

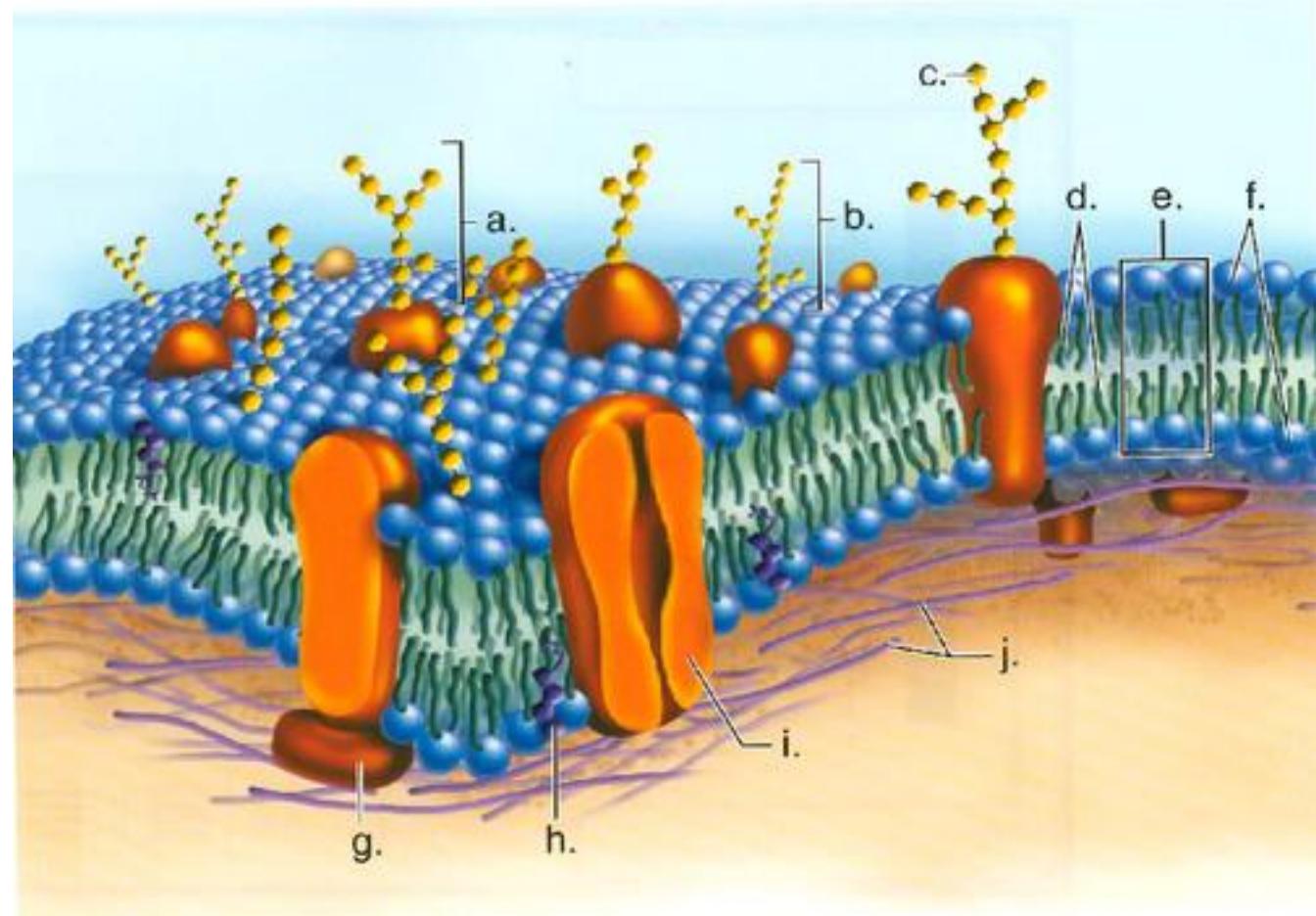
MYP 4

UNIT 3

LESSON 5

**TOPIC: MOVEMENT OF
SUBSTANCES IN AND OUT OF
CELLS.**

**UNIT TITLE: HOW DO ORGANISMS SUSTAIN
THEMSELVES**



Objectives

- Define diffusion, osmosis, and active transport.
- Explain how oxygen, carbon dioxide, glucose, and water move in and out of cells.
- Describe the structure and function of partially permeable membranes.
- Explain the role of the concentration gradient.

Starter Quiz

1. Define diffusion in one sentence.
2. Which substance moves by osmosis?
 - a) Oxygen
 - b) Glucose
 - c) Water
 - d) Carbon dioxide
3. The movement of particles from low concentration to high concentration is called:
 - a) Diffusion
 - b) Osmosis
 - c) Active transport
 - d) Transpiration
4. Which structure controls what enters and leaves the cell?
 - a) Cell wall
 - b) Cytoplasm
 - c) Cell membrane
 - d) Nucleus
5. Oxygen moves from the alveoli into the blood by:
 - a) Active transport
 - b) Osmosis
 - c) Diffusion
 - d) Respiration

Starter Quiz

6. A plant cell placed in a very concentrated salt solution will:
- a) Become turgid
 - b) Burst
 - c) Become plasmolysed
 - d) Divide
7. Which process requires energy (ATP)?
- a) Diffusion
 - b) Osmosis
 - c) Active transport
 - d) Translocation
8. The movement of water through a partially permeable membrane is called _____.
9. Explain why root hair cells have many mitochondria.
(1–2 sentences)
10. State one difference between diffusion and active transport.

Starter Quiz Answers.

1. Define diffusion in one sentence.

Diffusion is the movement of particles from an area of high concentration to an area of low concentration.

2. Which substance moves by osmosis?

c) Water

3. The movement of particles from low concentration to high concentration is called:

c) Active transport

4. Which structure controls what enters and leaves the cell?

c) Cell membrane

5. Oxygen moves from the alveoli into the blood by:

c) Diffusion

6. A plant cell placed in a very concentrated salt solution will:

c) Become plasmolysed

7. Which process requires energy (ATP)?

c) Active transport

8. The movement of water through a partially permeable

membrane is called:

Osmosis

9. Explain why root hair cells have many mitochondria.

They need a lot of energy (ATP) for active transport of mineral ions from the soil into the cell.

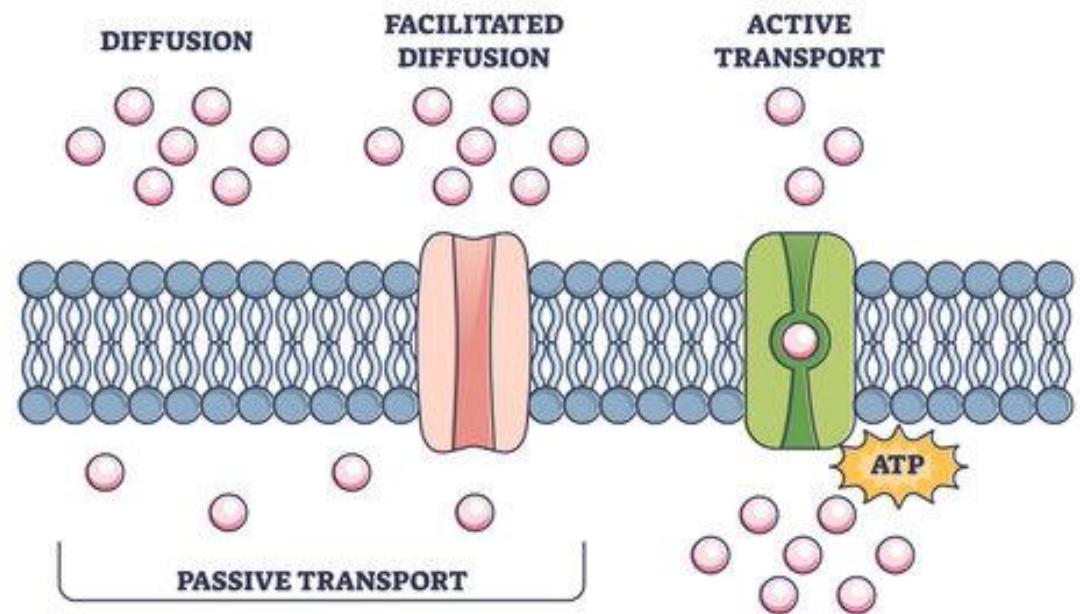
10. State one difference between diffusion and active transport.

Diffusion moves particles down a concentration gradient without energy, while active transport moves particles against the gradient using energy (ATP).

Movement of substances in and out of cells.

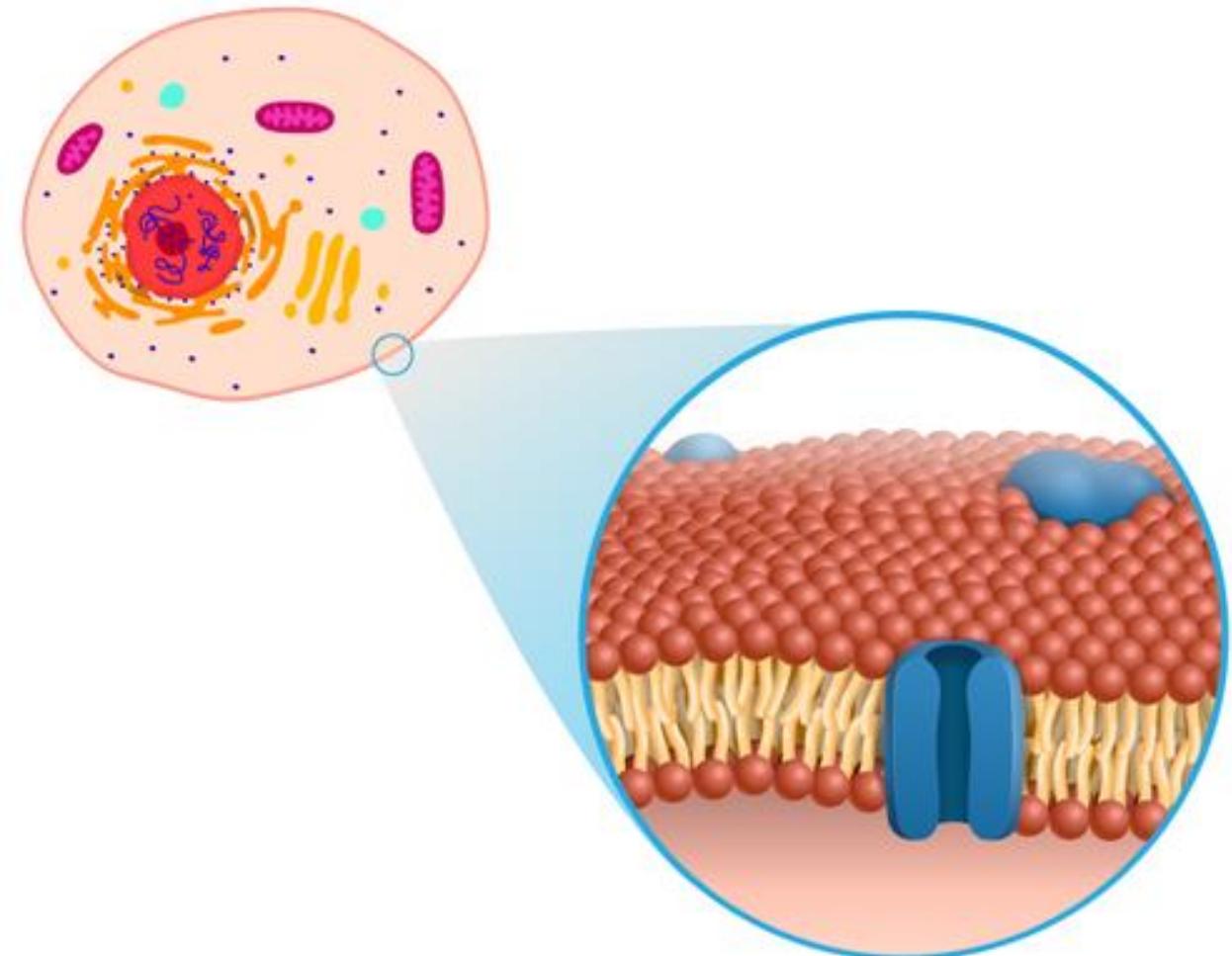
- Cells need oxygen, water, mineral ions, nutrients, and must remove wastes.
- Substances move across the cell membrane by:
 - Diffusion (passive)
 - Active transport (requires energy)

ACTIVE AND PASSIVE TRANSPORT



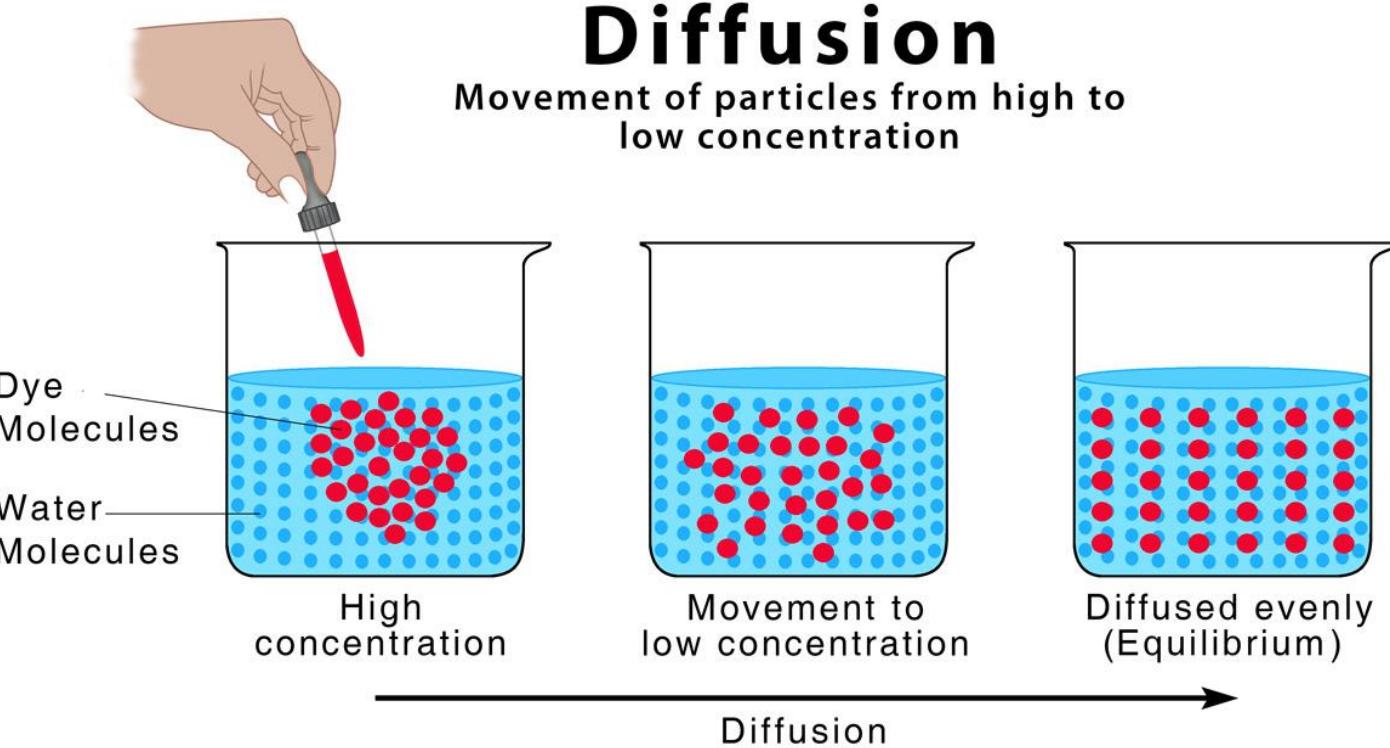
Why Transport is Important

- Cells need oxygen and glucose for respiration.
- Cells must remove waste such as carbon dioxide.
- Plants need water and mineral ions.
- Without transport, cells would die.



What is Diffusion?

- *Diffusion is the net movement of particles from a region of higher concentration to a region of lower concentration, down a concentration gradient, driven by random motion.*



Diffusion

- Passive process (no energy needed).
- Happens due to the random motion of particles.
- Faster when:
 - The difference in concentration is large
 - The temperature is high
 - Surface area is large
 - The distance is small

- Examples:

- Oxygen moving from alveoli into blood.
- Carbon dioxide moves from the blood into the alveoli.
- Glucose moving into intestinal cells.

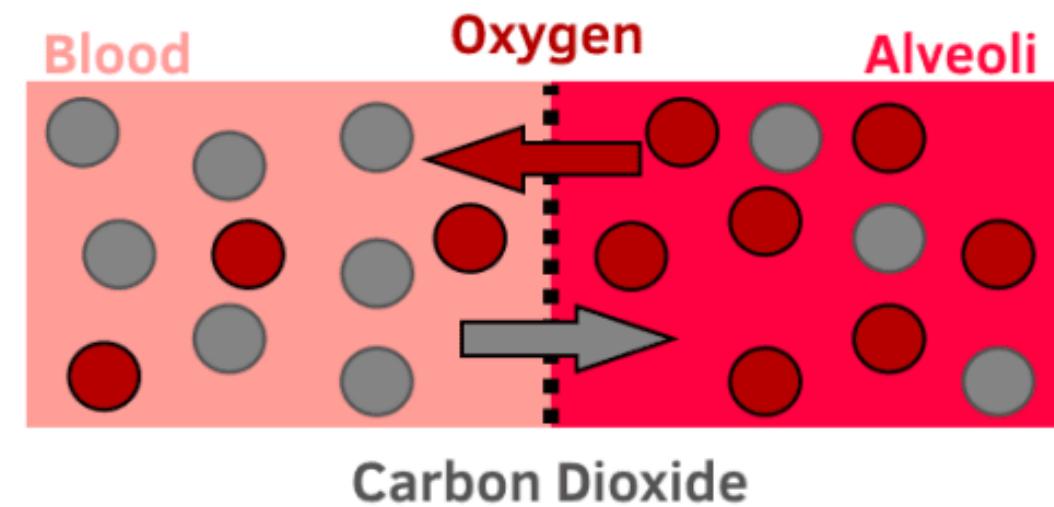
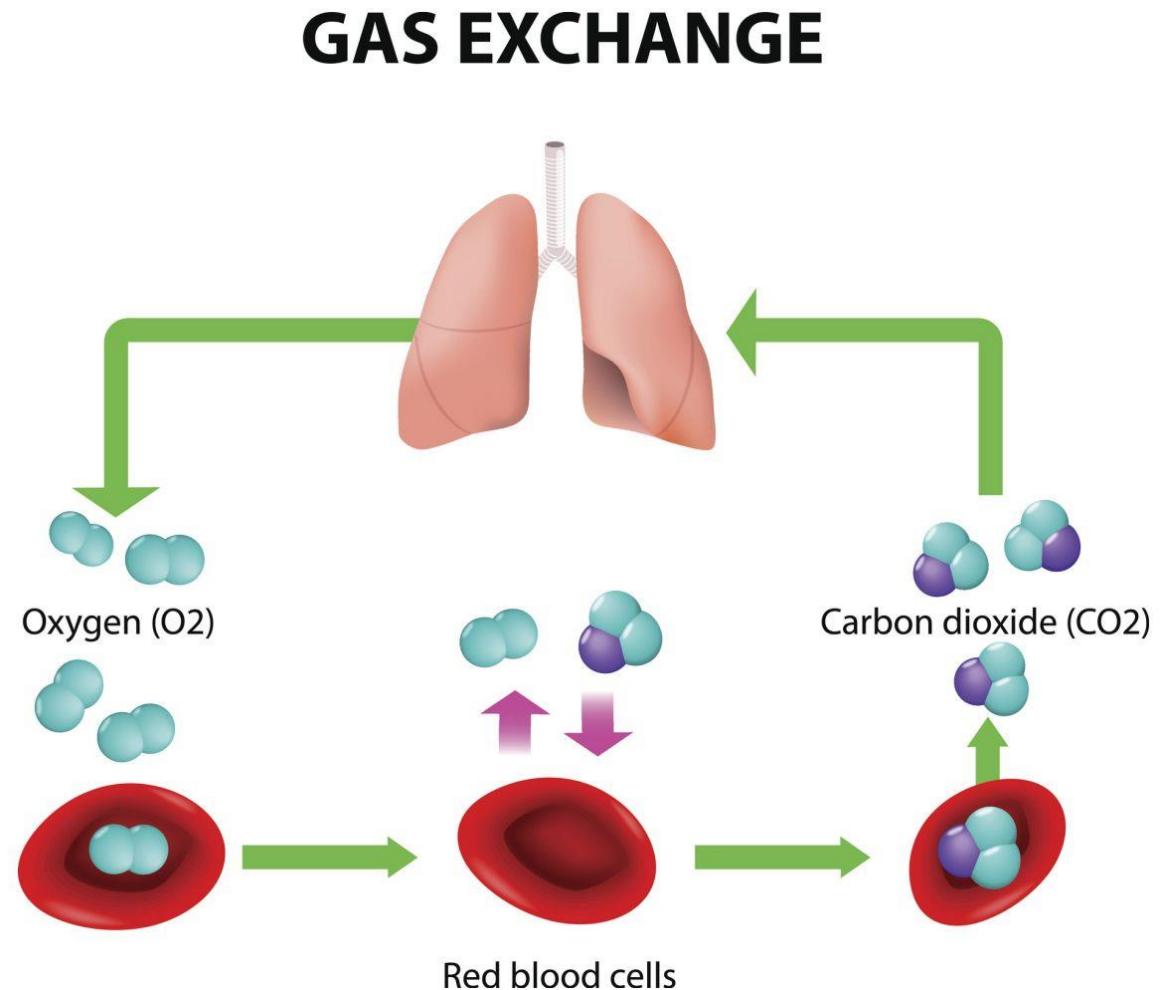


Fig 2. Diffusion in the Blood.

How Diffusion Occurs

https://youtu.be/c_IYK8sy0QA?si=tTkpm_VCqf1zin7o

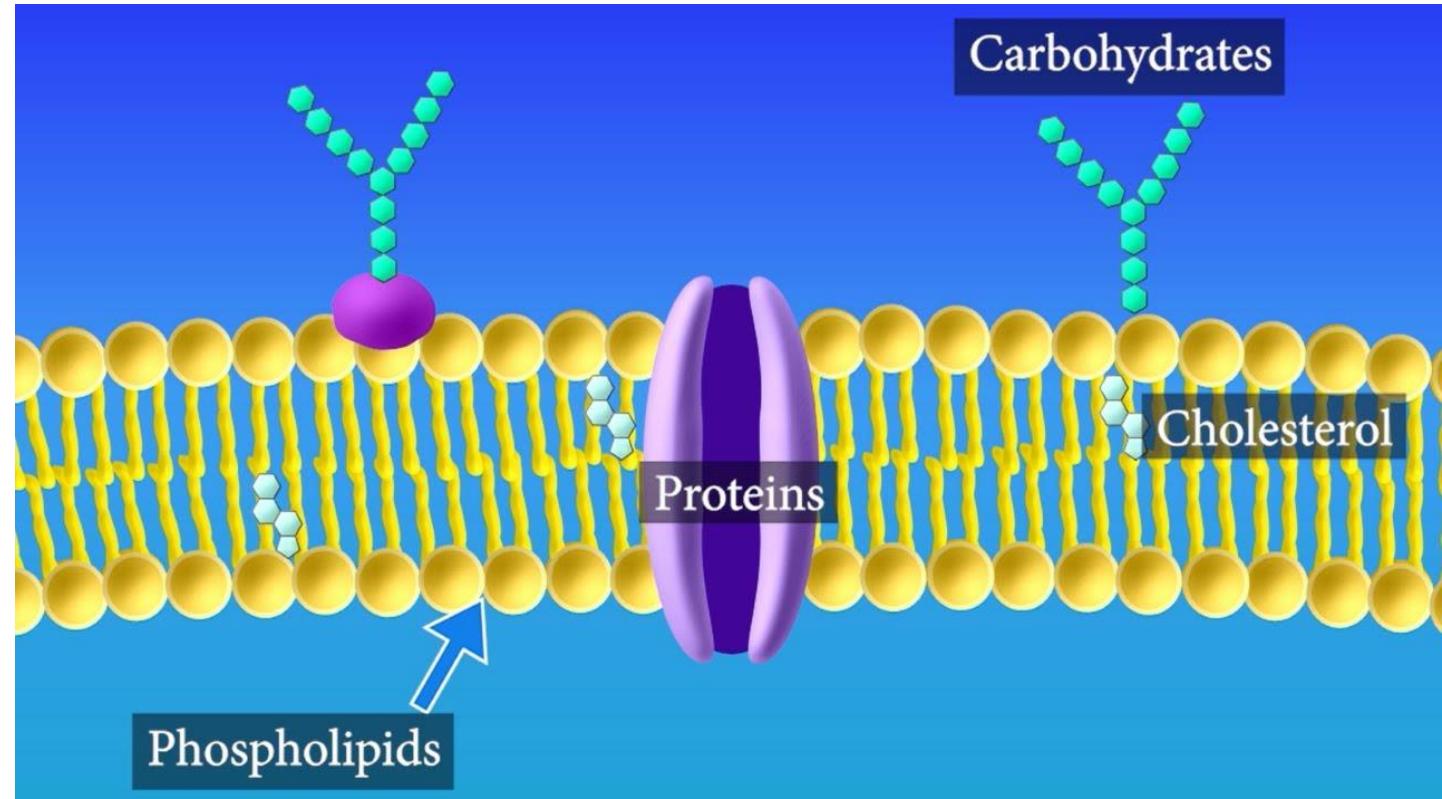
- Particles of gases and liquids move continuously.
- They spread out evenly until they are equally distributed.
- Movement continues until concentrations are the same.



Structure of Cell Membrane

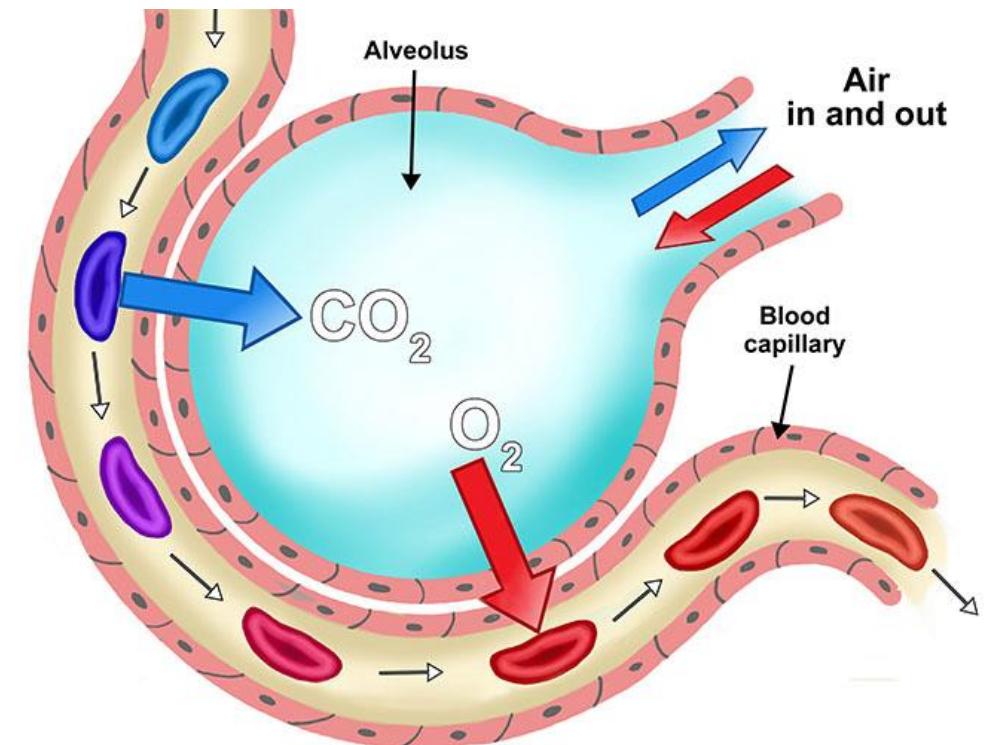
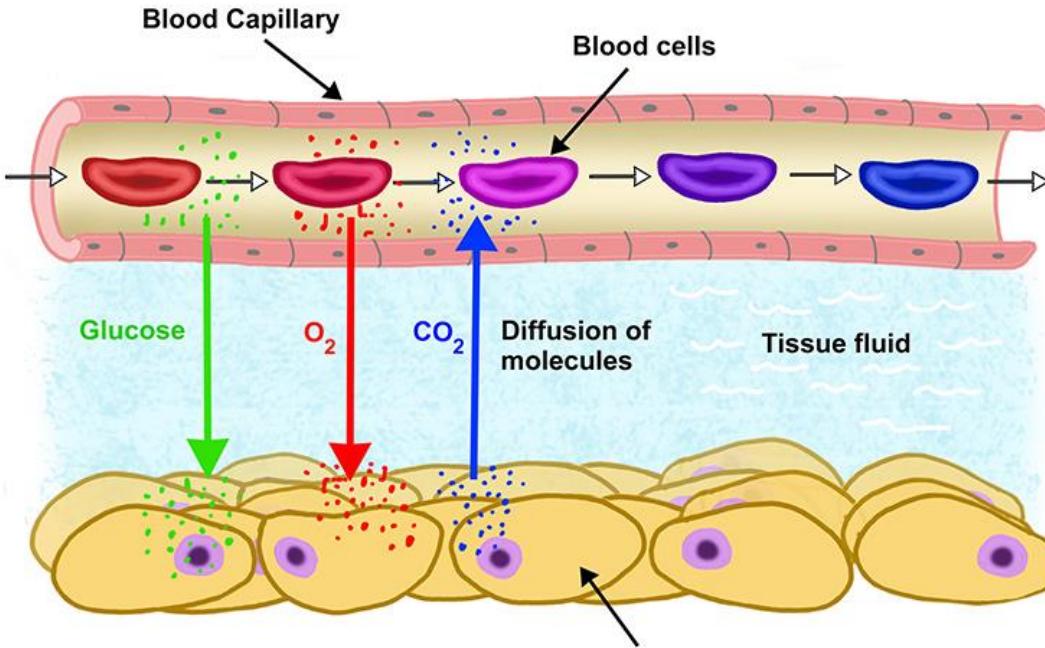
<https://youtu.be/fJfTDc3WzQ8?si=Dlxz06oKmWPmeNkF>

- Partially permeable.
- Made of a phospholipid bilayer and proteins.
- Allows small molecules (O_2 , CO_2 , H_2O) to pass.
- Controls what enters and leaves the cell.



Diffusion in Respiration

- Oxygen is used in aerobic respiration → concentration inside the cell decreases.
- Carbon dioxide is produced → concentration inside the cell increases.
- Carbon dioxide diffuses out of the cell.
- Oxygen diffuses into the cell.



Importance of Diffusion

Allows cells to:

- Take in oxygen for respiration.
- Remove carbon dioxide (waste gas).
- Maintain normal chemical reactions.

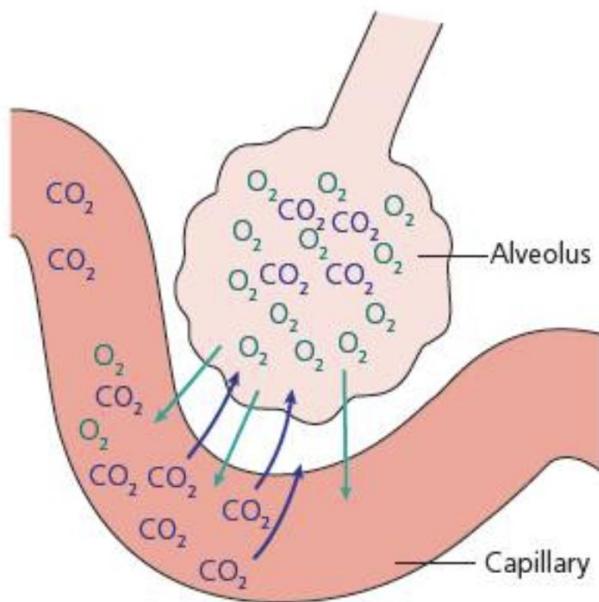
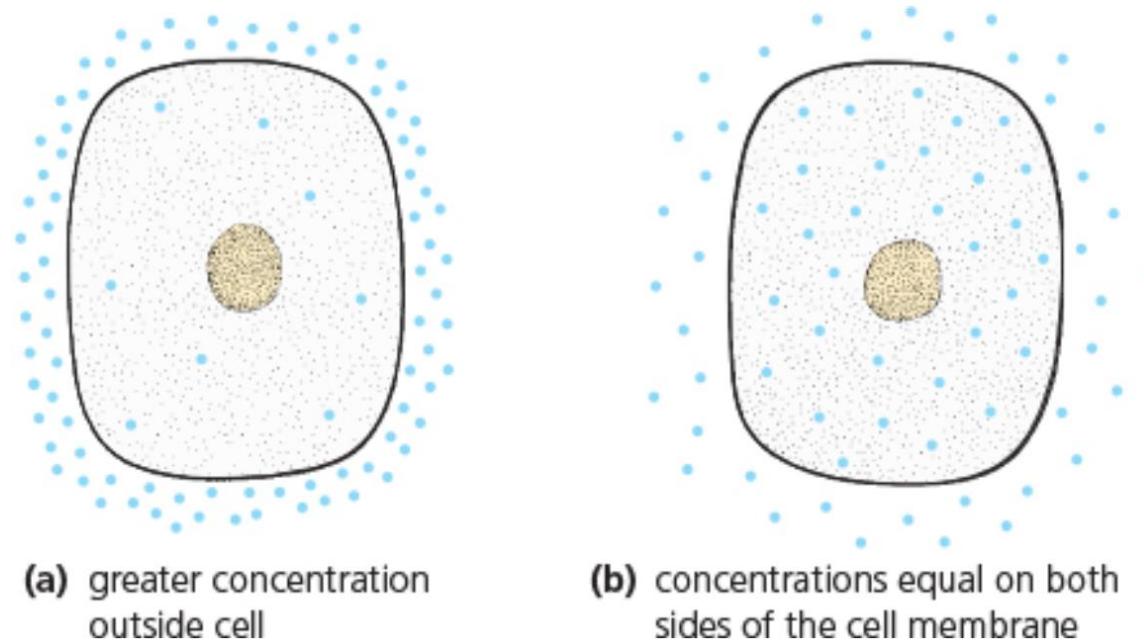


Figure 3.28
Movement of
carbon dioxide
from blood,
and oxygen
into blood at
alveolus



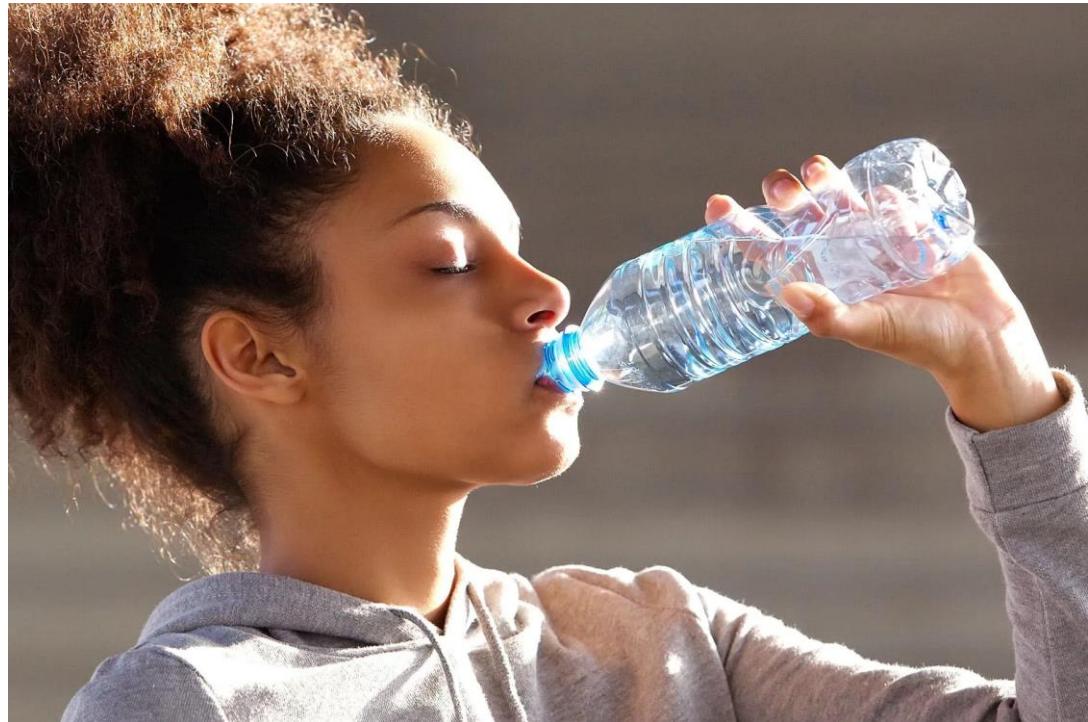
(a) greater concentration outside cell

(b) concentrations equal on both sides of the cell membrane

3.2 Molecules entering a cell by diffusion

Roles of Water in Living Organisms

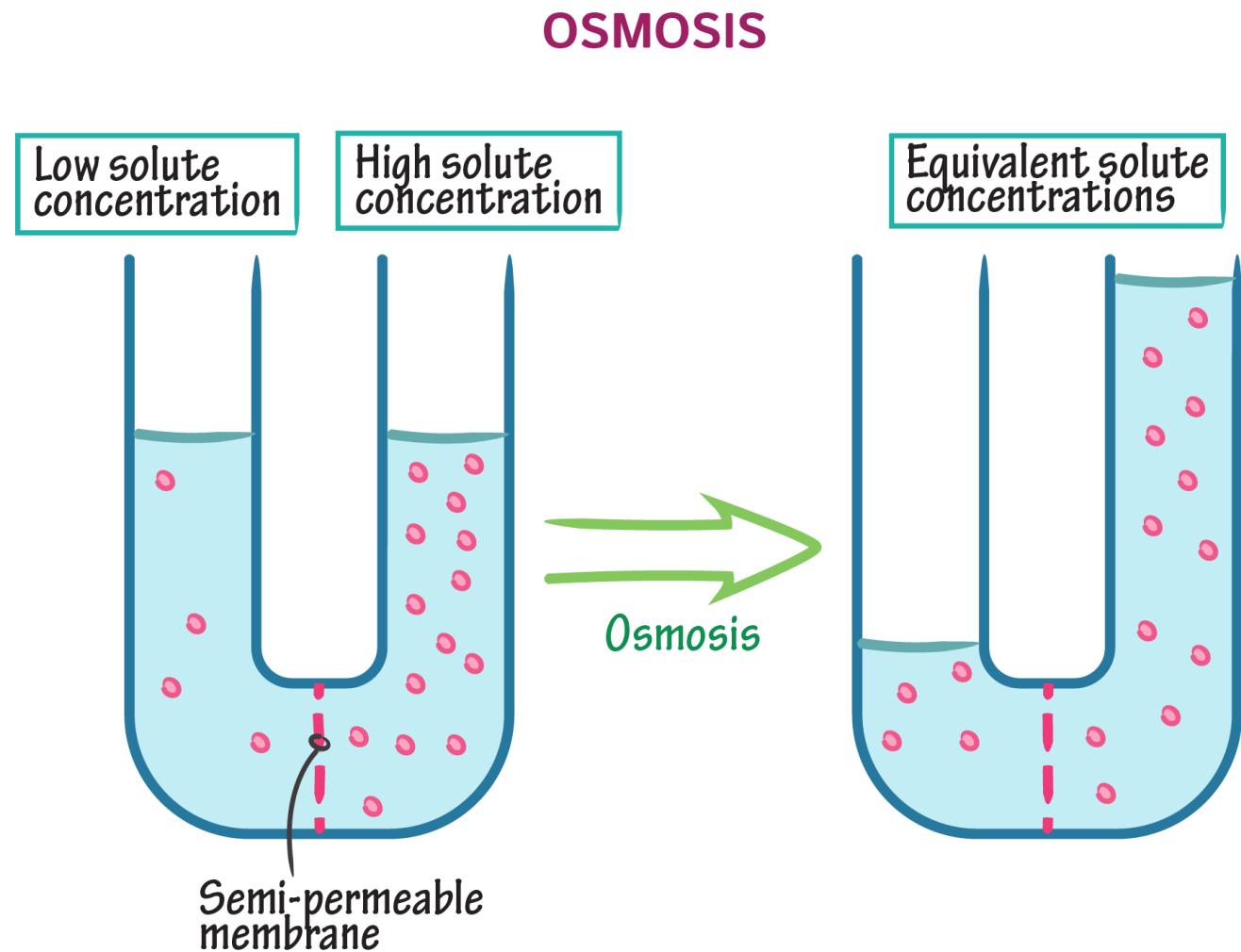
- Makes up about 75% of most cells
- Acts as a solvent for dissolved substances
- Medium for chemical reactions
- Transports materials in blood (plasma is 92% water)
- Transports minerals and sugars in plants (xylem and phloem)
- Helps in excretion (e.g., urea, salts, hormones)
- Regulates temperature (high heat capacity)



Osmosis

Definition:

Osmosis is the diffusion of water molecules through a partially permeable membrane from a high water concentration (dilute solution) to a low water concentration (concentrated solution).



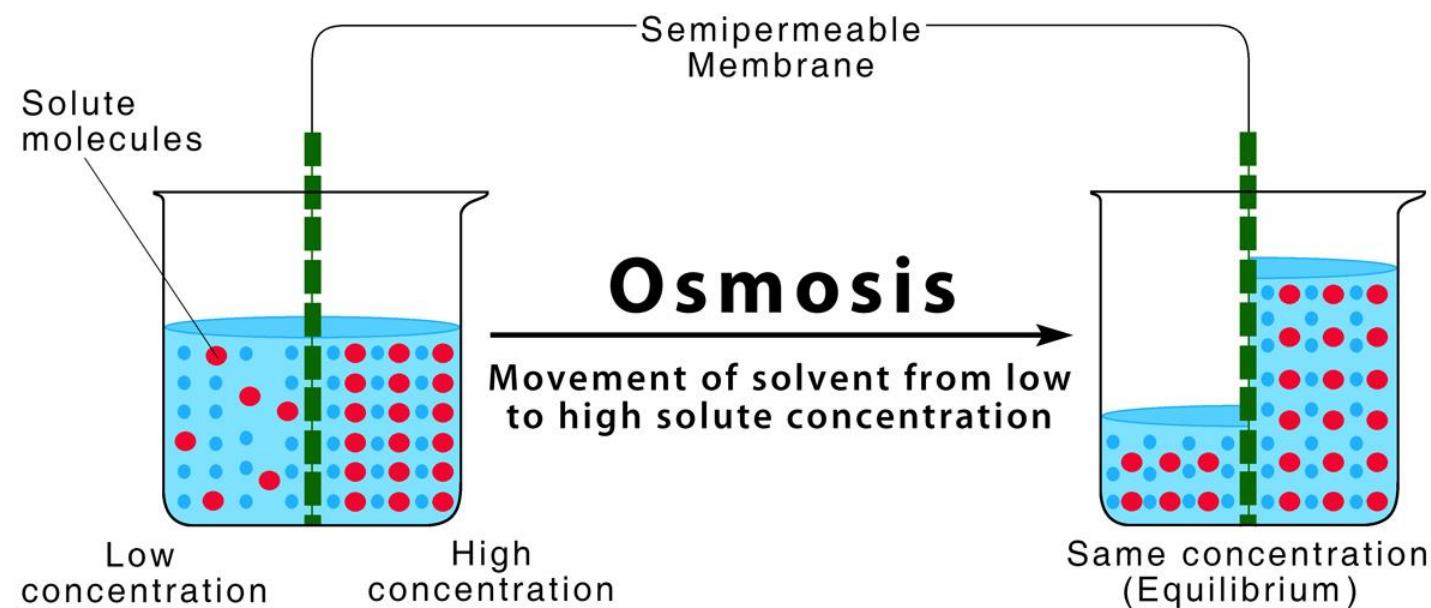
How Osmosis Works

- Dissolved substances reduce free water molecules

- More free water on the dilute side

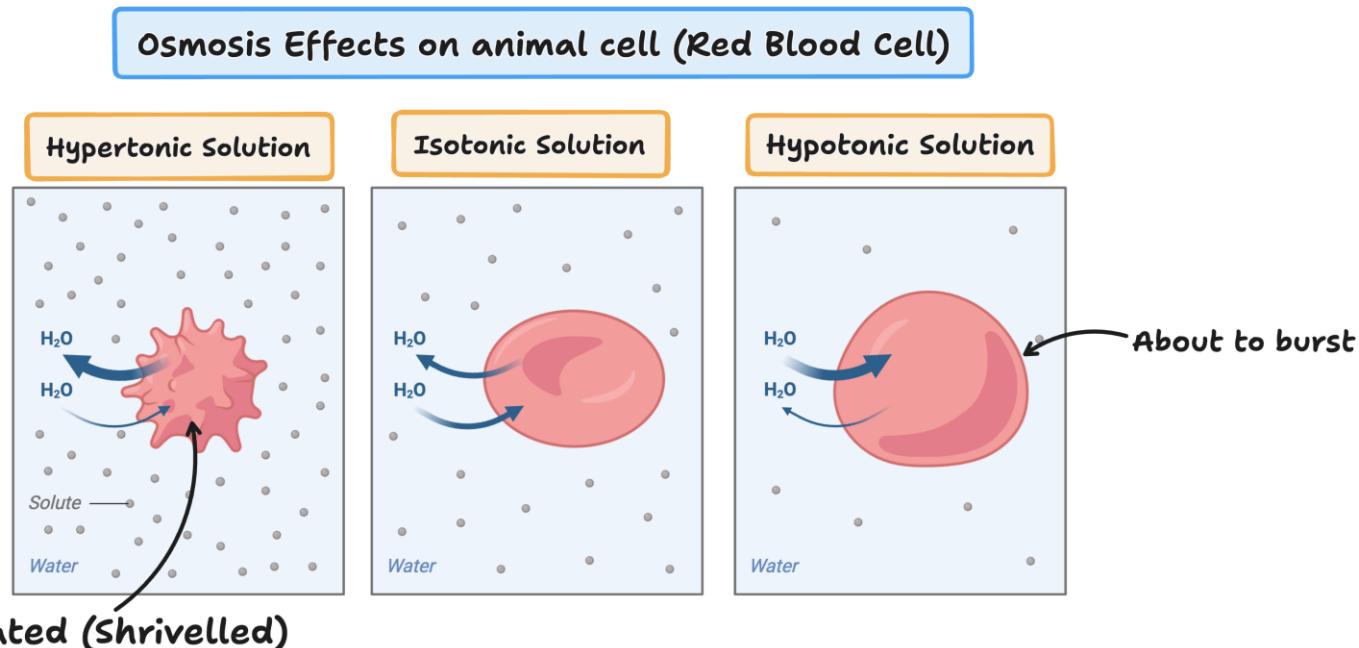
- Water diffuses faster from the dilute to the concentrated side

- The cell membrane acts as a partially permeable membrane



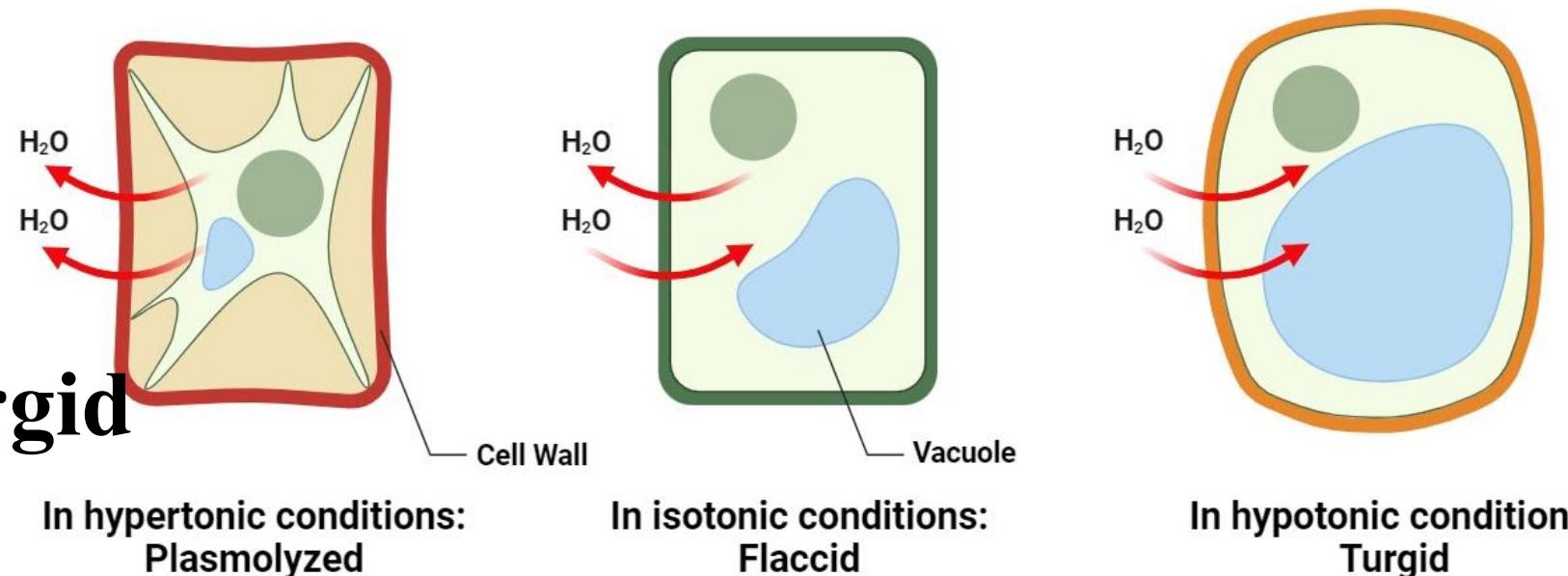
Osmosis in Animal Cells

- In pure water, cells gain water, swell, and may burst
- In a concentrated solution, cells lose water and shrink
- Tissue fluid must have the same water potential as cells
- Kidneys and the brain regulate water balance



Osmosis in Plant Cells

- Water enters the vacuole by osmosis
- The vacuole pushes against the cell wall
- The cell becomes **turgid**
- Provides support to stems and leaves



Turgor and Wilting

- Turgor pressure: outward force on the cell wall
- Turgid cells keep the plant upright
- Loss of water → flaccid cells
- Many flaccid cells → plant wilts



(a) plant wilting



(b) plant recovered after watering

Comparing Plant and Animal Cells in Osmosis

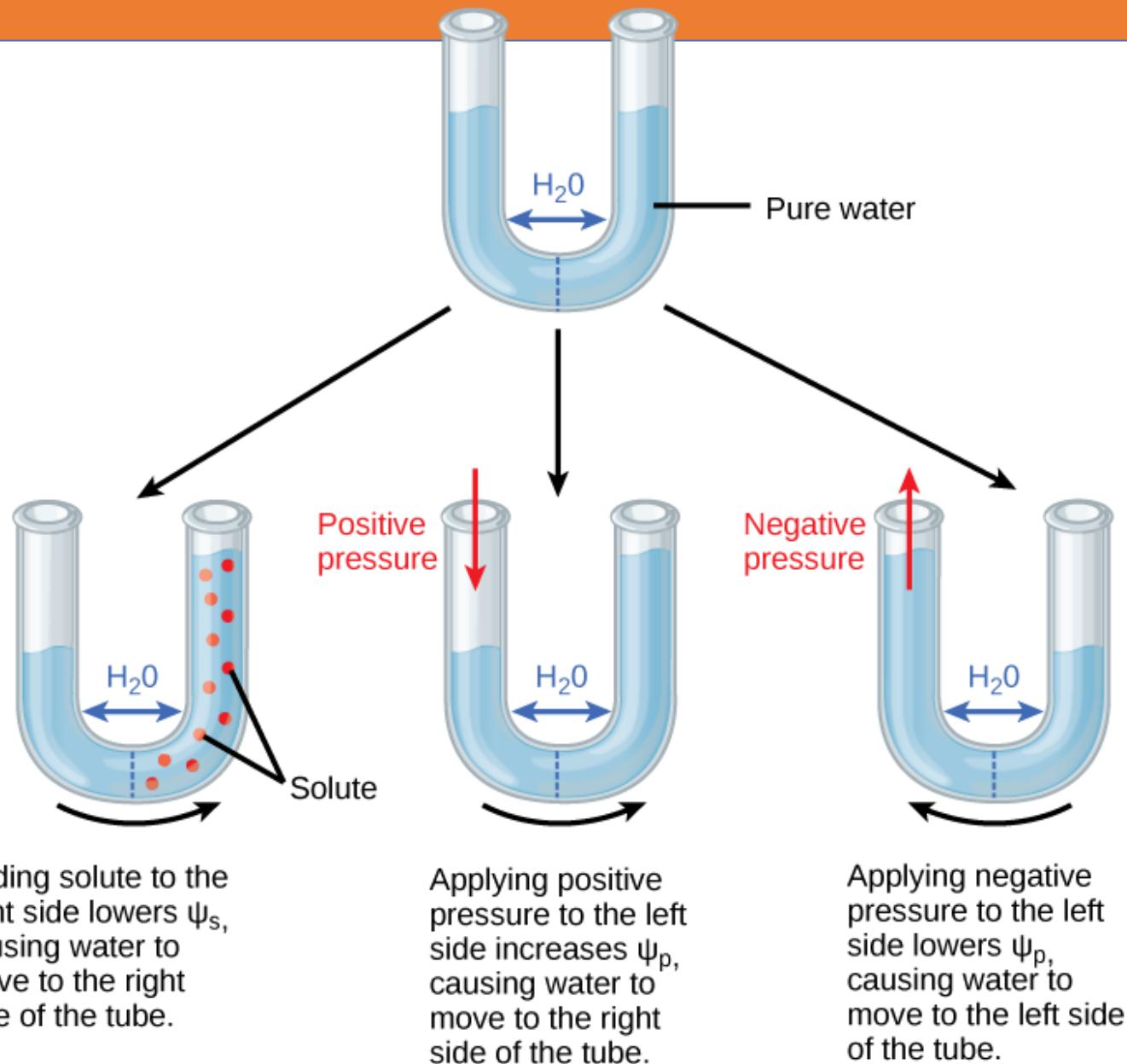
Feature	Plant Cells	Animal Cells
Rigid Cell Wall	Present; prevents bursting.	Absent; cells may burst.
Response to Hypotonic	Becomes turgid (healthy state).	Swells and may burst (lysis).
Response to Hypertonic	Becomes flaccid or plasmolysed.	Shrinks (crenation).
Role of Osmosis	Supports structure and water transport.	Balances hydration and fluids.

Key Terms

- **Turgid:** swollen with water
- **Turgor pressure:** pressure against the cell wall
- **Flaccid:** limp, low pressure
- **Plasmolysis:** loss of water from the cell
- **Water potential:** the tendency of water to move

Water Potential

- Pure water = highest water potential
- Dilute solution = higher water potential
- Concentrated solution = lower water potential
- Water moves down the water potential gradient



Osmosis Experiments (Dialysis Tubing)

<https://youtu.be/QufnJ4VisWg>

- Sugar solution in tubing
- Water in a beaker
- The level rises in the capillary tube
- Shows water enters by osmosis

Partial Permeability Experiment

- Iodine moves into the tubing
- Starch cannot move out
- Shows the membrane is partially permeable

Potato Osmosis Experiment

- In water: potato gains mass, becomes firm
- In a sugar solution: potato loses mass and becomes flaccid
- Shows water movement by osmosis

Effect of Concentration

- Low concentration: water enters cells
- High concentration: water leaves cells
- Isotonic point: no net movement

Important of osmosis

Importance in Plants

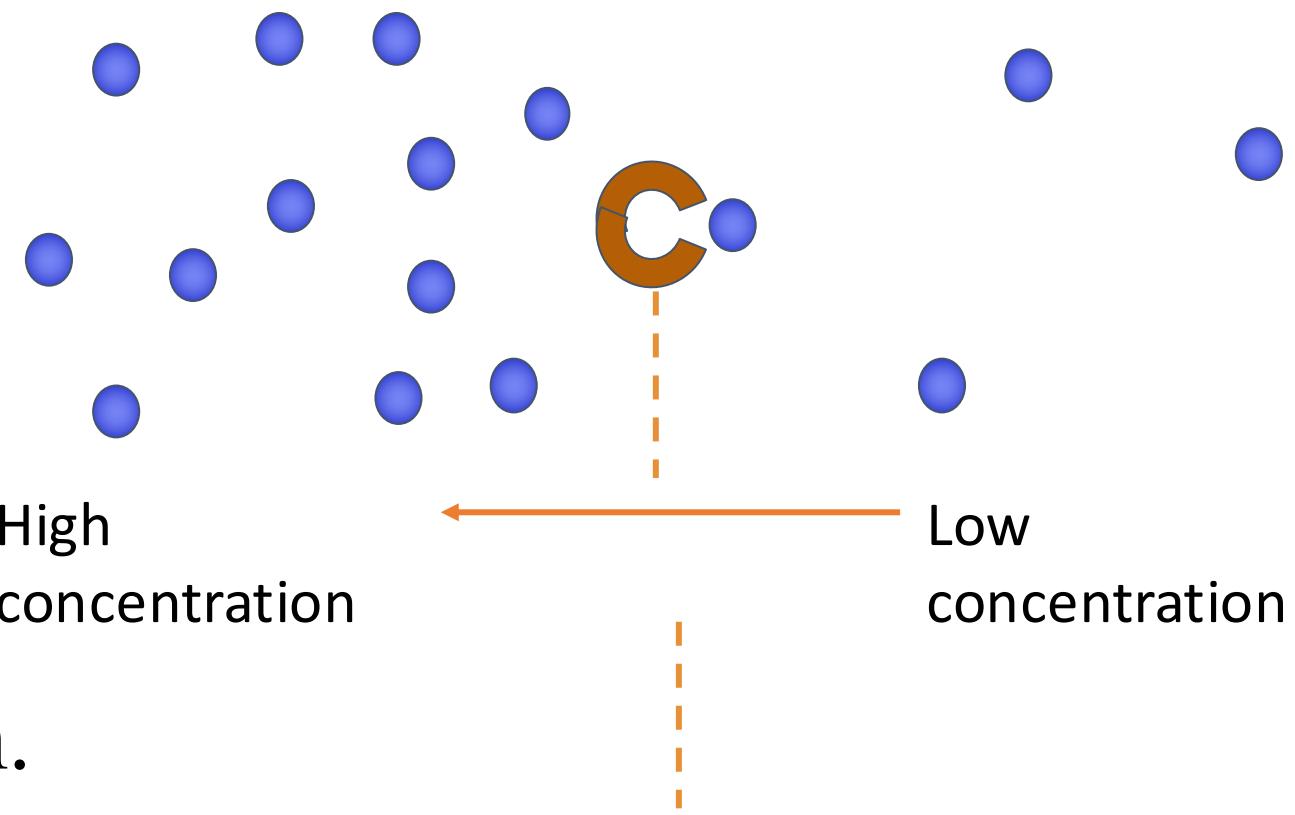
- Root hair cells absorb water by osmosis
- Excess fertilizer lowers soil water potential
- Water leaves roots → wilting
- Irrigation salts can cause plasmolysis

Importance in Animals

- Red blood cells need an equal water potential
- Pure water causes cells to burst
- Saline is used in surgery
- Dehydration causes cells to shrink

Active Transport

Active transport is the movement of substances from **low concentration to high concentration** against a concentration gradient using energy (ATP) from respiration.



Active Transport

Examples:

- Glucose absorption in small intestine.
- Mineral ion uptake by root hair cells.
- **Sodium ions** can continue to move out of a cell even when their concentration is higher outside.
- **Glucose** is absorbed into cells of the small intestine against its concentration gradient.
- Active transport uses **protein carrier molecules** in the cell membrane.

Active Transport

Energy and Active Transport

- Active transport **requires energy**.
- Energy comes from **respiration**.
- Anything that interferes with respiration (e.g., lack of **oxygen** or **glucose**) will **stop active transport**.
- Chemical energy from respiration is converted into **kinetic energy** to move substances.

Role of Protein Carriers

- **Protein carrier molecules** are proteins found in the cell membrane.
- They bind to specific substances and **carry them across the membrane**.
- These carriers are essential for active transport to occur.

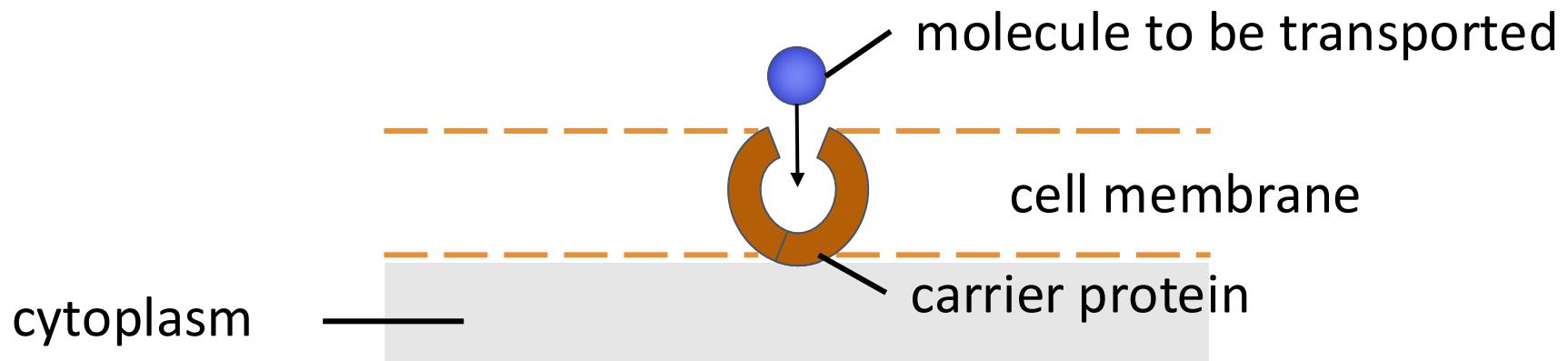
Role of Protein Carriers



Large molecules can be assisted by carrier proteins in the membrane.

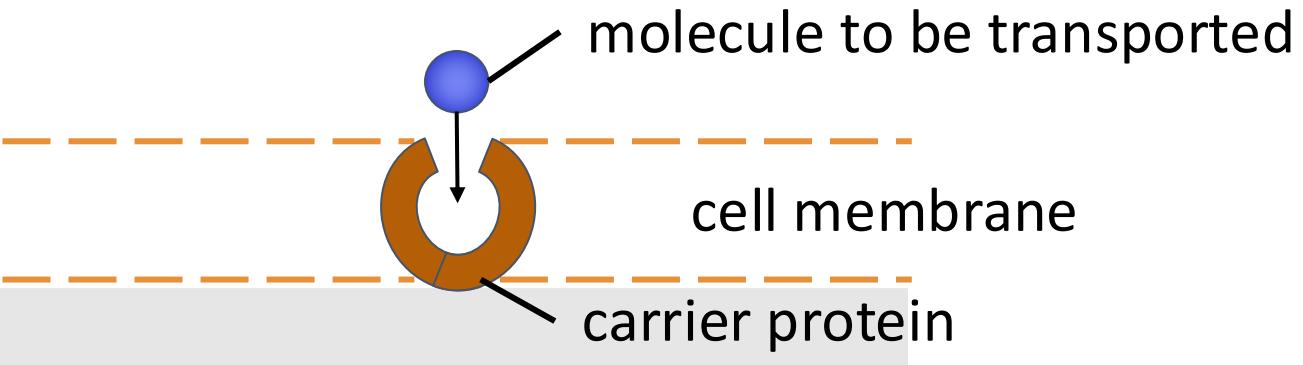
These proteins can change shape to transport the molecule through the membrane.

This requires energy in the form of ATP.

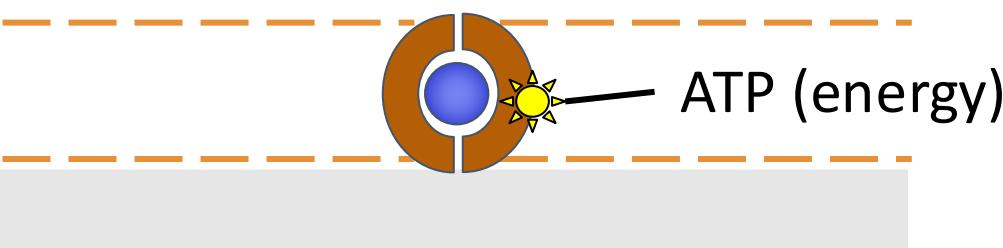


Moving large particles through the membrane

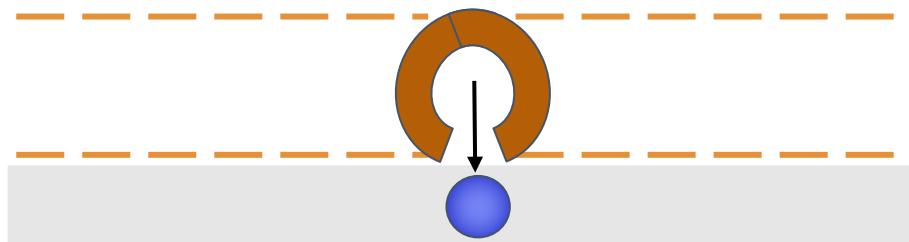
1. The molecule binds to the carrier protein.



2. The carrier protein changes shape.
This requires energy.



3. The molecule is released on the other side.



Active Transport

Active Transport in Humans

- Epithelial cells in the villi of the **small intestine** absorb glucose against a concentration gradient.
- These cells contain **many mitochondria** to provide energy.
- **Kidney tubule cells** also use active transport to **reabsorb glucose** into the bloodstream.

Active Transport in Plants

- Plants absorb **mineral salts** from the soil, where they are in very **dilute solutions**.
- **Root hair cells** use active transport to absorb these minerals against the concentration gradient.
- Energy from respiration is used to move mineral ions into the cells.

Comparison Table

Feature	Diffusion	Osmosis	Active Transport
Energy	No	No	Yes (ATP)
Gradient	Down	Down	Against
Substance	Any	Water only	Ions, glucose
Membrane	Not always	Yes	Yes



Check

Quiz

Complete the sentences below, using some of the key words.

energy

high

shape

low

acid

ATP

protein

carrier

Active transport involves the movement of particles from _____
low once high

This requires __ energy form of _____ ATP.