

Listen Maths

The Basic Ideas of Mass and Size

Mass

Mass is a measure of how much force gravity exerts on an object.

Heavy things have a lot of mass; light things have a small mass.

The basic unit of mass is the gram. A gram is about the mass of a bean or an almond.

We use larger units for heavier things like people, buses etc.

A kilogram is 1000 grams. The prefix kilo- always means 1000, so a kilometre is 1000 metres, a kilovolt is 1000 volts, a kilolitre is 1000 litres and so on. A kilobyte of hard-drive memory is 1000 bytes.

An average adult weighs 60-100 kilograms.

A bus has a mass of thousands of kilograms, so we often use an even larger unit, the tonne. 1 tonne is 1000 kilograms. A bus might weigh 10 tonnes.

A tonne, spelt TONNE, is similar to the old British imperial unit, ton, spelt TON, though not exactly the same.

For very light things we can use a smaller unit, the milligram which is $\frac{1}{1000}$ of a gram.

The prefix milli- always means $\frac{1}{1000}$ of. So a millimetre is $\frac{1}{1000}$ of a metre, a millilitre is $\frac{1}{1000}$ of a litre, a millifarad is $\frac{1}{1000}$ of a farad and so on.

A mosquito might weigh about a milligram.

People sometimes confuse the prefixes milli- and kilo-. If you know a millimetre is a small unit and kilometre is a large unit, then that should tell you which is which. Another way to remember is that a millipede might be weighed in milligrams, while a killer whale might be weighed in kilograms. Not vice versa.

Length and Distance

Length is how long something is; distance is how far it is from one place to another. Both are measured in metres.

A metre is a large pace for an adult. A room might be 5 metres long.

1000 metres is a kilometre. The distance between two towns might be a few kilometres.

$\frac{1}{1000}$ of a metre is a millimetre. A fly might be a few millimetres long.

In everyday use, people sometimes also use the unit 'centimetre'. A centimetre is $\frac{1}{100}$ of a metre, and is therefore 10 millimetres.

'Centi-' comes from 'centum', the Latin for 100, as does the word 'century' meaning '100 years' and 'percent' meaning 'hundredths' or 'out of 100'.

A finger might be a centimetre wide and 7 centimetres long.

Area

Length is the size of something in one direction or one dimension. We might say the length of a road is 500 metres.

But a road also has a width. If we take its width into account as well, then we are talking about the surface of the road. The size of a surface is called its area.

Area is measured in square metres. A square metre is a square 1 metre by 1 metre. The area of the road is how many square metres it would take to cover it.

If the road is 5 metres wide, then a row of 5 squares would fit across it. 500 such rows would cover its whole length. So the area is 5×500 or 2500 square metres.

A surface is two dimensional. It has two dimensions, length and width. Each dimension can be measured in metres. The surface is measured in square metres.

A surface can also be measured in square kilometres (squares 1 kilometre by 1 kilometre), square millimetres (squares 1 millimetre by 1 millimetre), square centimetres (squares 1 centimetre by 1 centimetre) or hectares (squares 100 metres by 100 metres).

Volume

The tar and underlying gravel of the road also has a thickness or depth. Thickness or depth is its size in the vertical direction, a third dimension. The size of something in three dimensions is called its volume. Volume is measured in cubic metres (cubes 1 metre by 1 metre by 1 metre).

If the road is 2 metres thick, then 2500 metre cubes would cover it, but there would have to be another layer underneath to make it 2 metres thick. This would be a total of 5000 cubic metres. So the volume of the road would be 5000 cubic metres.

Note that to find the area of the road surface, we multiplied the width by the length (5 metres by 500 metres to make 2500 square metres).

To find the volume of the road, we multiplied the width by the length and then by the depth (5 metres by 500 metres by 2 metres to make 5000 cubic metres).

Volume can also be measured in cubic kilometres (cubes 1 kilometre by 1 kilometre by 1 kilometre), cubic millimetres or cubic centimetres.

Litres

There are actually a million cubic centimetres in a cubic metre. It would be handy to have a unit in between those. We do; it's the litre. A litre is 1000 cubic centimetres.

A kilolitre is 1000 litres and is the same as a cubic metre.

A millilitre is $1/1000$ of a litre and is the same as a cubic centimetre.

Litres and millilitres are the volume units we are most familiar with. We might buy a litre of milk or ice cream or 40 litres of petrol. We might buy 150 millilitres of nail polish remover or cough medicine.

Capacity

Capacity is how much a container can hold – the volume of stuff it will hold.

When you buy a 2-litre tub of ice cream, the ice cream has a volume of 2 litres; the tub has a capacity of 2 litres.

Because capacity is the volume that a container will hold, capacity and volume are measured in the same units – litres, millilitres, cubic centimetres, cubic metres etc.

Summary

We use different words for size depending on the number of dimensions we are interested in.

For a piece of string, we might be interested in just one dimension, its length. So then its size is its length, measured in metres, millimetres etc.

A block of land or a field might have a length, but its width is also important if we want to talk about its size. It is 2-dimensional and its size is called its area, measured in square metres, hectares etc.

The water in a lake has length and width, but also depth. We have to know the depth as well to know how much water there is. So the body of water has 3 dimensions. The size of a 3-dimensional thing is its volume, measured in cubic metres, cubic centimetres, litres, kilolitres etc.