



Membrane Transport

WALT: Explain what is meant by passive transport, active transport, endocytosis & exocytosis.

Explain osmosis in terms of water potential.

Explain the effects of different water potentials on plant & animal cells.



Diffusion

- Gas/liquid molecules have kinetic energy.
 - They are free to move about randomly.
- Diffusion is the net movement of molecules from a region of high concentration to a region of lower concentration.
 - We say the movement is down a concentration gradient.



Diffusion in action

What happens to molecules during diffusion?

The diagram shows a rectangular container divided into two chambers by a vertical divider. The left chamber contains 20 green spherical molecules and a green box with the number '20'. The right chamber is empty and contains a green box with the number '0'.

divider: on off





Rate of diffusion is affected by:

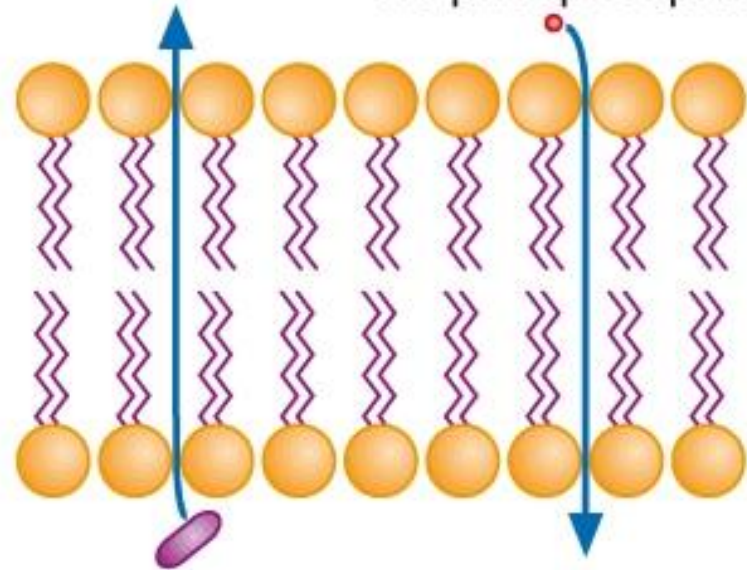
- Temperature
- Concentration gradient
- Stirring/agitation
- Surface area
- Distance over which diffusion occurs
- Size of molecule



Diffusion across cell membranes

- Some molecules can diffuse directly across a cell membrane:
 - Fat soluble molecules.
 - Small molecules.

Carbon dioxide is small enough to pass between the phospholipids



Lipid-based molecules like steroid hormones easily pass through the hydrophobic region



Diffusion across cell membranes

- Small charged particles or larger molecules cannot simply pass through the membrane bilayer.
 - Intrinsic proteins spanning the membrane allow these substances through.
 - This is known as **facilitated diffusion**.

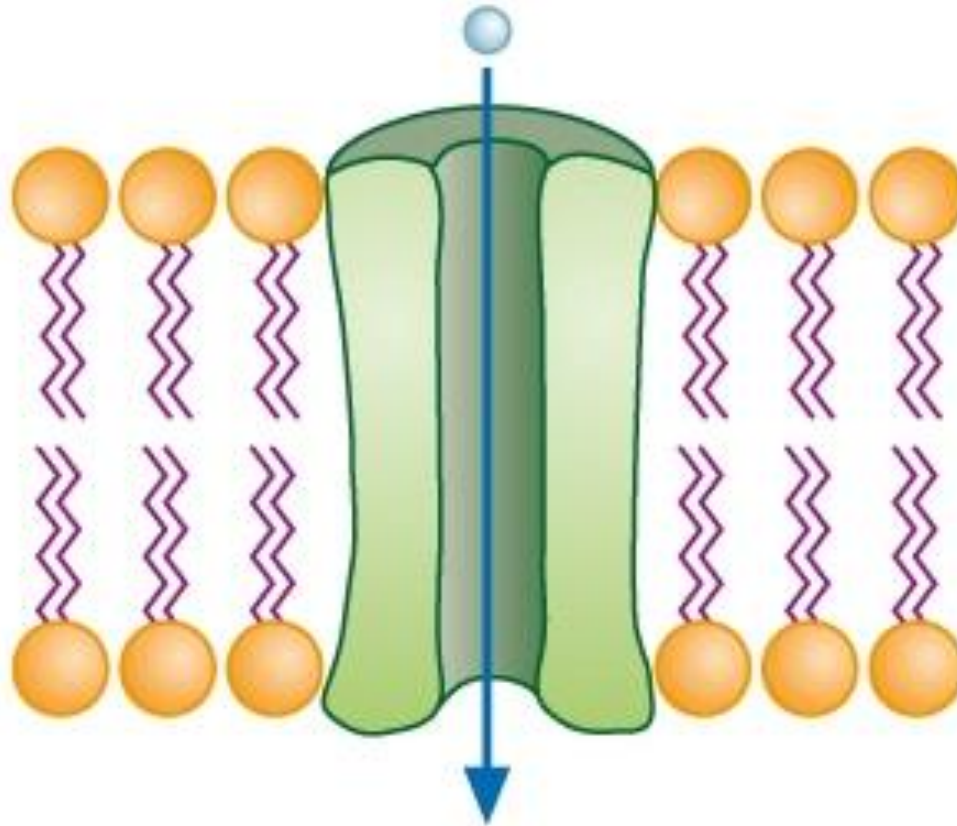


Facilitated Diffusion

- Two types of membrane proteins:
 - Channel proteins
 - Form pores within the membrane.
 - Often only let certain ions/molecules through.
 - Many can open or close (they are **gated**).
 - Carrier proteins
 - Have a specific shape that only allows specific molecules to enter.
 - The carrier protein then changes shape to allow the specific molecule to pass through.



Channel Proteins

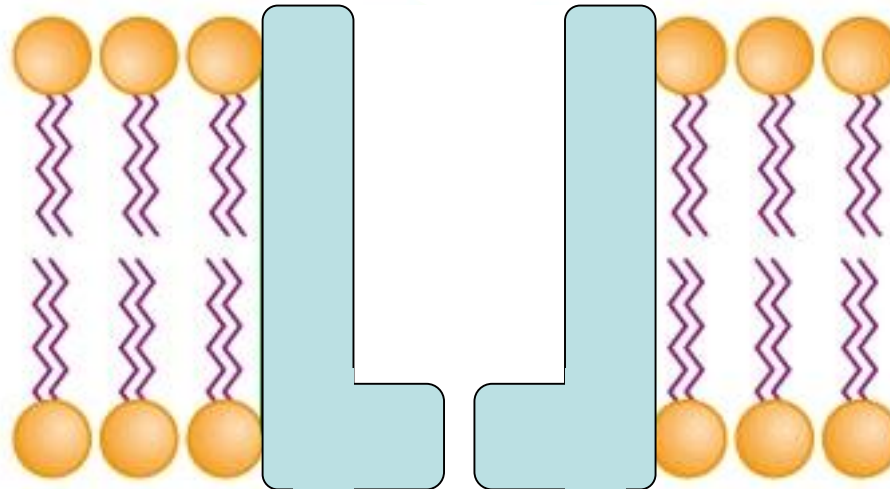
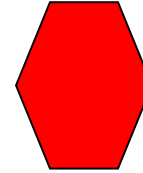


Protein 'pore' allows small water-soluble molecules or ions through, e.g. calcium ions.



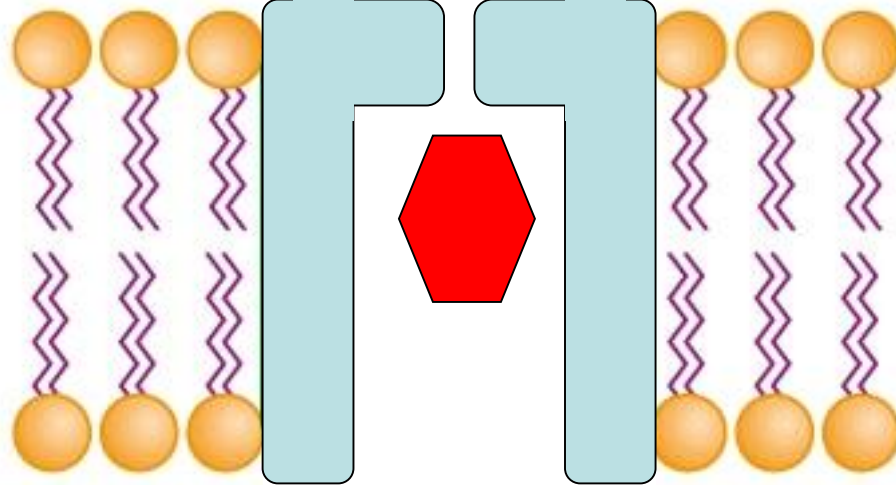
Carrier Proteins

Specific molecule
fits into carrier,
e.g. glucose





Carrier Proteins



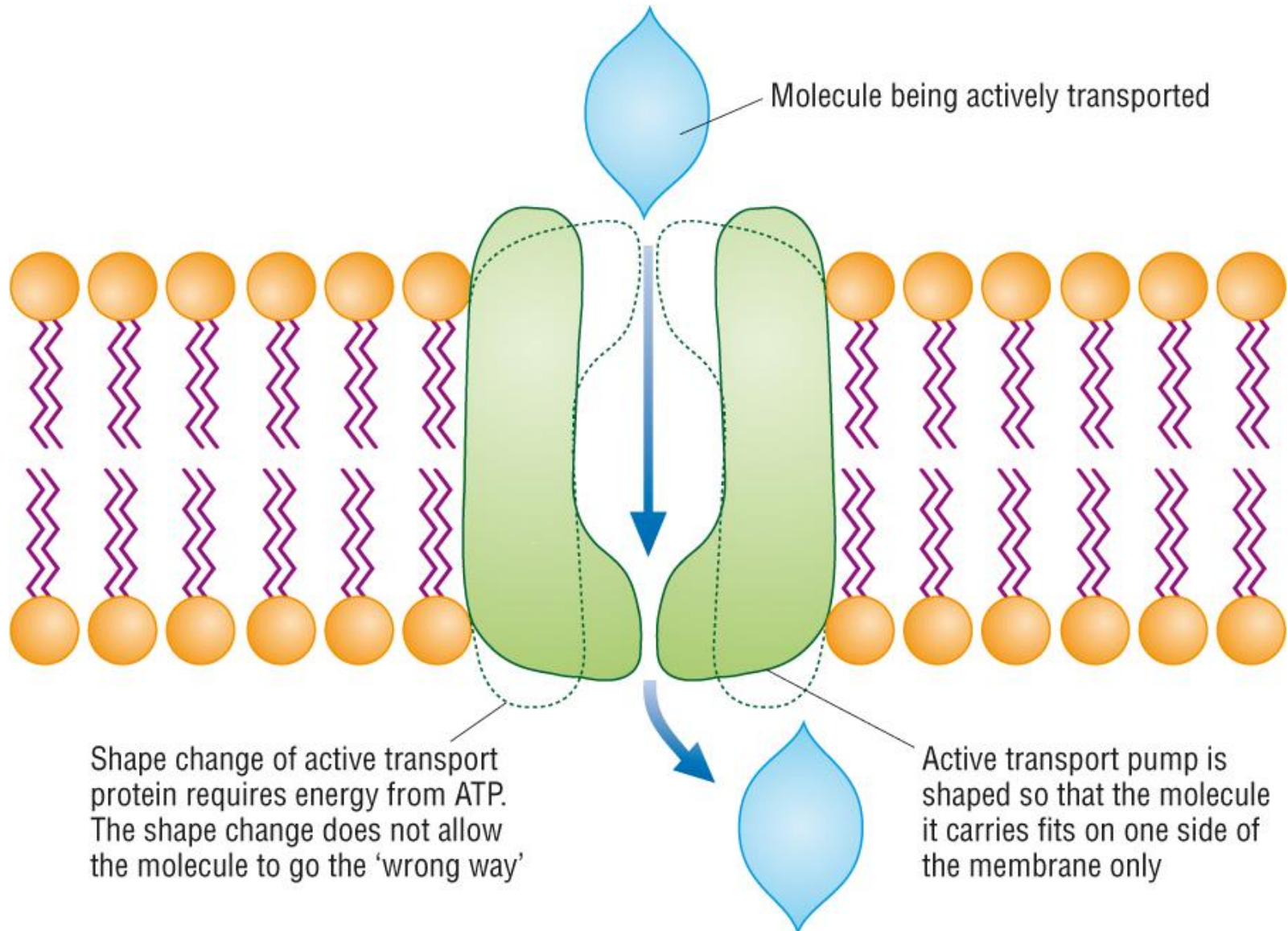


Active Transport

- The active pumping of molecules/ions across a membrane using ATP driven protein pumps.
 - The proteins used are similar to those used in facilitated diffusion.
 - They only carry specific molecules/ions due to their shape.
 - Energy (ATP) is used to drive the pump.
 - Transport is faster than that of facilitated diffusion.
 - Substances can be transported against a concentration gradient.



Active Transport



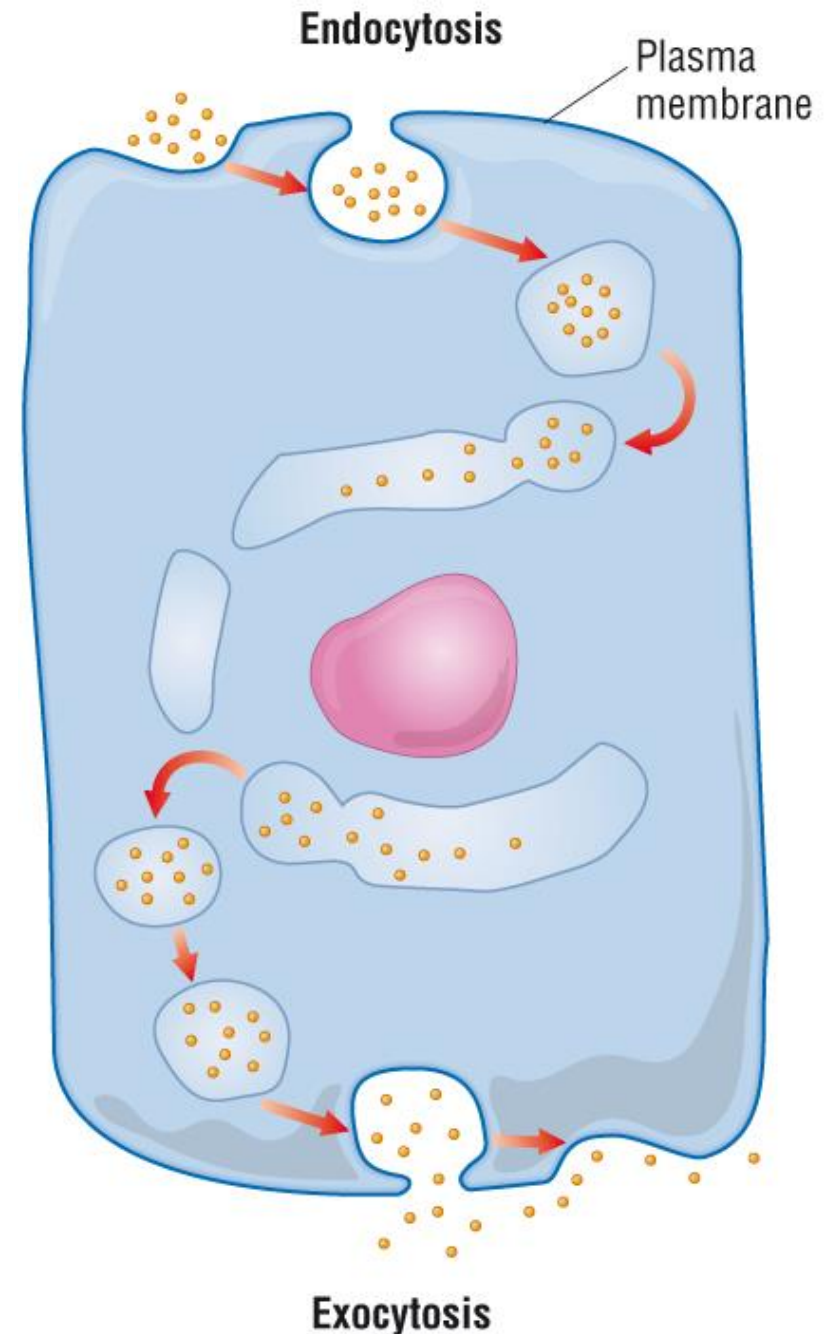


Bulk Transport

- Moving large quantities of material into or out of the cell.
- Involves vesicles containing the material being pinched off or fusing with the plasma membrane.
- Uses ATP to move vesicles around.



- **Endocytosis** = transport of material **into** the cell.
- **Exocytosis** = transport of material **out of** the cell.





Osmosis

- A special kind of diffusion.
 - Refers to the diffusion of water molecules across a partially permeable membrane.
 - Water molecules diffuse from a region of high **water potential** to a region of low **water potential**.
- Hang on, what's water potential?



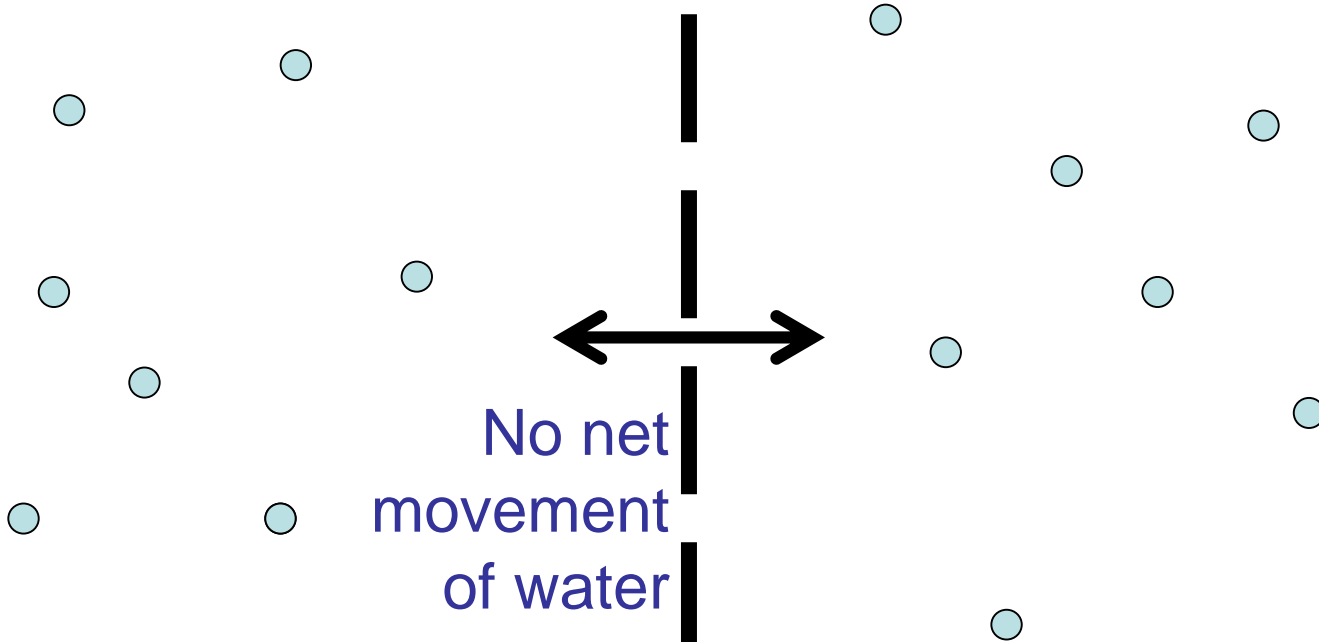
Water Potential

- A measure of the amount of free water molecules available in a solution.



Osmosis

Free water molecules



No net movement of water

High water potential

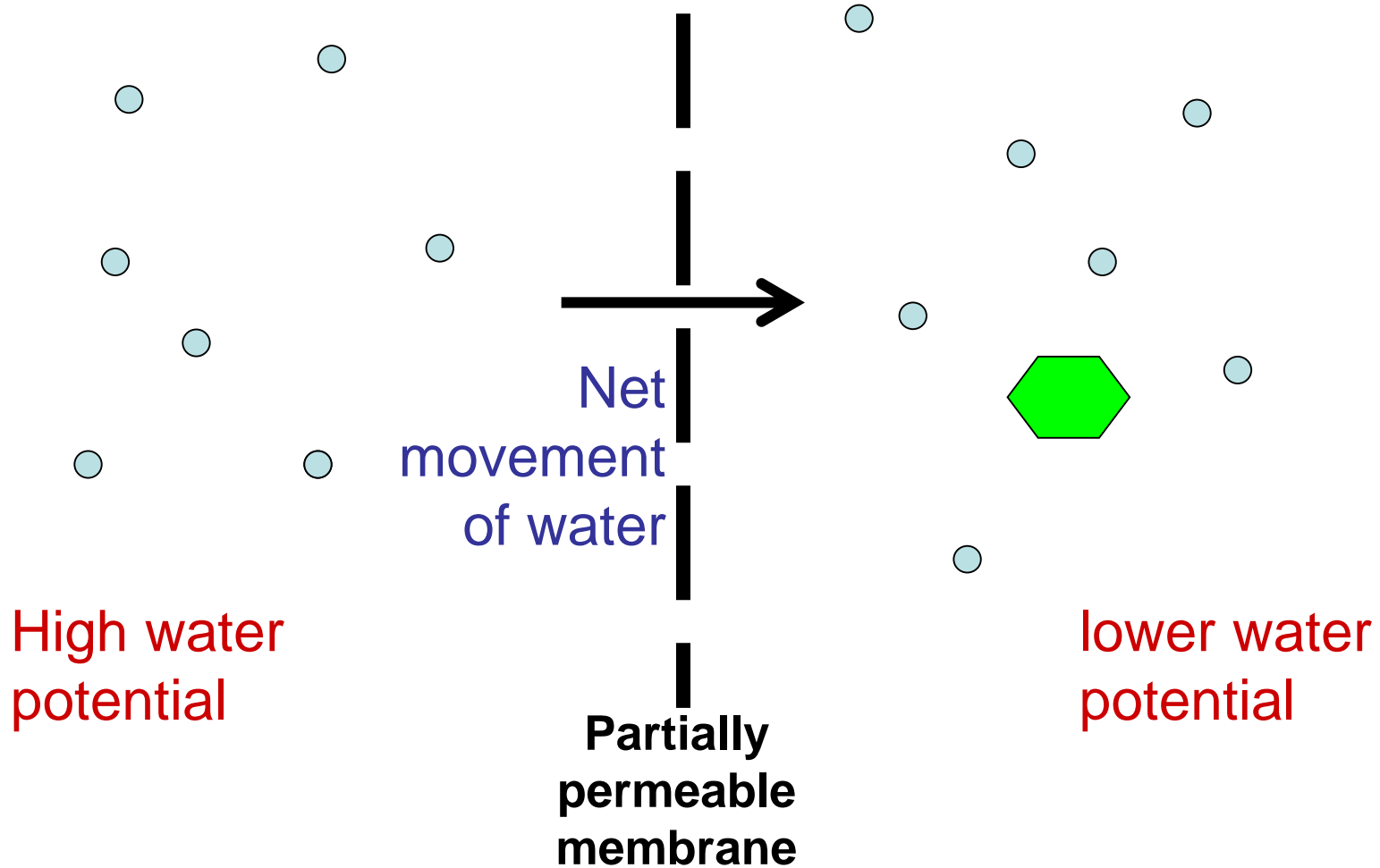
High water potential

Partially permeable membrane



Osmosis

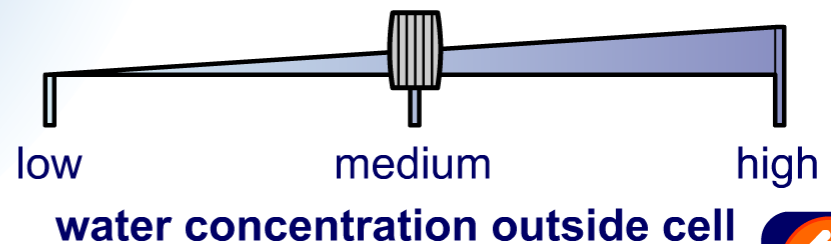
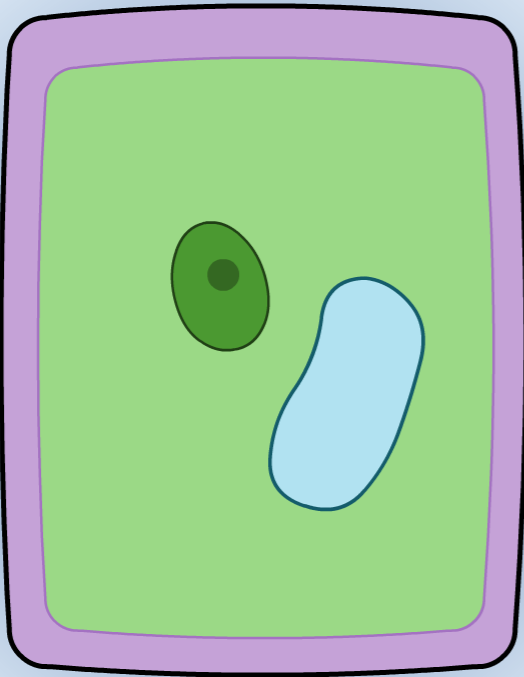
Free water molecules





Osmosis and plant cells

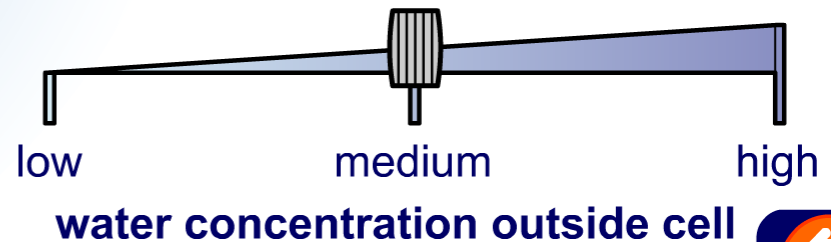
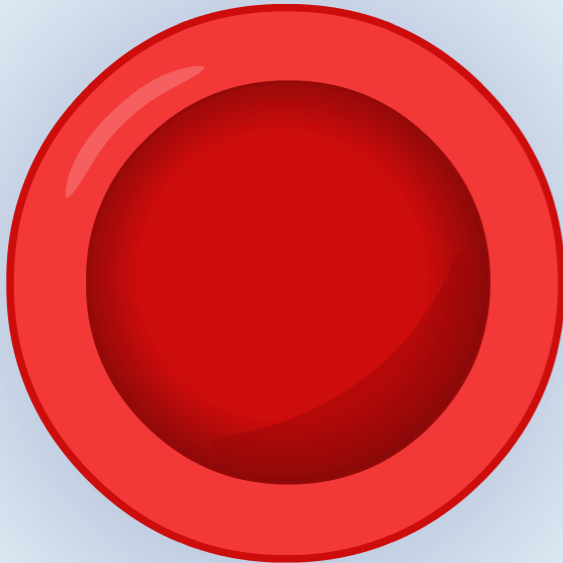
How do plant cells react to osmosis?





Osmosis and animal cells

How do animal cells react to osmosis?



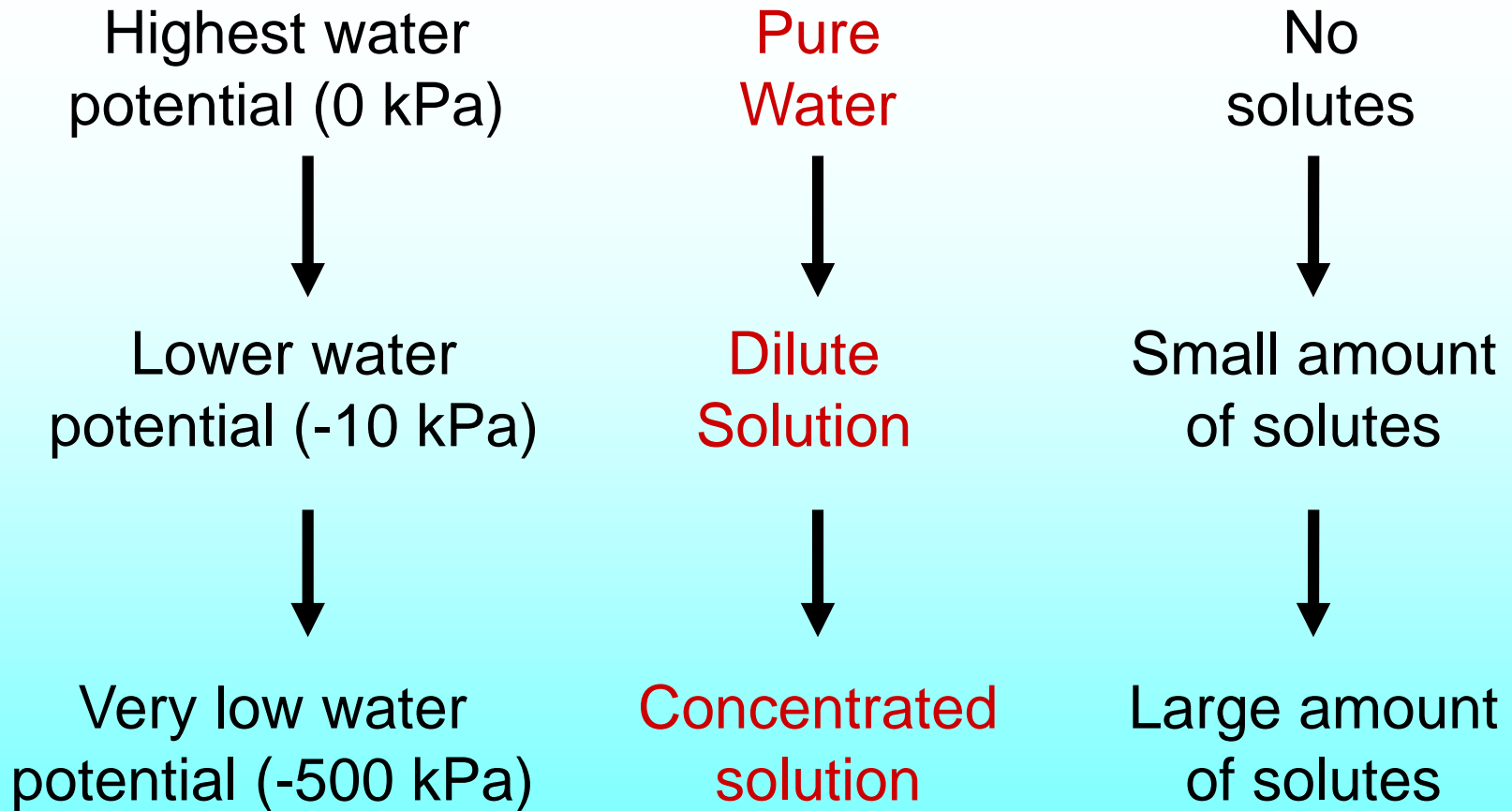


Measuring Water Potential

- Measured in kilopascals (kPa).
- Pure water has the highest water potential.
 - This has a water potential of 0 kPa.
- Adding solutes reduces the water potential.
 - This gives it a negative value.



Summary



Decreasing water potential



Summary of cell membrane transport

Active / Passive	Name	Description
Passive	Diffusion	Very small or lipid soluble molecules, down a concentration gradient.
	Facilitated diffusion	Charged (hydrophilic) molecules/ions, down a concentration gradient, via channel or carrier proteins.
	Osmosis	Through the lipid bilayer or via pores, down a water potential gradient.
Active	Active transport	Against a concentration gradient, through carrier proteins, using energy from ATP.
	Exocytosis / Endocytosis	Via vesicles that fuse with or pinch off from the plasma membrane.