

# Epithelial Structure and Function

HST.035 Spring 2003

# Epithelium: The Definition

- **Dorland's Medical Dictionary**
  - **The cellular covering of internal and external body surfaces, including the lining of vessels and small cavities. It consists of cells joined by small amount of cementing substances, and is classified . . .**

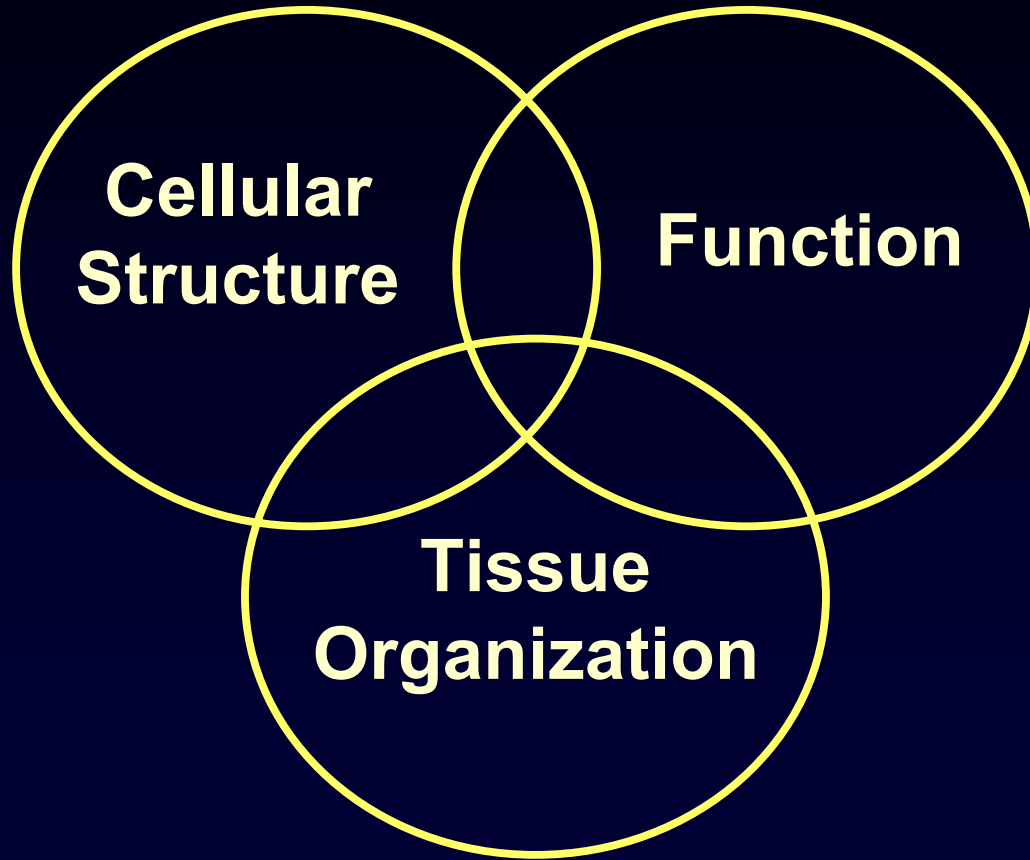
# Epithelium: The Definition

- **Basic Histology (Junqueira et al.)**
  - **Epithelial tissues are composed of closely aggregated polyhedral cells with very little intercellular substance. Adhesion between these cells is strong. Thus cellular sheets are formed that cover the surface of the body and line its cavities . . . Epithelia are derived from all three embryonic germ layers.**

# Epithelium: The Definition

- **Cell and Tissue Biology (Weiss)**
  - **Epithelium is a tissue existing in a multiplicity of forms which are specialized to carry out one or more characteristic tasks. The unique function of epithelia lies in providing a boundary . . . [that] line inner surfaces and cover outer surface . . . In some organs, such as skin, the epithelium serves as a protective barrier, but the additional activities in which most epithelia engage are in some instances their primary role. Characteristic functions include transport, absorption, and secretion.**

# Epithelium: A Working Definition



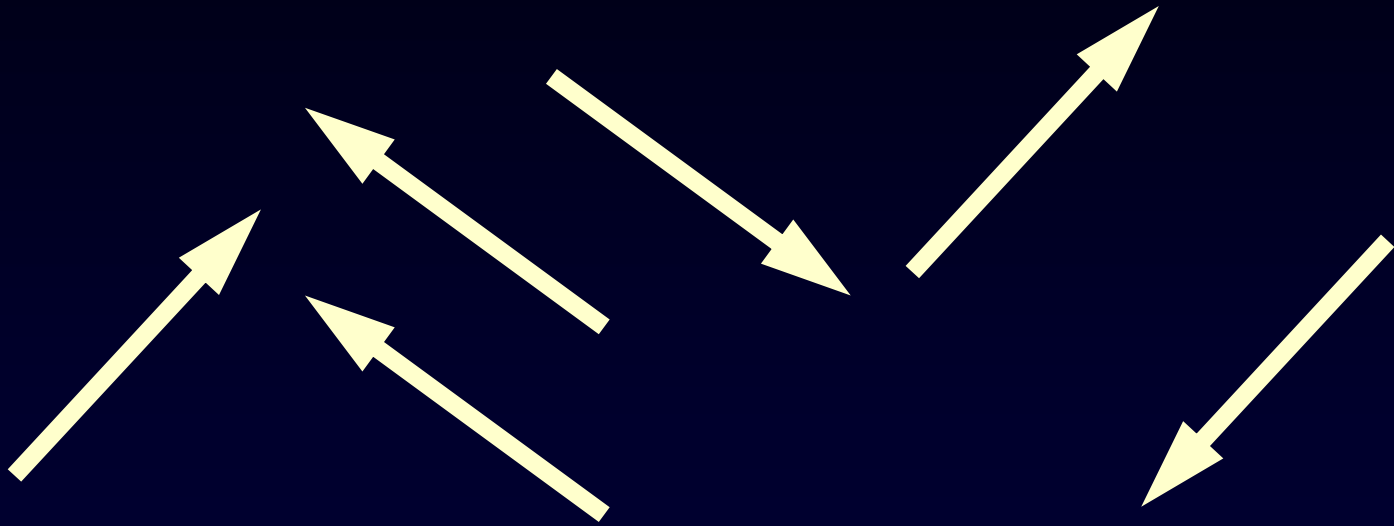
# Epithelium

*An Engineering Definition!*

# Non-Epithelial Tissue

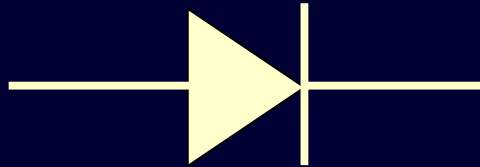
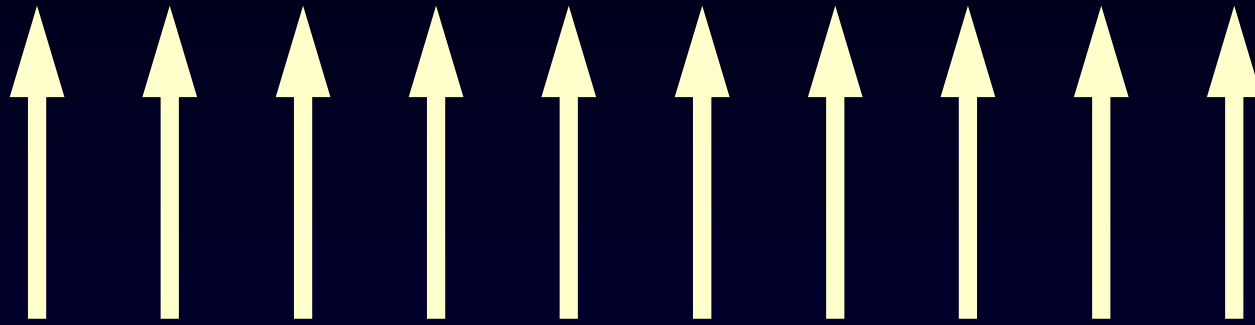


# Non-Epithelial Tissue

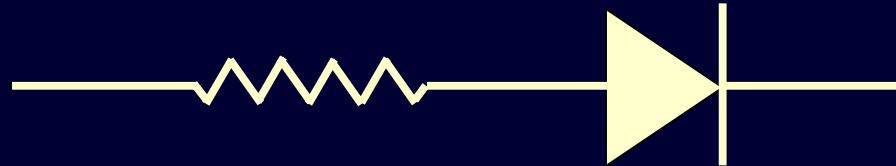
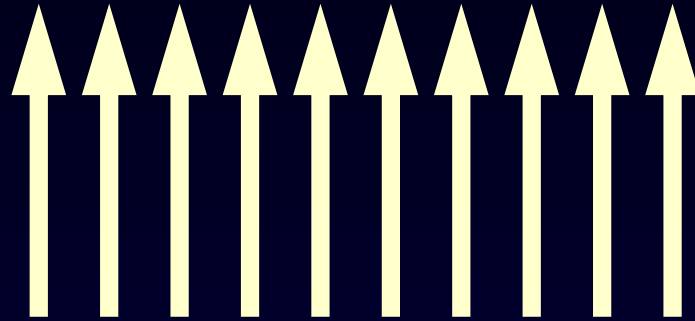




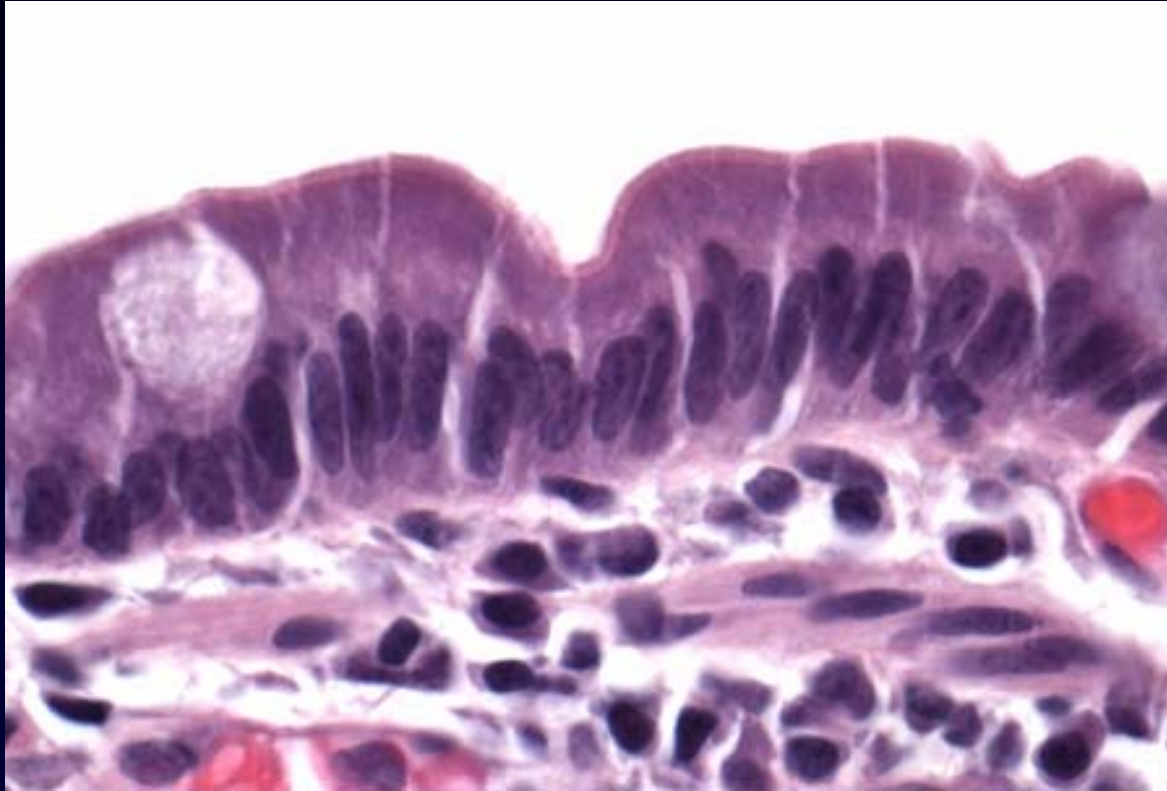
# The 1<sup>st</sup> Fundamental Property: *Tissue Polarization at the Surface*



# The 2<sup>nd</sup> Fundamental Property: *High Resistance Across the Surface*



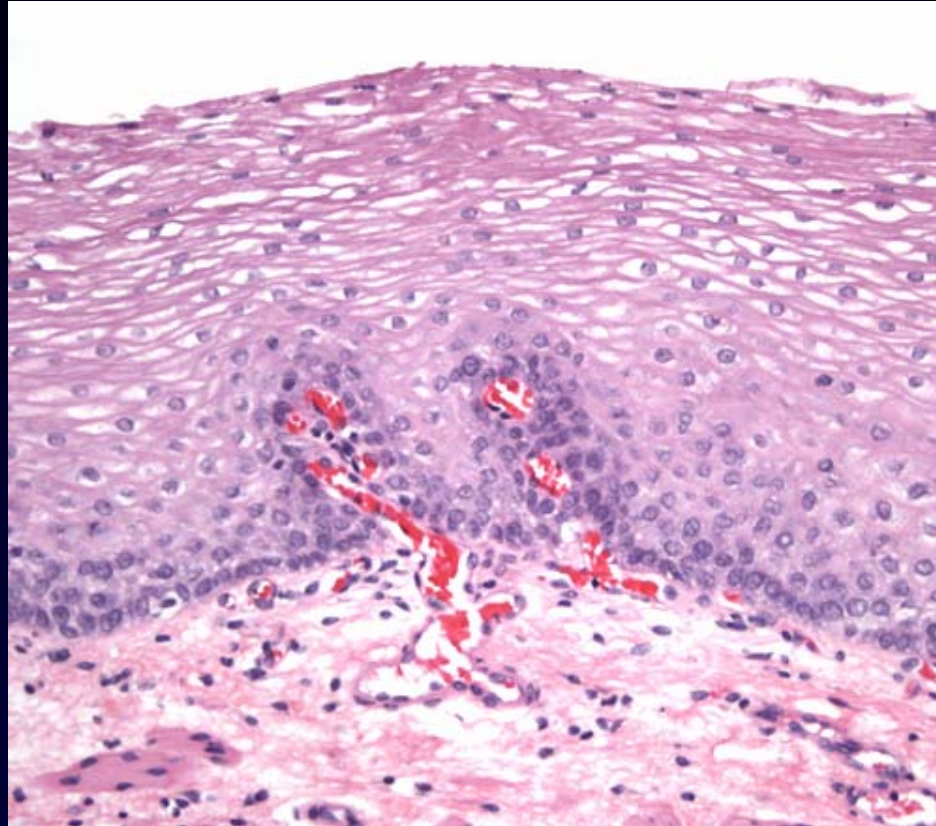
**Make a Guess:**  
***Is this tissue epithelial or not?***



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Please see Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

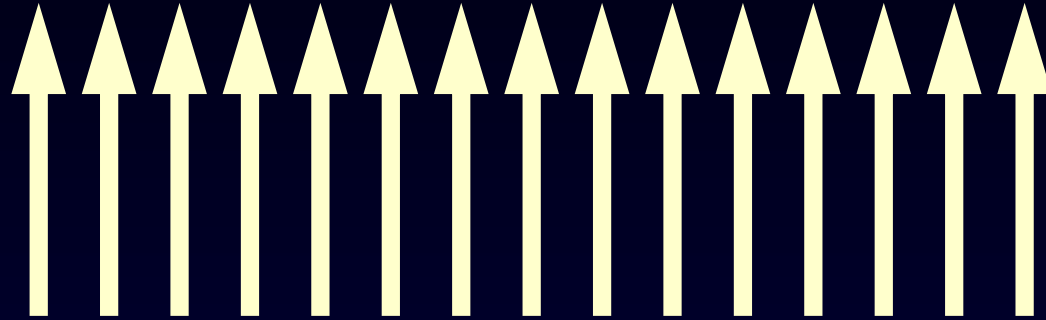
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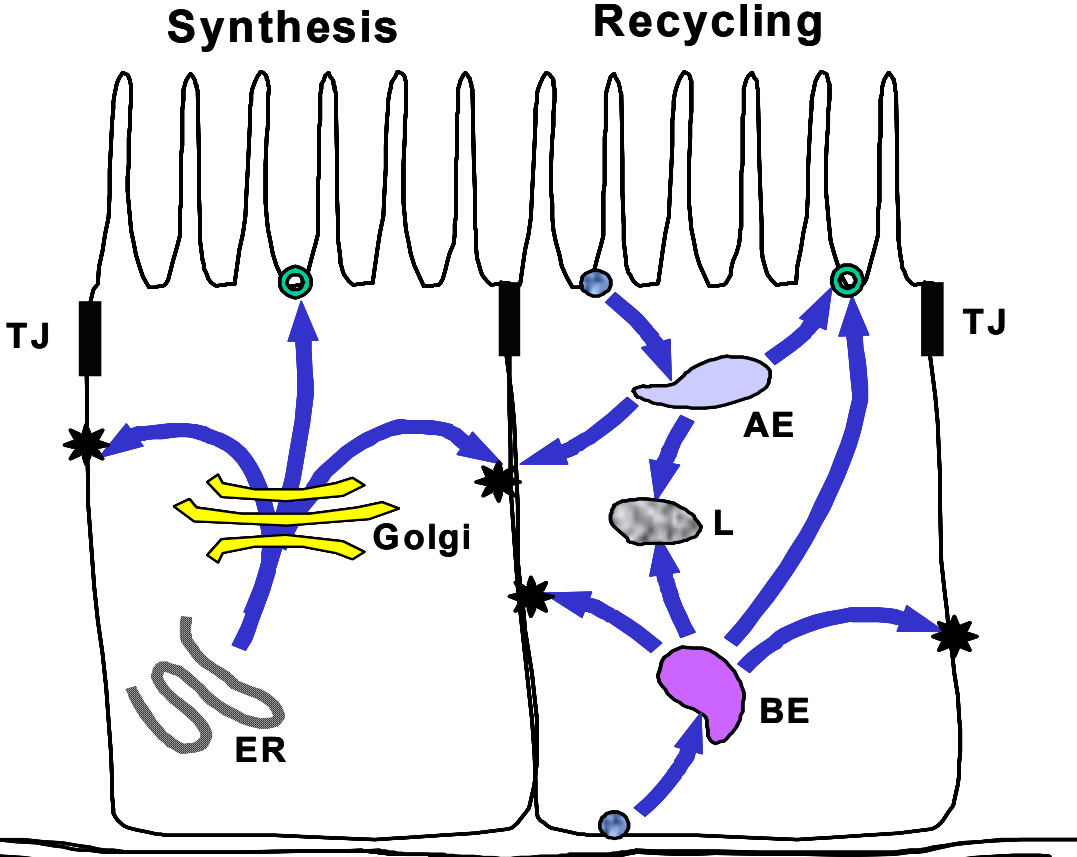
Please see figure 5-46 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

# Epithelial Structure



*How would a tissue like  
this be made?*

# Mechanisms of Cell Polarity



- TJ Tight junction
- AE Apical endosome
- BE Basal endosome
- L Lysosome
- ⊙ Apical protein
- ★ Basolateral protein
- Endocytic vesicle



# The Tight Junction

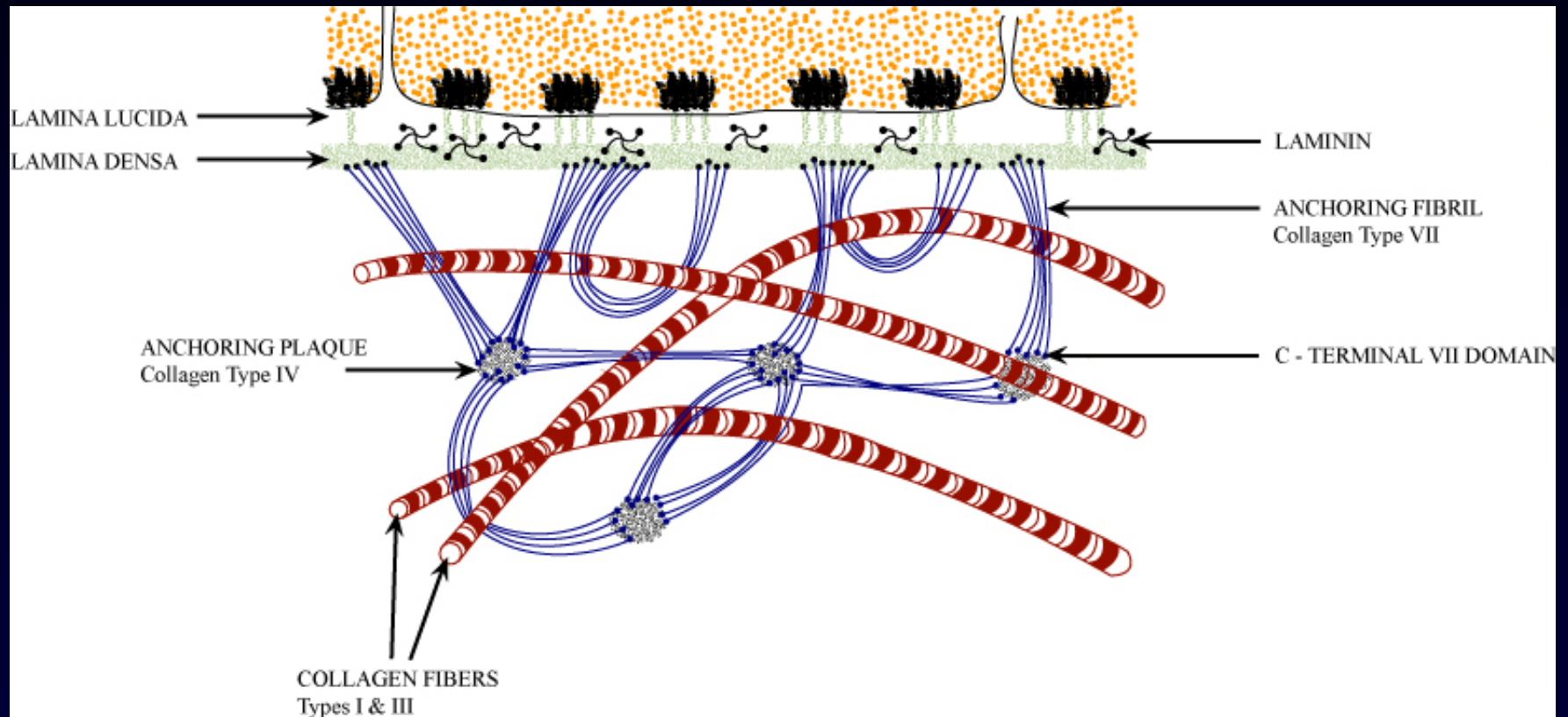
Please see figure 4-6 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

# The Junctional Complex

Please see figure 4-5 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

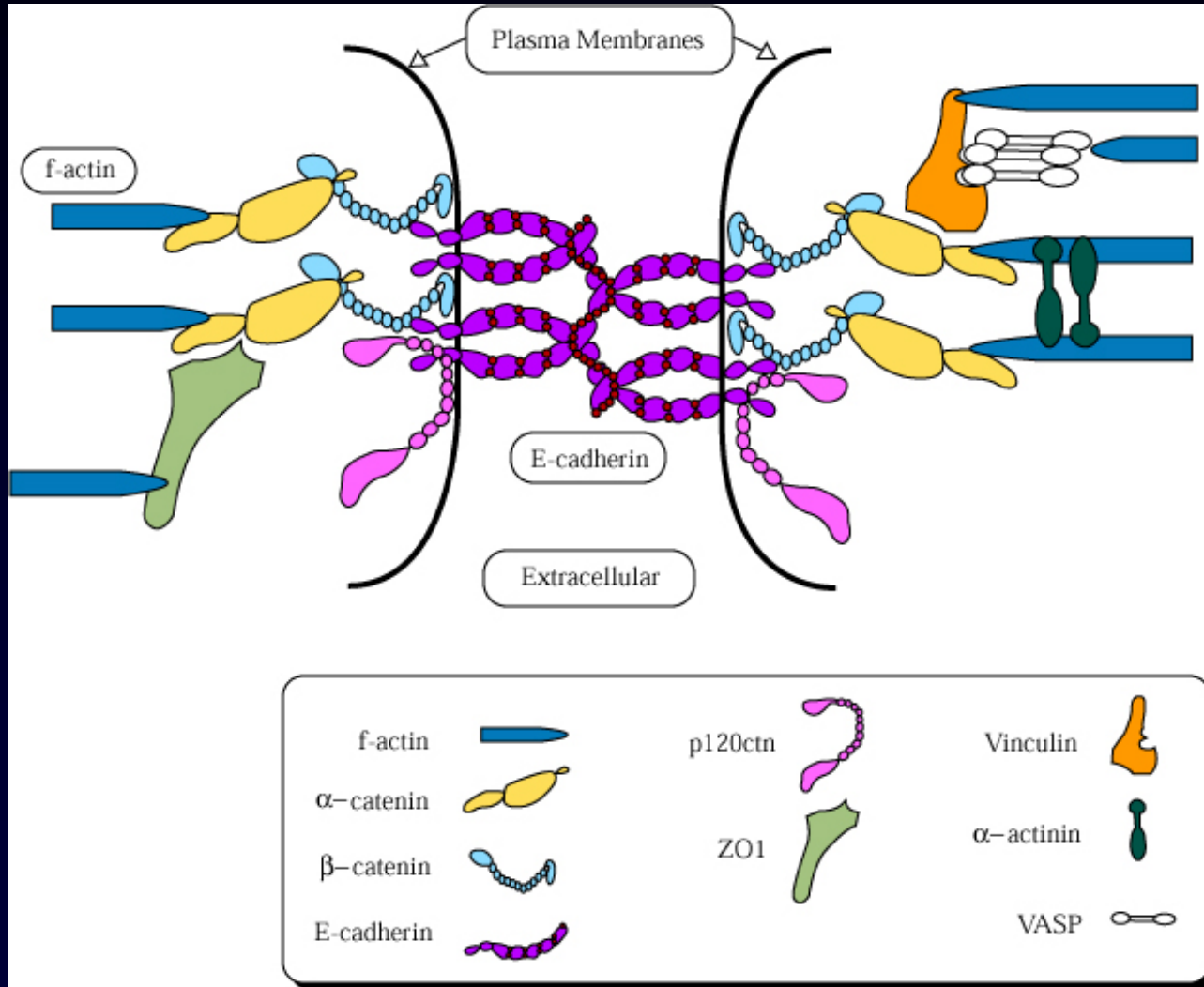
# The Desmosome

# The *Hemidesmosome*



**EB**

# Intercellular Adhesions



# The Gap Junction

Please see figure 4-7 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

**Based on these definitions, what makes a *cell* an epithelial cell?**



# **The Junctions!!**

*(Except for one.)*

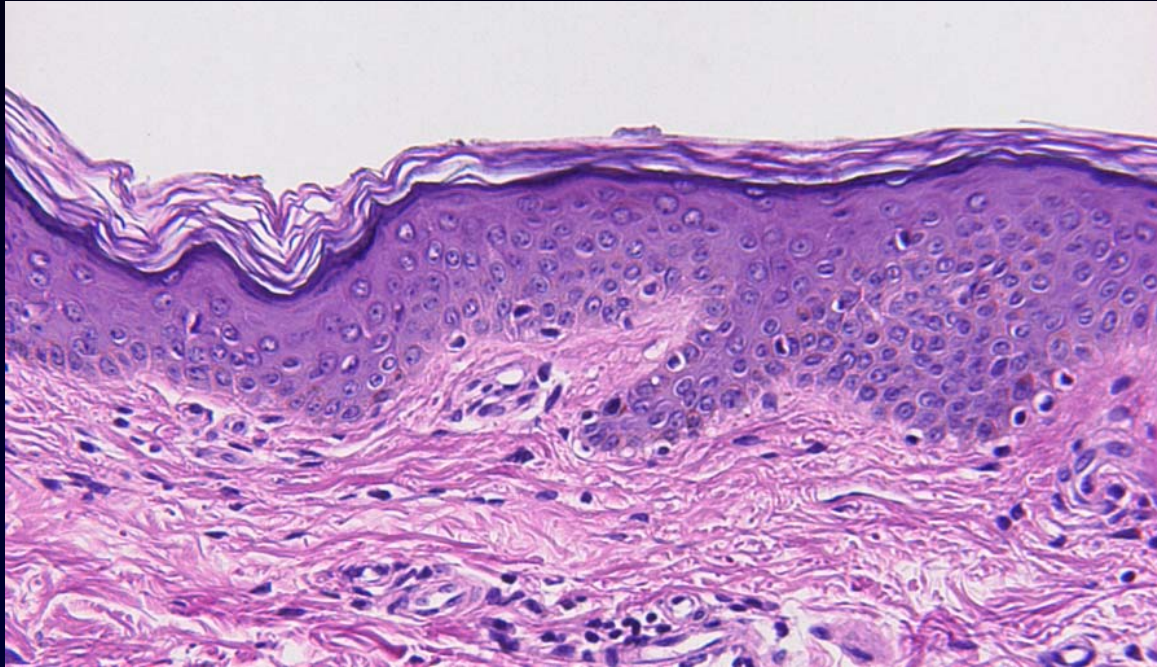
# Classification of Lining Epithelia

- **Simple**
- **Stratified**
- **Pseudostratified**
- **Transitional (urothelium)**

# The Apical Surface Specializations

Please see figure 4-10 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

# The Apical Surface Specializations



**Keratin**

# Simple Epithelia

Please see figure 4-11 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill, 2003. ISBN: 0071378294.

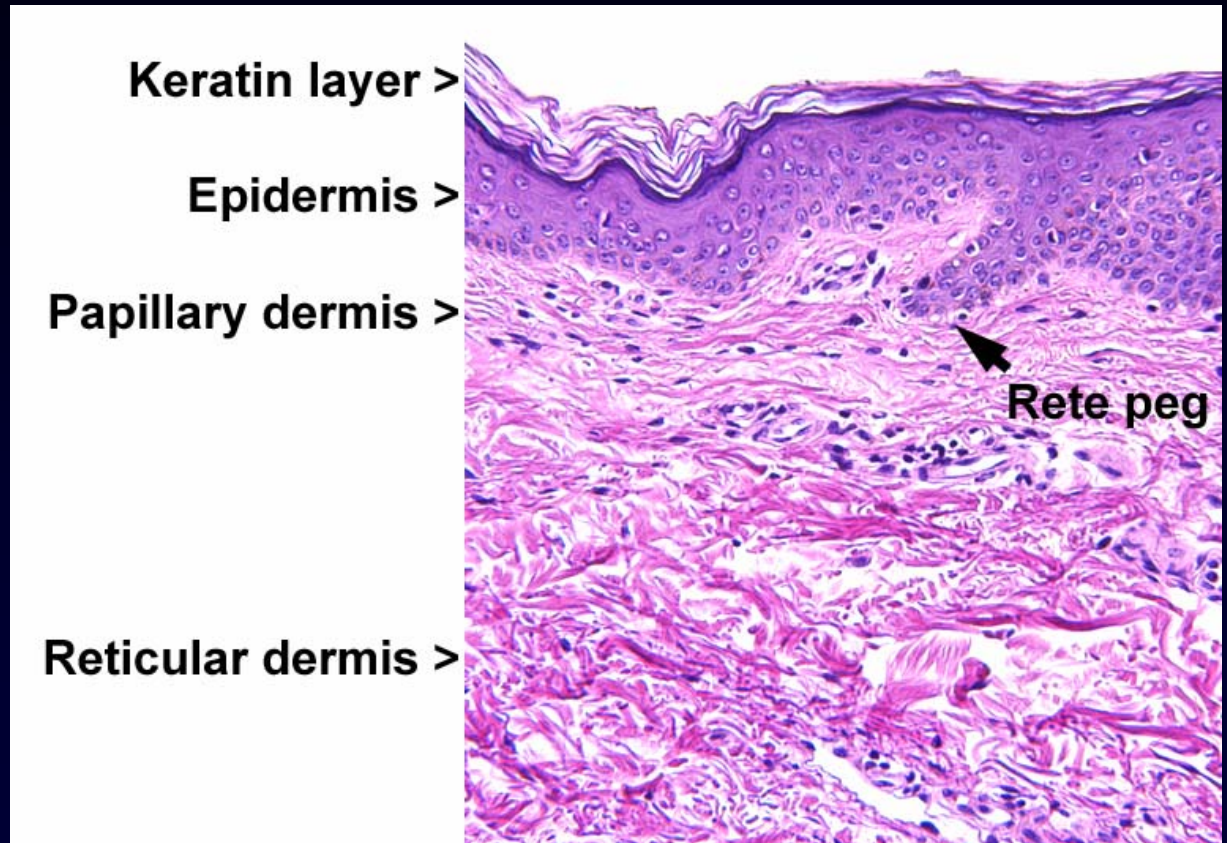
# Stratified and Pseudostratified Epithelia

Please see figure 4-12 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

# Organization of Epithelial Tissues

## ***Skin:***

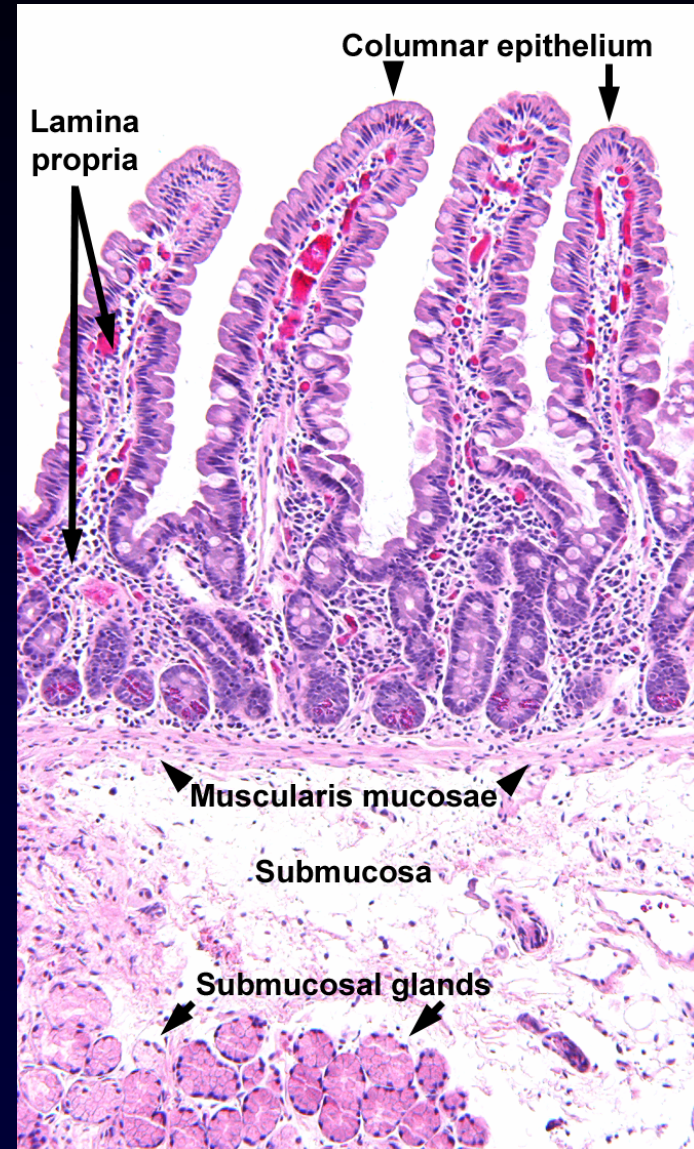
- Epidermis (epithelium)
- Dermis
  - Papillary dermis
  - Reticular dermis



# Organization of Epithelial Tissues

## *GI Tract:*

- Mucosa
  - Epithelium
  - Lamina propria
  - Muscularis mucosae
- Submucosa
- Muscularis Propria
- Serosa





# **Glandular Epithelia**

*Life gets a little complicated!*

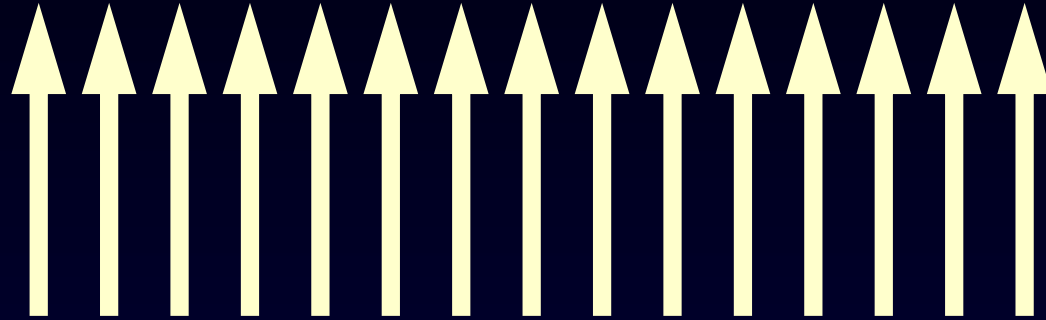
**Make a Guess:**  
***Is this tissue epithelial or not?***

Please see figure 4-29 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

# Epithelia Are the Origin of Glands and Accessory Organs

Please see figure 4-21 of Junqueira & Carneiro. *Basic Histology: Text and Atlas*. 10<sup>th</sup> edition. McGraw Hill. 2003. ISBN: 0071378294.

# Epithelial Functions



*What would a structure like this be useful for?*

# Epithelial Functions

- **Barrier function**
- **Host defense**
- **Secretion**
- **Transport**
- **Sensory function**
- **Thermoregulation**

# Barrier Function: The Extrinsic Barriers

- **Mucus and glycocalyx**
- **Stagnant layers**
- **Immunoglobulins**
- **Buffers**

# Barrier Function: The Intrinsic Barriers

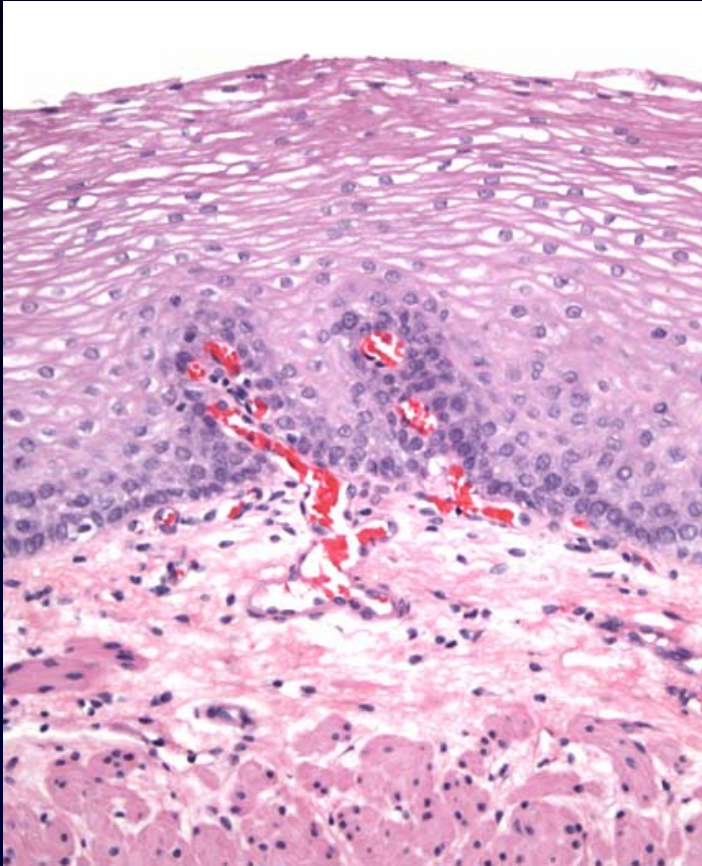
- The **paracellular** (shunt) pathway
  - The major transepithelial passive permeation pathway accounting for 85% of ions and 100% of large hydrophilic solutes ( $>4\text{\AA}$ )
- The **transcellular** pathway
  - The reflection coefficient of biological membranes for inert solutes  $>4\text{\AA}$  is  $\sim 1$
  - Resistance to passive ion flow across model lipid bilayers is  $10^6\text{-}10^9 \Omega\cdot\text{cm}^2$

# Epithelium *Gone Bad*

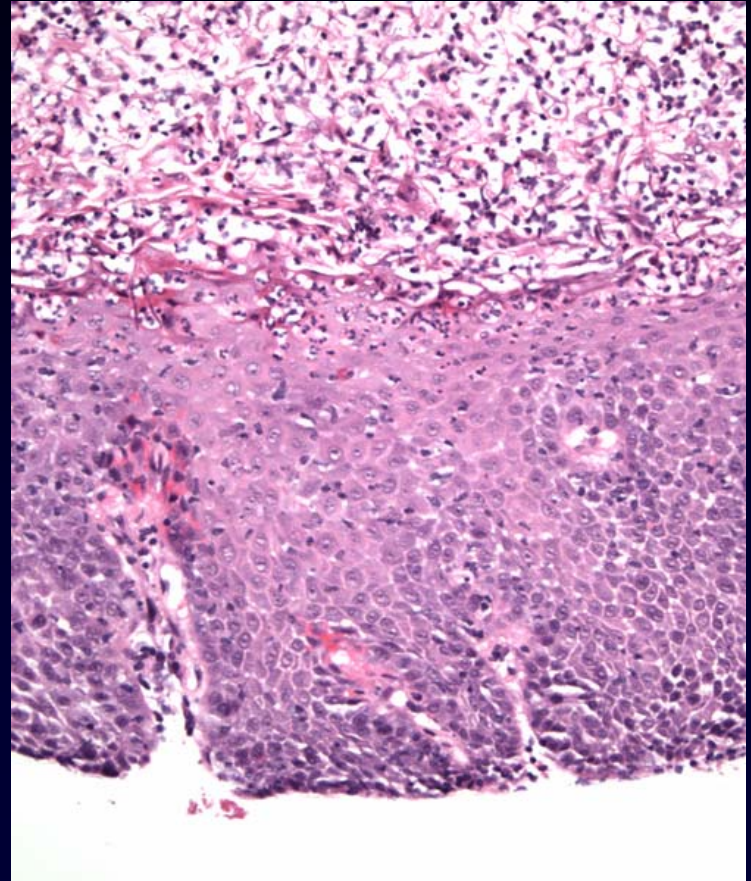
- Infections
- Neoplasia
- Inflammatory disorders
- Circulatory disorders
- Structural disorders



# Infections

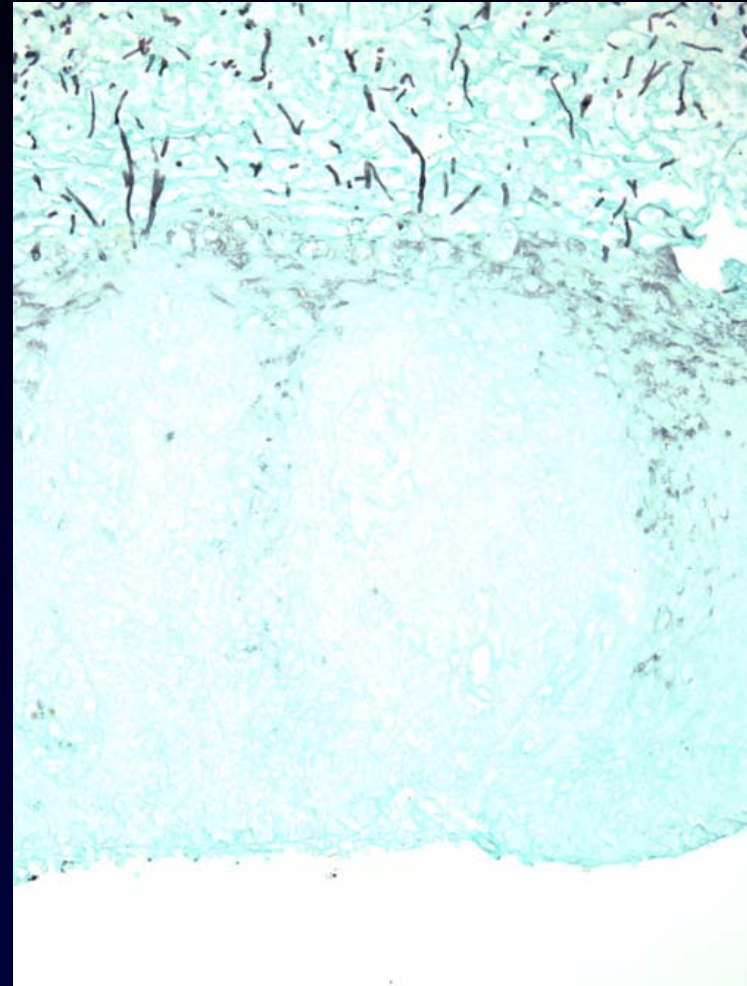
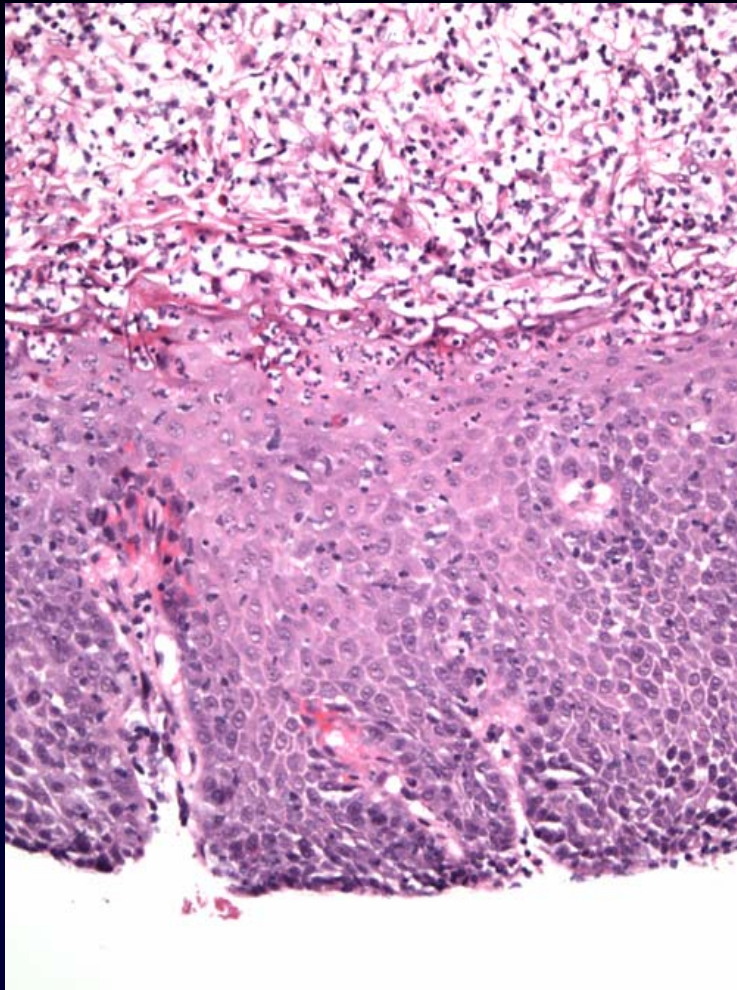


**Normal**



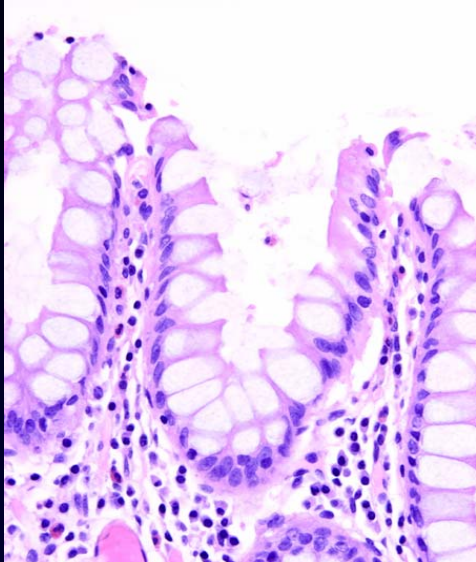
**Abnormal**

# Fungal (Candida) Esophagitis

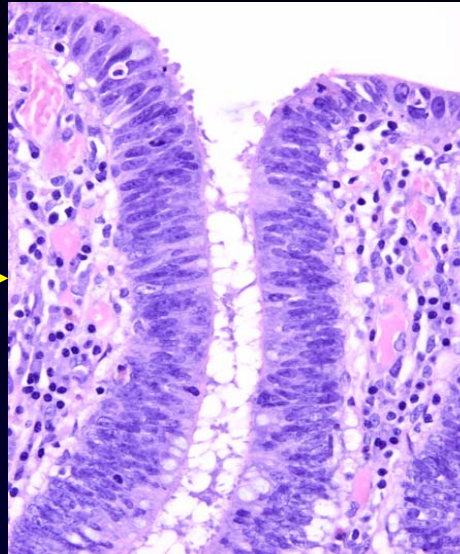


# Neoplasia

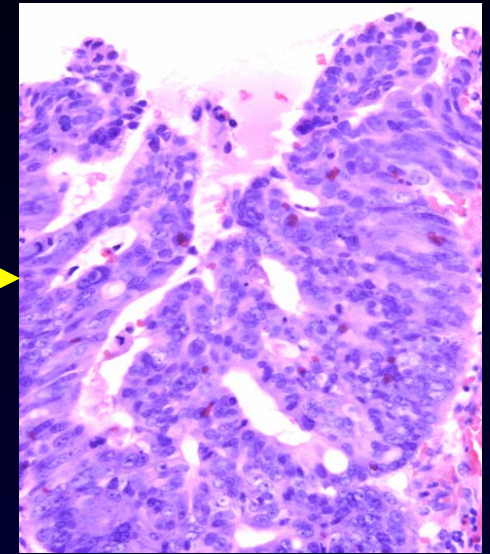
Normal Epithelium



In situ neoplasia

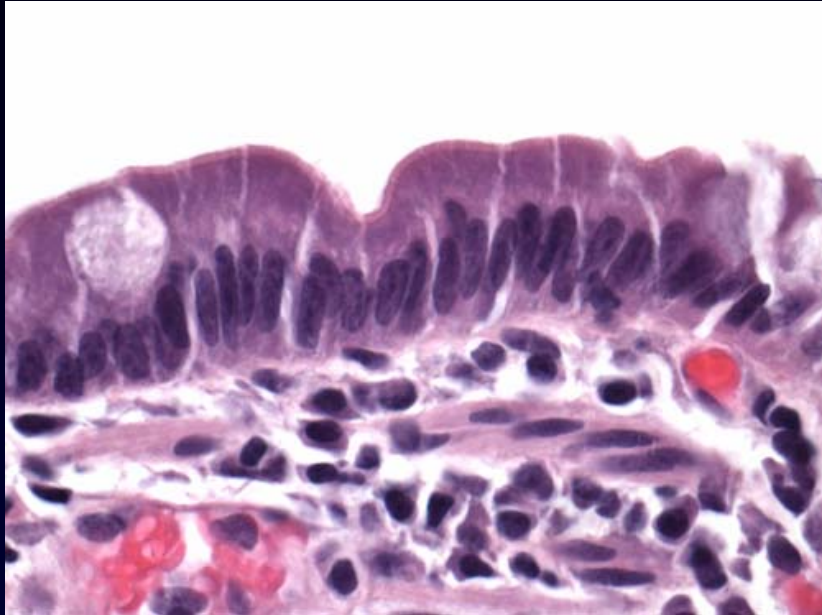


Invasive neoplasia

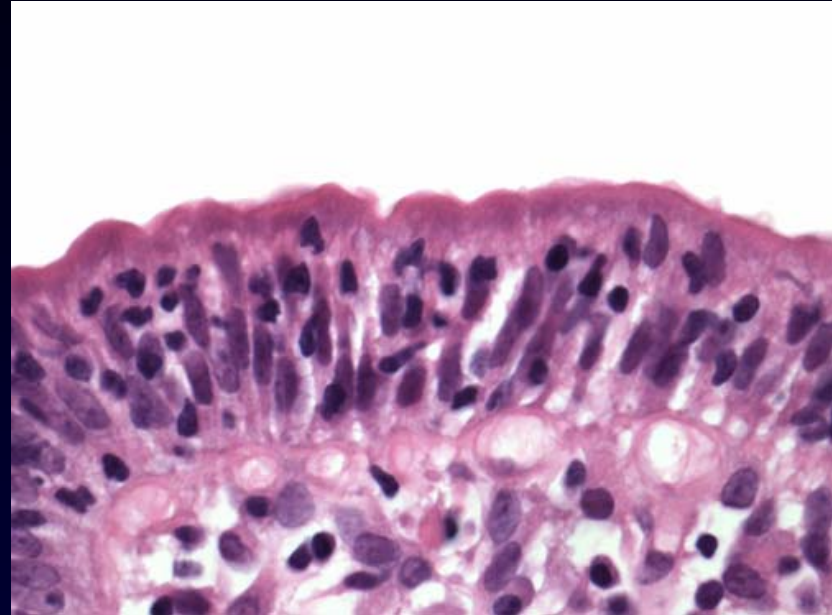


- Increased nuclear size and density (crowding)
- Variability in nuclear size, shape, and staining (pleomorphism)
- Increased staining intensity (hyperchromasia)
- Nuclear stratification and cribriforming
- Decreased cytoplasmic maturation
- Increased mitotic activity

# “Inflammatory” Disorders



**Normal**

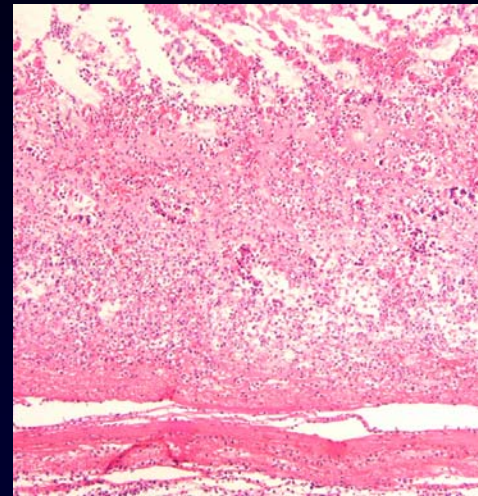


**Abnormal**

# Circulatory Disorders

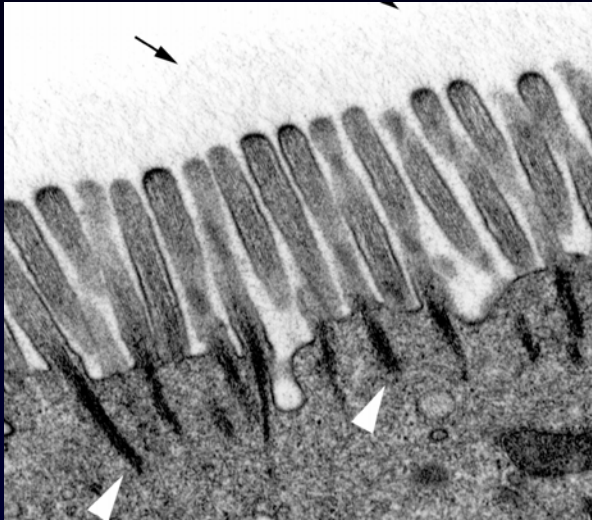


**Normal**

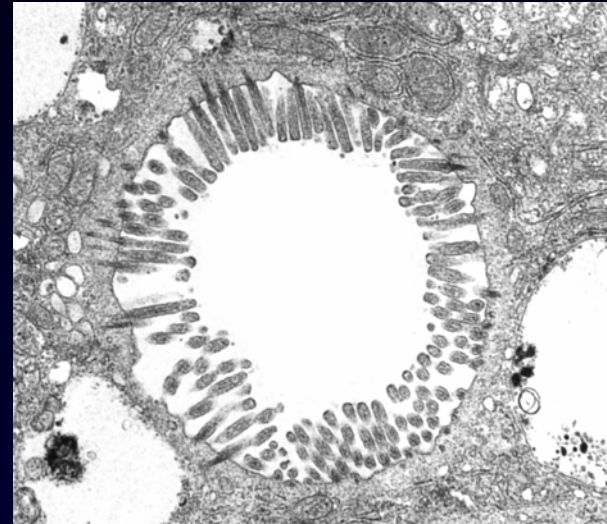


**Abnormal**

# Structural Disorders



**Normal**



**Abnormal**