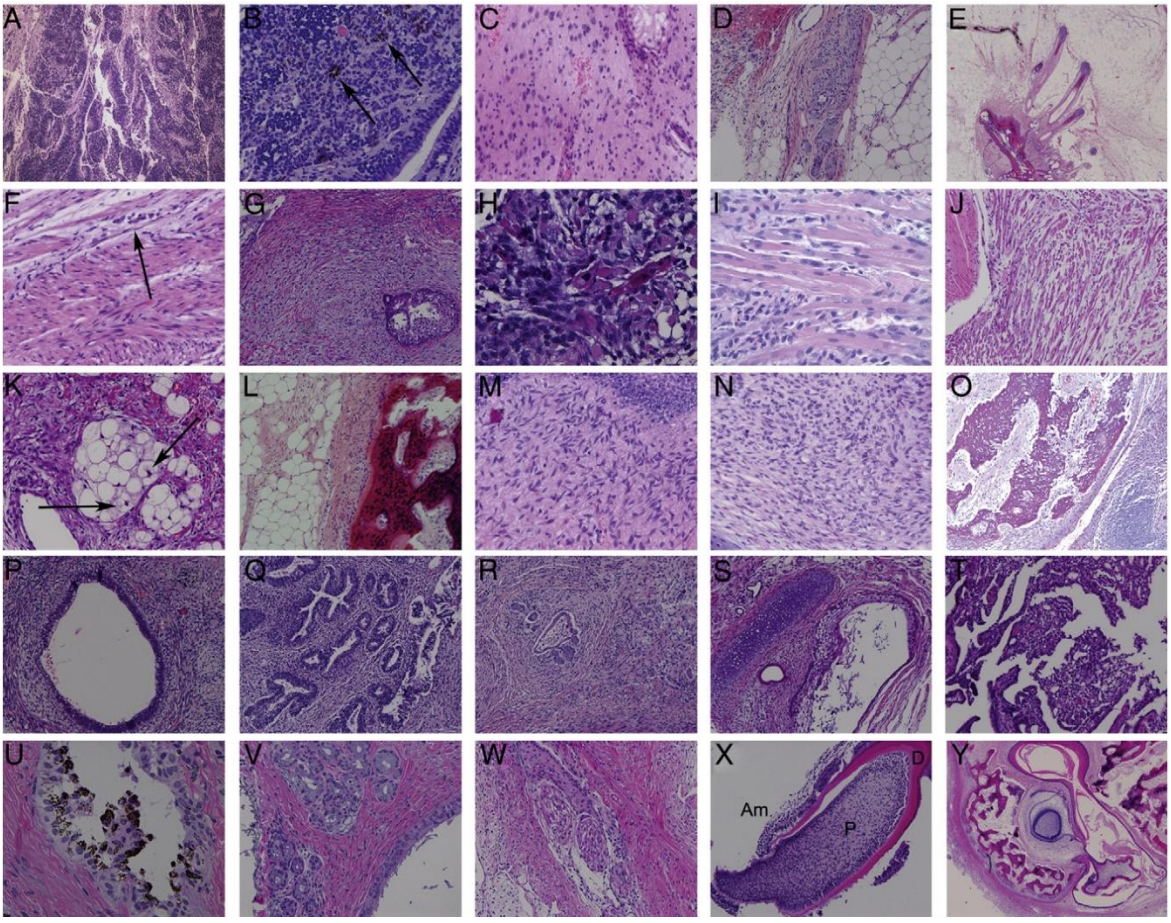
The University of Jordan

Dentistry 020

Histology



Title: third lecture- Epithelium tissue

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- There are four major types tissues:

1. Epithelium
2. Connective Tissue
3. Muscle Tissue
4. Nervous Tissue

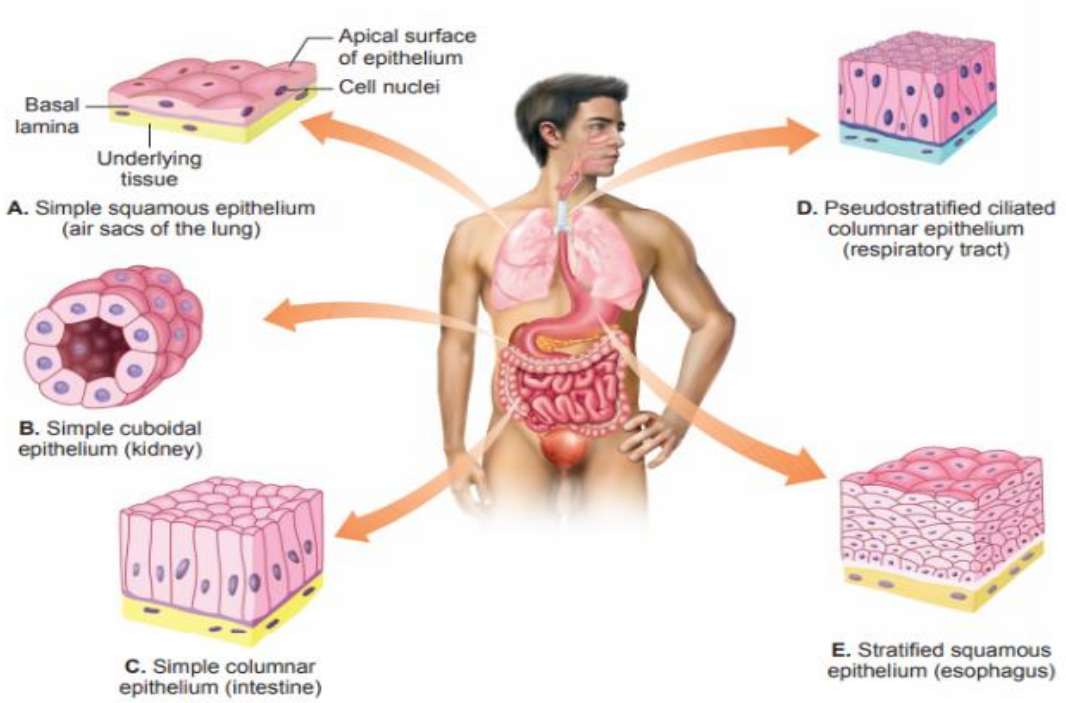
In this lecture, we will talk about **epithelium tissue**.

•Epithelial cells are aggregated polyhedral cells that line cavities of organs and cover the body surface

The main functions of epithelial tissue:

- The principal functions of epithelial tissues include the following:
  - ■ Covering, lining, and protecting surfaces (skin/epidermis)
  - ■ Absorption (the intestinal lining)
  - ■ Secretion (glands)

(epidermis=الجزء الخارجي للجلد)



- Skin consists of two kinds of tissues :(**epithelial** and **connective**).
- In the photo, we can see that an example of epithelial tissue is **upper side of skin (epidermis)** which covers the body from the outside with one layer of cells (simple epithelia).
- Another example of epithelial tissue is **stomach** that has a cover of one layer of epithelial tissue cells from the inside to protect its connective tissue (simple epithelia).

*So, the function of the tissue is determined by the type and the shape.

Characteristic of Epithelial Cells:

The shapes and dimensions of epithelial cells are quite variable, ranging from tall columnar to cuboidal to low squamous cells.

1. **Supported by the underlying connective tissue**:

The epithelial tissue rests (not directly) on the top of a connective tissue with an intermediate structure between them called **basement membrane**.

2. This tissue is **impermeable**, meaning that there is no pass of molecules between cells of the tissue.

Anything that needs to reach the connective tissue must pass through the cells and cannot pass between them (Transcellular transport is allowed- and paracellular transport isn't allowed but there is exceptions).

(Transcellular transport involves the transportation of solutes by a cell through a cell)

3. **Innervated** (has nerves):

Nervous ends reach and branch through the tissue (that is what makes us feel the tissues when they are stimulated).

4. **Avascular** (no blood vessels); blood supply is in supporting connective tissue.

Most epithelia are adjacent to connective tissue containing blood vessels from which the epithelial cells receive nutrients and O2 throw cells by diffusion from connective tissue.

Even thick epithelia do not normally contain blood vessels.

توضيح :

الخلايا الطلائية ليست هي التي تمتلك الأوعية الدموية، بل هي مستقرة فوق خلايا النسيج الضام الذي يحتوي على اوعية دموية والتي تغذي خلايا النسيج الطلائي وتزودها بالأكسجين .

5. **High regeneration capacity:** the tissue can renew itself in case it needs to(like skin when its injured).

In the basal layer, there are cells that have the capacity to produce new cells.

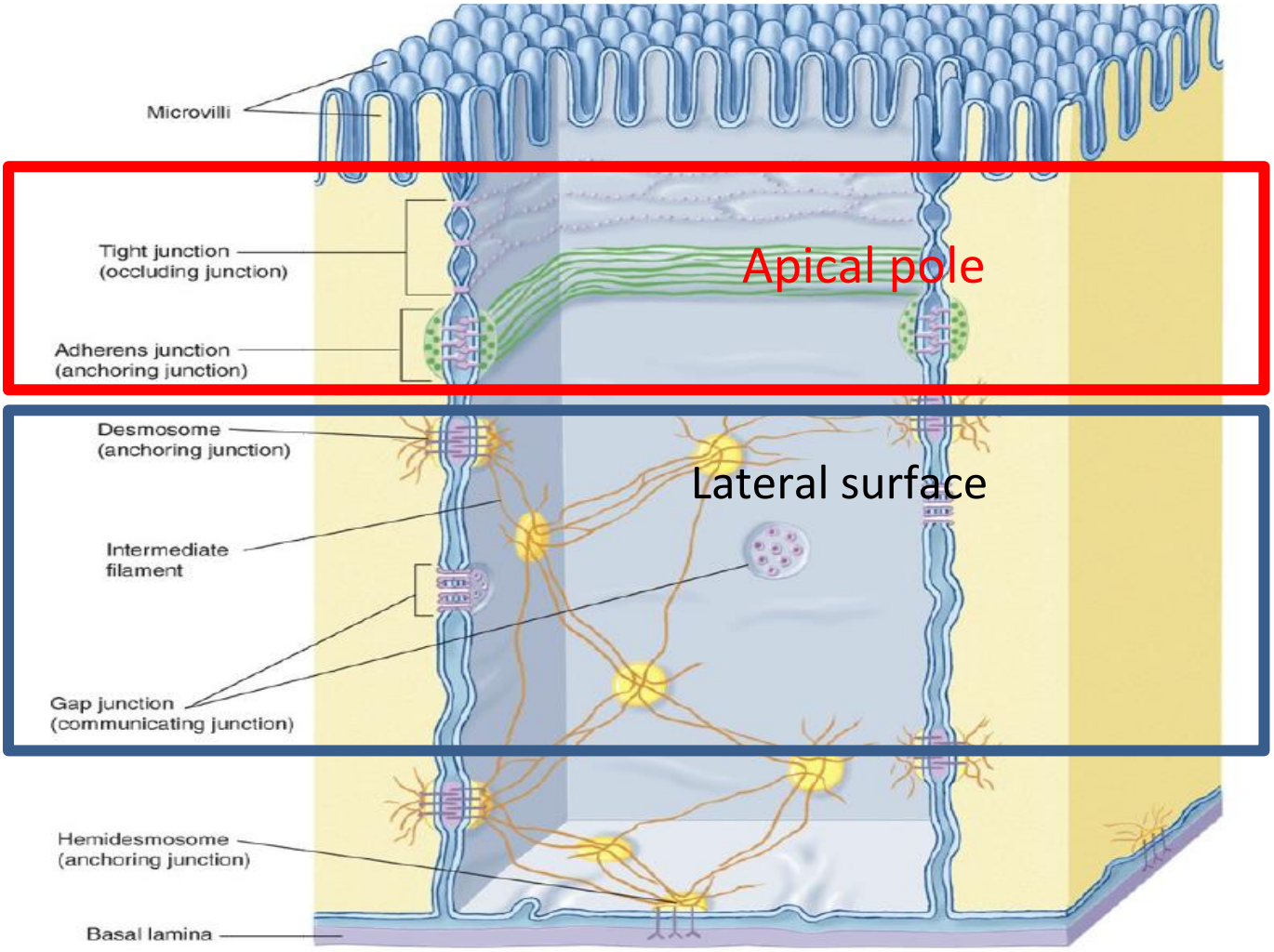
6. **Polarized tissue**: Epithelial cells generally show polarity, with organelles and membrane proteins distributed unevenly within the cell.

(Polarized means it can distinguish its poles *regarding the content of the cell*)

The region of the cell contacting the ECM and connective tissue is called the **basal pole.**

The facing space and opposite end of basal pole is **apical pole**.

Regions of cuboidal or columnar cells that adjoin neighboring cells comprise the cells' **lateral surfaces**; cell membranes here often have numerous folds which increase the area and functional capacity of that surface.



Note: that the lateral surface is not the entire region inside the blue box, but it's the side surfaces in that region.

Intercellular Adhesion & Other Junctions:

- Several membrane-associated structures provide **adhesion** and **communication between cells.** (adhesion=connection, glow of cells)
- Intercellular Adhesion & Other Junctions are:

1) Junctions at the apical end:

a) Tight junctions form a seal between adjacent cells; they are the most apical of the junctions.

b) Adherent or anchoring junctions are sites of strong cell adhesion:

Encircles the epithelial cell, usually immediately below the tight junction, and firmly anchoring a cell to its neighbors.

Tight junctions and adherent junctions are typically close together and each **forms a continuous band around the cell**.

Multiple ridges of the tight junction **prevent passive flow of material between the cells** but are not very strong.

The adhering junctions immediately below them **serve to stabilize and strengthen the circular occluding bands and help hold the cells together**.

2) Junctions at the lateral surface are:

a) Desmosome: Desmosomes are disc-shaped structures at the surface of one cell that are matched with identical structures at an adjacent cell surface.

Desmosomes form very strong attachment points and play a major role to maintain the integrity of an epithelium.

A desmosome does not form a belt around the cell and it's widely spread on the membrane of epithelial cells.

b) Gap junctions:

Mediate intercellular **communication** rather than adhesion or occlusion between cells.

The transmembrane gap junction proteins, **connexins**, form hexameric complexes called **connexons.**

Through Gap Junctions**,** exchange of nutrients and signal molecules between cells without loss of material into the intercellular space can happen. (it only allows the passage of small molecules or ions)

The communicating channels are formed by pairs of abutting particles (connexons), which are in turn **each(connexons) composed of six protein subunits (connexins)** that span the lipid bilayer of each cell membrane.

3) Junctions at basal region are **Hemidesmosomes:**

These adhesive structures resemble **a half-desmosome** ultrastructurally, but unlike desmosomes **the clustered transmembrane proteins that link the cells of tissue with basal lamina are integrins**.

‘’’To simplify it for you guys:

Anchoring junctions are (**Tight junctions, Adherent junctions, Desmosomes, Hemidesmosomes)**

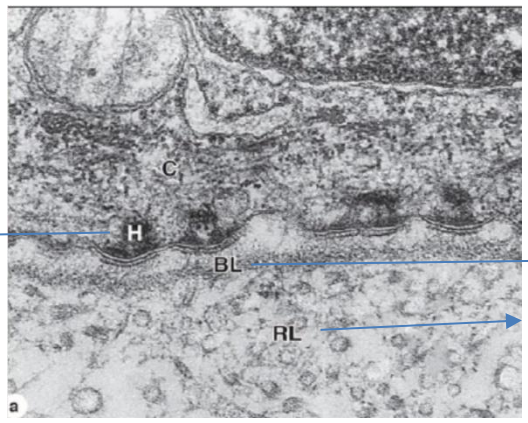
communication junctions are **Gap junctions** ‘’’

Junction	Tight Junction (Zonula Occludens)	Adherens Junction (Zonula Adherens)	Desmosome (Macula Adherens)	Hemidesmosome	Gap Junction (Nexus)
Major transmembrane link proteins	Occludins, claudins, ZO proteins	E-cadherin, catenin complexes	Cadherin family proteins (desmogleins, desmocollin)	Integrins	Connexin
Major functions	Seals adjacent cells to one another, controlling passage of molecules between them; separates apical and basolateral membrane domains	Provides points linking the cytoskeletons of adjacent cells; strengthens and stabilizes nearby tight junctions	Provides points of strong intermediate filament coupling between adjacent cells, strengthening the tissue	Anchors cytoskeleton to the basal lamina	Allows direct transfer of small molecules and ions from one cell to another

-there’s medical significance in dr.ghada’s slides <u>but</u> it’s read only

Basement Membranes:

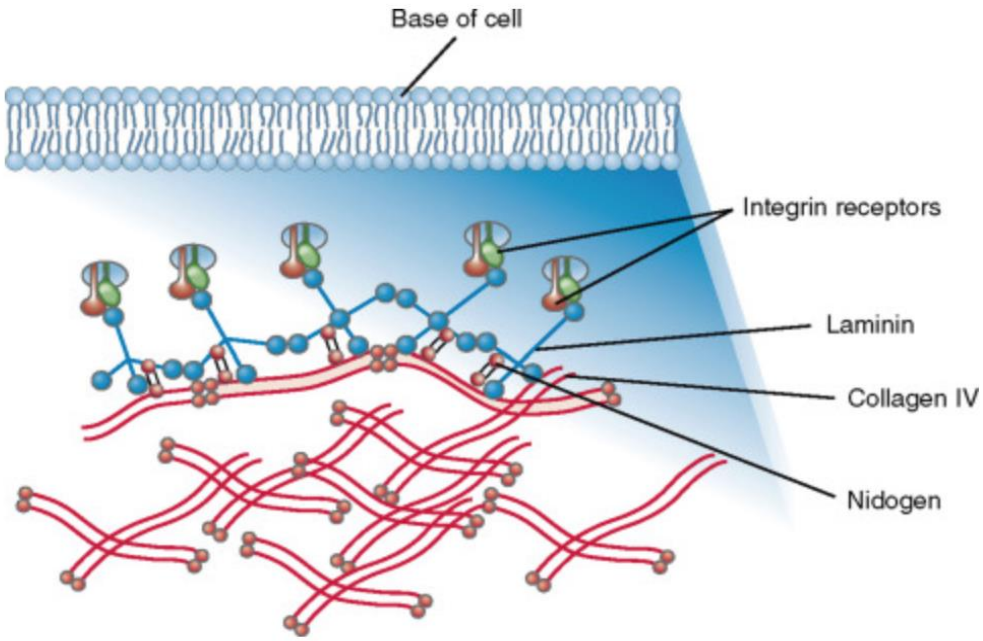
- The basal surface of all epithelium rests on a thin extracellular, felt-like sheet of macromolecules referred to as the **basement membrane** (*located between the epithelial tissue and connective tissue*).
- It can often be stained and visualized with the light microscope and with transmission electron microscope (TEM) two parts of the basement membrane (**basal lamina** and **reticular lamina**) may be resolved.
- The ultrastructural components of the basement membrane are :
  1) **Basal lamina**.(more dense)
  2) **Reticular lamina.**(less dense)



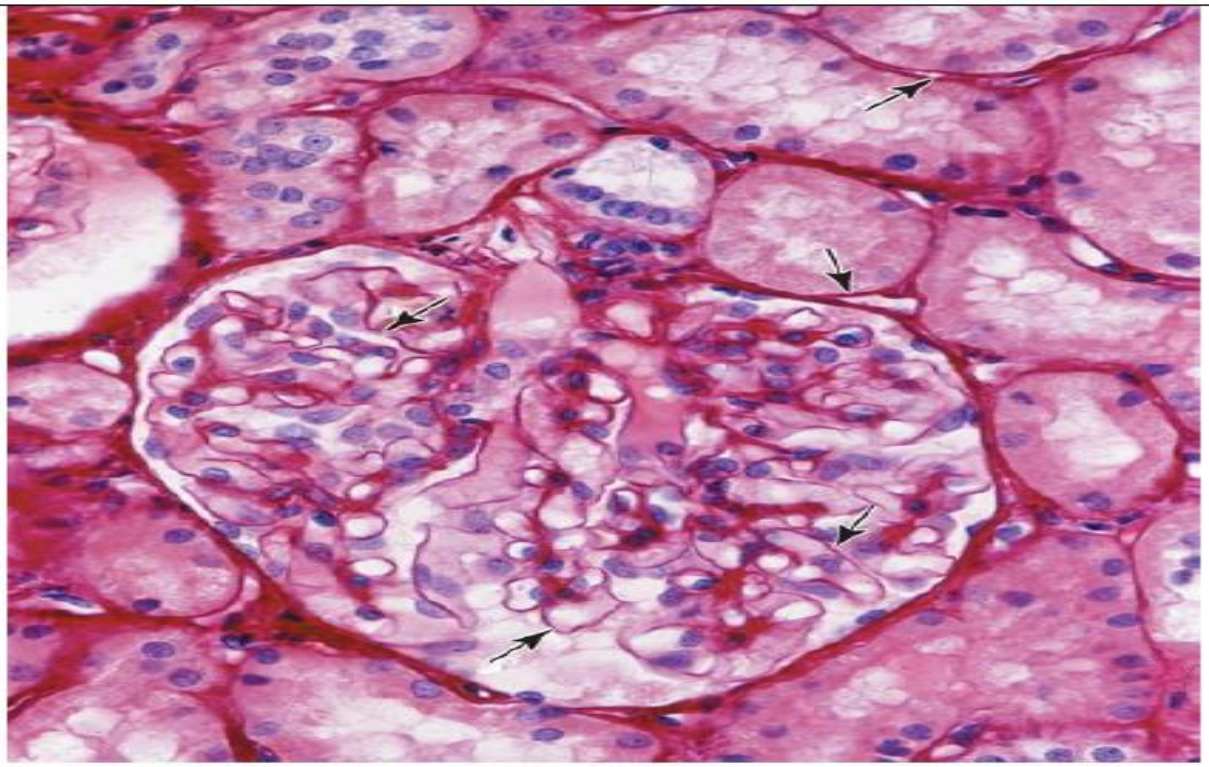
hemidesmosome

Basal lamina

Reticular lamina



- <u>The macromolecules of the *basal lamina* are secreted from the basal sides of the epithelial cells and form a sheet-like array</u>, these macromolecules include:
  1) **Type IV collagen**.
  2) **Laminin**: attach to transmembrane proteins called integrins at the cells' basal surface and project through the network of type IV collagen.
  3) **Nidogen** and **perlecan.**
- Macromolecules of type III collagen are:
  1) **Type VII collagen.**
  2) **Type III collagen**: bound to the basal lamina by anchoring fibrils of type VII collagen.



This section of kidney shows the well-stained basement membranes (arrows) of epithelia forming structures within the large, round renal glomerulus and its surrounding tubules. In kidney glomeruli the basement membrane, besides having a supporting function, has a highly developed role as a filter that is key to renal function.(I don't know weather you need it or not, but read it just for sure and in case that it is required to study it).

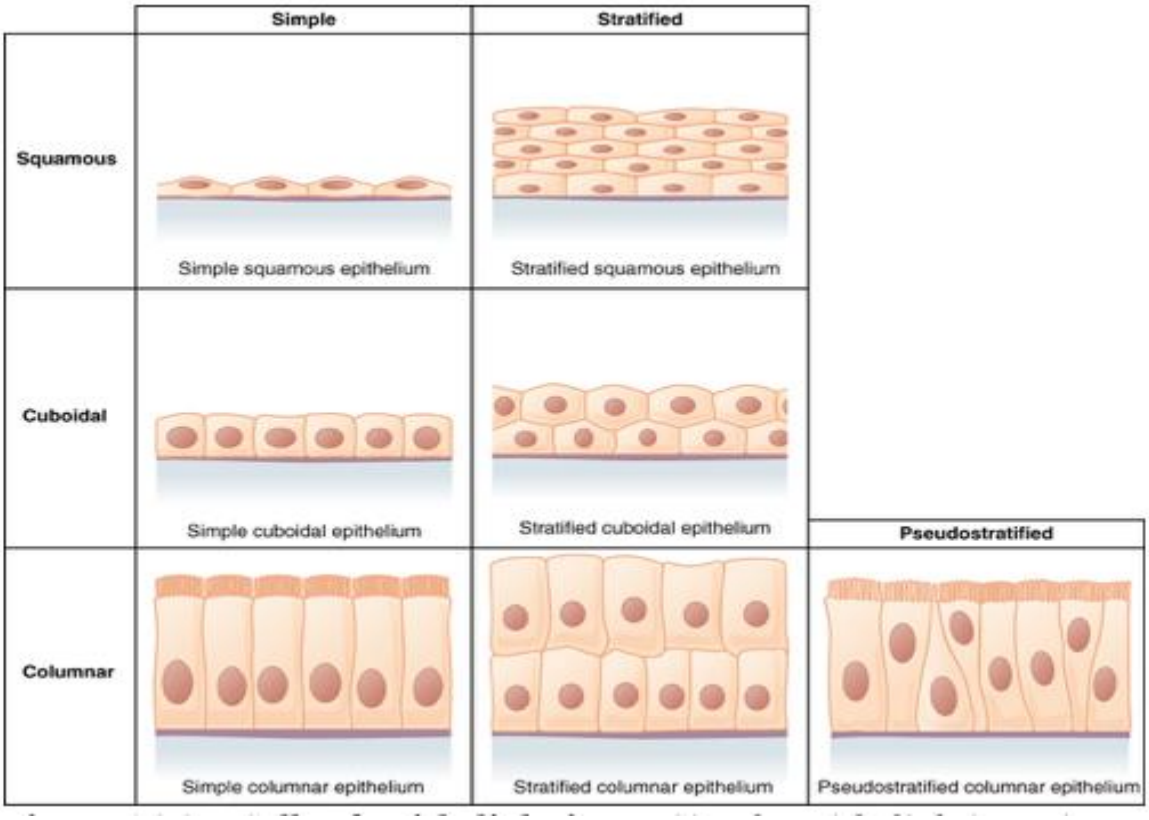
((When the challenge become harder, the fun begins))

TYPES OF EPITHELIA:

- Epithelia is devised by:

1) **The shape of the cells**:
   a) **<u>Squamous</u>**(thin)
   b) **<u>Cuboidal</u>** (cell width and thickness are roughly similar)
   c) **<u>Columnar</u>** (cells taller than they are wide).

2) **The number of layers**:
   a) **<u>Simple</u>** epithelia contain one cell layer.
   b) **<u>Stratified</u>** epithelia contain two or more layers.



Note; we've tried as possible as we can to simplify this lecture, we've put everything the doctor said in the lecture and combined it with the needed or mentioned information in the text book.

Excuse us for any mistake we made while writing this sheet.

Good luck for all of you