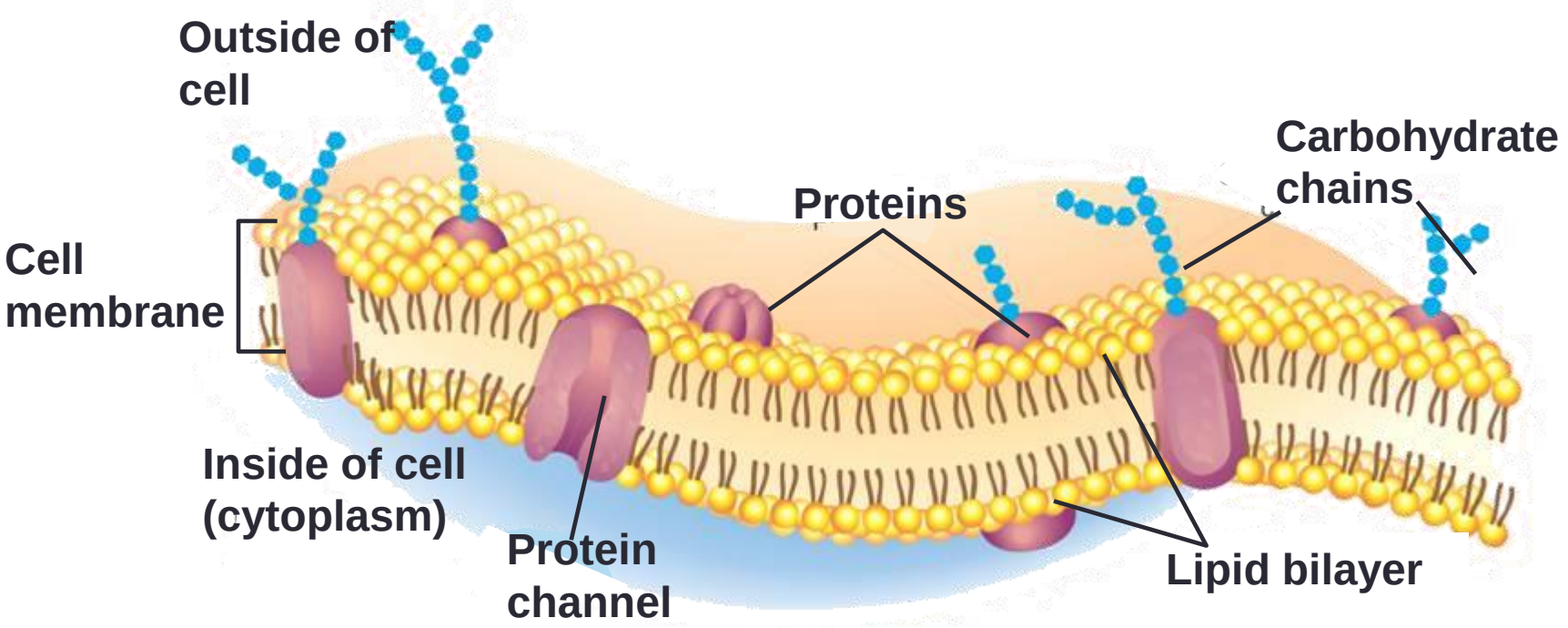
Transport Across Membranes

- Cells need to maintain **homeostasis**.
- They must have a way of moving substances through the cell membrane.
  - Membrane is a selective barrier.



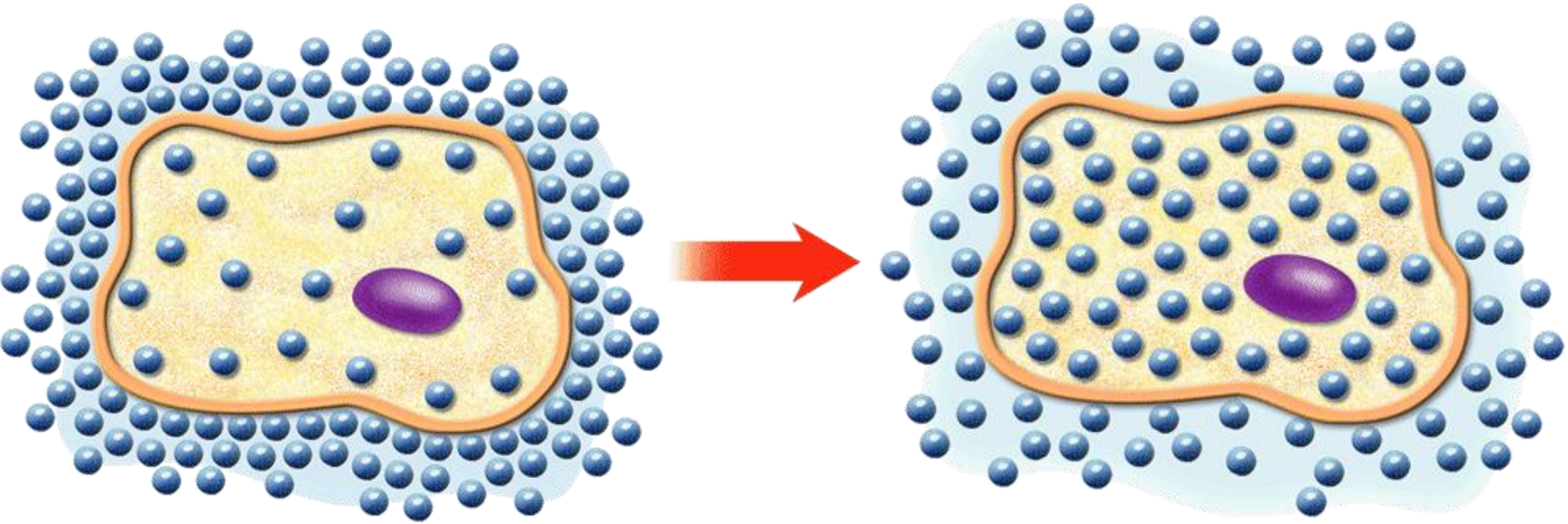
Transport Across Membranes

- The concentration of a solution is the amount of solute in the volume of liquid (solvent).
- **HIGH concentration means LOTS of solute**.
- There are two ways that the cell regulates solute concentration in cells:

1. passive transport
2. active transport.

Passive Transport: Diffusion

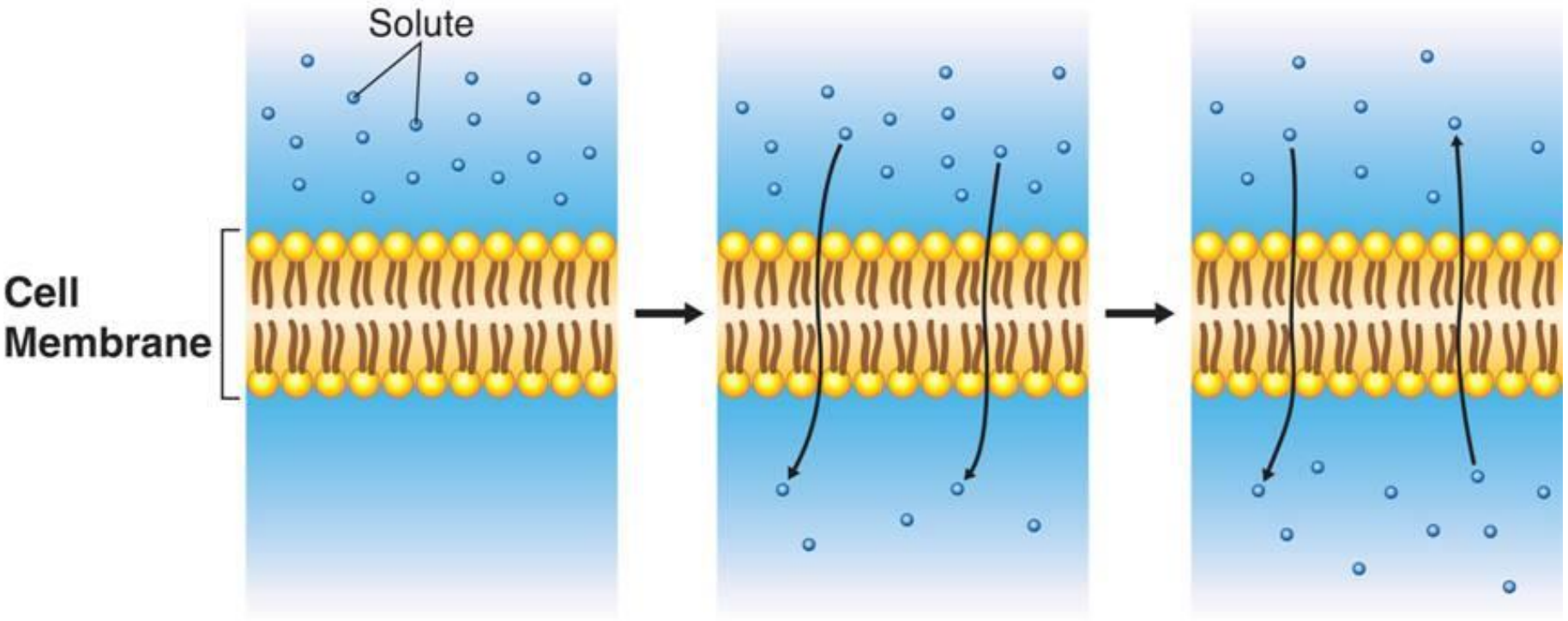
- Diffusion: when molecules move from an area of higher concentration to an area of lower concentration.
- The solute particles will continue to move until equilibrium is reached (same amount of solutes on both sides of the membrane).



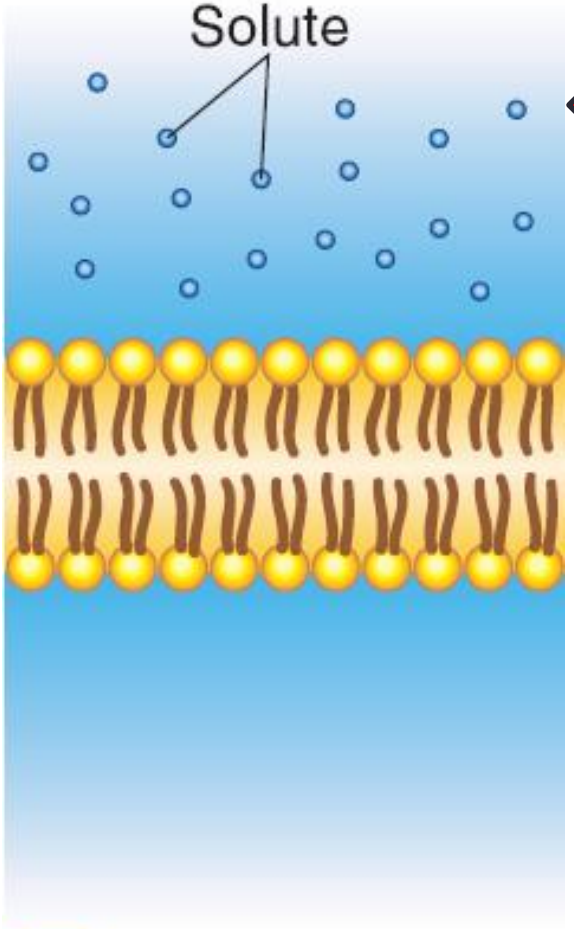
Before Diffusion
There is a higher concentration of oxygen molecules outside the cell than inside the cell.

After Diffusion
The concentration of oxygen molecules is the same outside and inside the cell.

Diffusion Through Cell Boundaries

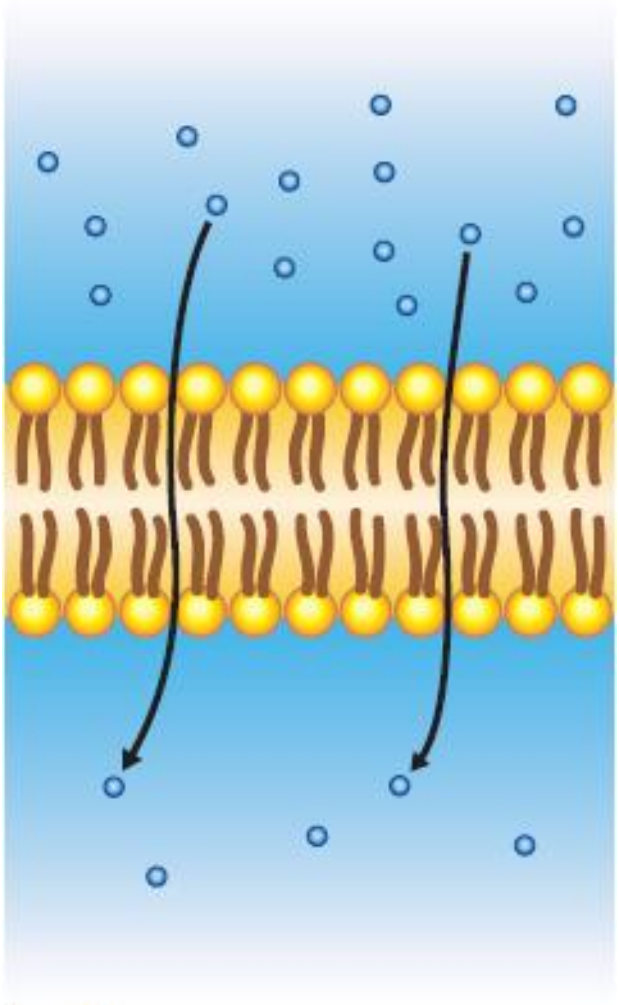


Diffusion Through Cell Boundaries



There is a higher concentration of solute on one side of the membrane as compared to the other side of the membrane.

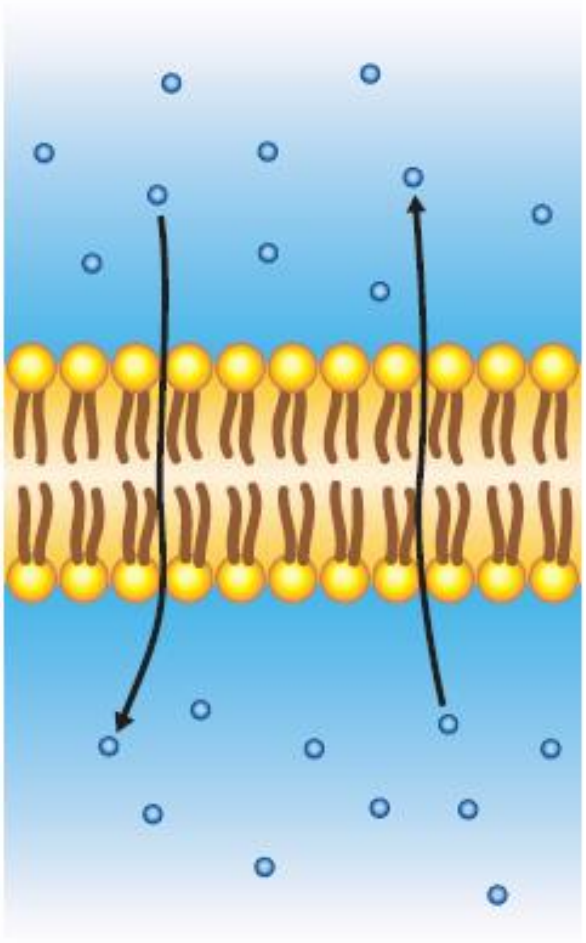
Diffusion Through Cell Boundaries



Solute particles move from the side of the membrane with a higher concentration of solute to the side of the membrane with a lower concentration of solute (**HIGH → LOW**).

The solute particles will continue to diffuse across the membrane until equilibrium is reached.

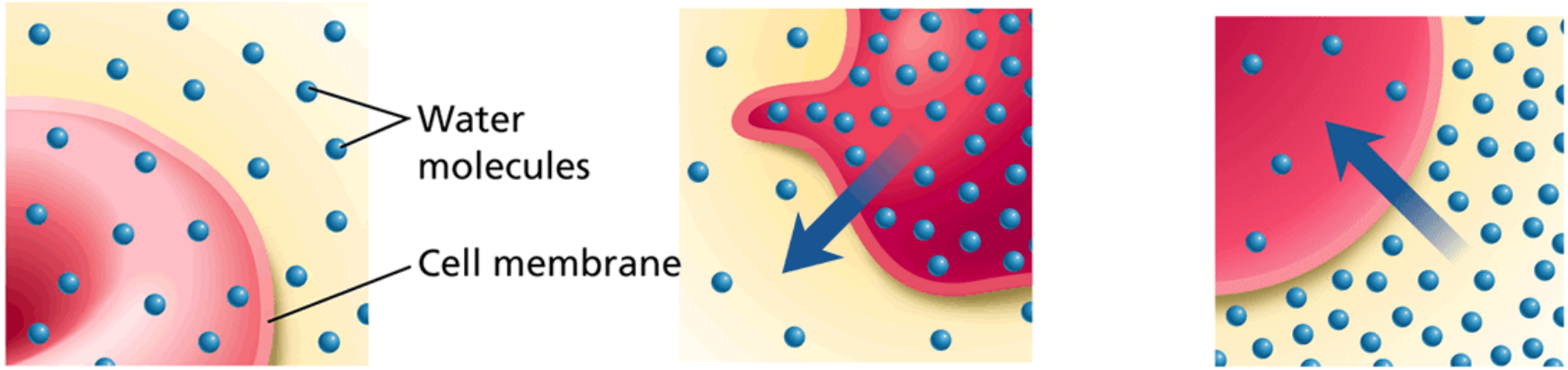
Diffusion Through Cell Boundaries



- When equilibrium is reached (same amount of solutes on both sides), **solute particles continue to diffuse** across the membrane in both directions.

Passive Transport: Osmosis

- **Water** diffuses through a **selectively permeable membrane**.



A **Normal Red Blood Cell**
Concentration of water inside the cell is the same as outside.

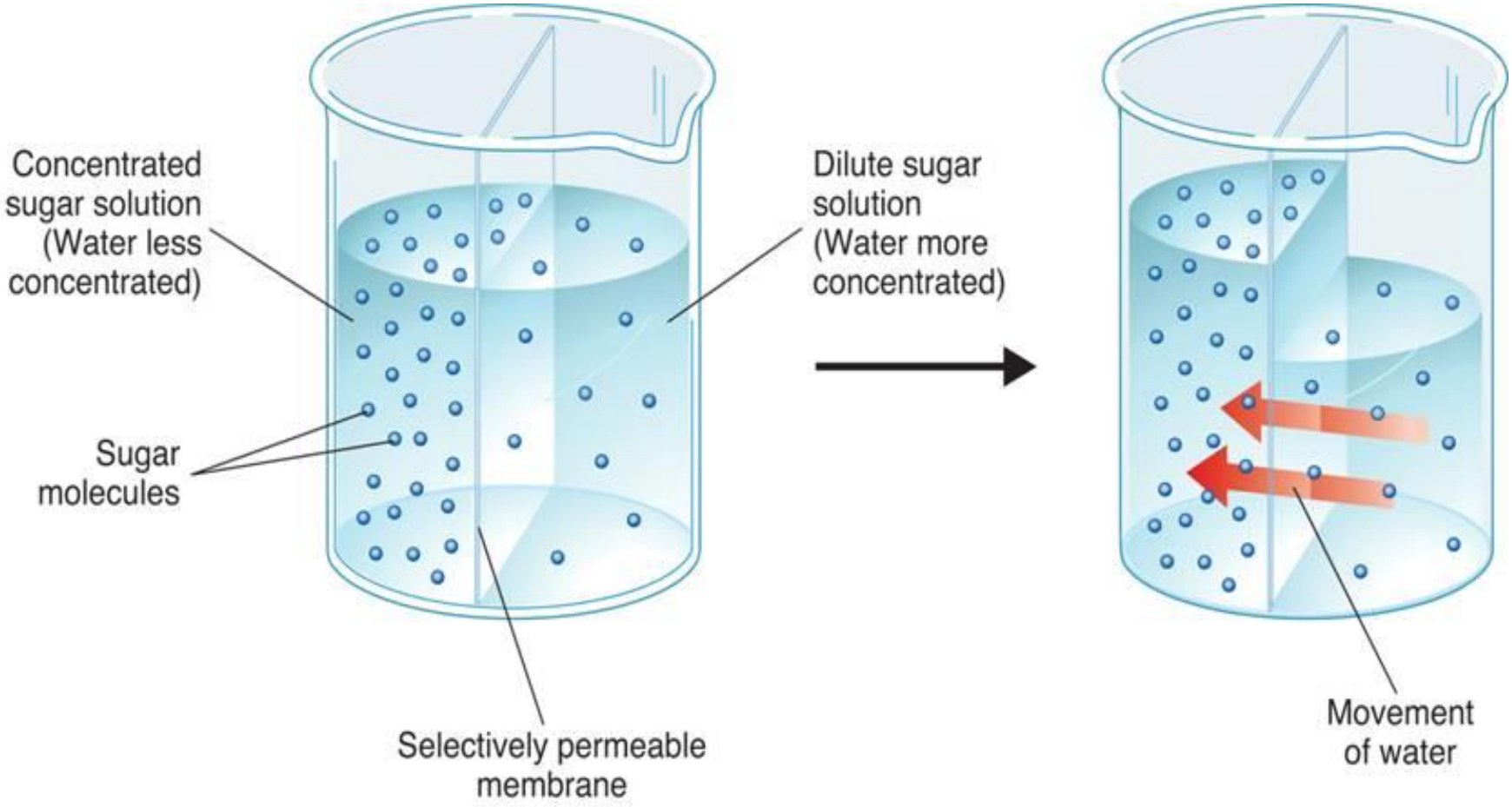
B **Low Water Concentration Outside Cell**
Water moves out of the cell during osmosis.

C **High Water Concentration Outside Cell**
During osmosis, water moves into the cell.

• When a membrane is **selectively permeable**, it means that **only certain things can pass through it** (like water or very small ions/solutes). If it is **NOT permeable** to a solute, that solute can **NOT get through**.

Passive Transport: Osmosis

• Water will always move from where there is **MORE water (high concentration of water) to where there is LESS water (lower concentration of water)**.

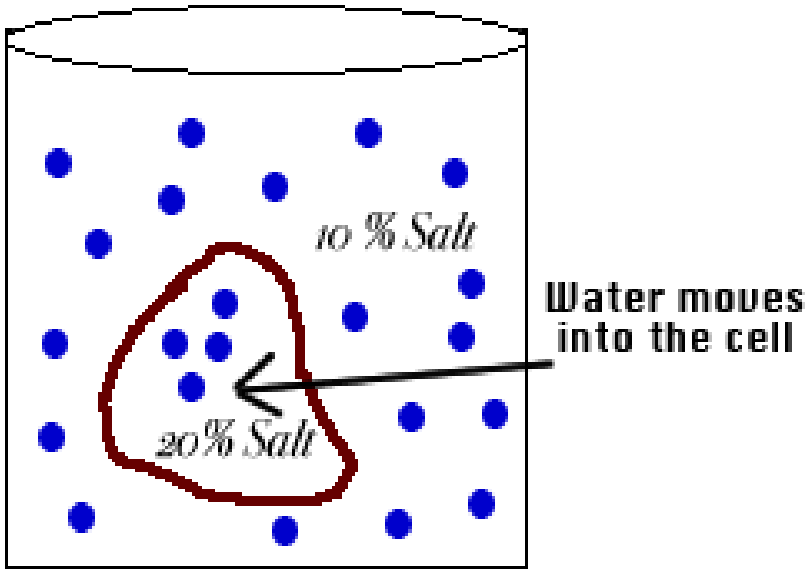


Passive Transport: Osmosis

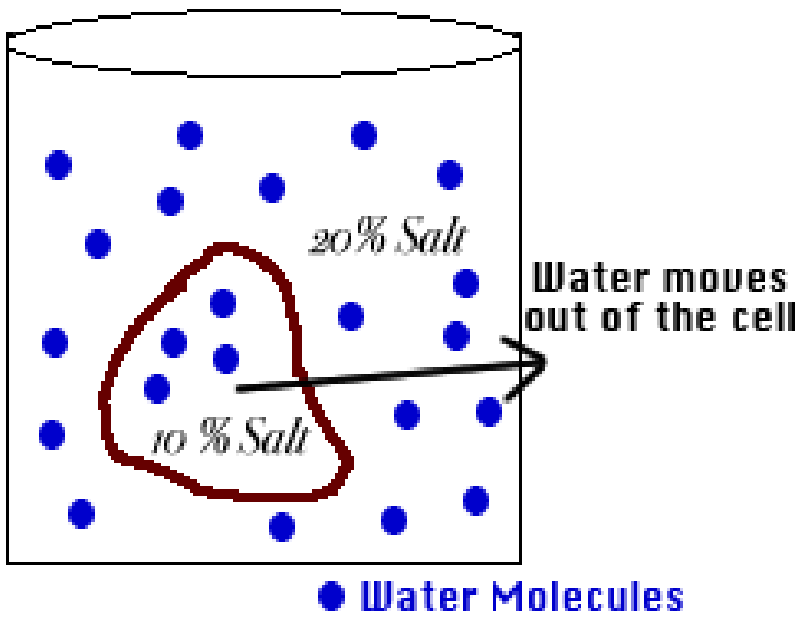
- When a cell is in a solution, that solution may be **hypertonic, hypotonic, or isotonic to the cell.**

- **Hypertonic**- when a solution has a **higher concentration of solutes** (and less water) than the cell
- **Hypotonic-** when a solution has a **lower concentration of solutes** (and more water) than the cell.
- **Isotonic**- when a solution has the **same concentration of solutes** as the cell.

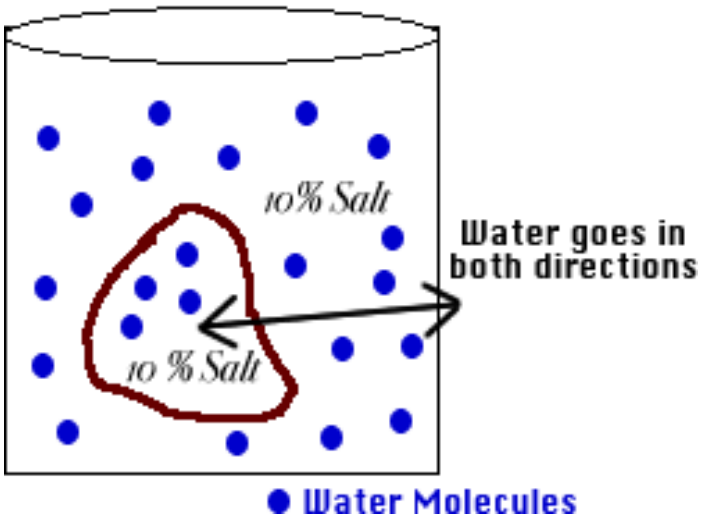
Solution is Hypotonic

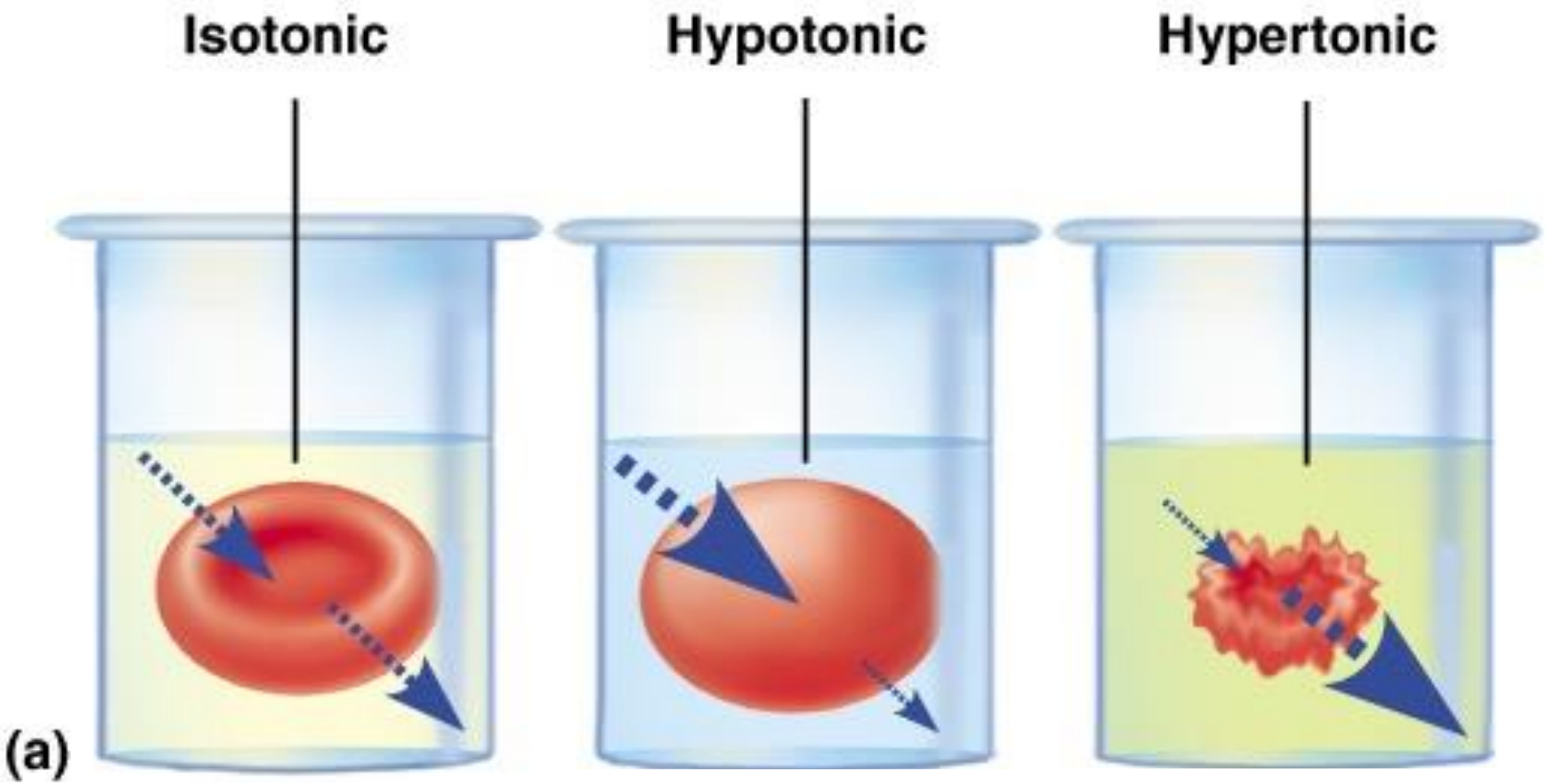


Solution is Hypertonic



Solution is Isotonic





Solution with **same** solute concentration as cell (no water mvmt)

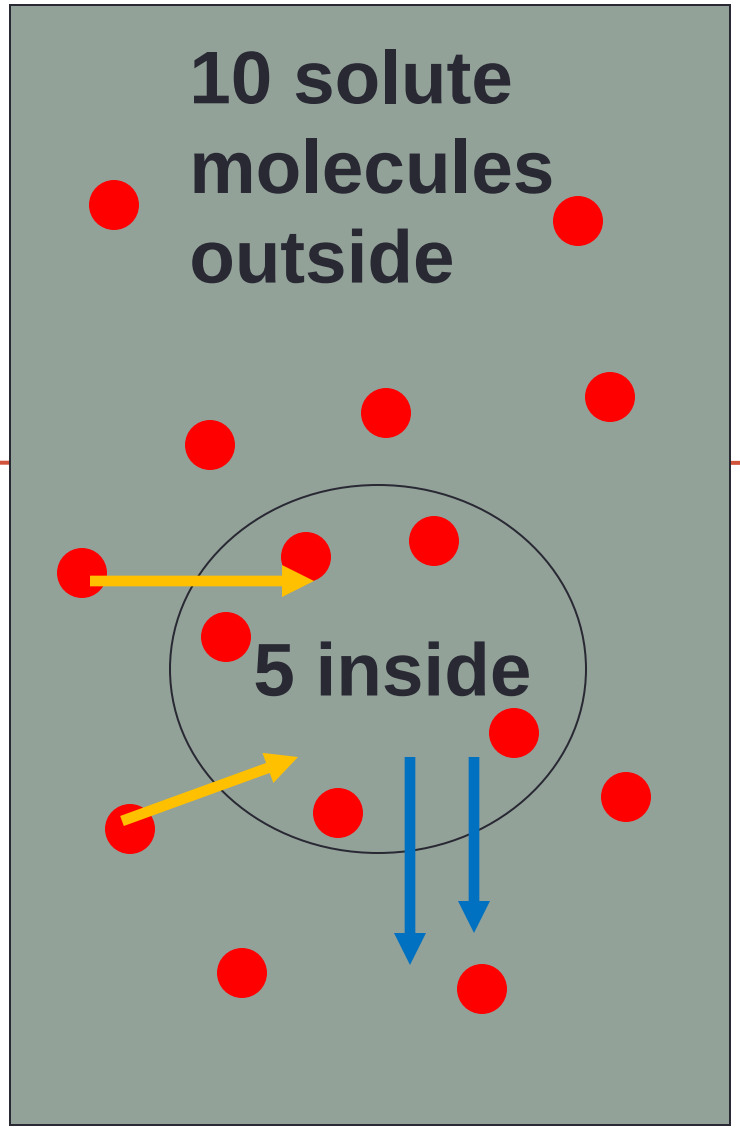
Solution with **lower** solute conc. than cell (water moves **INTO** cell)

Solution with **higher** solute conc. than cell (water moves **OUT** of cell)

Draw a cell in a **hypertonic** environment

Which way will the solute travel?

Which way will the water travel?

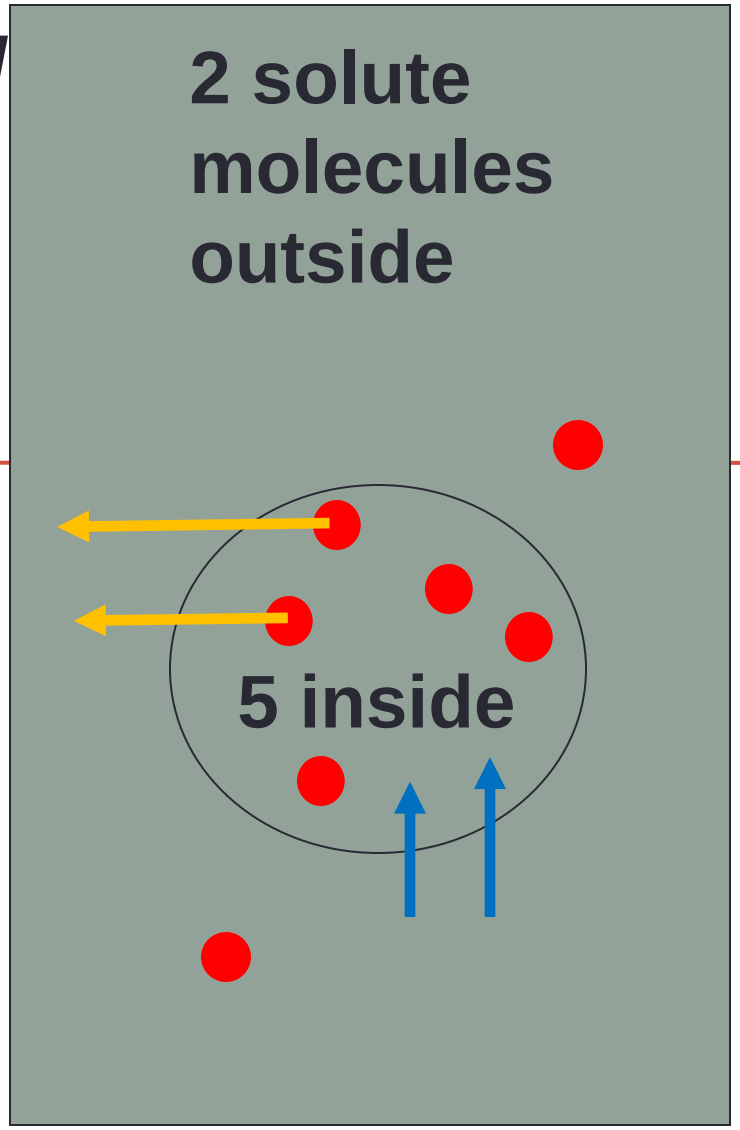


● = solute molecule

Draw a cell in a **hypotonic** environment

Which way will the solute travel?

Which way will the water travel?

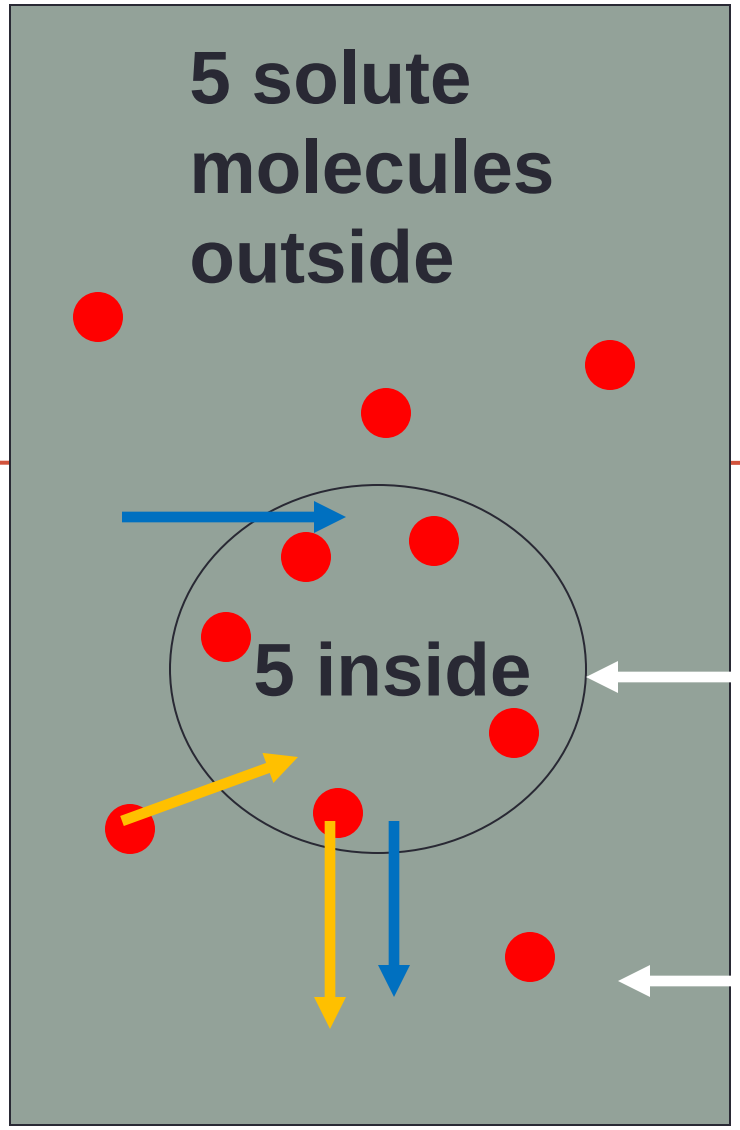


● = solute molecule

Draw a cell in an **isotonic** environment

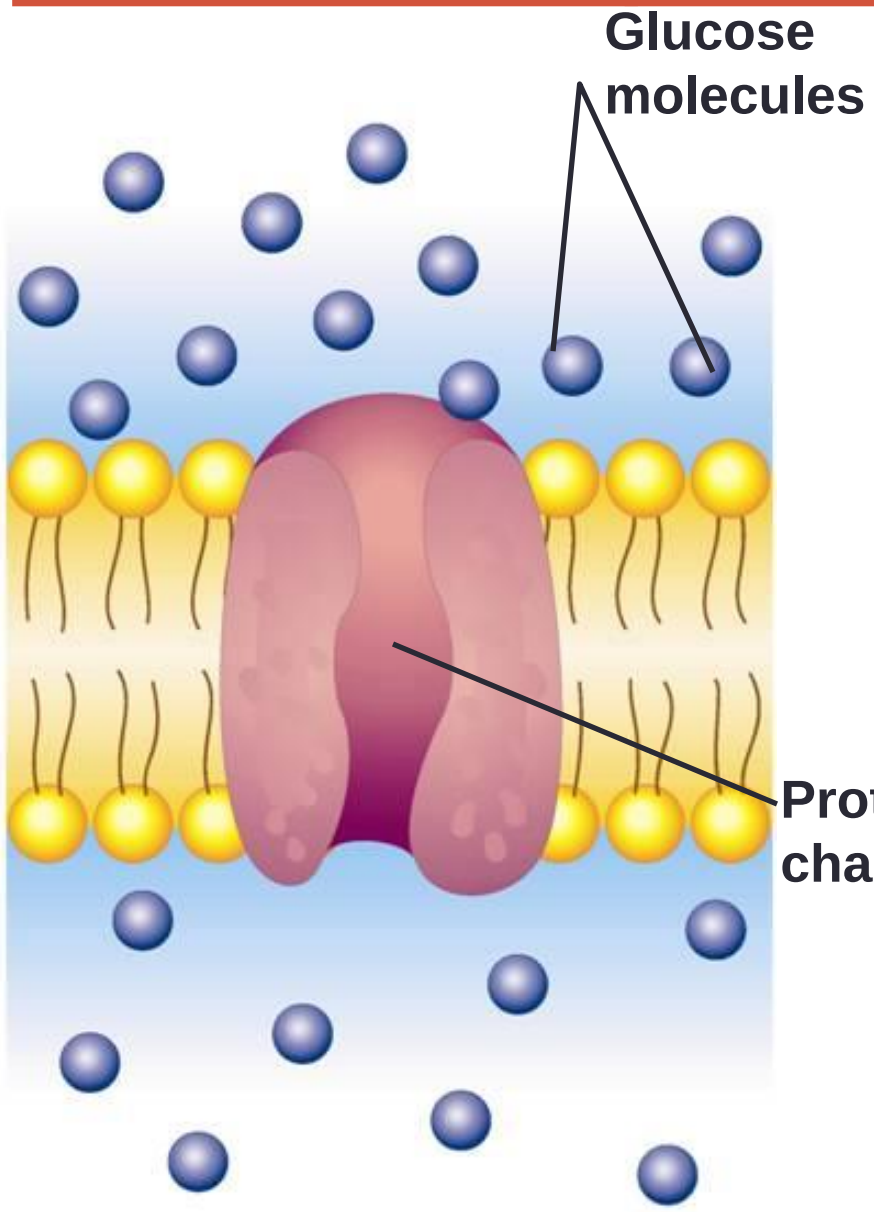
Which way will the solute travel?

Which way will the water travel?



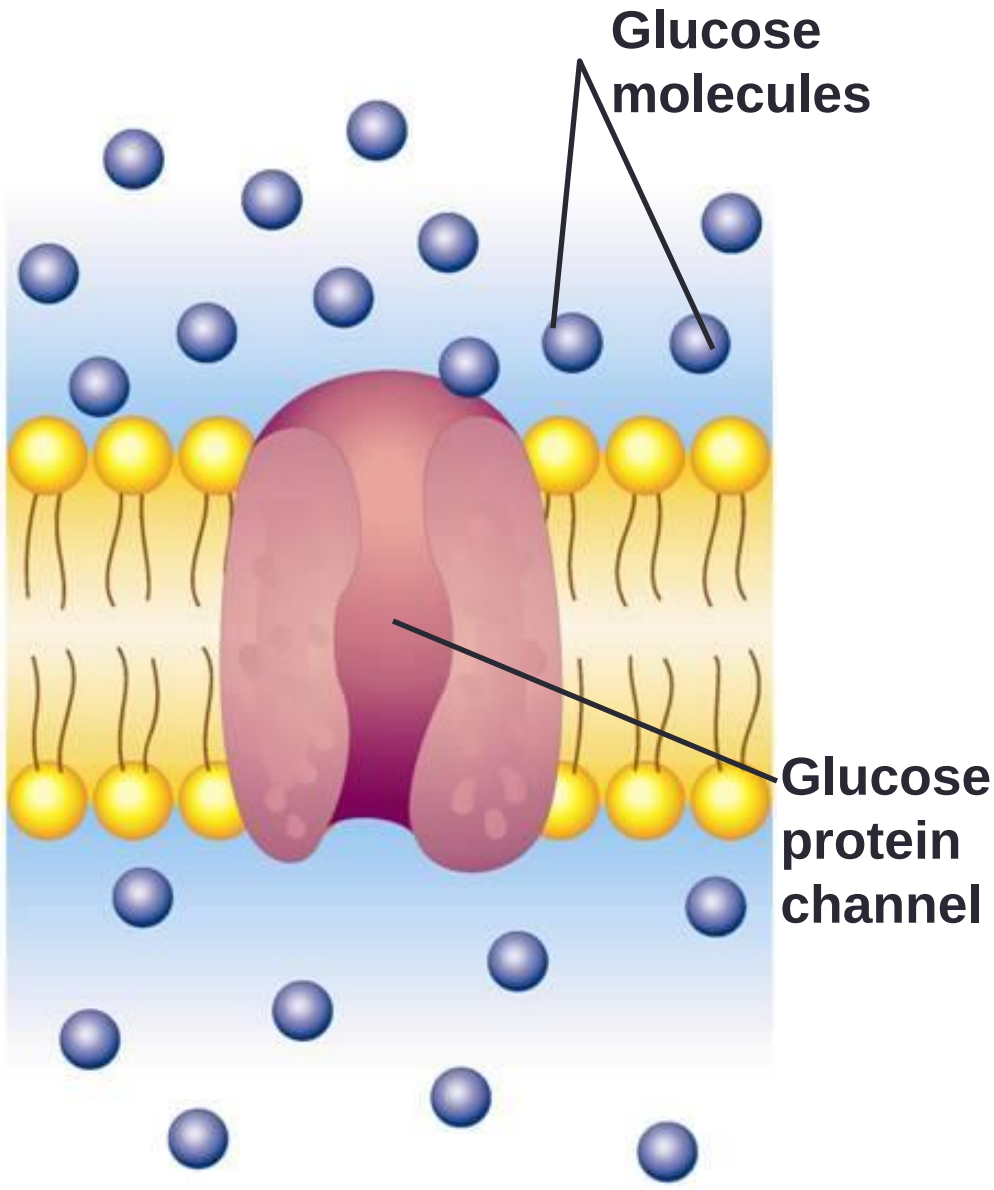
● = solute molecule

Passive Transport: Facilitated Diffusion



- Facilitated diffusion is when molecules move across the cell membrane from HIGH to LOW concentration **using the help of a facilitator protein** to act as a **channel** for the solute to pass through the membrane**.**

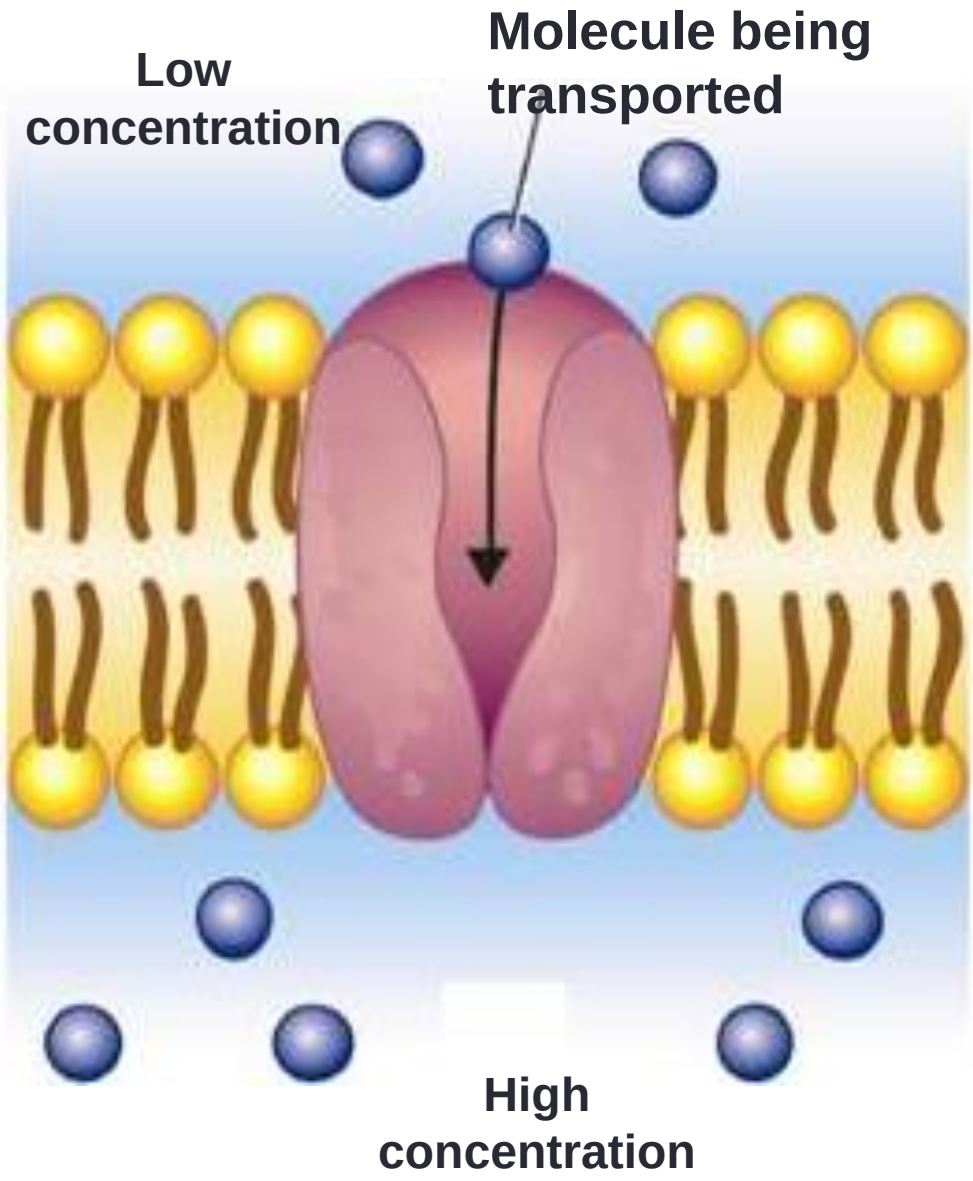
Passive Transport: Facilitated Diffusion



- Facilitated diffusion is needed for molecules that are **too big** to move through the lipid bilayer on their own.

- Each facilitator protein is **specific to each kind of molecule** (for example, glucose can only go through glucose facilitator proteins).

Active Transport



- Sometimes cells move materials in the **opposite direction** from which the materials would normally move—that is **from LOW to HIGH concentration**. This process is known as **active transport**.

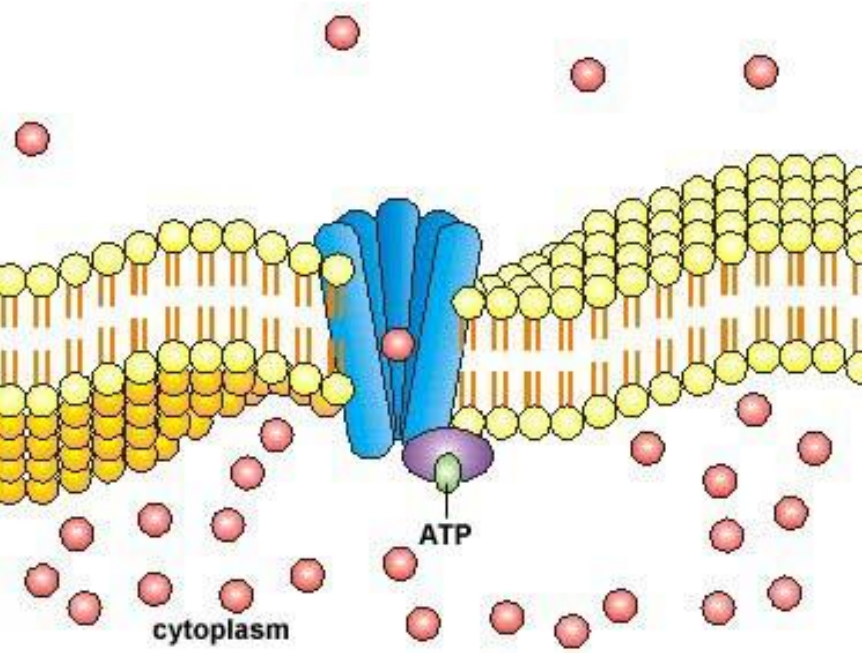
- Active transport **requires energy**.

Active Transport

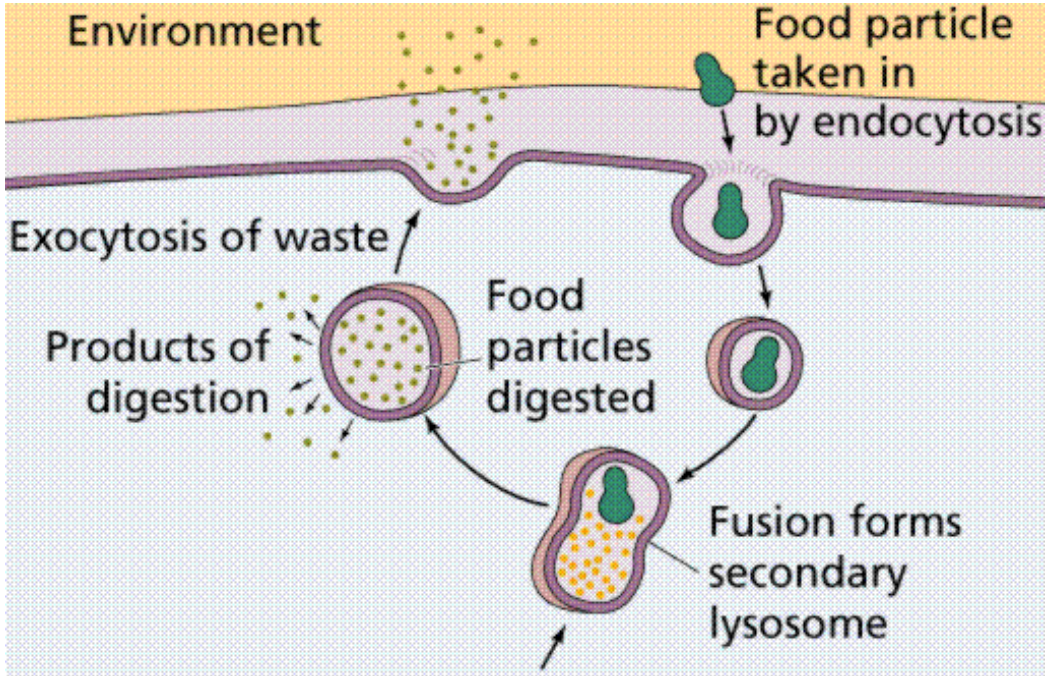
- There are **two major types of active transport**.

1) When **ONE molecule** is transported at a time using **protein pumps**

2) When **MANY molecules** are transported at a time using **endo and exocytosis**.



One molecule at a time (protein pumps)



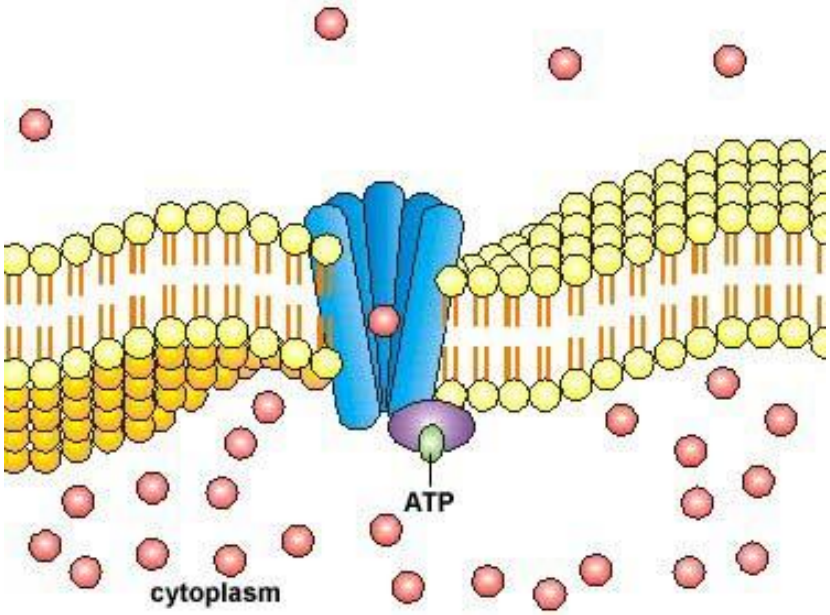
Many molecules at a time (endo and exocytosis)

Active Transport: Protein Pumps

- Pumps are **special transport proteins** that allow molecules to travel from **low to high** concentration **USING ENERGY!!!**

- Pumps often move ions like calcium, potassium, and sodium, which **normally can't pass through the membrane**

- This is **NOT** the same thing as facilitated diffusion



Active Transport: Endocytosis

- **Endocytosis** is the process of taking material into the cell by **pockets created by the cell membrane**.
- Cells use **pinocytosis** to take in liquid (**cell drinking**)
- Cells use **phagocytosis** to take in solids (**cell eating**)

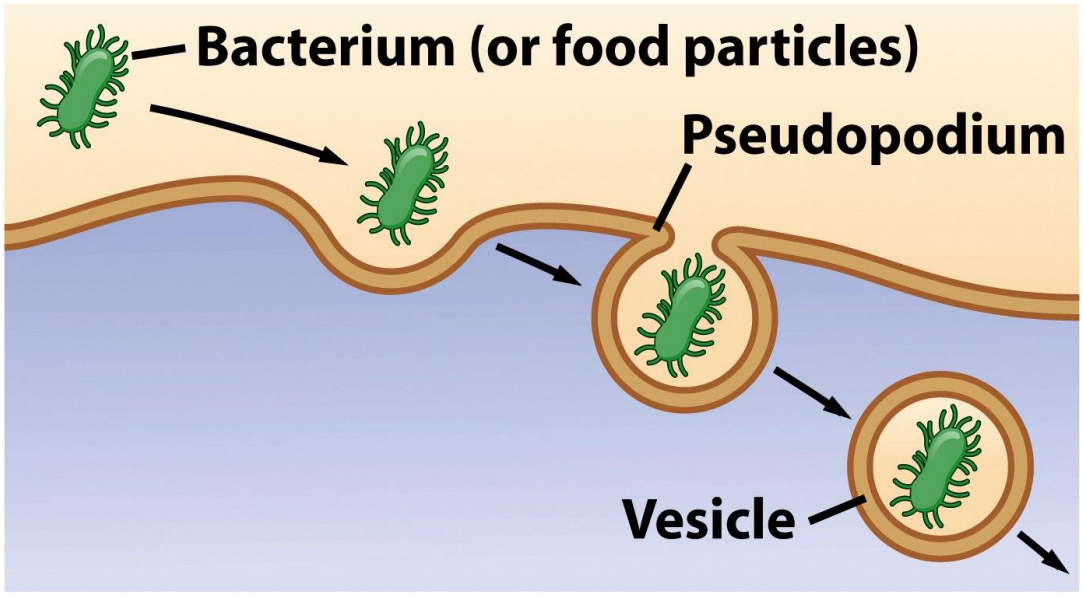
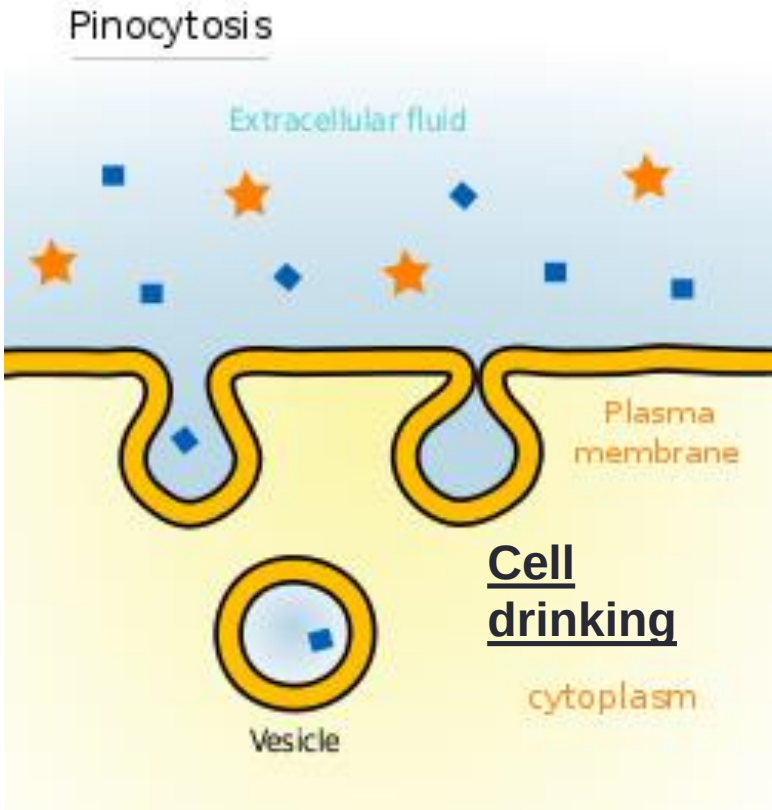


Figure 6-5d Discover Biology 3/e
© 2006 W. W. Norton & Company, Inc.

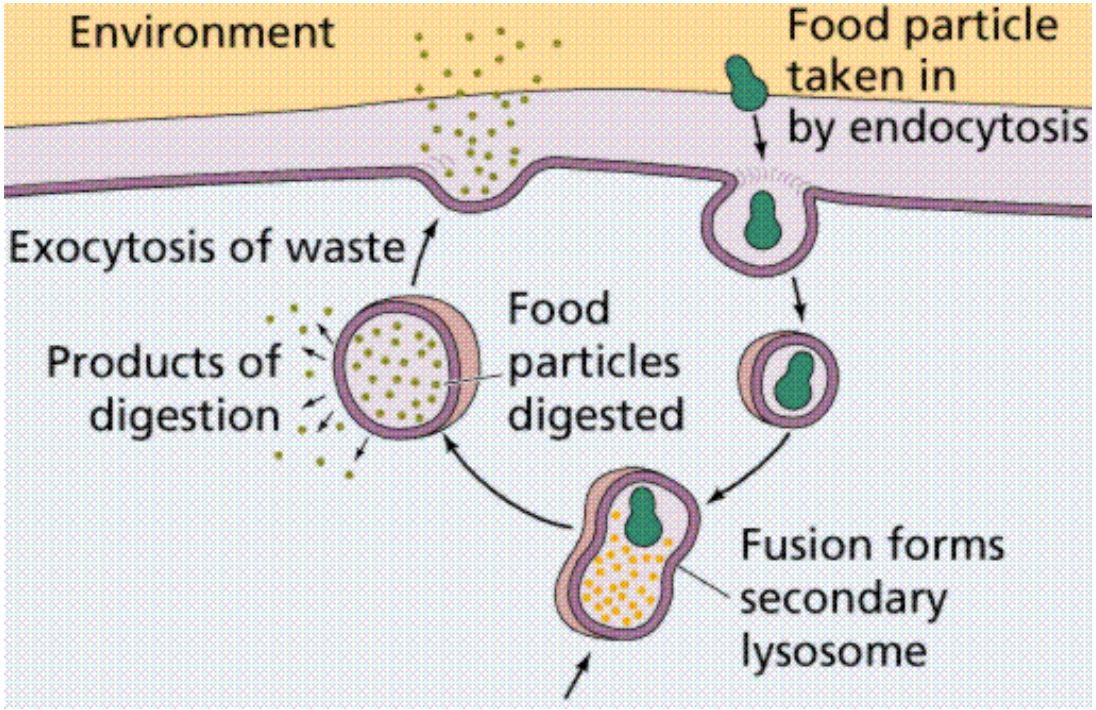
Cell eating



Active Transport: Exocytosis

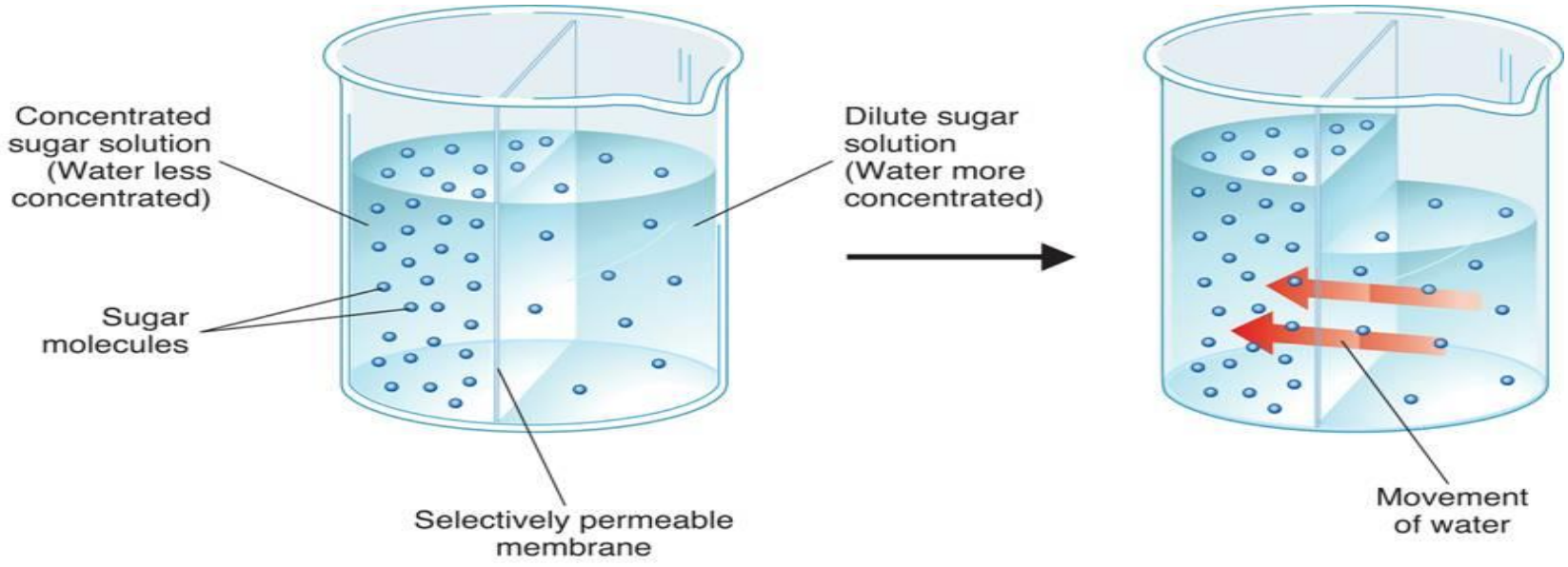
• Many cells also **release large amounts of material** from the cell in a process called exocytosis.

• During **exocytosis**, the membrane of the food or water vacuole (blob) binds with the cell's membrane and then **forces the waste contents out** of the cell.



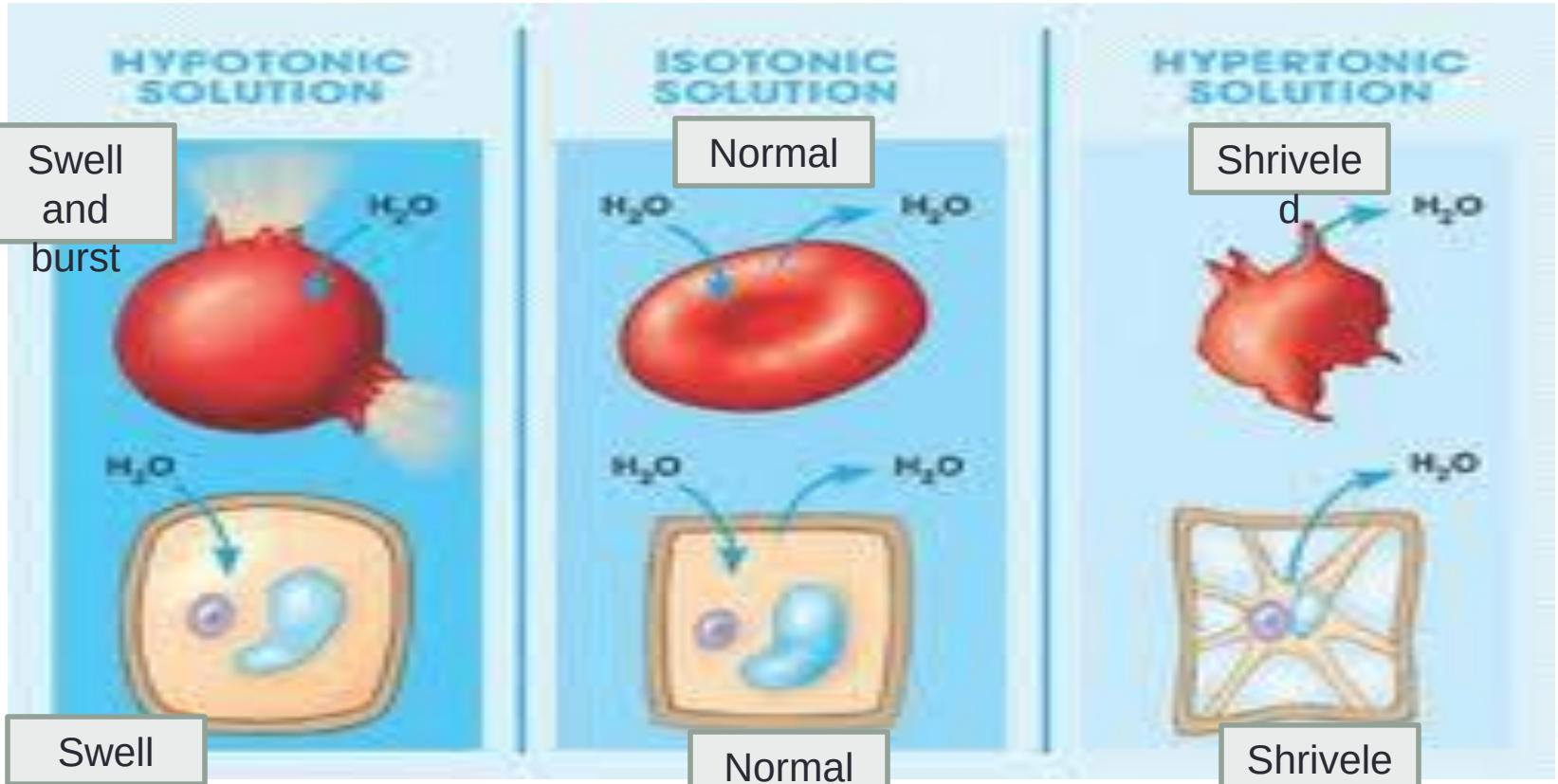
Osmosis

- Many biological membranes are ***selectively permeable***, which means that some substances can pass through them while others cannot.
- Some solute molecules are too large or otherwise unable to pass through cell membranes. However, water can pass through very well.
- The diffusion of water through selectively permeable membranes is called ***osmosis***.



The Effects of Osmosis on Cells

Hypotonic solution: The solution has a lower solute concentration than the cell.	**Isotonic solution:** The concentration of solutes is the same inside and outside the cell.	**Hypertonic solution:** The solution has a higher solute concentration than the cell.



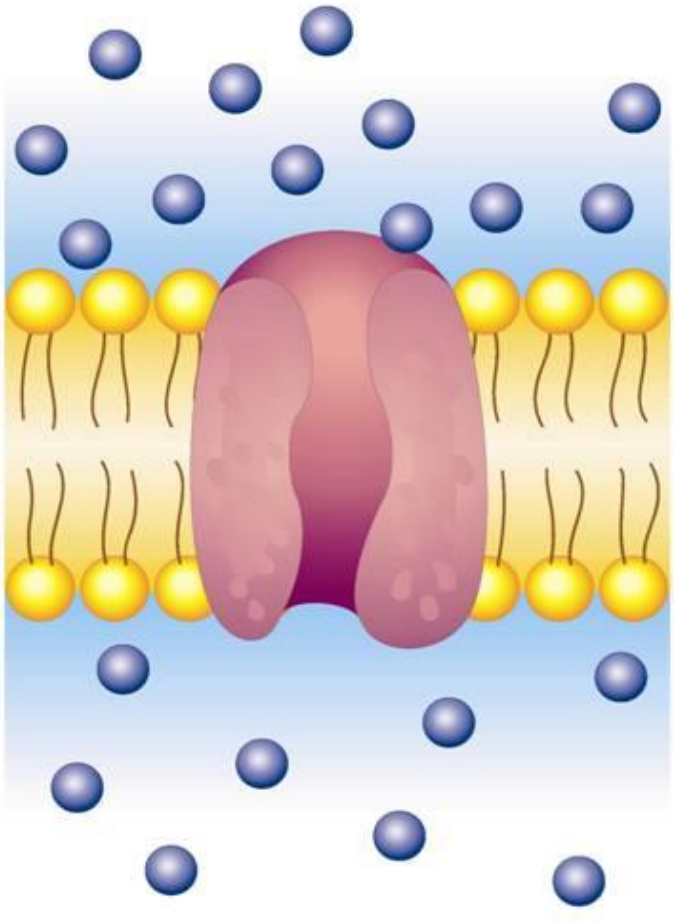
Facilitated Diffusion

- Some larger molecules cannot pass through the cell membrane's lipid bilayer. Instead, they pass through protein channels in the membrane.
- This process is called ***facilitated diffusion*** because the protein channels

  help molecules diffuse across the

  cell membrane.
- Since this process is still

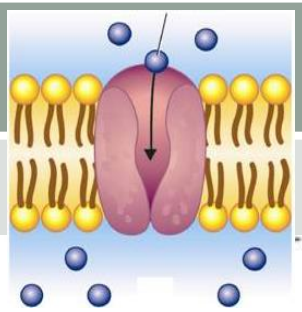
  diffusion, no energy is required!

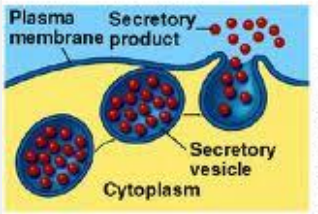


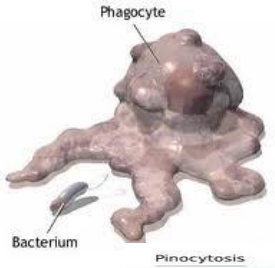
Active Transport

Cells sometimes need to move materials in the opposite direction that would occur during diffusion (from low to high concentration) – this process requires energy and is called ***active transport***.

Type of Active Transport	Description or examples
Molecular Transport	Small molecules are “carried” across the cell membrane by proteins that act like pumps.
Exocytosis	Cells release large amounts of material from the cell by fusing with the cell membrane and forcing the material out of the cell.
Endocytosis - Cells take materials into the cell by forming pockets in the cell membrane.	Phagocytosis – cytoplasm extensions surround particles and engulf it
	Pinocytosis – Pockets form along the cell membrane, fill with liquid, and pinch off to form vacuoles.







Pinocytosis