Epithelial Tissue

by Prof. Dr. Talib jawad

TYPES OF EPITHELIAL TISSUE

Different epithelia show different structures as they perform different functions

Type of Epithelium	Structure	Location in the body	Function
Squamous epithelium 	Cells are thin, flat, irregular cells which fit like floor tiles to form delicate lining called **PAVEMENT EPITHILIUM** **Nuclei in centre**	Oesophagus,lining of mouth, alveoli of the lungs, blood vessels	Protects the underlying tissue from injury,grems Exchange of gases in lungs and materials between cells and blood
Cuboidal epithelium 	Cells are cuboidal with round nucleus in centre **Nuclei in centre**	Kidney tubules, duct of salivary glands	Gives mechanical support At times the epithelial tissue folds,forms a gland that secretes substances. Such epithilium is called **GLANDULAR EPITHILIUM**
Columnar epithelium 	Cells are more tall and less wide (**PILLAR LIKE**), placed side by side. Nucleus is situated near the base. **Nuclei near base**	Inner lining of intestine, In respiratory tract,cells have cilia (hair like) that move and push the mucous to clear it.Such epithilium is called **CILIATED COLUMNAR EPITHILIUM**	Helps in absorption excretion and secretion
Striated squamous epithelium 	Squamous flat cells arranged in many layers to prevent wear and tear of parts.	Skin (to prevent wear and tear) tongue, oesophagus lining of mouth.	Protection, prevent wear and tear

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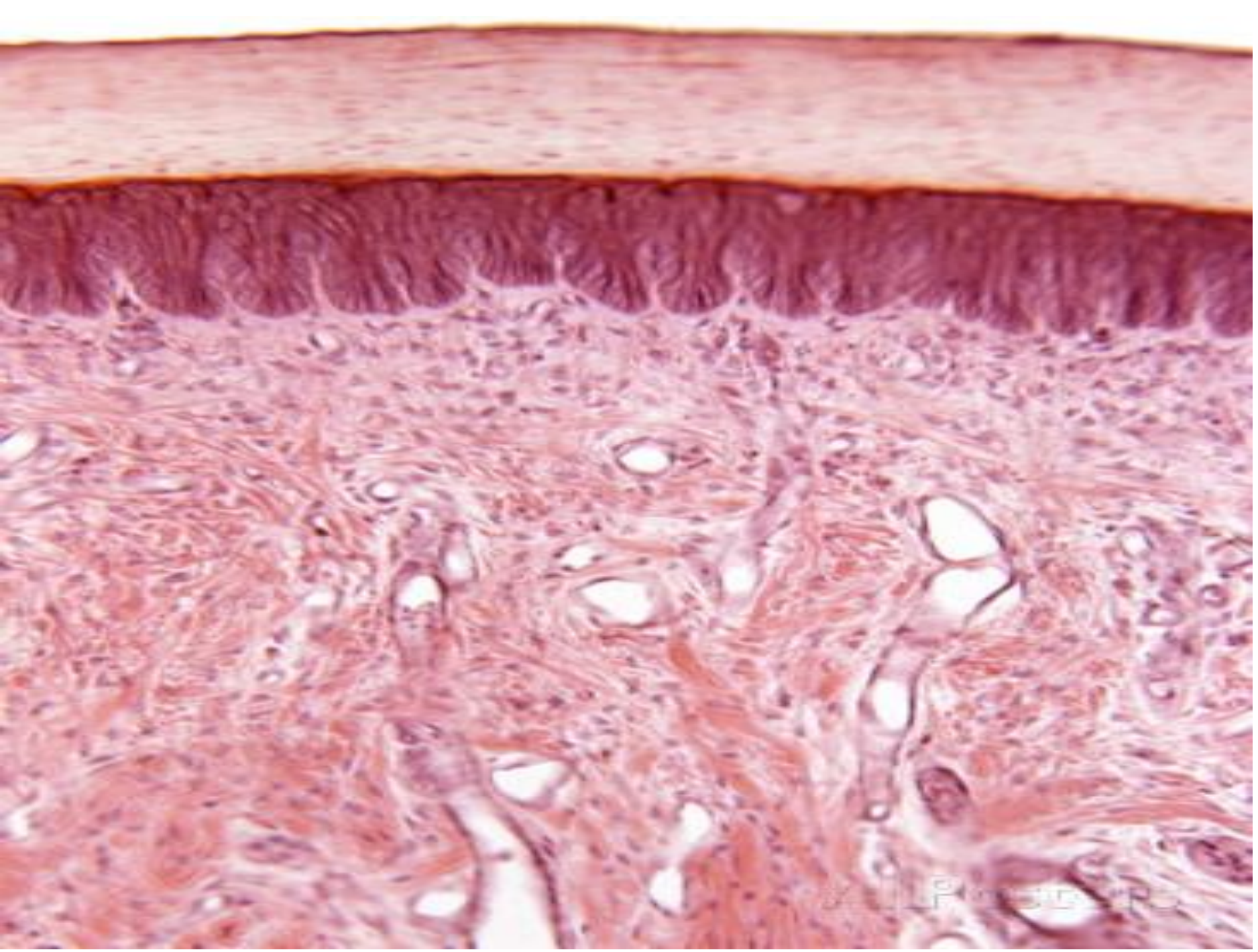
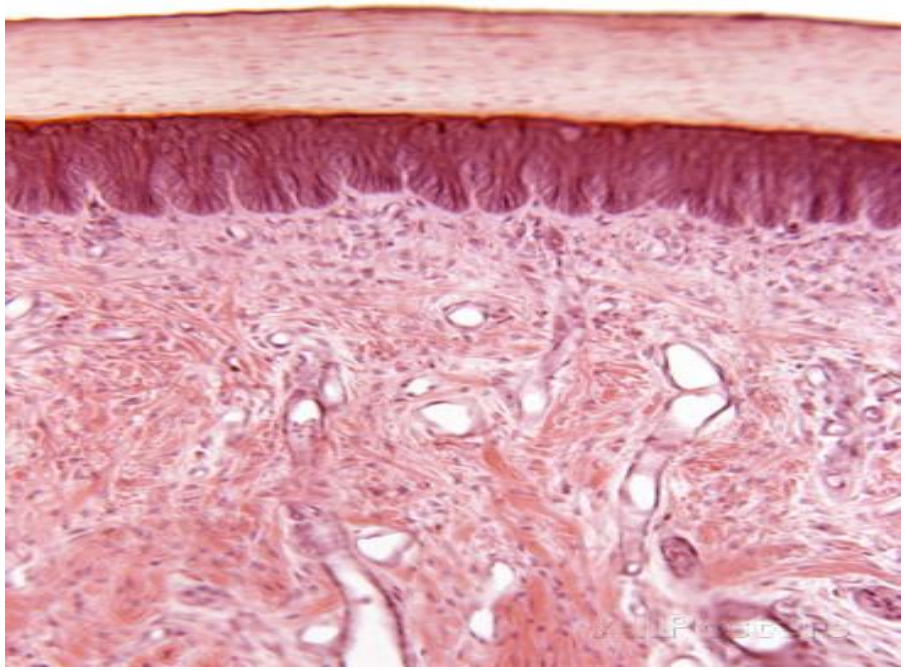


Epithelium (*epi- + thele + -ium*) is one of the four basic types of animal tissue. The other three types are connective tissue, muscle tissue and nervous tissue.

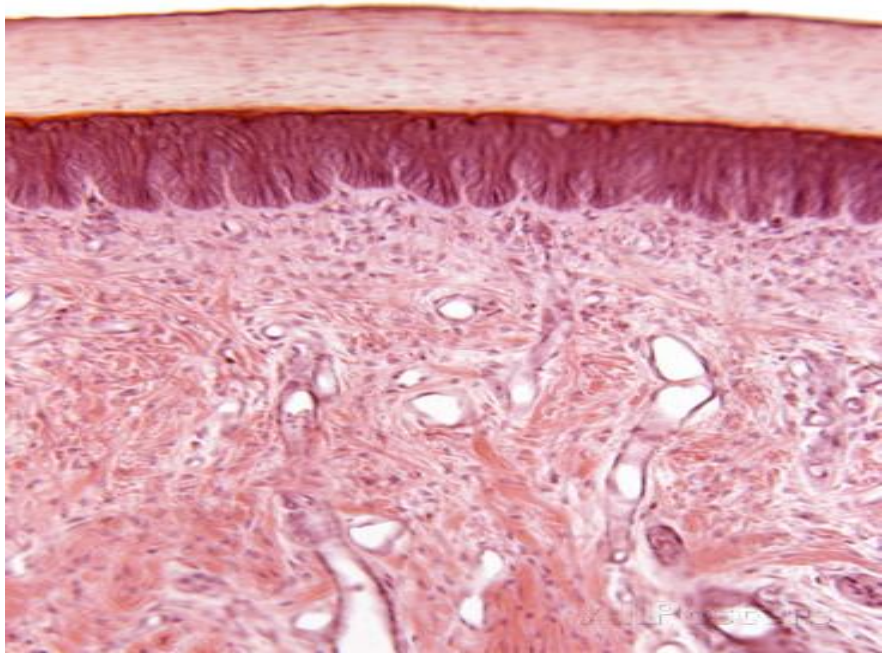
Epithelial tissues line the cavities and surfaces of blood vessels and organs throughout the body.

Epithelial Tissue

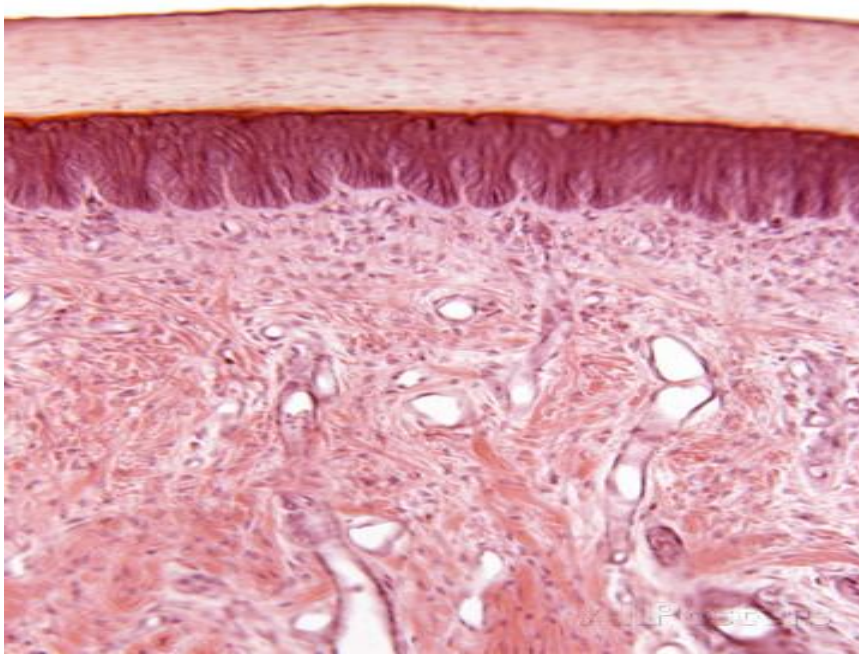
- *Epithelial tissue,* or epithelium, has the following general characteristics:
- **closely packed, flattened cells that make up the inside or outside lining of body areas. There is little intercellular material.**



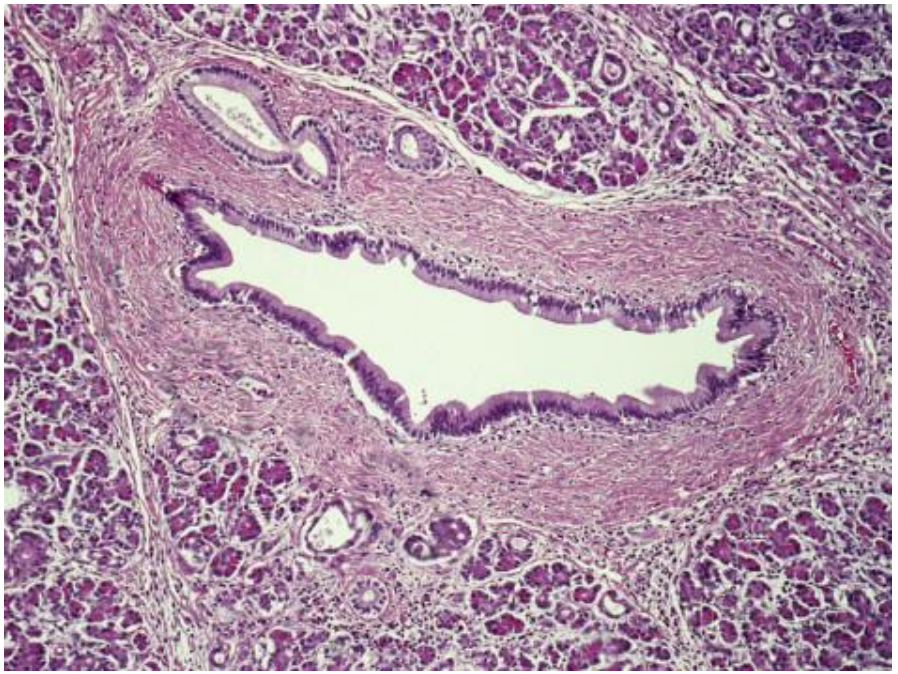
- The tissue is **avascular**, meaning without blood vessels. Nutrient and waste exchange occurs through neighboring connective tissues by diffusion.



The upper surface of epithelium is free, or exposed to the outside of the body or to an internal body cavity.

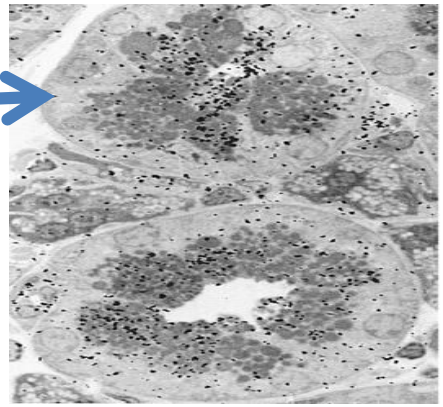


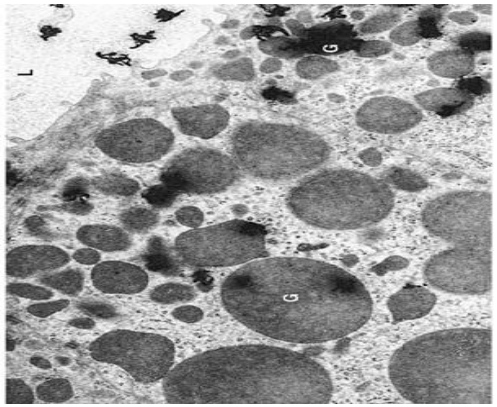
The basal surface rests on connective tissue. A thin, extracellular layer called the *basement membrane* forms between the epithelial and connective tissue.



Considering the site there are two kinds of epithelial tissues:

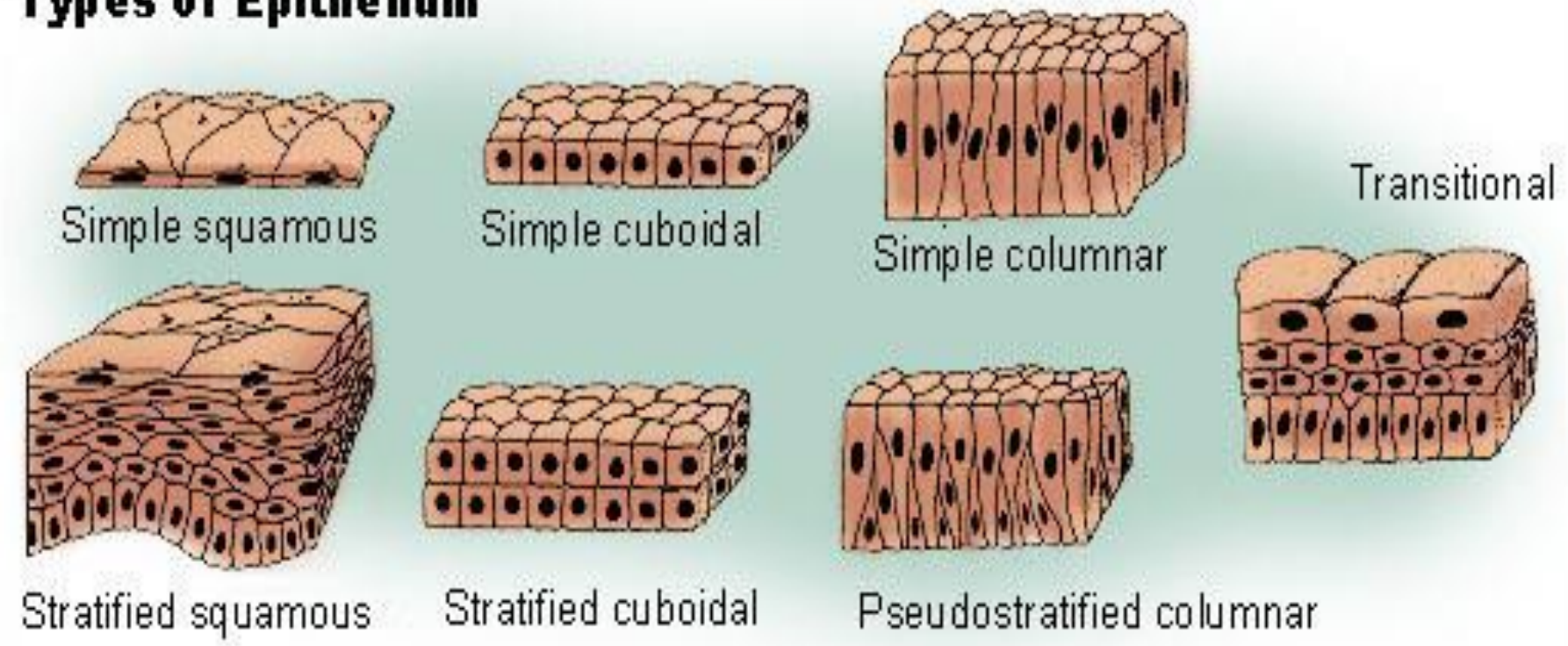
- Glandular epithelium secretes hormones or other products.





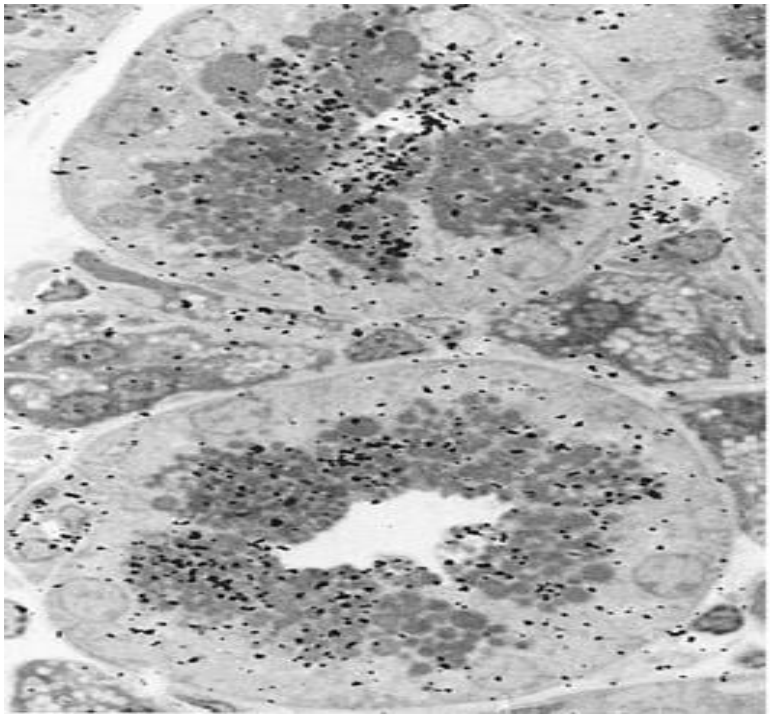
- Covering and lining epithelium covers the outside surfaces of the body and lines internal organs.

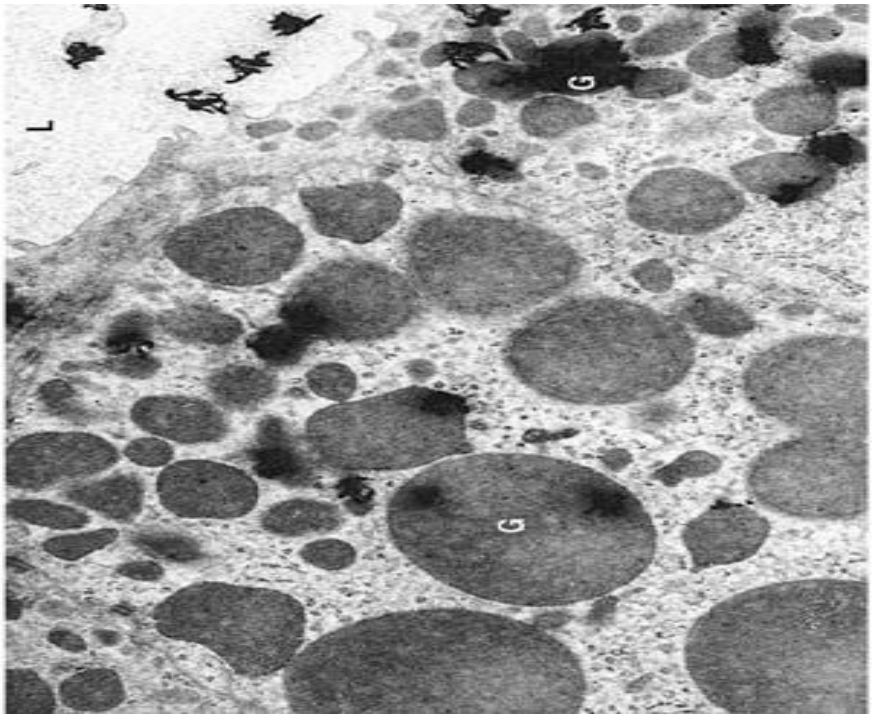
Types of Epithelium



- There are three principal shapes of epithelial **cells: squamous, columnar, and cuboidal.** These can be arranged in a single layer of cells as simple epithelium, either squamous, columnar or cuboidal, or in layers of two or more cells deep as stratified (layered), either squamous, columnar or cuboidal.

All glands are made up of epithelial cells. Functions of epithelial cells include secretion, selectiveabsorption, protection, transcellular transport, and sensing.



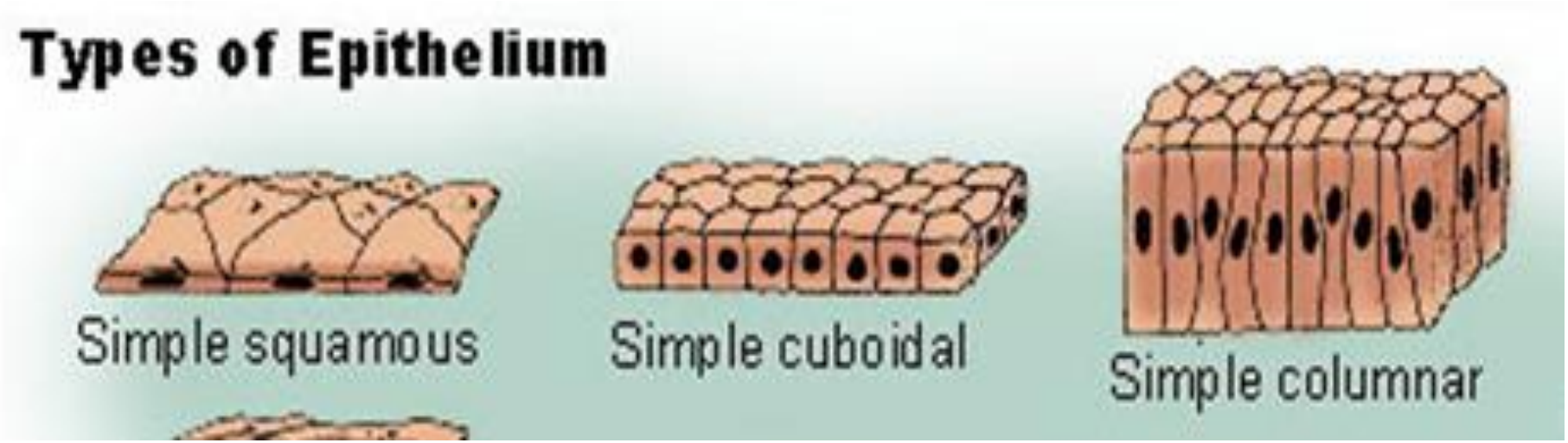


-:The three principal shapes

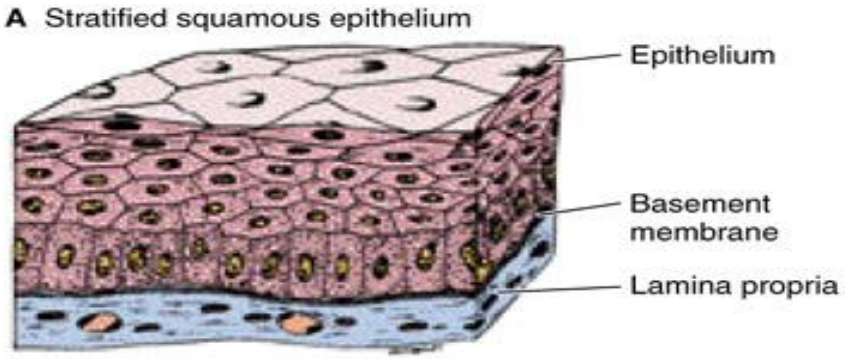
Squamous epithelium has cells that are wider than their height (flat and scale-like).

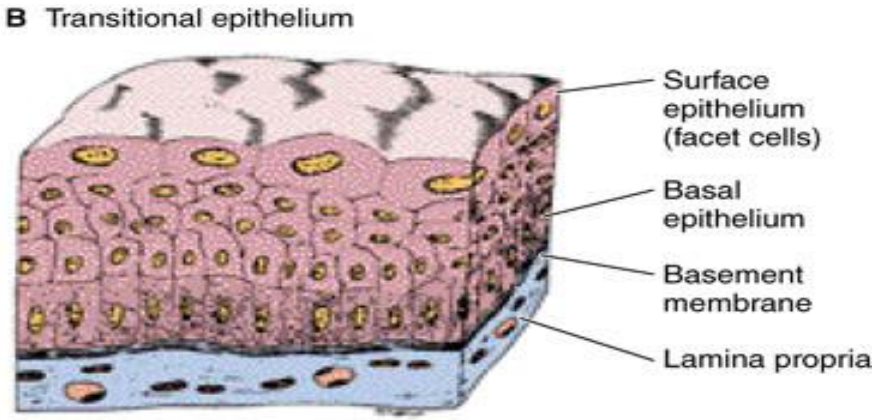
Cuboidal epithelium has cells whose height and width are approximately the same (cube shaped).

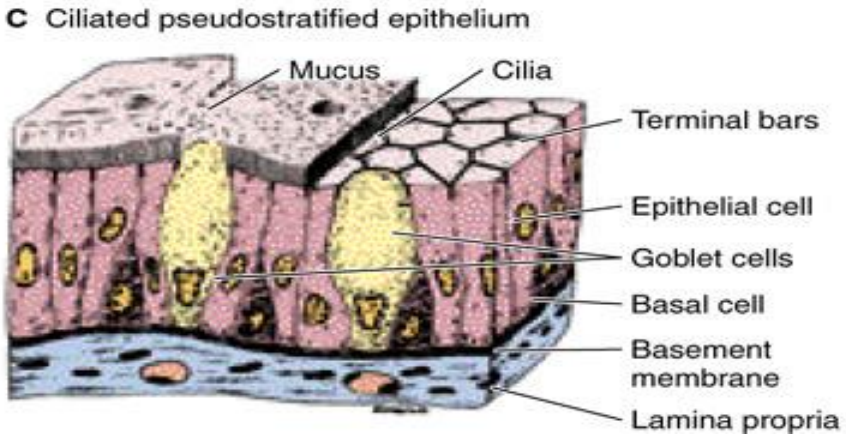
Columnar epithelium has cells taller than they are wide (column-shaped)



Epithelial layers contain no blood vessels, so they must receive nourishment via diffusion of substances from the underlying connective tissue, through the basement membrane





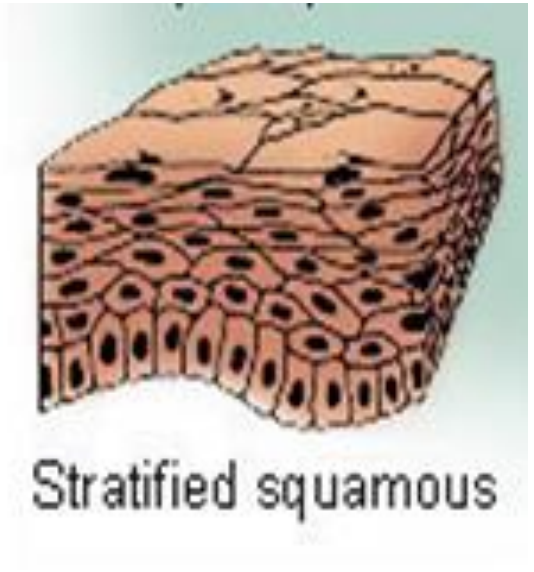


By layer, epithelium is classed as

either

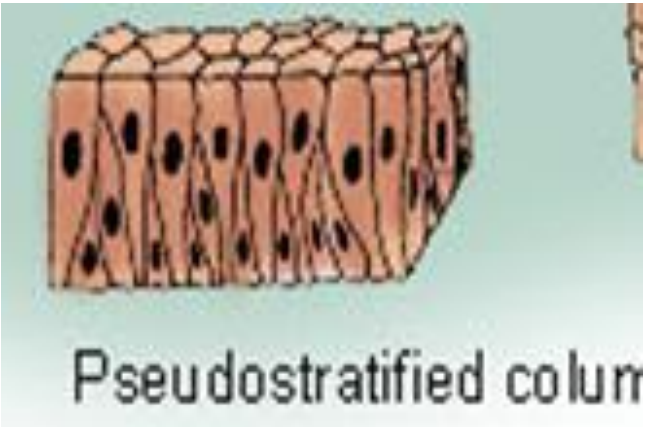
simple epithelium, only one cell thick (unilayered) or

stratified epithelium, two or more cells thick (multi-layered), and both can be made up of any of the cell shapes.

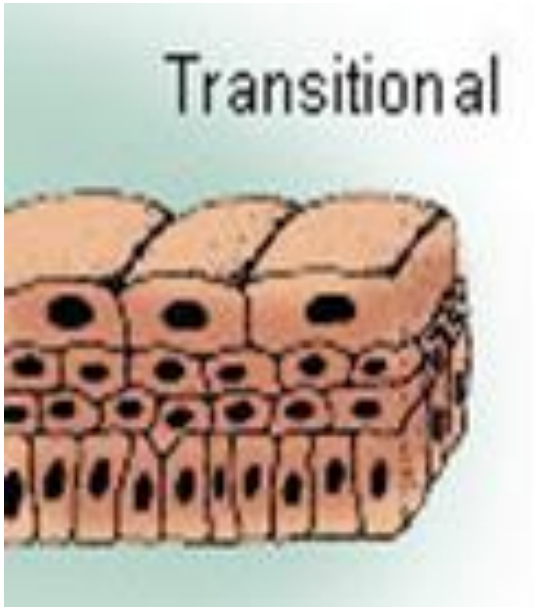


pseudostratified epithelium

when taller simple columnar epithelial cells are viewed in cross section showing several nuclei appearing at different heights, they can be confused with stratified epithelia.



Transitional epithelium has cells that can change from squamous to cuboidal, depending on the amount of tension on the epithelium



Simple epithelium

- is a single layer of cells with every cell in direct contact with the basement membrane that separates it from the underlying connective tissue. In general, it is found where absorption and filtration occur. The thinness of the epithelial barrier facilitates these processe

In general, simple epithelial tissues are classified by the shape of their cells. The four major classes of simple epithelium are:

simple squamous; (١)

(2) simple cuboidal; (٢)

(3) simple columnar;

(4) pseudostratified

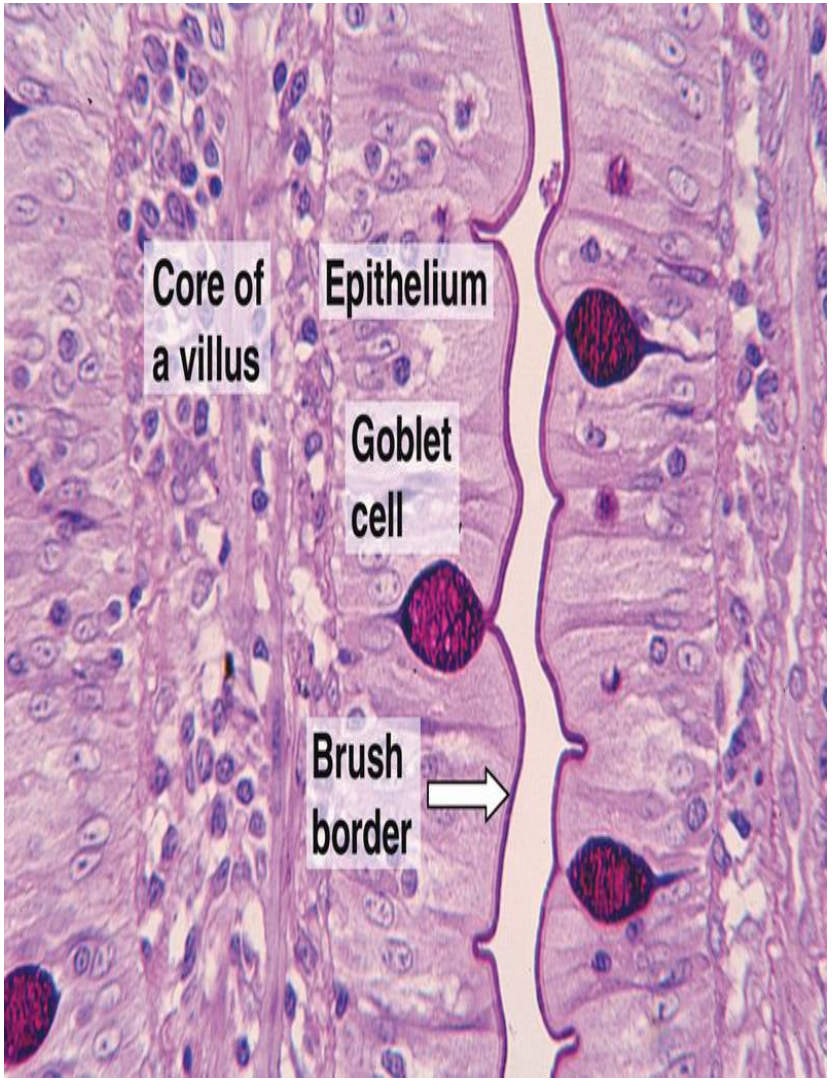
(1) simple squamous;

- which is found lining areas where passive diffusion of gases occur. e.g. skin, walls of capillaries, linings of the pericardial, pleural,and peritoneal cavities, as well as the linings of the alveoli of the lungs.

(2) simple cuboidal

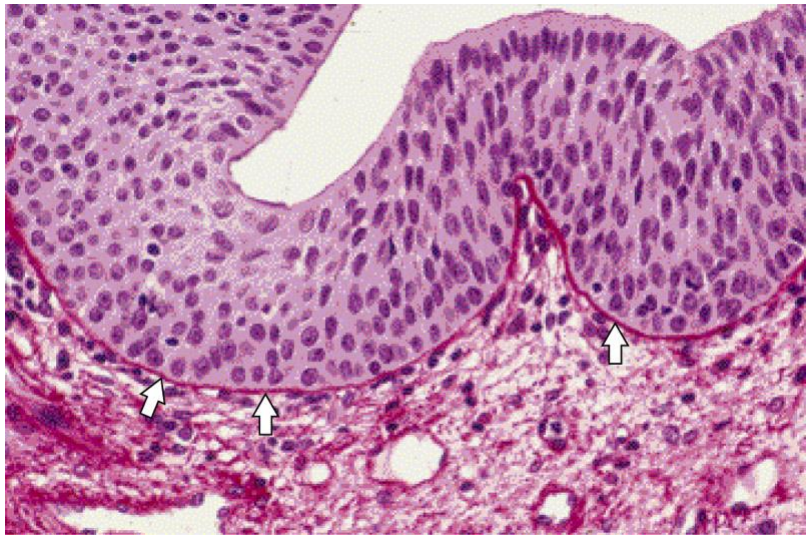
- : these cells may have secretory, absorptive, or excretory functions. examples include small collecting ducts of kidney, pancreas and salivary gland.

(3) simple columnar ; found in areas with extremely high secretive (as in wall of the stomach), or absorptive (as in small intestine) areas. they possess cellular extensions (e.g. microvilli in the small intestine, or cilia found almost exclusively in the female reproductive tract).



(4) pseudostratified epithelium

; this is also called respiratory epithelium as it is almost exclusively confined to the larger respiratory airways of the nasal cavity, trachea and bronchi



Stratified epithelium

Stratified epithelium differs from simple epithelium in that it is ***multilayered***. It is therefore found where body linings have to withstand mechanical or chemical insult such that ***layers can be abraded and lost without exposing sub epithelial layers***. Cells flatten as the layers become more apical, though in their most basal layers the cells can be squamous, cuboidal or columnar.[9]

Stratified epithelia (of columnar, cuboidal or squamous type) can have the following specializations

Location

Epithelium lines both the outside (skin) and the inside cavities and lumina of bodies. The outermost layer of human skin is composed of dead stratified squamous, keratinizedepithelial cells.[10]

Tissues that line the inside of the mouth, the esophagus and part of the rectum are composed of nonkeratinized stratified squamous epithelium. Other surfaces that separate body cavities from the outside environment are lined by simple squamous, columnar, or pseudostratified epithelial cells. Other epithelial cells line the insides of the lungs, the gastrointestinal tract, the reproductive and urinary tracts, and make up the exocrine and endocrine glands.

citation needed]

The outer surface of the cornea is covered with fast-growing, easily regenerated epithelial cells.

Endothelium (the inner lining of blood vessels, the heart, and lymphatic vessels) is a specialized form of epithelium.

Another type, mesothelium, forms the walls of the pericardium, pleurae, and peritoneum.[

Basement membrane

Epithelial tissue rests on a basement membrane, which acts as a scaffolding on which epithelium can grow and regenerate after injuries.[12]

Epithelial tissue has a nerve supply, but no blood supply and must be nourished by substances diffusing from the blood vessels in the underlying tissue.

The basement membrane acts as a selectively permeable membrane that determines which substances will be able to enter the epithelium

Cell junctions

Cell junctions are especially abundant in epithelial tissues. They consist of protein complexes and provide contact between neighboring cells, between a cell and the extracellular matrix, or they build up the Para cellular barrier of epithelia and control the Para cellular transport.[13]

Cell junctions are the contact points between plasma membrane and tissue cells. There are mainly 5 different types of cell junctions: tight junctions, adherens junctions,desmosomes, hemidesmosomes, and gap junctions.

Tight junctions are a pair of trans-membrane protein fused on outer plasma membrane.

Adherens junctions are a plaque (protein layer on the inside plasma membrane) which attaches both cells' microfilaments. Desmosomes attach to the microfilaments of cytoskeleton made up of keratin protein. Hemidesmosomes resemble desmosomes on a section. They are made up of the integrin (a transmembrane protein) instead of cadherin. They attach the epithelial cell to the basement membrane. Gap junctions connect the cytoplasm of two cells and are made up of proteins called connexins (six of which come together to make a connexon).

Development

Epithelial tissues are derived from all of the embryological germ layers

from ectoderm (e.g., the epidermis);

from endoderm (e.g., the lining of the gastrointestinal tract);

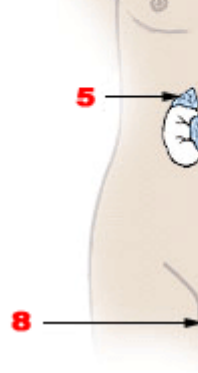
from mesoderm (e.g., the inner linings of body cavities).

pathologists label cancers in endothelium and mesothelium sarcomas,

whereas true epithelial cancers are called carcinomas.

Also, the filaments that support these mesoderm-derived tissues are very distinct. Outside of the field of pathology, it is, in general, accepted that the epithelium arises from all three germ layers.[*citation needed*]

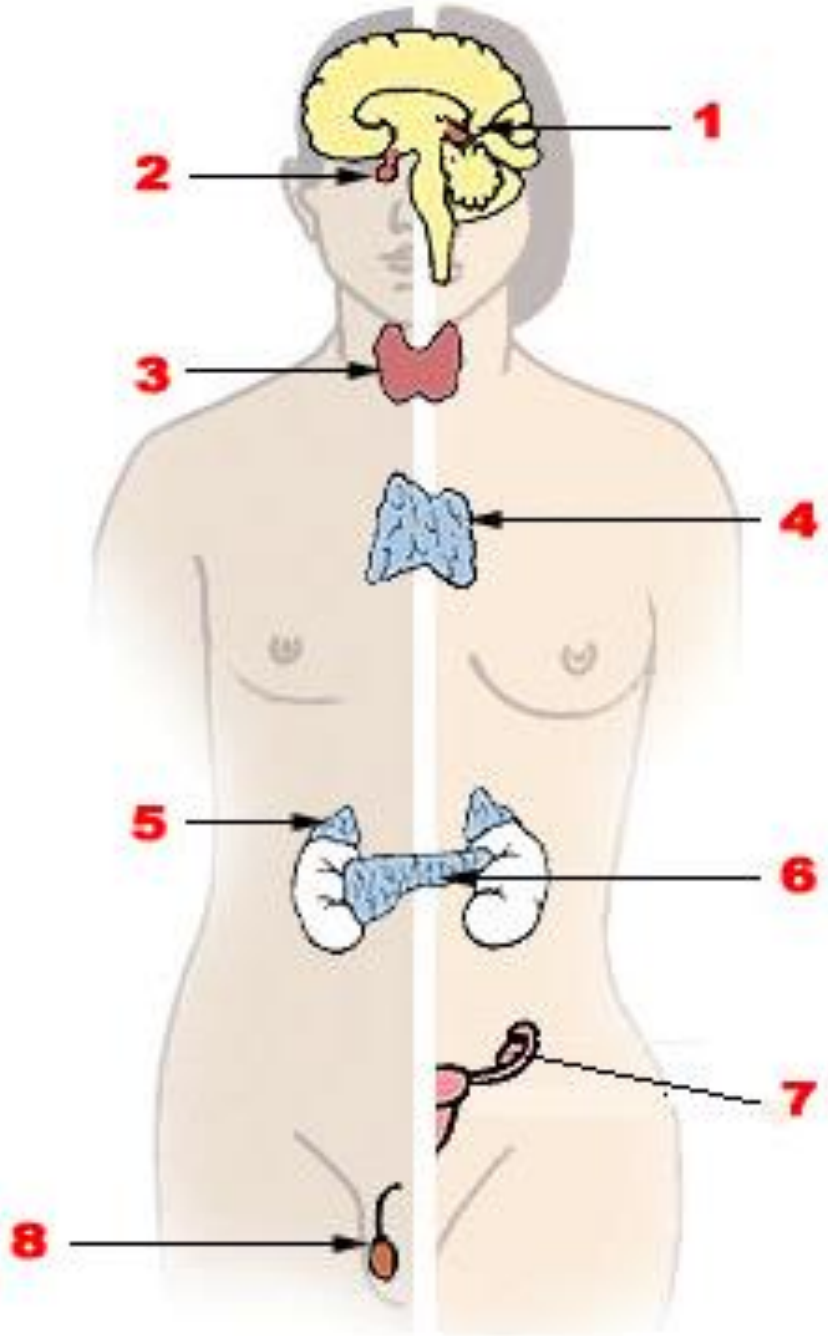
Function



The primary functions of epithelial tissues are:

(1) to protect the tissues that lie beneath it from radiation, desiccation, toxins, invasion by pathogens, and physical trauma;

(2) the regulation and exchange of chemicals between the underlying tissues and a body cavity;
(3) the secretion of hormones into the blood vascular system, and/or the secretion of sweat, mucus, enzymes, and other products that are delivered by ducts.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Glandular tissue

- is the type of epithelium that forms the glands from the enfolding of epithelium and subsequent growth in the underlying connective tissue. There are two major classifications of glands:
- endocrine glands and exocrine glands.
- Endocrine glands secrete their product into the extracellular space where it is rapidly taken up by the blood vascular system.
- Exocrine glands secrete their products into a duct that then delivers the product to the lumen of an organ or onto the free surface of the epithelium.

Sensing the extracellular environment

"Some epithelial cells are ciliated, especially in respiratory epithelium, and they commonly exist as a sheet of polarised cells forming a tube or tubule with cilia projecting into the lumen." Primary ciliaon epithelial cells provide chemosensation, thermoception, and mechanosensation of the extracellular environment by playing "a sensory role mediating specific signalling cues, including soluble factors in the external cell environment, a secretory role in which a soluble protein is released to have an effect downstream of the fluid flow, and mediation of fluid flow if the cilia are

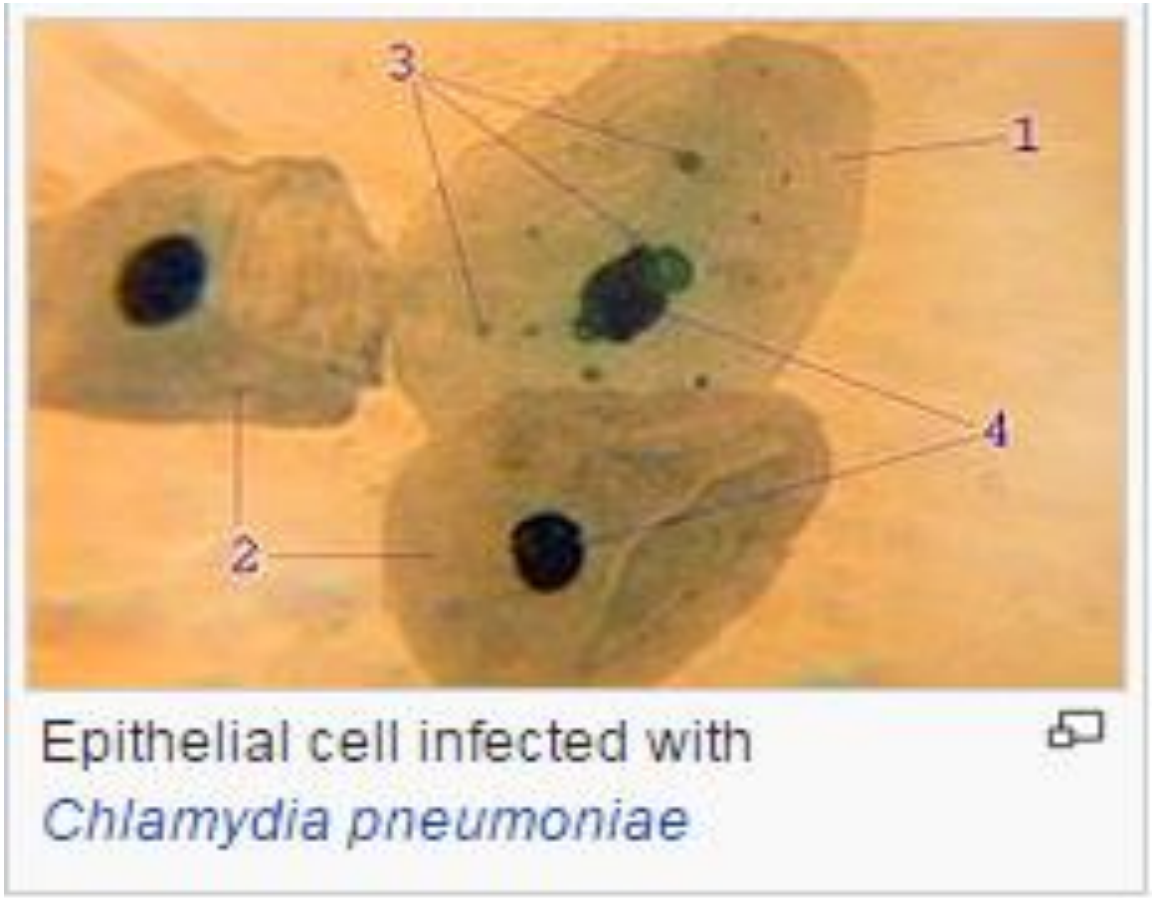
Clinical significance

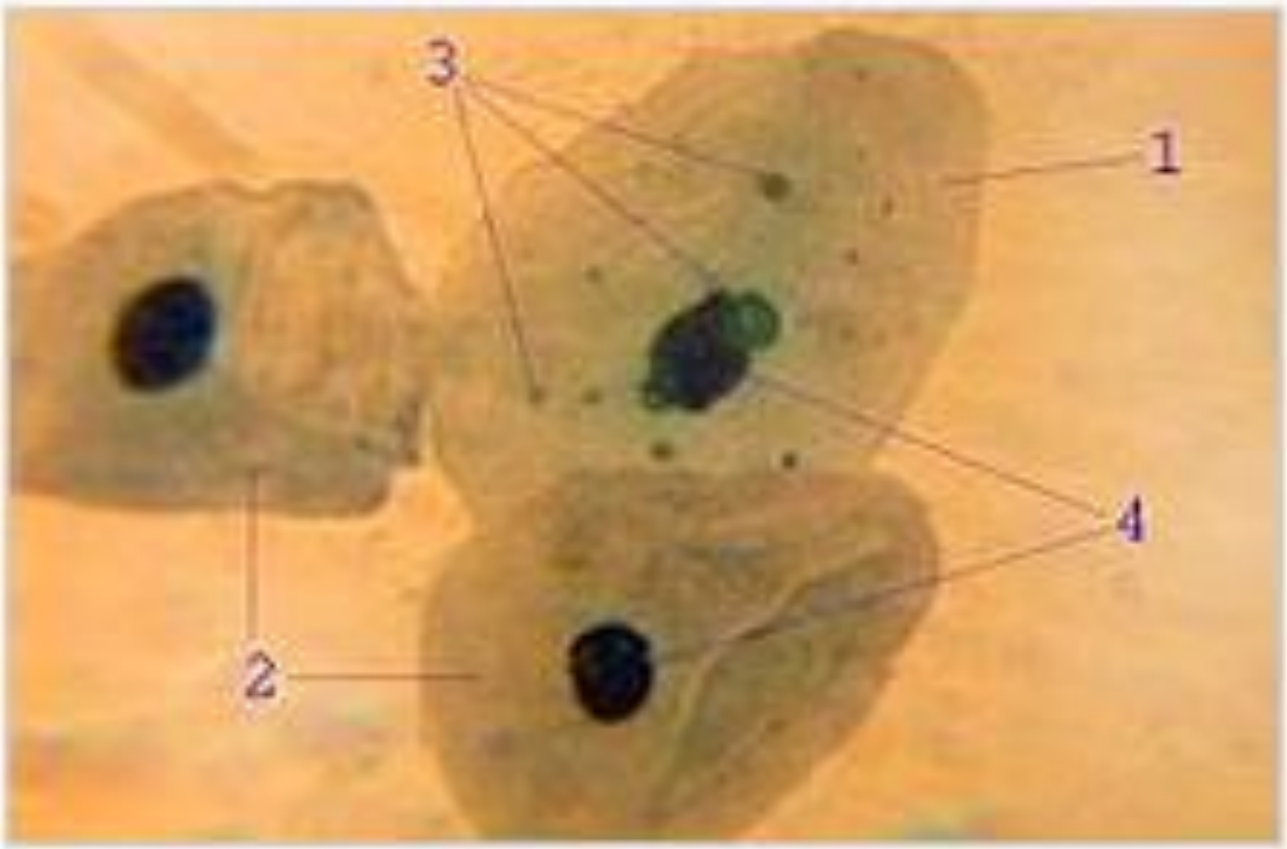
Classification[edit]

Epithelium grown in culture can be identified by examining its morphological characteristics. Epithelial cells tend to cluster together, and have a "characteristic tight pavement like appearance".

But this is not always the case, such as when the cells are derived from a tumor. In these cases, it is often necessary to use certain biochemical markers to make a positive identification. The intermediate filament proteins in the cytokeratin group are almost exclusively found in epithelial cells, and so are often used for this purpose

- The slide shows at (1) an epithelial cell infected by *Chlamydia pneumonia*; their inclusion bodies shown at (3); an uninfected cell shown at (2) and (4) showing difference between infected cell nucleus and uninfected cell nucleus





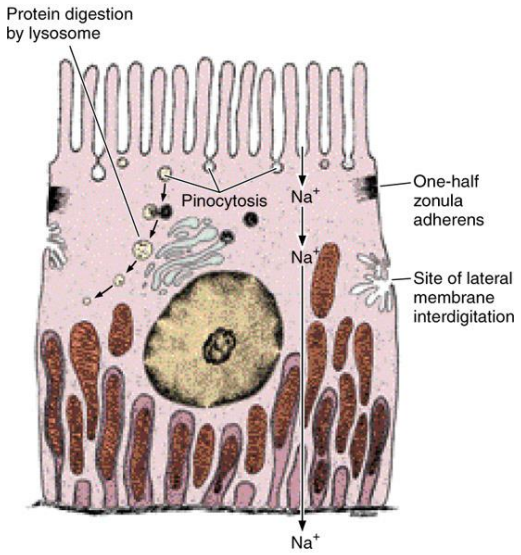
Epithelial cell infected with *Chlamydia pneumoniae*

Epithelial tissues have five main characteristics

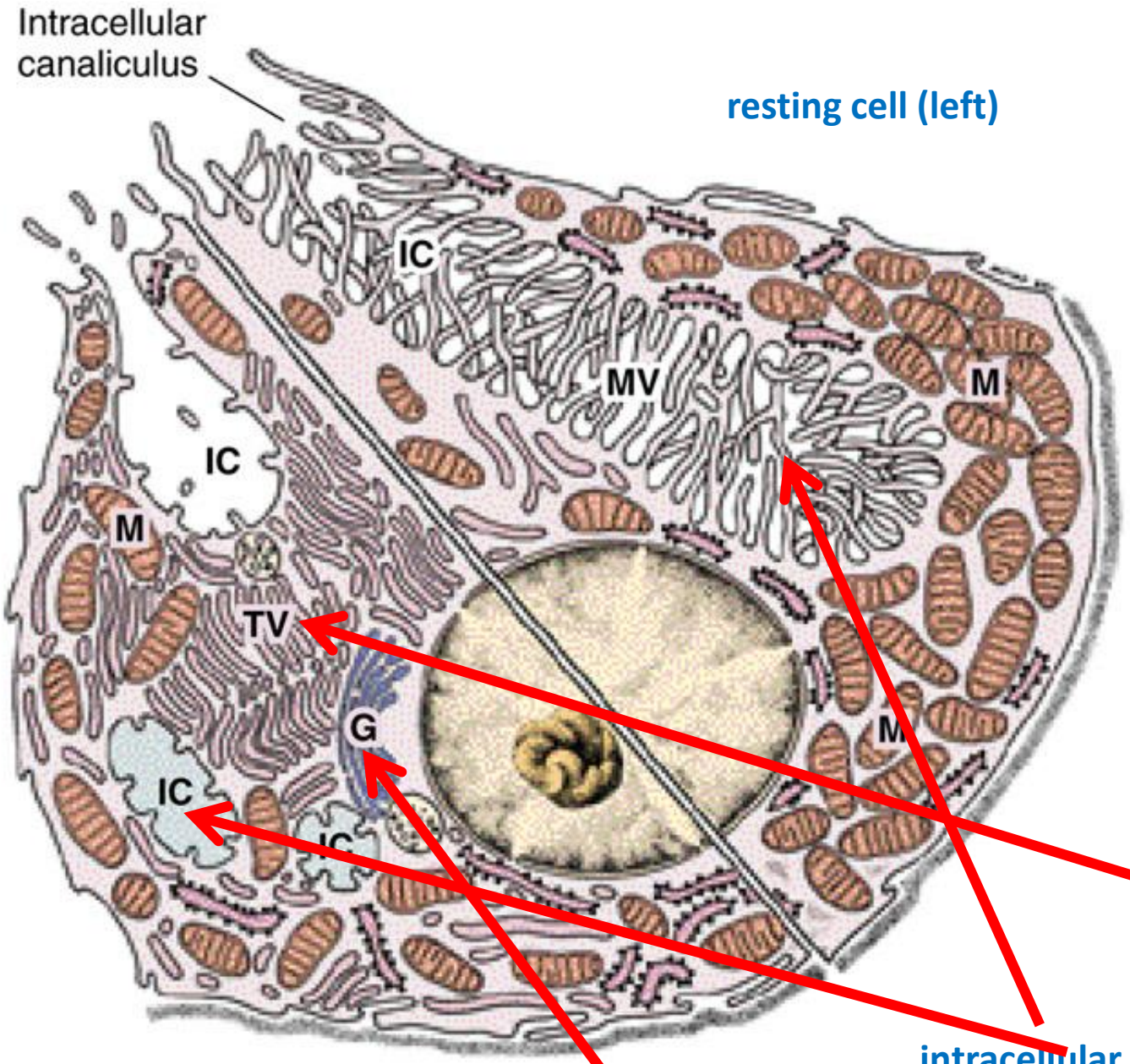
Polarity– all epithelia have an **apical surface** and a lower attached **basal surface** that differ in structure and function. For this reason, epithelia is described as exhibiting *apical basal polarity*.

intestine and kidney tubules

brush border.



Most apical surfaces have microvilli (small extensions of the plasma membrane) that increase surface area.



parietal cell, ultrastructural differences between a and an (right). Note that the in the cytoplasm of the resting cell fuse to form microvilli (MV) that fill up the (IC). M, mitochondria.

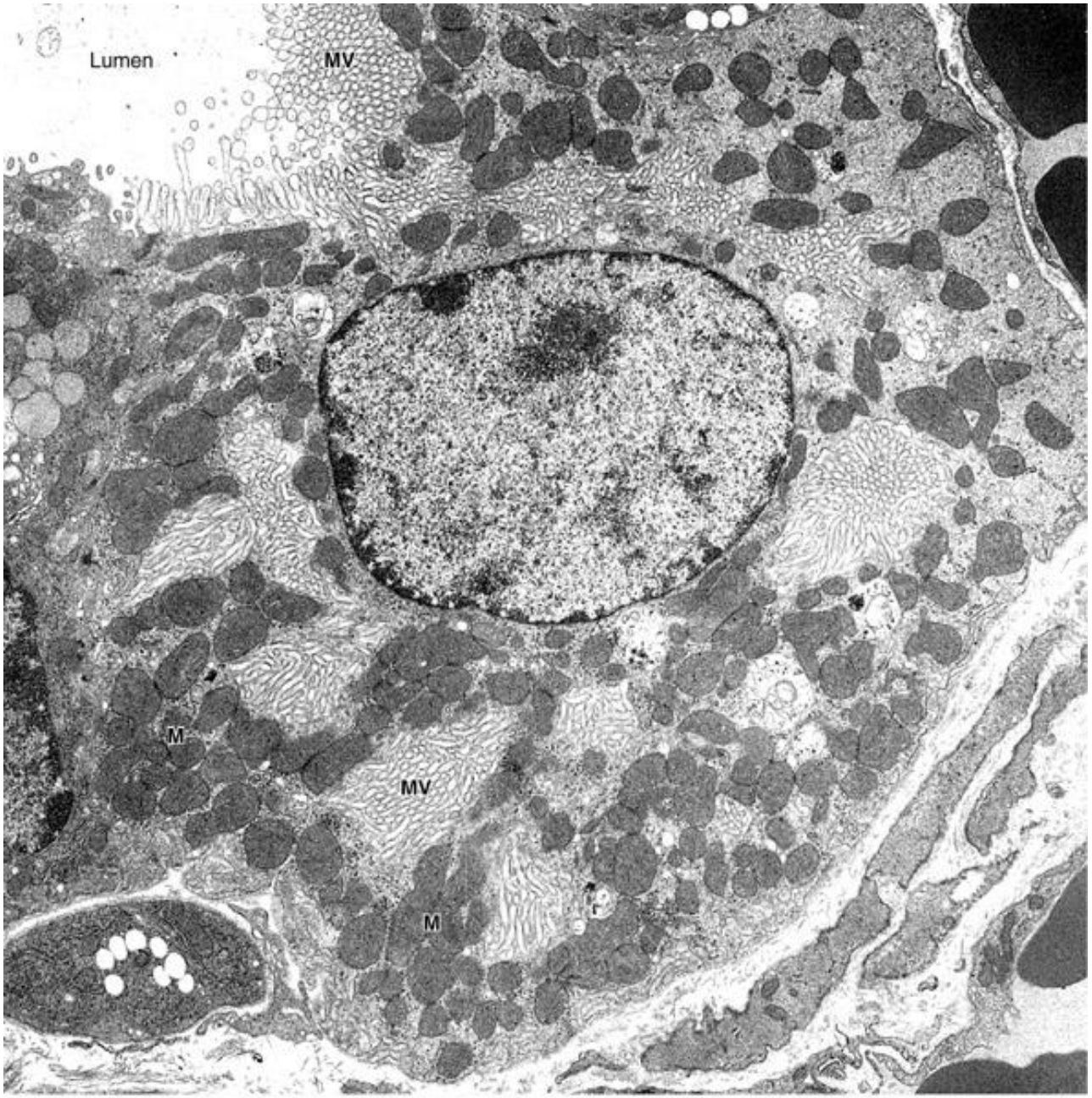
resting cell (left)

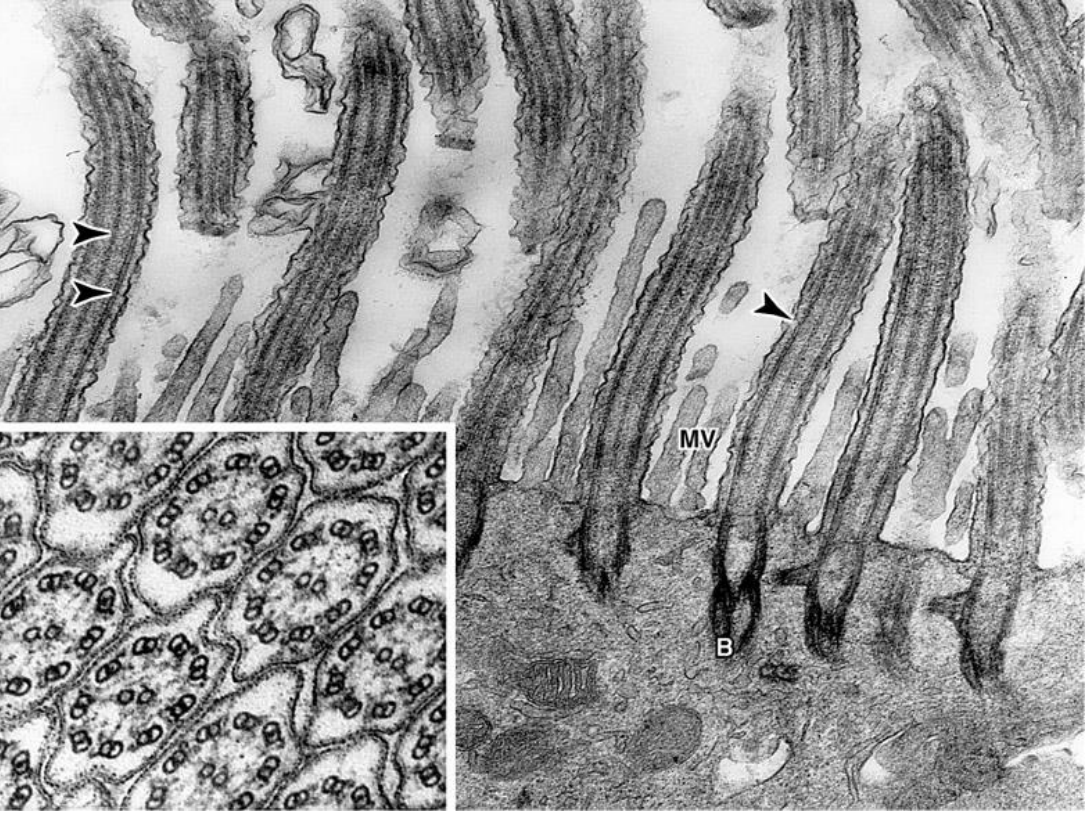
tubulo vesicles (TV)

intracellular canaliculi

active cell

G, Golgi complex;

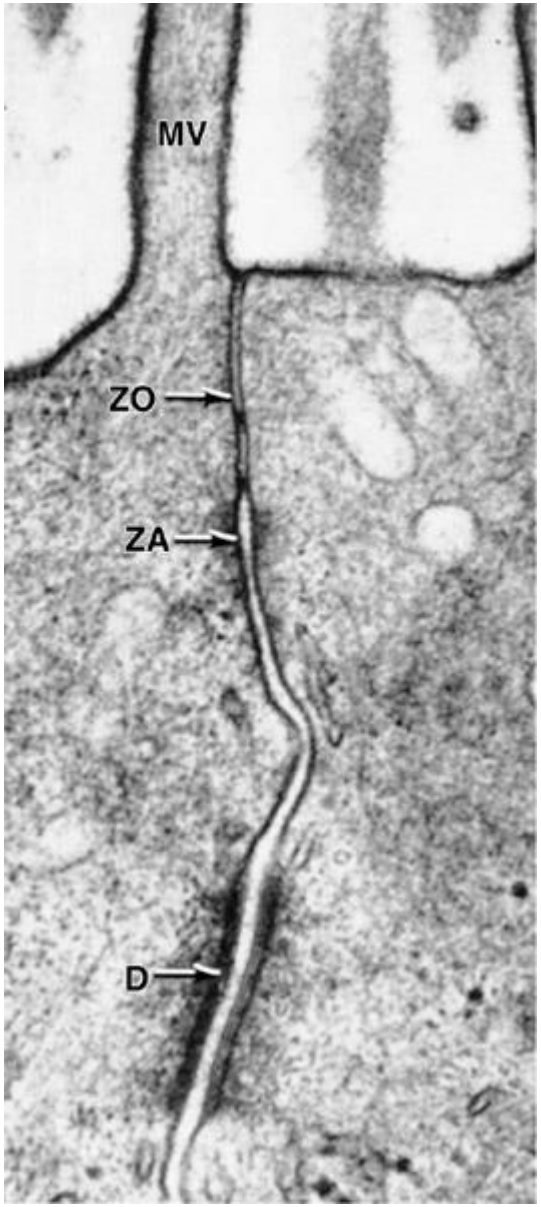

Lumen
MV
M
MV
M



Each cilium has a basal body (B) from which it grows. Microvilli (MV) are shown. x59,000. Inset: Cilia in cross section. The 9 + 2 array of microtubules in each cilium is evident

Electron micrograph of the apical portion of a ciliated epithelial cell.
Cilia are seen in longitudinal section. At the left, arrowheads point to the central and peripheral microtubules of the axoneme. The arrowhead at right indicates the plasma membrane surrounding the cilium.. x80,000.

- Other epithelia have motile **cilia** (hairlike projections) that push substances along their free surface.
- Next to the basal surface is the **basal lamina** (thin supporting sheet). The basal lamina acts as a filter allowing and inhibiting certain molecules from passing into the epithelium.



Electron micrograph of a section of epithelial cells in the large intestine showing a junctional complex with its zonula occludens (ZO), zonula adherens (ZA), and desmosome (D). Also shown is a microvillus (MV). x80,000.

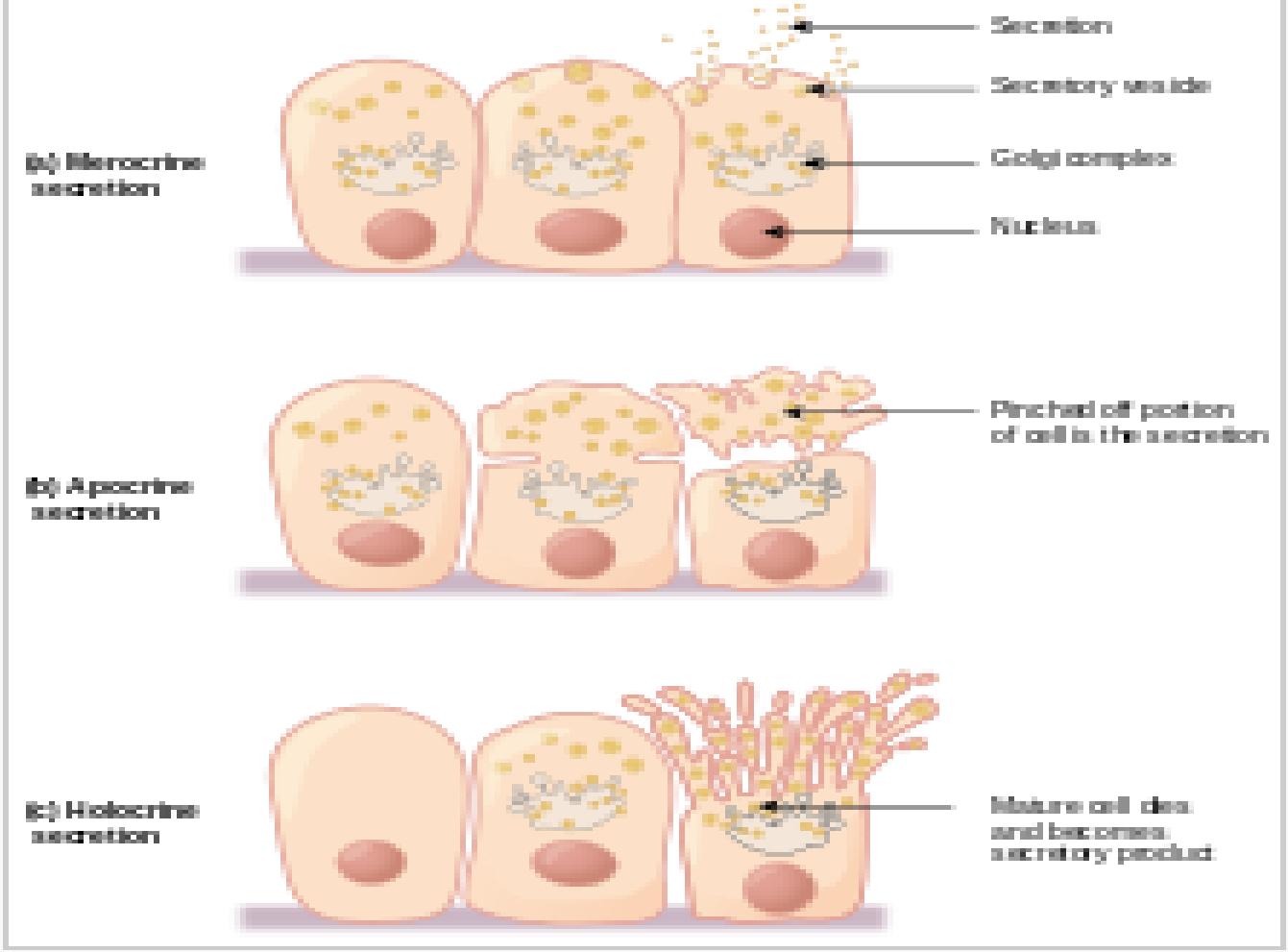
Specialized contacts– epithelial cells fit close together and form continuous sheets (except in the case of glandular epithelia). They do this with **t*ight junctions* and *desmosomes***. Tight junctions form the closest contact between cells and help keep proteins in the apical region of the plasma membrane. Desmosomes connect the plasma membrane to intermediate filaments in the cytoplasm.

Supported by connective tissue– all epithelia are supported by connective tissue. For instance, deep to the basal lamina is **reticular lamina** (extracellular material containing collagen protein fiber) which forms the **basement membrane.** The basement membrane reinforces the epithelium and helps it resist stretching and tearing.

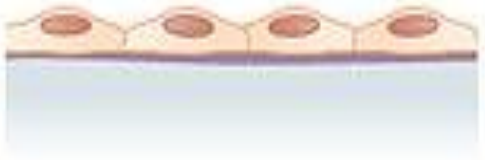
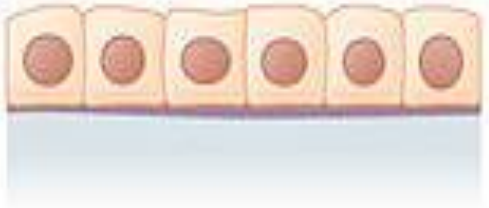
Avascular and innervated– even though epithelium is *avascular* (contains no blood vessels), it's still *innervated* (supplied by nerve fibers).

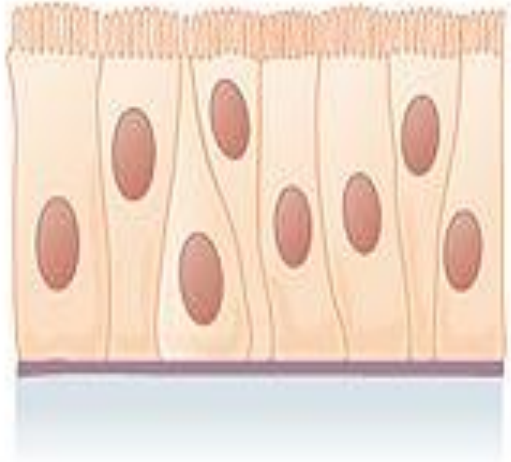
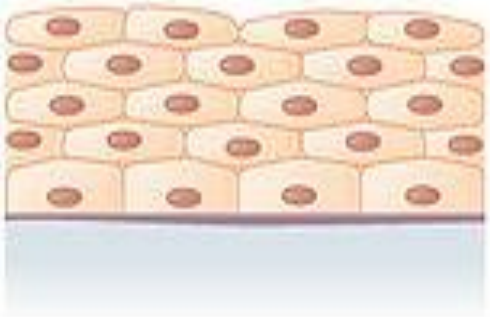
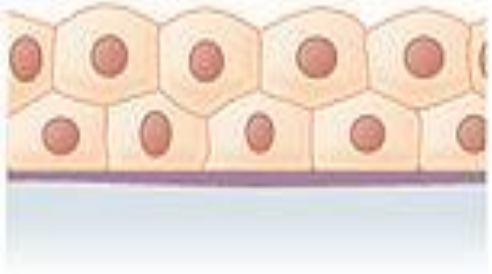
Regeneration– epithelium have a high regenerative capacity and can reproduce rapidly as long as they receive adequate nutrition.

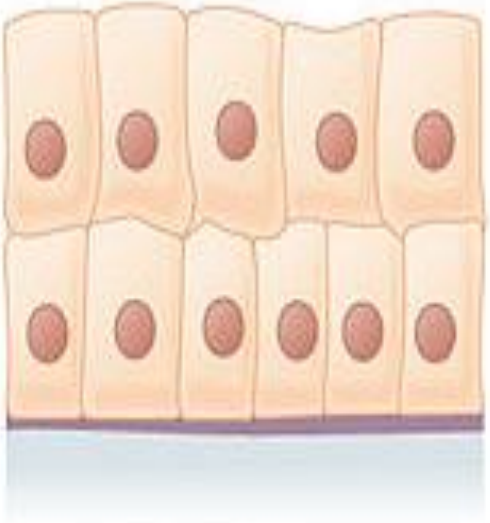
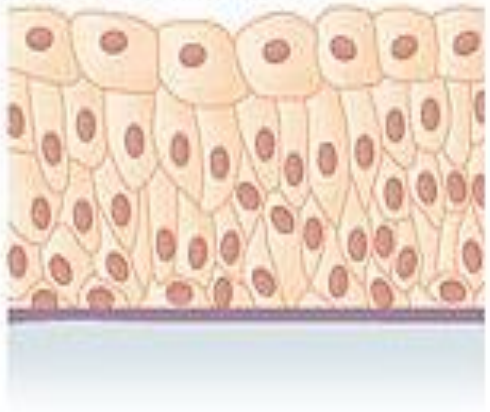
Glandular tissue [edit]



Forms of secretion in glandular tissue

Cells	Location	Function
Simple squamous epithelium 	Air sacs of lungs and the lining of the heart, blood vessels, and lymphatic vessels	Allows materials to pass through by diffusion and filtration, and secretes lubricating substance
Simple cuboidal epithelium 	In ducts and secretory portions of small glands and in kidney tubules	Secretes and absorbs
Simple columnar epithelium 	Ciliated tissues are in bronchi, uterine tubes, and uterus; smooth (nonciliated tissues) are in the digestive tract, bladder	Absorbs; it also secretes mucous and enzymes

Pseudostratified columnar epithelium 	Ciliated tissue lines the trachea and much of the upper respiratory tract	Secretes mucus; ciliated tissue moves mucus
Stratified squamous epithelium 	Lines the esophagus, mouth, and vagina	Protects against abrasion
Stratified cuboidal epithelium 	Sweat glands, salivary glands, and the mammary glands	Protective tissue

Stratified columnar epithelium 	The male urethra and the ducts of some glands	Secretes and protects
Transitional epithelium 	Lines the bladder, uretha, and the ureters	Allows the urinary organs to expand and stretch