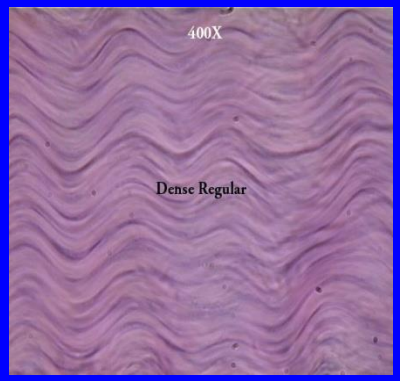
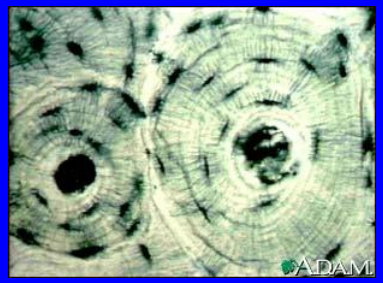
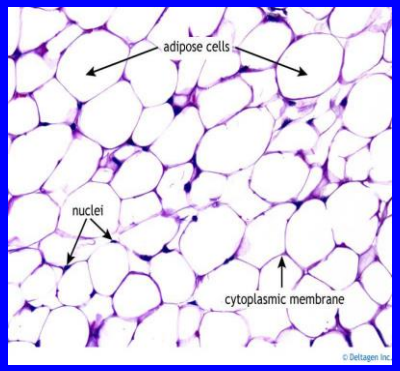
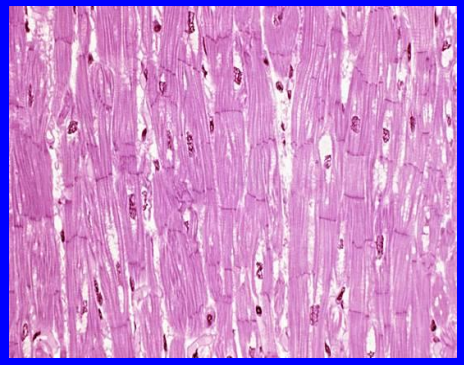
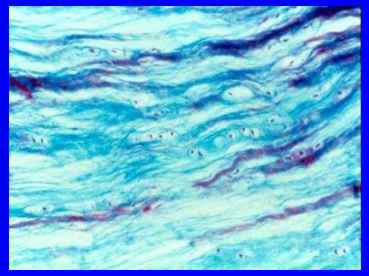


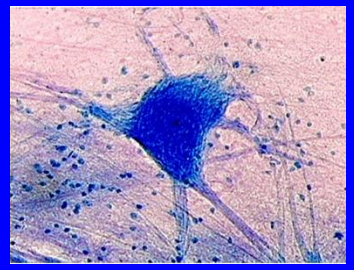


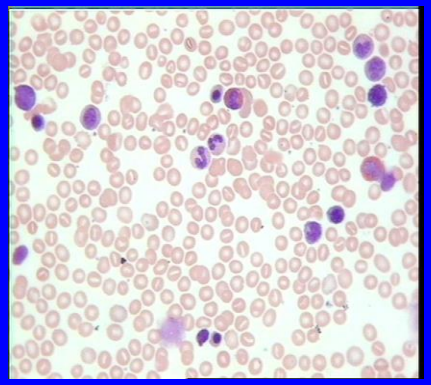


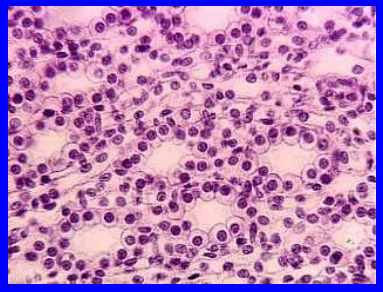
Chapter 4 - Tissues

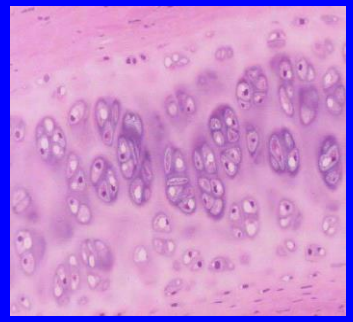


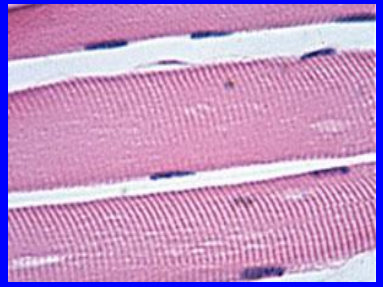












Tissues

- **Definition**
  - A group of similar cells and their intercellular substances specialized to perform a specific function.

Tissues

- **Epithelial** – covers exposed surfaces, lines internal passageways and chambers, and forms glands.
- **Connective** – Fills internal spaces, provides structural support for other tissues, transports materials within the body, and stores energy.
- **Muscle** – Specialized for contraction.
- **Nervous** – Regulates and controls body functions. Carries information in the form of electrical impulses.

Epithelial Tissue or Epithelium

- "epithe" = laid on, covering
- Sheet of cells that covers a body surface or lines a body cavity
- Forms boundaries between different environments.

Occurs in the body as:

- **Covering and lining epithelium**
  - Forms the outer layer of skin, dips into and lines the open cavities of the cardiovascular, digestive, and respiratory system, and covers the walls and organs of the ventral body cavity.
- **Glandular epithelium**
  - Forms the glands of the body.

Functions

- Protection
  - Protects underlying tissues from mechanical and chemical injury and bacterial invasion and contains nerve endings
- Absorption
  - Digestive system is specialized to absorb substances.
- Filtration
  - Kidneys filter the blood.
- Excretion
  - Excrete waste products from the body and reabsorb needed materials from the urine. Sweat is excreted from the body in the sweat glands
- Secretion
  - Specialty of glands. Examples: enzymes, hormones and lubricating fluids
- Sensory reception
  - Has sensory nerves (smell, taste, sight, and hearing)

Special Characteristics

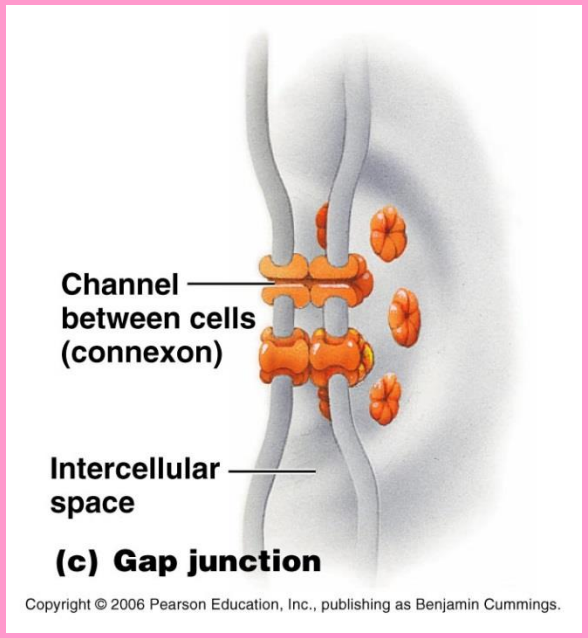
1. Polarity
   - **Apical surface –** upper free surface that is exposed to body exterior or the cavity of an internal organ.
     - May have microvilli, cilia, or be smooth
   - **Basal surface –** Lower attached surface to the basement membrane
     - Basal lamina – non cellular, adhesive sheet (consists mainly of glycoproteins) that lies adjacent to basal surface.
       - Filter - determines which molecules can diffuse from the basement membrane
       - Scaffolding so cells can migrate to repair a wound

Special Characteristics

2. Specialized Contacts
   - Cells are fit very close together to form continuous sheets.
   - Cell Junctions:
     - Specialized areas of plasma membrane that attach a cell to another cell
       - Gap Junction
       - Tight Junction
       - Desmosomes

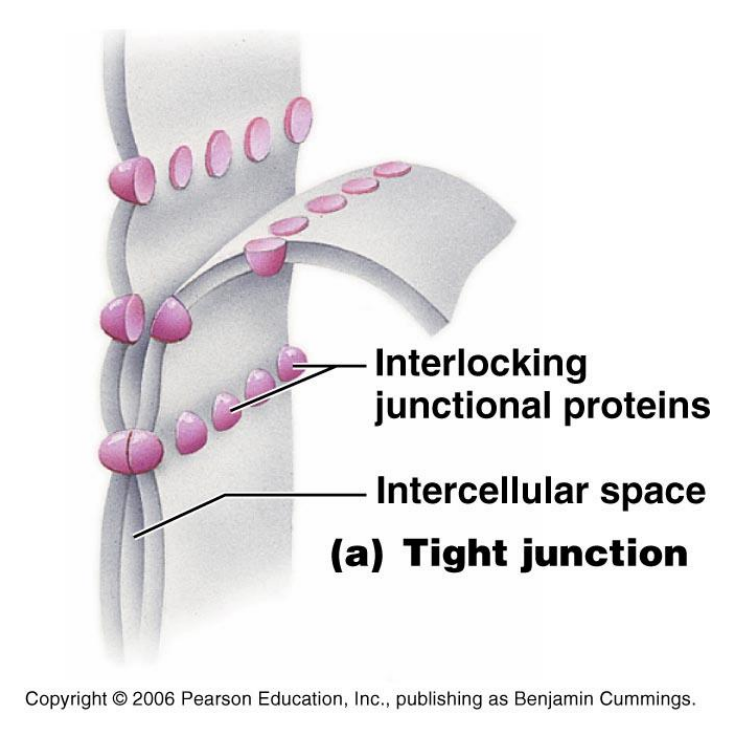
Special Characteristics

- Gap Junction
  - Forms a narrow passageway between two cells that allows molecules or ions to move between the cells
  - Common where the movement of ions helps to coordinate function.
    - Beating of cilia
    - Beating of cardiac cells



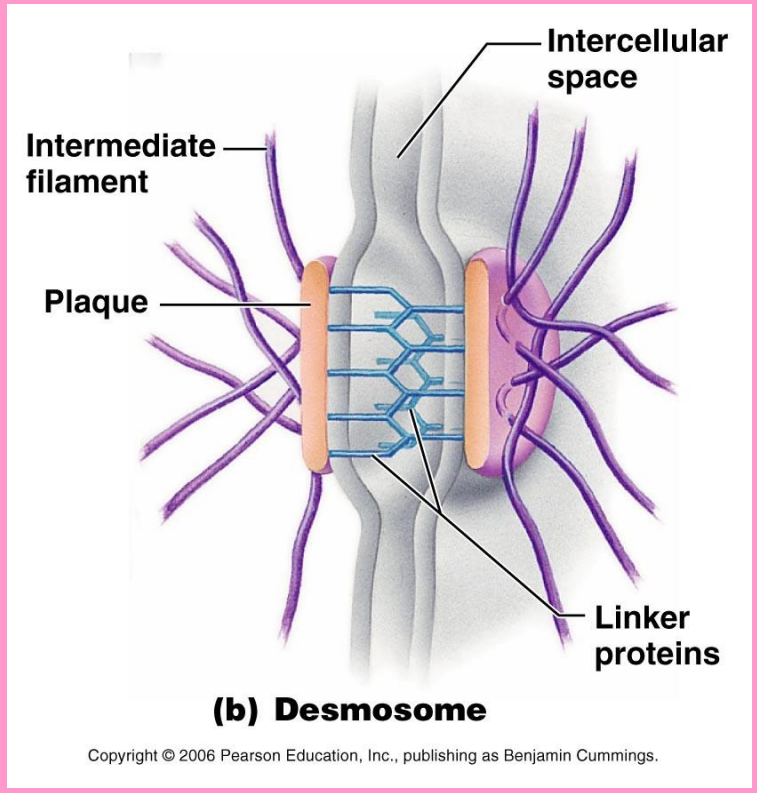
Special Characteristics

- Tight Junction
  - The lipid portions of the two plasma membranes are tightly bound together.
  - So tight that prevents water and solutes from passing between cells.
  - Impermeable junction.



Special Characteristics

- Desmosomes
- “Binding bodies” – Anchoring junction
- Prevents the separation of cells
- Like nails in wood.
- Seen in the skin, why when you burn your skin peels off in sheets.



Special Characteristics

3. Supported by Connective tissue
   - All rest upon and are supported by connective tissue
   - Basement membrane – made up of the reticular lamina and the basal lamina

Special Characteristics

4. Avascular but innervated
   - Avascular – contains no blood vessels. Cells get nutrients by diffusion or absorption across the apical or basal surface.
   - Innervated – supplied by nerve fibers

Special Characteristics

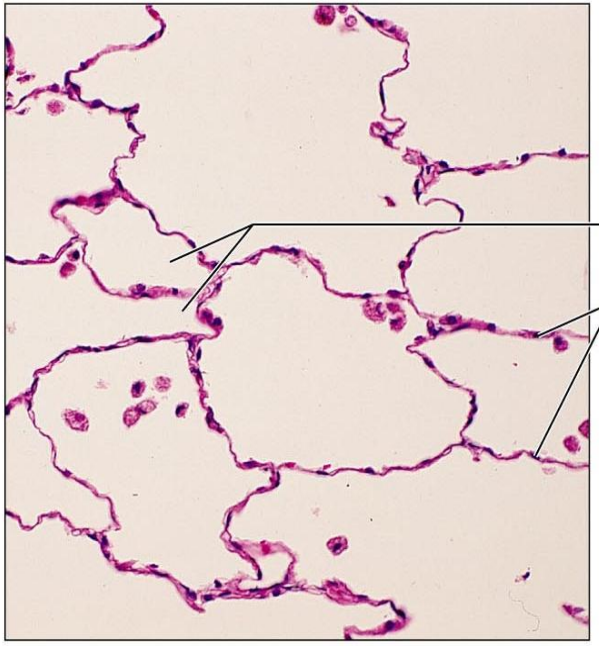
5. Regeneration
   - If/when the tissue is destroyed, epithelial cells begin to reproduce themselves rapidly. As long as epithelial cells receive adequate nutrition, they can replace lost cells by cell division.

Epithelial Tissue

- Classification
  - Number of cell layers
    - Simple – only a single layer of cells
    - Stratified – Several layers of cells
  - Shape of exposed cells
    - Squamous – flattened/scale like
    - Cuboidal - boxlike
    - Columnar – tall and column shaped

Epithelial Tissue – Simple Squamous

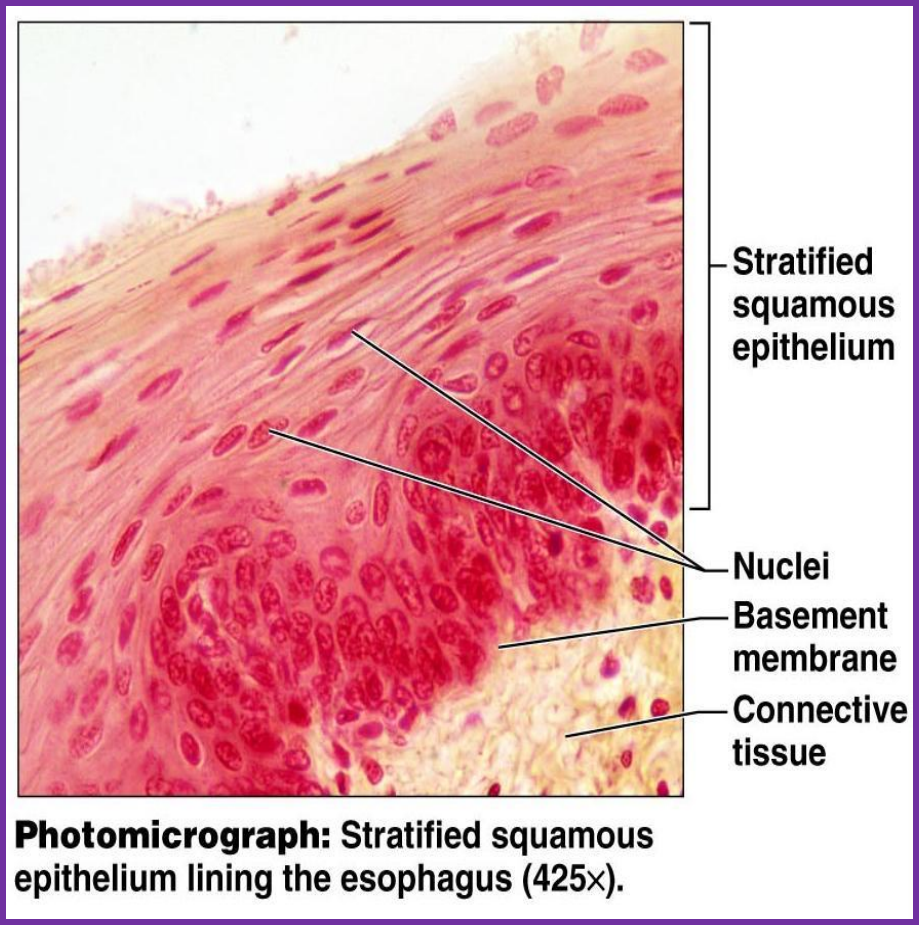
- Description
  - Single layer of thin, flat, irregularly shaped cells with disc-shaped central nuclei
  - Most delicate
- Functions
  - Allows passage of materials by diffusion & filtration (controls vessel permeability)
  - Secretes lubricating substances in serosae (to reduce friction)
  - Absorption and secretion
- Locations
  - Kidney glomeruli; Air sacs of lungs, walls of heart/blood vessels, and lymphatic vessels lining of ventral body cavity (serosae)



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

Epithelial Tissue – Stratified Squamous

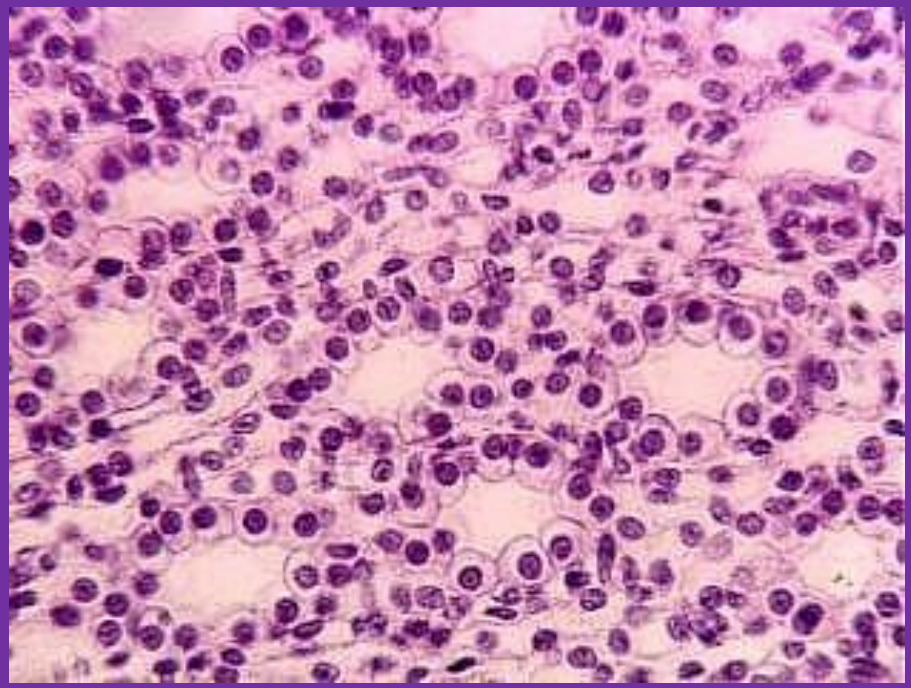
- Description
  - Thick membrane composed of several cell layers; basal cells are cuboidal/columnar shaped; surface cells are flattened.
- Functions
  - Protects underlying tissues where mechanical stresses are severe.
  - Protects against pathogens and chemicals
- Locations
  - Skin (keratinized); lining of mouth, vagina, and esophagus (nonkeratinized).



Photomicrograph: Stratified squamous epithelium lining the esophagus (425×).

Epithelial Tissue – Simple Cuboidal

- Description
  - Single layer of cube-shaped cells with large spherical nuclei
  - As tall as they are wide
- Functions
  - secretion and absorption
- Locations
  - Kidney tubules; small ducts and glands; ovary surface

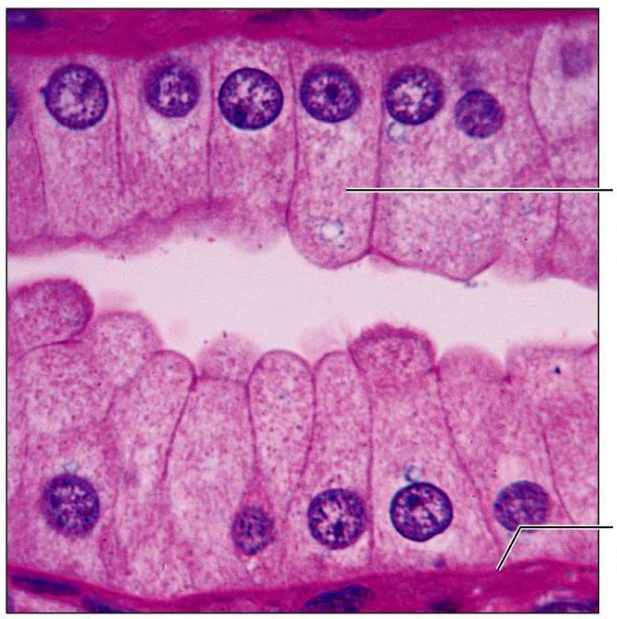


Epithelial Tissue – Stratified Cuboidal

- Description
  - Typically has two layers of cuboidal cells.
  - Quite rare in the body.
- Function
  - Protection, secretion, absorption
- Location
  - Sweat glands, mammary glands

Epithelial Tissue – Simple Columnar

- Description
  - Single layer of tall cells with round to oval nuclei.
  - Some may have cilia or mucus secreting unicellular glands (goblet cells)
- Functions
  - Absorption, secretion (mucus, enzymes), propulsion (ciliated)
- Locations
  - Nonciliated - Digestive tract, gallbladder, and excretory ducts of some glands.
  - Ciliated – lines small bronchi, uterine tubes and some regions of the uterus.



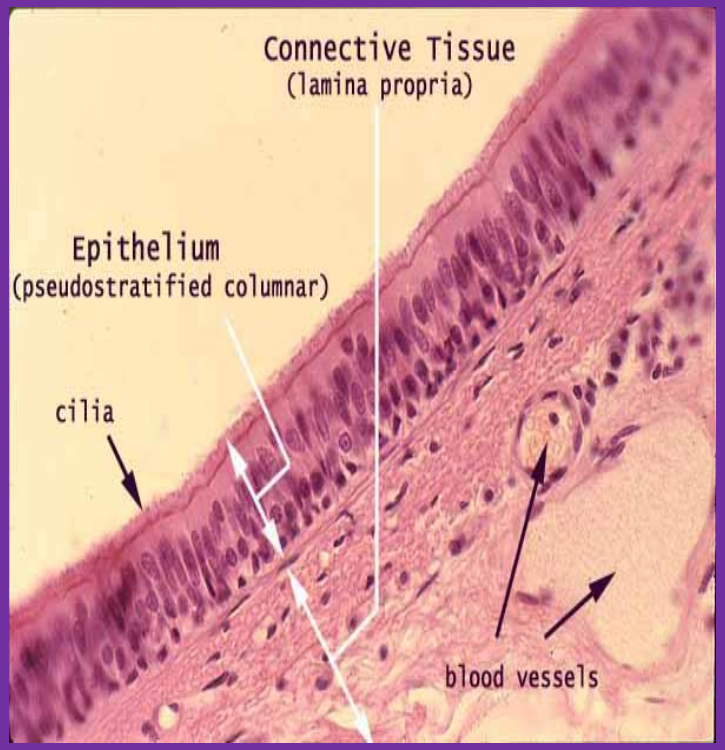
Photomicrograph: Simple columnar epithelium of the stomach mucosa (1300×).

Epithelial Tissue – Stratified Columnar

- Description
  - Only apical layer of cells are columnar
  - Rare
- Function
  - Protection
- Locations
  - Small areas of the pharynx, epiglottis, male urethra, epiglottis, salivary glands.
  - Also found at transition areas or junctions between two other types of epithelia.

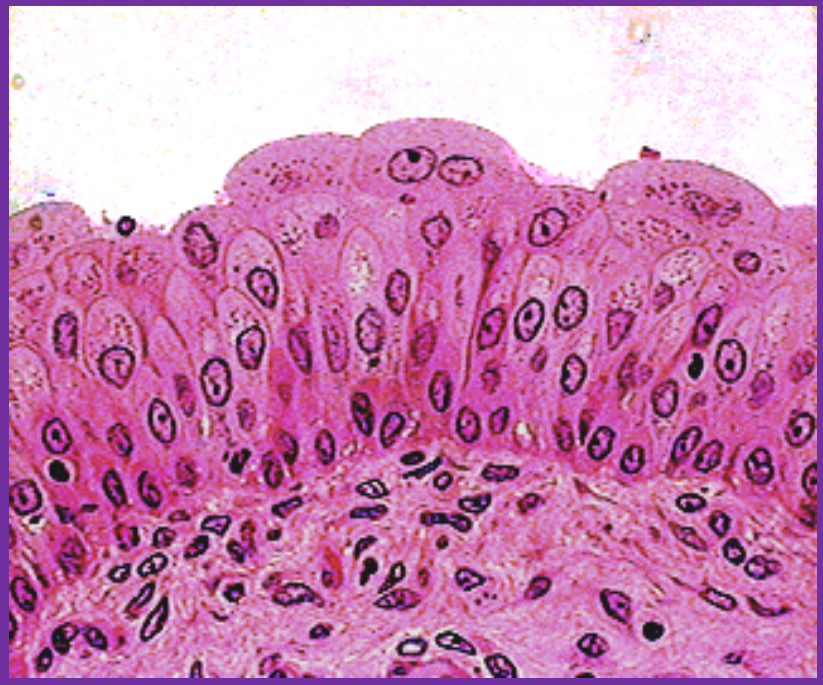
Epithelial Tissue – Pseudostratified Columnar

- Description
  - Single layer of cells of differing heights, some not reaching the free surface. Nuclei seen at different levels
  - May possess cilia or goblet cells
- Functions
  - Secretion, particularly of mucus; propulsion of mucus by ciliary action
- Locations
  - Cilia – trachea and most of the upper respiratory tract
  - No cilia – male sperm ducts, and ducts of large glands



Epithelial Tissue – Transitional

- Description
  - Resembles both stratified squamous and stratified cuboidal.
  - Basal cells cuboidal/columnar and surface cells are dome shaped or squamous depending on the degree of organ stretch
- Function
  - Stretches readily and permits distension of urinary organs
- Location
  - Lines ureters, bladder, and part of the urethra



Glandular Epithelia

- **Gland** – consists of one or more cells that make and secrete (export) a particular product called a **secretion**.
- **Secretion** – an aqueous solution that usually contains proteins
- **Two types:**
  - Endocrine
  - Exocrine

Endocrine

- Called ductless glands because they lose their ducts
- Structurally diverse, so one general description won’t do

Endocrine

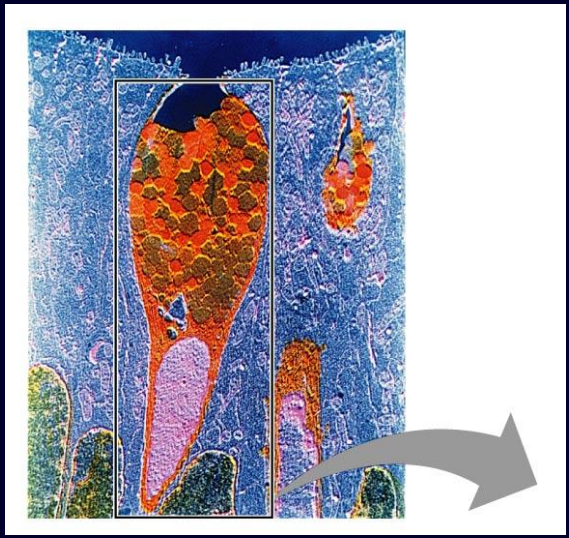
- Produce hormones that are excreted directly into the extracellular space (interstitial fluid). From there the hormones enter the blood or lymphatic fluid and travel to specific target organs
- Examples: Pancreas, thyroid, thymus, pituitary

Exocrine

- All secrete their products onto body surface or into body cavities.
- Numerous and diverse – mucous, sweat, tear, oil, salivary glands, liver (bile), pancreas (digestive enzymes)
- Types:
  - Unicellular
  - Multicellular

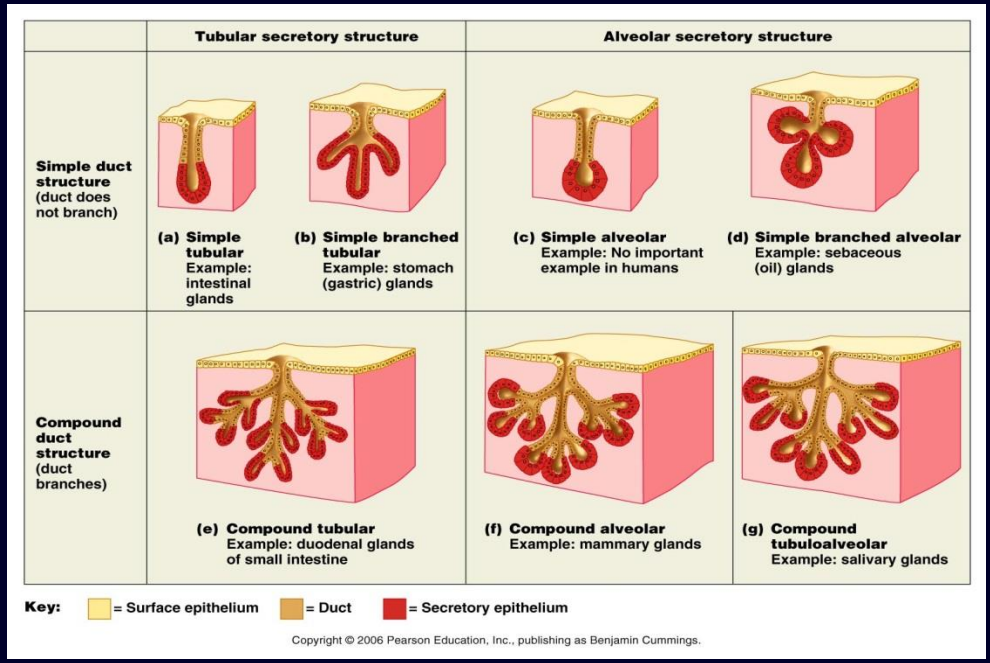
Exocrine - Unicellular

- Goblet cell – shaped like a goblet and produces **mucin** – dissolves in water → forms **mucus** the slimy coating that protects and lubricates surfaces.
  - Found in columnar epithelial tissues



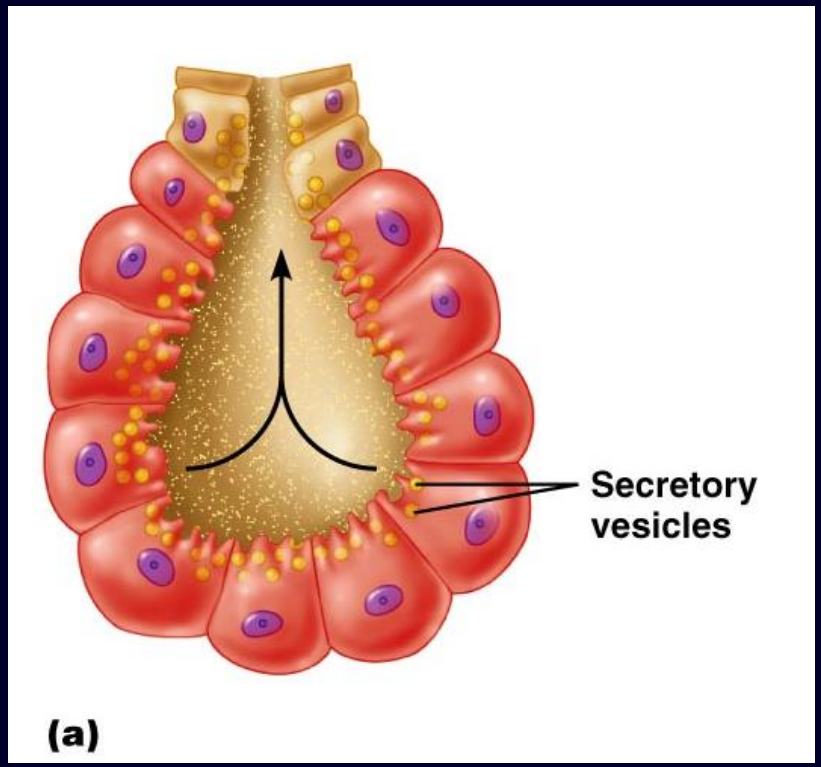
Exocrine - Multicellular

- Two Main Parts
  - Duct
  - Secretory unit
- Structural Classification
  - Simple
    - Unbranched duct
  - Compound
    - Branched duct



Exocrine - Multicellular

- Modes of secretion:
  - Merocrine – secrete their products my exocytosis as they are produced. Cells aren't altered
    - Pancreas, sweat, salivary glands



Exocrine - Multicellular

- Modes of secretion
  - Holocrine – cells accumulate their products within them until they rupture.
  - Releases secretions and dead cell fragments.
  - Cells “die for the cause.”
  - Sebaceous glands