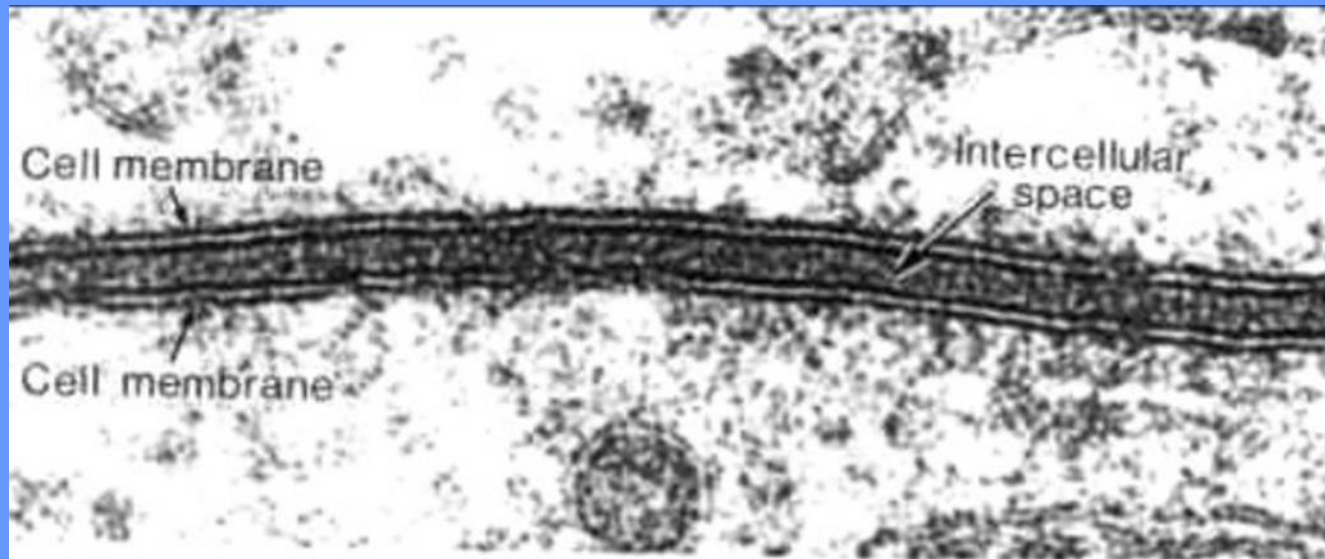


Cell Membranes: The Movement of Molecules



Functions of Membranes

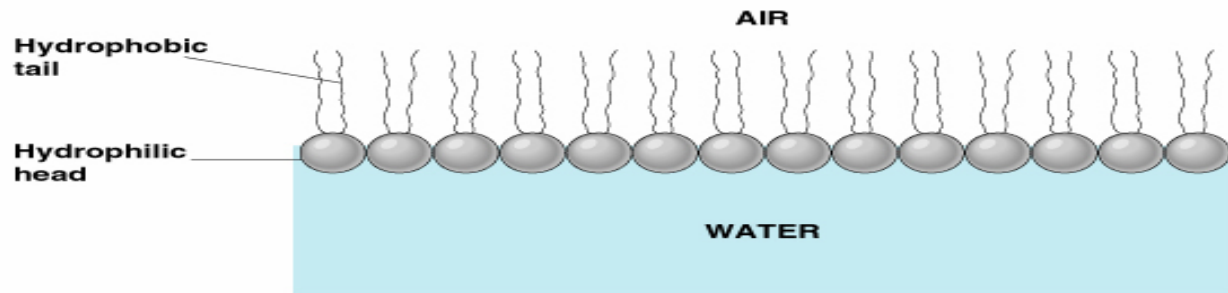
1. **Protects the cell**
2. **Controls incoming and outgoing substances**
3. **Maintains a constant internal balance of the cell called homeostasis**
4. **Selectively permeable - allows some molecules in, others are kept out**

What is the purpose of cellular transport?

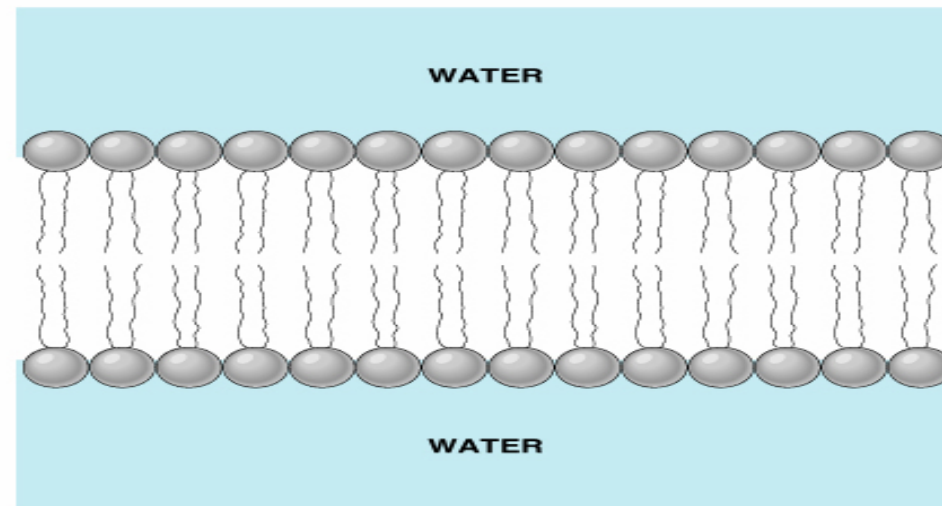
- Homeostasis depends upon appropriate movement of materials across the cell membrane.
 - **Required** materials must pass **into** the cells so they can be utilized.
 - Ex. **Oxygen** and **glucose** for cellular respiration
 - **Waste** materials must pass **out of** the cells as they are produced
 - Ex. The **CO₂** produced as a waste product of cellular respiration
- The **cell membrane** regulates the passage of materials into and out of the cell.
 - Needed materials move **in**
 - Excess materials move **out**



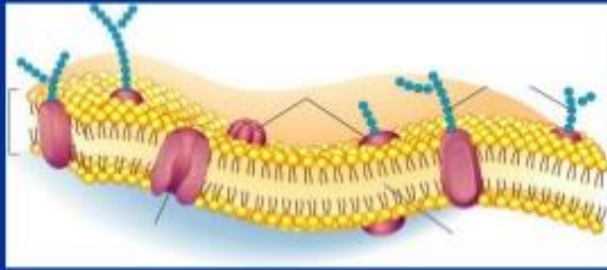
Phospholipid Bilayer



(a)



(b)

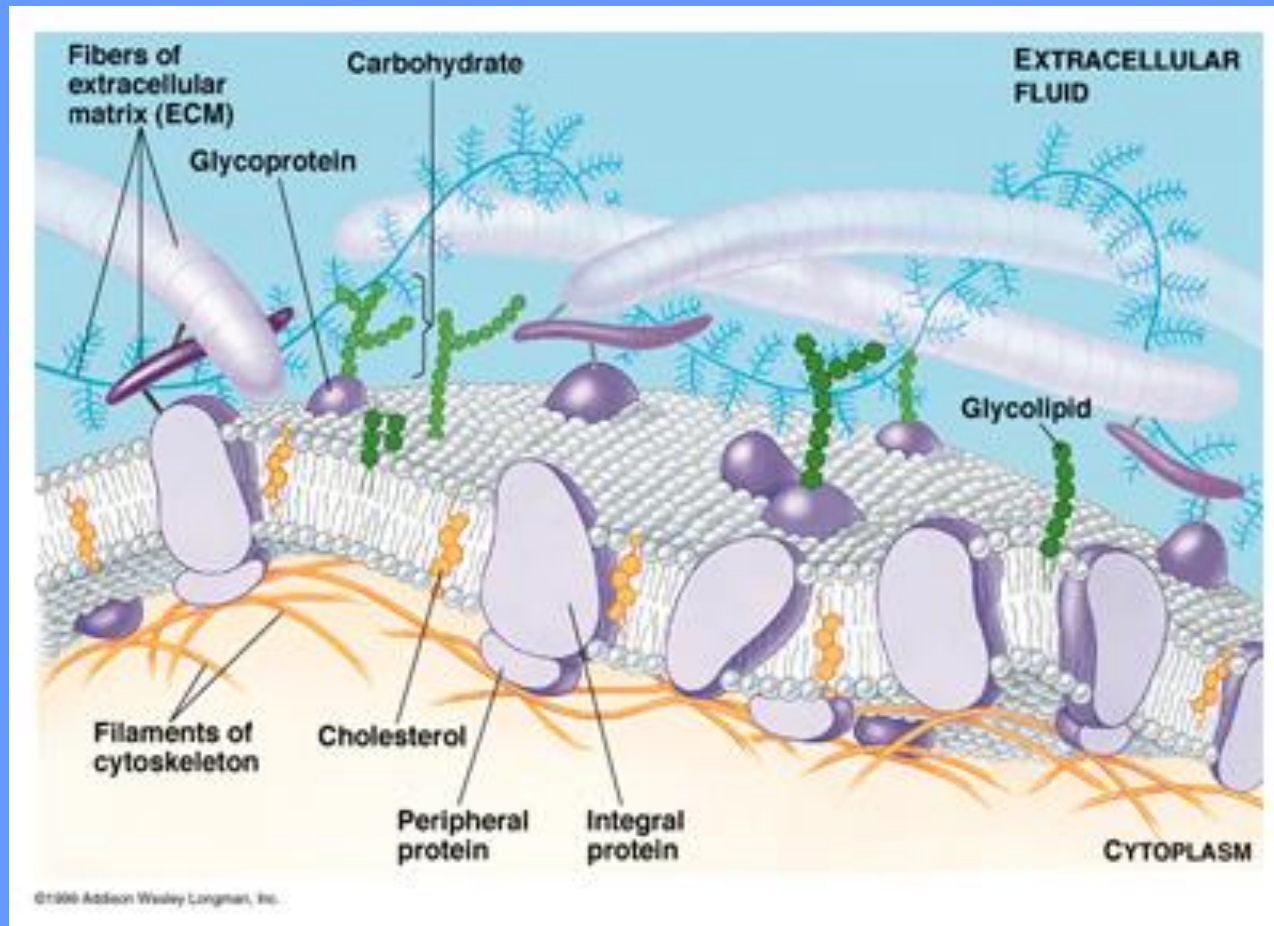


How?

Membrane m

- Each individual cell exists in a **fluid** environment, and the **cytoplasm** within the cell also has a fluid environment. The presence of a **liquid** makes it possible for substances (such as **nutrients, oxygen, and waste** products) to move into and out of the cell.
- A cell membrane is **semipermeable** (selectively permeable), meaning that **some** substances can pass directly through the cell membrane while other substances **can not**.
- Materials can enter or exit through the cell membrane by **passive** transport or **active** transport.

Fluid Mosaic Model



Blood-Brain Barrier

- Allows some substances into the brain, but screens out toxins and bacteria
- Substances allowed to cross include: water, CO₂, Glucose, O₂, Amino Acids, Alcohol, and antihistamines. HIV and bacterial meningitis can cross the barrier.

Methods of Transport Across Membranes

1. Diffusion
2. Osmosis
3. Facilitated Diffusion
4. Active Transport

Methods of Transport Across Membranes

1. **Diffusion - passive transport** - no energy expended
2. **Osmosis - Passive transport** of water across membrane
3. **Facilitated Diffusion** - Use of proteins to carry polar molecules or ions across
4. **Active Transport**- requires energy to transport molecules against a concentration gradient – energy is in the form of **ATP**

Passive Transport

- The cell does not use any energy to move molecules across the cell membrane
- Types of Passive Transport
 - Diffusion
 - Facilitated Diffusion
 - Osmosis

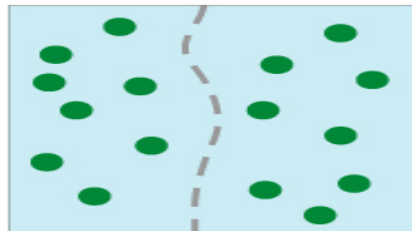
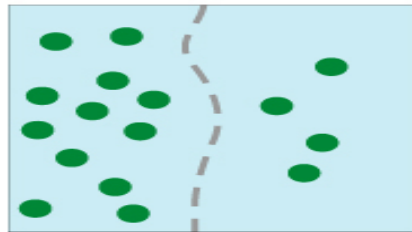
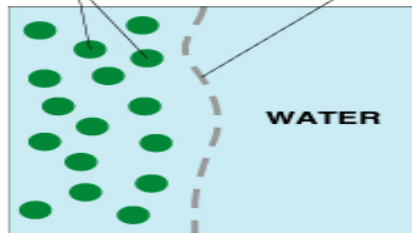
Video Link for Passive Transport: <https://www.wisc-online.com/learn/natural-science/life-science/ap11103/passive-transport--filtration-and-facilitated-diffusion>

Diffusion

- **Movement of molecules from an area of high concentration to an area of low concentration until equilibrium is reached.**
- **Movement from one side of a membrane to another, un-facilitated**

Diffusion

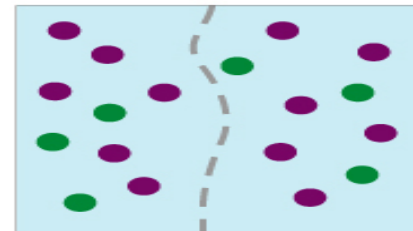
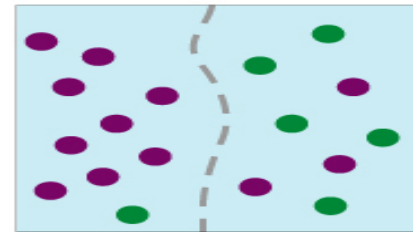
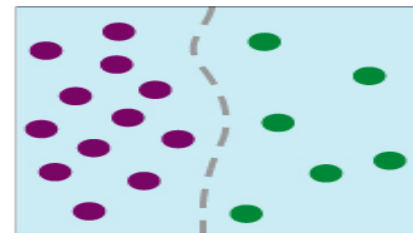
Molecules of dye Membrane



EQUILIBRIUM

(a) Diffusion of one solute

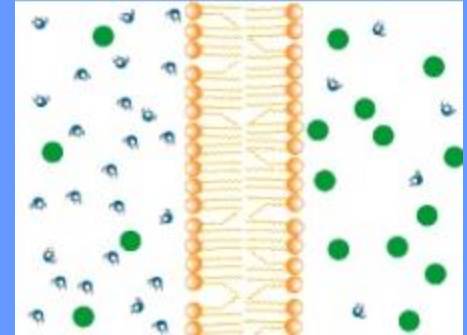
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EQUILIBRIUM

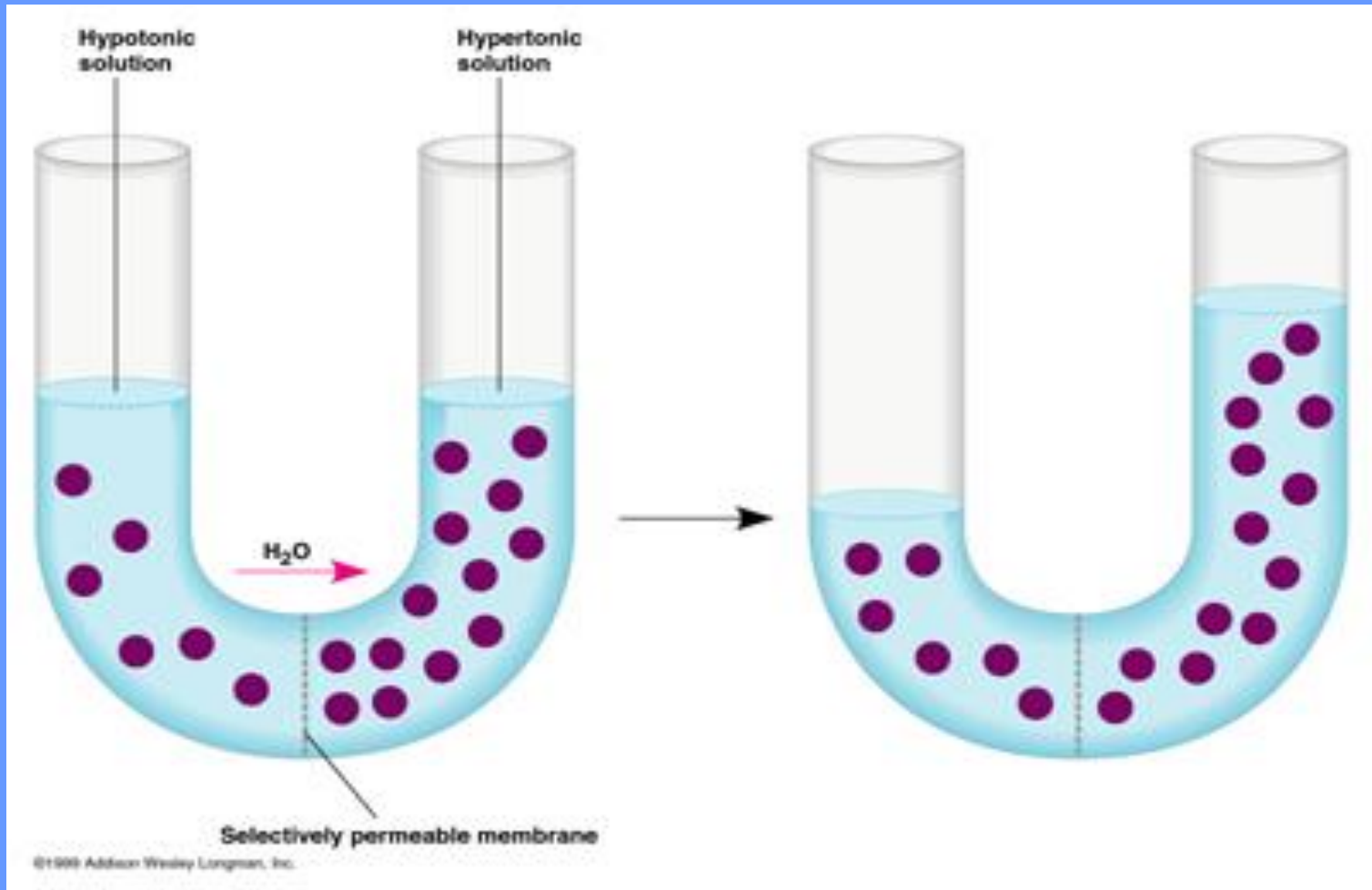
(b) Diffusion of two solutes

Osmosis



- The diffusion of **water** molecules from an area of **high concentration** to an area of **low concentration** until **equilibrium** is reached.
- Because water molecules are so **small** and in such **abundance**, the cell cannot control its movement through the cell membrane

Osmosis

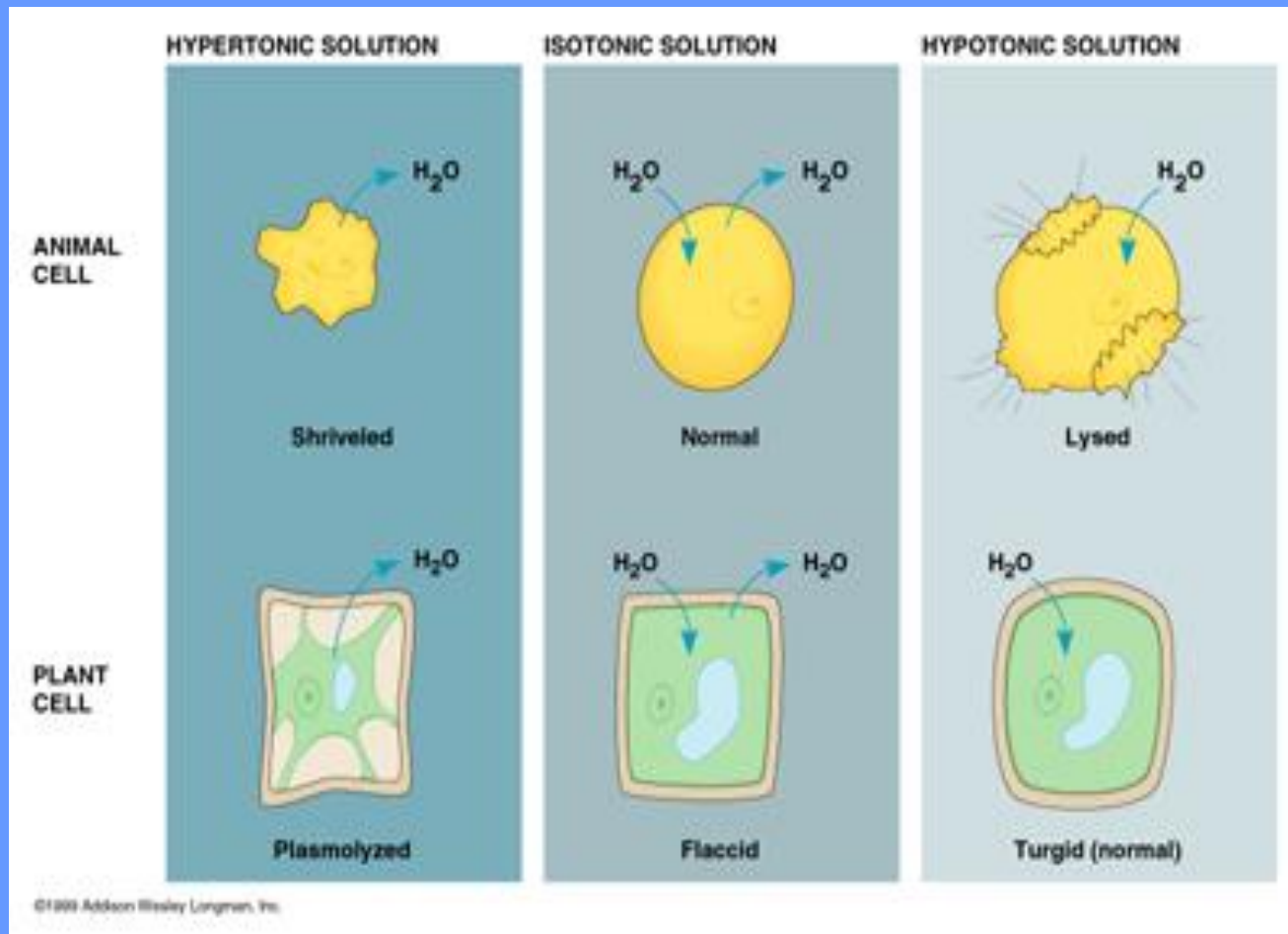


Tonicity is a relative term

- **Hypotonic Solution** - One solution has a lower concentration of solute than another.
- **Hypertonic Solution** - one solution has a higher concentration of solute than another.
- **Isotonic Solution** - both solutions have same concentrations of solute.

Video Link to View: <http://www.linkpublishing.com/video-transport.htm#OSMOSIS>

Plant and Animal Cells put into various solutions



Active Transport

- Cell uses energy (ATP) to move molecules through the cell membrane
- Molecules move from an area of low concentration to an area of high concentration
- The cell membrane actually opens and closes
- Types of Active Transport
 - Exocytosis
 - Endocytosis
 - Protein Pumps

Video of Active Transport: <https://www.wisc-online.com/learn/natural-science/life-science/ap11203/transport-processes-requiring-atp>

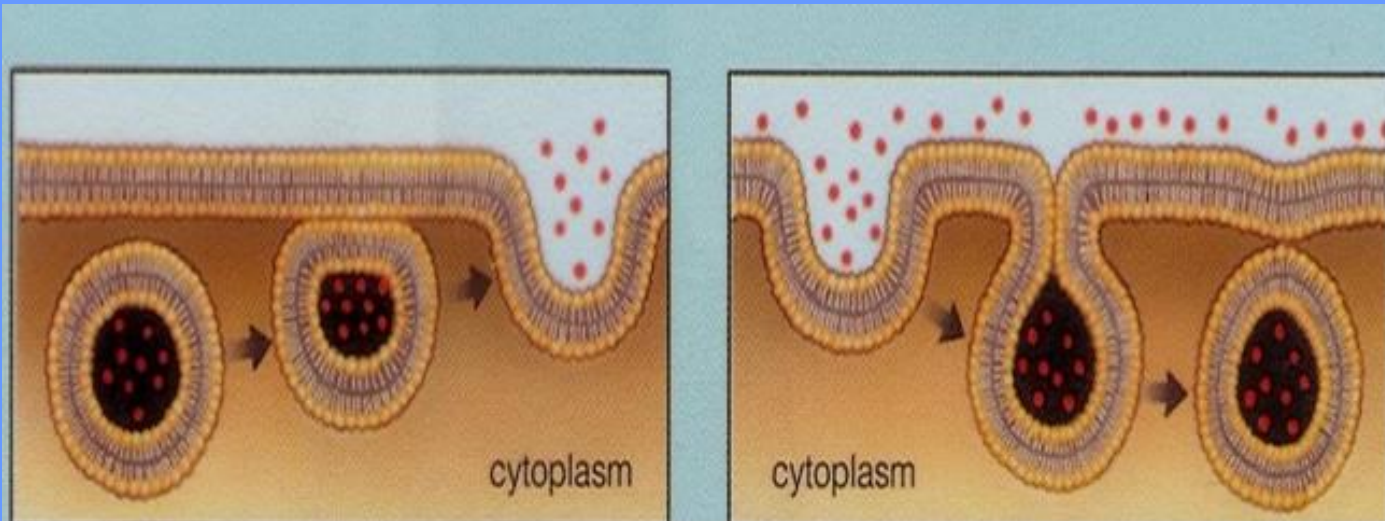
Exocytosis

- Forces material out of the cell in bulk
 - Membranes surrounding the material fuses with the cell membrane
- Cell changes shape and requires energy
- Examples include
 - Hormones
 - Waste products released from cell

Endocytosis

- Takes bulky material into a cell
- Uses energy
- Cell membrane folds around a food particle
- “Cell Eating”
- Examples
 - Forms food vacuole and digests food
 - This is how a white blood cell eats bacteria

Exocytosis & Endocytosis



Exocytosis (molecules
“exit” the cell.

Ex: Waste products

Endocytosis (substances
“enter” the cell).

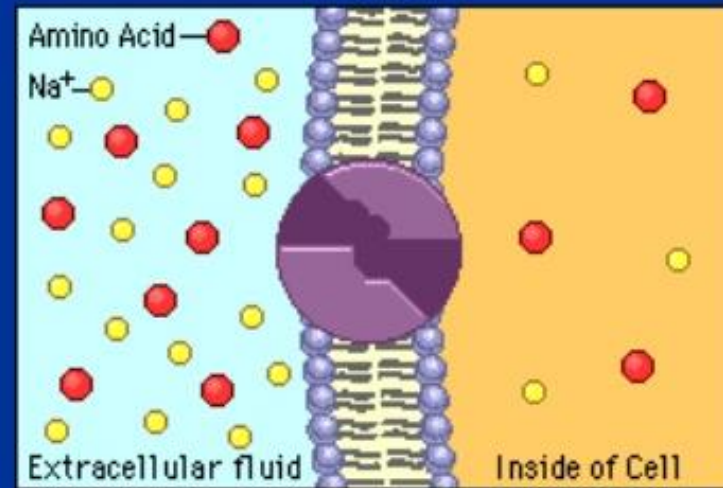
Ex: Food molecules

Protein Pumps

1. Protein Pumps

-transport proteins that require energy to do work

- Example: Sodium / Potassium Pumps are important in nerve responses.



Protein changes shape to move molecules: this requires energy!

Types of Transport

