

EB Education Revision Guide



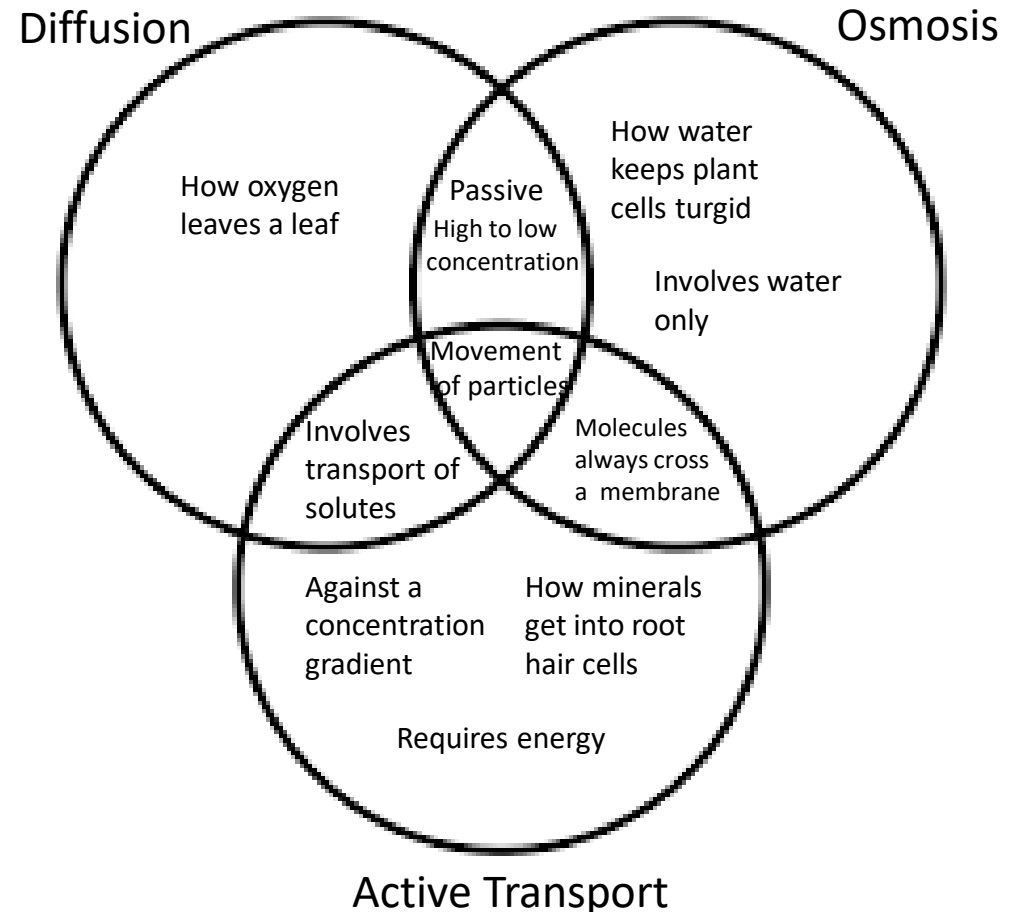
How to work with Diffusion, Osmosis and Active Transport

Movement of substances

Substances need to be able to move in and out of cells across the cell membrane.

There are 3 main types of movement:

- Diffusion
- Osmosis
- Active Transport



Diffusion

What is it?

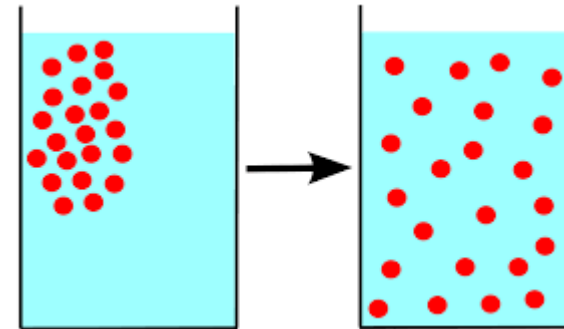
Dissolved or gaseous substances have to pass through the cell membrane to get into or out of a cell.

Diffusion is the **gradual** and **random** movement of particles from places where there are lots of them, to places where there are not as many.

They move from a region where they are in **high concentration** to a region where they are in **low concentration**. Diffusion happens when the particles are free to move. Diffusion cannot happen in solids as the particles are not free to move.

Large molecules, like proteins or starch cannot diffuse through the cell membrane as they are too large. Small molecules like oxygen, carbon dioxide and urea can diffuse through.

Diagram



Examples:

Smelling cooking around the house

Smelling perfume across the room

Diffusion in living organisms

- **Small intestines**

The products of digestion, such as glucose and amino acids, dissolved in water, can pass across the wall of the small intestine by diffusion. Their concentration is higher in the small intestine than their concentration in the blood, so there is a concentration gradient from the intestine to the blood.

- **Lungs**

Oxygen and carbon dioxide, dissolved in water, are exchanged by diffusion in the lungs. Oxygen moves down a concentration gradient from the air in the alveoli to the blood. Carbon dioxide moves down a concentration gradient from the blood to the air in the alveoli.

- **Liver**

Urea will move from areas of high concentration in the liver cells to areas of low concentration in the blood.

- **Leaf**

Carbon dioxide moves into the leaf through stomata, via spongy mesophyll cells and into palisade cells by diffusion for use in photosynthesis. Oxygen, as a product of photosynthesis will move out by diffusing from a high concentration in the palisade cells to a lower concentration outside.

Rate of diffusion

Rates of diffusion can be increased by:

- **Increasing temperature**

Increasing the temperature provides the particles with more kinetic energy. If the particles have more energy, they will move more and diffusion will be faster.

- **Increasing concentration gradient**

The greater the difference in concentration the quicker the rate of diffusion. The alveoli in the lungs, and villi in the small intestines have a good blood supply in order to maintain the concentration gradient.

- **Increasing surface area**

The greater the surface area, the faster the rate of diffusion.

- **Reducing thickness of diffusion pathway**

The thinner the diffusion pathway, the faster the rate of diffusion.

Osmosis

What is it?

Osmosis is the **net movement** of water molecules across a **partially permeable membrane** from a region of high water concentration to a region of lower water concentration.

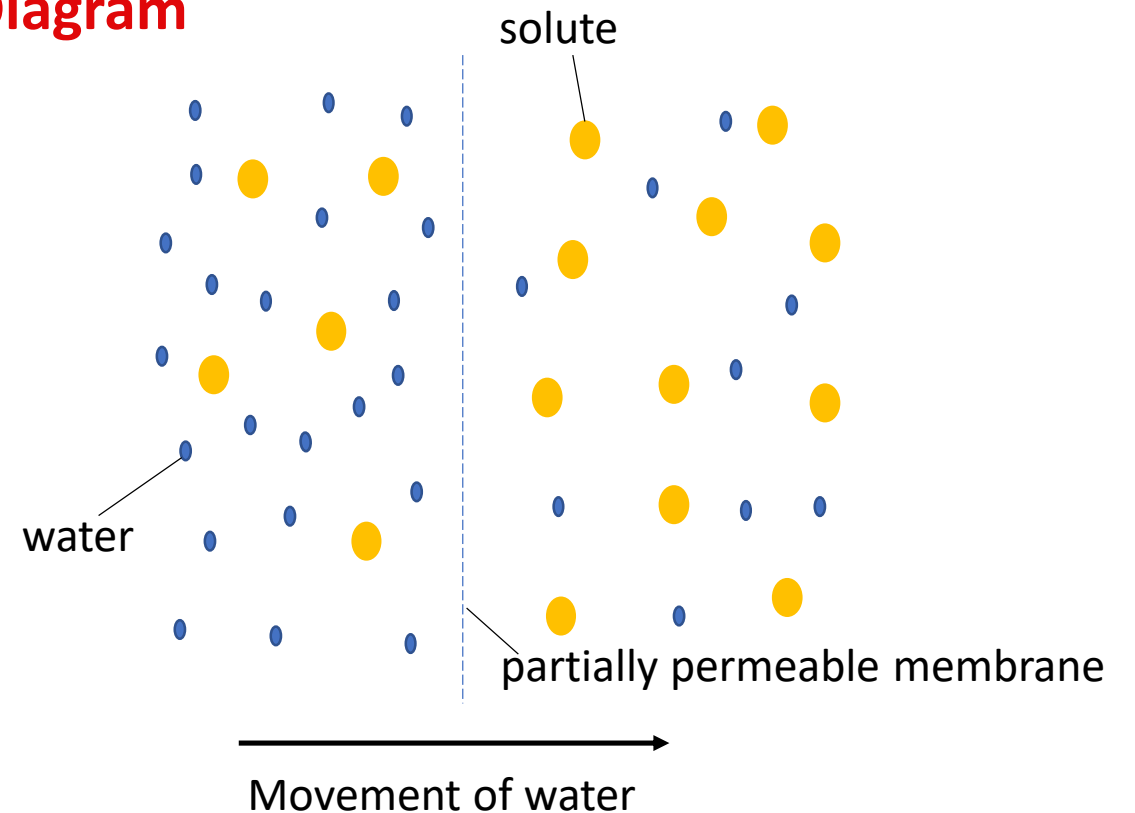
A partially permeable membrane has very small holes in it, which will only let very small molecules, like water, pass through them.

As the particles are always moving randomly, water molecules will move backwards and forwards across the membrane during osmosis.

However, if there are more water molecules on one side than the other, there will be a **NET FLOW** to the side with fewer water molecules (or to the more concentrated solution - the side with more solute molecules).

Water travels into, and through plants, by osmosis.

Diagram



Active Transport

What is it?

Active transport is the movement of particles across a membrane **against a concentration gradient**.

This means that the particles are moving from an area of lower concentration to an area of higher concentration.

Because the particles are moved up a concentration gradient, energy is needed.

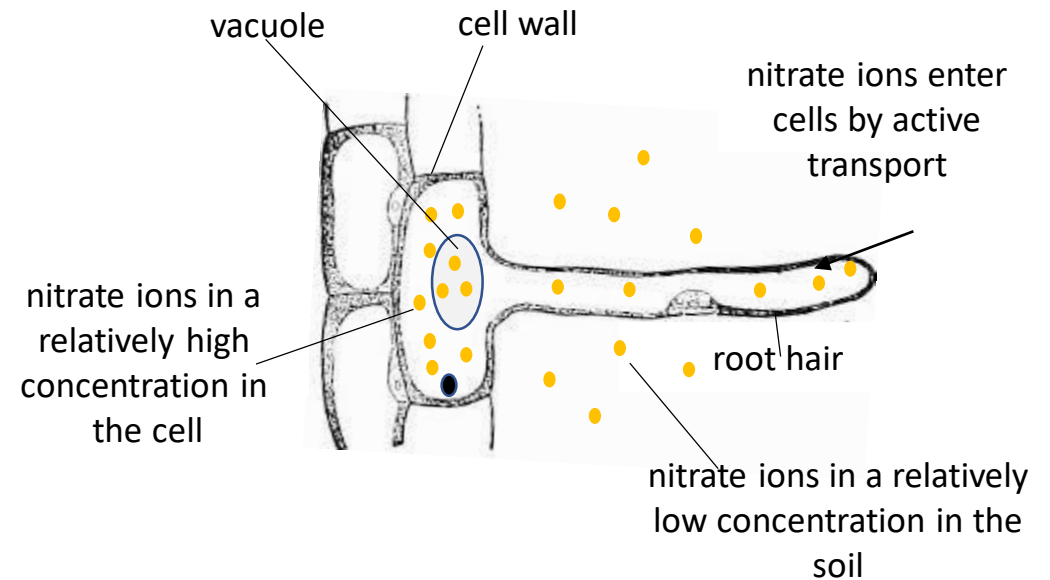
Active transport can happen in:

- **Small intestines**

When there is a lower concentration of nutrients in the intestines, than in the blood, active transport will allow the nutrients to move into the blood.

- **Roots**

When there is a lower concentration of minerals in the soil than in the root hair cells, active transport will allow the minerals to be moved into the plant.



Your turn:

1. Single-celled organisms, such as bacteria, can use osmosis to obtain molecules from their environment.

a) Which of these is a correct description of a process which involves the transport of molecules?

- A) Active transport is used to obtain molecules in a low concentration environment
- B) Diffusion uses energy to transport molecules into cells
- C) Active transport moves substances along the concentration gradient
- D) Diffusion is used to transport molecules against the concentration gradient

b) Explain how water moves from cell to cell in a leaf.

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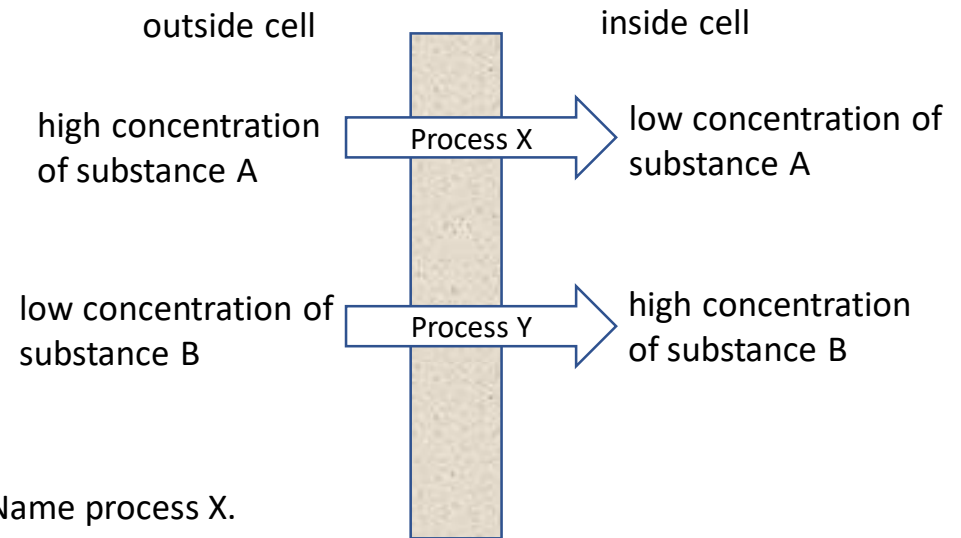
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2. Root hair cells take up substances from the soil.

The diagram below shows the direction of movement of two substances A and B across the cell membrane of a root hair cell.



a) Name process X.

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b) Name process Y.

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Your turn:

3. Explain how active transport and diffusion provide a plant with the substances it needs for growth.

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4. A fresh fruit salad is prepared by cutting up different fruits and placing them in a bowl with layers of sugar in between. After 3 hours the fruit is surrounded by syrup (concentrated sugar solution).
Explain why syrup was produced.

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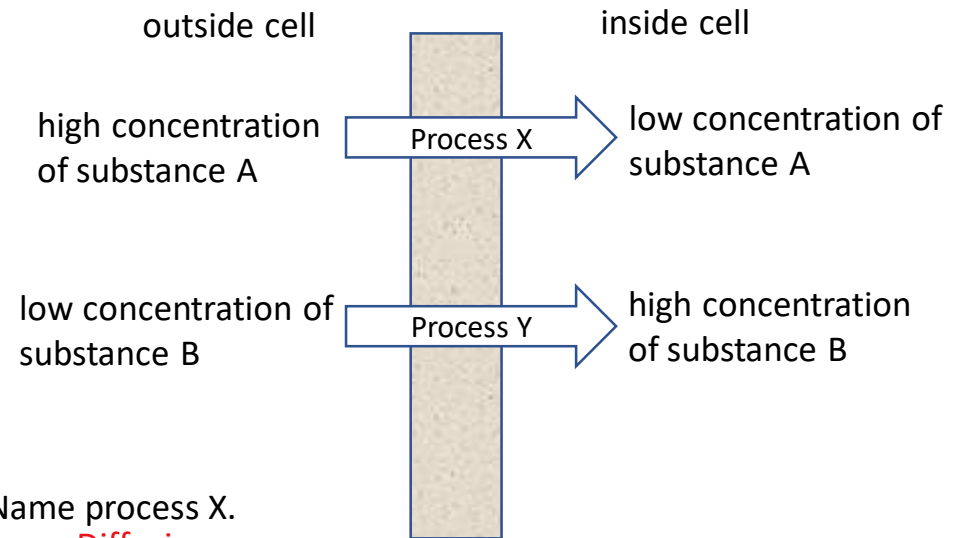
- A) Active transport is used to obtain molecules in a low concentration environment
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b) Explain how water moves from cell to cell in a leaf.

By osmosis, from an area of high water concentration to an area of low water concentration, across a partially-permeable membrane

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The diagram below shows the direction of movement of two substances A and B across the cell membrane of a root hair cell.



a) Name process X.
Diffusion

b) Name process Y.
Active transport

Answers:

3. Explain how active transport and diffusion provide a plant with the substances it needs for growth.

Active transport requires energy, to move mineral ions from the soil into root hair cells from a low concentration in the soil to a high concentration in the cells eg nitrates

Diffusion is a passive process. Gases diffuse from high to low concentrations. Gas exchange in the leaf occurs by diffusion, carbon dioxide diffuses into air spaces in the leaves for photosynthesis. Oxygen diffuses out as a waste product (or can be used by the plant for respiration).

4. A fresh fruit salad is prepared by cutting up different fruits and placing them in a bowl with layers of sugar in between. After 3 hours the fruit is surrounded by syrup (concentrated sugar solution).

Explain why syrup was produced.

Sugar has dissolved in moisture on the surface of the fruit. This solution is more concentrated than the solution inside the fruit.

Osmosis takes place - movement of water out of the fruit through the partially permeable membrane (of fruit cells)

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