Movement of materials across the cell membrane

Membranes

- Are *differentially permeable* i.e.
  Permeable to SOME substances.

The membrane selects what substances pass through and what does not.

Different substances use different mechanisms to move across the cell membrane. We will divide these into:

- Small non-polar substances
- Water
- Non polar substances

4 forms of transport through membranes

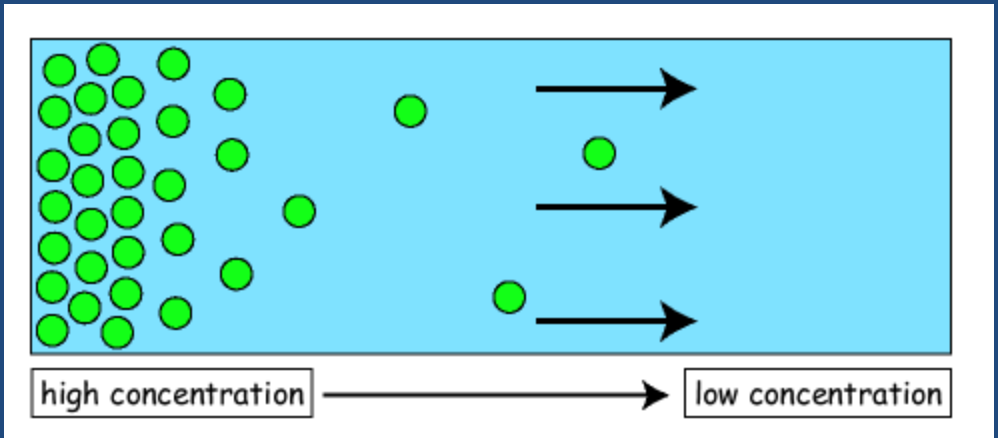
- Diffusion (passive transport)
- Osmosis (passive transport)

- Active transport
- Endocytosis and exocytosis

Diffusion

- Passive transport i.e no energy required

Diffusion: movement of a **substance** from a region of high concentration to one of low concentration

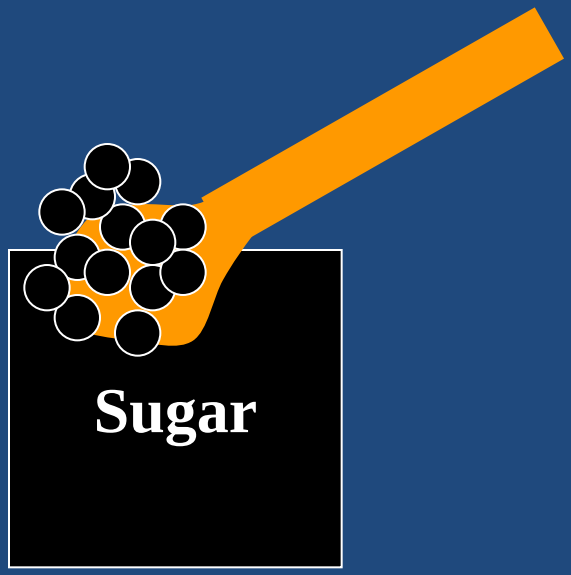


Diffusion

- Is the net movement of *particles (solutes)* from a region where they are at a relatively HIGH concentration in a solution to a region where they are at a LOWER concentration in a solution.

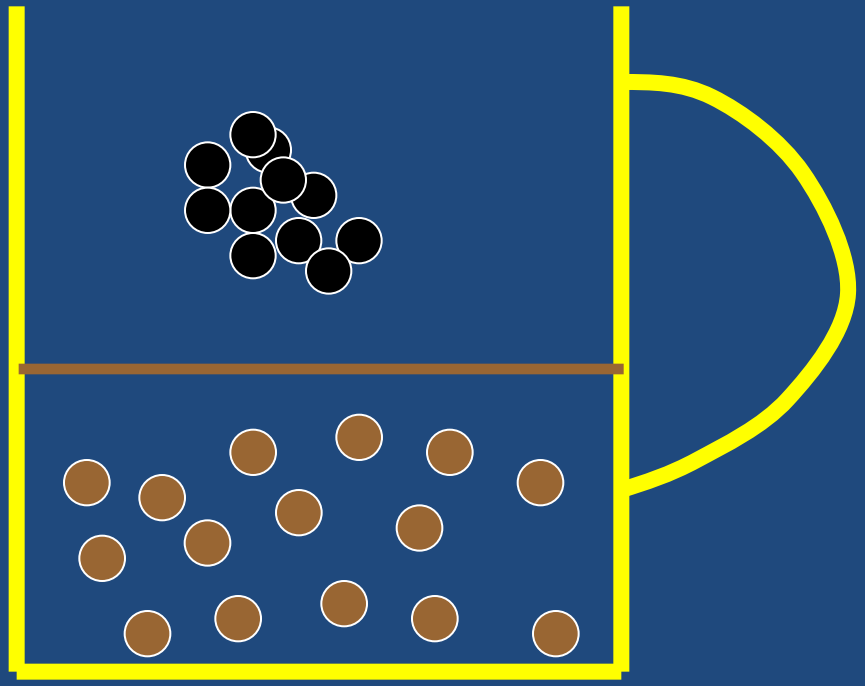
- Passive transport – does NOT require energy to pass through the membrane

Diffusion



= Sugar particles

= Coffee particles



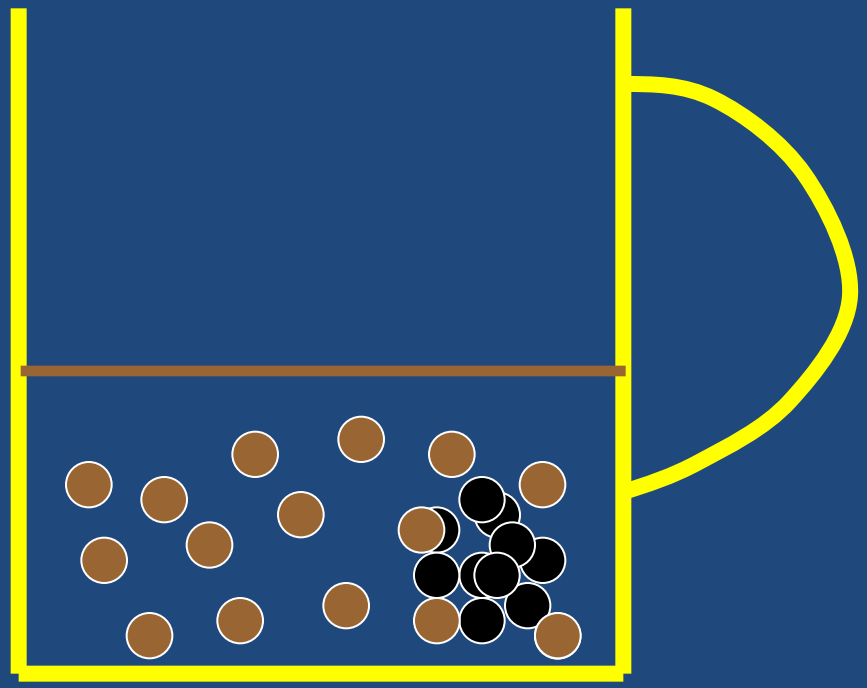
Mug of Coffee

Diffusion

The sugar diffuses from a region of HIGH sugar concentration to a region of LOW sugar concentration

= Sugar particles

= Coffee particles

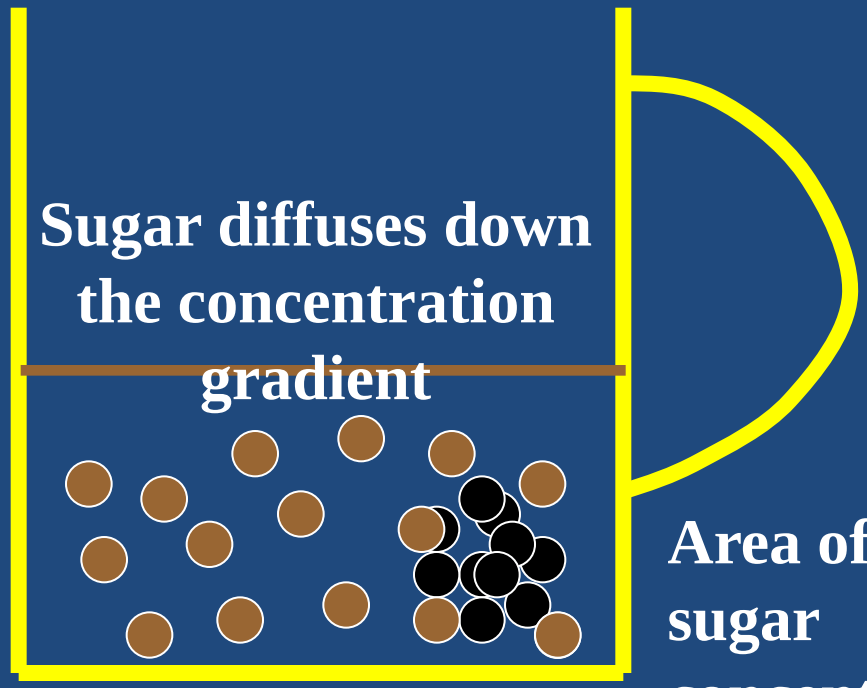


Mug of Coffee

Diffusion

- CONCENTRATION GRADIENT –

The difference in concentration of molecules across a space



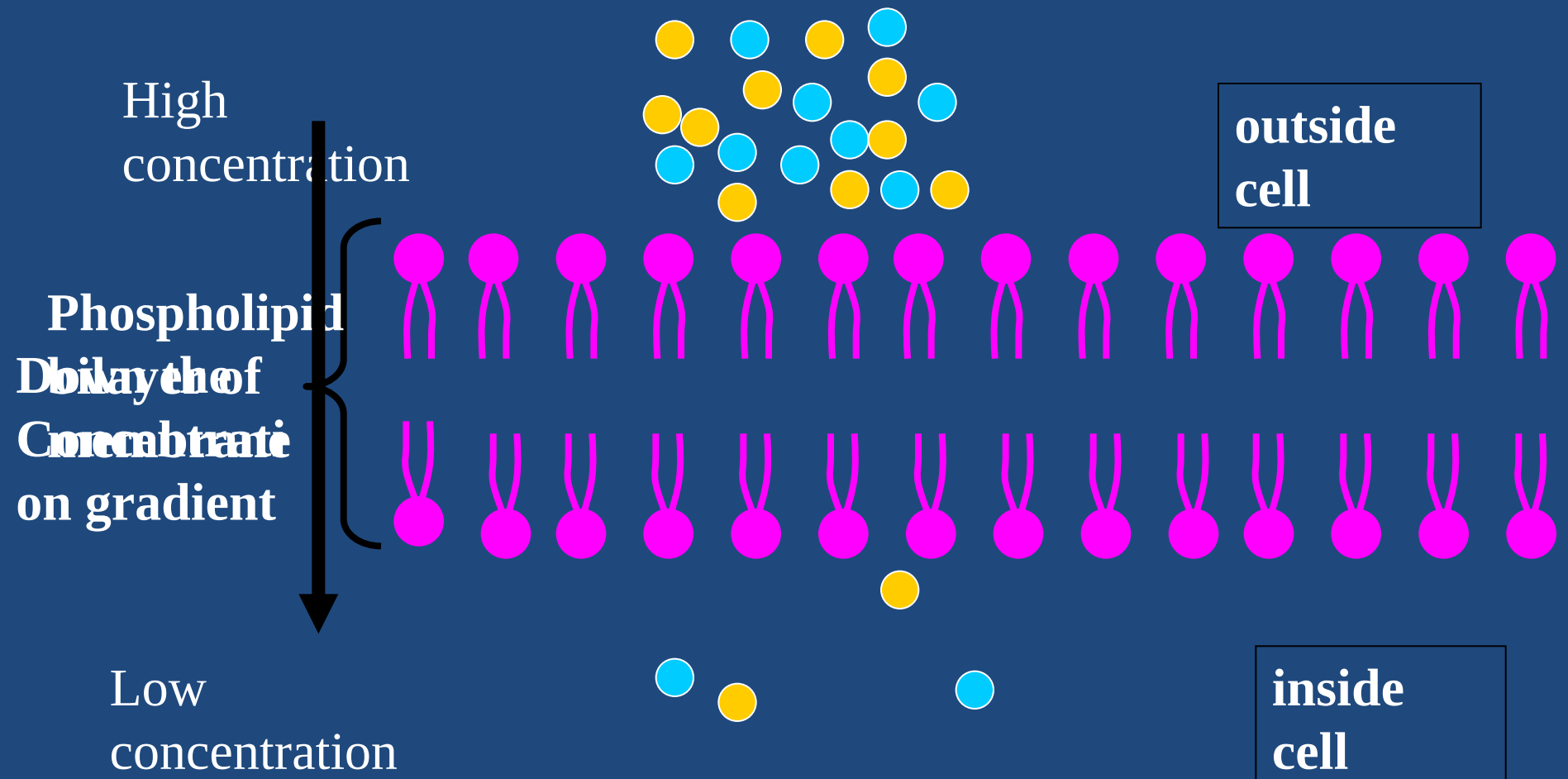
Diffusion

Rate of diffusion increases when:

- Concentration gradient is great
- Heat is applied (particles move faster)
- Molecules are smaller
- Movement occurs through gaseous medium

Diffusion Across the membrane

Small particles such as water, oxygen and carbon dioxide can easily pass through the plasma membrane by diffusion

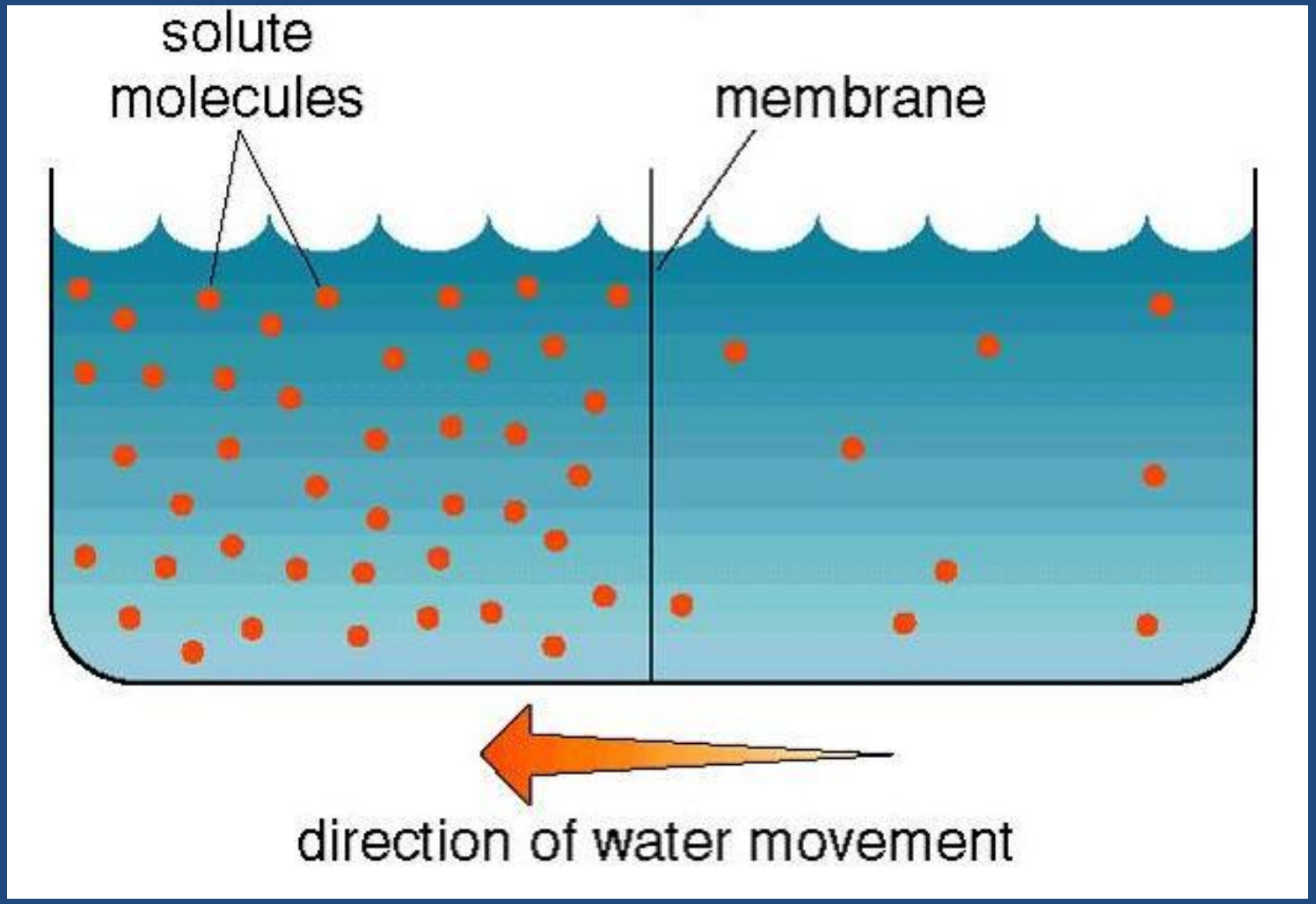


Osmosis

- A type of diffusion, so it also requires NO energy
- Osmosis is the net movement of *solvent*, usually water, across a membrane
- Water will move from a region of HIGH WATER concentration (weak / dilute solution) to a region of LOW WATER concentration (strong solution)

High water = dilute solution, low solute
Low water = Strong solution, high solute

Osmosis: Movement of **water** from a dilute solution (high water concentration) to a more concentrated solution (low water concentration)



Osmosis

Net movement of ***water*** molecules from a region of high concentration to a region of low concentration

Dilute solution:

– HIGH water

– LOW solute

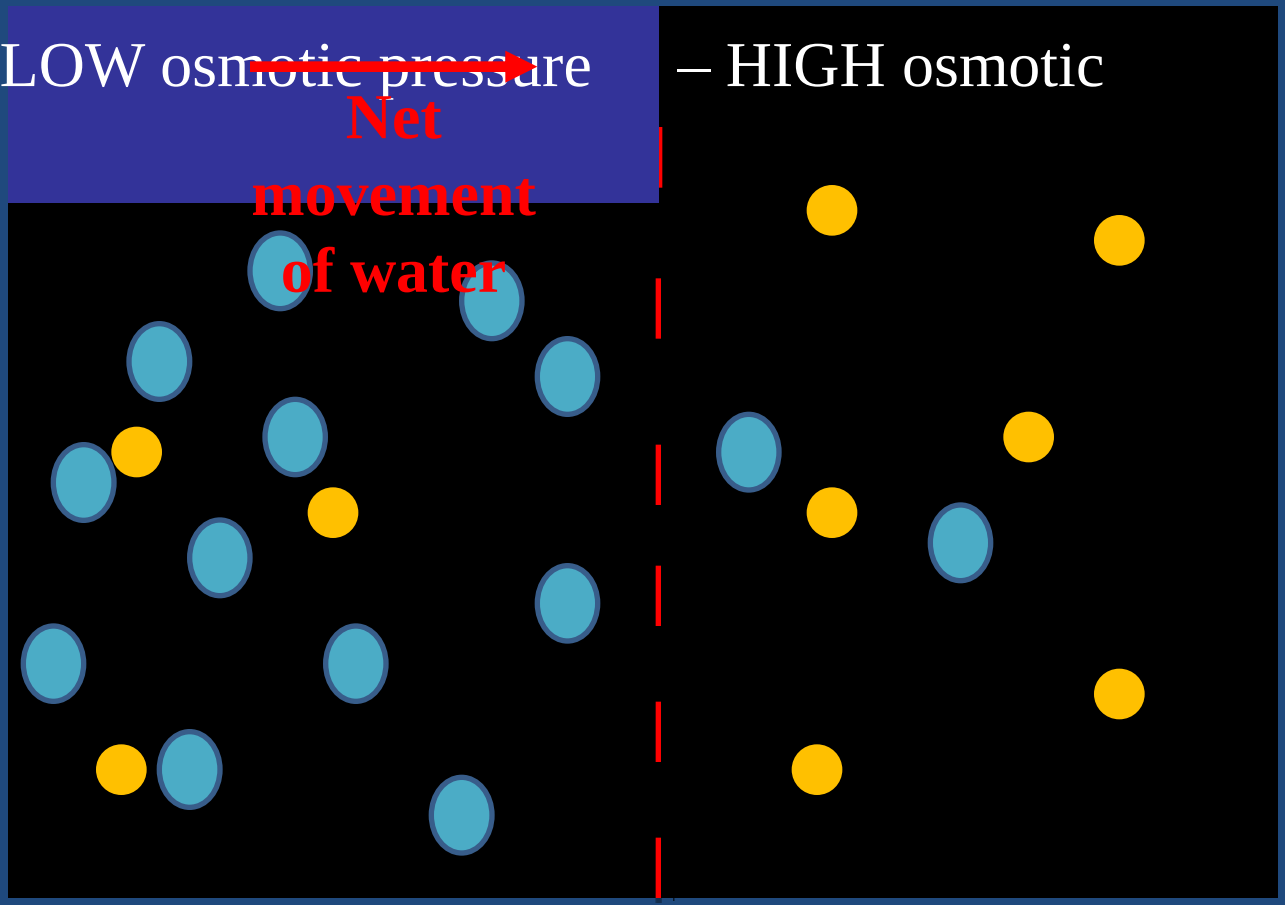
– LOW osmotic pressure

Strong solution:

– LOW water

– HIGH solute

– HIGH osmotic



Osmosis and animal cells

- Movement into & out of cells is vital for life processes

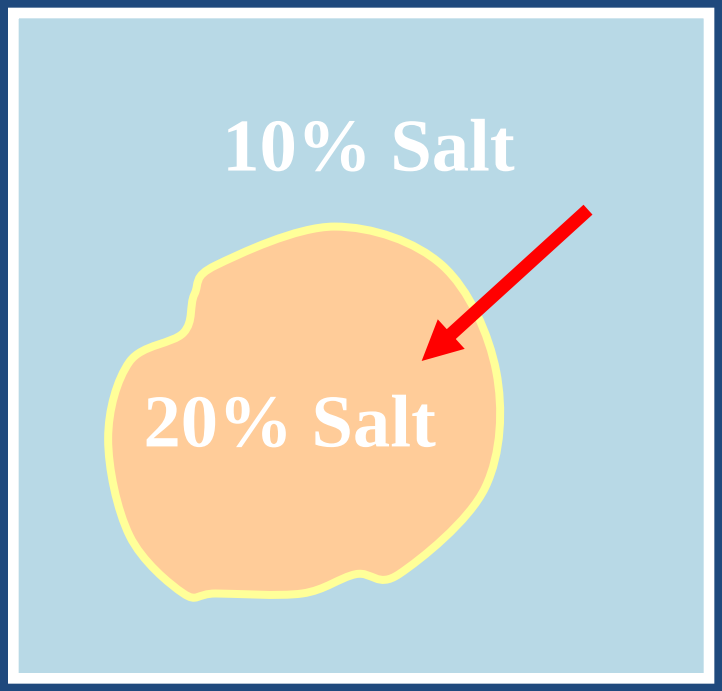
- Cells are bathed in **ISOTONIC** solutions –

  a solution where the solute concentration is the equal to the solute concentration inside the cell.

- Water can diffuse equally in both directions, no net movement of water overall.

Osmosis and animal cells

- **HYPOTONIC** solution – contains a lower solute concentration compared to inside the cell



Water moves into the cell

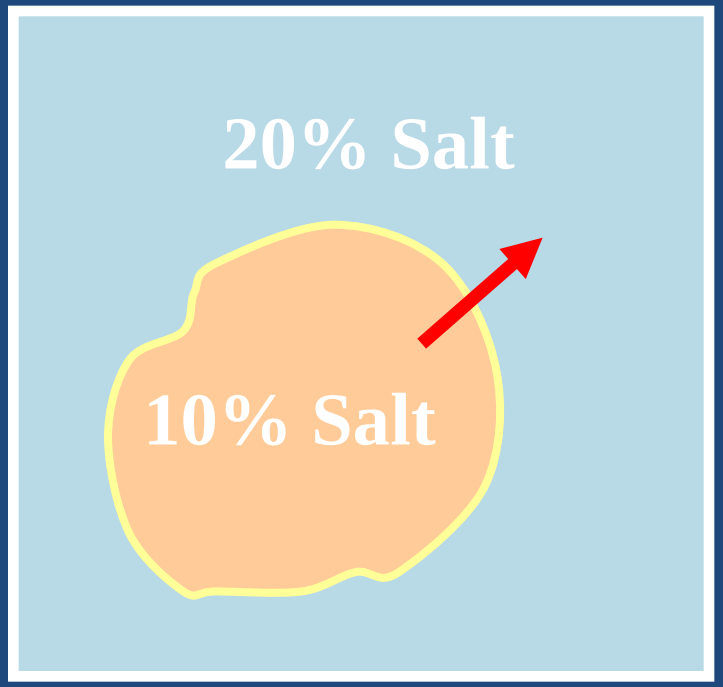
The solution has:

– Lower solute

– High water concentration

Osmosis and animal cells

- **HYPERTONIC** solution – contains a higher solute concentration compared to inside the cell.



The solution has:

– High solute

– Low water concentration

Water moves out of the cell

Osmosis and plants

- Vegetables such as celery will not burst in a hypotonic solution
- The vacuole fills with water, putting pressure on the cell wall, and the cell becomes turgid (no more water can come in)
- The tough cell wall prevents the cell from bursting
- Turgor supports plants and maintains their shape

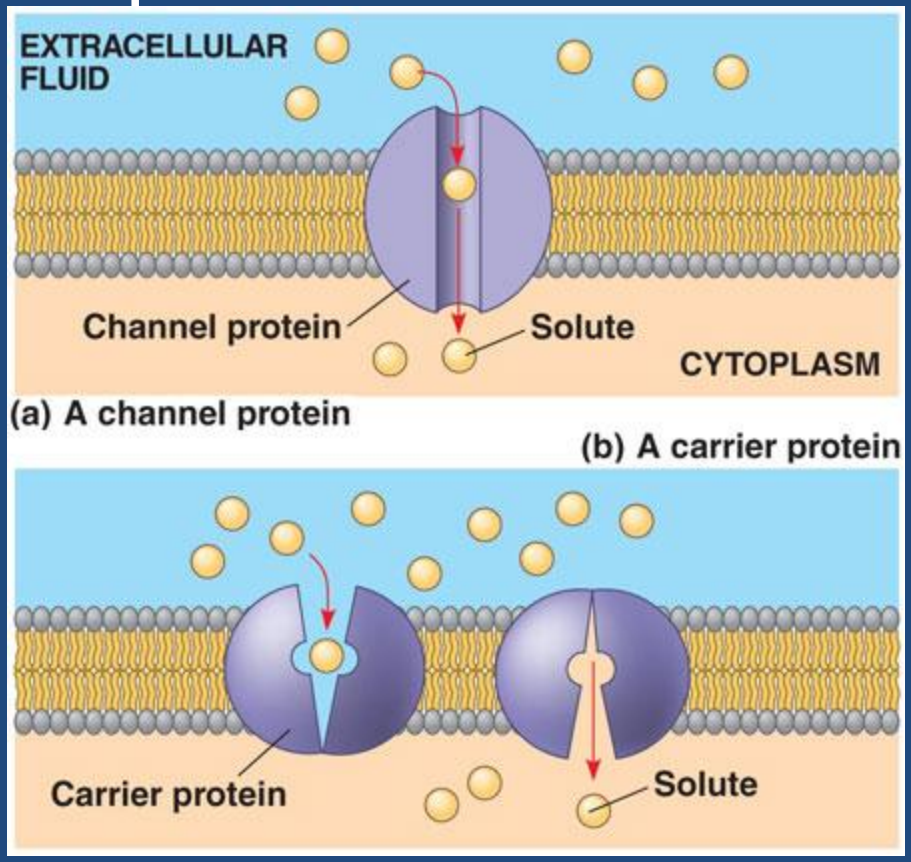
Facilitated diffusion

Facilitated Diffusion: Movement of a substance (such as charged particles Na^+ and Cl-) along the concentration gradient aided by protein transporters in the cell membrane.

2 types of proteins involved in facilitated diffusion

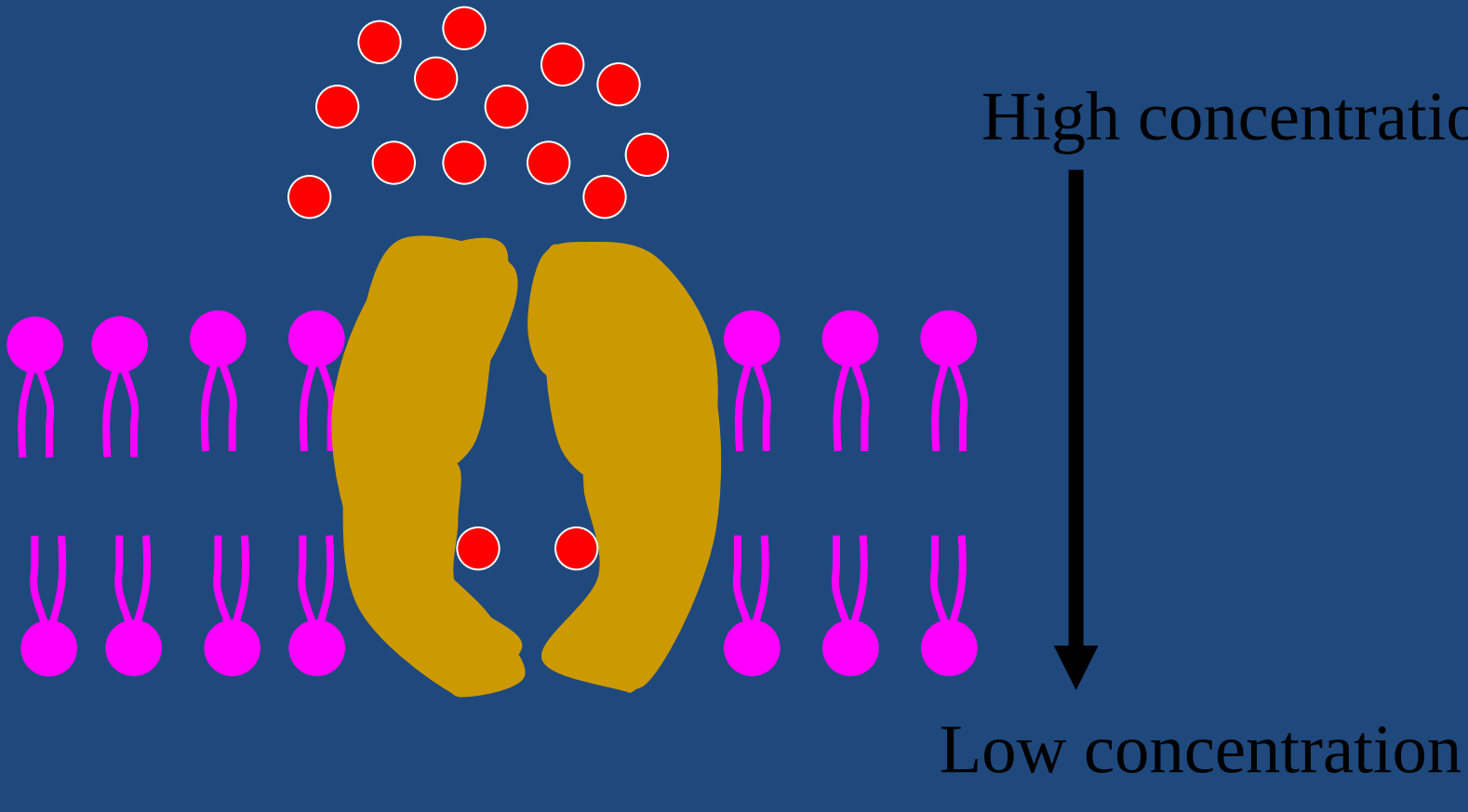
– Channel proteins

– Carrier proteins



Carrier proteins

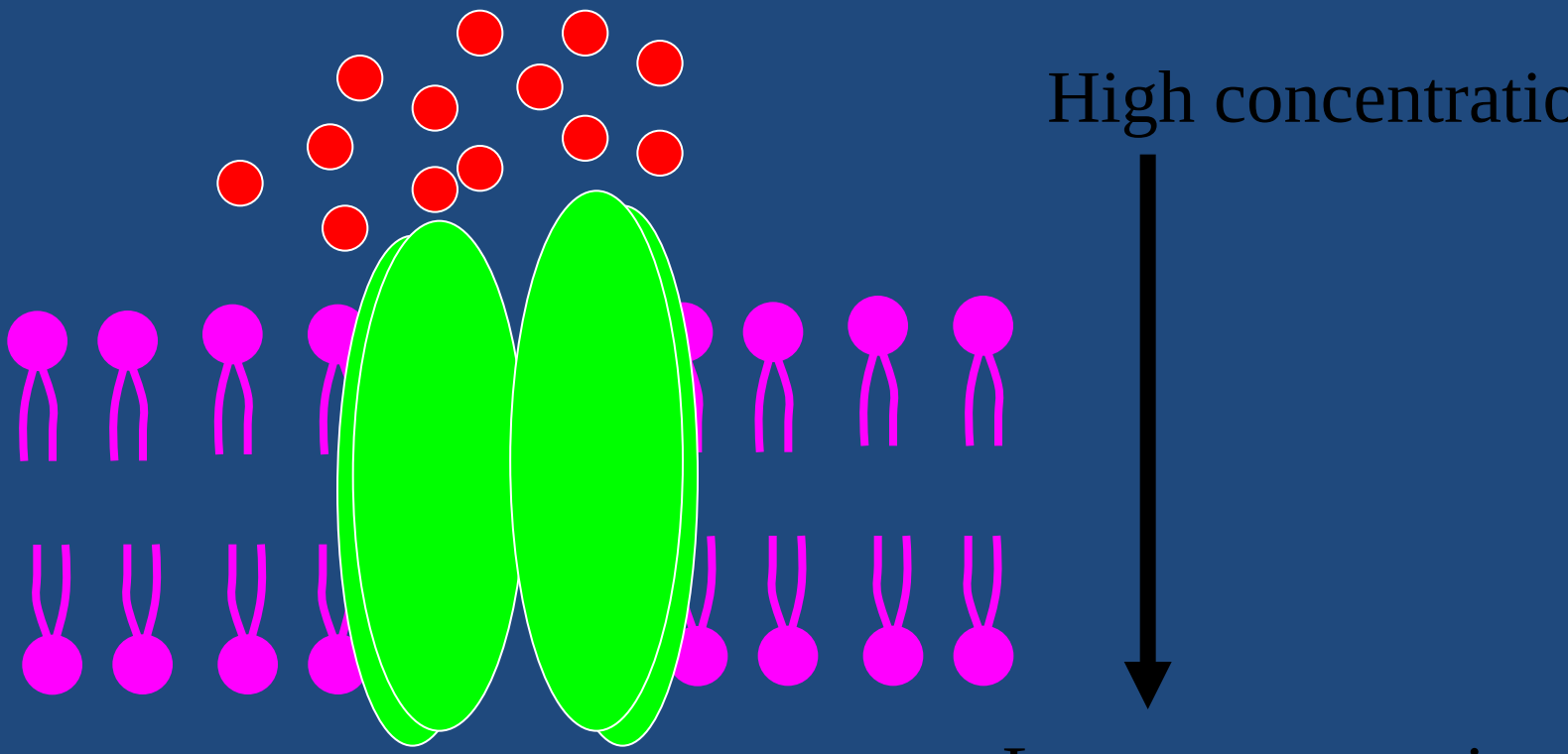
Carrier proteins bind to specific molecules on one side of membrane, change shape and releases them on the other side



Channel proteins

Channel proteins form narrow passageways that small ions can diffuse through rapidly. These channels select which molecules the cell needs

Channel protein closes



High concentration

Low concentration

Active transport

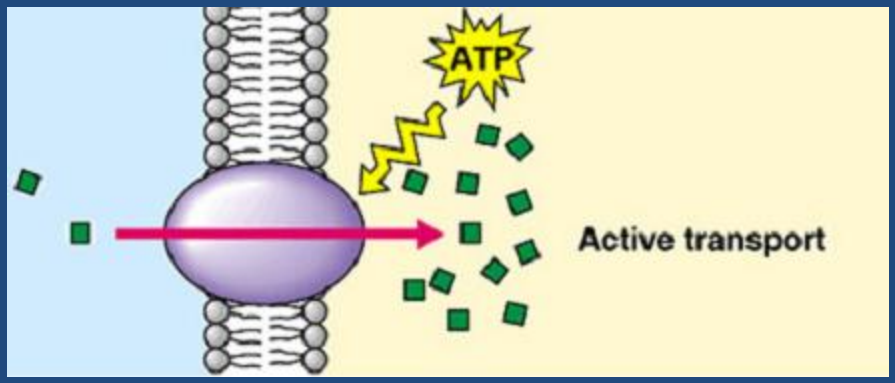
- Pumps substances into or out of a cell AGAINST their concentration gradient

ie – from a region of low to high concentration

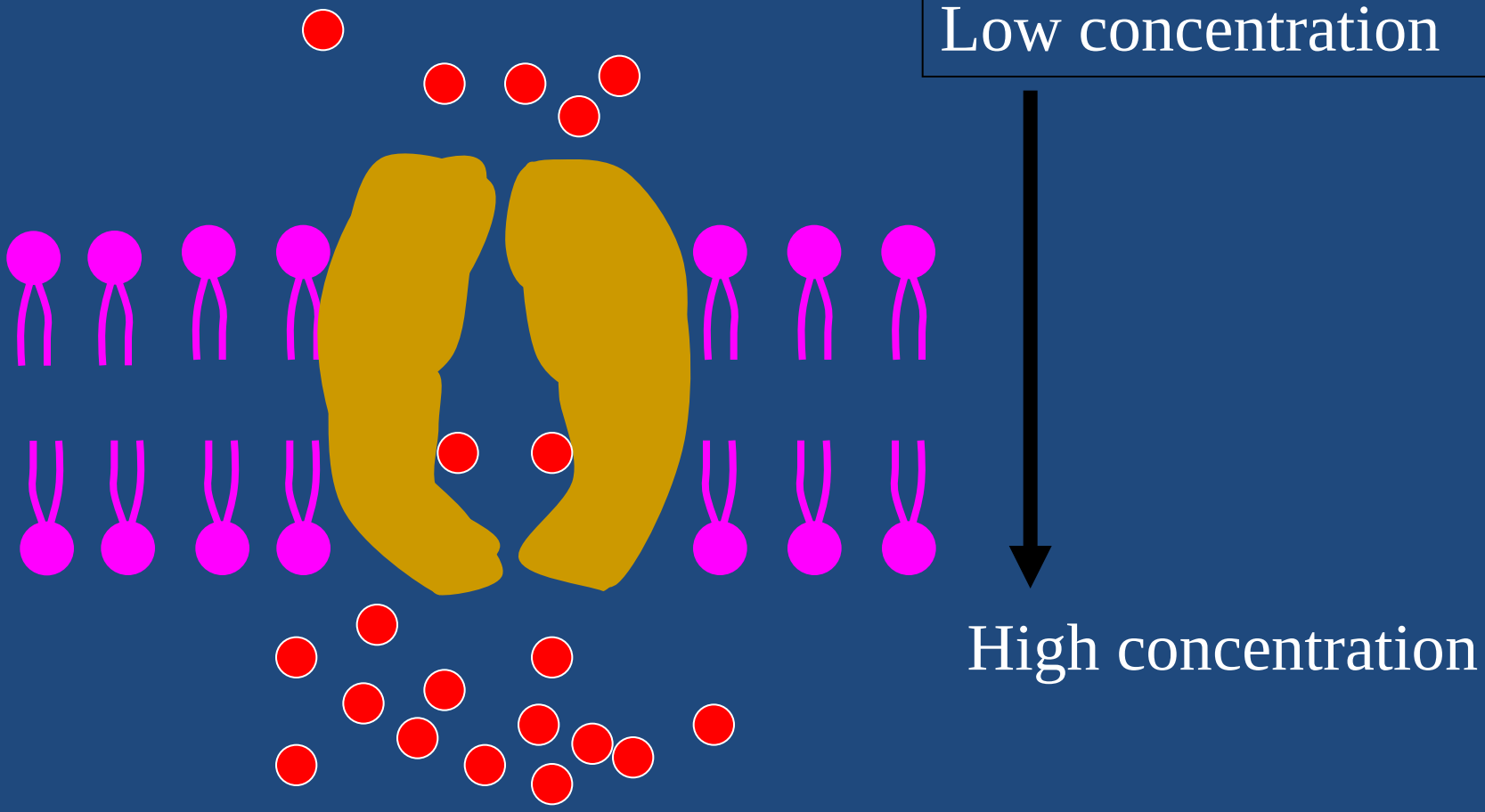
- Needs energy to occur – ATP is used

- involves carrier proteins which require ATP to work. They also only work in ONE direction

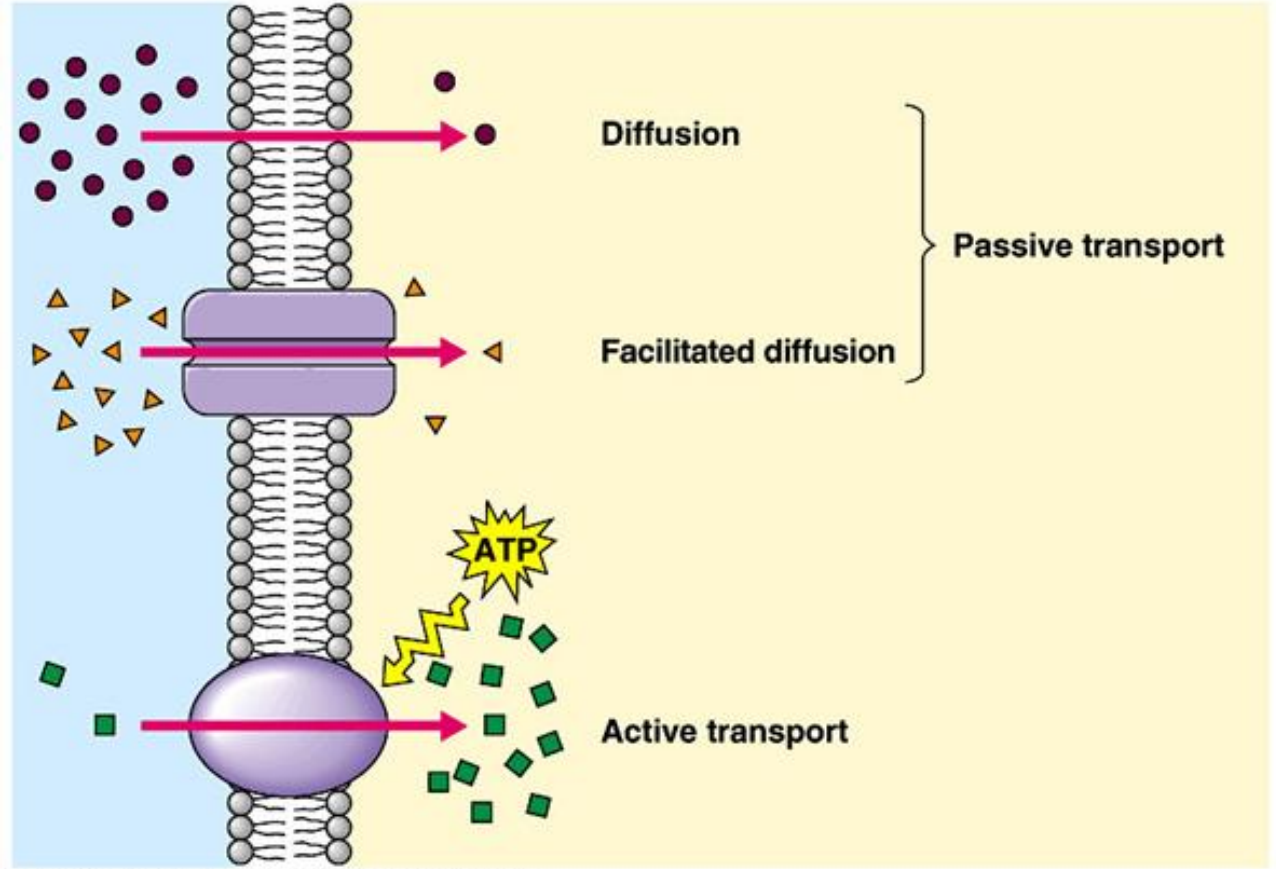
Active Transport: Movement of a substance from a region of low concentration to one of high concentration. This process requires energy from the cell in the form of ATP.



Active transport



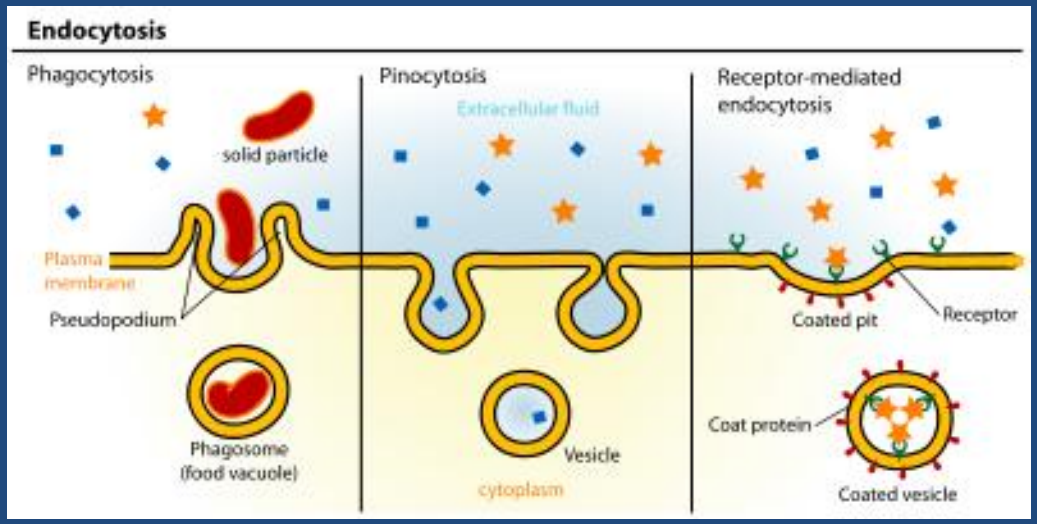
Difference between Passive and Active Diffusion



Bulk Transport

- is used to move large amounts of substances out of and into the cell as they cannot fit through the membrane
- 2 types
  - Endocytosis
  - Exocytosis

Endocytosis

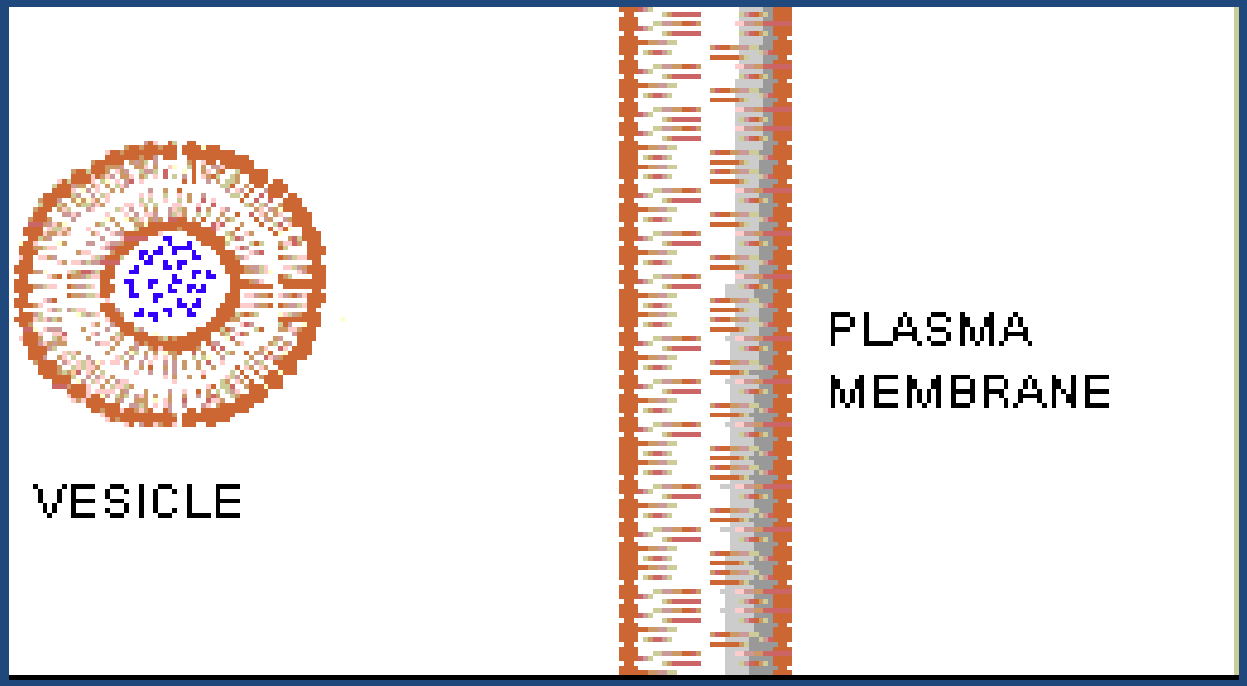


❖ a process the cell uses to TAKE IN large substances. The cell extends its cytoplasm around the substance forming endocytotic vesicles

- Phagocytosis – bulk transport of solids into a cell egwhite blood cells phagocytose bacteria
- Pinocytosis – occurs when the cell's membrane engulfs a drop of extracellular fluid EG fat droplet

Exocytosis: movement of substances out of a cell by the use of vesicles that fuse with the cell membrane. Substances that cross the cell membrane by this method are often large molecules.

Inside the cell



Outside the cell

http://www.youtube.com/watch?v=K7yku3sa4Y8