Membrane permeability

- Biological membranes are selectively permeable
  - They can allow passage of some molecules but not others
  - This selective permeability is important in e.g. maintenance of ion concentration gradients between ICF and ECF, membrane potential etc

Passive Transport Mechanisms

Ion Channels

- **Ions** are usually transported across membranes by different mechanisms via ion channels of different types

1. Ungated ion channels

- Provide actual holes through which the ions can diffuse across the membrane.

NOTE

- No binding takes place.
- A few are open all the time and thus are **ungated**.
- Typically, cells have some ungated K+ and ungated Cl- ion channels.

1. Voltage-Gated

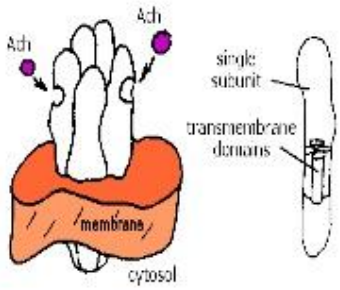
- Ion channels that open or close in response to **changes in the membrane potential** are termed **voltage-gated**.

- Especially important are voltage-gated Na+, Ca++, K+, and Cl- ion channels, which provide split second regulation in the nervous system and in muscles.

2. Ligand-Gated

- Many ion channels are **ligand-gated**;and open in response to binding of an **extracellular** or **intracellular** regulatory molecule e.g. the **acetylcholine receptor** found in the membrane of skeletal muscle cells.

These open in response to neurotransmitter acetylcholine released by the neurons that cause muscle contraction. This ion channel has five subunits, which is a characteristic of an important class of neurotransmitter receptors in the brain



3. Mechanically Gated

- Ion channels that open in response to mechanical movement of adjacent structures include touch sensors in the skin and vibration sensors in the inner ear that respond to sound.
- Plus, most hollow organs, such as the bladder, intestines and heart, have stretch sensors that respond to expansion of the organ.

4. Temperature-Gated

- Found in sensory neurons in the skin and mucous membranes and open/close with temperature changes.

- Naturally, leads to the sensations of warm and cold.

1. Facilitated Diffusion

- **Facilitated diffusion** is based on ***transporters*** that must ***specifically bind*** the substance to be transported.

- The binding causes a **conformation change**, which allows the transported substance to be released on the other side of the membrane

2. Co-transporters

Uniport

Uniport- 1 molecule bi directionally

Cotransport

Symport= 2 molecules Same direction

Antiport= 2 molecules opposite directions

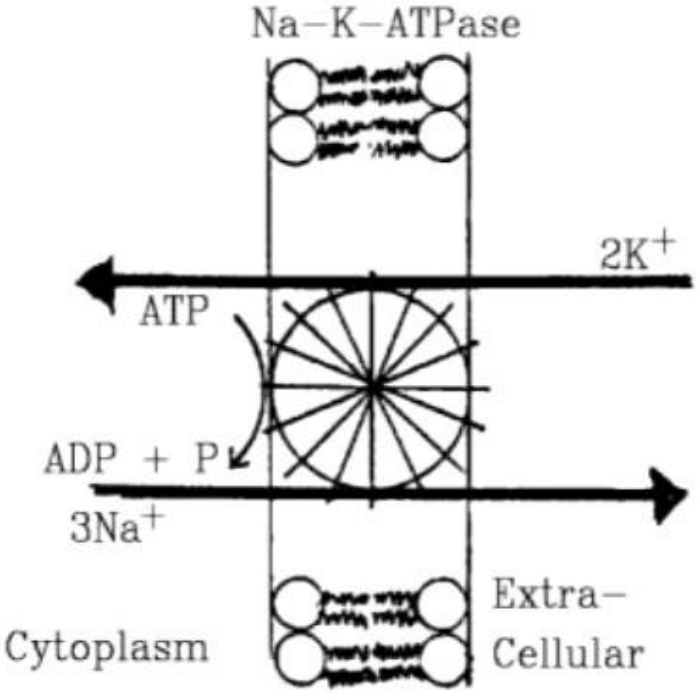
3. Active Transport

- **Active transport** is similar to the preceding two mechanism in that **specific binding** of the transported substance occurs.
- However, here **ATP is required** in a step in which the transporter is phosphorylated.
- Because E is provided in this way, the transporter can move the substance to a higher concentration.

- Thus, these transporters always move the transported substance in one direction, regardless of the concentration gradient.

- Example: Na-K ATPase Present in nearly every cell in the body Pumps 3 Na ions out in exchange for 2 K ions pumped in (cost=1 ATP)
- Other pumps include the Ca-ATPase, and the H-ATPase.

Active transport



- In addition, there are active transporters for both Ca++ and for H+.

- The later, for example, are found in the stomach and participate in the secretion of acid into stomach

Transport of macromolecules across membranes

- Endocytosis
- Pinocytosis
- Phagocytosis
  - Exocytosis

Endo & Exocytosis