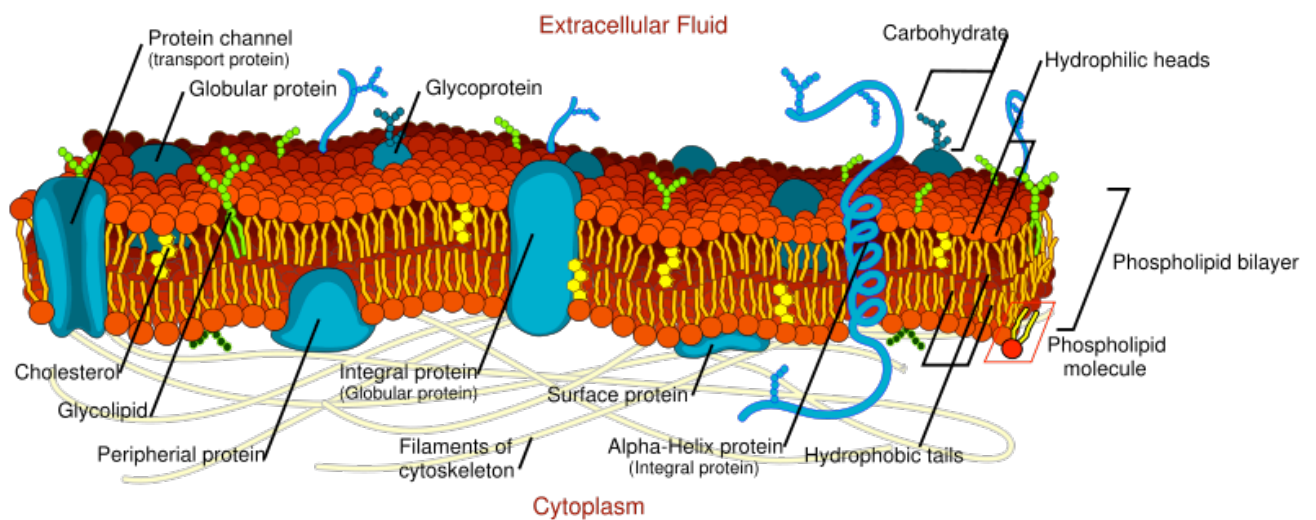
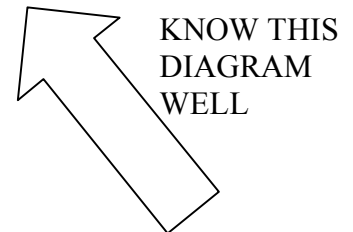


# Membranes – Summary



## A. Functions of Membranes

- Influences interaction with foreign cell bodies
  - E.g. white blood cells attaching foreign bodies
  - E.g. HIV and human cells
- Influences cell interaction
  - E.g. stem cells differentiate into similar cells when surrounded by other cells
- Influences interaction with chemical signals.
  - Insulin
  - Nerve impulses
- Selective permeable barrier
  - **Compartmentalization**
- Surface for chemical reactions



## B. Membrane Structure

- Components
  - Phospholipids
  - Cholesterol
  - Proteins
  - Carbohydrates

- FLUID MOSAIC MODEL
  - Fluid bilayer of phospholipid molecules in which proteins are dispersed and embedded or otherwise associated superficially.
  - Very much like tiles in a mosaic.
  - The mosaic is not static
  - Proteins constantly changing as they move about like icebergs in a **fluid sea of phospholipids**.
  - Hydrophilic portions – outside
  - Hydrophobic portions – inner core
  - PRERIPHERAL, TRANSMEMBRANE, INTEGRAL MEMBRANE Proteins
  - Lateral movement of phospholipids are common, but flip flopping is rare.
  - Membrane proteins drift more slowly than lipids.
- Temperature
  - Less fluid as temperature ↓
  - Dependent on % of phospholipids and cholesterol in membrane.
  - Dependent of % of phospholipids with unsaturated hydrocarbon tails.
  - Cholesterol
    - -OH group aligns with phosphate heads of phospholipids.
    - Steroid rings closely attracted to part of the fatty acid chain nearest to the phospholipid heads.
      - Prevents excess fluidity at warmer temperatures
    - Found in high concentrations in cells (nearly 1:1 ratio – molecule for molecule).
      - Prevents crystallization of membrane at low temperatures.
- Bifacial – asymmetric distribution of lipids, proteins and carbohydrates between the two sides of the lipid bilayer.
- Carbohydrates (MUST UNDERSTAND)
  - Cell-cell recognition
  - Basis for:
    - Sorting out an animal embryo's cells into tissues and organs.
    - Rejection of foreign cells by the immune system.
  - Membrane carbohydrates
    - Branched oligosaccharides (<15 monomers)
    - Some covalently bonded to lipids (glycolipids)
    - Most covalently bonded to proteins (glycoproteins)
    - VARY FROM SPECIES TO SPECIES

- E.g. Blood – A, B, AB, O
- Project out from cell in aqueous environment.

## B. Selective Permeability

- Enter - Sugar, amino acids, other nutrients
- Leave – Metabolic waste products
- Hydrophobic Molecules
  - E.g. Hydrocarbons, CO<sub>2</sub>, O<sub>2</sub>
  - Dissolve in the membrane to cross
  - Smaller molecules cross faster
- Hydrophilic Molecules
  - Generally have difficulty passing through the membrane
    - Due to hydrophobic core
  - Na<sup>+</sup>, H<sup>+</sup>, glucose, sugars have difficulty passing.

Even water (small size) has difficulty passing.

## C. Transport Across Membranes

- Purpose:
  - Obtain nutrients, raw materials
  - Excrete waste substances
  - Secrete useful substances
  - Generate ionic gradients essential for nervous and muscular activity
  - Maintain a suitable pH and ionic concentration within the cell for enzyme activity.
- Mechanisms

Passive Mechanisms	Active Mechanisms
Diffusion	Active Transport
Osmosis	Bulk transport (endo- & exocytosis)

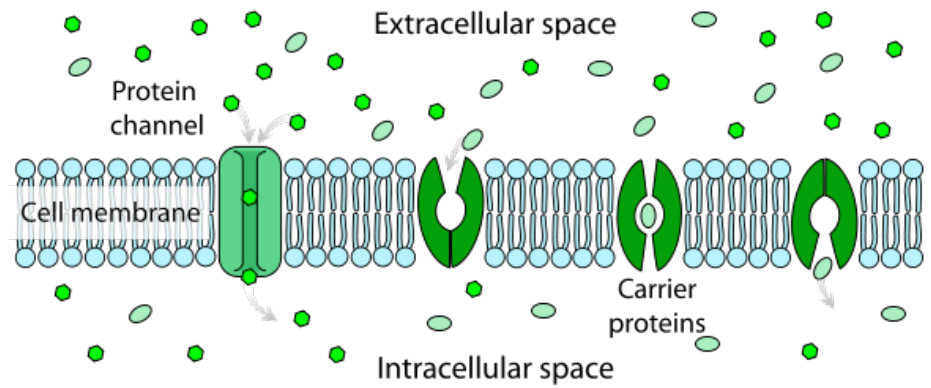
\*\*\* Bulk transport ≠ active transport

- Endocytosis – vesicle/vacuole formed
- Molecules are wrapped in membrane (bulk transport)
- Not transported across a membrane
- Diffusion
  - Factors:

- Molecular size
- Solubility in lipid bilayer
- Charge of molecule
- Concentration gradient
- Kinetic energy of molecules
- Surface area
- Distance

- Facilitated diffusion

- No direct use of energy.
- Hydrophilic channels
  - Transmembrane channel proteins.
  - E.g. H<sub>2</sub>O
- Carrier proteins



- Protein conformation changes when solute binds, moving it across membrane
  - Both ways across membrane
    - Which way depends on solute concentration
  - E.g. Glucose

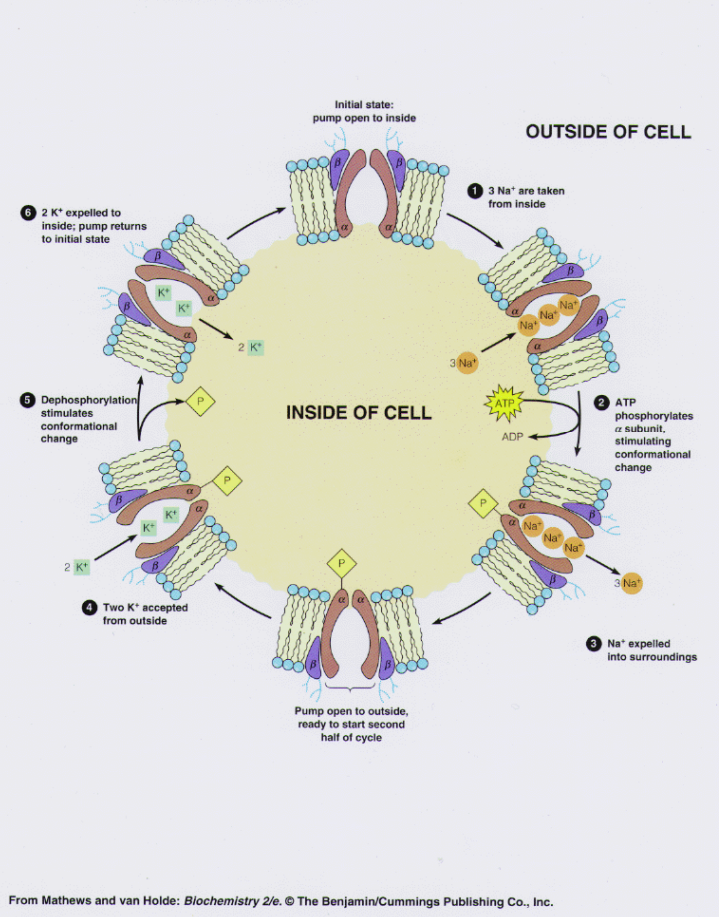
- Active transport

- Energy (ATP) consuming
- Across a membrane
- AGAINST a concentration gradient
- Usually one way
- E.g. Sodium-potassium pump, proton pump.

- Bulk transport

- Active
- But not active transport
- Exocytosis – out of cell
- Endocytosis – into cell

**Figure 10.25 Schematic model of the sodium-potassium pump in operation**



From Mathews and van Holde: *Biochemistry 2/e*. © The Benjamin/Cummings Publishing Co., Inc.