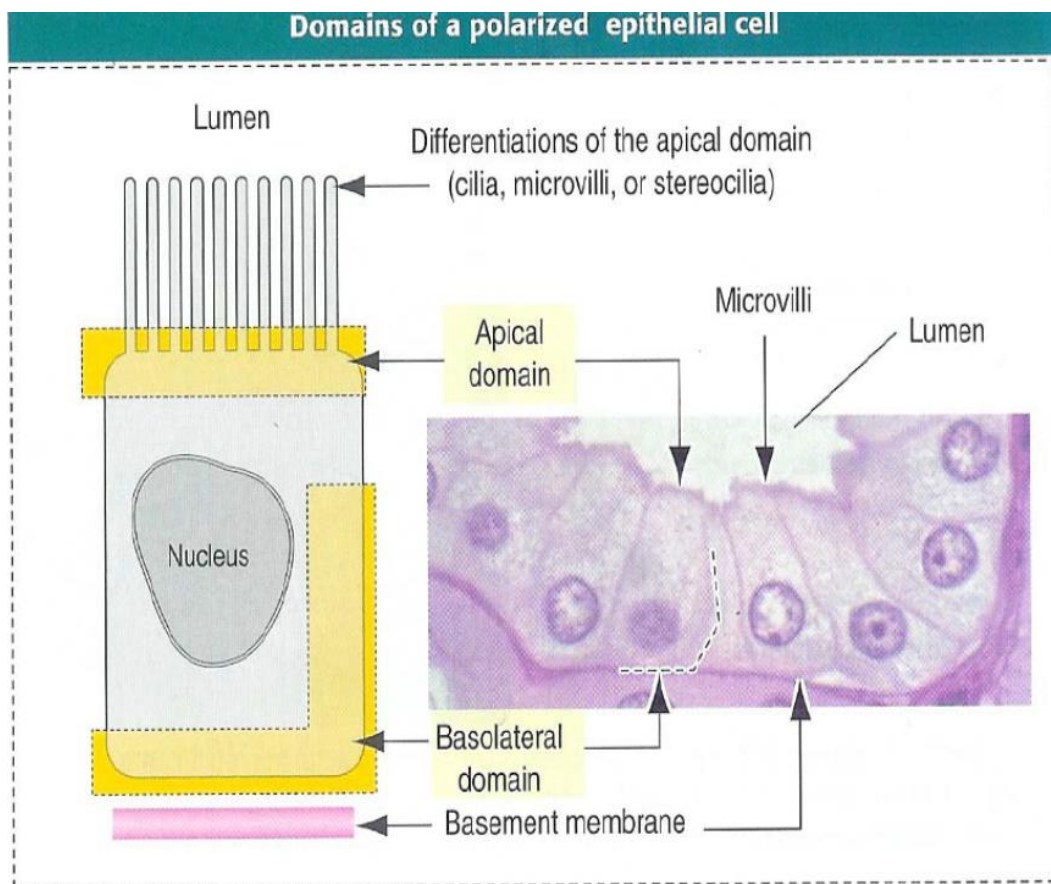


Modification of Plasma Membrane (Polarity)

Polarity is characteristic of most epithelial cells. It is best seen in simple epithelia, where each cell has 3 surfaces: an apical (Free) surface, lateral surfaces, and a basal surface attached to the basal lamina.

The Apical Domain is the region of the cell that is exposed to the lumen or external environment. This region of some epithelial cells can have specialized structures like cilia, flagella, microvilli, stereocilia and caveolae.

Apical (Surface or luminal) modifications specialized to carry out functions that occur at these interfaces, including secretion, absorption, and movement of luminal contents.



Cell junctions:

Epithelial tissue is composed of cells physically close together that are connected by one or all three types of junctions with very little intervening intercellular substances.

Water, solutes and ions can move through epithelium by two different pathways:

1-Trans-cellular pathway, material going through the cell, involves channel and transporter molecules.

2-para-cellular pathway, materials travel between adjacent cells, this process is regulated by cell junction which is present in definite order from the apical to the basal ends of the cells.

There are three major types of junctions

1-Occluding junctions (zonula occludens, tight junctions)

All epithelia have at least one important function in common: they serve as selective permeability barriers, separating fluids on either side that have a different chemical composition. This function requires that the adjacent cells be sealed together by occluding junctions. Tight junctions have this barrier role in vertebrates, as we illustrate by considering the epithelium of the mammalian small intestine, or gut.

Occluding junctions are symmetrical structures on opposite sides of two adjacent cells separating the apical domain from the baso lateral domain, its form a belt-like seal around the apical surfaces of two adjacent cells; occluding junctions are not associated with cytoskeletal elements.

Tight junctions or zonula occludens are the most apical of junctions, zonula indicates that the junctions form bands

completely encircling each cell and occludens refers to the membrane fusion that close of the space between the cells.

The major components of zonula occludens are cells trans membrane protein called claudin which forms linear fibrils in the occluding junction.

The junctions are tight and prevent movement of lipids and proteins between adjacent cells thus setting paracellular pathway.

Beside forming a seal between compartments on either side of an epithelium , the zonula occludens of epithelial cells help prevent the integral membrane proteins of the apical surface from being transferred to the basolateral surface and vice versa, this allow the two sides of the epithelial to maintain different receptors and function differently. Occluding Junctions form a selective permeability barrier across epithelial cell sheets.

2-Anchoring or adhesive junctions, A-zonula adherens (belt-desmosome), B- macula adherens (spot- desmosome), C- hemi desmosome.

Adhesion is mediated by trans membrane glycoprotein of each cell, **cadherins** .

Anchoring junctions are associated with cytoskeletal elements and connect the cytoskeleton of a cell either to the cytoskeleton of its neighbors or to the extracellular matrix ,found bellow the tight junctions, **zonula adherens or belt desosome** has belt like distribution and associated with actin filaments which connect Intermediate filaments from cell to cell.

Belt desmosome and tight junction are typically close together and each forms a ribbon around the cells apical end.

Macula adherens or spot desmosome has a spot like distribution and is associated with intermediate filaments.

Zonula adherens and macula adherens are symmetrical structures that anchor adjacent cells at the apical domains which provide strength and rigidity to an epithelial cell layer.

Hemidesmosomes are symmetrical structures that anchor the basal domain of the cell to the basal lamina.

Anchoring junctions are widely distributed in animal tissues and most abundant tissues are subjected to several mechanical stresses, such as heart, muscle and epidermis.

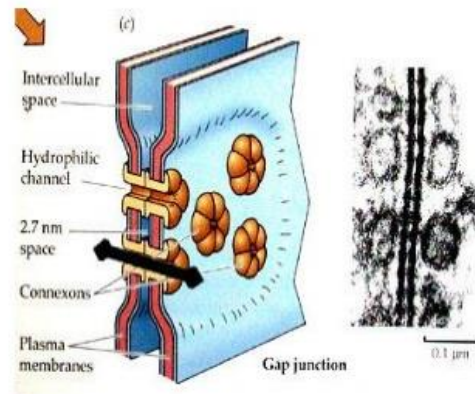
3-Gap (communicating) junctions

Button-like structures made up of integral membrane protein called connexins, six connexin sub units assemble in the plasma membrane to form a hollow cylinder called connexons. Connexons from adjacent cells when aligned together form direct channels of communication between the cytoplasm of two cells. Connexons usually form patches and facilitate the movement of molecules such as Ca^{+2} and AMP between cells.

Most cells in animal tissues are in communication with their neighbors via gap junctions, which present in most mammalian tissues and responsible for the chemical and electrical coupling between adjacent cells for example cardiac muscles and smooth muscles of the uterus. Gap junctions have a little strength but serve as intercellular channels for flow materials and allow the passage of small signaling molecules between adjacent cells to coordinate the response.

Gap Junctions

- Also called “Communicating Junctions”
- 2 opposing connexons join across intercellular space.
- Connexons: assembly of six proteins that create gap between two plasma membranes



Gap junctions

1-permit the rapid exchange between cells of molecules with small diameter (1.5 nm).

2-responsible for the heart coordinated beat because some molecules move radially through gap junctions, allowing cells in many tissues to act in coordinated manner rather than as independent units.

The nutrient from blood vessels reach to the epithelium via diffusion across basal lamina and taken up through basolateral surfaces of the epithelia cell, usually by an energy dependent process.

Receptors for chemical messengers like hormones , that influence the activity of epithelial cells are localized in the basolateral membrane.

The conclusion

-Occluding junctions are important in the regulation of the paracellular pathway and the permeability of epithelial sheets.

-Anchoring junctions are important in distributing mechanical stress - and mainting integrity of epithelial cell layers.

-Gap junctions are important in the communication between cells.

All of these types of junctions are found in certain other cell types beside epithelia.

