Movement in and out cells

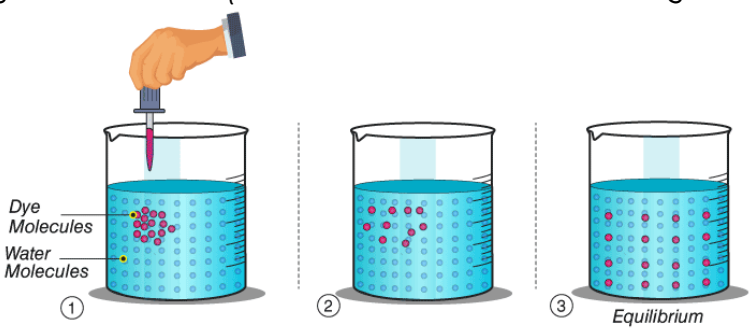
Diffusion

Molecules have kinetic energy so they move randomly and collide with each other. There are more collisions in a region of high concentration than in low concentration,

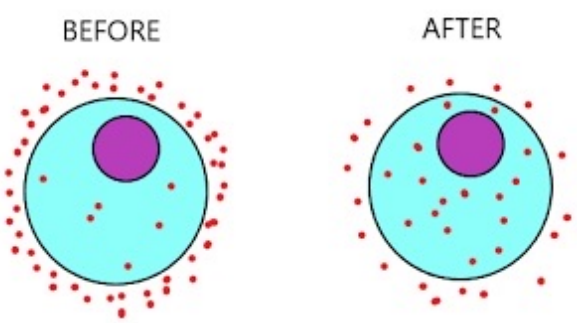
Concentration gradient is the difference in concentration of a particles substance in one region compared to another region.

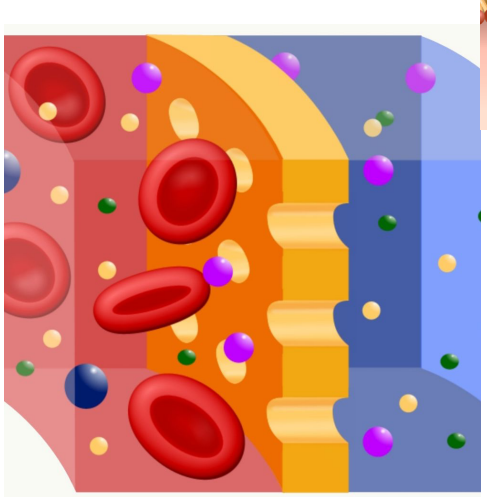
Definition of diffusion

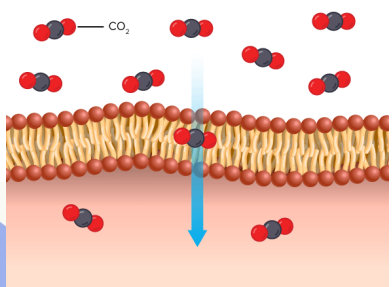
Diffusion is the process by which molecules, atoms and ions spread from a region of higher concentration to a region of lower concentration down a concentration gradient, until the molecules, atoms and ions are evenly distributed. They are said to be equilibrium if the molecules are evenly distributed.



Cells is surrounded by a selectively permeable cell membrane. This means that the composition of the membrane allows some molecules to cross with ease, but others not at all.







Factors that are influence diffusion

- Surface area

The larger surface area the quicker the rate of diffusion will be, because there is more space to diffuse into.

- Temperature

The increased of temperature ,will increase the energy , which will increase the movement. So rate of diffusion will be quicker .

- Concentration gradient

the greater difference in concentration , the quicker rate of diffusion will be.

- Diffusion distance

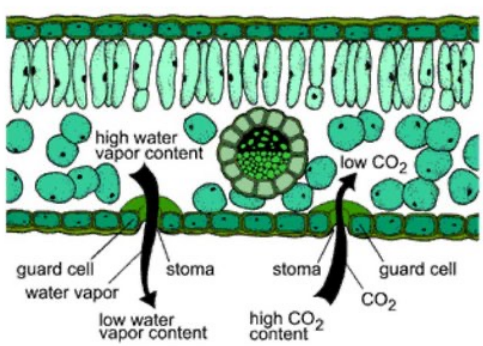
smaller or shorter distance results in faster diffusion and larger distance results in slower diffusion rate.

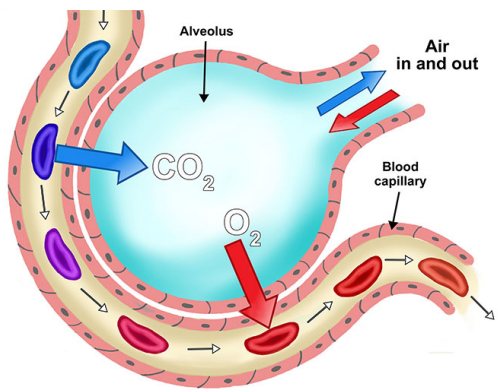
Importance of diffusion

Diffusion helps living organisms to obtain many of their requirements, get rid of many of their watse products and help

Importance of gaseous diffusion

- CO2 used by plants for photosynthesis diffuses from the air into leaves, through the stomata. There is a lower concentration of CO2 inside the leave, as the cells are using it. O2, which is a waste product of photosynthesis , diffuses out of the leaf in the same way



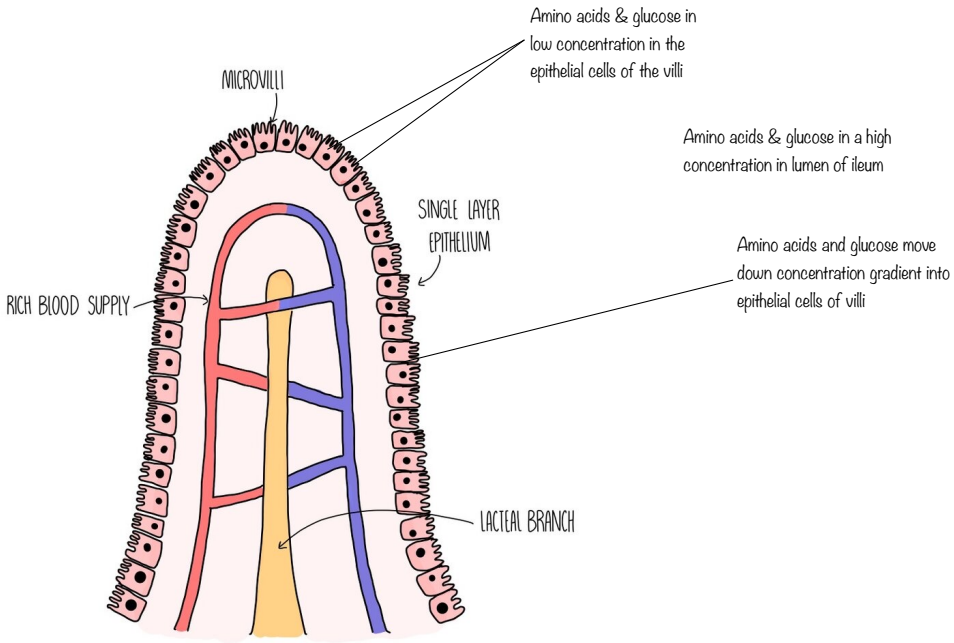


- Flowering plants use diffusion to attract pollinators. They attract by fragrance , which diffuses from high concentration in the petals into air for insects to smell.
- Diffusion occurs in alveolar in the lungs, which separates the carbon dioxide- rich blood from oxygen-rich air.

The capillaries around the alveoli have a high concentration of carbon dioxide and low concentration of oxygen. The alveoli have a high concentration of oxygen and low concentration of carbon dioxide. Oxygen diffuses from high concentration in the alveoli to a Low concentration in the blood. Carbon dioxide diffuses from a high concentration in the blood to a low concentration in the alveoli.

Importance of solute diffusion

Some of the products of digestion are absorbed from ileum of mammals by diffusion. Solutes like glucose and amino acids can diffuse from ileum where there is a high concentration, into the bloodstream where there is a low concentration.



Osmosis

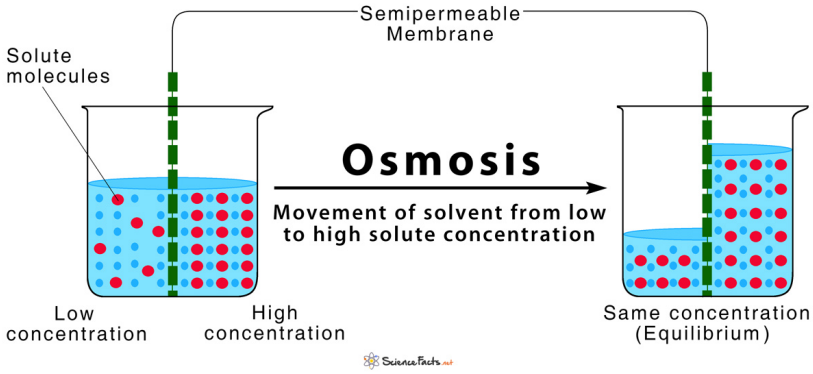
Water potential of a solution

A simple solution is basically two or more substances that are mixed together. One of them is called the solute and the other is the solvent. A solute is the substance to be dissolved (e.g. sugar or salt). The solvent is the one doing the dissolving (water). Ψ

Water potential is the relative tendency of water molecules in a solution to move from one area to another. Water potential is commonly represented by the Greek letter .

If there are many free water molecules in a solution because there are fewer solutes, water molecules can easily move from one area to another. The solution then has a high water potential. The solution is said to be dilute and weak. Such a solution is described as being hypotonic. Distilled water has a high water potential. Water with a high 4 has a high force driving it to move from one area to another.

When a solution has fewer free water molecules because there are more solutes, water molecules cannot easily move from one area to another. The solution then has a low water potential. The solution is said to be concentrated or strong. Such a solution is described as being hypertonic. Sugar water or salt water has a low water potential. Water with a low Ψ has a low force driving it to move from one area to another.



Hypotonic solution

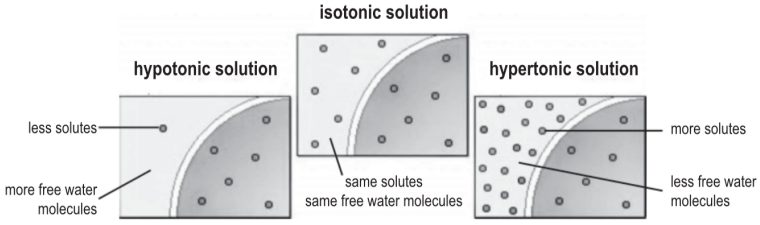
- A hypotonic solution refers to a solution that contains less dissolved substances (solutes) and more water (lots of free water molecules).
- When a solution is hypotonic it has many free water molecules - it has a high water potential. It is a dilute or weak solution. Distilled water is dilute, weak and hypotonic and has a high water potential.
- When a cell is put in a hypotonic solution, the water will move into the cell through osmosis (endosmosis)

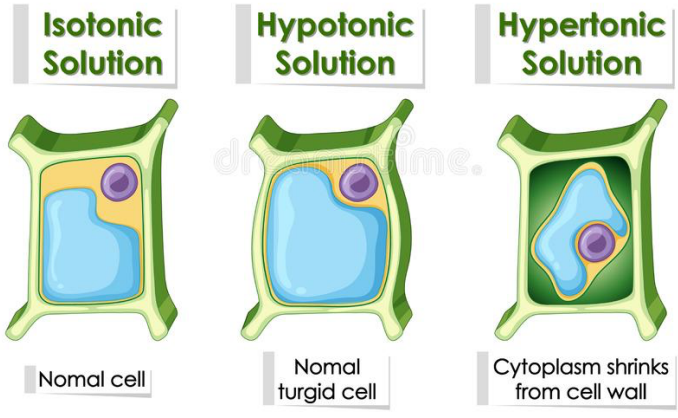
Hypertonic solution

- A hypertonic solution refers to a solution that contains more dissolved substances (solutes) and less water (fewer free water molecules).
- When a solution is hypertonic it has fewer free water molecules - it has a low water potential. It is a concentrated or strong solution. Salt water is concentrated, strong and hypertonic and has a low water potential.
- When a cell is put in a hypertonic solution, the water will move out of the cell through osmosis (exosmosis).

Isotonic solution

Isotonic solutions refer to two solutions having the same water potential. This means that the two solutions have the same amount of water molecules and the same concentration of solutes. It is when a cell has the same concentration of solutes outside as well as inside the cell.

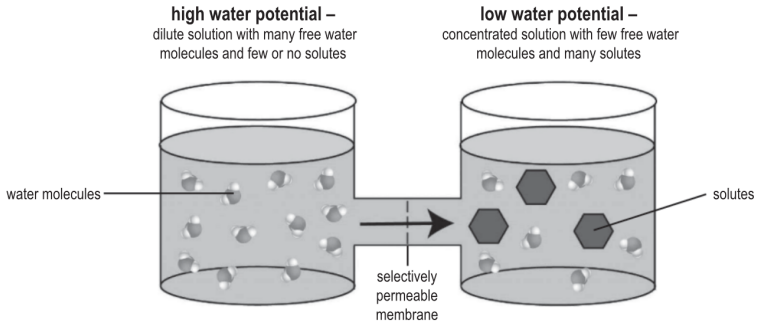




Effects of immersing plant tissues in solutions of different concentrations

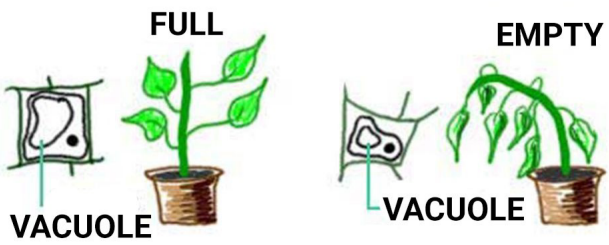
Definition of osmosis

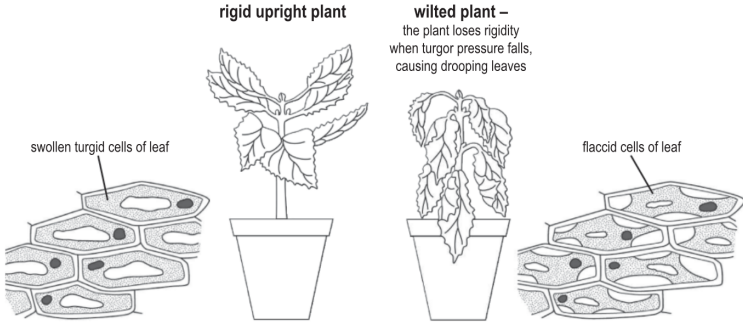
Osmosis is the movement of water molecules from a high water potential to a low water potential through a partially or selectively permeable membrane down a water potential gradient.
Selectively permeable membrane: Some substances move through the cell membrane while other substances cannot pass through. In other words, the cell membrane is "picky" about what it lets into and out of the cell.



Turgor pressure

Plant cells are very much like your own cells, except they are surrounded by a cell wall. This cell wall is part of what gives plants such a rigid and sturdy structure. Plant cells need acertain amount of pressure to make sure that the cell walls stay rigid. Pressure from fluid within the cell pushing against the cell wall is called turgor pressure. This gives rigidity to the cell wall and the entire plant. Turgor pressure is maintained by osmosis.
Turgor pressure is the pressure exerted by water inside the cell against the cell wall. Turgor pressure is caused by the cytoplasm pressing against the cell wall and pushing the cell membrane against the cell wall of plant, bacteria and fungi cells, as well as those of protoctist cells which have cell walls.
When the plant loses so much water that the turgor pressure falls towards zero, the cells become plasmolysed and flaccid and the cell membrane is not pressed tightly against the cell wall anymore. This causes wilting of the plant.

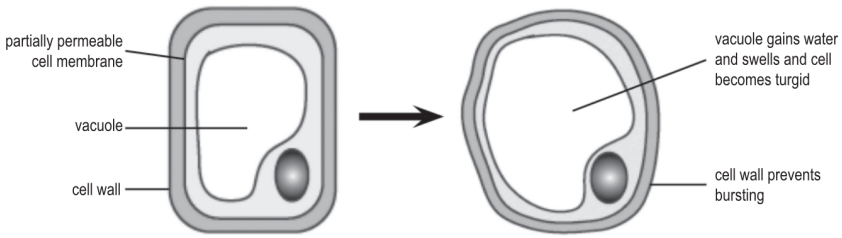




Effects of osmosis on plant cells

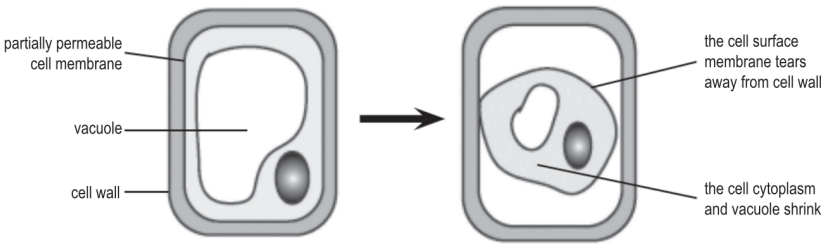
Plant cells in hypotonic solutions

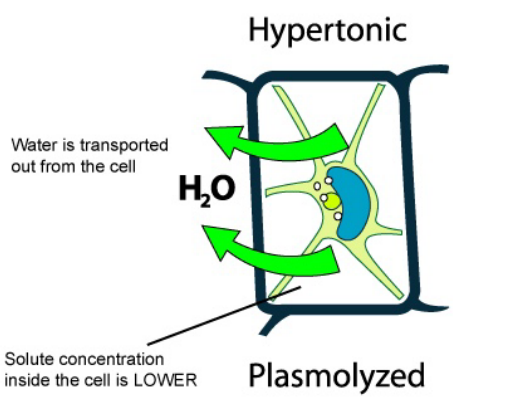
- If a plant cell is placed in pure (distilled) water (a hypotonic, weak, dilute solution), water moves into the cell by endosmosis. The pure water has a high water potential and the cell sap (cytoplasm) of the cell has a low water potential (it is hypertonic, strong and concentrated).
- The plant cell will expand and the vacuole swells, so the cell becomes turgid. The rigid cellulose cell wall only expands slightly, which prevents it from bursting. This occurs because osmosis takes place. There is higher water potential outside the cell than inside the cell sap, causing water to enter the cell.

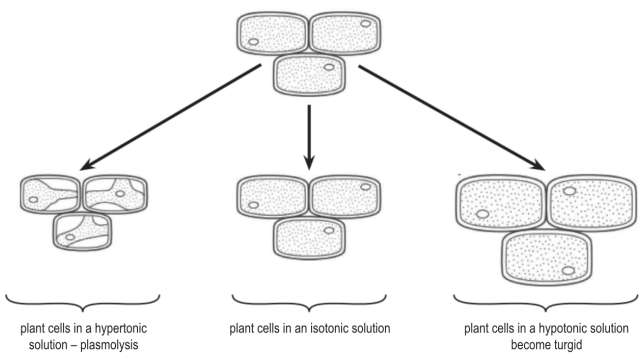


Plant cells in hypertonic solutions

- If a plant cell is placed in a concentrated salt solution (a hypertonic, strong, concentrated solution), water moves out of the cell by exosmosis. The salt water has a low water potential and the cell sap (cytoplasm) of the cell has a high water potential (it is hypotonic, weak and diluted).
- The plant cell's cytoplasm and vacuole shrink, so the cell becomes flaccid. A flaccid plant cell is one in which the plasma membrane is not pressed tightly against the cell wall. The cell membrane eventually tears (peels) away from the cell wall and the cell will undergo plasmolysis. This occurs because osmosis takes place. There is higher water potential inside the cell than outside the cell sap, causing water to leave the cell.



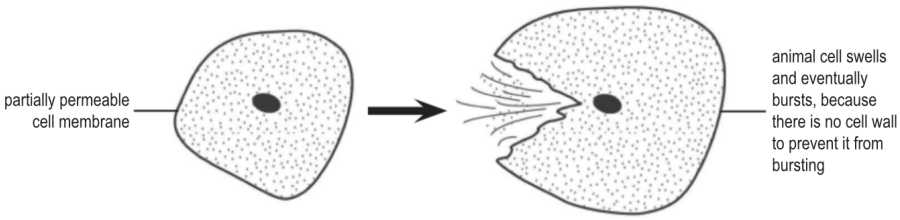




Effects of osmosis on animal cells

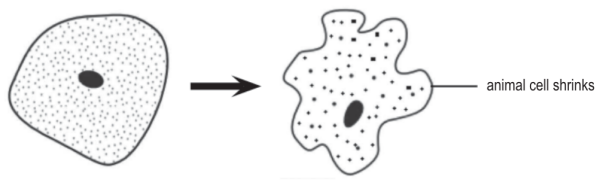
Animal cells in hypotonic solutions

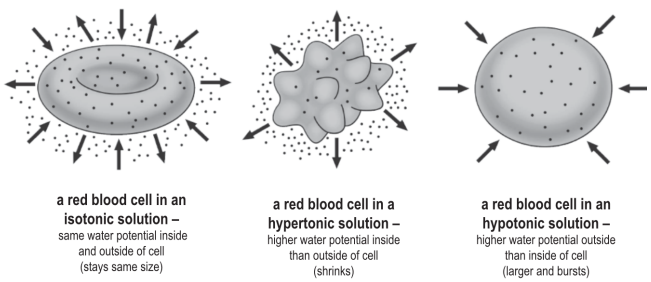
- Animal cells do not have cell walls. If an animal cell is placed into a hypotonic solution, water will move into the cell by endosmosis. The cell swells up and will eventually explode or burst (lyse) as it cannot become turgid, because there is no cell wall to prevent the cell from bursting. When an animal cell is in danger of bursting, specific structures will pump water out of the cell to prevent this.



Animal cells in hypertonic solutions

- In hypertonic solutions, water diffuses out of the animal cell due to exosmosis and the cell shrinks. Thus, the animal cell has to always be surrounded by an isotonic solution. In the human body, the process of osmoregulation regulates the concentration of water and mineral salts in the body.





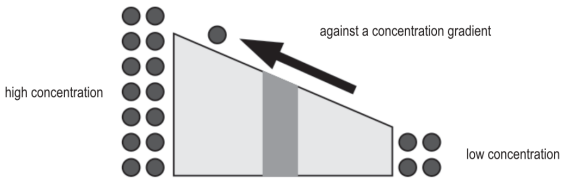
Importance of water potential and osmosis

Osmosis facilitates the movement of water across the cell membrane, so it causes the migrating of water into and out of cells and maintaining the water balance. This is vital to all living things. Organisms are made of billions of cells and every one of those cells needs materials like water to move in and out. Osmosis is the control by which cells maintain just the right amount of water. This is important for two reasons. Firstly, water is important for many biological processes and secondly, it also regulates
the water potential of the cell.
Plants gain water through osmosis into their roots from the soil. Without a water potential gradient, water will be lost from. the roots. Osmosis makes the plant absorb water from the soil or the groundwater to use it in photosynthesis. The plants that do not receive enough water wilt, because there is not enough pressure in their cells to support the structure of the plant. Conversely, cells that fill with too much water begin to burst, causing brown spots on plant leaves.
Many nutrients and essential molecules that animals need are dissolved in water. So if water does not move by osmosis, our bodies won't get the essential molecules to stay alive. Metabolic waste products like urea also dissolve in water, which is transported to the kidneys to be excreted

Active transport

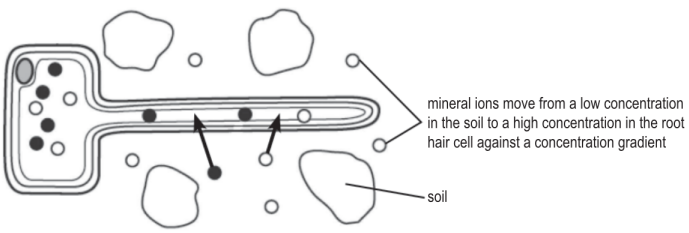
Definition of active transport

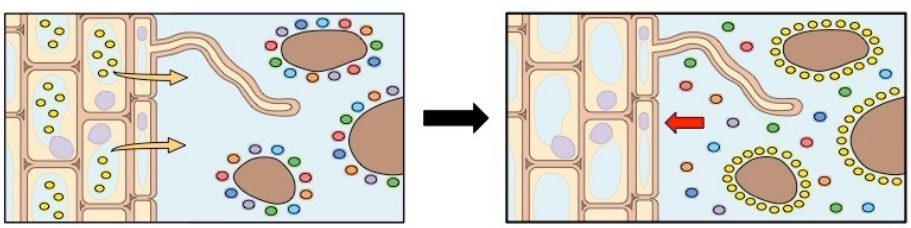
Active transport is the movement of particles (molecules, atoms or ions) through a cell membrane, from a region of lower concentration to a region of higher concentration against a concentration gradient, using energy from respiration.



The importance of active transport

- Uptake of mineral ions by root hairs through active transport
- Mineral ions like iron, magnesium, phosphates and nitrates are absorbed from the soil into the root hairs of plants.
- E.g. root hair cells in plants take in nitrate ions from the soil. Their concentration are often higher inside the root hair cell than in the soil, so a diffusion gradient is from the root hair to the soil. Despite this, the root hair cells still,can take nitrate ions in, by active transport.
- The ions move from a low concentration in the soil to a high concentration in the root hair cell against a concentration gradient.
- Active transport requires energy as ATP to drive these ions uphill. Large number of root hair cells give a large surface area to the root. Mitochondria are present to provide energy for active transport.
- The active transport is carried out by "carrier proteins' in the membrane, which bind to the solute molecule, change shape and carry the molecule across the membrane. It then reverts back to its original position



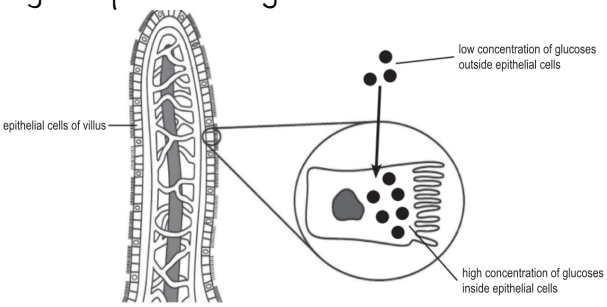


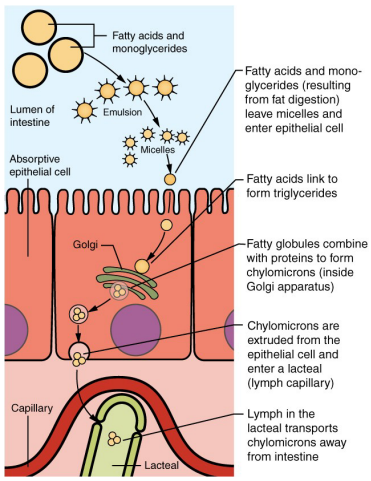
Hydrogen ions are actively transported **out** of the vacuoles of root cells and into the soil

H^+ ions displace minerals from clay particles, which diffuse into root (move along gradient)

Uptake of glucose by epithelial cells of villi through active transport

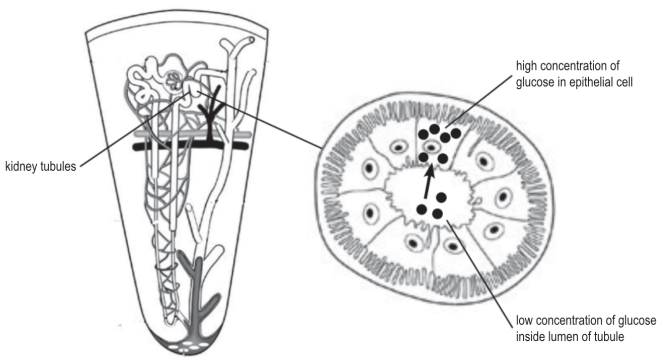
Absorption of glucose by villi entails transport from the intestinal lumen, across the epithelial and into blood. There are many occasions when cells need to take in substances like glucose, which is only present in small quantities around them, and present in large quantities inside them. Glucose is therefore required to be move against the concentration gradient, from a region of lower concentration to a region of higher concentration, using energy released during respiration. The active transport is carried out by 'carrier proteins' in the membrane, which bind to the solute molecule, change shape and carry the molecule across the membrane.





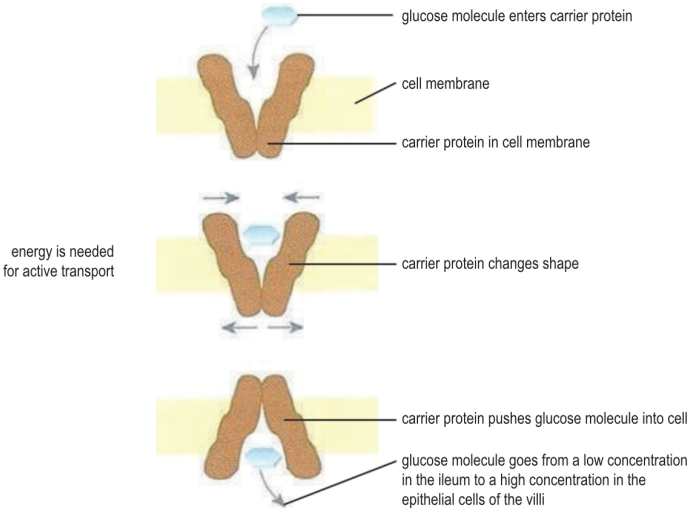
Uptake of glucose by epithelial cells of kidney tubules by active transport

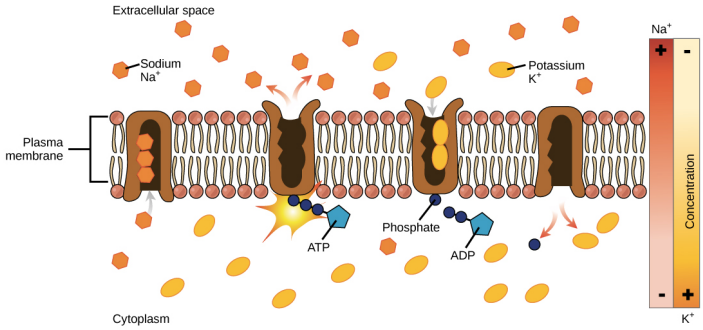
Re-absorption of glucose by kidney tubules entails transport from the lumen of the tubule, into the epithelial. There are many occasions when cells need to take in substances like glucose, which is only present in small quantities around them, and present in large quantities inside them. Glucose is therefore required to be move against the concentration gradient, from a region of lower concentration to a region of higher concentration, using energy released during respiration. The active transport is carried out by 'carrier proteins in the membrane, which bind to the solute molecule, change shape and carry the molecule across the membrane.



Role of protein molecules in active transport

Protein molecules move particles, e.g. mineral ions and glucose, across a membrane during active transport.


glucose molecule enters carrier protein
cell membrane
carrier protein in cell membrane
energy is needed for active transport
carrier protein changes shape
carrier protein pushes glucose molecule into cell
glucose molecule goes from a low concentration in the ileum to a high concentration in the epithelial cells of the villi


Extracellular space
Sodium
Na+
Potassium
K+
Plasma membrane
ATP
Phosphate
ADP
Cytoplasm
Na+
Concentration
K+