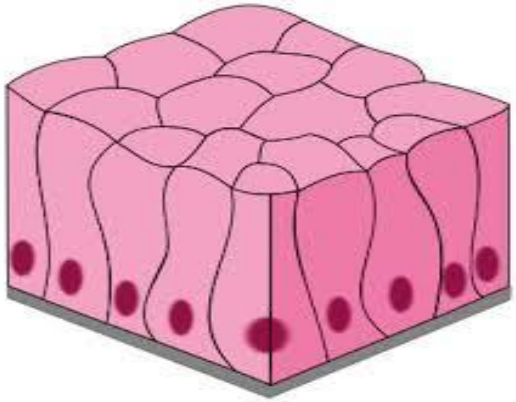
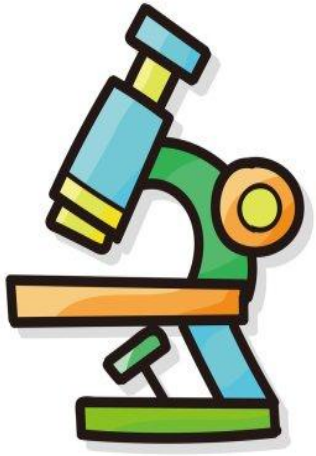
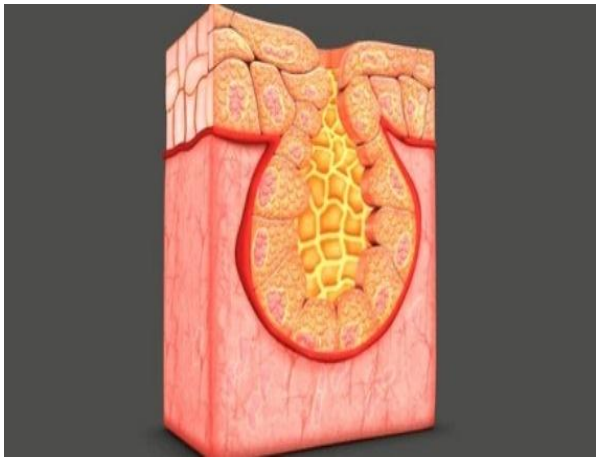
# Epithelial tissue-1







By

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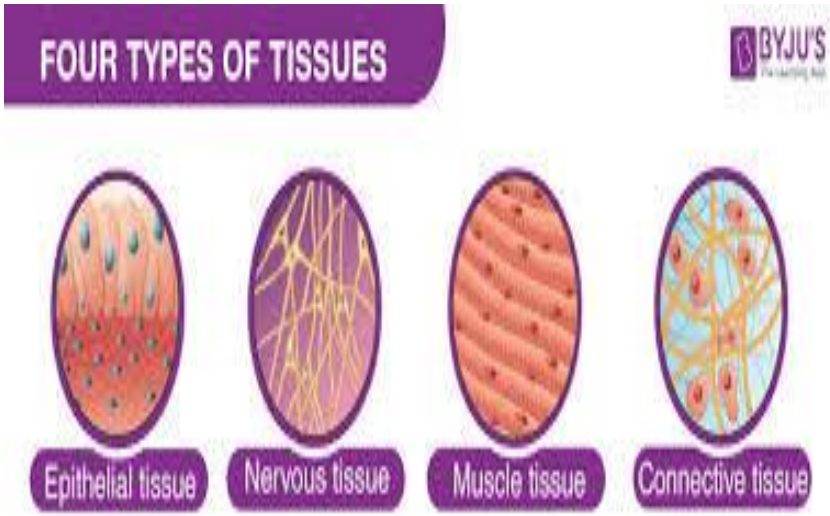
# ILOs

1. Identify different types of epithelium.
2. Describe the structural characteristics of the epithelial tissue
3. Predict the special type of epithelial cells from its components.
4. Differentiate between different types of epithelial tissue.
5. Relate the composition of epithelial tissue type to its specific function.
6. Identify the biology of epithelial cells

- Despite its complexity, the human body is composed of only **4** basic types of tissue:
  - Epithelial tissue.
  - Connective tissue.
  - Muscular tissue.
  - Nervous tissue .




- What is the structure of a tissue?

**- Group of cells that are similar in structure and function with extracellular matrix in-between.**

# 4Tissues

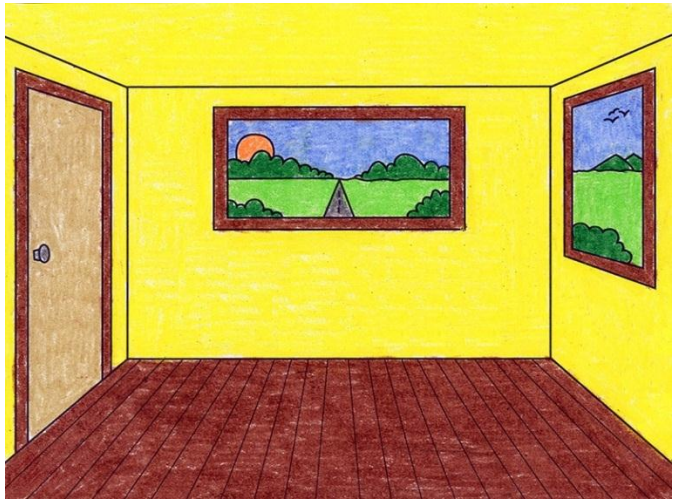
## Cells

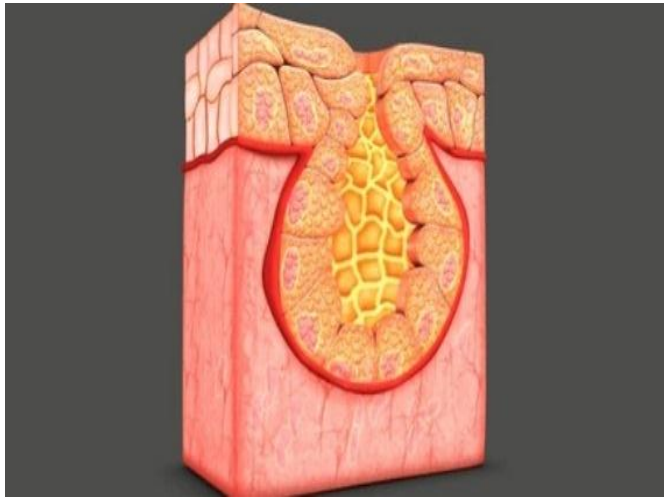
## Extracellular Matrix ( ECM)

ECM consists of many kinds of macromolecules

# Epithelium

- *Epi* , upon +*thele* , nipple.
- One of the four basic tissues of the body
- Epithelia either form membranes that are represented as sheets *covering the body* surface and lining its internal surface *Or* form secretory elements known as *glands*.





# Characters of the epithelial cells

## 1-Origin:

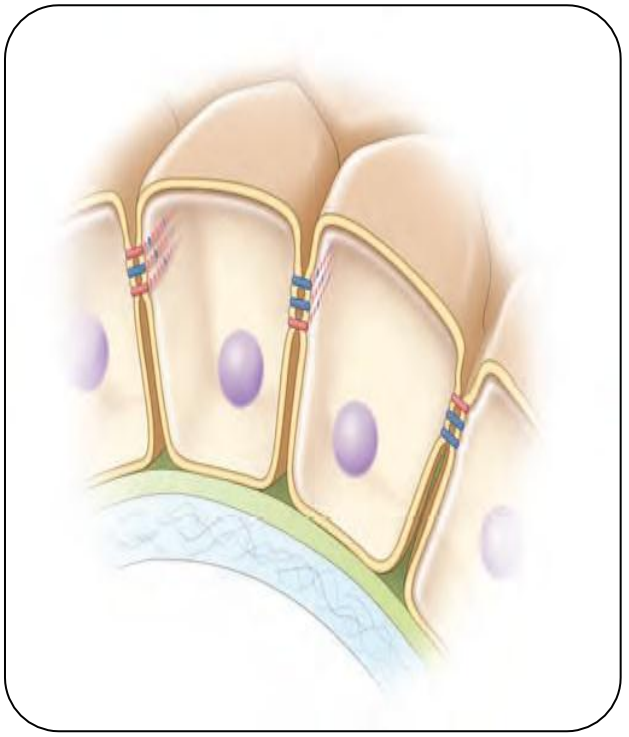
**Derived from all three embryonic germ layers:**

- **Ectoderm:** e.g: skin
- **Endoderm**: e.g: Respiratory system
- **Mesoderm**: e.g: Endothelial lining of Blood vessels

# 2- Structure :

**The epithelial cells are:**

- Closely aggregated with very little intercellular substance in-between.

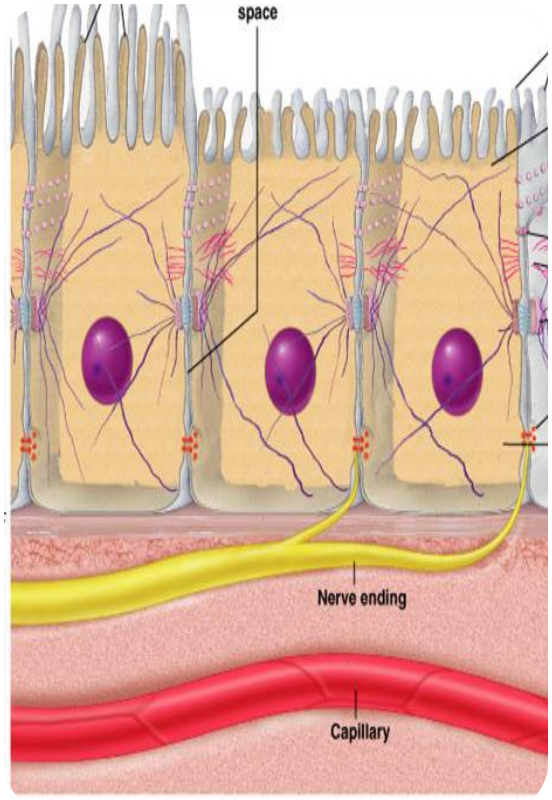


- Have strong adhesion to one another and attached to each other by many types of cell junction Forming continuous sheet

- Resting on basement membrane that separated it from the underlying connective tissue.

# 3- Blood &Nerve supply :

- Blood vessels do not penetrate the epithelial tissue, *however* its nutrition depends on the diffusion of metabolites from the capillaries present in the underlying connective tissue.
- Most epithelial tissues receive nerve endings that form network present in the underlying connective tissue .
- The sensory nerve ending penetrate the epithelium and provide it with proper sensation.




# 4- renewal :

Epithelial cells renewed continuously by mitotic activity

# Functions of epithelial tissue

**1- Protection** (covering and lining of surfaces e.g. skin):from:

- mechanical abrasion, chemical penetration
- bacterial invasion
- reduction of friction

**2- Absorption** e.g. small intestine (of nutrients )

**3- Secretion** e.g. glands. **forming glands** whose function is **secreting** enzymes, hormones, lubricants, or other products

**4-Excretion** of waste products; kidney tubules

**4- Sensation** receiving sensory signals e.g. neuroepithelium.

**5- Contractility** e.g. Myoepithelial cells.

# Classification of Epithelium

**Epithelia are classified according to their structure & function into**

- **Two main groups:**

**(1) Covering and lining epithelium**

**(2) Glandular epithelium**

- **Special types**

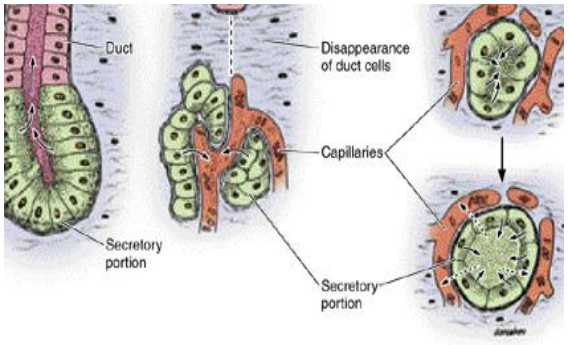
**(3) Neuroepithelium.**

**(4) Myoepithelium.**

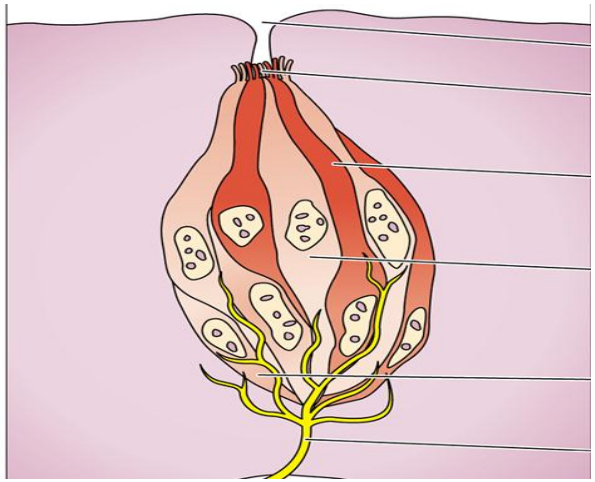
# Types of Epithelium

I- covering& lining.

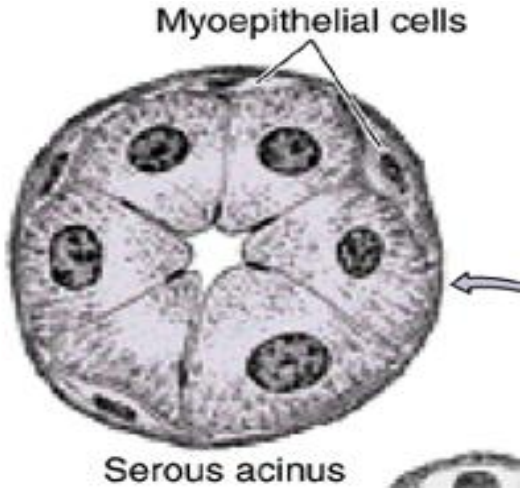
II- Glandular.




III-Neuroepithelium.



IV-Myoepithelium.



# I. Covering epithelium (Epithelial membranes)

## Are classification according to the:

1-The **shape** of the most superficial cell layer **to**

**-**Squamous (flat)

-Cuboidal

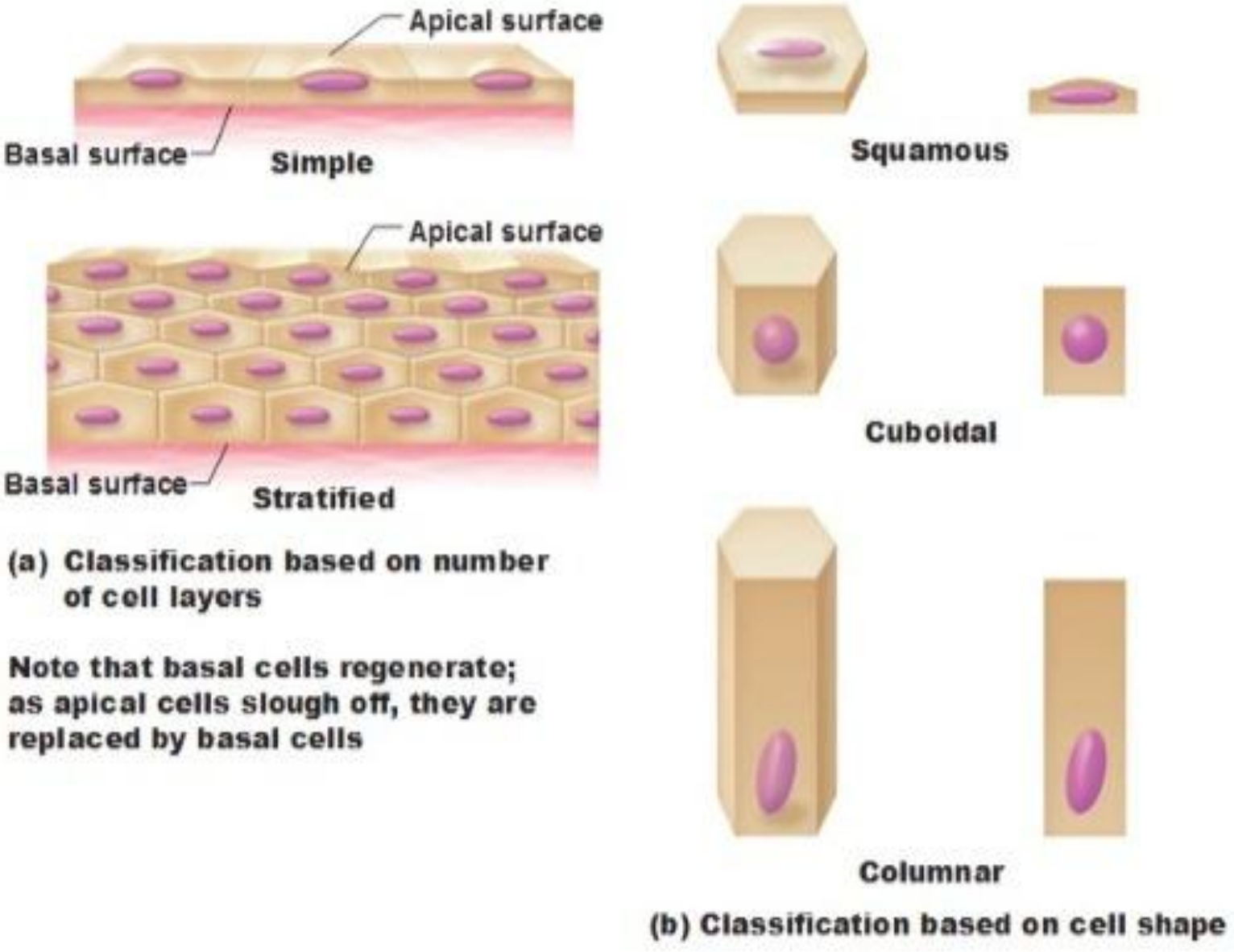
-Columnar

N.B: the shape of the nuclei are suitable to the shape of the cells

2-The **number** of cell layers composing the epithelium:

- Single layer of cells constitutes a **simple epithelium,**
- Two or more layers of cells are referred to as a **stratified epithelium**.

# Classifications of Epithelia




(a) Classification based on number of cell layers

Note that basal cells regenerate; as apical cells slough off, they are replaced by basal cells

(b) Classification based on cell shape

# Covering epithelium

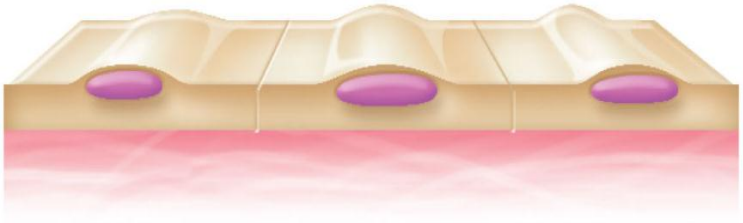
**-Cover a surface**

**or- Line a cavity**

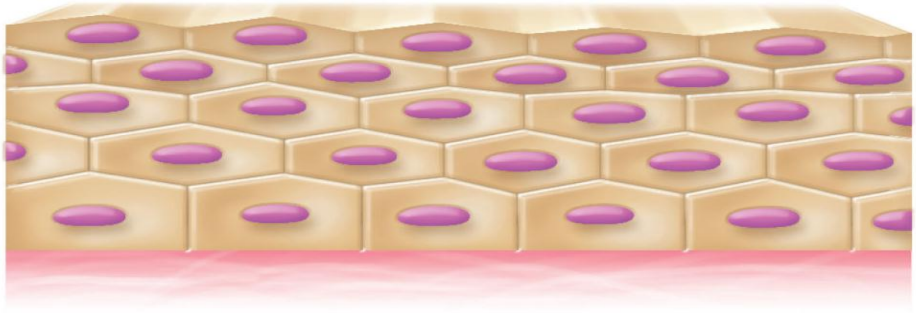
It can be divided according to the **number** of layers into:

A) **Simple epithelium: contain only one layer of cells.**

B) **Stratified Epithelium: contain more than one layer of cells.**



**Simple**



**Stratified**

# Simple epithelium

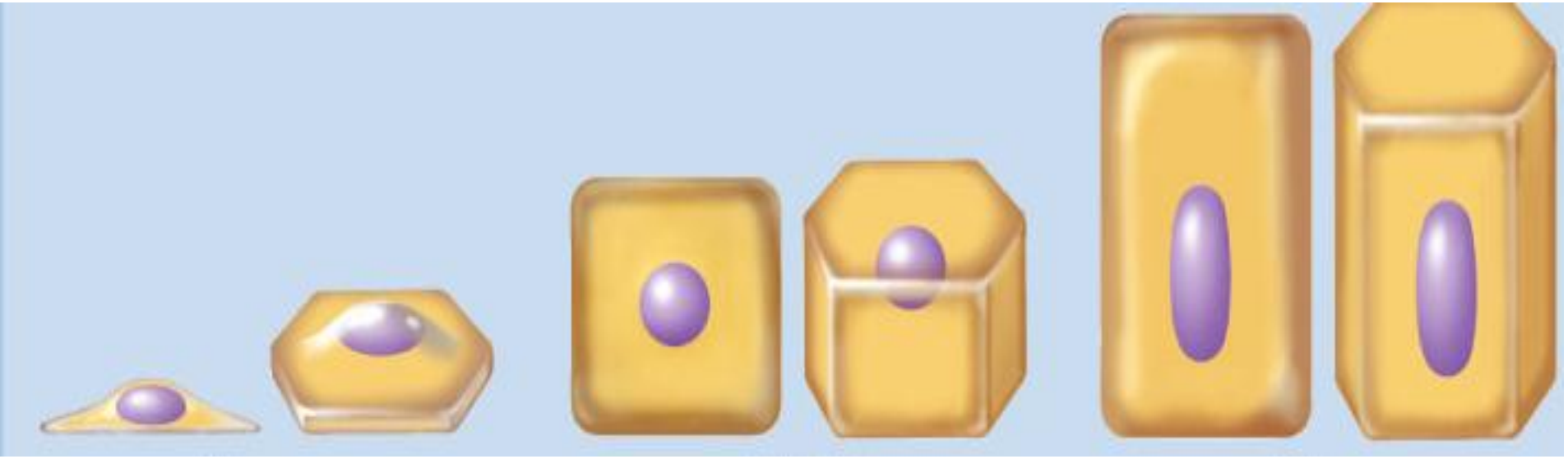
Classified according to **shape** of cells into:

**1- Simple squamous epithelium**

**2- Simple cuboidal epithelium**

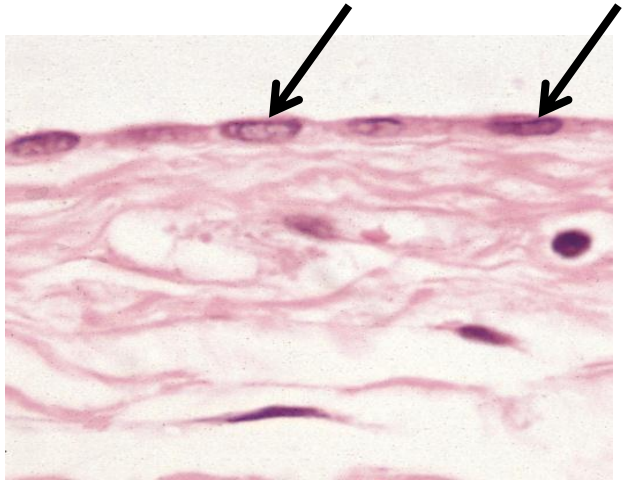
**3- Simple columnar epithelium**

**4- Pseudostratified columnar epithelium**



# Simple squamous epithelium

- ***Shape of the cell:*** Thin-flat, plate like

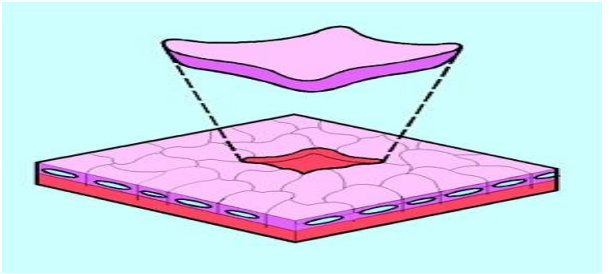


- ***Shape of the nucleus*:** Flat

- ***function:***

-Interchange of substances (gases or liquids)

-Easy movement due to its smooth surface

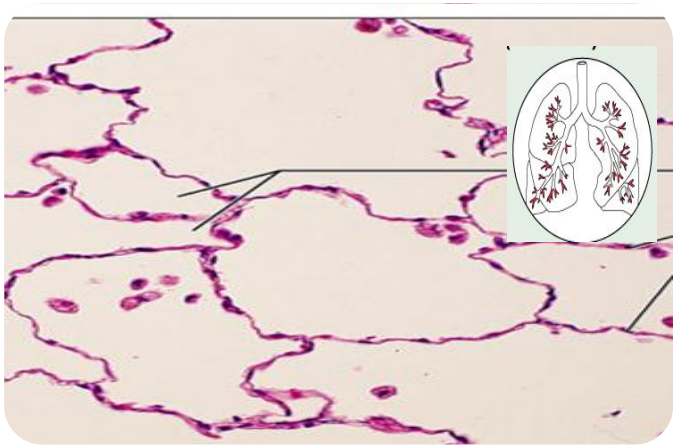


- ***Sites***

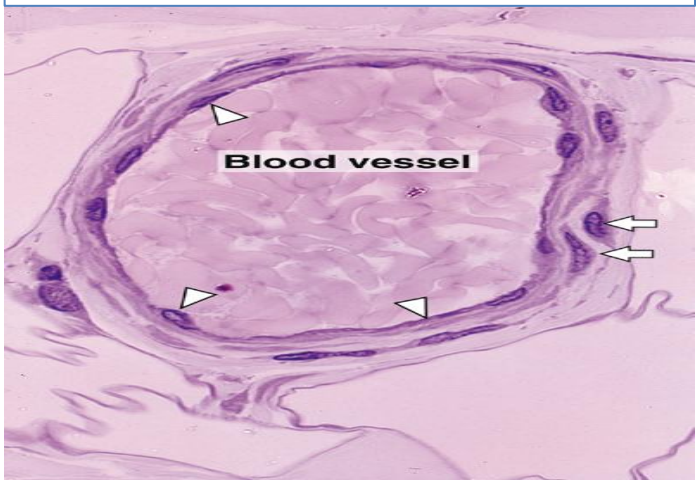
- Kidneys (Bowman's capsule).
- Lungs (lining the alveoli).
- Endothelium (lining the blood and lymphatic vessels).
- Mesothelium (peritoneum, pericardium and pleura).

# Simple squamous epithelium

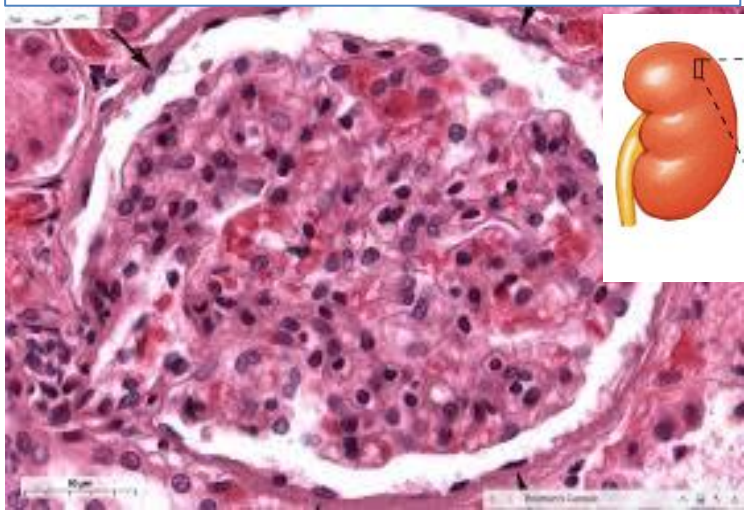
**Lungs (lining the alveoli).**
**Gas exchange**



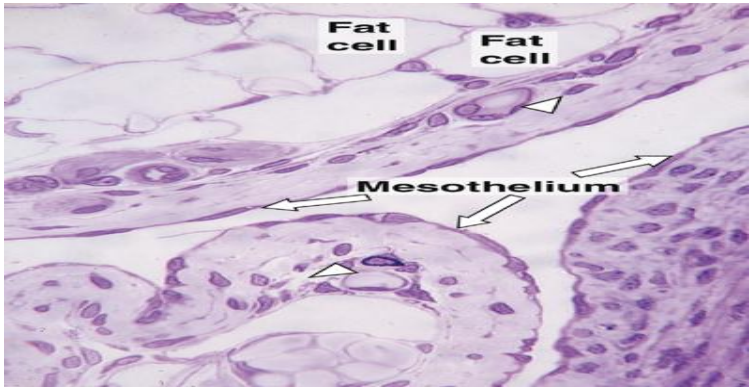
**blood vessel: Endothelium lining**
**Smooth surface**




**Kidneys (Bowman's capsule).**
**Filtration of blood**



**Mesothelium**
**Easy movement**



# Simple cuboidal epithelium

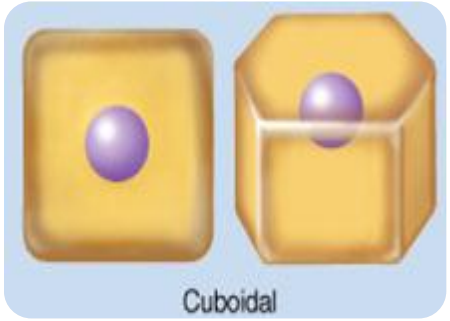
- ***Shape of the cell:***

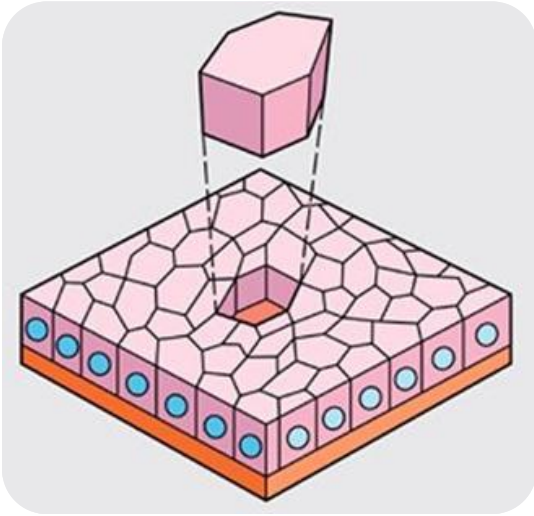
Cuboidal

- ***Shape of the nucleus***

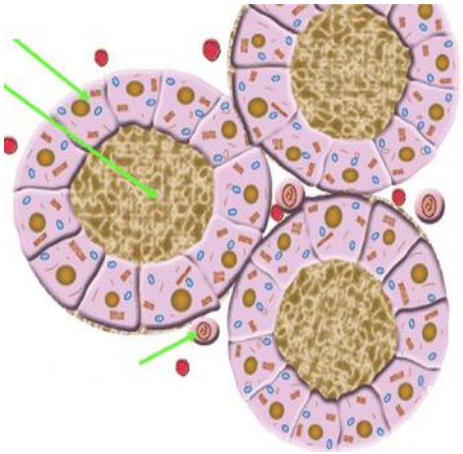
Rounded Central nucleus

- ***Sites: lining:***

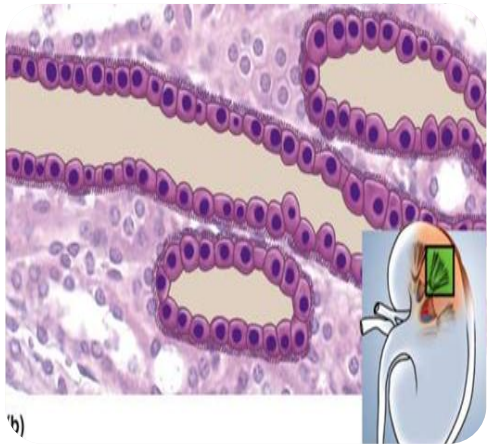


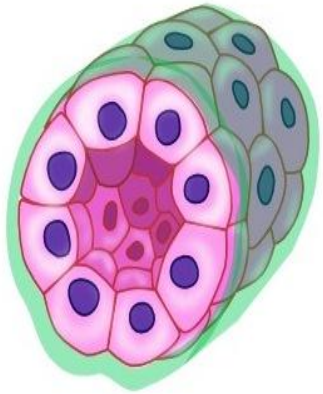
**Thyroid follicles**



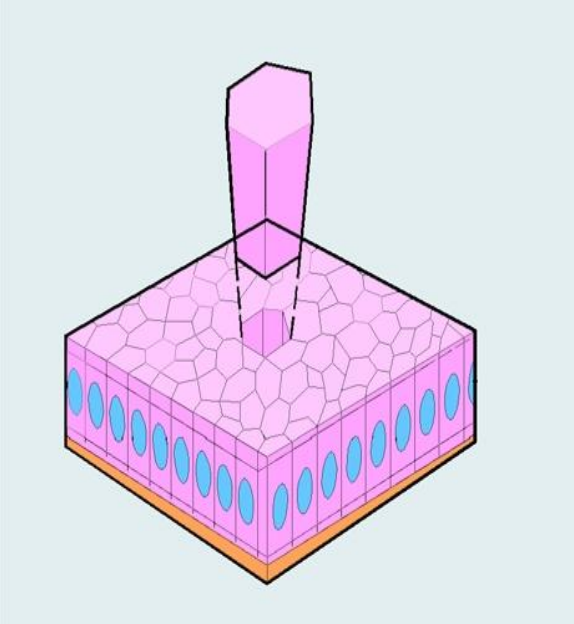
**Tubules of the kidney**



**Ducts of glands(medium)**



# Simple columnar epithelium



- ***Shape of the cell:***

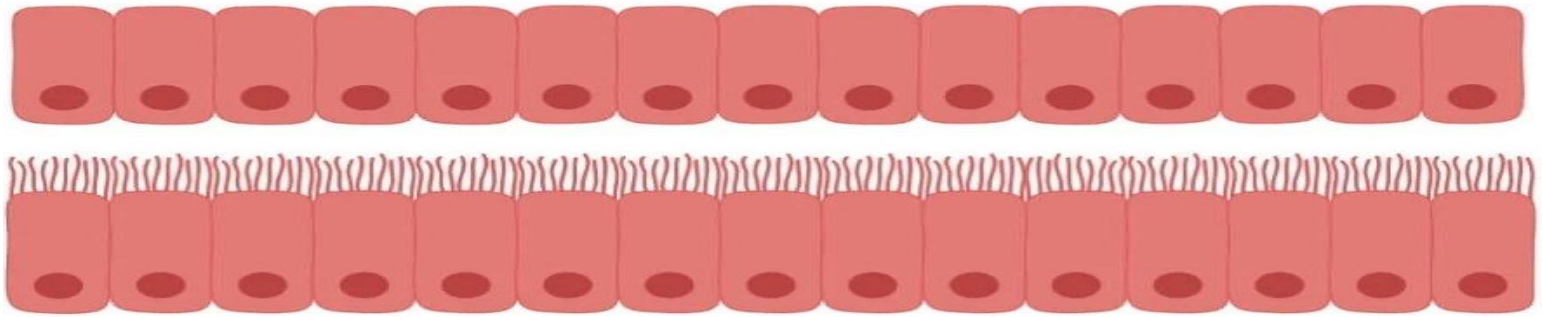
tall rectangular

- ***Shape of the nucleus***

oval basal nuclei.

- ***It is subdivided into:***

Non-ciliated and ciliated varieties:



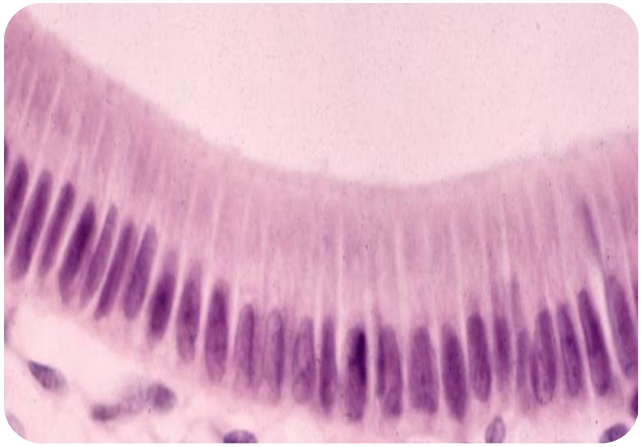
# Simple columnar epithelium

## Simple columnar ciliated epithelium:

- ❑ The cells have motile hair-like processes called cilia on their free surface
- ❑ Function: movements of particles or fluids over the surface
- ❑ Sites
  - Conducting bronchioles of lung
  - Central canal of spinal cord.
  - Together with non-ciliated lining the uterus and fallopian tubes

## Simple columnar non-ciliated epithelium:

- ❑ Sites & functions:
  - Gastro-intestinal tract & Gall bladder : absorption
  - Glands, line the large ducts :secretion



# Pseudostratified Columnar Epithelium

❑ **Structure:**

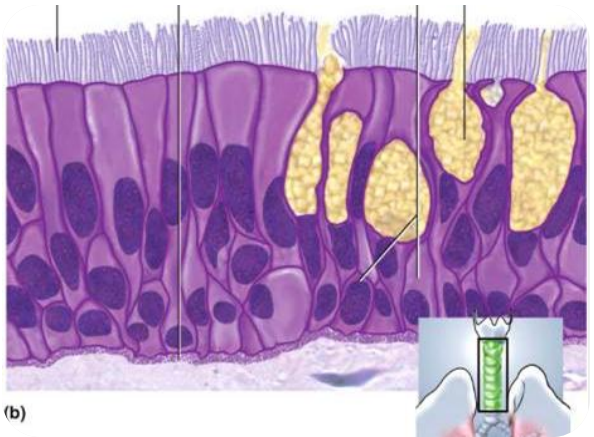
-A single layer of cells. It gives the appearance of being stratified

- some cells are tall
- while others are short not reach the surface.
- However ***all*** the cells are resting on the basement membrane.
- **The nuclei** lie at a various levels so give the false appearance of being stratified.

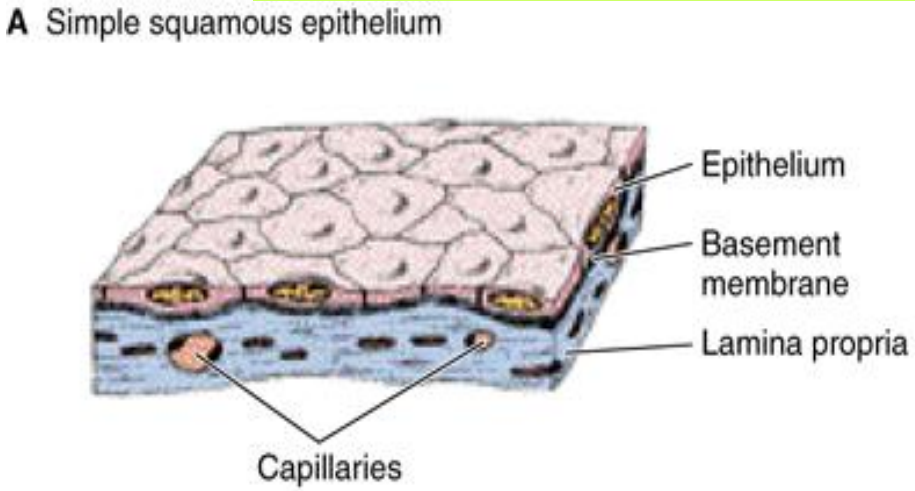
❑ **Site:**

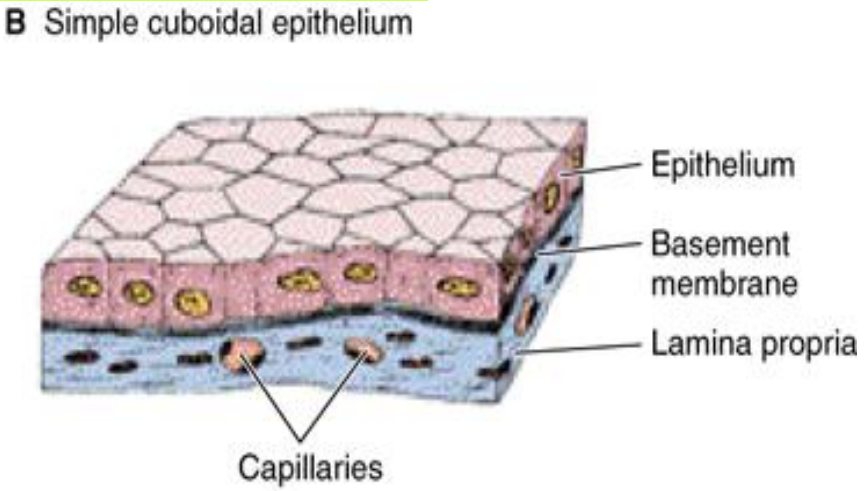
*I) The ciliated type* is present in the respiratory passage as trachea and is usually associated with goblet cells.

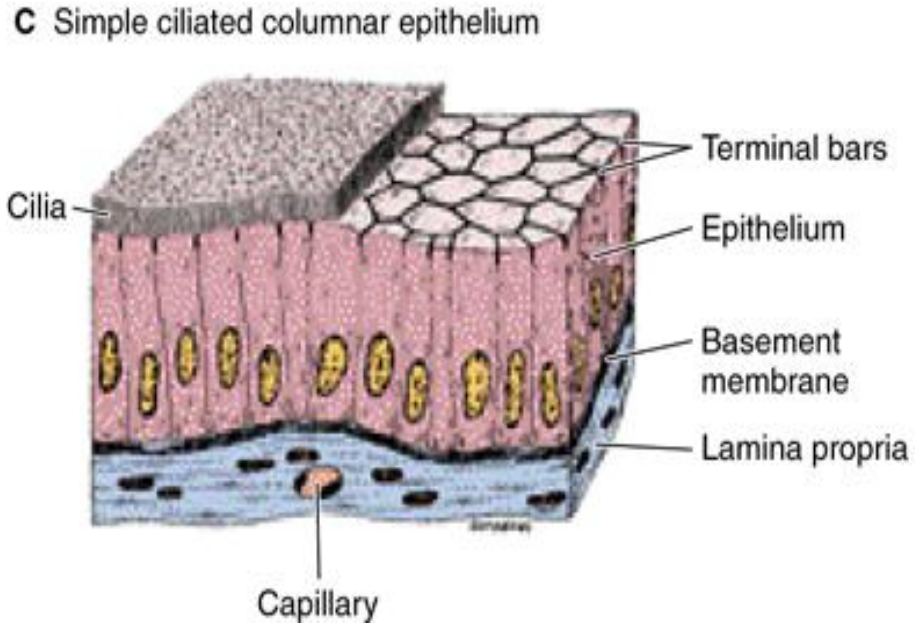
*II) The non ciliated type* is found in the large ducts of the glands.

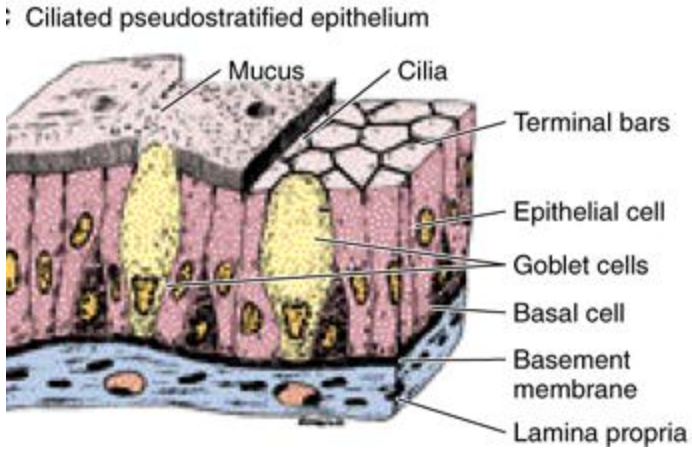


- **Simple epithelium classified according to shape of cells.**



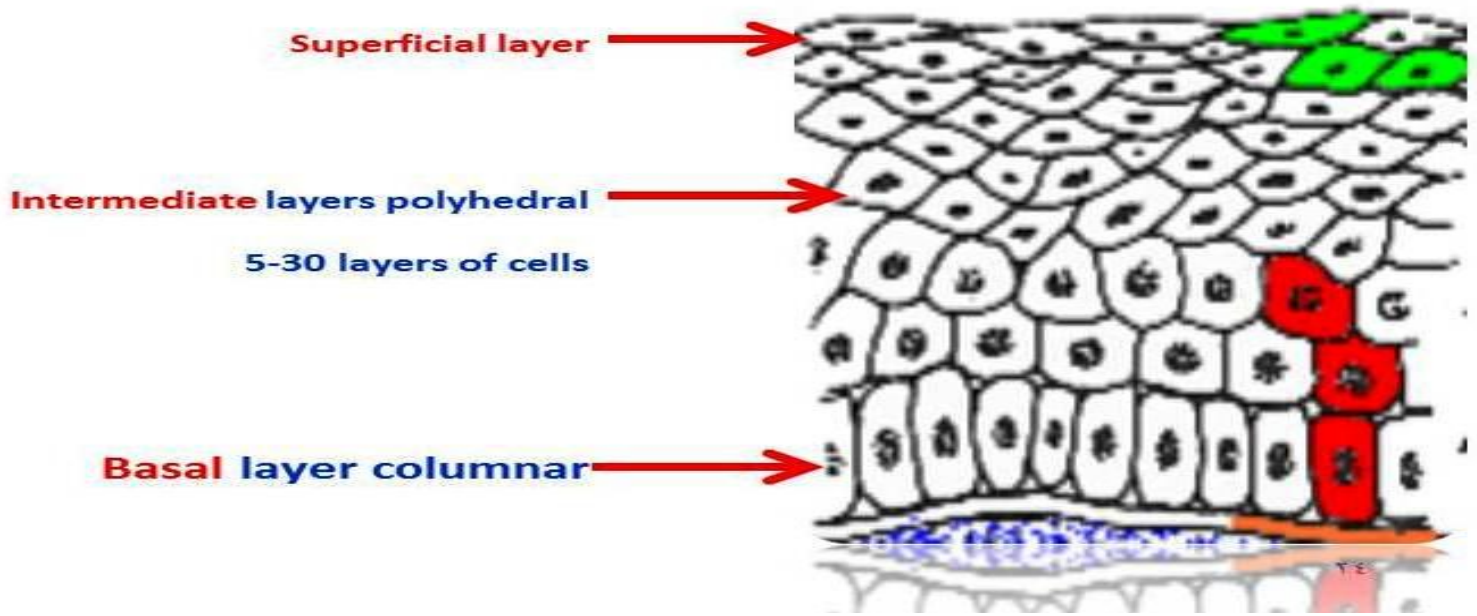



# Stratified Epithelium

**It is formed of many layers of cells**
**-the basal layer is columnar in shape**
**-the intermediate layers are polyhedral cells**
**-the superficial layer: the shape of the cells depends on the type of the epithelium.**



# Stratified Epithelium

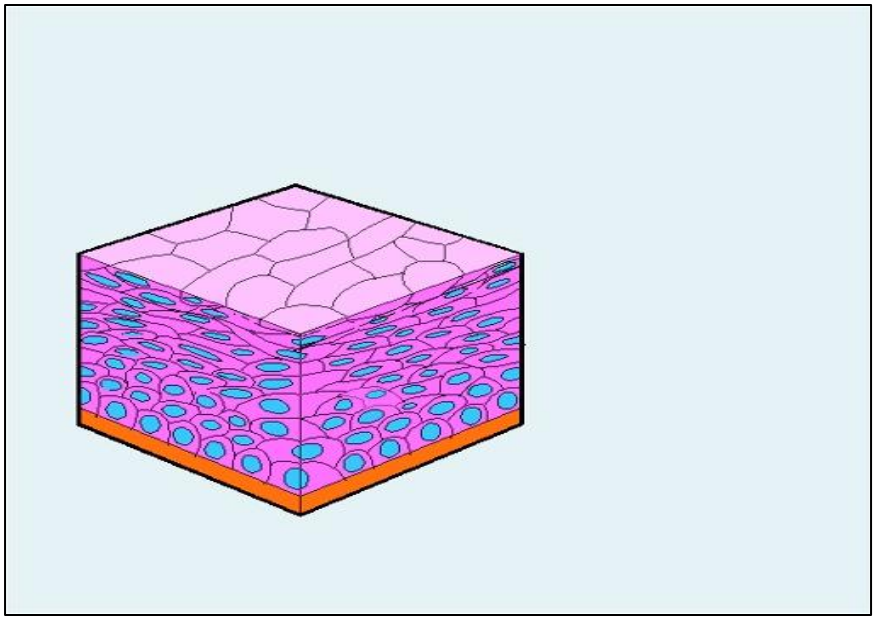
Classified according to shape of superficial cells:

1- Stratified squamous epithelium

2- Stratified cuboidal epithelium

3- Stratified columnar epithelium

4. Transitional epithelium



# Stratified squamous epithelium

- Superficial layer squamous
- Non keratinized or keratinized

***- Stratified Squamous keratinized epithelium***

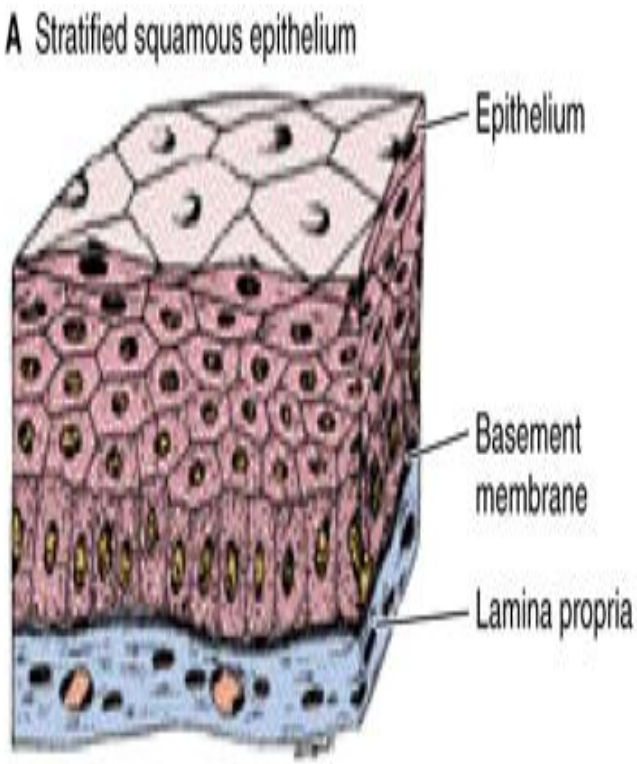
- This type is covered with non living layer of keratin.
- Covers dry surfaces to protect about water loss

-**sites:** Epidermis of skin

-All the opening on the surface of the skin ( lips, nose, ears and anus)

***-Stratified squamous non keratinized epithelium***

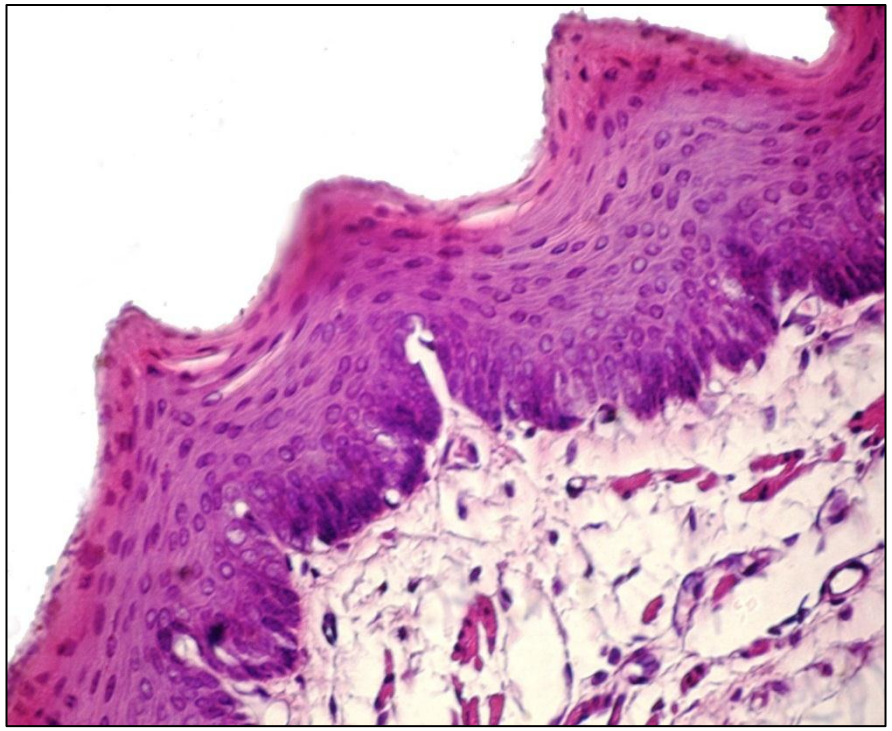
- Superficial flattened living cells
- Lines wet surfaces for protection
- Present in the oral cavity and esophagus



# Stratified squamous epithelium

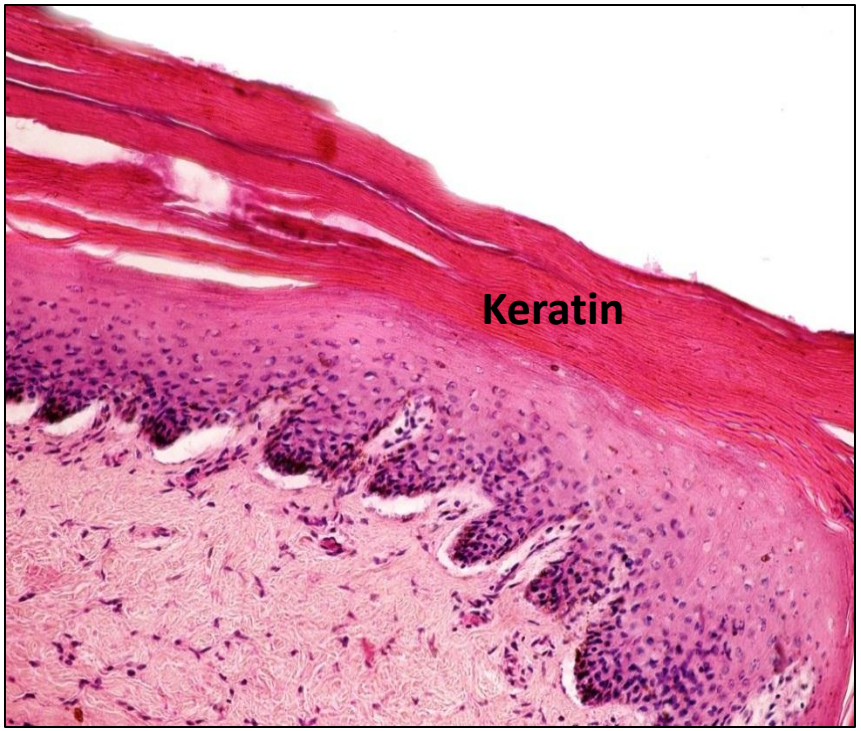
***Non keratinized***

**Esophagus**



***keratinized***

**Skin**



# Stratified cuboidal epithelium

- Superficial cells cuboidal.
- Arranged mainly in two layers
- ***Site:*** Lining ducts of sweat glands.
- ***Function:*** secretion


# Stratified columnar epithelium

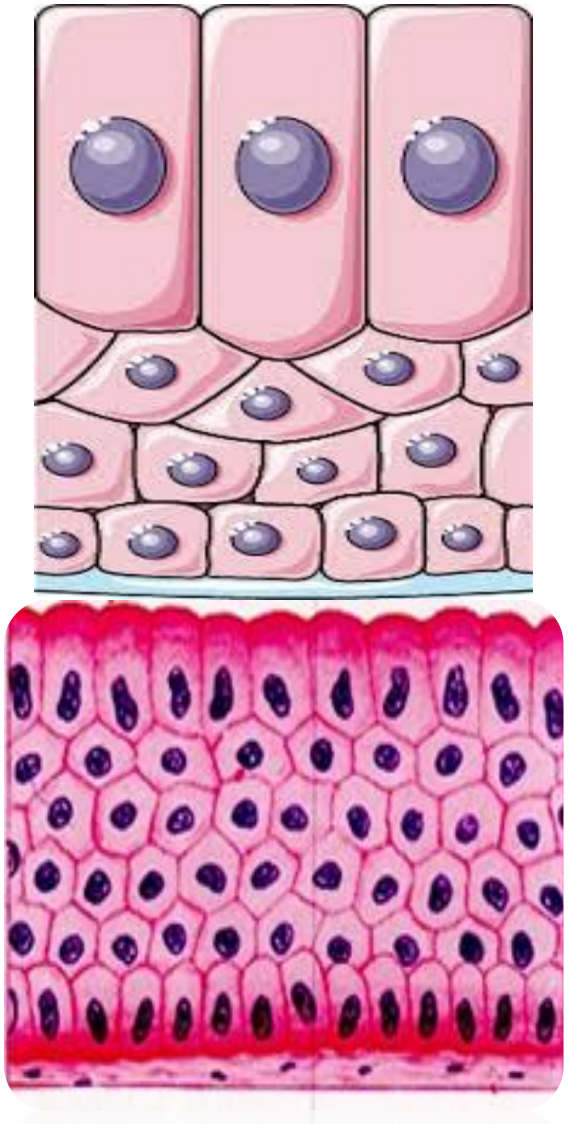
- Superficial cells columnar.
- Ciliated and non ciliated.

***a) Stratified columnar non ciliated.***

- ***Sites:*** Large ducts of glands- *Fornix of conjunctiva*

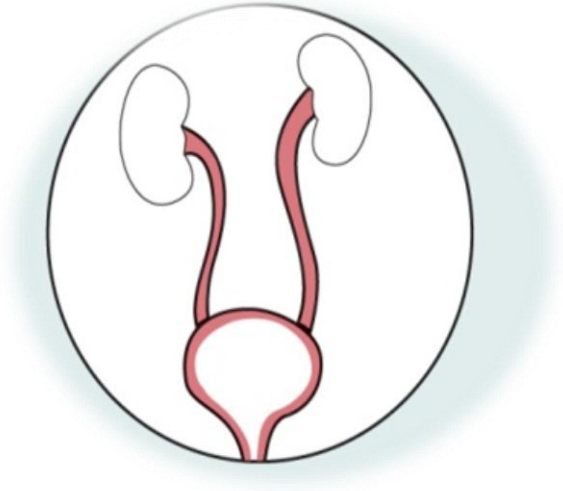
***b- Stratified columnar ciliated.***

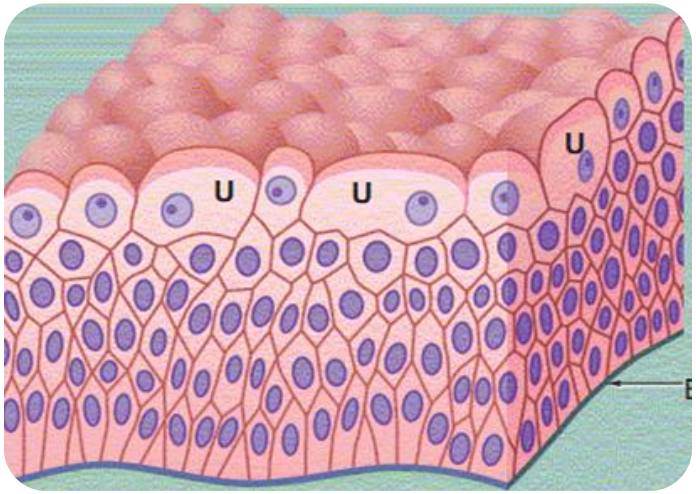
- ***Sites:*** Fetal esophagus



# Transitional epithelium

- **Structure:** The most superficial cells are cuboidal or dome shaped with one or two nuclei.
- **Site:** it is present in the urinary tract.
- It is called transitional because the number of layers changed depending on whether the organ is contracted or distended.

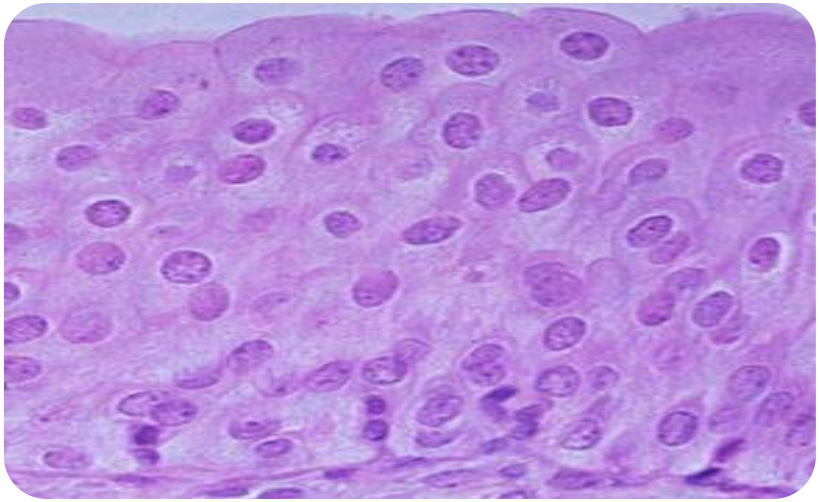




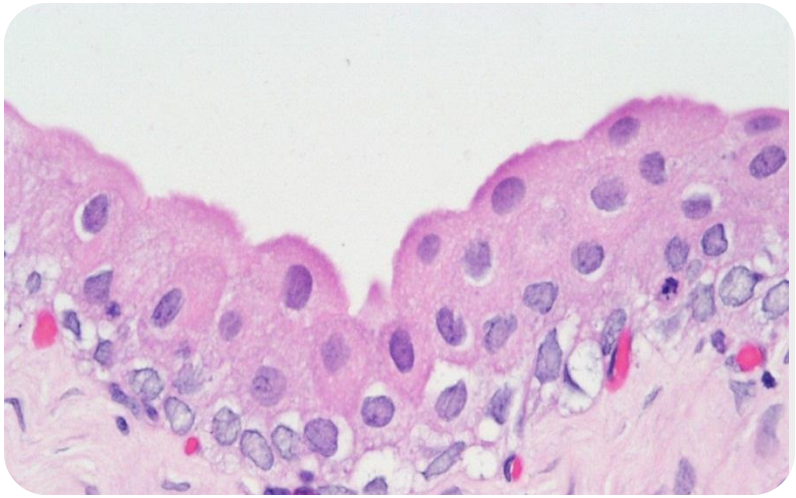
- **e.g: Urinary Bladder** when:

- Contracted : (empty) transitional epithelium formed of several layers (6-8 layers).

-Full: the epithelium formed of two or three layers and appears as *stratified squamous epithelium non keratinized.*



**Empty bladder**

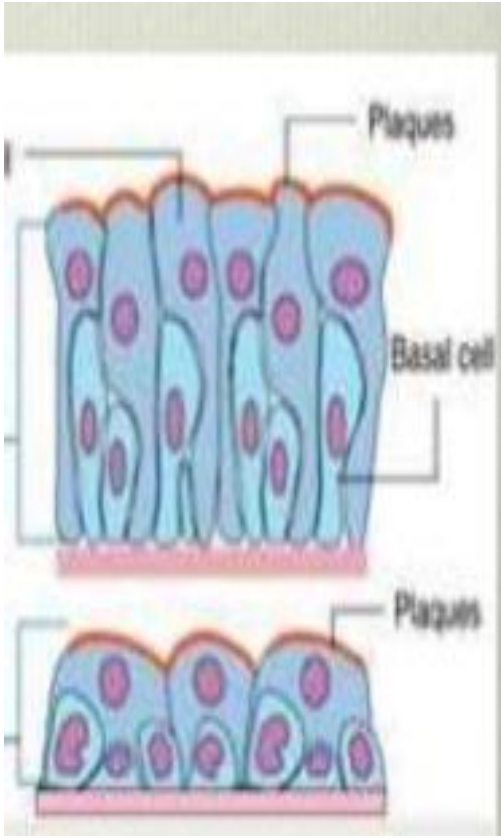


**Full bladder**

# Causes of changes occur in transitional epithelium

- Thin corrugated basement membrane
- Abundant mucous-like intercellular substance allowing the cells to glide over
- Thick cuticular border on free surface of the superficial cells

- ❑ prevents the escape of urine between the cells during distension.
- ❑ protects the cells from the injurious substances present in the urine.



| Type | Surface Cell Shape | Examples (Some) |
|---|---|---|
| ***Simple*** | | |
| Simple squamous | Flattened | Lining blood and lymphatic vessel walls (endothelium), pleural and abdominal cavities (mesothelium) |
| Simple cuboidal | Cuboidal | Lining ducts of most glands |
| Simple columnar | Columnar | Lining much of digestive tract, gall bladder |
| Pseudostratified | All cell rest on basal lamina with only some reaching the surface. Cells that reach the surface are columnar. | Lining of nasal cavity, trachea, bronchi, epididymis |
| ***Stratified*** | | |
| Stratified squamous (nonkeratinized) | Flattened (with nuclei) | Lining mouth, esophagus, vagina |
| Stratified squamous (keratinized) | Flattened (without nuclei) | Epidermis of the skin |
| Stratified cuboidal | Cuboidal | Lining ducts of sweat glands |
| Stratified columnar | Columnar | Conjunctiva of eye, lining some large excretory ducts |
| Transitional | Large dome-shaped cells when bladder is empty, flattened when bladder is distended | Lining renal calyces, renal pelvis, ureter, urinary bladder, proximal portion of urethra |

# II. Glandular epithelium

**Definition:**

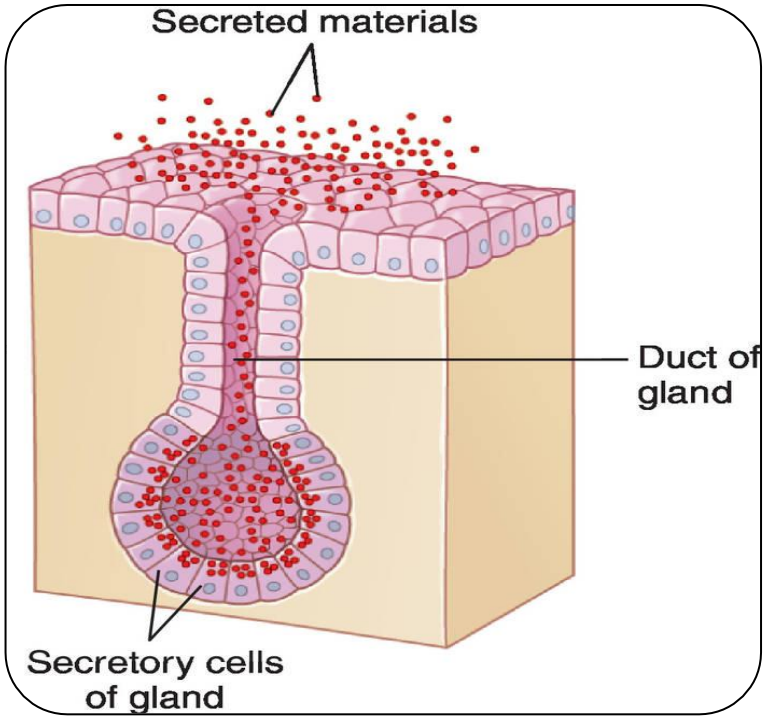
It is a special type of epithelium

**Function:**

epithelial cells specialized to produce secretion

**Origin:**

- All glands develop embryonically from surface epithelium.
- The surface cells differentiate & proliferate & penetrate the underling C.T.



## Glandular epithelium is classified

## according to:

*I- Ducts:*
*(Presence or absence)*

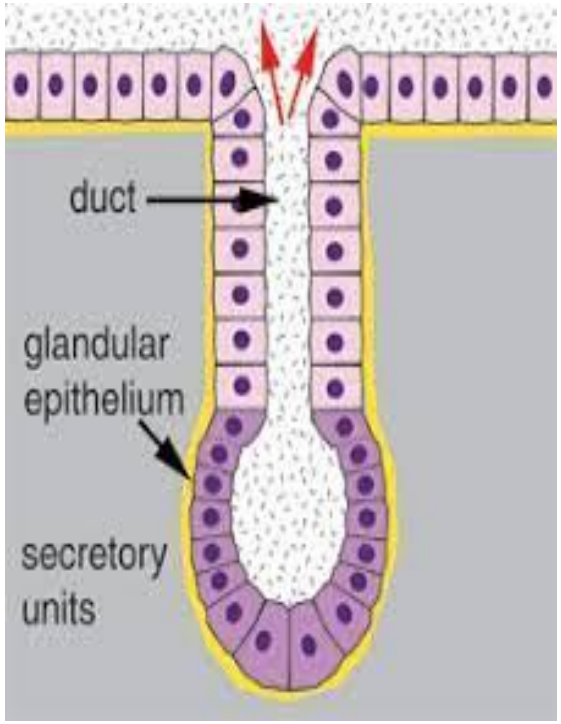
*II- Cells (Number)*

*III-Branching of the duct system*

*IV-Shape of the Secretory part*

*V- Mode (Way) of Secretion*

*VI-Type (Nature) of Secretion*



# *I. Presence or absence of ducts*

**1- Ducts present: Exocrine glands.**

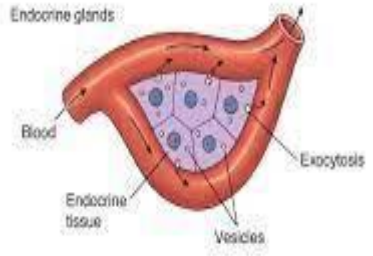
- They retain their connection with the surface epithelium
- Have ducts to carry their secretion outside
- Examples: Salivary glands and sweat glands

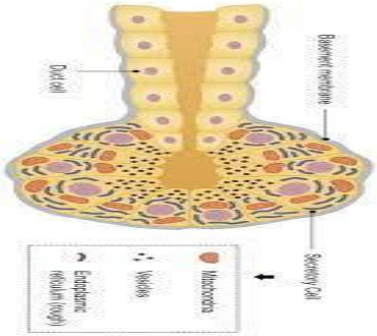
**2- Ducts absent: Endocrine glands.**

-connection with the surface was obliterated-

-They secret hormones directly in the blood

Example: Thyroid gland




**3- Mixed glands:**

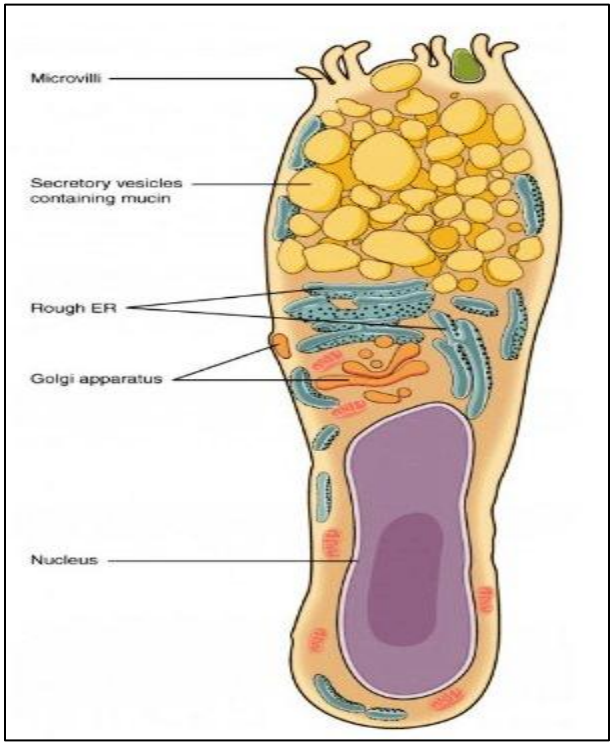
-Have both exocrine and endocrine functions

- Example: pancreas

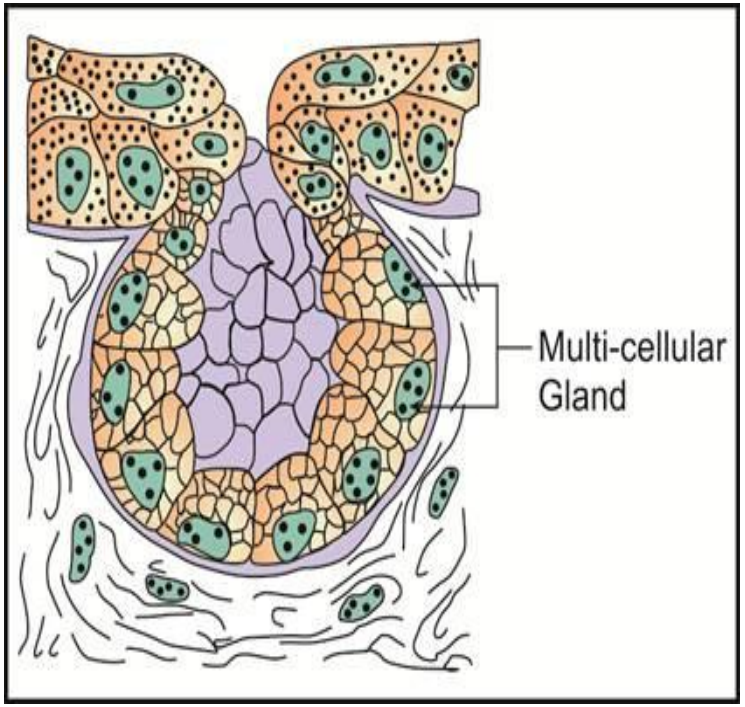
# *II. Number of cells*

1- Unicellular (goblet cells)

-one cell is responsible for secretion

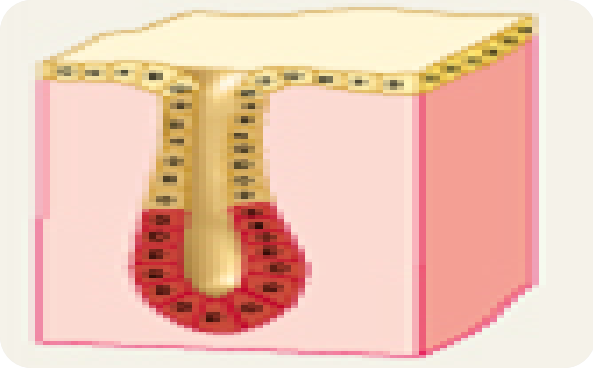



2- Multicellular (salivary glands): many cells form a secretory unit

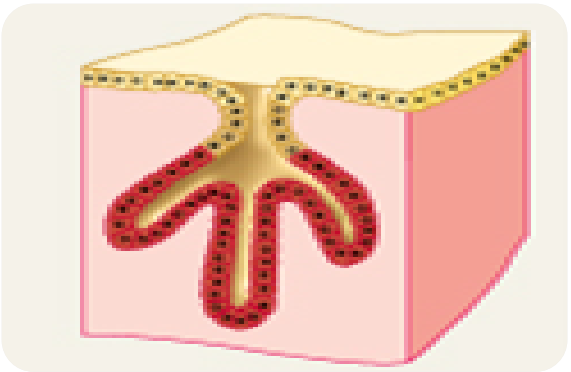


# III-Branching of the duct system

**1- Simple glands** have only one unbranched duct and one secretory unit.



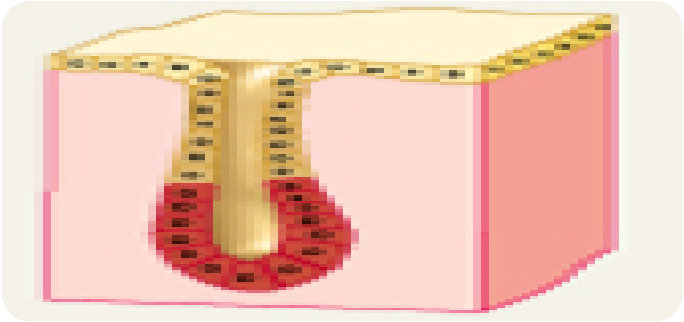
**2- Simple branched glands** have one duct and branched secretory units.



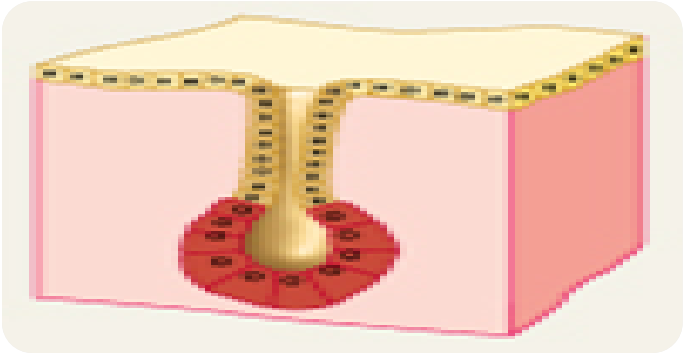
**3- Compound glands** have branched *ducts* and branched *secretory* units.

# *IV. The shape of secretory portion*

**1- Tubular** :secretory units are tubular in shape.

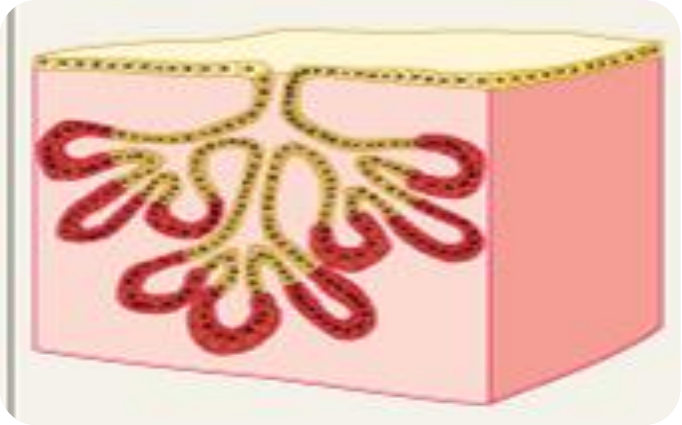


**2- Alveolar (acinar):**
secretory units are pear shaped.



**3- Tubuloalveolar:**

have both acinar and tubular secretary units.



# V. The mode of secretion

## Merocrine glands

-the secretory products leave the cell by exocytosis

-with no loss of the cell material.

-Salivary glands.

## Apocrine glands

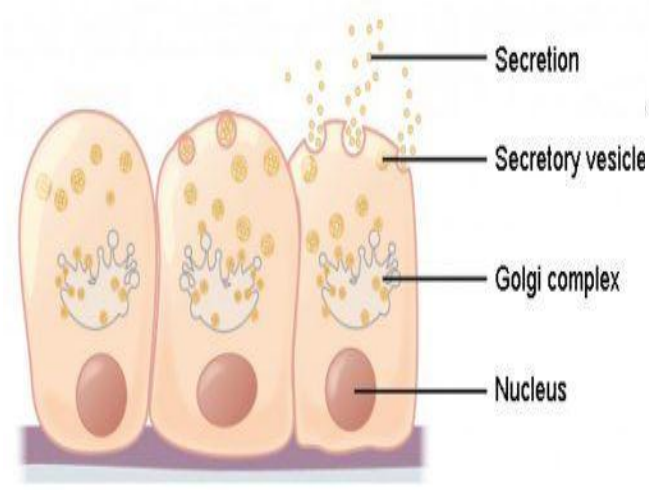
-In which the apical parts of the cells of the glands are lost and come out with the secretion.

- Mammary glands.

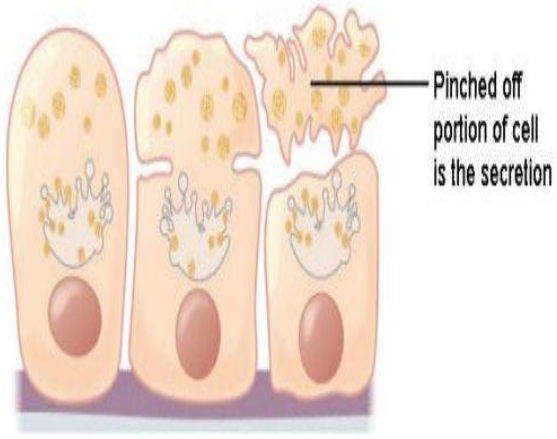
## Holocrine glands

-In which the whole secretory cells are destroyed and come out with the secretion.

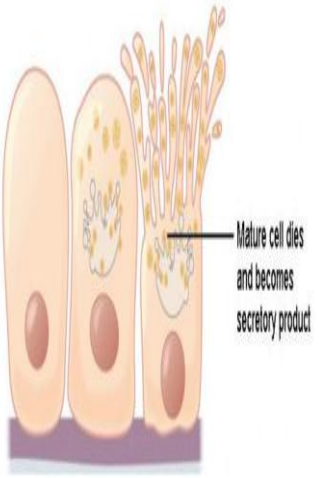
- Sebaceous glands.




(a) Merocrine secretion

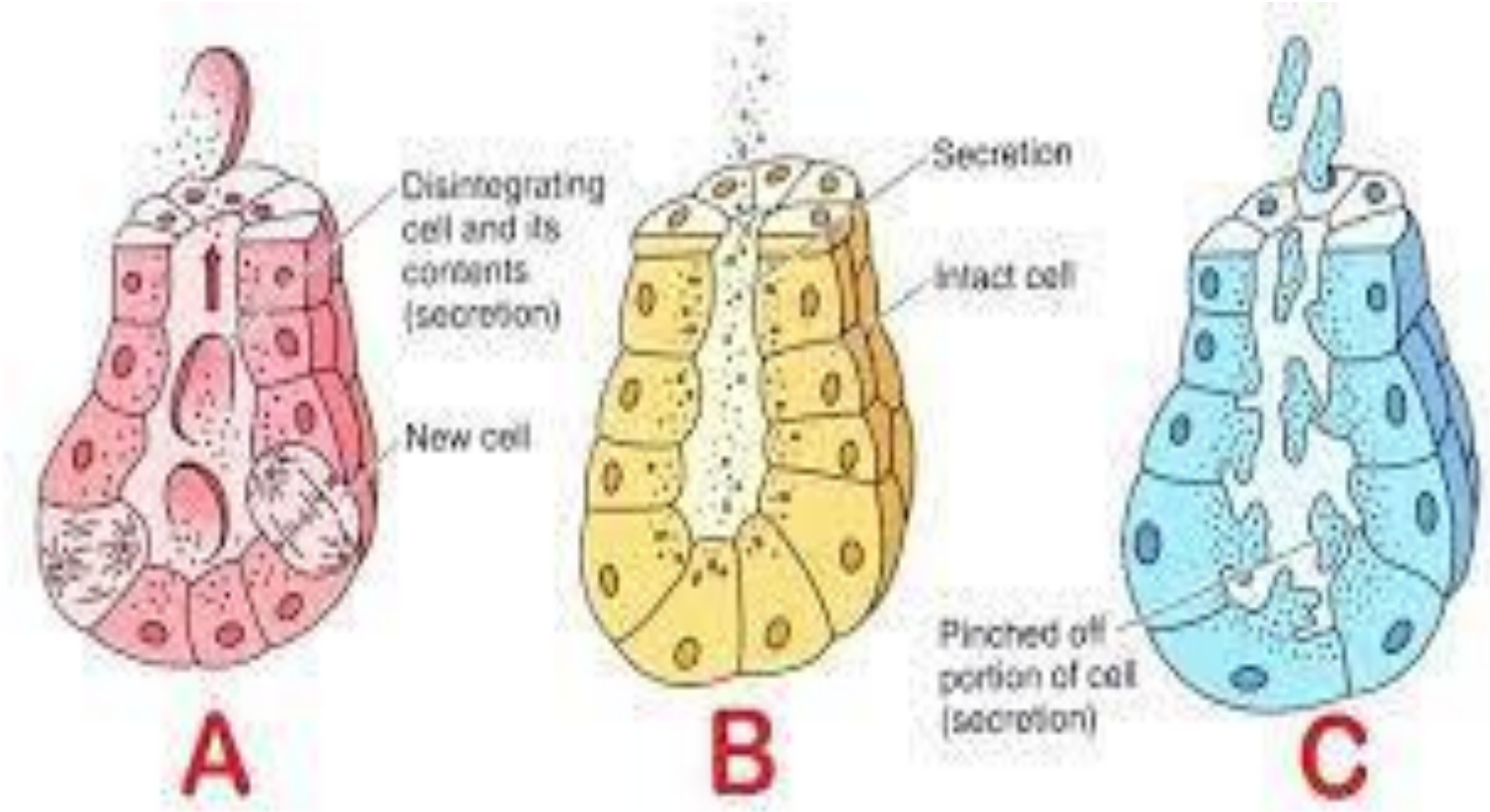



(b) Apocrine secretion




(c) Holocrine secretion

# Mode of secretion




**Holocrine** **Merocrine** **Apocrine**

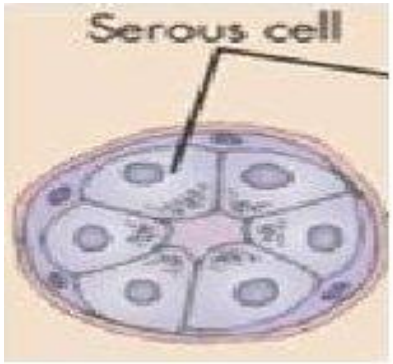
# *VI. The type of secretion*

**a) Serous gland**

- parotid gland.
- The secretion is watery fluid.

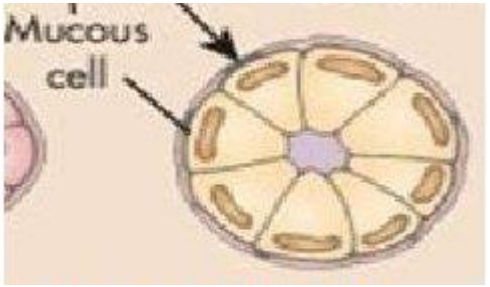
**b) Mucous glands**

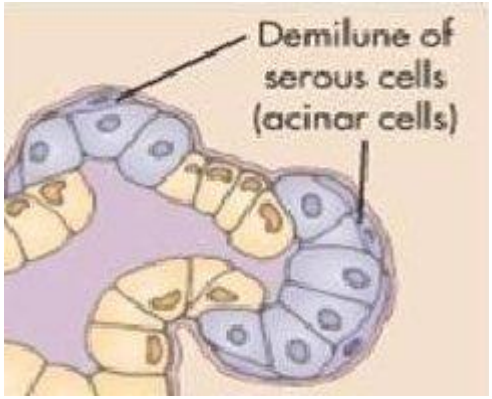
- The secretion is viscid mucus secretion



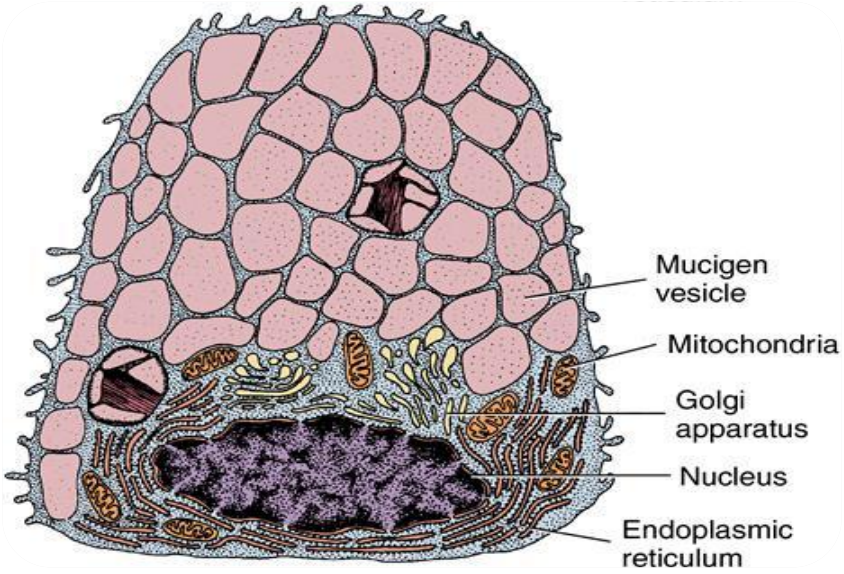

**c) Mixed glands**

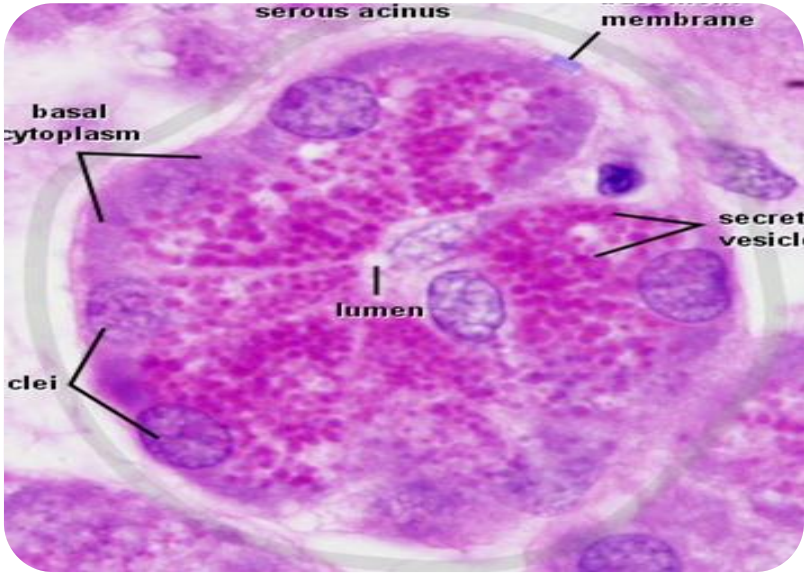
(seromucus) as submandibular glands.



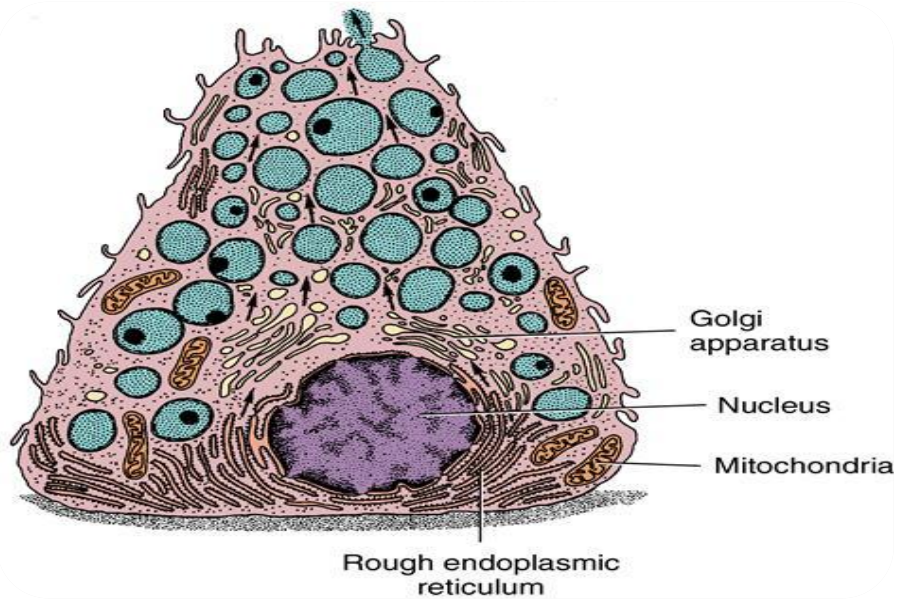



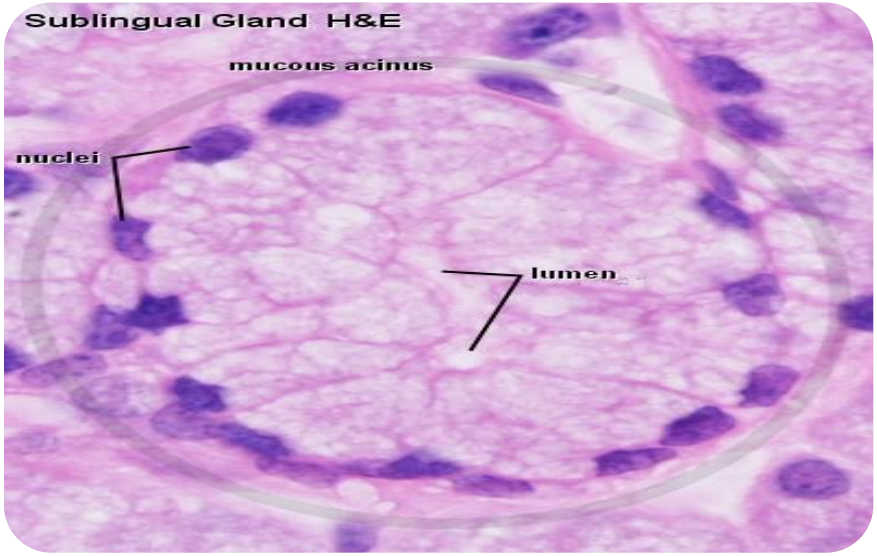
# Mucous cell




# Serous cell



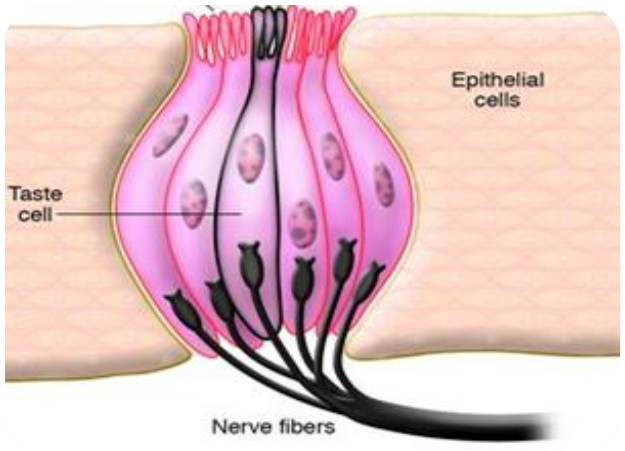



| | Serous cell | Mucous cell |
|---|---|---|
| **Site** | parotid - pancreas | Goblet cell |
| **Secretion** | Serous | Mucous |
| **Nature** | Watery | Viscid |
| **Content** | Protein | Glycoprotein |
| **Nucleus** | Central rounded | Basal flat |
| **Cytoplasm by Hx & E** | Apical Acidophilia (secretory granules) & Basal Basophilia (RER) | Pale vacuolated (secretion dissolved) |

# Special types of epithelium

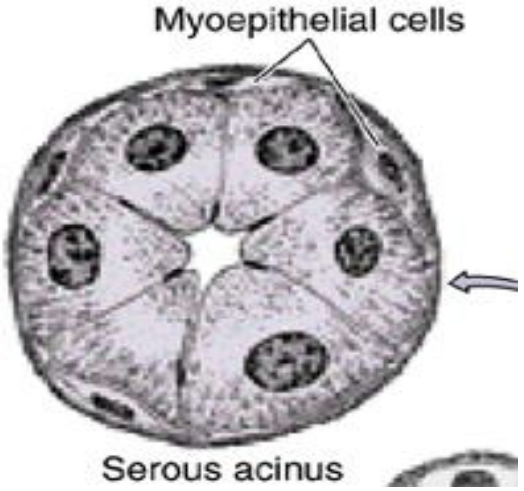
## Neuroepithelium

- Retina of the eye.
- Organ of Corti in the ear.
- Olfactory epithelium of the nose
- Taste buds of the tongue.




## Myoepithelium

- Mammary glands



# III. Neuroepithelium

- Epithelial cells have special sensory functions.
- Structure:

it is composed of 3 types of cells

## 1-Hair cells (sensory cells)

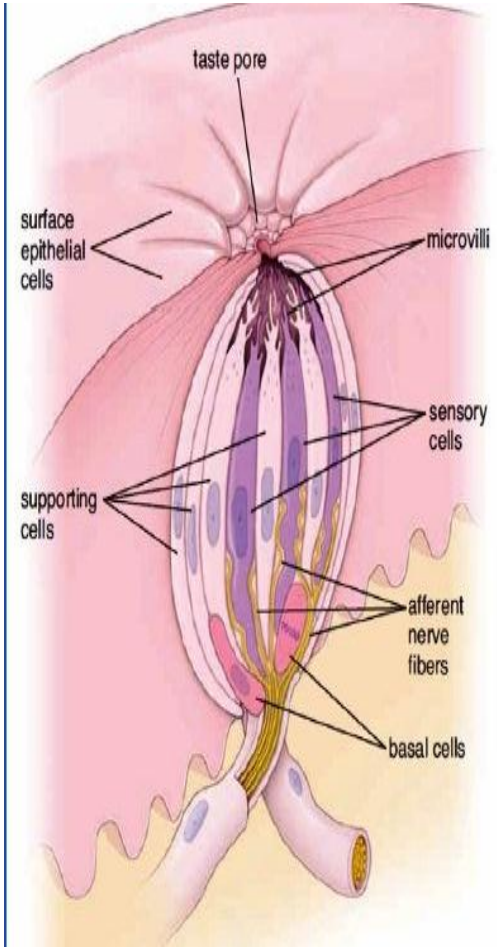
-receive sensation
-Surround by nerve ending at their bases
-have Apical microvilli

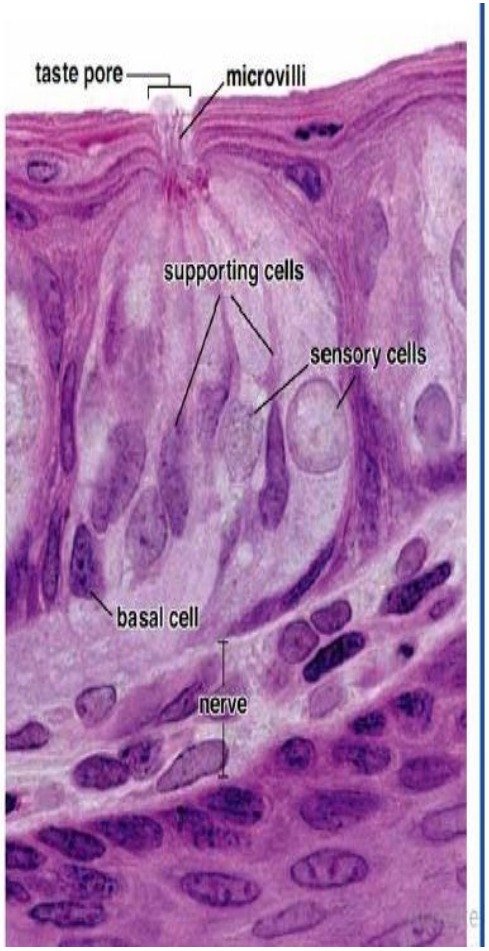
## 2-Supporting cells

Give support to hair cells

## 3- Basal cells

Act as a *stem cells* for regeneration



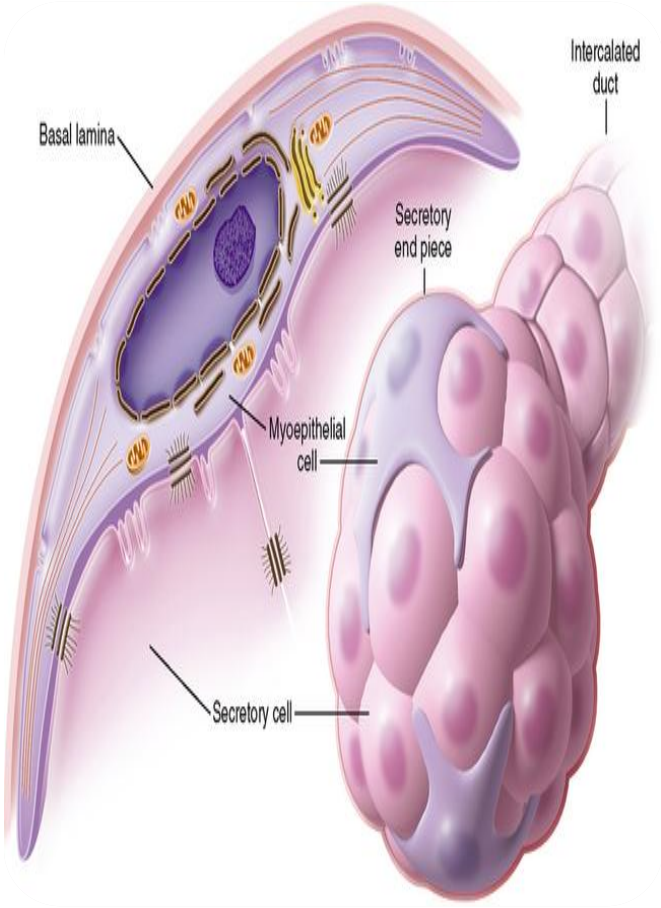



# IV. Myoepithelium

**Epithelial cells specialized for contraction.**

- **Stellate or Spindle shaped.**
- **Present Around gland acini and ducts**
- **Present between basal lamina and secretory cells.**
- **Contain actin and myosin filaments.**
- **- Sites:**

**-Lining the acini of mammary, Sweat & Lacrimal glands.**



# Biology of epithelial cells

As cells **differentiate**, they **acquire** morphologic and physiologic characteristics related to their functions.

**These are the basic epithelial cell types:**

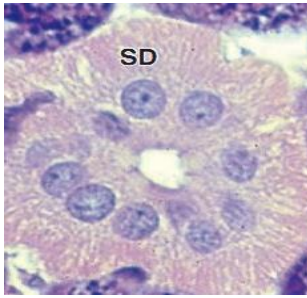
1. **Ion- transporting cells**
2. **Protein synthesizing cells**
3. **Mucus-secreting cells**
4. **Steroid secreting cells**
5. **Diffuse neuroendocrine system (DNES)**

# Ions transporting cell

## Definition

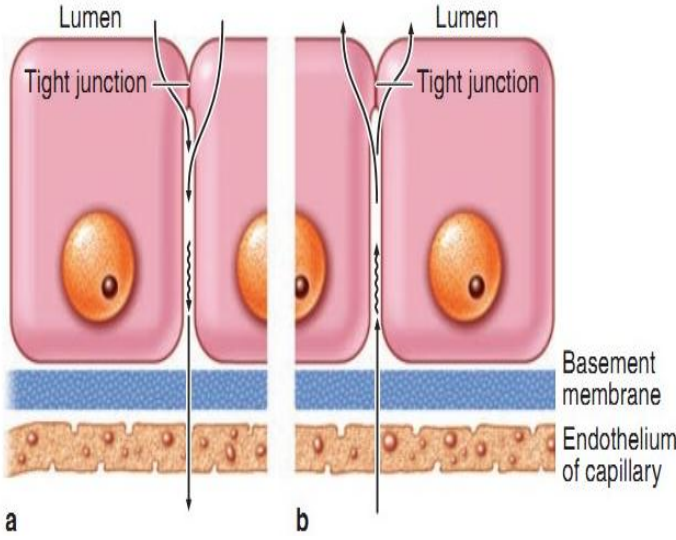
Epithelial cells able to transport certain ions against a concentration gradient (active transport )using ATP.

Transfer across the epithelium from the apex to the base by what is known as transcellular transport



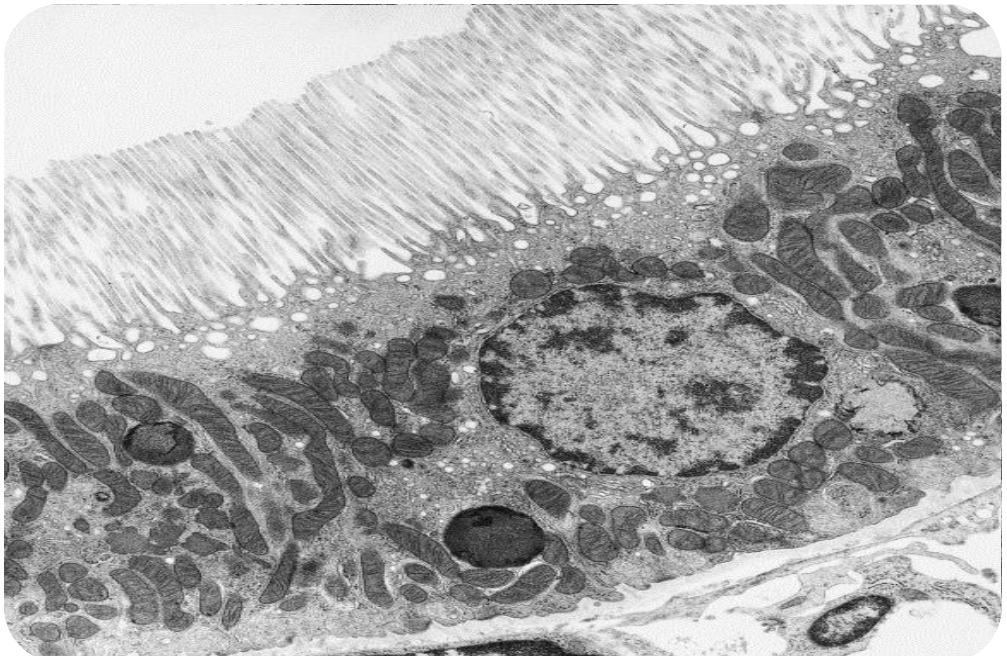

## Site*(absorption sites)*:

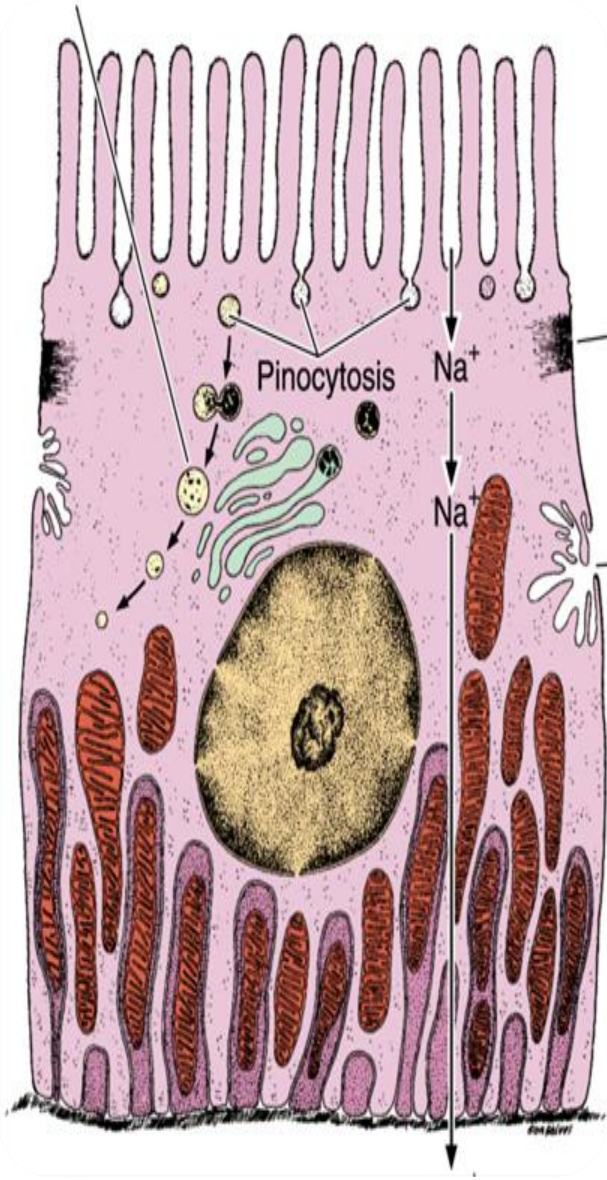
- proximal and distal renal tubules
- striated ducts of salivary glands
- intestine
- gall bladder



- ***E/M:***

- Apical microvilli :increase surface area exposed for ions transport.
- Apical tight junctions: They are impermeable to ions, water and larger molecules, to prevent back diffusion of materials.
- Basal surfaces of these cells have many long invaginations with vertically oriented mitochondria (supply energy for active transport)
- Lateral membranes, there are interdigitations between the adjacent cells.





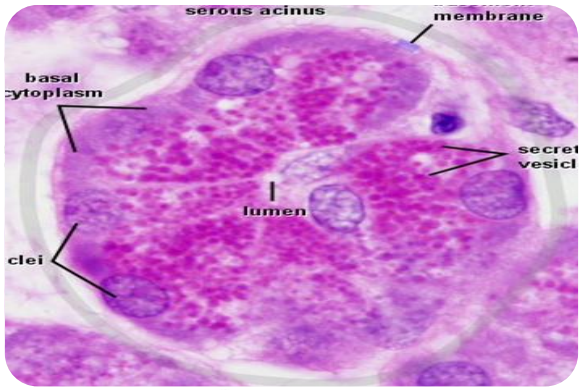
# Protein synthesizing cells

***Sites:*** Parotid - Pancreas

*acinar cells*

***LM***

Cells pyramidal.
Nucleus central rounded.
Apical Acidophilia (secretory granules).
Basal Basophilia
(RER).



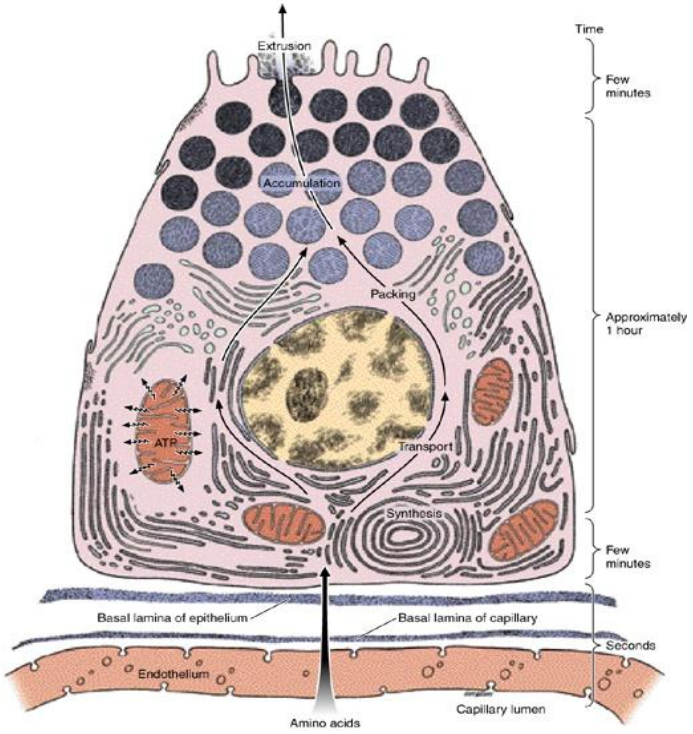

***E/M***

*In the basal region:*

- Infranuclear parallel arrays of rER
- Abundant ribosomes.
- Mitochondria are interspersed among rER.

*In the apical region:*

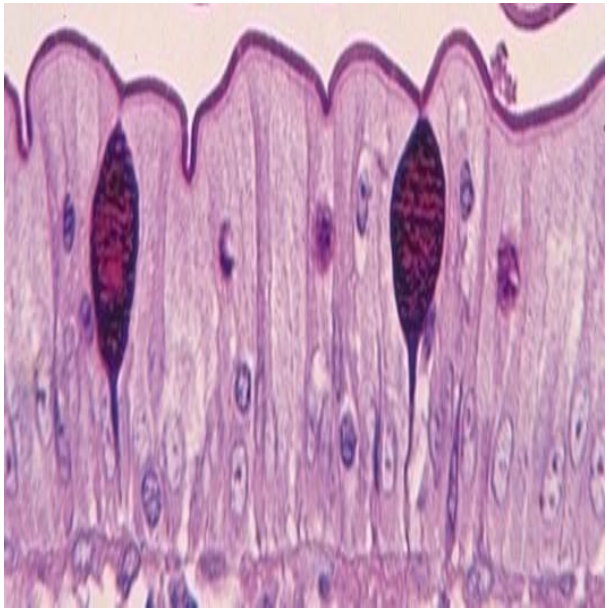
- Golgi complex supranuclear
- Secretory granules



# Mucus-secreting cells

**Sites:**

- stomach,
- salivary glands
- respiratory tract
- genital tract



-vary in the chemistry of their mucus secretions

-have different morphologic characteristics.

Example: Goblet cell

# Goblet cell

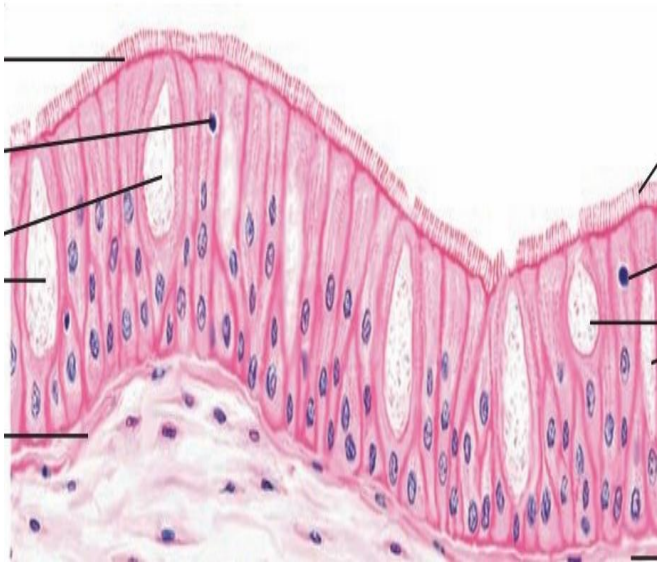
***L/M:***

-Apical pale, secretory granules(numerous, large and lightly stained

-Base nucleus in narrow

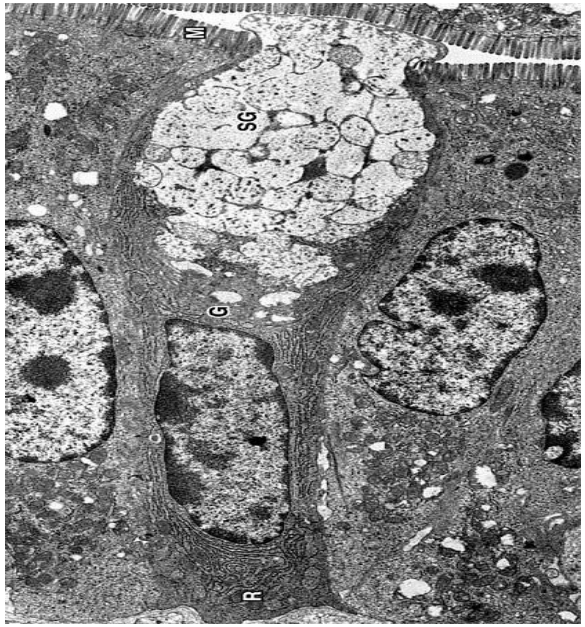
of the cell.

***Special stain:*** PAS



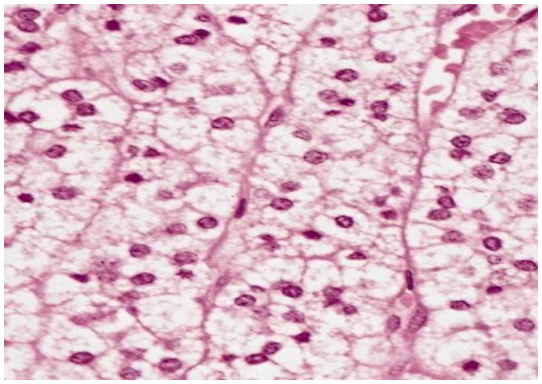
***E/M:***

- *Wide apical part multiple large pale stained secretory granules*
- Supranuclear Golgi
- Narrow Basal part nucleus & RER.



# Steroid secreting cells

They are endocrine cells that synthesize and secrete steroids with hormonal activity.



***Sites:*** testes, ovaries and adrenal glands.

***L/M:*** -polyhedral

-acidophilic cytoplasm

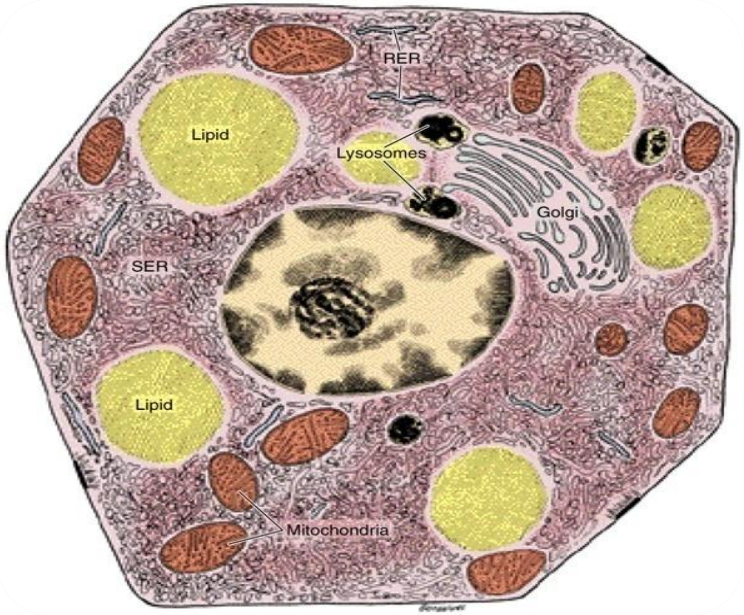
-central nucleus.

-Rich in lipid droplets

*E/M:*

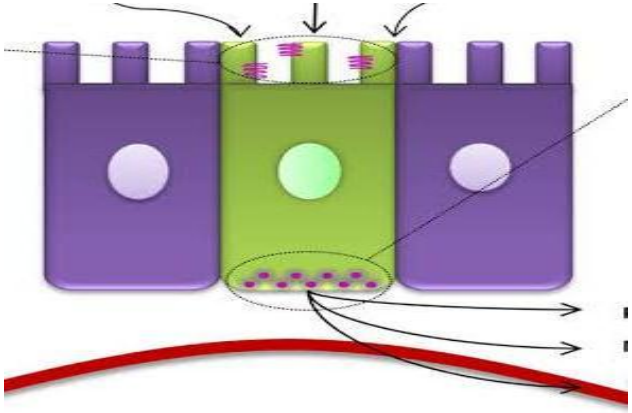
- Microvilli on the surfaces facing blood capillaries
- Rich in SER.
- Rich in lipid droplets
- mitochondria with tubular cristae

Golgi apparatus, lysosomes, and few RER

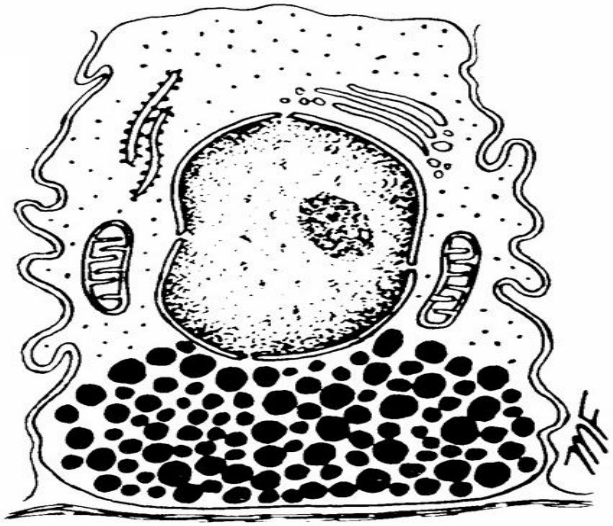


# Diffuse Neuroendocrine System (DNES)

- Small granules-containing cells
- Exist individually or in small groups.
- Endocrine cells present among non-endocrine
- Cells synthesize & release hormones or amine with hormonal activity
- These hormones control many body functions

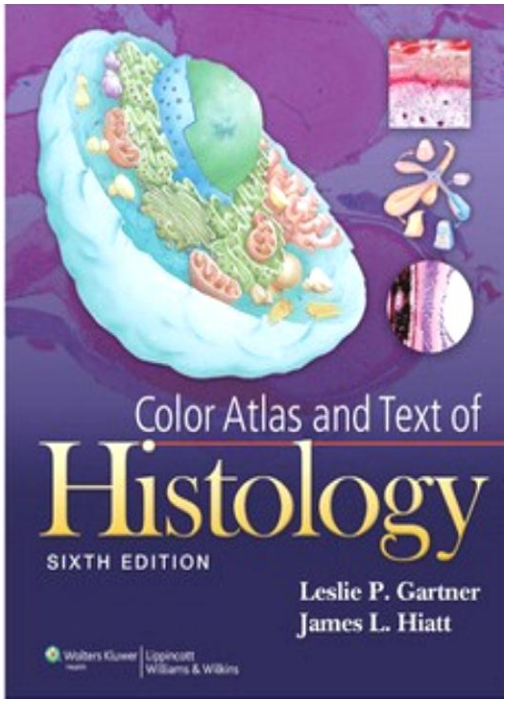


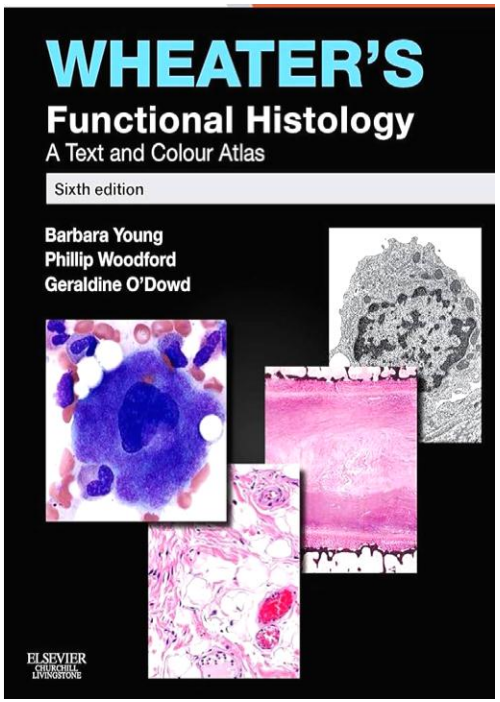
- ***E/M***
  - -Few RER.
  - -Supra-nuclear Golgi.
  - -Basal secretory granules.
- ***Sites(*spread throughout the body** )
  - Digestive system.
  - Respiratory mucosa.

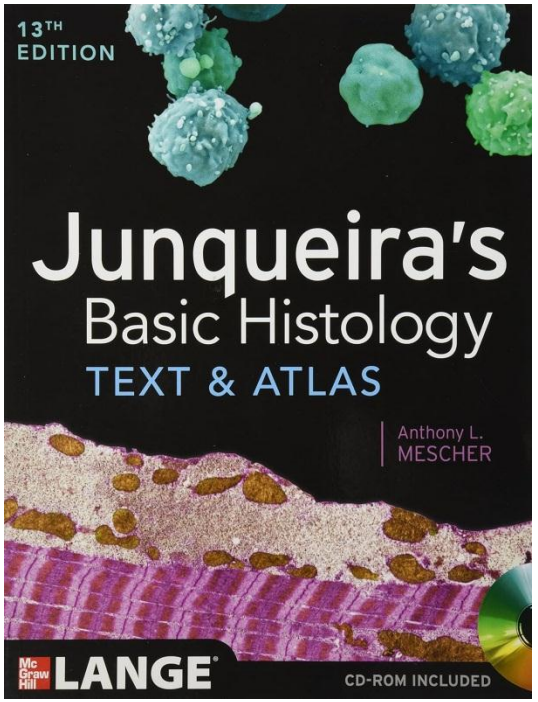


# References

## Text books




Web sites

www.histology-world.com

# Thank you