Tissue Histology

Epithelium

By: *Dr. Ammar Ismail*

Tissue Histology

Tissue Types

- **A group of cells of similar structure that**
- **perform a common function.**
- There are 4 types of tissue:
- 1. Epithelium
- 2. Connective
- 3. Muscle
- 4. Nervous
- A groups of tissues form organs

Epithelial Tissue

- **Epithelium** – A sheet of cells that cavers a body surface or lines a body cavity.

  Examples: outer skin, inner lining of stomach, respiratory tubes lining, lining of blood vessels, and most of the body's glands.

- Functions of Epithelial Tissue
  - **Protection**
  - **Sensory reception**
  - **Absorption**
  - **Ion transport**
  - **Filtration**
  - **Secretion (Glandular)**

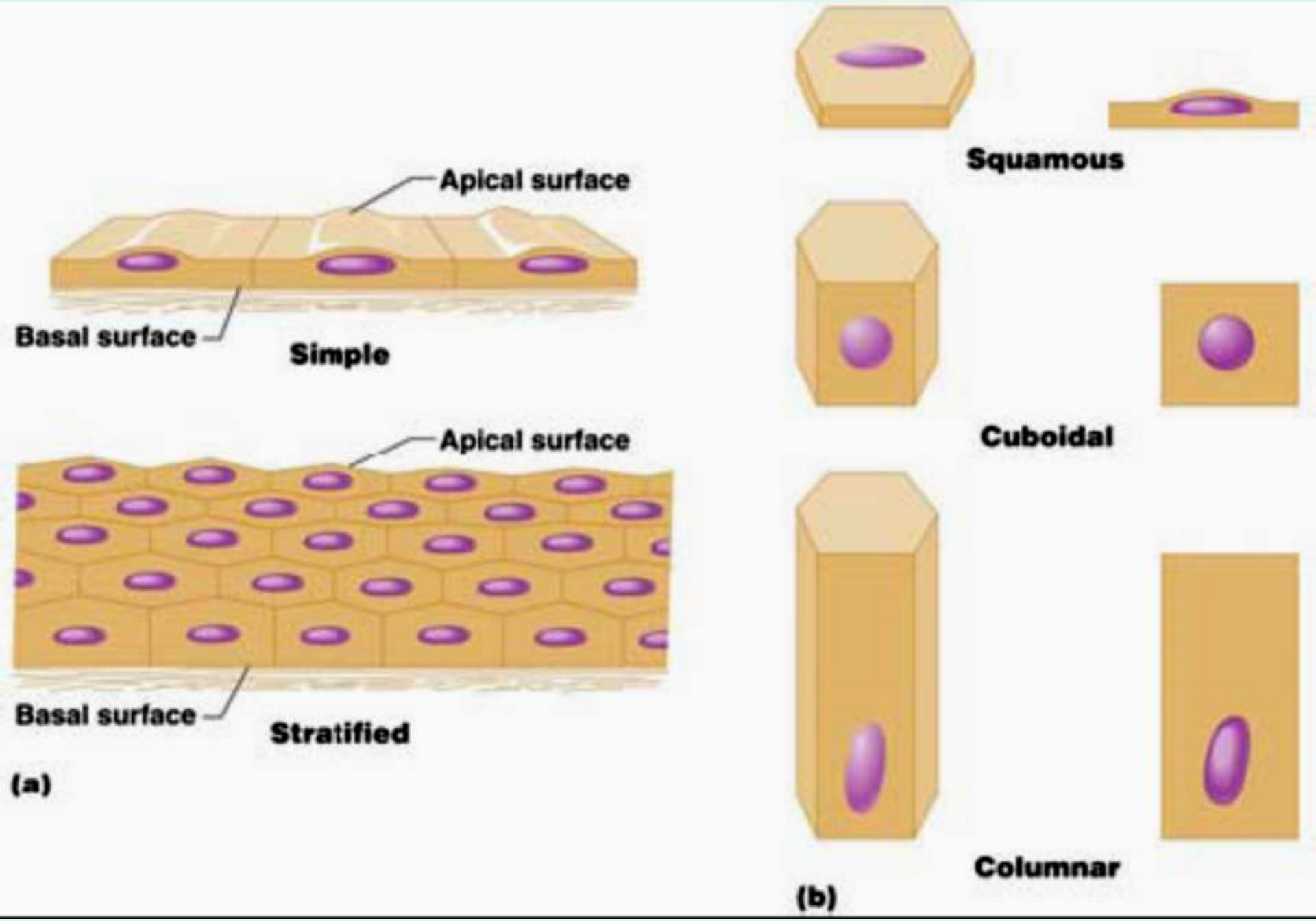
Epithelial Tissue
"Characteristics"

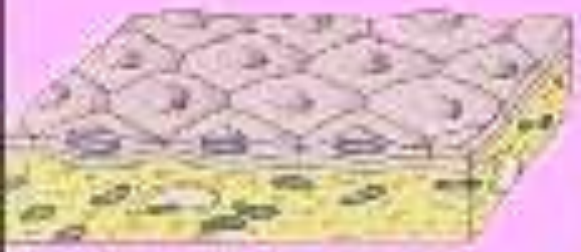
- ***Cellularity*** – composed almost entirely of cells
- ***Special contacts*** – form continuous sheets held together by tight junctions and desmosomes.
- ***Polarity*** – apical and basal surfaces
- ***Supported by connective tissue*** – reticular and basal laminae.
- ***Avascular but innervated*** – contains no blood vessels but supplied by nerve fibers
- ***Regenerative*** – rapidly replaces lost cells by cell division

Classification of Epithelia

- Number of layers
  - Simple (single layer)
  - Stratified (more than one layer)

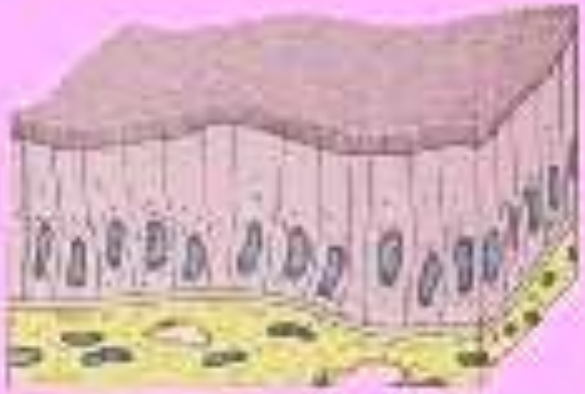
- Cell Shape
  - Squamous – Plate-like
  - Cuboidal – Shaped like cubs
  - Columnar – Taller than wide


Apical surface
Basal surface
Simple
Apical surface
Basal surface
Stratified
(a)
Squamous
Cuboidal
Columnar
(b)

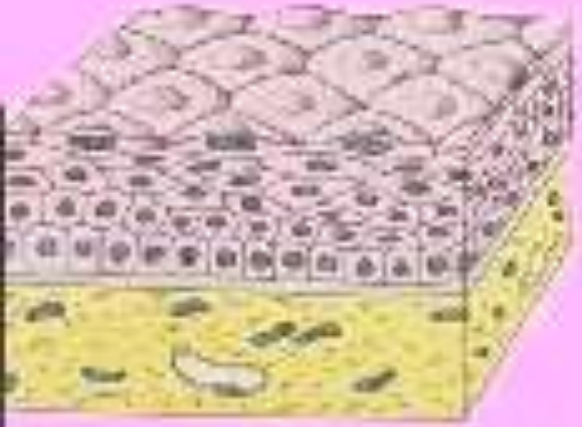


simple squamous

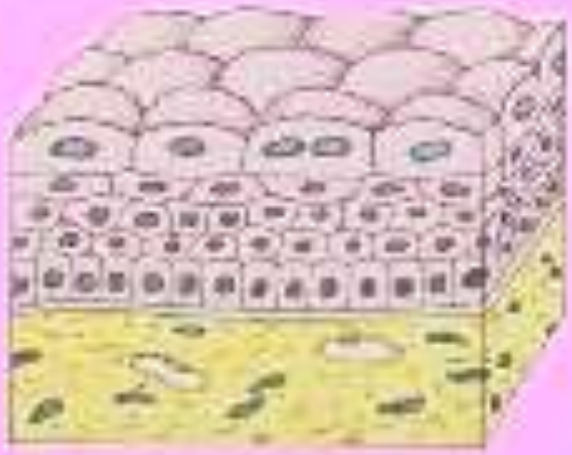
simple cuboidal



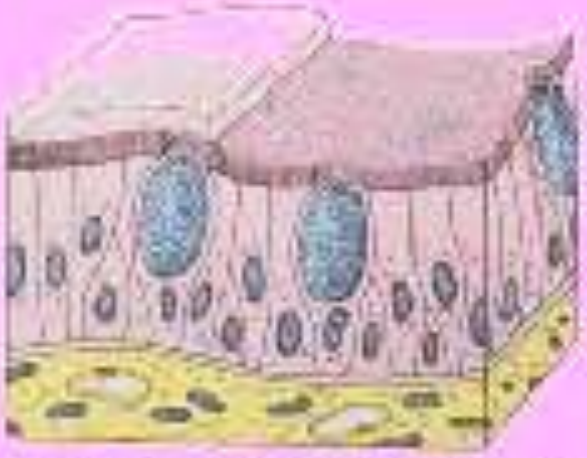
simple columnar w/microvilli



stratified squamous



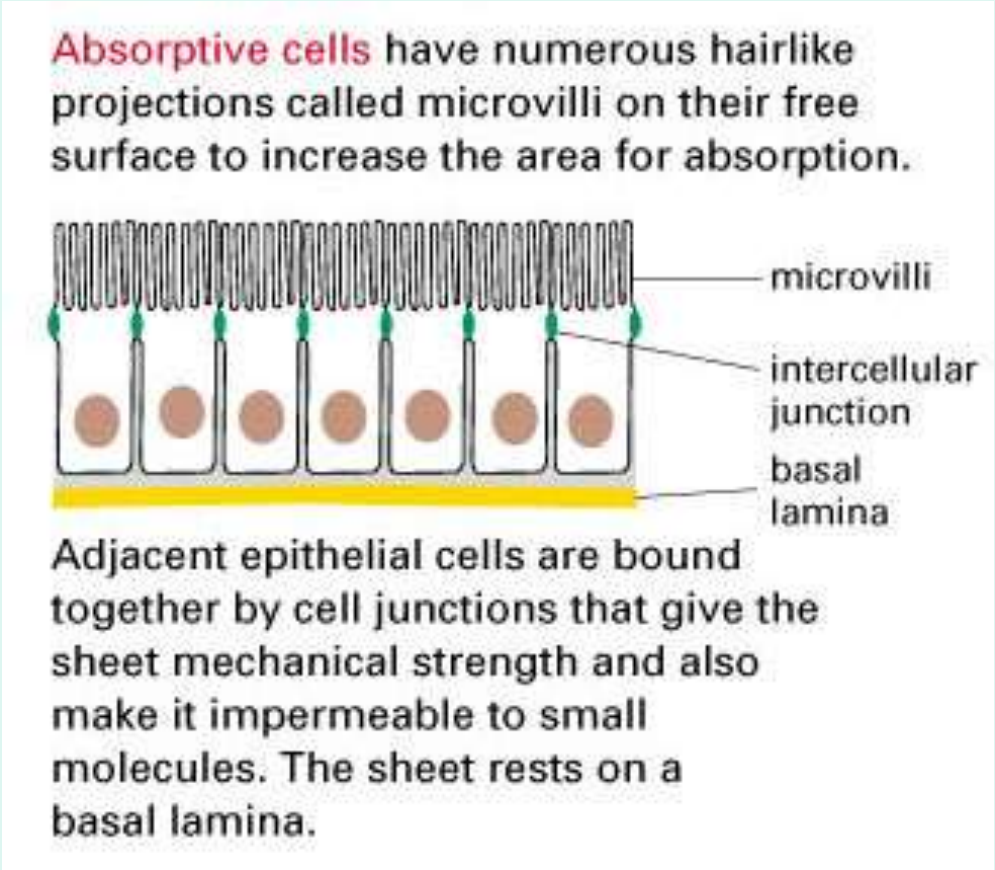
transitional



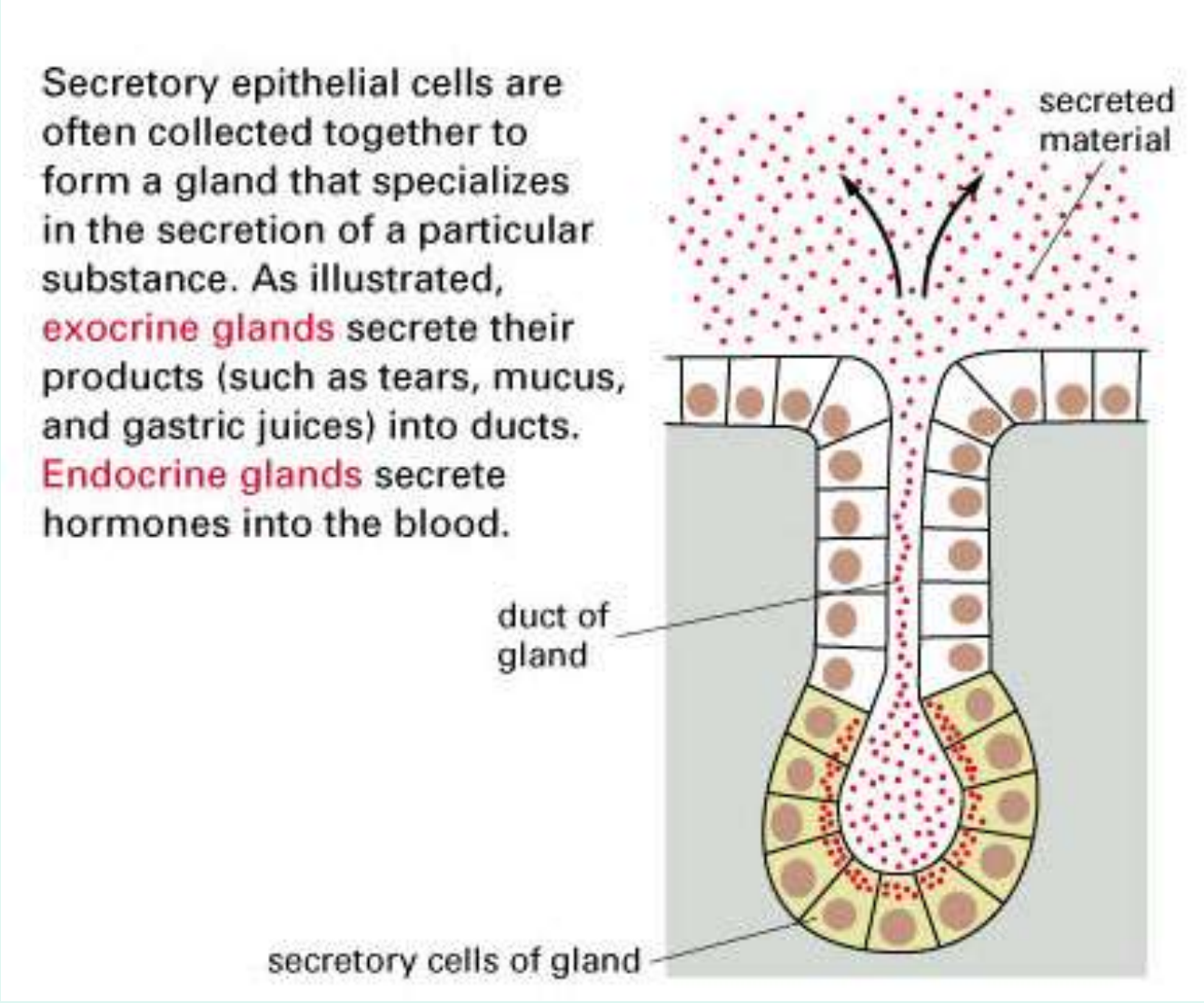
pseudostratified columnar w/cilia and microvilli

Epithelium function

Absorption : **Epithelial cells are found in those organs (e.g., small intestine) which are involved in absorption of substances important for life. These cells often have microscopic projections on the apical surface of their plasma membranes called microvilli which increase cell surface area in order to facilitate absorption .**



Secretion : The secretory cells of endocrine and exocrine glands are epithelia.

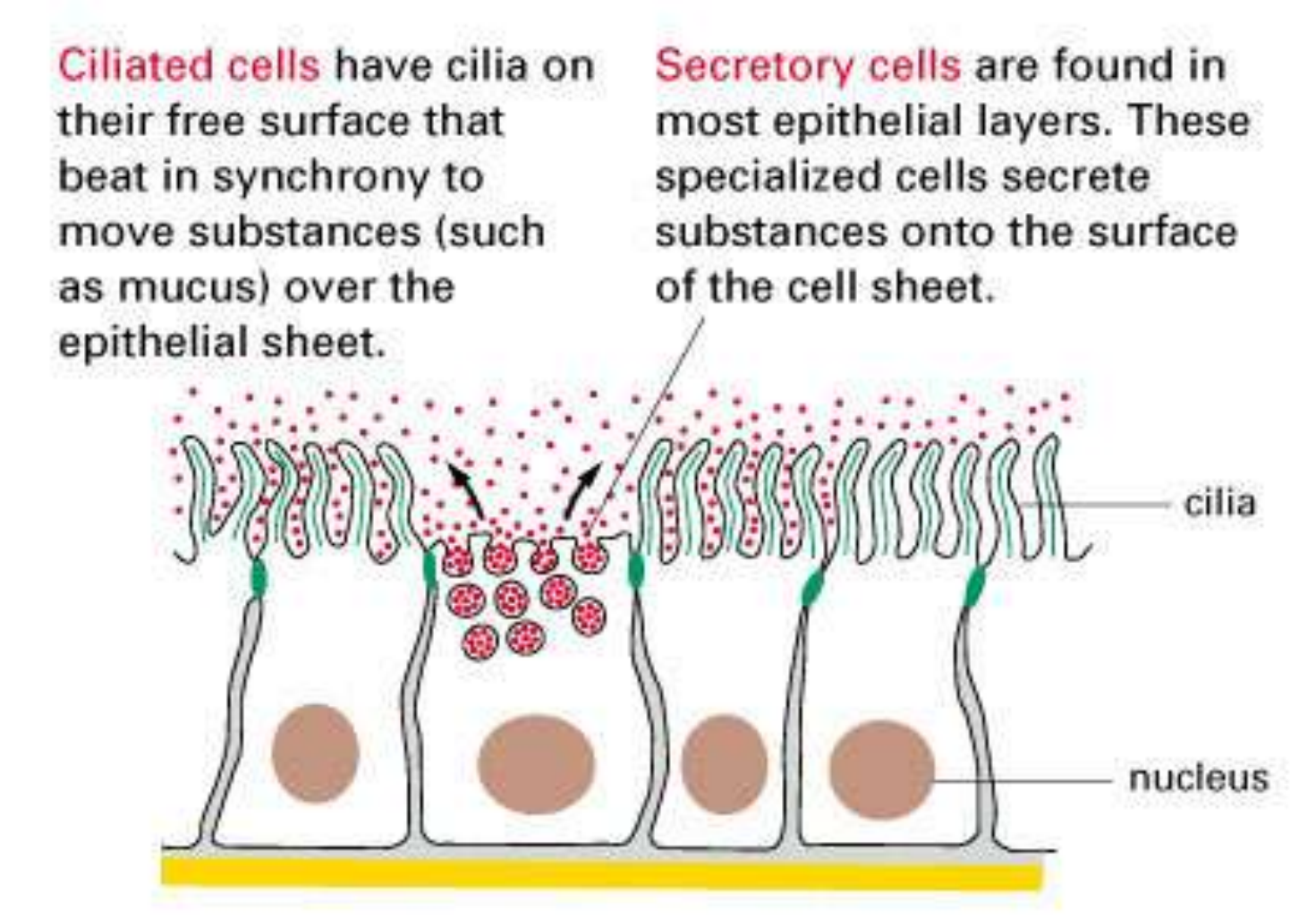


Sensory : Many of the more complex sensory receptors of the nervous system are derived from specialized epithelia called neuroepithelia (e.g., the rods and cones of the retina, olfactory receptors of the nose, taste receptors on the tongue, etc.).

Sensory receptors function by converting mechanical, chemical, or electromagnetic signals from the environment into nerve impulses which can be processed by the nervous system .

Contractility : Some very specialized epithelial cells (myoepithelia) contain the contractile proteins myosin and actin similar to muscle. Myoepithelia are associated with the ducts end piece of sweat, salivary, lacrimal, amd mammary glands and assist in the secretory process .

Surface And apical Aspect of epithelium



The free surface always directed toward exterior or lumen of the enclosed body cavity. May have *surface modifications* depending upon specific function:

1. Microvilli:

- **Closely packed, finger-like projections of cytoplasm that increase surface area of the cell.**
- **Number and shape on cell surface correlate with absorptive capacity.**
- **Can be seen under LM ("brush border" or "striated border").**
- **Contain a *core of Actin filaments*, which are anchored to *Villin* in tip.**
- ***Examples of where found*: kidney and intestine (fluid and metabolites actively transported and absorbed).**

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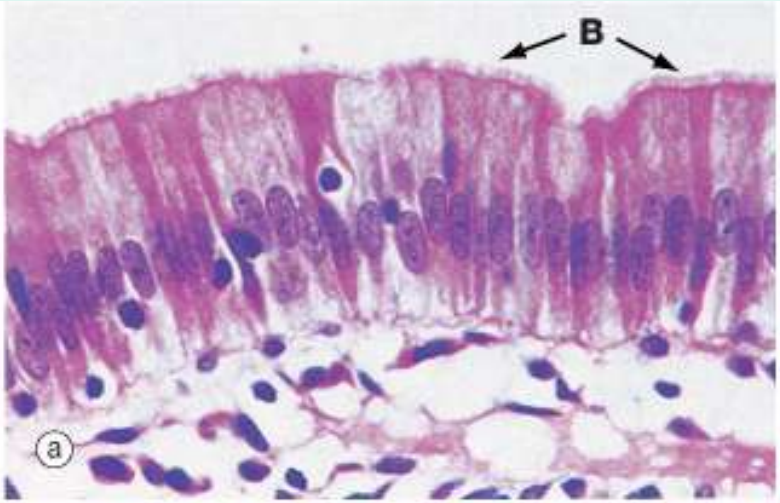
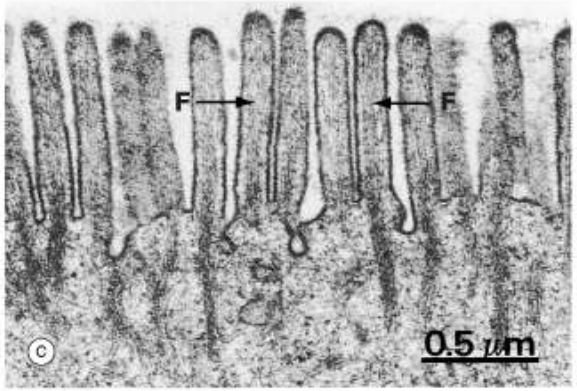
Microvillus



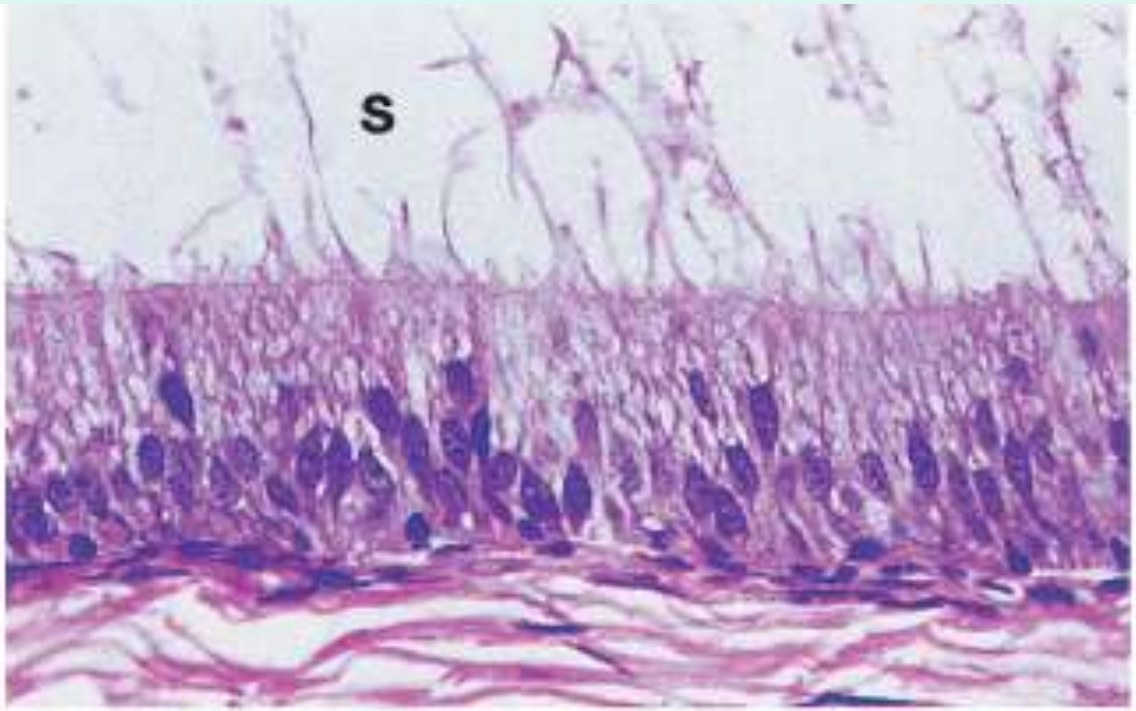


2. Stereocilia:

Long microvilli.

Apical cytoplasmic protrusions, with intermingling thin and thick regions. Cytoplasmic bridges interconnect thick regions.

Actin filament bundles that are cross-linked by *fimbrin* support them.



3. Cilia:

<u>Motile</u> cytoplasmic structures capable of actively propelling particles along cell surface.

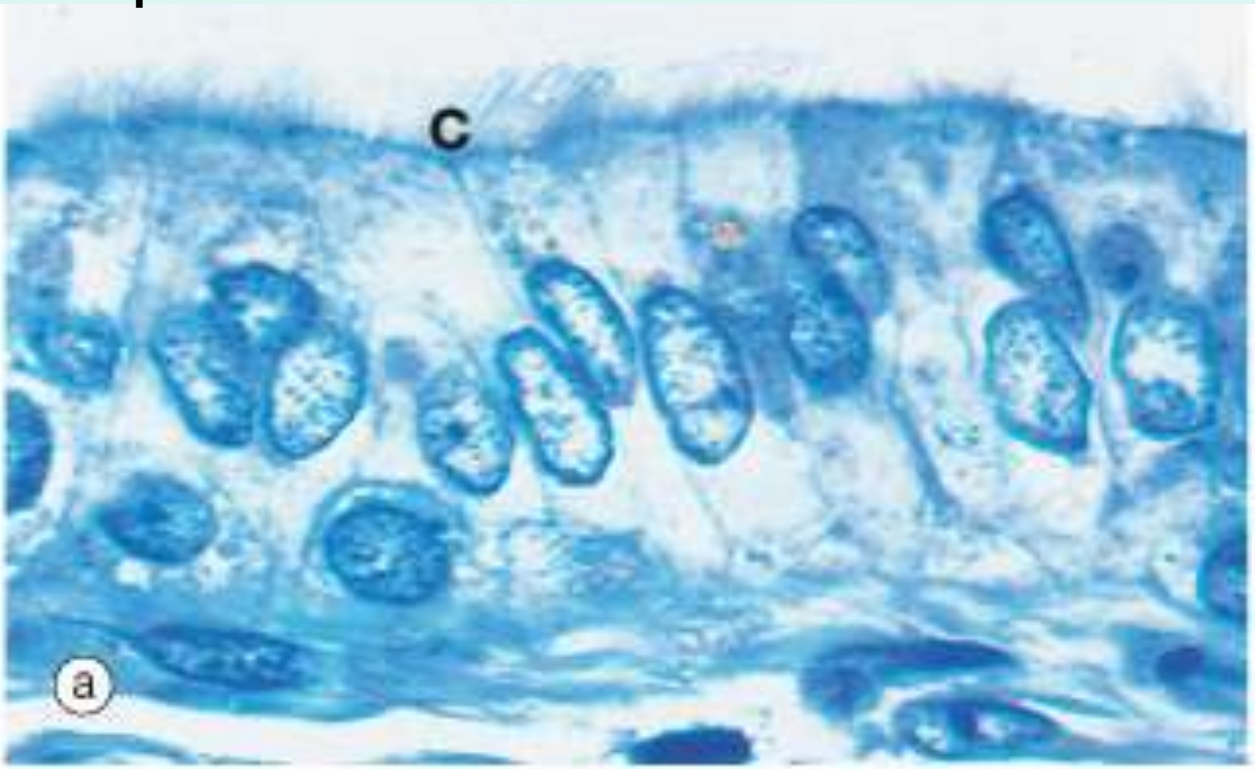
Beat in a synchronous pattern and utilize ATP for movement.

Arranged into orderly rows (respiratory tract) occur as single structure (rete testis or vestibular cells of ear).

By LM, cilia appear as hair-like structures from apical surface.

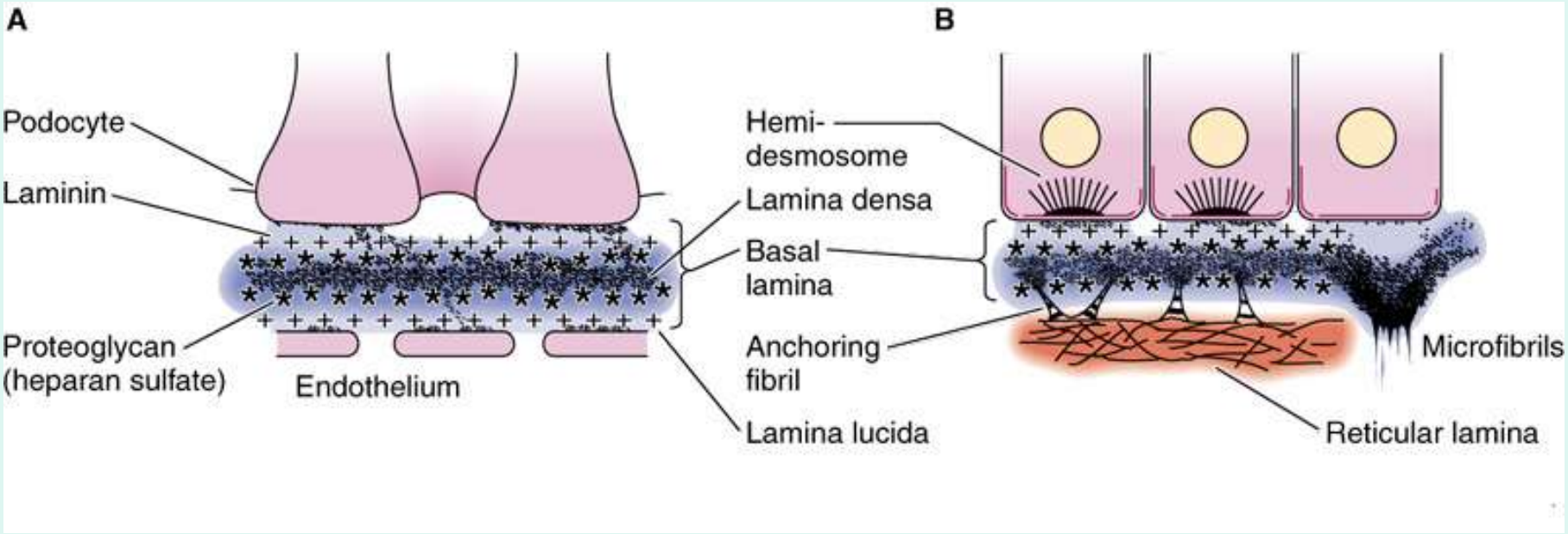
They are anchored into apical cytoplasm by a basal body:

Each cilium contains an inner core of *microtubules* arranged in a *9+2* pattern.



Basal aspect of the Epithelial

- Called **Basal Lamina**
- – Non-cellular sheet – Made of proteins
- – Acts as filter
- – Scaffolding on which new cell grow
- **Basement Membrane** – Basal lamina plus
- - Reticular fibers belonging to the underlying Connective tissue.



Simple Epithelium

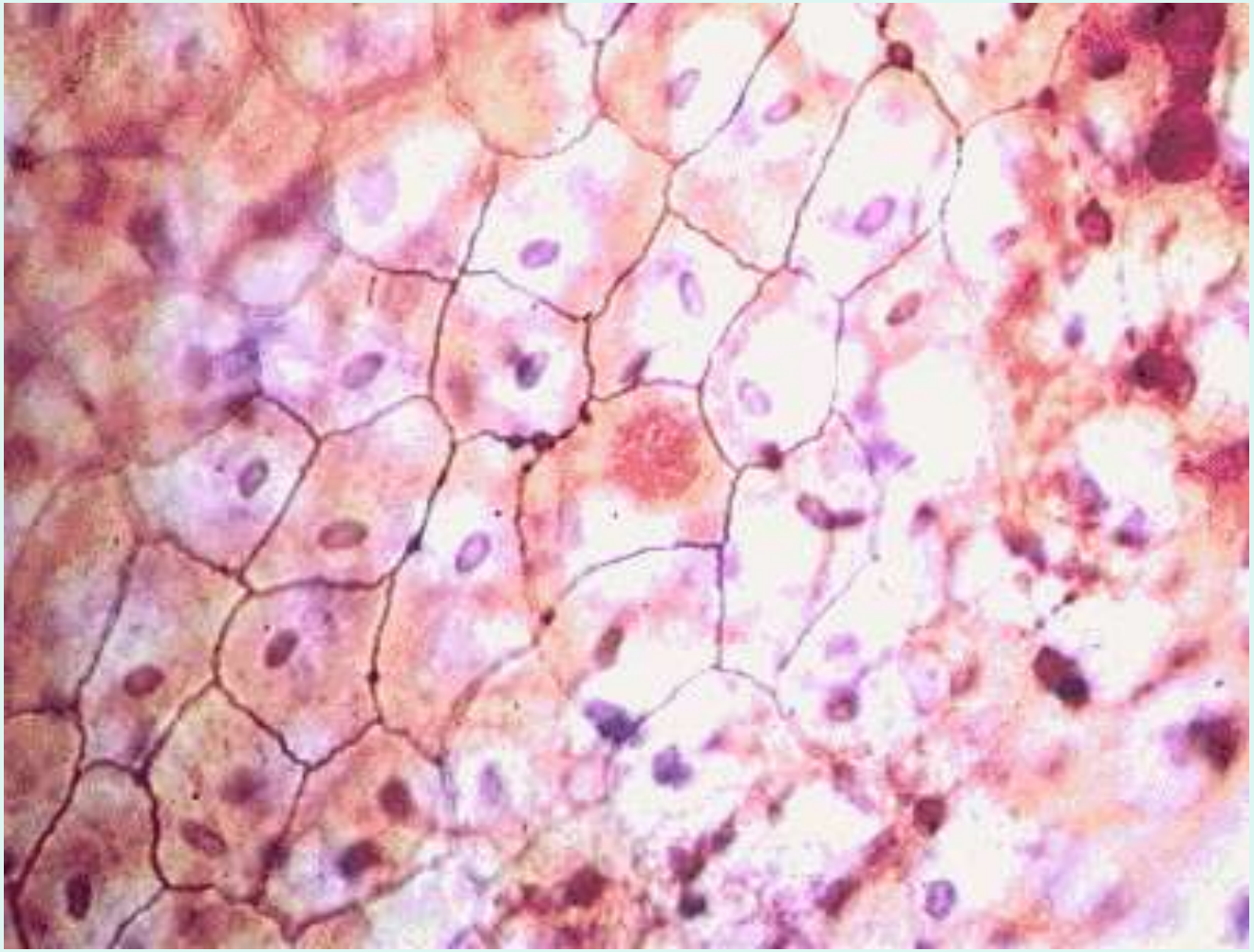
One Layered Cell Epithelium

Epithelia: Simple Squamous

- Single layer of flattened cells with disc-shaped nuclei and sparse cytoplasm
- Functions
  - Diffusion and filtration
  - Provide a slick, friction-reducing lining in lymphatic and cardiovascular systems
- Present in the kidney glomeruli, lining of heart, blood vessels, lymphatic vessels, and serosae

Simple Squamous Epithelium

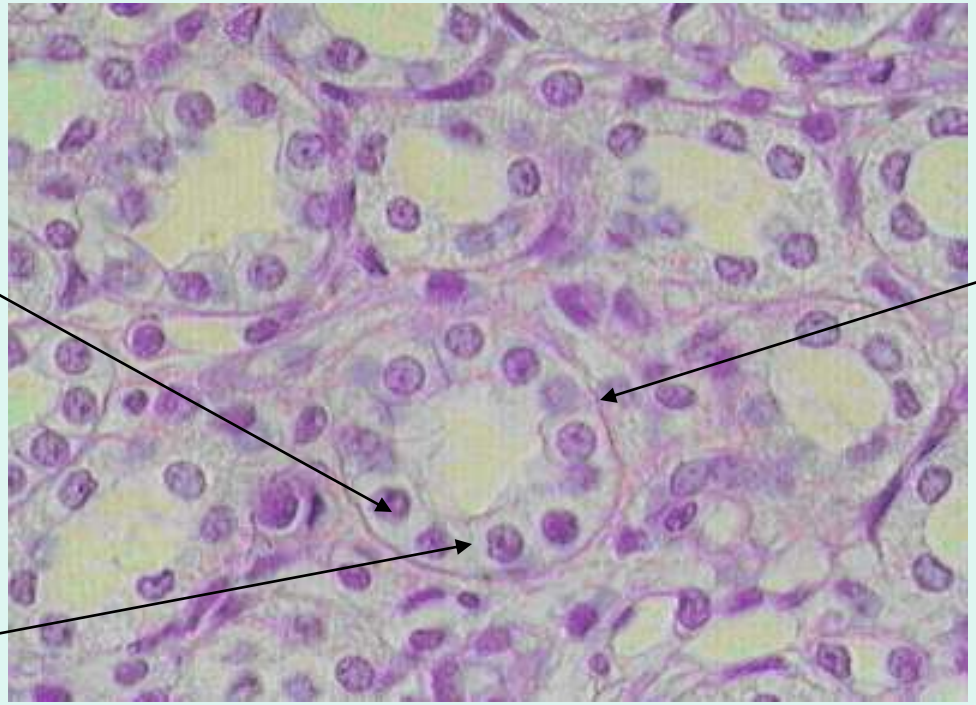
Composed of a single layer of flattened cells lying on a basement membrane. In section only their flattened nuclei are often visible.



Epithelia: Simple Cuboidal

- Single layer of cube-like cells with large, spherical central nuclei
- Function in secretion and absorption
- Present in kidney tubules, ducts and secretory portions of small glands, and ovary surface

Cuboidal epithelium

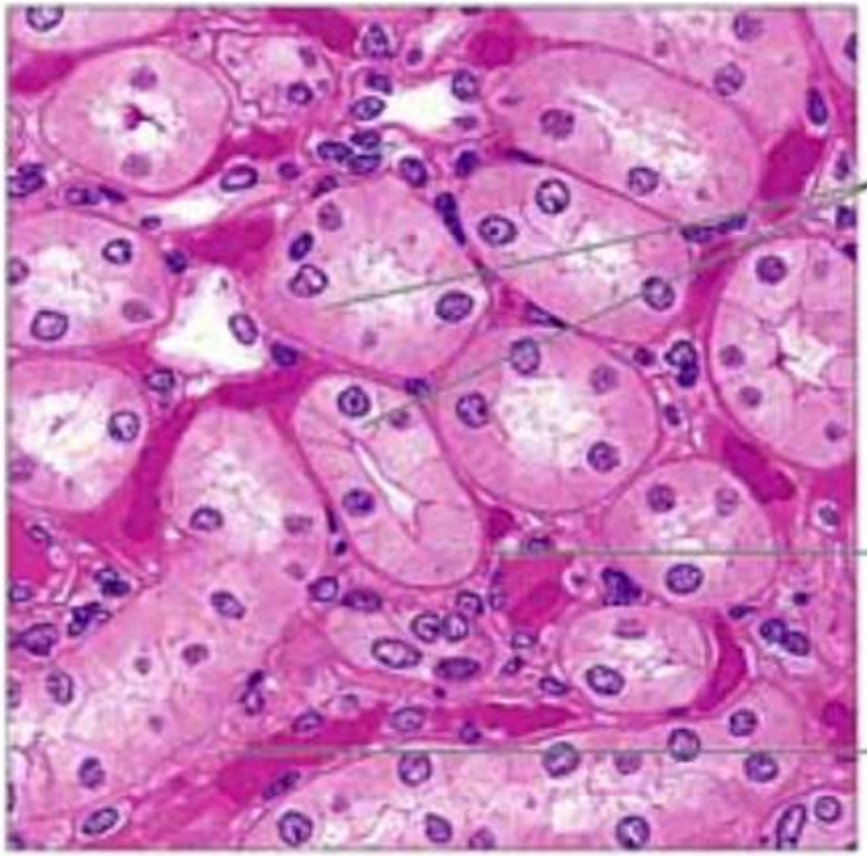


(b) Simple cuboidal epithelium

Description: Single layer of cubelike cells with large, spherical central nuclei.

Function: Secretion and absorption.

Location: Kidney tubules; ducts and secretory portions of small glands; ovary surface.



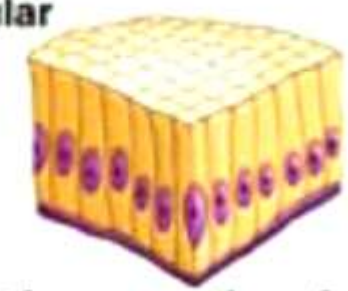
Photomicrograph: Simple cuboidal epithelium in kidney tubules (400×).

Simple Columnar

- Single layer of tall cells with oval nuclei; many contain cilia
- Goblet cells are often found in this layer
- Function in absorption and secretion
- Non-ciliated type line digestive tract and gallbladder
- Ciliated type line small bronchi, uterine tubes, and some regions of the uterus

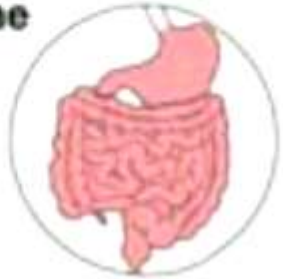
(c) Simple columnar epithelium

Description: Single layer of tall cells with *round* to *oval* nuclei; some cells bear cilia; layer may contain mucus-secreting unicellular glands (goblet cells).



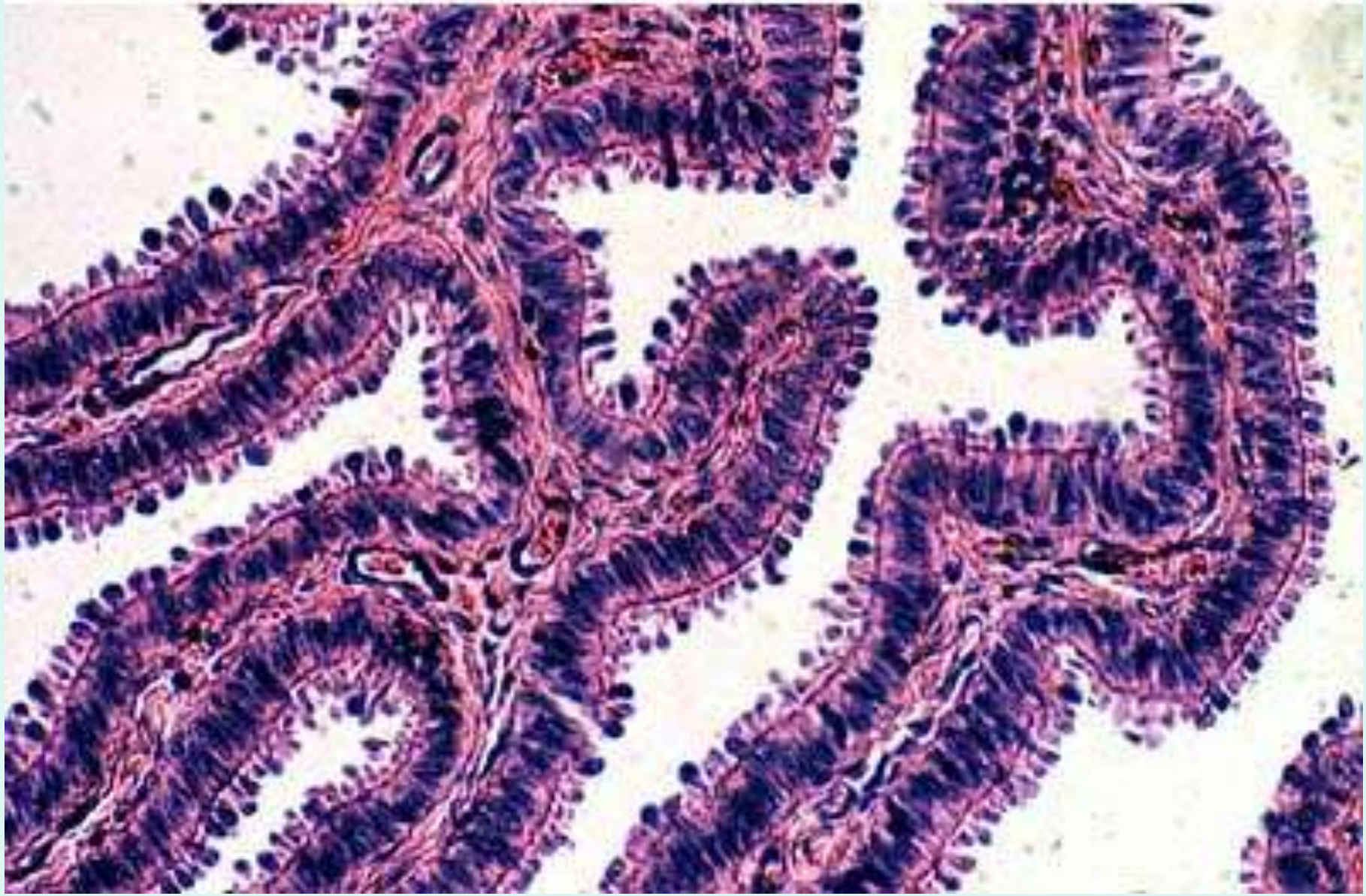
Function: Absorption; secretion of mucus, enzymes, and other substances; ciliated type propels mucus (or reproductive cells) by ciliary action.

Location: Nonciliated type lines most of the digestive tract (stomach to anal canal), gallbladder, and excretory ducts of some glands; ciliated variety lines small bronchi, uterine tubes, and some regions of the uterus.



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

Ciliated Columnar Epithilium



Pseudostratified Columnar

- Single layer of cells with different heights; some do not reach the free surface
- Nuclei are seen at different levels
- All cells are resting on basement membrane
- Function in secretion and propulsion of mucus
- Present in the male sperm-carrying ducts (nonciliated) and trachea (ciliated)

(d) Pseudostratified columnar epithelium

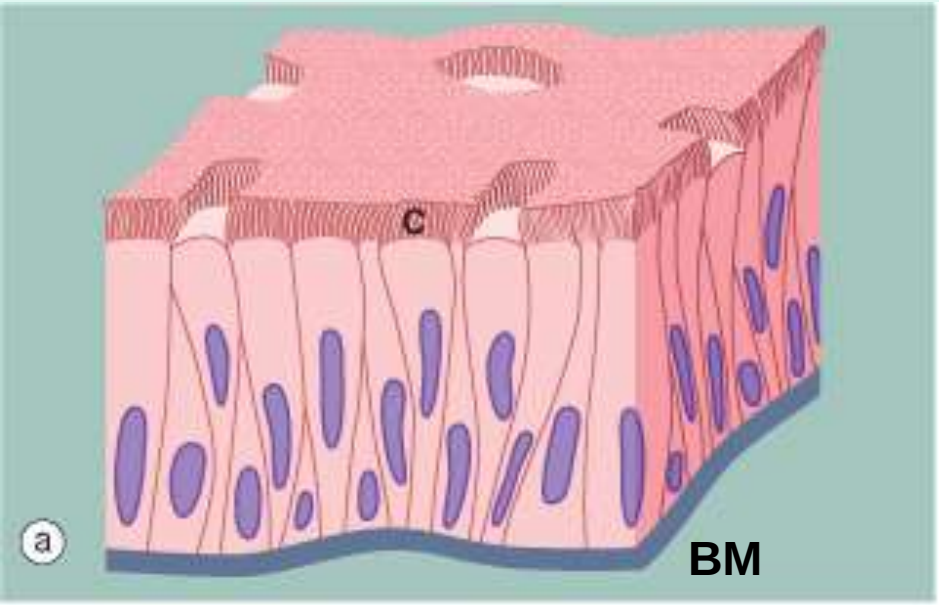
Description: Single layer of cells of differing heights, some not reaching the free surface; nuclei seen at different levels; may contain goblet cells and bear cilia.

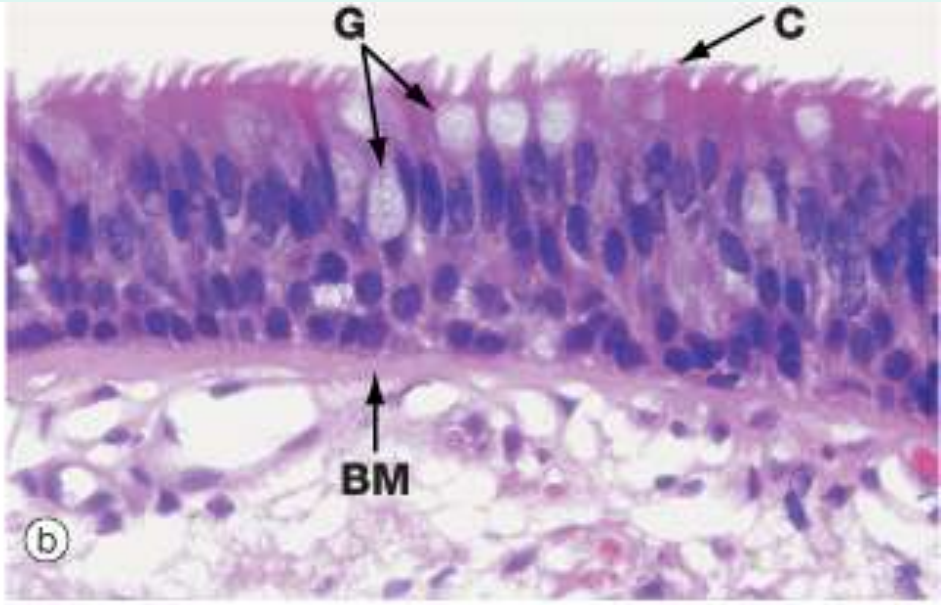
Function: Secretion, particularly of mucus; propulsion of mucus by ciliary action.

Location: Nonciliated type in male's sperm-carrying ducts and ducts of large glands; ciliated variety lines the trachea, most of the upper respiratory tract.

Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (350×).

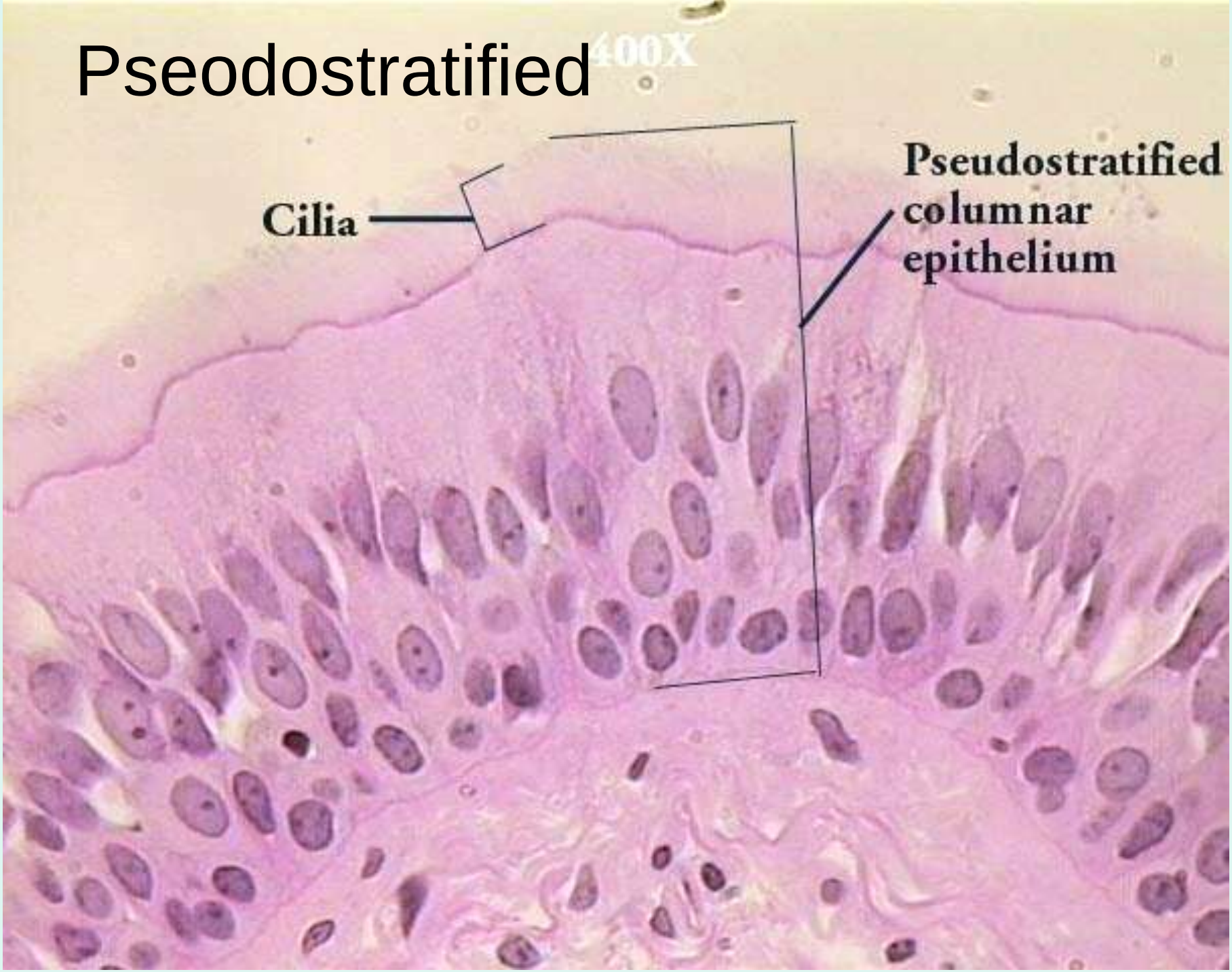
Pseudo-stratified columnar ciliated epithelium





G = Goblet Cells
C = Cilia
BM = Basement memb.

Pseodostratified



Stratified Epithelium

layers). Multilayered and thick (2 or more

- Resists abrasion, Protection.
- Basal cells divide & push apically to replace older surface cells.

Stratified Squamous

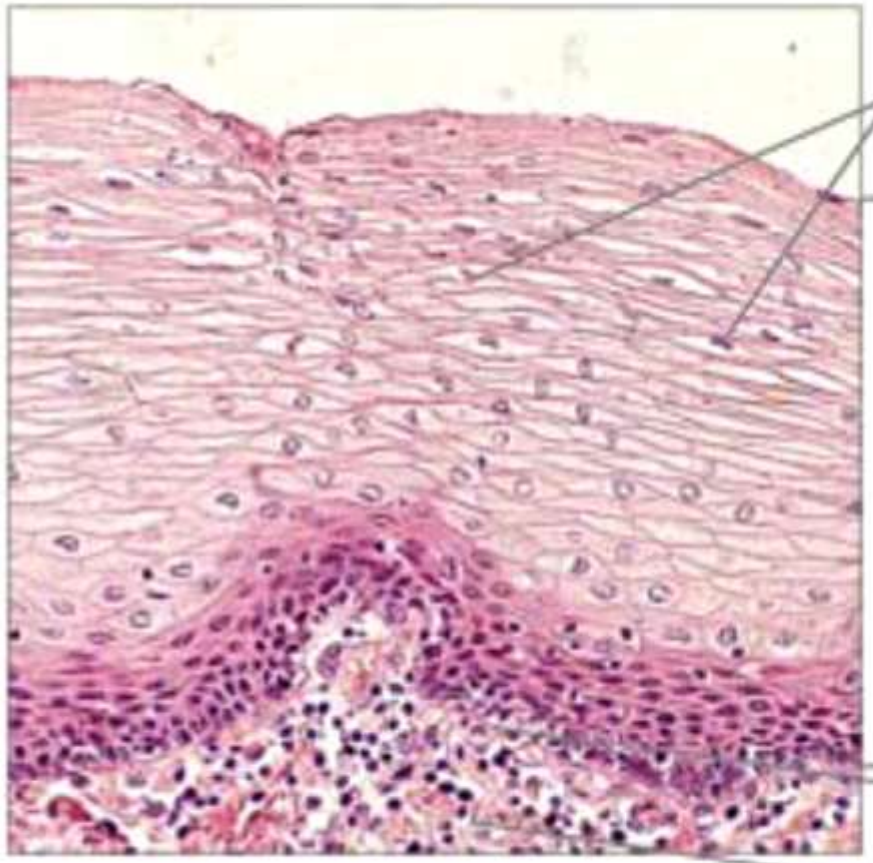
- Thick membrane composed of several layers of cells
- Function in protection of underlying areas subjected to abrasion
- Forms the external part of the skin's epidermis (keratinized cells), and linings of the esophagus, mouth, and vagina (nonkeratinized cells).

(e) Stratified squamous epithelium

Description: Thick membrane composed of several cell layers; basal cells are cuboidal or columnar and metabolically active; surface cells are flattened (squamous); in the keratinized type, the surface cells are full of keratin and dead; basal cells are active in mitosis and produce the cells of the more superficial layers.

Function: Protects underlying tissues in areas subjected to abrasion.

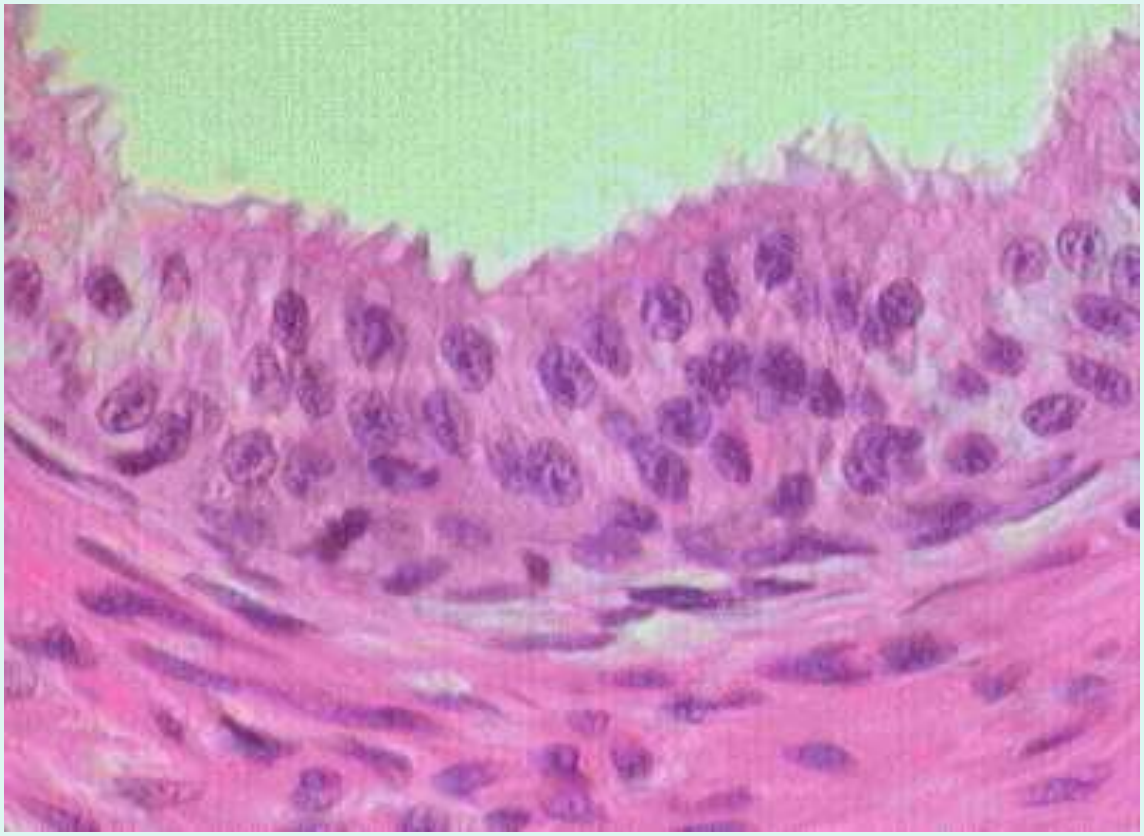
Location: Nonkeratinized type forms the moist linings of the esophagus, mouth, and vagina; keratinized variety forms the epidermis of the skin, a dry membrane.



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

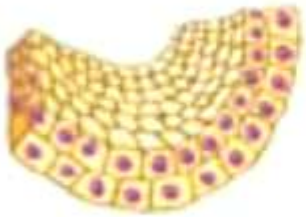
Stratified Cuboidal & Columnar Epithelium

- Uncommon type of tissue.
- Located in the large ducts of glands.
- Ex: Sweat glands, mammary glands, salivary glands.



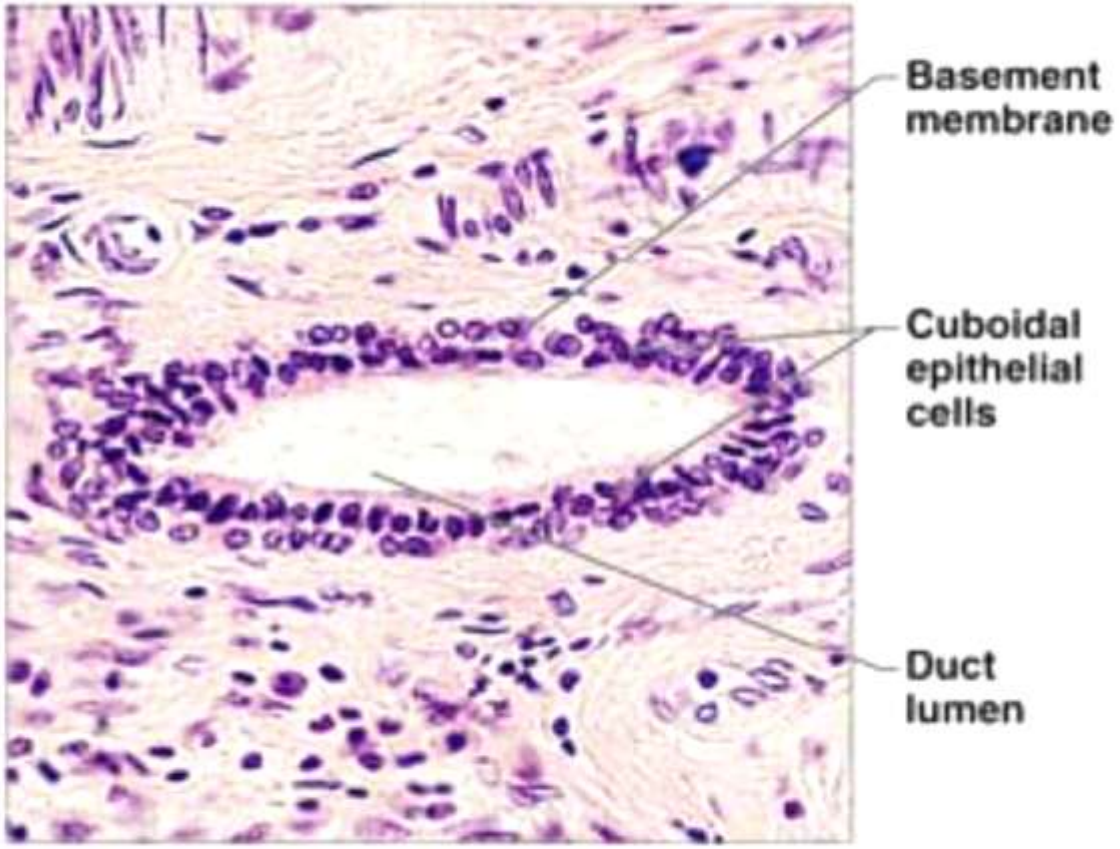
(f) Stratified cuboidal epithelium

Description: Generally two layers of cubelike cells.



Function: Protection

Location: Largest ducts of sweat glands, mammary glands, and salivary glands.



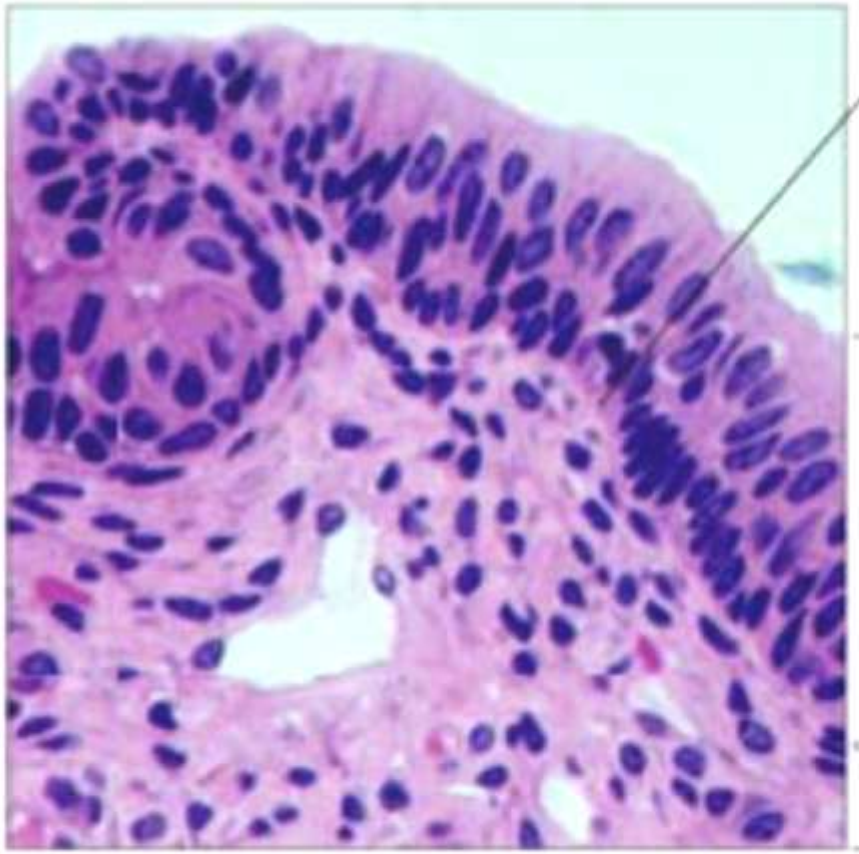
Photomicrograph: Stratified cuboidal epithelium forming a salivary gland duct (300×).

(g) Stratified columnar epithelium

Description: Several cell layers; basal cells usually cuboidal; superficial cells elongated and columnar.

Function: Protection; secretion.

Location: Rare in the body; small amounts in male urethra and in large ducts of some glands.



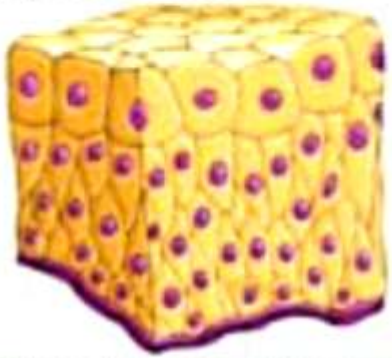
Photomicrograph: Stratified columnar epithelium lining of the male urethra (460×).

Transitional Epithelium:

- Several cell layers, basal cells are cuboidal or columnar, surface cells are dome shaped
- Stretches to permit the distension of the urinary bladder
- Lines the urinary bladder, ureters, and part of the urethra

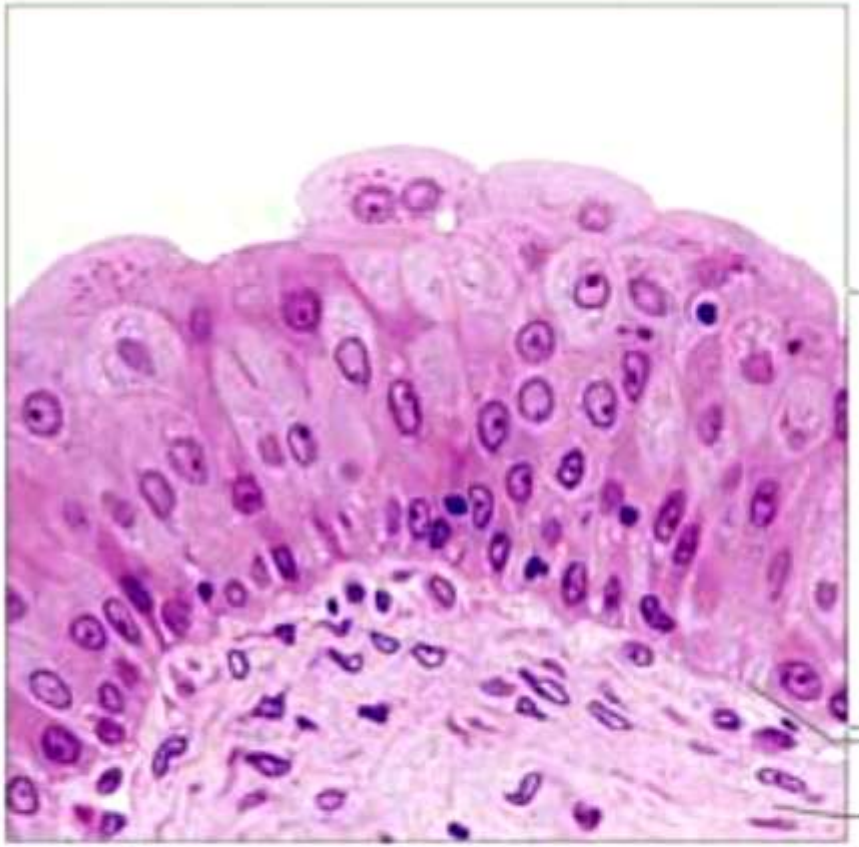
(h) Transitional epithelium

Description: Resembles both stratified squamous and stratified cuboidal; basal cells cuboidal or columnar; surface cells dome shaped or squamouslike, depending on degree of organ stretch.



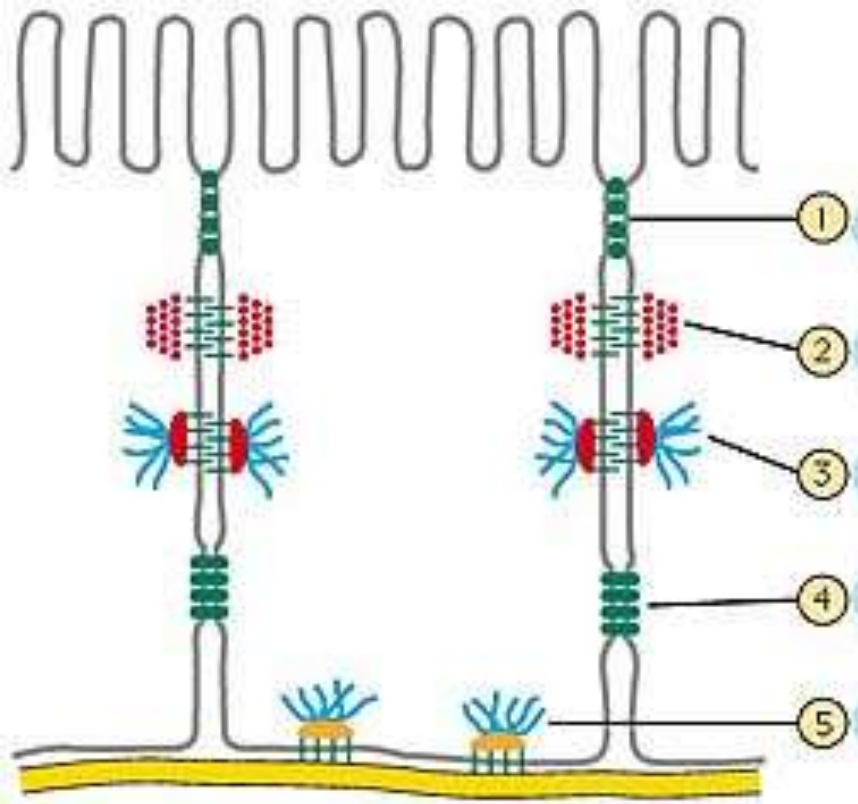
Function: Stretches readily and permits distension of urinary organ by contained urine.

Location: Lines the ureters, bladder, and part of the urethra.



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.

Cell Junctions



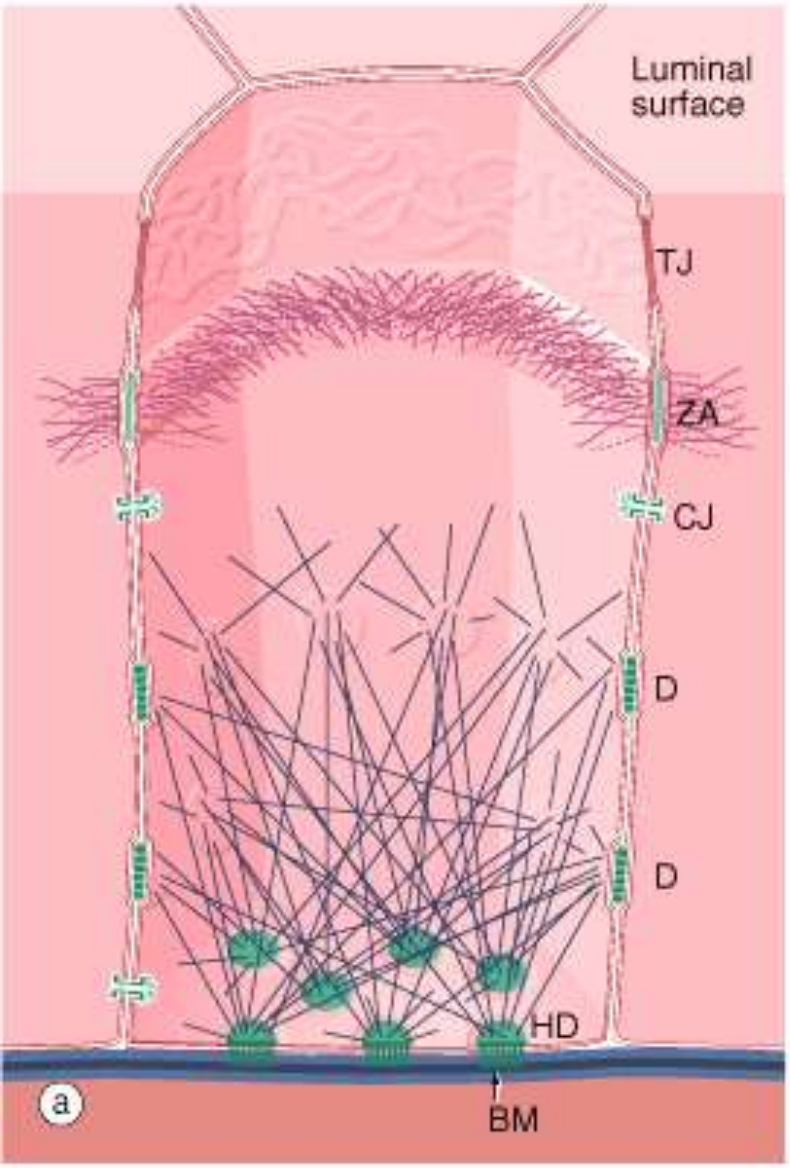
name	function
1 tight junction	seals neighboring cells together in an epithelial sheet to prevent leakage of molecules between them
2 adherens junction	joins an actin bundle in one cell to a similar bundle in a neighboring cell
3 desmosome junction	"spot weld" that anchors the tough intermediate filaments in one cell to those in a neighbor
4 gap junction	cell-cell junction allowing passage of small water-soluble ions and molecules
5 hemidesmosome junction	anchors intermediate filaments in a cell to the basal lamina

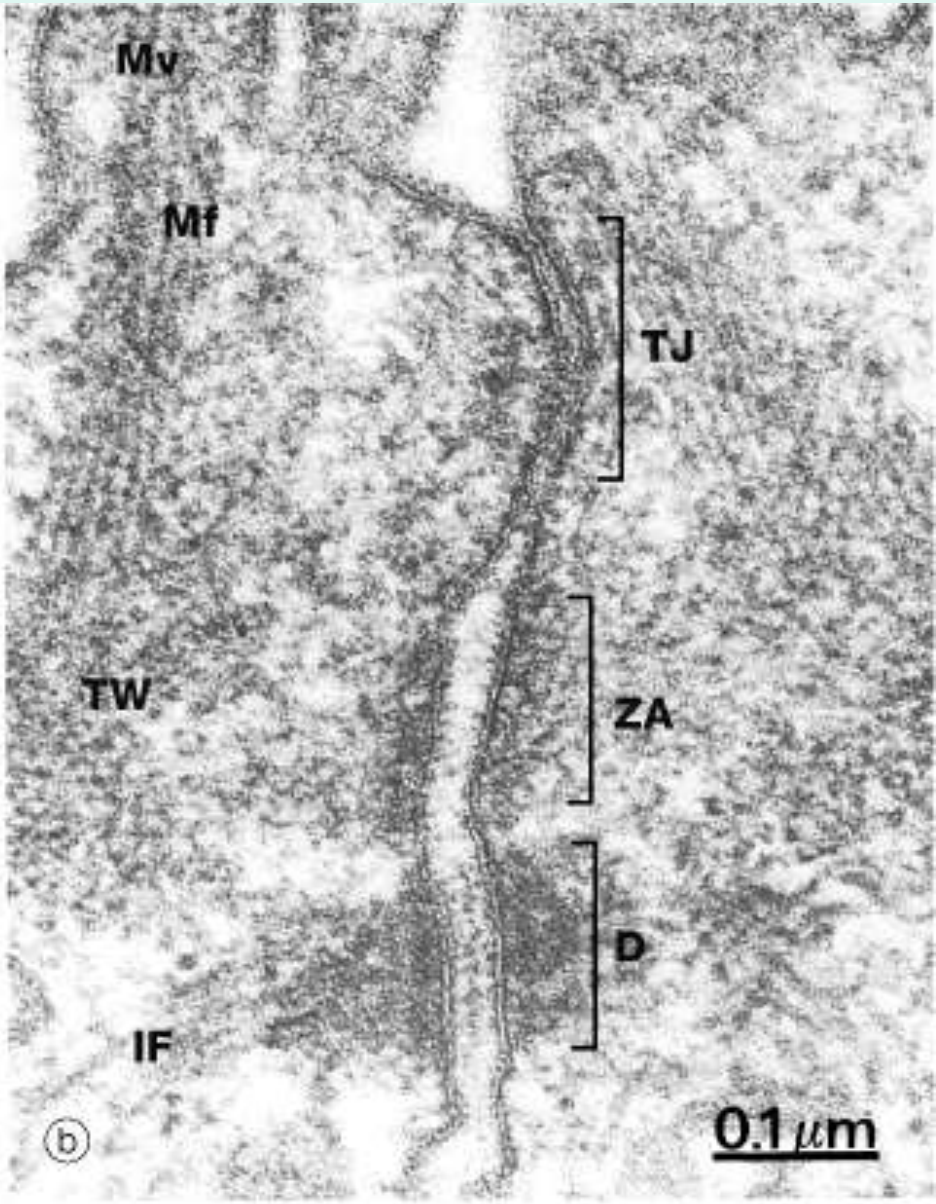
- **Tight junctions** (Belt like junction)

  Prevents molecules from passing between
- **Adhering junctions** (Reinforces tight junctions) A type anchoring junction
- **Desmosomes** (Binding Bodies)

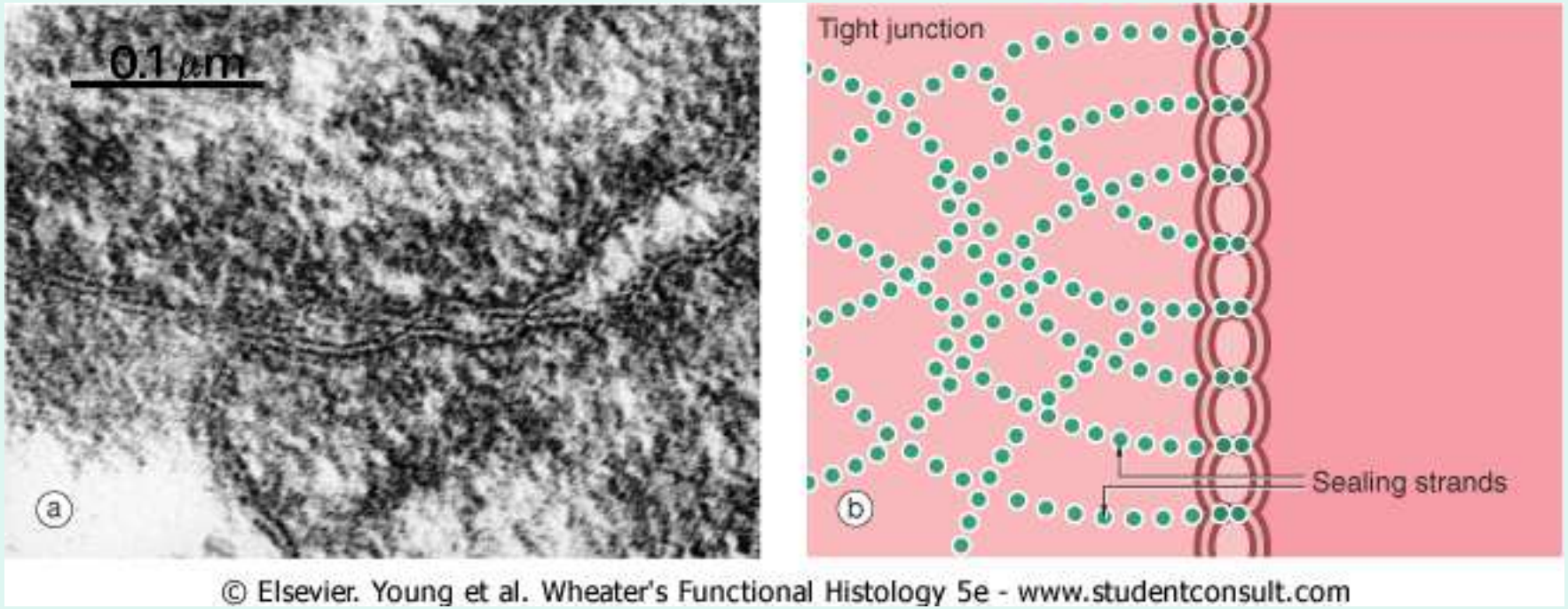
  Act like Rivets - A type anchoring junction
- **Gap junctions** (Tunnel-like junction)

  Allow passage of ions

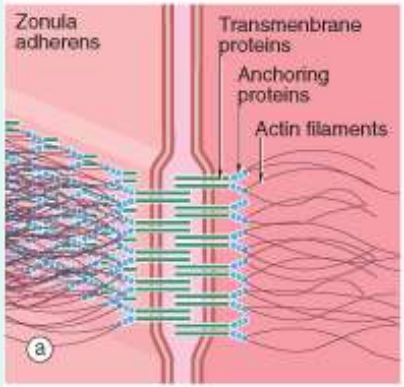


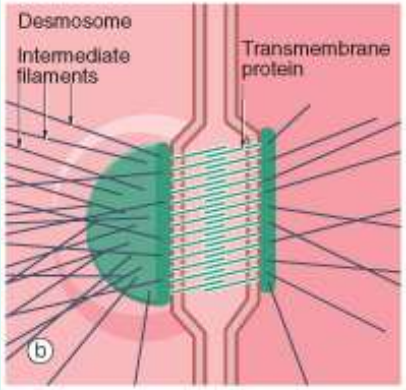


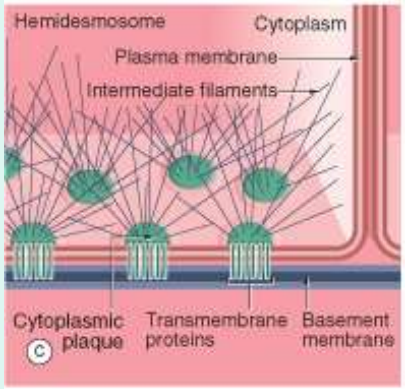
Tight junctions

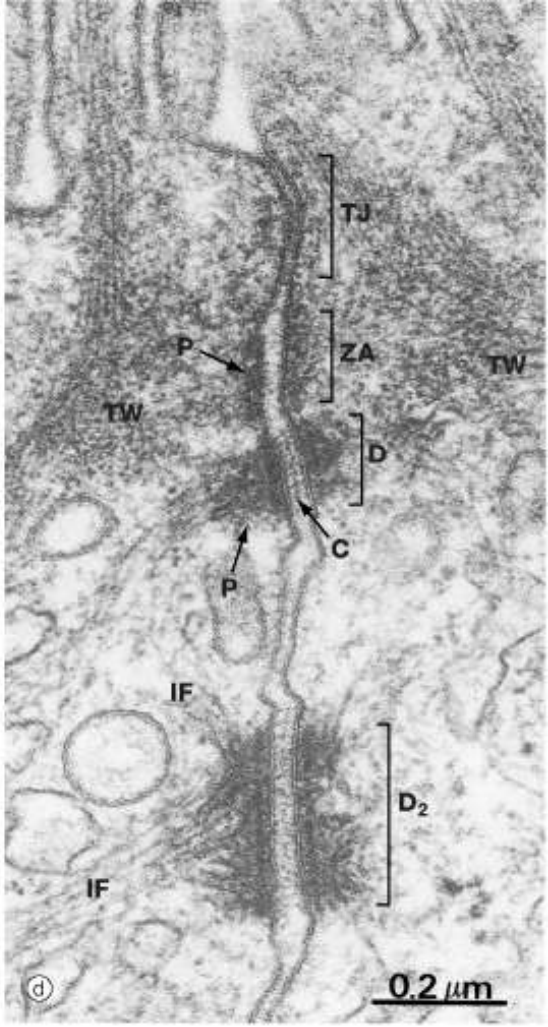


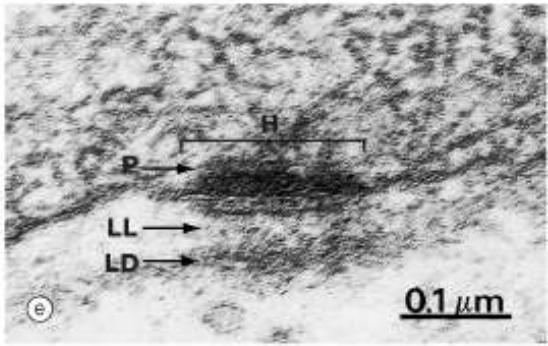
Adhering junctions











Gap junctions