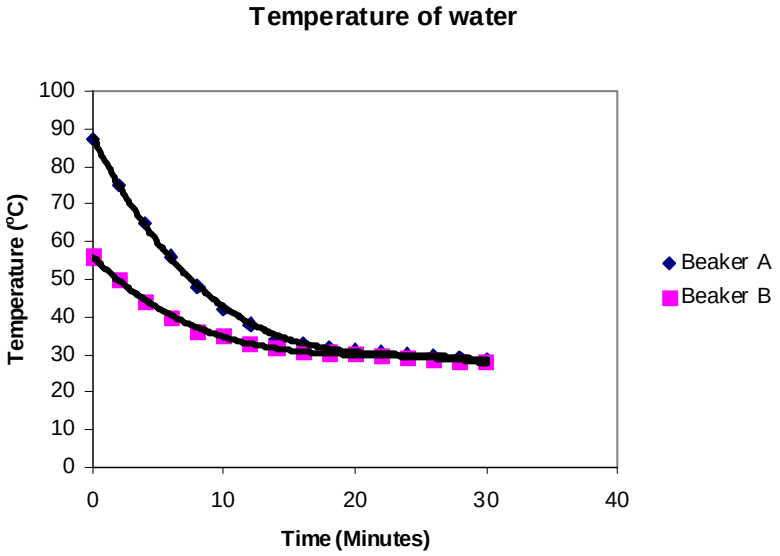
S1/2 Science Heat Transfer

Temperature & Heat

Temperature tells us how hot or cold something is and is measured in degrees Celsius (^0C).
Heat is a form of energy, and is measured in joules (J).
Heat energy always moves from hot things to cold things.
Temperature goes up when heat energy is taken in.
Temperature goes down when heat energy is given out.

Cooling Curves

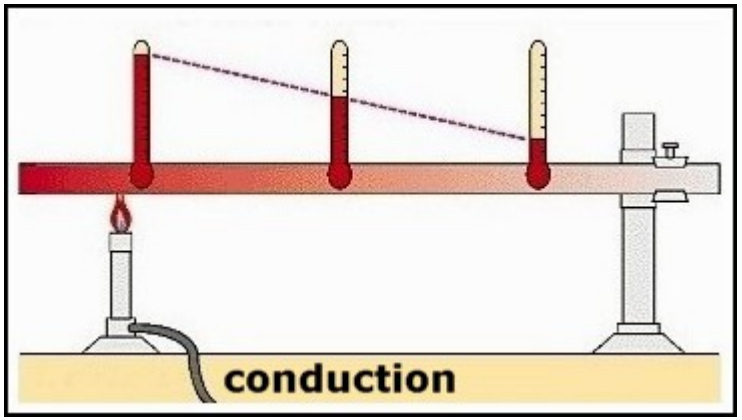
In an experiment to see how things cool down we get a graph that looks like this:-



The liquid in Beaker A loses heat energy to the cooler air around it and so the temperature falls.
The liquid stops cooling when it reaches the same temperature as the air around it.
Beaker A loses heat more quickly than beaker B because the difference in temperature is bigger at the start.
Both beakers will stop losing heat when they get to the same temperature as the air around them.

Conduction

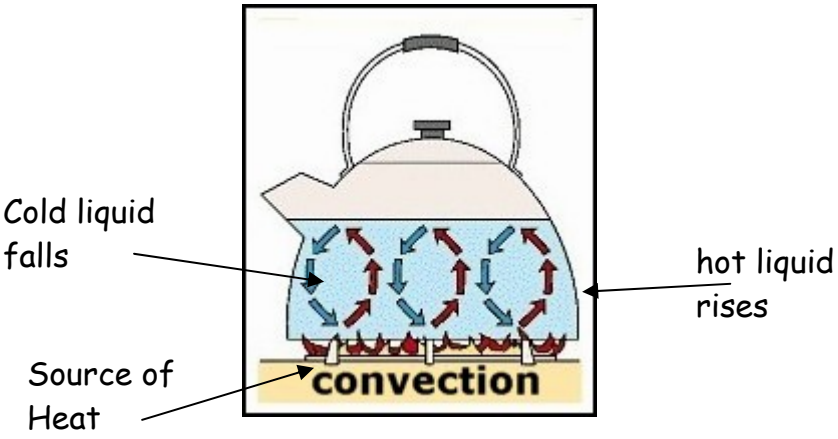
When the temperature of an object increases, its particles gain more energy and vibrate more. (Even cold objects have some heat energy!).
In a solid, particles are close together. When a solid is heated, the particles vibrate more. Each particle jostles the particle next to it, passing on heat energy. Heat can travel through solids this way and we call it CONDUCTION.



Materials that allow heat to travel through them are called conductors. Some materials are better conductors than others.
Metals are good conductors of heat and non-metals are poor conductors (insulators).
When we touch a good conductor it feels cold because it conducts heat away from the body. So metals feel cold to touch, but plastics and other insulators don't.

Convection

When liquids and gases are heated, their particles move faster and further apart and they expand. A hot liquid or gas is less dense (less particles in the same space) and so it rises. The colder gas or liquid around can get closer to the source of heat. This is how the heat can move through a liquid or gas and it's called convection. The movement of the particles upwards as they warm and down as they cool, creates a flow called a convection current.



Uses of Conductors and Insulators

We can use poor conductors (insulators) to help stop heat loss by conduction. Air is a poor conductor of heat, and trapped air can be used to stop heat loss. For example, birds fluff up their feathers to trap air and keep warm. Most forms of heat insulation use trapped air, e.g. fibreglass loft insulation, cavity wall insulation or clothes. Double-glazing traps air between two panes of glass.
Insulators can stop heat being lost so they can also stop heat being gained. We can use them to keep cold things cold. A good example is a cool box.

Sometimes we want heat to travel easily, so things like saucepans are made of metal to allow good conduction of heat. Of course, the handles are insulators so we can pick them up without being burned.

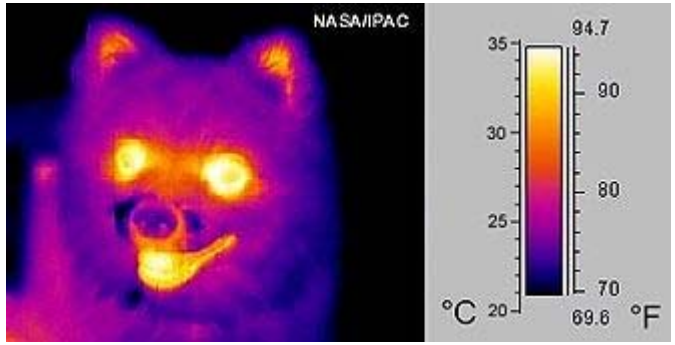
Saving Energy

Using conductors and insulators to prevent heat loss saves energy. This saves money and also helps the environment by reducing CO_2 emissions which cause global warming. We can also reduce pollution and save coal, oil and gas which are going to run out eventually.

Infrared Radiation

All hot objects give out heat rays called infrared radiation. Infrared travels in straight lines in all directions. It can travel through a vacuum so we can feel heat from the sun. It travels very fast, at 300 million metres per second, which is the same as the speed of light.

Infrared is invisible, but we can use special cameras to detect it. This is how night vision cameras work and how firefighters can find people trapped in smoke filled buildings. We can also use a special picture of the infrared that comes from our bodies called thermograms.
White or yellow areas are hot and blue areas are cold.



Colder areas sometimes mean that blood flow in the body is blocked.

Emission/Absorption of Infrared

Bright, shiny surfaces reflect infrared and so they are not good at absorbing (taking in) infrared or emitting (giving out) infrared. Dull, dark surfaces are best at absorbing or emitting infrared.