EPITHELIUM I

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Intended learning outcomes

by the end of this chapter **(EPITHELIUM)** the students will be able to:

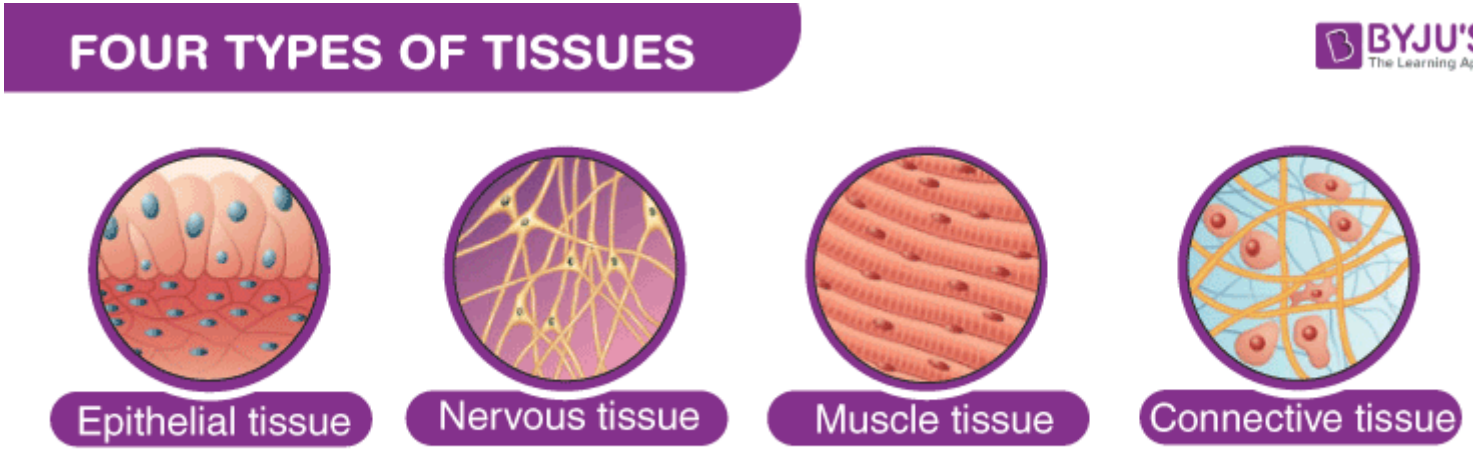
1. Describe the structural characteristics of the epithelial tissue.

2. Differentiate between different types of epithelial tissue.

3. Recognize the structural specializations of the cell surfaces

4. Relate the composition of epithelial tissue type to its specific function.

TISSUES



- The human body is composed of **four basic types** of tissues:

1. Epithelial,
2. connective,
3. muscular,
4. nervous.

- These tissues are formed of cells and extracellular matrix.
- These tissues do not exist as isolated units but in association with each other

EPITHELIUM

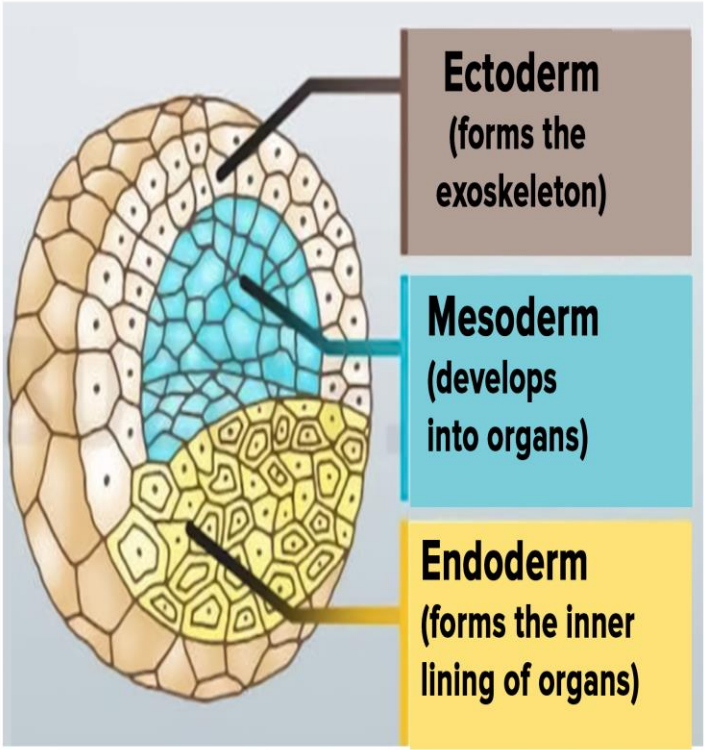
Epithelium is a tissue that covers the body surfaces, lines body cavities and forms glands.

Characteristics of epithelial tissue:

1- Origin:

- Epithelium is derived from all **three embryonic germ layers**:

The epithelia lining the skin, parts of the mouth and nose, and the anus develop from the **ectoderm**. Cells lining the airways and most of the digestive system originate in the **endoderm.** The epithelium that lines vessels in the lymphatic and cardiovascular system derives from the **mesoderm** and is called an endothelium



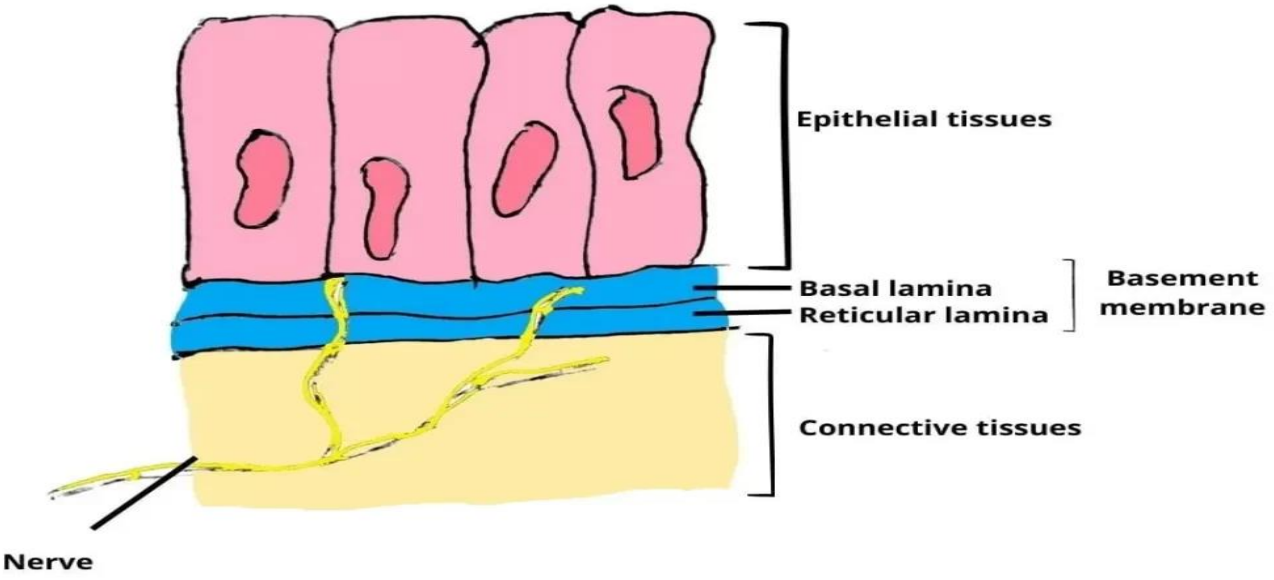
2- Structure:

- It is composed of **closely aggregated cells** with **very little intercellular substance (matrix**).

- Cells joined together with **junctional complexes** forming strong cellular sheets, **firmly bound** to the underlying connective tissue by a thin membrane called **basement membrane**.

3- Blood vessels do not penetrate the epithelial tissue (avascular tissue).

4- Sensory nerve endings penetrate the epithelium providing it with the proper sensation.



5-Renewal:

- Epithelial cells are renewed continuously by **mitotic activity**.

6- Functions of epithelial tissue are:

1- Protection: Epithelial tissues provide the body's first line of protection from physical, chemical, and biological wear and tear.

2- Permeability: The cells of an epithelium allowing selective transfer of materials across a physical barrier.

3- Secretion: The epithelium of the small intestine releases digestive enzymes. Cells lining the respiratory tract secrete mucous that traps incoming microorganisms and particles.

4- Sensation: Taste buds, Retina in eye and hair cells in ear.

5- Contractility: Myoepithelial cells in glands.

6- Reproduction: Testes and ovaries.

7- Excretion: Sweat glands and kidney

Classification of Epithelial Tissues:

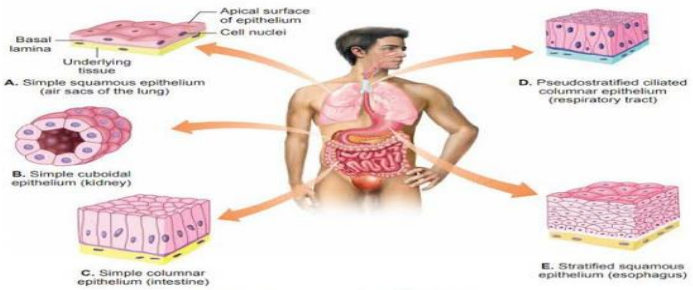
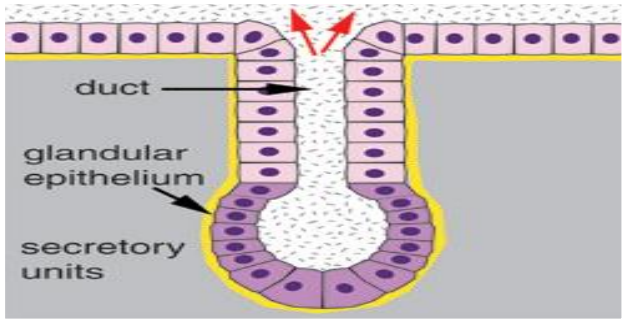


Figure 3.2 Types of Epithelial tissues

Covering epithelium



Glandular epithelium

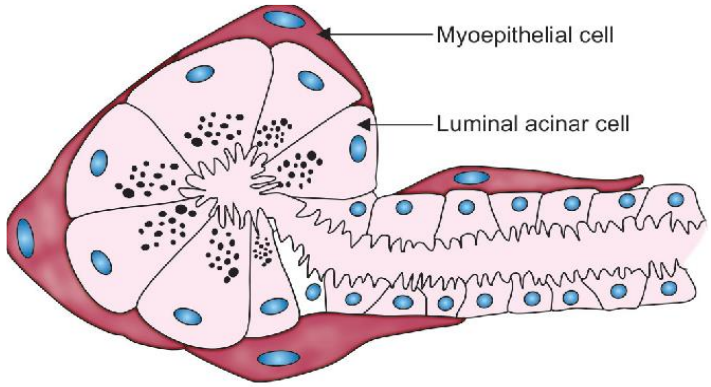
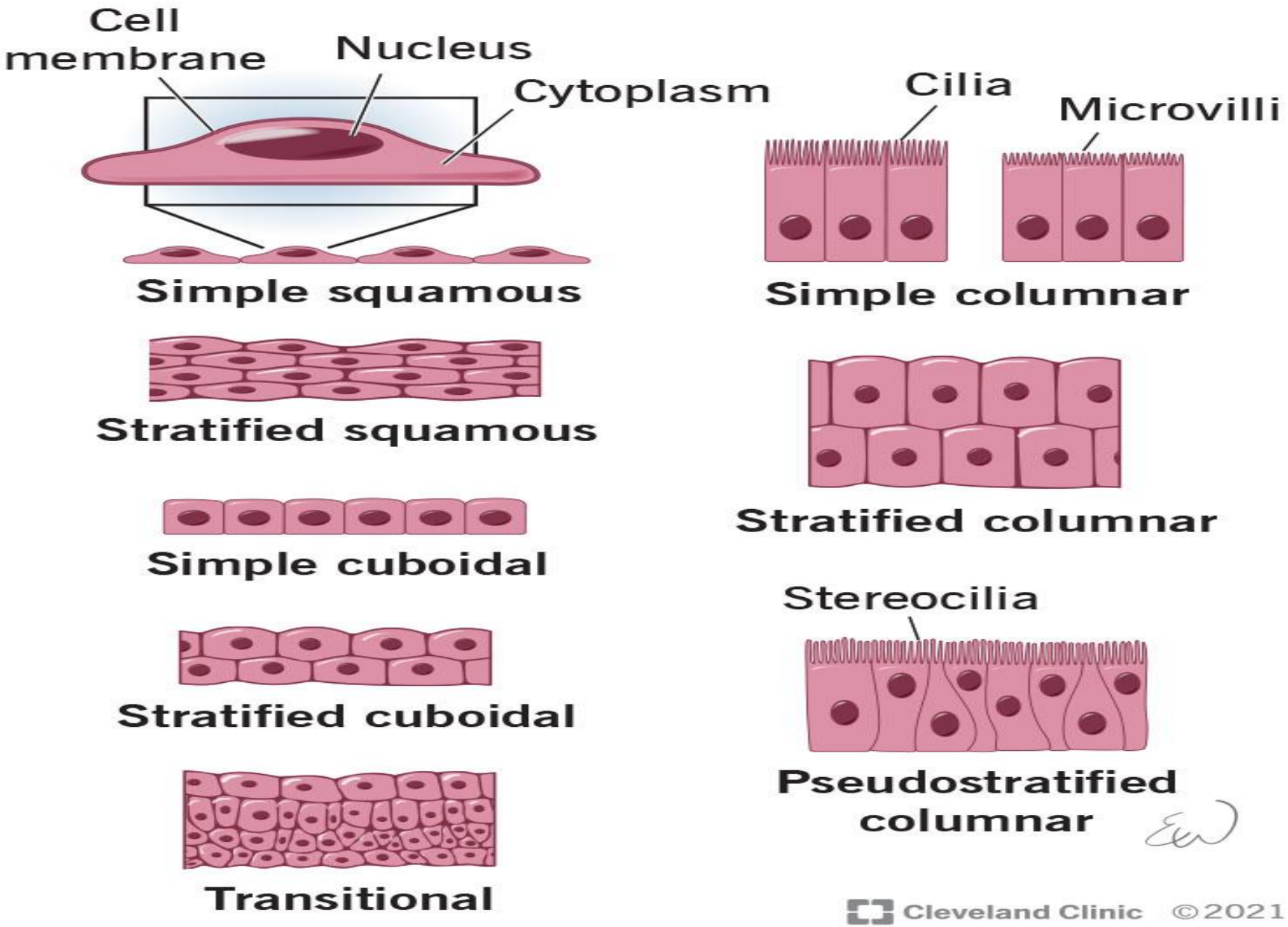


Fig. 1: Myoepithelial cell

Special epithelium

Epithelium


Cell membrane
Nucleus
Cytoplasm
Simple squamous
Stratified squamous
Simple cuboidal
Stratified cuboidal
Transitional
Cilia
Microvilli
Simple columnar
Stratified columnar
Stereocilia
Pseudostratified columnar
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COVERING or SURFACE EPITHELIUM

- These tissues either cover the external surface or line the cavities of the body and organs. It can be divided according to number of its layers into:

- **Simple epithelium:** consists of only a single layer of cells in which all the cells rest on the basement membrane

- **Stratified epithelium**: formed of two or more cell layers, where only the basal cell layer rests on the basement membrane.

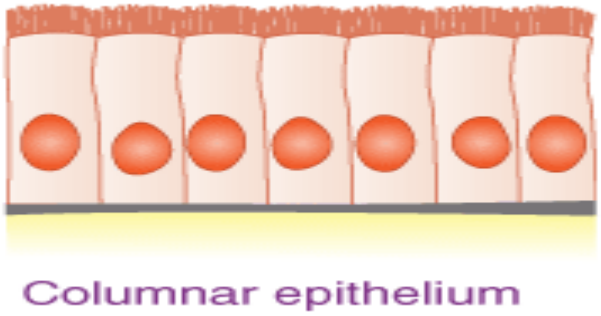
Simple epithelium

It is further classified according to the cell shape into:

- **Squamous**: flat cells with flattened nuclei.

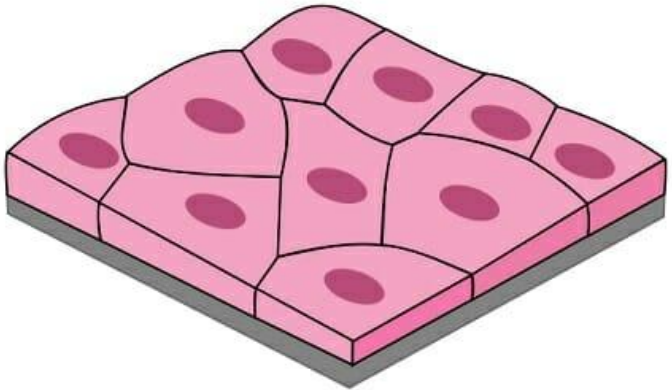
- **Cuboidal:** cubical cells in which the height and width are similar. Cuboidal cells have central rounded nuclei.

- **Columnar:** in which the height is greater than width. Columnar cells have oval basal nuclei.

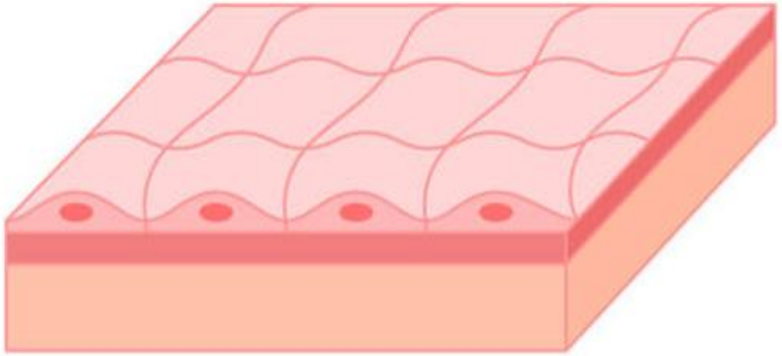


SIMPLE EPITHELIUM

- **Simple squamous epithelium:** it is composed of one layer of squamous cells that rests on a basement membrane. A ***surface view*** shows that the cells have polygonal outline. A ***side view*** shows that cells are extremely flattened with flattened nuclei.
- **Sites:** it is characteristically thin to allow material transport across it.

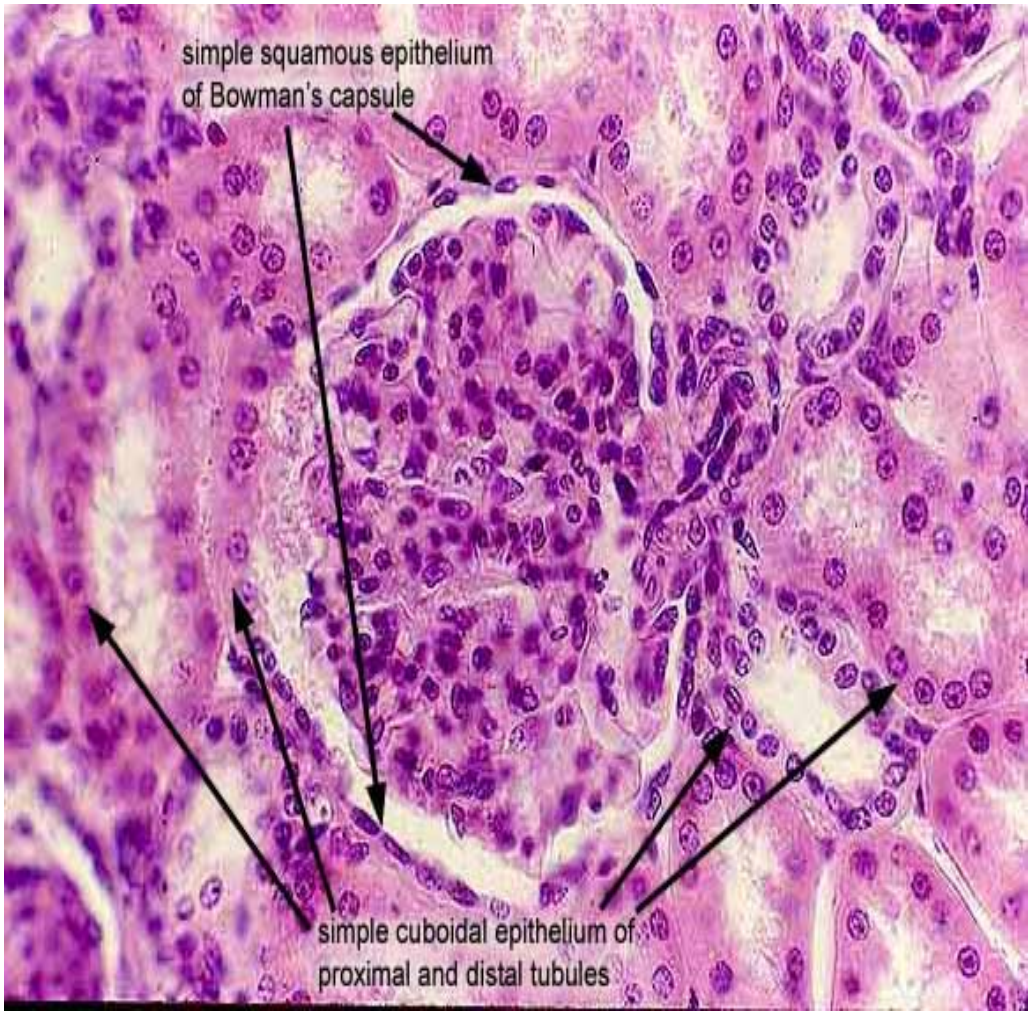


- ❑ In Bowman's capsule of the kidney.
- ❑ Lining the alveoli of the lung for diffusion of gases.
- ❑ The ***endothelium*** is the simple squamous epithelium lining of the blood vessels and lymphatic vessels
- ❑ The ***mesothelium*** is the simple squamous epithelium lining the serous membranes e.g. pleura, pericardium and peritoneum.

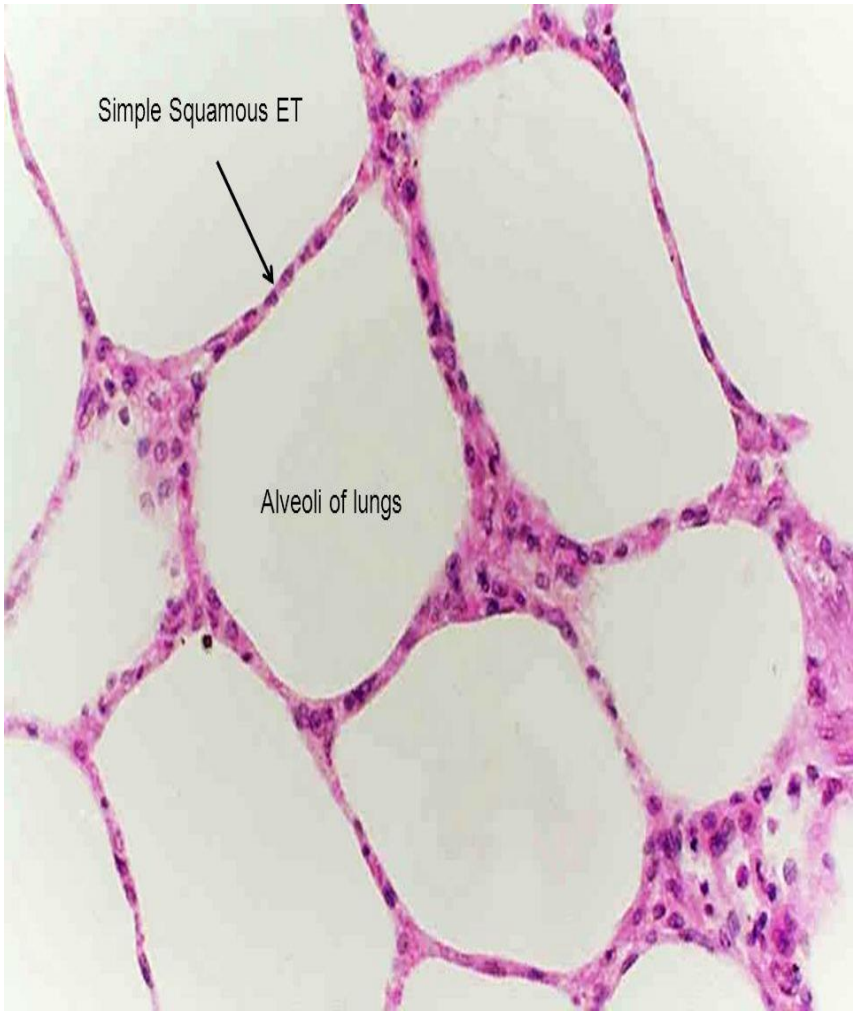


Simple Squamous Epithelium

(Bowman's capsule- kidney)

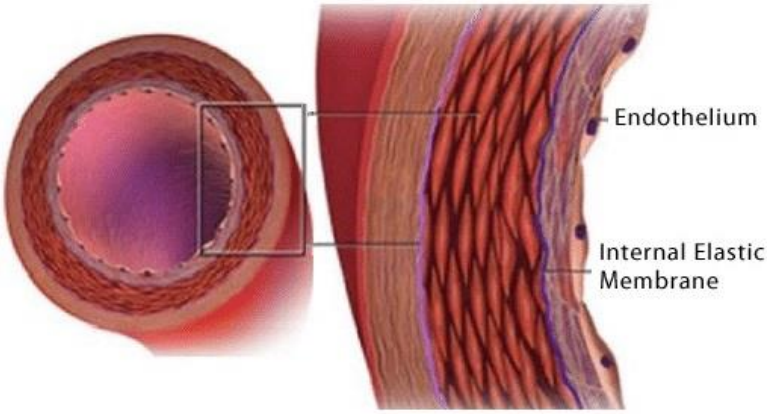


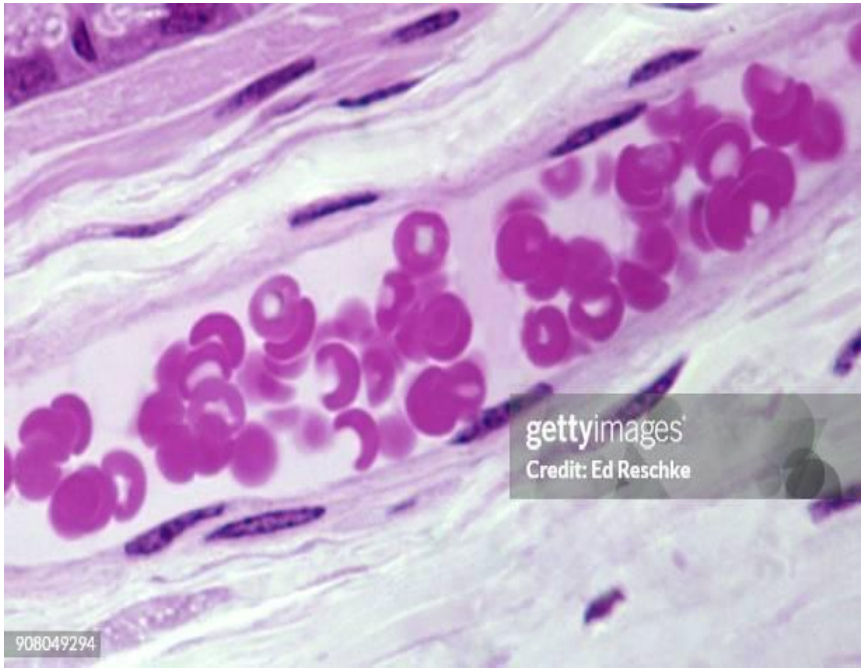
(Lung alveoli)



Simple Squamous Epithelium

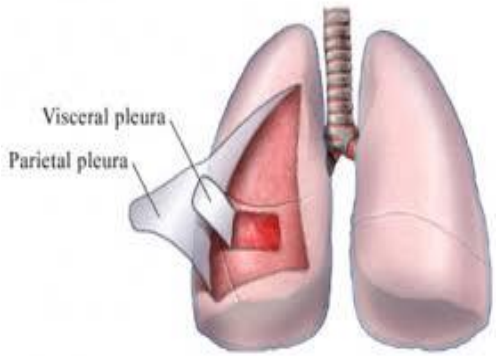
Endothelium:

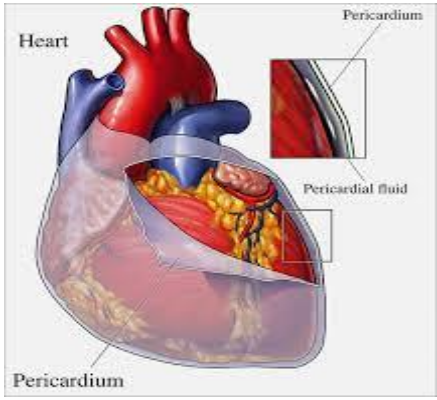




Methothelium :

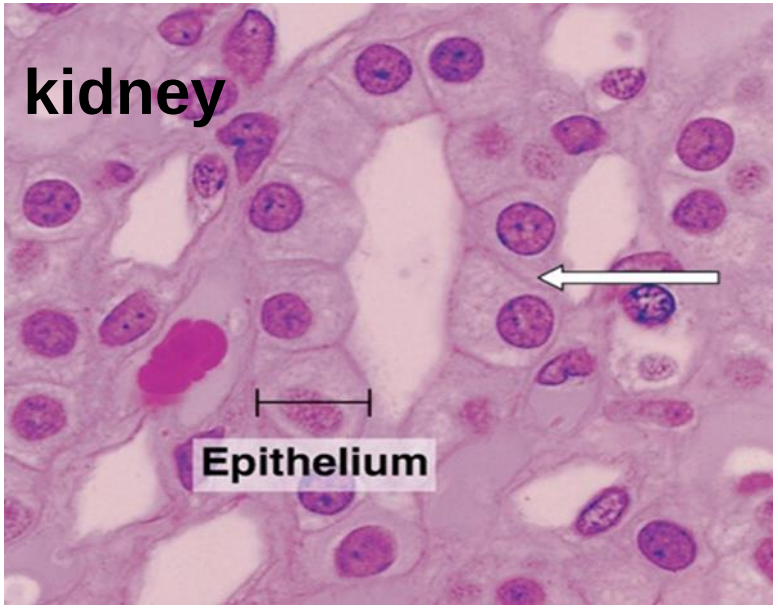
Pericardium, pleura, peritonieum





- **Simple cuboidal epithelium:** it is composed of one layer of cubical cells with central rounded nuclei. It is relatively thick compared to the squamous epithelium.

- **Sites:** it is present in areas where ion exchange is required.
- Lining the thyroid gland follicles.
- Lining the kidney tubules.



- **Simple columnar epithelium:** it is made up of a single layer of tall columnar cells. The nuclei are ovoid and close to the base of the cell. It has 2 types:

❖ ***Non-ciliated simple columnar epithelium:*** their free surface is smooth and may have microvilli.

- **Sites:** lining most of the digestive tract and the gall bladder.

❖ ***Ciliated simple columnar epithelium****:* the free surfaces of the columnar cells have many motile hair-like processes called cilia.

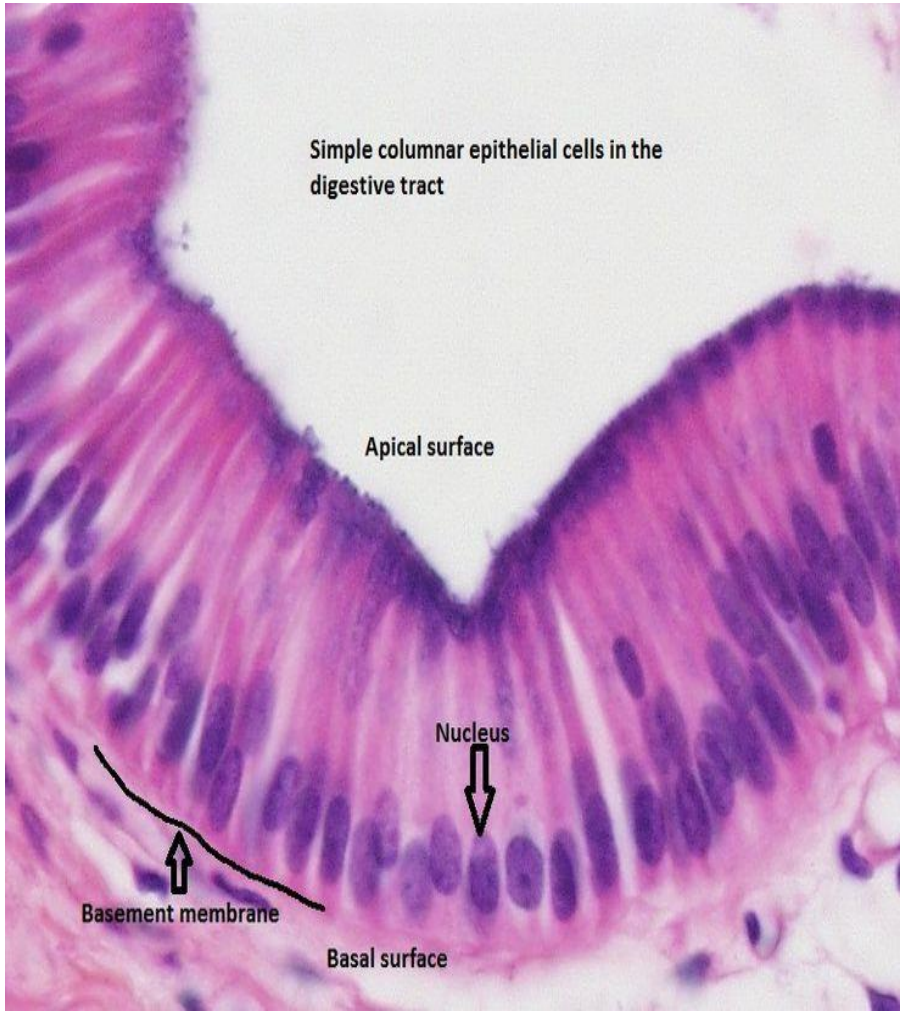
- **Sites:**

1- Conducting bronchioles of lungs.

2- Lining the central canal of spinal cord.

3- Together with the non-ciliated variety lining the uterus and fallopian tubes.

Non-ciliated simple columnar epithelium



Ciliated simple columnar epithelium

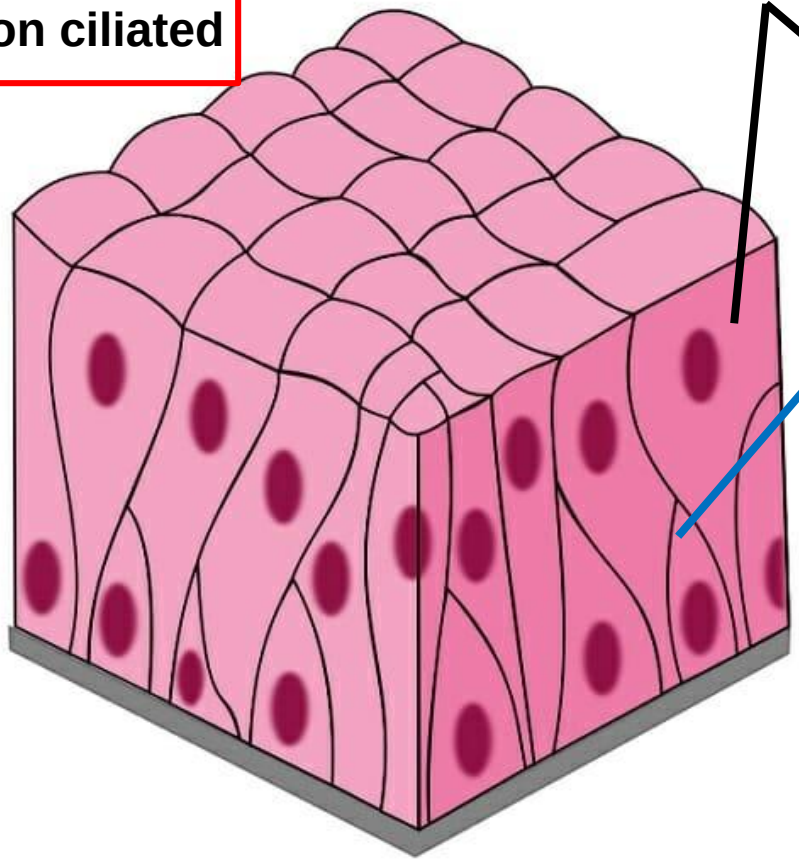
Pseudostratified columnar epithelium

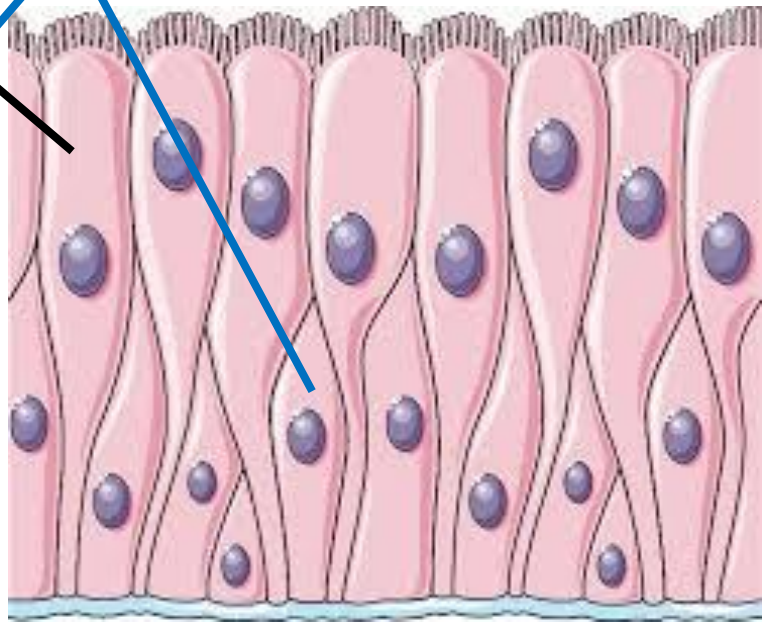
Tall columnar cell

Non ciliated

Short triangular cell

ciliated





Pseudostratified columnar epithelium

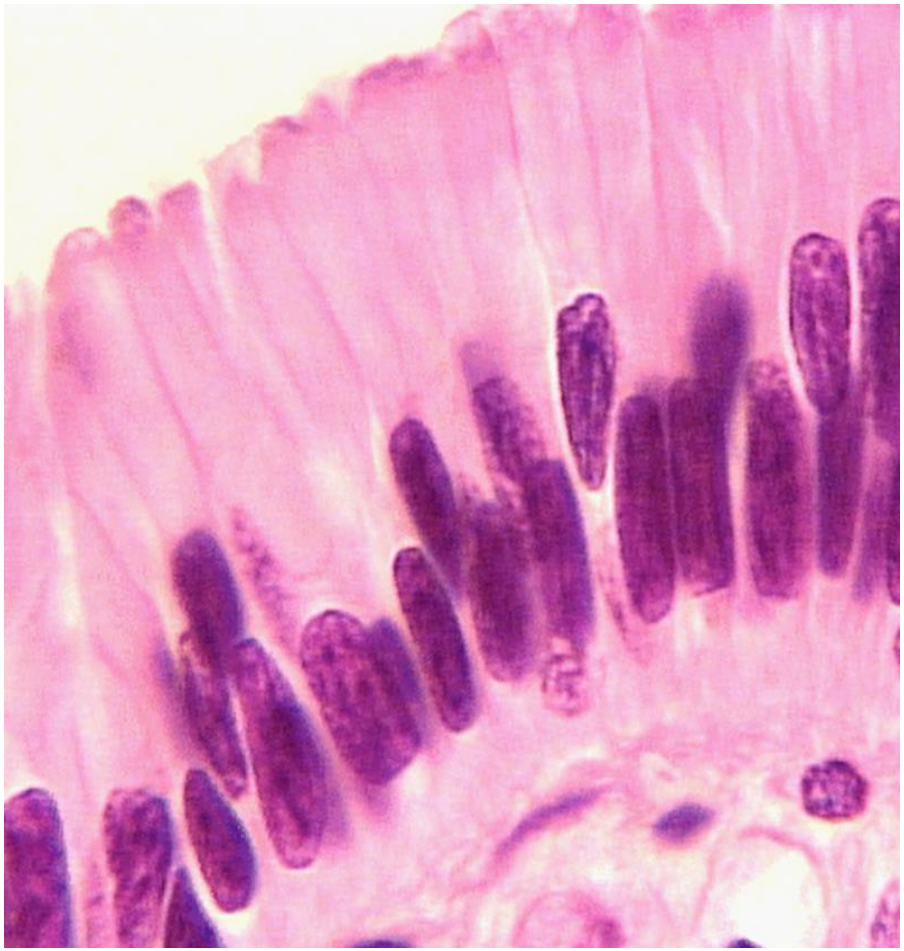
- This type is essentially simple, composed of only one layer but it has a false appearance of stratified epithelium.

- It consists of crowded columnar cells so that all cells lie in contact with the basement membrane but they do not all reach the surface. Those that reach the surface are **tall columnar cell** while the other cells which do not reach the surface are **short and triangular**. There are several layers of nuclei giving false appearance of stratification. This type of epithelium has non-ciliated and ciliated types:

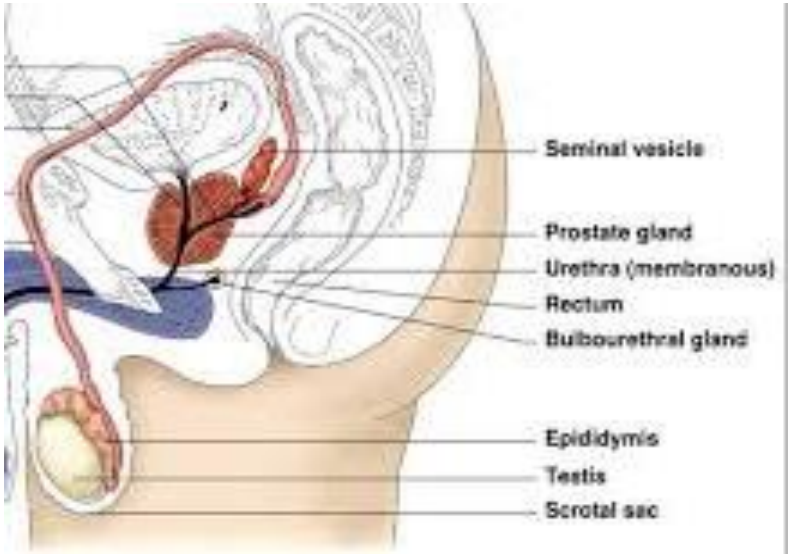
- **Sites:**

a. **Non-ciliated pseudostratified columnar epithelium**: lining the male genital tract e.g. epididymis.
b. **Ciliated pseudostratified columnar epithelium :** This type is usually associated with goblet cells lining most of the respiratory system.

a- Pseudostratified columnar epithelium non ciliated



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



b. Pseudostratified columnar epithelium ciliated

Pseudostratified columnar :

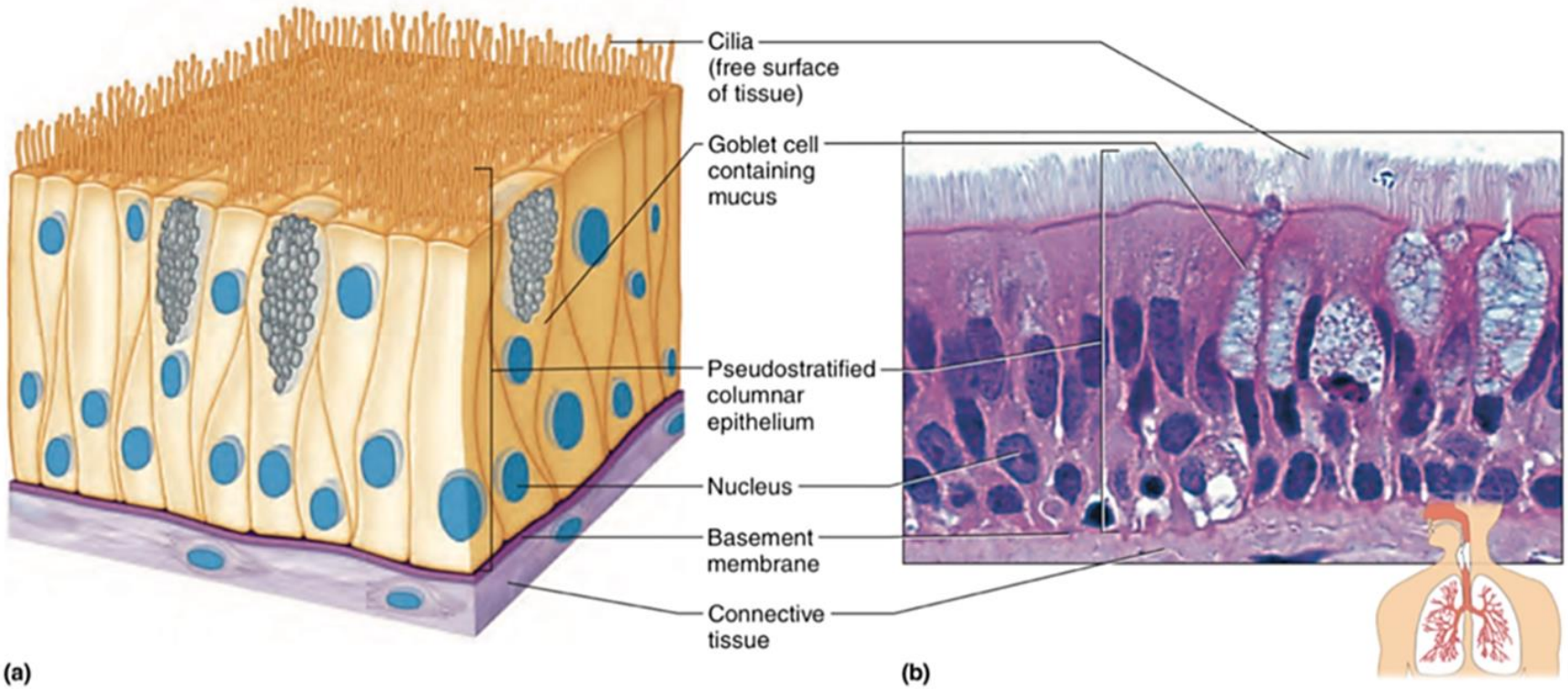
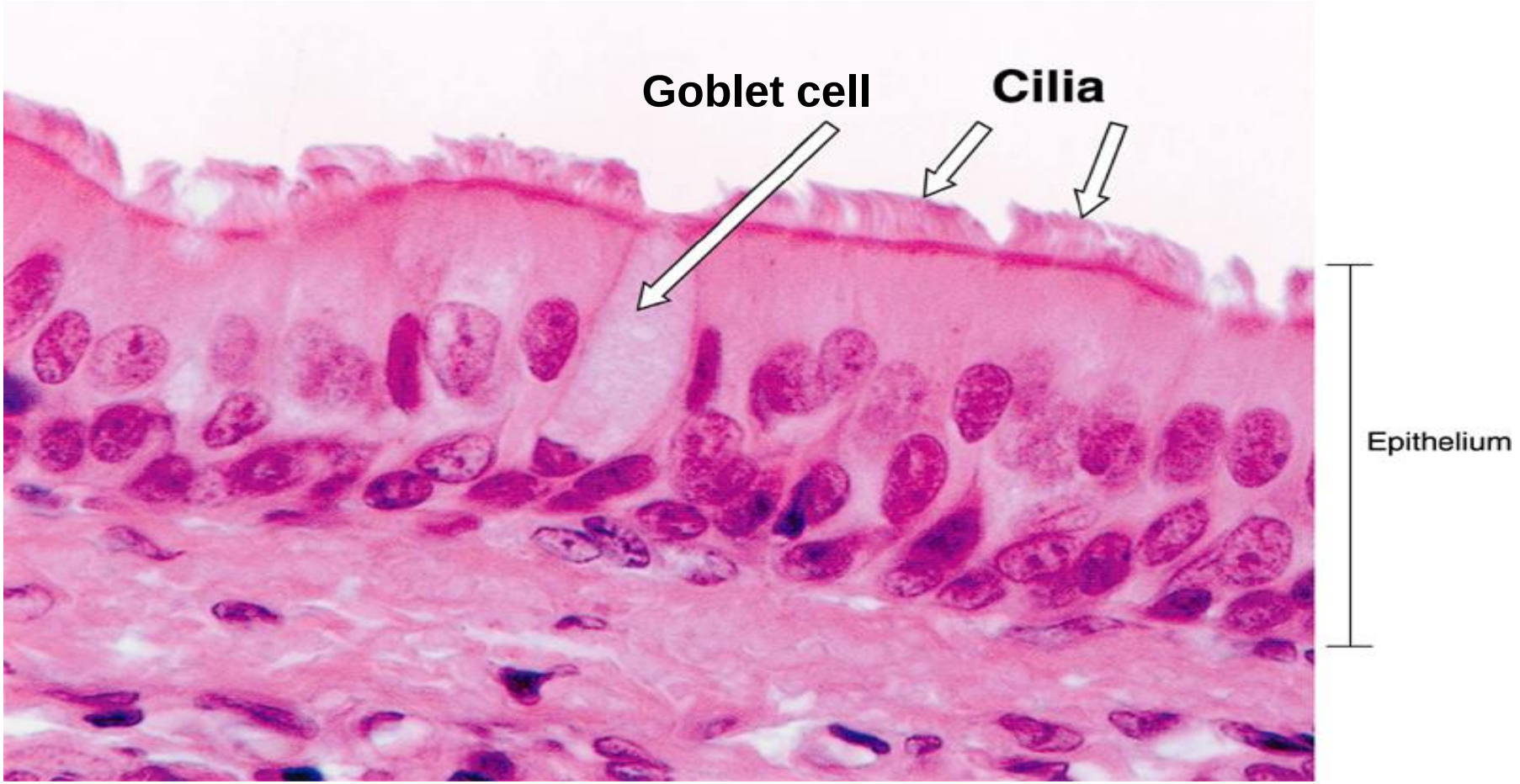


FIGURE 5.5 AP|R Pseudostratified columnar epithelium appears stratified because the cell nuclei are located at different levels (1,000×).

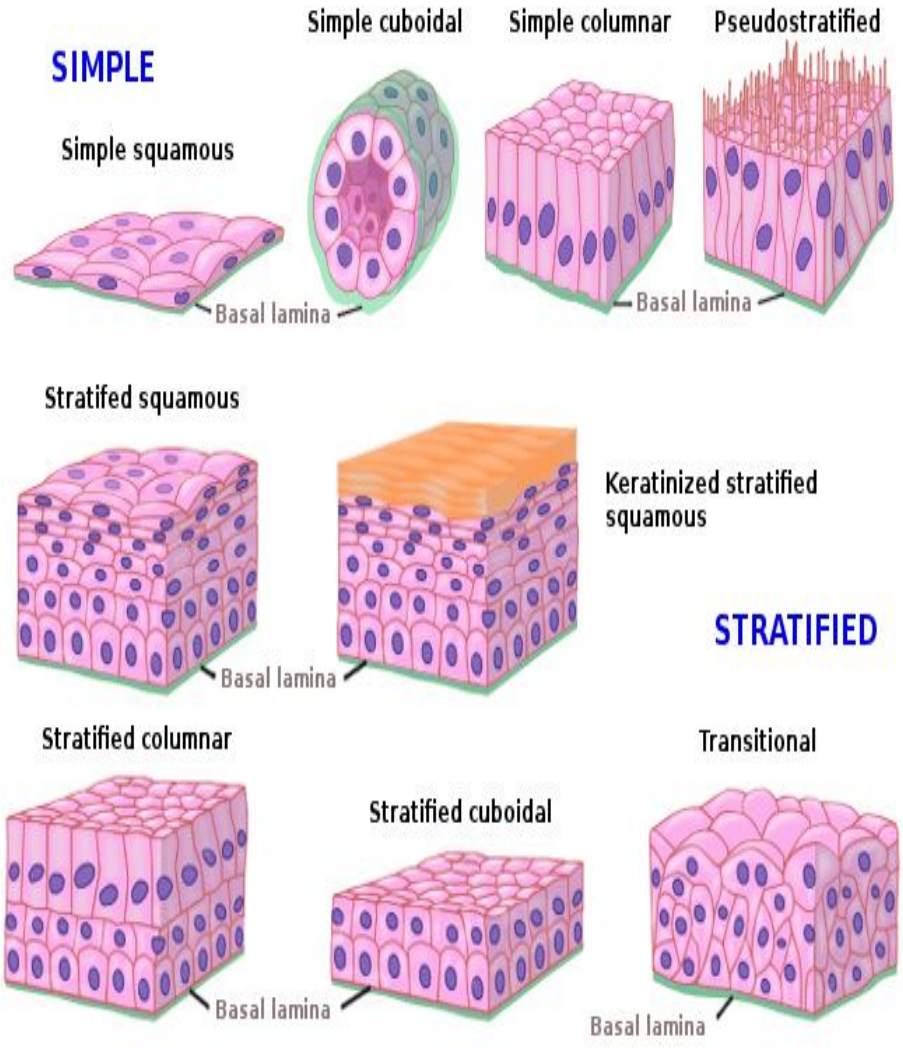
b. Pseudostratified columnar epithelium ciliated

Sites: Nose- Trachea



STRATIFIED EPITHELIUM

- It has a protective function.
- The epithelium is made of more than one layer of cells.
- The basal layer is columnar followed by a few layers of polyhedral cells.
- It is classified according to the shape of the most superficial layer of cells



Stratified squamous epithelium:

- The most superficial cells are flat squamous. This type of epithelium is either keratinized or non-keratinized.

Keratinized stratified squamous epithelium: the superficial layers of this epithelium are composed of flat scale- like cells whose nuclei and cytoplasm are replaced with ***keratin*****,** thus form a ***dry*** tough layer.

- **Sites:** - epidermis of skin covering the whole body.

- All openings on the surface of the skin e.g. lips, nose, ears and anus.

Non-keratinized stratified squamous epithelium**:**

- **Sites:** the ***wet surfaces*** subjected to wear and tear

- Digestive tract; it lines the mouth cavity, tongue, palatine tonsils, oropharynx, esophagus and anal canal.

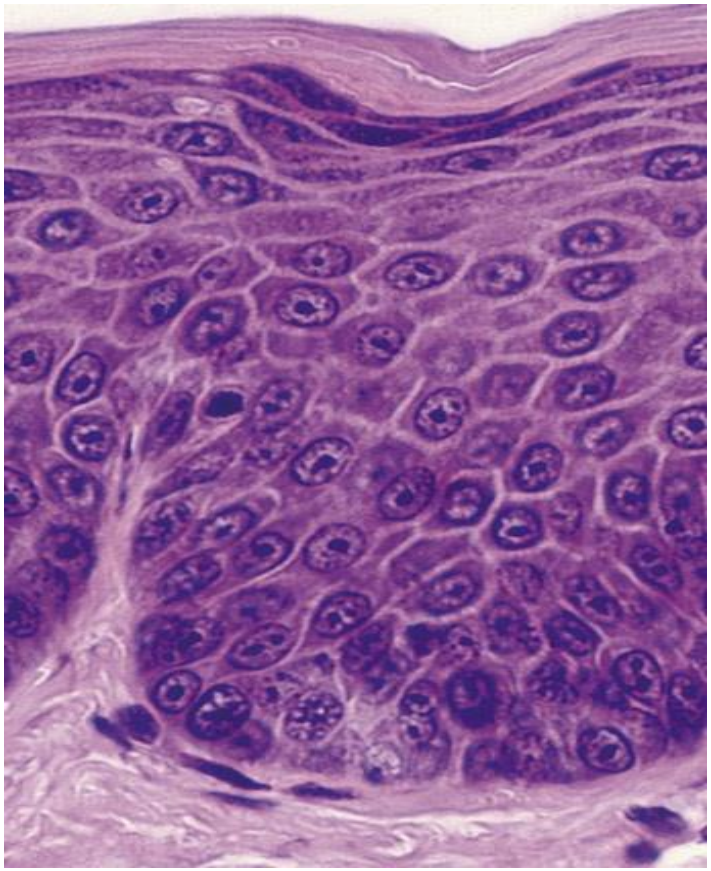
- Female genital system; it lines the vagina

Stratified squamous epithelium

Non Keratinized

Oesophagus- vagina

Keratinized



skin

Stratified cuboidal epithelium:

- The superficial cells are cuboidal. It is **uncommon type**, lining ducts of sweat glands.

Stratified columnar epithelium:

The superficial cells are columnar. There are two varieties: ciliated and non-ciliated.

a) Stratified columnar non-ciliated epithelium

Sites: 1- Fornix of conjunctiva

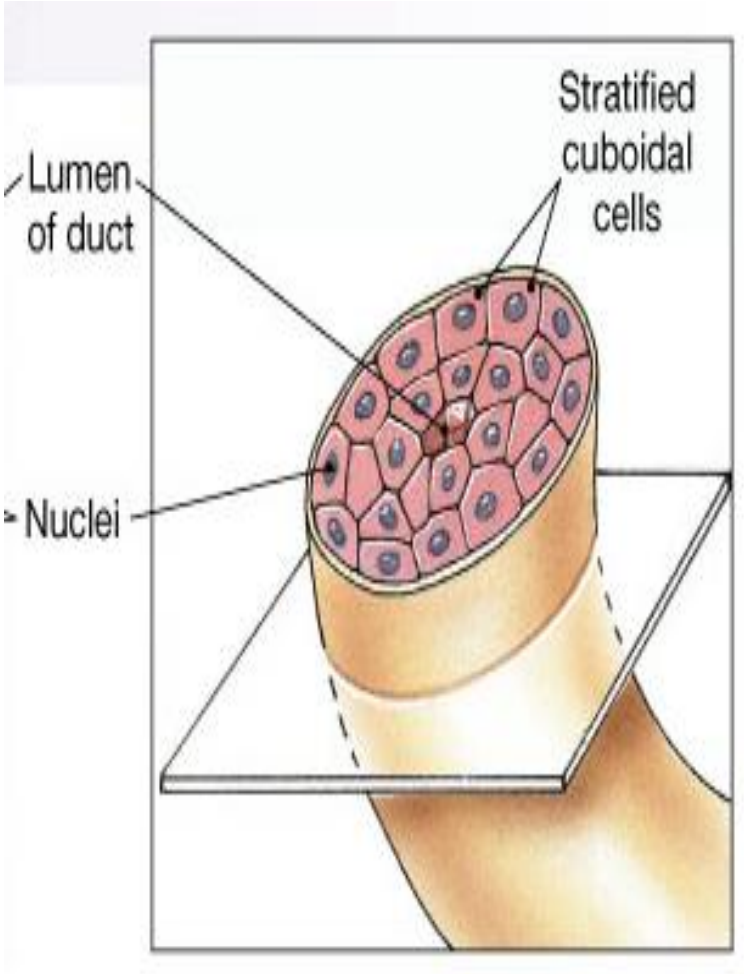
2- Large ducts of glands

b) Stratified columnar ciliated epithelium

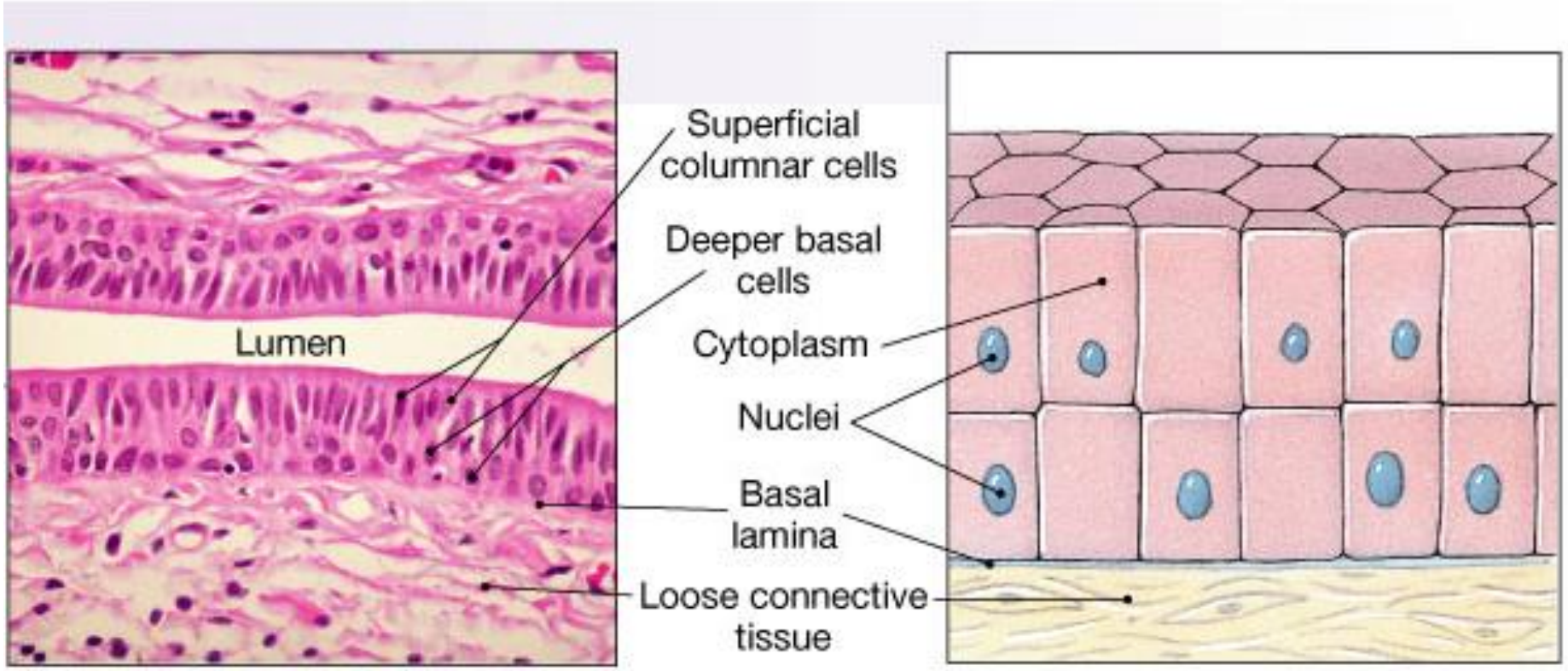
Sites: Fetal esophagus

Stratified Cuboidal Epithelium

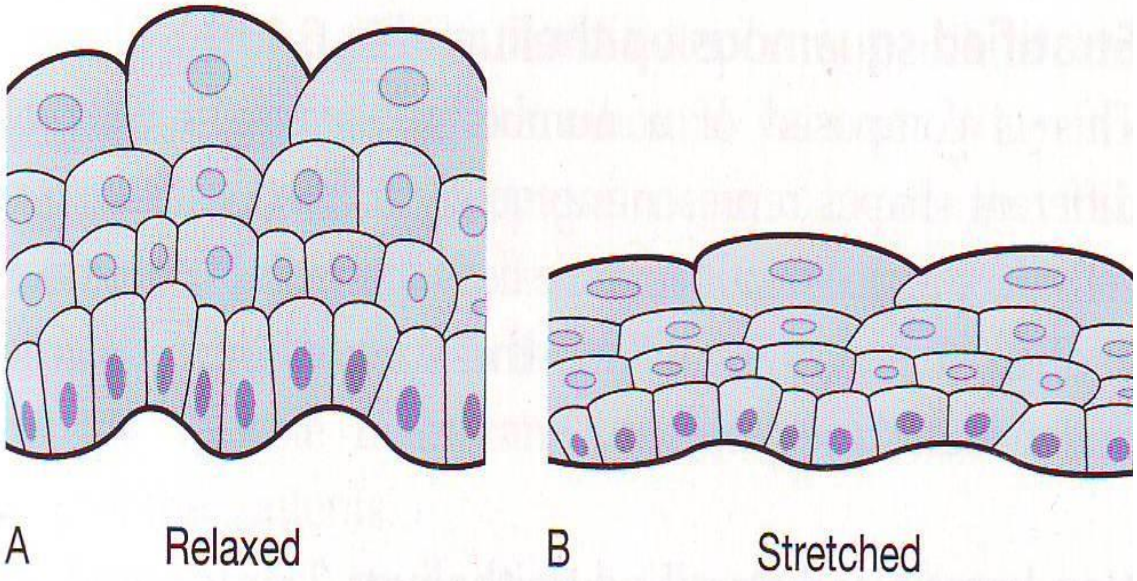
(Ducts of sweat glands: secretion) (Rare)



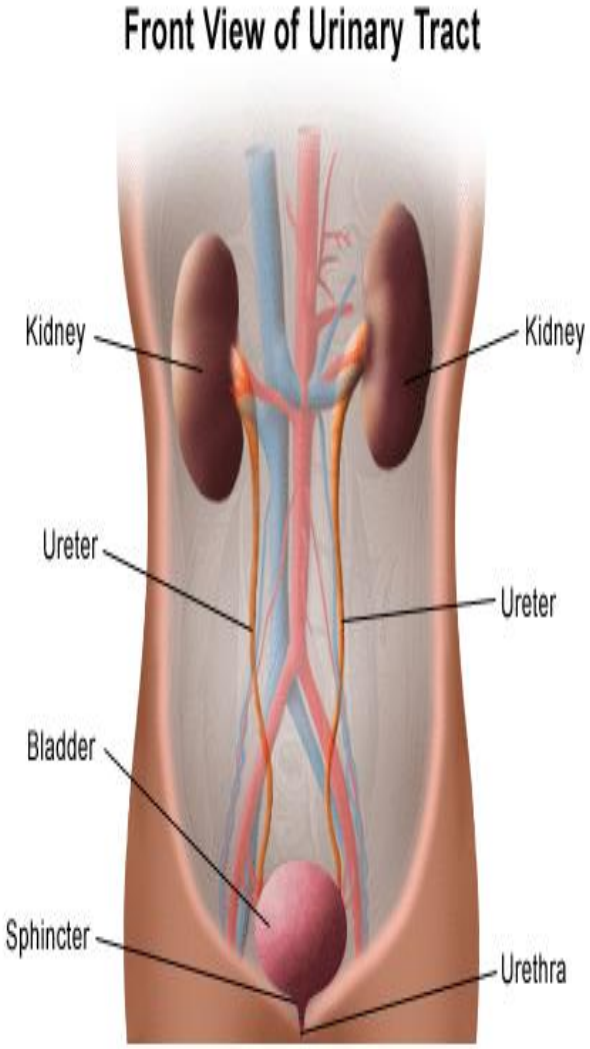
Stratified Columnar Epithelium (Rare)



Transitional epithelium



Transitional epithelium: A. Relaxed. B. Stretched.



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. the cell layer immediately below the surface layer is pear-shaped.

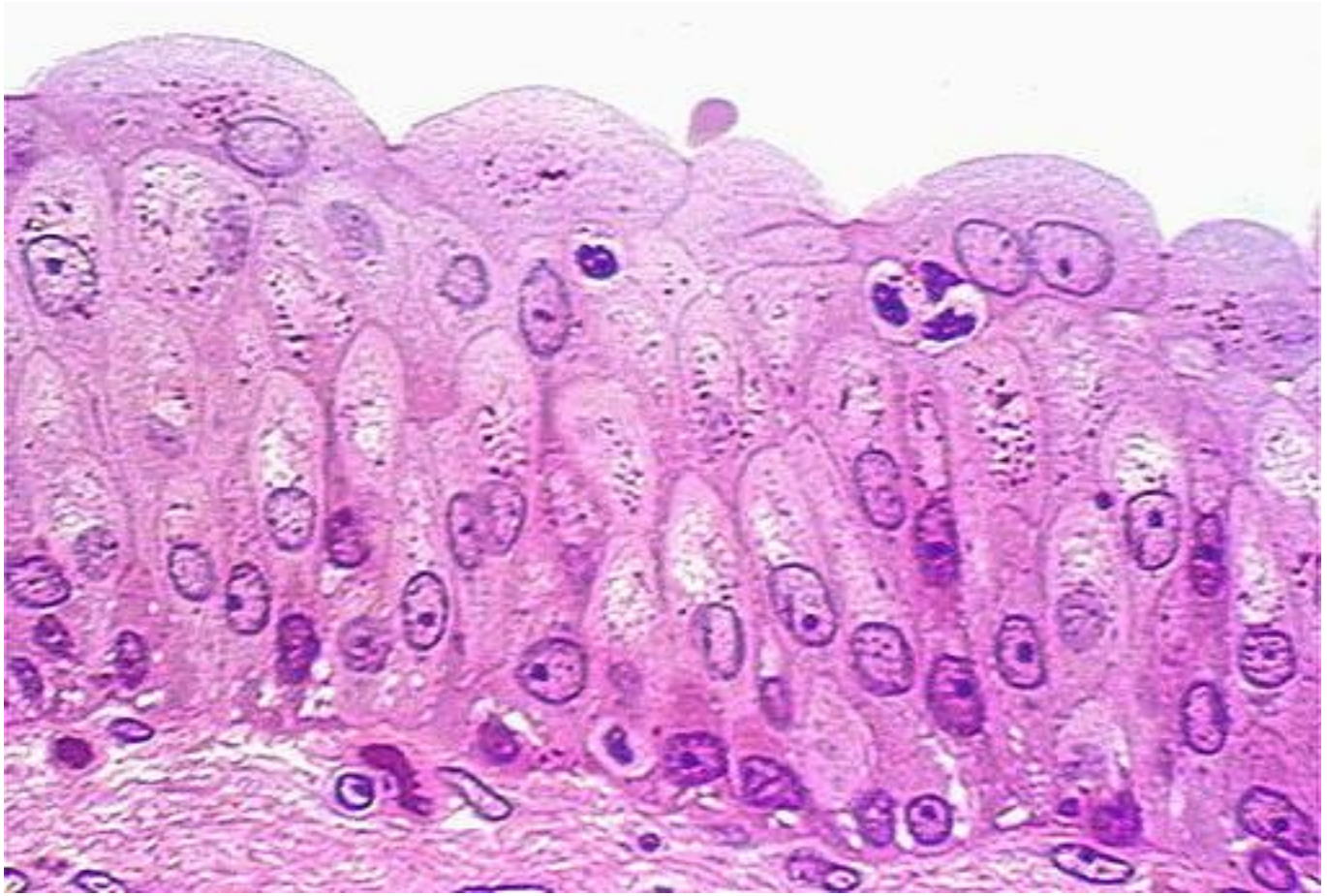
-The surface layer is composed of large cuboidal single or binucleated, ***dome-shaped cells (umbrella cells)*** with a convex upper surface and concave lower surface. The dome-shaped cells are so large that each cell covers about three of the underlying pear-shaped cells.

***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



(urinary bladder - empty)

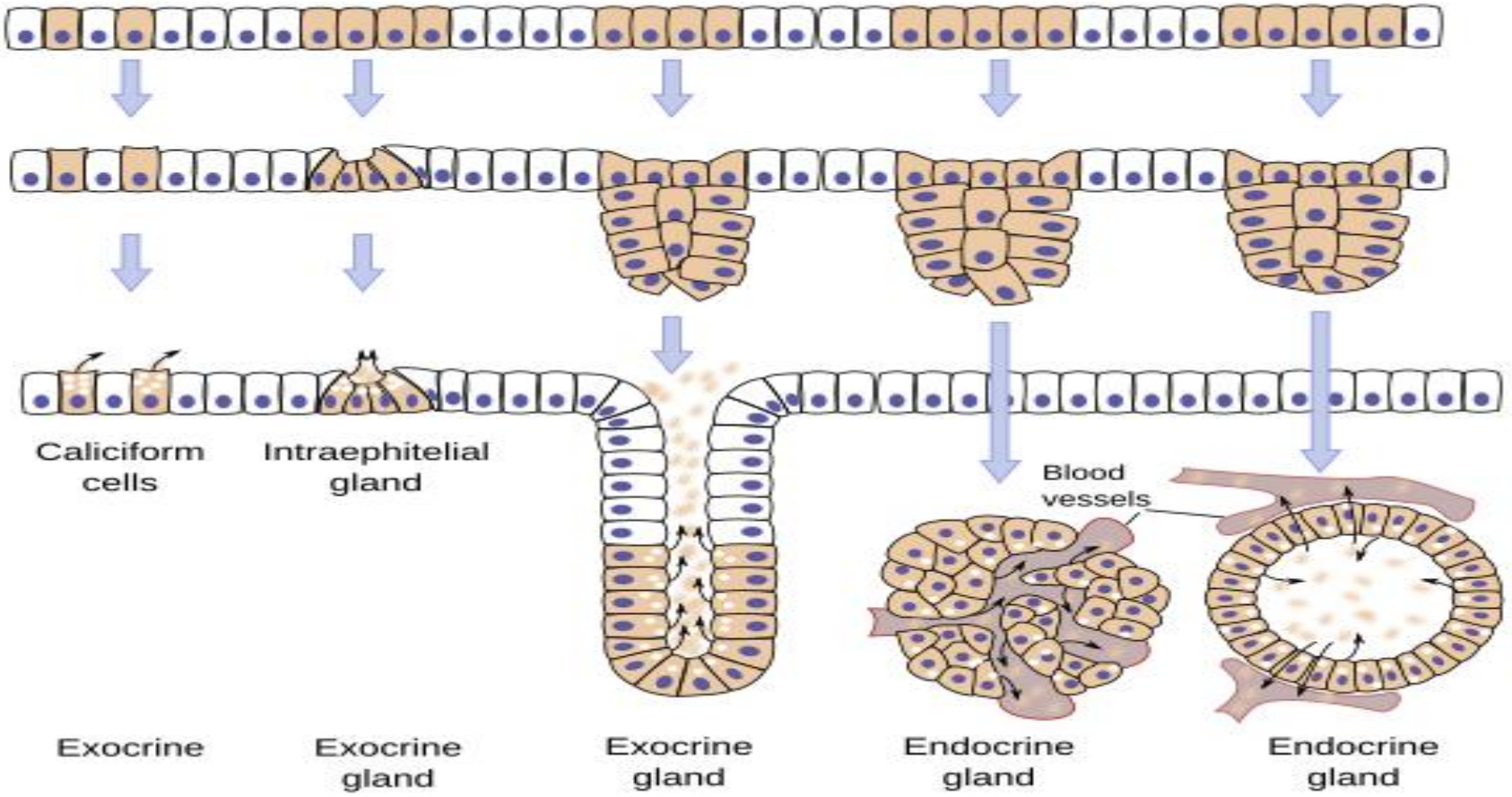
Transitional epithelium

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.**

GLANDULAR EPITHELIUM

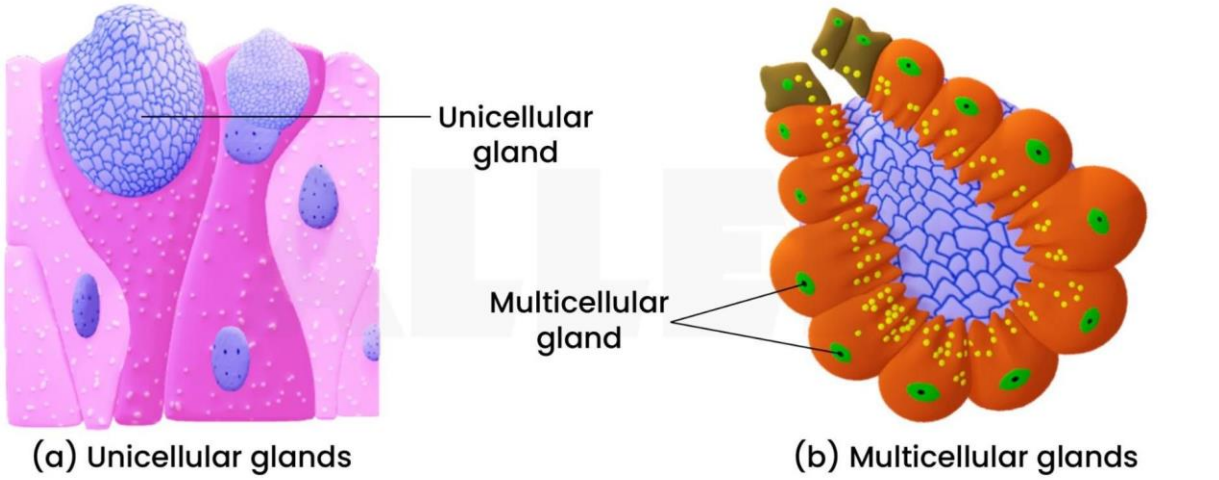
This type of epithelium is formed of secretory cells produce secretion. Glands arise from the covering epithelium which proliferates into the underlying connective tissue.



Glandular epithelium can be classified according to various criteria

I- According to the number of cells:

- **Unicellular glands,** consist of one cell e.g. goblet cells present in the lining of the small intestine and the respiratory tract
- **Multicellular glands,** consist of clusters of cells e.g. most glands of the body.

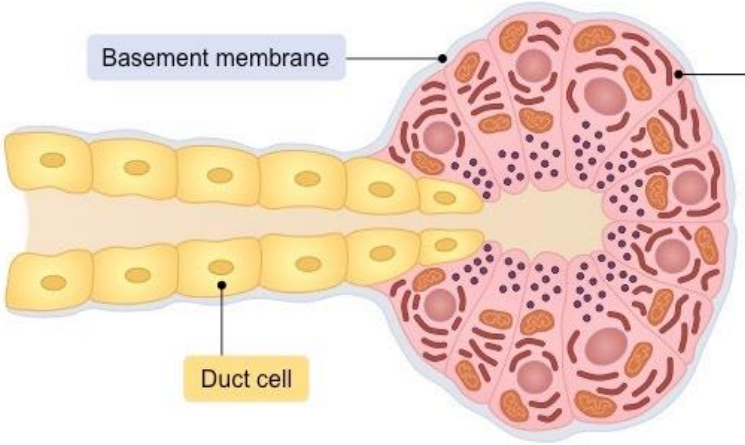


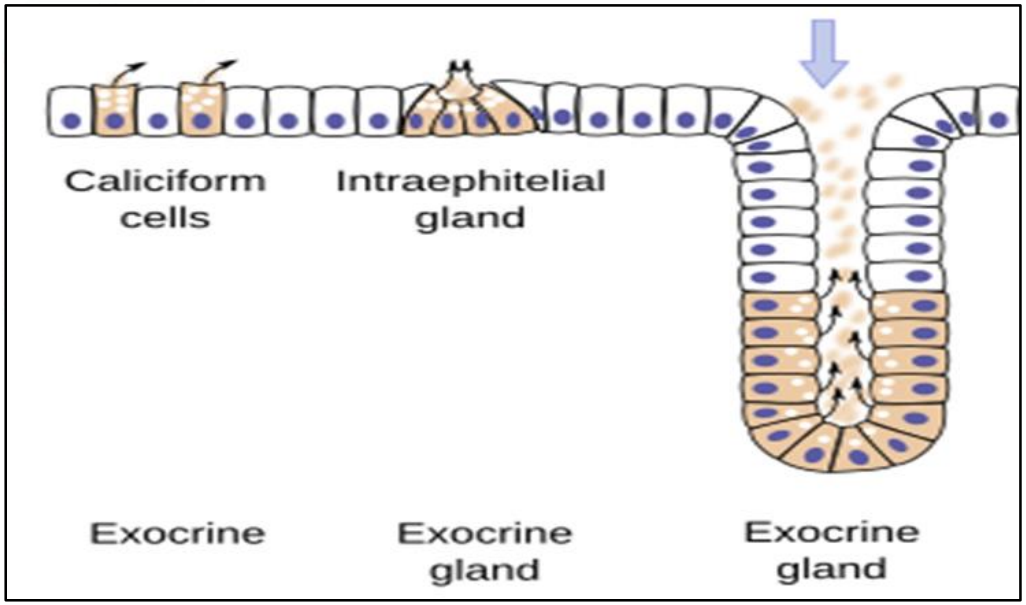
II- According to the presence or absence of a duct system: Exocrine and endocrine glands:

1- The exocrine glands:

- They retain their connection with the surface epithelium from which they originated. This connection takes the form of ducts.

- Exocrine glands have a secretory portion whose cells are responsible for the secretory process, and duct system that transports the secretion.





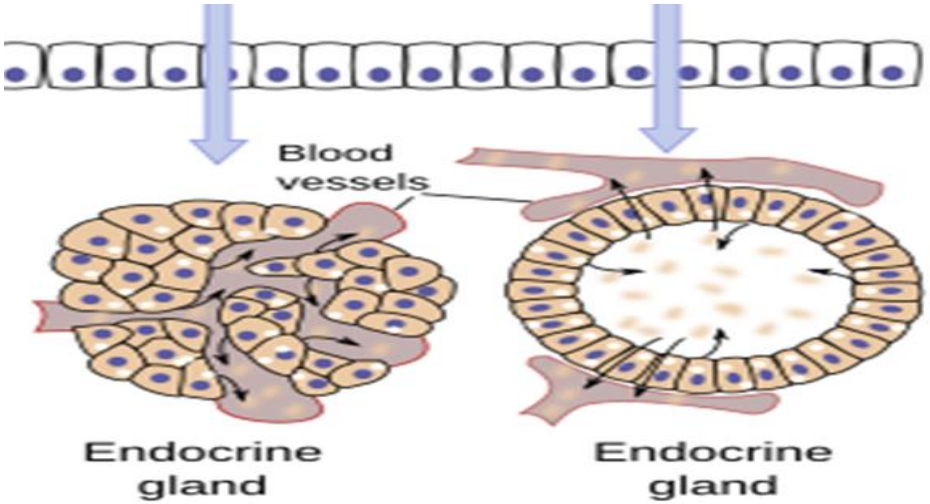
2- The endocrine glands:

- They are glands whose connection with the surface was obliterated, so they are ductless glands and their secretions are transported to the site of action by blood stream.

3- Mixed exocrine and endocrine glands: they contain both types.

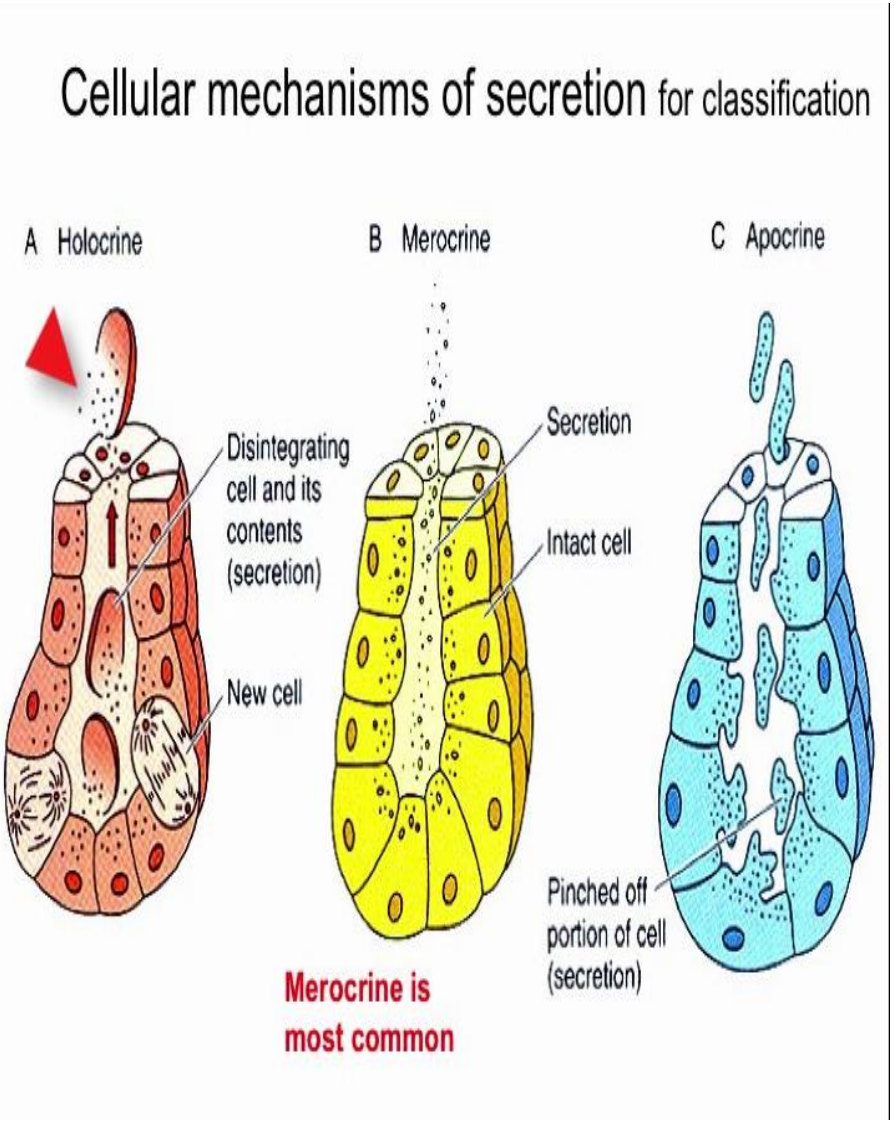
Some organs have both endocrine and exocrine functions where one cell type secrete both e.g. in liver (hepatocyte)

- In other organs, some cells are specialized in exocrine secretion and others are concerned with endocrine secretion e.g. pancreas.



III- According to the mode of secretion

- **Merocrine glands**, in which the secretory granules are discharged by exocytosis through the cell membrane without losing any part of the cell e.g. pancreas, salivary glands and goblet cells.
- **Apocrine glands**, in which the secretory produced is discharged together with the apical parts of the cytoplasm e.g. lactating mammary gland.
- **Holocrine glands,** in which the secretion produced is shed off with the whole cell leading to its complete destruction e.g. sebaceous gland.



IV- According to the nature of secretion:

- **Serous glands**, which secrete a watery secretion. Serous cells are characterized by:

a) Secretory granules at the apex.

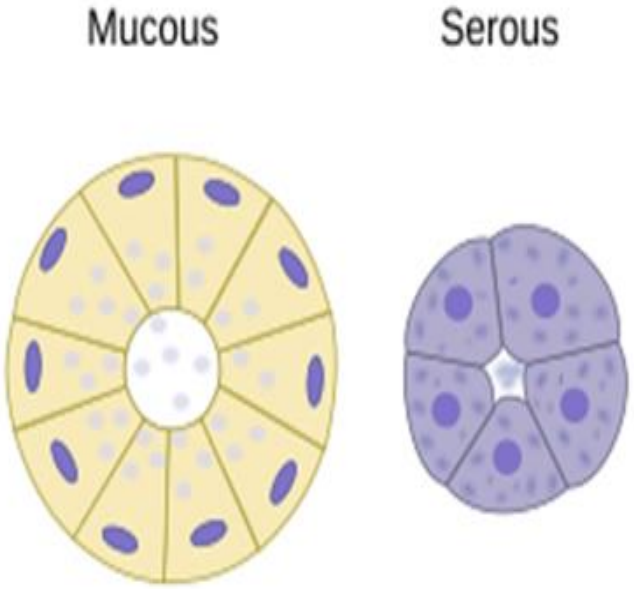
b)Central rounded nucleus with extended chromatin.

c) Basal rough endoplasmic reticulum.

- **Mucous glands,** which secrete a viscid mucoid secretion. Mucous cells are characterized by:

a) Presence of large translucent secretory granules occupying most of the cell.

b) Basal flattened nucleus containing condensed chromatin.



IV- According to the nature of secretion:

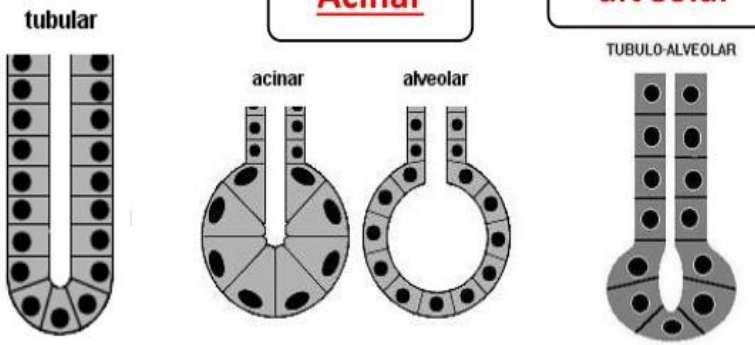
- **Mixed glands,** which secrete both mucous and serous secretions e.g. submandibular salivary gland.

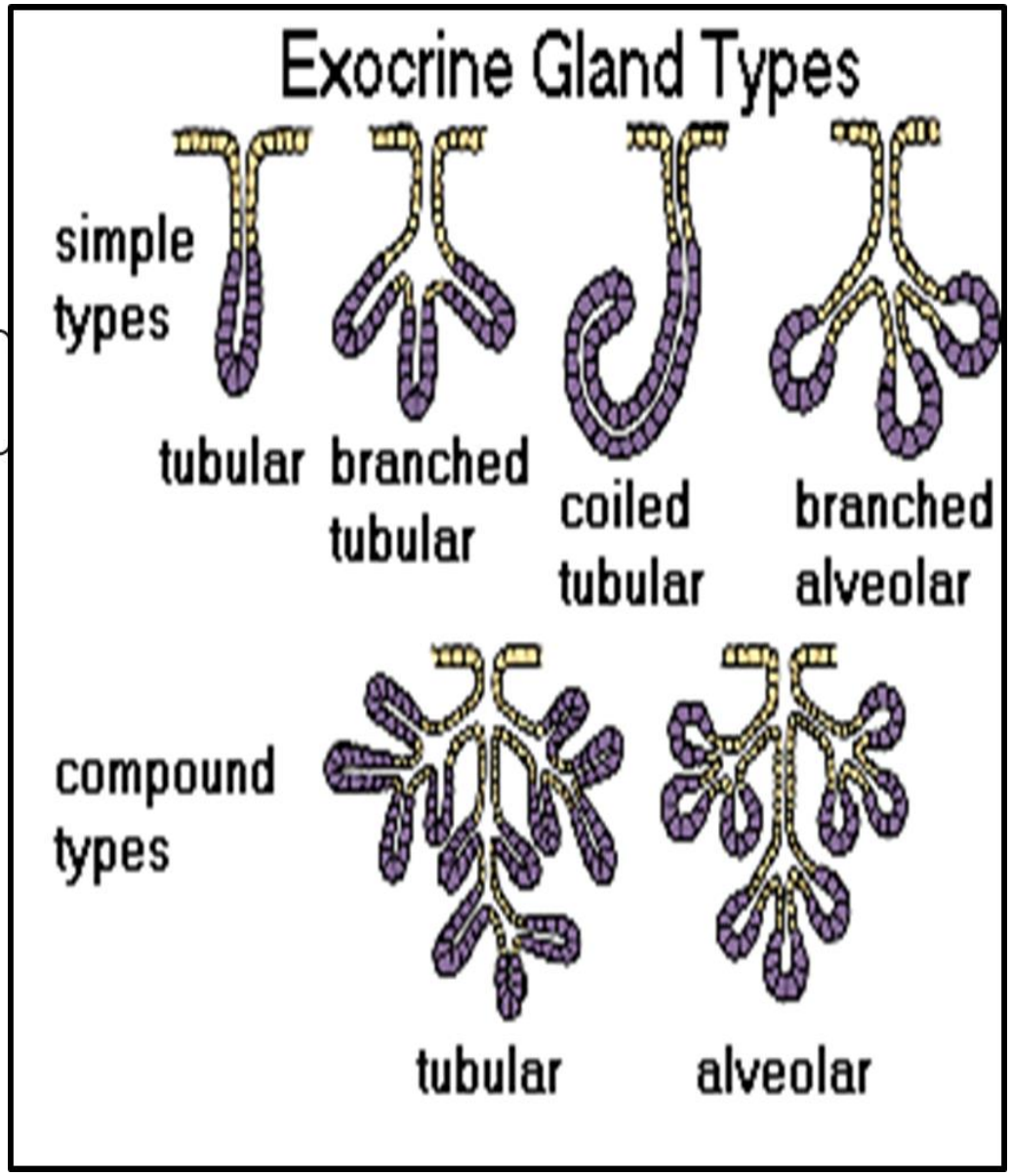
- **Glands with special secretions** e.g. ceruminous glands secrete wax of ear, sebaceous glands secrete a fatty secretion, lacrimal glands secrete a watery secretion, mammary gland secrete milk and sweat glands secrete sweat.

Multicellular Exocrine Glands

2. Based on Shape of Secretory End Piece

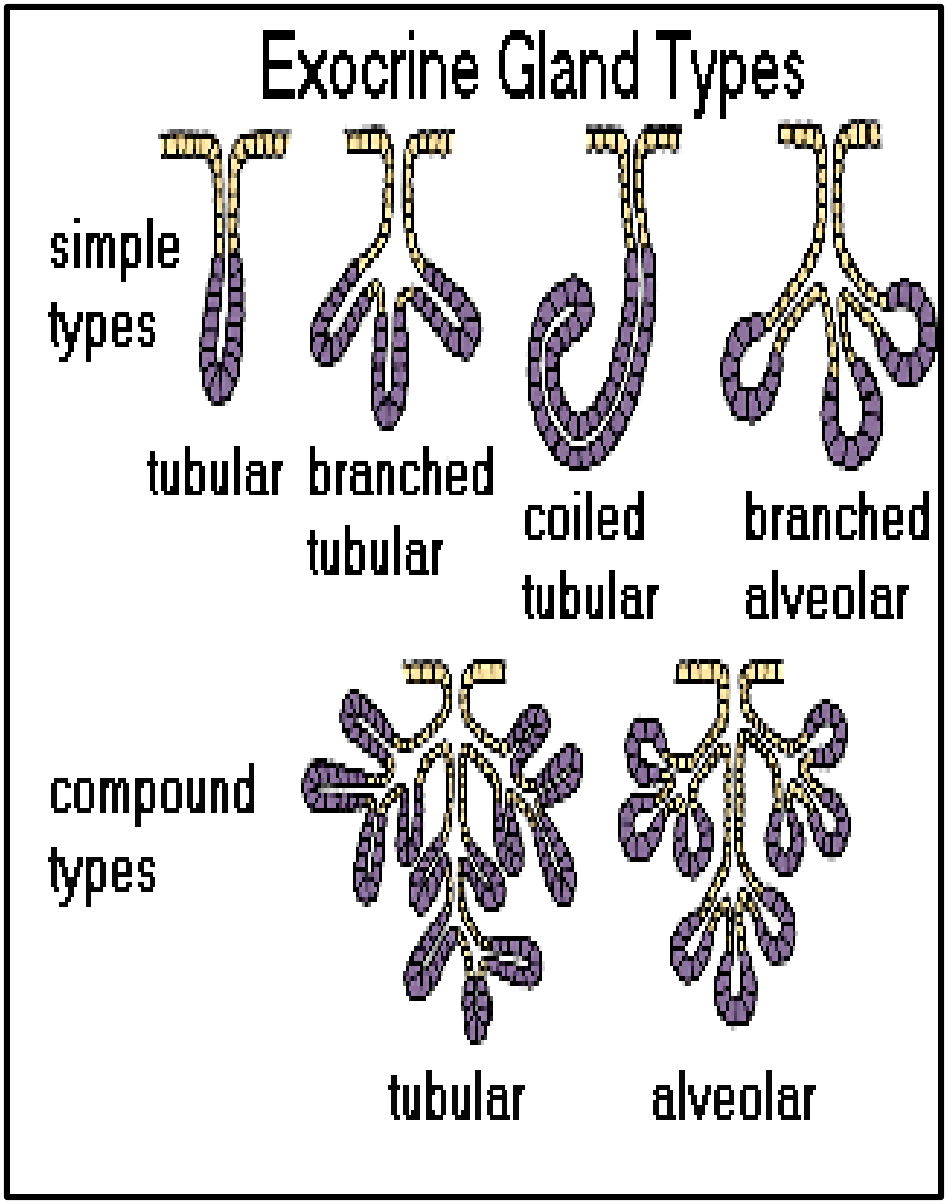
- **Tubular**
- **Alveolar / Acinar**
- **Tubulo-alveolar**





V- According to the branching of the ducts and branching of the secretory portion:

- **Simple glands,** which have only one unbranched duct and one secretory unit.
- **Simple branched glands**, which have one unbranched duct and branched secretory units.
- **Compound glands**, which have branched duct system as well as branched secretory units.



VI- According to the shape of the secretory portion:

- **Tubular,** in which the secretory units are elongated and tubular in shape.

a) Simple tubular e.g. intestinal glands.

b) Simple coiled tubular e.g. sweat glands

c) Simple branched tubular e.g. glands of stomach.

d) Compound tubular e.g. kidney, testis, liver.

- **Alveolar** (acinar), in which the secretory units are rounded.

a) Simple acinar e.g. sebaceous gland.

b) Simple branched acinar e.g. sebaceous gland, tarsal gland.

c) Compound acinar e.g. sebaceous gland, mammary gland.

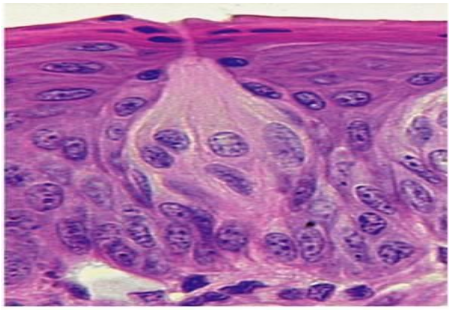
- **Tubuloalveolar** (tubuloacinar), in which the secretory units have both tubular and alveolar parts.

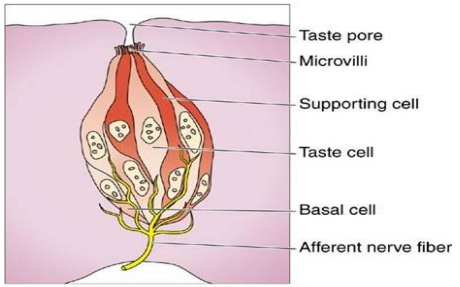
Special types of epithelium

- **Neuroepithelium:** the epithelial cells differentiate to act as nerve receptors.

Sites:

- The taste buds of the tongue.
- The organ of Corti in the ear.
- The retina of the eye.

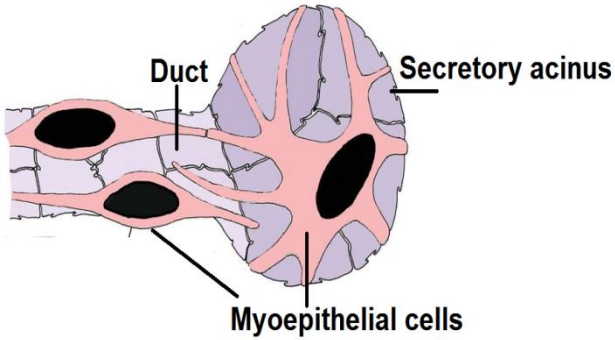




- **Germinal epithelium:** specialized type of epithelium carrying the function of reproduction and produce the germ cells. It is present in the testis and ovary.
- **Myoepithelial cells :** they are modified stellate epithelial cells which surround the secretory units (the acini) and the ducts of the glands. They contain myosin and actin myofilaments; hence, they are able to contract and squeeze the secretion from the glands.

Sites:

- Sweat glands.
- Salivary gland.
- Mammary gland.




Thank
you