Junctions are structures that link cells to each other and to the extracellular matrix

1. Occludens (tight) junctions regulate movement of fluid across epithelial cell barriers
2. Anchoring junctions provide strong attachments of cells to each other and to the extracellular matrix
3. Communication junctions allow movement of small ions and other signals between cells.
Occludens Junctions

- Functionally separate apical cell membranes from basolateral membranes.
- Regulate fluid movement. Their permeability can be regulated.
- Usually the most apical of cell junctions.
- There are 2 types: tight junctions (vertebrates) and septate junctions (invertebrates).
Tight junctions are formed by a branched network of contacts between plasma membranes of two cells, called sealing strands.
Occludens Junctions Structure:

- Homodimers of two protein classes, claudins and occludins, create sealing strands in tight junctions.
Septate junctions function like tight junctions but are found in invertebrates and are more regularly arranged. A protein called “Discs-large” forms septate junctions and is related to occludins.
Anchoring Junction General Structure:

- All anchoring junctions have both intracellular anchor proteins and transmembrane adhesion proteins.
Anchoring junctions can be classified based on their function and the supporting cytoskeletal system. The cytoskeletal filaments play a crucial role in anchoring these junctions to the extracellular matrix. The table below summarizes the components involved in different types of anchoring junctions:

<table>
<thead>
<tr>
<th>Anchoring Junctions</th>
<th>Actin</th>
<th>Intermediate Filament</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell-Cell</td>
<td><strong>Adherens Junctions</strong></td>
<td><strong>Desmosomes</strong></td>
</tr>
<tr>
<td>Transmembrane</td>
<td>Cadherins (E-cadherin)</td>
<td>Cadherins (desmoglein, desmocollins)</td>
</tr>
<tr>
<td>Intracellular</td>
<td>Vinculin, alpha actinin</td>
<td>Desmoplakin, desmoglob in</td>
</tr>
<tr>
<td>Cell-Matrix</td>
<td><strong>Focal Adhesions</strong></td>
<td><strong>Hemidesmosomes</strong></td>
</tr>
<tr>
<td>Transmembrane</td>
<td>Integrins</td>
<td>Integrins</td>
</tr>
<tr>
<td>Intracellular</td>
<td>Vinculin, alpha actinin, filamin</td>
<td>plectins</td>
</tr>
</tbody>
</table>
Adherens Junctions

- Transmembrane proteins: Cadherins (E-cadherin)
- Intracellular anchoring proteins: Vinculin, alpha actinin
Cadherins in adherens junctions
Focal Adhesions

- Transmembrane proteins: Integrins
- Intracellular anchoring proteins: Vinculin, alpha-actinin, talin, or filamin
Integrins

- Integrins are calcium-dependent cell-matrix adhesion molecules with cytoskeletal support.
- Classes: Integrins are heterodimers, with an alpha and beta subunit. They are classified by the type of subunit.
- There are 24 alpha subunit types and 9 beta subunit types. Various combinations show specificity for different extracellular matrix and cell-surface proteins, and have different binding strengths.
Desmosomes

- **Transmembrane proteins:** desmoglein, desmocollin
- **Intracellular anchoring proteins:** desmoplakin, plakoglobin
Desmosomes

- Form strong connections between cells. Most common in mechanically stressed tissues.
- Intermediate filaments junctions (desmosomes and hemidesmosomes) are stronger than actin supported junctions (adherens junctions).

Desmosomes in Skin cells
Desmosomes form stable attachments between epithelial cells.

Hemidesmosomes

- Transmembrane proteins: Integrins
- Intracellular anchoring proteins: Plectins
III Communication Junctions: Gap junctions (animals)

interacting plasma membranes

channel 1.5 nm in diameter

gap of 2–4 nm

two connexons in register forming open channel between adjacent cells

connexon composed of six subunits

homomorphic connexons

heteromorphic connexons

homotypic

heterotypic

connexins

intercellular channels
Function:

- Communication junctions allow electrical signals and small but not large molecules to move between cells

The permeability of connecting junctions can be regulated.

(A) Control neurons

(B) Dopamine treated neurons

(B) Open and closed connexons
Plasmodesmata are channels of cytoplasm that join neighboring plant cells through small holes in the cell wall.

Desmotubules are ER derived membrane tubes found in the center of plasmodesmata.