

Epithelial Tissue



EPITHELIAL TISSUE

It is a layer of cells, which covers the external surface (skin) or lines the internal surface (lumen) of gastrointestinal, respiratory, and urogenital tracts. They are structurally minor but functionally important component of an organ. Glands are epithelial invagination from the lumen into the underlying connective tissue layer.

Features

- The cells are arranged in single or many layers. They are continuously renewed and replaced. Cells closest to the basal lamina (or basement membrane) undergo continuous mitosis, and their progeny replace the surface cells.
- They are avascular. They receive nutrition from the blood vessels present in underlying connective tissue through diffusion.
- They are adherent to one another by means of cell-to-cell adhesion molecules that form cell junctions.
- The basal surface is attached to an underlying basement membrane, non-cellular, proteinopolysaccharide-rich layer.
- They have little intercellular substance. The cells are densely packed and closely apposed.
- They undergo metaplasia (they change from one type to another) when exposed to chronic environment changes.
- They are derived from all the three germ layers (ectoderm, endoderm and mesoderm).

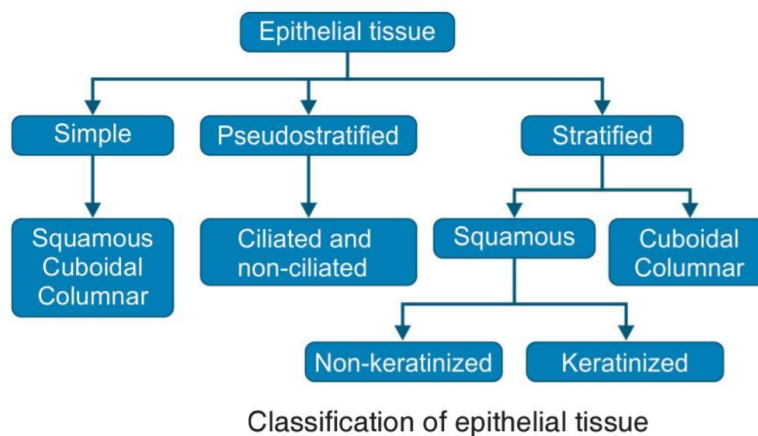
Functions

- Mechanical protection: It protects the body surface from drying or bacterial invasion. Epithelium covering the skin called epidermis which protects the body.
- Transport: Transport of materials or cells along the surface of an epithelium propelled by motile cilia or transport of materials across an epithelium (pinocytosis or endocytosis) to and from connective tissue.

- **Secretion:** The cells secrete the product synthesized, either to the lumen (e.g. lining epithelium of stomach) to the blood.
- **Excretion:** May excrete metabolic waste products.
- **Absorption:** It absorbs essential substances from the lumen of the gastrointestinal tract and kidney tubules (where it is called reabsorption).
- **Lubrication:** The epithelium lining the body cavities (mesothelium) serve this function.
- **Sensory:** In the skin (touch sensation), nasal mucosa (smell sensation) and tongue (taste sensation), it serves as sensory organ.

Types of Epithelia

Epithelium is classified into simple, pseudostratified and stratified varieties.



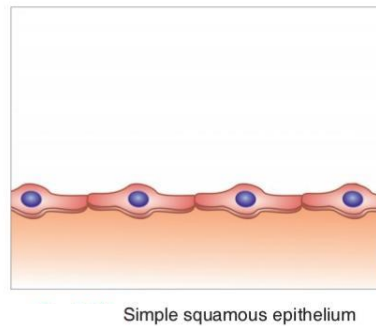
1. Simple Epithelium

It consists of single layer of cells resting on a basement membrane.

a. Simple squamous:

The cells are irregular flat, plate like cells that function as a semipermeable barrier between compartments. These are the cells with height less than width.

Distribution: Alveoli of the lungs, Bowman's capsule and loop of Henle of kidney, mesothelium—the lining of peritoneum peritoneal, pleura and pericardial cavities, endothelial cells lining blood vessels.



b. Simple cuboidal:

The height and width of the cell is nearly equal, and nuclei are central in position.

Distribution: Lining epithelium of proximal convoluted tubules of the kidney, follicles of the thyroid (during moderate activity), walls of the secretory and excretory ducts of salivary glands and surface of the ovary (germinal epithelium). Their function includes protection, regulation of ion and water concentration (in ducts) or secretion (thyroid follicles) or reabsorption (renal tubules).

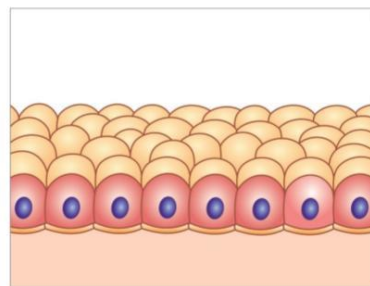
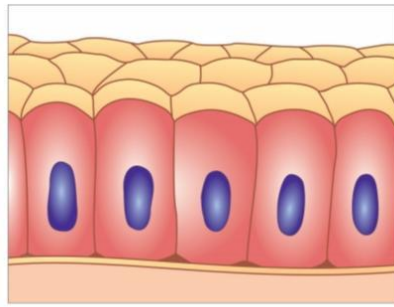


Fig. 5.2B: Simple cuboidal epithelium

c. Simple columnar:

The cells are cylindrical with height is greater than width. Nuclei are elongated and placed towards the base. The apical (free) surface of the cell may be covered by microvilli or cilia or without any surface modifications. Its function is absorption, secretion and when ciliated,

Distribution: Propulsion of mucus and trapped debris. Non-ciliated simple columnar epithelium lines the stomach. Simple columnar epithelium with microvilli lines the intestine. Simple columnar epithelium with cilia lines the bronchioles.



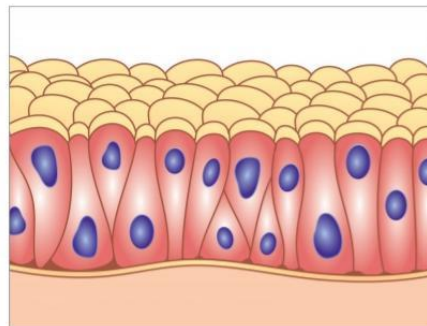
Simple columnar epithelium

2. Pseudostratified Columnar Epithelium

It is a single layer of epithelial cells resting on a basement membrane. Some cells are shorter and do not reach the lumen, while tall cells reach the lumen. The nuclei of the cells therefore lie at different levels. This gives the impression of stratification (false stratification).

a. Pseudostratified non-ciliated

Distribution: Male urethra (membranous and penile part), auditory tube and vas deferens.



Pseudostratified columnar epithelium

b. Pseudostratified ciliated:

Cells that reach the surface are ciliated.

Distribution: Upper part of the respiratory tract (trachea and larger bronchi).

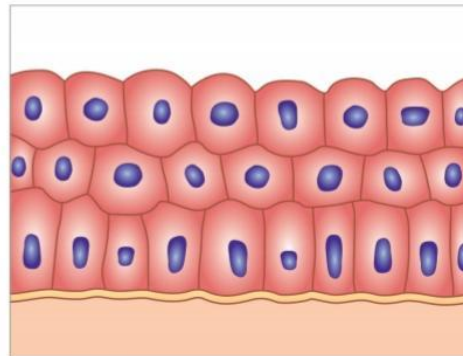
3. Stratified Epithelium

The epithelium is made up of many layers of cells. They are found in areas, which are subjected to friction.

a. Stratified cuboidal epithelium:

It consists of few (Two to Three) layers of cuboidal cells.

Distribution: Ducts of sweat glands.



Stratified cuboidal epithelium

b. Stratified columnar epithelium:

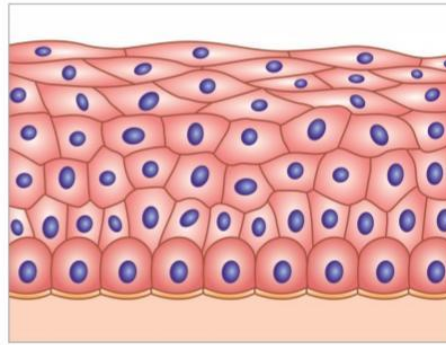
It consists of two or more layers of cells. The basal cells are polyhedral, while superficial cells are columnar.

Distribution: Larger ducts of some glands, conjunctiva, over the respiratory surface of the epiglottis.

c. Stratified squamous non-keratinized

Epithelium is made up of many layers of cells. Basal cells resting on the basement membrane are columnar or low cuboidal. The superficial cells are squamous and flat, hence called stratified squamous epithelium. It is less resistant to water loss than the keratinized type.

Distribution: Epithelium lining mouth, pharynx and oesophagus, anal canal, vagina and cornea.

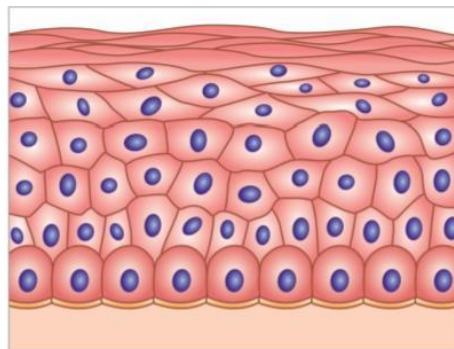


Stratified squamous non-keratinized epithelium

d. Stratified squamous keratinized epithelium

The superficial layer consists of non-living cells with keratin in their cytoplasm. They are tough and water-resistant.

Distribution: Epidermis of the skin.

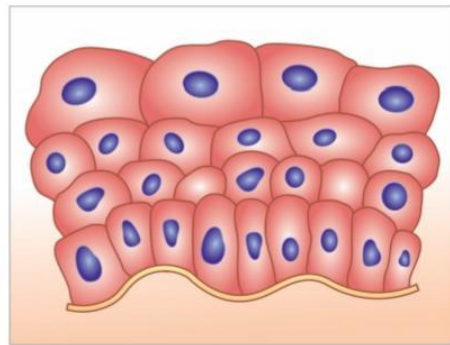


Stratified squamous keratinized epithelium

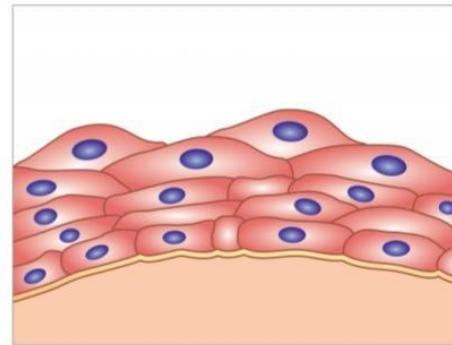
4. Transitional Epithelium (Urothelium)

This is a stratified epithelium with three to four layers of cells. The deepest cells are columnar or cuboidal. The middle layers are made up of polyhedral or pear-shaped cells. The cells of the surface are large and are shaped like an umbrella. The surface cells are often binucleated. It mainly lines the urinary bladder. When the bladder is empty, the surface cells appear dome-like, giving the epithelium a “cobblestone” appearance; when the bladder is full, the surface cells stretch and flatten. Transitional epithelium can be stretched considerably without being damaged. When stretched the cells become flattened. Presence of a glycoprotein membrane on the surface cells is believed to protect the underlying tissue from toxic substances present in the urine.

Distribution: Renal pelvis, ureter, urinary bladder and proximal part of the urethra



Transitional epithelium—relaxed



Transitional epithelium—stretched

Table 1 : Summary of the epithelial tissue

Type	Location	Function
Simple squamous	Alveoli of the lung, lining cells of the blood vessels	Diffusion, filtration, osmosis
Simple cuboidal	Linings of the renal tubules in the kidney, linings of the ducts of the glands, outer covering of the ovary	Absorption, secretion
Simple columnar	Linings of stomach	Absorption, secretion and protection
Simple columnar with microvilli	Lining of the intestine	Absorption, secretion and protection
Simple columnar with cilia	Lining of bronchioles of lung	Protection
Pseudostratified columnar	Lining upper respiratory passage (trachea)	Movement of mucus, protection, secretion
Stratified squamous—non-keratinized	Lining oral cavity, pharynx, oesophagus, anal canal, vagina	Protection
Stratified squamous—keratinized	Outer layer of the skin (epidermis)	Protection
Stratified columnar	Lines part of the male urethra	Protection and secretion
Transitional	Lines the urinary bladder, ureter and part of the urethra	Distensibility and protection
Glandular epithelium	Endocrine, salivary and sweat glands	Secretion