Tissues

Concept and Classification

- ✓ **Tissues** are aggregates or groups of cells organized to perform one or more specific functions.
- ✓ Tissue types are grouped together to form **organs**
- ✓ Organs are grouped together to form organ systems

Human body consists of **four** basic tissue:

- Epithelium (epithelial tissue) covering, lining body cavities, and forms glands.
- Connective tissue supports the other three basic tissues,
- Muscle tissue responsible for movement.
- Nerve tissue control the activities of the body.

Epithelial Tissue

Epithelium is a basic tissue of body that consists of tightly adhered cells called epithelial cells.

Covers external surface of body and line lining body cavities, and forms glands.

General Characteristics of Epithelium

Cellularity

- Cells are in close contact with each other with little or no intercellular space between them.

Specialized contacts

- Epithelial cells show various types of junctions with adjacent cells and basement membrane .

Polarity

- Epithelial tissues always have an apical (faces external environment or lumen) ,basal surface (in contact with basal lamina) and lateral surfaces.

General Characteristics of Epithelium

Support by connective tissue

- At the basal surface, both the epithelial tissue and the connective tissue contribute to the basement membrane.

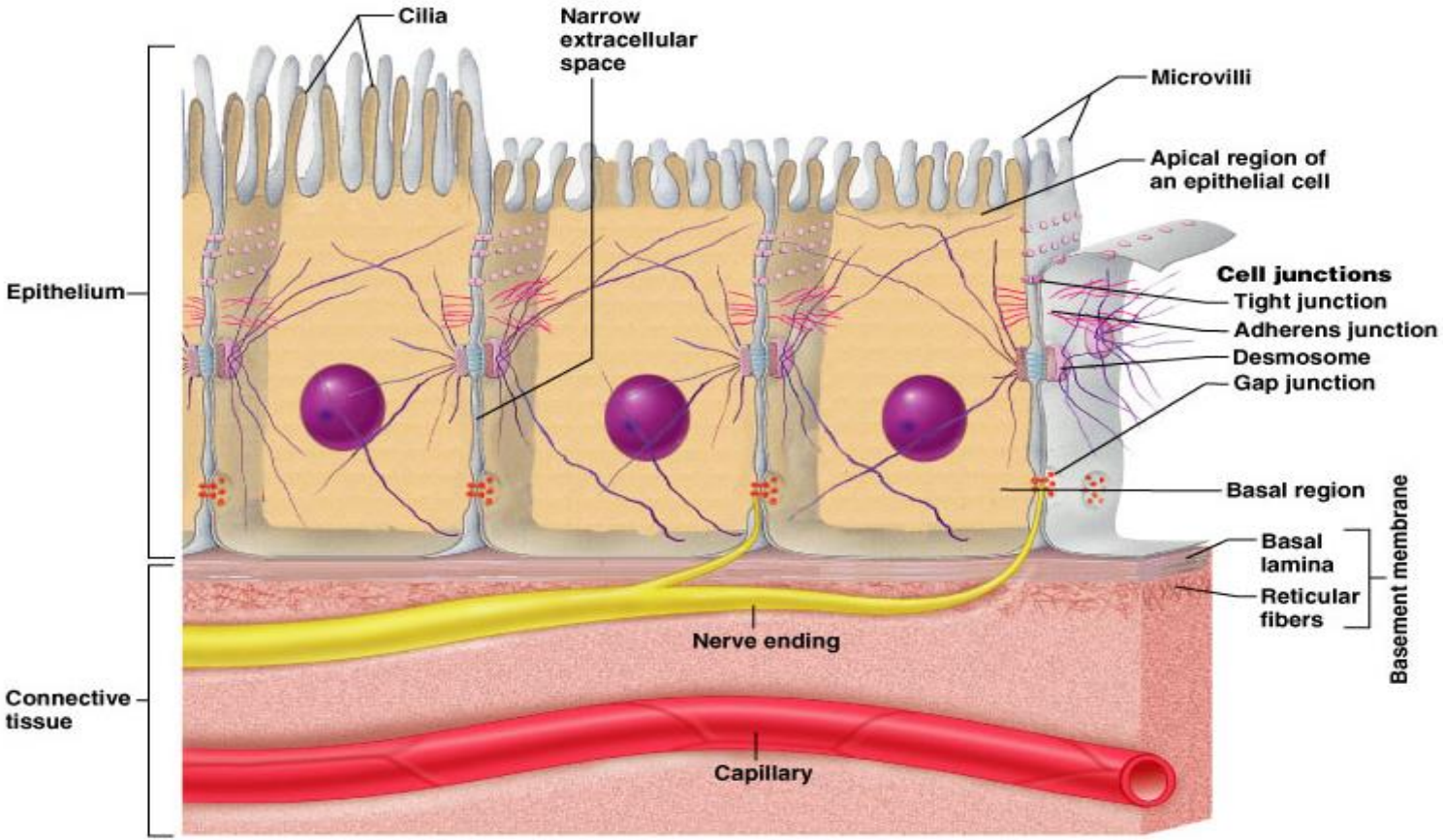
Avascular

- Nutrients must diffuse from basal layer.

Innervated

Regenerative

- Epithelial tissues are highly mitotic , undergo mitosis and can regenerate damaged portion.


Cilia
Narrow extracellular space
Microvilli
Apical region of an epithelial cell
Epithelium
Cell junctions
Tight junction
Adherens junction
Desmosome
Gap junction
Basal region
Basal lamina
Reticular fibers
Basement membrane
Nerve ending
Connective tissue
Capillary

Functions of Epithelium

Epithelial cells perform various functions based on their location. Some of their basic functions are listed as follows:

1.Protection: Epithelium protects deeper structures. For example, in the skin, epithelium (called epidermis) protect deeper structures from external environment.

2.Barrier: mechanical barrier, epidermis prevents entry of viruses.

3.Absorption of substances ,in the intestine, epithelium absorbs nutrients from digested food.

4.Secretion , Forms slippery surfaces (mucus secretion in intestine, saliva secretion in salivary gland).

5. Sensory perception: receiving sensory signals from external environment. For example, epithelium of tongue (taste buds).

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CLASSIFICATION OF EPITHELIA

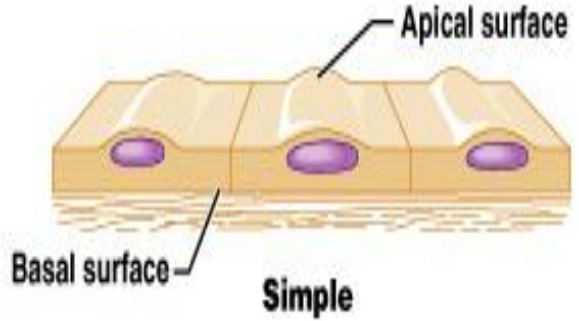
Epithelia are classified according to two features :

1. Layers of epithelial cells.

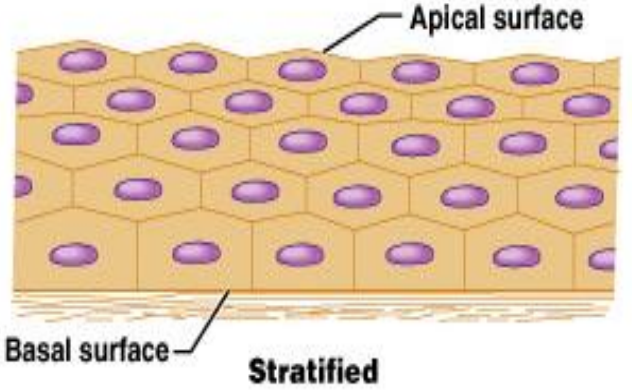
2. Shape of cells facing toward free surface of epithelium.

Layers of epithelial cells

- Simple epithelium has only one layer of cells.

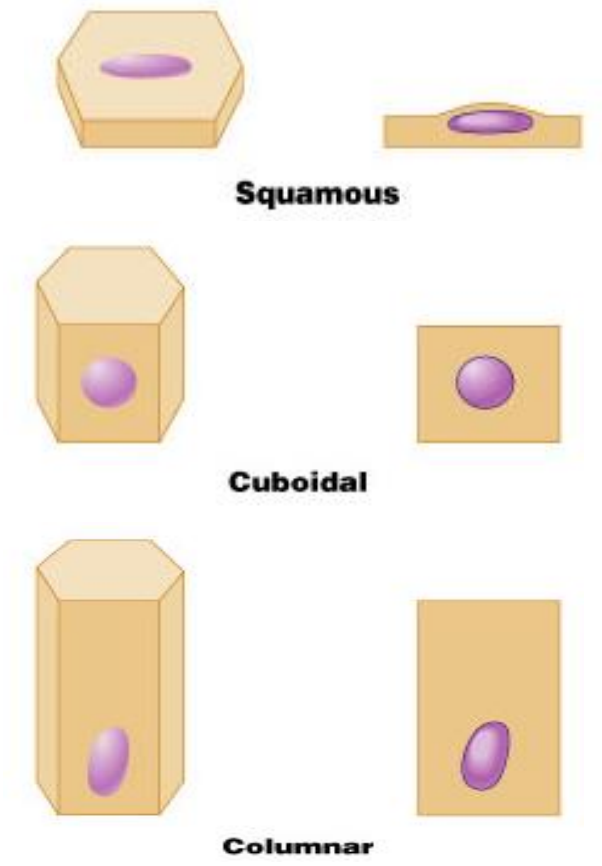


- Stratified epithelium has two or more layers of cells.



Last name of tissue describes **shape of cells**

- Squamous – Composed of flat cells (cells wider than tall (plate or “scale” like)
- Cuboidal –Composed of cells with equal height and width as in cubes
- Columnar – cells are more height than width, like columns



- Naming the epithelia includes both number of layers (first) and the shape of the cells (second)

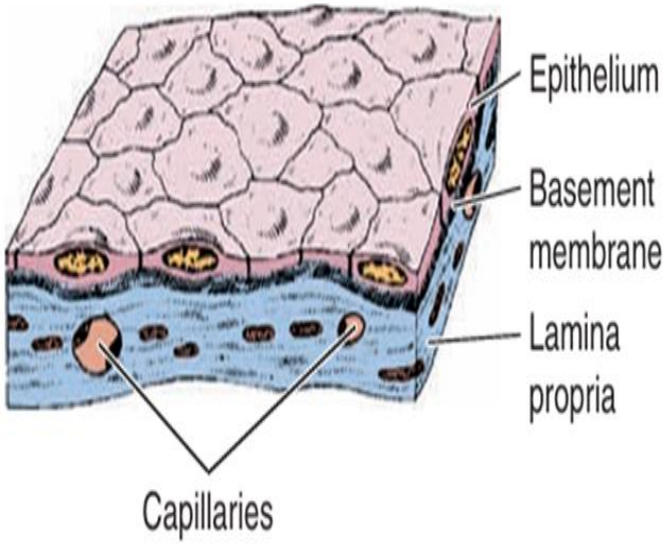
  i.e. stratified cuboidal epithelium / Simple squamous epithelium

- The name may also include any accessory structures
  - Goblet cells
  - Cilia
  - Keratin
- Special epithelial tissues (don't follow naming convention)
  - Psuedostratified
  - Transitional

Simple Squamous Epithelium

Features

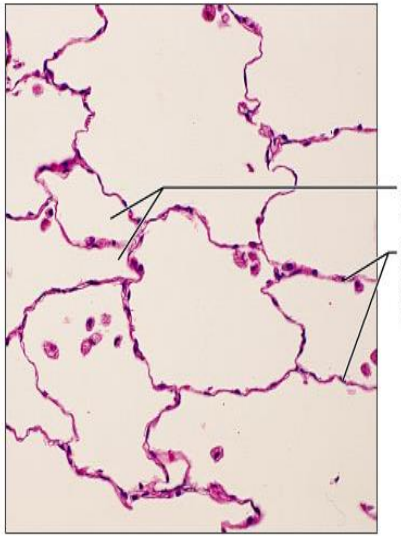
- Composed of a single layer of flattened (squamous = flat) polygonal cells.
- Nuclei are elongated, flat, and produce bulging on cell surface.
- Section of cell: It looks similar to a half-fried egg (consider nucleus as yolk and cytoplasm as egg white).



Simple Squamous Epithelium

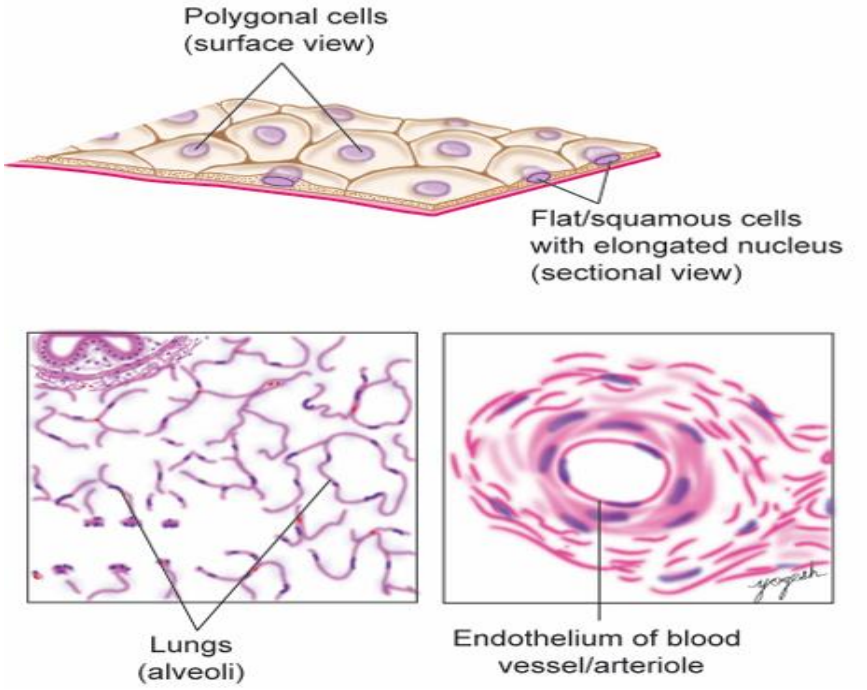
Locations

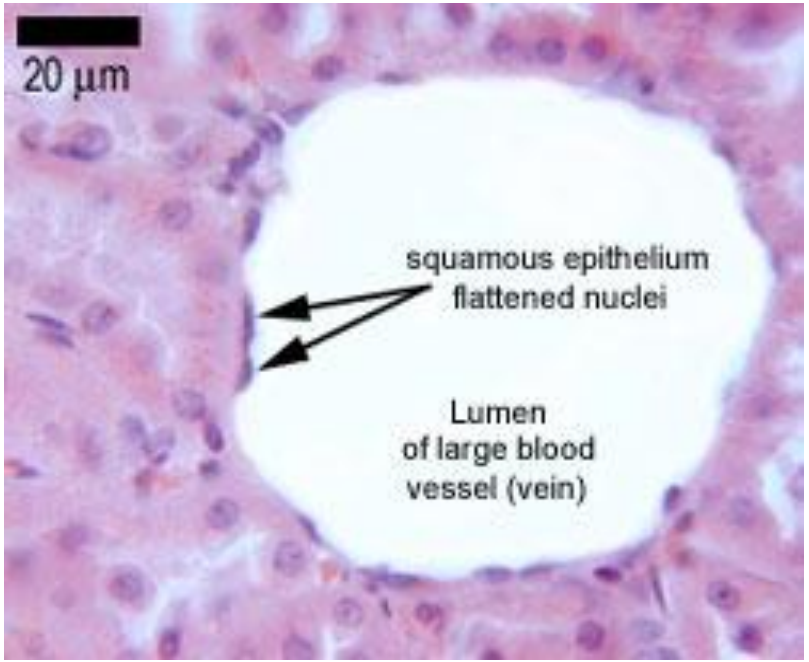
1. Lining epithelium of lung alveoli..
2. Endothelium (lining epithelium of blood and lymphatic vessels)
3. Endocardium (lining epithelium of heart).
4. Lining of serous cavities of body [pericardium, peritoneum, pleura.
5. Parietal cells of Bowman's capsule.



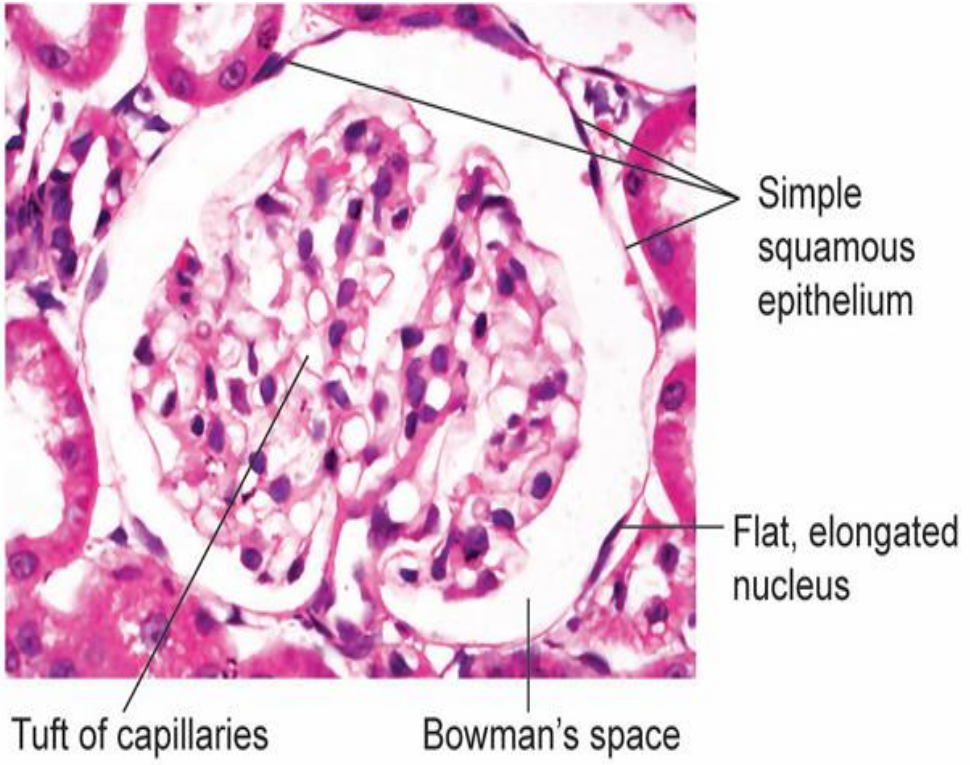
Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (400×).

Simple Squamous Epithelium





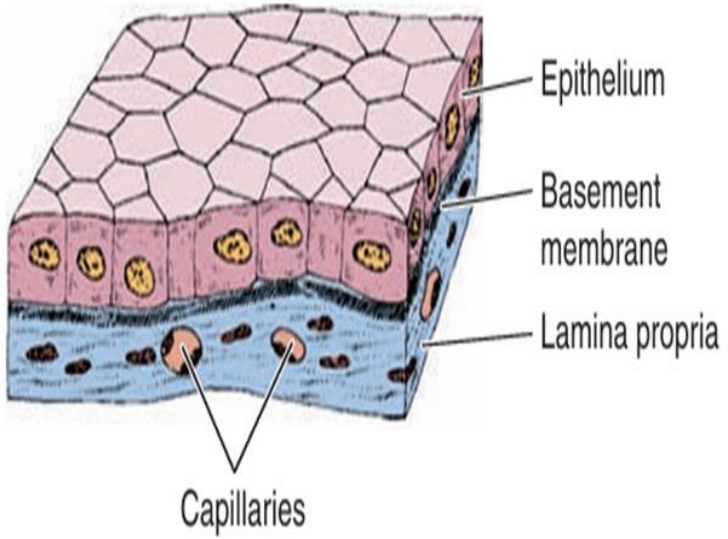
Simple Squamous Epithelium



Simple Cuboidal Epithelium

Features

- Composed of a single layer of cuboidal cells having equal width and height.
- Nuclei are rounded, placed centrally in cells.



Simple Cuboidal Epithelium

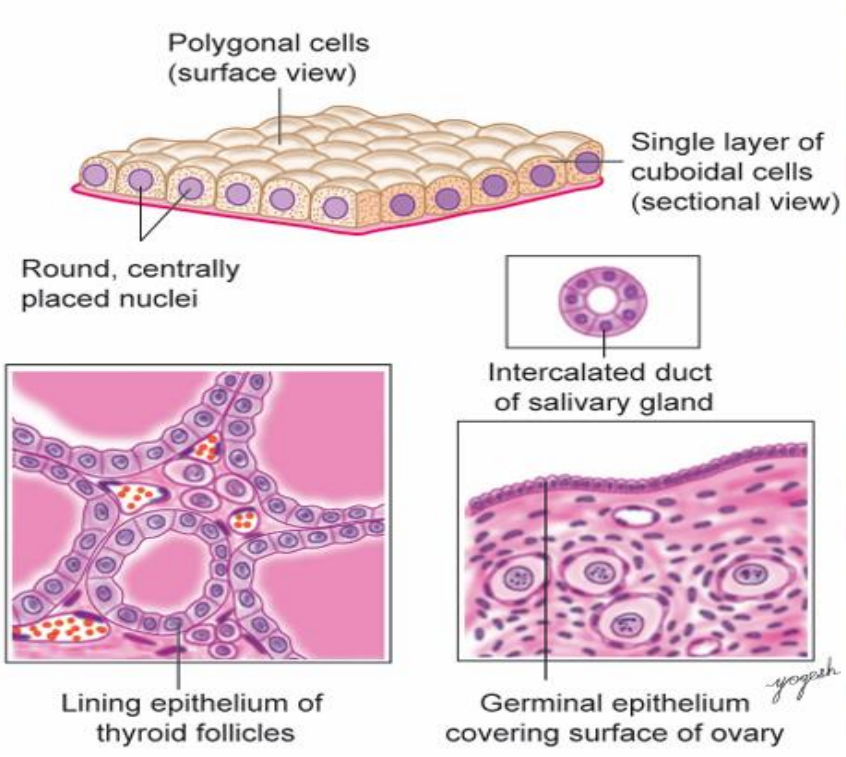
Locations

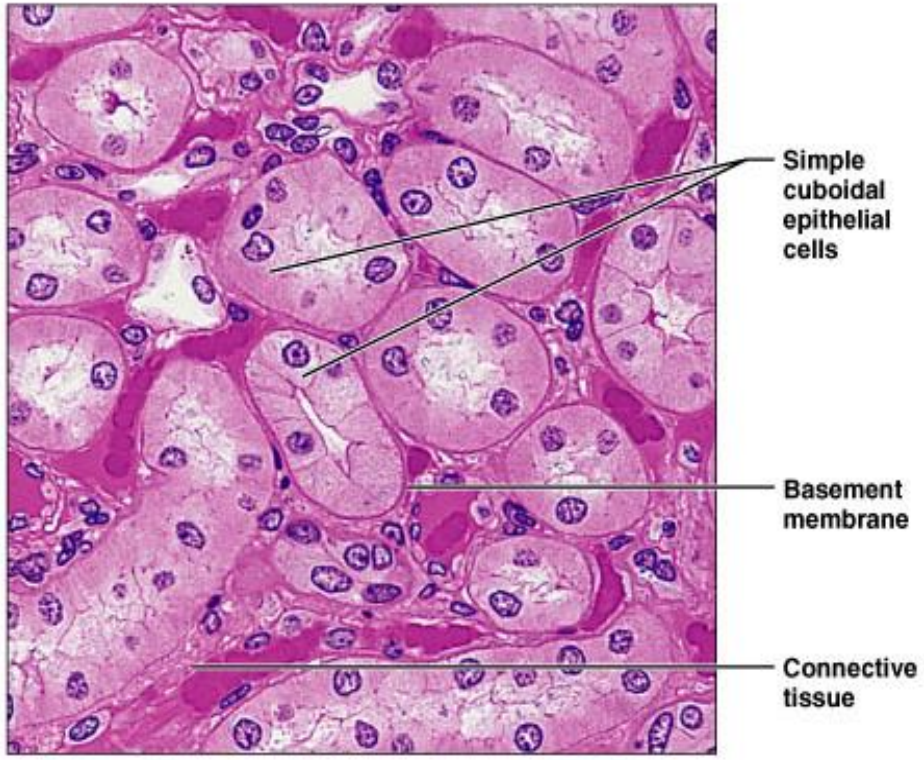
1. Lining epithelium of thyroid follicles
2. Lining ducts of exocrine glands
3. Epithelium covering the ovary
4. Some part of tubules in kidney (distal convoluted tubule)

Function

Absorption and secretion of substances.

Simple Cuboidal Epithelium





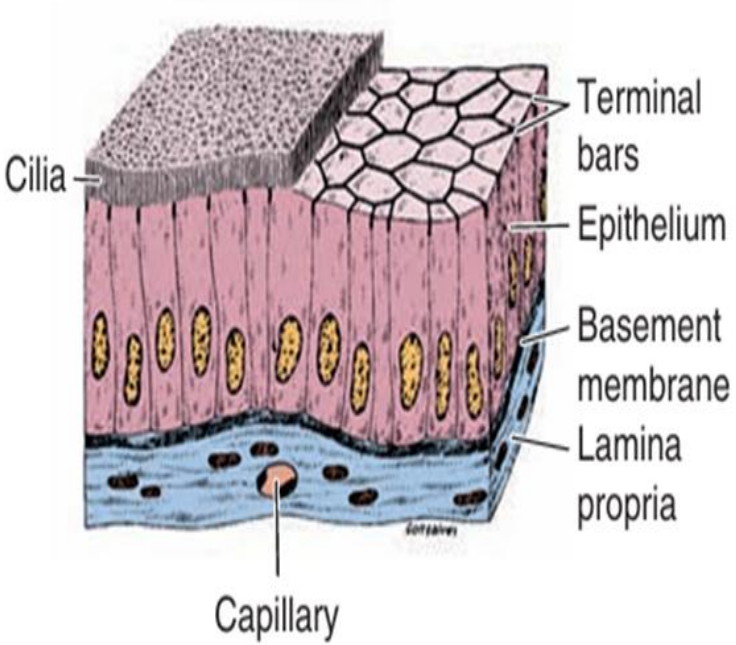
Photomicrograph: Simple cuboidal epithelium in kidney tubules (400×).

Simple Columnar Epithelium

Features

- Composed of a single layer of columnar cells having more height than their width

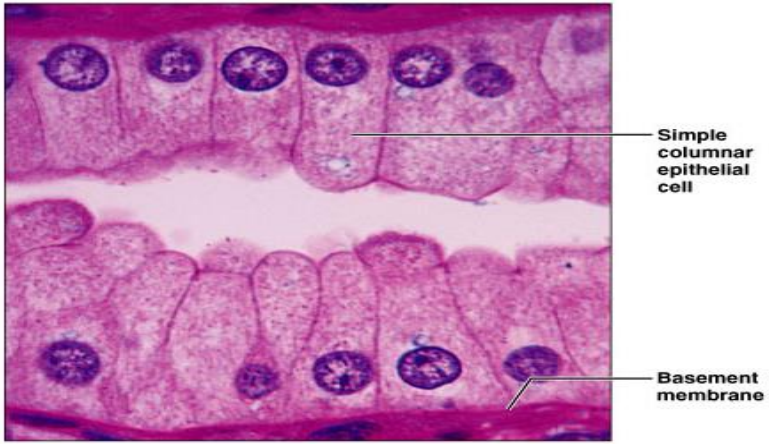
- Cytoplasm: abundant cytoplasm
- Nuclei : oval (elongated) and usually placed in basal region of cells.
- Some bear cilia at their apical surface
- May contain goblet cells and microvilli



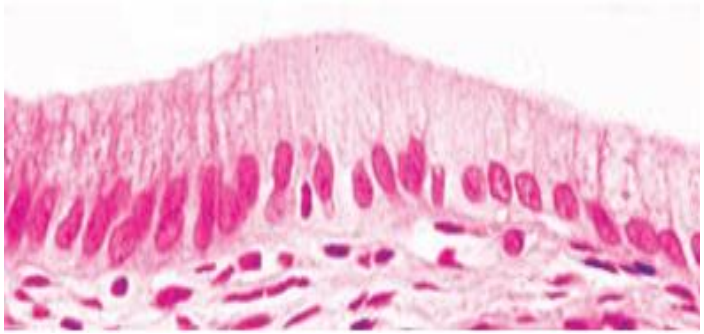
Simple Columnar Epithelium

Locations

1. Non_ciliated: lining epithelium of stomach, intestine, and gallbladder .
2. Ciliated: lining epithelium of Fallopian tube, uterus, some part of respiratory tract.

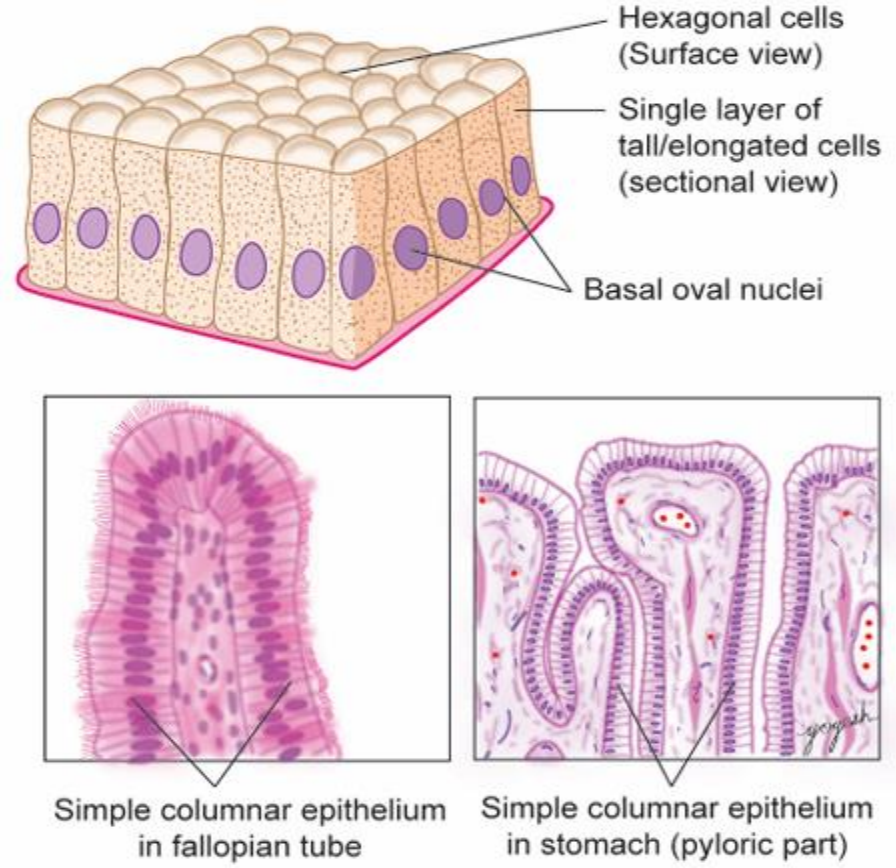


Photomicrograph: Simple columnar epithelium of the stomach mucosa (1300×).

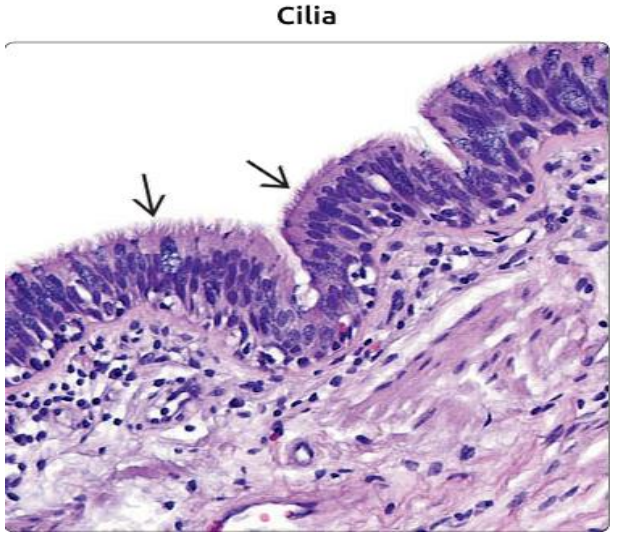


lining of the gallbladder

Simple Columnar Epithelium



Simple Columnar Epithelium



Functions

1. Secretion of enzymes, mucus .
2. Absorption of nutrients in intestine.
3. Ciliary beats: Propulsion of mucus in respiratory tract and ova in fallopian tube.
4. Microvilli: increase absorptive surface area of cells in gall bladder and intestine.

Simple epithelium (Single layer thick)

Simple squamous epithelium

Flat cells
Flat nucleus

Examples:
Endothelium, mesothelium, parietal cells of Bowman's capsule

Simple cuboidal epithelium

Cuboidal cells
Round nucleus

Examples:
Follicular cells of thyroid gland, renal tubules, ovarian epithelium

Simple columnar epithelium

Tall cells
Elongated nucleus

Examples:
Stomach, intestine, gallbladder, uterus

Pseudostratified Epithelium

Features

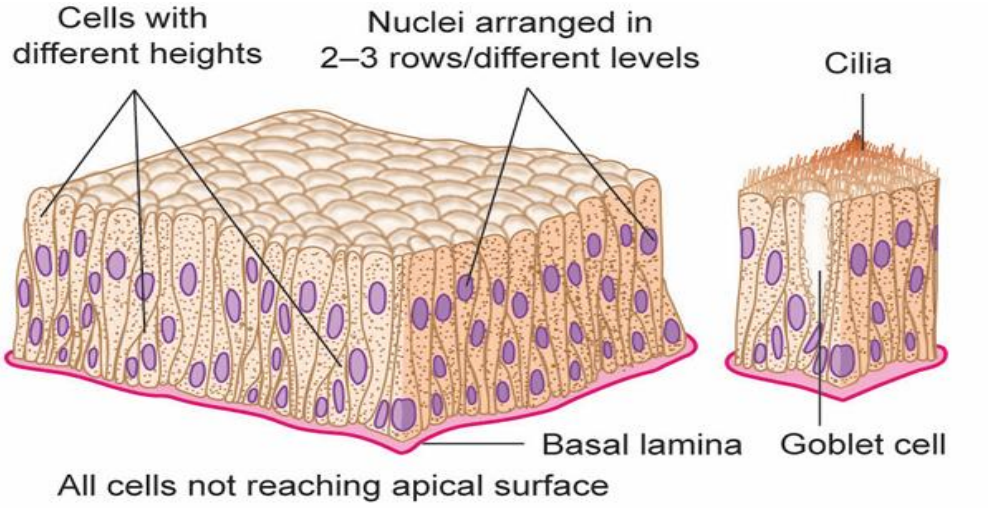
- consists of cells that rest on basement membrane and only some of these cells reach up to the free surface of epithelium
- This epithelium is not a true stratified epithelium. It appears to be stratified.
- Nuclei lie at varying heights within cells
  Gives false impression of stratification
- May contain goblet cells and bear cilia.

Locations

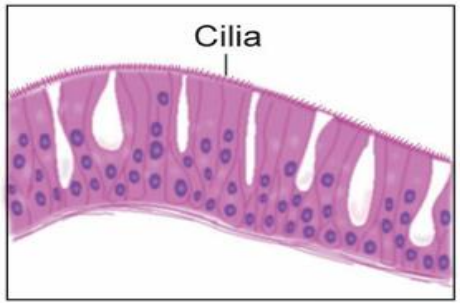
- Non-ciliated type
  - Ducts of male reproductive tubes
  - Ducts of large glands
- Ciliated type
  - Lines trachea and most of upper respiratory tract

Functions

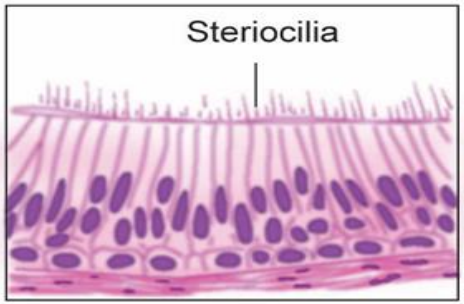
- Protection
- Secretion
- Ciliary movements remove the mucus



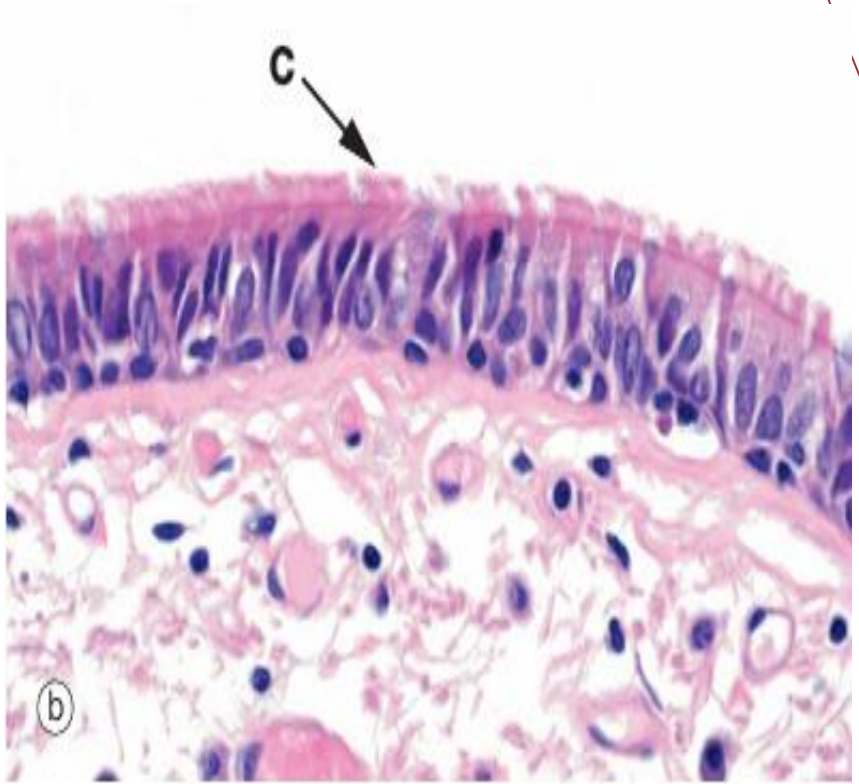
All cells not reaching apical surface

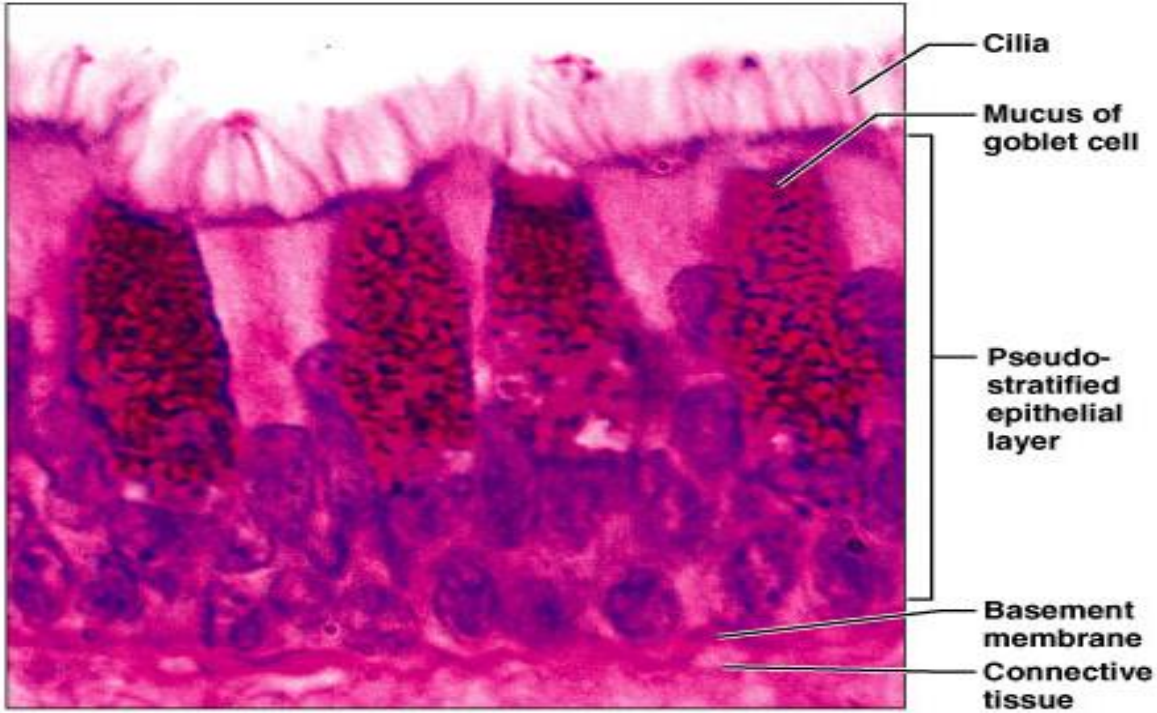


Ciliated pseudostratified columnar epithelium in respiratory tract



Pseudostratified columnar epithelium with steriocilia in epididymis





Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (400×).

Stratified Epithelium

- Stratified epithelium is a multilayered epithelium.
- Only the basal cell layer rest on basal lamina.
- Regenerate from below.
- Major role is protection.
- Are named according to the shape of cells at apical layer as follows:

1. Stratified squamous epithelium
2. Stratified cuboidal epithelium
3. Stratified columnar epithelium

Stratified Squamous Epithelium

Features

- Consists of several layers of cells
- Basal cell layer consists of cuboidal or columnar cells that rest on basal lamina.
- Cells above basal layer gradually decrease in size and become flat (squamous). Nuclei of the superficial layer are elongated and flat.

Stratified Squamous Epithelium

Specific types

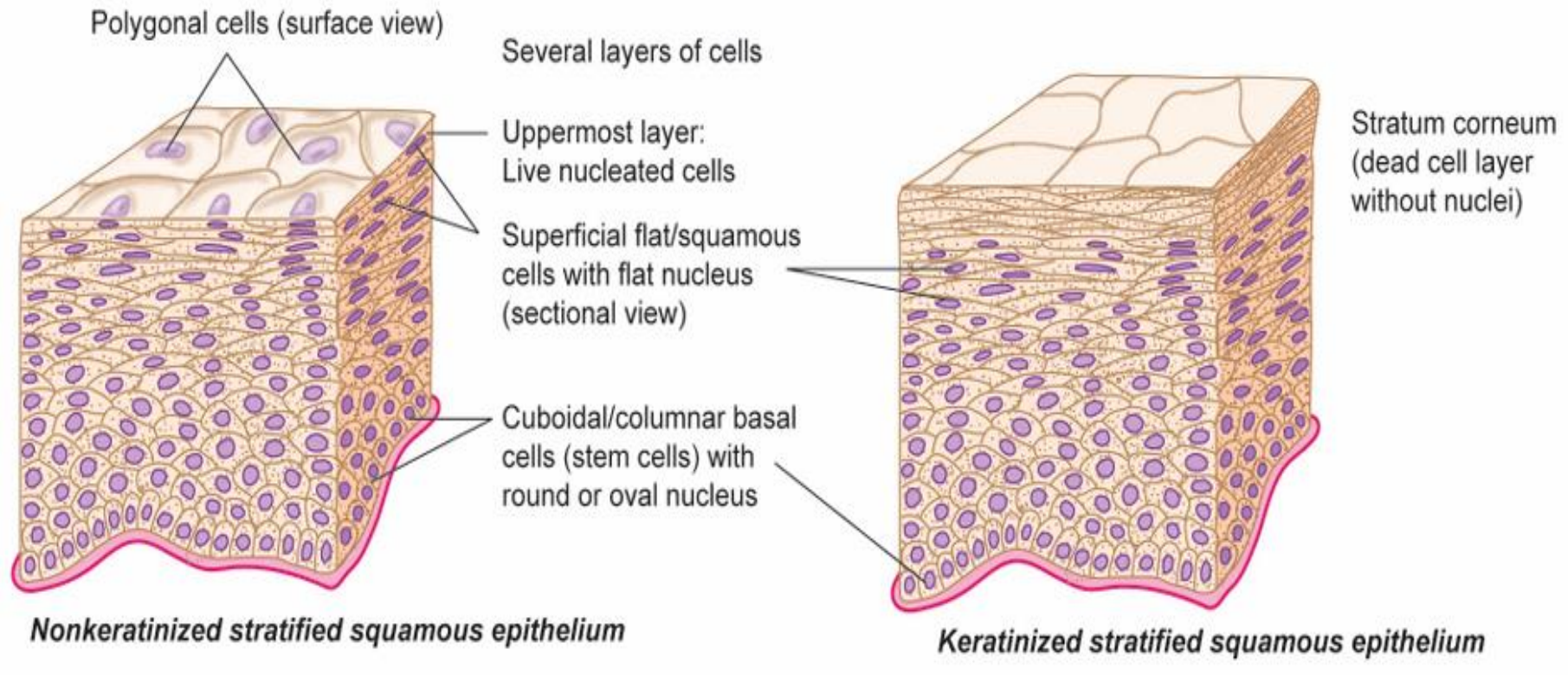
- Keratinized – contain the protective protein keratin.
  - Surface cells are dead and full of keratin, do not have nuclei.
- Non-keratinized – forms moist lining of body openings.

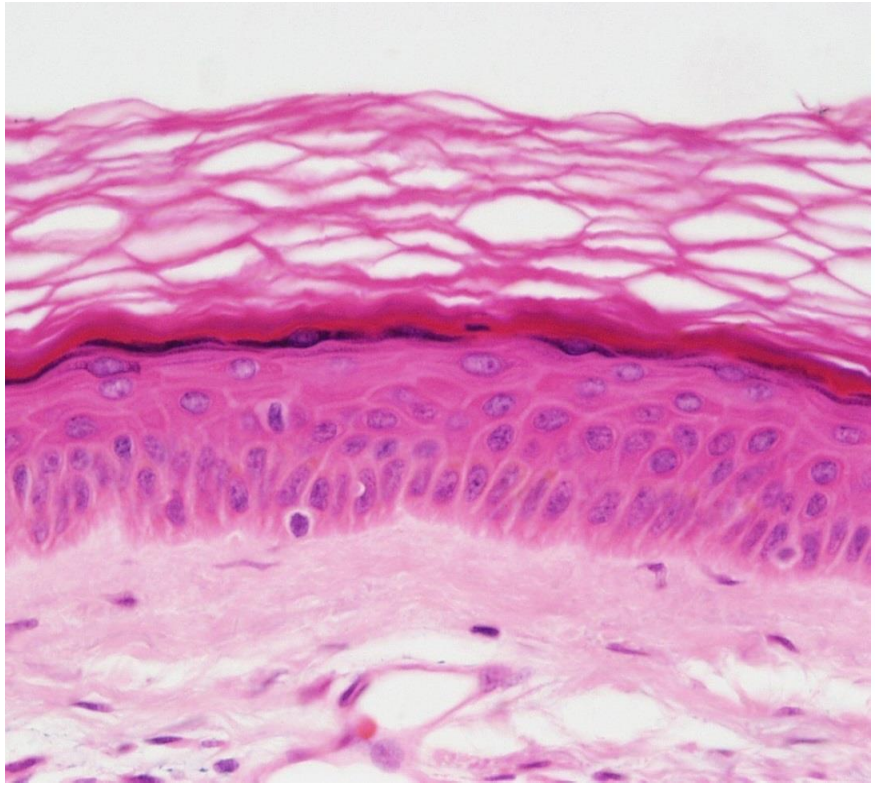
Location

- Keratinized – forms epidermis of skin.
- Non-keratinized – forms lining of esophagus, mouth, and vagina.

Function

- Protects underlying tissues in areas subjected to abrasion, barrier against infection and prevents water loss.


Polygonal cells (surface view)
Several layers of cells
Uppermost layer:
Live nucleated cells
Superficial flat/squamous
cells with flat nucleus
(sectional view)
Cuboidal/columnar basal
cells (stem cells) with
round or oval nucleus
Stratum corneum
(dead cell layer
without nuclei)
Nonkeratinized stratified squamous epithelium
Keratinized stratified squamous epithelium

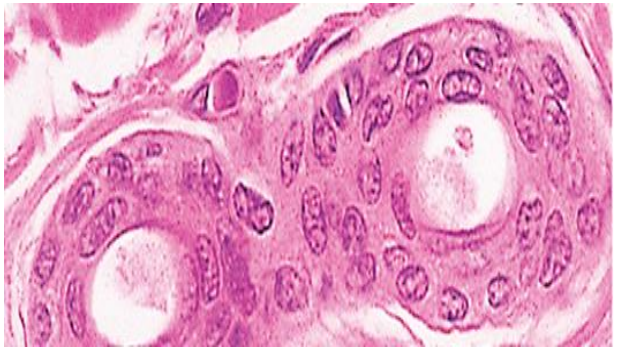


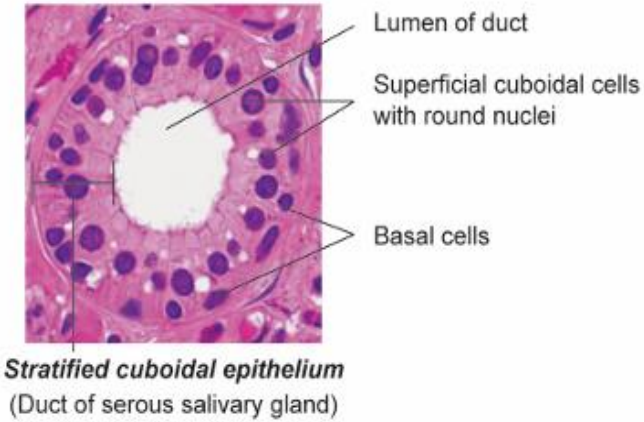
Photomicrograph: Stratified squamous epithelium lining of the esophagus (300×).

Stratified cuboidal & Stratified columnar epithelia

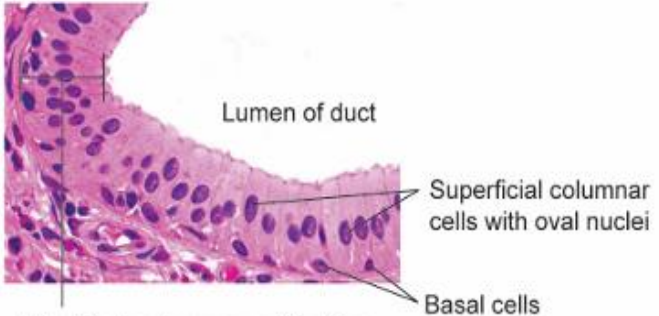
- Both are relatively rare.
- Stratified cuboidal epithelium appears in the excretory ducts of salivary and sweat glands
- Stratified columnar epithelium occurs in the conjunctiva lining the eyelids, where it is both protective and mucus-secreting.
- Function: It acts as a barrier and provides passage

for secretions.





Stratified cuboidal epithelium
(Duct of serous salivary gland)

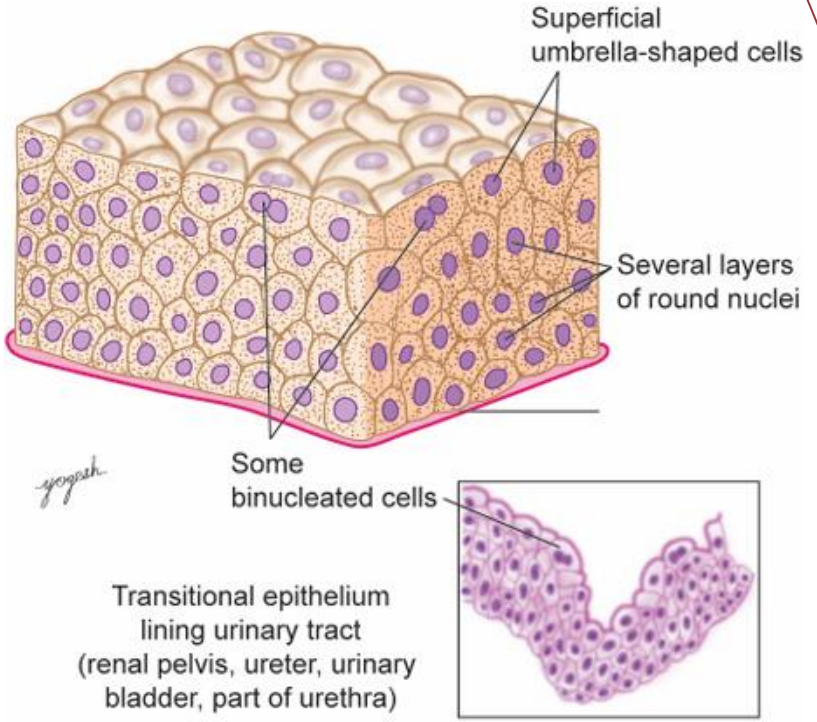


Stratified columnar epithelium
(Duct of serous salivary gland)

Transitional Epithelium

- Transitional epithelium (urothelium) lines much of the urinary tract, extending from the kidneys to the proximal part of the urethra.

- Basal cells are cuboidal and rest on basal lamina.
- Cells of the most superficial layer are dome-shaped/ umbrella-shaped.



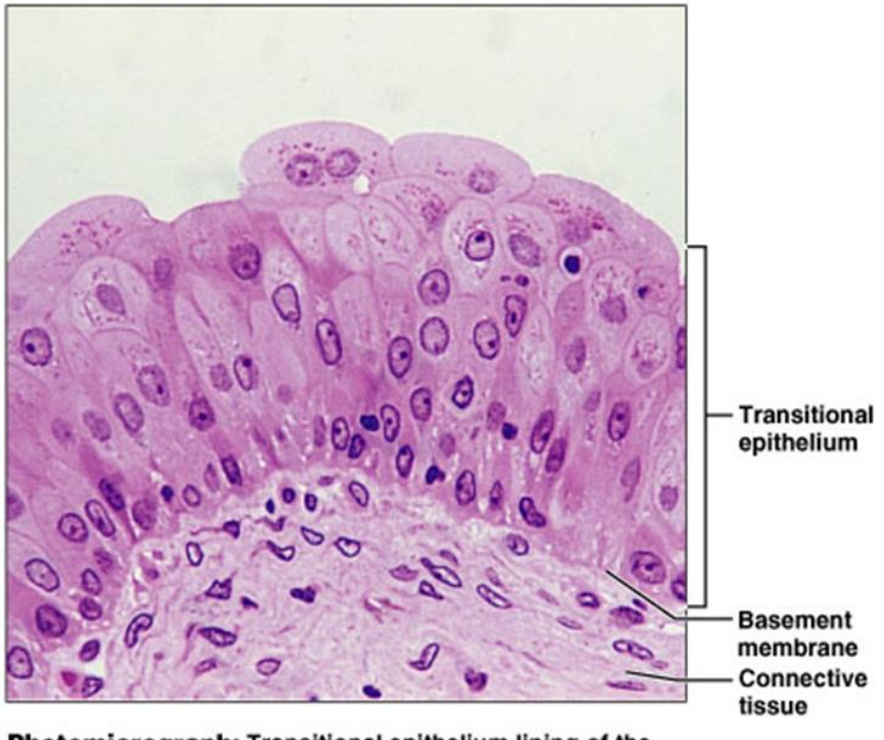
Transitional Epithelium

Location

- Lines ureters, urinary bladder and part of urethra

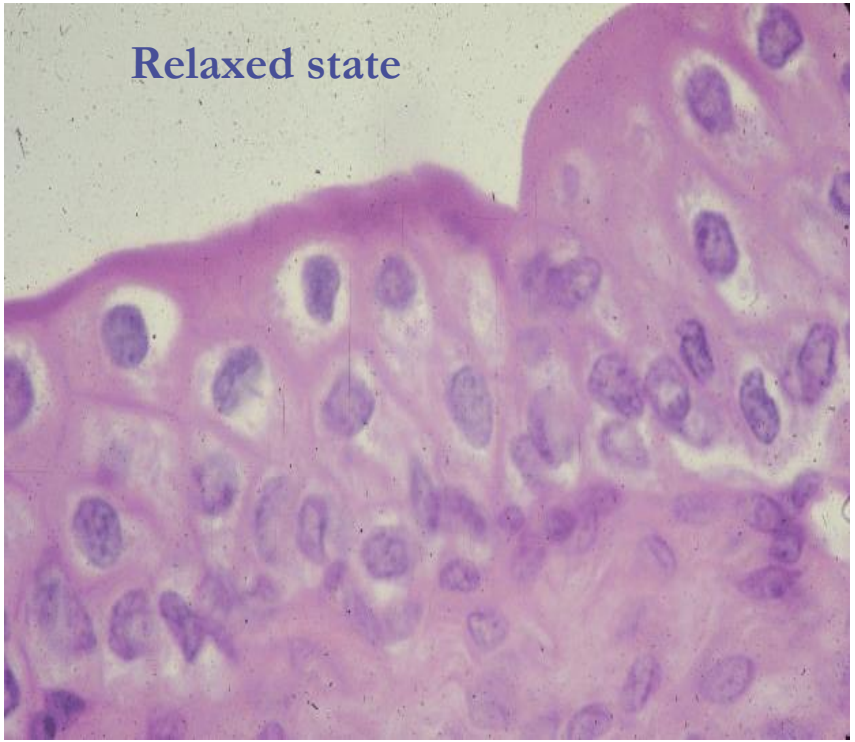
Function

- Stretches and permits distension of urinary bladder



Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (500×); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

Transitional Epithelium

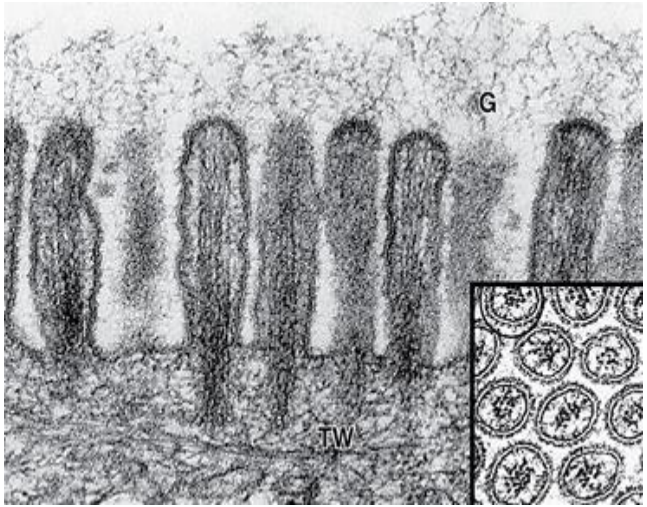


Umbrella cells allow distension of transitional epithelium as the urinary bladder fills

Epithelial Surface Features

Microvilli :

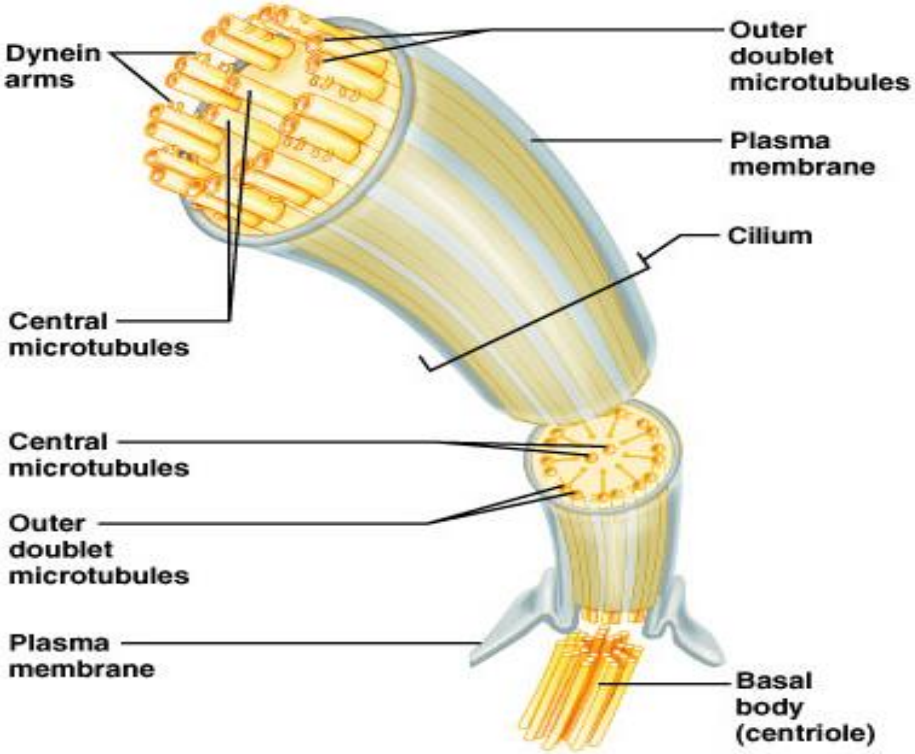
- ✓ Cytoplasmic projections best seen with the electron microscope.
- ✓ cytoskeleton: microfilament
- ✓ Abundant in epithelia of small intestine (brush border). Few on surface of WBC, and proximal convoluted tubules of kidney.
- ✓ Maximize surface area surface area for absorption or secretion 20- or 30-folds.



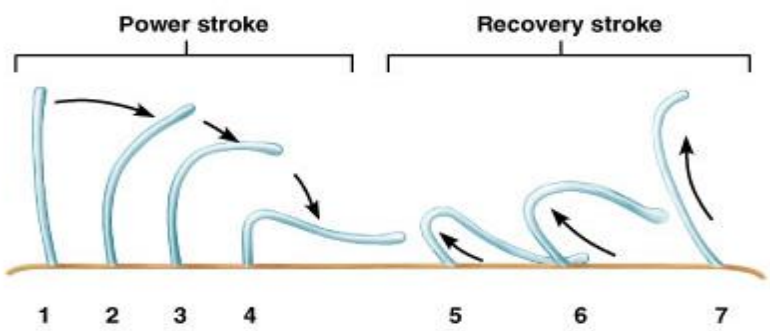
Cilia

Whip or hair-like, long, highly motile apical structures

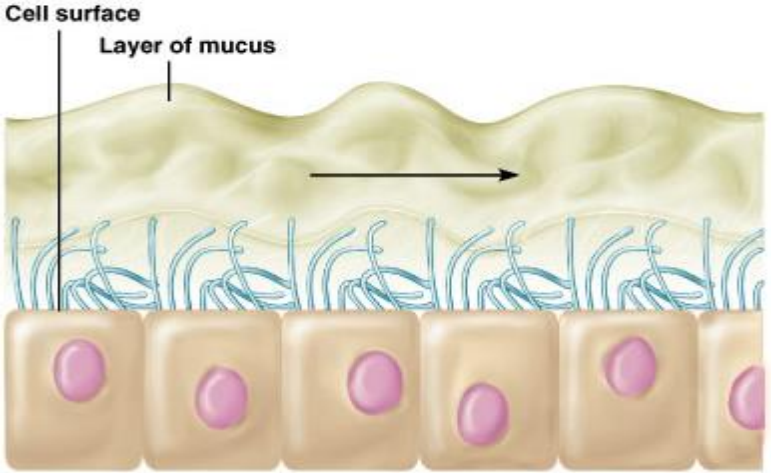
- Each cilium has a core structure consisting of microtubule cytoskeleton (in a 9 + 2 arrangement called the axoneme).
- Centrally placed 2 microtubules (pair)– Surrounding 9 pairs of microtubules.
- At the base of each cilium is a basal body (B) anchoring the axoneme to the apical cytoplasm.
- Movement of cilia – in rapid beating patterns in one direction along the epithelium.



(a) Cilium



(b) Ciliary motion



(c) Movement of mucus across cell surfaces

Thank you