

Epithelial Tissue W3



Dr. Deniz Balci
deniz.balci@neu.edu.tr

Epithelium Lecture Outline

- Function and types of epithelium
- Structure of epithelium
- Types of covering/lining epithelium

How is covering/lining epithelium categorized?

Shape of superficial cells

- Squamous: width > height (flattened)
- Cuboidal: width = height (square, round)
- Columnar: width < height (tall and slender)

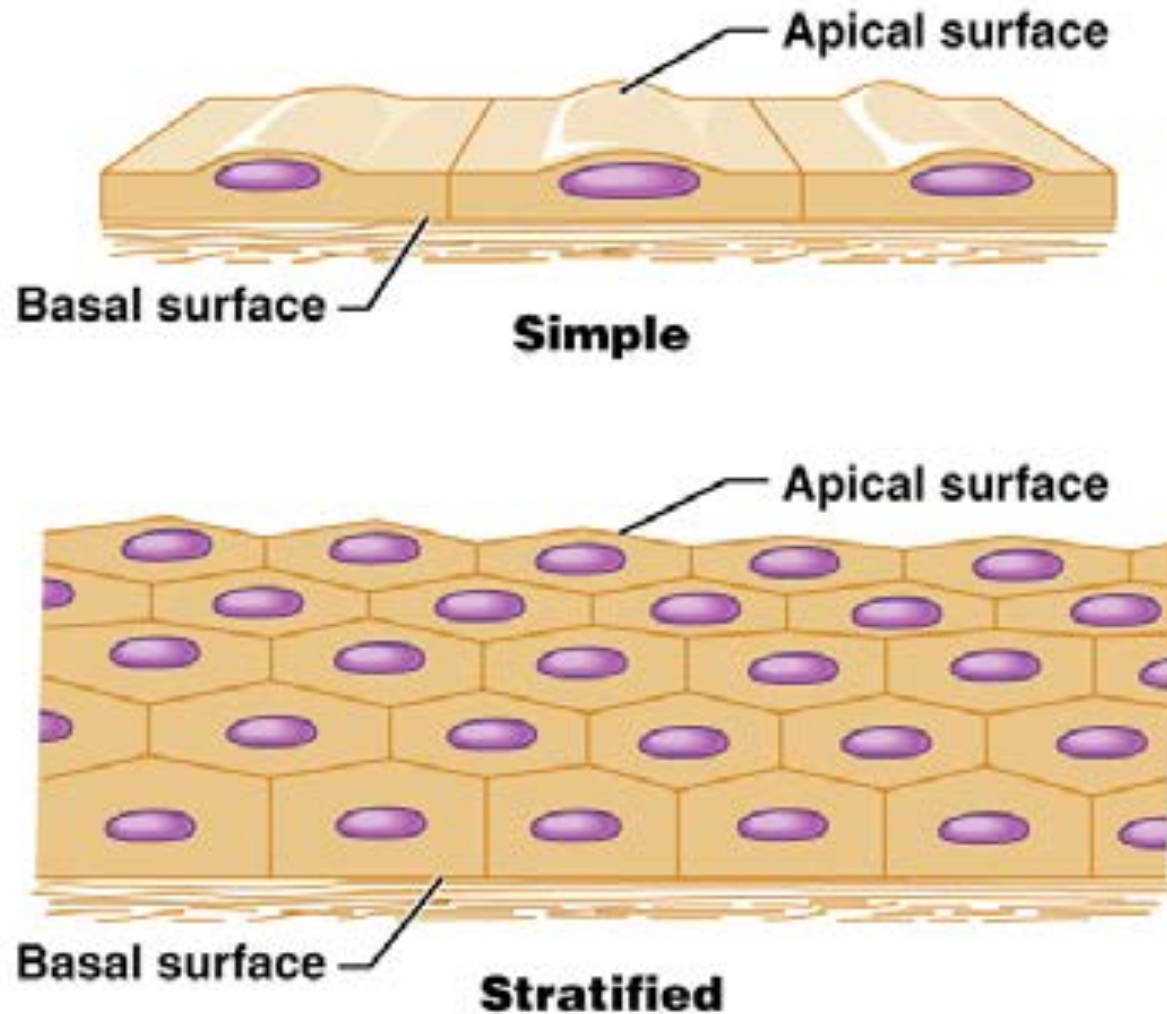
Number of cell layers

- Simple: one layer of cells
- Stratified: two or more layers of cells
- **Pseudostratified:** all cells contact basal lamina, but not all cells reach lumen

Presence of specialized structures

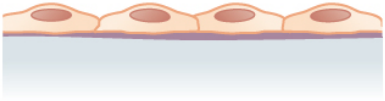
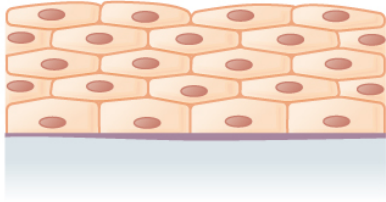

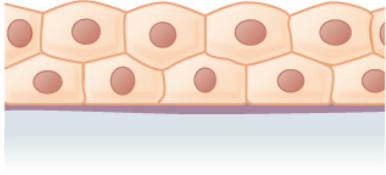
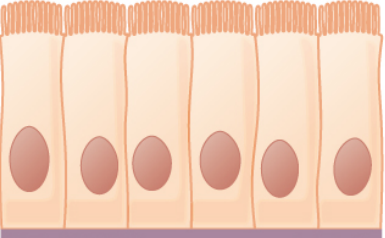
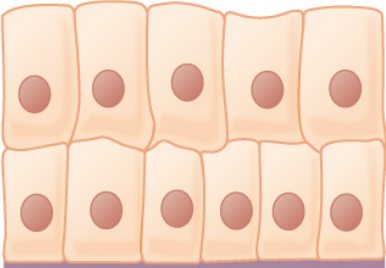
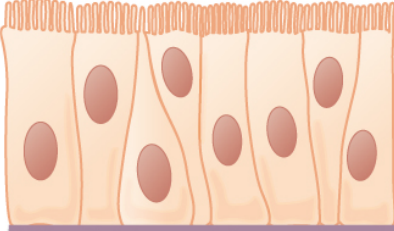
- Cilia
- Microvilli
- Keratin

Epithelial Cells have Different Number of Cell Layers

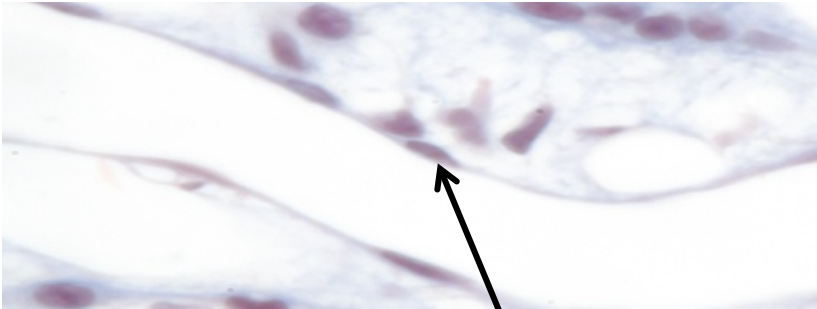


(a)

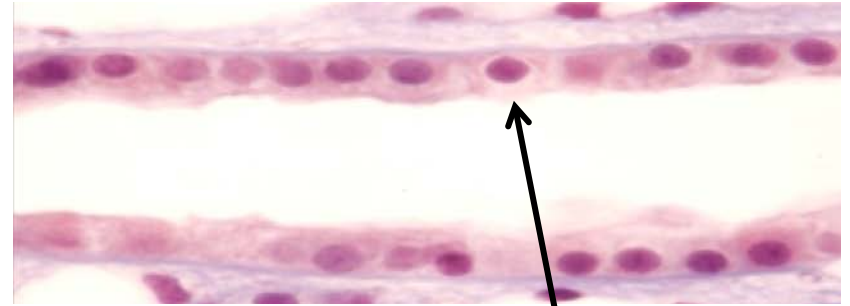
Classes of Epithelia

	Simple	Stratified	
Squamous	 <p>Simple squamous epithelium</p>	 <p>Stratified squamous epithelium</p>	
Cuboidal	 <p>Simple cuboidal epithelium</p>	 <p>Stratified cuboidal epithelium</p>	
Columnar	 <p>Simple columnar epithelium</p>	 <p>Stratified columnar epithelium</p>	Pseudostratified  <p>Pseudostratified columnar epithelium</p>

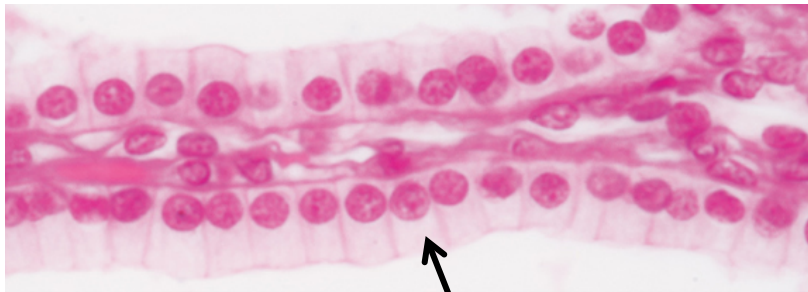
Epithelial cells have different shapes



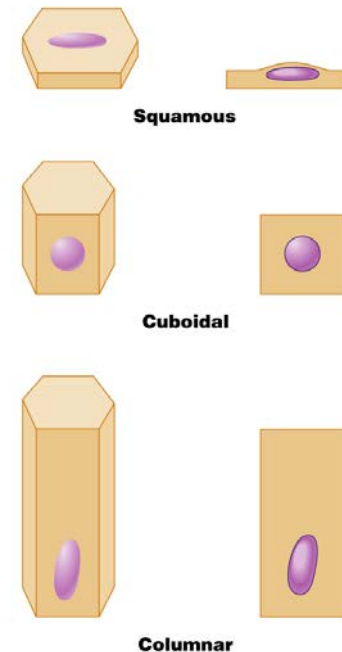
squamous cells are flat



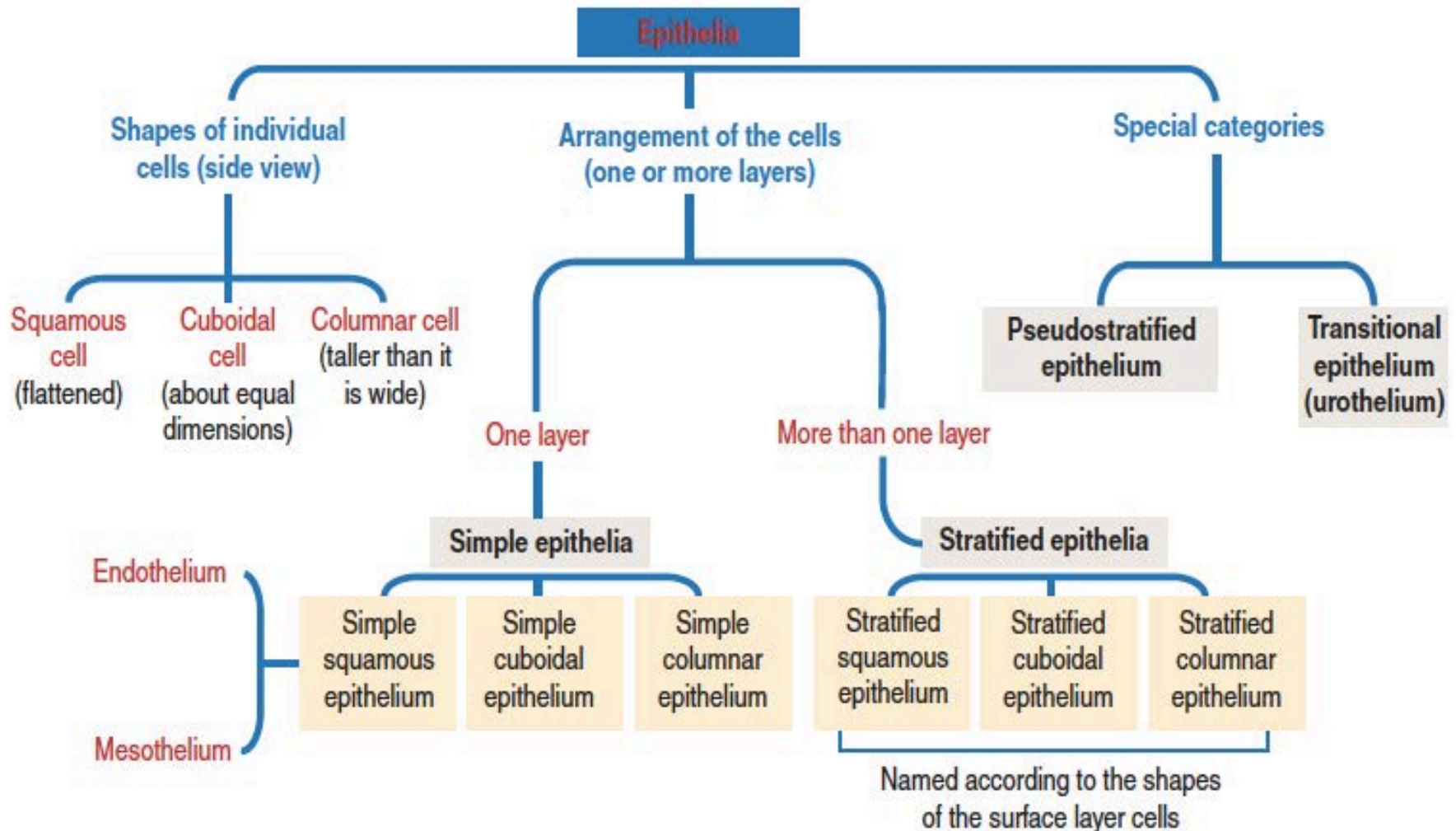
cuboidal cells are cute and boxy



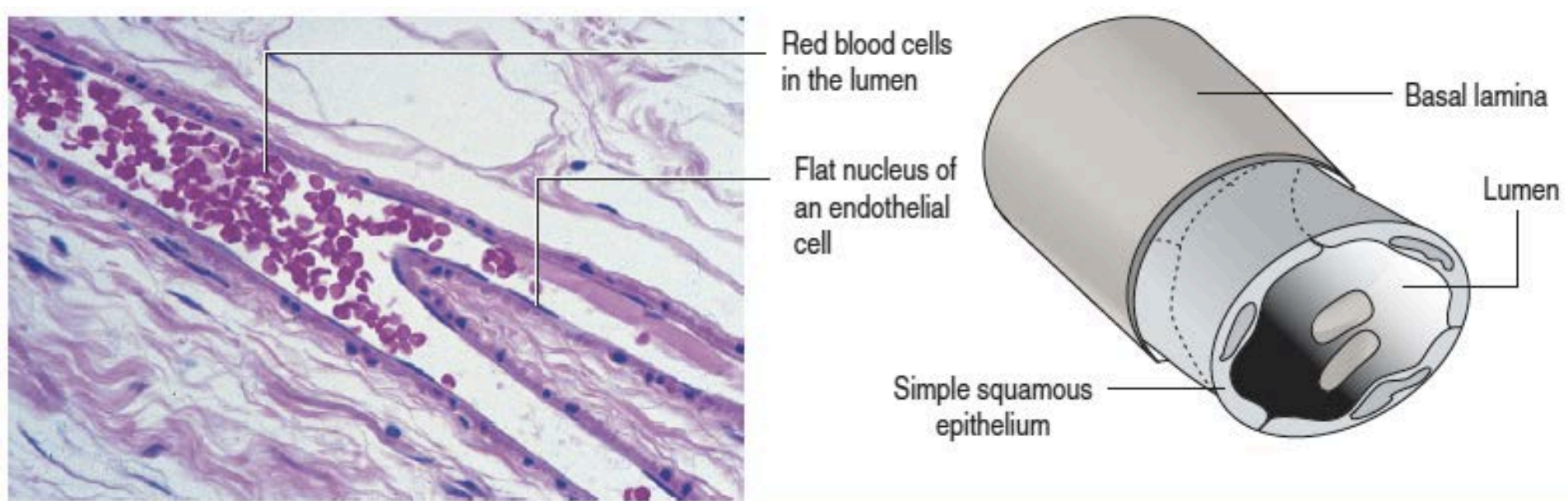
columnar cells are tall and regal



Concept mapping: Types of epithelia



Simple Squamous Epithelium



Simple squamous epithelium (endothelium)

The inner lining of all blood vessels consists of a single layer of squamous endothelial cells. The thinness of the simple squamous

epithelial cells reflects their primary function in rapid exchange of substances between blood and tissue. A similar epithelium (called mesothelium) covers the peritoneum, pleura, and pericardium.

Structural feature:

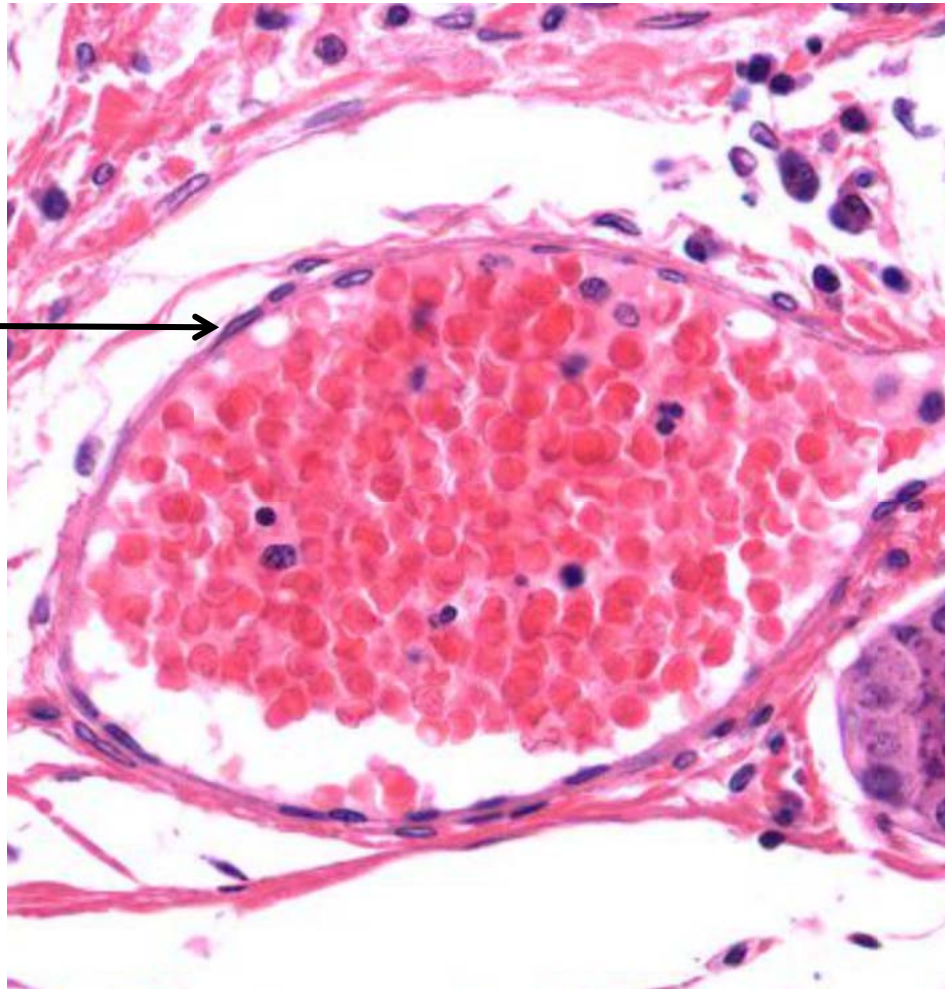
- Single layer of tightly packed, flattened cells, cell border are interdigitate
Flattened disc-shaped nucleus

Function:

Allows Diffusion, friction reduction, control blood vessels permeabilisation

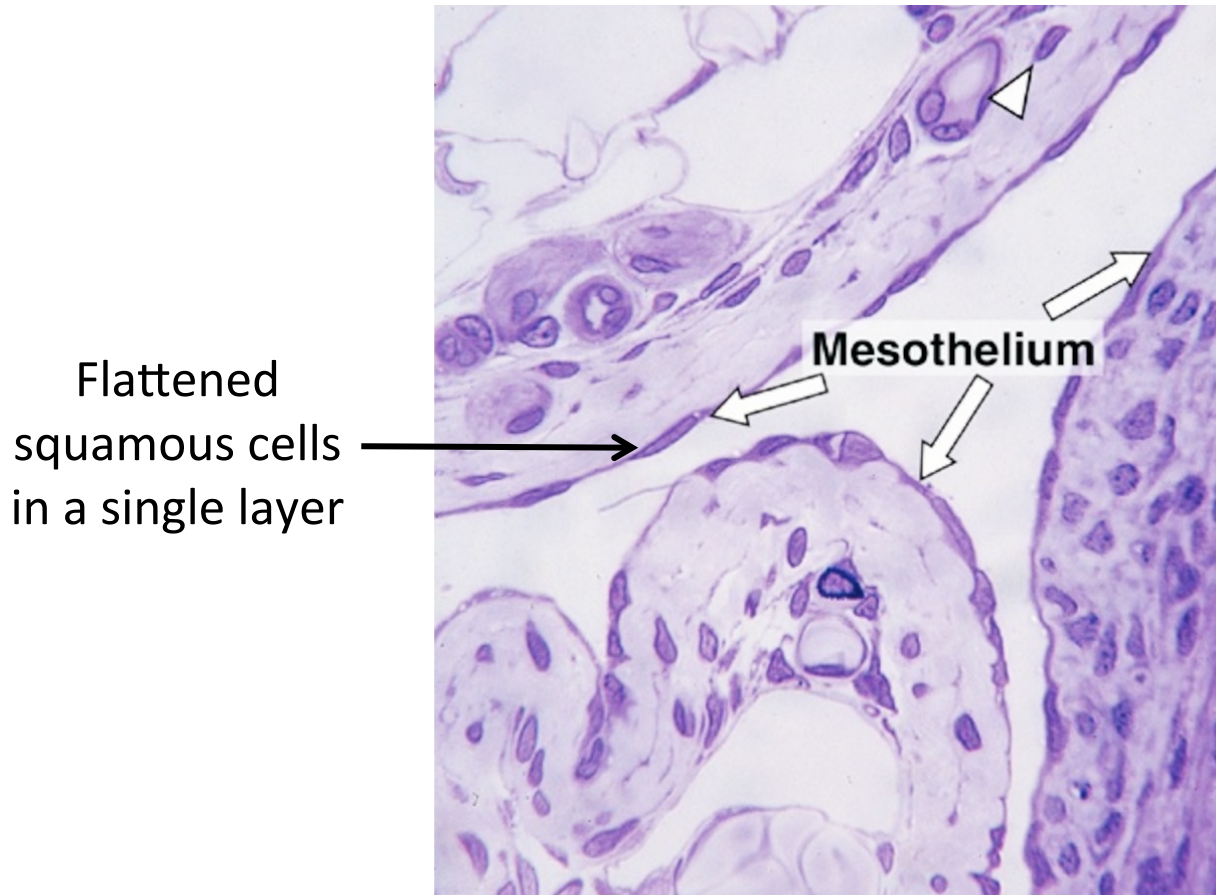
Simple Squamous Epithelium

Flattened
squamous cells
in a single layer



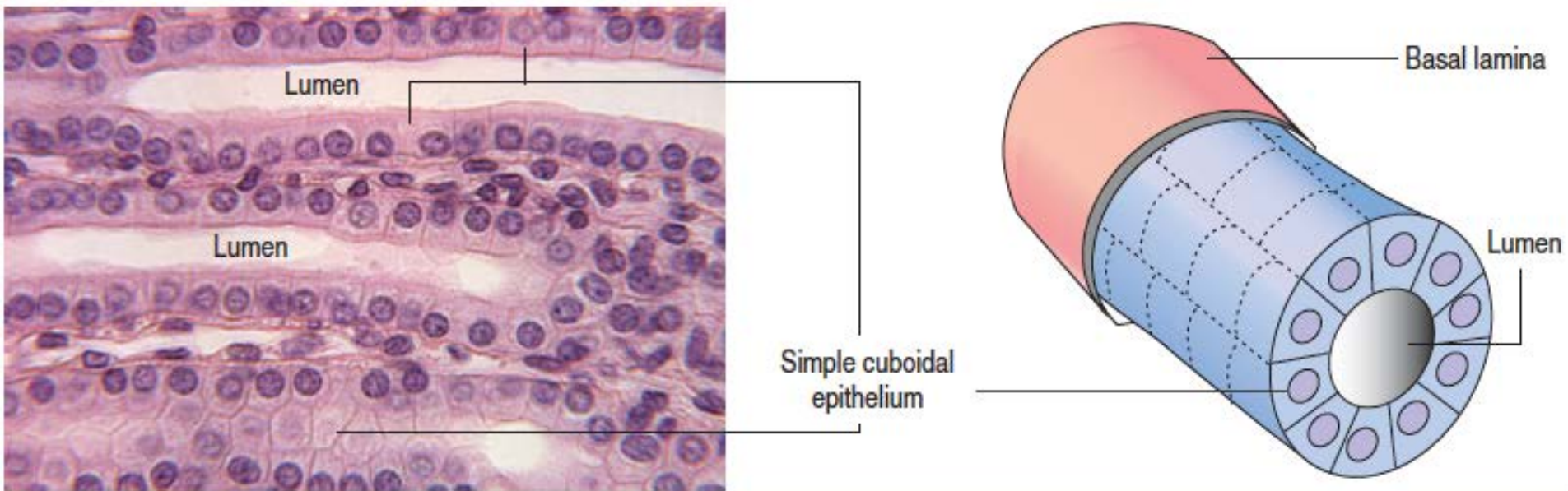
Endothelium is simple squamous epithelium.
It lines blood and lymphatic vessels.

Simple Squamous Epithelium



Mesothelium is simple squamous epithelium.
It lines all body cavities (pleura, pericardium, peritoneum).

Simple Cuboidal Epithelium



Simple cuboidal epithelium (collecting tubule, kidneys)

The inner lining of kidney tubules and thyroid follicles consists of a single layer of cuboidal cells. Cuboidal cells are highly polarized and

participate in absorption, secretion (thyroid gland), and active ion transport (kidneys). Similar to the endothelium, a basal lamina attaches the cell to the subjacent connective tissue.

Structural feature:

- one layer of cells with same height and width and hexagonal outline in surface view. Spherical centrally-located nucleus

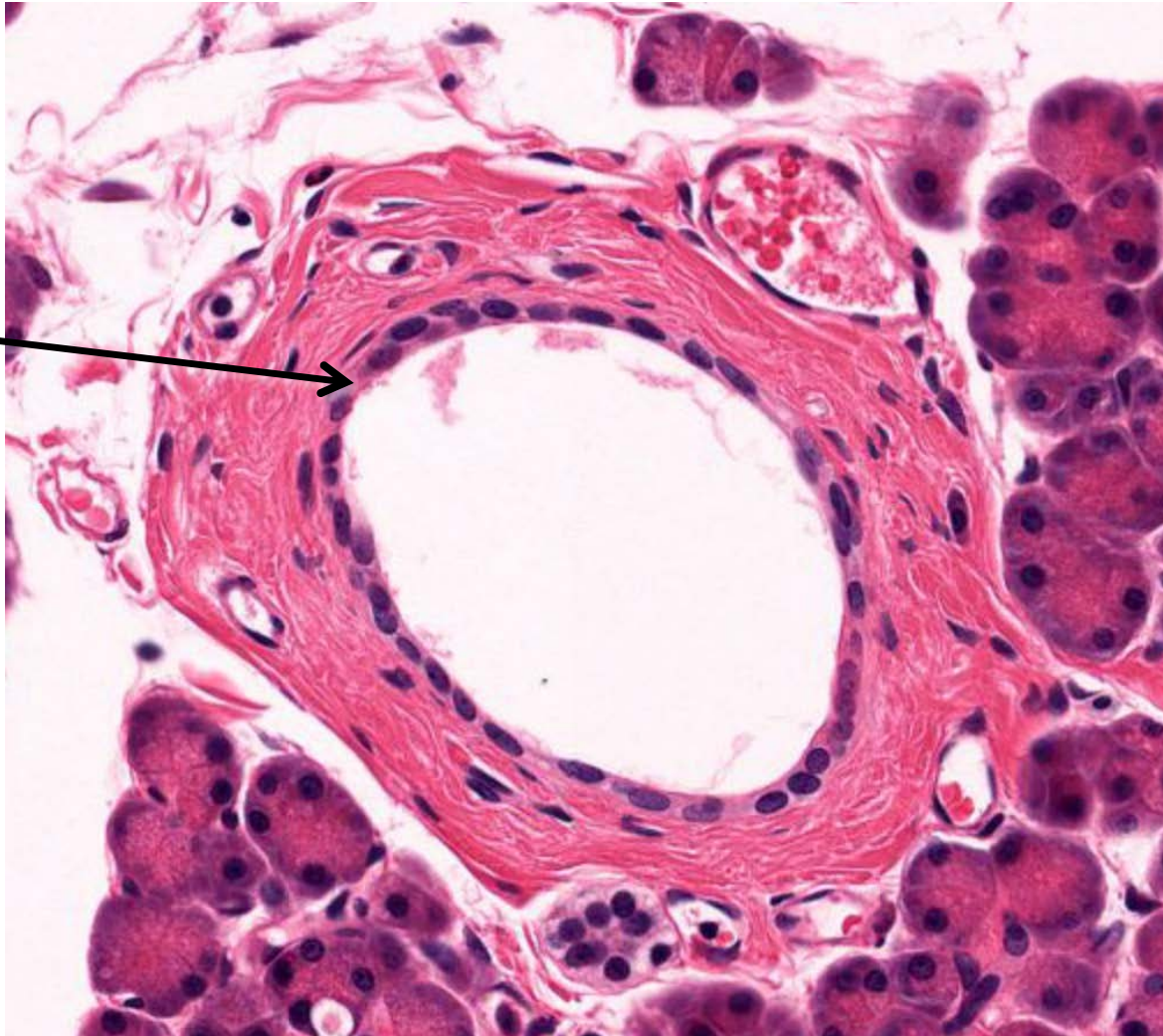
Function:

secretion and absorption, active ion transport

- ✧ Present in kidney tubules, ducts and secretory portions of small glands, and ovary surface

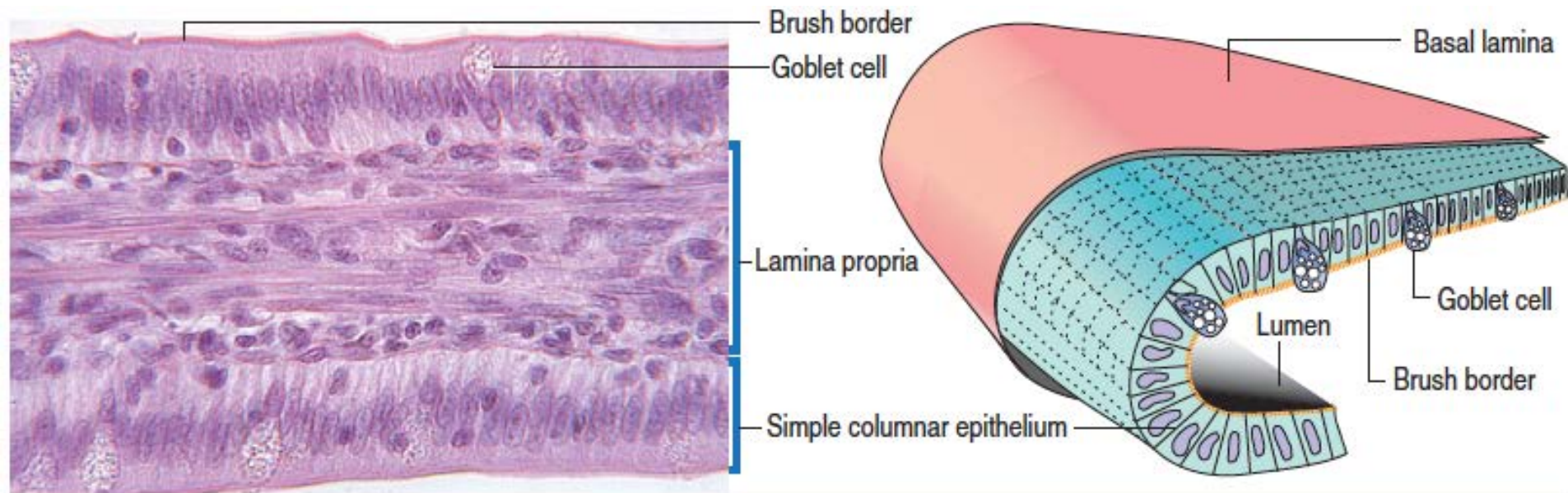
Simple Cuboidal Epithelium

Cuboidal
cells
in one cute
layer



Duct linings often have simple cuboidal epithelium,
like this **smallish duct** in the pancreas.

Simple Columnar Epithelium



Simple columnar epithelium (small intestine)

The small intestine is lined by columnar epithelial cells with the nucleus in the medial portion of the cell. The apical domain contains finger-like projections called **microvilli** forming a **brush border**. Microvilli participate in the absorption of proteins, sugar, and lipids, which are released at the basolateral domain into the blood

circulation for transport to the liver.

Goblet cells are present among the columnar epithelial cells. They can be distinguished by a dilated, goblet-like apical cytoplasm containing a light-stained mucus material. Mucus is released into the lumen and coats the epithelial cell surface. The **lamina propria** is indicated.

Structural feature:

- one layer of columnar-rectangular tall cells with basally located ovoid nucleus, may exhibit **microvilli, cilia. Goblet cells.**

Function:

secretion and absorption.

- ✧ Line digestive tract and gallbladder, small bronchi, uterine tubes, and some regions of the uterus

Intestinal lumen

Epithelial cell layer

Capillary

Carbohydrates

Proteins

+

Pancreatic
enzyme

Intestinal
enzyme

Amino
acids

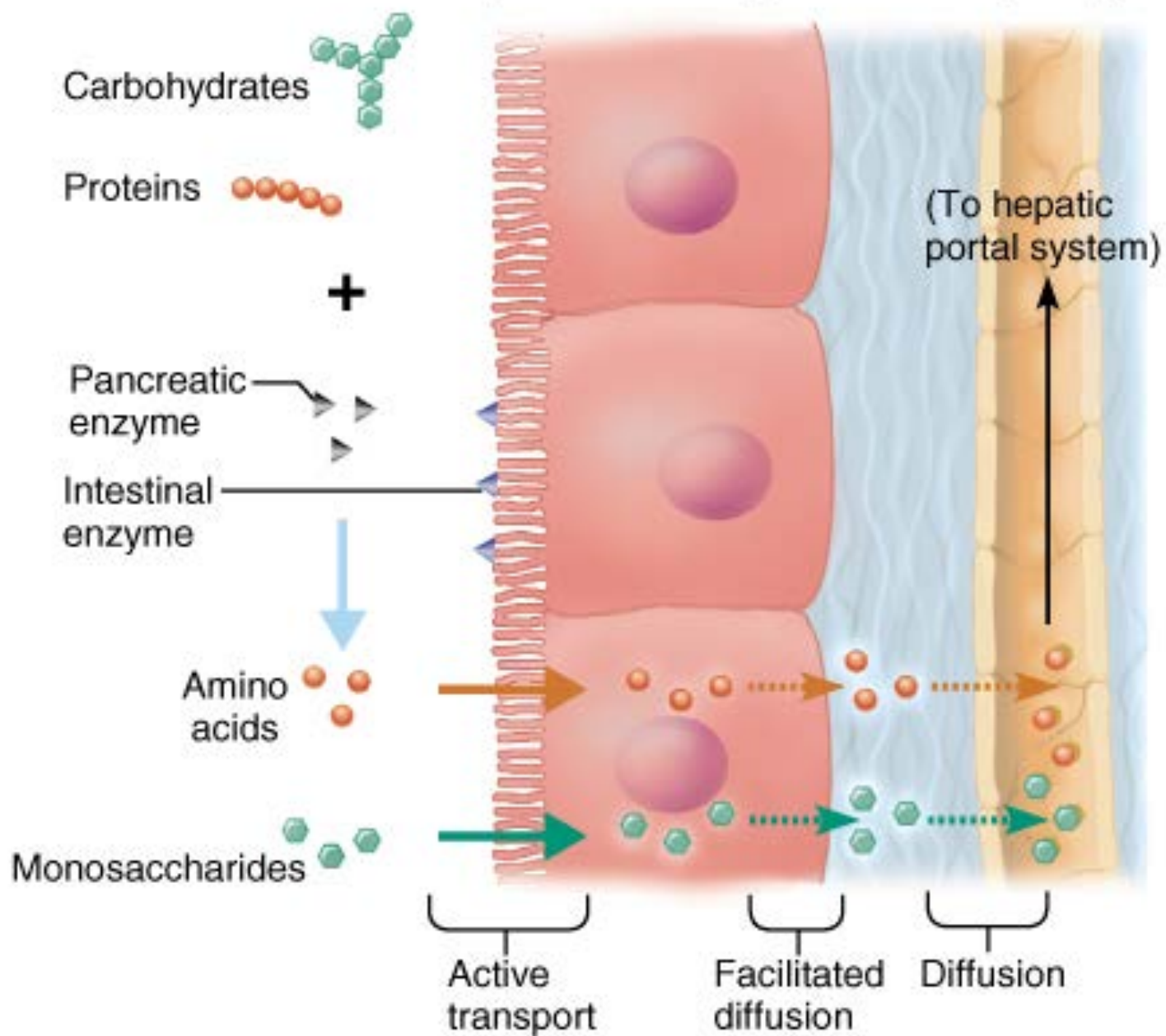
Monosaccharides

(To hepatic
portal system)

Active
transport

Facilitated
diffusion

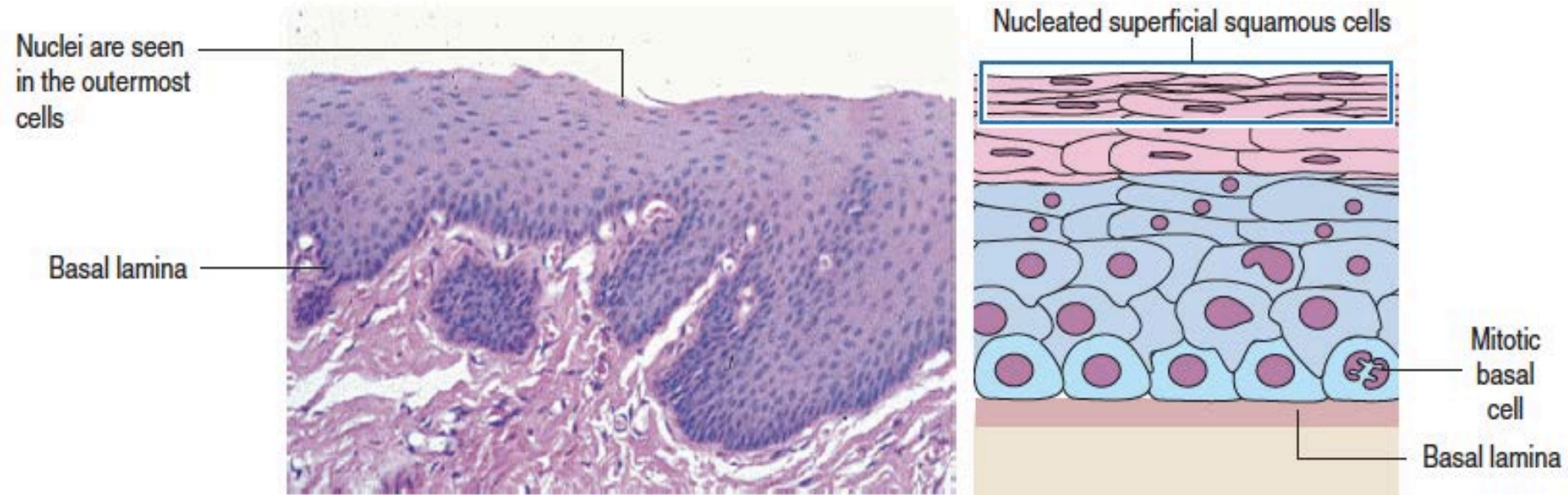
Diffusion



Stratified Epithelia

- Contain **two or more** layers of cells
- **Regenerate** from below
- Major role is **protection**
- Are named according to the **shape of cells at apical layer**

Stratified Squamous Epithelium



Stratified squamous epithelium with moderate keratin (esophagus)

This epithelium consists of undifferentiated **basal cells** specialized for **mitotic division**. Stratified cells covering the basal layer are differentiating cells. Cells of the outer layer are

highly differentiated: they increase their **keratin content** to protect the tissue from the mechanical action of ingested food. **The outermost cells retain their nuclei**. This epithelium is also known as **nonkeratinizing**.

Structural feature:

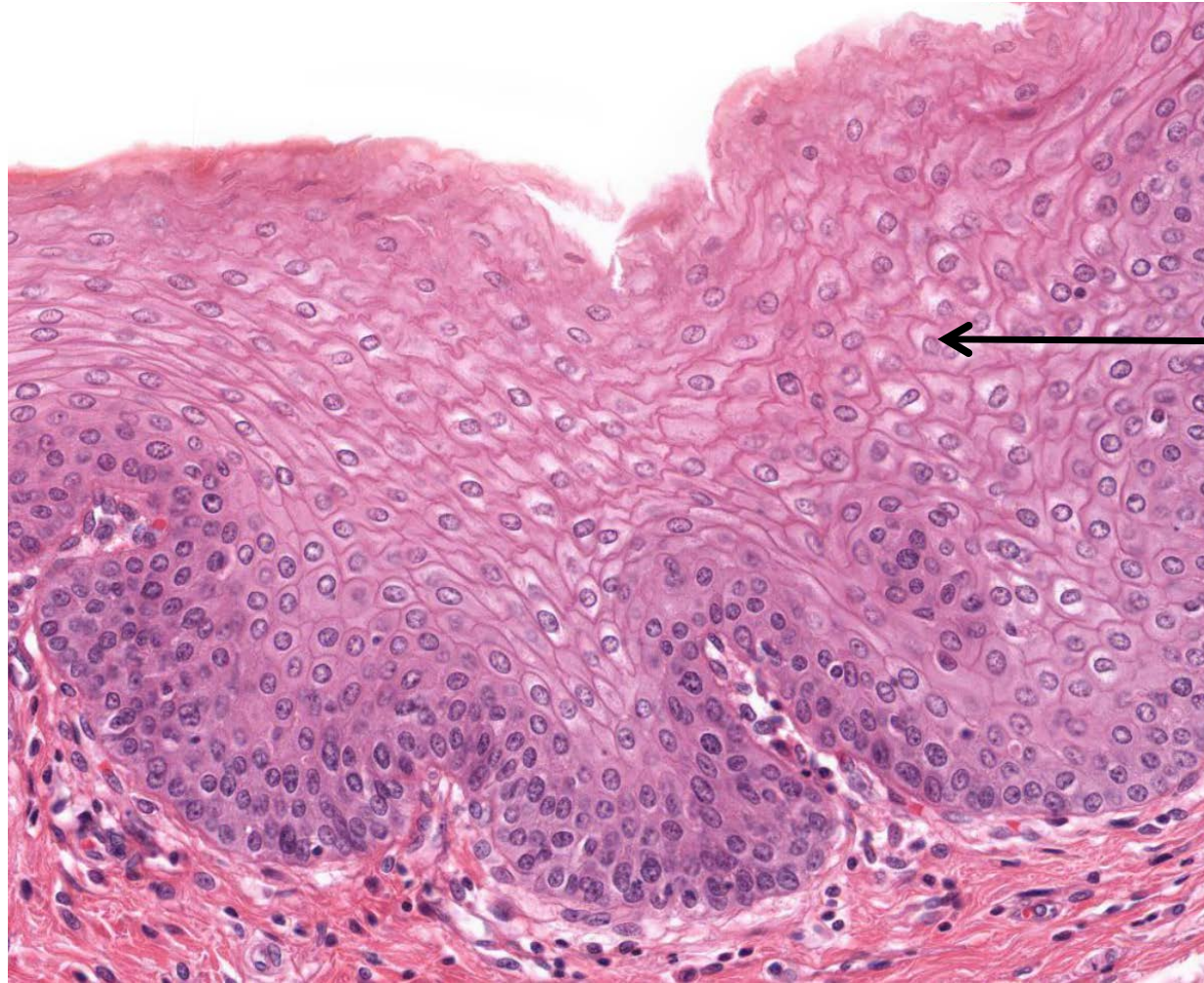
Thick membrane composed of several layers of cells

Function:

Protection of underlying areas subjected to corrosion

✧ Linings of the esophagus, mouth, and vagina

Stratified Squamous Epithelium



top layer of
cells is flat,
nucleated

deeper layers of
cells vary cuboidal
to columnar.

**basal cells
replicate by
mitosis**

Several
layers of
squamous
epithelial
cells

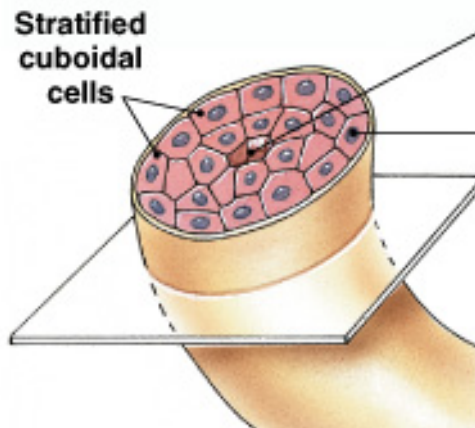
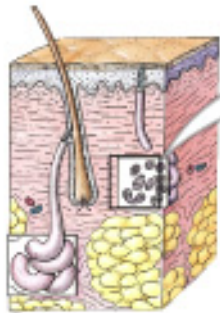
Mucous membranes are composed of stratified squamous epithelium.
Directly interact with **external environment**

Stratified Cuboidal Epithelium

STRATIFIED CUBOIDAL EPITHELIUM

LOCATIONS: Lining of some ducts (rare)

FUNCTIONS: Protection, secretion, absorption



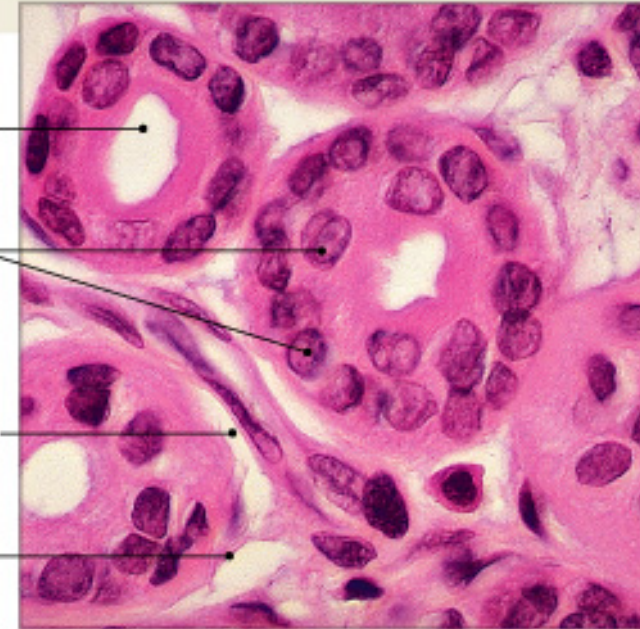
(b) Sweat gland duct

Lumen of duct

Nuclei

Connective tissue

Basal lamina



LM × 1413

- ✧ Found in some **sweat and mammary glands**
- Typically two cell layers thick
- Only top layer is cuboidal

Stratified Cuboidal Epithelium



Cuboidal
cells
in a few
layers

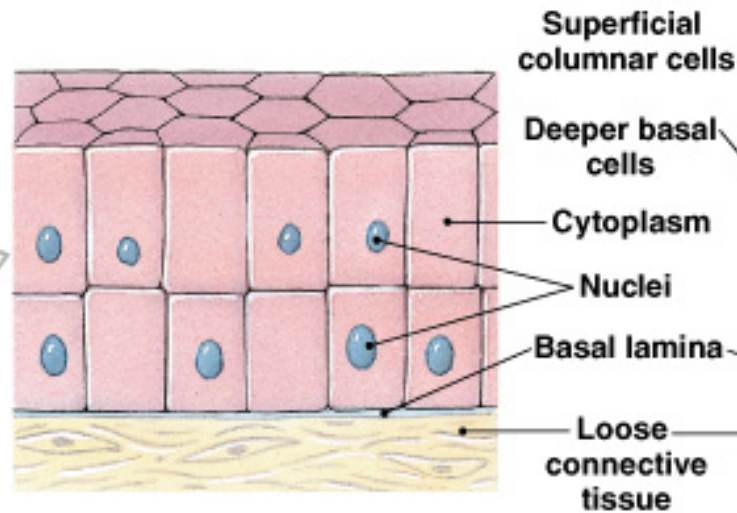
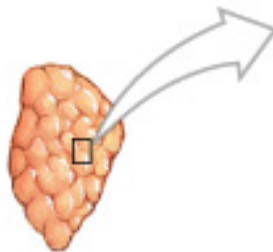
Some ducts are lined by stratified cuboidal epithelium,
like this **larger duct** in the pancreas.

Stratified Columnar Epithelium

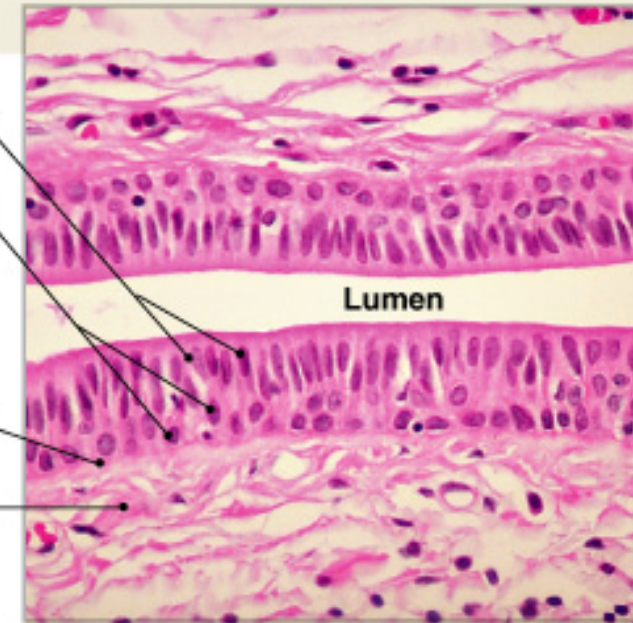
STRATIFIED COLUMNAR EPITHELIUM

LOCATIONS: Small areas of the pharynx, epiglottis, anus, mammary glands, salivary gland ducts, and urethra

FUNCTION: Protection



(c) Salivary gland duct



- Rare
- ✧ Salivary gland duct

How is covering/lining epithelium categorized?

Shape of superficial cells

Number of cell layers

Presence of specialized structures

- Cilia
- Microvilli
- Keratin

Pseudostratified Ciliated Columnar Epithelium



Structural feature:
3 types of cells

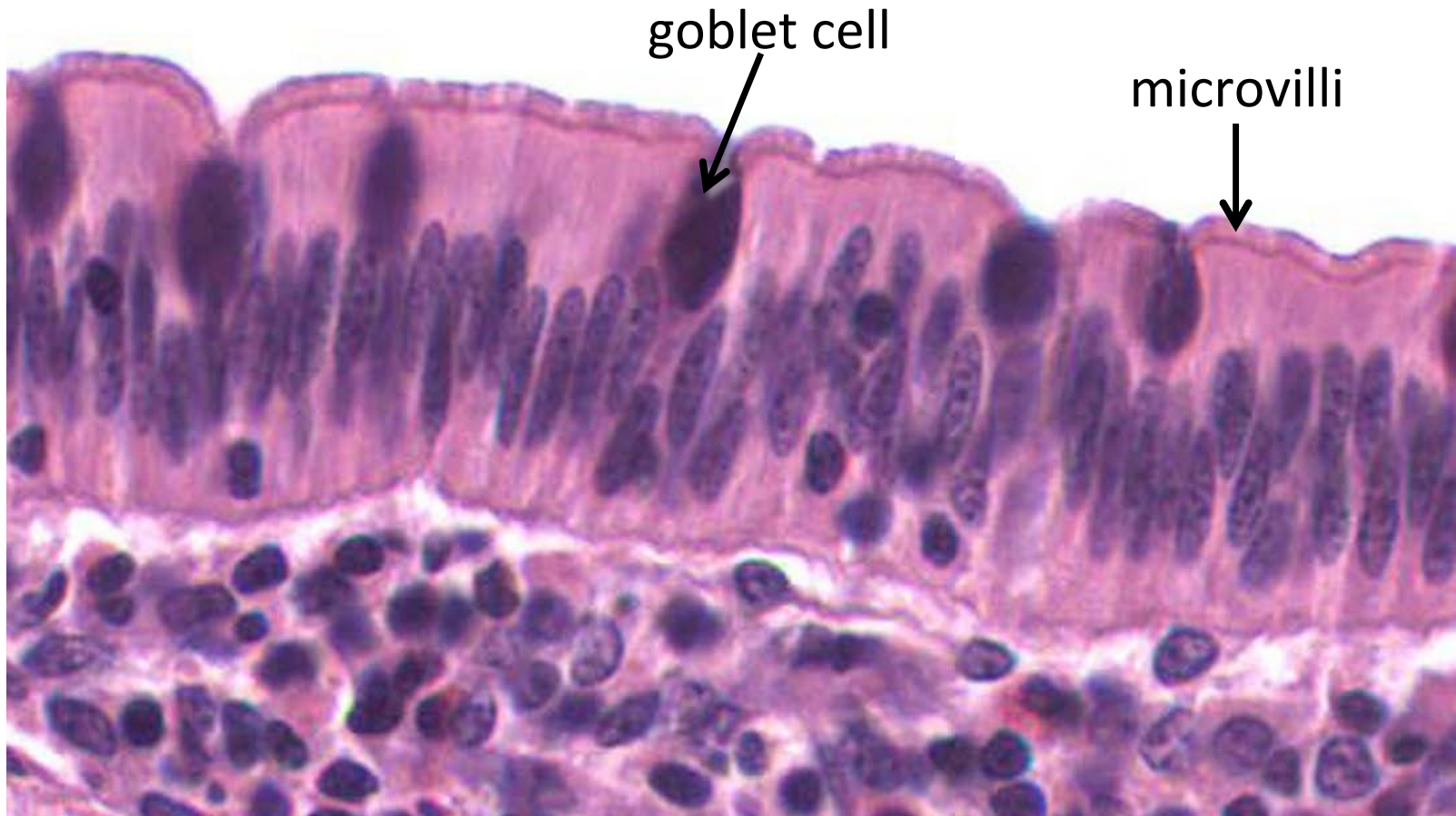
***Columnar cell:**
ciliated

***Basal cell:**
pyramid-shaped

*** Goblet cell**

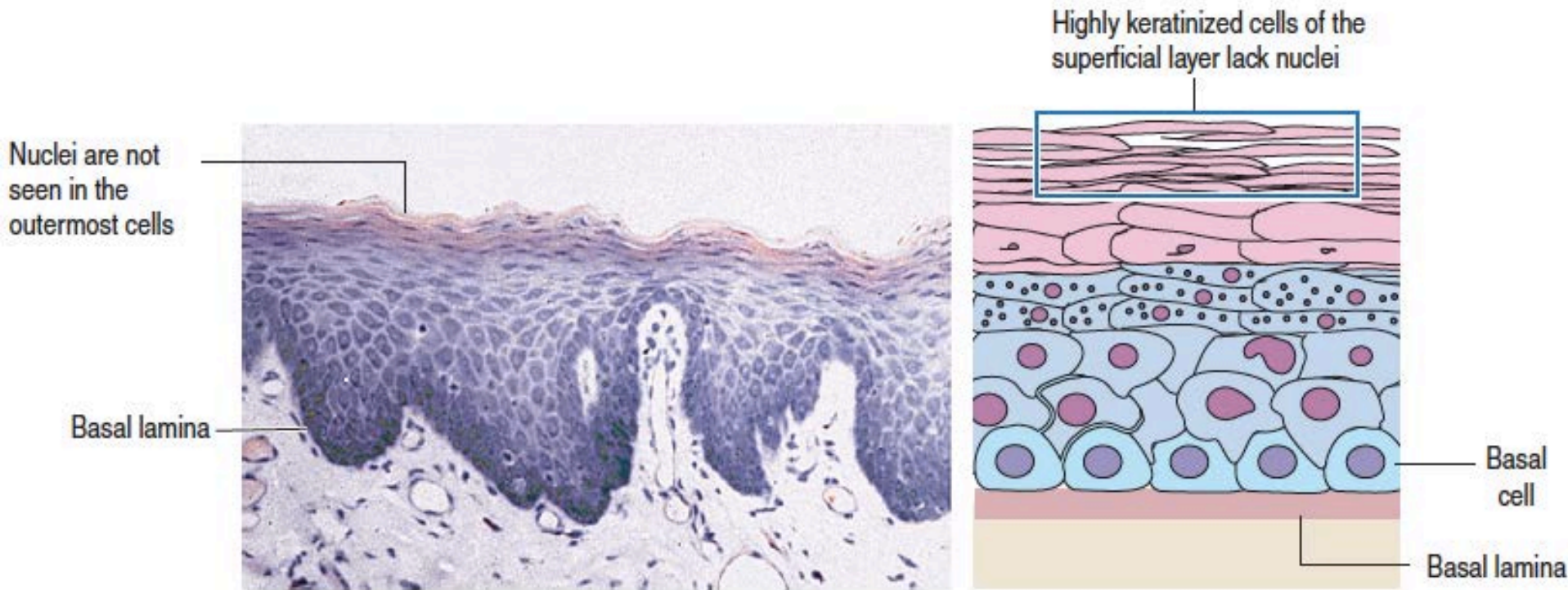
Respiratory epithelium is pseudostratified columnar,
with goblet cells and ciliated cells.

Simple Columnar Epithelium



The epithelium of the **small intestine** is simple columnar, with goblet cells and absorptive cells with microvilli.

Keratinized Stratified Squamous Epithelium

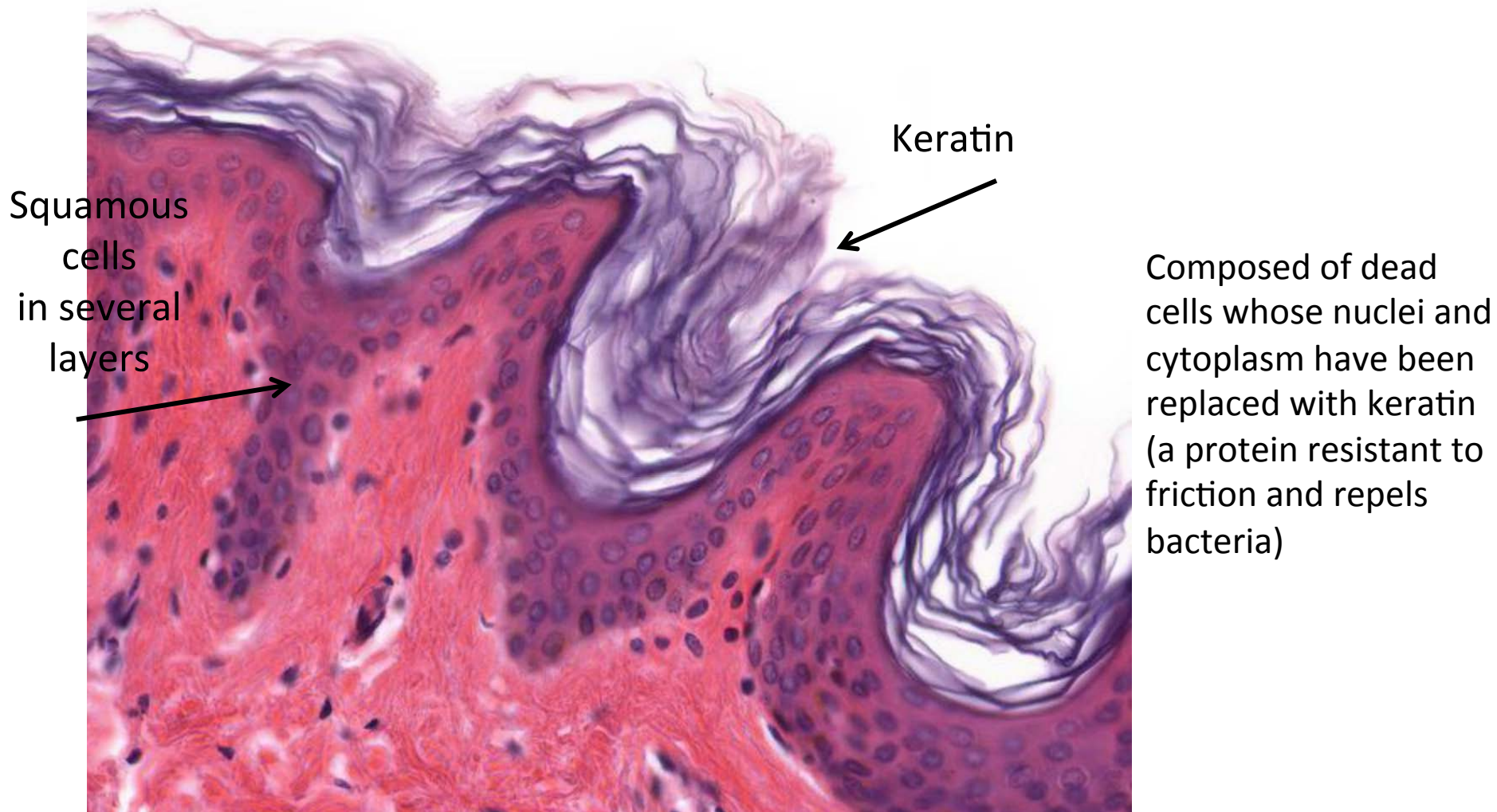


Stratified squamous epithelium with abundant keratin (epidermis)

This highly keratinized epithelium consists of undifferentiated **basal cells** specialized for **mitotic division**. Stratified cells

covering the basal layer are differentiating cells. Cells of the outer layer contain abundant **keratin** to prevent water loss and penetration of chemical and physical insults. **The outermost cells lack nuclei**. This epithelium is also known as **keratinizing**.

Keratinized Stratified Squamous Epithelium

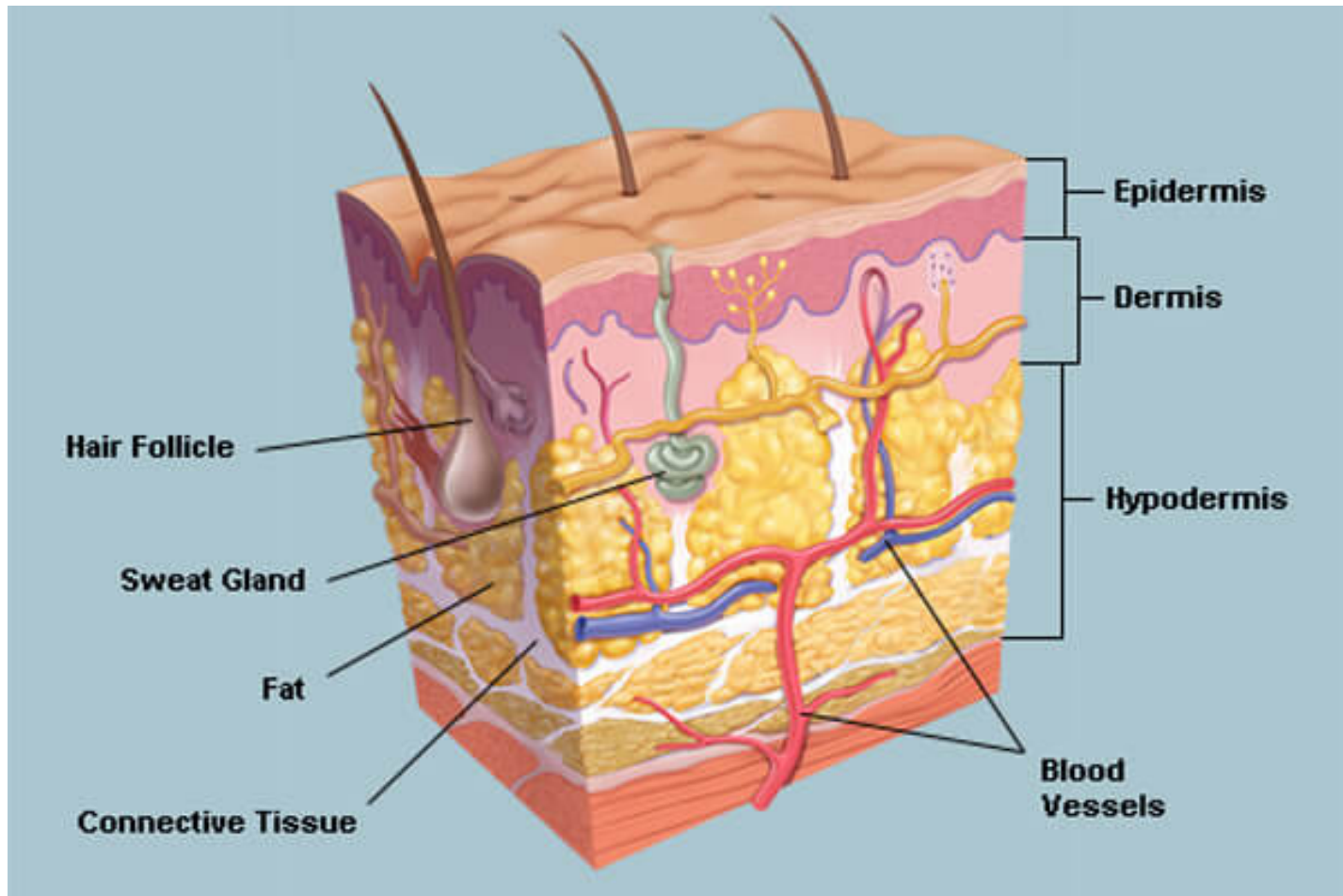


Keratin covers areas where skin is thin but needs protection.

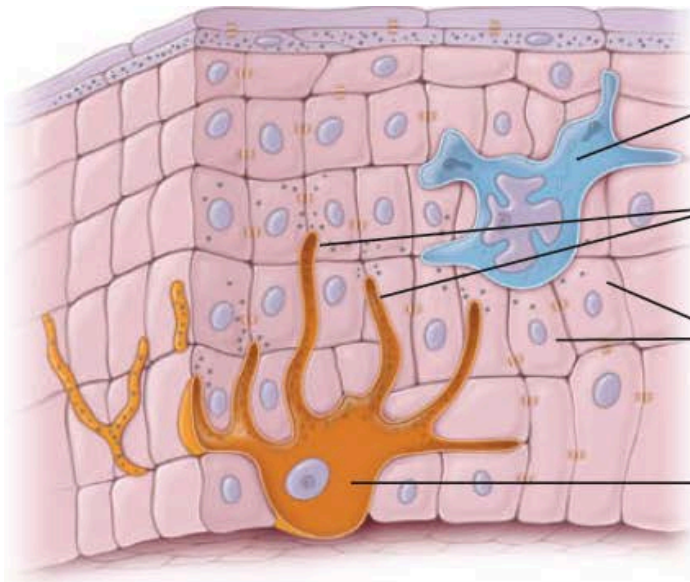
Impermeable to water

SKIN LARGEST ORGAN

- ① Epidermis - stratified squamous epithelium
- ② Dermis - Connective tissue layer
- ③ Hypodermis- Adipose tissue



Cells of Epidermis



Langerhans' cell

melanocyte process

keratinocyte

melanocyte



Keratinocytes are highly specialized epithelial cells separate the organism from its external environment.

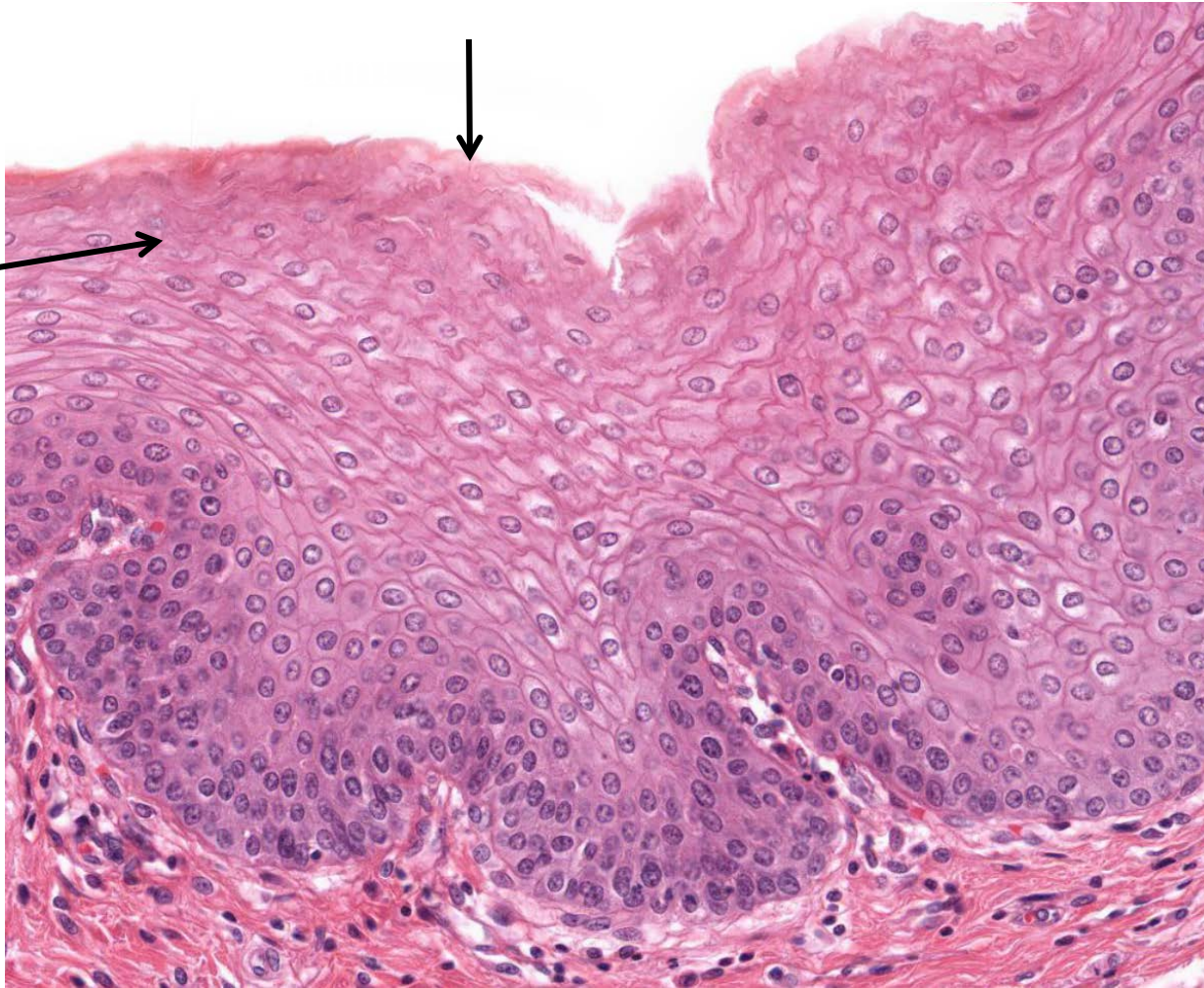
Melanocytes are the pigment-producing cells

Langerhans' cells are involved in signaling in the immune system. (Dendritic cell)

Merkel's cells are associated with sensory nerve endings.

Non-Keratinized Stratified Squamous Epithelium

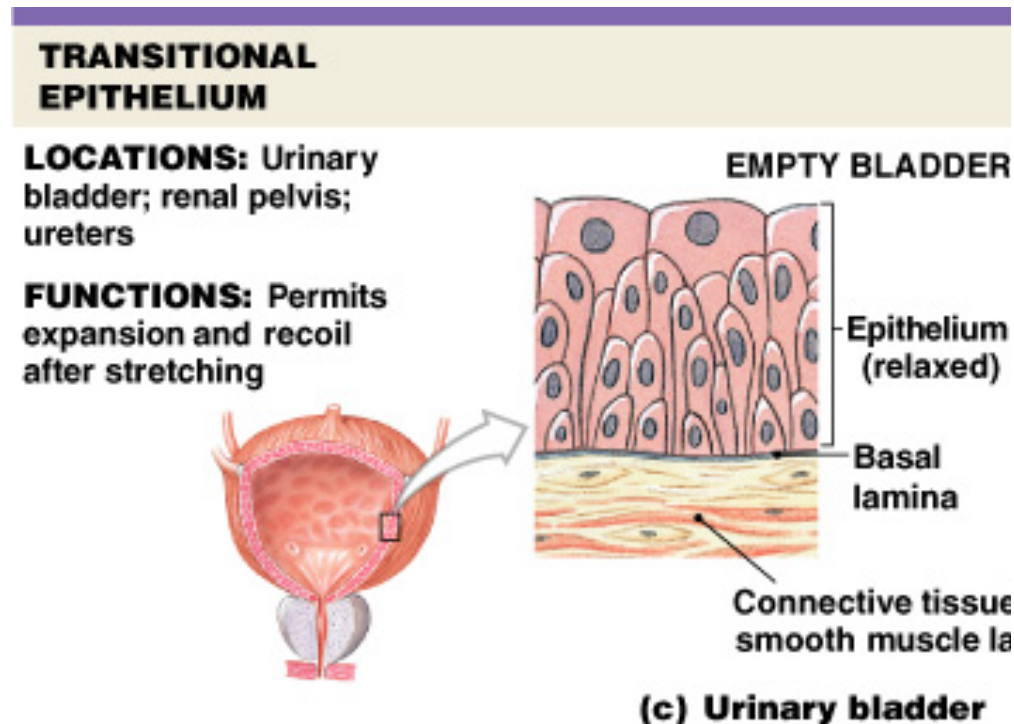
Squamous
cells
in several
layers



Areas that are always **moist** (like the esophagus) are often lined by stratified squamous epithelium without a layer of keratin.

Transitional Epithelium

- Several cell layers, basal cells are cuboidal, surface cells are flat
- Stretches to permit the distension of the urinary bladder
- ✧ Lines the urinary bladder, ureters, and part of the urethra

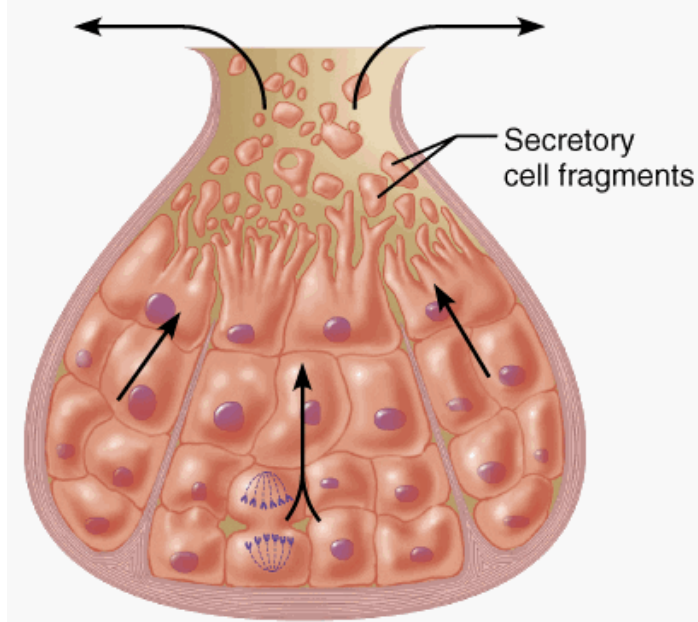


Epithelium Lecture Outline

- Function and types of epithelium
- Structure of epithelium
- Types of covering/lining epithelium
- Types of glandular epithelium

Glands

- Epithelial cells
- Production & secretion
- Aqueous (water-based) products
- The protein product is made in rough ER, packed into secretory granules by Golgi apparatus, released from the cell by exocytosis



(b)

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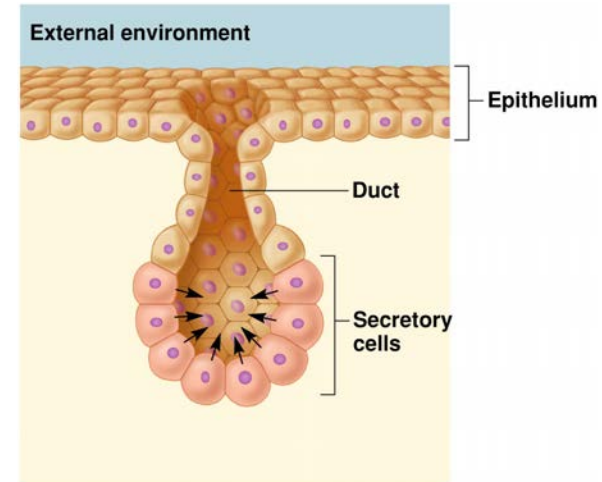
Classification of glands

- By where they release their product
 - Exocrine and Endocrine
- Relative number of cells forming the gland
 - Unicellular or Multicellular
- By their secretion mode (product)
 - Serous, mucous, mix
- By their lost when make secretion
 - Apocrine, Merocrine and Holocrine

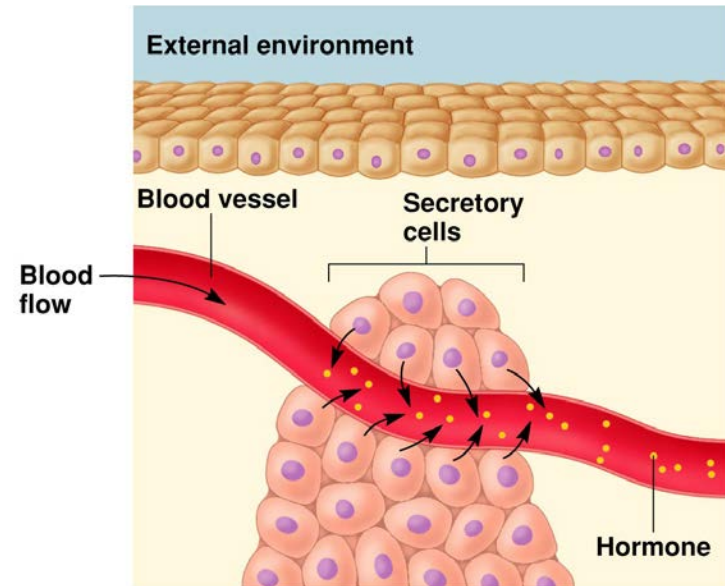
Epithelium: Glands

Major classes of glands

- Exocrine glands
 - Have ducts
 - Endocrine glands
 - No ducts, product into blood
- Product = hormone
- **Mucous goblet cell:**
unicellular gland



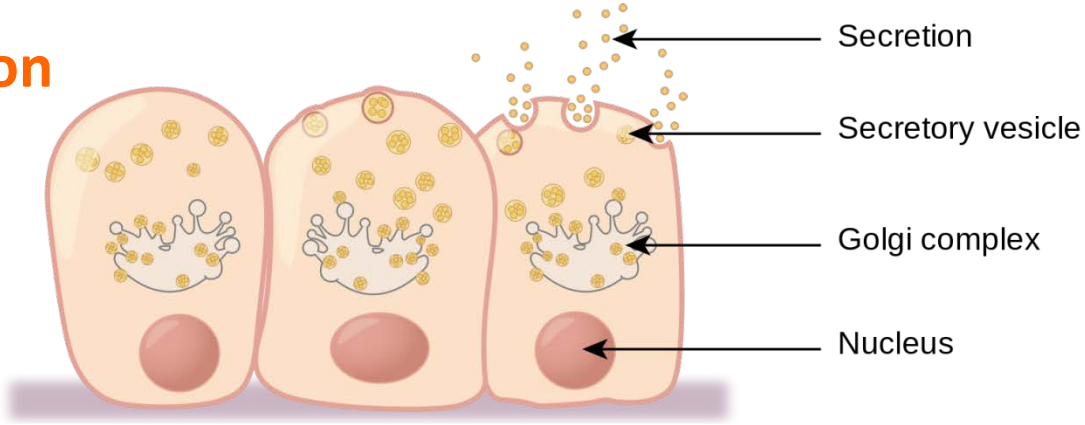
(a) Exocrine gland



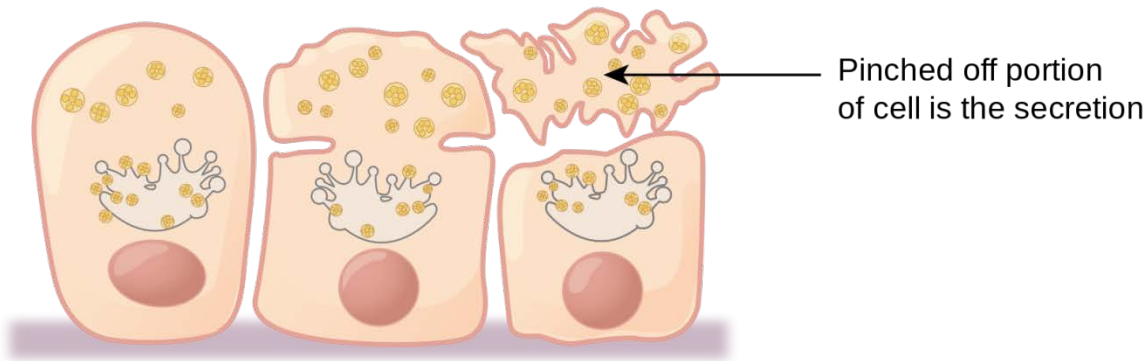
(b) Endocrine gland

Modes of Glandular Secretion

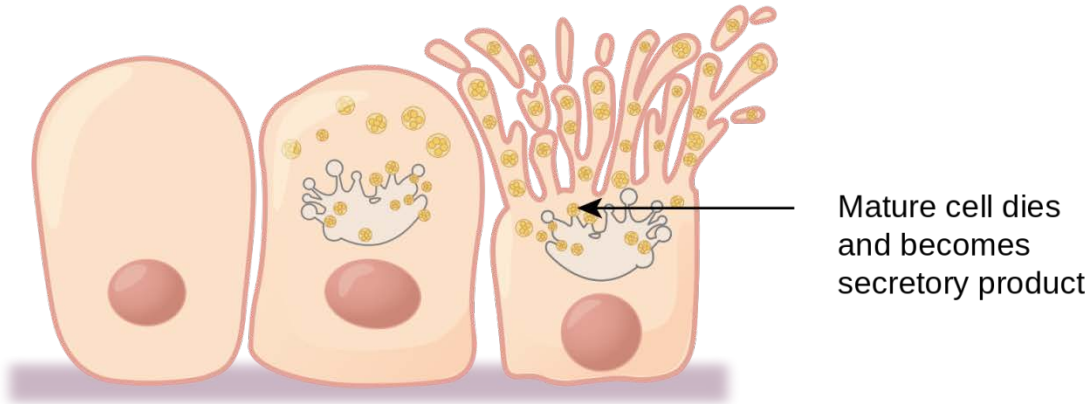
(a) Merocrine secretion



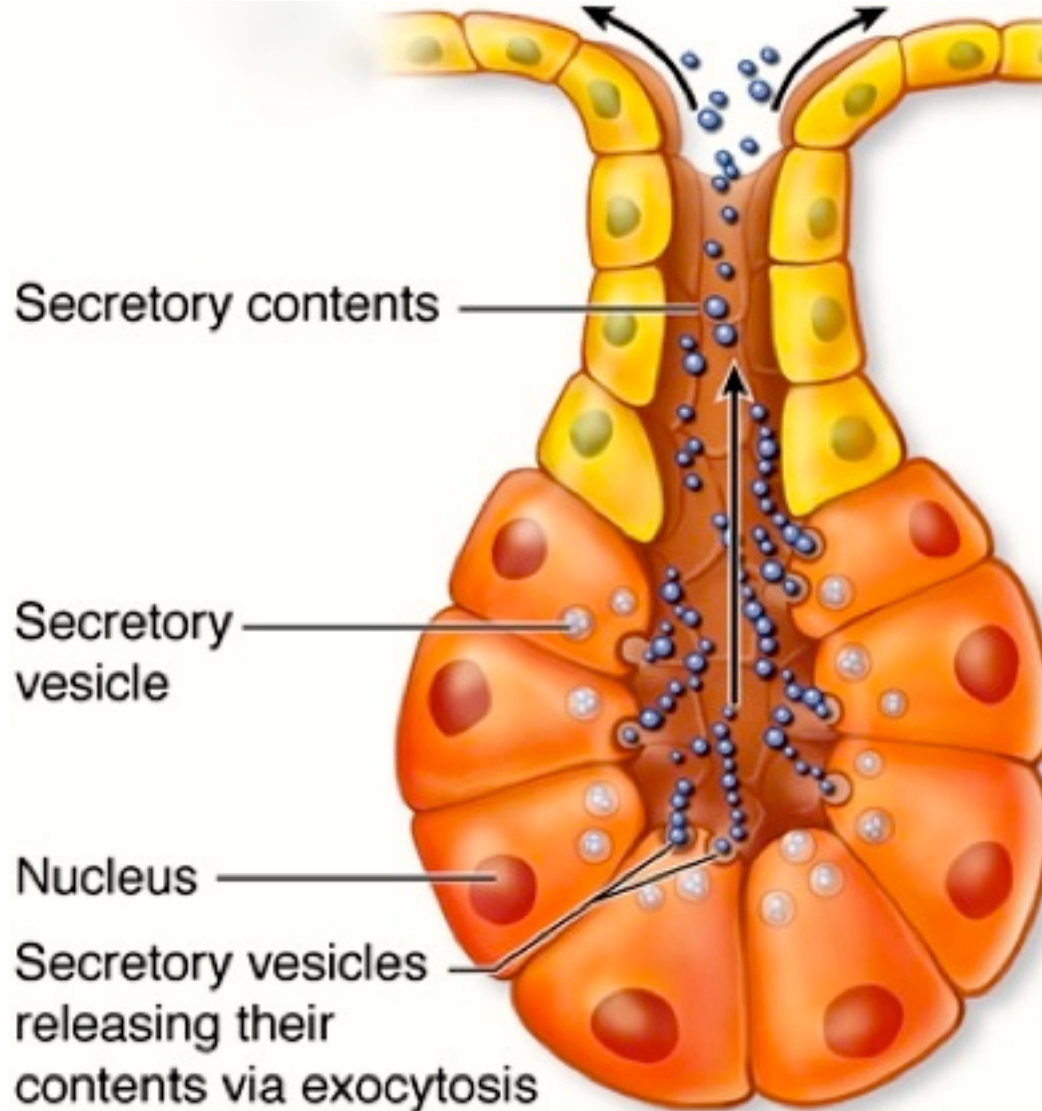
(b) Apocrine secretion



(c) Holocrine secretion

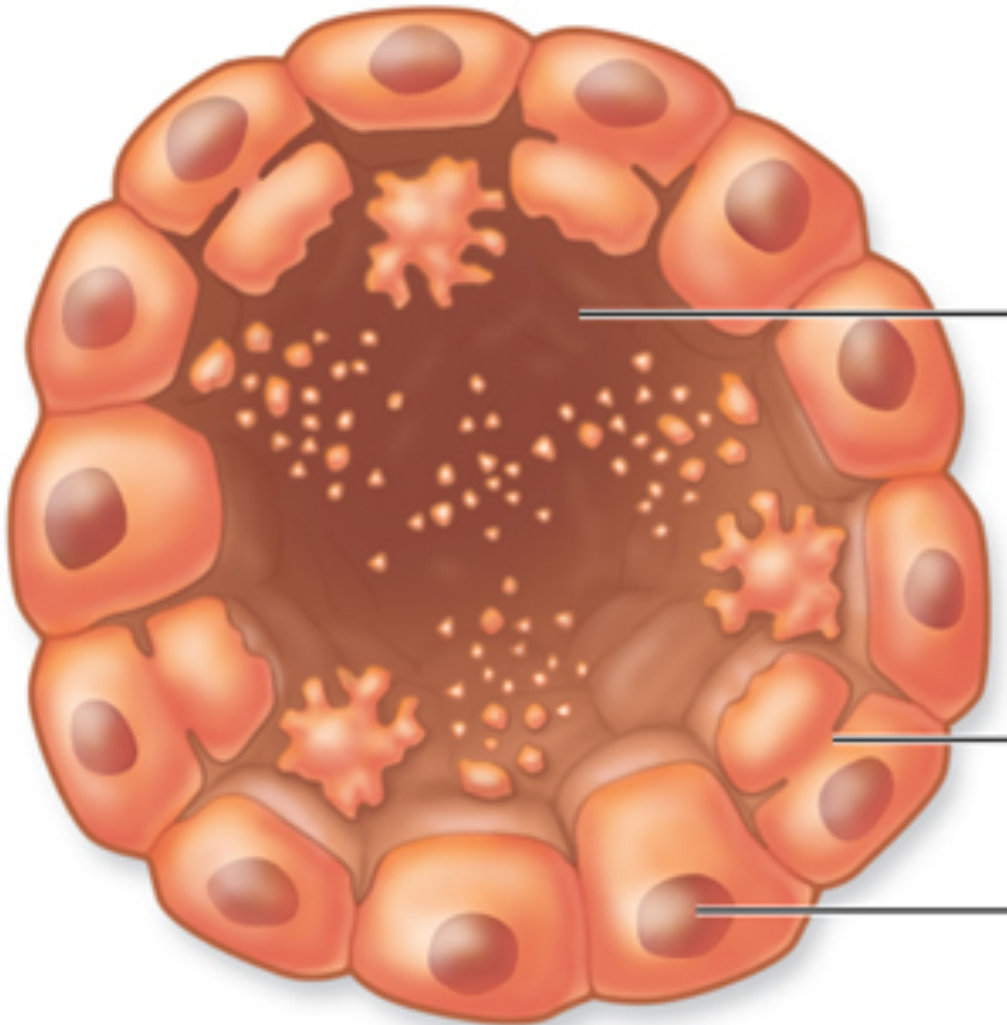


Merocrine gland



- secretory granules leave cell by exocytosis.
- MOST COMMON
- Exp: pancreas, sweat, and salivary glands

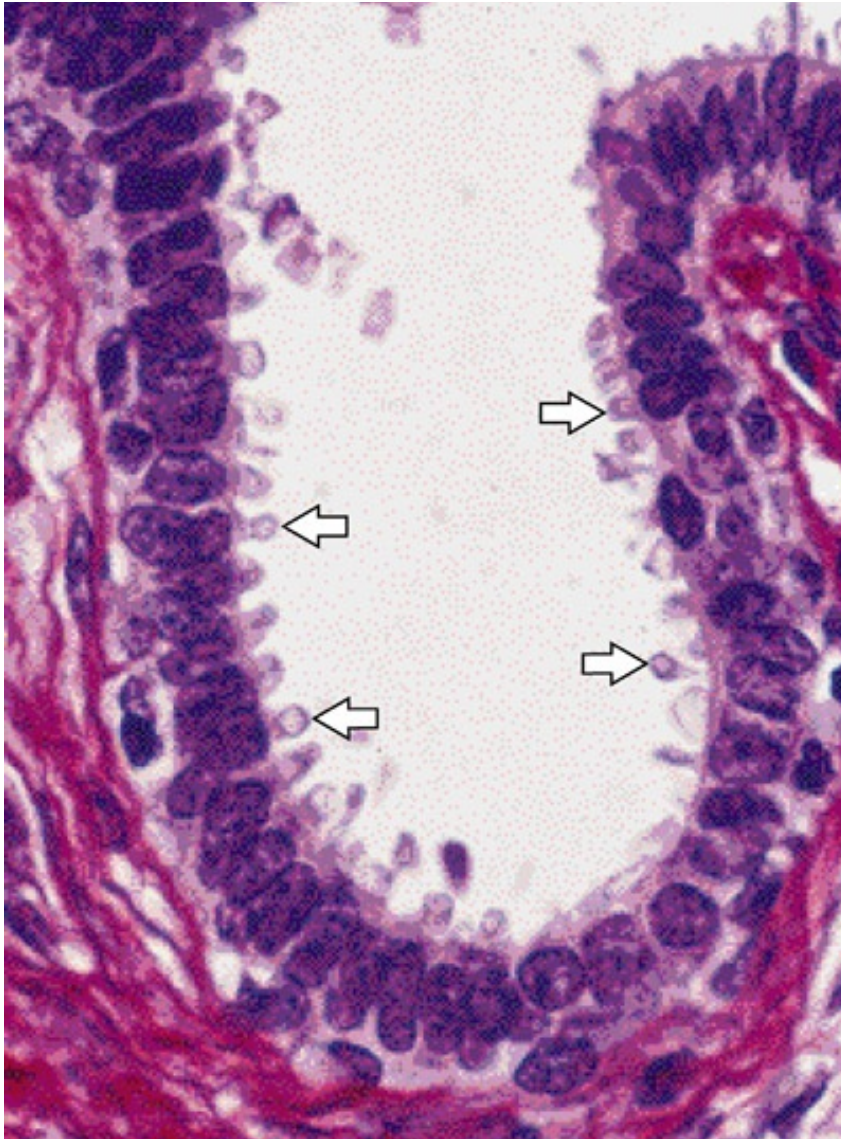
Apocrine gland



- Secretion occurs by loss of large amount of apical cytoplasm.
- Example: mammary glands.

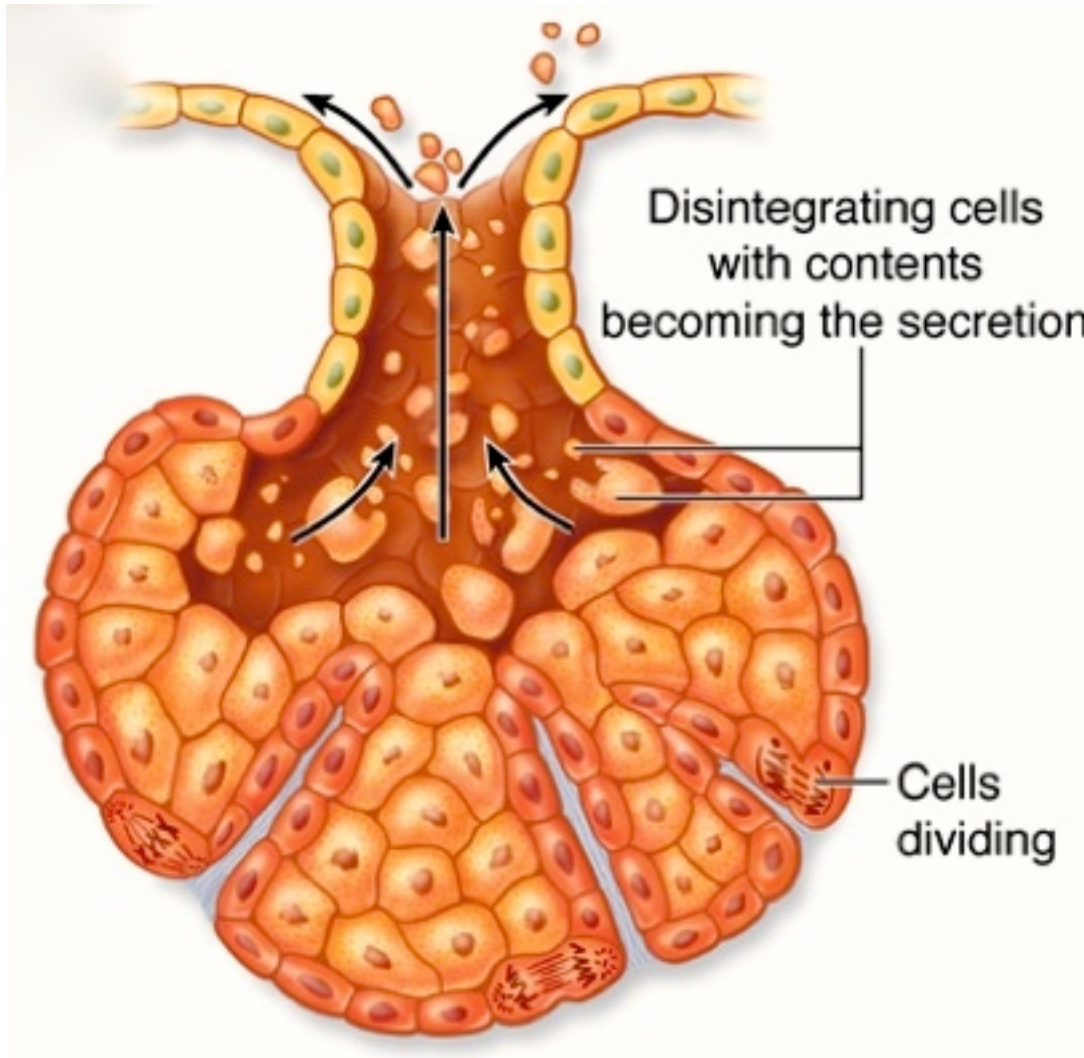


Mammary gland



Note loss of apical portions of cytoplasm.

Holocrine gland



- Secretion occurs by disintegration of secretory cells.
- Stem cells divide to replace lost cells
- Example: sebaceous glands.

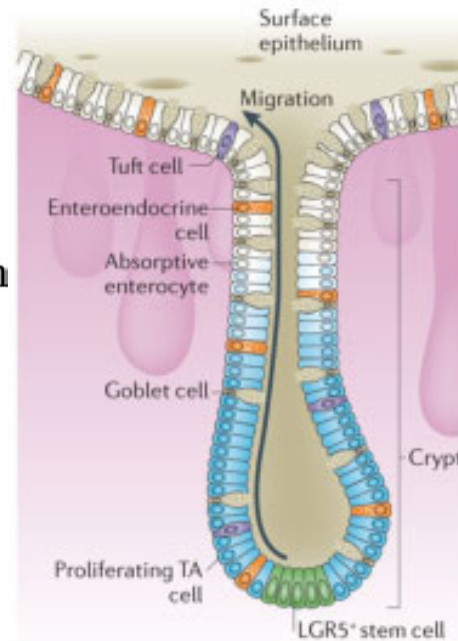
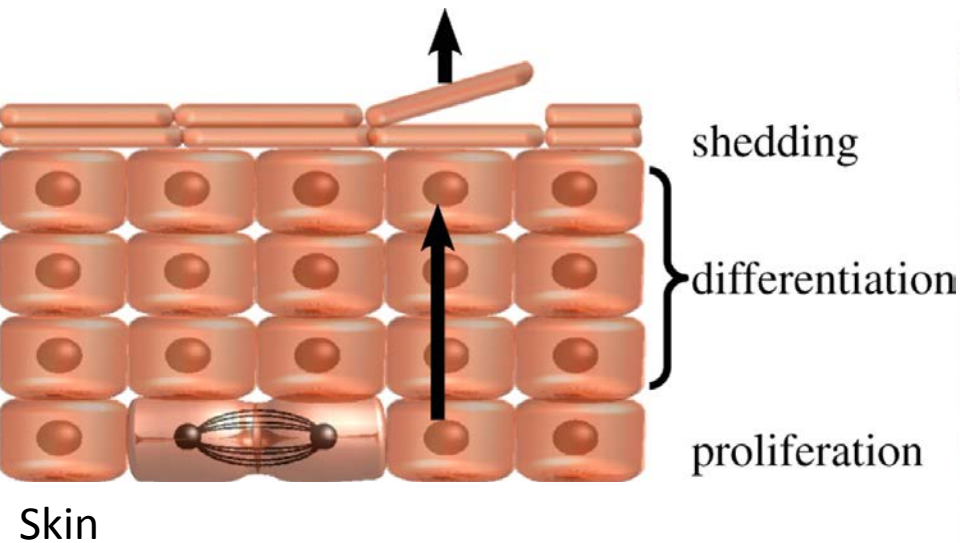


Regeneration

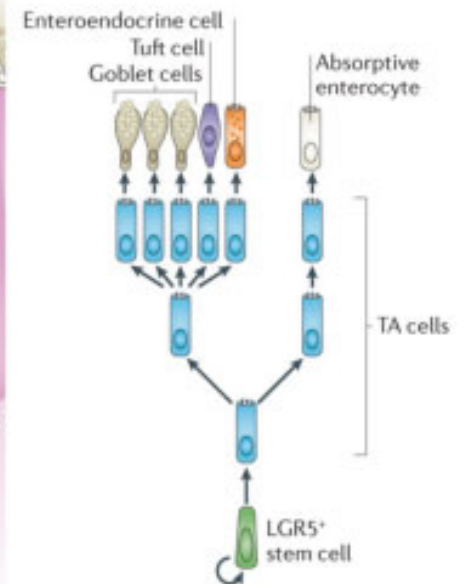
At the surface of body organs, epithelial tissues must withstand harsh external environments.

Stem cells reserve

*repair wounds and replace the cells that die



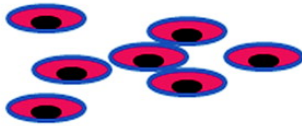
Intestine



Epithelial-to-Mesenchymal Transition

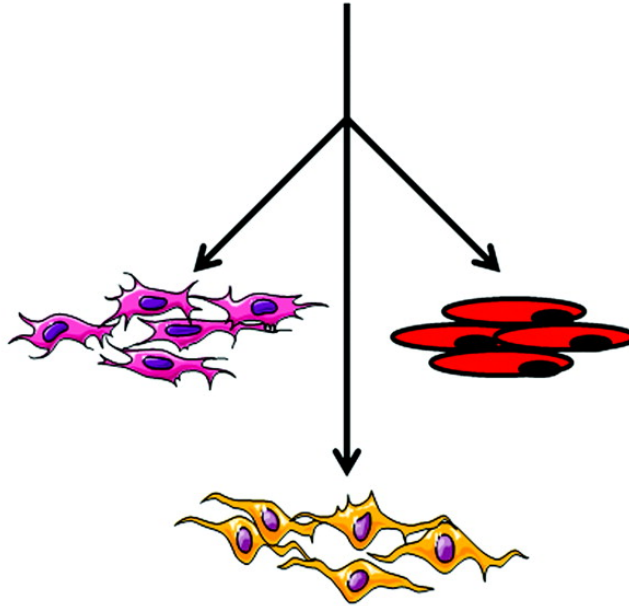
EMT

**Developmental:
Type 1 EMT**



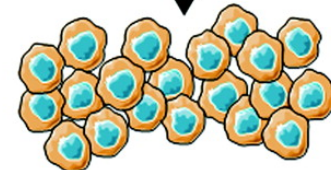
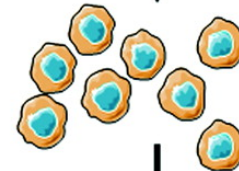
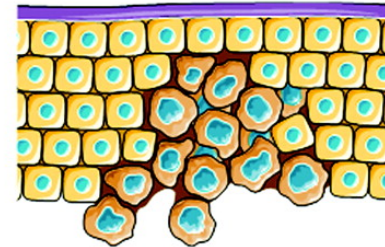
*Successive waves of
EMT-MET generate
embryonic
tissues and organs*

**Chronic (fibrosing)
injury: Type 2 EMT**



*Various mesenchymal cells
may be derived in the
adult via EMT in the setting
of chronic/fibrosing injuries*

**Malignancy:
Type 3 EMT**



*Epithelial tumors
(Carcinoma) acquire
malignant features and
metastasize via EMT*

Examples of glandular epithelial cells

- Ion transporting cells
- Serous secretory cells
- Mucous secretory cells
- Neuroendocrine cells
- Myoepithelial cells

THE END



Next week

✓ Connective Tissues