CELL JUNCTIONS

LEARNING OBJECTIVES

At the end of the lecture students should be able to:

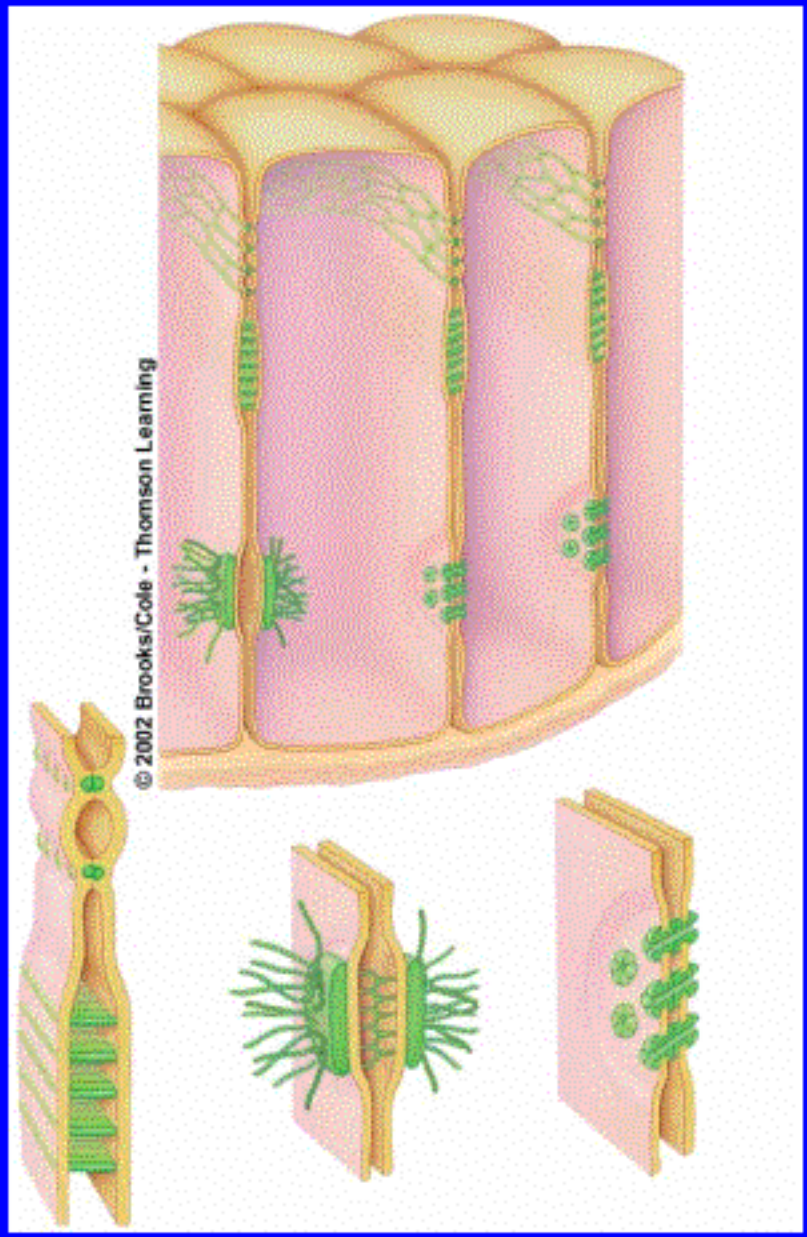
- Define cell junction
- Identify the junctions along the lataral and basal surfaces of cells
- Discuss the structure and functions of the five main types of cell junction
- Recognize various sites of their distribution
- Enlist the components of junctional complex

INTERCELLULAR JUNCTIONS

- Cells are kept together by a mutual force of cohesion or attraction
- In addition the cells shows several specializations (i.e. specially arranged connections)
- these specialized structures are known as “intercellular junctions”.
- Present in apposed surfaces of epithelial cells
- Also present in other body cells such as cardiac & smooth muscle cells

Cell Junctions

- Tight junctions prevent leaks
- Gap junctions connect abutting cytoplasms
- Adhering junctions cement cells together



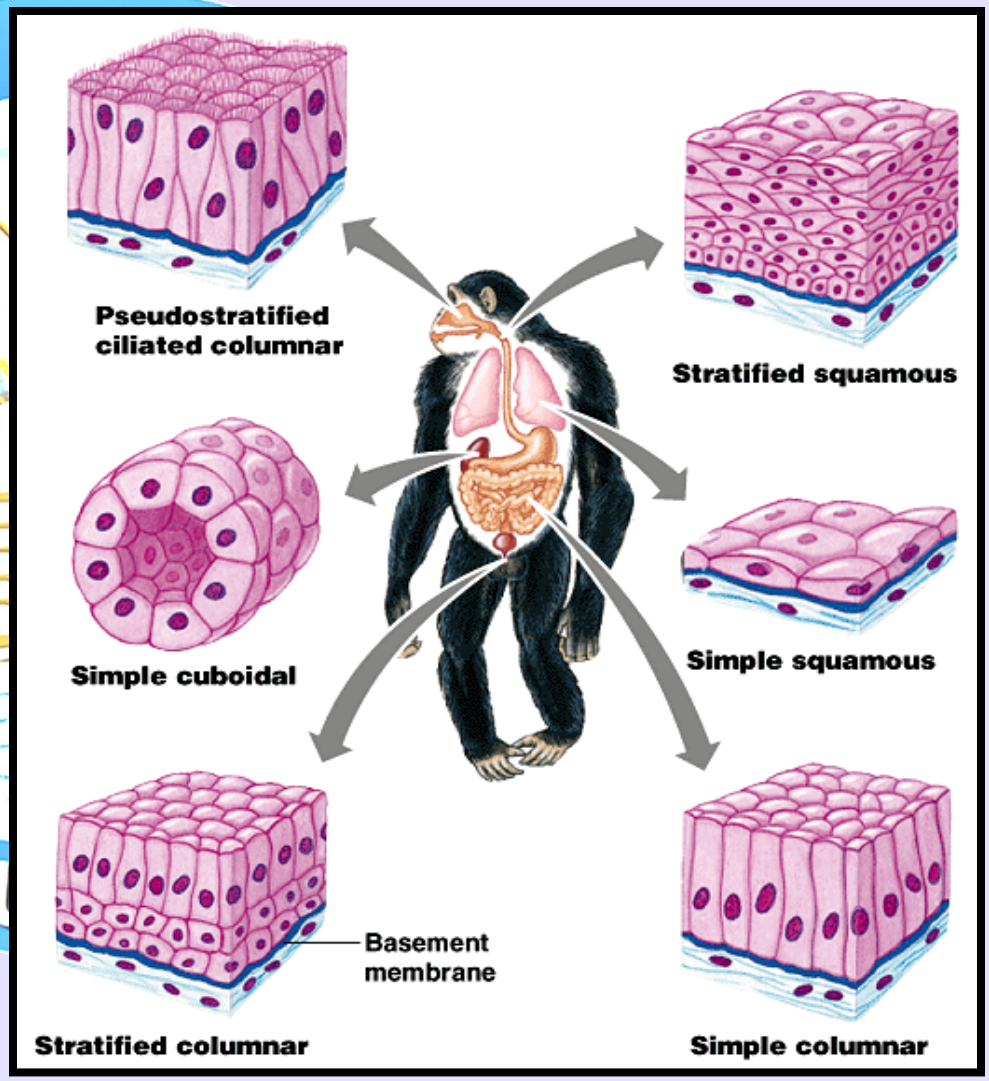
FUNCTIONS
INTERCELLULAR JUNCTIONS

1. They form sites of binding between the adjacent cells.
2. They permit the epithelia to form a continuous cohesive layer in which all the cells communicate and cooperate to achieve a particular function
3. They act as seals to prevent the flow of materials through the intercellular space (paracellular pathway).
4. They provide communication between the adjacent cells.

EPITHELIUM

Epithelium is a tissue composed of cells, tightly-bound to each other, with no intercellular connective tissue.

There are specializations of the cell membranes that play roles in maintaining the integrity of the tissue.



INTERCELLULAR JUNCTIONS

NOMENCLATURE

- **Two factors are taken in account for describing the cell junctions.**

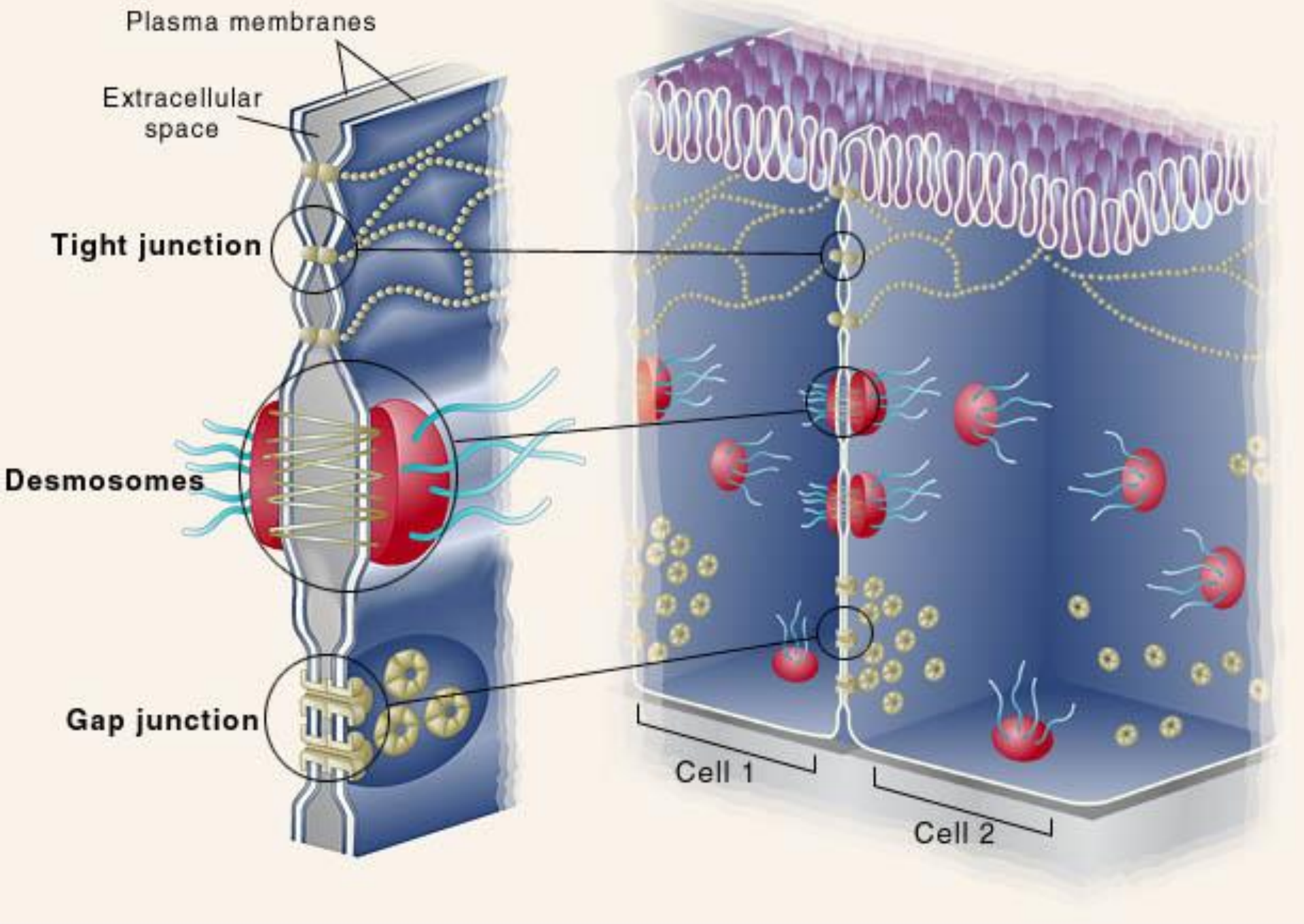
A. Shape & Extent of the contact area.

1. **Macula. (contact area is limited to a circular spot).**
2. **Zonula. (contact area is more than a spot, may be entire cell like a belt or girdle).**

B. Relatively closeness & nature of the cell contact.

1. **Occludens. (Intercellular space is obliterated).**
2. **Adherens. (Intercellular space is about 20 - 25 nm).**
3. **Gap junctions. (Intercellular space is about 2-4 nm).**

Specialized cell junctions

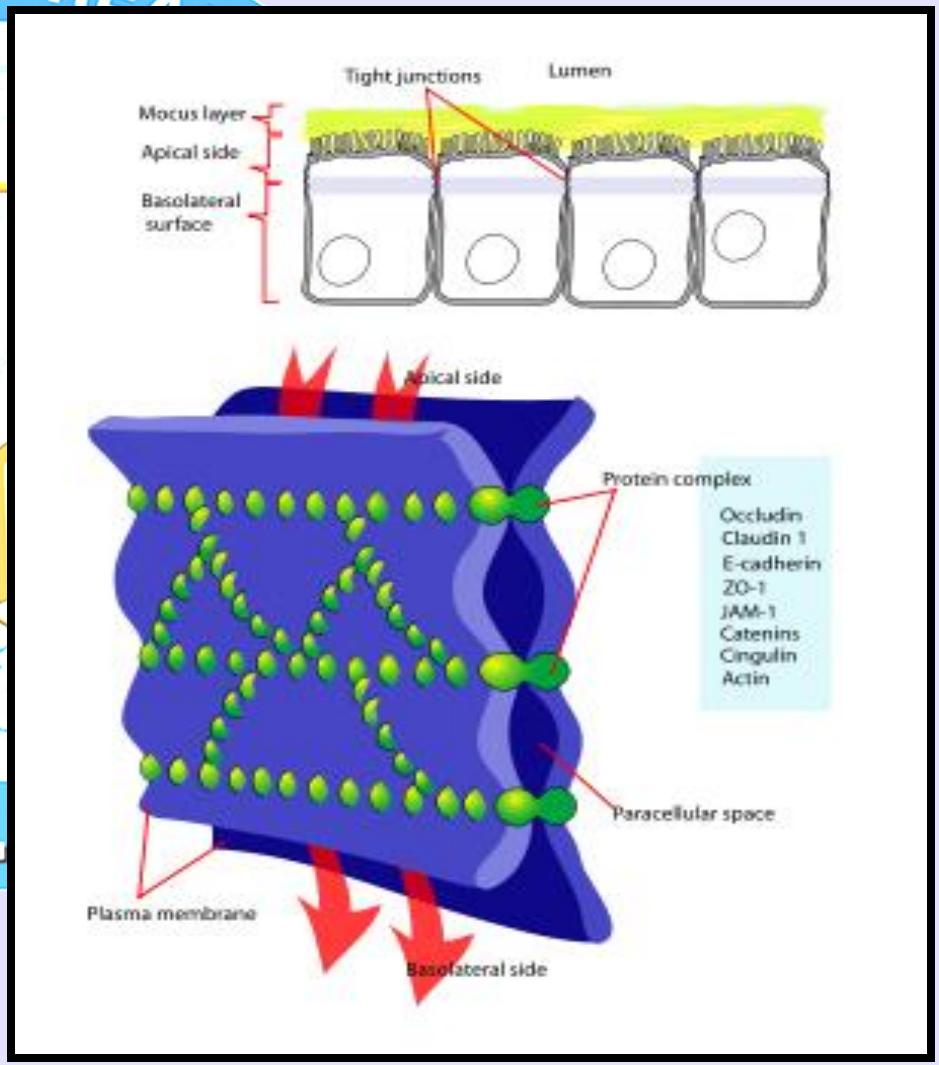


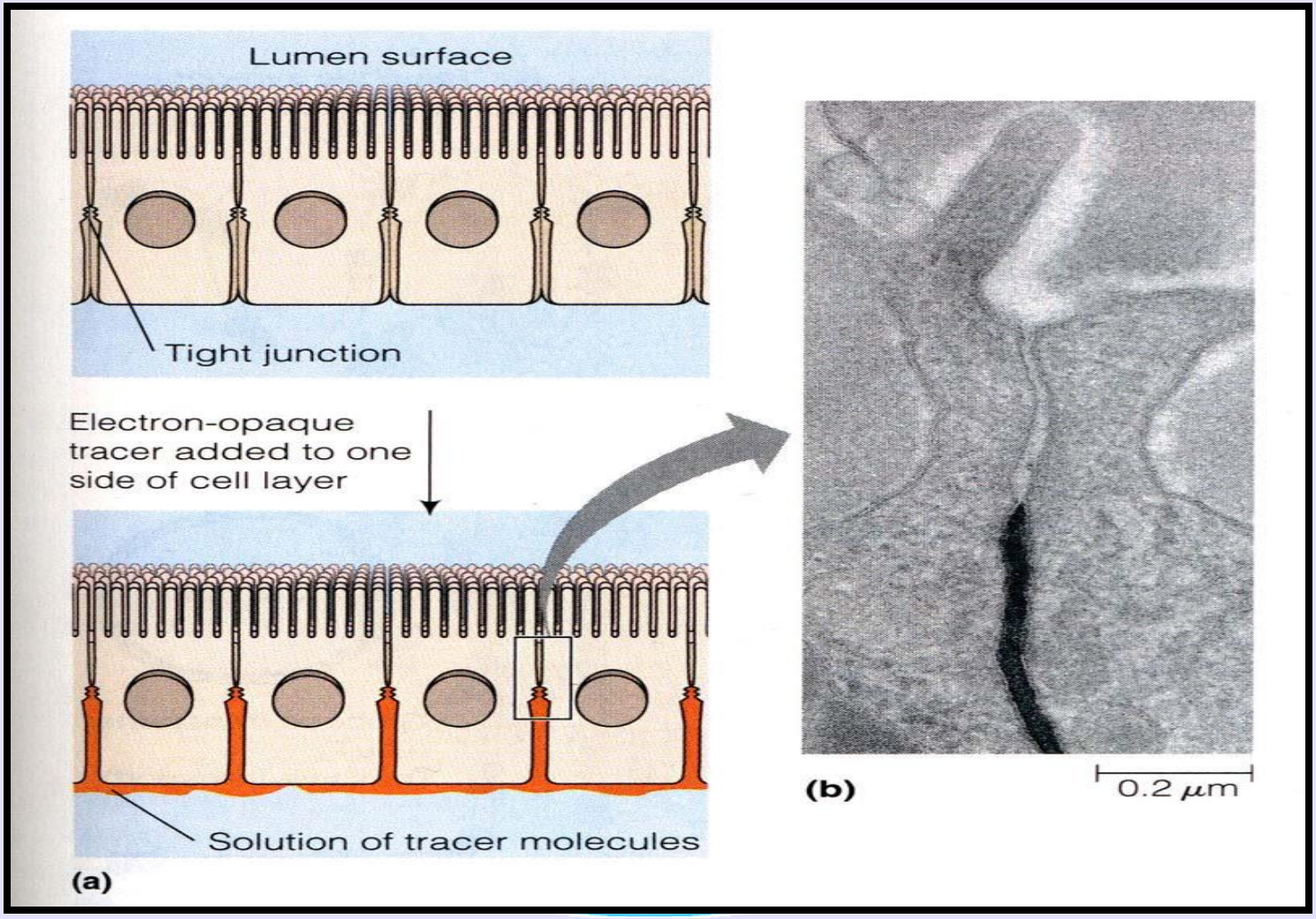
TYPES OF INTERCELLULAR JUNCTIONS

1. Zonula occludens (Tight junction).
2. Zonula adherens (Belt desmosome)
3. Macula adherens (Desmosome).
4. Gap junction (Nexus).

ZONULA OCCLUDENS (Tight Junctions)

- Most apical location.
- Plasma-membranes of the adjacent cells are fused, so no intercellular gap.
- Principal function: To form a more or less tight seal, sealing the intercellular space from luminal environment
- Found: b/w the epithelial cells, lining the intestinal mucosa.

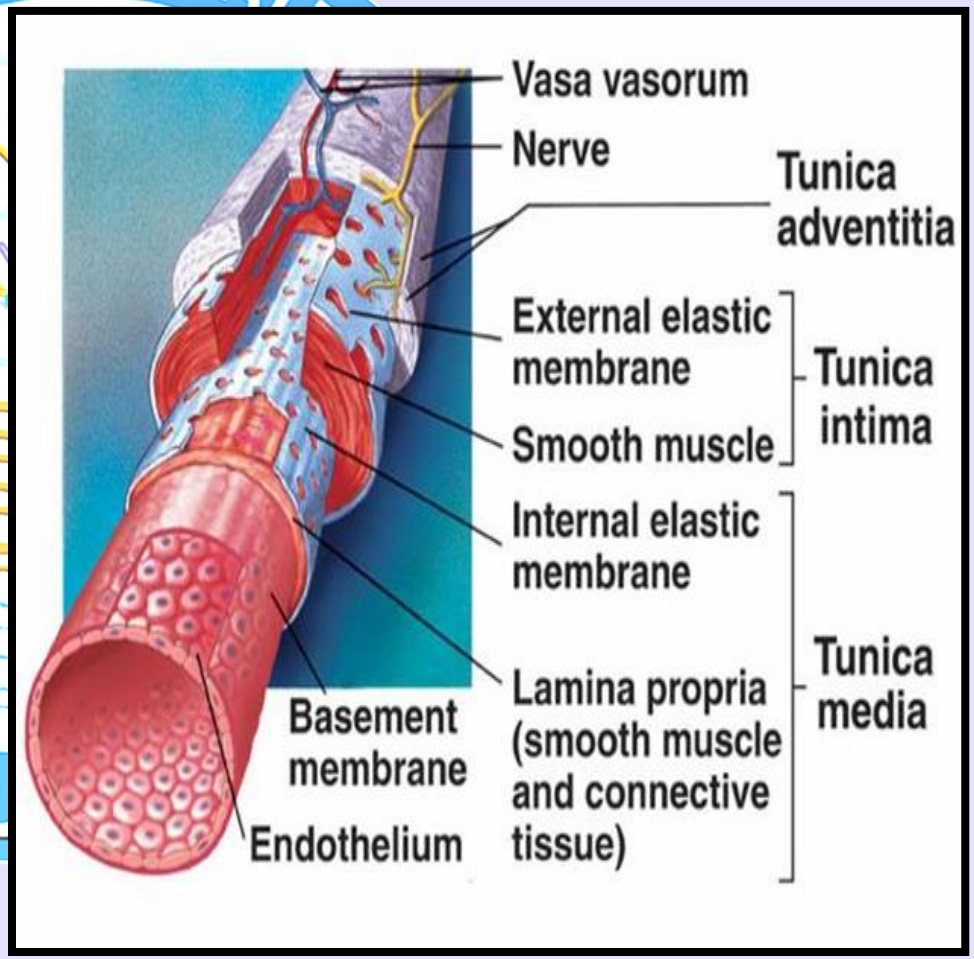



Lumen surface
Tight junction
Electron-opaque tracer added to one side of cell layer
Solution of tracer molecules
(a)
(b)
0.2 μm

FASCIA OCCLUDENS

- **Discontinuous strips of tight junction**

Found between endothelial lining of blood vessels

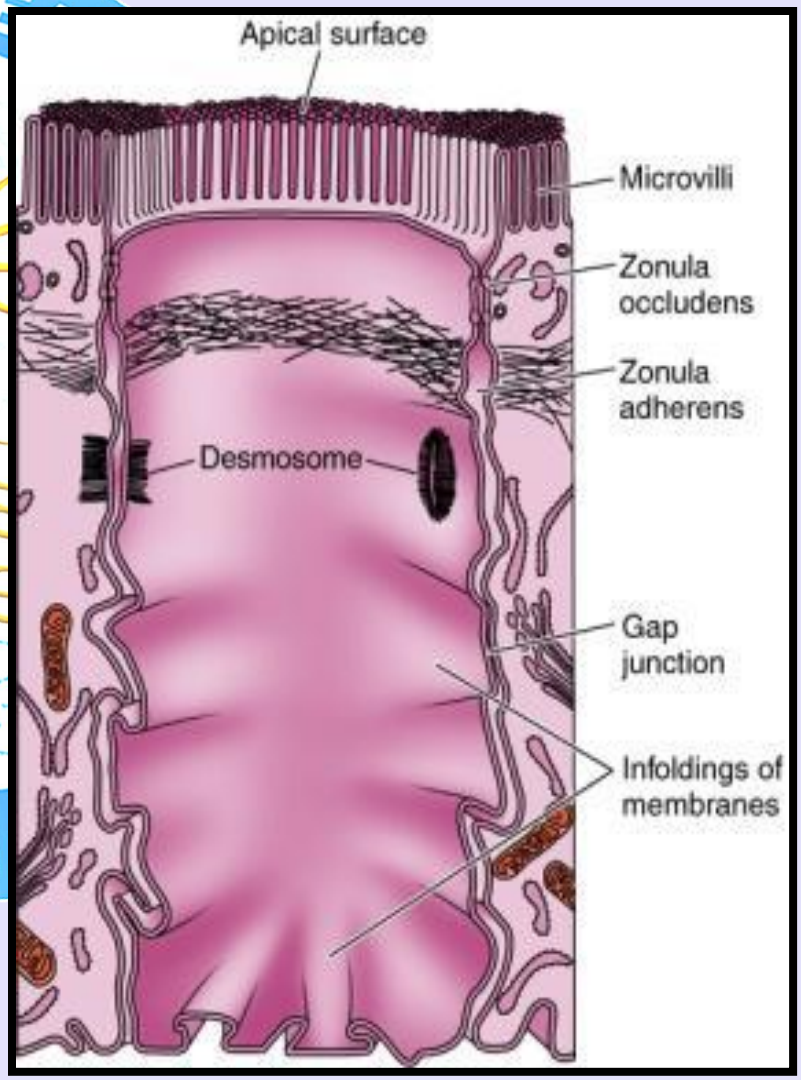


ADHERING JUNCTIONS

- Provide anchorage site for cytoskeleton
- May be in the form of

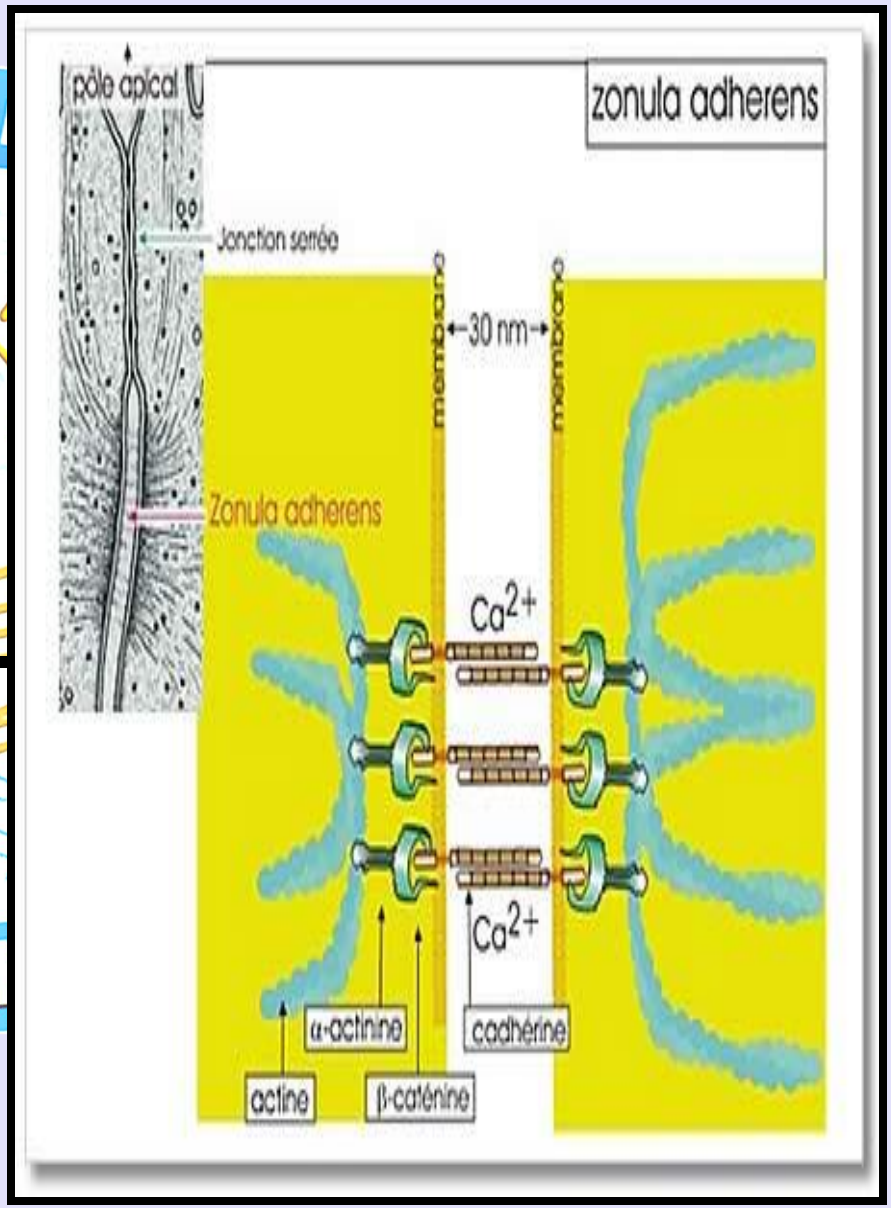
❖Belt----zonula adherens or belt desmosome

❖Spot or patch---- macula adherens or desmosome



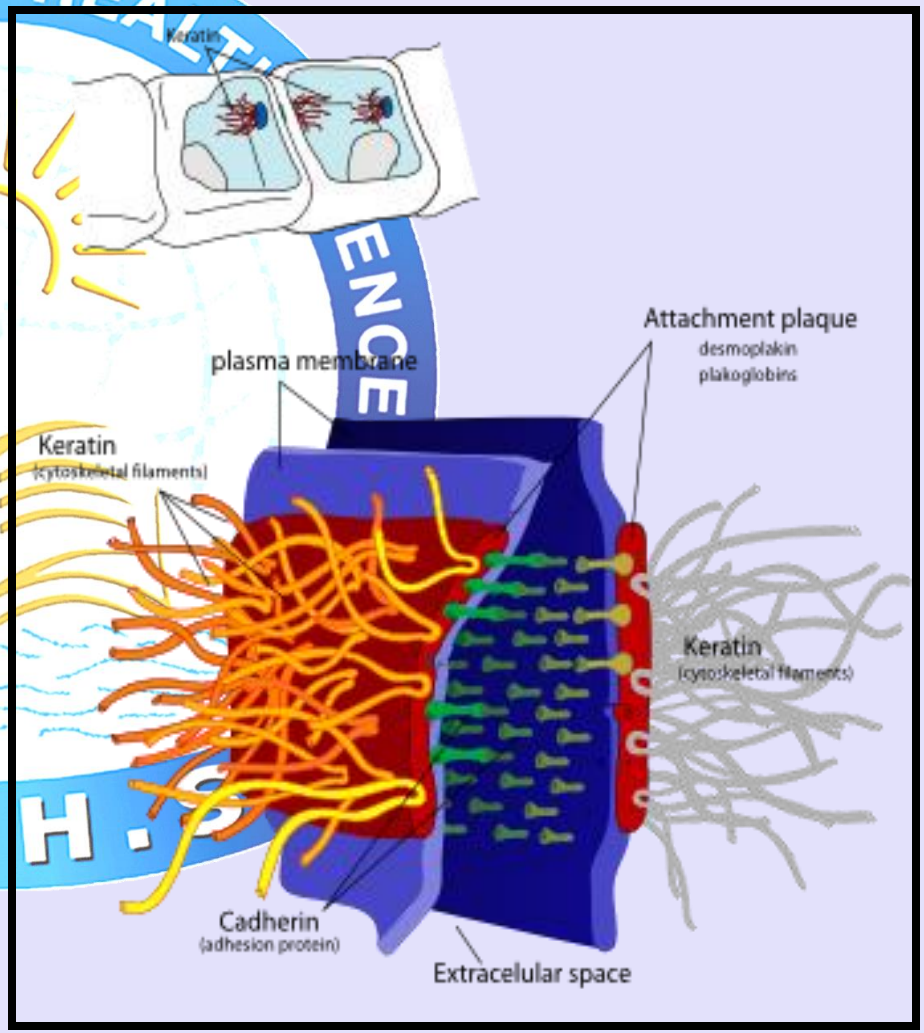
ZONULA ADHERENS

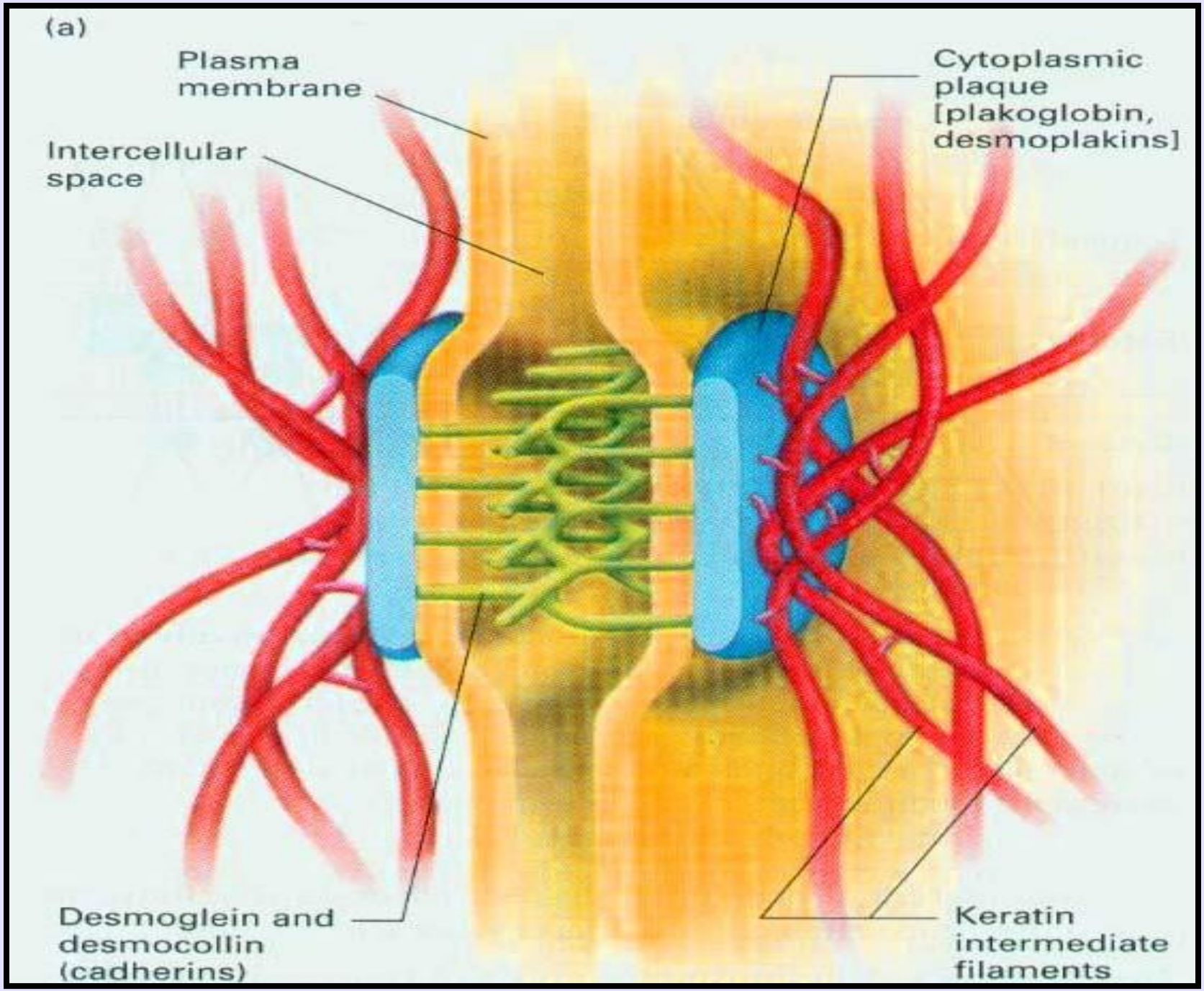
- **Intercellular gap is about 20 nm.**
- **<u>Noteworthy feature</u>: insertion of numerous actin filaments into the <u>Dense or Attachment plaques</u>, lying on the cytoplasmic surfaces of the junctional membranes.**
- **<u>Function:</u> form sites of binding b/w the adjacent cells.**
- **<u>Found</u>: among epithelial cells, fibroblasts, smooth muscle cells, etc**



MACULA ADHERENS(Desmosome)

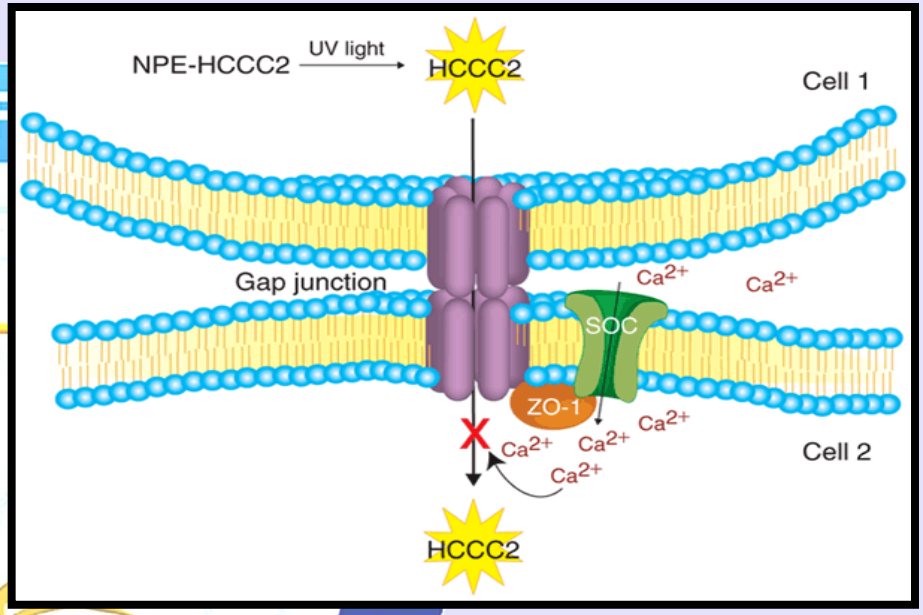
- **Small discoid (disk-shaped) structures, located at various levels.**
- **Cell-membranes are very straight in this region.**
- **Intercellular gap is normal (about 25 nm), contains a dense numerous fine transverse filaments called "Transmembrane linkers".**
- **Function: form binding sites b/w the adjacent cells.**
- **Found: among most epithelial cells.**

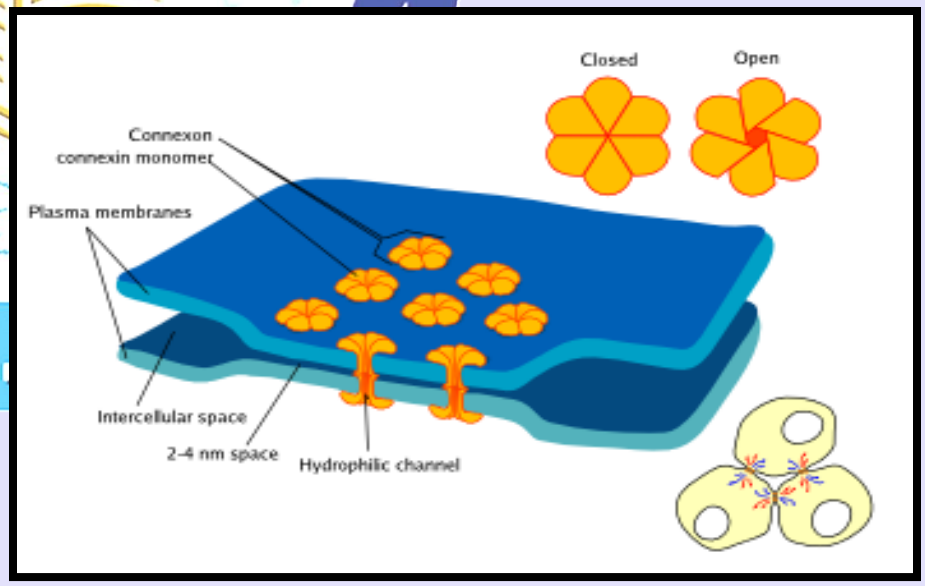



(a)
Plasma membrane
Intercellular space
Cytoplasmic plaque [plakoglobin, desmoplakins]
Desmoglein and desmocollin (cadherins)
Keratin intermediate filaments

GAP JUNCTIONS (Nexus)

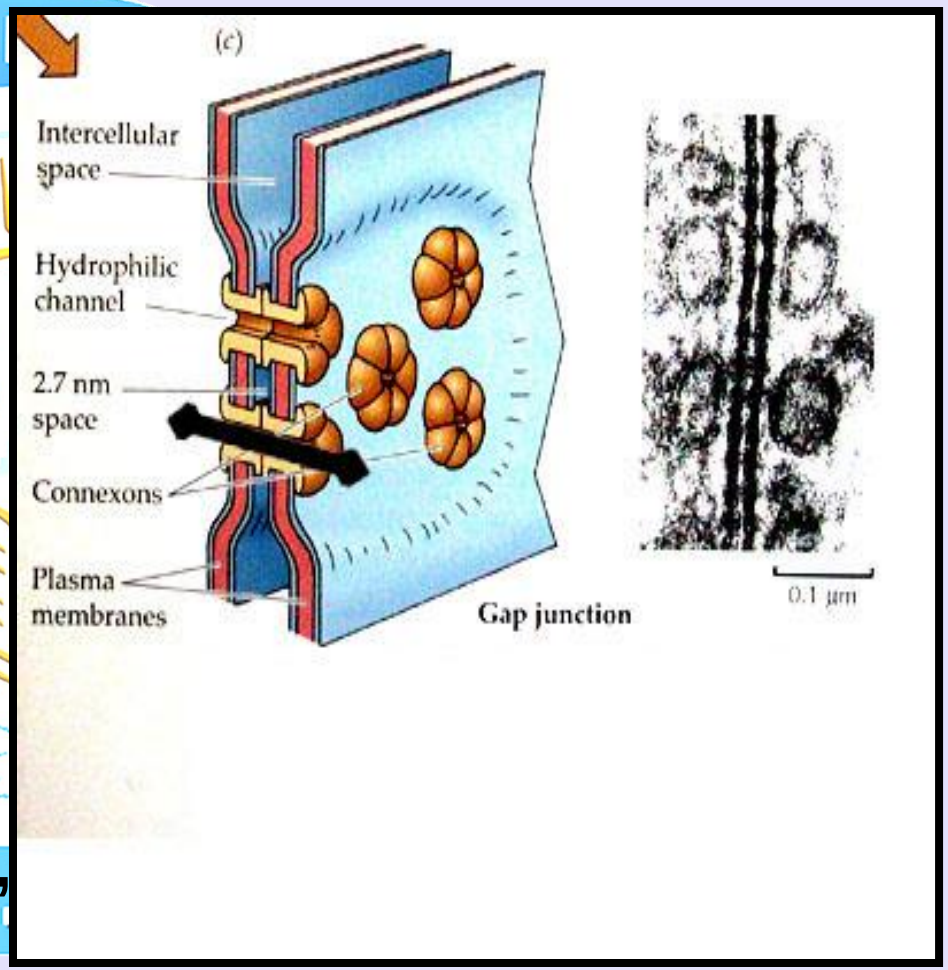
- Intercellular gap is narrow (about 2 – 4 nm).
- Protienaceous tubes called connexon that connect adjacent cells.
- These tubes allow material to pass from one cell to the next without having to pass through the plasma membranes of the cells.



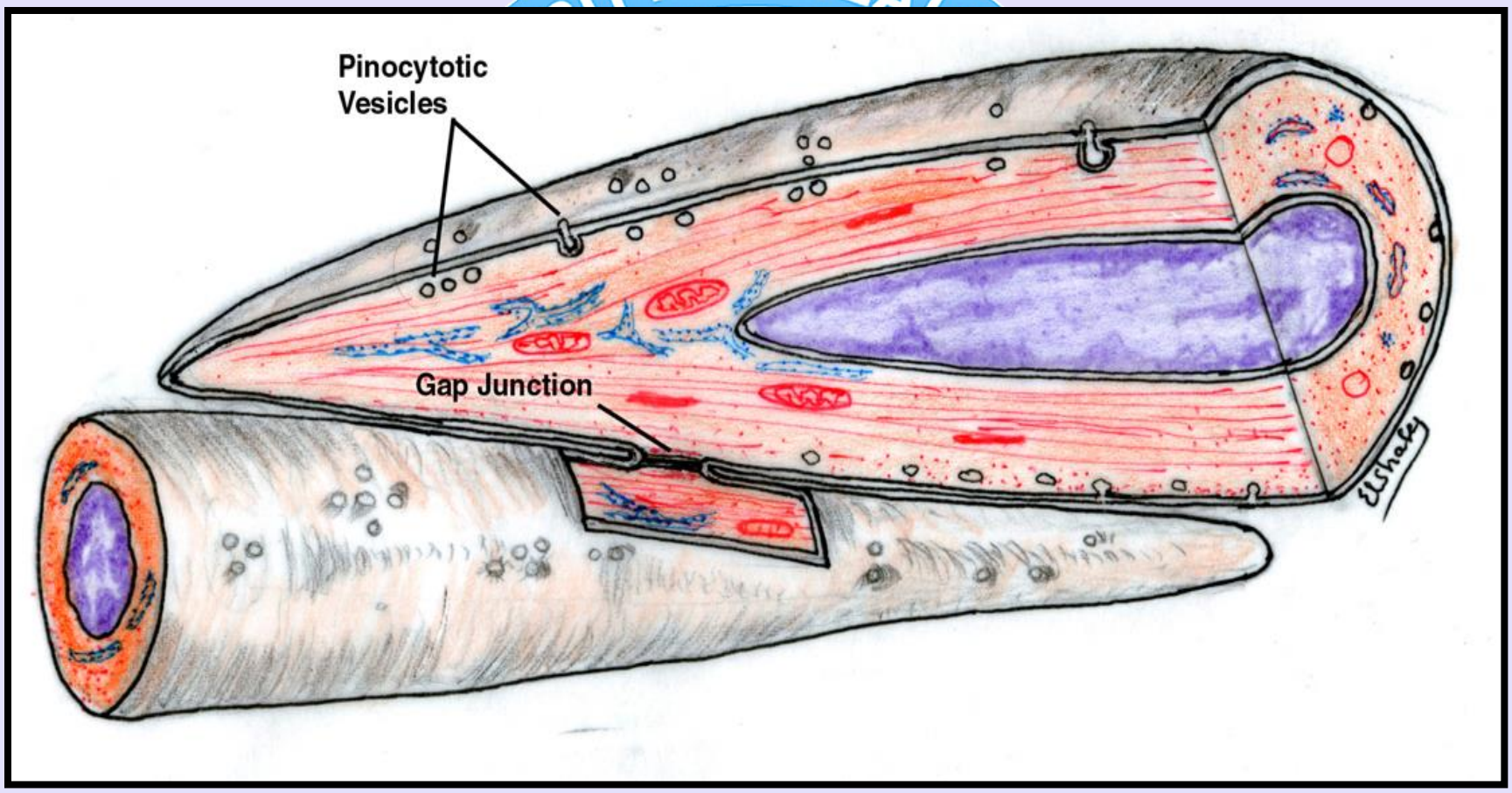


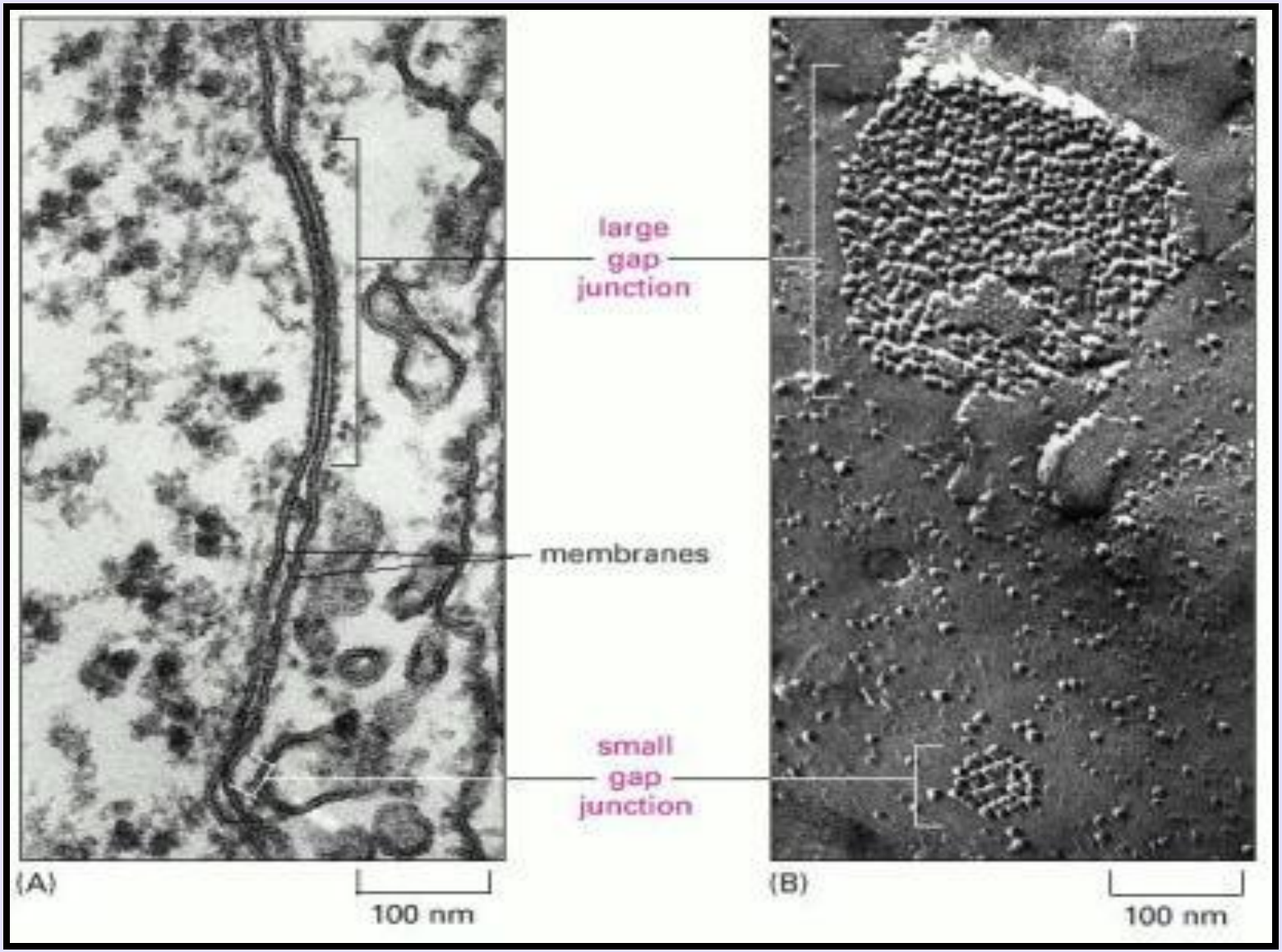
Function:

- Provide communication between the adjacent cells.
- Dissolved substances such as ions or glucose can pass through the gap junctions.
- Large organelles such as mitochondria connot pass.
- **Found**: Widely distributed. In skin, cardiac & smooth muscles, liver, kidney, thyroid, bladder, adrenals, pancreas, also in nervous system.



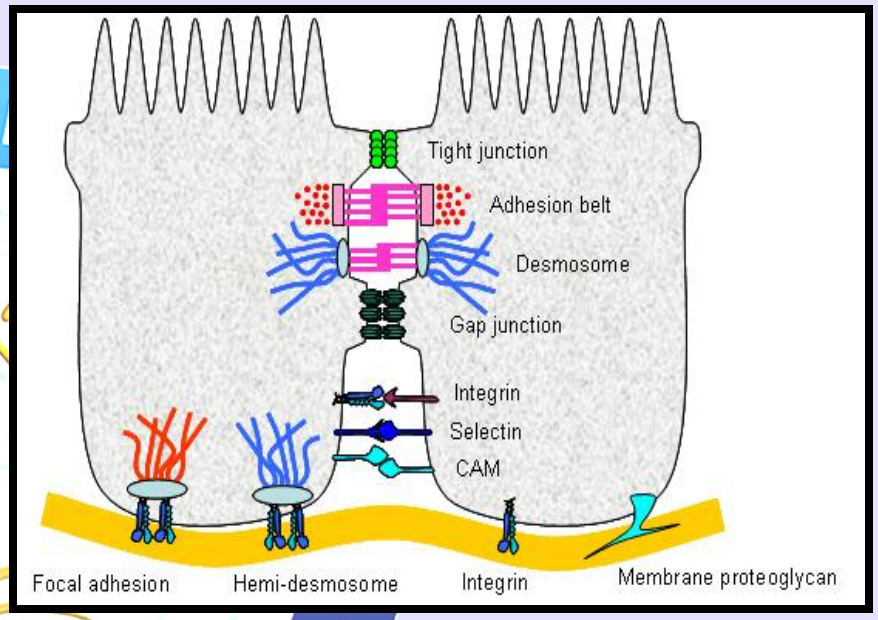
SMOOTH MUSCLE

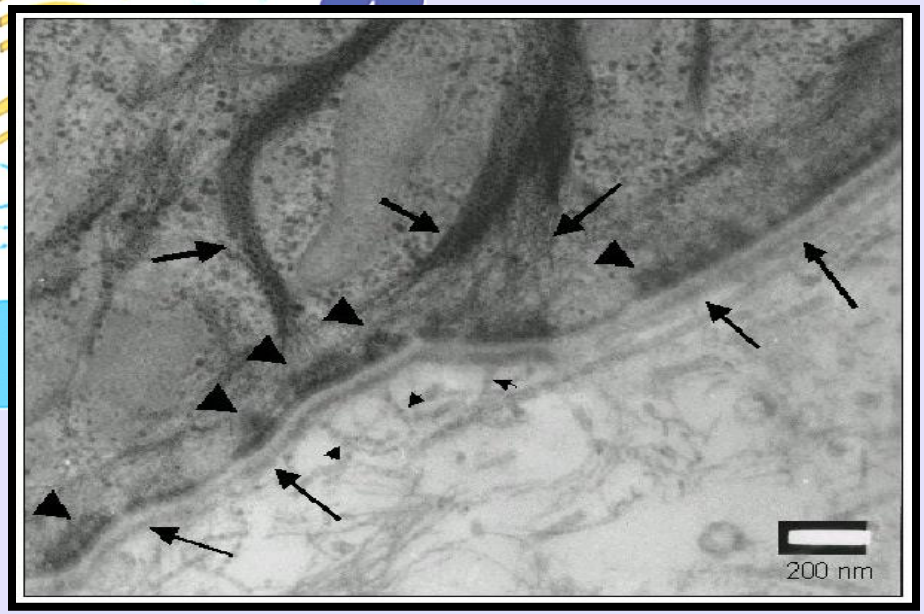



large
gap
junction
membranes
small
gap
junction
(A)
100 nm
(B)
100 nm

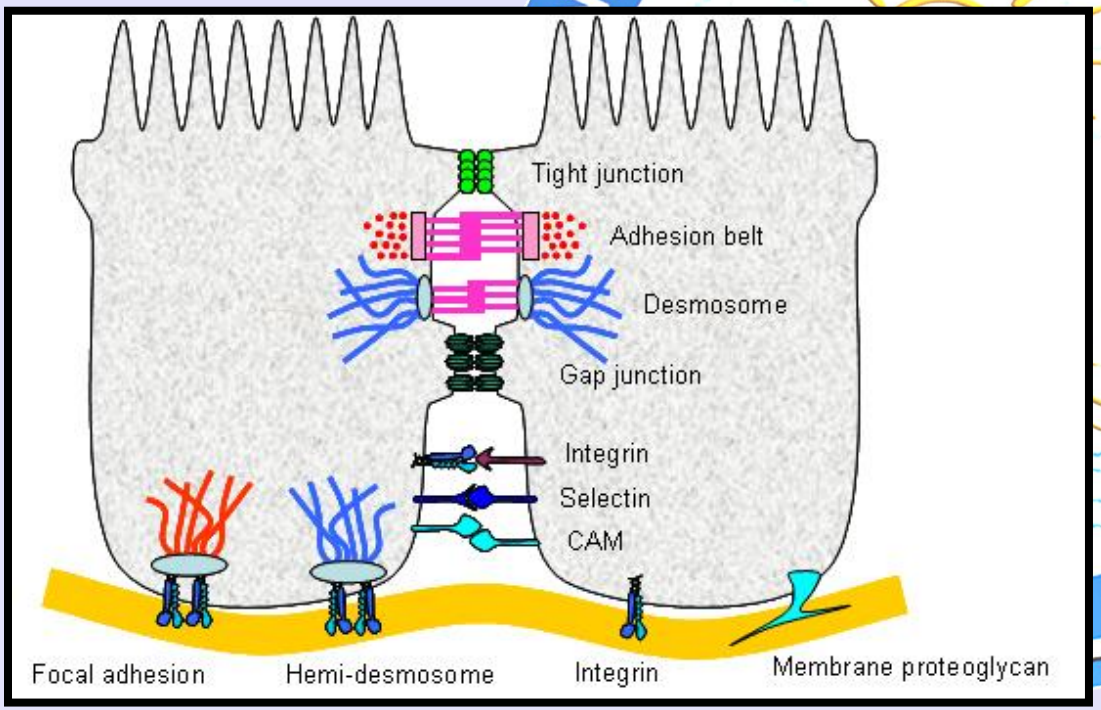
HEMIDESMOSOMES

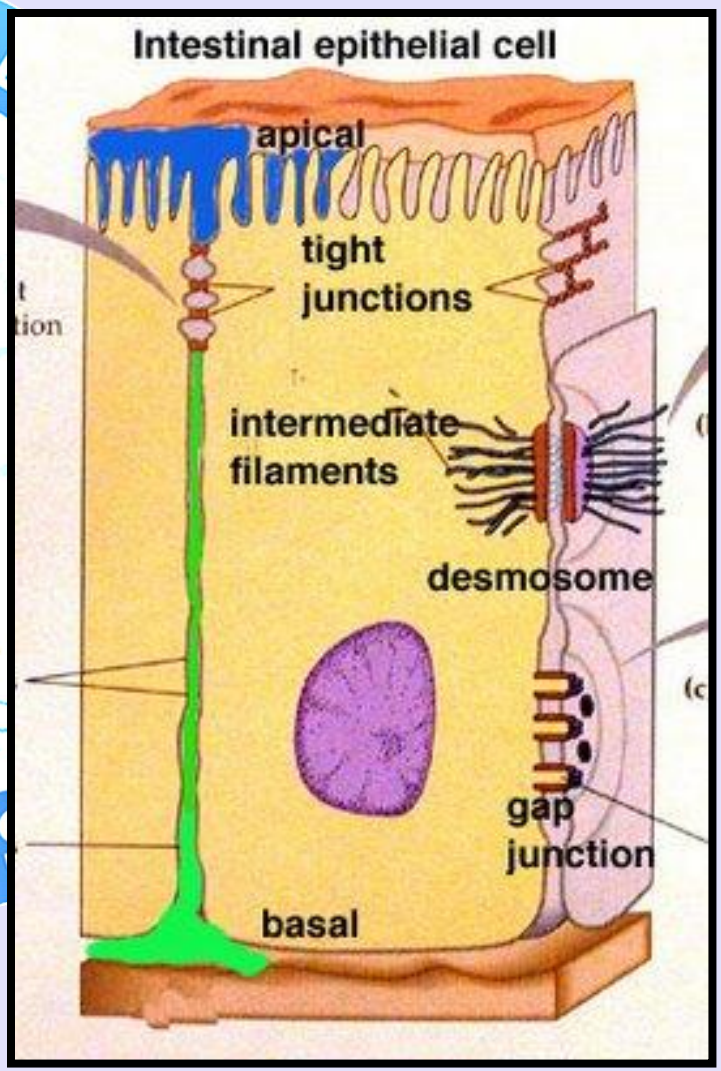
- Sometime observed in the contact zone b/w basal surfaces of the certain epithelial cells and the basal lamina.
- Morphologically these structures take the shape of half desmosome on the epithelial cell membrane only.
- Function: They serve to bind the epithelial cells to the subjacent basal lamina.

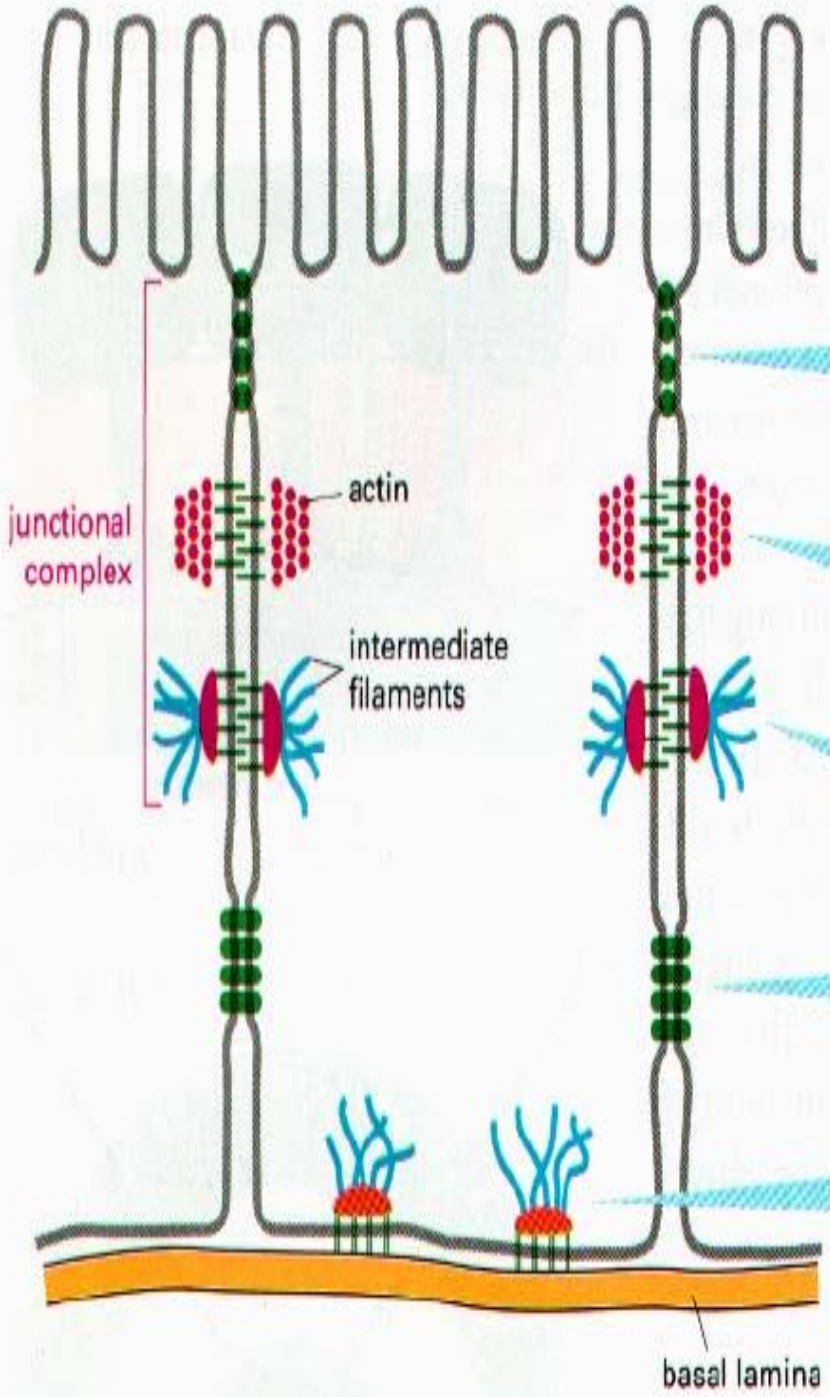




JUNCTIONAL COMPLEX







name	function
tight junction	seals neighboring cells together in an epithelial sheet to prevent leakage of molecules between them
adherens junction	joins an actin bundle in one cell to a similar bundle in a neighboring cell
desmosome	joins the intermediate filaments in one cell to those in a neighbor
gap junction	allows the passage of small water-soluble ions and molecules
hemidesmosome	anchors intermediate filaments in a cell to the basal lamina

JUNCTIONAL COMPLEX

- Three in one: The EM of an intestinal epithelium reveals a tight junction (arrows 1 to 2), adherens junction (arrows 2 to 3), and desmosomes (arrows 4 to 5).

JUNCTIONAL COMPLEX

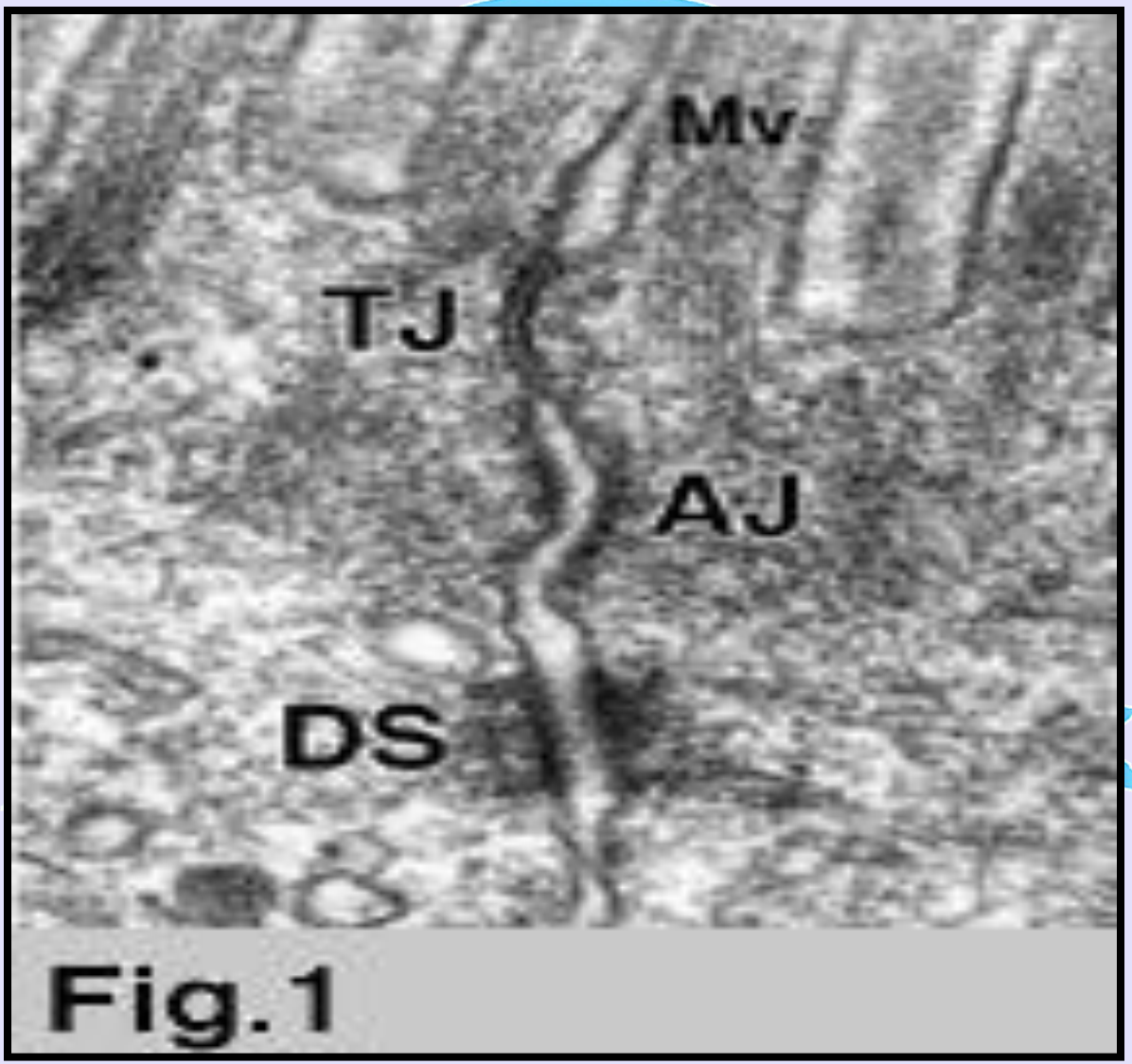
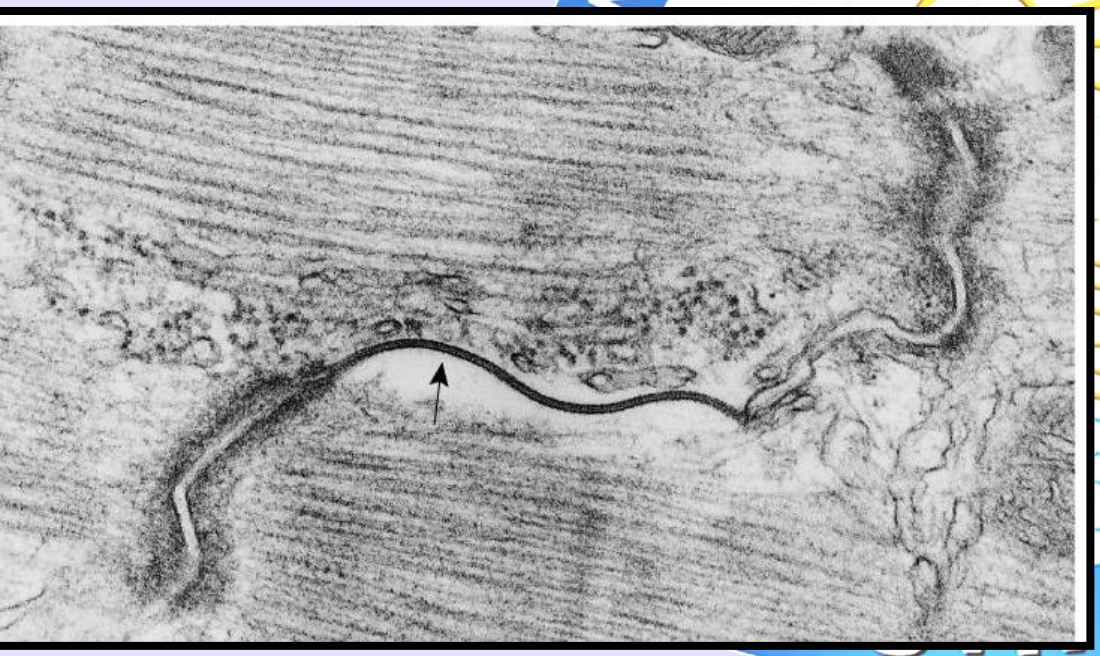
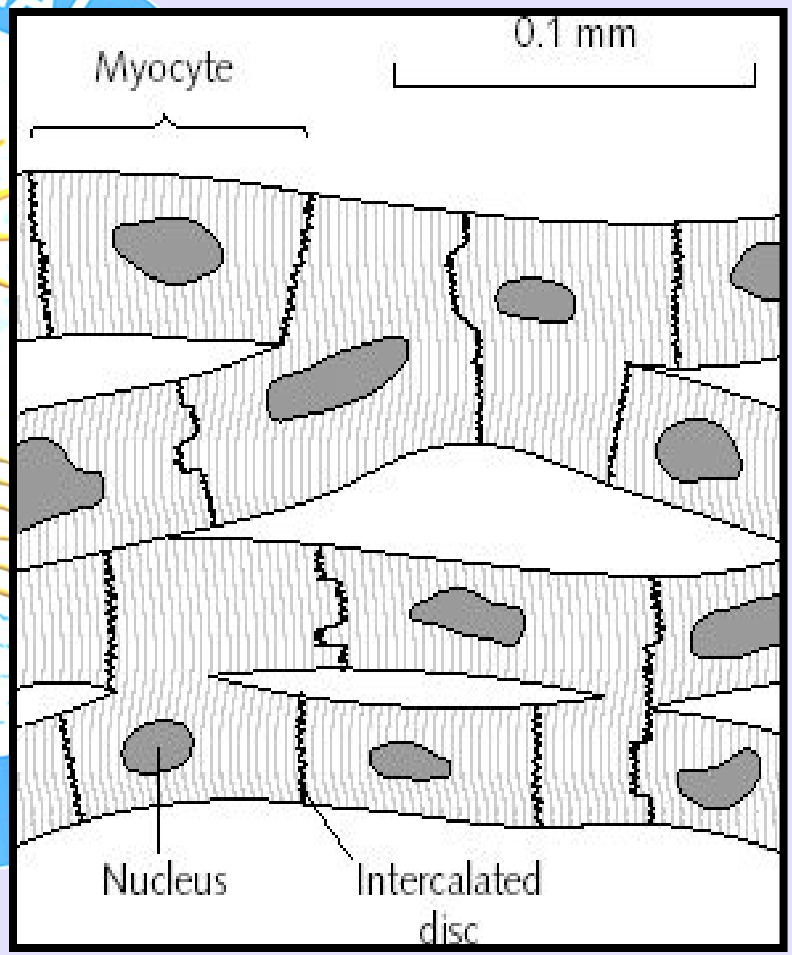


Fig.1

CARDIAC MUSCLE





REFERENCES

BASIC HISTOLOGY BY

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