General Histology Lab Guide

Dr. Mustafa Saad

(2024)

Important Notes

1. This presentation contains images of the microscope slides studied during the histology lab session and images taken from other sources.

2. While studying the images in this presentation, keep the theory lectures by hand to compare the features of the tissues seen in the images with the features mentioned in the lectures.

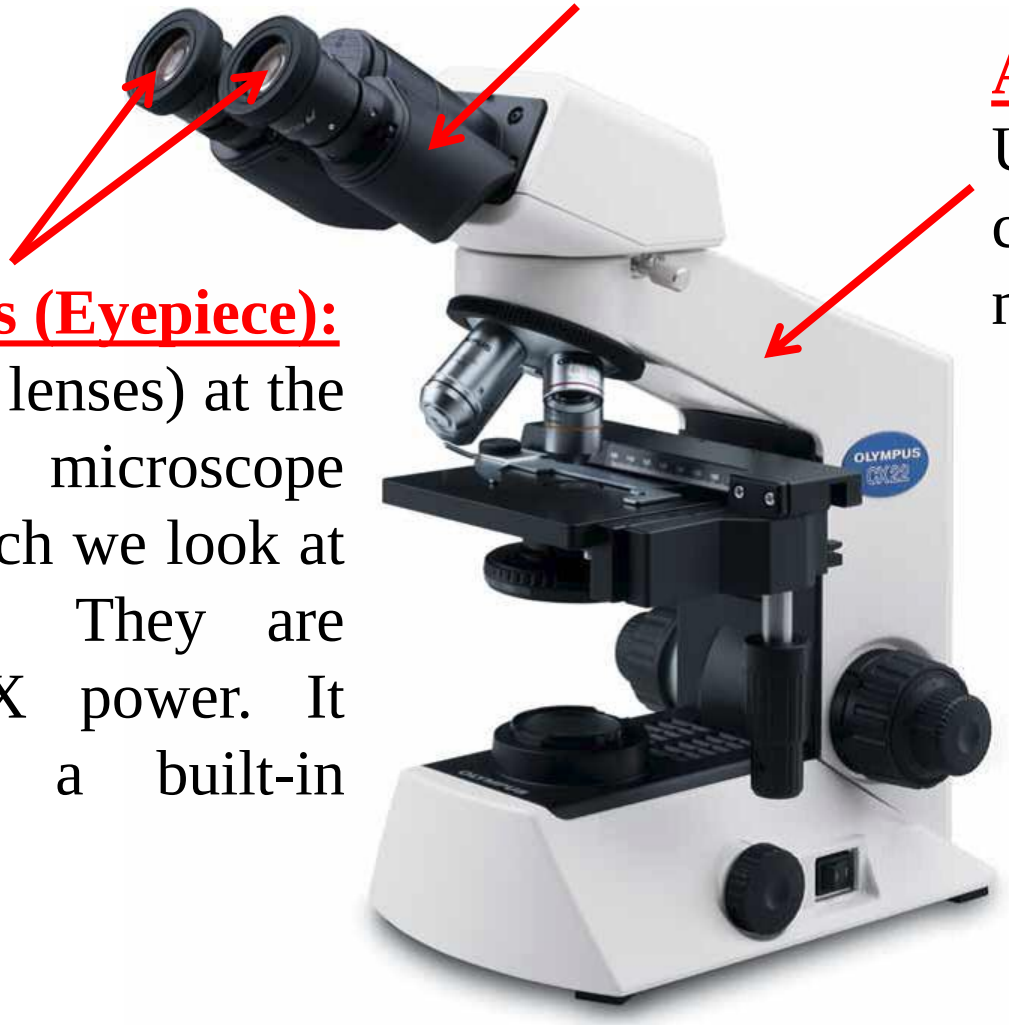
3. This presentation depends heavily on colors.

Light Microscope

Parts and Functions

Tube:

Connects the eyepiece to the objective lenses.

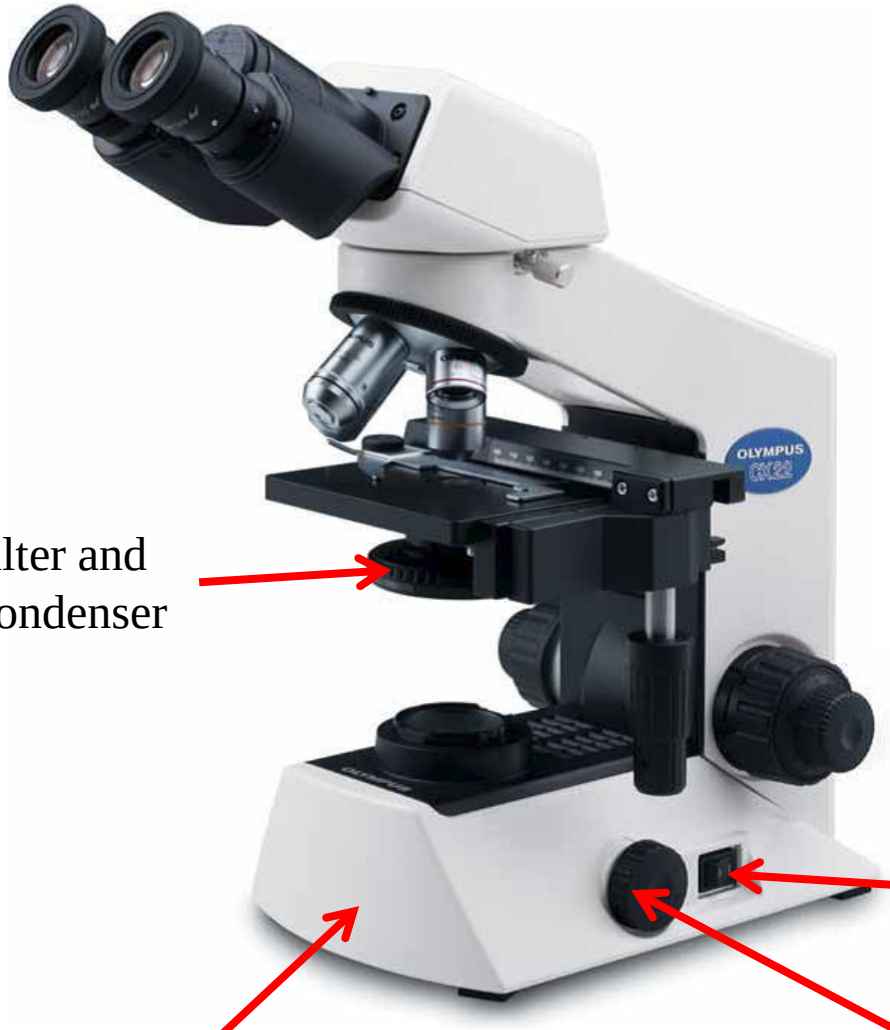


Arm:

Used to carry the microscope.

Ocular Lens (Eyepiece):

The lens (or lenses) at the top of the microscope through which we look at the slide. They are usually 10X power. It may have a built-in pointer.



Filter and Condenser

Light Switch

Light intensity adjustment knob

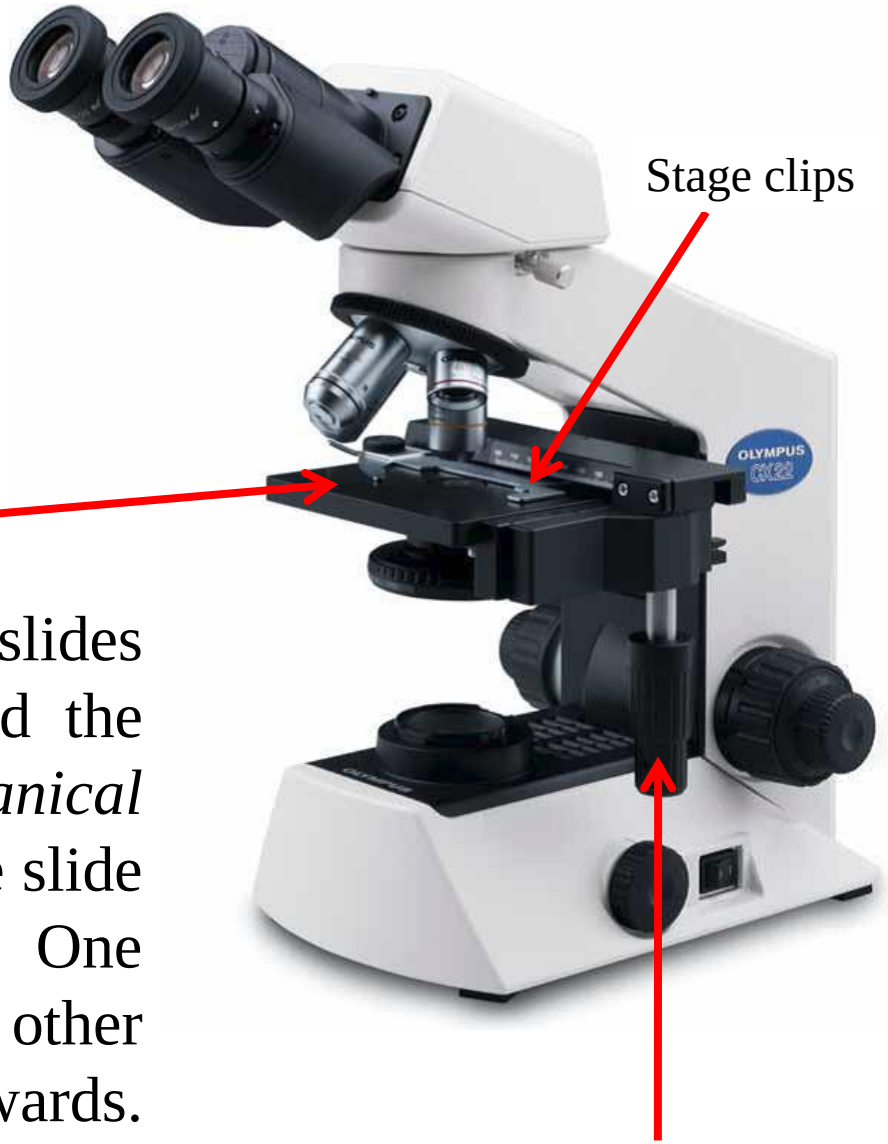
Light Source:

Either an electric light source or a mirror that reflects light from an external source (like sun light). The light from the source can be modified by ***filters*** and focused onto the specimen by a ***condenser***.

Base:

The bottom of the microscope.

Supports the microscope.



Stage:

The flat platform where the slides are placed. ***Stage clips*** hold the slide in place. With a *mechanical stage*, we are able to move the slide around by turning two knobs. One moves it left and right, the other moves it backwards and forwards. This is done to bring the part we want to examine into the path of light.

Course Adjustment Knob:

Moves the stage up/down a great distance bringing the image into general focus.

Fine Adjustment Knob:

Moves the stage up/down a small distance bringing the image into fine focus.

Revolving Nosepiece:

This is the part that holds the objective lenses and can be rotated to easily change power.

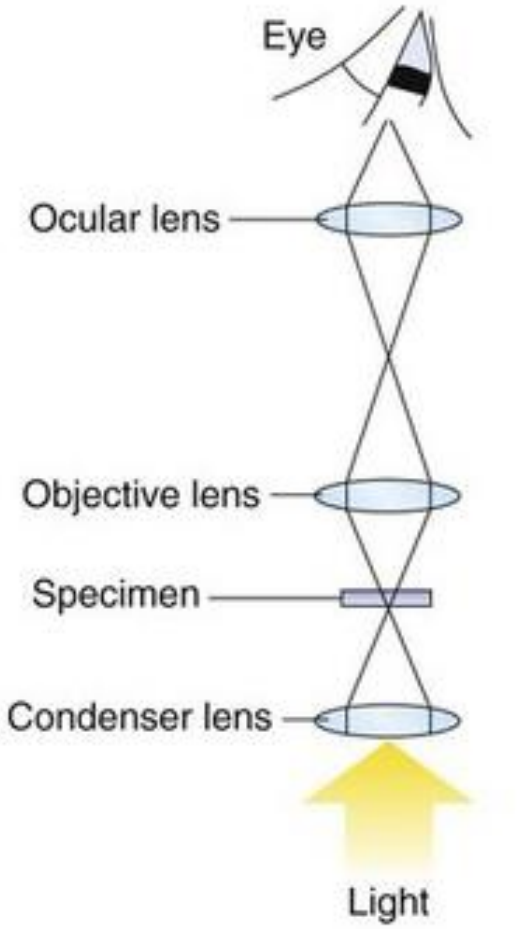
Objective Lenses:

They are the main image magnifiers. There are, usually, 3 - 5 objective lenses on a microscope. They almost always have 4X, 10X, 20X, 40X, and 100X powers. They differ in length and color code according to their power.

Total Magnification = Eyepiece power X Objective Lens power

Principle of bright-field light microscope

- Light, from the source, is focused on the specimen by the condenser.
- Light passing through the specimen is then collected by the objective lens to form a magnified image.
- The image is further magnified by the ocular lens.



Stain	Characteristic	Color

Hemtoxylin -eosin	Hematoxylin is a basic dye that binds to negatively charged structures:
	• DNA in nucleus
	• RNA in cytoplasm
	  • Rough endoplasmic reticulum
	  • Ribosomes
		Blue / violet

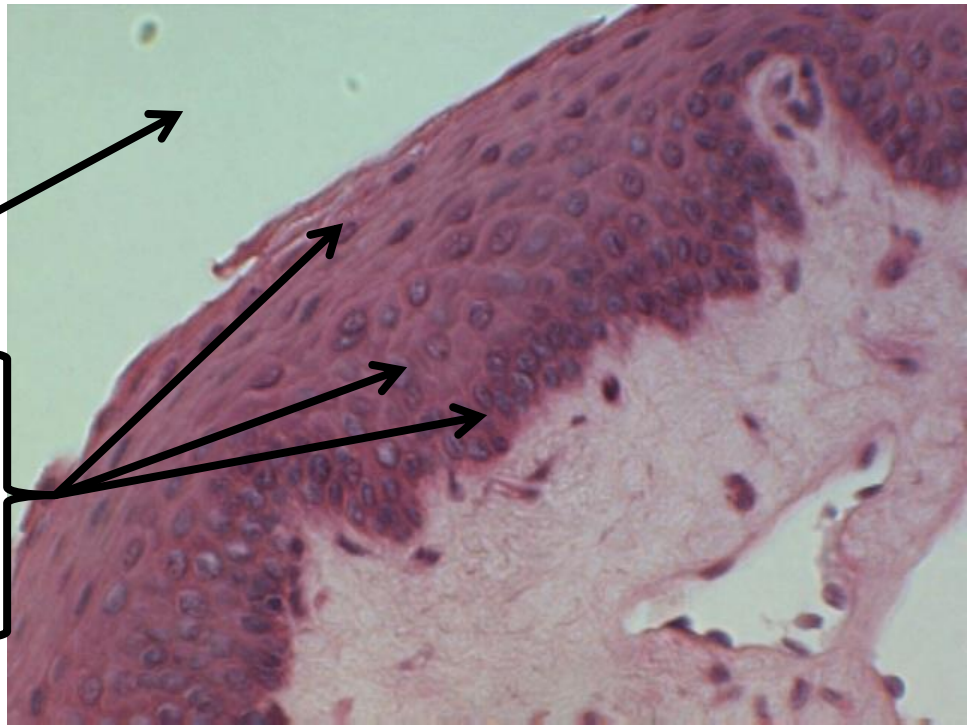
	Eosin is an acidic dye that binds to positively charged structures: • Cell membrane • Mitochondria • Actin • Collagen • Red blood cells	Pink / red

Stain	Characteristic	Color
Gomori's stain	Stains elastic fibers	Dark violet
Silver	Silver nitrate used to stain: • Reticular fibers • Neurofilaments	Black
Periodic Acid Schiff (PAS)	Used to stain structures with high amount of sugar groups: • Mucin (goblet cells) • Basement membrane	Dark red
Osmium tetraoxide	• Used to stain lipids	Black

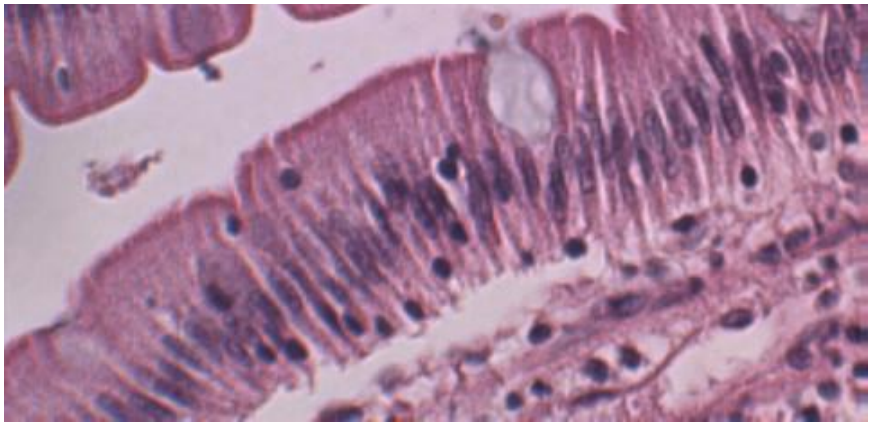
Part 1: Epithelial Tissue

- To identify epithelial tissue in a slide, keep in mind the following points:

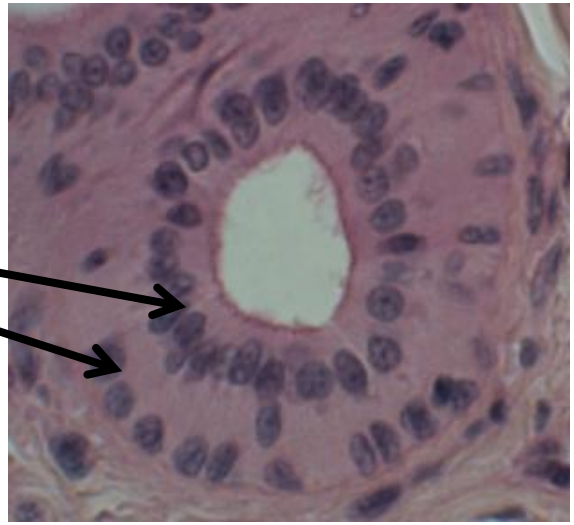
1. Epithelial tissues line cavities or cover organs → A white area should be adjacent to the epithelium
2. Epithelial cells are arranged in sheets
3. Epithelial cells are closely packed
4. No blood vessels are seen in the epithelium



- Once you have identified the tissue as epithelium, classify it by the following method:



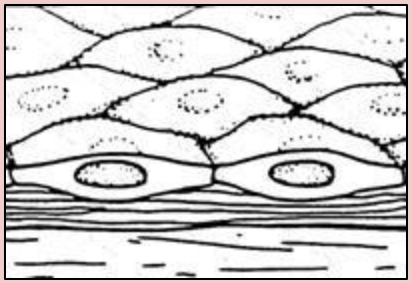
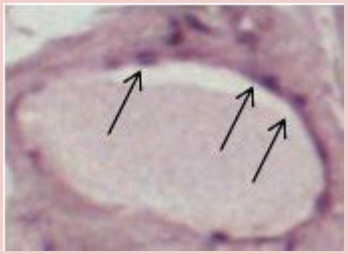
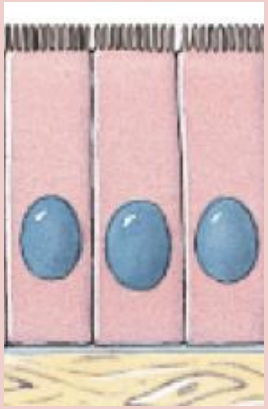
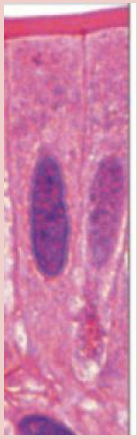
1. **Identify the number of layers**
   - All nuclei arranged in a single row → 1 layer → Simple
   - Nuclei arranged in different layers → Multiple layers → Stratified
   - ***Keep in mind the Pseudostratified epithelium***



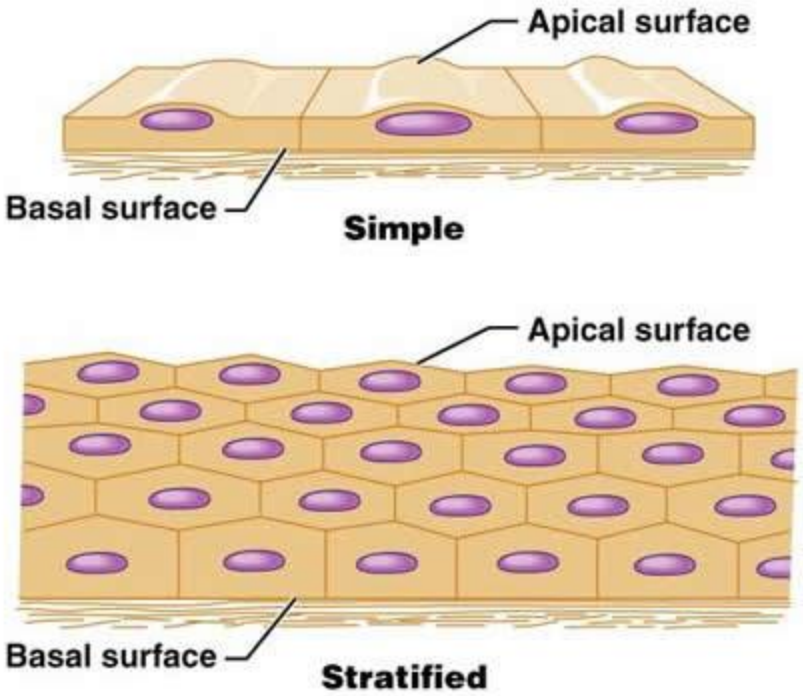
2. Identify the type of cell in the simple epithelium and the type of cells in the topmost layer of the stratified epithelium

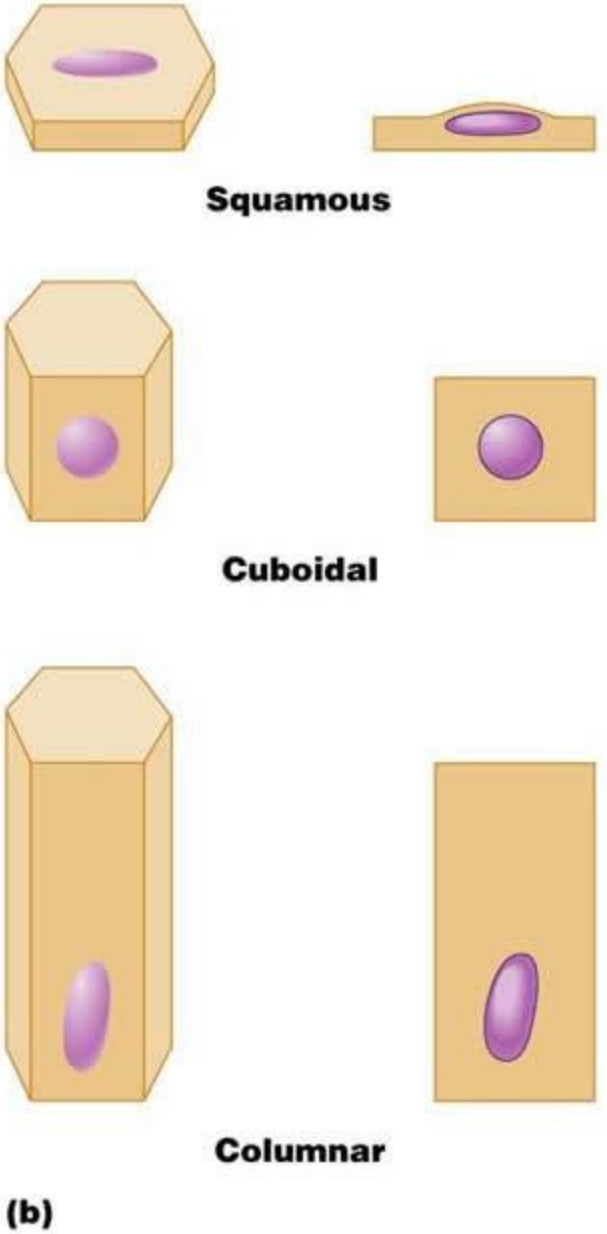
- *Remember:*
  - The cell membrane is usually not clearly seen under the light microscope. Therefore, the shape of a cell is identified by the appearance of its nucleus.

  - Topmost = Apical part = Luminal part of the epithelium is the part closest to the lumen of the organ; similarly, it's the part farthest away from the basal lamina. The Basal part is the part lying on the basement membrane.

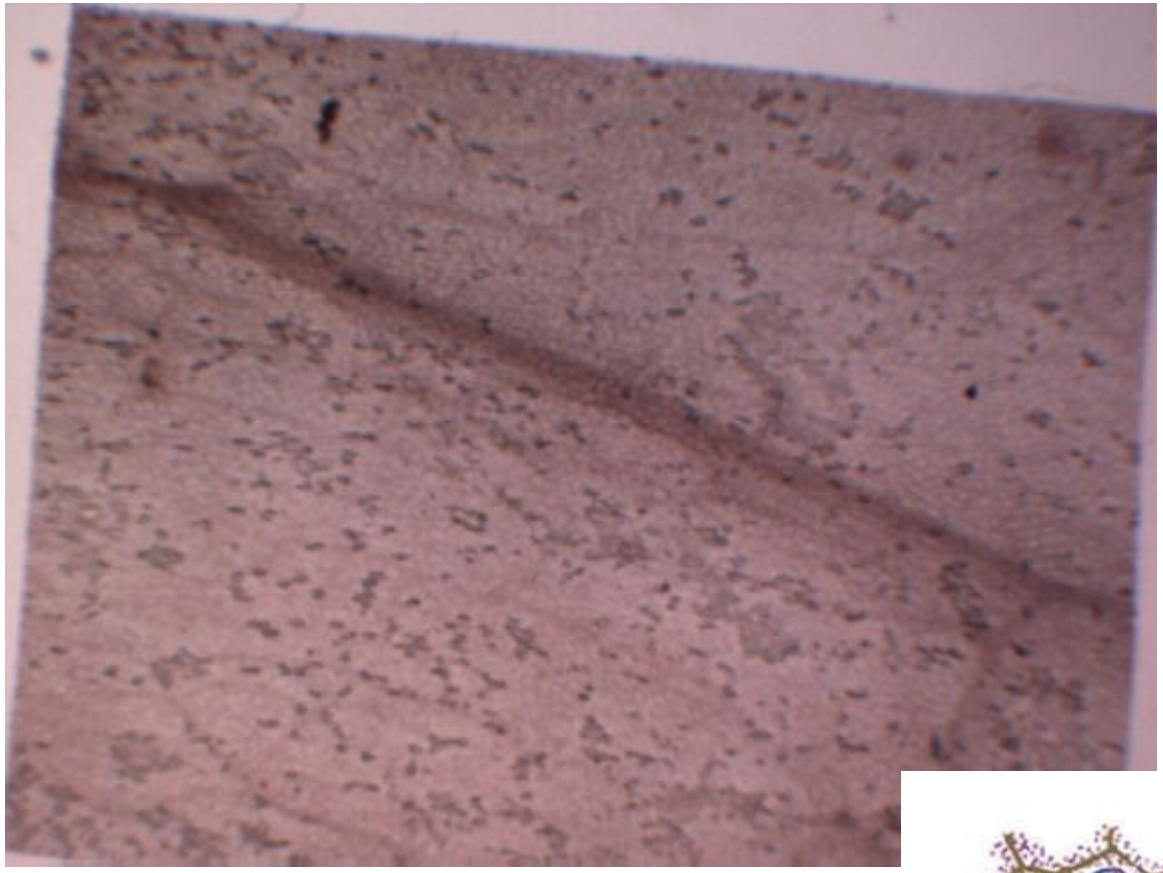
Cell	Shape	Appearance under LM	What we look for
Squamous			Flattened nucleus with thin cytoplasm
Cuboidal			Round nucleus
Columnar			Tall oval nucleus

Quick Review



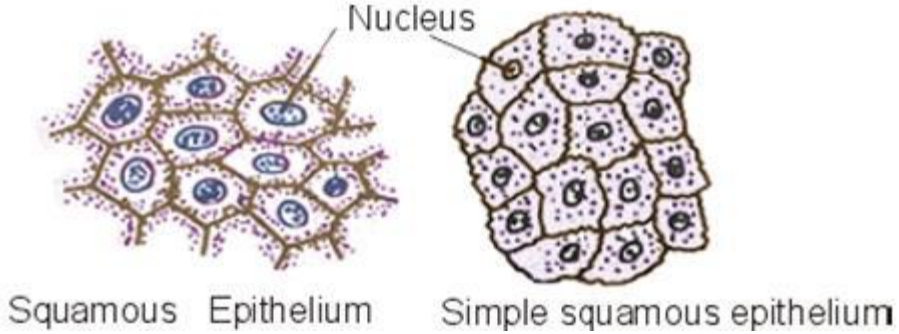


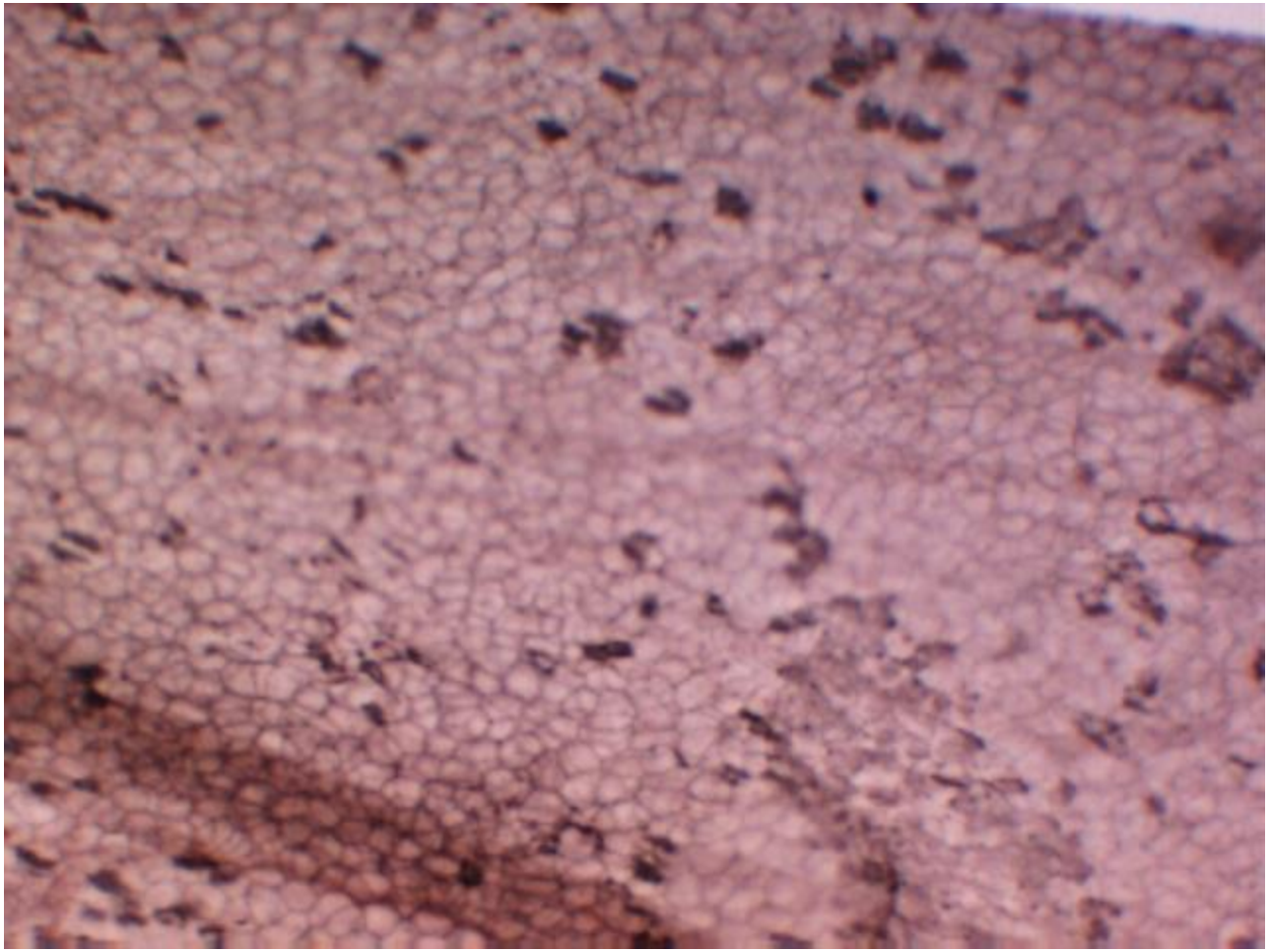
(1) Simple Squamous Epithelium



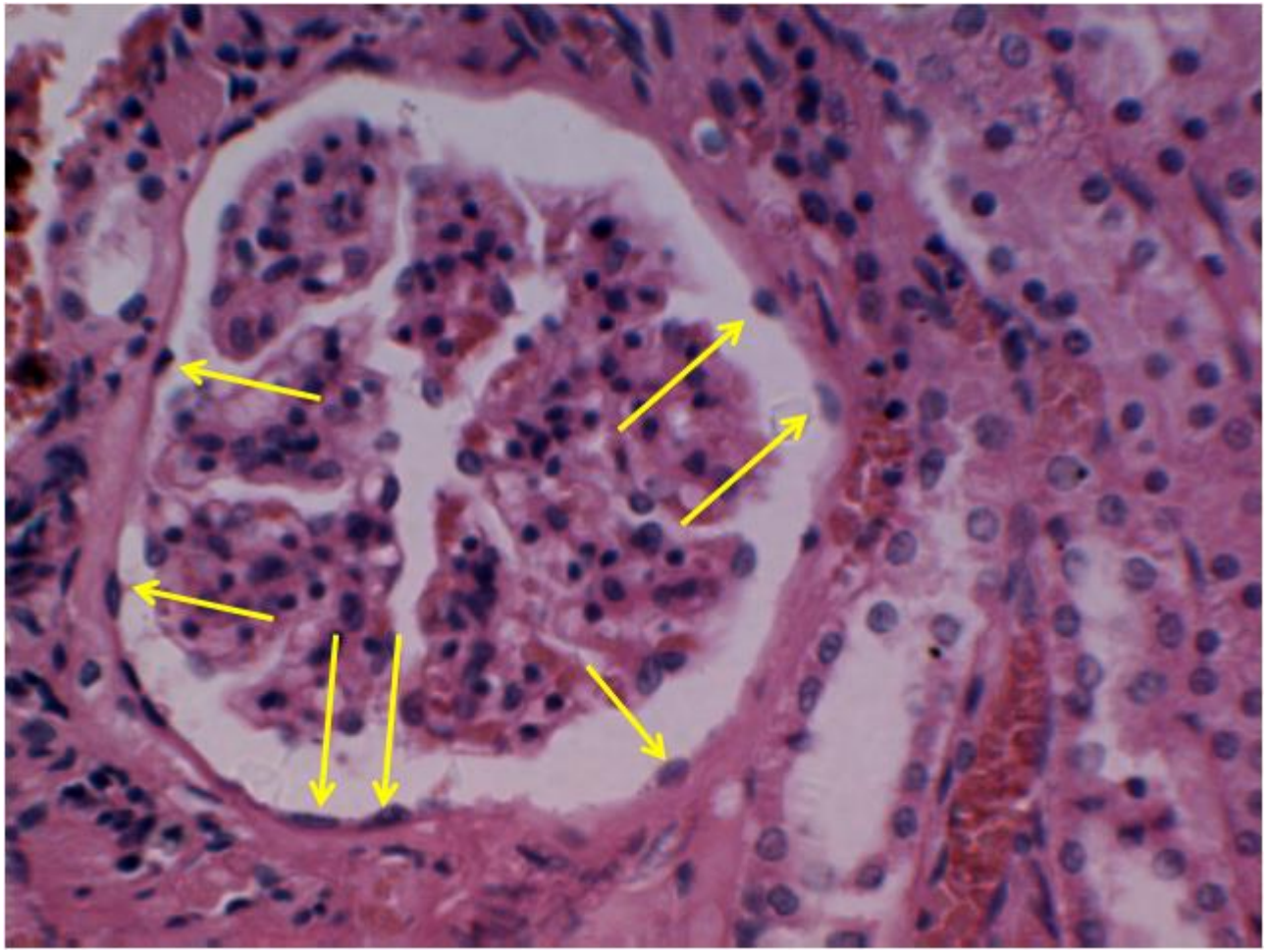
Top view of Mesothelium

Note: This is the only slide in which the epithelium is seen from a top view.



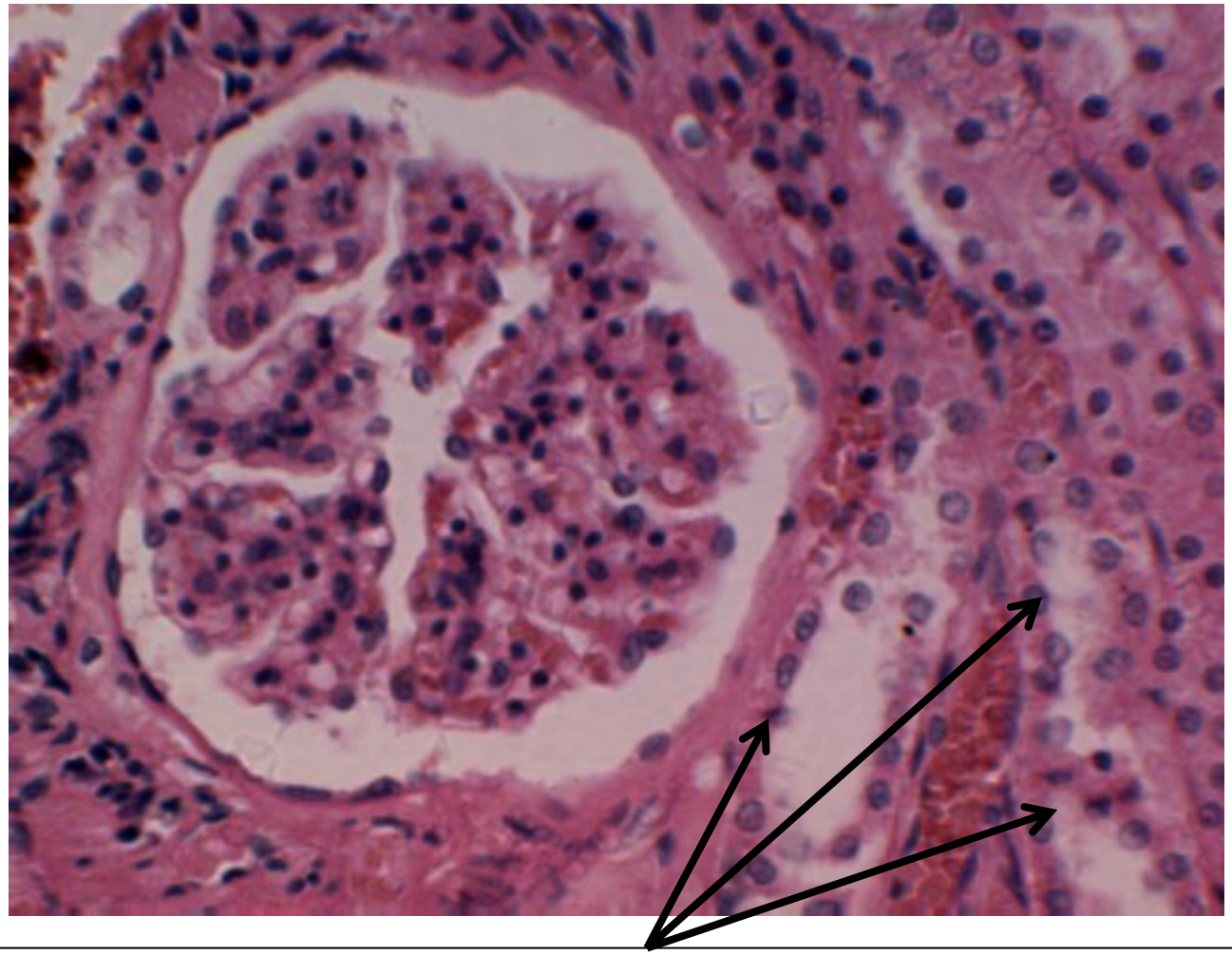


The same slide as before but under higher magnification. The faint boundaries between the cells can be seen.

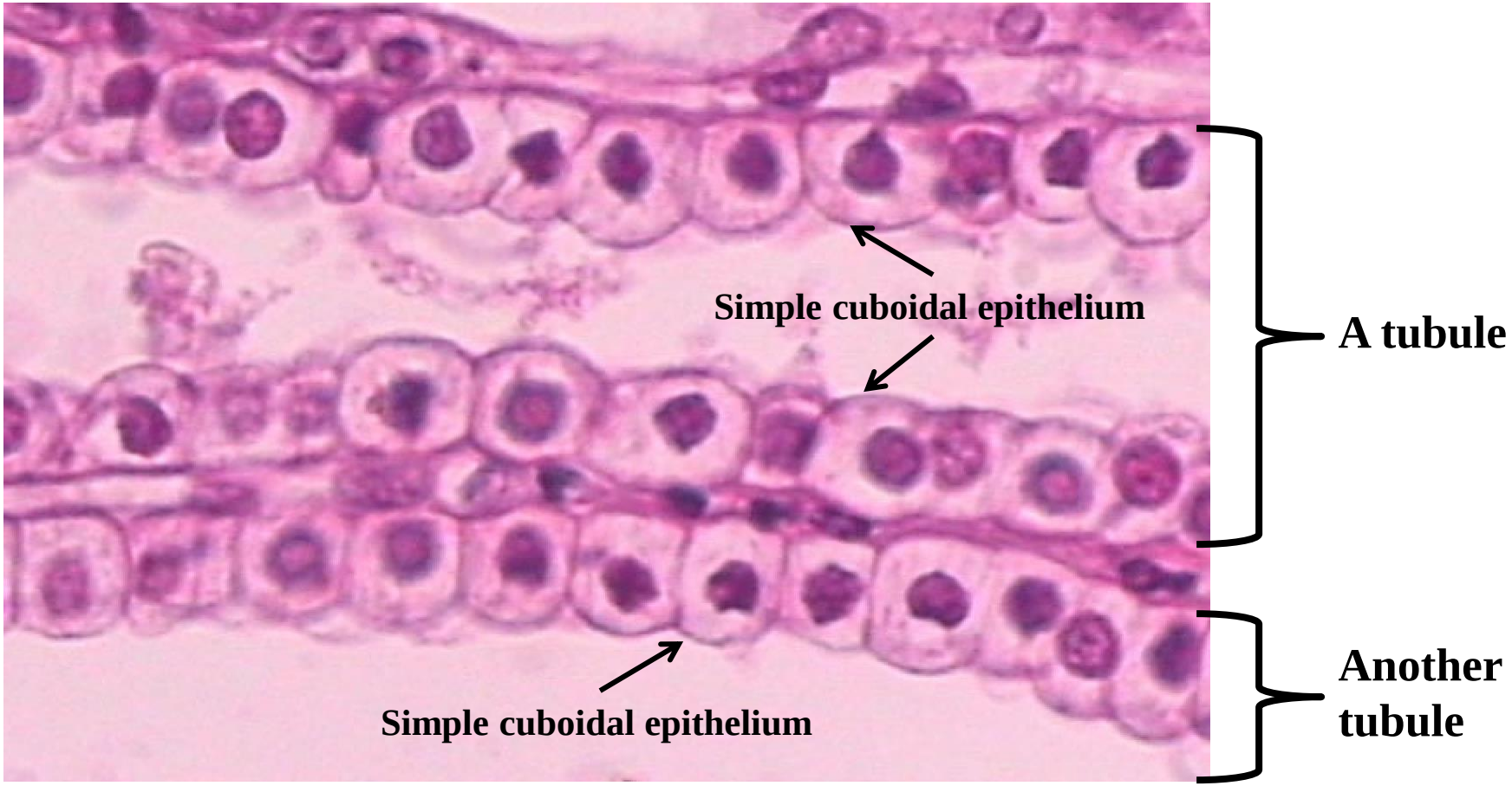


Section through kidney showing simple aquamous epithelium. Arrows indicate the nuclei of the squamous cells.

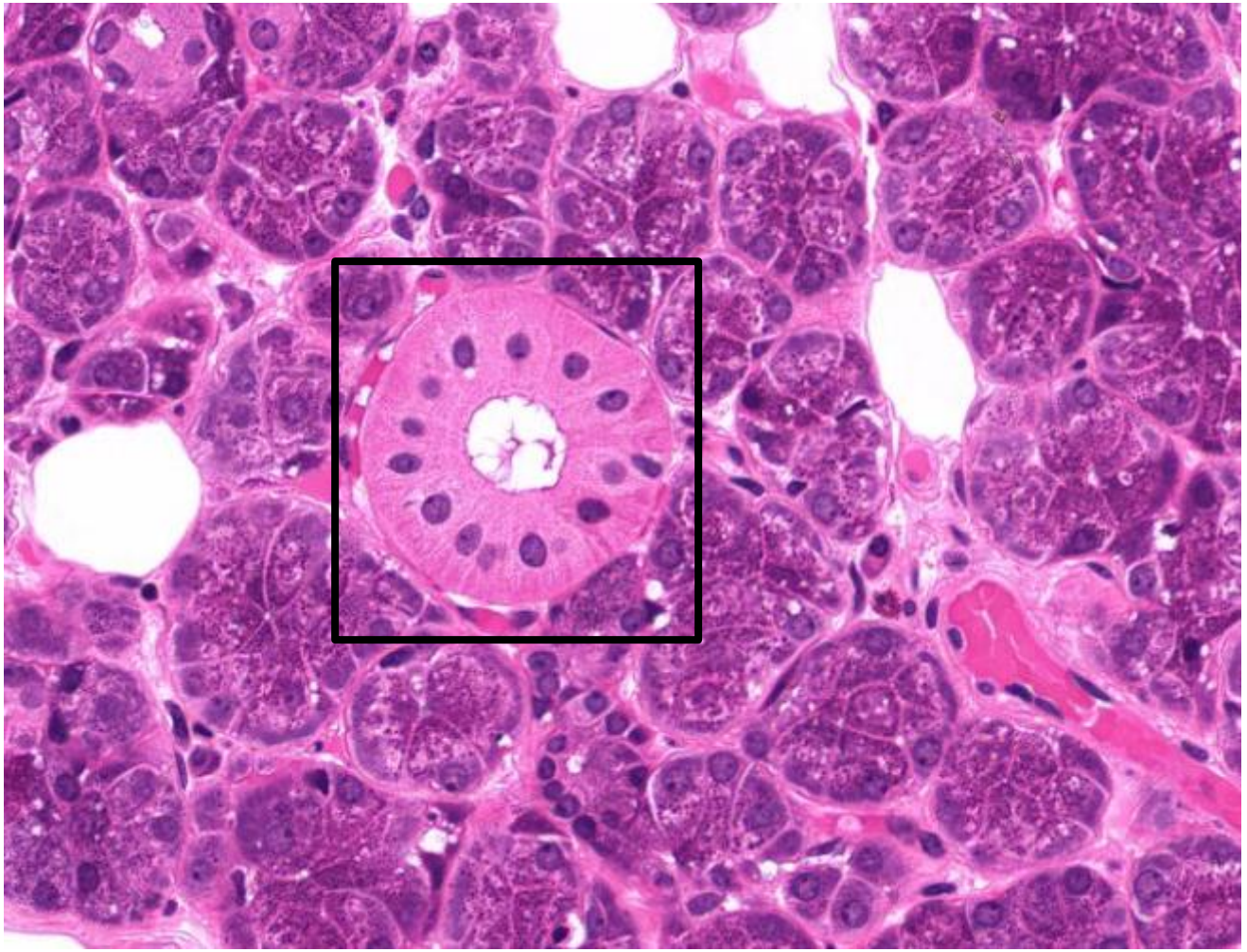
(2) Simple Cuboidal Epithelium



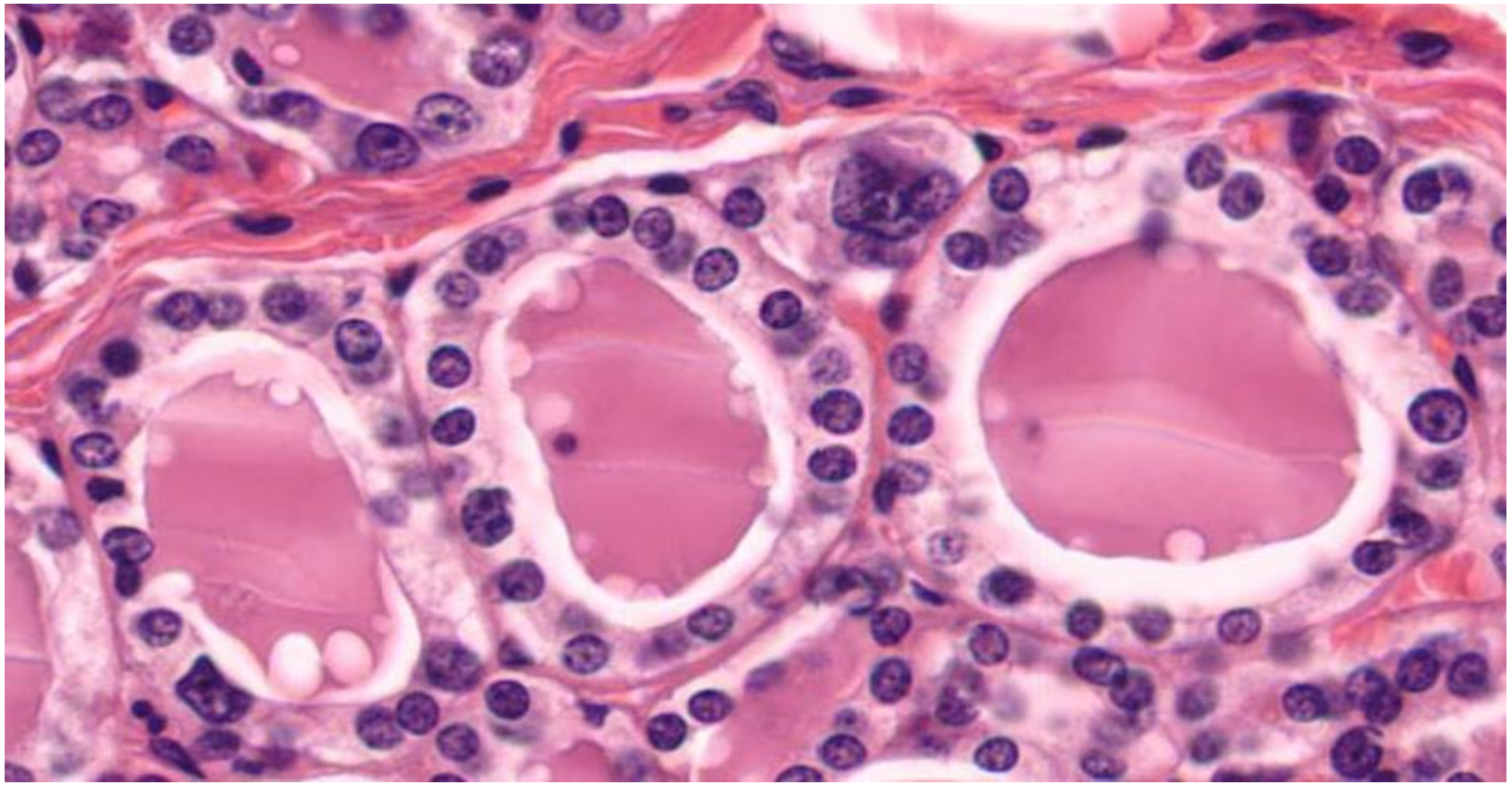
Section through kidney showing simple cuboidal epithelium. The round nuclei are those of cuboidal cells.



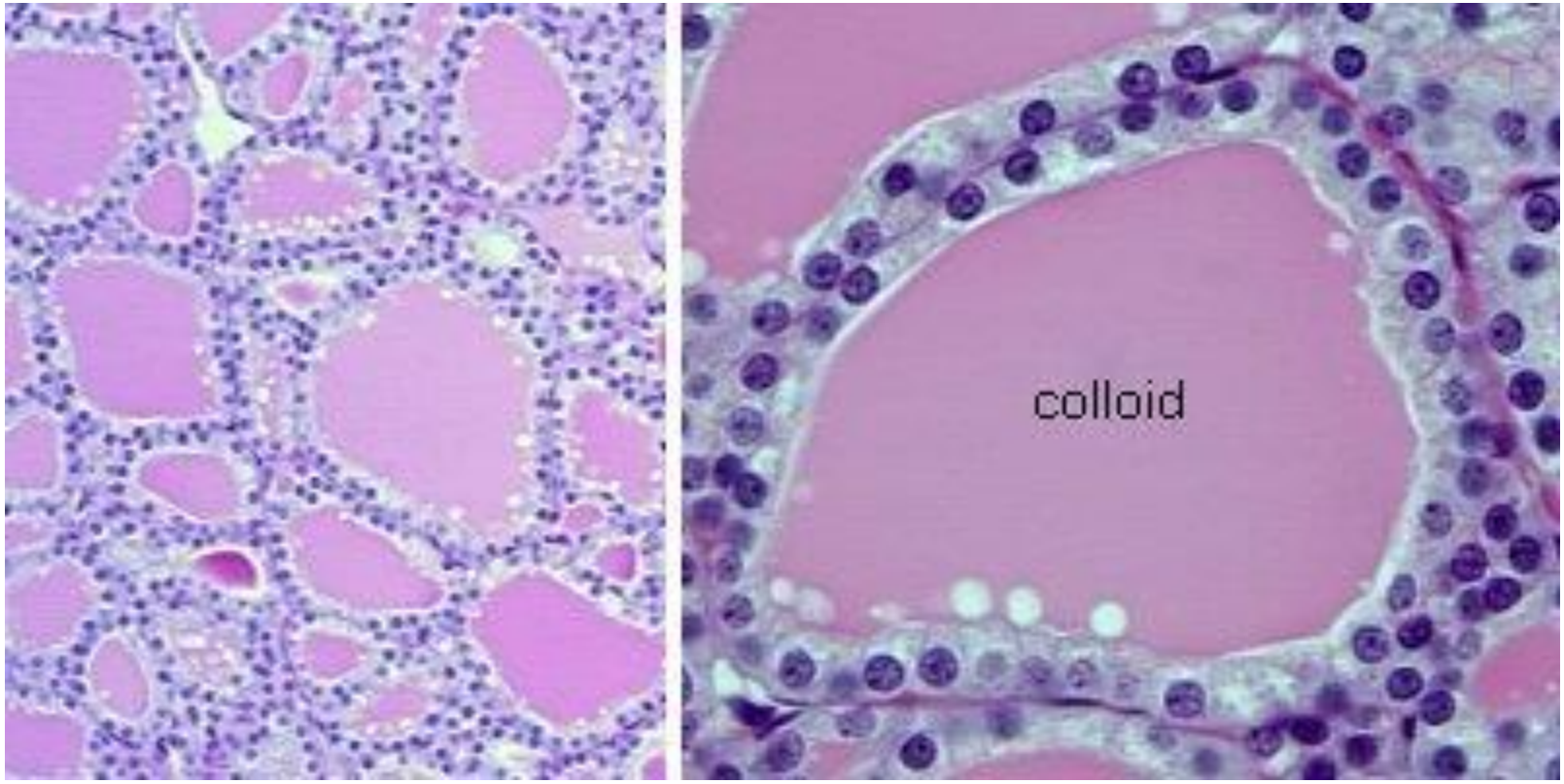
Simple cuboidal epithelium of the renal tubules.



Small duct of a salivary gland lined by simple cuboidal epithelium.



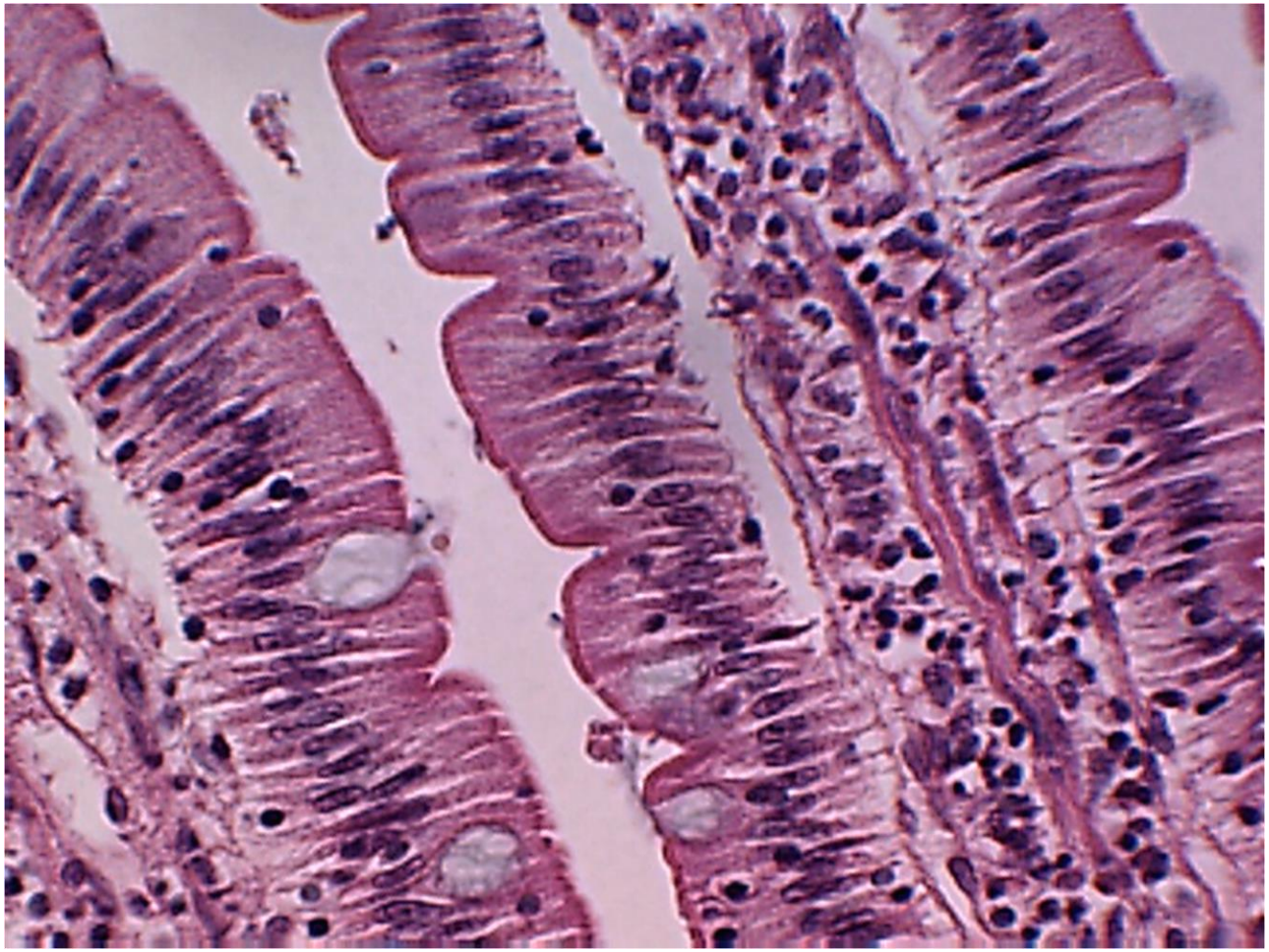
Thyroid follicles are lined by simple cuboidal epithelium.



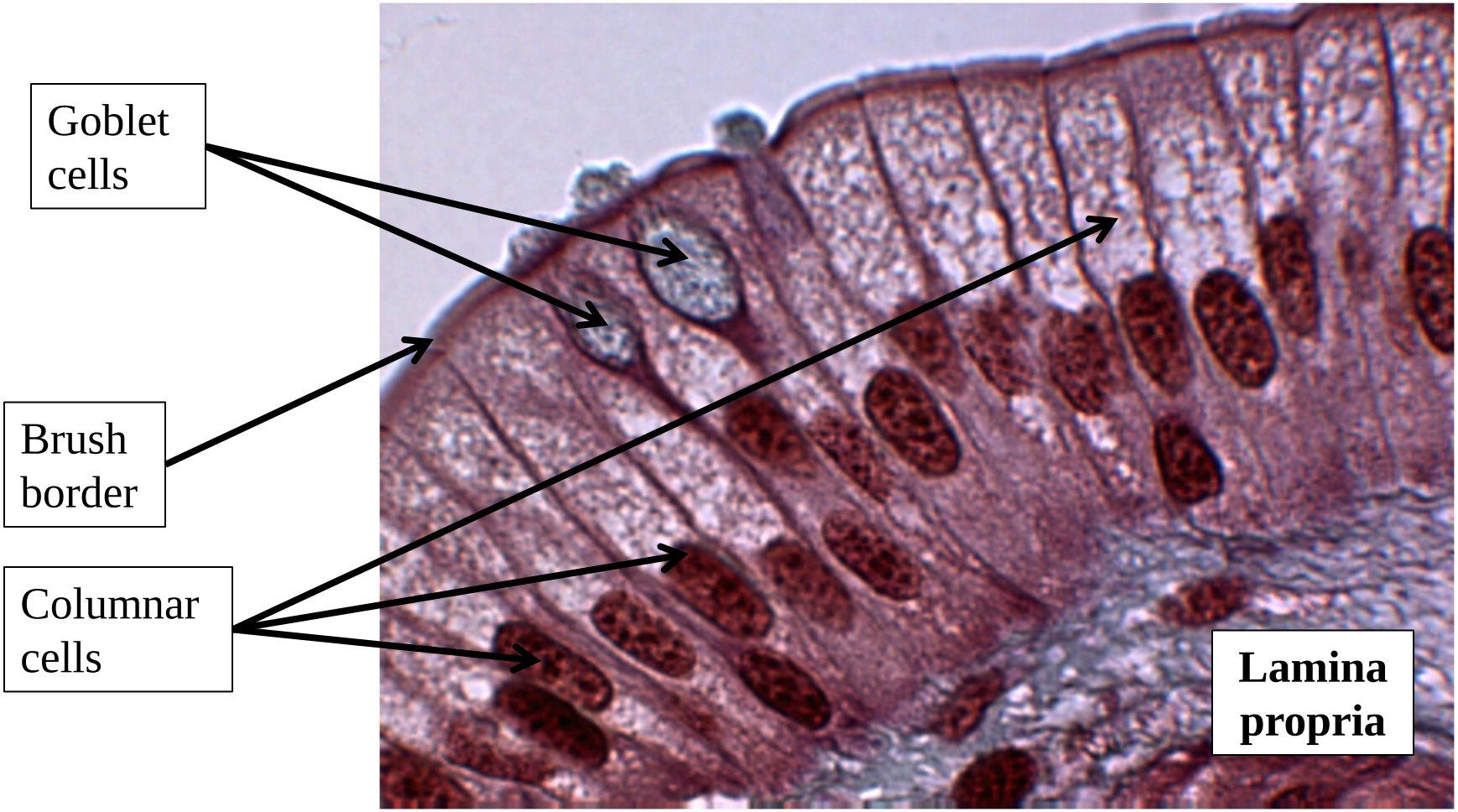
Another image showing thyroid follicles. The colloid inside the follicles is made up mostly of protein.

(3) Simple Columnar Epithelium

Simple columnar epithelium of the duodenum. Note the several lightly stained cells – these are Goblet cells



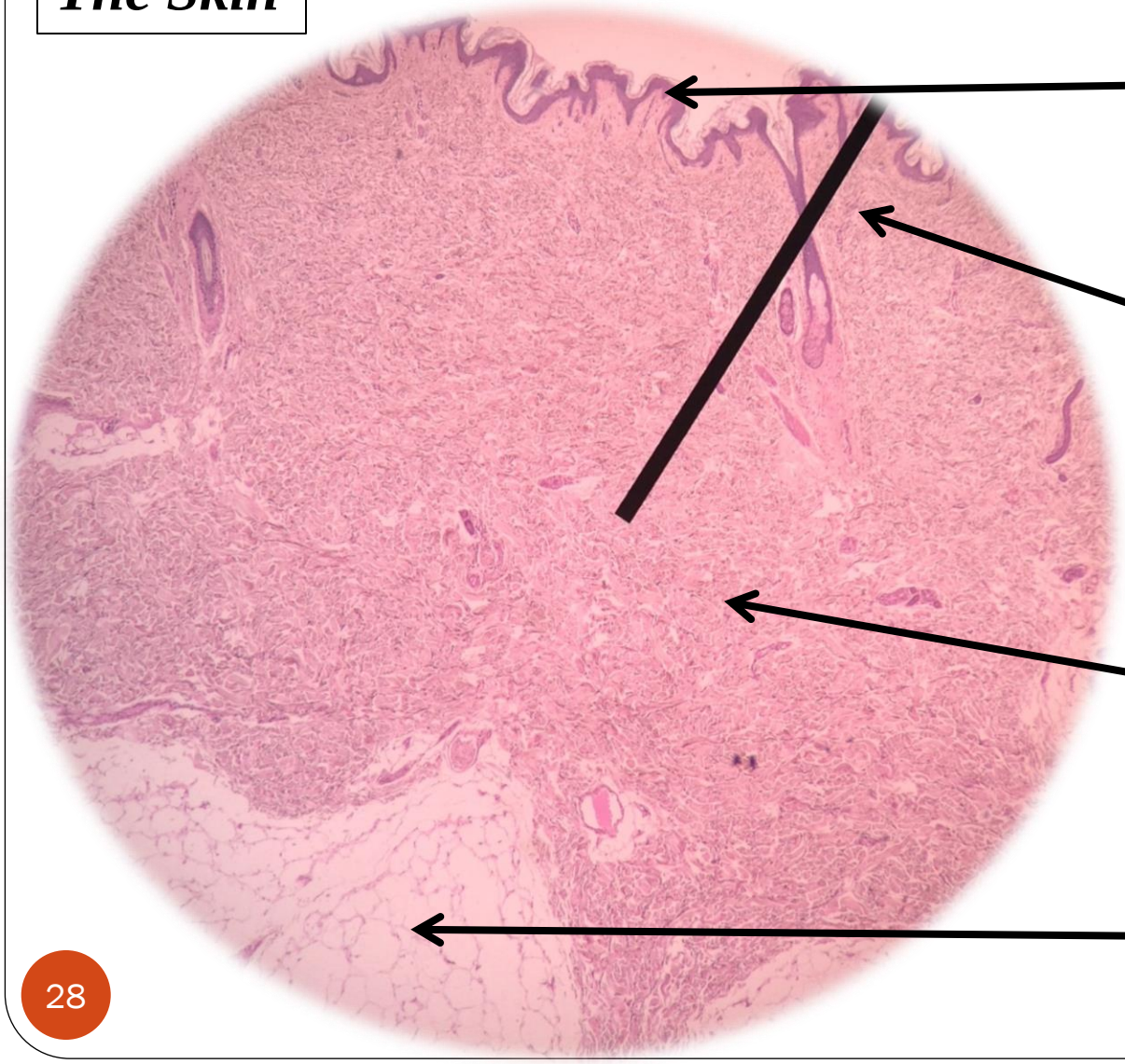
The same slide as before but under higher magnification. The oval nuclei of the columnar cells are easily seen. Note how the several Goblet cells seen are not stained.



Simple columnar epithelium of the small intestine. The cell membrane and the oval nuclei of the columnar cells are clearly seen. Goblet cells are present. The brush border (formed of numerous microvilli) is at the top of the epithelium.

(4) Stratified Squamous Keratinized Epithelium

The Skin



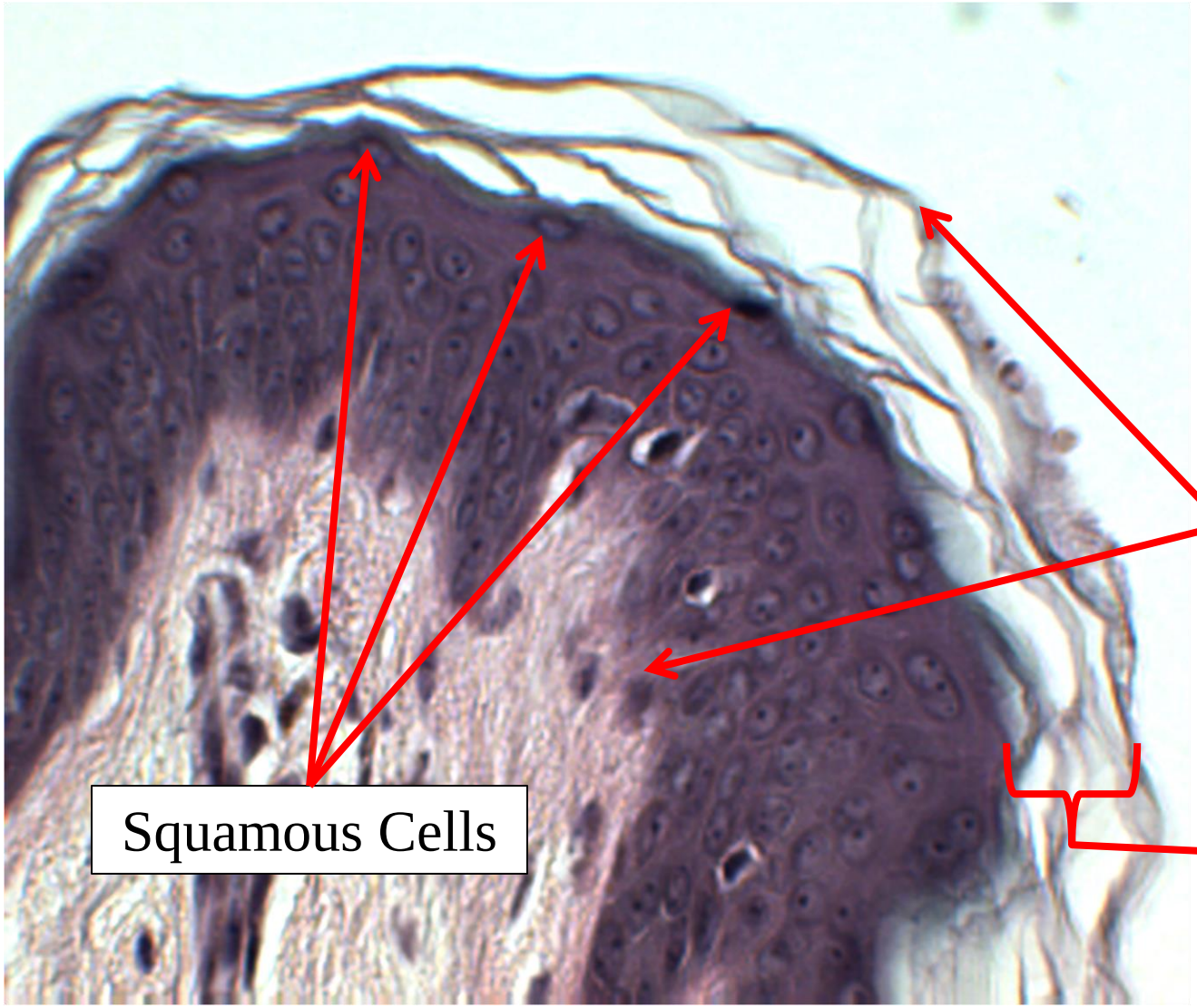
Epidermis (Epithelium)

Areolar Connective Tissue

Dermis

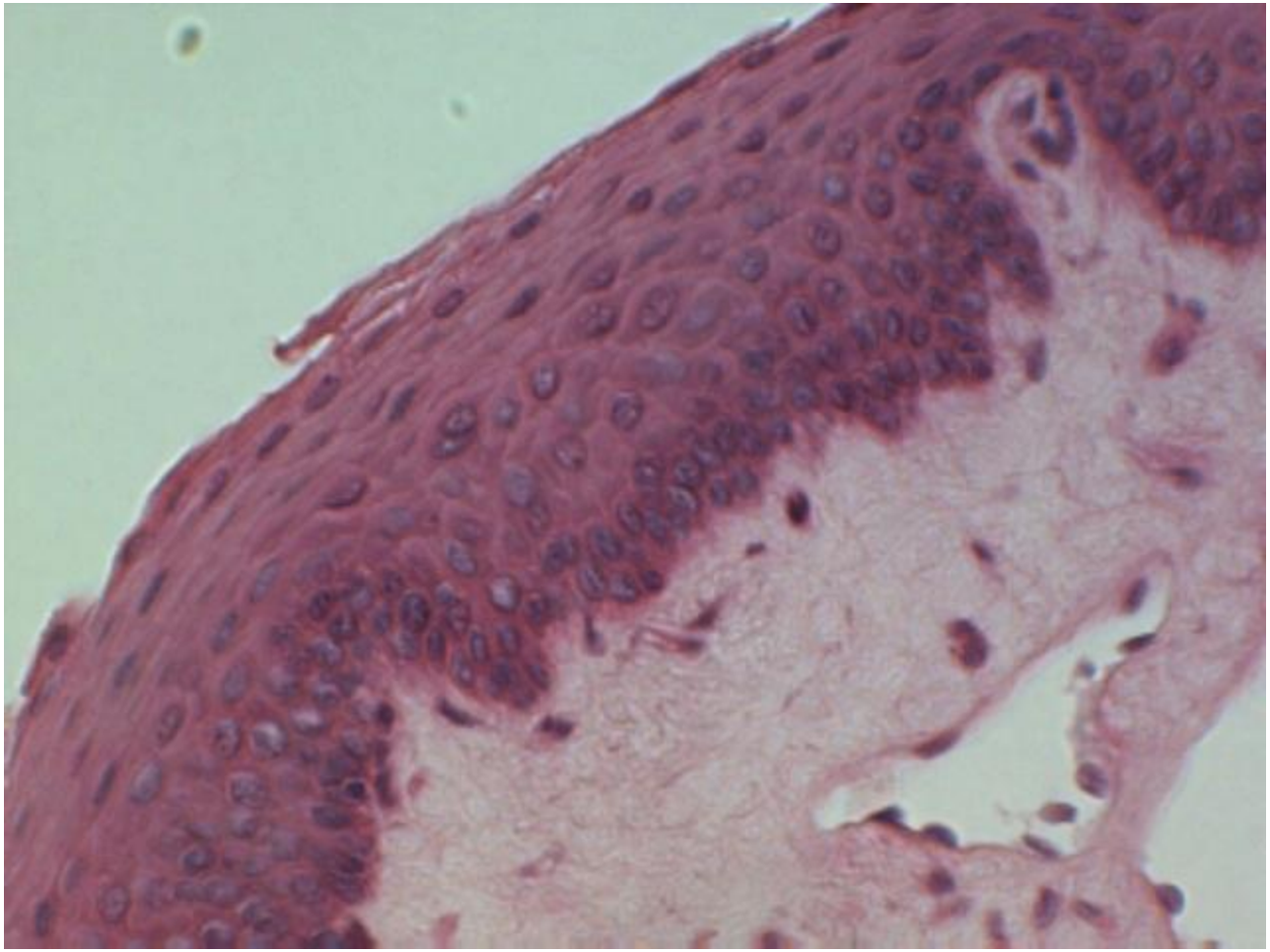
Dense Irregular Connective Tissue

Subcutaneous Fatty tissue



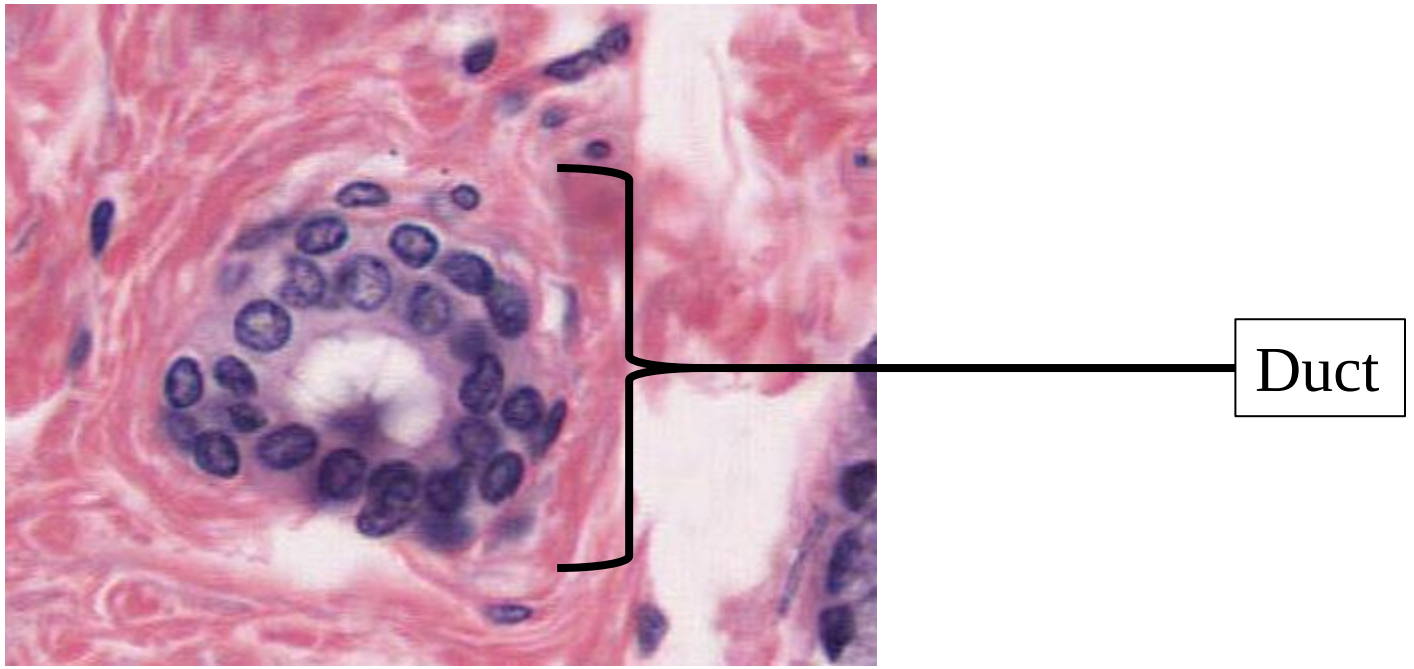
The Epidermis (stratified squamous keratinized epithelium).

(5) Stratified Squamous Non-Keratinized Epithelium

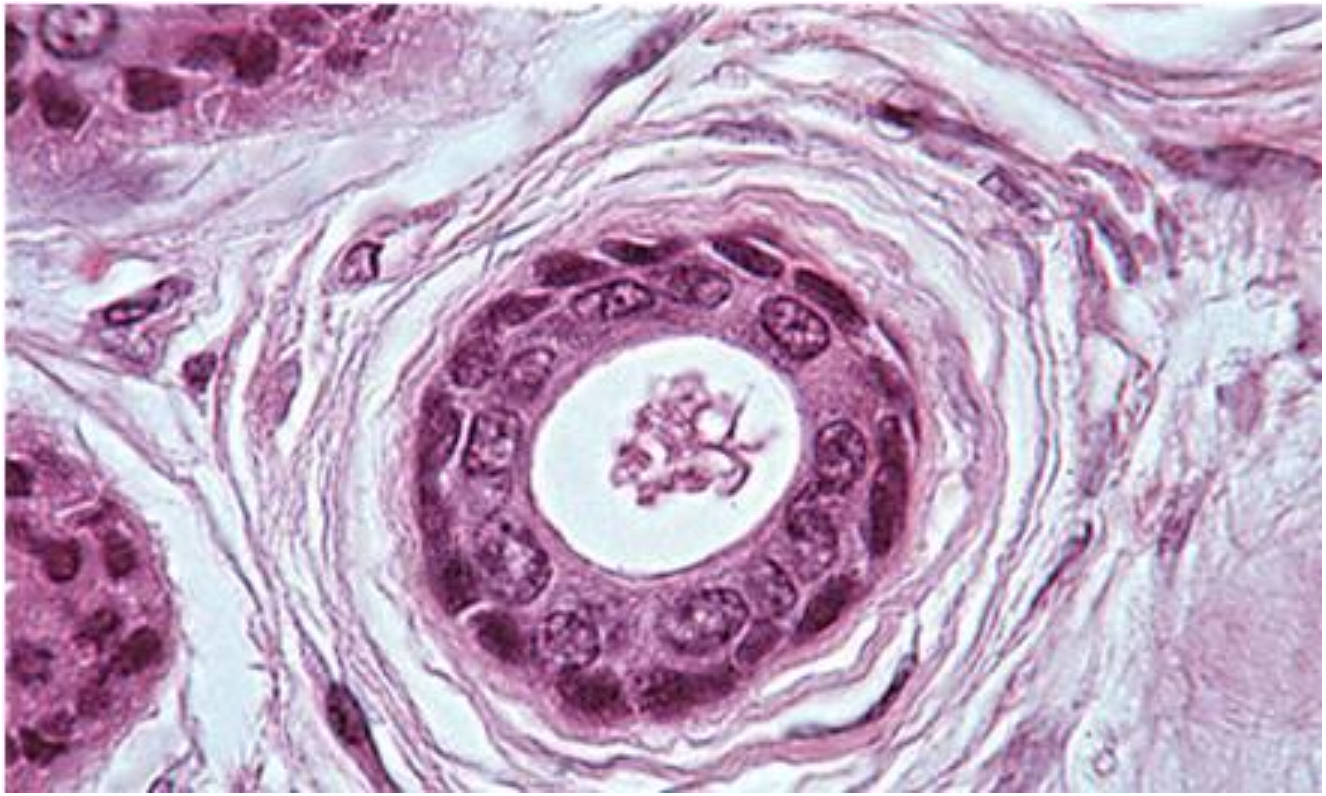


Stratified squamous non-keratinized epithelium of the esophagus.

(6) Stratified Cuboidal Epithelium

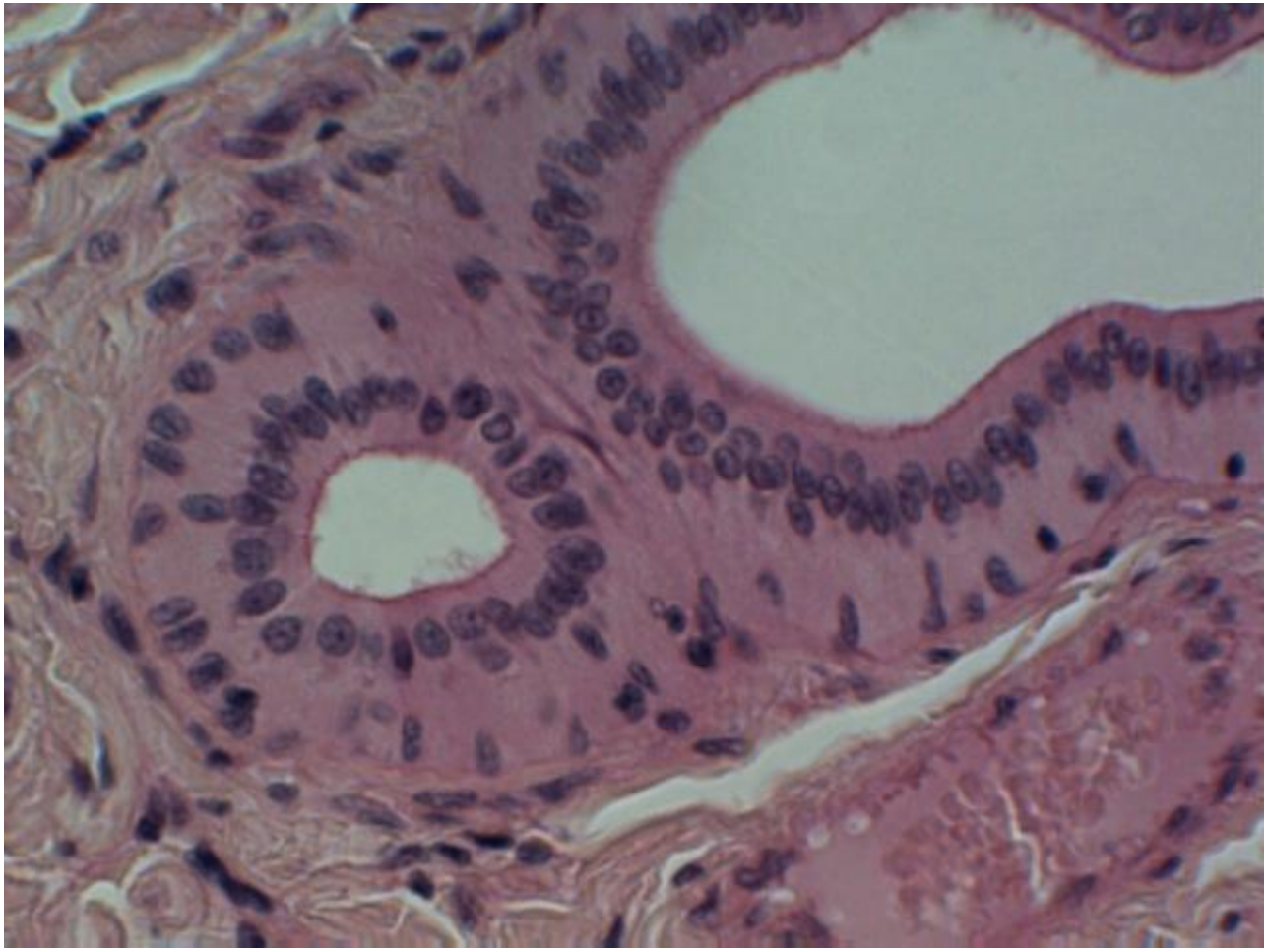


Stratified cuboidal epithelium lining a duct of a gland.



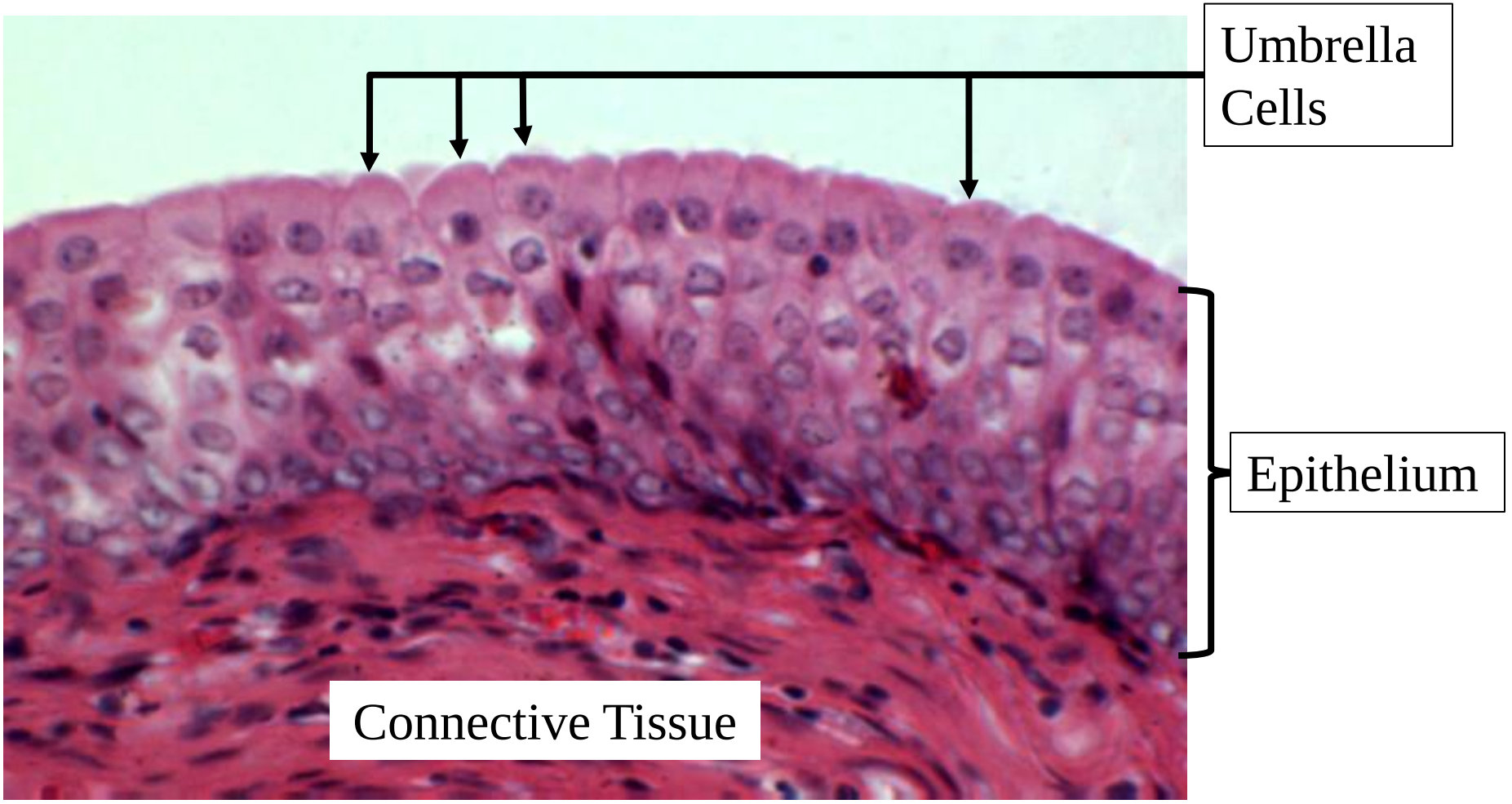
Stratified cuboidal epithelium lining a duct of a salivary gland. Note how the cells in the basal layer appear to have flattened nuclei and the cells in the apical layer have round nuclei. Remember, in the classification of stratified epithelium, we only look at the shape of cells (nuclei) in the apical layer.

(7) Stratified Columnar Epithelium



Stratified columnar epithelium lining a duct of a salivary gland.

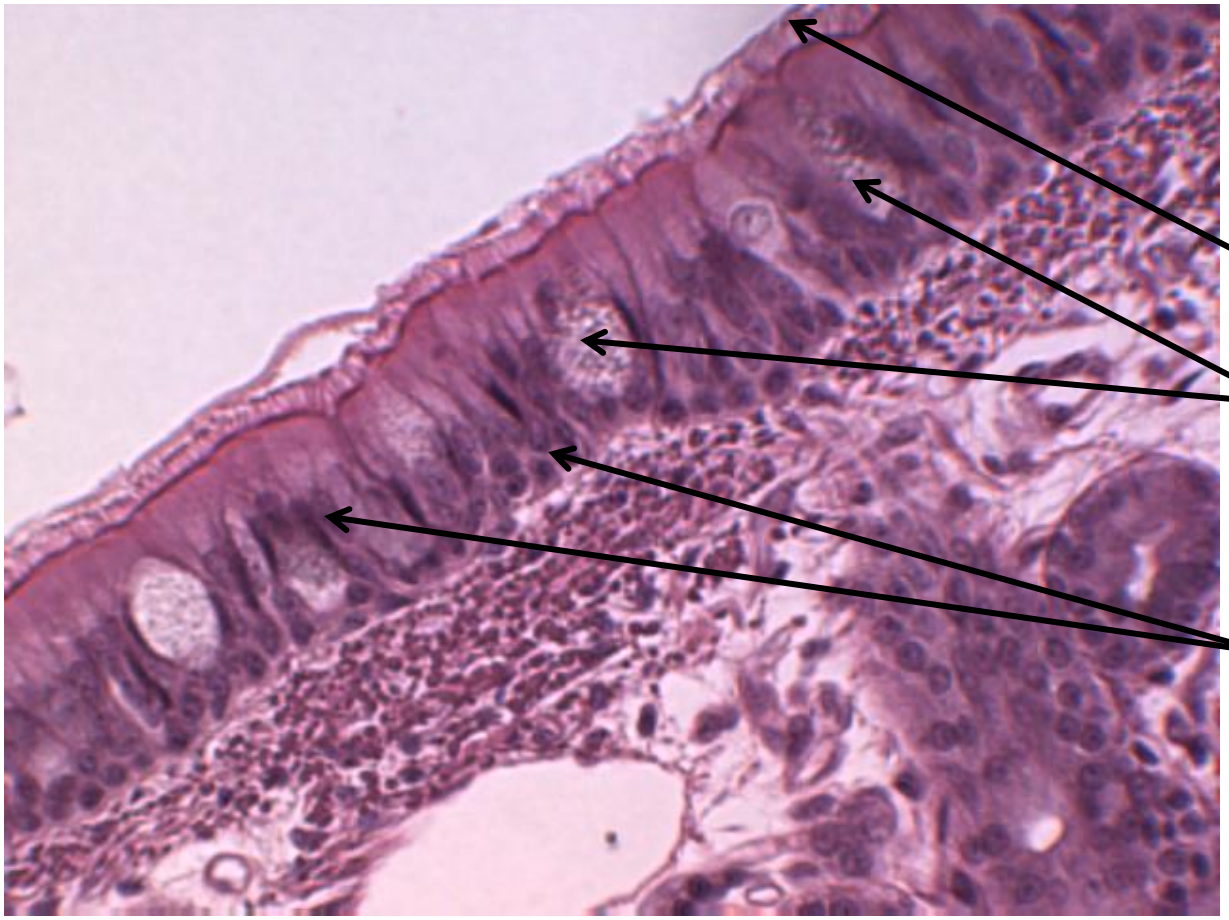
(8) Transitional Epithelium (Urothelium)



Transitional epithelium of the ureter. The presence of umbrella cells indicate the ureter was empty.

(9) Pseudostratified Columnar Ciliated Epithelium (Respiratory Epithelium)

This epithelium is identified by the presence of:

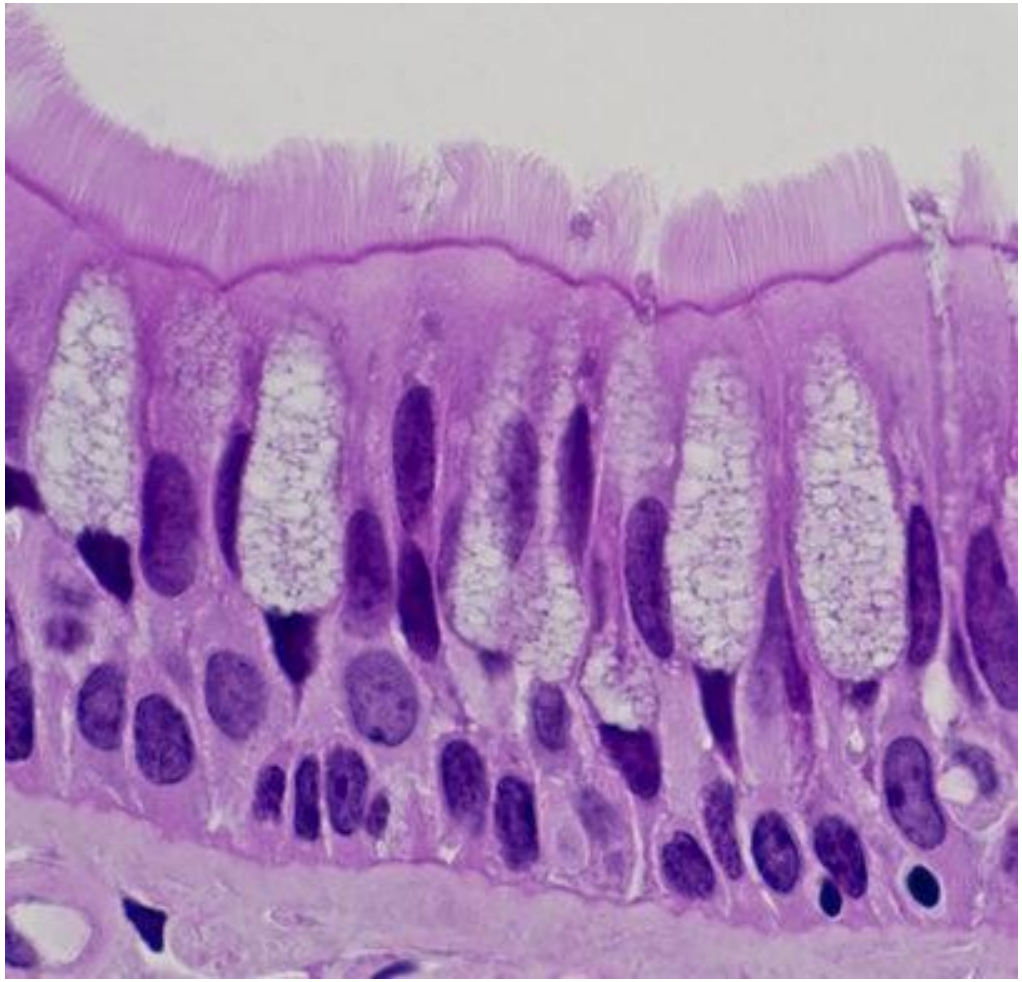


Cilia

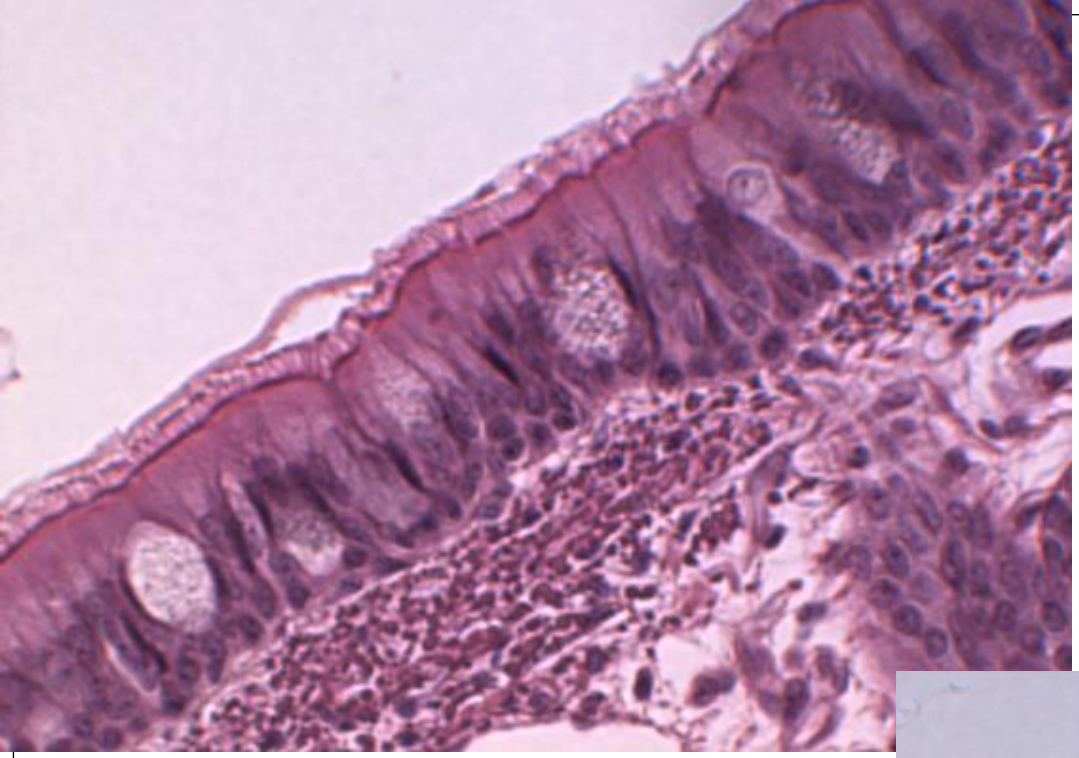
Goblet Cells

Nuclei at different levels

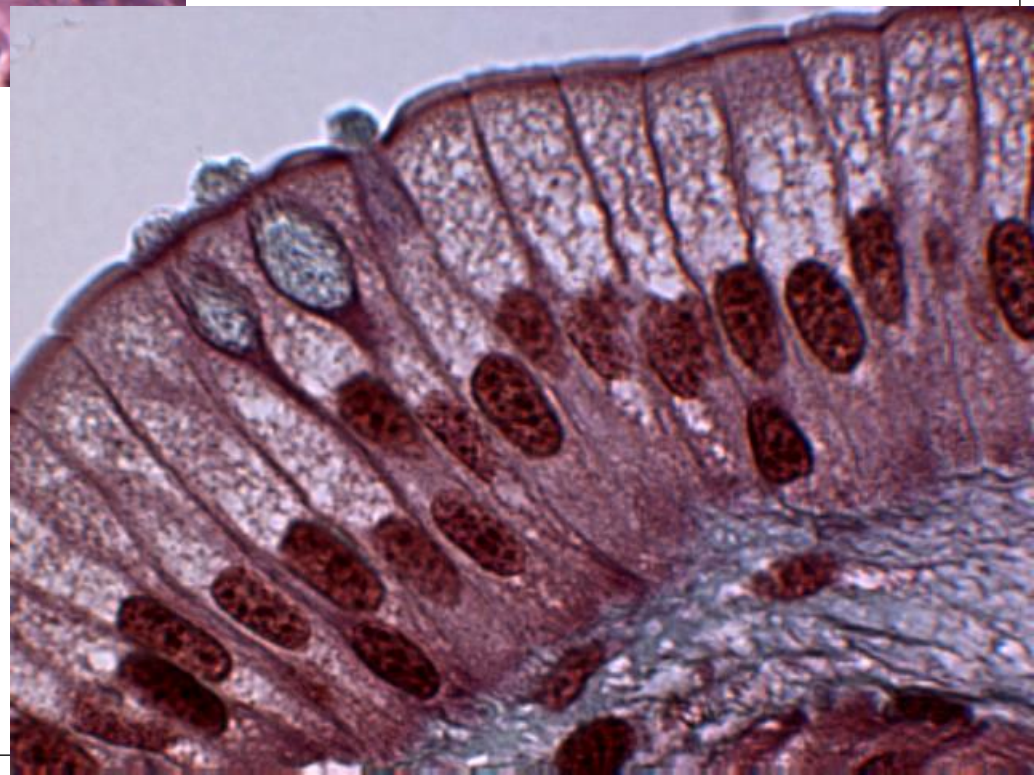
Pseudostratified epithelium of the trachea.



Pseudostratified columnar ciliated epithelium. Try to identify the different structures in this epithelium.

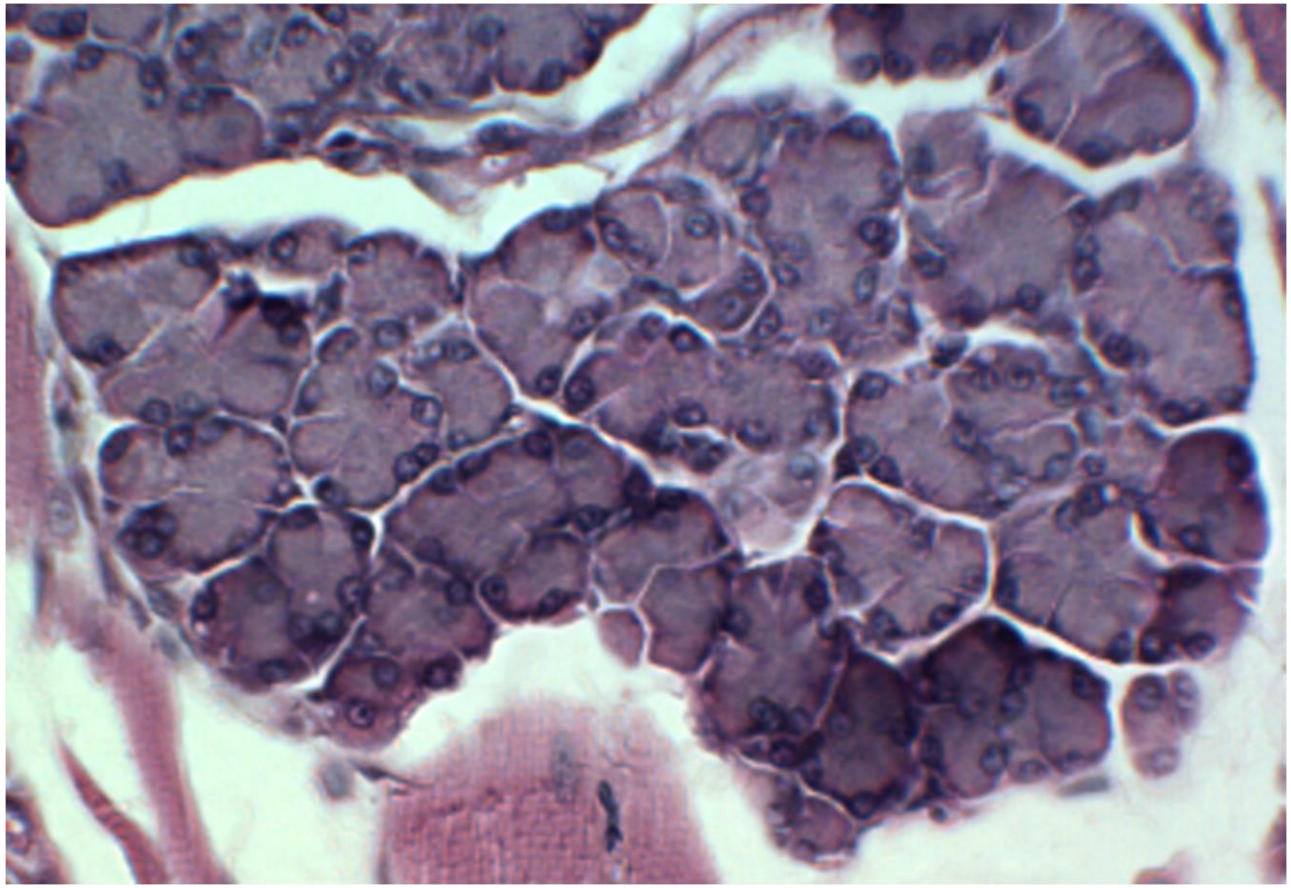


Compare the brush border of the small intestine with the cilia of the trachea (both images are at the same magnification).

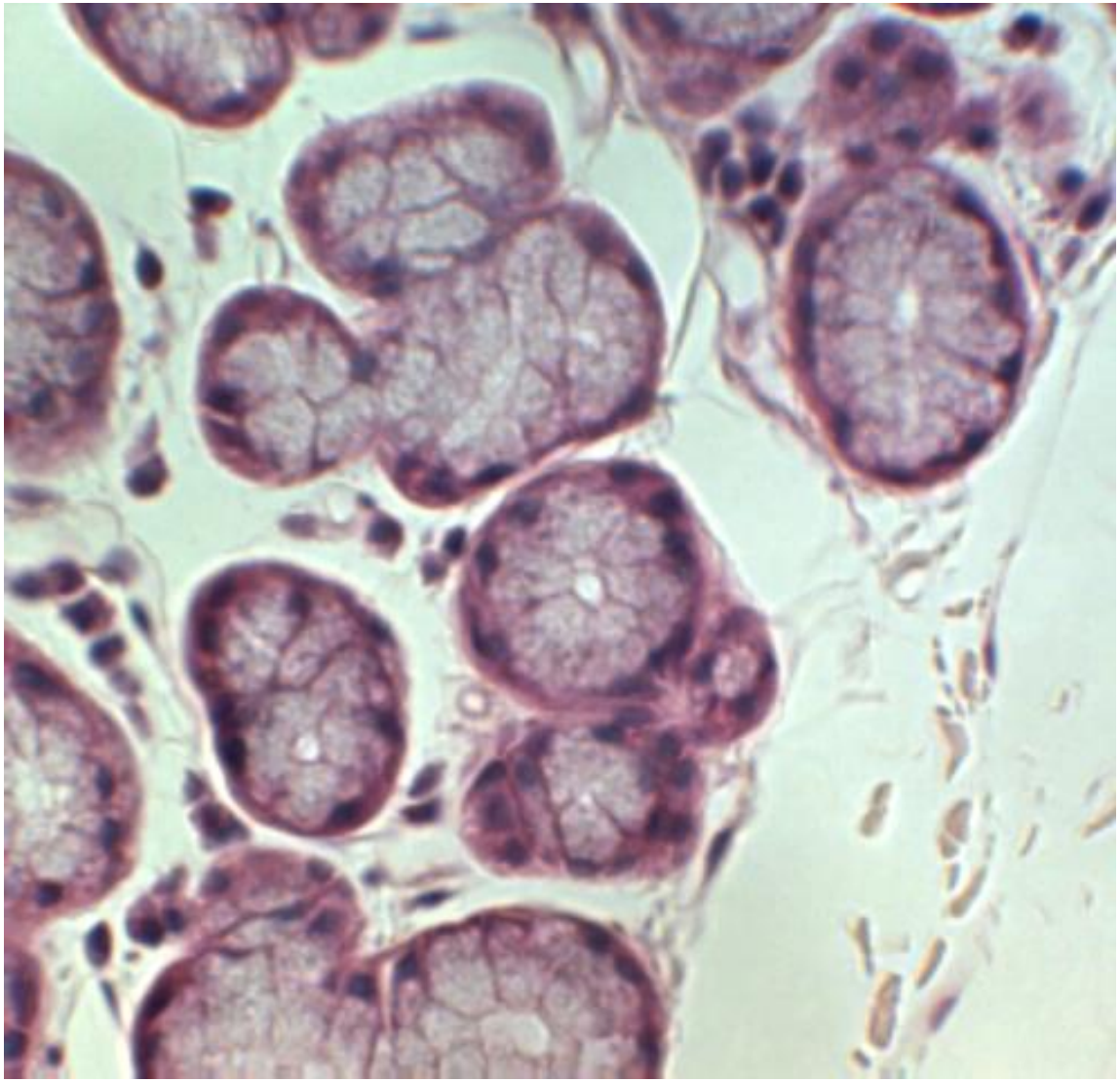


Cilia are much more easily seen than the brush border because cilia are larger than microvilli.

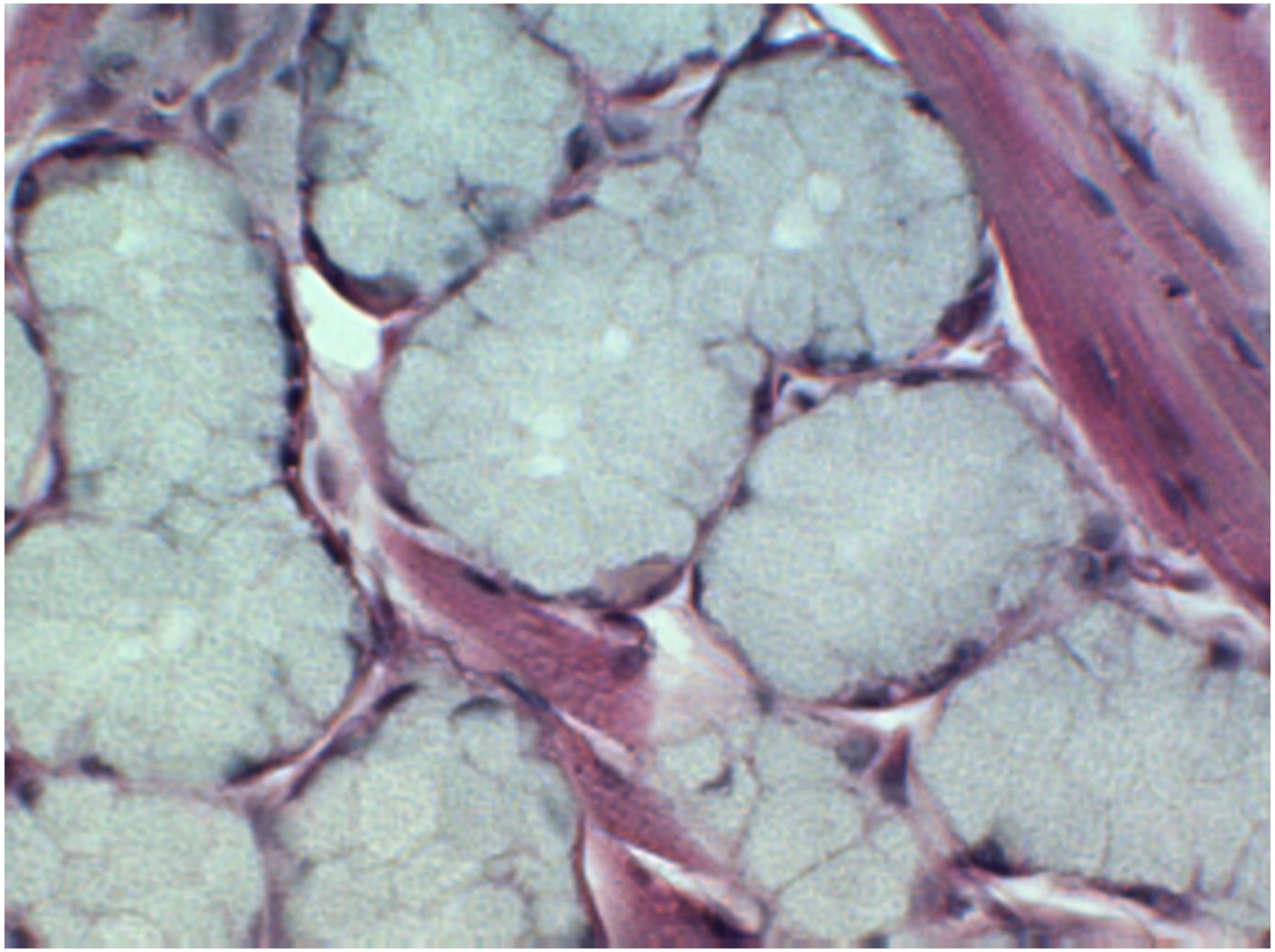
(10) Glandular Epithelium



Serous glands of the tongue. Note the round nuclei and the stained cytoplasm.



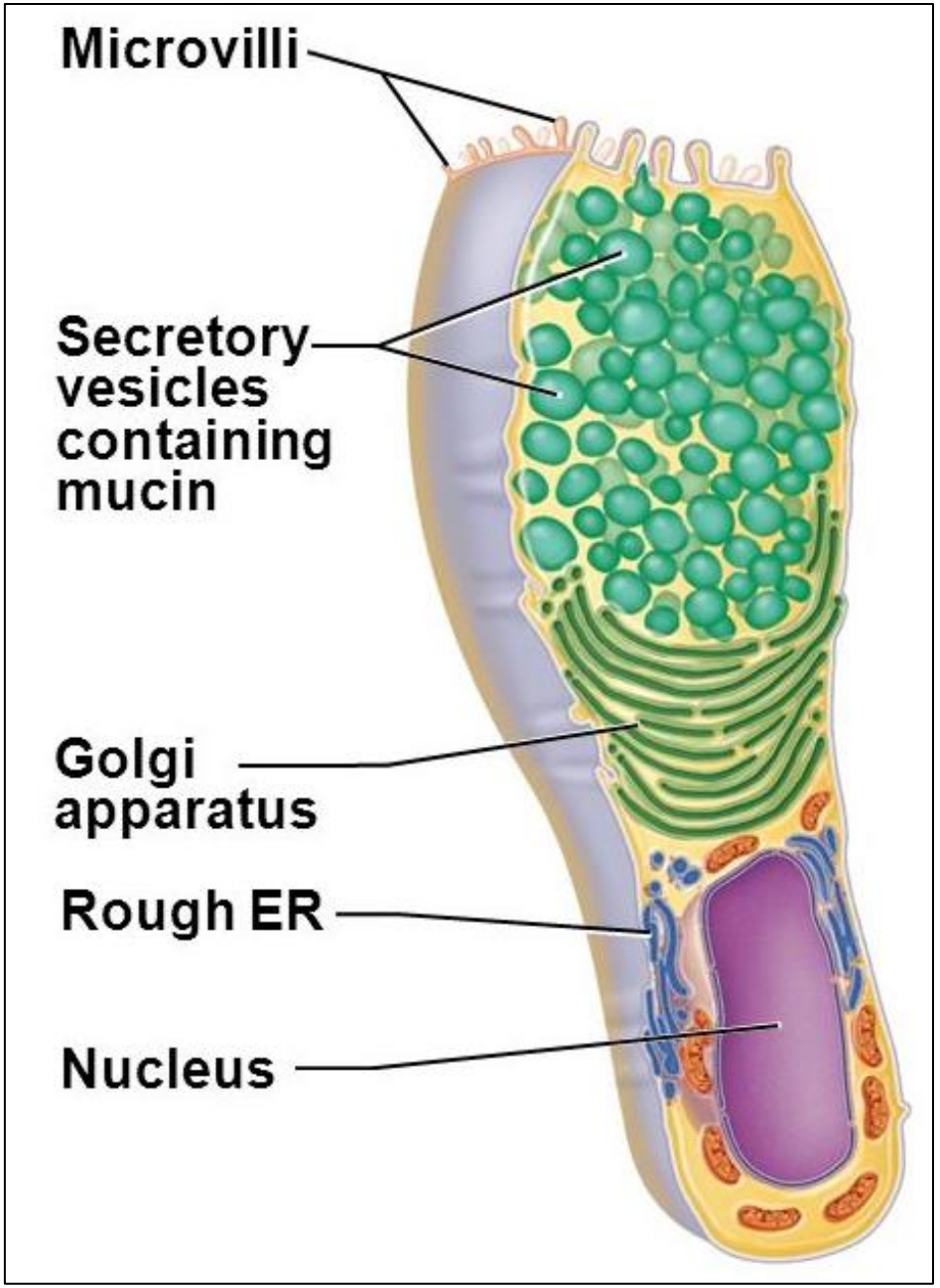
Mucous salivary gland. Note the nucleus in the bottom of the cell, the basal basophilia, and the unstained cytoplasm.



Mucous glands of the tongue.

Goblet cell:

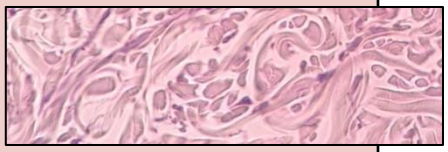
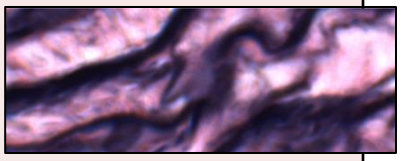
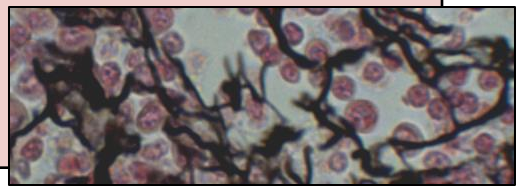
- Unicellular
- Exocrine
- Merocrine
- Mucous
- Located within epithelium



Part 2: Connective Tissue

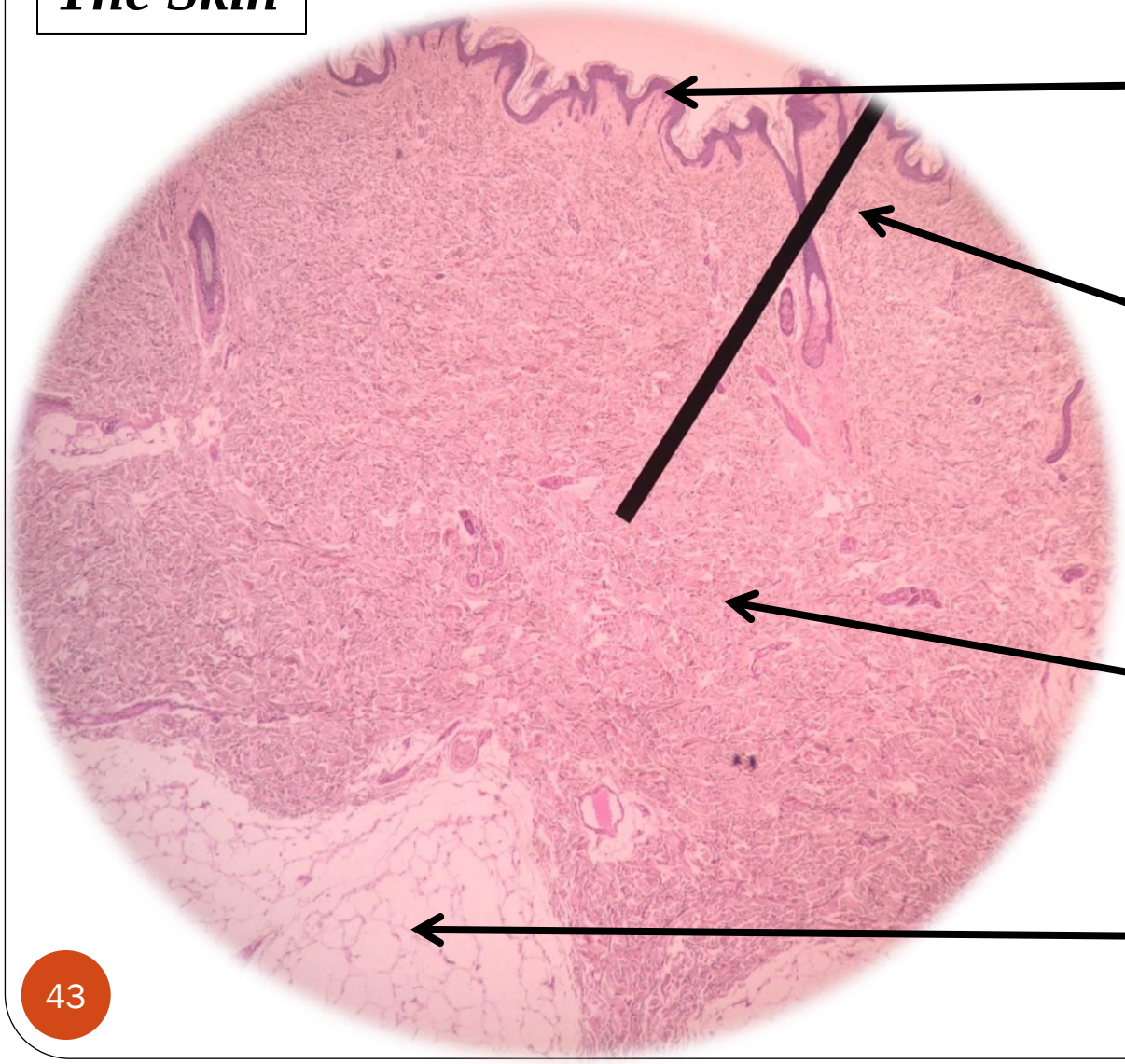
- In connective tissue, we see:

1. The cells are dispersed.
2. Various types of fibers are present between the cells.

Fiber	Appearance
Collagen	Thick acidophilic structures 
Elastic	Thin darkly stained wavy lines 
Reticular	Thin darkly stained net 

(1) Connective Tissues Related To The Skin

The Skin



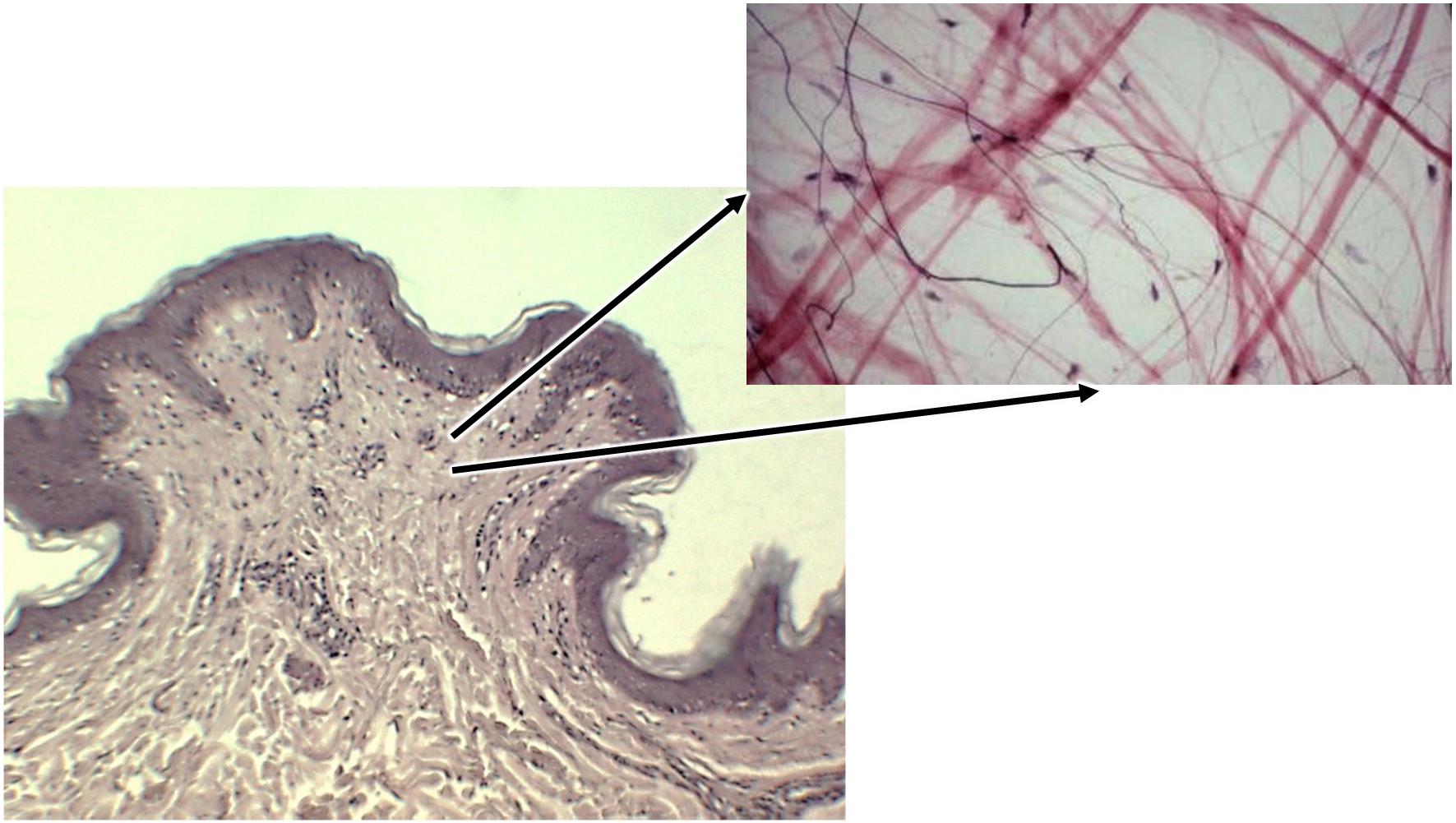
Epidermis (Epithelium)

Loose Areolar Connective Tissue

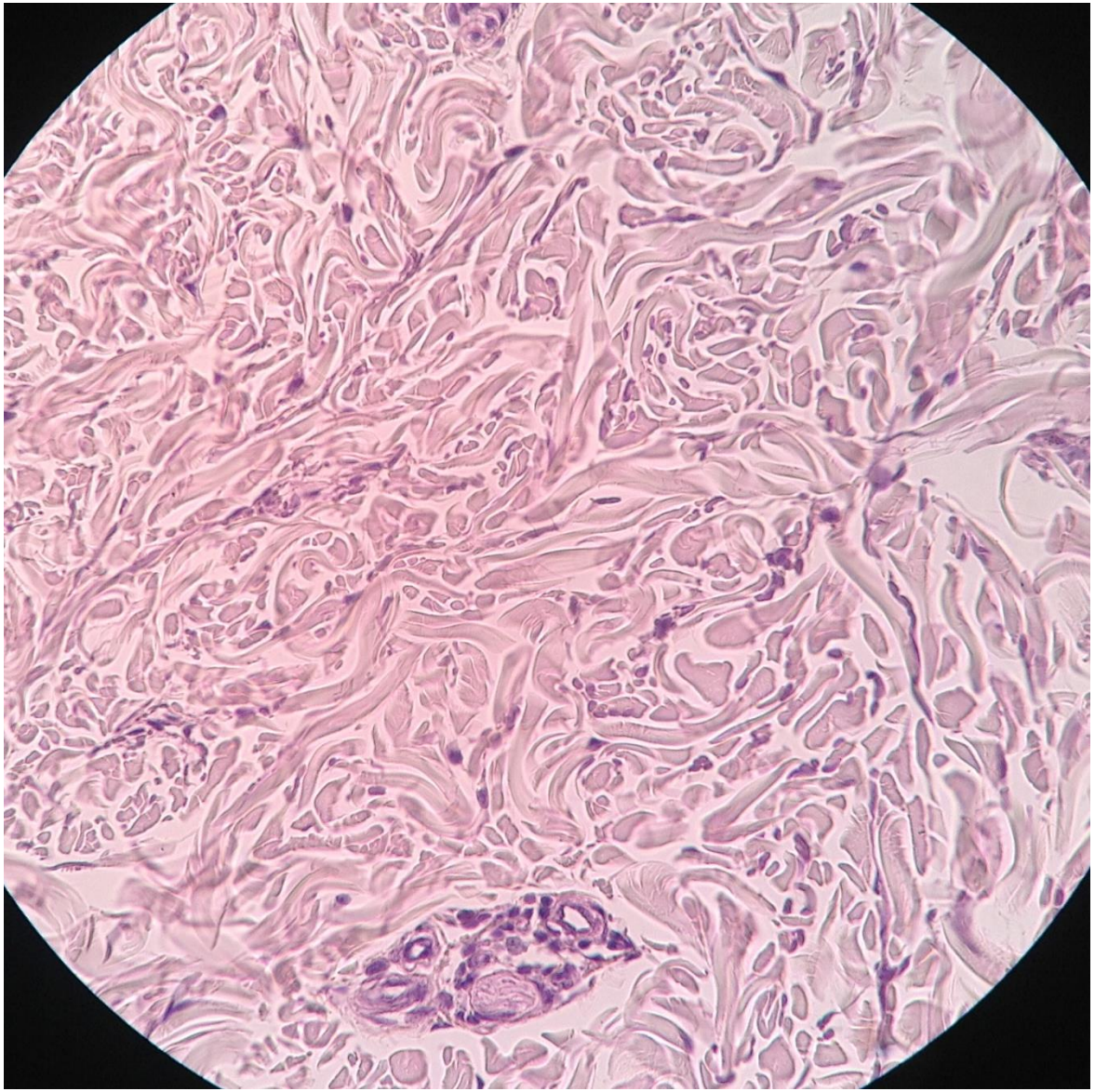
Dermis

Dense Irregular Connective Tissue

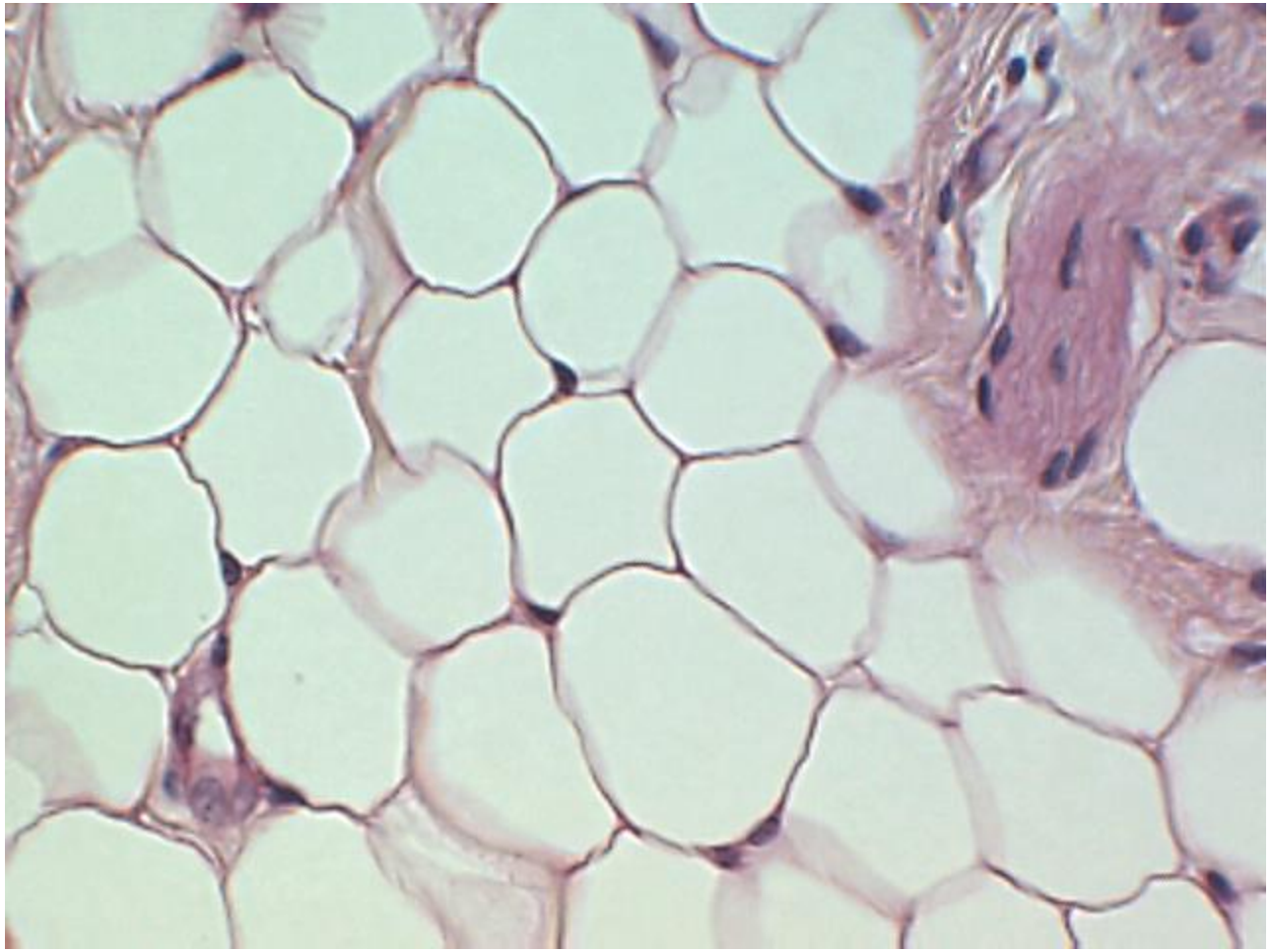
Subcutaneous Fatty tissue



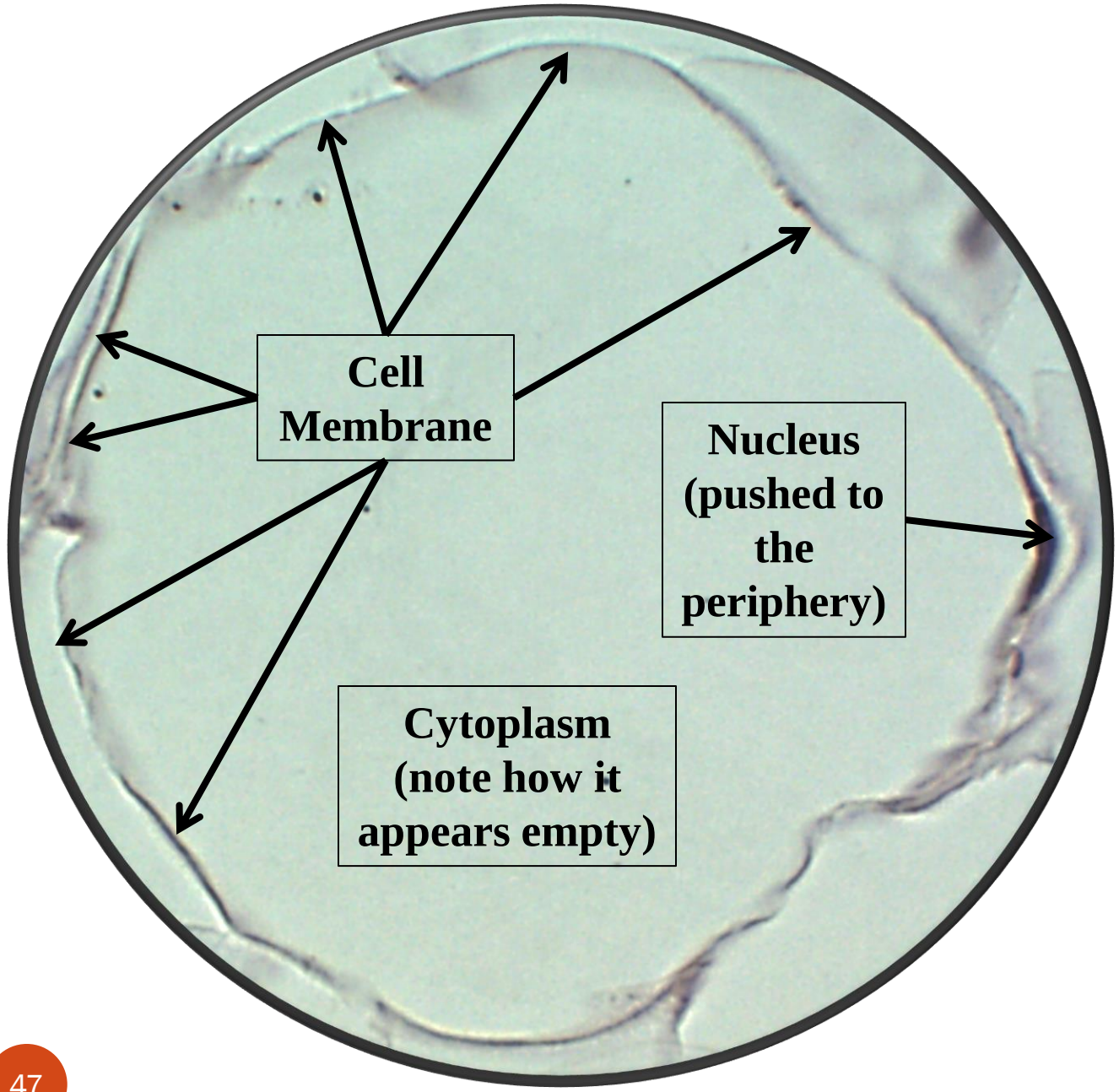
Loose connective tissue. It’s located immediately under the epithelium.



Dense collagenous irregular connective tissue. Note the abundance of collagen fibers. Note also how the fibers pass in different directions.

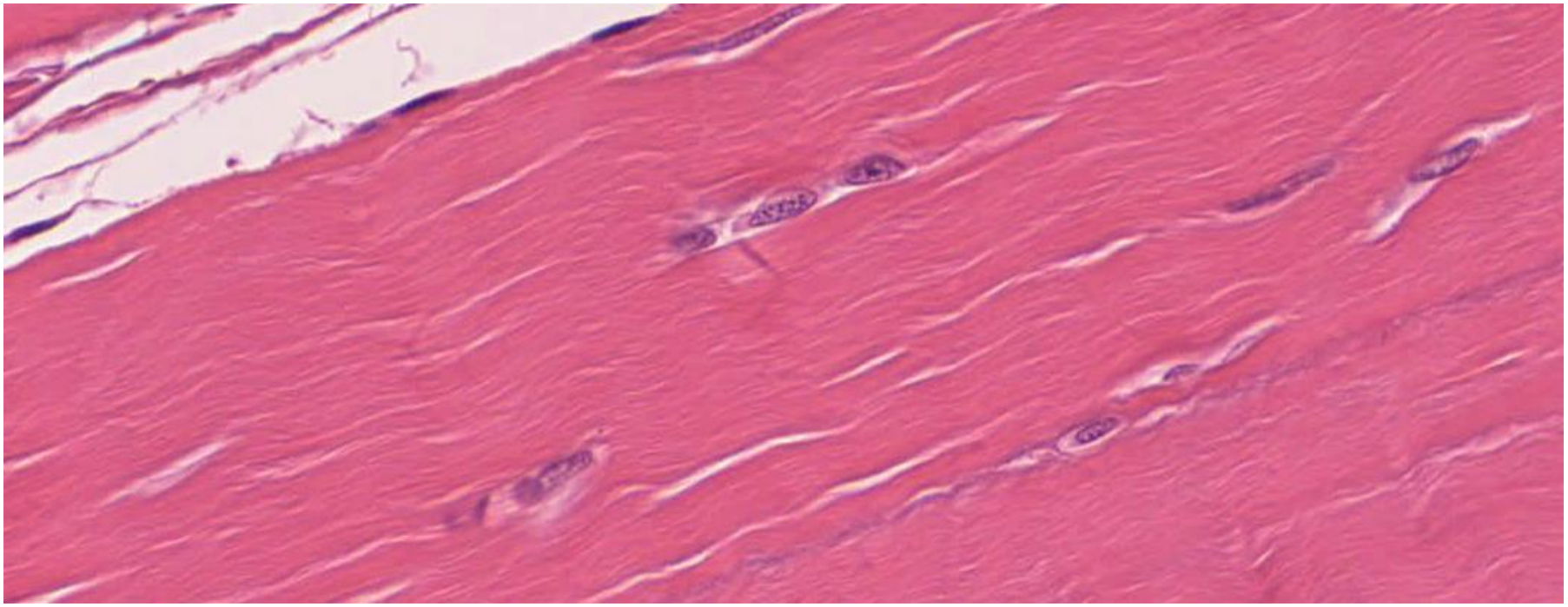


Fatty tissue. Each of the large round structures is an adipocyte.



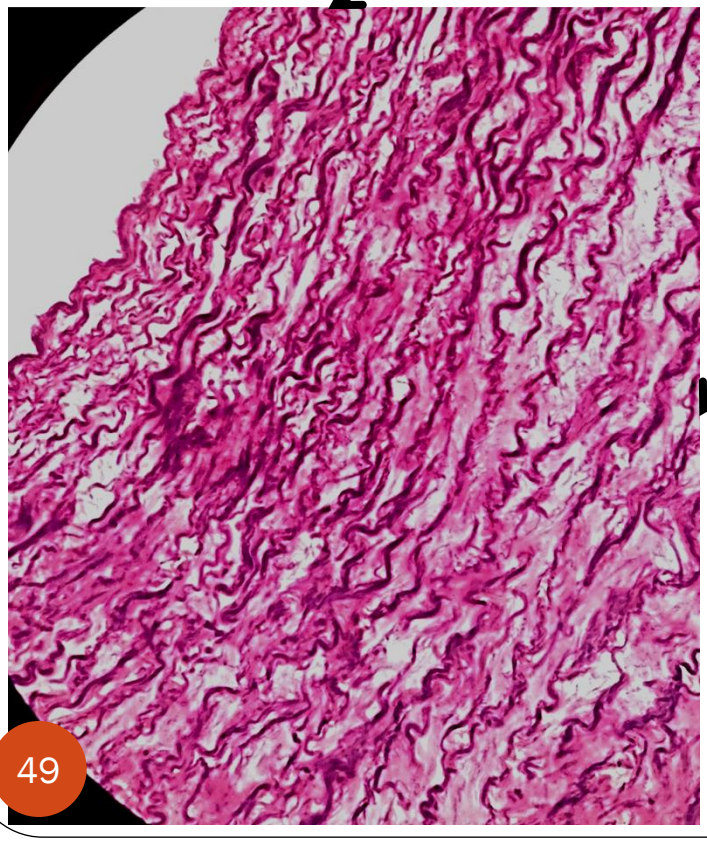
Adipocyte.
Note the typical ***signet-ring*** appearance.

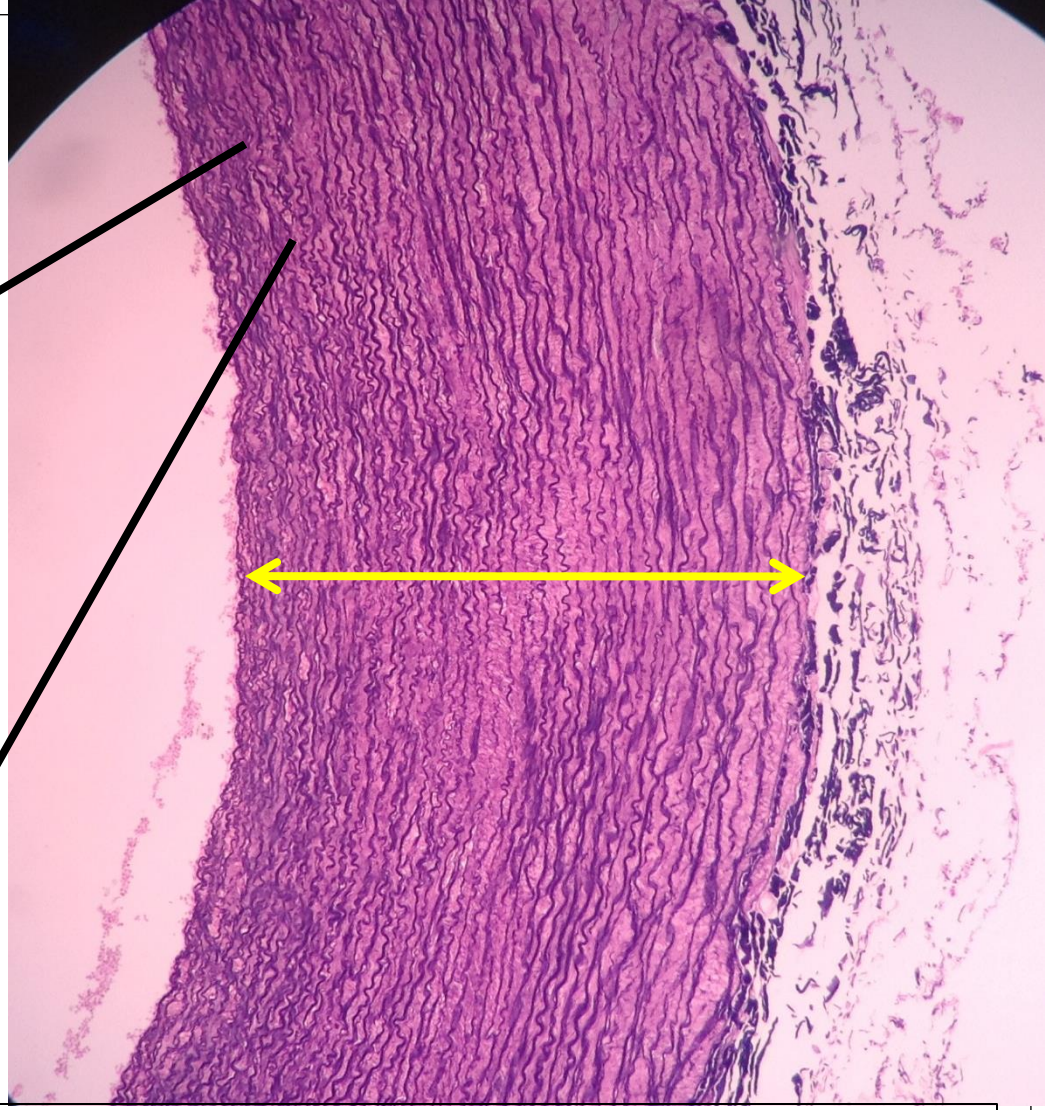
(2) Dense Regular Connective Tissue



Dense regular collagenous connective tissue in the tendon. Note the abundance of collagen fibers. Note also how all the collagen fibers are running in the same direction. The darkly stained structures are the nuclei of fibroblasts.

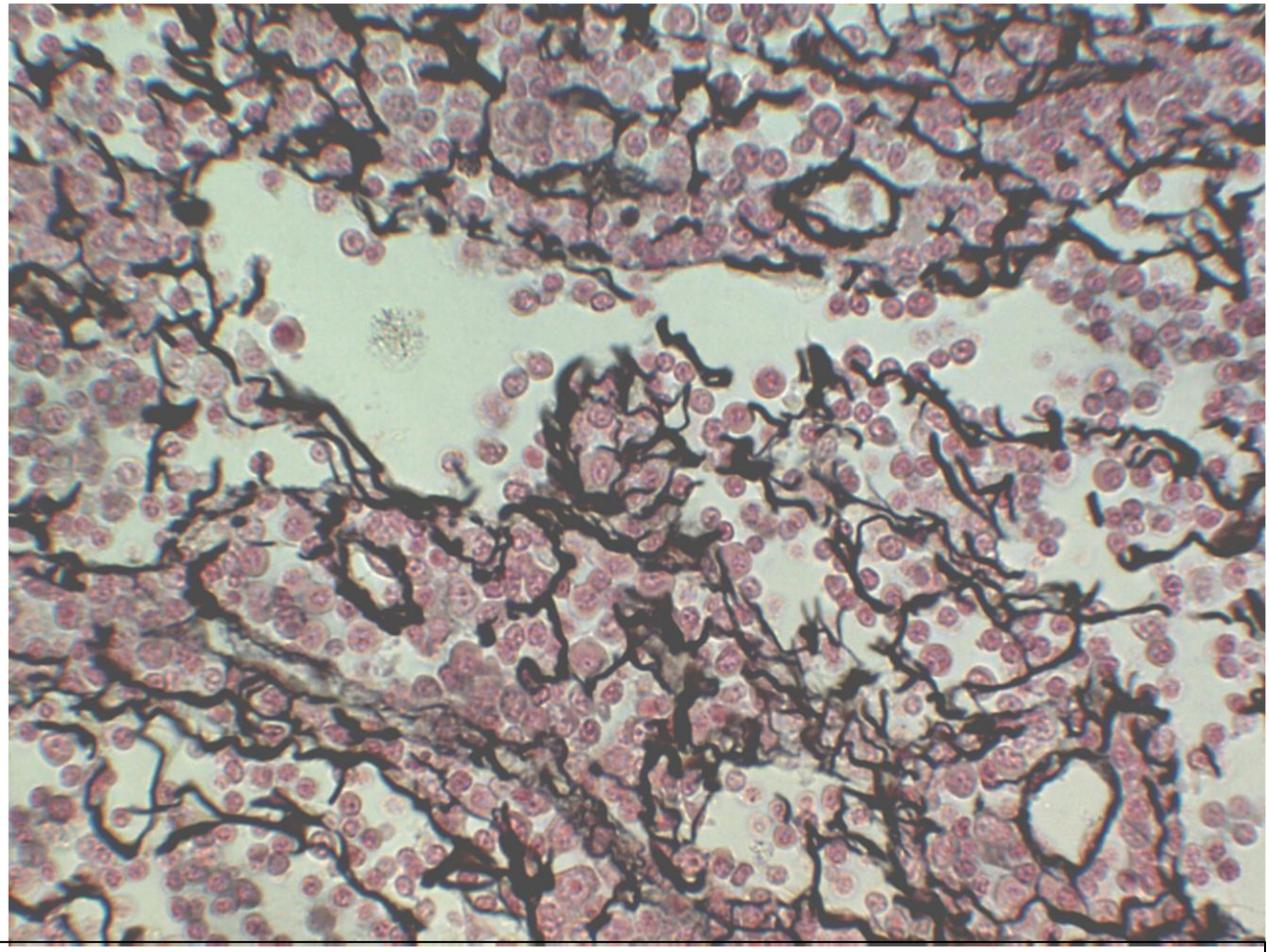
(3) Dense Elastic Connective Tissue





Elastic tissue in the aorta (the double-headed yellow arrow). Under higher magnification, the wavy appearance of the elastic fibers is clear.

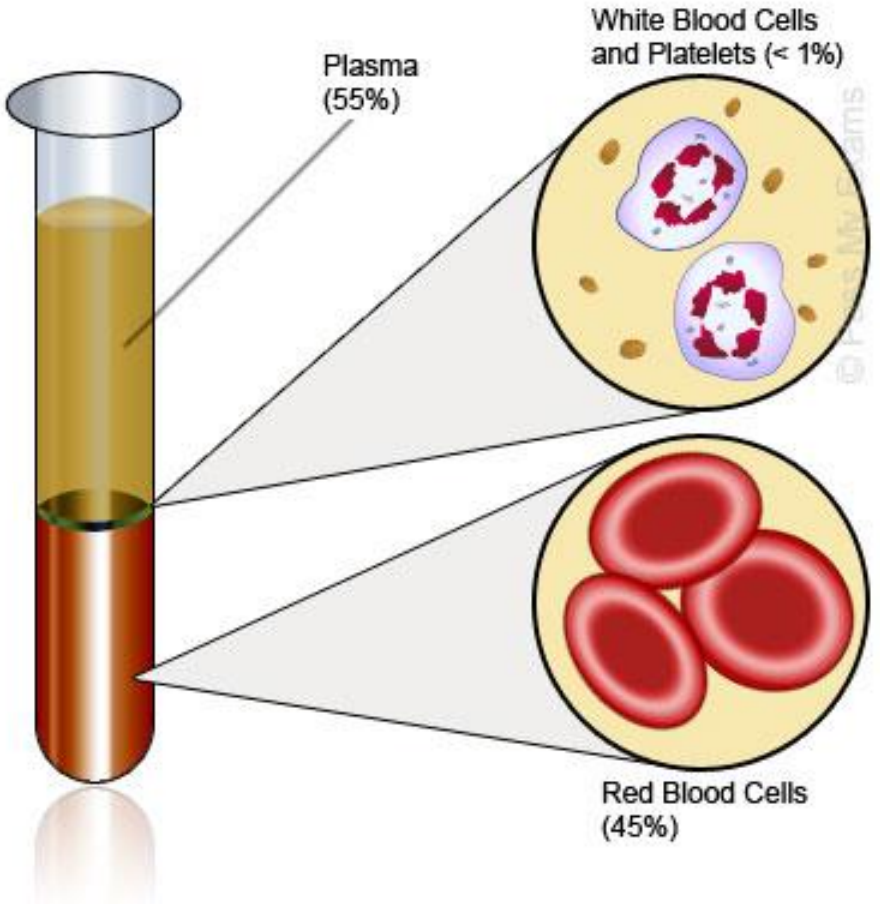
(4) Reticular Connective Tissue



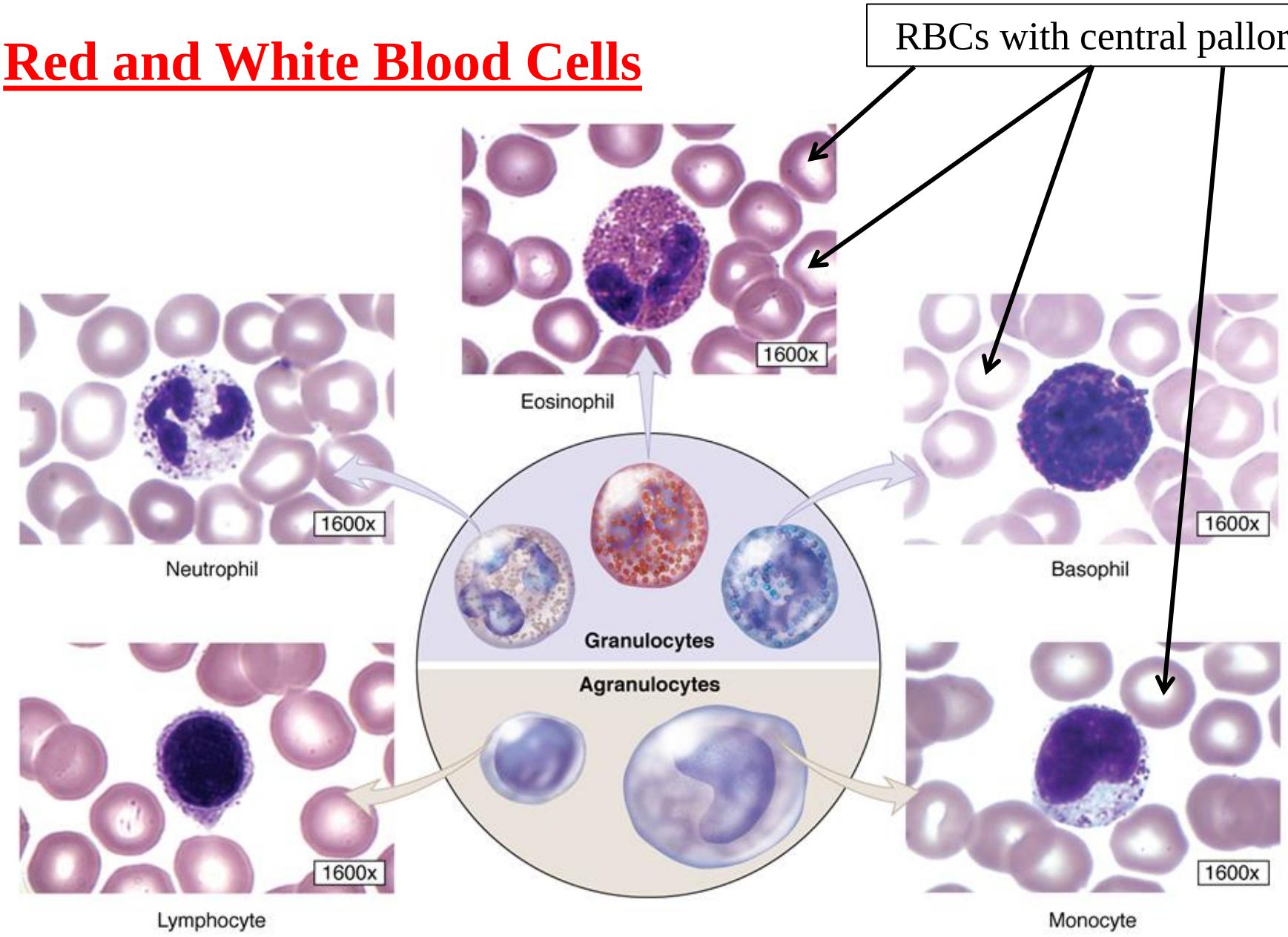
Reticular tissue in the lymph node. The reticular fibers (abundant in this tissue) require a special stain that gives them a black color. Note how the fibers form a network.

(5) Blood

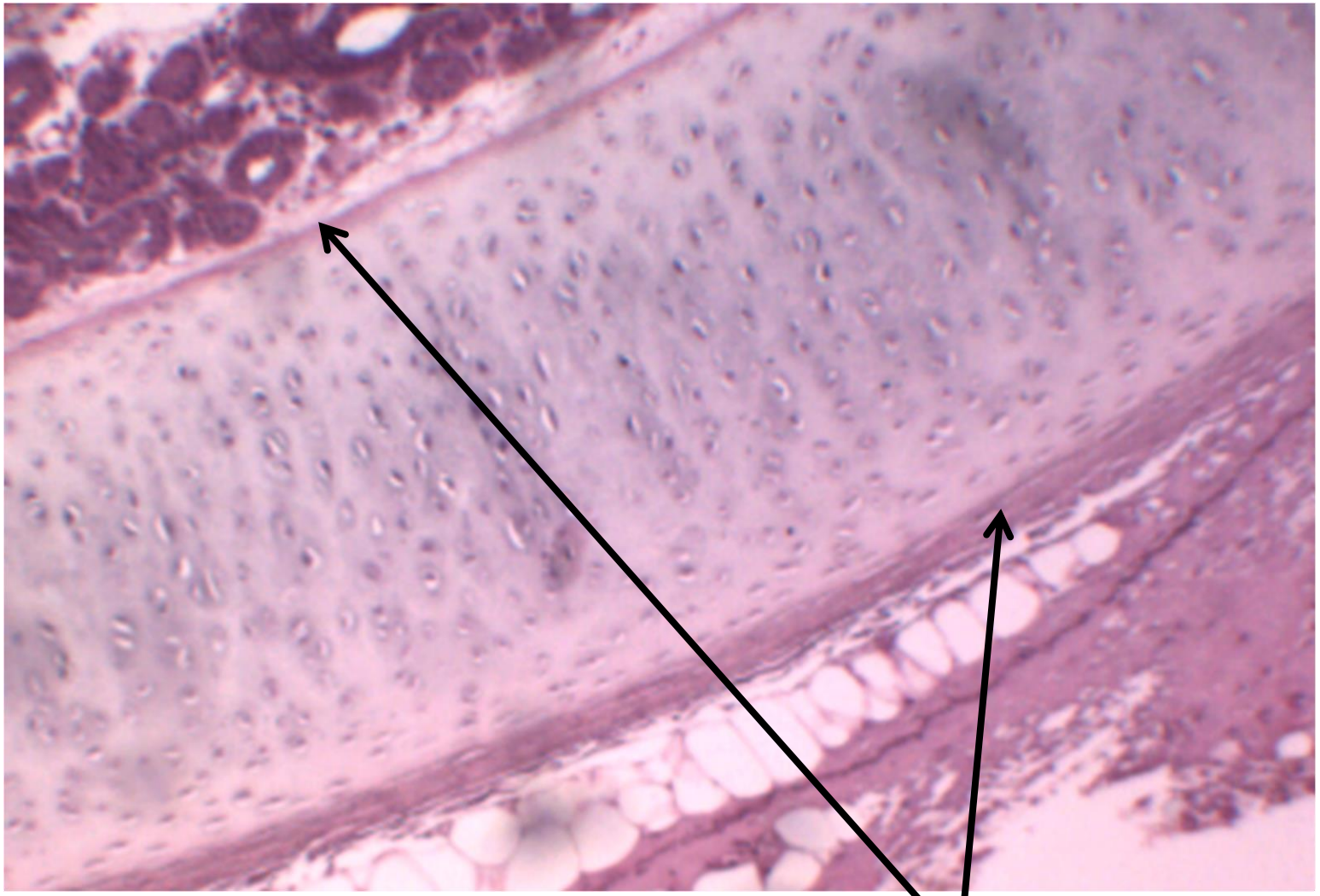
- Take a sample of blood
- Put it in a tube
- Put tube in centrifuge device
- Spin
- Blood components will be separated



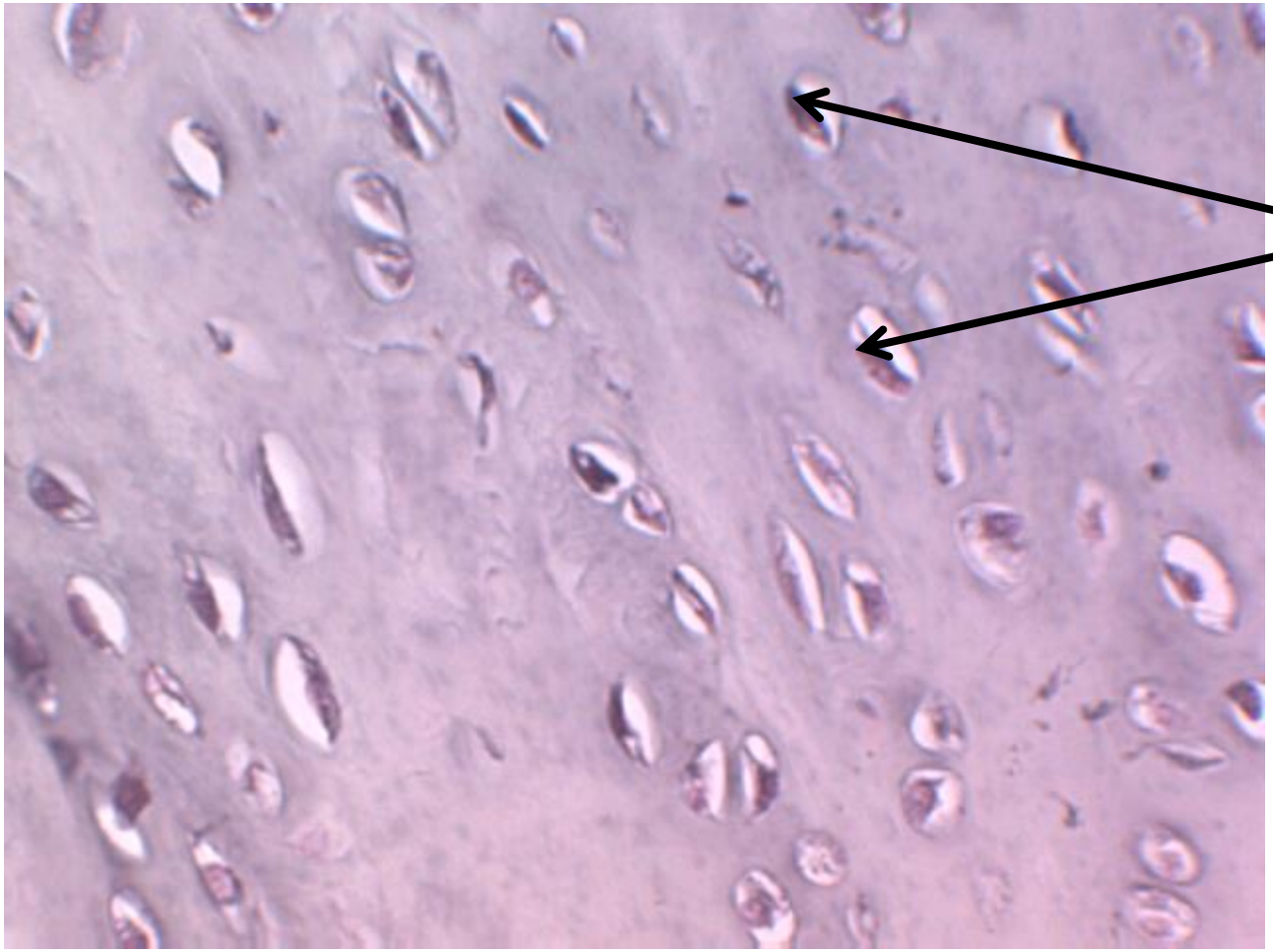
Red and White Blood Cells



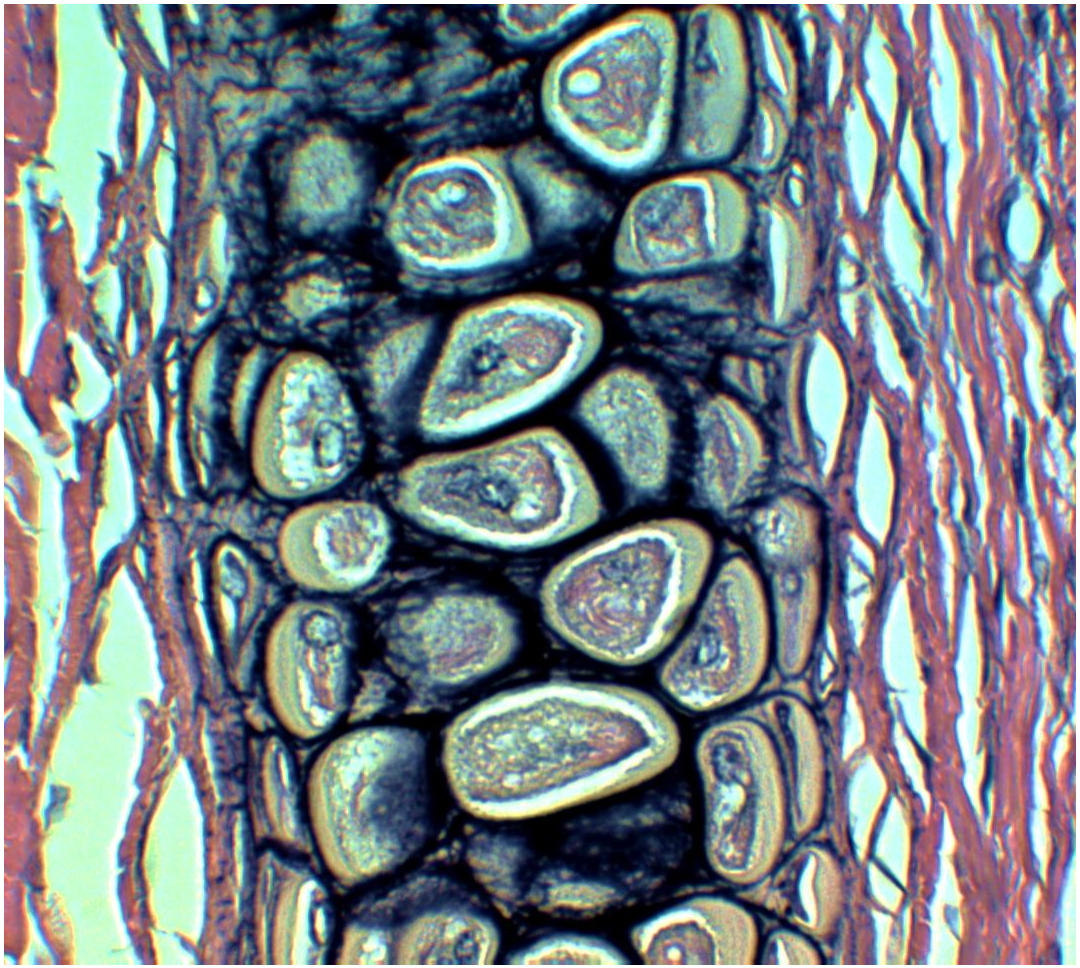
(6) Cartilage



Hyaline cartilage of the trachea. Note the perichondrium.

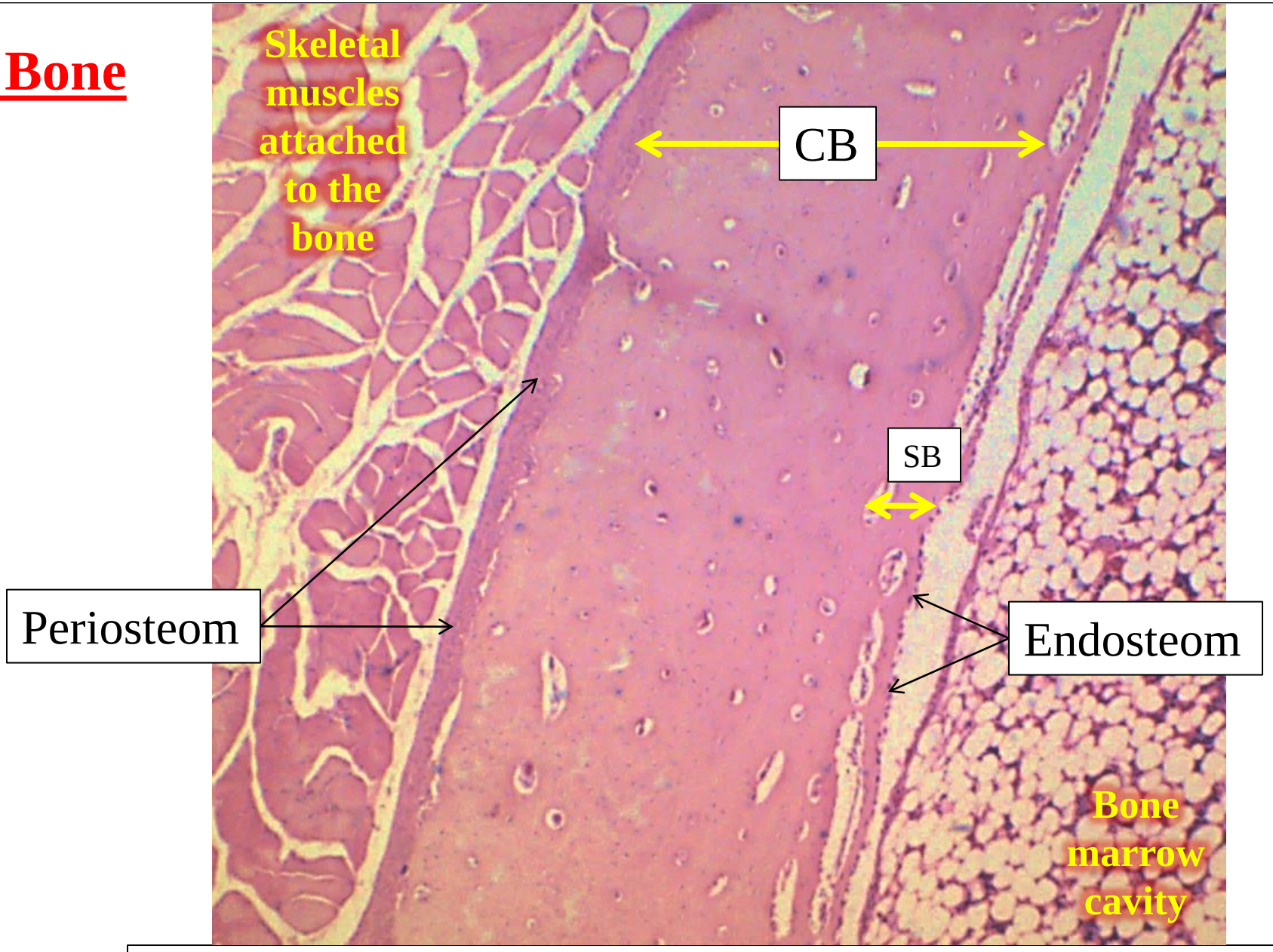


Hyaline cartilage of the trachea under higher magnification. Note the distinctive basophilic color of the matrix. Also note how the chondrocytes are located inside lacunae (the white spaces).

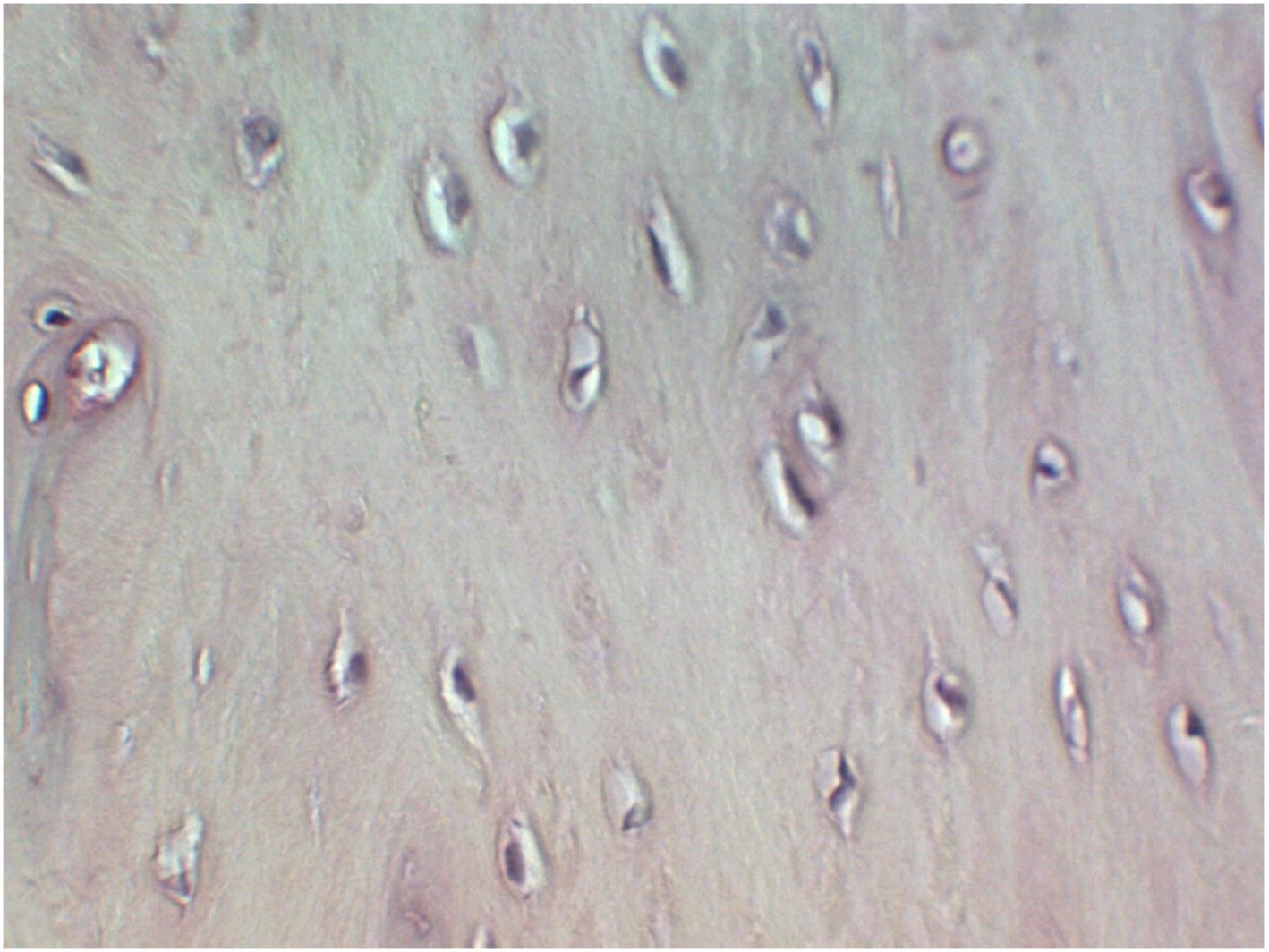


Elastic cartilage of the ear auricle. The dark color of the matrix is due to the abundance of elastic fibers. Also note how the chondrocytes are also located inside lacunae. The perichondrium is on each side.

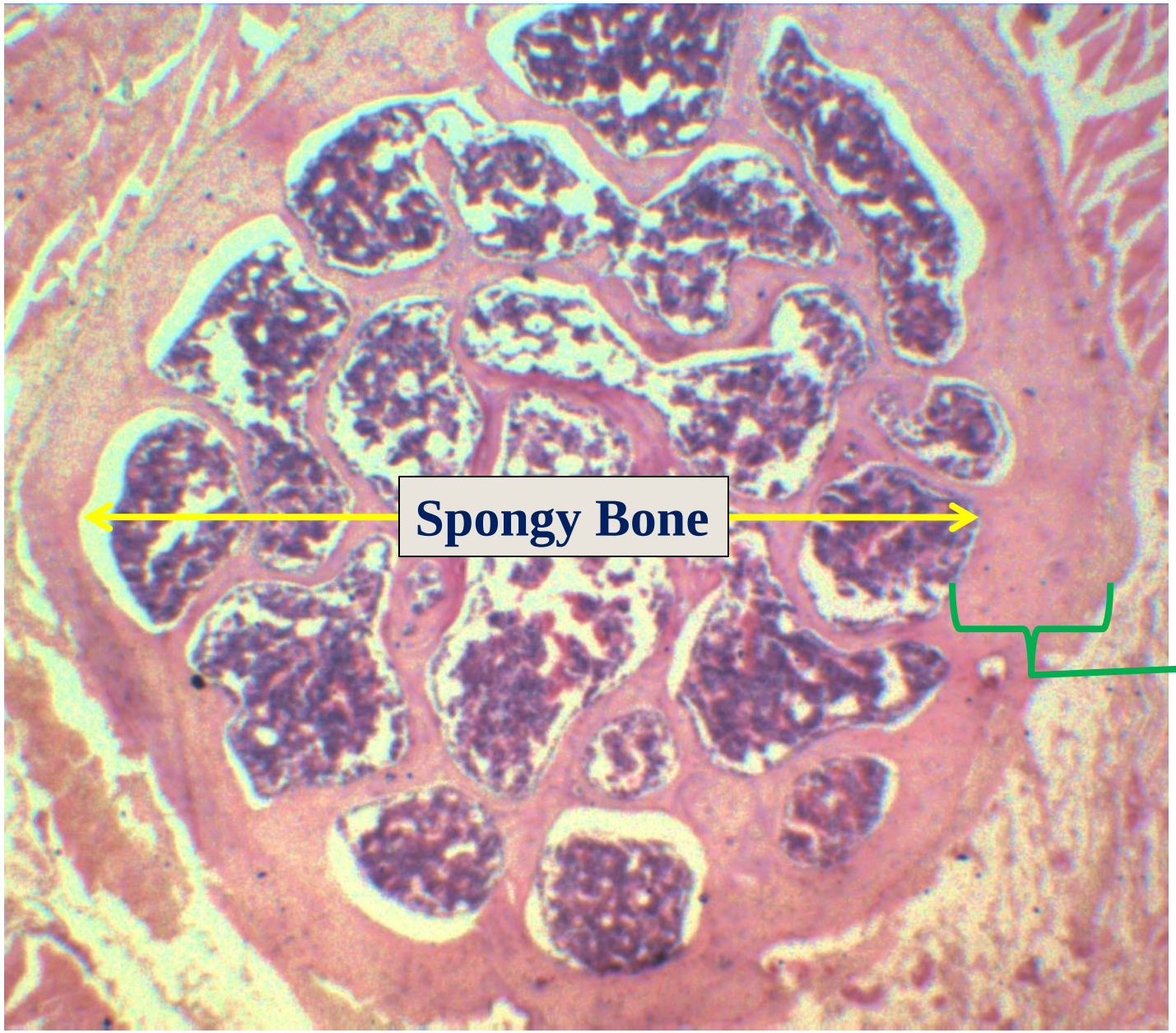
(7) Bone



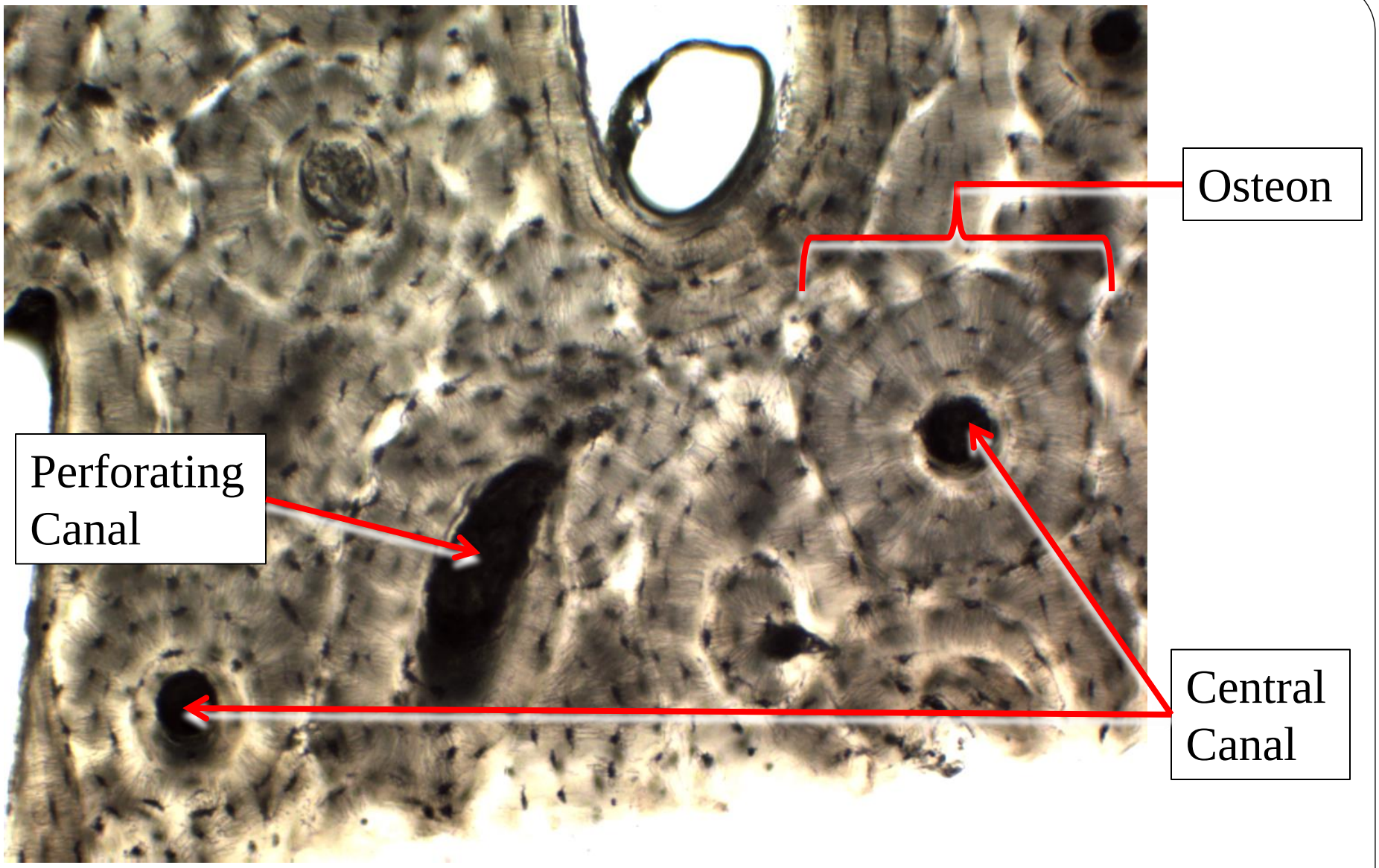
Cross Section through the diaphysis of a long bone. CB = compact bone. SB = Spongy bone.



Compact bone under higher magnification. Note how the osteocytes are located inside lacunae.



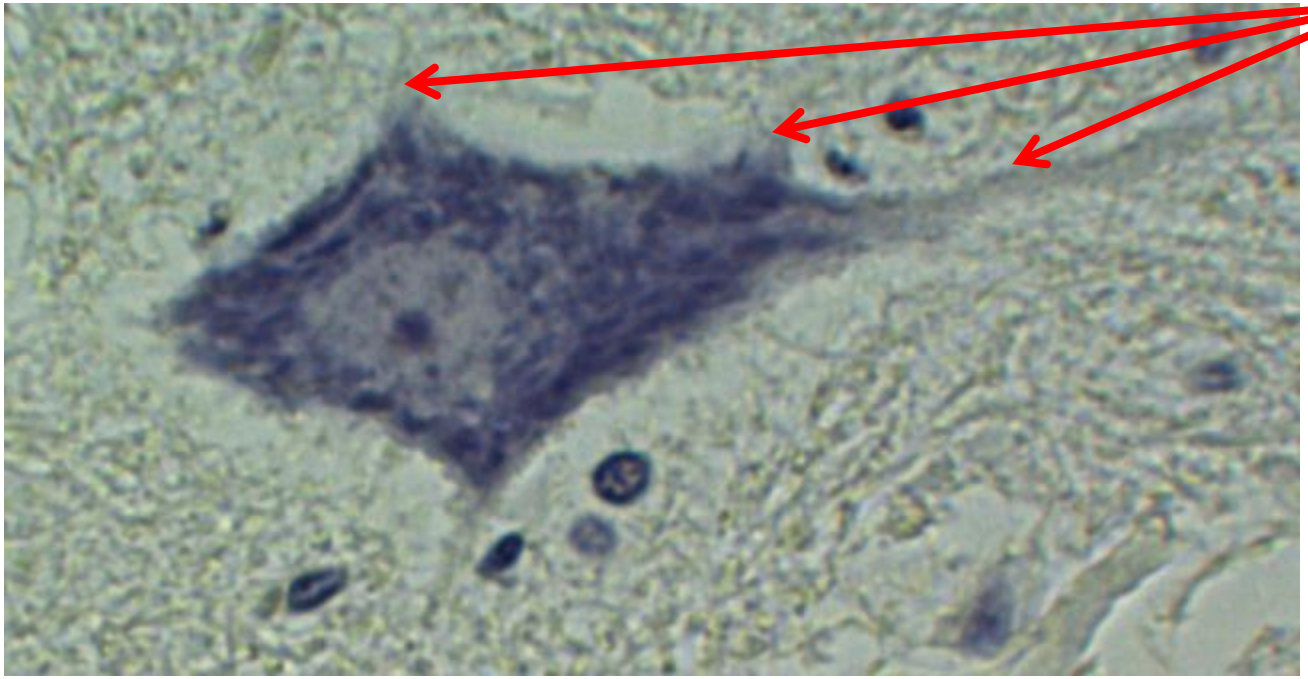
Section through a short bone.



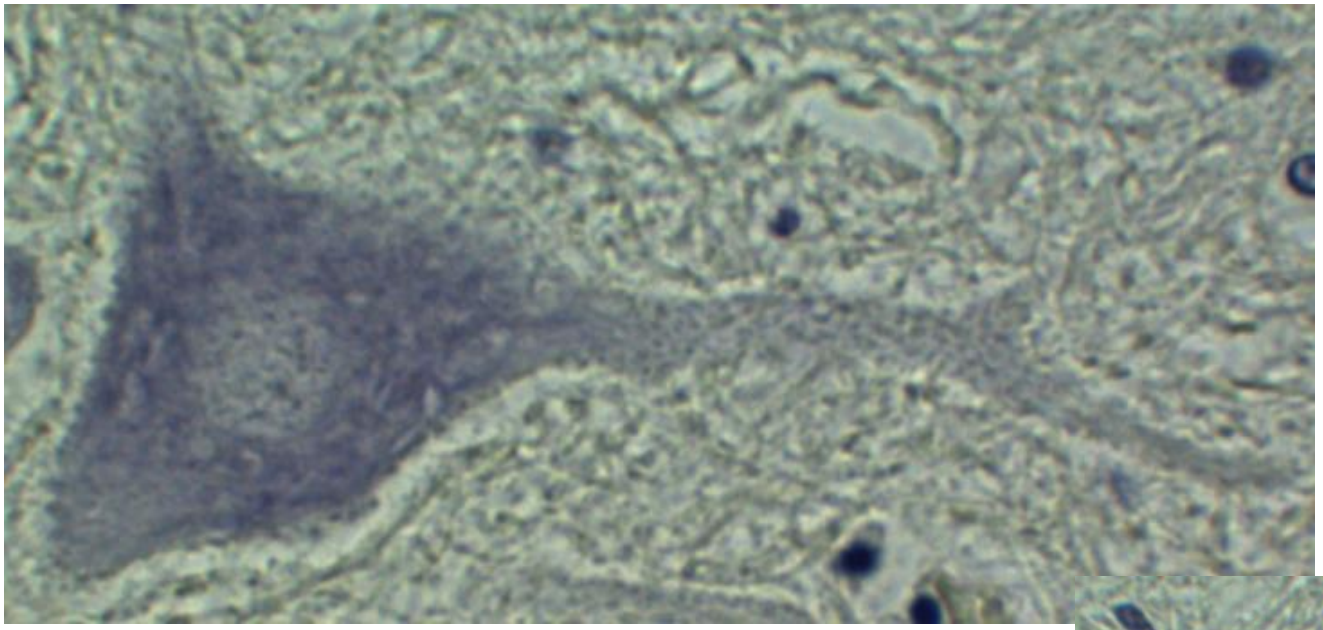
Ground bone. Note the arrangement of the lamellae and the lacunae.

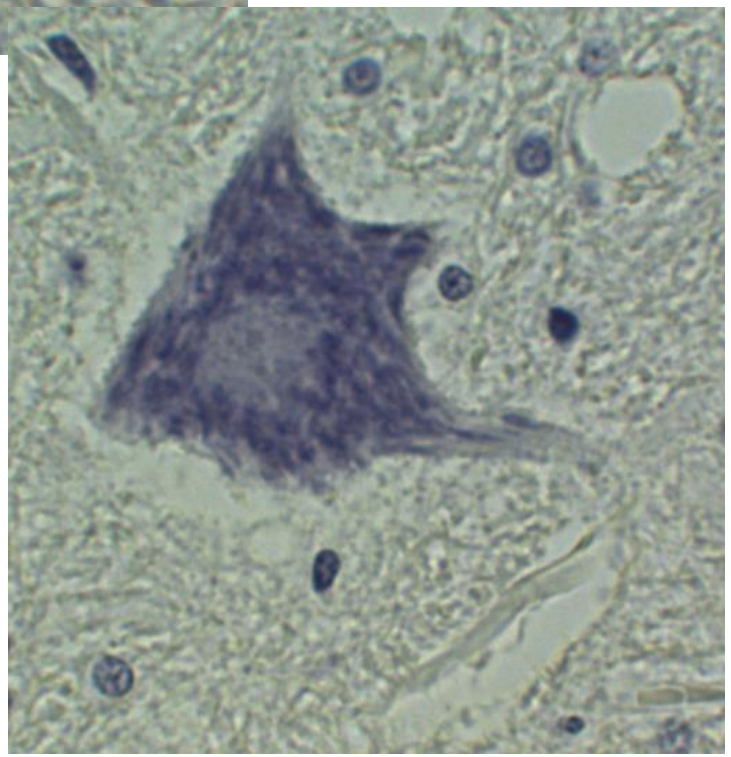
Part 3: Nervous Tissue

(1) Neurons



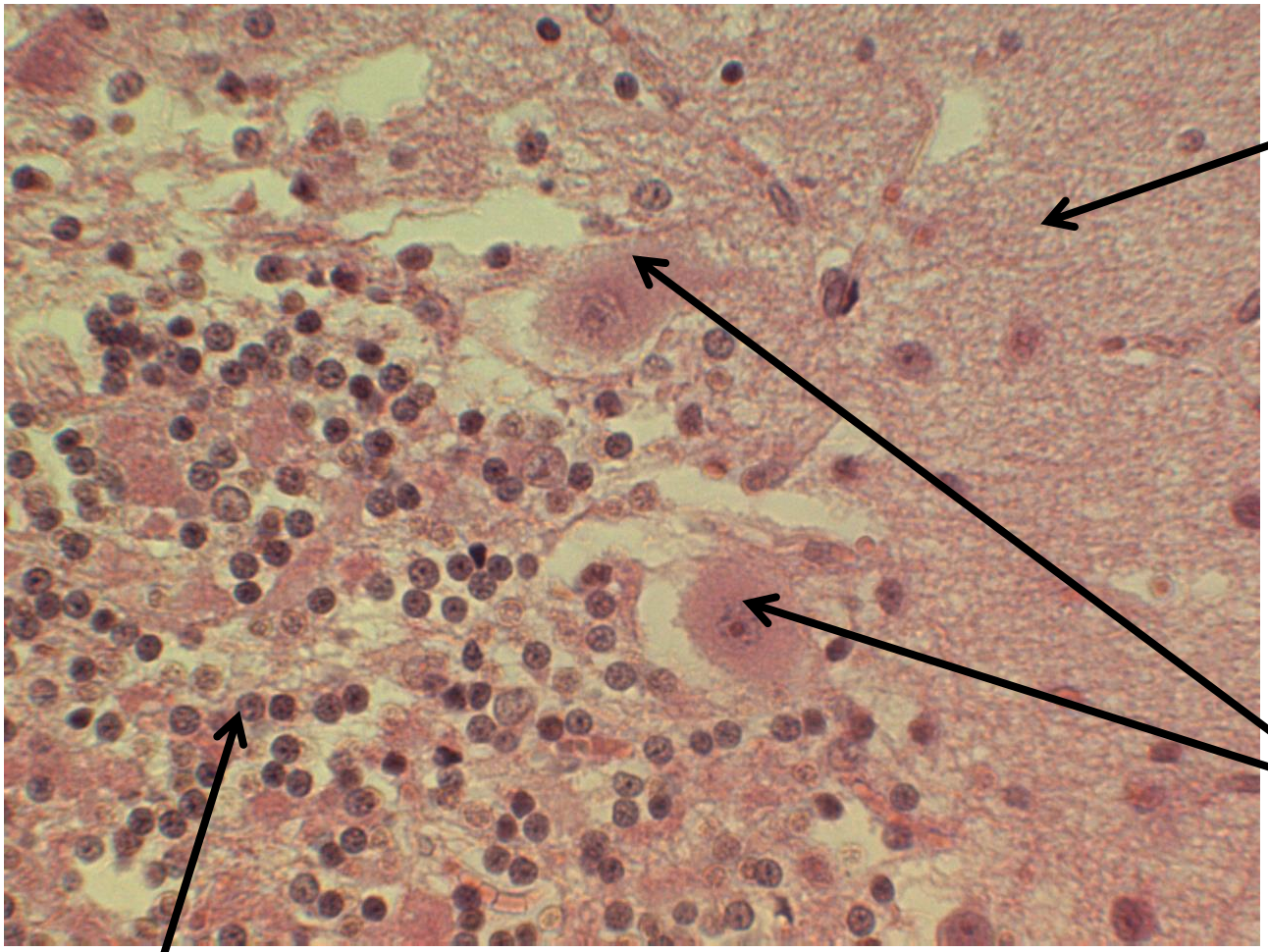
Anterior horn cell of the spinal cord. Note the typical features of neurons: basophilic cytoplasm, large spherical pale-staining nucleus with prominent nucleolus and cell processes.





Anterior horn cells of the spinal cord. Because these cells have at least three processes, they’re multipolar neurons.

(2) Cerebellar Cortex

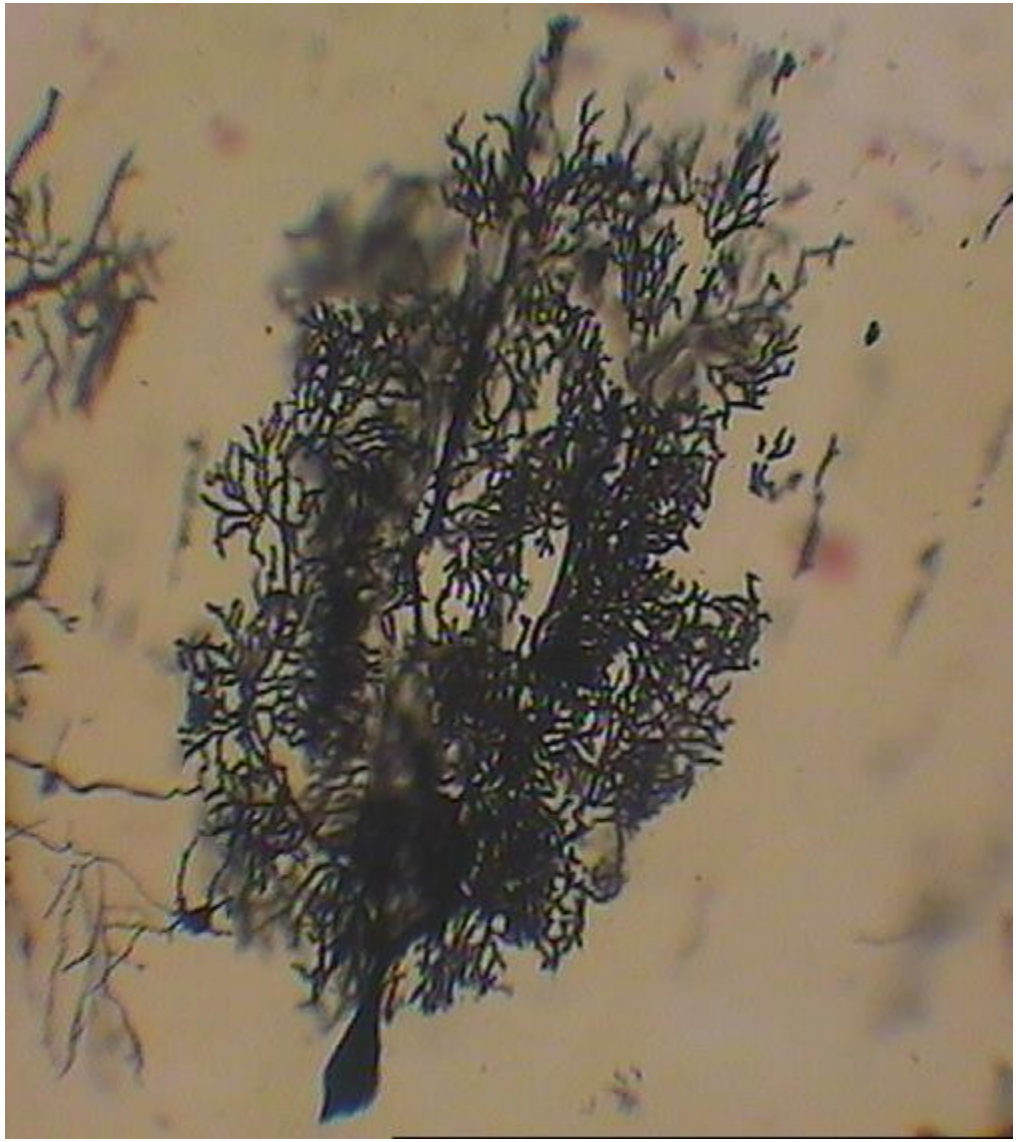


Molecular Layer

Cell bodies of Purkinje Cells

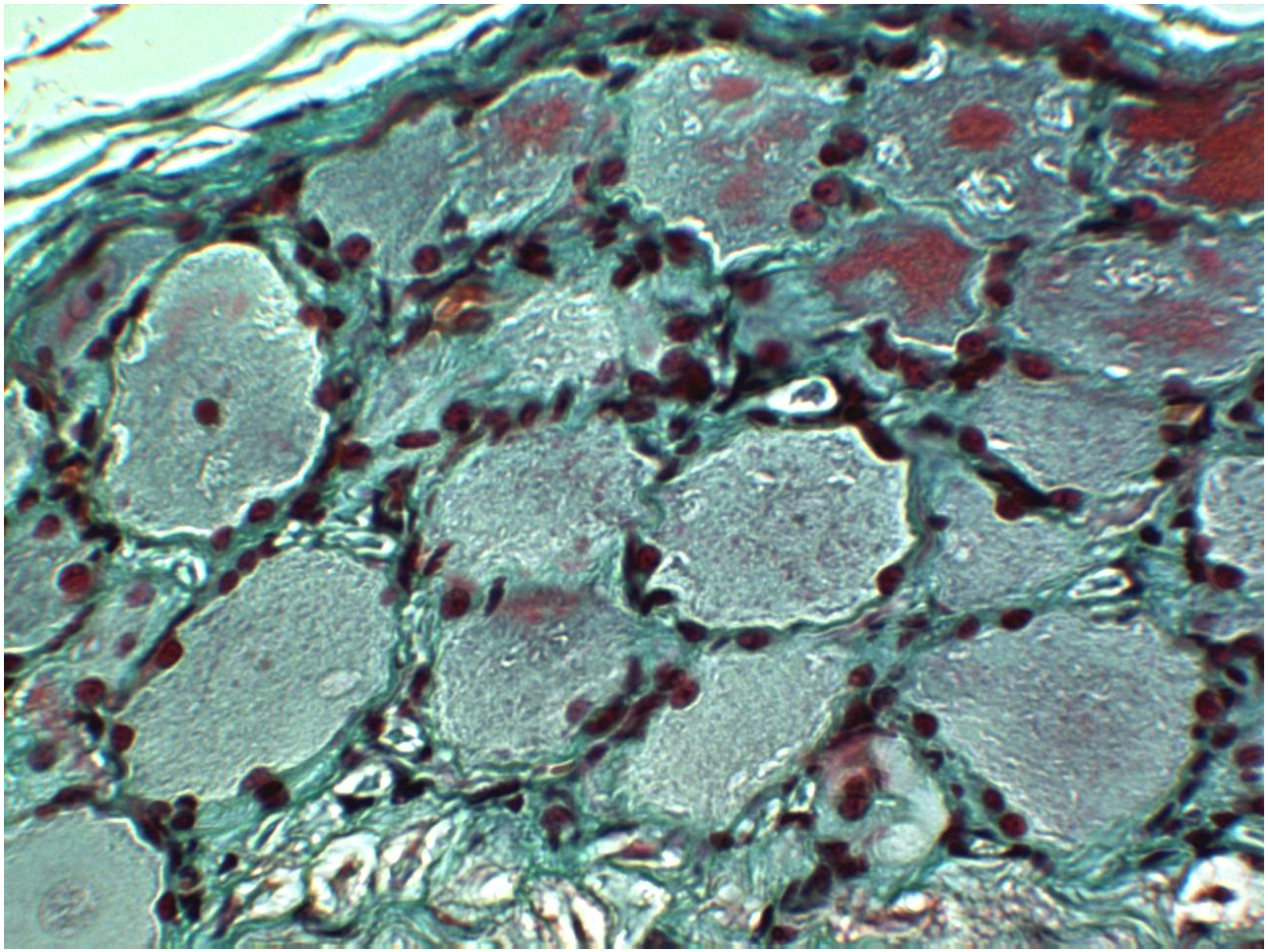
Granular Layer

Cerebellar Cortex



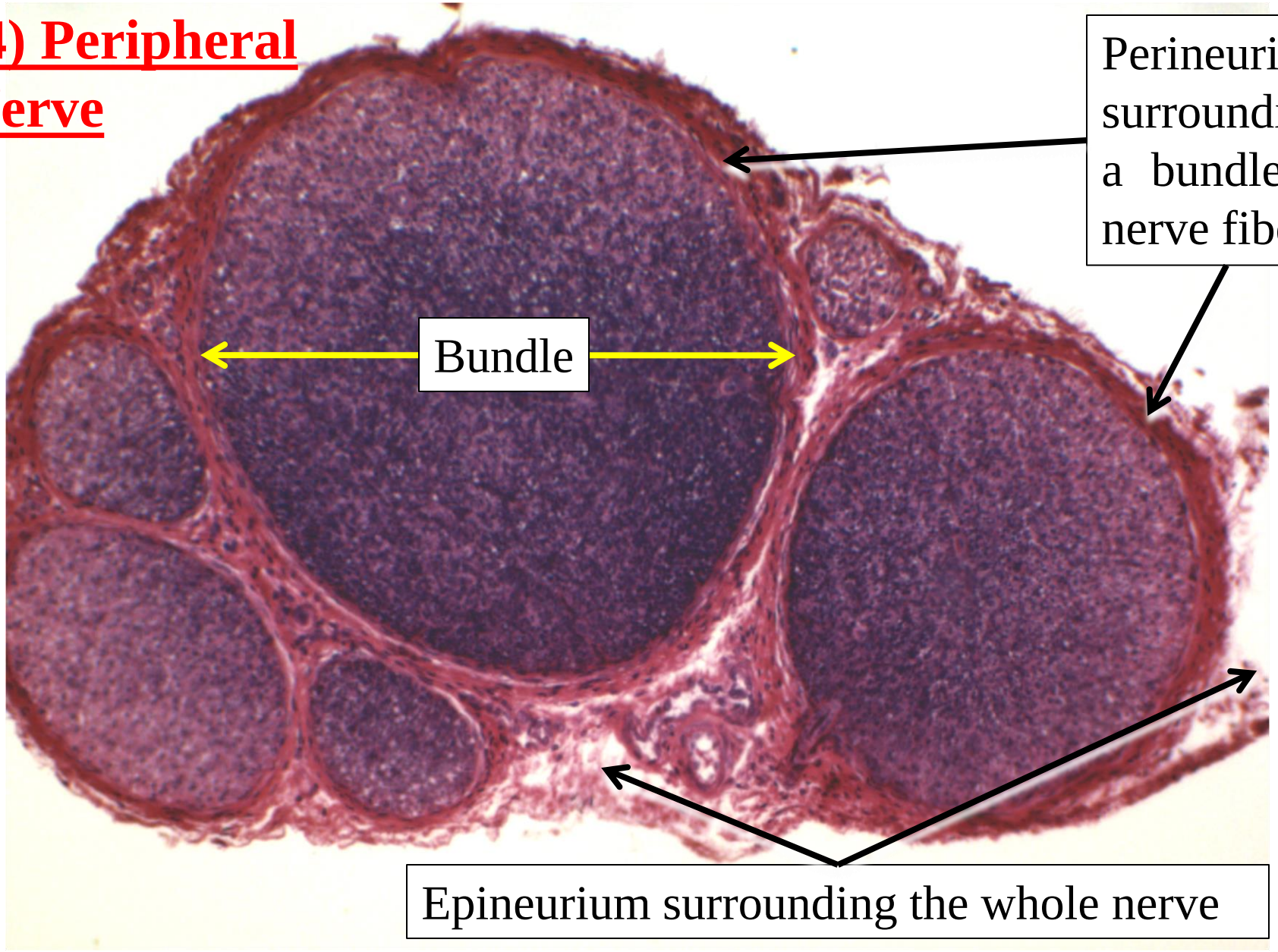
Purkinje cell of the cerebellar cortex stained with silver. Note the extensive branching of the dendrites. The downward projection is the axon.

(3) Spinal Ganglia

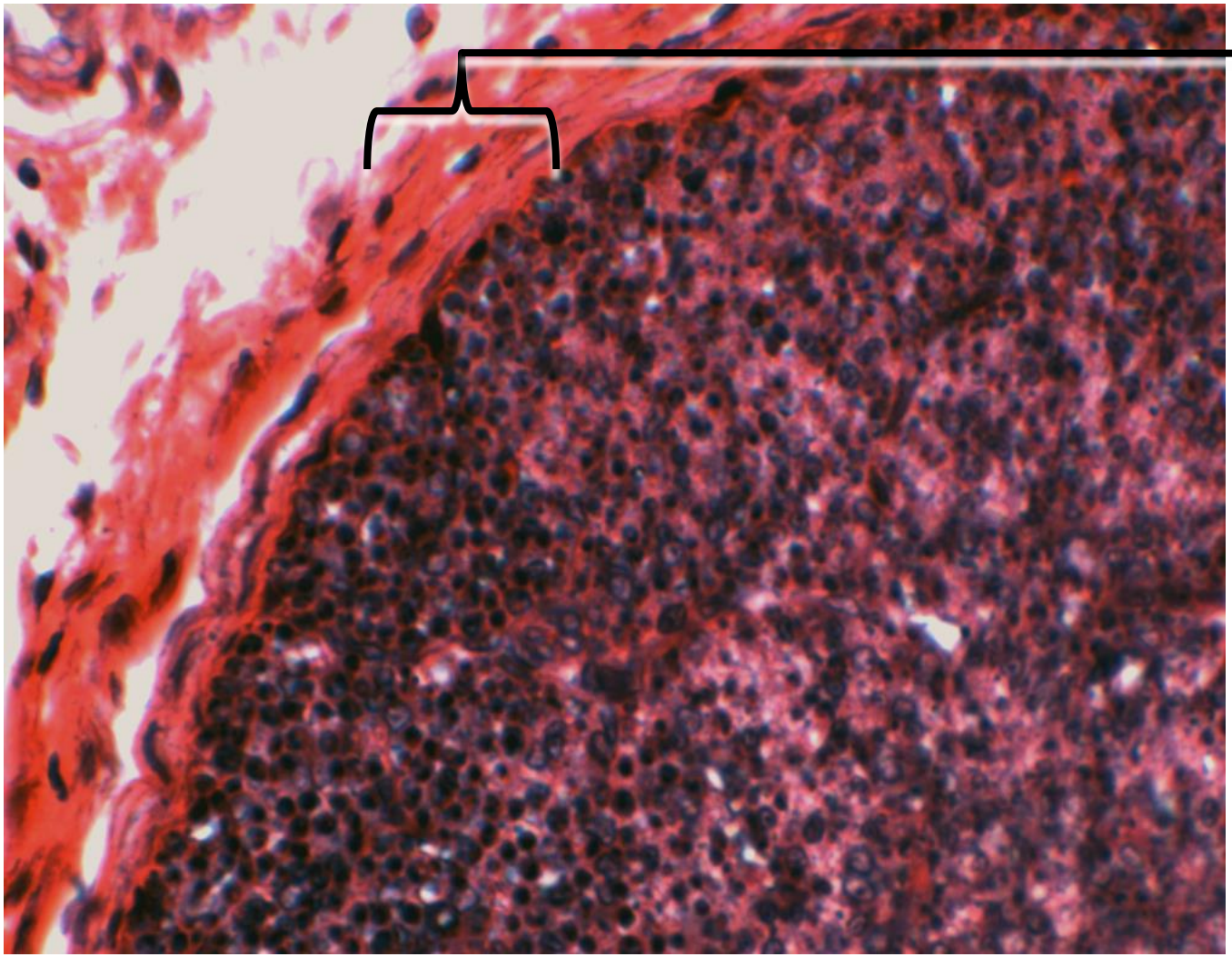


The larger structures are the cell bodies of the pseudounipolar neurons. The smaller dark circles around the neurons are the nuclei of the Satellite glia cells.

(4) Peripheral Nerve



Cross section through a peripheral nerve.

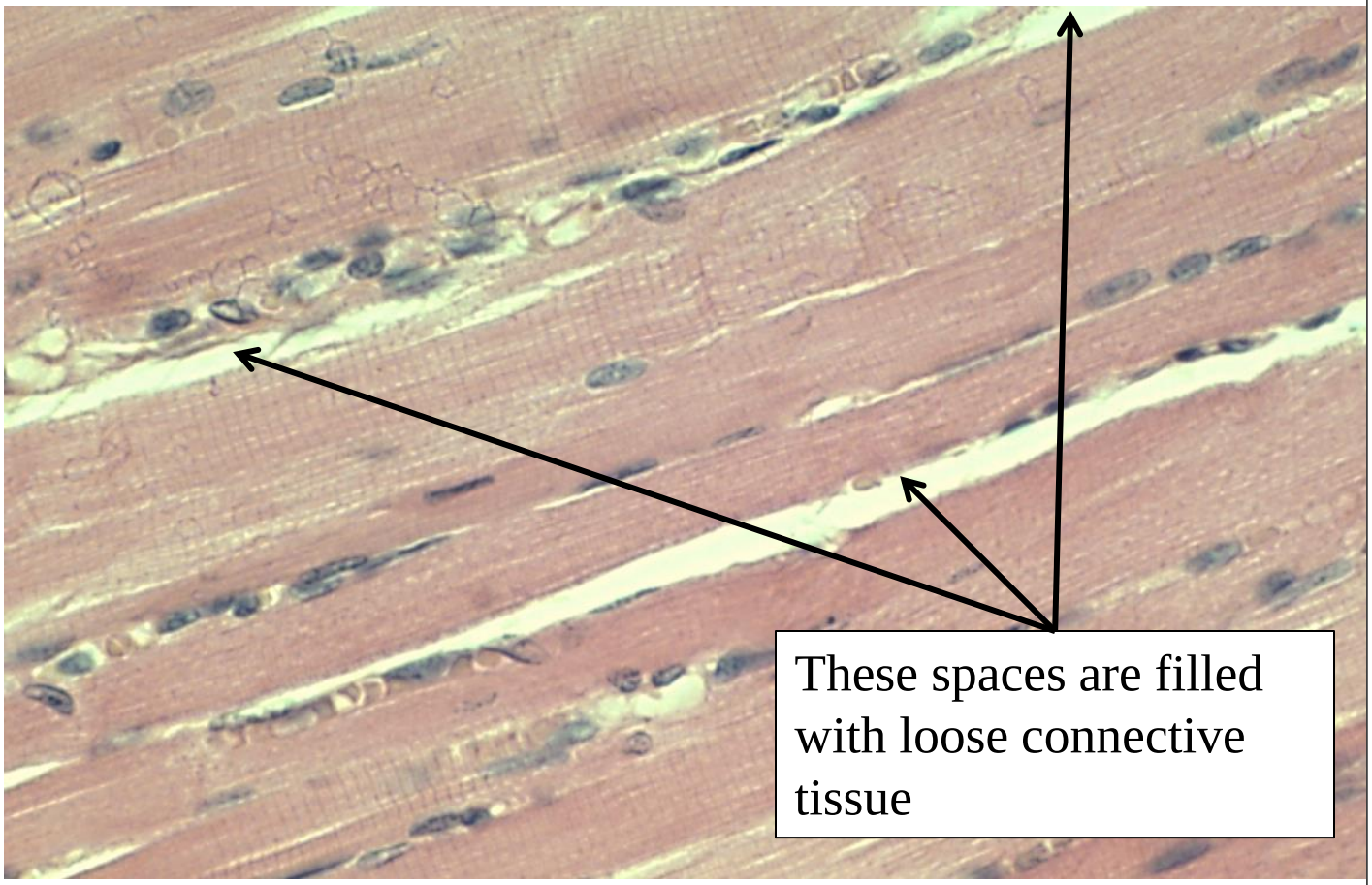


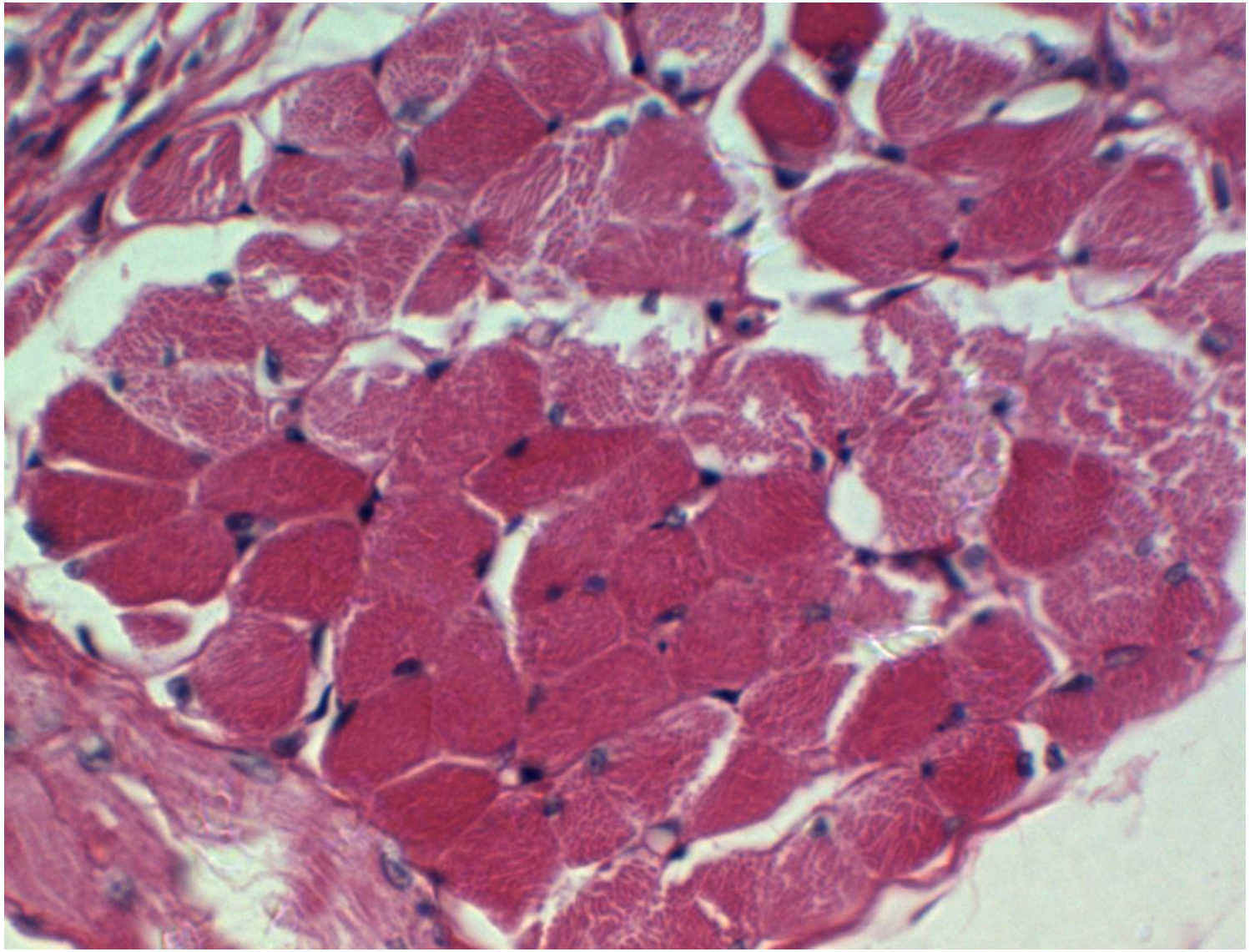
A magnified view of a bundle of nerve fibers. Each one of the small black dots is a single nerve fiber. Note the nuclei of cells in the perineurium.

Part 4: Muscular Tissue

(1) Skeletal Muscles

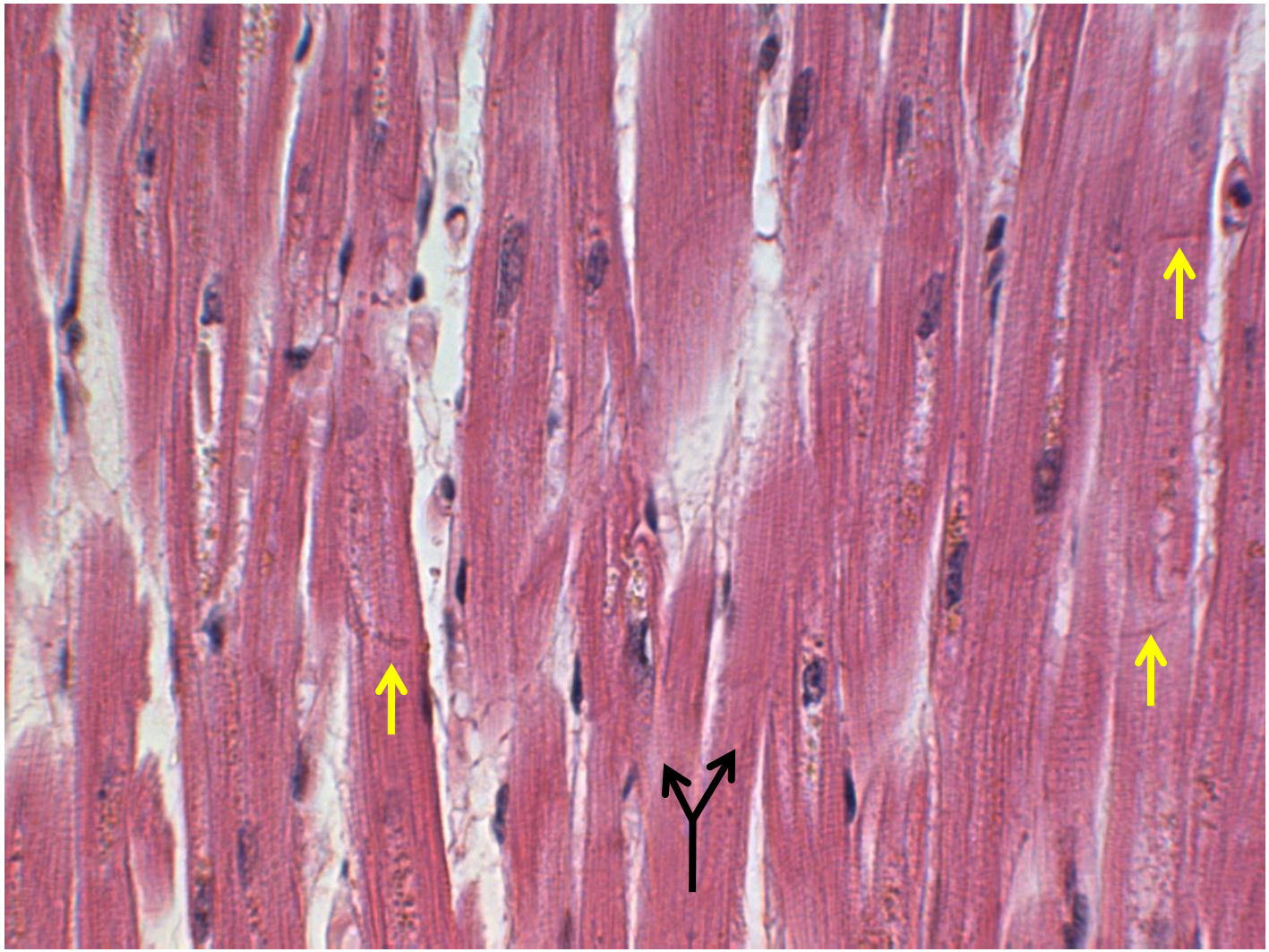
Longitudinal section through skeletal muscles. Note the striation and the peripheral location of the numerous nuclei.





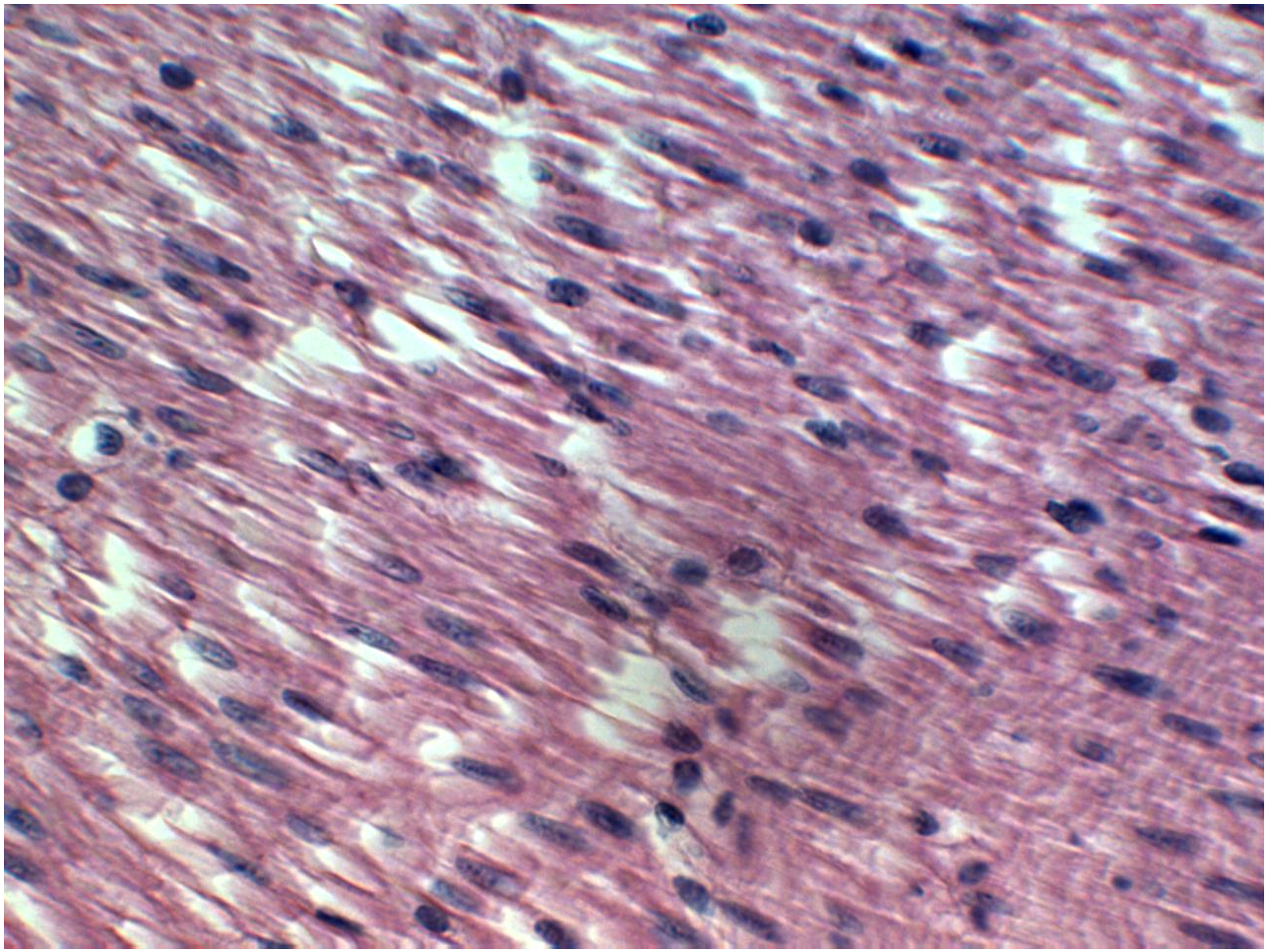
Cross section through skeletal muscle fibers. Note the peripheral location of the nuclei.

(2) Cardiac Muscles



Section through cardiac muscles. Note the striation, the central location of nuclei, the branching of the cell and the intercalated disc (yellow arrows).

(3) Smooth Muscles



Section through smooth muscles. Note the lack of striation. The large number of nuclei in the section is because the cells are small.

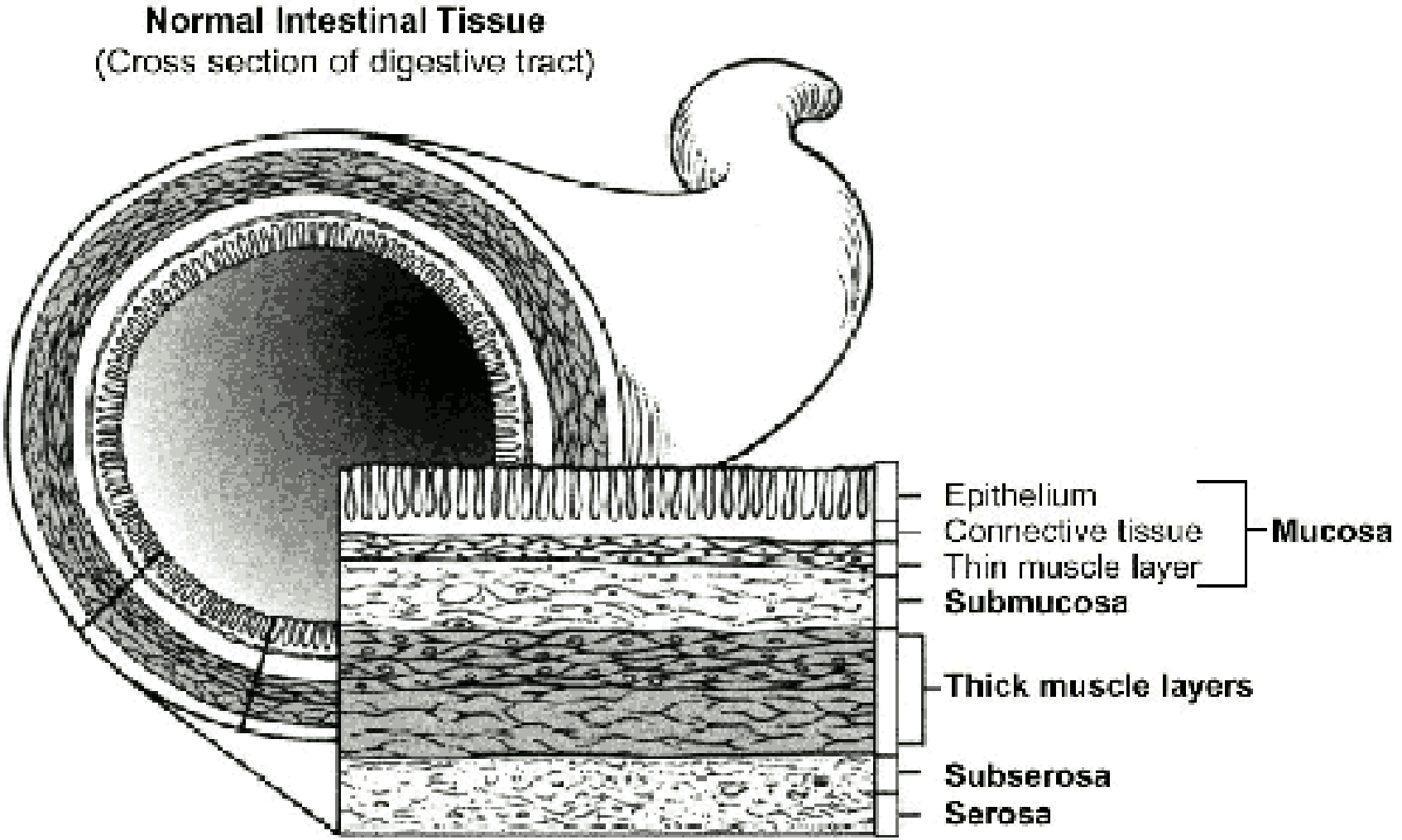
Important Final Notes

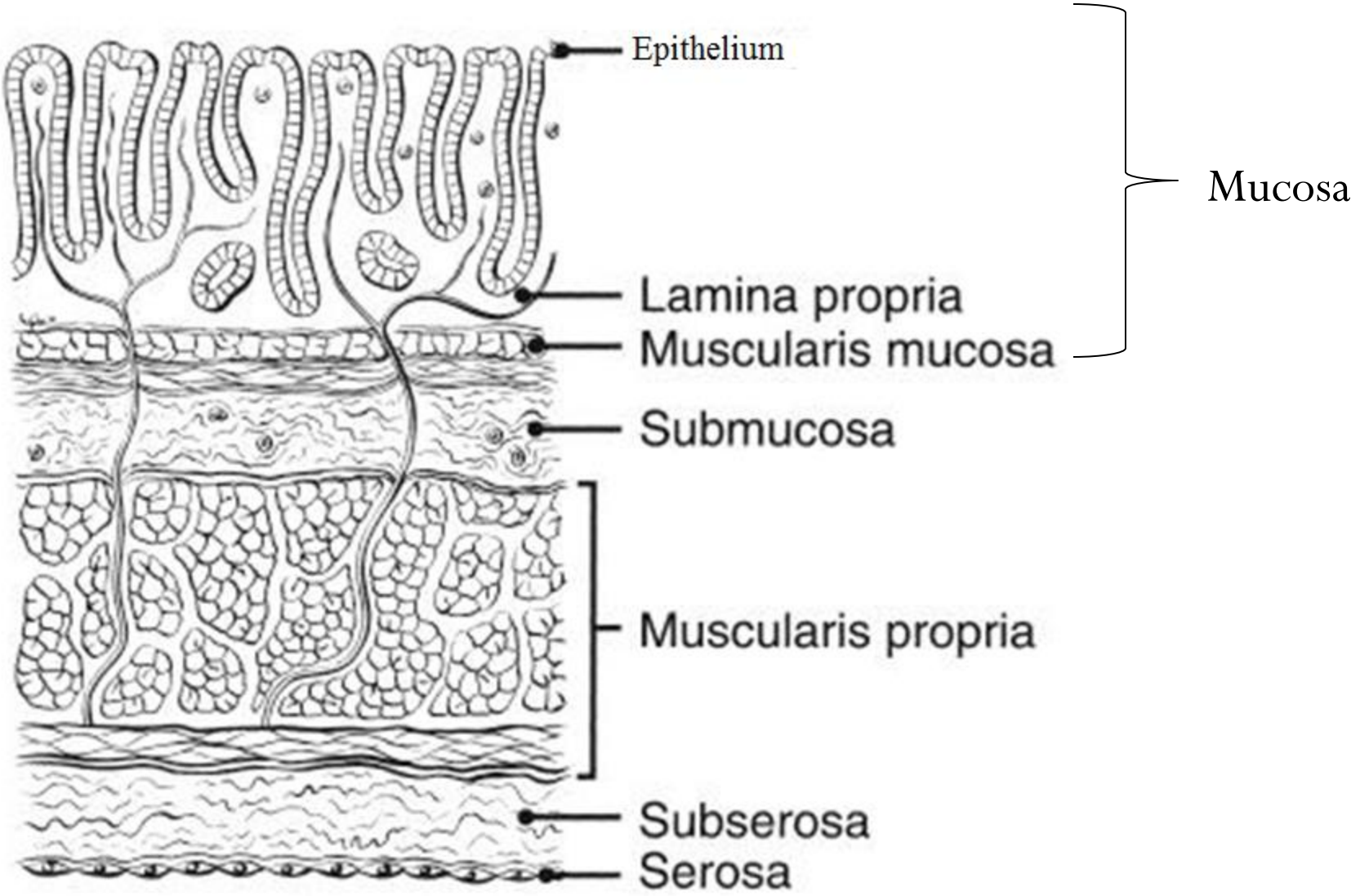
1. It's advisable to study images of microscopic slides from other sources (textbooks, atlases, internet, etc…).

2. Test yourself by using other images to see if you can recognize the tissue.

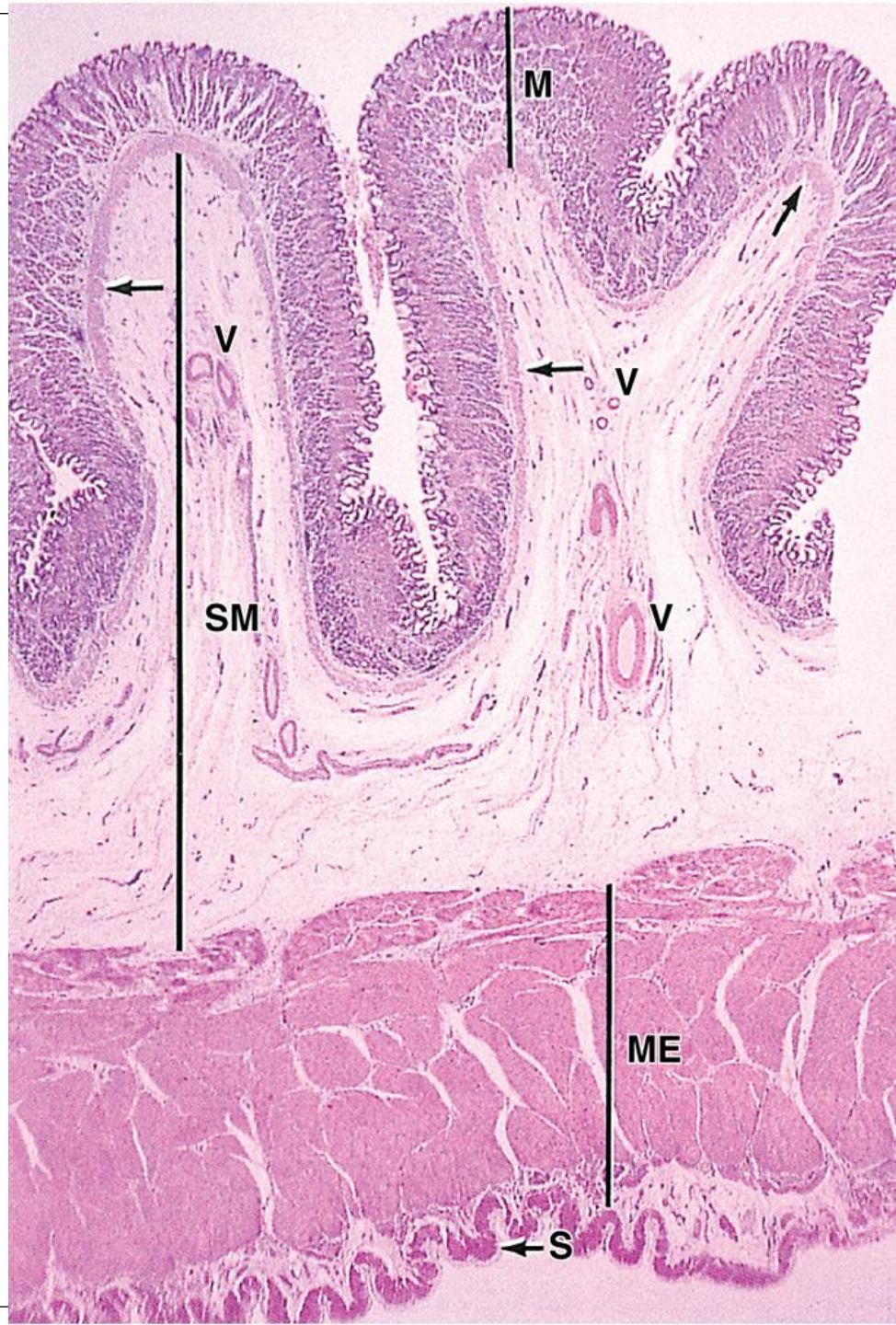
- ***Remember:***
  - ***Classification of exocrine glands according to morphology of duct and secretory portion and the various parts of the sarcomere are also included in the practical exam.***

Typical Structure of Hollow Organs

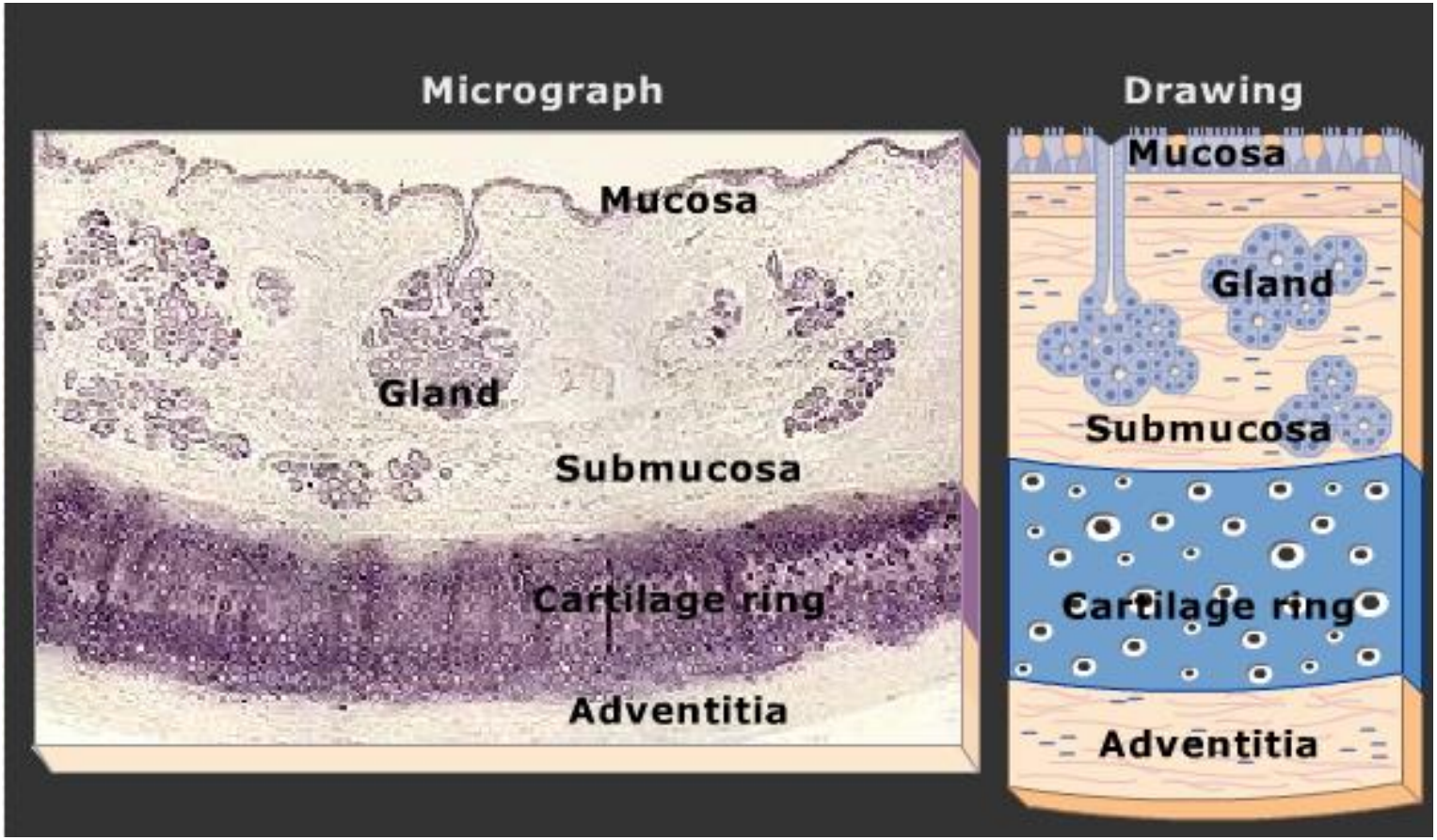



Epithelium
Lamina propria
Muscularis mucosa
Submucosa
Muscularis propria
Subserosa
Serosa
Mucosa

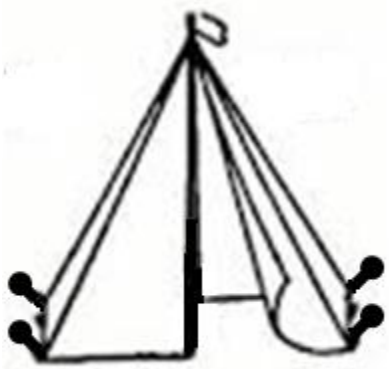
Stomach Wall



Tracheal Wall



The End
Thank You
And
Good Luck



A tent can be raised by a single pole; however, it must be firmly fixed to the ground by four pegs or else it would be blown away.