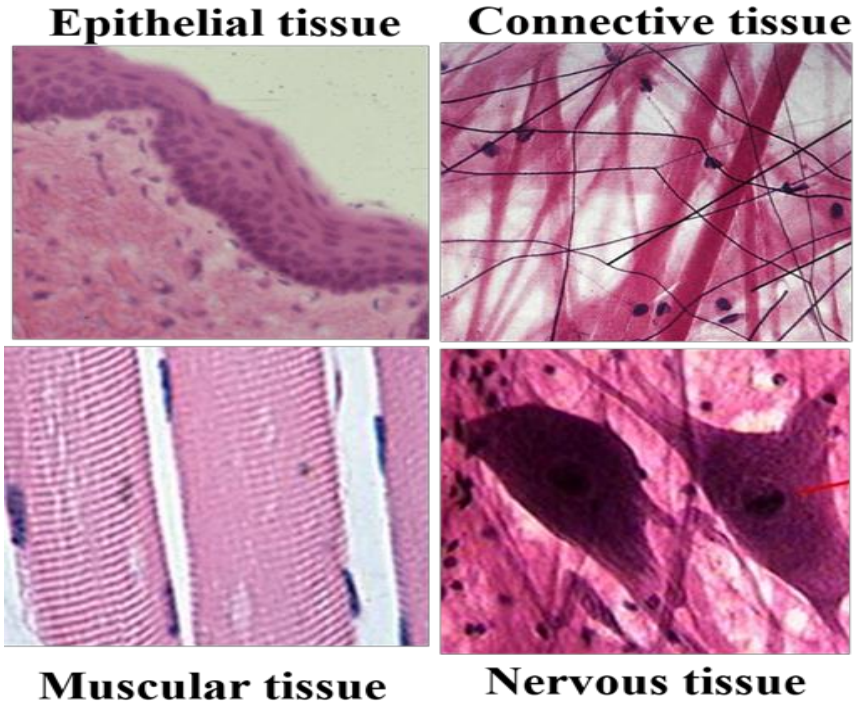
EPITHELIAL TISSUE

- Histology = the study of tissues
- Tissue = a complex of cells that have a common function
- 200 types of specialized cells in adult human body through attachments & communication are arranged into:

4 main basic tissues:

- Epithelium
- connective tissues
- Muscular tissues
- Nervous tissues



- Epithelium (epithelial tissue) **covers** body surfaces, lines body cavities, and **forms glands**.

"secretion"

- Connective tissue underlies or supports the other three basic tissues, both structurally and functionally.

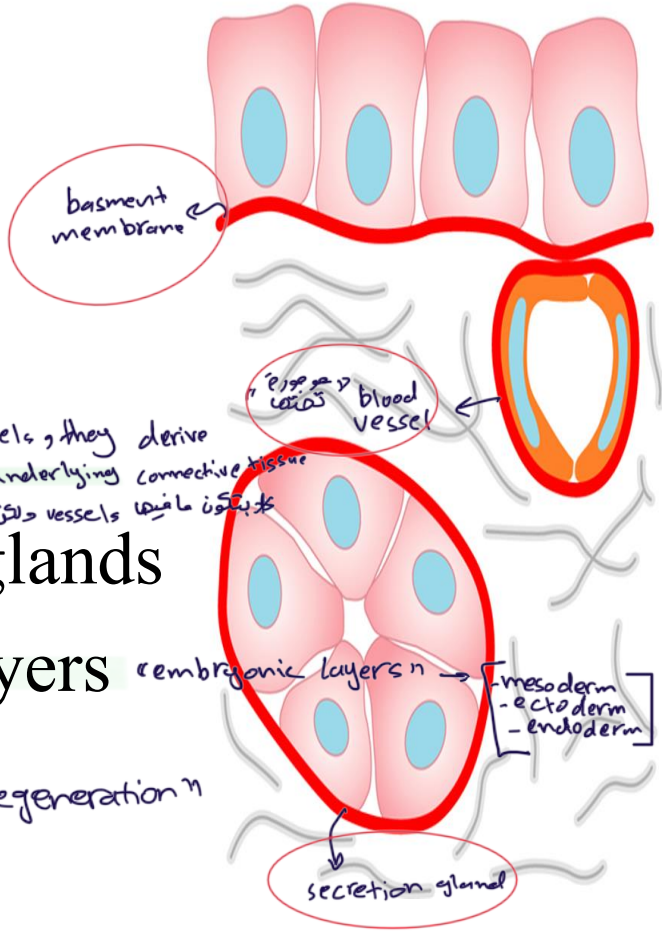
highly vascular "blood vessel"

- Muscle tissue is made up of contractile cells and is responsible for movement.

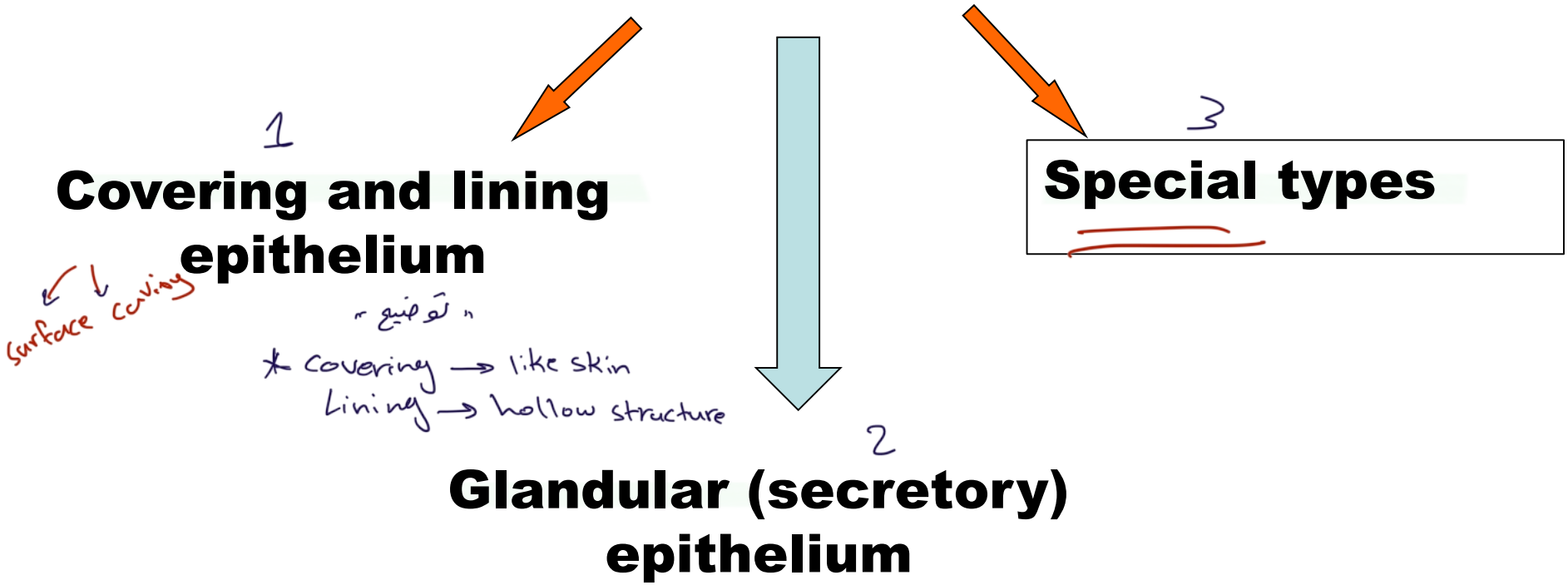
- Nerve tissue receives, transmits, and integrates information from outside and inside the body to control the activities of the body.

General features of Epithelium

1. Cells are laying close to each other
2. Little intercellular material «space»
3. Tend to form junctions
4. Rest on a basement membrane
5. Lack vessels → epithelial tissue don't have blood vessels, they derive their nutrition from the blood vessels of underlying connective tissue by diffusion. highly nerve supply
   «Avascular»
6. Line surfaces and cavities or form glands
7. Can be derivate of all three germ layers «embryonic layers» → mesoderm, ectoderm, endoderm
8. Mitotically active → «highly ability to regeneration»
9. Cells show polarity



Classification of epithelium



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

Classification of covering = lining epithelium

Number of cell layers

- ❑ **Simple**

One layer of cells

- ❑ **Stratified**

More than one layer

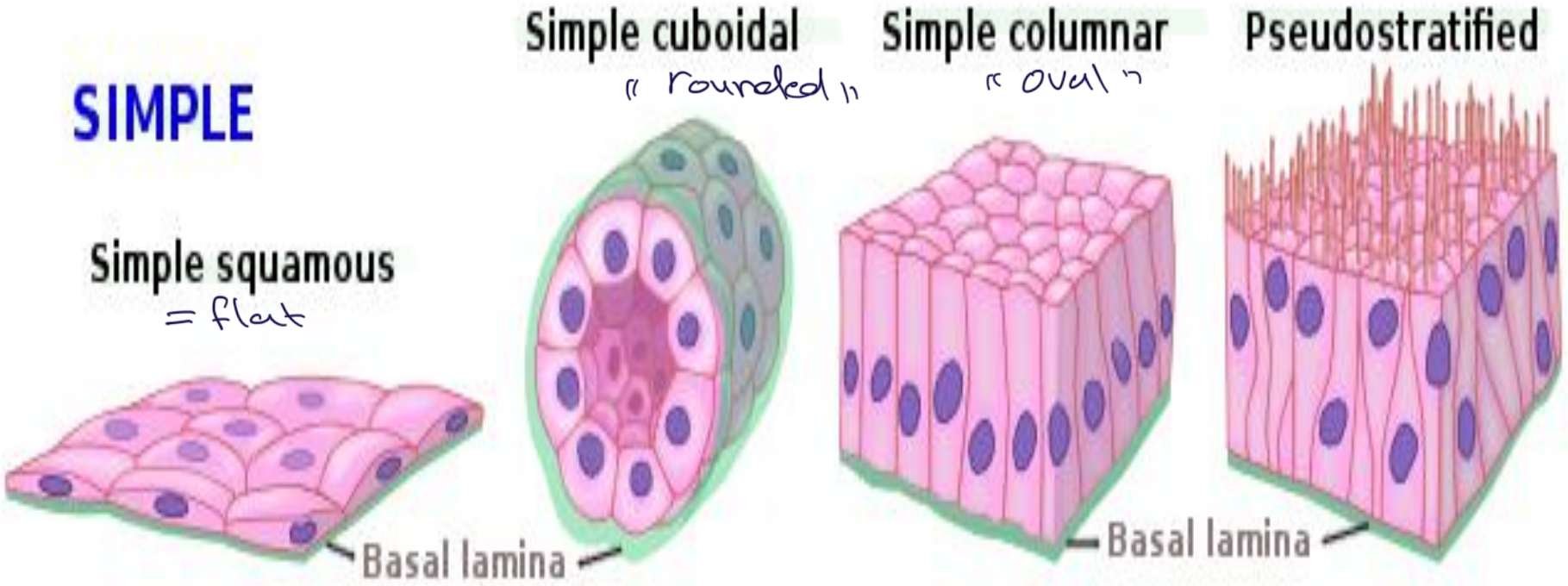
- ❑ **Pseudostratified**– one layer of cells of variable size and shape, with nuclei at a different level

Shape of cells

- ➢ Squamous
- ➢ Cuboidal
- ➢ Columnar

* we can determin the shape of the cell on the LM by shape of the nucleus.

Classification of lining epithelia

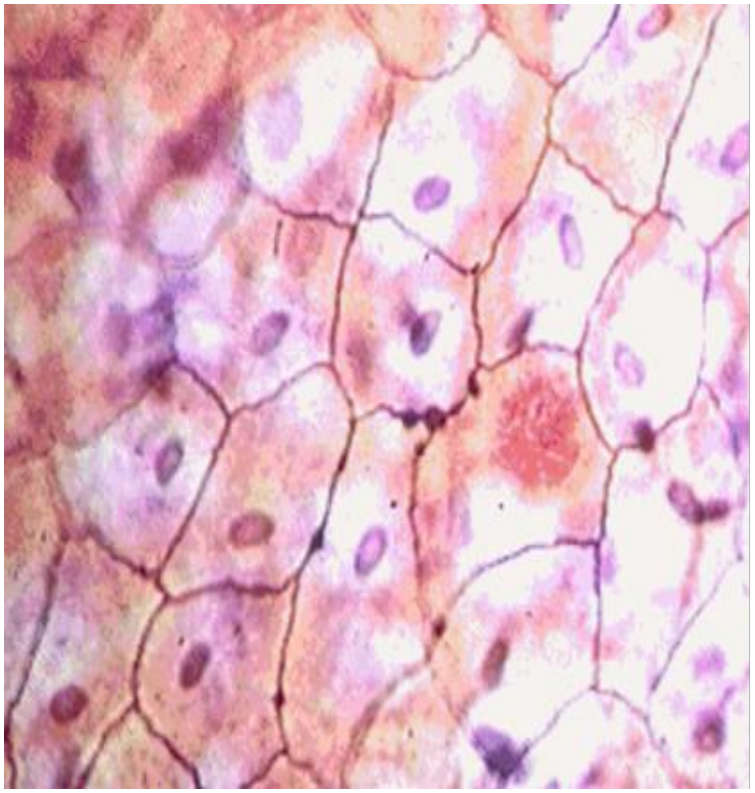


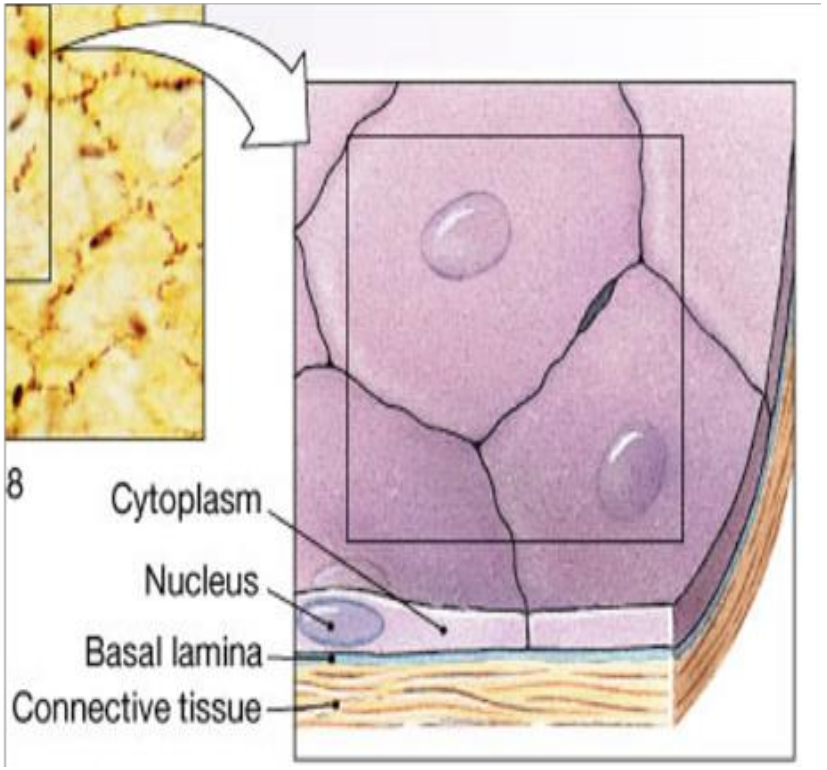
Simple Squamous Epithelium

→ very thin and smooth surface.

The width of the cell is greater than its height;

L.M





Simple Squamous Epithelium

Site : Bowman's capsule- kidney

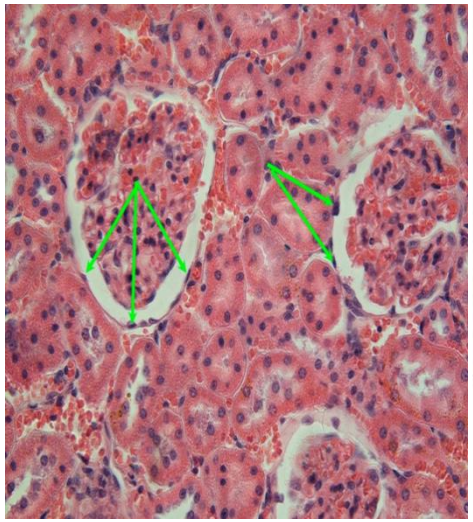
Function: Filtration of blood

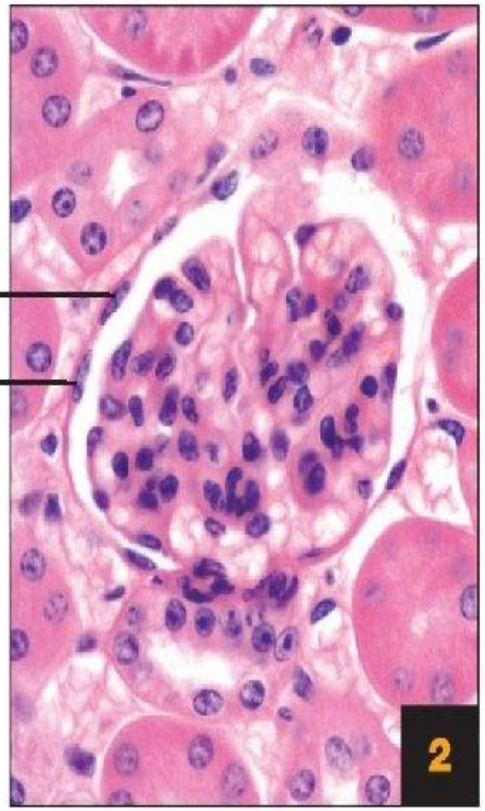
Site : Lung alveoli

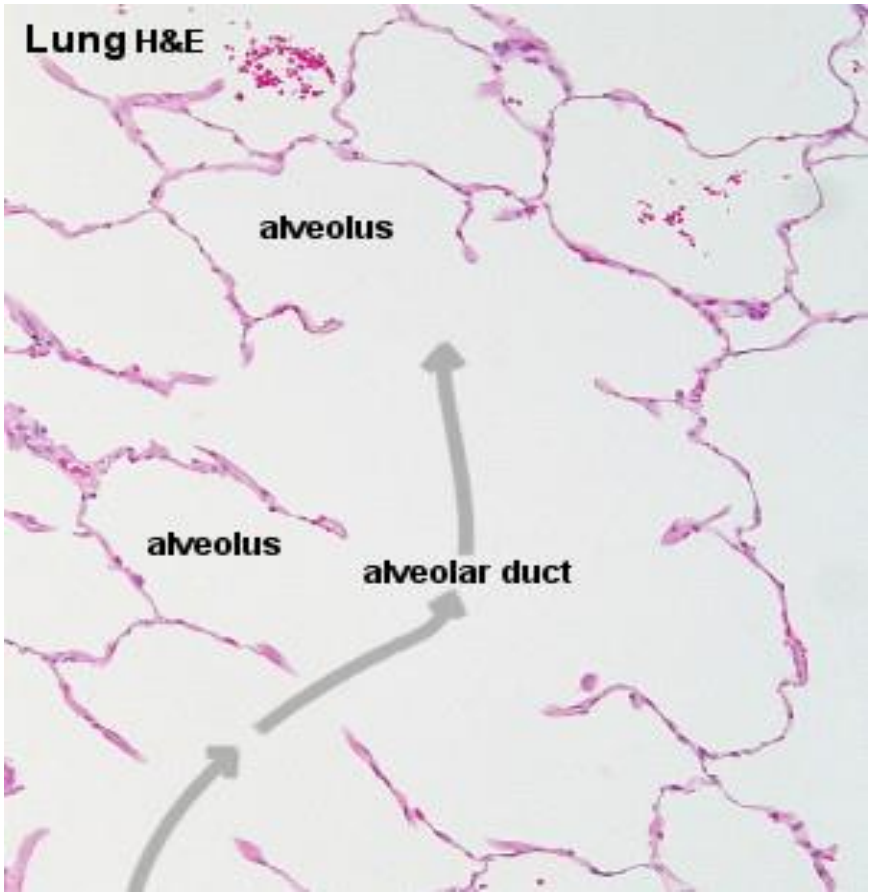
Function : gas exchange

Plate 2

Kidney





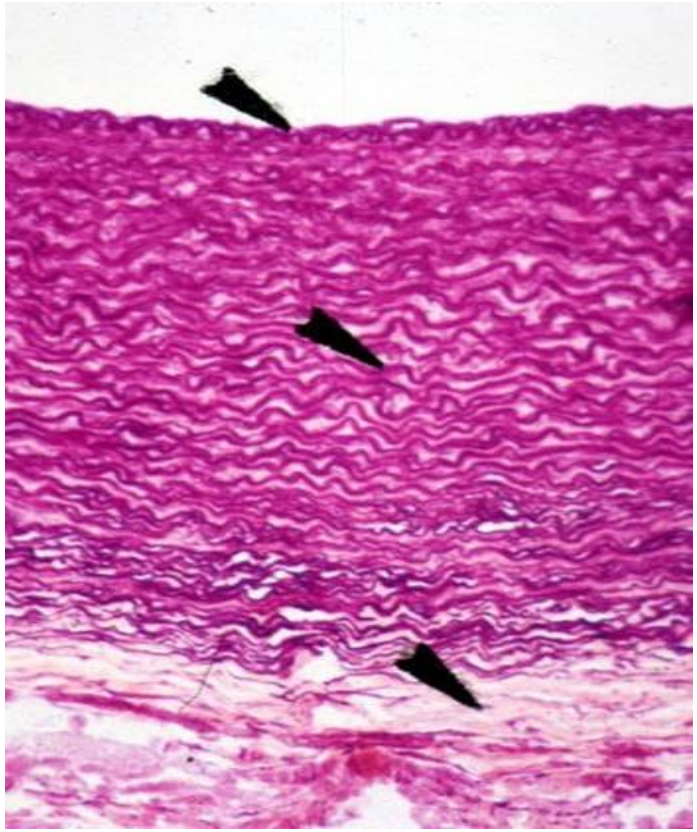


Endothelium:

Site : blood vessels

Function : smooth surface

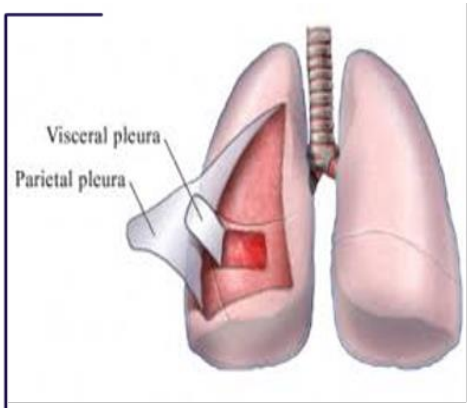
* Lining the lumen of blood vessel.

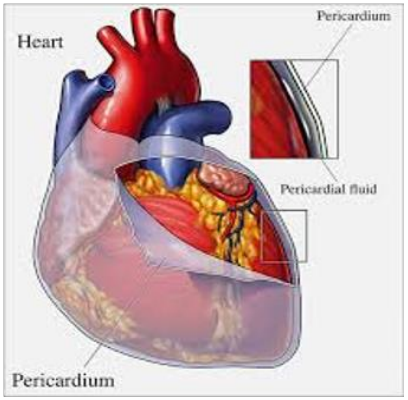


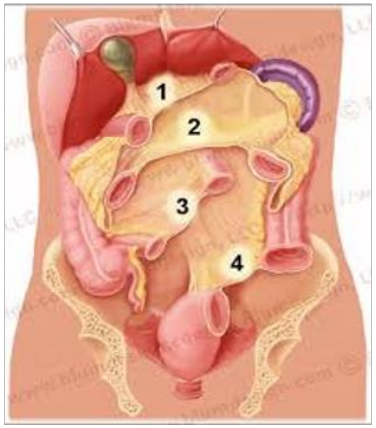
Methothelium :

Site : Pericardium, pleura, peritonieum

Function : smooth surface







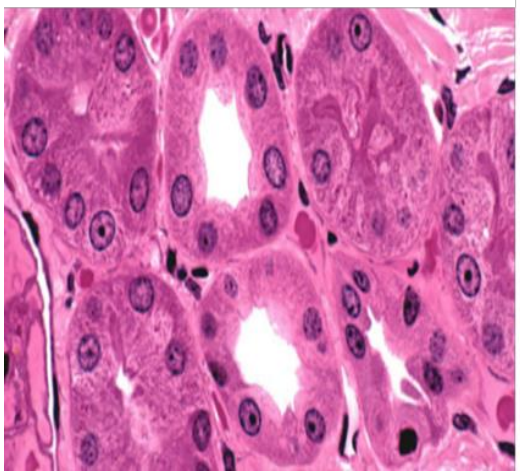
Simple cuboidal Epithelium

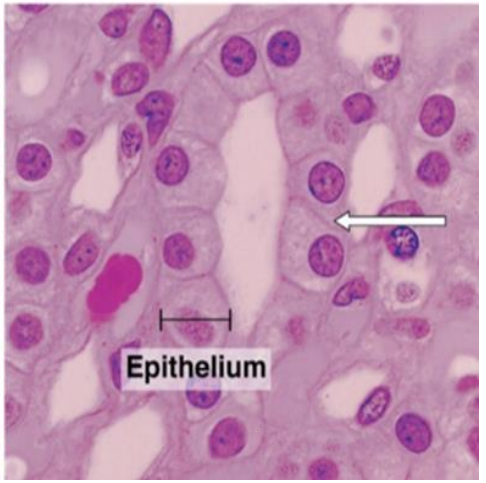
The width and height are approximately the same

[Covering and secretion]

Site: Thyroid gland ← secretion ← follicle ← hormone

- Thyroid gland : secretion
- kidney tubules : ion exchange





Simple Columnar Epithelium

Site : uterus, oviduct "fallopian tube"

Non ciliated

intestine أشهر مكان لما ي

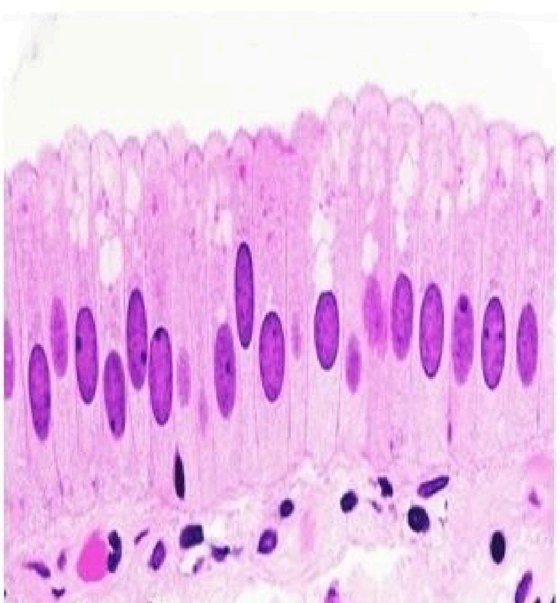
Sites:

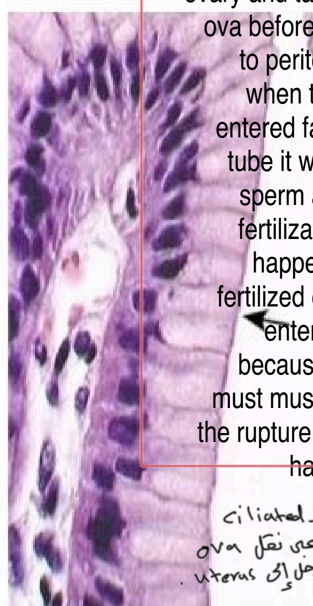
- ducts of glands: secretion
- digestive tract : absorption

حكمة الدكتور/م ما اتوقع هم بس للاحتياط اقرأوه للفهم

ovum doesn't enter rapidly from ovary to fallopian tube it will get lost in perittoneum of abdominal cavity so this doesn't happen &the end of fallopian tube has things like fingers so it surrounded ovary and takes the ova before it went to peritoneum, when this ova entered fallopian tube it will meet sperm and the fertilization will happen, then fertilized egg will enter uterus because it has must muscle and the rupture will not happen }}

باختصار ciliated لتساعد على نقل ova لما ترحل إلى uterus.





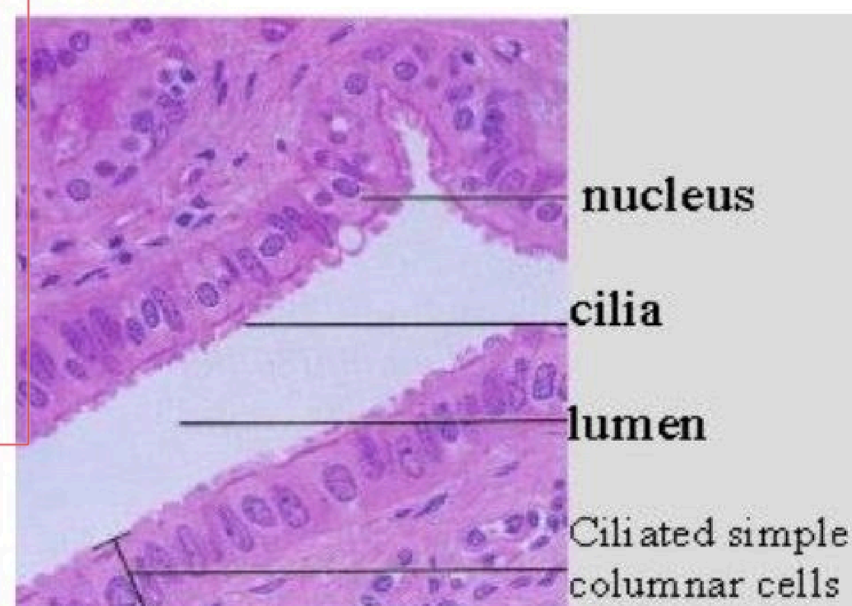
Ciliated

the most place have ciliated epithelium is respiratory tract because respiratory systems have most of duct particles "alot of bacteria" so it must washed "clean" by cilia.

Sites:

uterus, oviduct & bronchiole of the lung

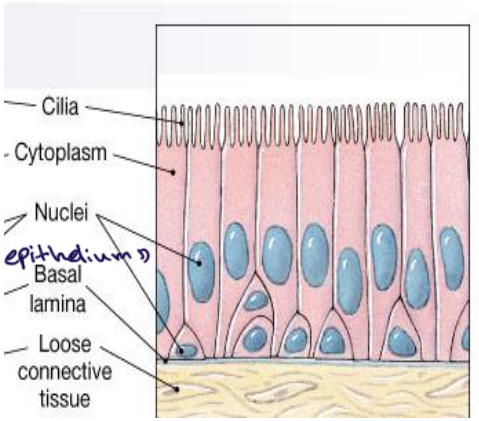
Function : movement of luminal contents



٤٩/١٣

Pseudostratified columnar epithelium

False



Non ciliated

Sites:

- **Male genital tract**
- **large ducts of glands**

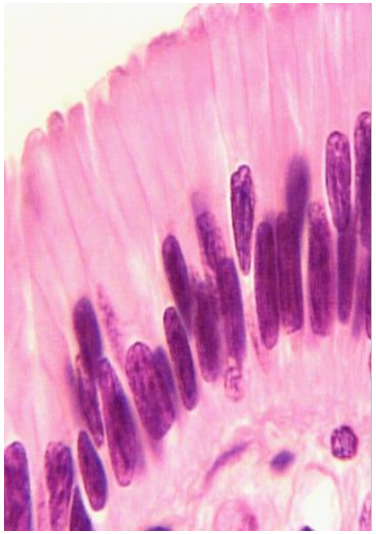
Function : secretion

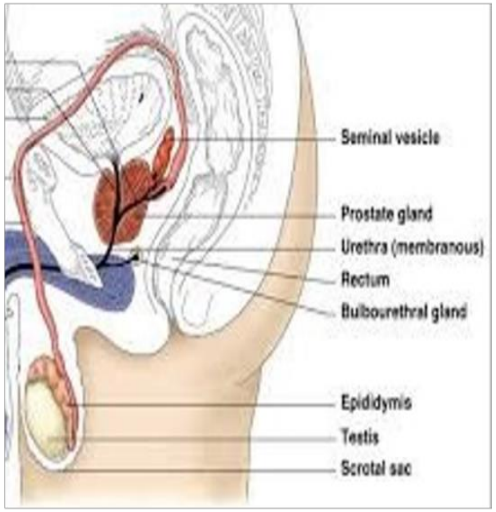
Ciliated (" respiratory epithelium ")

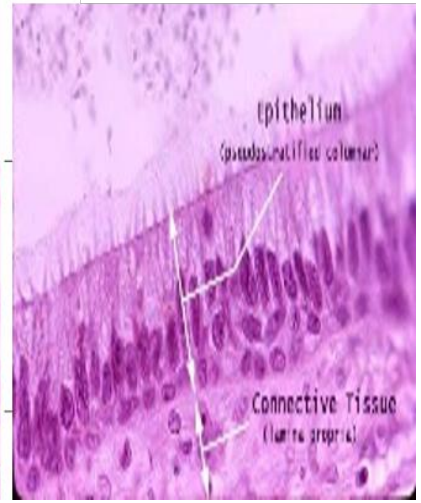
Sites:

- Nose- Trachea

Function = Movement of luminal contents







Type	Site	Function
Simple Squamous	• Bowman's capsule- kidney • Lung alveoli	Filteration
Simple cuboidal	❖ Thyroid follicles ❖ Kidney tubules	❖ Secretion ❖ Ions exchange
Simple Columnar non ciliated	➢ Digestive tube ➢ Ducts of the glands	➢ Absorption ➢ Secretion
Simple Columnar ciliated	▪ uterus, oviduct ▪ bronchiole of the lung	▪ Movement of luminal contents
Pseudostratified columnar ciliated	✓ Nose- Trachea	Movement of luminal contents
Pseudostratified columnar non ciliated	❑ Male genital tract ❑ large ducts of glands	Secretion

Stratified Epithelium

→ protection

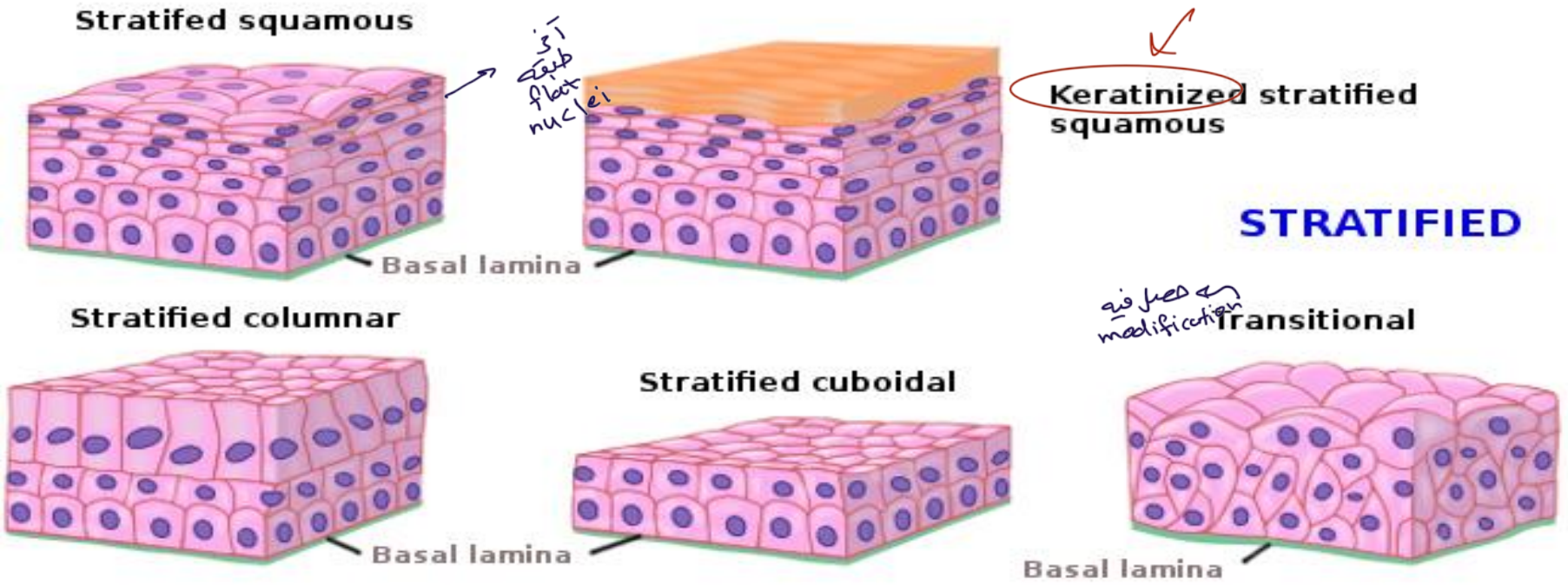
What cell is on the top layer?

Classification according to shape of most superficial layer *

- ❑ Stratified sqamous epithelium
- ❑ Stratified cuboidal epithelium
- ❑ Stratified columnar epithelium

→ rare

- ❑ Transitional epithelium

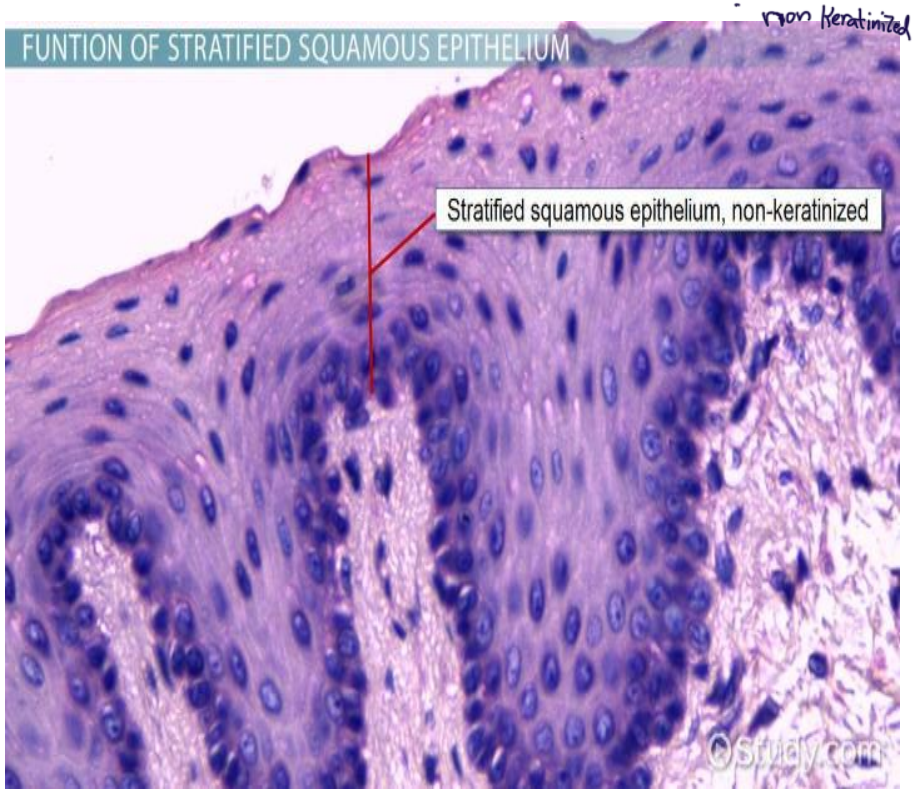


Stratified squamous epithelium

Non Keratinized

Site : Oesophagus- vagina

Function : Physical protection



Keratinized

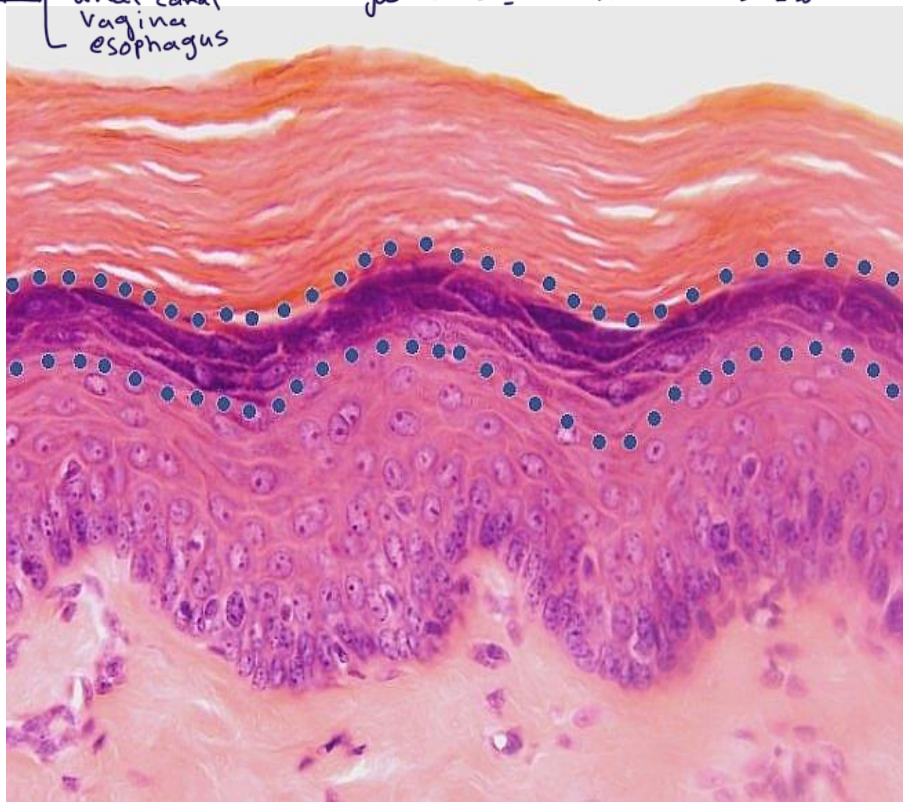
* Best example the epithelium for protection is Keratinized Stratified squamous

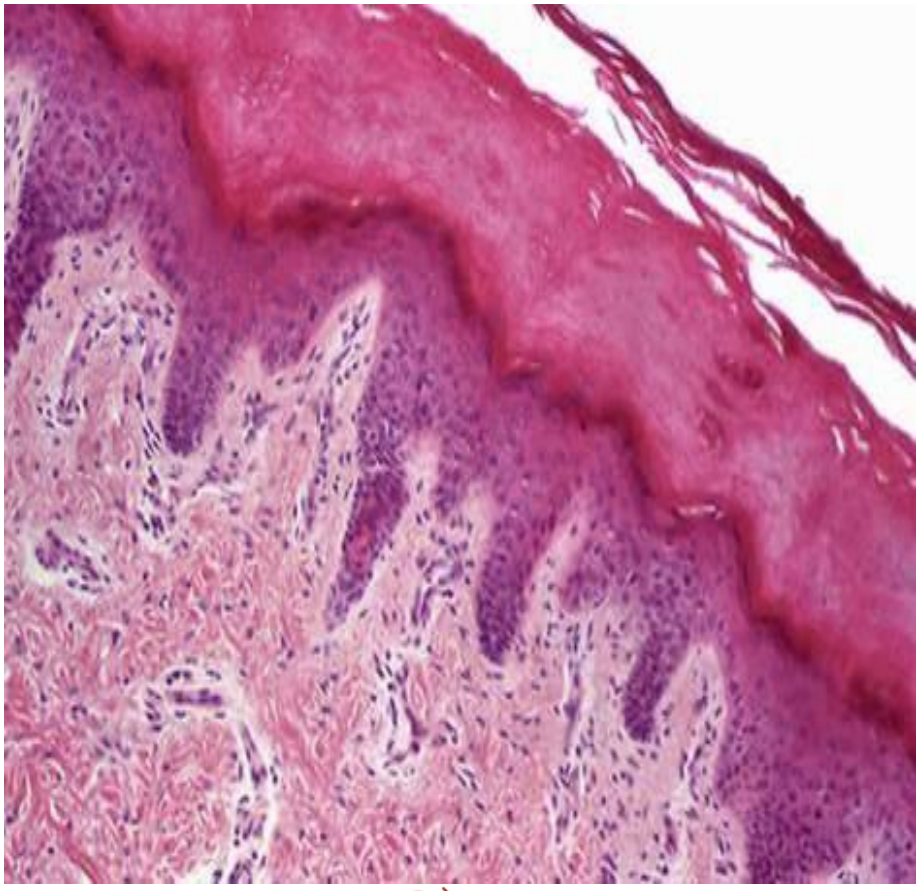
* أي مكان يوجد فيه طبقة skin بـ Keratinized stratified squamous يكون متقرن

Site : Skin

Function : Physical protection

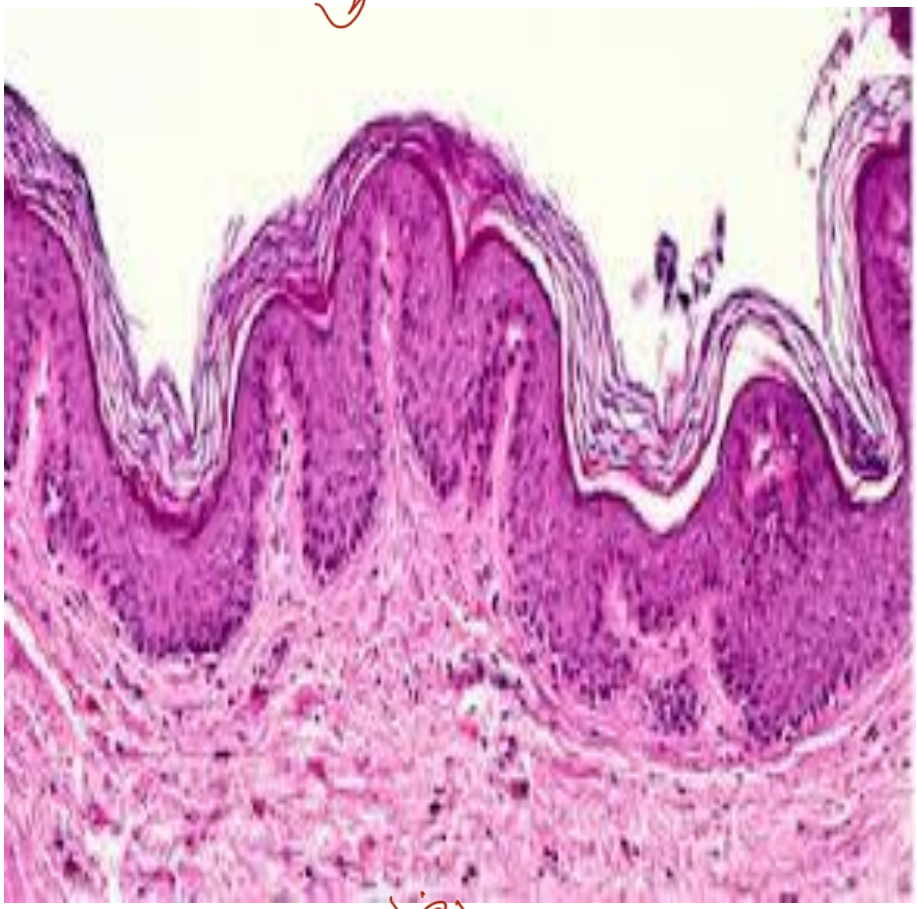
oral cavity
anal canal
vagina
esophagus





Thick skin

يوجد Palm و Sole



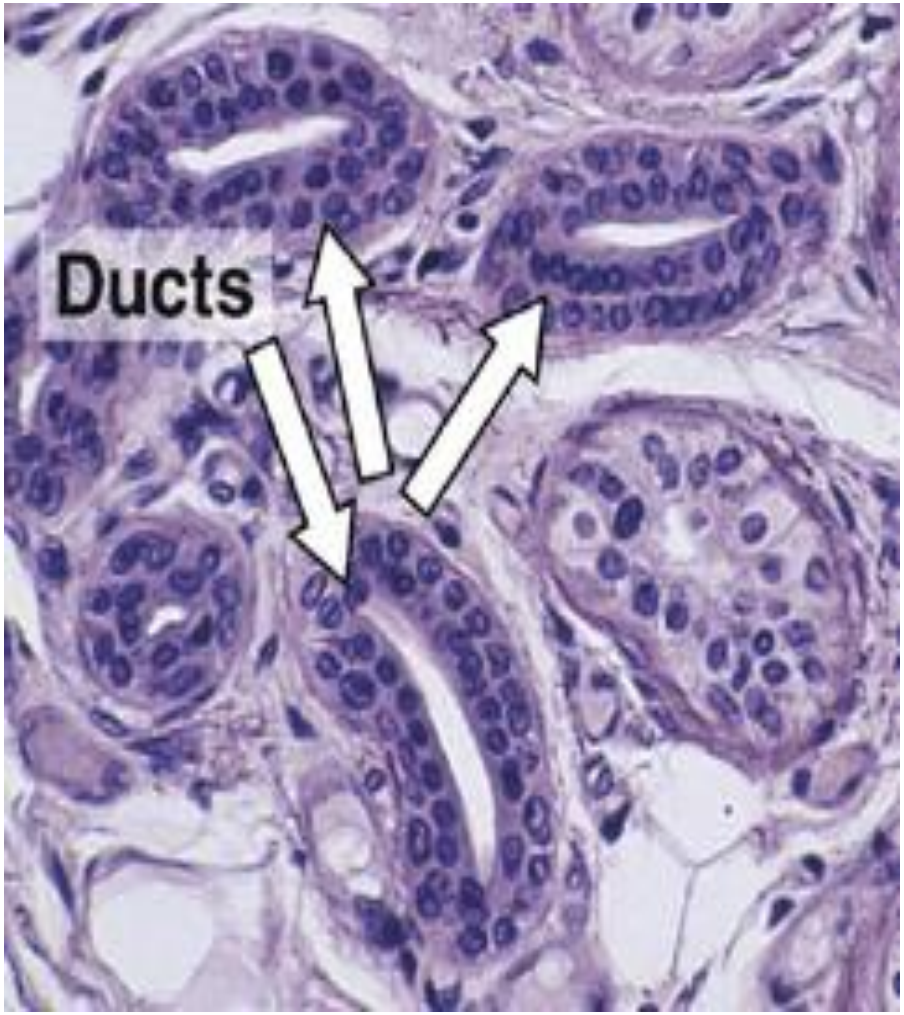
Thin skin

يغطي باقي الجسم يكون فيه hair follicle

Stratified Cuboidal Epithelium (Rare)

Site : Ducts of sweat glands

Function : secretion)

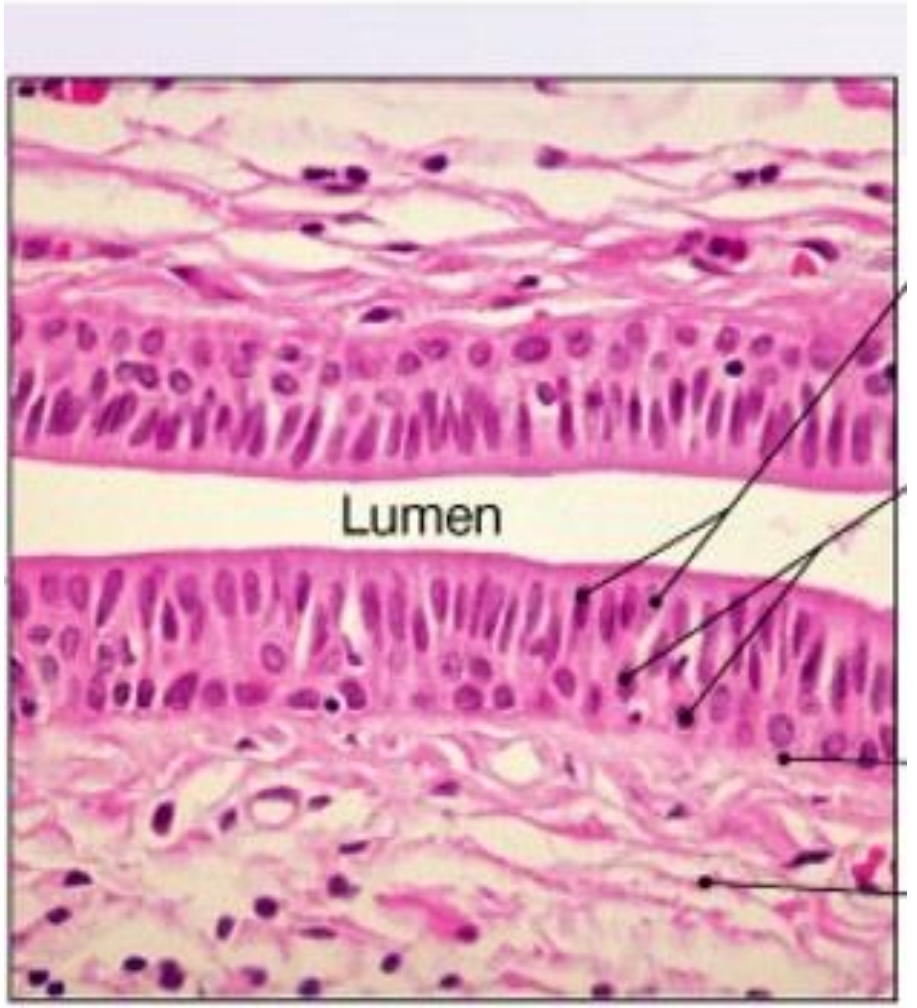


Stratified Columnar Epithelium (Rare)

Site :

- ❑ Ciliated: penile urethra
- ❑ Non ciliated: conjunctival fornix → the internal surface of eyelid (pink) طبقة العين

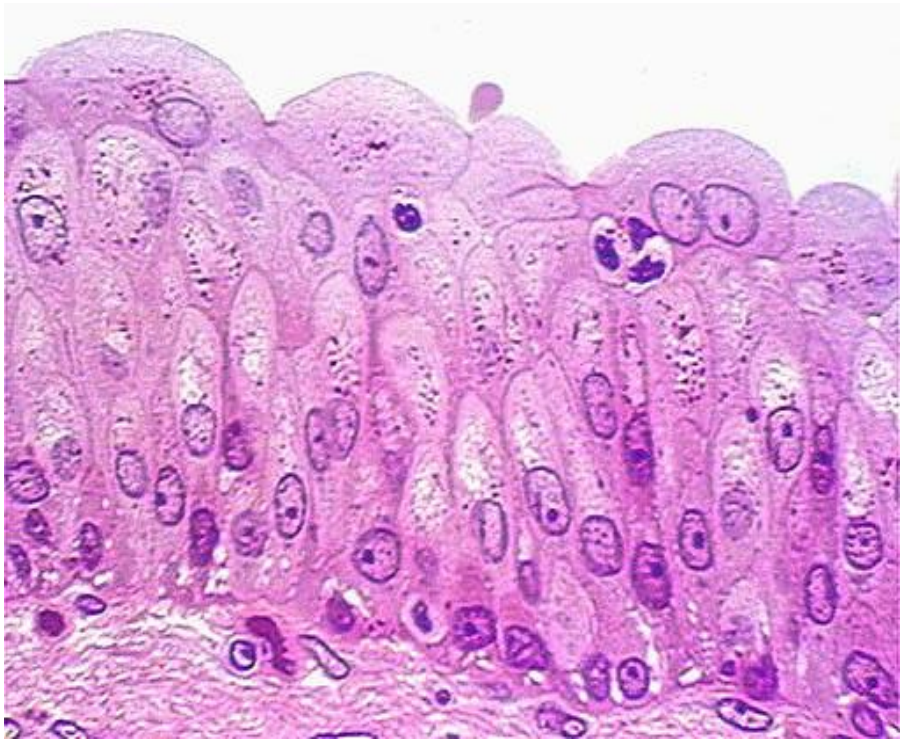
Function : protection



Transitional epithelium

هذا النوع * مهم ركزن عليه الدكتورة

اسم آخر "urothelium" لكنه فقط موجود في "urinary systeme"



A special type of stratified epithelium lining most of the urinary passages (ureters, bladder) When the organ is empty surface cells appear domelike When the organ s full the surface cells stretch and flatten

Site : urinary bladder, ureter

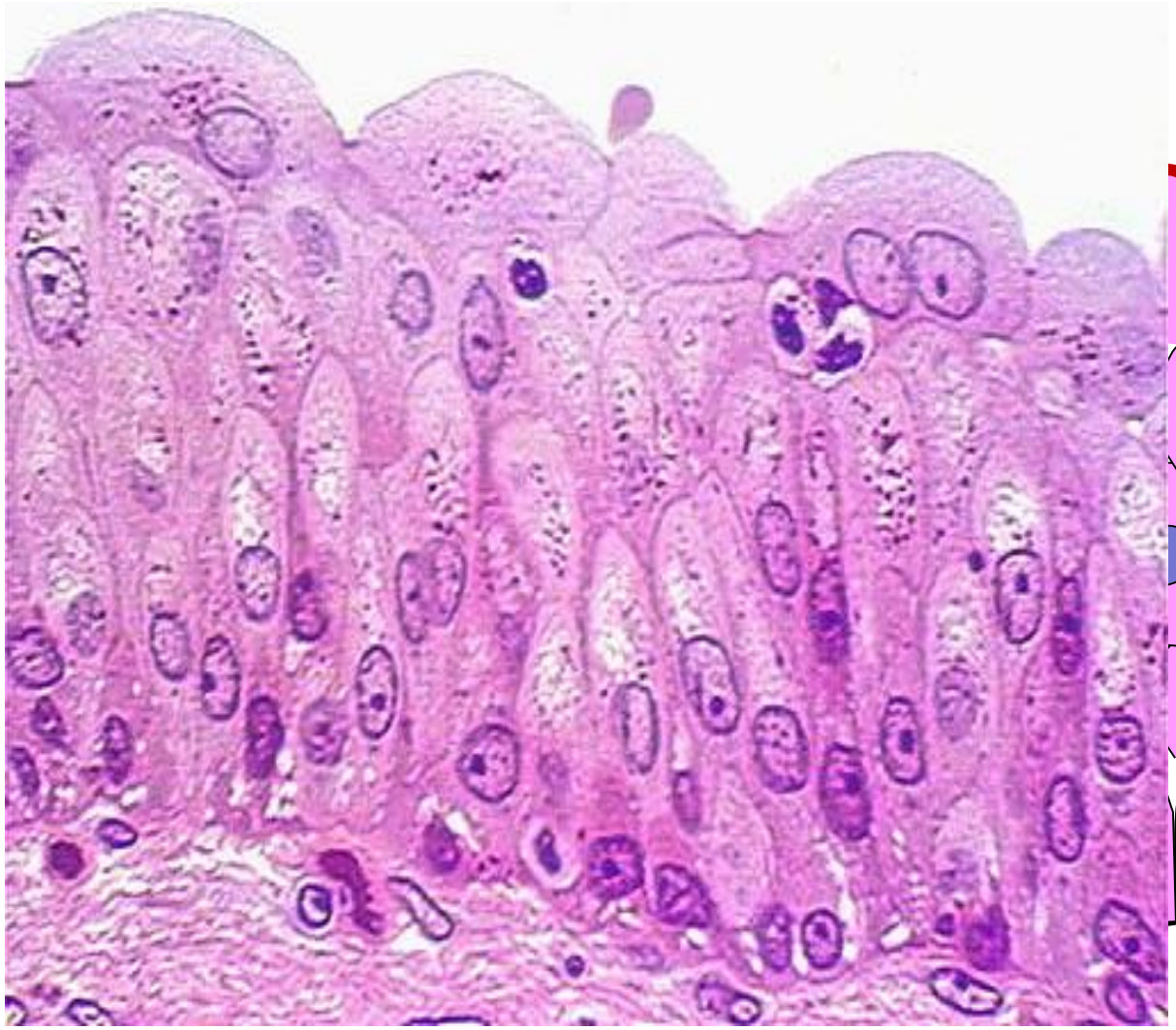
Function : protection

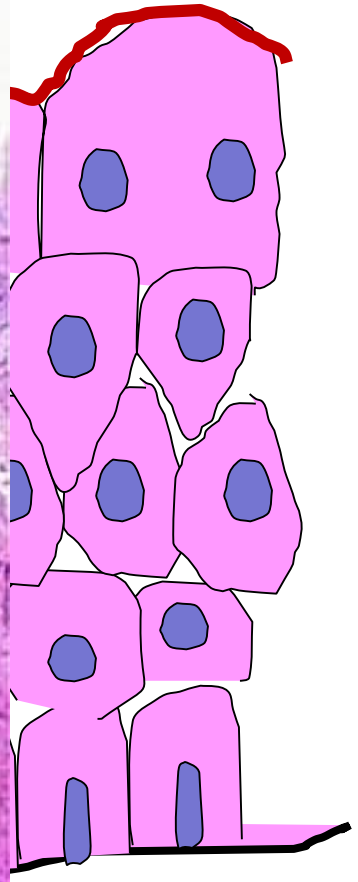
* the transition epithelium consists from 10 layers but in full urinary bladder state it becomes from 2-3 layers

Transitional Epithelium

Empty urinary bladder

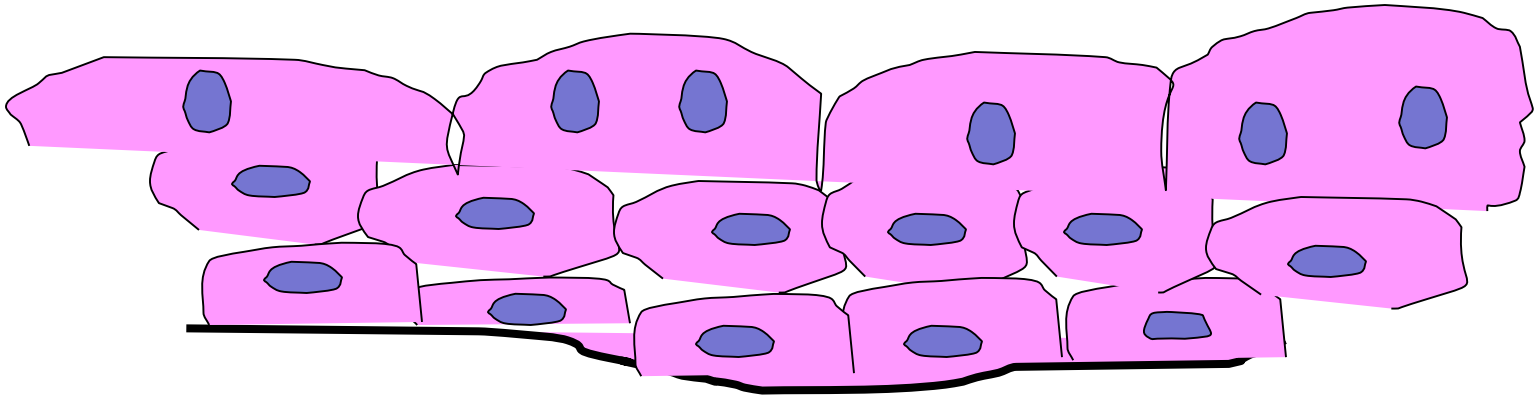
10 Layers

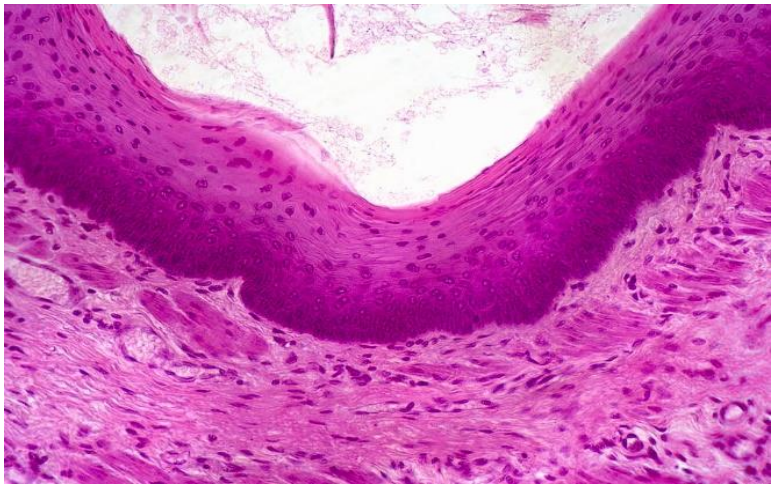


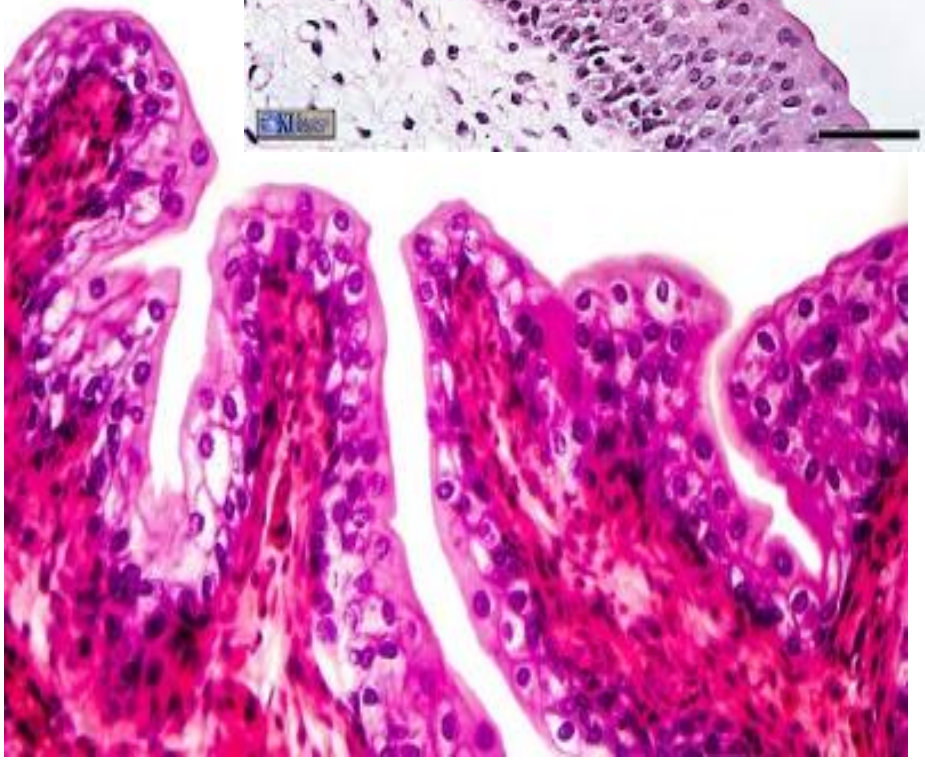


Transitional Epithelium

Full urinary bladder (2–3) layers







Str Sq Non Kerat

Transitional

Transitional epithelium

Adaptation of Transitional epithelium to its function:

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

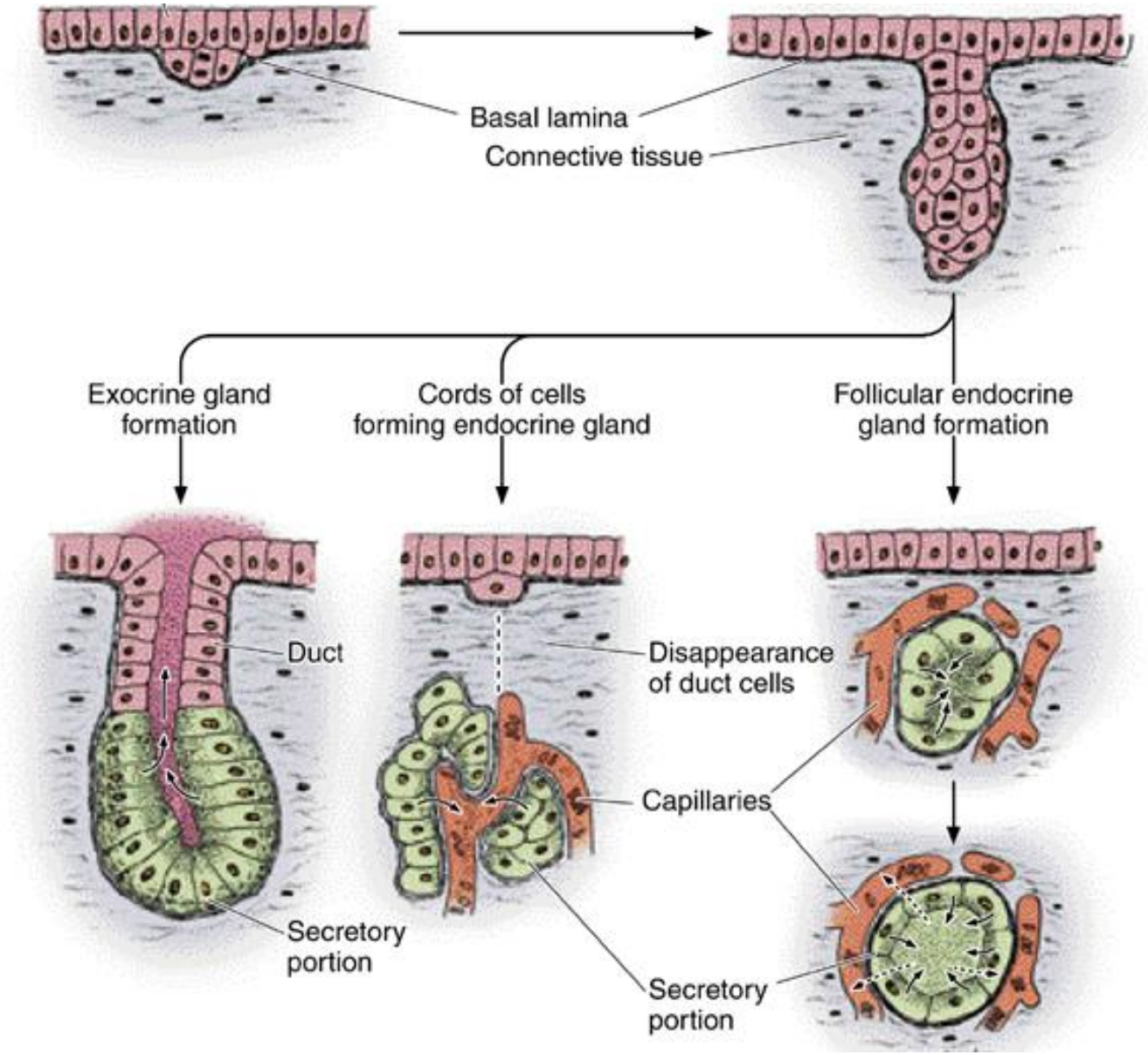
→ thick membrane to make the cells resist urin toxicity.

Type of epithelium	Site	Function
Stratified squamous Non Keratinized	❑ Oesophagus- vagina	Physical protection
Stratified squamous Keratinized	❑ skin	Physical protection
Stratified cuboidal	❑ Ducts of sweat glands	secretion (rare)
Stratified Columnar	❑ - ciliated: penile urethra ❑ - Non ciliated: conjunctival fornix	Protection (rare)
Transitional	❑ urinary bladder	protection

Glandular Epithelium

Origin

differentiation



Glandular epithelium

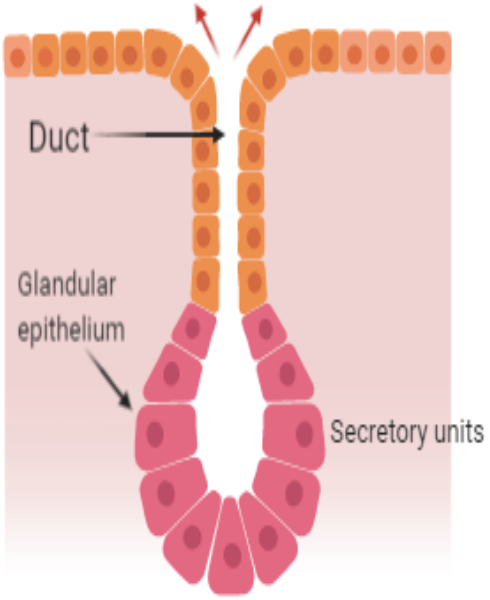
- Exocrine glands secrete their products through the ducts that are connected to a surface.

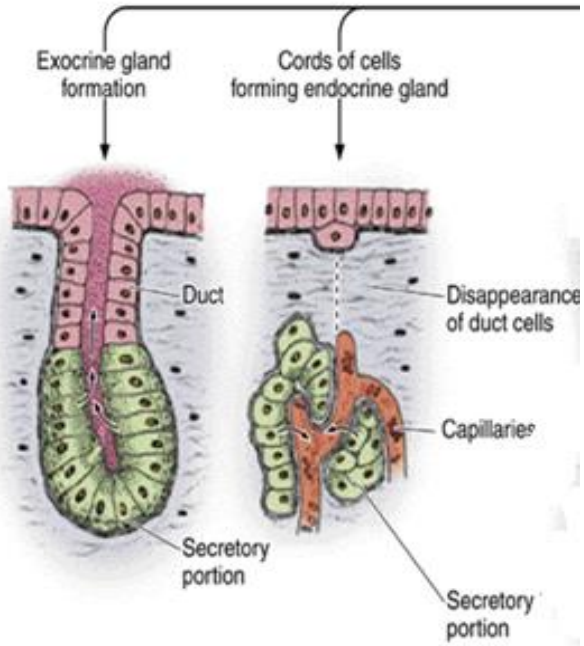
• Endocrine glands lack a duct system. They secrete their products into the bloodstream to reach their target cells. The products of endocrine glands are called hormones.

Presence of a duct system

Exocrine = duct

Endocrine = blood





Classification of exocrine gland

It is classified according to:

1. Number of cells
2. Mode of secretion (mechanism)
3. Nature of secretion
4. Shape of the secretory portion
5. Branching of duct

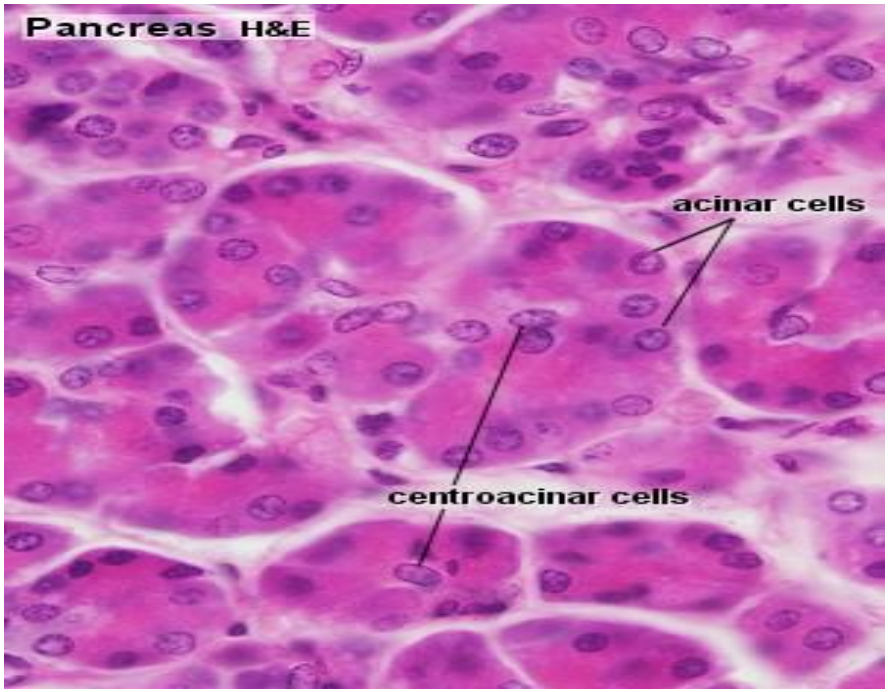
Number of cells

Unicellular

goblet cell

Multicellular

Most of the glands
e.g. Salivary glands)



Mechanism = Mode of secretions

- **Merocrine glands**

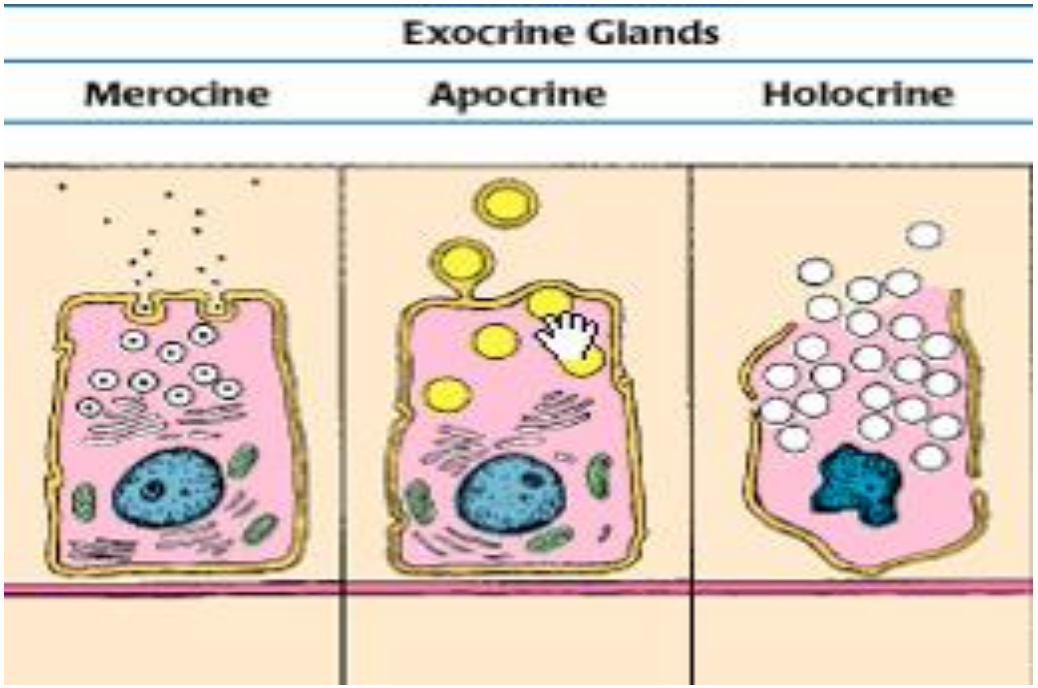
The secretion released through exocytosis
e.g. Pancreas

- **Apocrine glands**

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

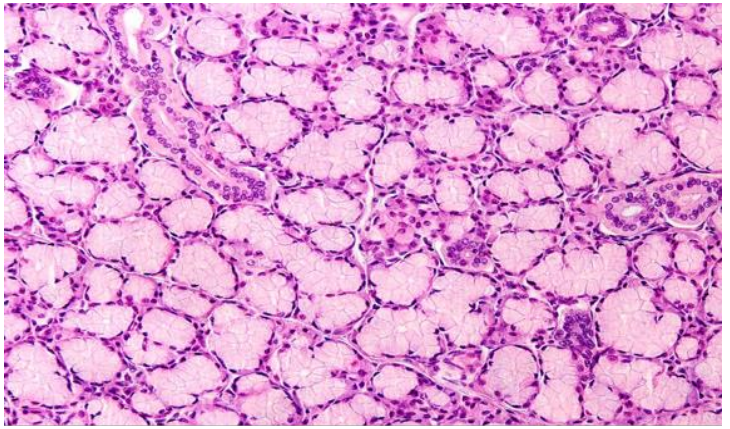
- **Holocrine gland**

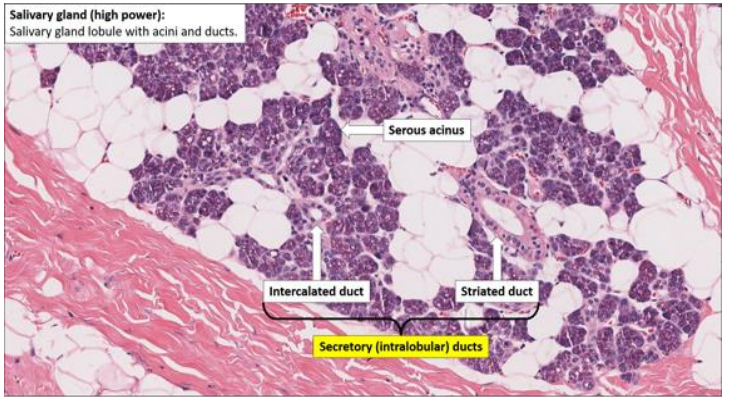
The secretion destroys the cell
e.g. Sebaceous glands

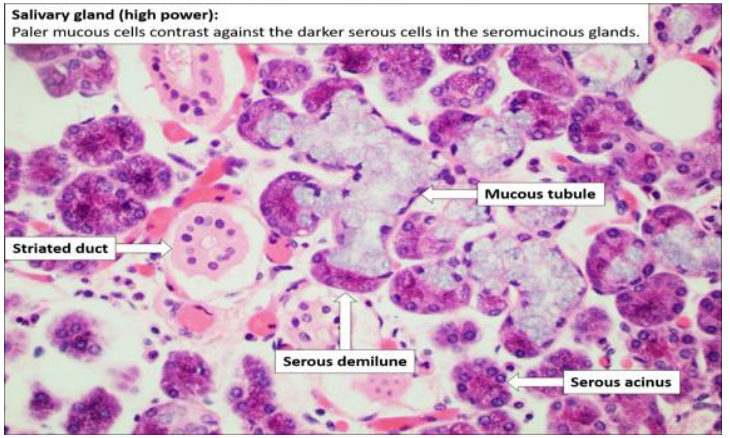


Nature of secretions

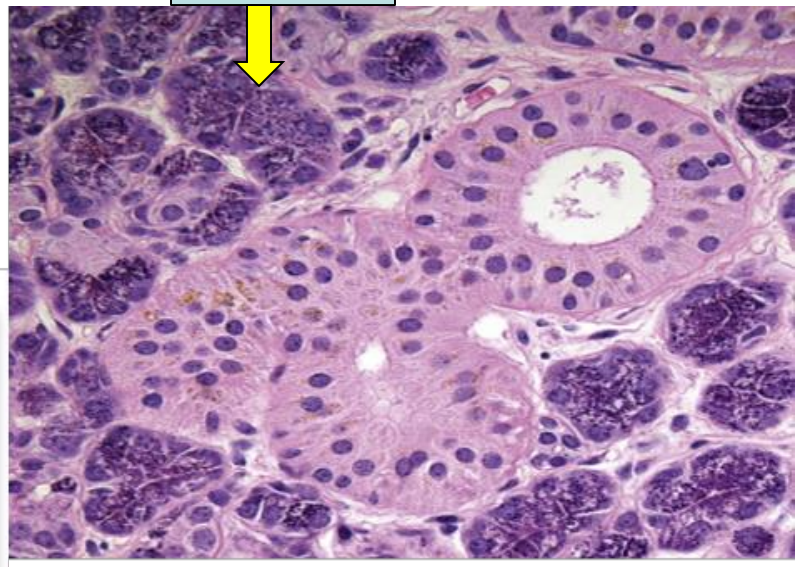
- Mucous glands: sublingual gland
- Serous glands: parotid gland
- Mixed glands: submandibular gland
- Glands with special secretion:
  - Oily secretion = sebaceous gland
  - watery secretion = lacrimal gland
  - Milk secretion = mammary gland
  - wax = glands in the ear



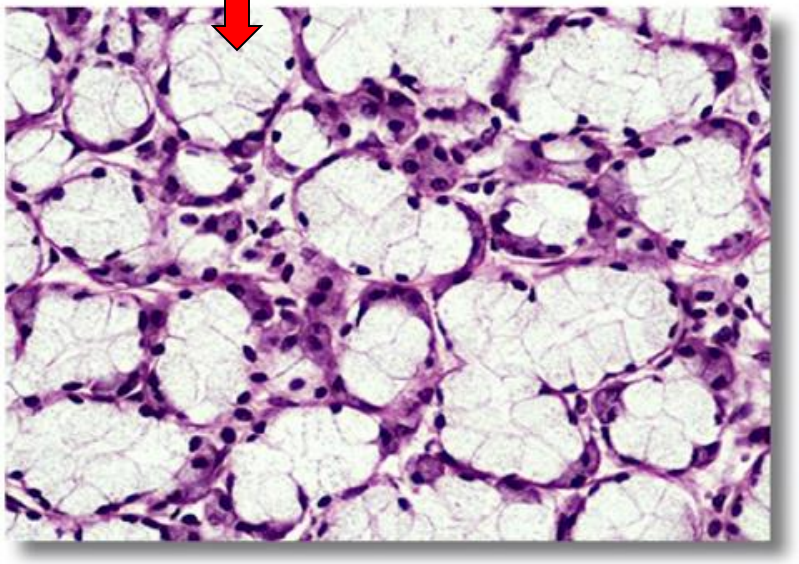


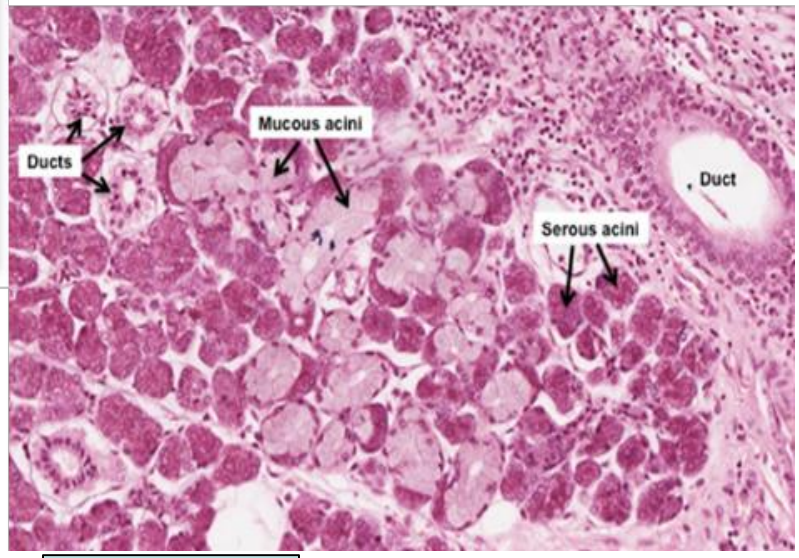


Serous



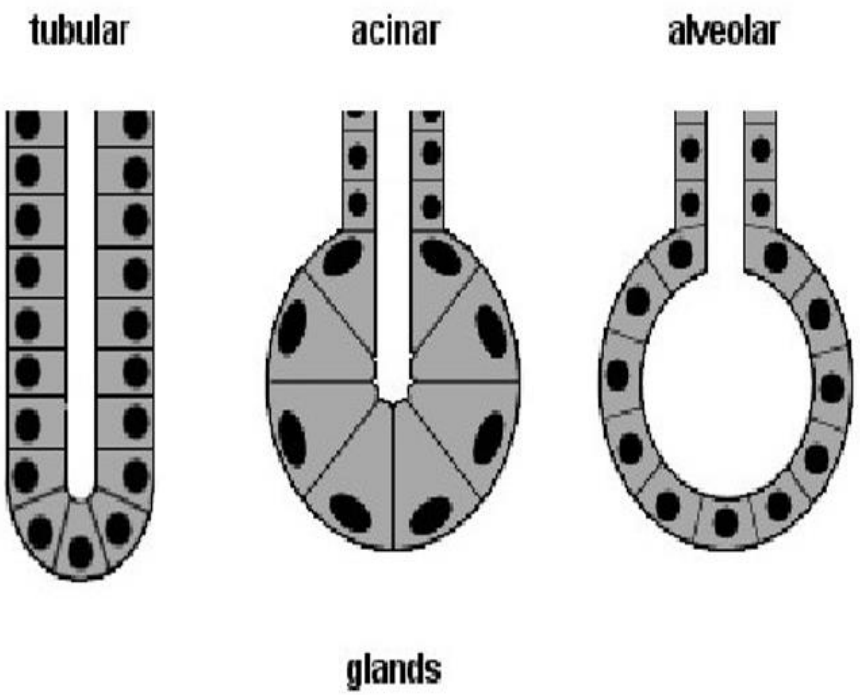
Mucus

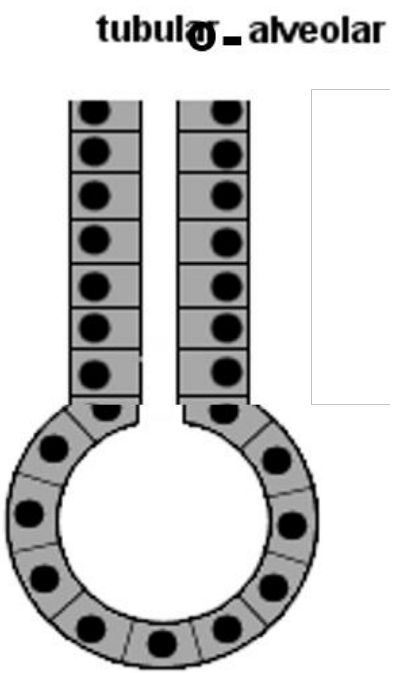




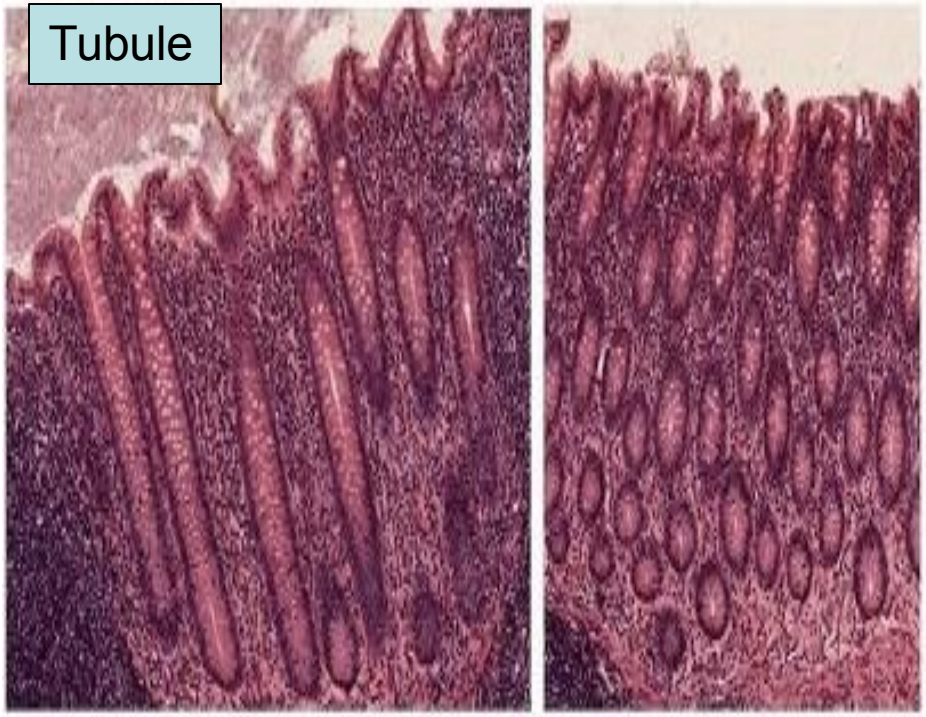
Mixed

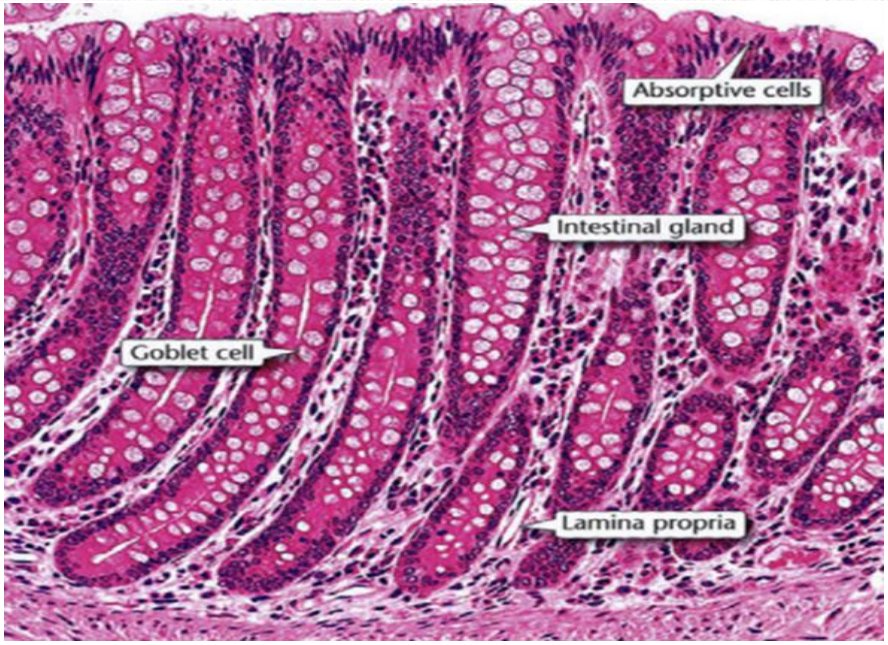
Shape of secretory portion



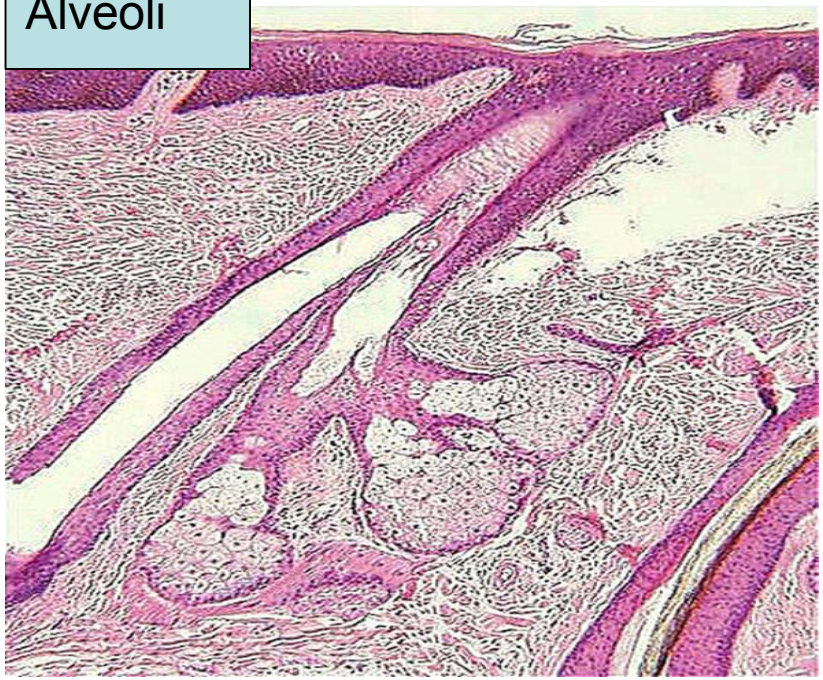


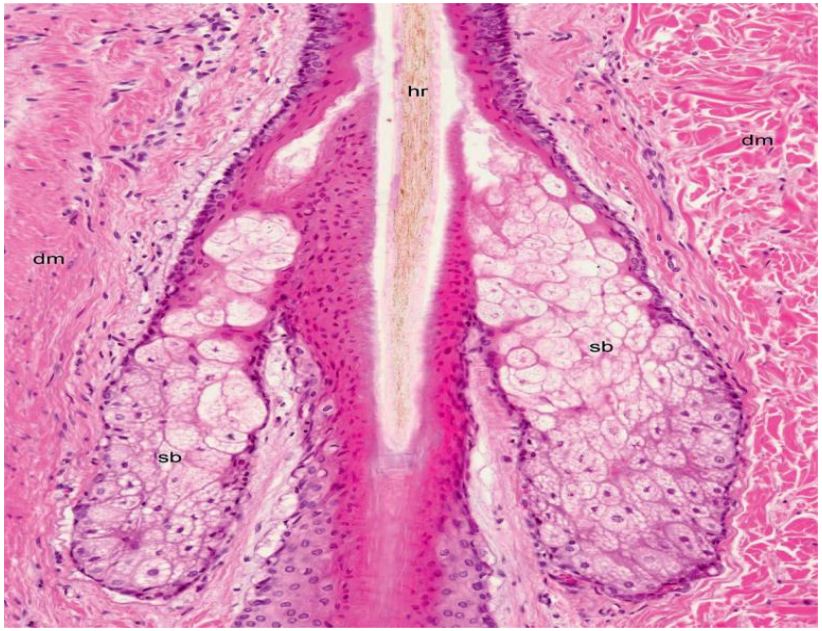
Tubule





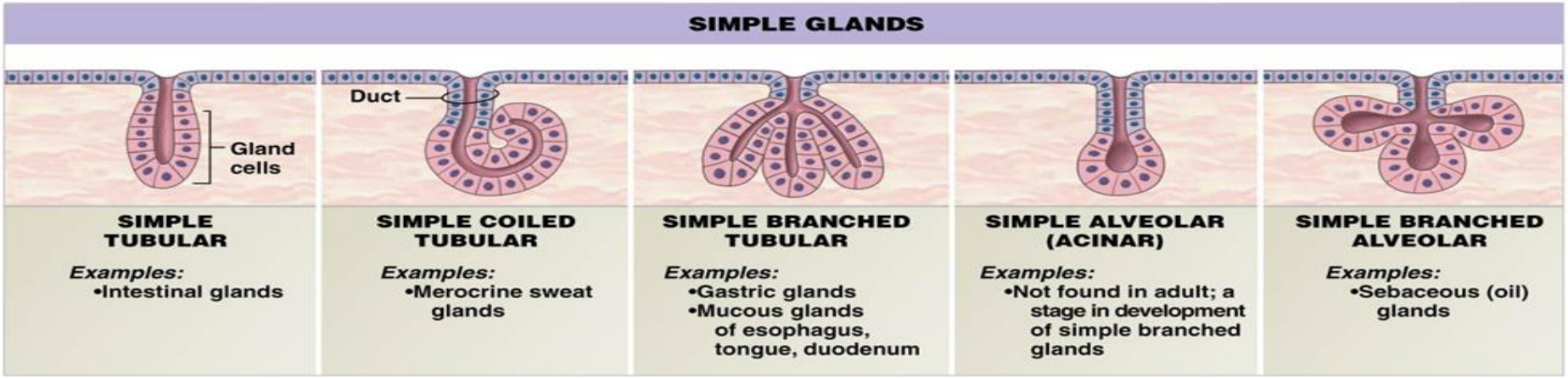
Alveoli

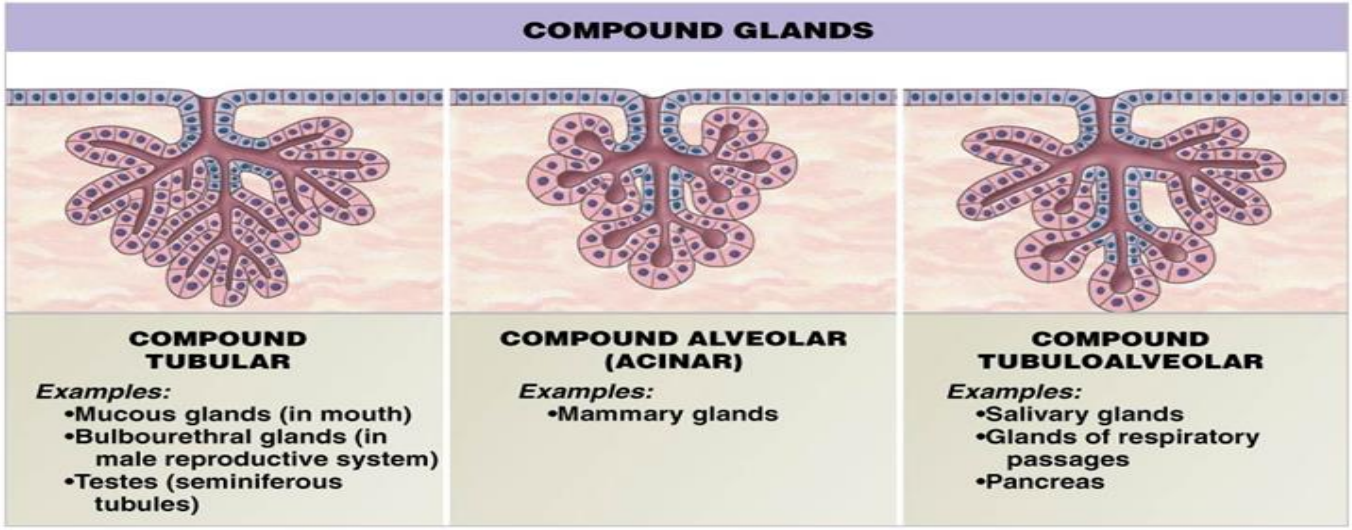




Classification according to branching of duct

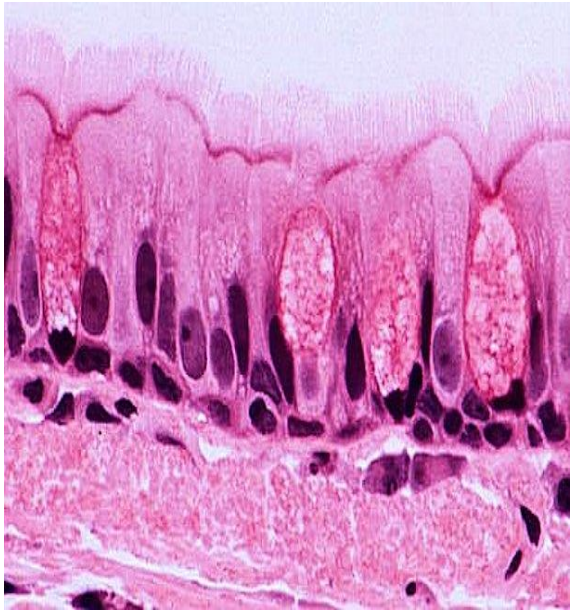
- Simple = one duct + secretory unit
- Compound = branched duct + branched secretory unit

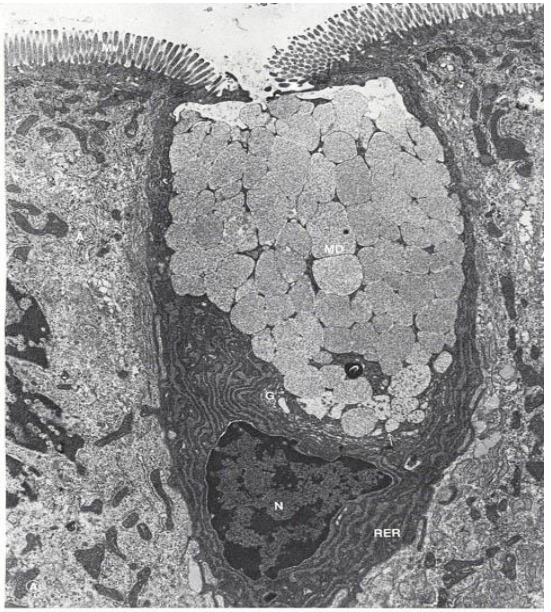




Goblet cells

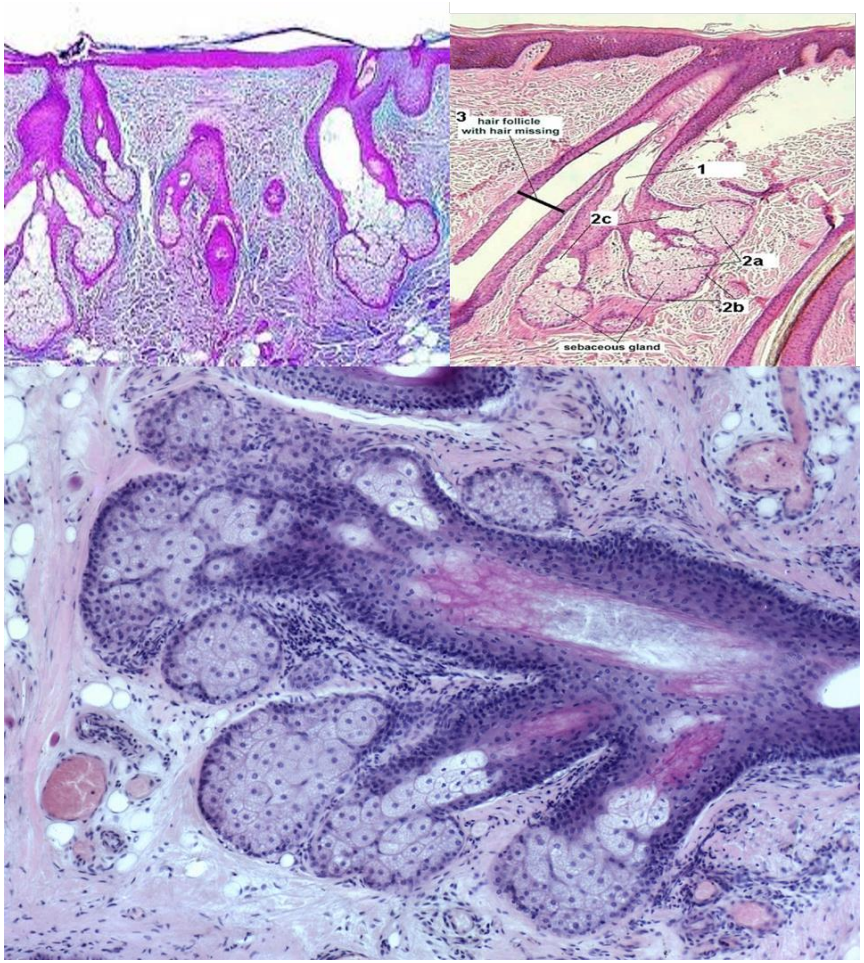
- Exocrine
- Unicellular
- Shape of the cell : flask shape with basal nuclei
- **Mode** of secretion: Merocrine
- **Nature** of secretion : Mucus
- **Site** : Respiratory system , gastrointestinal tract





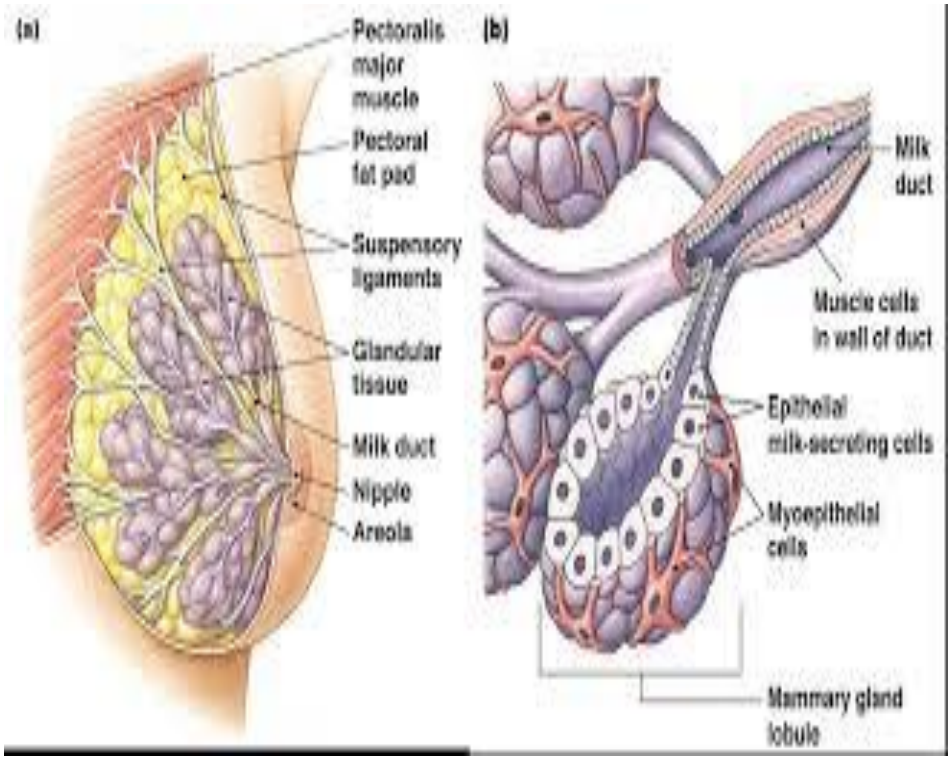
Sebaceous gland

- 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)



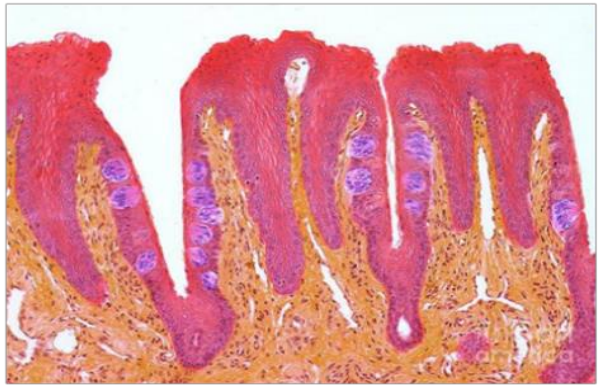
Special types of epithelium

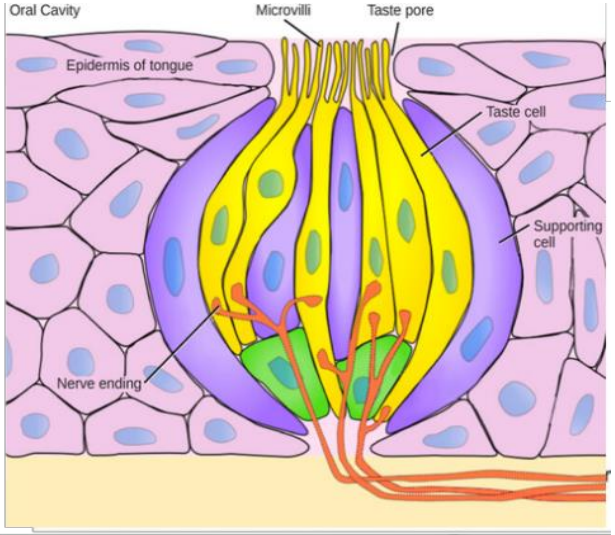
1-Neuro-epithelium

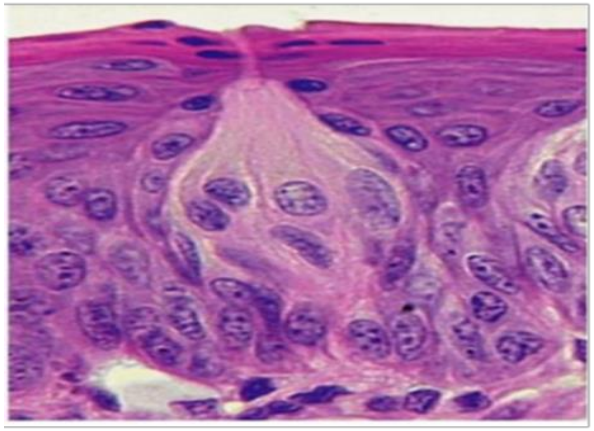
Special sense organs e.g. Taste buds

Site : dorsal surface of the tongue

Function : sensation





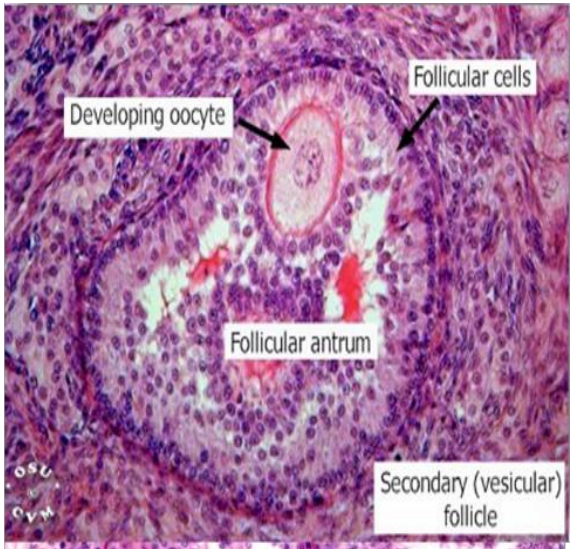


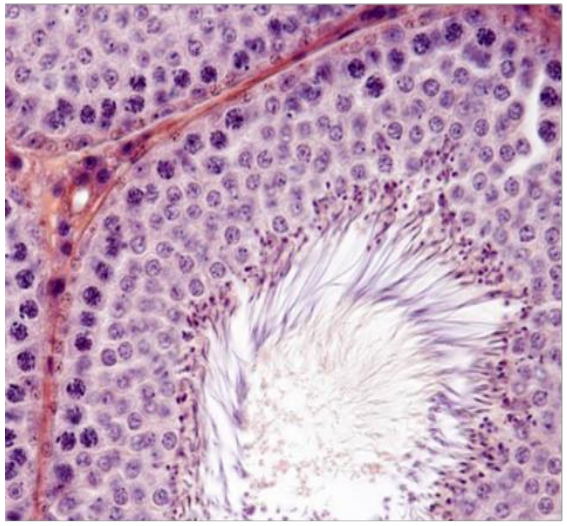
2. Germinal epithelium

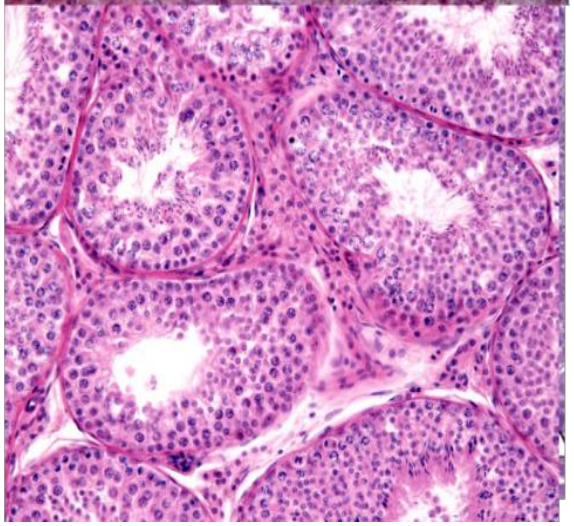
Ovary: ovum

Testis: sperm

Function: : Reproduction







3- Myo-epithelium

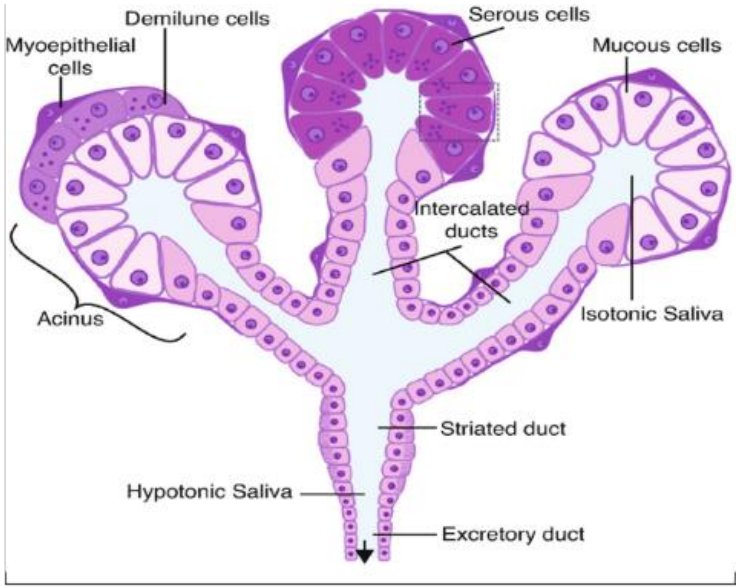
Shape : Irregular with many processes

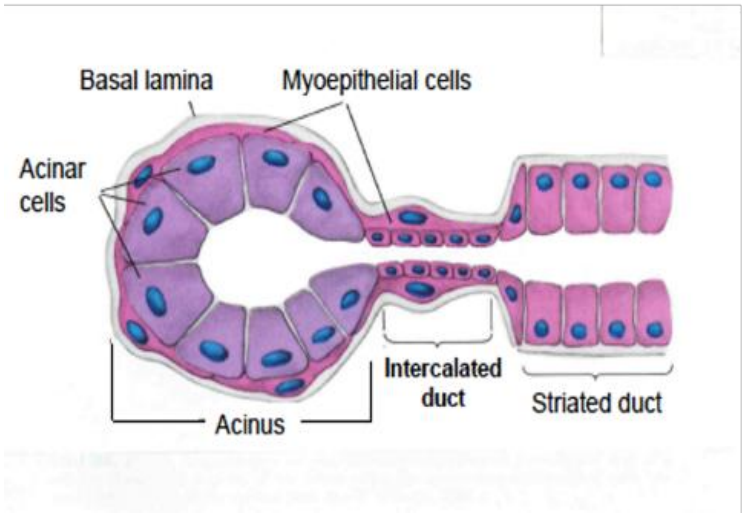
Contain actin & myosin in the cytoplasm

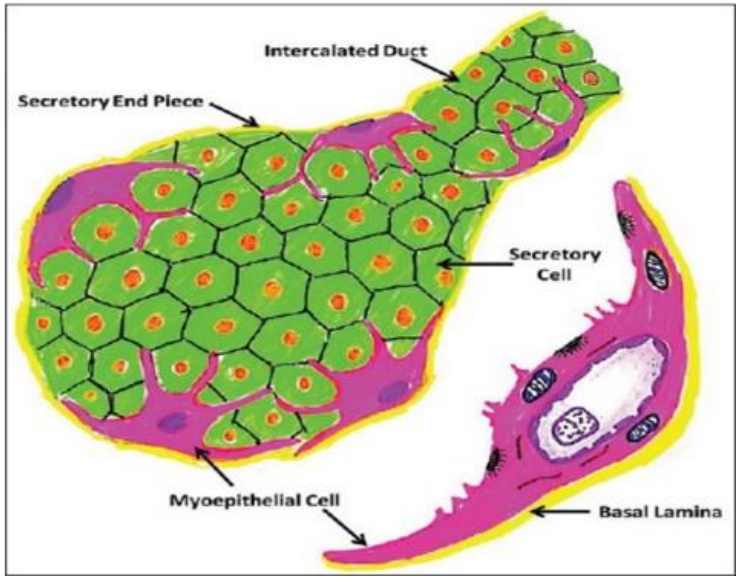
Site : Acini & ducts of the gland

Function :

Contraction for squeezing the secretion







Functions of epithelium

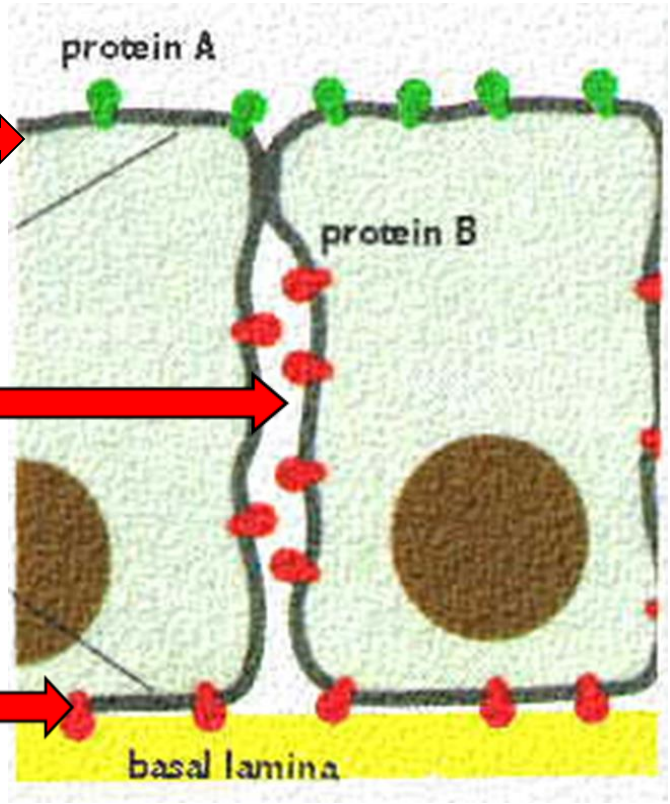
- **Protection,** protect underlying tissues from mechanical injury, harmful chemicals, invading bacteria and from excessive loss of water.
- **Absorption**: certain epithelial cells lining the intestine absorb nutrients from the digestion of food.
- **Secretion,** in glands, epithelial tissue is specialised 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

- Epithelial cells exhibit distinct polarity.

They have an:

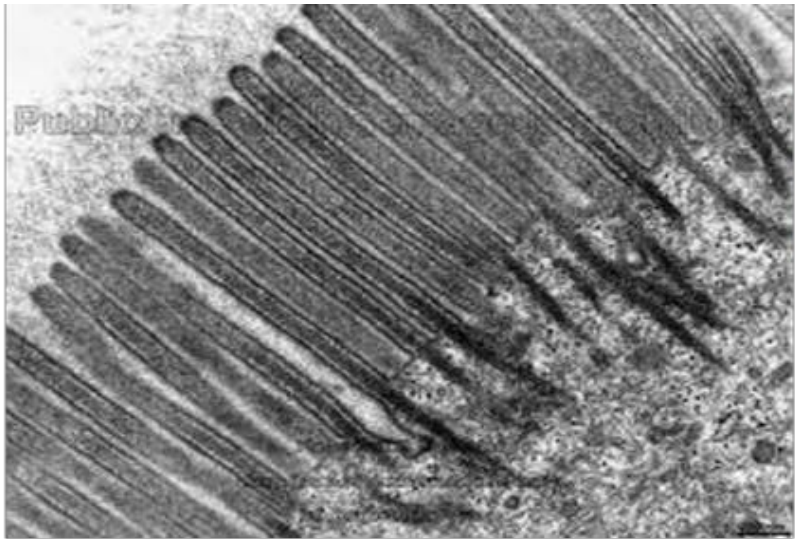
- ❑ apical domain
- ❑ a lateral domain
- ❑a basal domain

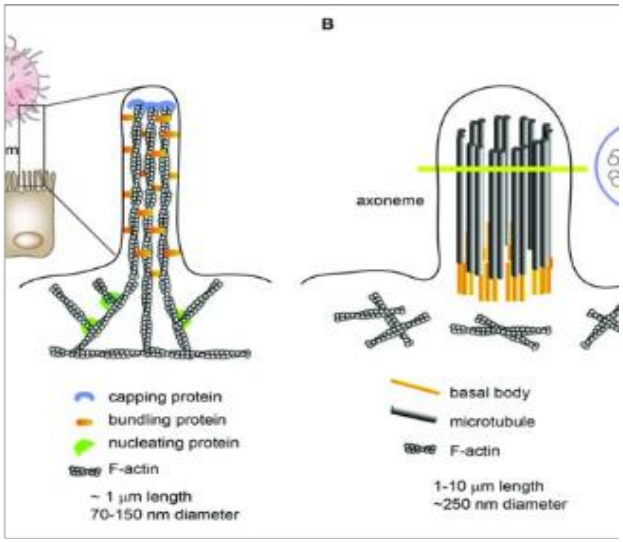


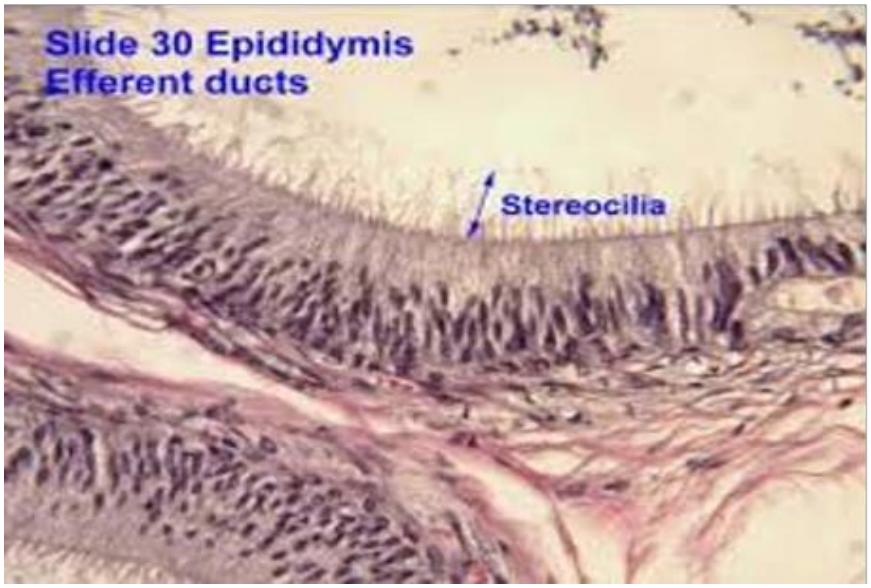
Apical modifications

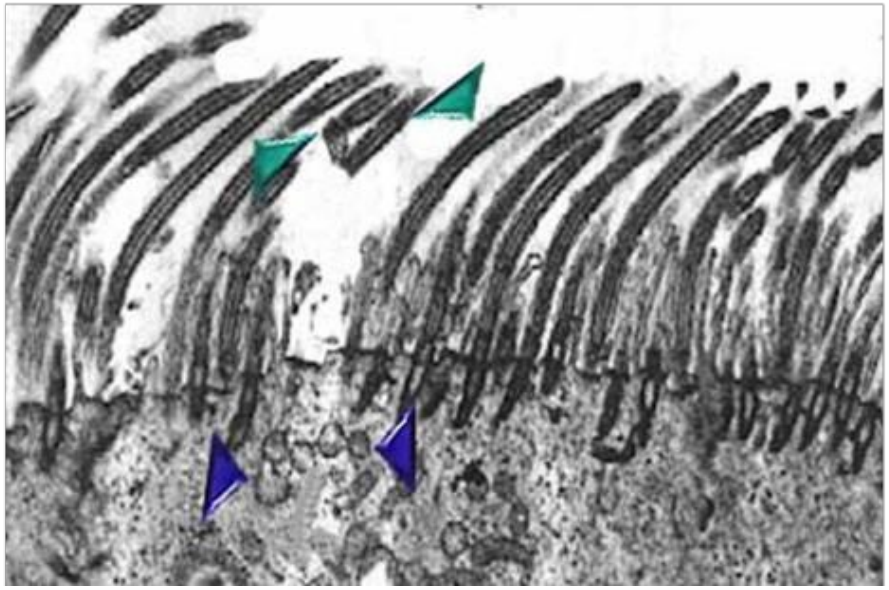
Part of the epithelial cell that looks towards the lumen or the surface

- Cilia
- Microvilli
- Stereocilia



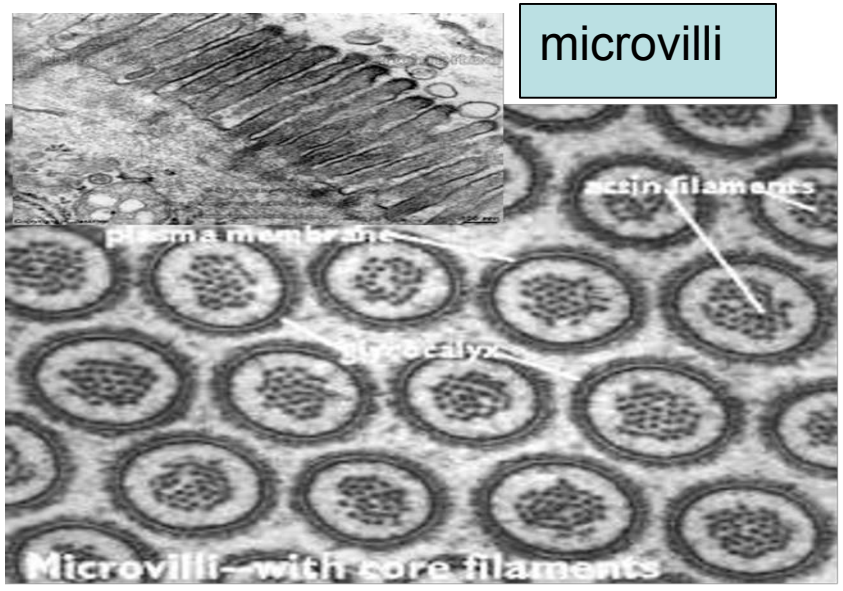


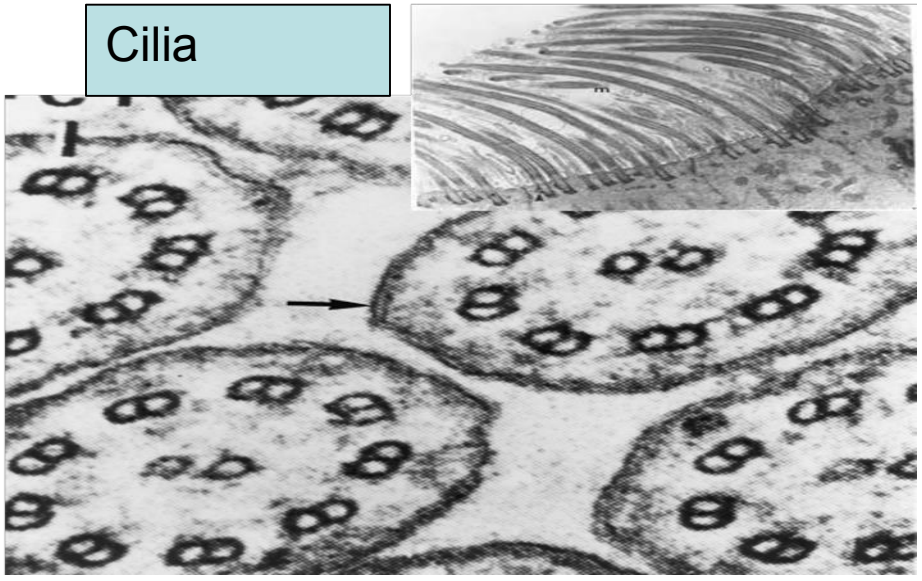




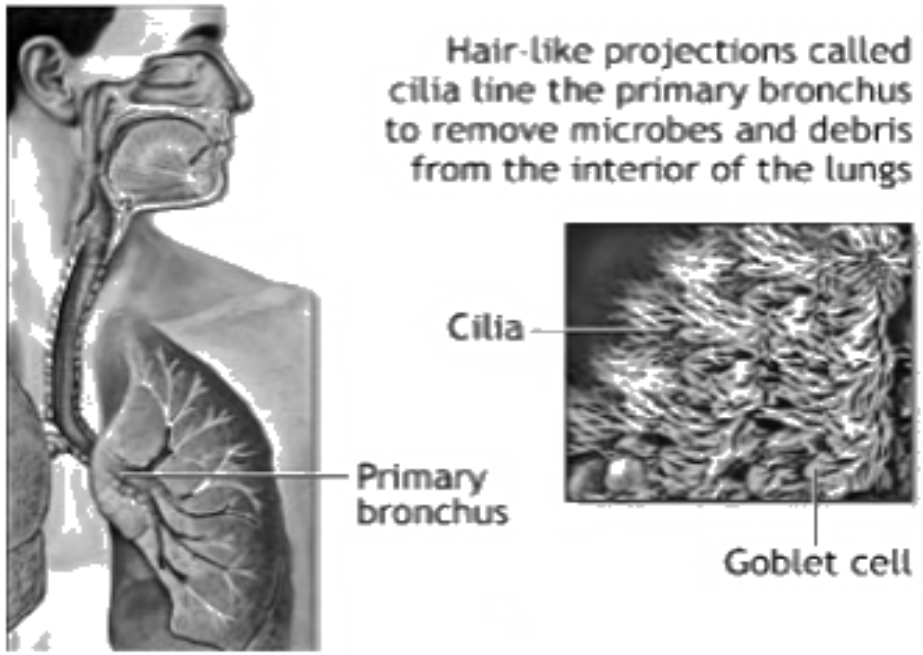
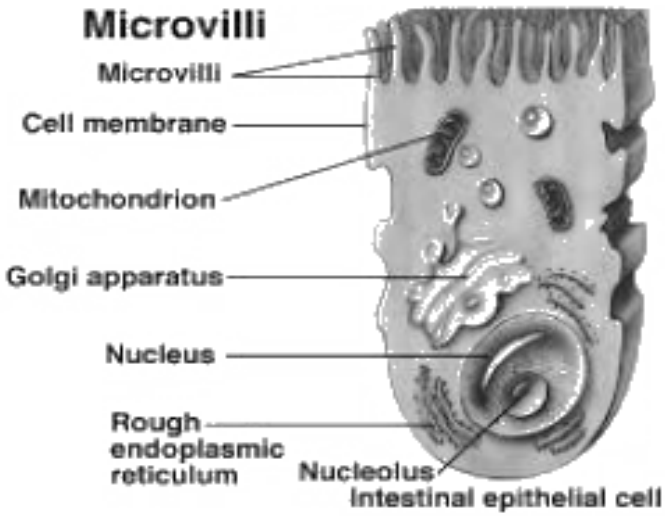
Apical modifications

- Fingerlike cytoplasmic projections on the apical surface
- Internal structure of microvilli contain a core of actin filaments
- Increase the surface of absorption (small intestine
- capable of moving fluid and particles along the epithelial surface (bronchial tree, oviducts)
- present in sperm cell as flagella (forward movement)





Cilia vs Microvilli

Cilia	Microvilli
	
Occur in cells of respiratory and reproductive tracts.	Found in intenstine; where absorption an secretions are the major activities
Arise from the basal granules	Basal granules are absent
Motile	Non motile
Cilia has 9+2 ultra structure	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.

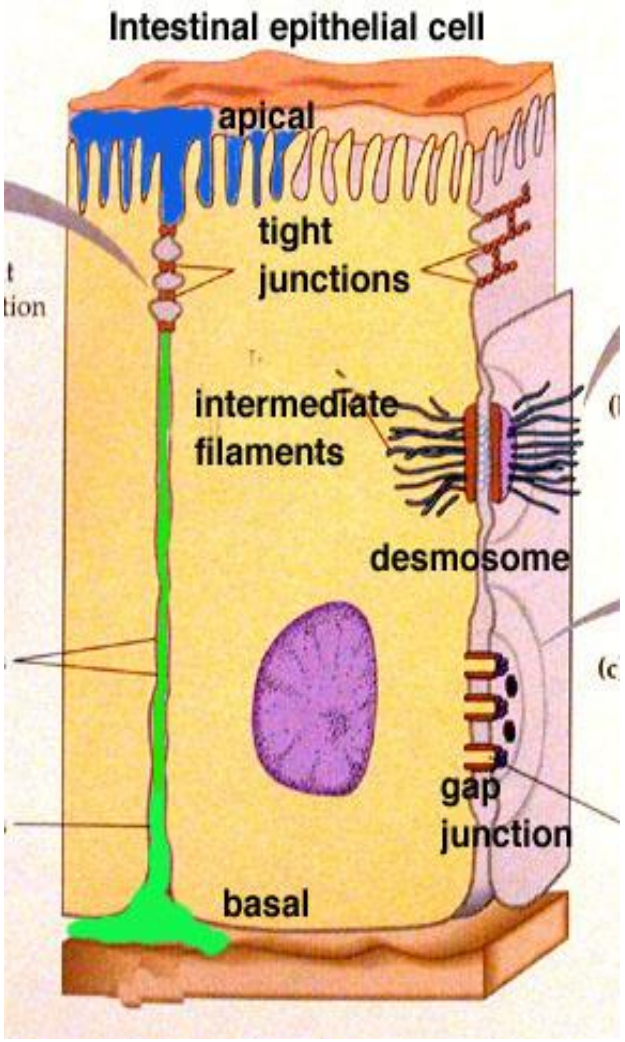
2- Anchoring junctions: (Adhering)

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

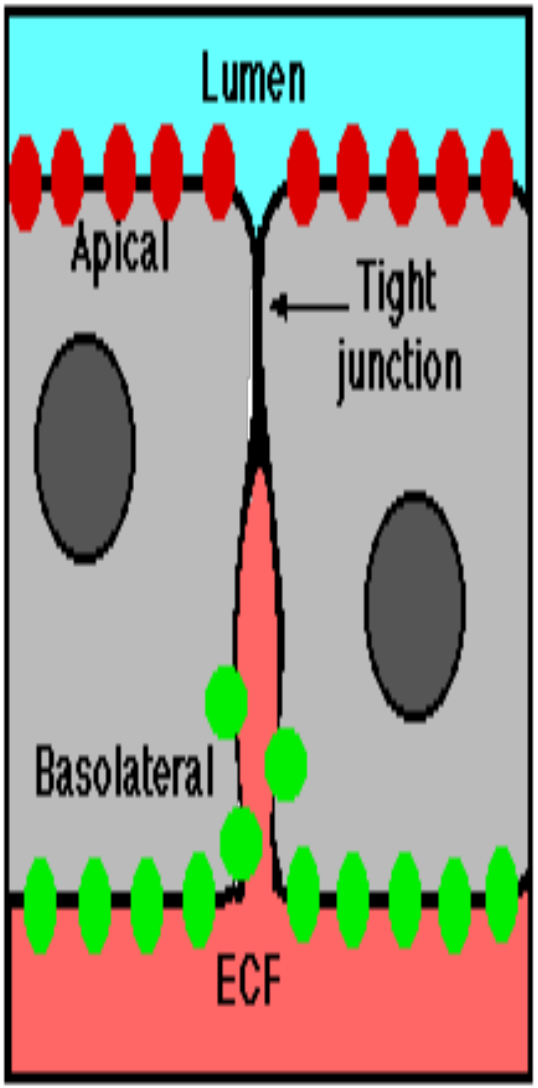
3- Communicating junctions: (Gap) allow movement of molecules between cells

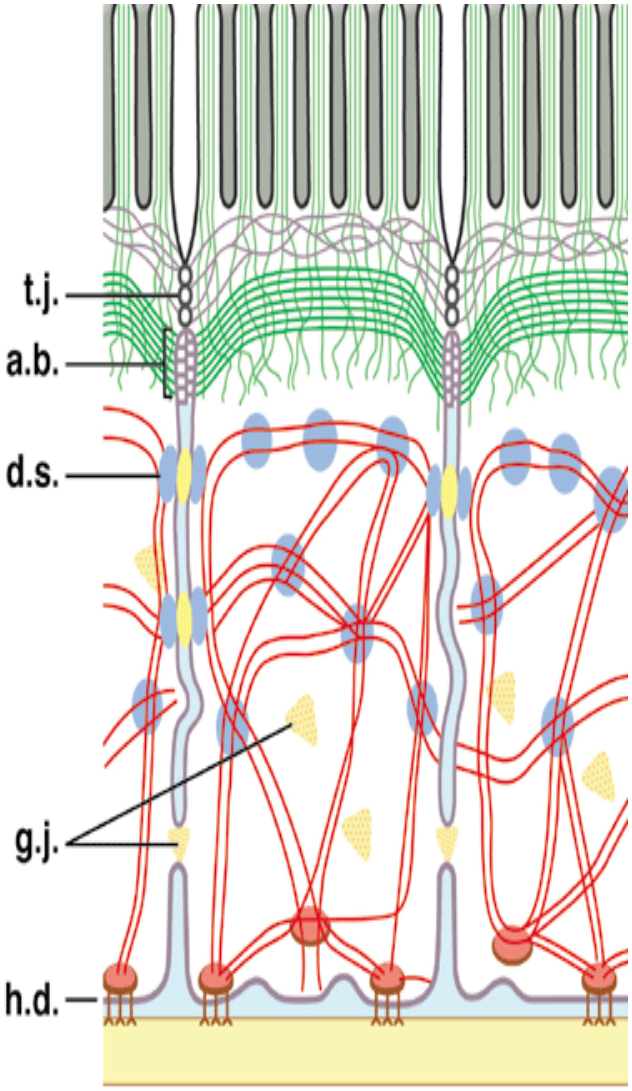
It permits the exchange of molecules e.g. ions, amino acids allowing integration, communication and coordination between cells

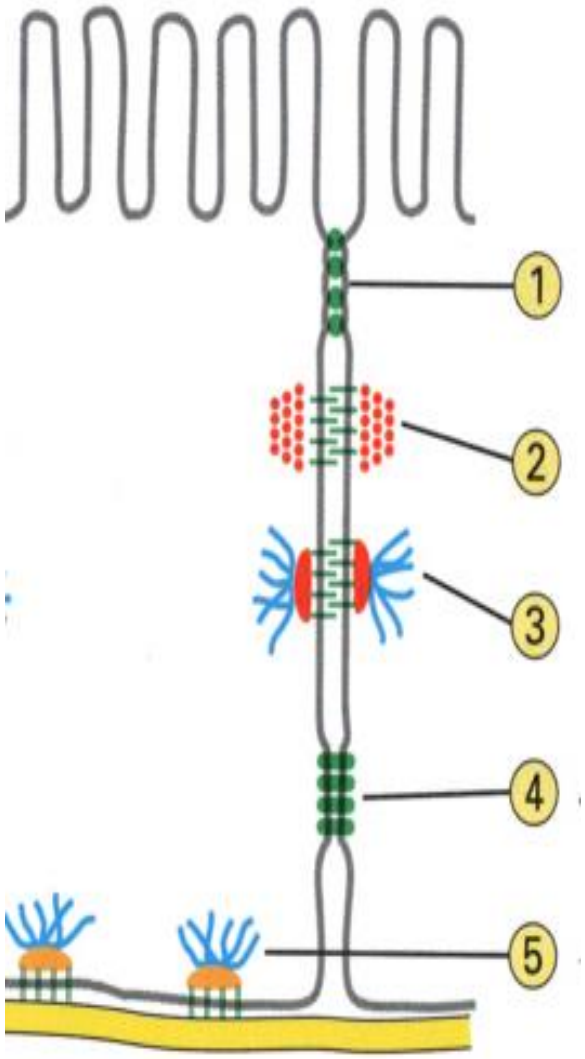
It is found mainly in cardiac and smooth muscle cells



Intercellular junctions





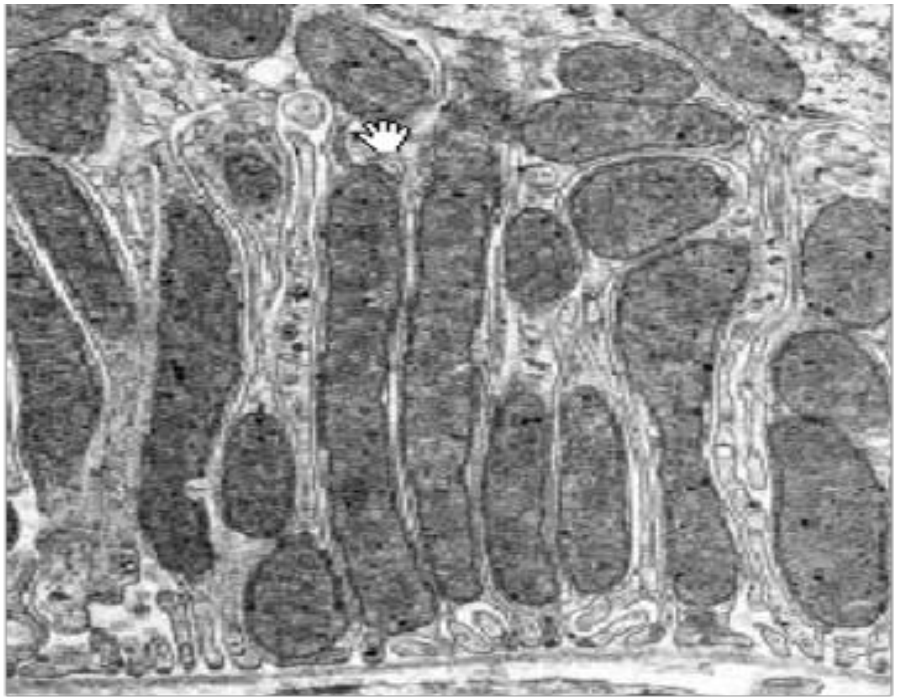


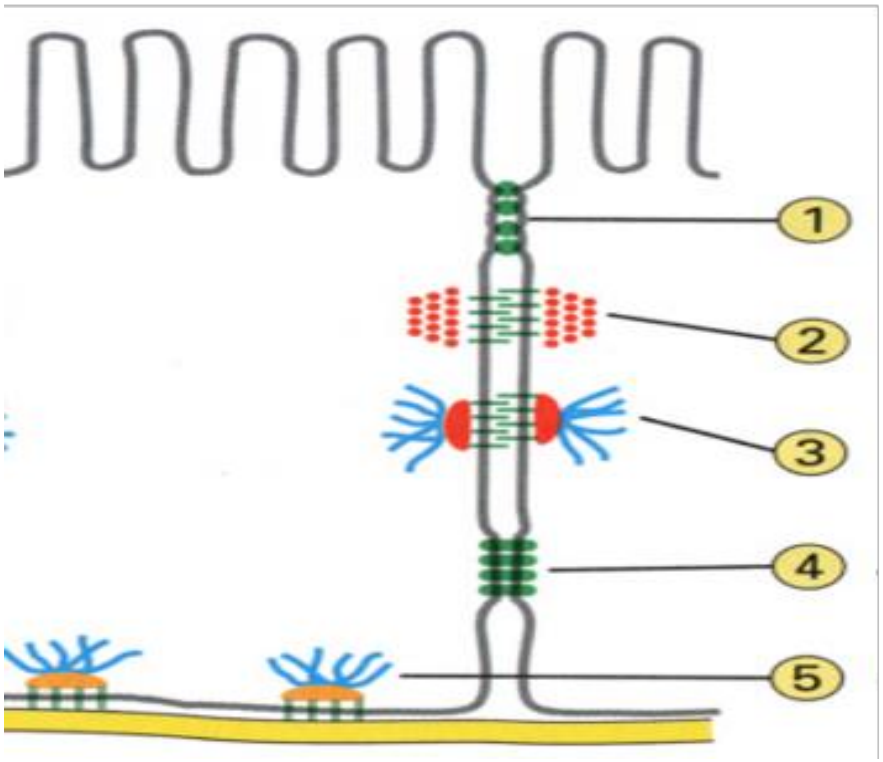
- Tight junctions - in the intestines – helps to keep the intestinal bacteria and toxins out of the bloodstream
- Desmosomes - skin – gives the ability to stretch but keeps cells together
- Gap junctions - cardiac muscle – allows to spread action potential for contraction of cardiomyocytes

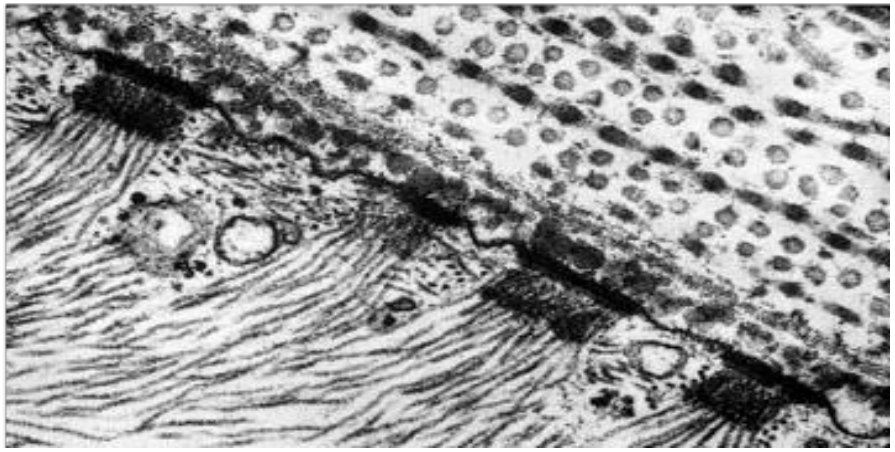
Basal modifications

A part of the cell faced towards the basement membrane

- Basal infolding
- Hemidesmosome
- Basement membrane







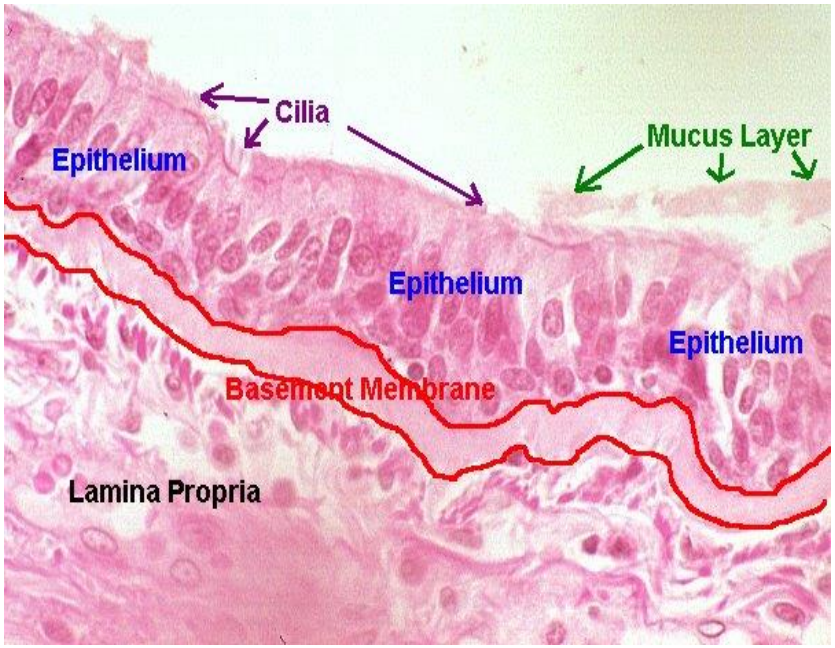
Basement membrane

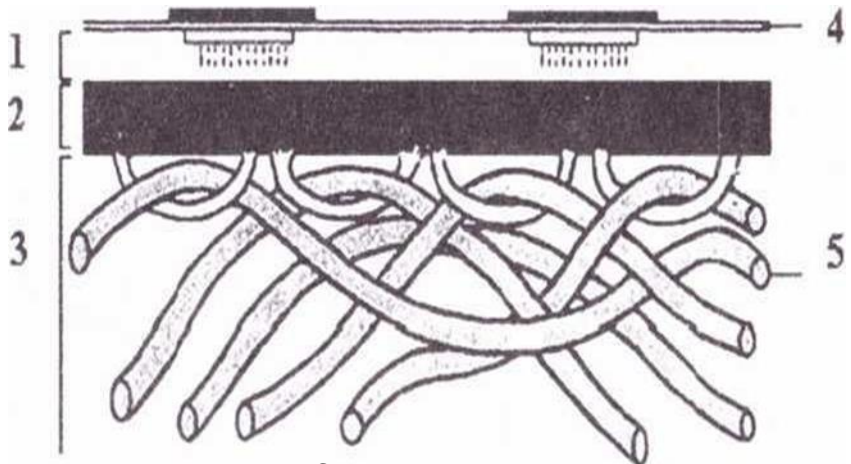
- a thin, fibrous, extracellular matrix that separates the epithelial cells from underlying connective tissue two parts:
- **Basal lamina :**

1- lamina lucida

2- lamina densa

- Collagen type IV ,Heparan sulfate , Fibronectine and laminine
- Produced by epithelial cell
- **Reticular lamina** : Type VII collagen + Collagen type III (reticular fibers) ,Proteoglycans
- Secreted by C.T. cells





Schematic diagram of the basement membrane.
1 - lamina lucida,
2- lamina densa,
3 - reticular lamina,

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.

Functions

- Anchoring the epithelial cells to underlying connective tissue
- Mechanical barrier
- Accelerates the differentiation of endothelial cells
- Allow nutrients and waste to diffuse

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, 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

Derivation

Ectoderm →

- Epidermis of skin
- Sweat glands and ducts

Mesoderm →

- Endothelium lining of blood vessels
- Mesothelium lining of body cavities
- Lining of urinary and genital organs

Endoderm →

- Lining of gastrointestinal tract& liver
- Lining of respiratory tract

Mitotic activity

Most epithelial cells have a life span less than that of the whole organism

The replacement of cells produced by mitotic activity of adult stem cells .

e.g. The stratified squamous epithelium of skin is replaced in a period of approximately 28 days.