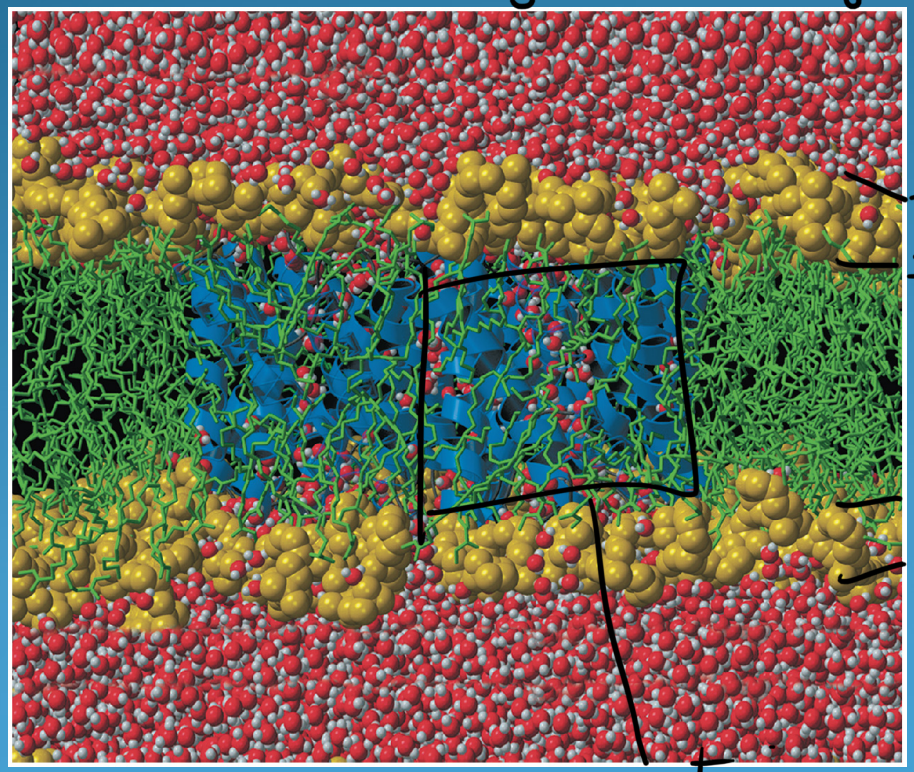
Chapter 5

Membrane Structure and Function

water causes the assembly of the bilayer



water molecules

head - polar group phospholipids

fatty acid tails nonpolar amphipathic

water molecules

protein - α-helix

What You Must Know:

- Why membranes are selectively permeable.
- The role of phospholipids, proteins, and carbohydrates in membranes.
- How water will move if a cell is placed in an isotonic, hypertonic, or hypotonic solution and be able to predict the effect of different environments on the organism.
- How electrochemical gradients and proton gradients are formed and function in cells.

Cell Membrane

A. Plasma membrane is **selectively permeable**
   - Allows some substances to cross more easily than others

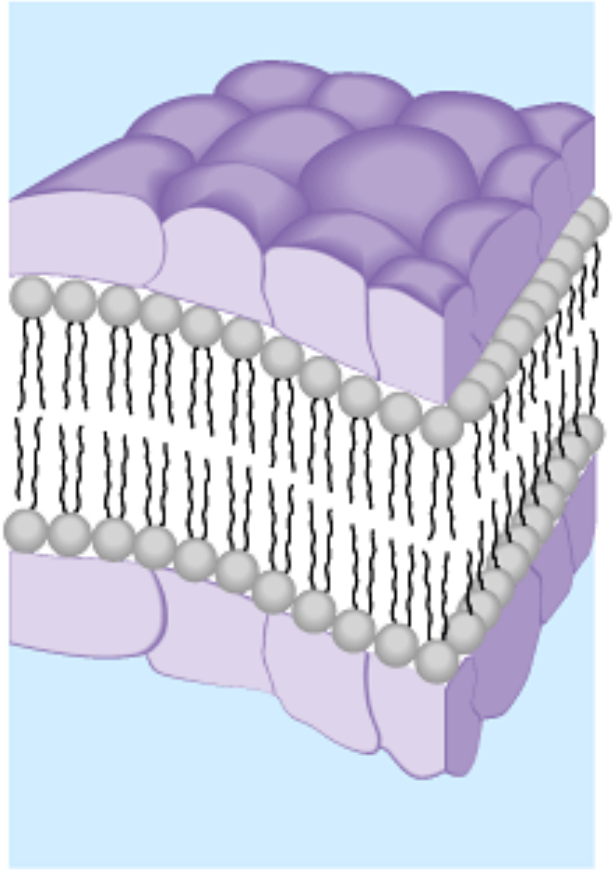
small and/or nonpolar allowed inside
large, polar/charged not allowed

B. **Fluid Mosaic Model**
   - **Fluid**: membrane held together by weak interactions
   - **Mosaic**: phospholipids, proteins, carbs

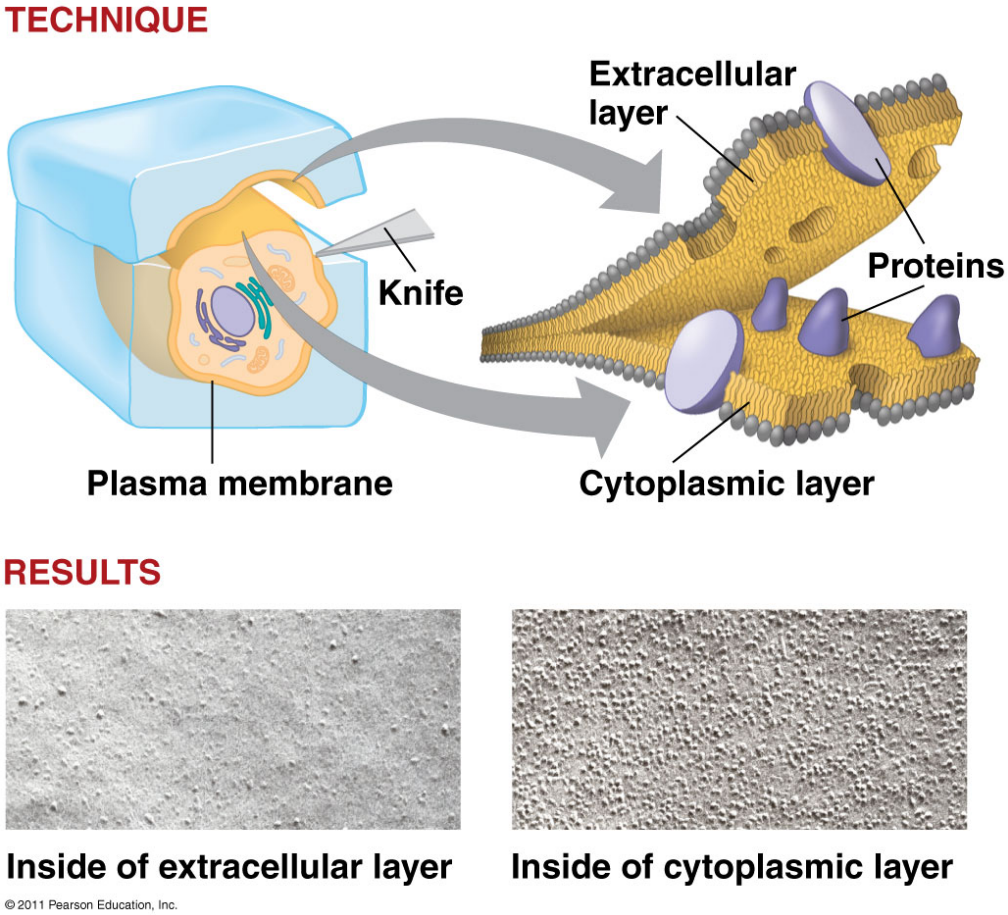
Proteins select specific substances.
are polar and/or large.

Early membrane model

- (1935) Davson/Danielli – Sandwich model
- phospholipid bilayer between 2 protein layers
- Problems: varying chemical composition of membrane, hydrophobic protein parts



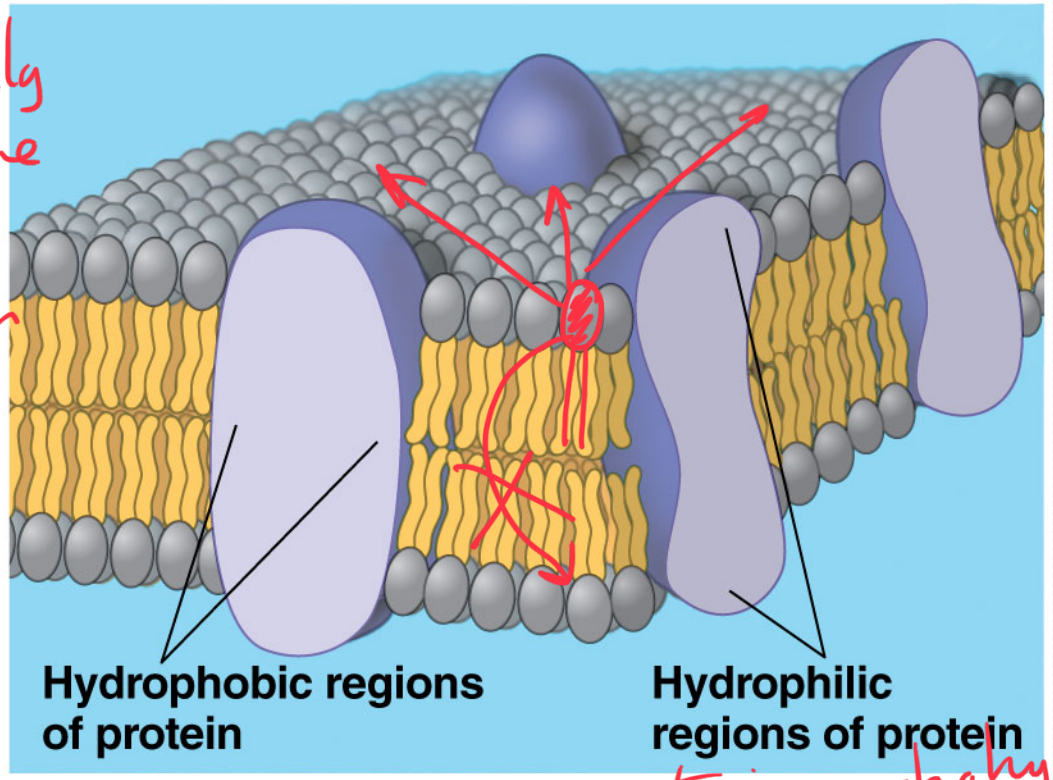
The freeze-fracture method: revealed the structure of membrane's interior



Fluid Mosaic Model

Fluid - lipid can freely move laterally across the membrane

Moves ; behaves like waves in ocean

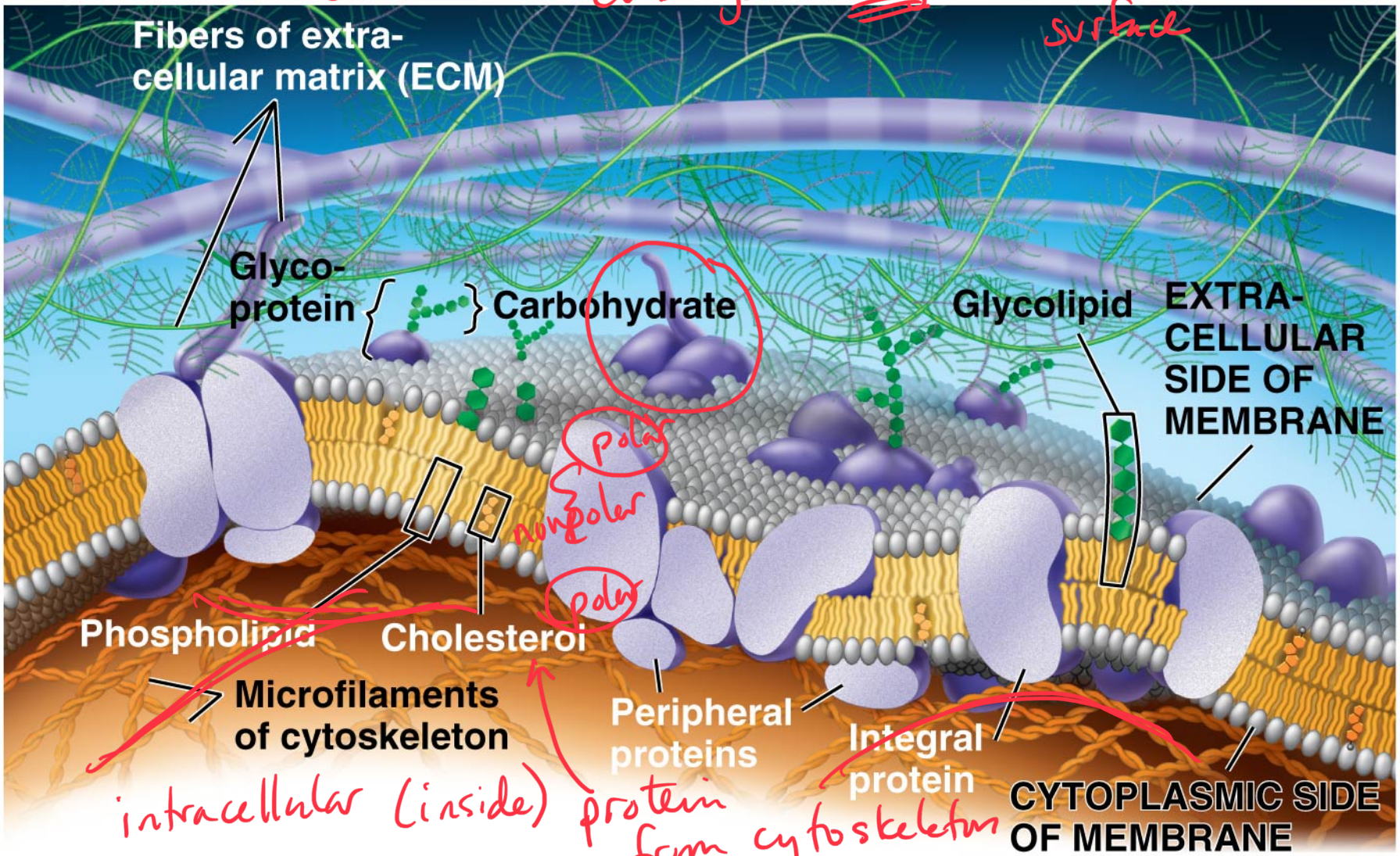


Does not move transversally (much) flip

Mosaic → presence protein, carbohydrate > 50%

Extracellular (outside)

carbohydrate only on extracellular surface



intracellular (inside)

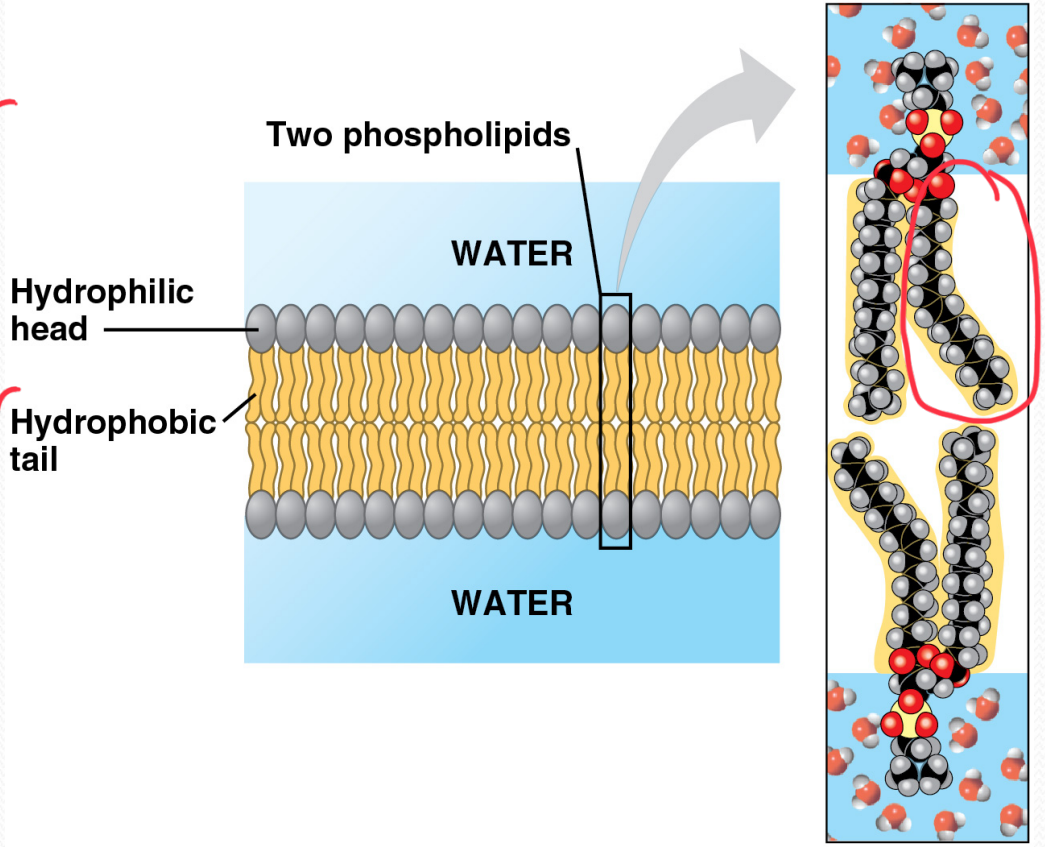
protein from cytoskeleton

Phospholipids

- Bilayer
- **Amphipathic** = hydrophilic head, hydrophobic tail
- Hydrophobic barrier: keeps hydrophilic molecules out

polar

nonpolar



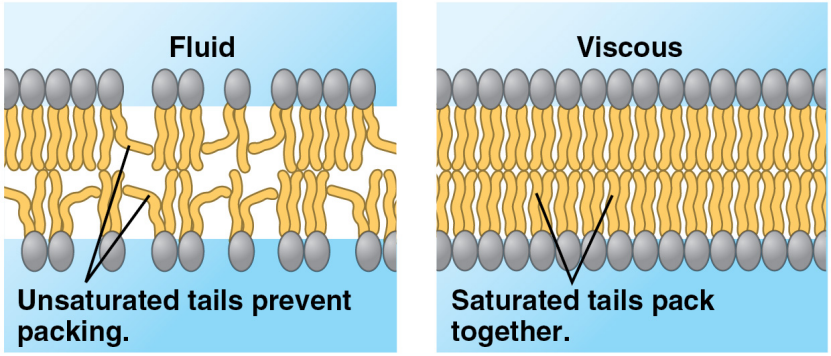
Membrane fluidity

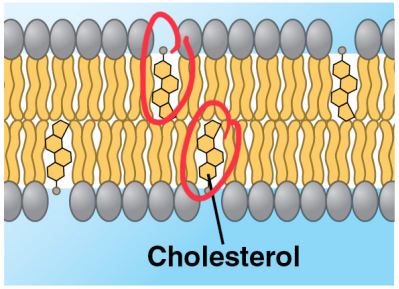
- **Low temps**: phospholipids w/ unsaturated tails (kinks prevent close packing)
- **Cholesterol** resists changes by:
  - limit fluidity at high temps
  - hinder close packing at low temps

Cholesterol - temperature and fluidity buffer

- Adaptations: bacteria in hot springs (unusual lipids); winter wheat (↑ unsaturated phospholipids)

(a) Unsaturated versus saturated hydrocarbon tails.





(b) Cholesterol reduces membrane fluidity at moderate temperatures, but at low temperatures hinders solidification.

Membrane Proteins

Integral Proteins

- Embedded in membrane
- Determined by freeze fracture
- Transmembrane with hydrophilic heads/tails and hydrophobic middles

Peripheral Proteins

- Extracellular or cytoplasmic sides of membrane
- NOT embedded
- Held in place by the cytoskeleton or ECM
- Provides stronger framework