Diffusion, Osmosis and Active Transport
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Substances spread out by diffusion

Particles in solutions and in gases move around and spread out from each other.

This process is called **diffusion**.

Where is the smell strongest?

The smell is strongest at the sock. The smell becomes weaker further away from the sock, where the gas particles have spread further apart from each other.
Diffusion across membranes

Dissolved substances and gases move into and out of cells across the cell membrane.

The direction of the **net movement** of particles is from an area of high concentration to an area of low concentration, until the diffused particles are evenly spread between the two areas. This means they have reached **equilibrium**.

No energy is needed because the particles move down the **concentration gradient**.

This is therefore a passive process.
Diffusion in action

What would happen if only the red particles were able to diffuse across the membrane?

The red particles would move down their concentration gradient from the area on the left to the area on the right.

Net movement will stop when equilibrium is reached.
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Movement across membranes

Some dissolved substances can continue to move across membranes with the help of carrier proteins, even if equilibrium has been reached.

This is called active transport.

Unlike passive diffusion, energy is required. This is because the proteins carry substances across the membrane against the concentration gradient.
Mechanism of active transport

What happens during active transport?

During active transport, carrier proteins ‘pick up’ molecules and transport them across the cell membrane.

Press "play" to find out more.
During digestion, **villi** in the small intestine absorb soluble nutrients. The concentration of nutrients in the blood soon reaches the same levels as in the intestines.

Active transport is used to continue the transport of the small amounts of remaining nutrients against the concentration gradient.

**glucose**
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What is osmosis?

Osmosis is the diffusion of **water molecules** from a dilute to a more concentrated solution across a **partially-permeable membrane**.

A partially-permeable membrane contains holes that allow water molecules through, but are too small to allow larger molecules through. Osmosis can be demonstrated using visking tubing filled with a solution and placed in a beaker of pure water.
Dilute vs. concentrated

During osmosis, water molecules diffuse from pure water or dilute solution to more concentrated solutions.

- **Dilute solutions** have a **high** concentration of water molecules.
- **Concentrated solutions** have a **low** concentration of water molecules.
Osmosis and cells

Plant and animal cells are surrounded by a partially-permeable plasma membrane. This allows water and other small molecules to diffuse into and out of the cells.

Plant cells also have a strong cell wall surrounding the membrane which offers support and protection.
Investigating osmosis in potato plant cells

Water moves into and out of plant cells by osmosis. However, the direction of water movement depends on the fluid surrounding the plant cells.

How could you investigate osmosis in potato cells?

Press "play" to design an appropriate experiment.
Osmosis in animal cells

In pure water, or dilute sugar solutions, osmosis can cause animals cells to swell up and burst. This is called **lysis**.

As the water concentration outside of the animal cell is greater, the water molecules will diffuse **into** the cell.

In concentrated sugar solutions, water loss causes the cells to shrink. When this happens to red blood cells, it is called **crenation**.
What are the missing words about osmosis?

The Principles of Osmosis in Plant and Animal Cells

When a piece of a potato is left in pure water for five hours, the mass of the potato will ↓.

This is because the concentration of water outside of the potato cells is ↓ the water concentration inside the cells. Water enters the cell by osmosis and fills up the ↓. This presses the cytoplasm against the cell wall, and the cell looks ↓.

When red blood cells are placed in a high sugar solution,
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Replacing what is lost from cells

Most soft drinks contain water, sugar and mineral ions.

**Sports drinks** also contain water and sugar (usually glucose), but have a higher concentration of mineral ions like sodium and potassium.

As we sweat, ions leave the cells. Water is then drawn out of the cells by osmosis. Sports drinks are designed to replace the water and mineral ions that have been lost through sweating during exercise.

They contain sugar to replace the glucose used up during respiration.
Why use sports drinks?

Some sports drinks are known as **isotonic drinks** because they contain a similar combination of water, sugar and mineral ions as the fluids in the human body.

They are used by athletes because:

- they can quickly replace the water and mineral ions lost through sweating
- they provide an energy boost in the form of a simple carbohydrate: glucose
- they keep the cells working efficiently.

The delicate mineral ion/water balance of the body needs to be maintained in order for the body to function efficiently.
Sports drinks are much more expensive than soft drinks.

Manufacturers claim that they are an effective way to rehydrate tissues, replace the energy used in exercise and restore the mineral ion balance. Are they right?
Evaluation of the claims

There is some evidence that water is as effective as a sports drink in keeping the cells hydrated after exercise lasting less than an hour.

Diluting water with squash can help to replace the sugar used up in respiration during exercise.

The addition of a pinch of salt may also be effective in replacing the most important mineral ions in the cells.

It has been claimed that milk can also replenish water, salts and sugars, whilst providing protein and vitamins.
Let’s evaluate

Advantages of energy drinks or advantages of water?

advantages of energy drinks

advantages of water

effective for instant rehydration
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Glossary of keywords: diffusion, osmosis and active transport

**active transport** – The movement of molecules against a **concentration gradient**, which requires energy.

**carrier protein** – A protein embedded in the cell membrane that transports molecules against the **concentration gradient**.

**concentration gradient** – The difference in concentration across a given area. If a substance moves with the concentration gradient it is moving from an area of high concentration to an area of low concentration.
How much information has diffused into your memory?

Press "start" to begin.