

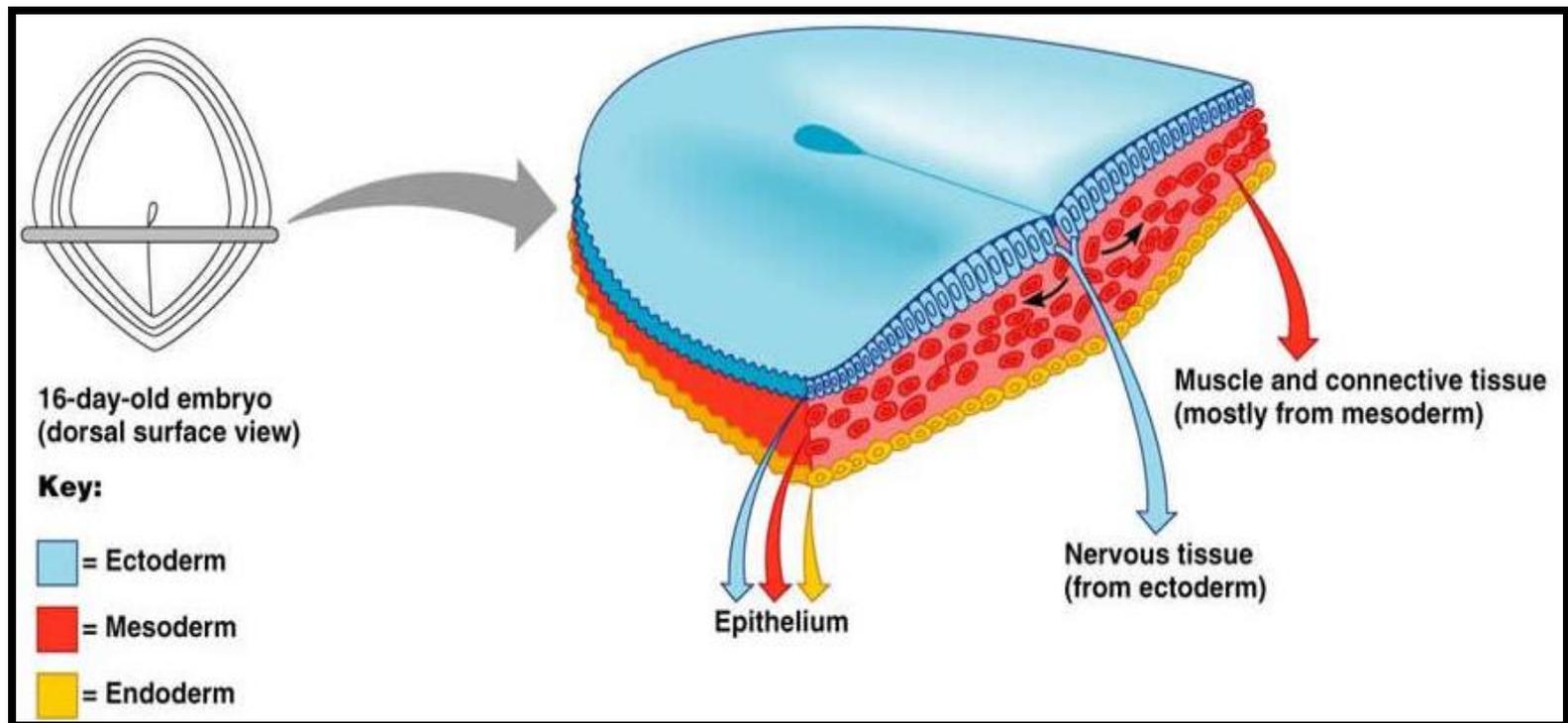
# Epithelium

النسيج الظلاني (الظهاري)



# Features of Epithelium

- Epithelium occurs in the body as a sheet of cells that covers a body surface, lines a cavity, or forms a gland.
- *Coverings, linings, glands.*
- Derived from any embryonic layer.



# Special Characteristics of Epithelium

- Composed of closely packed cells with little extracellular material between.
- Adjacent epithelial cells are bound together by specialized contacts such as desmosomes and tight junctions.
- Exhibits polarity by having an apical surface (free) and a basal surface (attached).
- Supported by the underlying connective tissue.
- **Innervated** (has nerves) but **avascular** (no blood vessels) ; blood supply is in supporting connective tissue.
- Has a high regeneration capacity.

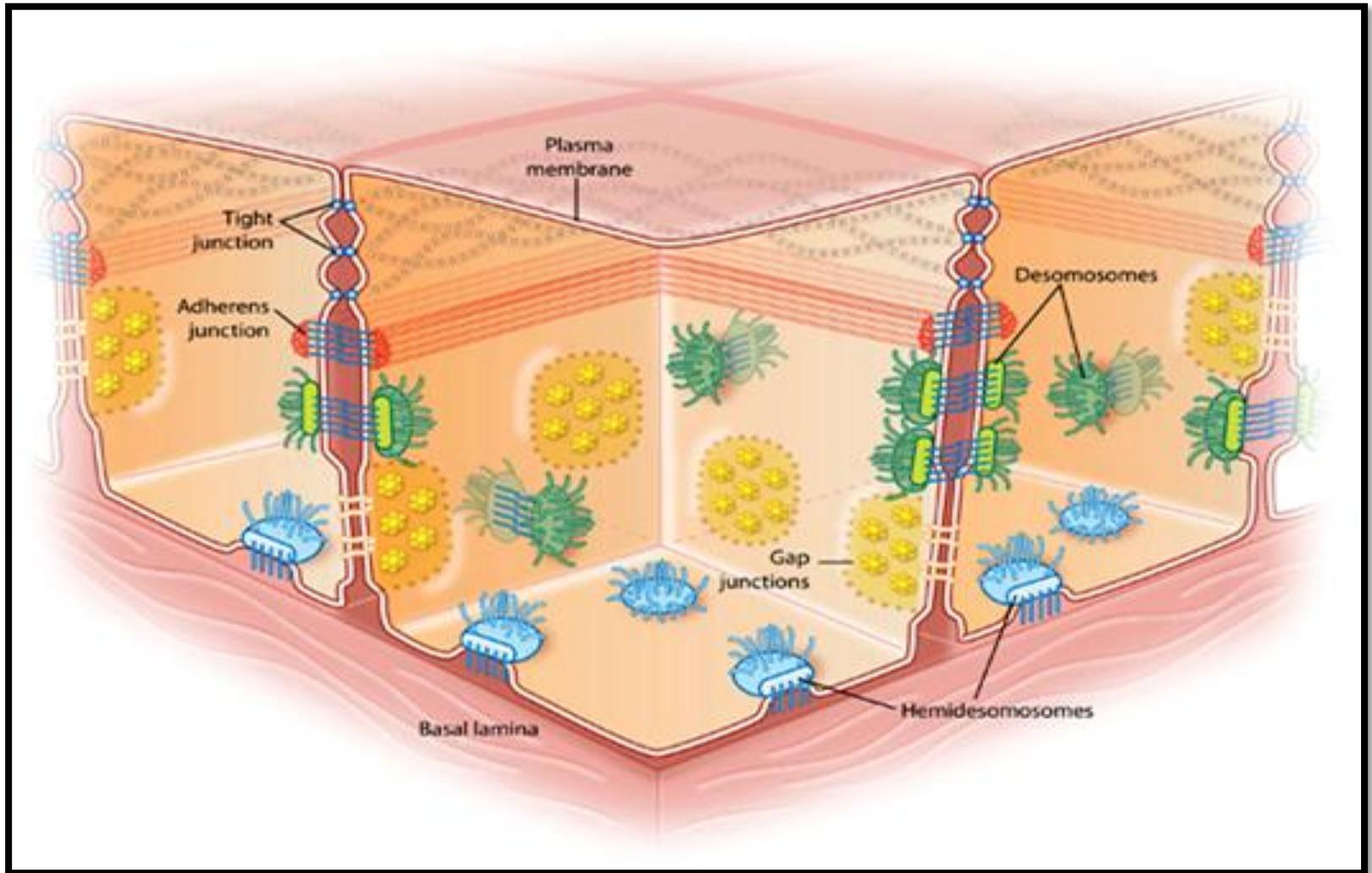
# Functions of Epithelium

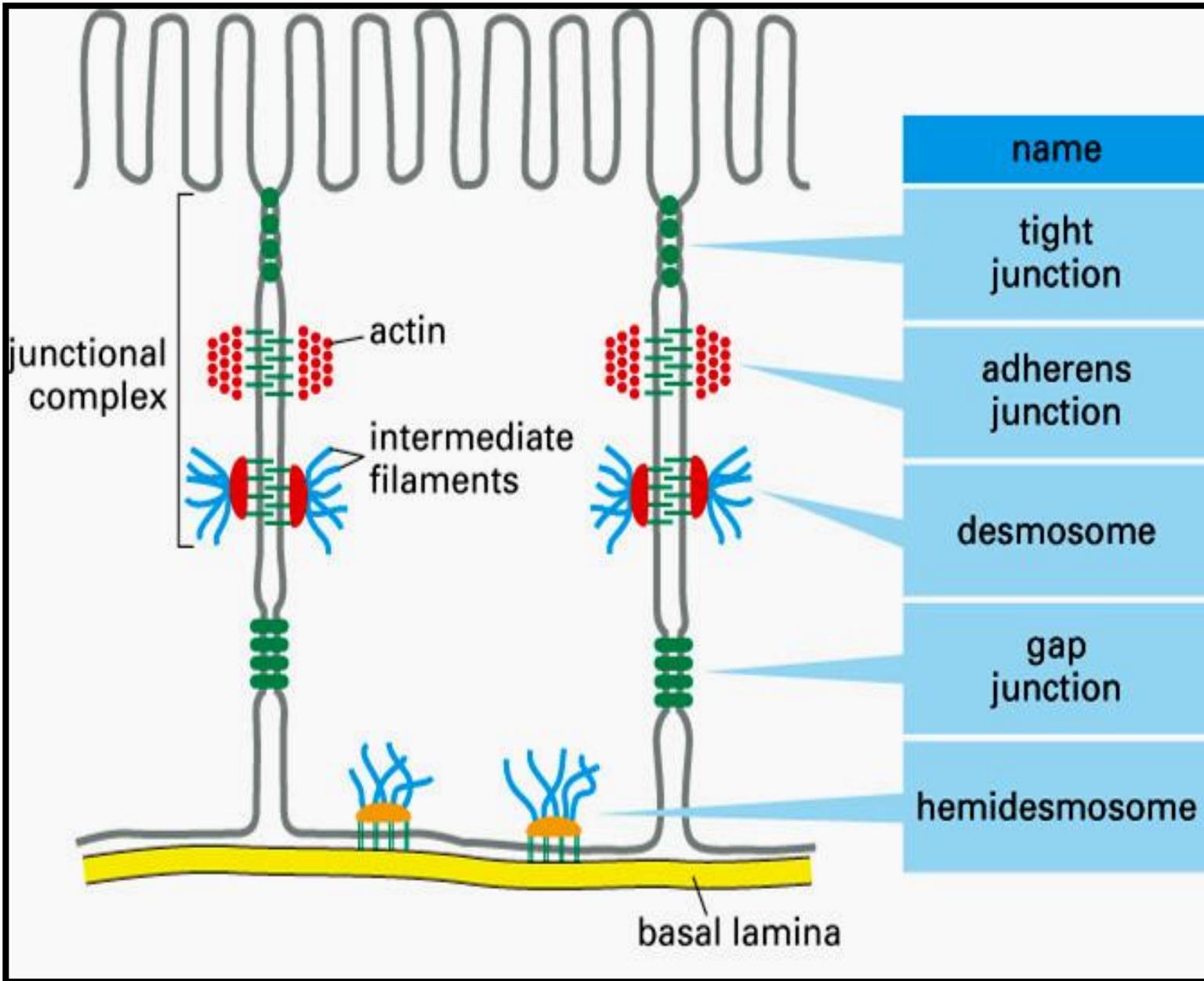
- ✓ Protection
- ✓ Transcellular transport
- ✓ Secretion
- ✓ Absorption
- ✓ Selective permeability
- ✓ Detection of sensations

!! Remember

Every thing that enters or leaves the body must cross an epithelial sheet.

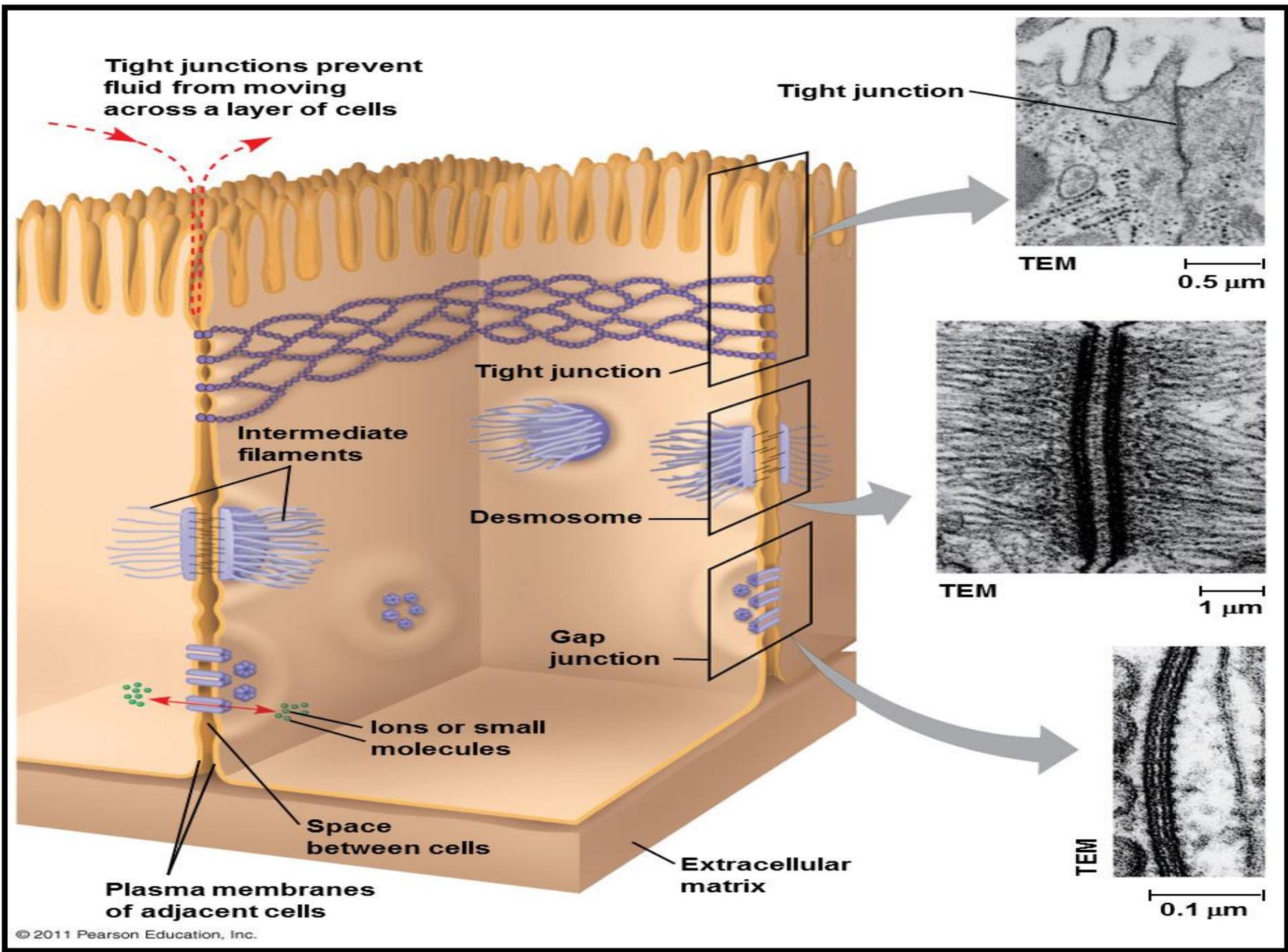
# Intercellular Junctions



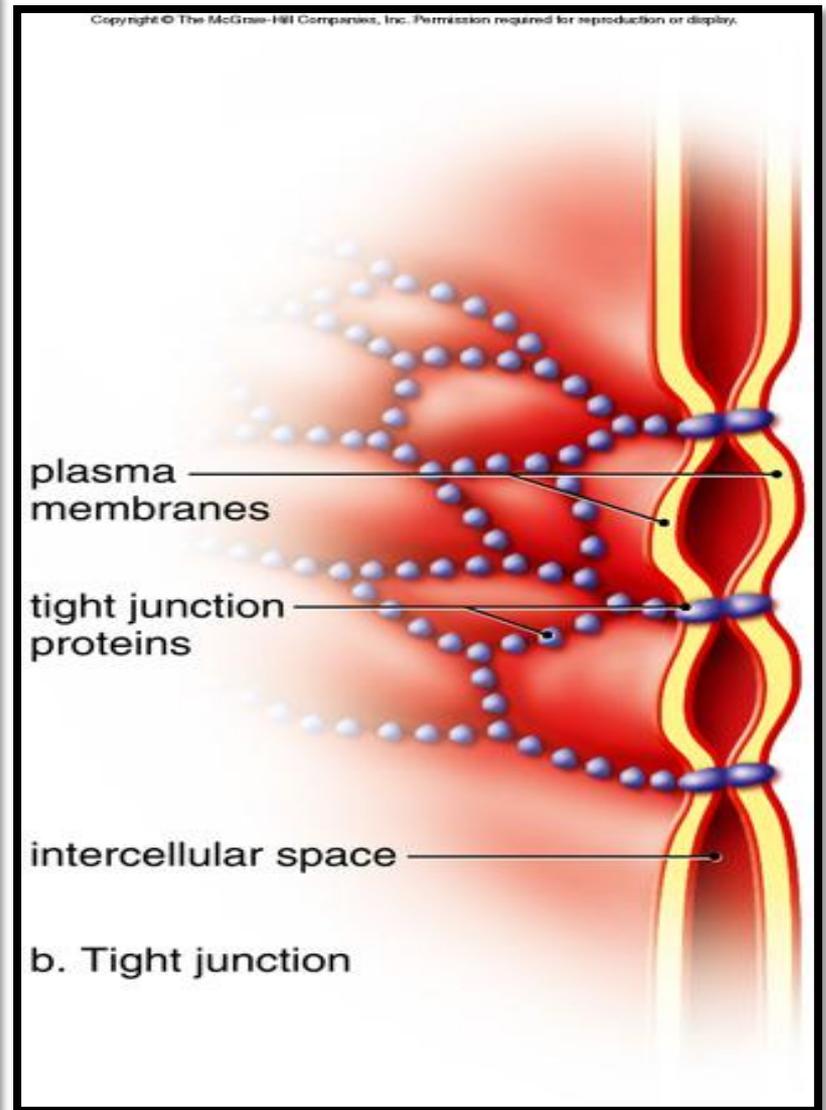
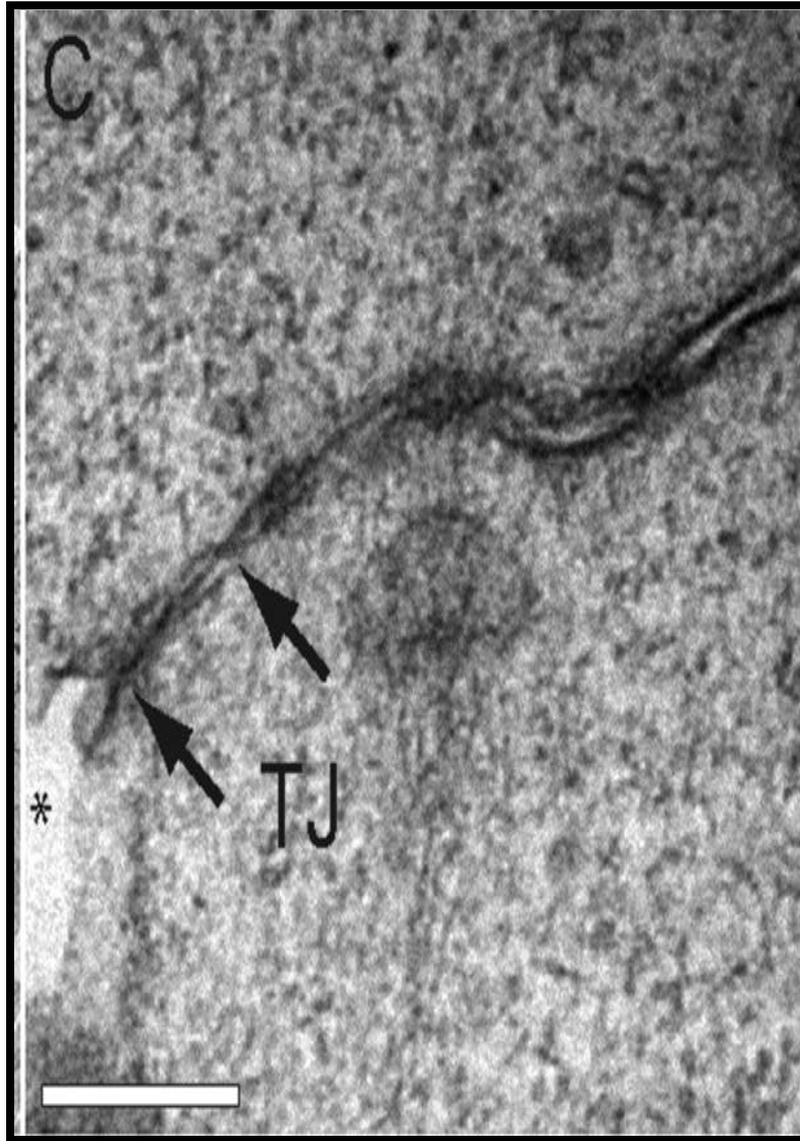


name
tight junction
adherens junction
desmosome
gap junction
hemidesmosome

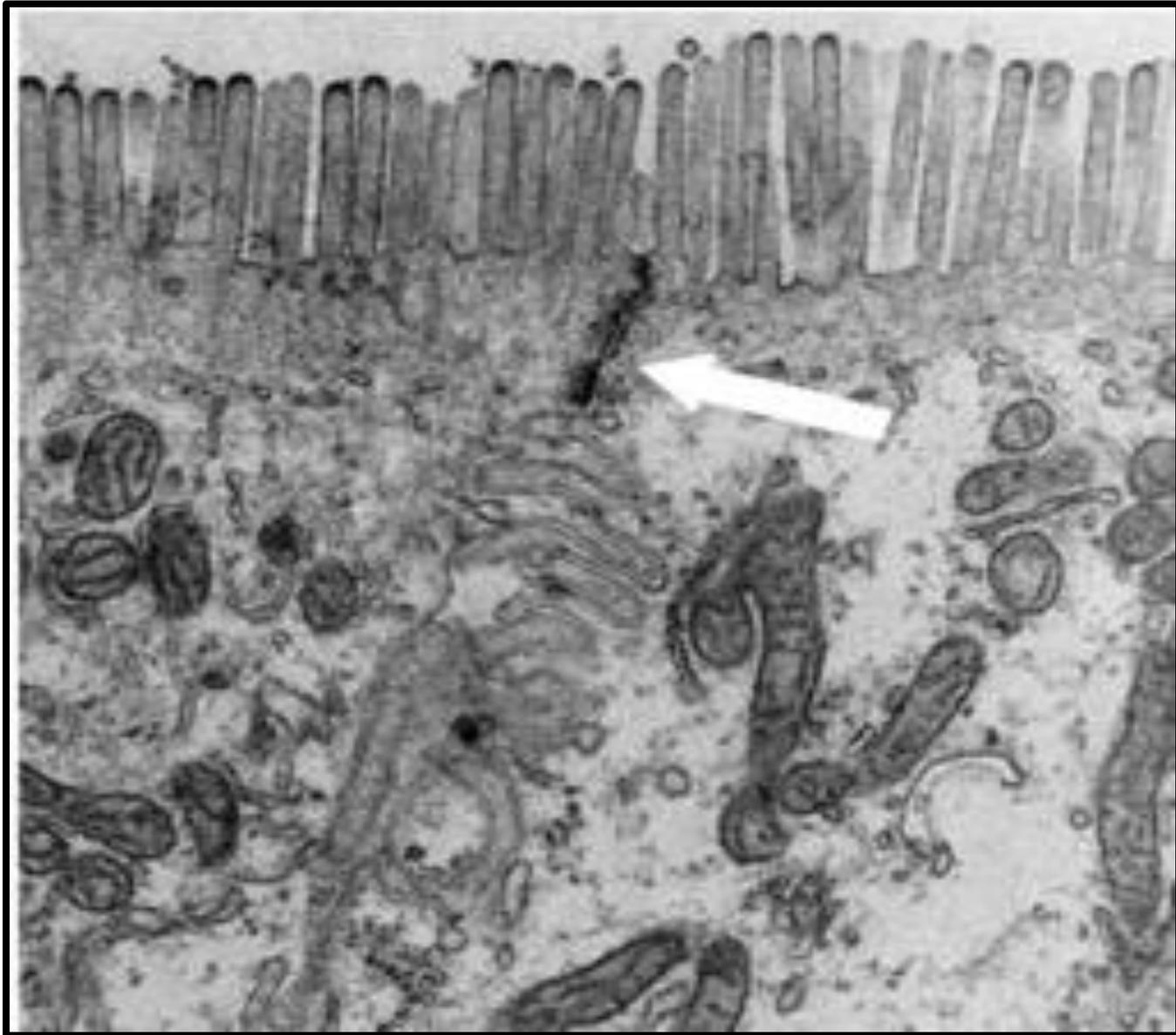




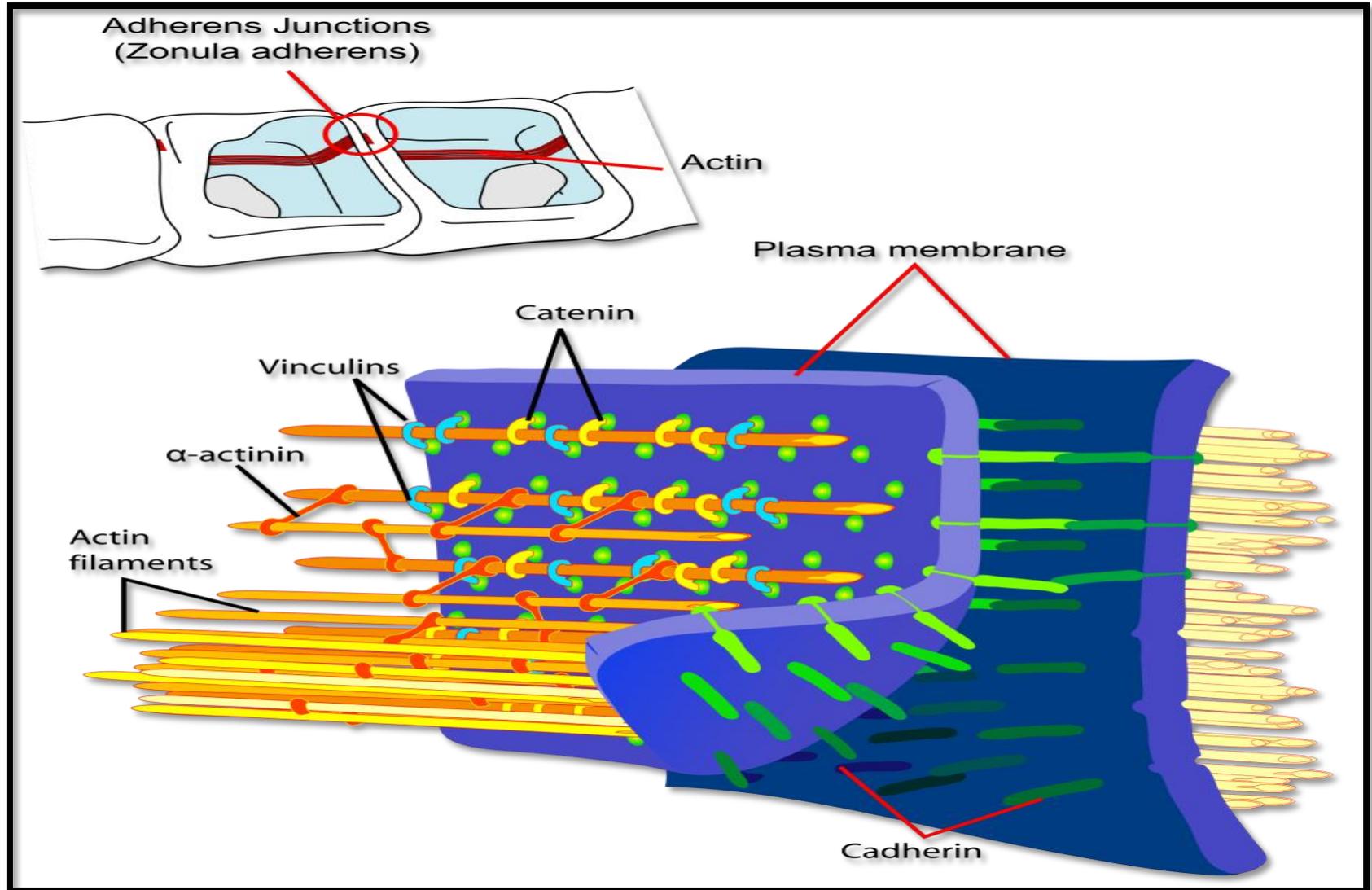
# Tight Junction ( Zonula occludens )

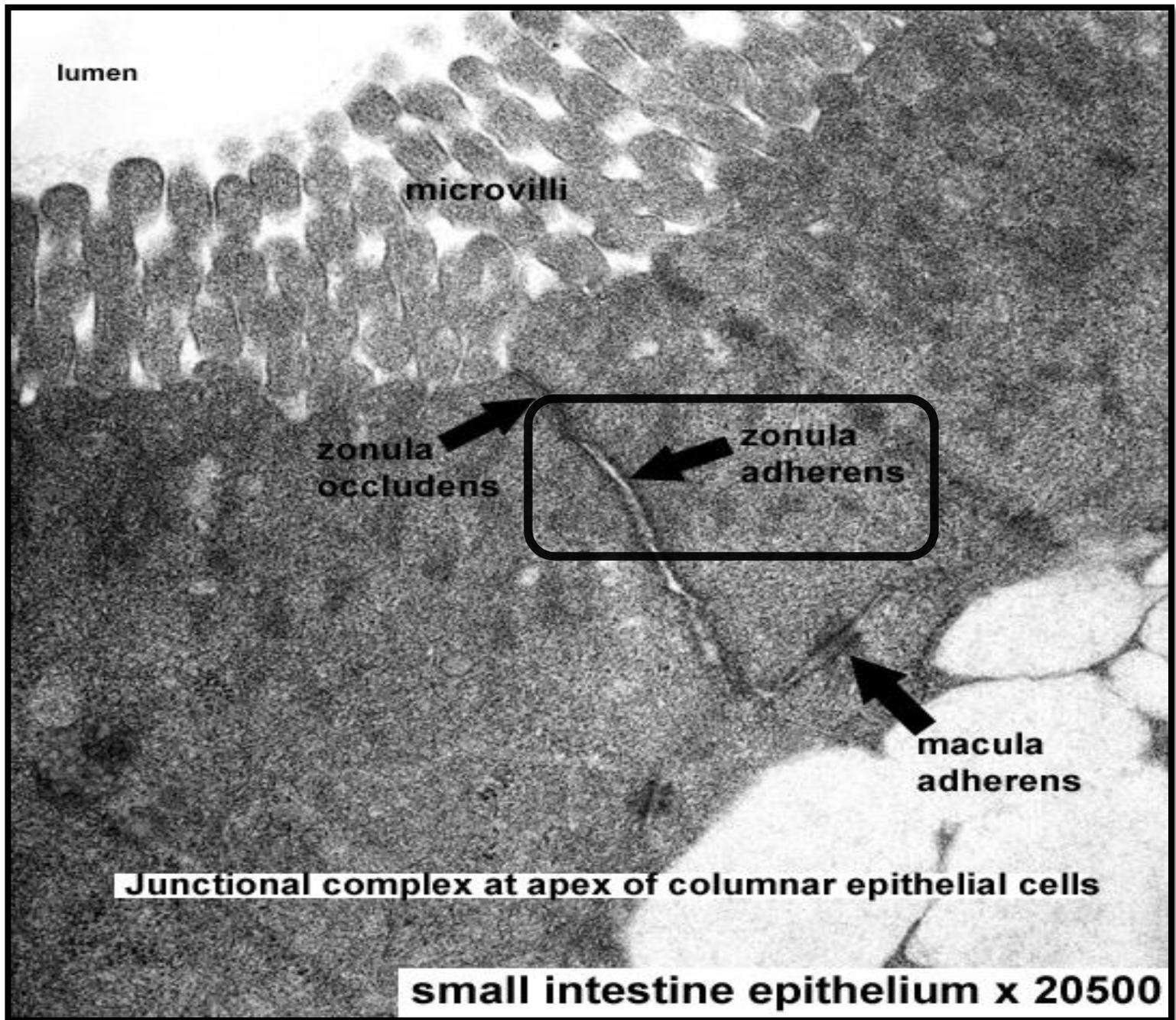


# Tight Junction (Zonula occludens)

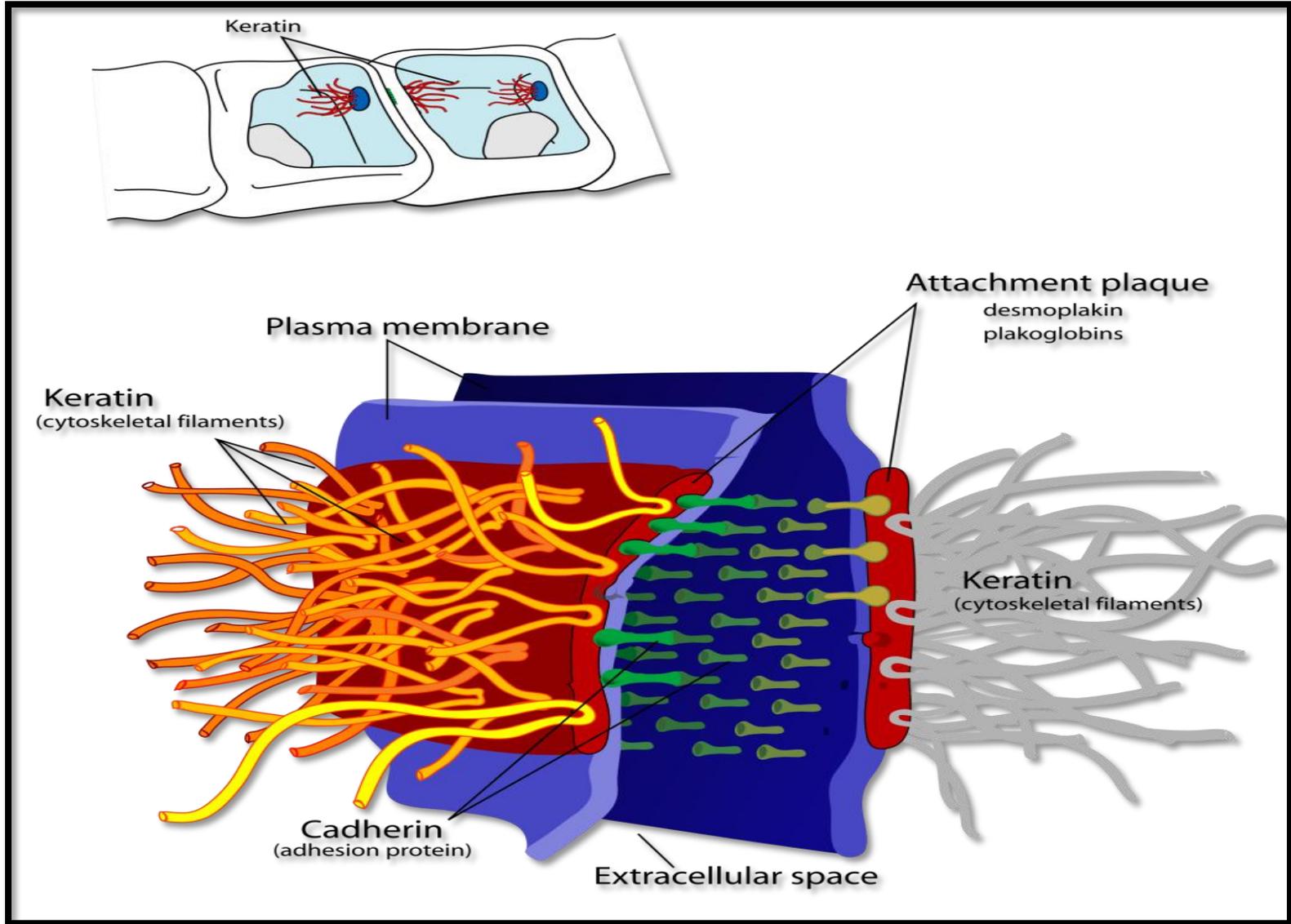


# Adherens Junctions (Zonula adherens)

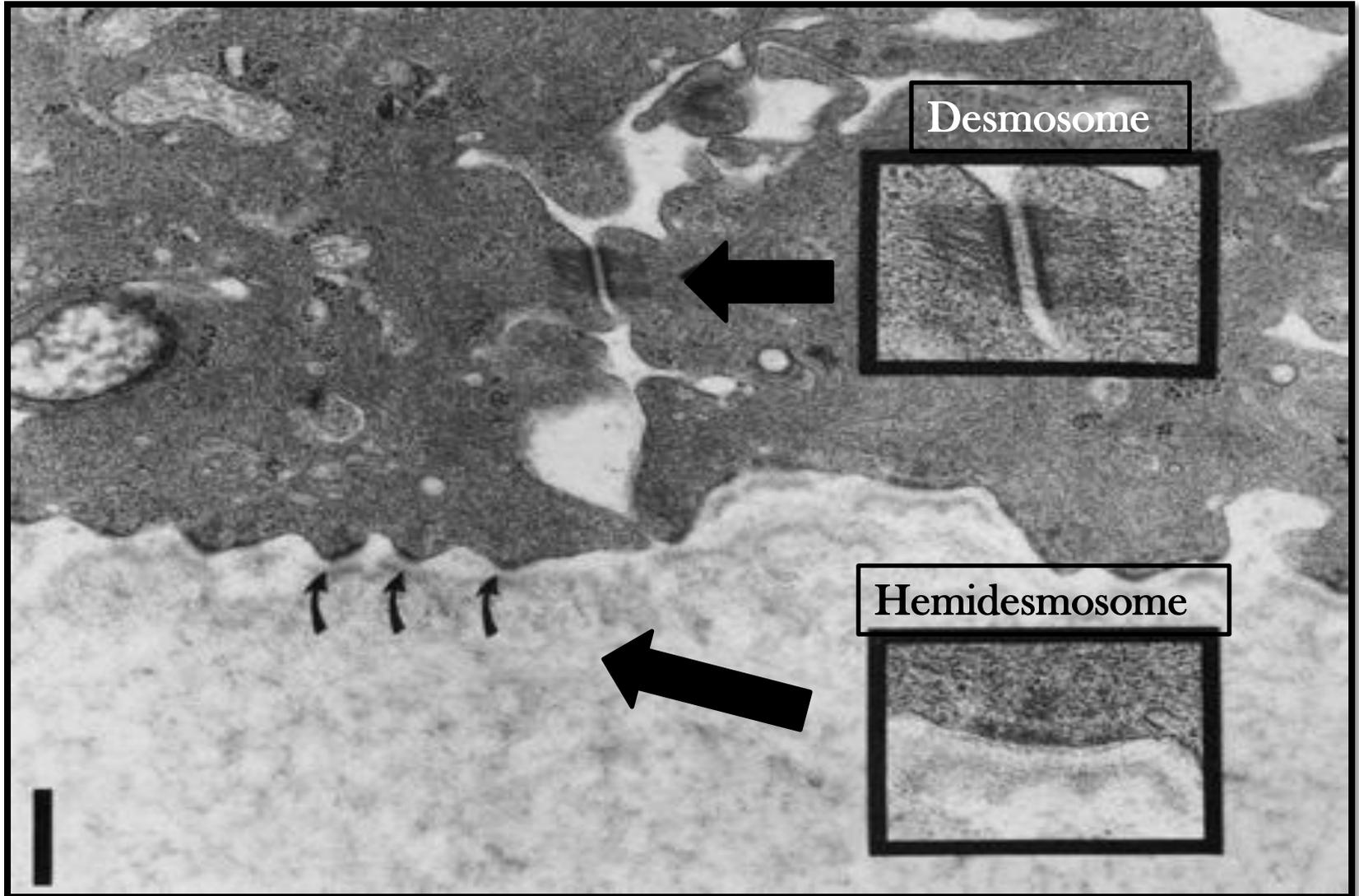




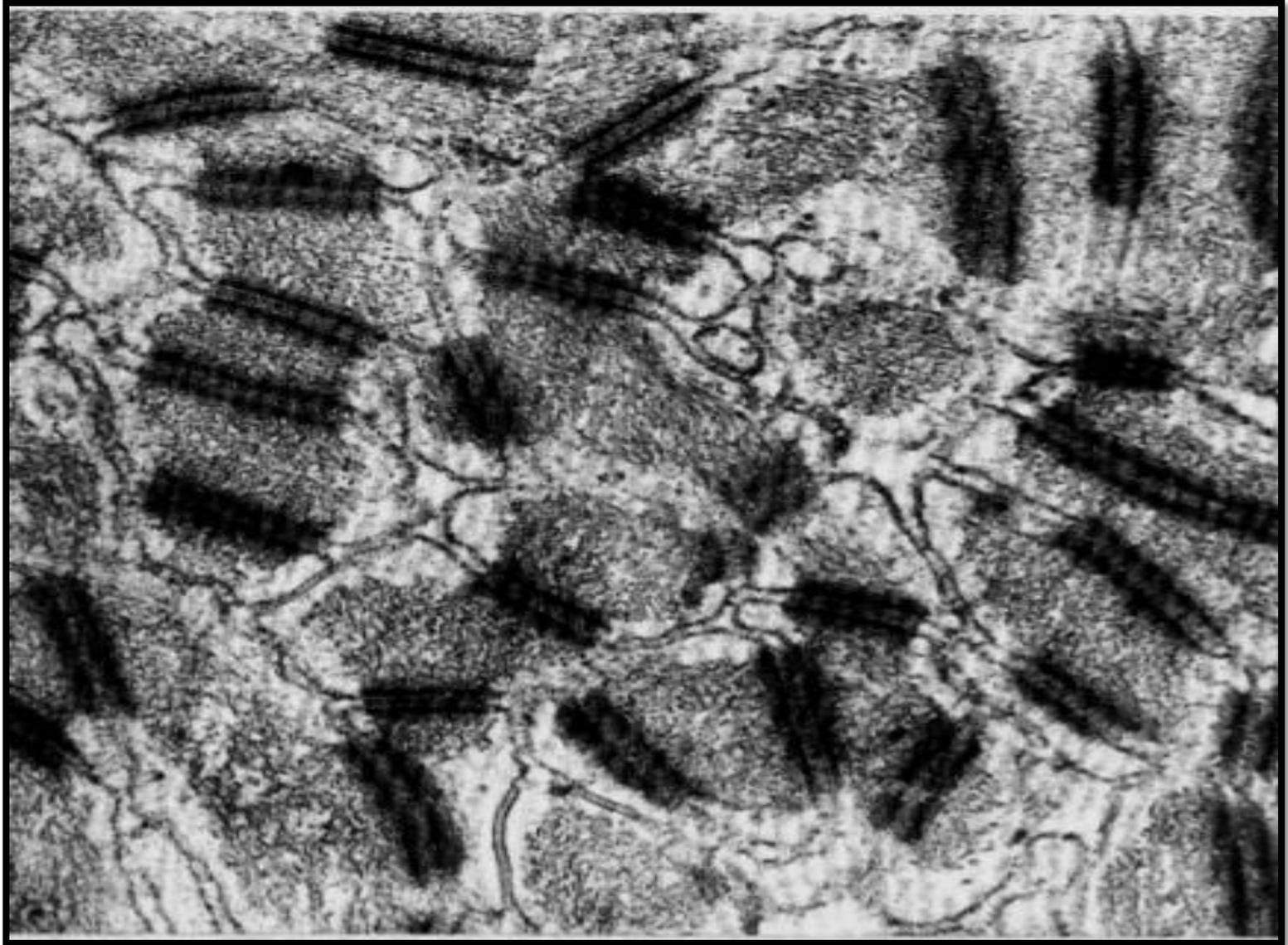
# Desmosome ( Macula adherens )



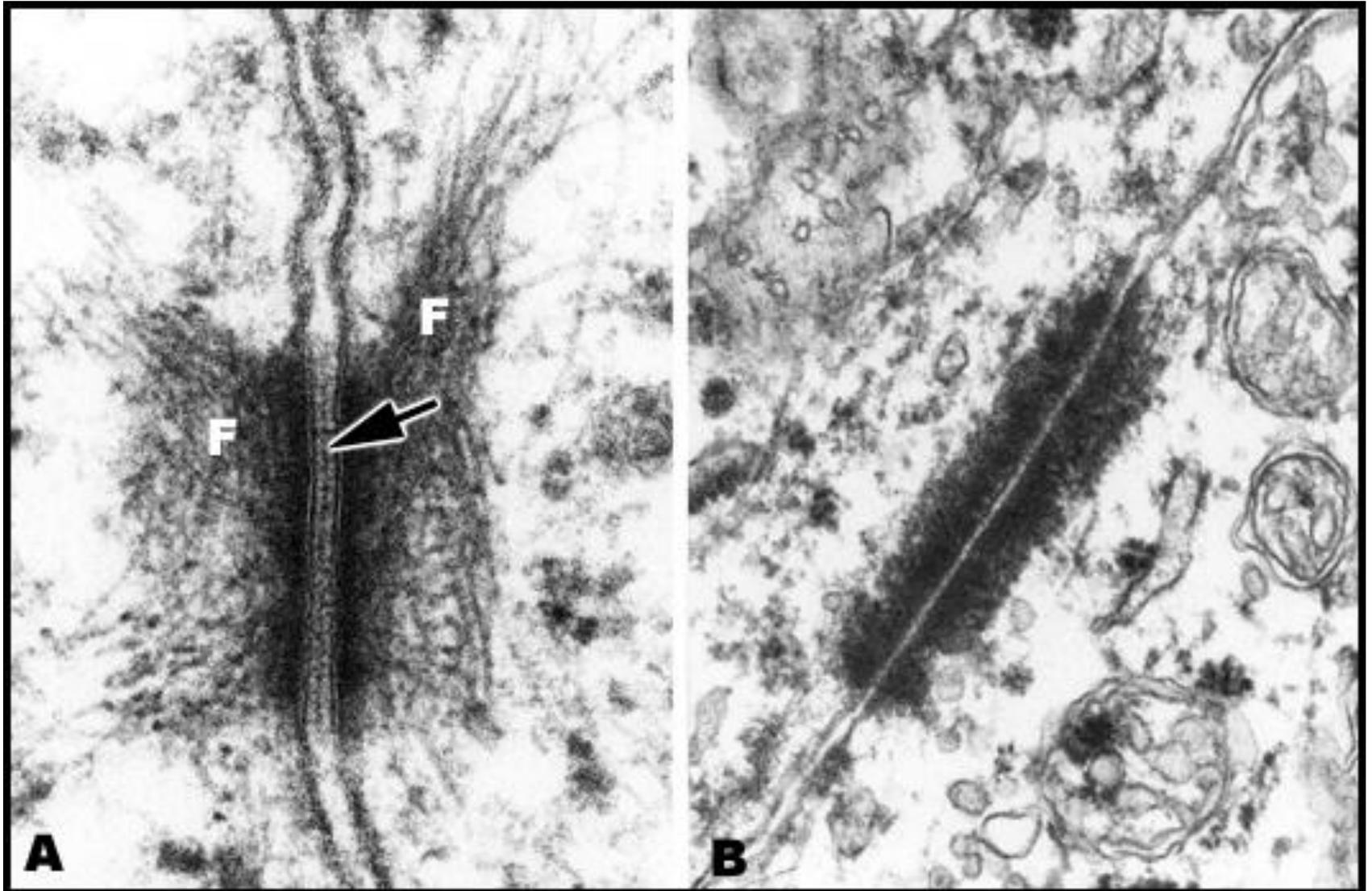
# Desmosome ( Macula adherens )



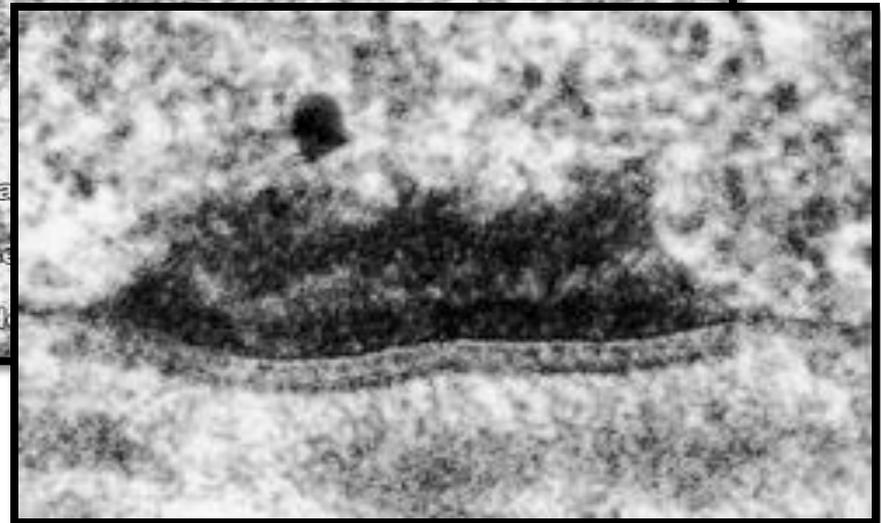
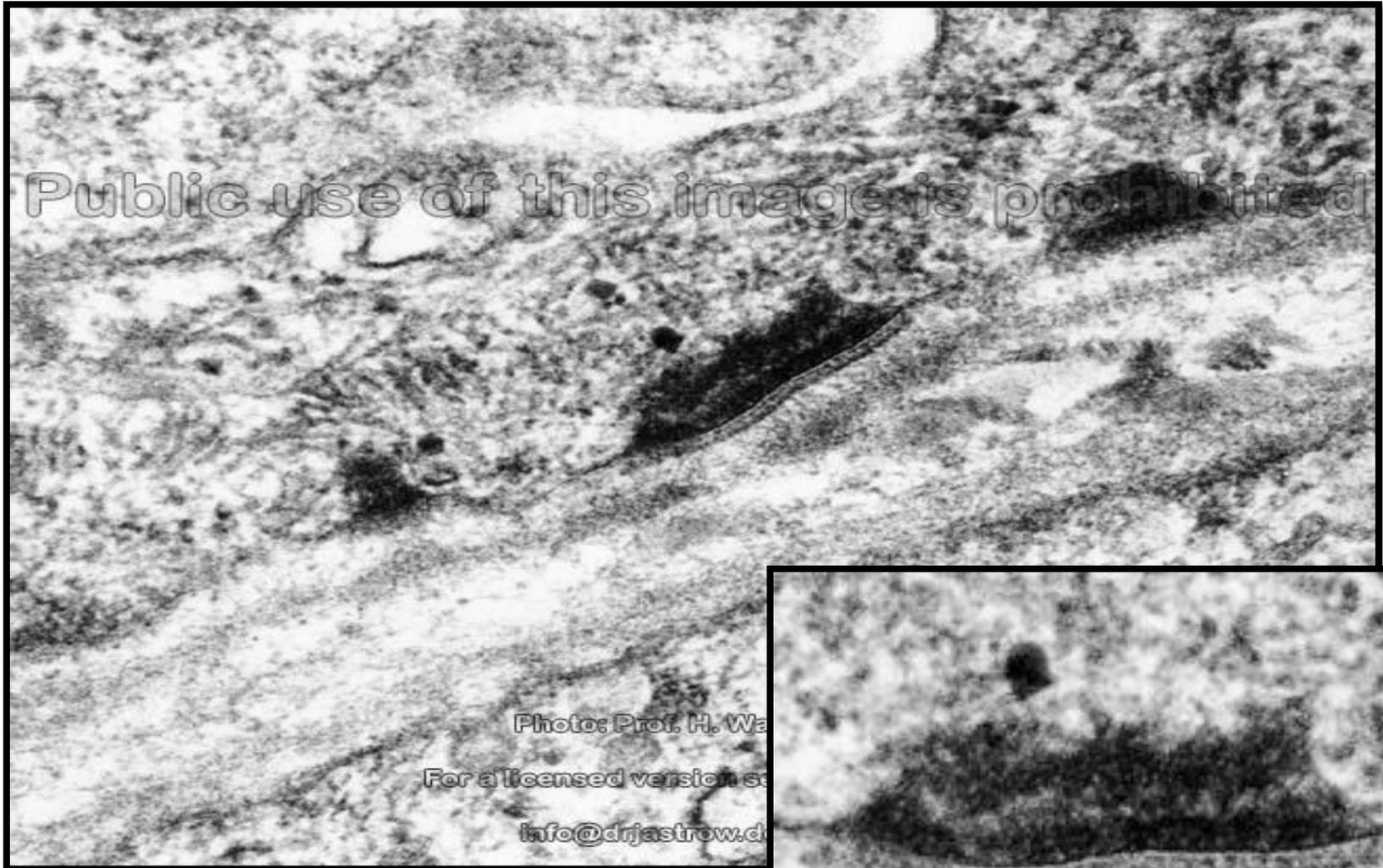
# Desmosome ( Macula adherens )



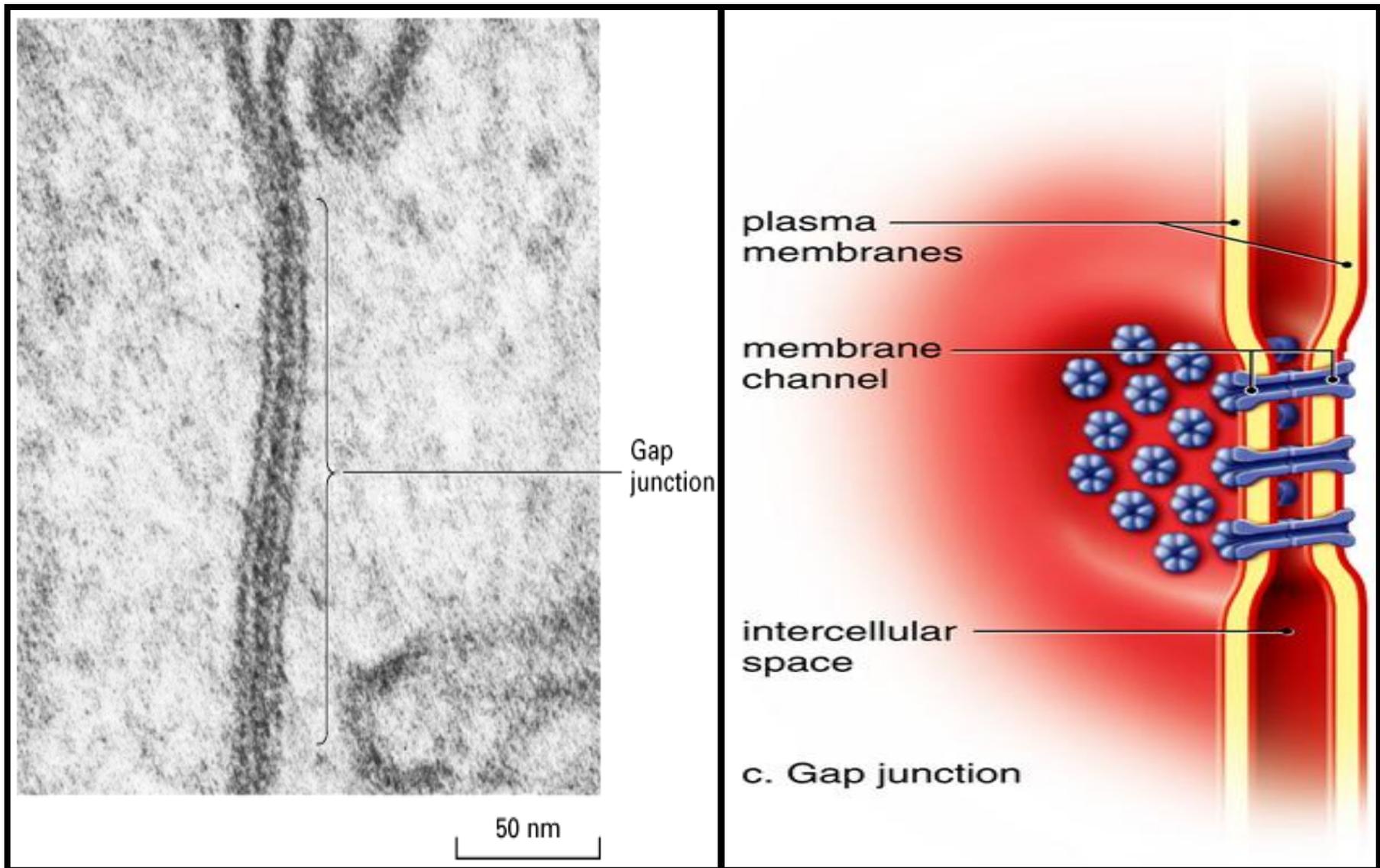
# Desmosome ( Macula adherens )

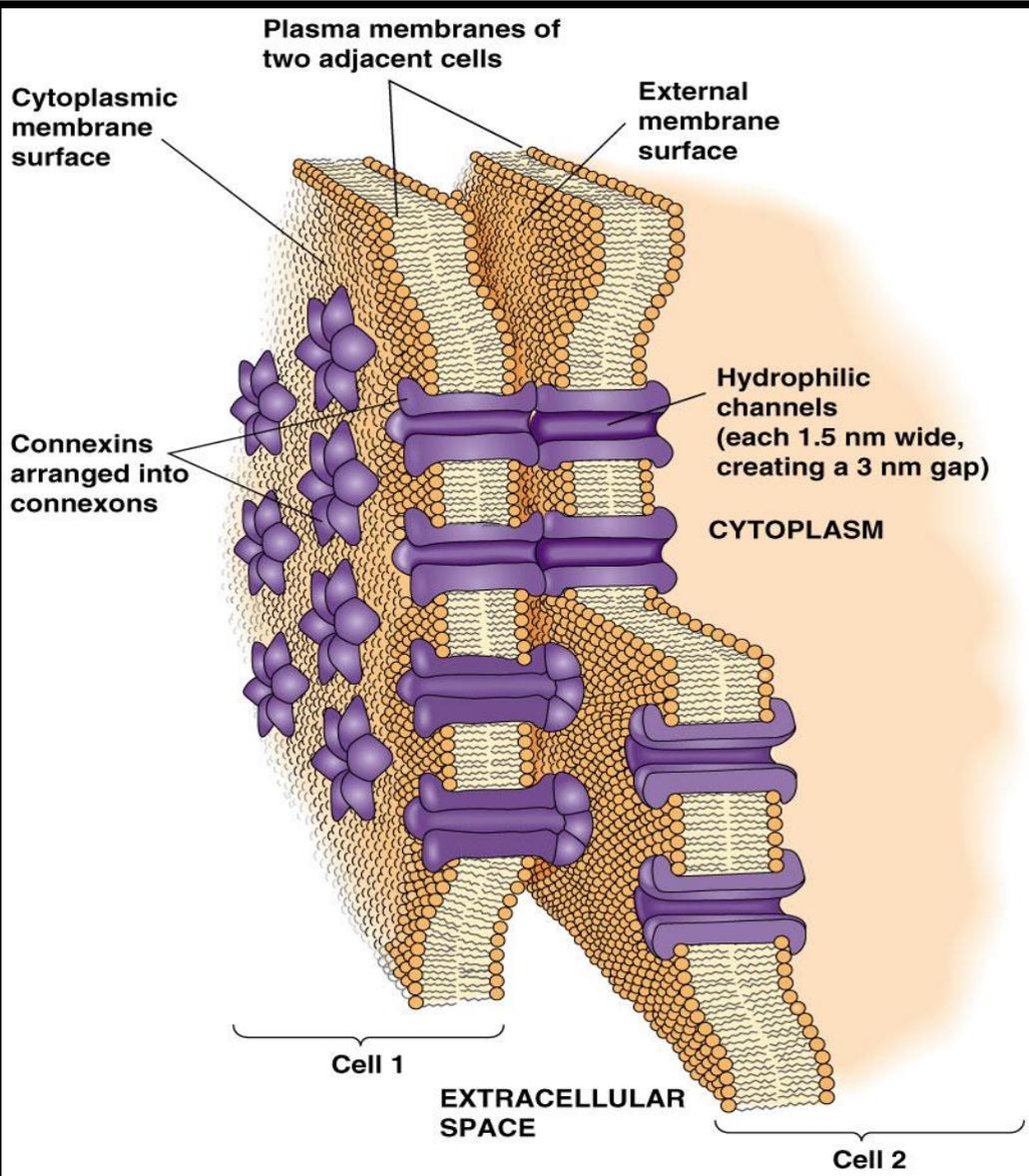


# Hemidesmosome

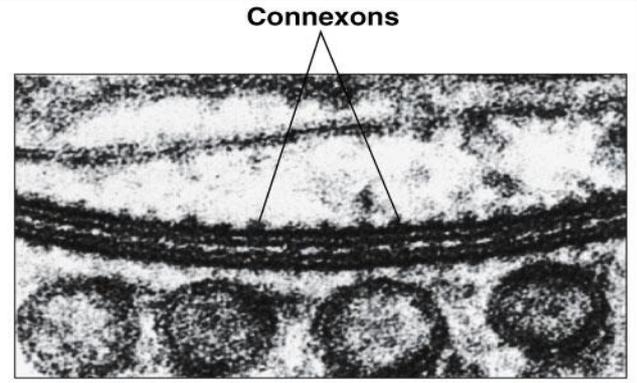


# Gap (Communicating) Junction



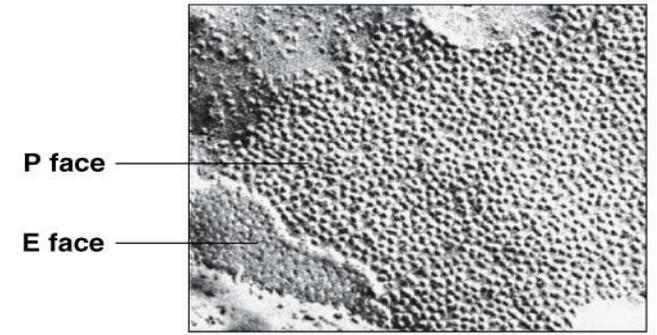


**(a) Gap junction diagram**



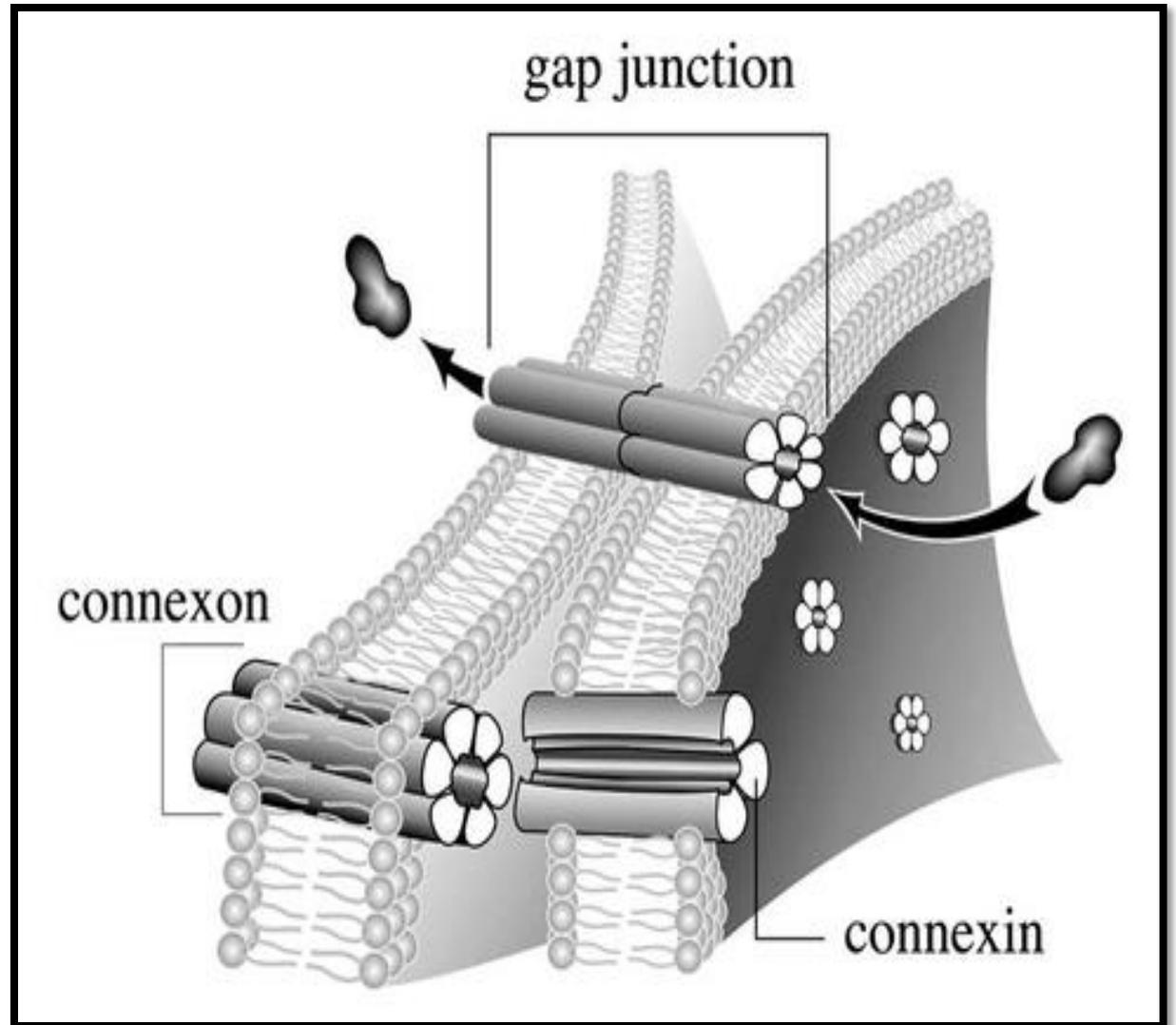
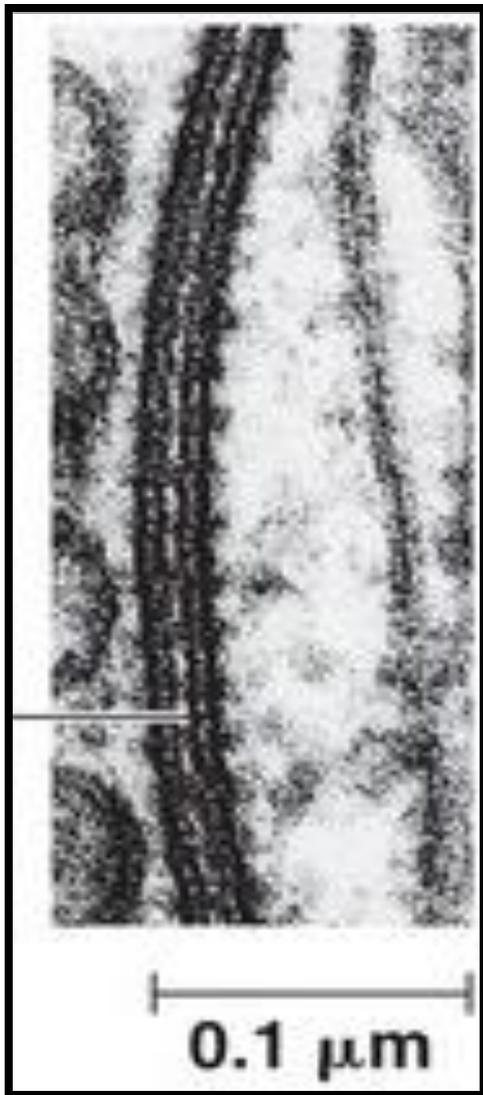
**(b) Electron micrograph of a gap junction**

0.1  $\mu\text{m}$

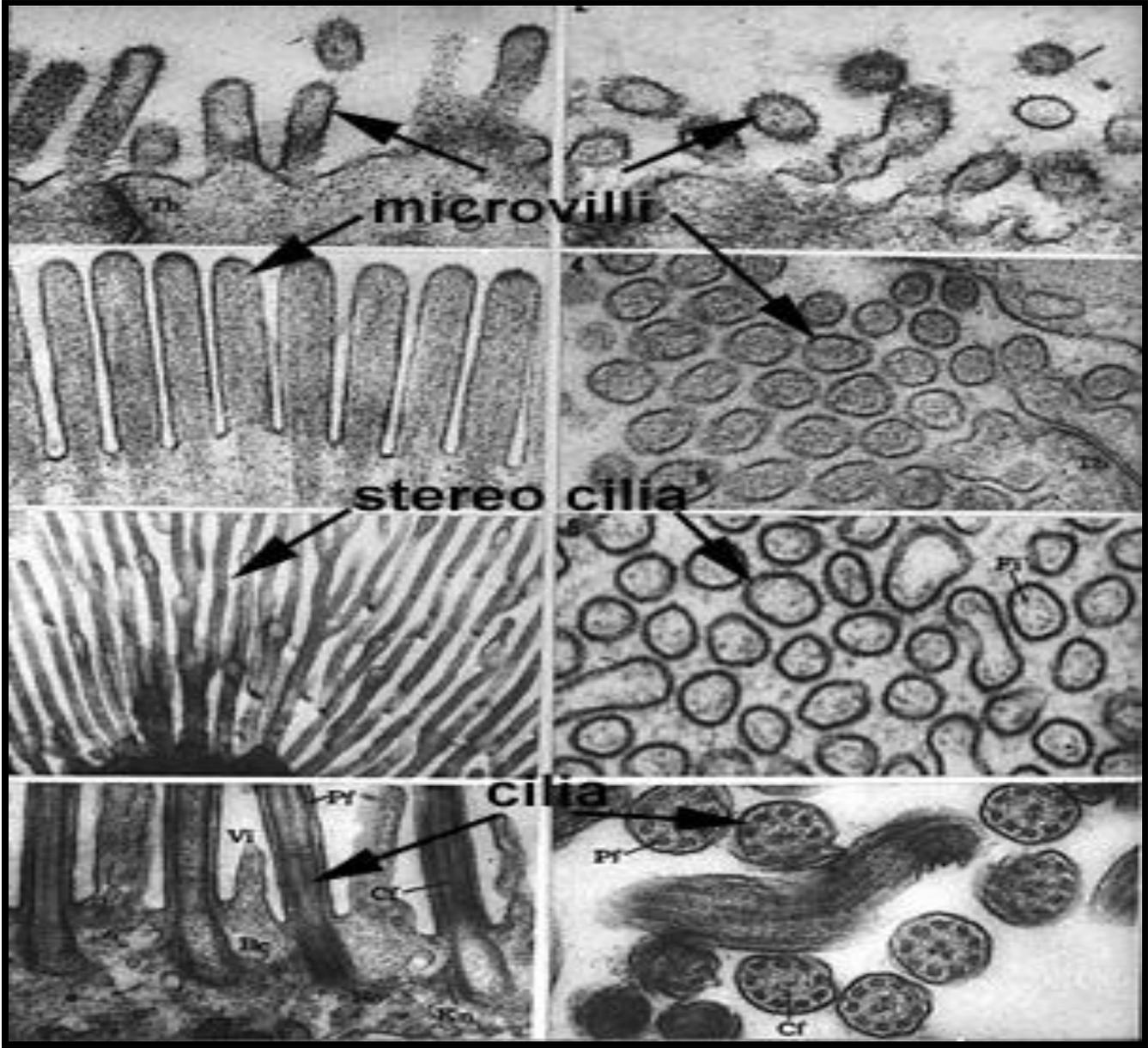


**(c) Freeze-fracture of a gap junction**

0.5  $\mu\text{m}$



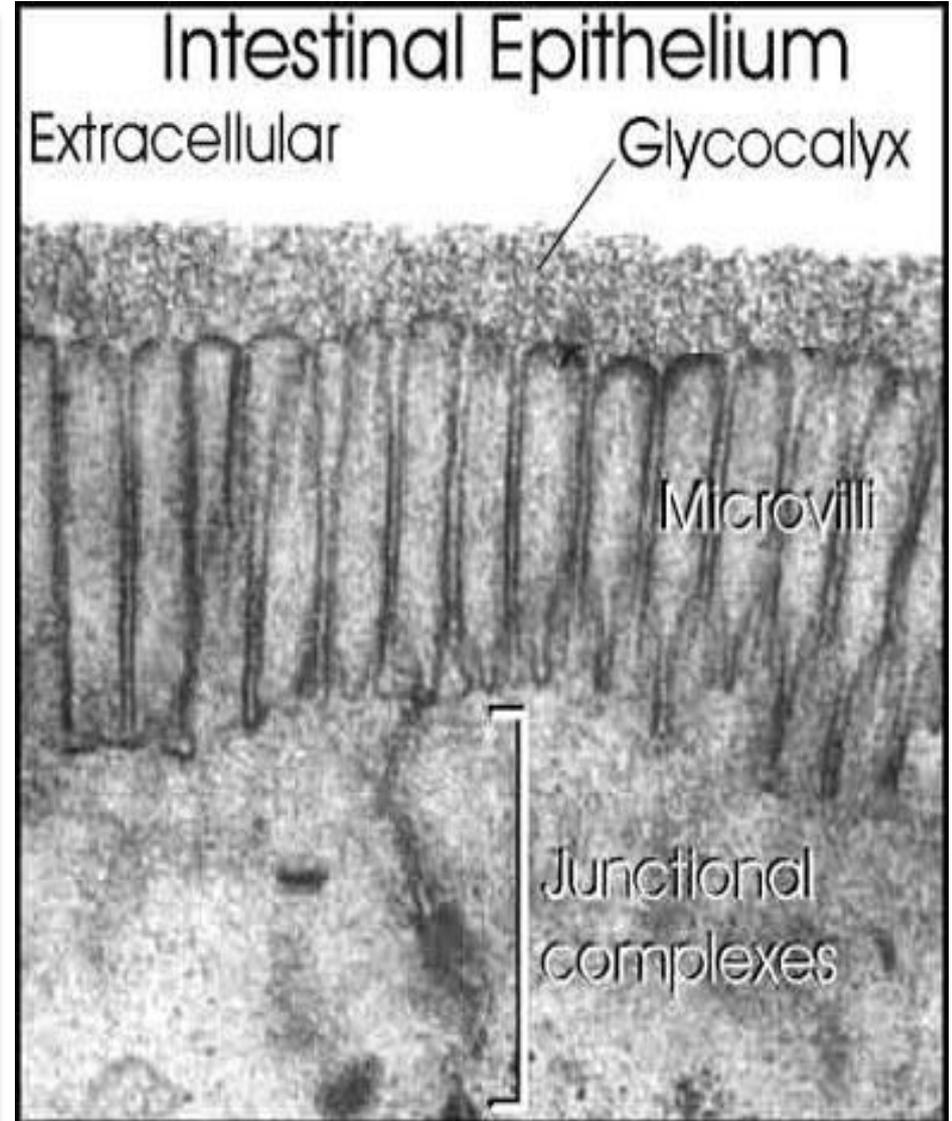
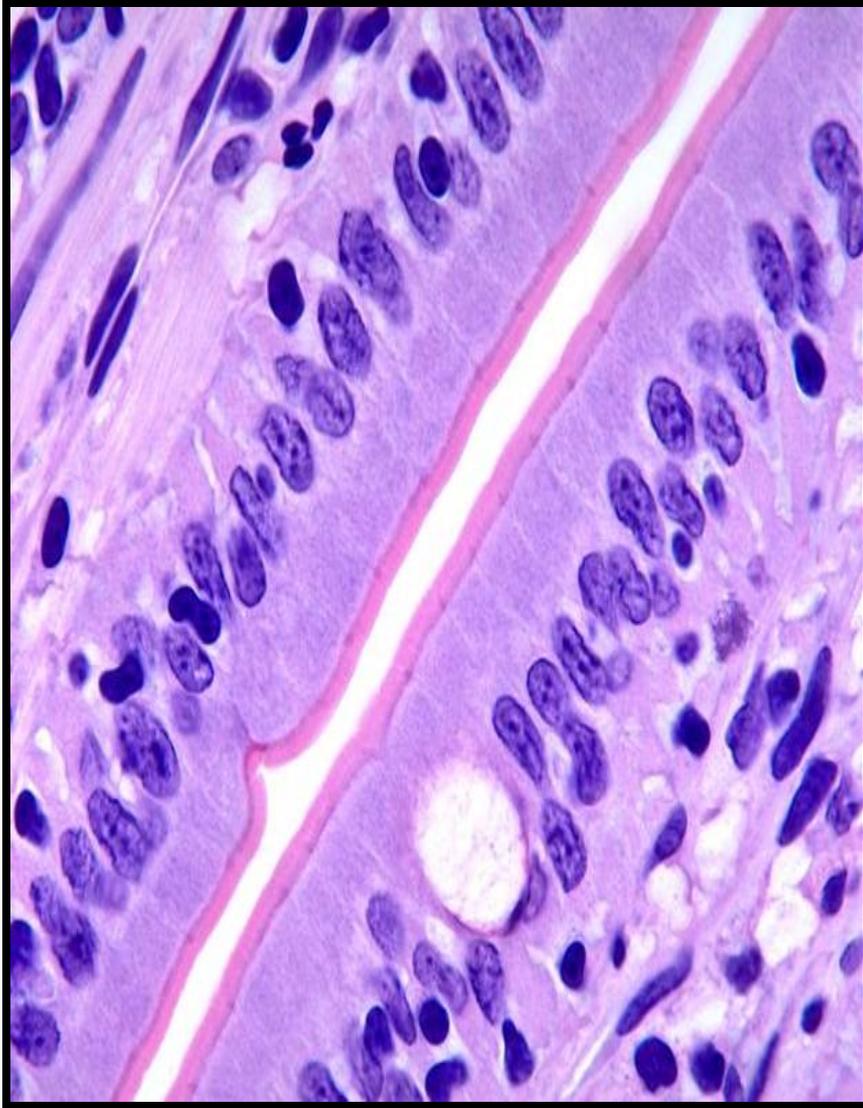
# Features of Apical surface of Epithelium



# Microvilli

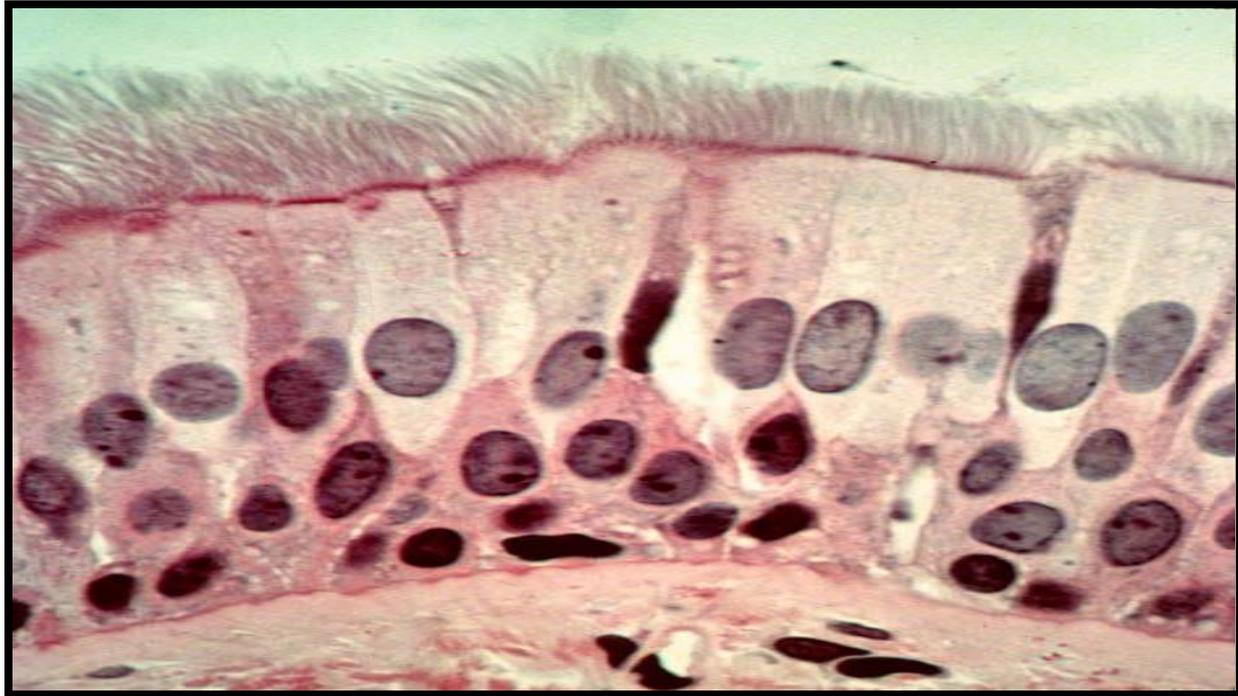
- Finger-like extensions of plasma membrane of apical epithelial cell.
- Present mainly in absorptive cells, increase surface area for absorption
- Temporary or permanent.
- **BRUSH/STRIATED BORDER:** seen in L.M. They are usually crowded on the cell apex forming the **Striated border** in the **intestine** and the **Brush border** in the **kidney**.
- Terminal web : supports microvilli
- Microvilli are motile. They have many actin-containing microfilaments and large amounts of myosin.
- Their number and size vary according to the degree of activity of the cell.

# Microvilli

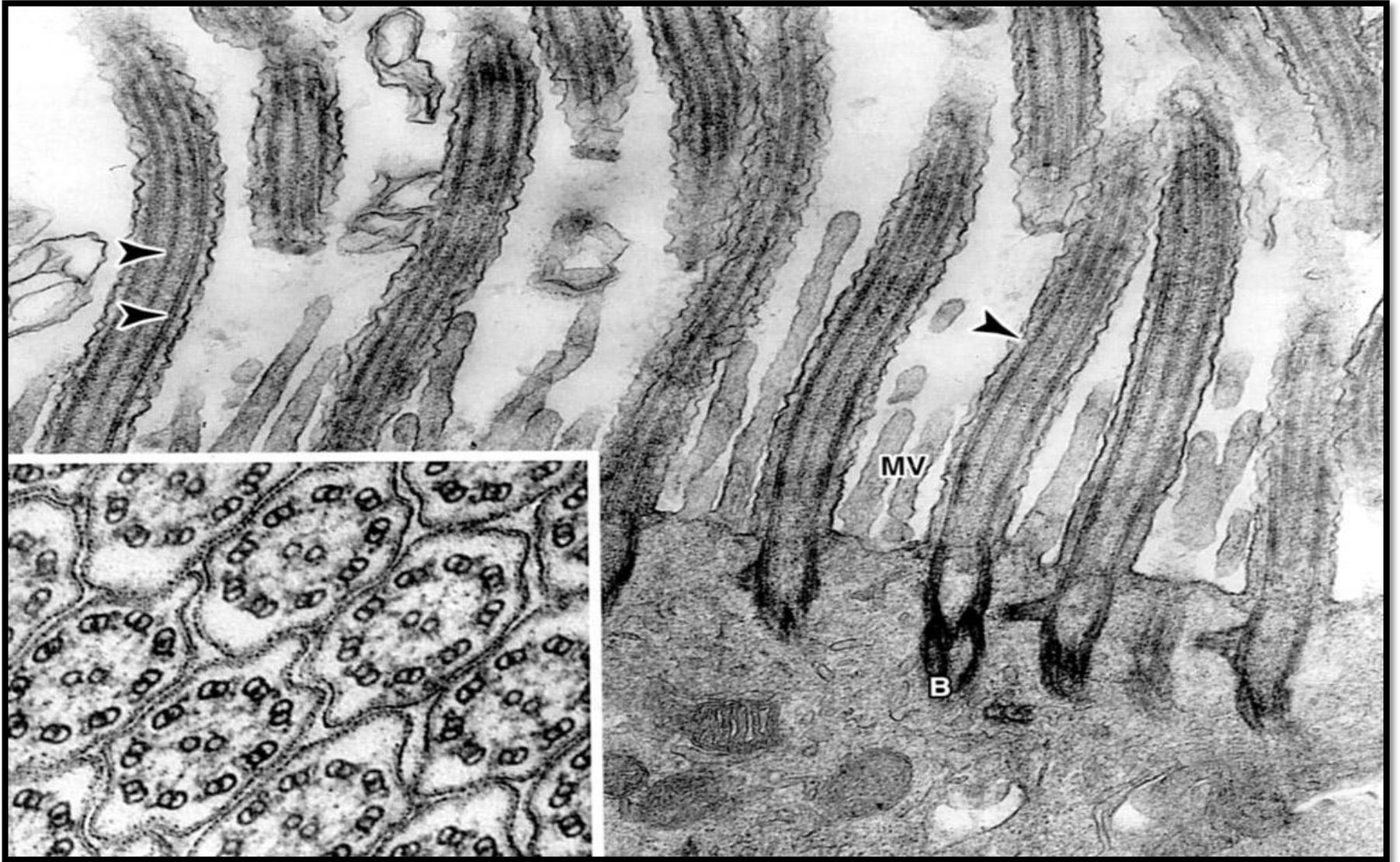


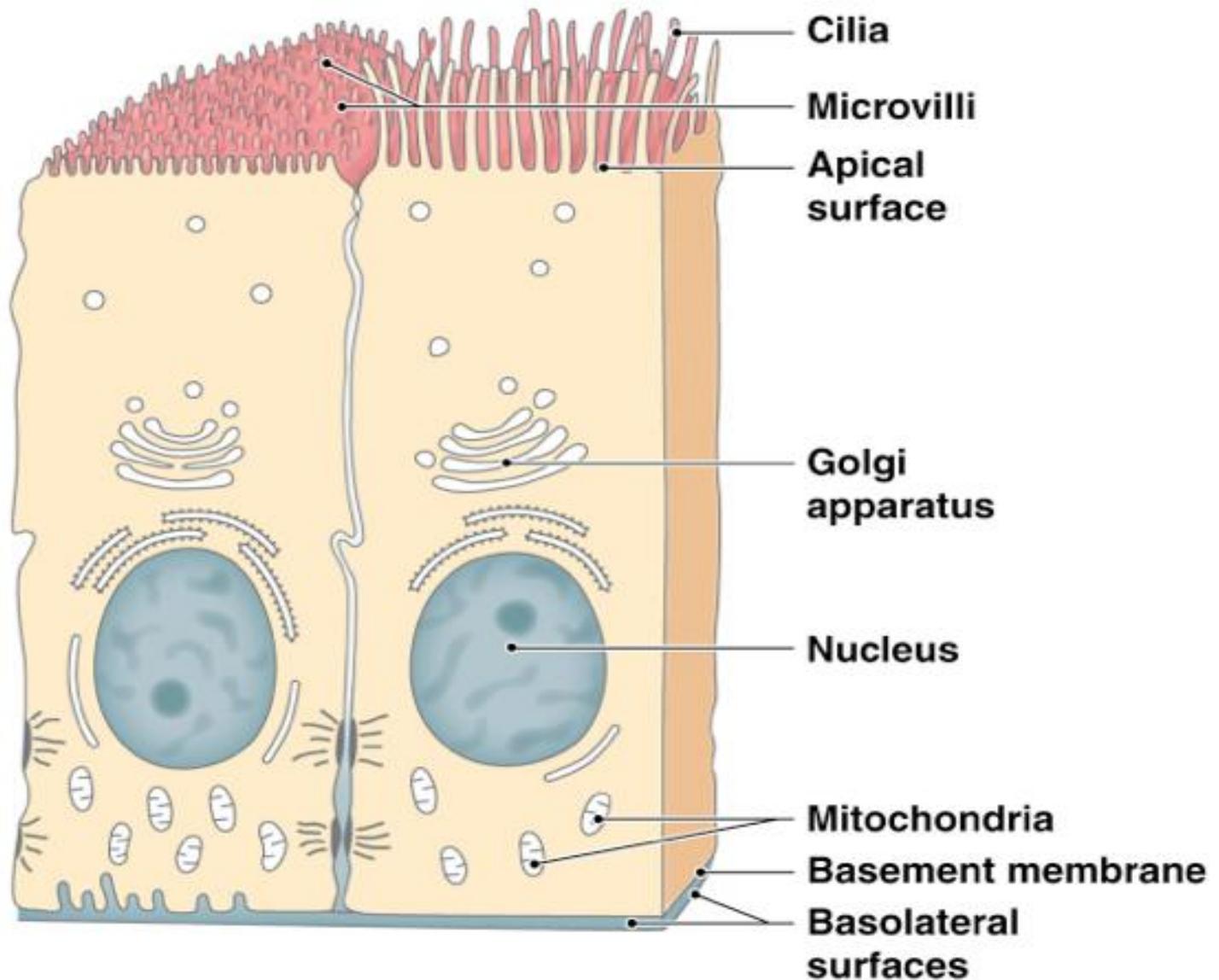
# Cilia

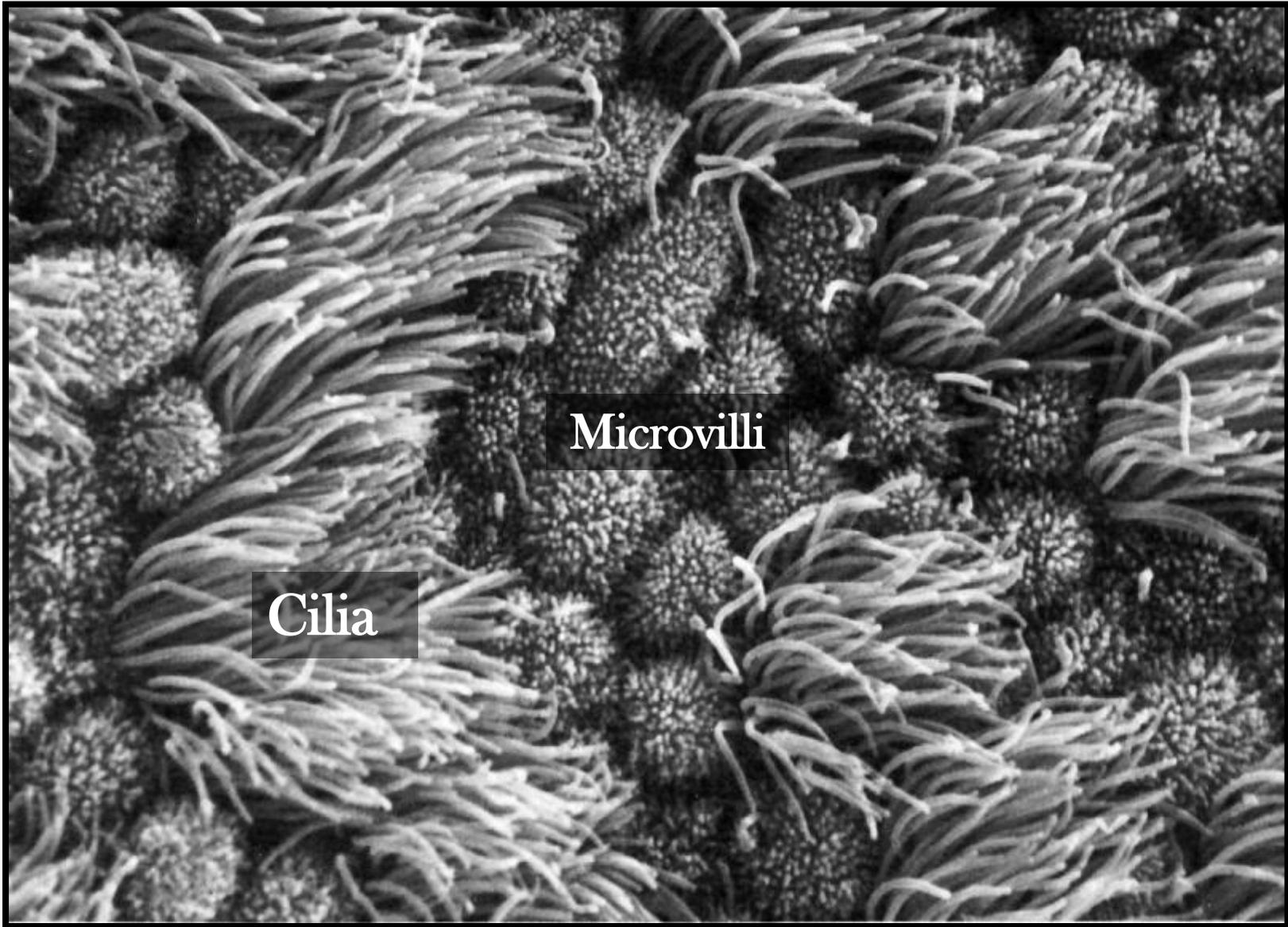
- Motile cytoplasmic hair like projections capable of moving fluid and particles along epithelial surfaces.
- Measurements: length 5-10  $\mu$ , diameter 0.2 $\mu$ .
- Number of cilia /cell is variable and ranges 1-300.
- They move rhythmically and rapidly in one direction.



# Cilia







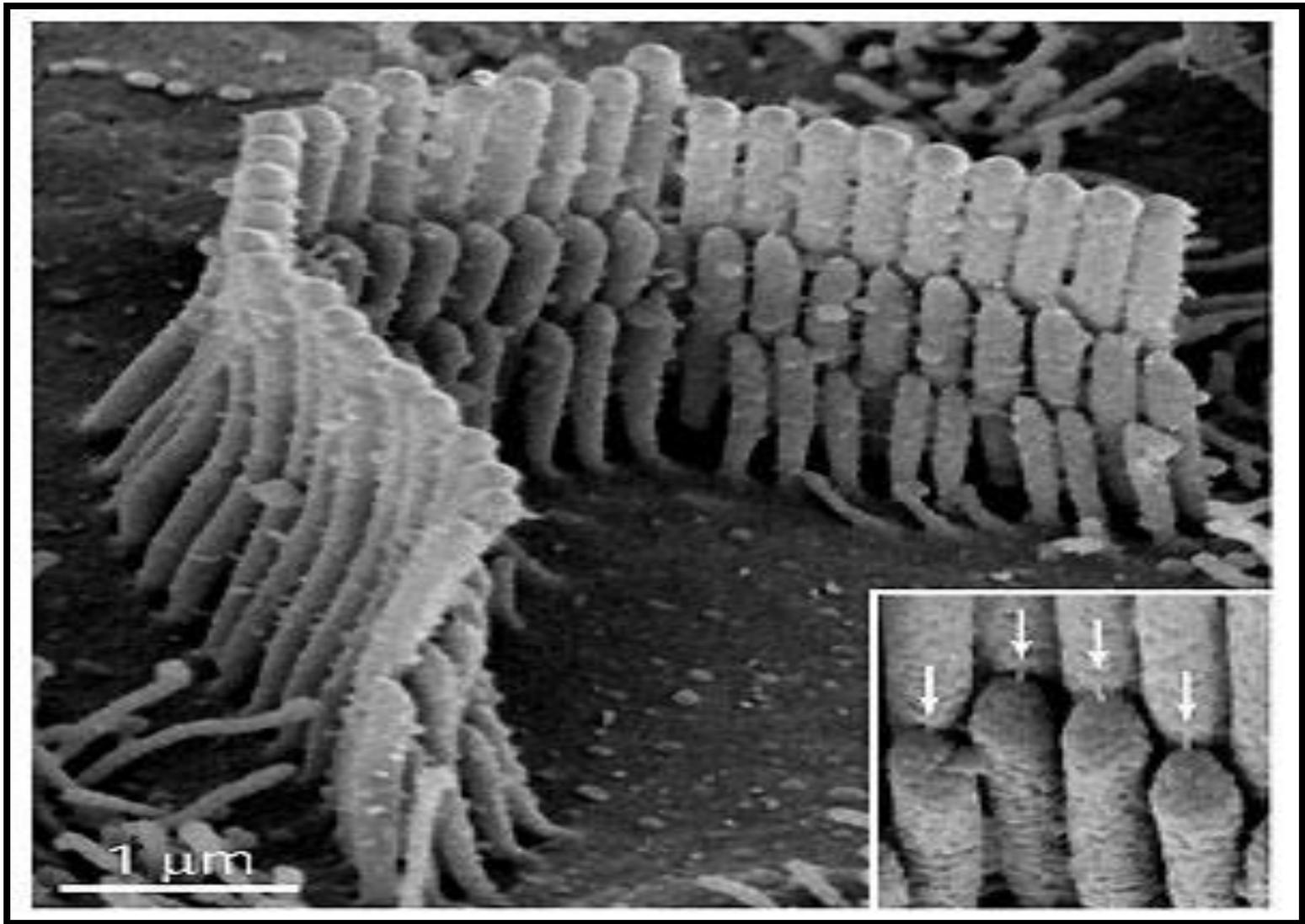
Microvilli

Cilia

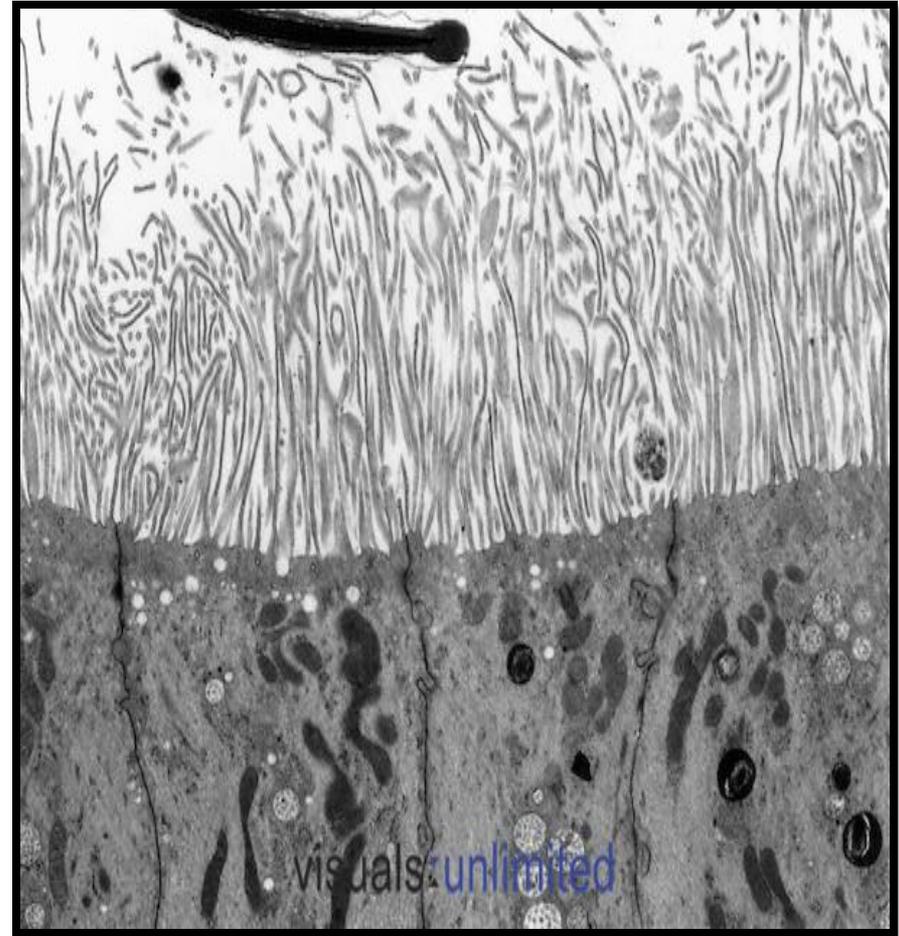
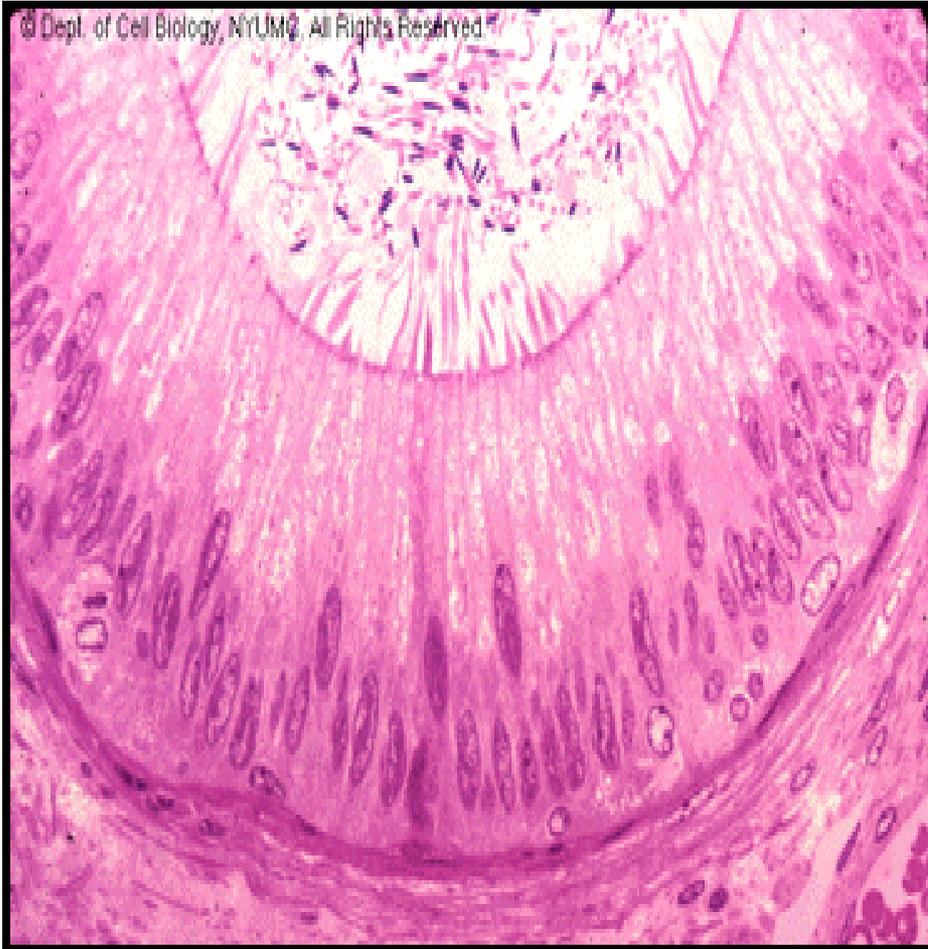
# Stereocilia

- They are similar to microvilli except that they are longer and (**much less motile**) than microvilli.
- Little is known about their movements in vivo.
- Sensory stereocilia contain many actin-containing microfilaments and large amounts of myosin.
- Branched.
- Location:
- In **epididymis** and **ductus deferens** they have an **absorptive** function,
- In the **internal ear** they have a **sensory** function.

# Stereocilia



# Stereocilia



# Classification of Epithelium

According to the number of cell layers, epithelium is classified into:

- **Simple**
- **Stratified**

Simple epithelium is named according to the shape of its cells.

Stratified epithelium is named according to the shape of the cells in the outermost layer.

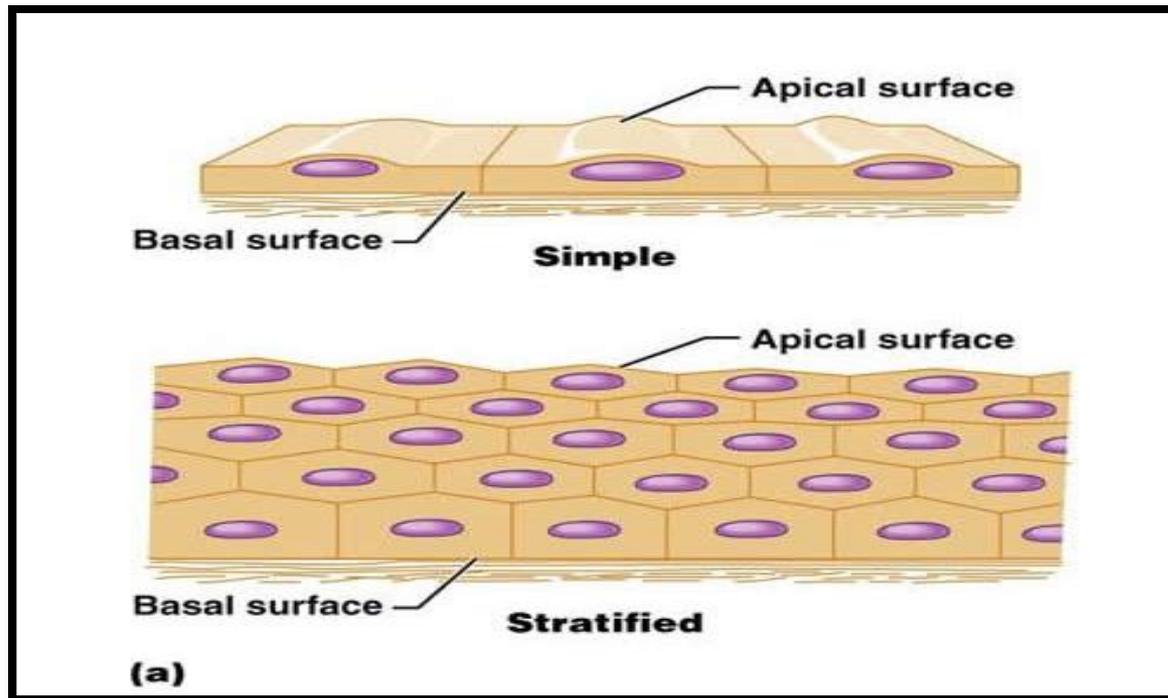
# Terms referring to the layers

**Simple** = one layer

**Stratified** = more than one layer

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

**Ciliated** = with cilia



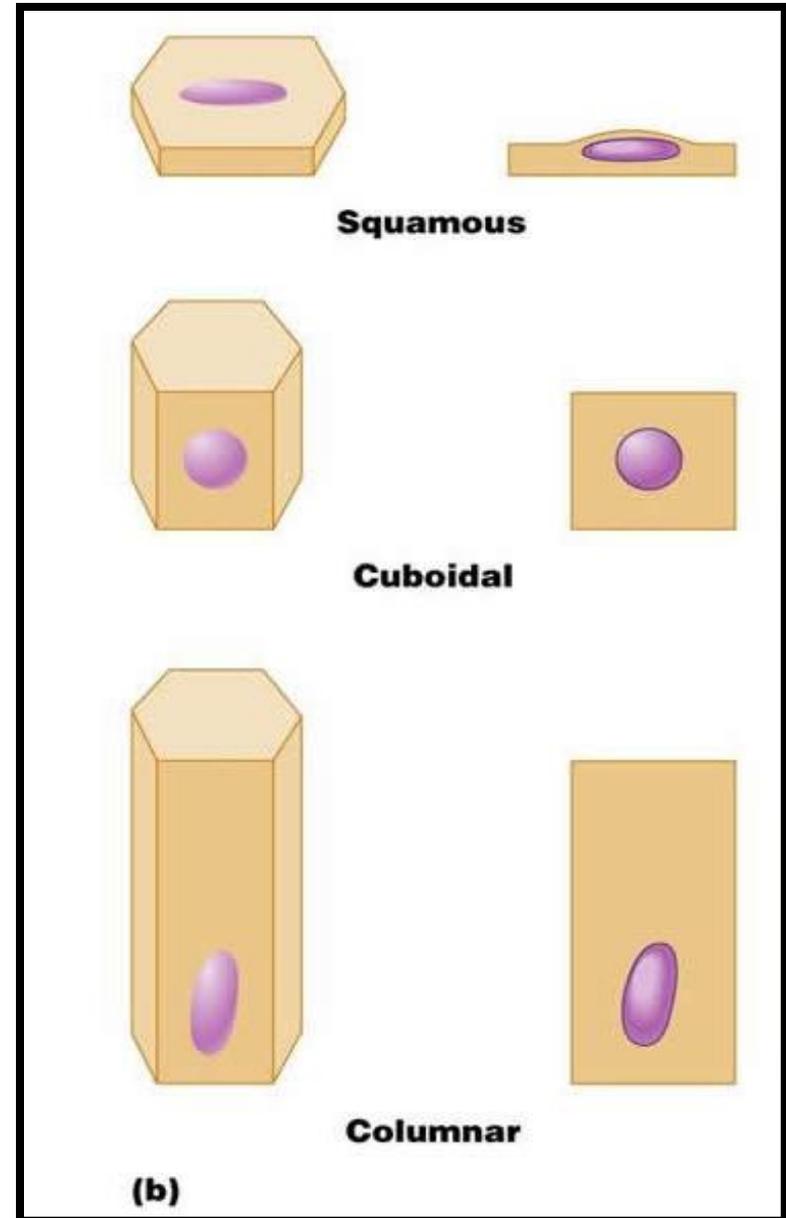
# Terms referring to the cell shapes

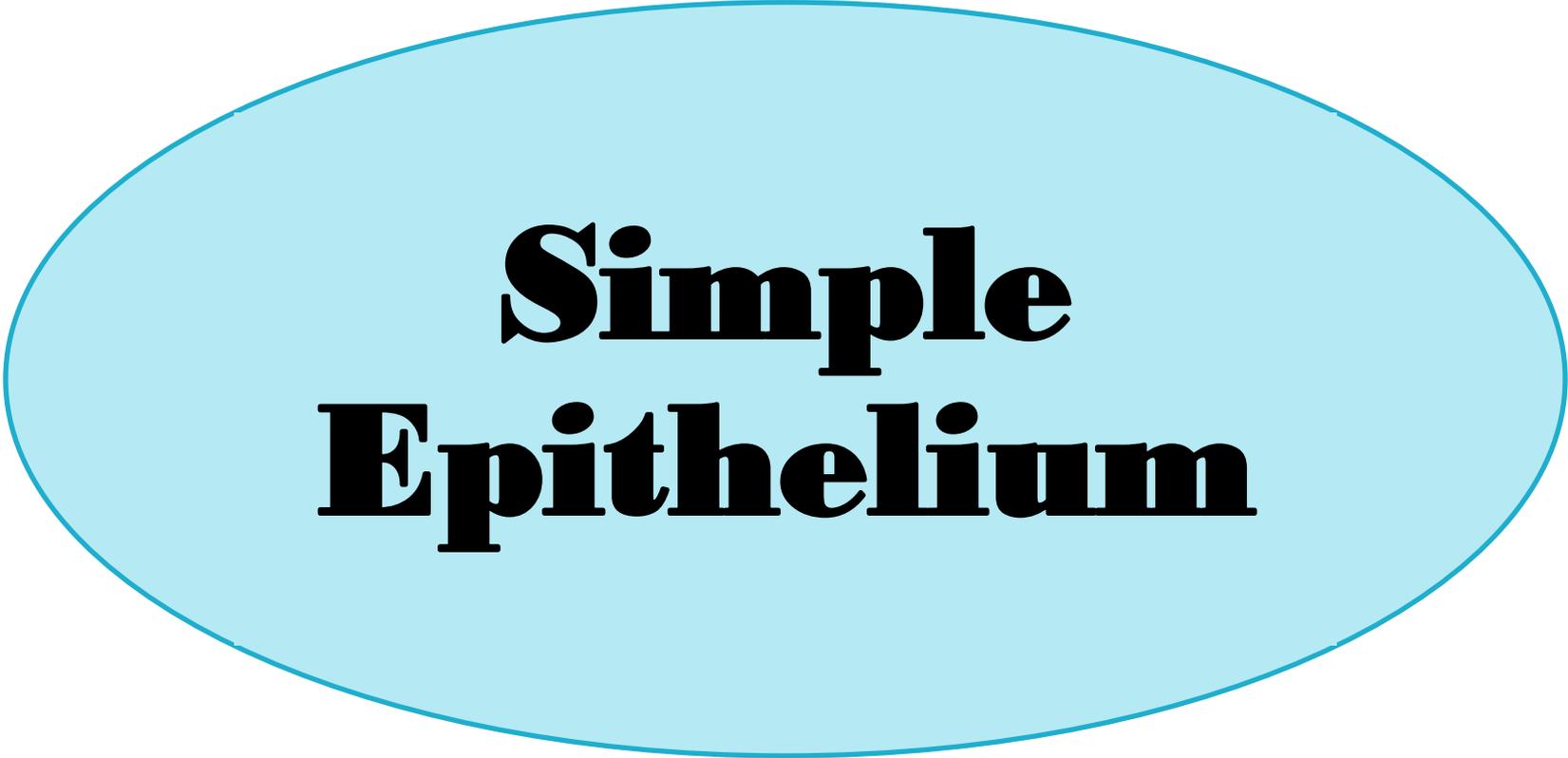
**Squamous** = flat

**Cuboidal** = cube

**Columnar** = rectangular (column)

**Transitional** = ability to change shape





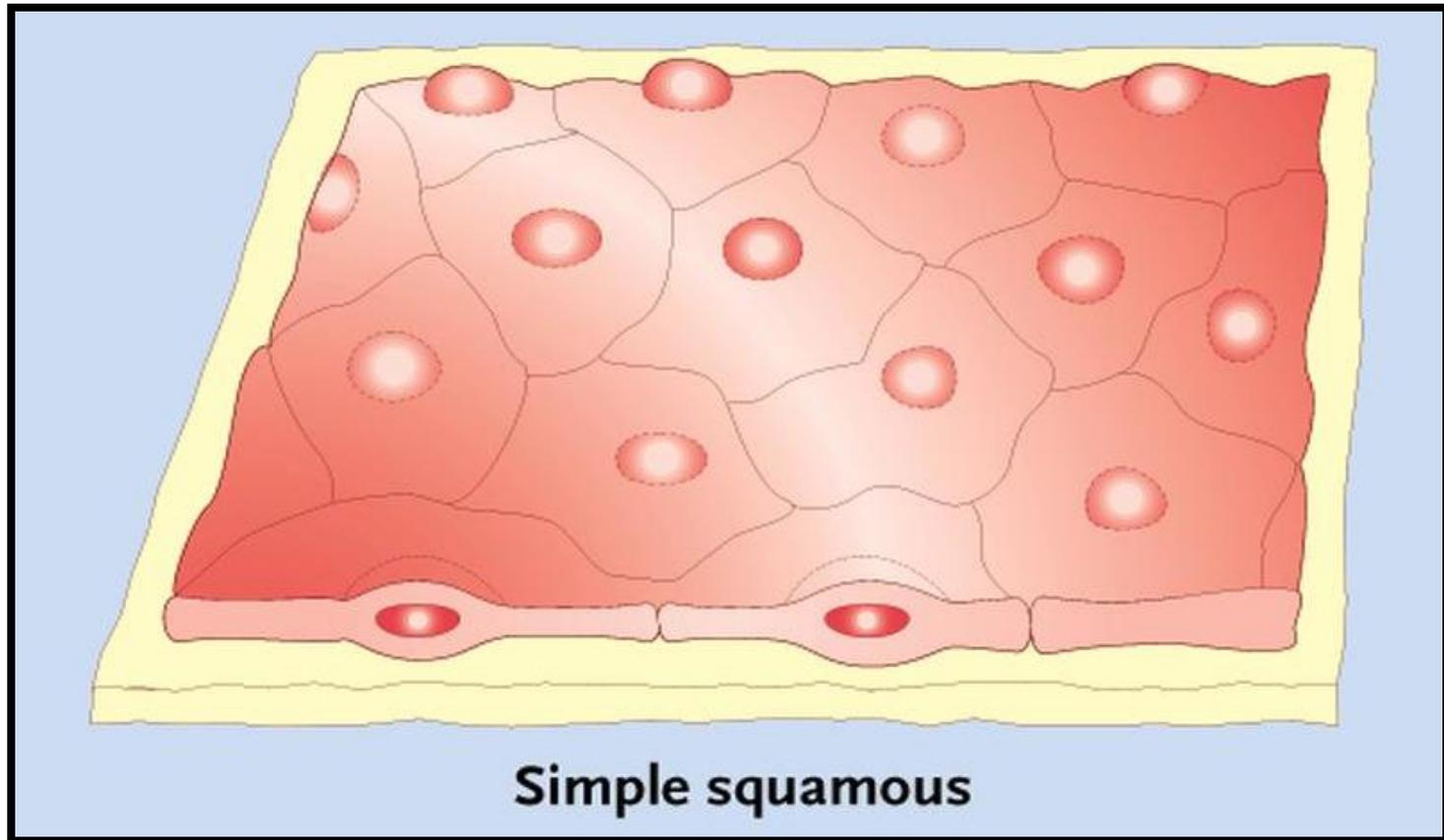
**Simple  
Epithelium**

# Types of Simple Epithelium

Simple squamous	Simple cuboidal	Simple columnar	Pseudostratified columnar
Lung alveoli Loop of Henle	Small collecting ducts of kidney	Stomach Gall bladder	<b>Ciliated</b> Respiratory tract (trachea and bronchi).
<b>Endothelium</b> Blood vessels Lymph vessels The heart	Glands and ducts (pancreas & salivary) Kidney tubules Cover ovaries	<b>Ciliated</b> Fallopian tube	<b>Stereocilia</b> Epididimus Ductus deferens
<b>Mesothelium</b> Peritoneum Pleura Pericardium		<b>Microvilli</b> Proximal - convoluted tubules Small intestine	

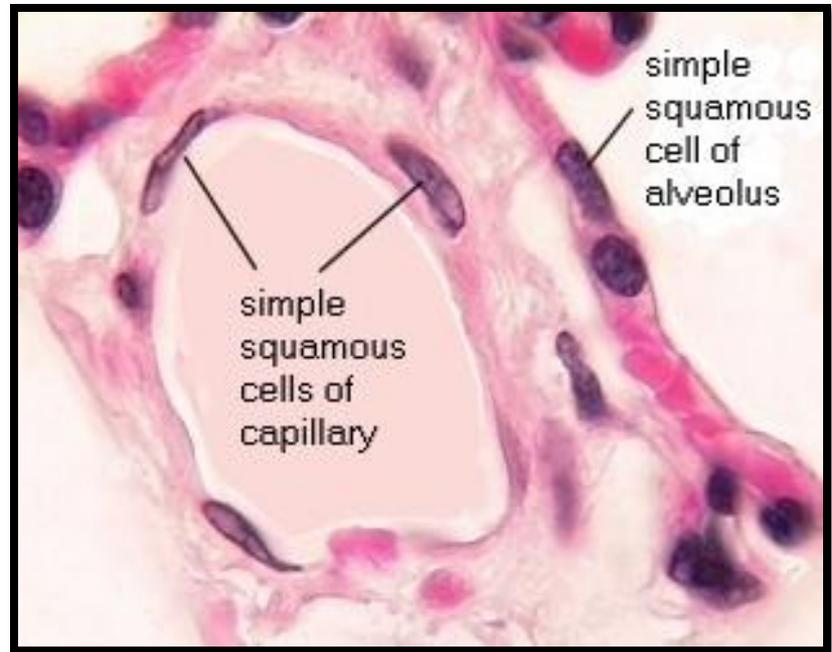
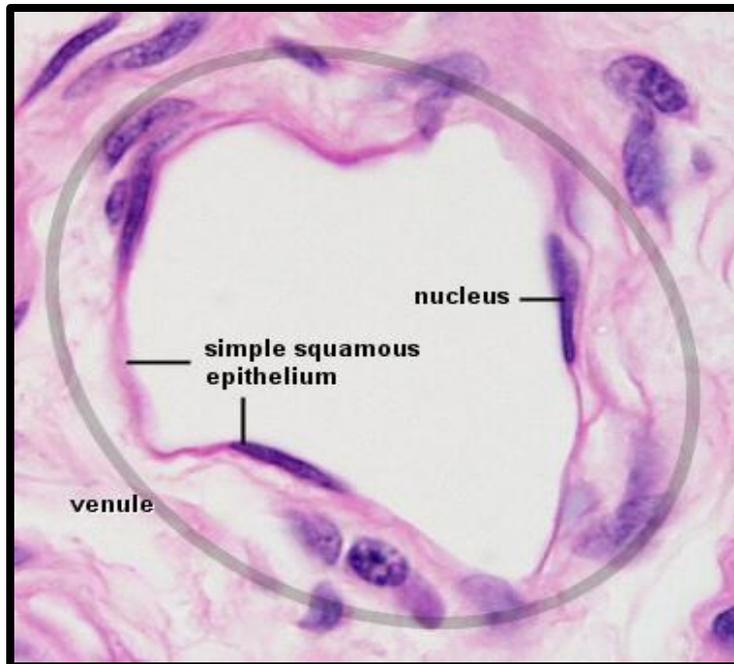
# Simple Squamous Epithelium

- Participates in the formation of blood tissue barriers.
- Permits and bidirectional movement of gases, fluids and nutrients from the free surface to underlying tissue.

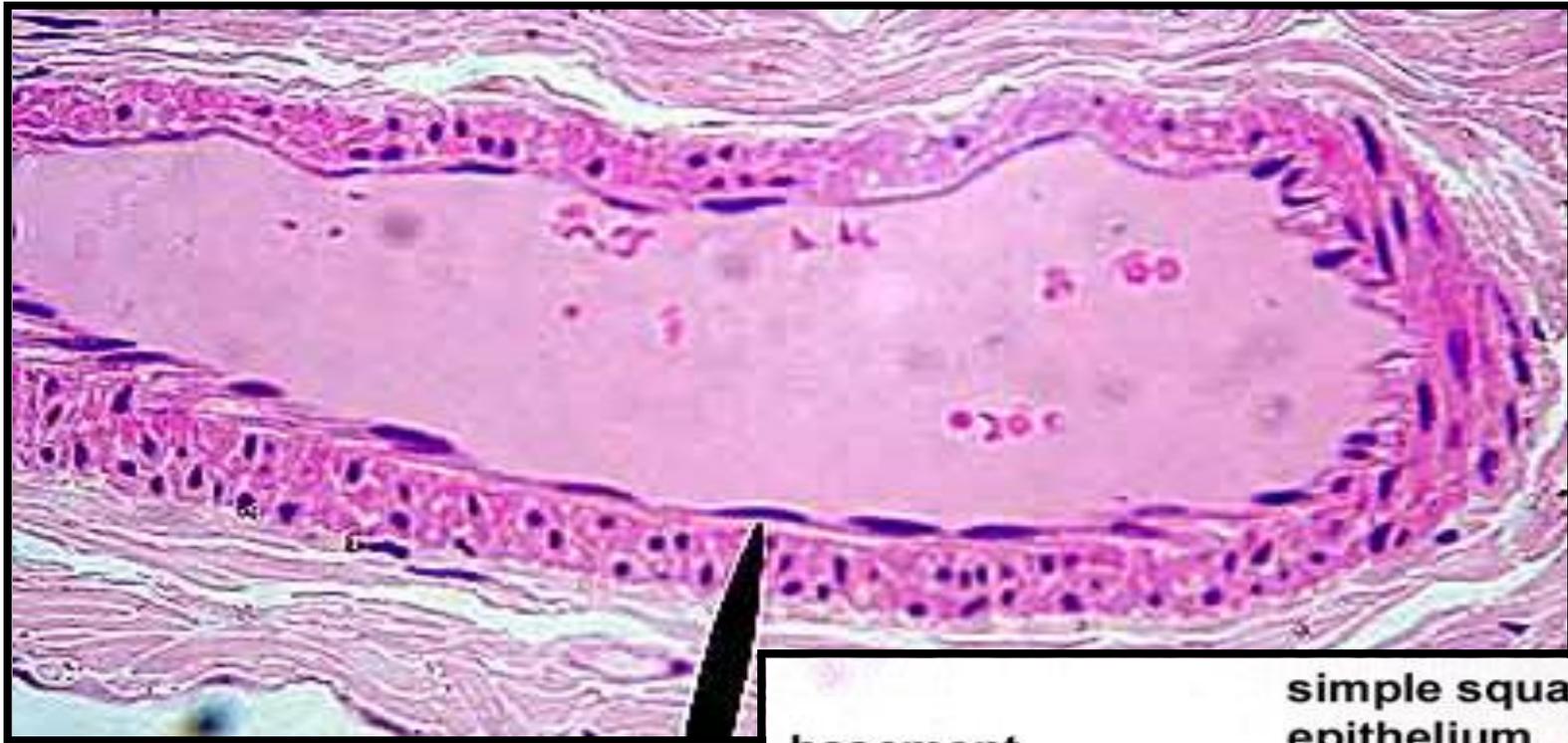


# Naming of the simple squamous epithelium depends on the location:

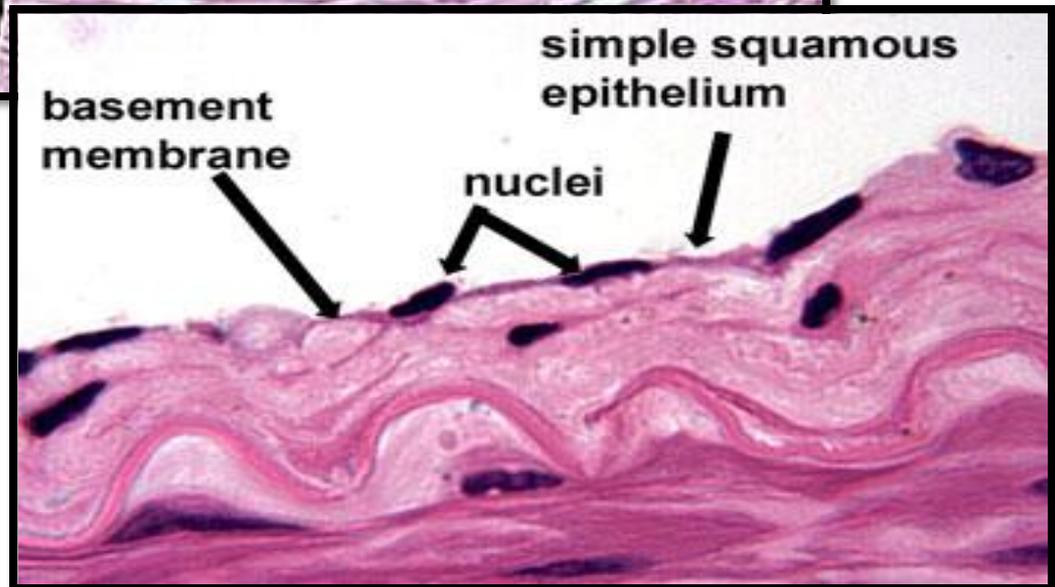
- **Endothelium** is the lining of the blood vessels, lymph vessels and the heart.
- **Mesothelium** is the epithelium forming serous membrane lining internal body cavities: **Peritoneum, Pleura and Pericardium.**
- Simple squamous epithelium found in **Lung alveoli & Loop of Henle.**



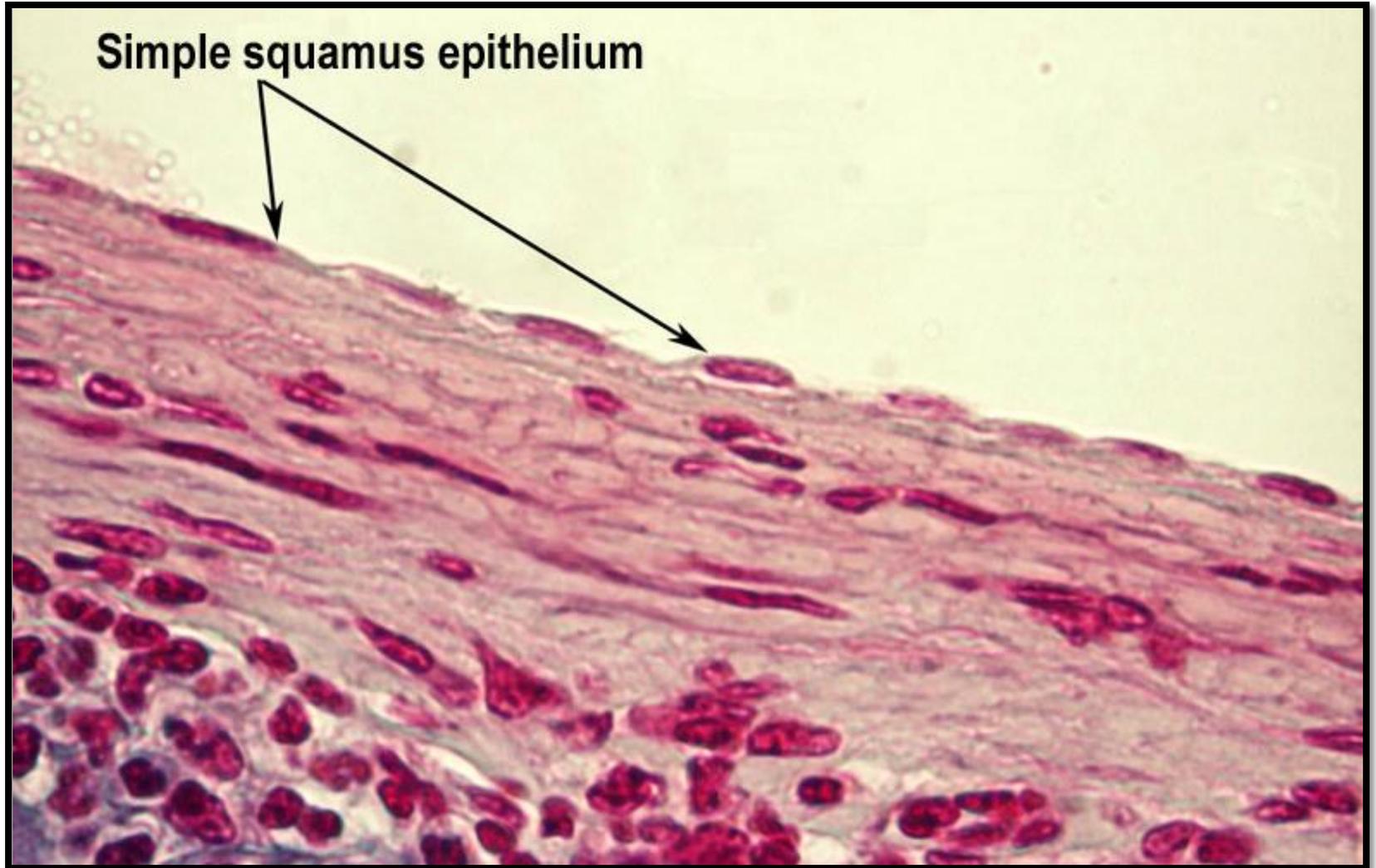
# Simple Squamous Epithelium



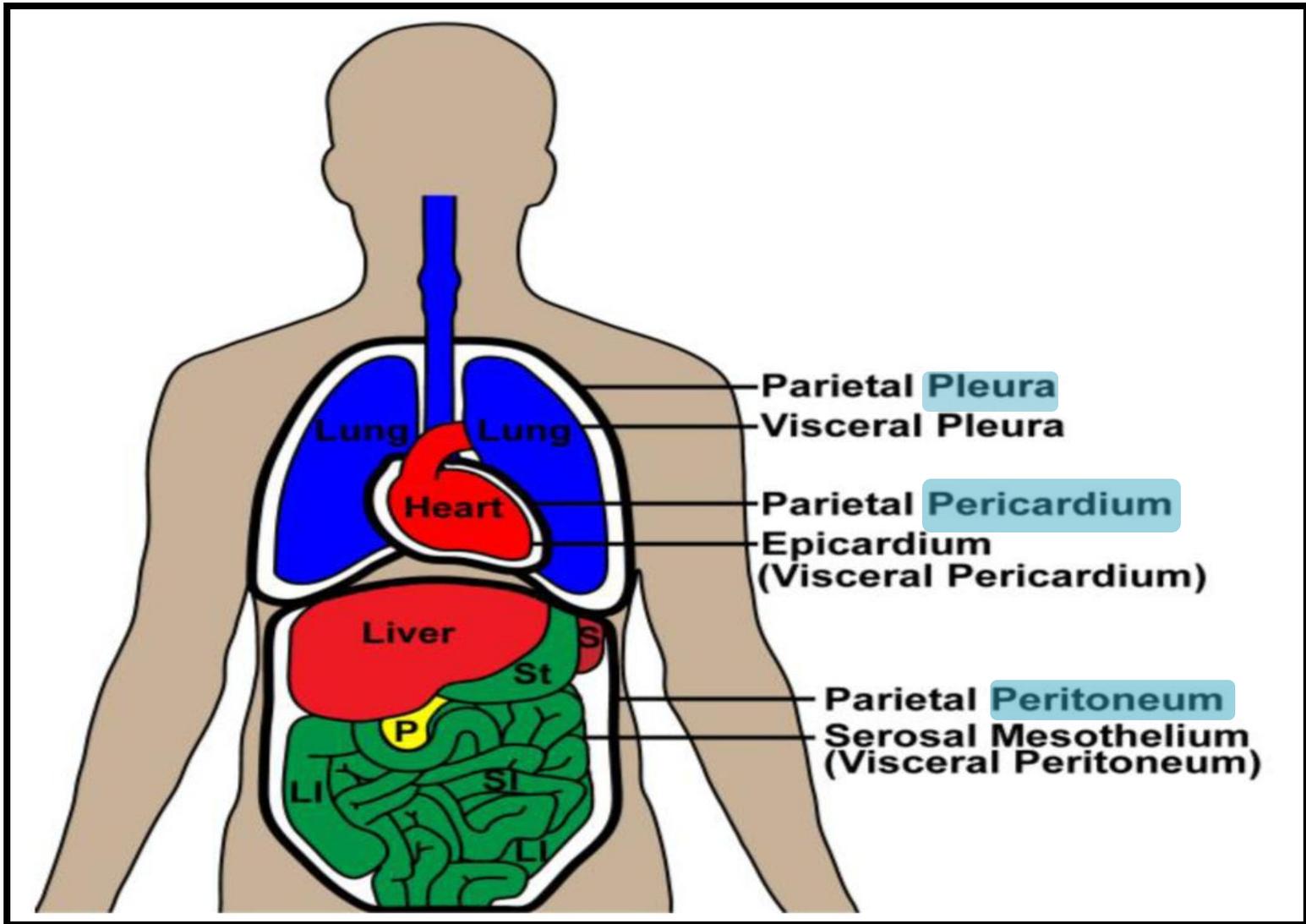
**Endothelium**



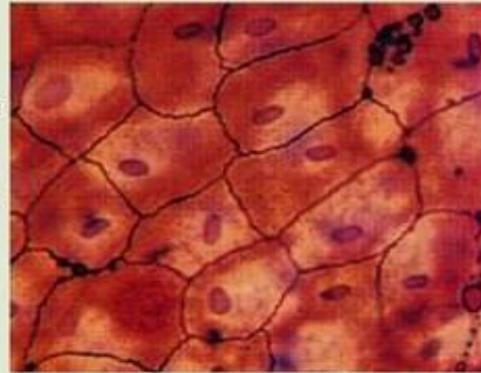
# Simple Squamous Epithelium



# Mesothelium

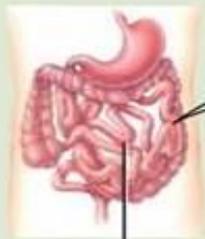


# Mesothelium



LM 243x

Surface view of simple squamous epithelium of mesothelial lining of peritoneum



Small intestine



LM 700x

Sectional view of simple squamous epithelium of small intestine

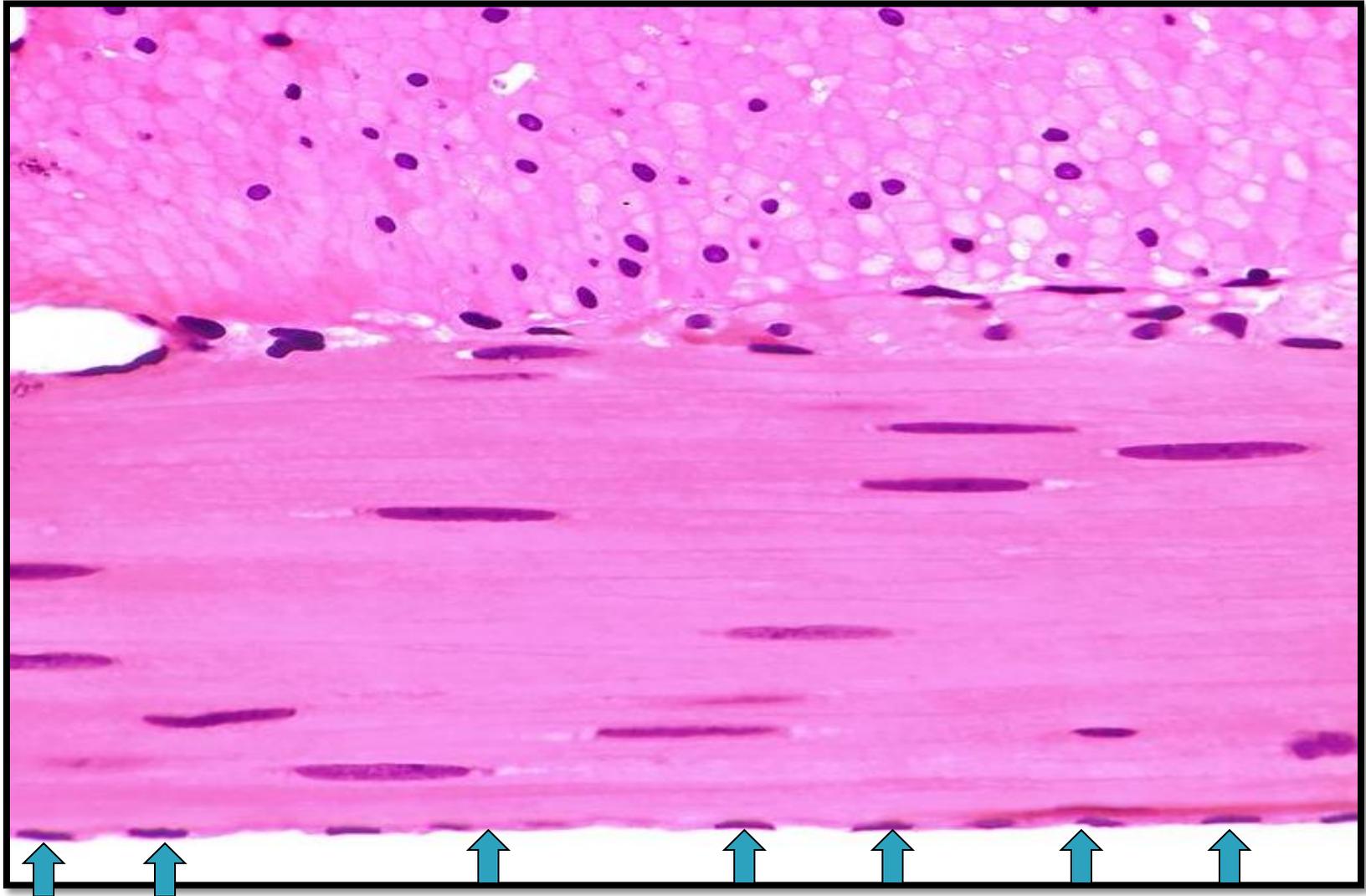


Simple squamous epithelium

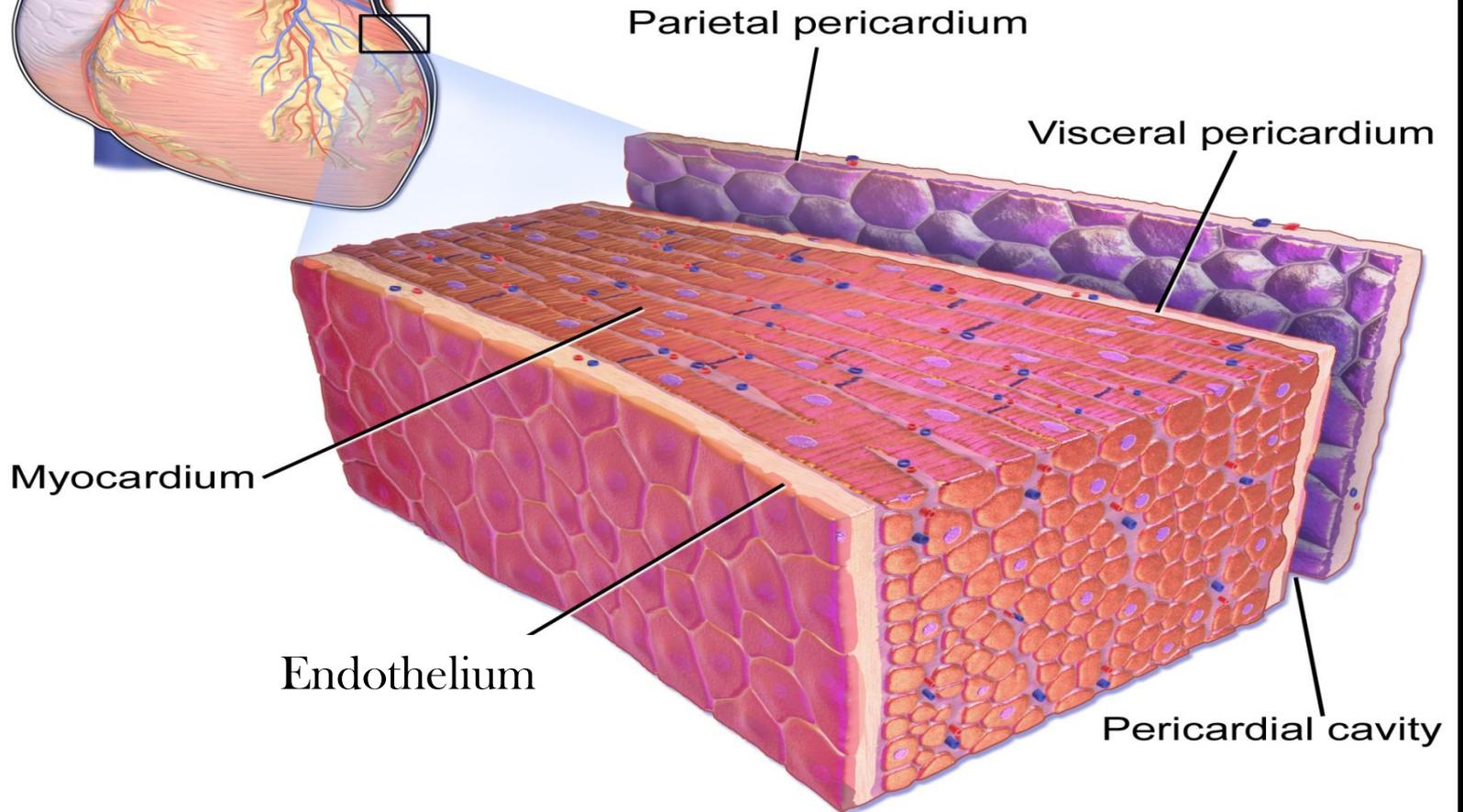
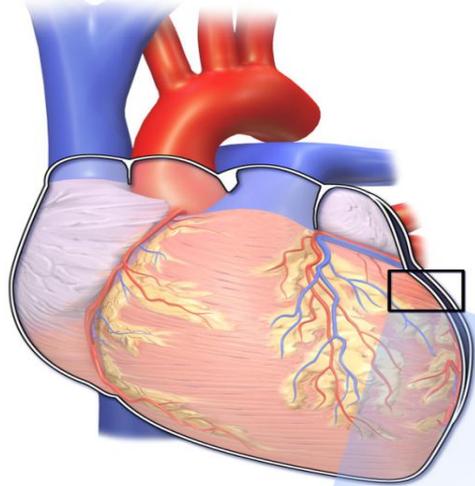
# Mesothelium



# Mesothelium



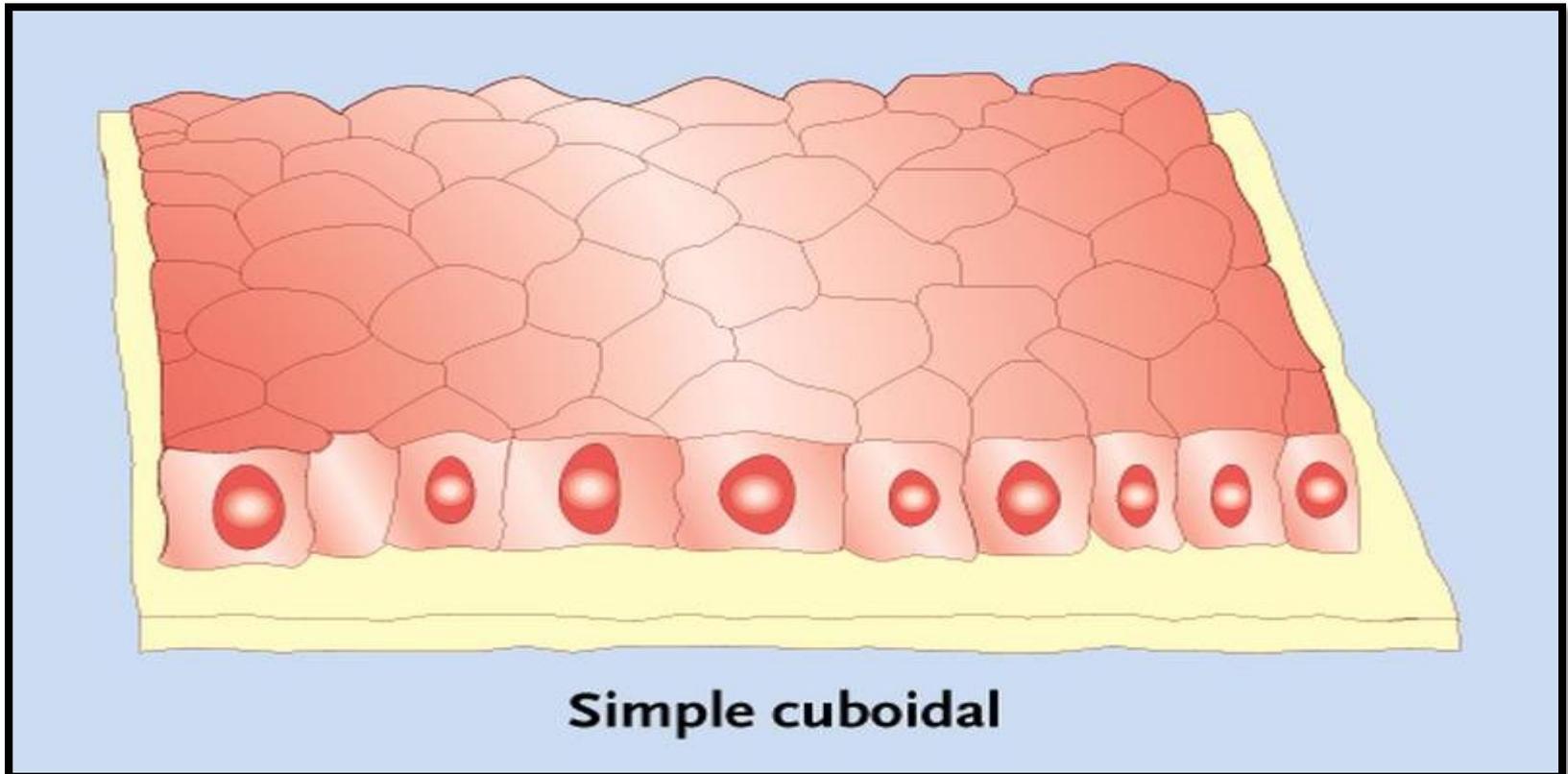
# The Heart Wall



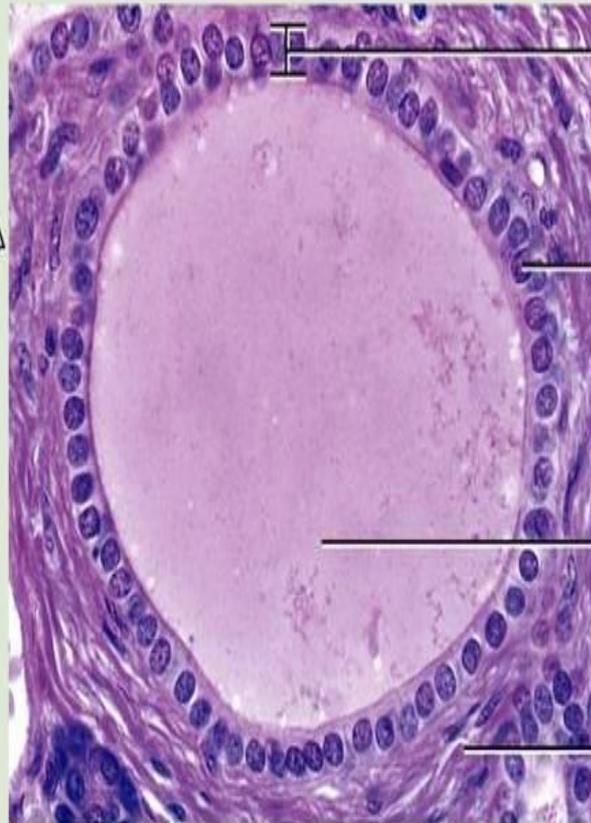
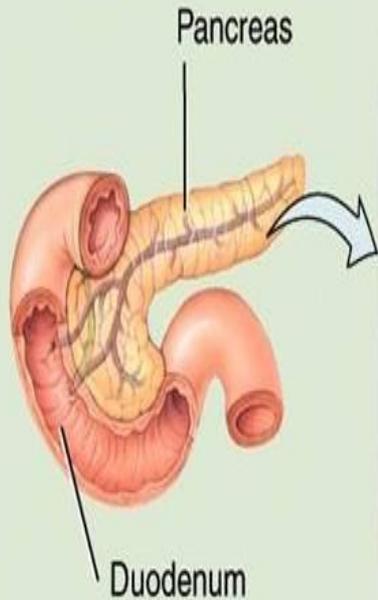
# Simple Cuboidal epithelium

Structure : Single layer of cube shaped cells.

Location: Small collecting ducts of kidney, Glands and ducts of (pancreas & salivary glands), Kidney tubules, Cover ovaries.



# Simple Cuboidal epithelium



Simple cuboidal epithelium

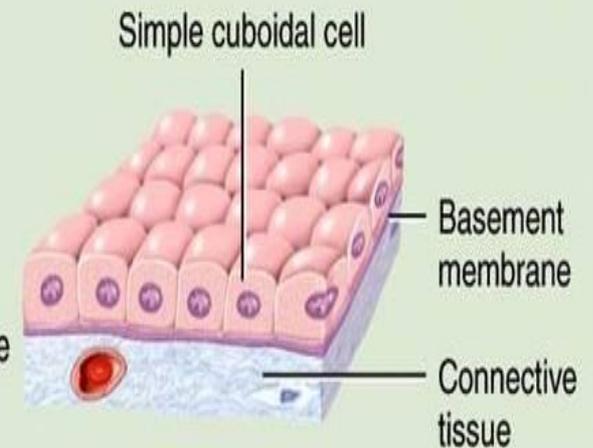
Nucleus of simple cuboidal cell

Lumen of duct

Connective tissue

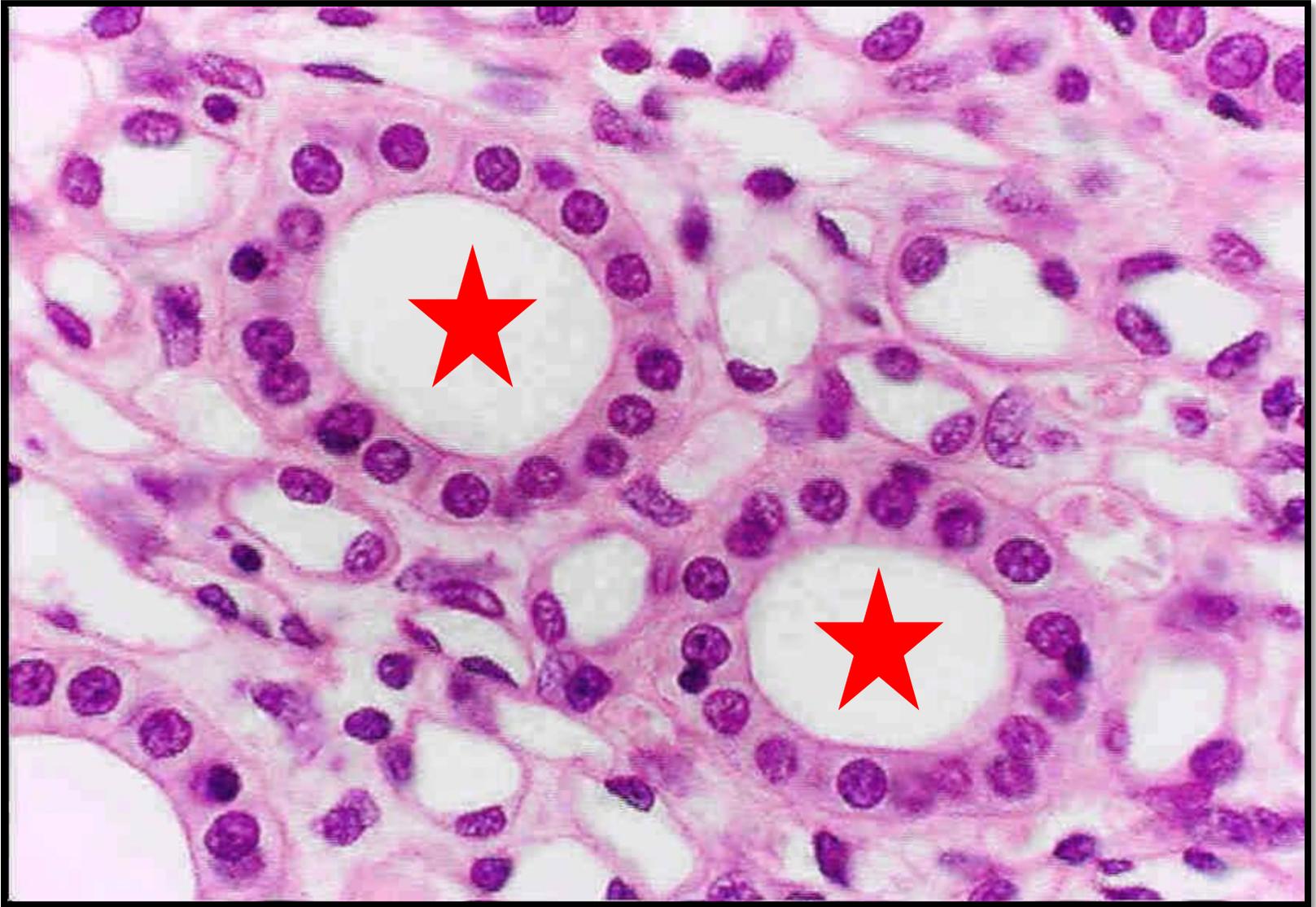
LM 330x

Sectional view of simple cuboidal epithelium of intralobular duct of pancreas



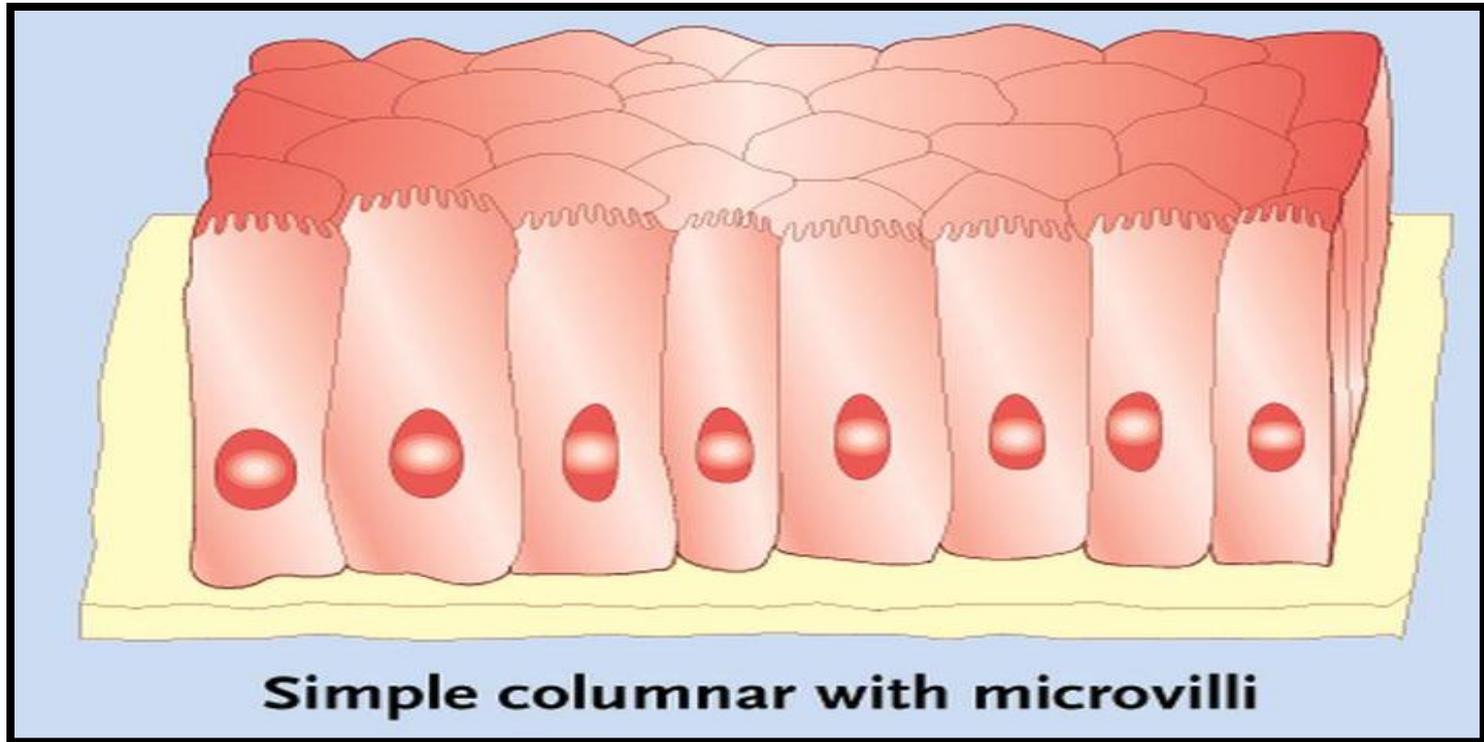
Simple cuboidal epithelium

# Simple Cuboidal epithelium



# Simple Columnar Epithelium

- Structure : Elongated layer of cells with nuclei at same level.
- Location : Small intestine, Stomach, Gall bladder, Proximal convoluted tubules, Forms major ducts of exocrine glands.



# **Simple Columnar Epithelium**

- Engaged in the protection of wet surfaces, absorption and secretion.
- **Simple columnar Epithelium:** Found in Stomach , Forms major ducts of exocrine glands
- **Simple columnar Epithelium ciliated:** Found in (Fallopian tube, Uterus), it helps in movement of fluid in the female genital tract.
- **Simple columnar Epithelium with microvilli:** Found in Small intestine and proximal convoluted tubules( kidney), Gallbladder, it helps in absorption.

# Simple Columnar Epithelium



# **Simple Columnar Epithelium ciliated**



Fallopian tube, Uterus

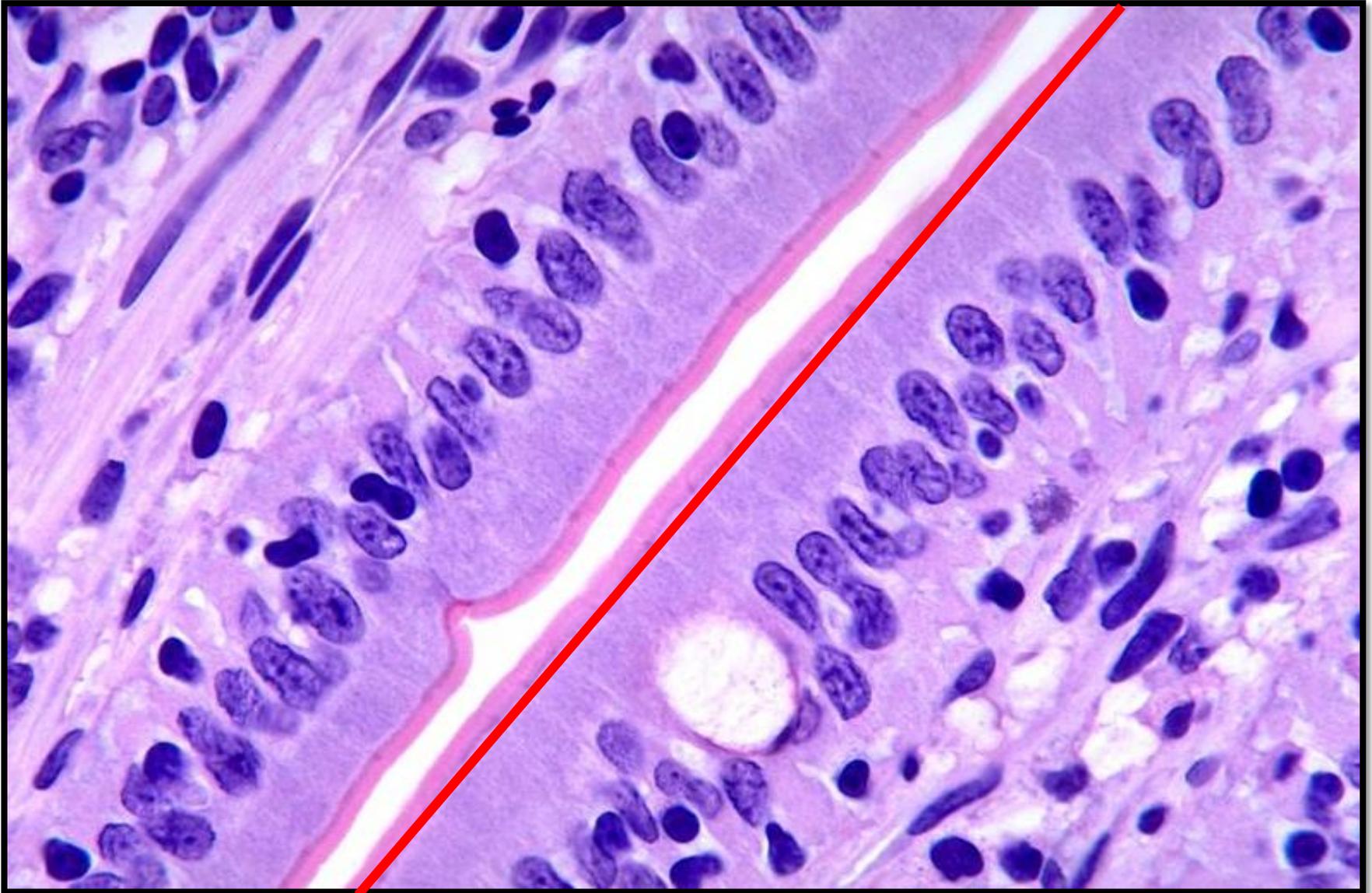
# **Simple Columnar Epithelium with microvilli ( H&E stain)**



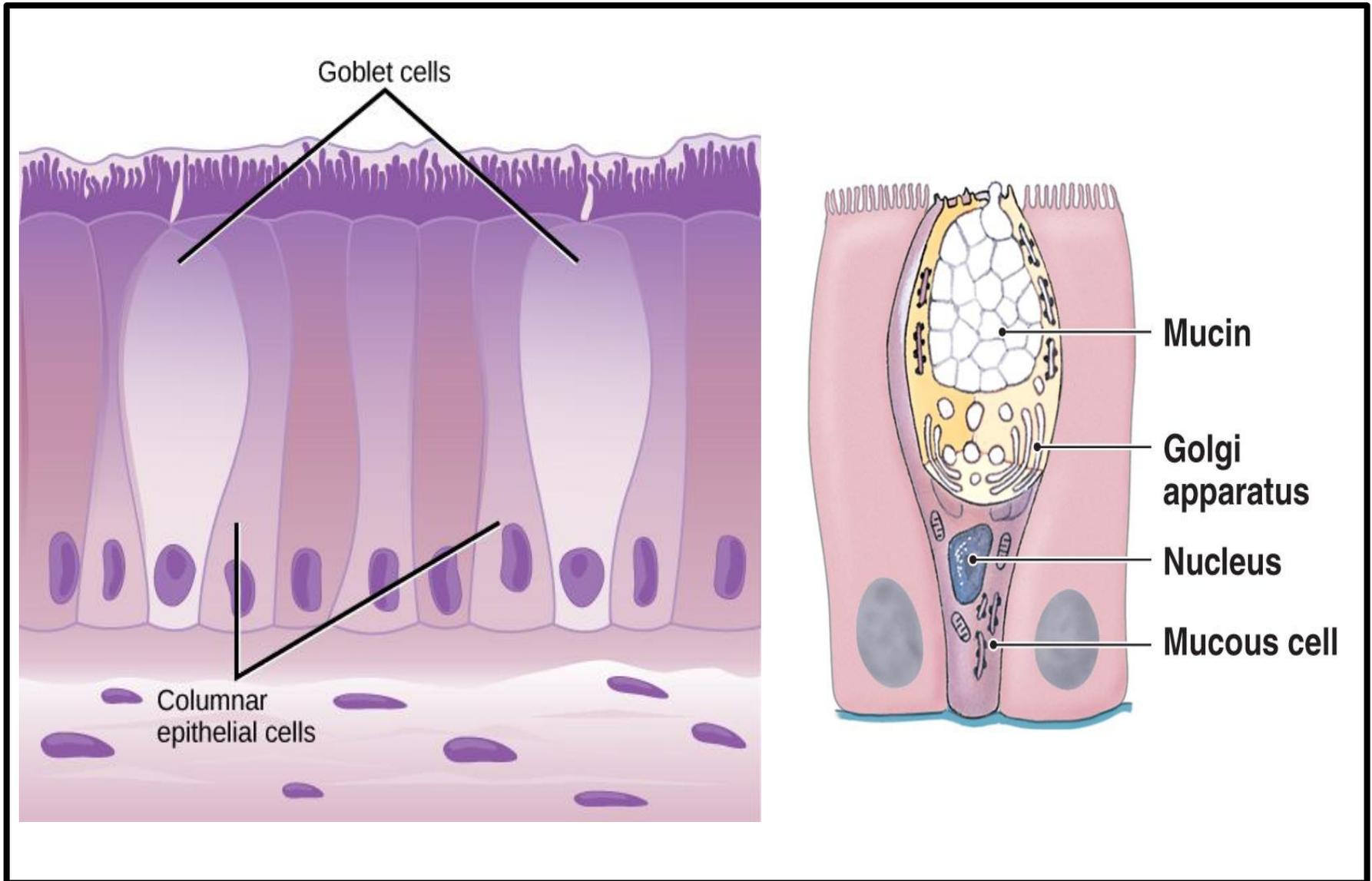
# **Simple Columnar Epithelium with microvilli**



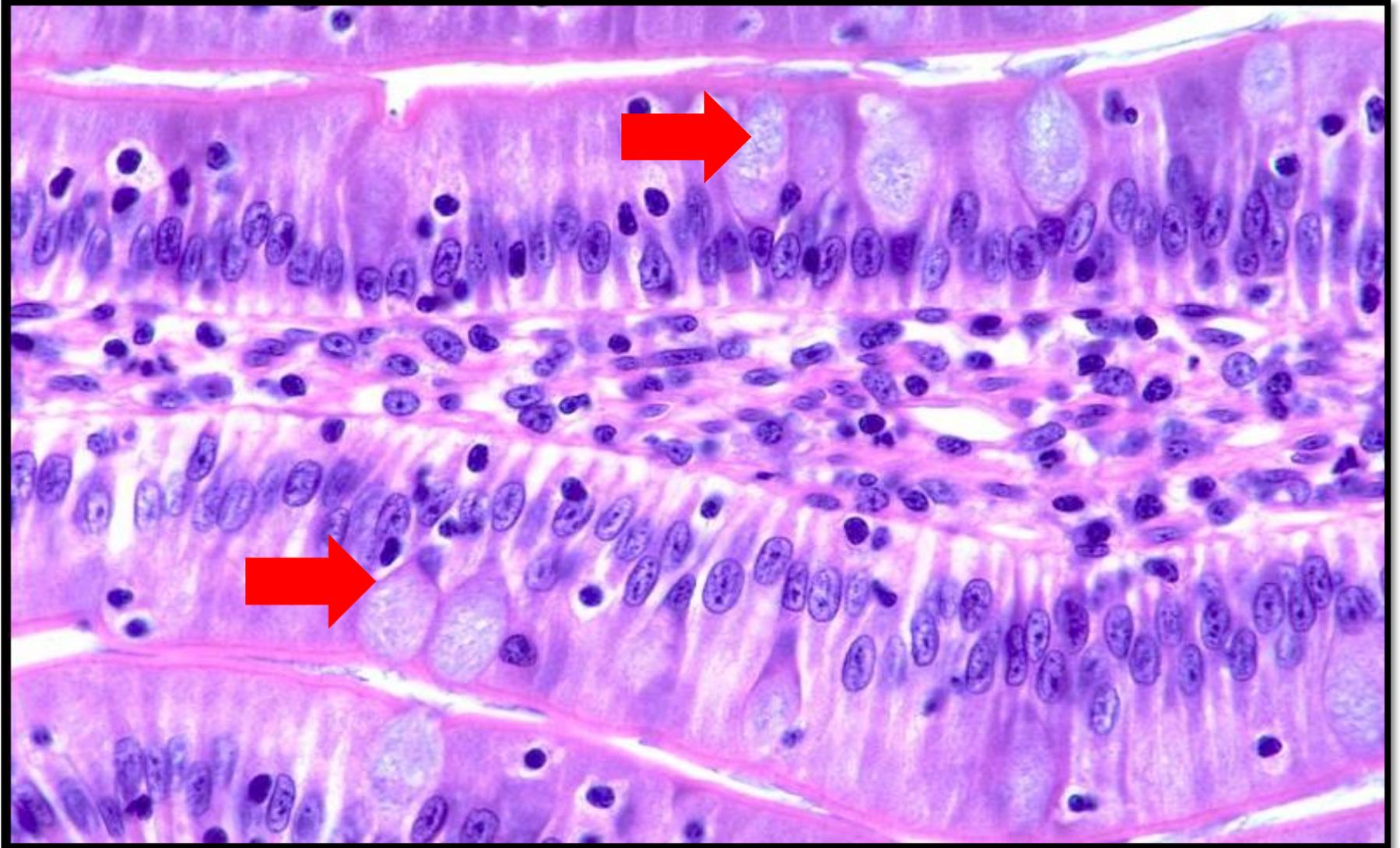
# Simple Columnar Epithelium with microvilli (PAS stain)



# Goblet Cells



# **Simple Columnar Epithelium with microvilli & goblet cells**



# Goblet Cells (PAS stain)



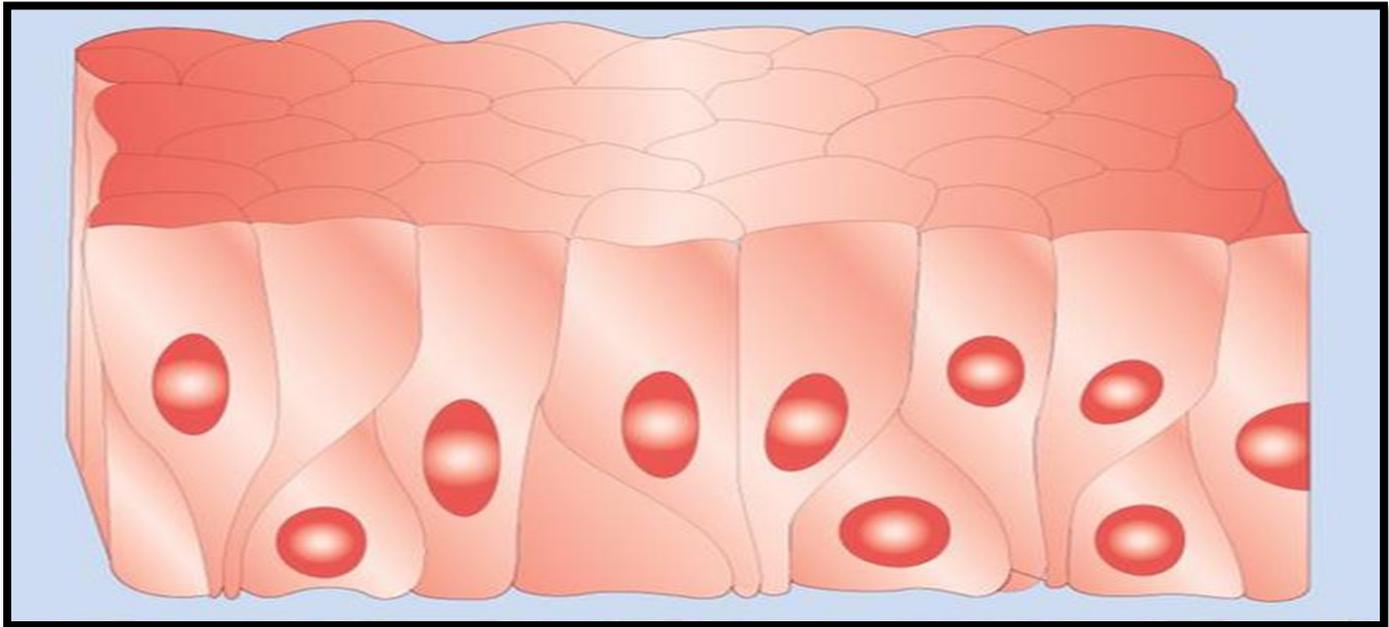
# Pseudostratified Columnar Epithelium

- **Structure** : Irregularly shaped cells with nuclei at different levels - appear stratified, but aren't.

All cells reach basement membrane.

- **Location**: **Ciliated with goblet cells** = Found in Upper respiratory tract (trachea and bronchi). It entraps foreign particles in the respiratory tract.

**With stereocilia** = Found in epididymis and ductus deferens.  
Perform a secretory and absorptive functions



# **Pseudostratified Columnar Epithelium**

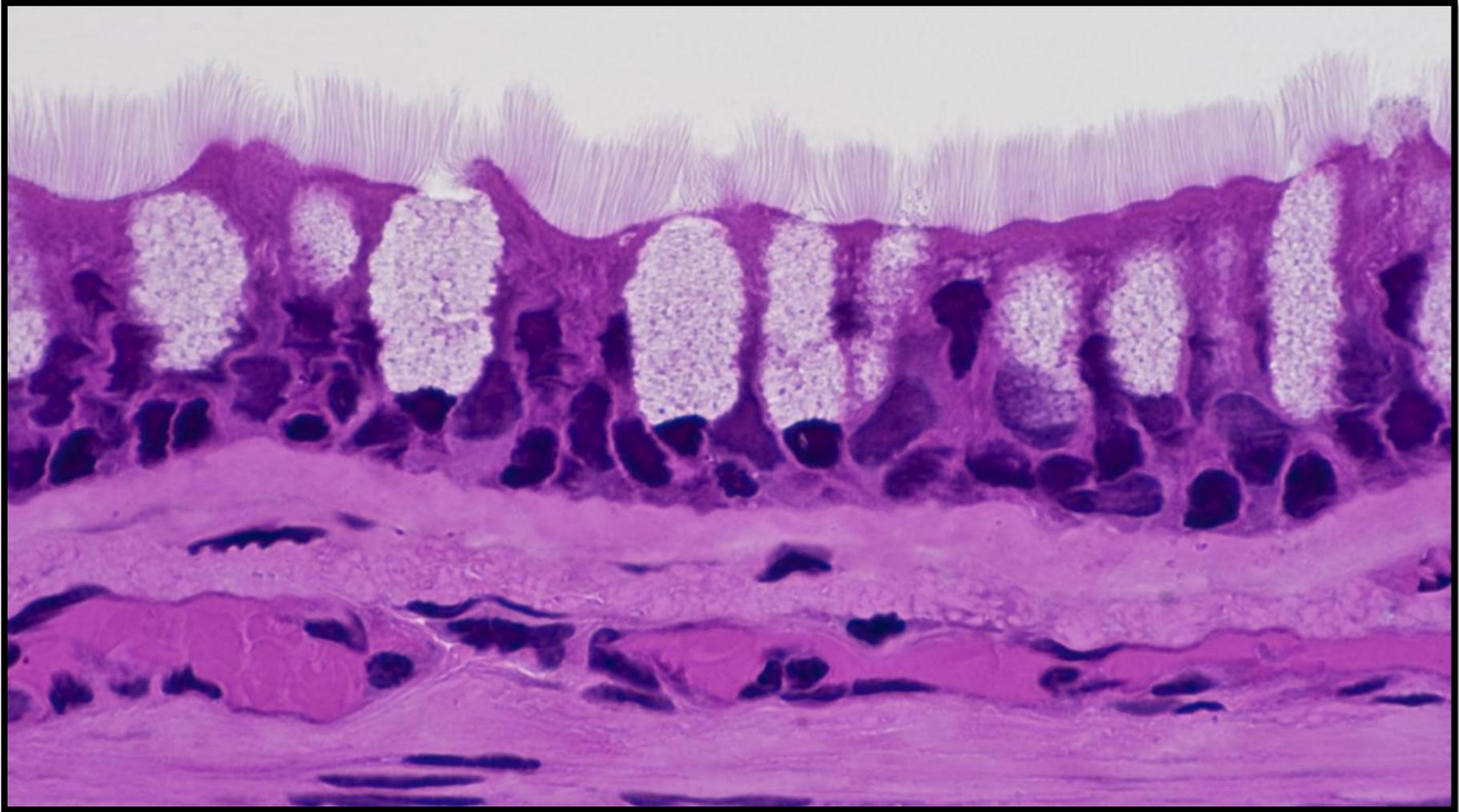
## **Ciliated with goblet cells**



Upper respiratory tract (trachea and bronchi)

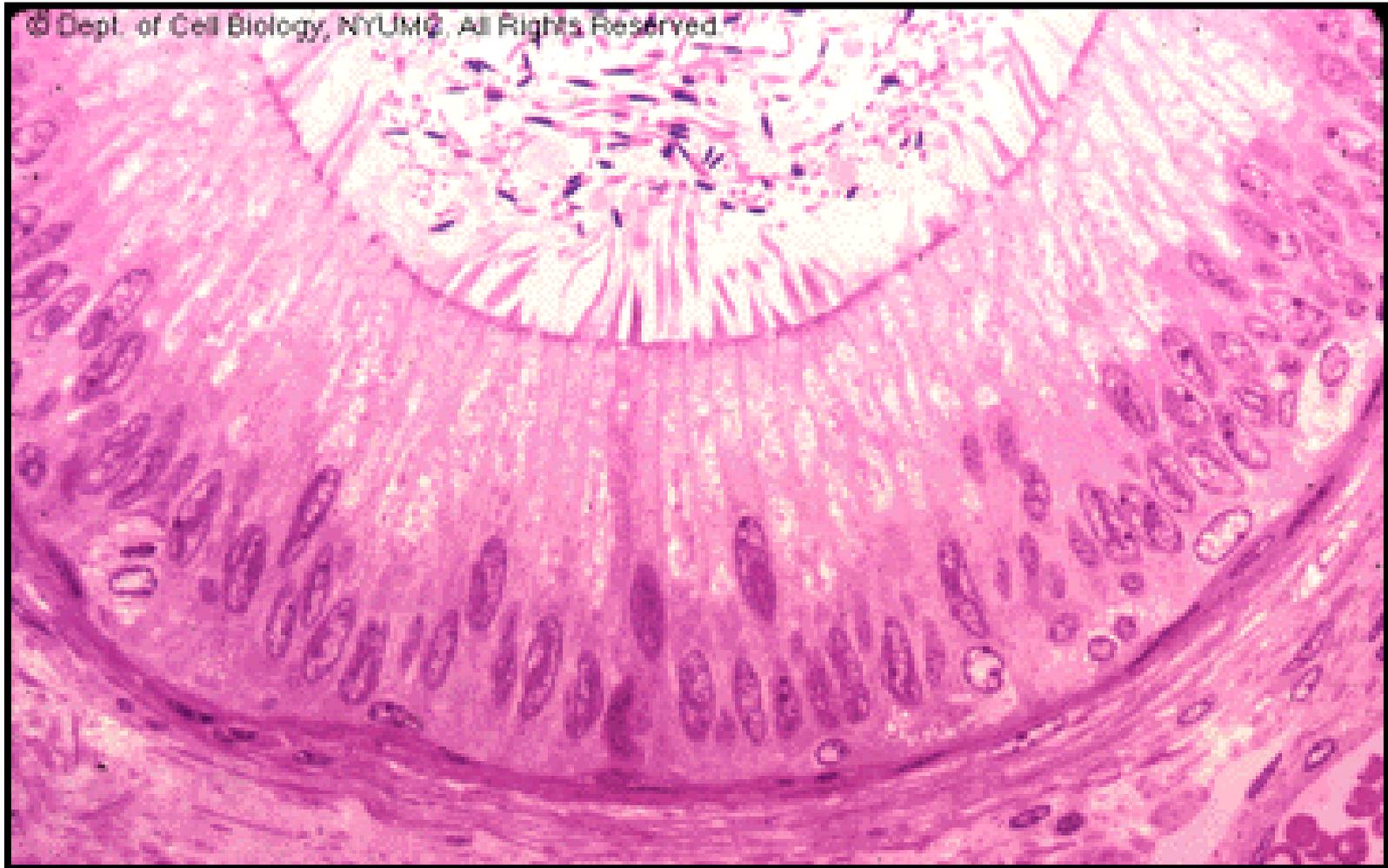
# **Pseudostratified Columnar Epithelium**

## **Ciliated with goblet cells**



Upper respiratory tract (trachea and bronchi)

# **Pseudostratified Columnar Epithelium with stereocilia**



Epididymis and ductus deferens



**Stratified  
Epithelium**

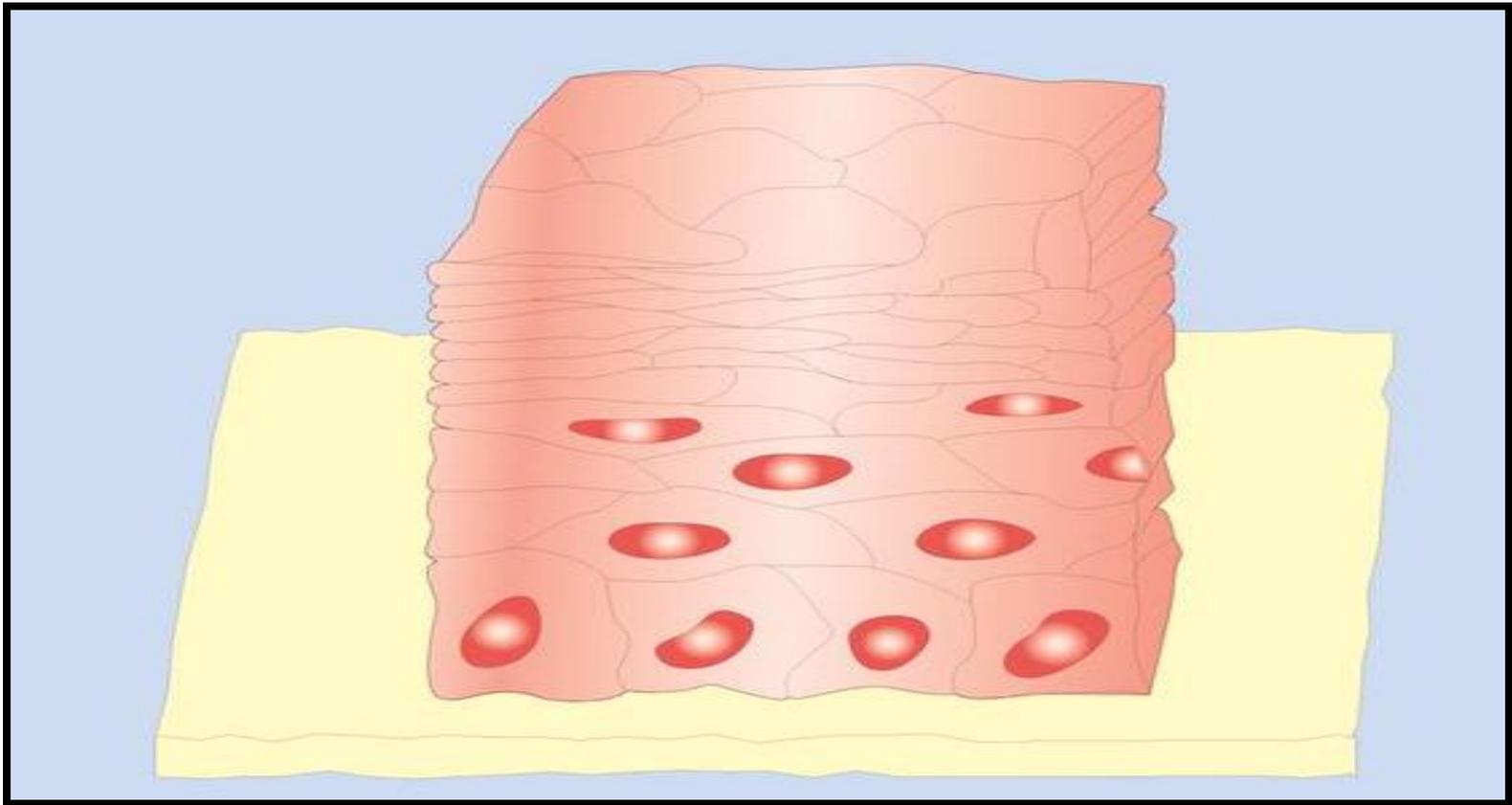
# Types of Stratified Epithelium

Stratified squamous	Stratified cuboidal	Stratified columnar	Transitional epithelium
<b>Keratinized</b> Epidermis of skin	Larger ducts of exocrine glands such as: salivary glands .	Conjunctiva, lining the eyelids. Large excretory duct.	Urinary tract (Urinary bladder & Ureters )
<b>Non Keratinized</b> Oral cavity ,Pharynx Oesophagus, Anal canal. Uterine cervix, Vagina			

# **Stratified Squamous Epithelium Keratinized**

**Structure:** The surface cells are full of keratin and non-nucleated, basal cells are active in mitosis and produce the cells of the more superficial layers.

**Location:** Epidermis of skin.

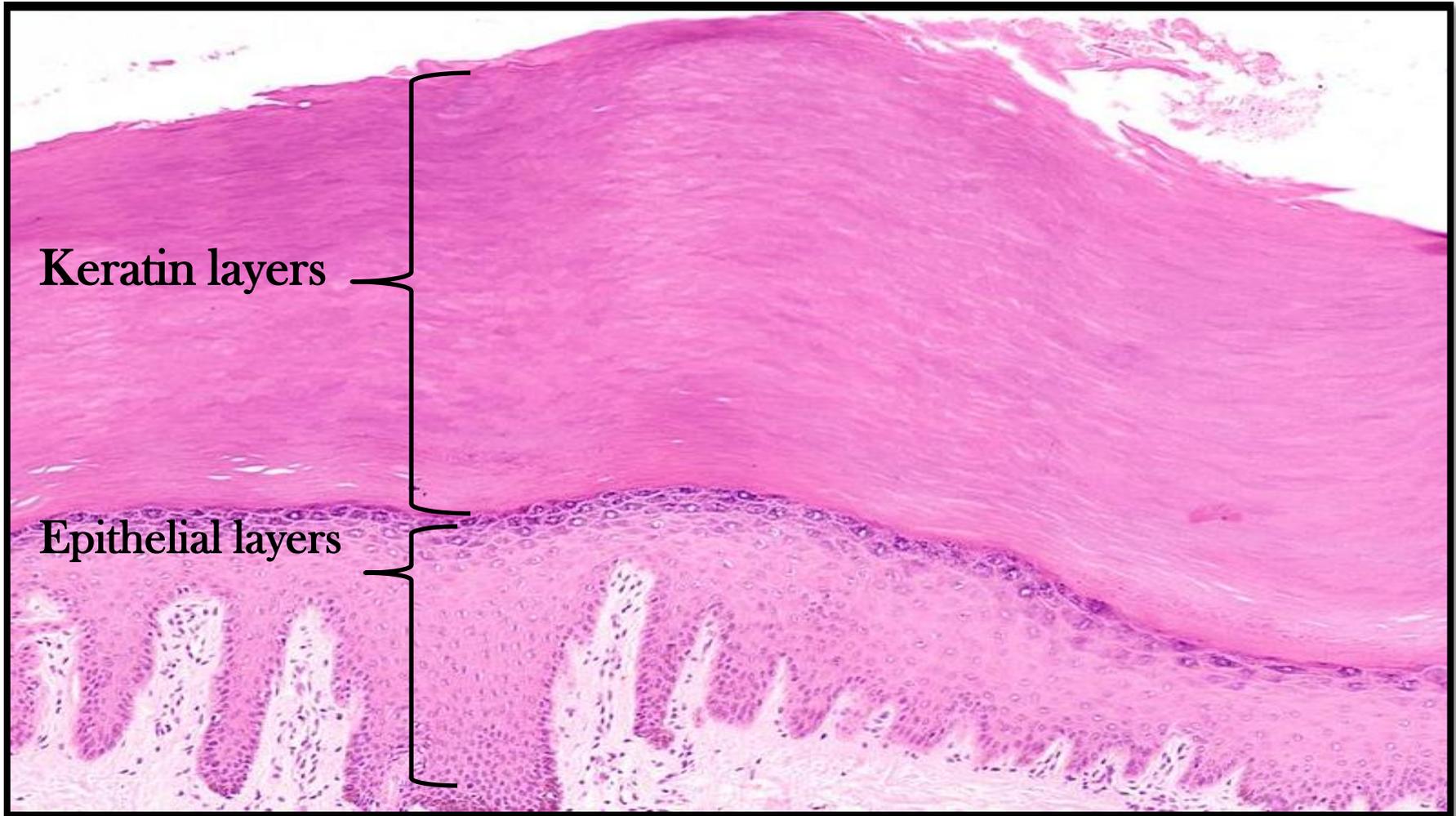


# Stratified Squamous Epithelium Keratinized



Epidermis of skin

# Stratified Squamous Epithelium Keratinized



Epidermis of skin

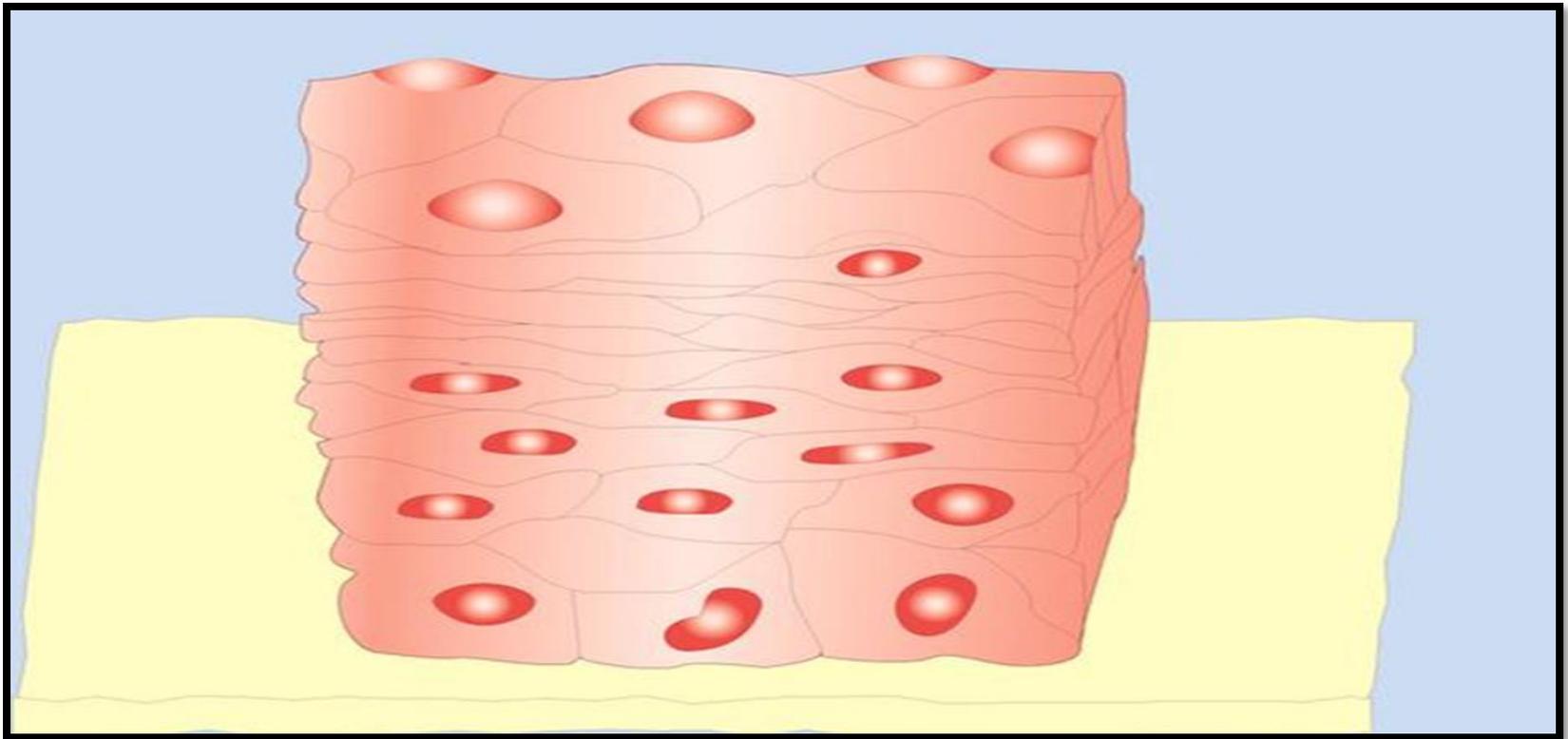
# **Stratified Squamous Epithelium Keratinized**



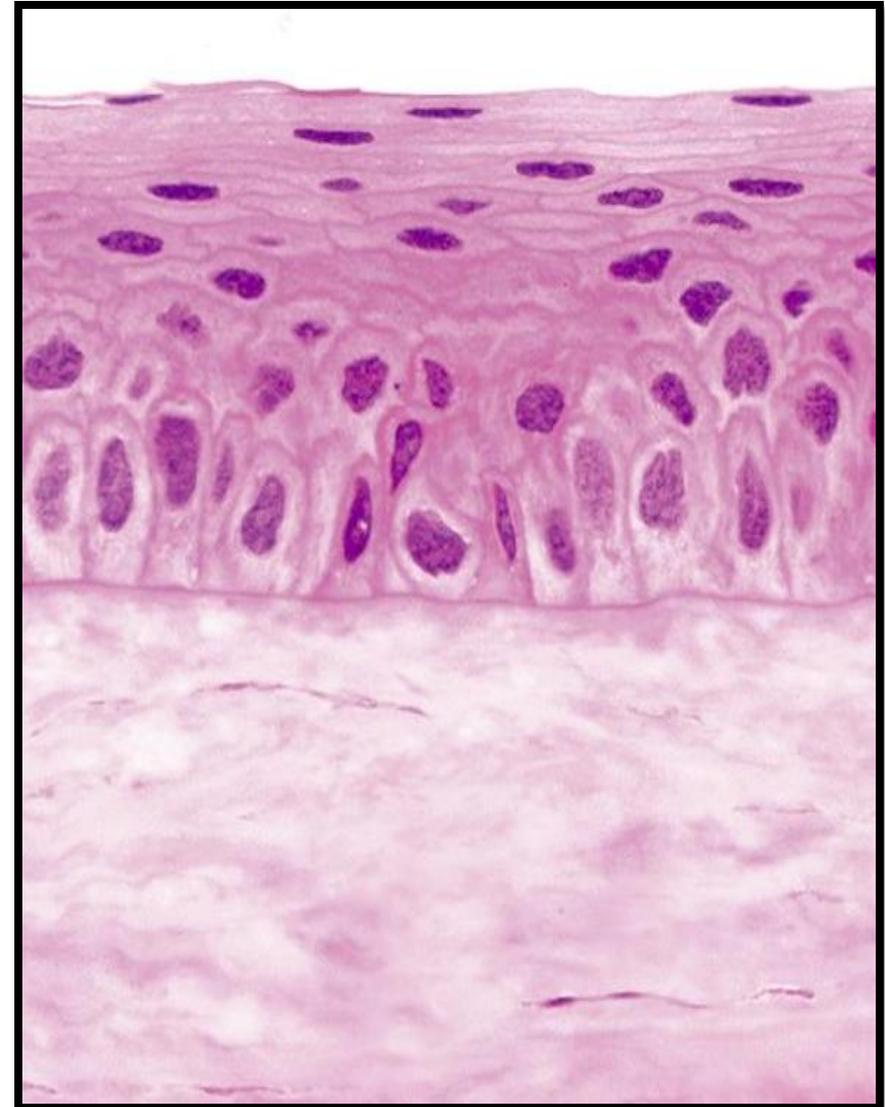
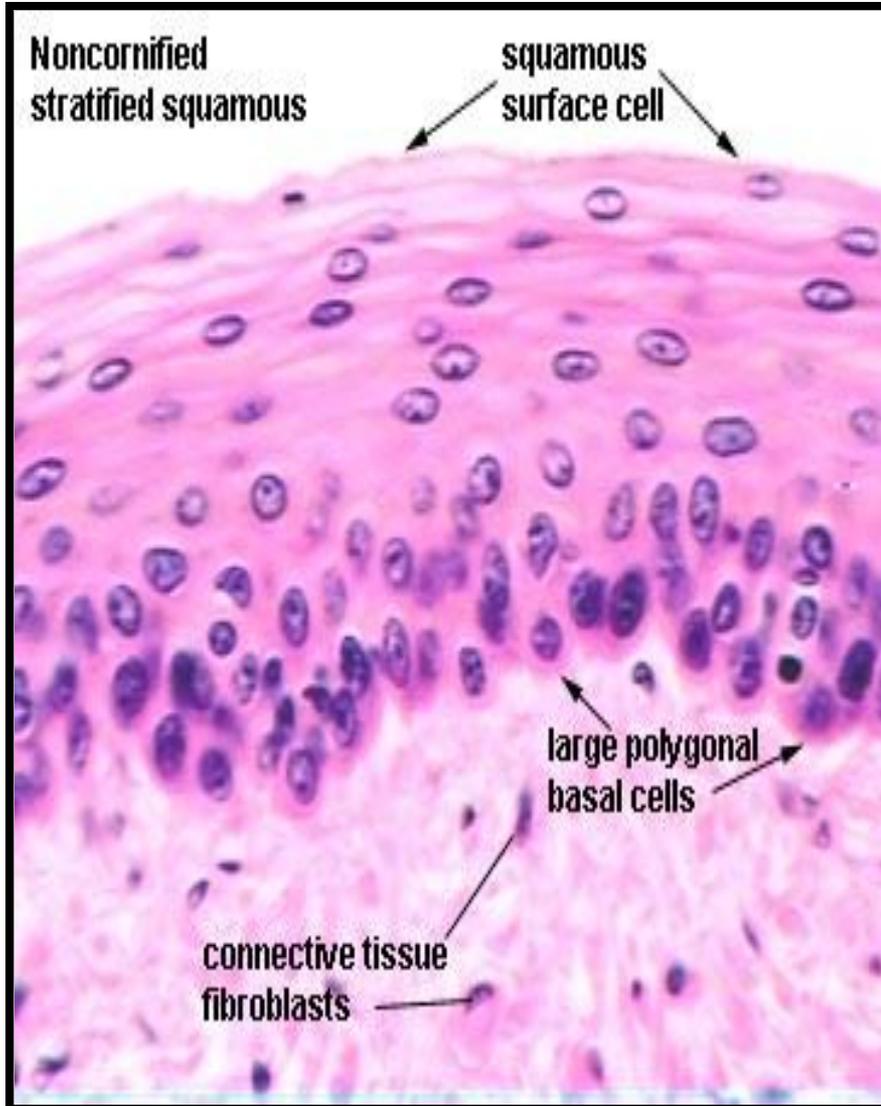
Epidermis of skin

# Stratified Squamous Non keratinized Epithelium

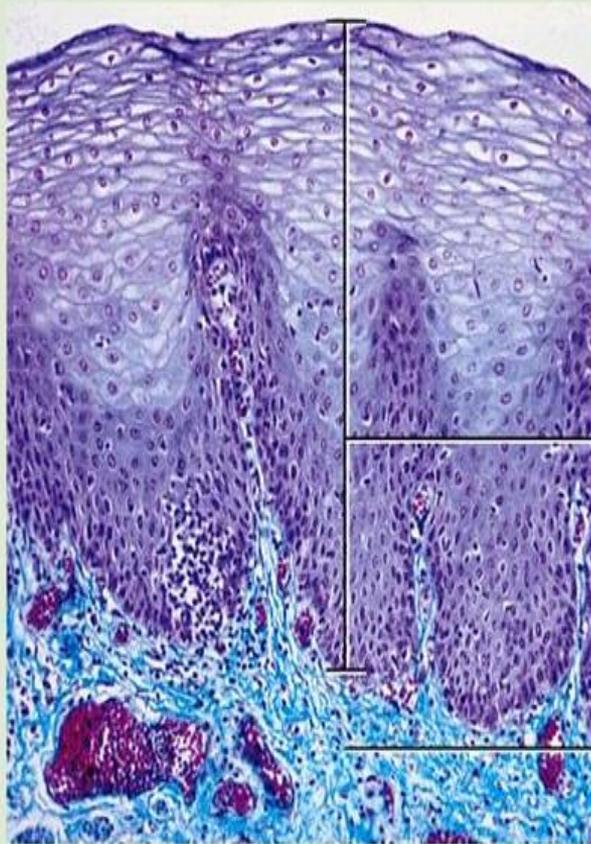
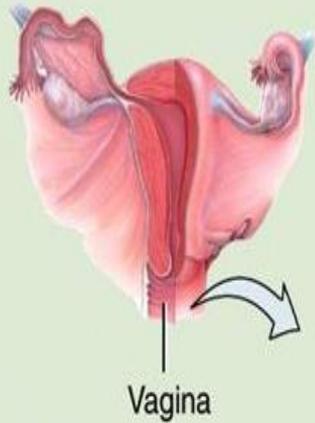
- **Structure:** Composed of several layers, basal cells are cuboidal or columnar and metabolically active, surface cells are flattened ( Squamous) and nucleated.
- **Location:** Oral cavity, Pharynx, Oesophagus, Anal canal, Uterine cervix, Vagina.



# Stratified Squamous Non keratinized Epithelium



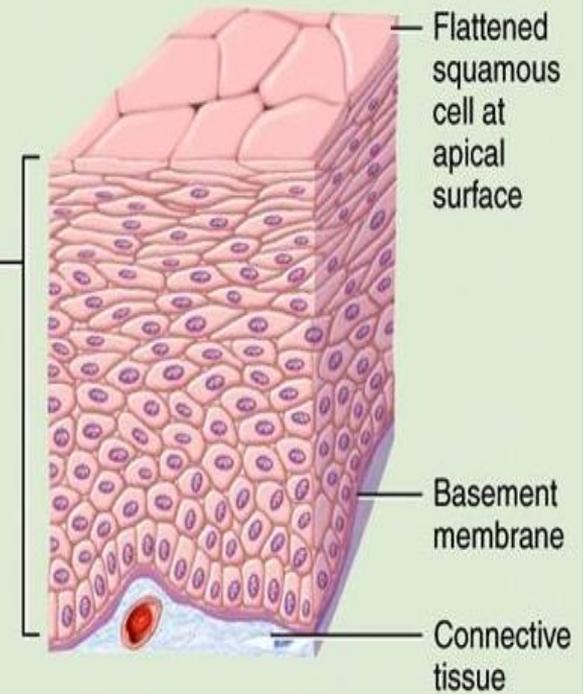
# Stratified Squamous Non keratinized Epithelium



Stratified squamous epithelium

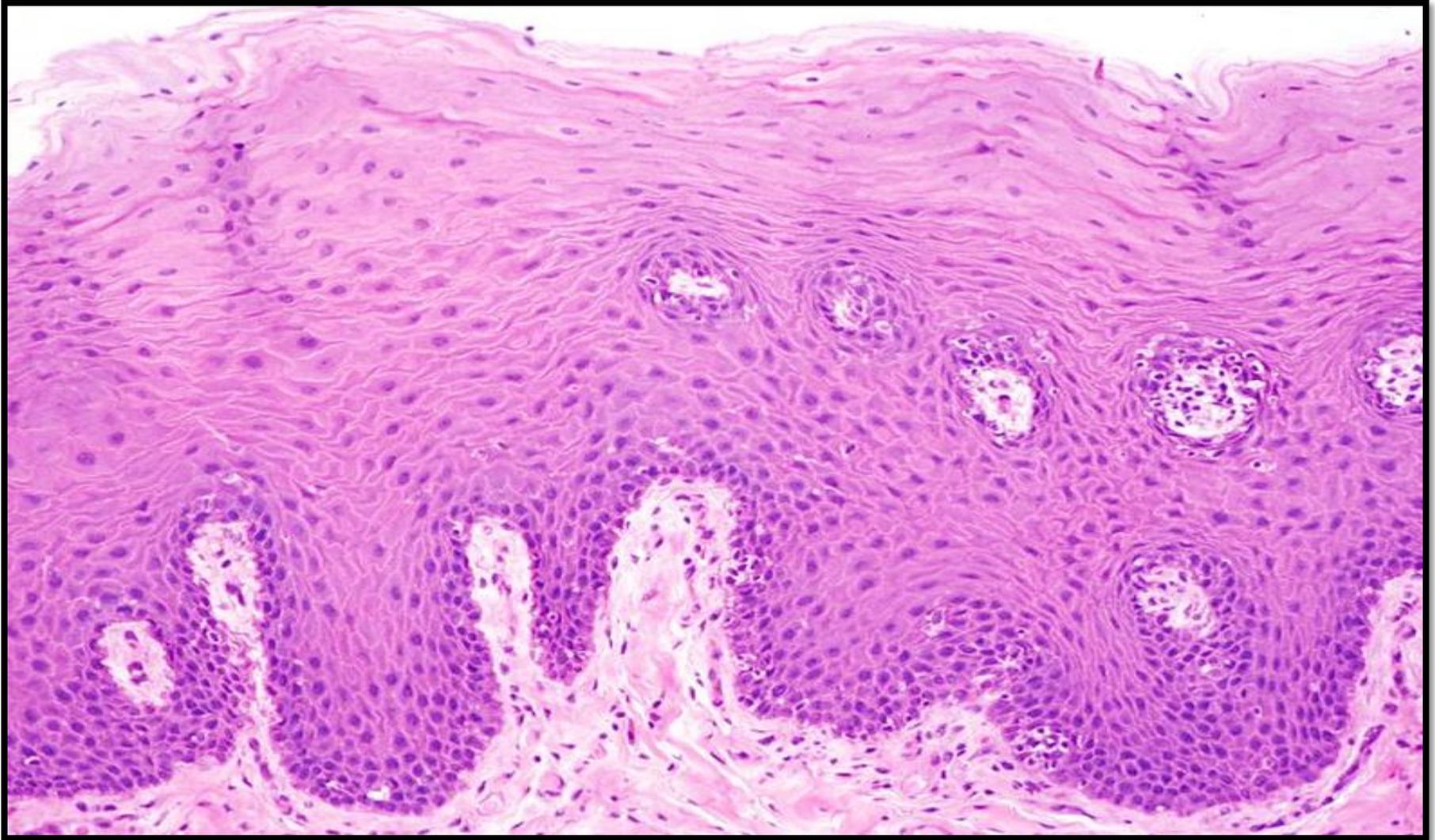
Connective tissue

Sectional view of stratified squamous epithelium of vagina



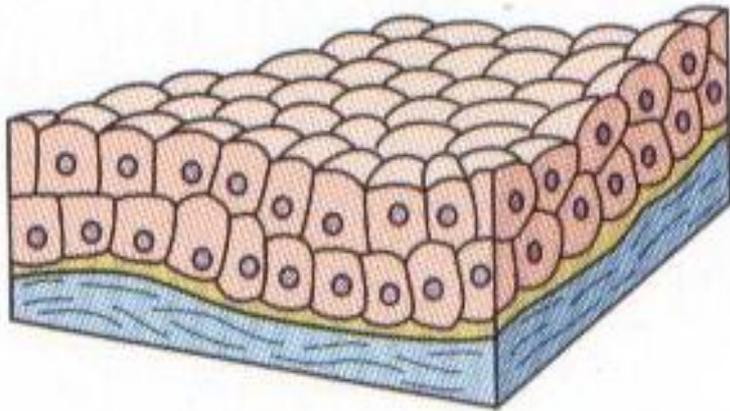
Stratified squamous epithelium

# Stratified Squamous Non keratinized Epithelium

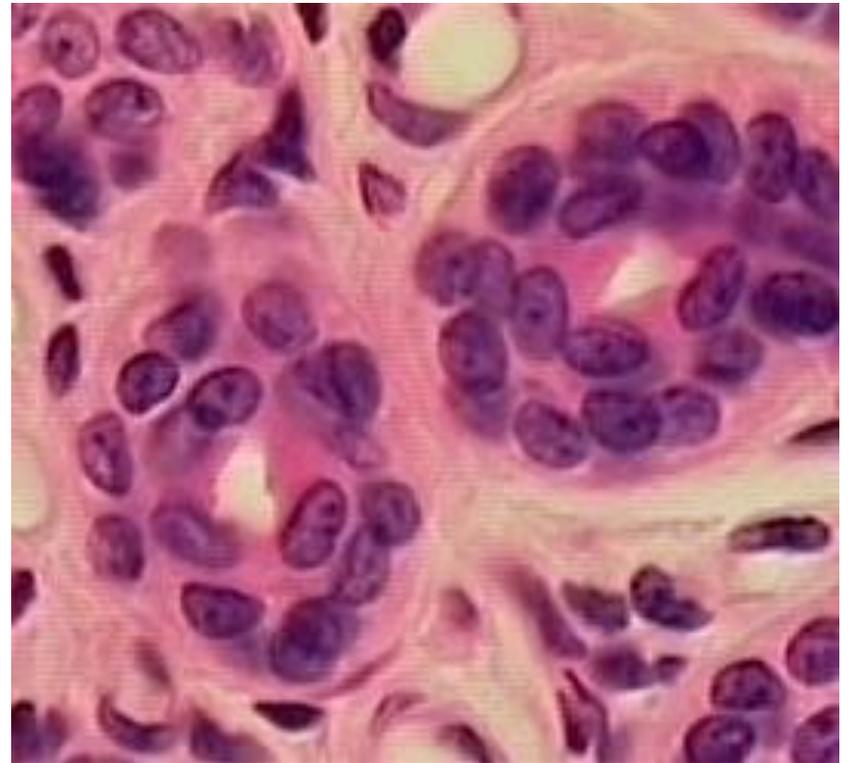


# Stratified Cuboidal Epithelium

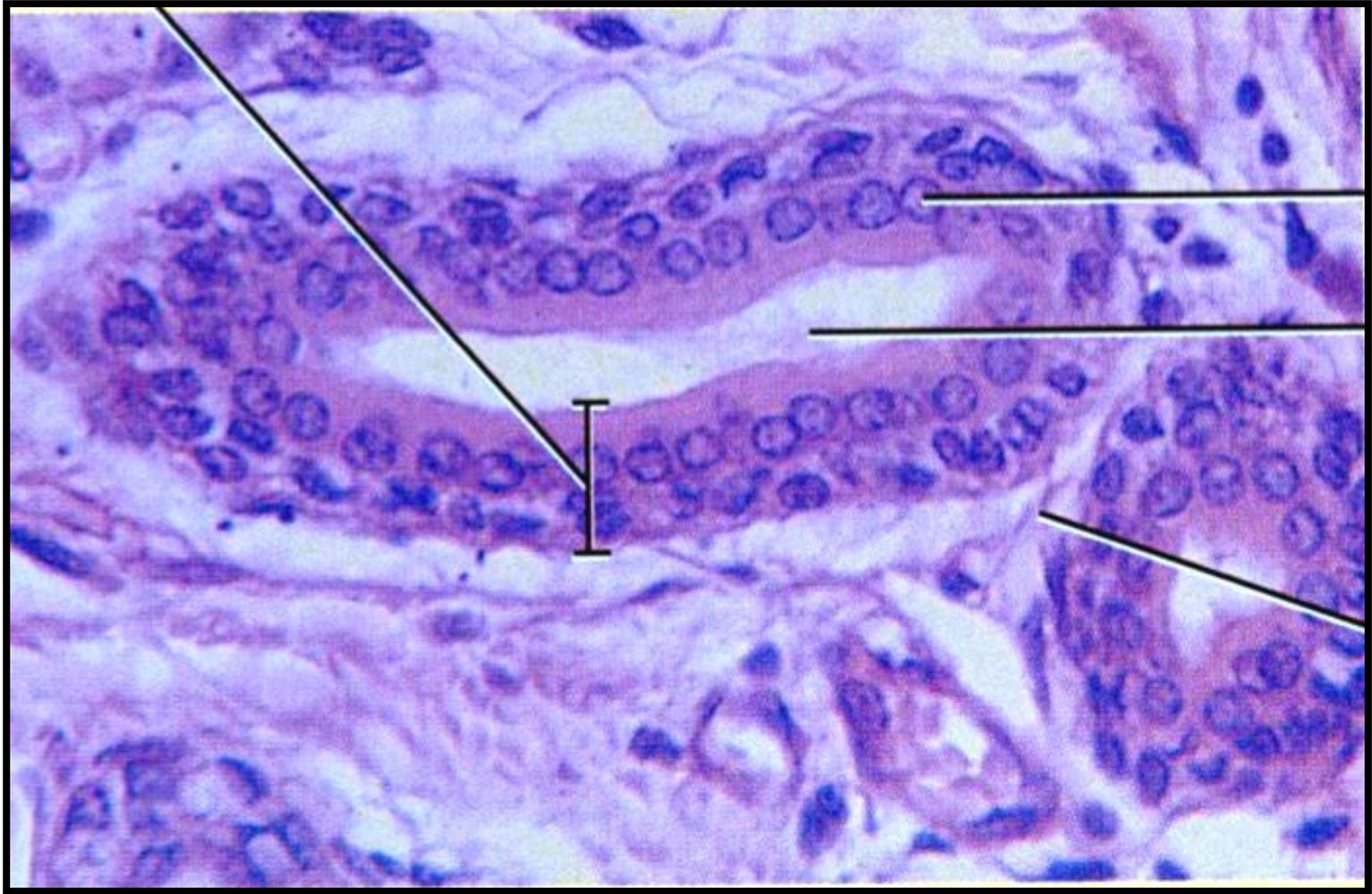
- Structure: Generally two layers of cuboidal cells.
- Location : Larger ducts of exocrine glands such as salivary glands.



Cuboidal



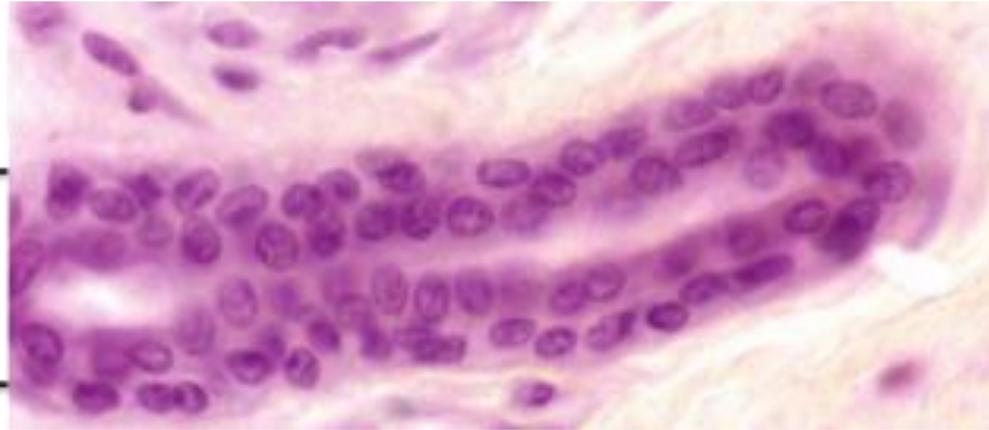
# Stratified Cuboidal Epithelium



Larger ducts of exocrine glands such as salivary glands.

# Stratified Cuboidal Epithelium

Stratified Cuboidal  
Cells



Duct

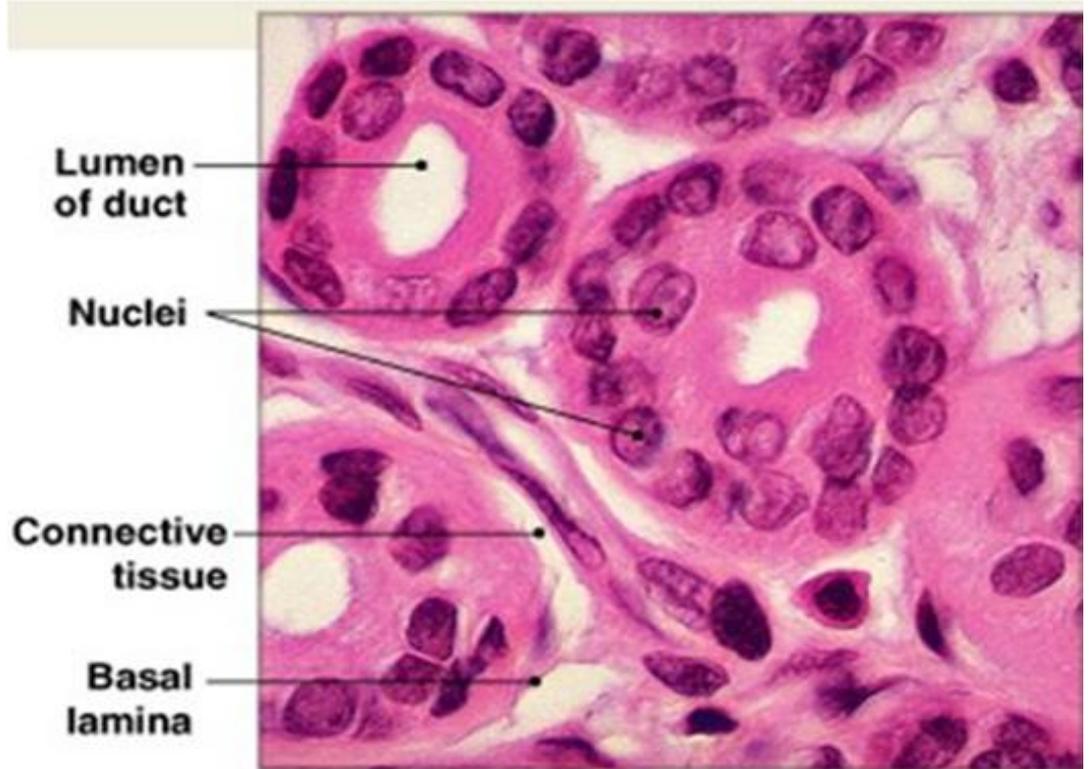


Lumen  
of duct

Nuclei

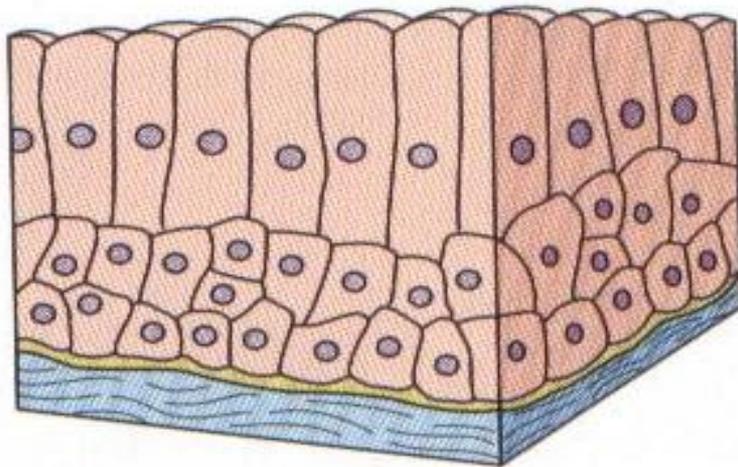
Connective  
tissue

Basal  
lamina

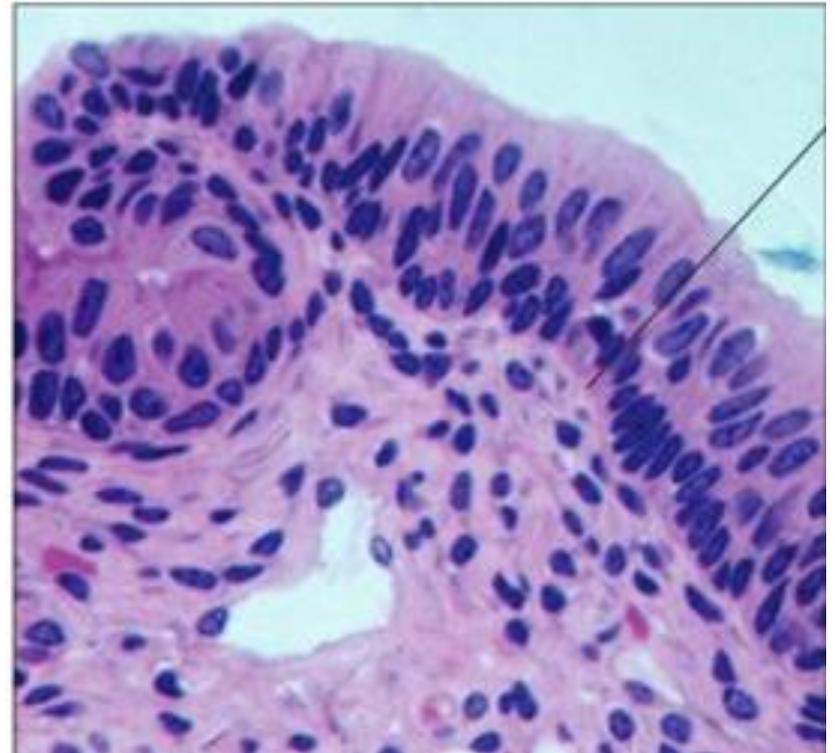


# Stratified Columnar Epithelium

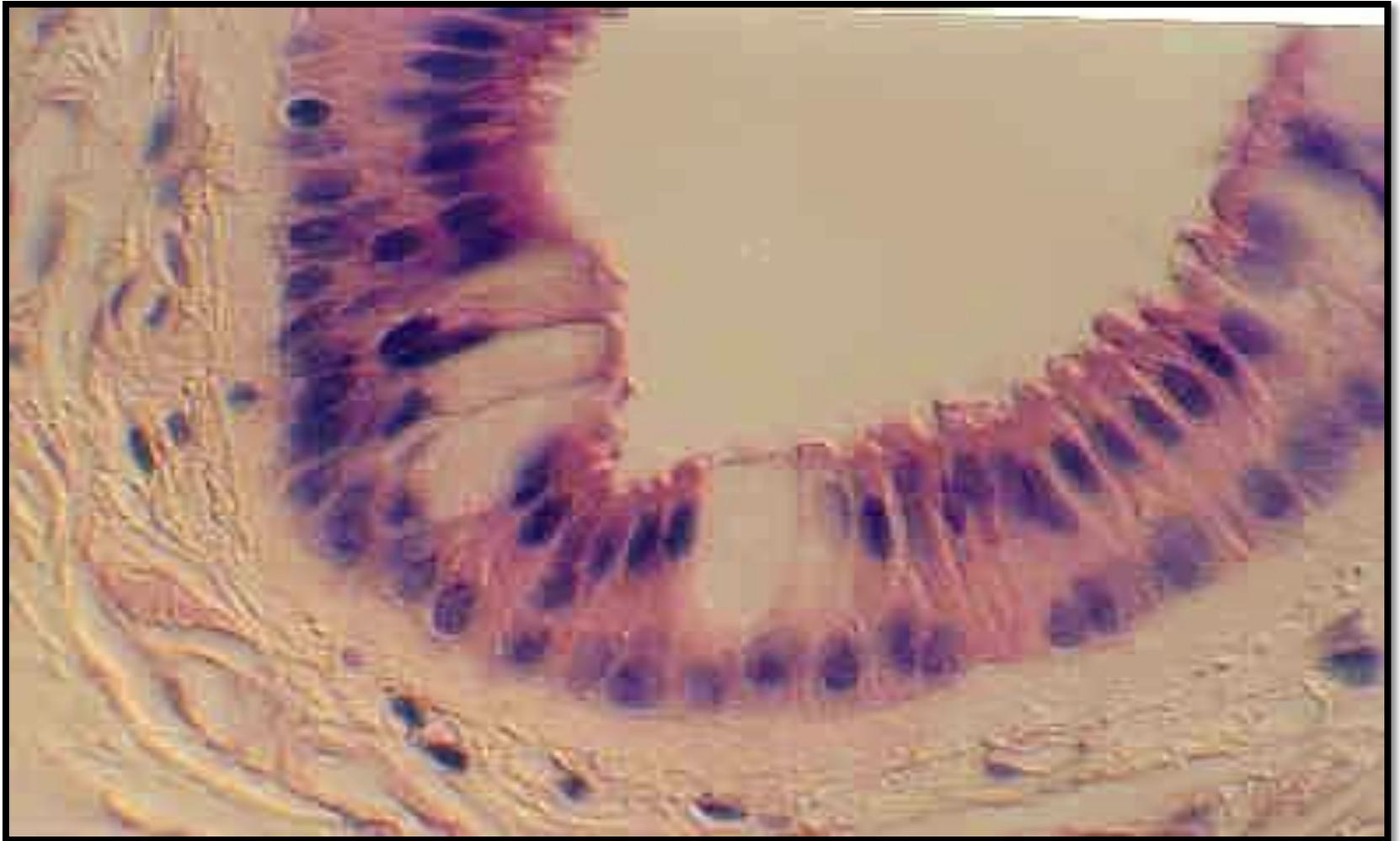
- Structure: Several cell layers, basal cells usually cuboidal, superficial cells elongated and columnar.
- Location: Conjunctiva, lining the eyelids & Large excretory duct.



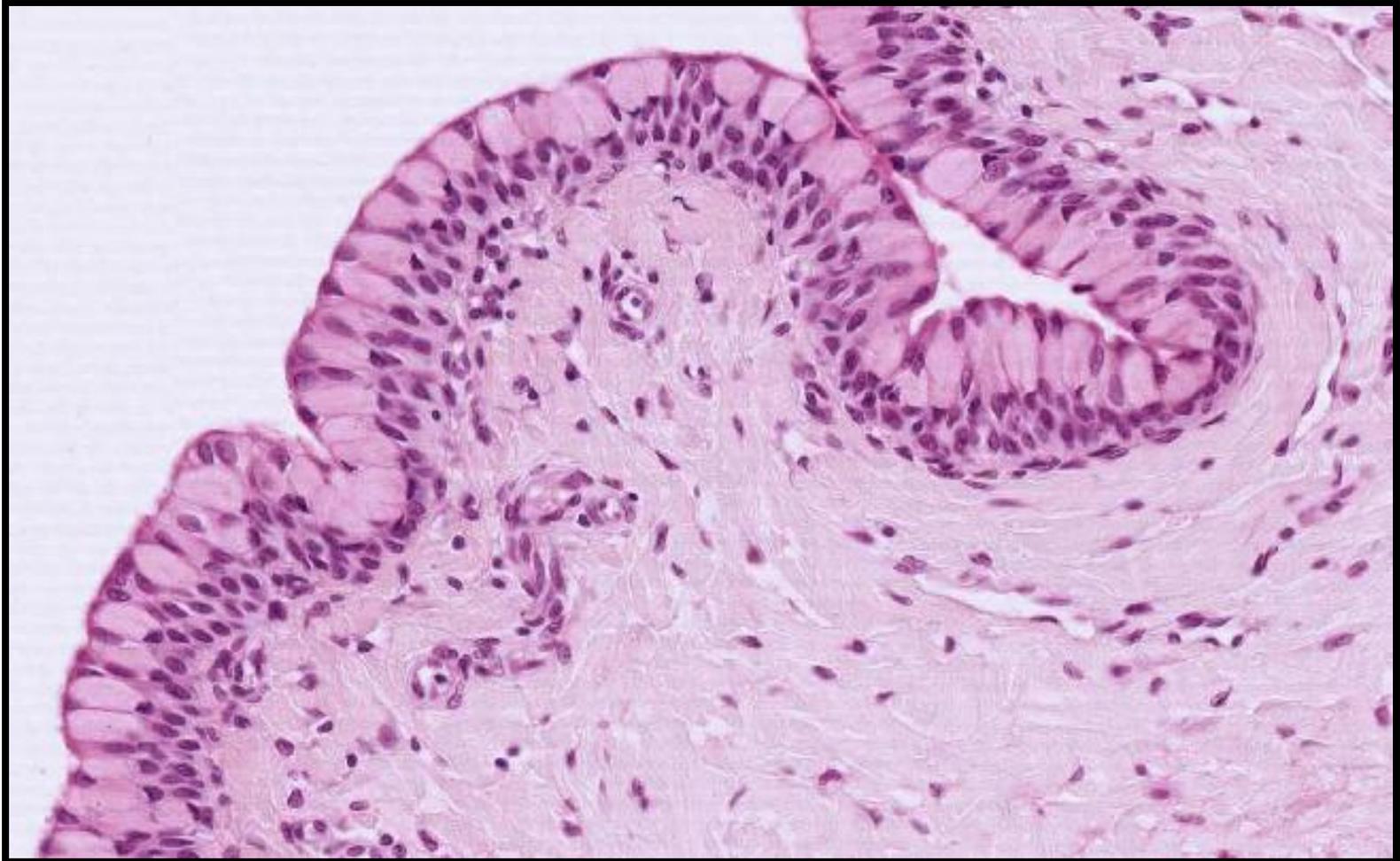
Columnnar



# Stratified Columnar Epithelium



# Stratified Columnar Epithelium



Conjunctiva, lining the eyelids

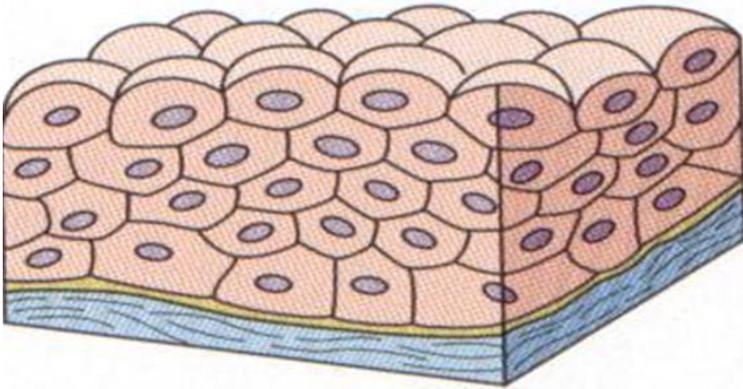
# Stratified Columnar Epithelium



Excretory duct of salivary gland “distal parts”

# Transitional Epithelium

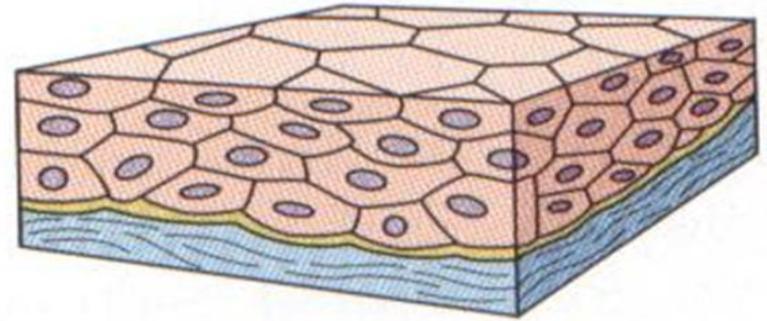
- Structure: Many layers
- Function: Allows stretching (change size), Protection.
- Location: Urinary tract (urinary bladder & ureters )



Transitional (relaxed)

Unstretched (empty organ)

Superficial layer of  
umbrella-shaped cells



Transitional (distended)

Stretched (distended organ)

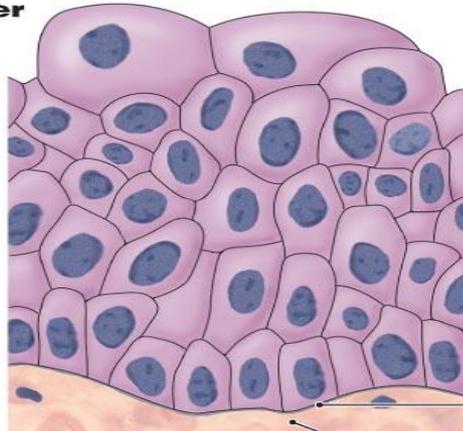
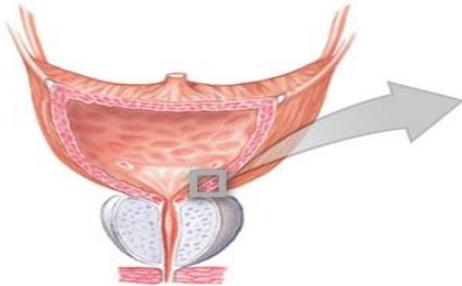
Fluid pressure

# Transitional Epithelium

## The transitional epithelium in an empty and a full urinary bladder

### Epithelium in a Relaxed Bladder

In an empty urinary bladder, the superficial cells are cuboidal with a dome-shaped surface.



Relaxed bladder

Epithelium (relaxed)

Basal lamina

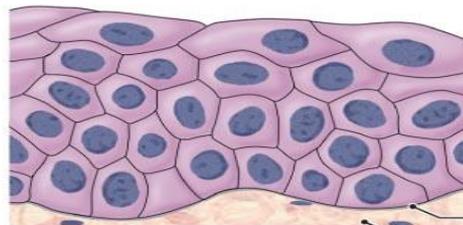
Connective tissue and smooth muscle layers



LM × 400

### Epithelium in a Stretched Bladder

When the urinary bladder is full, the volume of urine has stretched the lining to such a degree that the epithelium appears flattened, and more like a stratified squamous epithelium.

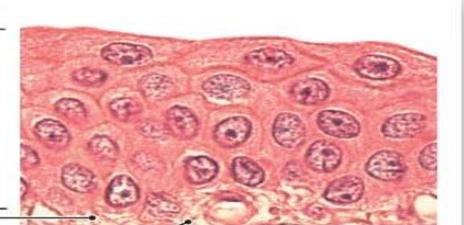


Stretched bladder

Epithelium (stretched)

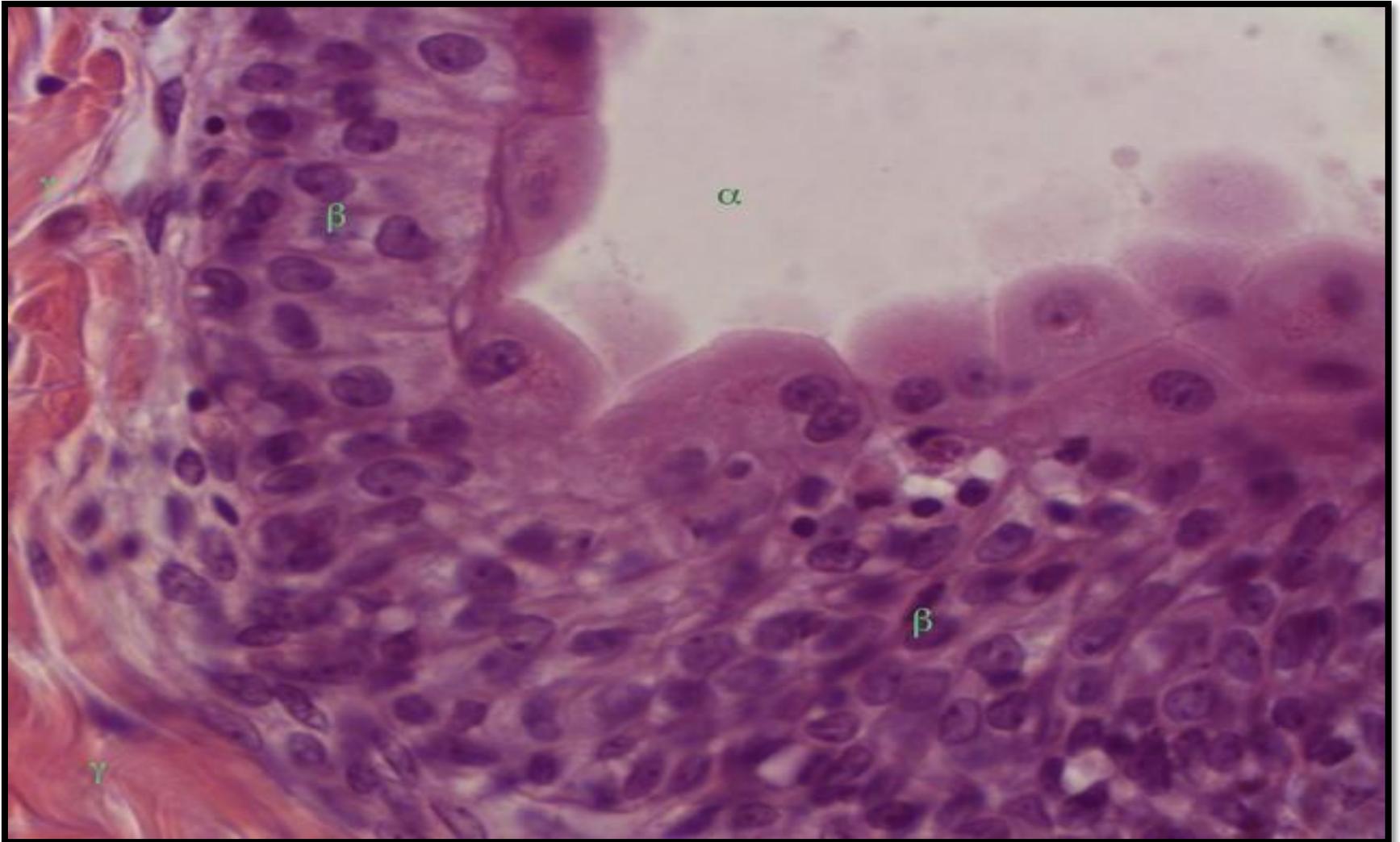
Basal lamina

Connective tissue and smooth muscle layers



LM × 400

# Transitional Epithelium



# Transitional Epithelium

