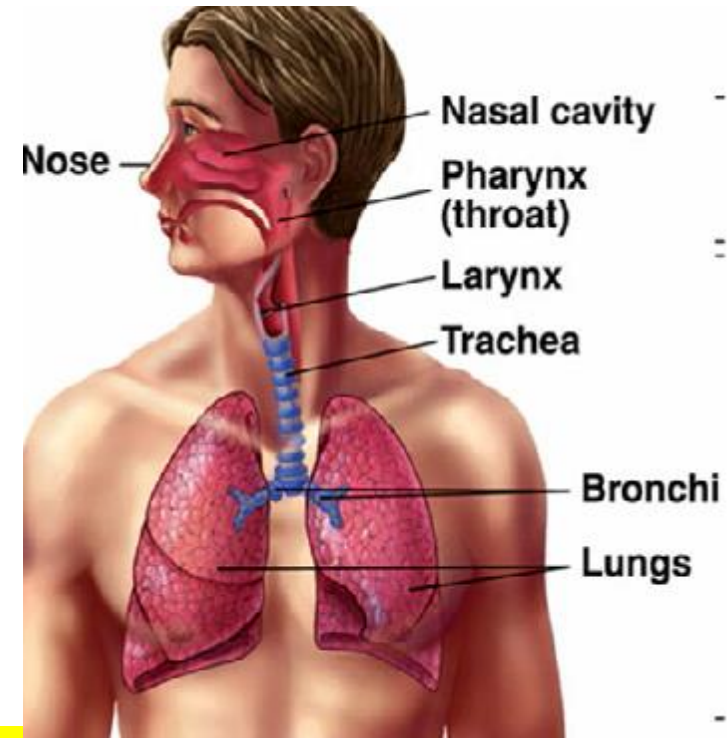
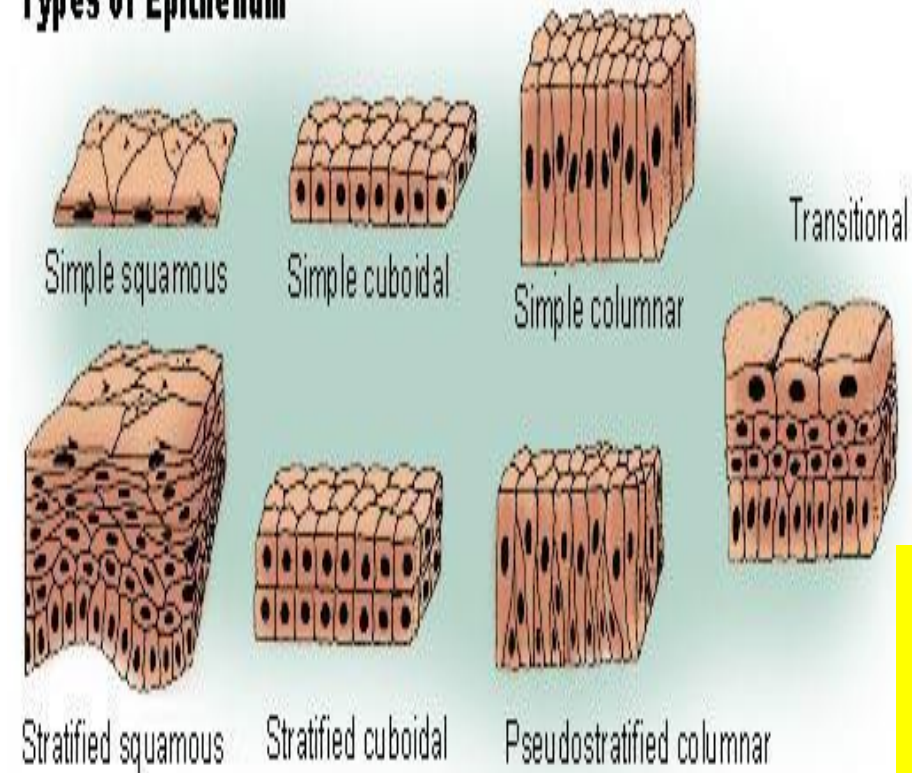


Epithelial Tissue

Types of Epithelium



Presented by:

Shaymaa H. Al-Kubaisy

B.Sc. M. & Ph. D. Med. Microbiology

Epithelial Tissue

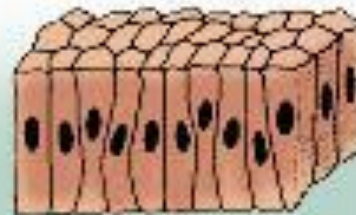
Types of Epithelium



Simple squamous

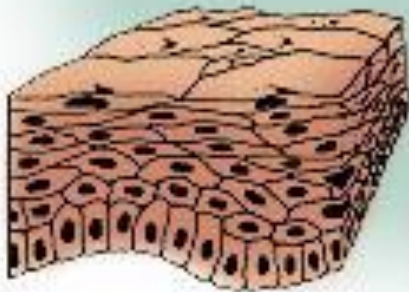


Simple cuboidal



Simple columnar

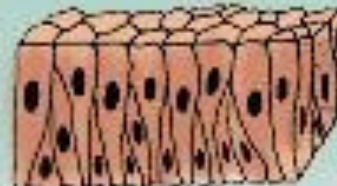
Transitional



Stratified squamous



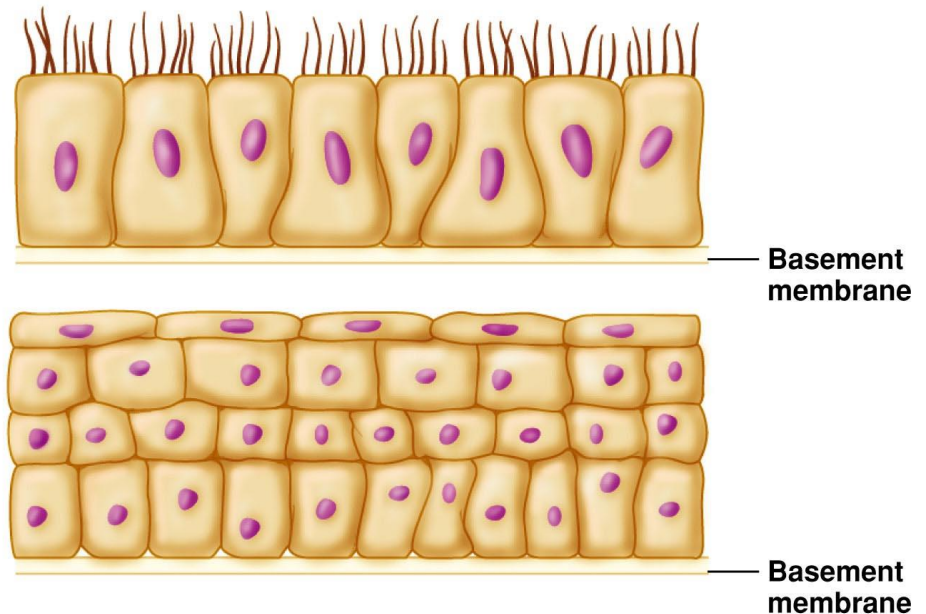
Stratified cuboidal



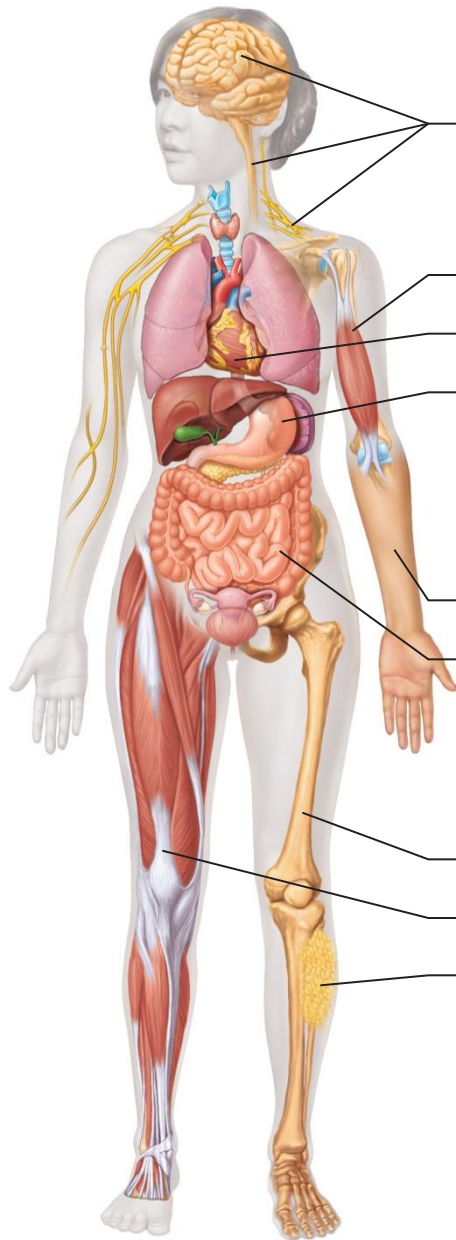
Pseudostratified columnar

Cells and Tissues

- Cells are the building blocks of all living things
- Tissues are groups of cells that are similar in structure and function – protection, absorption, secretion, movement, electrical impulses, etc.



(c) Epithelial cells



Nervous tissue: Internal communication

- Brain, spinal cord, and nerves

Muscle tissue: Contracts to cause movement

- Muscles attached to bones (skeletal)
- Muscles of heart (cardiac)
- Muscles of walls of hollow organs (smooth)

Epithelial tissue: Forms boundaries between different environments, protects, secretes, absorbs, filters

- Skin surface (epidermis)
- Lining of GI tract organs and other hollow organs

Connective tissue: Supports, protects, binds other tissues together

- Bones
- Tendons
- Fat and other soft padding tissue

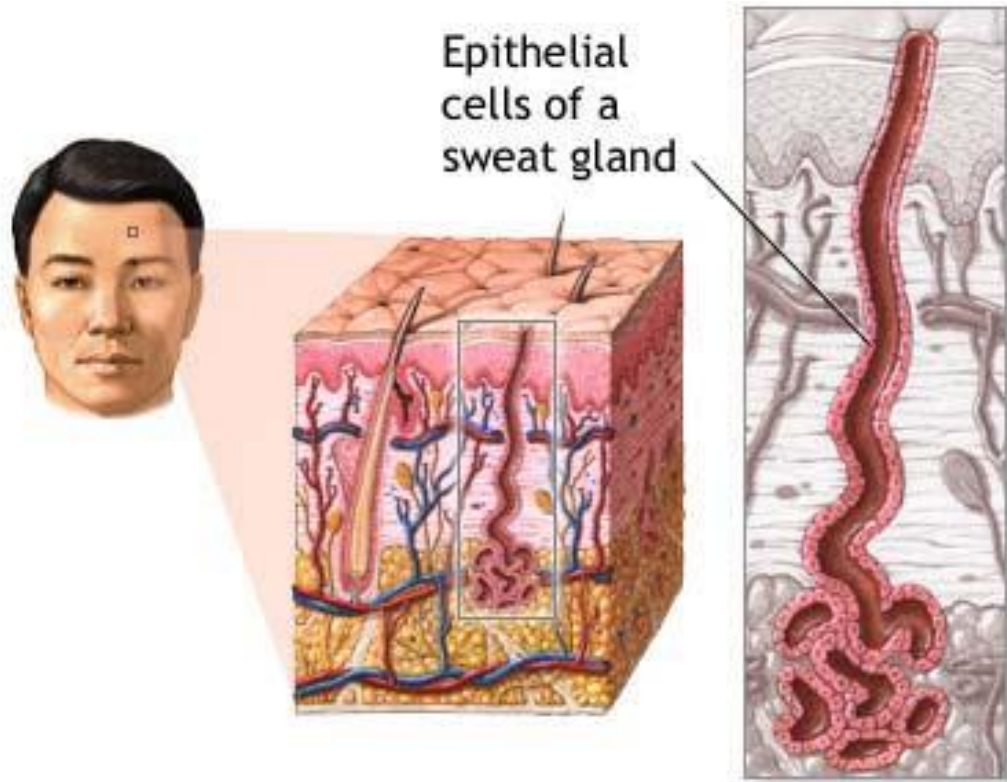
Figure 4.1

Tissues

- Four types of tissue
 - **Epithelial = covering**
 - **Connective = support**
 - Muscle = movement
 - Nervous = control
- Most organs contain all 4 types
- Connective tissue has non-living extra-cellular material (matrix) between its cells

Tissues

- Epithelial
 - Covers body surfaces
 - Lines body cavities
 - Lines hollow organs
 - Ducts
 - Forms glands

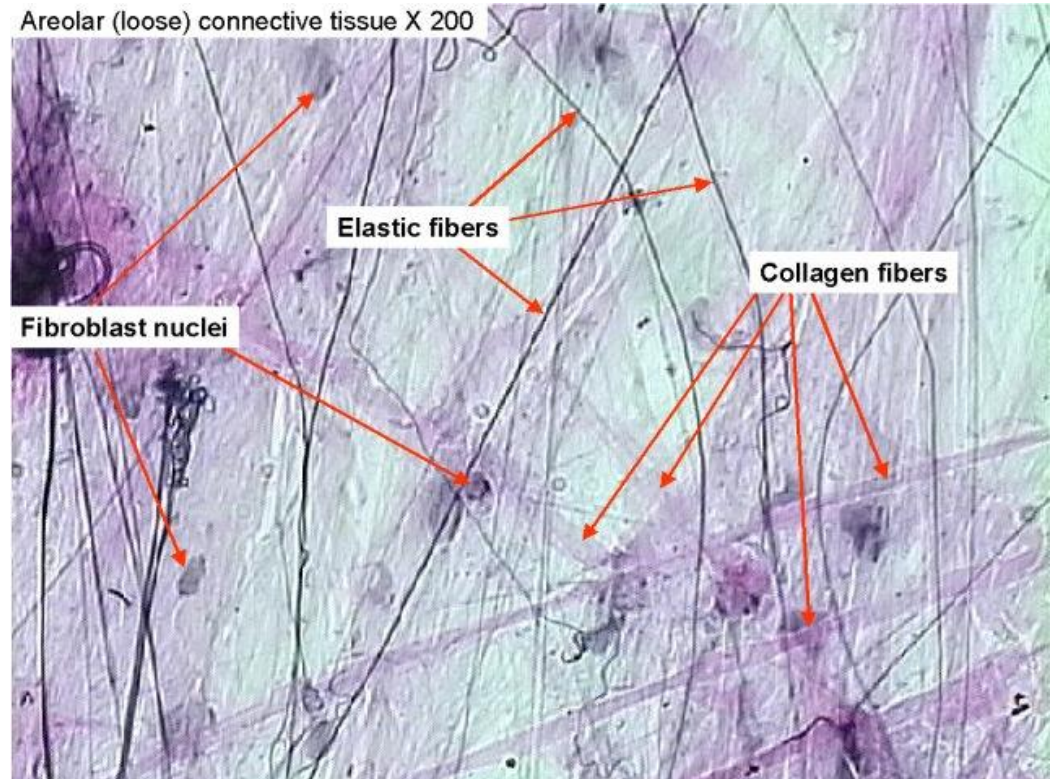


Epithelial Tissue (Epithelium)

- Two main types (by location):
 1. Covering and lining epithelia
 - On external and internal surfaces
 2. Glandular epithelia
 - Secretory tissue in glands

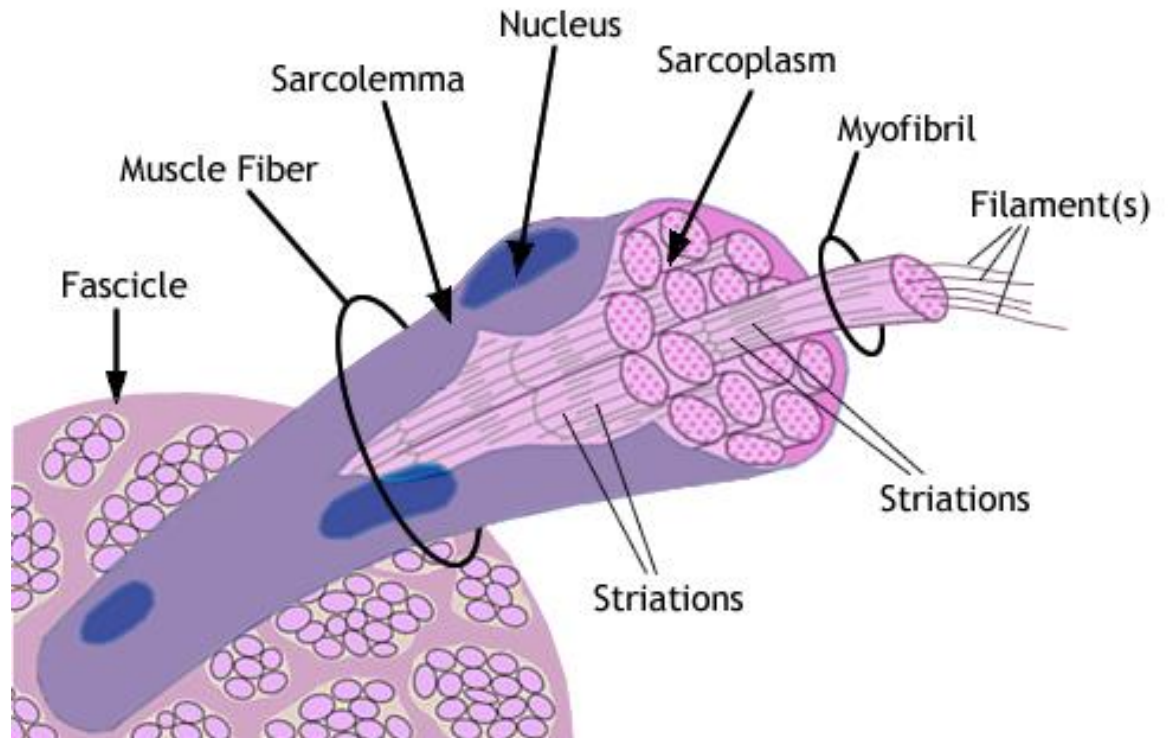
Tissues

- Connective
 - Protection and support
 - Binds organs together
 - Stores energy – bone marrow
 - Immunity



Tissues

- Muscle
 - Movement

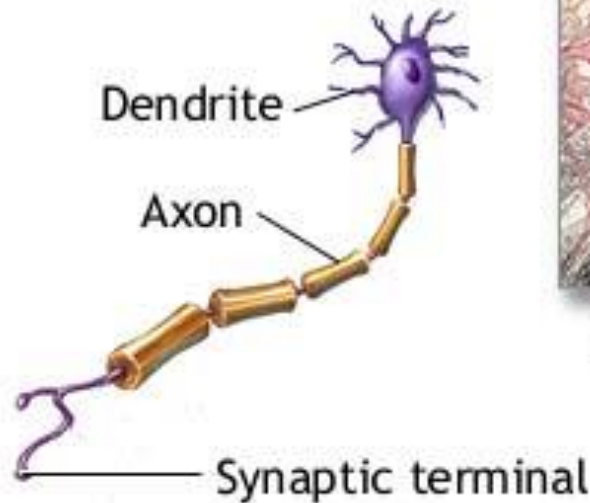


Tissues

- Nerve
 - Detects change
 - Nerve impulses
 - Homeostasis



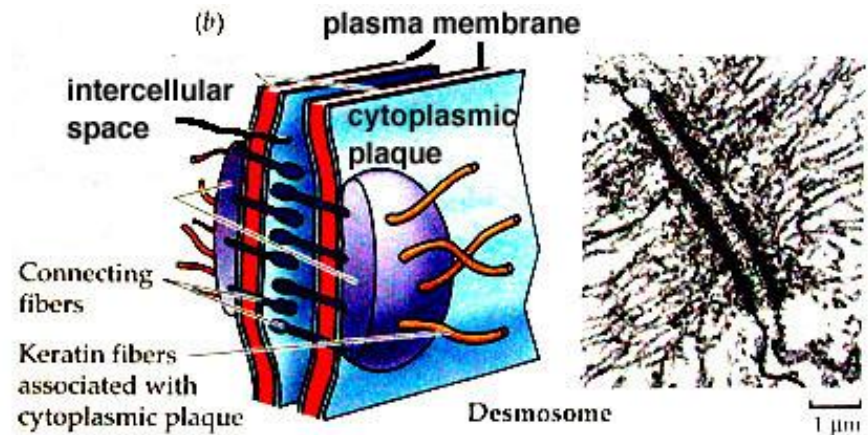
Aging brain



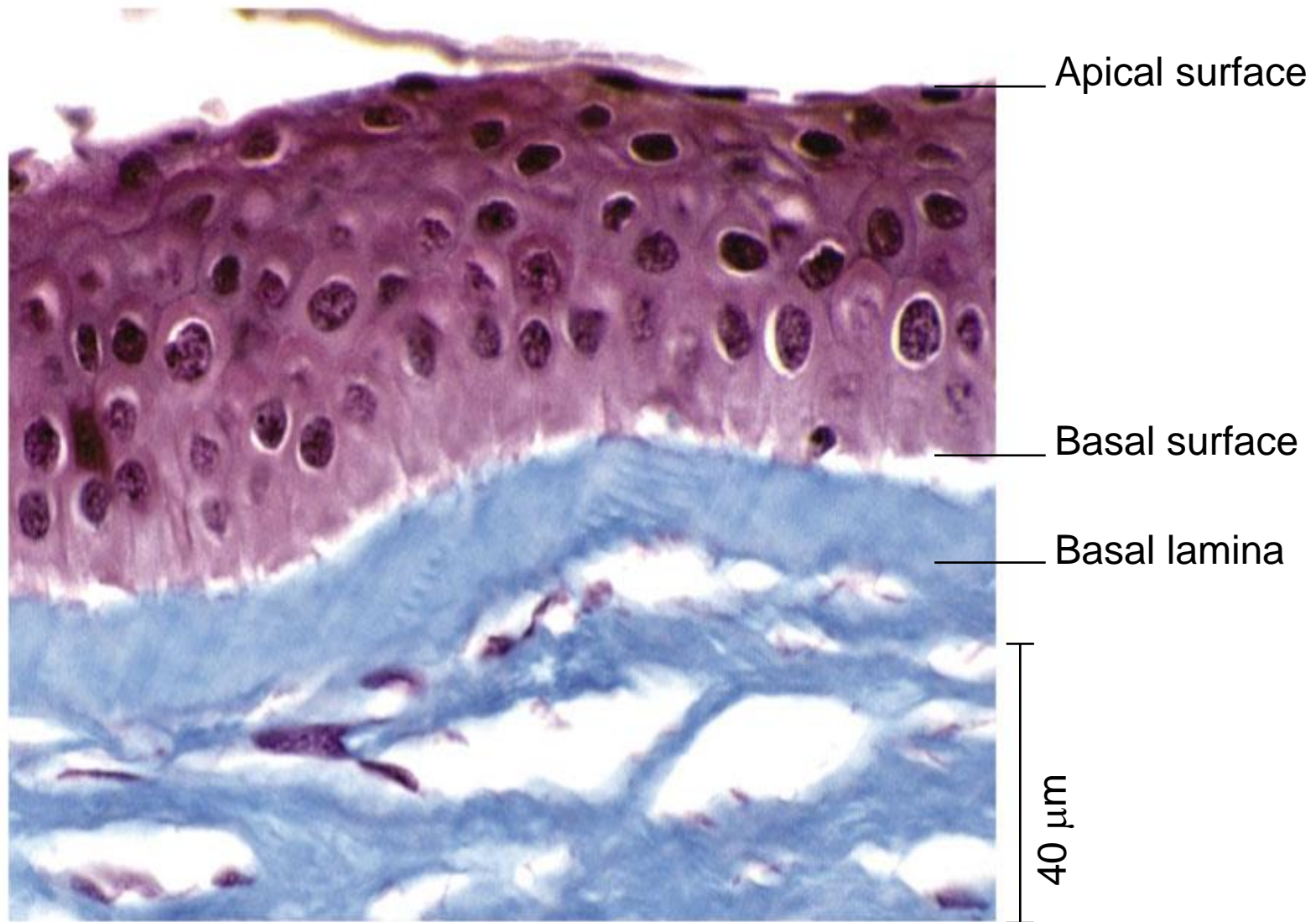
Neurons in aging brain

Epithelial Tissue

- Tightly packed cells
- Cell Junctions – form continuous sheets held together by **cell junctions**.
 - Tight junctions – Nothing passes through
- Surfaces – apical, lateral and basal



Desmosomes tightly link adjacent cells but permit materials to move around them in the intercellular space. Anchored in dense plaques, cell adhesion proteins cross the intercellular space, binding adjacent cells together. Keratin fibers extend through the cytoplasm from one plaque to another.

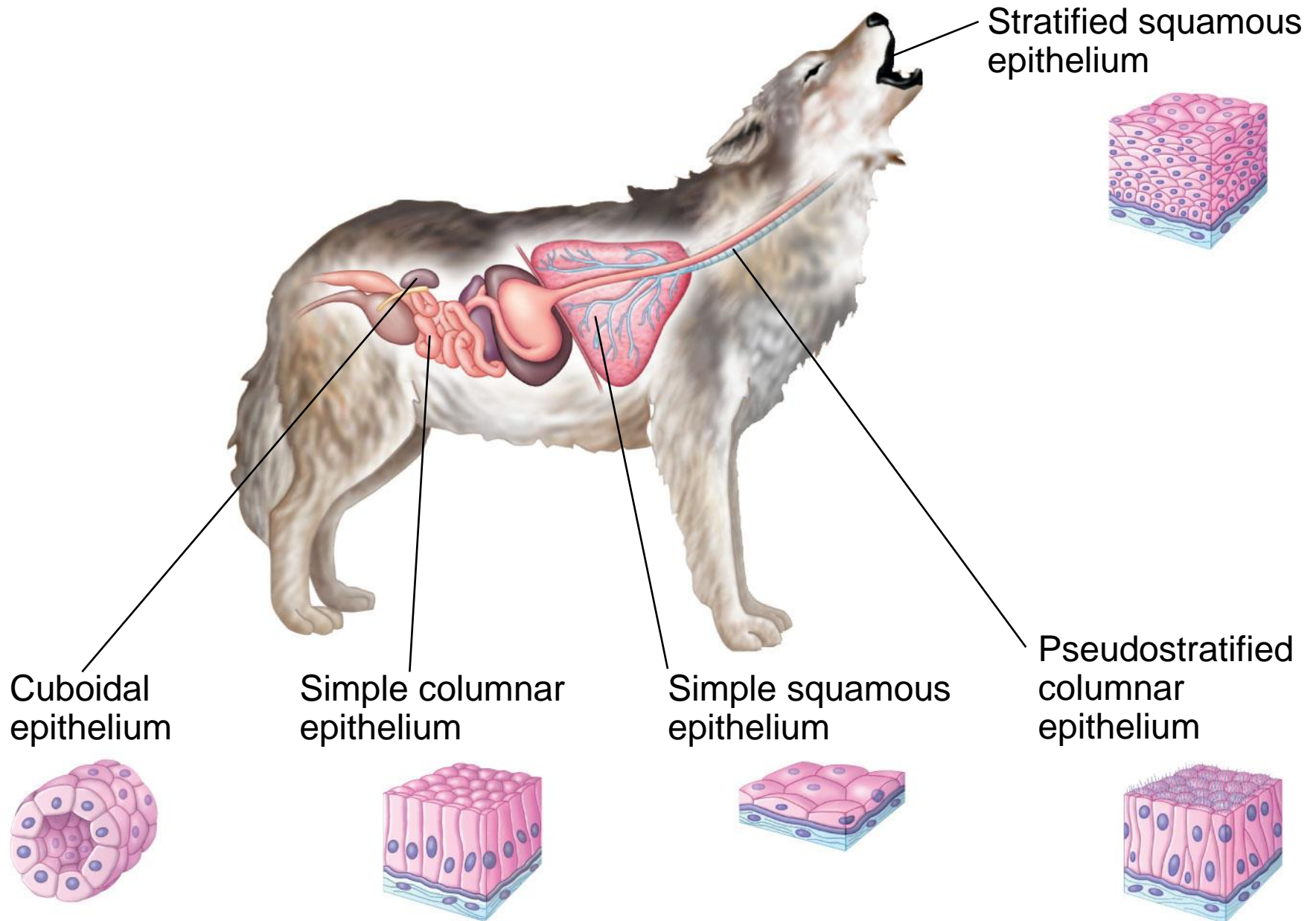


Polarity of epithelia

Epithelial Tissues

- Found in different areas
 - Body coverings
 - Body linings
 - Glandular tissue
- Functions
 - Protection – Skin, lining of internal organs
 - Absorption – intestines
 - Filtration – Kidney
 - Secretion – Hormones, mucus, sweat, etc.

1. Epithelial Tissue



Epithelial Tissues

- Two types:

1. Covering and lining epithelium

- Outer covering of skin, and internal organs
- Body cavities
- Blood vessels and ducts
- Interior of respiratory, digestive, urinary and reproductive organs
- Parts of sense organs

2. Glandular epithelium

- Secreting portion of glands

Epithelium Characteristics

- Cells fit closely together
- Tissue layer always has one exposed surface (Apical surface)
- The lower surface (basal surface) is bound by a **basement membrane** – Fibers
- The side surface (lateral surface) is bound to other epithelial cells.
- Avascular (have no blood supply)
- Nerve supply
- Regenerate easily if well nourished

Classification of Epithelium

- Number of cell layers
 - Simple – one layer: diffusion (lungs), osmosis, filtration (kidneys), secretion (glands), absorption (intestines)
 - Stratified – more than one layer: protection, secretion

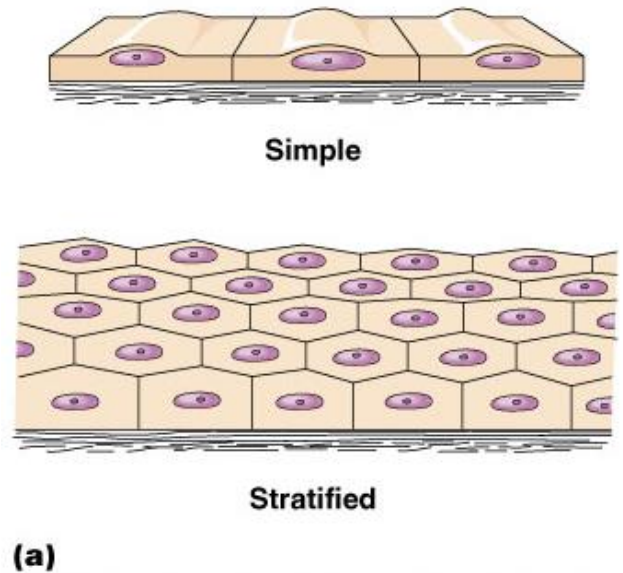


Figure 3.16a

Classification of Epithelium

- Shape of cells
 - Squamous – flattened
 - Cuboidal – cube-shaped
 - Columnar – column-like
- Cilia
 1. Nonciliated – absorptive cells (microvilli) and goblet cells (secrete mucus)
 2. Ciliated – to move substances (Ex. Ovaries)

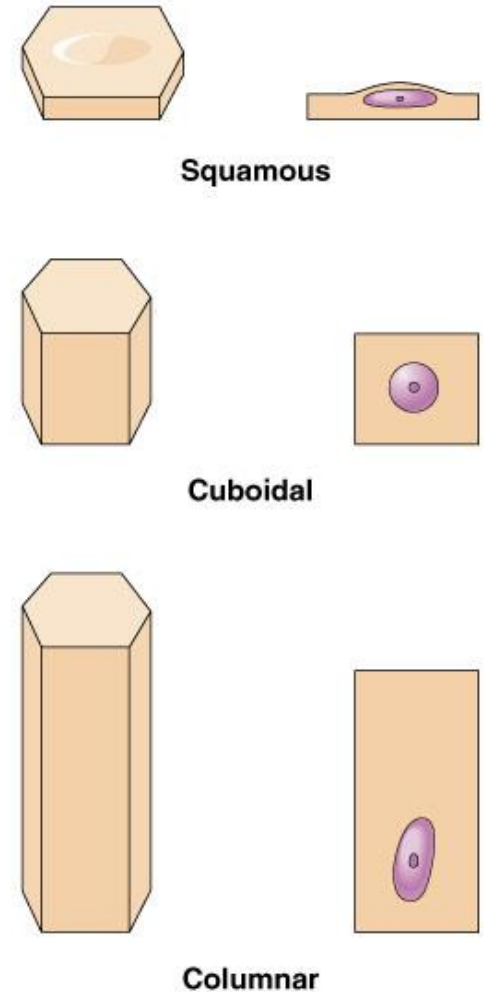
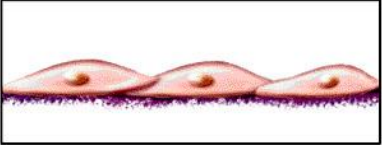
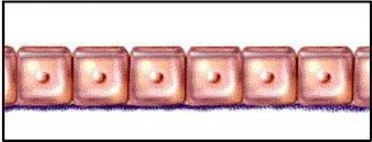



Figure 3.16b

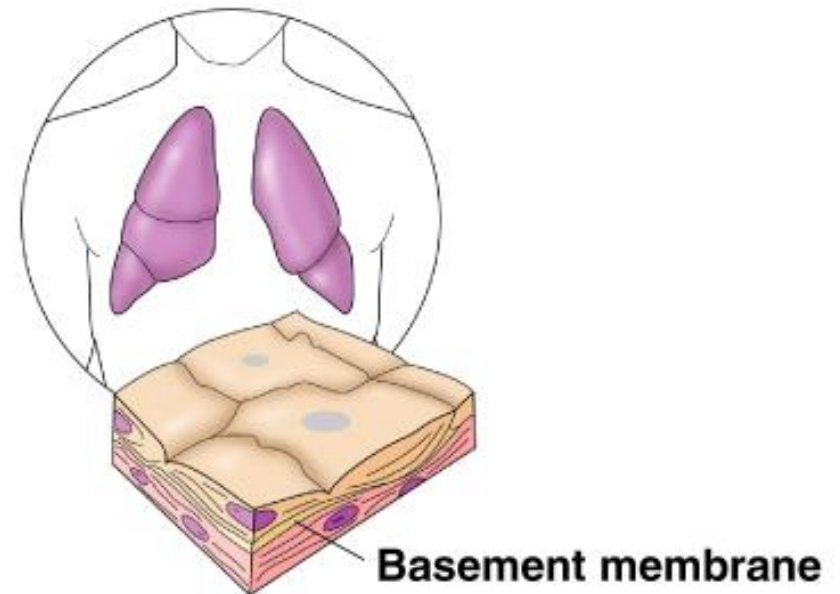
(b)

Simple Epithelia

	Type	Cell shape	Example
Squamous 	Squamous	Squashed	Endothelium (lines blood vessels), mesothelium (serous lining of celom) Walls of glands
Cuboidal 	Cuboidal	Cubed	
Columnar 	Columnar	Columns	Lining of gut tube; sometimes with cilia like lining of uterine tube
	Pseudo-stratified	Flat cells give rise to columns	With cilia in respiratory tubes to move mucous/particles out of lungs

Simple Epithelium

- Simple squamous
 - Single layer of flat cells
 - Usually forms membranes
 - Lines body cavities
 - Lines lungs and capillaries



(a) Simple squamous

Figure 3.17a

Simple Epithelium

- Simple cuboidal
 - Single layer of cube-like cells
 - Common in glands and their ducts
 - Forms walls of kidney tubules
 - Covers the ovaries

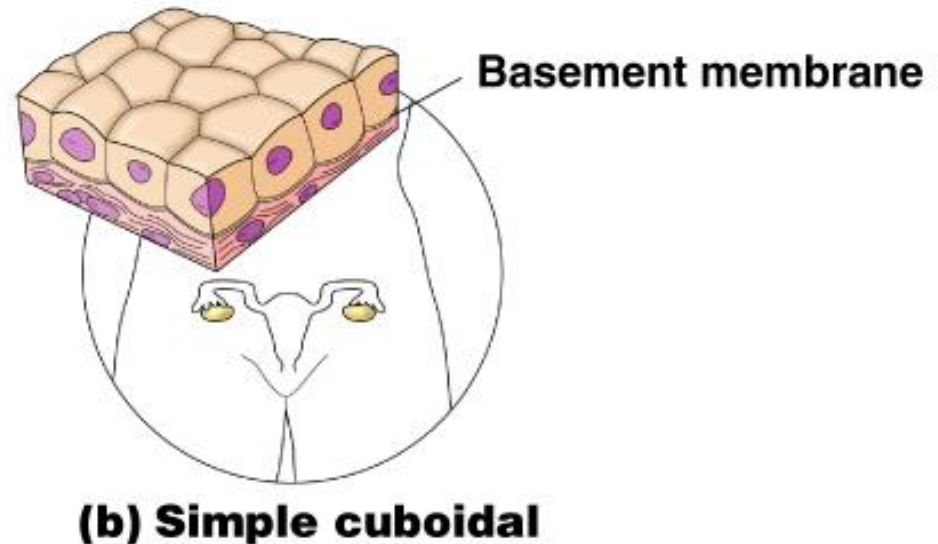
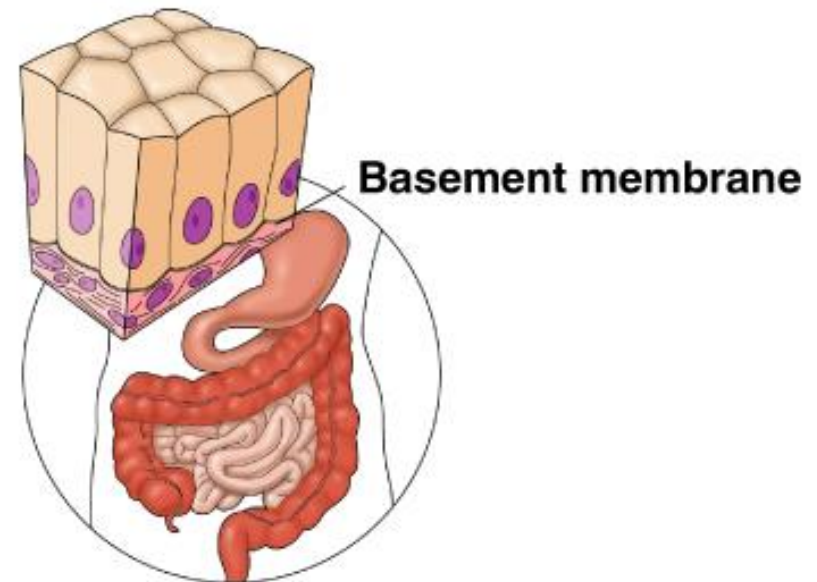


Figure 3.17b

Simple Epithelium

- Simple columnar
 - Single layer of tall cells
 - Often includes goblet cells -- produce mucus
 - Lines digestive tract – absorption of nutrients.



(c) Simple columnar

Figure 3.17c

Stratified Epithelium

- Stratified squamous
 - Cells at the free edge are flattened
 - Cells below can have other shapes
 - Found as a protective covering where friction is common
 - Locations
 - Skin
 - Mouth
 - Esophagus

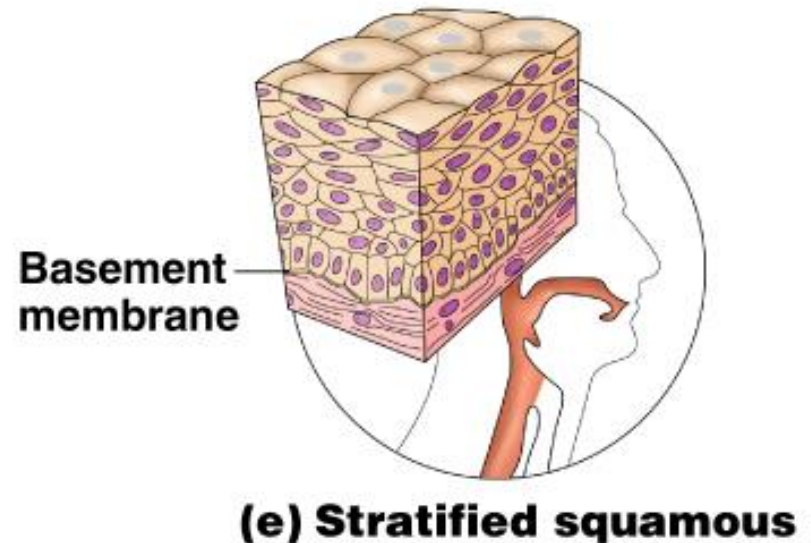


Figure 3.17e

Stratified Epithelium

- Stratified squamous
 1. Keratinized stratified squamous
 - Keratin deposit in apical layer and several layers below it.
 2. Non-keratinized stratified squamous
 - No keratin

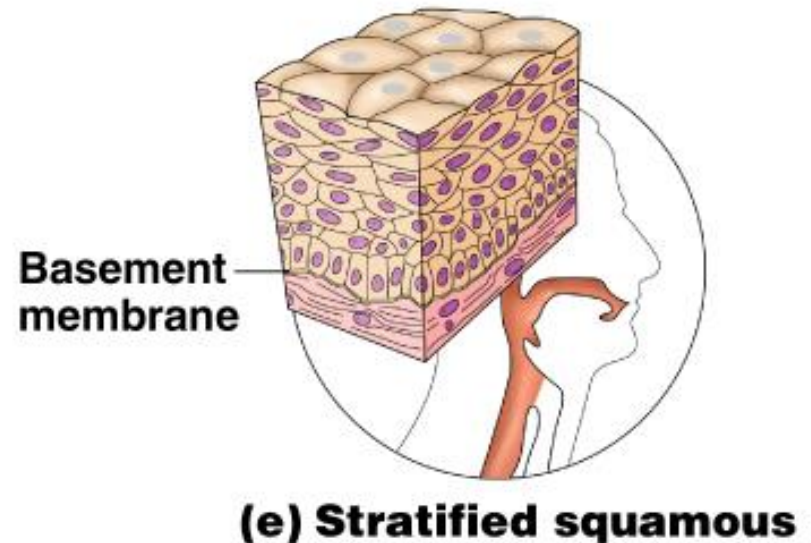


Figure 3.17e

Stratified Epithelium

- Stratified cuboidal – Rare
 - More than two layers of cuboidal cells
 - Protection, secretion, absorption
- Stratified columnar – Rare
 - Surface cells are columnar, cells underneath vary in size and shape
 - Protection and secretion

Stratified Epithelium

- Transitional epithelium
 - Elastic
 - Shape of cells depends upon the amount of stretching
 - As the cells stretch, they become flattened
 - Lines organs of the urinary system

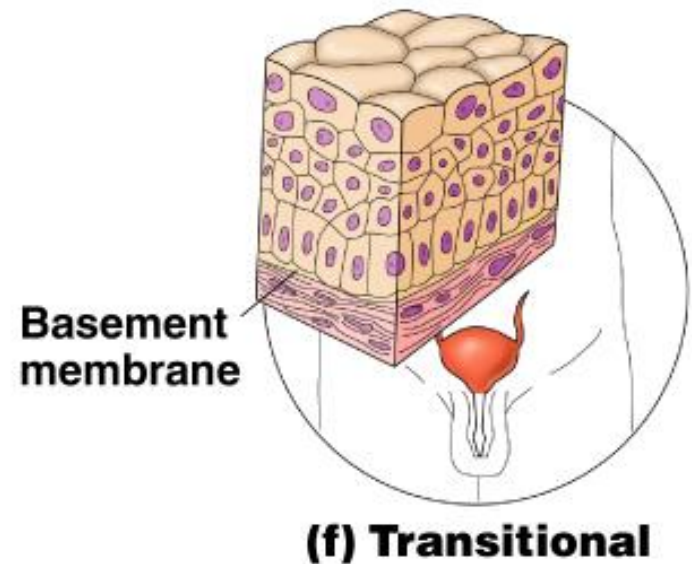
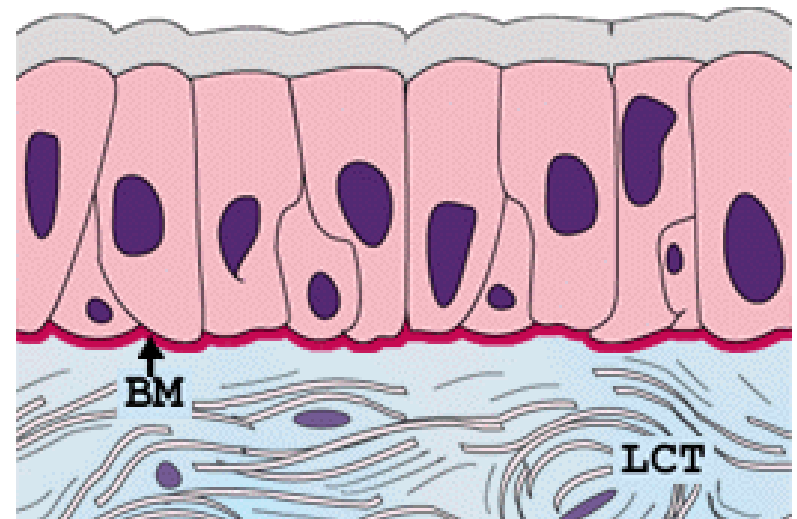


Figure 3.17f

Pseudostratified Columnar Epithelium

- Not a true stratified tissue.
- All cells are attached to the basement membrane but not all reach the apical surface.
- When viewed from the side, it appears that they have several layers



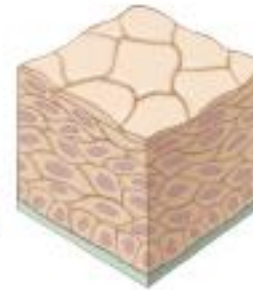
Simple squamous

- Lines blood vessels and air sacs of lungs
- Permits exchange of nutrients, wastes, and gases



Stratified squamous

- Outer layer of skin, mouth, vagina
- Protects against abrasion, drying out, infection



Simple cuboidal

- Lines kidney tubules and glands
- Secretes and reabsorbs water and small molecules



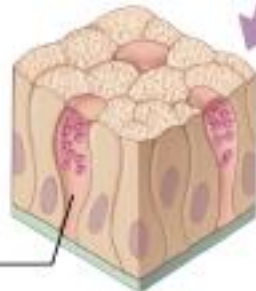
Stratified cuboidal

- Lines ducts of sweat glands
- Secretes water and ions



Simple columnar

- Lines most digestive organs
- Absorbs nutrients, produces mucus



Stratified columnar

- Lines epididymus, mammary glands, larynx
- Secretes mucus

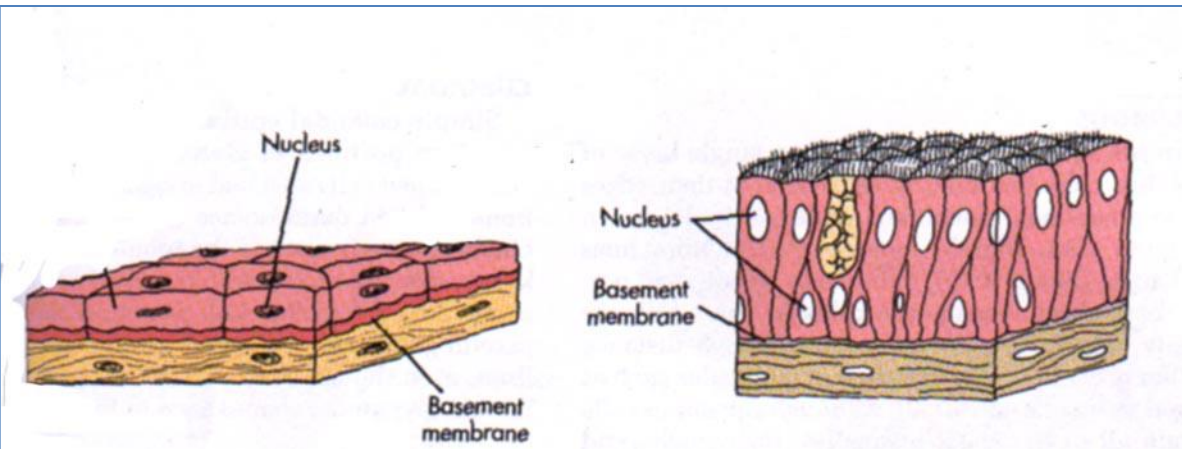


(a) Most epithelial tissues line or cover surfaces or body cavities

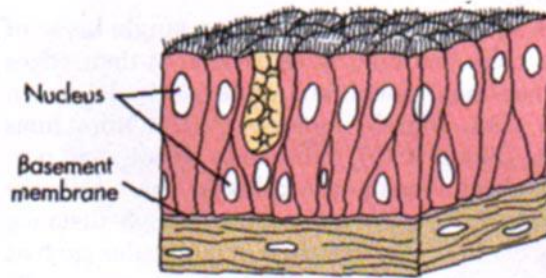
Quiz!!

Can You Identify the
Classes of Epithelium?

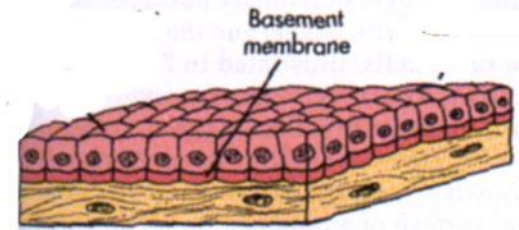
A



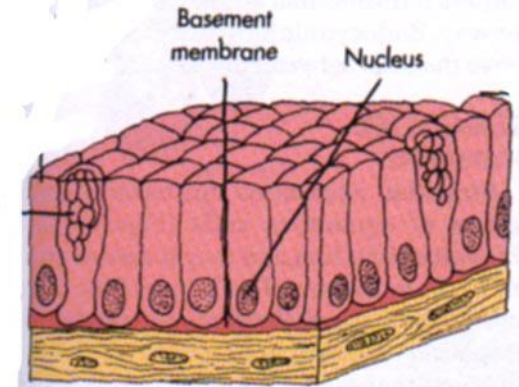
B



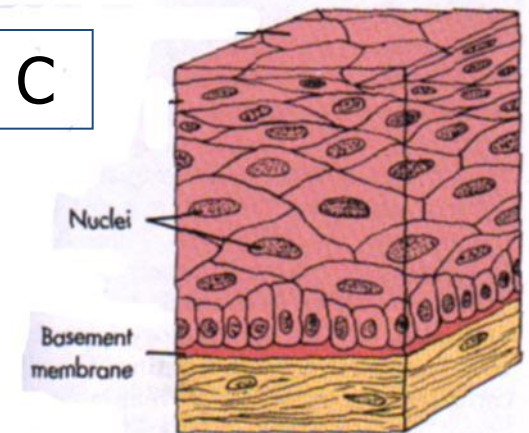
E



D

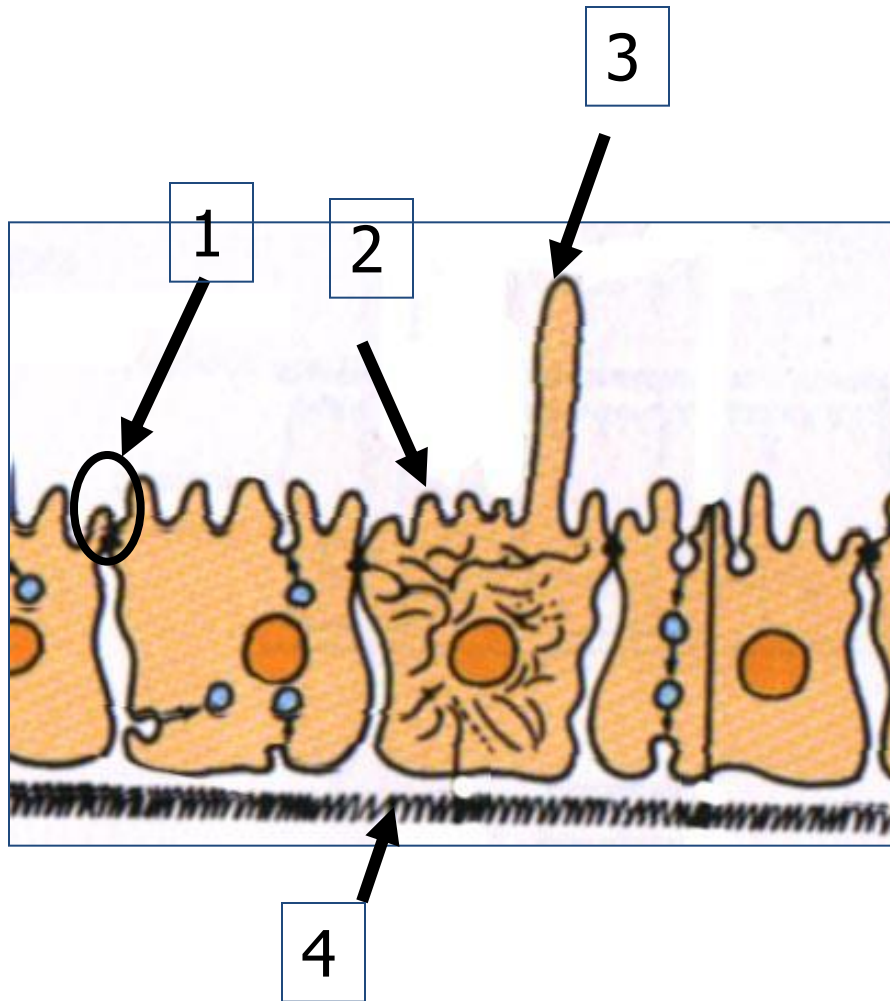


C



Name that Epithelial Feature!

(name and location on cell)



- Cilia →3
- Tight junction →1
- Microvilli →2
- Basement membrane →4

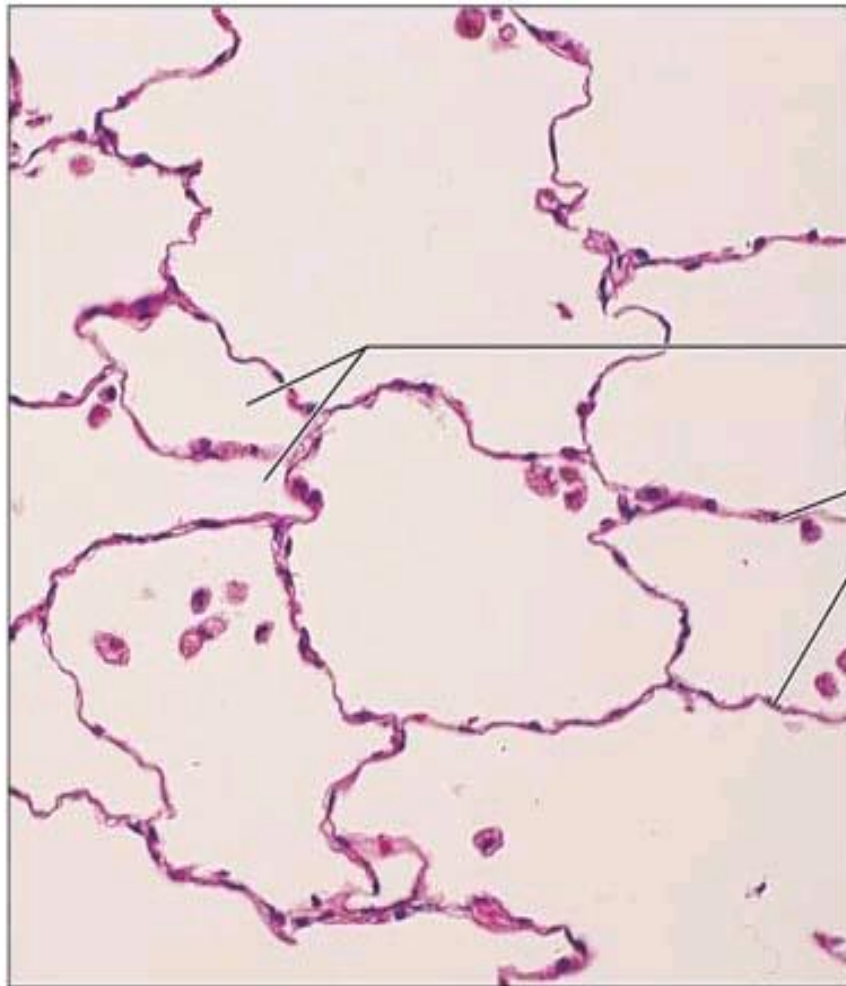
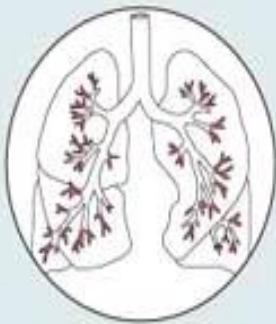
(a) Simple squamous epithelium

Description: Single layer of flattened cells with disc-shaped central nuclei and sparse cytoplasm; the simplest of the epithelia.



Function: Allows passage of materials by diffusion and filtration in sites where protection is not important; secretes lubricating substances in serosae.

Location: Kidney glomeruli; air sacs of lungs; lining of heart, blood vessels, and lymphatic vessels; lining of ventral body cavity (serosae).



Air sacs of lung tissue

Nuclei of squamous epithelial cells

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

Epithelia: Simple Squamous

- Two other locations
 - Endothelium
 - The lining of lymphatic vessels, blood vessels, and heart
 - Mesothelium
 - The epithelium of serous membranes in the ventral body cavity

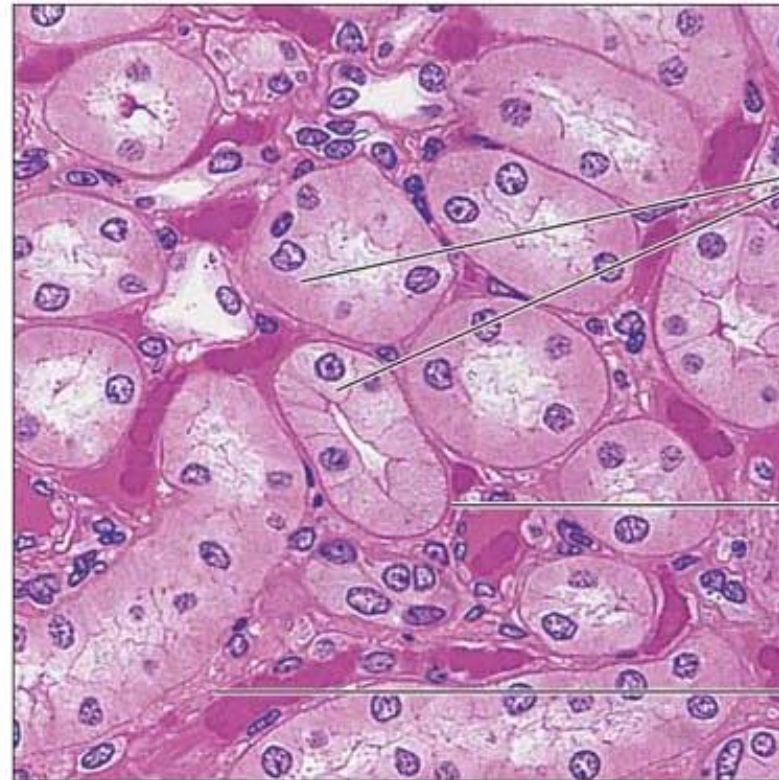
(b) Simple cuboidal epithelium

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.



Simple cuboidal epithelial cells

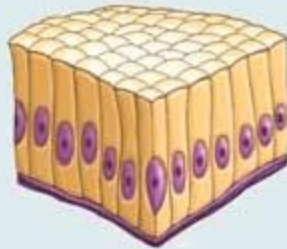
Basement membrane

Connective tissue

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

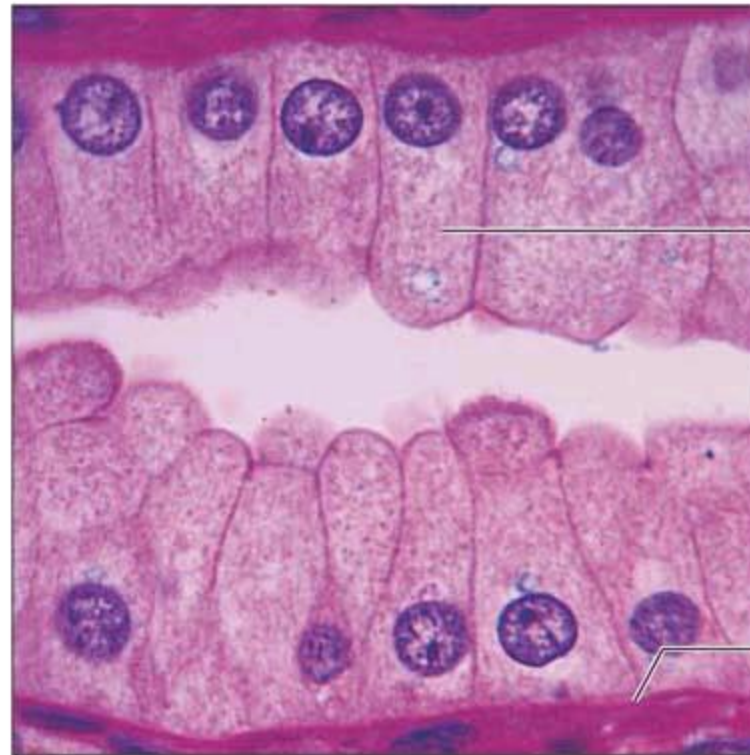
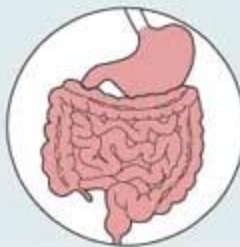
(c) Simple columnar epithelium

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.



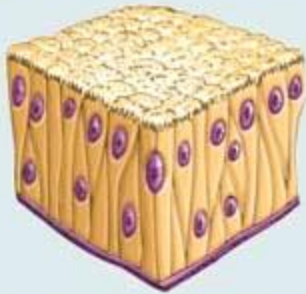
Simple columnar epithelial cell

Basement membrane

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

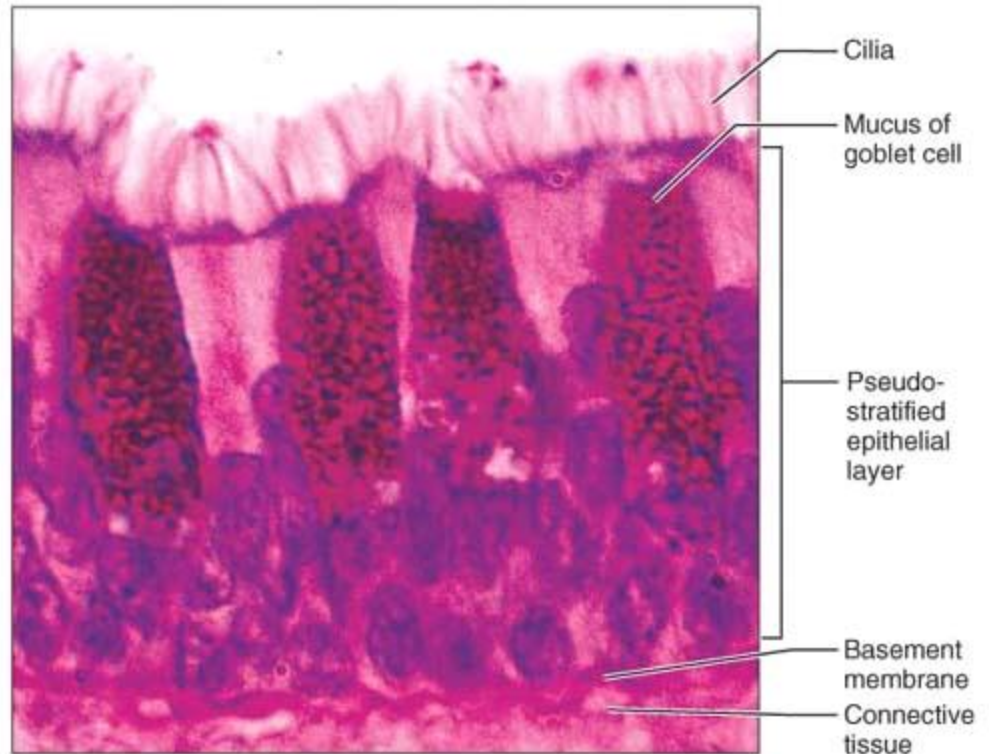
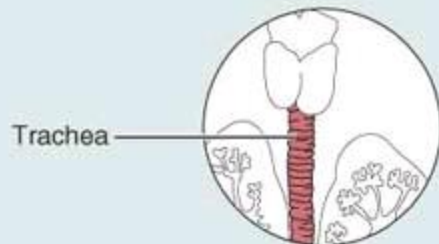
(d) Pseudostratified columnar epithelium

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 (400 \times).

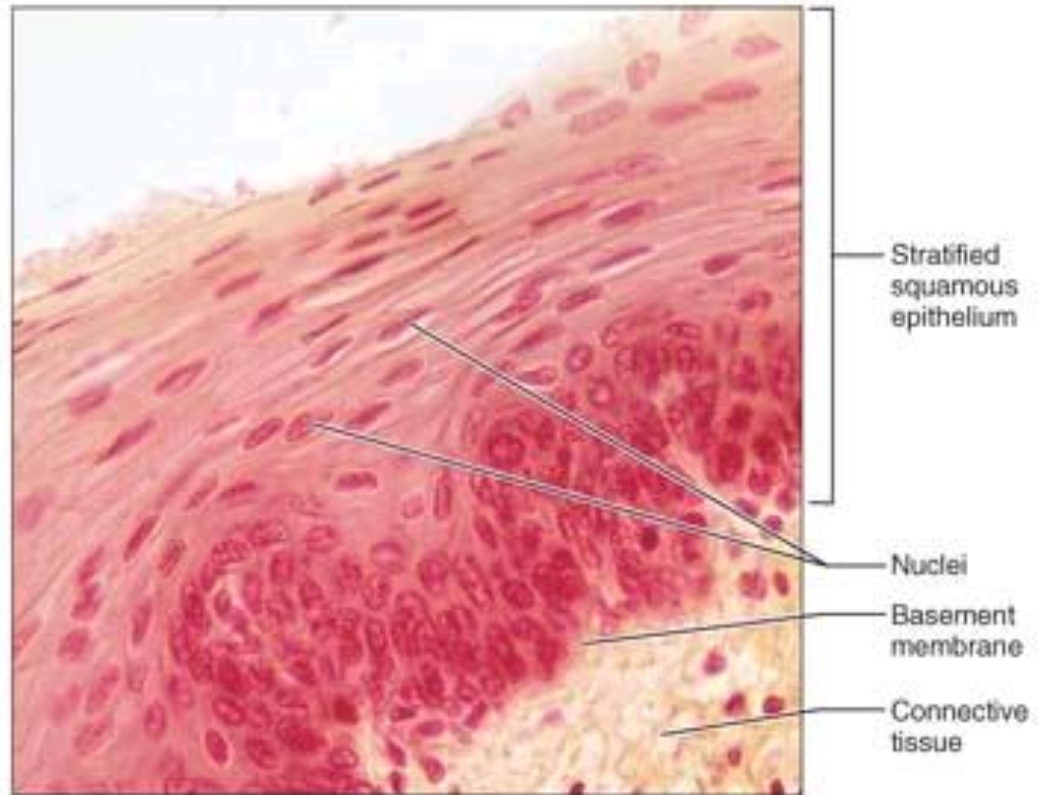
(e) Stratified squamous epithelium

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.

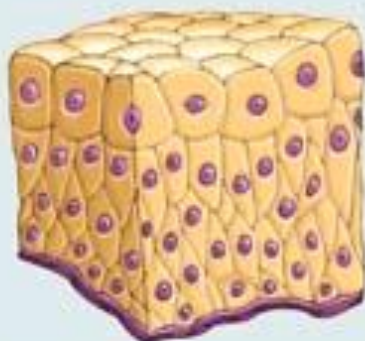
Location: Nonkeratinized type forms the moist linings of the esophagus, mouth, and vagina; keratinized variety forms the epidermis of the skin, a dry membrane.



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

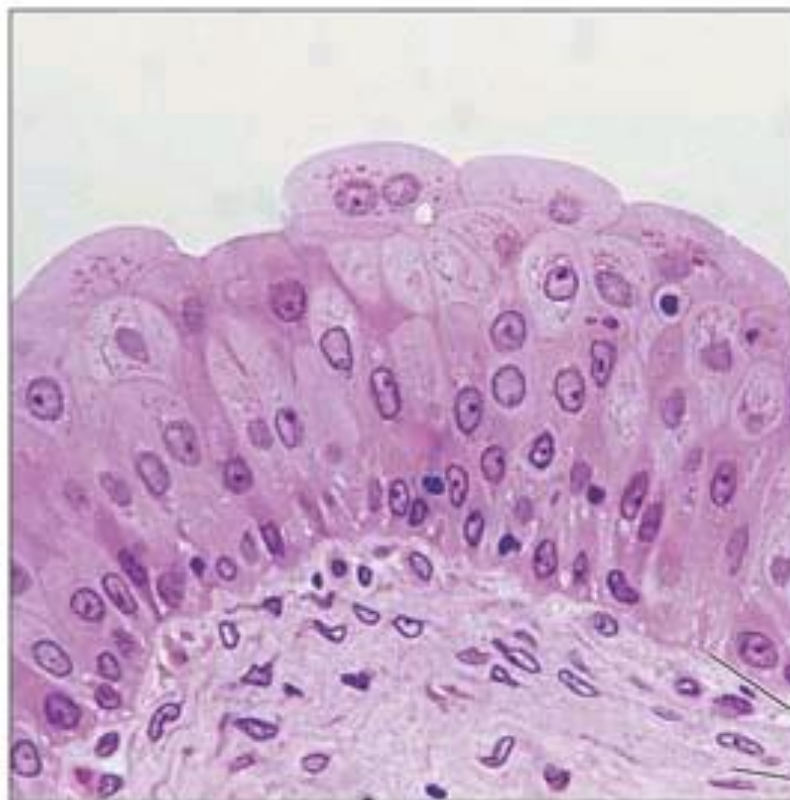
(f) Transitional epithelium

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.



Transitional epithelium

Basement membrane
Connective tissue

Photomicrograph: Transitional epithelium lining the bladder, relaxed state (500 \times); 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.

Glandular Epithelia

- A gland is one or more cells that makes and secretes an aqueous fluid
- Classified by:
 - Site of product release—endocrine or exocrine
 - Relative number of cells forming the gland—unicellular (e.g., goblet cells) or multicellular

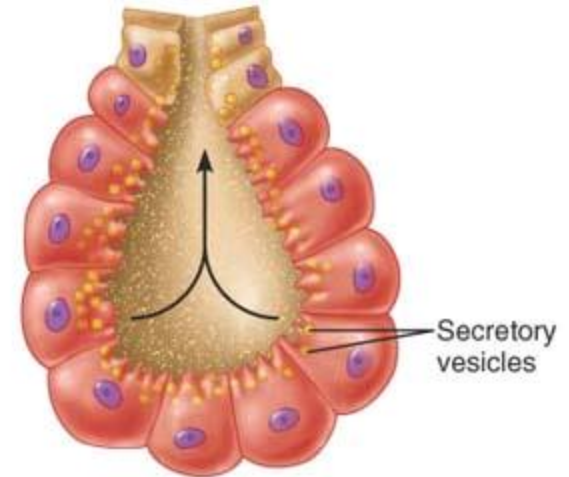
Glands: epithelial cells that secrete

- **Exocrine Glands**

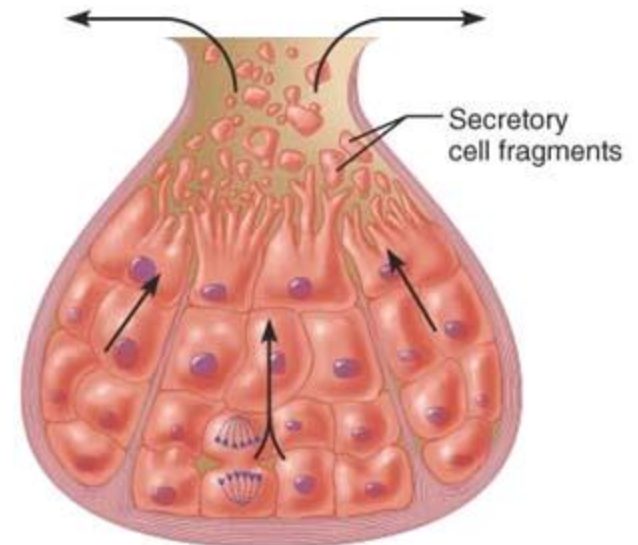
- Secrete substance onto body surface or into body cavity
- Have ducts
- E.G., salivary, mammary, pancreas, liver

- **Endocrine Glands**

- Secrete product into blood stream
- Either stored in secretory cells or in follicle surrounded by secretory cells
- Hormones travel to target organ to increase response
- No ducts



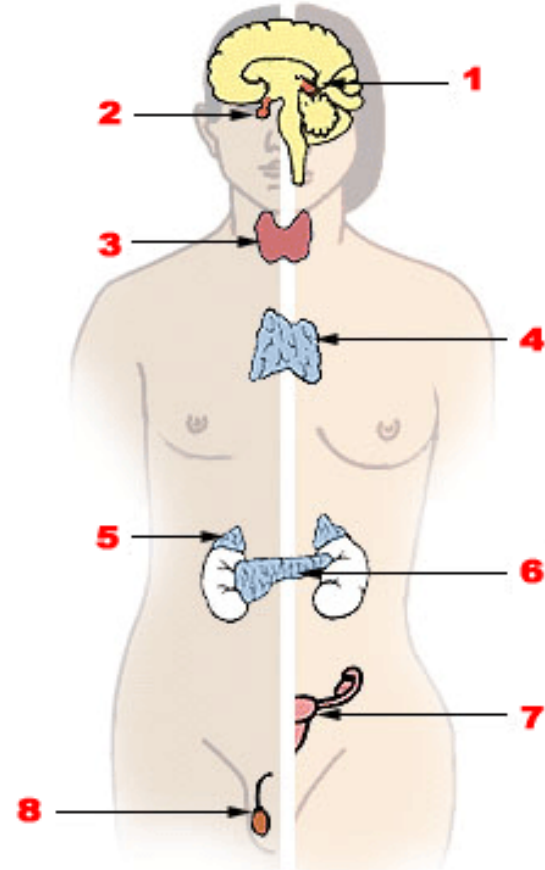
(a)



(b)

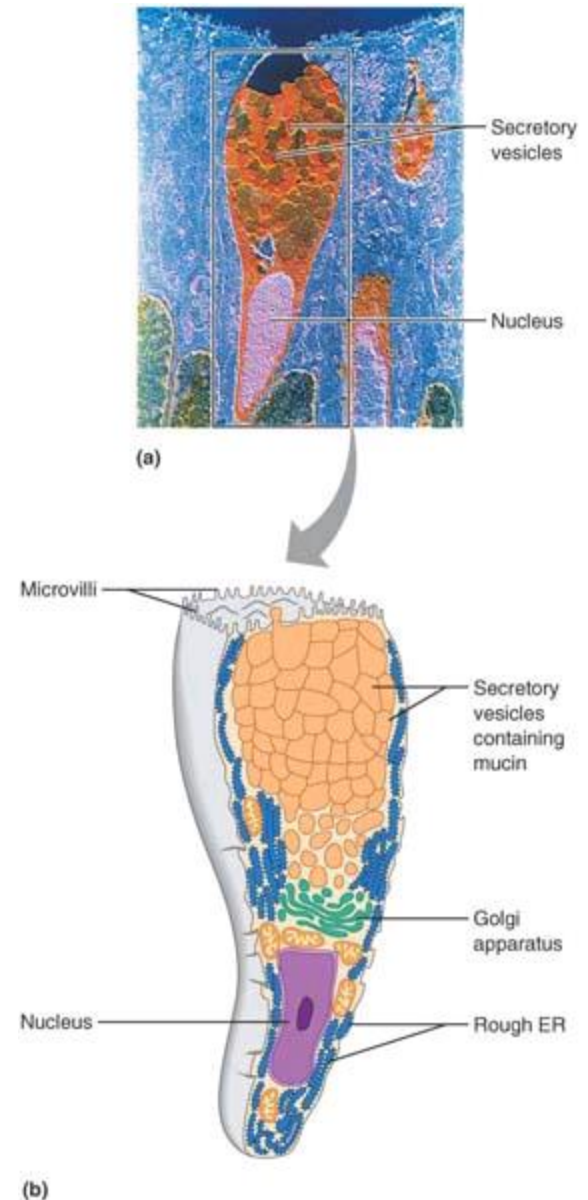
Endocrine Glands

- Secretion enter the interstitial (between cells) fluid and diffuse into blood stream – Hormones
 - Pituitary
 - Thyroid
 - Adrenal
- Secretions include amino acids, proteins, glycoproteins, and steroids



Exocrine Glands

- Secretion into ducts that empty at the surface of covering and lining epithelium or onto a free surface
 - Skin
 - Interior surface of a hollow organ (lumen)
- Examples
 - Sweat
 - Saliva
- Some glands of the body have both endocrine and exocrine parts
 - Pancreas
 - Ovaries and testes



(a)



Microvilli

Secretory vesicles containing mucin

Rough ER

Golgi apparatus

Nucleus

(b)

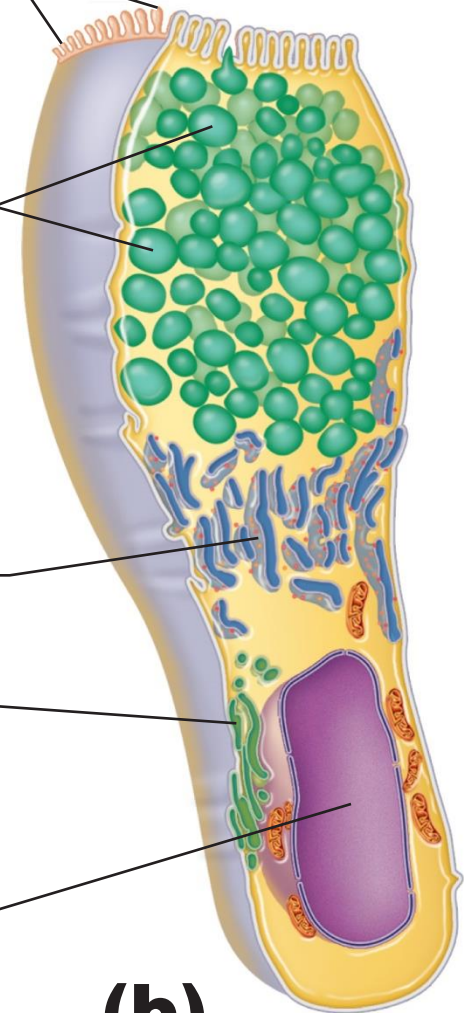


Figure 4.4

Exocrine Glands

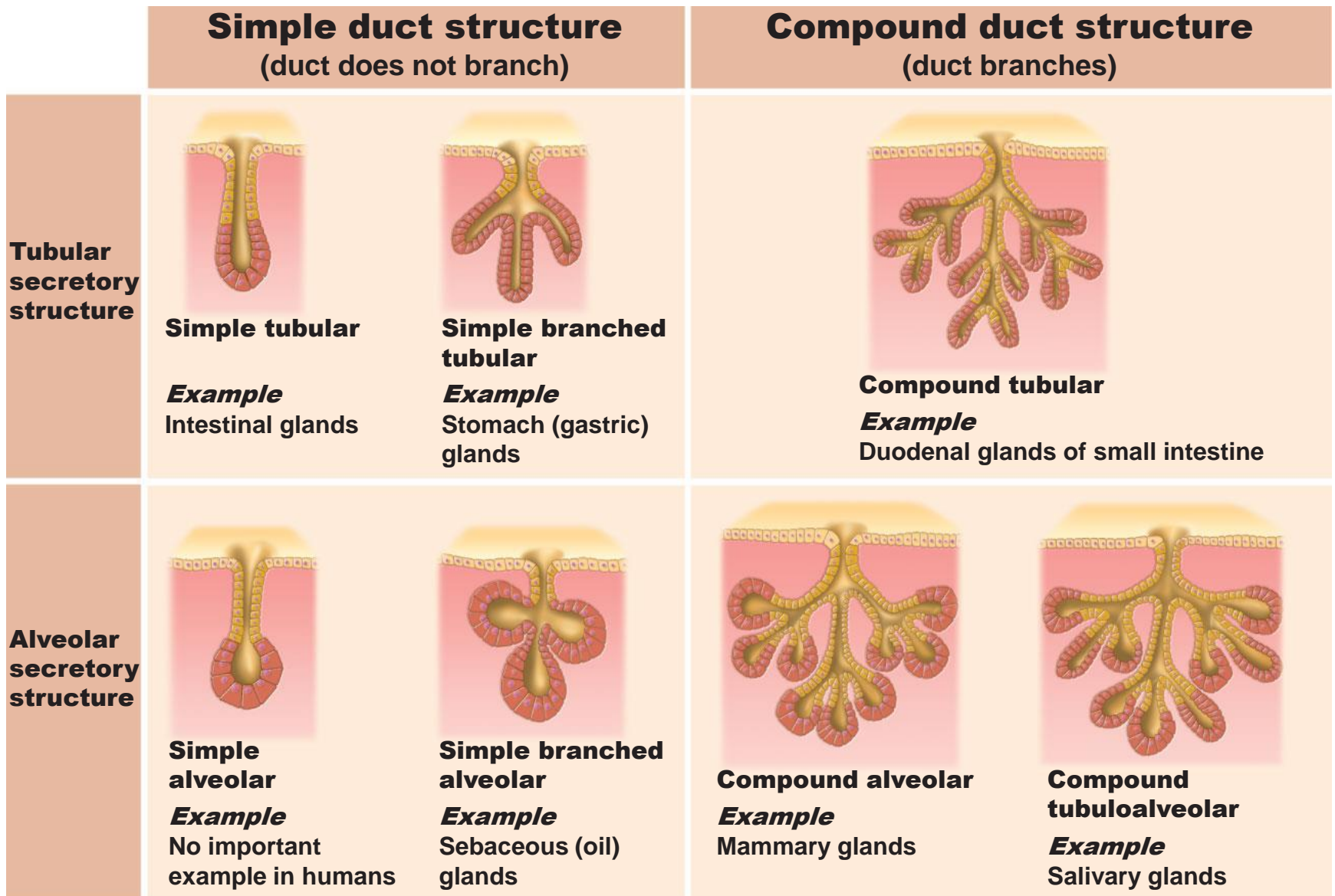
- More numerous than endocrine glands
- Secrete products into ducts
- Secretions released onto body surfaces (skin) or into body cavities
- Examples include mucous, sweat, oil, and salivary glands

Unicellular Exocrine Glands

- The only important unicellular gland is the goblet cell

Multicellular Exocrine Glands

- Multicellular exocrine glands are composed of a duct and a secretory unit
- Classified according to:
 - Duct type (simple or compound)
 - Structure of their secretory units (tubular, alveolar, or tubuloalveolar)



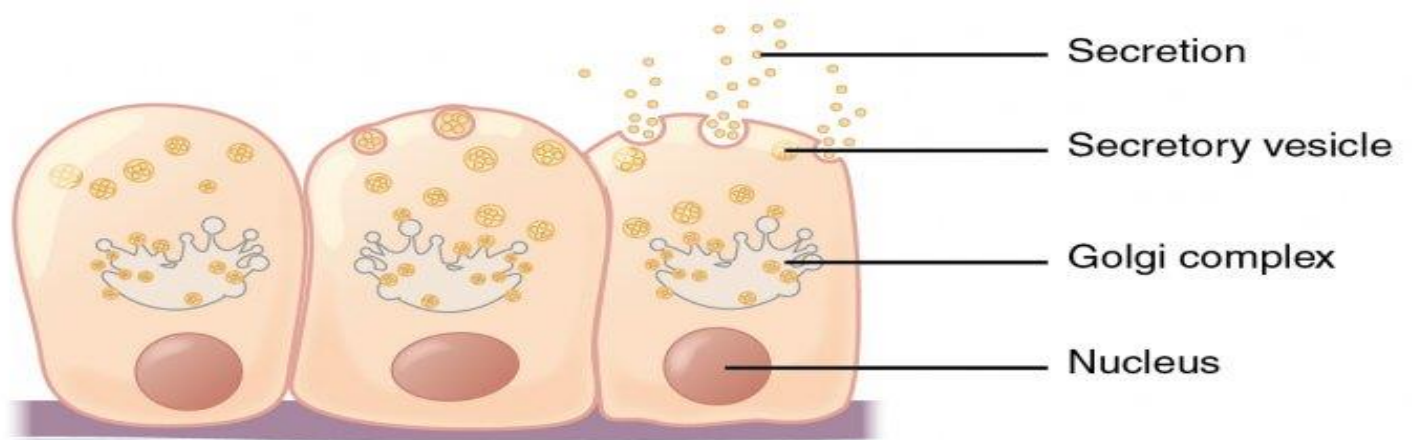
Surface epithelium
 Duct
 Secretory epithelium

Figure 4.5

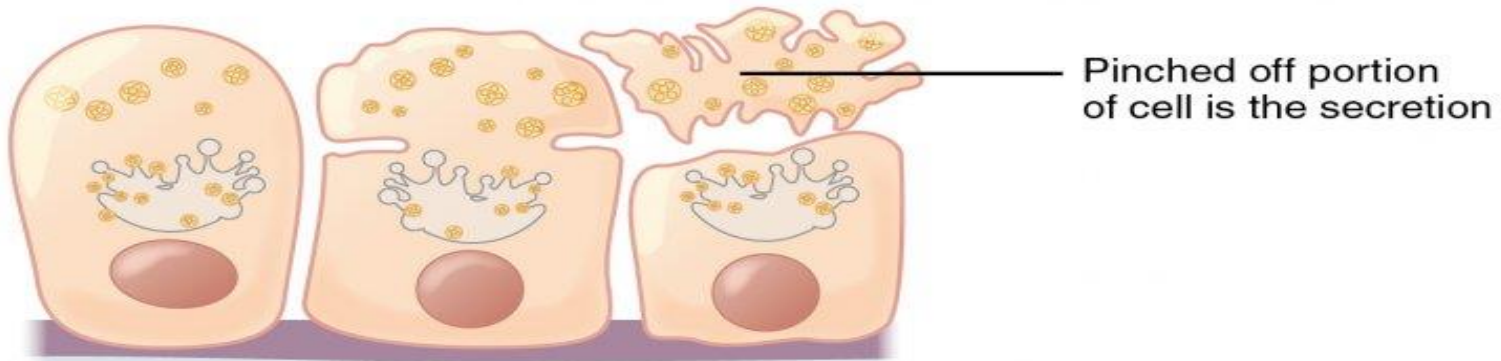
- **Pancreas:** Special form of glandular tissue

The pancreas has the particular anatomical and physiological characteristic of having both types of glands. Its exocrine portion passes digestive enzymes through the pancreatic duct into the duodenum, while the endocrine portion (islets of Langerhans) produces the hormones insulin and glucagon and releases them into the body.

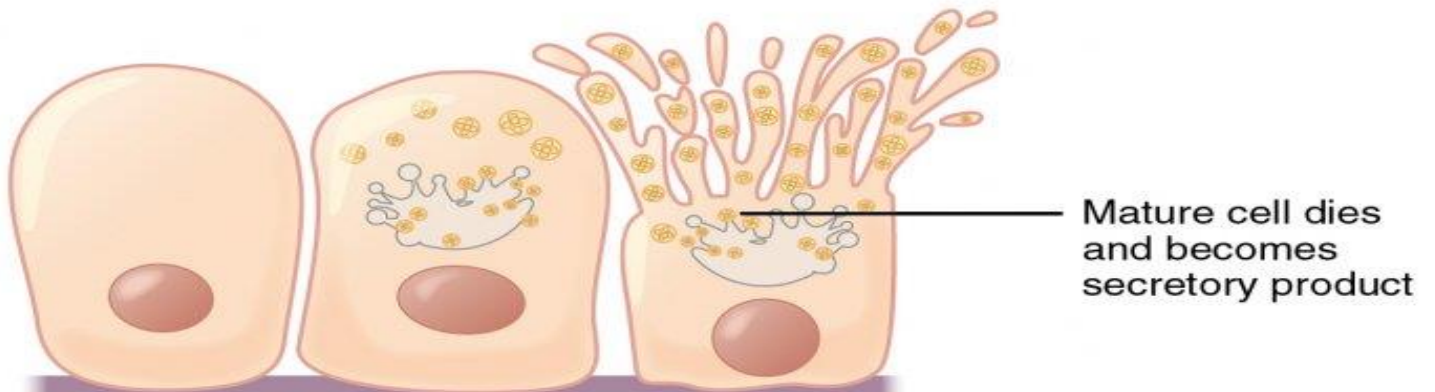
(a) Merocrine secretion



(b) Apocrine secretion



(c) Holocrine secretion



Modes of Secretion

- Merocrine
 - Products are secreted by exocytosis (e.g., pancreas, sweat and salivary glands)
- Holocrine
 - Products are secreted by rupture of gland cells (e.g., sebaceous glands)

Special Epithelial Pathologies

- **Mechanical damage**
- In simple wounds, like cut, scrapes, the healing process is done by the proliferation and spread of epithelial cells in 24 hours. Deep burns (third degree) are largely corrected by epithelial regrowth.

Papillomas

- are benign epithelial tumors. They grow in stratified squamous epithelium. The most frequent form is the wart (basal cell papilloma), a proliferation of epithelial cells from the stratum basale of the skin. The result is a compact organized epithelial node that can keratinize.
- **Adenomas**
- Like the papillomas, adenomas are also benign epithelial tumors that can grow in glands. Adenomas can develop into malignant tumors, the so-called adenocarcinomas.

Allergic contact dermatitis

- When in contact with a specific allergen, the skin epithelium is loosened up like a sponge by the formation of edema. This edema is an intercellular accumulation of fluid that can also converge into bubbles. Typical allergens that cause such eczema are, e.g., animal hair (epithelium allergy).

Thank you

