Numeracy across the Curriculum

Parents Booklet

Our Mission Statement:

St Luke's is committed to raising the standards of numeracy of all of its students, so that they develop the ability to use numeracy skills effectively in all areas of the curriculum and the skills necessary to cope confidently with the demands of further education, employment and adult life.

Section 1 – Number

Reading and writing numbers

Pupils must be encouraged to write numbers simply and clearly. The symbol for zero with a line through it (∅), ones which could be mistaken for 7 (1) should be discouraged.

Most children are able to read, write and say numbers up to a thousand, but often have difficulty with larger numbers. It is now common practice to use spaces rather than commas between each group of three figures. eg. 34 000 not 34,000 though the latter will still be found in many text books and cannot be considered incorrect.

In reading large figures children should know that the final three figures are read as they are written as ***hundreds, tens*** and ***units.***
Reading from the left, the next three figures are ***thousands*** and the next group of three are ***millions.***

eg. 3 027 251 is three million, twenty seven thousand, two hundred and fifty one.

Order of Operations

It is important that children follow the correct order of operations for arithmetic calculations. Most will be familiar with the mnemonic: **BIDMAS.**

Brackets, **I**ndices, **D**ivision, **M**ultiplication, **A**ddition, **S**ubtraction

This shows the order in which calculations should be completed. eg

5 + 3 x 4
means
5 + 12
= <u>17</u> ✓

<u>NOT</u> 5 + 3 x 4
means 8 x 4
= <u>32</u>

The important facts to remember are that the **B**rackets are done first, then the **I**ndex (powers), **M**ultiplication and **D**ivision and finally, **A**ddition and **S**ubtraction.

eg(i) (5 + 3) x 4
= 8 x 4
= 32

eg (ii) $5 + 6^2 \div 3 - 4$
$= 5 + 36 \div 3 - 4$
$= 5 + 12 - 4$
$= 17 - 4$
$= 13$

Calculators

Some children are over-dependent on the use of calculators for simple calculations. Wherever possible children should be encouraged to use mental or pencil and paper methods. It is, however, necessary to give consideration to the ability of the pupil and the objectives of the task in hand.
In order to complete a task successfully it may be necessary for children to use a calculator for what you perceive to be a relatively simple calculation. This should be allowed if progress within the subject area is to be made. Before completing the calculation children should be encouraged to make an estimate of the answer. Having completed the calculation on the calculator they should consider whether the answer is reasonable in the context of the question.

Mental Calculations

Most children should be able to carry out the following processes mentally though the speed with which they do it will vary considerably.

- recall addition and subtraction facts up to 20
- recall multiplication and division facts for tables up to 10 x 10.

Pupils should be encouraged to carry out other calculations mentally using a variety of strategies but there will be significant differences in their ability to do so. It is helpful if parents discuss with children how they have made a calculation. Any method which produces the correct answer is acceptable.

eg $53 + 19 = 53 + 20 - 1$

$284 - 56 = 284 - 60 + 4$

$32 \times 8 = 32 \times 2 \times 2 \times 2$

$76 \div 4 = (76 \div 2) \div 2$

Written Calculations

Pupils often use the ‘ **=** ‘ sign incorrectly. When doing a series of operations they sometimes write mathematical sentences which are untrue.

eg $5 \times 4 = 20 + 3 = 23 - 8 = 15$

It is important that all parents encourage children to write such calculations correctly.

eg $5 \times 4 = 20$
$20 + 3 = 23$
$23 - 8 = \underline{\underline{15}}$ ✓

The ‘ = ‘ sign should only be used when both sides of an operation have the same value. There is no problem with a calculation such as:

$43 + 57 = 40 + 3 + 50 + 7 = 90 + 10 = \underline{100}$ ✓

since each part of the calculation has the same value.

Pencil & Paper Calculations

All children should be able to use some pencil and paper methods involving simple addition, subtraction, multiplication and division. Some less able children will find difficulty in recalling multiplication facts to complete successfully such calculations. In these circumstances it may be more useful to use a calculator in your subject to complete the task.

Before completing any calculation, children should be encouraged to estimate a rough value for what they expect the answer to be. This should be done by rounding the numbers and mentally calculating the approximate answer. After completing the calculation they should be asked to consider whether or not their answer is reasonable in the context of the question.

There is no necessity to use a particular method for any of these calculations and any with which the pupil is familiar and confident should be used. The following methods are some with which children may be familiar.

Addition & Subtraction

Estimate

Addition 3 456 + 975 3 500 + 1 000 = 4 500

$$\begin{array}{r} 3\,456 \\ +\quad 975 \\ \hline 4\,431 \\ \hline {\scriptstyle 1\;\;1\;\;1} \end{array}$$

Subtraction by 'counting on'

Estimate

eg 8 003 – 2 569 8 000 – 3 000 = 5 000

Start	**Add**
2 569	1
2 570	30
2 600	400
3 000	5 000
8 000	3
Total	5 434

Subtraction by decomposition

Estimate
8 000 – 3 000 = 5000

$$\begin{array}{r} {\scriptstyle 7\;\;9\;\;9\;\;1} \\ \text{eg}\;\; \cancel{8}\,\cancel{0}\,\cancel{0}\,3 \\ -2\,5\,6\,9 \\ \hline 5\,4\,3\,4 \end{array}$$

Addition and subtraction of decimals is completed in the same way but reminders may be needed to maintain place value by keeping decimal points in line underneath each other.

Multiplication and Division by 10,100,1000…

When a number is multiplied by 10 its value has increased tenfold and each digit will move one place to the left so multiplying its value by 10. When multiplying by 100 each digit moves two places to the left, and so on… Any empty columns will be filled with zeros so that place value is maintained when the numbers are written without column headings.

eg. 46 x 100 = 4 600

Th	**H**	**T**	**U**
		4	6
4	6	0	0

The same method is used for decimals.

eg. 5.34 x 10 = 53.4

H	T	U	.	t	h
		5	.	3	4
	5	3	.	4	

Empty spaces after the decimal point are not filled with zeros. The place value of the numbers is unaffected by these spaces.

When dividing by 10 each digit is moved one place to the right so making it smaller.

eg. 350 ÷ 10 = 35

	T	U	.	t	h
3	5	0	.		
	3	5	.		

eg. 53 ÷ 100 = 0.534

	T	U	.	t	h
	5	3	.		
		0	.	5	3

When the calculation results in a decimal the units column must be filled with a zero to maintain the place value of the numbers.

Multiplication

```
      3 7 6
 x      2 4
 ----------
    1 5 0 4  ←  376 x  4
    7 5 2 0  ←  376 x 20
 ----------
    9 0 2 4
 ----------
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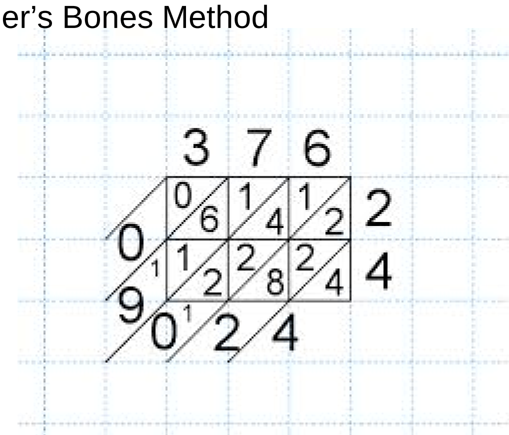
Conventional multiplication as set out above may not suit all children and parents should be aware that other methods may be employed by some children.

eg(i) Napier's Bones Method



Division

Conventional division methods as set out below may not suit all children and parents should be aware that other methods may be employed by some children.

Short Division — **Long Division**

$$\begin{array}{r} 3\ 6 \\ 7\overline{)25^{4}2} \end{array} \qquad \begin{array}{r} 36 \\ 7\overline{)252} \\ -\underline{21\ \ } \\ 42 \\ -\underline{42} \\ 0 \end{array}$$

Multiplying Decimals

As always, estimate the answer. Napier's Bones method is encouraged to be used first or completing the calculation as if there were no decimal points and inserting them at the end of the sum.

eg (i) 1.2 x 0.3

Ignoring the decimal points, this will be calculated as 12 x 3 = 36 and will now need two decimal places in the answer.

$\therefore$ 1.2 x 0.3 = 0.36

Percentages

Whilst children should be familiar with many operations involving percentages in mathematics lessons it is not proposed to elaborate on all of them in this booklet. The following is a sample of operations which children will be expected to use in other areas.

Calculating percentages of a quantity

Methods for calculating percentages of a quantity vary depending upon the percentage required. Pupils should be aware that fractions, decimals and percentages are different ways of representing part of a whole and know the simple equivalents

eg 10% = $^{1}/_{10}$ 12% = 0.12

Where percentages have simple fraction equivalents, fractions of the amount can be calculated.

eg. i) To find 50% of an amount, halve the amount.
ii)To find 75% of an amount, find a quarter by dividing by four and then multiply it by three.

Most other percentages can be found by finding 10%, by dividing by 10, and then finding multiples or fractions of that amount

When using the calculator it is usual to think of the percentage as a decimal. Pupils should be encouraged to convert the question to a sentence containing mathematical symbols. ('of' means X) and this is how it should be entered into the calculator.

eg. Find 27% of £350 becomes
0.27 X £350 = £94.50

Section 2 – Algebra

The most common use of algebra across the curriculum will be in the use of formulae.
When transforming formulae children will be taught to use the ‘balancing’ method where they do the same to both sides of an equation.

eg (i) $A = lb$ Make b the subject of the formula

[÷l] $\frac{A}{l} = b$

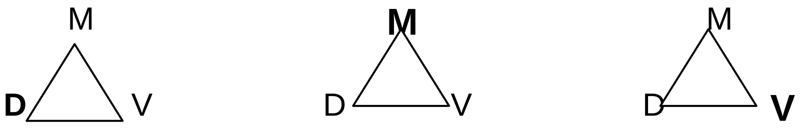
eg (ii) $4a + 10 = 20$ take 10 from both sides

$4a = 10$ divide both sides by 4

$a = 2.5$

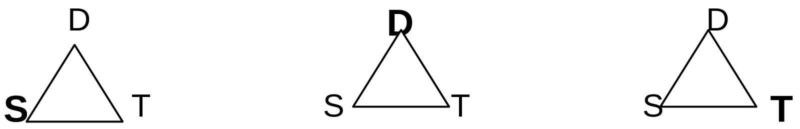
However , in some cases triangles can be useful for specific cases.

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



Density = $\frac{\text{Mass}}{\text{Volume}}$, **Mass** = Density x Volume, **Volume** = $\frac{\text{Mass}}{\text{Density}}$

Similarly with **Distance, Speed and Time**

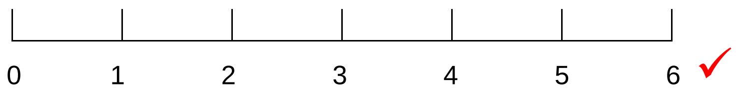


Speed = $\frac{\text{Distance}}{\text{Time}}$,**Distance** = Speed x Time, **Time** = $\frac{\text{Distance}}{\text{Speed}}$

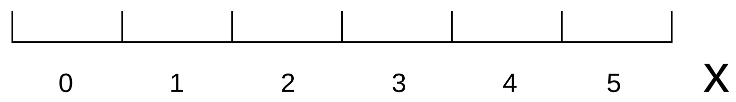
Plotting Points

When drawing a diagram on which points have to be plotted some children will need to be reminded that the numbers written on the axes must be on the lines not in the spaces.

eg



NOT



Axes

When drawing graphs to represent experimental data it is usual to use the horizontal axis for the variable which has a regular class interval. In an experiment in which temperature is taken every 5 minutes the horizontal axis would be used for time and the vertical axis for temperature.

Section 3 – Data Handling

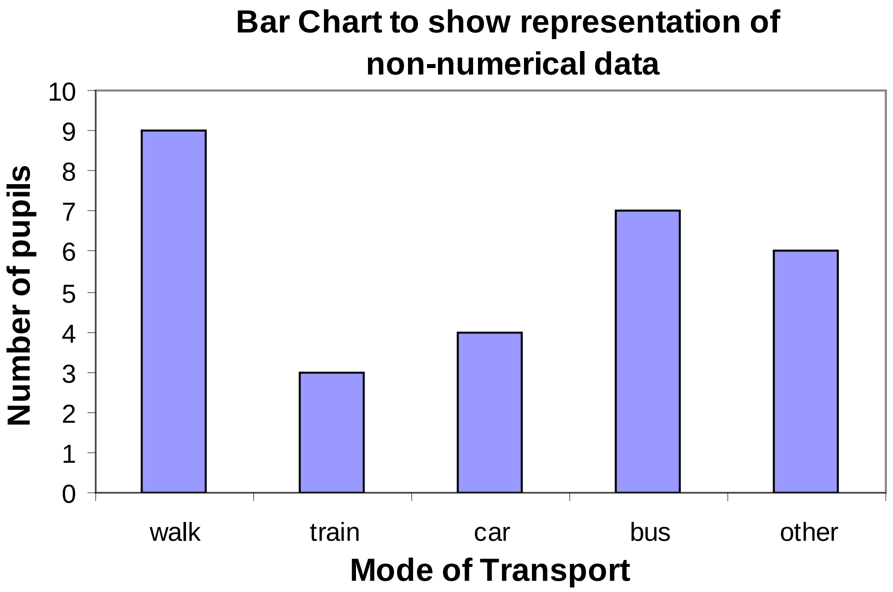
It is important that graphs and diagrams are drawn on the appropriate paper:

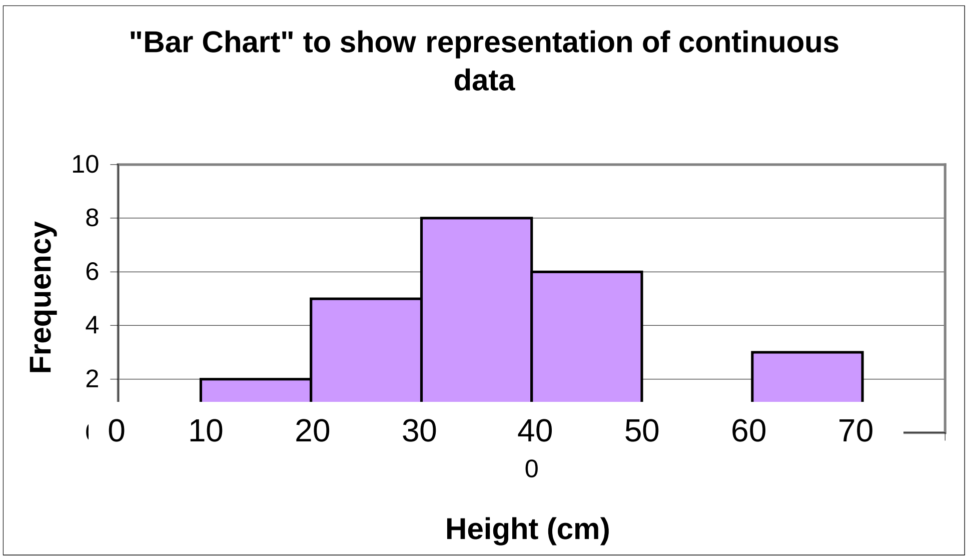
- bar charts and line graphs on squared or graph paper.
- pie charts on plain paper.

Bar Charts

These are the diagrams most frequently used in areas of the curriculum other than mathematics. The way in which the graph is drawn depends on the type of data to be processed.

Graphs should be drawn with **gaps between the bars** if the data categories are discrete e.g. colours, makes of car, names of pop star, etc. There should also be gaps if the data is numerical but can only take a particular value (shoe size, KS3 level, etc). In cases where there are gaps in the graph the horizontal axis will be labelled beneath the columns.
The labels on the vertical axis should be on the lines.
eg.





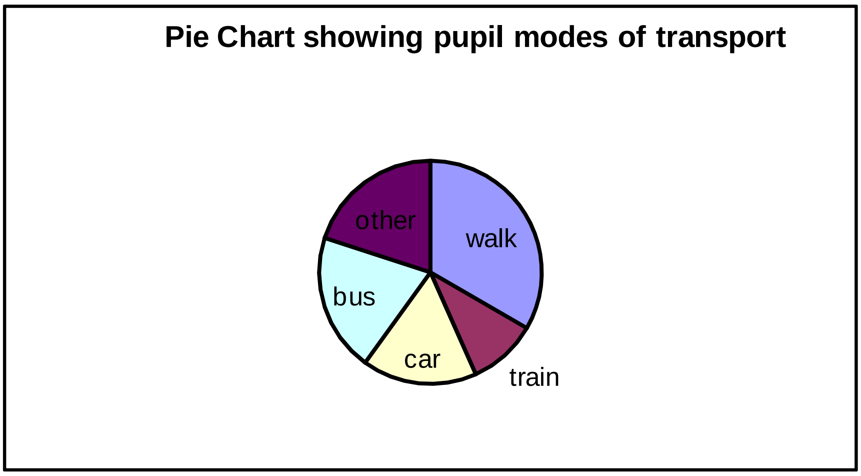
Line Graphs
Line graphs should only be used with data in which the order in which the categories are written is significant.
Points are joined if the graph shows a trend or when the data values between the plotted points make sense to be included. For example the measure of a patient's temperature at regular intervals shows a pattern but not a definitive value.

Computer Drawn Graphs & Diagrams
Pupils throughout the school should be able to use **Excel** or other spreadsheets to draw graphs to represent data. Because it is easy to produce a wide variety of graphs there is a tendency to produce diagrams that have little relevance. Pupils should always be encouraged to write a comment explaining their observations from the graph.

Pie Charts
The way in which children should be expected to work out angles for a pie chart will depend on the complexity of the question. If the numbers involved are simple it will be possible to calculate simple fractions of 360°.

eg. The following table shows the results of a survey of 30 children travelling to school. Show this information on a pie chart.

Mode of Transport	Frequency	Fraction	Angle
Walk	10	$\frac{1}{3}$	120º
Train	3	$\frac{1}{10}$	36º
Car	5	$\frac{1}{6}$	60º
Bus	6	$\frac{1}{5}$	72º
Other	6	$\frac{1}{5}$	72º
Total	**30**	**1**	**360º**



However, with more difficult numbers which do not readily convert to a simple fraction children should first work out the share of 360° to be allocated to **one** item and then multiply this by its frequency.

eg. 180 children were asked their favourite core subject.

Each child has 360 ÷ 180 = 2° of the pie chart.

Subject	Number of children	Pie Chart Angle
English	63	63 x 2 = 126º
Mathematics	75	75 x 2 = 150º
Science	42	42 x 2 = 84º
Total	180	360º

If the data is in percentage form each item will be represented by 3.6° on the pie. To calculate the angle children will need to multiply the frequency by 3.6.

eg. 43% will be represented by 43 X 3.6 = 154.8°
≈ 155°

Any calculations of angles should be rounded to the nearest degree only at the **final stage of the calculation.** If the number of items to be shown is 47 each item will need:

360 ÷ 47 = 7.659574468°

This complete number should be used when multiplying by the frequency and then rounded to the nearest degree.

Using Data

Range

The range of a set of data is the difference between the highest and the lowest data values.

eg. If in an examination the highest mark is 80% and the lowest mark is 45%, the range is 35% because 80% - 45% = 35%

The range is always a **single number** , so it is **NOT** 45% - 80%

Averages

Three different averages are commonly used:

Mean – is calculated by adding up all the values and dividing by the number of values.

Median – is the middle value when a set of values has been arranged in order.

Mode – is the most common value. It is sometimes called the **modal group.**

eg. for the following values: **3, 2, 5, 8, 4, 3, 6, 3, 2,**

Mean = $\frac{3 + 2 + 5 + 8 + 4 + 3 + 6 + 3 + 2}{9} = \frac{36}{9} = 4$

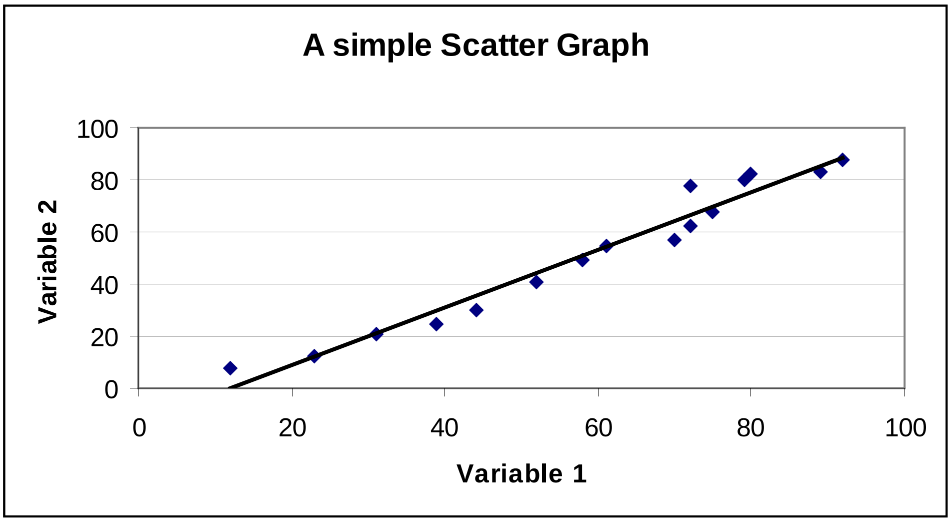
Median – is 3 because 3 is in the middle when the values are put in order.

2, 2, 3, 3, 3, 4, 5, 6, 8

Mode - is 3 because 3 is the value which occurs most often.

Scattergraphs

These are used to compare two sets of numerical data. The two values are plotted on two axes labelled as for continuous data. If possible a 'line of best fit 'should be drawn.



The degree of correlation between the two sets of data is determined by the proximity of the points to the 'line of best fit'

The above graph shows a positive correlation between the two variables. However you need to ensure that there is a reasonable connection between the two, e.g. ice cream sales and temperature. Plotting use of mobile phones against cost of houses will give two increasing sets of data but are they connected?

Negative correlation depicts one variable increasing as the other decreases, no correlation comes from a random distribution of points. See diagrams below.