Chapter 12
Membrane Structure and Function
(Problems: 1-6,8,10-15,17,19-20,22,24-26,28-30.)

- Sheetlike structures, closed boundaries
- Lipids, proteins, carbohydrates
- Amphipathic, barrier function
- Protein pumps, channels, receptors, transducers, and enzymes
- Noncovalent
- Asymmetric
- Fluid
- Electrical polarity
12.1 Phospholipids and Glycolipids from Bimolecular Sheets

- The hydrophobic effect; entropy of water.
- Van der Waals forces.
- Electrostatic
- H-bonds
Formation of Lipid Vesicles

Potential for targeted drug delivery

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Permeability of Lipid Bilayers

![Diagram showing permeability of different molecules through lipid bilayers.](image)

**Figure 12.4**
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12.2 Membrane Fluidity

Dependent on length of fatty acyl chains and their degree of unsaturation.
12.3 Membrane Proteins

- Pumps, channels, receptors, enzymes.
- Varying protein content; e.g. 18 – 75%
- Different proteins = different functions.
Types of Membrane Proteins

- Transmembrane Integral
- Peripheral
- Lipid anchored

Prostaglandin H₂ synthase-1

bacteriorhodopsin

Porin

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Clinical Insight: Prostaglandin H2 Synthase-1 and Aspirin

Cyclooxygenase (COX)

Aspirin (Acetylsalicylic acid)
12.4 Diffusion of Membrane Lipids and Proteins

**Fluid mosaic model**

Lateral diffusion shown by **fluorescence recovery after photobleaching (FRAP)**.

- Rafts
- Diffusion barrier
- Two-dimensional solutions
- Membrane asymmetry
12.5 Membrane Protein Transporters

- **Diffusion**
  - **Simple**
  - **Facilitated (Passive transport)**

  Down ("with") a concentration gradient. Does not require energy.

  \[ \frac{V_{\text{max}}}{2} \]

- **Active transport**
  Up ("against") a concentration gradient. Does require energy.

\[ v = \frac{V_{\text{max}} [S]_{\text{out}}}{K_{tr} + [S]_{\text{out}}} \]

- Initial rate of transport increases until a maximum is reached (site is saturated)
Active Transport: the Sodium/Potassium ATPase Pump

Na⁺ and K⁺ transported against a concentration gradient; energy is provided via coupling to ATP hydrolysis.

A p-type ATPase
Ca²⁺ ATPase
Gastric H⁺-K⁺ ATPase

Cell volume
Electronic response of neurons and muscle cells
Transport of sugars, amino acids via secondary active transport
Secondary Transporters

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Channel Transport

- Passive
- Rapid
- Specific
- Molecular machines

**Voltage gated:**
respond to changes in membrane potential.

**Ligand-gated:**
respond to binding of small molecules.

**Nerve Impulse:** Na\(^+\) into cell and K\(^+\) out.
The **K⁺ Channel**

The selectivity filter, “filters” water molecules away from the K⁺.

K⁺ channel is 100 X more permeable to K⁺ than to Na⁺.
The K⁺ Channel is Rapid

Cell exterior → Cell interior

Repulsion

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