

Medical Biology

Epithelial Tissue

Lec: 4

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Tissues are cells that are similar in structure and perform a common related function.

There are four types of tissues:

- Epithelial tissue
- Connective tissue
- Muscle tissue
- Nerve tissue

Tissues are organized into organs, most organs containing all 4 types of tissue.

Epithelial tissue is a sheet of cells that covers a body surface or lines a body cavity. Two forms occur in the human body:

1. Covering and lining epithelium: forms the outer layer of the skin, lines open cavities of the digestive and respiratory systems, covers the walls of organs of the closed ventral body cavity.

2. Glandular epithelium: surrounds glands within the body.

- Functions of epithelial cells include secretion, selective absorption, protection, transcellular transport, and sensing
- Epithelial layers contain no blood vessels, so they must receive nourishment via diffusion of substances from the underlying connective tissue, through the basement membrane. Cell junctions are well-employed in epithelial tissues.

Characteristics of epithelial tissue:

1- Polarity: all epithelia have an apical surface and a lower attached basal surface that differ in structure and function. Most apical surfaces have microvilli (small extensions of the plasma membrane) that increase surface area. For instance, in epithelia that absorb or secrete substances, the microvilli are extremely dense giving the cells a fuzzy appearance called a brush border. Examples of this would include epithelia lining the intestine and kidney tubules. Other epithelia have motile cilia (hair like 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.

2-Specialized contacts: epithelial cells fit close together and form continuous sheets (except in the case of glandular epithelia). Such as tight junctions and desmosomes.

3-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.

4-Avascular: epithelium typically lacks its own blood supply

5-Regeneration: epithelium has a high regenerative capacity and can reproduce rapidly as long as they receive adequate nutrition.

Classification of Epithelia:

Based on the number of cell layers, epithelia can classify to simple and stratified.

- **Simple epithelia:** consist of a single cell layer (found where absorption, secretion, and filtration occur).
- **Stratified epithelia:** are composed of two or more cell layers.

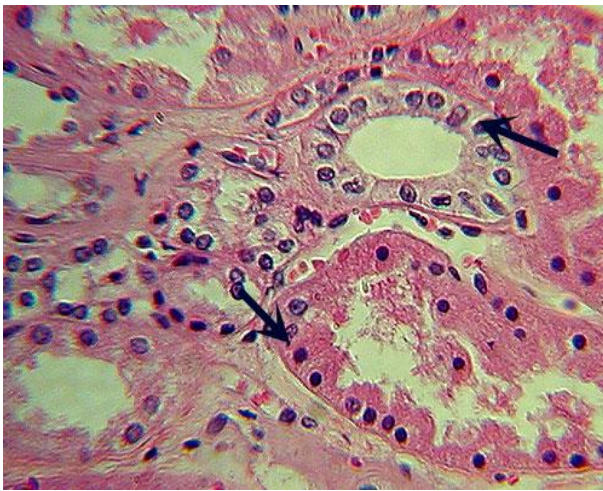
Simple epithelial tissue: Depending on the shape of the cells, simple epithelial tissue can be classified to:

1-Simple squamous epithelium: flat, thin scale like cells with disc nuclei, they are close fitting and flattened laterally. They're found where filtration occurs

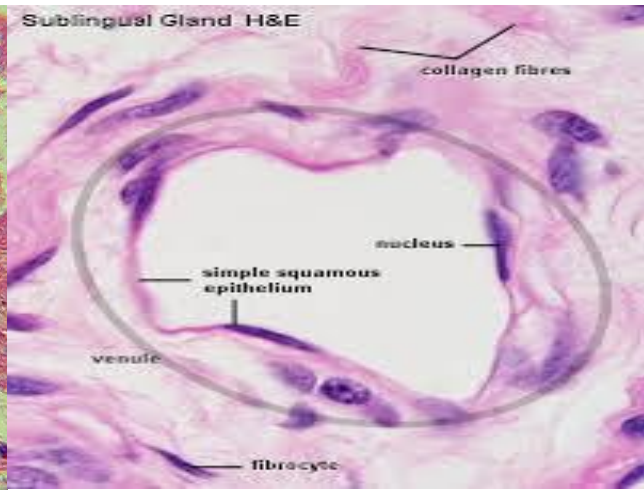
Location: Bowman's capsule in kidneys, lungs, endothelium of blood vessels.

2-Simple cuboidal epithelium: consists of a single layer of cup-like cells with central nuclei and same height and width. Functions include secretion and absorption.

Location: in small ducts of glands (thyroid, salivary, pancreas), kidney tubules and ovary surface.



Simple cuboidal epithelial tissue



Simple squamous epithelial tissue

3-Simple columnar epithelium: is a single layer of tall cell with oval basal nuclei, closely packed cells that line the digestive tract from the stomach to the rectum. Functions include absorption and secretion. They contain dense microvilli on their apical surface. Additionally, some simple columnar epithelia may display cilia on their free surface also. Also there is goblet cell which produce mucous and protect lining of intestine.

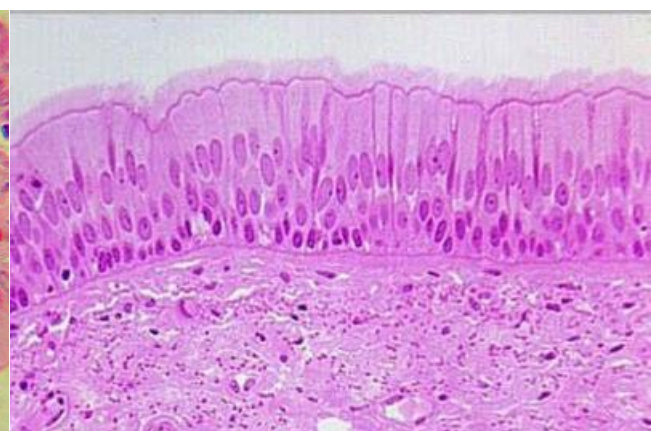
Location: Digestive system

4-Pseudostratified columnar epithelium: It looks like composed of several layers of cells, because the cells have different heights, and gives the illusion of multiple cell layers. All of their cells rest on the basement membrane and vary in height but only the tallest reach the apical surface. Most pseudostratified epithelia contain cilia on their apical surface and the goblet cells are found for secretion.

Location: line the respiratory tract (trachea, bronchi).



Simple columnar epithelial tissue



Pseudostratified epithelial tissue

Stratified epithelial tissue: It based on the shape of cells in the apical layer, stratified epithelia can classify to:

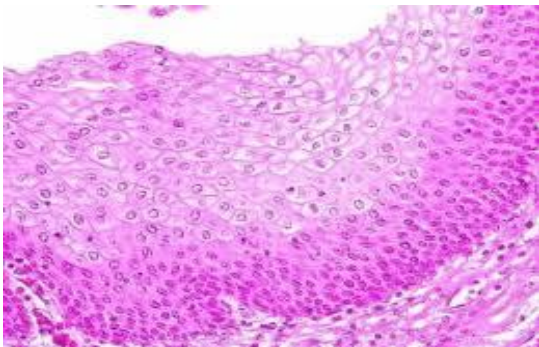
1- Stratified squamous epithelium: There are two types

A- Non-keratinized Stratified squamous epithelium: Is the most widespread stratified epithelia. It's composed of several layers and is perfect for its protective role. Its apical surface cells are squamous and cells of the deeper layer are either cuboidal or columnar while the intermediate cells are polyhedral.

Location: Oral cavity, esophagus, pharynx, cornea and vagina.

B- keratinized Stratified squamous epithelium:The surface cells are full with keratin, a protective protein and dead, basal cells are active in mitosis and produce the cell of the more superficial layers.

Location: epidermis of the skin.



Non-keratinized Str.sq.epi.tissue



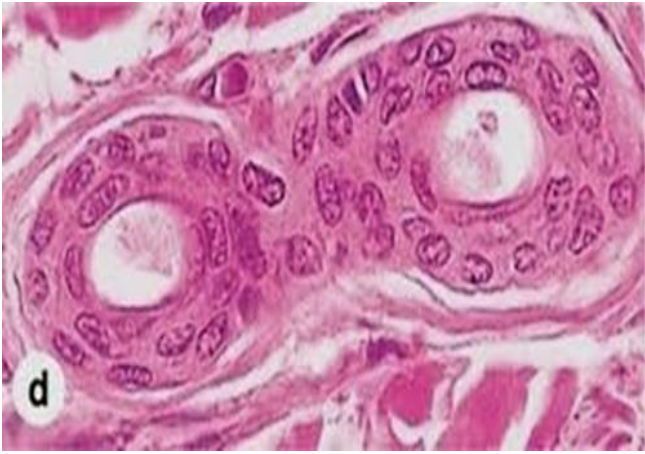
Keratinizes. Stra. sq. epi. tissue

2-Stratified cuboidal epithelium : It is typically have two layers of cuboidal cells.

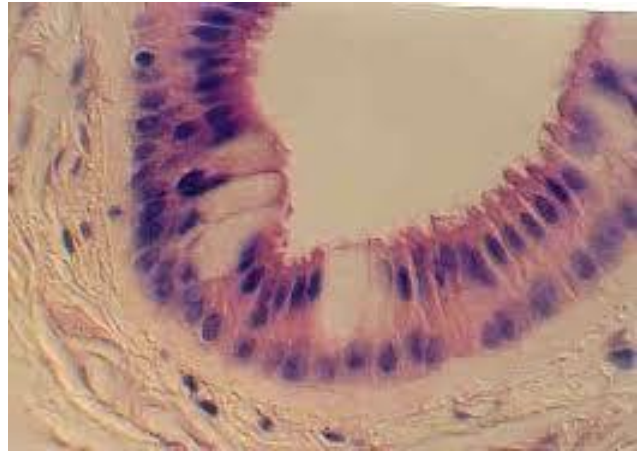
Location: It's mainly found in the ducts of glands (sweat glands, mammary glands)

3- Stratified columnar epithelium: is also rare in the human body.

Location: pharynx, male urethra, and lining of some glandular ducts.



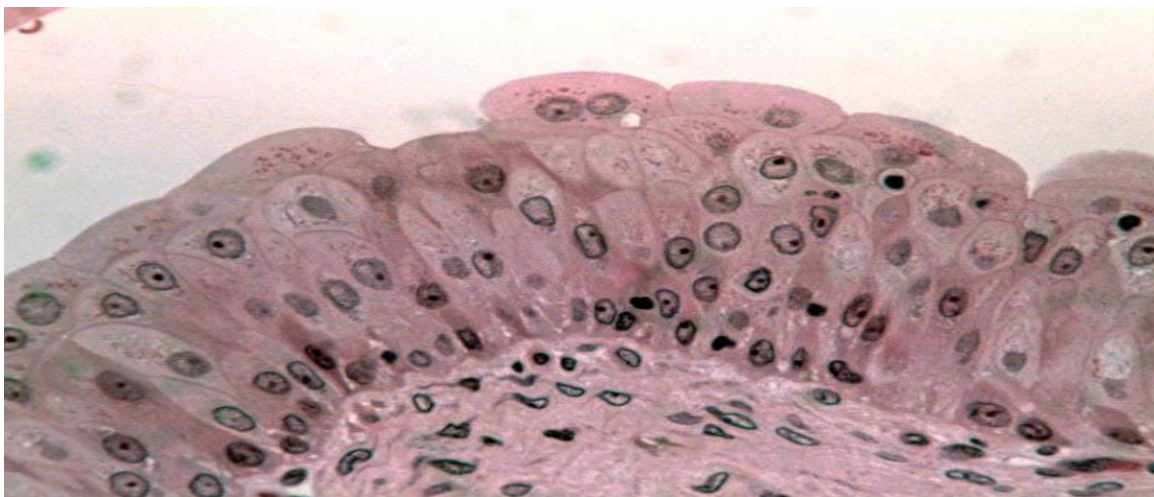
Stratified cuboidal epithelium tissue



Stratified columnar epithelium tissue

4- Transitional epithelium: forms the lining of hollow urinary organs, which stretch as they fill with urine. Cells in the basal layer are cuboidal or columnar. Cells by the apical surface vary in appearance depending on the distension of the organ. When the organ is not stretched, the membrane is many layers and the superficial cells are rounded and dome shape. When the organ is distended with urine, the apical cells flatten and become squamous like.

Location: Lines the ureter, urinary bladder and part of urethra.



Transitional epithelial tissue

Glandular tissue

Glandular tissue is the type of epithelium that forms the glands from the in folding of epithelium and subsequent growth in the underlying connective tissue. A gland consist of one cell or more that make and secrete a particular product which called secretion.

According to their secretion, 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 such as hormone, steroid, amino acid and protein.
- **Exocrine glands:** Secrete their products into a duct that then delivers the product to the lumen of an organ or onto the free surface or body cavities such as sweat, oil, mucous and salivary glands.

According to their structure, the glands classified to:

1- Unicellular glands: Gland consists of one cell such as goblet cell which produces mucin, a complex glycoprotein that dissolves in water to form mucus.

2- Multicellular glands: Gland consists from many cells.

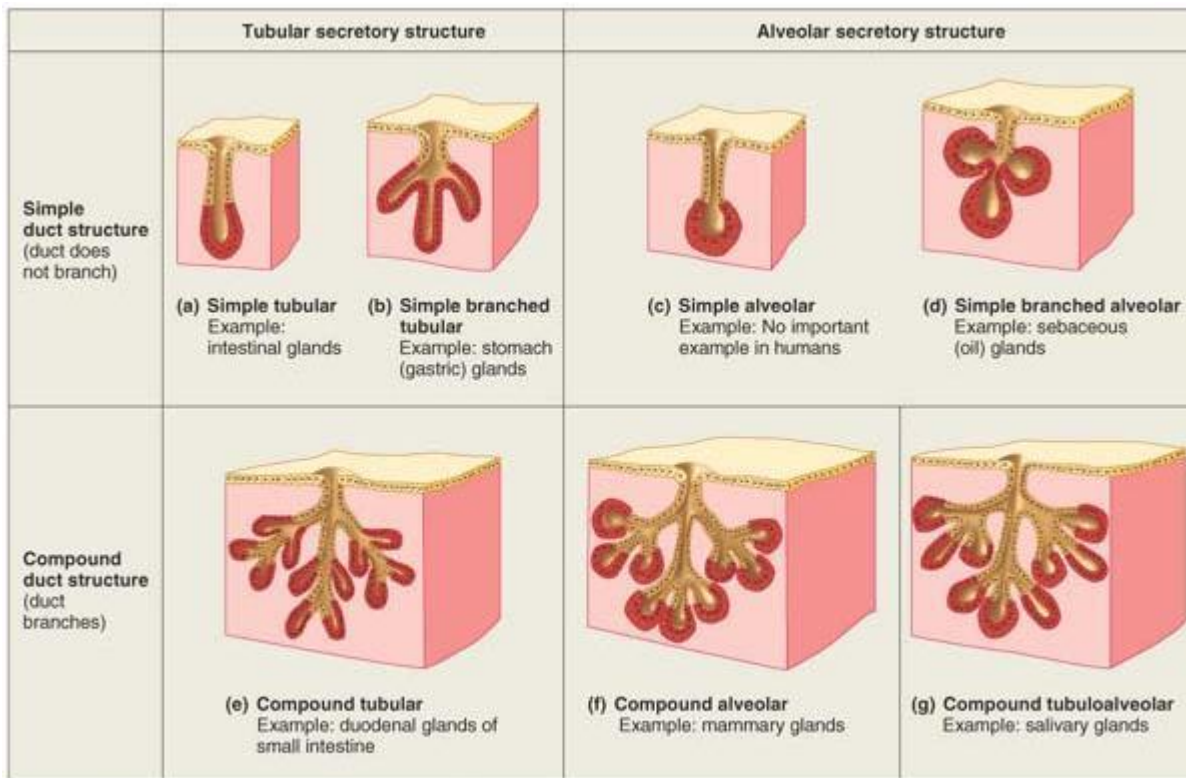
According to their ducts and secretory parts, the glands classified as following:

A-Simple multicellular glands

- Simple tubular glands
- Simple coiled tubular glands
- Simple branched tubular glands
- Simple alveolar glands
- Simple branched alveolar

B- Compound multicellular glands

- Compound tubular glands
- Compound alveolar glands
- Compound tubuloalveolar glands



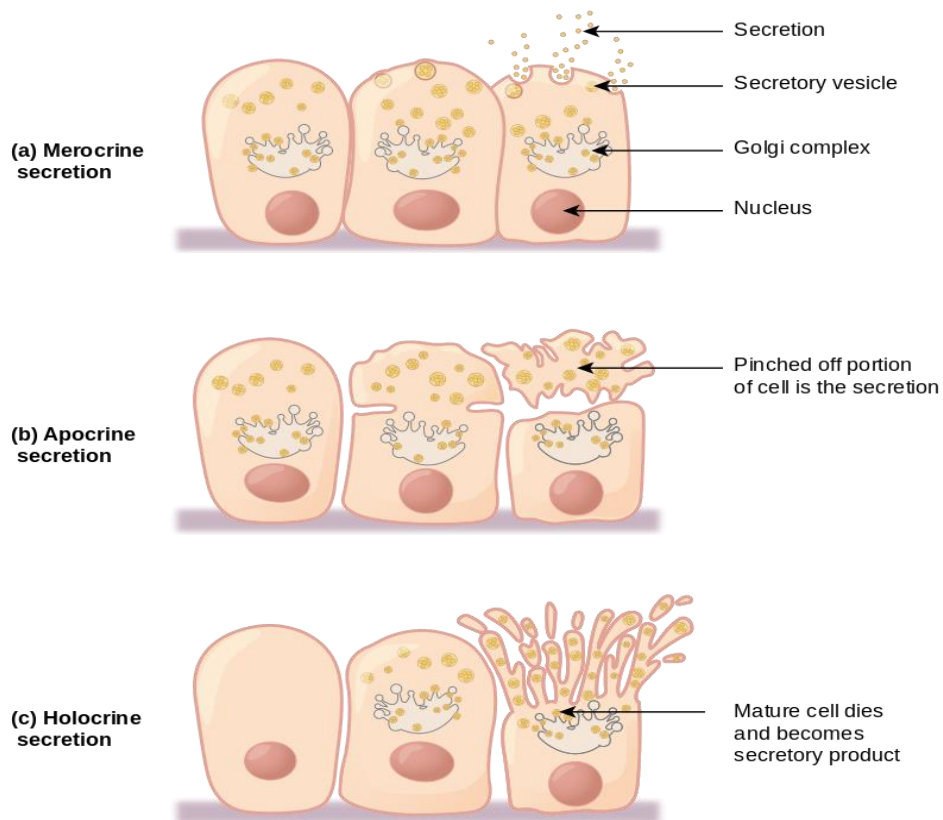
Key:  = Surface epithelium  = Duct  = Secretory epithelium

According to the mode of secretion, the glands are:

(a) **Merocrine glands:** Secretions products are secreted by exocytosis, but the secretory cells are not altered. Example: pancreas, sweat, and salivary glands.

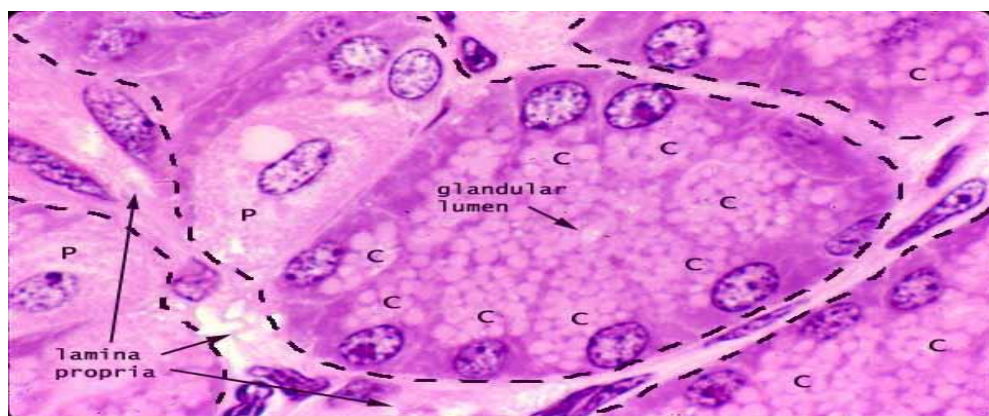
(b) **Apocrine glands:** Secretions off through the plasma membrane producing membrane-bound vesicles in the lumen. The apical portion of the secretory cell of the gland pinches off and enters the lumen. It loses part of its cytoplasm in their secretions, example: mammary glands.

(c) **Holocrine glands:** Secretions are produced in the cytoplasm of the cell and released by the rupture of the plasma membrane, which destroys the cell and results in the secretion of the product into the lumen. Examples of holocrine glands include the sebaceous glands.



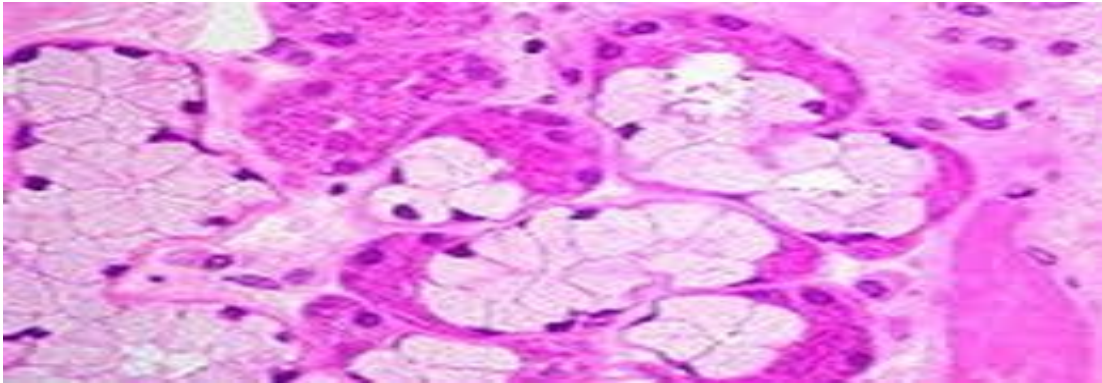
According to the nature of secretion, the glands classified as following:

1- Serous cell glands: Serous alveoli are polyhedral or pyramidal cells arranged around a small visible lumen with central, rounded nuclei, produce watery solution rich in enzymes. In the basal region, serous cells display an intense basophilia, which results from large accumulations of rough endoplasmic reticulum (rER) and free ribosomes. While in the apical region, serous cells contain prominent Golgi apparatus and numerous rounded, protein-rich, membrane-bound vesicles called secretory granules, these cells that produce digestive enzymes which called zymogen granules. e. g: parotid glands and pancreas.



2- Mucous cell glands: Mucous alveoli larger than serous alveoli, the mucous cells are pyramid shape with flattened nuclei which located in the cell base and larger lumen, mucous cell produce mucous poor in enzymes e.g. goblet cells and minor salivary glands.

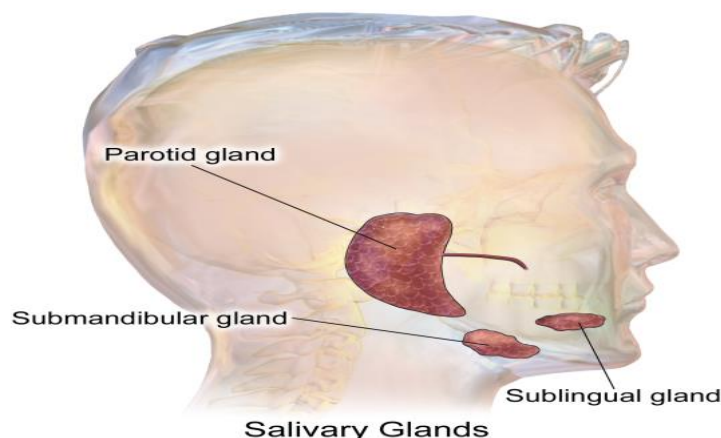
3- Seromucous glands (Mixed): It mixed of mucous alveoli surrounded by one or more groups of serous, it produce both types of secretions e. g: submandibular and salivary glands.



Salivary glands: salivary glands are exocrine glands with ducts, that produce saliva, which moistens the mouth to help a person chew and swallow food. Saliva also contains amylase and digestive enzymes that breakdown starch. There are three pairs of major salivary glands:

- The parotid glands are located between the ear and the jaw.
- The submandibular (submaxillary) glands are located under the jaw.
- The sublingual glands are located on the floor of the mouth under the tongue.

In addition to that, there are numerous small glands in the tongue, palate, lips, and cheeks. These glands produce only a small amount of saliva.



In addition to the glandular epithelia, There are another epithelial cells:

- **Myoepithelial cells:** a thin layer above the basement membrane but generally beneath the luminal cells. They contain myosin and actin microfilaments for contract and expel the secretions of glands. They are found in the sweat glands, mammary glands, lacrimal glands and salivary glands.
- **Neuroepithelial cells:** they consider as stem cells of the nervous system. These neural stem cells then differentiate further into multiple types of cells, like neurons, astrocytes and other glial cells. They made up from cells and serve as sensory cells for external stimuli as in the taste buds in the tongue.

