

Tissues of adult organism

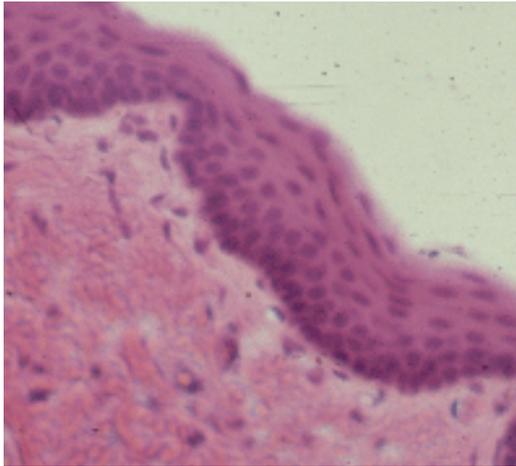
- ❑ A tissue is defined as a group of cells with their extracellular matrix , specialized in common direction and set apart for the performance of a common function
- ❑ Cells work together in functionally related groups called **tissues**

How is this done?

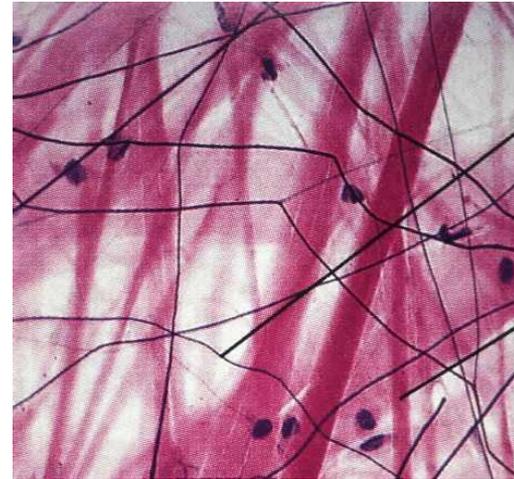
- ❖ Attachments
- ❖ Communication
- ❑ About 200 types of specialized cells in adult human body are arranged into **4 main tissues**:
 - Epithelium
 - connective tissues
 - Muscular tissues
 - Nervous tissues

4

Basic Types of Tissues



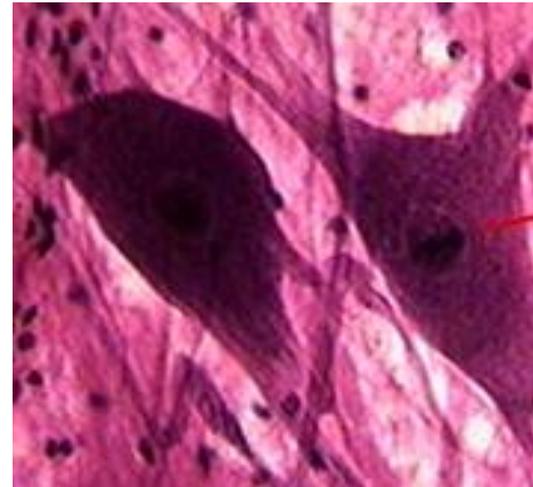
Epithelial tissue



Connective tissue



Muscular tissue



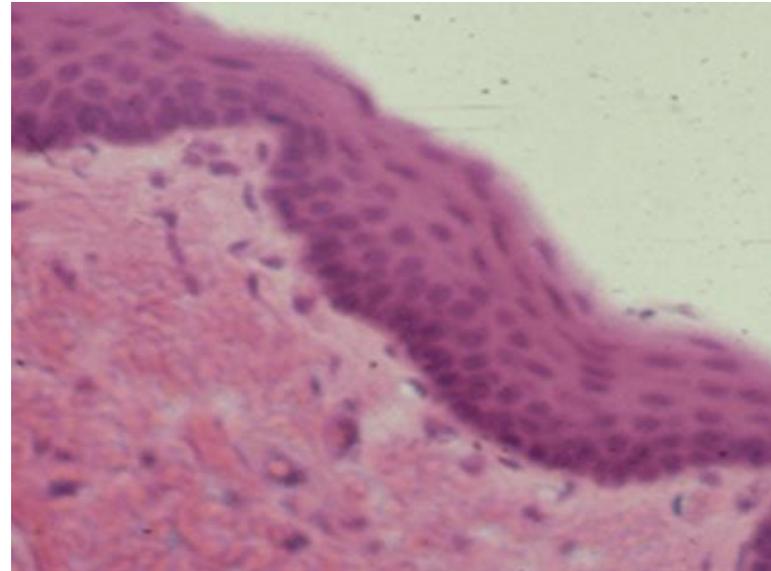
Nervous tissue

General characters of epithelial tissues

- ❑ Epithelium creates a selective barrier between the external environment and the underlying connective tissue
- ❑ The cells predominate, they are closely apposed and adhere to one another by means of special junctions
- ❑ Their basal surface is attached to an underlying basement membrane

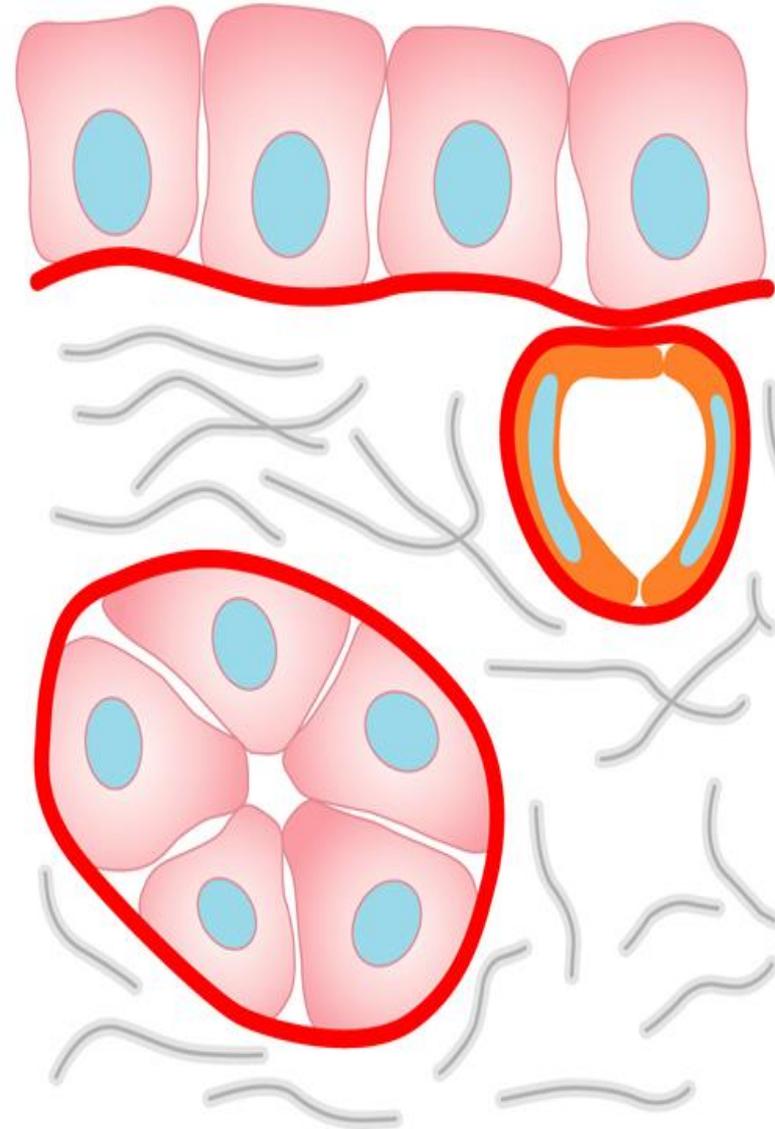
❑ **Epithelial tissues** are widespread throughout the body. They form the covering of all body surfaces, line body cavities and hollow organs, and are the major tissue in glands.

1. Derived from **three** embryonic layers
2. Cells are closely packed together.
3. very little intercellular substances .
4. Cells rest on the **basement membrane** (basal lamina).
- 5. All epithelia don't have blood vessels.** They derive their nutrition from the blood vessels of underlying connective tissue.
6. Availability of intercellular junctions.
7. High ability to regeneration.
8. Polarity of epithelial cells

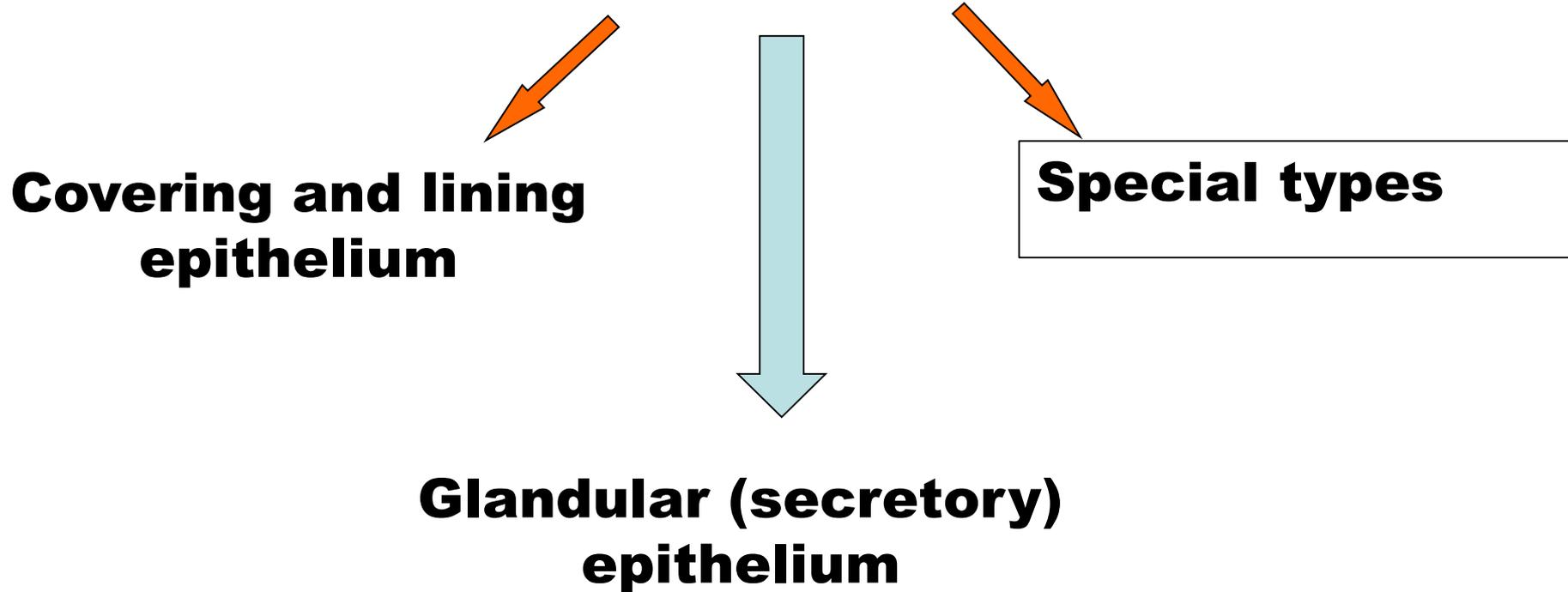


General features of epithelium

- Derived from **3** embryonic layers .
- Closely aggregated cells
- Very little intercellular substances
- Regular shaped cells bind together by **junctional complexes**
- Basal lamina (**basement membrane**)
- Avascular
- Rich in nerve supply
- High renewal rate

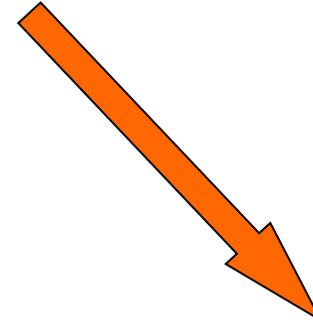
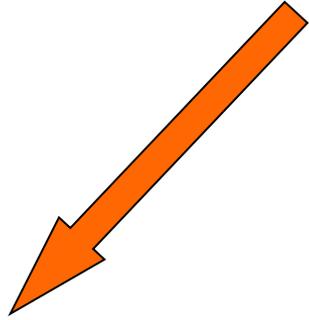


Classification of epithelium



- Epithelium covers body surfaces, lines body cavities, and constistutes glands, therefore it is subdivided into lining , glandular and special types

Classification of covering = lining epithelium



Number of layers

Simple

One layer of cells

Stratified

More than one layer



Shape of cells

➤ Squamous

➤ Cuboidal

➤ Columnar

➤ Pseudostratified

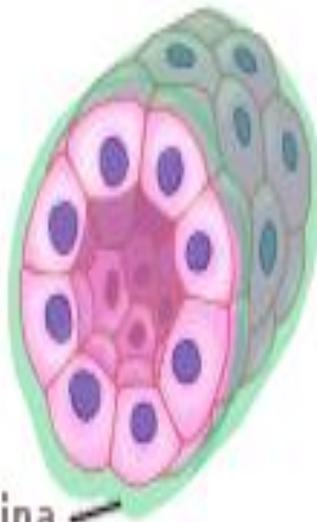
Classification of lining epithelia

SIMPLE

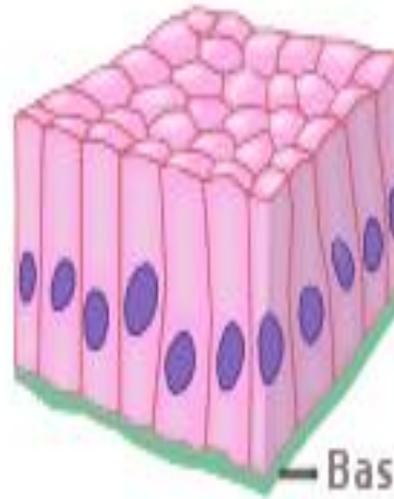
Simple squamous



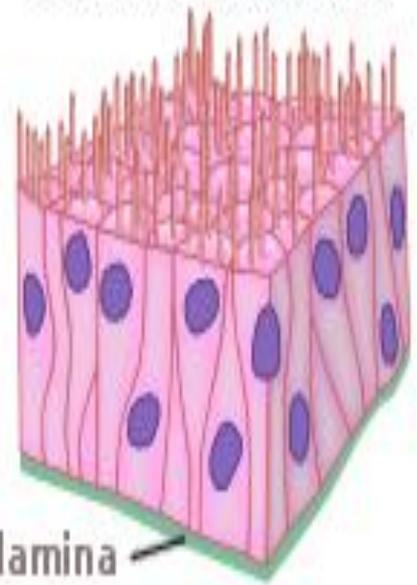
Simple cuboidal



Simple columnar

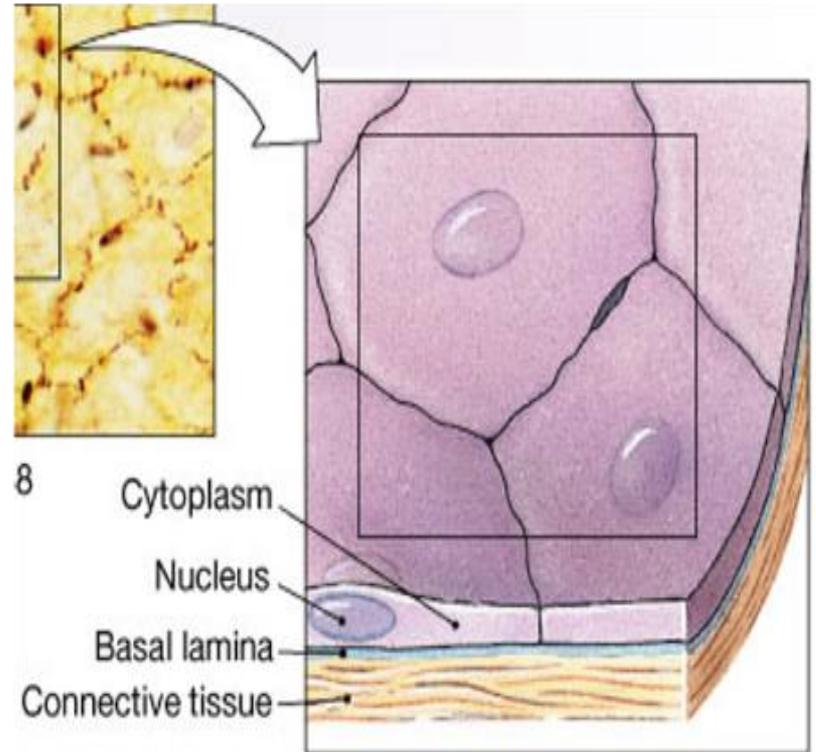
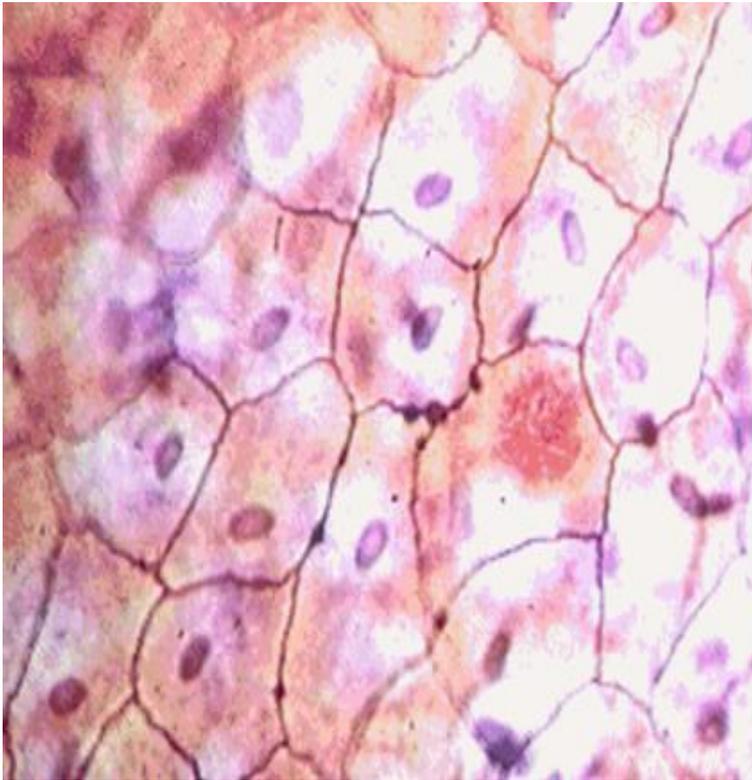


Pseudostratified



Simple Squamous Epithelium

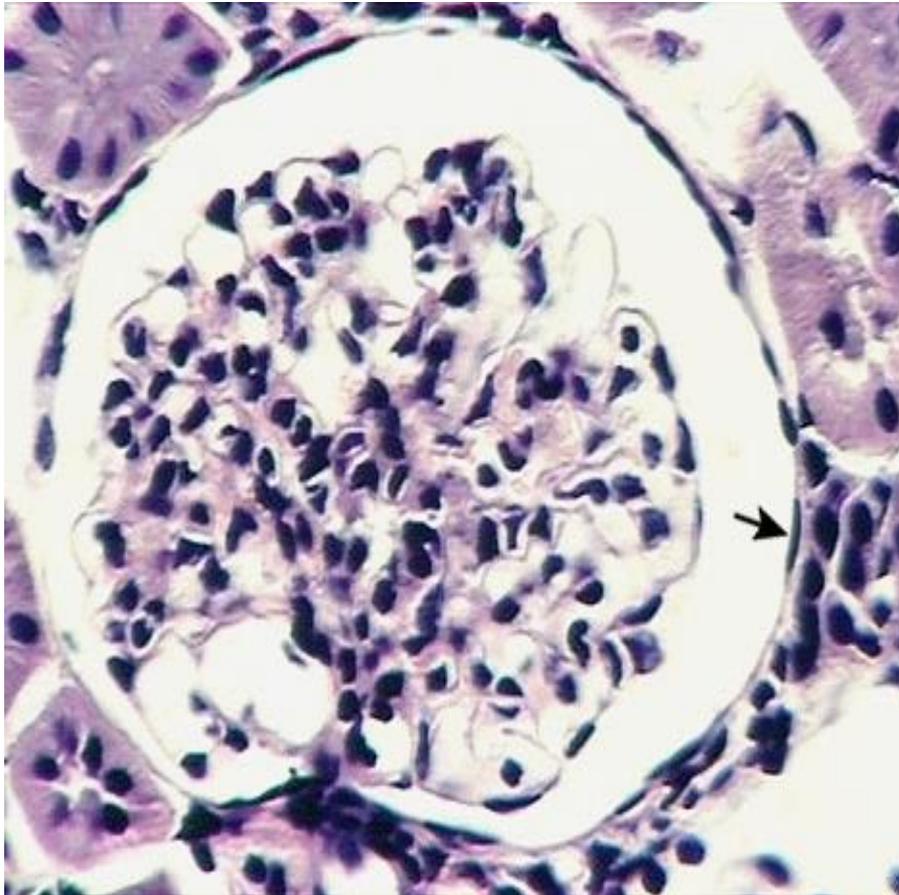
L.M



Simple Squamous Epithelium

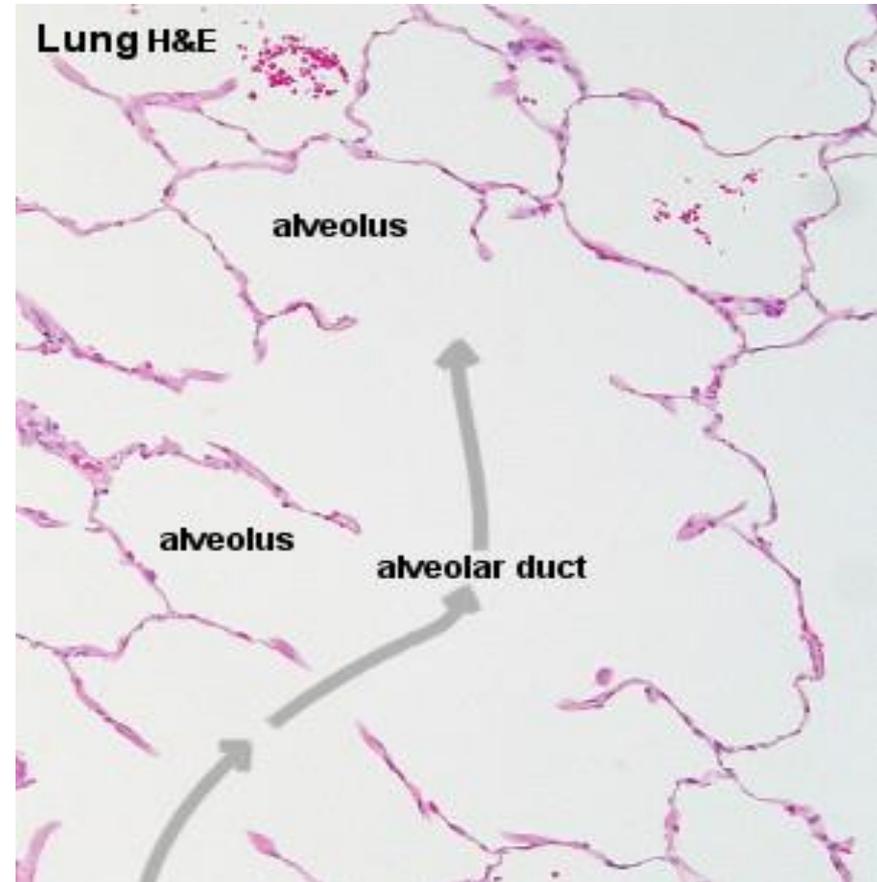
Site : Bowman's capsule- kidney

Function: Filtration of blood



Site : Lung alveoli

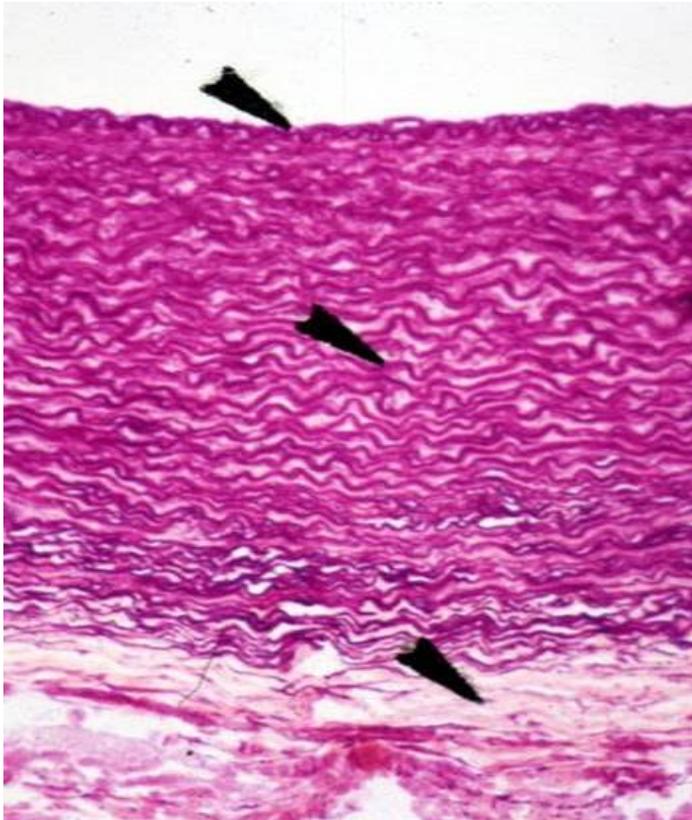
Function : gas exchange



Endothelium:

Site : blood vessels

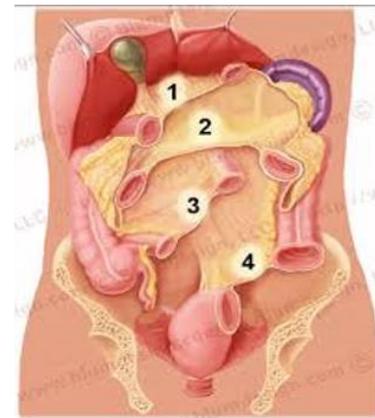
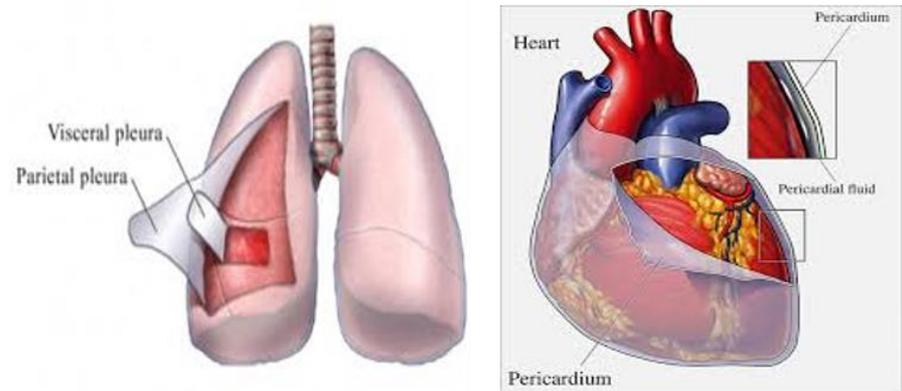
Function : smooth surface



Methothelium :

Site : Pericardium, pleura, peritonieum

Function : smooth surface

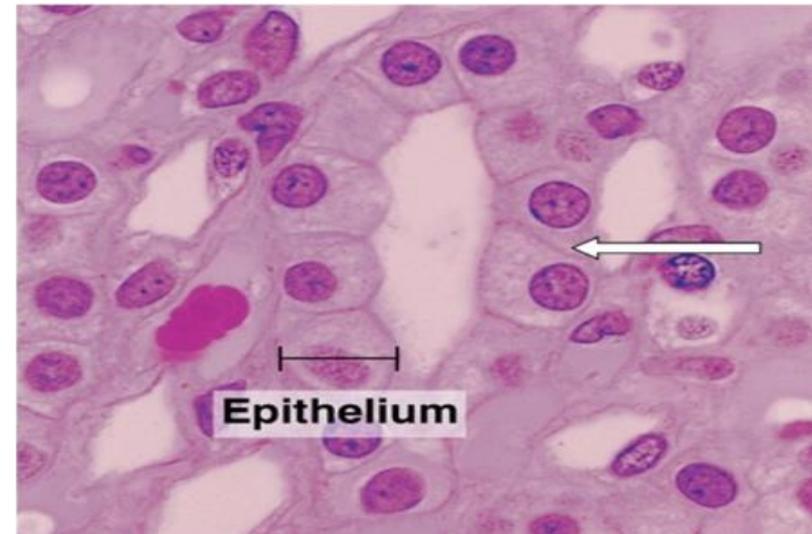
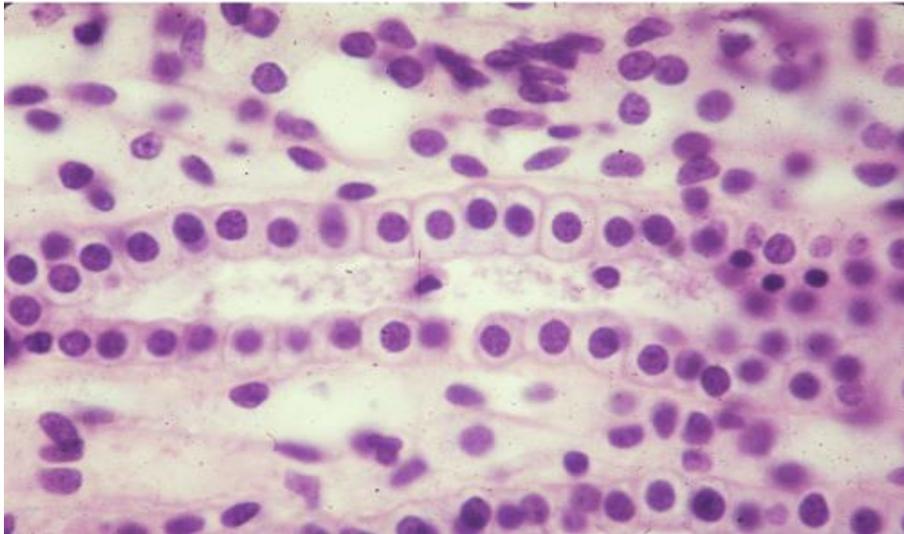


Simple cuboidal Epithelium

Site:

Thyroid gland : secretion

kidney tubules : ion exchange

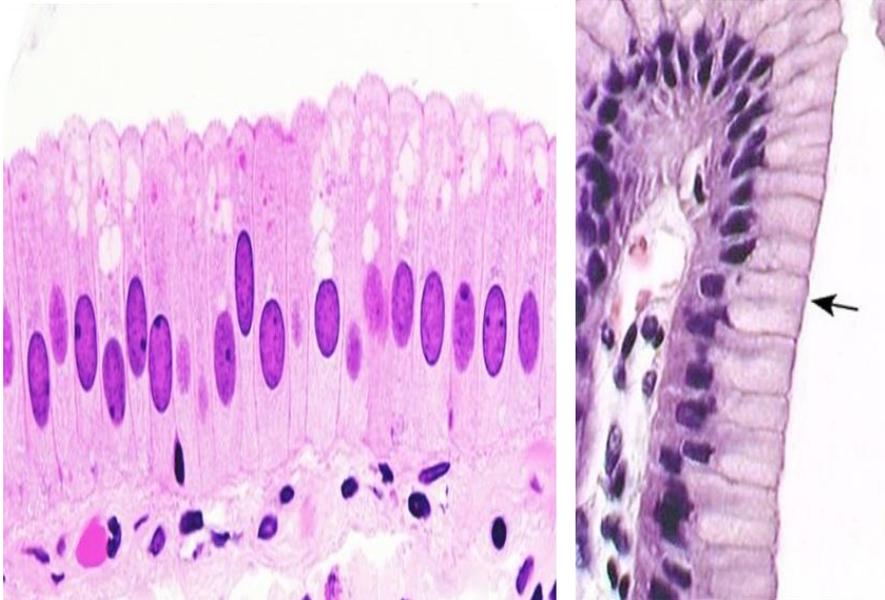


Simple Columnar Epithelium

Non ciliated

Sites:

- ducts of glands: secretion
- digestive tract : absorption

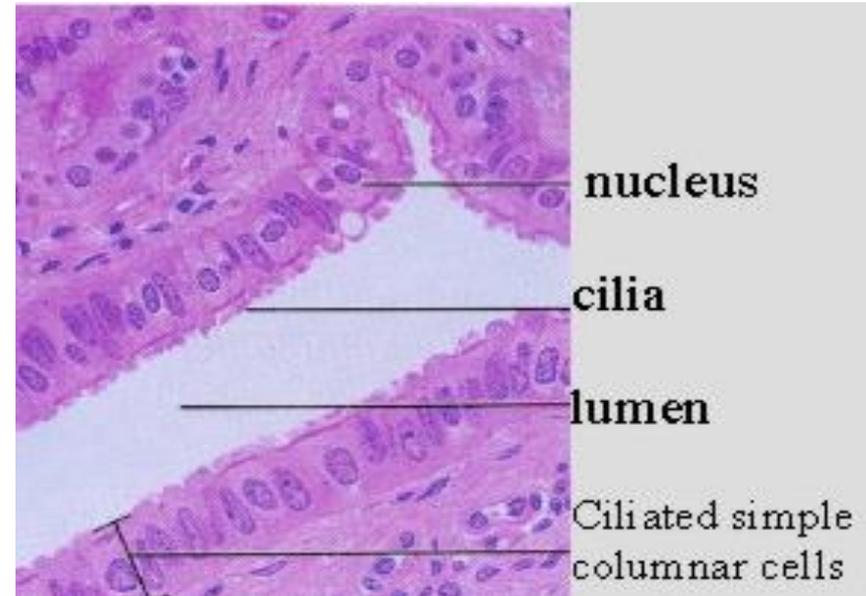


Ciliated

Sites:

uterus, oviduct & bronchiole of the lung

Function : movement of luminal contents



Pseudostratified columnar epithelium

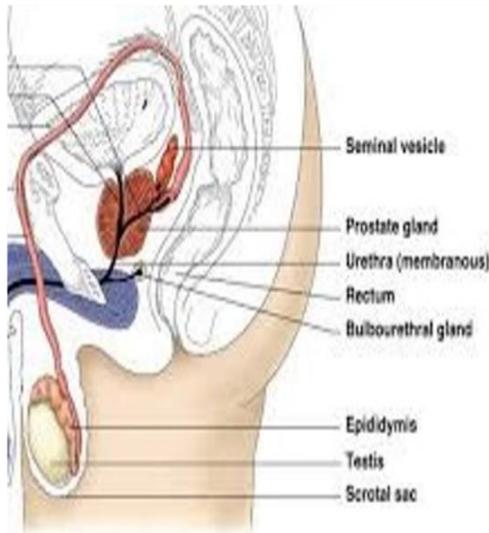
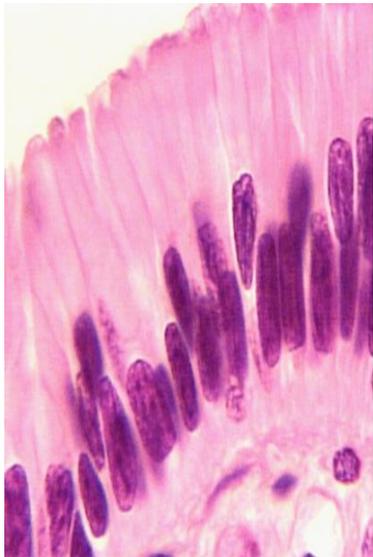
False

Non ciliated

Sites:

- Male genital tract
- large ducts of glands

Function : secretion

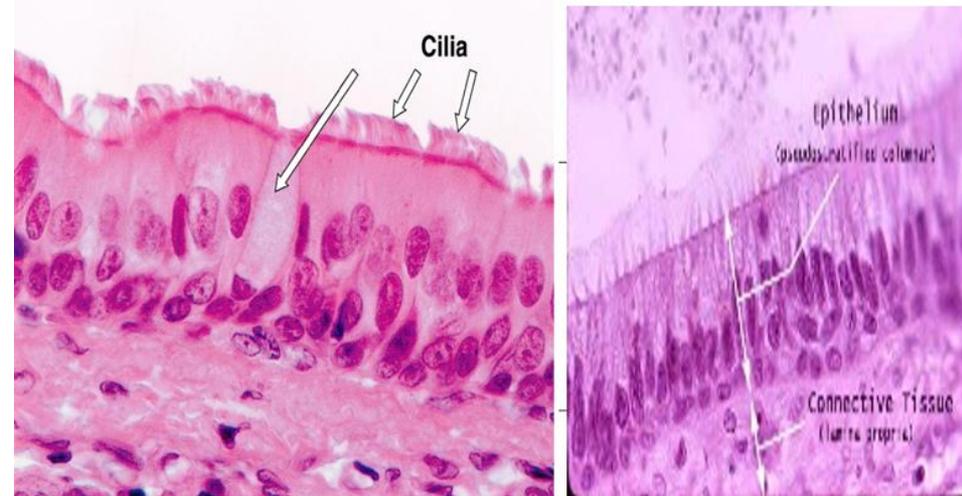
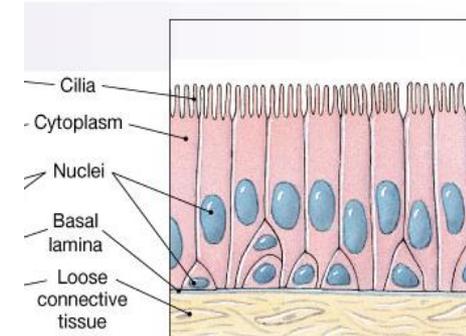


Ciliated

Sites:

- Nose- Trachea

Function = Movement of luminal contents



Type	Site	Function
Simple Squamous	<ul style="list-style-type: none"> • Bowman’s capsule- kidney • Lung alveoli 	Filtration
Simple cuboidal	<ul style="list-style-type: none"> ❖ Thyroid follicles ❖ Kidney tubules 	<ul style="list-style-type: none"> ❖ Secretion ❖ Ions exchange
Simple Columnar non ciliated	<ul style="list-style-type: none"> ➤ Digestive tube ➤ Ducts of the glands 	<ul style="list-style-type: none"> ➤ Absorption ➤ Secretion
Simple Columnar ciliated	<ul style="list-style-type: none"> ▪ uterus, oviduct ▪ bronchiole of the lung 	<ul style="list-style-type: none"> ▪ Movement of luminal contents
Pseudostratified columnar ciliated	<ul style="list-style-type: none"> ✓ Nose- Trachea 	Movement of luminal contents
Pseudostratified columnar non ciliated	<ul style="list-style-type: none"> ❑ Male genital tract ❑ large ducts of glands 	Secretion

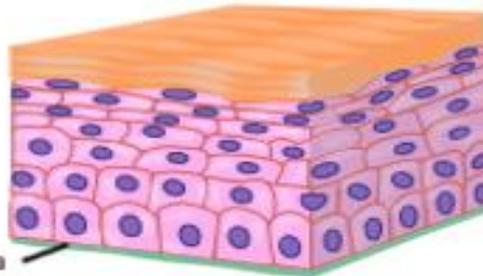
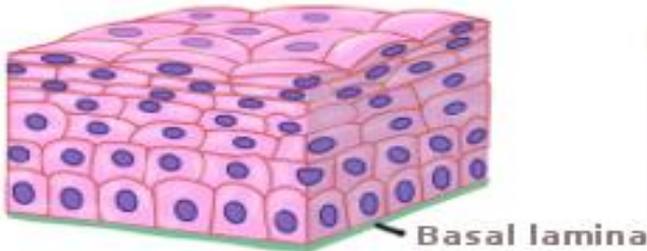
Stratified Epithelium

What cell is on the top layer?

Classification according to shape of most superficial layer

- Stratified squamous epithelium
- Stratified cuboidal epithelium
- Stratified columnar epithelium
- Transitional epithelium

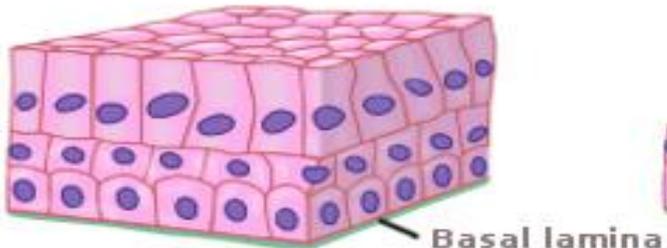
Stratified squamous



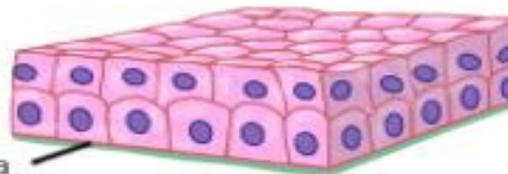
Keratinized stratified squamous

STRATIFIED

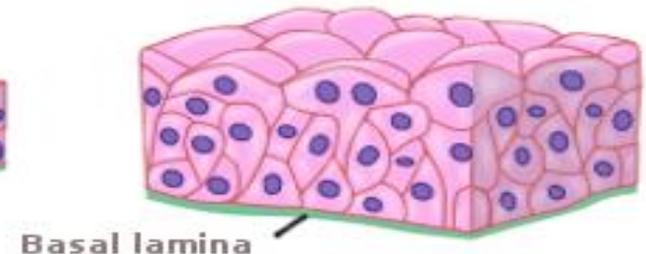
Stratified columnar



Stratified cuboidal



Transitional

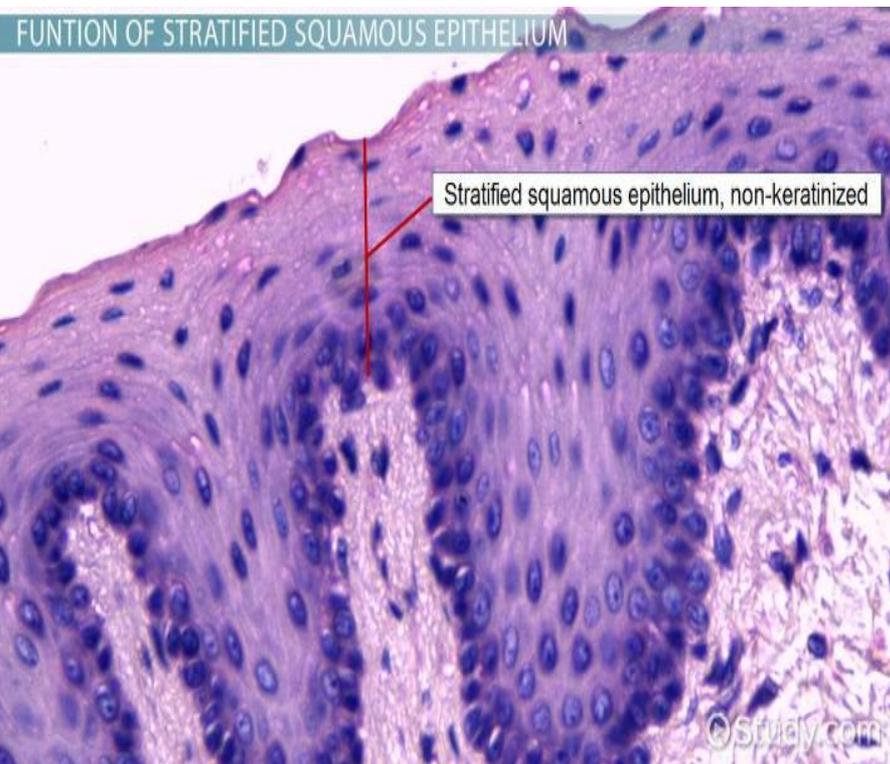


Stratified squamous epithelium

Non Keratinized

Site : Oesophagus- vagina

Function : Physical protection



Keratinized

Site : Skin

Function : Physical protection



Stratified Cuboidal Epithelium (Rare)

Site : Ducts of sweat glands

Function : secretion)

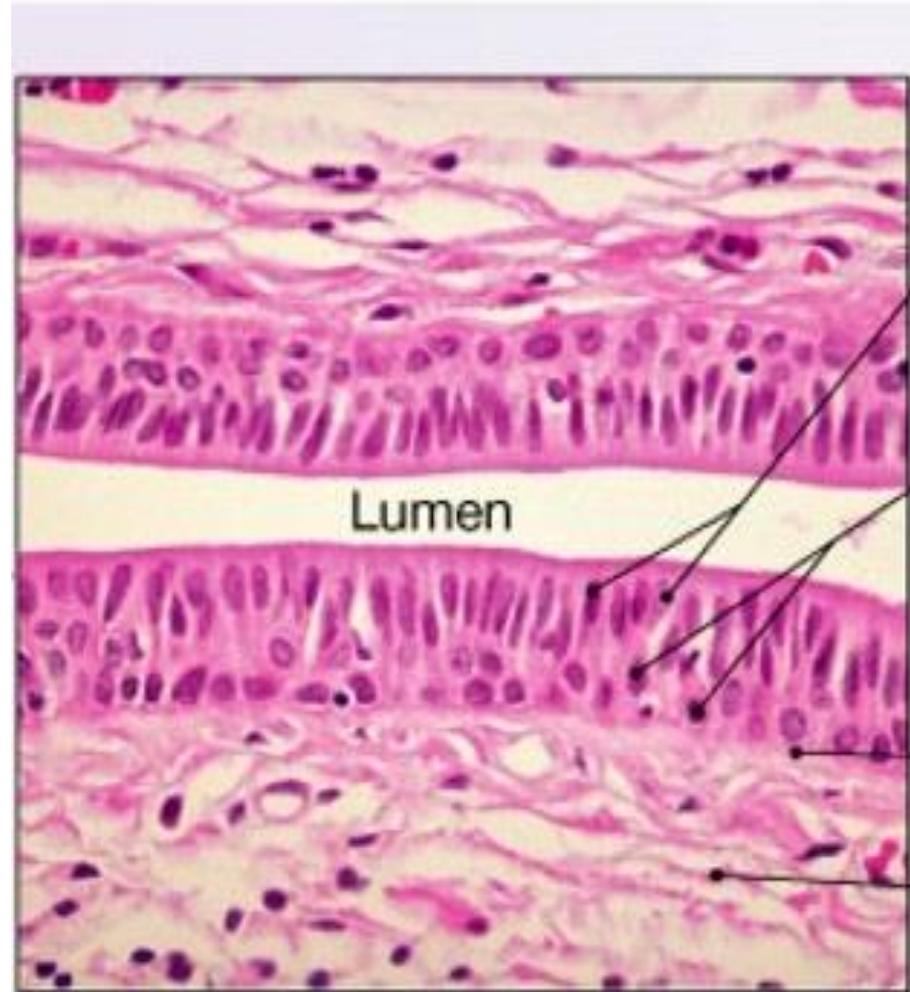


Stratified Columnar Epithelium (Rare)

Site :

- ❑ Ciliated: penile urethra
- ❑ Non ciliated: conjunctival fornix

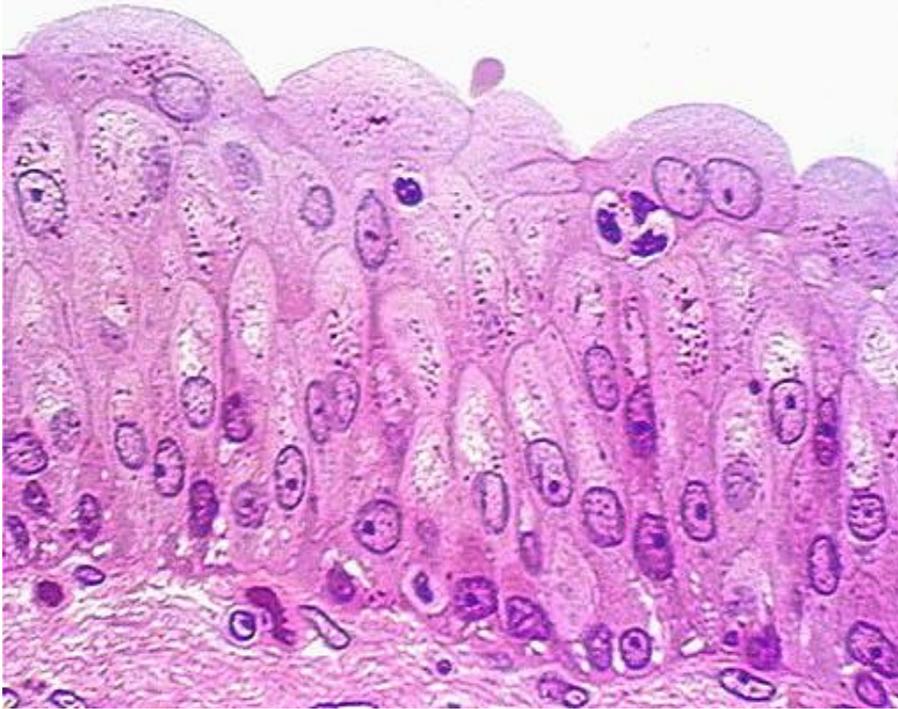
Function : protection



Transitional epithelium

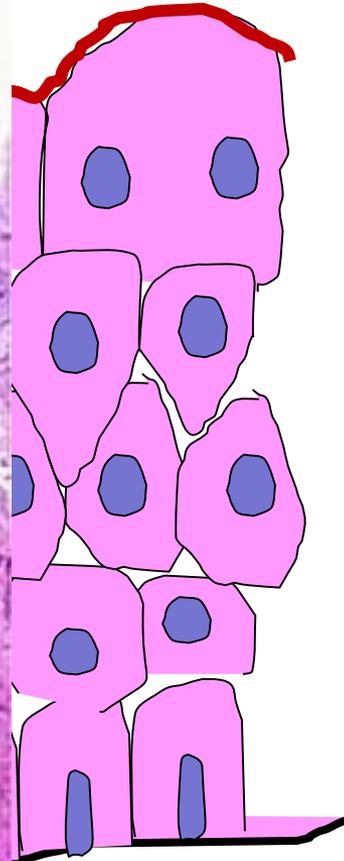
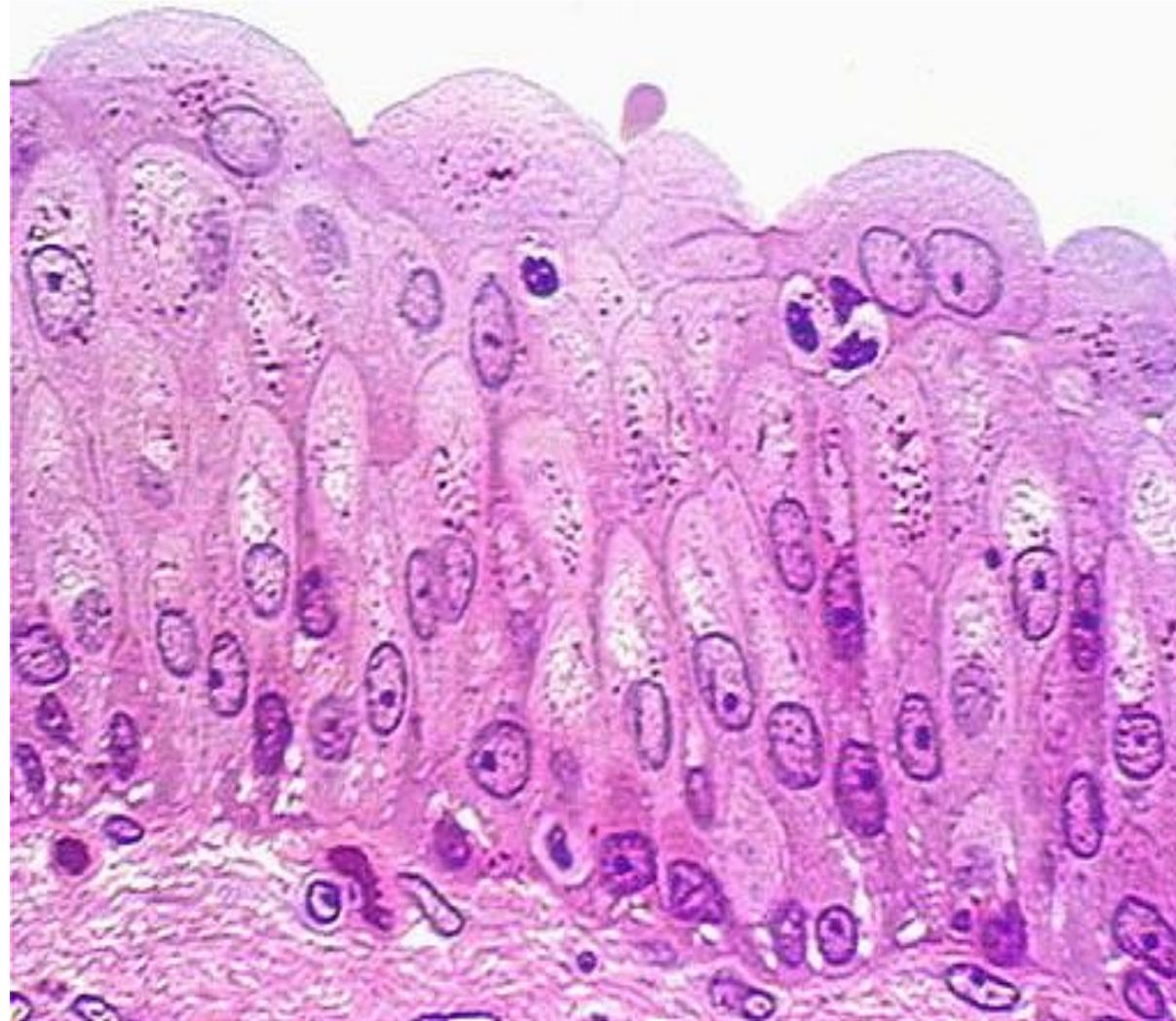
Site : urinary bladder, ureter

Function : protection



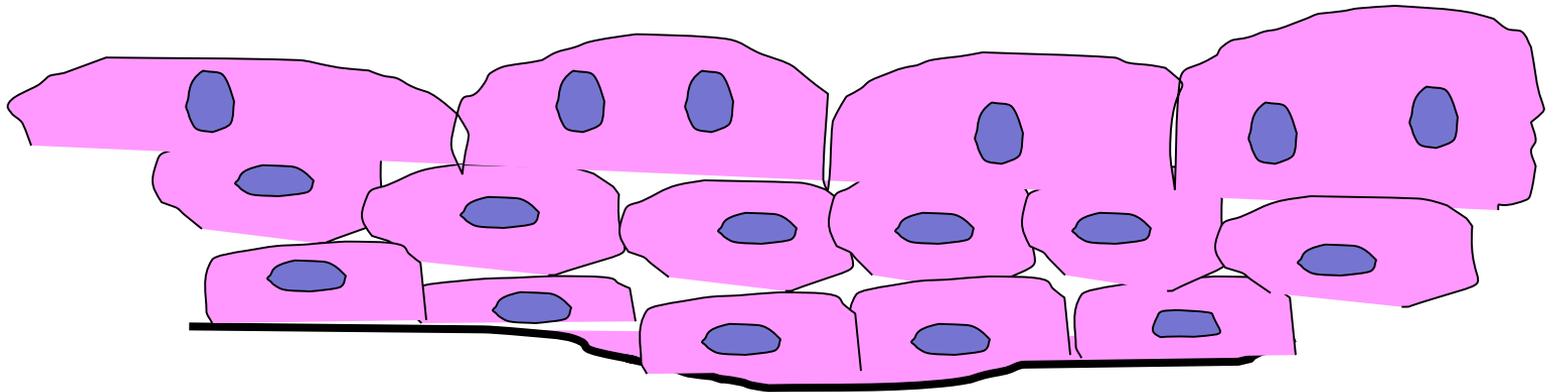
Transitional Epithelium

Empty urinary bladder



Transitional Epithelium

Full urinary bladder



Transitional epithelium

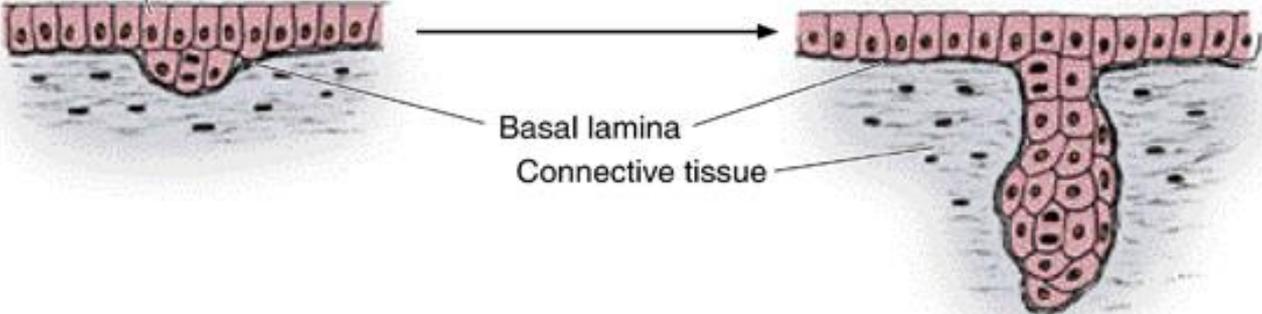
Adaptation of Transitional epithelium to its function:

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

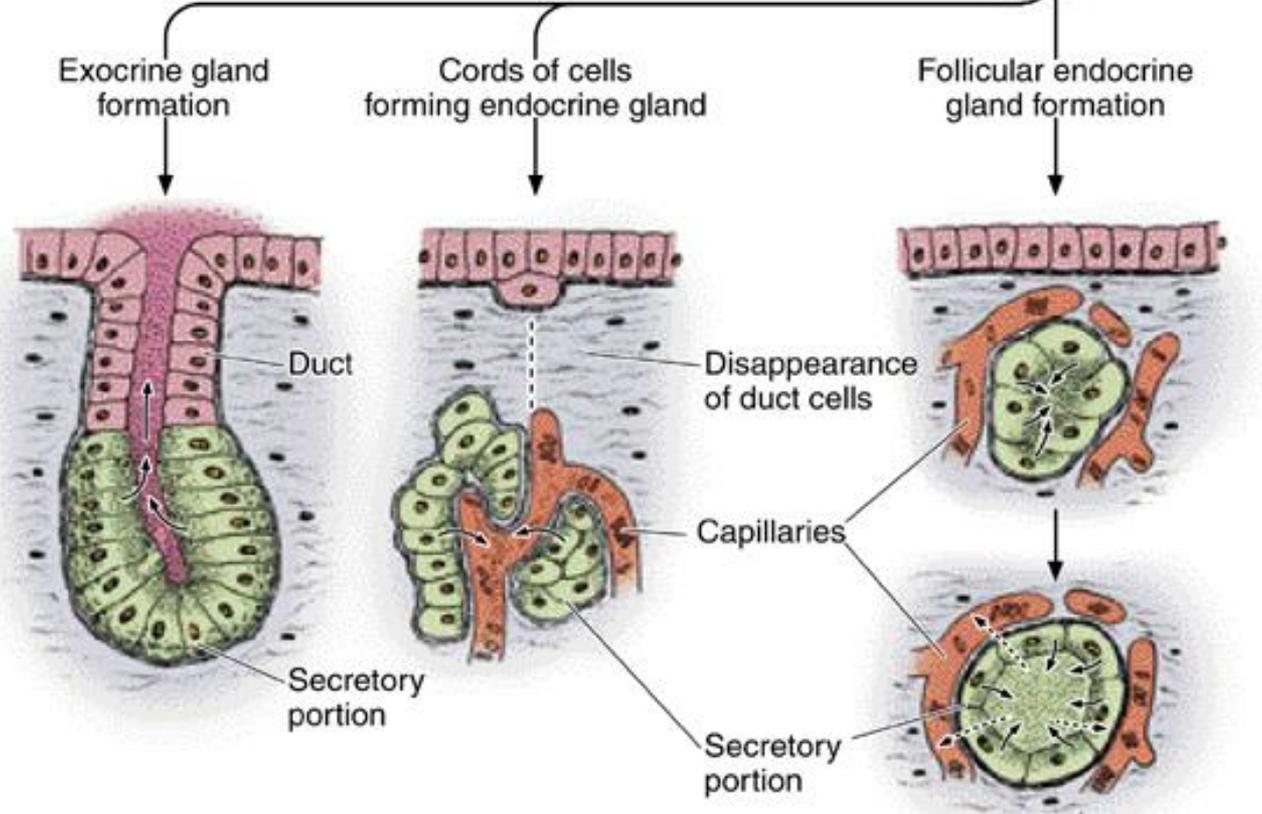
Type of epithelium	Site	Function
Stratified squamous Non Keratinized	<input type="checkbox"/> Oesophagus- vagina	Physical protection
Stratified squamous Keratinized	<input type="checkbox"/> skin	Physical protection
Stratified cuboidal	<input type="checkbox"/> Ducts of sweat glands	secretion (rare)
Stratified Columnar	<input type="checkbox"/> - ciliated: penile urethra <input type="checkbox"/> - Non ciliated: conjunctival fornix	Protection (rare)
Transitional	<input type="checkbox"/> urinary bladder	protection

Glandular Epithelium

Origin



differentiation

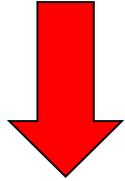


Types of glandular epithelium

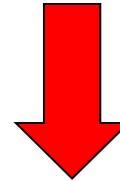
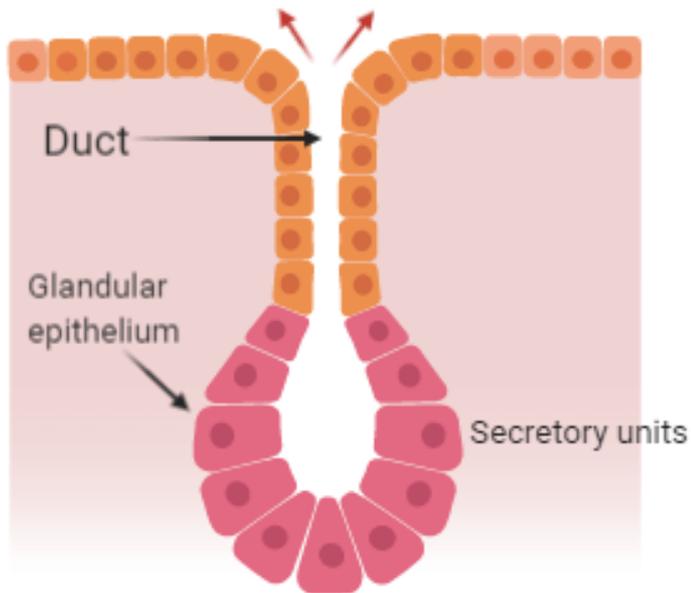
It is classified according to:

1. Presence or absence of a duct system (**exocrine** ---endocrine)
2. Number of cells
3. Mode of secretion (mechanism)
4. Nature of secretion
5. Shape of the secretory portion
6. Branching of duct

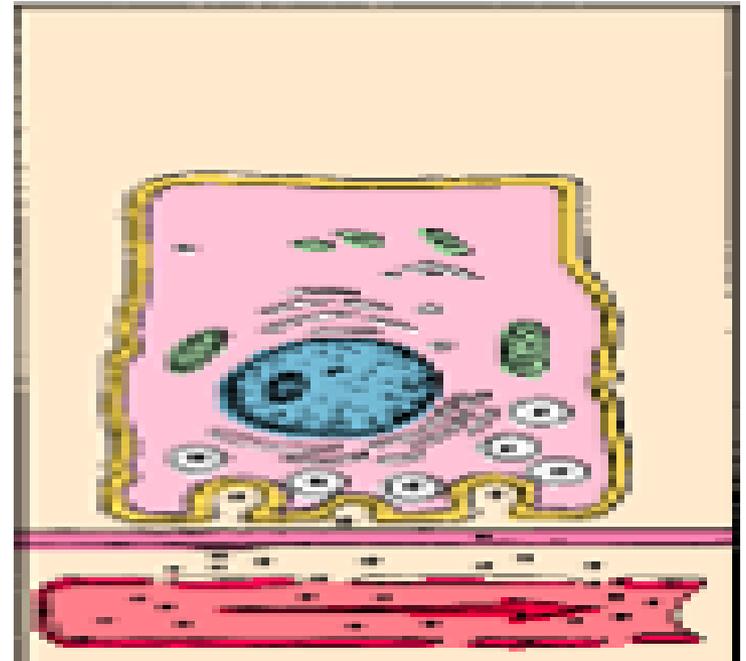
Presence of a duct system



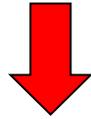
Exocrine = duct



Endocrine = blood

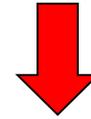


Number of cells



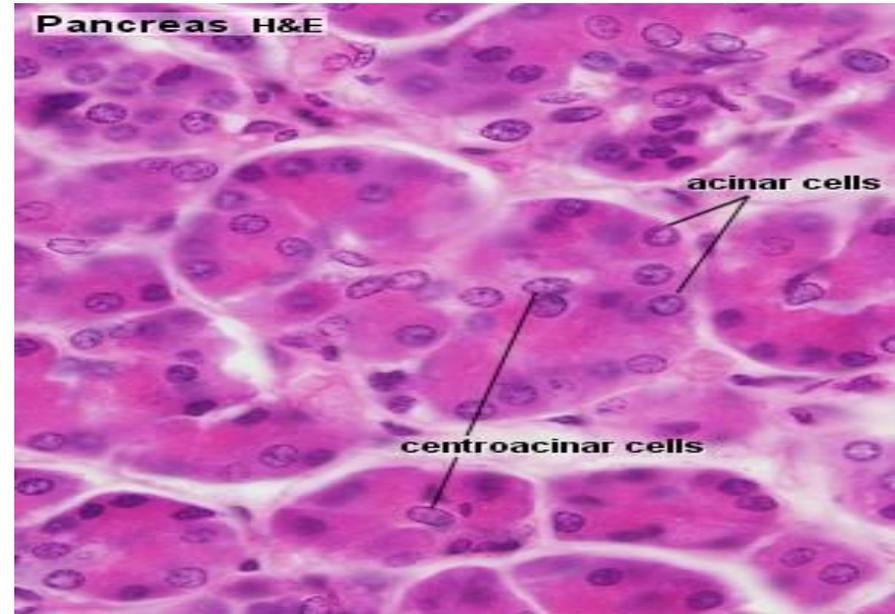
Unicellular

goblet cell



Multicellular

Most of the glands
e.g. Salivary glands)



Mechanism = Mode of secretions

❑ Merocrine glands

The secretion released through exocytosis

e.g. Pancreas

❑ Apocrine glands

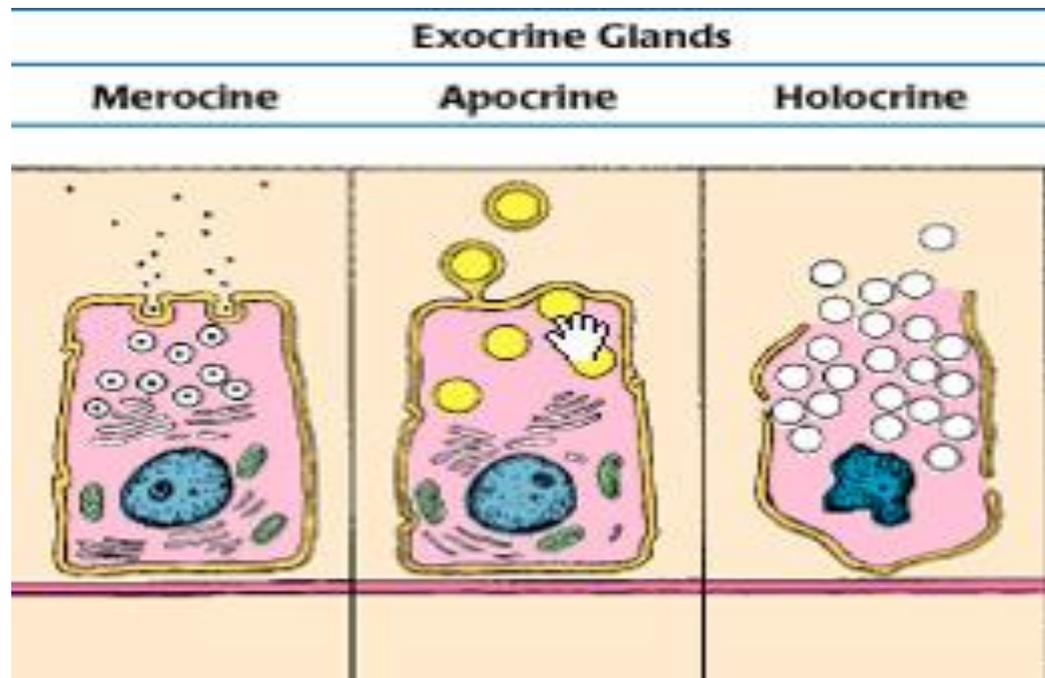
The secretion involves the loss of both product and apical cytoplasm e. g.

Mammary glands

❑ Holocrine gland

The secretion destroys the cell

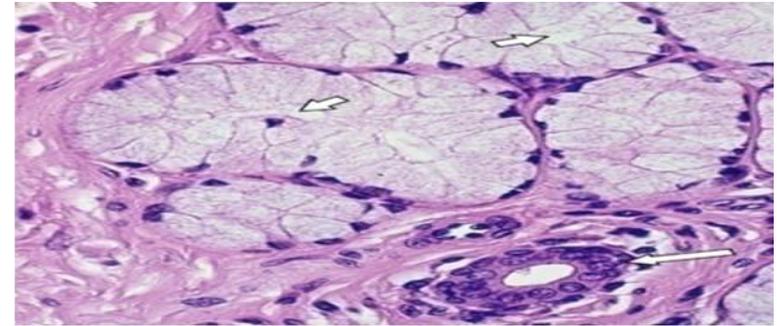
e.g. Sebaceous glands



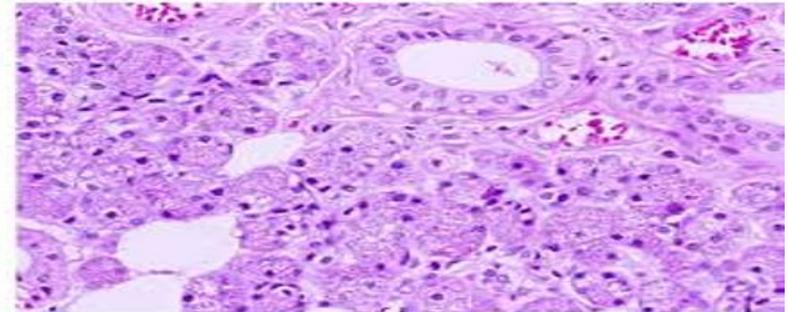
Nature of Glandular secretions

- ❑ Mucous glands: sublingual gland
- ❑ Serous glands: parotid gland
- ❑ Mixed glands: submandibular gland
- ❑ Glands with special secretion:
 - Oily secretion = sebaceous gland
 - watery secretion = lacrimal gland
 - Milk secretion = mammary gland
 - wax = glands in the ear

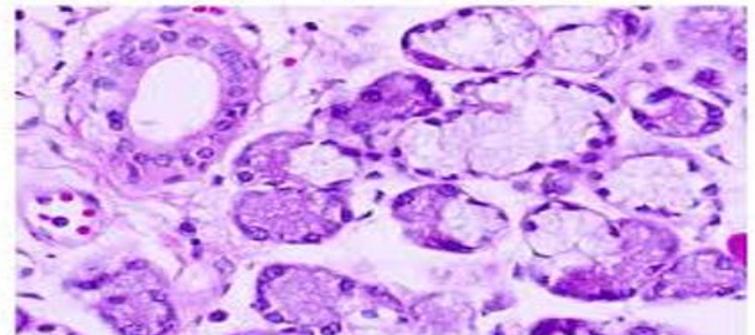
Sublingual



Parotid Gland

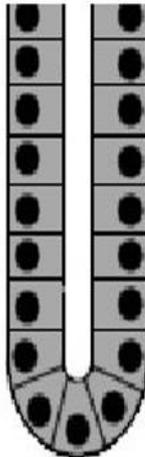


Submandibular Gland

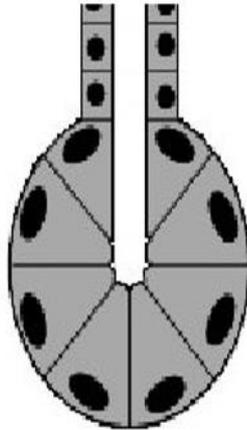


Shape of secretory portion

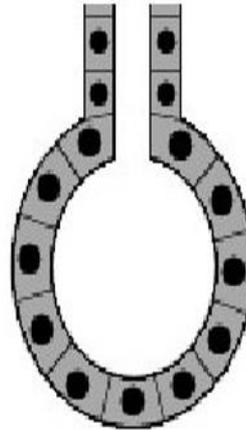
tubular



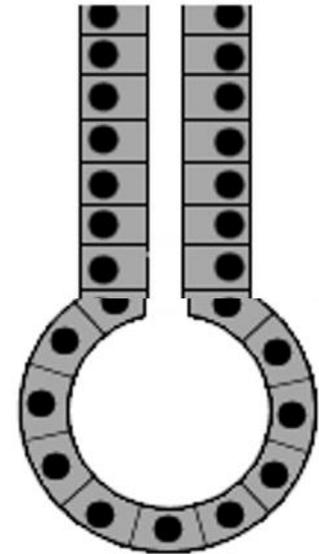
acinar



alveolar



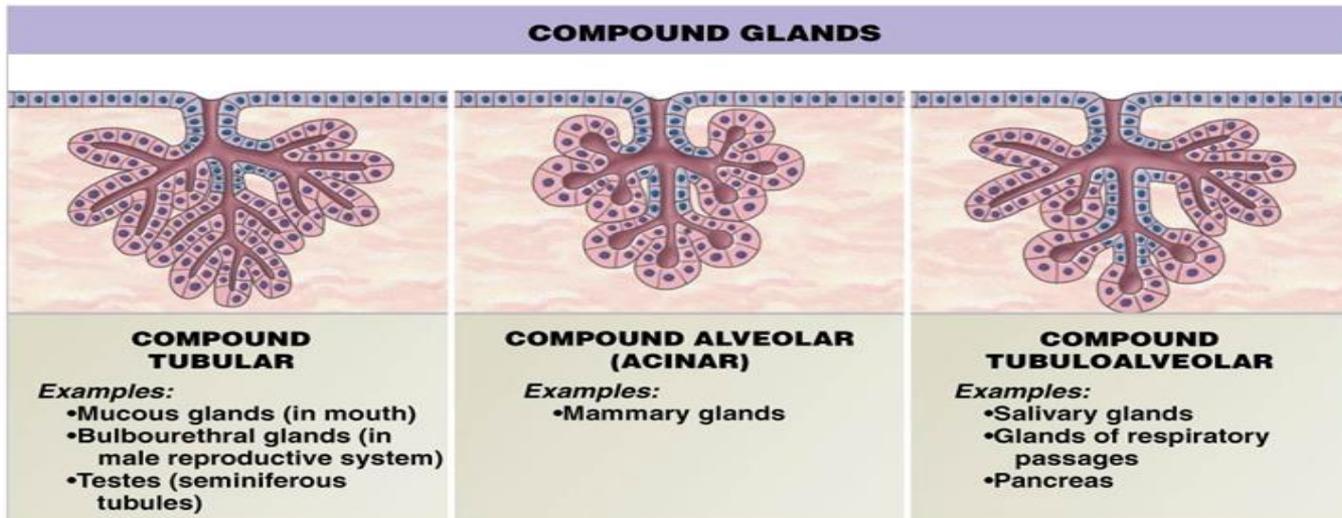
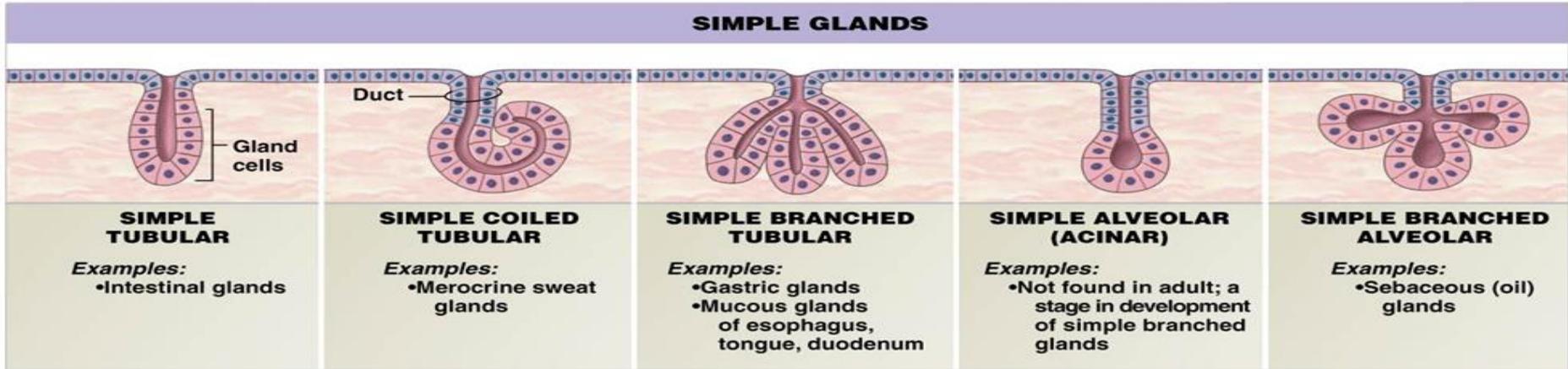
tubulo-alveolar



glands

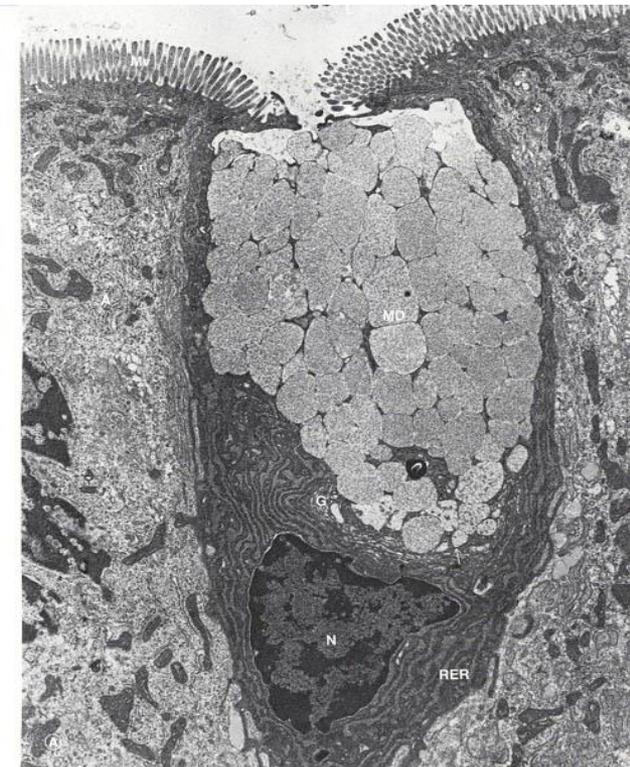
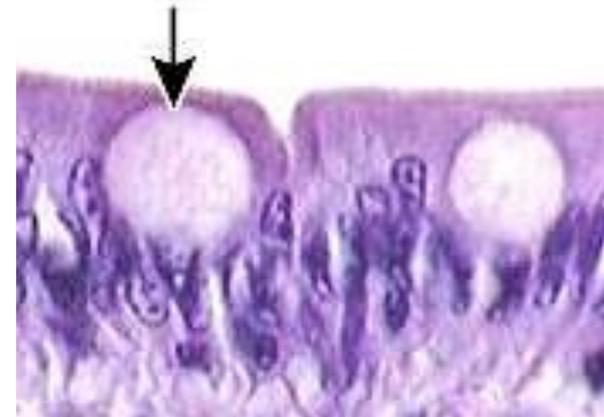
Classification according to branching of duct

- Simple = one duct + secretory unit
- Compound = branched duct + branched secretory unit



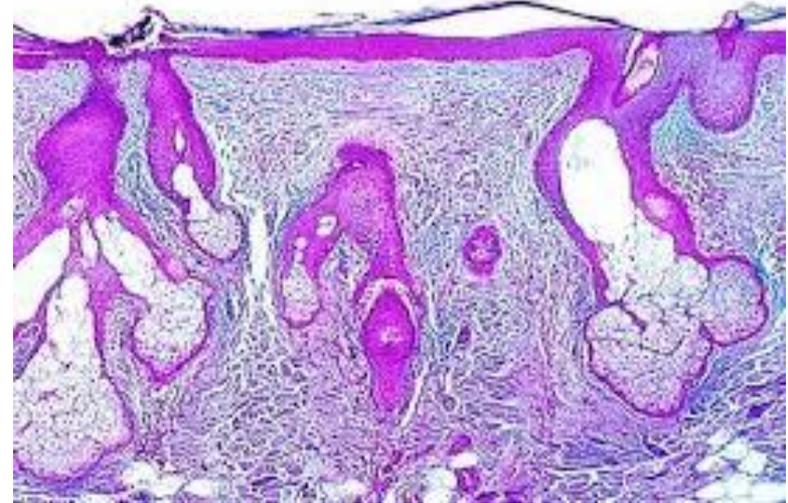
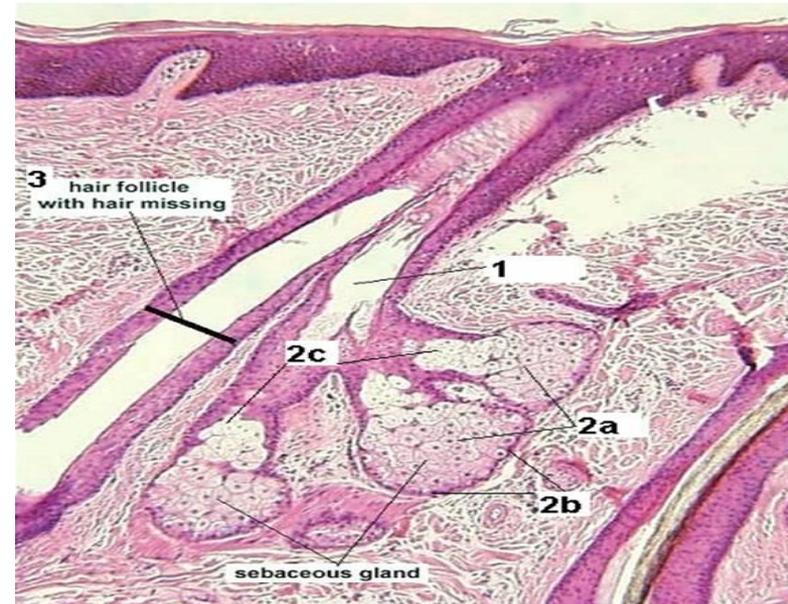
Goblet cells

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



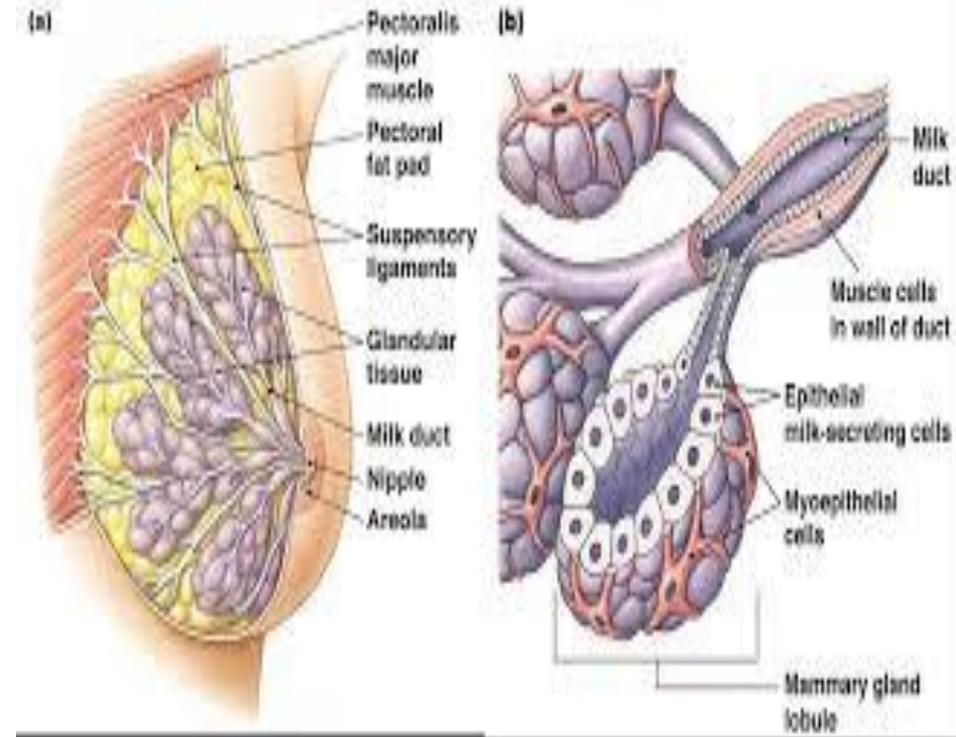
Sebaceous gland

- Exocrine
- Multicellular
- Shape of secretory units : Branched alveolar
- **Mode** of secretion : Holocrine
- **Nature** of secretion :(oily secretion)
- 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
- Multicellular
- Shape of secretory units :
Compound alveolar
- **Mode** of secretion : Apocrine
- **Nature** of secretion (milk secretion)



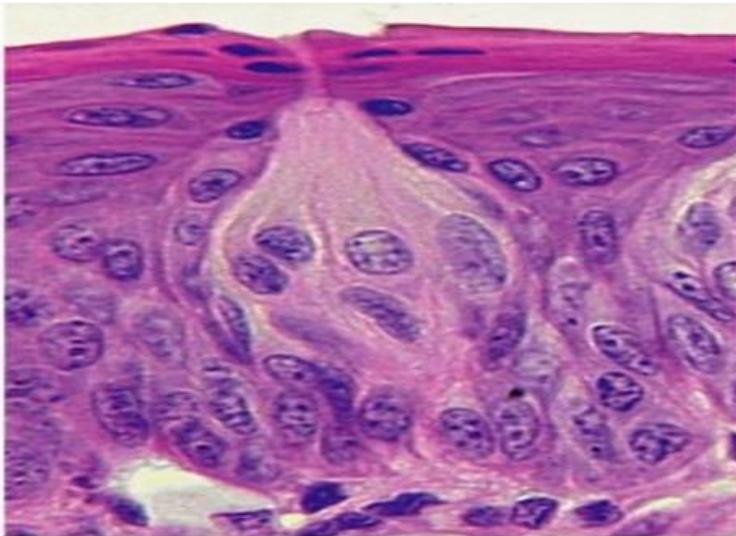
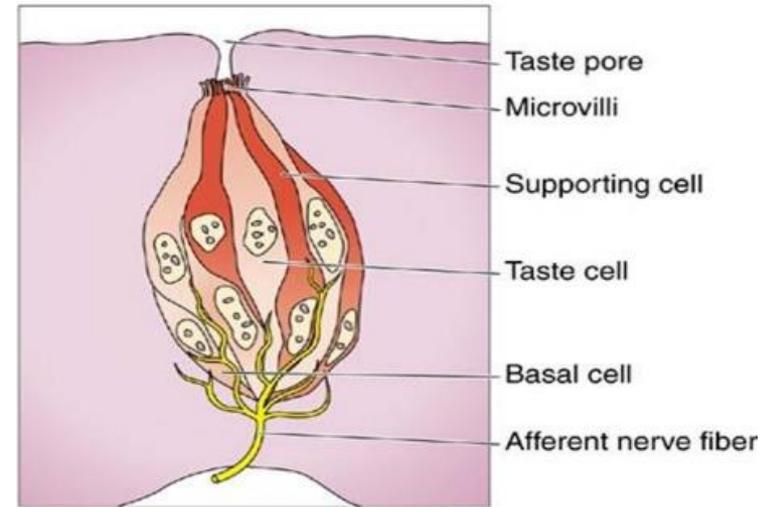
Special types of epithelium

1-Neuro-epithelium

E.g. Taste buds

Site : dorsal surface of the tongue

Function : sensation

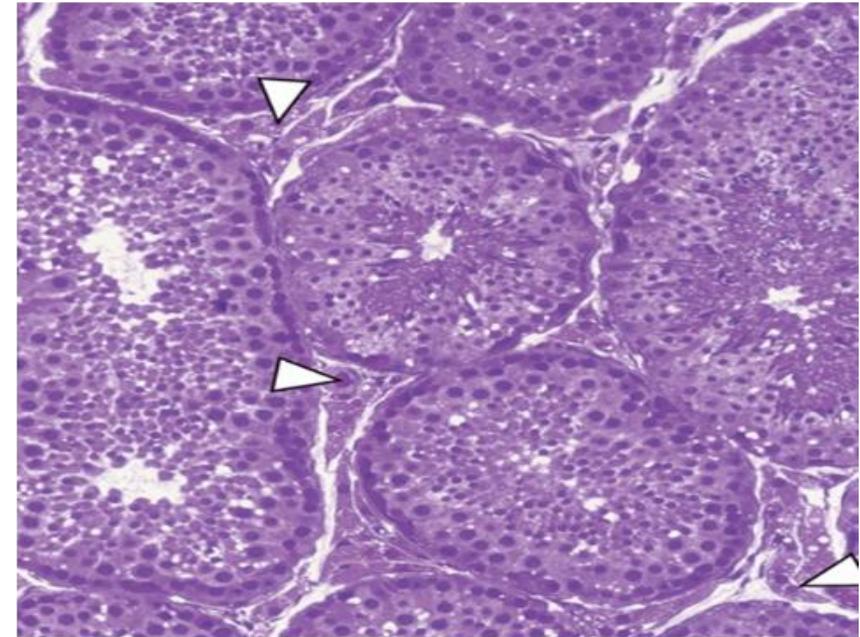
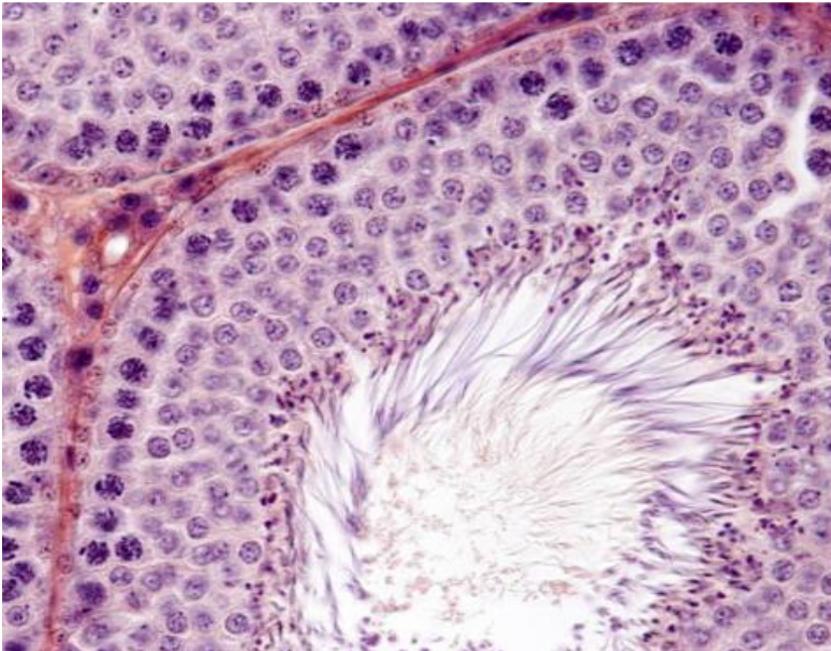
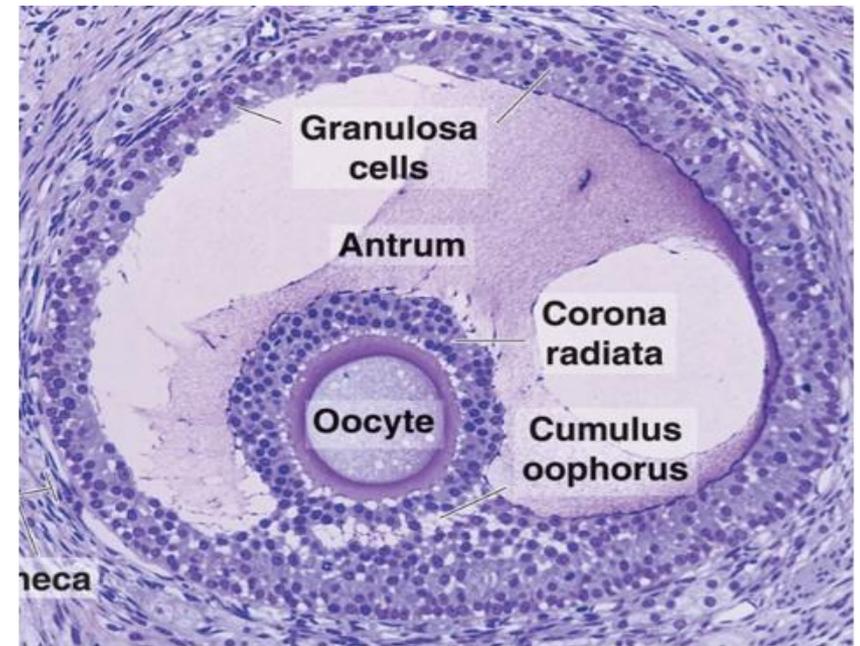


2. Germinal epithelium

Ovary: ovum

Testis: sperm

Function: : Reproduction



3- Myo-epithelium

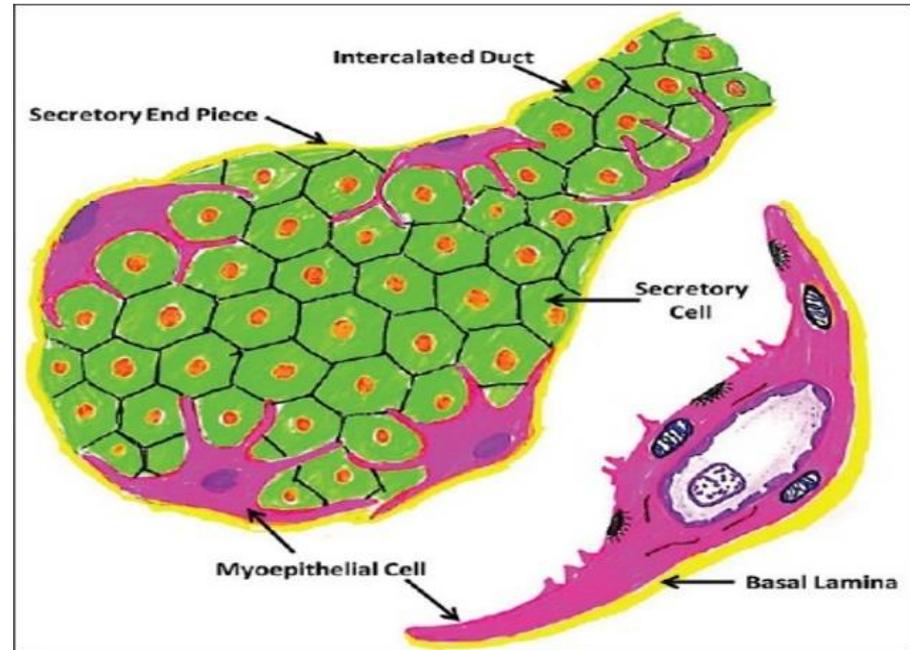
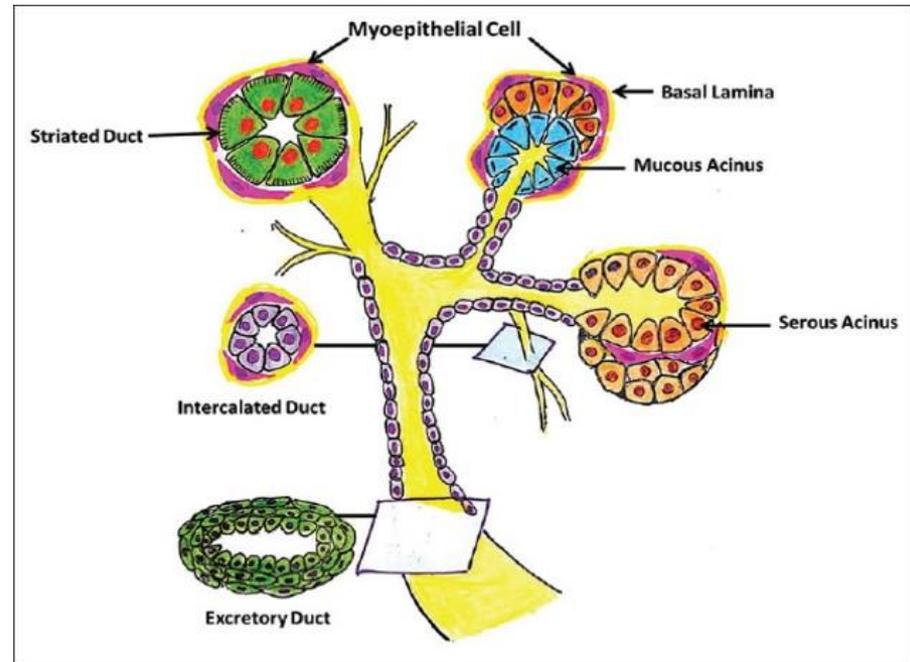
Shape : Irregular with many processes

Contain actin & myosin in the cytoplasm

Site : Acini & ducts of the gland

Function :

Contraction for squeezing the secretion



Functions of epithelium

- **Protection**, protect underlying tissues from mechanical injury, harmful chemicals, invading bacteria and from excessive loss of water.
- **Absorption**: certain epithelial cells lining the intestine absorb nutrients from the digestion of food.
- **Secretion**, in glands, epithelial tissue is specialised to secrete specific chemical substances such as enzymes, hormones and lubricating fluids.
- **Excretion**, epithelial tissues in the kidney excrete waste products from the body and reabsorb needed materials from the urine. Sweat is also excreted from the body by epithelial cells in the sweat glands.
- **Sensation**: sensory stimuli are detected by specialized epithelial cells; specialized epithelial tissue containing sensory nerve endings is found in the skin, eyes, ears and nose and on the tongue.
- **Diffusion**, simple epithelium promotes the diffusion of gases, liquids and nutrients; because they form such a thin lining, they are ideal for the diffusion of gases (e.g. walls of capillaries and lungs).
- **Contraction** e.g., myoepithelial cells have ability to contract.
- **Cleaning**: ciliated epithelium assists in removing dust particles and foreign bodies which have entered the air passages.

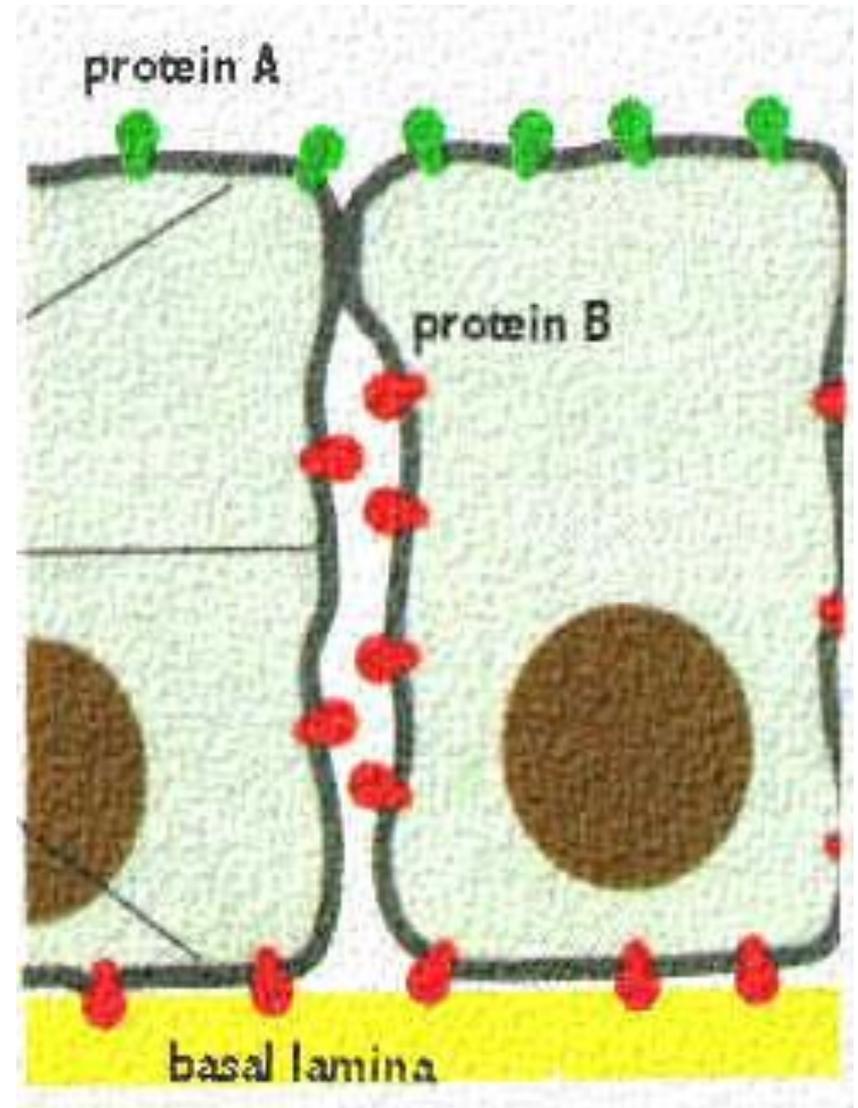
Epithelial polarity

- Cells have a top , lateral and a basal sides
- So different activities take place at different places

❑ Apical modifications

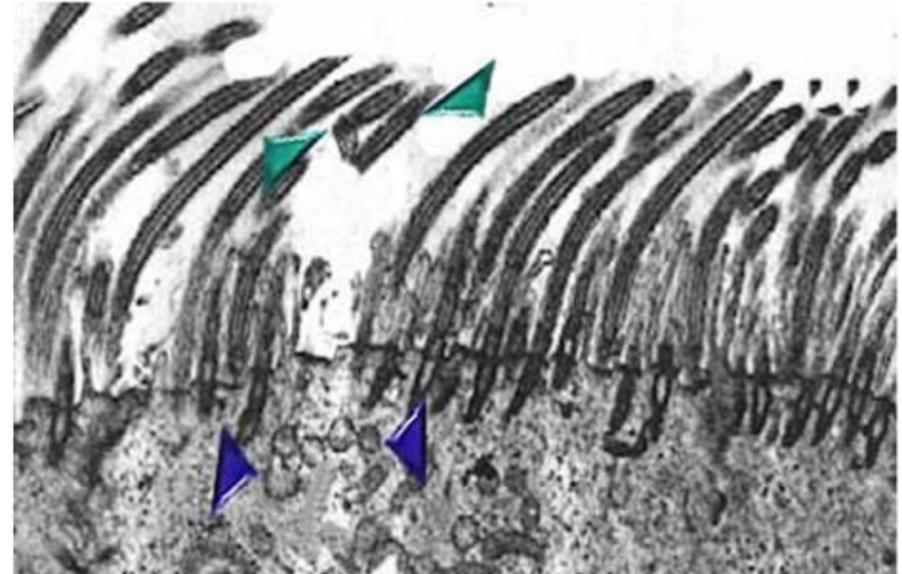
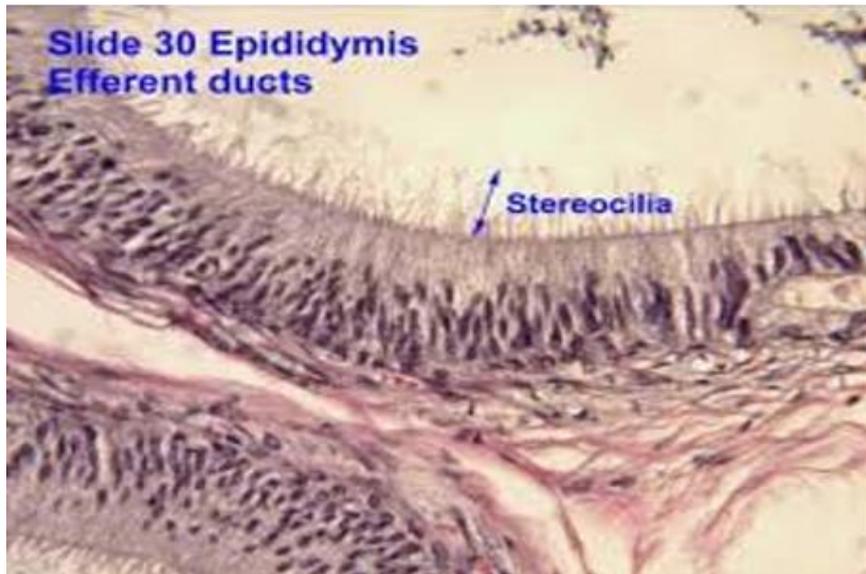
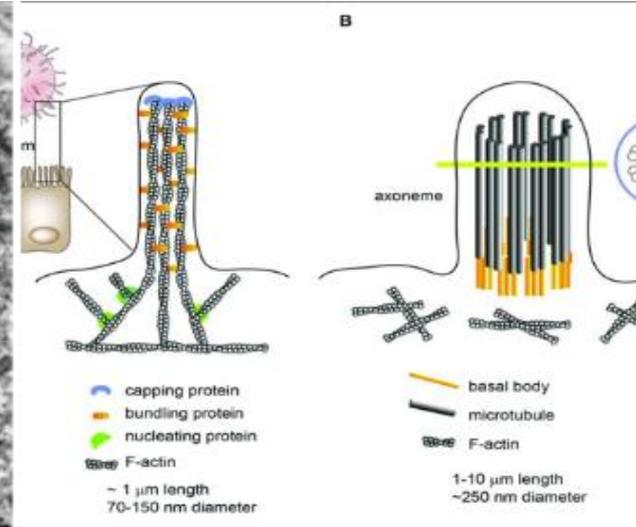
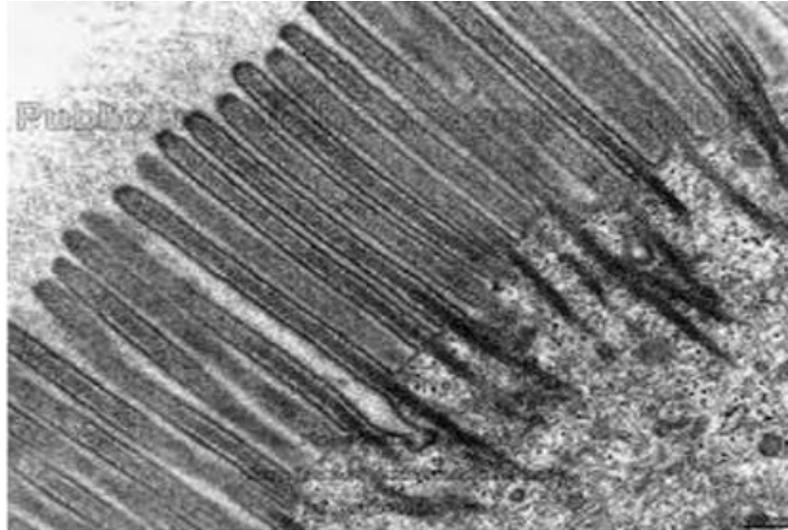
❑ Lateral modifications

❑ Basal modifications



Apical modifications

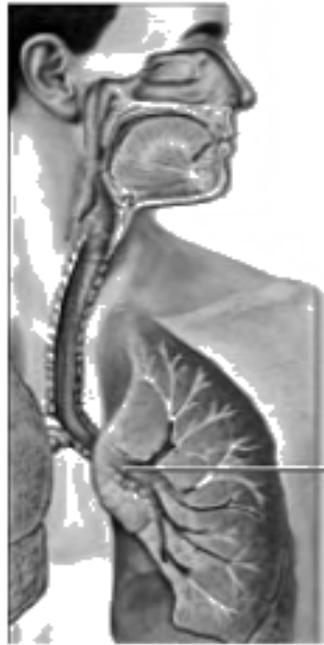
- Cilia
- Microvilli
- Stereocilia



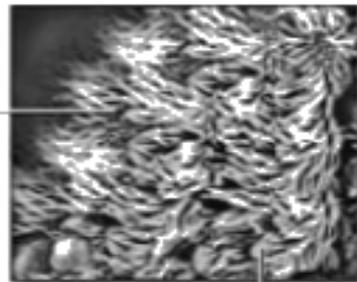
Cilia vs Microvilli

Cilia

Hair-like projections called cilia line the primary bronchus to remove microbes and debris from the interior of the lungs



Cilia

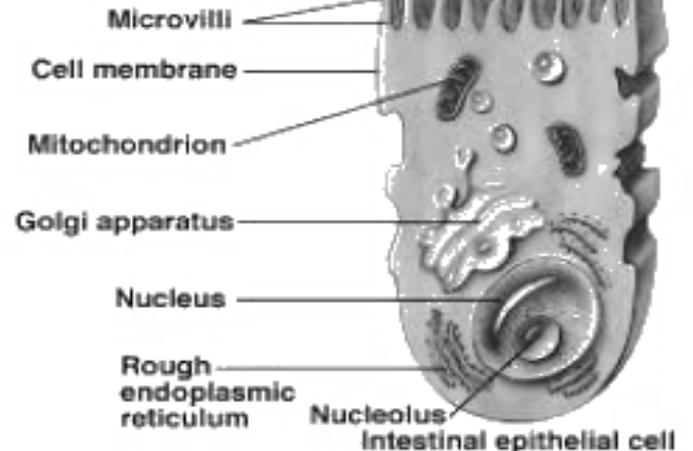


Primary bronchus

Goblet cell

Microvilli

Microvilli



Occur in cells of respiratory and reproductive tracts.

Arise from the basal granules

Motile

Cilia has 9+2 ultra structure

Found in intestine; where absorption and secretions are the major activities

Basal granules are absent

Non motile

9+2 ultra structure absent

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:**

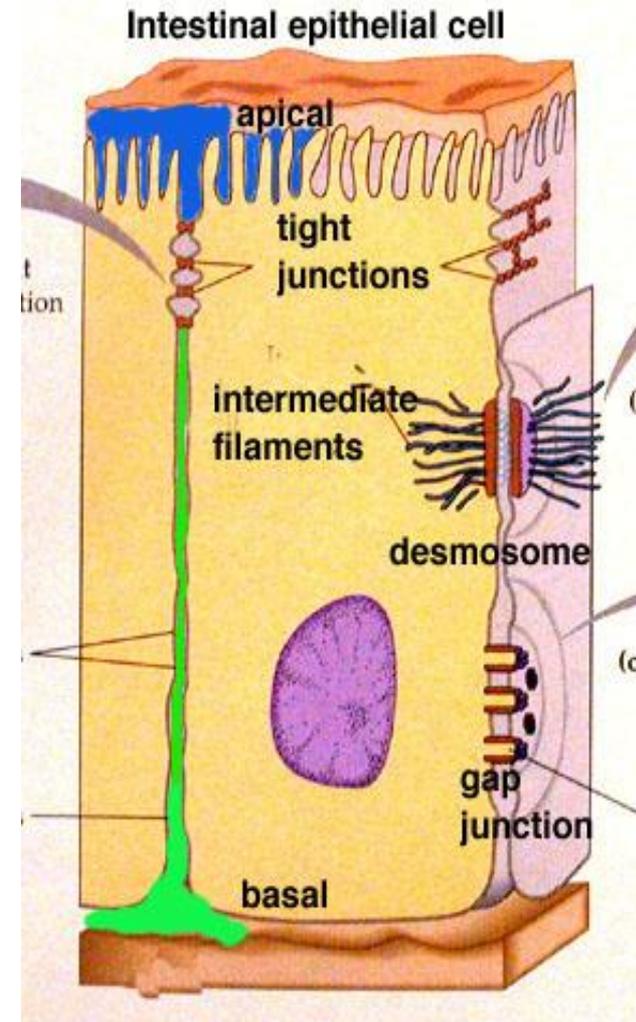
- **Macula adherens = desmosomes:**

3- Communicating junctions: (**Gap**) allow

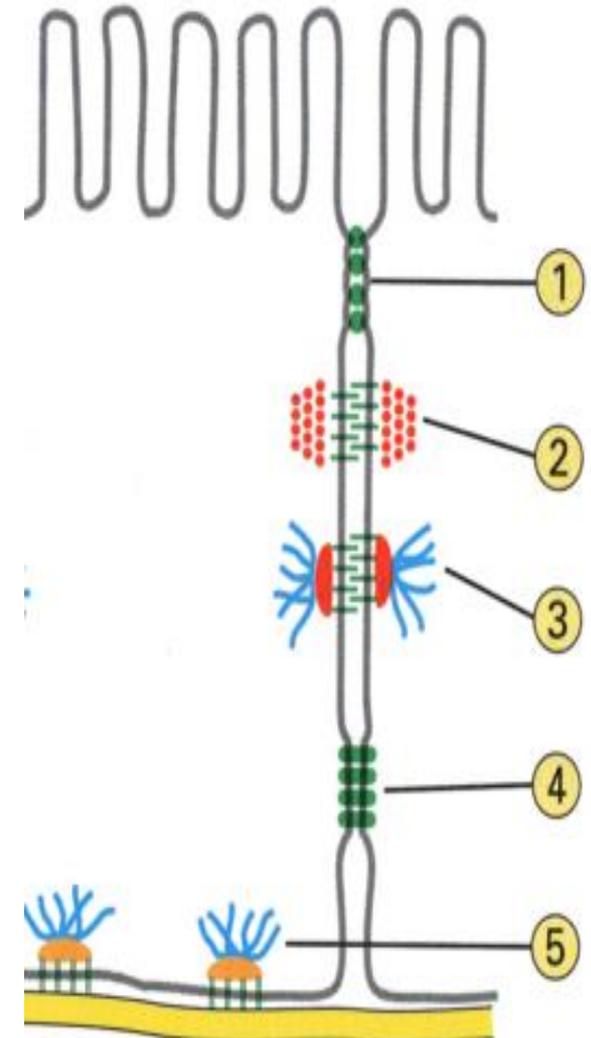
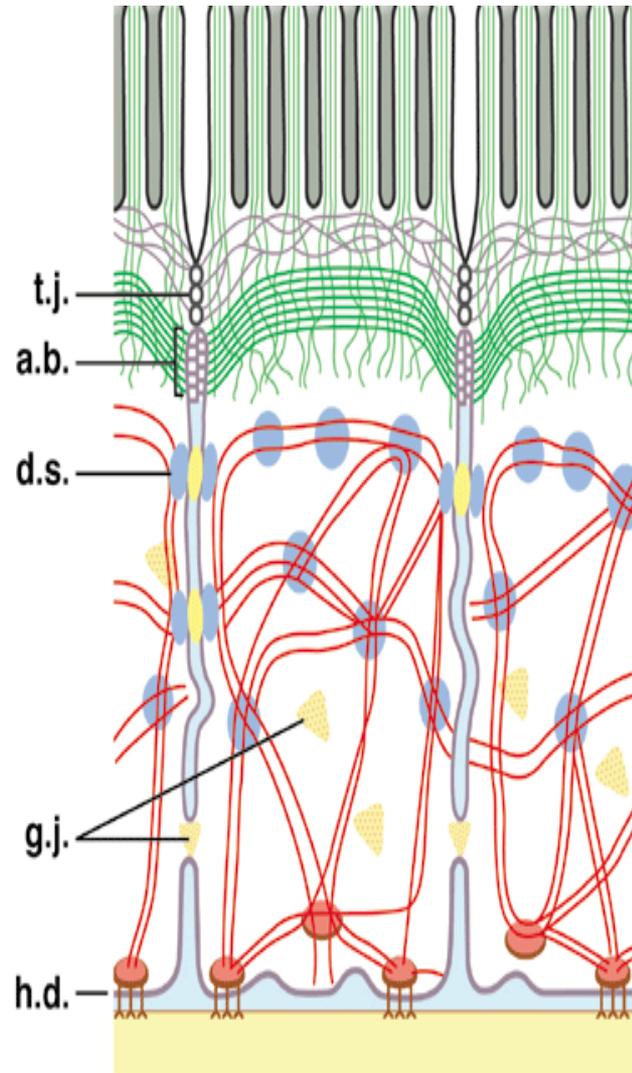
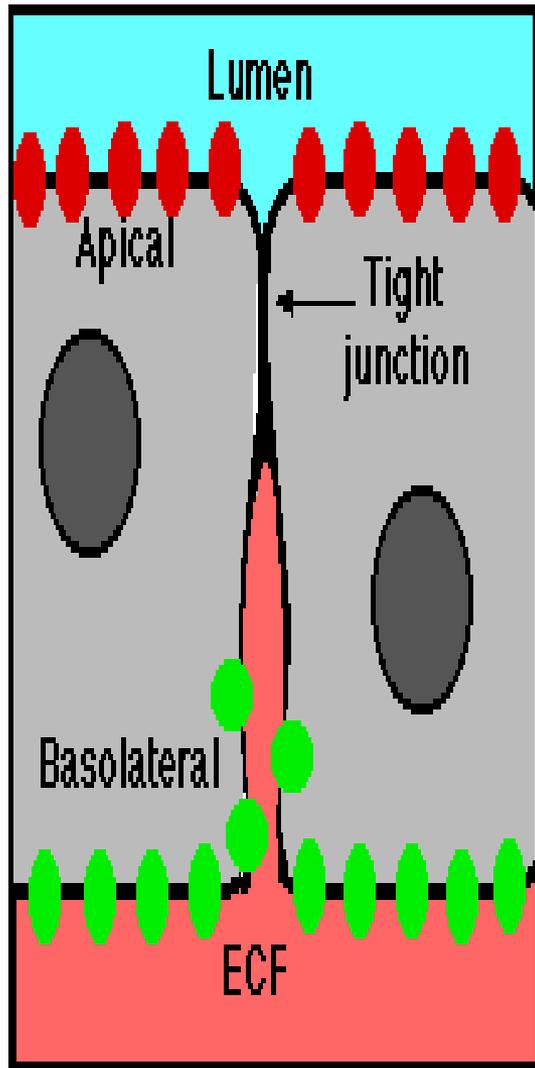
movement of molecules between cells

It permits the exchange of molecules e.g. ions, amino acids allowing integration, communication and coordination between cells

It is found mainly in cardiac and smooth muscle cells

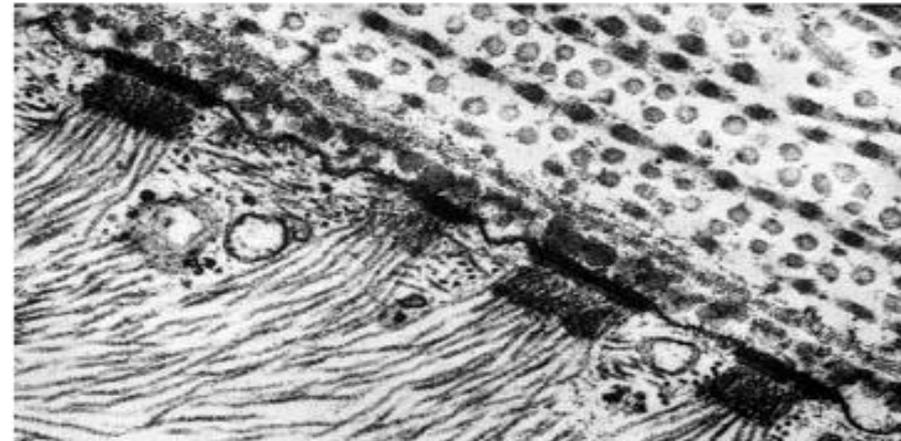
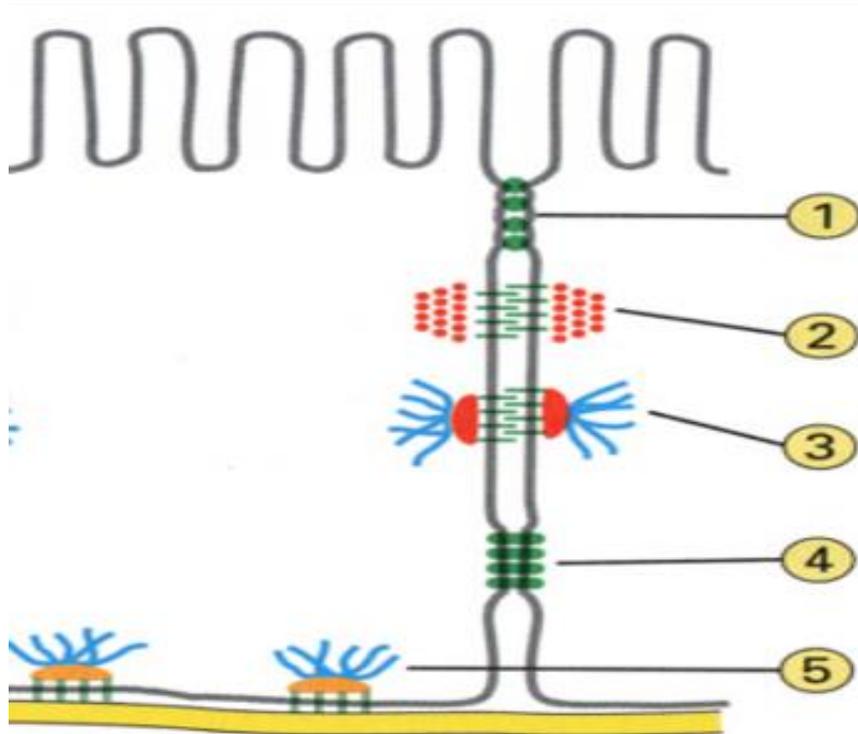
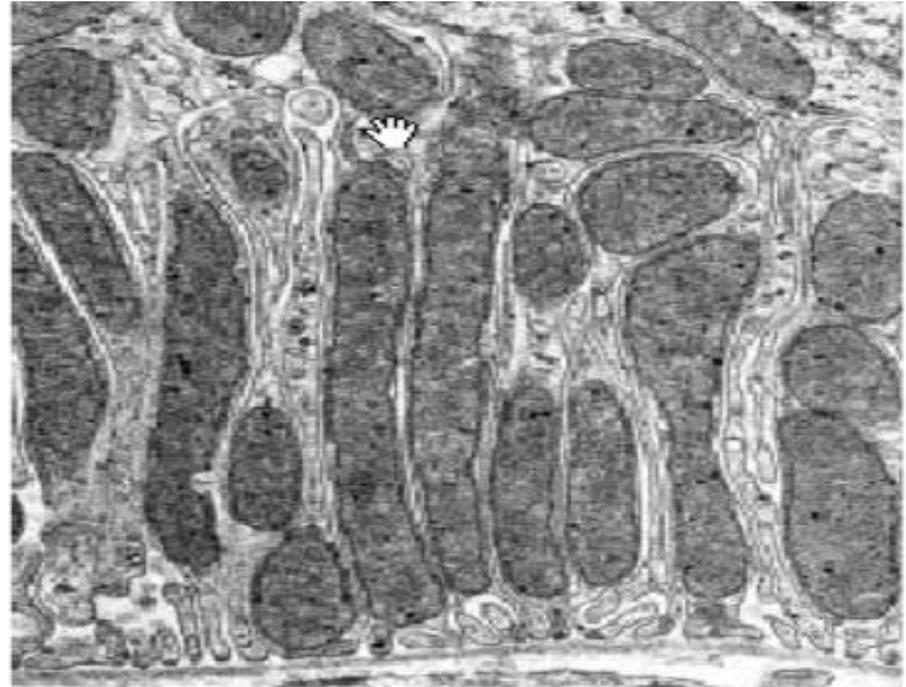


Intercellular junctions



Basal modifications

- Basal infolding
- Hemidesmosome
- Basement membrane

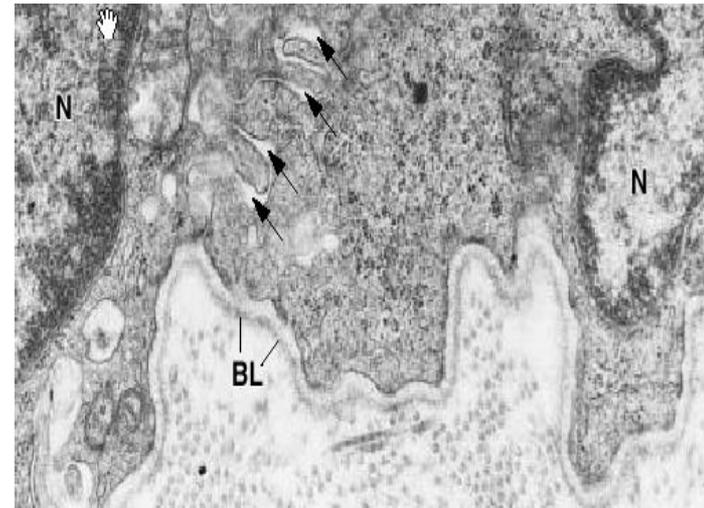
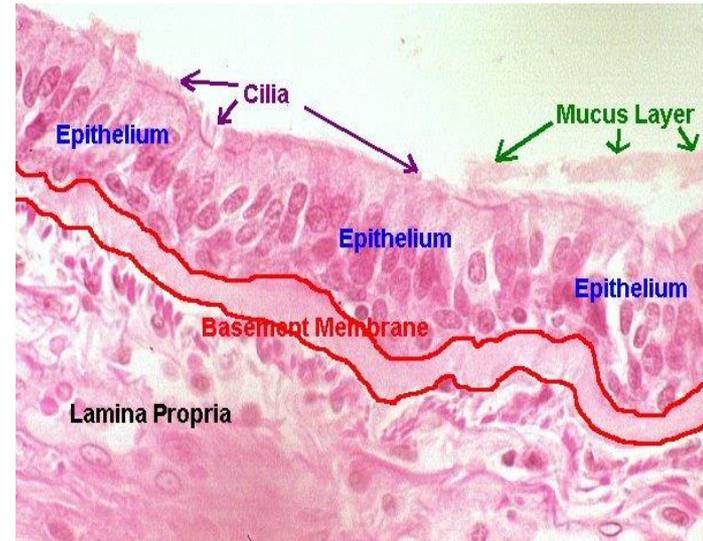


Basement membrane

- 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



Basal lamina. Basement membrane

The basal lamina connects the epithelium and subjacent connective tissue.

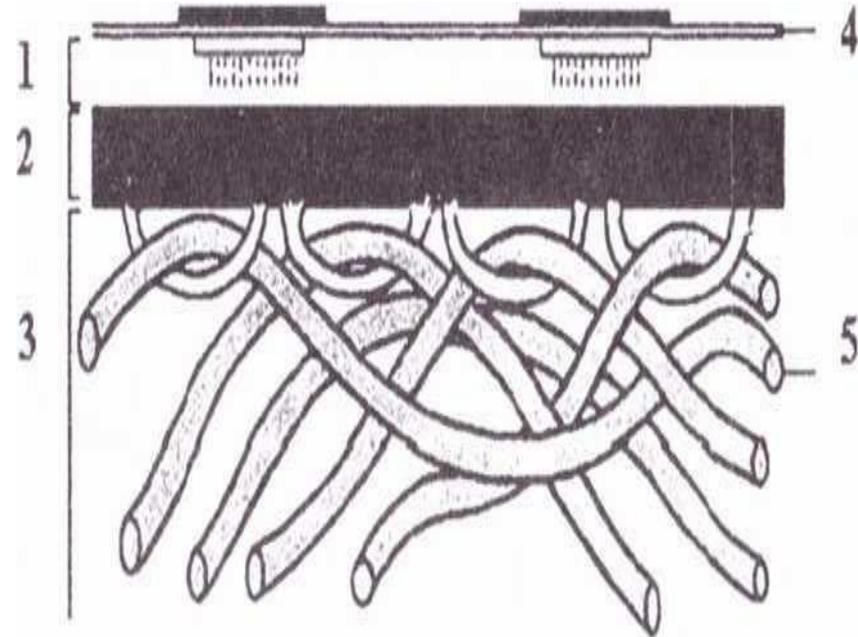
With electron microscope the basal lamina consists of 2 layers:

- inner lamina **lucida** (thin layer of glycoprotein)
- Outer lamina **densa** (thick network of collagen fibrils).

Outside the basal lamina is associated with the reticular lamina it consists of delicate reticular fibers.

Schematic diagram of the basement membrane.

- 1 - lamina lucida,
- 2- lamina densa,
- 3 - reticular lamina,



CLINICAL APPLICATION

Basement Membranes and Diabetes

In untreated cases of diabetes mellitus (type 1 or type 2 diabetes), the basement membranes of the epithelial lining of capillaries thicken over time. This thickening is caused by increased amounts of glucose, present in high concentrations in diabetics, binding to the proteins of the basement membrane. This process is referred to as increased glycosylation of the basement membrane. Thickening is especially evident in the capillaries in the kidneys and retina of the eye, which can become nonfunctional. For this reason, kidney failure and blindness are major symptoms of advanced diabetes

Basement Membranes and cancer

When cancer cells penetrate the basement the cells spread and metastasis