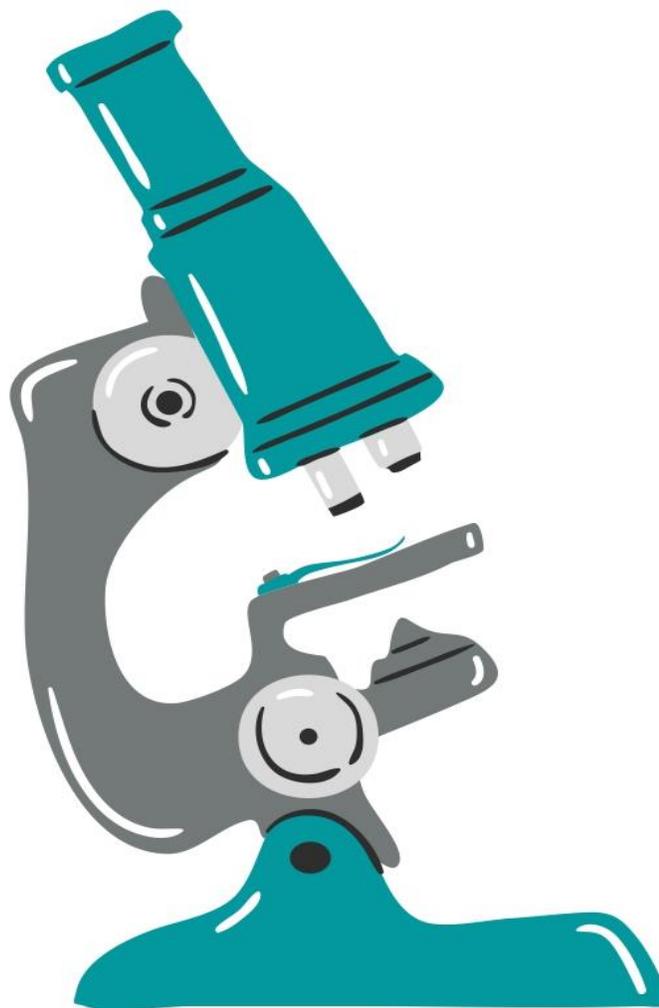


Sheet no.3



# Histology



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# MAJOR TISSUE TYPES

The organs of the human body are composed of only four basic tissue types: epithelial, connective, muscular, and nervous tissues. The basic tissues, each containing extracellular matrix (ECM) as well as cells, associate with one another in the variable proportions and morphologies characteristic of each organ. The main features of the basic tissue types are summarized in Table (FOR MEOMRISED )

Tissue	Cells	Extracellular Matrix	Main Functions
Epithelial	Aggregated polyhedral cells	Small amount	The lining of surface or body cavities; glandular secretion
Connective	Several types of fixed and wandering cells	Abundant amount	Support and protection of tissues/organs
Muscle	Elongated contractile cells	Moderate amount	Strong contraction; body movements
Nervous	Elongated cells with extremely fine processes	Very small amount	Transmission of nerve impulses

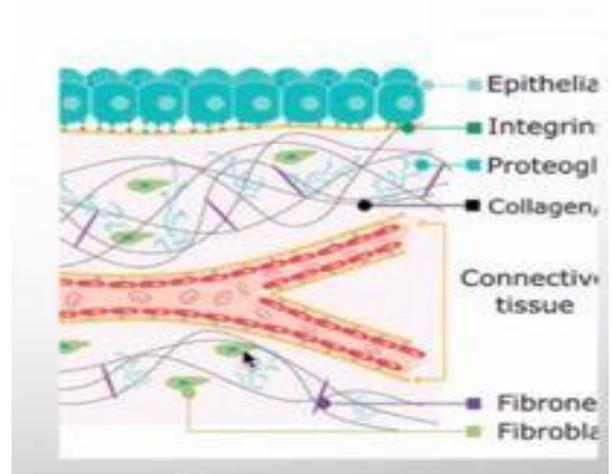
**Note:** there are many specific types of tissues that are under categories of connective tissue like: Reticular, blood, bone, cartilage, adipose tissue. Moreover, the differences between them are based on the nature of the extracellular matrix (ECM) its composition, mechanical and physical properties.

**Note:** Epithelial tissues are composed of closely aggregated polyhedral cells adhering strongly to one another and a thin layer of ECM. So, the amount of any material in between the cells is something that is not necessary.

# Epithelium

Continuous sheets of cells that line internal surfaces and cover the external surfaces. They are side by side and very close to each other. they are resting on a structure is called the **basement membrane**. It is a selective barrier that protects tissue and is often involved in ABSORPTION OR SECRETION. Also, it is separated from the adjacent connective tissue by a basement membrane.

under the basement membrane, there is a layer of connective tissue. we can find epithelial tissue for example: covering surfaces, lining a cavity, lining a tube, a duct the vessel.



## **Example: (Digestion system)**

It starts with the oral cavity particularly the mouth opening it ends all the way with Anus .so, you eat the food you digest it you take what you need from it and excrete what is not needed it as a stool.

Oral cavity → pharynx → esophagus → dilation (GI tract) →  
Stomach (digestion) → (narrowing ) small and large intestine → lower part  
of GI tract anus.

From the beginning with an oral cavity to the anus that's considered space Whether it is a cavity or a tube, it has to be lined with epithelium .that can be exposed to something that is moving, you have to have epithelium lining.

**ALSO**, when we took about blood vessels there is something that is moving it so, it has an epithelial lining(simple epithelium).

**MOREOVER**, respiratory track (starts with the nose down alveoli, there is air moving so it has to have epithelium lining.

**NOTE:** The types of epithelium will differ from one location to another, FOR EXAMPLE, the epithelium tissue in the oral cavity differs compared to the epithelial tissue in the stomach (because when food reach the stomach will become much softer and smother so somehow the type of epithelium in the stomach it will differ of the one in the oral).

## THE PRINCIPAL FUNCTIONS

**1-Covering:** lining, and projection surfaces (EG, EPIDERMIS: The most superficial of skin)

**2- Absorption** :The intestinal lining

**3- Secretion:** parenchymal cells of GLANDS

## CHARACTERISTIC OF EPITHELIUM

**1-**supported by the connective tissue

**2-**Innervated ( HAS NERVES )

**3-**Avascular ( NO BLOOD VESSELS ), blood supply is in supporting connection tissue

**4-**Has a high regeneration capacity(it can renew itself)

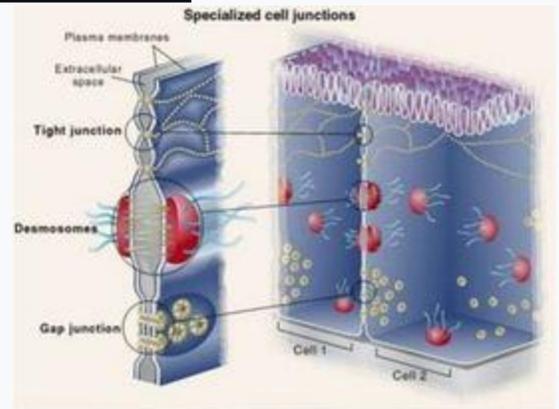
EXAMPLE: -when we took about the skin, if you lose your skin and are not compensating these dead cells with underlying new living cells you will lose your whole skin, why we don't have this? because the basal cells keep dividing to renew the more superficial-GI tract, when we eat a certain number of meals it might harm the oral cavity lining, if we lose cells every time we are eating we will end with an

ulcer we don't have this is because we have regeneration

**5-Polarized** :(direction: cell has certain directions it had top, bottom, lateral)

## **Epithelial cells are highly polarized :**

**Apical surface**:-faces the lumen of the external environment



Microvilli ,Cilia , Streocilia

**Lateral surface**:- faces the sides of adjacent cells

Tight junction, Desmosomes, GAP junction (intercellular junction )

**Basal surface**:- attaches to the basement membrane

Basement membrane, hemidesmosomes

Note: connective tissue supported the epithelium tissue with innervation and vascularity that's why you can feel the sensation. For example, on your skin, you can feel it soft, if it is harsh material, if it is cold, if it is warm .however, there are no blood vessels in epithelium tissue so anything will be uptaken from the underlying connective tissue by diffusion

## **Basement Membrane**

Two parts of the basement membrane (TEM):

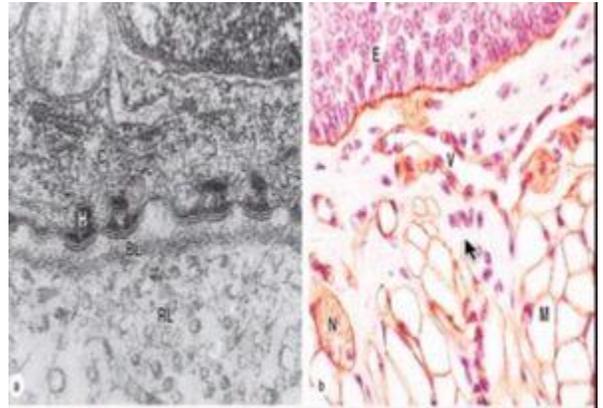
1-The basal lamina, a thin,electron-dense,sheet-like layer of fine fibrils (type IV collagen, laminin, and other proteins)

2-Reticular lamina: more diffuse meshwork that contains type III collagen and bound to the basal lamina by anchoring fibrils of type VII collagen

The picture on the left is only part of the cell (electron microscope image )

But in the right, every structure round represented a cell (light microscope image)

1) The ultrastructural components of the basement membrane are revealed by TEM. The dense basal lamina (BL), 20-100 nm thick, may appear with thin clear zones on each side and is anchored to a thicker, more diffuse reticular lamina (RL) containing collagen III fibers.



2) Laminin, a major glycoprotein within basal laminae, is shown here by immunohistochemistry and identifies the basement membranes of the stratified epithelium

### **FUNCTION OF THE BASEMENT MEMBRANE :**

1-Filteration

2-provides structural support

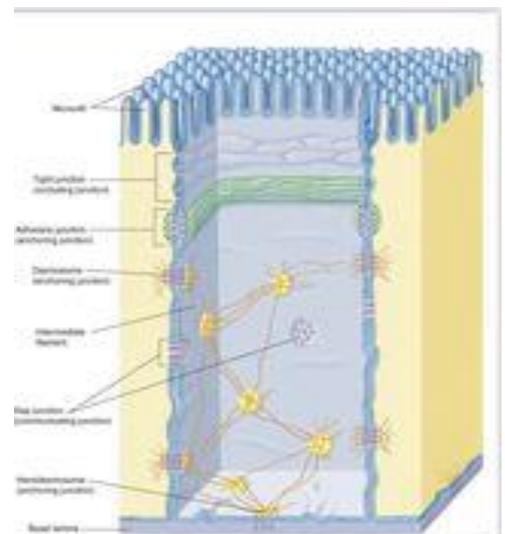
3-attaches epithelia to underlying connective tissue

The lateral adhesion of cells work to glue the two lateral surface to the adjacent cells to prevent any movement of any material of any kind in between the cells (nothing is allowed to pass through paracellular movement)

**But we have exceptions :**

In the KIDNEY, it has leakiness so some paracellular is allowed and it's physiological, we need it

In all other places, there is no paracellular movement, are only transcellular movement



**What is gluing these epithelium cells together?** epithelial cells have intercellular junctional complexes with different types of junctions. At the apical end, 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 the passive flow of material between the cells, they are the most efficient in preventing Paracellular and in creating the adhesion of the two lateral membranes and it does make sense that they are located apically to prevent paracellular from its beginning

If we move more basally will find a structure, like adhesion spots are called desmosomes, the two proteins on both ends if you cut it into two halves one on lateral the other one in the other lateral and we have other proteins is spanning the two parts of the desmosomes, it's more focally localized to further enhance the adhesion between cells, but they are not as efficient as the over two (tight and adherent junction) in adhesion and in preventing the paracellular movements . the forth type of junctions is gap junctions that focal adhesions between neighboring two cells .however; these gap junctions they seem to create tiny channels between the two cells which allows the movement of materials but extremely tiny molecules that are allowed to pass through it mainly like: ions, small particles of glucose or amino acid and extremely tiny proteins. (this is between epithelial cells themselves not with the external environment) so the major function of gap junction is communication. the last type is Hemidesmosomes its like a half desmosomes (use the desmosomes is made of two adjacent epithelial cells ), whereas the hemidesmosomes is a focal attachment or adhesion among the basal with basement membrane (so this is one of the ways to glue the epithelium on the basement membrane in which you cant easily peel it or slotted, so it stays there it goes nowhere.

## **NOTE:**

Mutations in the integrin- $\beta$ 4 gene are linked to some types of epidermolysis bullosa, a skin blistering disorder <https://www.mayoclinic.org/diseases-conditions/epidermolysis-bullosa/symptoms-causes/syc-20361062?p=1> (Check this article that talks about epidermolysis bullosa)

Lecture homework

## Epithelial cell junctions, their major structural features and functions (FOR MEOMERISED) 😞

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
Cytoskeletal components	Actin filaments	Actin filaments	Intermediate filaments (keratins)	Intermediate filaments	None
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

## TYPES OF EPITHELIUM

There are several functions of epithelium so we must have different types of epithelium, each one will fit the specific function that's going to perform.

### 1-Simple Epithelium :(one layer of cells )

#### a- SIMPLE SQUAMOUS EPITHELIUM

This is a type like more compressed, flat(the nucleus is flattened )

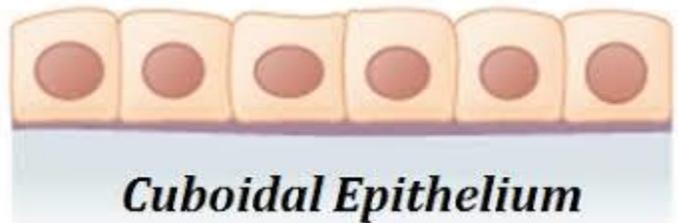
The cell doesn't have a lot of cytoplasm



Simple squamous epithelium

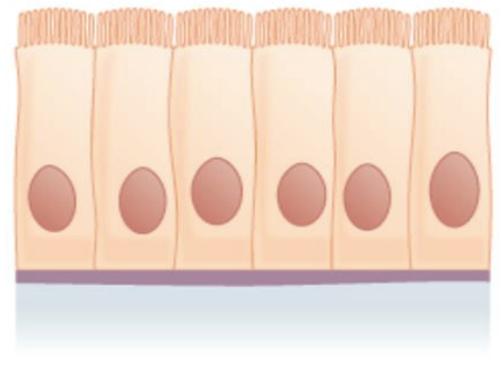
**b- SIMPLE CUBOIDAL EPITHELIUM**

The nucleus is circular or rounded, cytoplasm around the nucleus seems to be even



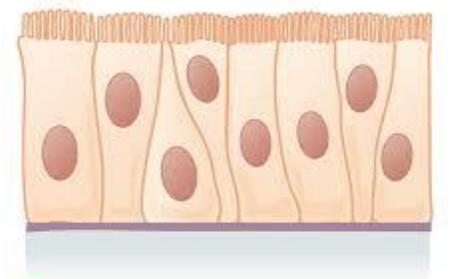
**c- SIMPLE COLUMNAR EPITHELIUM**

Cell more elongated (the nucleus is oval), the cell has much more above the nucleus than below of cytoplasm



**d- PSEUDOSTRATIFIED COLUMNAR EPITHELIUM**

Simple epithelium because all cells touching the basement membrane (isn't true stratification), they much taller than the columnar epithelium and these cells appear like two groups of cells one of them is the apical arrangement and the other one is basal, and we can examine this by H&E stain. (this is not a typical simple they created a new category of words)

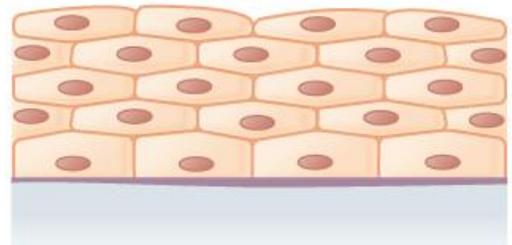


There are differences among them in length, shape (the nucleus follows the general shape of the cell ), and amount of the cytoplasm, they are very important to identify the sections you are going to see and these are the key features to look for .in addition, usually the columnar they will be more associated with the apical modifications like microvillous and cilia

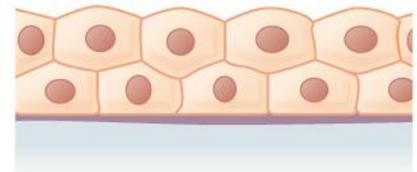
## **2-Stratified Epithelium**(two or more layers of cells)

### **a-STRATIFIED SQUAMOUS EPITHELIUM**

the one that you will see the most in the body

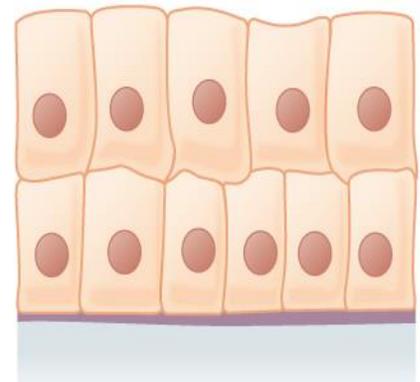


### **b-STRATIFIED CUBOIDAL EPITHELIUM**



### **c-STRATIFIED COLUMNAR EPITHELIUM**

the least type you will see in the body (its distribution is very limited)

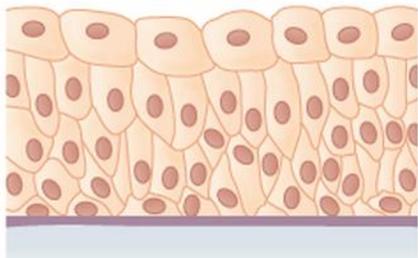


## d-TRANSITIONAL EPITHELIUM

one of the locations for this epithelium is the urinary bladder (sac) that accumulates urine, with time it will distend (the volume that is accommodating, it is increasing over time with increased amount or volume of urine that is coming in).

the urinary bladder is lined with epithelium, the middle layer is smooth muscle and the outer layer is connective tissue, smooth muscle while this urinary bladder is being distended it should relax up to a certain point this is a time when you feel the urgency that you need to go to bathroom, smooth muscles are relaxed urine will push, so the epithelial tissue will stretch (the epithelium stratified squamous) and thickness of this tissue will be decreased (like rubber principle) so the surface area will increase, while the bladder is empty the epithelium is stratified cuboidal

this type we call transitional epithelium because you see it on both types either cuboidal or squamous.



**NOTE:** the classification of these types is based on the most superficial layer