Histology section

General information

Histology is a branch that studies the microscopic structure of biological tissues, in order to understand their organization and function through techniques such as thin tissue sections and specific staining, and observation under a microscope.

A biological tissue is defined as a group of cells that share the same morphology and origin; these cells work together to perform a specific function within the organism.

Four fundamental types of biological tissue can be distinguished: **epithelial**, **connective**, **muscular**, and **nervous**.

I- Epithelial Tissue (Epithelium)

This is a collection of closely packed, contiguous cells resting on a basement membrane, covering the external surface of the body and the body's natural cavities. This tissue is avascular; it is always associated with another underlying tissue, generally connective tissue, which provides nutrients and removes waste products via the basement membrane.

There are two types of epitheliums: **lining epithelium** (Liner function) and **glandular epithelium** (Excretory function).

I-1- Lining Epithelium

This is a tissue that covers the entire body (the skin), its internal cavities (oral cavity, nasal cavity...), and its tubes (digestive tract, urinary and genital tracts...). It derives from the three embryonic germ layers: **ectoderm** (e.g., epidermis), **mesoderm** (e.g., mesothelium), and **endoderm** (e.g., the epithelium that lines the respiratory and digestive tracts).

I-1-1- Characteristics of Lining Epithelia

- Epithelial cells are tightly joined and juxtaposed by cell junctions.
- Epithelial cells rest on a basement membrane.
- Epithelial tissue is associated with connective tissue, which nourishes it.
- It is an avascular tissue.
- Epithelial cells possess an apical pole and a basal pole (polarity).
- Cell renewal is very high.

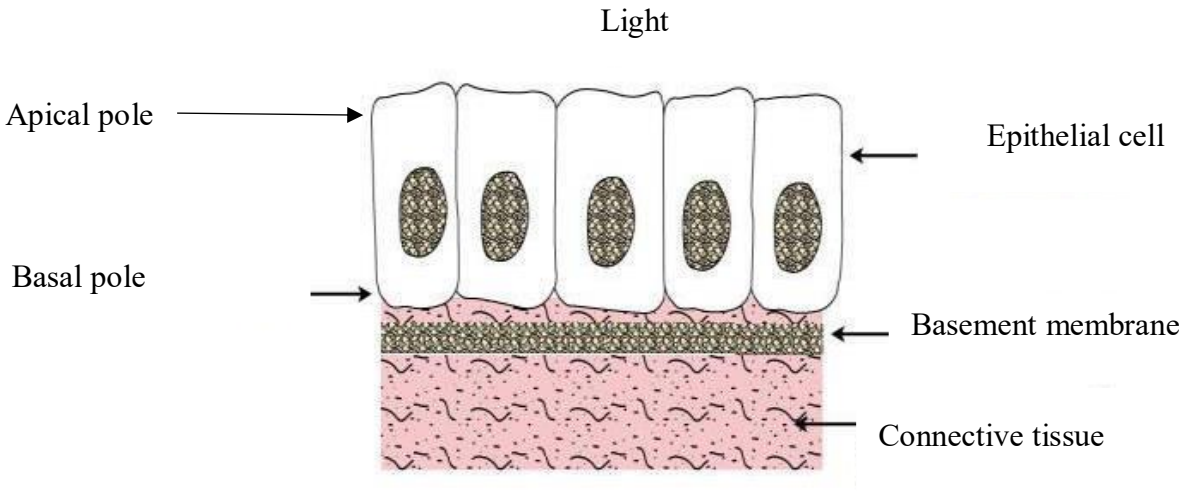

Figure: Characteristics of lining epithelium

I-1-2- Roles of Lining Epithelium

It performs several functions in the body:

- **Protection:** This can be mechanical, as in the case of the keratinized epidermis of the skin, which protects against dehydration and chemical agents, or chemical, due to the mucus synthesized by gastric epithelium.
- **Absorption:** Enterocytes (intestinal epithelium) absorb nutrients from the lumen into the blood.
- **Movement:** When the epithelium is equipped with cilia, it allows the movement of particles or fluids (Fallopian tubes and respiratory tract).
- **Exchange:** Epithelia facilitate gas exchange (air/blood), as in the case of the pulmonary alveoli, or chemical exchange (urine/blood).

I-1-3- Classification of Lining Epithelia

They are classified according to three criteria:

- **Cell Shape**

Epithelial cells can be **cuboidal** (wider than tall with a round, central nucleus), **columnar** or **prismatic** (taller than wide with an elongated, peripheral nucleus), or **squamous** (flat cells with a central nucleus).

- **Number of Layers**

The epithelium can be **simple** (consisting of a single cell layer), **stratified**, or **compound** (formed by several superimposed cell layers, the deepest of which is the germinal layer), or

pseudostratified (the epithelial cells are all in contact with the basal lamina, but do not reach the entire lumen).

- **Differentiation of certain apical structures**

The apical portion of epithelial cells may exhibit **microvilli** (enterocytes), **motile cilia** (fallopian tube), **non-motile stereocilia** (epididymis), **mucus** (respiratory tract), or **keratin** (epidermis).

I-1-4- Types of Lining Epithelia

a- Simple Epithelia: This type of epithelium performs the following functions: absorption, filtration, and secretion.

1- Simple Cuboidal Epithelium: Composed of a single layer of cuboidal cells, it is found in glandular epithelia and renal tubules.

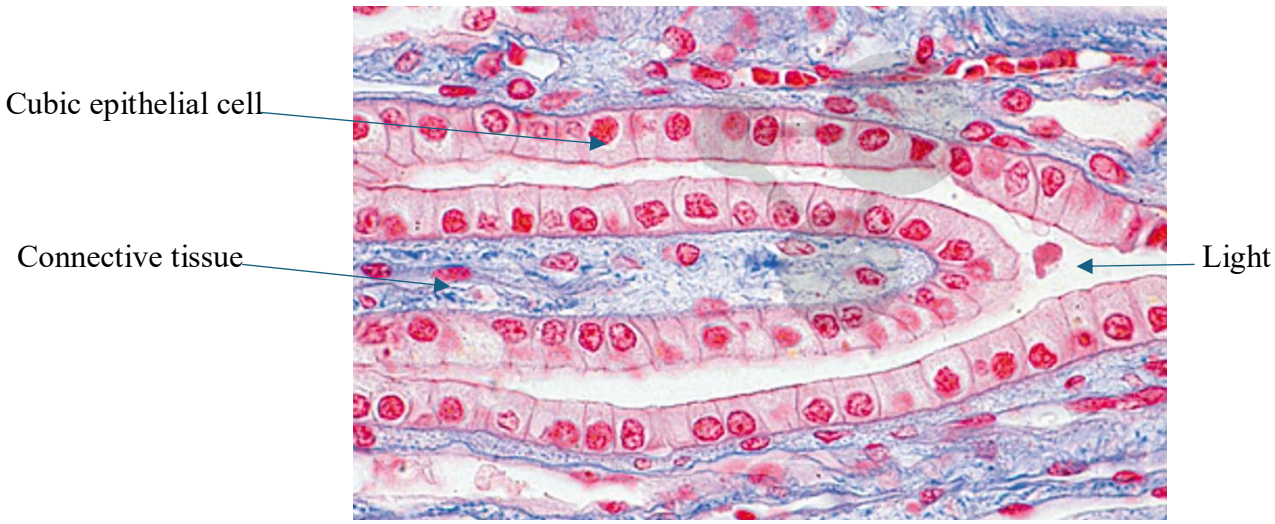

Figure: Simple Cuboidal Epithelium

2- Simple columnar epithelium: Formed of a single layer of columnar cells. It is found in the digestive tract and the genital tract; the cells exhibit apical differentiation (cilia, microvilli...).

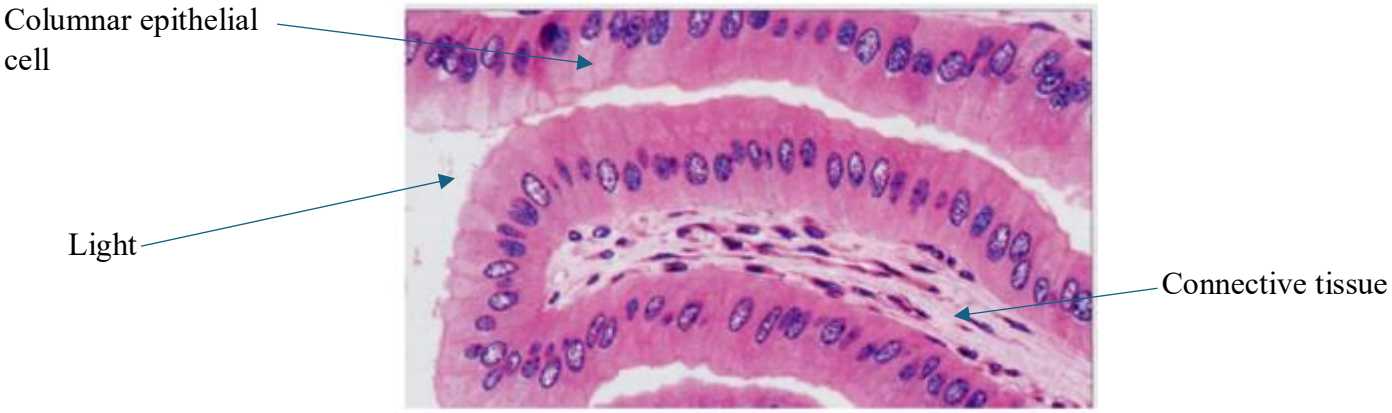

Figure: Simple Columnar Epithelium

3- Simple squamous epithelium: Formed of a single layer of squamous cells, the nucleus is generally swollen. It is found in the **endothelium** and the **mesothelium**.

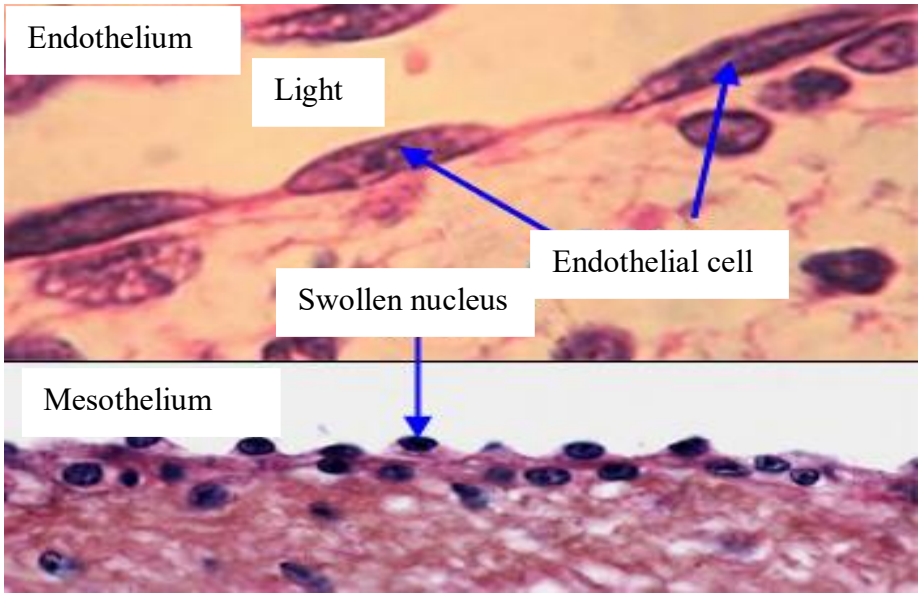

Figure: Simple Squamous Epithelium

b- Stratified Epithelia

1- Stratified Columnar Epithelia: These are rare and possess a layer of basal cells (germinal layer) that divide and transform into polyhedral cells, arranged in several layers. Only the

superficial layer has a cylindrical shape. They are found in the urethra and the large excretory ducts of exocrine glands.

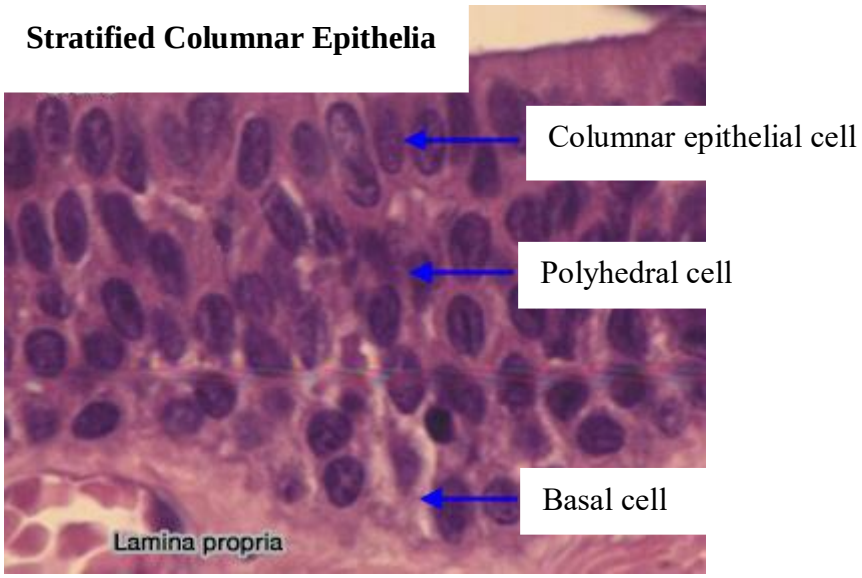

Figure: Stratified columnar epithelium

2- Stratified cuboidal epithelia: these are uncommon, composed of two layers of cuboidal cells. They are found in sweat glands, salivary glands and mammary glands.

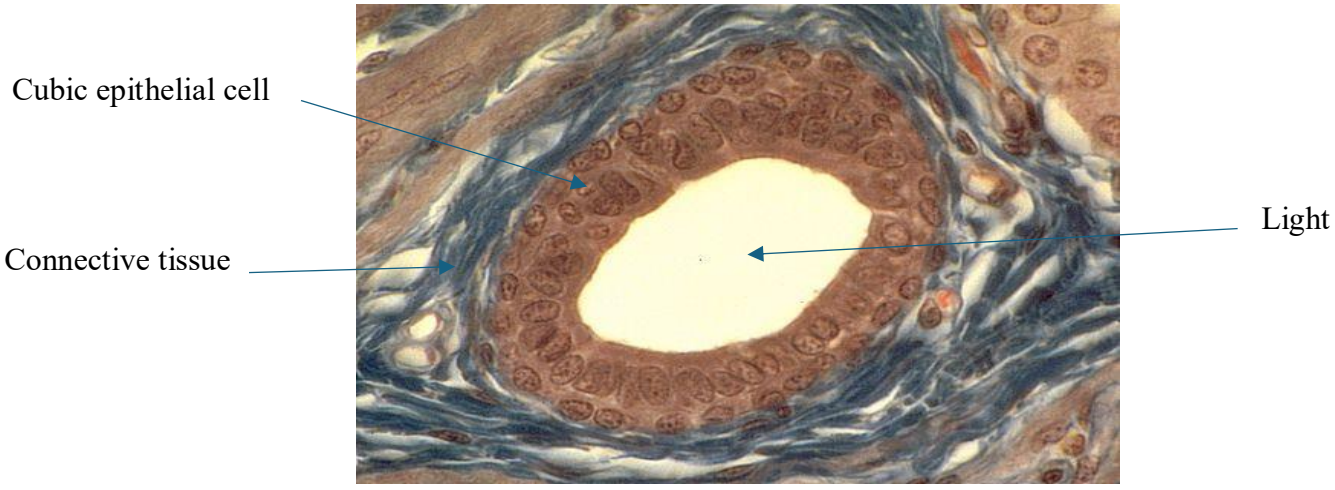

Figure: Stratified cuboidal epithelium

3- Stratified squamous epithelia: whose superficial layers are formed of flattened cells. They can be keratinized (Skin) or non-keratinized (Esophagus and vagina).

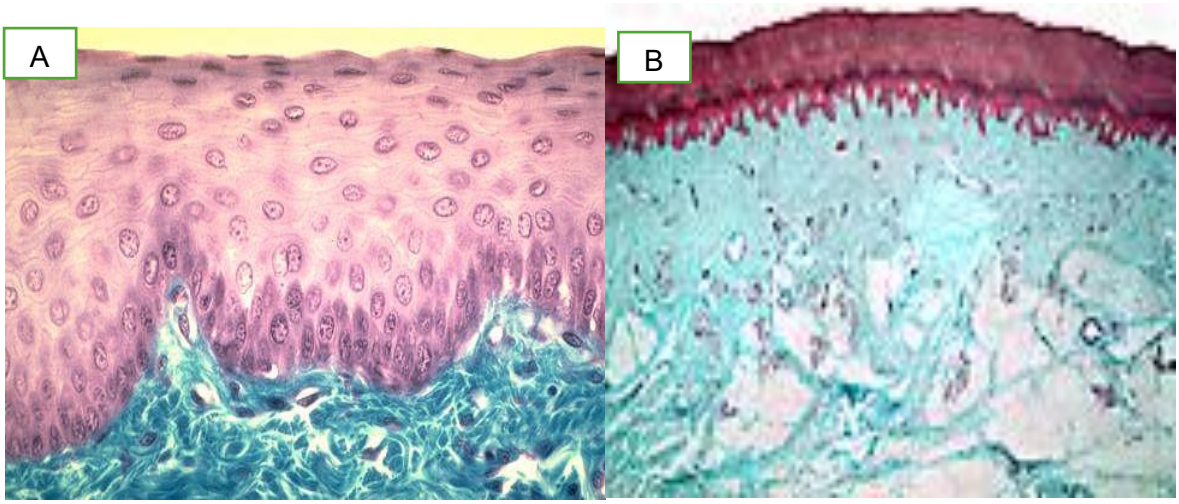

Figure: Non-keratinized (A) and keratinized (B) stratified squamous epithelia

c- Pseudostratified epithelia

1- Pseudostratified columnar epithelium: present in the upper respiratory tract (Ciliated pseudostratified columnar epithelium) which contains caliciform cells, or in the epididymides (Stereocilar pseudostratified columnar epithelium).

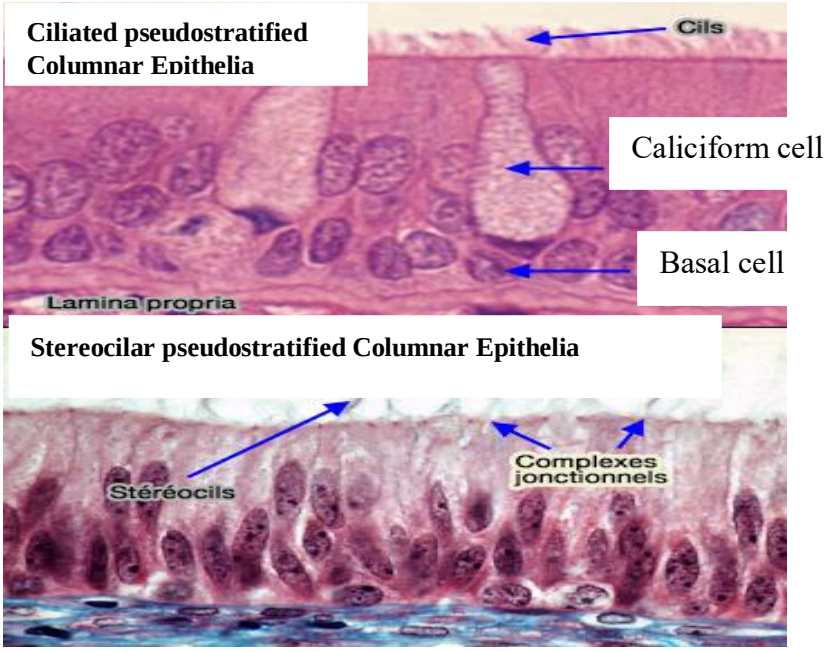

Figure: Pseudostratified columnar epithelium

2- Transitional or polymorphic epithelium: is a pseudostratified epithelium, present in the excretory urinary tract (bladder).

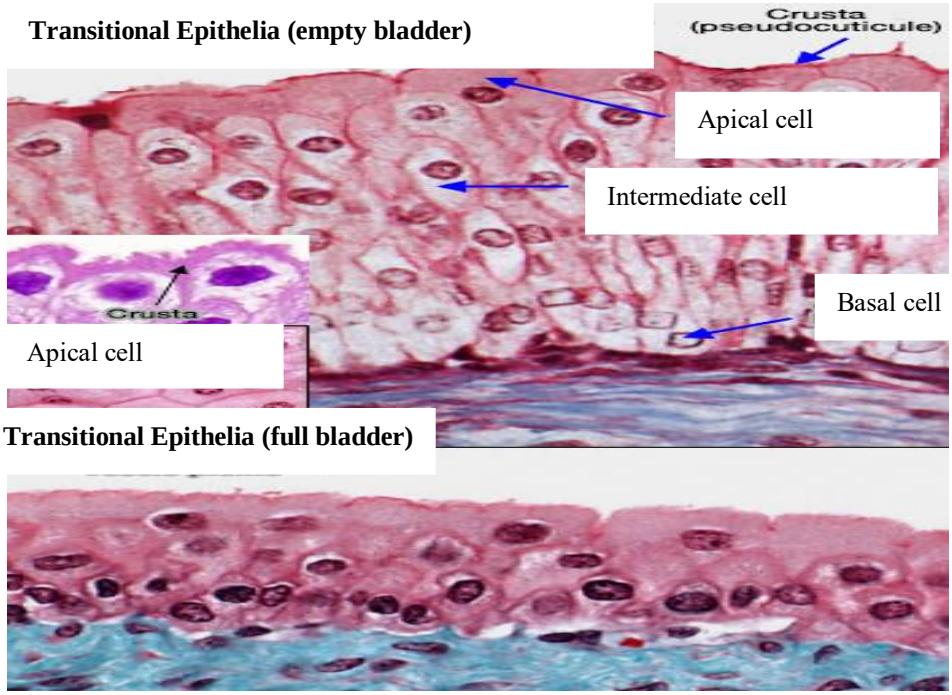

Figure: Transitional or polymorphic epithelium (bladder)

I-2- Glandular Epithelium

Like lining epithelia, glandular epithelia are made of closely juxtaposed and contiguous epithelial cells. However, their cells are specialized for secreting products. If the product is secreted into the external environment, it is called **exocrine secretion**, and if the product is secreted into the internal environment, it is called **endocrine secretion**. We distinguish between:

- **Exocrine glands:** which release their secretions onto the surface of the body or into the lumen of a hollow organ via an excretory duct. Examples: sebaceous glands, mammary glands...
- **Endocrine glands:** which release their secretions into the bloodstream or lymphatic system. Examples: thyroid, adrenal glands...
- **Amphicrine or mixed glands:** which have both exocrine and endocrine structures. Examples: liver, ovaries, testicles...