Epithelial tissue

 The epithelium is a sheet of aggregated cells of similar type that covers body surfaces, lines hollow organs or modified to form glands or neuroepithelium.

General features of epithelium

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- It may originate from all three embryonic germ layers (ectoderm, mesoderm and endoderm).
- It is composed of high number of closely applied cells with very little intercellular substances.
- It is separated from the underlying connective tissue by a basement membrane.
- It is avascular, blood and lymph vessels do not penetrate the basement membrane. Thus, it receives its nutritional support by diffusion.
- The epithelial cells have high capacity for regeneration.
- The epithelium can change from one form to another in a process called metaplasia.
- It performs many functions such as protection, secretion, excretion, absorption and sensory reception.

Classification of epithelium

1. Epithelial membranes.

2. Glandular epithelium.

3. Myoepithelium.

4. Neuroepithelium.

Epithelial membranes

- The epithelial membranes are classified according to the number of cell layers:
- a. Simple epithelium: It consists of single layer of epithelial cells resting on basement membrane. The simple epithelium is classified according to the shape of the cells (squamous, cuboidal, columnar)
- b. Stratified epithelium: It consists of <u>two or more</u> than two layers of cells. The stratified epithelium is classified according to shape of the cells in the <u>upper most</u> <u>layers</u>.

Simple squamous epithelium

- It consists of a single layer of thin flat, scale-like cells
- On surface view, the cells have an irregular shape with a
 - slightly serrated border.
- Each cell has a centrally located spherical or oval nucleus.
- In a side view:
- the cells are so flat
- they can only recognize by their elongated nuclei that bulge into the lumen.
- The cytoplasm is scanty and has sparse organelles.



Simple squamous

Simple cuboidal epithelium

- It consists of a single layer of cube-like cells whose width and height are nearly equal.
- In sections, the cells are square with spherical centrally located nuclei.
- Locations: thyroid follicles, glandular ducts and kidney tubules









Simple columnar epithelium

- It consists of a single layer of tall, narrow cells having greater height than width.
- The nuclei are oval and are located near the base of the cells.
- Simple columnar absorptive with microvili (small intestine, gall bladder).
- Simple columnar secretory (stomach).
- Simple columnar ciliated (oviducts and bronchioles).





Pseudostratified columnar epithelium

- It is composed of single layer of irregular cells.
- All the cells rest on the basement membrane but not all the cells reach to the luminal surface.
- The nuclei are located at different levels, thus creating the illusion of cellular stratification.
- The cells reaching the surface are either ciliated or goblet cells.
- The short cell acts as progenitors for the tall cells.





Stratified epithelium

- It consists of two or more than two layers of cells.
- The stratified epithelium is classified <u>according to shape</u> of the cells in the <u>upper most layers</u>.

Stratified squamous epithelium

- It consists of several layers of cells with only the <u>superficial cells</u> having squamous shape.
- There are two types:
- 1. <u>Keratinized (dry) type</u>. This type is covered with non living layer of keratin and is found in skin.
- 2. <u>Non Keratinized (wet) type</u>. It is present in oral cavity and esophagus.



Noncornified stratified squamous

squamous /surface cell

> large polygonal basal cells

connective tissue fibroblasts



Stratified cuboidal epithelium

- It consists of two or more layers of cells, with only the superficial cells having a cuboidal shape
- It is frequently occurs as twolayered epithelium located in the large glandular ducts.





Stratified columnar epithelium

- It consists of several layers of cells with only the superficial layer having tall columnar cells.
- Locations: distal portion of the urethra, parotid and mandibular ducts, lacrimal sac and lacrimal duct.





Transitional epithelium

- It is called transitional because the number of layers changes depending on whether the organ is contracted or distended.
- In contracted state (when the urinary bladder is empty) transitional epithelium has several layers (6-8 layers).
- When the bladder is full the epithelium has two or three layers and appears as stratified squamous epithelium non keratinized.
- It is present in the urinary tract.





Glandular epithelium (Glands)

The glands are classified according to:

- I. Number of cells forming the gland (unicelluar and multicellular glands)
- II. presence or absence of ducts (exocrine and endocrine glands)
- III. Branching of the duct (simple, simple branched, and compound glands)
- IV. shape of secretory part (tubular, acinar, and alveolar)
 - V. Nature of secretion (serous, mucous, mixed)
- VI. Mode of secretion (merocrine, apocrine, and holocrine)

I. According to presence or absence of duct

Exocrine glands: they are glands that have a duct system to convey their secretory products to the sites of utilization (e.g., salivary glands).

Endocrine glands: they do not have a system of duct (ductless).

The secretory product (hormone) reaches the site of utilization through blood or lymph (e.g., pituitary gland and thyroid gland).

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Vessels

a hand

II. According to the number of cells forming the gland

- Unicellular glands: It consists of a single secretory cell in a nonsecretory epithelium (e.g., goblet cells).
- <u>Multicellular</u> <u>glands:</u> It is composed of more than one cell (e.g., salivary gland).





III. Classification according to branching of the duct: Simple gland

- Simple tubular where the duct is not branched and the secretory part is in the form of tubule (e.g., glands of the large intestine).
- Simple acinar or alveolar glands where the duct is not branched and the secretory part is in the form of alveolus or acinus (e.g., sebaceous gland and the glands of skin of amphibians).

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Simple tubuloalveolar glands where the duct system is not branched and the secretory part is tubular and alveolar (are rare).



III. Classification according to branching of the duct: Simple branched glands

- Simple branched tubular where the duct is not branched while the tubular secretory part is branched (e.g., glands of the stomach).
 - Simple branched alveolar where the duct is not branched while the alveolar secretory part is branched (e.g., sebaceous glands).
- Simple branched tubuloalveolar where the duct is not branched while the tubular and alveolar secretory part is branched (e.g., minor salivary glands).



III. Classification according to branching of the duct: Compound glands

- Compound tubular glands where the duct is branched and the secretory parts are tubular (e.g., liver).
- Compound alveolar glands where the duct is branched and the secretory parts are alveolar (e.g., mammary glands).
- Compound tubulo-alveolar glands where the duct is branched and the secretory parts are tubular and alveolar (e.g., pancreas).



V. Classification according to the <u>nature of</u> <u>secretion:</u> a. <u>Mucous gland</u>

- Mucous glands: they produce thick, viscous secretions (mucus).
- The cells of the mucous secretory units are cuboidal in shape and filled with mucinogen, the precursor of mucus that stain light (foamy or vacuolated) in H&E.
- The nuclei are flattened and rest on
 the basement membrane.
- The cell boundaries are distinct.
- The lumen is wide (e.g., palatine glands and the glands of the tongue).



lumen

mucous acinus

Sublingual Gland H&E

nuclei

mucous acinus



Sublingual Gland

o plasma cell

Mucous Tubules

Serous Deminlunes

V. Classification according to the <u>nature of</u> <u>secretion:</u> b. <u>Serous glands</u>

- Serous gland: they produce thin watery secretion.
- The cells of the secretory units are pyramidal in shape.
- The nuclei are spherical and situated near the center of the cells.
- The cytoplasm has two zones, basal zone that appears basophilic due to the presence of rER and apical eosinophilic zone due to the presence of zymogen granules. (e.g., parotid glands and pancreas).





Serous Mucous

Intralobular = Striated Ducts

V. Classification according to the <u>nature of</u> <u>secretion:</u> c. <u>Sero-mucous gland</u>

(mixed)

gland: they produce mixed secretions.

Seroumucous

- They consist primarily of mucous secretory units with crescent-shaped clusters of serous cells (serous demilunes) located at the periphery of the mucous units.
- The serous secretion reaches the lumen through intracellular canaliculi located between the mucous cells. (e.g., submandibular and
 - sublingual salivary glands).



Sublingual Gland

o plasma cell

Mucous Tubules

Serous Deminlunes

VI. Classification according to the mode of secretion

- Merocrine glands (secretion without loss): The cells of which remain intact and not destroyed during the process of secretion. The secretory granules are discharged by exocytosis (e.g., salivary glands).
 - Apocrine glands (secretion with apical loss). The apical parts of the cells are destroyed during the secretory process (e.g., some sweat glands and mammary glands).
- Holocrine glands (secretion with whole loss)

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The whole secretory cells are discharged then destroyed to release the secretory product (e.g., sebaceous glands).





apocrine





Myoepithelium

- The myoepithelial cells are flattened cells with long cytoplasmic processes lie between the secretory cells and the basement membrane.
- The processes form a basket-like network (hence the name basket cells) around the secretory units.
- Their cytoplasm is rich in contractile actin and myosin filaments.
- Contraction of these cells forces the secretory product into the duct system.
- The myoepithelial cells are found in sweat and mammary glands.



Neuro-epithelium

- It is a special type of epithelium designed to receive sensory stimuli (e.g., taste buds and olfactory epithelium).
- It will be considered with the digestive and the respiratory systems.