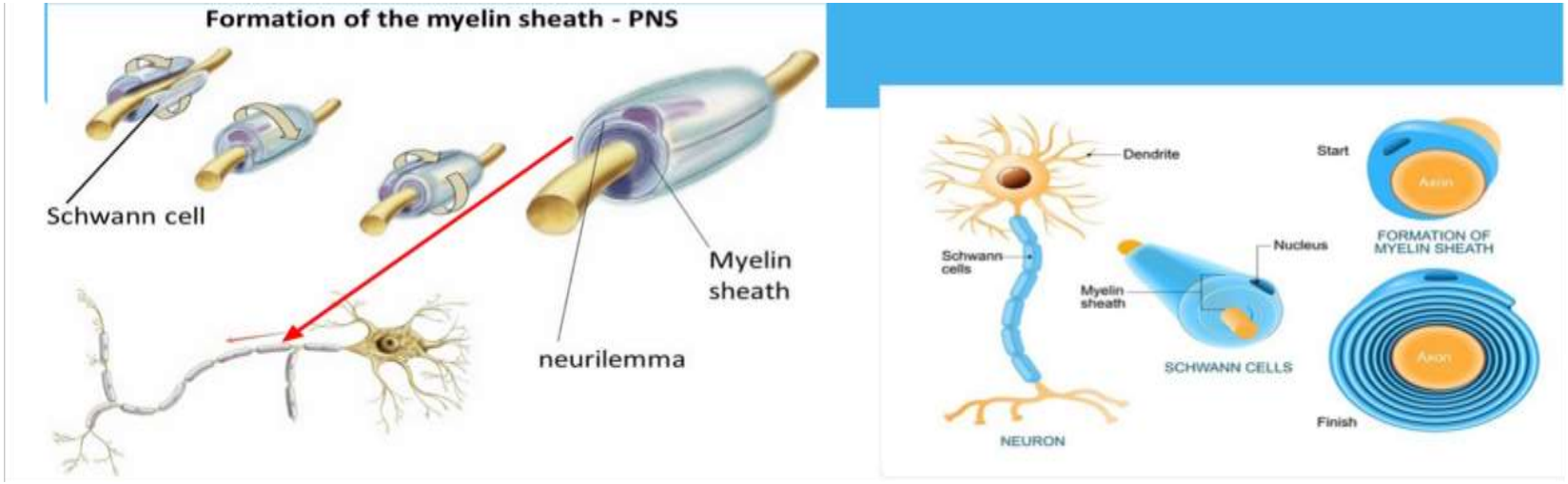
Nerves :Bundles of axons surrounded by Schwann cells and connective tissue layers:

Epineurium: Perineurium: Endoneurium

Ganglia Oval structures with neuron cell bodies and glial cells.

•Sensory ganglia:

Autonomic ganglia: .



The Digestive System

- The digestive system (also called the gastrointestinal system or GI system) is a group of organs responsible for ingestion, mechanical and chemical digestion, absorption, and excretion of food.

- Its primary function is to break down complex macromolecules into simple absorbable molecules that the body uses for energy production, growth, metabolism, and cellular repair.

Major Functions of the Digestive System

Ingestion: Entry of food into the oral cavity.
Mechanical Digestion:

Chemical Digestion:

Enzymatic breakdown of carbohydrates, proteins, and lipids into their monomers

Absorption:Transport of nutrients into the bloodstream or lymphatic circulation.

Excretion (Defecation):Elimination of undigested materials as feces.

The digestive tract (also called the gastrointestinal tract or GI tract) includes:

A. Upper GI Tract

- 1. Mouth
- • Begins mechanical digestion by chewing (mastication).
- • Saliva contains amylase, which starts carbohydrate digestion.

- 2. Pharynx and Esophagus
- • Pharynx directs food to the esophagus.
- • Esophagus transports food to the stomach using peristalsis.

3. Stomach

- A muscular organ that stores and mixes food.
- Secretes:Hydrochloric acid (HCl): Kills bacteria
- Pepsin: Begins protein digestion.

- B. Lower GI Tract

1. Small Intestine

Divided into:

- Duodenum
- Jejunum
- Ileum

Main site for chemical digestion and absorption.

2. Large Intestine (Colon)

- Absorbs water .
- beneficial bacteria that produce vitamins like vitamin K.

Forms and stores feces.

3. Rectum and Anus

- Responsible for storage and elimination of waste.

- The four main accessory digestive organs are the salivary glands, the liver, the gallbladder, and the pancreas.

Enzyme / Factor Responsible	Site of Digestion	Nutrient
Salivary amylase	Mouth	**Carbohydrates**
Pancreatic amylase	Small intestine	
Pepsin	Stomach	**Proteins**
Trypsin & Chymotrypsin	Small intestine	
Bile salts (emulsification)	Small intestine	**Fats (Lipids)**
Pancreatic lipase	Small intestine	

Layers of the Gastrointestinal (GI) Tract

Layer 1: Mucosa :it consists of three parts:

1) Epithelium

- Mouth and esophagus: Stratified squamous epithelium (for protection)
- Stomach and intestines: Simple columnar epithelium (for absorption and secretion)

2) Lamina propria

- A connective tissue layer that contains:
- Capillaries ،Lymphatic vessels
- Immune cells

3) Muscularis mucosae

- A thin layer of smooth muscle that helps move the mucosa and enhances absorption.

- Layer 2: Submucosa
- his • Dense connective tissue
- • Larger blood vessels
- Glands in some regions
- An important nerve plexus

- Layer 3: Muscularis externa
- This layer contains two main layers of smooth muscle:
- • Auerbach’s plexus
- • Responsible for regulating peristalsis

- Layer 4: Serosa
- • Found in organs covered by the peritoneum
- • Composed of simple squamous epithelium

Muscle tissue

Muscle tissue is one of the four basic tissue types in the body, along with epithelial, connective, and nervous tissues. It is specialized for contraction.

In all muscle cells, microfilaments and associated proteins generate the forces necessary for muscle contraction.

This contraction causes movement, which drives movement within organ systems, blood, and the body as a whole.

All muscle types contract through sliding of myosin filaments along actin filaments.

Other proteins regulate weak interactions between actin and myosin bridges, generating the necessary force

Essentially all muscle cells are of mesodermal origin and differentiate through a gradual process of cell elongation, accompanied by abundant synthesis of myofibrillar proteins, actin, and myosin.

Based on morphological and functional characteristics, muscle tissue can be classified into three types:

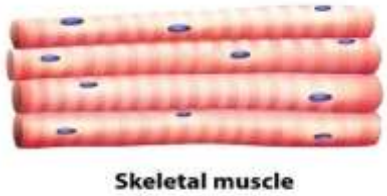
skeletal, cardiac, and smooth muscle, each adapted to its specific physiologic role.

Sarcoplasm →Cytoplasm of the muscle cell

Sarcolemma →Muscle cell membrane

Sarcoplasmic reticulum →Stores calcium for contraction

Skeletal Muscle



- Composed of long, cylindrical, multinucleated fibers with diameters of 10–100 μm.
- During embryonic development, mesenchymal myoblasts fuse to form myotubes with many nuclei.
- Myotubes differentiate further to form striated skeletal muscle fibers.
- Nuclei are elongated and located peripherally under the sarcolemma, a feature unique to skeletal muscle fibers.
- A small population of muscle satellite cells (reserve progenitor cells) remains adjacent to most fibers to help with muscle repair and regeneration.

Cardiac Muscle

Found only in the heart wall .

Fibers are branched and connected by special junctions called intercalated discs.

Usually one centrally located nucleus per cell Contraction is involuntary .rhythmic, strong, and continuous.

Like skeletal muscles, they are striated .

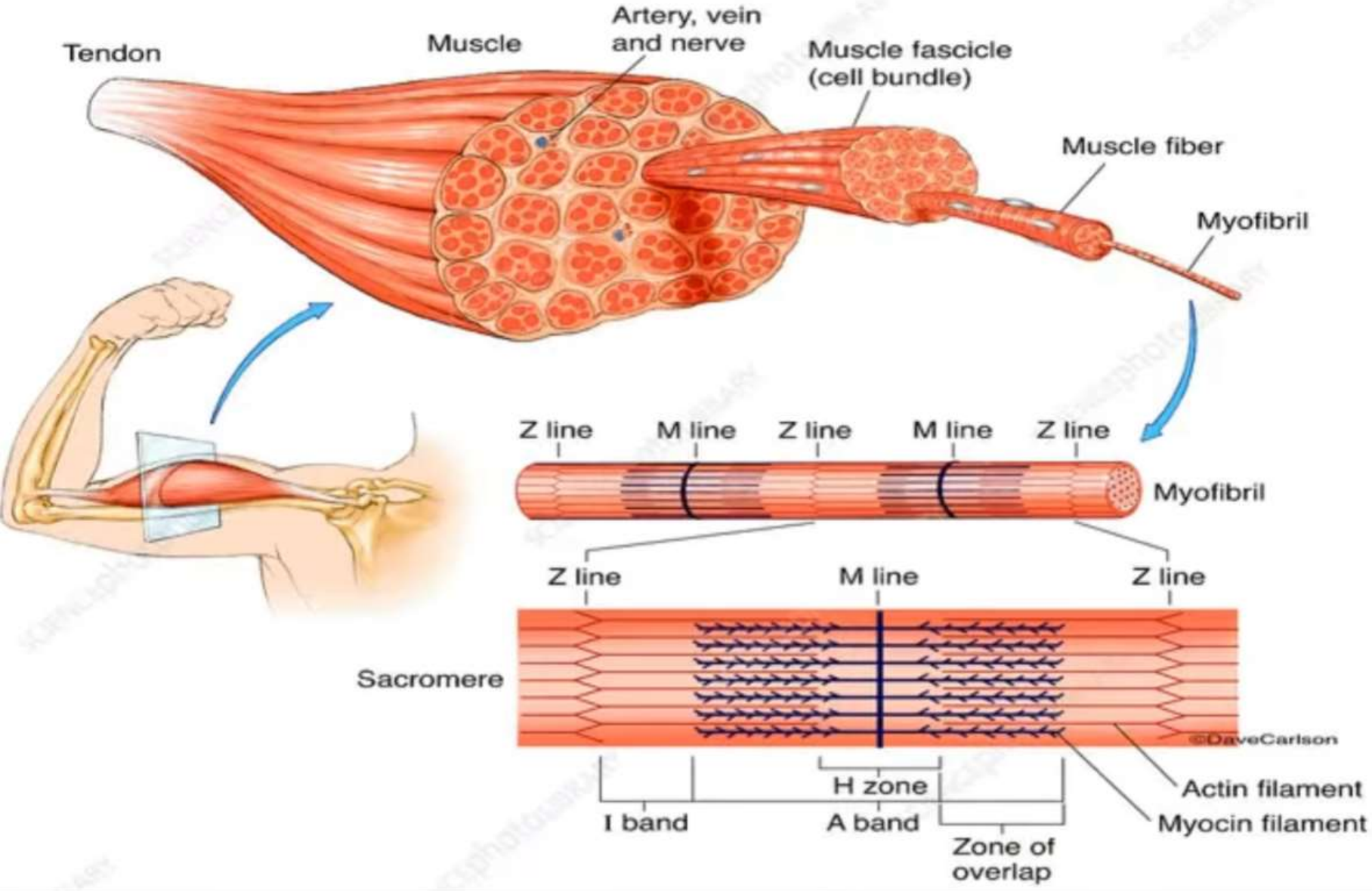
Smooth Muscle

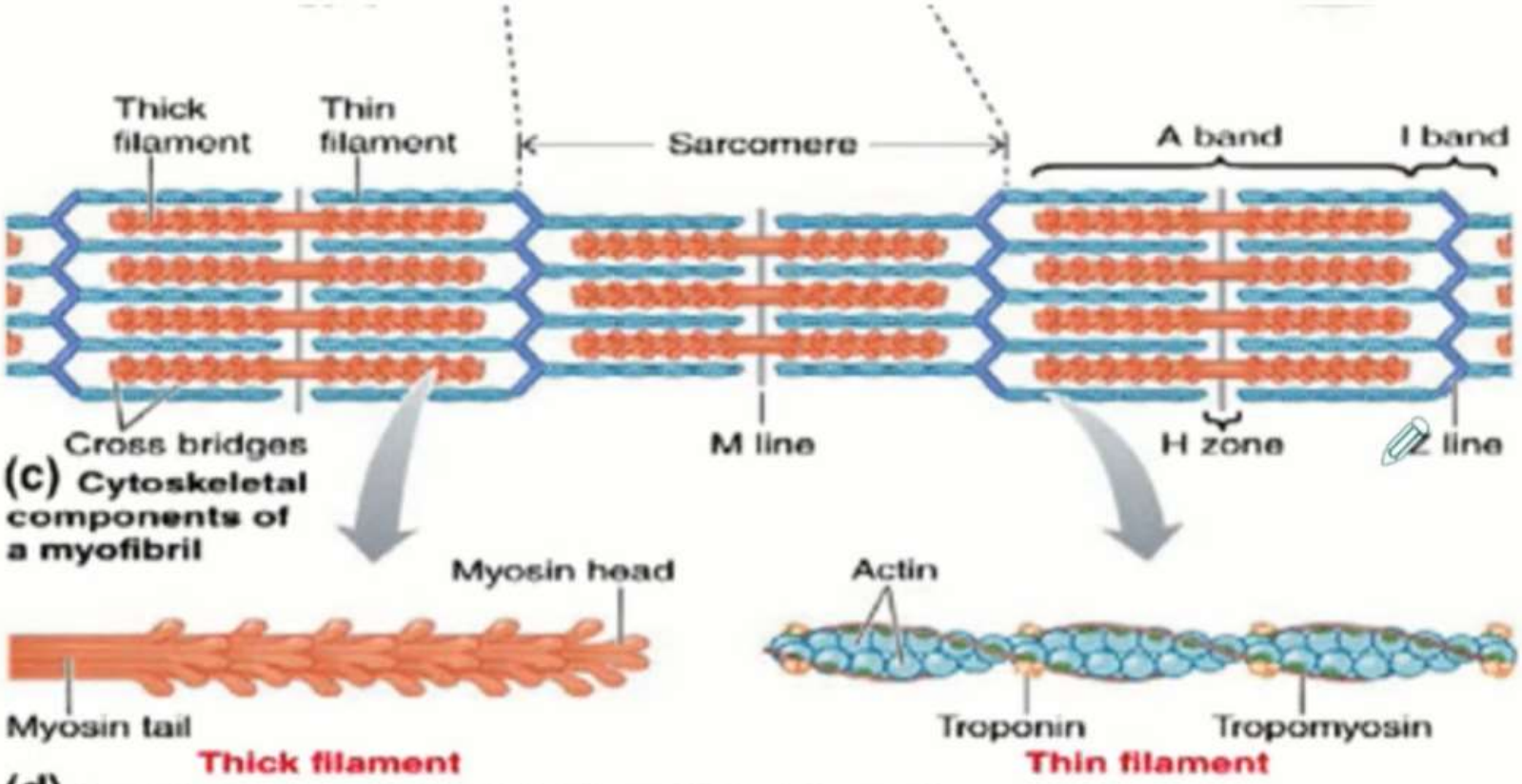
Found in the walls of the intestine and other internal organs, so they are also called visceral muscles.

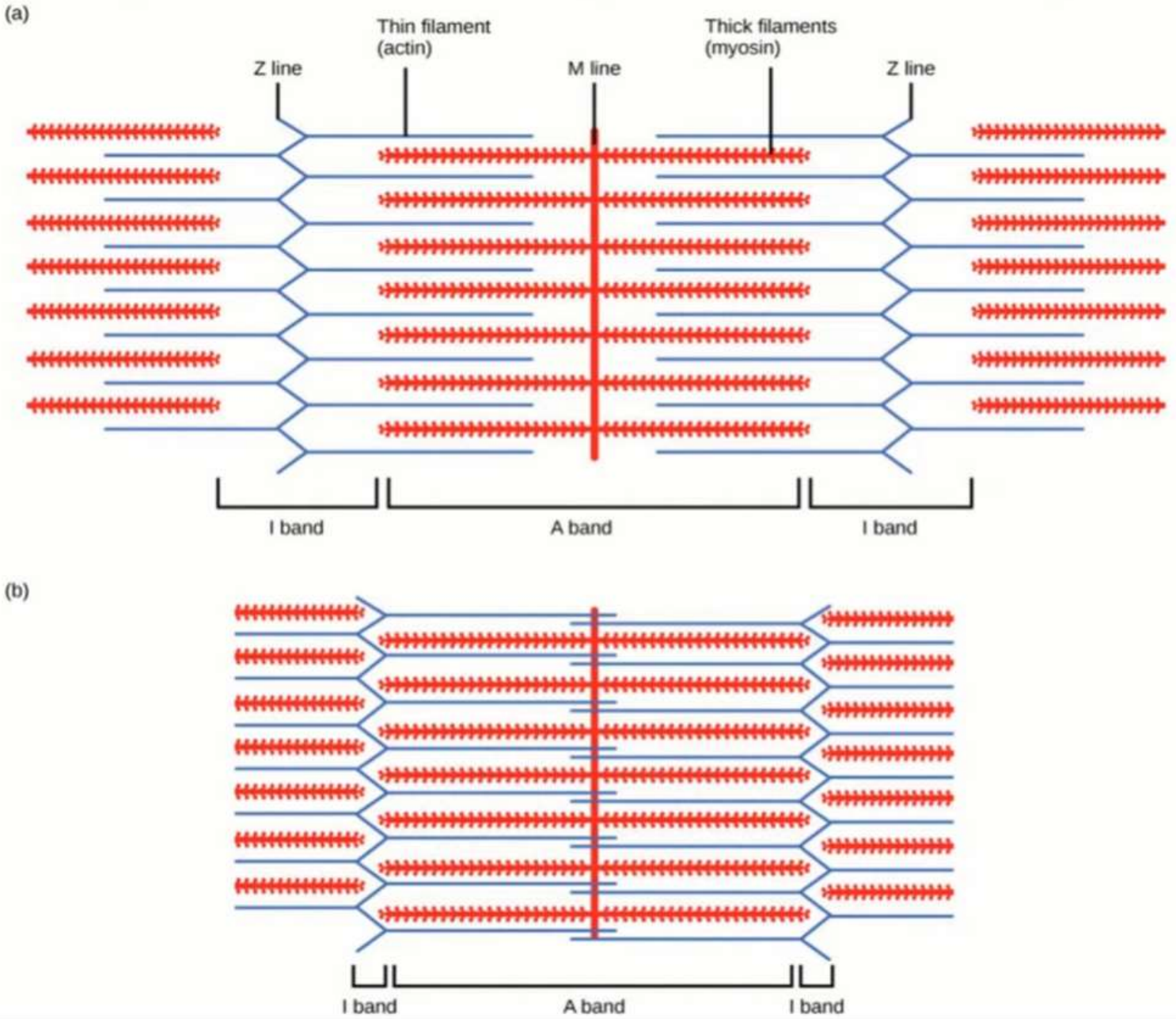
Composed of long, spindle-shaped cells has a single, centrally located nucleus (oval or rod-shaped)

Their contraction is not under voluntary control, so they are called involuntary muscles.

non-striated .


Tendon
Muscle
Artery, vein and nerve
Muscle fascicle (cell bundle)
Muscle fiber
Myofibril
Z line
M line
Z line
M line
Z line
Myofibril
Z line
M line
Z line
Sacromere
©DaveCarlson
H zone
I band
A band
Zone of overlap
Actin filament
Myocin filament


Thick filament
Thin filament
Sarcomere
A band
I band
Cross bridges
M line
H zone
Z line
(c) Cytoskeletal components of a myofibril
Myosin head
Actin
Myosin tail
Troponin
Tropomyosin
Thick filament
Thin filament
(d) Protein components of thick and thin filaments

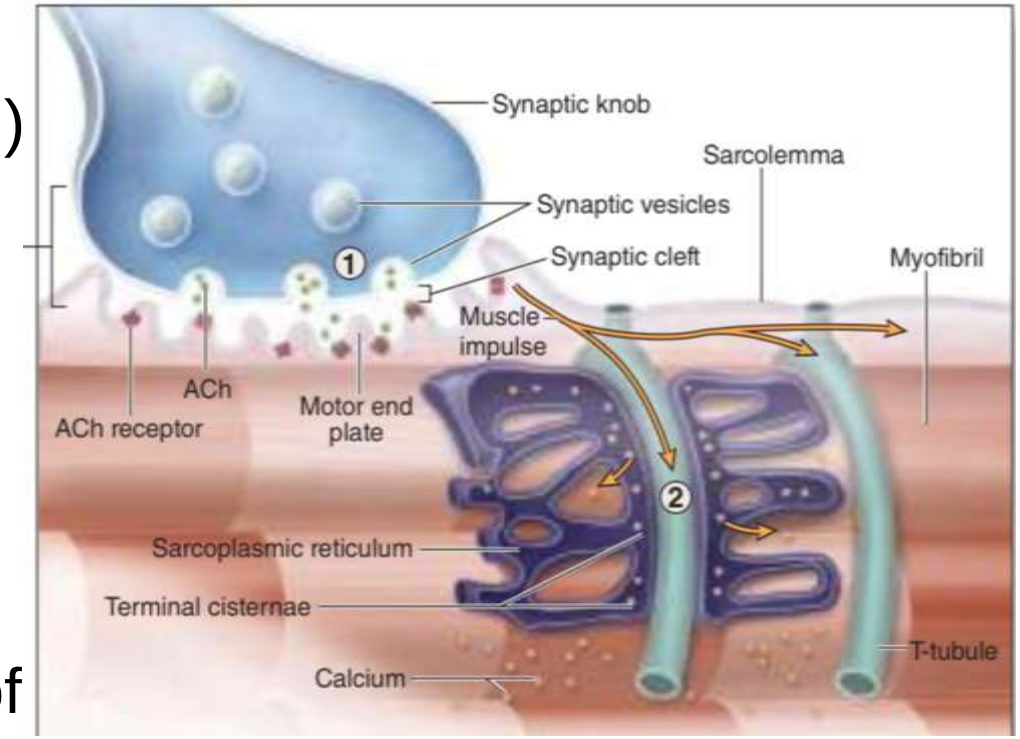

(a)
Thin filament
(actin)
Thick filaments
(myosin)
Z line
M line
Z line
I band
A band
I band
(b)
I band
A band
I band

neuromuscular junction

A nerve impulse reaches the synaptic knob (axon terminal)

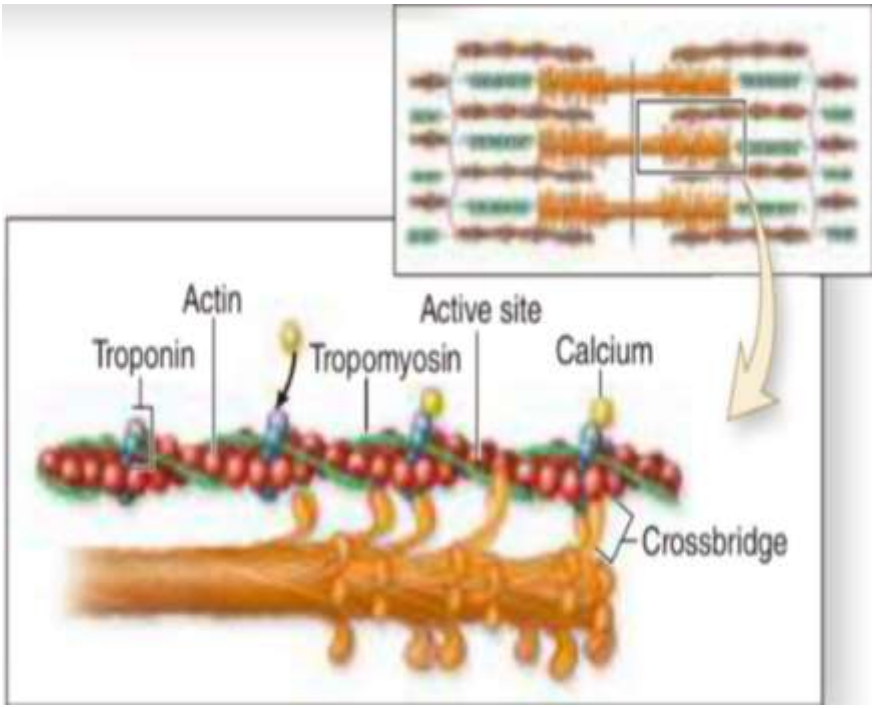
This triggers the release of acetylcholine (ACh) into the synaptic cleft.

ACh binds to ACh receptors on the motor end plate .This binding initiates a muscle impulse in the sarcolemma of the muscle fiber.

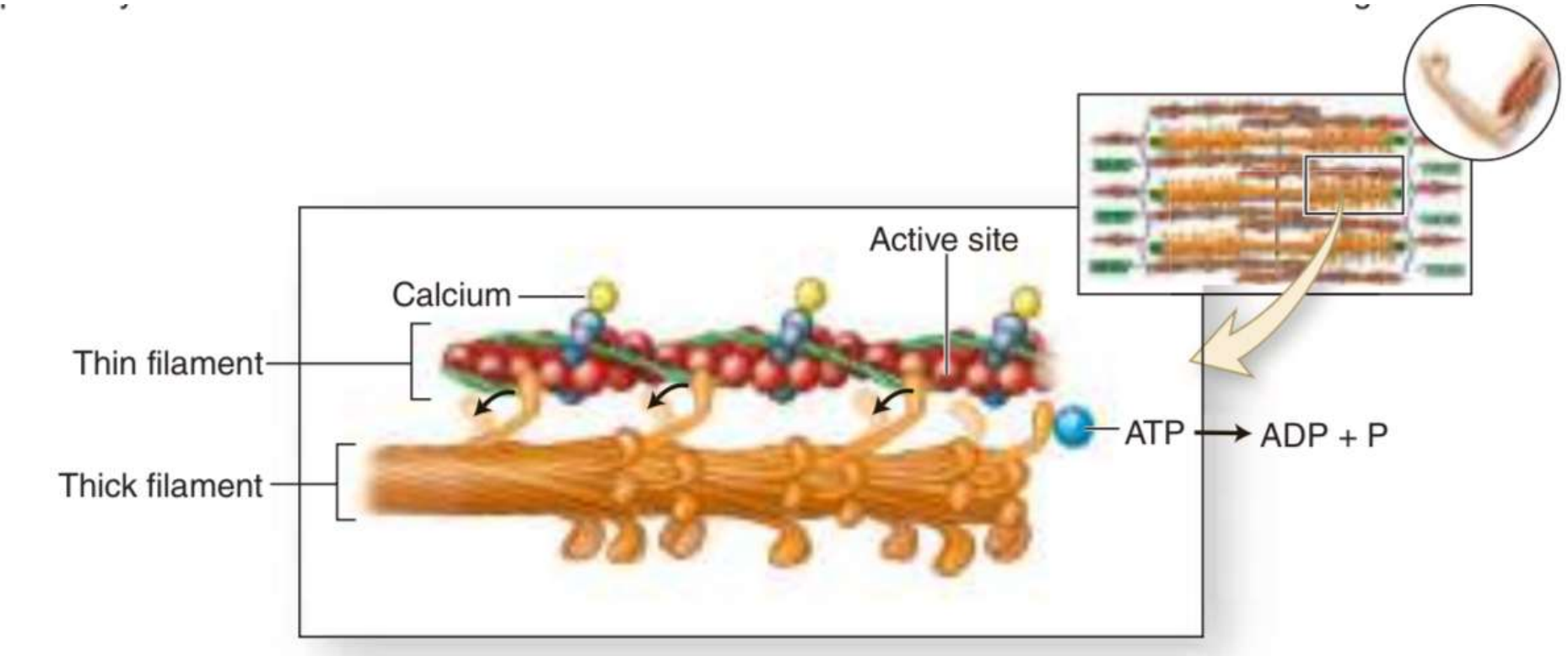


As the muscle impulse spreads quickly from the sarcolemma along T tubules, calcium ions are released nto the sarcoplasm.

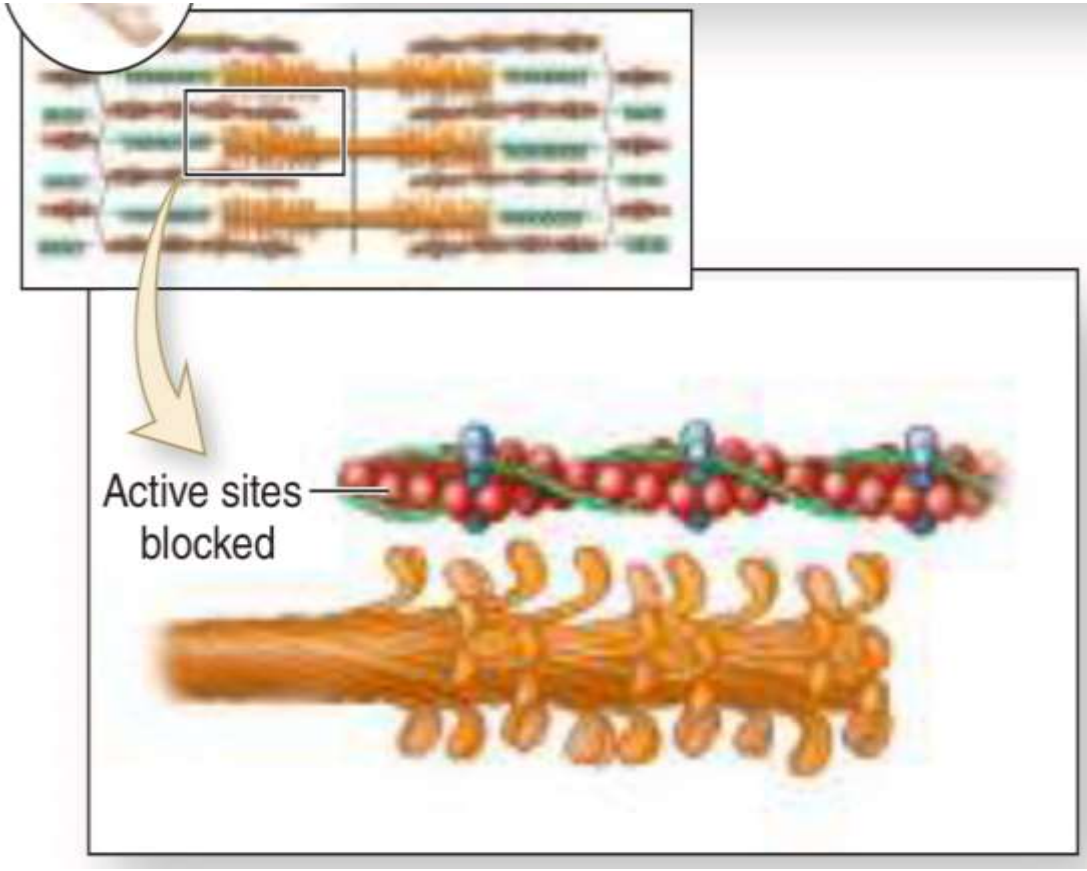
- Calcium ions bind to troponin. Troponin changes shape, moving tropomyosin on the actin to expose active sites on actin molecules of thin filaments. Myosin heads of thick filaments attach to exposed active sites to form crossbridges.



- Myosin heads pivot, moving thin filaments toward the sarcomere center. ATP binds myosin heads and is broken down into ADP and P. Myosin heads detach from thin filaments and return to their prepivot position. The repeating cycle of attach-pivot-detach-return slides thick and thin filaments past one another. The sarcomere shortens and the muscle contracts.



When the impulse stops, calcium ions are actively transported into the sarcoplasmic reticulum, tropomyosin re-covers active sites, and filaments passively slide back to their relaxed state.



Circulatory system

MSC.MARIAM ISSAM

The circulatory system consists of the blood vascular system and the lymphatic system.

The blood vascular system includes:

1. Heart: Pumps blood throughout the body.
2. Arteries: Blood vessels that carry oxygenated blood away from the heart to the tissues.
3. Capillaries: The smallest blood vessels where the exchange of gases and nutrients occurs between blood and tissues.
4. Veins: Blood vessels that return deoxygenated blood from the tissues back to the heart to be pumped again.

It is a closed system that ensures continuous, one-way blood flow, delivering oxygen and nutrients while removing waste products.

- The lymphatic vascular system begins with closed-ended lymphatic capillaries that merge to form larger vessels, eventually draining into the large veins near the heart.
- Its main function is to return interstitial fluid from the tissues back to the bloodstream, maintaining fluid balance in the body.
- All parts of the blood and lymphatic systems are lined by a single layer of squamous epithelial cells called endothelium, which regulates fluid and immune cell movement.

The heart is a muscular organ that contracts rhythmically to pump blood through the circulatory system.

The right ventricle pumps blood to the lungs, while the left ventricle pumps blood to the rest of the body.

The right atrium receives blood from the body, and the left atrium receives blood from the pulmonary veins.

The walls of all four heart chambers consist of three main layers:

1. The internal layer (endocardium),
2. The middle layer (myocardium),
3. The external layer (epicardium).

The internal layer (endocardium) is composed of a single layer of squamous endothelial cells,

which rests on a thin layer of loose connective tissue containing elastic fibers and collagen fibers, as well as some smooth muscle cells.

Structural Plan of Blood Vessels

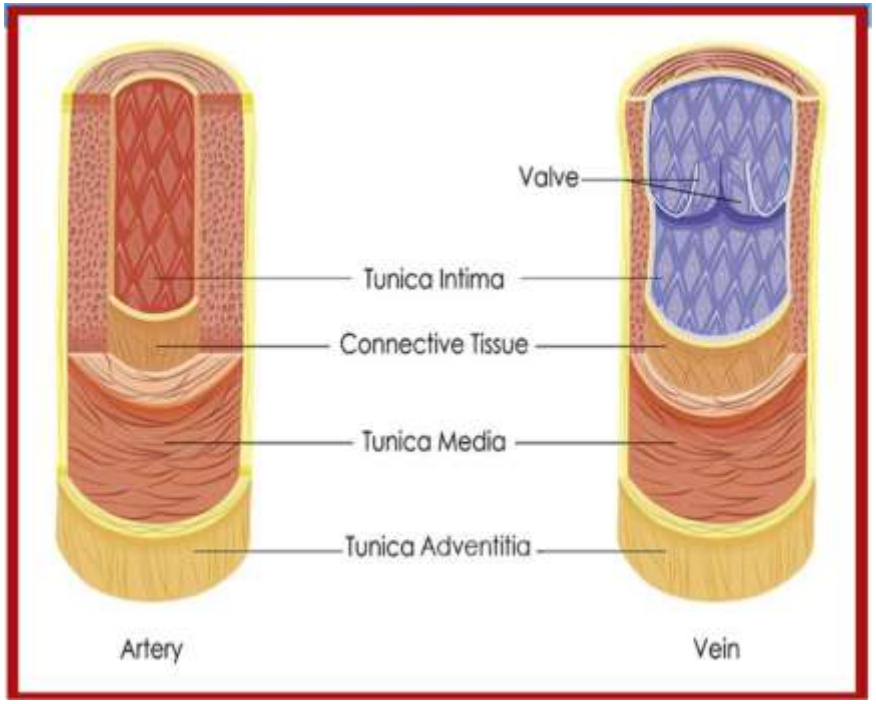
- Blood vessels are usually composed of the following layers, or tunics:
- 1- Tunica Intima:
- It consists of a single layer of endothelial cells supported by a thin subendothelial layer of loose connective tissue, with occasional smooth muscle cells.

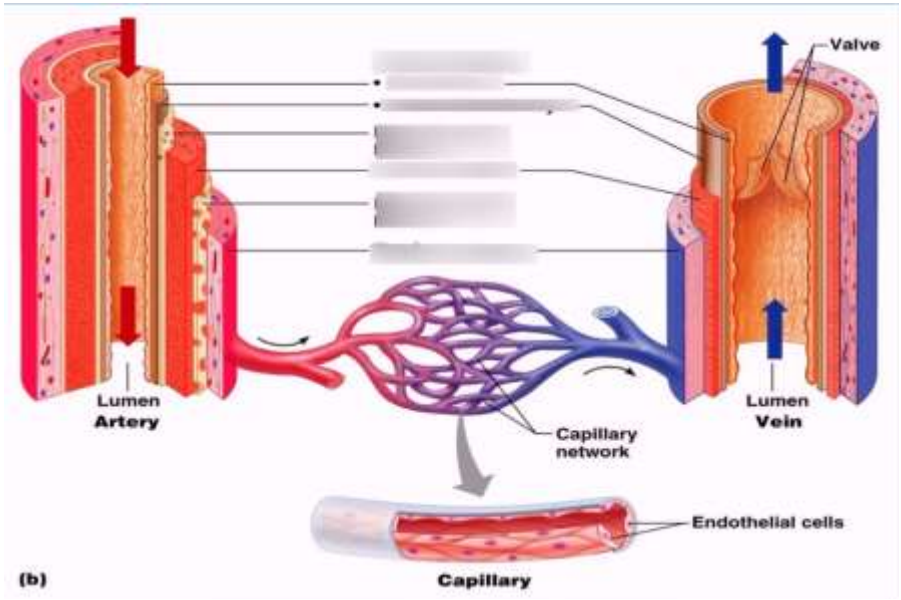
- In arteries, the tunica intima is separated from the tunica media by an internal elastic lamina, which is the outermost component of the intima.
- This lamina, composed of elastin, contains holes (fenestrae) that allow the diffusion of substances to nourish cells deep in the vessel wall

- 2- Tunica Media:
- The middle layer is composed mainly of concentric layers of helically arranged smooth muscle cells.
- Interposed among the smooth muscle cells are variable amounts of elastic fibers, lamellae, reticular fibers, and glycoproteins, all produced by these cells.

- In arteries, the media has a external elastic lamina that separates it from the tunica adventitia.

- 3- Tunica Adventitia (or Tunica Externa):
- This layer consists mainly of type I collagen and elastic fibers.





Arteries:

Have a thicker tunica media. a relatively narrow lumen.

Veins:

Have a larger lumen.

The tunica externa is the thickest layer.

The tunica intima is often folded to form valves.

Capillaries:

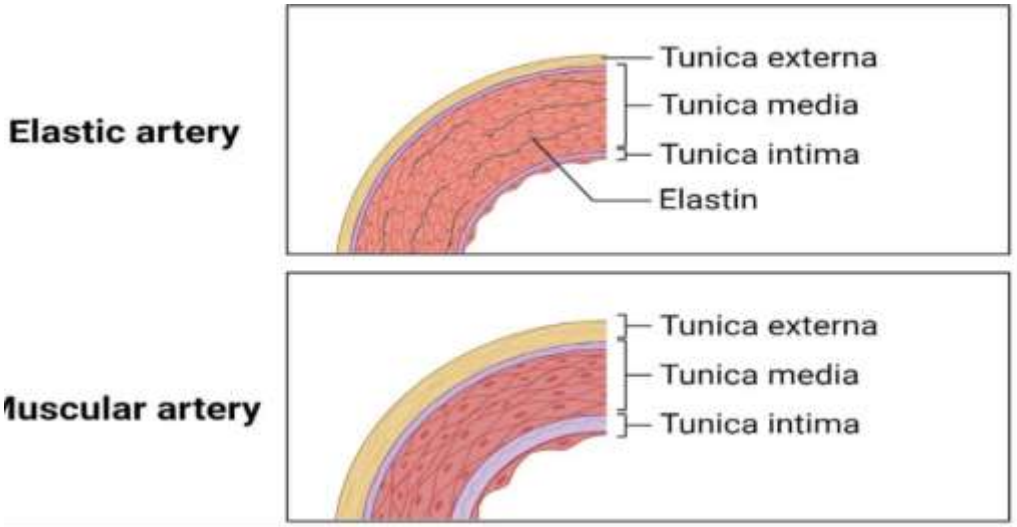
Have only an endothelium.

No subendothelial layer or other tunics.

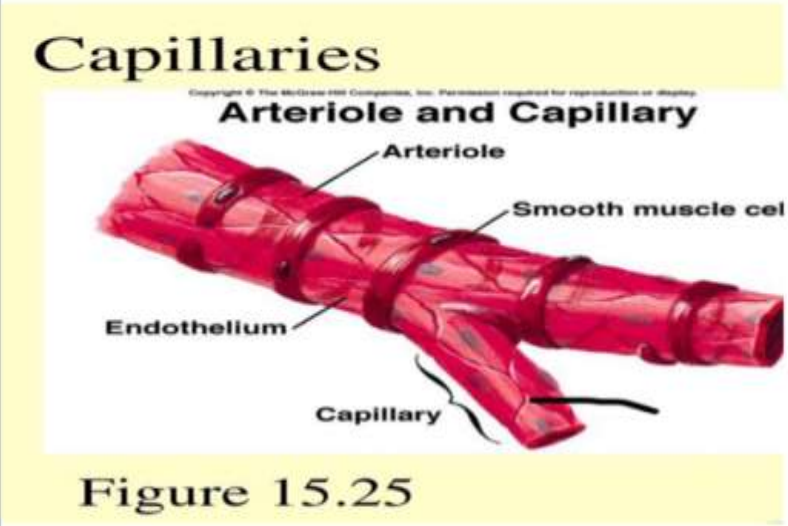
- Large blood vessels have vasa vasorum ("vessels of the vessel") in the tunica adventitia and outer media to supply nutrients because their walls are too thick for diffusion from the lumen. Only the tunica intima is nourished directly by luminal blood. Large veins usually have more vasa vasorum than arteries since they carry deoxygenated blood.

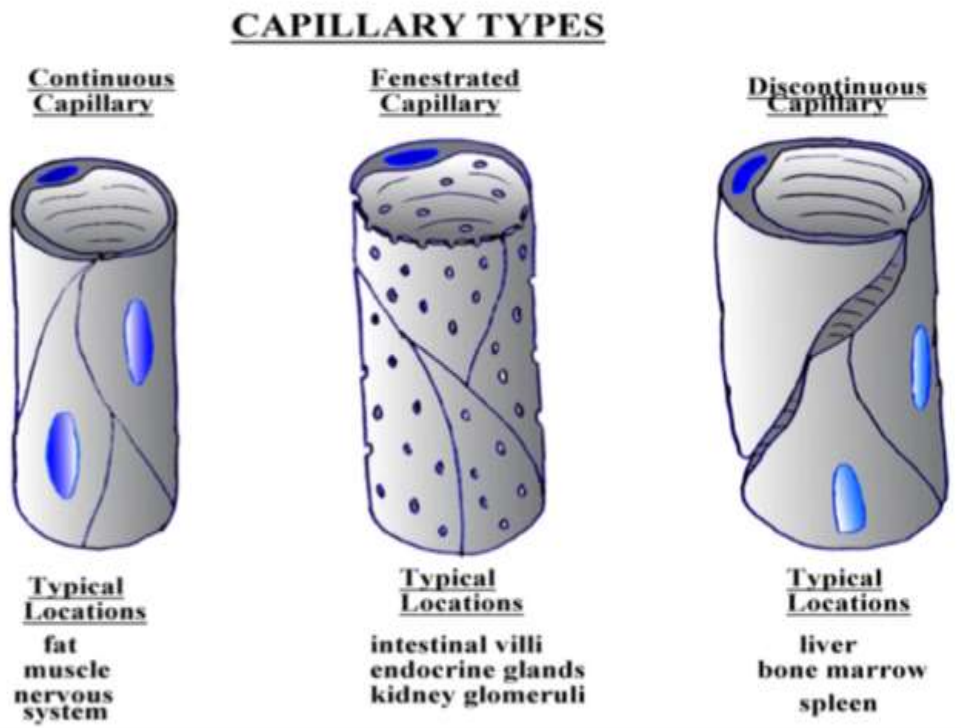
-

Muscular Arteries	Elastic Arteries	Feature
Control blood flow to organs	Stabilize and smooth blood flow from the heart	Function
Less abundant; some elastic lamellae among smooth muscle layers	Abundant in the tunica media	Elastin
Normal, not yellowish	Yellowish due to elastin	Color (freshly dissected)



- Capillaries allow different levels of metabolic exchange between the blood and the surrounding tissues.
- They are made of a single layer of endothelial cells rolled into a thin tube.
- Because their walls are very thin and the blood flow inside them is very slow, they are ideal for the exchange of water, small solutes, and large molecules (macromolecules) between blood and tissues.





Continuous Capillaries:

- Their wall is made of continuous endothelial cells
- Allow regulated exchange of small molecules only.
- Found in: muscles, connective tissue, and exocrine glands.

Fenestrated Capillaries:

- Have (fenestrae) in endothelial cells covered by thin diaphragms.
- Allow faster exchange of dissolved substances.
- Found in: kidneys, intestines, endocrine glands, and choroid plexus.

Sinusoidal (Discontinuous) Capillaries:

- Have fenestra and discontinuous endothelial cells
- Allow passage of large molecules .
- Found in: liver, spleen, bone marrow, and some endocrine organs.

2. Veins

Blood in veins is under very low pressure, so it cannot easily flow toward the heart on its own.

Blood moves toward the heart through:

1. Contraction of the muscle layer in the vein wall (tunica media).
2. Pressure from surrounding muscles and other organs on the vein.

Veins have valves to prevent backflow of blood (they act like one-way gates).

•

Small and medium veins:

Usually located beside muscular arteries.

Vein wall consists of layers:

1. Tunica intima :thin, with a small subendothelial layer.
2. Tunica media : small bundles of smooth muscle mixed with elastic and reticular fibers.

Large veins:

- Associated with large arteries near the heart.
- Tunica intima is well-developed.
- Tunica media is relatively thin, contains fewer muscle layers and more connective tissue.

- In addition to blood vessels, the body has a system of thin-walled lymphatic vessels that collect excess interstitial fluid from tissues and return it to the blood. This fluid is called lymph, and unlike blood, it flows in only one direction, toward the heart.
- Lymphatic capillaries closed-ended vessels made of a single layer of endothelium and an incomplete basal lamina.