Epithelium

HUMAN HISTOLOGY

Semester 2, Year 1

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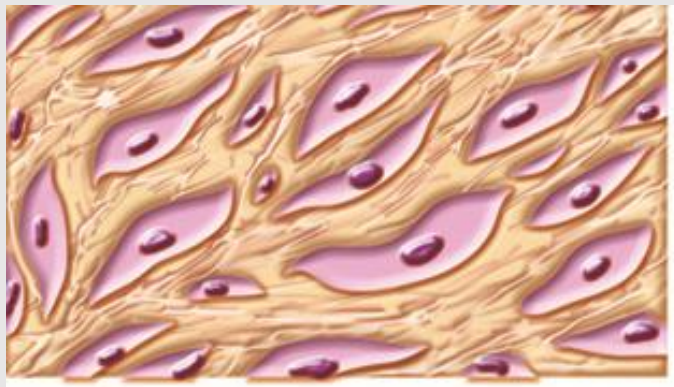
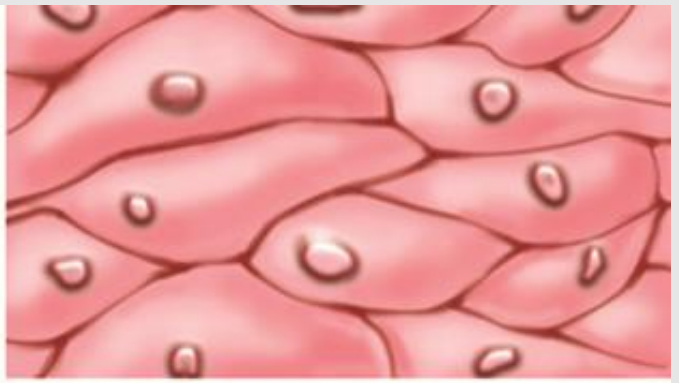
Epithelial Tissue

Learning objectives:

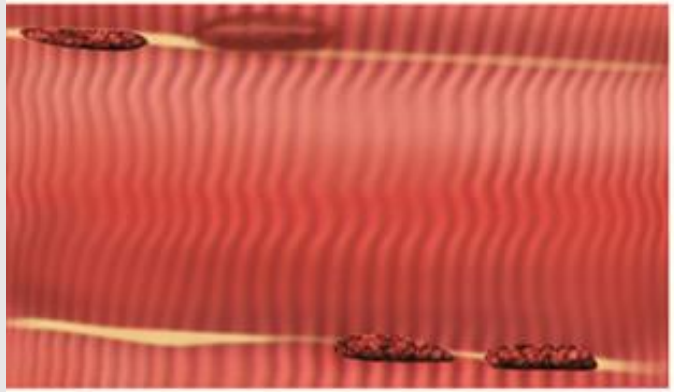
1. Define the epithelial tissue.
2. Identify the general characters of the epithelial tissue.
3. Identify types and sites of epithelial tissue .
4. Differentiate between different types of epithelial tissue.



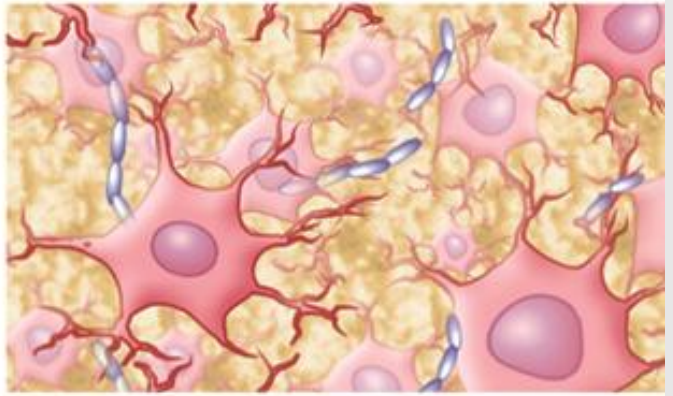
Connective tissue



Epithelial tissue



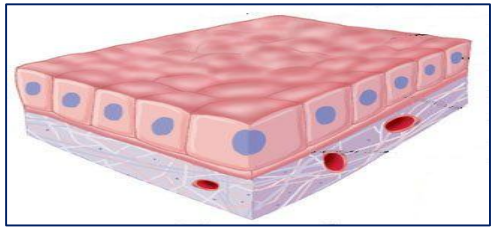
Muscle tissue



Nervous tissue

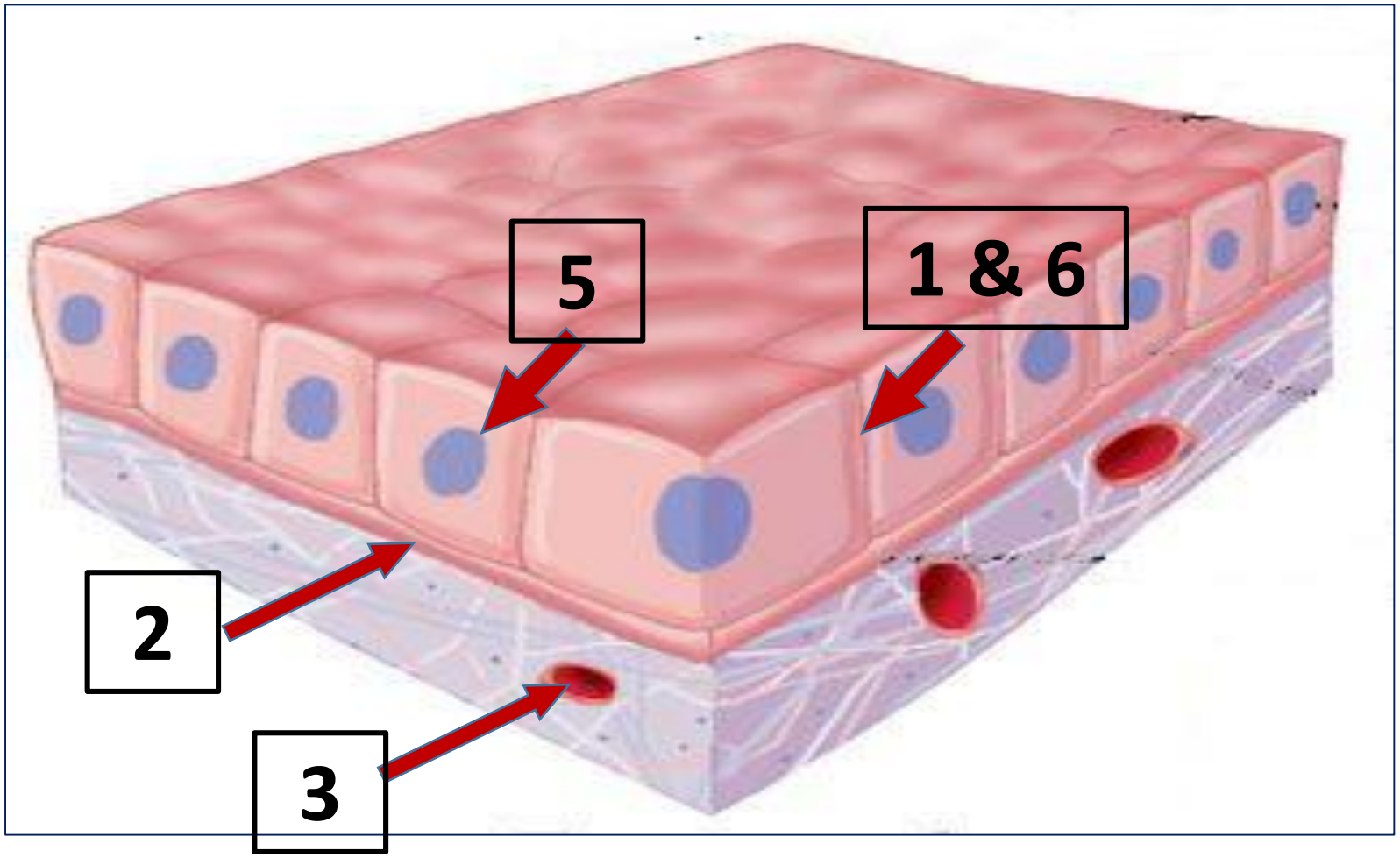
Tissues of the body

EPITHELIAL TISSUE



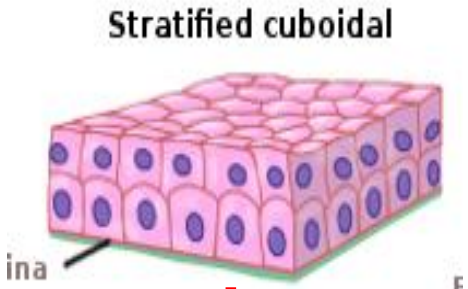
- It is one of the four basic tissues present in the body.
- **General characters:**
  1. It is formed of continuous sheet of cells arranged in one or more layers with very little amount of intercellular substance.
  2. All the cells are resting on a basement membrane.
  3. Blood vessels do not penetrate the epithelial tissue, however its nutrition depends on the diffusion of metabolites from the capillaries in the underlying connective tissue.
  4. Most epithelial tissues receive nerve ending that form rich nervous network.
  5. The shape of nuclei correspond to the shape of cells.
  6. In between epithelial cells there are many types of cell junction.

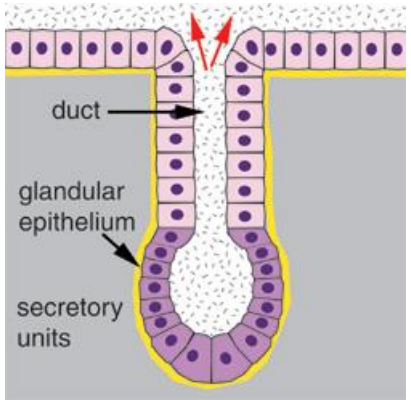
EPITHELIAL TISSUE

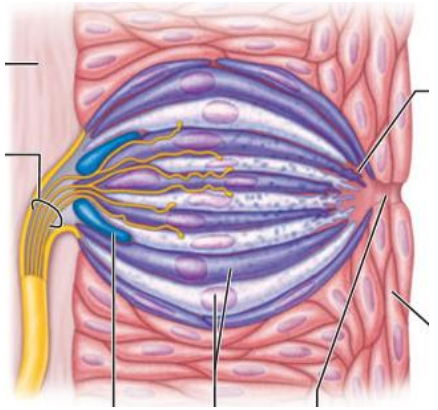


Types of Epithelium

- Covering and Lining
- Glandular
- Neuro-epithelium
- Myo-epithelium







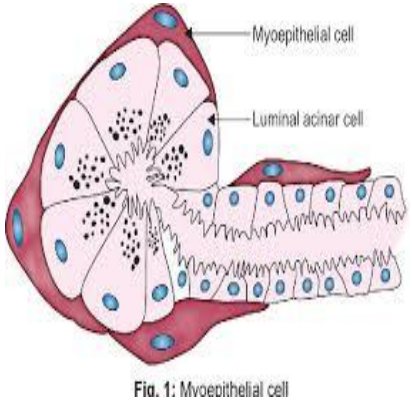
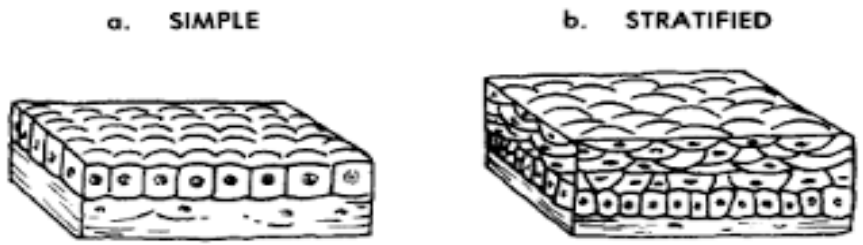


Fig. 1: Myoepithelial cell

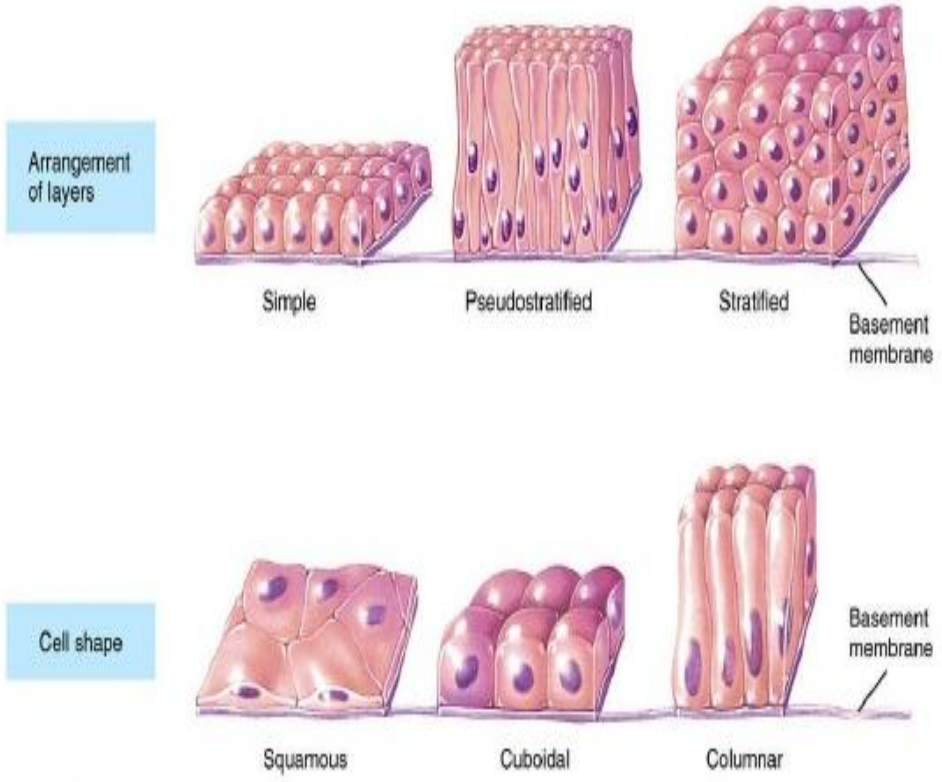
Covering the body (e.g. skin) and lining cavities (e.g. gastrointestinal tract).

- **Covering and lining epithelium**
- It can be divided according to the number of layers into:
  - Simple epithelium "formed of one layer of cells".
  - Stratified epithelium "formed of more than one layer of cells".



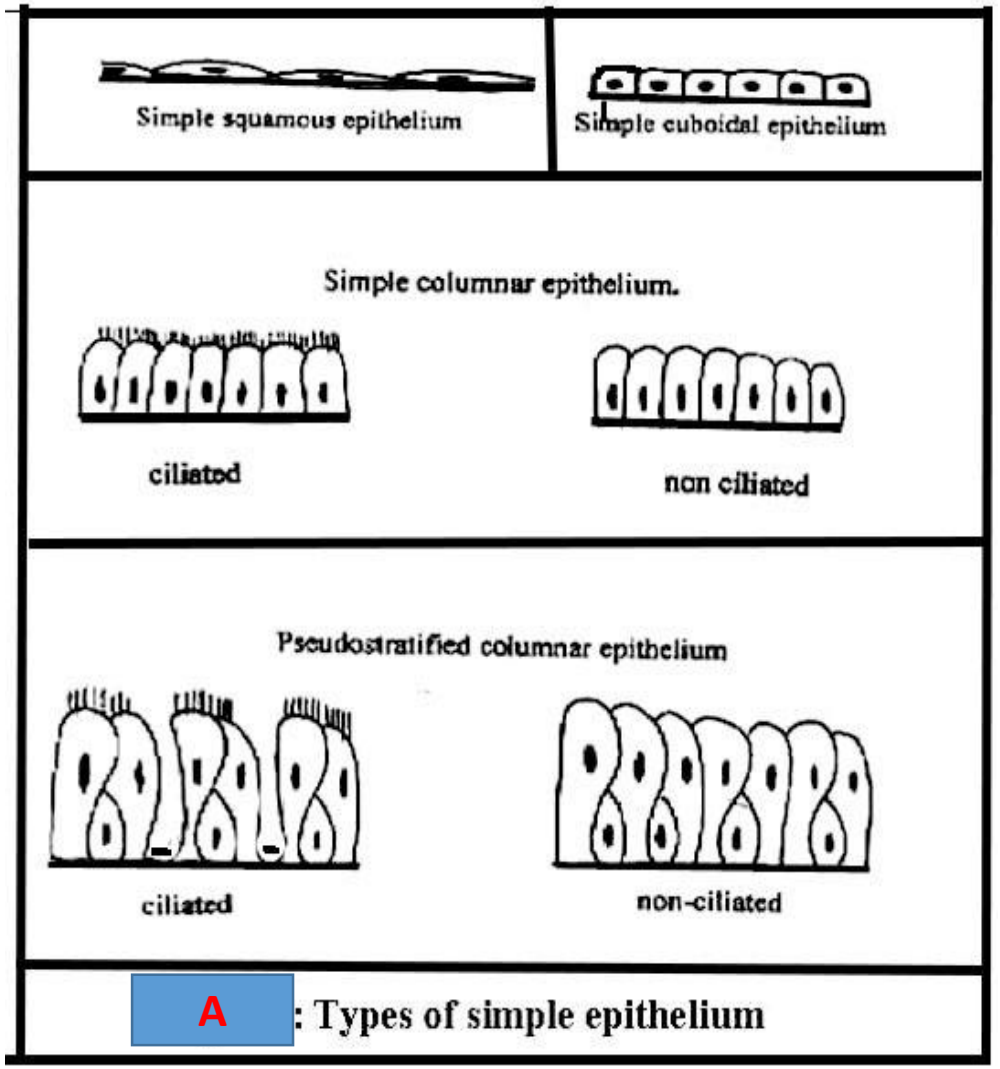
Covering and Lining Epithelium

- Normally classified according to:
  - Arrangement of cells into layers
  - Shapes of cells



A-Simple epithelium

- It is formed of single layer of cells resting on a basement membrane.
- - It is divided according to the shape of the cells into:
    - Simple squamous epithelium.
    - Simple cubical epithelium.
    - Simple columnar epithelium.
    - Psuedostratified columnar epithelium.



A : Types of simple epithelium

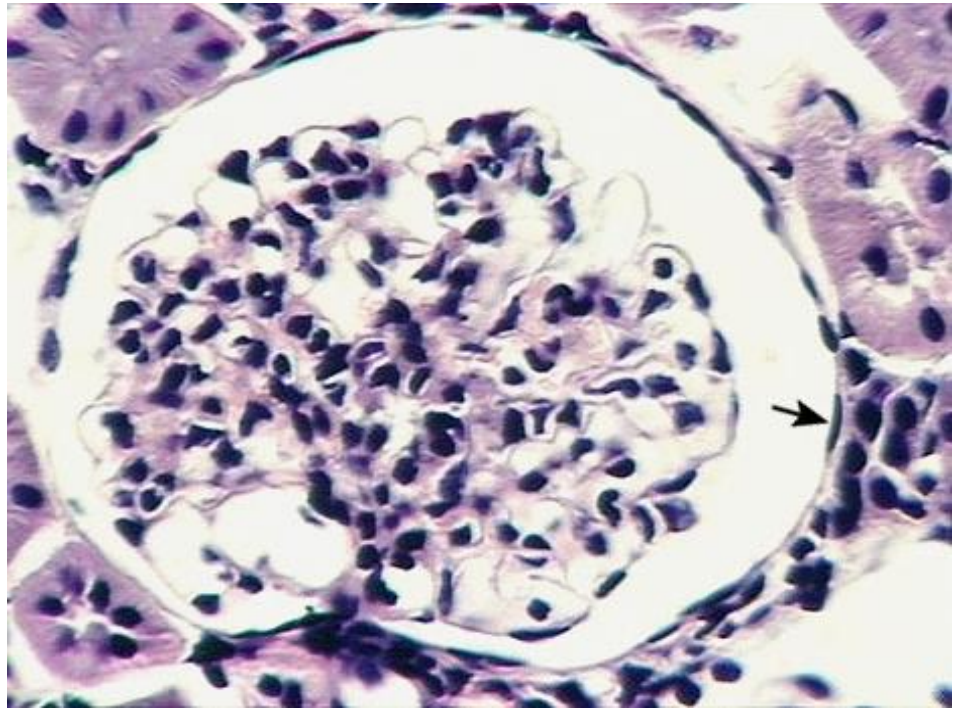
A-Simple epithelium

- ***Simple squamous epithelium*** **:**
  - It is formed of a single layer of flat thin cells with central flat bulging nuclei.
  - ***Site***: it is characteristically thin to allow material transport across it.
  - In Bowman's capsule of the kidney.

  - Lining the alveoli of the lung for diffusion of gases.
  - The endothelium is the simple squamous epithelium lining of the blood vessels , lymphatic vessels and heart to permit smooth passage of blood and lymph.
  - The mesothelium is the simple squamous epithelium lining the serous membranes e.g. pleura, pericardium and peritoneum.

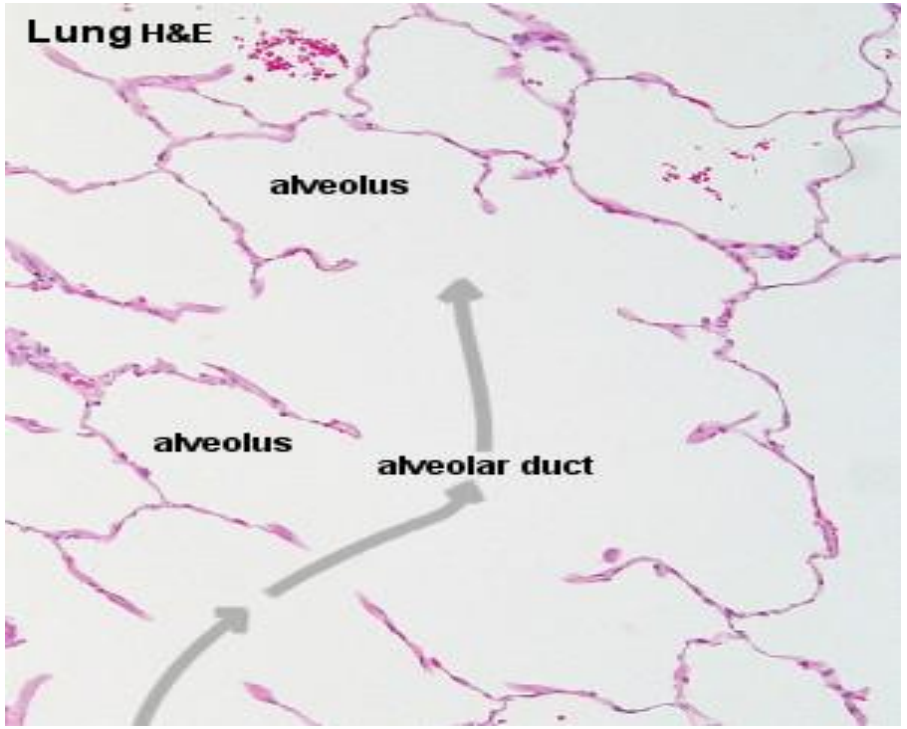
1- Simple Squamous Epithelium

(Bowman's capsule- kidney)



Function: Filtration of blood

(Lung alveoli)

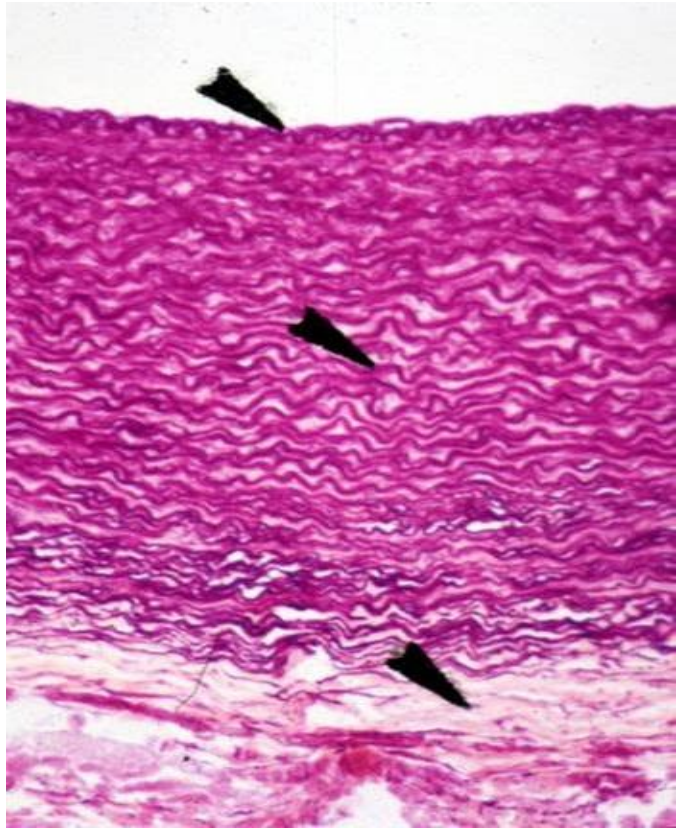


Function: gas exchange

Simple Squamous Epithelium

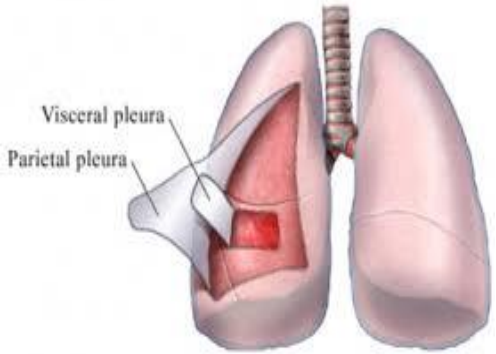
Endothelium:

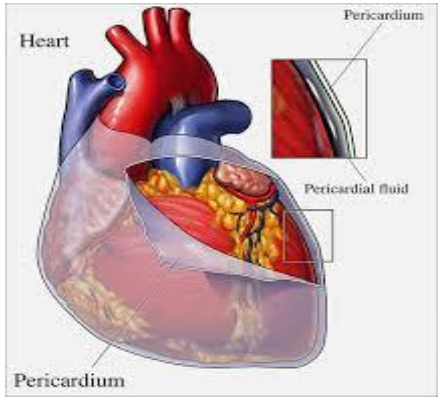
of the blood vess



Methothelium :

Pericardium, pleura, peritonieum
Function : smooth surface





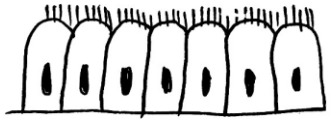
A-Simple epithelium

- ***Simple cubical epithelium*** :

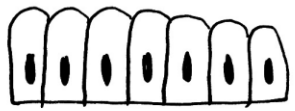
  - It is formed of a single layer of cubical cells with rounded nuclei.
  - ***Site***: thyroid follicle and lines the tubules of the kidney.(secretory function)

- ***Simple columnar epithelium*** : one layer of tall columnar cells with basal oval nuclei.
  - It may be: 1-Simple columnar non-ciliated .
  - ***Site***: stomach, intestine and gall bladder.(absorption)
  - **ducts of glands: secretion**
  - 2-Simple columnar ciliated.
  - **Sites:** lining the uterus and the oviducts (the Fallopian tubes).

Simple columnar epithelium.

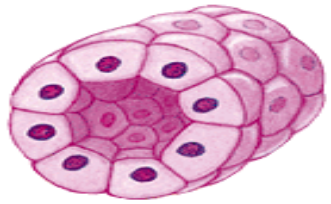


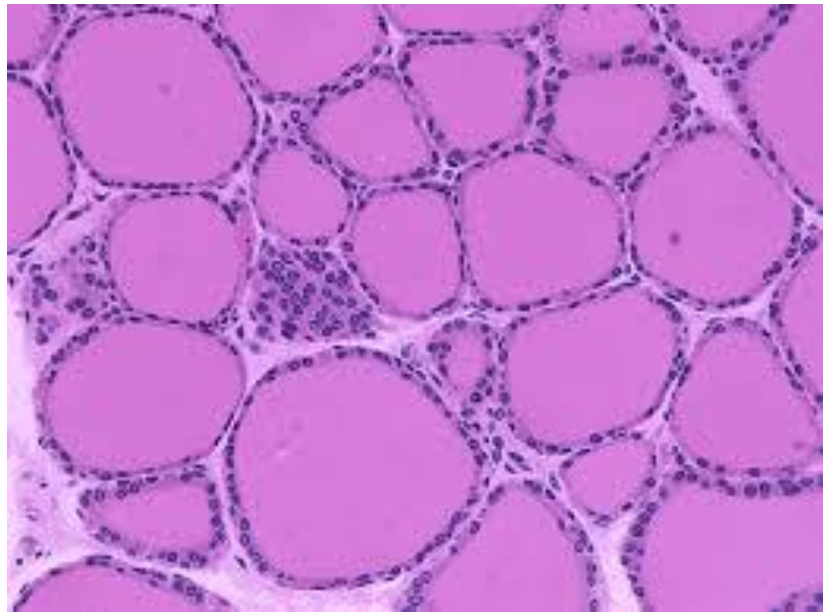
ciliated



non ciliated

2- Simple cuboidal Epithelium

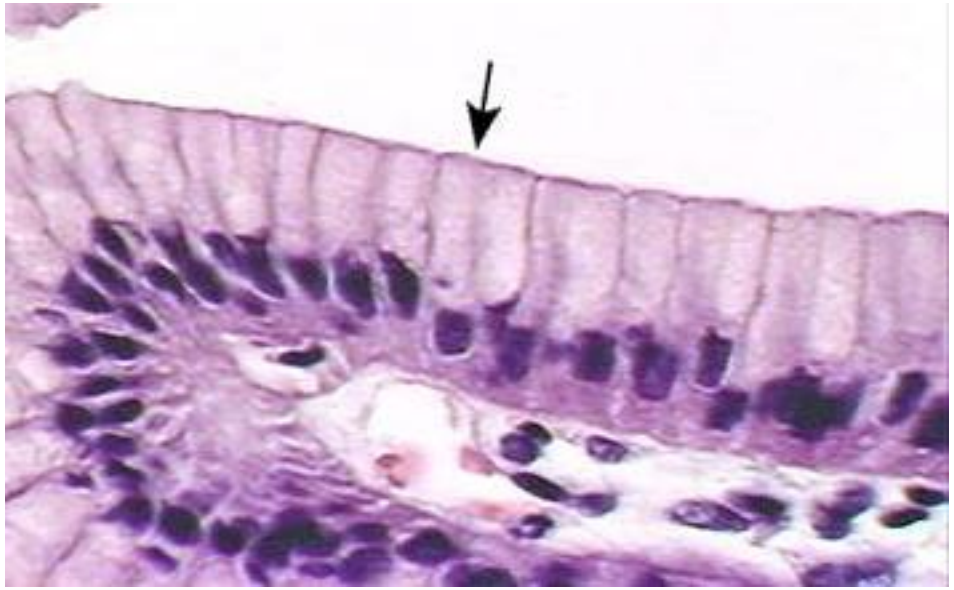


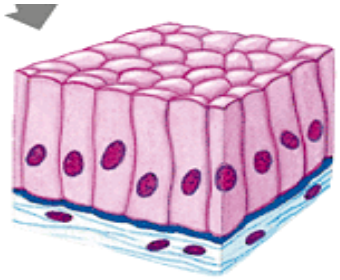


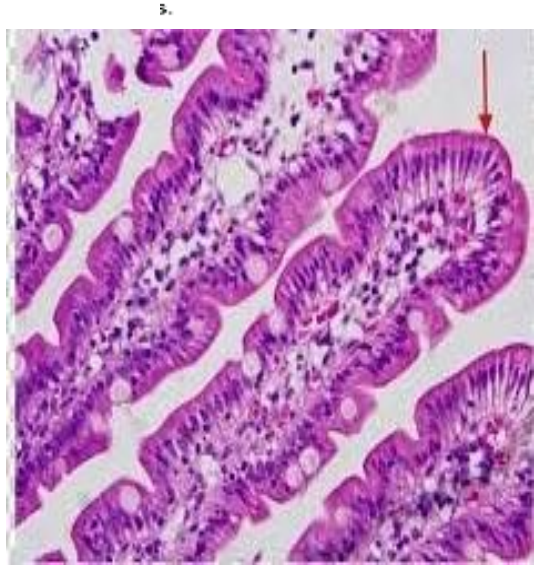
Site: Thyroid gland : secretion
kidney tubules :ion exchange

a. Simple columnar epithelium (non ciliated)

LM



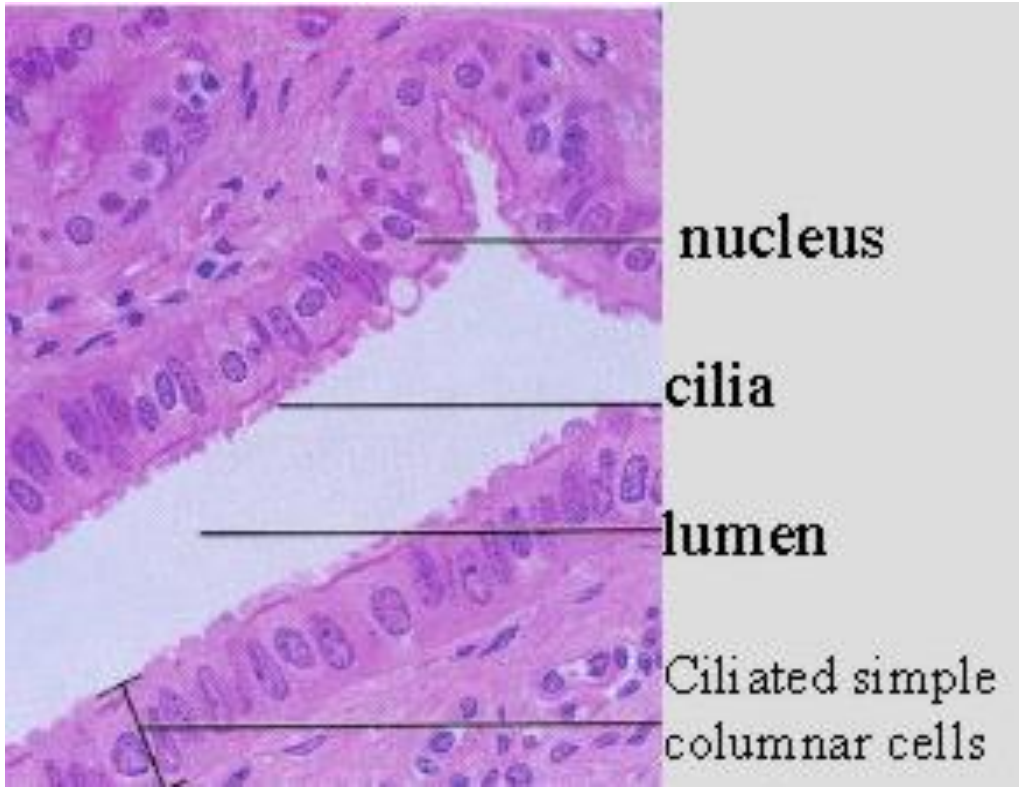


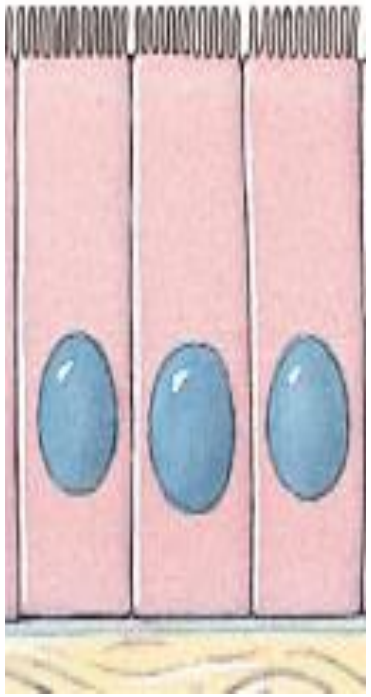


Sites: ducts of glands: secretion

digestive tract : absorption

b. **Simple columnar epithelium ciliated**





Sites: uterus, oviduct & bronchiole of the lung
(movement of luminal contents)

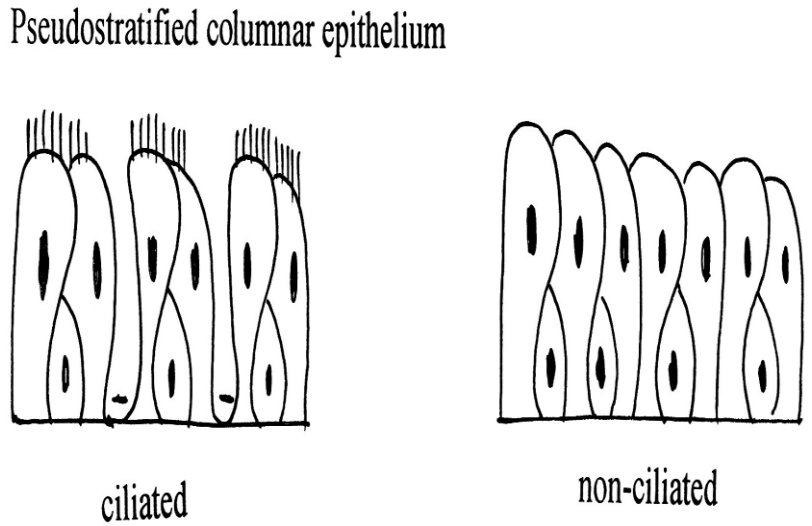
Pseudostratified columnar epithelium:

It gives the appearance of being stratified, but it is actually formed of :

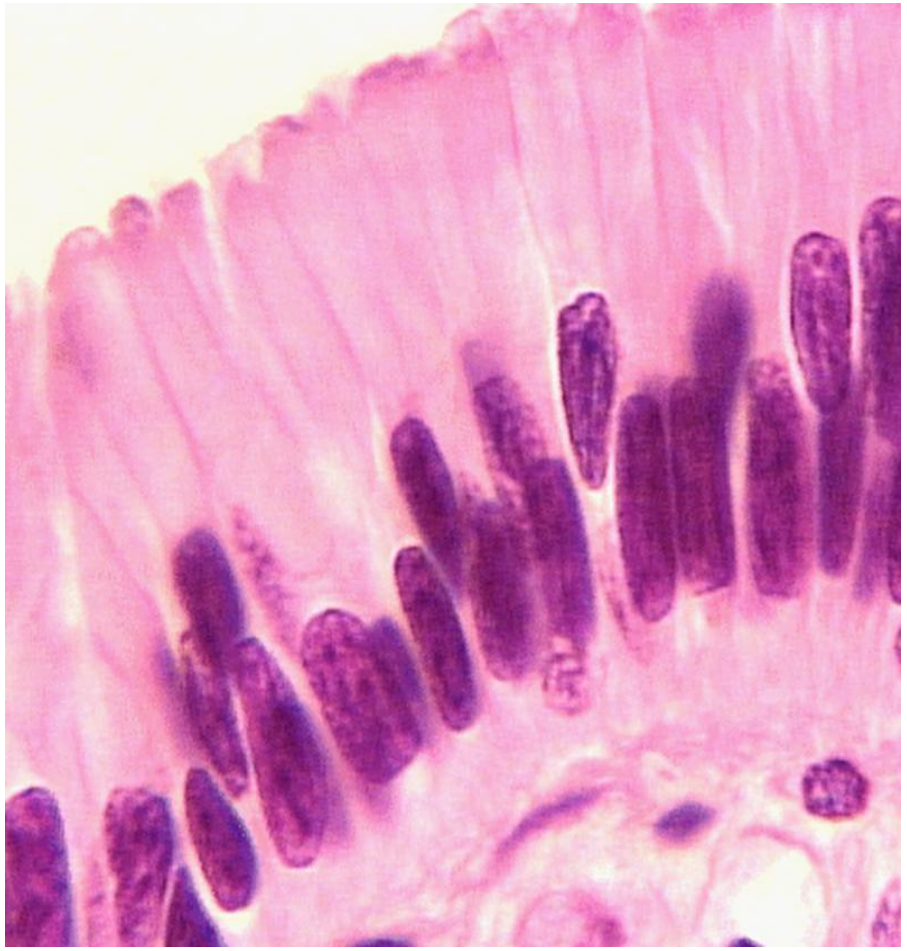
- 1 layer of columnar cells.
- All cells reach basement membrane.
- Not all cells reach the surface(i.e. some cells are tall and others are short).
- The nuclei are arranged at different levels giving false impression that this type is formed of many layers(i.e. false stratified epithelium).
- ***Site***: According to the type:

  a) Pseudostratified columnar ciliated with goblet cells.
  - ***Site:*** Respiratory passages(e.g. Trachea).

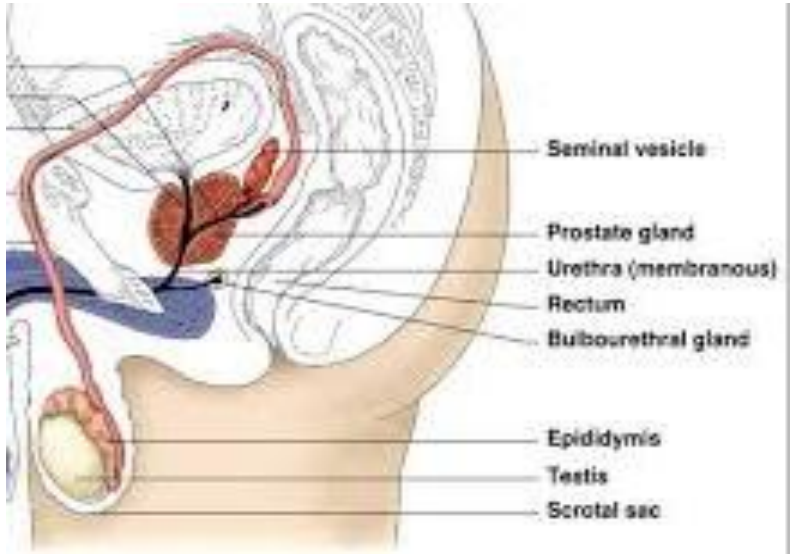
  b) Pseudostratified columnar non-ciliated.
  - ***Site:*** lining the male genital tract e.g. epididymis



a- Pseudostratified columnar epithelium non ciliated

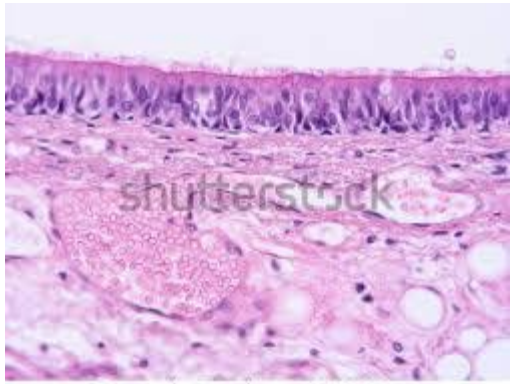


- **Sites**: Male genital tract – large ducts of glands: (secretion)



b. Pseudostratified columnar epithelium ciliated

Sites: Nose- Trachea



STRATIFIED EPITHELIUM

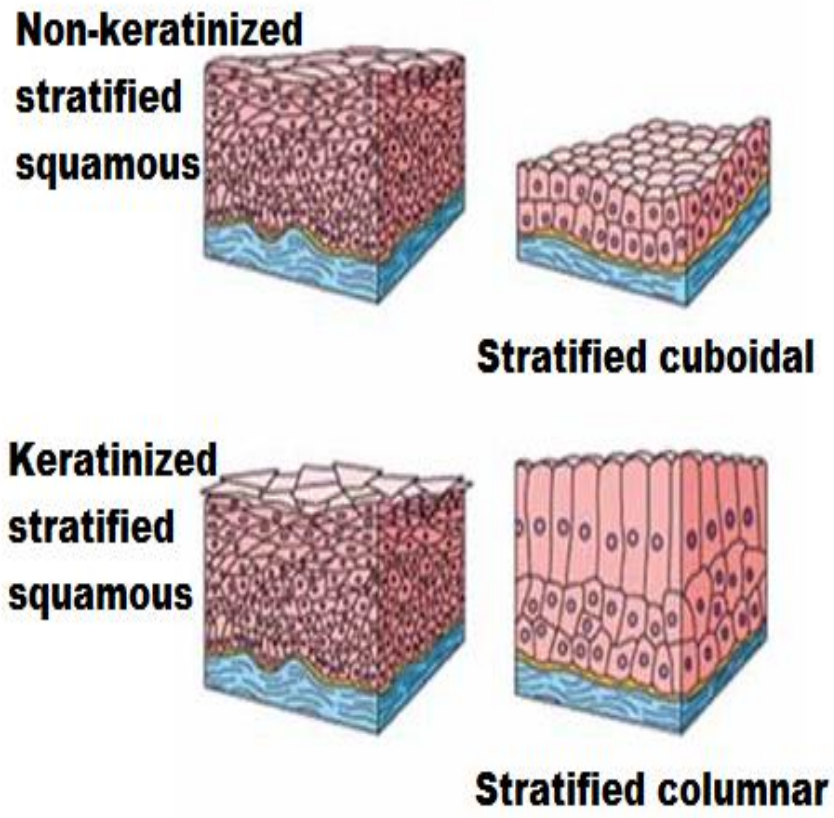
- **It is multilayered** composed of

❖**a *basal cell layer*** of columnar cells, lying on the basement membrane.

❖Above it are one or more ***intermediate layers*** of polygonal cells.

❖The shape of **the free *surface layer*** of cells determines the name of the stratified epithelium into

❖Stratified epithelium **has a protective** function and can withstand wear and tear than simple epithelium.



Stratified Squamous Epithelium

Basal layer

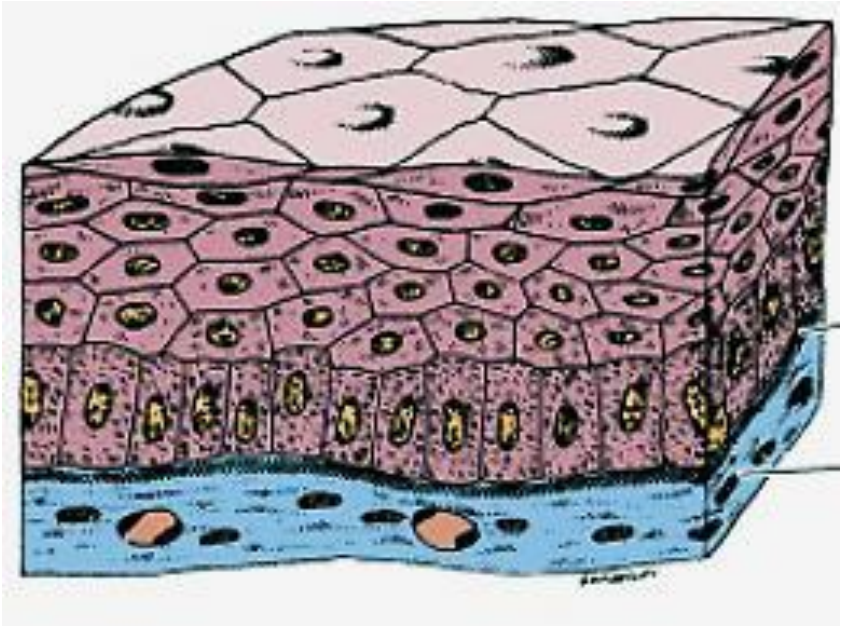
- Columnar one layer

Middle layers

- Polyhedral many layers

Top layer

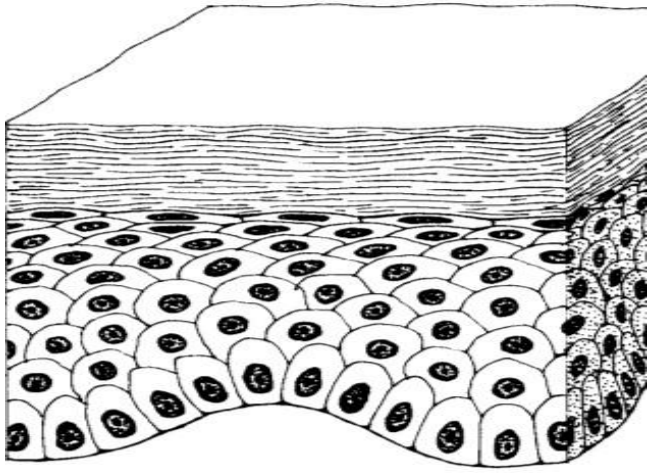
- Squamous



Stratified Squamous Epithelium

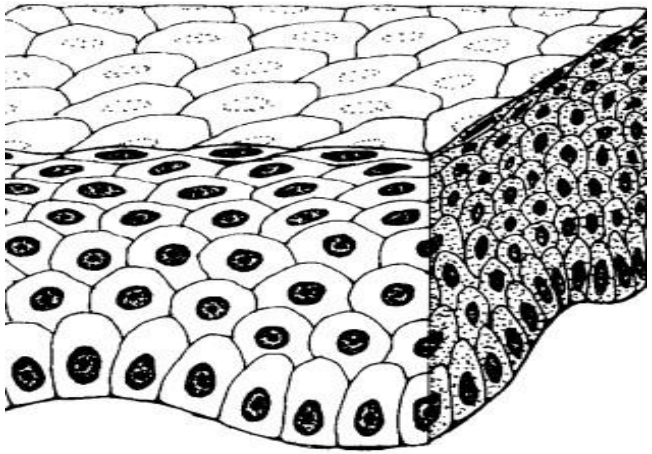
Keratinized

- Covered by keratin.
- Dry surface (epidermis of skin).



Non keratinized

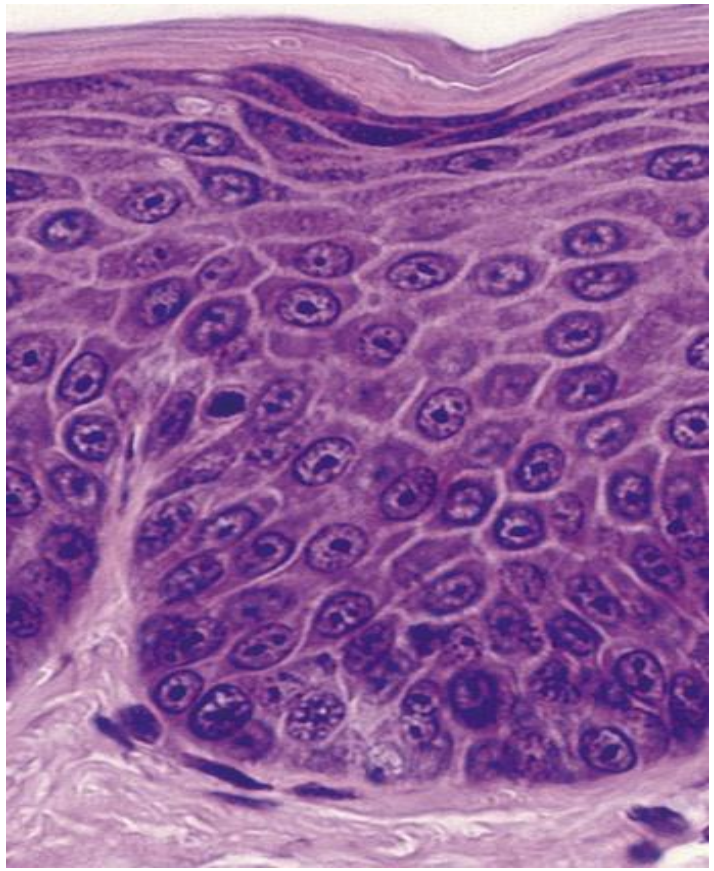
- Not covered by keratin.
- Wet surface leading to skin:
  - Mouth cavity.
  - Vagina.
  - Oesophagus.



Stratified squamous epithelium

Non Keratinized

Keratinized



Oesophagus- vagina

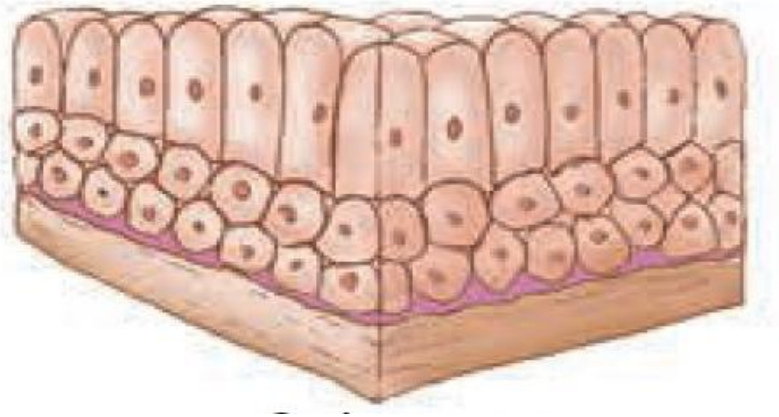
skin

(Physical protection)

Stratified Columnar Epithelium

Top layer

- Columnar

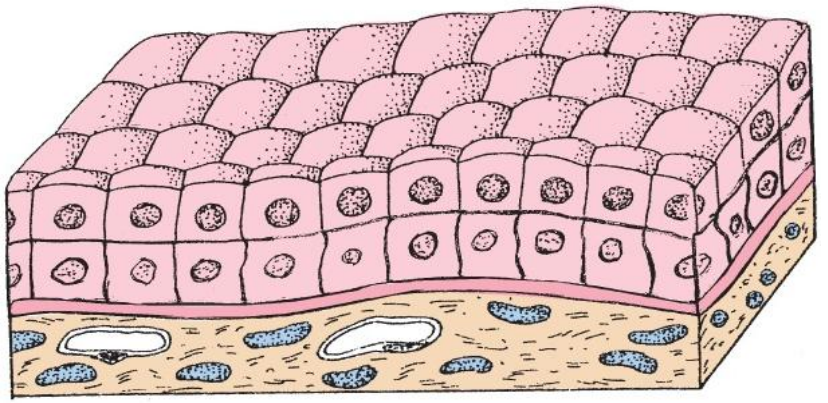


Site:

- Conjunctiva of the eye.

Stratified Cuboidal Epithelium

Two or more layers of cuboidal cells.

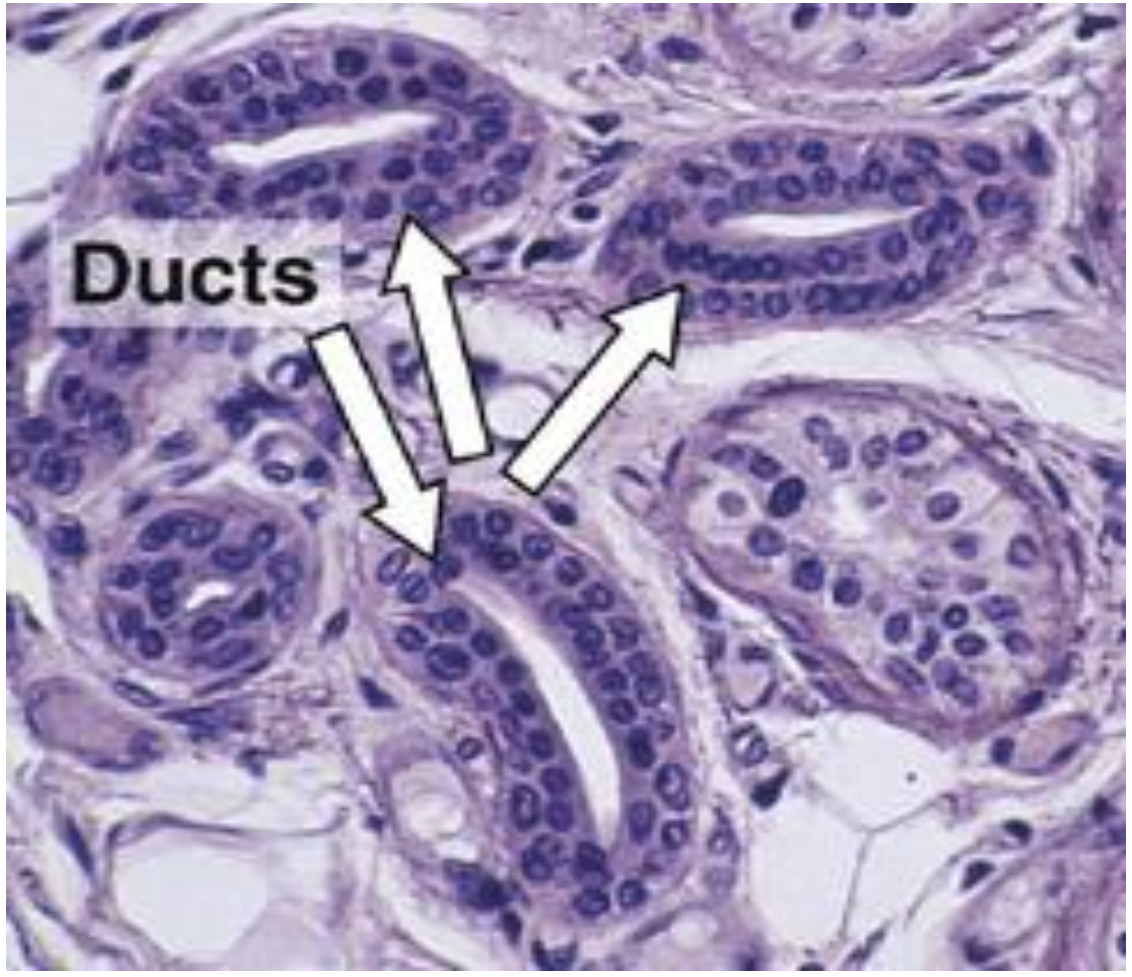


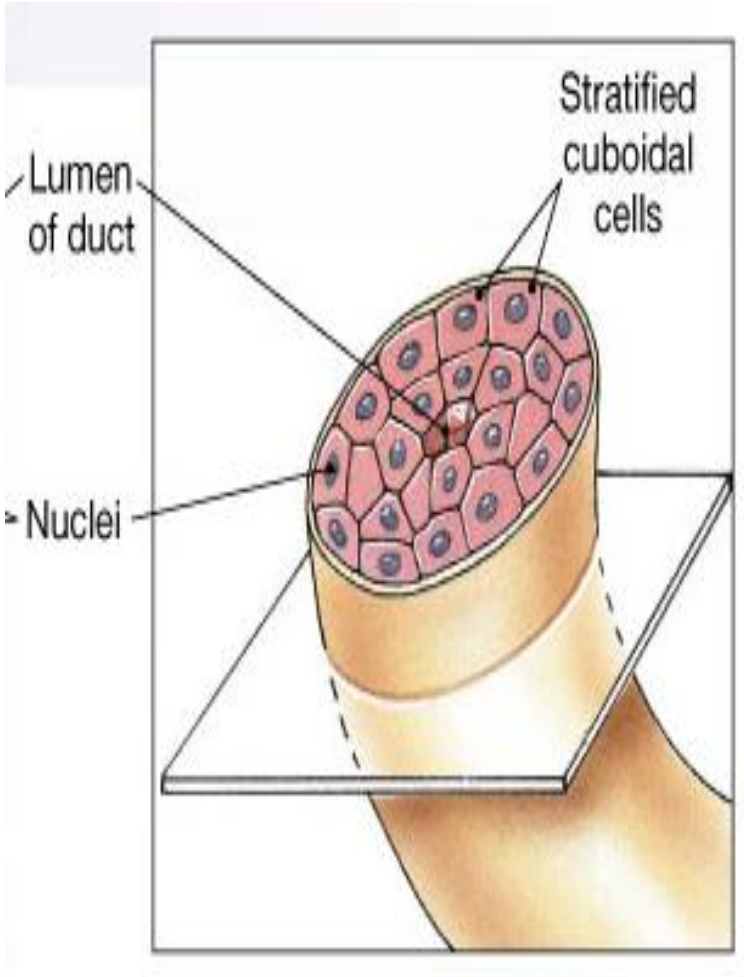
Site:

- Ducts of salivary glands.

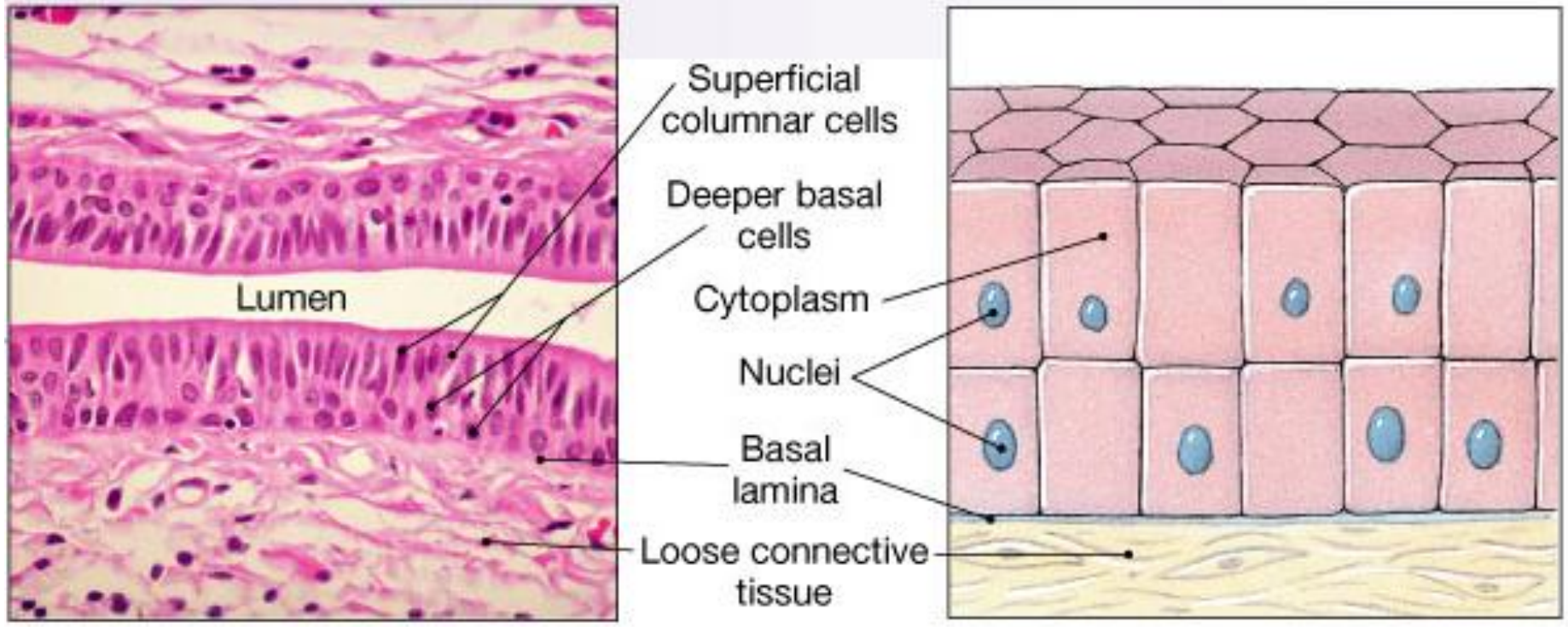
Stratified Cuboidal Epithelium

(Ducts of sweat glands: secretion) (Rare)





Stratified Columnar Epithelium (Rare)



- ciliated: penile urethra

- Non ciliated: conjunctival fornix

(protection)

Transitional Epithelium

Sites:

- Ureter.
- Urinary bladder.

Forms:

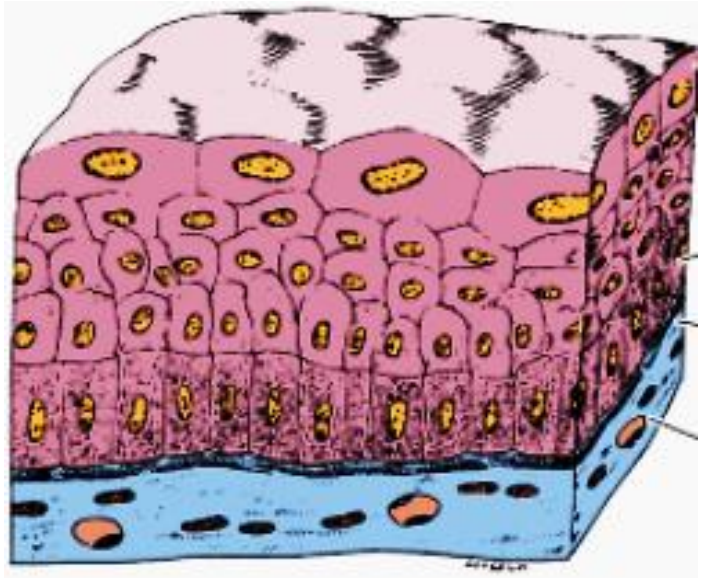
❖ **Empty bladder:** 6-8 layers

Basal layer: low columnar.

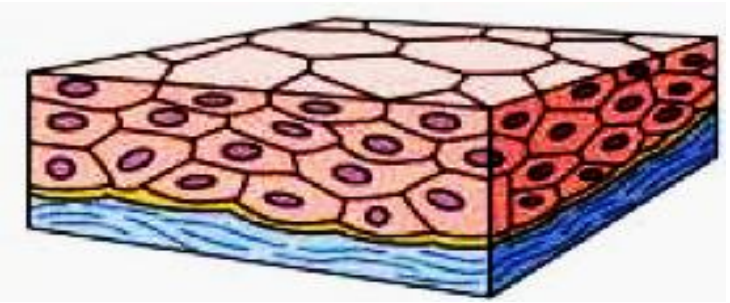
Middle layers: polyhedral.

Superficial layer:

- Cubical dome-shaped.
- May be binucleated.



❖ **Full bladder:** 2-3 layers



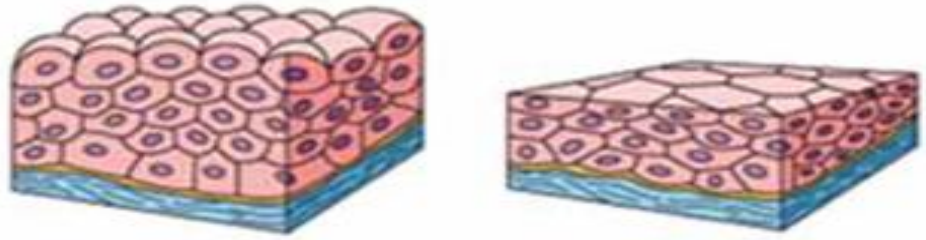
Transitional epithelium

This type of epithelium **varies greatly in appearance** i.e. it can change its shape and number of layers, according to the functional state of the organ.

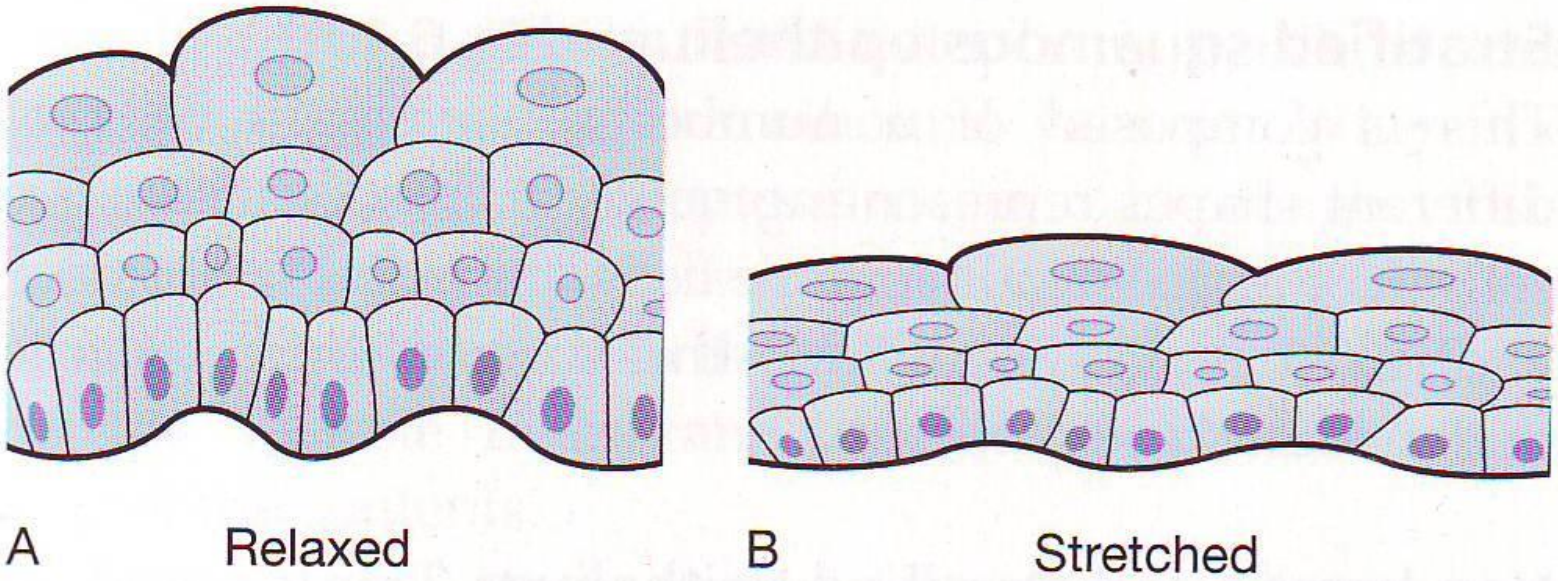
Sites: lining the urinary passages; the ureter and the urinary bladder. In these sites, the lumen is subjected to volume changes due to emptying and distension.

In the empty condition, the epithelium consists of several layers:
A ***basal cell layer*** formed of low columnar cells.
Varying number of intermediate polygonal cell layers of which the cell layer immediately below the surface layer is pear-shaped.
The surface layer is composed of large cuboidal single or binucleated, ***dome-shaped cells (umbrella cells)*** with a convex upper surface and concave lower surface. The dome-shaped cells are so large that each cell covers about three of the underlying pear-shaped cells.

In the full (distended) condition, the epithelial cells glide on each other and become formed of only two layers:
The superficial large flattened cells.
The basal cuboidal cells.

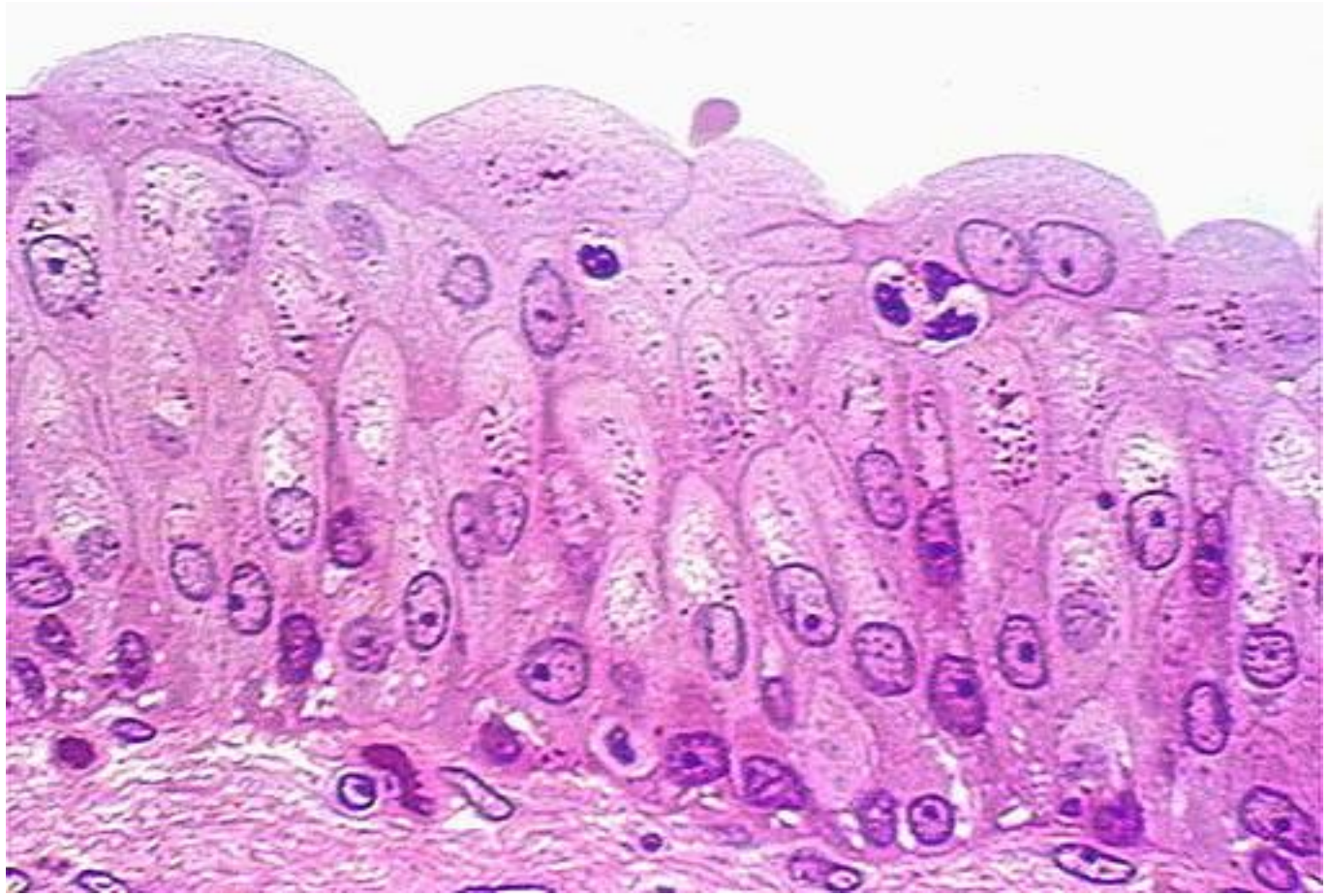


Transitional epithelium



Transitional epithelium: A. Relaxed. B. Stretched.

Transitional epithelium



(urinary bladder - empty)

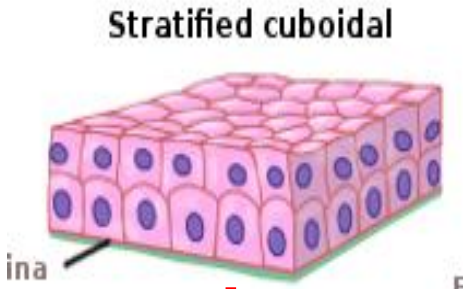
Transitional epithelium

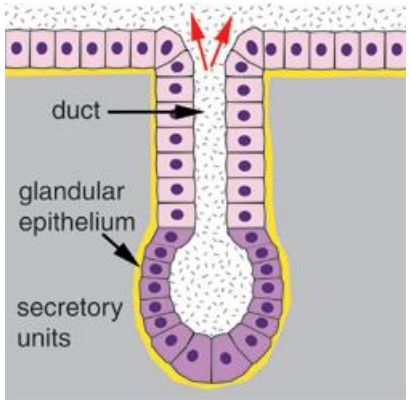
Adaptation of Transitional epithelium to its function:

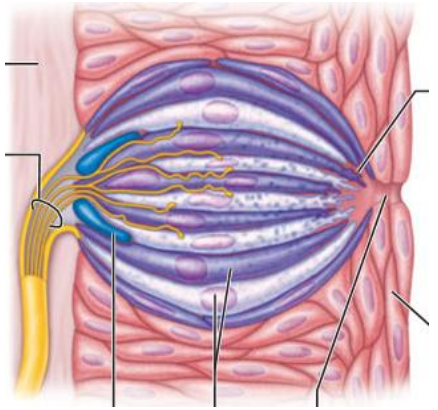
- **Thin corrugated basement membrane**
- **Abundant mucoid intercellular substance to allow gliding of cells on each other.**
- **Cuticular border at the free surface.**

Types of Epithelium

- Covering and Lining
- Glandular
- Neuro-epithelium
- Myo-epithelium







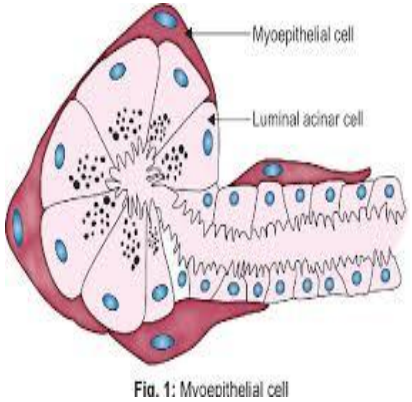
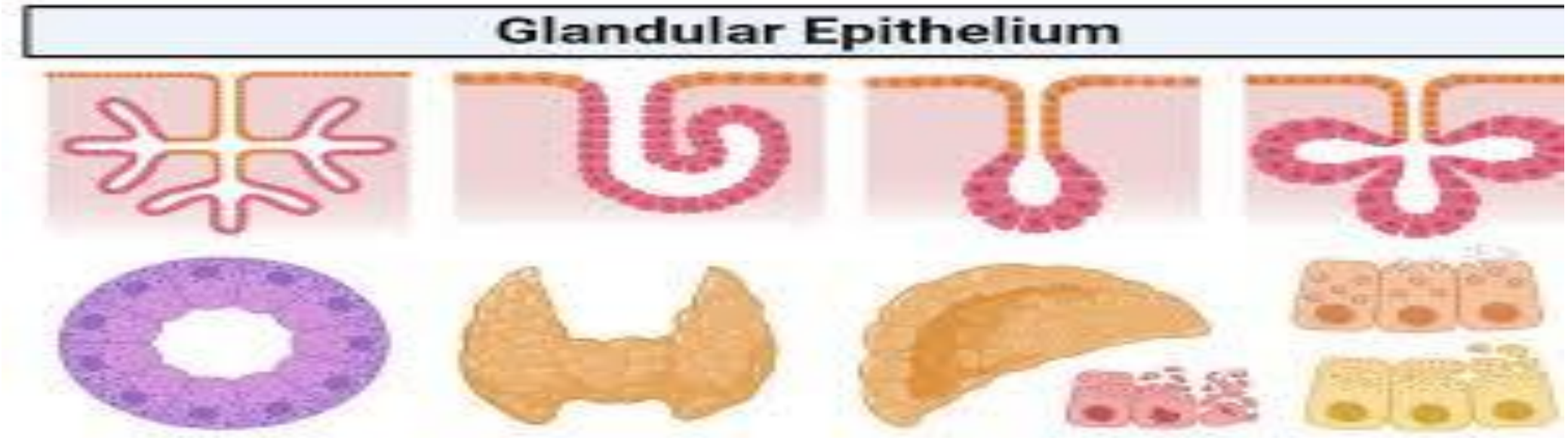


Fig. 1: Myoepithelial cell

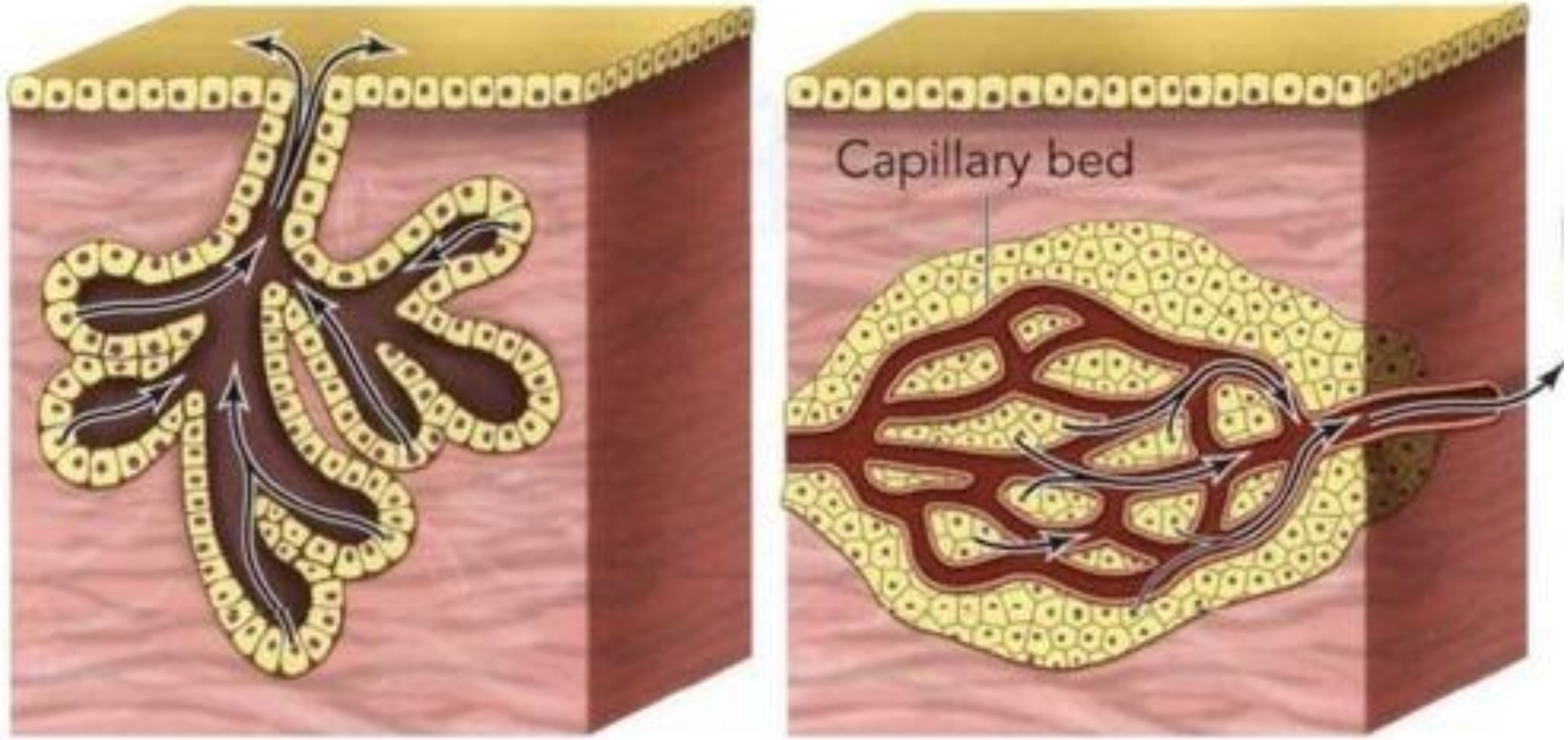
Covering the body (e.g. skin) and lining cavities (e.g. gastrointestinal tract).



• *II- Glandular epithelium*

- **This type of epithelium is specialized to produce secretion. It can be classified into:**
- **Endocrine glands, ductless gland which secretes hormones directly in the blood e.g. thyroid and pituitary glands.**
- **Exocrine gland: they have ducts to convey their secretion to outside e.g. salivary glands.**
- **Mixed glands: which possess both endocrine and exocrine functions as pancreas, testis and ovary.**

FIGURE 3.2 Exocrine and Endocrine Glands



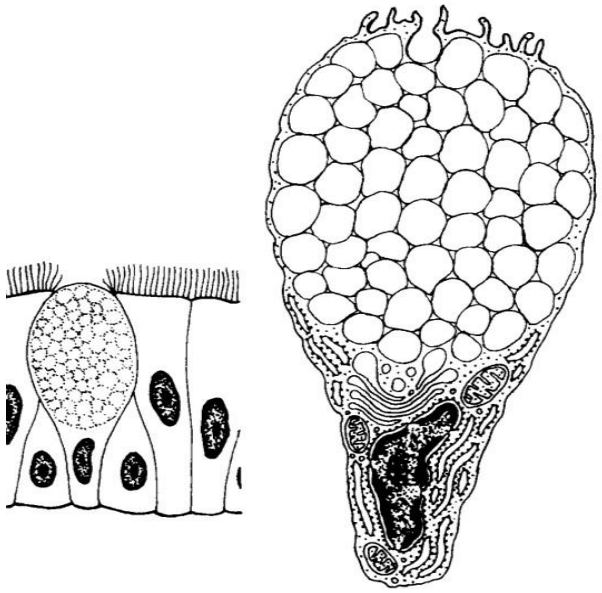
Exocrine gland
Releases enzymes to external environments through ducts

Endocrine gland
Releases hormones into fluids that circulate throughout the body

- **Classification of exocrine glands:**

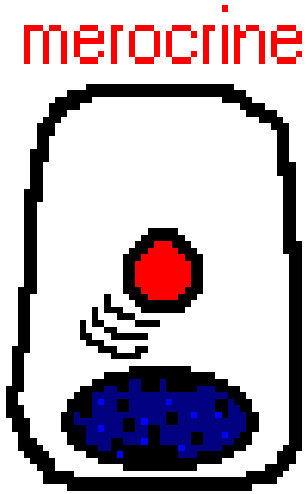
a) ***According to the number of cells***

  - Unicellular gland e.g. goblet cells.



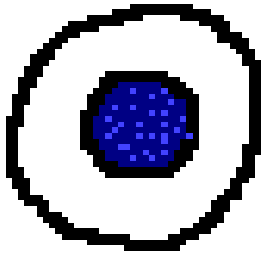
  - Multicellular gland e.g. salivary glands.

Merocrine gland



Apocrine gland

Holocrine gland



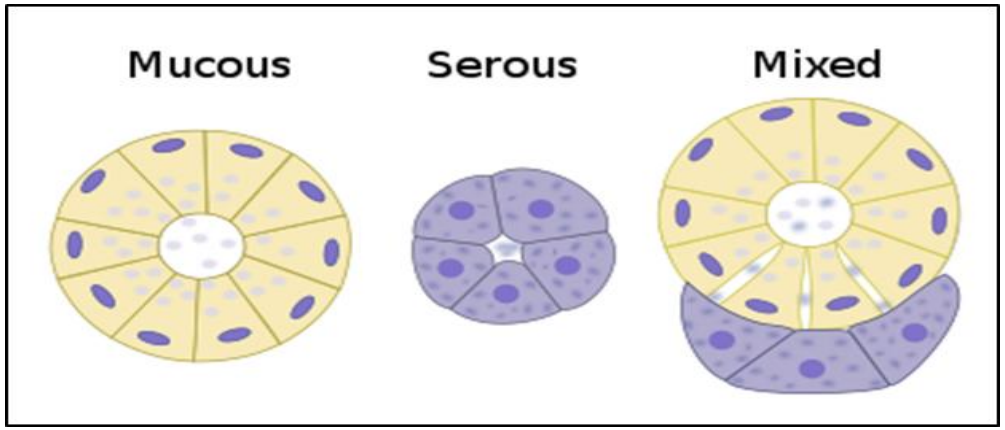
b) According to mode of secretion:

- **Merocrine gland** e.g. salivary gland. The cells remain intact during secretion without destruction of part of the cell.
- **Apocrine glands** e.g. mammary gland: the apical part of the cytoplasm is detached from the cells and come out with secretion.
- **Holocrine gland** e.g. sebaceous gland: the whole cytoplasm of the secretory cells are destroyed and come out with the secretion.

c- According to the nature of secretion

1- <u>Mucous glands</u> that consist of acini (secretory unites) of mucous secretory cells surrounding wide lumen and produce a viscid mucoid secretion. The cells are characterized by:

- Basal flattened nucleus
- Pale vacuolated cytoplasm due to presence of large mucus secretory granules that occupy most of the cytoplasm.

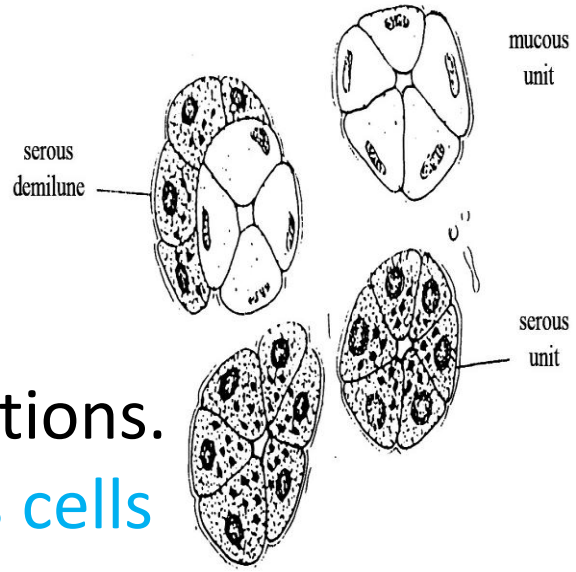


2- <u>Serous glands</u>, consist of acini of serous cells with relatively narrow lumen which secrete a watery fluid. The cells are characterized by:

- Central rounded nucleus
- Basal cytoplasmic basophilia due to presence of many RER.
- Apical acidophilia due to presence of secretory granules at the apex.

	Serous cell	Mucous cell
Secretion	Serous	Mucous
Nature	Watery	Viscid
Nucleus	Central rounded	Basal flat
Cytoplasm by Hx & E	AA (secretory granules) & BB (RER)	Pale vacuolated

Acinus: group of cells + central lumen

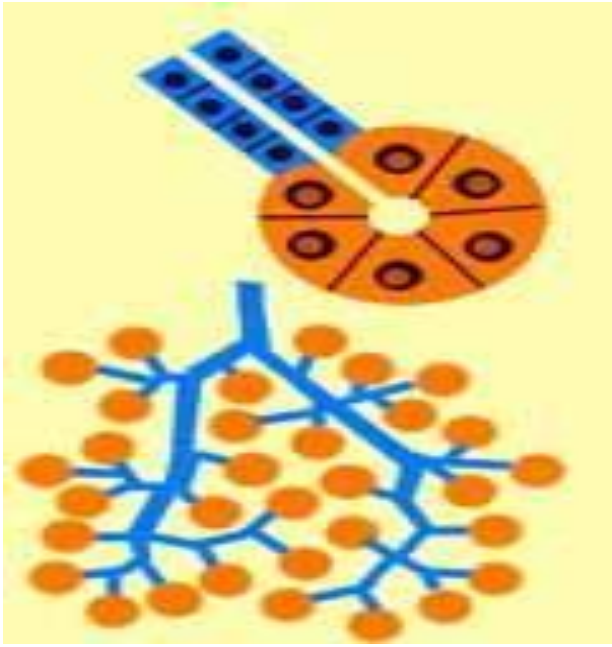


3- Mixed glands, which secrete both mucous and serous secretions. It consists of mucous acini surrounded by a crescent of serous cells called serous demilune.

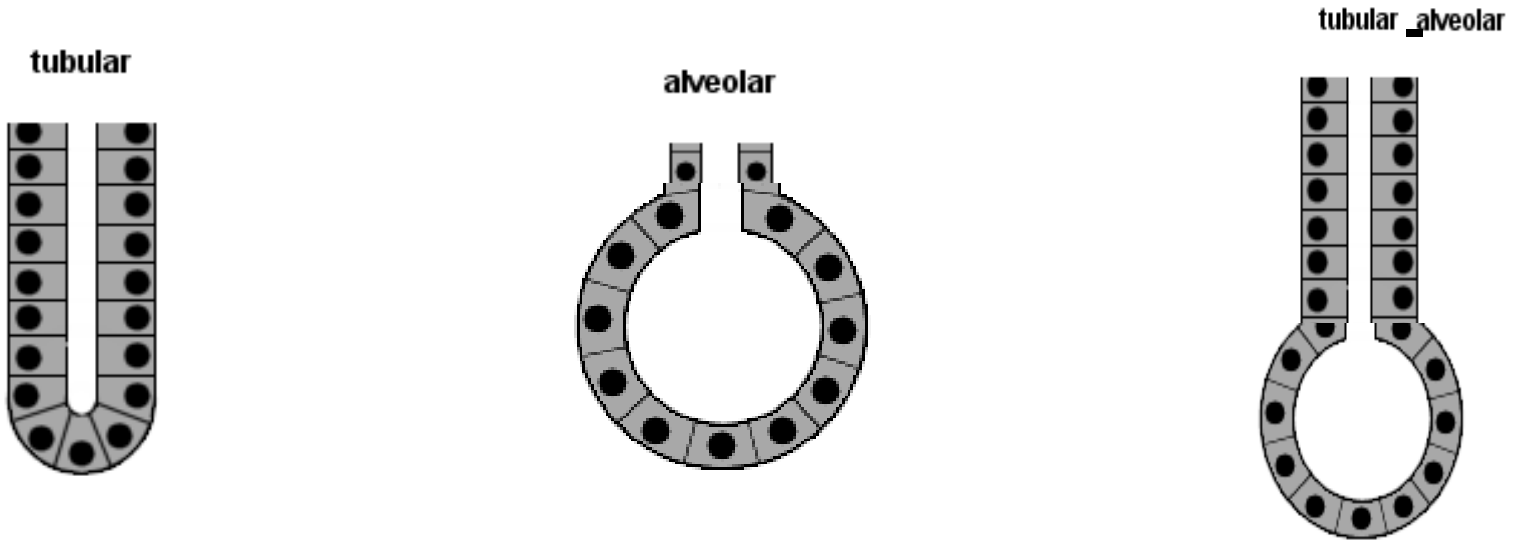
4- Glands with special secretions e.g. ceruminous glands which secrete wax (in the ear), sebaceous glands which secrete a fatty secretion (in the hair follicle) and sweat glands which secrete a watery secretion (in the skin).

D- According to branching of the duct

- i- Simple glands if the duct is not branched.
- ii- Compound gland if the duct is branched.

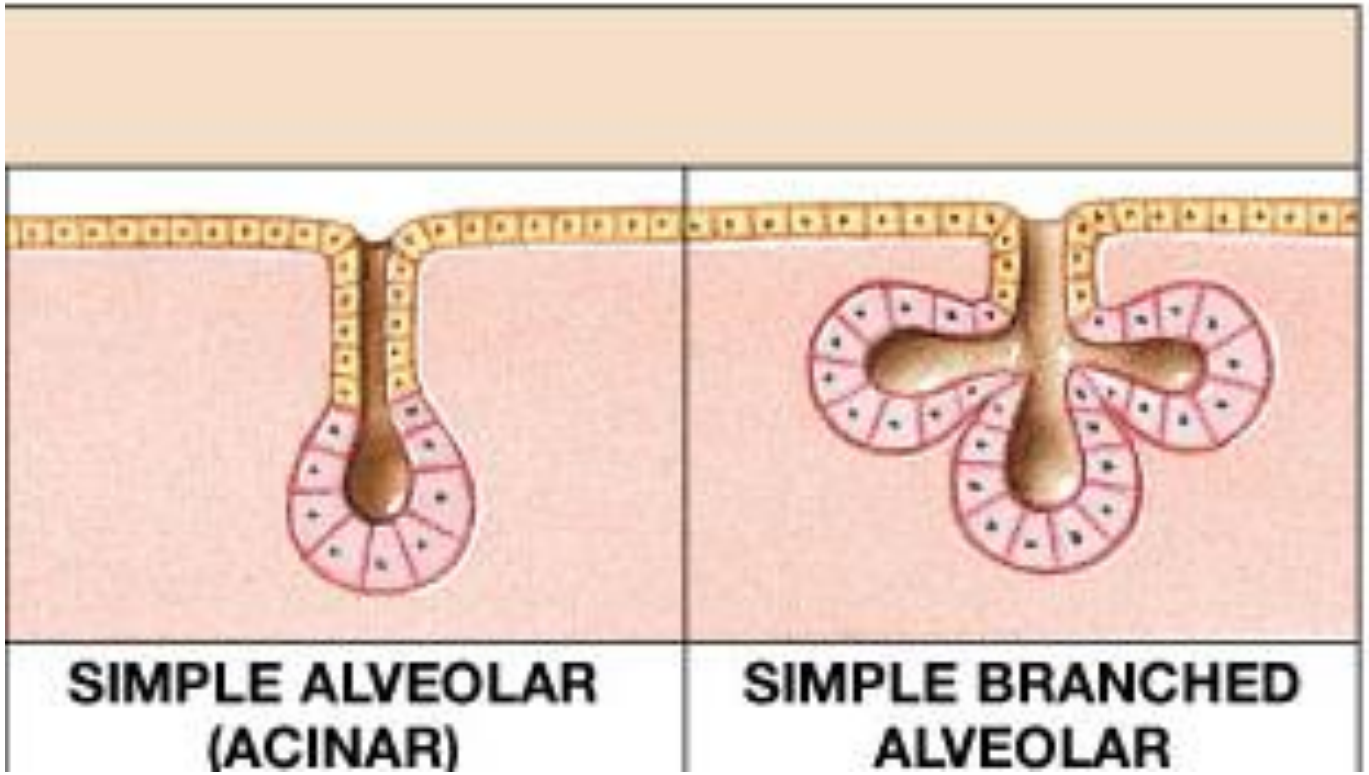


E- According to the shape of secretory part

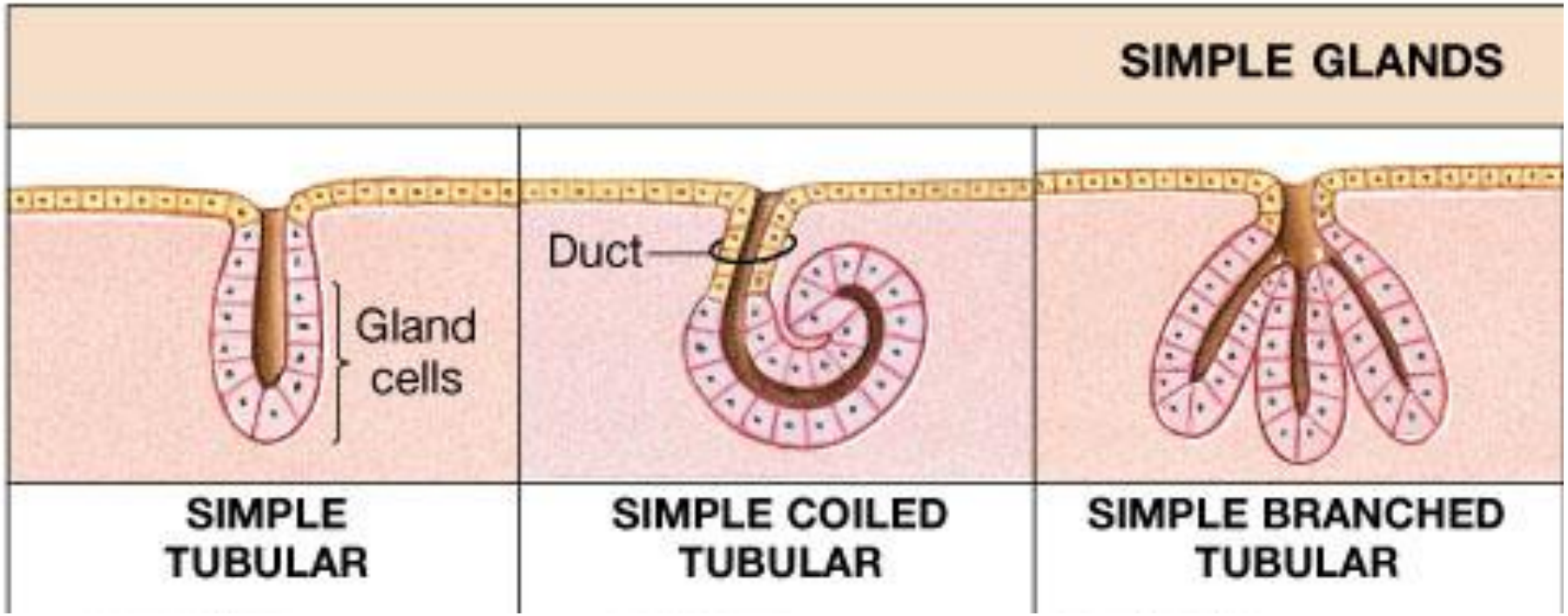


- **i- Acinar (alveolar)** (flask like) may be simple **acinar** as in sebaceous glands or compound **acinar** as in mammary gland.
- **ii- Tubular** (tube like) may be simple tubular as in intestinal glands or compound tubular as in liver.
- **iii- Tubuloacinar (tubuloalveolar)** may be simple "not found in man" or *compound* as in salivary glands.

Classification of Alveolar Glands

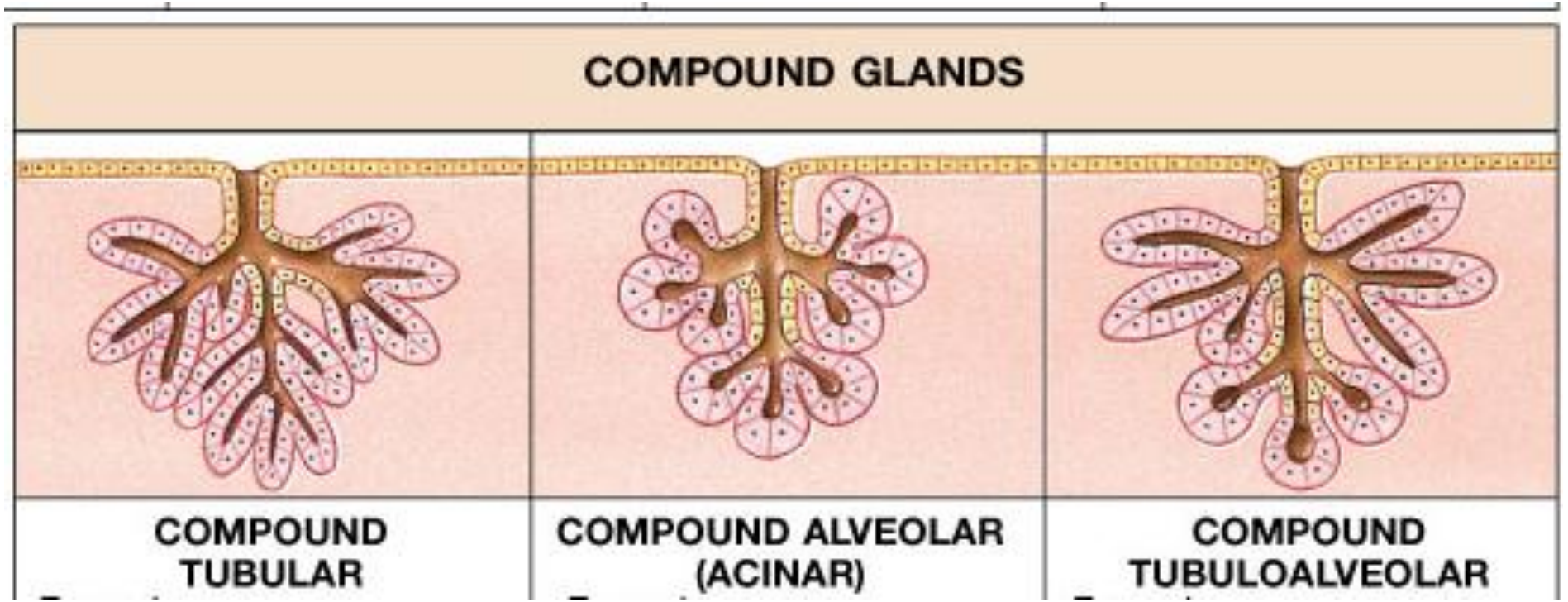


Classification of Tubular Glands



Classification of Compound Glands

Compound: branched duct, branched secretory portion



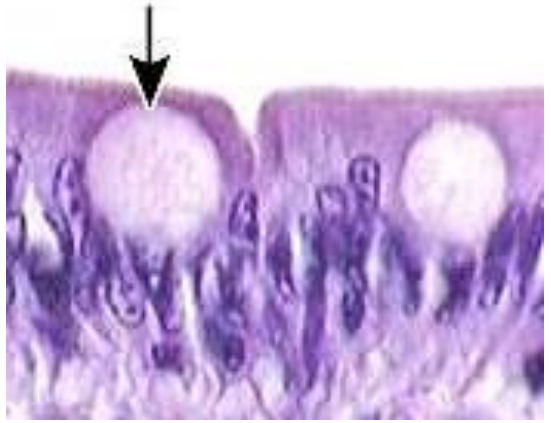
Liver

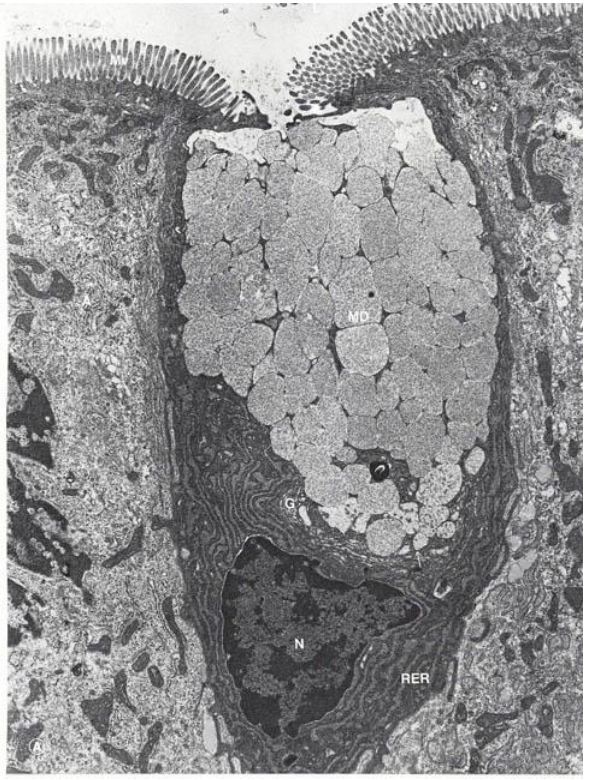
mammary glands

salivary glands

Goblet cells

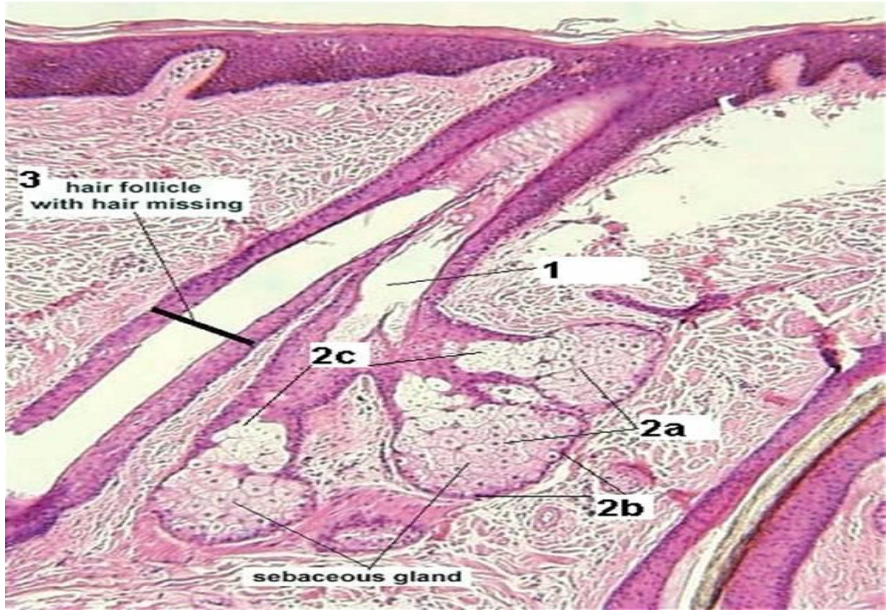
- Unicellular
- Exocrine
- Shape of the cell : flask shape with basal nuclei
- **Mode** of secretion: Merocrine
- **Nature** of secretion : Mucus
- **Site** : Respiratory system , GIT

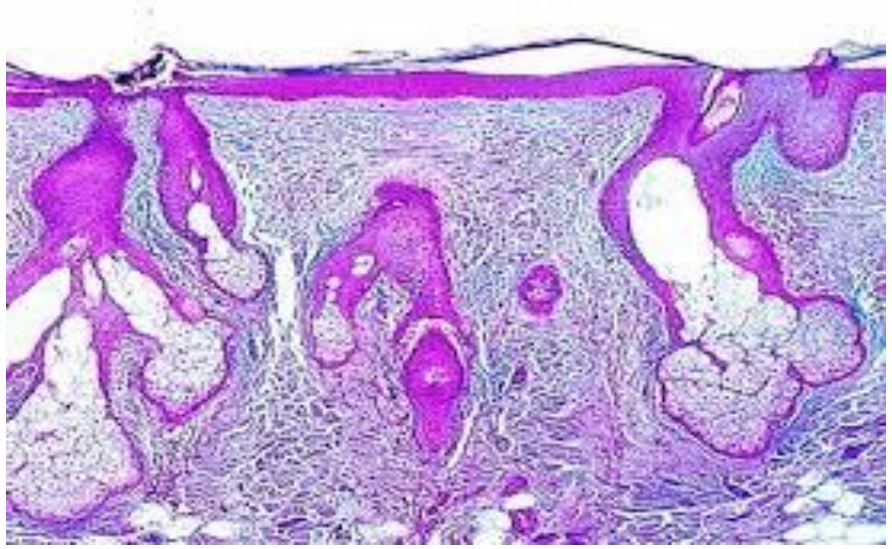




Sebaceous gland

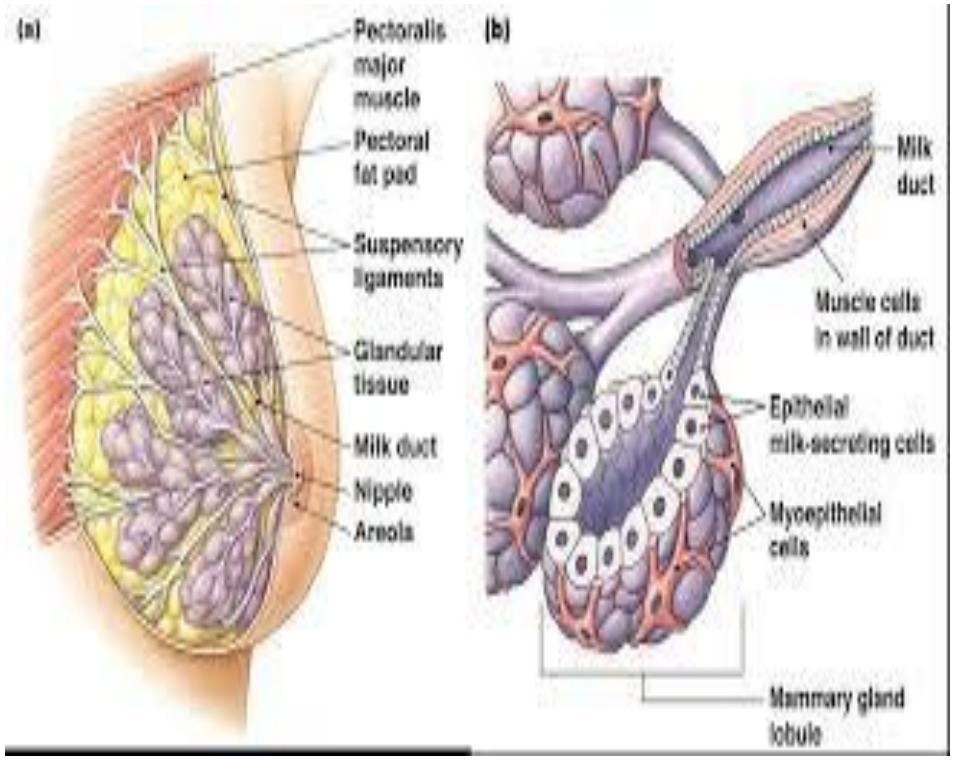
- Exocrine
- Mode : Holocrine
- **Nature : (oily secretion)**
- **Shape of secretory units : Branched alveolar**
- **Site : Related to hair follicles**
- **Activity of the gland increase at the age of puberty**
- **Obstruction of the duct by thick secretion & keratin → Acne**





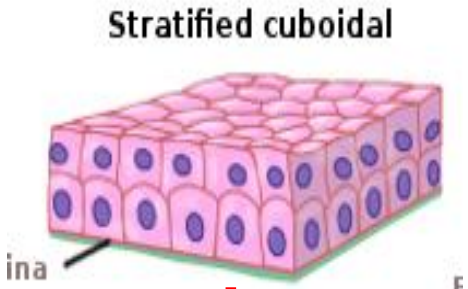
Mammary gland

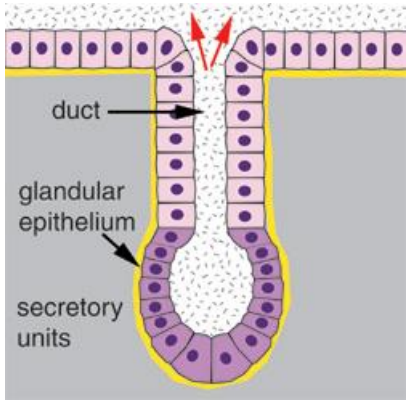
- Exocrine
- Mode : Apocrine
- **Nature : (milk secretion)**
- **Shape of secretory units : Compound alveolar**
- **Site : Related to skin**

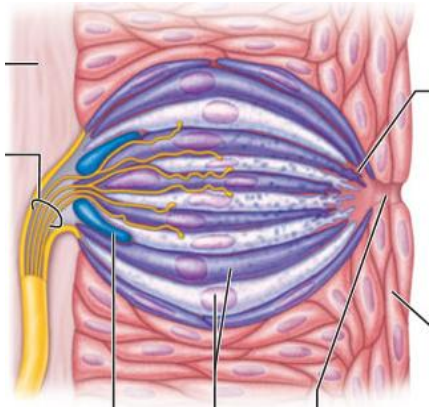


Types of Epithelium

- Covering and Lining
- Glandular
- Neuro-epithelium
- Myo-epithelium







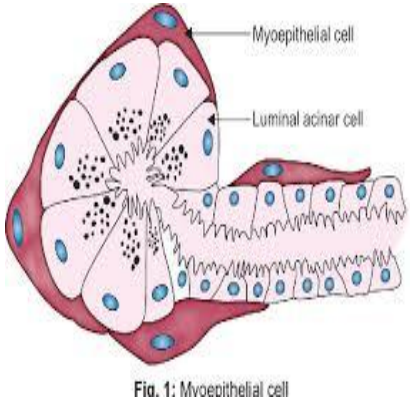
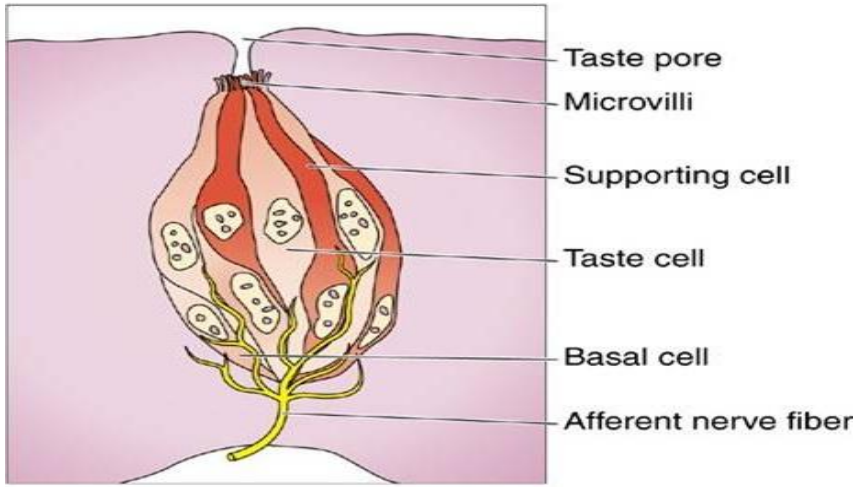


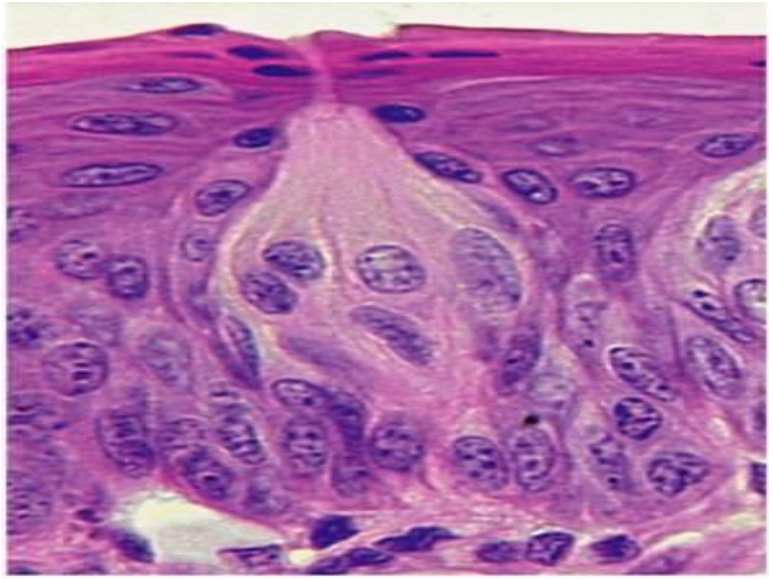
Fig. 1: Myoepithelial cell

Covering the body (e.g. skin) and lining cavities (e.g. gastrointestinal tract).

Special types of epithelium

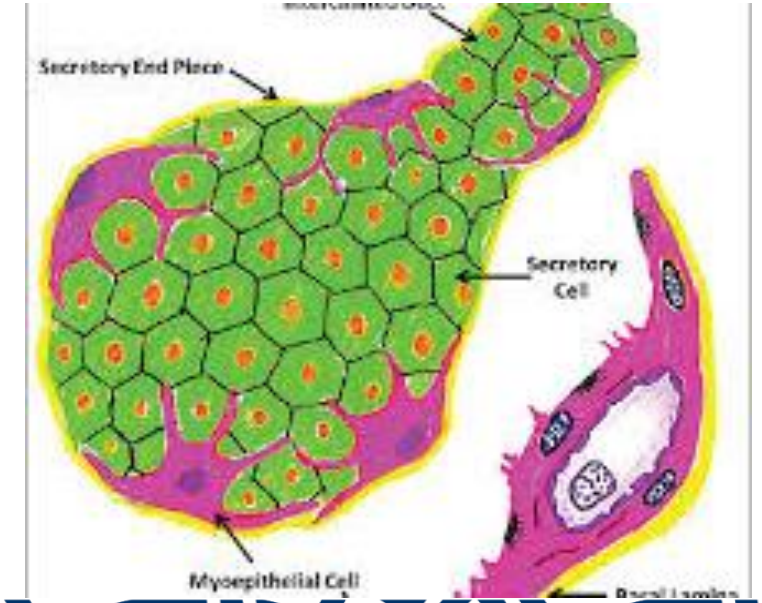
- **Neuroepithelium**
- E.g. Taste buds
- Site : dorsal surface of the tongue
- Function : sensation

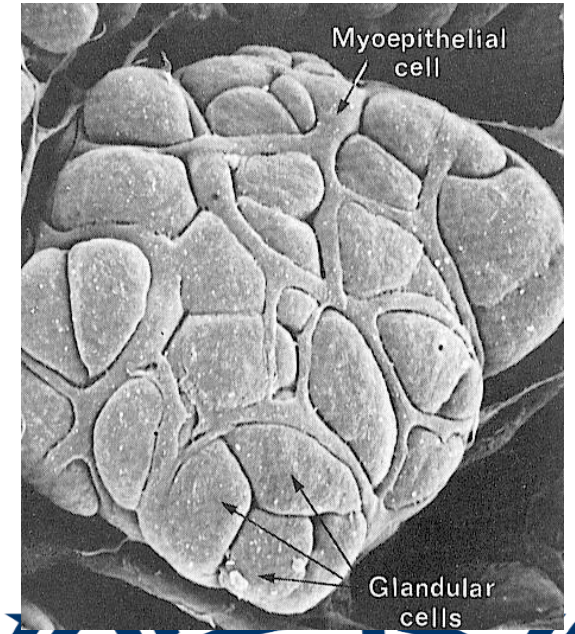




IV- Myoepithelium

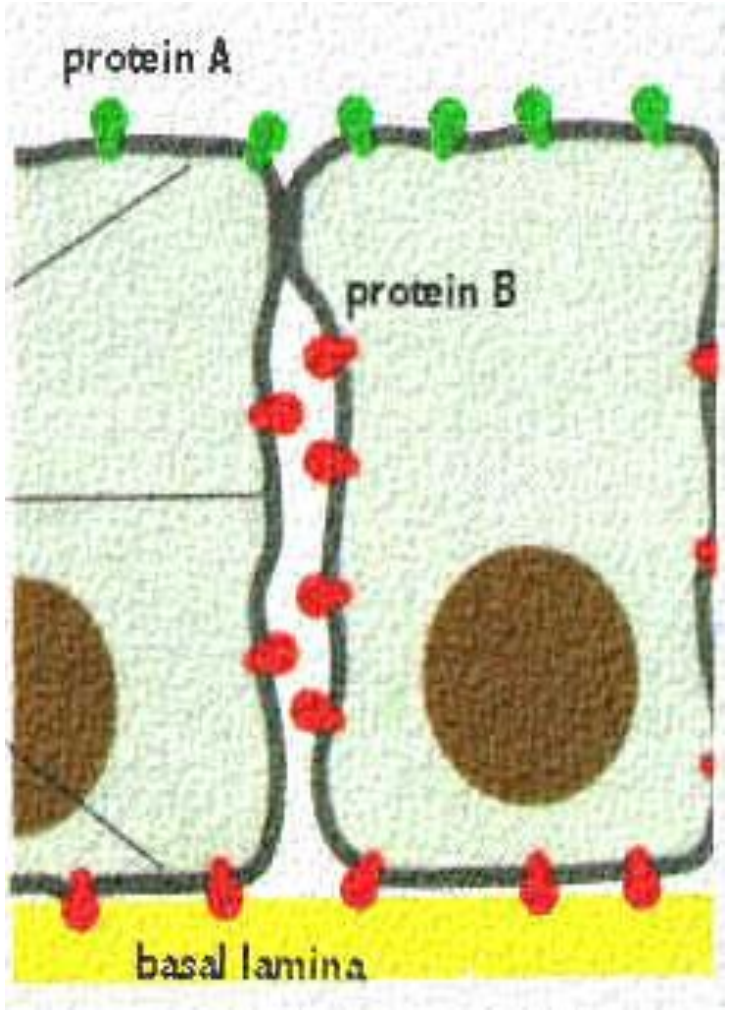
- They are branched cells that are located between the basal part of some secretory cells and its basal lamina. They are called basket cells.
  - Their cytoplasm contain myofilaments and intermediate filaments.
  - Sites: sweat, salivary and mammary gland.
  - Function: Contraction for squeezing the secretion
  - .





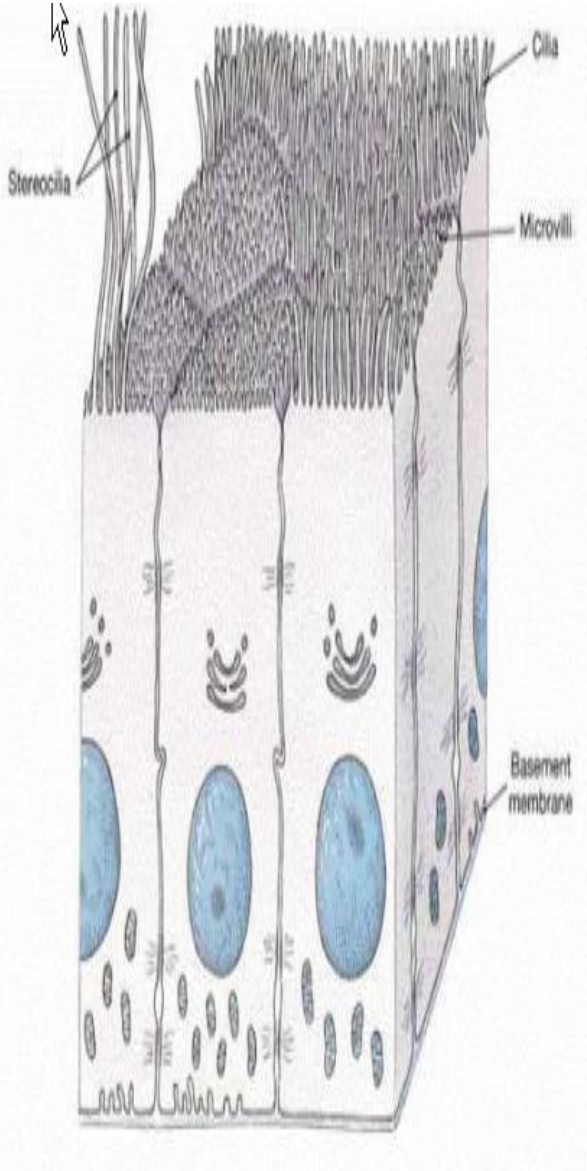
Epithelial polarity

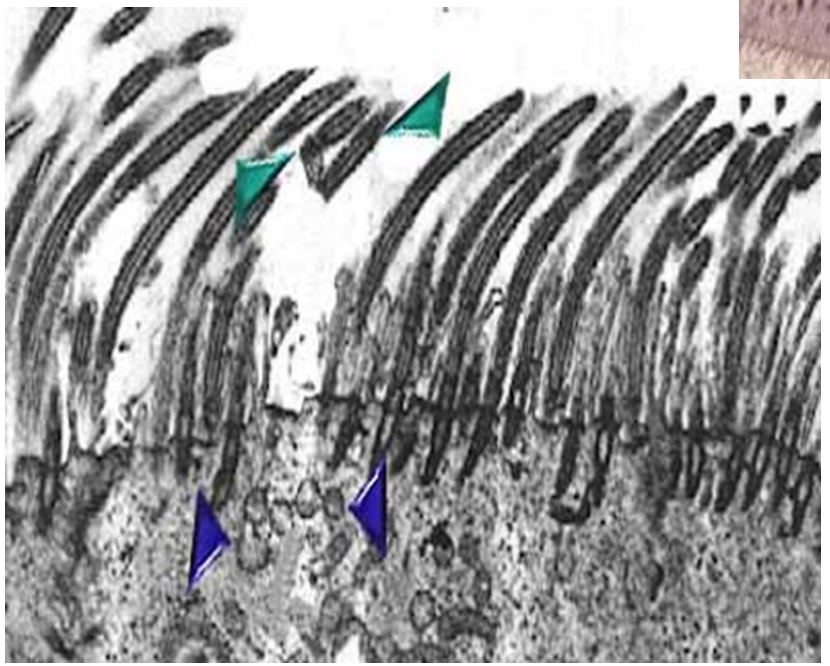
- Cells have a top , lateral side and a bottom
- So different activities take place at different places
- **Apical modifications**
- **Basal modifications**
- **Lateral modifications**



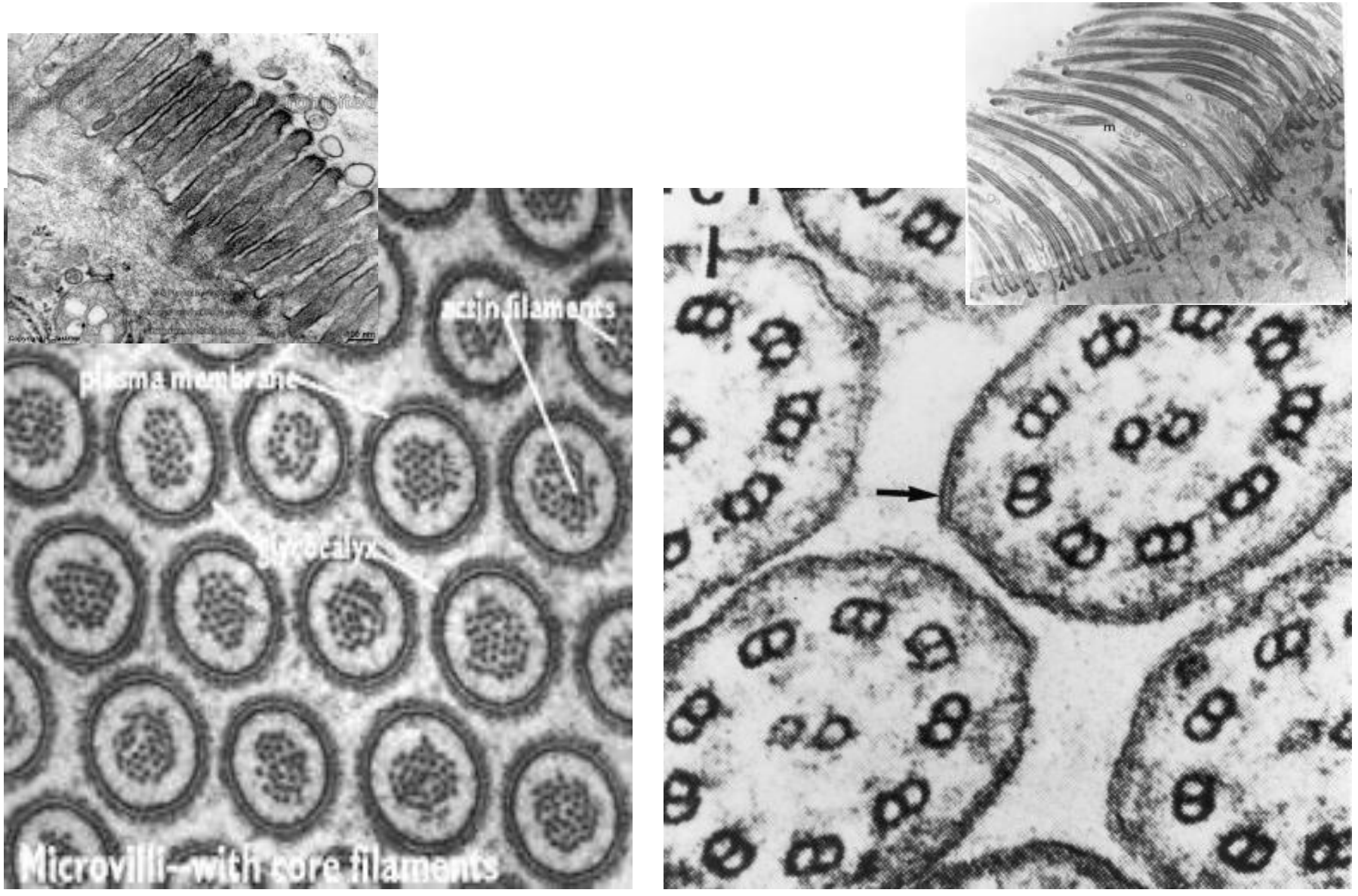
Apical modifications

- **Cilia**
- **Microvilli**
- **Stereocilia**





Apical modifications



Intercellular junctions (cell to cell adhesion)

- The intercellular junctions are more **numerous between the epithelial cells**. They are three types

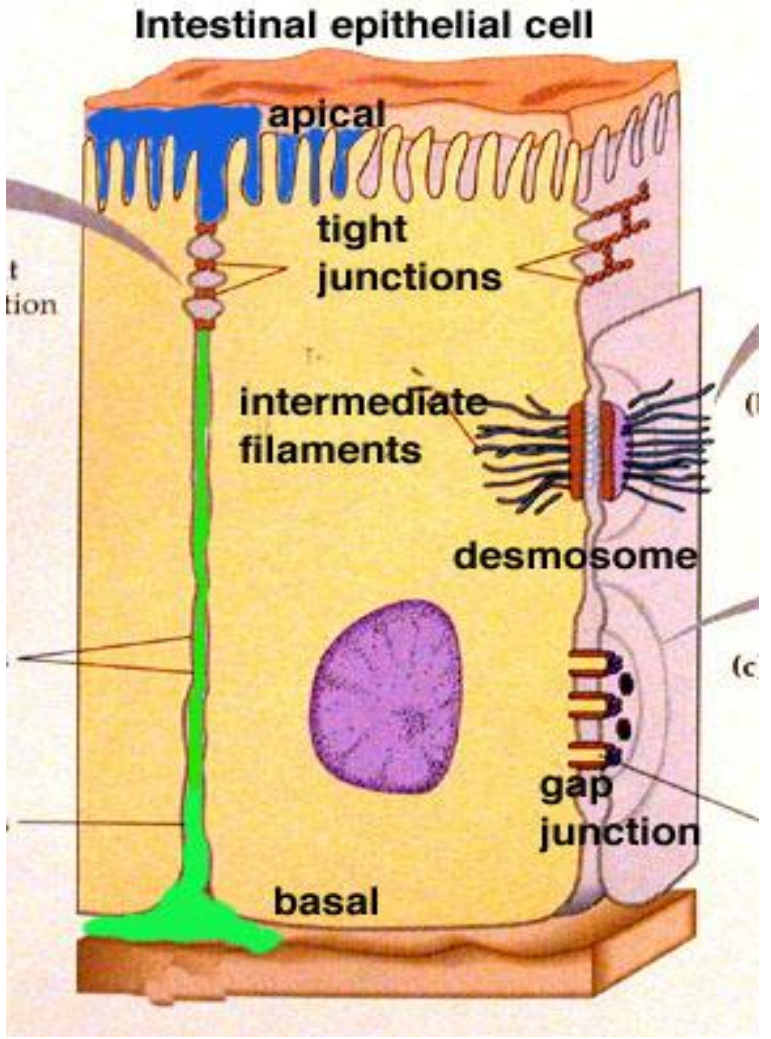
1- Occluding junctions: (Tight)

link cells to form an impermeable barrier.

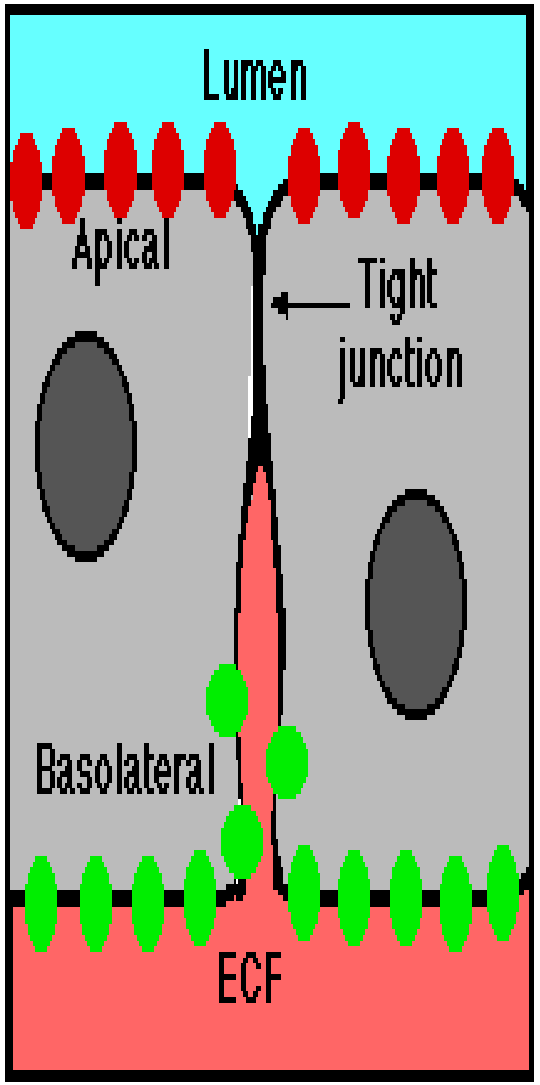
2- Anchoring junctions: (Adhering)

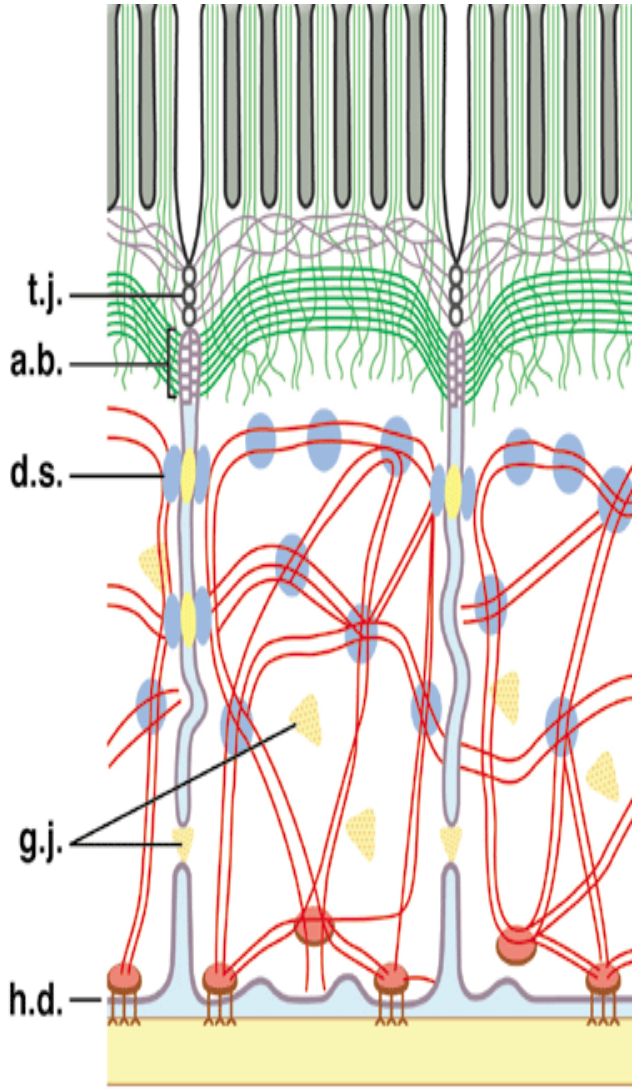
- provide mechanical stability to the epithelial cells.
- **Zonula adherens:**
- **Macula adherens = desmosomes:**

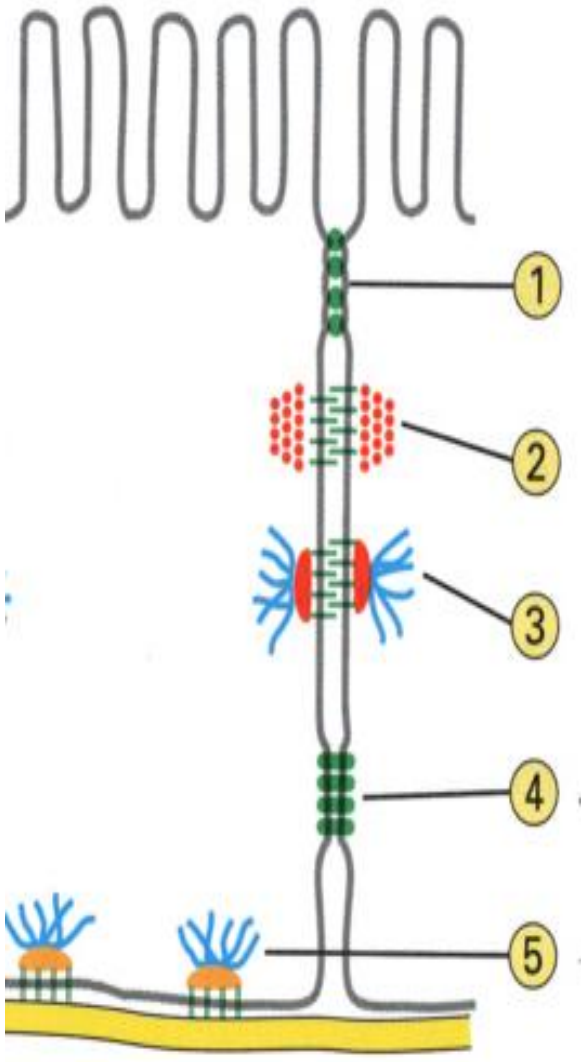
3- Communicating junctions: (Gap) allow movement of molecules between cells



Intercellular junctions

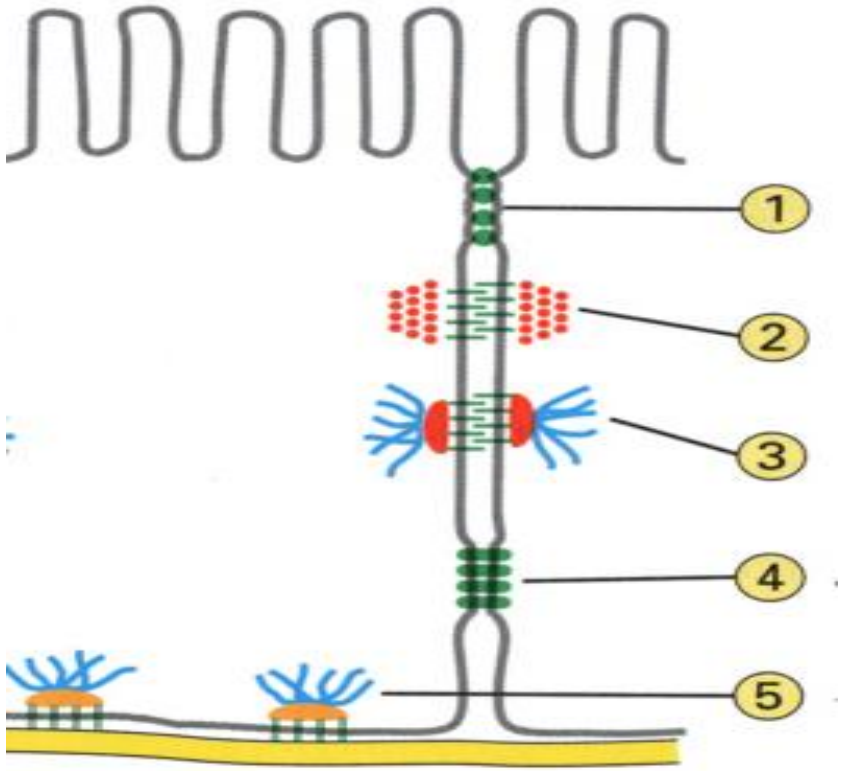


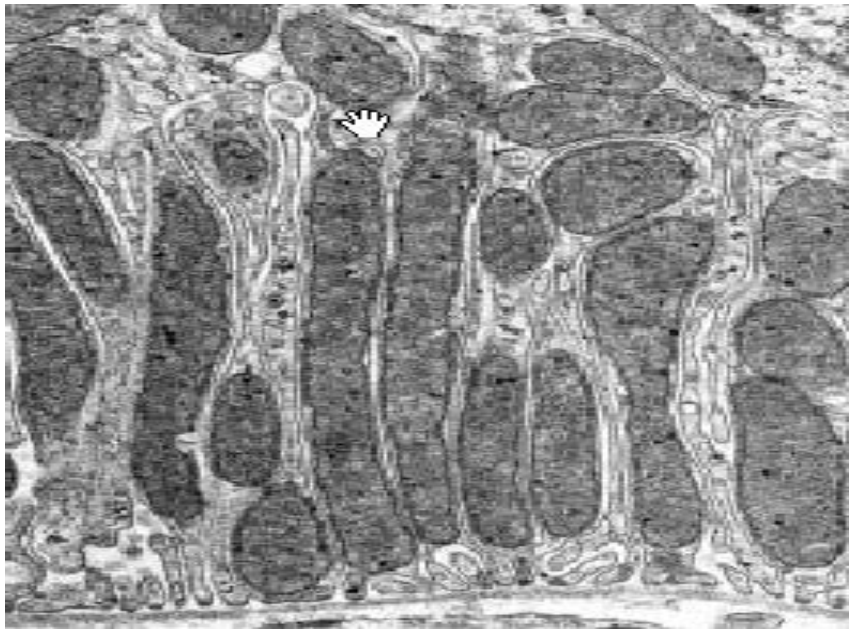


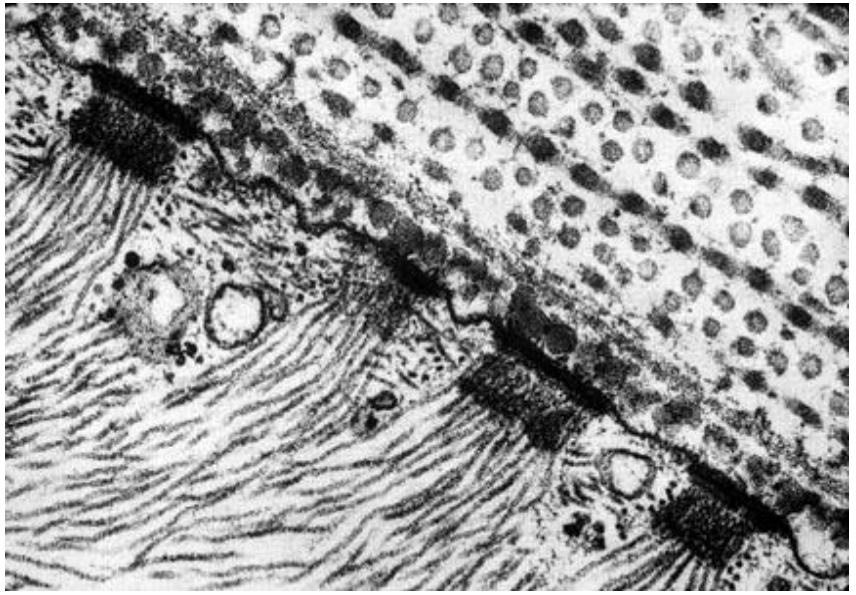


Basal modifications

- Basement membrane
- Basal infolding
- Hemidesmosome







Basement membrane

- Thin extracellular layer having two parts:
- **Basal lamina :** type IV collagen + laminin
- Produced by epithelial cell
- **Reticular lamina** : Type VII collagen + type III collagen (reticular F)
- Secreted by C.T. cells

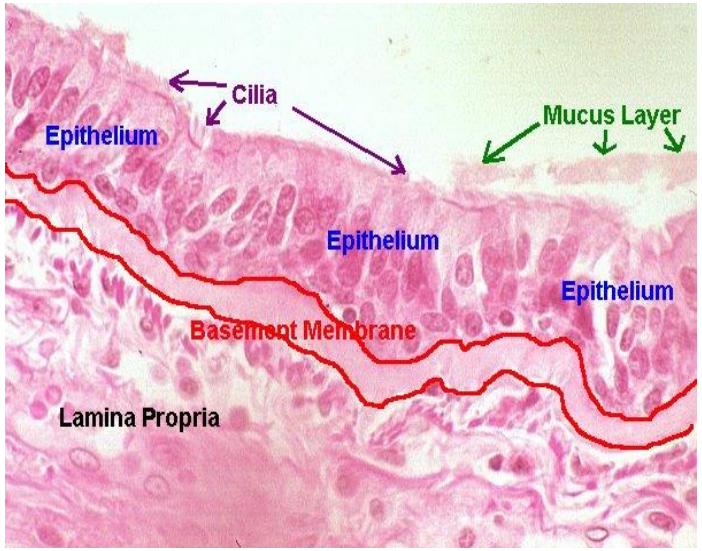
Function :

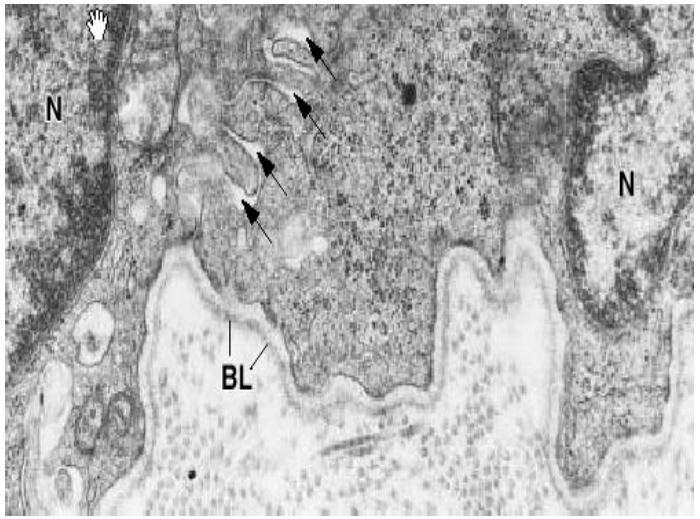
1.Attach epithelium to C.T.

2.Separate epithelium from other tissue

3.Regulate (filter) substances passing from C.T. to epithelium

4.Guide during tissue regeneration





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