Epithelium-2

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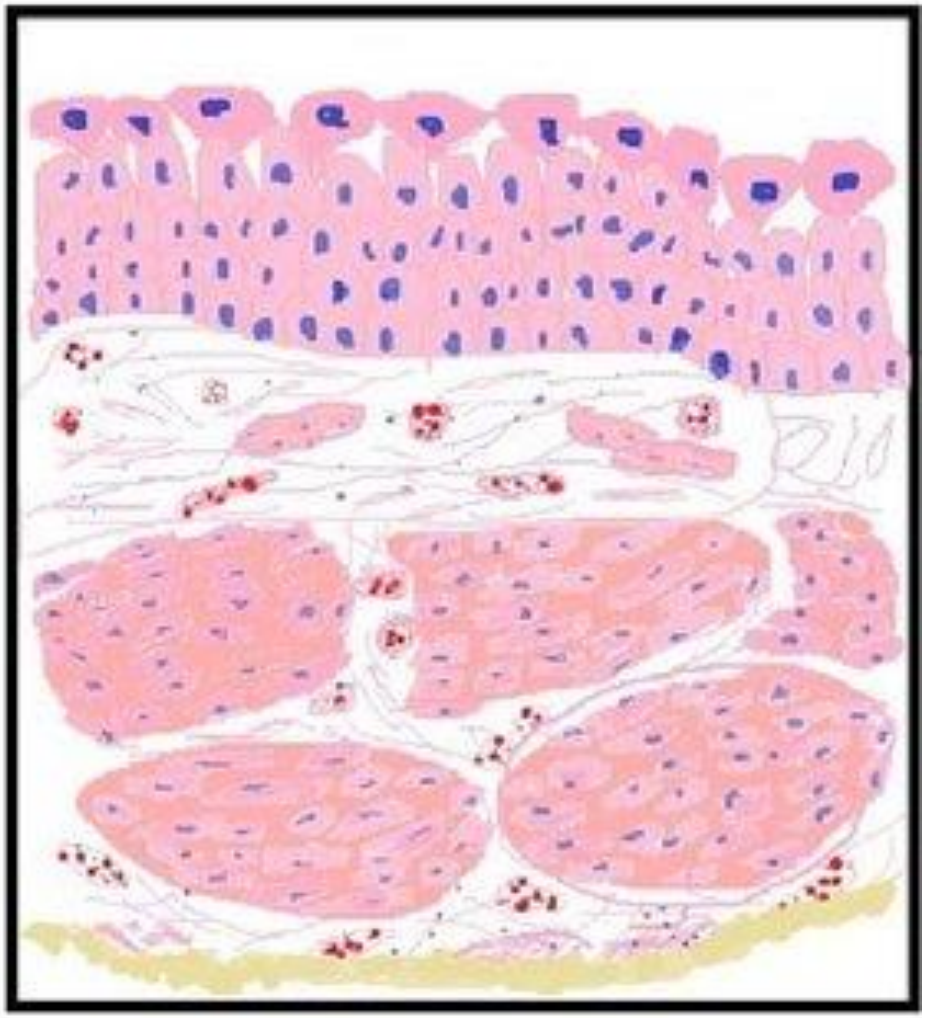
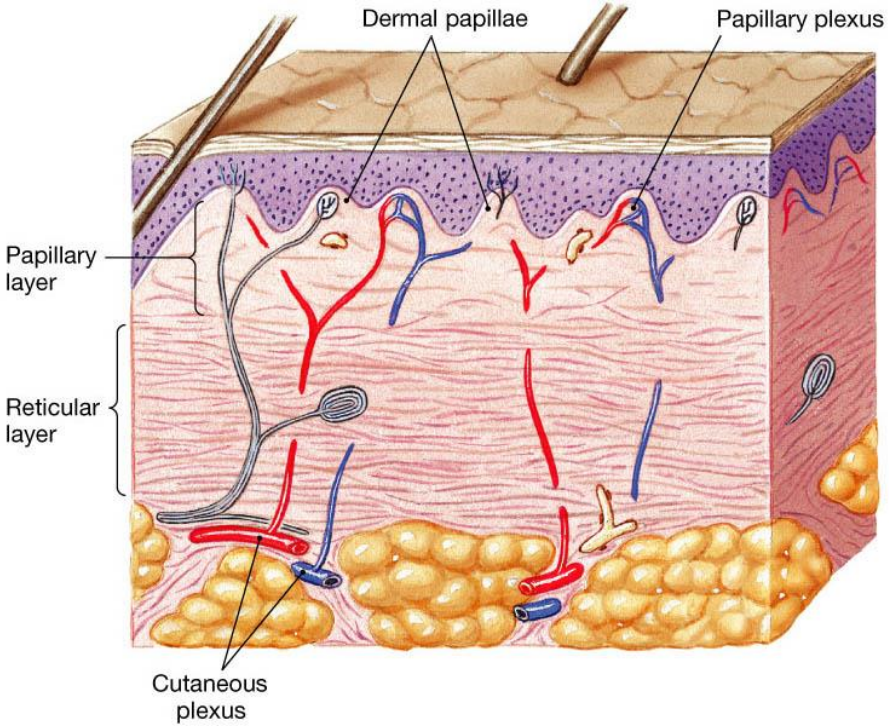
Relationship between CT and Epithelium

- All epithelial cells rest on connective tissue
- In case of epithelia that line internal organs, this connective tissue is called **lamina propria**
- Area of contact between epithelium and lamina propria increased by irregularities called **papillae**, most frequent in areas of stress

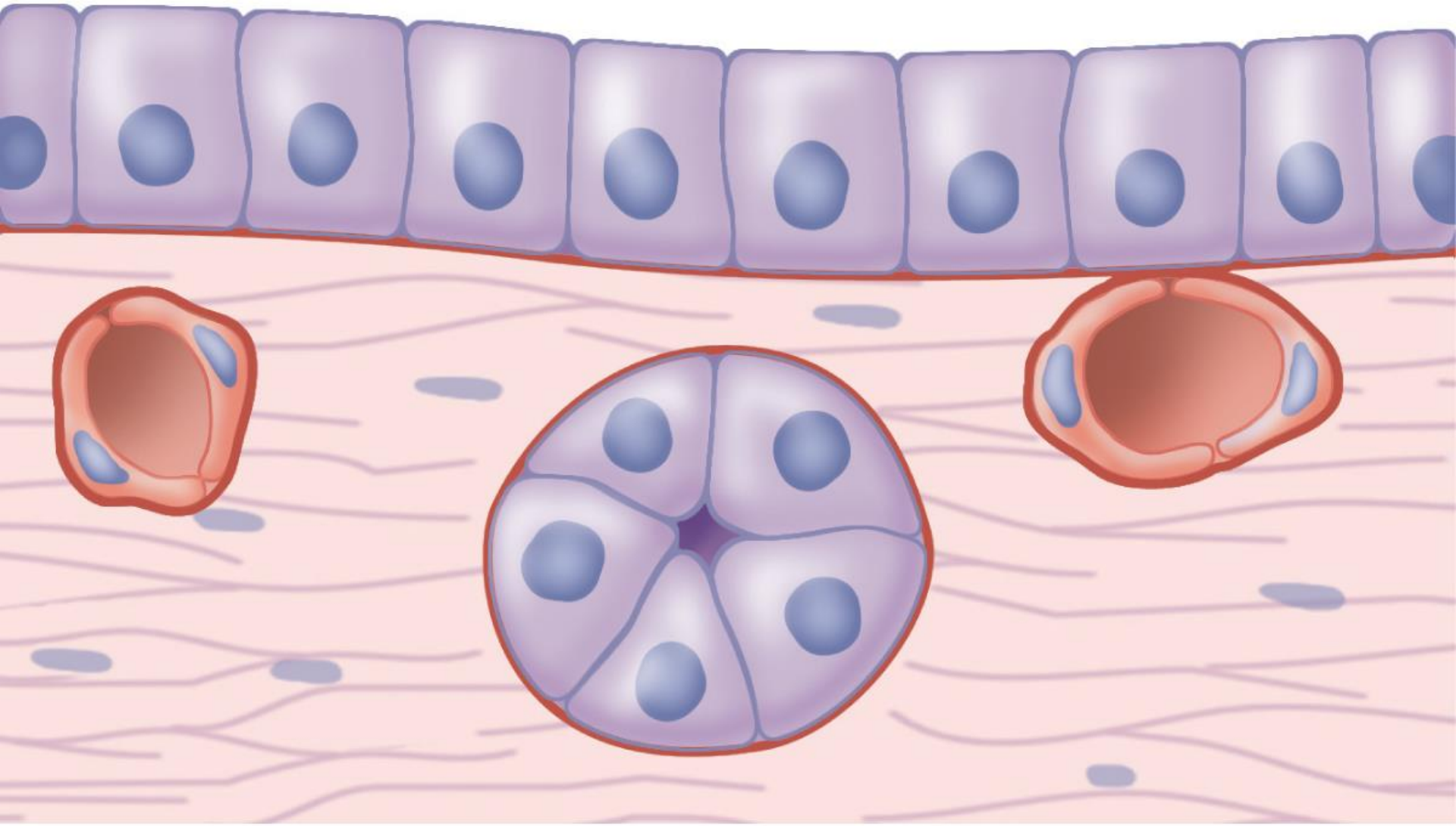



Dermal papillae
Papillary plexus
Papillary layer
Reticular layer
Cutaneous plexus

Basal Lamina and Basement Membrane

- Most epithelial cells are separated from the connective tissue by a sheet of extracellular material called the **basal lamina** (only visible under EM).
- The term **basement membrane** is used to specify a PAS-positive layer visible under LM present beneath some epithelia.

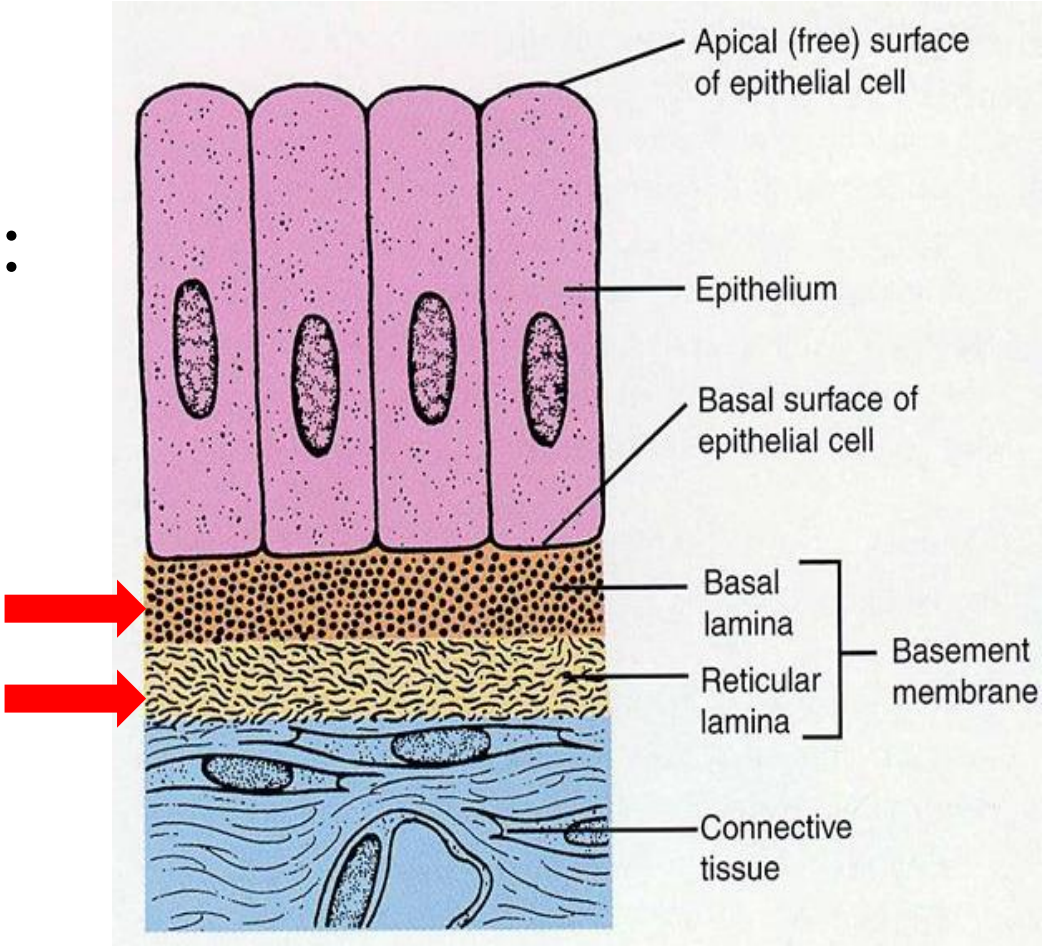
Basal lamina and basement membrane



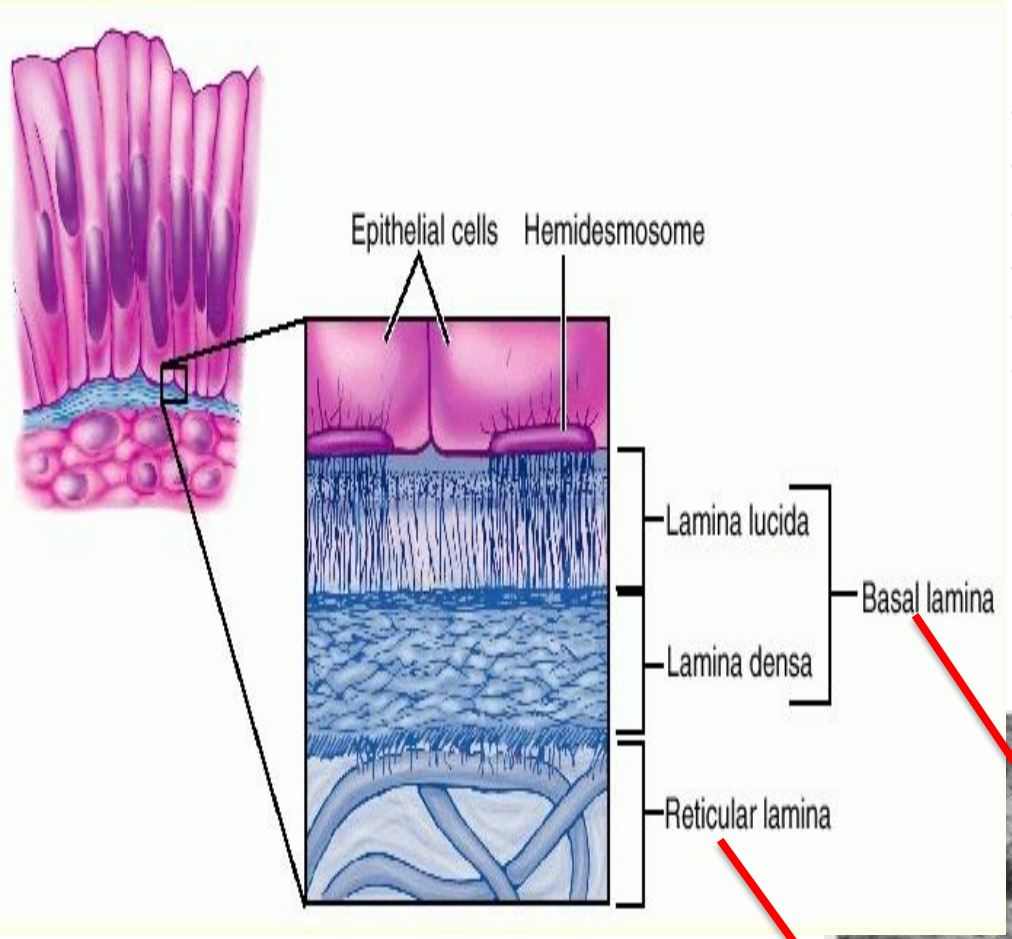
Basement membrane is composed of two layers:

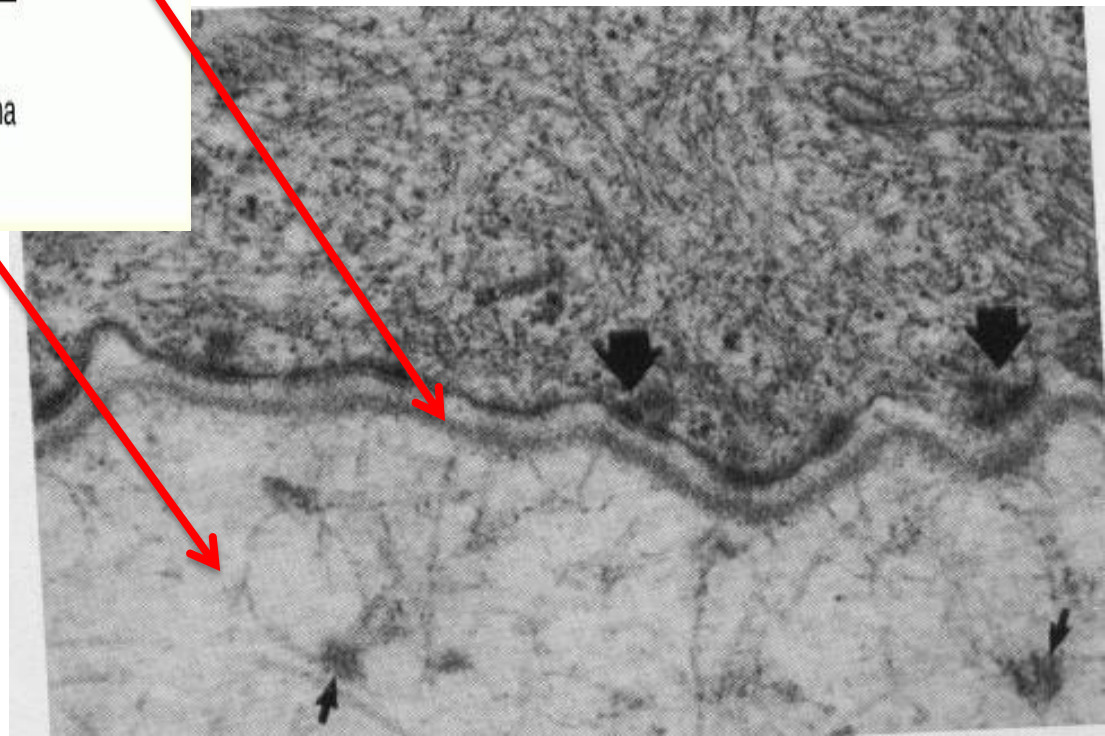
1- Basal lamina

2- Reticular lamina



Layers of basal lamina:
Lamina Lucida (rara)
Lamina Densa





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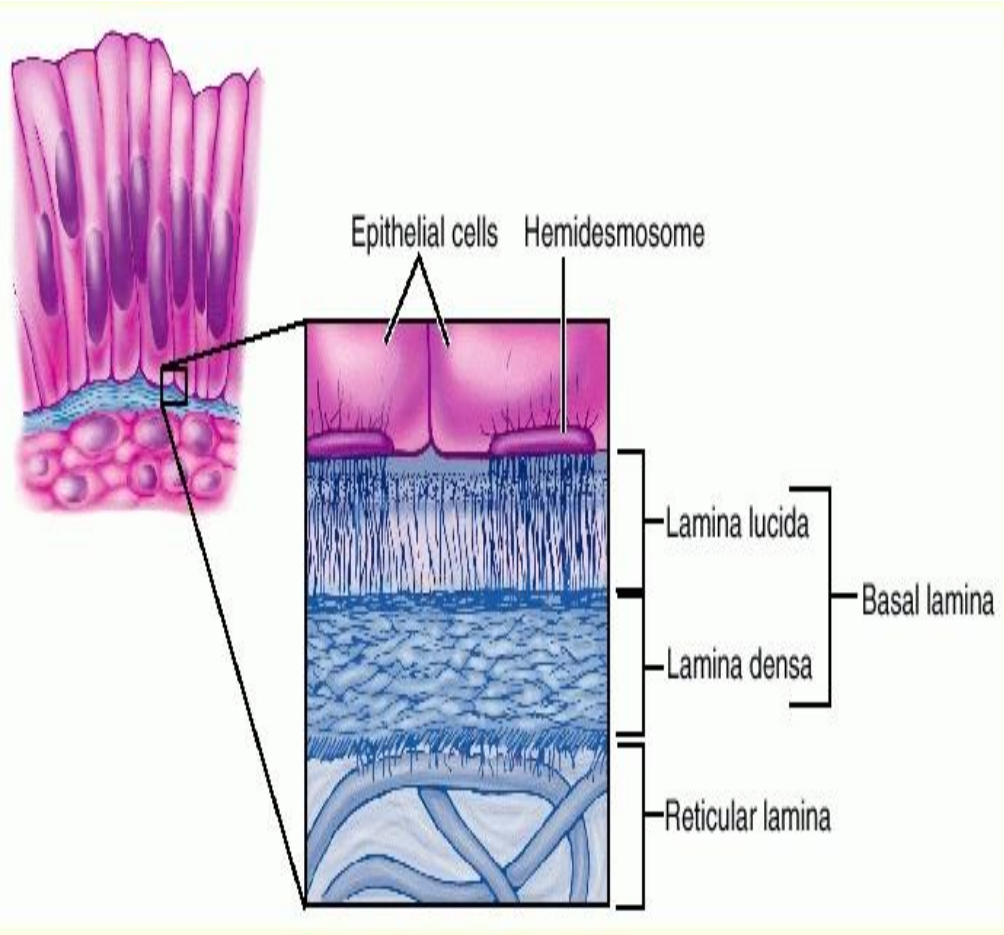
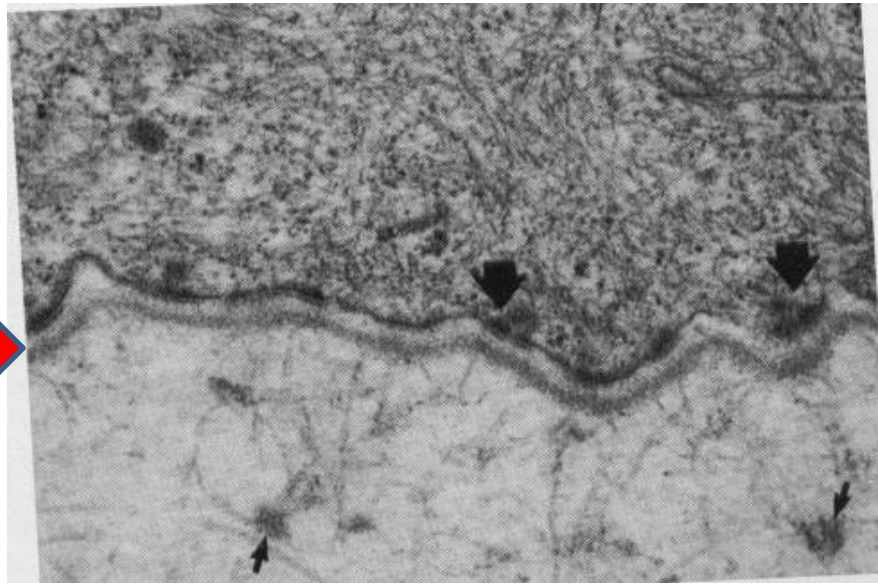


Lamina lucida: The clear layer closer to the epithelium

Lamina densa: the dense layer closer to the connective tissue

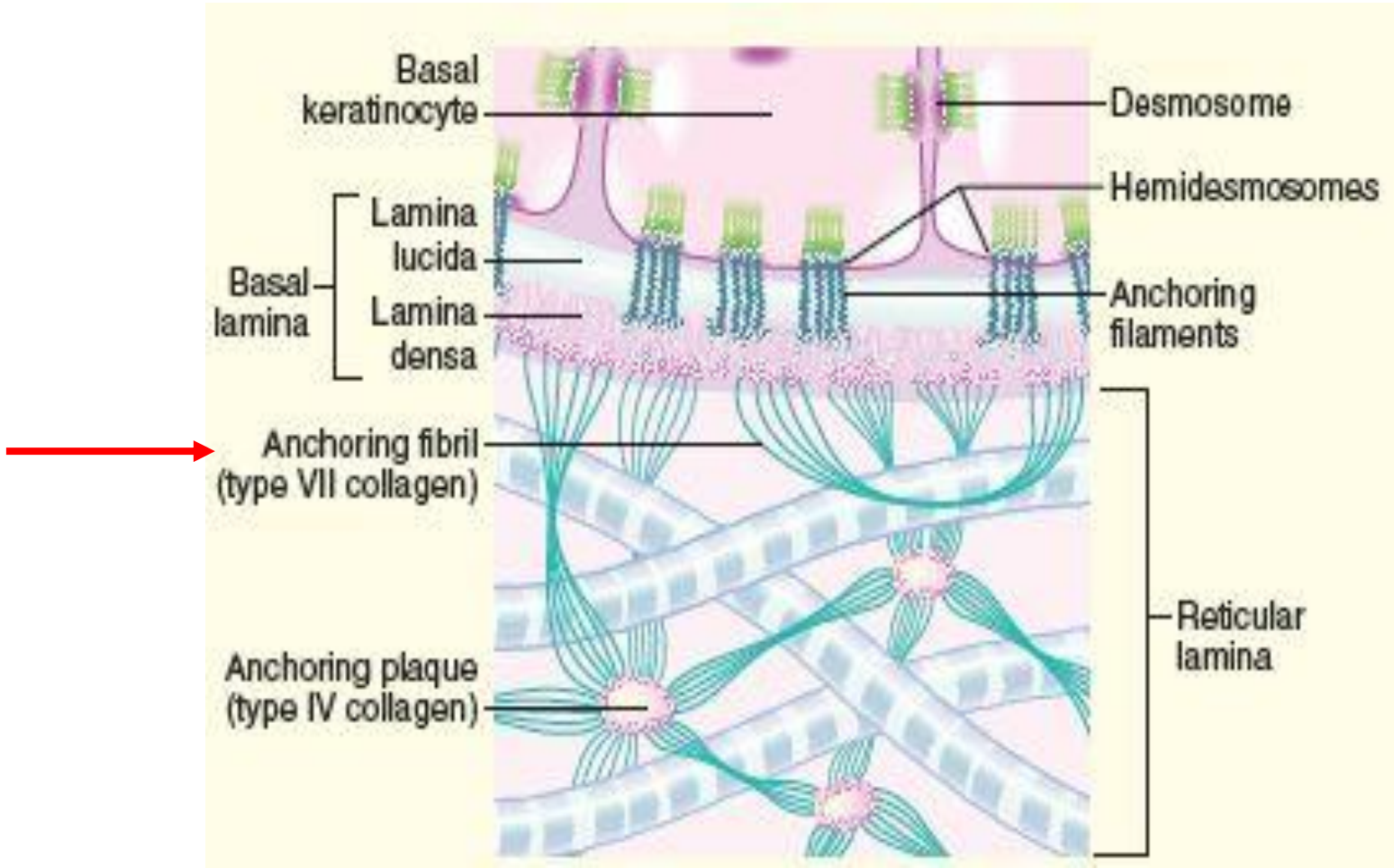
- Composed of lucida and densa
- Only visible with E.M
- Found also in other tissues, muscle cells, adipocytes, peripheral neurons (external lamina)
- Components are secreted by epithelium

Basal lamina



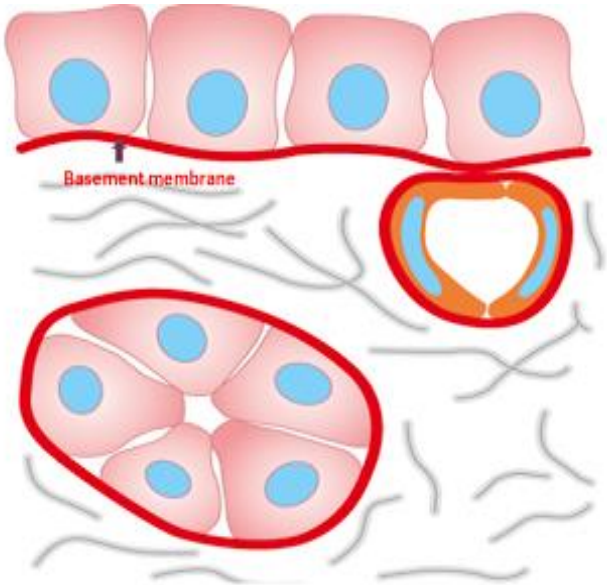
Molecular components are variable but include:

- **Type IV collagen**
- **proteoglycans**: e.g. Heparan sulfate proteoglycan called Perlecan
- **Glycoproteins** (Laminin, entactin…)



Basement membrane

- Used to specify a PAS positive layer, visible on light microscope
- It is thicker and usually formed by fusion of two basal laminae or basal lamina and reticular lamina
- the basement membrane is not actually a membrane; rather, it is a matrix



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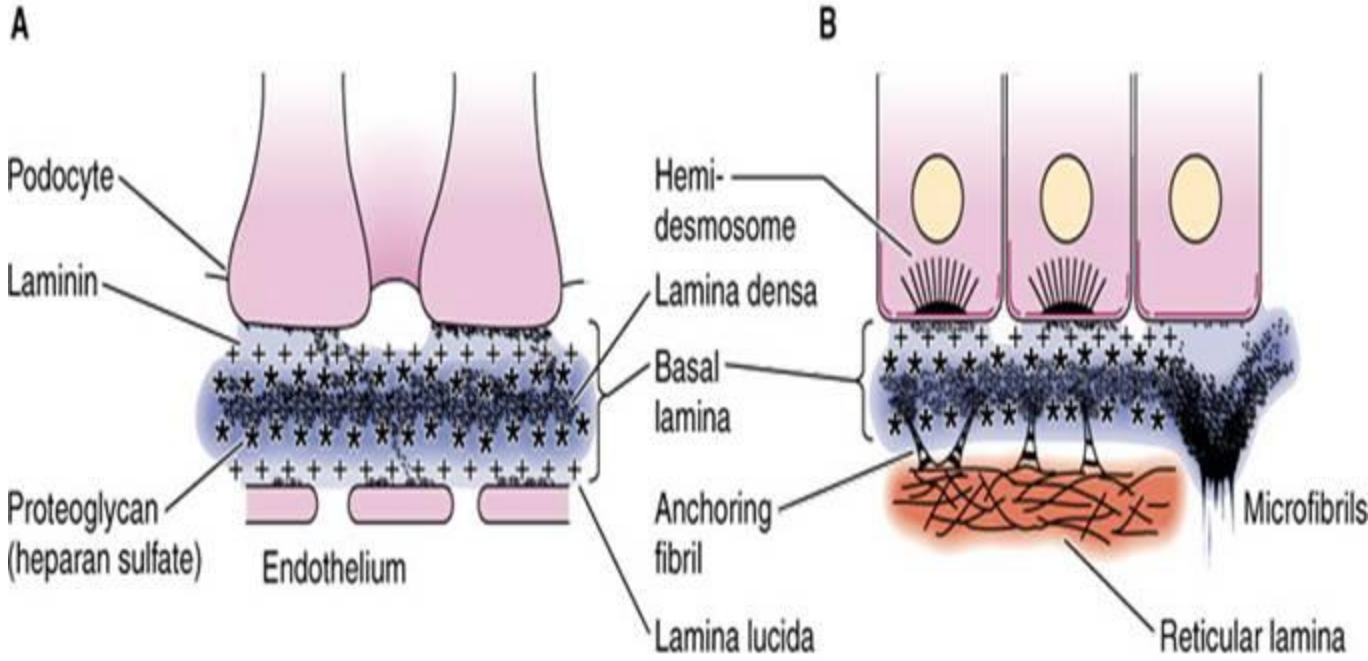


Functions of basal lamina:

1- Support
2- Selective barrier
3- Influencing cell polarity
4- Regulation of proliferation and differentiation
5- Affect cell-cell interaction
6- Pathway for cell migration

!!

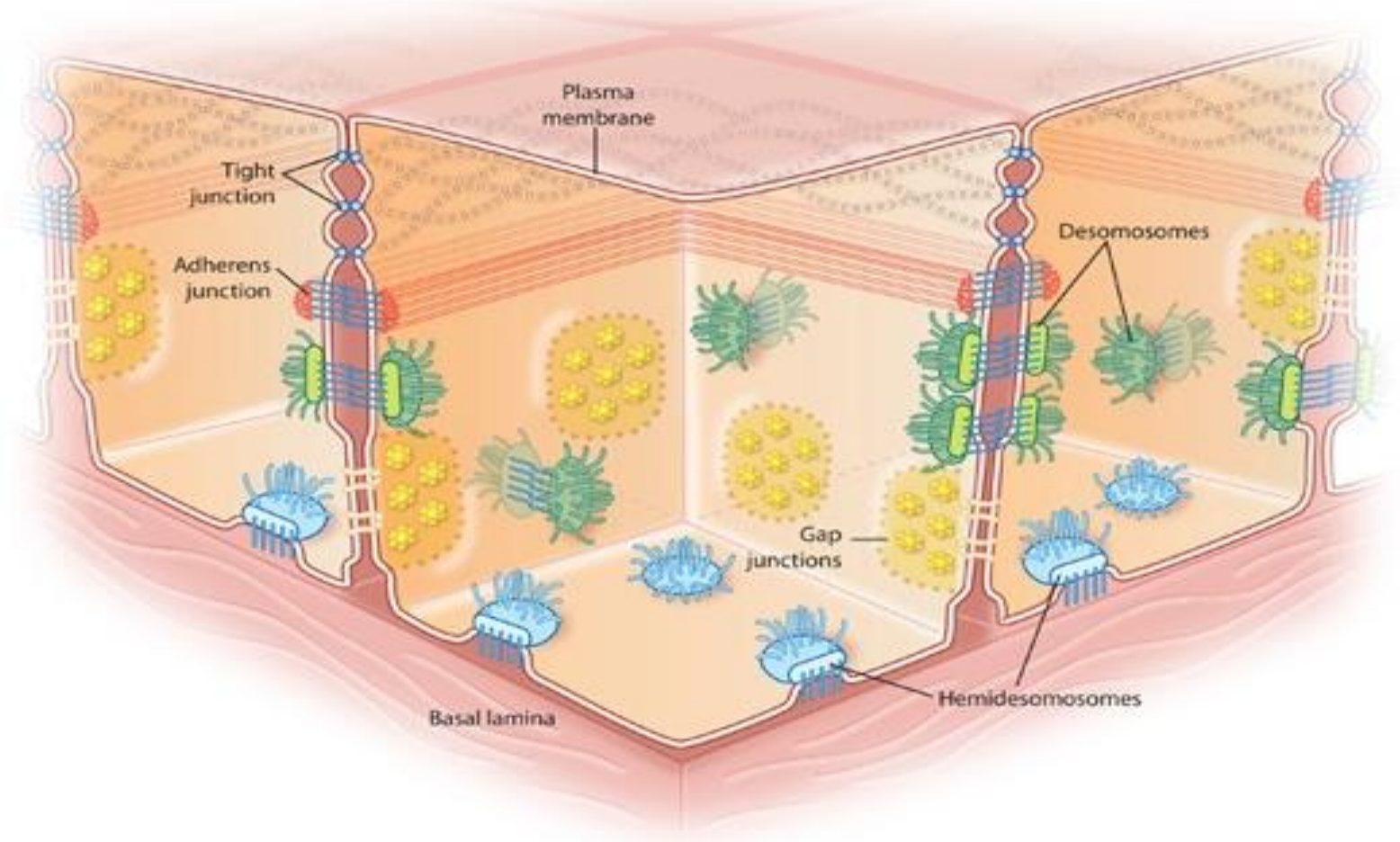
Every thing that enters or leaves the body must cross an epithelial sheet.

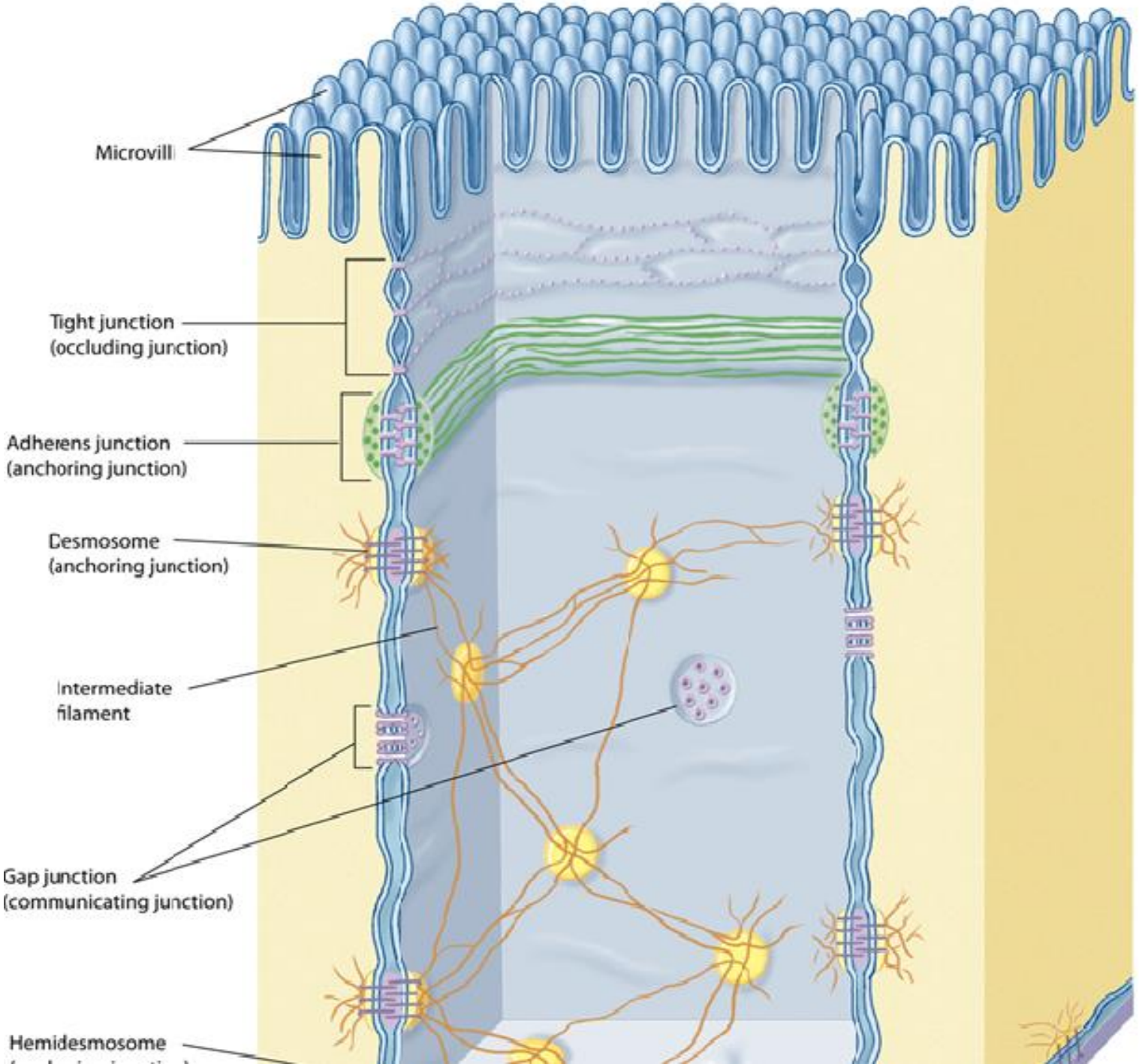
Epithelium occurs in the body as a sheet of cells that covers a body surface, lines a cavity, or forms a gland.

Coverings, linings, forming glands.

Cell Junctions

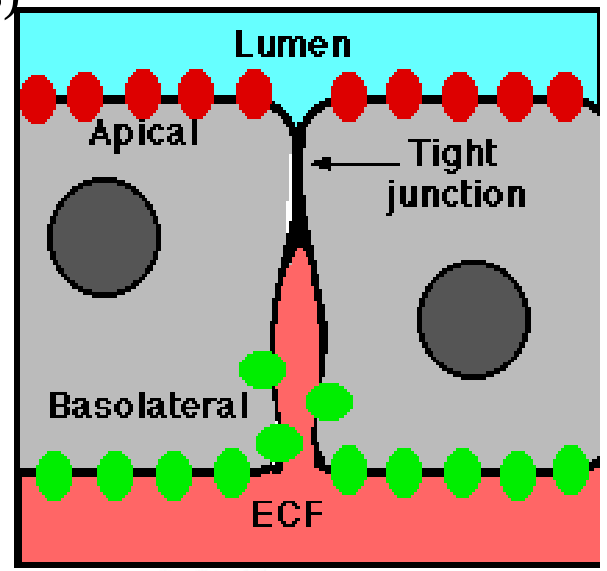
Basolateral domain

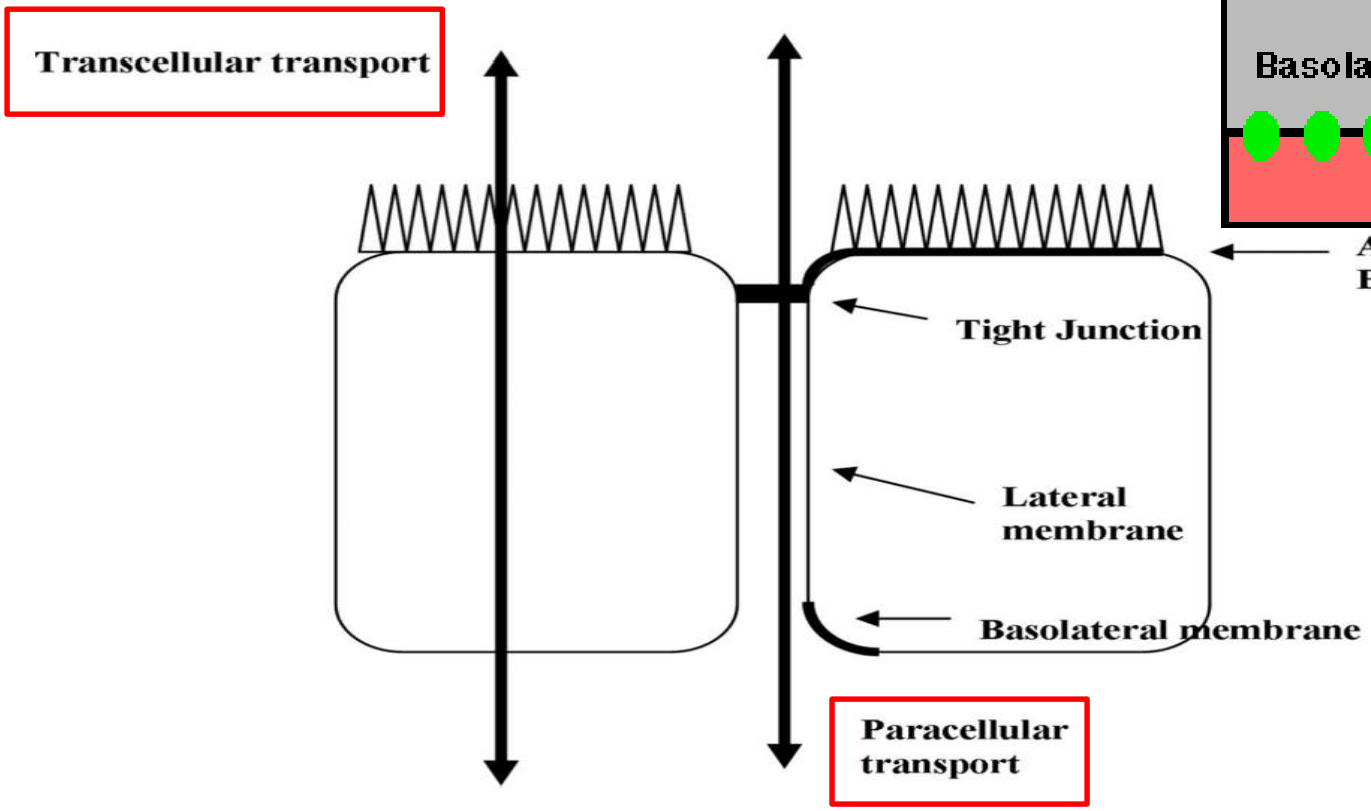



Microvilli
Tight junction
(occluding junction)
Adherens junction
(anchoring junction)
Desmosome
(anchoring junction)
Intermediate
filament
Gap junction
(communicating junction)
Hemidesmosome

Tight junction/ zonula occludens

- Occluding junction forms a band (encircles epithelial cells)
- Barrier to diffusion between cells (paracellular pathway)
-Separates apical and basolateral plasma membranes,
the outer layers of 2 adjacent plasmalemma fuse together.





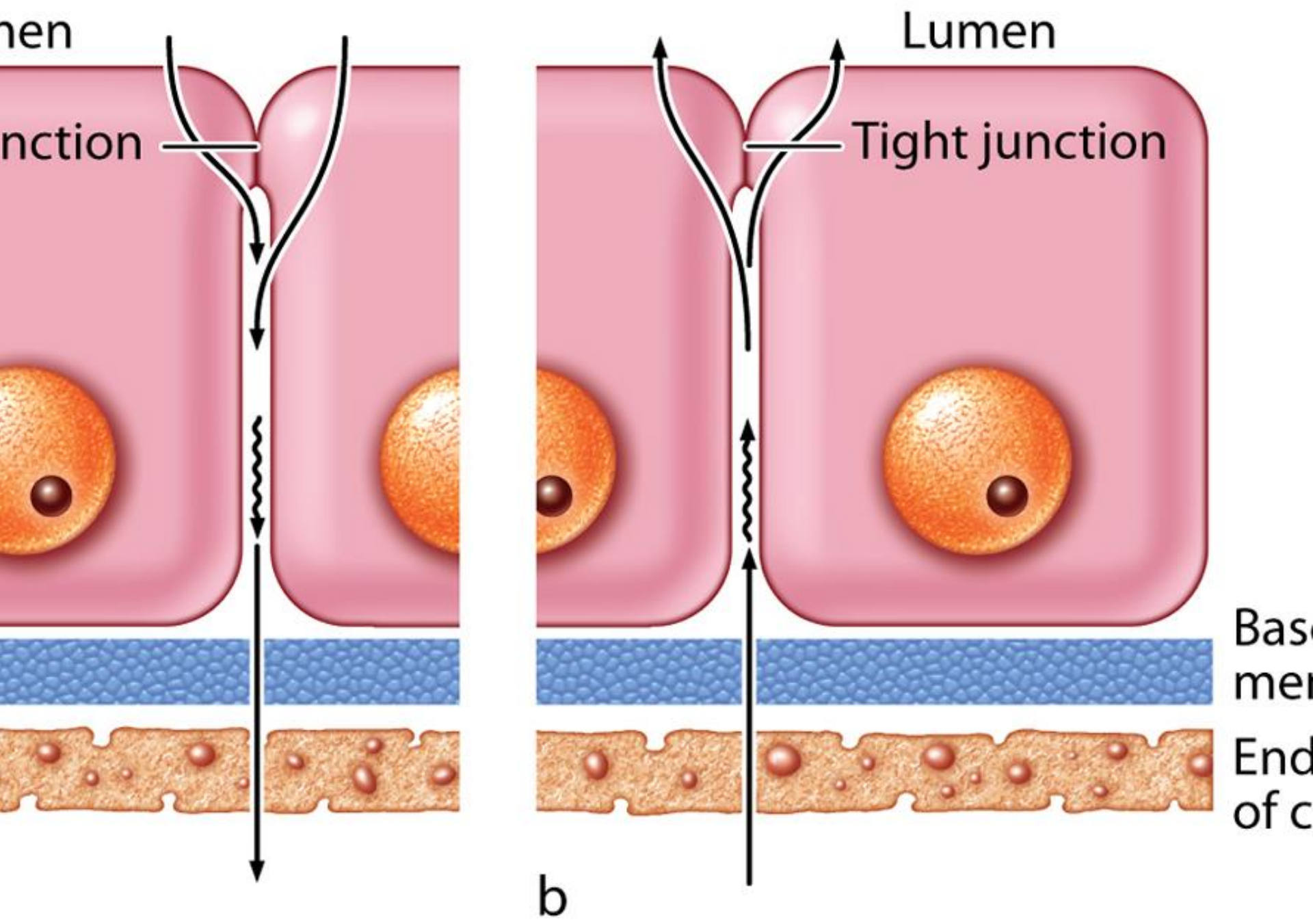
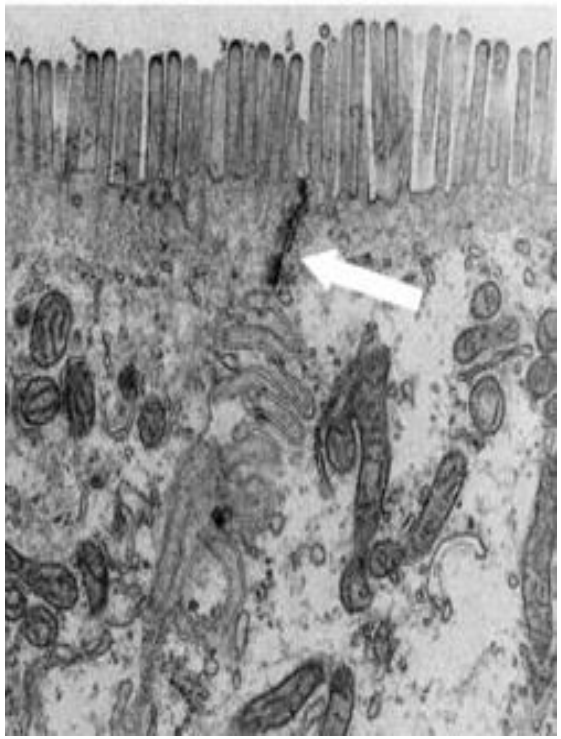
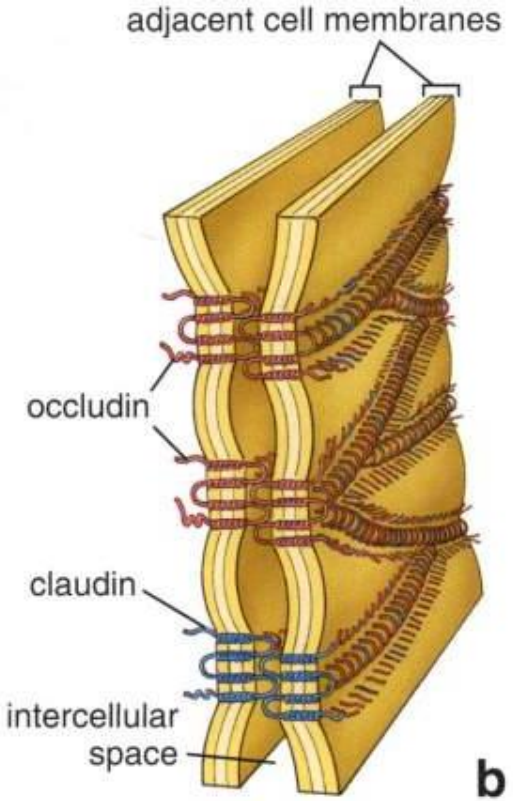
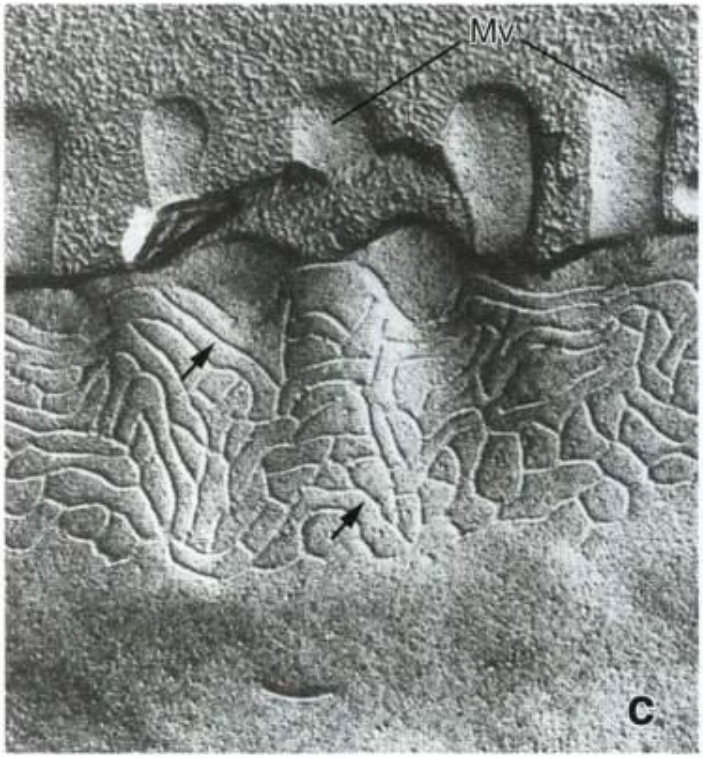


Figure 4-28

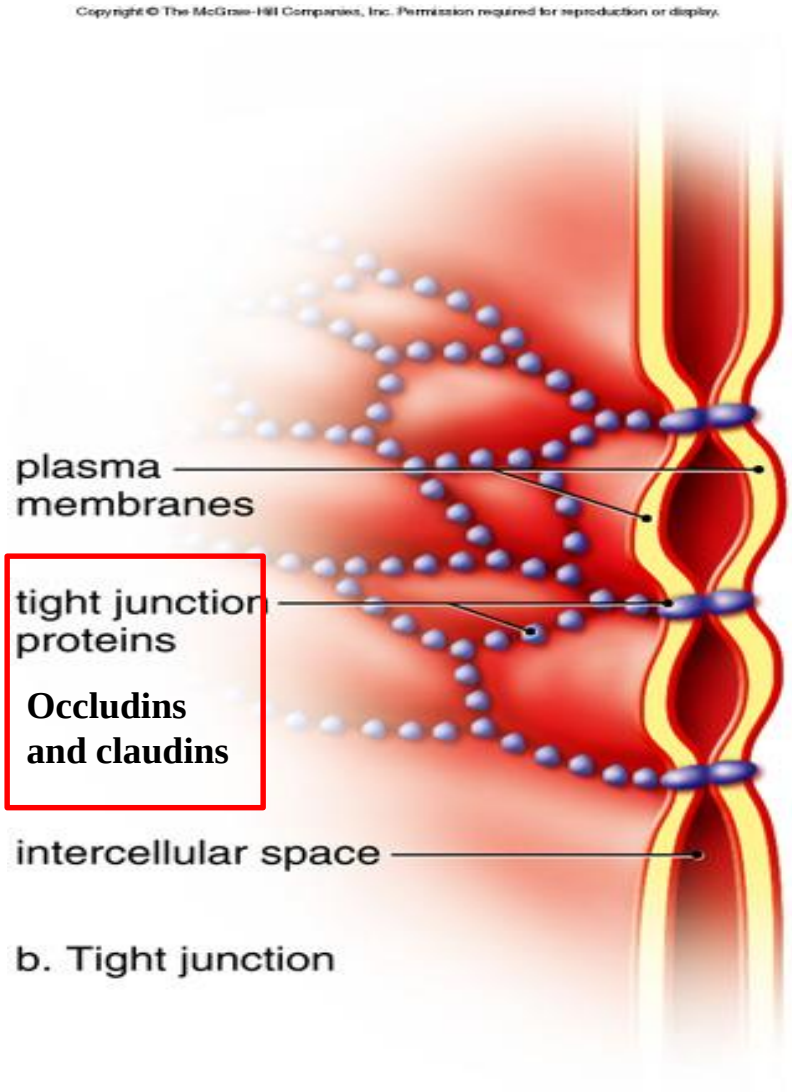




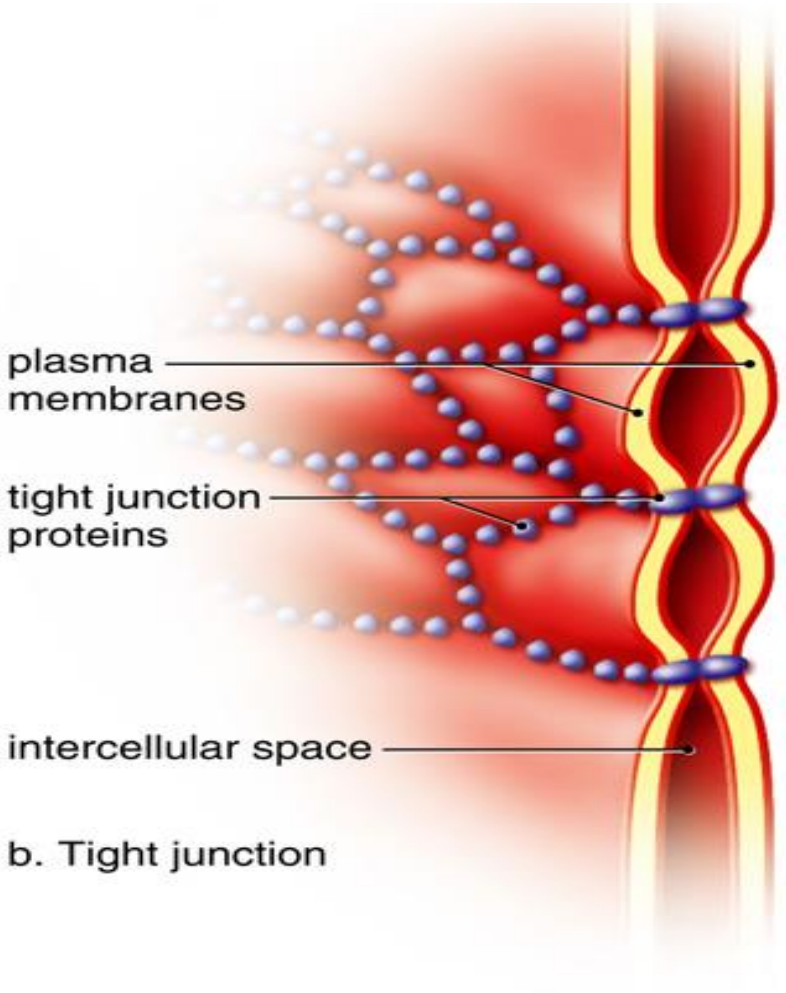


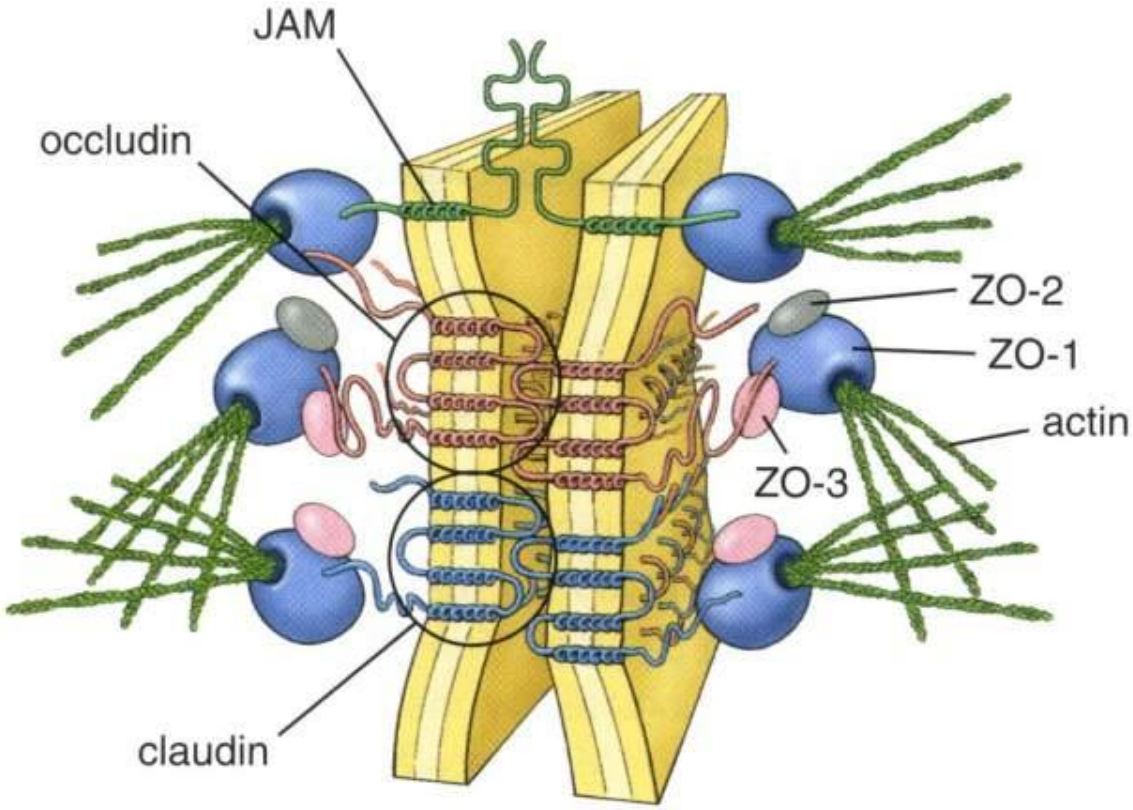
- TEM: is the most apical junction
- Freeze fracture of TJ reveals **ridges** in membranes that correspond to sites of contact between cells
- Ridges are linear arrays of occludin and claudin proteins

Tight Junction (Zonula occludens)



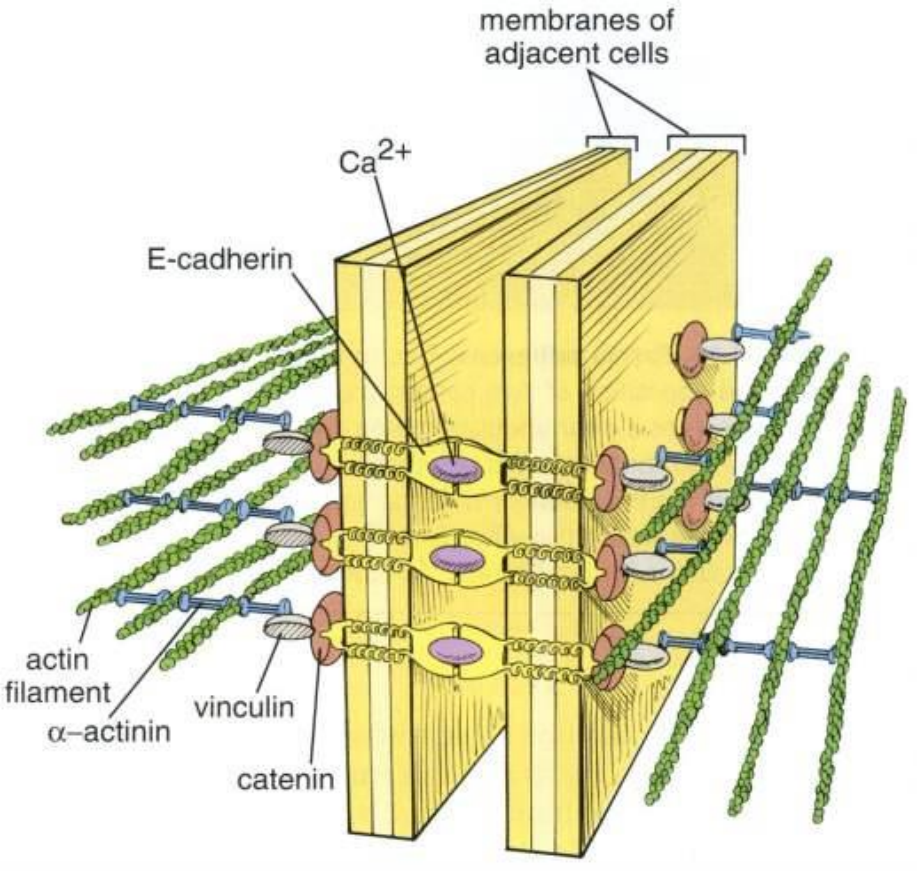
Each strand is a row of transmembrane proteins in both PMs with ECDs joining together

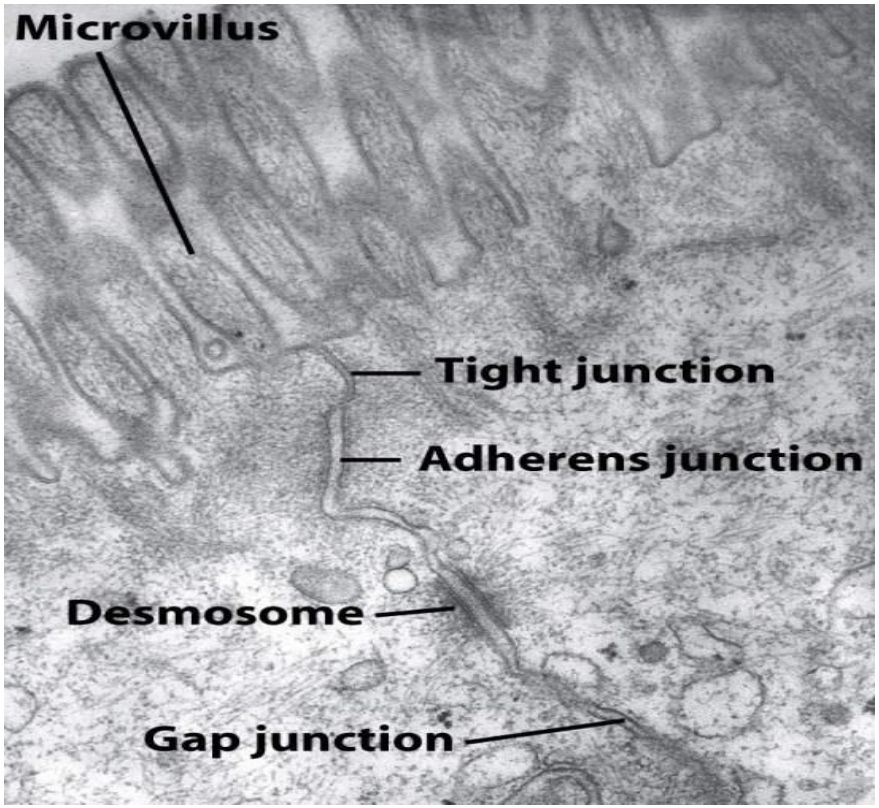




- Occludins and claudins are transmembrane proteins that interact across the intercellular space to form TJs
- ZO (zonula occludens) proteins 1-3 link occludin and claudin to each other, to JAMs, and to actin filaments

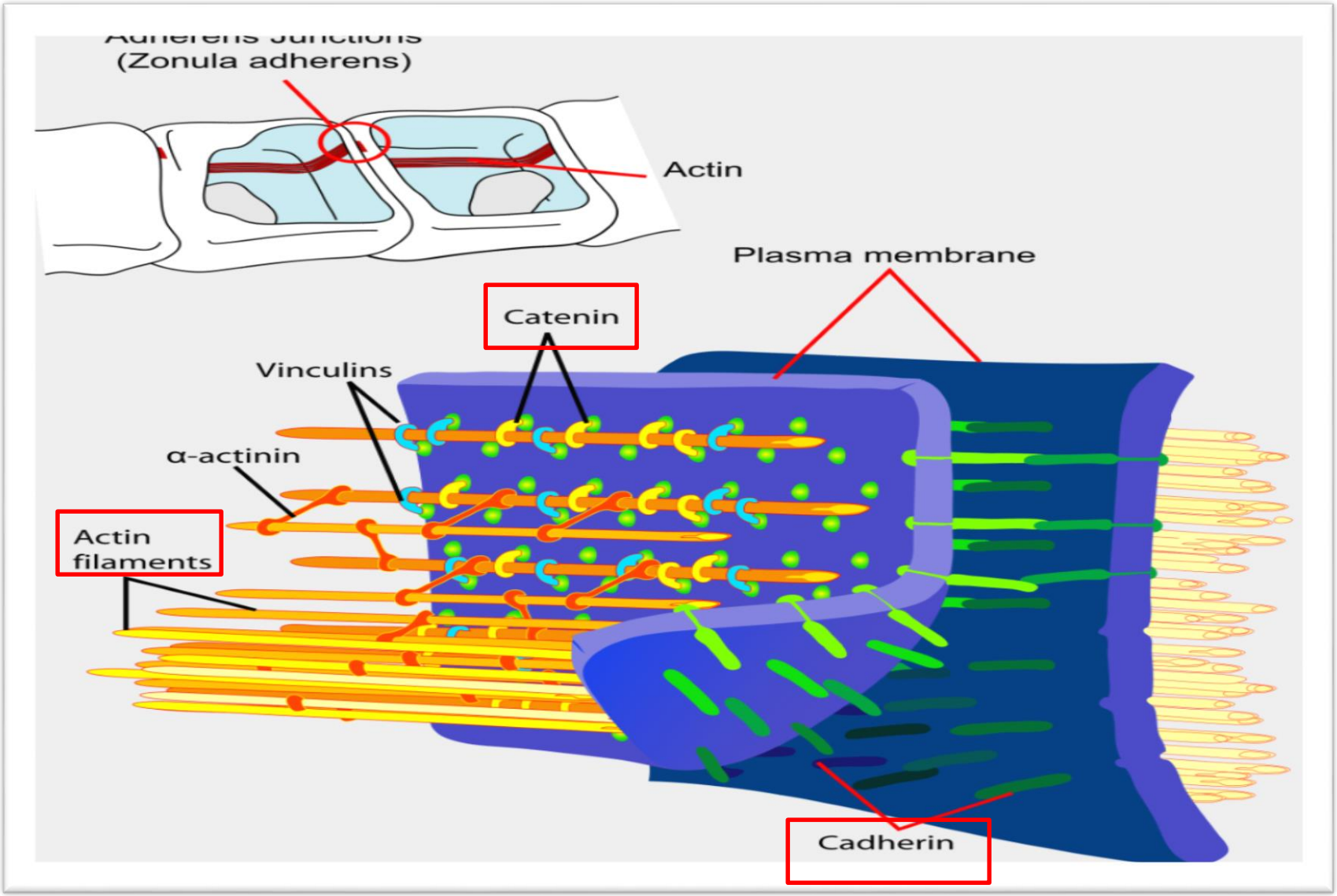
Zonula adherens



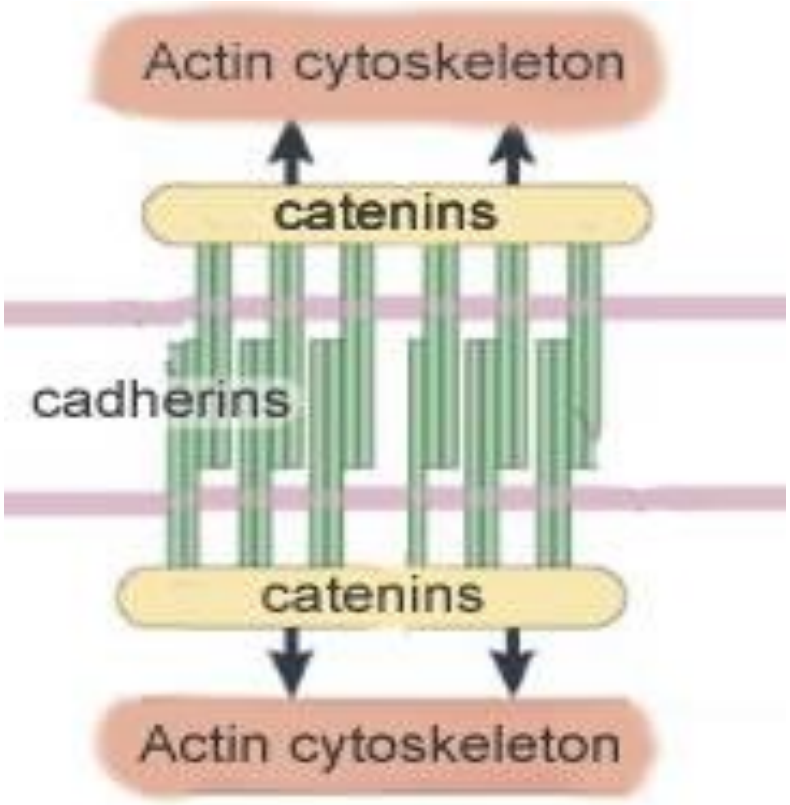


- Anchoring junction (encircles the cell) belt junction, or belt desmosome
- Located "under" tight junction in epithelial cells
-Connected to actin microfilaments that join terminal web
-Cadherin proteins attach to cross-linked actin filaments
- Mechanical support - ZA and actin filaments transmit and distribute stress throughout cell and to neighboring cells

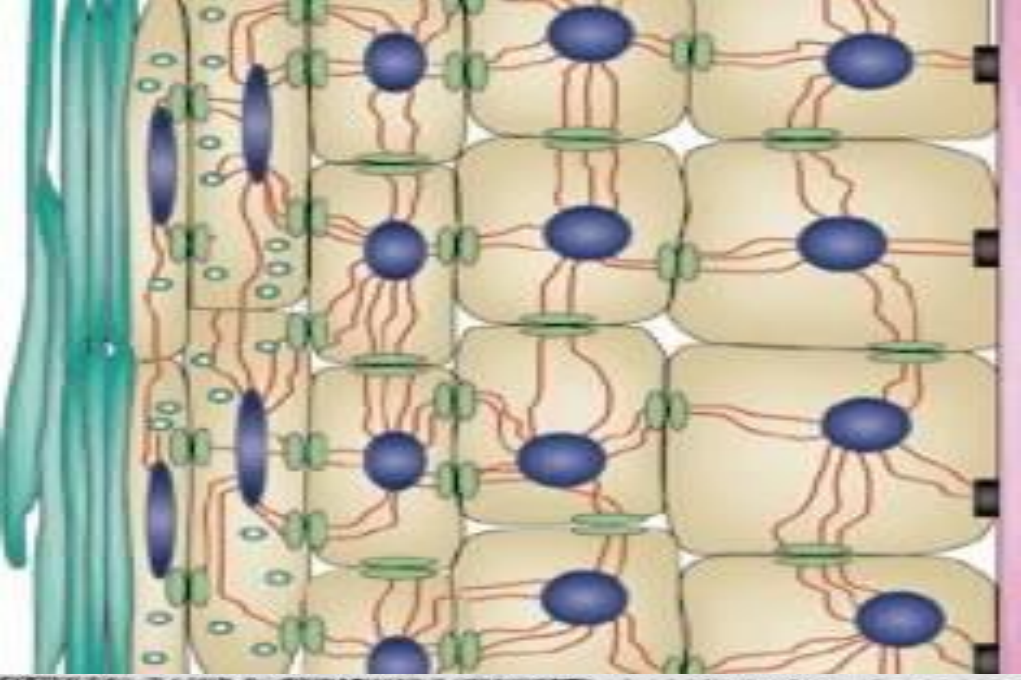
Zonula adherens

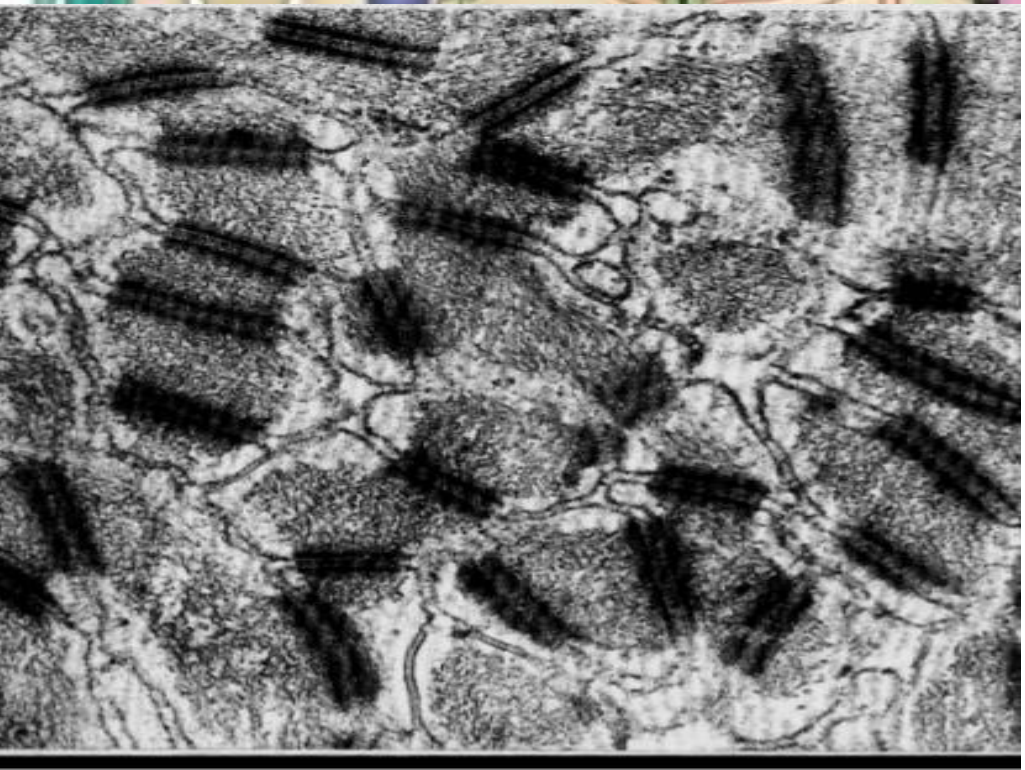


Catenins join cadherins to actin filaments in adherence junctions



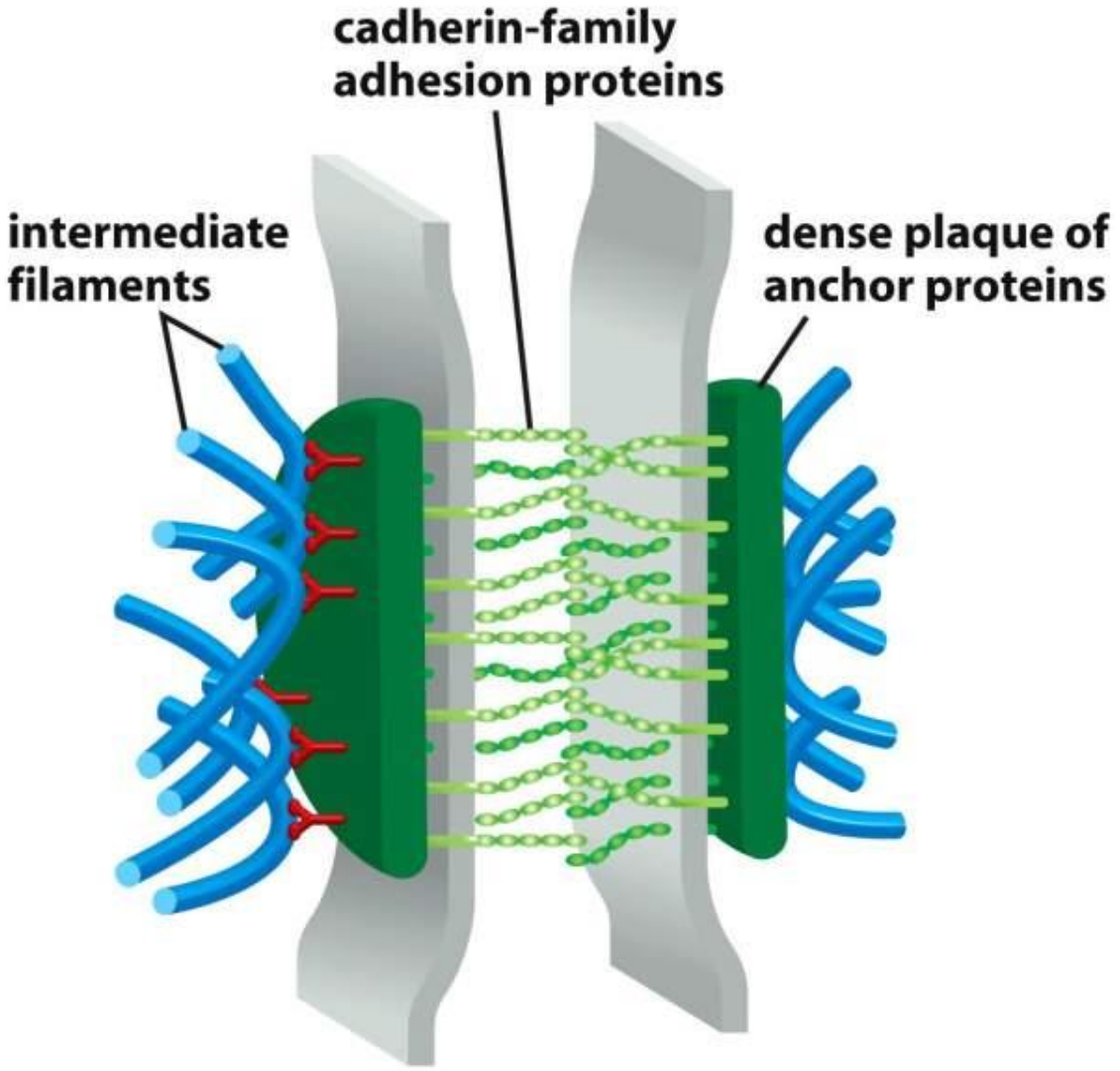
This junction keeps epithelial cells from slipping/sliding out of position





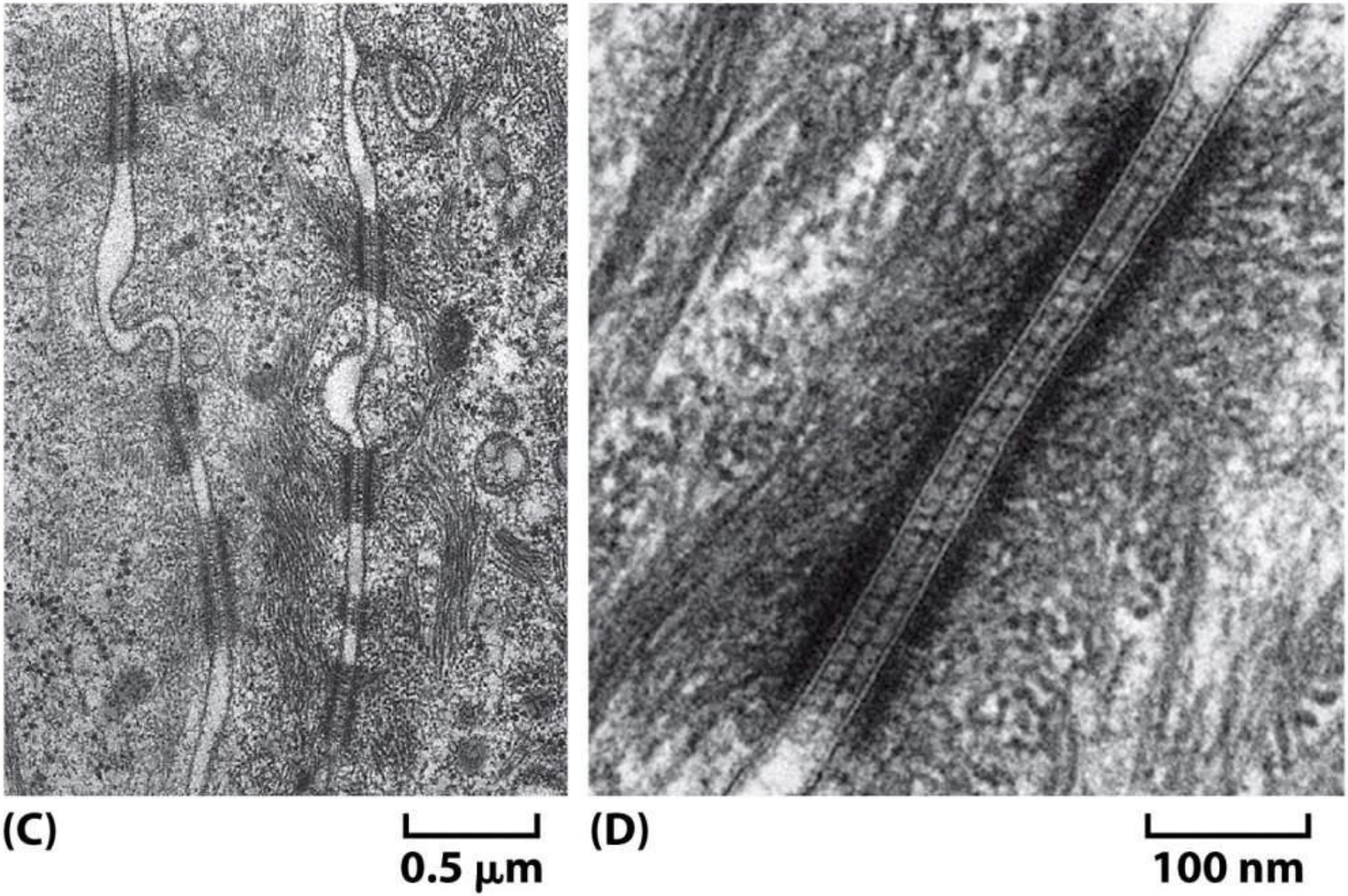
Desmosome/ macula adherens

- Anchoring junctions
- Provides firm adhesion between cells
- Function as "spot welds" to join cells
- Located along lateral plasma membranes of columnar epithelial cells or on processes of squamous cells
- Intermediate filaments associate with plaque proteins in cytoplasm

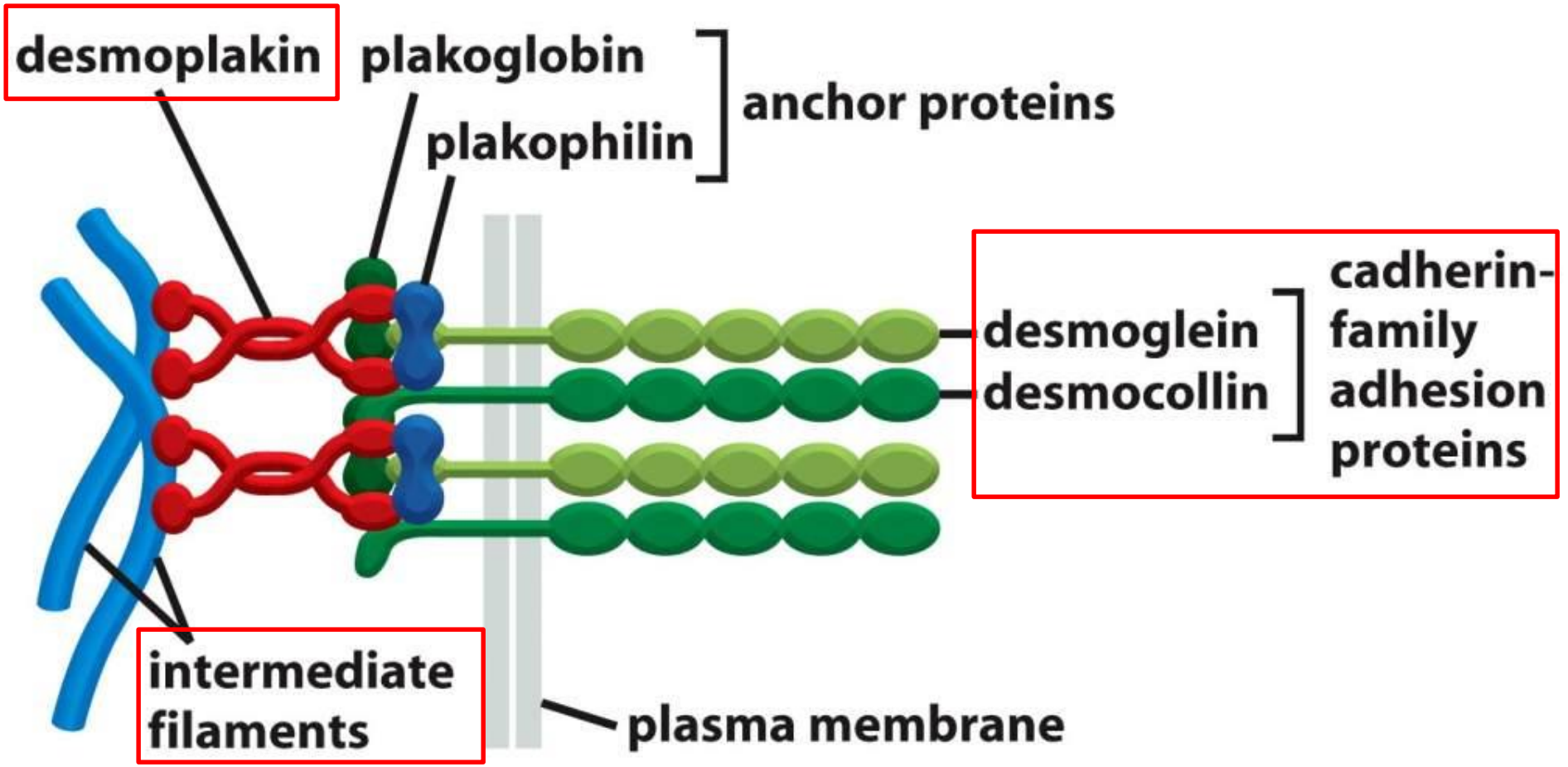


- Non-classical cadherins interact across intercellular space
- Adaptor proteins form a dense plaque that interconnects cadherins and binds them to intermediate filaments

Desmosomes



Desmosome (Macula adherens)



- Desmoglein and desmocollin are non-classical cadherins
- Adaptor proteins such as γ-catenin (plakoglobin) and desmoplakin link cadherins to intermediate filaments

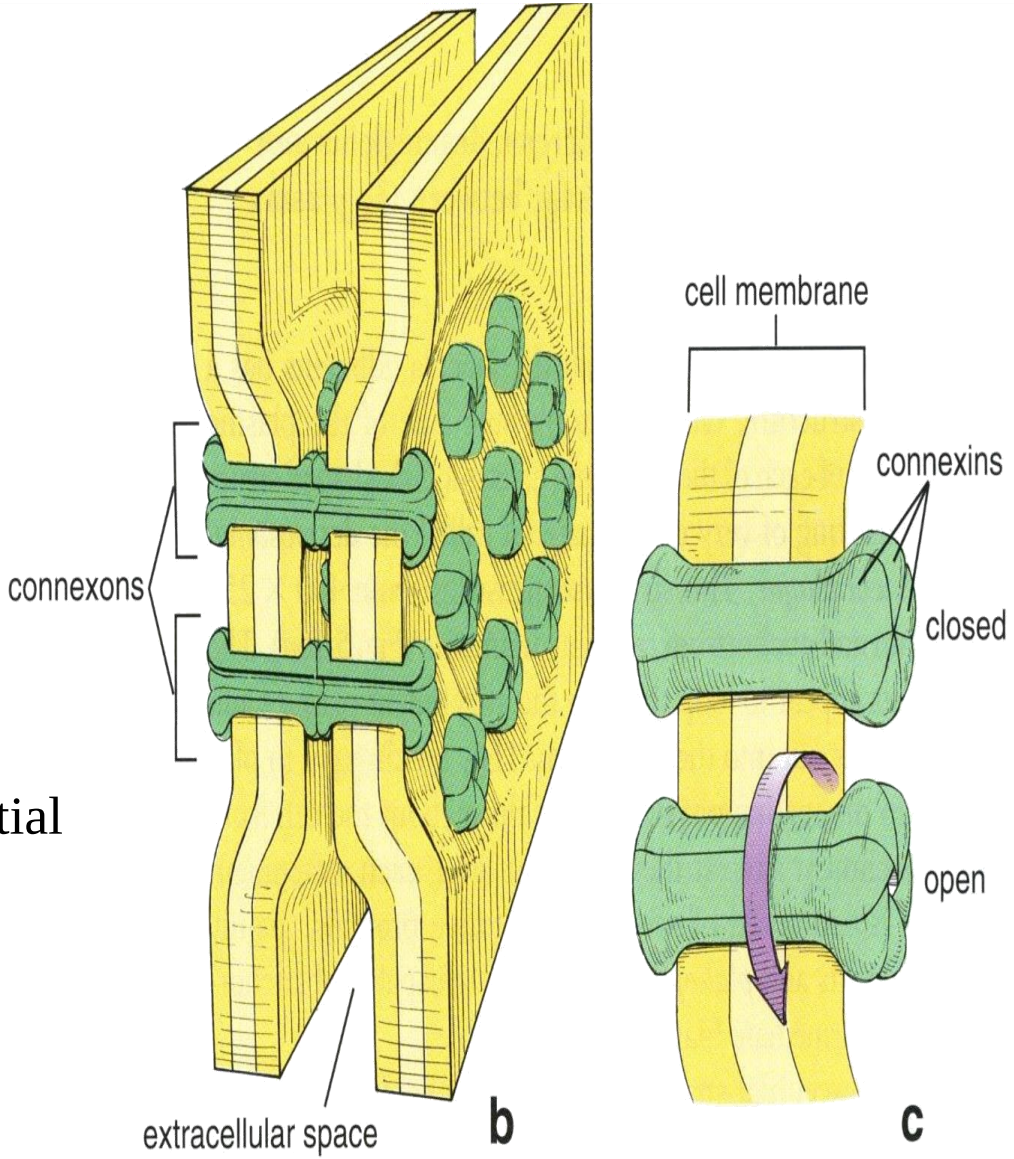
Gap junction

•Channel-forming junction

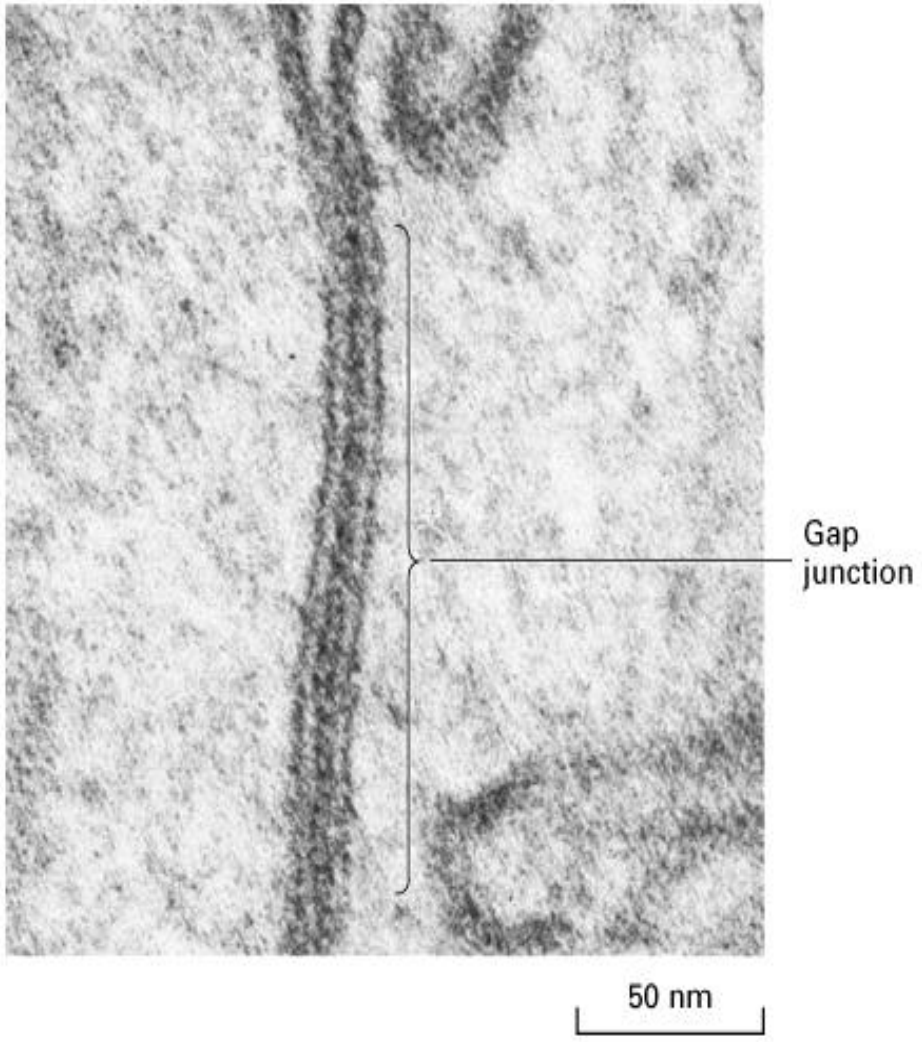
•Named for gap of regular width between cells visualized by TEM

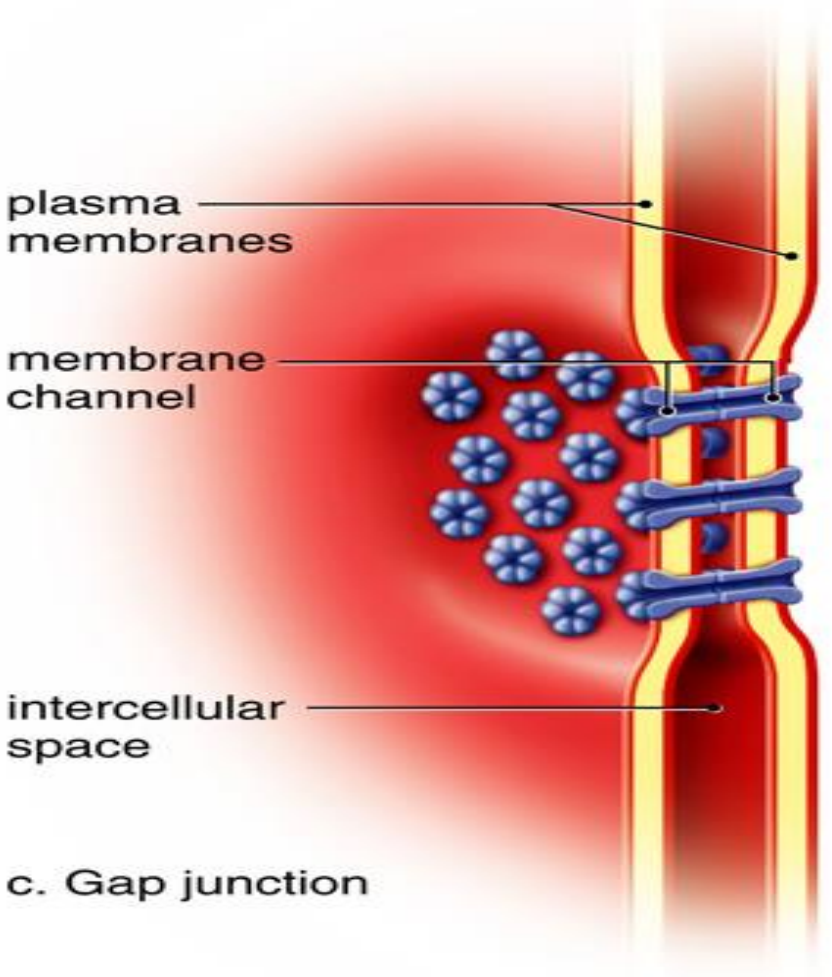
•Water-filled junctions transport molecules <1 kDal such as ions, nucleotides (including cAMP), and metabolites

•Rapid propagation of action potential from one cell to another cell



Gap (Communicating) Junction





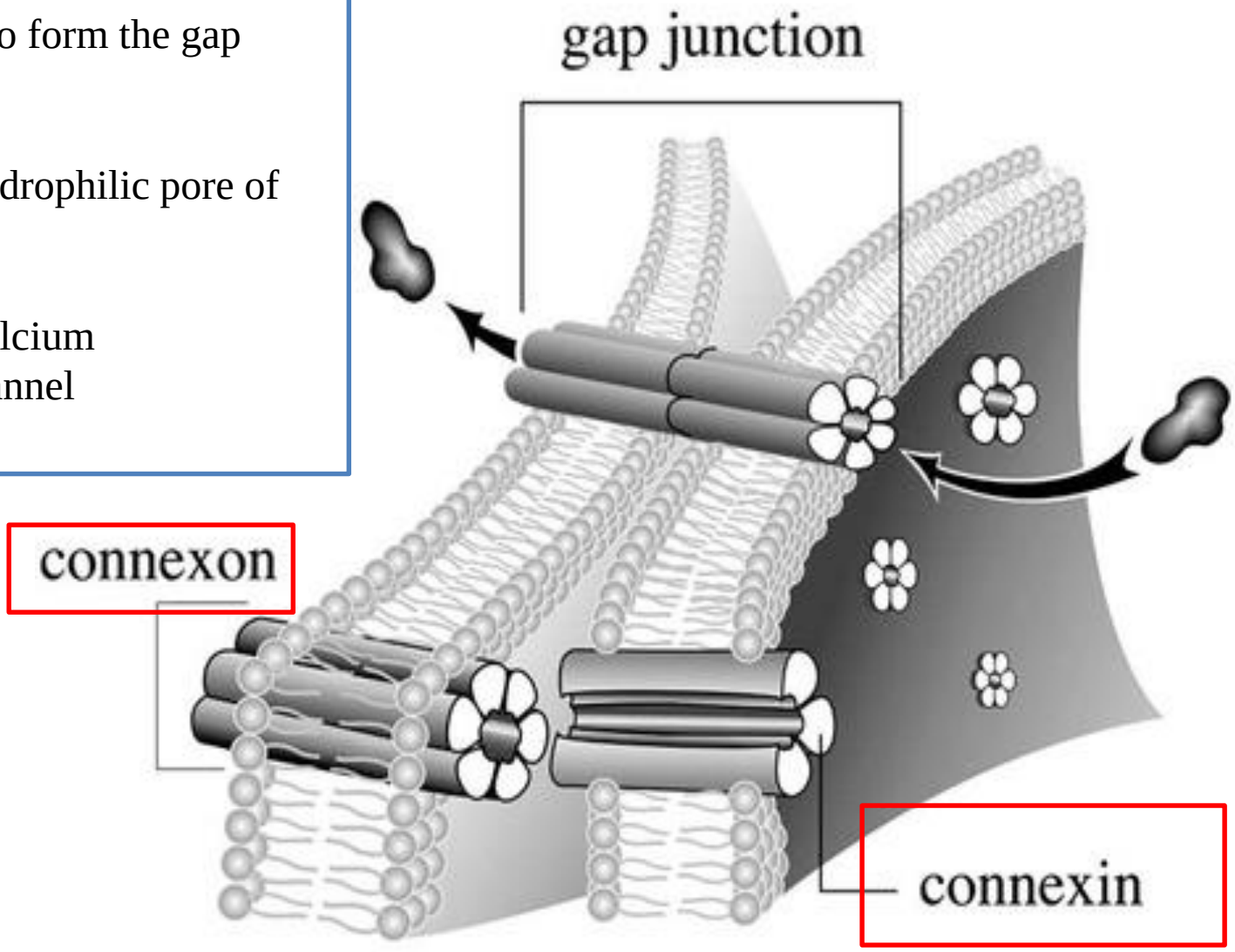
The gap junction is seen as an area of close plasma membrane apposition

Connexin - protein subunit, six form a hexameric connexon

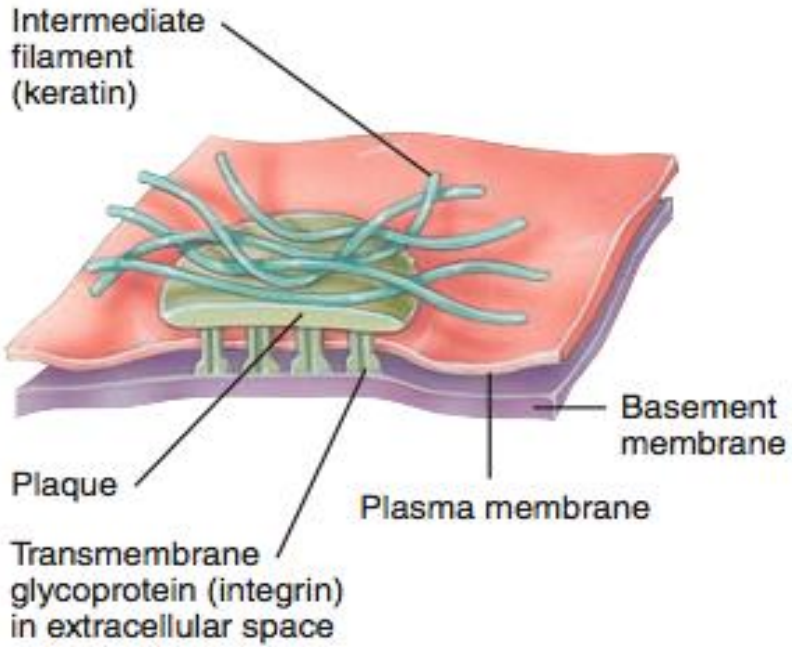
Connexons - two align to form the gap junction channel

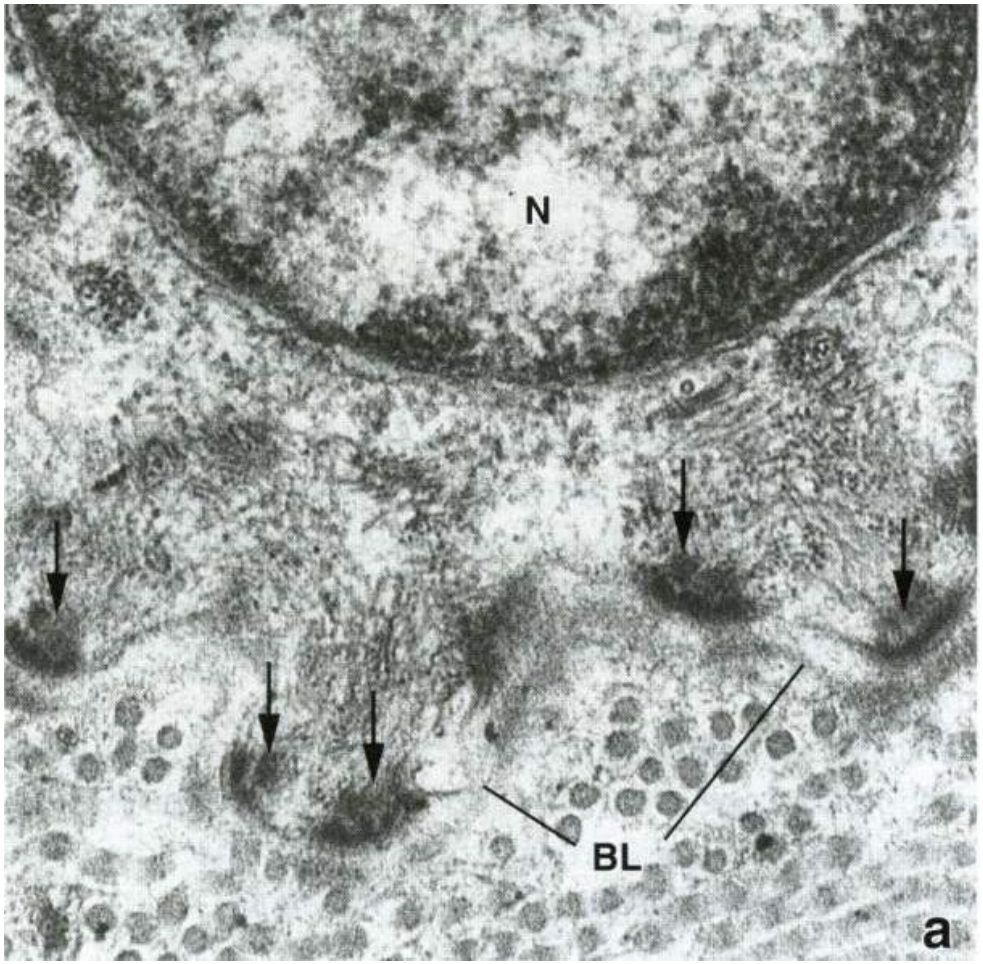
Each connexon has a hydrophilic pore of 1.5nm in diameter

Regulation - elevated calcium concentrations close channel



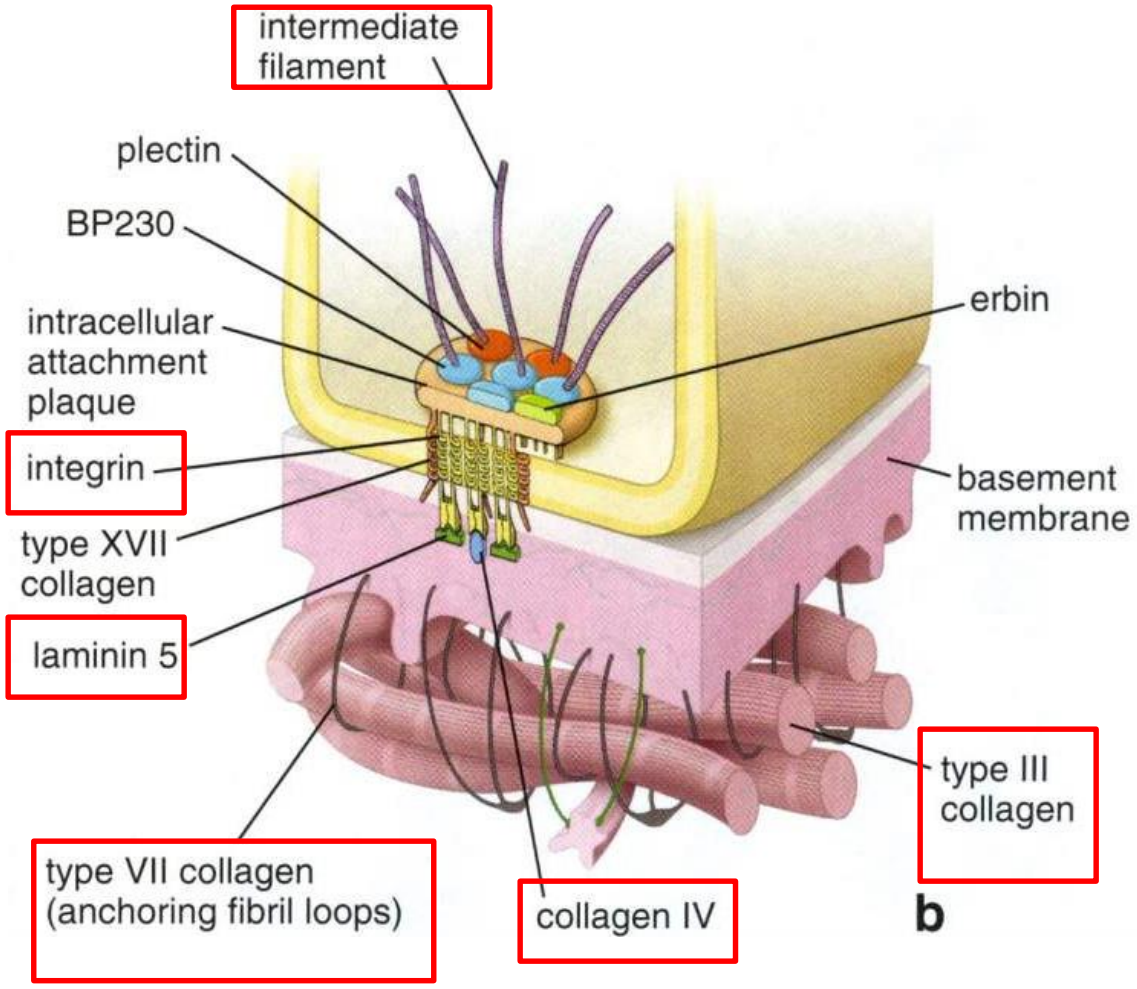
Hemidesmosomes





- Hemidesmosome - "half-desmosome" in appearance only
- Mediates attachment to basal lamina (extracellular matrix)
- Cytoplasmic plaque is attached to intermediate filaments

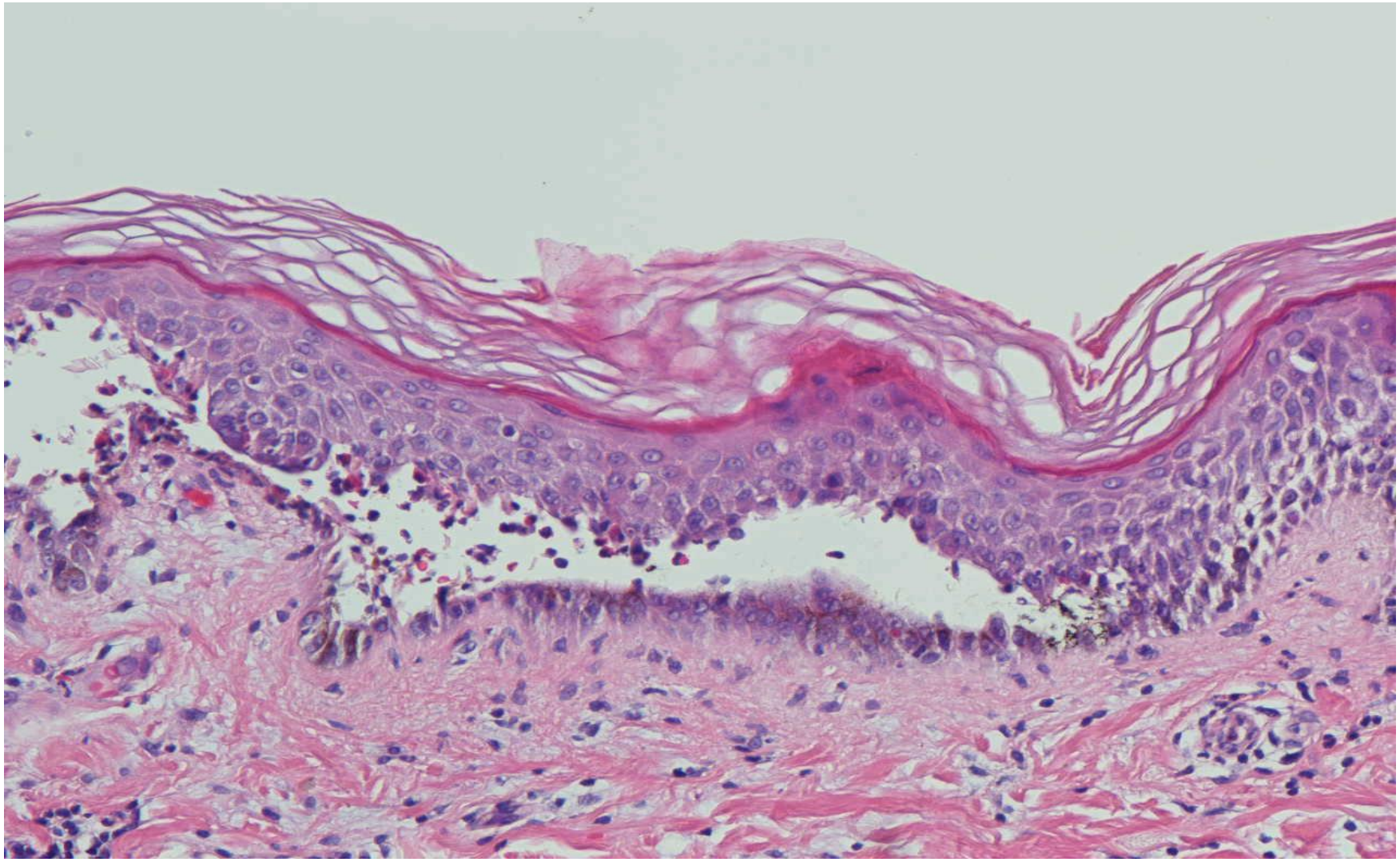
Integrins - membrane protein that "integrates" cell into matrix
Integrins bind to ECM (laminin and collagen 4)

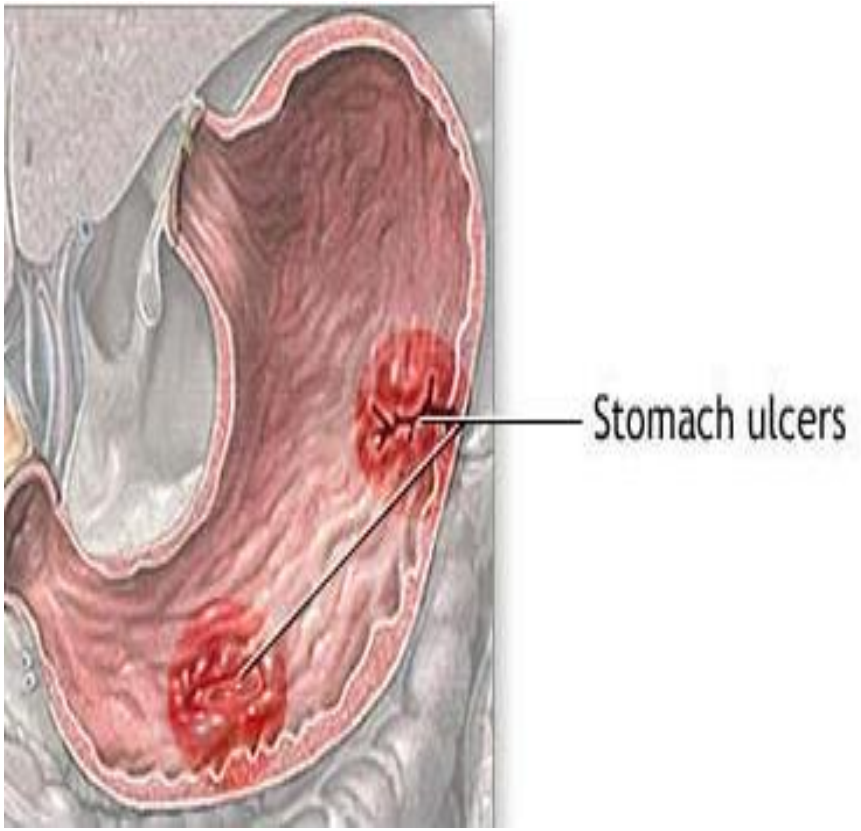


Blistering Disease

- Many mechanisms underlie blistering disorders of the skin
- Pemphigus group - autoimmune disease in which autoantibodies target desmogleins present in desmosomes

Pemphigus Histology





Helicobacter pylori targets ZO-1 and disrupts this junction

Summary of cell junctions found between epithelial cells (basolateral domain)