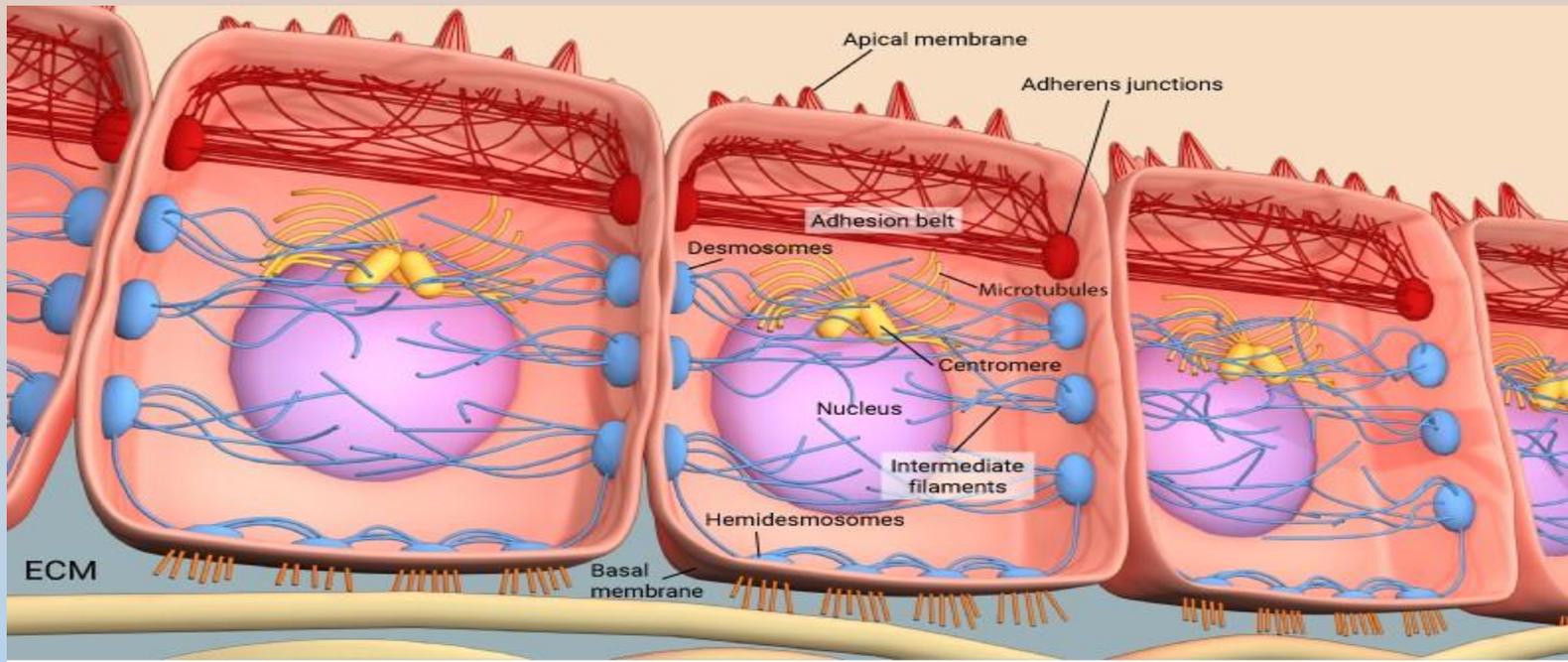


Cell junctions



By

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OUTCOMES

- 1. Know the definition and functions of cell junctions.**
- 2. Know the cell polarity.**
- 3. Identify the components of cell adhesions.**
- 4. Identify the cell adhesion molecules (CAMs) .**
- 5. Describe and relate the structural characteristics of different types of cell junctions to its specific function.**

Cell junctions

Definition:

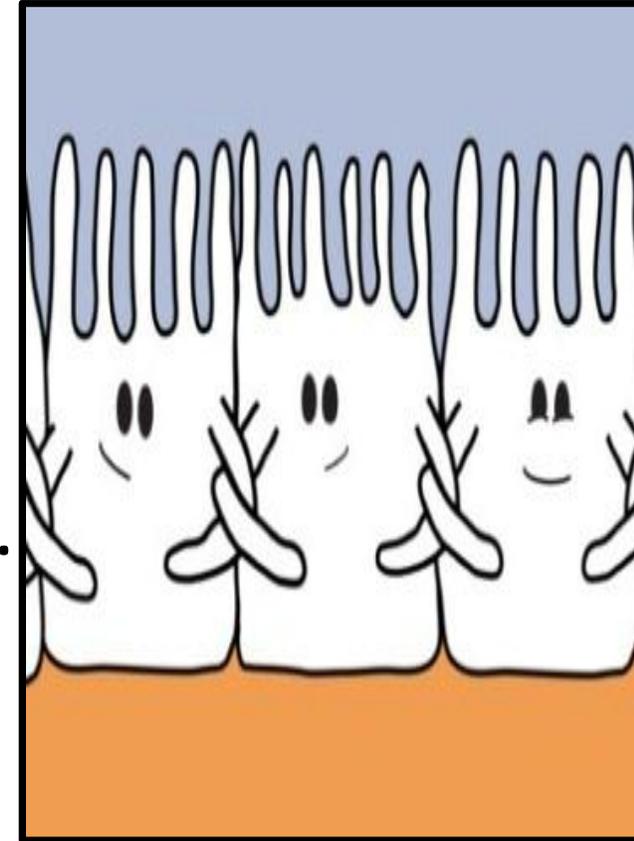
They are several **membrane-associated structures**.

Function:

Provide **adhesion** and **communication** between cells.

Sites:

- Some are present in tissues
- But all are particularly numerous and **prominent** between **epithelial cells**.

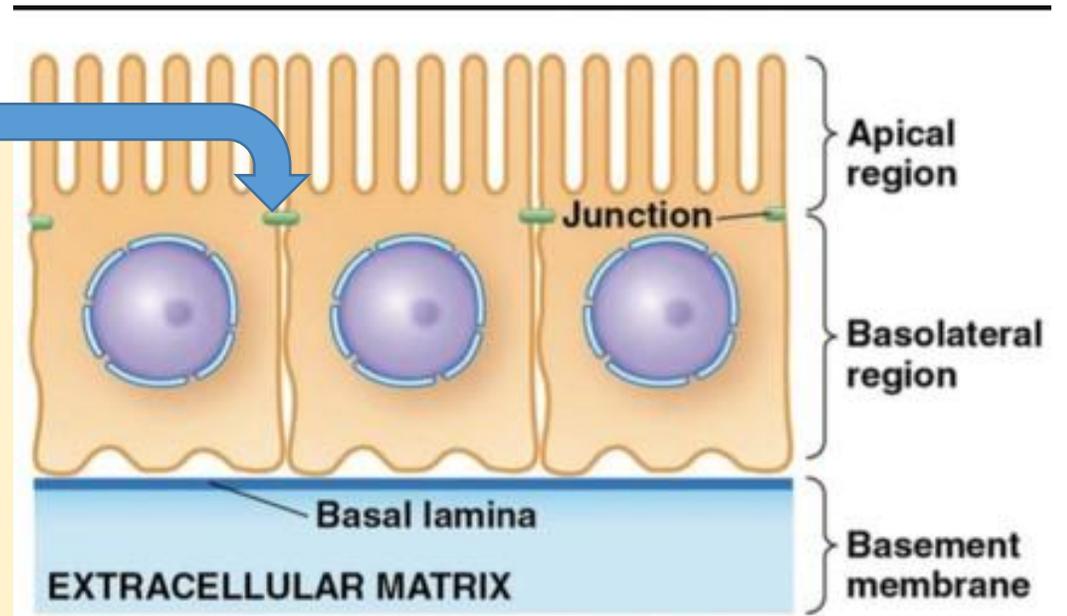


Cell junctions

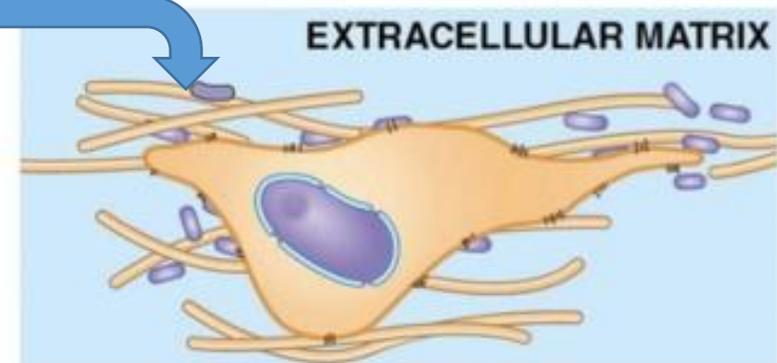
Is the connection between adjacent cells
(Cell-cell adhesion)

or

The connection between the cell and
extracellular matrix (basement membrane)
(Cell-matrix adhesion)



(a) Epithelial tissue



(b) Cell embedded in connective tissue

Cell adhesion is a dynamic process

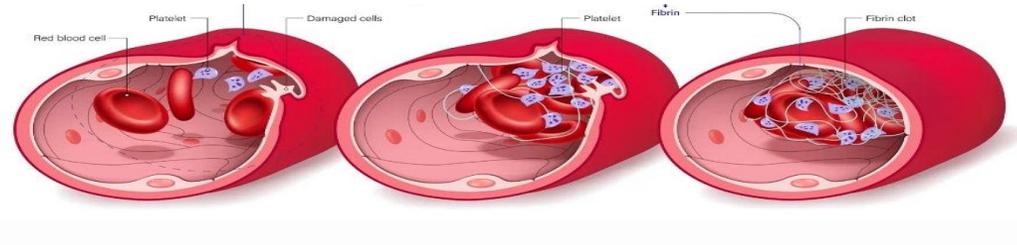
Adhesive cells become non adhesive

Epithelial cells are adhesive that become non adhesive
as in cancer

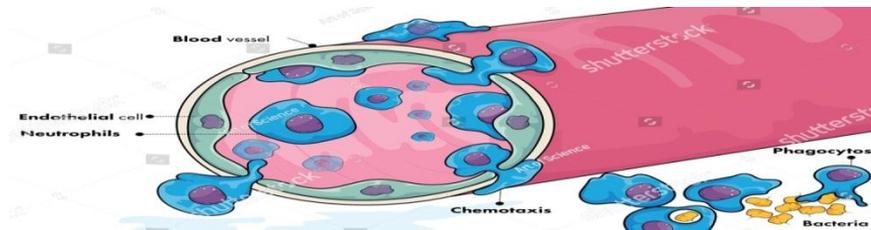


Non adhesive cells that become adhesive:

- **Platelets** to form blood clot.

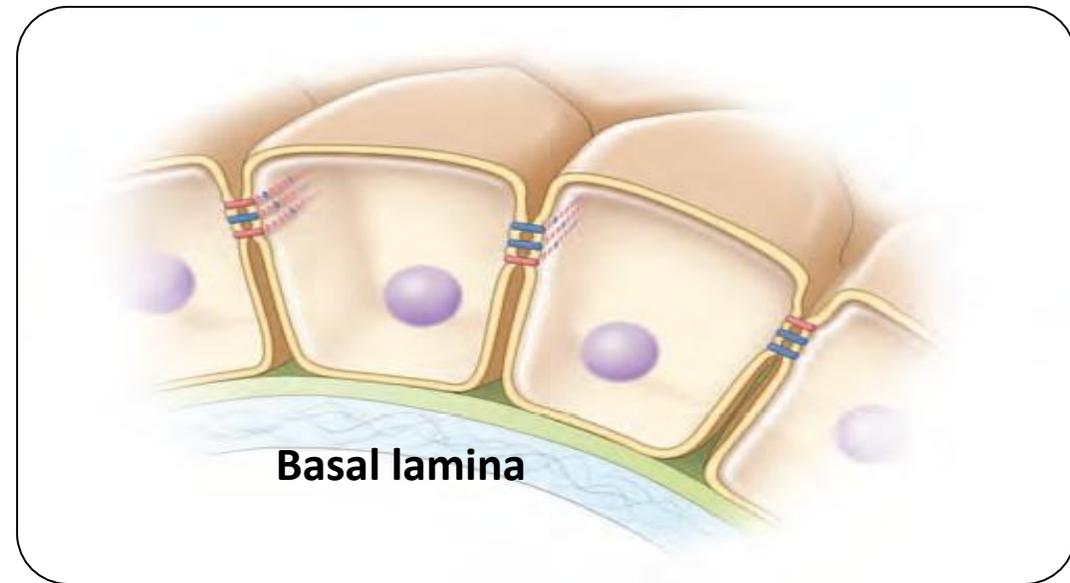
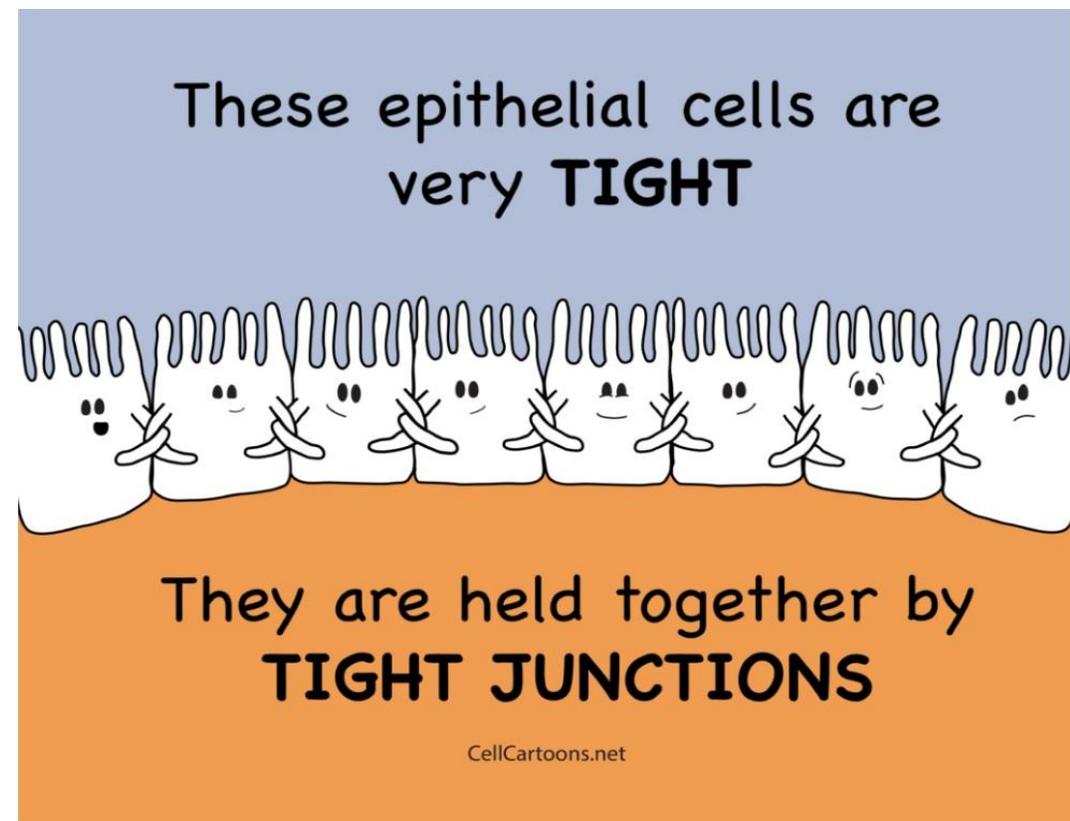


- **Neutrophils** during migration to tissues.



The epithelial cells :

- ❑ **Closely aggregated cells.**
- ❑ Resting on **basal lamina.**
- ❑ Have **strong adhesion** to one another and attached to each other by **many types of cell junction** Forming **continuous sheet** especially cells subject to friction or other mechanical forces (e.g): epidermis of the skin.



Cell polarity

Epithelial cells have **different poles**, each one has **specific biochemical** and **structural specializations** to perform **specific function**.

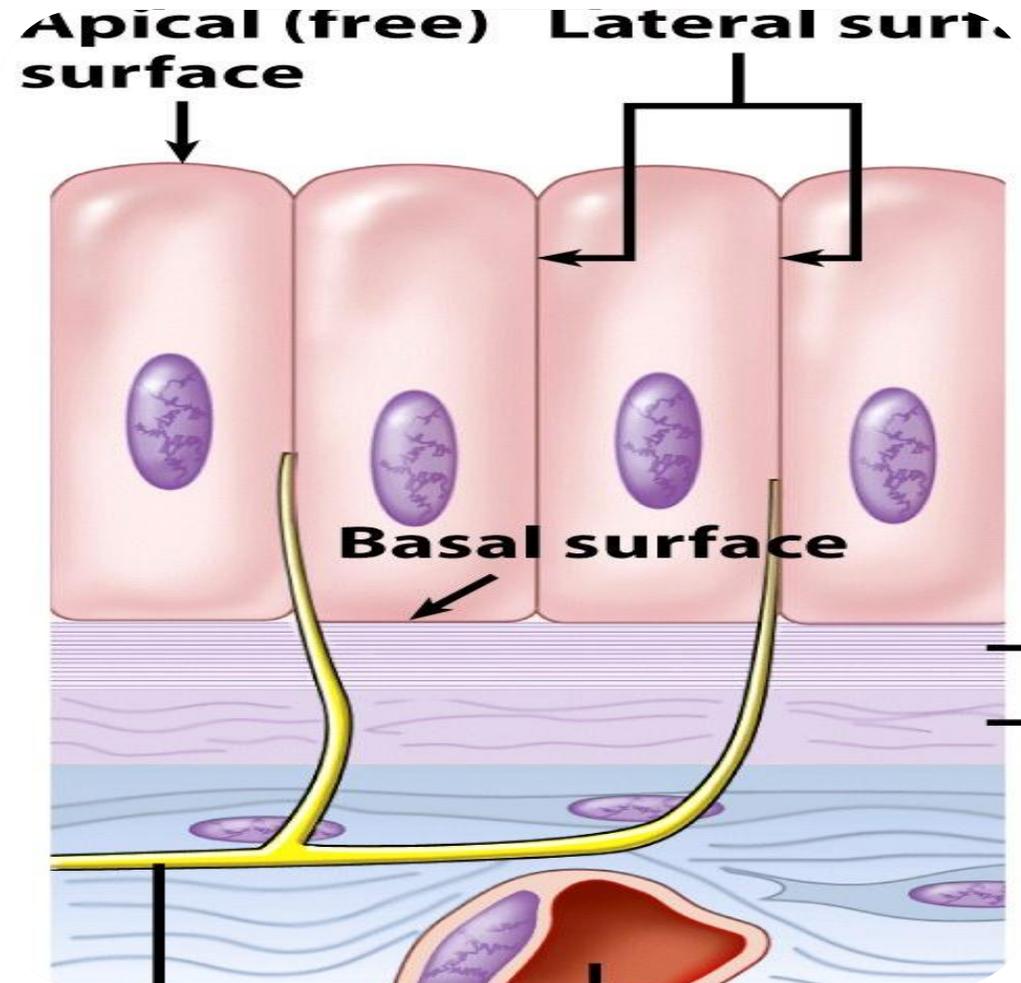
A- Apical pole.

B- Basal pole.

C- Lateral surfaces.



3 D shape



Specializations Of The Cell Surface

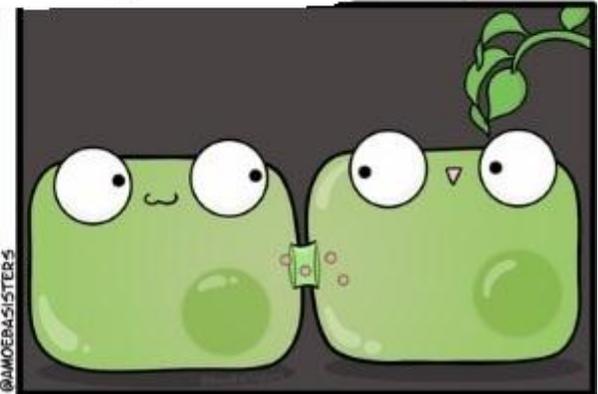
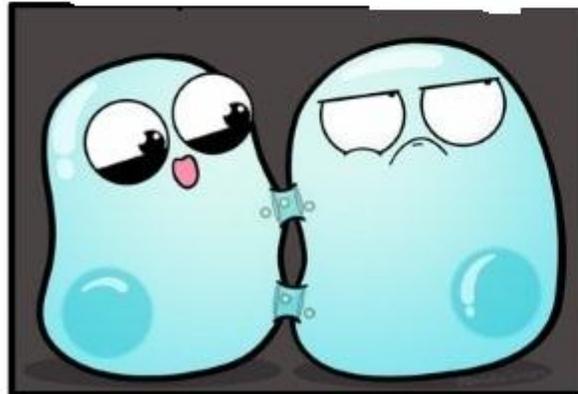
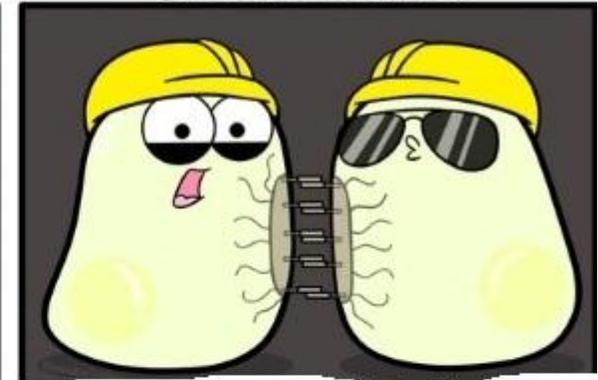
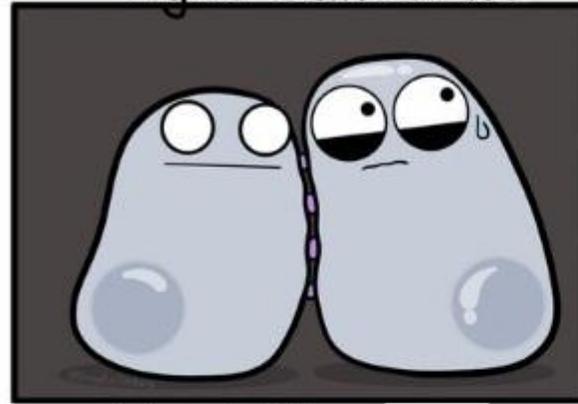
A- Apical specializations.

B- Basal specializations.

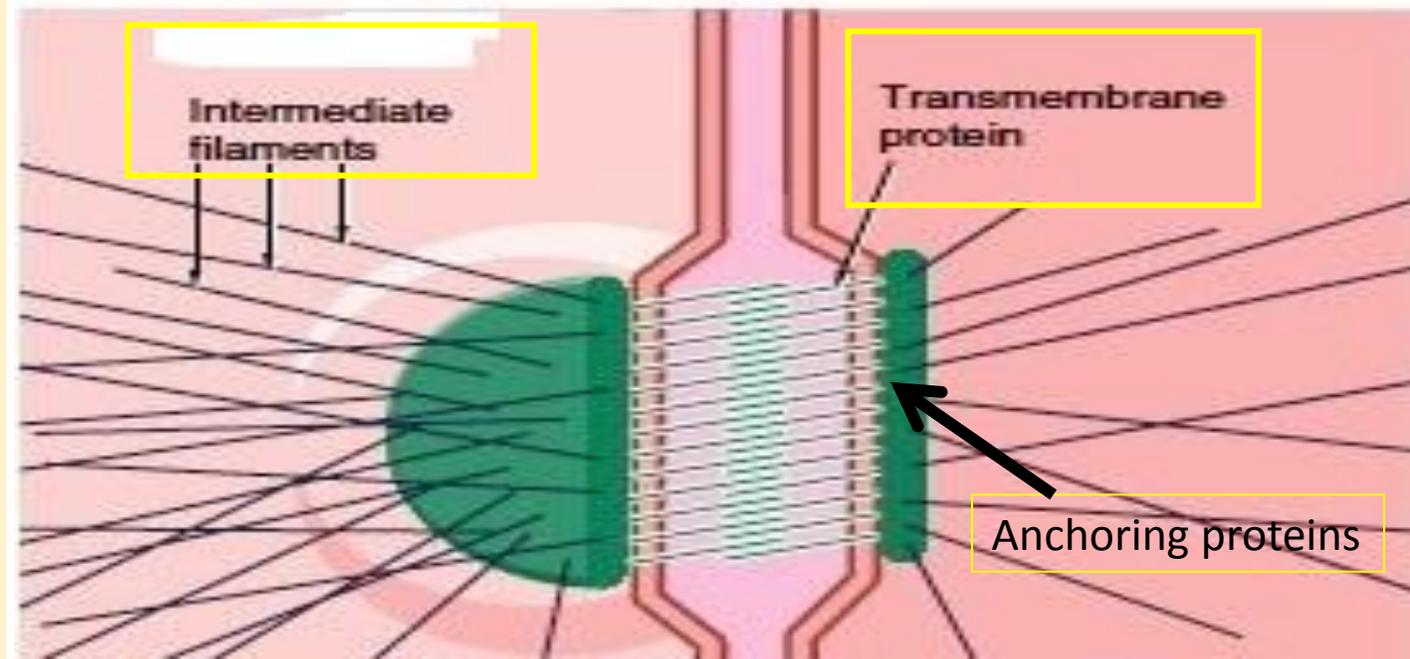
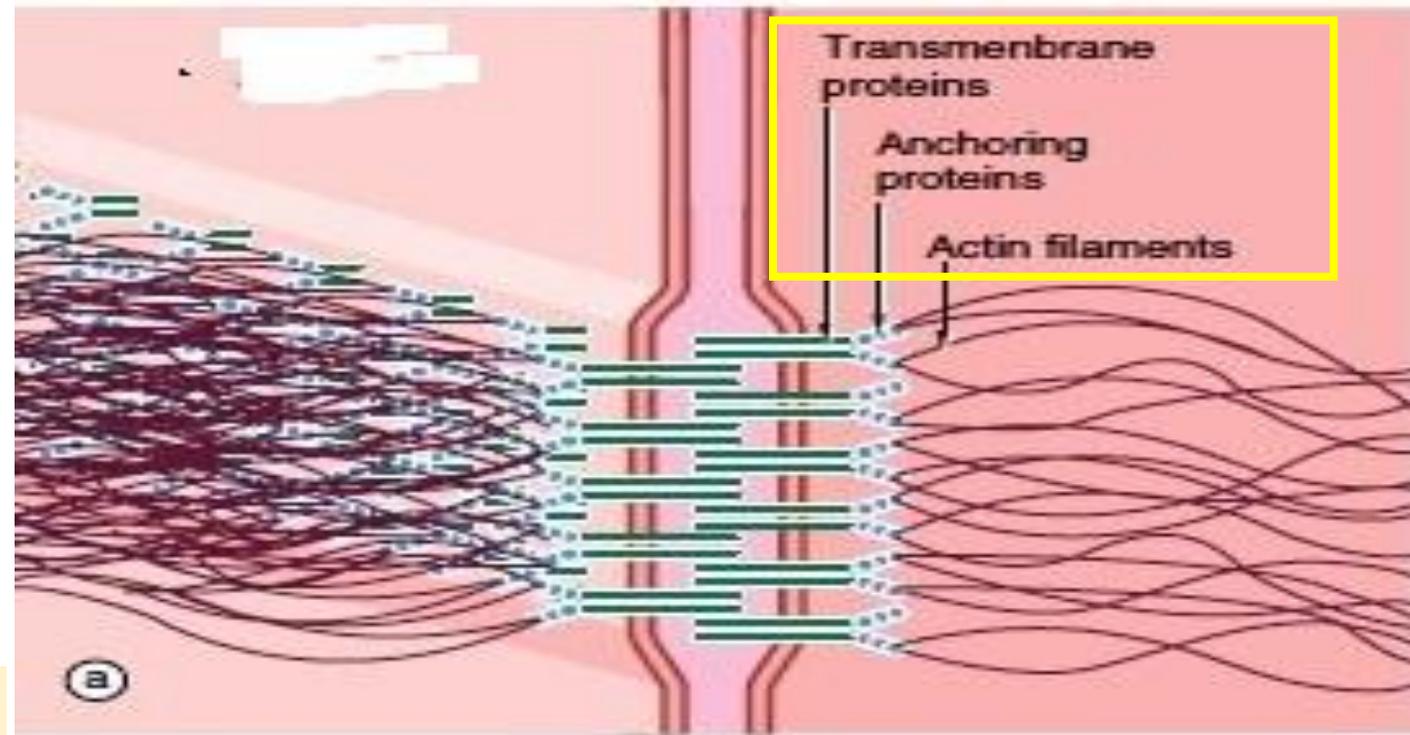
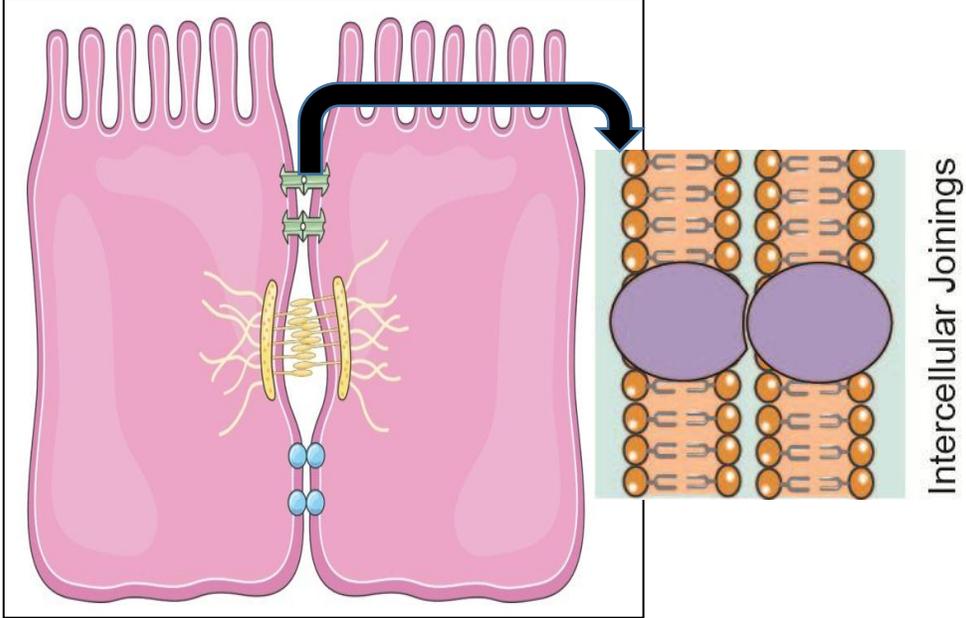
C- Lateral specializations.

A- Apical specializations	B- Lateral specializations	C- Basal specializations
1) Microvilli	1) Impermeable junctions	1) Hemidesmosome
2) Stereocilia	2) Adhering junctions	2) Basement membrane & basal lamina
3) Cilia	3) Communicating junction	3) Basal Infoldings
4) Flagella	4) Lateral interdigitations	

How **cells** communicate to each other????



@AMOEBASISTERS



1. Transmembrane proteins.

2. Anchoring proteins.

3. cytoskeletons :

-Actin filament

-Intermediate filament

Cell adhesion (junction) is due to the action of

1-Cell Adhesion Molecules (CAMs)

2-Intercellular junctions (Adhesions)

Cell Adhesion Molecules (CAMs)

❑ Definition:

They are transmembrane proteins. Proteins on a cell's surface that allow the cell to bind to other cells or the extracellular matrix.

❑ Structure: CAM molecule composed of 3 major domains:

The extracellular domain:

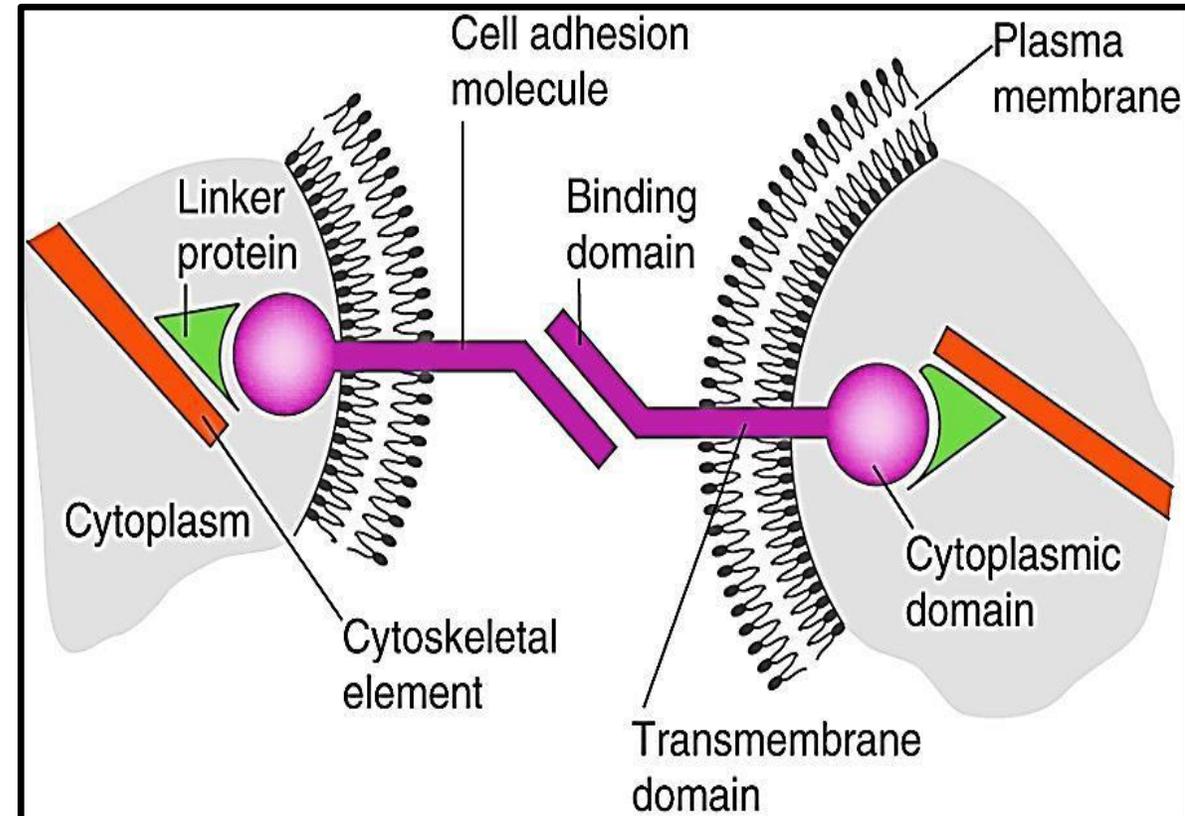
allows one CAM to **bind with another CAM** on an adjacent cell

Intermembrane domain:

present within the phospholipid bilayers.

The cytoplasmic domain:

is directly connected to the **cytoskeleton** by **anchoring (linker) proteins**.



Types of CAMs :

1- Calcium-dependent : affected by calcium concentration in the tissues:

Cadherin :

- involved in cell to cell adhesion.
- present in adhering junction.

Selectins :

involved in transient cell to cell adhesion

Help adhesion of neutrophils with endothelial cells.

Integrins:

involved in cell to matrix adhesion.

Bind cell to the extracellular matrix (basement membrane),

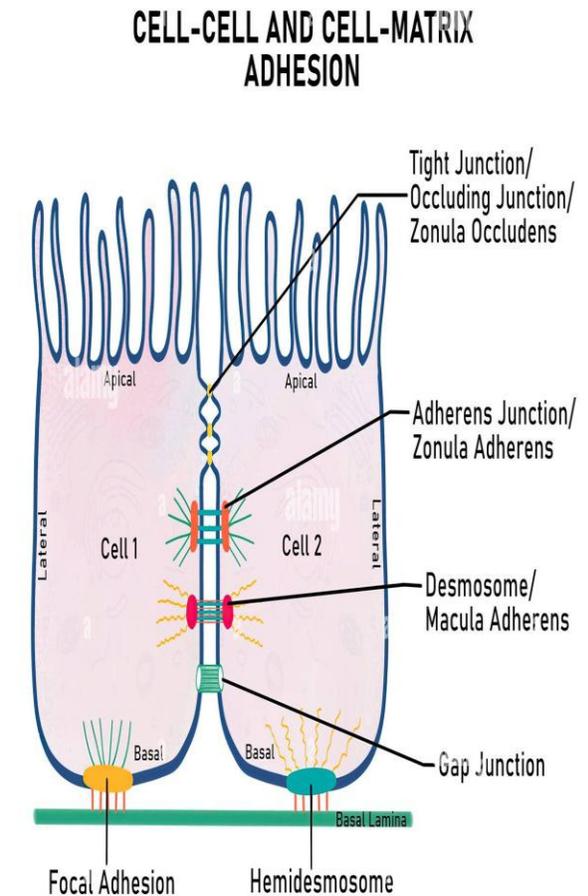
2-Calcium-in dependent: not affected by calcium concentration in the tissue.

Immunoglobulin superfamily :

Involved in neural cell to cell adhesion

Intercellular junctions (Adhesions)

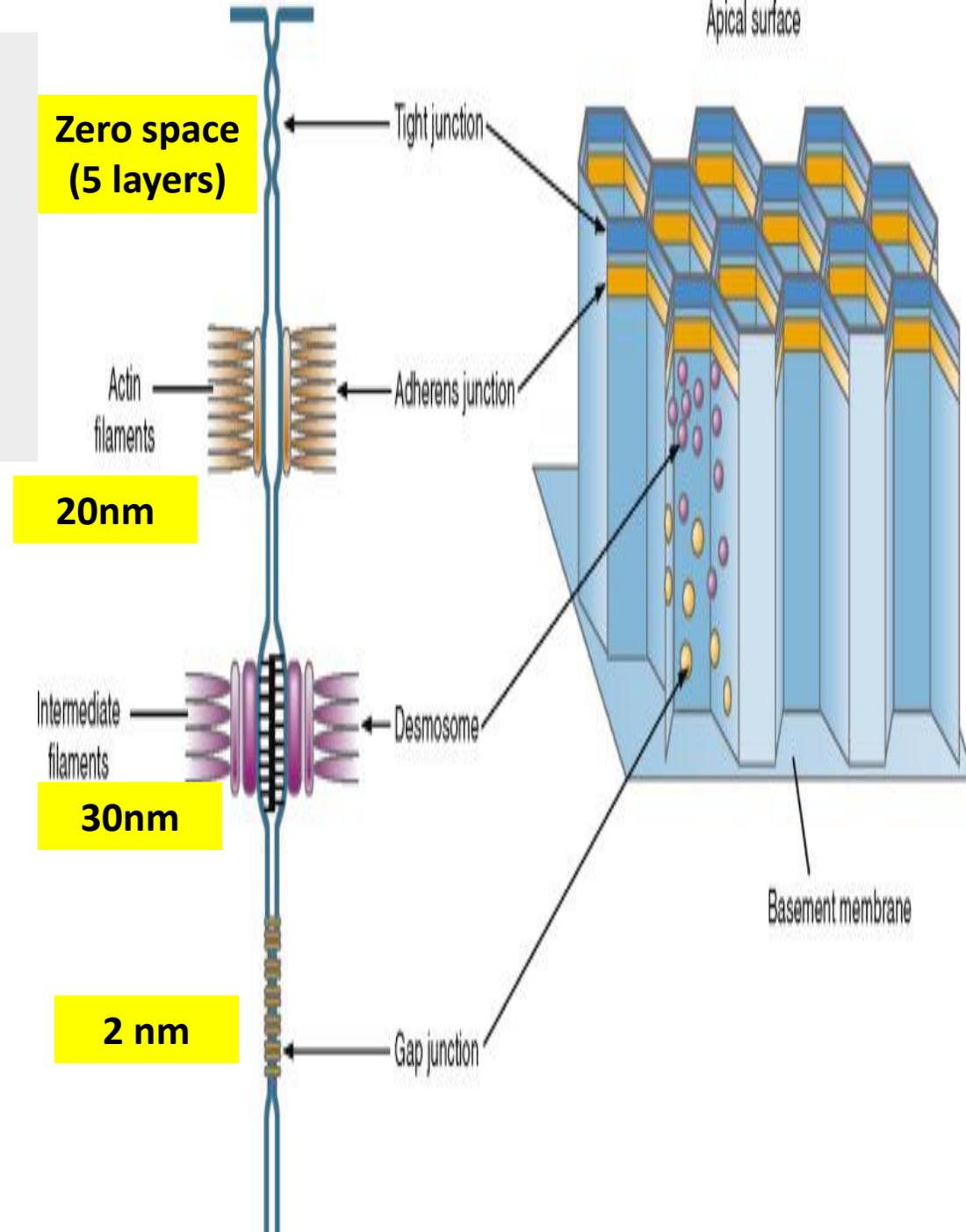
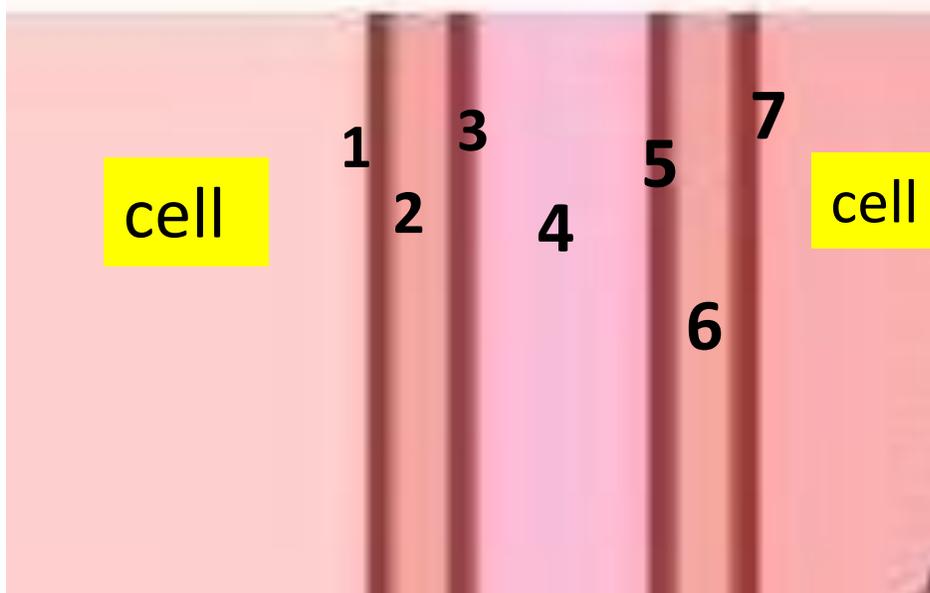
- They are **several** specialized intercellular junctions with **different functions**:
- Present in a definite order from **apex to base** of epithelial cells.
- ✓ **Occluding or Impermeable junctions (Tight junction)**: **seal cells together** to prevent the passage of molecules into the intercellular space.
- **Adherent or anchoring junctions** **attach cell to cell-** provide strong attachment between them .They are:
 - *Zonulae adherens.*
 - *Desmosomes.*
 - *Hemidesmosomes.*
- ✓ **Communicating junctions(Gap junctions)**: are channels allow movement of molecules between the adjacent cells.



Normally : intercellular space (20 nm).

Normally **7 layers** between adjacent cells:

- 3 for each trilaminar cell membrane
- 1 for intercellular space



Occluding or Impermeable junctions (Tight junction)

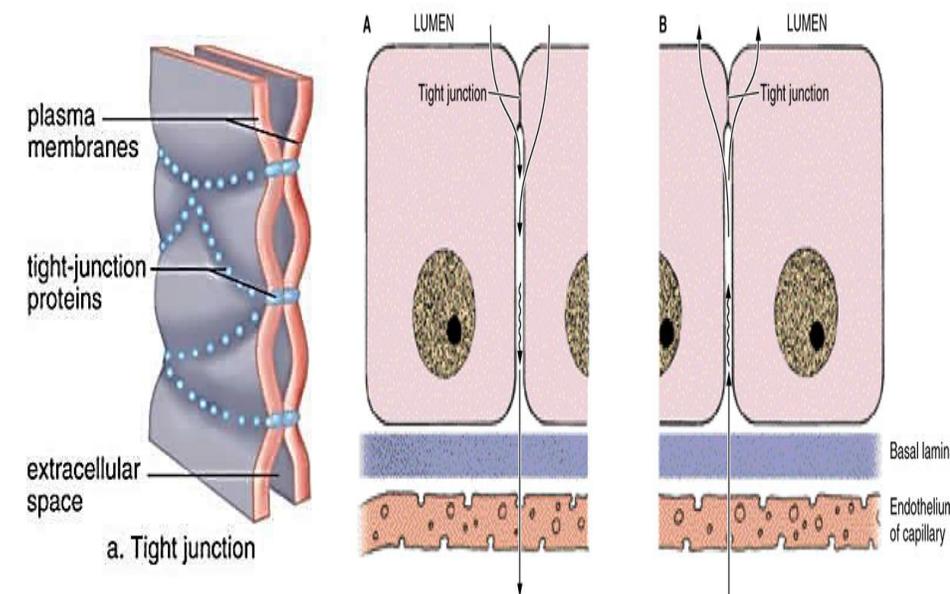
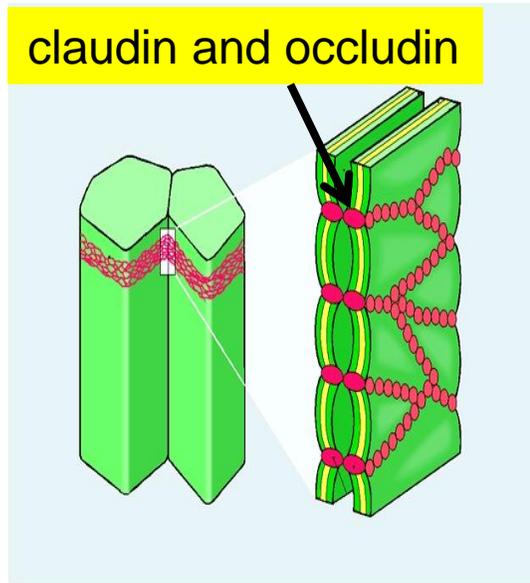
-The most apical junction

□ Structure:

- Completely encircles the apical surface of epithelial cells like a **belt (Zonulae occludens)**.
- Completely seal the adjoining cells.
- Completely close the **intercellular space** by fusion of the **transmembrane proteins** of the adjoining cells (claudin and occludin).

□ Function: provide a tight seal that prevent the flow of material in the intercellular space.

□ Sites: -Columnar cells of small intestine
-Urinary bladder



Adherent or anchoring junctions

- **Functions:**

- Provide strong attachment between cells.
- Act as linker between the cytoskeleton of the adjoining cells

- **Sites:**

At cell that are subjected to **severe mechanical stress**.

e.g:- cardiac muscle

-Epidermis of skin.

- **They are:**

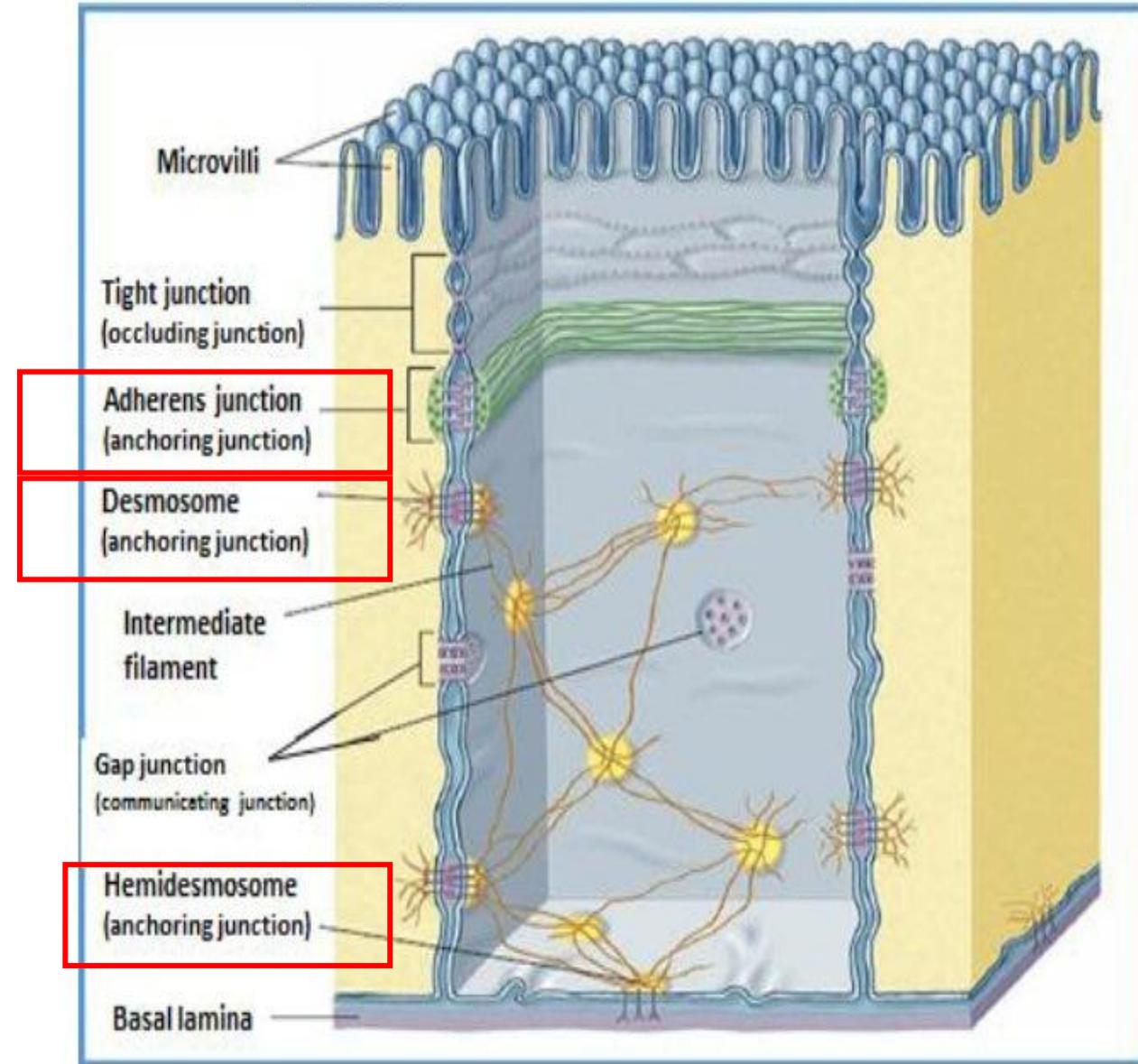
Cell to cell junctions:

- Zonulae adherens.
- Desmosomes.

Cell to matrix:

- Hemidesmosomes

CAMs are Calcium-dependent
Removal of calcium leads to
disruption of the junction.

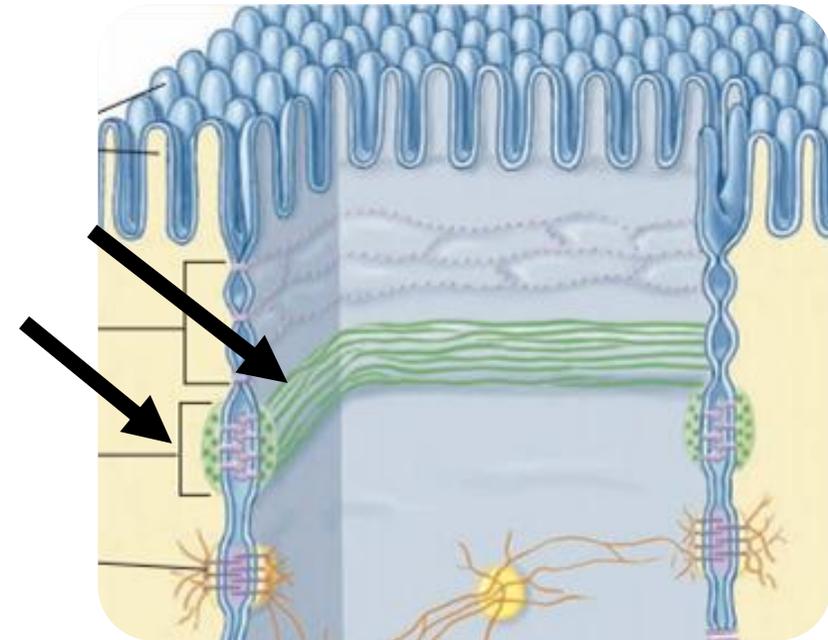
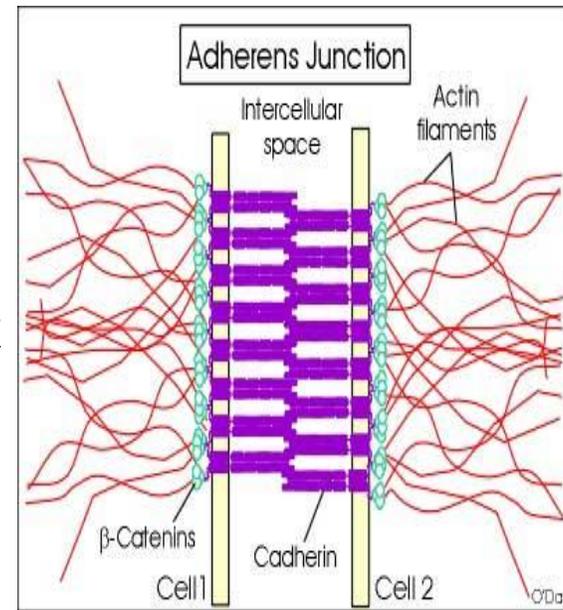


1-Zonula adherens

□ Structure:

- Belt-shaped adhesion that encircles the apical part of 2 adjoining cells.
- Intercellular space **20nm (normal)**.
- The membrane proteins cadherins (Calcium-dependent) adhere the 2 cells together.
- 2 **plaques** of (anchoring) proteins on cytoplasmic surfaces of adjacent membranes attached to **actin microfilaments** of cytoskeleton.

□ **Function:** **adhere** the adjacent cells and prevent their separation



2- Macula adherens (Desmosome)

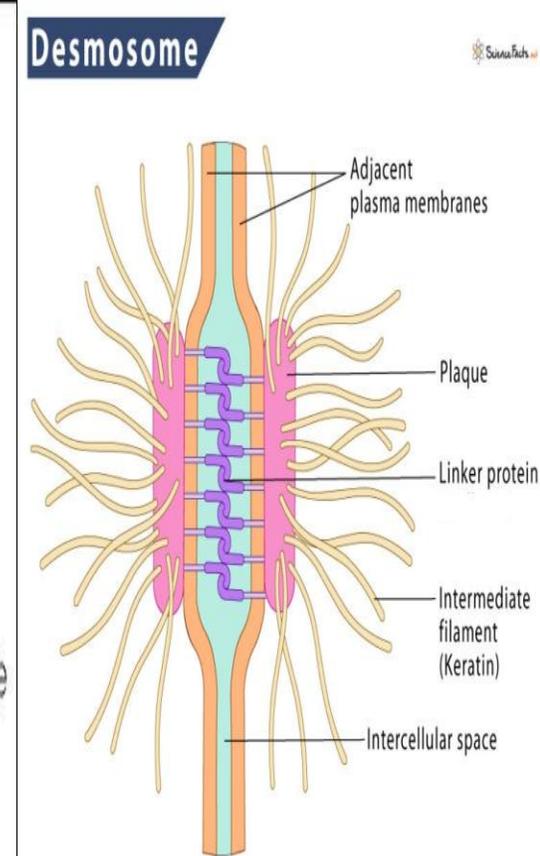
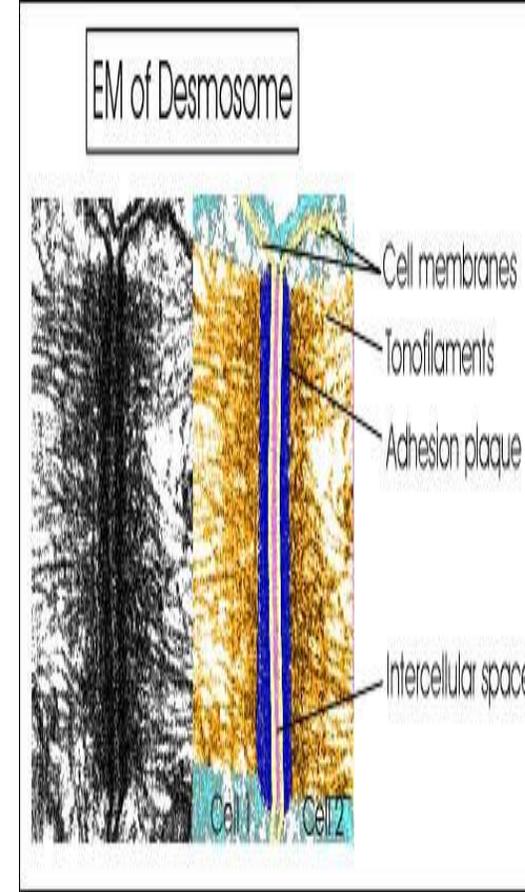
□ Structure:

- Disk-like structure (spot like). NOT A BELT
- Randomly distributed along the lateral surface of the cells.
- Intercellular space 30nm.

The transmembrane proteins attached with 2 **plaques** on cytoplasmic surfaces of adjacent cells that attached to **intermediate filaments (keratin)** in the cytoplasm of the adjoining cells.

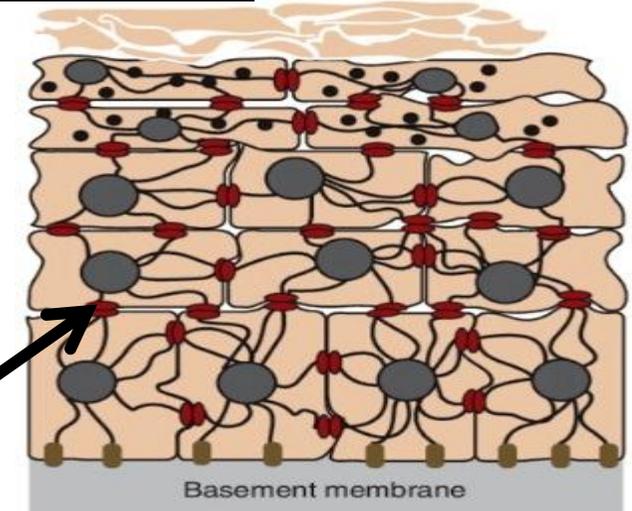
□ **Function** : provide firm adhesion between the adjacent cells

□ **Sites**: In epidermis of **skin**.



Epidermis of skin

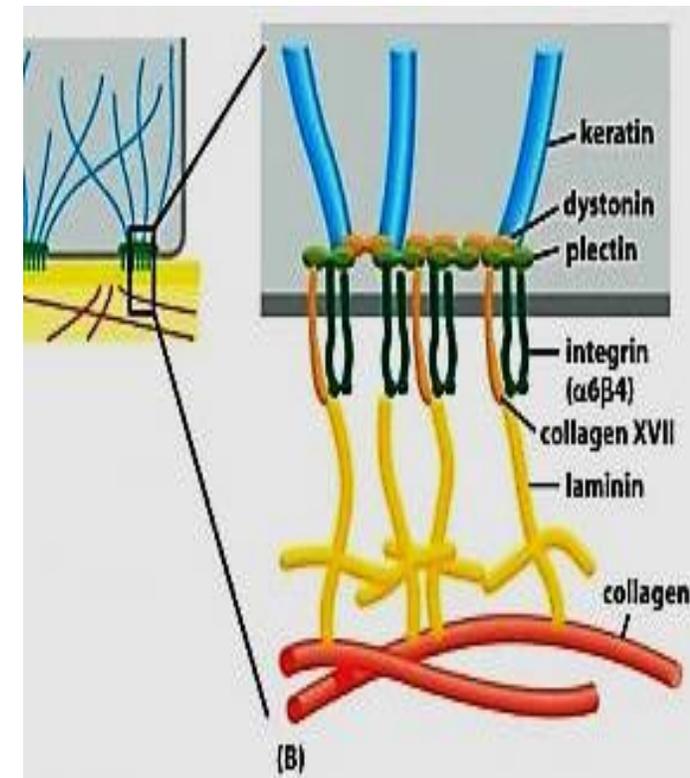
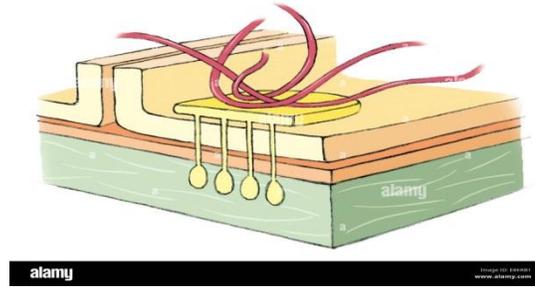
Desmosome



3- Hemidesmosome

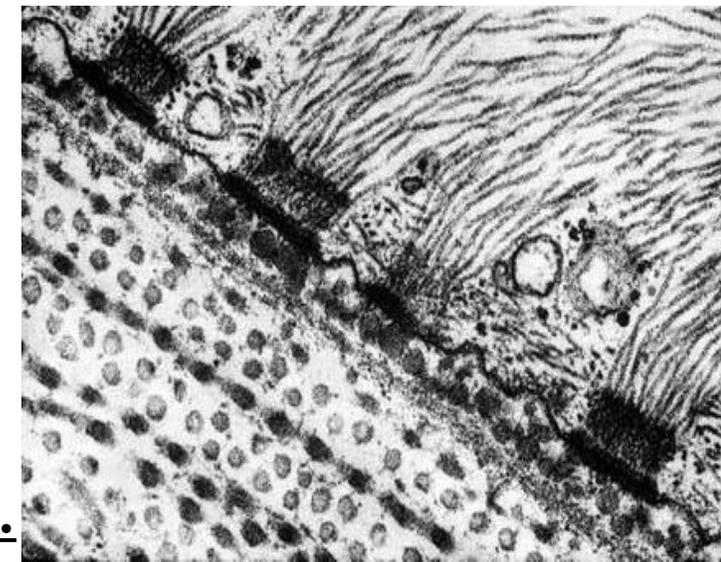
□ **Structure:**

- Half a desmosome.
- Cytoplasmic **plaque** attaches transmembrane proteins (**integrins**) to **intermediate filaments** in the cytoplasm.
- **Integrins** connect to **laminin** of the basal lamina.
- **Laminin** of the basal lamina connect with collagen in extracellular matrix.



□ **Function:**

Bind cells to basal lamina (**cell to matrix adhesion**).



Communicating junctions (Gap junctions) (Nexus)

□ Structure:

-Adjacent membranes separated by narrow intercellular space (2nm).

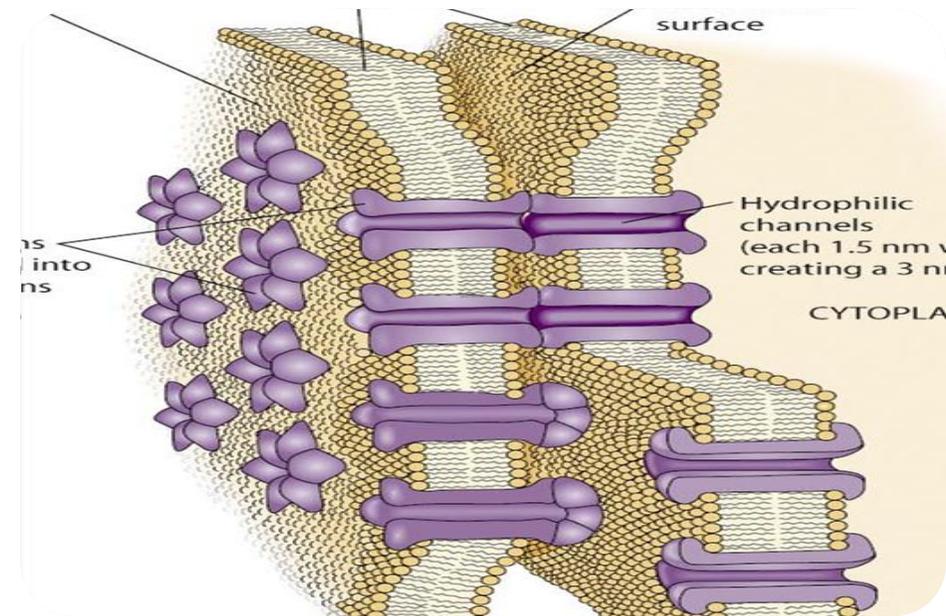
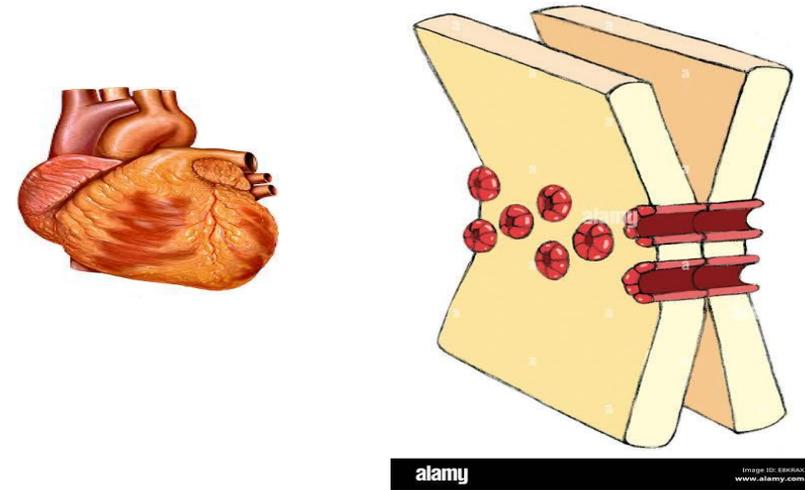
-**Connexin** (Transmembrane protein particles with central hydrophilic pore) forms channels between adjacent cells named (**connexon**).

□ Function:

-It permits the **intercellular exchange** of small molecules between cells.

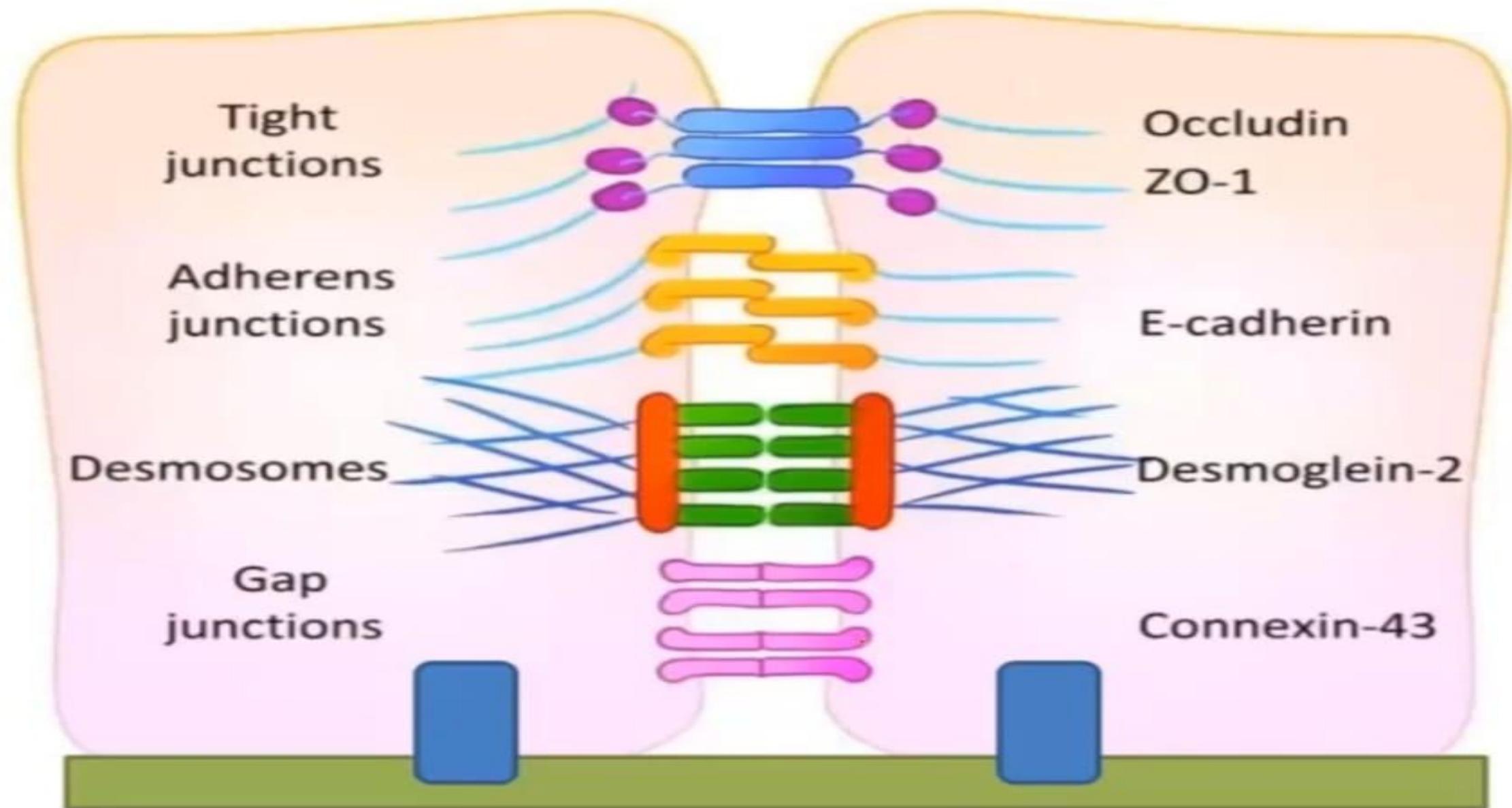
-It permits the **rapid movement** of small ions , cyclic AMP across the cells.

□ **Sites:** **cardiac muscle** (reasonable for heartbeat coordination).

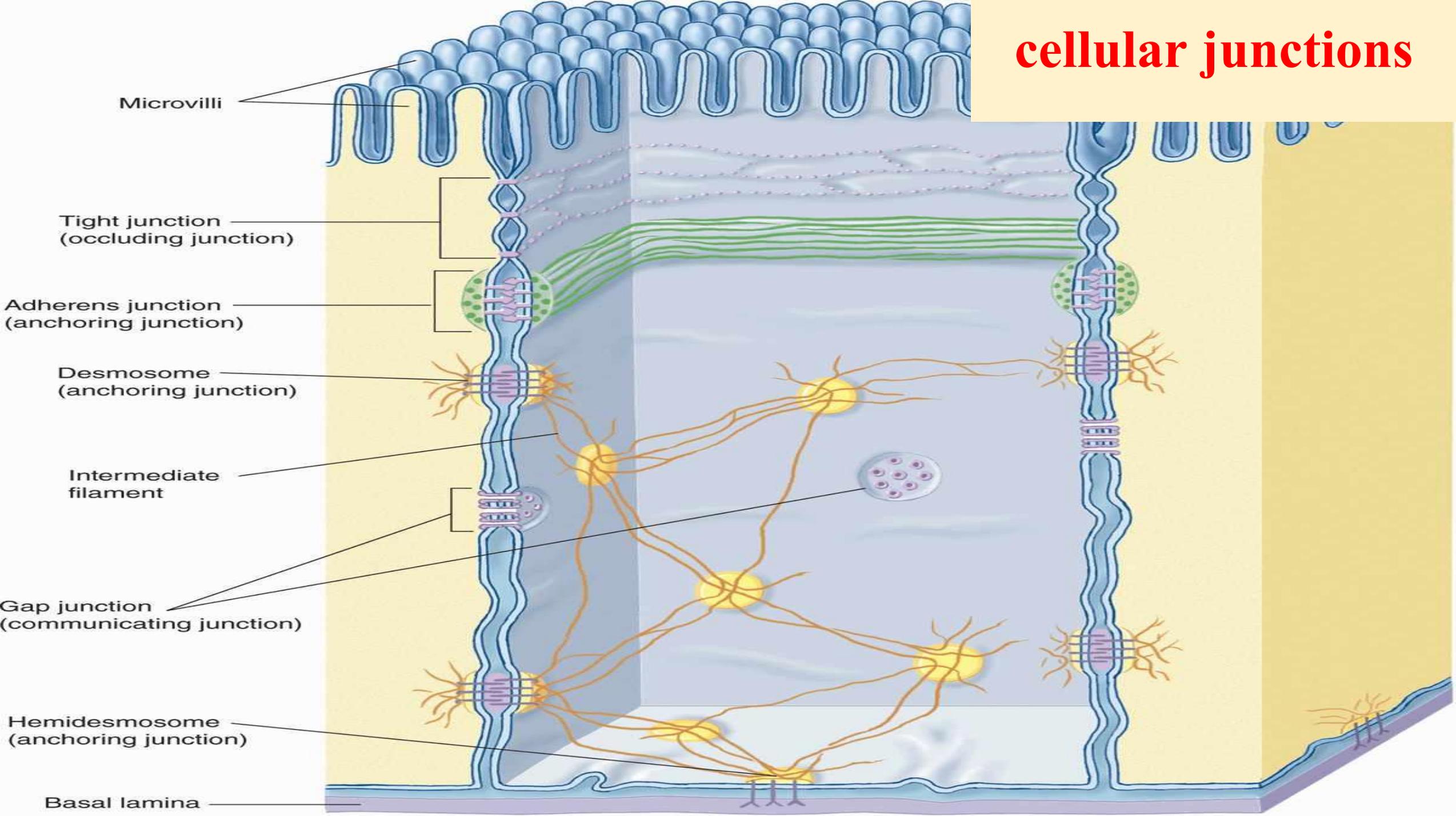


Cell-cell junctions

Studied proteins



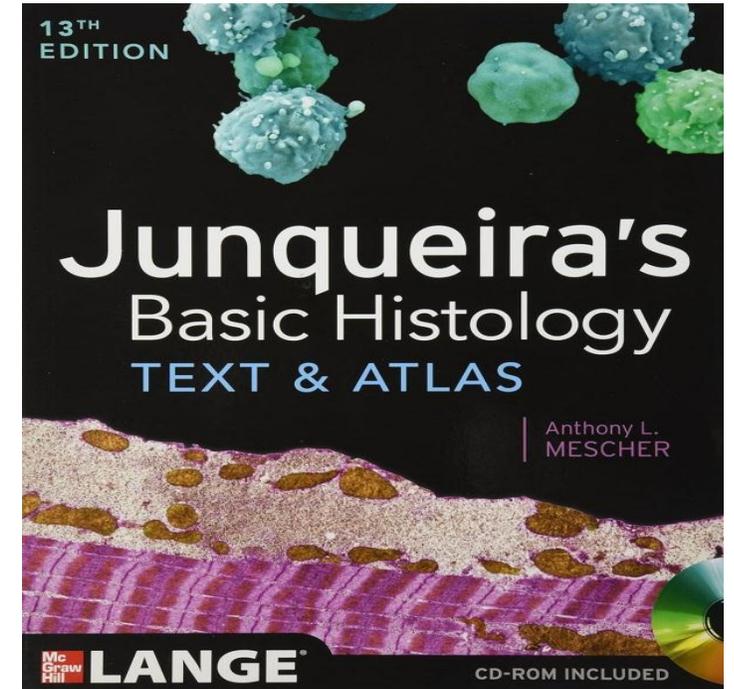
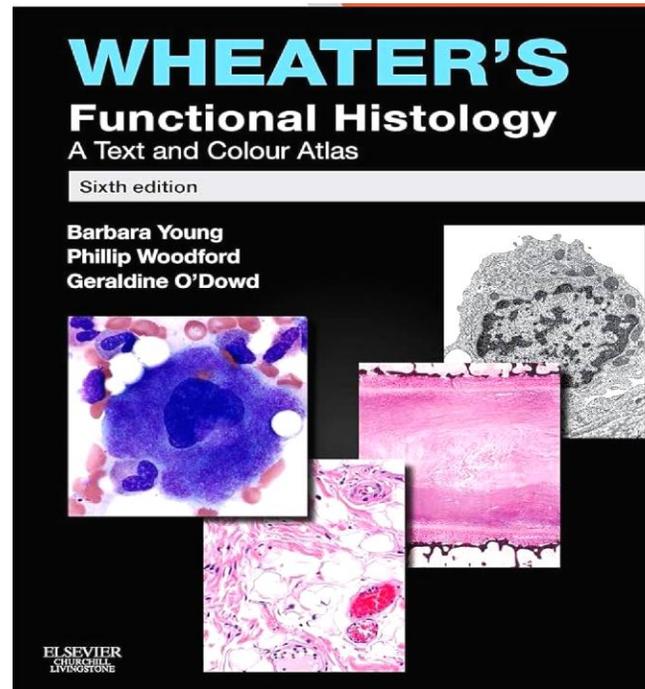
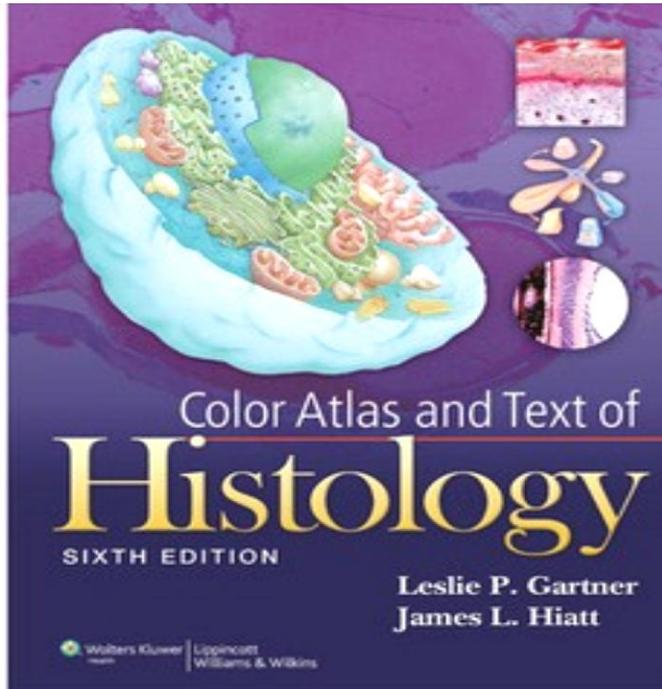
cellular junctions



Types	Tight	Gap	Adhere
Other name	Zonula occludens	Nexus	Zonula or macula adherens
Function	Impermeable	Connecting	Adherence
Number of layers (normally 7)	5	7	7
Transmembrane proteins	claudin and occludin	Connexin	Cadherins
Intercellular space (normally 20nm)	Zero	2 nm	20 or 30 nm
Shape	Belt like	Channel	Belt or spots

References

Text books



Thank you

