Repetition

Summary of last lecture

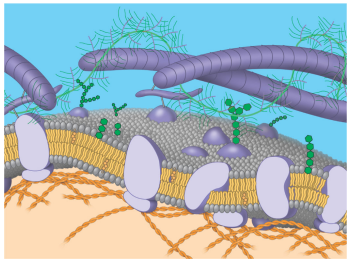
Cells

Eukaryotic (membrane systems, mitochondria, nucleus , **chloroplasts**)

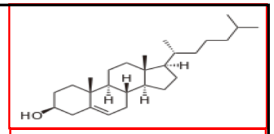
Prokaryotic

- Life at the Edge
- ***The plasma membrane*** is the boundary that separates the living cell from its 'nonliving' surroundings

- The plasma membrane exhibits selective permeability - it allows some substances to cross it more easily than others

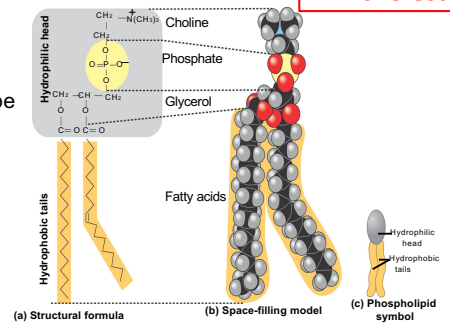


- The Davson-Danielli sandwich model of membrane structure
  - stated that the membrane was made up of a phospholipid bilayer sandwiched between two protein layers, and this



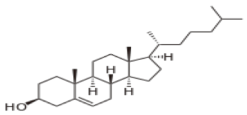
cholesterol

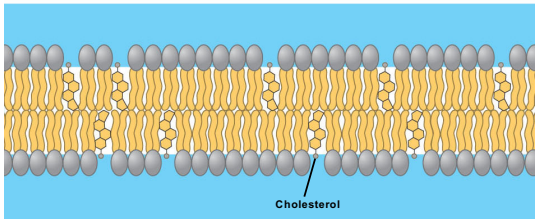
was supported by electron microscope pictures of membranes



- The steroid **cholesterol**

has different effects on membrane fluidity at different temperatures



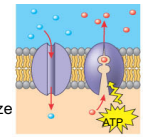


Cholesterol within the animal cell membrane

Adding Cholesterol to a cell membrane reduces fluidity, therefore, making the cell membrane more rigid reducing phospholipid movement. Without cholesterol, cell membranes would be too fluid, not firm enough, and too permeable to some molecules. While cholesterol adds firmness and integrity to the plasma membrane and prevents it from becoming overly fluid, it also helps to maintain its fluidity. At the high concentrations as it is found in our cell's plasma membranes cholesterol helps to separate the phospholipids so that the fatty acid chains can't come together and crystallize. Therefore, cholesterol helps to prevent extremes-- whether too fluid, or too firm -- in the consistency of the cell membrane.

An overview of major functions of membrane proteins

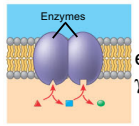
(a) **Transport. (left)** A protein that spans the membrane may provide a hydrophilic channel across the membrane that is selective for a particular solute. **(right)** Other transport proteins shuttle a substance from one side to the other by changing shape. Some of these proteins hydrolyze ATP as an energy source to actively pump substances across the membrane.



e.g. ABC-transporter

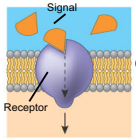
Na/K-ATPase, NMDAR

(b) **Enzymatic activity.** A protein built into the membrane may be an enzyme with its active site exposed to substances in the adjacent solution. In some cases, several enzymes in a membrane are organized as a team that carries out sequential steps of a metabolic pathway.



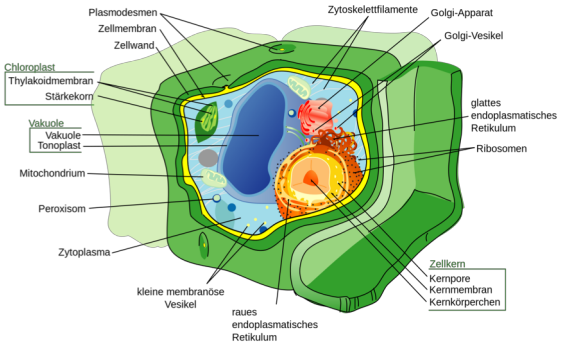
e.g. PLC γ-secretase

(c) **Signal transduction.** A membrane protein may have a binding site with a specific shape that fits the shape of a chemical messenger, such as a hormone. The external messenger (signal) may cause a conformational change in the protein (receptor) that relays the message to the inside of the cell.

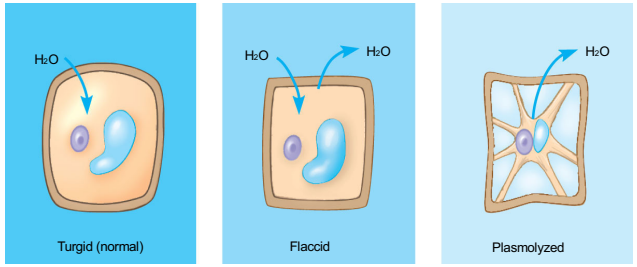


Receptors:
e.g. TRKA
p75NTR
NMDR

Plant - Cell

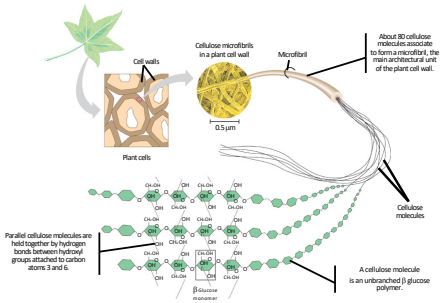


- **Water balance in cells with walls**



Plant cell. Plant cells are turgid (firm) and generally healthiest in a hypotonic environment, where the uptake of water is eventually balanced by the elastic wall pushing back on the cell.

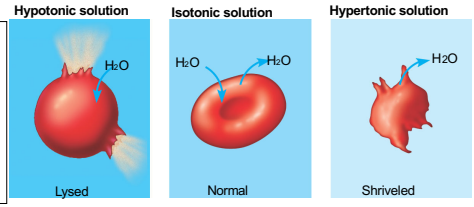
- Cellulose is a major component of the tough walls that enclose plant cells



- Water balance in cells without walls

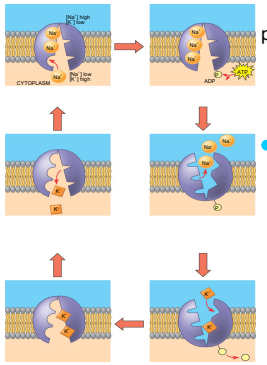
- Animals and other organisms without rigid cell walls living in hypertonic or hypotonic environments
  - must have special adaptations for **osmoregulation**

Animal cell. An animal cell fares best in an isotonic environment unless it has special adaptations to offset the osmotic uptake or loss of water.



The sodium-potassium pump (Na/K-ATPase is one type of **active** transport system

- Cytoplasmic Na^+ binds to the sodium-potassium pump.
- Na^+ binding stimulates phosphorylation by ATP.
- Phosphorylation causes the protein to change its conformation, expelling Na^+ to the outside.
- Extracellular K^+ binds to the protein, triggering release of the Phosphate group.
- Loss of the phosphate restores the protein's original conformation.
- K^+ is released and Na^+ sites are receptive again; the cycle repeats.



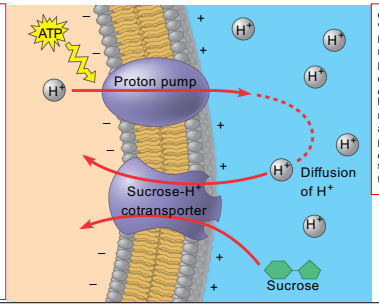
- An electrogenic pump is a transport protein that generates the voltage across a membrane
- Cotransport: active transport driven by a concentration gradient

See also
F-class H^+-pump:

Mitochondria:
ATP generation

Chloroplasts:
Photosynthesis

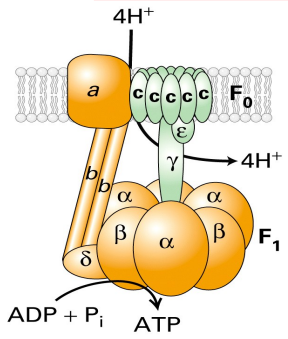
compare with:
Na/K ATPase



e.g.:
V-class proton pumps at vacuolar membranes in plants, yeast, other fungi; at endosomal and lysomal membranes in animal cells; at plasma membrane of osteoclasts and some kidney tubule cells.

H^+ gradient is either created by ATP or H^+ gradient is used to make/synthesize ATP (as in choroplasts or mitochondria)

ATP-synthesis: F-class H^+-pump



F-class proton pumps

Bacterial plasma membrane

Inner mitochondrial membrane

Thylakoid membrane of chloroplast

electromotive force (emf)

F-class pumps do not form phosphoprotein intermediates and transport only protons. V/F-class structures are similar and contain similar proteins, but none of their subunits are related to the P-class pumps. F-class pumps operate in the reverse directions (compared to V-class) to utilize energy in a proton concentration or electrochemical gradient to synthesize ATP.