Numeracy across the Curriculum

Numeracy booklet

Dalziel High School 2010

Introduction

Numeracy is the ability to reason using numbers and other mathematical concepts. We are numerate if we can use numbers to solve problems, analyse information and make informed decisions based on calculations. Numeracy is a skill for life, learning and work. Having well-developed numeracy skills allows young people to be more confident in social settings and enhances their enjoyment in a large number of leisure activities.

Numeracy is developed in Maths but is reinforced in departments across the school. It is more than an ability to do basic arithmetic and requires understanding of a range of techniques. The concepts of numbers and measures, number systems and problem solving can be approached in a range of different contexts, such as calculations in Science, map scales in Geography or representing musical notes as fractions. Numeracy also requires understanding of the ways in which data can be collected by counting and measuring and can be presented in graphs, charts and tables. These skills are taught across the school in different settings and contexts and, as such, it is important that there is a consistent approach by all teachers to avoid confusion for our young people.

Content:

1. Estimation and Rounding

An estimate is a good approximation of a quantity that has been arrived at by judgement rather than guessing. Rounding is used to obtain this good approximation.

Rounding to the nearest ten, hundred or thousand:

Remember the rule, 'five or more'. Look at the next digit after the one to which you are adjusting. If this is five or more, the digit you are adjusting goes up.

To the nearest 10	32 becomes	30
	36 becomes	40
To the nearest 100	327 becomes	300
	352 becomes	400
To the nearest whole number	86.2 becomes	86
	86.5 becomes	87

7.52 to 1 decimal place   7.5
7.96 to 1 decimal place   8.0

3.141592 = 3.14 (2 dec places)
= 3.142 (3 dec places)
= 3.1416 (4 dec places)

Using rounding to estimate:

Eg At a concert in Wembley stadium, there were 64,880 fans. Here we would say there were approximately 65,000 fans.

2. Subtraction

Standard decomposition method is used as a written method. We encourage pupils to check answers by addition. We actively promote varied mental strategies as appropriate.
We do not use 'borrow and pay back' method.

- decomposition

$$\begin{array}{r} 2\ \overset{5}{\cancel{6}}\ {}^{1}1 \\ -\ \ 2\ 8 \\ \hline 2\ 3\ 3 \end{array} \qquad\qquad \begin{array}{r} \overset{2}{\cancel{3}}\ \overset{9}{\cancel{{}^{1}0}}\ {}^{1}0 \\ -\ \ 6\ 3 \\ \hline 2\ 3\ 7 \end{array}$$

- counting on
  to solve 51 – 24, count on from 24 until you reach 51

- breaking up number being subtracted
  to solve 51 – 24, subtract 20 then subtract 4

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3. Fractions

Simple fractions

$\frac{1}{3}$ of 12 = 4 we do 12 ÷ 3

$\frac{1}{5}$ of 40 = 8 we do 40 ÷ 5

$\frac{3}{4}$ of 120 = 90 we do 120 ÷ 4 and then multiply by 3

Addition and subtraction of fractions

$\frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$ we make the denominators equal

Multiplication of fractions

$\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$ we multiply top and bottom and then simplify

Division of fractions

$\frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \times \frac{5}{2} = \frac{15}{8}$ we invert the second fraction and multiply

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In Music, pupils are asked to compile 2, 3 or 4 beats in the bar. To do this they may use a variety of different notes, all carrying different fractional amounts, but must ensure that their fractions add up to the amount of beats they have been given.

For example:

Crotchet	♩	1 beat
Quaver	♪	$\frac{1}{2}$ beat
Semi-quaver	𝅘𝅥𝅯	$\frac{1}{4}$ beat
Demi-semi-quaver	𝅘𝅥𝅰	$\frac{1}{8}$ beat

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4. Percentages

Pupils are expected to have a sense of common percentages and equivalent fractions.

100% = 1 50% = $\frac{1}{2}$ 25% = $\frac{1}{4}$ 10% = $\frac{1}{10}$

We tend not to use the % button on calculators because of inconsistencies and increased error risk.

Pupils are expected to find more complex percentages with the use of a calculator. For example 24% of 400 would involve 24÷100x400. Pupils should recognise the word ‘of’ as meaning multiply.

Some mental strategies:

Eg 65% of 40

50% = 20
10% = 4
5% = 2

so 65% = 26

(we often use this strategy to calculate VAT at 17.5% by calculating 10%, 5% and 2.5%).

Eg express $\frac{2}{5}$ as a percentage

$$\frac{2}{5} = \frac{4}{10} = \frac{40}{100} = 40\%$$

Percentages in context:

i)An electrical shop has a 25% off sale. How much would a kettle cost if its original price was £24?

Here we are being asked to consider £24 less 25% (or a quarter).

Solution: $\frac{1}{4}$ of £24 = £6. Then £24 - £6 = £18.

ii)A car is purchased for £5000. It is sold a year later for £3500. Calculate the percentage loss.

Loss = 5000 – 3500 = 1500

$$\frac{1500}{5000} \times 100 = 30\%$$

iii) Calculate the percentage increase for the following Biology example.

In 1950, 5 tonnes of fertiliser per hectare was added to a field. By 2003 this increased to 16.2 tonnes of fertiliser per hectare.

Calculate the % increase in fertiliser over the period.

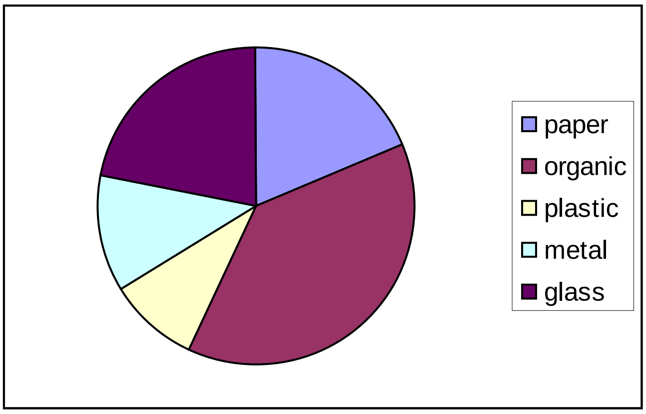
16.2 – 5 = 11.2

It follows then $\frac{11.2}{5}$ X 100 = 224% increase

(iv)Waste Diary – Pupils record types of waste over a week using tally marks (example from Geography)

Results

Paper	12
Organic	24
Plastic	6
Metal	8
Glass	14
Total	64



Percentage paper = $\frac{\text{amount}}{\text{total amount}}$ x 100

= $\frac{12}{64}$ x 100

= 18.75 %

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5. Proportion and Ratio

We use the unitary method of proportion, which means that we find the value of one item and then multiply by the required number.

Eg If 5 apples cost 80p, what do 3 apples cost ?

5	-------	80p
1	-------	80p ÷ 5 = 16p
3	-------	16p x 3 = 48p

Ratio example – divide £1000 in the ratio of 3:2

3 + 2 = 5 so there are five parts
Divide 1000 by 5 to get 200 which means £200 per part

For 3 $3 \times 200 = £600$
For 2 $2 \times 200 = £400$

In Home Economics, ratio is used extensively in recipes.
For example, in making a sponge cake, scaling up can be used as follows:

1 egg to 50g of flour, 50g of sugar, 50g of margarine
2eggs to 100g of flour, 100g of sugar, 100g of margarine

If on a map the scale is 1:50 000. What distance is 10cm on the map in real life?

1cm (map)	=	50 000 cm (real)
	=	50 000 ÷ 100 (there are 100cm in a metre)
	=	500m
10cm (map)	=	10x 500m
	=	5000m
	=	5000 ÷ 1000 (there are 1000m in a km)
	=	5km

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6. Time

Conversion of time between 12 and 24 hour clock is reinforced in S1 maths. Calculation of duration in hours and minutes is taught by counting on to the next hour and then on to the required time.
We do not teach time as a subtraction.

Eg How long is it from 0655 to 0942?

0655 to 0700	5 mins
0700 to 0900	2 hours
0900 to 0942	42 mins
Total time	2hrs 47mins

Conversion between hours and minutes is taught by multiplying by 60 for hours into minutes. From minutes into hours we divide by 60.

Eg. Change 33 minutes into hours equivalent
33 mins = 33 ÷ 60 = 0.55 hours

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7. Rules of Operators – BODMAS

Pupils are taught to know that multiplication and division have precedence over addition and subtraction and that brackets have an even higher precedence.
BODMAS is the mnemonic we teach in maths to enable pupils to use the correct sequence of carrying out number operations. Pupils are taught to recognise that basic (four function) calculators will work differently from scientific calculators.

B Brackets
O Of
D Division
M Multiplication
A Addition
S Subtraction

Consider   2 + 3 x 4

Using BODMAS the multiplication must be carried out first, followed by the addition.

Solution   2 + 12 = 14

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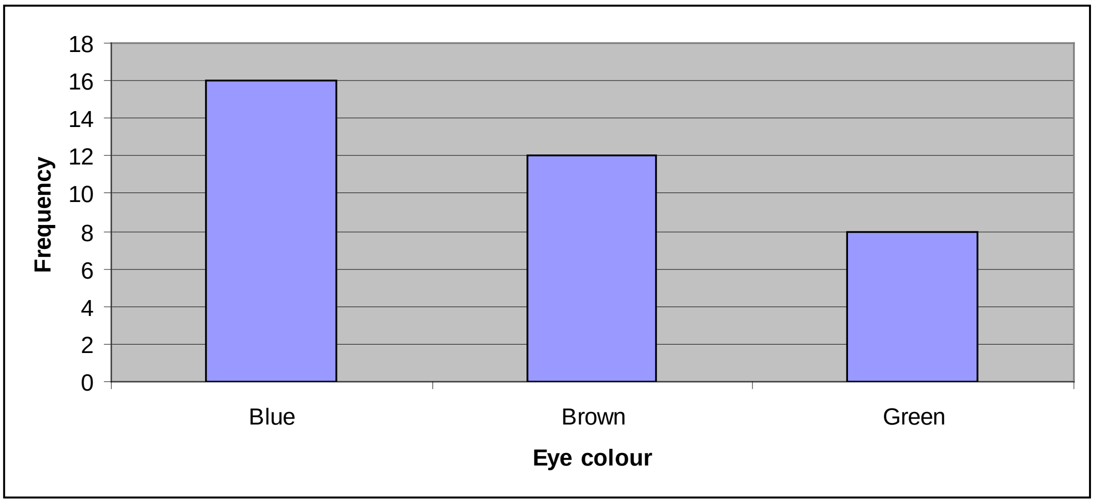
8. Information Handling

Pupils are expected to interpret and construct various types of statistical information. Graphs and charts have to be labelled appropriately, as are axes.
Example - 36 students compared colour of eyes

Blue	16
Brown	12
Green	8
Total	36

Statistical displays:
Bar Chart

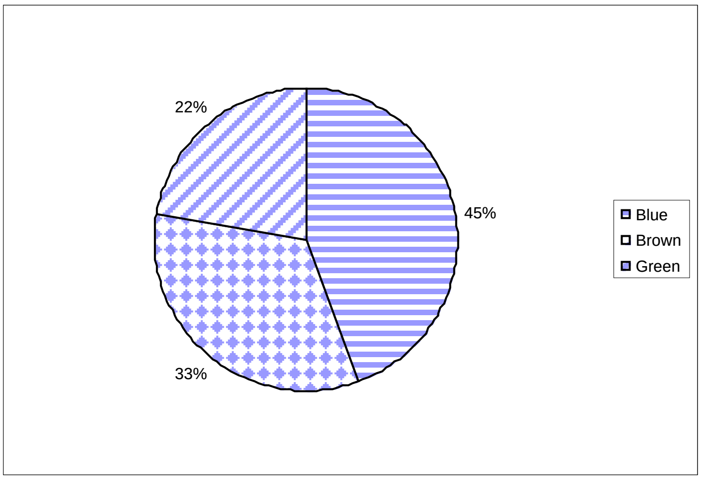


Pie Chart

Blue $\frac{16}{36}$ x 100 = 45%

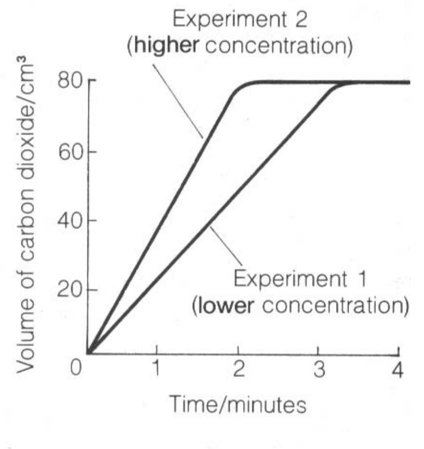
Brown $\frac{12}{36}$ x 100 = 33%

Green $\frac{8}{36}$ x 100 = 22%



The following charts are examples of graphs used in Chemistry

1. <u>Graphs and Changing Concentration</u>



Conditions for Experiments 1 & 2

- Equal mass of chalk
- Identical particle size of chalk
- Equal volumes of acid
- Same temperature
- Chalk runs out, not acid

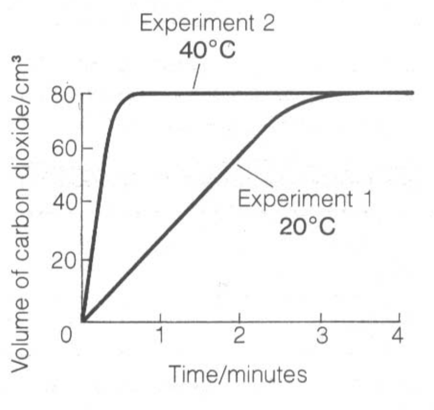
Experiment 1 – dilute acid

Experiment 2 – concentrated acid

Result

Experiment 2 has faster initial reaction rate (i.e. it is steeper at start). This is due to more concentrated acid being used.
Experiments 1 & 2 end at same volume of gas because same conditions were used.

2. <u>Graphs and Changing Temperature</u>



Conditions for Experiments 1 & 2

- Equal mass of chalk
- Identical particle size of chalk
- Equal volumes of acid
- Equal concentrations of acid

Experiment 1 – 20^{o}C

Experiment 2 – 40^{o}C

Result

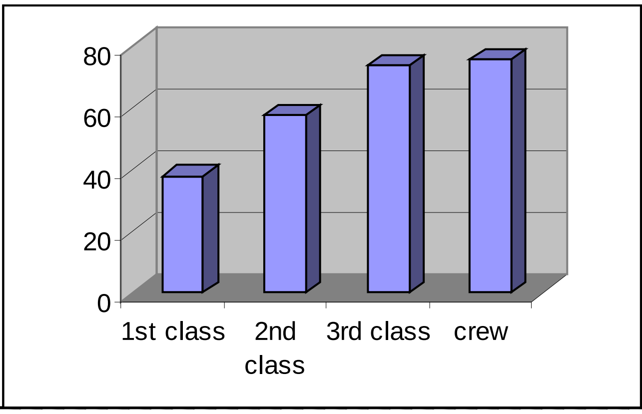
Experiment 2 has faster initial reaction rate (i.e. it is steeper at start). This is due to the increased temperature speeding up the reaction.
Experiments 1 & 2 end at same volume of gas because same conditions were used.

Social Subjects example - Death Rate on the Titanic

	Total	Deaths	Death rate %
First Class	325	124	
Second Class	281	163	
Third Class	710	531	
Crew	892	685	

Death rate is calculated $\frac{\textbf{Deaths}}{\textbf{Total}} \times 100$

	Total	Deaths	Death rate %
First Class	325	124	38%
Second Class	281	163	58%
Third Class	710	531	75%
Crew	892	685	77%



9. Scientific Notation or Standard Form

This is where a number in scientific notation is written as a number between one and ten multiplied by 10 to a power of a value.

Examples

$5{,}700{,}000 = 5.7 \times 10^{6}$

$23{,}400{,}000 = 2.34 \times 10^{7}$

$1{,}425{,}000{,}000 = 1.425 \times 10^{9}$

$0.000025 = 2.5 \times 10^{-5}$

$0.000766 = 7.66 \times 10^{-4}$

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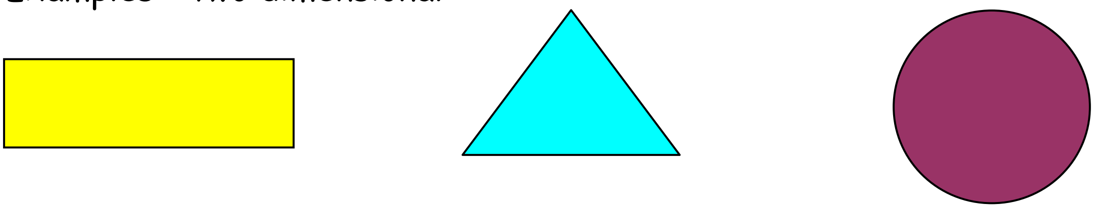
10. Geometry

Pupils frequently confuse the names of two and three-dimensional shapes. It is important, therefore, that we use the correct terminology.

Examples – two dimensional



Rectangle Triangle Circle

These shapes only have length and width – no depth.
As soon as a shape has thickness (depth) in addition to length and width it becomes three dimensional and must assume the three – dimensional name.

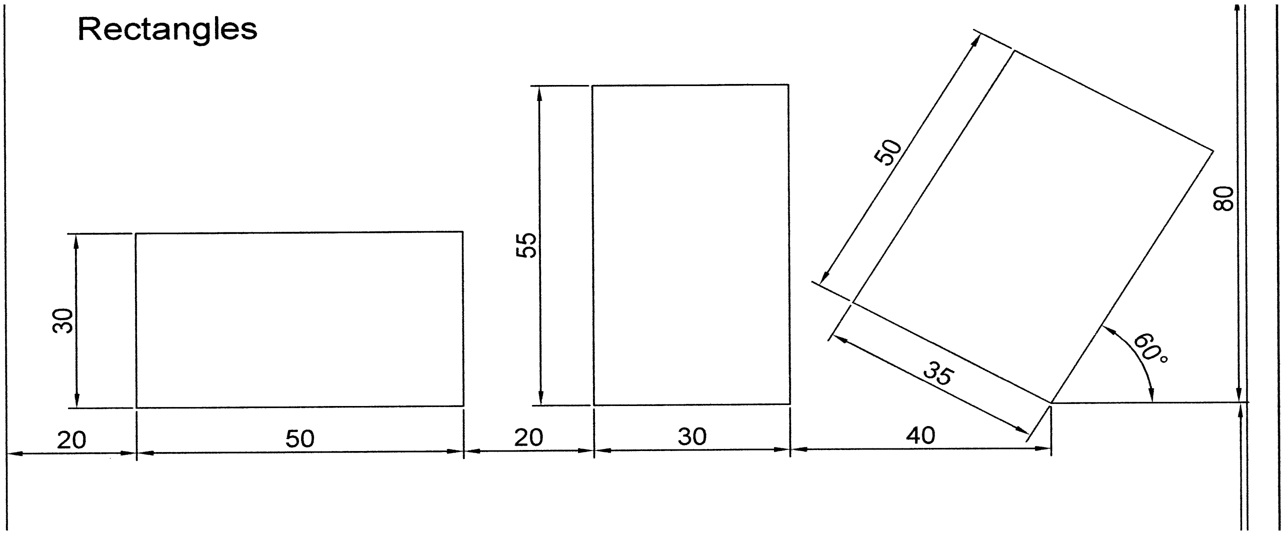
Examples – three dimensional

Cuboid

Sphere

Cylinder

A piece of work from Graphic Communications



11. Measures

Metric Units Equivalence

<u>Length</u>	<u>Volume</u>	<u>Weight/Mass</u>
10mm = 1cm	1000ml = 1 litre	1000mg = 1g
100cm = 1m	100cl = 1 litre	1000g = 1 kg
1000m = 1 km	$1cm^3$ = 1ml	1000kg = 1 tonne

Imperial Units Equivalence

<u>Length</u>	<u>Volume</u>	<u>Weight/Mass</u>
1 inch = 2.5cm	8 pints = 1 gallon	16 ounces = 1 pound

1 mile = 1.6km

14 pounds = 1 stone

Approximations

<u>Length</u>

12 inches = 1 foot

<u>Volume</u>

1 litre = $1\frac{3}{4}$ pints

<u>Weight/Mass</u>

1kg = 2.2 pounds

Useful websites for reference:
numeracyworld.com
mathsroom.co.uk
nrich.maths.org

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