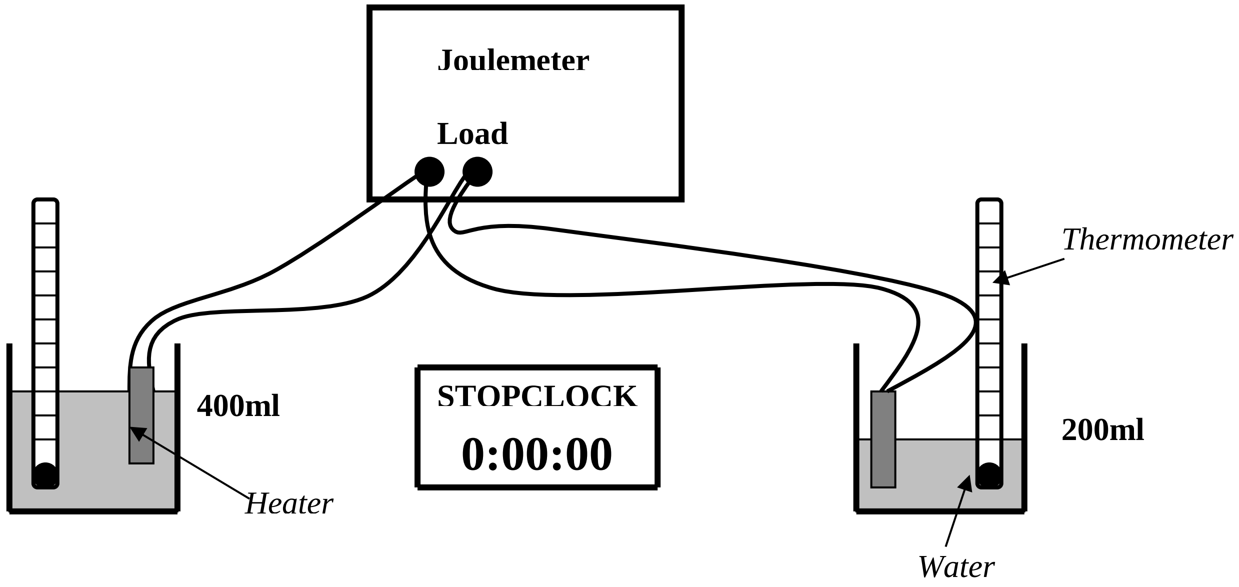
Heat

Heat and Temperature

Heat is a form of energy. This is measured in Joules (J). Temperature tells us how hot or cold an object is and is measured in degrees Celsius (°C) using a **thermometer**. Temperature is a measure of the average heat energy of particles in a substance.

A paper clip and metal block are both heated to the same temperature. However, they do not have the same amount of heat energy. The metal block will increase the temperature of water by more than the paper clip. This is because the metal block has more particles at that temperature which means a higher total amount of heat energy.

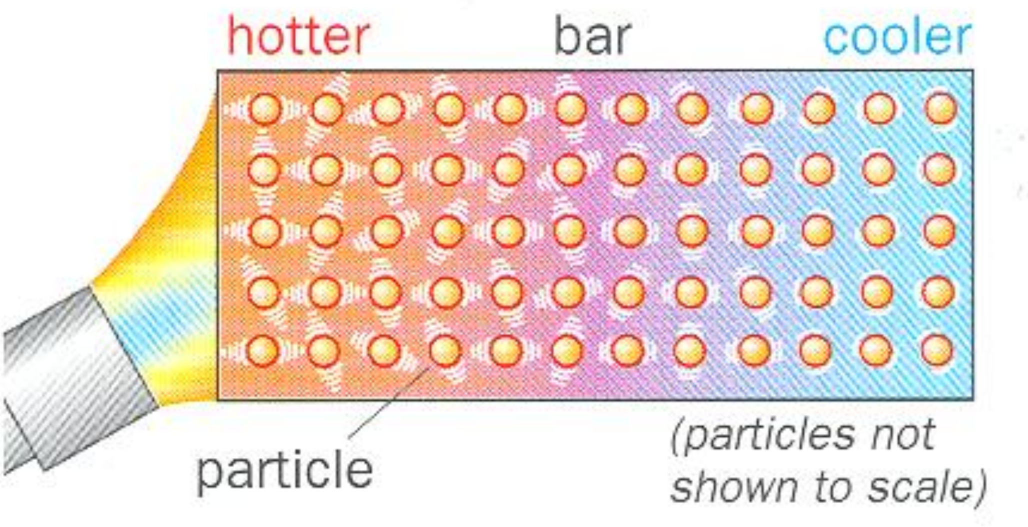
Experiment to show the difference between Heat and Temperature



The same amount of heat energy was passed into both samples of water. However, the 200ml sample of water showed a bigger increase in temperature than the 400ml sample.

Conduction

Heat travels through solids by conduction. The heat energy is passed on from one particle to those next to it.



Metals are good conductors of heat while non-metals, such as plastics, wood and glass, are poor conductors (insulators).

However metals conduct at different rates. The following experiment showed that copper conducts heat faster and more easily than the other metals.

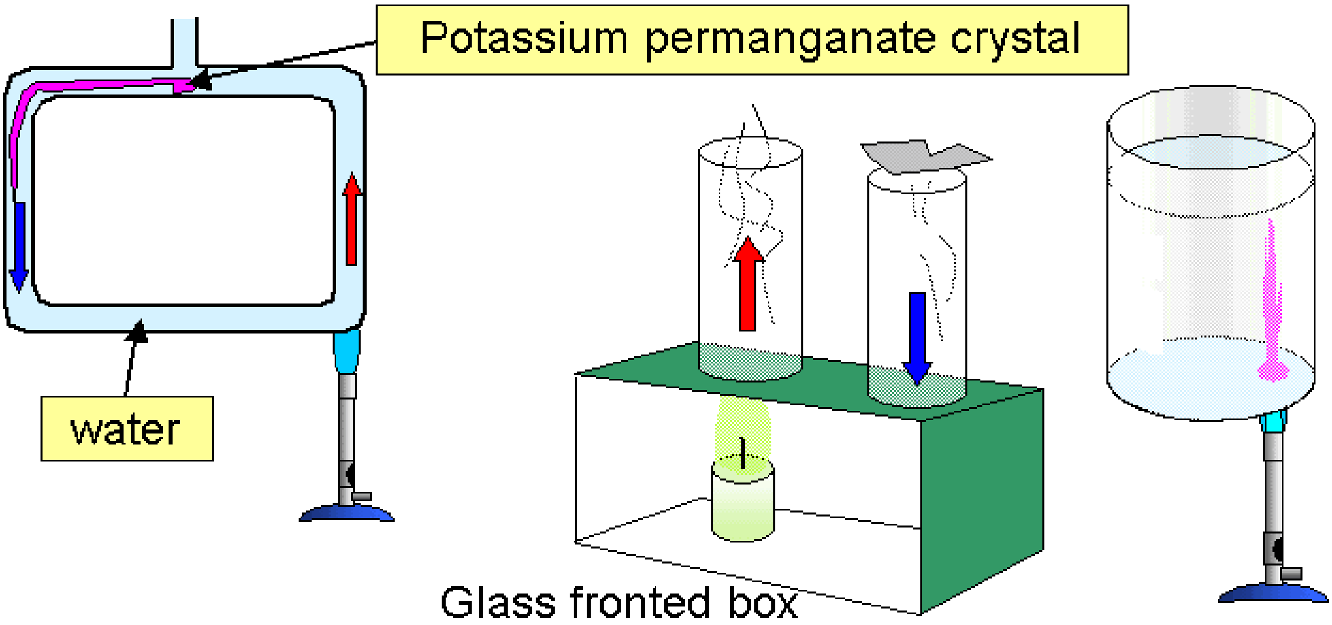
Conductors feel colder to touch than insulators because as soon as you touch them the heat moves away from your fingers

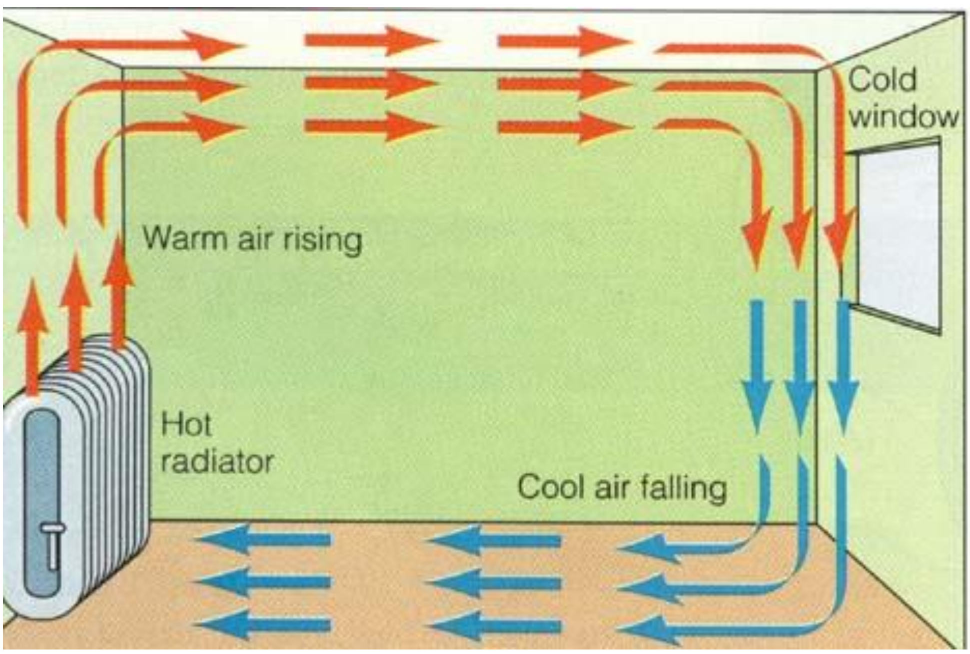
Convection

Heat travels through liquids and gases by convection. The hot particles rise and take the heat with them. This can only happen because liquids and gases are **fluids** (their particles can **flow** past each other).

The hot particles rise because they have bigger spaces between them as they vibrate more. This makes them less dense, so they rise.

If this keeps going a convection current forms.

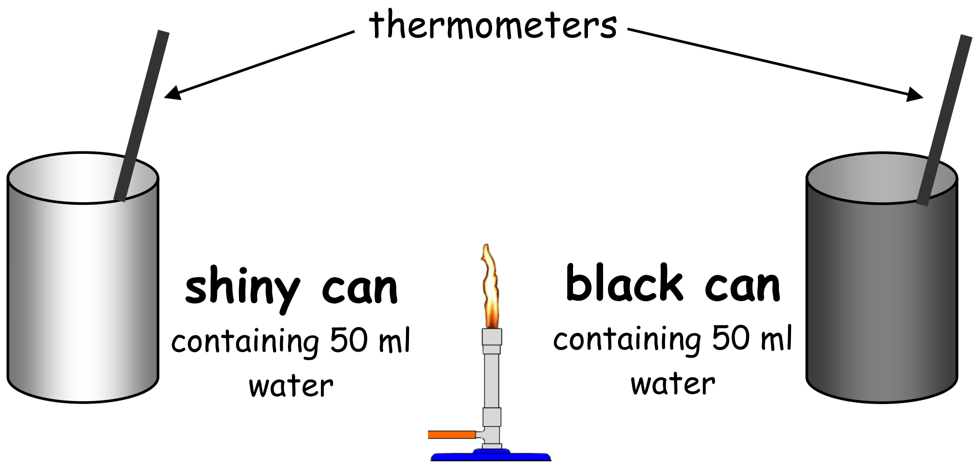




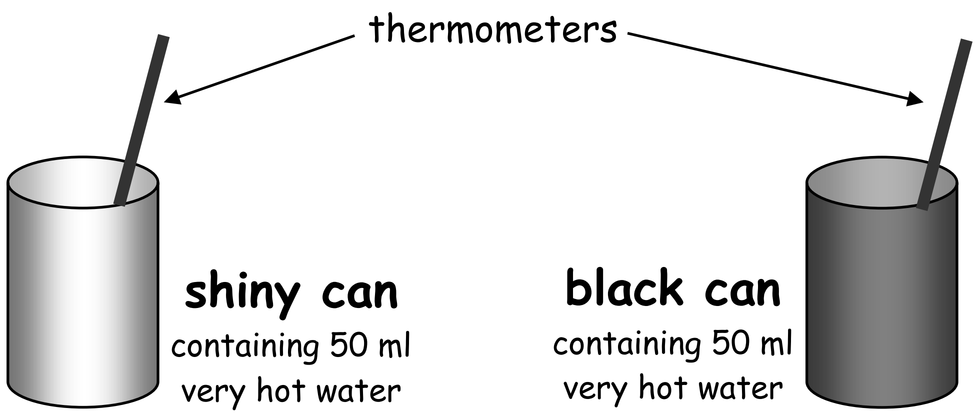
Radiation

All hot objects emit (give out) heat as rays called infrared radiation. This is invisible, can travel through a vacuum and travels very quickly.

Dark, dull surfaces are good at absorbing infra-red radiation.
Shiny, or white, surfaces are poor at absorbing radiation. These surfaces reflect infra-red radiation.



Dark, dull surfaces are good at emitting (giving out) infra-red radiation.
Shiny, or white, surfaces are poor at emitting radiation. These surfaces reflect infra-red radiation back inside the object.



Radiation Conclusions

Heat (infra-red) radiation travels in straight lines in all directions and does not need particles.

It passes through (in either direction) dull, black surfaces more easily than shiny, white or silver surfaces, which reflect the radiation.

Insulation

Air is a poor conductor of heat. This makes it a good insulator. Things which can trap air therefore are good for reducing heat loss.

These include fur, hair, wool and feathers on living things.

A lot of heat can be lost from houses.

Source of Heat Loss	Reduced by
Walls	Cavity wall insulation
Windows	Double glazing
Roof	Loft insulation
Doors	Draught excluders
Floors	Carpets

Hot water pipes are also insulated with a plastic foam, so the water stays hot. This is known as lagging and the foam works by trapping air.

The Vacuum Flask

A vacuum flask is used to keep drinks hot. There are different ways the heat loss is reduced.

1. The vacuum between the walls means there can be no heat loss by conduction or convection.
2. The glass walls are not the best conductors.
3. The plastic lid reduces heat loss by convection.
4. The shiny, silver walls reduce heat loss by infra-red radiation.

Non-Renewable & Renewable Energy

Fossil fuels are still the source of most of our energy needs, mainly to produce **electricity** in power stations. Here, they are used to **boil water**. The water vapour then turns turbines to produce electricity. The 3 fossil fuels are:

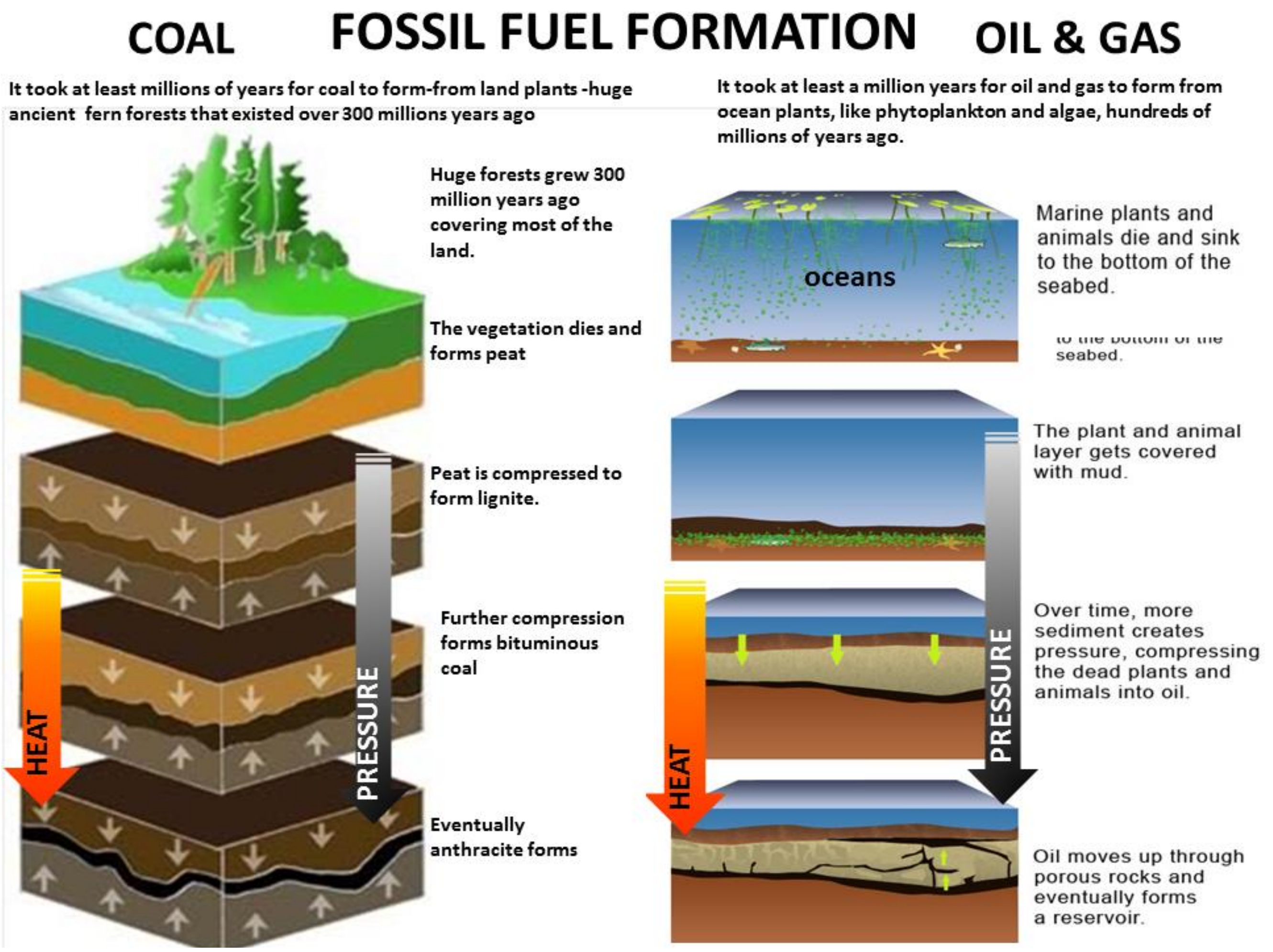
- Coal
- Crude oil
- Natural gas

All 3 were formed over hundreds of millions of years.

Coal was formed from trees and plants in swamp areas. When they died, they sank and layers of mud formed over the top of them.

Oil and gas were formed from microscopic sea creatures and plants. When they died, they sank and layers of sand formed over the top of them.

In each case the pressure and heat of the layers converted them into the fossil fuels.

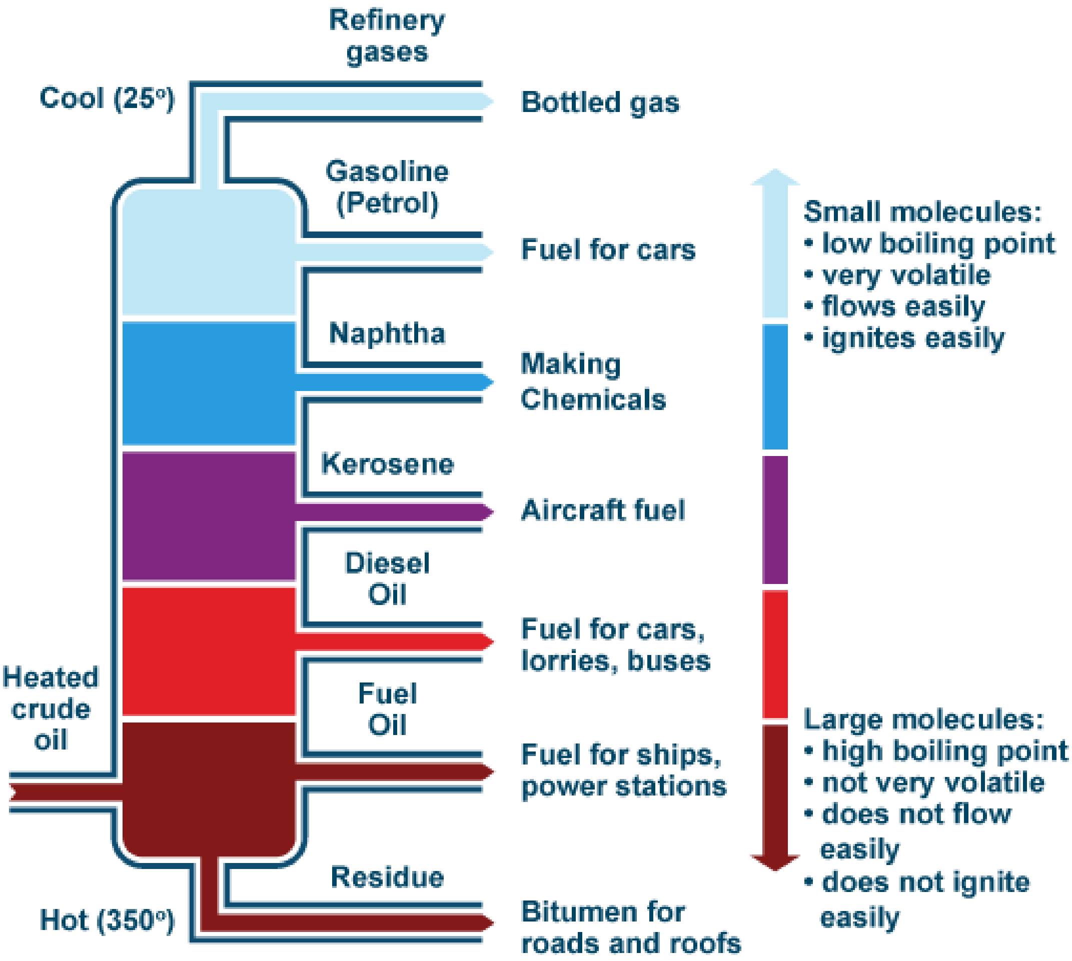


Crude Oil and its Uses

Crude oil is a mixture of compounds called hydrocarbons. These contain only hydrogen and carbon.

Crude oil is not much use until we separate it into fractions. This is done by fractional distillation. It works because liquids have different boiling points.

This gives us camping gas, petrol, diesel, lubricating oil, candle wax and bitumen (tar for roads). It also gives us chemicals for making plastics with.



However, fossil fuels are **finite** resources, which means they are running out. So we are working on using alternative sources of energy. Most of these are **renewable**, which means they will never run out.

Nuclear reactions can be used to produce energy to make electricity. However, nuclear materials are **not renewable** as they come from the Earth's crust.

Renewable forms of energy include:

Wind – turbines turn with the wind to produce electrical energy.
Tidal – the movement of the tide is used to produce electrical energy.
Wave – the up and down movement of waves is used to produce electrical energy.
Hydroelectricity – the movement of water running down a hillside is used to produce electrical energy.
Solar – light energy from the sun is converted into electrical energy.
Geothermal – the heat from the Earth is used to produce electrical energy.

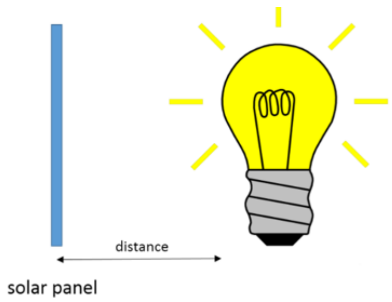
The following renewable energy sources are used to burn as fuels:

Ethanol – made by fermentation of sugar cane.
Biogas – made from rotting plant material.
Biomass – plant material which can be burned.

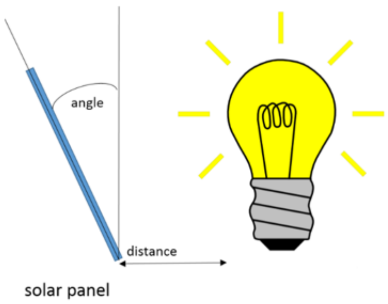
Solar Panel Investigation

The voltage of electricity produced by a solar panel can be increased by:

1. Decreasing the distance between the solar panel and the light.
2. Decreasing the angle of the solar panel (make sure it's pointing directly at the light).
3. Increasing the power/brightness of the light.
4. Increasing the surface area of the solar panel.



Distance (cm)	Voltage (mV)
5	750
10	640
15	550
20	460



Angle (°)	Voltage (mV)
0	750
20	730
40	710
60	660