# introduction to tissue

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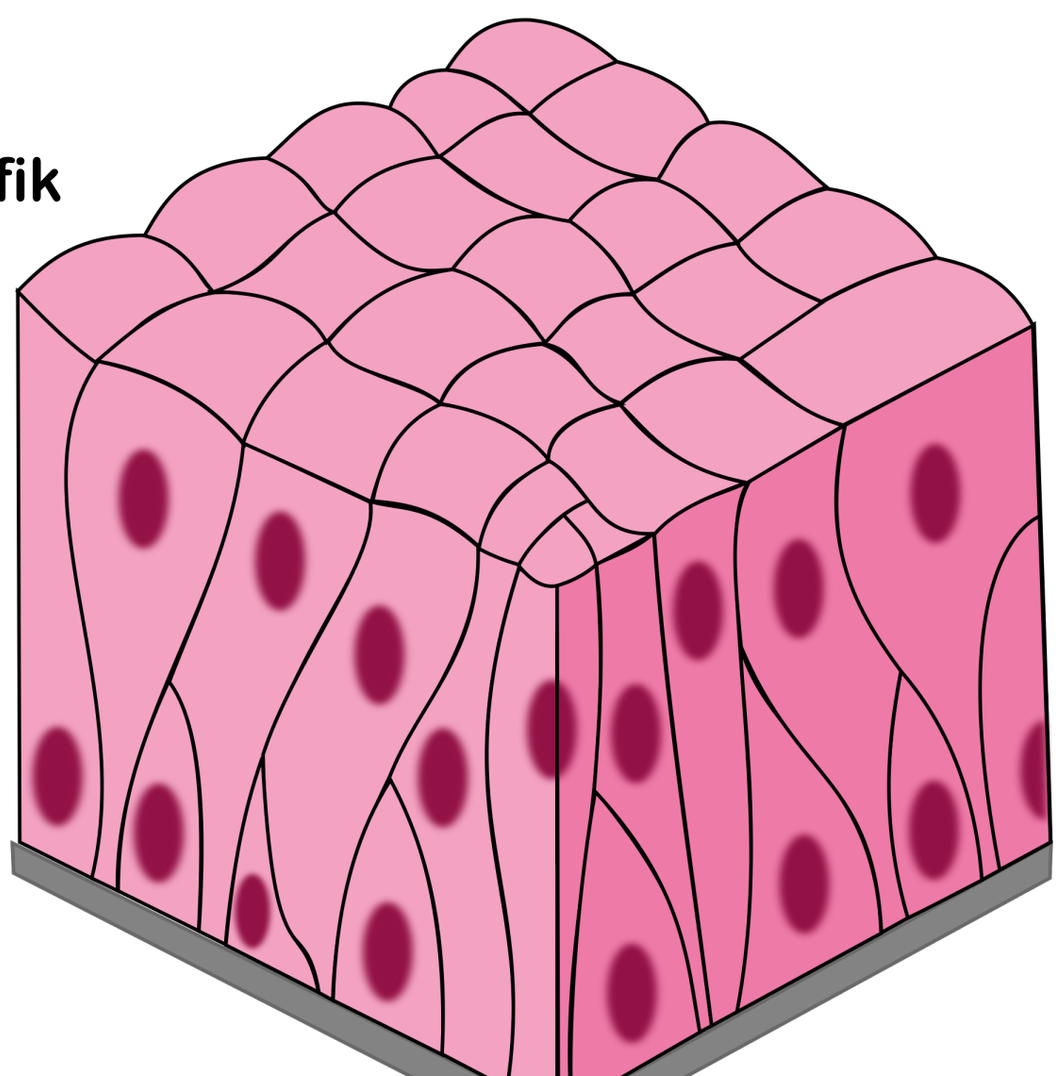
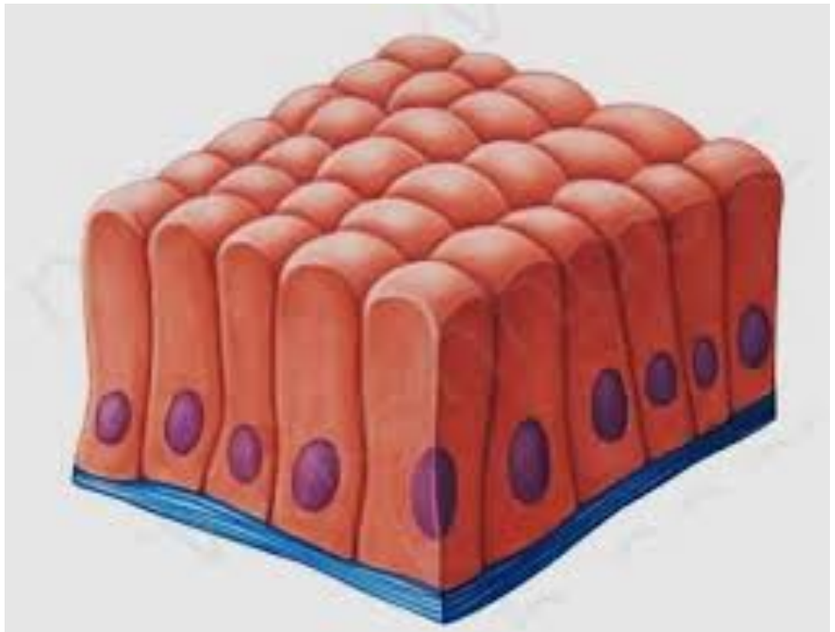


# TISSUES

Cells come together with extracellular matrix (a jelly-like fluid) to form
the four types of tissues found in the human body: :1- Epithelial tissue 2-
Connective tissue 3- Muscle tissue 4- Nervous tissue.
Tissues join
together in different arrangements to form our body organs. Organs work
together in systems.



## Epithelial Tissue

A. Structure. Epithelia are specialized layers that line the internal and
cover the external surfaces of the body. An epithelium consists of a sheet
of cells lying close together with little matrix (ECM). The cells are located on top of dense irregular connective tissue, the basement membrane (BM).

1. The basement membrane separates the epithelium from underlying
connective tissue and blood vessels.
2. Epithelia are avascular and receive nourishment by diffusion of molecules through the basal lamina.

# Classification of Epithelial Tissues

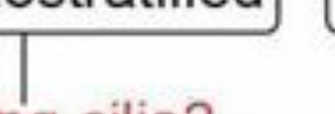
Epithelial Tissues

Layers of cells?

Simple

cell shapes?

Pseudostratified

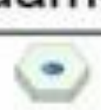


forming cilia?

Ciliated

Non-ciliated

Squamous



Cuboidal

Columnar

Compound

change shapes?

Stratified

cell shapes?

Stratified squamous

containing keratin?

Keratinized

Non-keratinized

Stratified cuboidal

Stratified columnar

# C. Function

**1. Transcellular Transport:**
**a. Diffusion – e.g., oxygen and carbon dioxide diffuse across alveolar epithelium in the lungs.**
**b. Carrier-mediated transport – e.g., glucose and amino acids are absorbed in the intestinal epithelium via specific transport proteins.**
**c. Vesicle-mediated transport – e.g., immunoglobulin A (IgA) is transported across epithelial cells via transcytosis.**

**2. Absorption:**

- **Occurs by endocytosis or pinocytosis in specialized epithelial cells, such as in the proximal convoluted tubule of the kidney.**

**3. Secretion:**

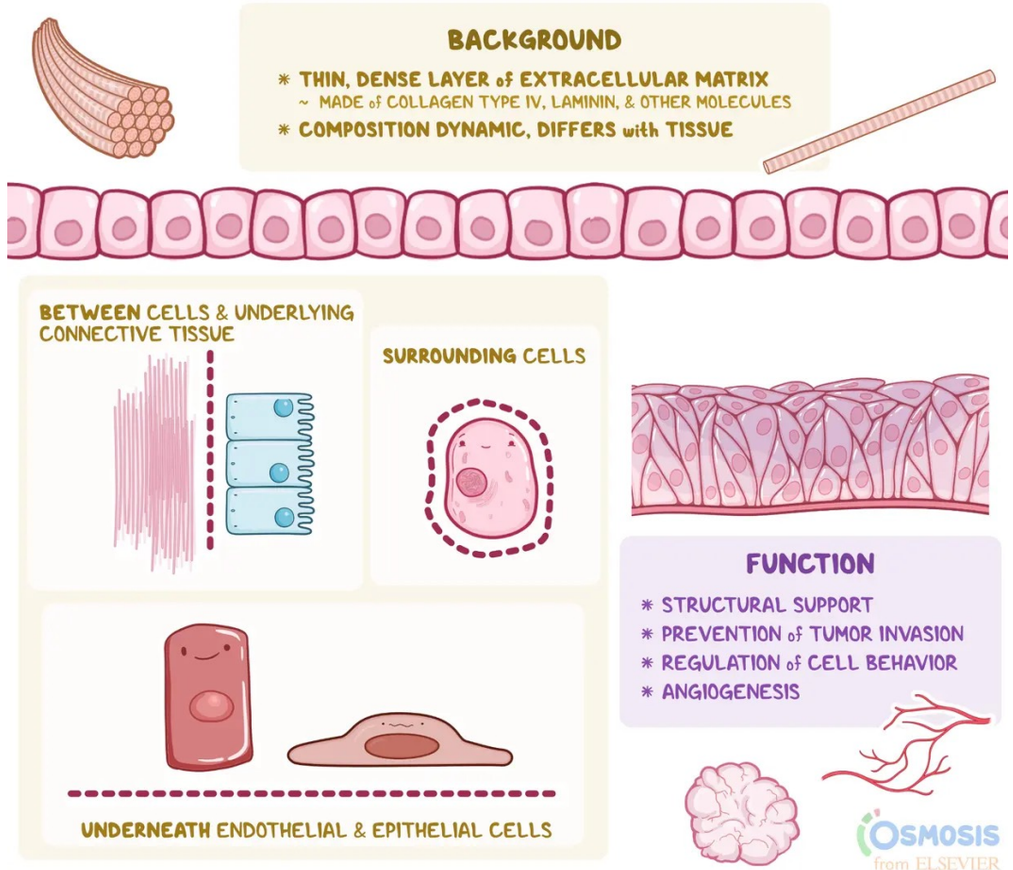
- **Molecules like hormones, enzymes, mucus, and proteins are released by exocytosis from epithelial cells (e.g., glandular epithelium).**

## 4. Selective Permeability:

- Maintained by tight junctions between epithelial cells, allowing distinct fluid environments on each side — e.g., intestinal epithelium maintains different luminal and interstitial compositions.

## 5. Protection:

- The epidermis (skin epithelium) protects underlying tissues from mechanical abrasion, pathogens, and dehydration.



Common Characteristics of All Epithelial Tissues:

1. They form sheets of tightly bound cells or roll into tubes.
2. Epithelial cells lie on the **basement membrane**.
3. Epithelial cells have two different "sides" — **apical** and **basolateral**.
4. The apical side always faces out of the body (toward a lumen or external surface).

## Characteristic Features of Epithelial Cells

Epithelial Cell Forms & Supporting Structures – Key Points:

1. Variations in Epithelial Cell Shape:

- Epithelial cells range from **high columnar**, to **cuboidal**, to **low squamous**.
- The shape of the nucleus often matches the cell shape:
- Cuboidal cells → spherical nuclei
- Squamous cells → flattened nuclei
- The long axis of the nucleus is always parallel to the main axis of the cell.

2. Nucleus as a Diagnostic Tool:

• In light microscopy, **lipid-rich cell membranes** may not be visible, so the **stained nucleus** helps identify:

• Cell shape

• Number of layers

• **Nuclear form** is essential in classifying epithelium (e.g., **simple vs. stratified**).

3. Support by Connective Tissue:

• Most epithelia rest on **connective tissue**.

• In internal organs (digestive, respiratory, urinary), this supporting layer is called the **lamina propria**.

4. Functions of the Lamina Propria:

• **Supports** the epithelium

• Provides **nutrition**

• **Anchors** epithelium to underlying structures

5. Papillae Increase Contact Surface:

• **Papillae** are **small evaginations** of connective tissue.

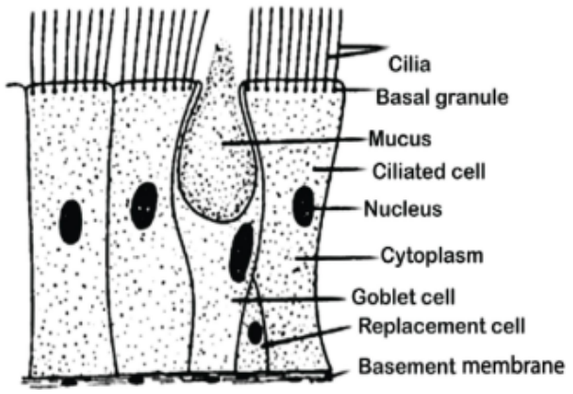
• They **increase the surface area** between the epithelium and lamina propria.

• Commonly found in areas of **high friction** like the **skin and tongue**.

# Specializations of the Apical cell Surface

## Cilia

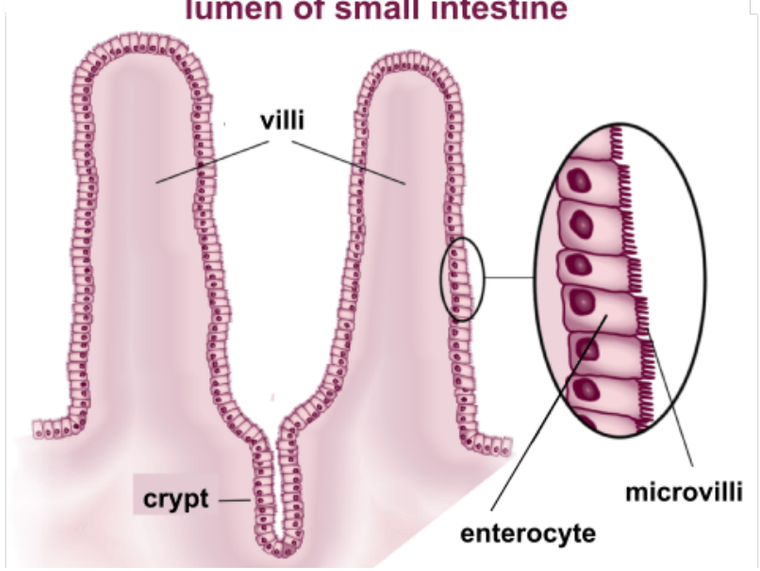
1. Structure and Appearance:
    - Cilia are hair-like, motile appendages located on the apical surface of epithelial cells.
    - They are longer and wider than microvilli.
    - Each cilium arises from a **basal body** (an **electron-dense, cylindrical structure**) found just beneath the cell membrane.




2. Size and Visibility:
    - Diameter: **0.2 µm**
    - Length: **5–10 µm**
    - They can be seen as individual structures under a light microscope due to their size.

3. Functions:
    - Help in the **transport of materials** along the epithelial surface (e.g., mucus).
    - Act as **sensory structures** and **produce movement** across the cell surface.

4. Location in the Body:
    - Found in pseudostratified ciliated columnar epithelium of the respiratory tract.
    - Also present in ciliated simple columnar epithelium of the oviduct (fallopian tube).




# Microvilli – Structure, Function, and Location

1. Size and Appearance:
    - Microvilli are smaller and shorter than cilia.
    - Size: about 0.08 µm in diameter and 1 µm in length.
    - Not visible individually under light microscope, but appear collectively as a **brush border**.

2. Structural Support:
    - Anchored to the **terminal web** in the apical cytoplasm.
    - The terminal web contains **actin filaments** that **stabilize the microvillus** structure.

3. Function:
    - Increase the apical surface area of epithelial cells.
    - Play a crucial role in **absorption**, especially in organs that need efficient nutrient uptake.

4. Common Locations:
    - Seen in simple columnar epithelium lining the small intestine.
    - Also present in simple cuboidal epithelium of the proximal tubules in the kidney.

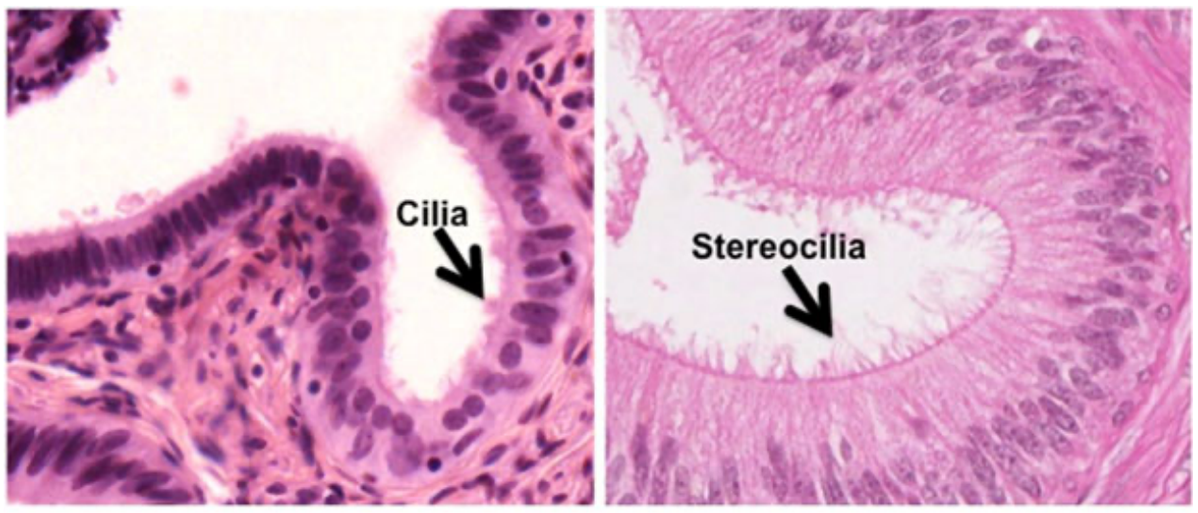
# Stereocilia – Structure, Function, and Location

1. Structure and Composition:
    - Stereocilia are long, slender projections that are actually modified microvilli.
    - They consist of actin microfilaments, just like ordinary microvilli.

2. Size:
    - Diameter: **< 0.1 µm**
    - Length: can reach **10 µm or more** (longer than typical microvilli).
    - Despite the name, **they are non-motile** and **not true cilia**.

3. Function:
    - Aid in **absorption**, similar to microvilli.
    - Do **not move** – unlike true cilia.

4. Locations in the Body:
    - Found in pseudostratified columnar epithelium of the ductus epididymis and vas deferens (male reproductive tract).



# Specializations of the Basal Surface (Basal Domain)

1. Structural Support:
    - Epithelial cells rest on a **basement membrane**, which acts as a **foundation** for the epithelium.

2. Components of the Basement Membrane:
    - Composed of two layers:

**a. Basal lamina**
**b. Reticular lamina**

3. Microscopy Terms:
    - The term “**basement membrane**” is used in light microscopy, but often hard to see.
    - “Basal lamina” and “reticular lamina” are ultrastructural terms seen only with electron microscopy.

4. Attachment to Basement Membrane:
    - **Hemidesmosomes** are specialized junctions that **anchor epithelial cells** to the **basement membrane**.

# Basal Laminae & Basement Membranes

1. Definition & Location:
    - **Basal lamina** is a **felt-like extracellular sheet** located at the **basal surface** of epithelial cells, where they contact **connective tissue**.
    - Found not only under epithelium, but also **where other cells meet connective tissue**.

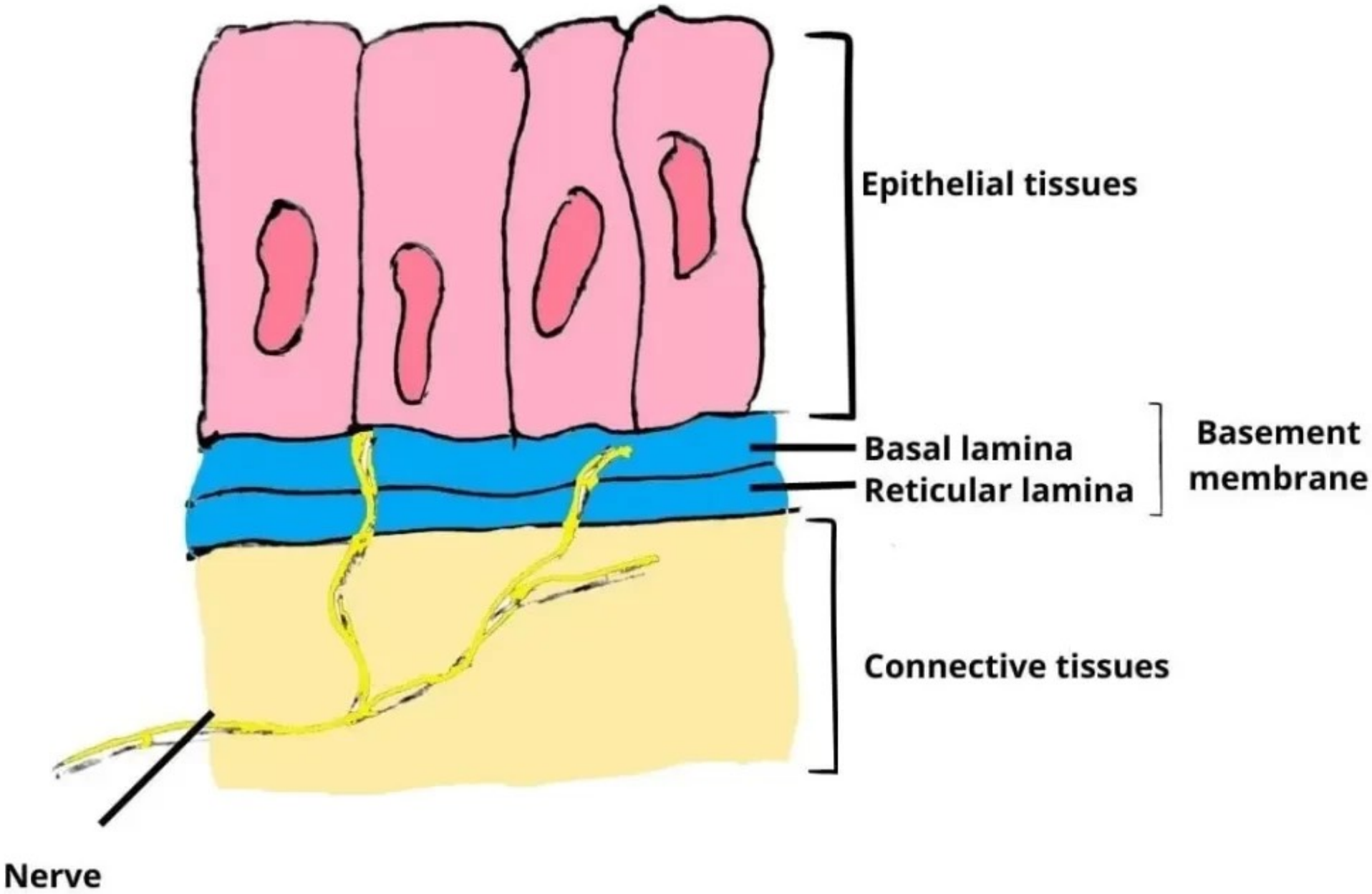
2. Visibility:
    - Seen only with the **electron microscope**.
    - Appears as an electron-dense layer (called lamina densa), 20–100 nm thick.
    - May also have surrounding **clear layers (laminae lucida)** on one or both sides.

3. Relation to Basement Membrane:
    - When visible under **light microscopy**, this combined structure is called the **basement membrane**.

4. Functions of the Basal Lamina:
    - Regulates cell proliferation and differentiation by binding growth factors.
    - Influences cell metabolism and survival.
    - Organizes plasma membrane proteins, affecting signal transduction.
    - Serves as pathways for cell migration.
    - Separates epithelial cells from underlying connective tissue.

5. Nutrient Exchange & Innervation:

- **Nutrients diffuse** across the basal lamina to reach epithelial cells.
- Nerve fibers may pass through, but blood capillaries never enter across the basal lamina.



Specializations of the Lateral Surface (Lateral Domain)

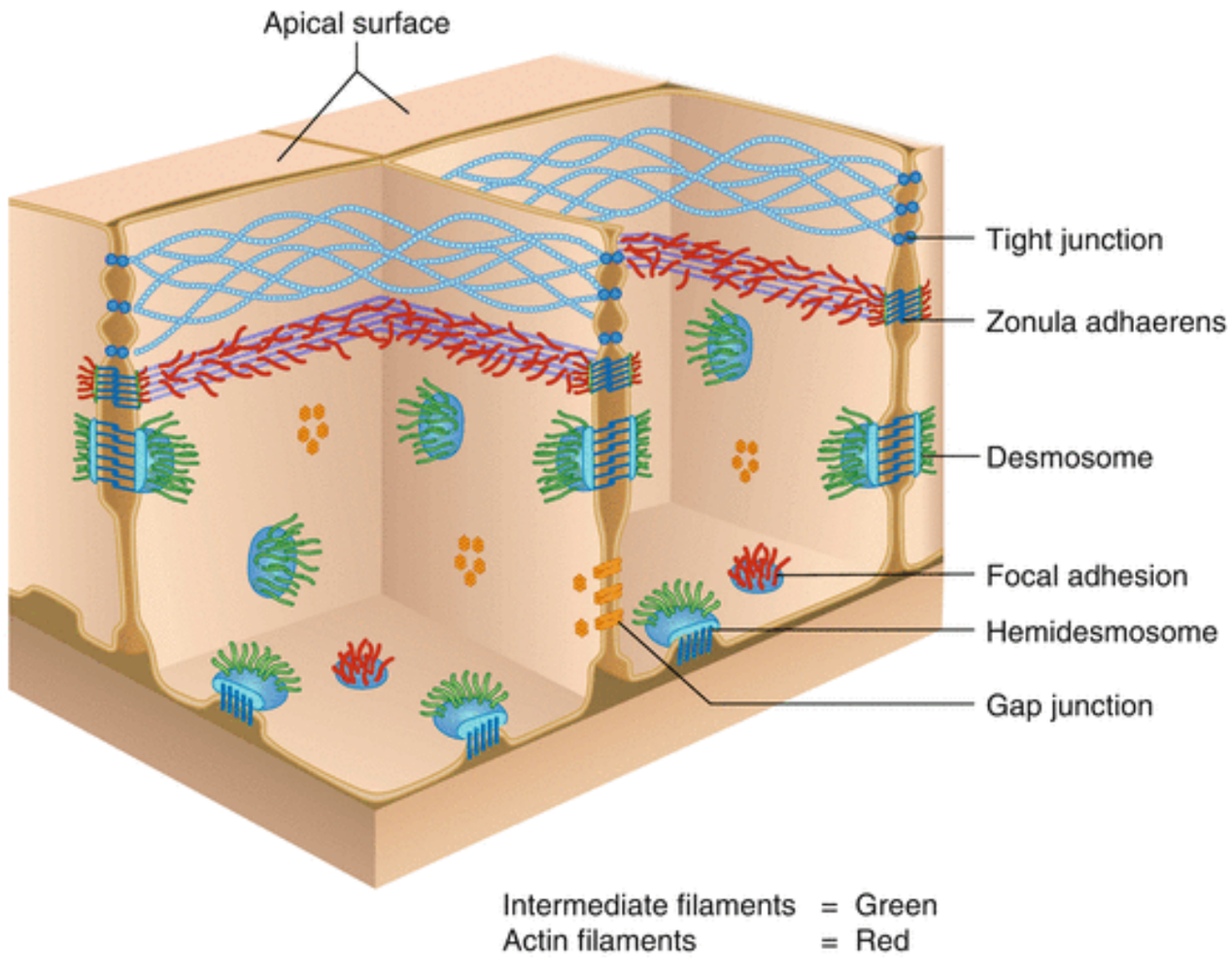
1. General Role:

• The **lateral surface** of epithelial cells contains **junctional complexes** that provide:

• Cell-to-cell adhesion

• Communication between neighboring cells

• These junctions are especially numerous in epithelia, particularly those exposed to friction or mechanical stress.



**Types of Intercellular Junctions:**

1. Tight (Occluding) Junctions:
 • Located at the **apical part** of lateral membranes.
 • Form **seals** between adjacent cells, preventing passage of materials between them.
 • Ensure **compartmentalization** (e.g., intestinal epithelium).

2. Adherent (Anchoring) Junctions:
 • Link cells via cytoplasmic actin filaments.
 • Provide mechanical strength and support.

3. Gap Junctions:
 • Form channels between adjacent cells.
 • Allow **ions and small molecules** to pass through, facilitating **intercellular communication**.

4. Desmosomes (Macula Adherens):
 • **Spot-like adhesions** on the lateral sides of the plasma membrane.
 • Specialized for strong cell-to-cell adhesion.
 • Important in tissues subject to stress (e.g., skin).

Special Case – Basal Adhesion:

5. Hemidesmosomes:

- Resemble half of a desmosome.
- Located on the **basal surface** of epithelial cells.
- Anchor cells to the **basal lamina** (not to other cells).
- Found in tracheal epithelium, stratified squamous epithelium, and myoepithelial cells.


Thank
you!