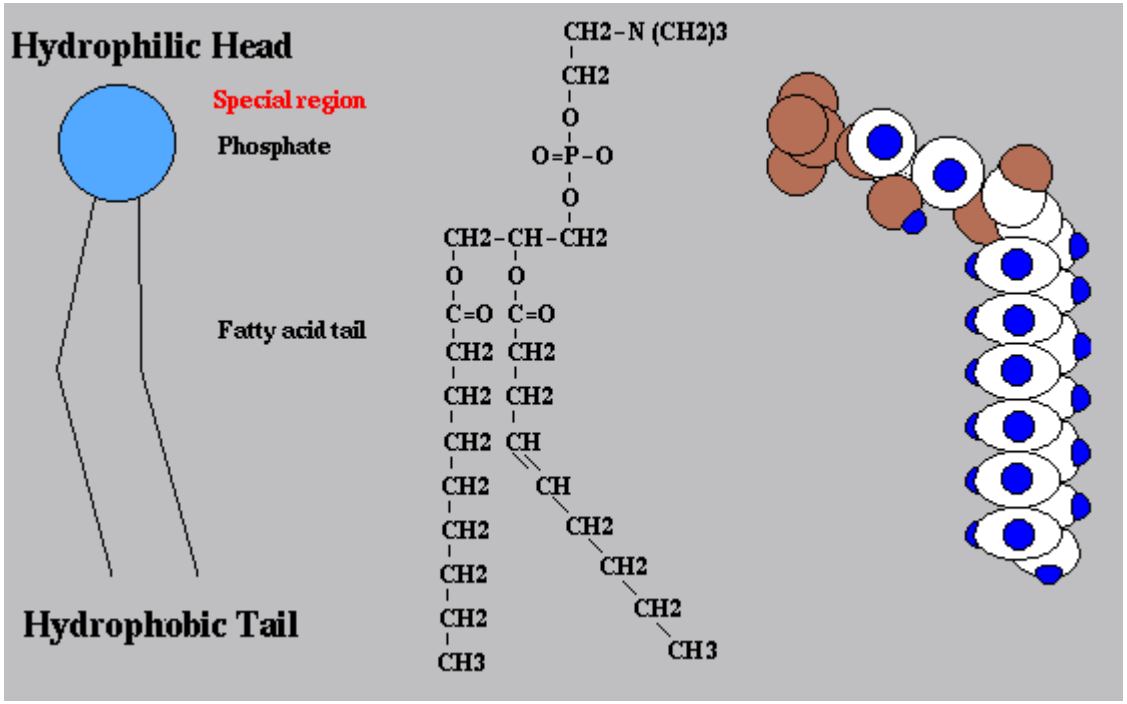
Membranes, membrane transport.

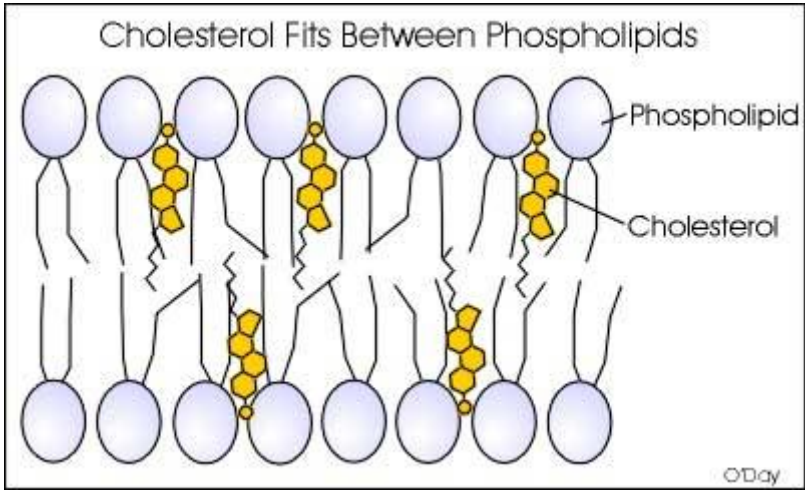
Cell-cell contacts

Membrane lipides:

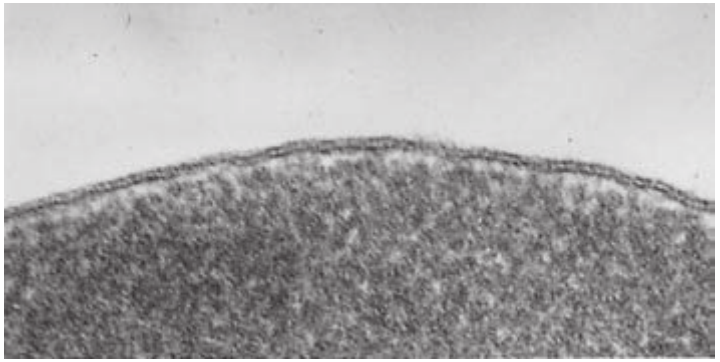
Phospholipids



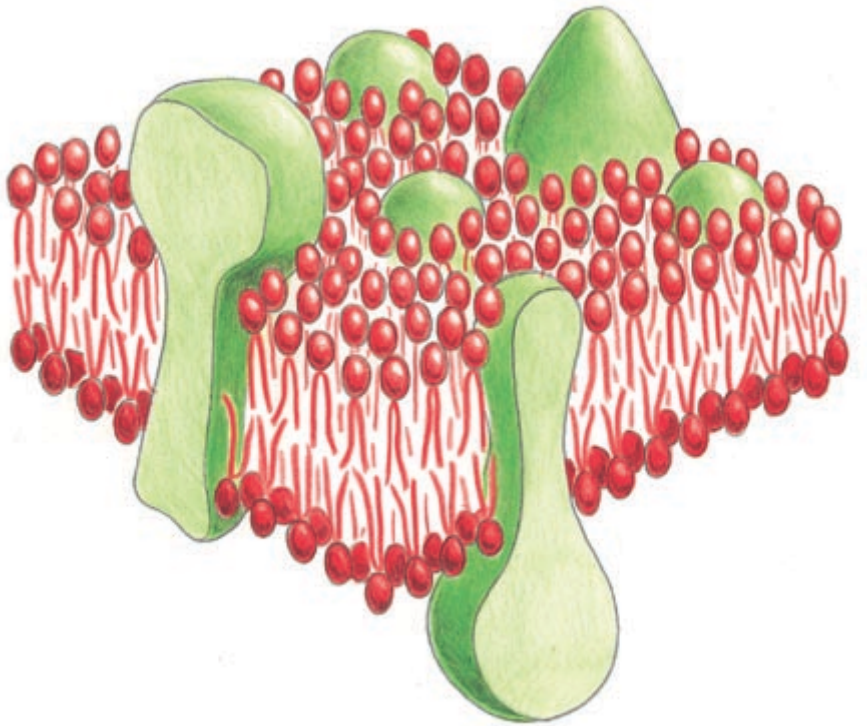
Cholesterol



Lipid bilayers are formed by amphipatic phospholipid molecules. The hydrophilic head is attracted to water, while the hydrophobic tail seeks to aggregate with other hydrophobic molecules.



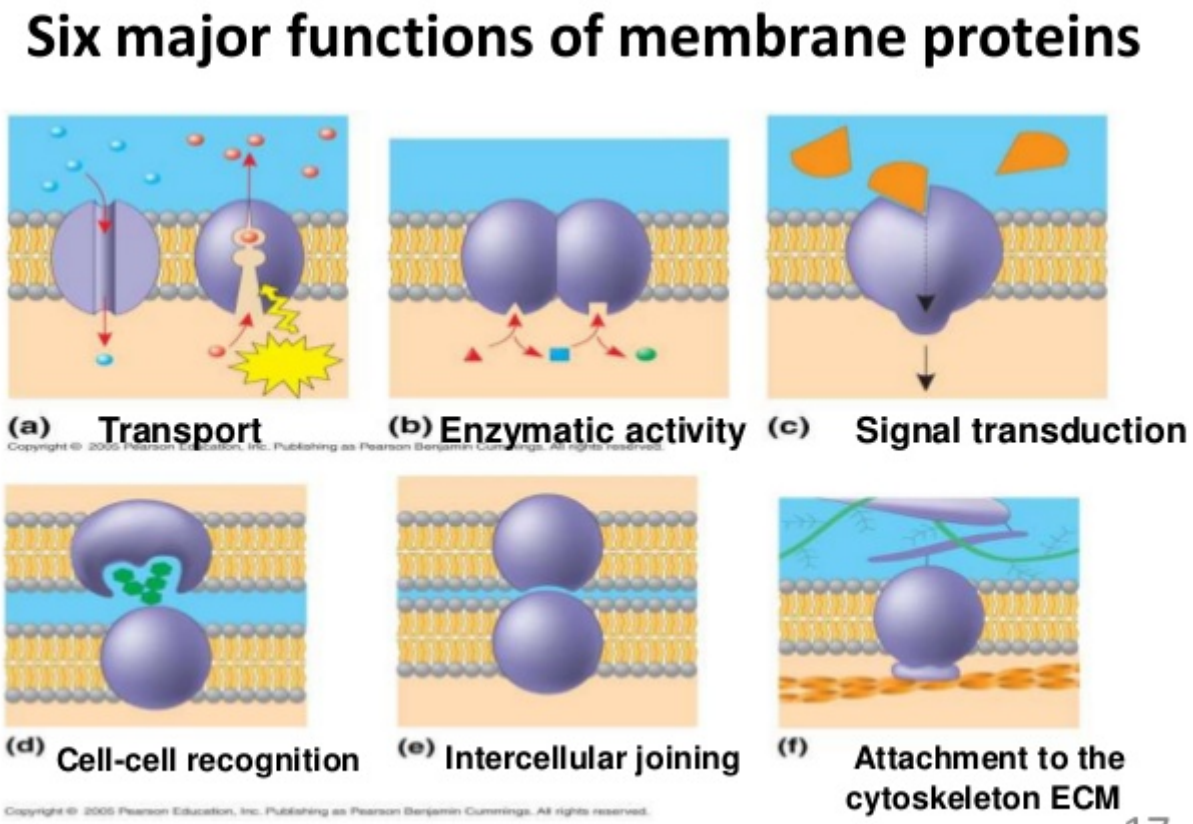
Electronmicroscopic image of the cell membrane



Schematic drawing showing the three-dimensional views of a cell membrane (red: lipid molecules, green: proteins)

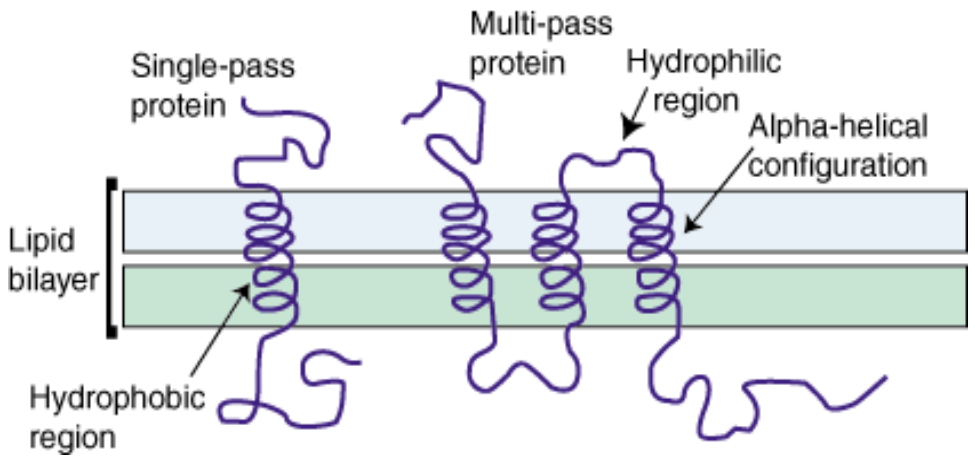
Membrane proteins:

Membranes are loaded with proteins, they account for roughly half the mass of most cellular membranes.



Transmembrane (integral) proteins:

These proteins are embedded into the membrane and stick out on both sides. The portions of these proteins that are nested amid the hydrocarbon tails have hydrophobic surface characteristics, and the parts that stick out are hydrophilic.



Peripherial membrane proteins:

- Proteins located entirely in the cytosol, and they are associated with the inner leaflet of the lipid bilayer by an amphipathic helix exposed on the surface of the protein.
- Proteins lie entirely outside the bilayer, on one side or the other, attached to the membrane only by one or more covalently attached lipid groups.
- Proteins bound indirectly to one or the other face of the membrane, they are held in place only by their interactions with other membrane proteins.

Membran fluidity:

At physiological temperatures, cell membranes are fluid; at cooler temperatures, they become gel-like.

Membrane fluidity affected by three factors:

Temperature:

with temperature the fluidity increases

Cholesterol:

at physiological temperature it decreases membrane fluidity: saturated fatty acids chains can attached to cholesterol.

Saturation of the fatty acid chains:

The presence of double bonds increase the fluidity

What can go through the cell membrane?

Phospholipids are attracted to each other, but they are also constantly in motion and bounce around a little off of each other. The spaces created by the membrane's fluidity are incredibly small, so it is still an effective barrier.

The transport of polar/hydrophyllic molecules (they are capable of forming bonds with water and other hydrophilic molecules) and nonpolar/hydrophobic molecules (the opposite can be said for them, they are water fearing) is different.

1. Small, nonpolar molecules (ex: oxygen and carbon dioxide) can pass through the lipid bilayer and do so by squeezing through the phospholipid bilayers. They don't need proteins for transport and can diffuse across quickly.
2. Small, polar molecules (ex: water): This is a little more difficult than the molecule type above. Recall that the interior of the phospholipid bilayer is made up of the hydrophobic tails. It won’t be easy for the water molecules to cross, but they can cross without the help of proteins. This is a somewhat slower process.
3. Large, nonpolar molecules (ex: carbon rings): These rings can pass through but it is also slow process.

Membrane transport:

For molecules can not cross the membrane.

Ion channels

Transporters

ATPase enzymes

Active and passive transport:

Concentration or electrostatic gradient

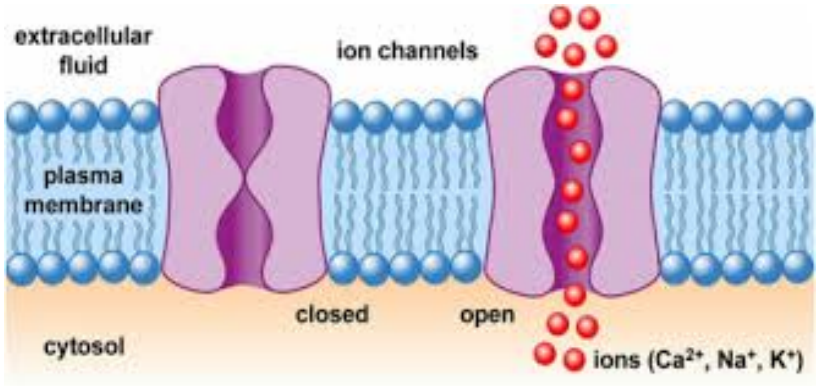
Active transport needs energy and can transport molecules against their concentration ans electrostatic gradients.

Ion channels:

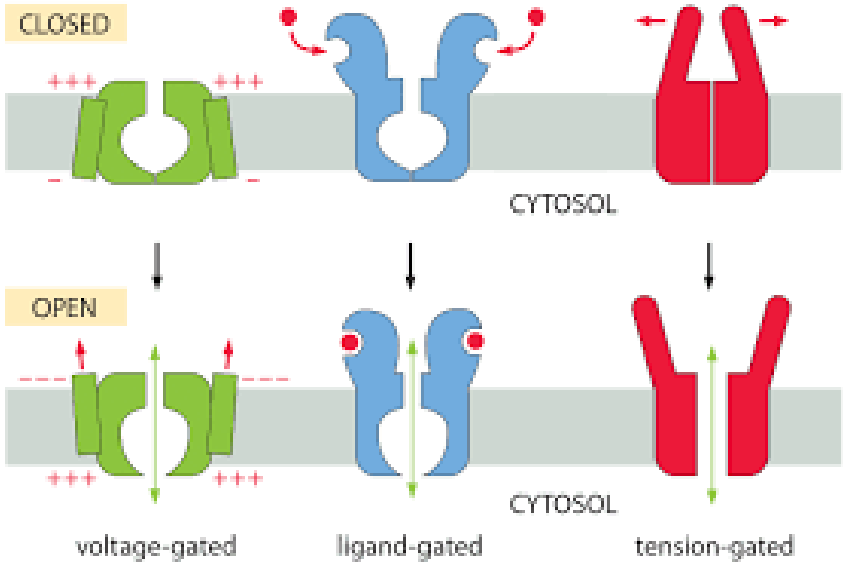
Allows only passive transport

Selective: size charge

Quick transport



Gating: special mechanism determining when the channel should open and close.

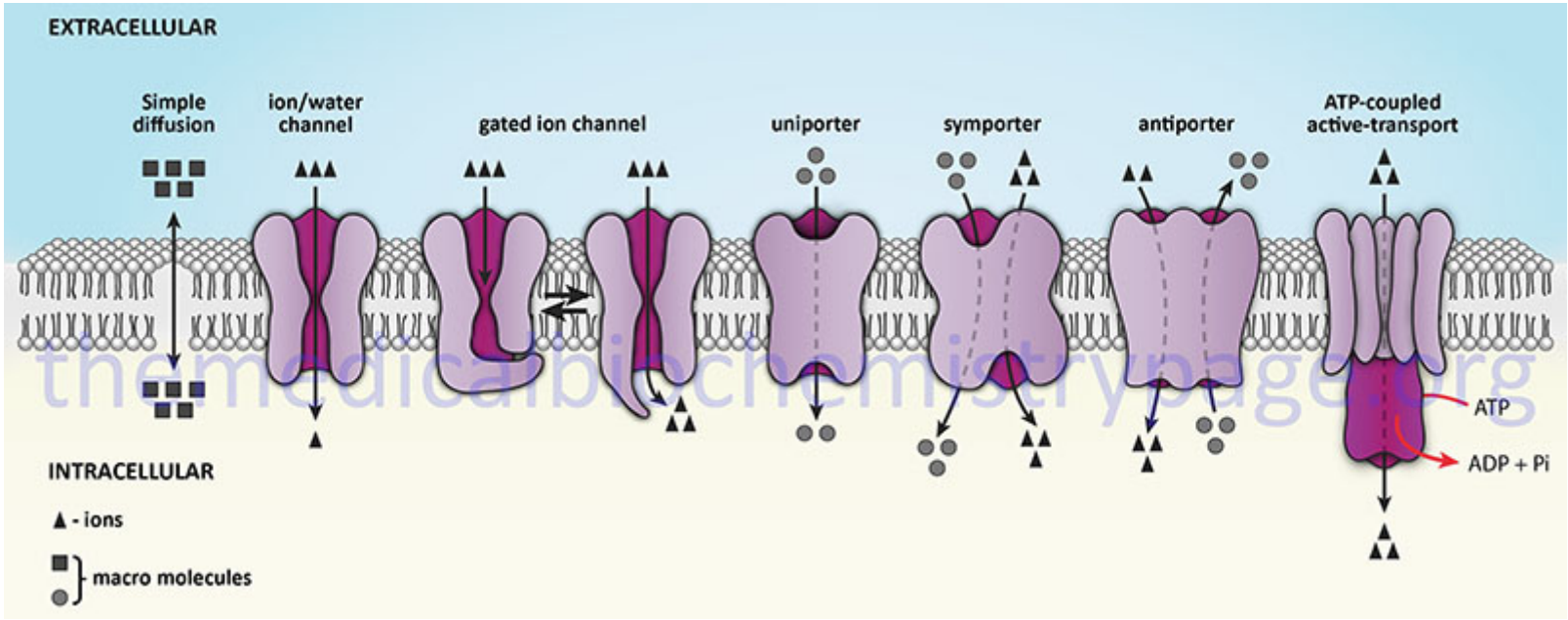


Transporters:

uniporter: only passive transport, facilitated diffusion

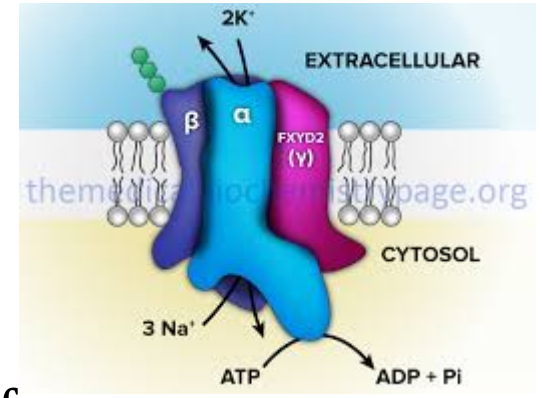
synporter: active and passive transport

antiporter: active and passive transport



slower transport than the transport through the ion channels

ATPases/Pumps



active transport

uses the energy of the ATP molecules

slow transport

needs to maintain the ionic composition of intracellular and intraorganellar spaces.

Na^+ - K^+ pumps: resting membrane potentials of neurons

H^+ pumps : kidney pH regulation

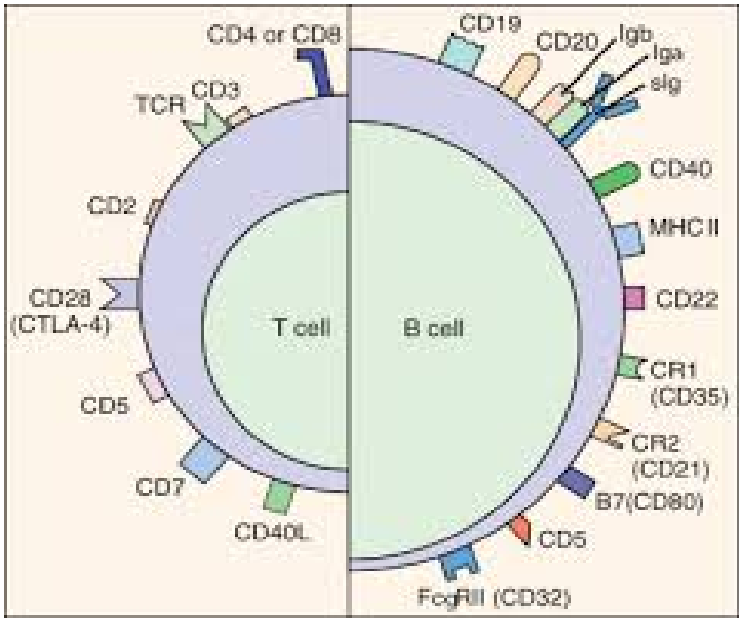
Cell-cell contact:

The Expression of Cell Identity.

Cells possess on their surfaces a variety of tissue-specific identity markers that identify both the tissue and the individual.

In tissues as the cell develops, it acquires a unique set of cell surface molecules.

These molecules serve as markers proclaiming the cells' tissue-specific identity.

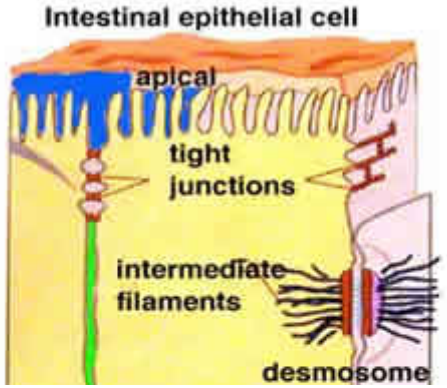


Intercellular Adhesion.

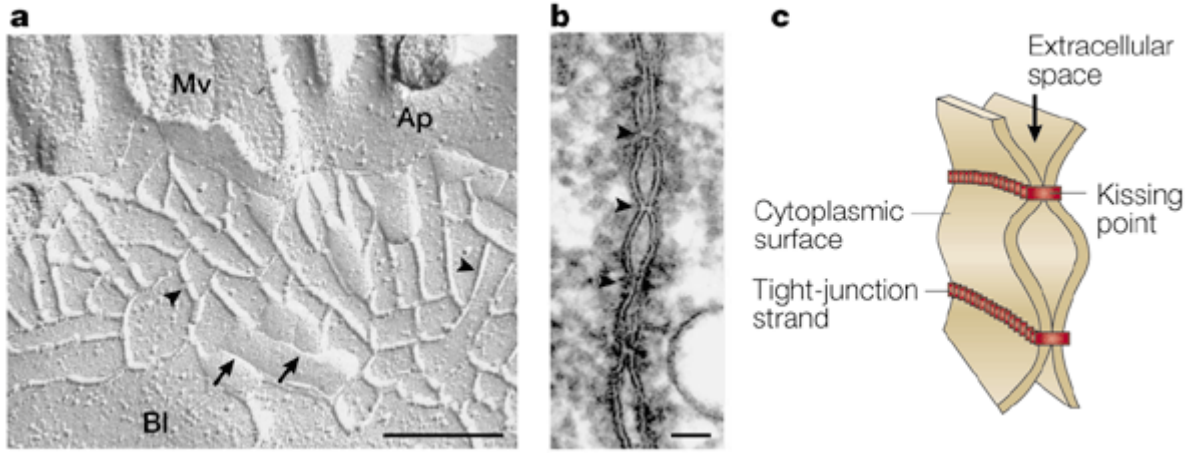
Cells attach themselves to one another with protein links.

Tight Junctions.

When cells are connected by tight junctions molecules are encouraged to flow through the cells, not between them.

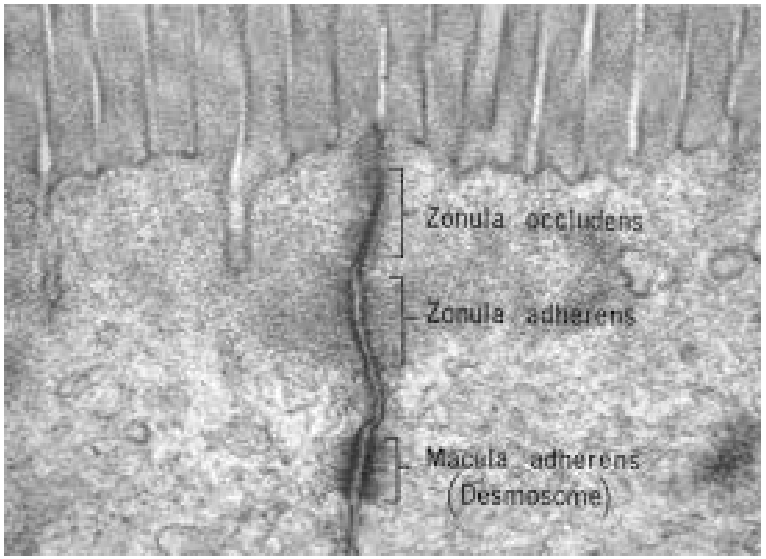


Tight junctions connect the plasma membranes of adjacent cells in a sheet, preventing small molecules from leaking between the cells. This allows the sheet of cells to act as a wall within the organ, keeping molecules on one side or the other.



Anchoring Junctions.

The cytoskeleton of a cell is connected by an anchoring junction to the cytoskeleton of another cell or to the extracellular matrix. They are commonest in tissues subject to mechanical stress, such as muscle and skin epithelium.

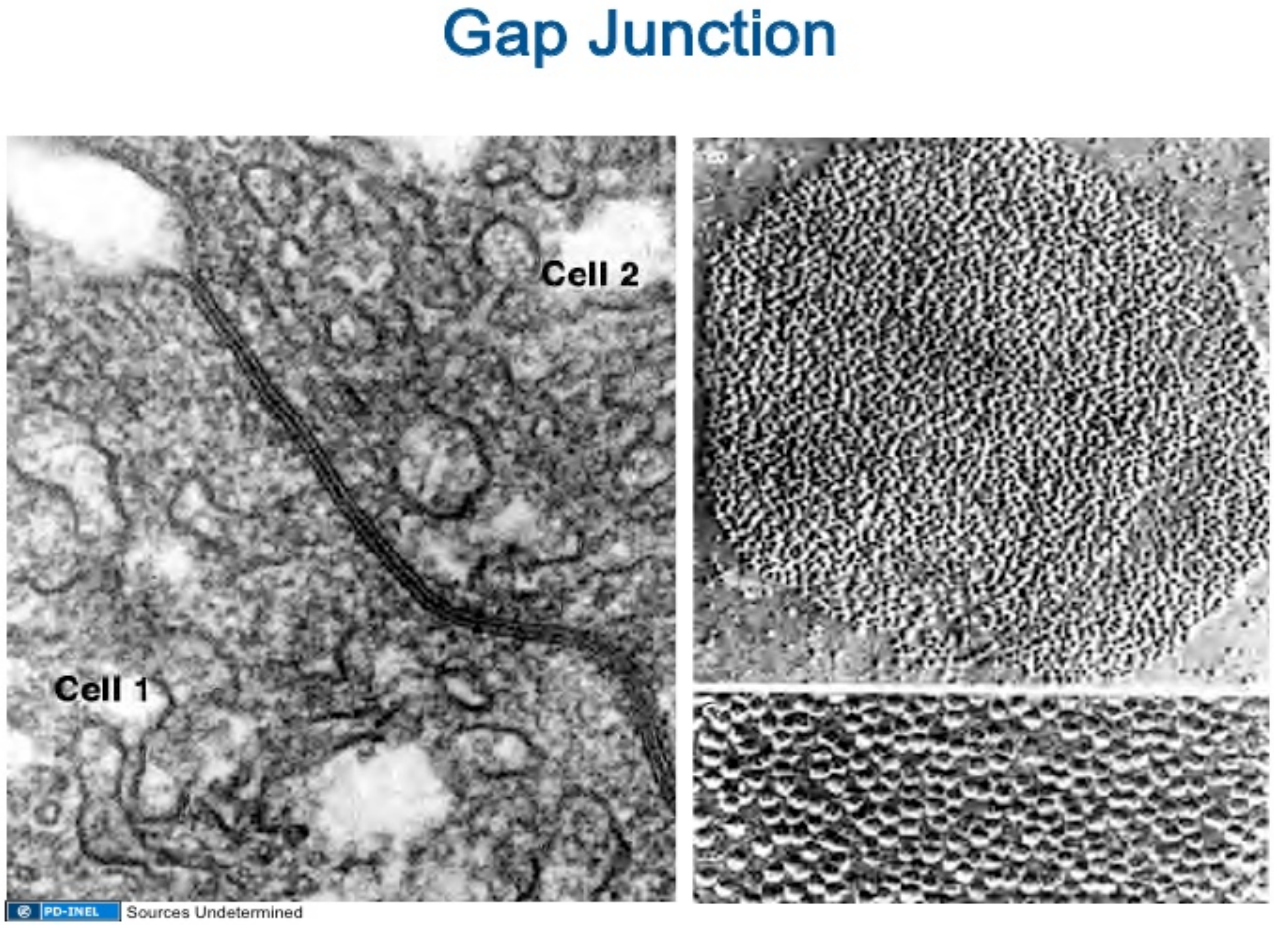


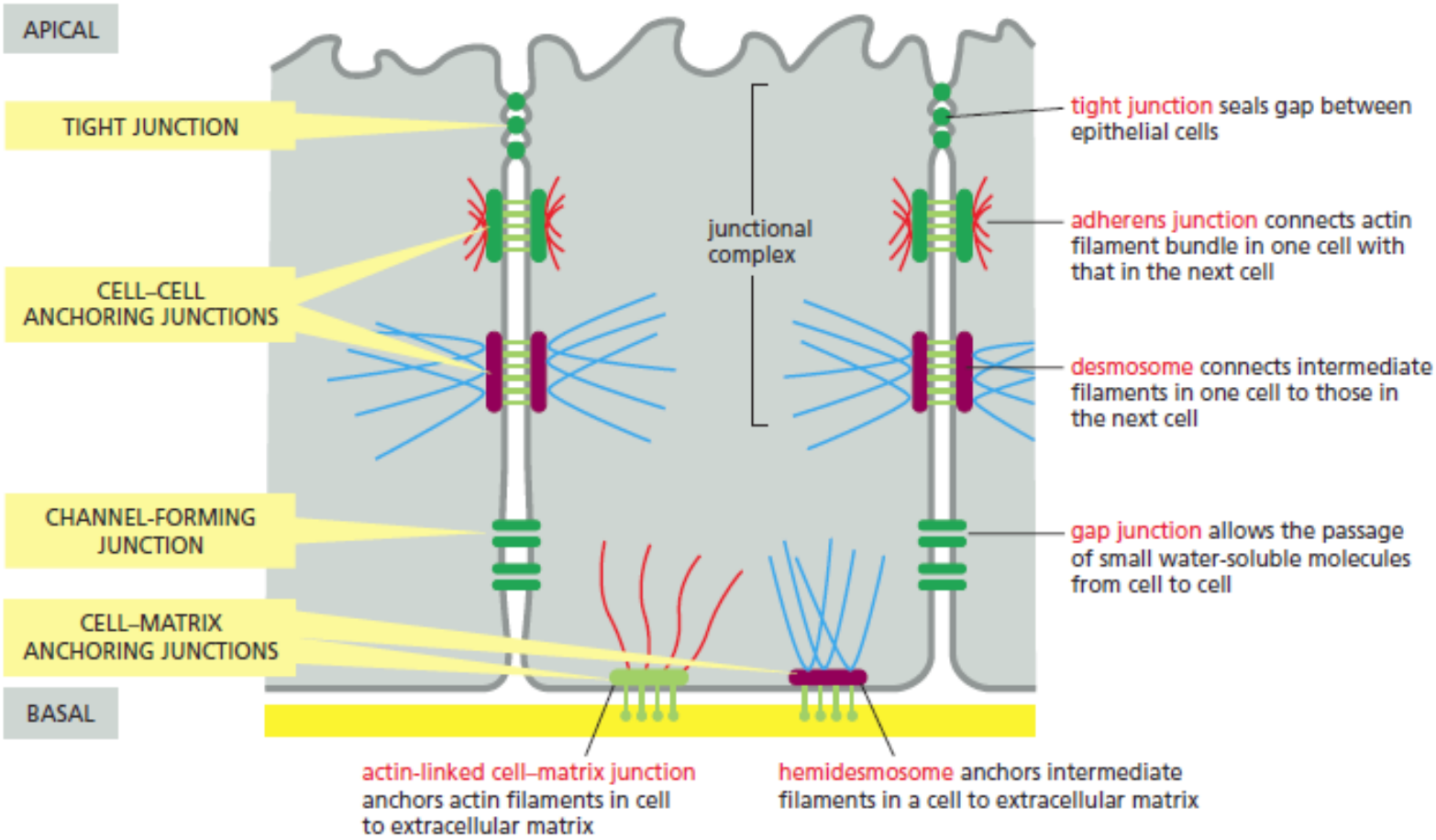
Communicating Junctions.

Many adjacent cells have direct passages that link their cytoplasms, permitting the passage of ions and small molecules.

Gap junctions.

Connexons in gap junctions create passageways between the cytoplasms of adjoining cells. They allow the passage of small molecules and ions required for rapid communication (such as in heart tissue), but do not allow the passage of larger molecules like proteins.





A summary of the various cell junctions found in a vertebrate epithelial cell, classified according to their primary functions. In the most apical portion of the cell, the relative positions of the junctions are the same in nearly all vertebrate epithelia. The tight junction occupies the most apical position, followed by the adherens junction (adhesion belt) and then by a special parallel row of desmosomes; together these form a structure called a junctional complex. Gap junctions and additional desmosomes are less regularly organized. Two types of cell-matrix anchoring junctions tether the basal surface of the cell to the basal lamina. The drawing is based on epithelial cells of the small intestine.