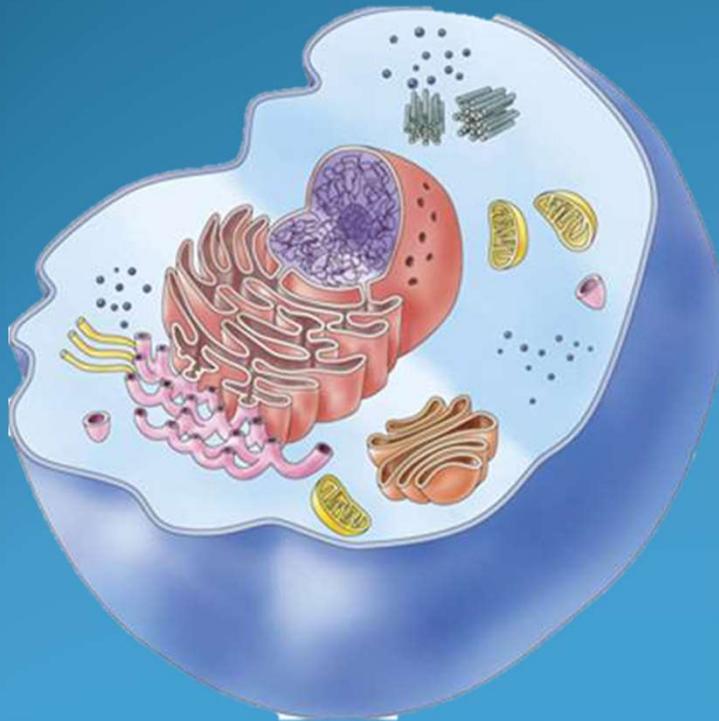


# CELL JUNCTIONS



**Centurion**  
**UNIVERSITY**



**Suman Kumar Mekap**

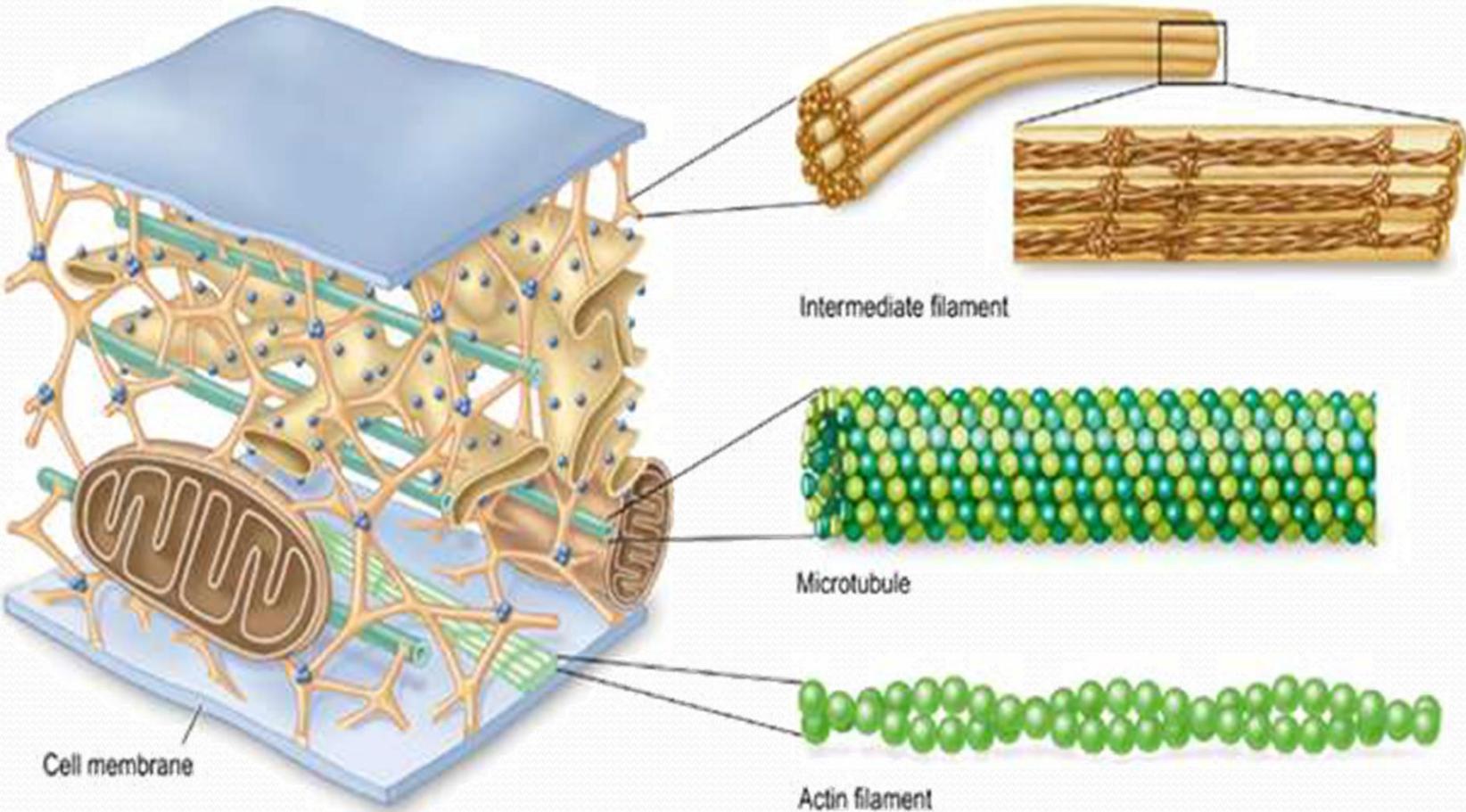
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# CYTOSKELETON

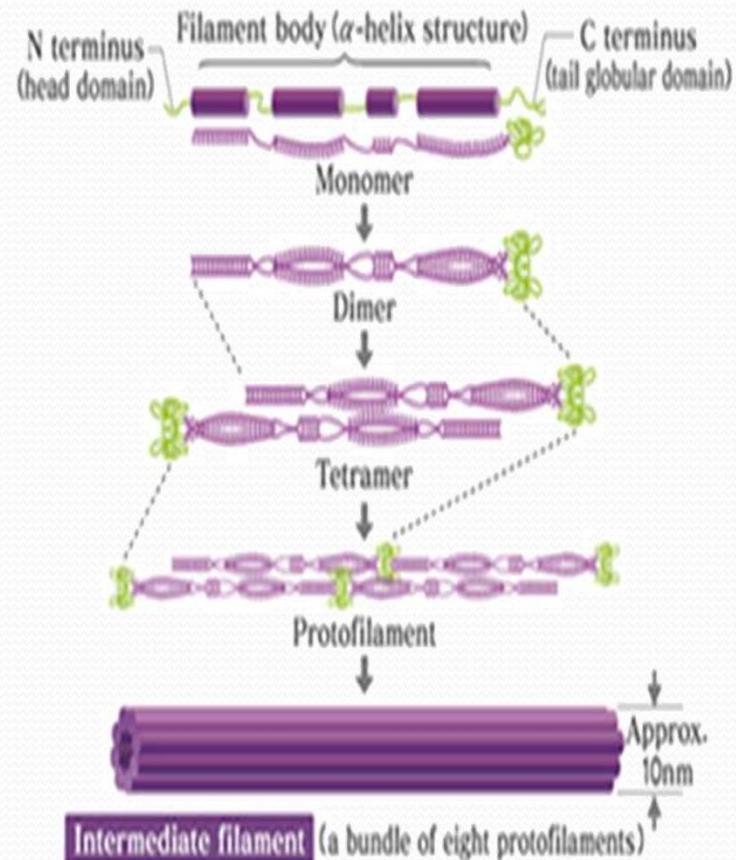
- Cells possess a cytoskeleton that provides :
- A structural framework,
- Facilitates intracellular transport,
- Supports cell junctions and
- Transmits signals about cell contact and adhesion, and
- Permits motility.

# CYTOSKELETON

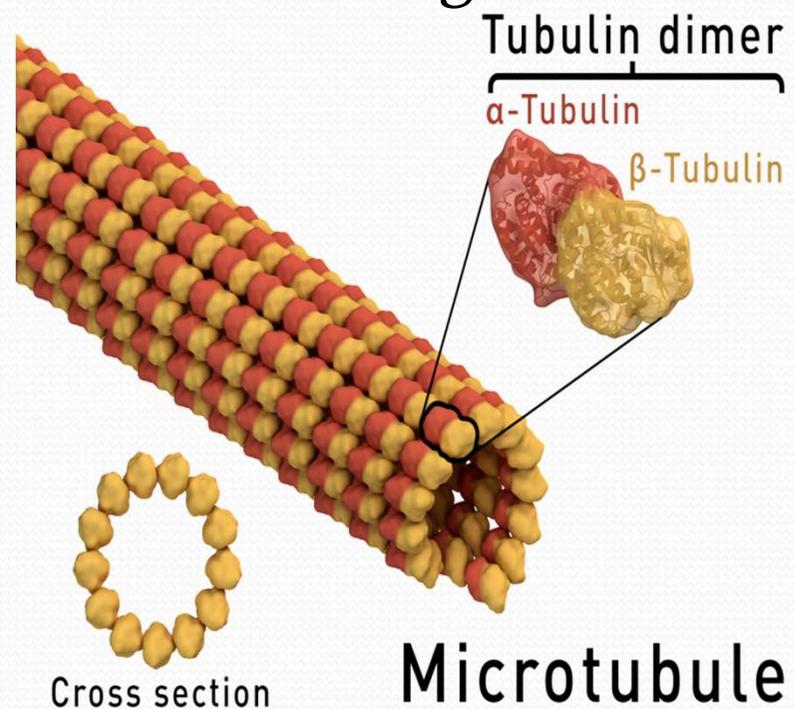
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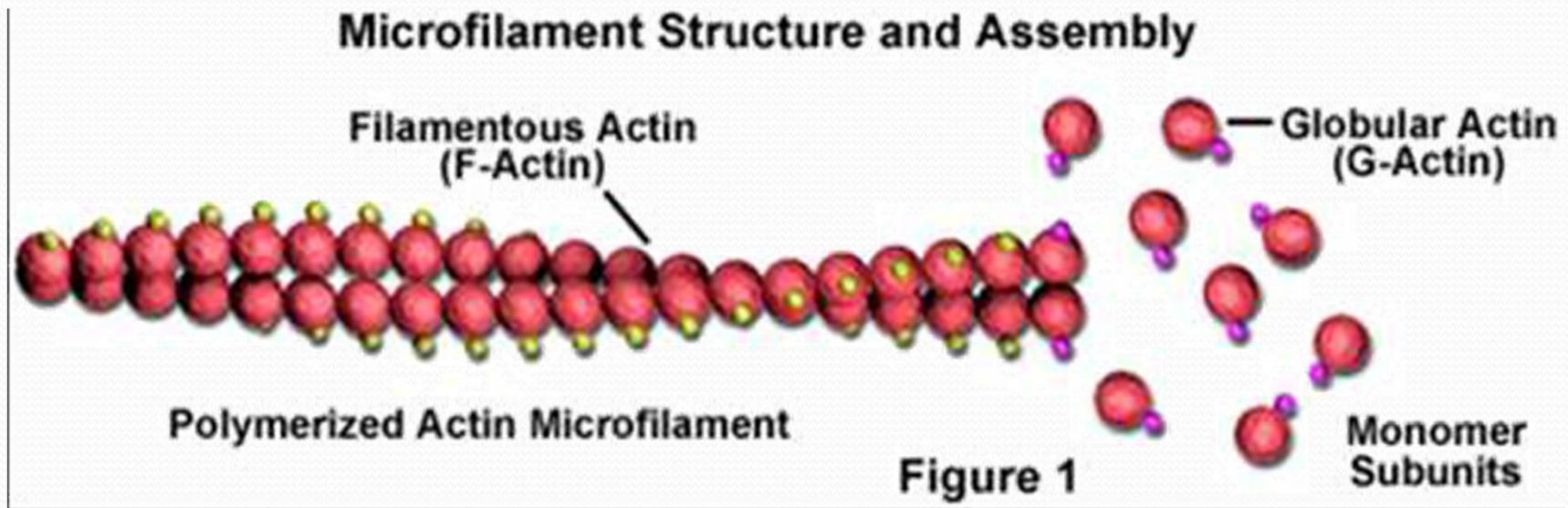
- **INTERMEDIATE FILAMENTS:** Important in the maintenance of cell shape and contact between adjacent cells and the extracellular matrix



- **MICROTUBULES:** Provide internal support for the cell and are the basis of motility for certain organelles, such as cilia
- Act as guide paths and part of the motor mechanism
- For the movement of secretory vesicles and other organelles; and serve to position certain organelles within the cell.



- **MICROFILAMENTS:** Maintenance of cell shape, movement, and contractility.
- They are composed predominantly of a contractile protein called actin, which is the most abundant cellular protein.



# Intercellular Connections.

## OCCLUDING JUNCTIONS

- Tight Junctions (Zona Occludens)

## ANCHORING JUNCTIONS

### *Actin filament attachment sites*

- Cell-cell junctions (Zonula Adherens)
- Cell-matrix junction (Focal Adhesions)

### *Intermediate filament attachment sites*

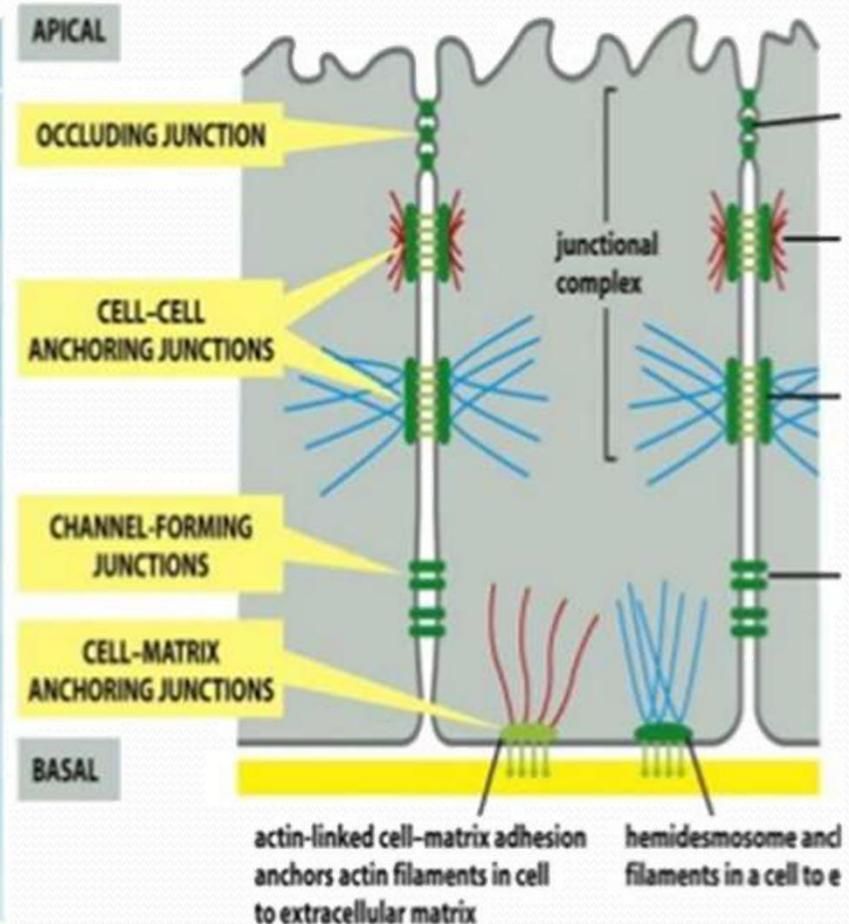
- Cell-cell junction (Desmosomes)
- Cell-matrix junction (Hemidesmosomes)

## CHANNEL FORMING JUNCTIONS

- Gap junctions

## SIGNAL RELAYING JUNCTIONS

- Chemical synapse



# The Function

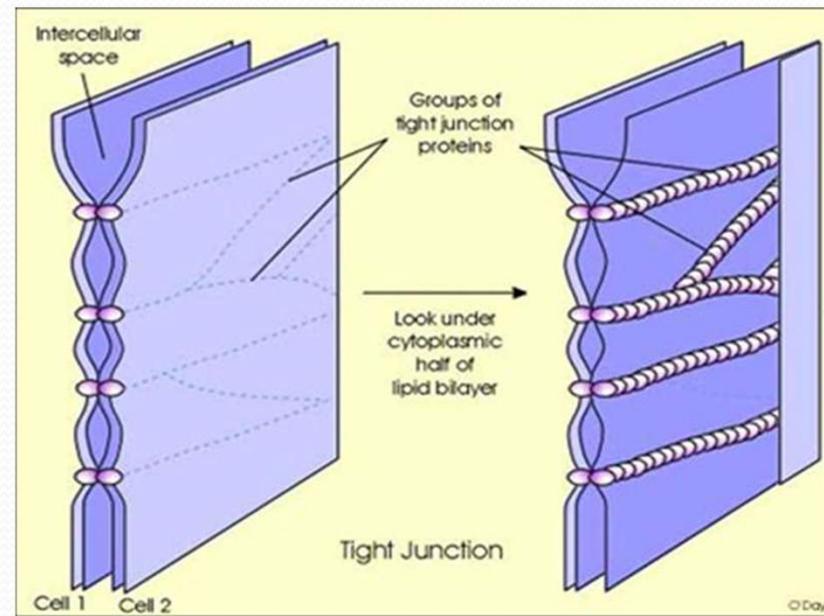
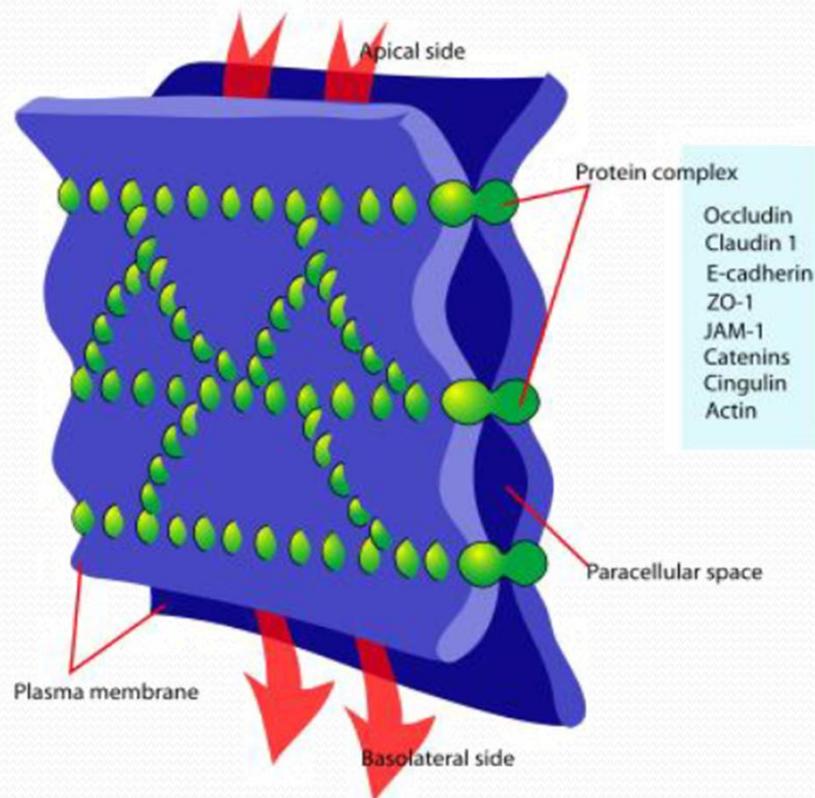
- Cell junctions allow activities of individual cells that make up the systems to be co-ordinated
- Enables each system to function as an integrated whole
- They are fundamental to the interactions between cells.

- 
- On the molecular level, intercellular junctions typically consist of three components which differ depending on the type of junction:
  - **Transmembrane adhesive protein**
  - **Cytoplasmic adapter protein**
  - **Cytoskeletal filaments**

# 1. Occluding junctions or tight junctions

- Multiple strands of protein form the tight junction
- More strands = more impermeability
- Each strand formed from proteins
- **Claudins**
- **Occludins**

- The borders of two cells are fused together, often around the whole
- Perimeter of each cell, forming a continuous belt like junction known as a tight junction or zonula occludens



# The Function of Tight Junctions

- At tight junctions

Plasma membranes of neighboring cells are tightly pressed against each other

- Form continuous seals around the cells

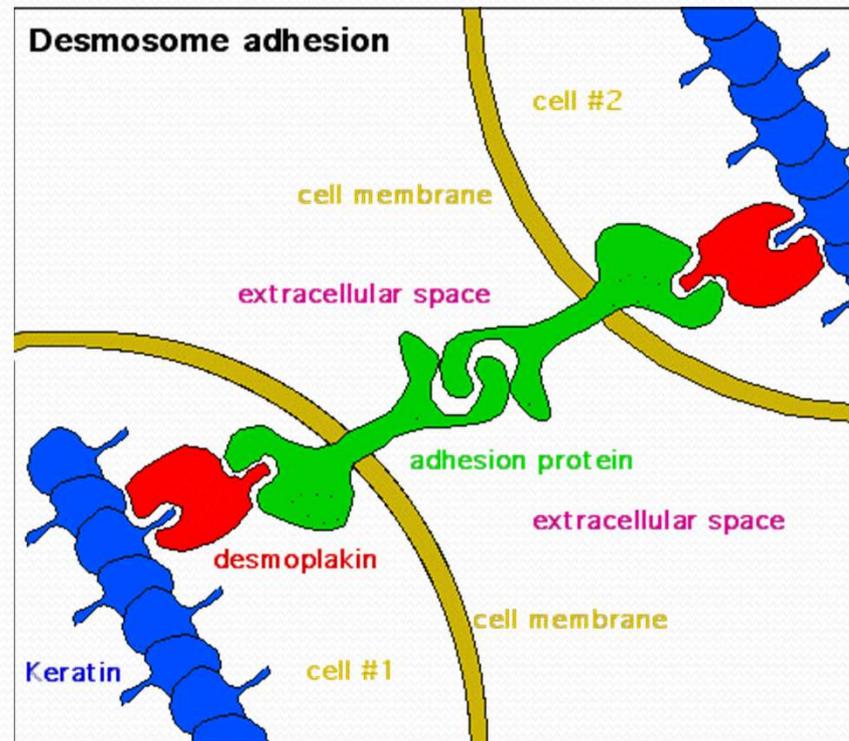
## **Prevents...**

- leakage of extracellular fluid across a layer of epithelial cells
- passage of molecules and ions through the space between cells.

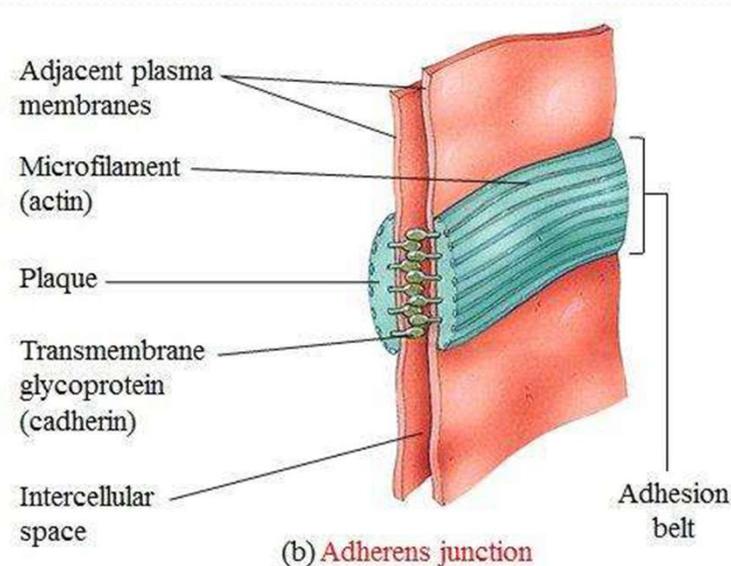
Ex: Make us watertight

## 2. Adhesive junctions or anchoring junctions:

- Also called “**Desmosomes**”
- Arranged randomly on the lateral side of cells membranes
- The adhesion protein bridges the space between the cells

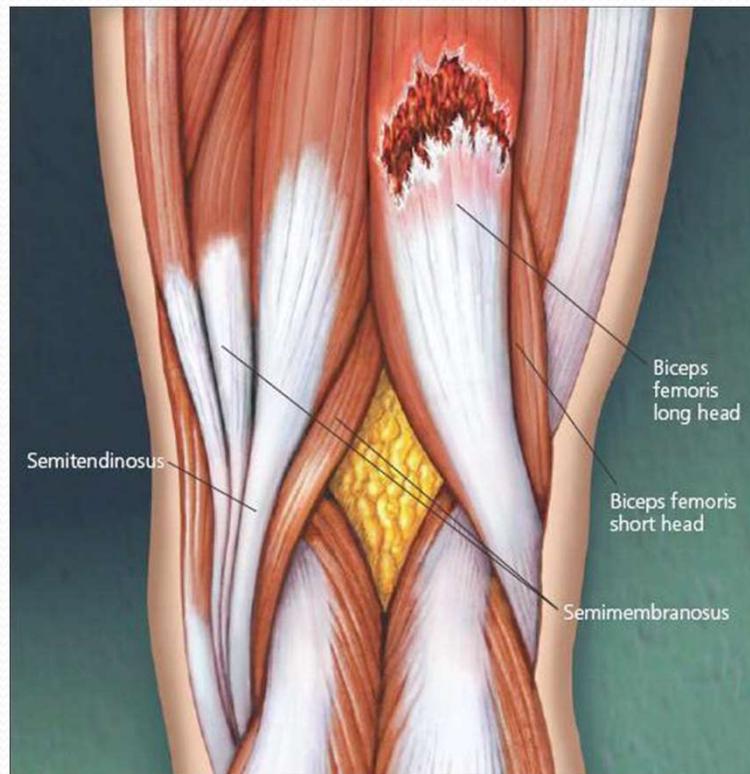


- In this type of junction cells anchor to the extracellular matrix.
- The intercellular space is maintained at approx. 20nm. They can appear as bands encircling the cell (zonula adherens) or as spots of attachment to the extracellular matrix (adhesion plaques).



# The Function of Desmosomes

- Fasten cells together into strong sheets
- Attach muscle cells to each other in a muscle
- Muscle tears can involve rupture of desmosomes



# Actin filaments attachments site

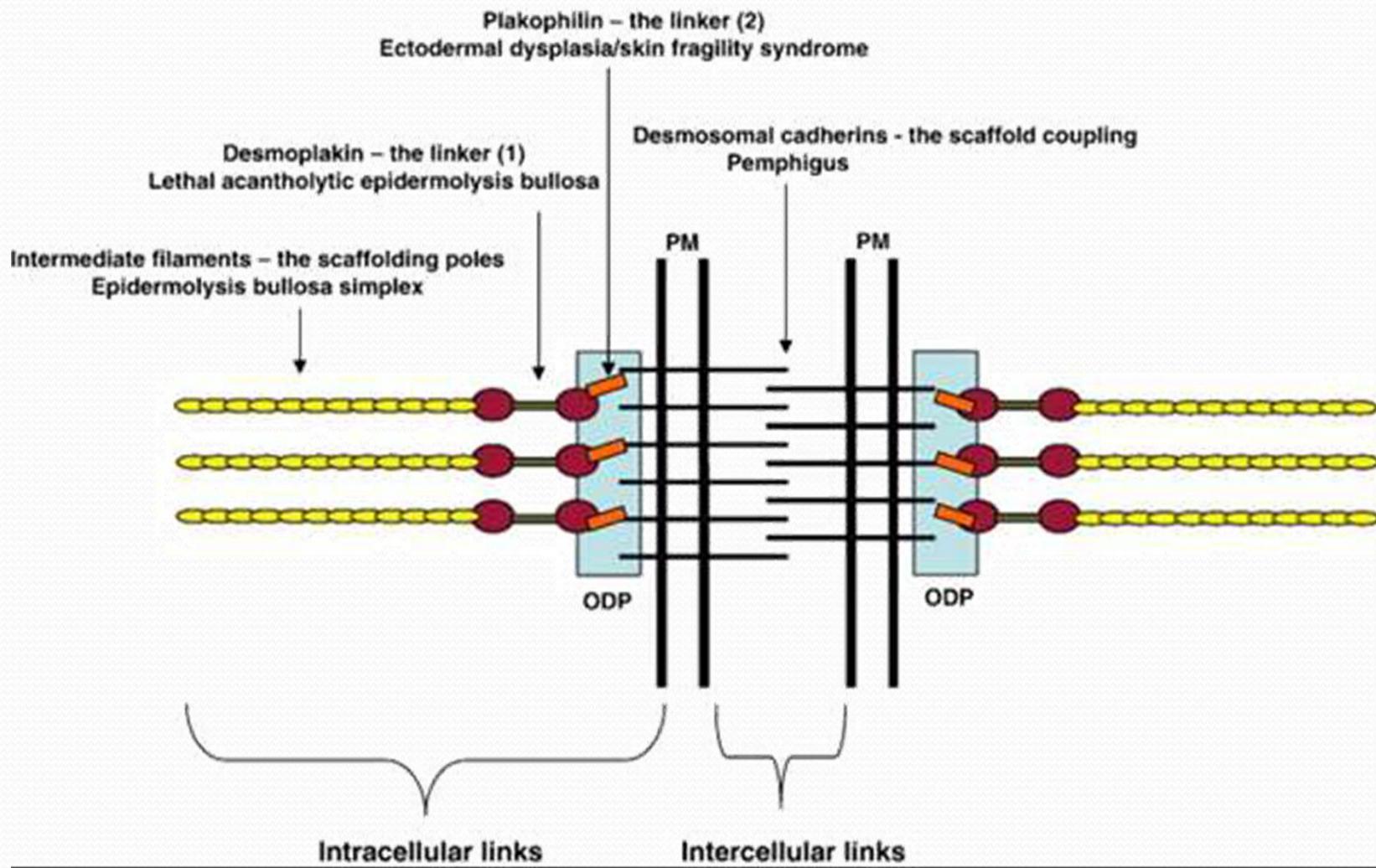
## Zonula adherens and focal adhesions:

- The principal transmembrane proteins are members of the **cadherin family**. E-cadherin is a single pass, transmembrane glycoprotein that belongs to the classical cadherin family of  $\text{Ca}^{2+}$ -dependent adhesion proteins.
- Different members of the cadherin family are found in different locations.
- CDH1 - E-cadherin (epithelial): found in epithelial tissue
- CDH2 - N-cadherin (neural): found in neurons
- CDH12 - cadherin 12, type 2 (N-cadherin 2) : found in Brain
- CDH3 - P-cadherin (placental): found in the placenta



## Intermediate filaments attachments sites Desmosomes and hemidesmosomes:

- Desmosomes are intercellular junctions of epithelia and cardiac muscle. They resist mechanical stress because they adopt a
- strongly adhesive state in which they are said to be hyper-adhesive and which distinguishes them from other intercellular junctions; desmosomes are specialised for strong adhesion and their failure can result in diseases of the skin and heart



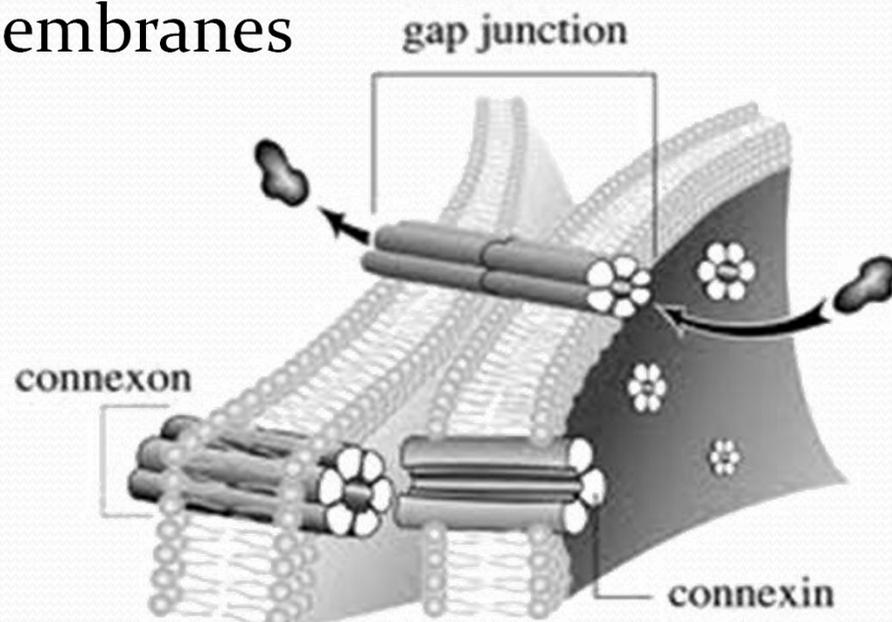
- 
- Hemidesmosomes link the cell to the basal lamina and, through additional extracellular molecules, to the rest of the extracellular matrix.
  - **Significance:** Several types of **epidermolysis bullosa**, a blistering skin disorder, have been shown to be caused by mutations of the genes for various desmosomal, hemidesmosomal, and intermediate filament proteins.
  - In addition, some forms of the disease are caused by mutations of the genes for extracellular matrix proteins involved in cell-matrix adhesion. **Pemphigus vulgaris and pemphigus foliaceus**, blistering diseases of the oral mucosa and skin, respectively, are caused by autoantibodies to desmoglein-3 and desmoglein-1, the cadherin in desmosomes.



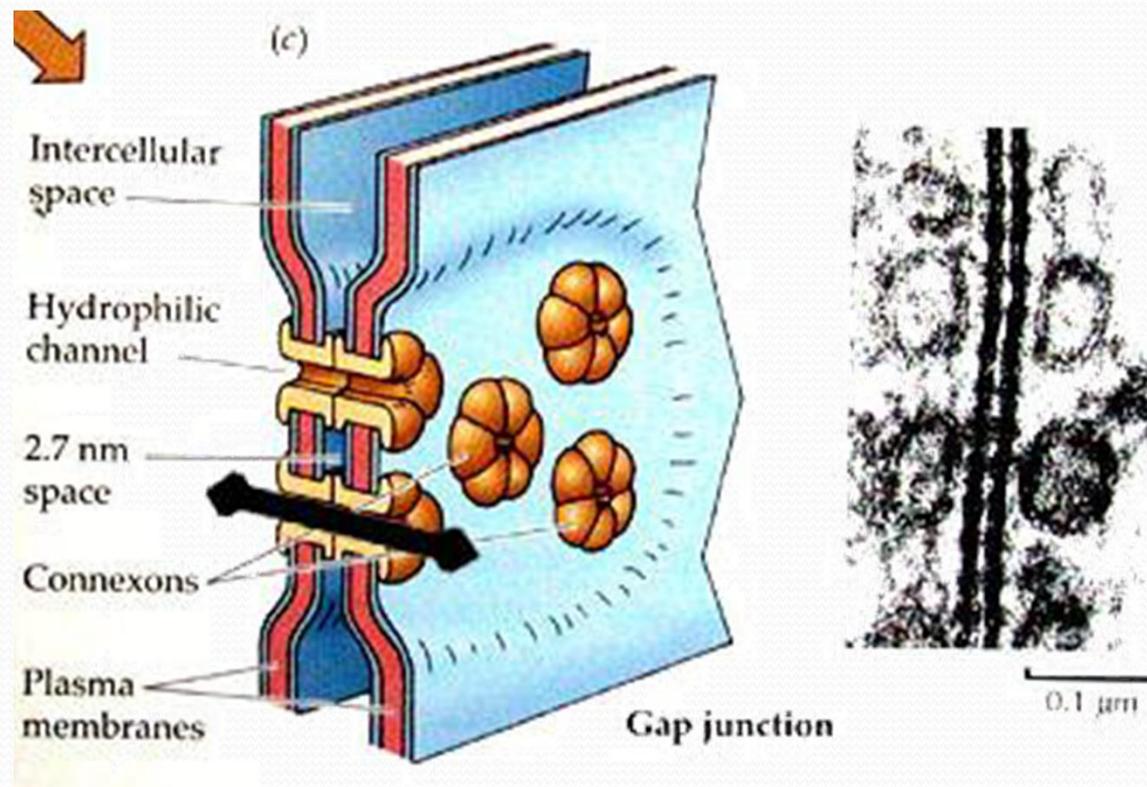
**Epidermolysis bullosa**  
**Pemphigus vulgaris**  
**pemphigus foliaceus**

### 3. Gap Junctions

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



- Gap junctions are plaque-like regions of the cell membrane where the intercellular space narrows to 2 to 3 nm and transmembrane proteins of the connexin family form aqueous channels between the cytoplasm of adjacent cells.



# The Function of Gap Junctions

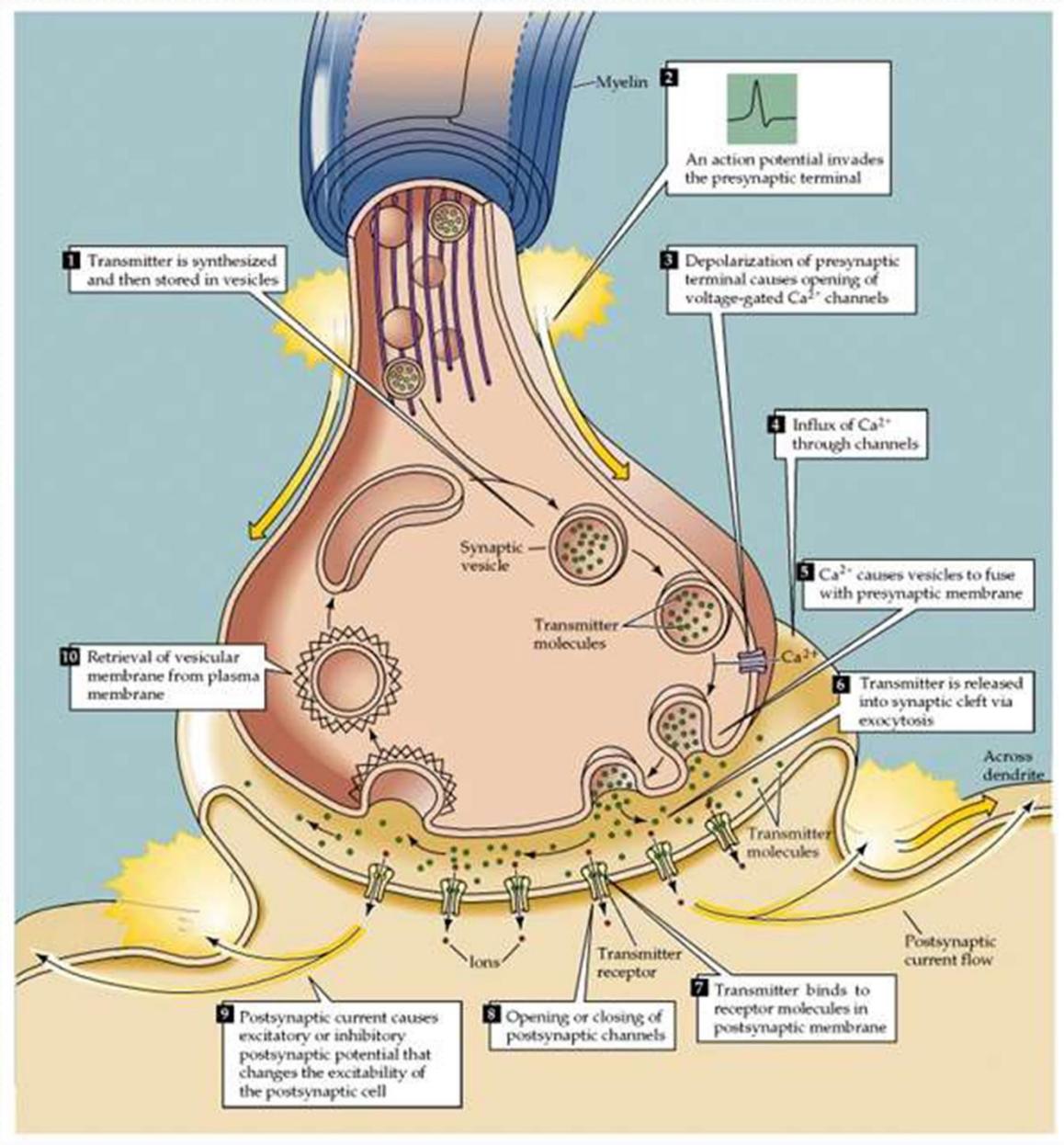
The created gap...

- Provides cytoplasmic channels from one cell to an adjacent cell
- Allows for communication through exchange of materials and transmission of electrical impulses
- Necessary for communication between cells
- Ions/molecules are able to pass through
- Some molecules too big
- Isolate damaged cells so damage does not spread

## 4. Signal relaying junctions

### Chemical synapse:

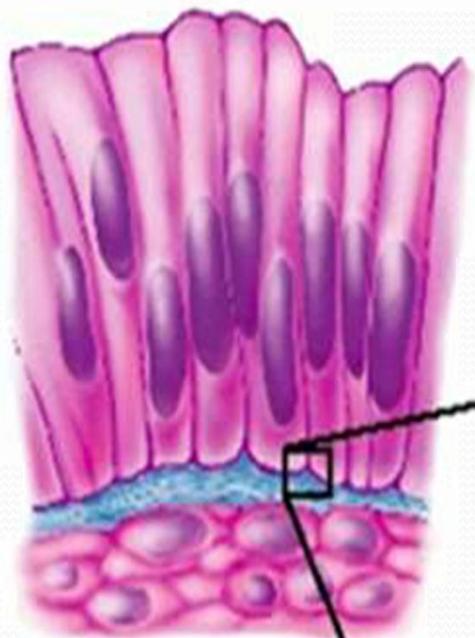
- Chemical synapses are specialized junctions through which neurons signal to each other and to non-neuronal cells such as those in muscles or glands. Chemical synapses allow neurons to form circuits within the central nervous system.
- The key feature is the presence of synaptic vesicles at presynaptic terminals. These vesicles are filled with 1 or more neurotransmitters.
- It is these chemical agents that act as messengers between the communicating neurons that gives it a name as chemical synapse.



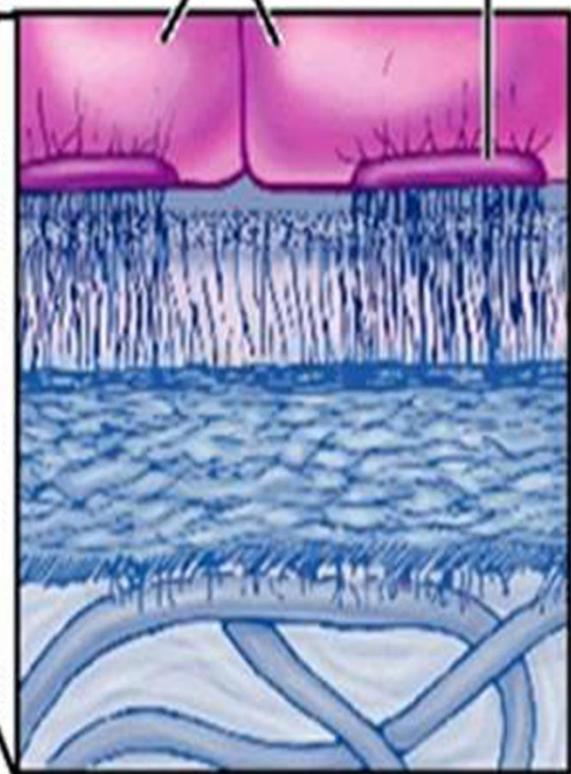


## EPITHELIUM-CONNECTIVE TISSUE INTERFACE

- All epithelia are separated from the underlying connective tissue by a layer of extracellular matrix organized as a thin sheet immediately adjacent to the epithelial cells.
- The basal lamina, along with hemidesmosomes, attaches the epithelium to the underlying connective tissue, functions as a filter to control the passage of molecules between the epithelium and connective tissue, and acts as a barrier to cell migration.



Epithelial cells    Hemidesmosome



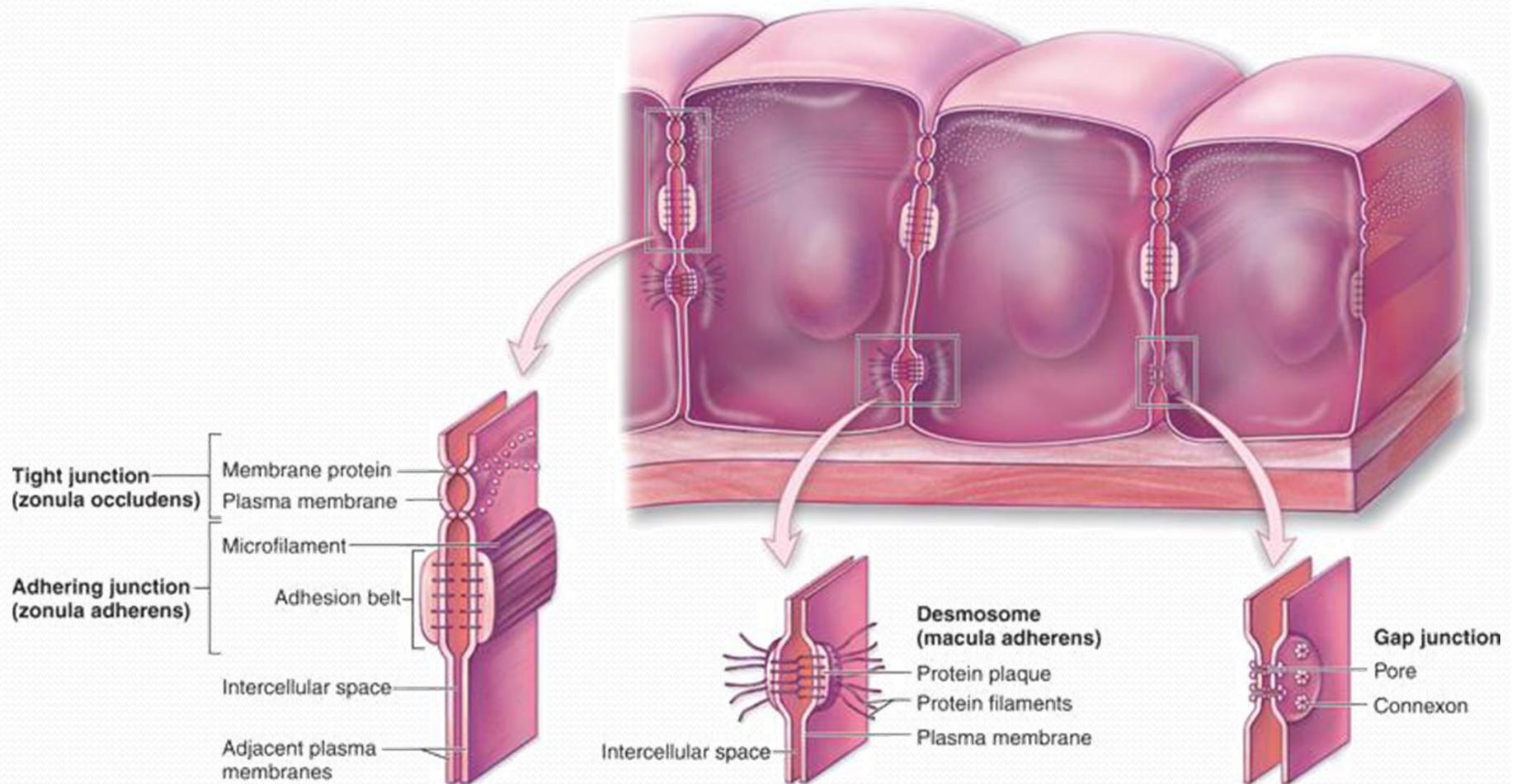
Lamina lucida

Lamina densa

Reticular lamina

Basal lamina

# Summary of Junctions in Animals





**Happy to answer if you have any  
questions.....?**

**THANK YOU**