

# Epithelial Structure and Transport

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# What we'll talk about...

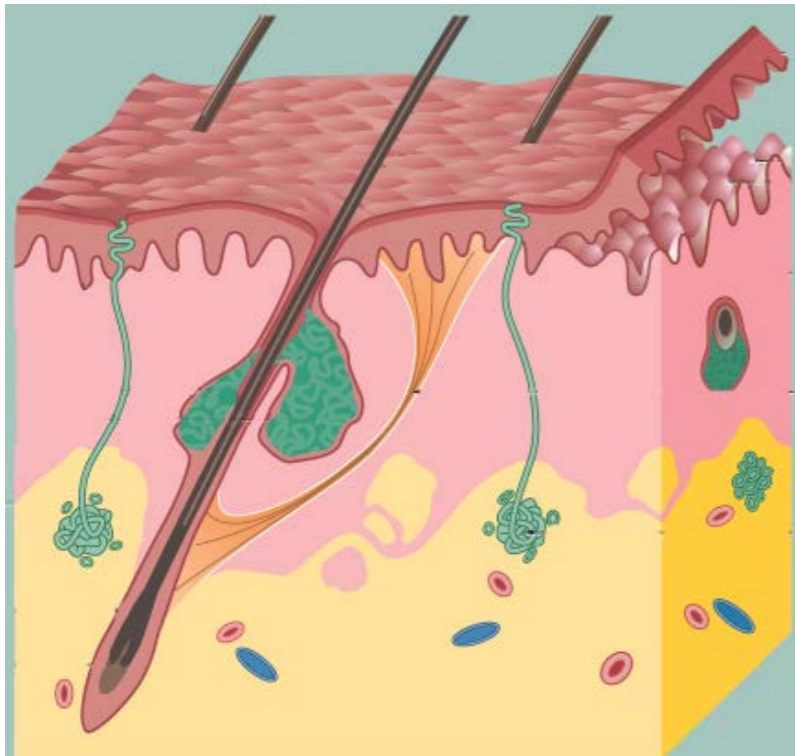
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- Review of types of epithelia
- Epithelial cell polarity
- Adhesion between epithelial cells
- Vectorial transport across epithelia
- Basement membrane
- Renewal of epithelia

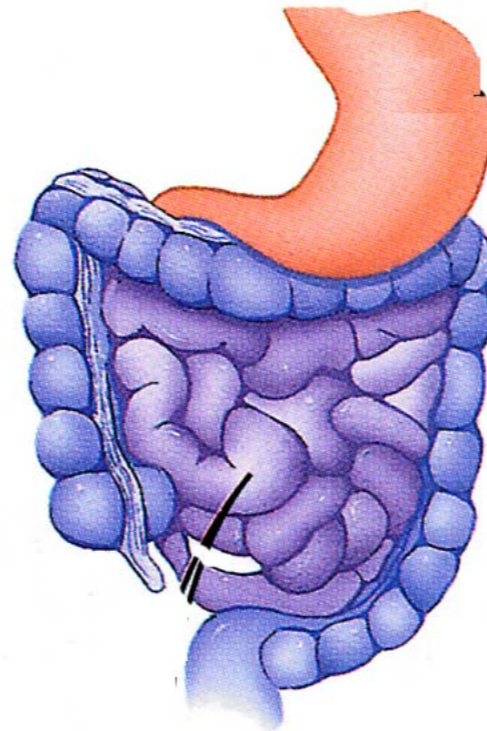
Epithelia form an interface between the human body and external environment.

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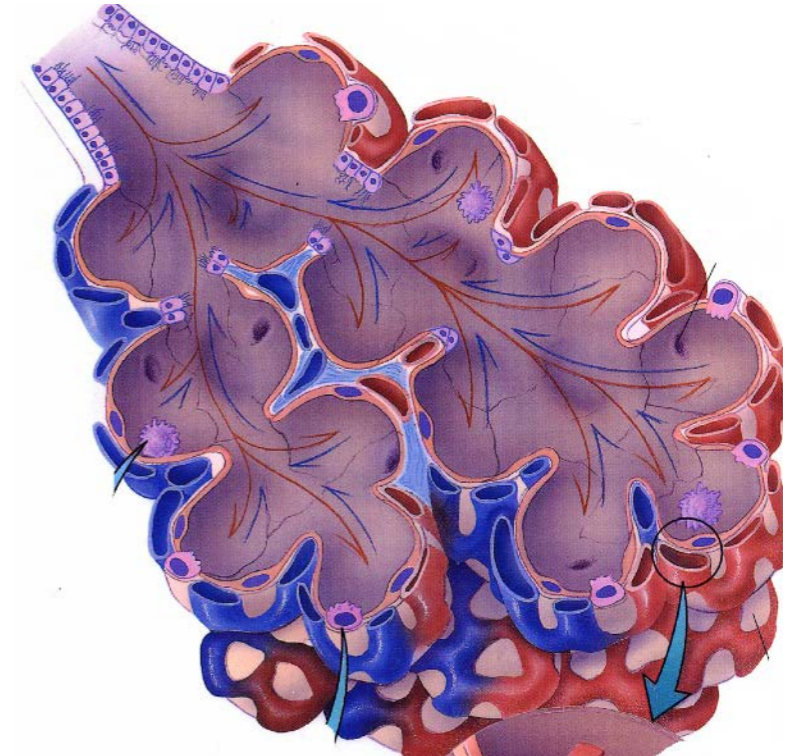
Skin



Gastrointestinal Tract

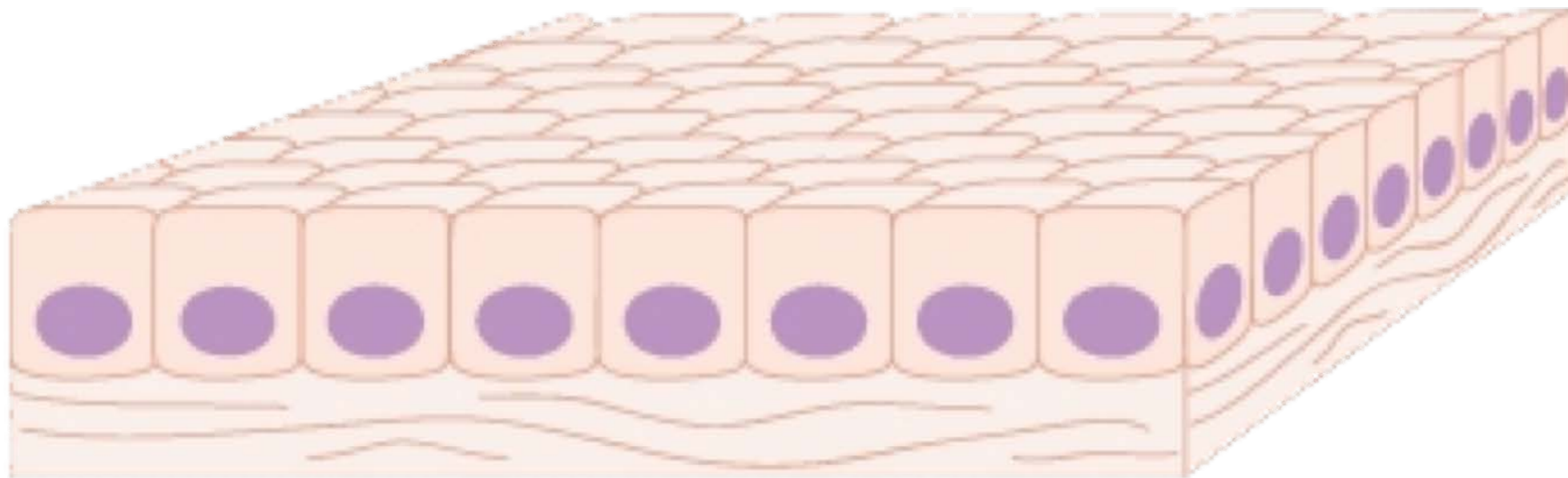


Respiratory Tract



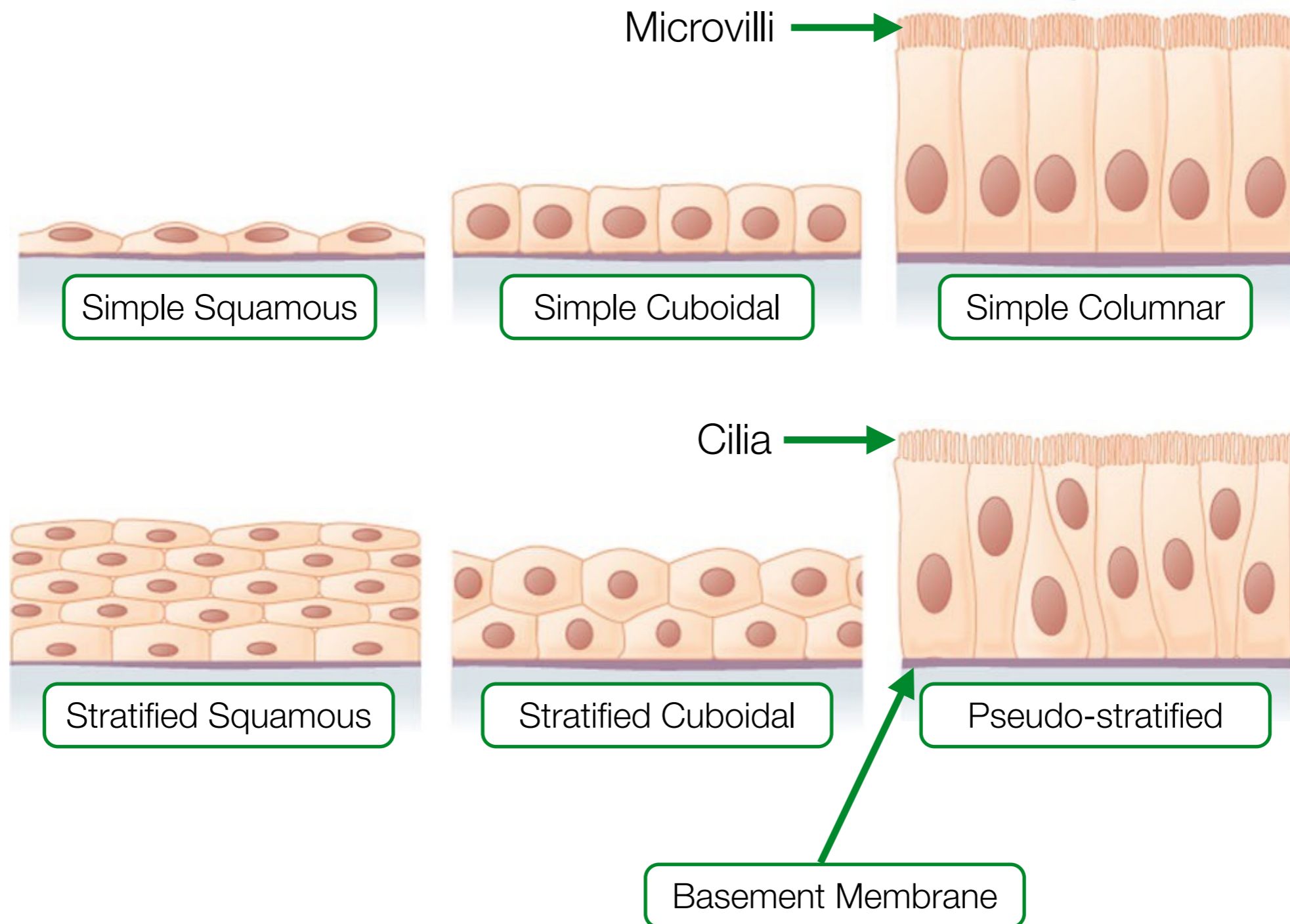
An epithelium is a sheet of cells that can cover a large surface area.

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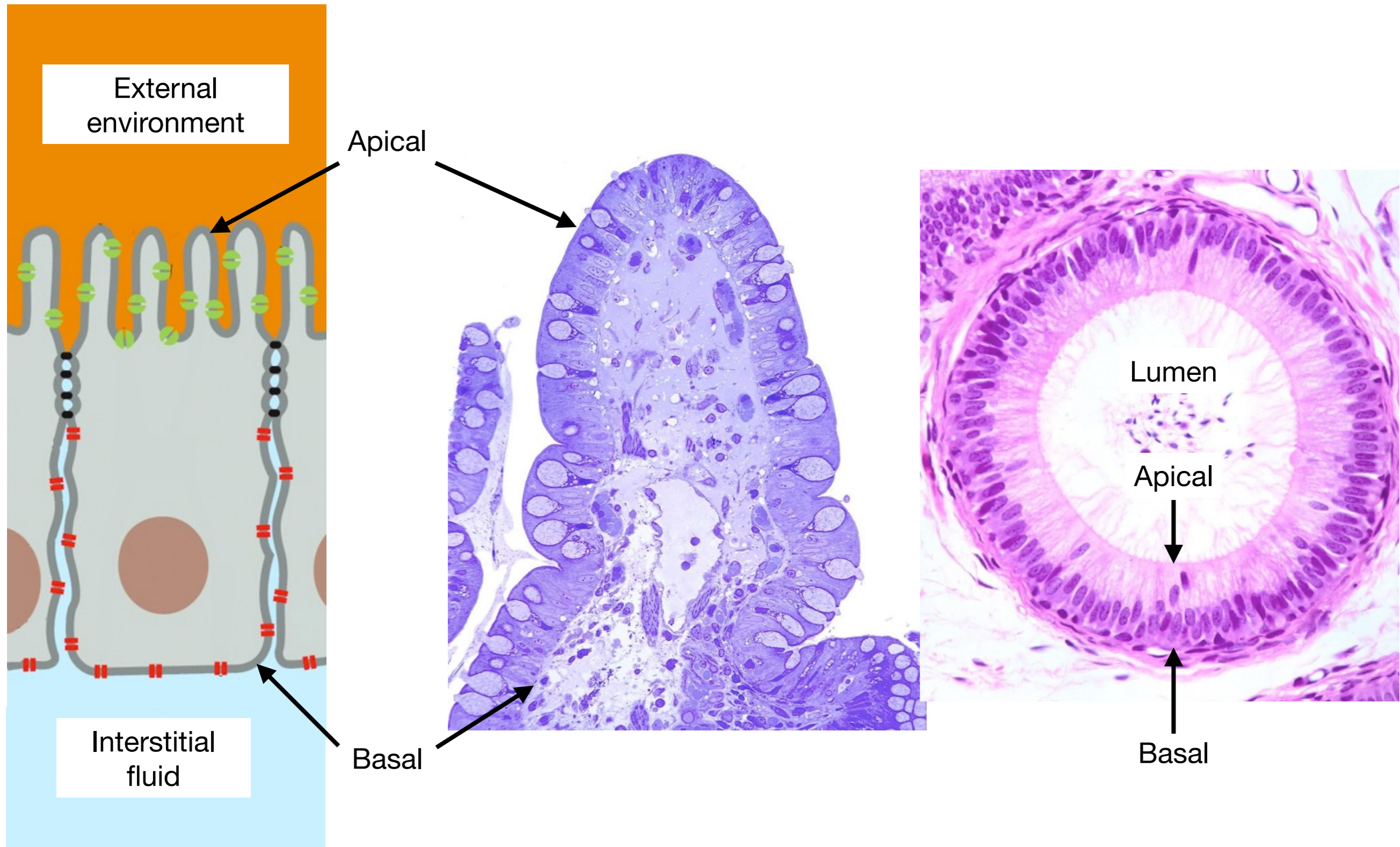
Epithelia are classified based on the shape of its cells and the number of layers of cells.

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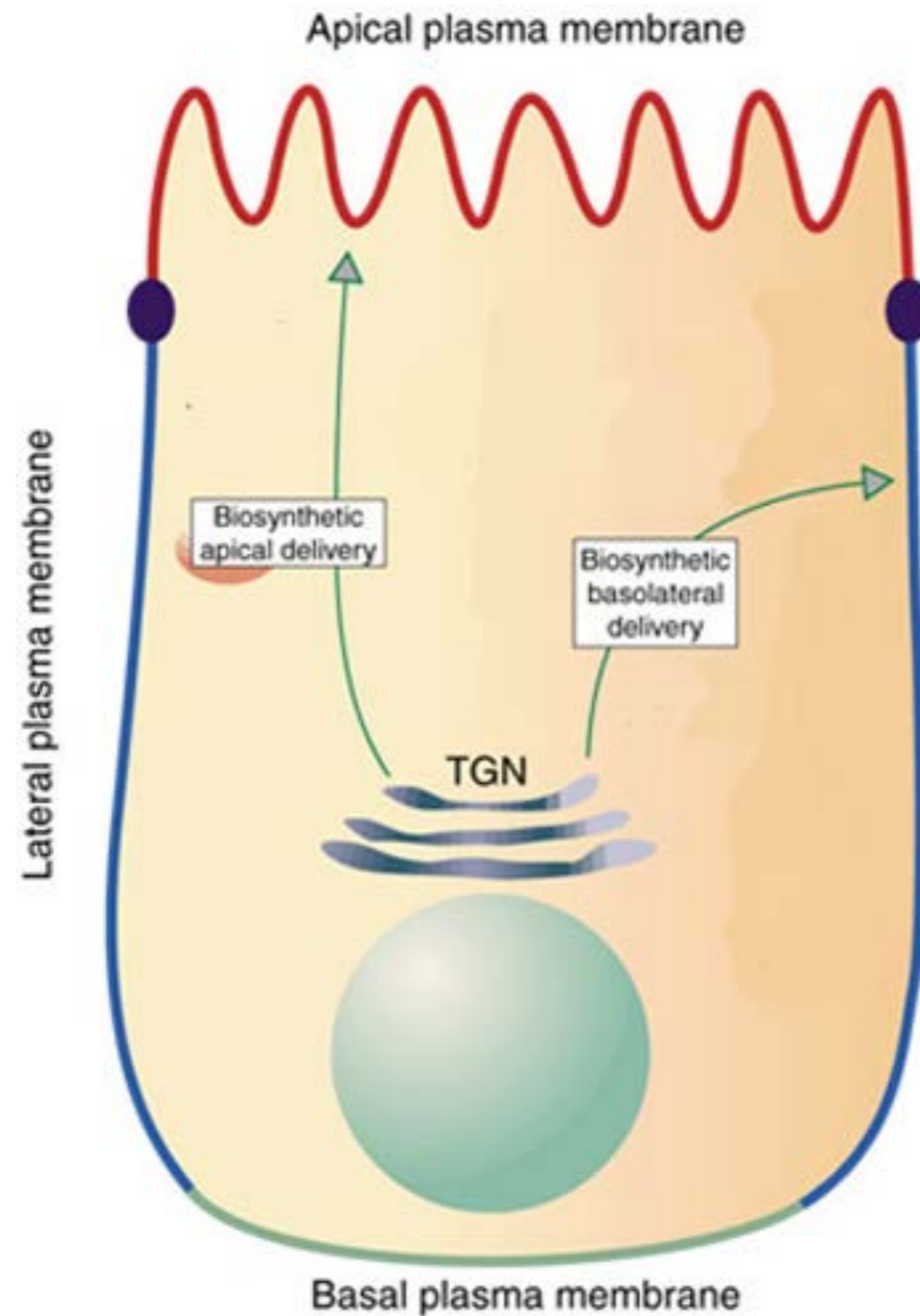


Polarity of epithelial cells is critical for their function.



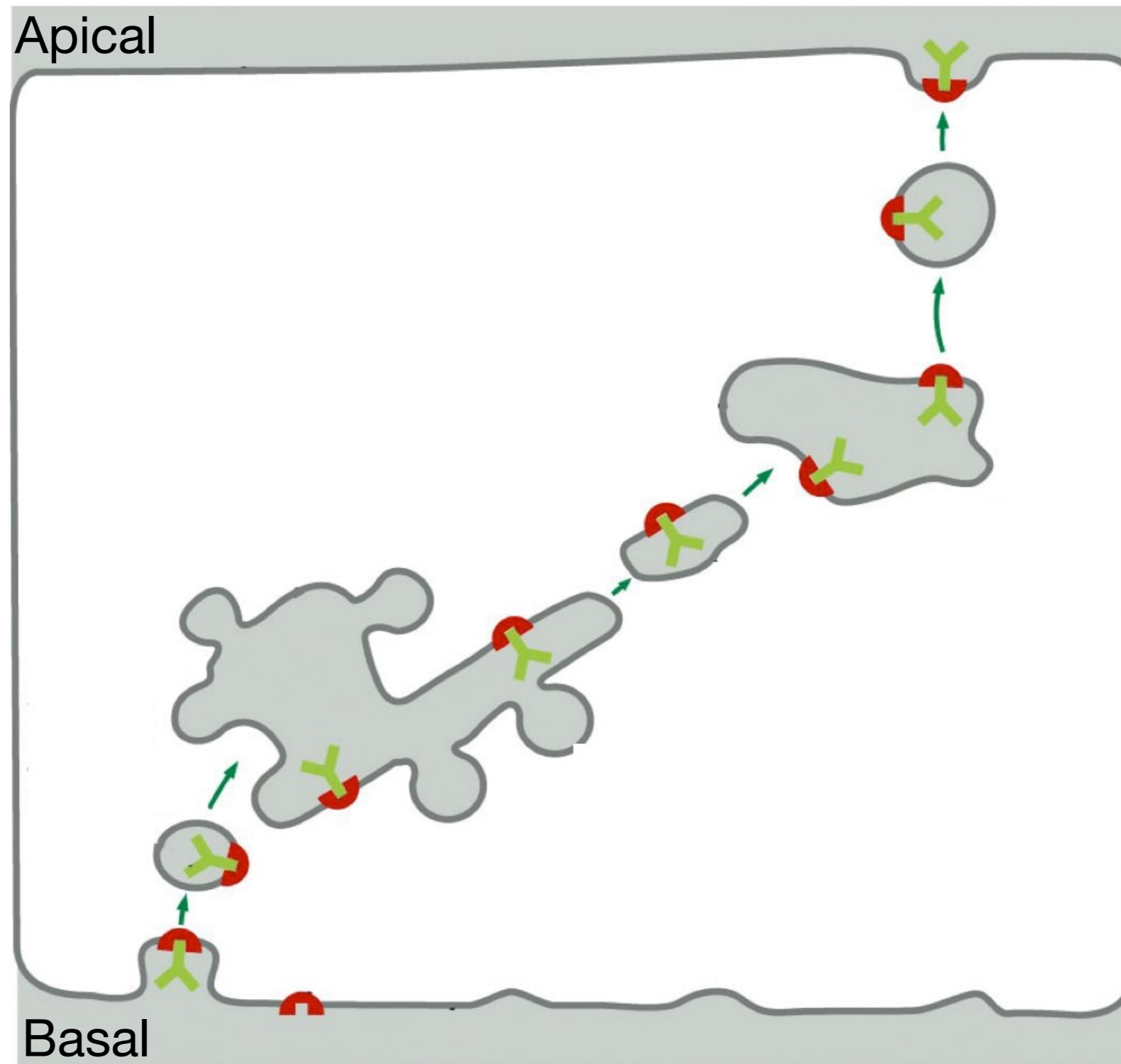
Proteins are sorted in the trans-Golgi network and delivered to apical or basolateral cell membrane.

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Transcytosis mediates transfer of protein across epithelial cells.

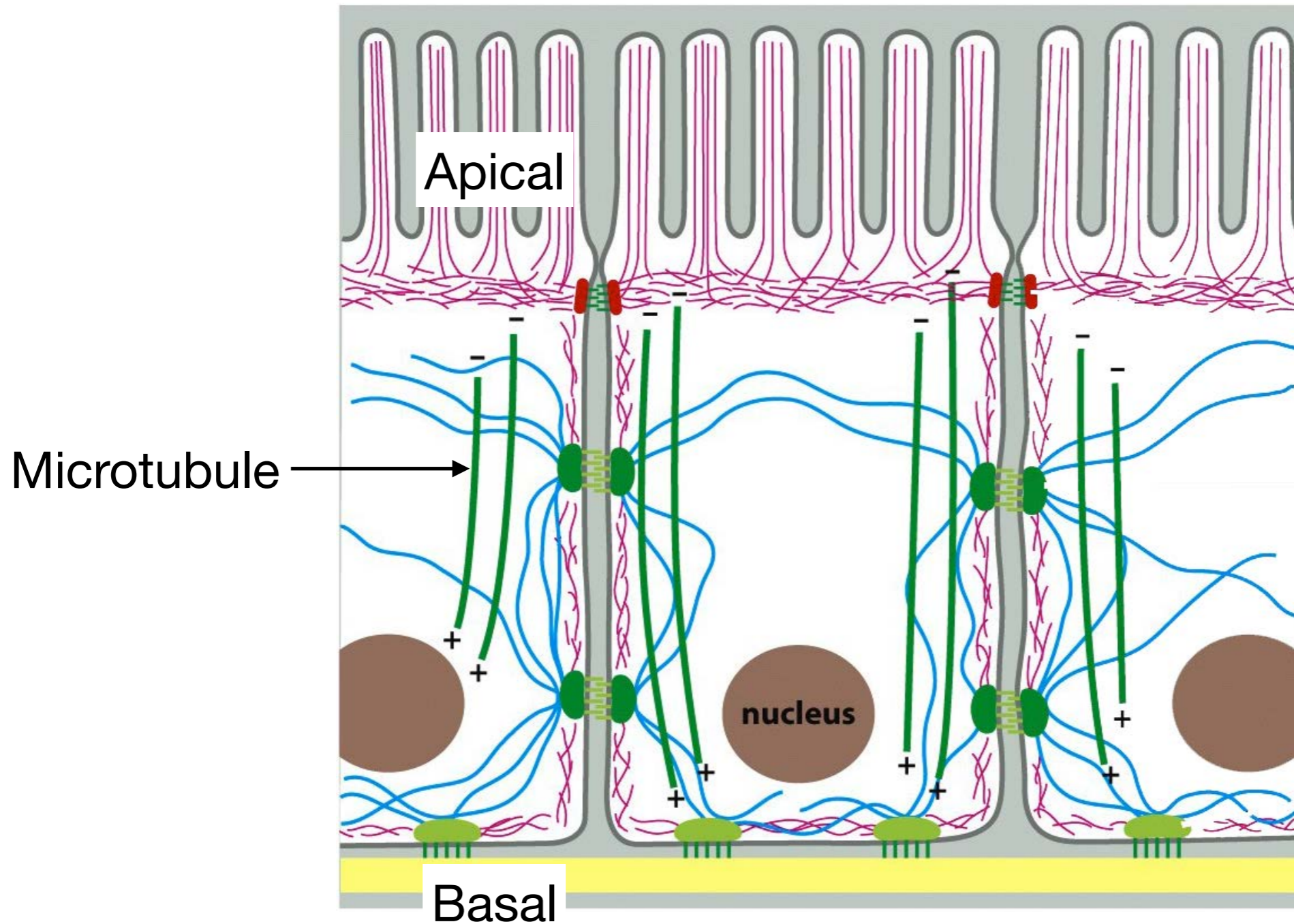
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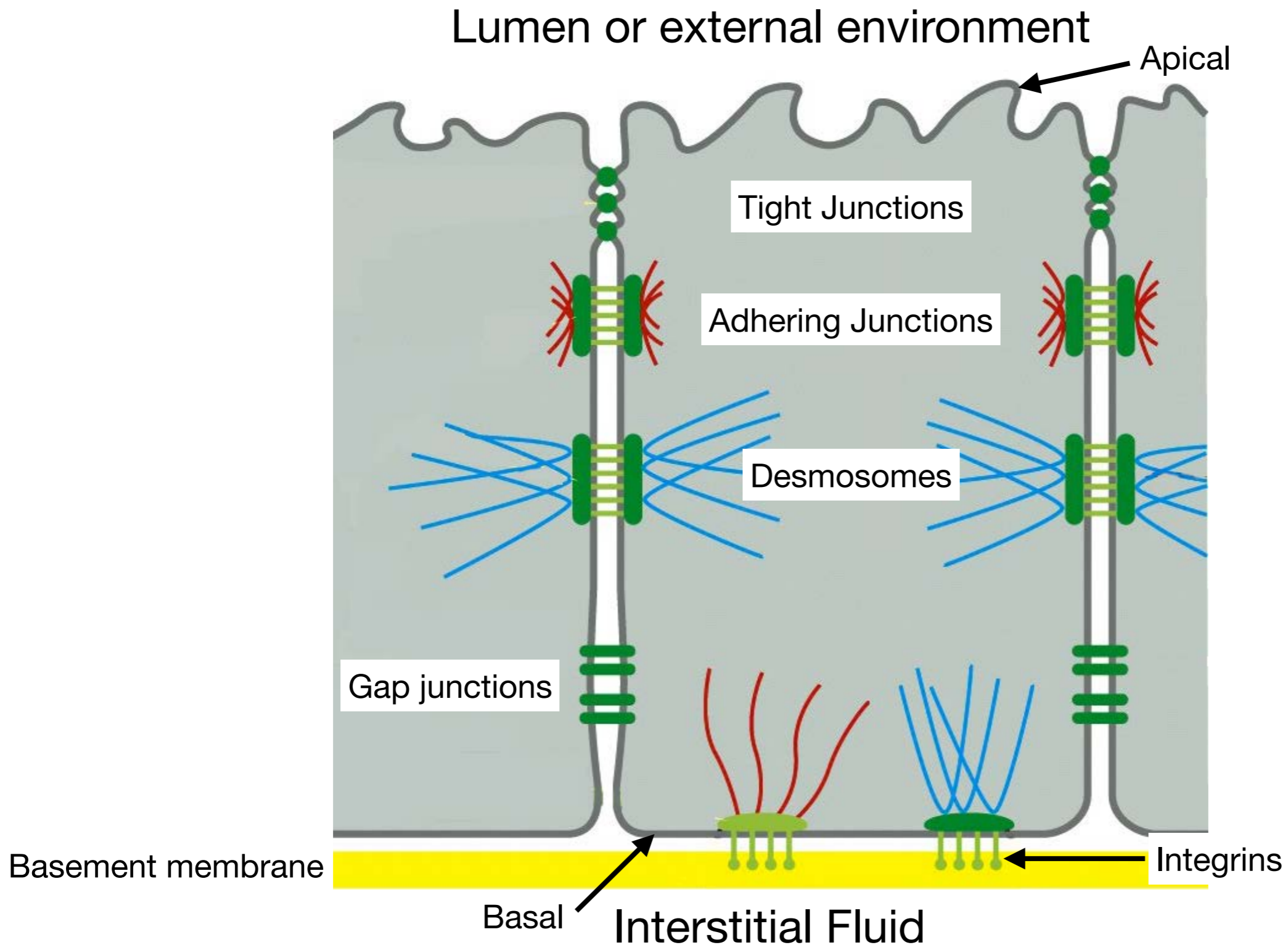
Minus ends of microtubules face the apical surface.

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Adhesion

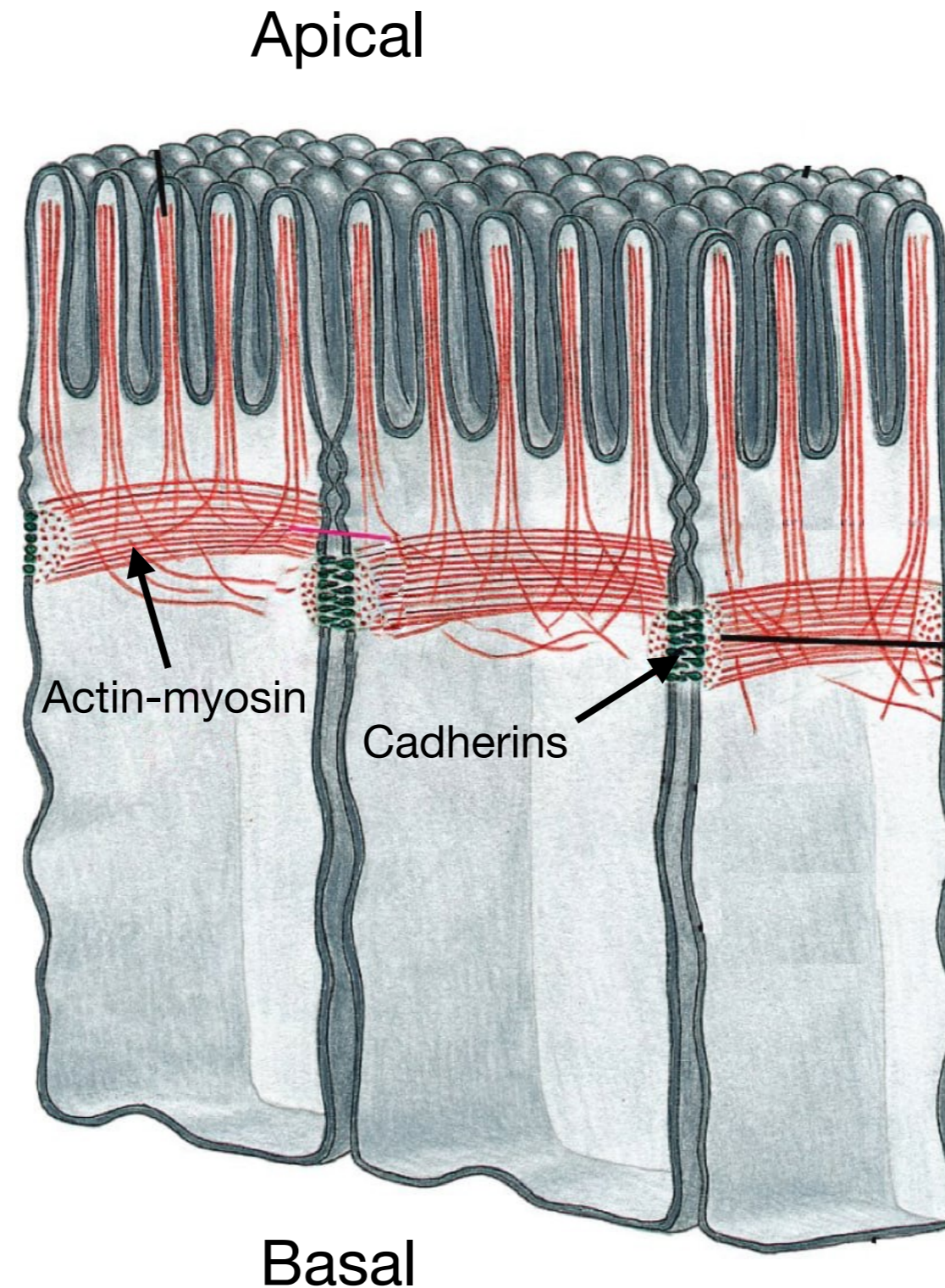
Epithelial cells are held together by several junctional complexes.





Adhering junctions form a belt-like zone around epithelial cells.

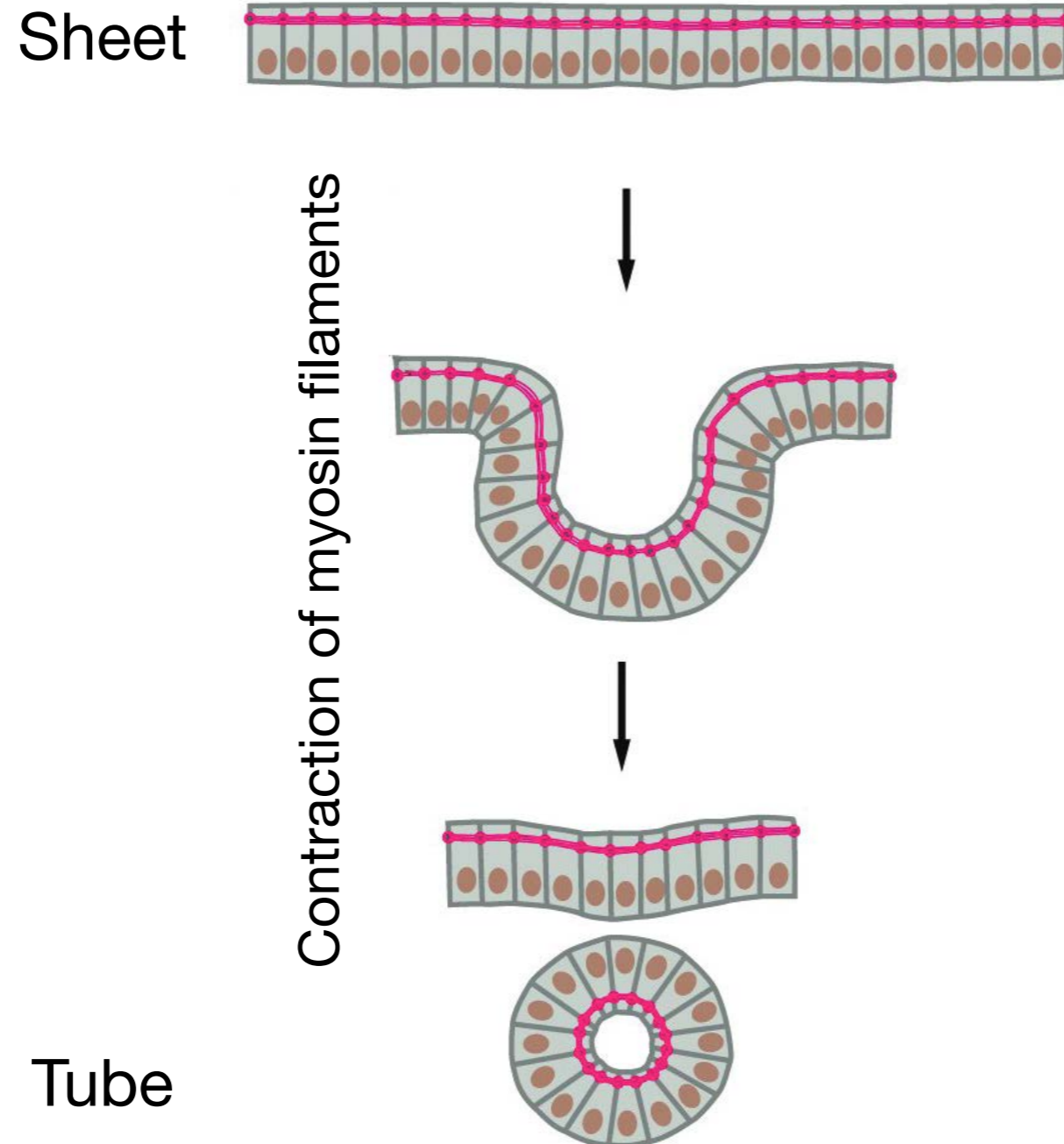
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Contraction of myosin-actin filaments changes cells shape to generate different structures.

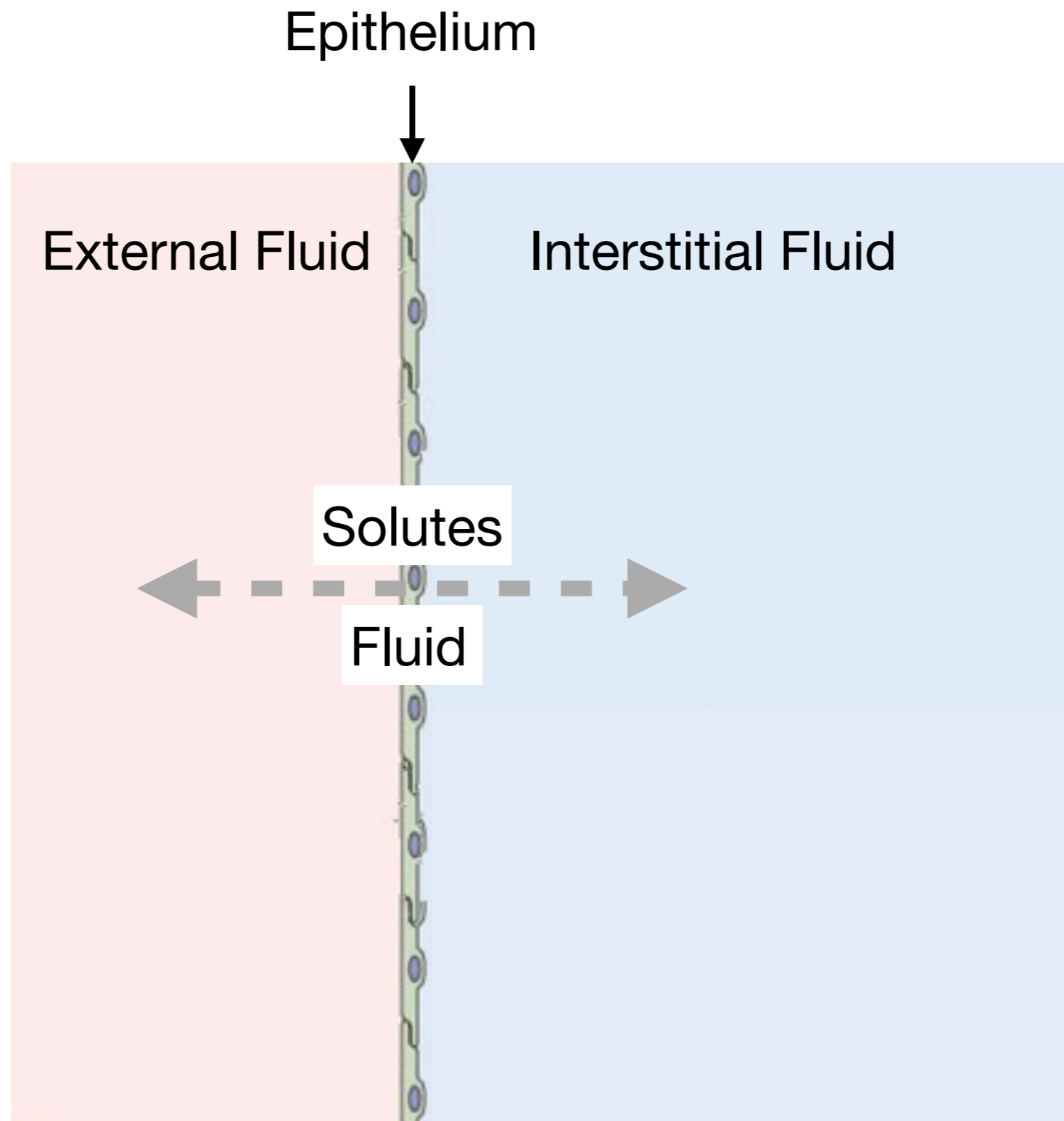
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Transport of solutes across epithelia

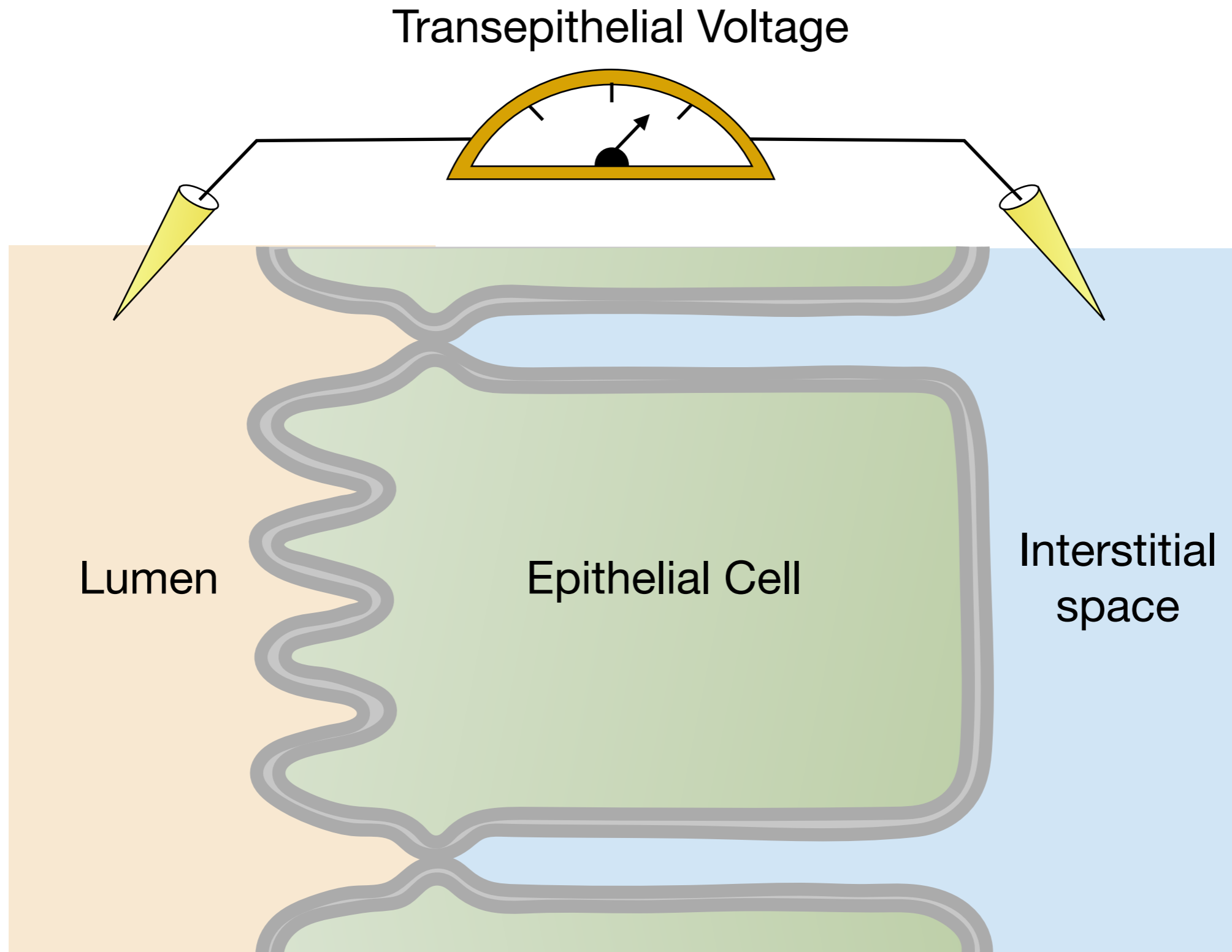
Epithelia control the passage of solutes and fluids between different fluid compartments.

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Voltage across an epithelium can be measured to determine the resistance of the epithelium.

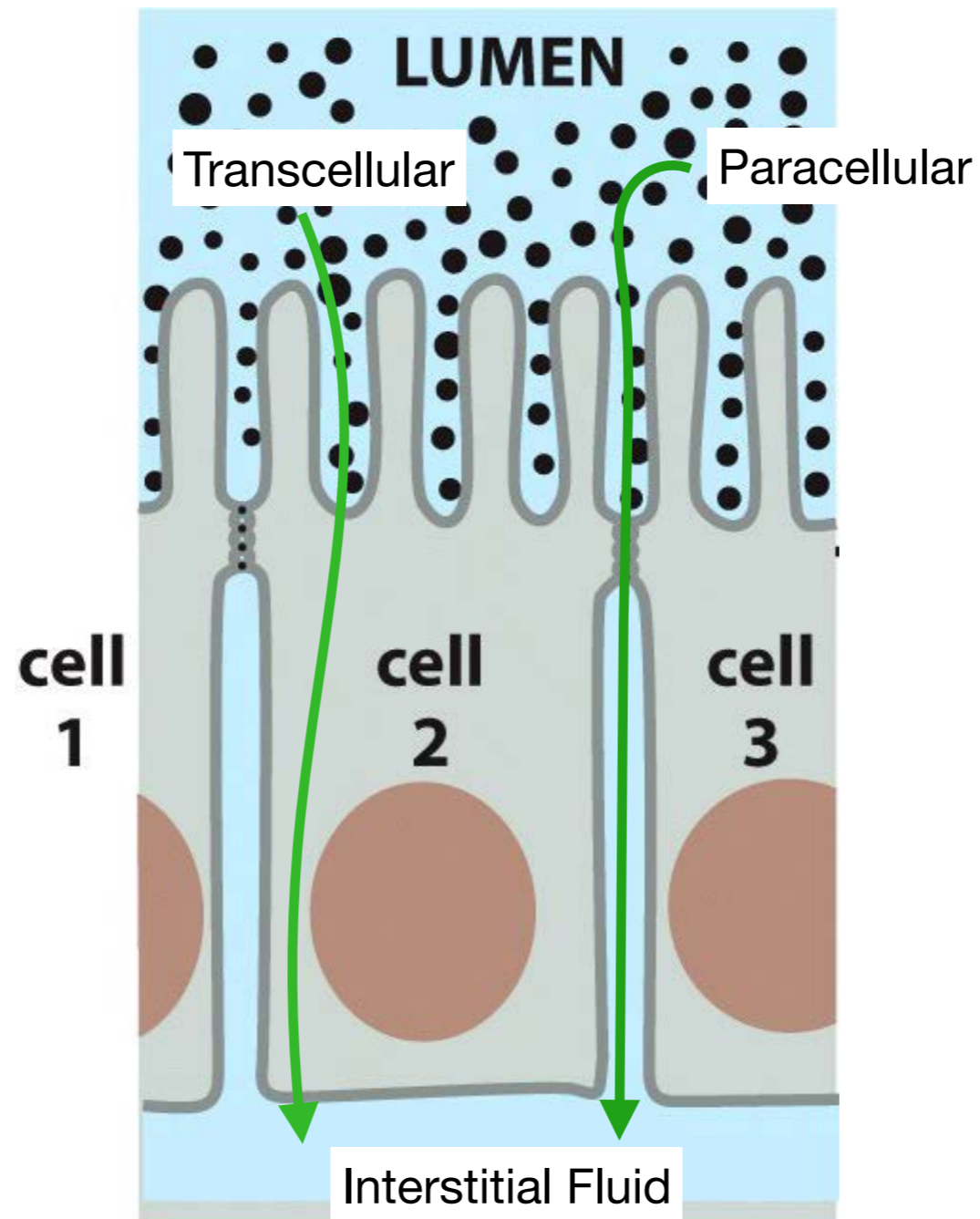
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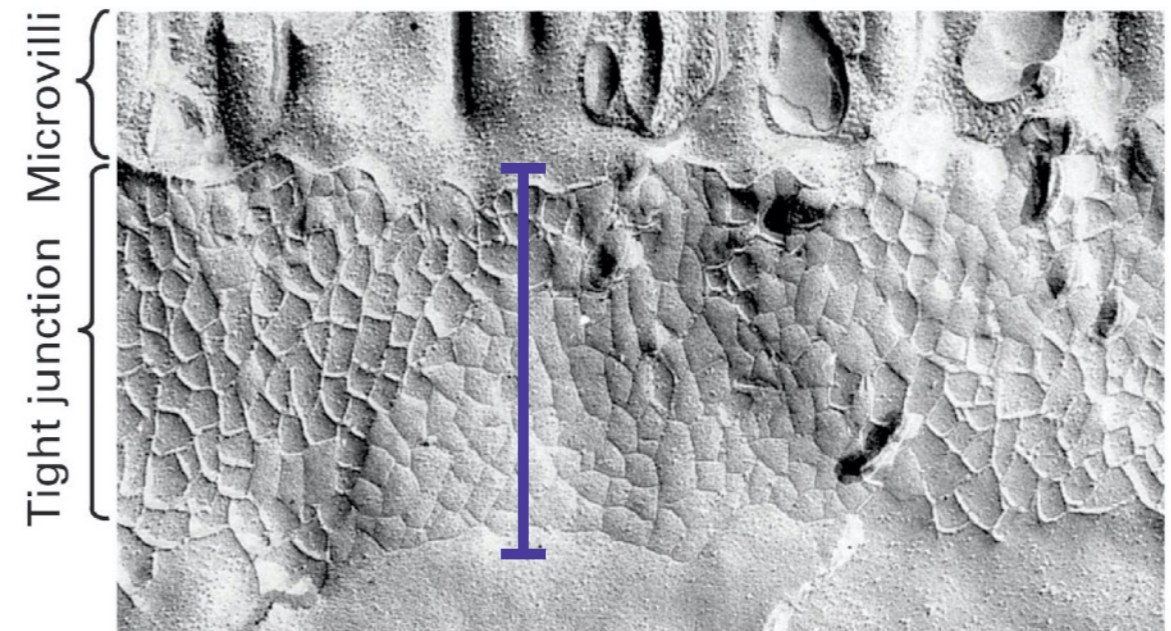
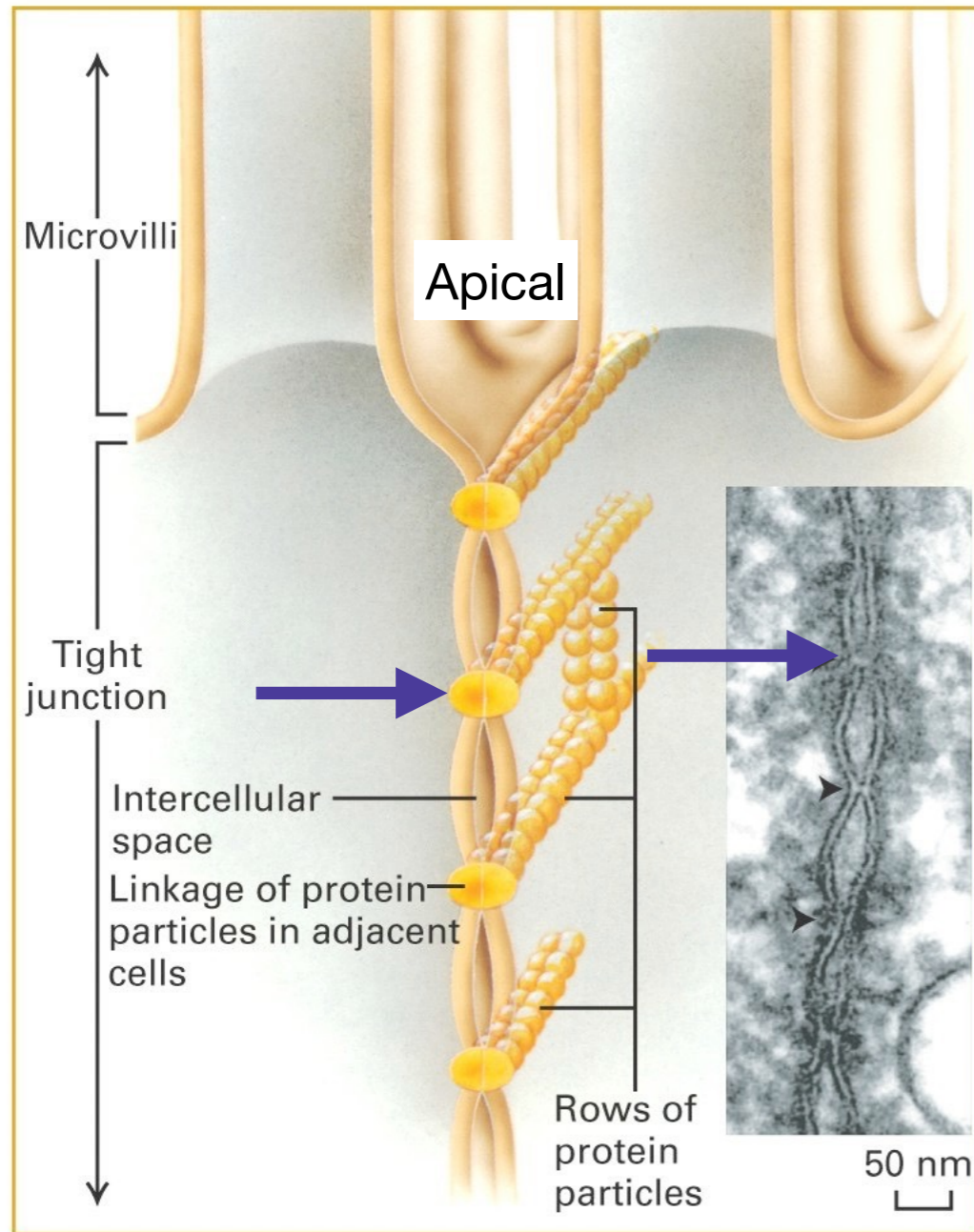
Transcellular and paracellular pathways allow passage of solutes and fluid.

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Tight junctions

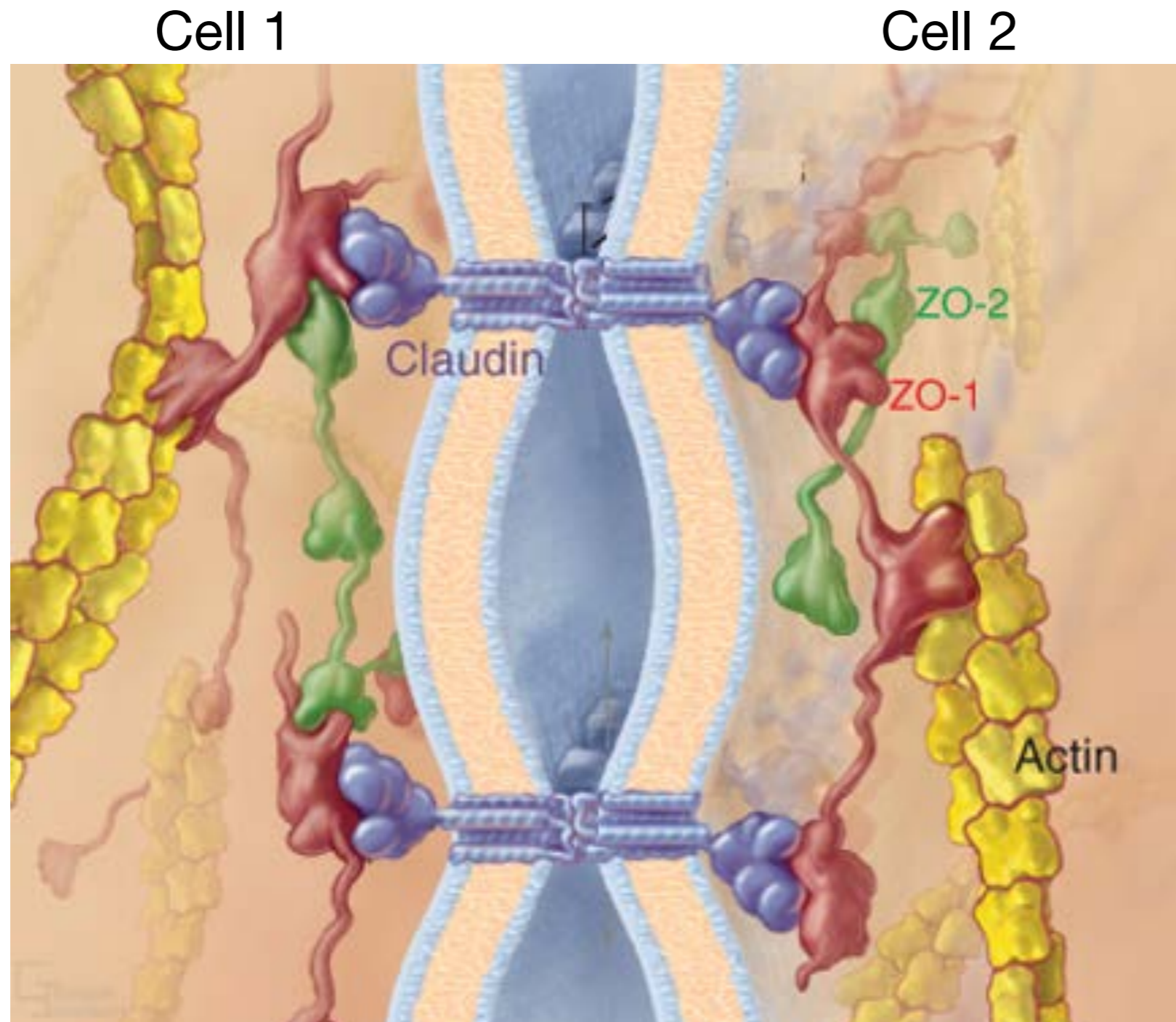
Tight junctions form a network of sealing strands that encircle epithelial cells.





Claudins are the primary component of tight junctions that determine permeability.

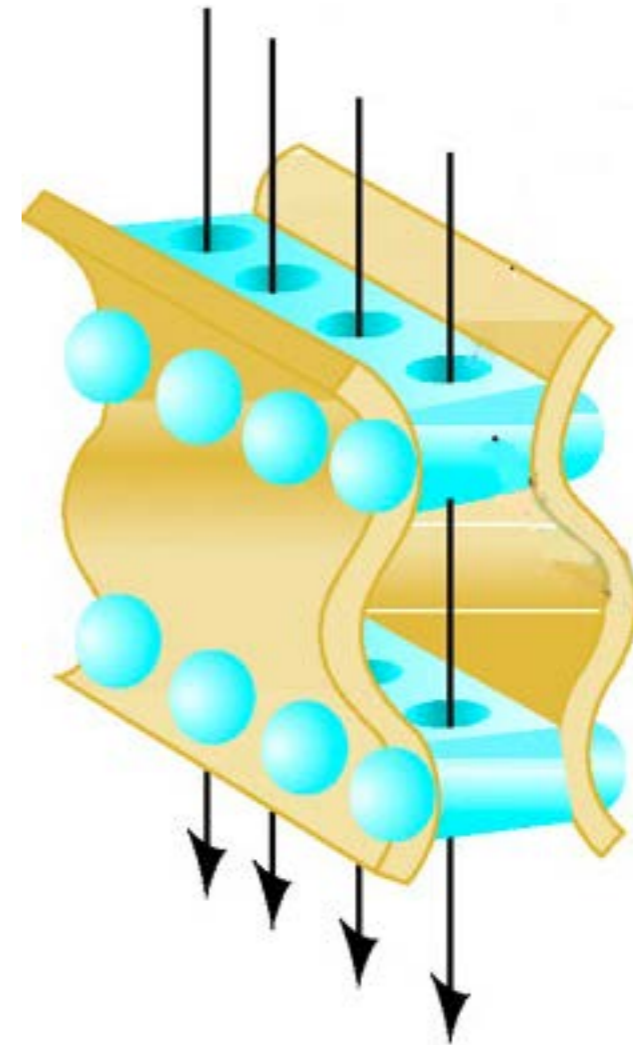
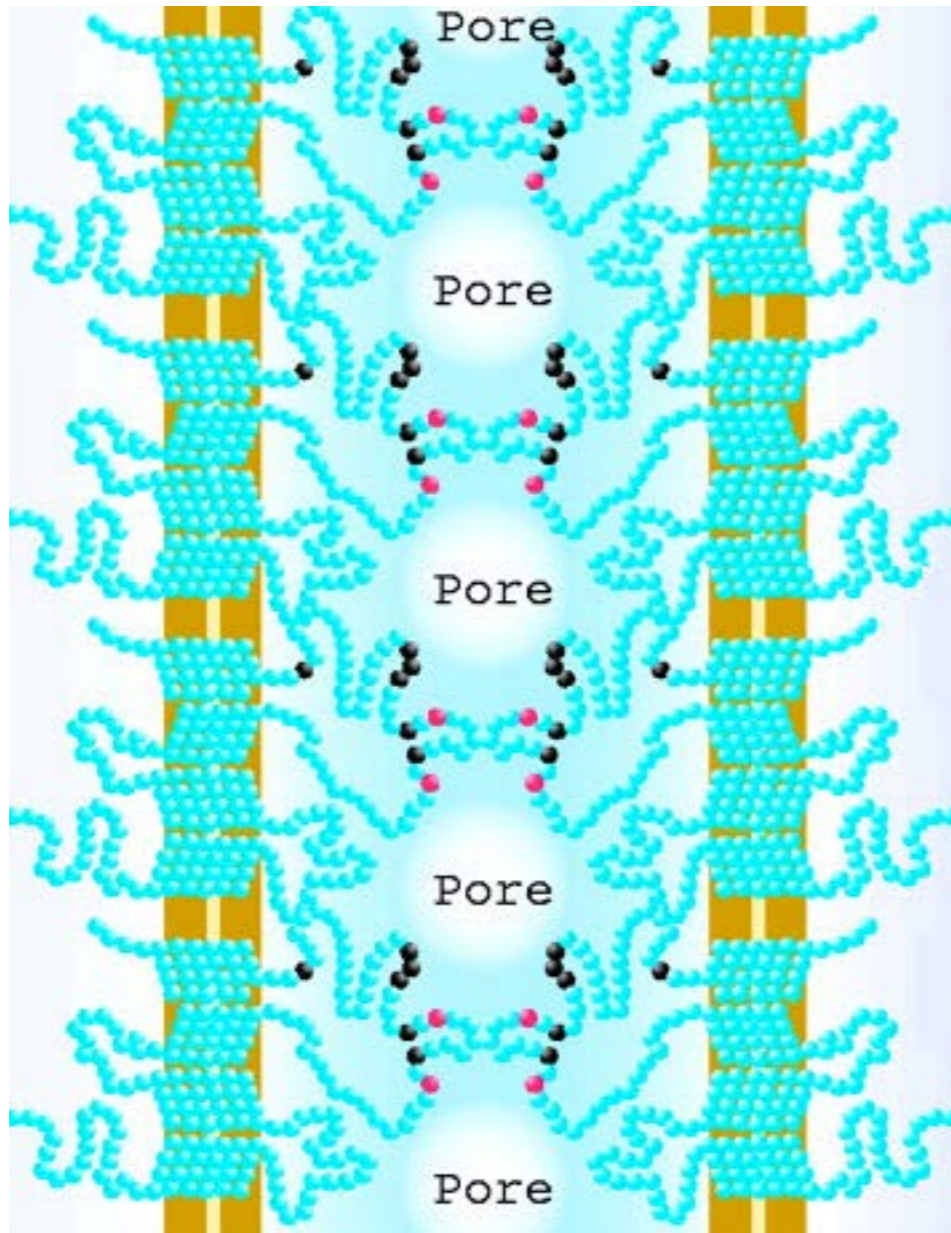
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Interactions between claudins generates size restrictive pores.

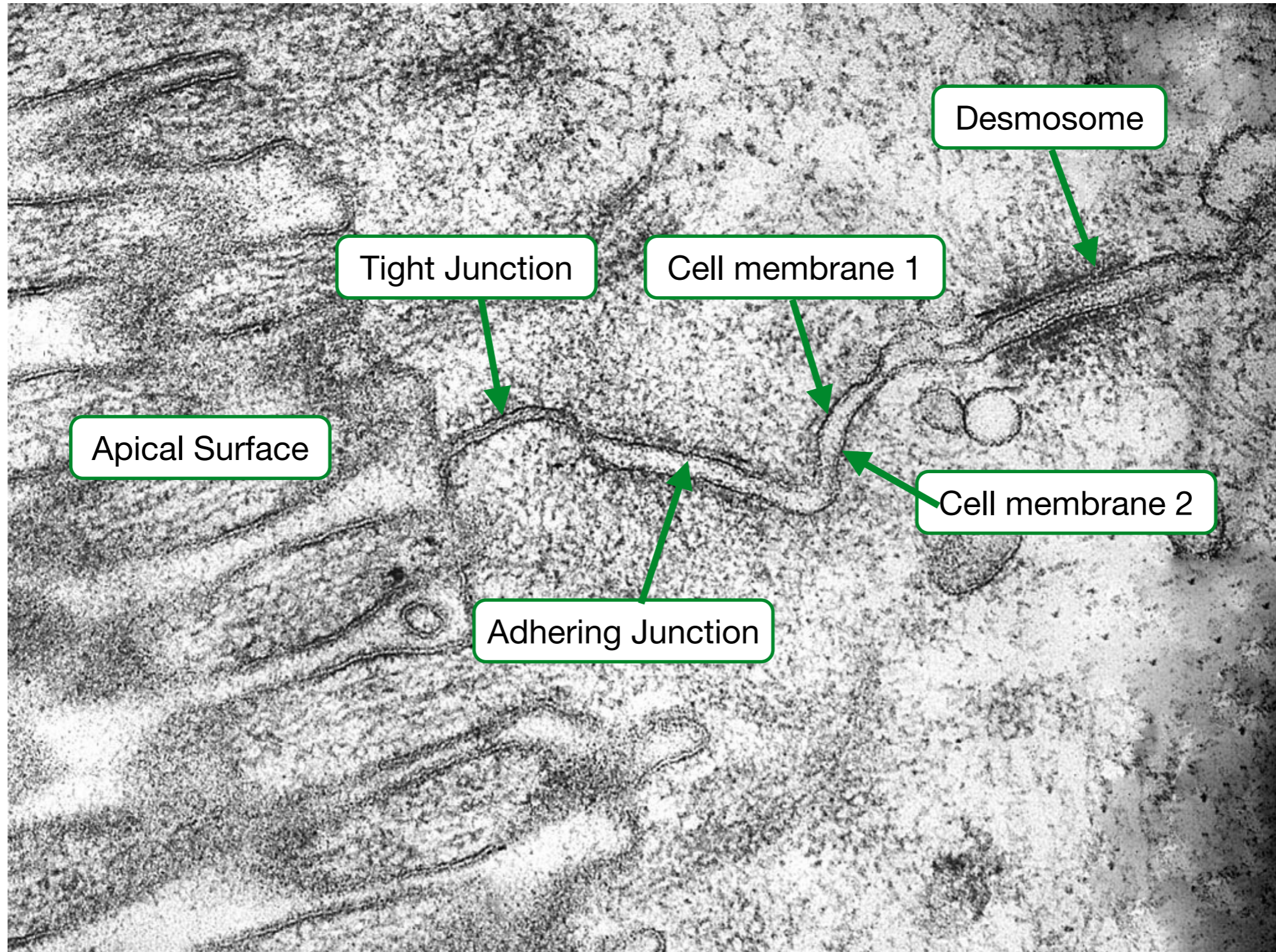
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Tight junctions are located close to the apical surface.

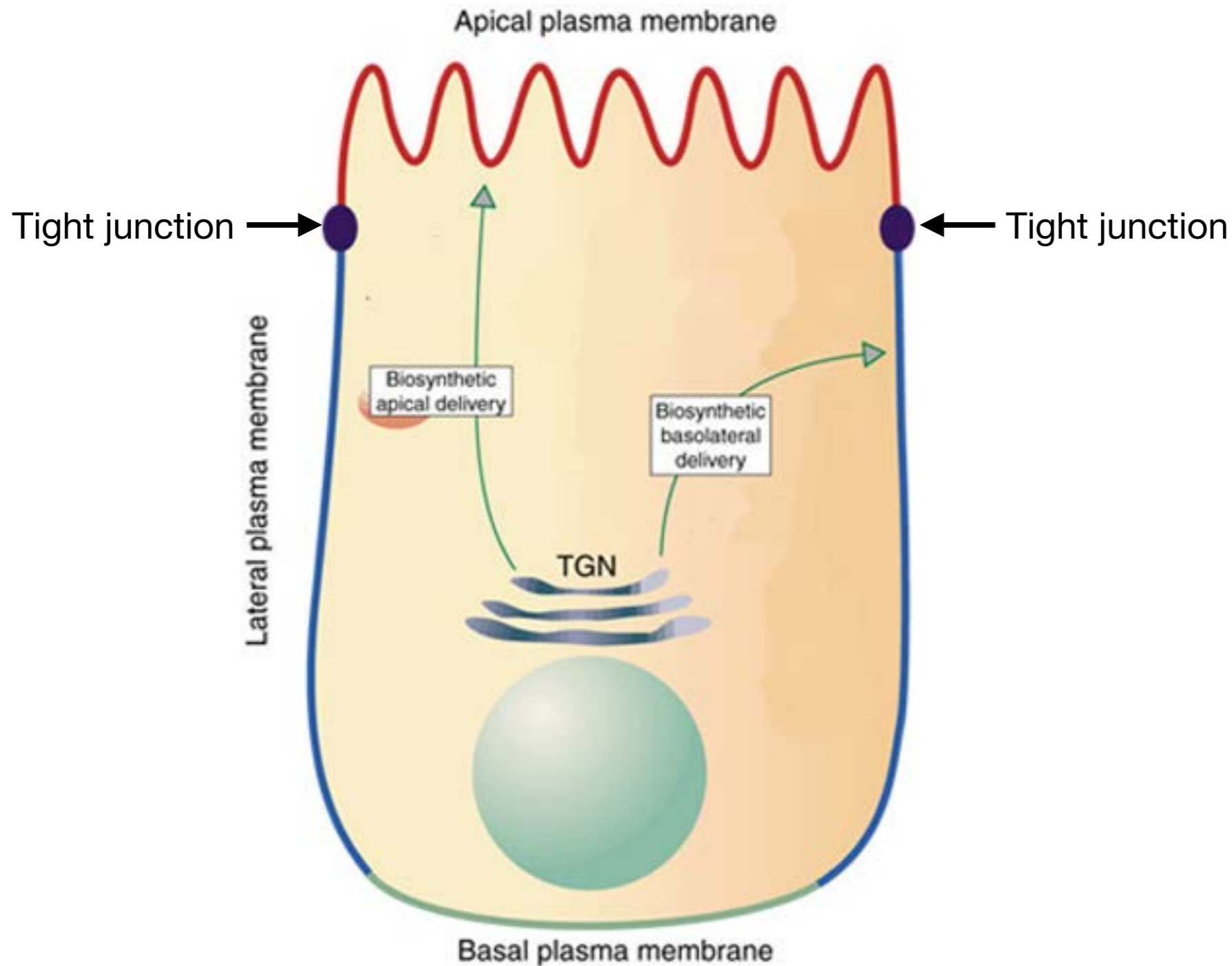
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Tight junctions restrict the diffusion of proteins in the cell membrane to maintain cell polarity.

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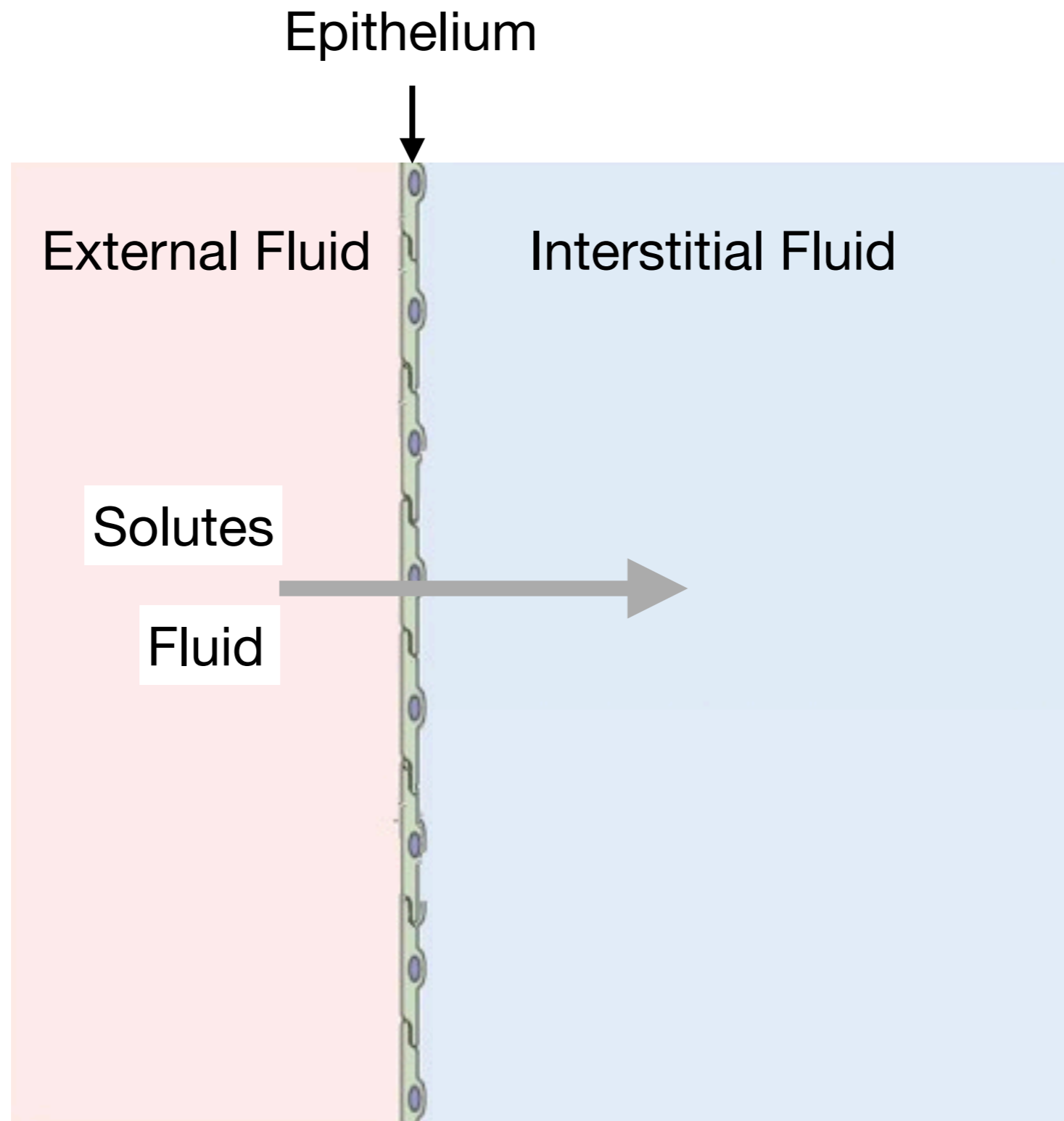


Transport across epithelia

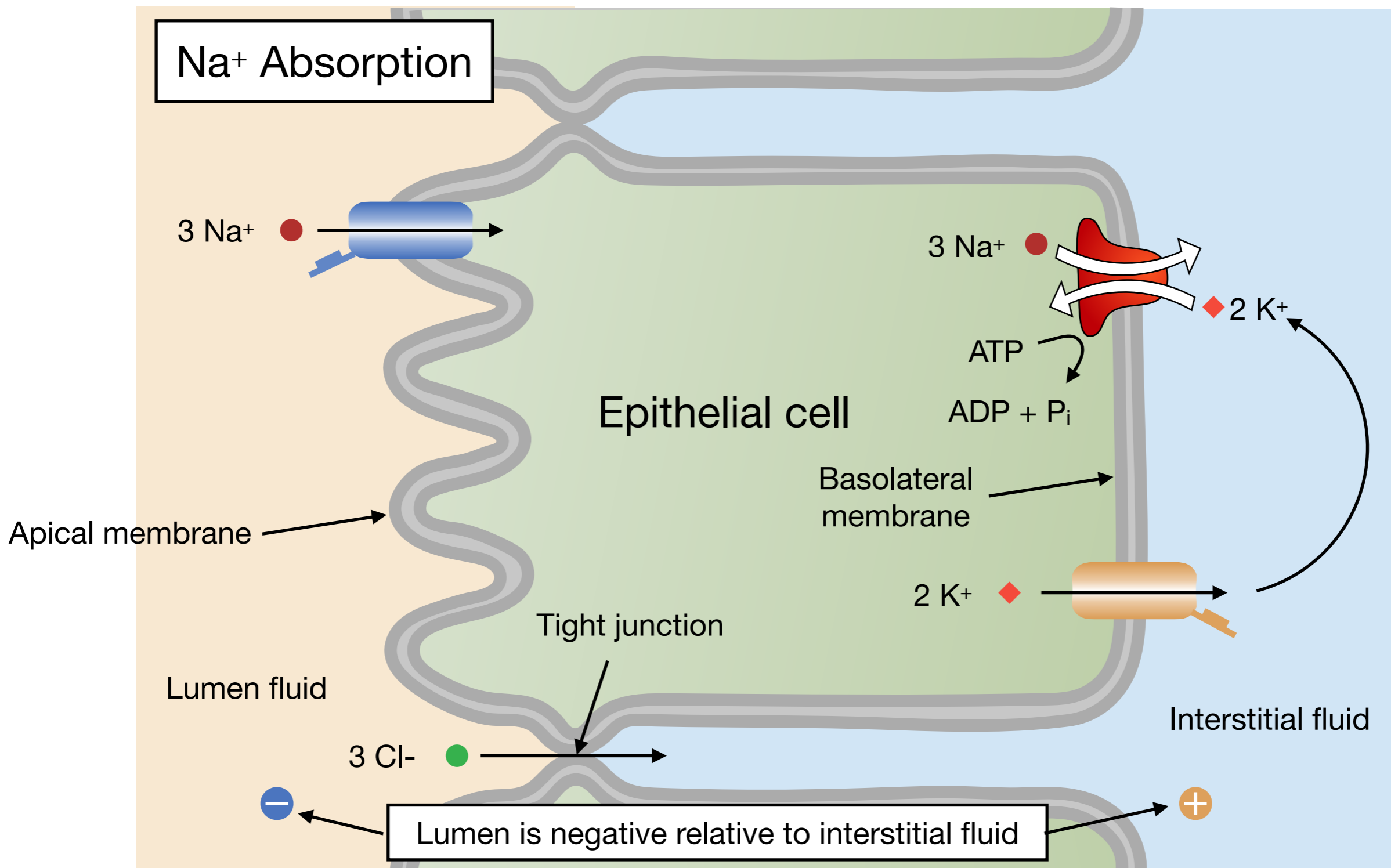


Vectorial transport is the movement of specific solutes or water from one compartment to another.

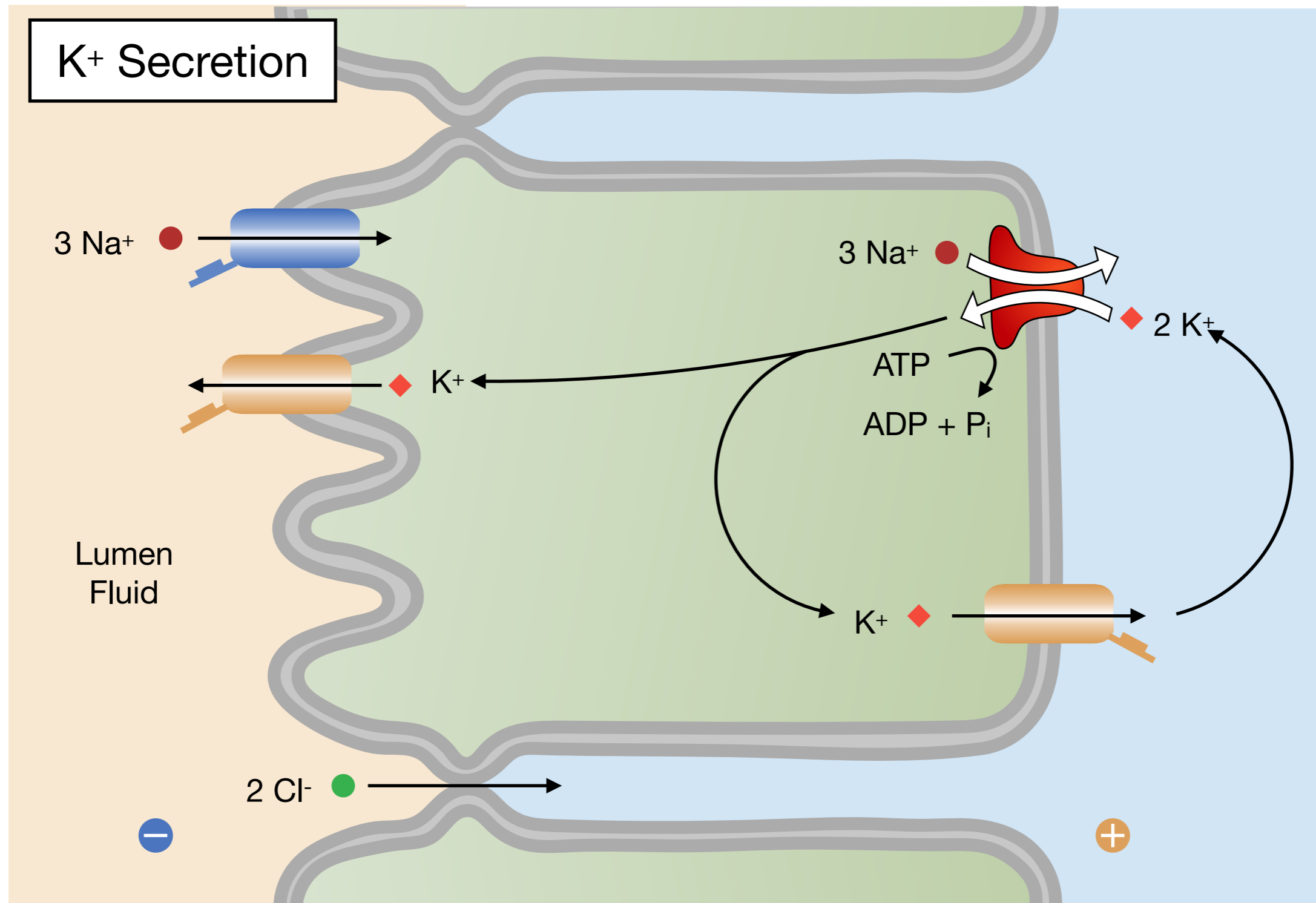
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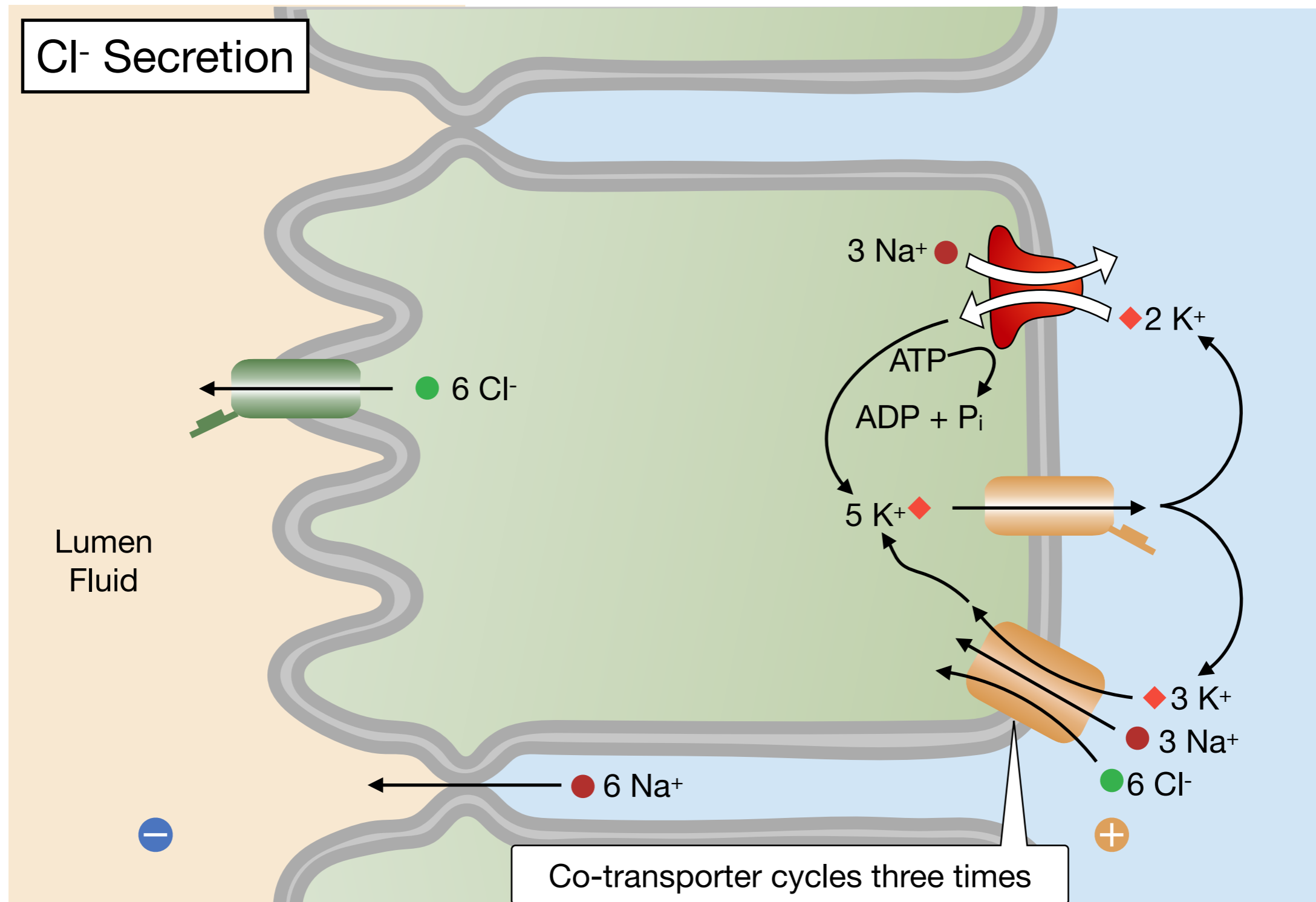
Sodium chloride absorption is mediated by sodium channels in the apical cell membrane.



Potassium channels in the apical membrane mediate secretion of potassium.

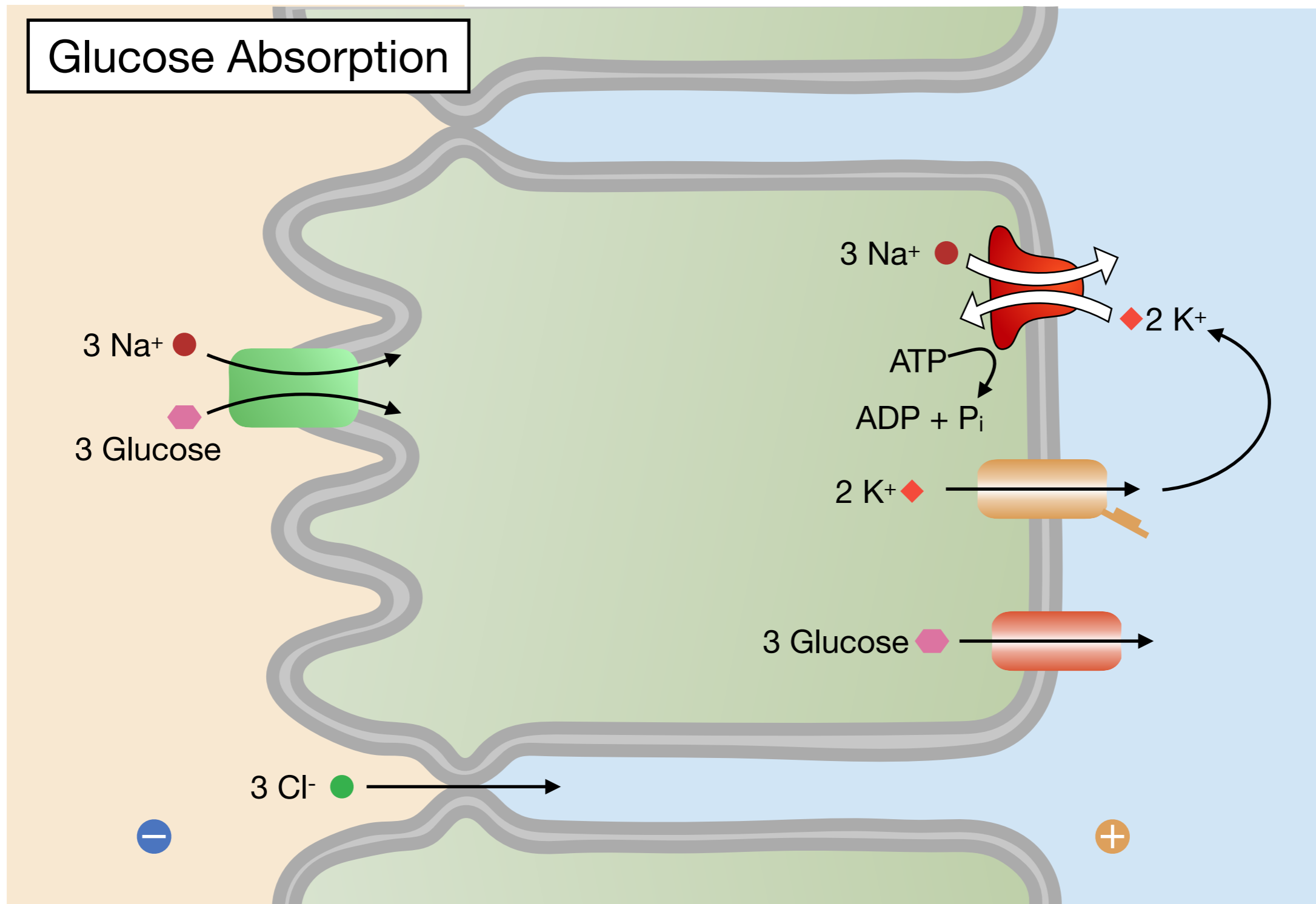


Sodium chloride secretion is mediated by chloride channels in the apical cell membrane.





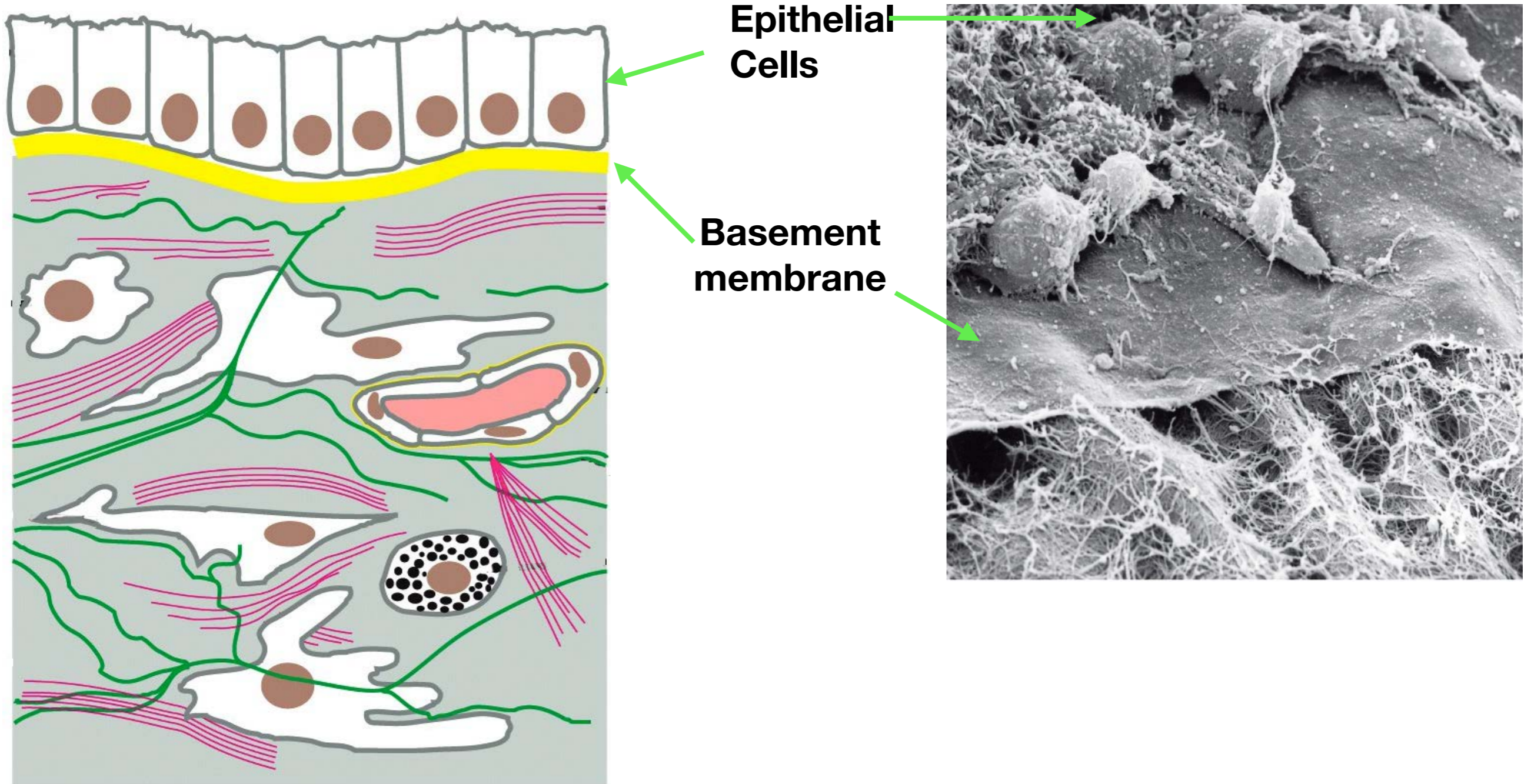
Glucose uptake is mediated by the sodium-glucose co-transporter in the apical cell membrane.



Basement membrane

All epithelia rest on a basement membrane.

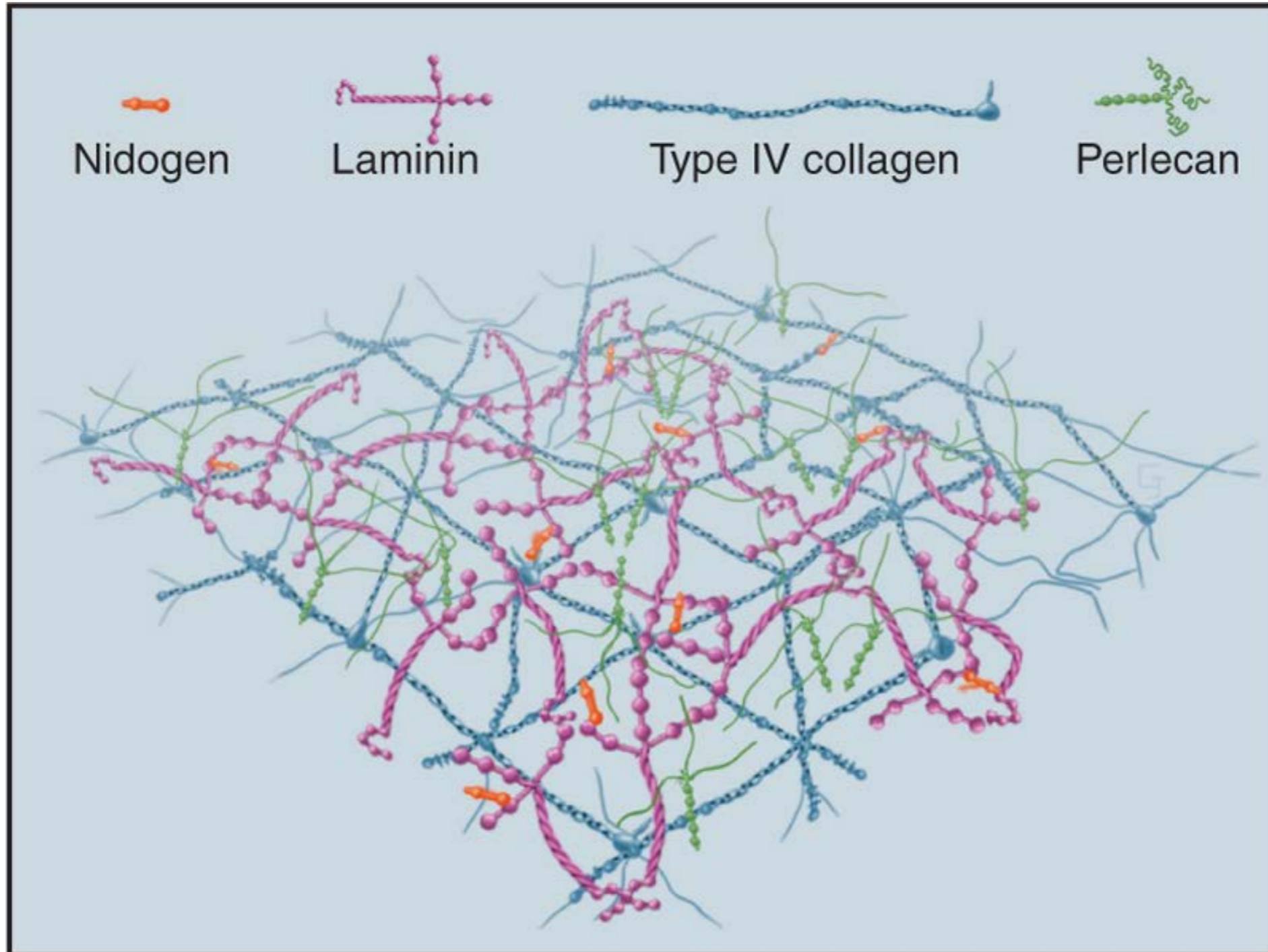
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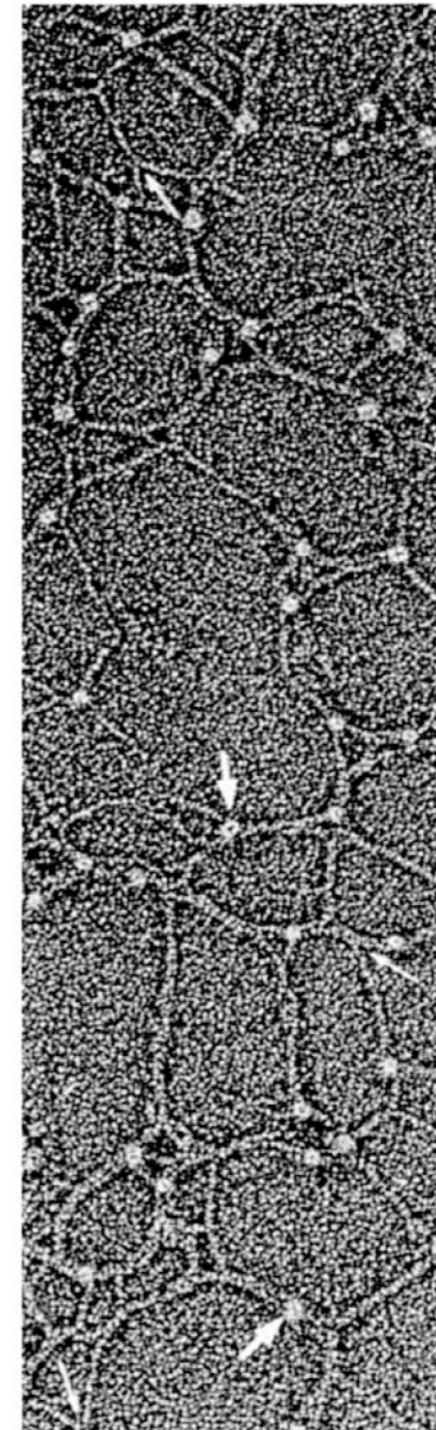
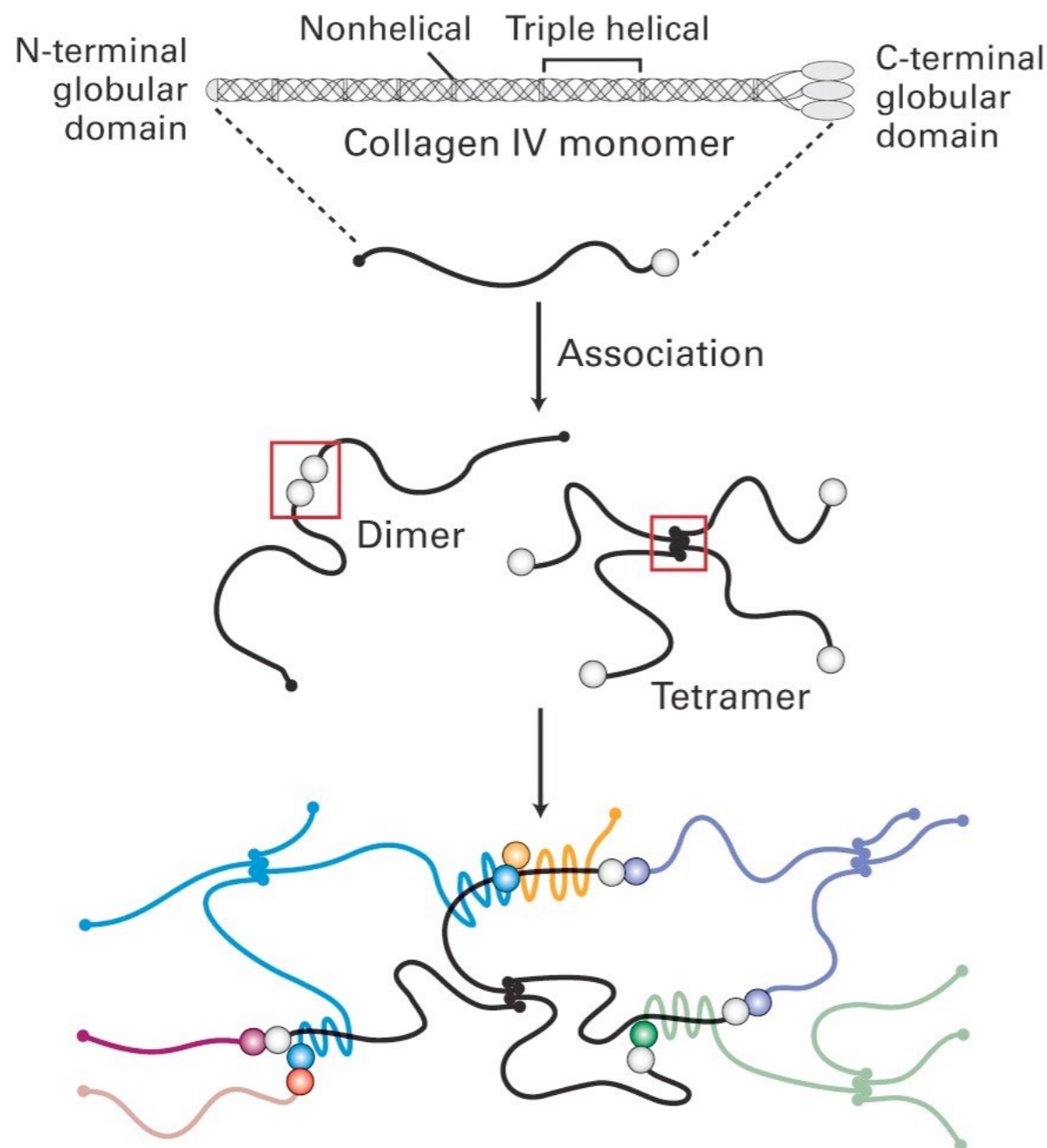
The basement membrane is a meshwork of interconnected fibers.

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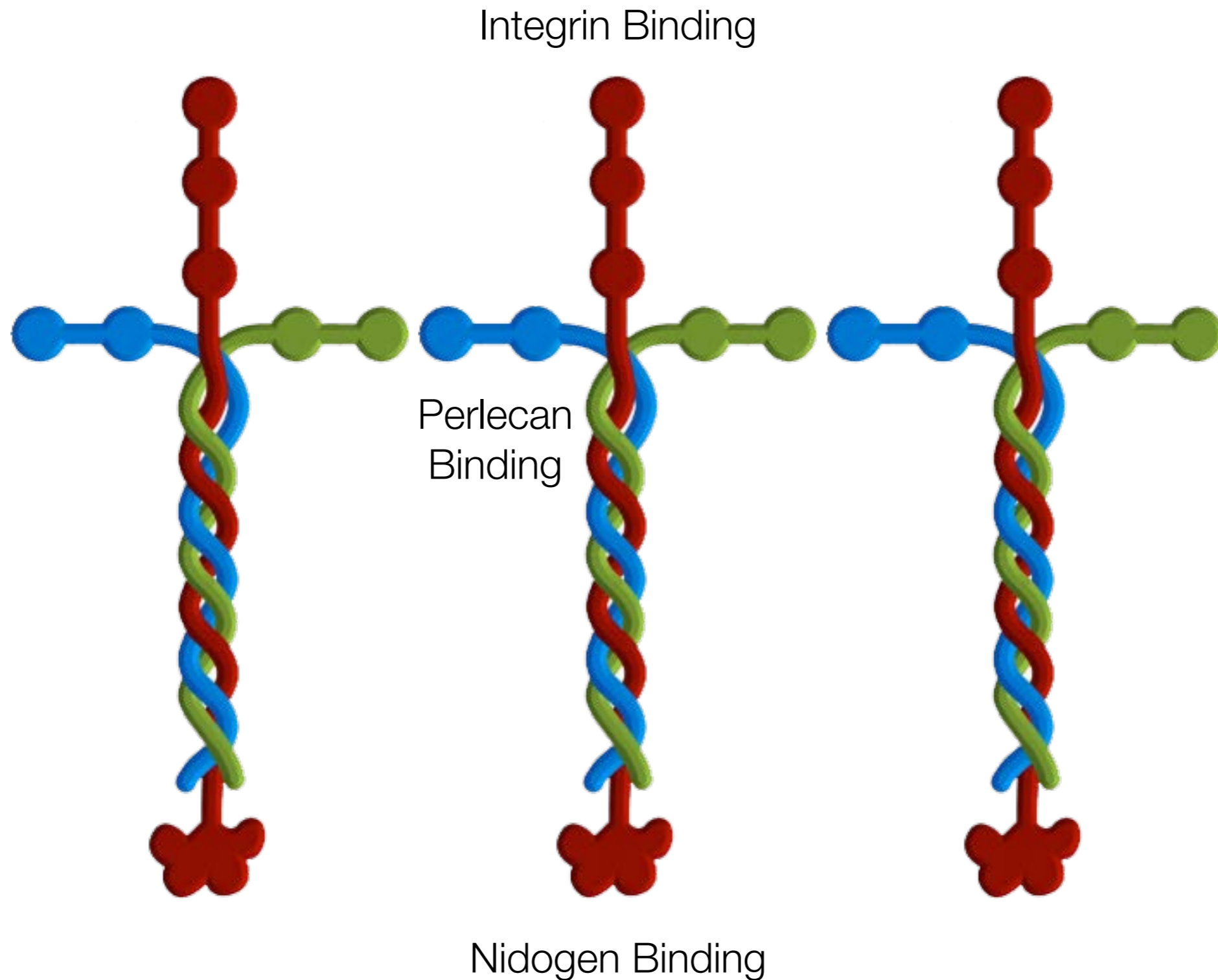


Type IV collagen is the main structural component of the basement membrane.



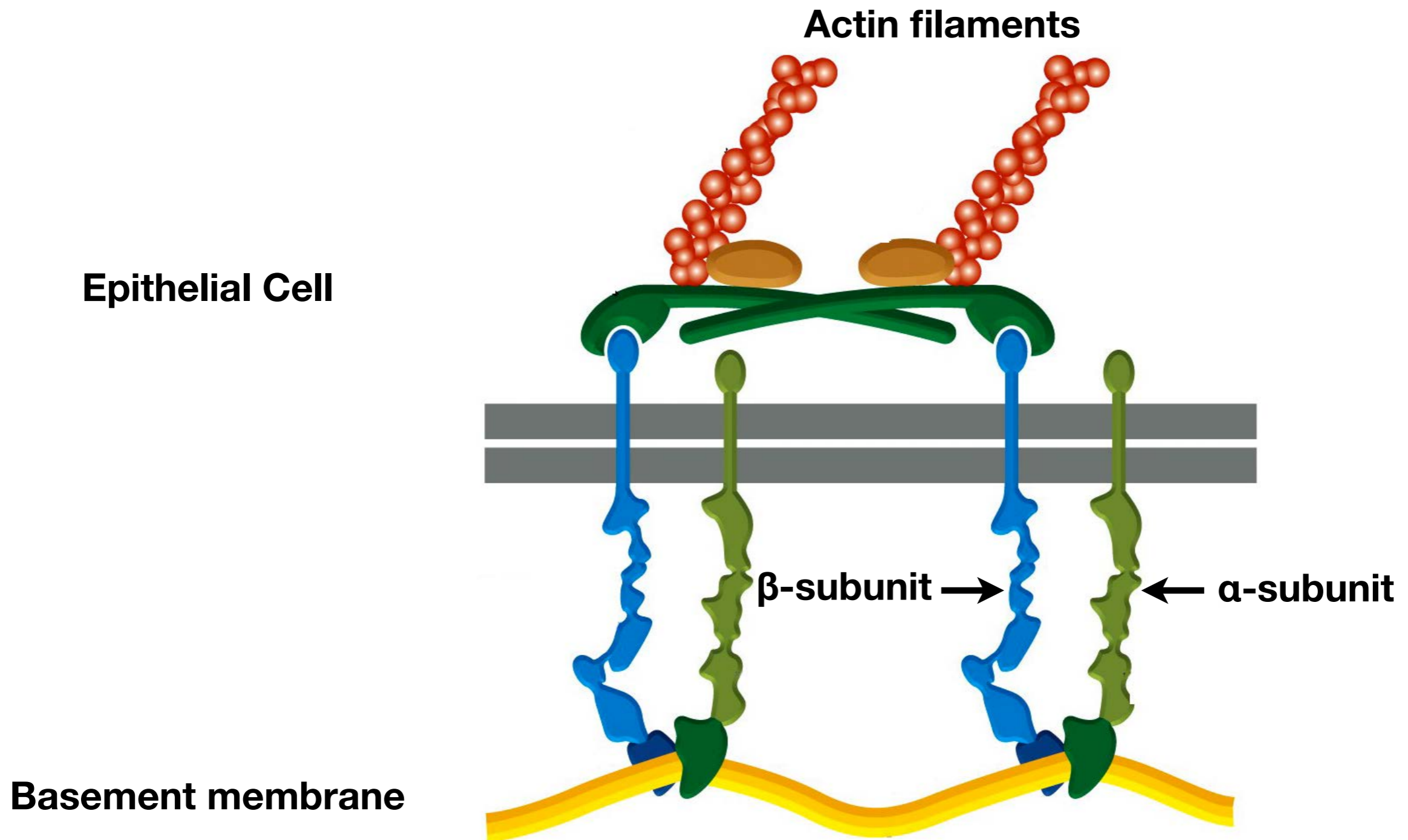
Laminins form network and organize components of the basement membrane.

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Integrins in epithelial cells bind laminin and fibronectin in basement membrane.

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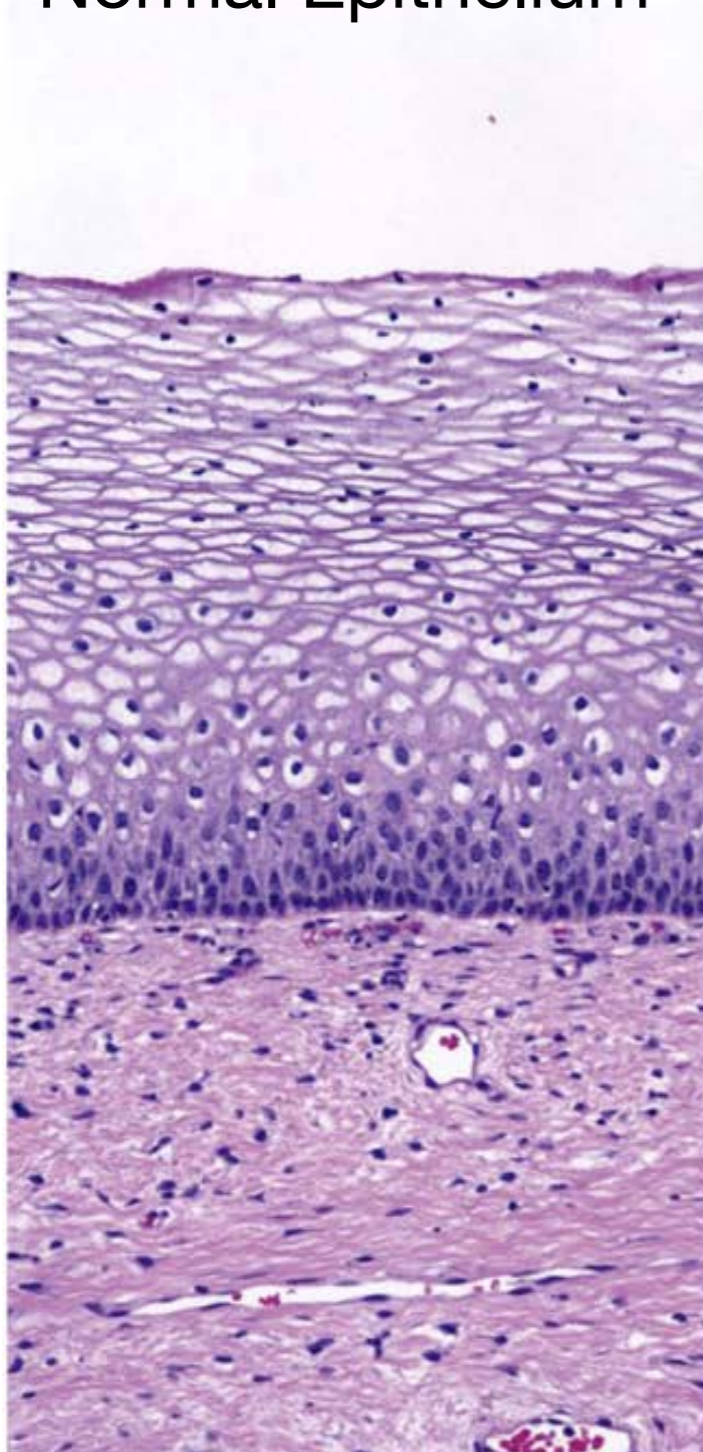




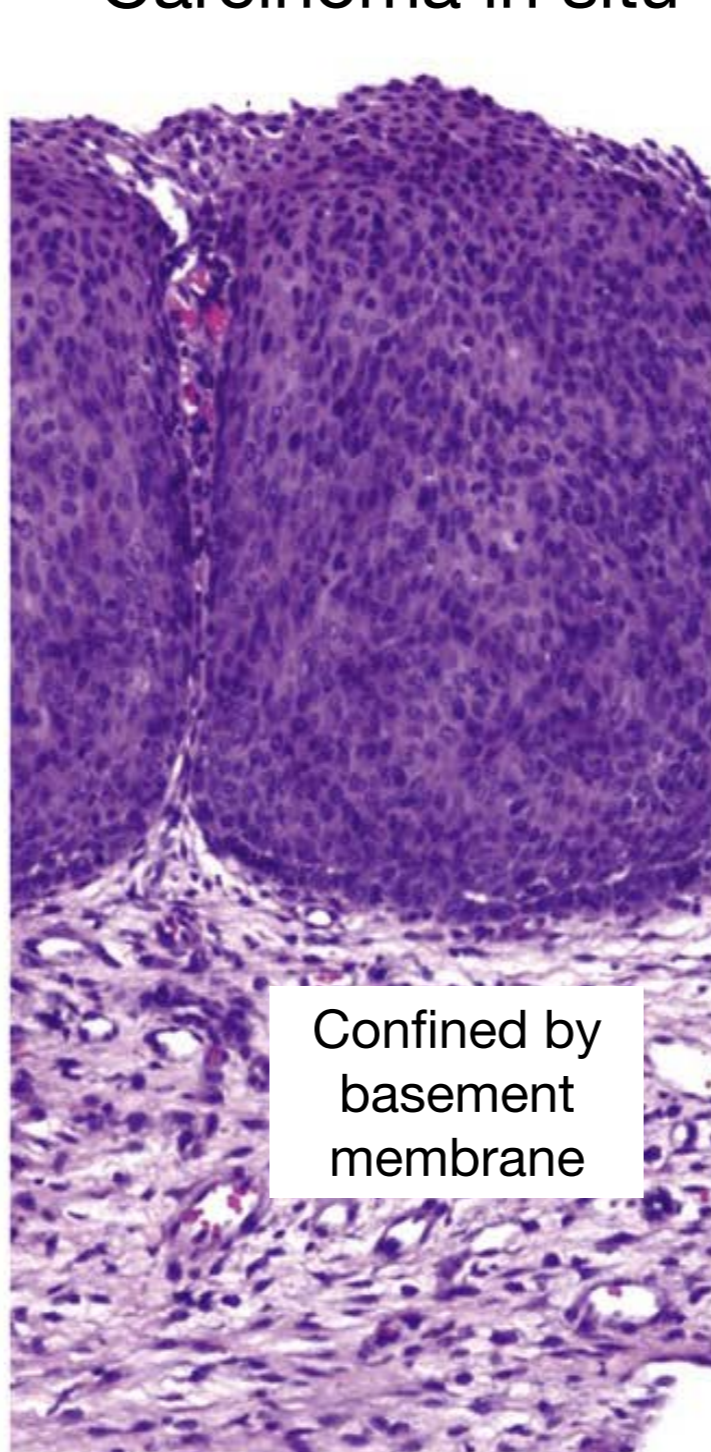
# Basement membrane restricts invasion of malignant cells.

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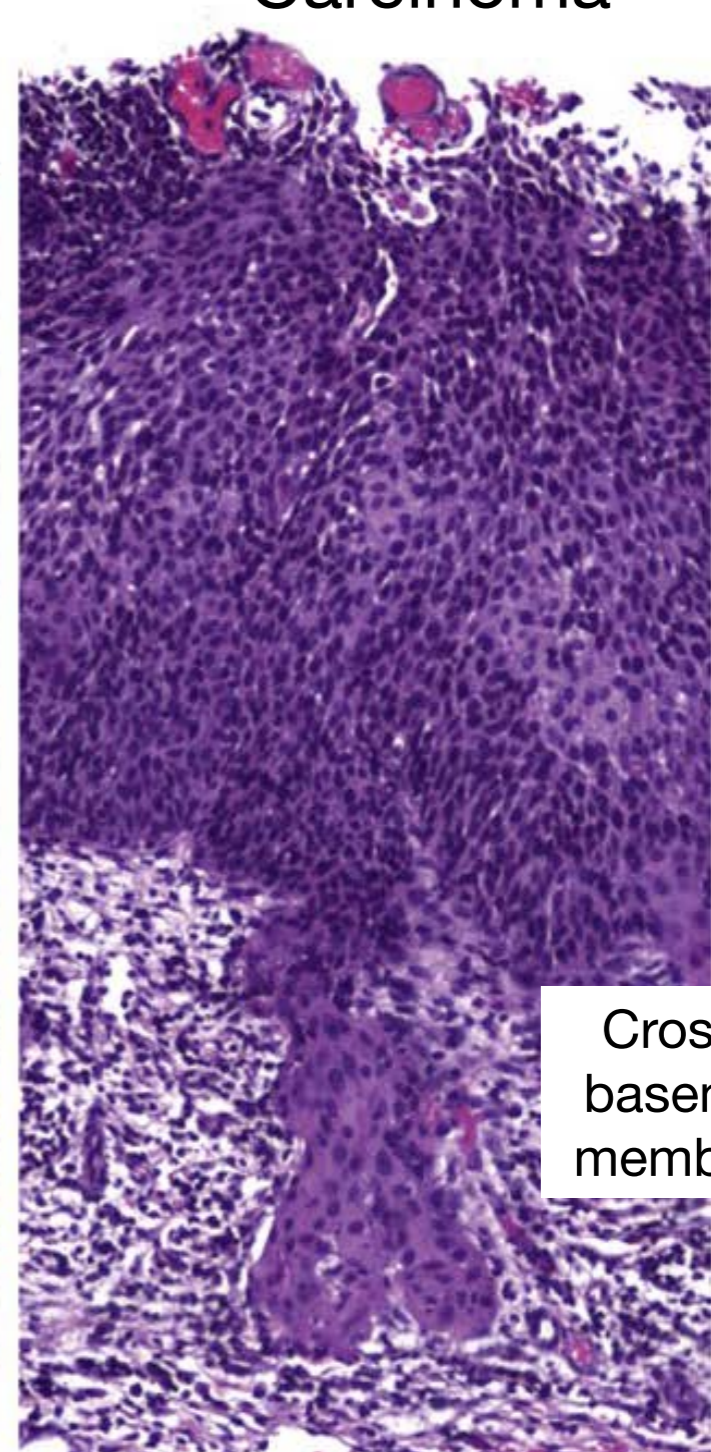
Normal Epithelium



Carcinoma in situ



Carcinoma

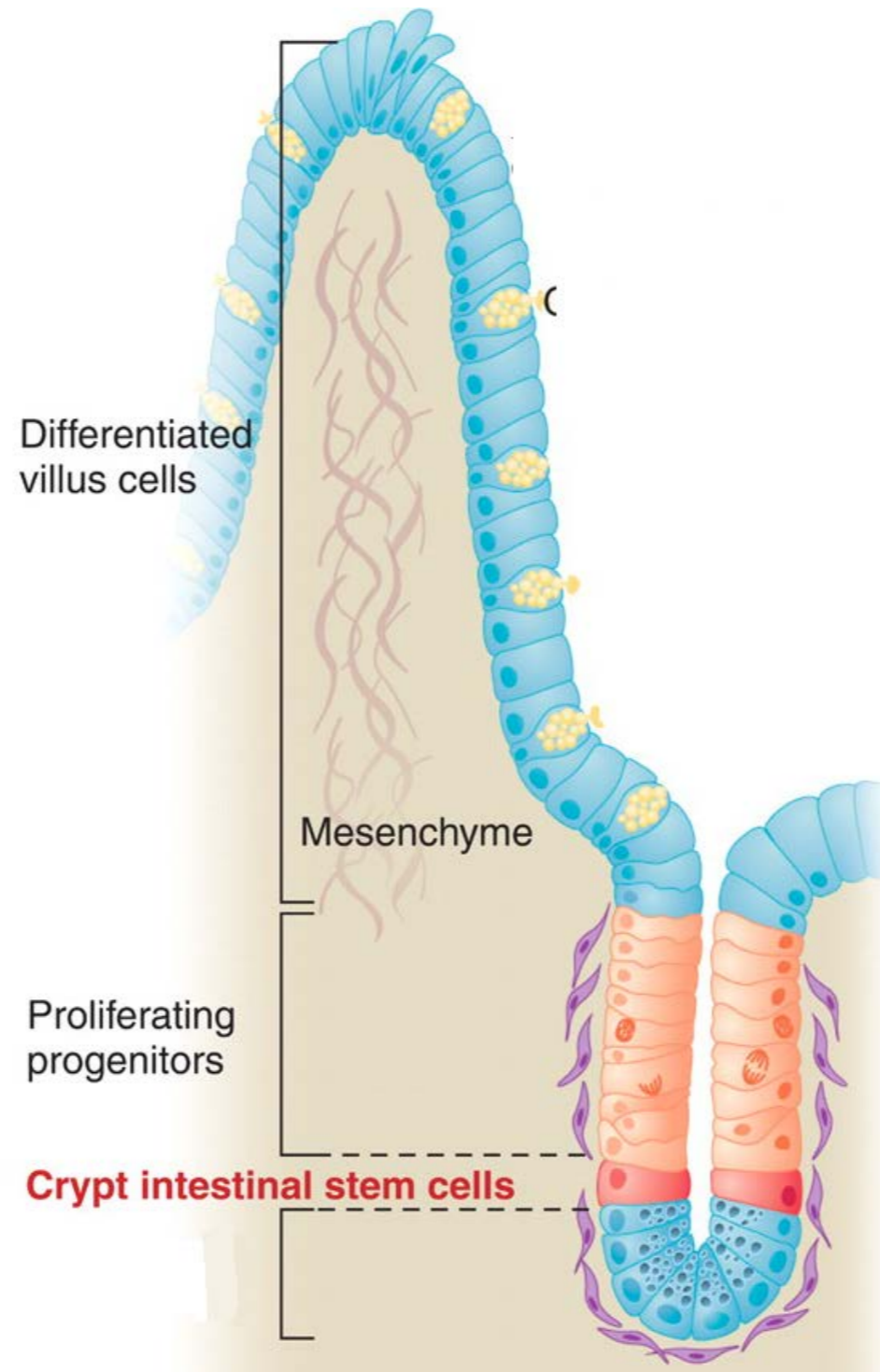




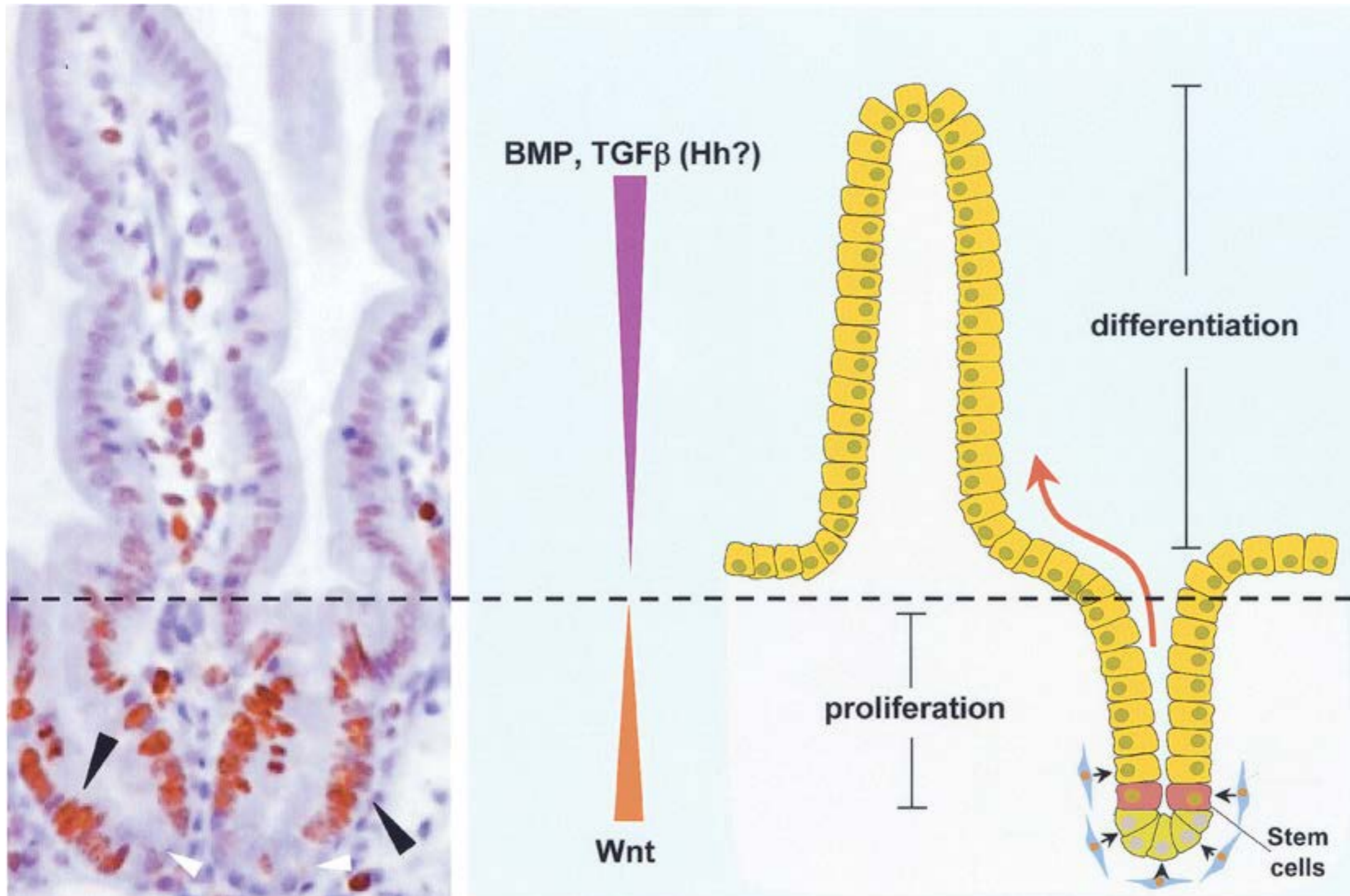
Renewal of epithelia

Intestinal epithelial stem cells resides in niche at the base of the epithelium.

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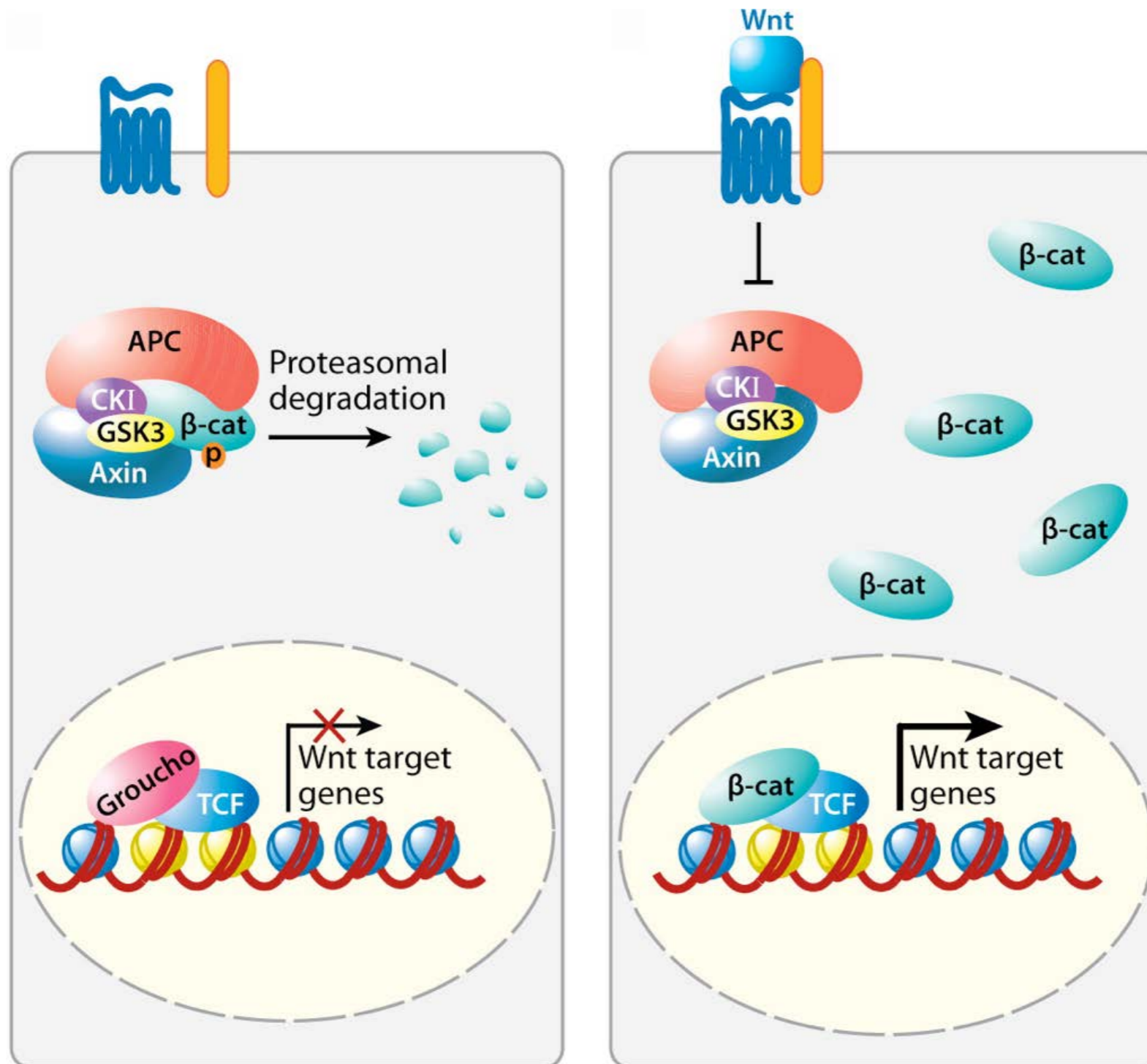


# Growth factors regulate the cell division of cells in different regions of the epithelium





Wnt increases concentration of  $\beta$ -catenin allowing cells to grow and divide.

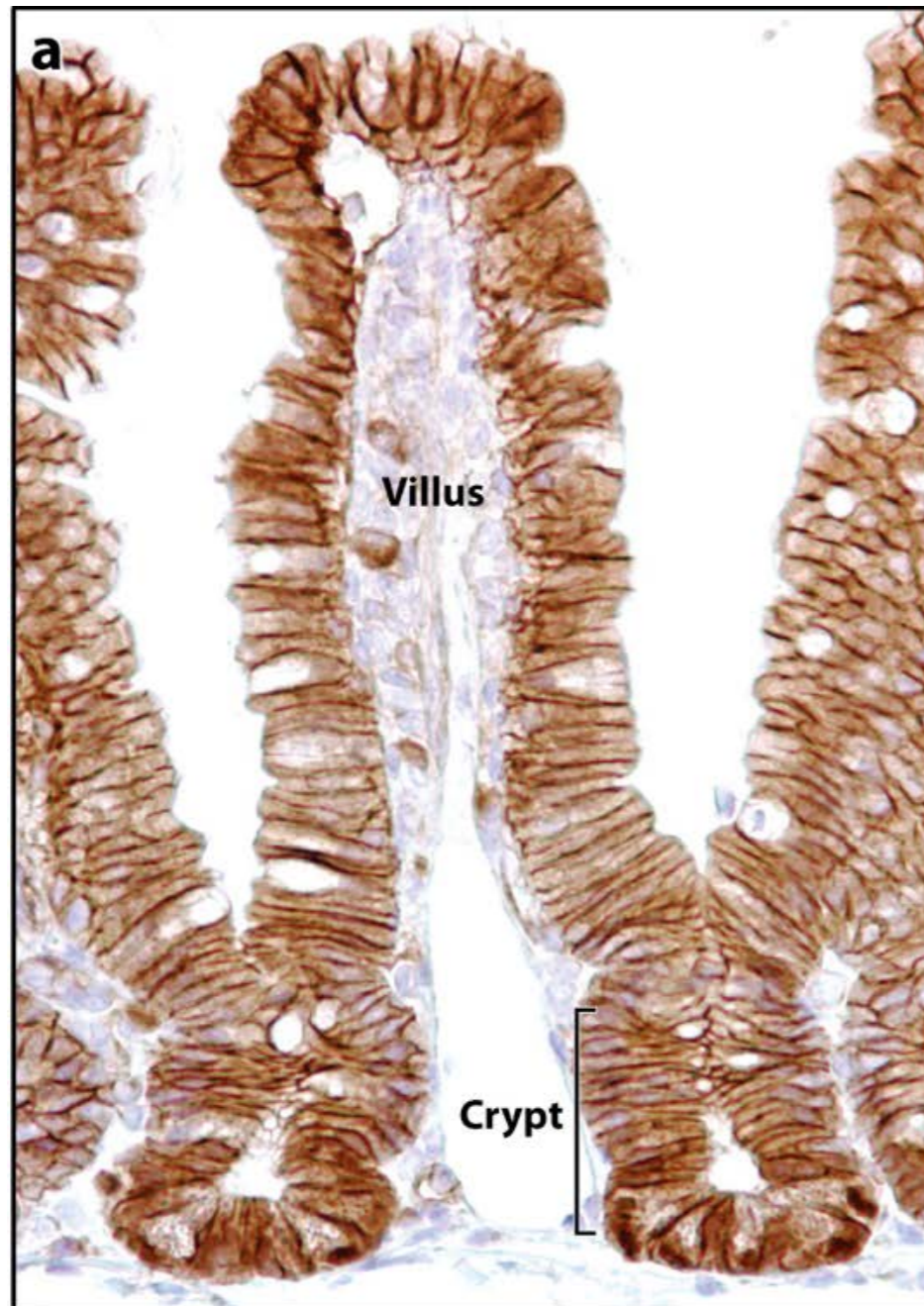




Mutated APC leads to elevated beta-catenin in nucleus and cell proliferation.

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Normal



Adenoma



# Take home points...

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- Tight junctions regulate the paracellular diffusion of small molecules and ions across an epithelium.
- The basement membrane provides structural support and separates epithelia from underlying tissue.
- Epithelia cells are polarized and can target proteins to apical and basolateral surfaces.
- Channels localized to the apical and basolateral surfaces allow for vectorial transport of solutes.
- Stem cells allow replacement of epithelial cells and reside in niches