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Histology /2rd Stage
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Lec. 1

Histology

is the study of the tissues of the body and how these tissues are arranged to constitute organs.

Classification of tissues:

The human body is composed of only **four** basic types of tissue: **epithelial**, **connective**, **muscular**, and **nervous** (Table 1). Also of great functional importance are the free cells found in body fluids such as blood and lymph.

Table 1 Main characteristics of the four basic types of tissues

Tissue	Cells	Extracellular Matrix	Main Functions
Epithelial	Aggregated polyhedral cells	Small amount	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

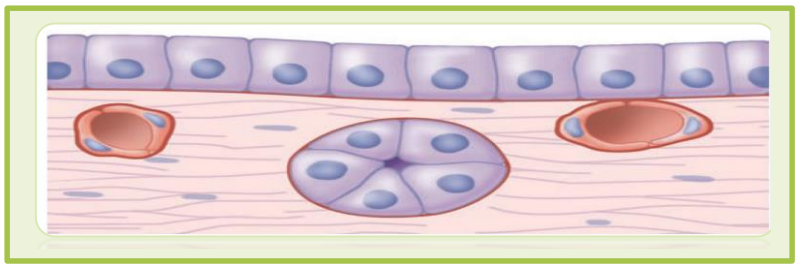
Epithelial Tissues:

One or more layers of cells that cover the outer surface (of the body) or line the luminal surface of tubular structures and cavities of the body are called epithelia (singular= epithelium). Epithelial cells are held together in intimate contact with each other as well as to the underlying connective tissue. Epithelial tissue is generally **avascular**, and thus is dependent on the blood vessels in the underlying connective tissue for oxygen and nutrients.

Basement Membranes

All epithelial cells in contact with subjacent connective tissue have at their basal surfaces a specialized, felt like sheet of extracellular material referred to as the basement membrane Figure 1. An extracellular basement

membrane (red) always lies at the interface of epithelial cells and connective tissue. Nutrients for epithelial cells must diffuse across the basement membrane.



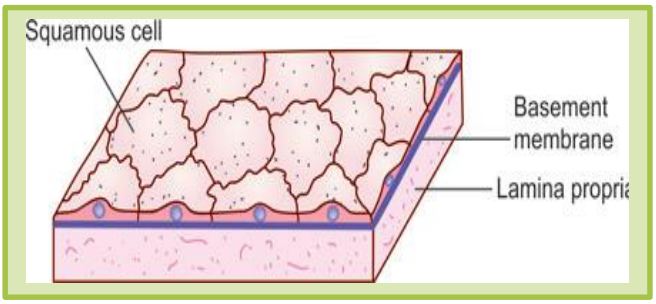
Types of Epithelia: Epithelia can be divided into **two** main groups: covering (or lining) epithelia **and** secretory (glandular) epithelia.

First: covering (or lining) epithelia

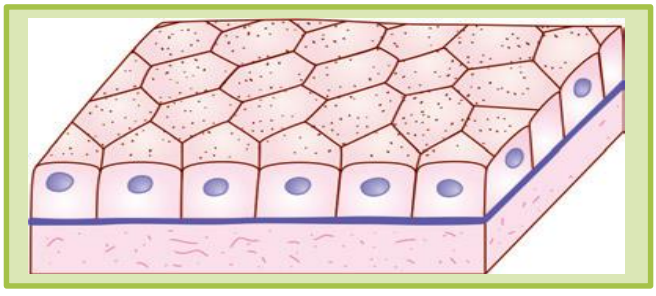
An epithelium may consist of only one layer of cells when it is called a unilayered or simple epithelium. Alternatively, it may be multilayered (stratified) or it can be pseudo-stratified.

A: Unilayered (simple) epithelia: Single layer of cells resting on a basement membrane. It may be further classified according to the **shape** of the cells constituting them.

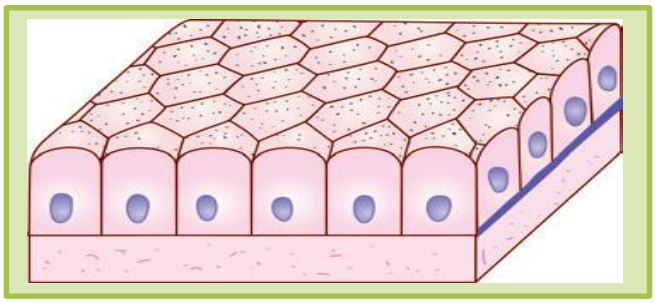
1. **squamous epithelium** :- the cells are flattened, their height being very little as compared to their width. Such an epithelium **(e.g**. lining of vessels, figure 2).



2. **cuboidal epithelium** the height and width of the cells of the epithelium are more or less equal (i.e. they look like squares in section) **(e.g.** covering the ovary, figure 3).



3. **columnar epithelium** the height of the cells of the epithelium is distinctly greater than their width, **(e.g.** lining of intestine, figure 4).



4. ciliated columnar the cell surface bears cilia. This is **epithelium (e.g.** lining of the respiratory tract). In other situations, the surface is covered with microvilli. At the light microscope the region of the microvilli is seen as a **striated border** (when the microvilli are arranged regularly) **(e.g.** the small intestine) or as a **brush border** (when the microvilli are irregularly placed).

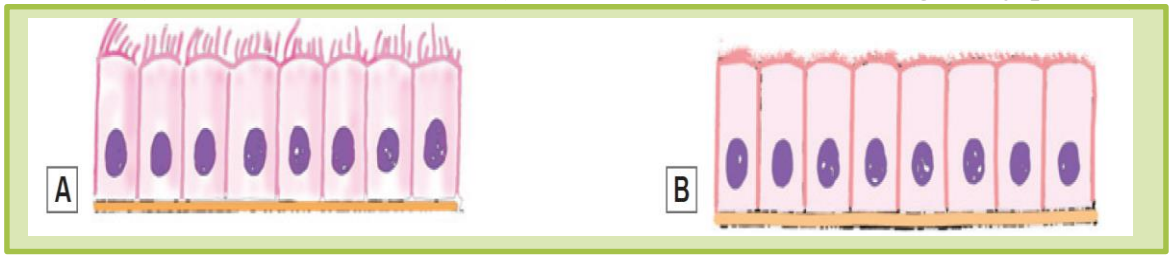
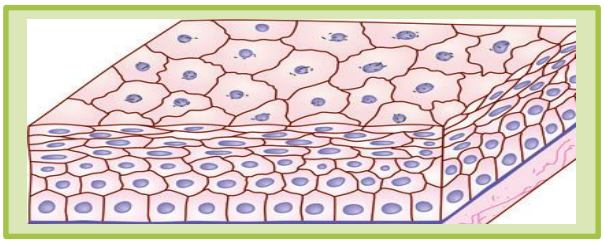


Figure 5: A. Columnar epithelium showing cilia; **B.** Columnar epithelium showing a striated border made up of microvilli

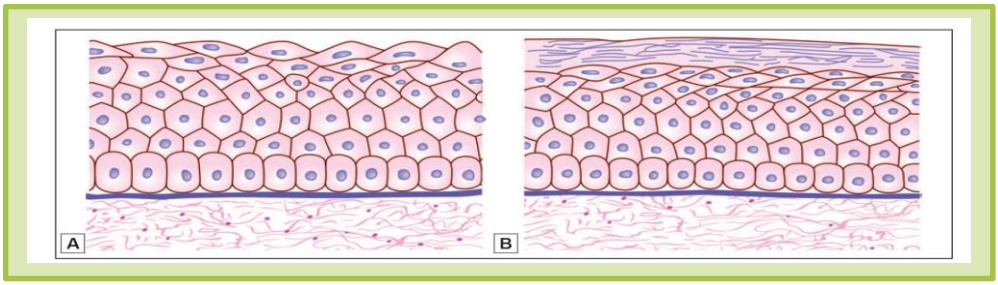
5.Pseudostratified columnar epithelia: In true sense this is a simple epithelium as each cell rests on the basement membrane (figure 6). This epithelium gives an appearance of a multilayered epithelium **due to** unequal height and shape of cells or layers of cells with nuclei at different levels; not all cells reach surface but all adhere to basal lamina (e.g. the auditory tube). The epithelium may bear cilia (ciliated epithelium) and may contain goblet cells. The cilia are capable of movement (e.g. lining of trachea).

B: Compound (stratified) epithelia: Epithelia which consist of multiple layers with the basal layer resting on the basement membrane.

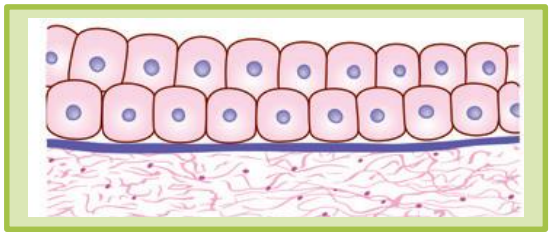
1. **Stratified squamous**: The deeper layers are columnar, but in proceeding towards the surface of the epithelium the cells become increasingly flattened (or squamous). It may be noted that all cells in this kind of epithelium are not squamous (e.g. epidermis, figure 7).



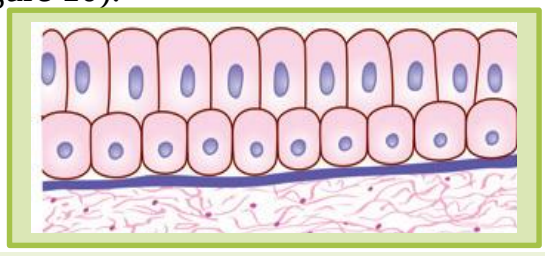
Stratified squamous epithelium can be divided into two types (figure 8): **non-keratinized A,** the most superficial cells are living and nuclei can be seen in them (e.g. **esophagus**) and **keratinized B,** the most superficial cells die and lose their nuclei. These cells contain a substance called **keratin**, which forms a non-living covering over the epithelium (e.g. **skin**).



2. **Stratified cuboidal**: The surface cells are cuboidal in shape (e.g. Sweat glands, figure 9).



3. **Stratified columnar**: The surface cells are columnar in shape (e.g. conjunctiva, figure 10).



4. **Transitional epithelium:** In this type of multilayered epithelium all layers are made up of cuboidal, polygonal or round cells. The cells towards the surface of the epithelium are round. As transitional epithelium is confined to the urinary tract, it is also called **urothelium** (figure 11).

Secretory epithelia and glands

Epithelial cells that function mainly to produce and secrete various macromolecules may occur in epithelia with other major functions or comprise specialized organs called **glands**. Products to be secreted are generally stored in the cells within small membrane-bound vesicles called **secretory granules**.

Classification of glands:

First: According to the number of cells, into:

- **Unicellular (goblet cell):** They can be found in the epithelium lining the intestines.
- **Multicellular**: They can be found in the lacrimal gland.

Second: According to the presence and absence of ducts, into:

- **Exocrine glands (or externally secreting glands):** They **retain** their connection with the surface epithelium, the connection forming the tubular ducts lined with epithelium by which secreted material leaves the gland. **Exocrine glands can be further classified:**

First: The basis of Branching of ducts:

Simple: When all the secretory cells of an exocrine gland discharge into one duct, e.g., gastric glands.

-Simple tubular glands, e.g. gallbladder and small intestine.
-Simple coiled tubular glands, e.g. sweat glands.
-Simple branched tubular glands, e.g. endocervical glands.
-Simple acinar glands, e.g. submucous glands of the trachea.

Compound: Sometimes there are a number of groups of secretory cells, each group discharging into its own duct, e.g., parotid gland.

-Compound tubular glands, e.g. prostate.

-**Compound tubuloacinar glands**, e.g. salivary glands.
-**Compound acinar glands**, e.g. mammary glands.

Second: The shape of the secretory unit: Both in simple and in compound glands the secretory cells may be arranged in **various ways**:

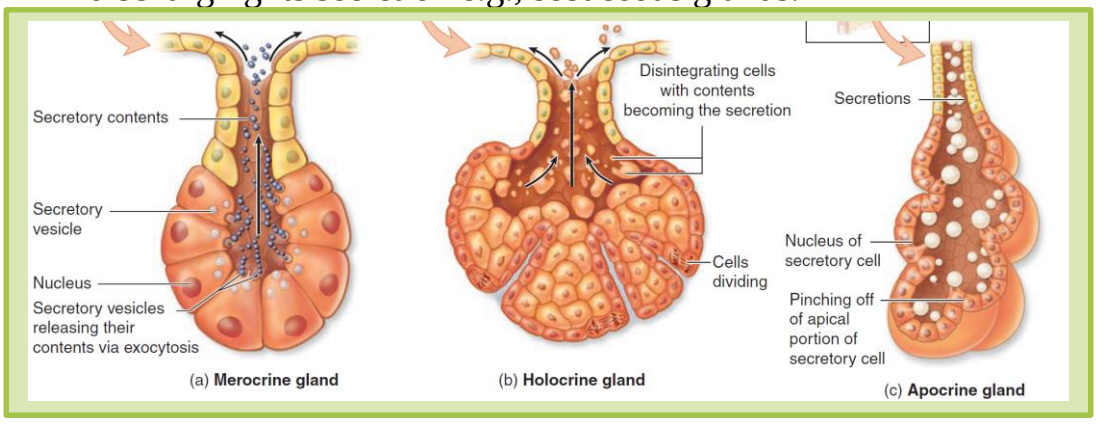
- **Tubular glands:** Glands with secretory unit tubular in shape. The tube may be straight, coiled or branched, e.g., gastric glands.
- **Acinar glands:** Glands with secretory unit round or oval in shape, e.g., salivary glands.
- **Alveolar glands:** Glands with secretory unit flask-shaped. Glands in which the secretory elements are greatly distended are called **saccular glands**.

Third: The nature of their secretions:

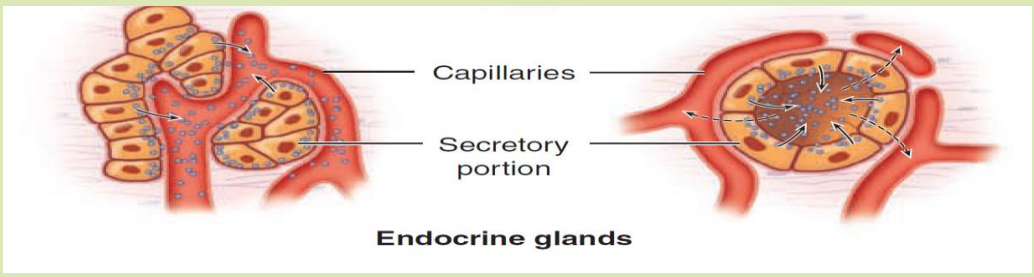
- **Mucous glands:** Cell of mucous acini is tall with flat nuclei at their bases, e.g. Sublingual gland.
- **Serous glands:** Cells of serous acini are triangular in shape with a rounded nucleus. Their nuclei are centrally placed, e.g. Parotid gland.
- **Some salivary glands are mixed seromucous glands**, with both serous acini and mucous tubules capped by groups of serous cells. The product of such glands is a mixture of digestive enzymes and watery mucus, e.g. salivary glands.

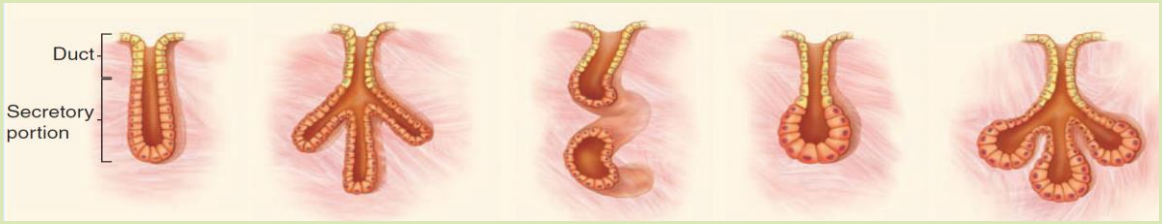
Fourth: The manner in which their secretions are poured out of the cells (figure 12):

- **Merocrine:** In most exocrine glands secretions are thrown out of the cells by a process of exocytosis, the cell remaining intact, e.g., goblet cell. • •
- **Apocrine:** In some glands the apical parts of the cells are shed off to discharge the secretion, e.g., mammary glands.
- **Holocrine:** In some glands, the entire cell disintegrates while discharging its secretion e.g., sebaceous glands.



Endocrine glands **internally secreting glands**, or **duct-less glands**: they lose the connection to their original epithelium and therefore lack ducts. Thin-walled blood vessels (capillaries) adjacent to the endocrine cells absorb their secreted hormone products for transport in blood to target cells throughout the body (figure 13).



Simple Glands (Ducts Do Not Branch)					
Class	**Simple Tubular**	**Branched Tubular**	**Coiled Tubular**	**Acinar (or Alveolar)**	**Branched Acinar**
					
Features	Elongated secretory portion; duct usually short or absent	Several long secretory parts joining to drain into 1 duct	Secretory portion is very long and coiled	Rounded, saclike secretory portion	Multiple saclike secretory parts entering the same duct
Examples	Mucous glands of colon; intestinal glands or crypts (of Lieberkühn)	Glands in the uterus and stomach	Sweat glands	Small mucous glands along the urethra	Sebaceous glands of the skin

Compound Glands (Ducts from Several Secretory Units Converge into Larger Ducts)			
Class	**Tubular**	**Acinar (Alveolar)**	**Tubuloacinar**
			
Features	Several elongated, coiled secretory units and their ducts converge to form larger ducts	Several saclike secretory units with small ducts converge at a larger duct	Ducts of both tubular and acinar secretory units converge at larger ducts
Examples	Submucosal glands (of Brunner) in the duodenum	Exocrine pancreas	Salivary glands

Some organs have both endocrine and exocrine functions and one cell type may function in both ways, e.g. liver cells. In other organs, some cells are specialized in endocrine and others in exocrine functions, e.g. the pancreas.

Development of glands

Glands, both exocrine and endocrine develop as diverticula of the epithelium. As shown in the Figure 14, the **exocrine** develops as a solid bud from the epithelium into the underlying connective tissue. Soon it elongates, undergoes canalization and displays a secretory and conducting portion. The conducting part forms the duct and is continuous with the epithelium. Hence, an exocrine gland discharges its secretions through a duct.

Endocrine gland also develops in a similar manner to exocrine gland but with further development it breaks the continuity with overlying epithelium. It appears as a clump of cells. Soon these groups of cells get surrounded by blood vessels into which they pour their secretions.