

Classification of Epithelia

Epithelia are classified based on the number of cell layers and the shape of the cells at the uppermost layer.

Simple Epithelium --- Only one layer of cells, all of which are in contact with the basal lamina they are very thin and found in areas of minimum wear and tear.

Their main function is to allow passage of substances between the lumen and the surrounding tissues.

Depending on the shape of the cells, simple epithelia can be further divided into:

1-Simple squamous --- One layer of flat cells nuclei are flat and parallel to the free surface, it is so thin layer that offers no protection. Its function is to allow materials to pass through.

Examples: flat endothelium lines blood and lymphatic vessels.

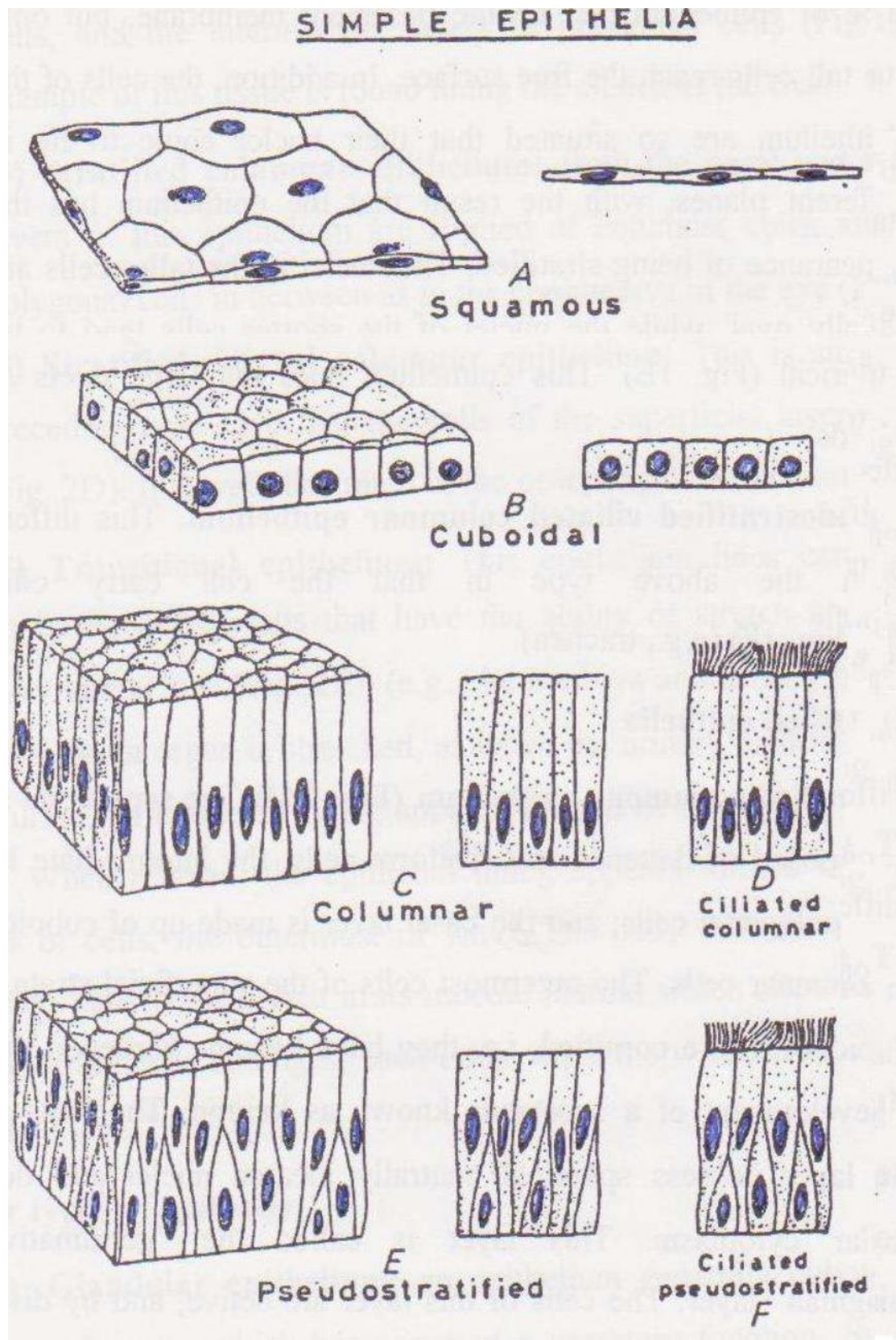
2-Simple cuboidal --- One layer of square cells. The nuclei are round and situated in the middle of the cell, this type offers some protection but it is more prevalent when material must be secreted and absorbed.

Example: kidney tubules.

3-Simple columnar --- One layer of tall cells the nuclei are oval and parallel to the axis of the cell and situated at its base, this type offers some protection of underlying tissue. It is found where some protection is necessary and where secretion occurs.

Example: absorptive epithelium in the intestine.

Simple columnar ciliated: Present in female reproductive tract (fallopian tube, uterus).



Stratified Epithelium --- Two or more layers of cells

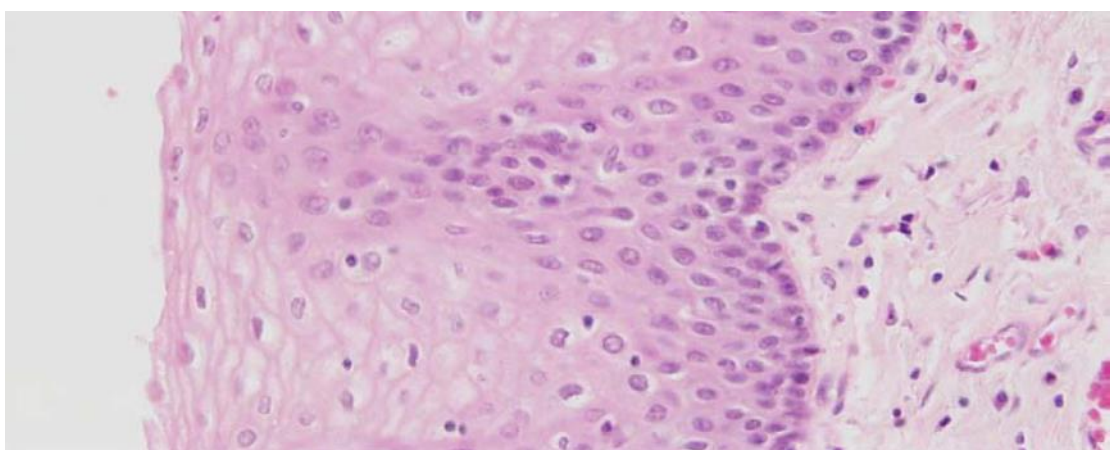
Only the cells of the bottom-most basal layer are in touch with the basal lamina. They are very thick and their main function is protect the tissues that they cover.

The shape of the cells closest to the basement membrane is quite different from that of the cells at the top, near the lumen. Mitosis takes place in the basal cells as the cells differentiate, they move upward in the epithelium.

The stratified epithelia are further classified according to the shape of the cells at the free surface.

1-Stratified squamous --- the most commonly found stratified epithelium and offers the most protection to the underlying tissue (e.g. skin). This can further be divided into:

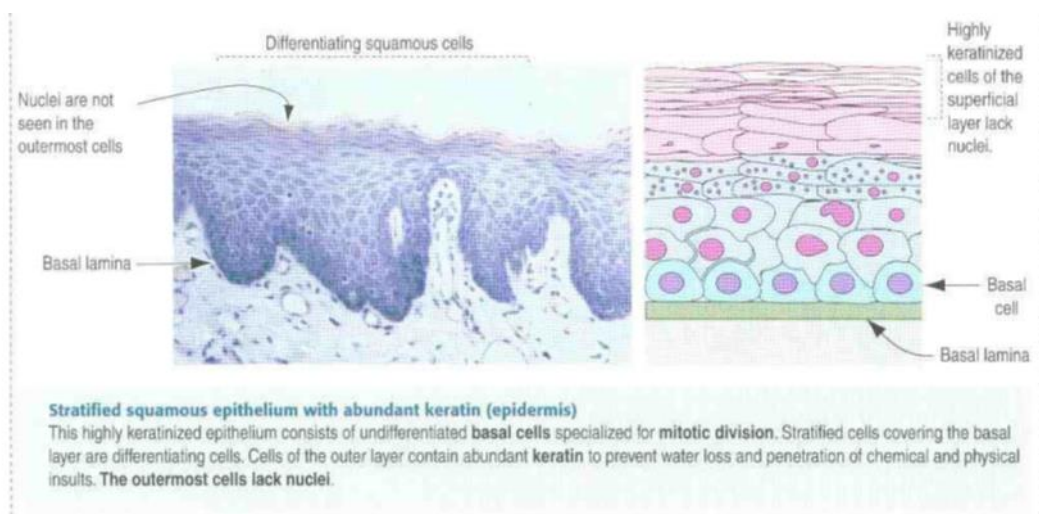
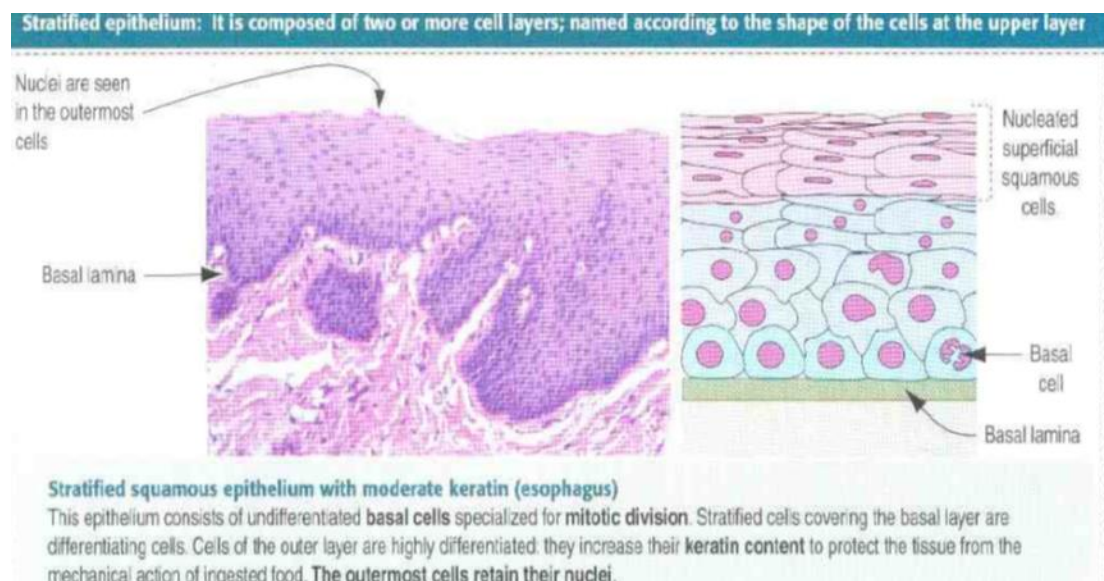
Stratified squamous non-keratinized --- multiple layers of cells with those in the outer layer displaying nuclei. Examples: esophagus, vagina.



Stratified squamous keratinized --- multiple layers of cells that are keratinized.

In the highly keratinized epithelium such as the epidermis of the skin, nuclei are absent in the outer layer.

In the moderately keratinized (para-keratinized), nuclei may still be present in the outer cell layer (e.g. lining of the cheek).



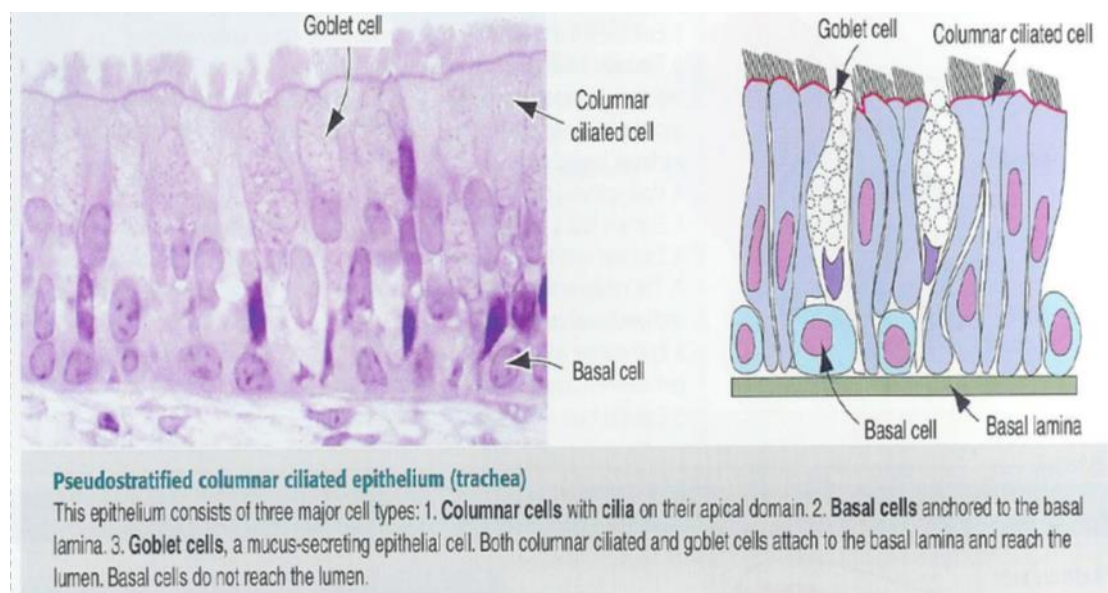
Stratified cuboidal and stratified columnar are less common and can be found in some secretory ducts. Stratified cuboidal typically found in areas where secretion is important (gland) and where more is needed than simple cuboidal protection. Example: large ducts in the salivary glands.

Pseudostratified Epithelium

This kind of epithelium contains basal and columnar cells resting on the basal lamina. The basal cells sit on the basal lamina but do not reach upward.

Only the columnar cells (also sitting on the basal lamina) reach the free surface. This tissue offers protection and usually found in places where mucus must be secreted (goblet cells).

In a routine paraffin section the nuclei of the cells appear to be staggered and suggest a stratified arrangement. In semi-thin and thin sections it can be clearly seen that there is only one layer of cells. Examples: ciliated epithelium of the trachea.



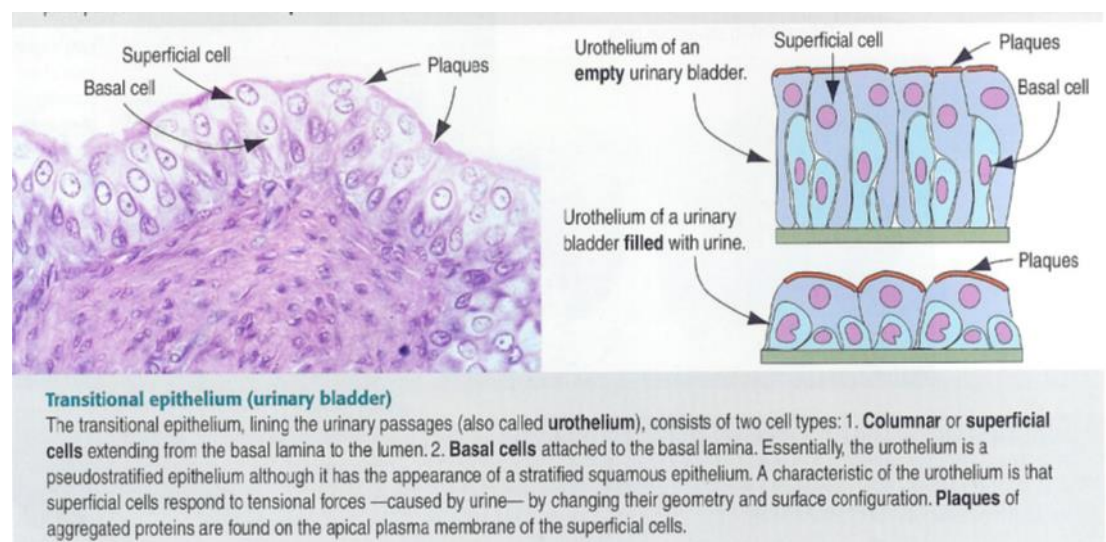
Transitional Epithelium

The transitional epithelium of the urinary passages is also called urothelium. The urothelium is composed of the following layers:

- 1-A single layer of small basal cells resting on a very thin basement membrane.
- 2-An intermediate region containing from one to several layers of more columnar cells.
- 3-A superficial layer of very large polyhedral or bulbous cells called umbrella cells, which are bi or multinucleated and are highly differentiated to protect underlying cells against the cytotoxic effects of hypertonic urine.

The cells of the surface layer are dome-like when the epithelium is not stretched (as in an empty bladder).

The degree of “stratification” varies depending on if the organ is distended (2-3 layers of cells) or collapsed (several layers of cells).



These cells vary in size and shape depending on the location from which they originate. These cells naturally slough into the urine in quite low numbers, so none to a few transitional epithelial cells are seen in the urine from healthy animals.

Epithelial Cell Type	Shape	Function	Example of Distribution
Simple	Squamous	Helps in the movement (contraction) of the organ (viscera) that it covers. Secretion of biologically active molecules that also help in lubrication.	Lining of vessels (blood and lymphatics) Serous lining of cavities, pericardium, pleura and peritoneum.
	Cuboidal	Covering and secreting.	Covers ovary and thyroid.
	Columnar	Protection, lubrication, absorption and secretion.	Lines the intestine and gallbladder.
Stratified	Squamous keratinized (dry)	Protection and prevents water loss.	Epidermis (skin).
	Squamous nonkeratinized (moist)	Protection, secretion and also prevents water loss.	Mouth, esophagus, larynx, vagina and anal canal.
	Cuboidal	Protection and secretion.	Sweat glands and developing ovarian follicles.
	Columnar	Protection.	Ocular Conjectiva and large ducts of salivary glands.
	Transitional	Protection and distensibility where the form changes based on the degree of distension.	Bladder, ureter and renal calyces.
Pseudostratified	Can be ciliated or non-ciliated.	Protection, secretion and cilia-mediated transport of particles trapped in mucus out of air passages.	Lining of trachea, bronchi and nasal cavity.