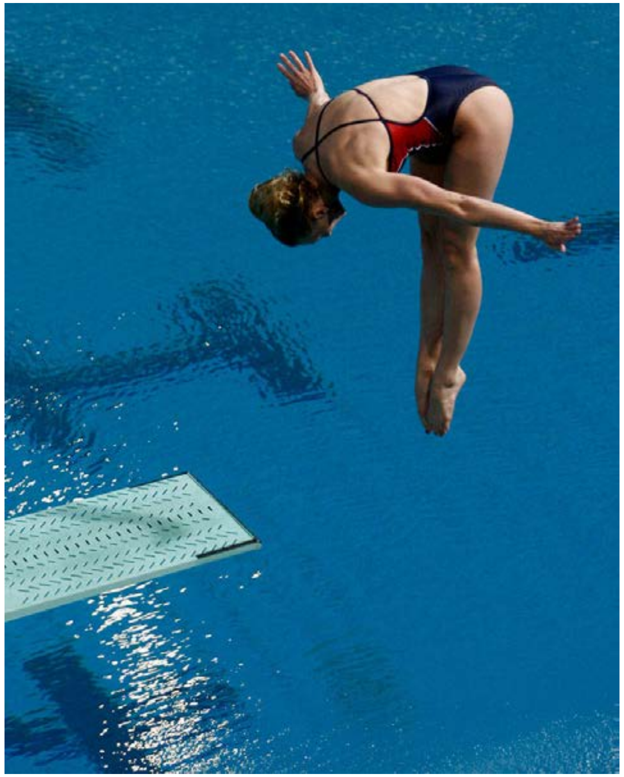
Numeracy Across the Curriculum

SCIENCE

Substituting into Formulae

In both your maths and science lessons you will be expected to substitute into formulae. In formulae different variables are represented by letters.

Substitution simply means putting numbers where the letters are to work something out.



Example

A diver who has a mass of 50 kg dives off a diving board 3.0 metres above the water level. What is her kinetic energy when she reaches the water?

[Formula 1] Kinetic energy gained = gravitational potential energy lost

= weight × height

You must calculate her weight to use in this equation

[Formula 2] Weight = mass × gravitational field strength

[Substitution] Weight = 50 kg × 10 N / kg

Weight = 500 N

Kinetic energy gained = weight × height

[Substitution] Kinetic energy gained = 500 N × 3 m

= 1500 J

Numeracy Across the Curriculum

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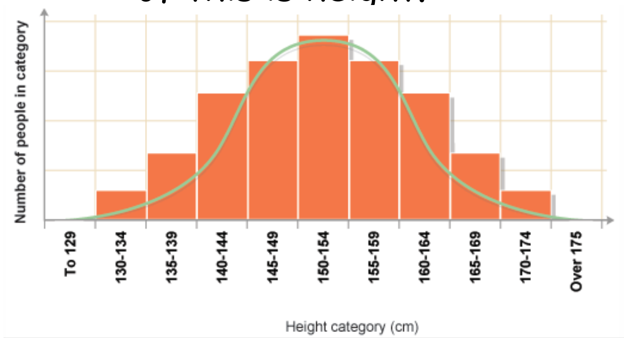
Continuous and Discrete Data

Continuous data

Continuous data can take any value in a range.

An example of a **continuous variable** is mass, for example the mass of iron in a mixture of iron filings and sulphur powder. The iron could have a mass of 3.6 g, 4.218g, 0.24g etc. depending on the mixture concerned.

In biology, a characteristic of a species that changes gradually over a range of values shows **continuous variation**. An example of this is height.



Discrete data

Discrete data can only take certain fixed values.

The pH of a solution is a **discrete variable**. The pH of a solution can take integer values of pH from pH 0 for a very strong acid to pH 14 for a very strong alkali. Solutions with pH 7 are said to be neutral.

In biology a characteristic of any species with only a limited number of possible values shows **discontinuous variation**. An example is blood group – there are only 4 types of blood group (A, B, AB and 0), no other values are possible.

Numeracy Across the Curriculum

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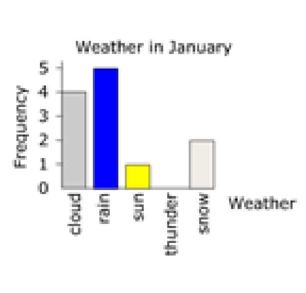
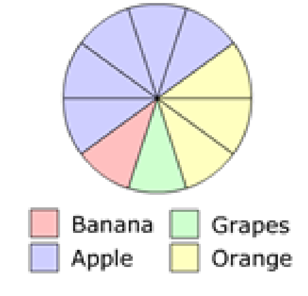
Handling Data

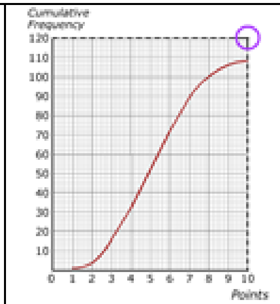
Most charts and graphs you use in science you will also use in maths. Here are some examples.



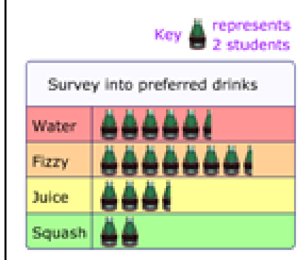
Bar Chart



Pie Chart



Cumulative frequency graph

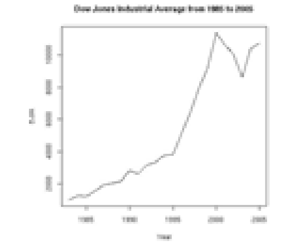


Pictogram

KEY: 2 | 5 means 25

0	6 7 8
1	0 2 3 4 7 7 7 8 9
2	1 3 4 4 5 7
3	1 1 2 6 6 9
4	1 5 5 6 9
5	0

Stem and leaf diagram



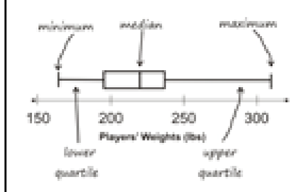
Line Graph

Height h (cm)	Tally	Frequency
$30 \le h < 40$	卌	5
$40 \le h < 50$	卌 II	7
$50 \le h < 60$	III	3
$60 \le h < 70$	卌	5
$70 \le h < 80$	III	3

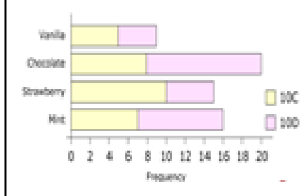
Grouped frequency table

	Blue	Black	Total
Fountain	32	32	
Ballpoint	22	34	
Fibre Tip	37	37	
Total			

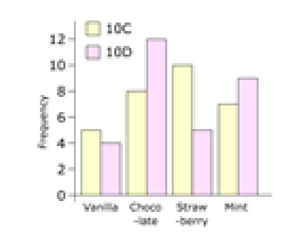
Two-way table



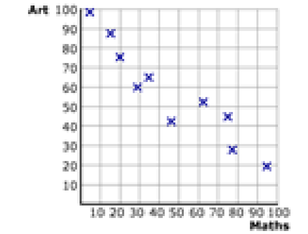
Box plot



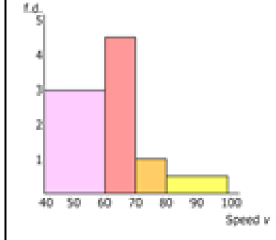
Stacked bar chart



Duel bar chart



Scatter graph



Histogram

Colour	Tally	Frequency
Red	卌 III	8
Black	卌 I	6
Blue	卌 I	6
Green	IIII	4
Silver	卌	5
Other	III	3

Tally chart

Venn diagram

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Converting between Metric Units

There are two main types of units:

Imperial Units	**Metric units**
(Stones, pints, miles etc.)	(kilograms, litres, metres etc.)
Old system of units	Modern system of units

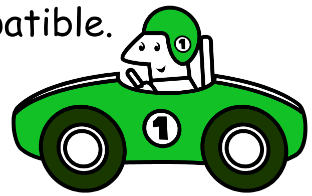
Metric units follow the decimal system. To convert between them you multiply or divide by multiples of 10.

For example 1 kg = 1000 g

So 3.4 kg = 3.4 x 1000 = <u>2400 g</u>

And 24 g = 24 ÷ 1000 = <u>0.024 kg</u>

When working out calculations it is important that the units you are using are compatible.



$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

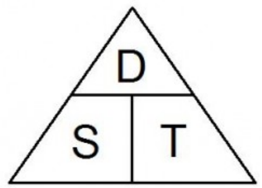
If the speed is in kilometres per hour then the distance needs to also be measured in kilometres and the speed needs to be measured in hours.

What is the average speed in km/h of a car if it travels 4600 metres in 15 minutes?

4600 m = 4600 ÷ 1000 = 4.6 km

15 minutes = 15 ÷ 60 hours = 0.25 hours

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{4.6}{0.25} = \underline{18.4 \text{ km/h}}$$



Numeracy Across the Curriculum

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Manipulating Algebraic Formulae

Manipulating algebraic formulae allows you to rearrange formulae so that you can work out the value of different variables. This is also known as "changing the subject of a formula."

The Power Equation

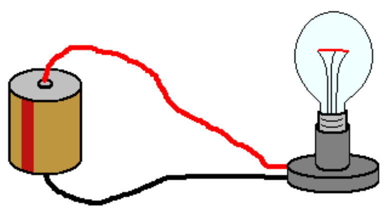
P = IV

P = power (watts)
I = current (amps)
V = voltage (volts)

e.g. If a bulb generates 24 watts with a current of 2 amps flowing through it, what is the voltage across it?

$P = IV$

[Rearranging] $V = \frac{P}{I}$



[Substituting] $V = \frac{24}{2} = \underline{12 \text{ volts}}$

Equations of Motion

v = u + at

v = final velocity (m/s)
u = initial velocity (m/s)
a = acceleration (m/s^2)
t = time (s)

e.g. A ball is rolled along the ground for 20 seconds. Its initial velocity is 10m/s and its final velocity is 45m/s. What is its acceleration?

$v = u + at$

[Rearranging] $v - u = at$ therefore $\frac{v - u}{t} = a$

[Substituting] $a = \frac{v - u}{t} = \frac{45 - 10}{20} = \underline{1.75 \text{ m/s}^2}$

Numeracy Across the Curriculum

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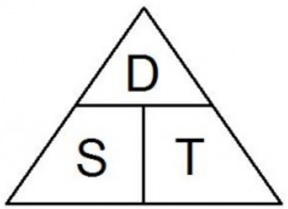
Compound measures

A compound measure is made up of two (or more) other measures.

Speed is a compound measure made up from a measure of length (kilometres) and a measure of time (hours).

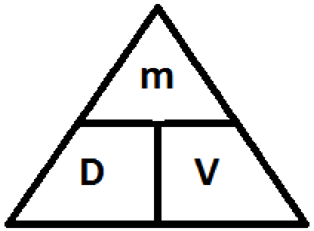


$$\textbf{Speed} = \frac{\textbf{Distance}}{\textbf{Time}}$$

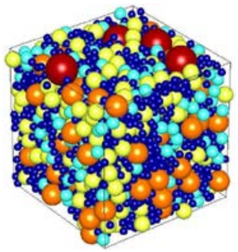
Triangles are often used to show the relationship between the compound measure and the measures it is made up of.

Density is made up from a measure of mass (grams) and a measure of volume (cubic centimetres).

Density tells you how compact a substance is.



$$\textbf{Density} = \frac{\textbf{Mass}}{\textbf{Volume}}$$



The triangle can be used to rearrange the formula.

For example in this case:

$$\text{Mass} = \text{Density} \times \text{Volume}$$

and

$$\text{Volume} = \frac{\text{Mass}}{\text{Density}}$$