Membrane Structure and Function

Membranes consist of Phospholipid Bilayers

Cholesterol is embedded in the Bilayer

Membranes are fluid Mosaic Models
Freeze-Fracture Visualizes Inside of Membrane

1. A cell frozen in medium is cracked with a knife blade.
2. The cell often fractures through the interior, hydrophilic area of the lipid bilayer, splitting the plasma membrane into two layers.
3. The plasma membrane separates such that proteins and other embedded membrane structures remain within one or the other layers of the membrane.
4. The exposed membrane is coated with platinum, which forms a replica of the membrane. The underlying membrane is dissolved away, and the replica is then viewed with electron microscopy.

Bilayers are fluid

Individual phospholipids and unanchored proteins can move through the membrane

Saturated fatty acids make the membrane less fluid than unsaturated fatty acids

Test of Membrane Fluidity

Membrane Proteins

- Various functions:
  1. Transporters
  2. Enzymes
  3. Cell-surface receptors
  4. Cell-surface identity markers
  5. Cell-to-cell adhesion proteins
  6. Attachments to the cytoskeleton

Membrane Proteins Have Many Functions
**Structural Features of Membrane Proteins relate to Function**

- Integral or Transmembrane proteins

**Structure of Membrane Proteins**

- Pores: e.g. Aquaporin

**Glycoproteins are important for immune function**

- The HIV virus binds to the CD4 and CCR5 receptor and enters the T-helper cell

**Transport can occur by simple Diffusion**

- Passive transport = movement of molecules through the membrane
  - No energy required
  - Molecules move in response to a concentration gradient
- Diffusion: movement of molecules from high concentration to low concentration
Facilitated Diffusion through Channels

- Channel proteins
  - Hydrophilic channel when open

Facilitated Diffusion by Carrier Proteins

- Carrier proteins
  - Bind specifically to molecules they assist

Channel Proteins: Aquaporin

- Outside cell
- Lipid bilayer membrane
- Aquaporin
- Water molecule
- Cytosol

Osmosis is the Diffusion of Water across a Membrane

- Osmosis: net diffusion of water across a membrane toward a higher solute concentration
**Osmotic Pressure and Tonicity**

- Cell in a hypotonic solution gains water causing cell to swell – creates pressure.
- If membrane strong enough, cell reaches counterbalance of osmotic pressure driving water in with hydrostatic pressure driving water out.
- If membrane is not strong, may burst.

**Active Transport requires ATP**

1. Carrier in membrane binds intracellular sodium.
2. ATP phosphorylates protein with bound sodium.
3. Phosphorylation causes conformational change in protein, reducing its affinity for Na⁺. The Na⁺ then diffuses out.

**Coupled Transport uses ATP indirectly**

- Glucose–Na⁺ symporter captures the energy from Na⁺ diffusion to move glucose against a concentration gradient.

**Bulk Transport: Endocytosis**

- **Phagocytosis:** ‘cellular eating’
- **Pinocytosis:** ‘cellular drinking’
Endocytosis: Phagocytosis

- Prey is enclosed in endocytic vesicle that sinks into cytoplasm.
- Lobes begin to surround prey.
- Lobes close around prey.

Bulk Transport: Receptor–mediated Endocytosis

- in Familial Hypercholesterolemia the LDL receptors lack tails. Cholesterol cannot be removed from the bloodstream.

Bulk Transport: Exocytosis

- Movement of substances out of cell
- Requires energy