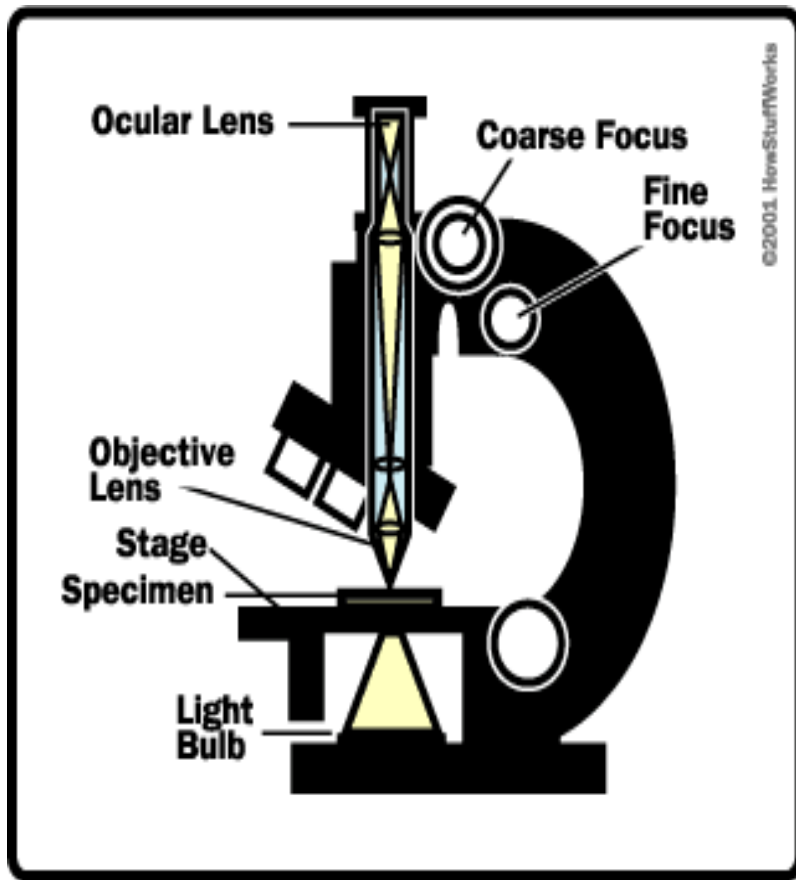


Microscope



One of the most important tools used to study living things.

“Micro” means very small

“Scope” means to look at



Types of microscope

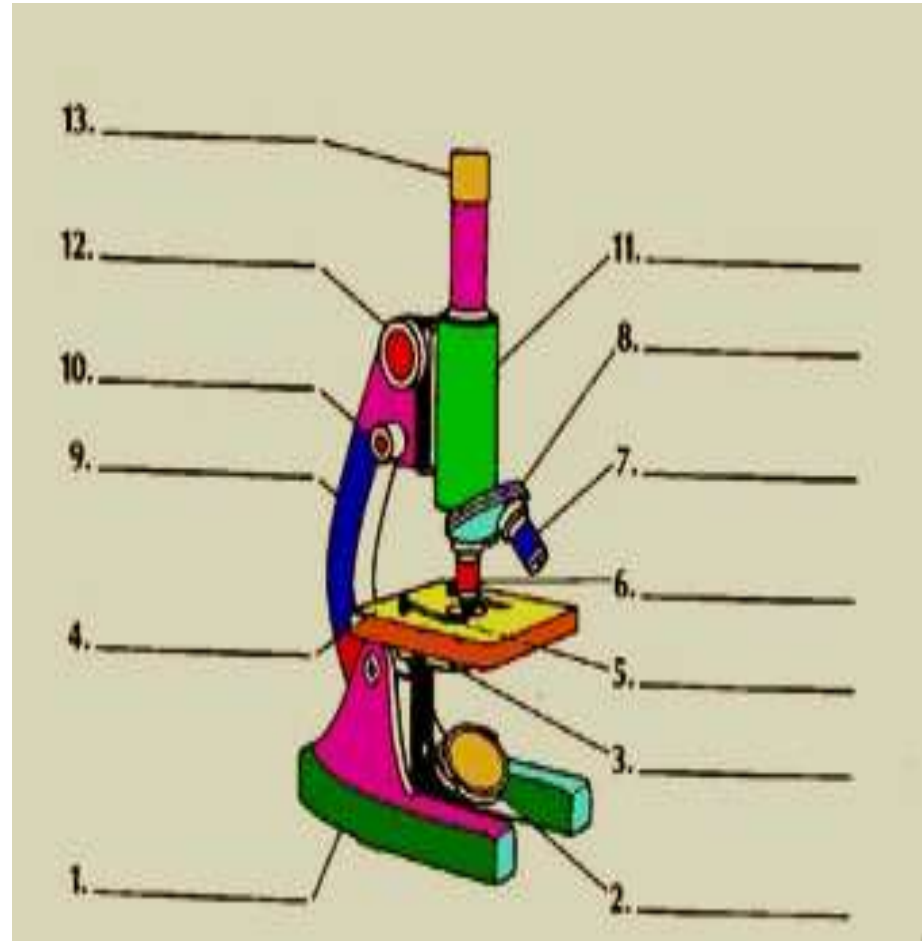
- 1. Electron microscop**
- 2. Light microscope**
- 3. X-ray Microscope**
- 4. Scanning Helium Ion Microscope (SHIM or HeIM):**
- 5. Scanning acoustic microscope (SAM):**
- 6. Neutron Microscope**
- 7. Scanning Probe Microscopes:**

Light microscope

- Used white light of the sun or use the tungsten lamp

Basic Microscope Parts

1. Base
2. Light source
3. Diaphragm
4. Stage
5. Stage clips
6. Low power
7. High power
8. Nosepiece
9. Arm
10. Fine Focus
11. Body Tube
12. Course Focus
13. Eyepiece



- The microscope used to produce an enlarged and well defined images of objects too small to be observed with the naked eye.
- The degree of enlargement is called magnification power of the microscope and its expressed as the number of times the length or the diameter of the object is multiplied

Component of microscope

1. The supporting system
 - A. The foot (base)
 - B. The limb (arm)
 - C. The revolving nose piece
 - D. Stage
 - E. Mechanical stage

Introducing the Arm and Base



Arm

Supports the body tube. Used to carry the microscope.

Base

Bottom part of the microscope often shaped like a horseshoe.



Stage and Stage Clips



Stage

Place where the object you are looking at is placed (Specimen).

Stage Clips

Holds down the slide on the stage.



Nosepiece

**The NOSEPIECE is
the round part that
holds the OBJECTIVE
LENSES apart.**



2. The magnification system: which consist from the lenses (2 types) which are

A. Eye piece (ocular lens): the user applies his eye on it and its made from upper eye lens and lower field lens.

Magnification power

magnification

4X

4 times

6 x

6 times

10 x

10 times

Eyepiece (Ocular Lens) and Body Tube

Eyepiece

The lens you look through that magnifies the specimen.

Body Tube

The hollow tube through which light passes. It holds the lenses apart.



B. Objective lens: They are just above the prepared object (slide) under examination.

Each objective lens has specific magnification power which engraved on the lens

total magnification = obj. lens multiply by ocular lens

lenses	Magnification power	Total magnification
4x	4 times	40 times
10x	10 times	100 times
40x	40 times	400 times
100x oil	100 times	1000 time

Low Power/High Power Objective Lenses

Low Power Objective

Magnifies the specimen at a *lower* power 4x and 10x

High Power Objective

Magnifies the specimen at a *Higher* power 40x and 100x



3. The illumination system

- A. Light source : electric light provide by a lamp
- B. The condenser : located between the mirror and the stage , its function to brings the rays of light into a common focus on the object to be examined
- C. The diaphragm : used to increase or decrease the amount of light by reducing or increasing the angle

Diaphragm and Light Source



Diaphragm

Changes the amount of light reaching the objective lenses. Located under the Stage.

Light Source

Located beneath the Stage and Diaphragm. Sends light towards the hole in the stage.



4. The adjustment system
 - A. The coarse adjustment used to achieve an approximate focus
 - B. Fine adjustment used to bring object in to perfect focus
 - C. The mechanical stage : its controlled by two screw , one to move backward or forward , the other to move left and right

Course and Fine Focus



Course Focus

Raises or lowers the Body Tube to focus

Fine Focus

Raises and lowers the Body Tube and used to bring objects into focus.



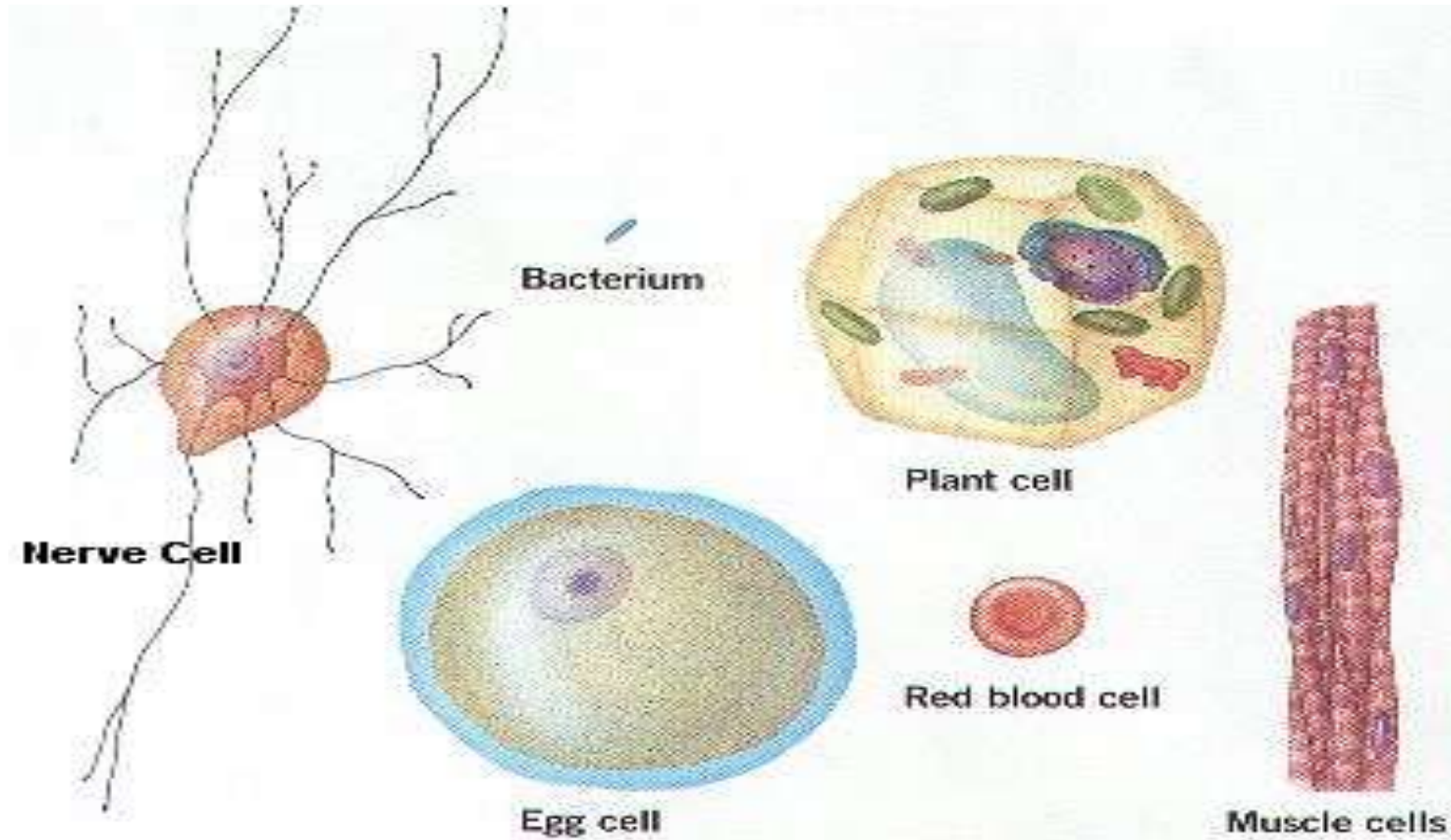
Microscope Examples



Cells

- **Cell**: is the smallest unit of living material that can exist on its own.
- The basic unit of all living organism which can reproduce itself exactly (**mitosis**) .
- Each cell is bounded by a **cell membrane** of **lipid** and **protein** (cell membrane or plasma membrane), which control the passage of substances into and out of the cell
- Cell contain **cytoplasm** in which are suspended a **nucleus** and other structures (organelles) specialized to carry out particular activities in the cell.
- Cells have different forms (**shapes**) because they have different jobs (**functions**) to do.

Cell Shape



- Organelle: a structure within a cell that is specialized for a particular function, include:
 - 1- **Nucleus**: contains the genetic material, **DNA** which is combined with protein which normally dispersed throughout the nucleus as **chromatin**, also contain **RNA**, most of which is located in the nucleolus
 - Nucleolus: a dense spherical structure within the cell nucleus that disappears during cell division. Contain RNA for the synthesis of ribosomes
 - 2- **Mitochondria**: it is the site of the cells energy production, contain ATP and enzymes involved in the cell metabolic activities, and also contain their own DNA

The Cell Nucleus

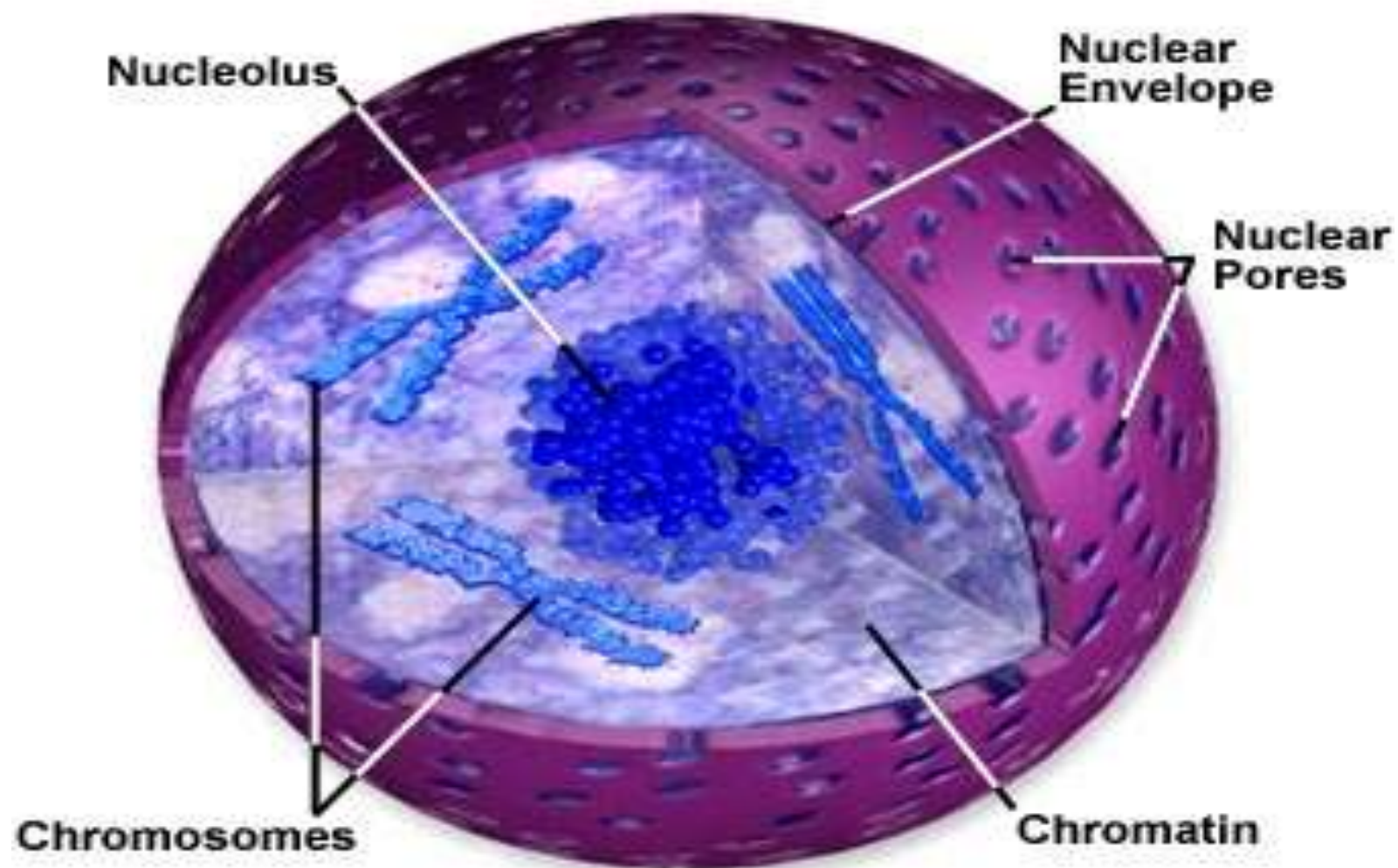
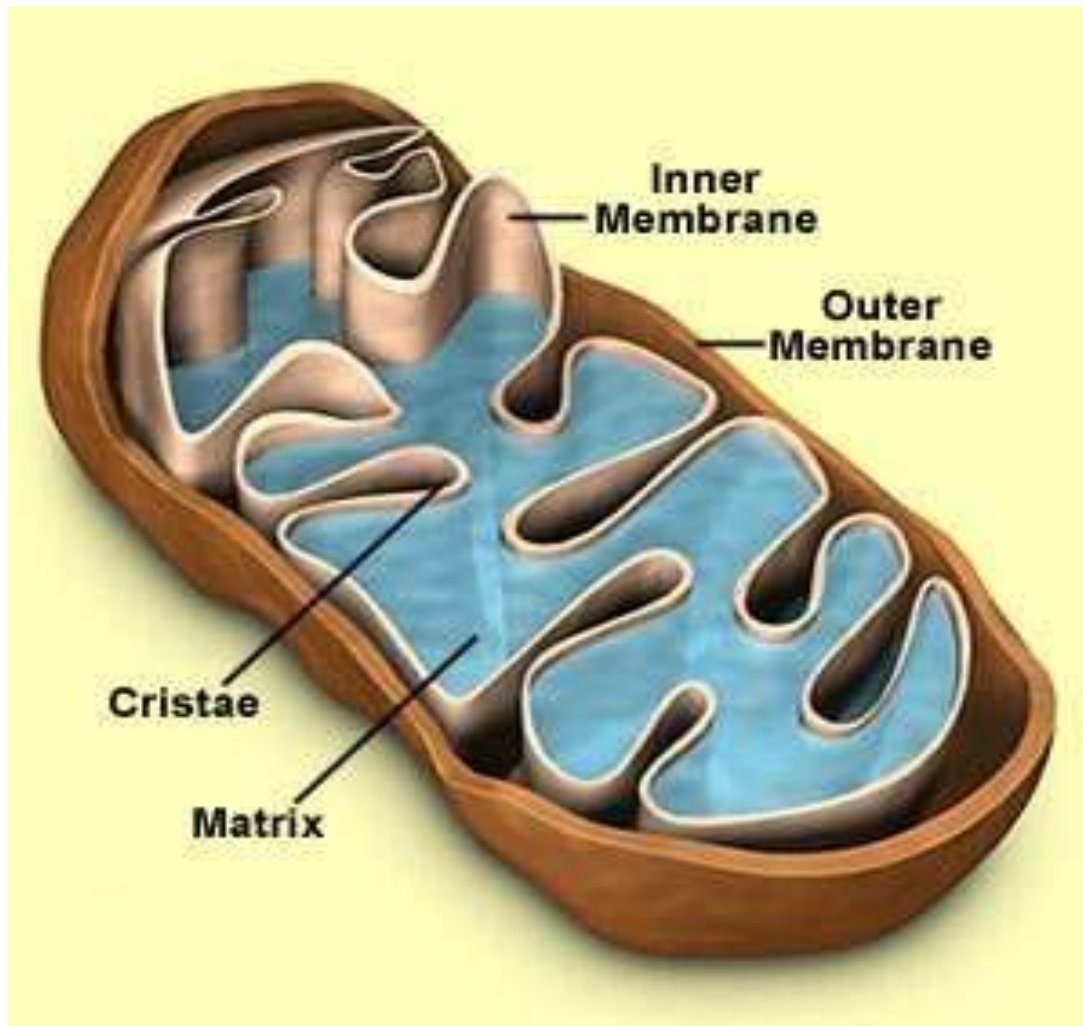


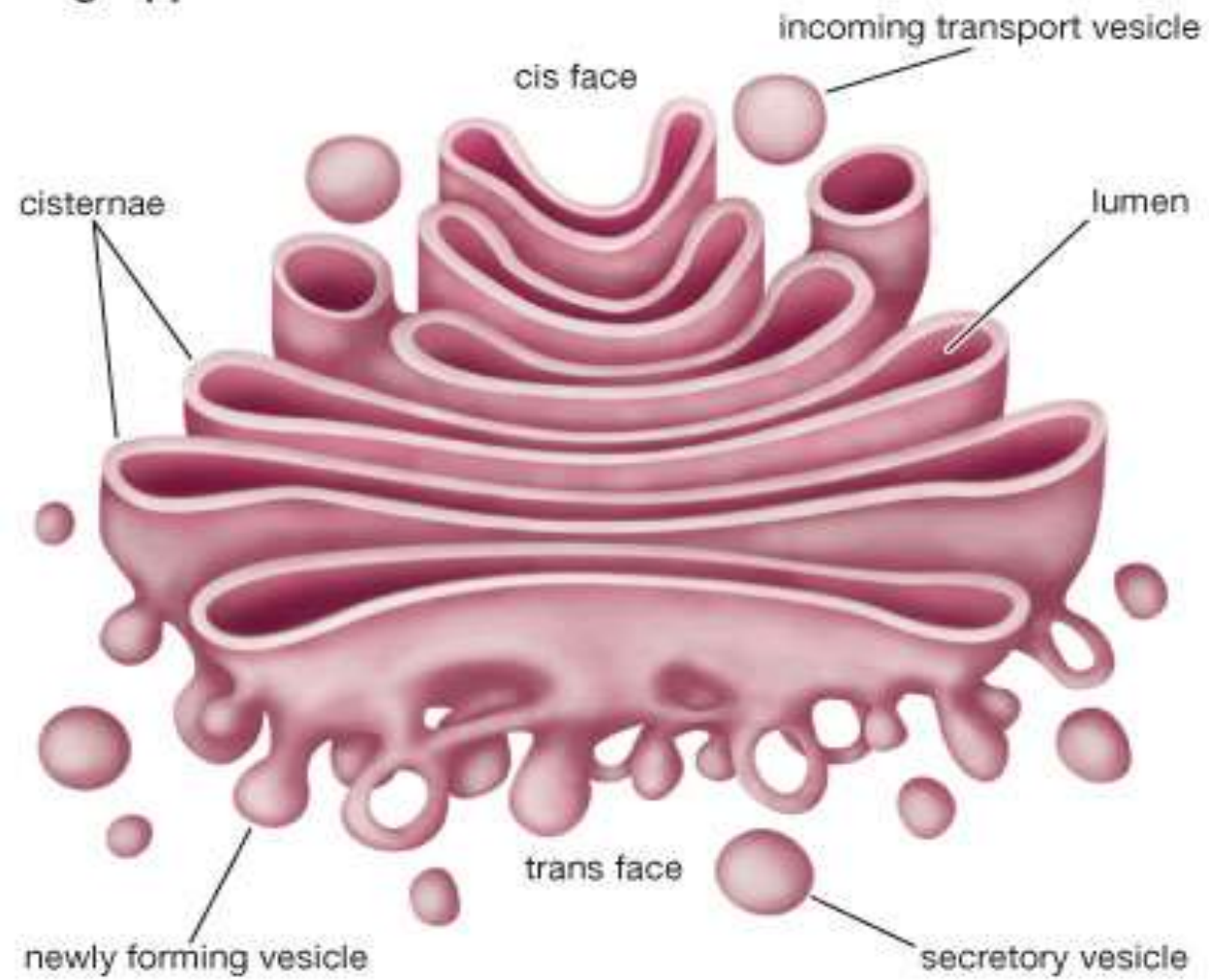
Figure 1



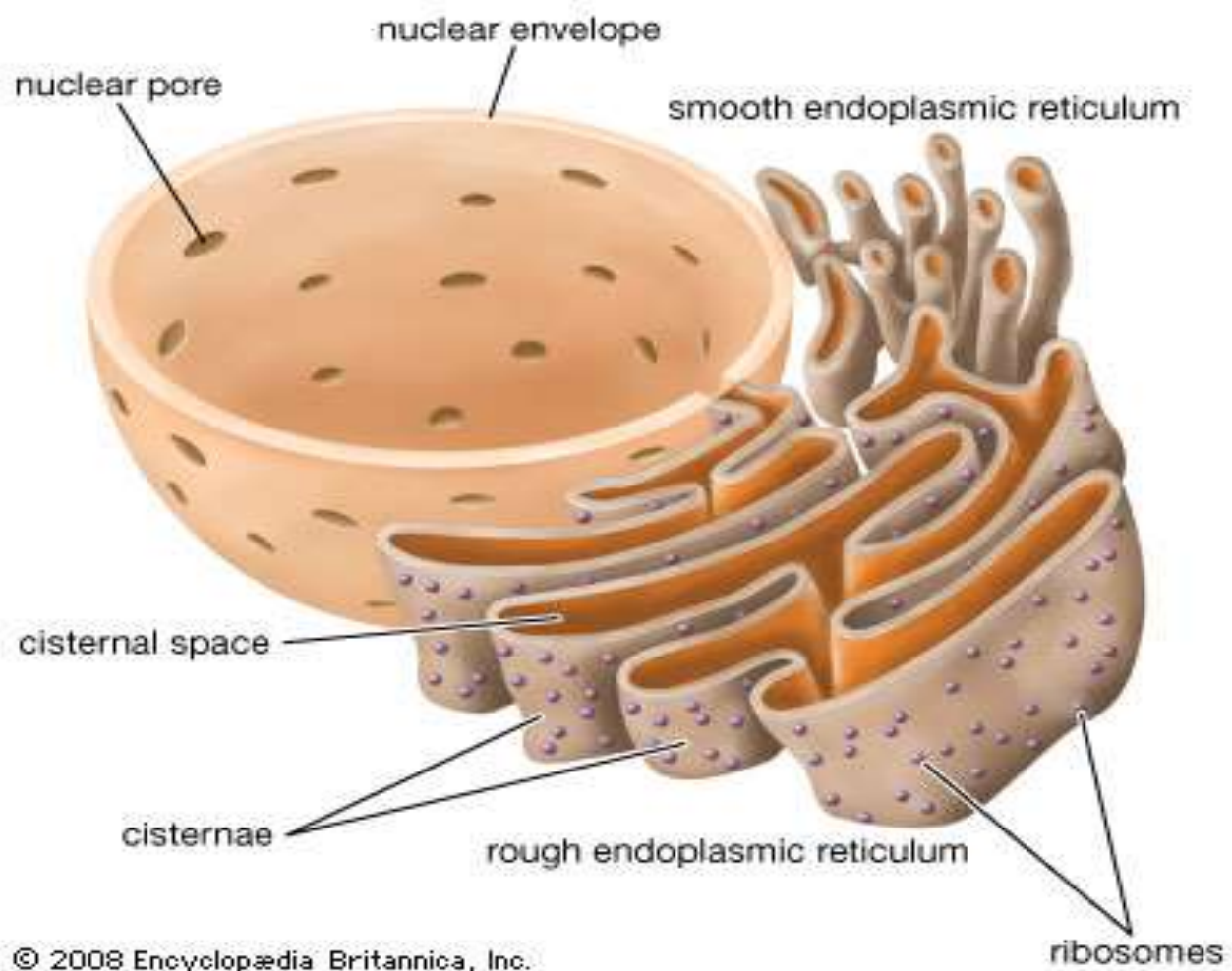
mitochondria

3. **Golgi apparatus**: a collection of vesicles and folded membranes in a cell usually connected to the **endoplasmic reticulum**. It stores and transports **proteins** manufactured in the endoplasmic reticulum.
 4. **Endoplasmic reticulum**: network of interconnecting membranes is describe as rough Endoplasmic reticulum, when it has **ribosome** attached to its surface and smooth Endoplasmic reticulum, when ribosomes are absent
- Endoplasmic reticulum is the site of manufacture of proteins and lipids and transport of these products within the cell.

Golgi apparatus



Endoplasmic reticulum



5. **Lysosomes:** it is produced by Golgi apparatus, it is contain digestive enzymes (hydrolases). Function is intracellular digestion of microorganisms, cell debris, and damaged, worn out or excessive cell organelles
6. **Centriols:** are involved in the formation of the spindle and a star during cell division. During cell division these centriols are separated and move to apposite sides of the nucleus
7. **spindle:** a collection of fibers seen in a cell when it is dividing.



lysosomes

The Cell Nucleus

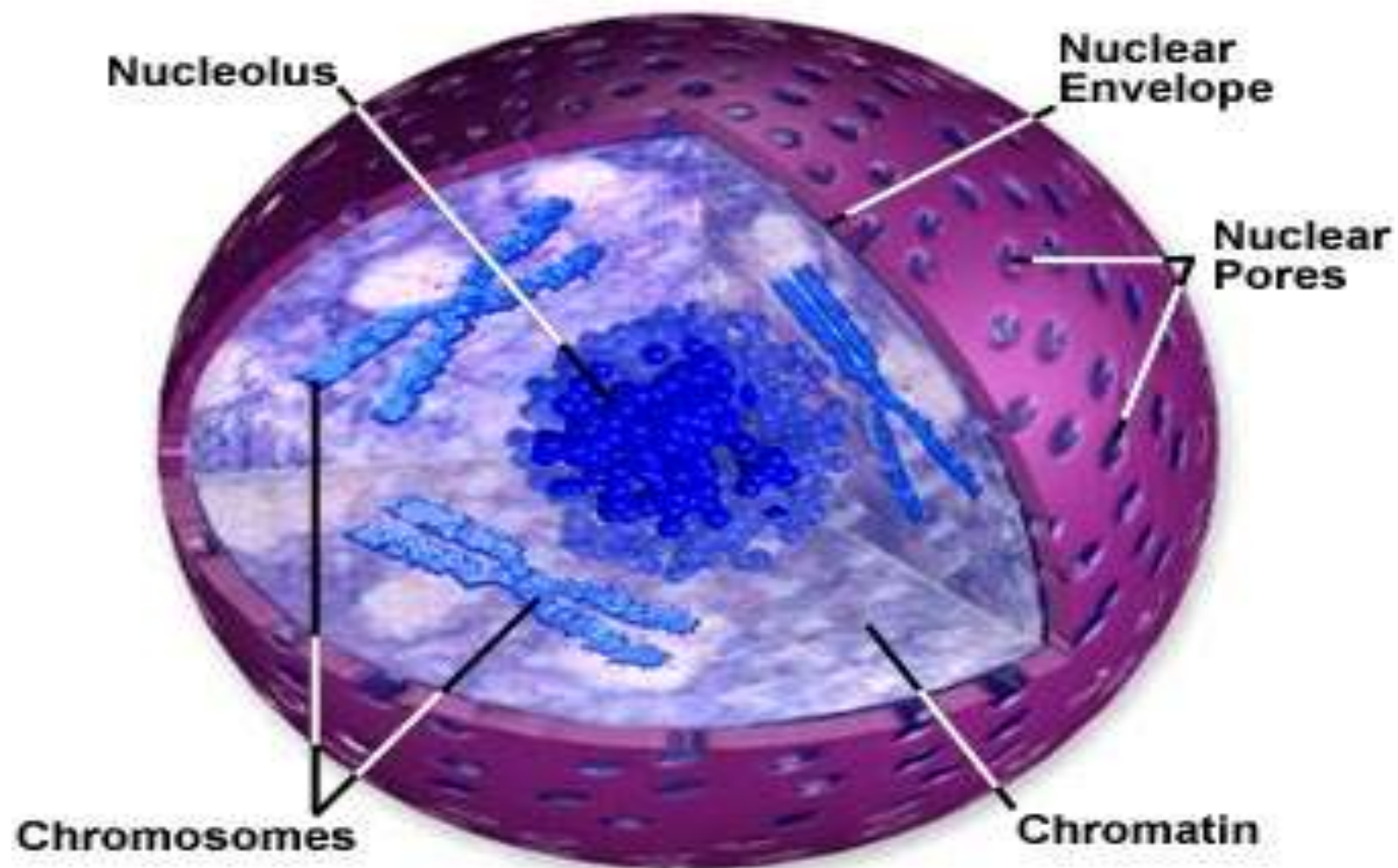


Figure 1

Bone and cartilage

Cartilage

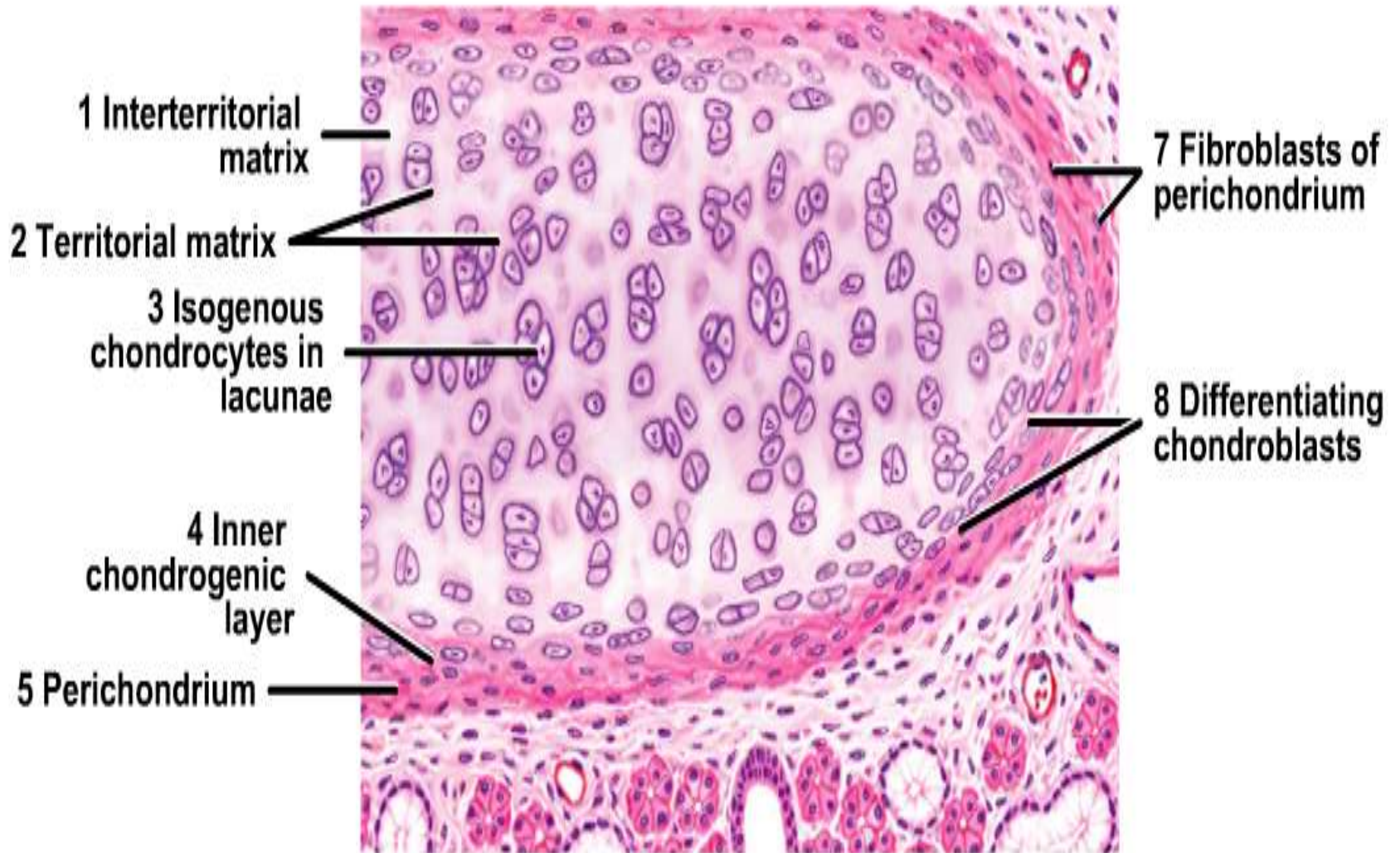
- It's a special form of C.T develops from **mesenchyme** consist of extracellular matrix (C.T fibers and ground substance) and cells (chondrocytes and chondroblasts).
- Function: performs a numerous **supportive functions** (provide support for soft tissue, allow flexibility with out distortion and resilient to compression).

- **Chondroblast** : synthesize the cartilage matrix and the extracellular material, then it differentiate into chondrocyte which trapped in to component called (**lacunae**). Some lacunae contain more than **one chondrocytes** , these groups of chondrocytes called **isogenous** .
- Function of chondrocytes is maintain the cartilage matrix
- **Perichondrium**: vascularized dense irregular C.T. layer surround the cartilage

Types of cartilage

- Its divide according to the amount and type of fibers
1. **Hyaline cartilage**: It's the most common type; in embryo serves as skeletal model for most bones, as the individual grows, the cartilage bone model is gradually replaced by bones by a process called **endochondral ossification**. In adult, it present on the articular surface of bones, end of ribs, nose, larynx, trachea and bronchi

Hyaline cartilage and surrounding structure trachea



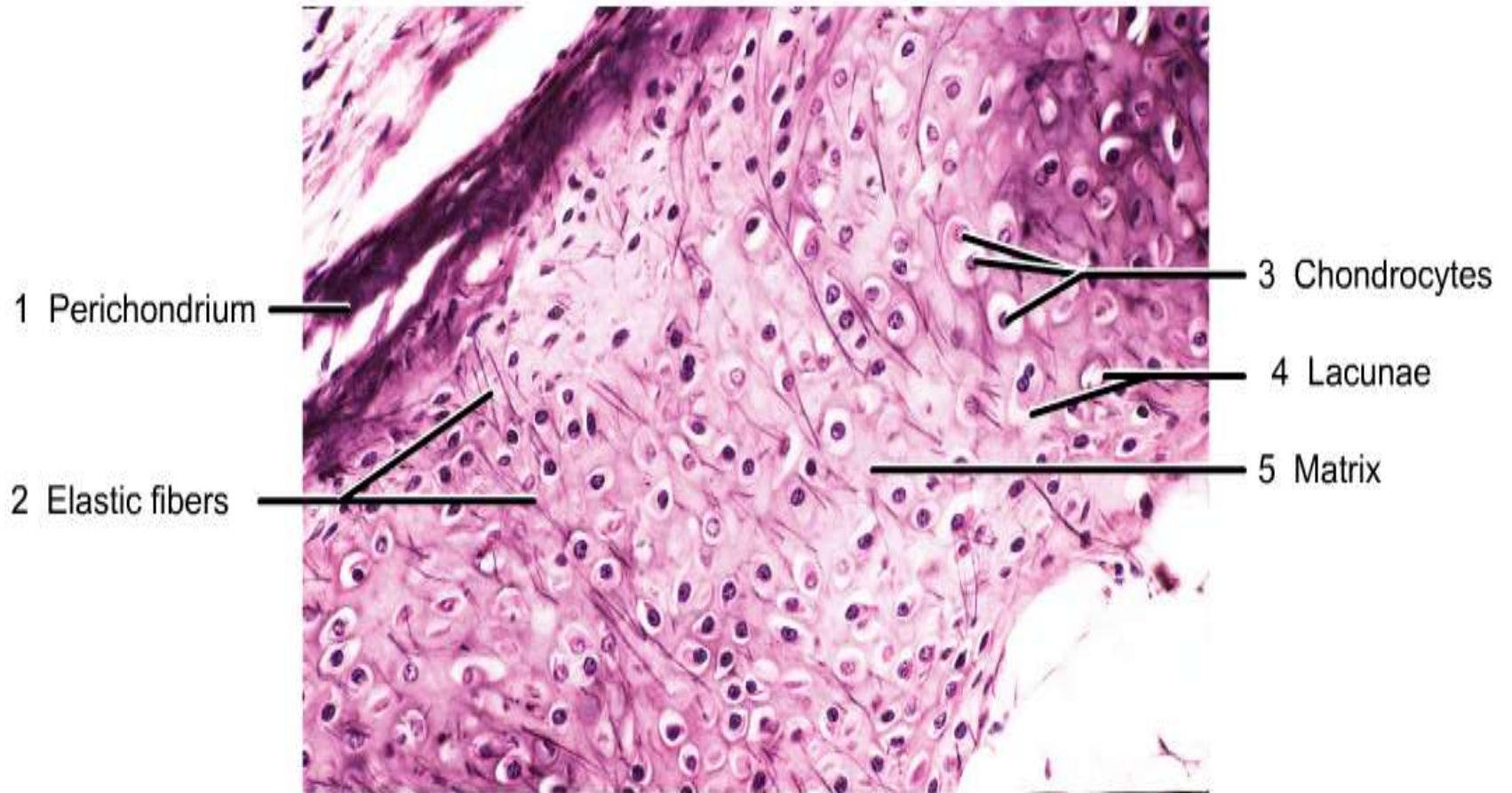
2. **Elastic cartilage**: its similar to hyaline cartilage but it has **more elastic fibers** in matrix.

- Location in external ear, epiglottis and auditory tube.
- Function: maintain the shape of a structure while allowing great flexibility
-

Elastic cartilage epiglottis

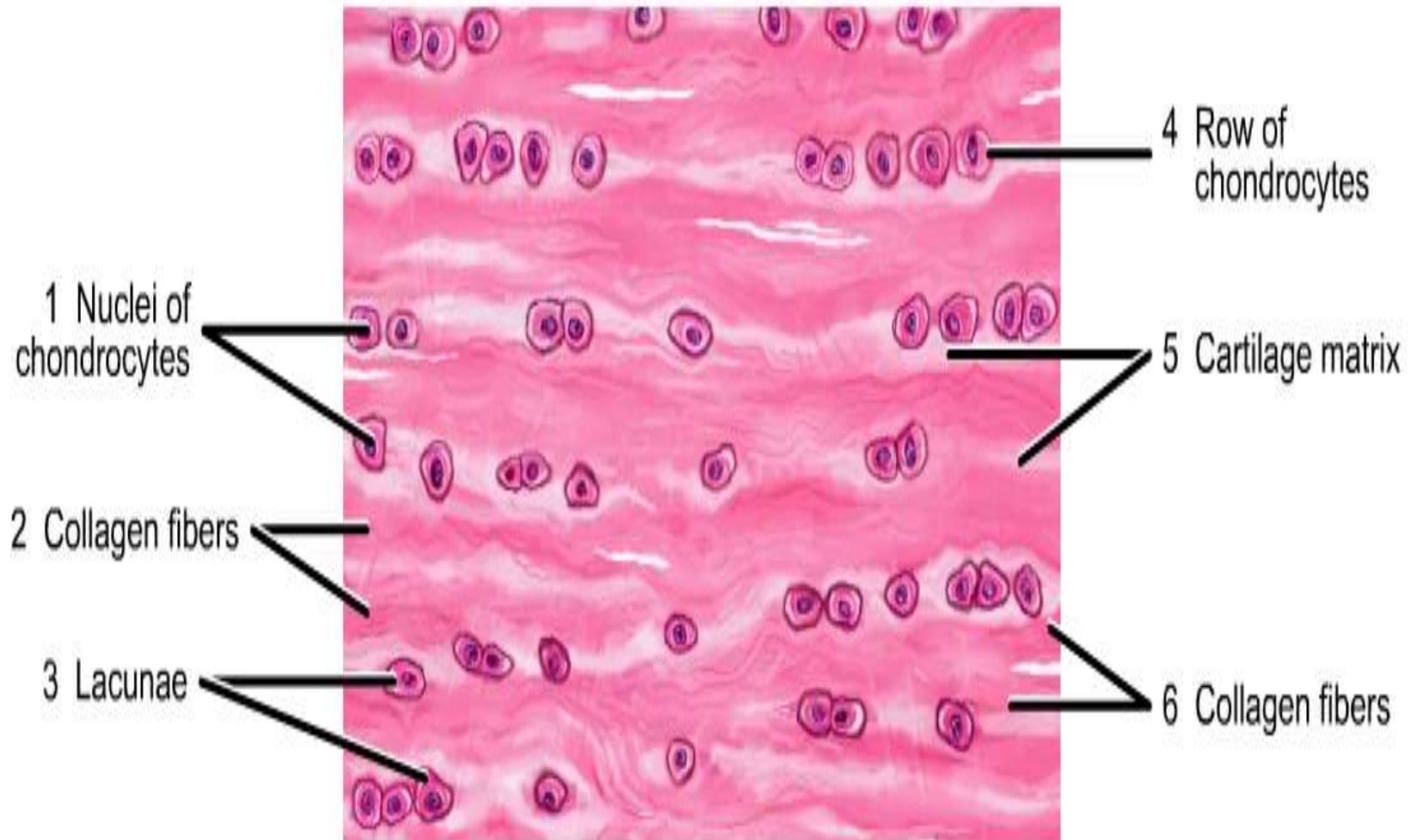


Elastic cartilage epiglottis



- **Fibrocartilage** : is characterized by large amount of **irregular and dense bundles** of collagen fibers in its matrix.
- Location: intervertebral disks and knee joint.
- Function: provides tensile strength, bears weight, and resist compression

Fibrous cartilages intervertebral disc

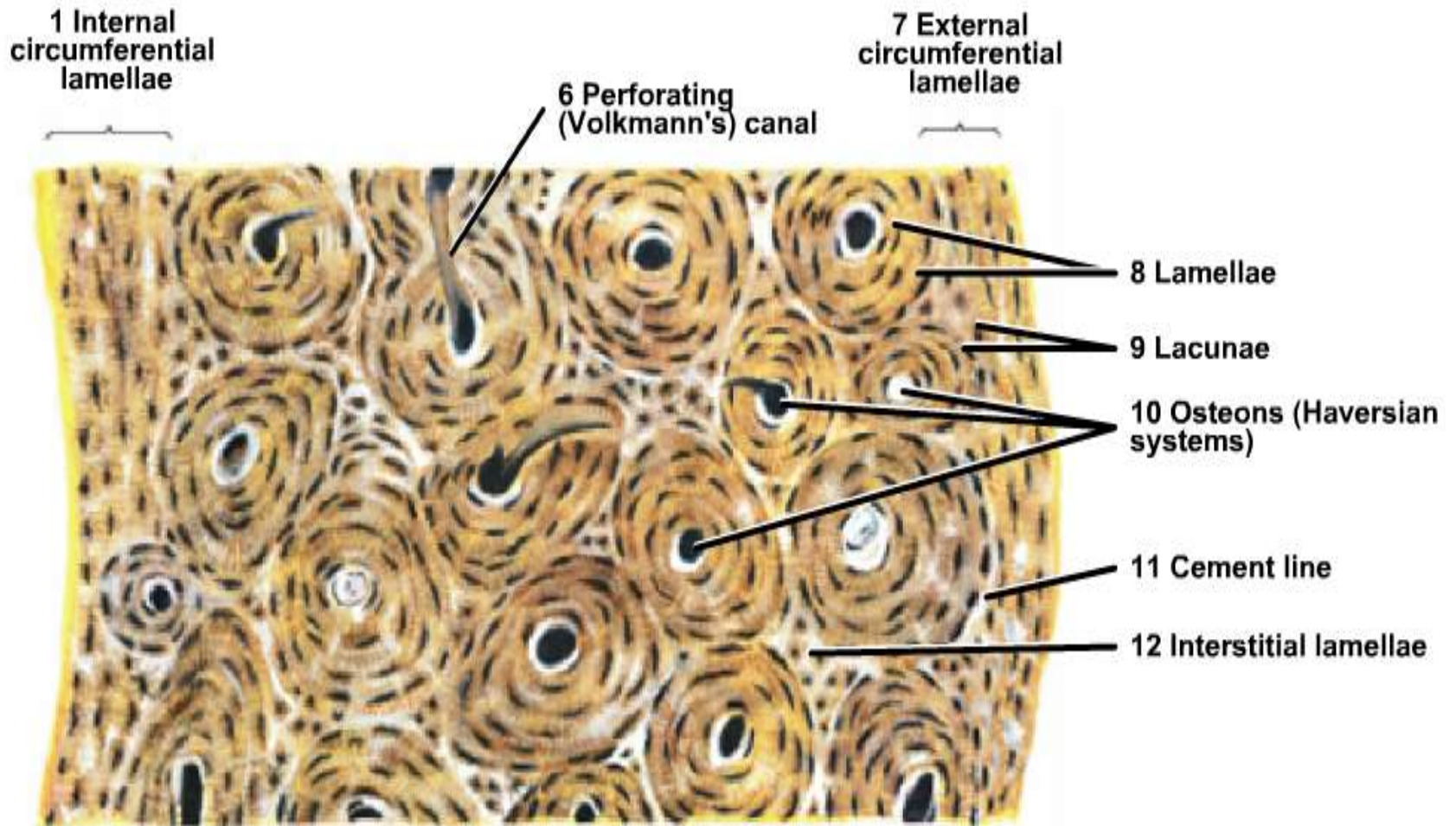


Bone

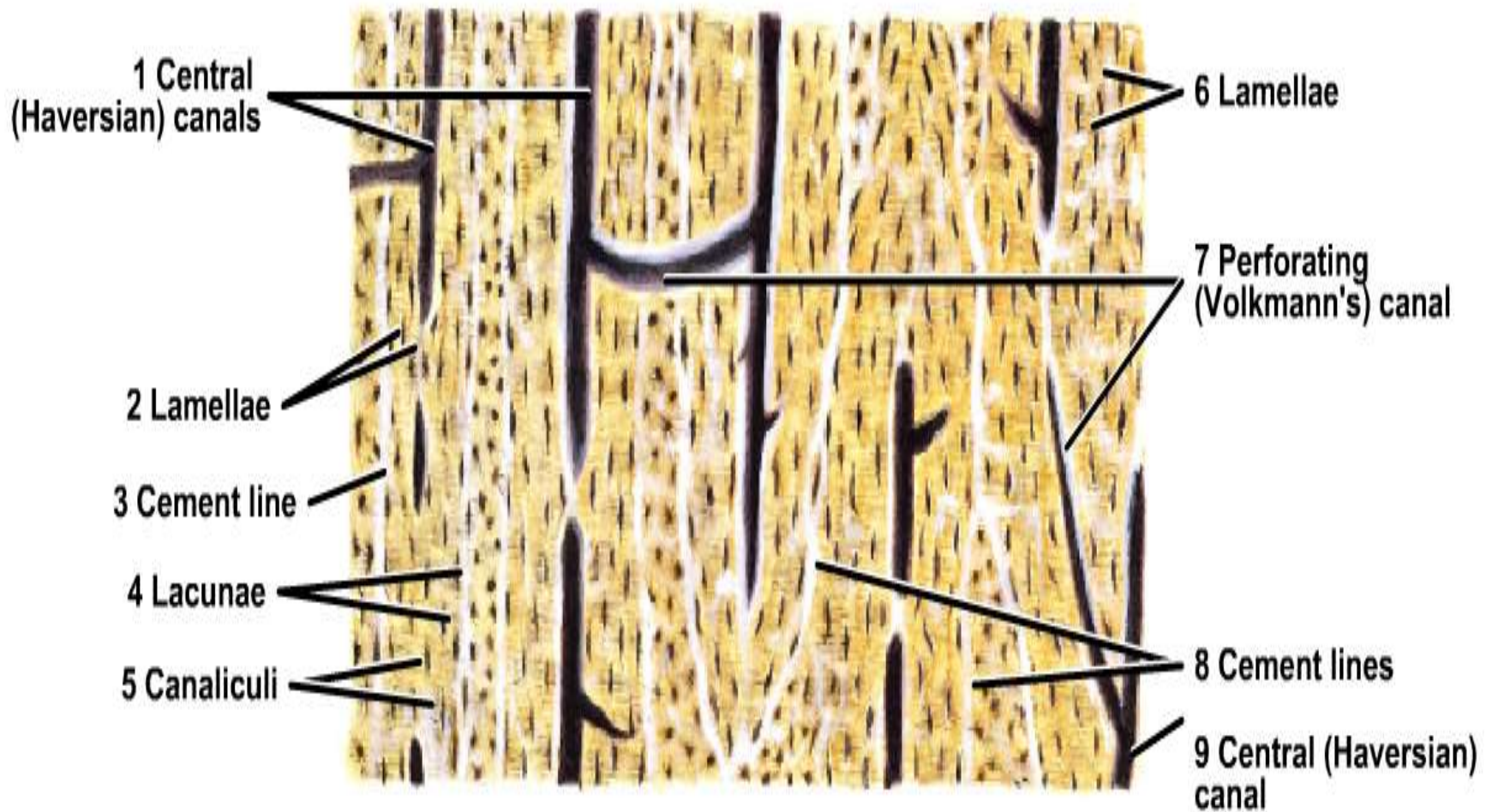
- Dense C.T that form skeleton of the body. Its composed from a matrix of collagen fibers impregnated with bone salt (mainly calcium carbonate and calcium phosphate) in which are embedded bone cell (osteocyte).
- 1. **Compact bone** : form the outer shell of the bone. its consist from a hard solid mass made up of bony tissue arranged in a concentric layers (Haversian system).
- 2. **Osteons**: it's the structural unit of the compact bone matrix, each osteon consist of concentric lamellae arranged around a central (Haversian) canal.
- The central canals contain blood vessels, nerves and reticular C.T

- **Lamellae**: thin plate of bone that contain osteocyte in an almond-shape spaces called **lacunae**. Radiating from each lacunae a tinny canals called **canaliculi**
- Anastomosis between central canals called perforating (volkman) canals.

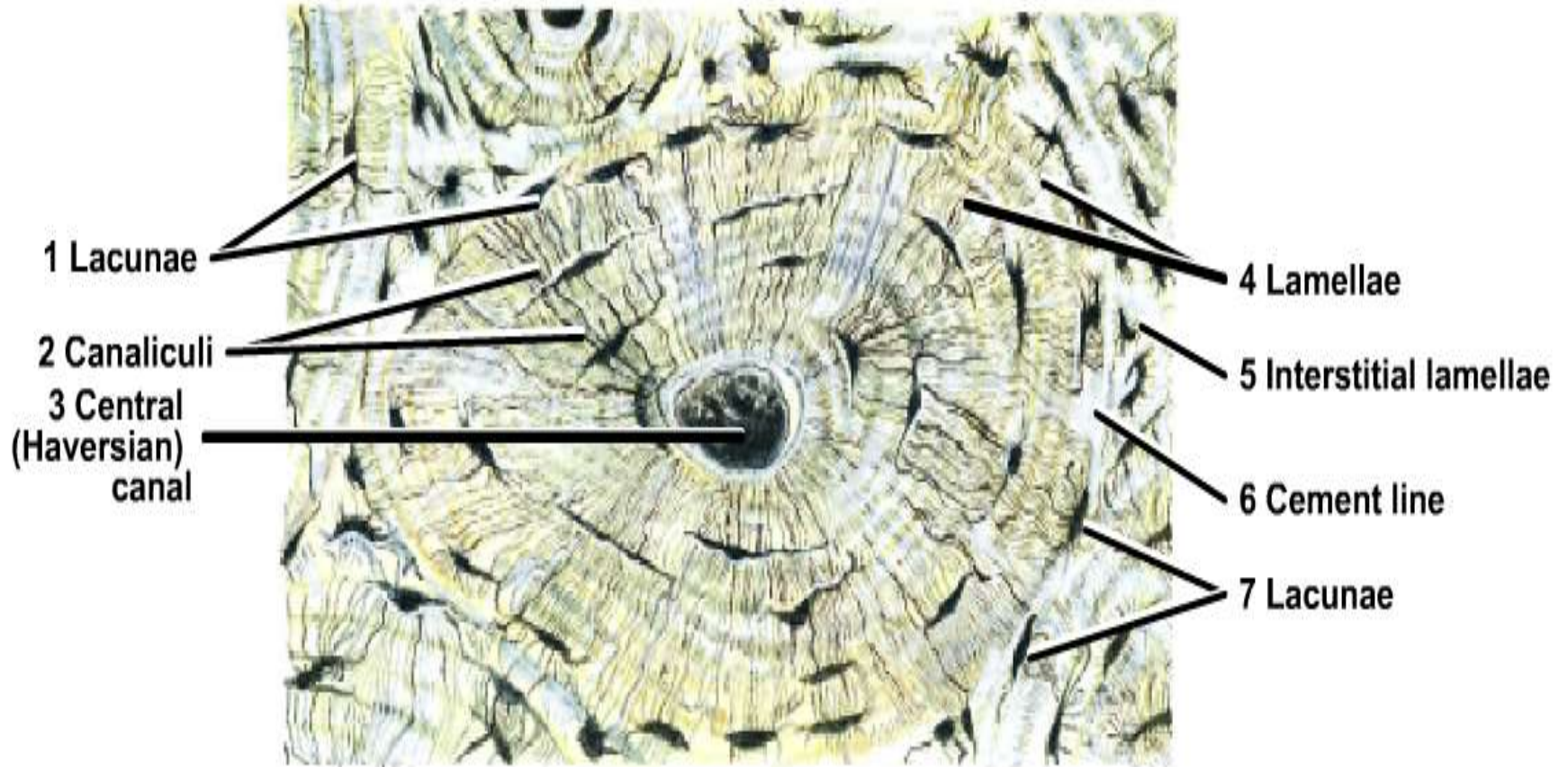
Compact bone transverse section



Compact bone longitudinal section



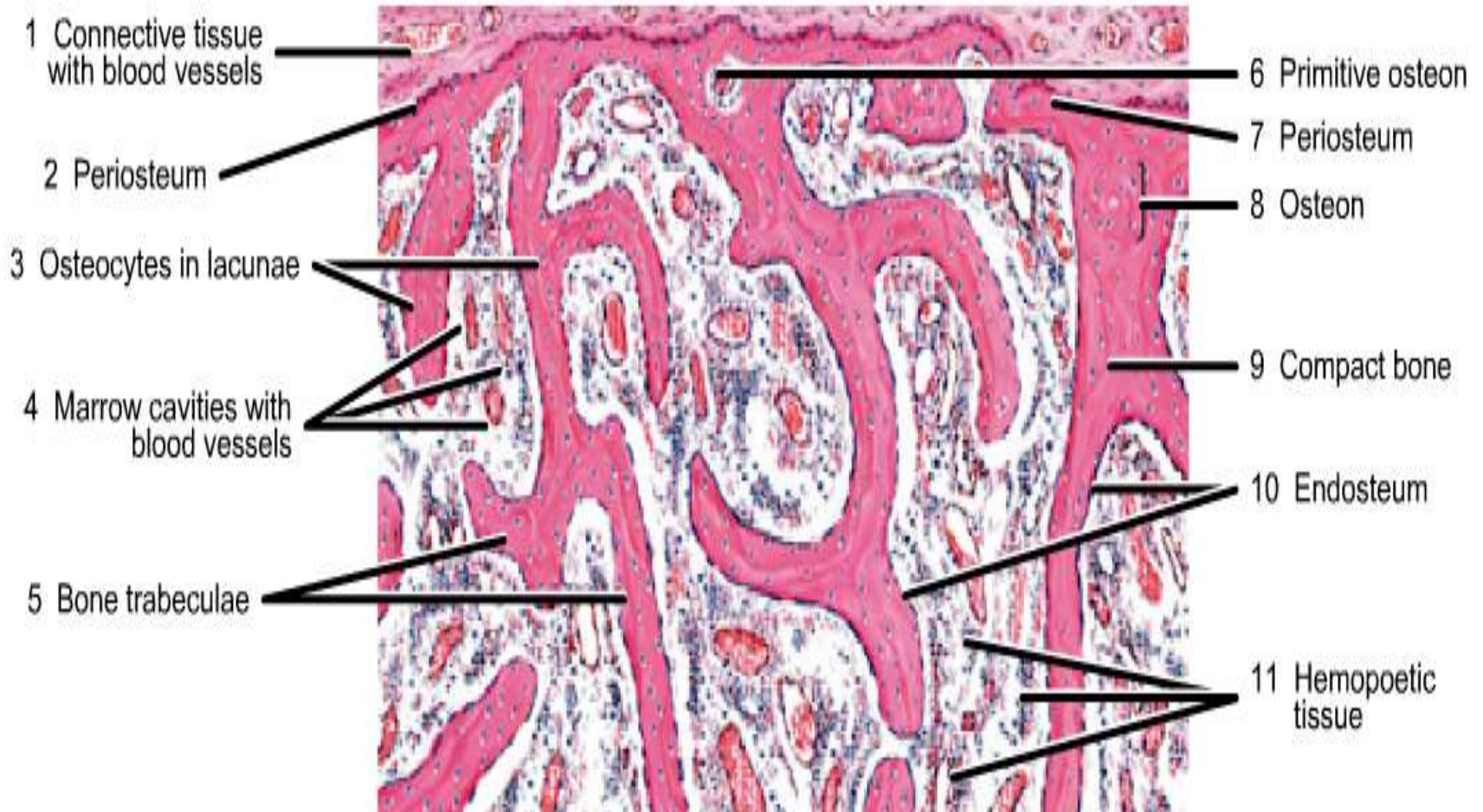
Compact bone osteon transverse section



2. Spongy (cancellous bone).

- Beneath the compact bone. Consist of bony bars (trabeculae) with spaces containing marrow.
- Outer layer of the bone called periosteum

Cancellous bone with trabeculae and marrow cavities sternum



Muscles

- Muscular tissue
- It is a tissue whose cell has the ability to **contract** to produce a **movement**
- They have the ability to convert the energy derived from **chemical** reaction in to **mechanical** energy.
- All muscular tissues consist from cells called **fibers**
- The cytoplasm of muscle cells called **sarcoplasm** and the cell membrane called **sarcolemma**
- Each sarcoplasm contains numerous **myofibrils** which contain two types of contractile proteins **actin** and **myosin**

Skeletal muscle (striated)

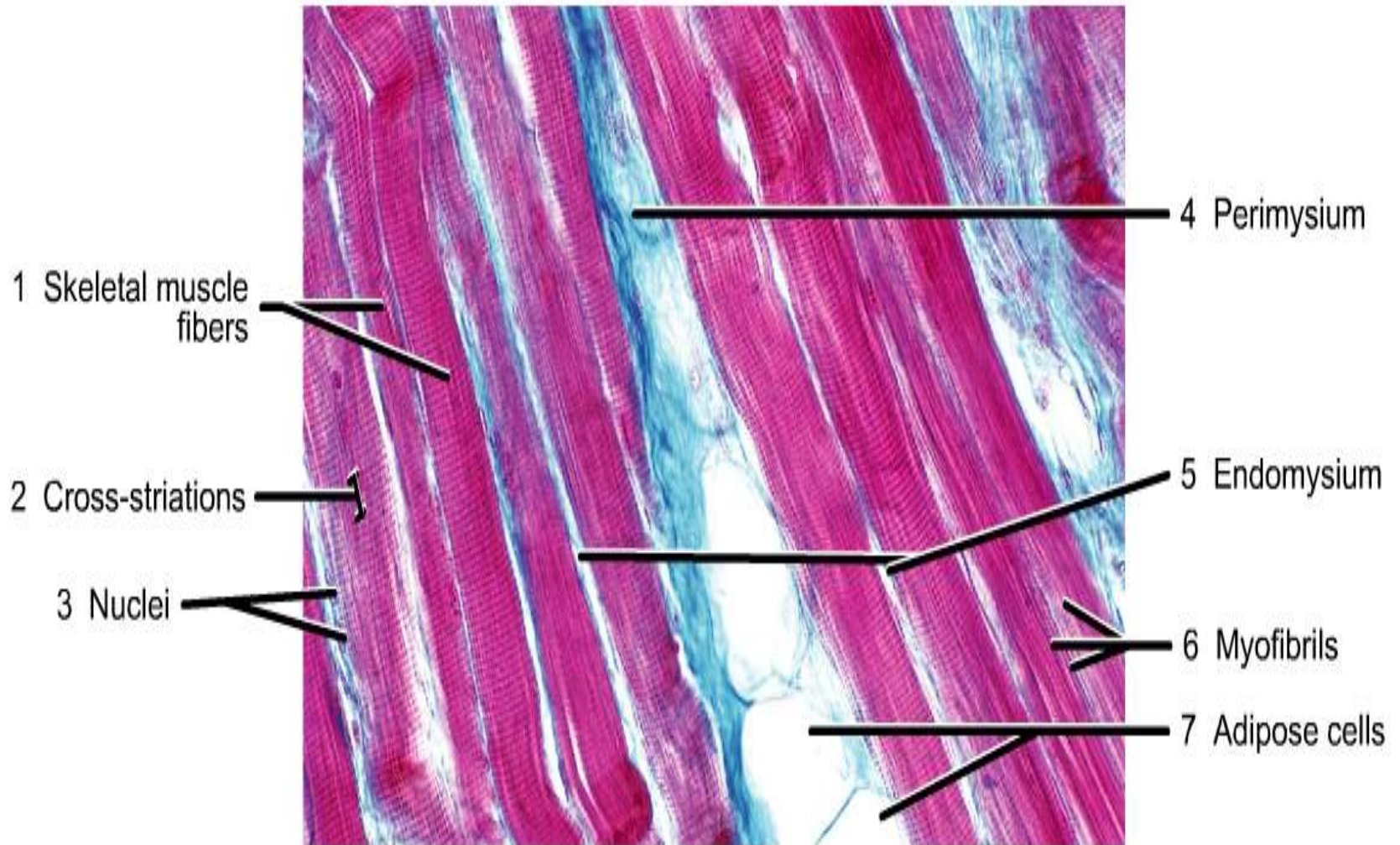
- They are responsible for the body movement (bone) (attached to the skeleton)
- They have a **voluntary movement** (under voluntary control).
- Fibers are long, cylindrical **multinucleated** cells with a **peripheral** nuclei
- Each muscle fiber consist from **myofibrils** which contain two types of contractile proteins **thin actin** and **thick myosin**

- In the sarcoplasm, the arrangement of actin-myosin filaments are very **regular** forming **cross striation** (seen under the microscope **as light I band** and **dark A band** in each fiber); that's why they are called striated muscle
- Epimysium : dense irregular C.T layer surround skeletal muscles
- Perimysium : dense irregular C.T surround muscle fascicles(fascicles is small bundles of muscle).
- Endomysium: reticular C.T fibers surrounding each muscle fiber

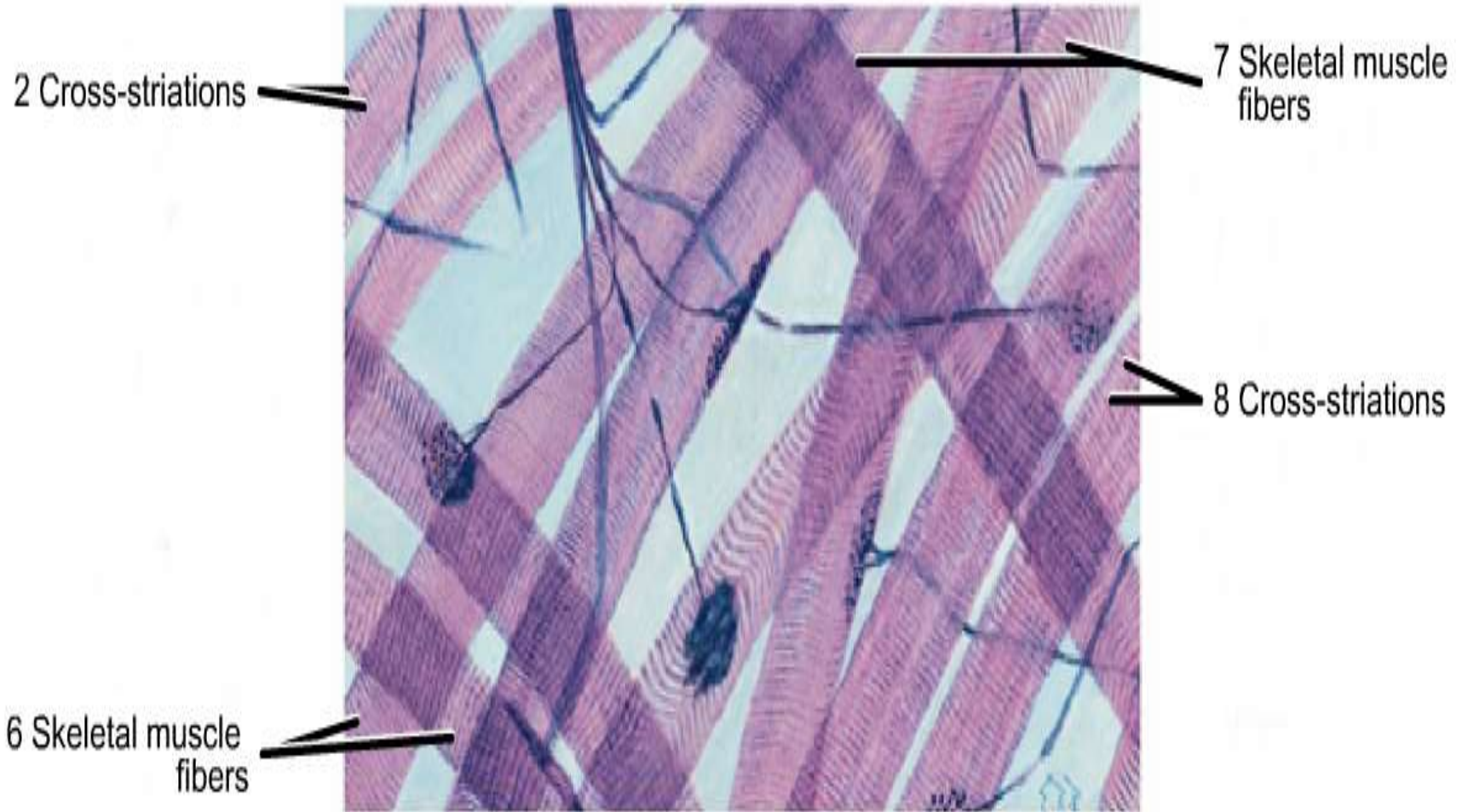
Skeletal muscle of the tongue (longitudinal and transverse section)



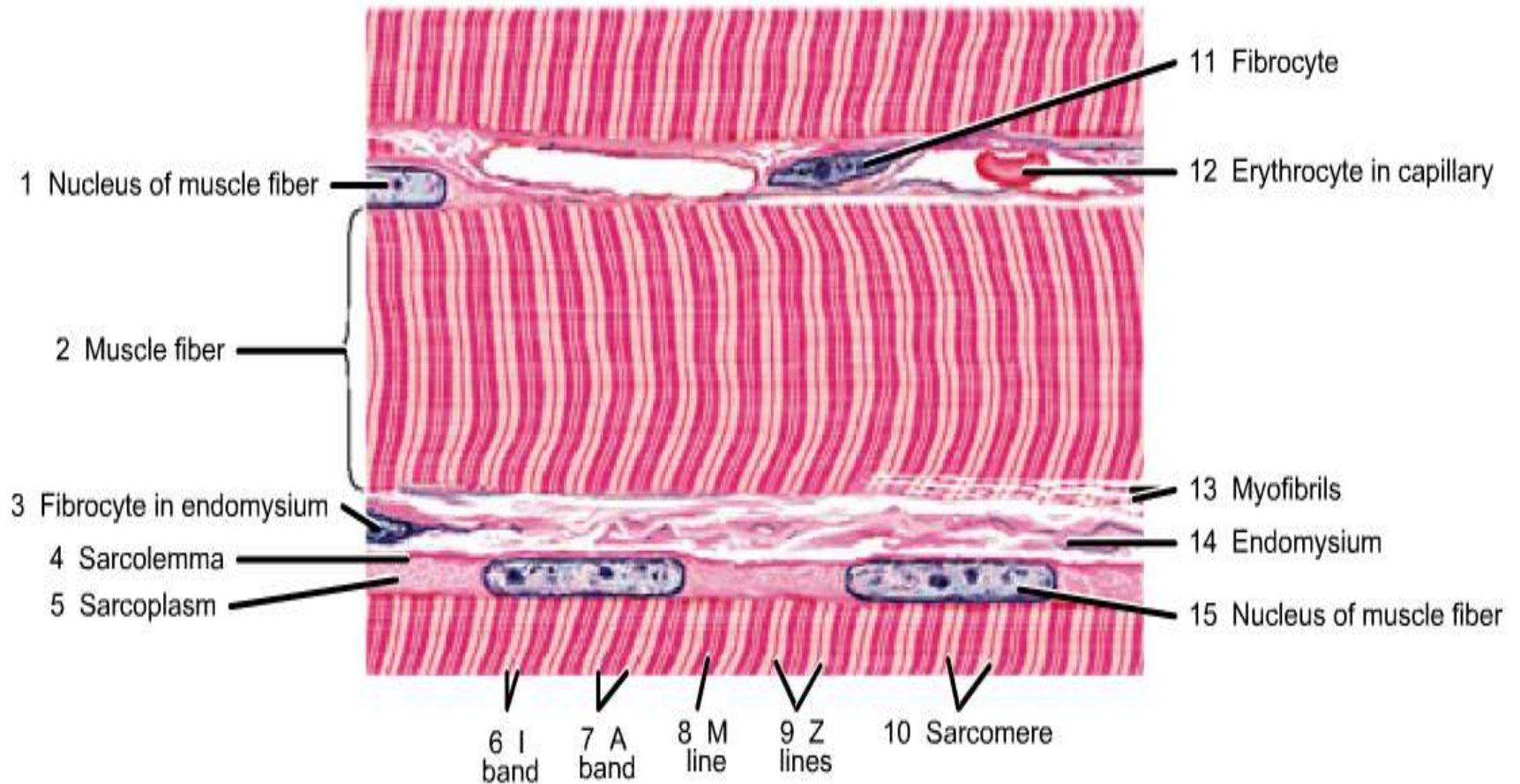
Skeletal muscle of the tongue (longitudinal section)



Skeletal muscles



Skeletal muscles



Cardiac muscle

- They are found in the walls of the **heart** and the walls of the **aorta** and **pulmonary trunk**.
- Similar to skeletal muscle, Cardiac muscle exhibit **cross-striation** (as a result of regular arrangement of actin and myosin filaments).
- Cardiac muscle fibers are **shorter** than that of cardiac muscle; and they have **one to two centric nuclei**, and they are branched cell, cardiac muscle characterize by the presence of intercalated disks.

- Intercalated disc: are specialized junctional complexes between cardiac muscle fibers which appear as dark staining structures formed at the irregular intervals in the cardiac muscle (characteristic feature).

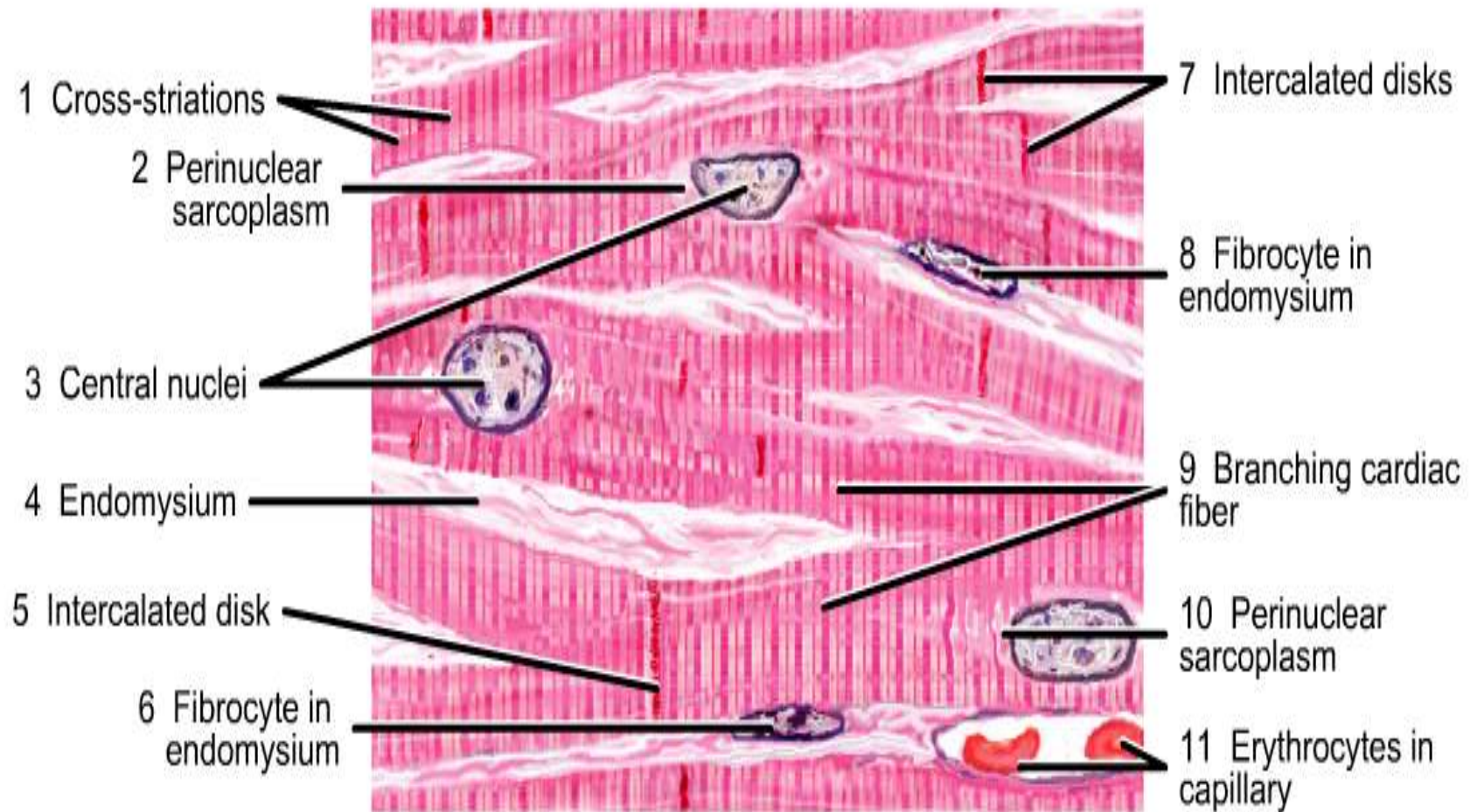
Cardiac muscle longitudinal and transverse section



Cardiac muscle longitudinal



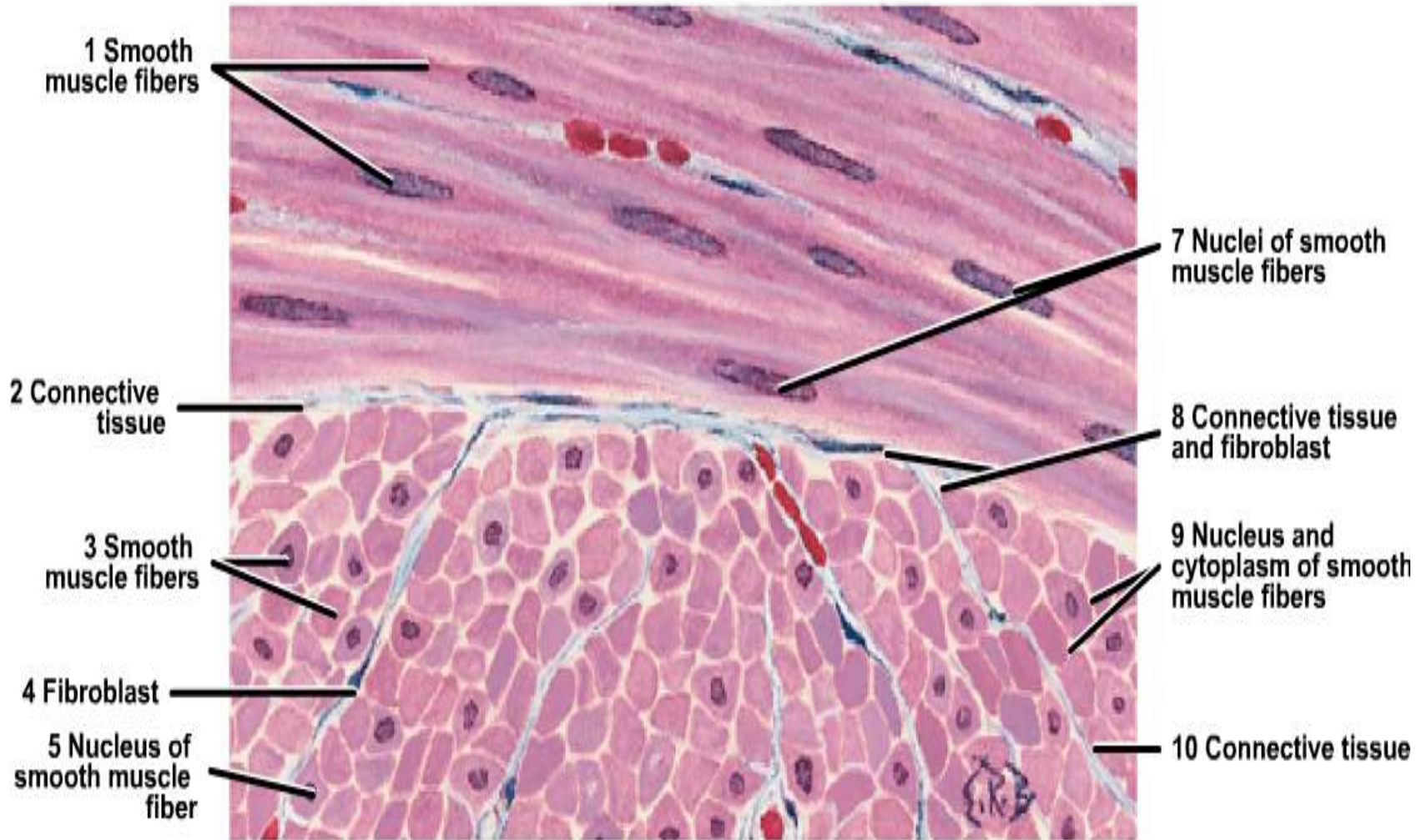
Cardiac muscle longitudinal



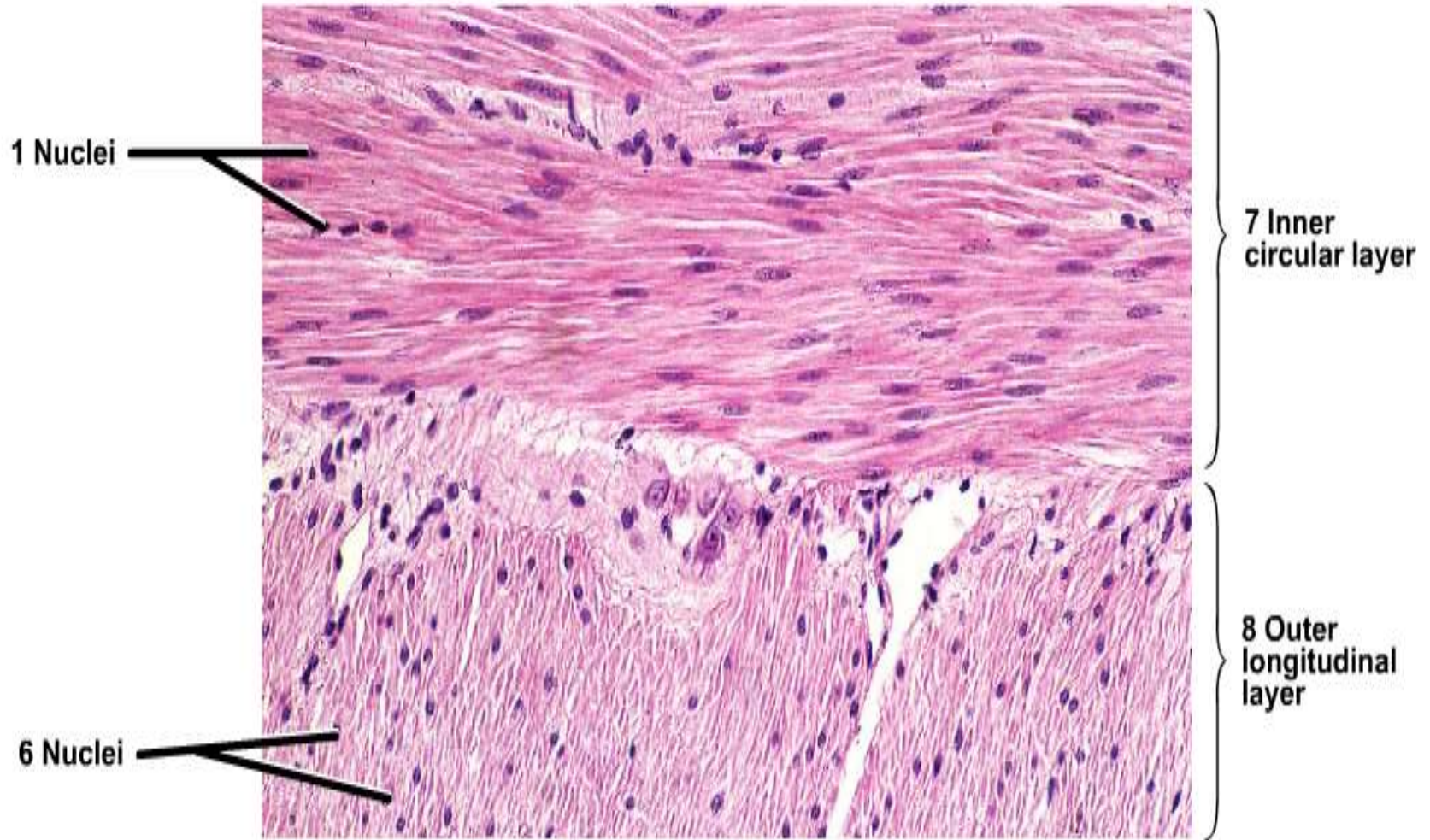
Smooth muscle

- They are found in the wall of hollow organs, blood vessel.
- They are **involuntary muscle** , and they are under the control of autonomic nervous system and hormones
- Fibers are **spindle** in shape, small and contain **single central nucleus**
- actin and myosin are not arranged in the regular, cross striated patterns, so these muscles appear smooth or not striated.

longitudinal and transverse section of smooth muscle small intestine (inner circular layer



longitudinal and transverse section of smooth muscle small intestine (inner circular and outer longitudinal layer)



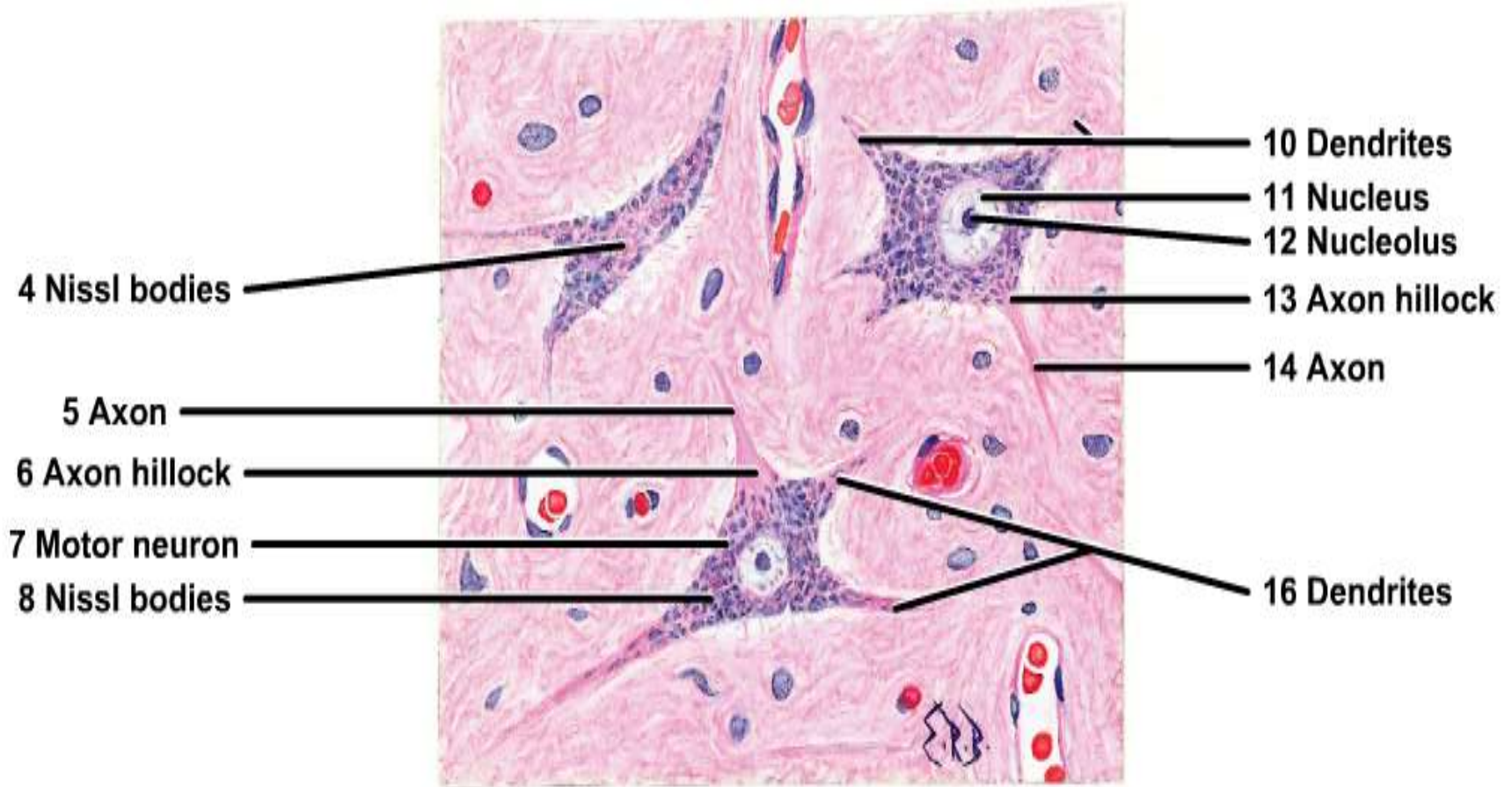
Nervous tissue

- The nerve tissue is sensitive to stimulation and conduct impulses from one point to other. Nerve cell or neurons have three parts
 - 1- neuron cell body
 - 2- dendrites
 - 3- the axon
- The axon terminate in fine filaments (**neuron endings**) which come into contact with another neuron cell dendrites (**synaps** (neuron-neuron)) or they form nerve-muscle junction (**myoneural junctions**)

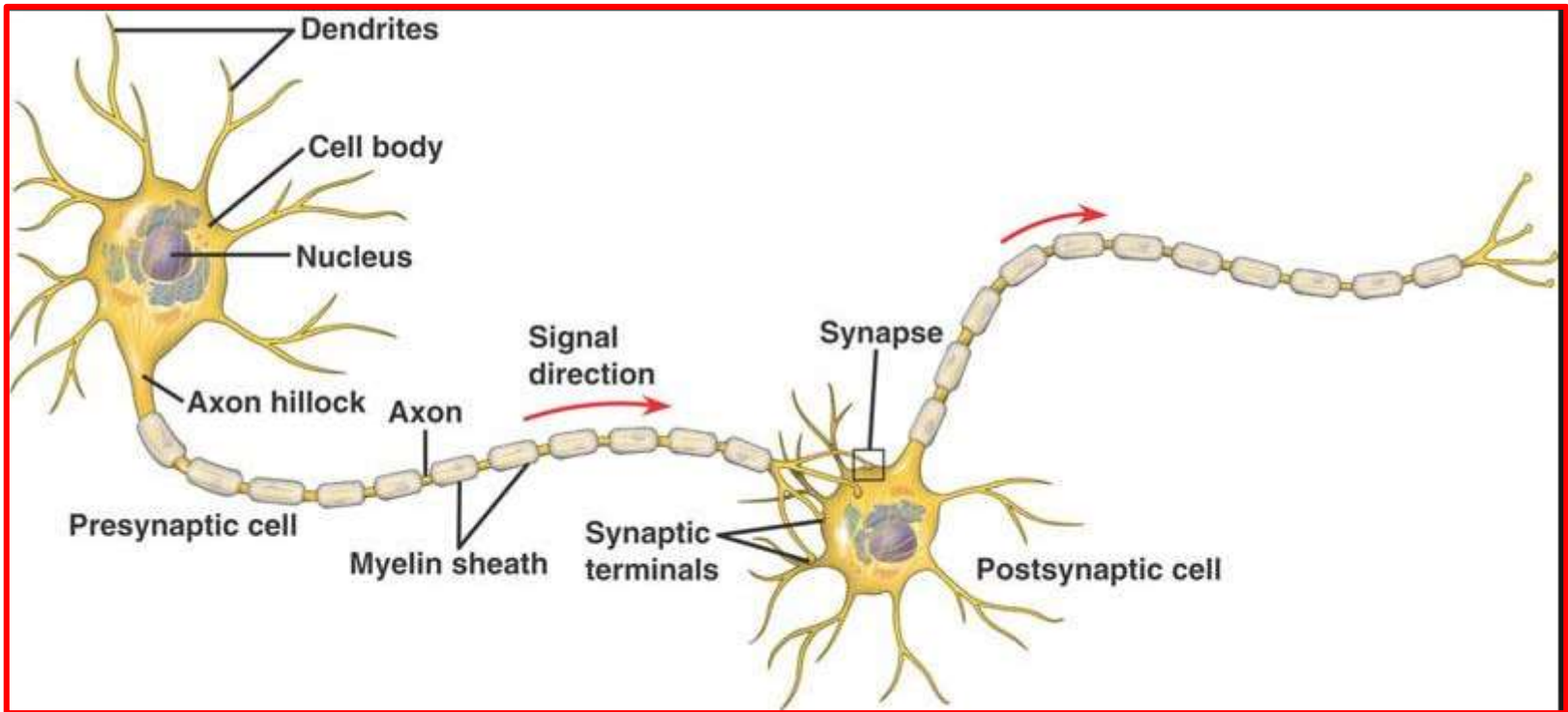
Types of neurons

- 1. Sensory neurons (afferent neurons):** Carry impulses from sensory organs receptors into brain or spinal cord (CNS)
- 2. Motor neurons (efferent neurons)** Carry impulses from brain and spinal cord to muscles or glands
- 3. Intermediary neurons (interneurons)** Found within brain or spinal cord, they link sensory and motor neurons

Motor neuron: anterior horn of the spinal cord



Structure of neuron



Connective tissue

Connective Tissue:

- Developed from the **mesenchyme** (an embryonic type of tissue).C.T binds body structures together or provides a framework for the body.
- Most diverse and abundant type of tissue.
- Function:
 1. Protection: Defending the body against infection (macrophages, plasma cells, mast cells, WBCs)
 2. Supporting, Binding, Separation more specialized tissues and organs or function as Packing tissue of the body
 3. Insulation
 4. Storing nutrients as fat (energy source)

- Connective tissue consist from
- extracellular matrix (ground substances + fibers) and cells

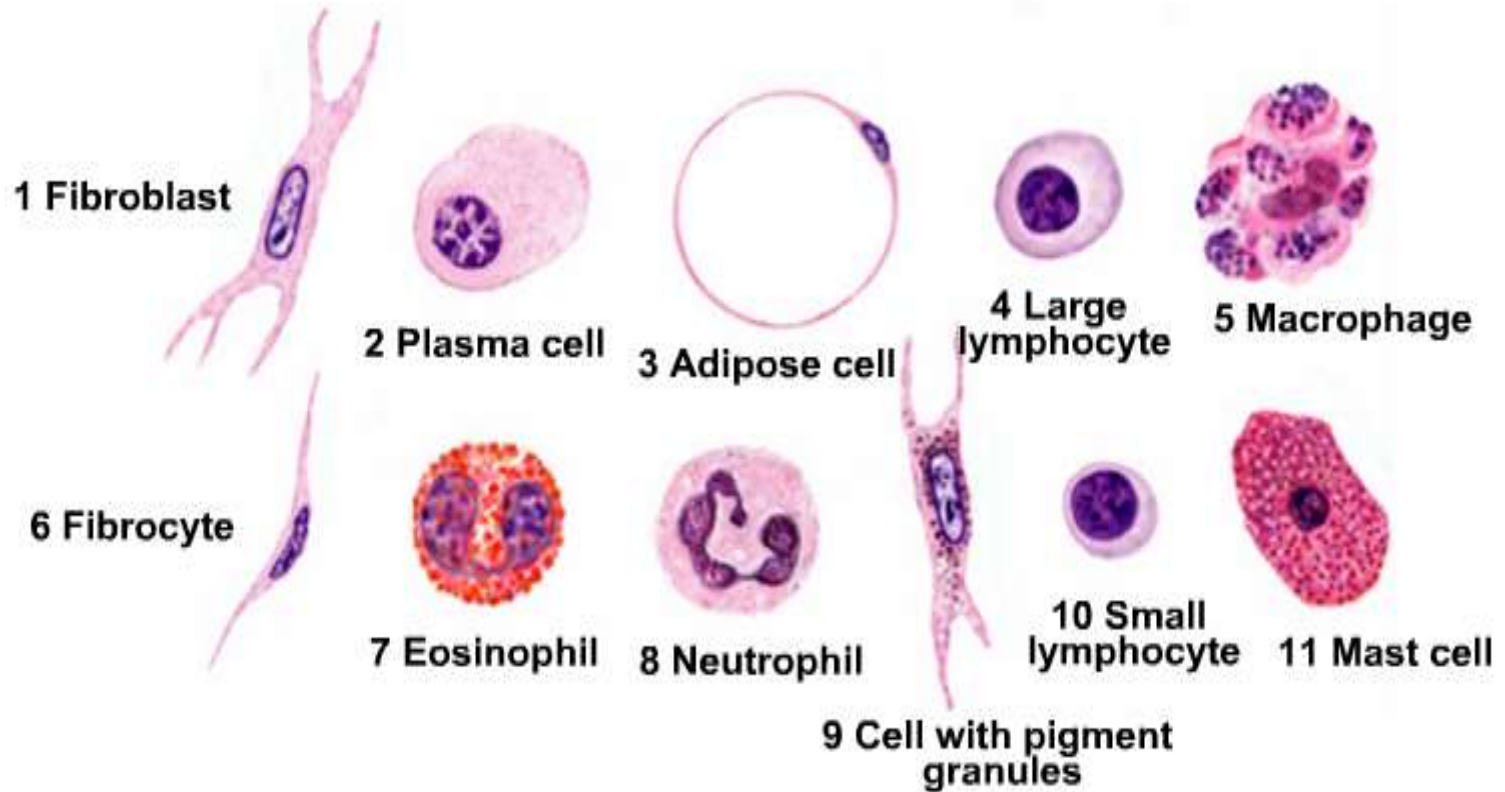
A. extracellular matrix

1. Amorphous ground substance of mucopoly-saccharides
2. Fibers: white (collagen) fibers, yellow (elastic) fibers and reticular fibers are embedded within the ground substance

B. Cells: fatty cells, mast cells, fibroblast, macrophages

- Variation in the **chemical composition** of the ground substance and in the **properties and quantities** of **cells and fibers** give rise to tissues of widely differing characteristics including bone, Cartilage, tendons, ligaments as well as adipose T. areolar T. and elastic tissue The greatest part of C.T. is intercellular material which can be fluid as in case of blood or hard and rigid as in bone
- Some of C.T. cells serve an important defensive function like phagocytes

Cells of the C.T

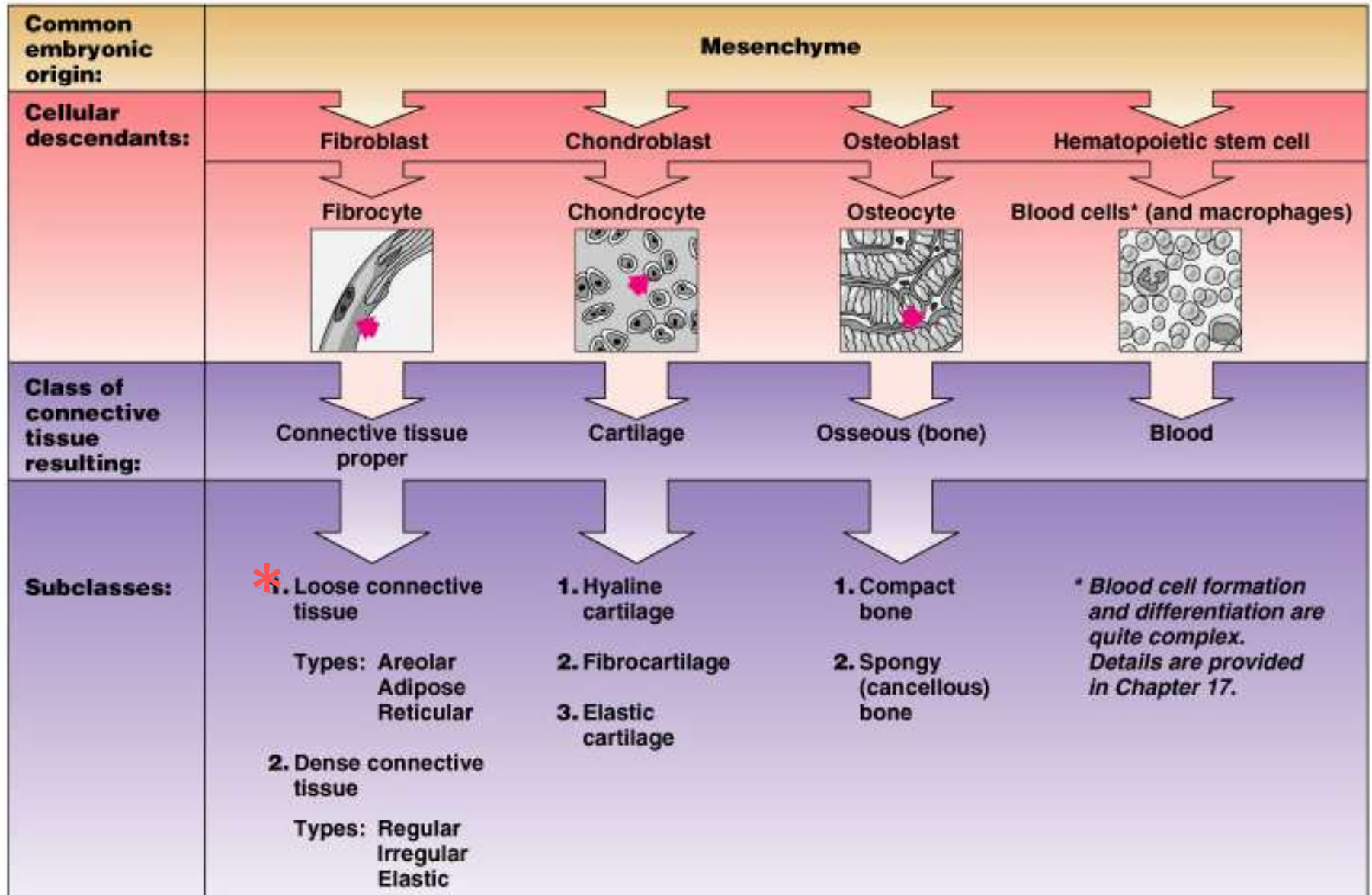


- **Cells of C.T.**

1. **Fibroblast:** - dominant cells in the C.T. fusiform-shaped
synthesized all of C.T. fibers and ground substance
2. **fibrocytes:**- smaller than fibroblast are **mature and inactive**
3. **Macrophages or histocytes:**- are **phagocytes** that ingest bacteria, dead cells, cell debris and other foreign matter.
Macrophage has different names, in liver called kupfer cells, in bone (osteoclasts) and in CNS (microglia)
4. **Adipose (fat) cells:** - in groups or singly. They **store fat**

5. **Mast cells:-** spherical cells filled with fine regular dark staining granules they synthesize and release **histamine** and **heparin**.
6. **Lymphocytes (large, small):-** they produce **antibodies**
7. **Plasma cells:-** derived from lymphocytes they secrete **antibodies**
8. **Neutrophils:-** has multilobuled nucleus has **phagocytic activity** against bacteria
9. **Eosinophils:-** large cells with bilobed nucleus and large cytoplasm granules they increase after **parasitic infection** and **allergic reactions** (phagocytes Ag-Ab complexes formed during allergic reaction)

Classes of Connective Tissue

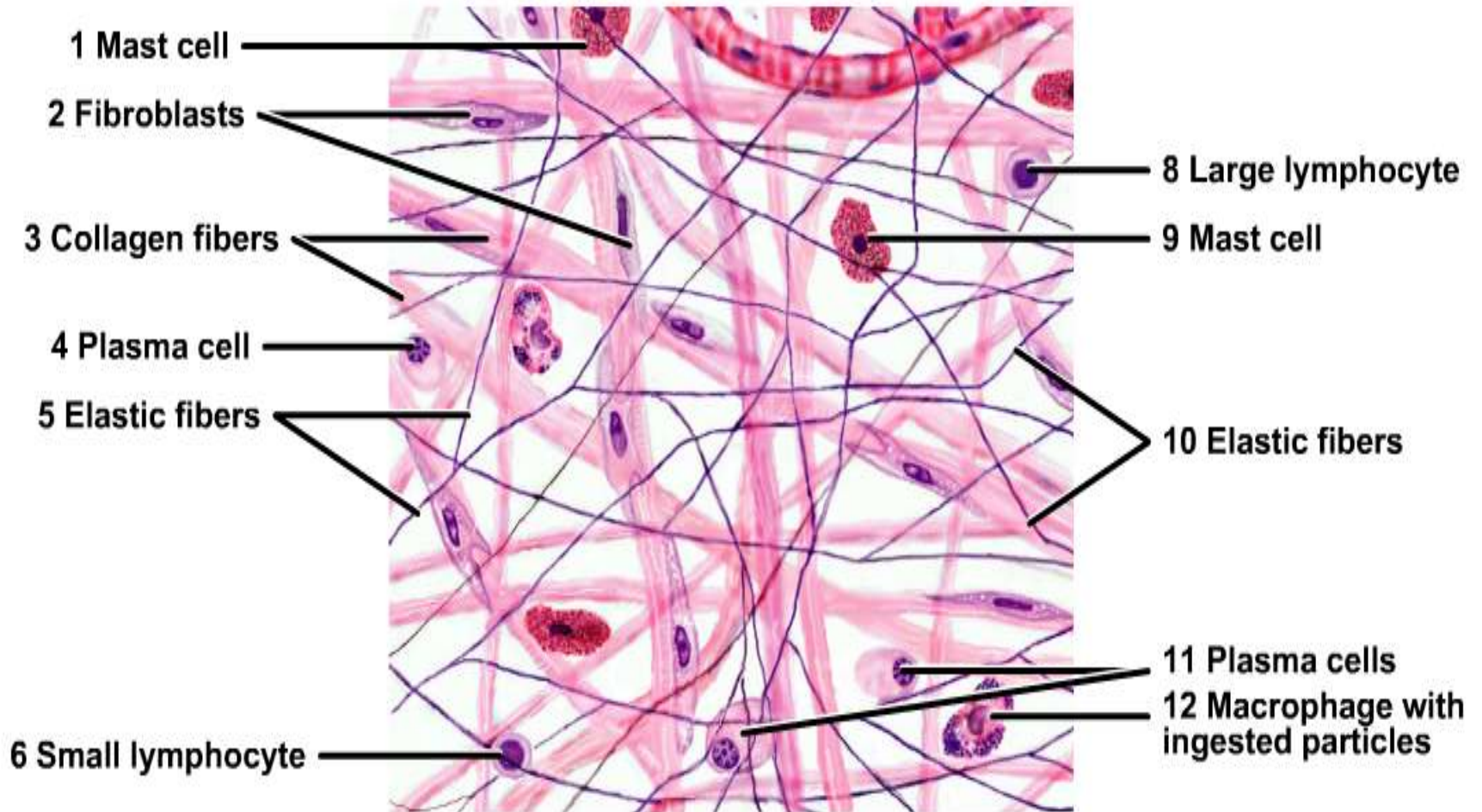


Types of C.T

A. Loose C.T

- 1. Areolar C.T.:-** loose, irregular arrangement of fibers (collagen, elastic, reticular) and abundant ground substance and cells.
 - **Function:-**wraps and cushions organs contain macrophages which phagocytes bacteria. Play important role in inflammation, holds and conveys tissue fluid
 - **Cells** fibroblast, macrophages, mast cell, adipose cell
 - **Location** under epithelia, under skin (subcutaneous), within walls of blood vessels , supporting organs (binds between organs)

Loose C.T

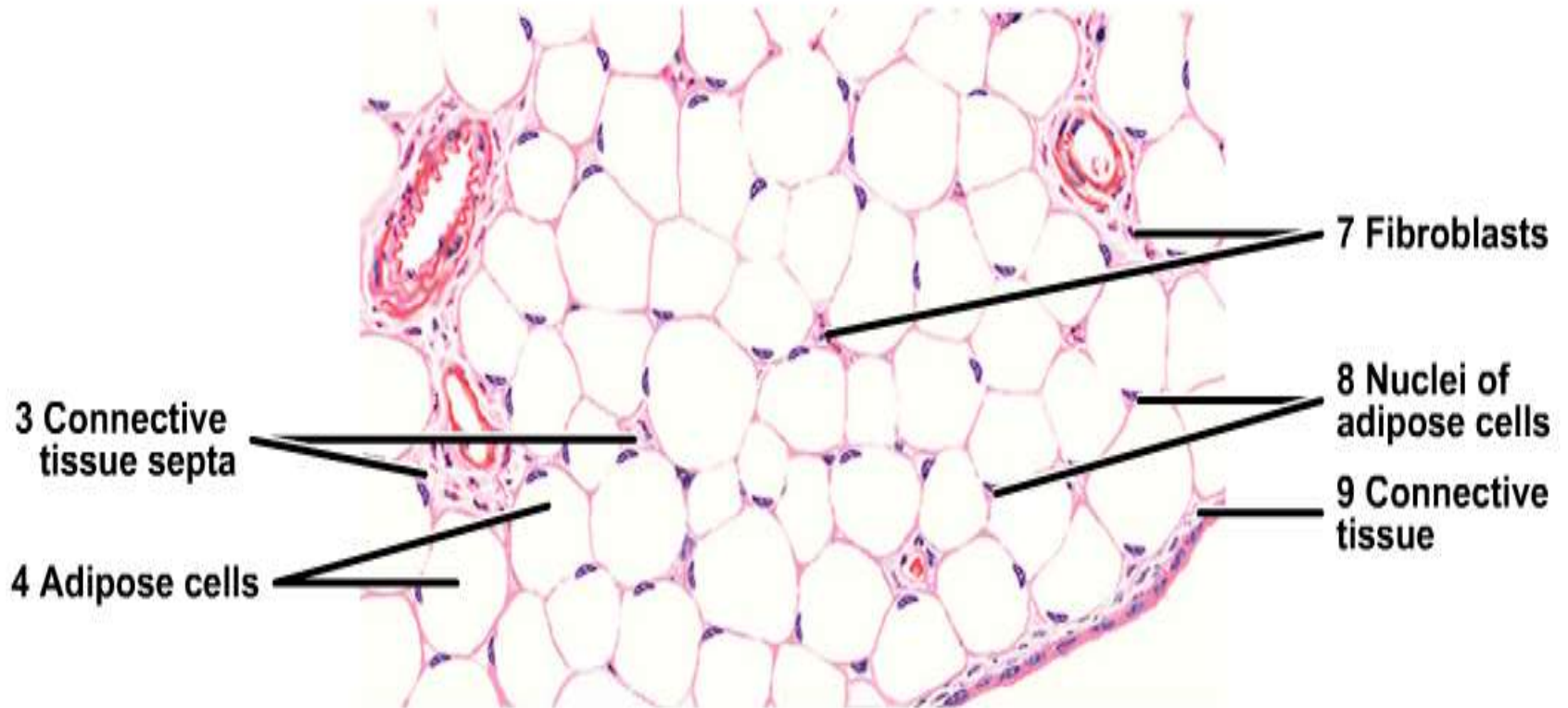


2. Adipose tissue

Location under skin around kidney, eye ball, abdomen and breast

Function energy source, insulation against heat loss (under skin), fat pads to support and protect organs

Adipose tissue



3. Reticular tissue

Almost non elastic branching fibers of C.T that join together to form delicate (supportive) meshwork around B.V , muscle fibers, glands, neurons.

Defensive function because they have phagocytic cells that defense foreign bodies

Composed from protein reticulin (like collagen)

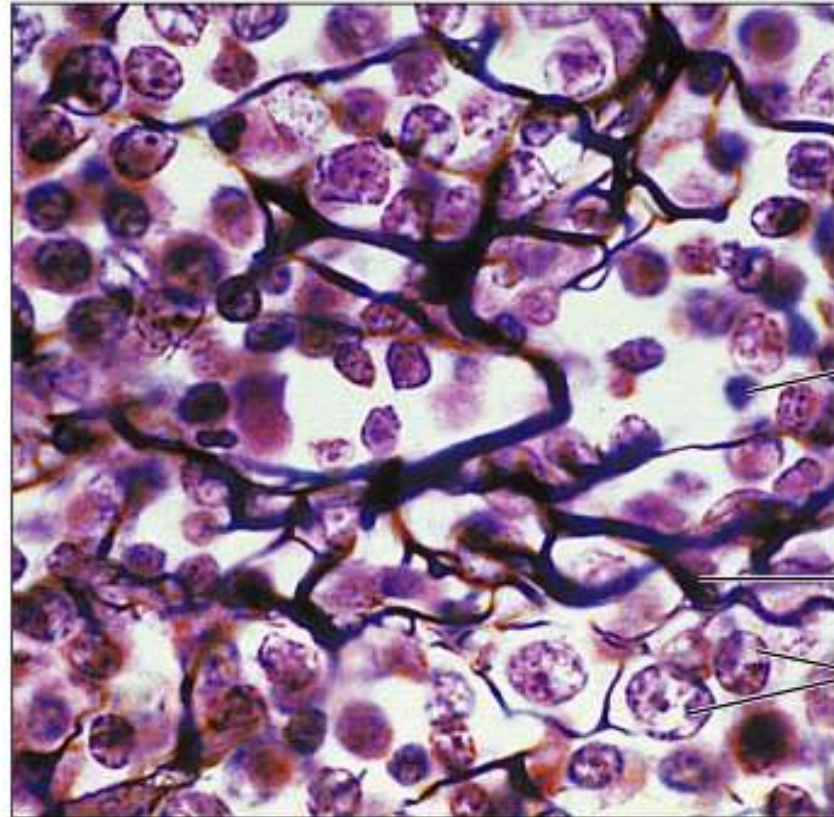
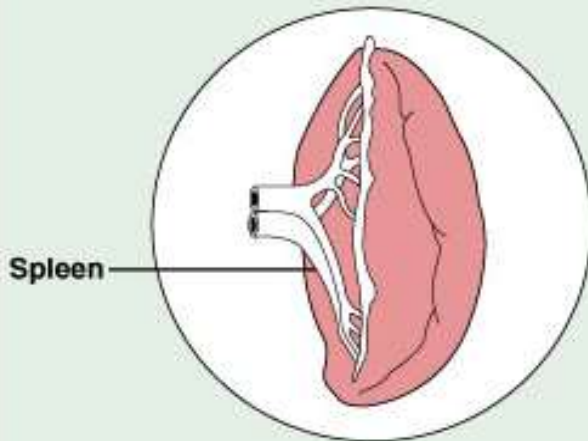
Location lymph node, bone marrow, spleen, liver, kidney and muscle

Reticular tissue

Description: Network of reticular fibers in a typical loose ground substance; reticular cells lie on the network.

Function: Fibers form a soft internal skeleton (stroma) that supports other cell types including white blood cells, mast cells, and macrophages.

Location: Lymphoid organs (lymph nodes, bone marrow, and spleen).



White blood (lymphocyte) cell

Reticular fibers

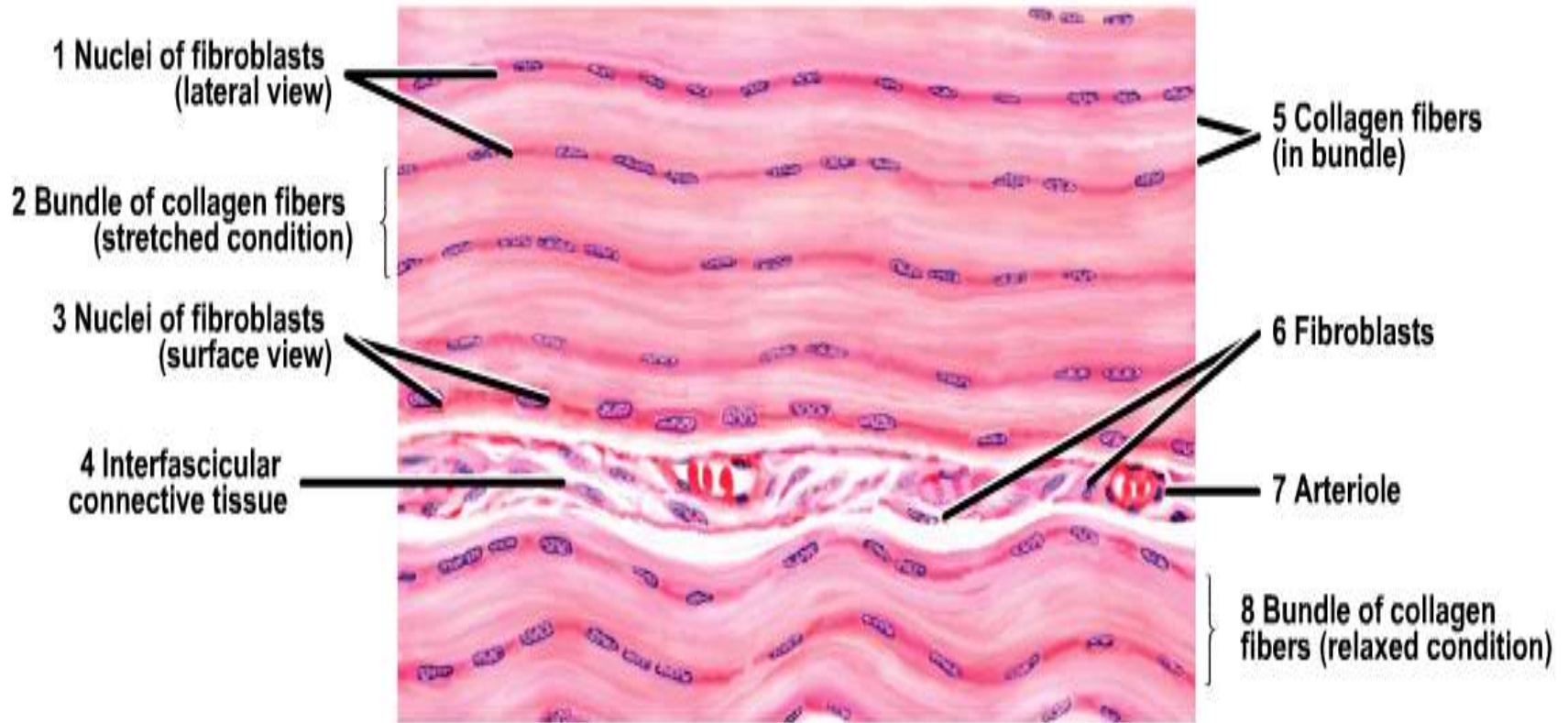
Mast cells

Photomicrograph: Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (350 \times).

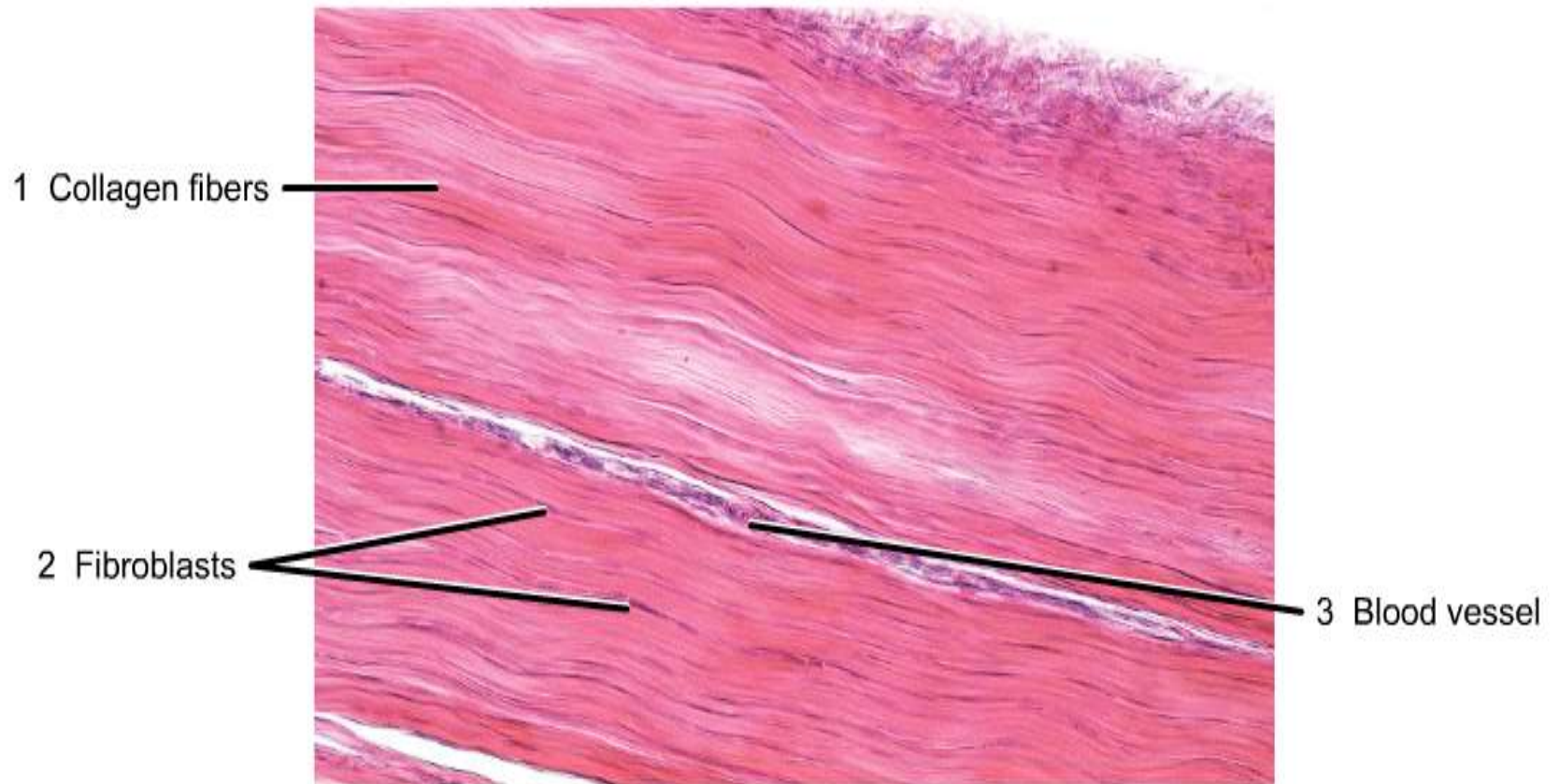
B. Dense C.T

- Thicker and more densely packed collagen fibers with fewer cell types and less ground substance
1. Dense irregular C.T: Collagen fibers have random or irregular orientation
 - **Location** dermis of skin, capsule of different organs, submucosa of digestive system
 - **Function:** provide structural strength, withstand tension in many directions.
 2. Dense regular C.T: Collagen fibers have regular and parallel arrangement
 - **Location** tendon (bone –muscle) ligament (bone-bone)
 - **Function:** withstand great tensile stress when pulling force applied in one direction.

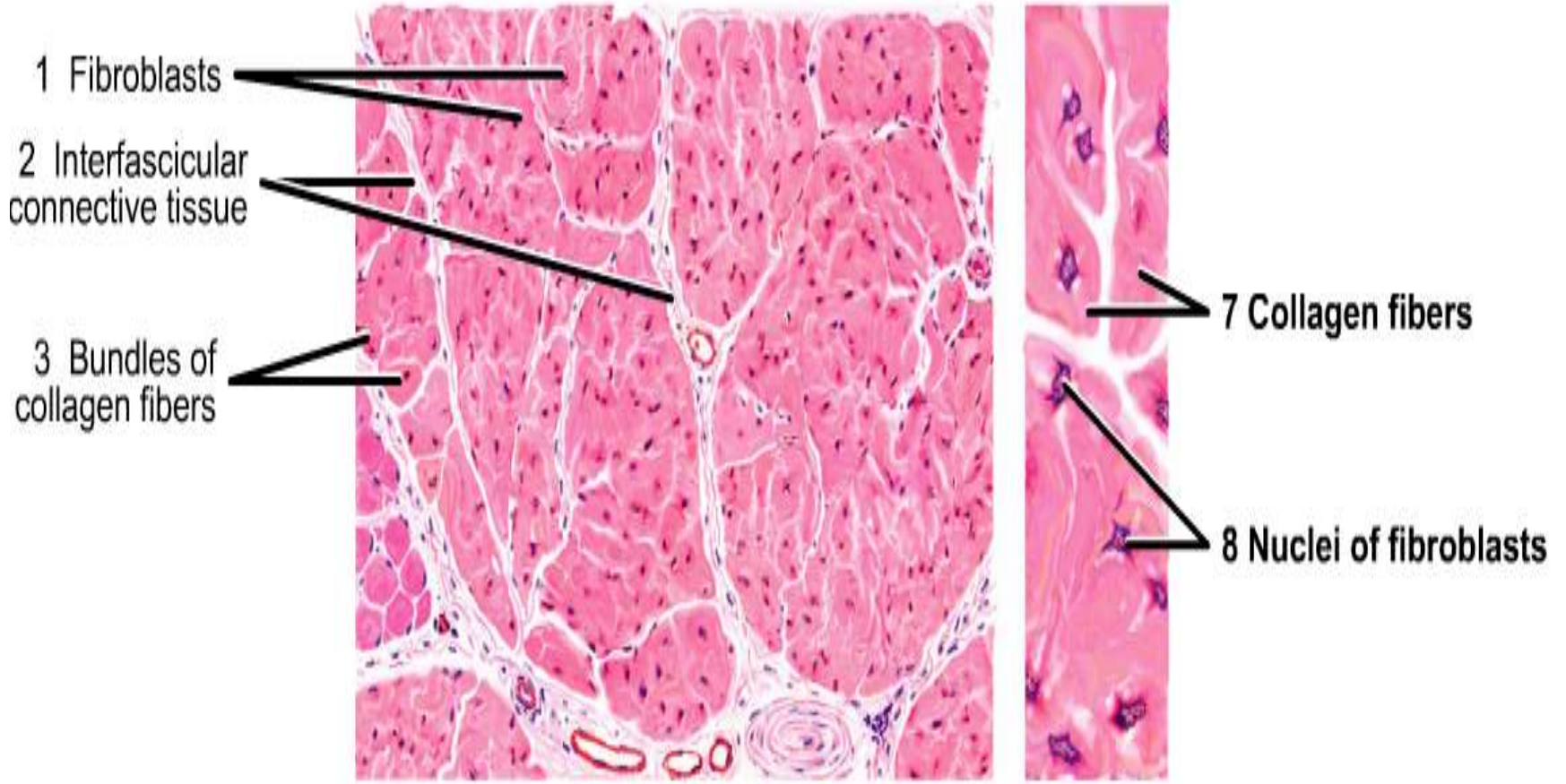
Dense regular C.T tendon longitudinal section



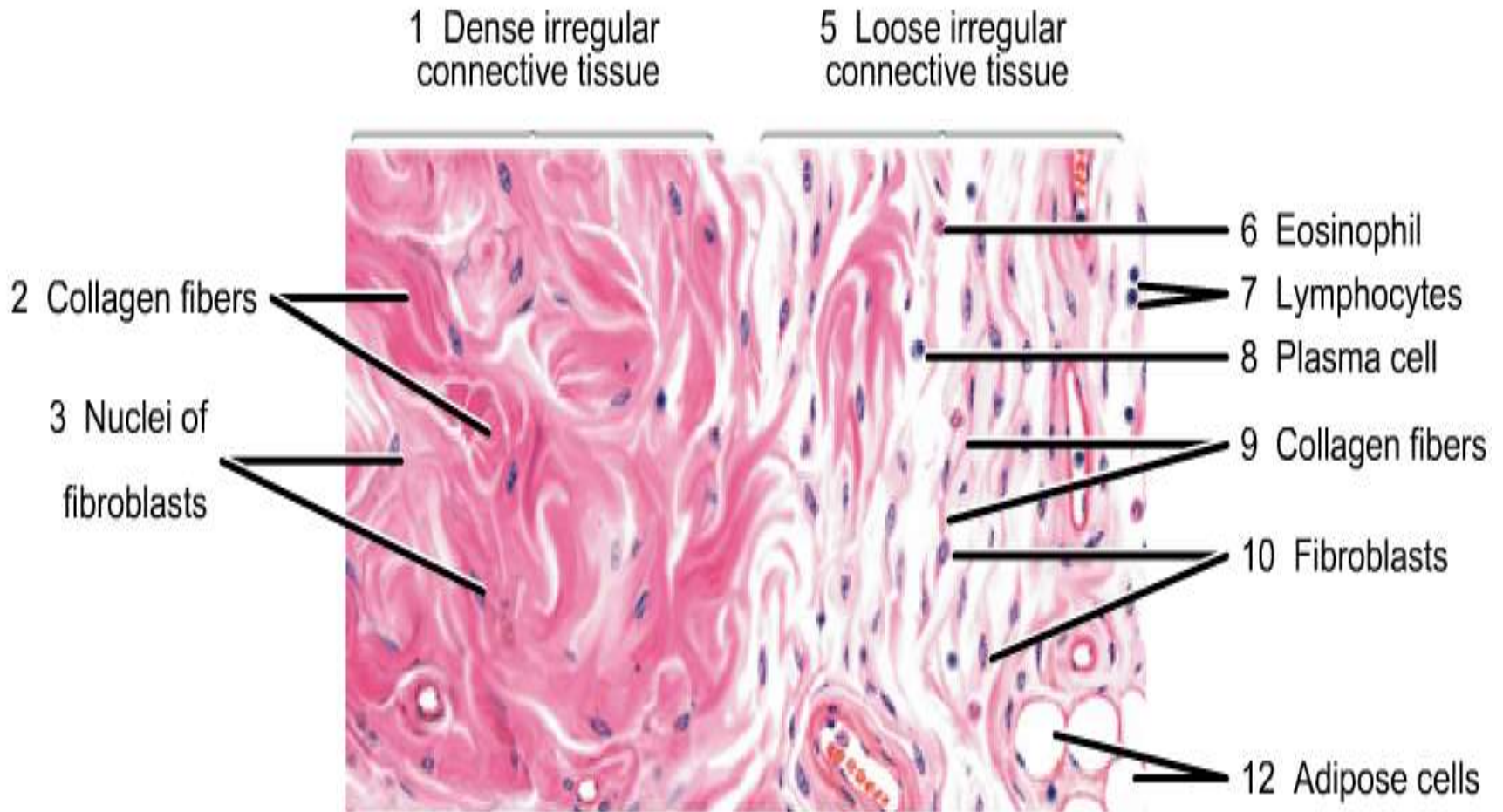
Dense regular C.T tendon longitudinal section



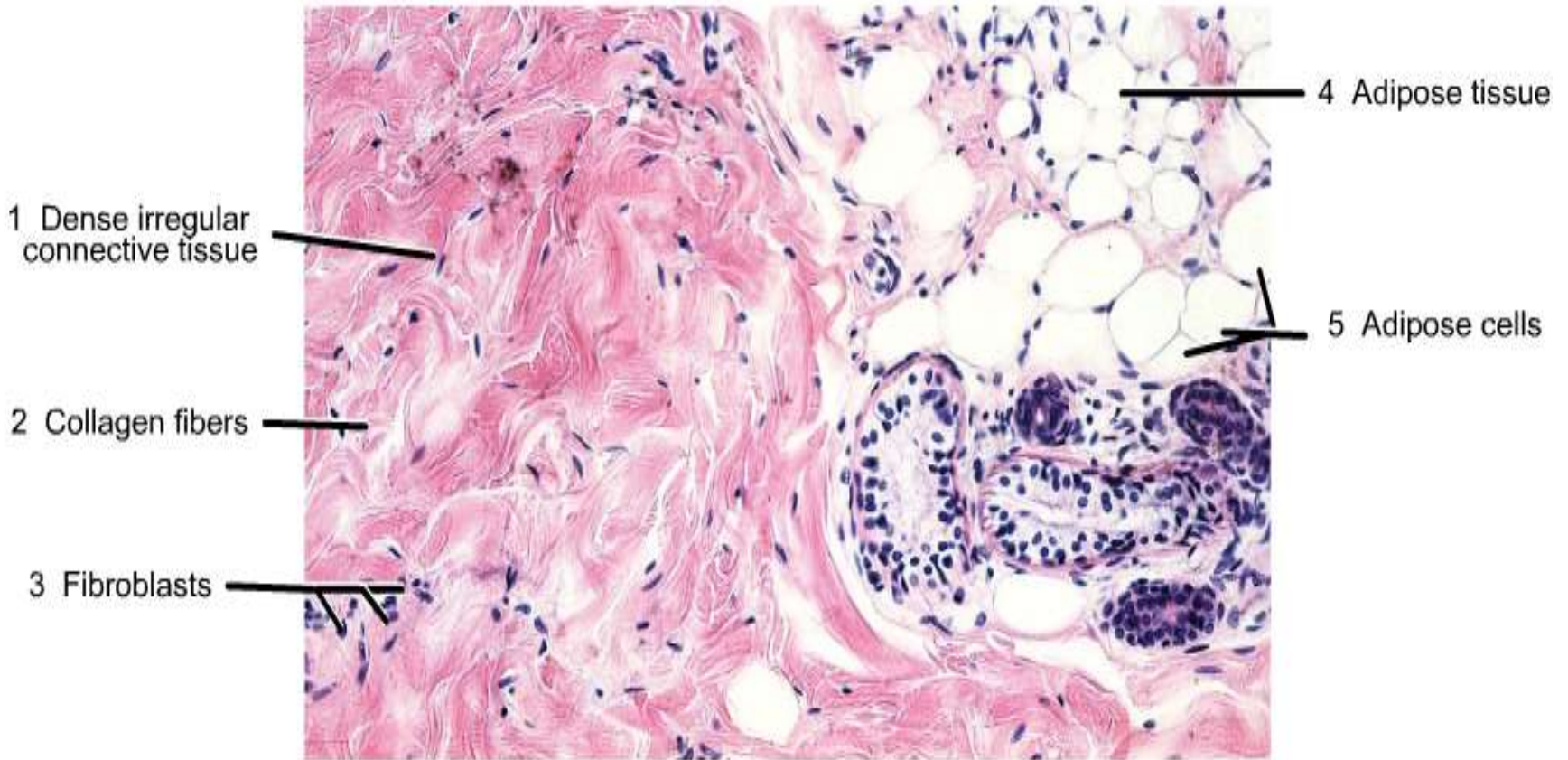
Dense regular C.T tendon transverse section



Loose irregular and dense irregular C.T



Dense irregular and adipose tissue

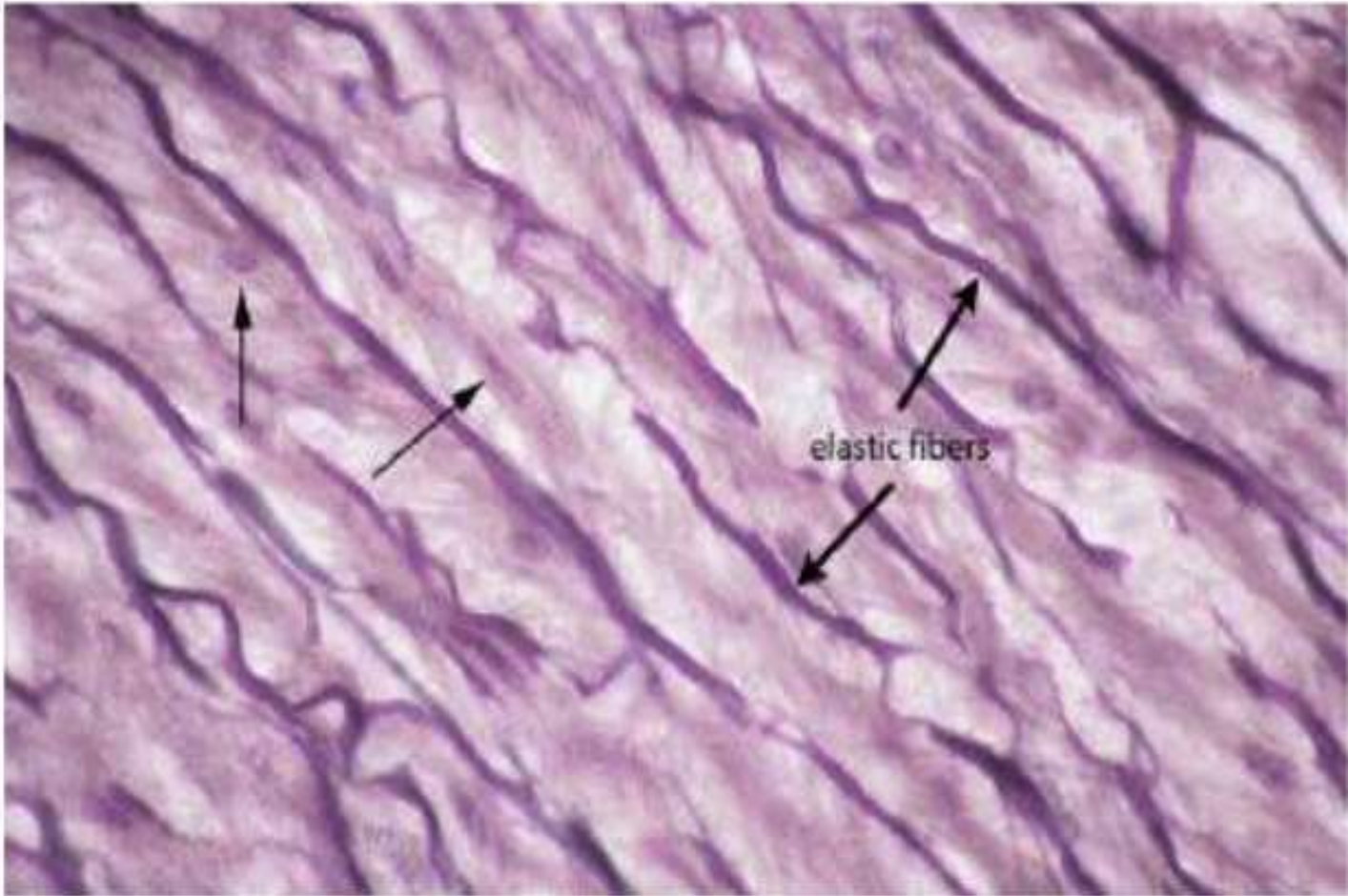


3. Elastic C.T

Strong extensible, flexible rich with yellow (elastic fiber) elastic fiber are thin and much more branching Consist from protein elastin (albumin like)

found in dermis of skin, in wall of alveoli of lungs and wall of arteries and bladder . function allow stretching of these organs)

Elastic C.T



The tissues

Tissue

- Tissue: is a collection of cells specialized to perform a particular function. The cells may be of the same type (nervous tissue) or of different types (connective tissue). Aggregations of tissues constitute organs.
- Tissues are Classified of into 4 categories:
 - 1- Epithelial tissue (EP.T.)
 - 2- Connective tissue (C.T.)
 - 3- Muscular tissue (M.T.)
 - 4- Nervous tissue (N.T.)

- **Epithelial tissue (epithelium):** they form the covering of all body surfaces, line body cavities, and hollow organs, and are the major tissue in the glands. It derived from the embryonic ectoderm and endoderm. The cells rest on a common basement membrane (is a thin non cellular region) which separates the epithelium from the underlying connective tissue.
- Epithelium is non vascular (a vascular) means, There is no blood vessels running into these tissue, oxygen, nutrients, and metabolite diffuse from the blood vessels located in the underlying C.T. to the epithelium.
- Epithelium is innervated (with nerve endings).

Epithelium:

- Two types:
 - membranous epithelia:
 - form the coverings or linings of organs.
 - glandular epithelia:
 - form exocrine and endocrine glands.

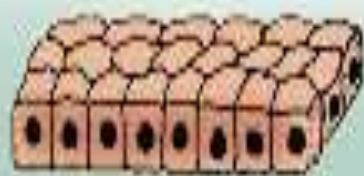
Classification of epithelia:

- According to number of cell layers (**thickness**)
 1. “simple epithelium tissue ” - one cell layer
 2. “stratified epithelium tissue ” – more than one layer of cells
 3. Pseudo stratified epithelium tissue (consists of a single layer of cells that attach to abasement membrane, but not all cells reach the surface.
- According to **morphology (shape)** of the cells in the apical layer:
 1. squamous” – wider than tall(flat cells)
 2. “cuboidal” – as tall as wide(cup-shaped)
 3. “columnar” - taller than wide

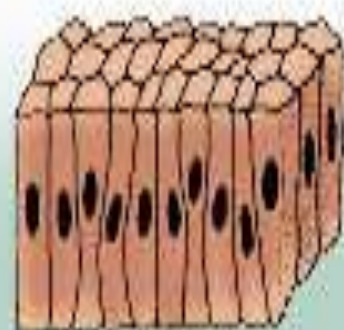
Types of Epithelium



Simple squamous

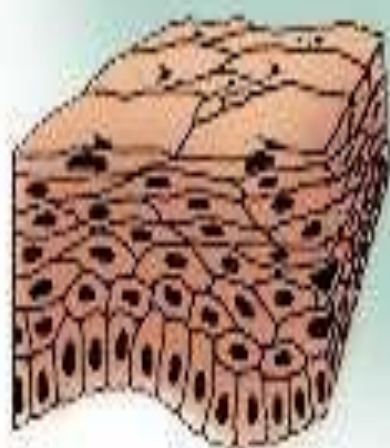


Simple cuboidal

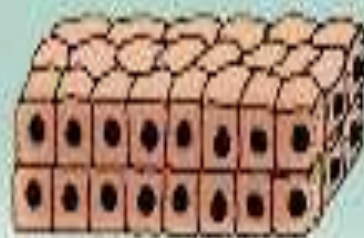


Simple columnar

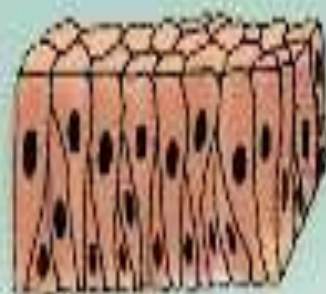
Transitional



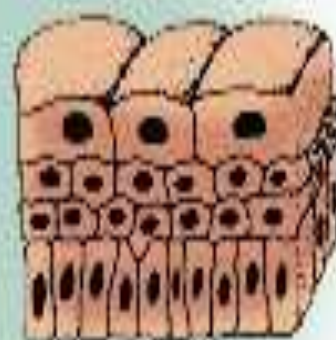
Stratified squamous



Stratified cuboidal



Pseudostratified columnar



Types of epithelia

- **A- Simple epithelium:**
- **1- Simple squamous epithelium:** covers the external surfaces of the digestive organs, lungs, and heart is called mesothelium. Simple squamous epithelium that covers the lumina of heart chamber, blood vessels, and lymphatic vessels is called endothelium.
- Function of simple squamous epithelium in peritoneal cavity is reducing friction between visceral organs by producing lubricating fluids and transporting fluid.
- In the cardiovascular system this epithelium or endothelium, allows for passive transport of fluids, nutrients, and metabolites across the thin capillary walls. In the lungs simple squamous epithelium provides for an efficient means of gas exchange or transport across the thin-walled capillaries and alveoli.

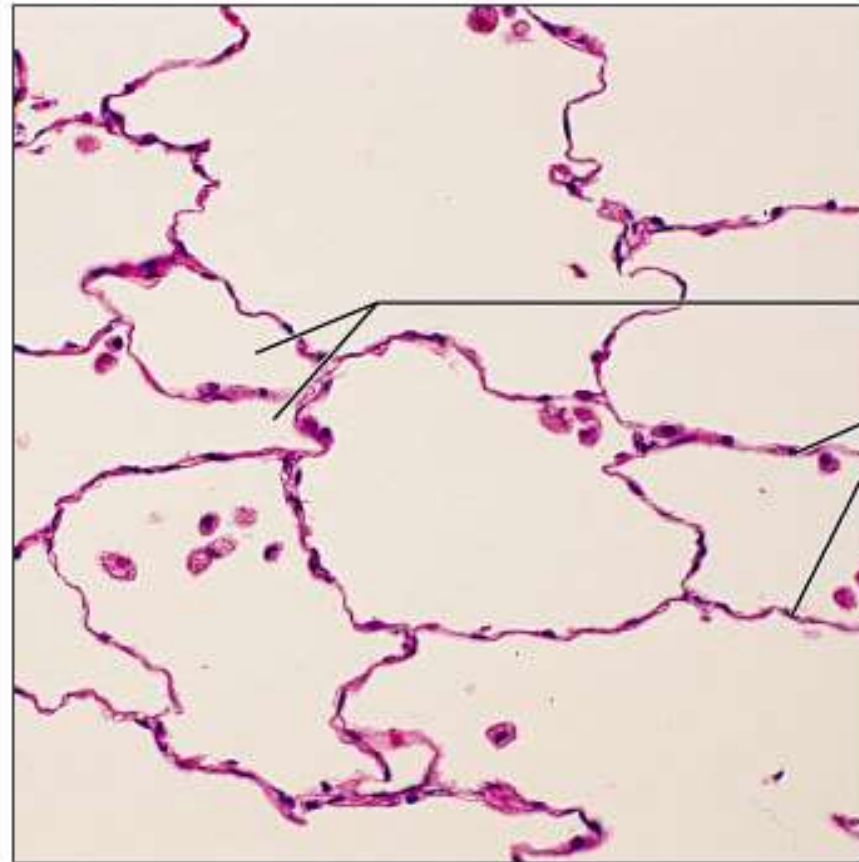
(a) Simple squamous epithelium

Description: Single layer of flattened cells with disc-shaped central nuclei and sparse cytoplasm; the simplest of the epithelia.



Function: Allows passage of materials by diffusion and filtration in sites where protection is not important; secretes lubricating substances in serosae.

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

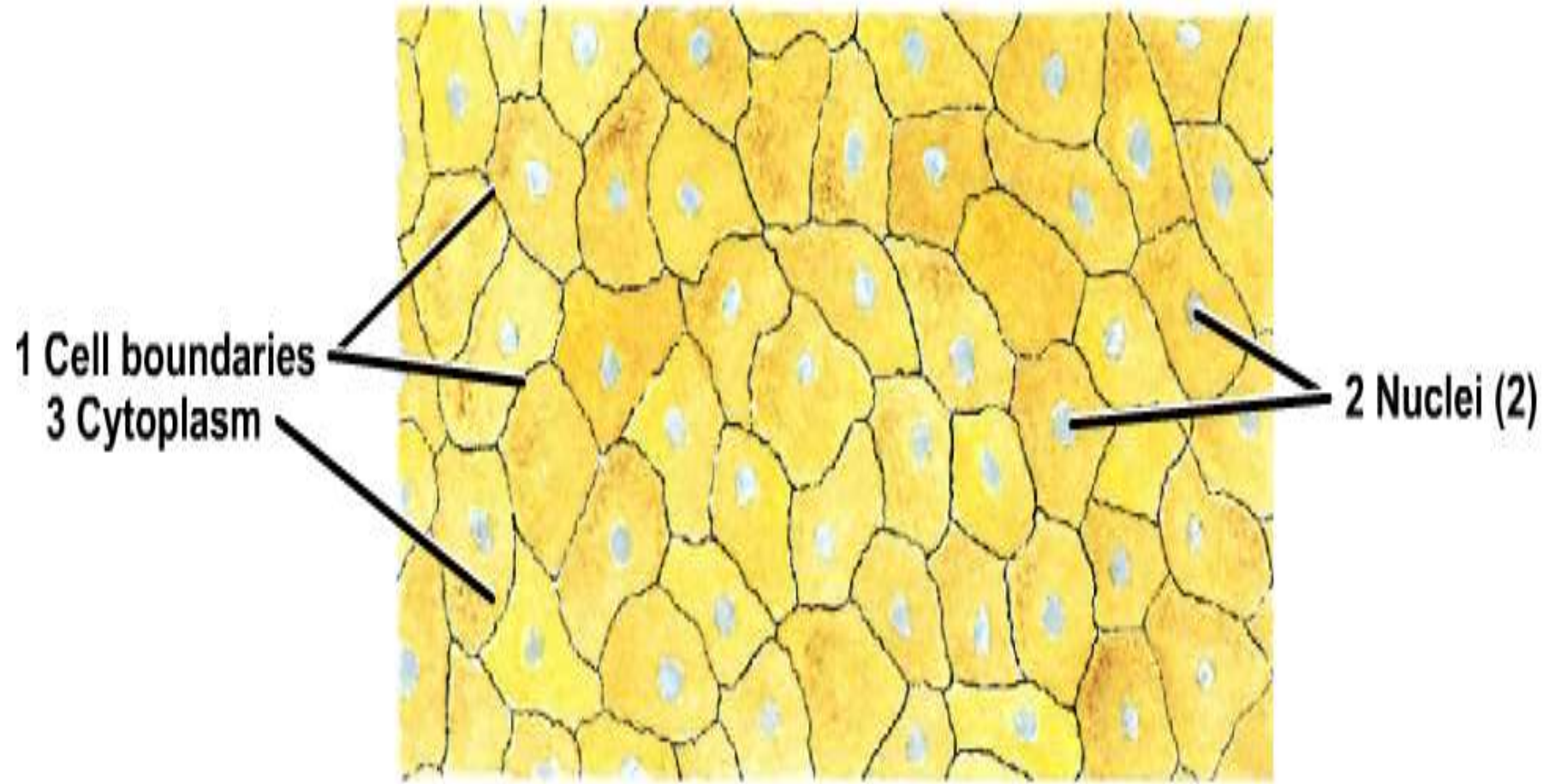


Air sacs of lung tissue

Nuclei of squamous epithelial cells

Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (400 \times).

Simple squamous epithelium



2. **Simple cuboidal epithelium:** lines small excretory ducts in different organs (function is secretion and absorption). And lines kidney tubules (function in transport and absorption of filtered substances).

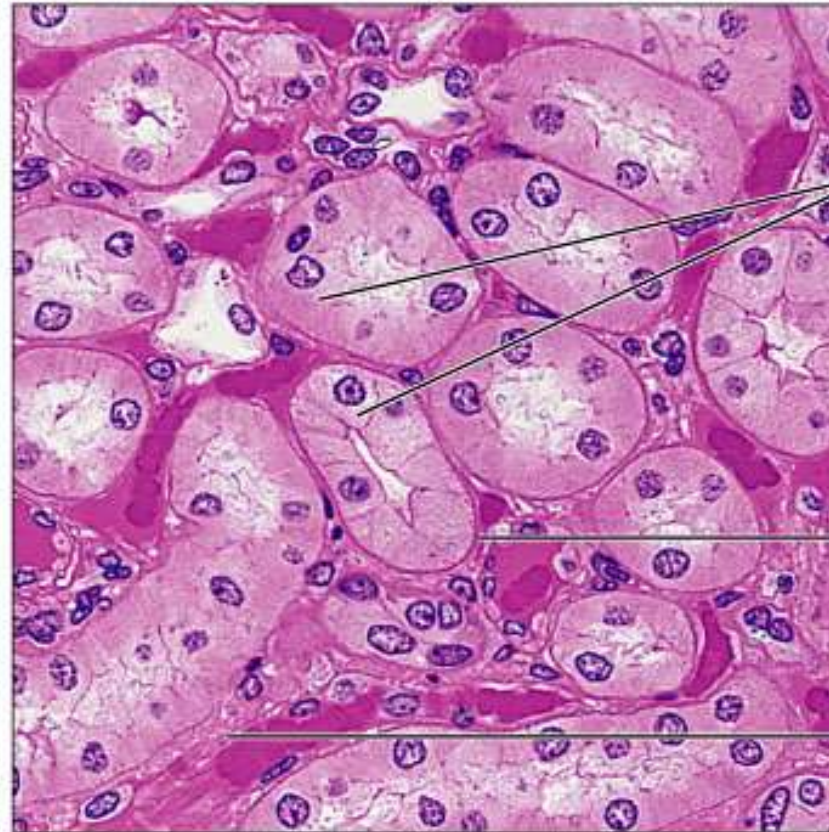
(b) Simple cuboidal epithelium

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.



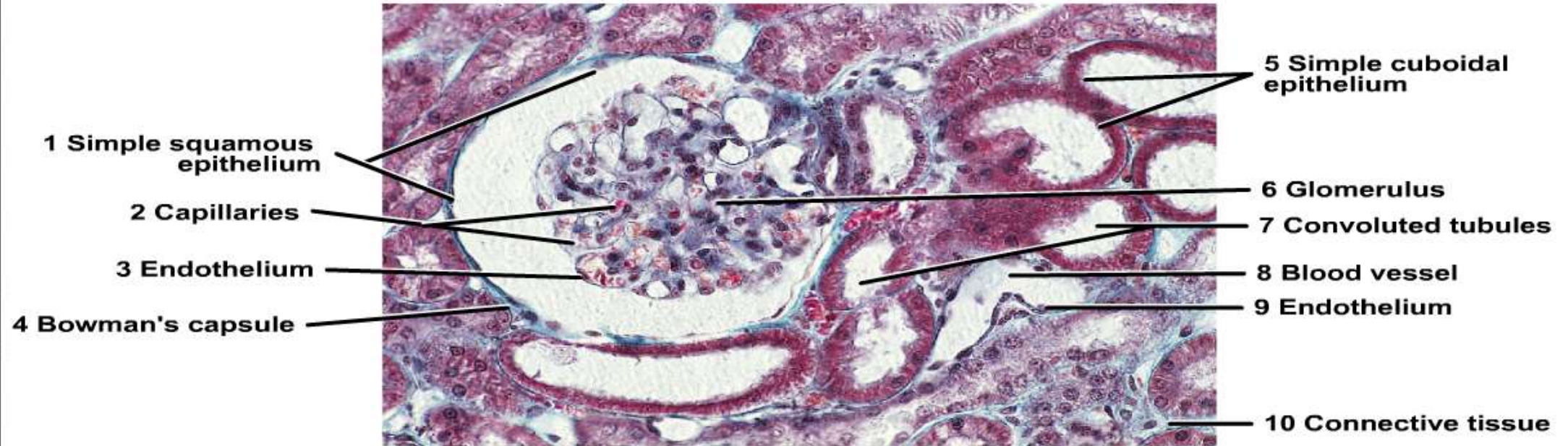
Simple cuboidal epithelial cells

Basement membrane

Connective tissue

Photomicrograph: Simple cuboidal epithelium in kidney tubules (400 \times).

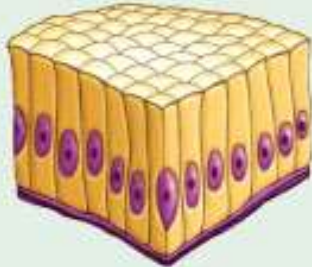
Different epithelial types in the kidney cortex



- **Simple columnar epithelium:** non ciliated is found or lined stomach and intestine and gallbladder. In stomach epithelial cells are secretory and produce mucus (that protect stomach surface from corrosive gastric secretions),. In small intestine epithelial cells function in absorption of nutrients. In intestine this epithelial layer may contain mucus secreting unicellular glands (goblet cells).
- Ciliated columnar cells lines female reproductive organs like uterus.

(c) Simple columnar epithelium

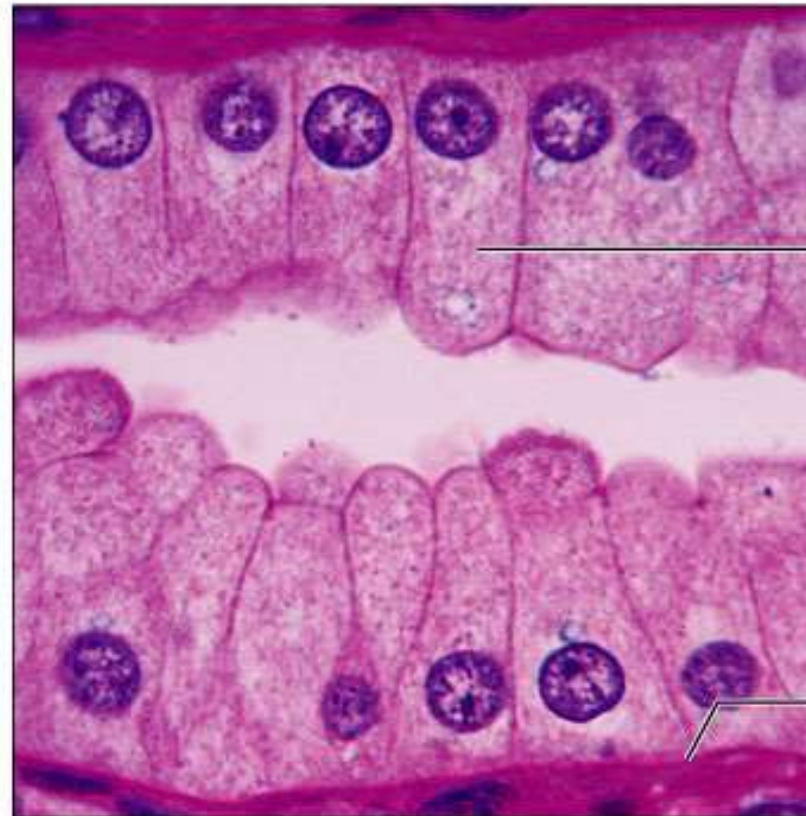
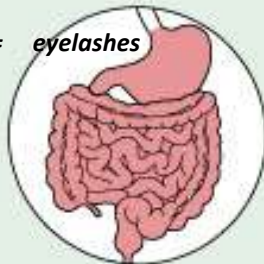
Description: Single layer of tall cells with *round to oval* nuclei; some cells bear cilia; layer may contain mucus-secreting unicellular glands (goblet cells).



Function: Absorption; secretion of mucus, enzymes, and other substances; ciliated type propels mucus (or reproductive cells) by ciliary action.

Location: Nonciliated type lines most of the digestive tract (stomach to anal canal), gallbladder, and excretory ducts of some glands; ciliated variety lines small bronchi, uterine tubes, and some regions of the uterus.

"ciliated" literally = *eyelashes*
(see next page)

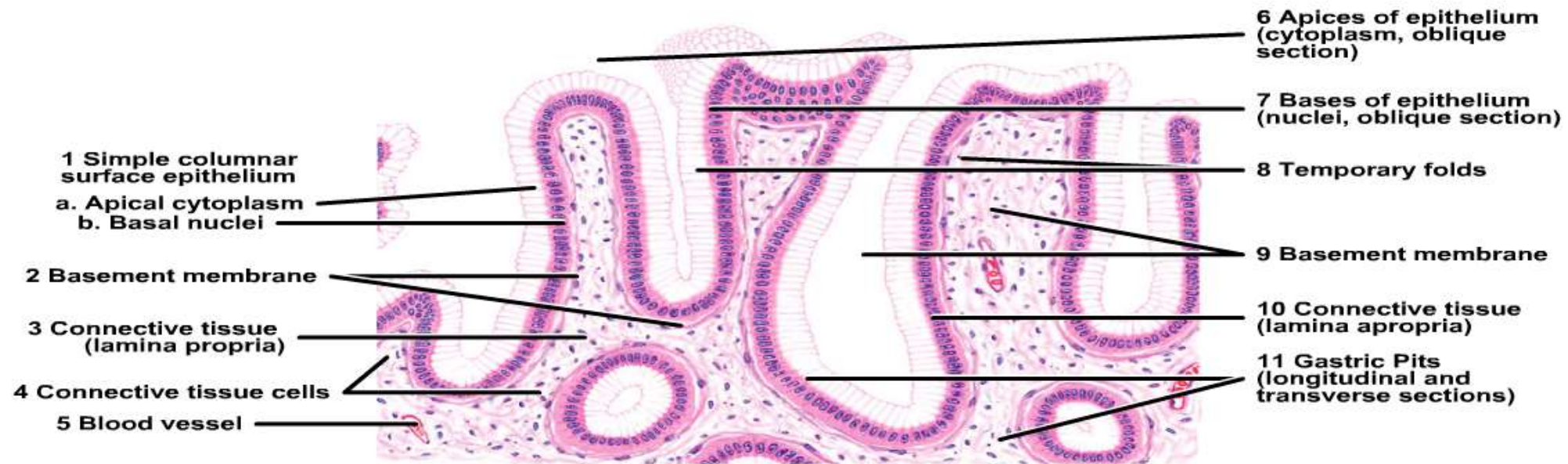


Simple
columnar
epithelial
cell

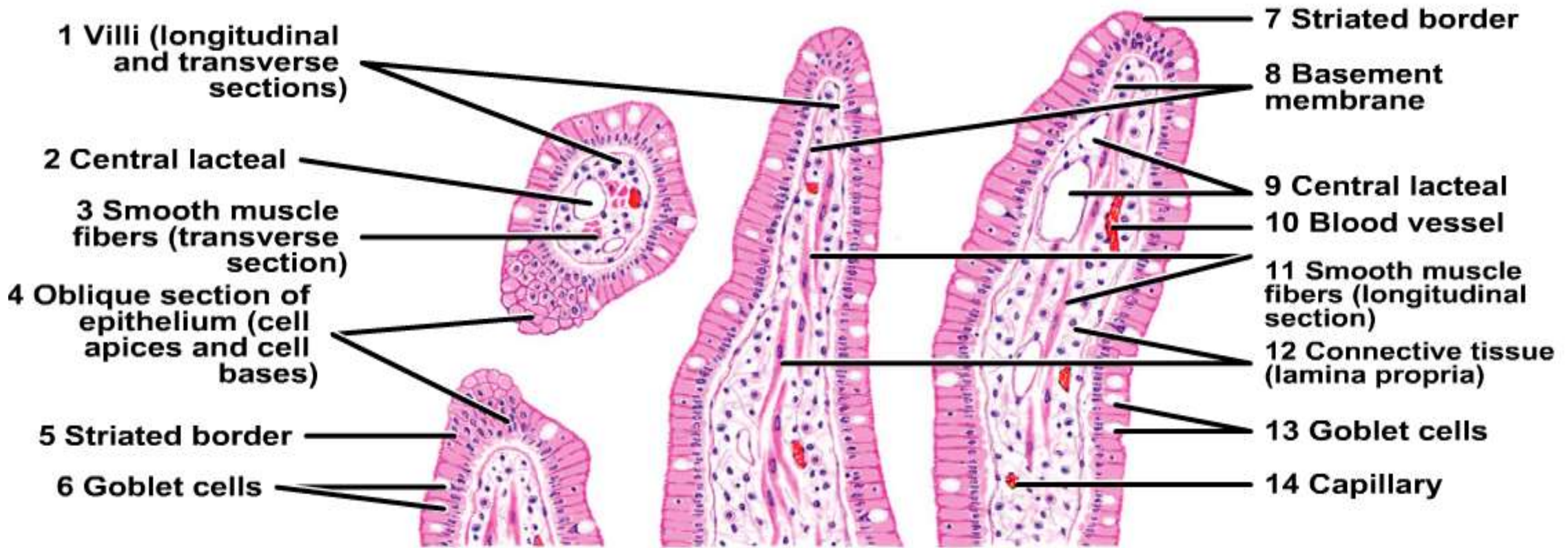
Basement
membrane

Photomicrograph: Simple columnar epithelium of the stomach mucosa (1300 \times).

Simple columnar epithelium (non- ciliated): lines the stomach.



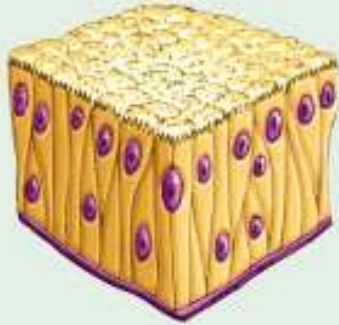
Simple columnar epithelium (non- ciliated): lines intestine.



- **Pseudostratified columnar ciliated epithelium:** lines the respiratory passages (trachea and bronchi), the surface cells exhibit motile cilia. In trachea ciliated cells cleans the inspired air and transport mucus and particulate material across the cell surface to the oral cavity for expulsion.
- Pseudostratified columnar non ciliated epithelium lines male's sperm carrying ducts.

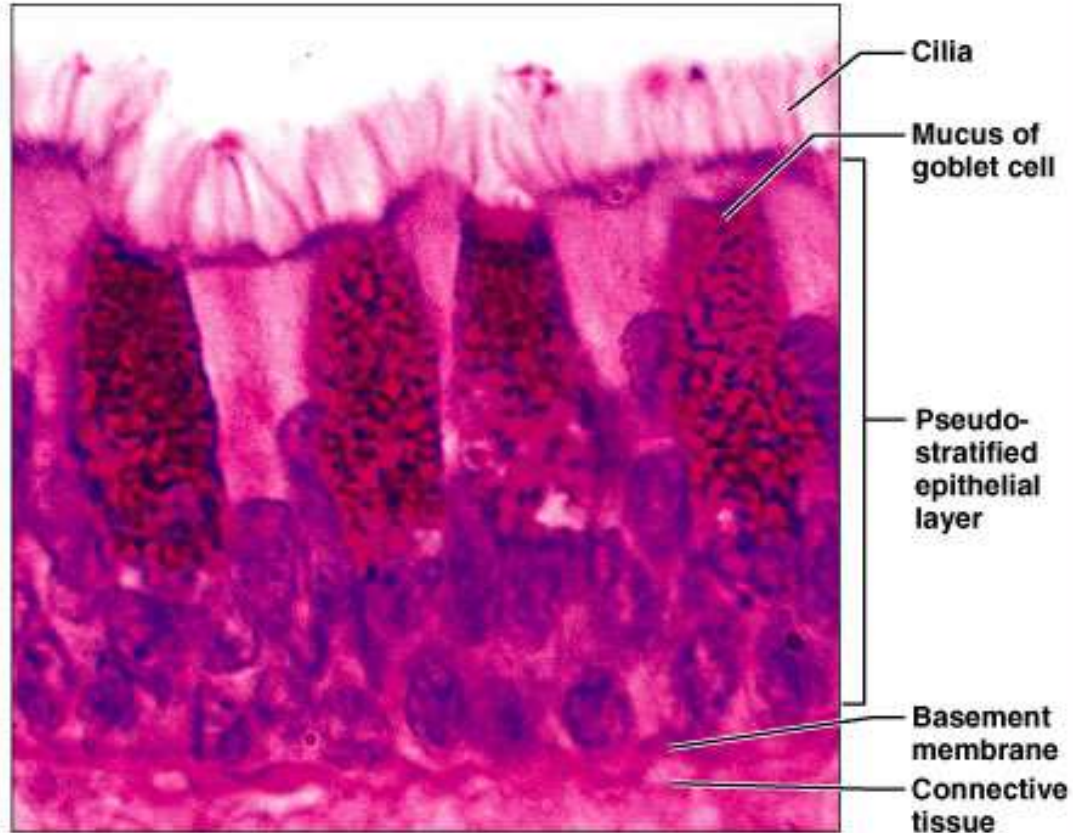
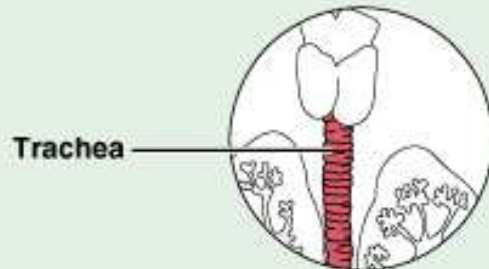
(d) Pseudostratified columnar epithelium

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



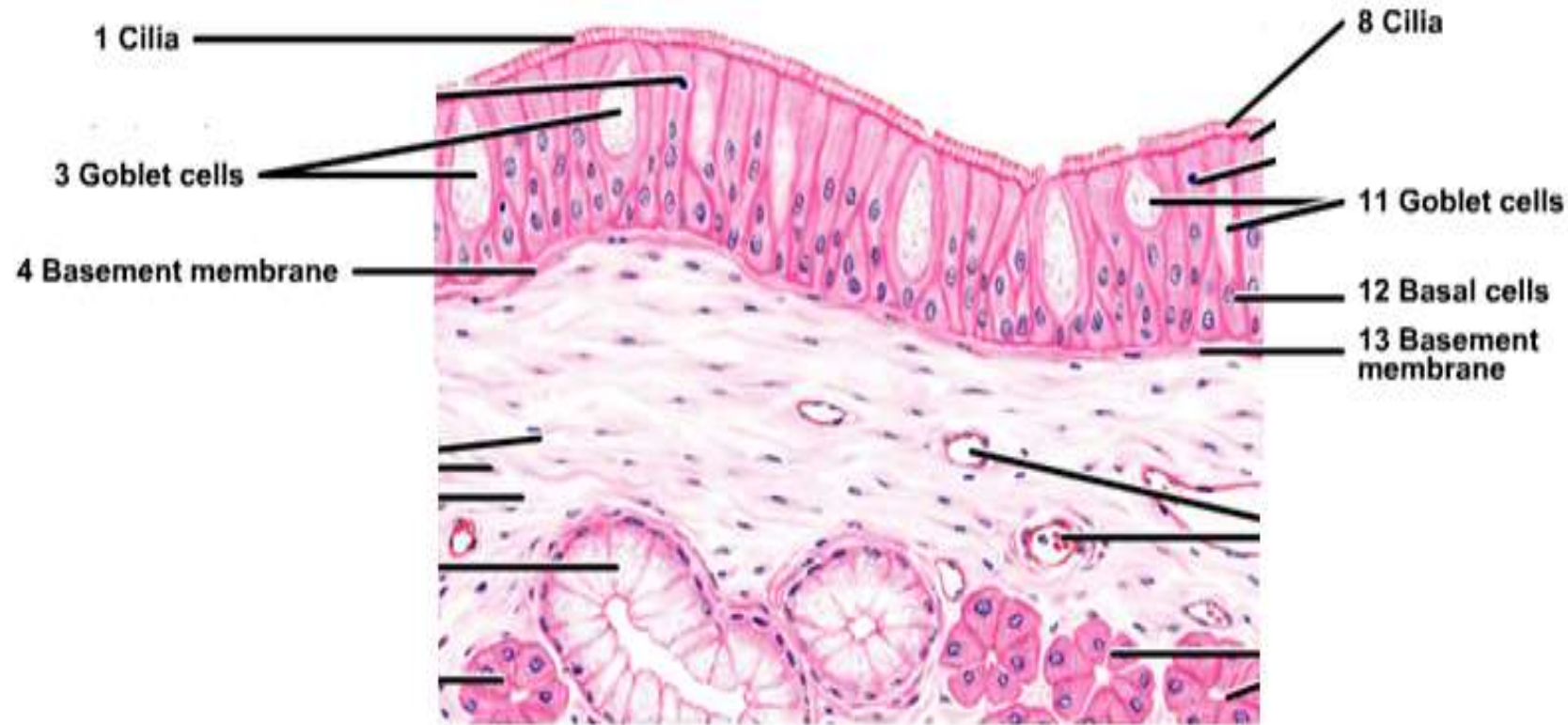
Function: Secretion, particularly of mucus; propulsion of mucus by ciliary action.

Location: Nonciliated type in male's sperm-carrying ducts and ducts of large glands; ciliated variety lines the trachea, most of the upper respiratory tract.



Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (400 \times).

Pseudostratified columnar epithelium (ciliated): lines portion of respiratory tract (trachea).

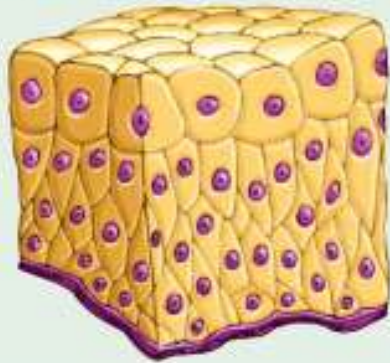


B- Stratified epithelial tissue:

- **1- Transitional epithelial:** line the bladder, ureters, and part of urethra. Basal cells are cuboidal or columnar, surface cells dome shaped or squamous. Function allow for distension of urinary organs during accumulation of urine and contraction of these organs during emptying process.

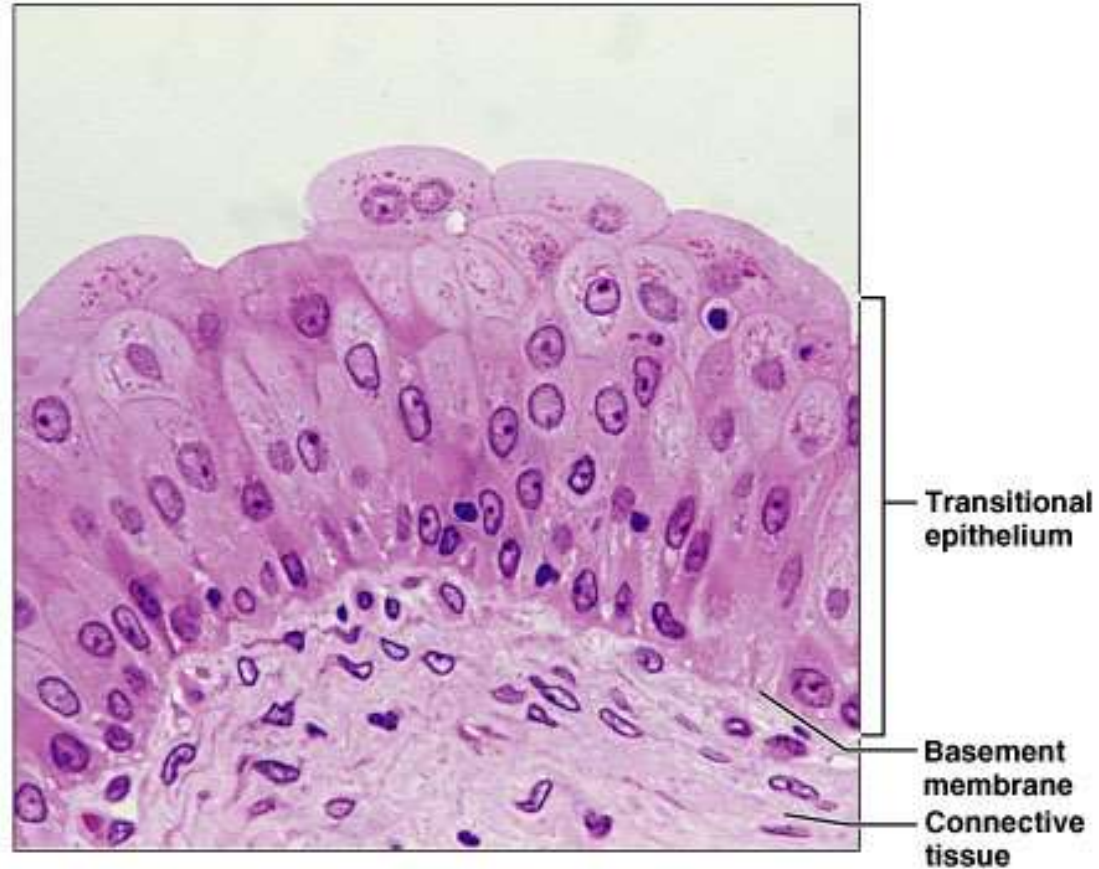
(h) Transitional epithelium

Description: Resembles both stratified squamous and stratified cuboidal; basal cells cuboidal or columnar; surface cells dome shaped or squamouslike, depending on degree of organ stretch.



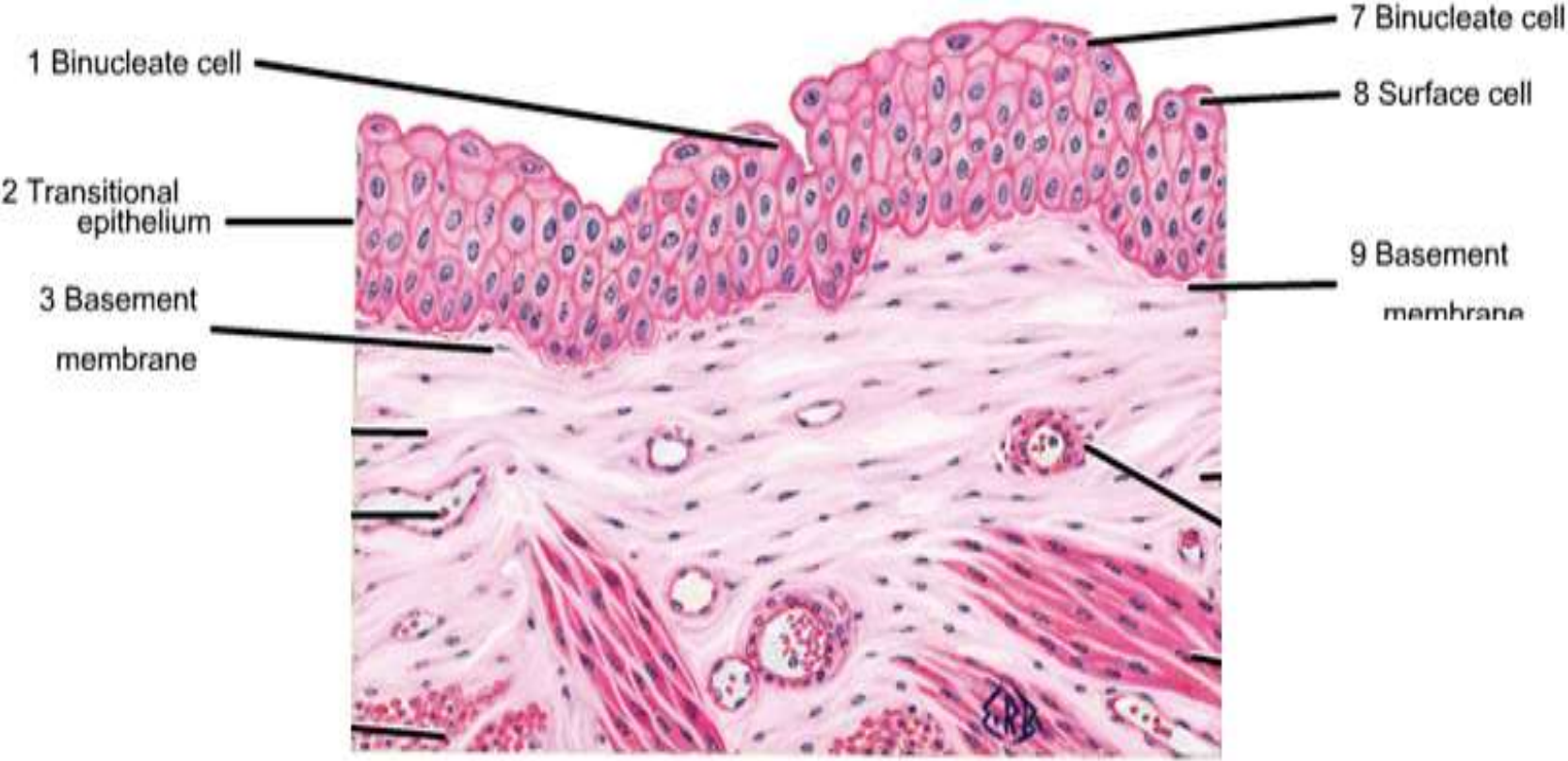
Function: Stretches readily and permits distension of urinary organ by contained urine.

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



Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (500 \times); 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.

Transitional epithelium: urinary bladder. (unstretched or relaxed)



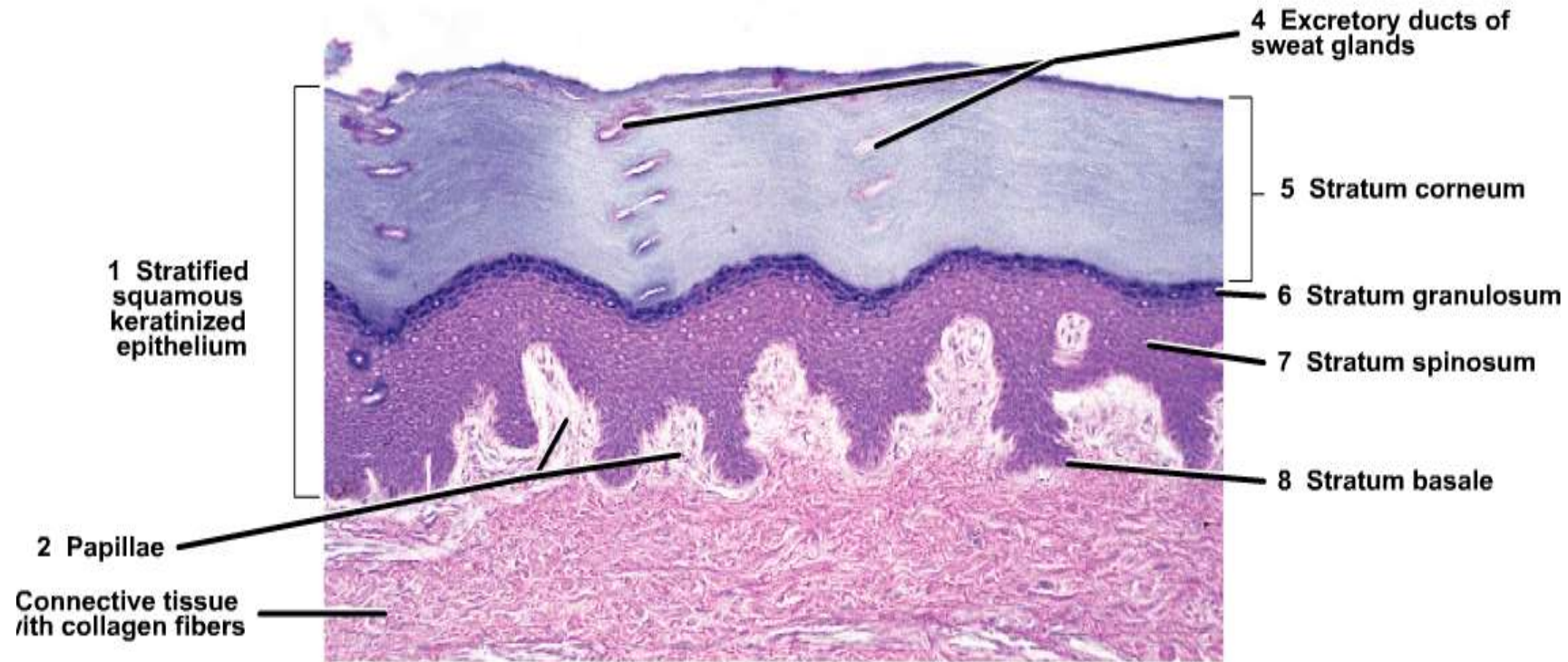
2. **Stratified squamous** : 2 types

a- Stratified squamous non keratinized epithelium: exhibit live surface cells and covers moist cavities such as mouth, pharynx, esophagus function is protection the surface of these organs.

b- Stratified squamous keratinized epithelium: the surface layer contains non living keratinized cells that are filled with the proteins keratin. Covers palm of hand and soles. Function is protection against bacteria, desiccation and abrasion

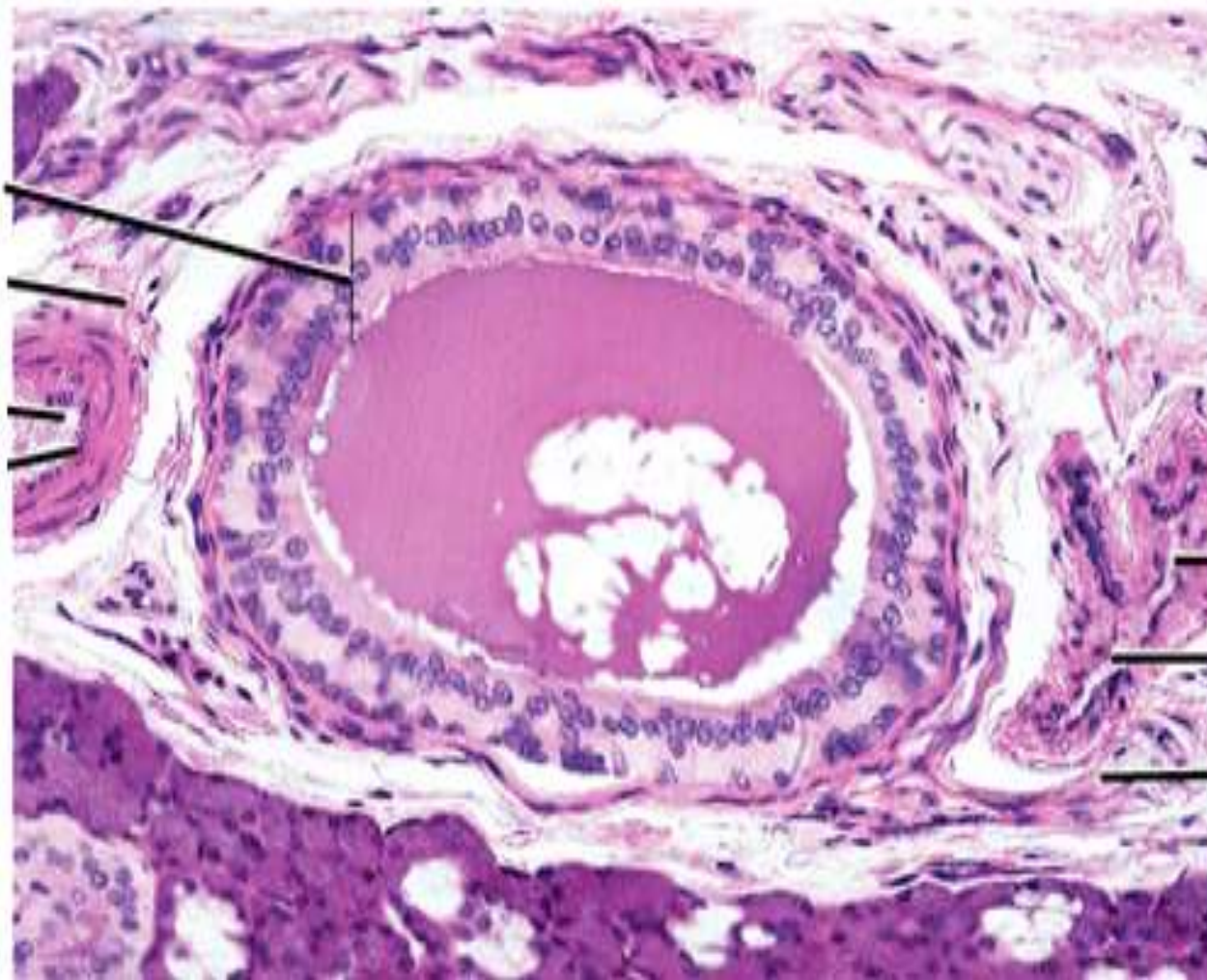
3- Stratified cuboidal and stratified columnar epithelium: line the large excretory duct of pancreas, salivary glands and sweat glands. Function is protection for the ducts

Stratified squamous keratinized epithelium skin (palm of hand)



Stratified cuboidal epithelium (non keratinized) excretory duct of the salivary gland

1 Stratified cuboidal epithelium



Stratified squamous non-keratinized epithelium: esophagus

