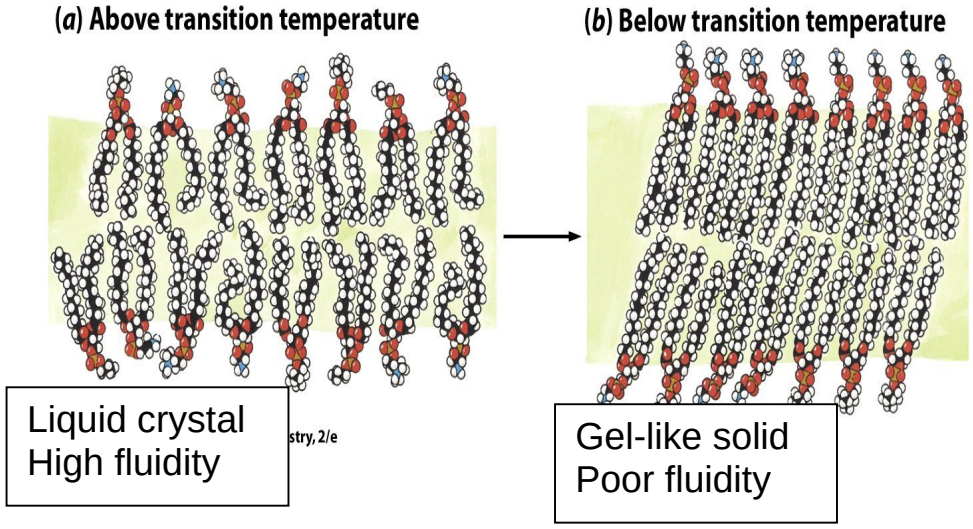
11.2.07 Recall from last lecture:

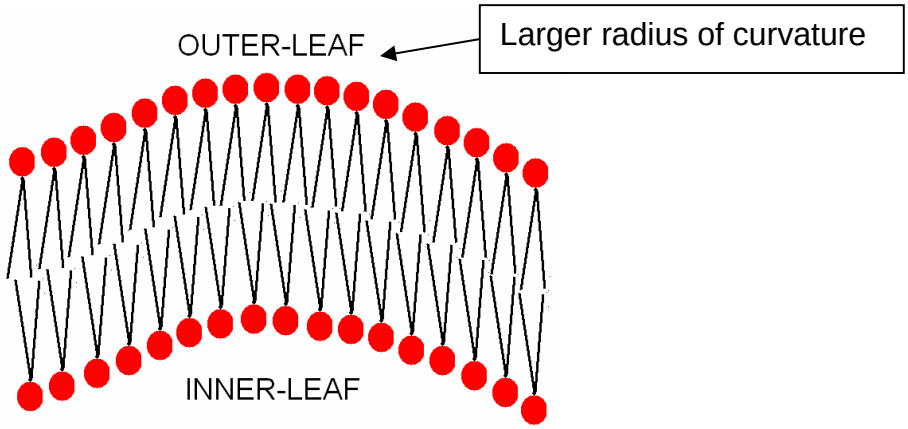
Fluidity can be regulated by:

- **Temperature**
  - Depends on transition temperature (temp of phase change)
    - Below transition temp,
      - becomes a gel-like solid, low fluidity (low disorder) → low permeability
    - Above transition temp,
      - liquid crystal, very fluid → high permeability
      - above liquid crystal state ➔ **hexagonal phase**
        - **prone to fusion and low permability**
  - Transition temp increases with chain length and saturation



FLUID MOSAIC MODEL

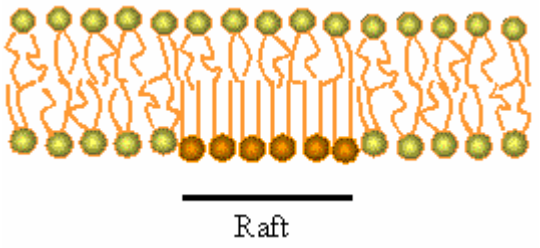
There are two leaves of the cell membrane:



The commonly accepted model of the cell membrane is called the Fluid Mosaic Model. The membrane itself has liquid properties.

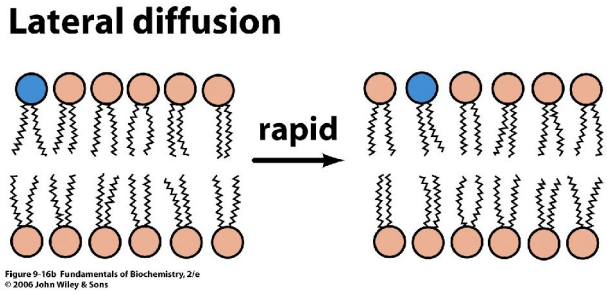
It used to be thought that the lipids exist uniformly throughout the membrane, but now lipid rafts are known to exist:

- There are areas of different fluidity
  - Some areas are very fluid, while others are gel-like
  - Lipid raft – lipid micro-domain which is enriched with different types of lipids including cholesterol and sphingolipids.

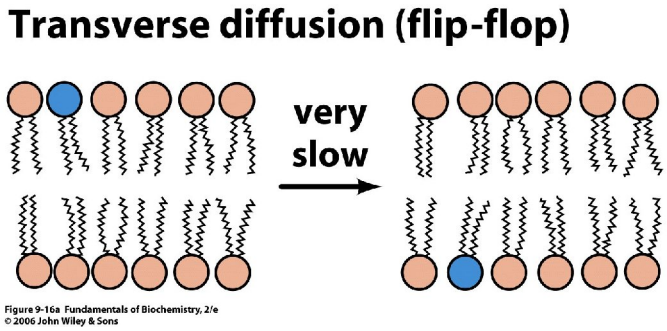


- These rafts ensure lateral asymmetry.

Lipids are free to diffuse laterally (with adjacent lipids) within one side of the membrane and only in areas of similar fluidity (can't diffuse between different rafts).



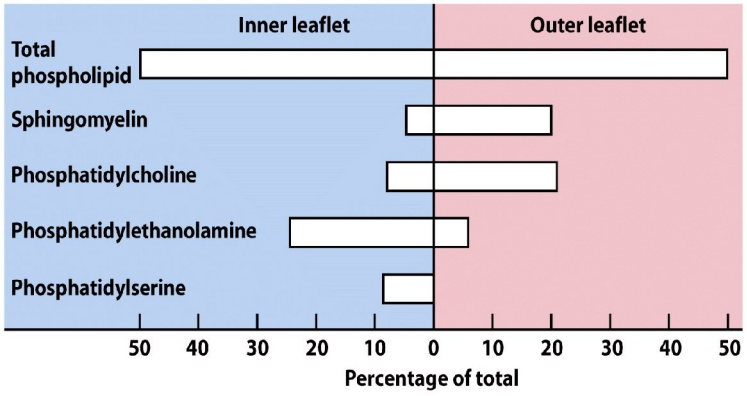
Lipids are **not** free to diffuse transversely (to the other leaf).



- If a lipid does transversely diffuse, it is returned to its original leaf by one of the enzymes:
  - Flippase
    - Does NOT require energy (ATP)
  - Phospholipid translocase
    - Requires energy (ATP)

- **Phosphatidylserine** is a type of phospholipid that is free to move between lipid leafs
  - Phosphatidylserine is found normally in the inner leaf of the plasma membrane, but can move to the outer leaf of the membrane

There are two sides to the lipid membrane and there are different amounts of each type of lipid on each side:



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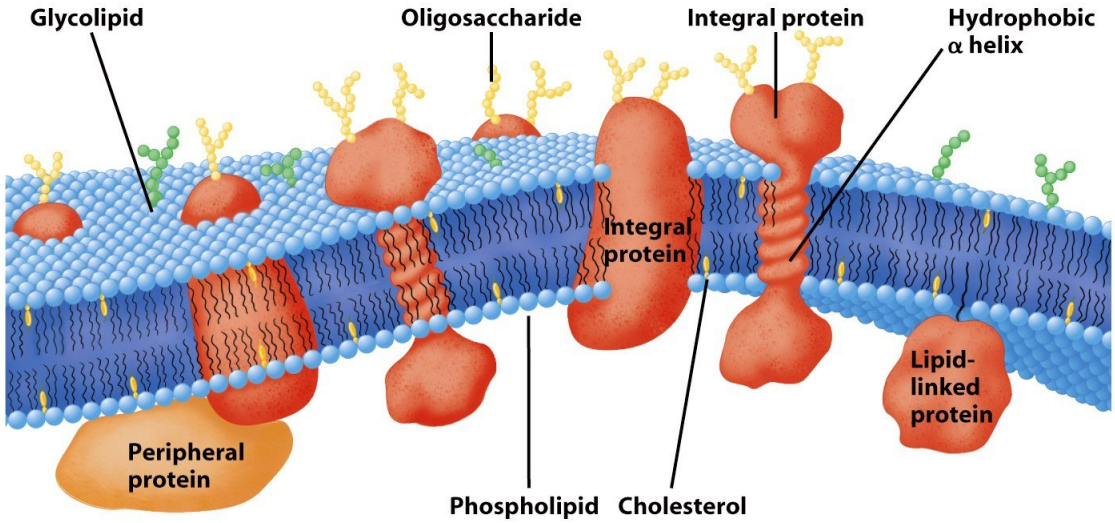
Oligosaccharides are always on the outer leaf of the membrane.

The presence of proteins and oliogosaccharides ensure transverse asymmetry.



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MEMBRANE PROTEINS

There are three different types of proteins in the cell membrane:

- Integral membrane proteins
- Lipid-linked protein
- Peripheral protein

Integral membrane proteins

- Span the lipid bilayer and extend into the extra- and intra-cellular space
  - Are both hydrophobic (inside lipid bilayer) and hydrophilic (outside)
  - Functionality depends on the fluidity of the membrane
  - Must destroy the membrane in order to remove it

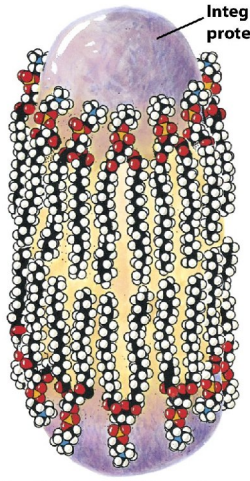
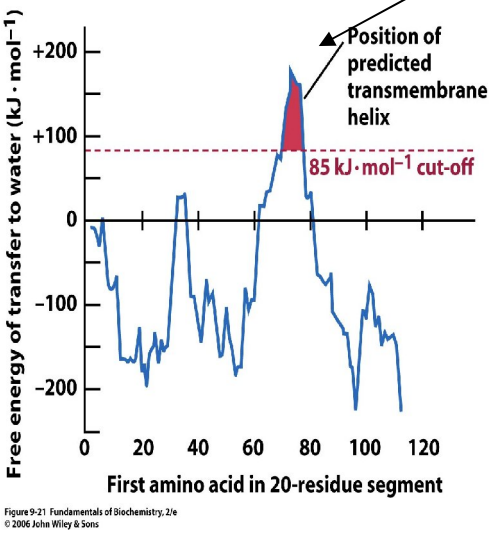


Figure 9-19 Fundamentals of Biochemistry, 2/e

Annular lipids – requ
protein to function prop

- Which part of the integral protein exists within the lipid bilayer can be predicted by the hydropathic index

Hydrophobic area will exist within the bilayer



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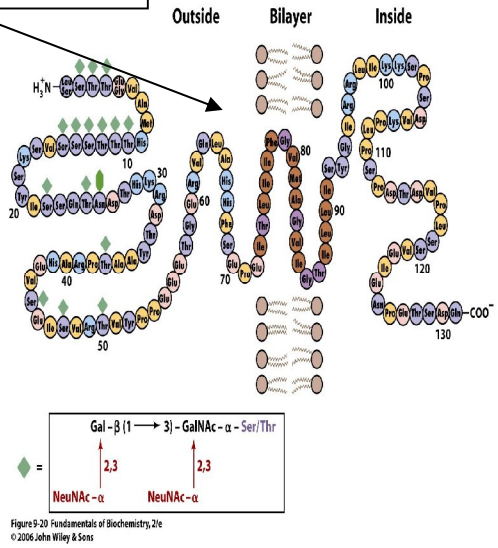

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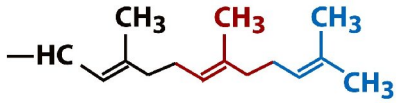
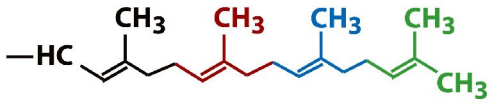
- Lipid–linked (lipid-anchored) protein
  - Achored to the membrane surface by
    - prenylation (isoprenoids),

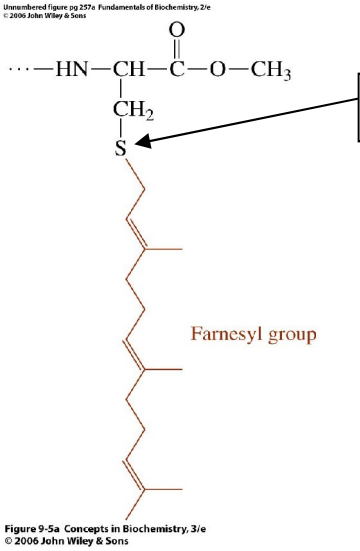


Farnesyl residue

Isoprenoids (NOT eicosonoids, no COOH)



Geranylgeranyl residue



Thioether linkage

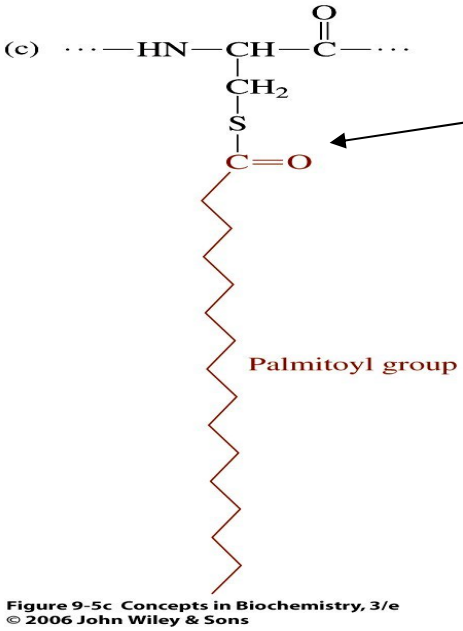
Note unsaturation: Exists in a more fluid environment

- myristoylation (myristic acid), and

Amide linkage

Note saturation: Exists in a less fluid environment

- palmitoylation (palmitic acid)



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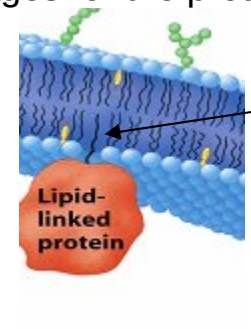
The above molecules are the linkages for the protein to the cell membrane



More on the lipid-linked protein itself:

- Exists on the inside of the cell membrane
- Protein is hydrophilic to interact with cytosol and phospholipids heads
- Removing the protein does not destroy the membrane

Peripheral proteins

- Attached to the bilayer through electrostatic attractions
  - Hydrophilic surface to interact with cytosol and phospholipids head
  - Most easily removed of the three proteins
    - Commonly found only on the interior face of the membrane so it is not equipped to face changing external environment
    - Change in ionic strength, pH, conformation can remove protein