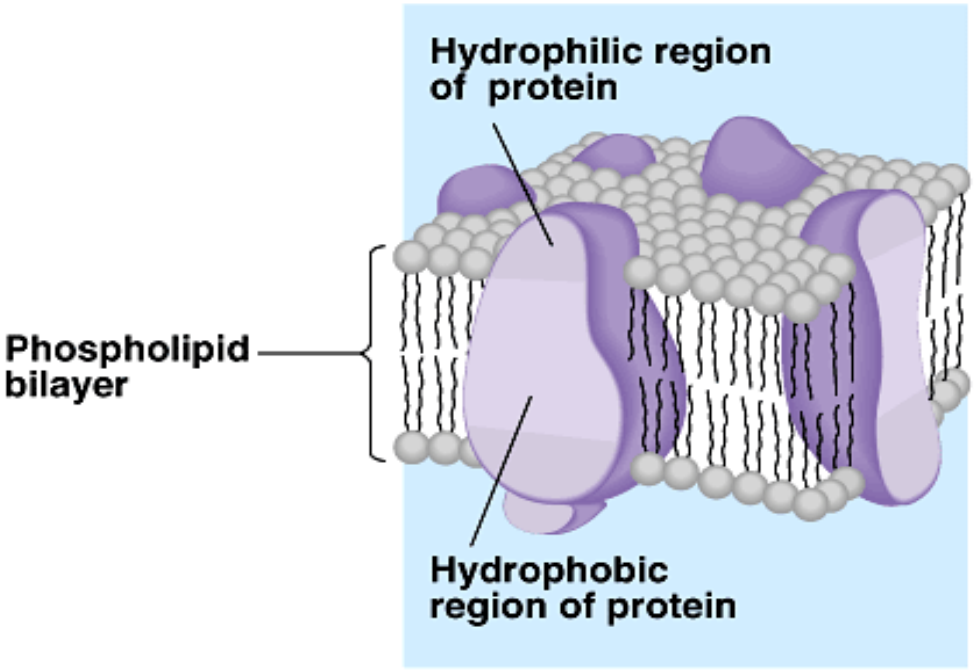
# Aim: What is the fluid mosaic model of the cell membrane?

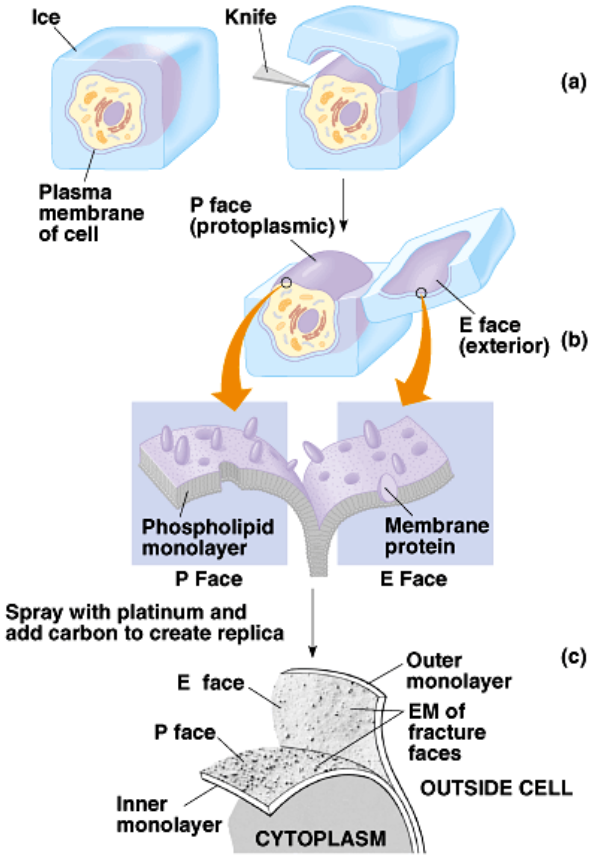
- In 1972, S.J. Singer and G. Nicolson presented a revised model that proposed that the membrane proteins are dispersed and individually inserted into the phospholipid bilayer.
  - In this fluid mosaic model, the hydrophilic regions of proteins and phospholipids are in maximum contact with water and the hydrophobic regions are in a nonaqueous environment.



(b) Current fluid mosaic model

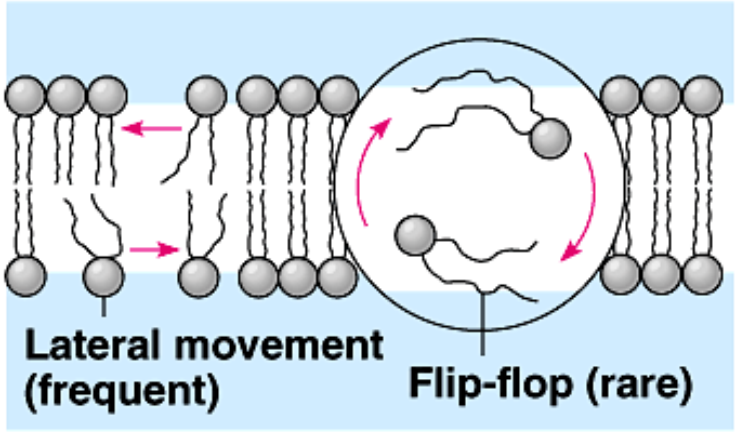
# Experimental evidence of the fluid mosaic model

- A specialized preparation technique, freeze-fracture, splits a membrane along the middle of the phospholid bilayer prior to electron microscopy.



# Membranes are fluid

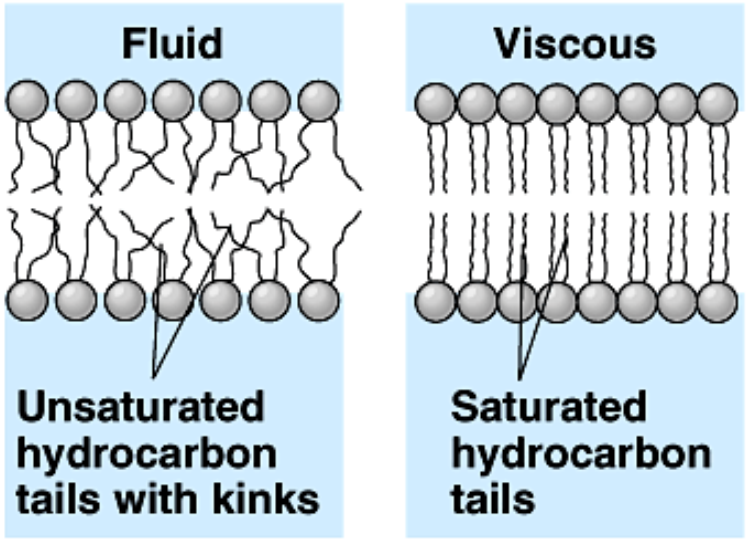
- Membrane molecules are held in place by relatively weak hydrophobic interactions.
- Most of the lipids and some proteins can drift laterally in the plane of the membrane, but rarely flip-flop from one layer to the other.




(a) Movement of phospholipids

# Membranes are fluid

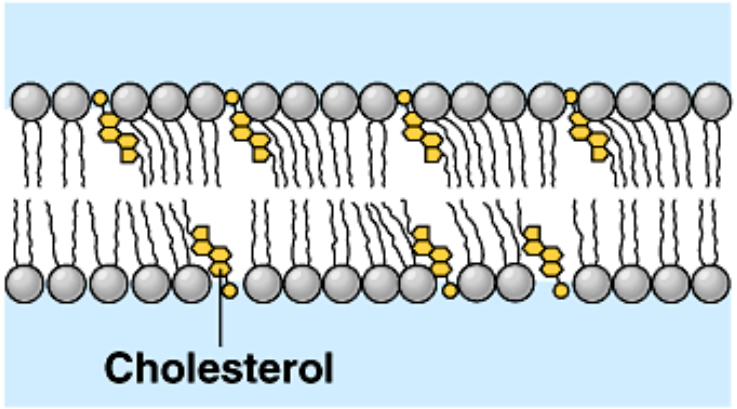
- As temperatures cool, membranes switch from a fluid state to a solid state as the phospholipids are more closely packed.
- Membranes rich in unsaturated fatty acids are more fluid that those dominated by saturated fatty acids because the kinks in the unsaturated fatty acid tails prevent tight packing.



(b) Membrane fluidity

# Membranes are fluid

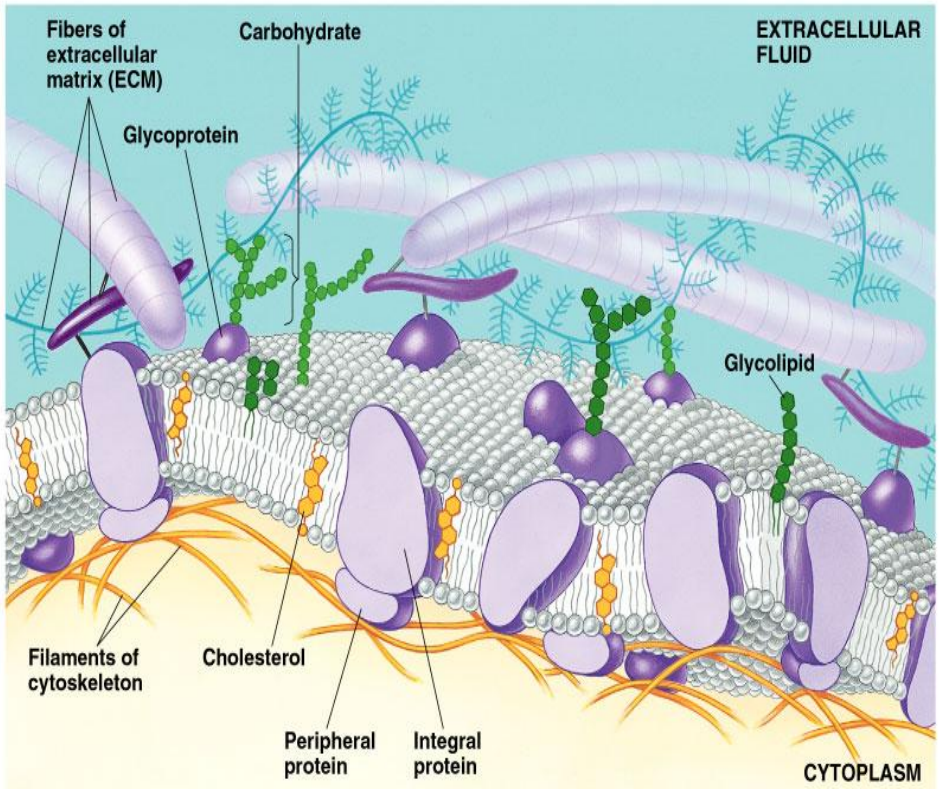
- The steroid cholesterol is wedged between phospholipid molecules in the plasma membrane of animals cells.
- At warm temperatures, it restrains the movement of phospholipids and reduces fluidity.
- At cool temperatures, it maintains fluidity by preventing tight packing.



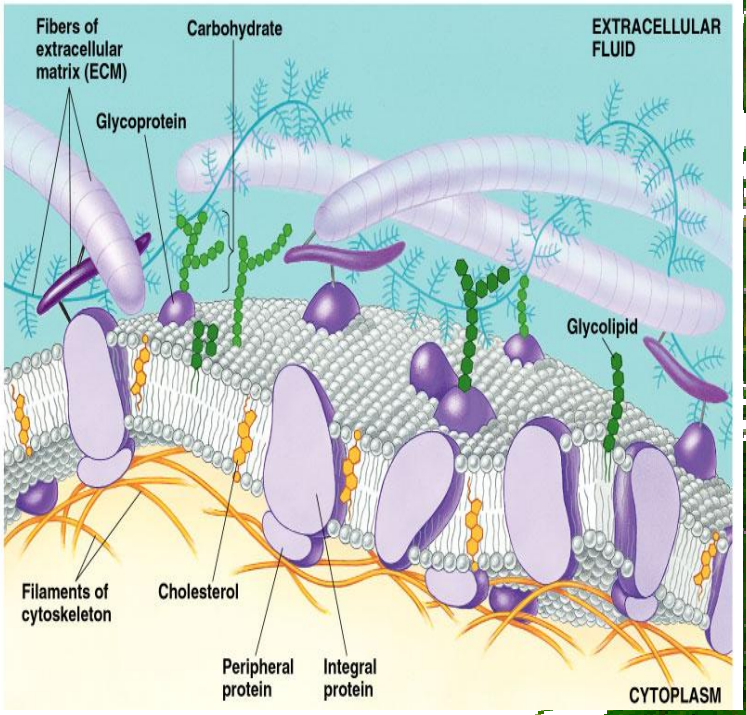

(c) Cholesterol within the membrane

# Membranes are mosaics of structure and function

- A membrane is a collage of different proteins embedded in the fluid matrix of the lipid bilayer



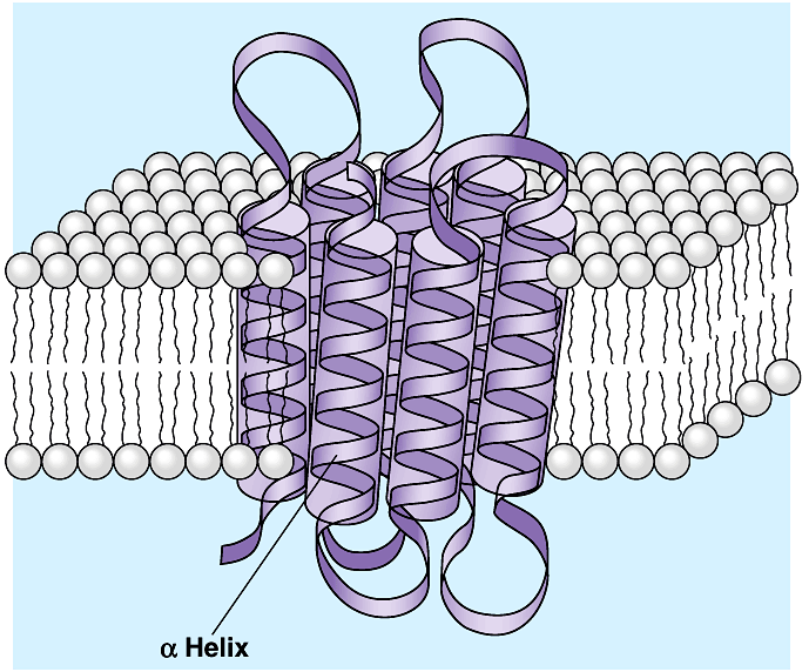
- Proteins determine most of the membrane's specific functions.
- The plasma membrane and the membranes of the various organelles each have unique collections of proteins.
- There are two populations of membrane proteins.
  - **1) Peripheral proteins** are not embedded in the lipid bilayer at all.
  - Instead, they are loosely bounded to the surface of the protein, often connected to the other population of membrane proteins.



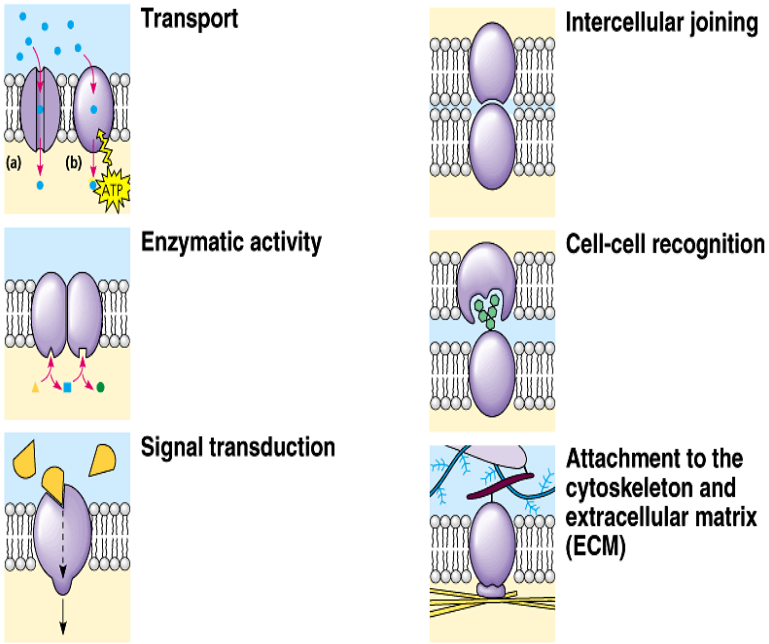
- **2)Integral proteins** penetrate the hydrophobic core of the lipid bilayer, often completely spanning the membrane (a *transmembrane* protein).

  - Where they contact the core, they have hydrophobic regions with nonpolar amino acids, often coiled into alpha helices.

  - Where they are in contact with the aqueous environment, they have hydrophilic regions of amino acids.



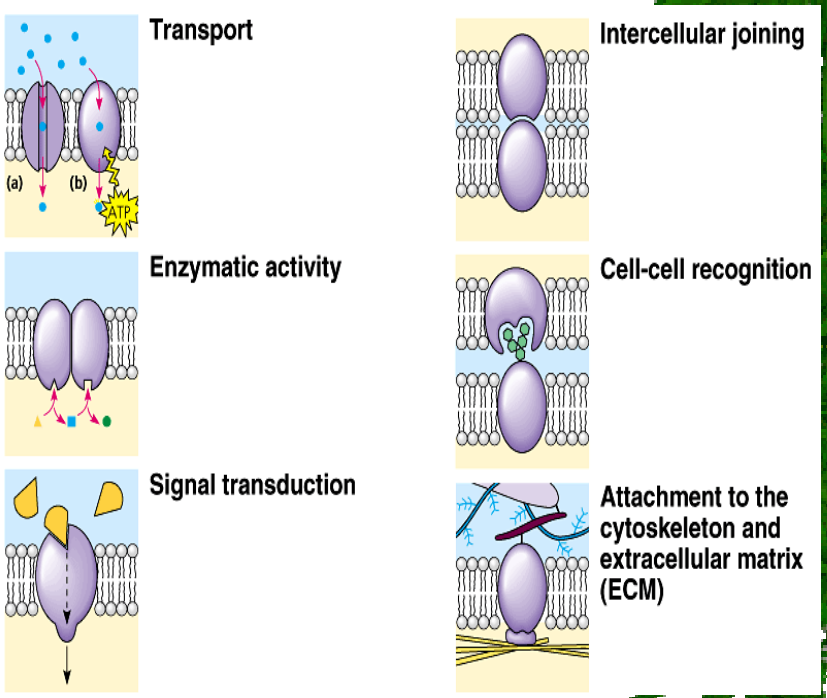
# Proteins in the cell membrane



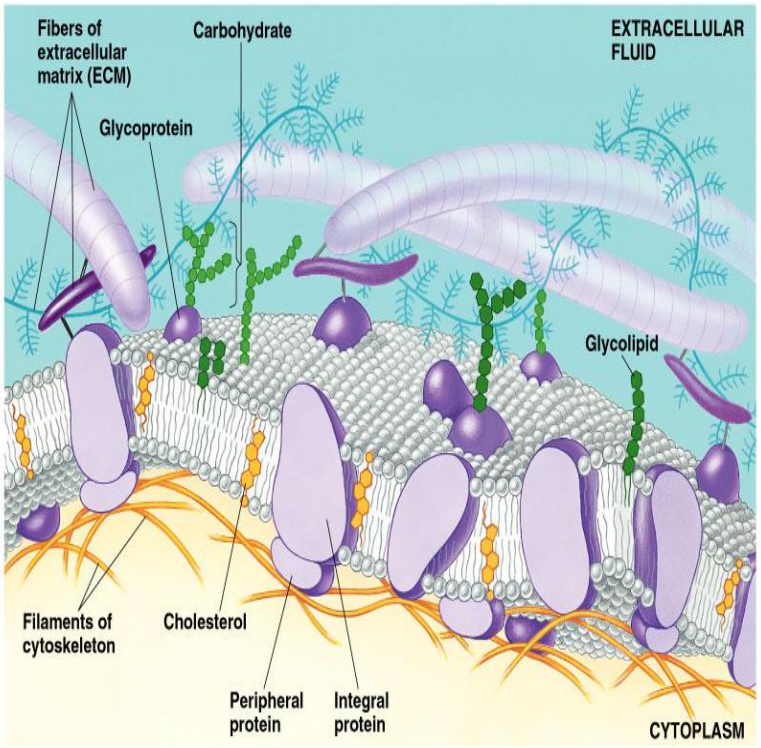

- Proteins embedded in membrane serve different functions
- Transport Proteins - regulate movement of substance
- Channel Proteins - form small openings for molecules to diffuse through

# Proteins in the cell membrane

- Carrier Proteins- binding site on protein surface "grabs" certain molecules and pulls them into the cell
- Gated Channels - similar to carrier proteins, not always "open"
- Receptor Proteins - molecular triggers that set off cell responses (such as release of hormones or opening of channel proteins)
- Recognition Proteins - ID tags, to identify cells to the body's immune system



- **One role of membrane proteins is to reinforce the shape of a cell and provide a strong framework.**
  - **On the cytoplasmic side, some membrane proteins connect to the cytoskeleton.**
  - **On the exterior side, some membrane proteins attach to the fibers of the extracellular matrix.**

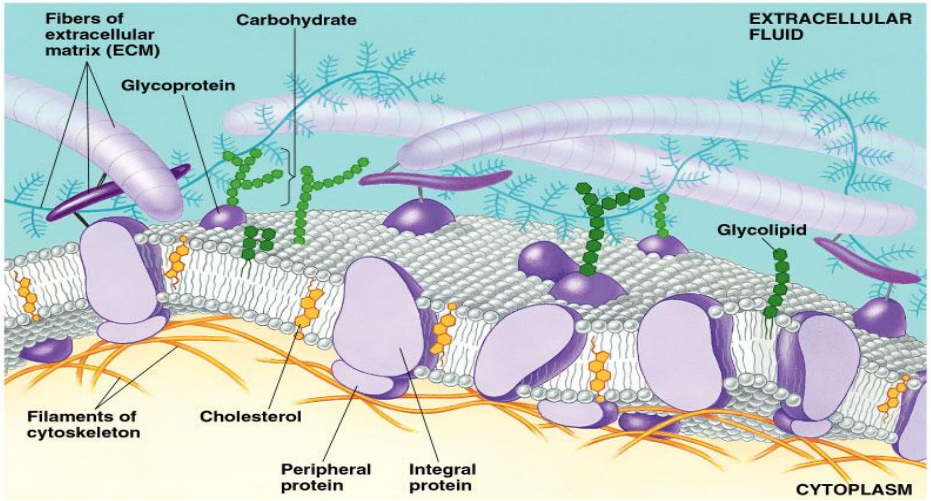


# Membrane carbohydrates are important for cell-cell recognition

- Cell-cell recognition is the ability of a cell to distinguish one type of neighboring cell from another.
- This attribute is important in cell sorting and organization as tissues and organs in development.
- It is also the basis for rejection of foreign cells by the immune system.
- Cells recognize other cells by keying on surface molecules, often carbohydrates, on the plasma membrane.

# Membrane carbohydrates are important for cell-cell recognition

- Membrane carbohydrates are usually branched oligosaccharides with fewer than 15 sugar units.
- They may be covalently bonded either to lipids, forming glycolipids, or, more commonly, to proteins, forming glycoproteins.



# Membrane carbohydrates are important for cell-cell recognition

- The oligosaccharides on the external side of the plasma membrane vary from species to species, individual to individual, and even from cell type to cell type within the same individual.
  - **This variation marks each cell type as distinct.**
  - **The four human blood groups (A, B, AB, and O) differ in the external carbohydrates on red blood cells.**