



КАЗАНСКИЙ (ПРИВОЛЖСКИЙ) ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ

EPITHELIAL TISSUE



Histology = the study of tissues



*Tissue = a complex of cells
that have a common function*

The Four Primary Tissue Types:



- ✓ **Epithelium (epithelial tissue)** covers body surfaces, lines body cavities, and forms glands.
- ✓ **Connective tissue** underlies or supports the other three basic tissues, both structurally and functionally.
- ✓ **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:

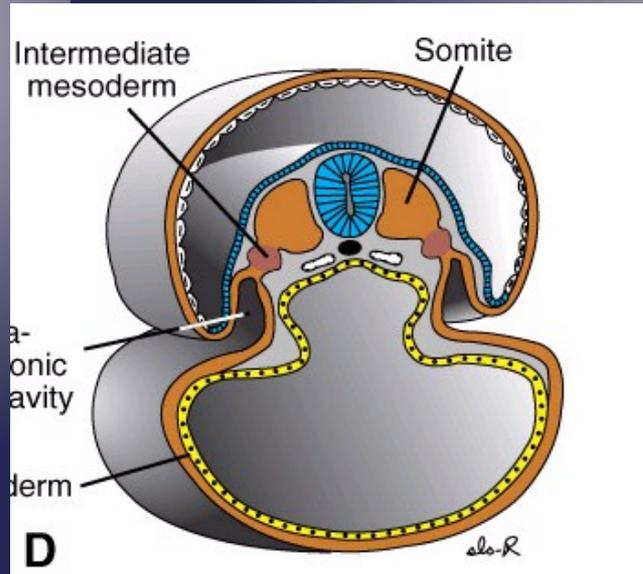
1. Can be derivate of all three germ layers
2. Cells show polarity
3. Little intercellular material
4. Cells are laying close to each other
5. Tend to form junctions
6. Rest on a basement membrane
7. Lack vessels
8. Line surfaces and cavities or form glands
9. Mitotically active

Derivation

Ectoderm

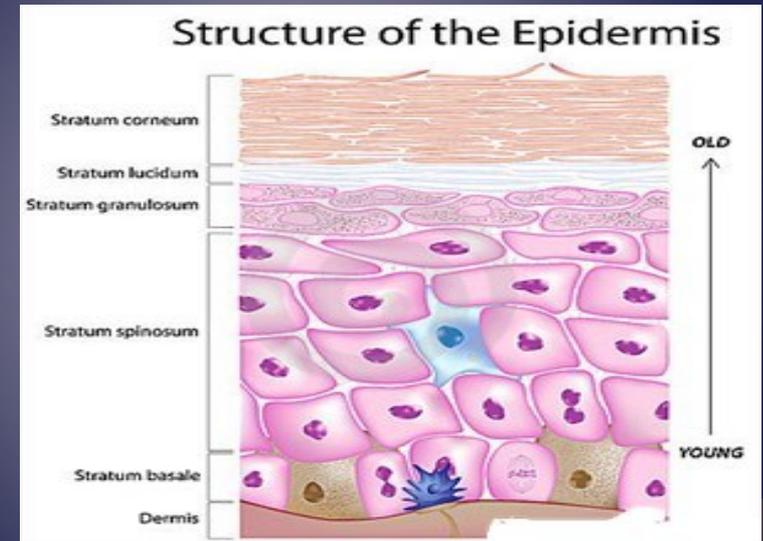
Mesoderm

Endoderm

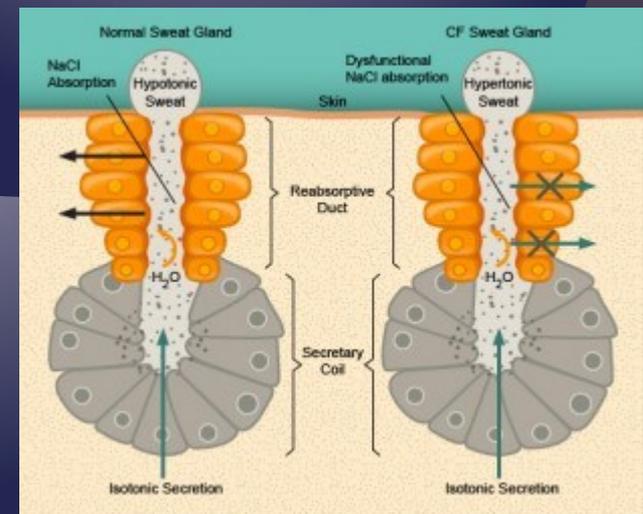


Ectoderm

➤ Epidermis of skin

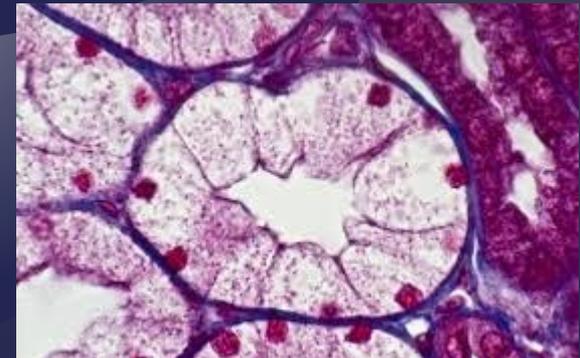
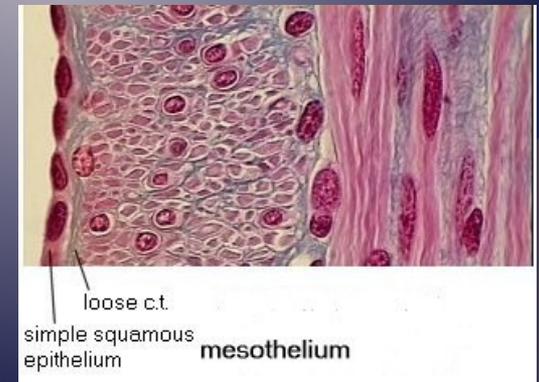
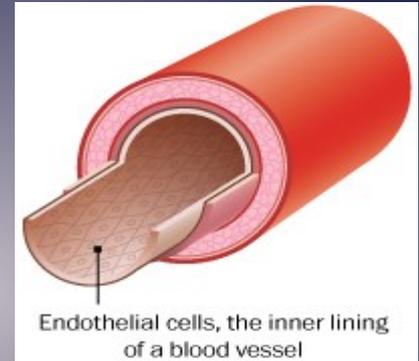


➤ Sweat glands and ducts



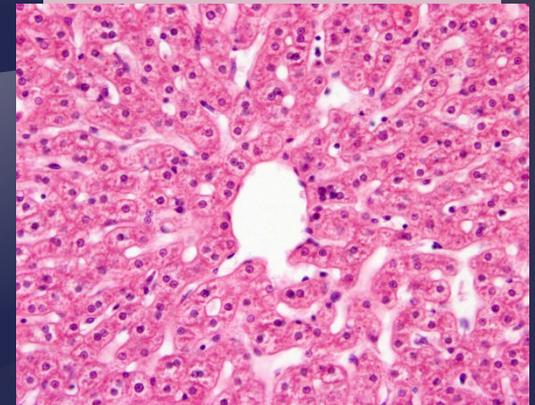
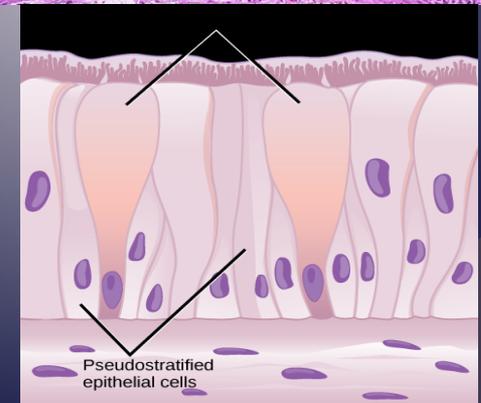
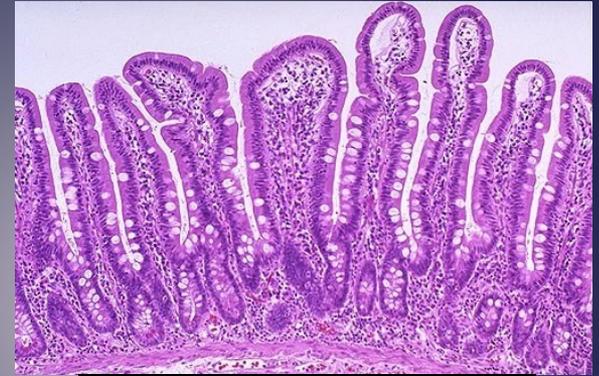
Mesoderm

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



Endoderm

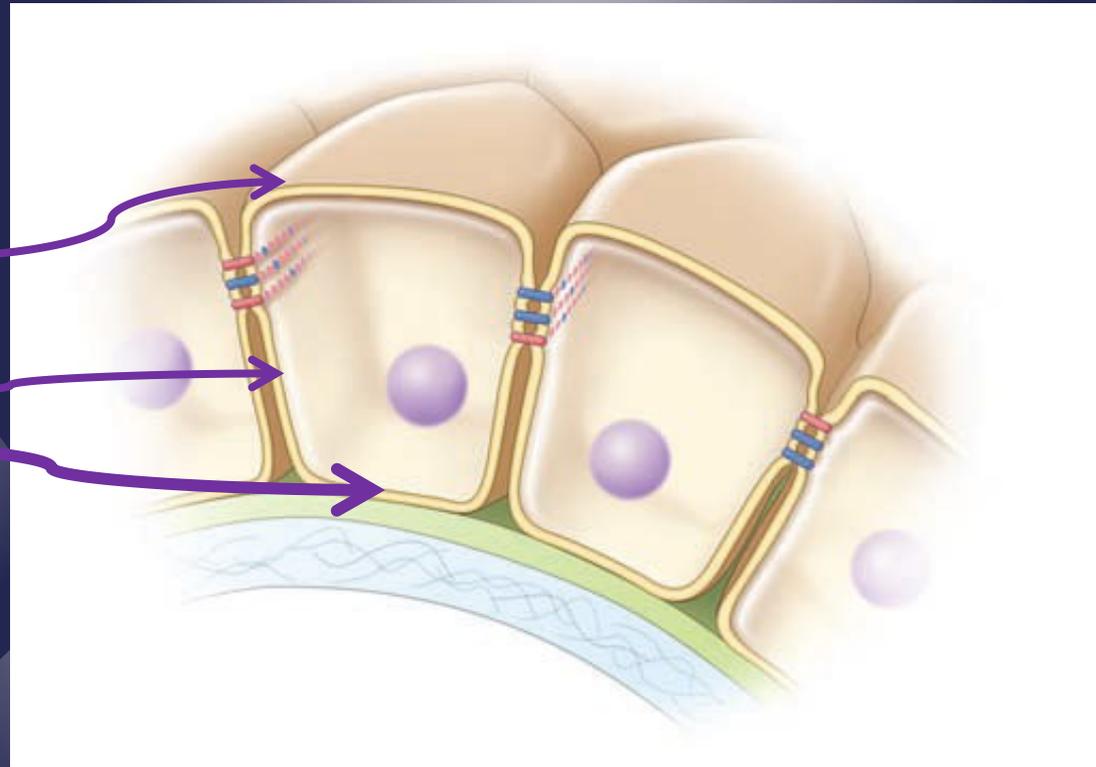
- Lining of gastrointestinal tract
- Lining of respiratory tract
- Liver



Polarity

Epithelial cells exhibit distinct polarity.

They have an apical domain,
a lateral domain,
and a basal domain.



The apical domain

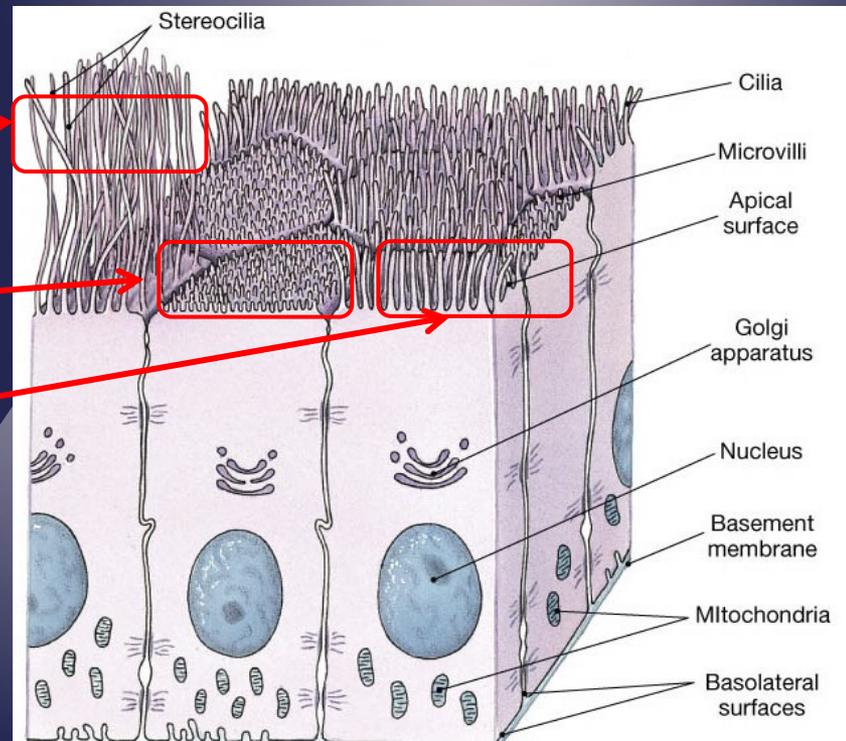
- Part of the epithelial cell that looks towards the lumen or the surface

- Can have:

- stereocilia

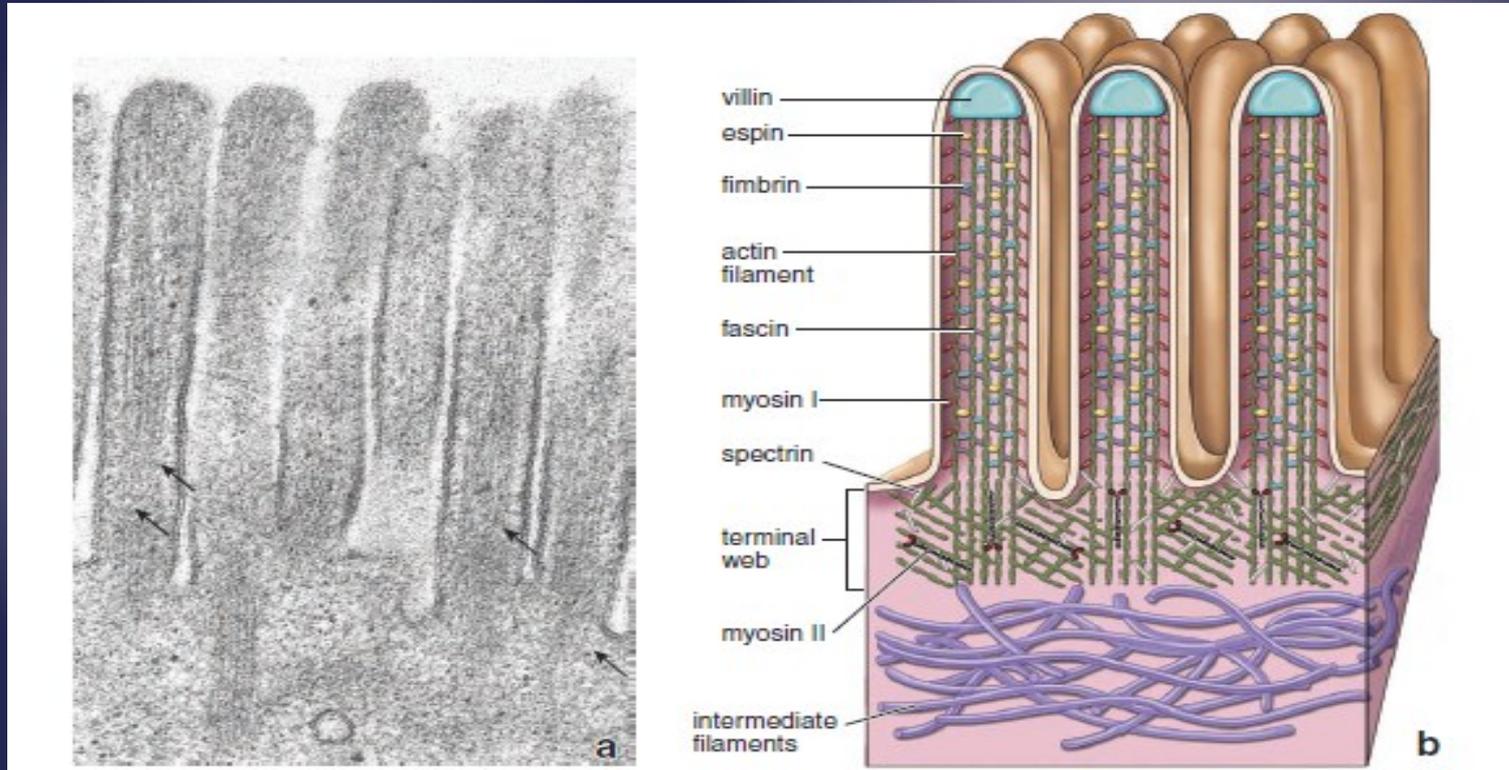
- microvilli

- cilia



Microvilli

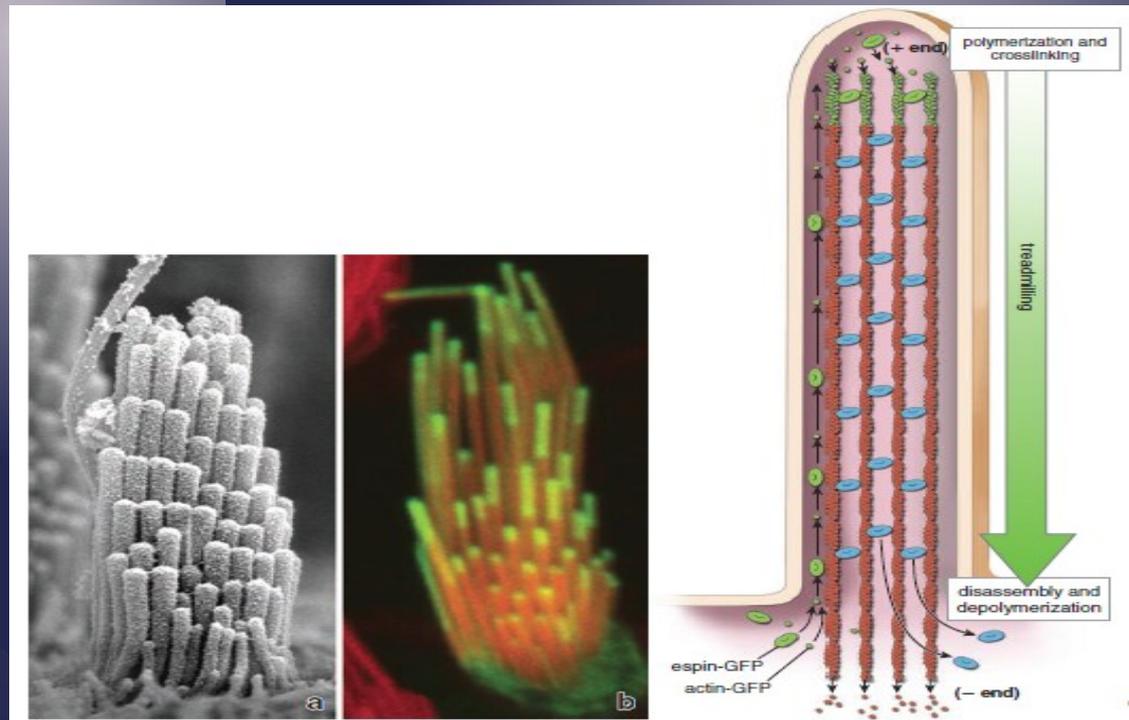
- Fingerlike cytoplasmic projections on the apical surface



- Internal structure of microvilli contain a core of **actin filaments**
- **Increase the surface of absorption (small intestine)**

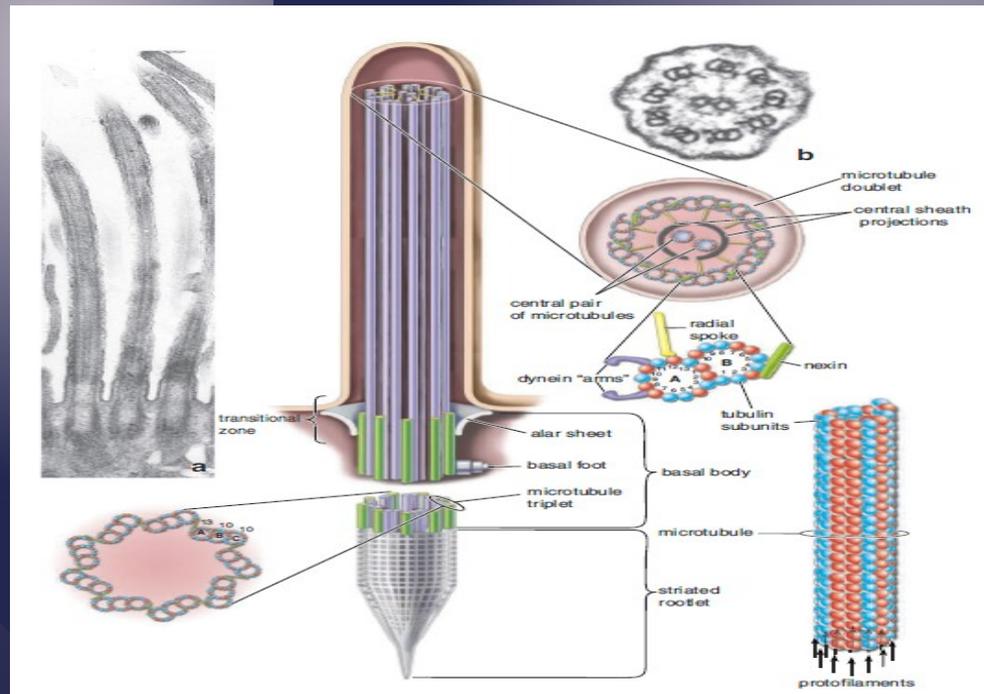
Stereocilia

- Unusually long, immotile microvilli
- In sense organs (hair cells) serve as mechanoreceptors
- In male reproductive system (epididymis) have absorptive function



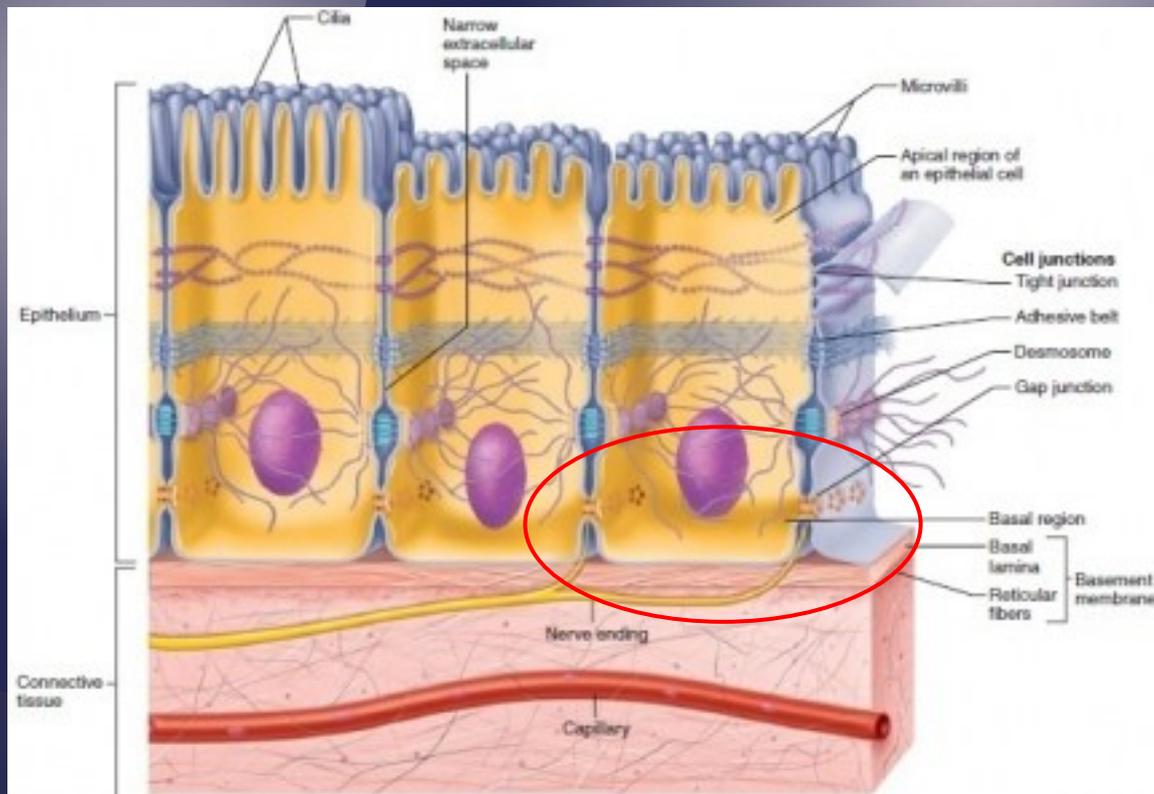
Cilia

- capable of moving fluid and particles along the epithelial surface (bronchial tree, oviducts)
- present in sperm cell as flagella (forward movement)



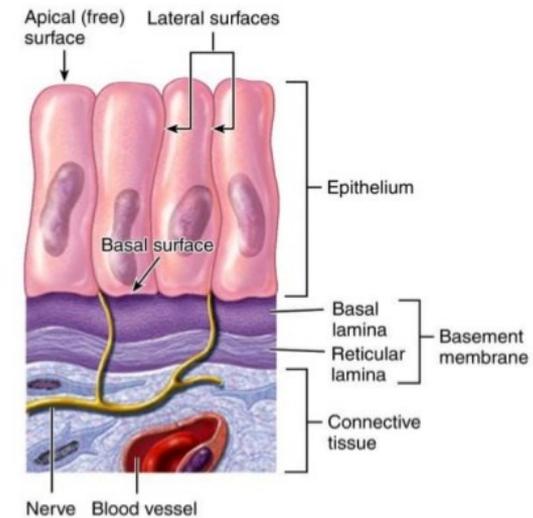
The basal domain

- A part of the cell faced towards the basement membrane



Basement membrane

- a thin, fibrous, extracellular matrix that separates the epithelial cells from underlying connective tissue

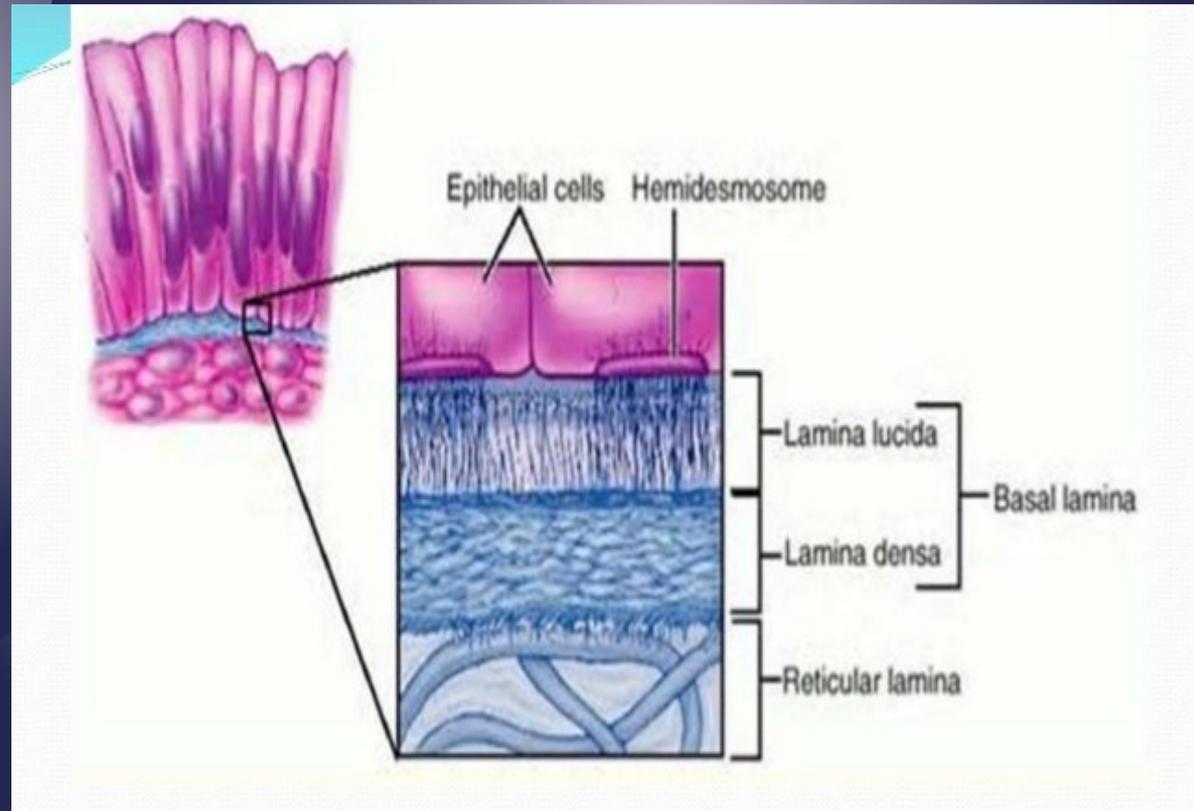


Basement membrane

Basal lamina:

- lamina lucida
- lamina densa

Reticular lamina

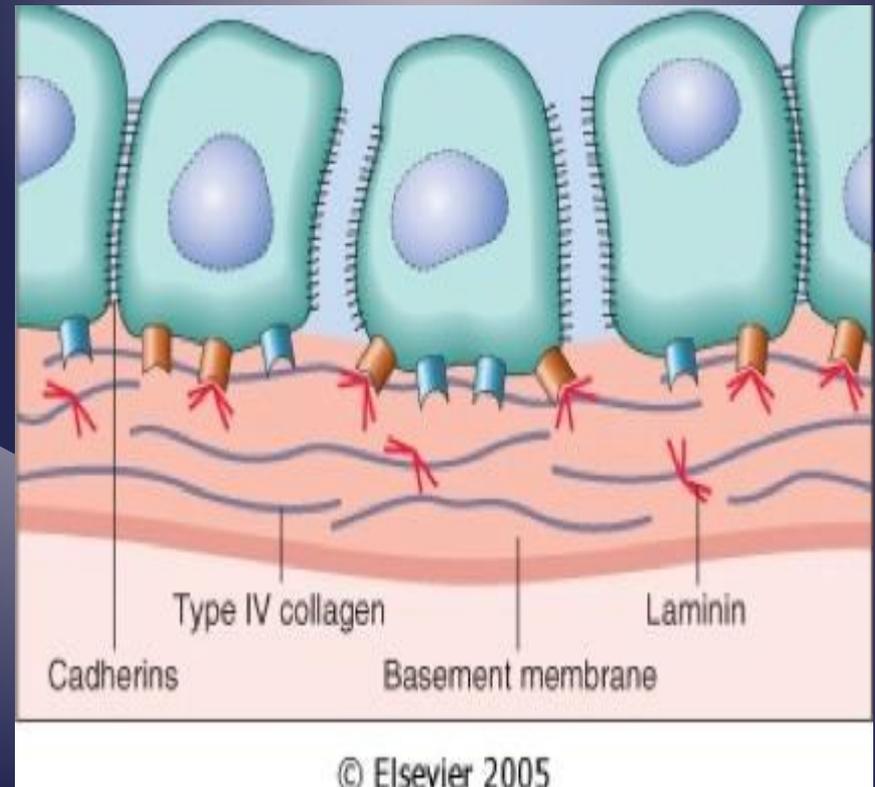


Basal lamina

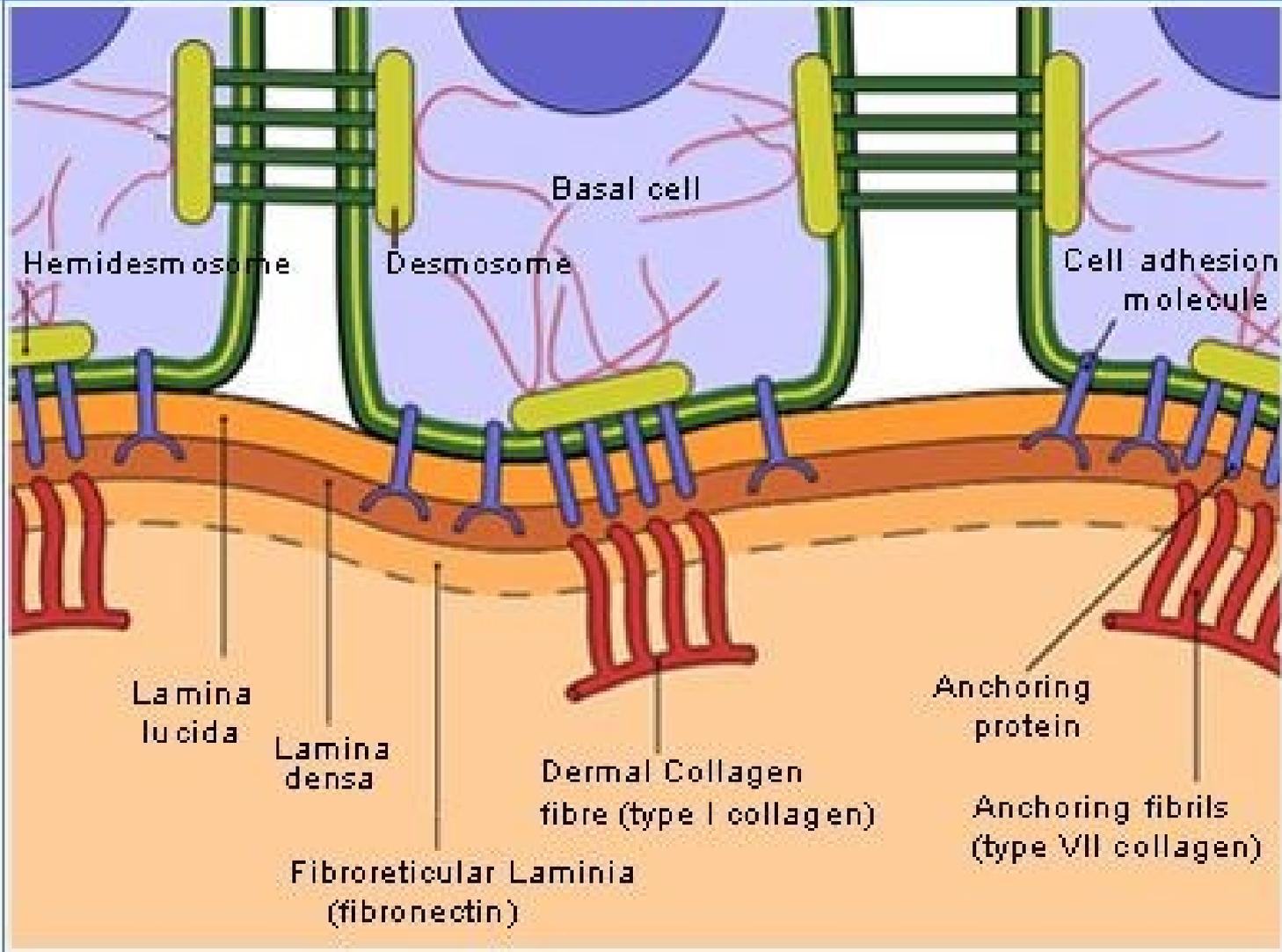
- ✓ Collagen type IV
- ✓ Heparan sulfate
- ✓ Fibronectine and laminine

Reticular lamina

- ✓ Collagen type III (reticular fibers)
- ✓ Proteoglycans



Basement membrane zone



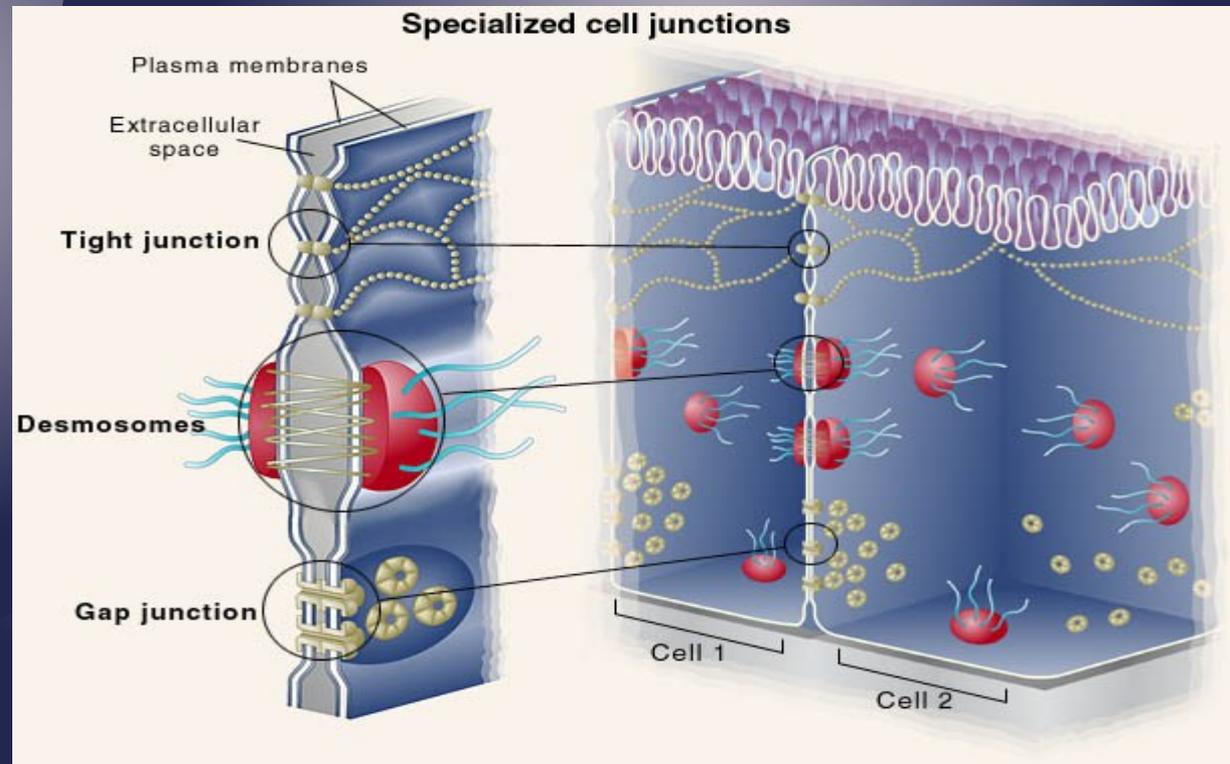
Functions of the basement membrane:

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

The lateral domain

Provide cellular connections

- Bind cells together
- Form permeability layer
- Intercellular communications

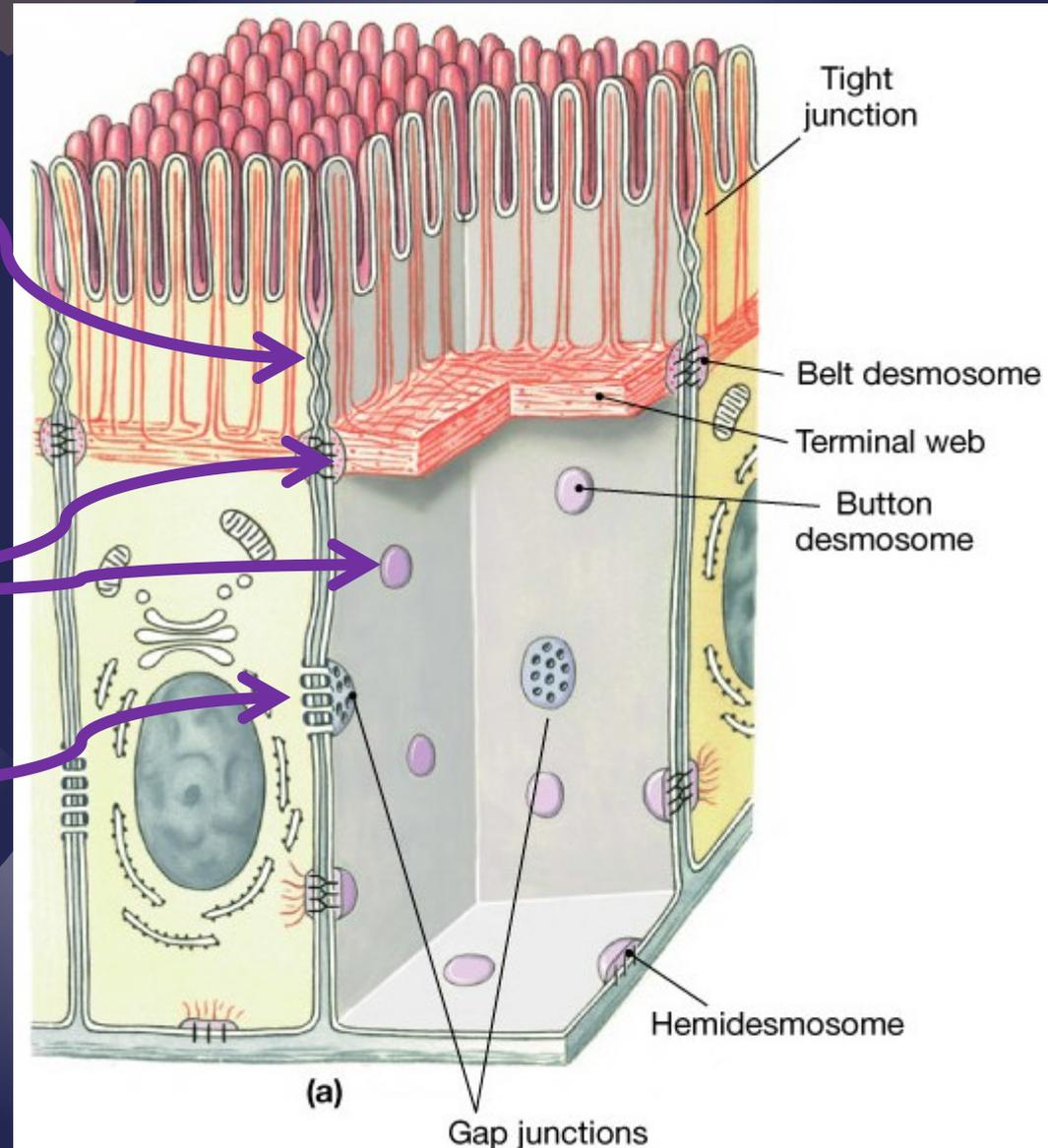


Types of cell junctions

Tight Junctions
(occluding junctions)

Desmosomes
(anchoring junctions)

Gap junctions
(communicating junctions)



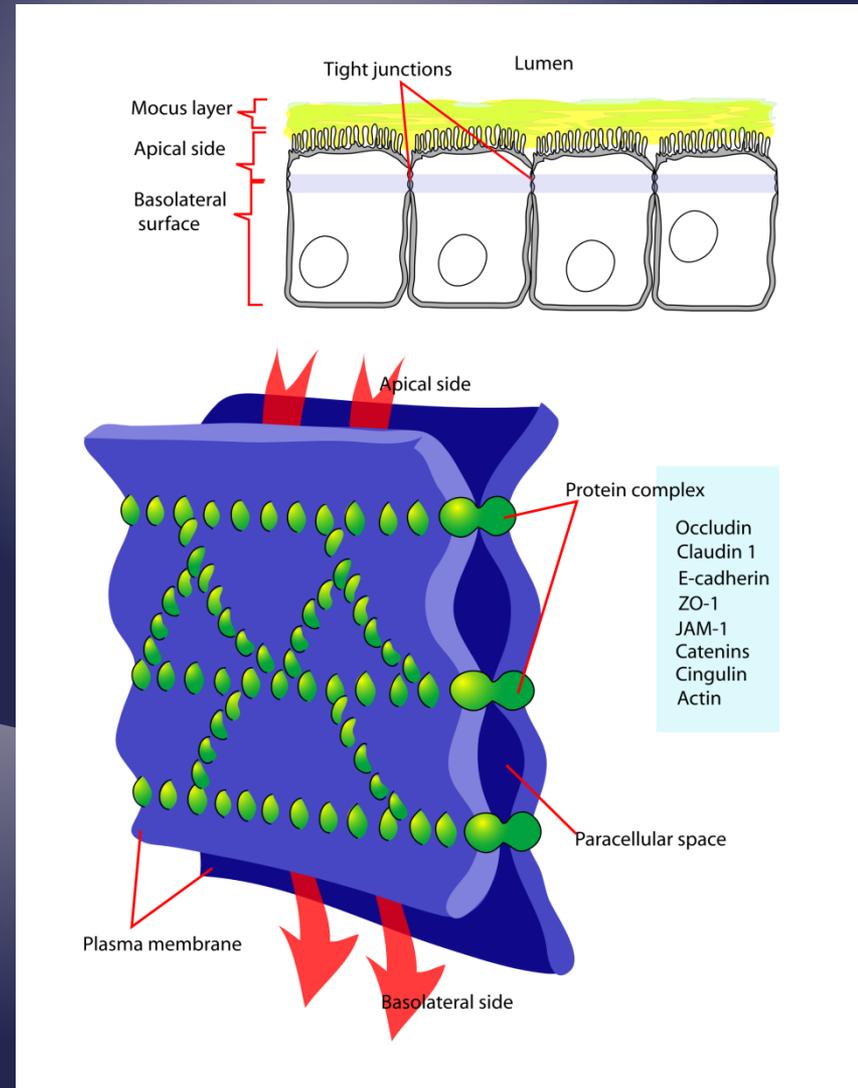
Tight junctions (occluding junctions)

✓ Plasma membranes of the neighboring cells are tightly sealed with each other

✓ 3 types of proteins:

- occludins
- claudins
- junctional adhesion molecules

✓ Functions as a permeability barrier
(ex. makes us waterproof)

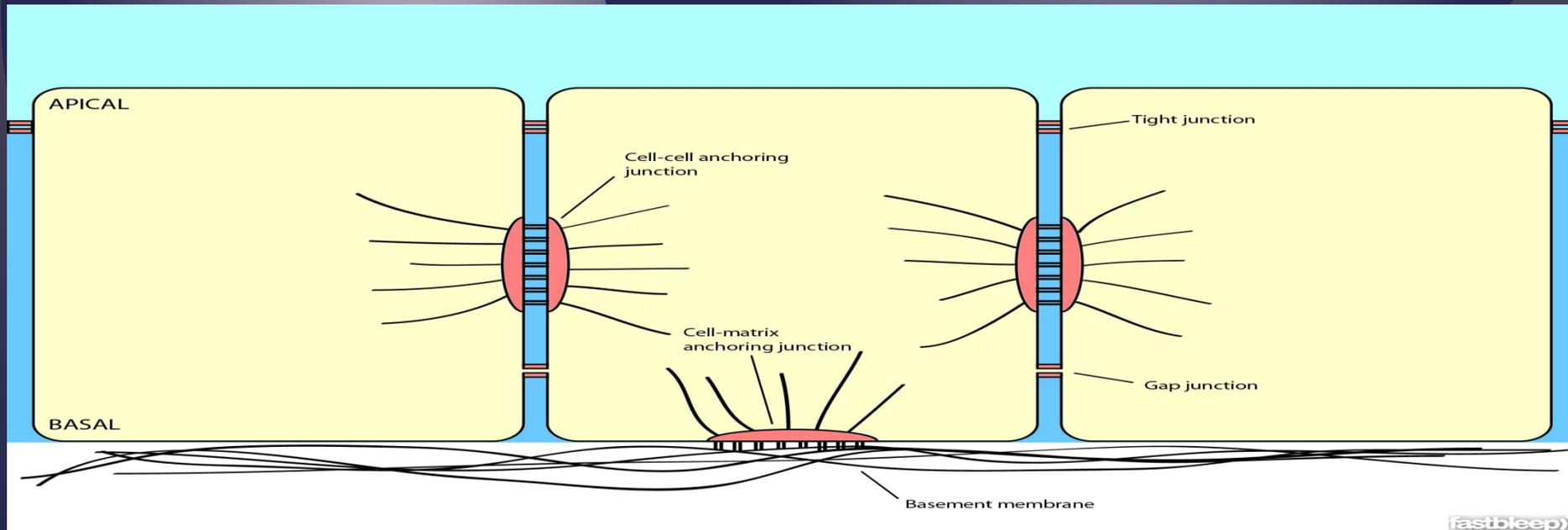


Anchoring junctions

Desmosomes

- ✓ Attach cytoskeleton of neighboring cells or to the extracellular matrix
 - Intracellular anchor proteins
 - Transmembrane adhesion proteins
- ✓ Do not prevent the flow of substances around cells

Hemidesmosomes



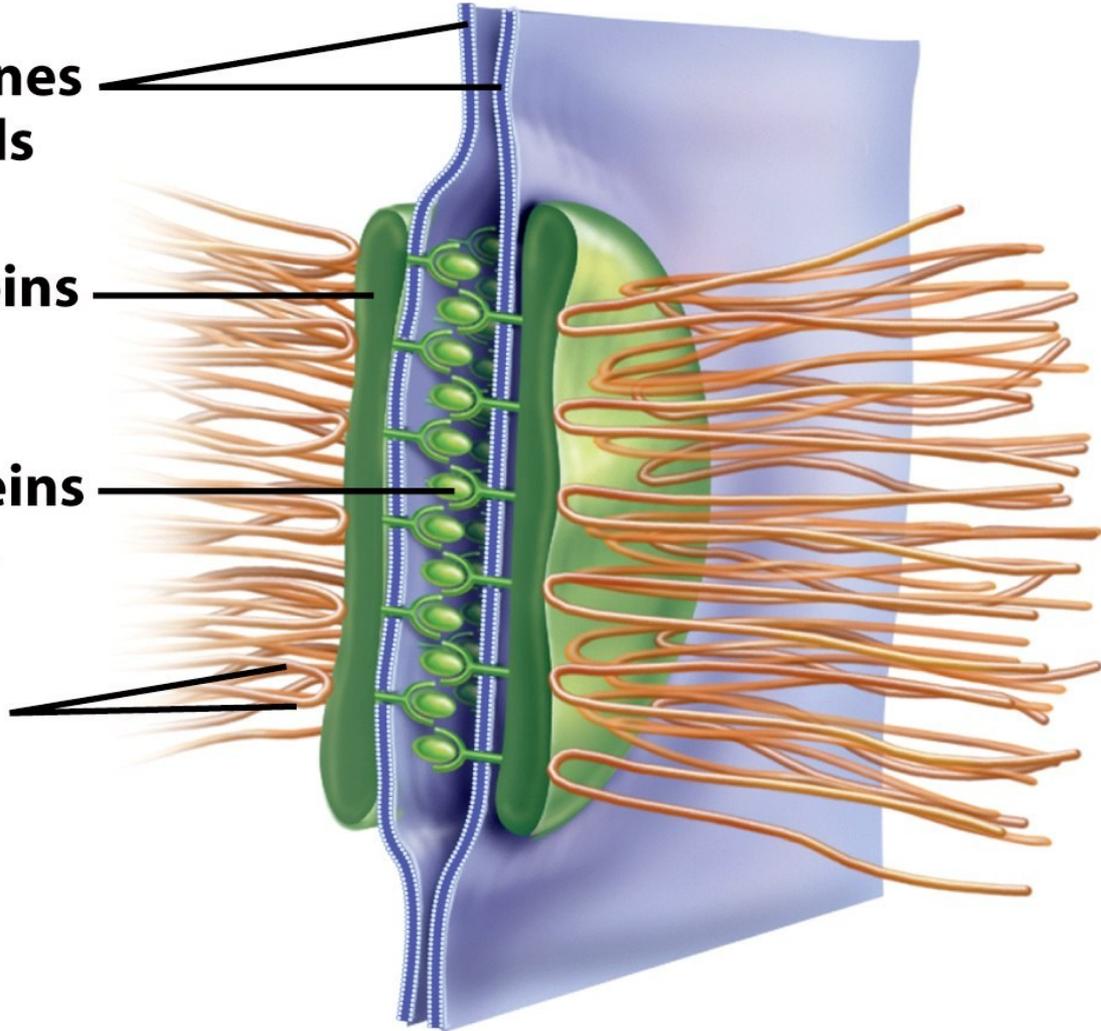
Three-dimensional view of desmosome

Plasma membranes
of adjacent cells

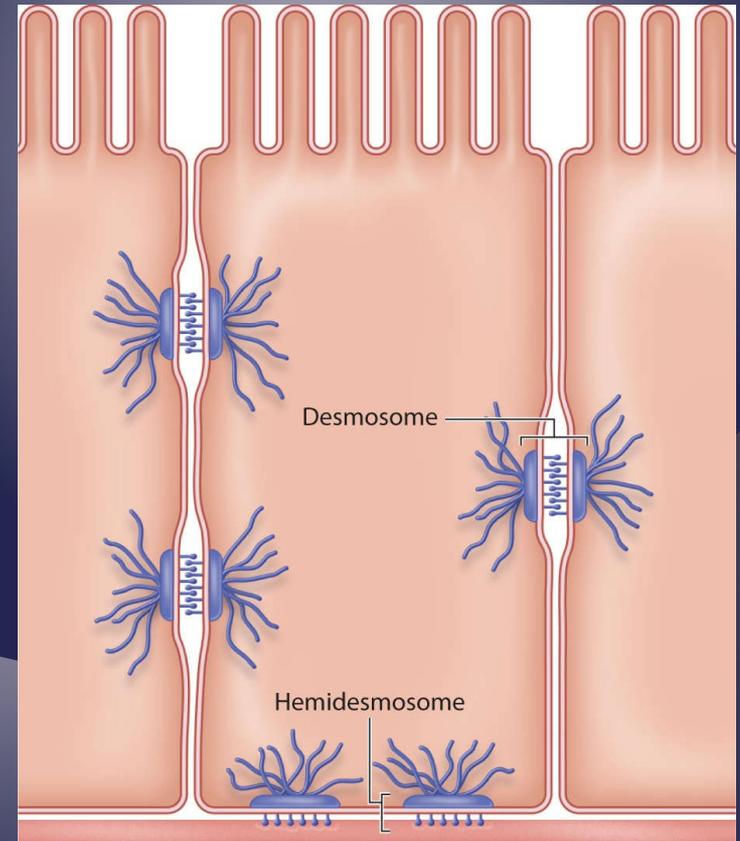
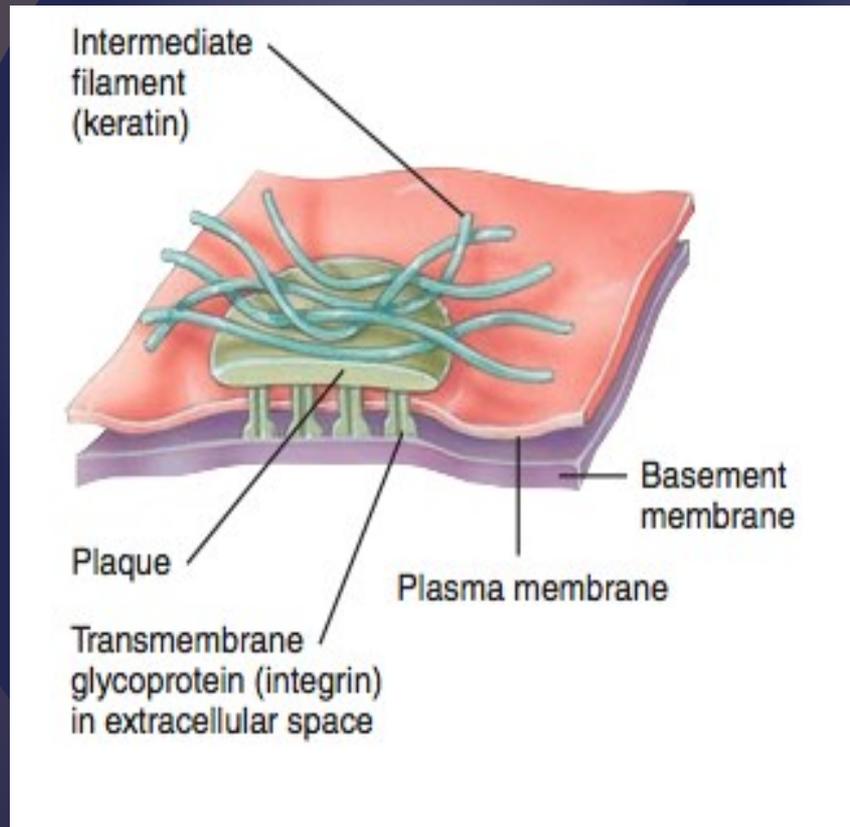
Anchoring proteins
in each cell

Membrane proteins
that link cells

Intermediate
filaments



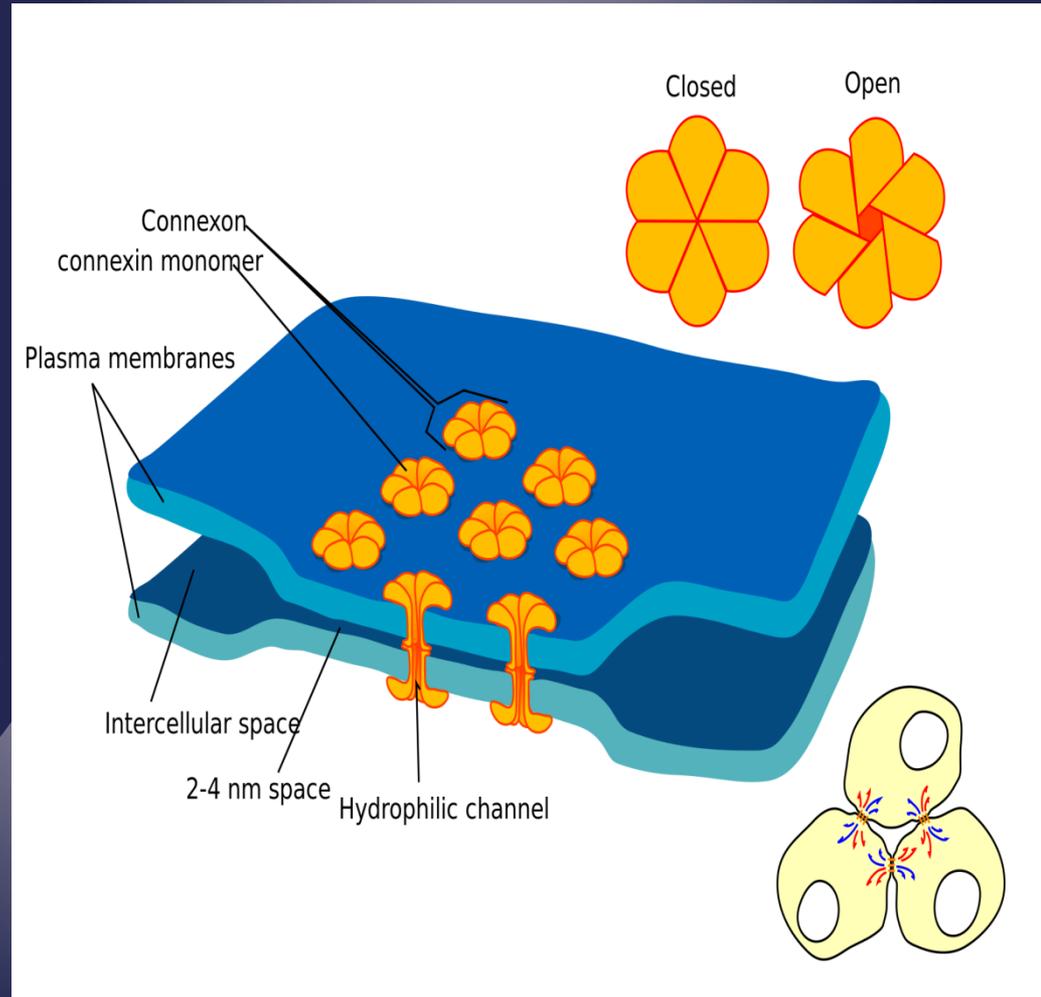
Hemidesmosome



Gap junction

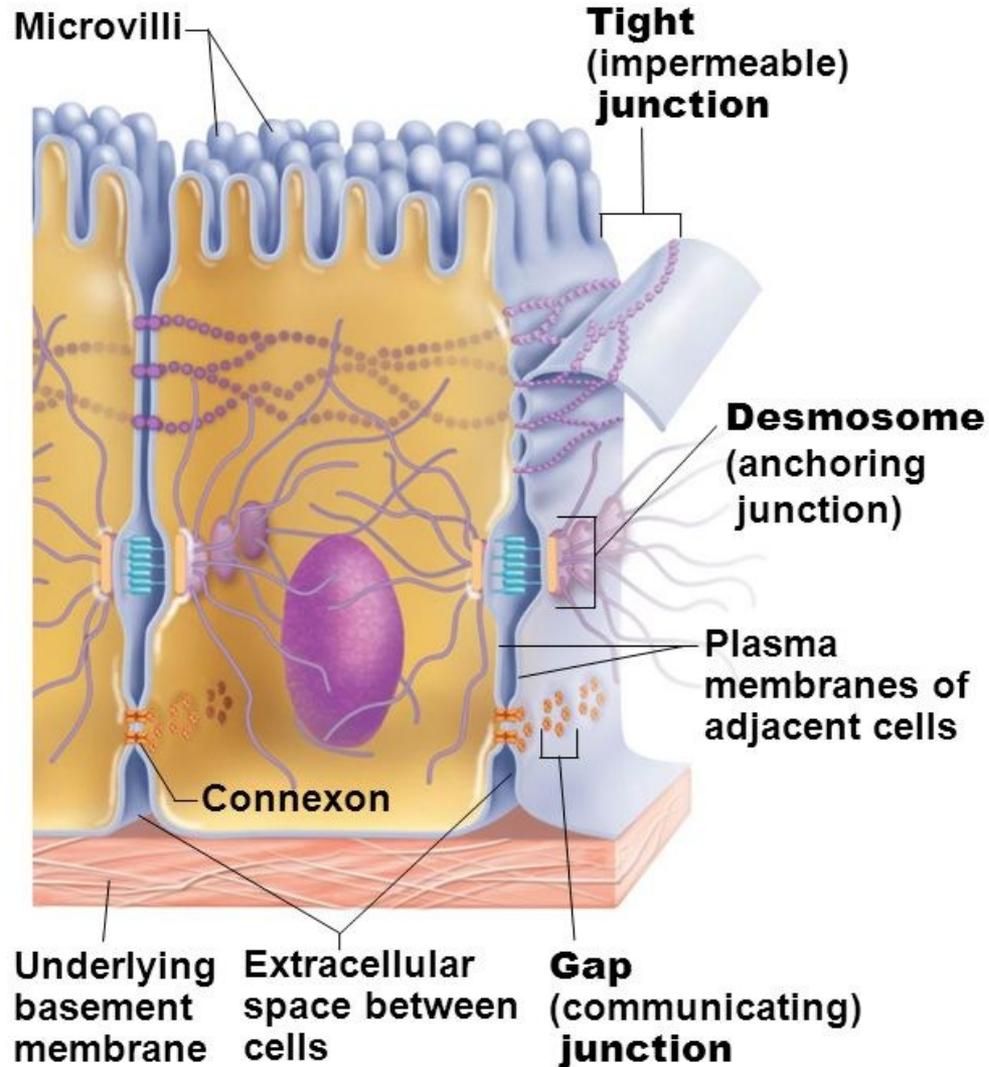
(communicating junction or nexus)

- ✓ Direct connection of the cytoplasm of two cells allows various molecules and ions to pass between cells
- ✓ Channels composed of transmembrane proteins – connexins
- ✓ Connexon – assembly of six connexin proteins creating a gap between plasma membranes of two cells



Junctional Complexes

Figure 3.3 Cell junctions.



Examples:

✓ 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

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**

- The **stratified squamous epithelium of skin** is replaced in a period of approximately 28 days.

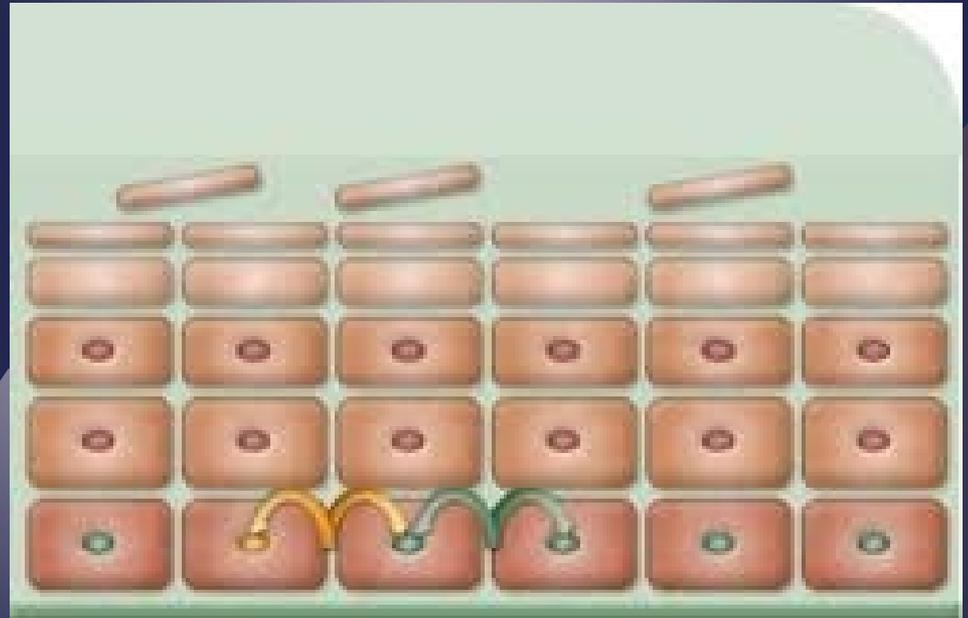
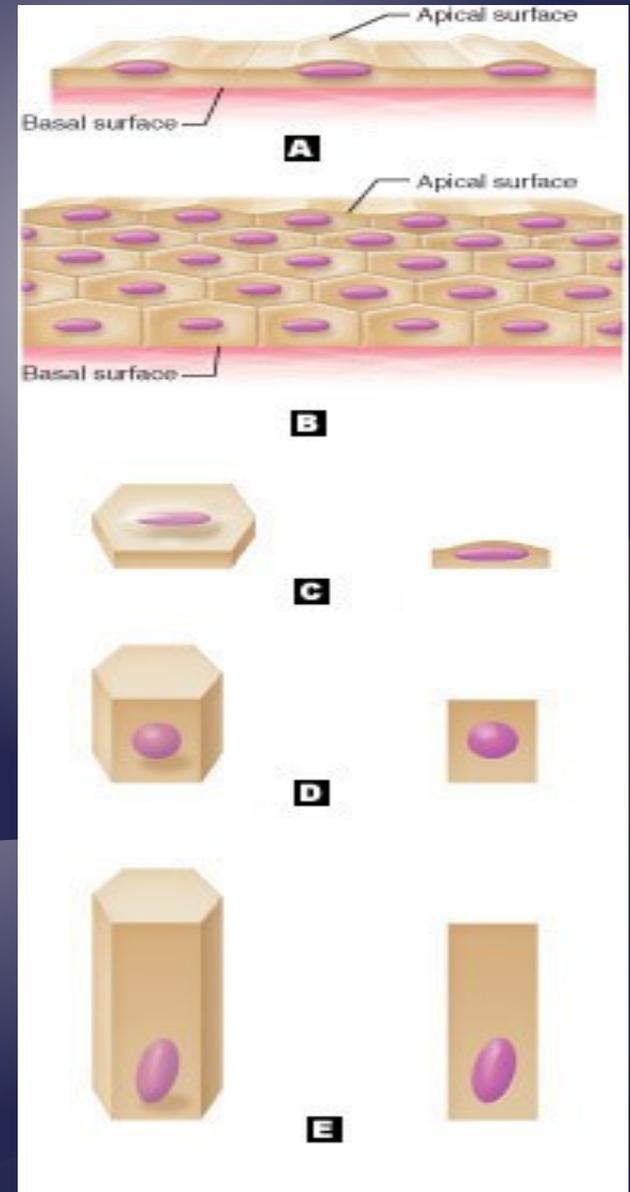


Figure 1 – Epidermal regeneration.

Classification of epithelium

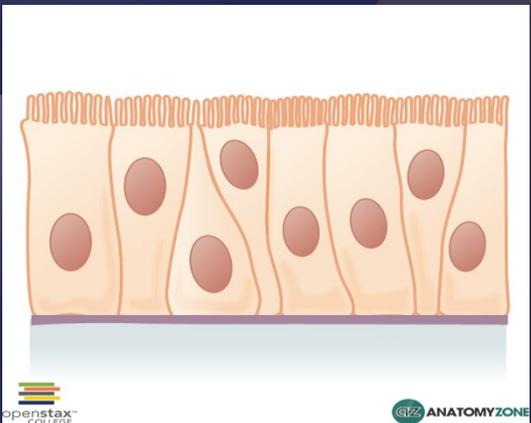
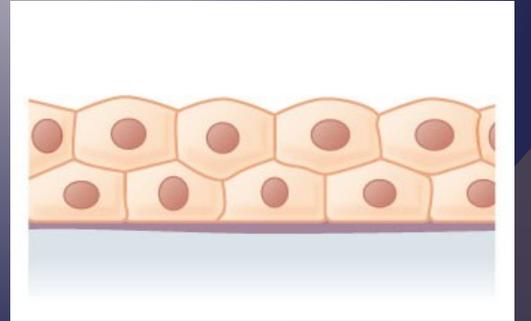
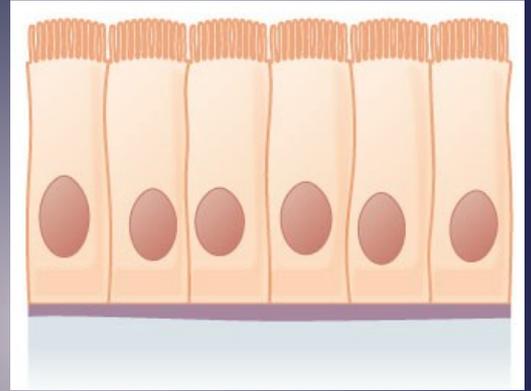
1. Number of cell layers

2. Shape of cells in the superficial layer



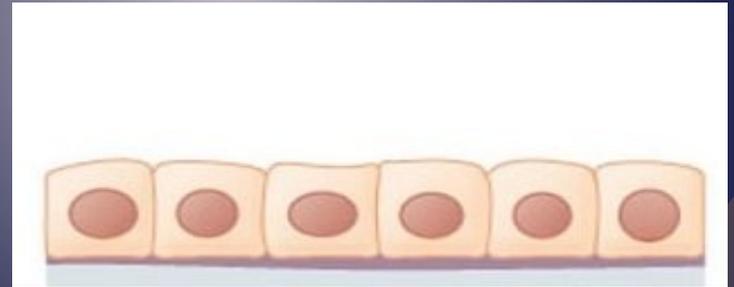
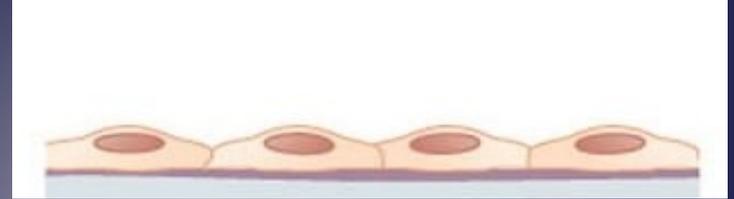
Number of cell layers

- ✓ **Simple** epithelium - single layer of cells
- ✓ **Stratified** epithelium - several layers of cells
- ✓ **Pseudostratified** epithelium – single layer of cells of variable size and shape, with nuclei at a different layer

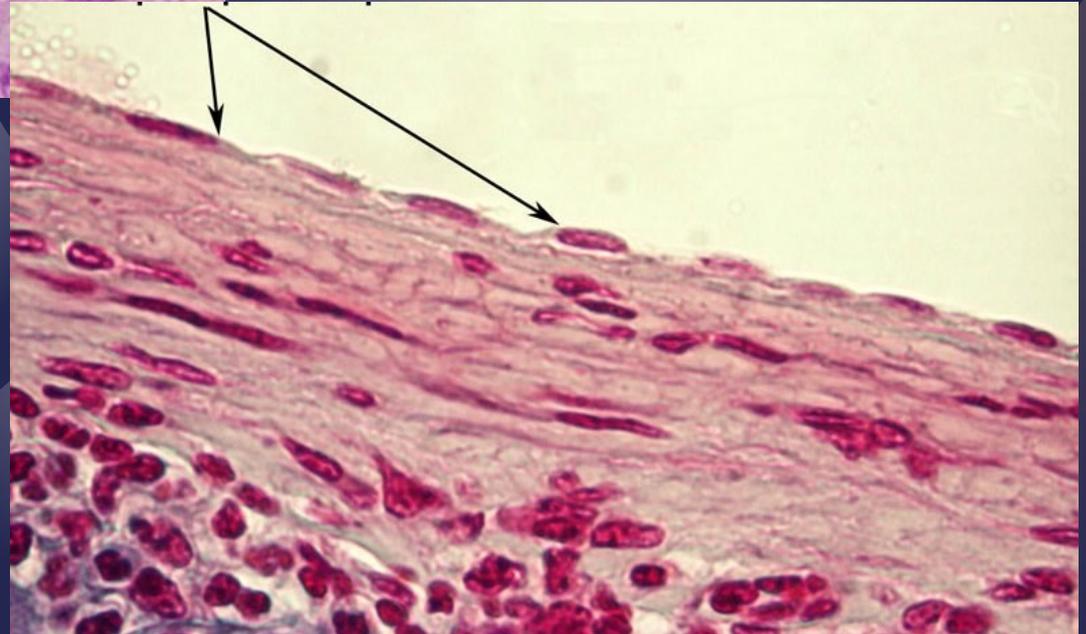
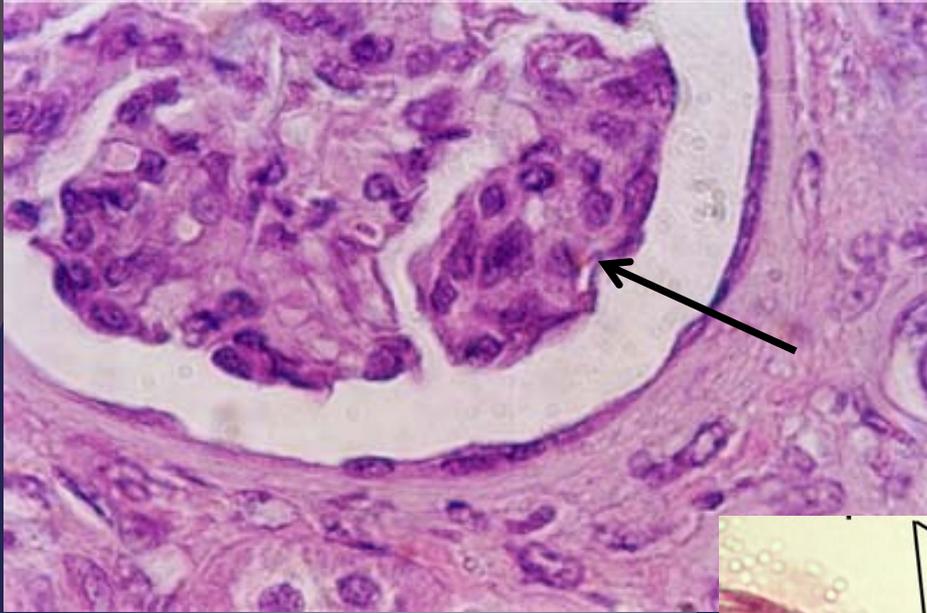


Shape of cells

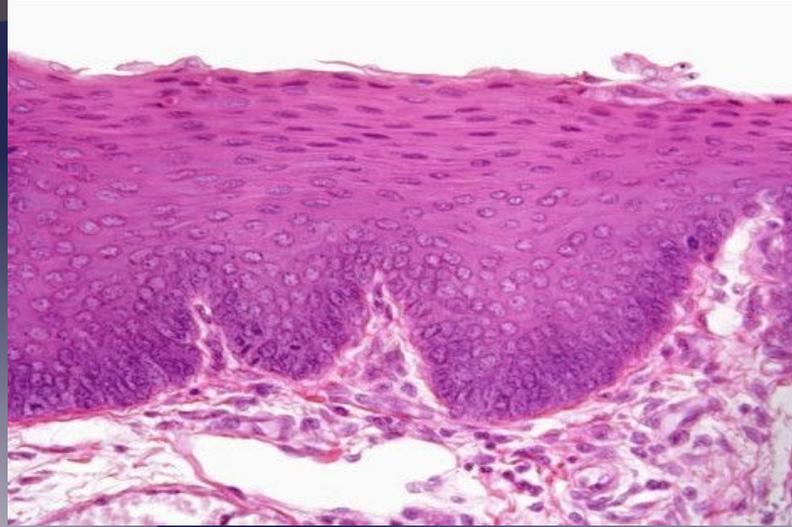
- ✓ **Squamous** - the width of the cell is greater than its height;
- ✓ **Cuboidal** - the width, depth, and height are approximately the same;
- ✓ **Columnar** - the height of the cell exceeds the width



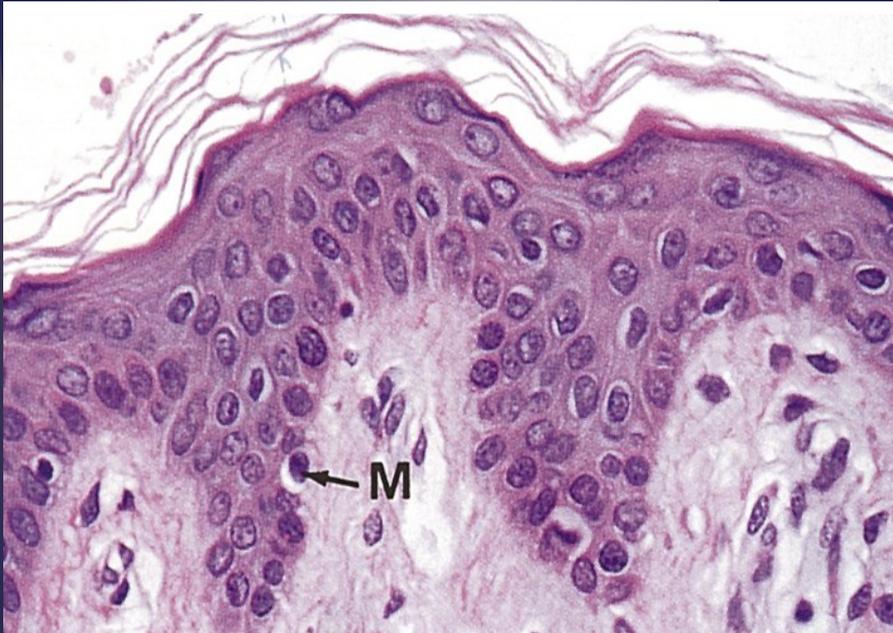
Simple squamous epithelium

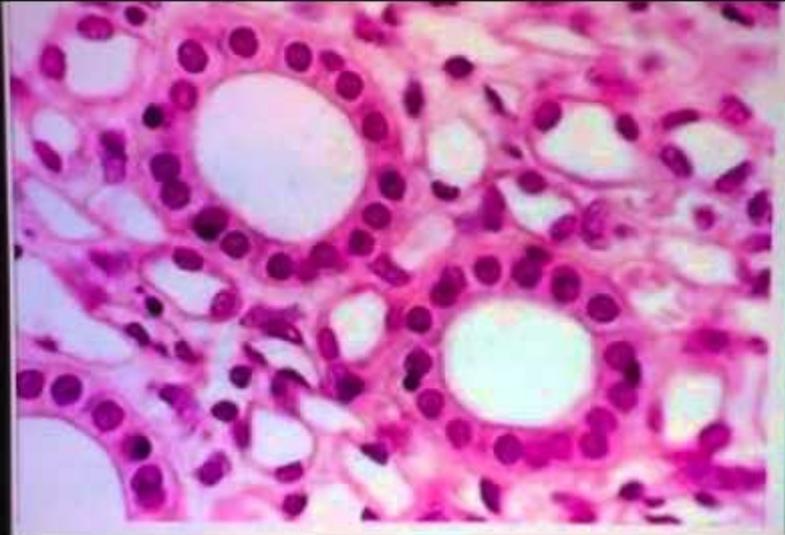


Stratified squamous nonkeratinized



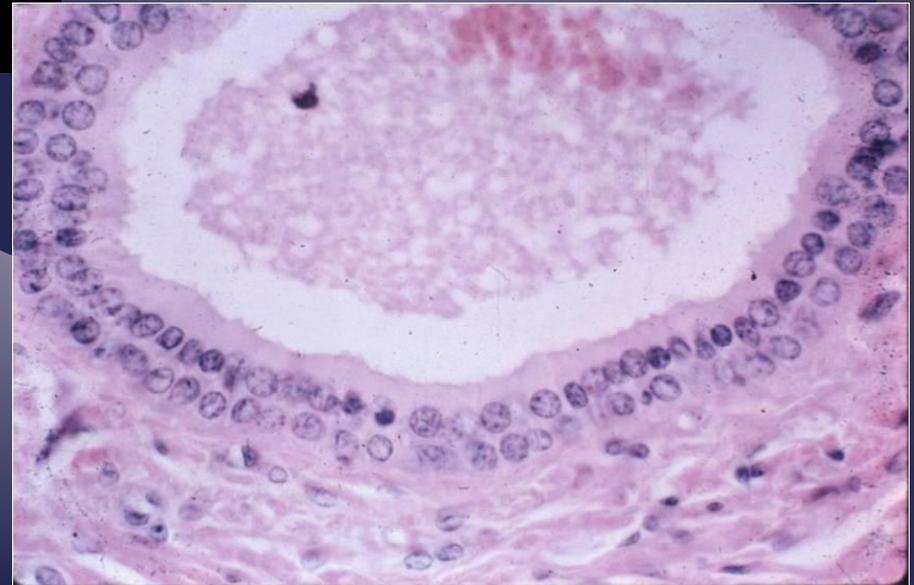
Stratified squamous keratinized



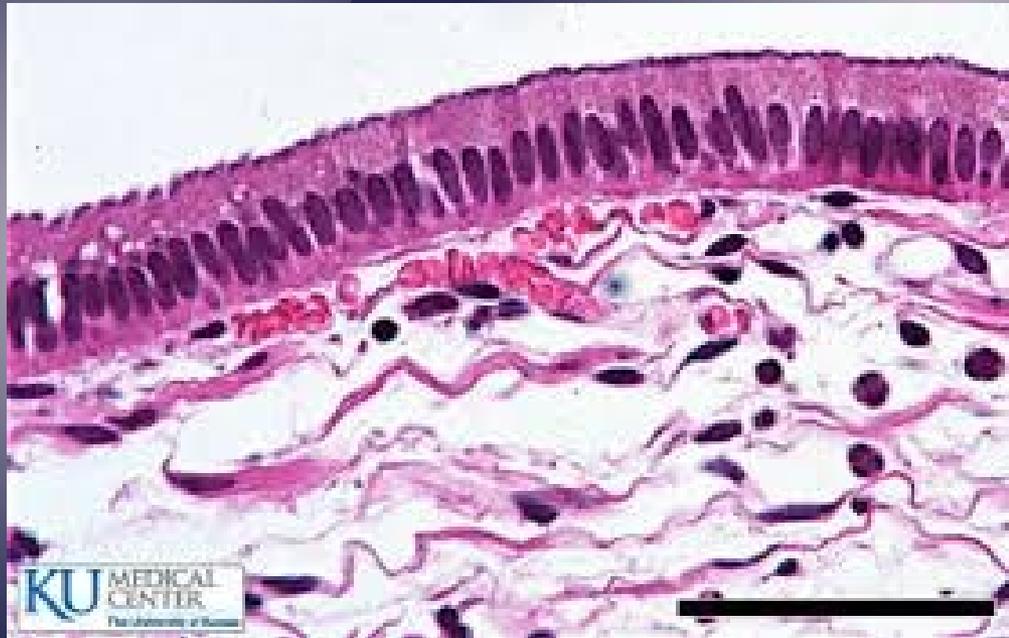


**Simple cuboidal
epithelium**

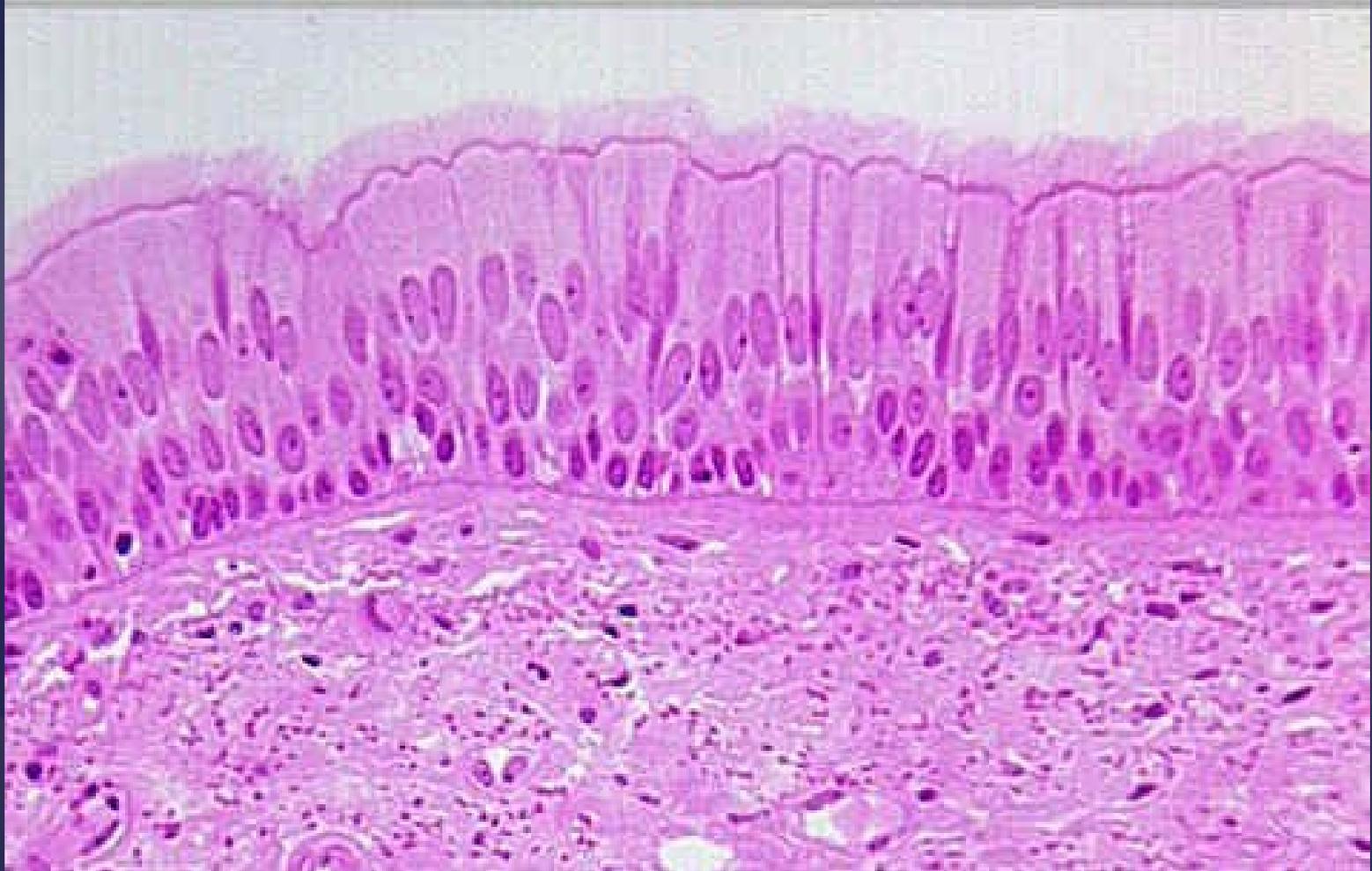
**Stratified cuboidal
epithelium**



Simple columnar epithelium

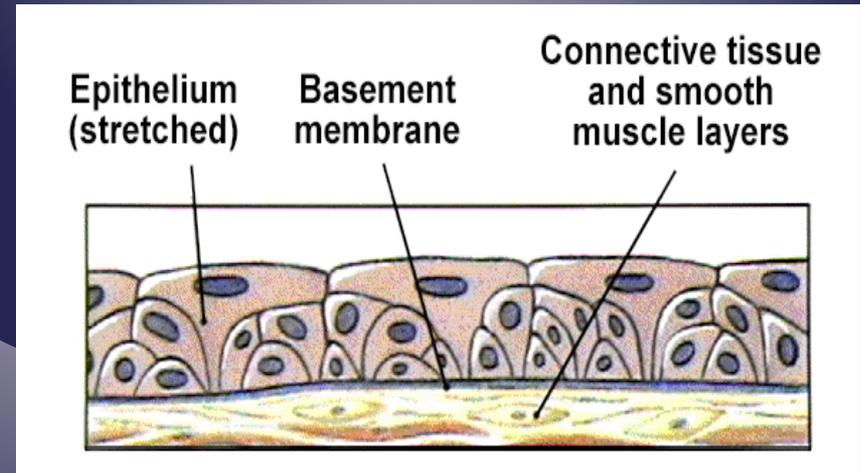
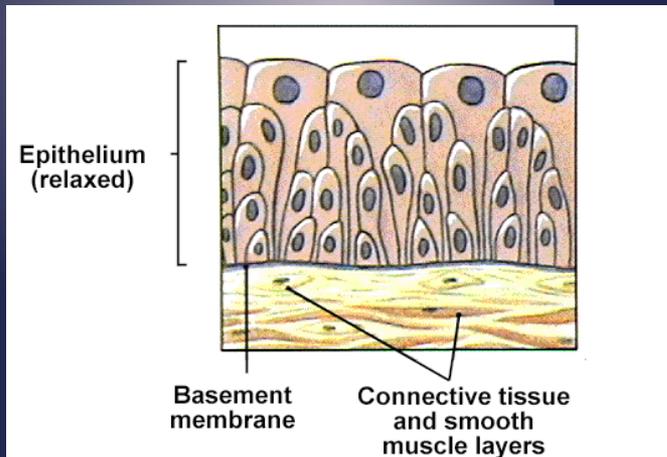


Pseudostratified columnar epithelium

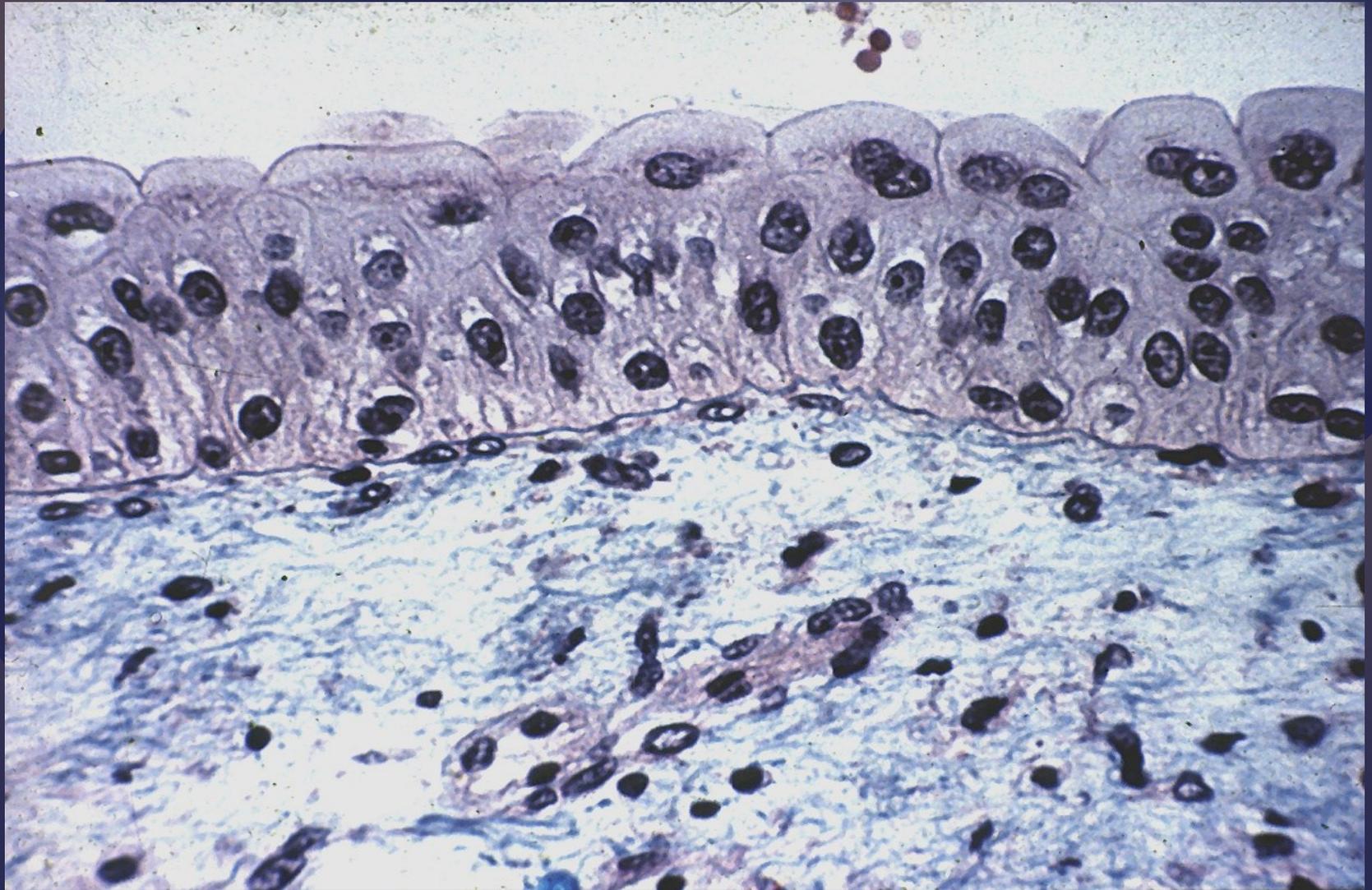


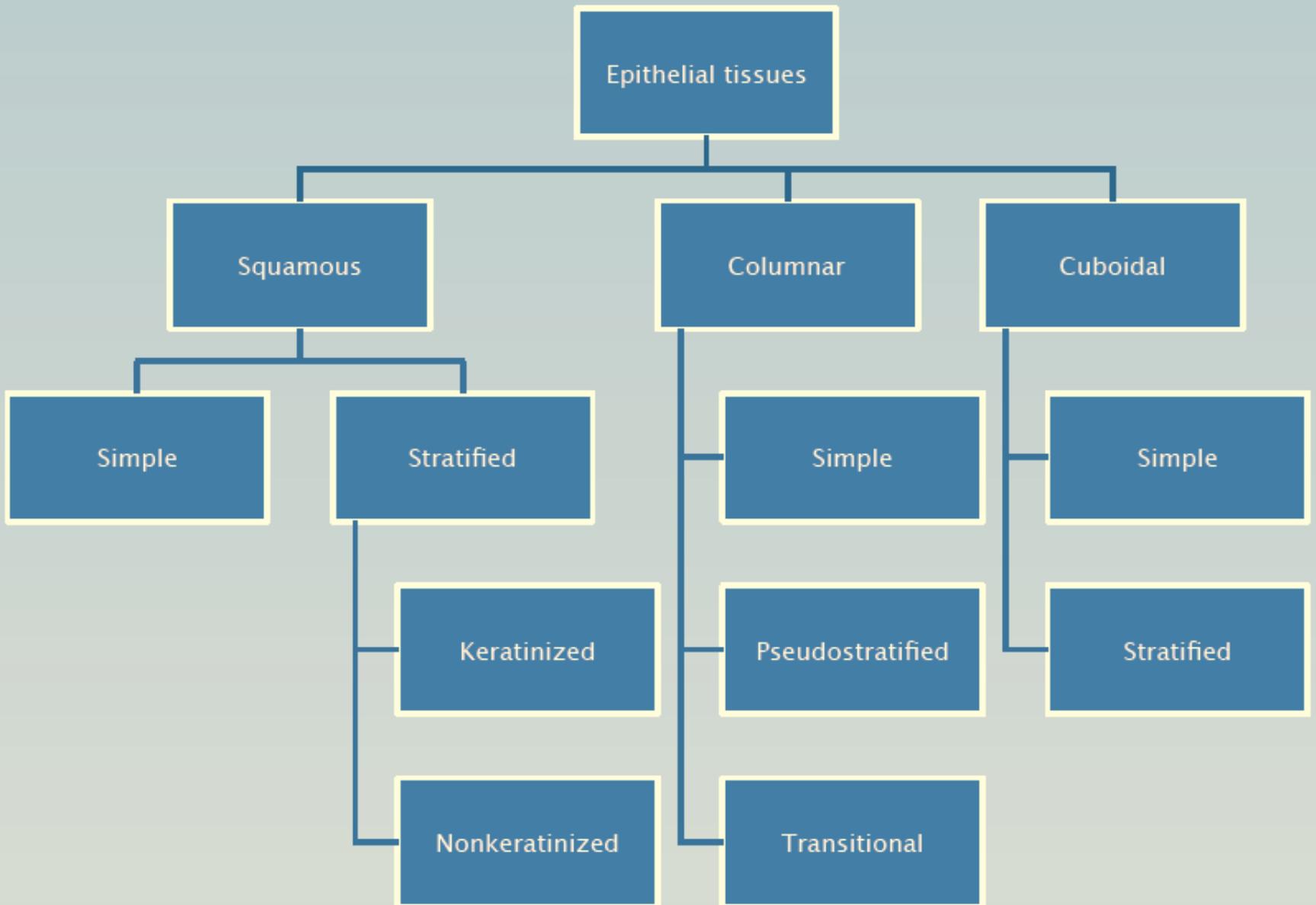
Transitional Epithelium

- ✓ 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 is full the surface cells stretch and flatten



Transitional Epithelium



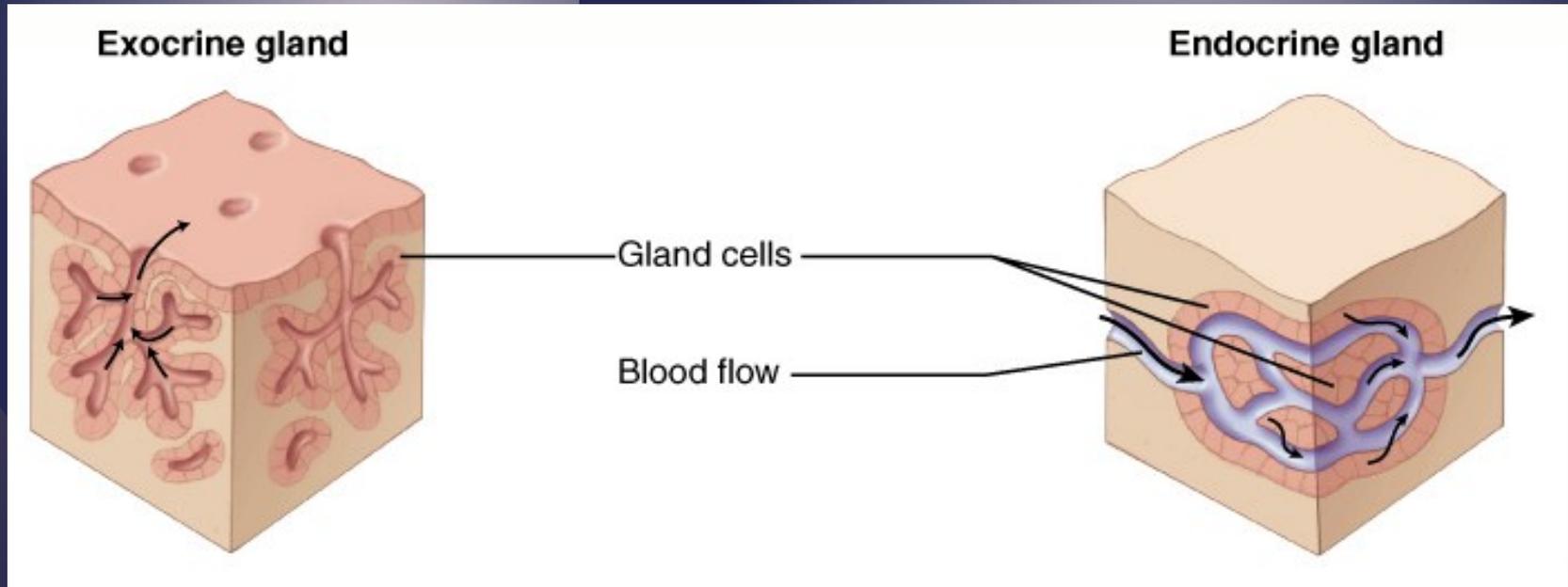


Functions of epithelium:

- **secretion**, as in the columnar epithelium of the stomach and the gastric glands;
- **absorption**, as in the columnar epithelium of the intestines and proximal convoluted tubules in the kidney;
- **transportation**, as in the transport of materials or cells along the surface of an epithelium by motile cilia or in the transport of materials across an epithelium to and from the connective tissue;
- **protection**, as in the stratified squamous epithelium of the skin (epidermis) and the transitional epithelium of the urinary bladder;
- **receptor function** to receive external stimuli, as in the taste buds of the tongue, olfactory epithelium of the nasal mucosa, and the retina of the eye.

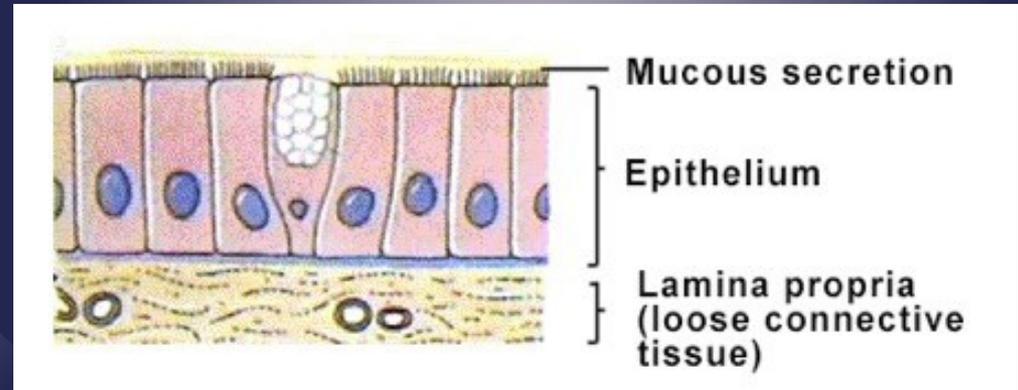
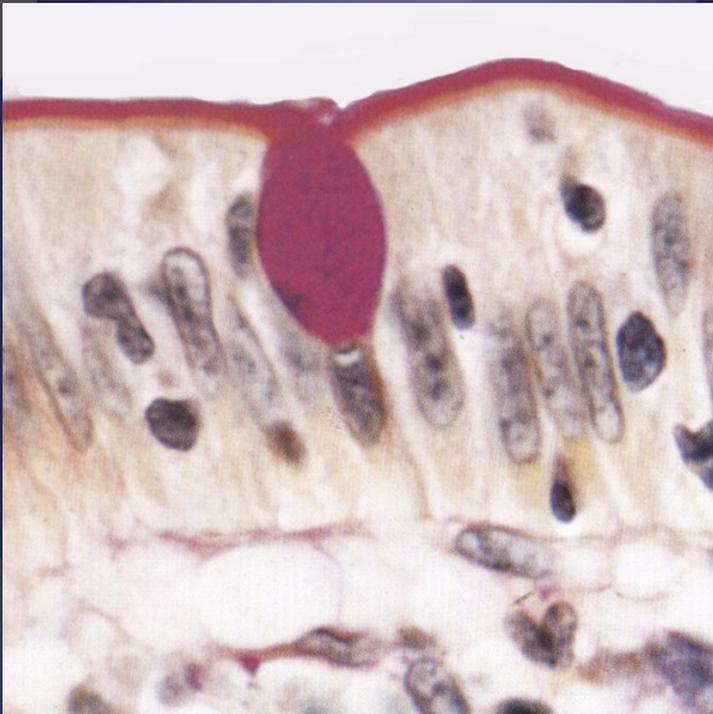
Glandular epithelium

- **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**.



Exocrine glands are classified as either unicellular or multicellular

Unicellular glands are the simplest in structure



A typical example is the goblet cell, a mucus-secreting cell positioned among other columnar cells

Light Microscopy



TEM



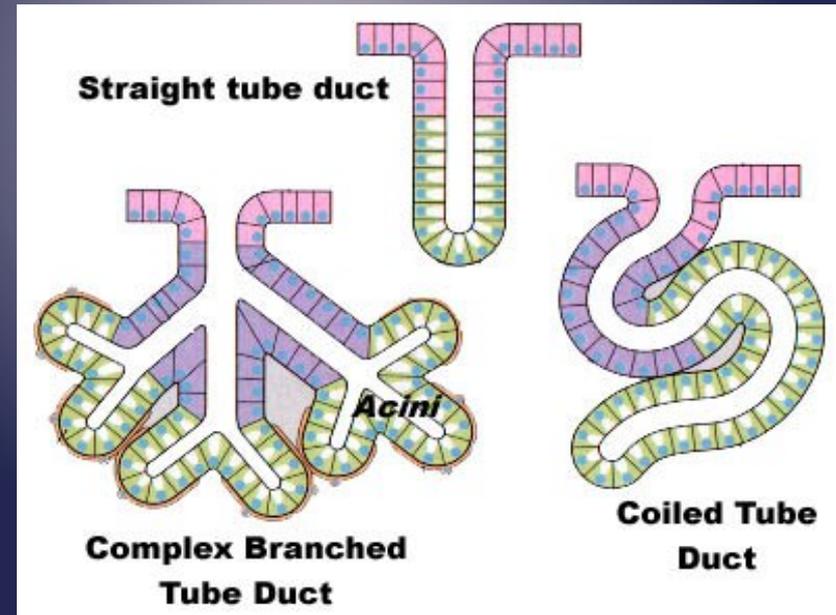
- ✓ **Multicellular glands are composed of more than one cell.**
- ✓ **Can be classified according to the arrangement of the secretory cells (parenchyma) and the branching of the duct elements.**

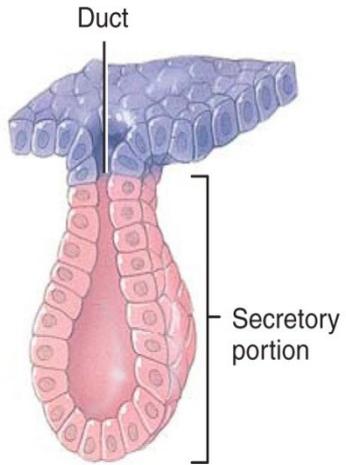
Ducts:

- ✓ **if the duct is unbranched, the gland is called simple;**
- ✓ **if the duct is branched, it is called compound.**

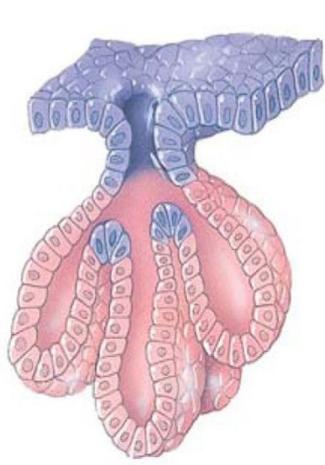
Secretory portion:

- ✓ **if the secretory portion is shaped like a tube, the gland is tubular;**
- ✓ **if it is shaped like a flask, the gland is alveolar or acinar;**
- ✓ **if the tube ends in a saclike dilation, the gland is tubuloalveolar.**

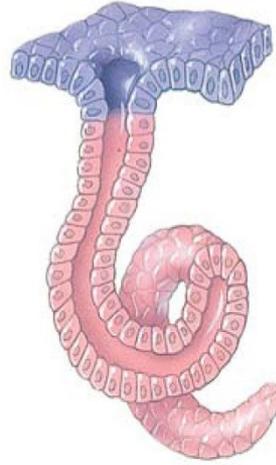




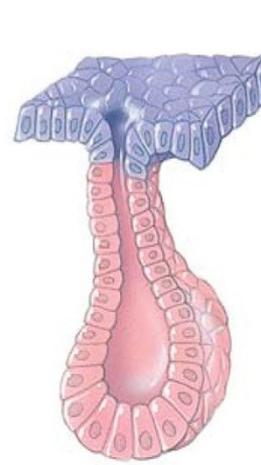
Simple tubular



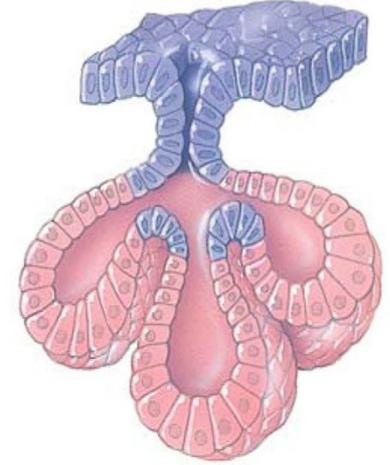
Simple branched tubular



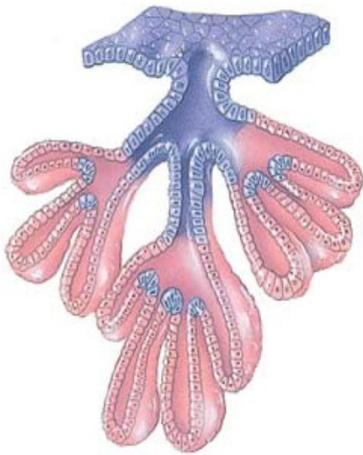
Simple coiled tubular



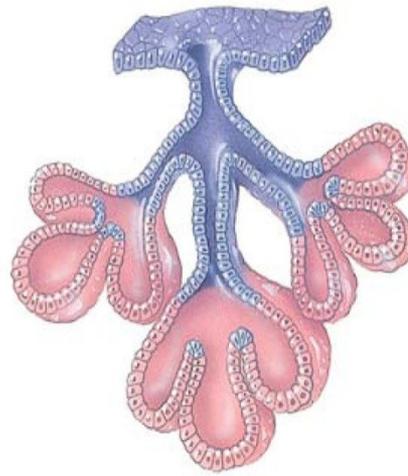
Simple acinar



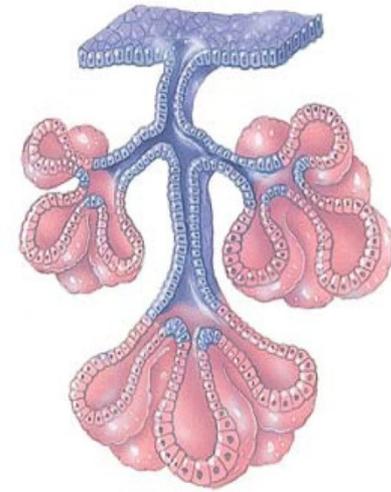
Simple branched acinar



Compound tubular



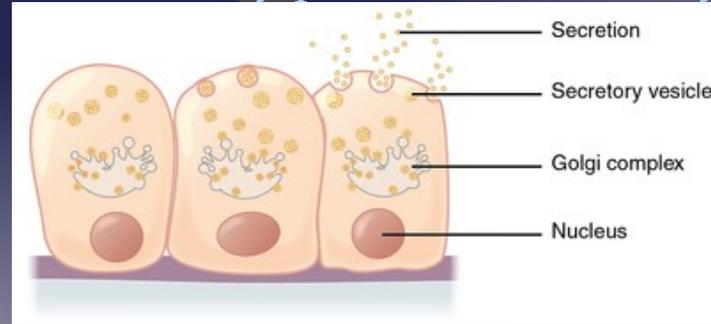
Compound acinar



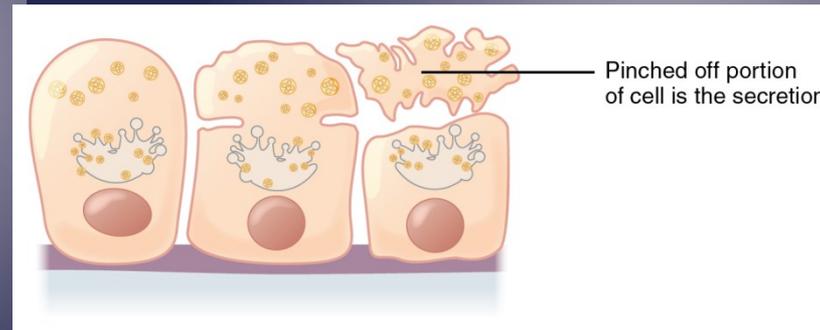
Compound tubuloacinar

The mechanisms of secretion

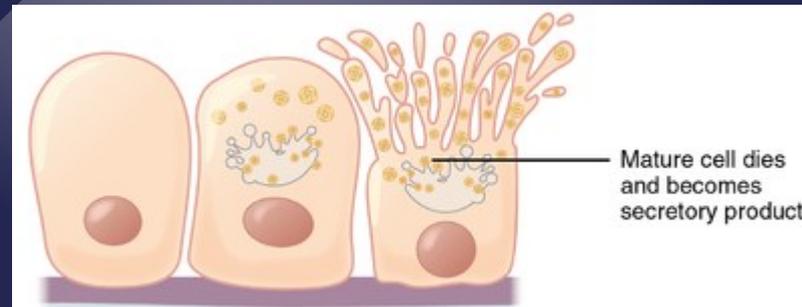
- **Merocrine secretion** - the secretory product exits cell by exocytosis, no loss of cytoplasm (pancreas).



- **Apocrine secretion** - the secretory product collects in cell apex, entire cell apex is shed (mammary gland).



- **Holocrine secretion** - the secretory product accumulates within the maturing cell, cell dyes, both secretory products and cell debris are discharged into the duct. (sebaceous glands of skin).



Type of secretory product:

- ✓ Mucous – thick secretion rich in glycoproteins (sublingual gland)
- ✓ Serous – thin, watery secretion containing proteins (parotid gland)
- ✓ Seromucous – mixed secretion of intermediate thickness (sebaceous gland)

Thank you for attention

