S1 SCIENCE
Measuring

What you need to know

Bunsen Burners:

- The yellow flame is the safety flame - it is easy to see.
- The air hole should be closed to use the yellow flame.
- The blue roaring flame should be used for heating.
- The air hole should be open to use the blue flame.
- You must follow safety precautions when using a Bunsen Burner such as:
  - Wear safety goggles
  - Bags under chairs
  - Lab surfaces clear
  - Ties tucked in

Temperature

- Thermometers are used to measure temperature.
- When a thermometer is heated, the alcohol inside expands and rises up in the tube.
- The unit of temperature is the degree Celsius (°C).
- Ice melts at 0 °C, room temperature is about 20 °C, the human body is 37 °C and water boils at 100 °C.

Mass

- A balance is used to measure mass.
- The units of mass are grams and kilograms (g and kg).
- There are 1000 grams in 1 kg.
- To convert kg into g, × 1000, and to convert g into kg, ÷ 1000.

Volume

- The volume of a substance is the amount of space it takes up.
- The volume of a cuboid can be calculated using the formula
  volume = length x breadth x height
- The volume of a liquid can be measured using a measuring cylinder.
- The units of volume are millilitres, litres, and centimetres cubed (ml, l, and cm^3).
- There are 1000 millilitres in 1 litre.
- To convert l into ml, × 1000, and to convert ml into l, ÷ 1000.

- The volume of an irregular shape can be measured by placing it into a measuring cylinder filled with liquid and noting the change in volume of the liquid.

Measuring Small Things

- Measuring small things without the correct equipment gives you inaccurate measurements.
- The best way of measuring small masses accurately, e.g. the mass of a pea is to measure the mass of 50 peas and divide the total mass by 50.
- The best way to a small volume, e.g. the volume of a drop of water is to measure the volume of many drops, e.g. of 40 drops and divide the total volume by 40.

Calculating the Mean

- To calculate the mean value of a series of measurements, add up all the results and then divide by the number of results taken.
- Repeating measurements many times and getting the mean value helps to reduce errors in our measurements which makes the results more reliable.

Other Measurements

- The scientific unit of time is the second (s).
- The scientific unit of distance/length is the metre (m).
- There are 100 centimetres (cm) in 1 metre.
- To convert m to cm, × 100, and to convert cm into m, ÷ 100.

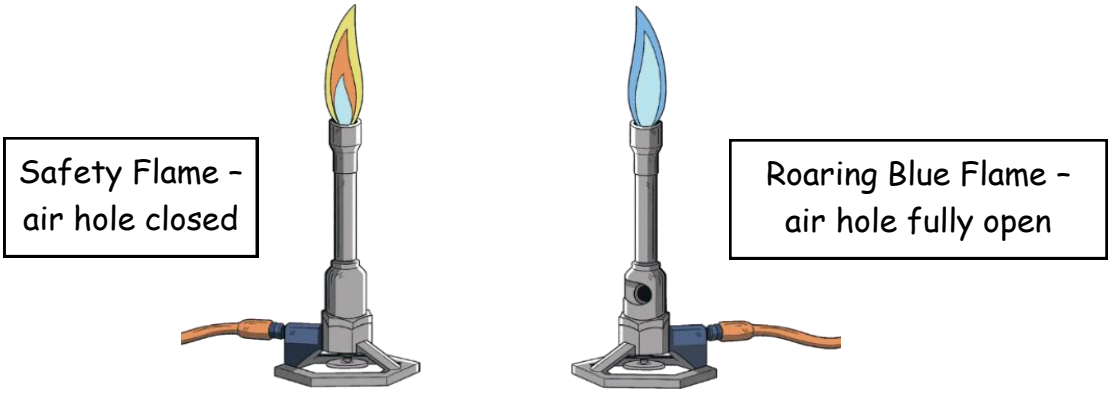
Pendulum Experiment

- In science, a fair test is when you only change one variable and keep the other variables the same.
- From a set of results, you should be able to describe how the variable that has been changed has affected the variable that has been measured.

Using Bunsen Burners

We use a **Bunsen Burner** in science to heat things up.

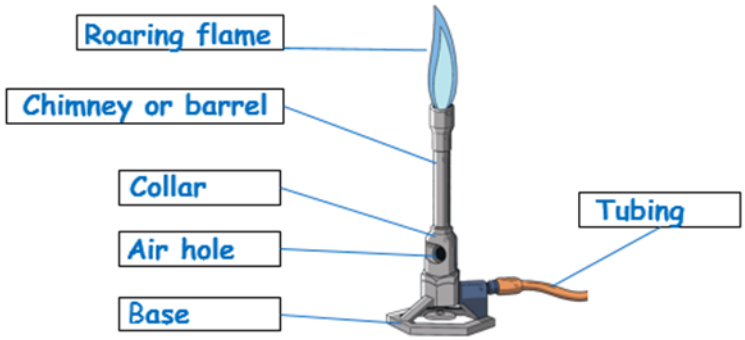
There are 2 different flames on the Bunsen Burner - a yellow flame and a blue flame.



The **yellow flame** is known as the **safety flame**. This flame can be seen easily when the Bunsen Burner is not in use.

The **roaring blue flame** is **used for heating** during experiments.

Below is a labelled diagram of the Bunsen Burner showing the different parts.



There are a number of safety precautions we must take when using a Bunsen Burner.

These include:

· stand up

· wear eye protection

· tie hair back

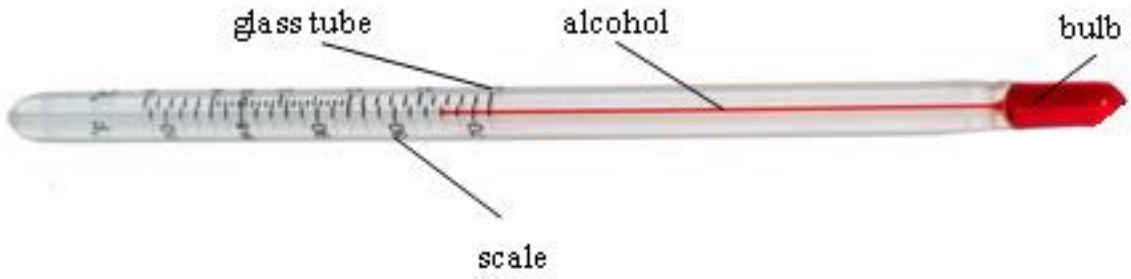
· tuck ties in

Temperature

Temperature is a measure of **how hot** something is.

Temperature is measured using a **thermometer**.

If a doctor wishes to find out if a person has a higher temperature than normal then they will use a thermometer. The **unit of temperature** is the **degree Celsius (°C)**. Normal human body temperature is 37°C.



Our laboratory thermometers are made from a hollow tube of glass. The bulb of the thermometer contains a liquid called alcohol with a red dye to make the alcohol easier to see. When the bulb is heated the alcohol expands (gets bigger) and rises up the tube.

Thermometers are used to measure different temperatures.

Some other useful temperature to remember:

- ice melts at 0°C
- water boils at 100°C
- room temperature is usually about 20°C.

It is possible to get temperatures lower than 0°C. Below this temperatures become negative. A temperature ten degrees below zero is said to be minus 10 degrees Celsius. We write this as -10°C.

In space, temperatures can be as low as -270°C.

Mass

In Science we do not talk about the *weight* of a bag of sugar being 1 kilogram.
We say that the *mass* of the bag of sugar is 1 kilogram (kg).

Mass is a measure of **how much matter** an object is made of.
Mass is measured in **grams (g)** and **kilograms** (**kg**)

To measure mass we use an instrument called **a balance** .

In the lab we use an electronic balance. The balances in the lab can measure the mass of an object in grams. There are 1000 grams in 1 kilogram

To change **grams into kilograms**, **÷ 1000** (so 3500 grams is 3.5 kg)

To convert **kilograms into grams**, **× 1000** (so 2.64 kilograms is 2640 grams)

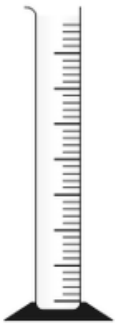
Volume

The **amount of space taken up** by an object is called the **volume** of an object.
You know the volume of a cuboid is found by multiplying the length by the breadth by the height.
If length, breadth and height are all in centimetres then the volume is measured in centimetres cubed.

For example, if a cuboid is 10cm in length, 5cm broad and 15cm high then the volume is:

$$\begin{aligned} \textit{Volume} &= \textit{Length} \times \textit{Breadth} \times \textit{Height} \\ &= 10\text{cm} \times 5\text{cm} \times 15\text{cm} \\ &= 750\ \text{cm}^3 \end{aligned}$$

You have seen how to use a measuring cylinder to measure the volume of a liquid. The **main unit of volume** is the **litre (l).** Other units used are **millilitres (ml)** and **centimetres cubed (cm^3).**



There are 1000 millilitres in 1 litre.

1 cm^3 is the same volume as 1 millilitre.

To convert litres into millilitres multiply by 1000, so 3.76 litres is equal to 3760ml.

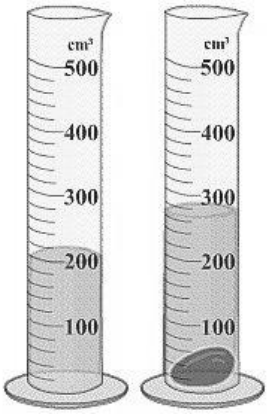
To convert millilitres to litres divide by 1000, so 150ml is equal to 0.15 litres.

The volume of irregular shapes can be measured by placing the irregular shape into a measuring cylinder filled with liquid. The increase in volume is equal to the volume of the object placed into the liquid.

Example:
The reading on the measuring cylinder opposite increases from 200cm^3 to 300cm^3 when the stone is placed into the liquid.

300cm^3 - 200cm^3 = 100cm^3

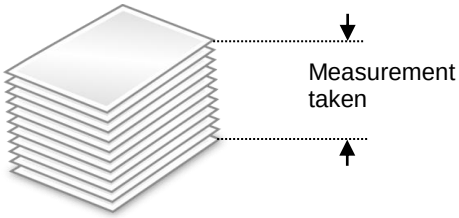
Therefore the volume of the stone is 100cm^3.



Measuring Small Things

It can be difficult to measure small things accurately in science. For example, you could not use a ruler to measure the thickness of a piece of paper. This problem can be overcome by measuring the thickness of 100 sheets of paper.

Stack of 100 sheets of paper.



If 100 sheets are 2 centimetres thick.
One sheet would be 2/100 centimetres thick. One sheet is 0.02 cm thick.

The same idea can be used to work out the volume of a drop of liquid.
If 20 drops are found to have a volume of 8 cm^3.
One drop would have a volume of 8/20 cm^3.
One drop has a volume of 0.4cm^3.

Calculating the Mean

In science when we want to get a reliable measurement from an experiment. We often repeat the measurements multiple times and then work out the mean of the measurements.

Calculating **mean** values makes a measurement more **reliable**.

For example, to get a reliable measurement for the time it takes a marble to run down a slope we should repeat the experiment at least 5 times.
We can then add the 5 times together and divide by 5 to get the mean.

Expt. No.	*1*	*2*	*3*	*4*	*5*
Time (seconds)	*2.1*	*2.0*	*1.9*	*2.1*	*1.9*

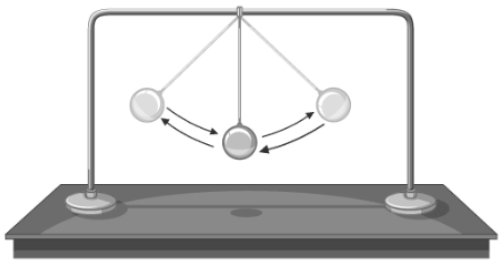
$$\text{So the mean time} = \frac{(2.1 + 2.0 + 1.9 + 2.1 + 1.9)}{5} = 2 \text{ seconds}$$

Carrying Out an Investigation

When a scientist carries out an experiment they are looking for an answer to a question. In order to obtain meaningful results the experiment must be **fair**. This means that **only one variable should be changed** - the variable the scientist is investigating!

For example, a scientist wants to find to find out how the length of a pendulum affects the time it takes to complete one swing.

To make it a fair test the scientist must keep all the other variables, like the mass of the ball, the same.



The only variable they change is the length of the string, and the time taken for one swing is measured for each of the different lengths.