

EPITHELIAL CLASSIFICATION

OBJECTIVES:

After completing this exercise, students should be able to do the following:

1. Identify epithelia in tissue sections.
2. List the epithelial classifications.
3. Classify an epithelium.

ASSIGNMENT FOR TODAY'S LABORATORY

GLASS SLIDES - <https://medmicroscope.uc.edu/>

- SL 063 (Heart with atrioventricular valve) simple squamous epithelium (lines heart)
- SL 137 (Ovary) Simple cuboidal epithelium (covers ovary) - varies in height
- SL 014 (Small intestine) Simple columnar epithelium
- SL 015B (Trachea) Pseudostratified columnar epithelium with goblet cells
- SL 156 (Epididymis) Pseudostratified columnar epithelium with stereocilia
- SL 016 (Esophagus) Stratified squamous epithelium, non-keratinized
- SL 009 (Auricle of ear) Stratified squamous epithelium, keratinized
- SL 025 (Sole of the foot) Stratified squamous epithelium, keratinized
- SL 092/SL 093 (Salivary glands) Stratified cuboidal and stratified columnar epithelium (large ducts)
- SL 018 (Ureter) and SL 057 (Bladder) Transitional epithelium lines these organs

ELECTRON MICROGRAPH (Gray envelope)

- [EM 9](#) (small intestine) simple columnar epithelium

SUPPLEMENTAL MATERIAL:

SUPPLEMENTARY ELECTRON MICROGRAPHS

Rhodin, J. A.G., An Atlas of Histology
Epithelium pp. 38 - 42

Copies of this text are on reserve in the HSL.

Epithelia line tubes or cover surfaces. They are composed of closely apposed cells, held together by one or several types of junctions, interdigitation of the lateral membranes, and a small amount of self-secreted glycocalyx (cell coat) that may aid in cell adherence. The "free surface" (top or apical surface) of an epithelium is exposed to the external environment (as in skin) or to fluid (internal cavities, ducts, tubes). The basal surface of epithelia rests on a basement membrane. The basement membrane (J. Figs. 4-1, 4-2, 4-3; R. Figs. 5.1, 5.28, 5.29) serves as a means of anchoring the epithelium to underlying tissue.

Epithelia are classified according to the number of cell layers:

1. SIMPLE = 1 layer
2. STRATIFIED = 2 or more layers

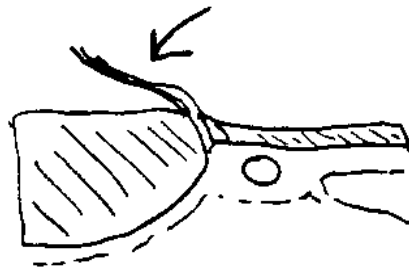
The shape of the cells also determines the name of the epithelium. Note that for stratified epithelia, the shape of the surface layer of cells is used to determine classification.

1. SQUAMOUS = flattened, scale-like cells with a flattened or absent nucleus
2. CUBOIDAL = cells about as tall as their width, with a round nucleus
3. COLUMNAR = cells taller than their width, usually with an oval nucleus

Most epithelia are classified using the descriptors above (e.g. simple squamous, or stratified columnar). Using this schema, there are 6 possible epithelial types. However, there are two additional classes, pseudostratified and transitional epithelia, which do not follow this schema precisely. Furthermore, for stratified squamous epithelia, there are two types, (keratinized and non-keratinized). Finally, stratified cuboidal and stratified columnar are essentially the same. Therefore, the total number of epithelial classes is eight (6 + 2 + 1 – 1).

I. SIMPLE EPITHELIA: consist of a single layer of cells. Each cell has three different surfaces: 1) an apical (upper) surface ("free surface") that faces a lumen, 2) a lateral surface that contacts neighboring cells and 3) a basal surface that lies against the basement membrane. Each of these surfaces has specialized characteristics that enable it to perform the specific functions required for its location.

A. SIMPLE SQUAMOUS EPITHELIUM (J. Fig. 4-12; R. Plate 1). [SL 063](#): (Heart with atrioventricular (AV) valve). Locate the projecting green-stained valve (arrow in diagram, [red arrow](#)) and note the thin, pink-staining simple squamous epithelium covering the surface. The nuclei (basophilic) stain deep blue or purple. This layer of simple squamous epithelium is the endothelium, which lines the chambers of the heart and continues as the lining of all blood vessels ([scan](#), [med](#), [red arrows](#), [high](#), [red arrows](#)).

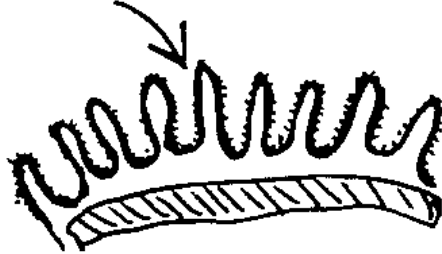


B. SIMPLE CUBOIDAL EPITHELIUM (J. Fig. 4-13; R. Fig. Plates 1, 2) [SL 137](#): (Ovary) Simple cuboidal epithelium covers much of the ovary; observe how this epithelium (mesothelium) varies in different regions from simple squamous to cuboidal to columnar. ([scan](#), [med](#), [high](#), [red arrow](#))



C. SIMPLE COLUMNAR EPITHELIUM (J. Fig. 4-14; R. Plate 2)

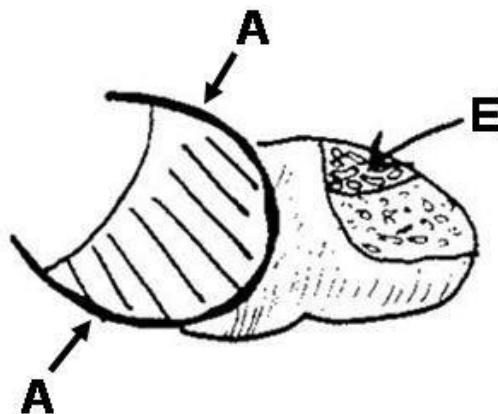
1. SL 014: (Small intestine). Tall cells cover the finger-like projections (red circle) of the inside wall of the gut. Each cell has an oval nucleus that lies nearer the basal region of the cell than the apical. Cells that have a round to ovoid shape and appear to be empty are goblet cells, unicellular glands that secrete mucus. Most cells are columnar absorptive cells (enterocytes, red rectangle). These cells have an apical fringe consisting of many microvilli that form the "striated border," evident as a wide "band" at the apical surface (low, high).



2. Electron Microscope - EM 9 of gut. This low magnification micrograph shows several absorptive cells with apical microvilli (9.2), and a goblet cell (9.5). Polarity of the cells is evident in the restricted distribution of organelles (9.3) that are found at the same level in adjacent cells. Absorptive cells also have specializations of the lateral membranes (e.g., finger-like folds that interdigitate with neighboring cells) which are most pronounced near the basal aspect of adjacent cells.

II. PSEUDOSTRATIFIED COLUMNAR EPITHELIUM (J. Fig. 4-17; R. Fig. Plate 2)

- A. SL 015B: (Trachea). There are three large structures with lumens on this slide. The trachea is the middle structure with the even circular outline. The trachea is lined by pseudostratified ciliated columnar epithelium with goblet cells. The epithelium appears to have several layers of cells, because the nuclei are not located at the same level in neighboring cells. In fact, every cell rests on the basement membrane, but some, termed "basal cells," do not reach the luminal surface (scan, med, high, basal cells, red arrows).
- B. SL 156: (Testis and epididymis) (scan, low). With your naked eye, orient the tissue on this slide with the drawing below, noting that the curved line represented by the arrows "A" indicates a feature of the tissue that is eosinophilic. Then, identify the region indicated by the arrow "E" and place this region directly under your microscope objective. This region indicated by "E" contains ducts of the epididymis (encircled by red line) (look for round profiles with a smooth, even lumen. (Figures J. 21-11 and R. Plate 88 show the appearance of these tubules.) In this pseudostratified columnar epithelium fewer basal cells are apparent (columnar cells, blue rectangle; basal cells, red arrows). The tall columnar cells have stereocilia: long apical, branching microvilli (the next lab session will compare microvilli, cilia, and stereocilia).



III. STRATIFIED EPITHELIA: two or many layers of cells. Only the surface layer of cells is exposed to the air or lumen; the basal layer of cells rests on the basement membrane. The shape of the cells in the surface layer determines the name of the epithelium; cells beneath this layer may be quite different in shape.

A. STRATIFIED SQUAMOUS EPITHELIUM (J. Fig. 4-15; R. Fig. Plates 2, 3)

1. [SL 016](#): (Esophagus). One surface of this section is covered by an epithelium that is composed of many layers of cells ([red arrow](#)). It is important to observe that the cells in the surface layer have nuclei. The presence of the nuclei in these surface cells indicates that this tissue is **non-keratinized stratified squamous epithelium** and indicates that the epithelium is derived from a region of the body that has a wet or moist surface ([scan](#), [high](#)).
2. [SL 009](#): (Auricle of ear). The surface cells of this epithelium (on the auricle of the ear) lose their nuclei and become scale-like. This type of epithelium is called **keratinized stratified squamous epithelium**. Note that cells in the lowest levels of this epithelium are cuboidal-columnar, thus it is essential to note the shape of surface cells when categorizing stratified epithelia ([scan](#), [high](#), [epithelium in red rectangle](#)).
3. [SL 025](#): (Skin of the sole of the foot). In this slide, the keratinized layer is much thicker ([entire epithelium indicated by the red brackets](#), [keratinized portion indicated by the blue brackets](#)), providing extra protection for this region.

B. STRATIFIED CUBOIDAL EPITHELIUM (J. Fig. 4-15d; R. Plate 3) and STRATIFIED COLUMNAR EPITHELIUM. These epithelia are relatively limited, occurring mostly as large ducts in glands.

1. [SL 092](#): (Submandibular Gland). This salivary gland has ducts of various sizes. The largest ducts are stratified cuboidal or columnar, and are found in the connective tissue outside the lobes of gland ([scan](#), [low](#), [high](#)).
2. [SL 093](#): (Sublingual Gland). Look for gradations in duct size and epithelial cell variations from simple cuboidal to stratified columnar ([scan](#), [high 1](#), [red arrow](#), [high 2](#), [red arrow](#)).

C. TRANSITIONAL EPITHELIUM (J. Fig. 4-16; R. Plate 3) Limited to excretory (urinary) passages. Transitional epithelium is generally considered to be stratified. When transitional epithelium is greatly distended it may appear to be only 2 to 3 cell layers thick.

1. [SL 018](#): (Ureter). The star-shaped lumen of this contracted ureter appears to be lined by many layers of cells. The cells adjacent to the lumen appear rounded, cuboidal-columnar, and many cells appear to bulge out into the lumen ([med](#), [red arrow](#) [high](#), [blue arrow](#)). Occasional binucleate surface cells are characteristic for this epithelium. Compare with true stratified squamous epithelium in esophagus ([SL 016](#)) ([scan](#), [high](#)).
2. [SL 057](#): (Bladder) ([scan](#)). The bladder also is lined with transitional epithelium. Observe the same characteristics that are indicated for the ureter.

SPECIFIC OBJECTIVES FOR EPITHELIAL CLASSIFICATION

1. Using the light microscope or digital slides, identify:

Epithelial types

Simple epithelia

Simple squamous

Simple cuboidal

Simple columnar

Pseudostratified columnar

Stratified epithelia

Stratified squamous

Non-keratinized

Keratinized

Stratified cuboidal / stratified columnar

Transitional

For all types, recognize apical, lateral, and basal surfaces