

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

General Histology

Presented by

Dr. Amjad Shatarat

Associate professor
of Anatomical sciences

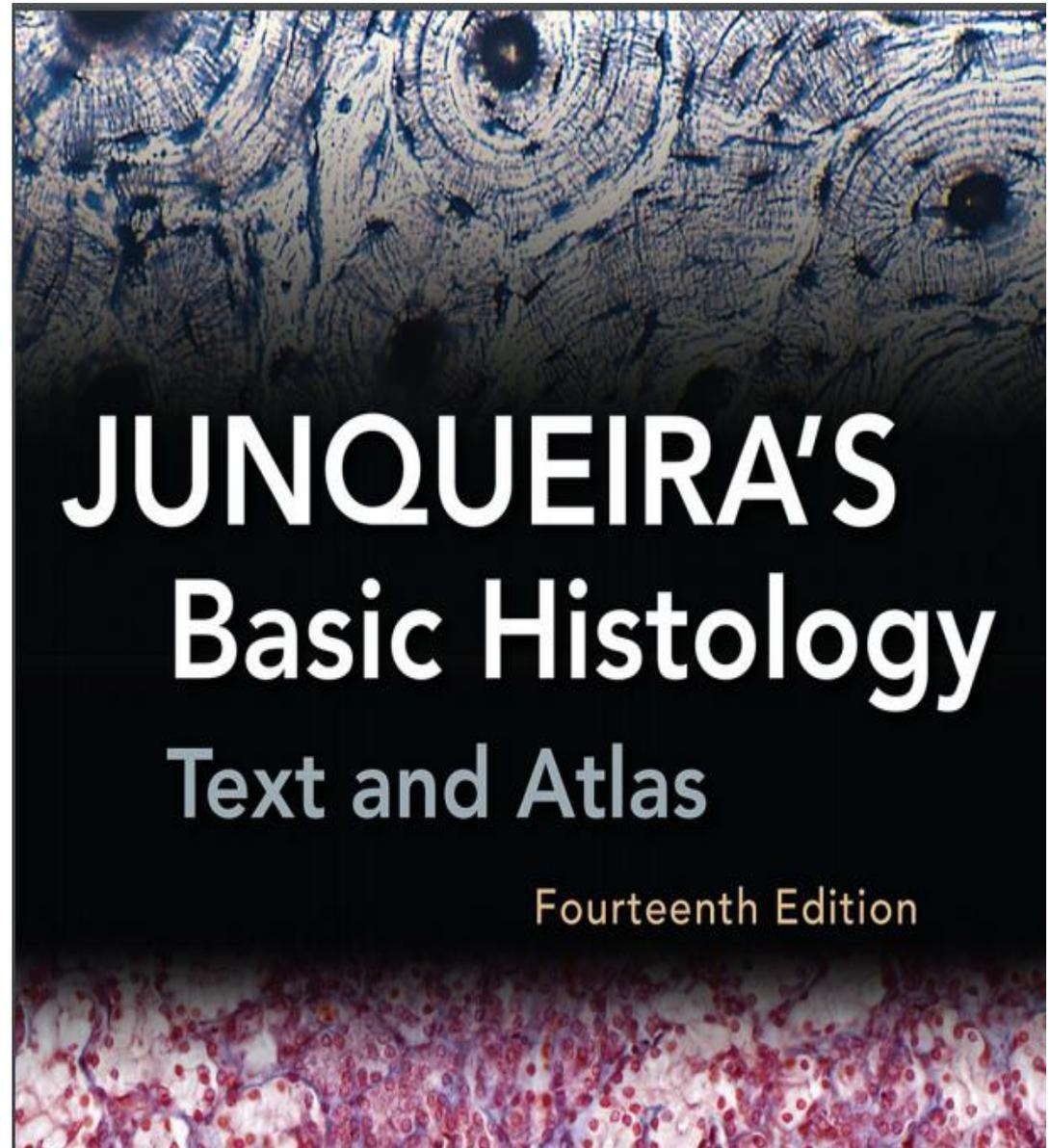
Special thanks to Prof. Darwaish Badran
For his valuable contribution to this lecture



a.shatarat@ju.edu.jo

Facebook: amjadshatarat

Recommended Text book

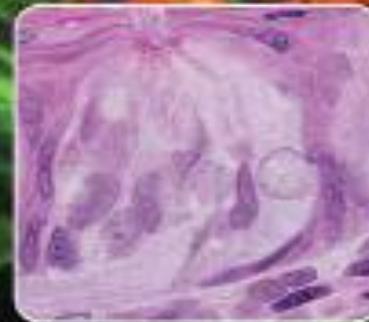


Sixth Edition

HISTOLOGY

A TEXT AND ATLAS

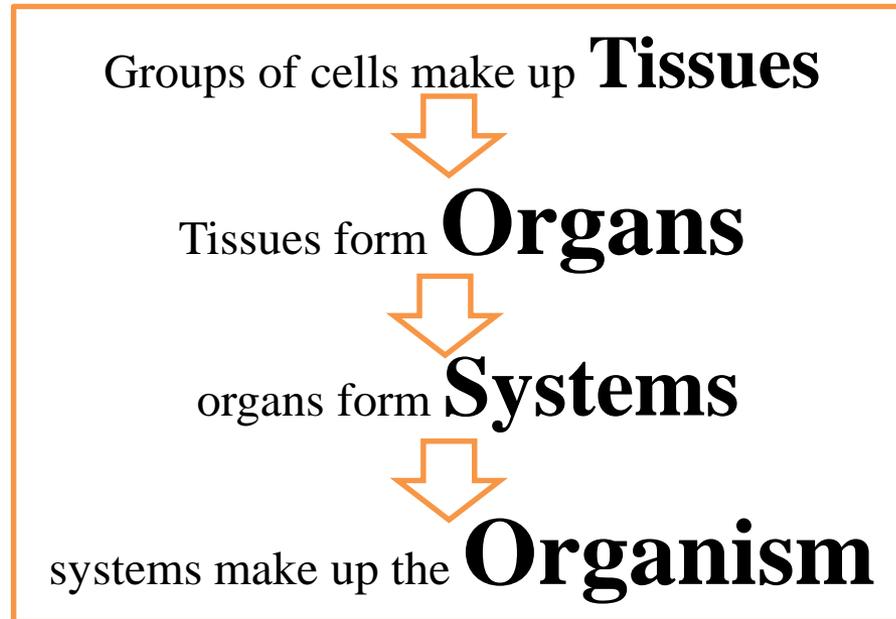
With Correlated Cell
and Molecular Biology



Michael H. Ross • Wojciech Pawlina

Some of the pictures presented in this lecture are taken from

Histology is the study of **Normal tissues**



TISSUES

ONLY FOUR BASIC TISSUE TYPES:

1-EPITHELIAL

2-CONNECTIVE

3-MUSCULAR

4-NERVOUS TISSUES.

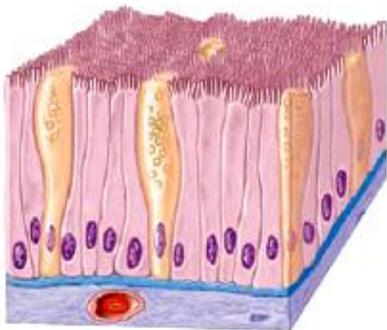
EACH TISSUE IS AN ASSEMBLAGE OF SIMILARLY SPECIALIZED

CELLS UNITED IN PERFORMING A **SPECIFIC FUNCTION**

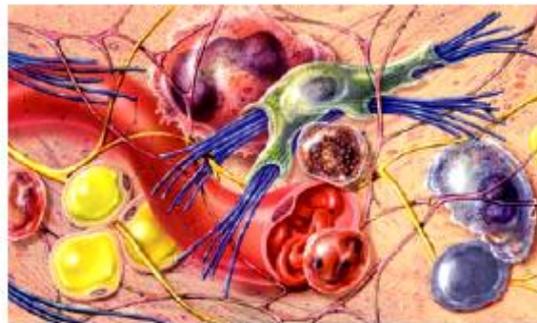
Types

Tissues are classified into 4 types according to their structure and function:

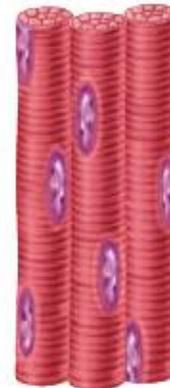
1. **Epithelial tissues**
2. **Connective tissues**
3. **Muscular tissues**
4. **Nervous tissue**



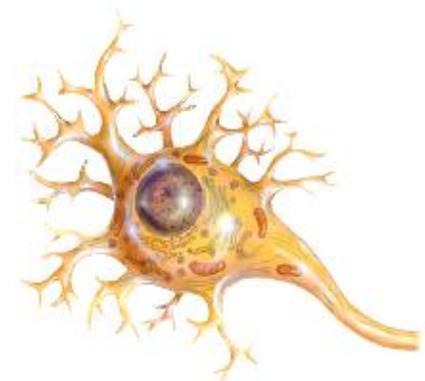
1- Epithelial tissue



2- Connective tissue



3- Muscular tissue



4- Nervous tissue

Epithelial Tissues

What do you think of the structure of the skin?

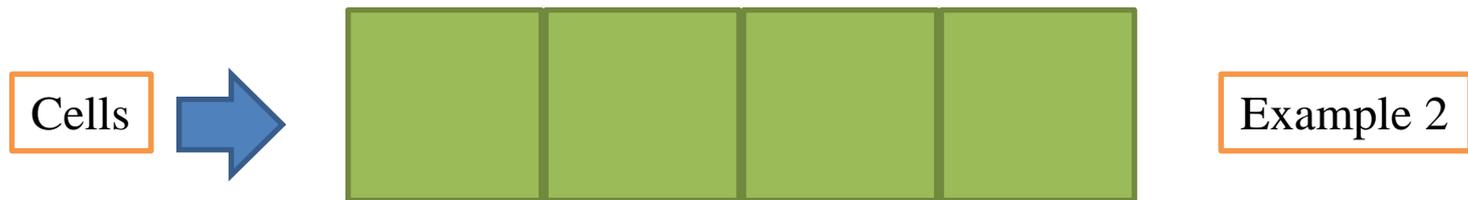
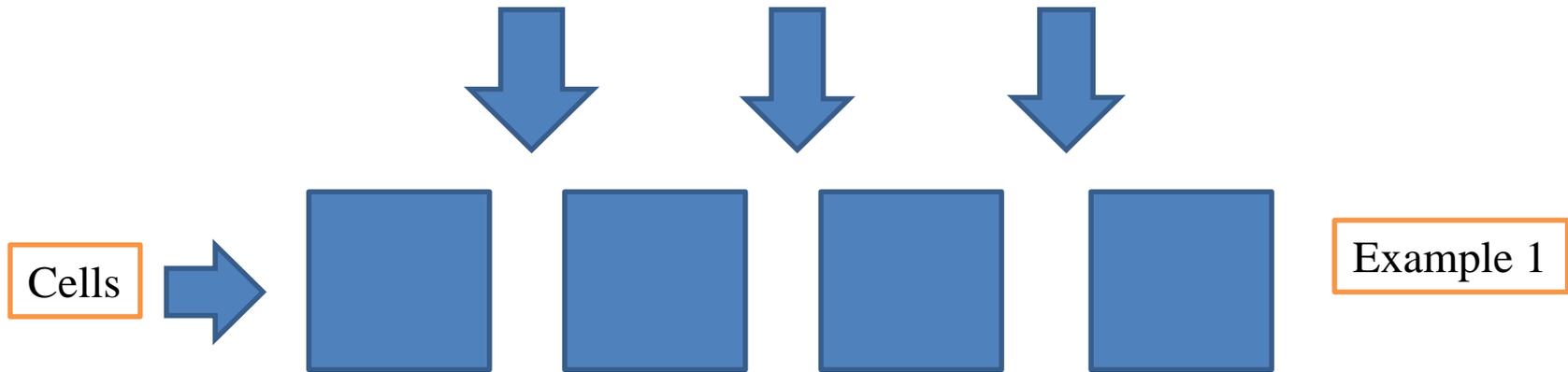
Think of the skin as a barrier!!!!!!

Cells ???

Intercellular space????!!!!!!



Which one could be a skin tissue? And why?



The principal functions of epithelial tissues include
The following:

- Covering, lining, and protecting surfaces
(eg, epidermis)
- Absorption (eg, the intestinal lining)
- Secretion (eg, parenchymal cells of glands)

Detection of sensations

FEATURES OF EPITHELIUM

1-Cellularity (Packed cells)

cells are in close contact with each other with little or no intercellular space between them

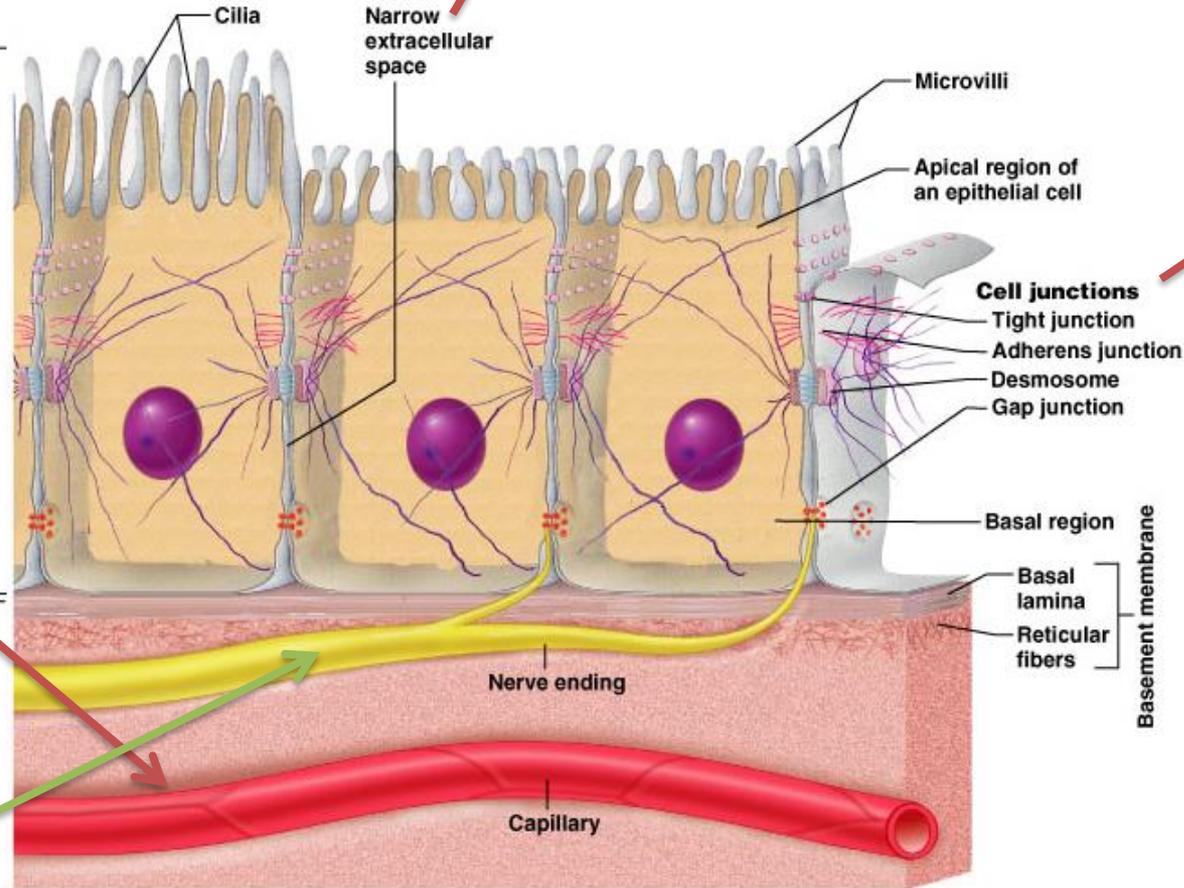
2-Specialized contacts may have junctions for both attachment and communication

See next slide

3-Polarity

Epithelial tissues always have an apical and basal surface

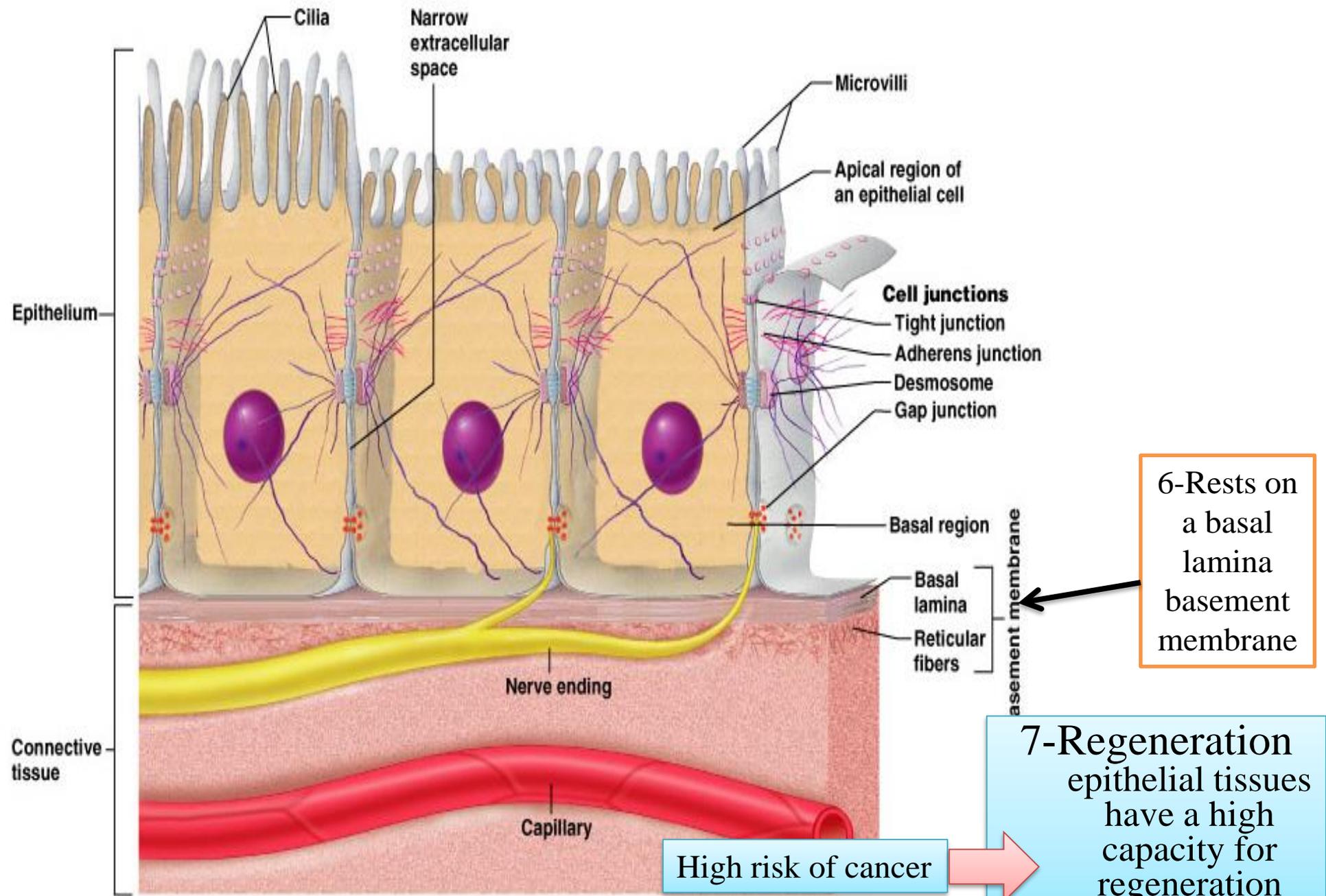
Epithelium



4-Avascular

nutrients must diffuse from near by connective tissue to reach the epithelial cells

5-Innervated



6-Rests on a basal lamina basement membrane

7-Regeneration epithelial tissues have a high capacity for regeneration

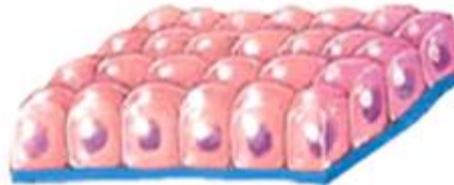
High risk of cancer

(Healing of wounds?)

Classification of epithelial tissue

First name of tissue indicates number of layers

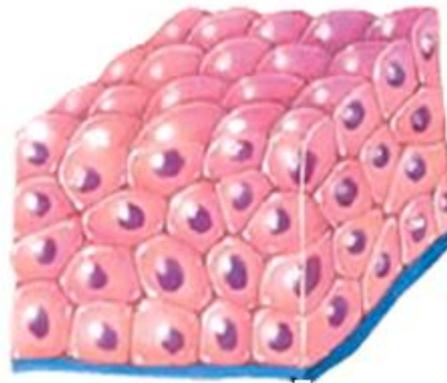
Simple – Cells arranged in one layer.



Simple

Stratified – more than one layer of cells

at the apical (apex / Top) surface



Stratified

Dr.shatarat
د.امجد الشطرات

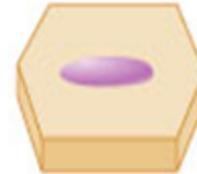
1-According to the number of layers, epithelium is divided into:
1- Simple
2-Stratified

Last name of tissue describes the shape of the cells

A- Squamous cells (flat): Are thin, like a plate.



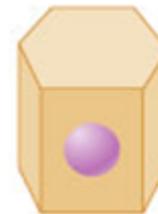
Squamous



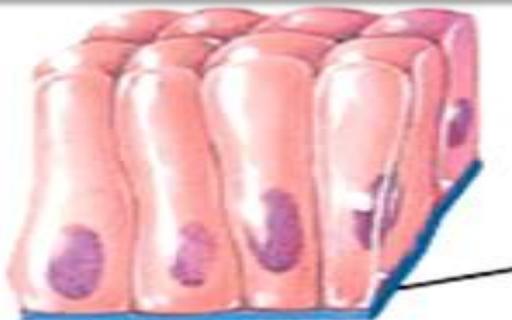
B- Cuboidal cells: shaped like cubes



Cuboidal



C- Columnar cells: like columns.



2/16/2018 Columnar



2- According to the shape of each cell, the epithelium is divided into:
1- Squamous
2- Cuboidal
3- Columnar

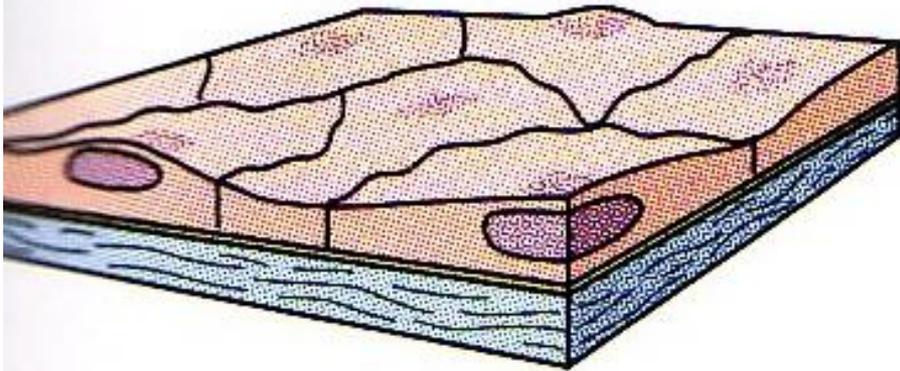
When we combine the 2 characters
(cell shapes and the number of layers),
epithelial tissue has the following types:

I. Simple epithelium

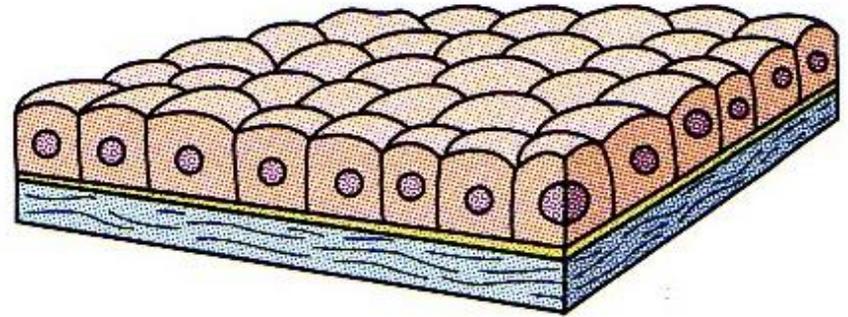
- a. Simple squamous.
- b. Simple cuboidal.
- c. Simple columnar (nonciliated and ciliated)
- d. Pseudostratified columnar (nonciliated and ciliated)



Simple squamous.

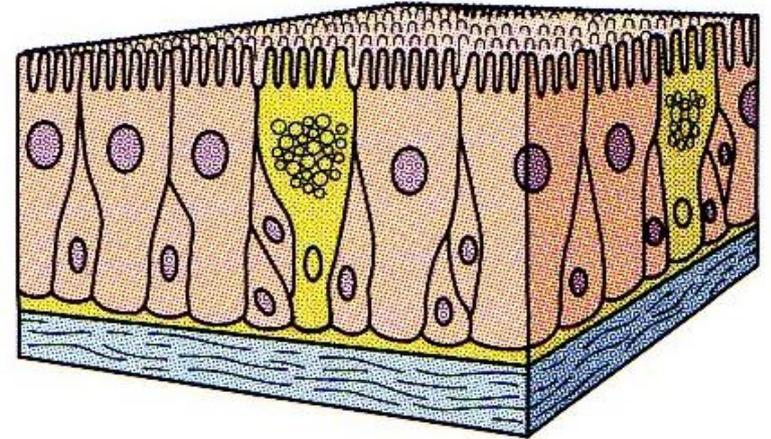
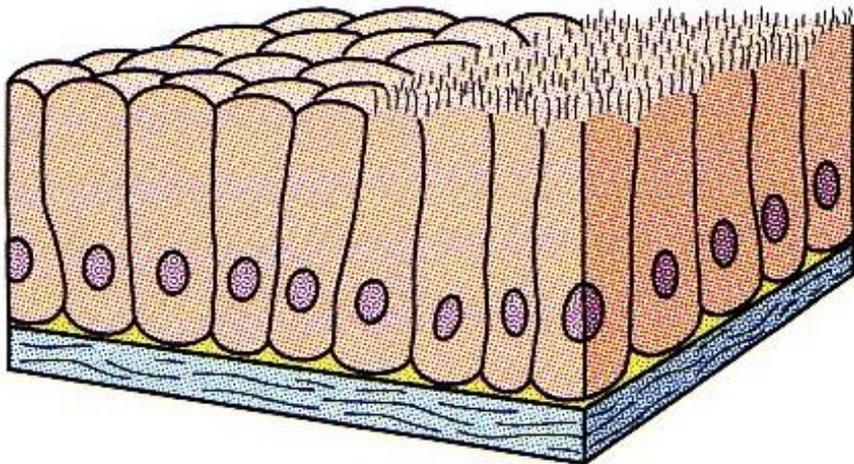


Simple cuboidal.



Pseudostratified columnar (nonciliated and ciliated)

Simple columnar (nonciliated and ciliated)



II. Stratified epithelium

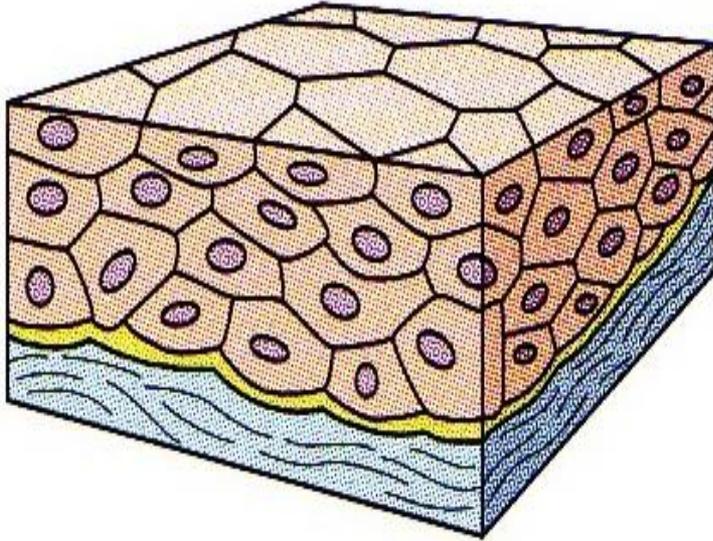
Types:

- a. Stratified squamous
 - keratinized
 - Nonkeratinized.
- b. Stratified cuboidal epithelium.
- c. Stratified columnar epithelium.
- d. Transitional epithelium.

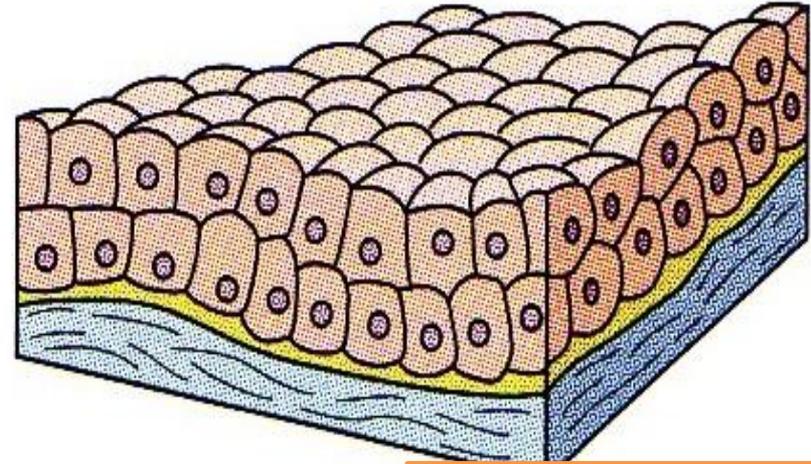


Stratified squamous

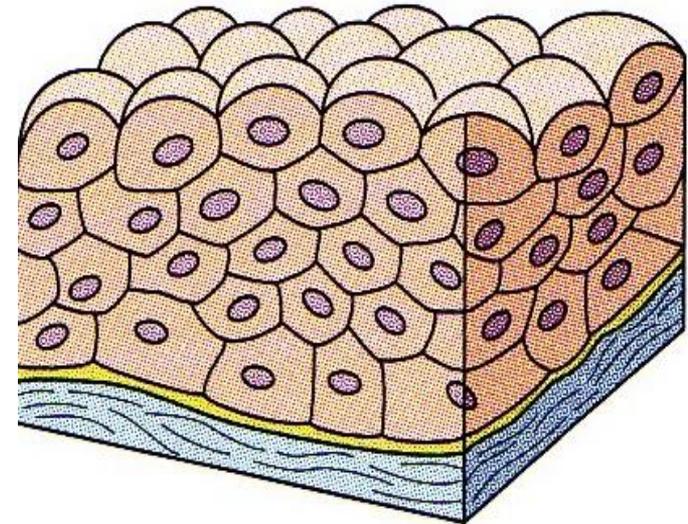
- keratinized
- Nonkeratinized.



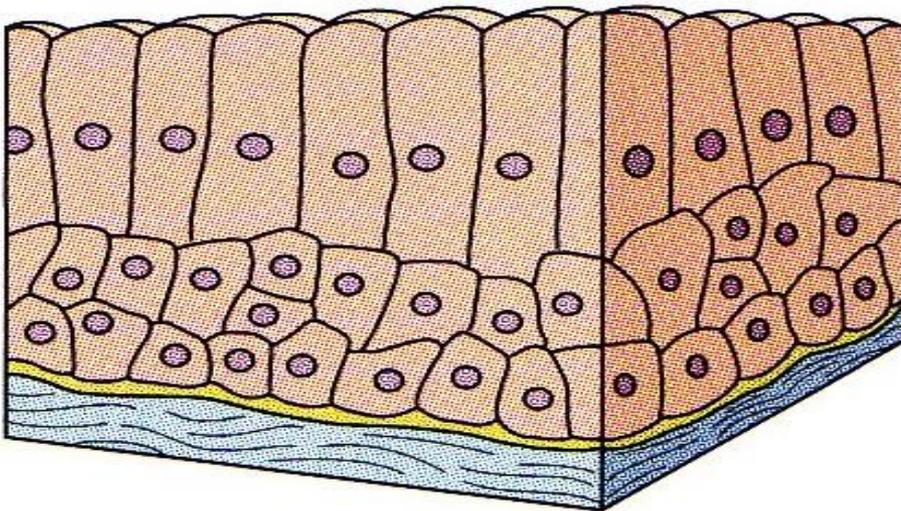
Stratified cuboidal epithelium.



Transitional epithelium.



Stratified columnar epithelium.



It should be Remembered!!!!!!

Simple epithelium is named according to **the shape of its cells**

Stratified epithelium is named according to

THE SHAPE OF THE CELLS IN THE OUTERMOST LAYER

Mitotic activity in stratified epithelium is limited to **the basal layer** (under normal conditions)

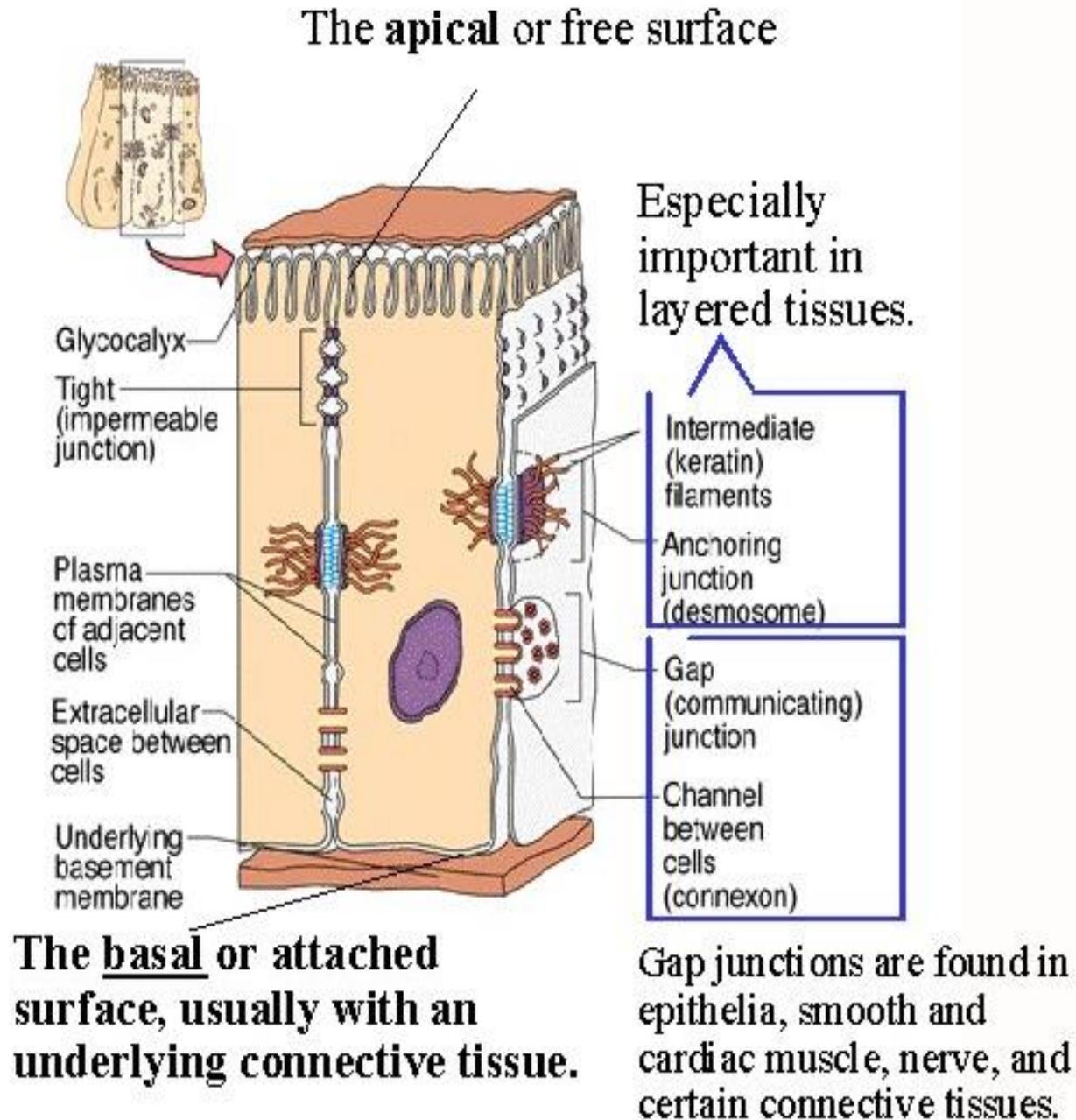
Epithelial cells generally show **polarity**, with organelles and membrane proteins distributed unevenly within the cell

Polarity

The epithelial cell shown to have the following domains:

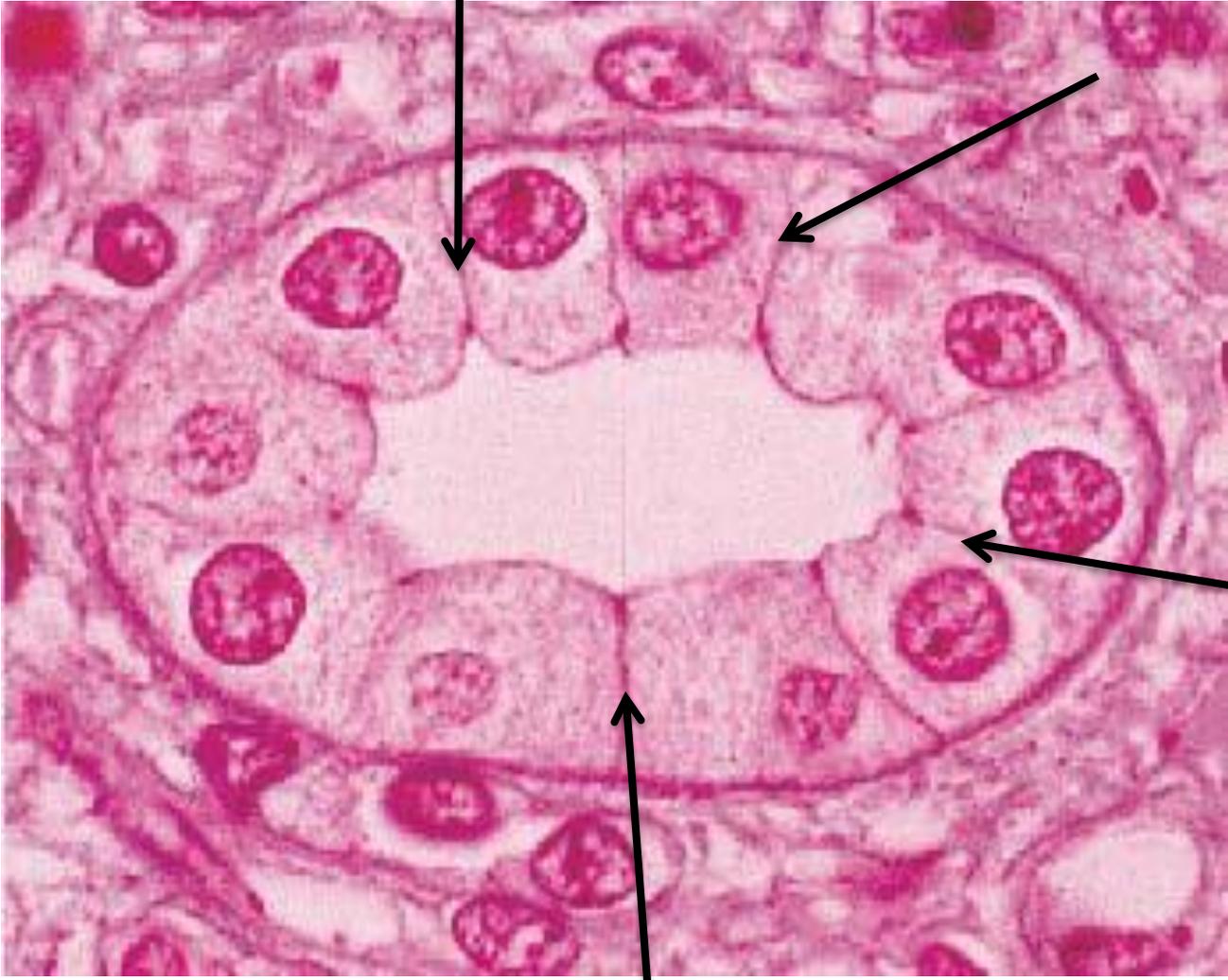
A- Apical
B- Basal
C- lateral

Each domain shows modifications to suit its functions



1-The lateral domain

What are these structures?



How the epithelial cells are attached to each other

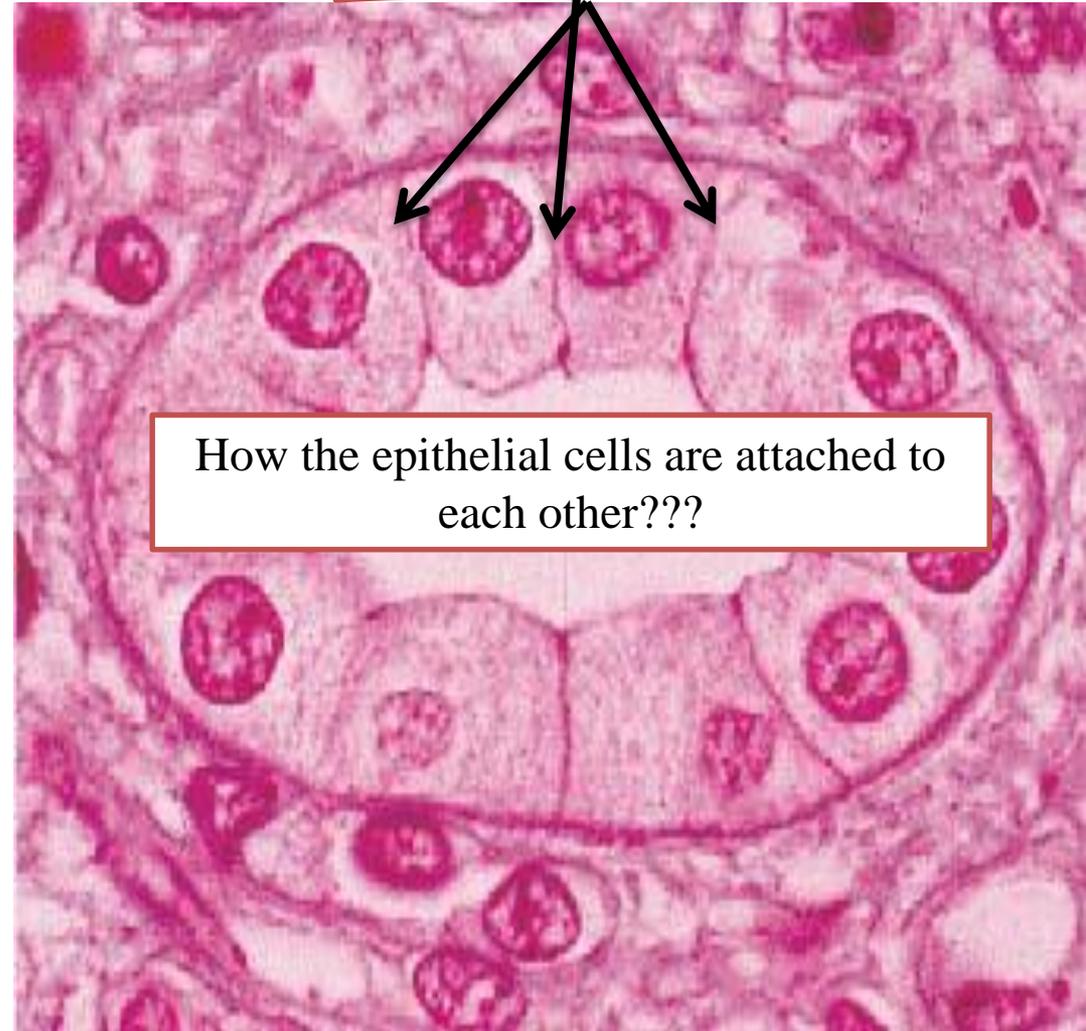
What do you think?

The lateral domain

What are these structures?

is characterized by the presence of unique proteins TO FORM junctional specializations

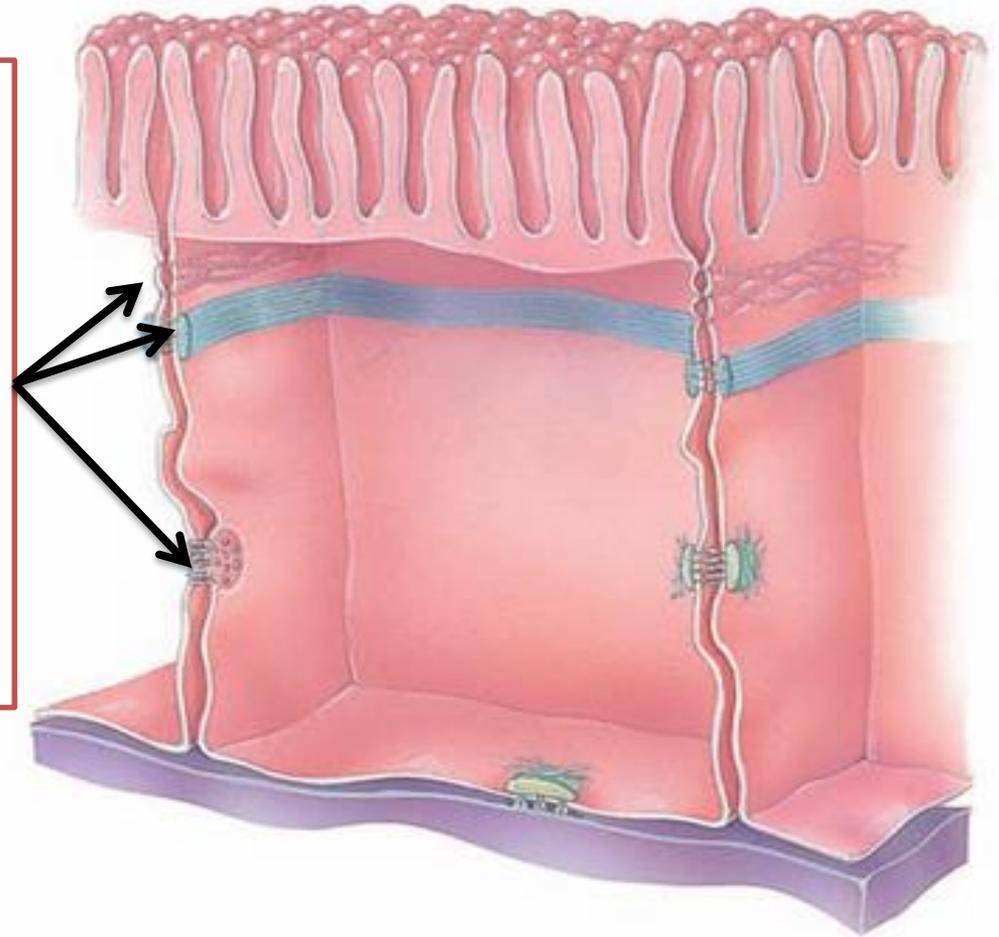
Before the advent of EM, the close apposition of epithelial cells was attributed to the presence of a viscous adhesive substance referred to as **intercellular cement**



How the epithelial cells are attached to each other???

Because of its location in the terminal or apical portion of the cell and its bar like configuration, the stainable material visible **in light microscopy** was called

The terminal bar



The terminal bars

Electron microscopy has shown that **the terminal bars** are specialized site that joins epithelial cells

The specific structural components that makeup **the terminal bars** are readily identified with the **EM** and are collectively referred to as

a junctional complex

These complexes are responsible for joining individual cells together.

There are three types of junctional complexes

1-Occluding junctions also called tight junctions

2-Adherens Junctions

3-Desmosomes



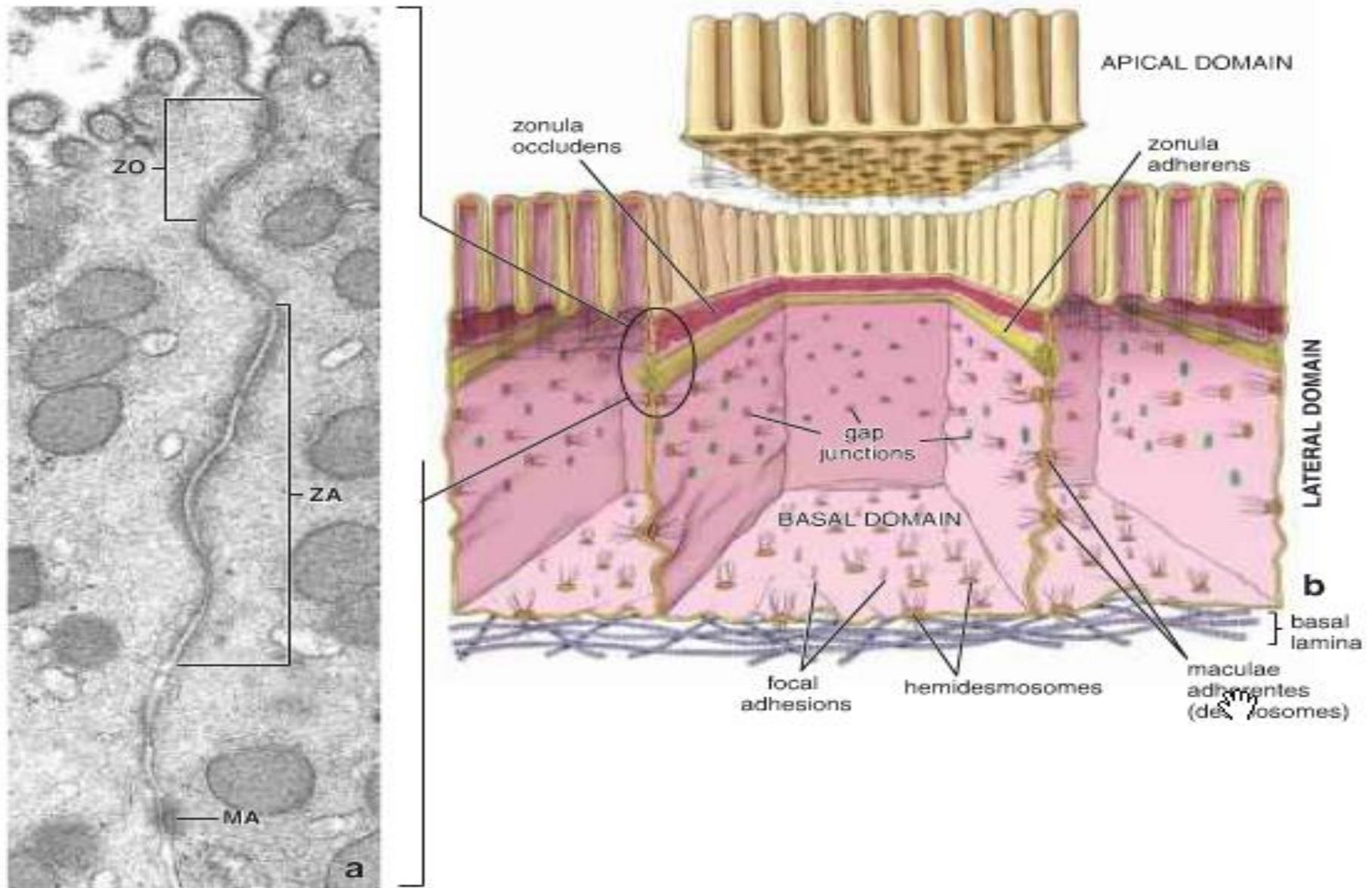
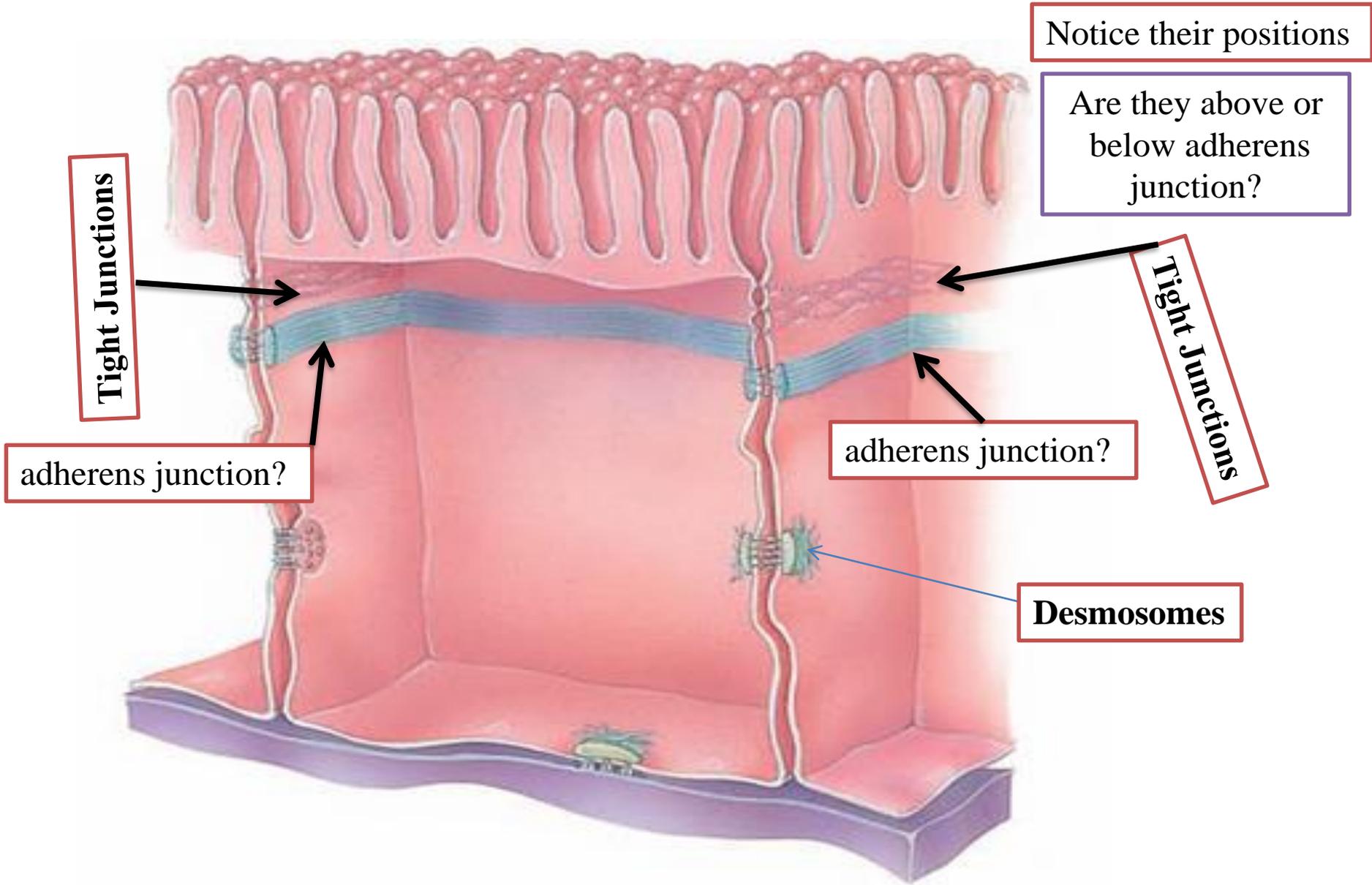


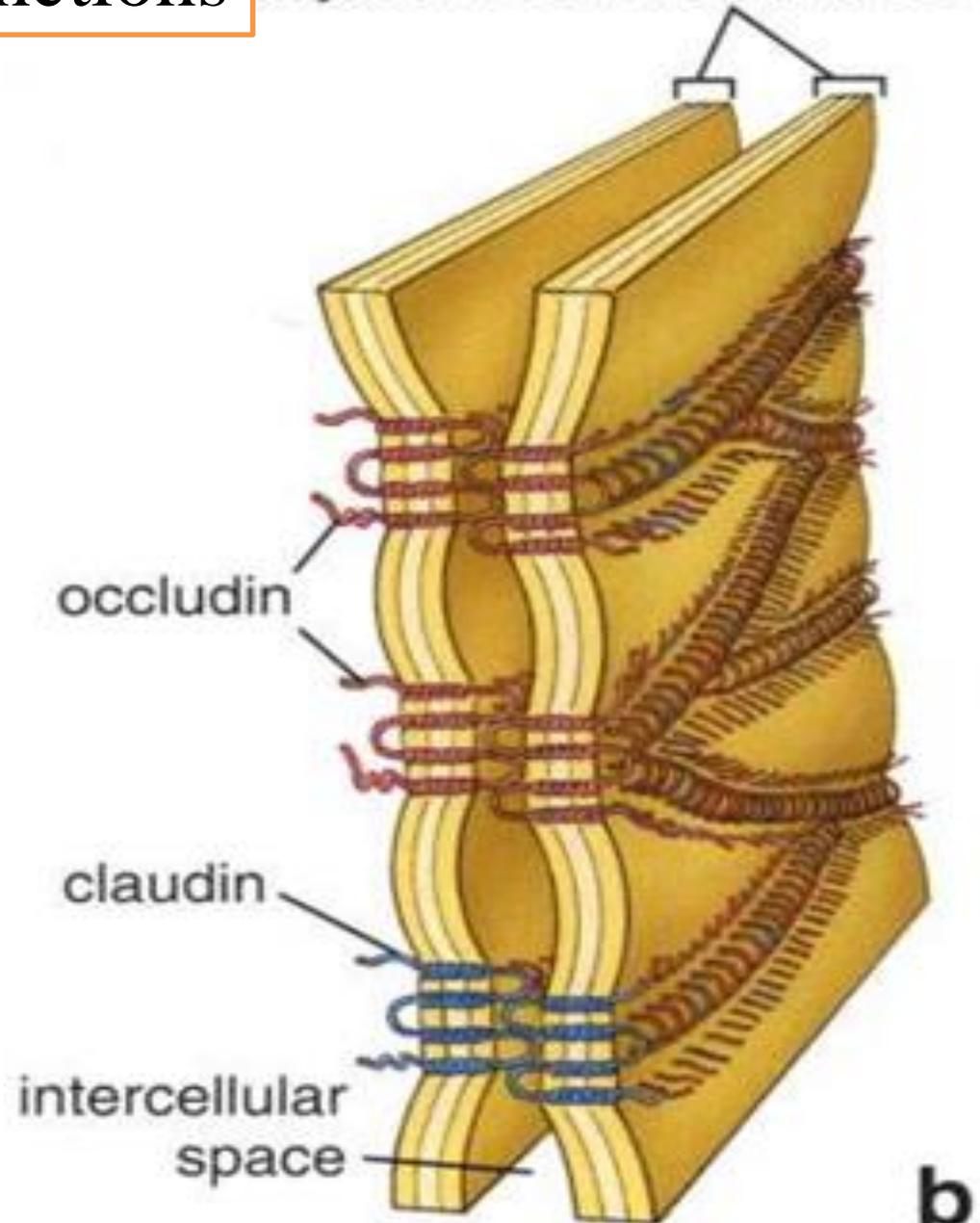
FIGURE 5.14 • Junctional complex. **a.** Electron micrograph of the apical portion of two adjoining epithelial cells of the gastric mucosa, showing the junctional complex. It consists of the zonula occludens (ZO), zonula adherens (ZA), and macula adherens (MA). $\times 30,000$ **b.** Diagram showing the distribution of cell junctions in the three cellular domains of columnar epithelial cells. The apical domain with microvilli has been lifted to better illustrate spatial arrangements of junctional complexes within the cell.



1-Tight junctions

adjacent cell membranes

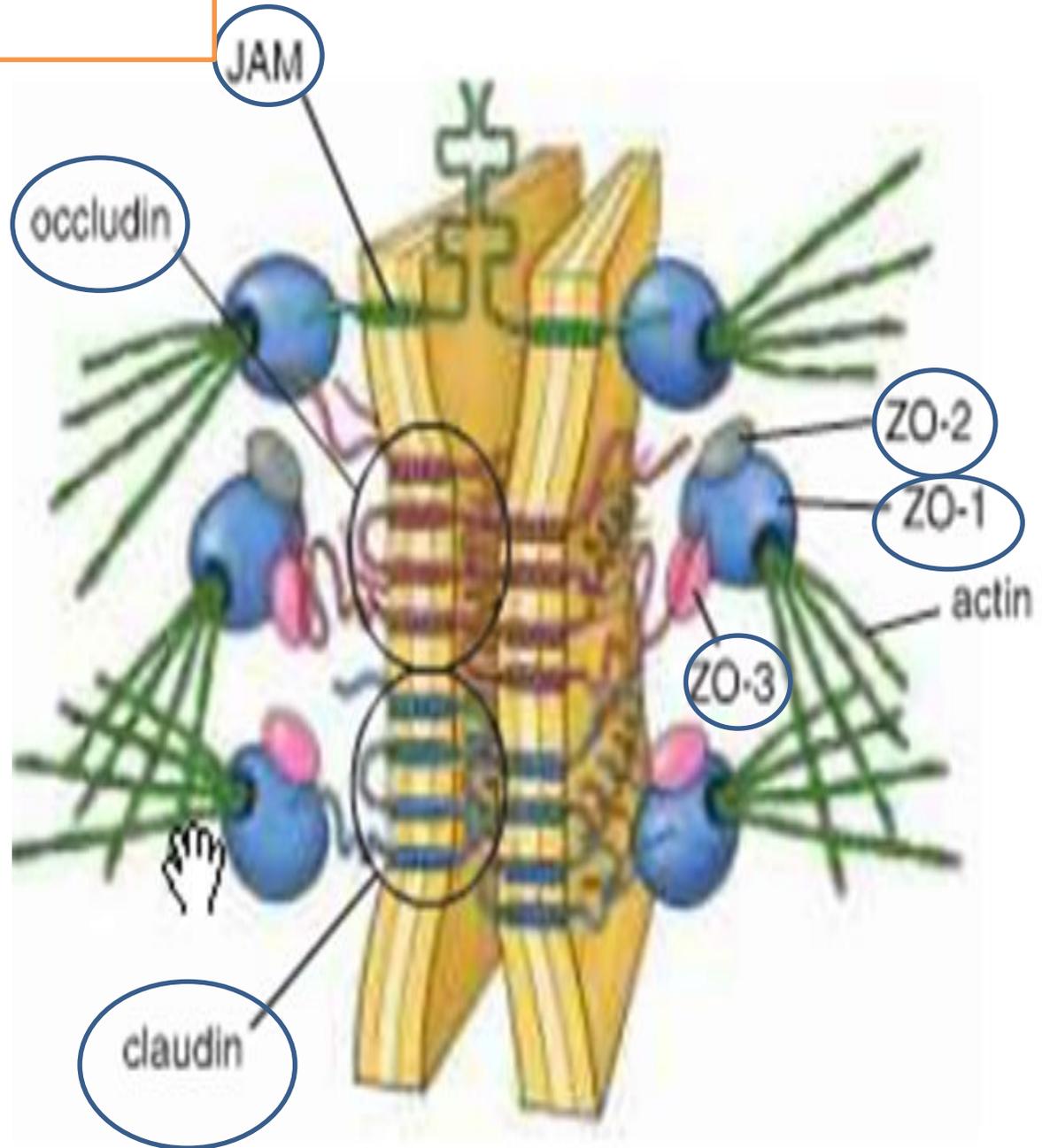
- ❖ Also called **zonulae occludens**, indicates that the junction forms a band completely encircling each cell.
- ❖ They form a series of punctate contacts of adjacent epithelial cells near **the apical end or luminal surface** of epithelial cells
- ❖ It is the most apical of all other cell junctions.



The major components
(Transmembrane link proteins) of tight
junctions

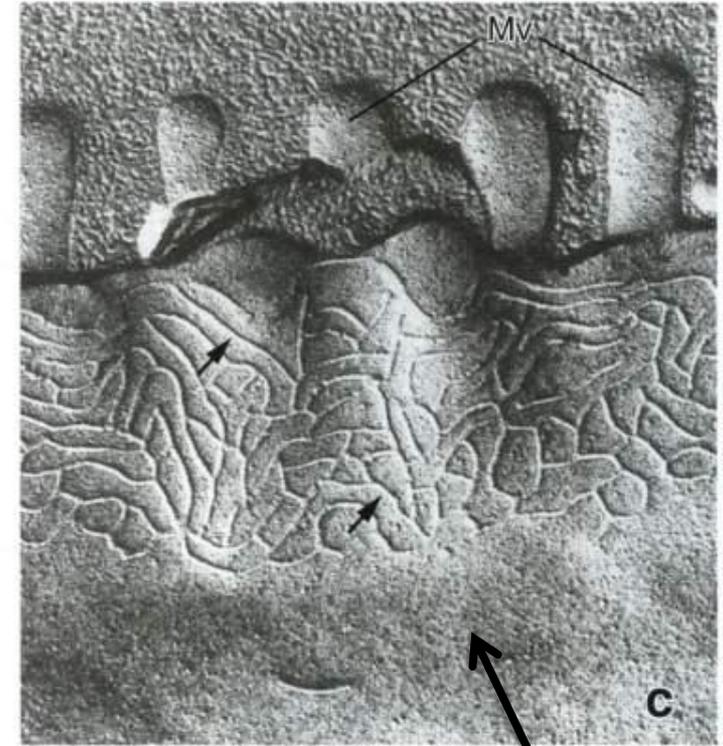
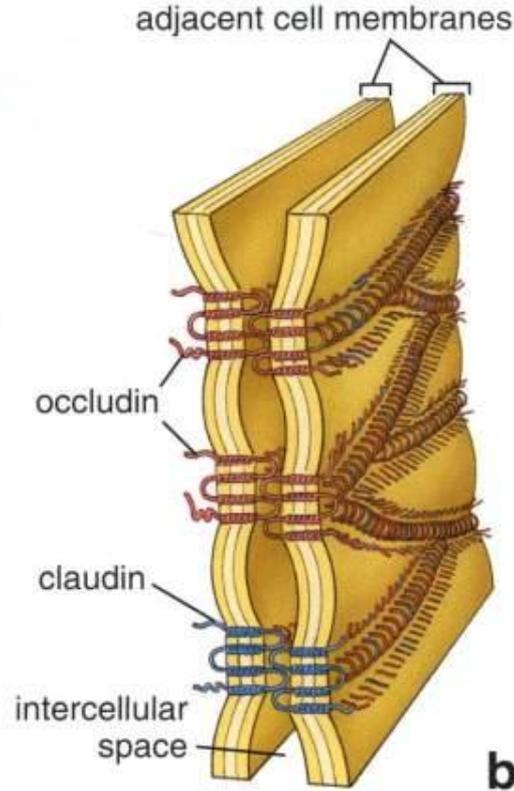
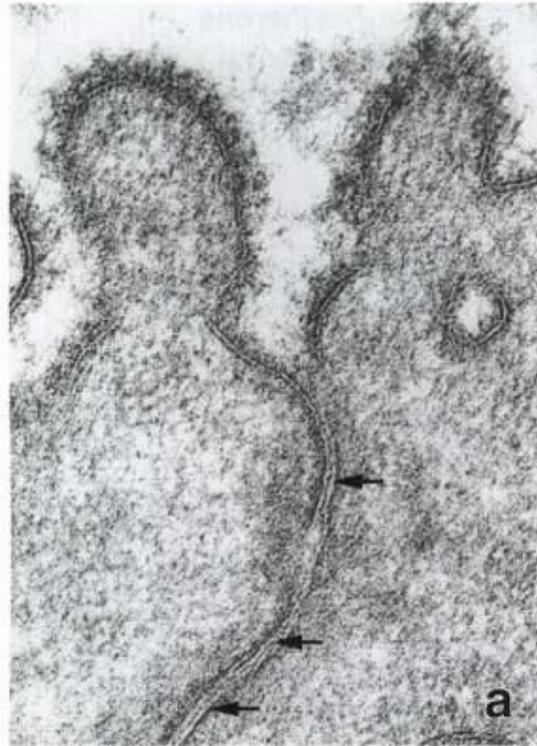
are
occludins (ZO-1,2,3)
and
claudin proteins

These
proteins span between the
adjacent cell membranes
and their cytoplasmic parts
bind to actin
microfilaments



Tight Junction

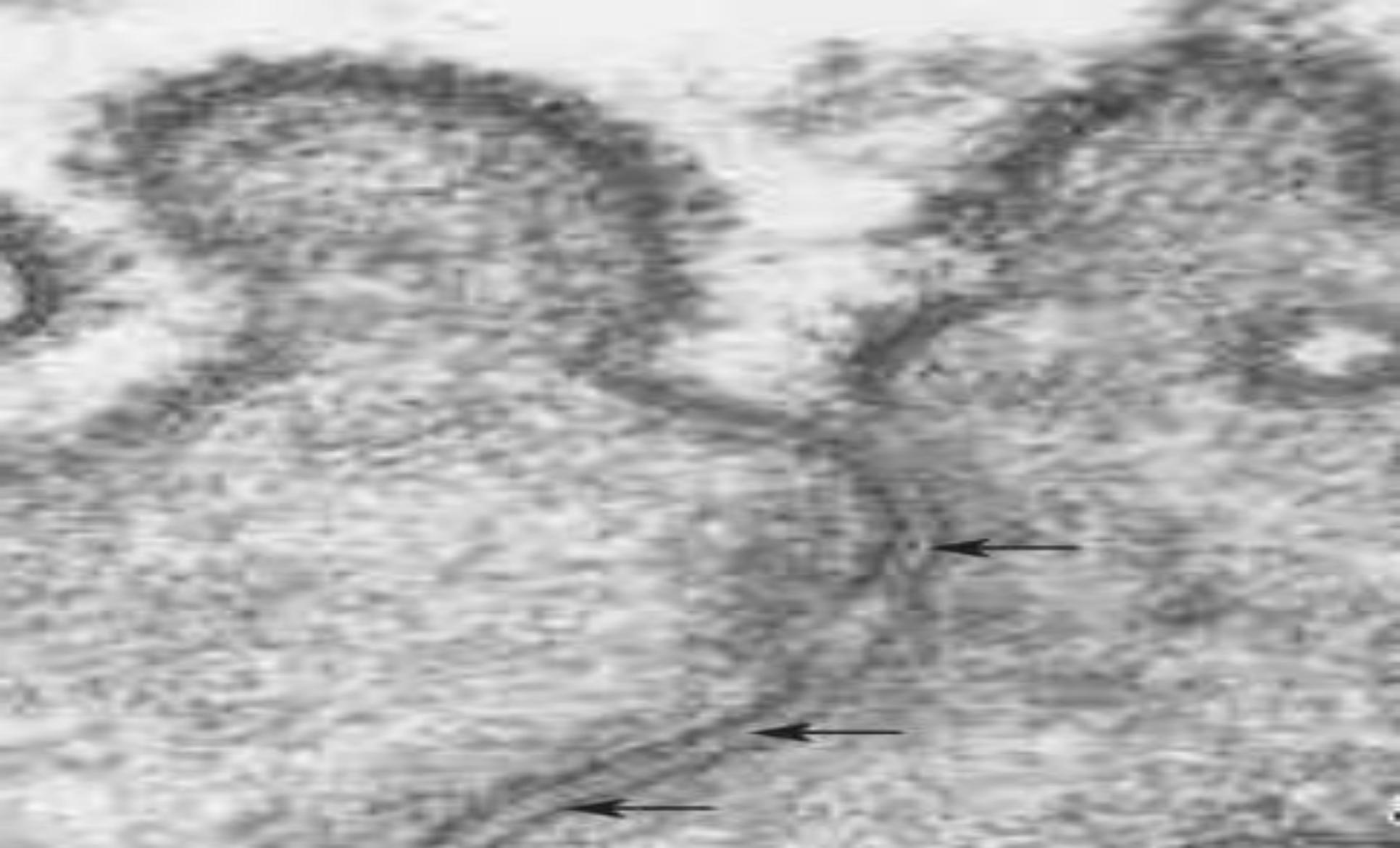
How they look?



TEM: is the most apical junction

Freeze fracture of TJ reveals ridges in membranes that correspond to sites of contact between cells

Ridges are linear arrays of occludin and claudin proteins



Zonula occludens. a. Electron micrograph of the zonula occludens showing the close approximation of the outer lamellae of adjoining plasma membranes. The extracellular domains of proteins involved in the formation of this junction (occludins) appear as single, electron-dense lines (*arrows*). $\times 100,000$.

Where do you expect to find Tight Junctions?

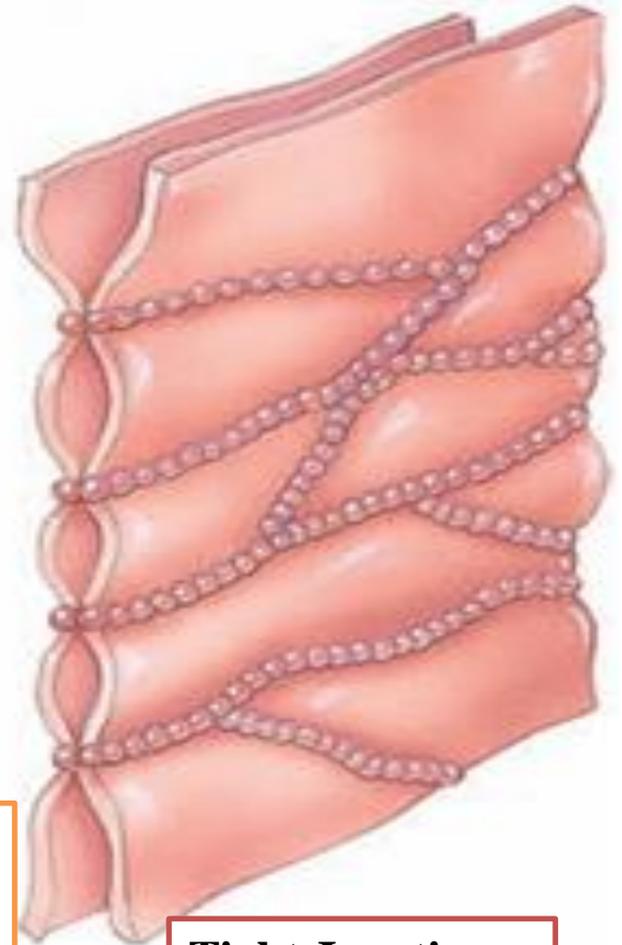
- 1-The stomach
- 2-Intestines
- 3-Urinary bladder

and why?

They inhibit the passage of substances between cells and prevent the contents of these organs from leaking into the blood or surrounding tissues



Epithelia with one or very few fused sealing strands (eg, proximal renal tubule) are more permeable to water and solutes than are epithelia with many fused strands (eg, the lining of the urinary bladder).



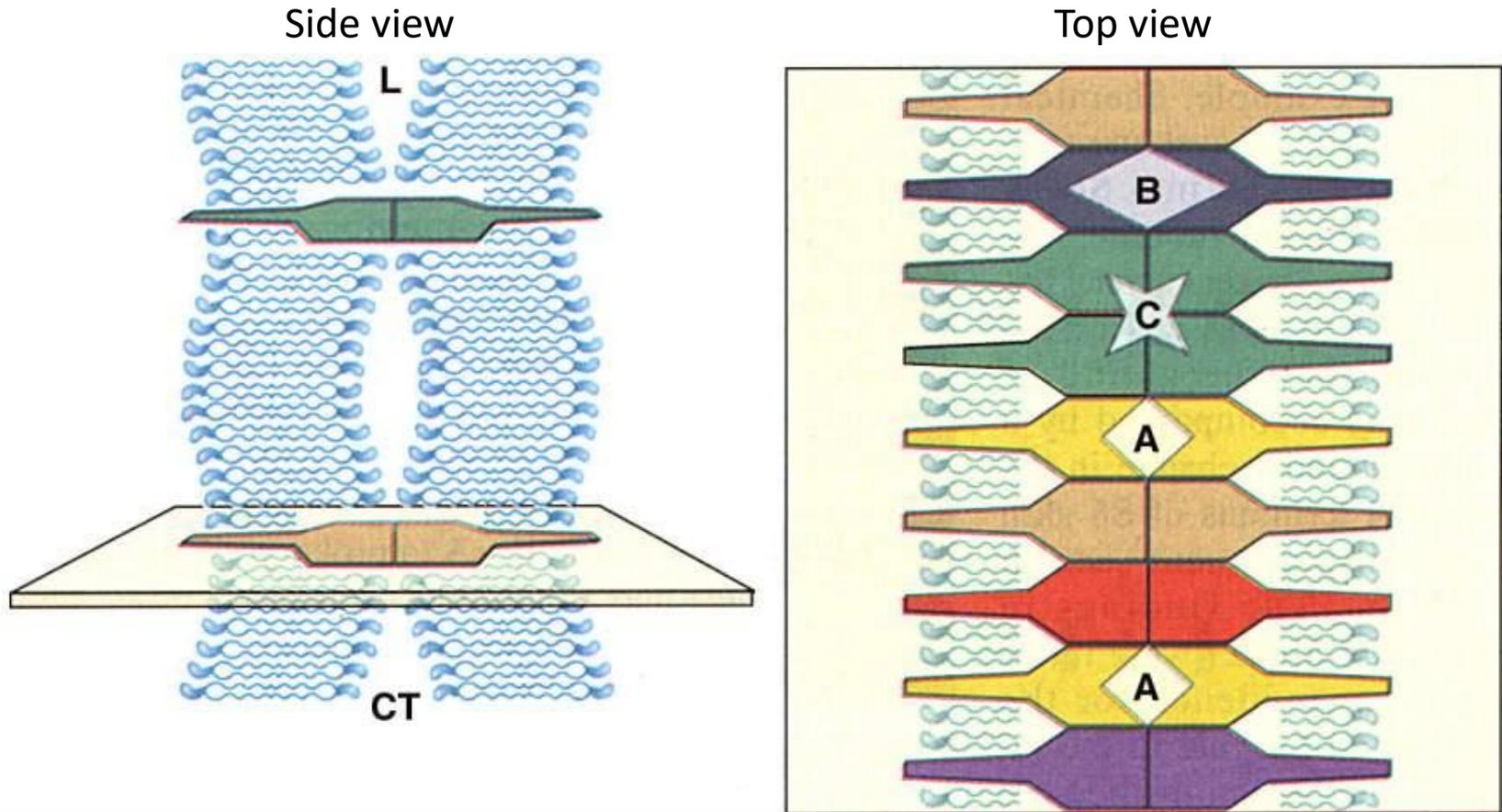
Tight Junctions

Based on what we have learned,
It seemed that we have a barrier!!!!

The question is

How the nutrients would pass this barrier ?

Tight Junction Permeability



Some claudins and occludins have pores (A, B, and C) that allow selective (paracellular) movement of ions or solutes

The **zonula occludens** separates the luminal space from the intercellular space and connective tissue compartment.

It is now evident that the **zonula occludens** plays an essential role in the selective passage of substances from one side of an epithelium to the other. The ability of epithelia to create a diffusion barrier is controlled by two distinct pathways for transport of substances across the epithelia (Fig. 5.17a):

- The **transcellular pathway** occurs across the plasma membrane of the epithelial cell. In most of these pathways, transport is active and requires specialized energy-dependent membrane **transport proteins** and **channels**. These proteins and channels move selected substances across the apical plasma membrane into the cytoplasm and then across the lateral membrane below the level of the occluding junction into the intercellular compartment.
- The **paracellular pathway** occurs across the zonula occludens between two epithelial cells. The amount of water, electrolytes, and other small molecules transported through this pathway is contingent on the **tightness of the zonula occludens**. The permeability of an occluding junction depends on the molecular composition of the zonula occludens strands and thus the number of active aqueous channels in the seal (see the following section). Under physiologic conditions, substances transported through this pathway may be regulated or coupled to transcellular transport.

Read only

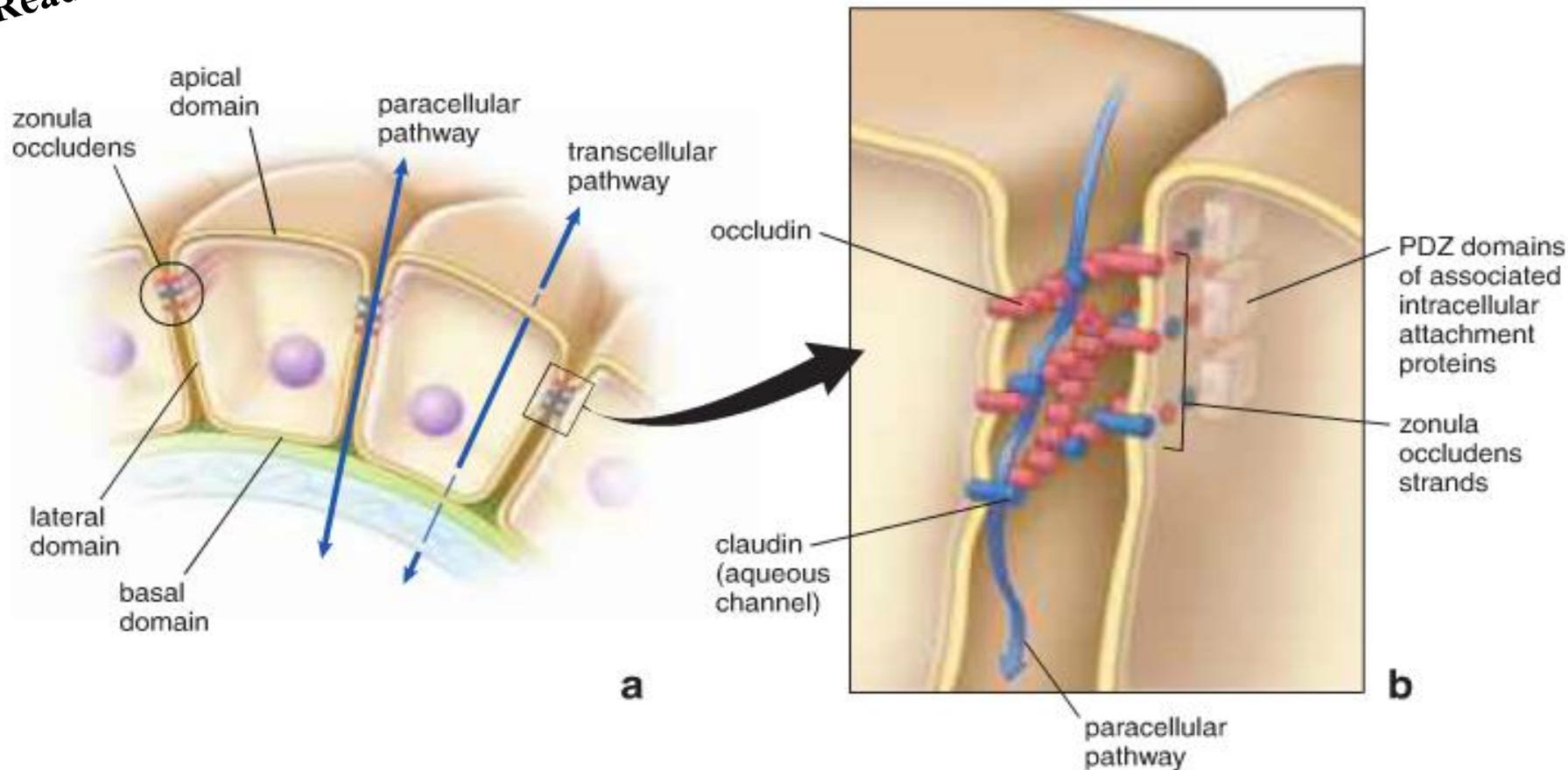


FIGURE 5.17 • Two transcellular and paracellular pathways for transport of substances across the epithelia. **a.** The transcellular pathway occurs across the plasma membrane of the epithelial cell and represents an active transport system that requires specialized energy-dependent membrane transport proteins and channels. The paracellular pathway occurs across the zonula occludens between two epithelial cells. The amount of water, electrolytes, and other small molecules transported through this pathway is contingent on the tightness of the zonula occludens. **b.** Structure of the extracellular and cytoplasmic portions of tight-junction strands. Two zonula occludens strands from neighboring cells fuse together in a zipperlike fashion and create a barrier to movement between the cells. Aqueous pores allow water to move between the cells. The permeability of the barrier depends on the mixture of claudins and occludins in the zipper seal. The cytoplasmic portion of the strand attracts PDZ-domain proteins that function in cell signaling.

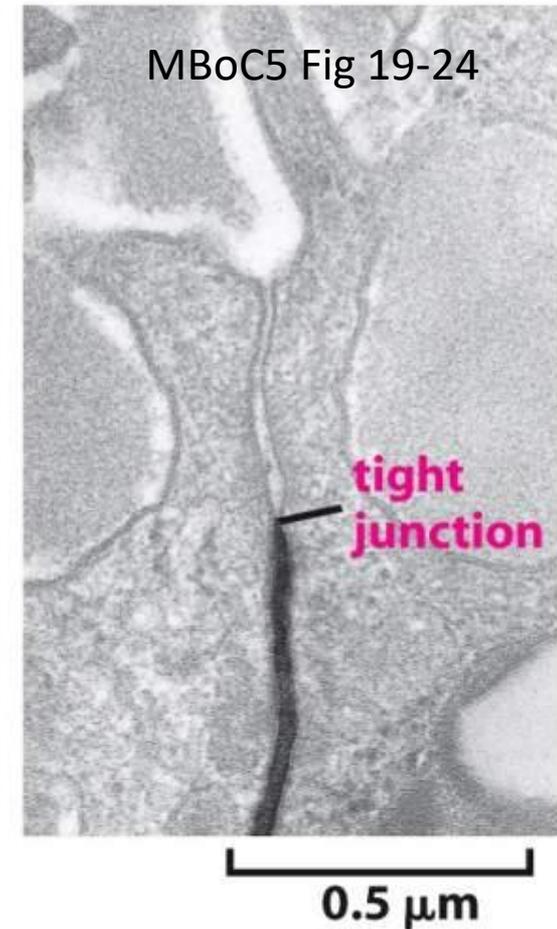
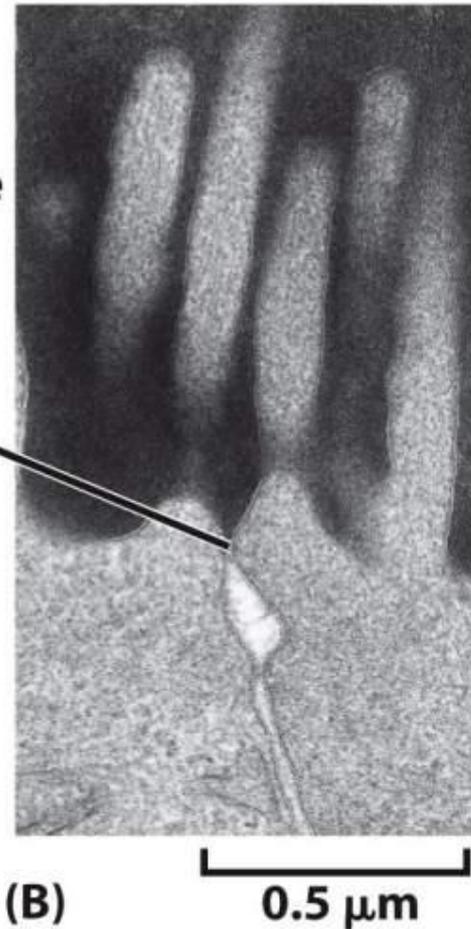
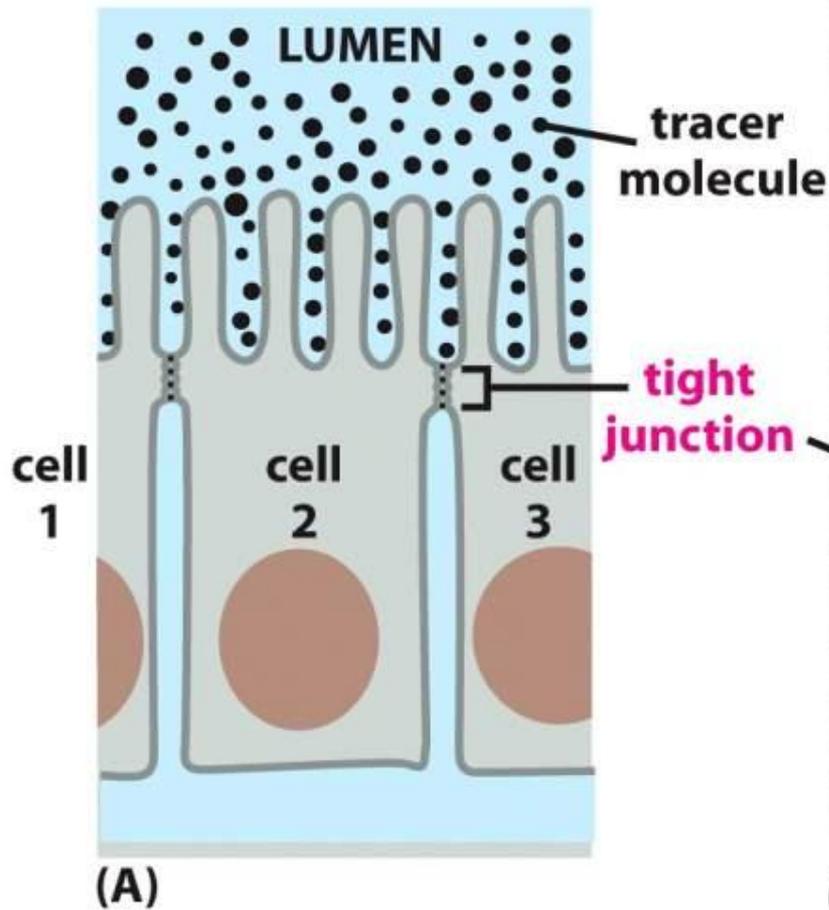
Functions

Tight junctions, are impermeable and allow epithelial cells to function as a barrier, occluding junctions form the primary intercellular diffusion barrier between adjacent cells

Function: by limiting the movement of water and other molecules through the intercellular space, **they maintain physico-chemical separation of tissue compartments**

Because they are located at the most apical point between adjoining epithelial cells, occluding junctions **prevent the migration of lipids and specialized membrane proteins between the apical and lateral surfaces**, thus maintaining the integrity of these two domains

Tight Junctions



Tight junction blocks diffusion of soluble tracer molecules added to either the apical or basolateral compartment.

Clinical application

common bacteria such as *Clostridium perfringens*
causes food poisoning
its enterotoxin

binds to **Claudin molecules of tight junctions** of the epithelial cells of the intestines
causes loss of tissue fluid into the intestinal lumen
via the paracellular pathway

Similarly, ***Helicobacter pylori***, which is important in the etiology of gastric ulcers, binds **the extracellular domains of tight-junction proteins** in cells of the stomach and inserts a protein into these cells, which **targets ZO-1** and disrupts signaling from the junction