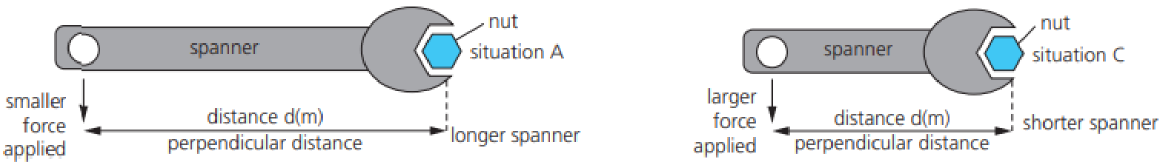
Work Done

In physics, **work done** is the **energy transferred** when a force is used to move an object a certain distance. Like energy, work is measured in **Joules (J).**
Work can be done in a range of situations e.g. lifting a book work is done against gravity, when you slide a book along a table work is done against friction.
We calculate work with the equation: work done (J) = force (N) × distance moved (m)

The physics of unscrewing a tight nut with a spanner



A **simple machine** makes it easier to lift things; they **reduce the force** needed
A **force multiplier** uses a smaller **input force** (what you apply) to generate a **larger output** force (what is created)
If you increase the **distance** from the pivot, less input force is needed to be used for the same output force as before
A **lever** is an example of a force multiplier, a longer lever will require a less input force than a shorter lever to produce the same output force

Energy and Temperature

The **temperature** of a substance is a measure of how hot or cold it is
Temperature is measured with a **thermometer**, it has the units of **degrees Celsius** (ºC)
The **thermal energy** of a substance depends on the individual energy of all of the **particles**, it is measures in **Joules (J**)
As all particles are taken into account, a bath of water at 30ºC would have more thermal energy than a cup of tea at 90 ºC as there are many more particles. The faster the particles are moving, the more thermal energy they will have.
When particles are heated they begin to move more quickly. The energy needed to increase the temperature of a substance depends on:

- the mass of the substance
- what the substance is made of
- how much you want to increase the temperature

Radiation

Radiation is a method of **transferring energy** without the need for **particles**
An example of radiation is **thermal energy** being transferred from the Sun to us through space (where there are no particles)
This type of radiation is known as **infrared radiation**, it is a type of **wave,** just like light
The hotter an object is the more infrared radiation it will emit (give out)

The amount of radiation **emitted** and **absorbed** depends on the surface of the object:

- Darker matte surfaces absorb and emit more infrared radiation
- Shiny and smooth surfaces absorb and emit less infrared radiation, instead reflecting this
- The amount of infrared radiation being emitted can be viewed on a thermal imaging camera

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Key words and Vocabulary

Make sure you can write definitions for these key terms:
Conduction, convection, current, force, multiplier, input force, insulator, infrared radiation, lever, output force, simple machine, temperature, thermometer, thermal conductor, thermal energy store, thermal imaging camera work done

Conduction

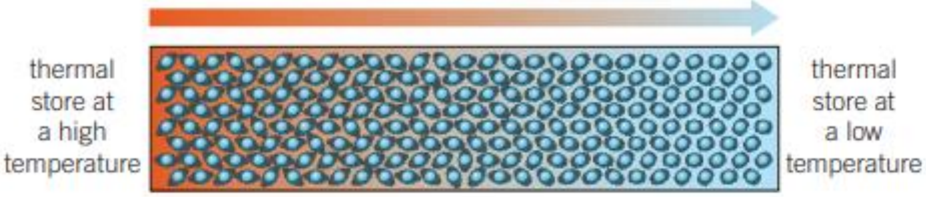
Conduction is the transfer of **thermal energy** by the **vibration of particles**, it cannot happen without particles. This means that every time particles **collide** they transfer thermal energy

Conduction happens effectively in **solids** as their particles are close together and can collide often as they **vibrate** around a **fixed point**

Metals are **also good thermal conductors** as they contain **electrons** which are **free to move**

In **conduction** the thermal energy will be transferred from an area which has a high thermal energy store (high temperature) to an area where there is a low thermal energy store (low temperature)

Gases and **liquids** are **poor conductors** as their particles are spread out and so do not collide often, we call these insulators



Convection

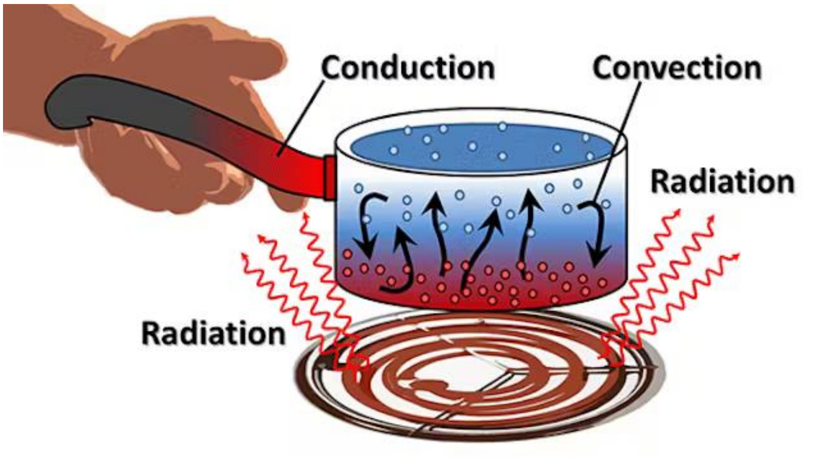
Convection is the transfer of thermal energy in a **liquid or a gas**, it cannot happen without particles

As the **particles** near the heat source are heated they spread out and become **less dense**, this means that they will rise

More dense particles will take their place at the bottom nearest the heat source creating a constant flow of particles. This is known as a **convection current.**

Convection cannot happen in a solid as the particles cannot flow, they can only move around a fixed point

Methods of Energy Transfer



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Respiration

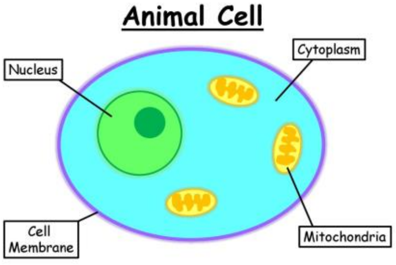
Respiration is the process in which **energy** is released from the molecules of food which you eat. Respiration happens in the **mitochondria** of the cell

Aerobic respiration involves oxygen, it is more efficient as all of the food is broken down to release energy

- **Word equation**: glucose + oxygen ➞ carbon dioxide + water (+energy)
- **Reactants**: The **glucose** is transported to the cells in the blood plasma. The **oxygen** is transported to the cells in red blood cells, by binding with haemoglobin
- **Products**: **Carbon dioxide** is a waste product and is transported from the cells to the lungs to be exhaled

Anaerobic respiration is a type of respiration which does **not use oxygen**, it is used when the body cannot supply the cells with enough oxygen for aerobic respiration

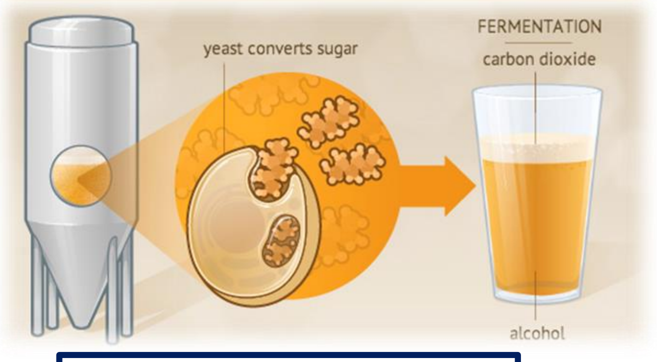
- **Word equation**: glucose ➞ lactic acid
- Anaerobic respiration takes place in the **cytoplasm**
- Anaerobic respiration releases **less energy** than aerobic respiration (+ energy)
- The lactic acid produced through anaerobic respiration can cause muscle cramps
- **Lactic acid** will build up if there is not enough oxygen present in the blood supply to break it down. This is known as an oxygen debt



Fermentation is a type of anaerobic respiration which occurs in yeast

- Word equation: glucose ➞ ethanol + carbon dioxide
- Instead of producing lactic acid, yeast produces ethanol, which is a type of alcohol
- This process can be used to form alcohol to drink, due to the production of ethanol, and allow bread and cakes to rise, due to the production of carbon dioxide (gas)

Fermentation in Yeast



Alcohol production

Bread rising

Key words and Vocabulary

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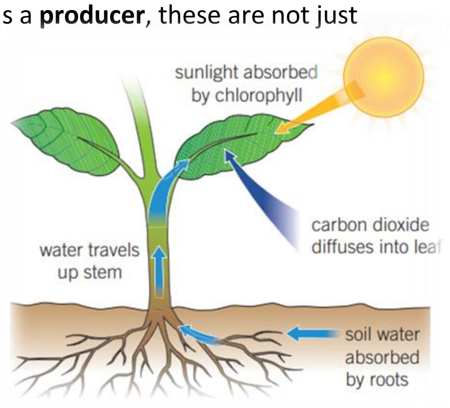
aerobic respiration, algae, anaerobic respiration, chlorophyll, mineral deficiency, fermentation, fertiliser, haemoglobin, lactic acid, magnesium, nitrates, oxygen debt, phosphates, photosynthesis, plasma, potassium, producer, red blood cells

Science – Bioenergetics

Photosynthesis

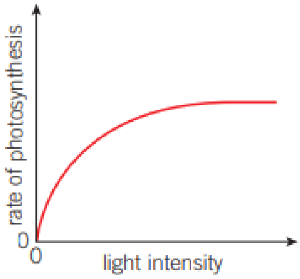
Photosynthesis is the process which occurs in the **chloroplasts** to produce **glucose** using sunlight

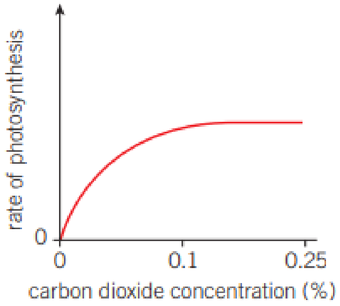
- **Word equation**: water + carbon dioxide + sunlight ➞ glucose + oxygen
- Any organism that can use photosynthesis to produce its own food is known as a **producer**, these are not just limited to plants but can include other organisms such as algae

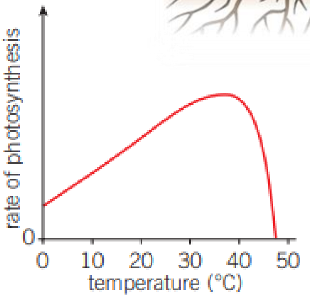


The **rate of photosynthesis** can be affected by:

- **Light intensity** – the higher the light intensity the higher the rate of photosynthesis up to a point
- **Carbon dioxide concentration** – the higher the carbon dioxide concentration the higher the rate of photosynthesis up to a point
- **Temperature** – the optimum temperature is the temperature at which photosynthesis occurs at the highest rate, before and after this the rate will be less





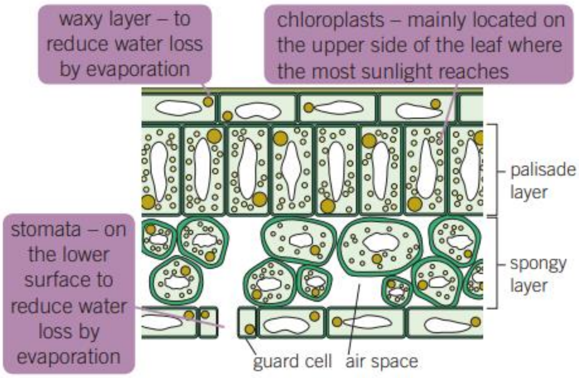


Leaves and Photosynthesis

To best adapt for photosynthesis leaves have a number of adaptations:

- They are thin to allow the most light through
- There is a lot of chlorophyll to absorb light
- They have a large surface area to absorb as much light as possible

Cells in a leaf



Plant minerals

Plants need minerals for healthy growth, if they do not have enough of these minerals this is known as a **mineral deficiency**

Fertilisers can be used to stop plants from suffering with mineral deficiencies

Mineral	What is It used for?	What happens if there is not enough?
nitrates (contain nitrogen)	healthy growth	poor growth and older leaves yellow
phosphates (contain phosphorus)	healthy roots	poor growth, younger leaves look purple
potassium	healthy leaves and flowers	yellow leaves with deadpatches
magnesium	making chlorophyll	leaves will turn yellow

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Key words and Vocabulary

aerobic respiration, algae, anaerobic respiration, chlorophyll, mineral deficiency, fermentation, fertiliser, haemoglobin, lactic acid, magnesium, nitrates, oxygen debt, phosphates, photosynthesis, plasma, potassium, producer, red blood cells