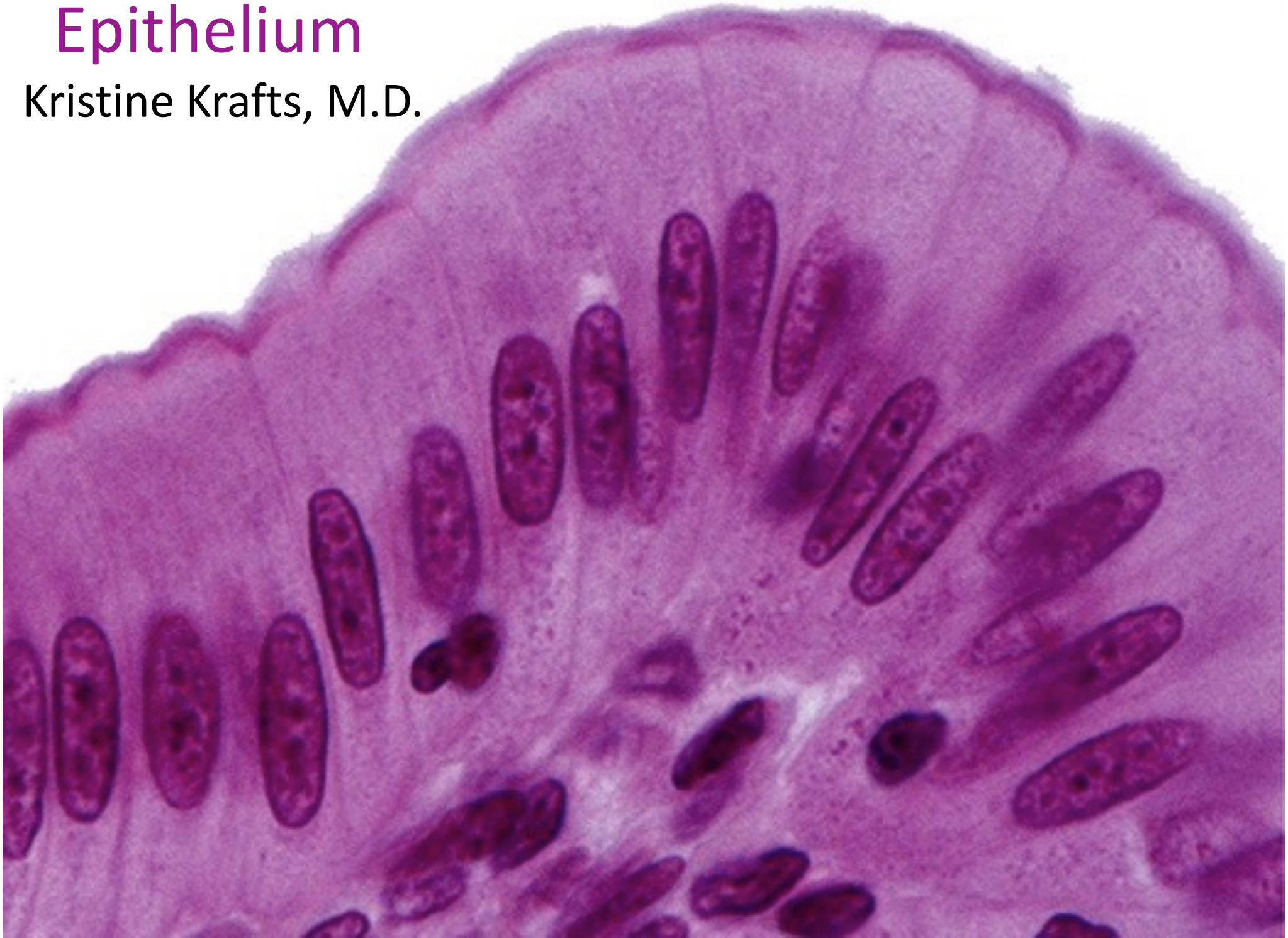


Epithelium

Kristine Krafts, M.D.



Epithelium Lecture Objectives

- Describe the structural and functional relationship between:
 - epithelium and connective tissue, and
 - epithelium and basal lamina.
- Describe the structural and functional features of epithelial intercellular junctions and specializations of the apical surface of epithelial cells.

More Epithelium Lecture Objectives

- Describe the structural and functional diversity of epithelium.
- Describe the classification system of covering/lining epithelium.
- Describe the histologic features of glandular epithelium.

Epithelium Lecture Outline

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

Epithelium Lecture Outline

- Function and types of epithelium

Functions of Epithelium

- Covering of external surfaces
- Lining of internal surfaces
- Protection
- Absorption
- Secretion
- Sensation
- Contraction

Two Main Kinds of Epithelium

Covering and lining epithelium

Covers outer surfaces of body and lines internal body passages

Glandular epithelium

Contains cells specialized for secretion

Unique Characteristics of Epithelium

- Basal lamina anchors epithelium to underlying connective tissue.
- Epithelial cells are very cohesive due to intercellular junctions.
- Epithelial cells vary a lot in shape and size.
- Epithelial tissues are avascular.
- Epithelial cells demonstrate polarity.

Epithelium Lecture Outline

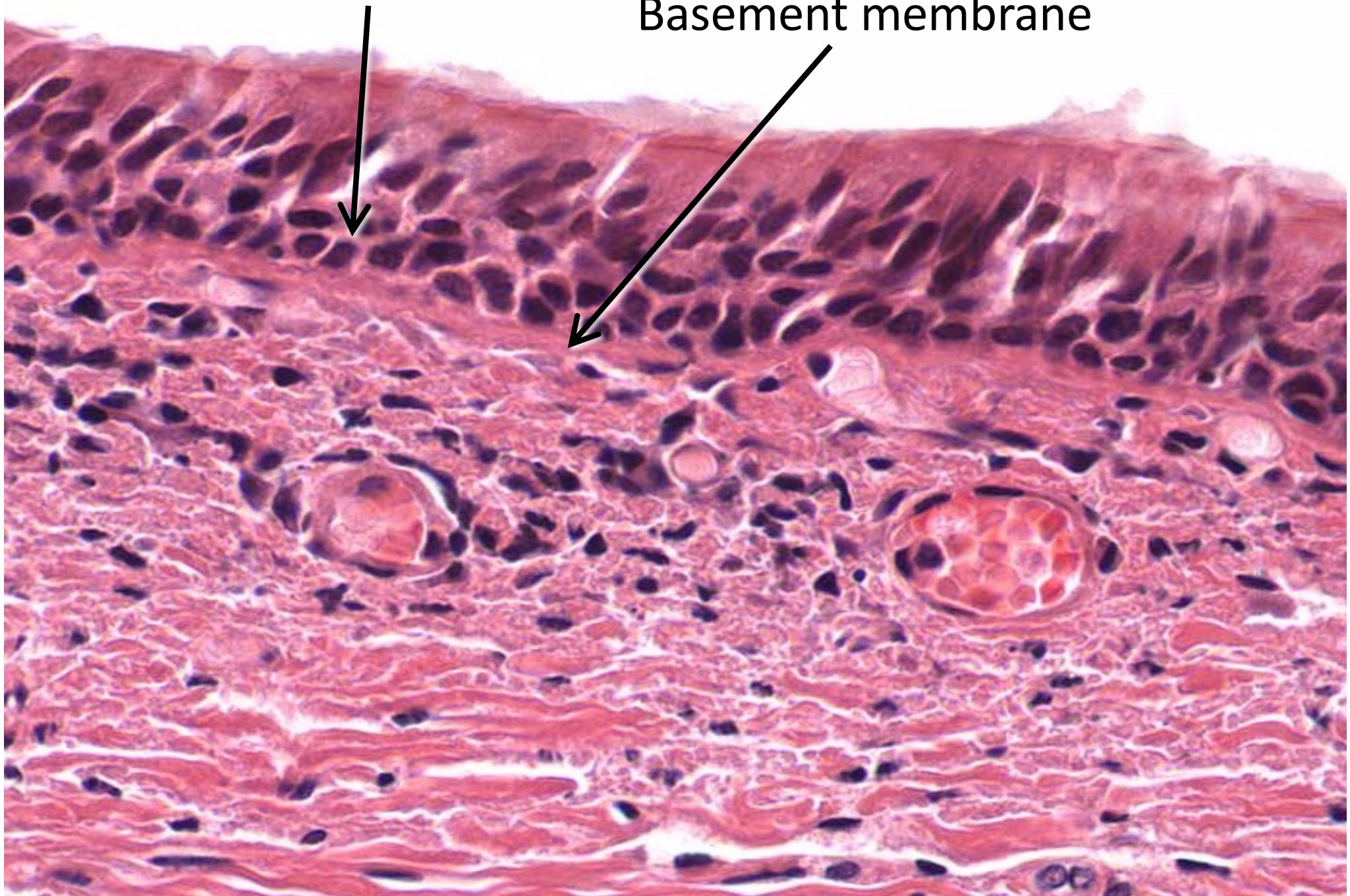
- Function and types of epithelium
- Structure of epithelium
 - Basement membrane
 - Connections between cells
 - Specialized apical structures

Epithelium Lecture Outline

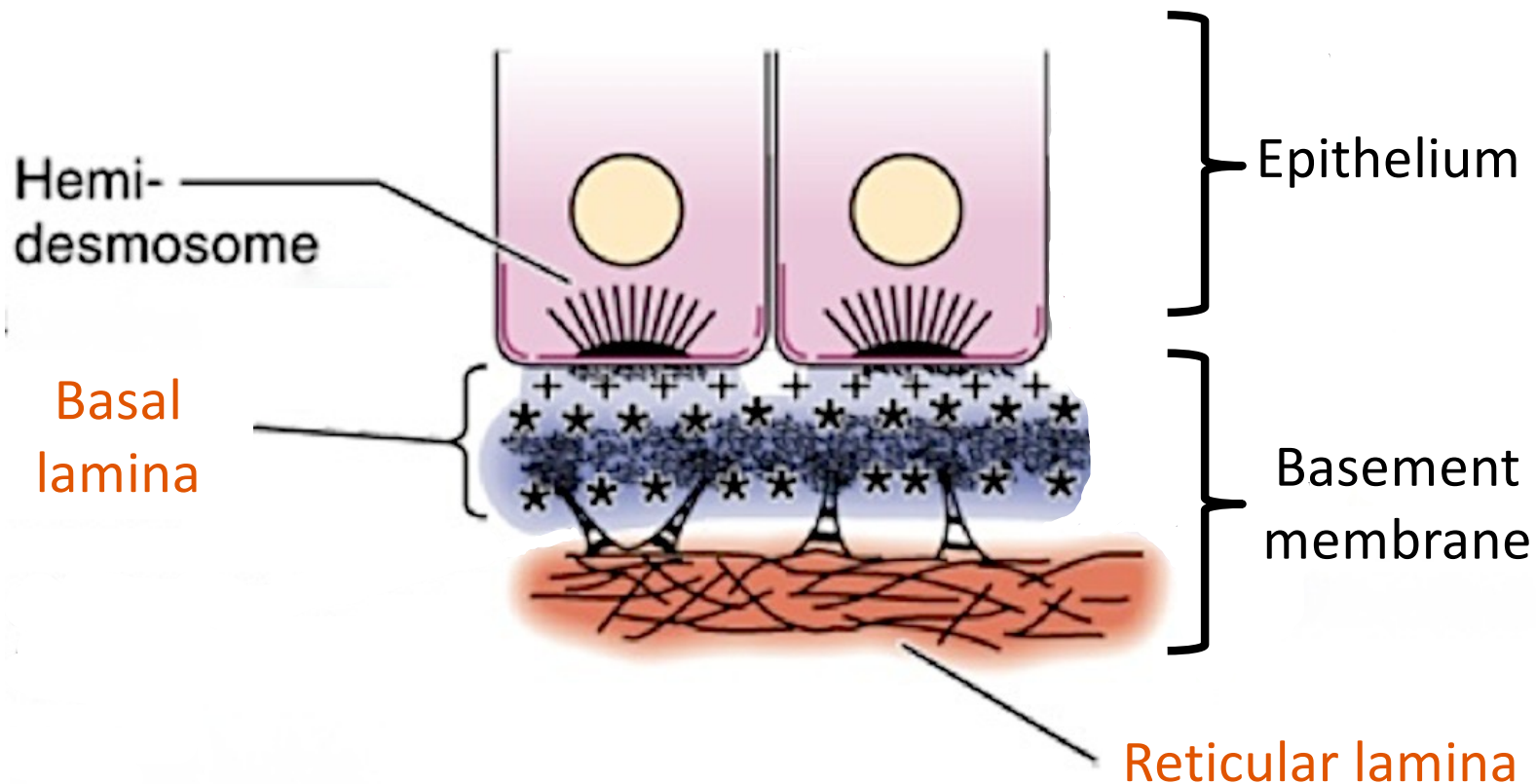
- Function and types of epithelium
- Structure of epithelium
 - Basement membrane

Epithelial cells

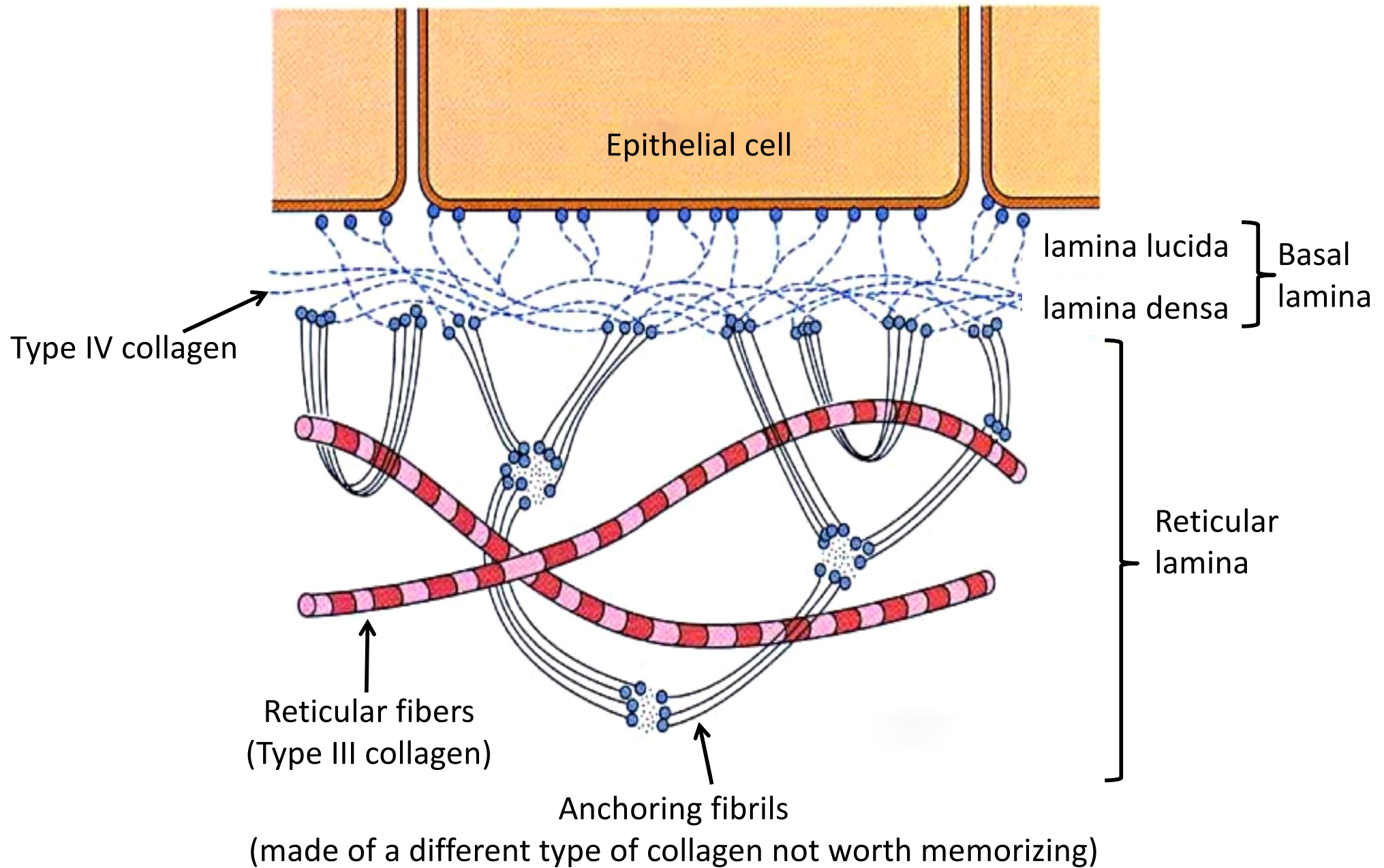
Basement membrane



Basement membrane = Basal Lamina + Reticular Lamina



Composition of Basal Lamina and Reticular Lamina



Don't make this mistake!

“Basal lamina” and “basement membrane”
are sometimes used interchangeably.

This is wrong, wrong, wrong!

The basal lamina is **part of** the basement
membrane. They are not the same thing.

Epithelium Lecture Outline

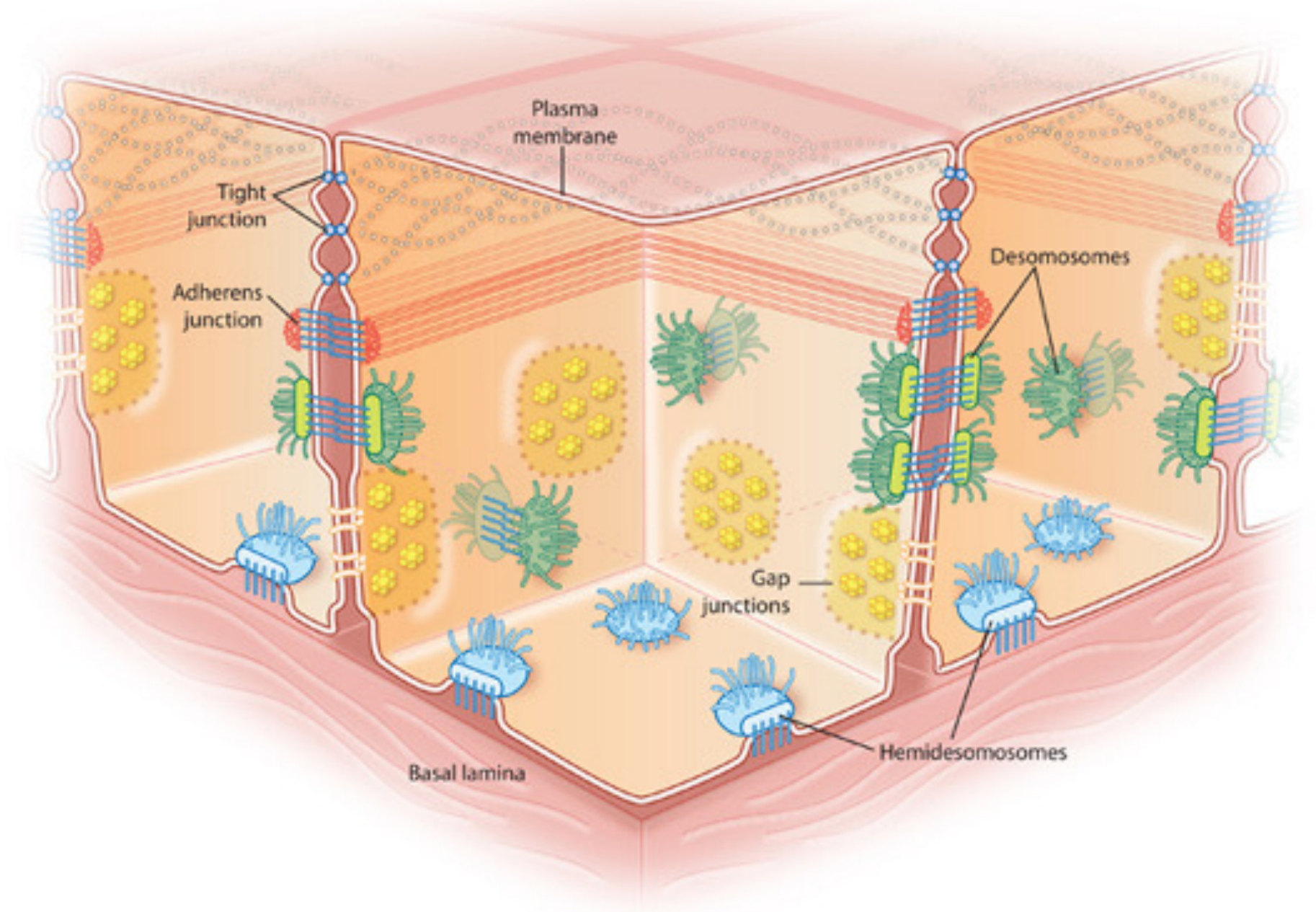
- Function and types of epithelium
- Structure of epithelium
 - Basement membrane
 - Intercellular junctions

Intercellular junctions connect epithelial cells

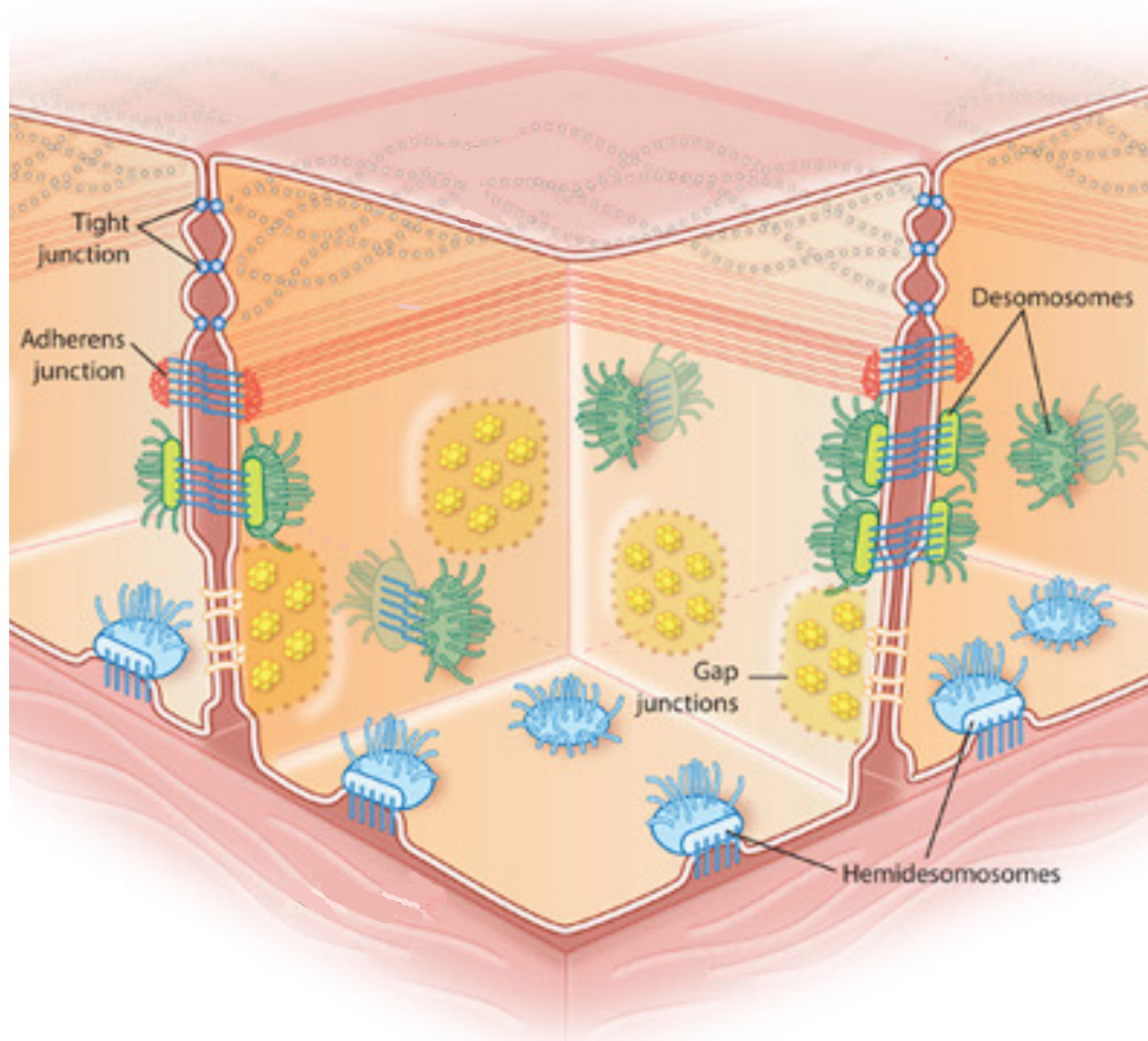
Intercellular junctions are present in many tissues but are especially numerous and prominent in epithelium.

- Tight junction (zonula occludens)
- Adhering junction (or zonula adherens)
- Desmosome (macula adherens)
- Hemidesmosome
- Gap junction

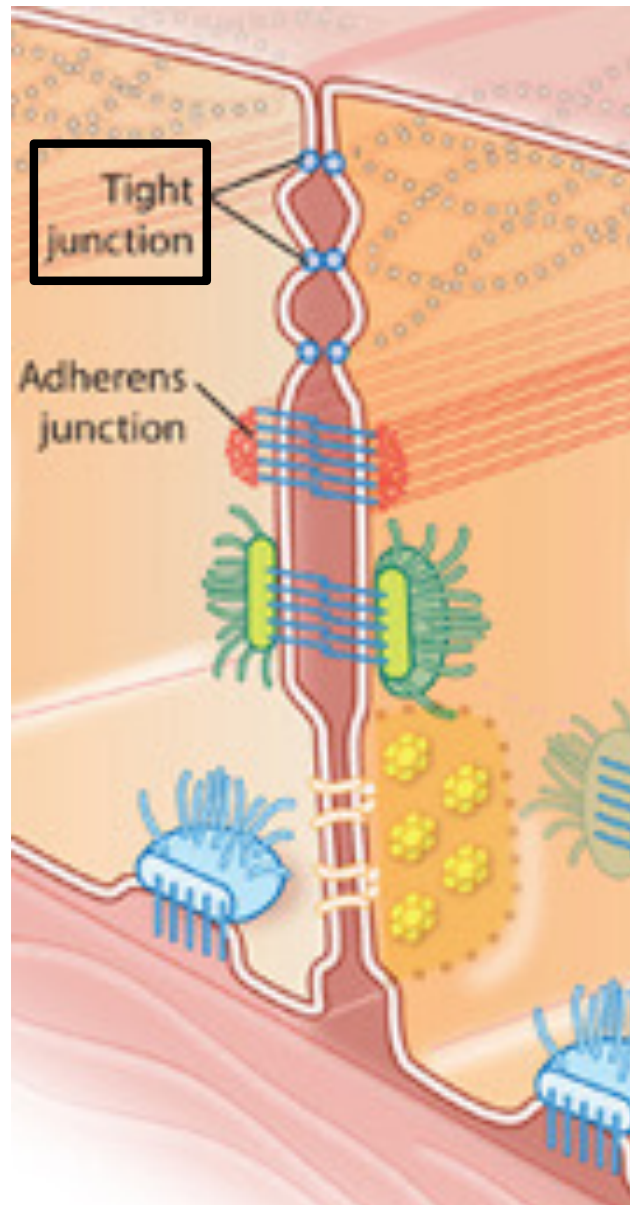
Intercellular Junctions



Intercellular Junctions

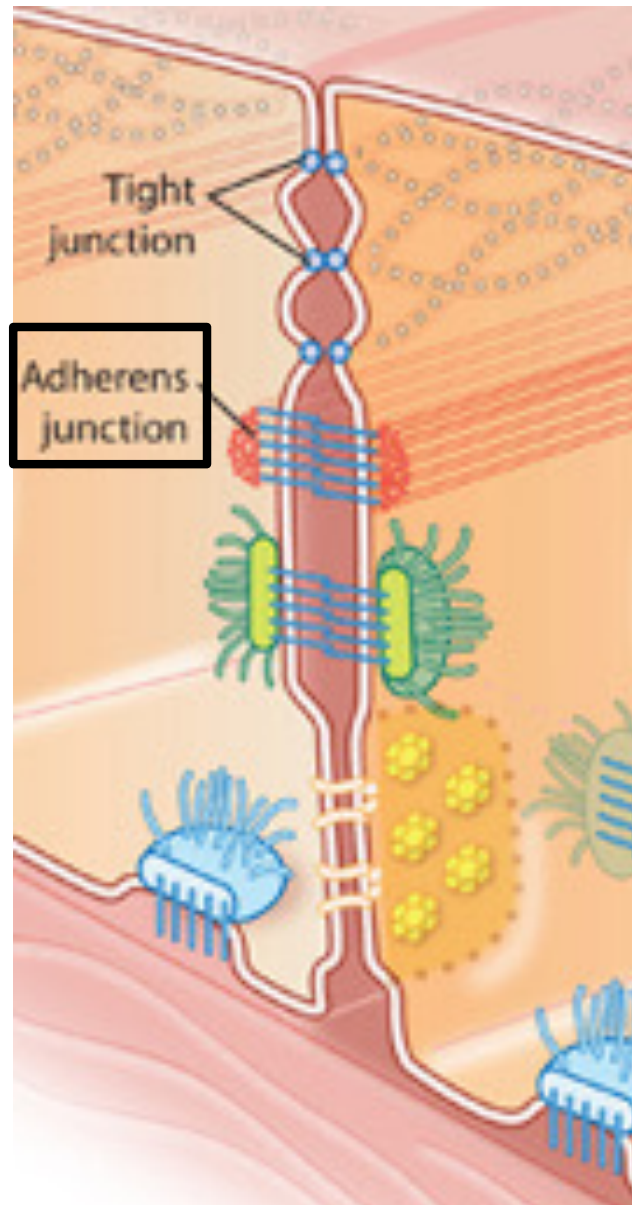


Tight junction (zona occludens)



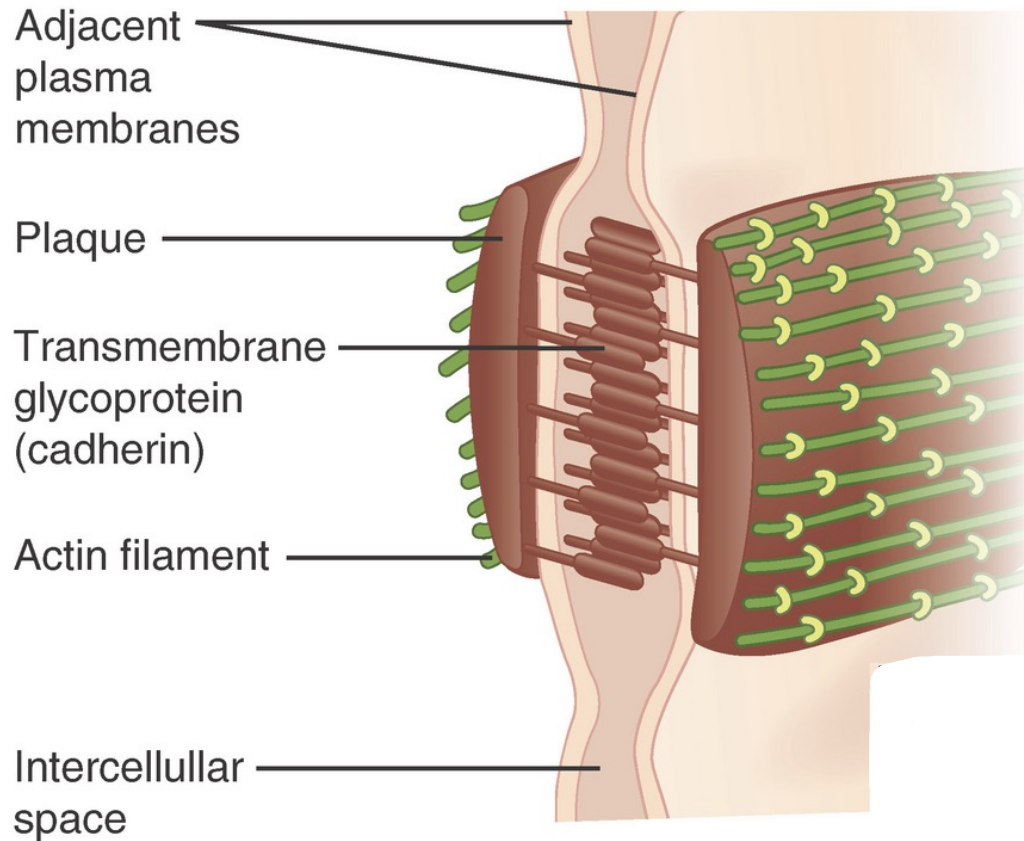
Form a super-tight seal towards the top of two adjacent cell to prevent flow of materials between cells.

Adherens junction (zonula adherens)



Forming a close bond between adjacent cells, this junction runs all the way around the cell like a belt.

Adherens junction (zonula adherens)

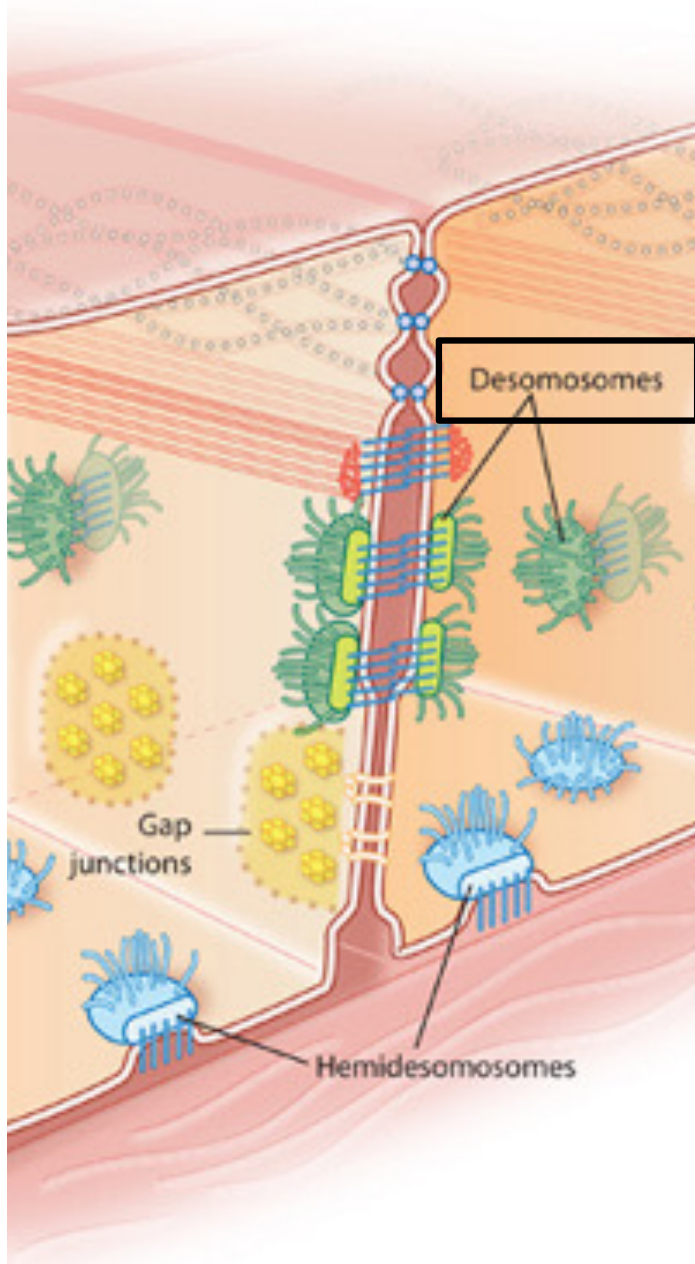


Form bands that completely encircle each cell

Cadherin and catenin proteins provide adhesion between adjacent cells

Actin filaments in cytoplasm insert into attachment plaques

Spot desmosome (macula adherens)

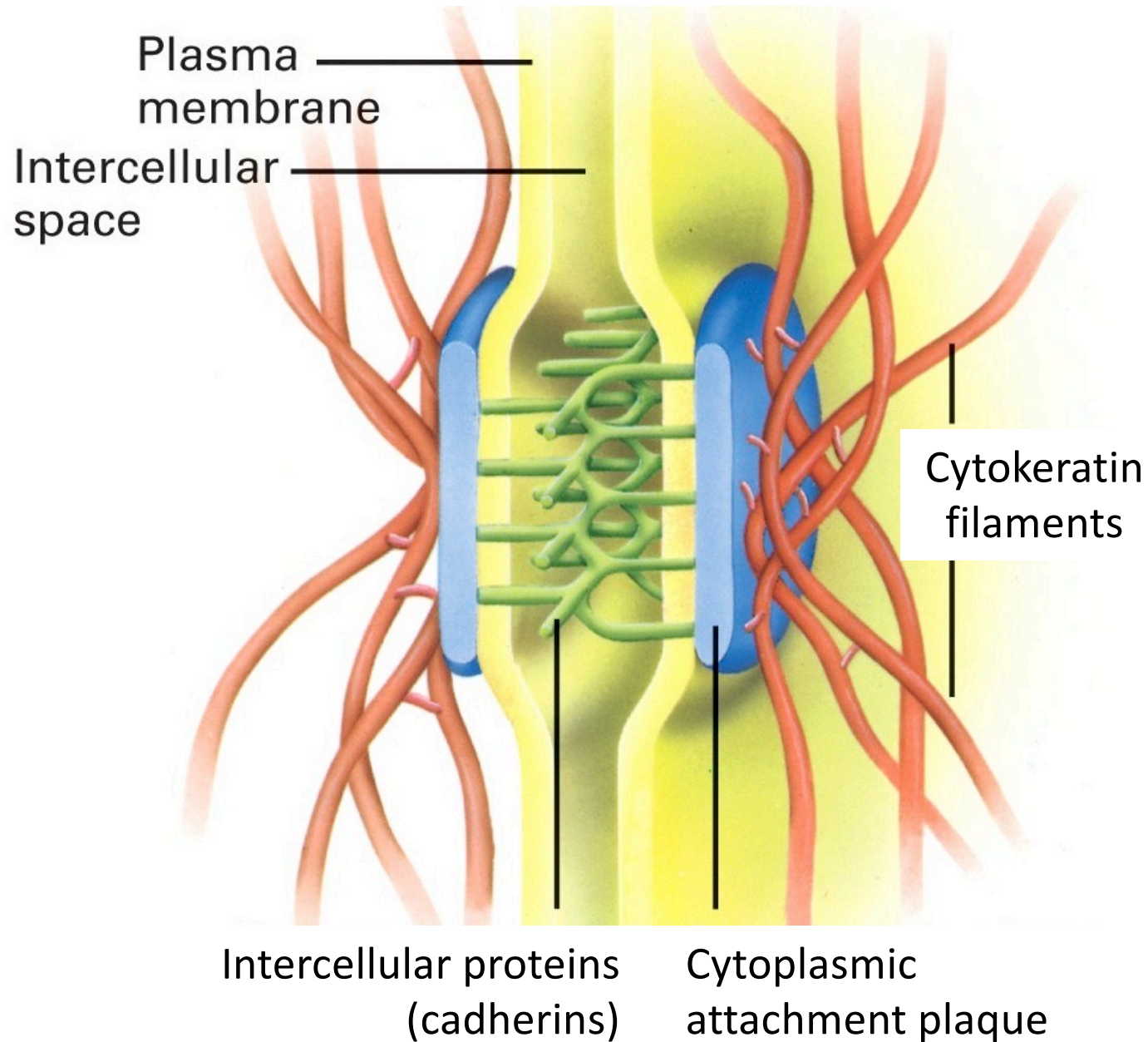


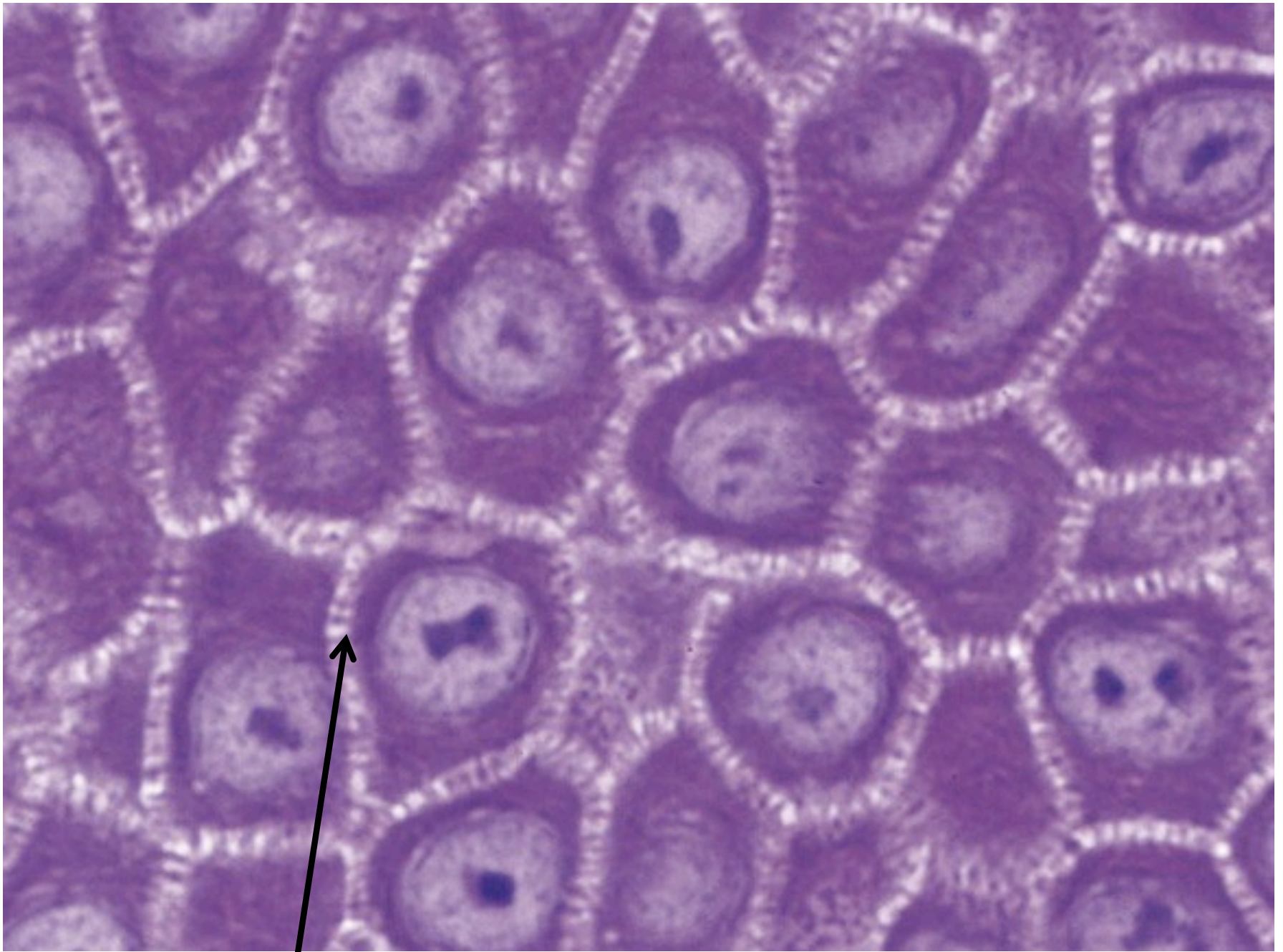
Spot adhesion (like a little spot-weld between cells)

Desmosomes on adjacent cells line up

Cadherins present in intercellular space

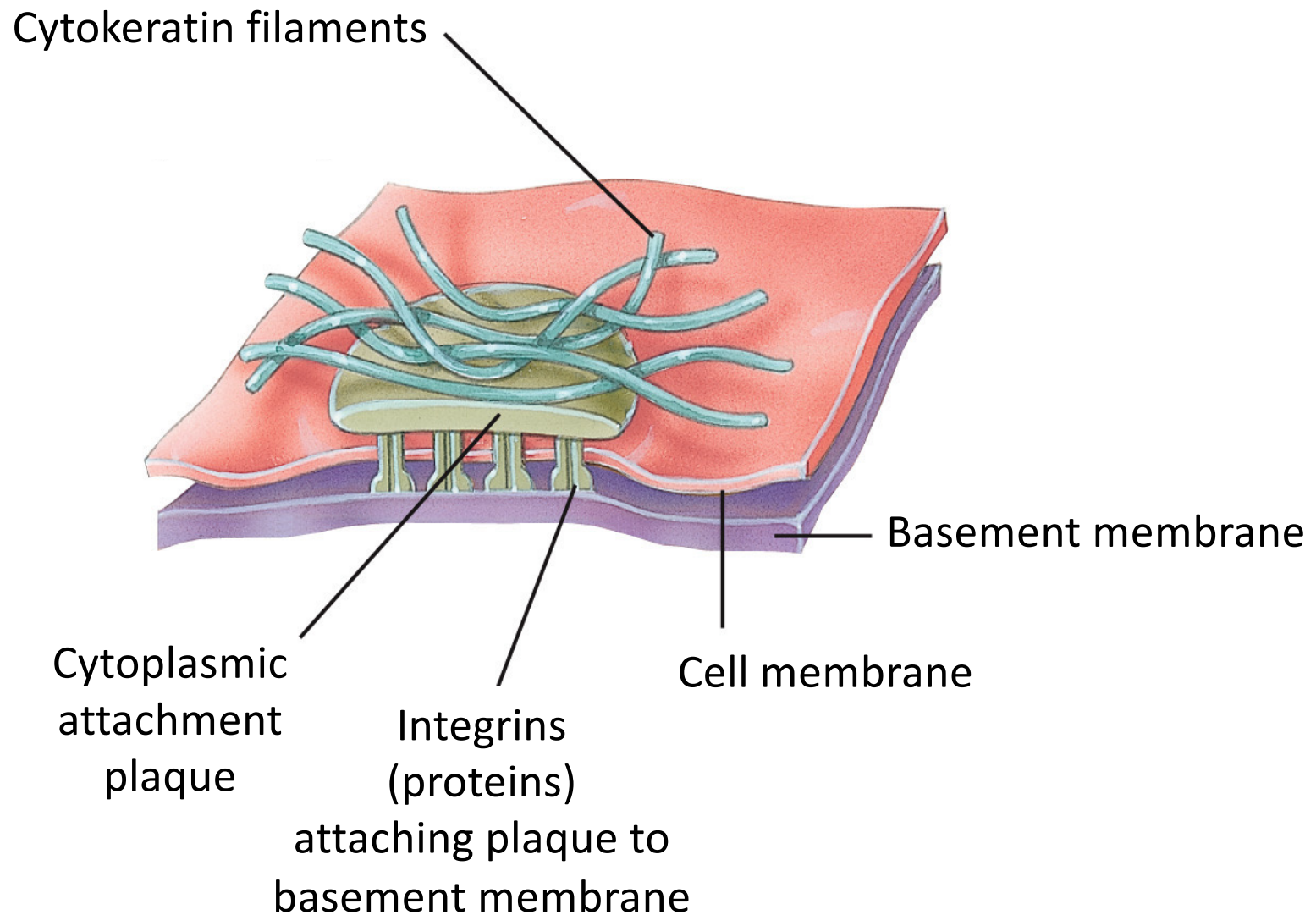
Spot desmosome (macula adherens)



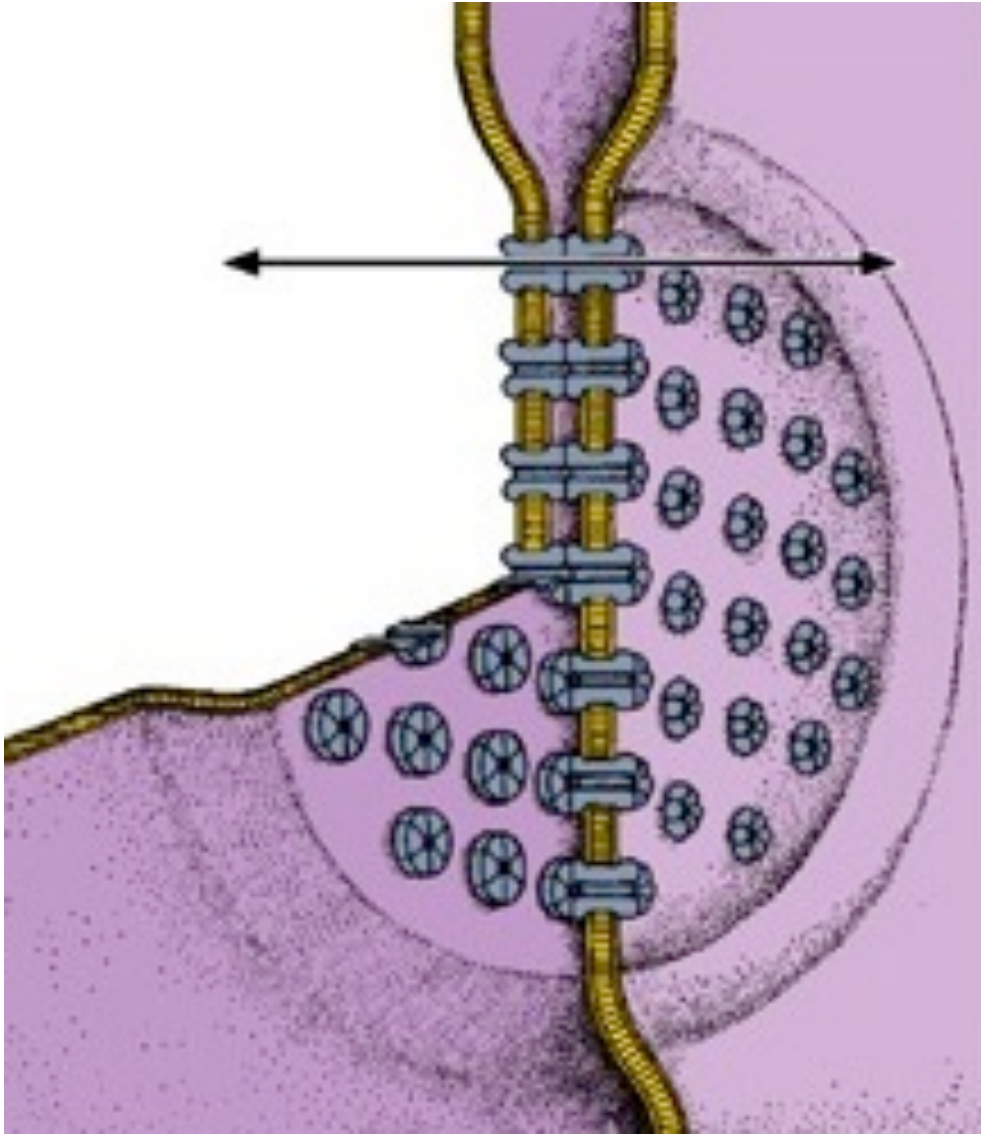


Spot desmosomes in stratum spinosum of skin

Hemidesmosome



Gap (communicating) junction

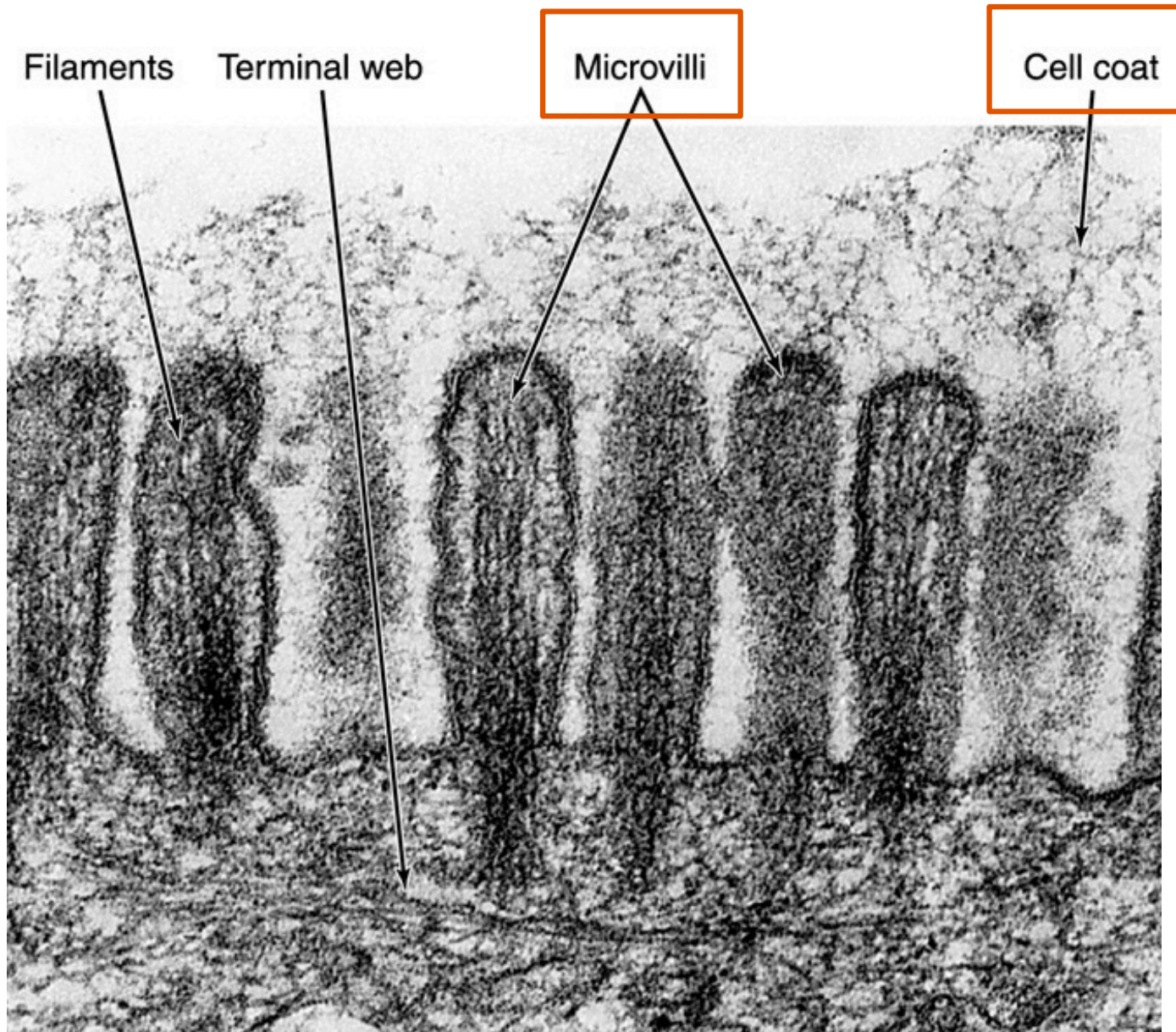


- Occur almost anywhere along lateral surfaces of epithelial cells and also in other cells, such as cardiac muscle cells
- Connexons are protein channels with central pores connecting plasma membranes
- Allow ions and other small molecules to pass through to adjacent cells to facilitate communication

Epithelium Lecture Outline

- Function and types of epithelium
- Structure of epithelium
 - Basement membrane
 - Intercellular junctions
 - Specialized apical structures

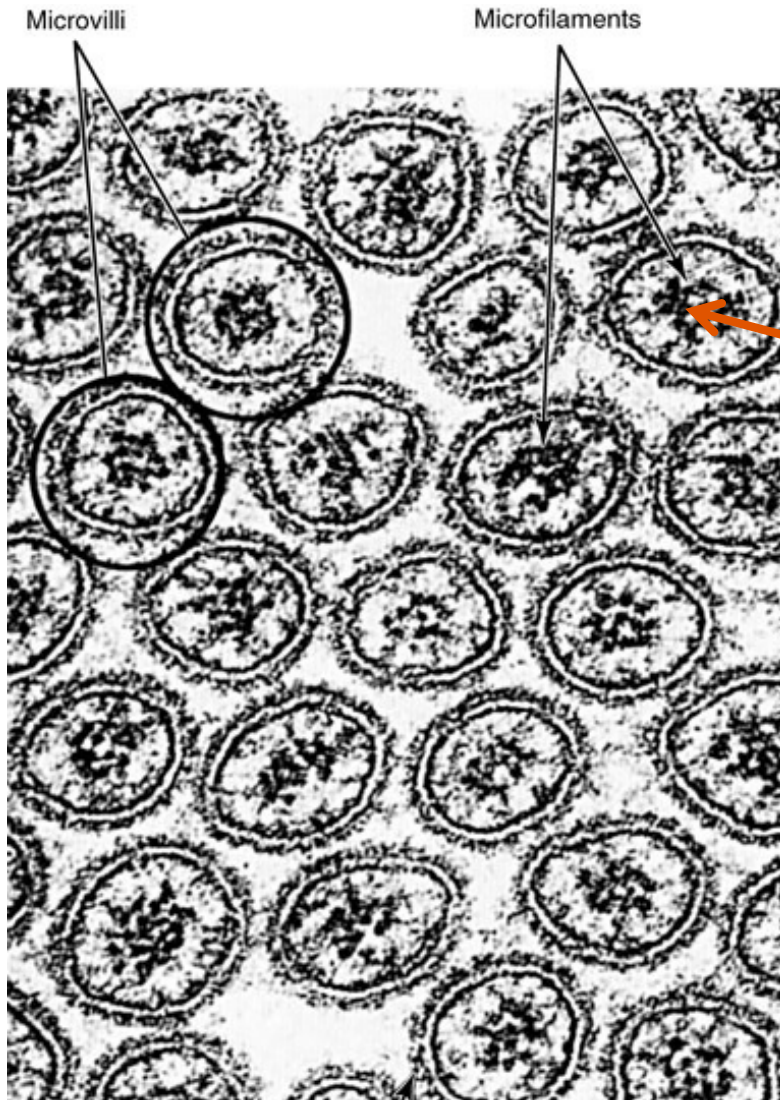
Microvilli



Microvilli + cell coat
(or glycocalyx) =
brush border or
striated border

Purpose of
microvilli: increase
surface area for
absorption or
secretion

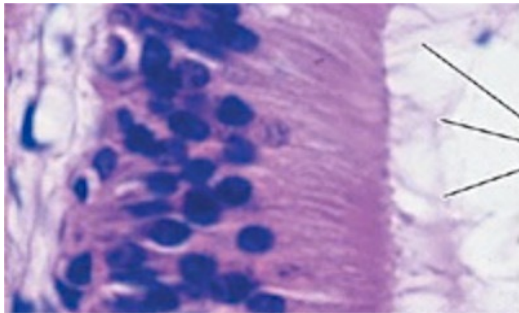
Microvilli



Microvilli have a
central core of
actin microfilaments

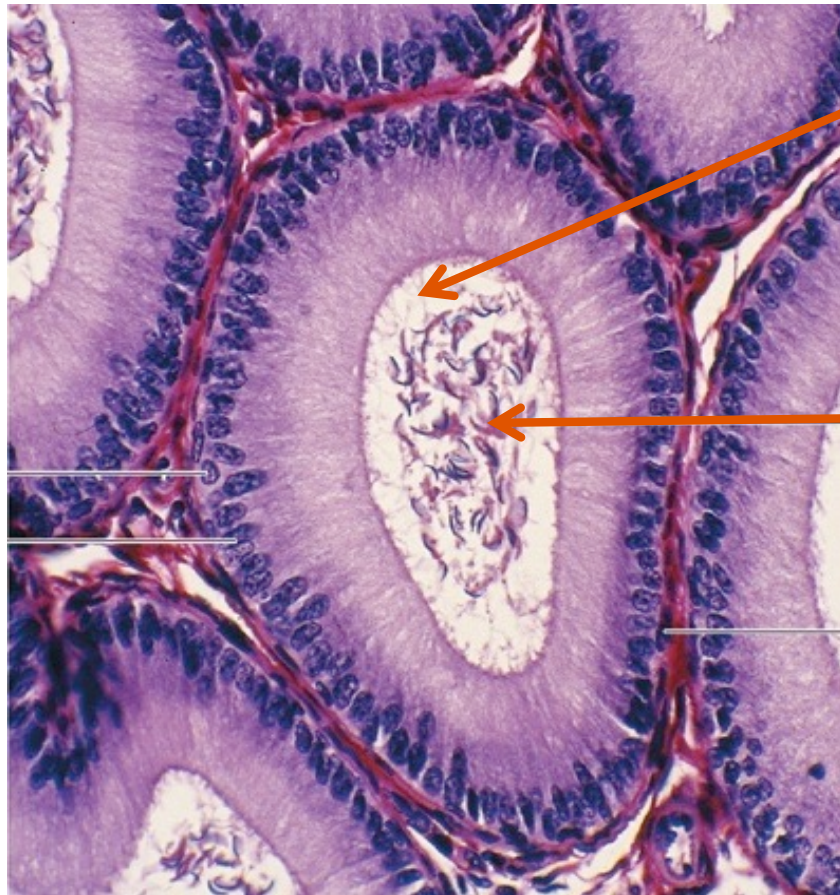
Microvilli don't wave
back and forth like cilia.

Stereocilia



Stereocilia

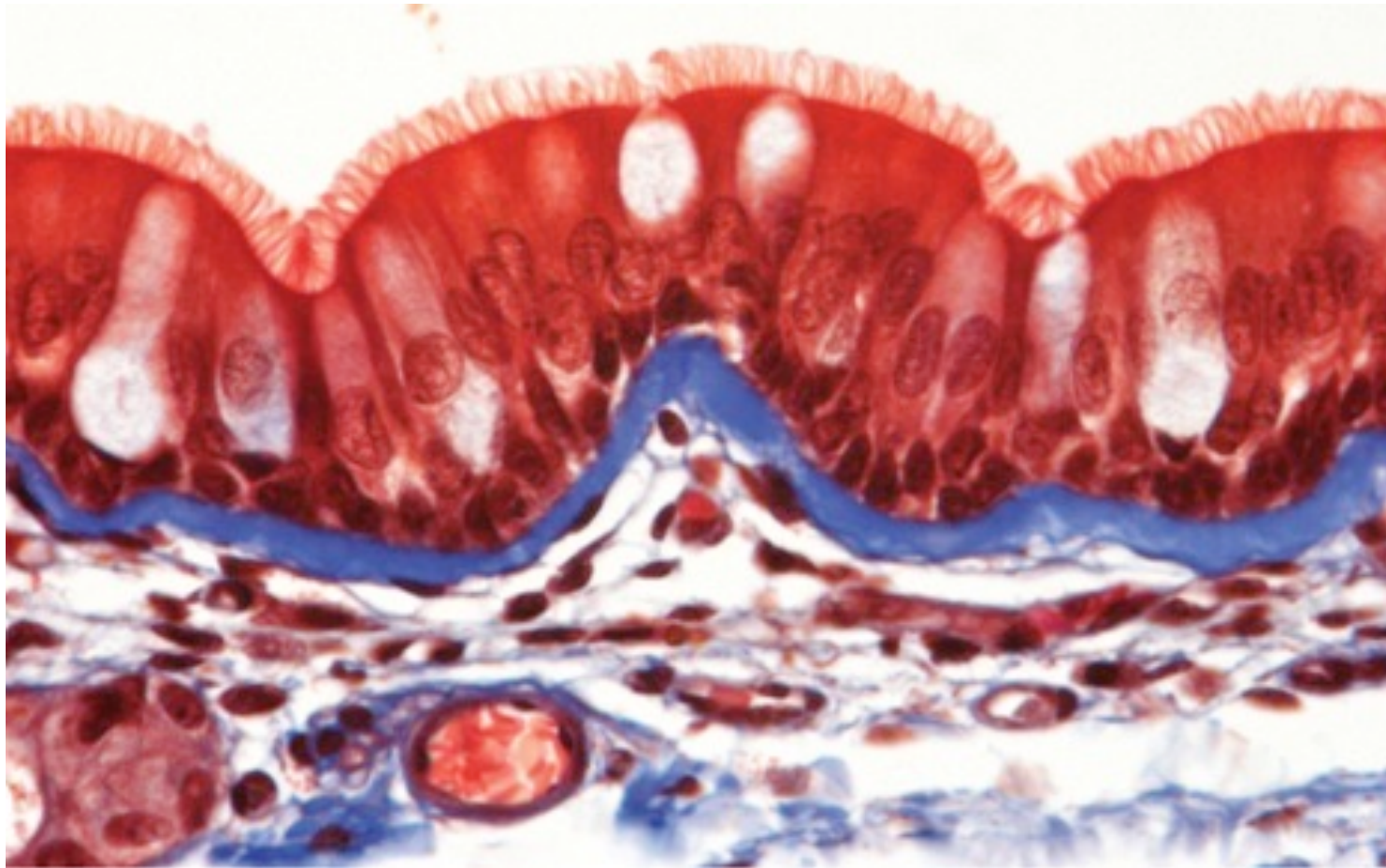
Stereocilia are long, non-motile microvilli found in parts of the male reproductive system



Spermatozoa

Cilia

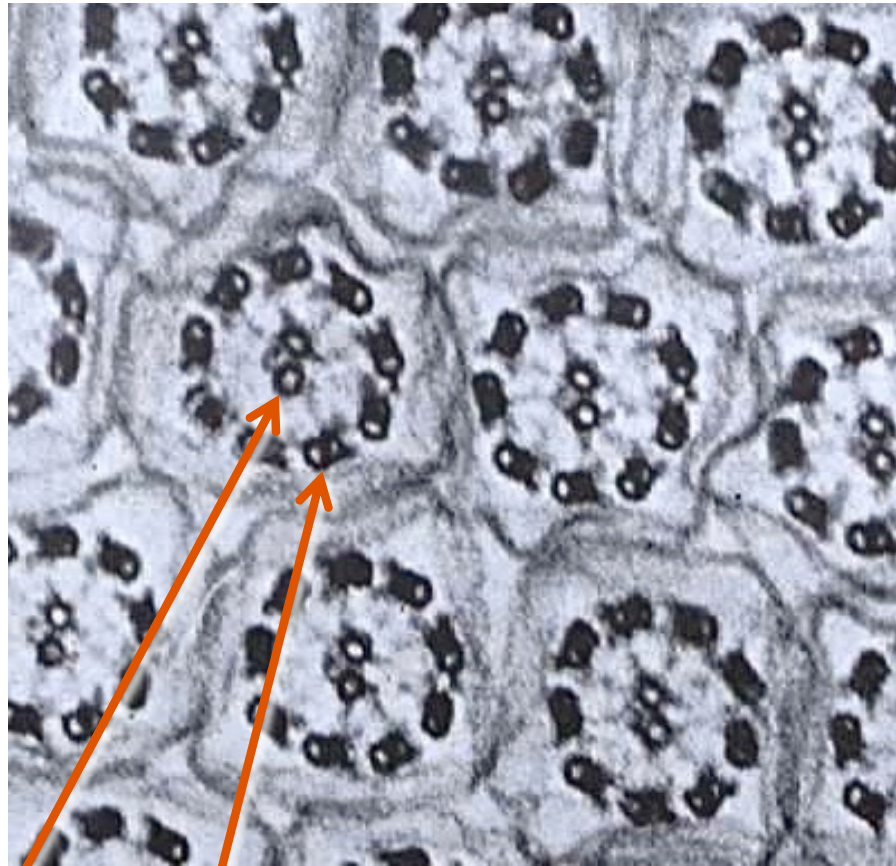
Cilia are much longer and wider than microvilli. They move back and forth to propel fluid along the epithelial surface.



Cilia on respiratory epithelial cells

Cilia

Cilia contain microtubules in a 9 + 2 configuration called an “axoneme”



2 central microtubules surrounded
by 9 pairs of microtubules

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

Number of cell layers

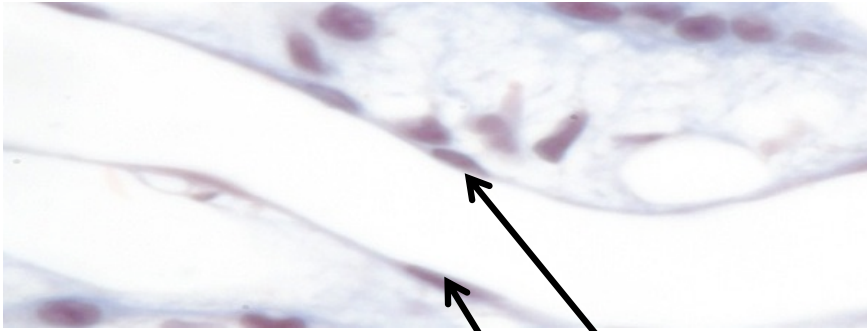
Presence of specialized structures

How is covering/lining epithelium categorized?

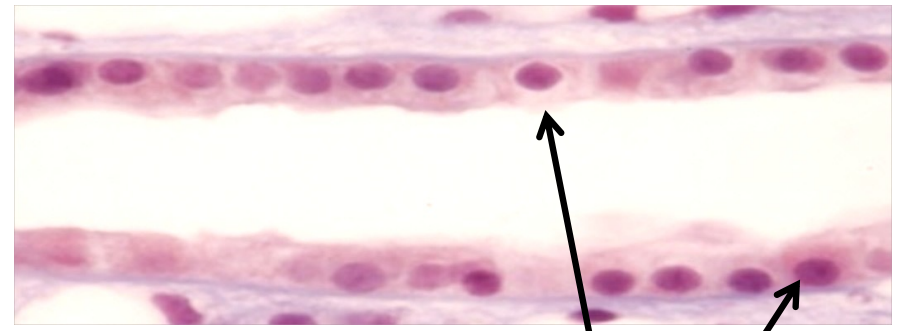
Shape of superficial cells

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

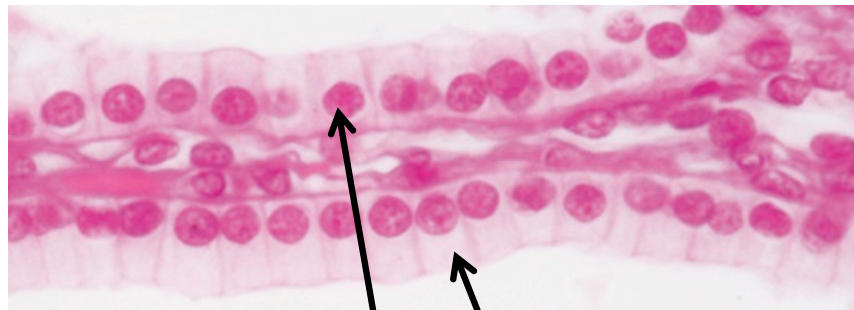
Epithelial cells have different shapes



squamous cells are flat



cuboidal cells are cute and boxy



columnar cells are tall and regal

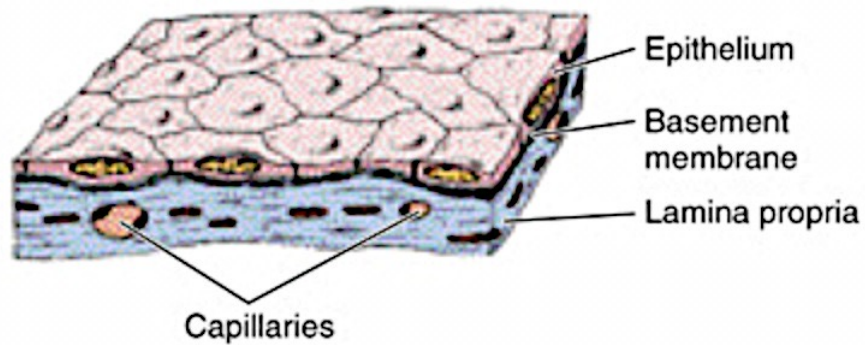
How is covering/lining epithelium categorized?

Shape of superficial cells

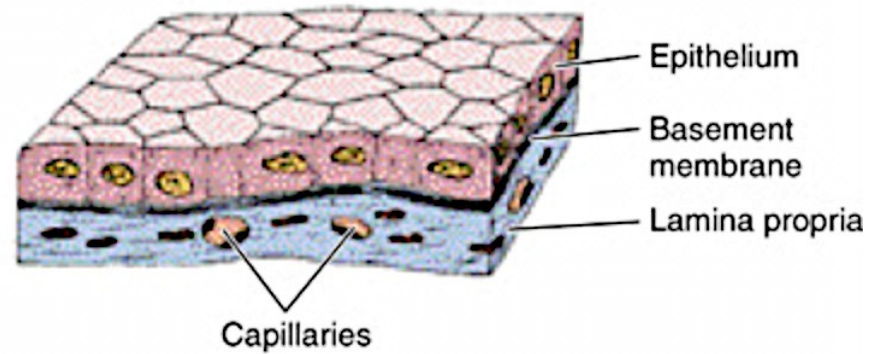
Number of cell layers

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

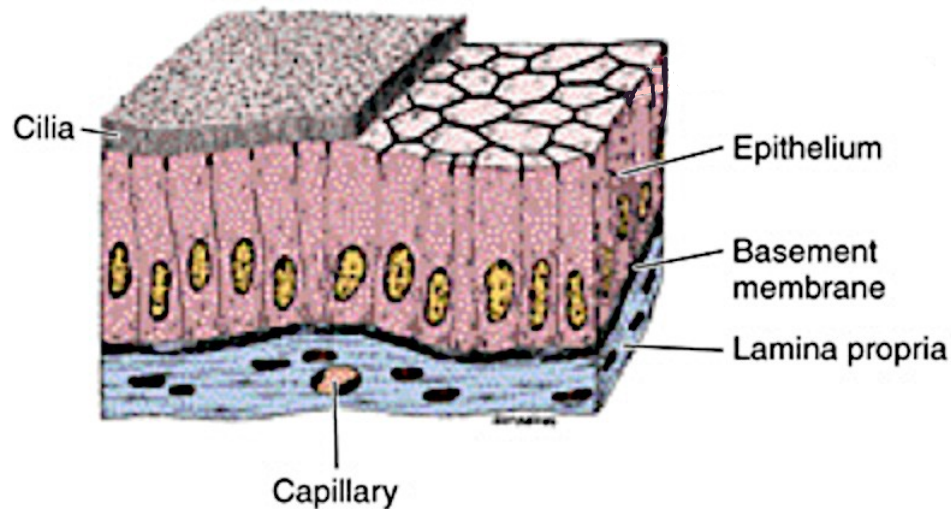
Simple epithelium: one layer of cells



Simple squamous epithelium



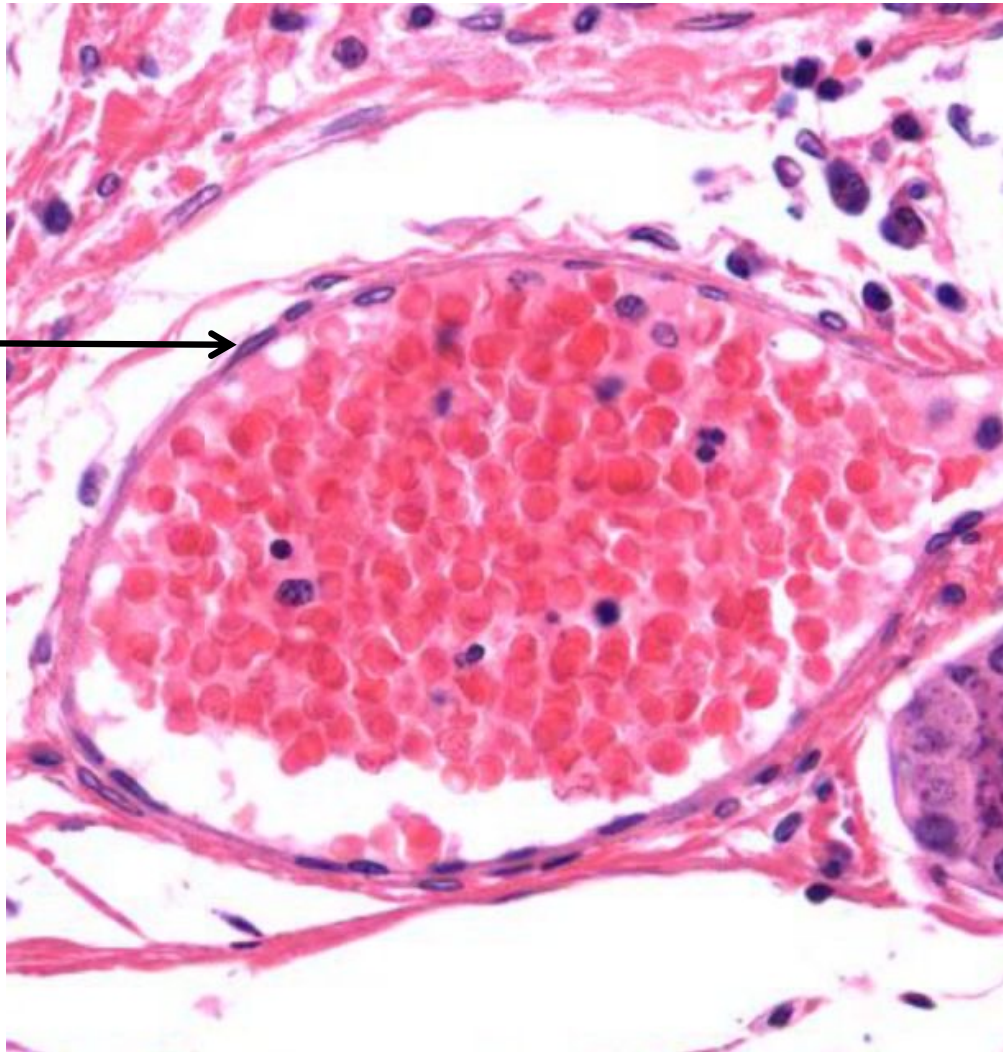
Simple cuboidal epithelium



Simple ciliated columnar epithelium

Simple Squamous Epithelium

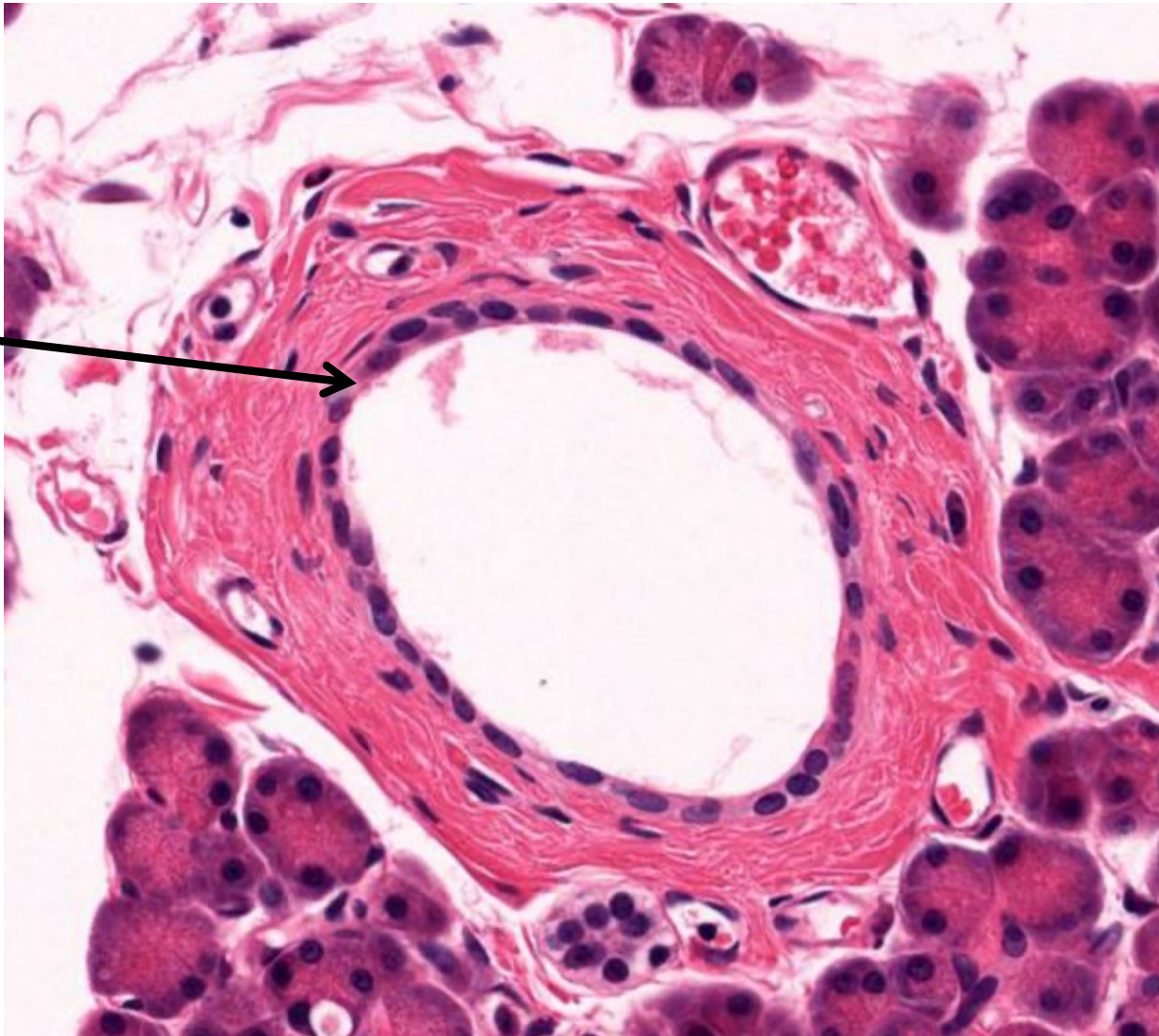
Flattened
squamous cells
in a single layer



Endothelium is simple squamous epithelium that lines vessels.
This is just an example, don't memorize for now.

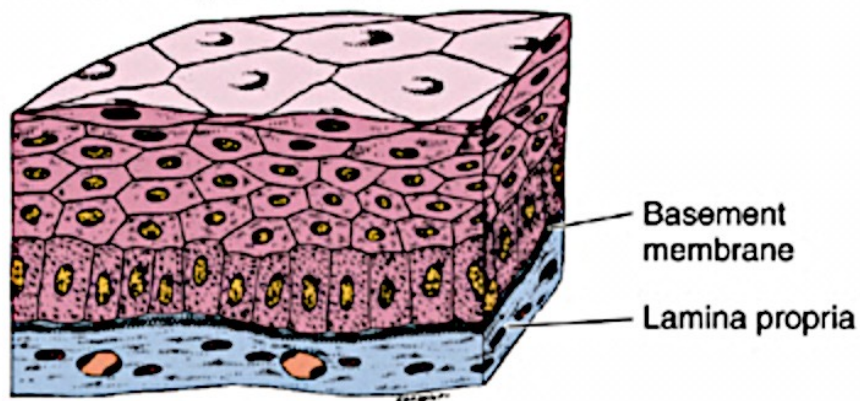
Simple Cuboidal Epithelium

Cuboidal
cells
in one cute
layer

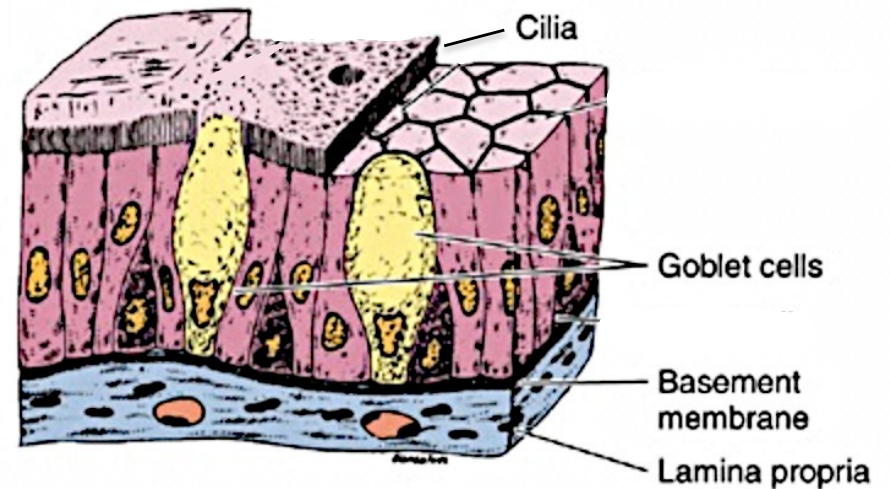


Ducts are often lined by simple cuboidal epithelium.
This is just an example, don't memorize for now.

Stratified and pseudostratified epithelium

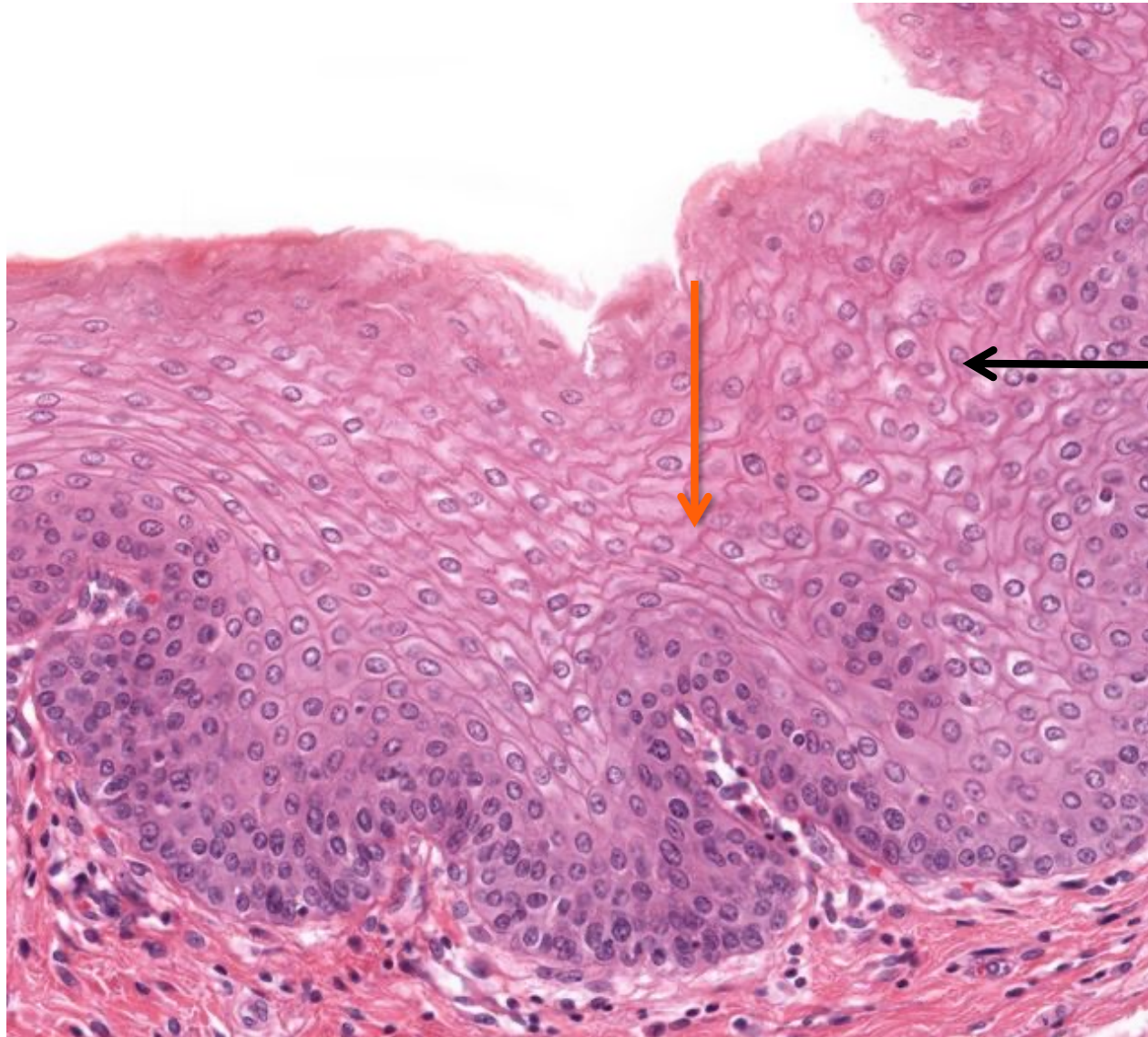


Stratified squamous epithelium



Pseudostratified ciliated columnar epithelium

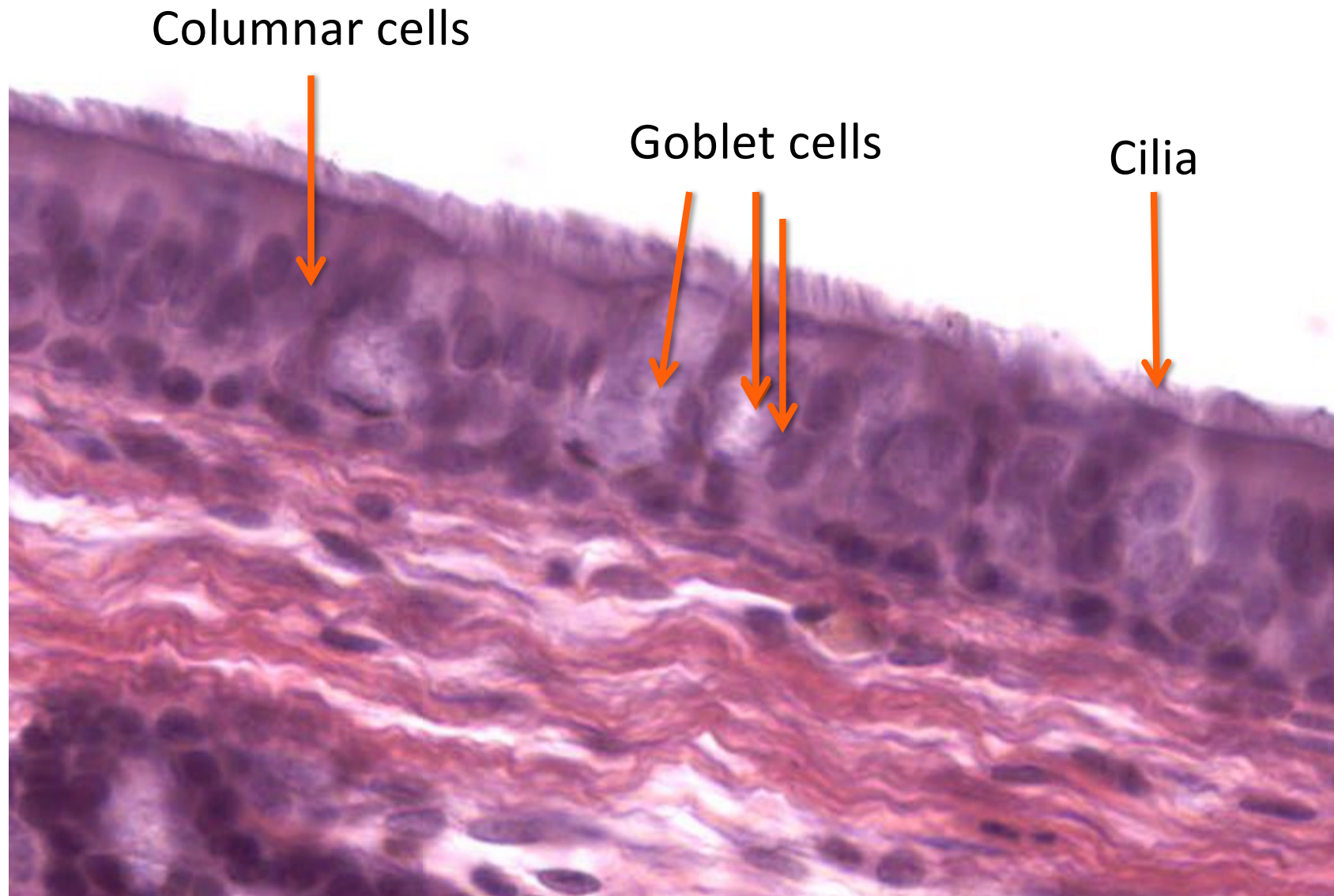
Stratified Squamous Epithelium



Several
layers of
squamous
epithelial
cells

Mucous membranes are composed of stratified squamous epithelium.

Pseudostratified Ciliated Columnar Epithelium



This is found in many parts of the lung

How is covering/lining epithelium categorized?

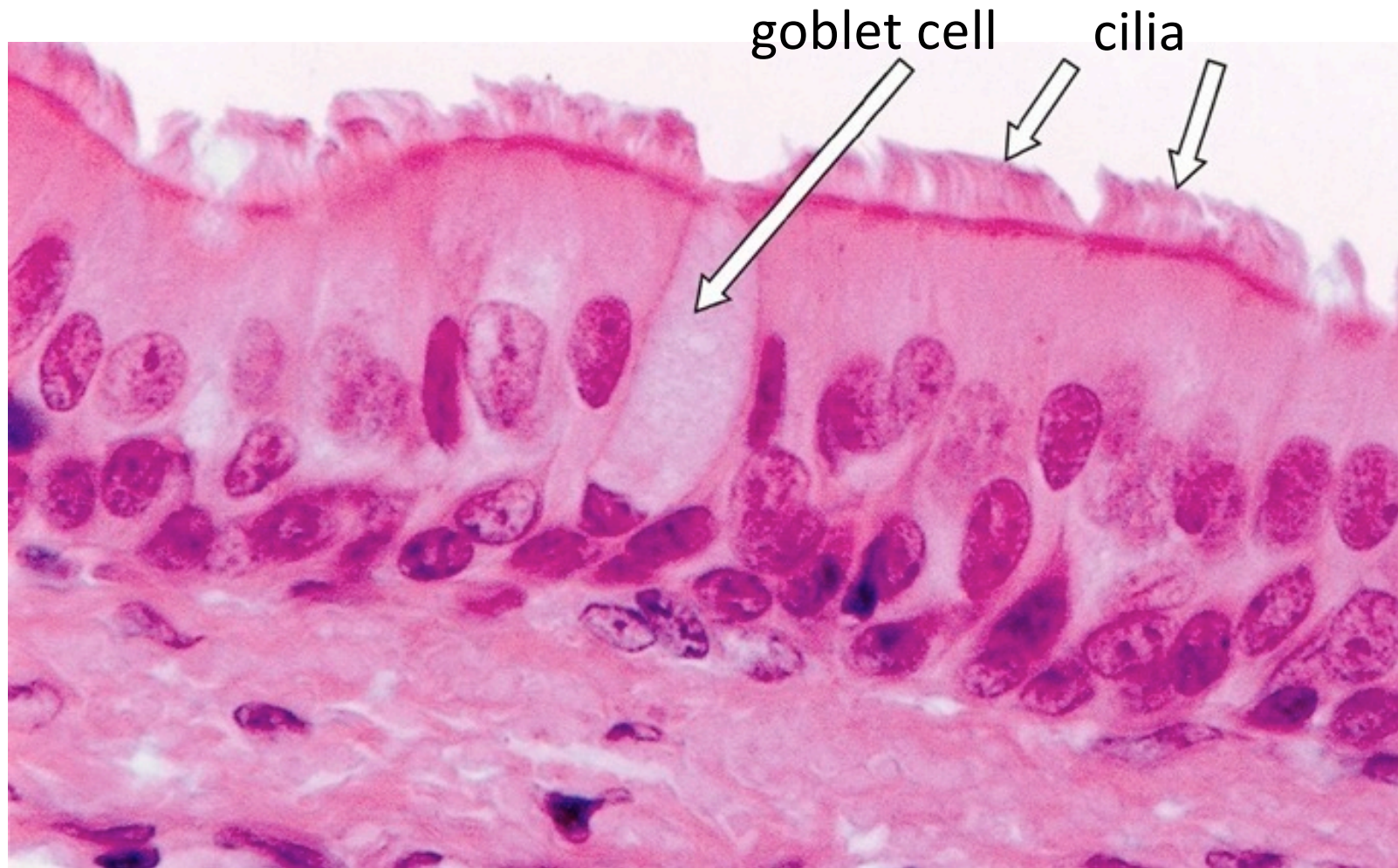
Shape of superficial cells

Number of cell layers

Presence of specialized structures

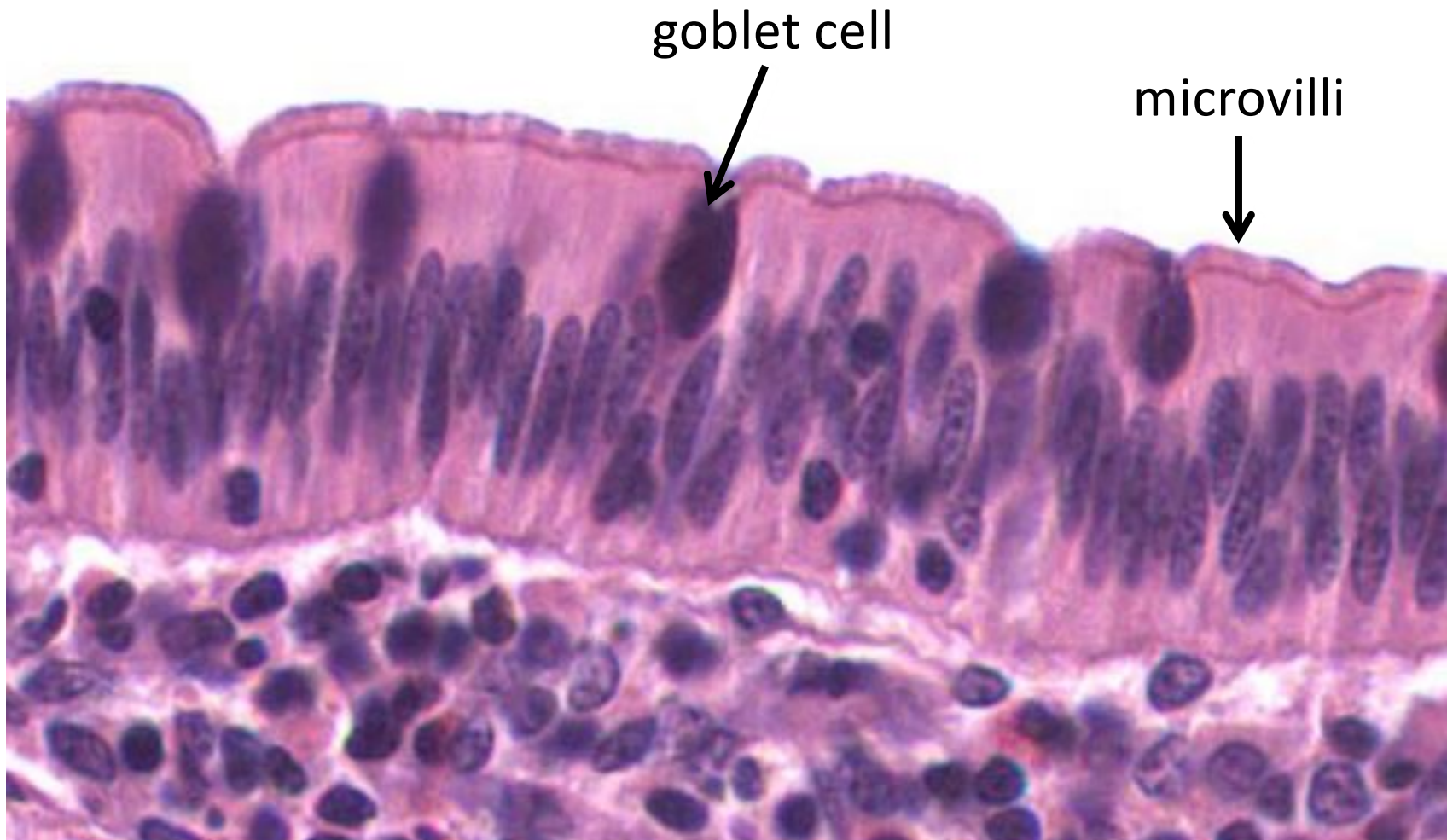
- Cilia
- Microvilli
- Keratin

Pseudostratified Ciliated Columnar Epithelium



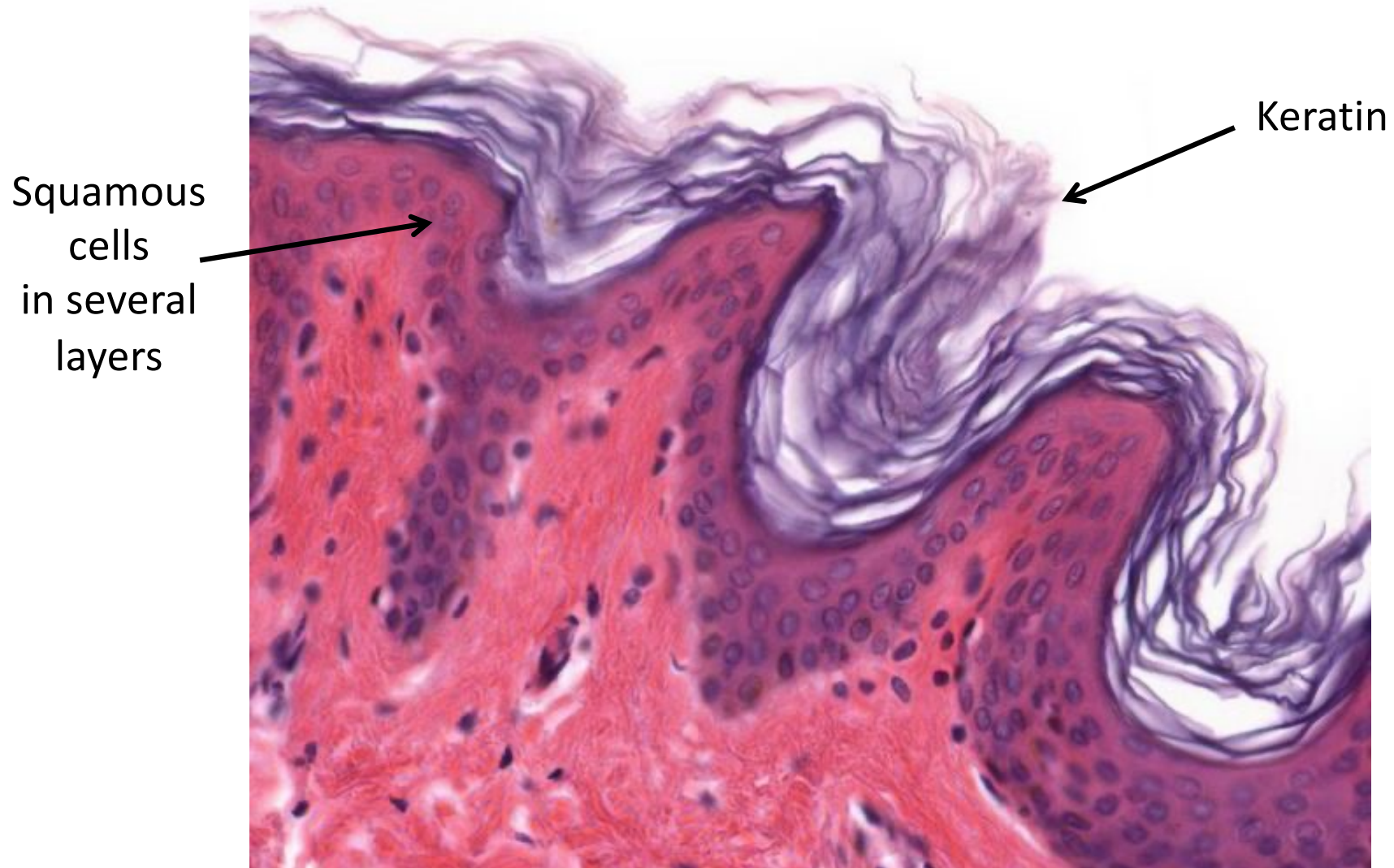
Respiratory epithelium is pseudostratified columnar, with goblet cells and ciliated cells.

Simple Columnar Epithelium



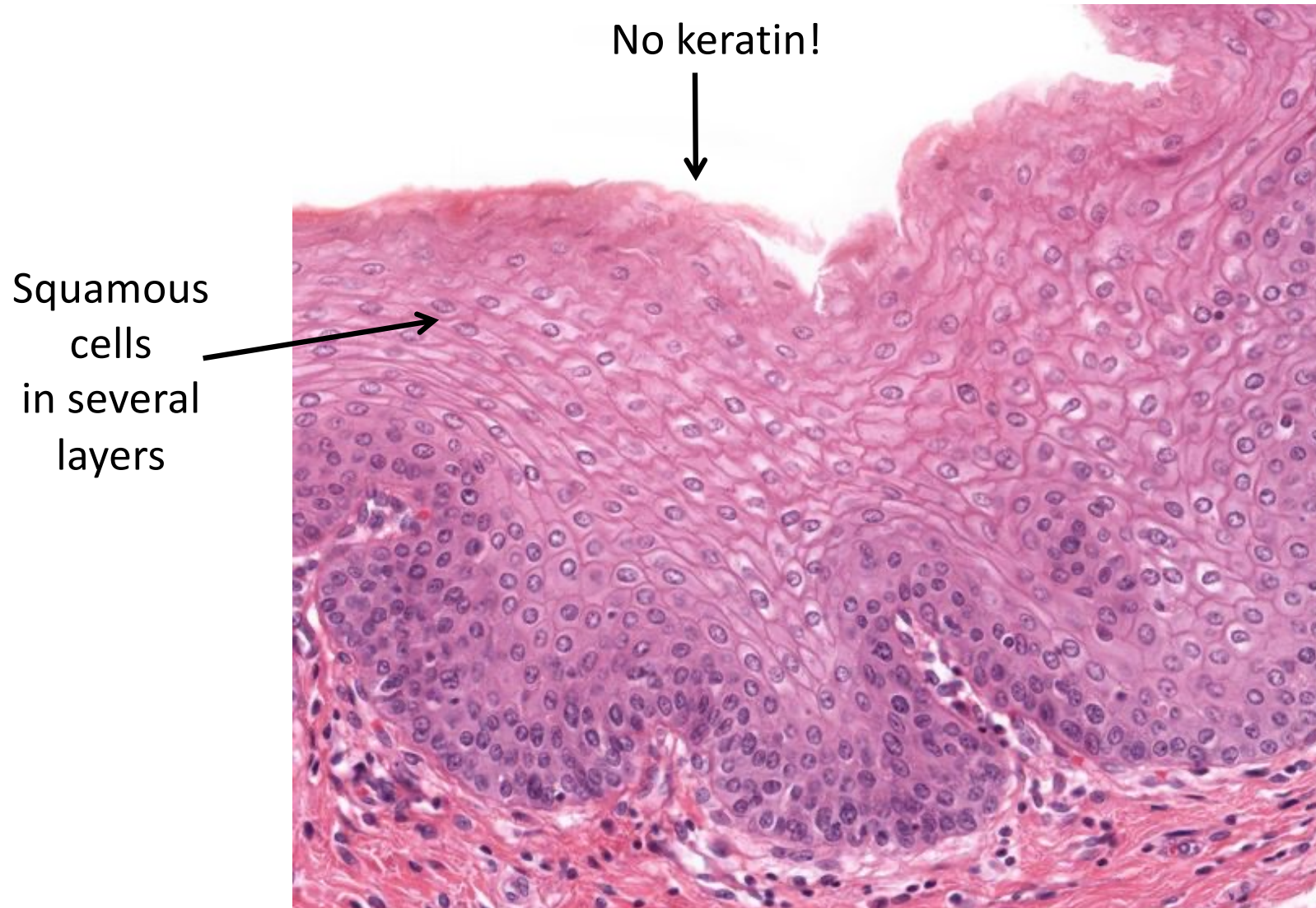
The epithelium of the small intestine is simple columnar, with goblet cells and absorptive cells with microvilli.

Keratinized Stratified Squamous Epithelium



Keratin covers areas where skin is thin but needs protection.

Non-Keratinized Stratified Squamous Epithelium



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

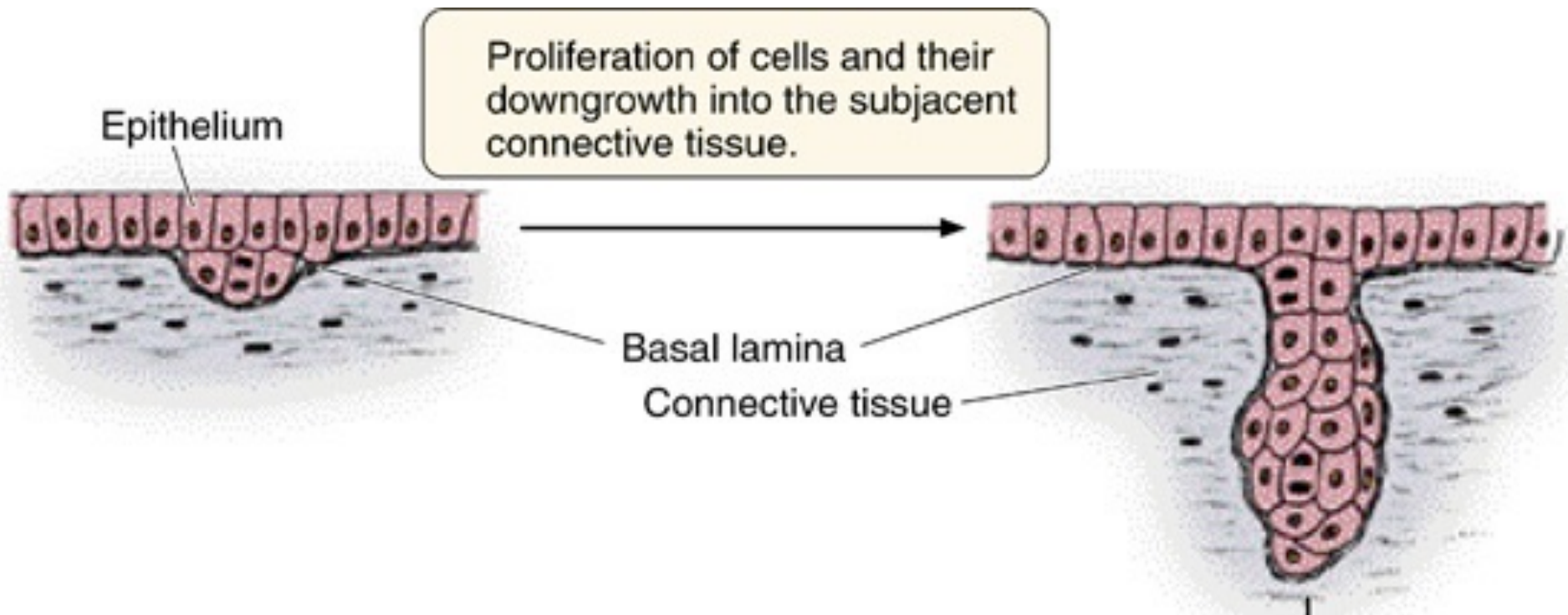
Epithelium Lecture Outline

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

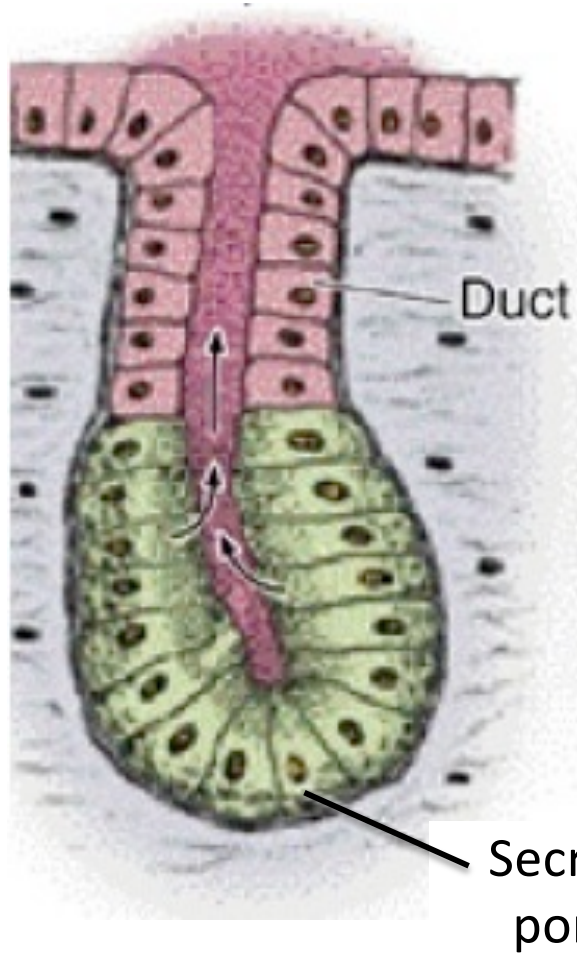
Types of Glandular Epithelia

- Mucous goblet cell: unicellular gland
- Exocrine gland: retains connection with surface epithelium; hormones secreted through ducts
- Endocrine gland: no connection with surface epithelium; hormones secreted through blood

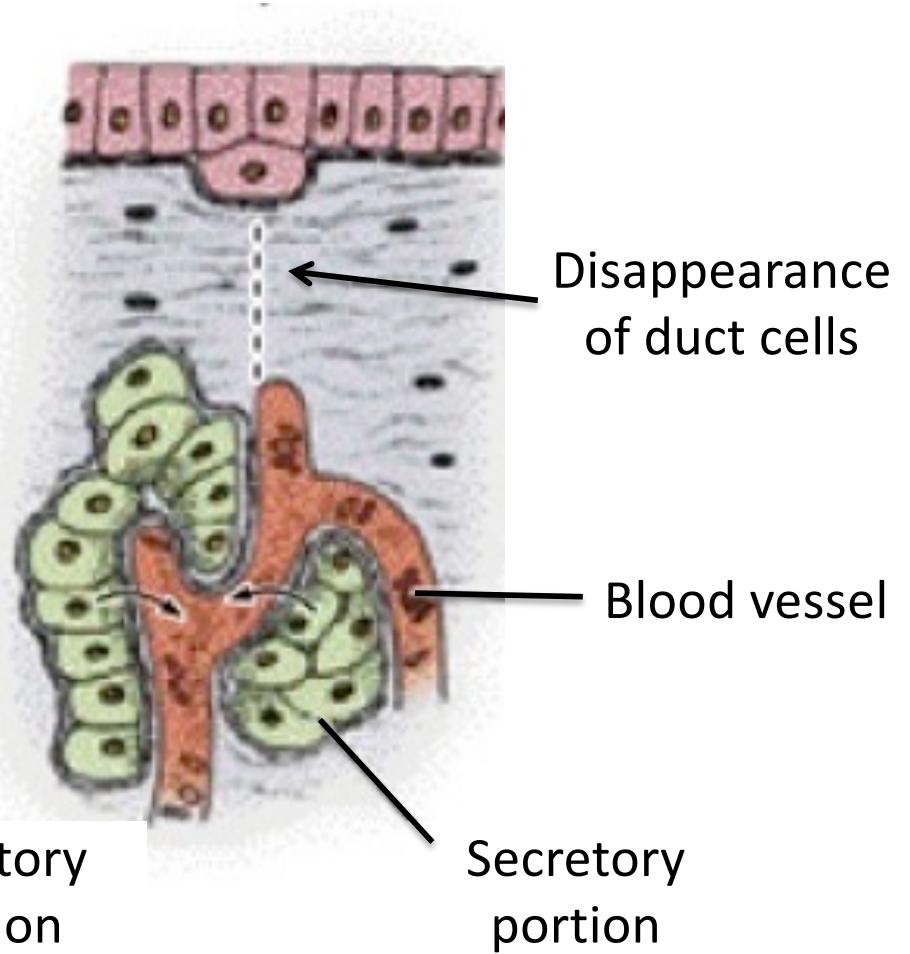
Formation of glands from surface epithelium



Exocrine gland



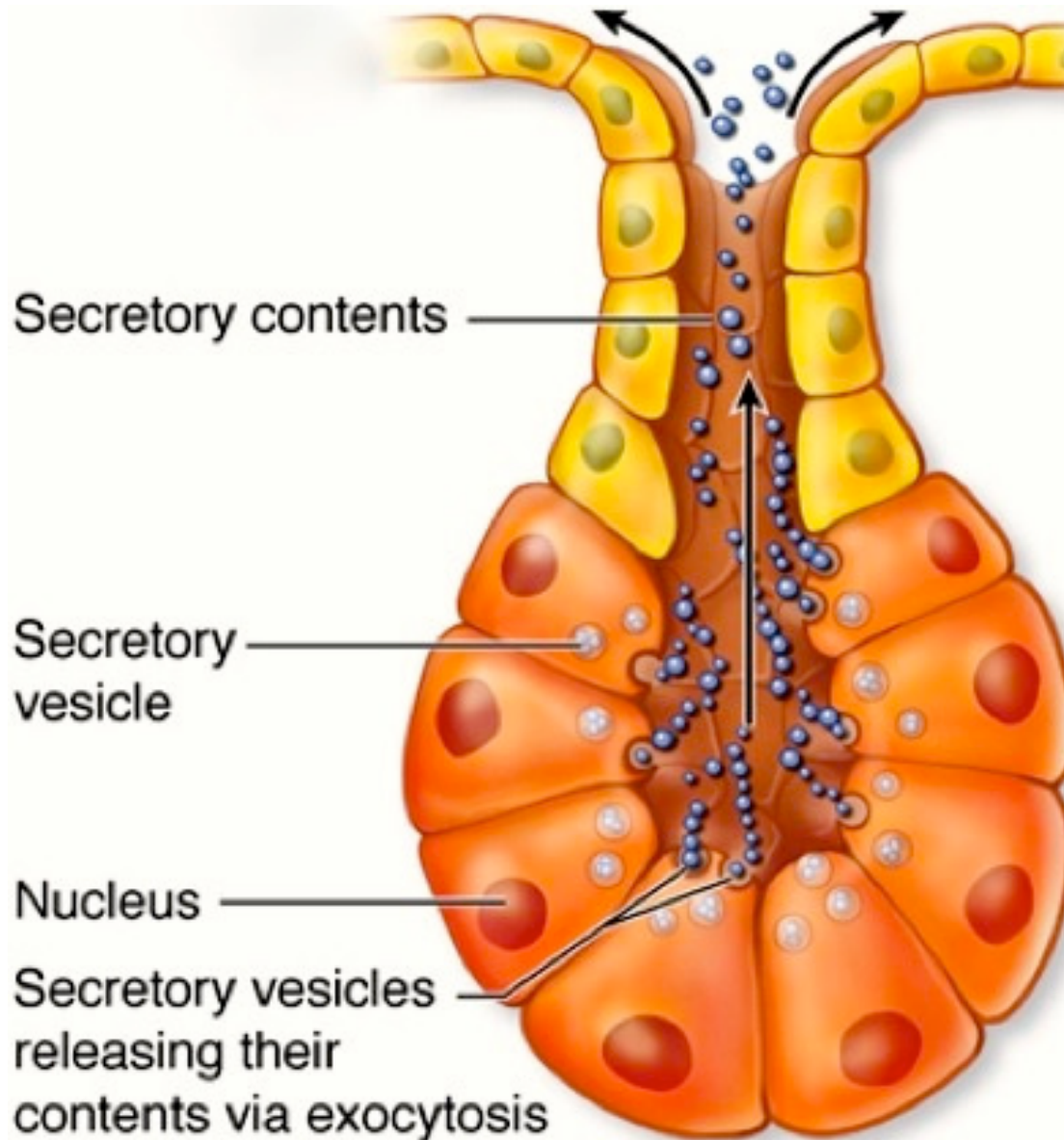
Endocrine gland



Methods of secretion in exocrine glands

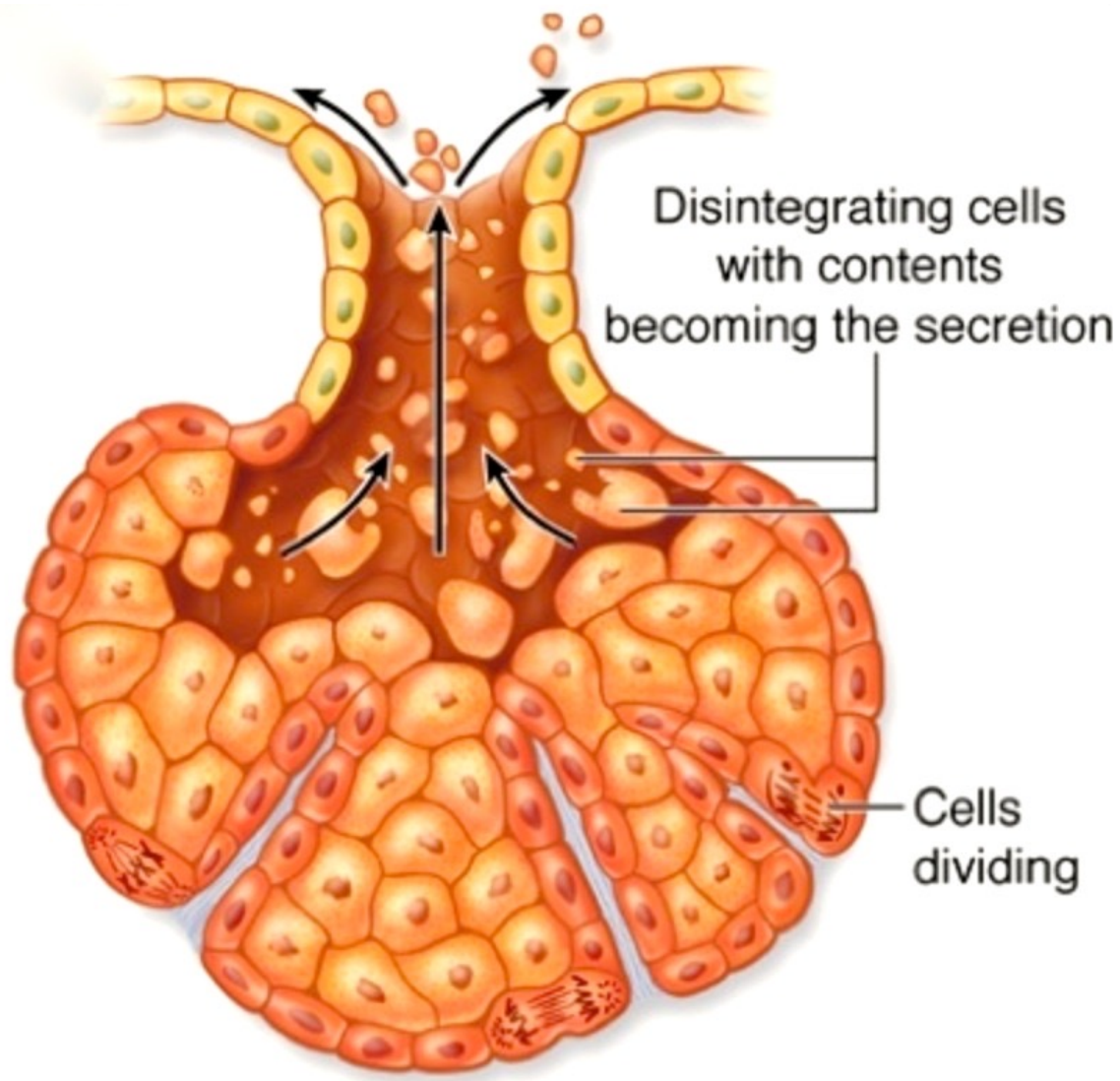
- **Merocrine**: secretory granules leave cell by exocytosis. Most common method.
- **Holocrine**: Secretory product shed with entire cell. Example: sebaceous gland
- **Apocrine**: secretory product shed with apical cytoplasm. Example: mammary gland

Merocrine gland



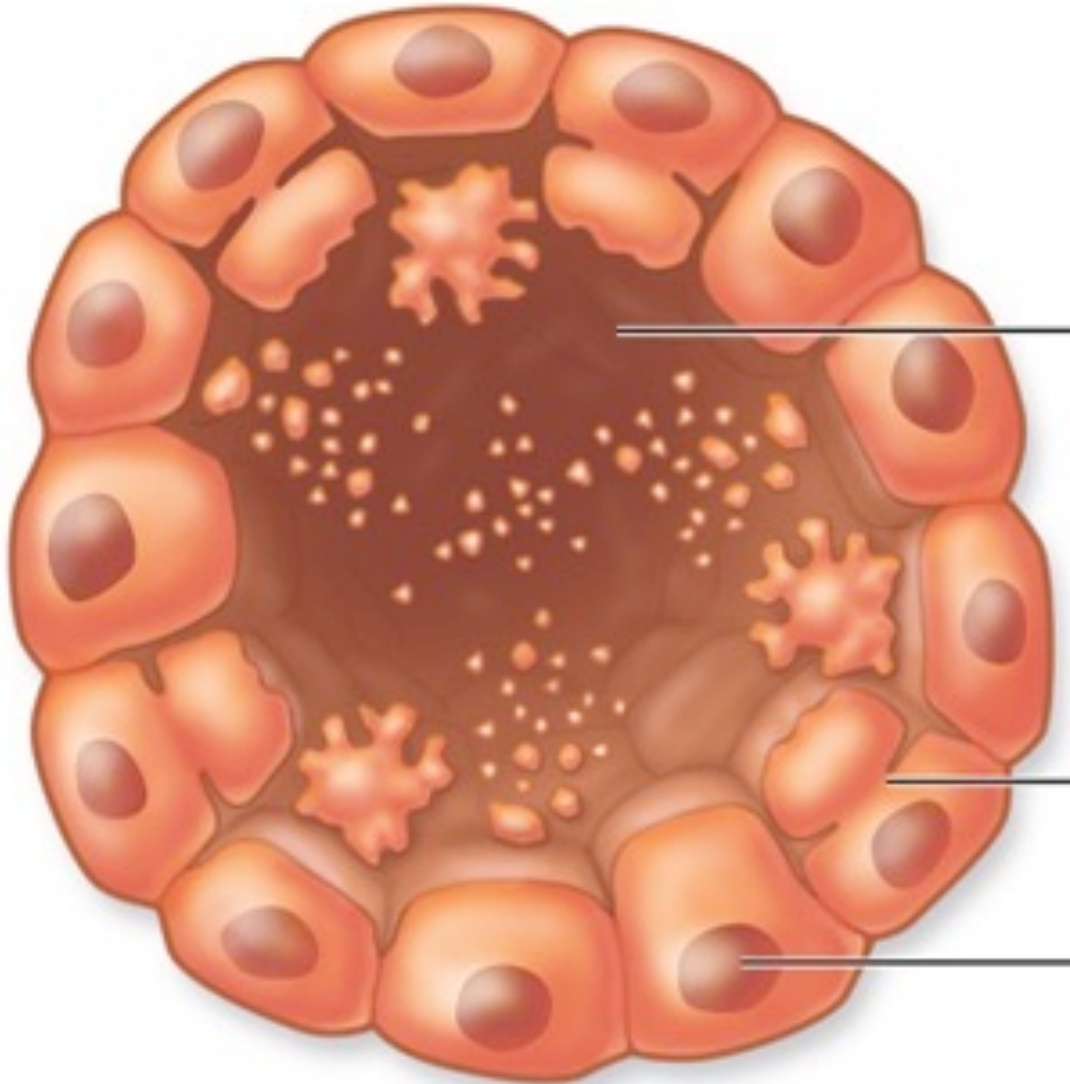
- Secretes by merocrine mode of secretion: exocytosis of product at apical end of cell.
- By far the most common type of exocrine gland based on mode of secretion.

Holocrine gland



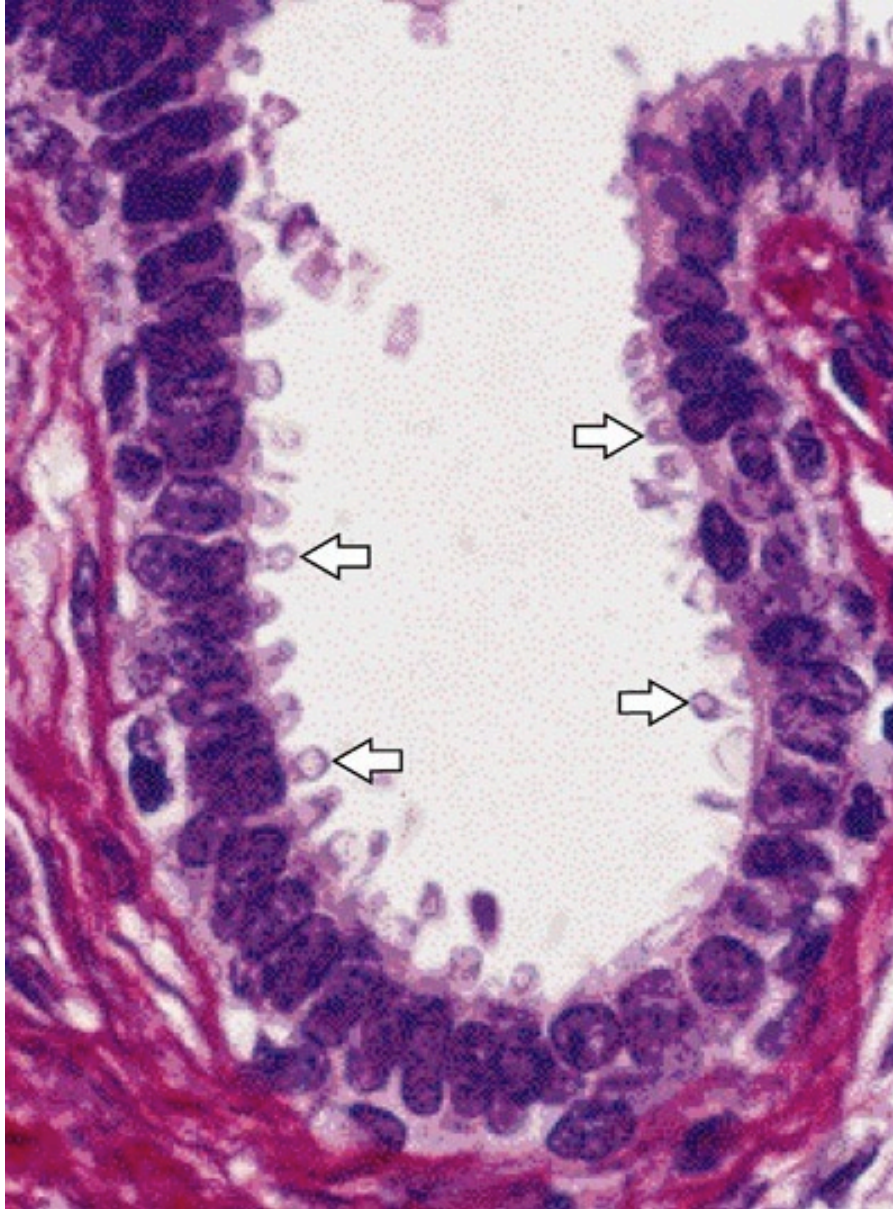
- Secretion occurs by disintegration of secretory cells.
- Example: sebaceous glands.

Apocrine gland



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

Mammary gland



Note loss of apical portions of cytoplasm.

Epithelium Lecture Outline

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