

# HEAT

Heat is measured in **Joules**, (J).  
Heat is a form of Energy and can do work.

Expansion happens when objects get hot.

Contraction happens when objects get cold.

## Advantages:

Thermometers use expanding liquids.  
Bimetallic Strips - can be used in fire alarms.



**Disadvantages:**

Railway tracks - must have gaps, because they expand in hot weather.



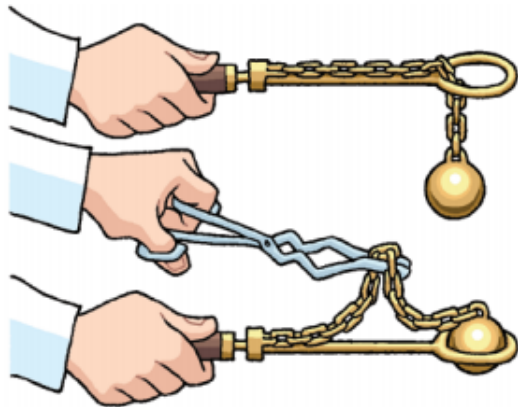
## Experiments for Expansion and Contraction

### Solids

#### Ball and Ring

We place a ball through the ring to see if it can fit.  
We then heat the ball to see what happens...

What will happen?



The Ball expands when heated and doesn't fit through the ring. When cooled, the ball contracts and fits through the ring.

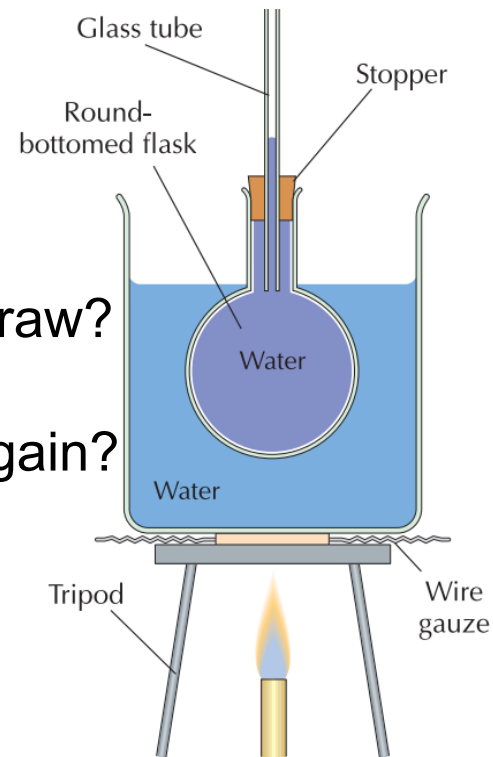
**This shows solids expand when heated and contract when cooled.**

## Liquids

### Flask of Coloured Water

In this experiment we heat a flask of water.  
What will happen to the water level in the straw?

What will happen when we cool the liquid again?



The liquid expands when heated and can only escape up the tube. When cooled, the liquid contracts and falls back down the tube.

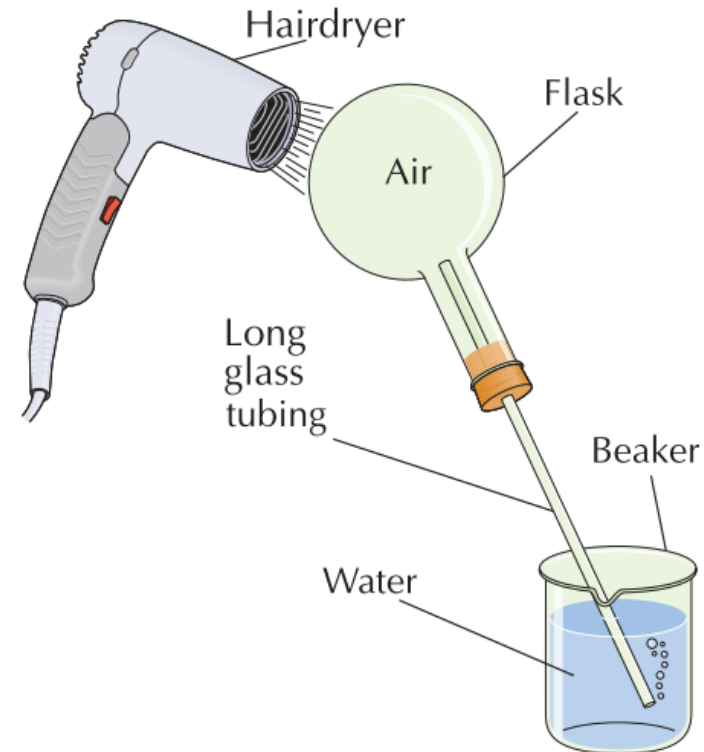
**This shows that liquids expand when heated and contract when cooled.**

## Gases

### Flask of Air

In this experiment we heat a flask of air to see what happens.

What you expect to happen?



The gas expands when heated and can only escape out of the tube. This makes **bubbles** in the water.

When cooled, the gas in the flask contracts and leaves a gap. Water is pushed into the flask to fill up the gap.

**This shows that gases expand when heated and contract when cooled again.**

# Water

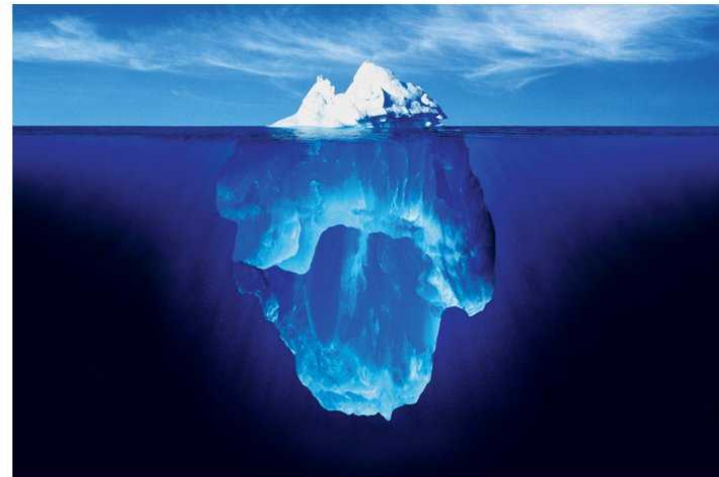
Water is a strange substance as it acts differently to most other chemicals.

It contracts as it gets colder but at  $4^{\circ}\text{C}$  it starts to expand again.

So ice takes up more space than water.



Water freezes at  $0^{\circ}\text{C}$  and boils at  $100^{\circ}\text{C}$ .



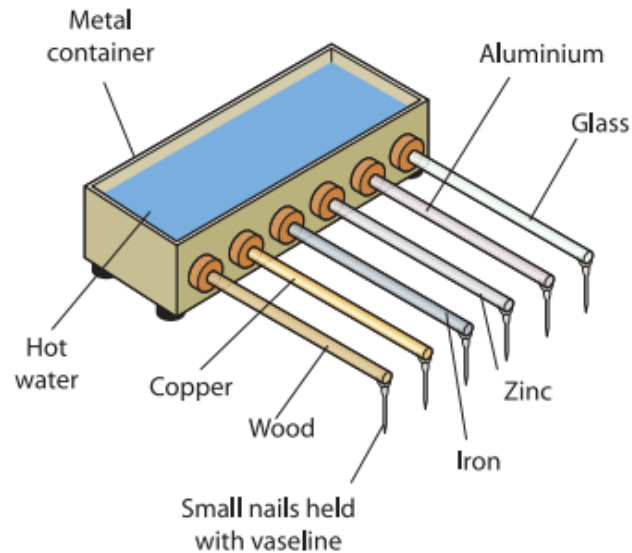
## Heat Transfer - There are 3 Types

**1. Conduction** - Is the movement of heat from particle to particle.



**Conduction** - moves heat through a spoon! (Solid)

## Conduction through a Solid



### Heat Box

Has various rods attached to the box.  
We add pins to the end of the rods with vaseline.  
We then add hot water into the box.

What do you expect to happen?

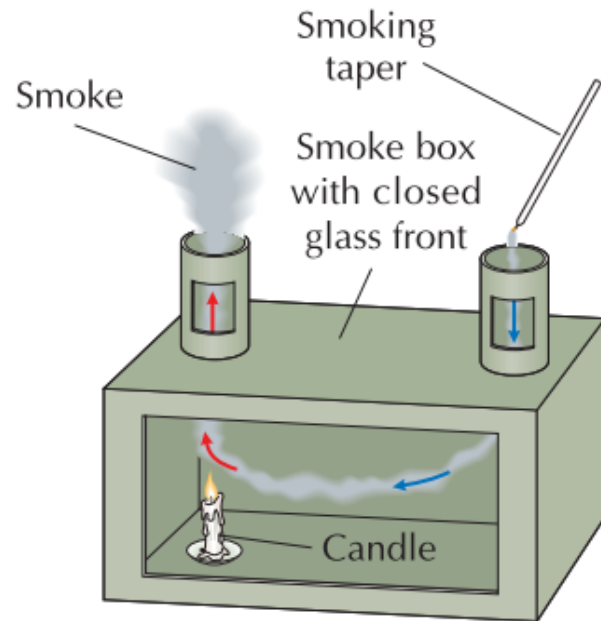
They heat up because of the hot water in the box.  
The vaseline melts and the pins drop off.  
The rods are Brass, Copper, Aluminium, Zinc, Iron, Glass, and Wood.

### Conclusion

Brass and Copper conduct heat the best.  
Glass and Wood don't conduct heat,  
they are **Insulators**.



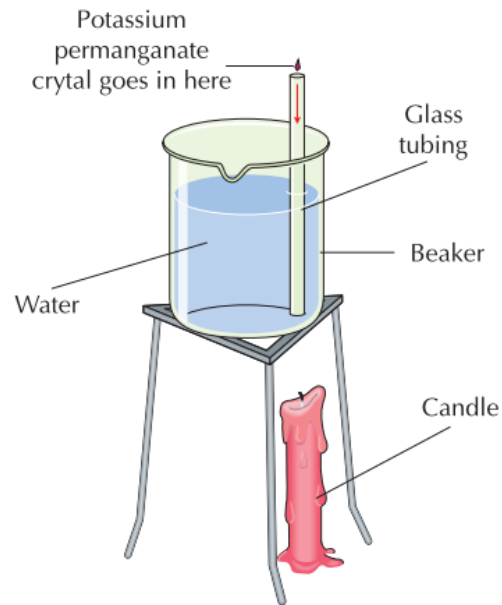
**2. Convection** - is the movement of gas or liquid particles that carry the heat with them.



To show heat moves through air by convection. by using a smoke box.

**Smoke Box** - shows that hot air rises and carries the heat with it. The smoke is carried into the box by the cold air that enters to replace the hot air that has left the box.

# Convection in Water



## Purple Dye

A beaker of water is heated in one spot by a candle. Potassium permanganate is added above the flame.

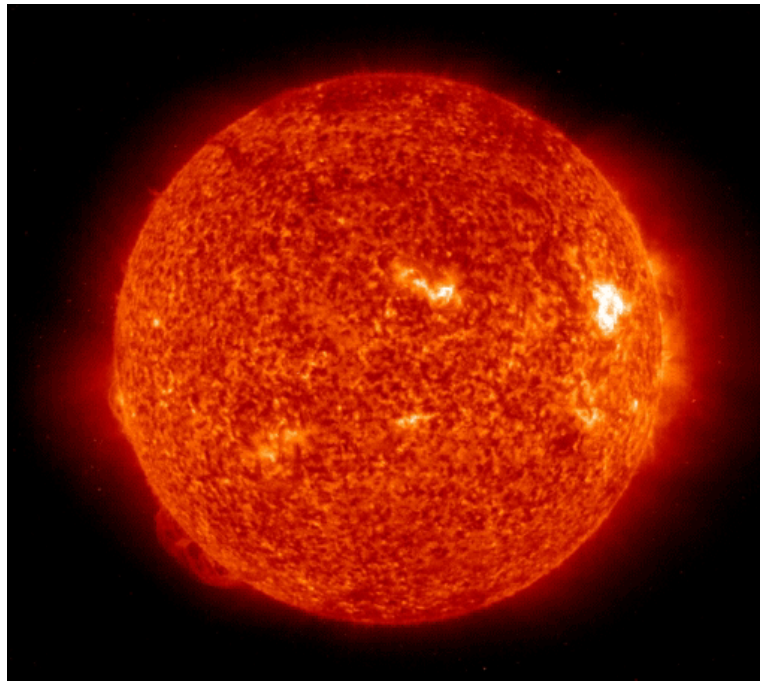
What will happen?

The purple dye rises up and spreads out along the surface across the top of the water. When it is away from the heat the water cools and the dye sinks down again.

**This shows heat moves by convection in a liquid.**

**3. Radiation** - is the rapid movement of heat from an object without any particles or medium.

The **sun** radiates heat constantly and the heat moves through empty space before reaching us.



## Black Body Radiation

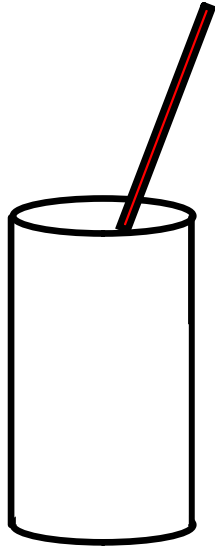
We take 2 Aluminium cans and paint one black.

We fill them both with boiling water and then place a thermometer in both

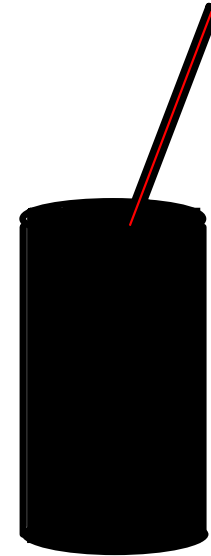
We record the temperature every 2 mins to see what happens.

Time	Black Can	Silver Can

# Results



We find that the **black** can actually **loses** heat more quickly than the silver one.

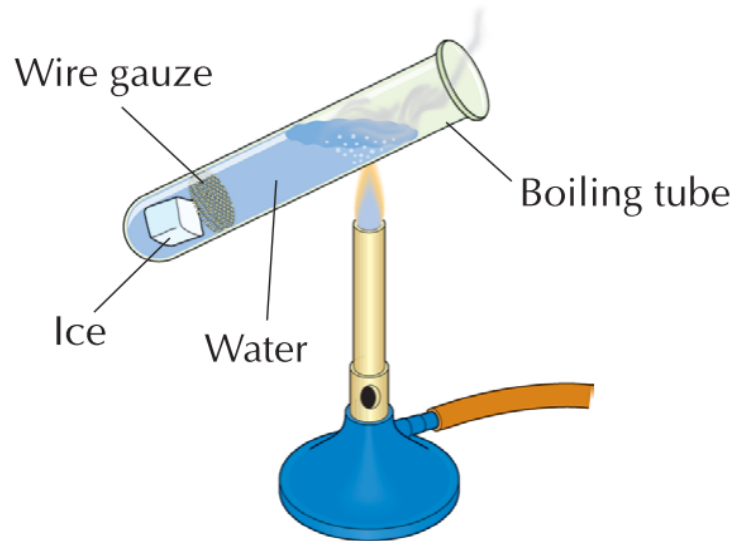


This shows that black objects give away heat better than other colours.

This type of radiation is called Black Body radiation.

What colour would be best for radiators in your house?

## Conduction of Heat by Water



What will happen to the ice cube?

Water is a poor conductor of heat. You can boil water and still have a lump of ice in the same test tube!

# Boiling Water

**What temperature does water boil at?**

**Would water boil at the same temperature on top of mountain?**

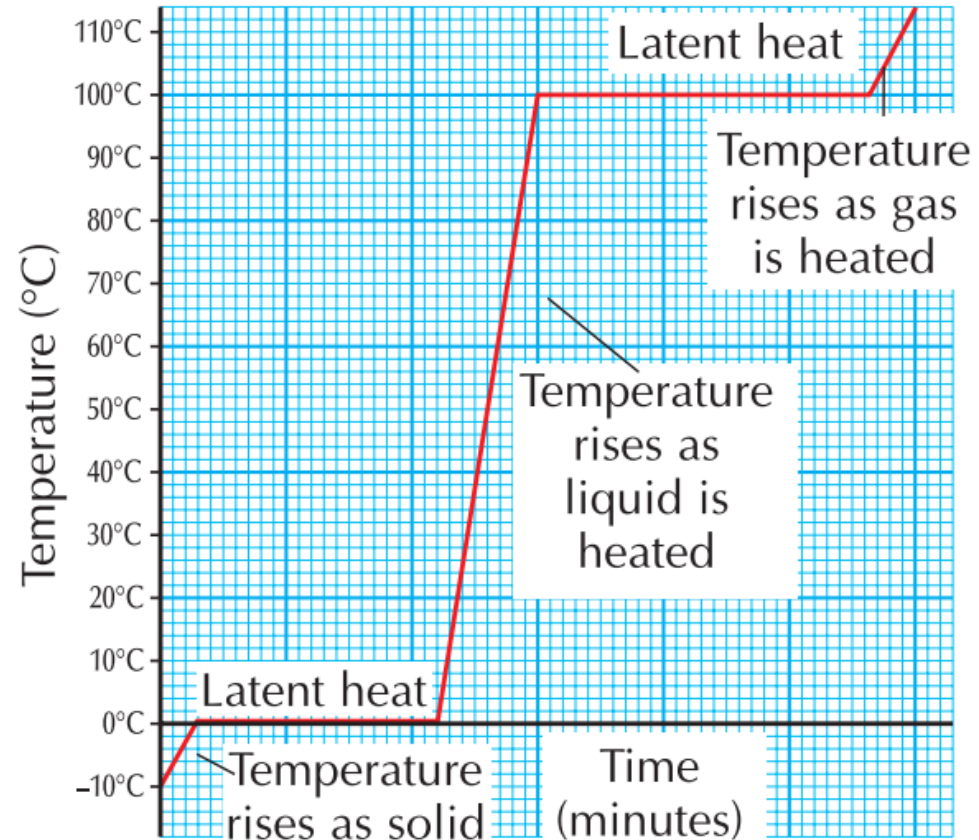


Decreasing pressure lowers the boiling point of water so it boils at a lower temperature on top of a mountain.

# Latent Heat

Latent heat is the energy used to change from **one state to another**. When solids melt into liquids some of the heat energy is used up in the change.

When the liquid boils into a gas some of the energy is used up in the change.





# Temperature and Heat

**Temperature depends on the amount of heat.**

The more heat there is then the higher the temperature.

