

Human Biology

The Tissues

First Stage

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The Tissue

A tissue is composed of specialized cells of the same type that perform a common function in the body.

The tissues of the human body can be categorized into four major types:

- Epithelial tissue covers body surfaces and lines body cavities.**
- Connective tissue binds and supports body parts.**
- Muscular tissue moves the body and its parts.**
- Nervous tissue receives sensory information and conducts nerve impulses.**

Body membranes line cavities and the internal spaces of organs and tubes.

The body membranes are four types:

Mucous, Serous, and Synovial membranes and Meninges.

- **Mucous membranes** line The body cavity or hollow passageway that is open to the external environment. Line the tubes of the digestive, respiratory and urinary systems.

They are composed of an epithelium overlying a loose fibrous connective tissue layer. The epithelium contains specialized cells that secrete mucus.

- **Serous membranes (mesothelium)** line the cavities of the body that do not open to the external environment. Line and support the lungs, the heart, and the abdominal cavity and its internal organs .

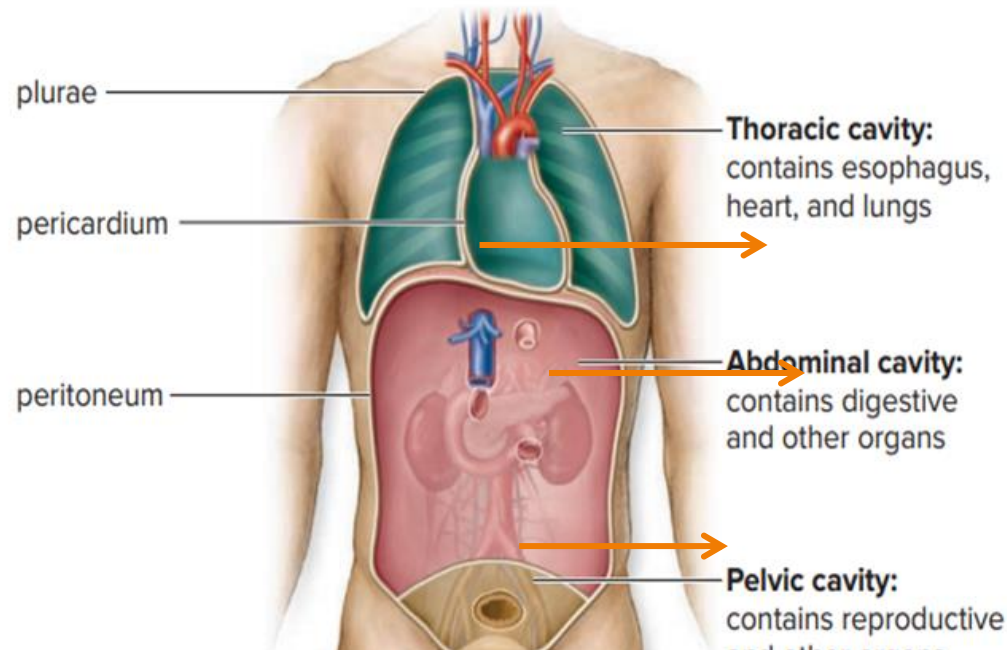
- They secrete **serous fluid** a watery fluid that keeps the membranes lubricated.

Serous membranes have specific names according to their location.

✓ **The pleurae** (sing., pleura) line the thoracic cavity and cover the lungs.

✓ **The pericardium** forms the pericardial sac and covers the heart.

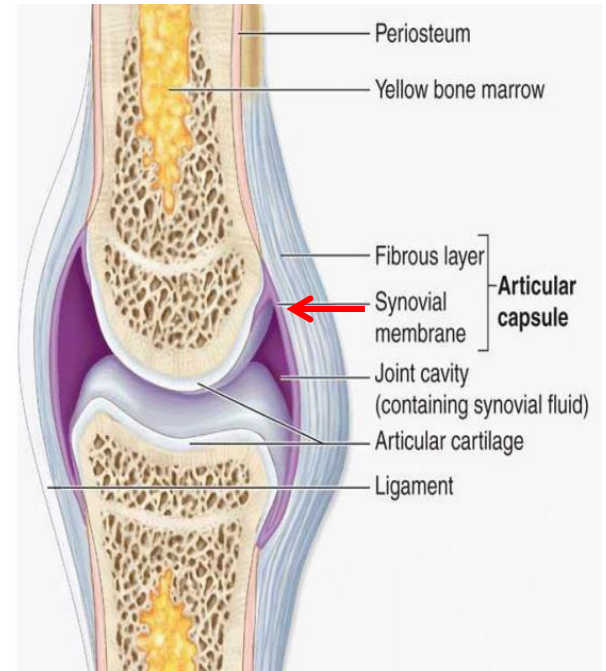
✓ **The peritoneum** lines the abdominal cavity and covers its organs.



- **Synovial membranes** composed only of loose connective tissue line the cavities of freely movable joints.

They secrete **synovial fluid** into the joint cavity.

This fluid lubricates the ends of the bones, so that they can move freely.

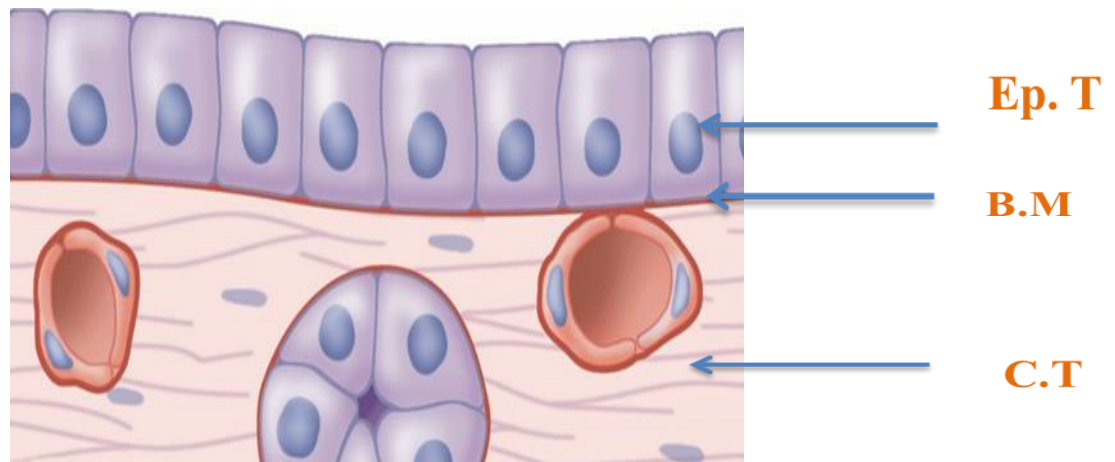


- **The meninges** (sing., meninx) are membranes within the dorsal cavity.

They are composed only of connective tissue and serve as a protective covering for the **brain** and **spinal cord**.

Epithelial tissue

- Consists of tightly packed cells that form continuous layer , rest on top of basement membrane, which separates epithelia from underlying connective tissues.
- The unique feature of the epithelial tissues is its highly cellular composition with little extracellular matrix (ECM).
- The epithelial tissue has no blood vessels but can soak up nutrients from blood vessels in connective tissue underneath.



The principal functions of epithelial tissues are:

- ✓ **Protection : Covering, lining, and protecting surfaces (eg, skin)**
- ✓ **Absorption : Cells may have microvilli which enhance absorption (eg, intestinal) .**
- ✓ **Secretion : Epithelial cell form glands that secrete various substances.**

Types of epithelia

Epithelia can be divided into two main groups according to their structure and function:

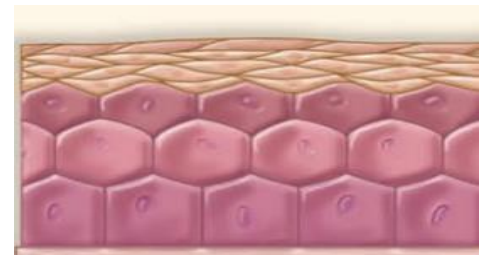
- **Covering (or lining) epithelia .**
- **Secretory (glandular) epithelia.**

Covering or Lining Epithelia :

Cells of covering epithelia are organized into one or more layers that cover the external surface or line the cavities of an organ.

are classified according to the number of cell layers:

- **Simple Epithelia Tissue** contain one cell layer.
- **Stratified Epithelia Tissue** contain two or more layers.

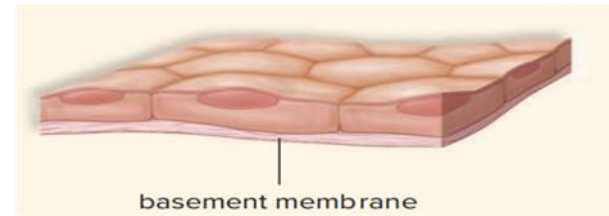


Simple Epithelium Tissue:

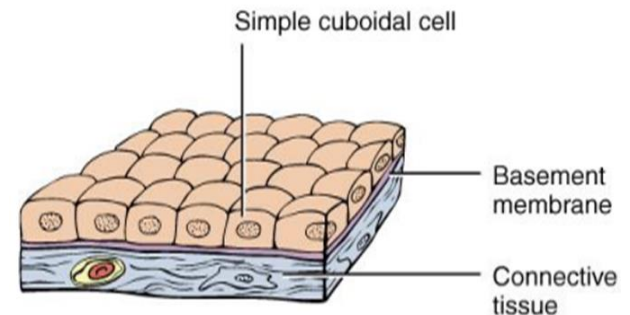
Is found where absorption and filtration occur.

Based on cell shape, simple epithelia are classified as:

1-Simple Squamous epithelium composed of flattened cells, lining the air sacs of lungs (alveoli) and walls of blood vessels.



2- Simple Cuboidal epithelium consists of a single layer of cube-shaped cells. This type of epithelium is found in glands, such as the salivary, the thyroid, the pancreas glands and lines kidney tubules.



3- Simple Columnar epithelium Single layer, rectangular cells, with nuclei located near the bottom of each cell, can be ciliated or non-ciliated; some tissues contain **goblet cells** (unicellular glands secrete mucus for lubricate gut intestine tract).

- **Ciliated columnar epithelium** , lining the oviducts.

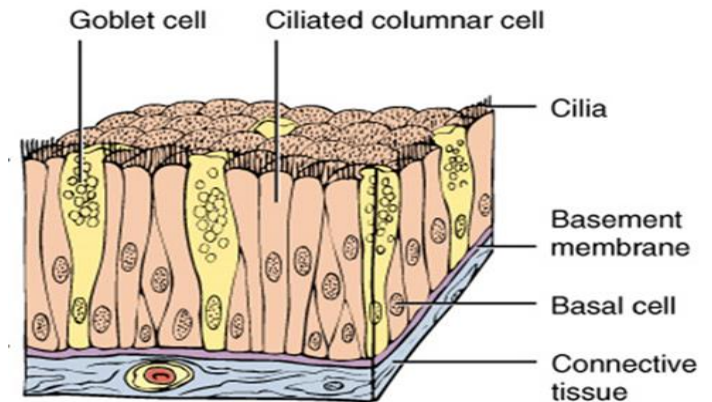
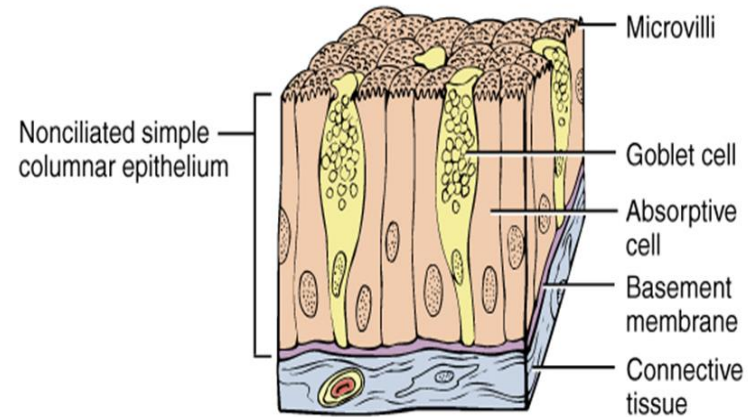
- **Non-ciliated columnar epithelium** can also possess **microvilli**.

4- Pseudostratified columnar epithelium

single cell layer, tall and irregular cells.

All cells attach to basement membrane but not all reach free surface. Nuclei at different level, giving a stratified appearance.

- Lining the upper respiratory tract.

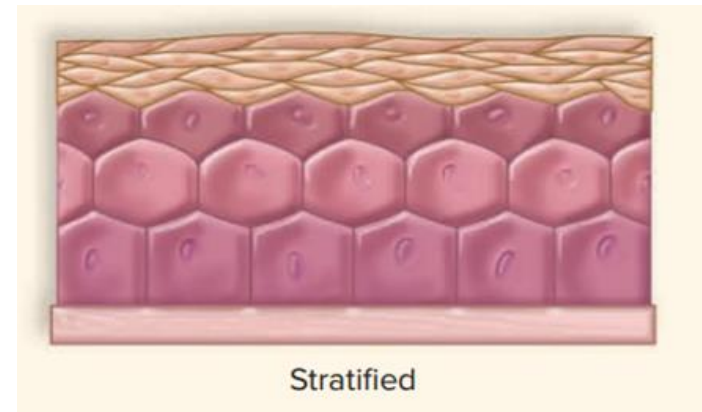


Stratified Epithelium Tissue

Is multilayered, therefore found where body linings have to withstand mechanical or chemical insult.

Most stratified epithelia are classified according to the **cell shape** of the **superficial layer(s)**:

1. **Stratified squamous epithelia** several cell layers thick, surface cells flat and can be:
 - **Keratinized** : Surface cells dead and filled with keratin, skin (epidermis).
 - **Nonkeratinized** : No keratin in moist living cells at surface lines wet cavities (mouth and esophagus).

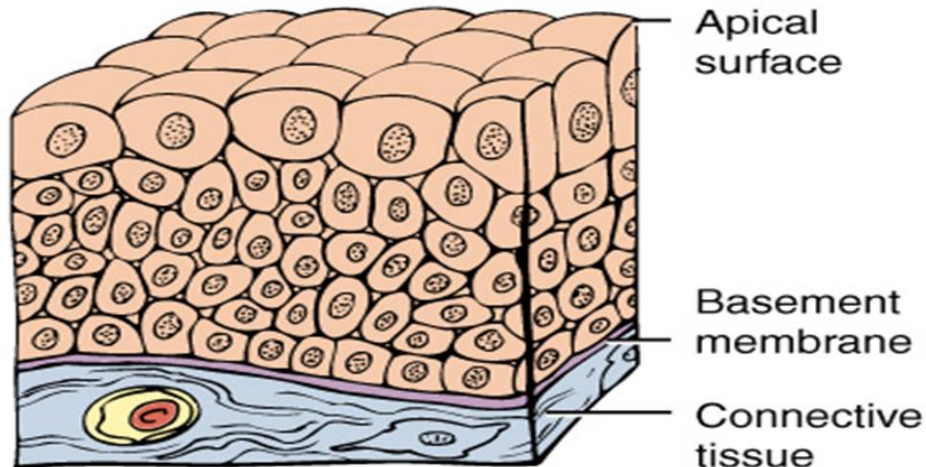


2- Stratified cuboidal epithelium is restricted to excretory ducts of salivary and sweat glands.

3- Stratified columnar epithelia can be found in the conjunctiva lining the eyelids.

3- Transitional epithelium or urothelium : multilayered , superficial layer are large dome-like cells sometimes **called umbrella cells.**

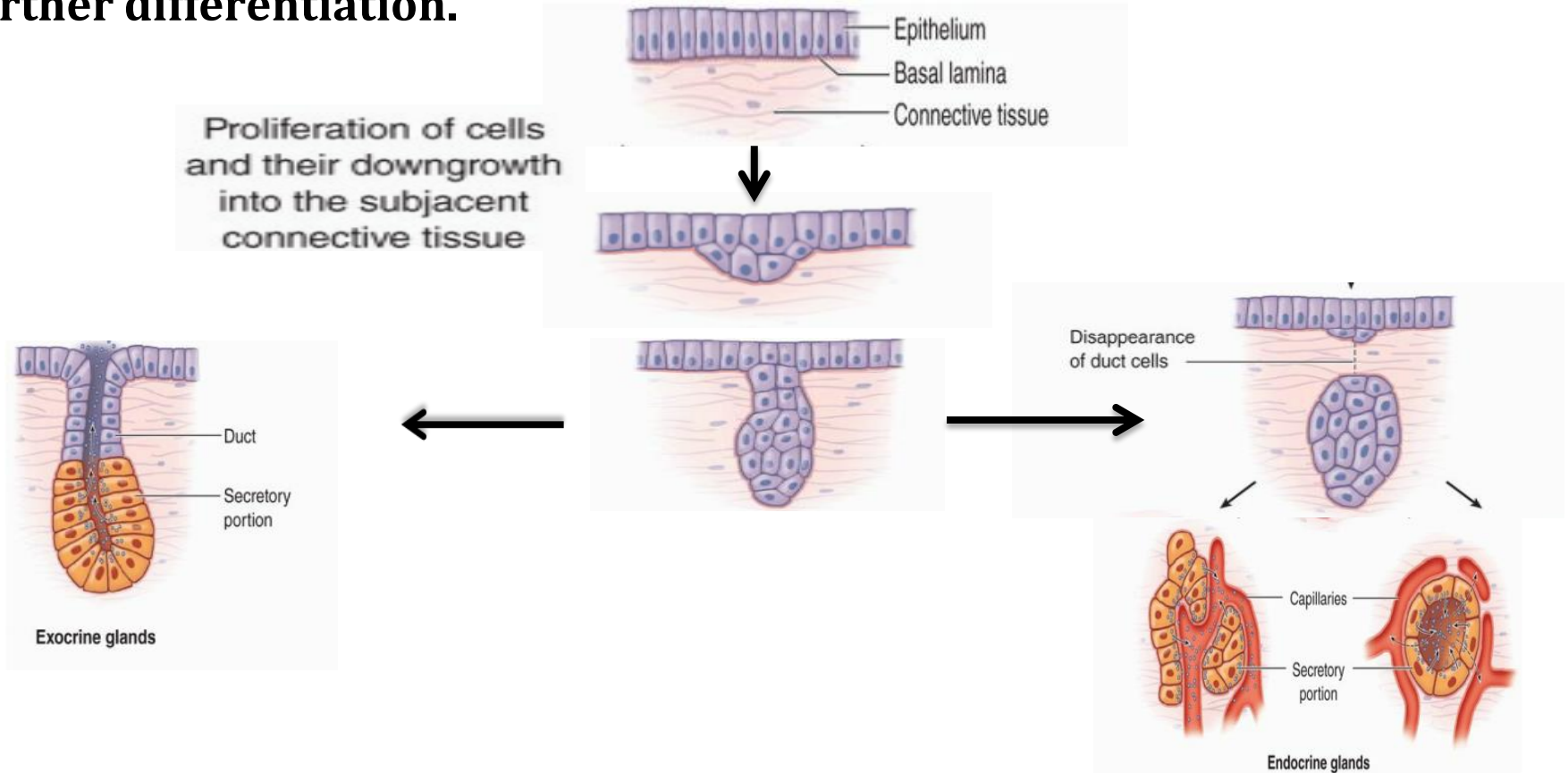
lines only the urinary bladder and the ureter.



The Secretory (glandular) epithelia.

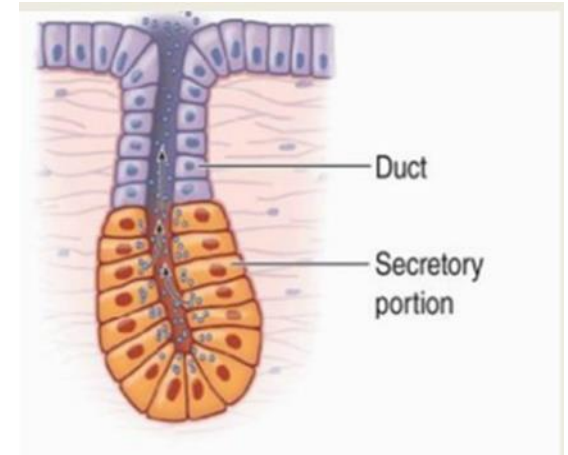
Glandular tissue is the type of epithelium that forms **the glands**, are formed by cells specialized to secrete.

Glands develop from covering epithelia during fetal life by means of cell proliferation and growth into the underlying connective tissue, followed by further differentiation.

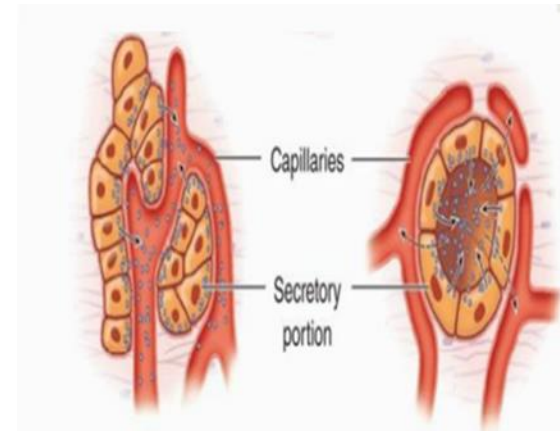


A gland can be a **single epithelial cell**, as in the case of a mucus secreting **goblet cell**, or a **gland can contain many cells**.

❑ Glands with ducts that secrete their product onto the outer surface are called **exocrine glands**.
e.g., sweat glands and mammary glands



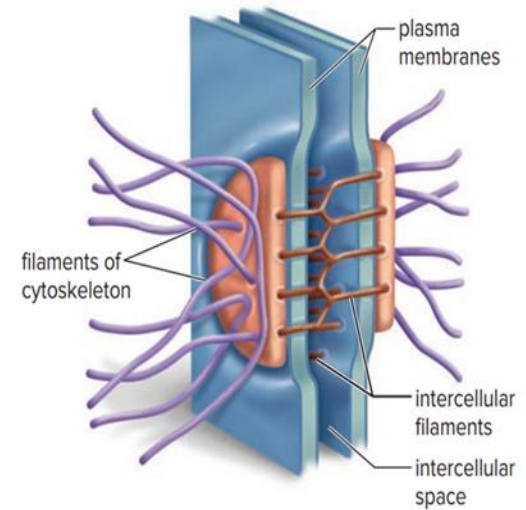
❑ Glands that have no ducts are called **ductless glands, or endocrine glands**, secrete hormones directly into the **bloodstream, e.g., pituitary and thyroid**.



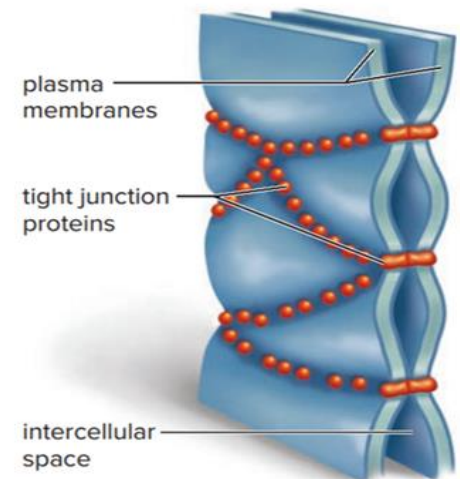
Junctions Between Cells

Intercellular junctions are well developed in epithelia and consist of three major types:

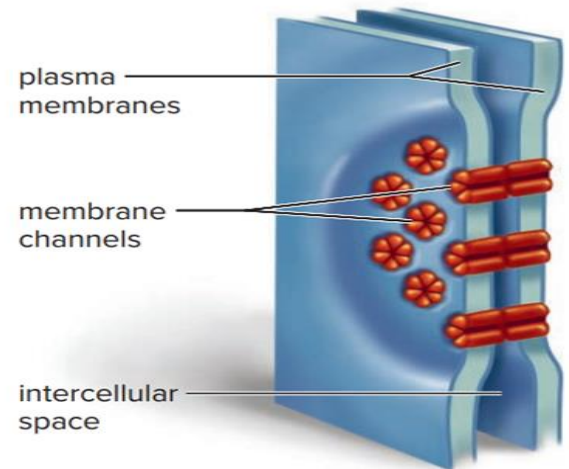
❑ **Adhesion junctions** mechanically attach adjacent cells. In these junctions, the cytoskeletons of two adjacent cells are interconnected. They are a common type of junction between skin cells.



❑ **Tight junctions**, connections between the plasma membrane proteins of neighboring cells. These types of junctions are common in the digestive system and the kidney.



❑ **Gap junctions** serve as communication portals between cells. In these junctions, channel proteins of the plasma membrane fuse.



Specializations of the apical cell surface

The apical ends of many columnar and cuboidal epithelial cells have specialized structures projecting from the cells. These function either to increase the apical surface area for better absorption or to move substances along the epithelial surface

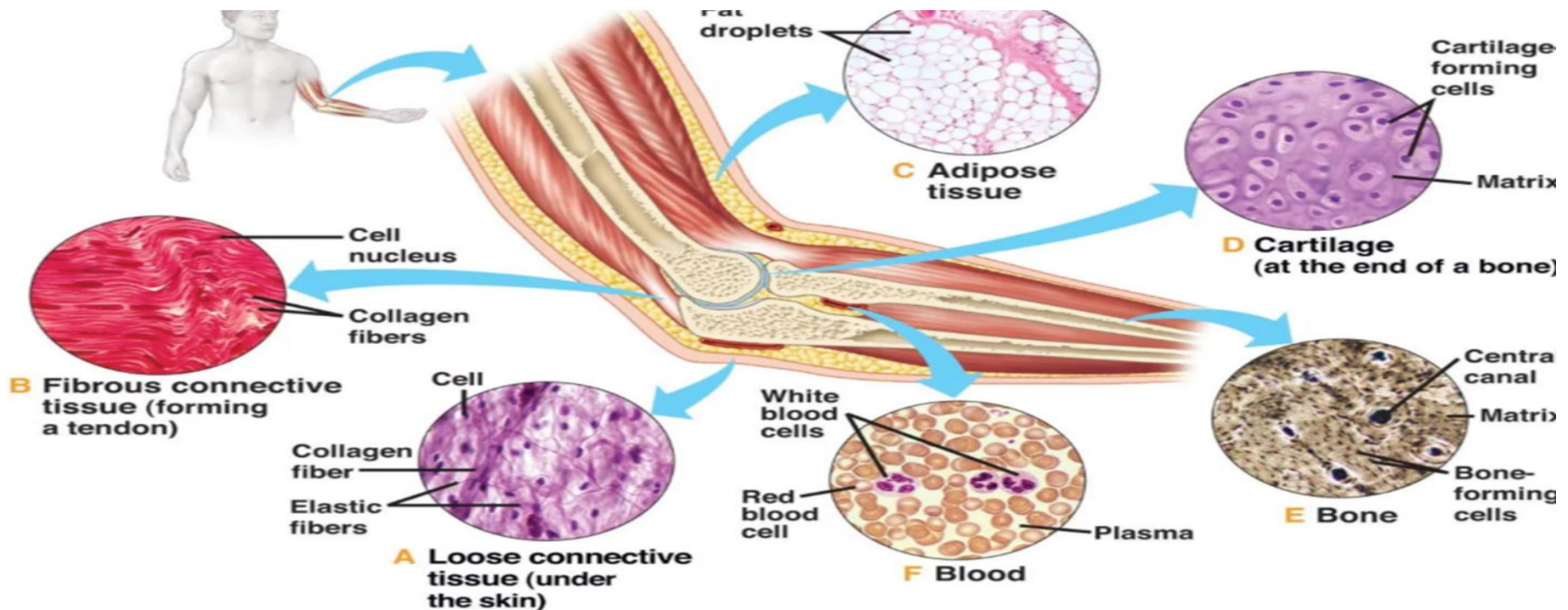
Microvilli : cytoplasmic projections In cells lining the small intestine.

Cilia : are long, highly motile apical structures, larger than microvilli.

The Connective Tissue

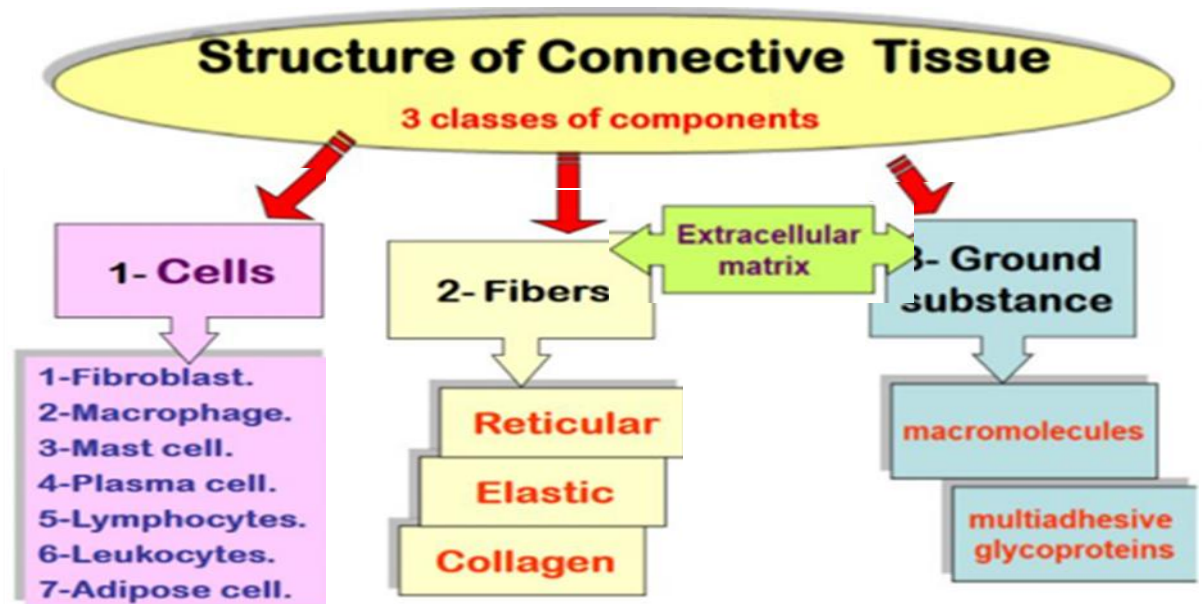
Is the most abundant tissue type in the body, connect the different parts of the body together. **The functions of connective tissue are :**

- ✓ Support and binding of other tissues,
- ✓ Defending the body against infections ,
- ✓ Storing nutrients as fat.



All types of connective tissue have three components

- ✓ **Specialized cells.**
- ✓ **Protein fibers.**
- ✓ **Ground substance.**



Connective tissue fibers and matrix are synthesized by specialized cells called **fibroblasts**. All adult connective tissues are derived from an embryonic form of connective tissue called **mesenchyme**, which contains uniformly undifferentiated cells called **mesenchymal cell**. The ground substance is a noncellular material that separates the cells. It varies in consistency from **solid** (bone) to **semifluid** (cartilage) to **fluid** (blood and lymph).

Connective Tissue Fibers

Connective tissue fibers are long, slender protein polymers that are present in variable proportions in different types of connective tissue.

Three main types of connective fibers include:

1- Collagen fibers (White) contain collagen, a protein that gives them flexibility and strength. Bind bones and other tissues together.

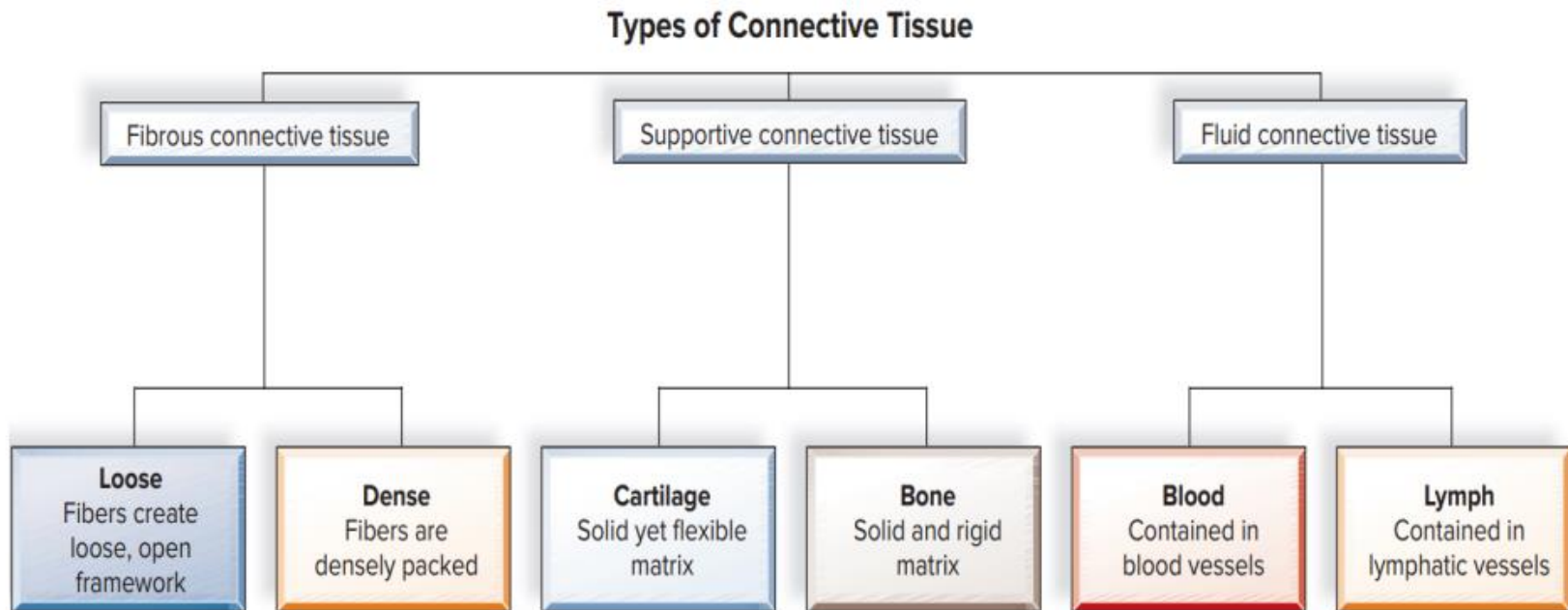
2- Elastic fibers (Yellow) contain elastin, a protein that is not as strong as collagen but is more elastic. They help to give connective tissue elasticity. found in lungs, blood vessels and ear cartilage.

3- Reticular fibers are very thin collagen fibers, highly branched proteins . Join connective tissues to other tissues, found in spleen and lymph nodes.

These fibers are distributed unequally among the types of connective tissue and the predominant fiber type is responsible for conferring specific properties on the tissue.

Connective Tissue Types

The connective tissue is diverse in structure and function , there are difference type of connective tissue :-



➤ **Fibrous Connective Tissue**

Fibrous connective tissue exists in two forms:

1- Loose fibrous connective tissue includes areolar and reticular connective tissue, supports epithelium and many internal organs.

- Its presence in lungs, arteries, and the urinary bladder allows these organs to expand.

2- Dense Connective Tissue

- Dense connective tissue is composed of large amounts of closely packed collagenous fibers.

- It is thicker and stronger than loose connective tissue

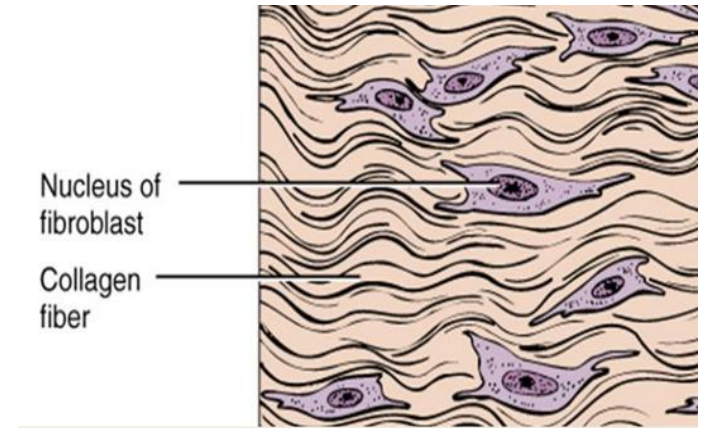
- Dense connective tissue can be categorized into:

✓ **Dense regular connective tissues.**

✓ **Dense irregular connective tissues.**

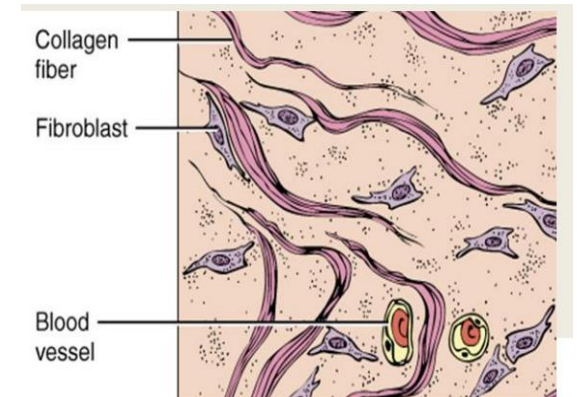
Dense regular:

- Collagen fibers in parallel bundles with fibroblasts between bundles of collagen fibers . Also known as white fibrous.
- forms **tendons** , connect muscles to bones and **ligaments**, connect bones to other bones at joints.



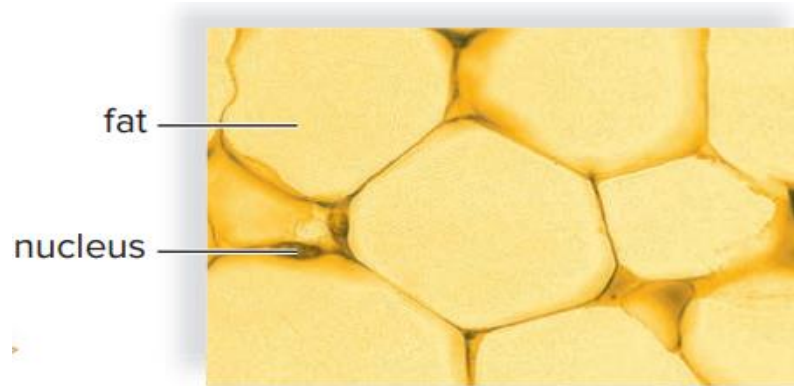
Dense irregular:

- Collagen fibers are irregularly arranged (interwoven).
- white of eyeball, dermis of skin.
- Dense irregular connective tissue is often found closely associated with loose connective tissue.



Adipose tissue

- Is a special type of loose connective tissue in which the cells enlarge and store fat.
- Adipose tissue has little extracellular matrix. Its cells are called **adipocytes**, are crowded, and each is filled with liquid fat.



- The body uses this stored fat for energy, insulation, and organ protection.
- Adipose tissue releases a hormone called **leptin** which regulates appetite-control centers in the brain.
- Adipose tissue is found beneath the skin, around the kidneys, and on the surface of the heart.

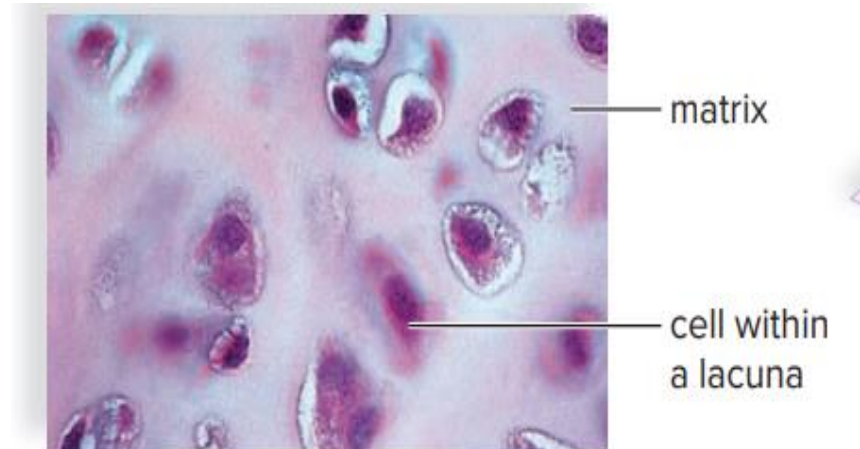
Supportive Connective Tissue

Cartilage and bone are the two main supportive connective tissues.

The Cartilage

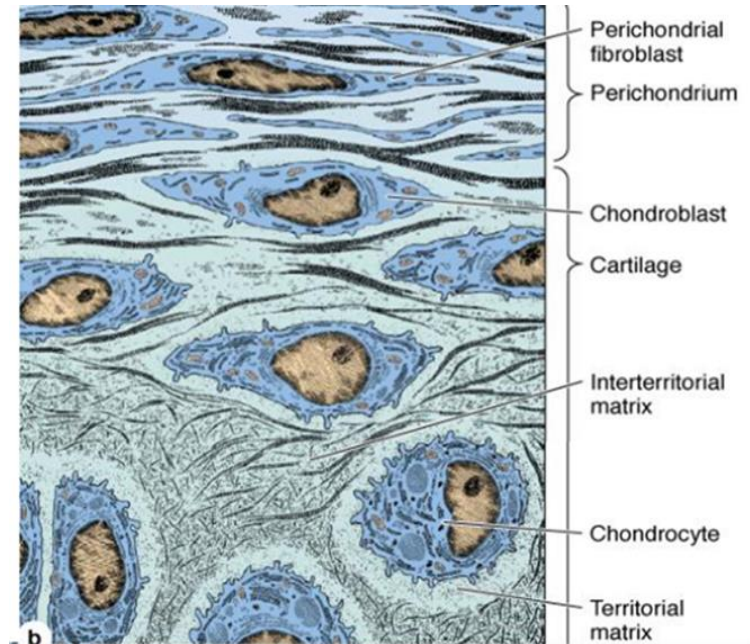
Is a specialized form of connective tissue, consists of cells called **chondrocytes** and an extensive extracellular **matrix**.

□ **Chondrocytes** lie in small chambers or cavities called **lacunae** (sing., lacuna), separated by a solid, flexible matrix. This matrix is formed by **chondroblasts** and **chondrocytes**.



The matrix enriched with **glycosaminoglycan** and **proteoglycans**, macromolecules that interact with collagen and elastic fibers.

The perichondrium is a sheath of dense connective tissue that surrounds cartilage in most places, forming an interface between the cartilage and the tissue supported by the cartilage.



The cartilage provides flexible support for certain structures.

Because this tissue lacks a direct blood supply, it often heals slowly.

Types of cartilage

1-Hyaline cartilage the most common type of cartilage, contains only fine collagen fibers. It is a glassy, translucent appearance. Is surrounded by perichondrium. Is found in the nose, at the ends of the long bones, the ribs, and it forms rings in the walls of respiratory passages.

2- Elastic cartilage has more elastic fibers than hyaline cartilage. For this reason, it is more flexible, it possesses a perichondrium. Found in the outer ear and larynx (voice box).

3- Fibrocartilage has a matrix containing strong collagen fibers. is found in the disks between the vertebrae in the backbone, in some joints, and in heart valves. Fibrocartilage does not have perichondrium.

Cartilage in external ear



Cartilages in nose

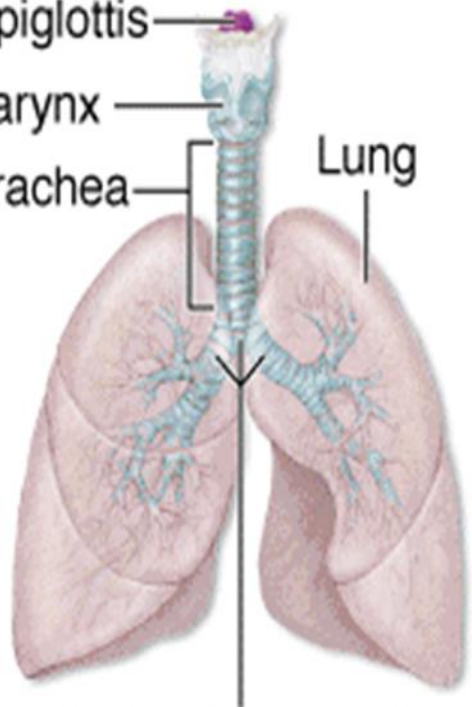


Epiglottis

Larynx

Trachea

Lung

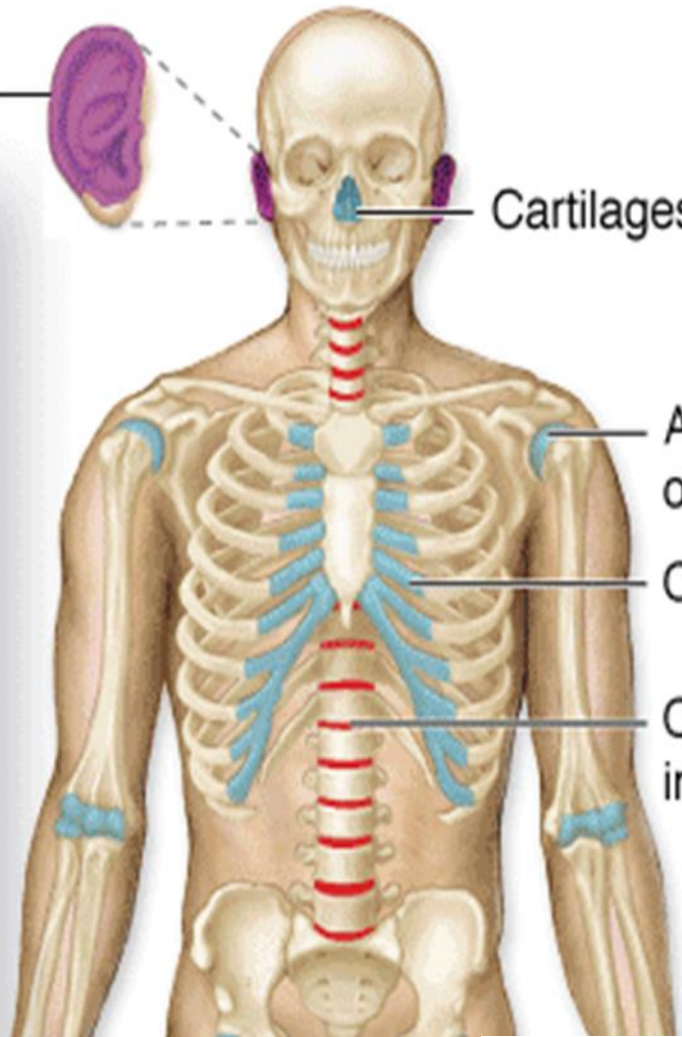





Respiratory tract cartilages
in the lungs, trachea,

Articular cartilage
of a joint

Costal cartilage

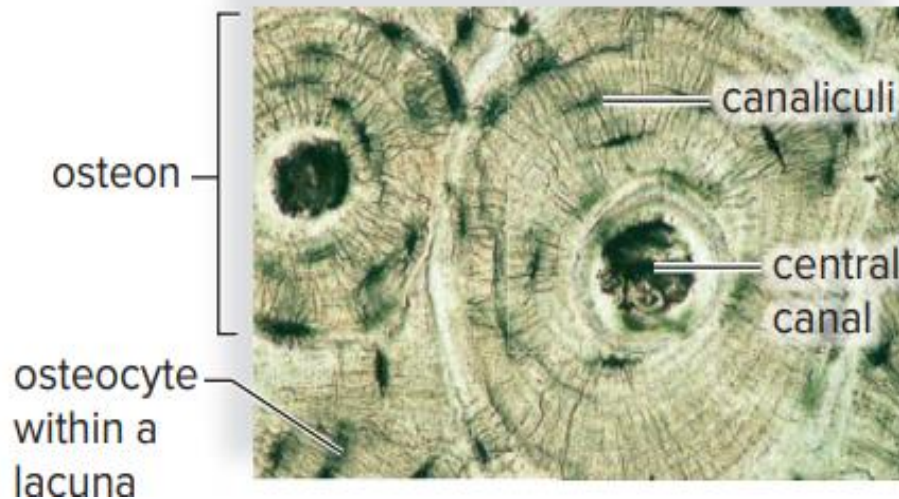
Cartilage of
intervertebral disc



-  Hyaline cartilage
-  Fibrocartilage
-  Elastic cartilage

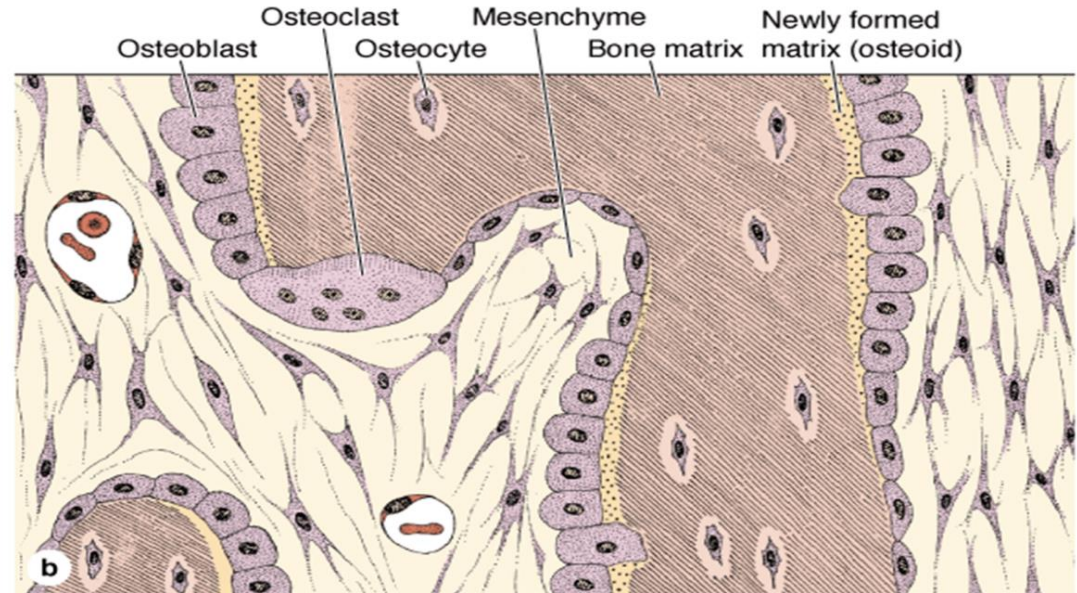
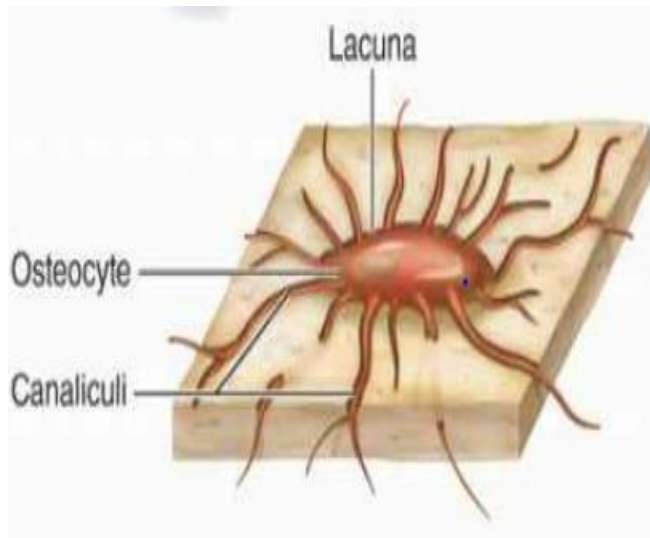
The Bone

- Is a specialized connective tissue composed of calcified intercellular material of inorganic salts .
- This bone tissue is composed of **collagen fibers** embedded in **calcium phosphate** which give bone rigidity while the protein fibers provide elasticity and strength.



Cells Type in Bone Tissue

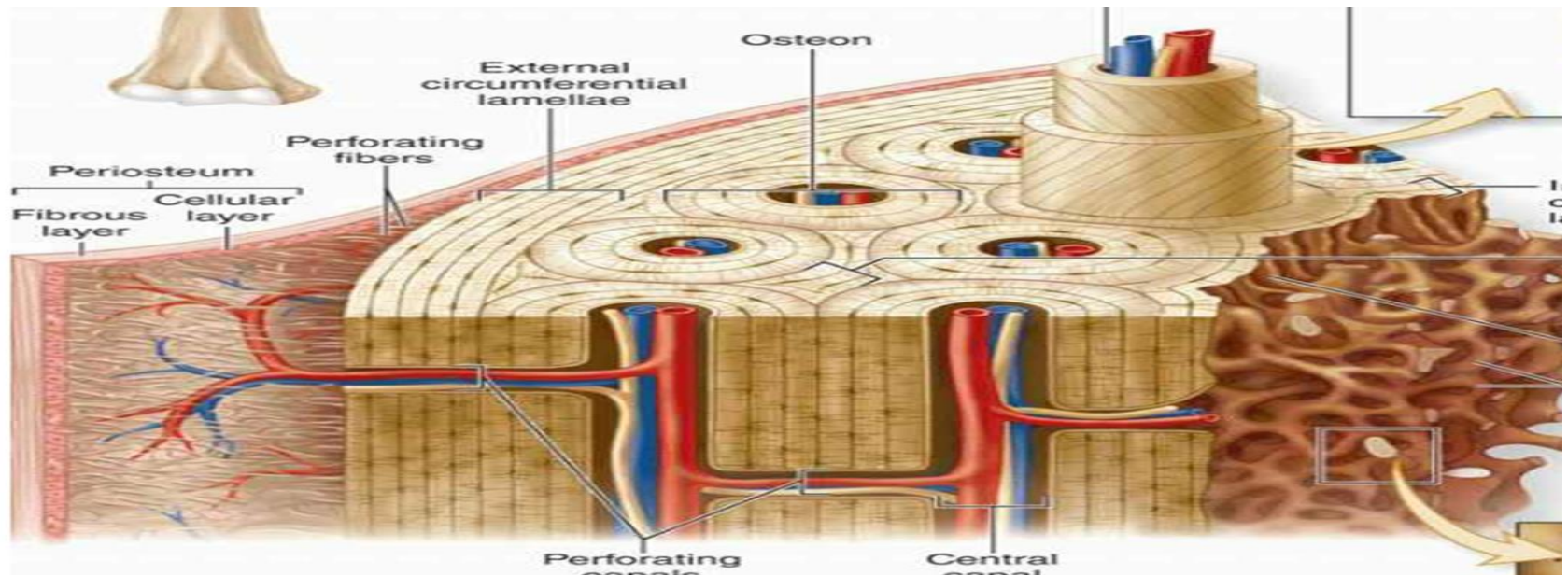
- ❑ **Osteocytes** which are found in cavities (lacunae) between layers (lamellae) of bone matrix, surrounded by calcifying matrix.
- ❑ **Osteoblasts** which synthesize the organic components of the matrix, are located at the surfaces of bone matrix, usually side by side in a layer somewhat resembling a simple epithelium .
- ❑ **Osteoclasts** which are multi-nucleated giant cells involved in the resorption and remodeling of bone tissue.



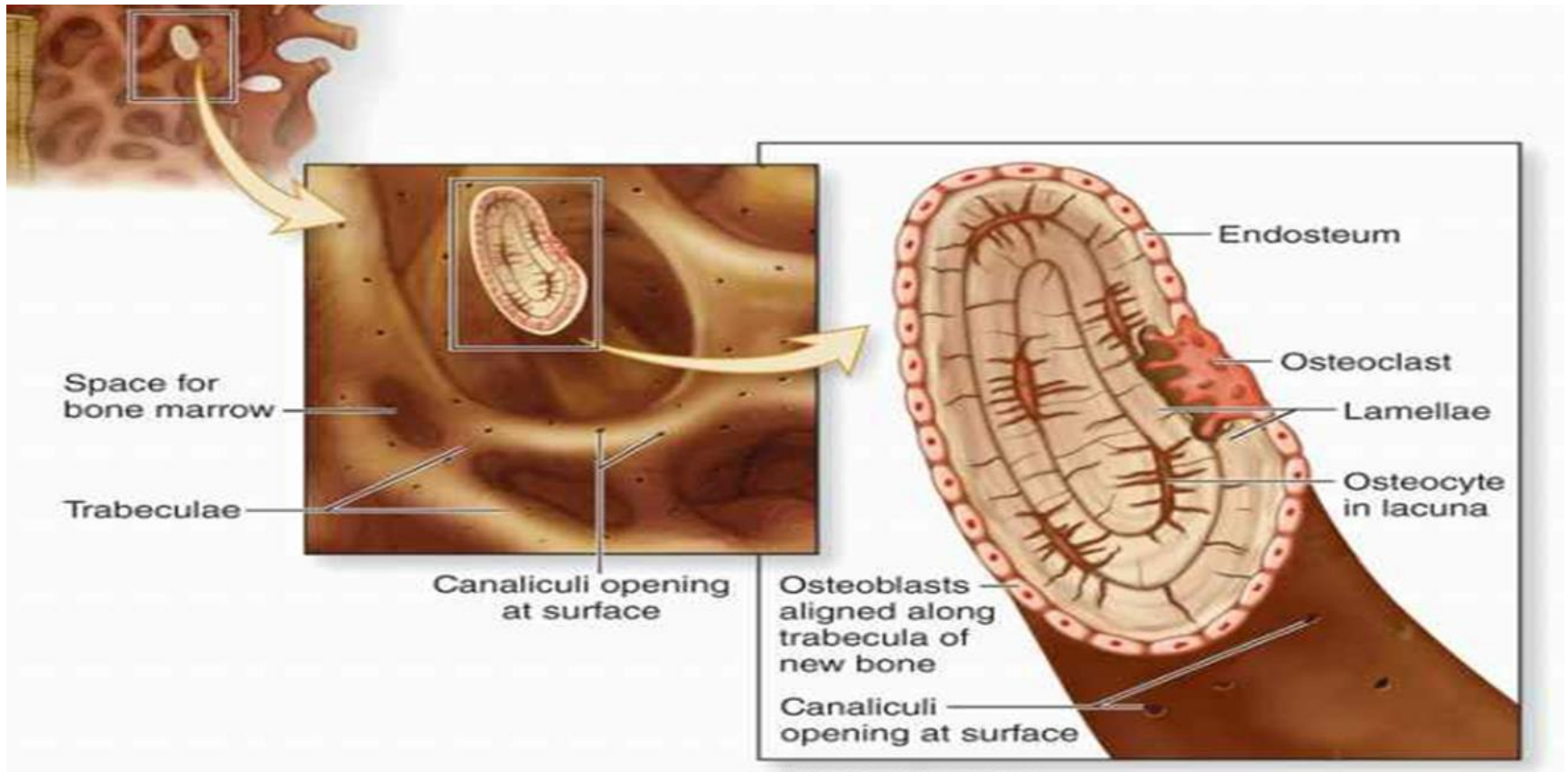
All bones are lined on both internal and external surfaces by layers of connective tissue:

Endosteum on the internal surface and **periosteum** on the external surface.

The Periosteum is a layer of dense connective tissue on the outer surface of bone, bound to bone matrix by bundles of type I collagen.



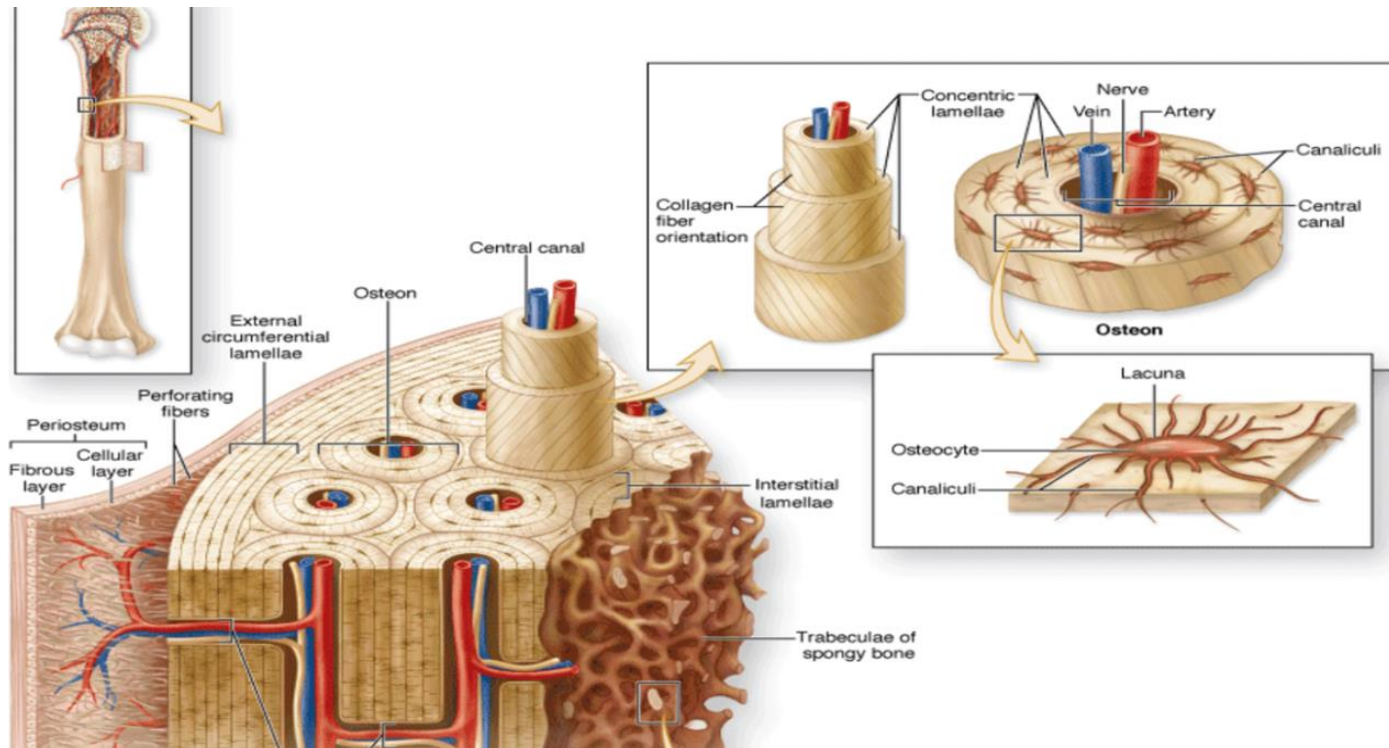
The endosteum is a thin layer of active and inactive osteoblasts, which lines all the internal surfaces within bone; osteoblasts here are also required for bone growth.



Type of bone tissue

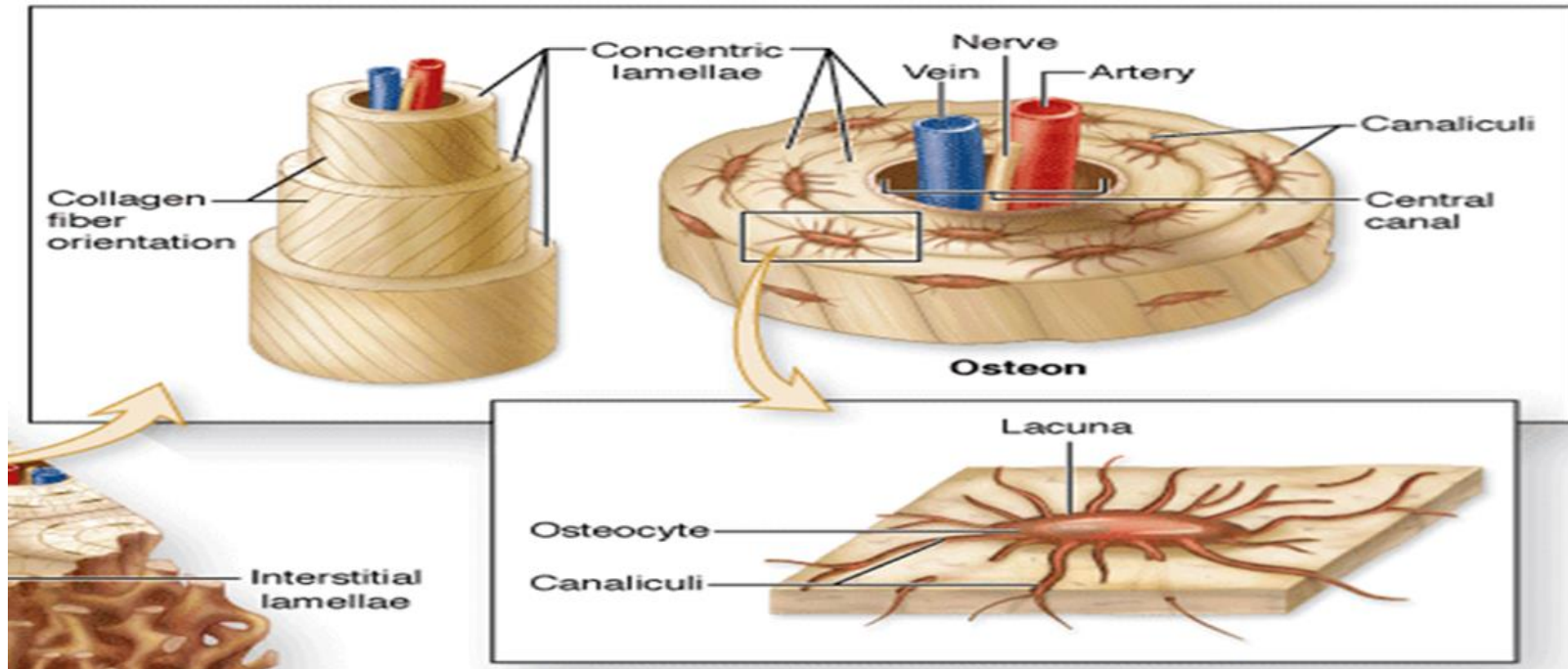
Compact bone Is strong, dense, and forms the hard outer bone surface. It consists of cylindrical structural units called **osteons** (haversian system).

The central canal of each osteon is surrounded by rings of hard matrix.



In the central canal, nerve fibers carry nerve impulses, and blood vessels carry nutrients that allow bone to renew itself.

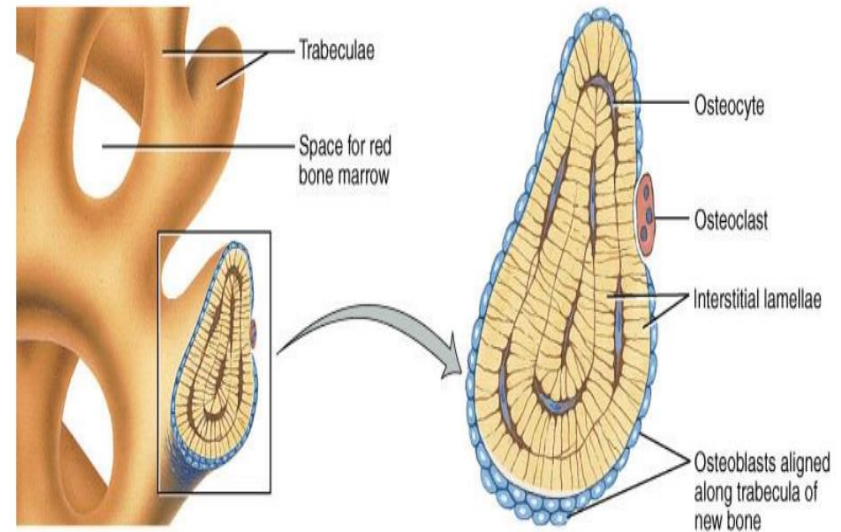
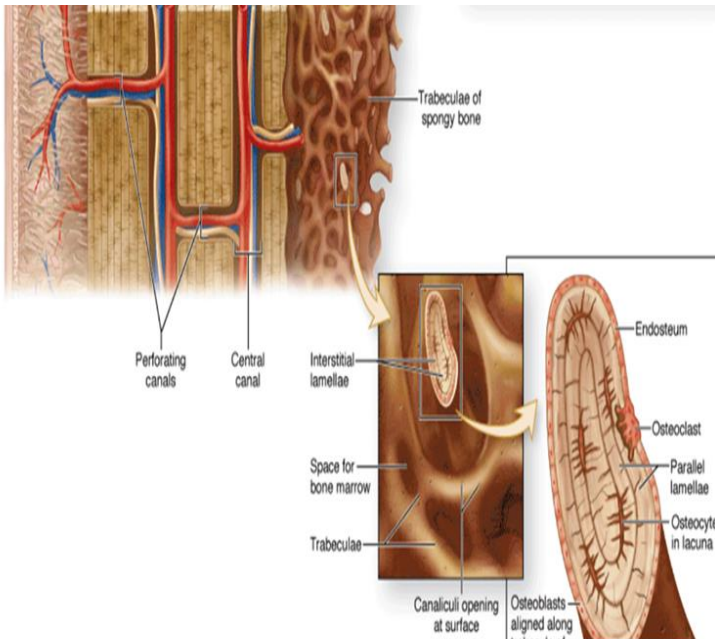
Bone cells (osteocytes) are located in lacunae between the rings of matrix, thin extensions of osteocyte called **canaliculi** (minute canals) connect the cells to each other and to the central canal, which allow all cells to be in contact with the source of nutrients and oxygen in the osteon canal.



Spongy Bone the ends of the long bones are composed of spongy bone (cancellous bone) covered by compact bone.

- Spongy bone also surrounds the bone marrow cavity.

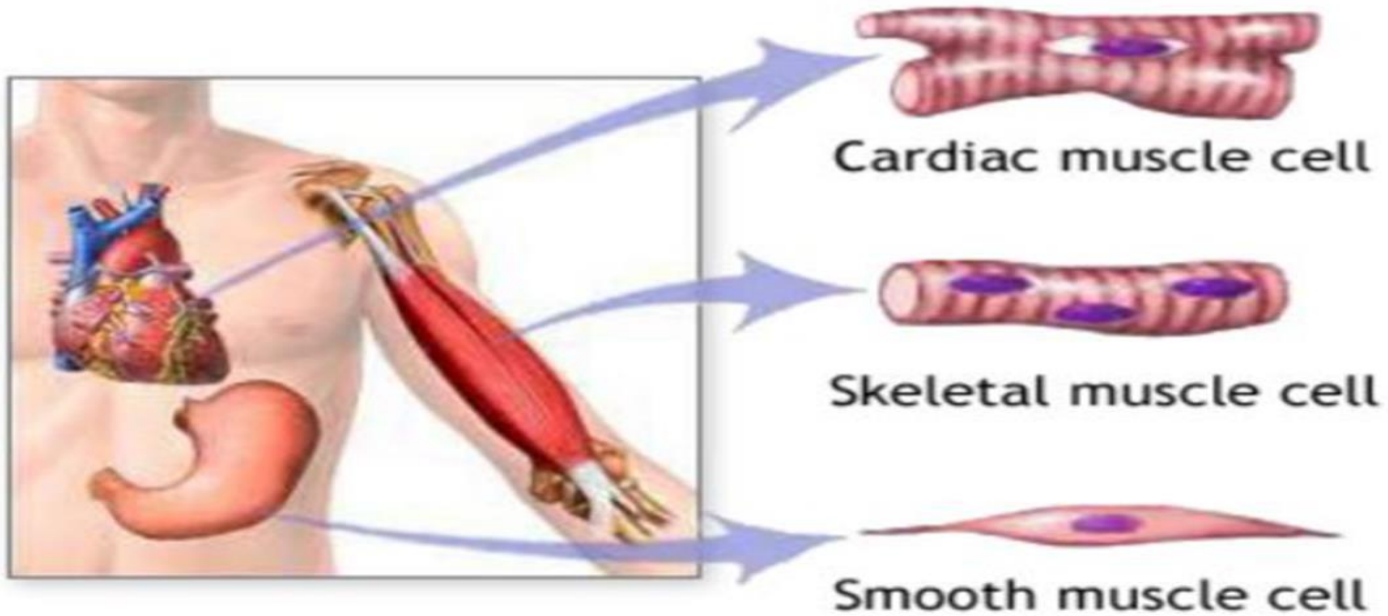
- Spongy bone appears as an open, bony latticework with numerous bony bars and plates, separated by irregular spaces contain blood vessels and bone marrow.



The Muscular Tissue

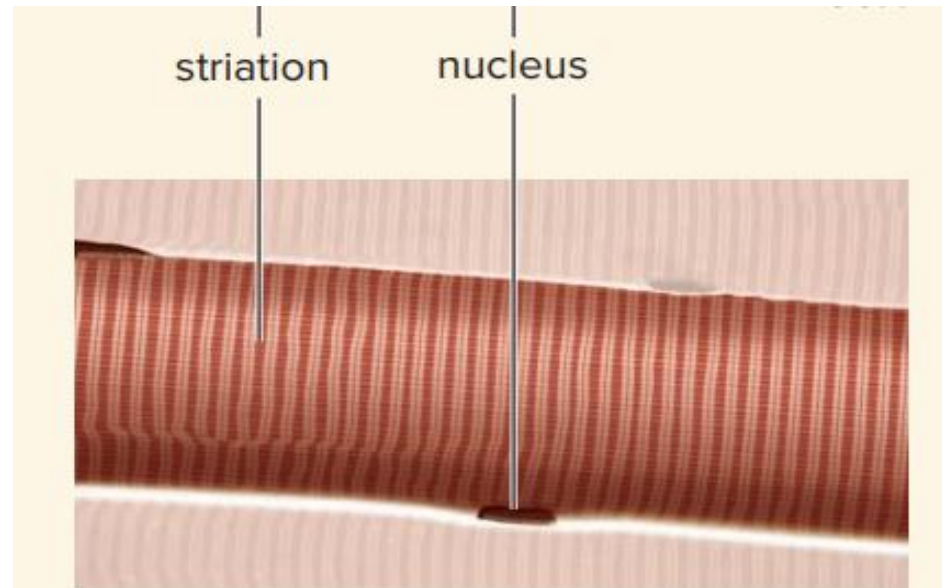
Muscular tissue is specialized to contract. It is composed of cells called **muscle fibers**.

Three types of muscle tissue can be distinguished on the basis of **morphologic and functional characteristics**.



Skeletal muscle

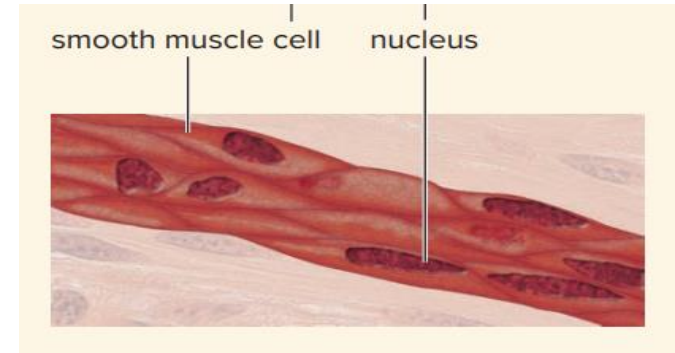
- Is also called voluntary muscle . It is attached by tendons to the bones of the skeleton.
- Contraction of skeletal muscle is under **voluntary control** and occurs faster than in the other muscle types.
- The fibers have alternating light and dark bands that give them a striated, or striped appearance.



The Smooth Muscle

- Is so named because the cells lack striations. Smooth muscle is involuntary.

- Smooth muscle is found in the walls of viscera (intestine, bladder, and other internal organs) and blood vessels.



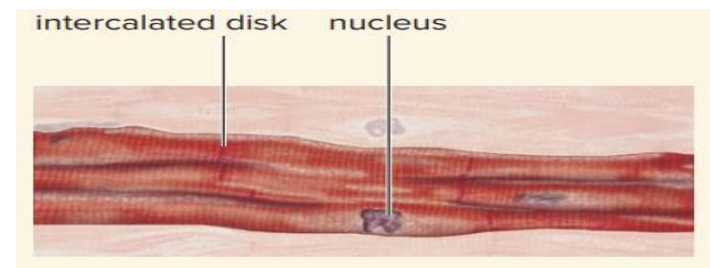
For this reason, it is sometimes referred to as visceral muscle.

The Cardiac muscle

- Is found only in the walls of the heart.

- Cardiac muscle combines features of both smooth and skeletal muscle.

Like skeletal muscle, it has striations, but the contraction of the heart is involuntary for the most part.



The Nerves Tissue

- The nervous system is a complex network of nervous tissue that carries electrical messages throughout the body.

- Nerves tissue consists of two basic types of nerve cells:

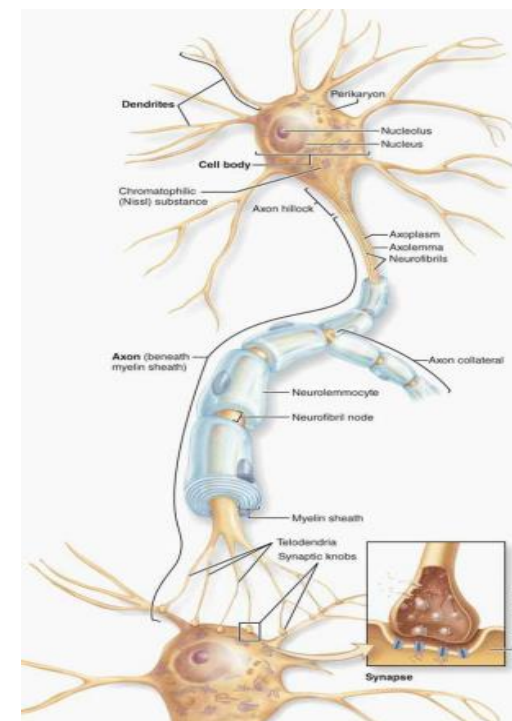
Neurons and **Neuroglia**.

□ **Neurons** are the structural and functional units of the nervous system, consists of three basic parts:

- **The cell body** contains the nucleus and other cell organelles.

- **The dendrites** extend from the cell body and receive nerve impulses from other neurons.

- **The axon** is a long extension of the cell body that transmits nerve impulses to other cells.



Types of Neurons

Neurons are classified based on the direction in which they carry nerve impulses.

- **Sensory neurons** carry nerve impulses from tissues and organs to the spinal cord and brain.
- **Motor neurons** carry nerve impulses from the brain and spinal cord to muscles and glands.
- **Interneurons** carry nerve impulses back and forth between sensory and motor neurons.

The primary function of neuroglia is to support and nourish neurons

Microglia, in addition to supporting neurons, engulf bacterial and cellular debris.

Astrocytes provide nutrients to neurons and produce a hormone known as glial-derived neurotrophic factor (GDNF).

Oligodendrocytes form the myelin sheaths around fibers in the brain and spinal cord.

