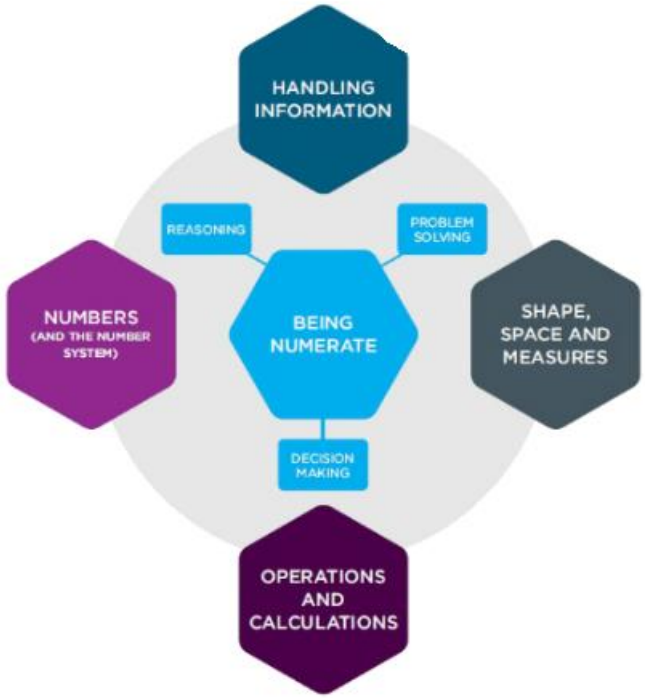
Numeracy across the curriculum



Numeracy - Mathematical literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.

In order to be numerate pupils should be fluent in certain mathematical skills however a numerate pupil is one who has the ability to cope confidently with the mathematical needs of adult life.

Consistency of Practice

The Mathematical Association recommend that teachers of Mathematics and teachers of other subjects co-operate on agreed strategies.

In particular that:

Teachers of mathematics should:

1. Be aware of the mathematical techniques used in other subjects and provide assistance and advice to other departments, so that a correct and consistent approach is used in all subjects.

2. Provide information to other subject teachers on appropriate expectations of students and difficulties likely to be experienced in various age and ability groups.

3. Through liaison with other teachers, attempt to ensure that students have appropriate numeracy skills by the time they are needed for work in other subject areas.

4. Seek opportunities to use topics and examination questions from other subjects in mathematics lessons.

Teachers of subjects other than mathematics should:

1. Ensure that they are familiar with correct mathematical language, notation, conventions and techniques, relating to their own subject, and encourage students to use these correctly.

2. Be aware of appropriate expectations of students and difficulties that might be experienced with numeracy skills.

3. Provide information for mathematics teachers on the stage at which specific numeracy skills will be required for particular groups.

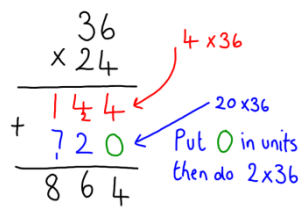
4. Provide resources for mathematics teachers to enable them to use examples of applications of numeracy relating to other subjects in mathematics lessons.

Operations and calculations

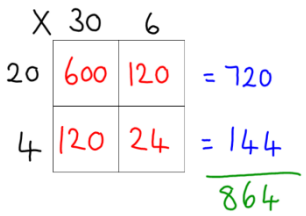
Multiplication (Multiply/Product/Times/Lots of)

The two main methods used are the “formal” method and the “grid method”

Formal

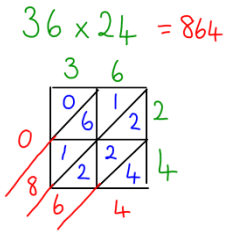


Grid



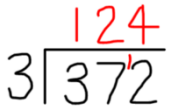
Although these are the two main methods used within the academy, if pupils have their own method that works (Chunking/Chinese…) then they should be encouraged to continue using their preferred method.

Example of Chinese-



Children should not actively be encouraged to use the Chinese method, as it does not give a sense of the size of number, however if they are confident in using this method they can continue to do so.

Division (Divide/Share)

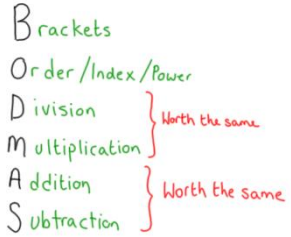


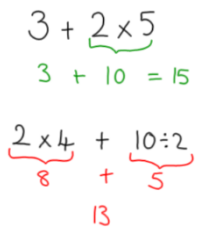
Some division calculations can be done mentally. If a written method is needed then the short method should be used

This method can be extended to use decimal values.

Order of operations (Bodmas/Bidmas)

This is a way of remembering in which order calculations should take place





Numbers

Rounding

We round numbers when we only need a rough idea of an amount

We look at the number to the RIGHT of the one we want. To round to:

- 100's, look at 10's (1874 → 1900)
- 10's, look at units (1874 → 1870)
- units, look at 1 d.p. (3.196 → 3)
- 1 d.p., look at 2 d.p. (3.196 → 3.2)
- 2 d.p., look at 3 d.p. (3.196 → 3.20)

If the number to the right is
0, 1, 2, 3, or 4: we leave our number as it is
5, 6, 7, 8, or 9: we round our number UP by 1

Estimate

Before any calculation is performed an estimate should take place. This allows us to check the final answer is sensible (is to the correct degree of accuracy)

To estimate we round numbers, usually to 1 significant figure, the calculation can then be done mentally

$38 \times 52 \approx 40 \times 50$
≈ 2000
The answer will be about 2000

Percentages

There are many methods for calculating percentages of an amount. The main methods used are….

Mentally….calculate 10% by dividing by 10…then use this to find other percentages

Multiplier method with a calculator…change percentage to decimal and then multiply

Fraction method with a calculator….divide by 100, multiply by the percentage

Pupils should NOT use the percentage button on a calculator.

23% of 500
(÷10) 10% of 500 = 50
(÷10) 1% of 500 = 5
20% is 2 x 10% = 100
\+ 3% is 3 x 1% = 15
23% of 500 = 115

23% of 500
23% is 0.23 as a decimal
0.23 x 500 = 115

Standard index form

This skill is a level 7/grade C skill in maths, and so most pupils will be study this until year 10. When converting numbers to standard form, the reference should be to the numbers moving columns each time they are multiplied by 10, as the decimal point is fixed.

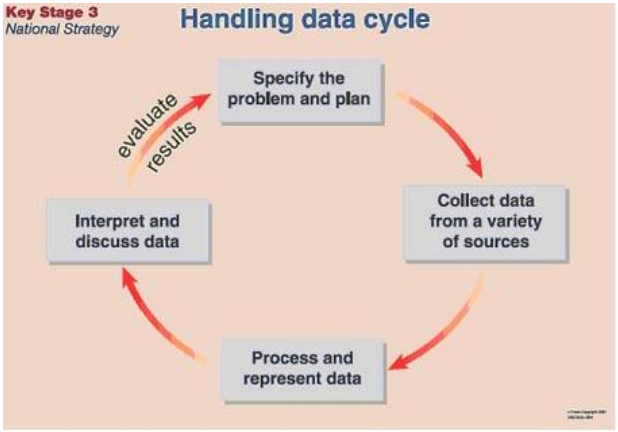
Changing the subject

Pupils should be encouraged to rearrange the equation, or to substitute values into the equation and solve, rather than using triangles to assist.

Pupils should be encouraged to only put <u>one equal sign per line</u> to avoid writing statement that are untrue

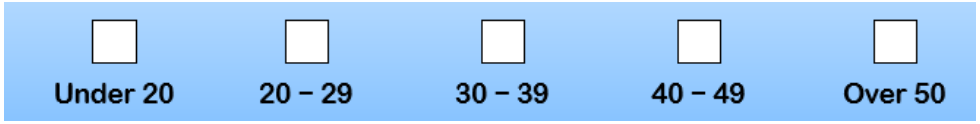
Handling data

The Handling data cycle should be used whenever data is being collected and interpreted.



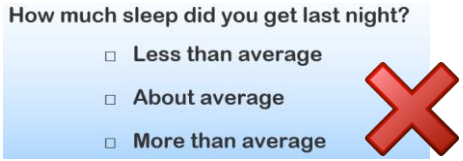
Questionnaires

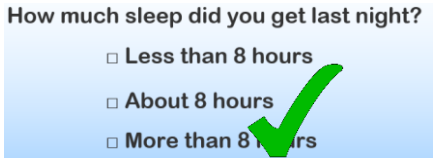
Questions must be easy to answer. Open questions allow the respondent to write anything, therefore a good questionnaire should contain closed questions with restricted answer options. Answer boxes should be clear and simple with responses that don't over lap and have no gaps in response.



Questions should not be biased/ push people towards an answer…and so should never begin with an opinion or phrases such as "Do you agree…"

The response section should not be vague, or open to interpretation. There should usually be a time frame for which the question is referring to….a week, a month, a year…





Pie charts

This is a level 6/grade D skill and so most pupils will not study this until year 8 or 9. To help pupils complete pie charts they should follow this format.

Sum the frequency
Divide 360° by the sum of the frequency
Multiply each frequency by the value obtained to get the angle of the sector

$\frac{360}{120} = 3°$

Planned Destination	Frequency	Calculation	Angle
Durham	27	27 x 3	81
York	23	23 x 3	69
Manchester	12	12 x 3	36
Peterborough	24	24 x 3	72
London	34	34 x 3	102
	120		360

Check the angles sum to 360°

to

Bar charts

Bar charts are a visual way to compare data. Pupils should….

Use a pencil and ruler

Use scales that are equally spaced

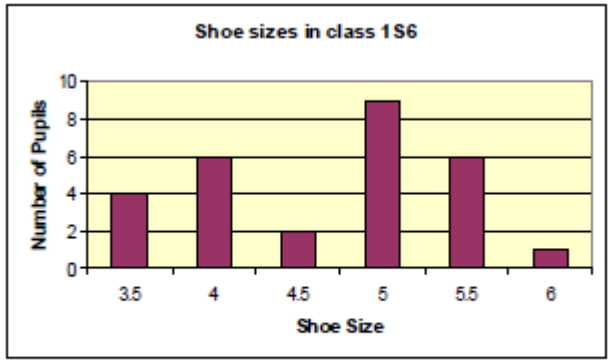
Label the axes and give the graph a title

When to leave gaps between the bars….Continuous data – no gaps, Discrete data – gaps

Continuous data may take **any value** within an interval eg) height, weight, temperature, time

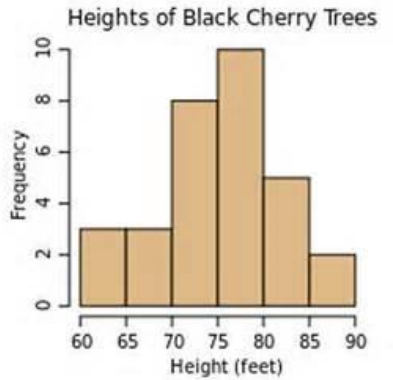
Discrete data may take only **particular values** eg) shoe size, number of siblings, or be **words** eg) colours, gender, blood groups.

Discrete data



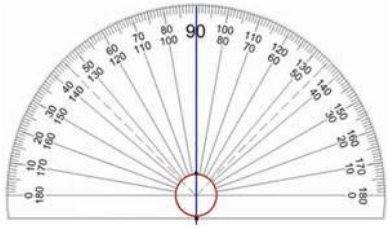
Shoe sizes in one class

Continuous data



When plotting coordinates pupils will need to be reminded that it is the lines that are labelled on the axes rather than the squares.

Shape, space and measure



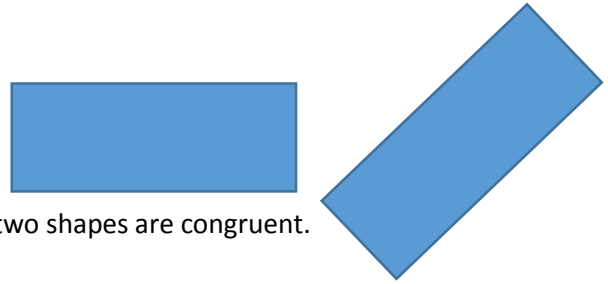
Angles should be measured to the nearest degree

Lines should be measured to the nearest mm

Congruent/Similar have specific meanings in maths.

Congruent – exactly the same size and shape

Similar – the same shape, but not the same size.



These two shapes are congruent.

Use of calculators

Although calculators are useful for completing calculations quickly, or checking values, they should not be a substitute for basic mentally calculations such as times tables, addition, subtraction, multiplication, division, basic percentages….

Pupils should be encouraged to estimate the approximate answer first and then use the calculator to check the reasonableness of their answer.
Pupils need to interpret calculator answers sensibly. For example know 3.5 could mean £3.50.

In all areas of the curriculum the use of calculators can be encouraged where they enhance the learning taking place, however, it is important that pupils do not develop a reliance on the use of a calculator to solve problems where mental and/or written methods can be used.

Transfer of Skills

The transfer of skills is something that many pupils find difficult. It is essential that pupils realise it is the same skill that is being used in a different subject area.

Subject areas should be aware of the underlying maths skills and approaches that go with the applications that they use. Some mathematical opportunities across the curriculum are listed below.

Subject	Ideas	Subject	Ideas
Arts	• Use standard measures to find length. • Form repeating patterns (tessellations), making use of reflection, rotation and translation. • Use of paint mixing as a ratio context. • Many patterns and constructions in our own and other cultures are based on spatial ideas and properties of shapes, including symmetry. • Calculating the golden ratio in pictures/drawings (Mona Lisa) • Perspective and scale. • Drawing in 3 dimensions.	Business Studies	• Estimation from spreadsheets. • Use of mathematical vocabulary e.g. sum, profit. • Sketching graphs to show change over time. • Accurate graph drawing including labelling axes. • Sampling and surveying in market research. • Designing data collection sheets. • Producing and interpreting averages and charts. • Costings. • Formulae. • Awareness of sensible answers – approximate calculation including percentages, fractions, multiplication, division etc.
Design Technology	• Use standard measures (metric and imperial) to find length, mass, time or capacity. • Use mathematical symbols and notation to construct and interpret graphs and charts. • Use scale and ratio to produce drawings. • Using ruler, compass, protractor correctly. • Using recipes as a ratio/proportion context. • Estimation of quantities or of results of calculations. • Sampling and surveying. • Reading scales on equipment. • Converting between units. • Drawing in 2 dimension or 3 dimensions, including plans and elevations. • Time planning including Gantt charts, timelines… • Pricing the cost of a meal/product.	English	• Comparison of 2 data sets on word and sentence length. • Use of fractions and percentages in persuasive writing including misleading graphs. • Reading and writing numbers, identifying centuries. • Coding, secret codes. • Grouping/categorising ideas/words.

Ethics & Philosophy	• Use mathematical symbols and notation, construct and interpret graphs and charts. • Use timelines and interpret negative numbers. • Consider infinity and the meaning of this conceptually. • Reflect on logic and the process of constructing a sound argument. • The discussion of moral and social issues is likely to lead to the use of primary and secondary data and the interpretation of graphs, charts and tables, helping pupils to make reasoned and informed decisions and to recognise biased data and misleading representations. By applying mathematics to problems set in financial and other real-life contexts, pupils will develop their financial capability and awareness of the applications of mathematics in the workplace.	Geography	• Use mathematical symbols and notation, construct and interpret graphs and charts. • Use grids to identify position (links to co-ordinates and grid references). • Use negative numbers to interpret below sea level. • Use standard measures (metric and imperial) to find length, mass, time, force, temperature area or capacity, especially distance and area. • Discussing evidence may involve measurement, estimation and approximation skills, and making inferences. • Pupils will make statistical enquiries, for example, in analysing population data to explore and compare lifestyles; they will also use a wide range of measurements and rates of change. • The study of maps includes the use of coordinates, angle, direction, position, scale and ratio.
History	• Use timelines and interpret negative numbers. • Use fractions and percentages to express and compare proportions. • Use scale to interpret maps and diagrams. • Use mathematical symbols and notation, construct and interpret graphs and charts.	ICT	• Use mathematical symbols and notation (sigma for sum), construct and interpret graphs and charts. • Use formulae to calculate and to interpret data in spreadsheets. • Collect and classify data, enter them into data-handling software, produce graphs and tables, and interpret and explain their results. • Spreadsheet skills, used in modelling and simulations, rely on the numeric, algebraic and graphical skills involved in constructing formulae and generating sequences, functions and graphs.
MFL	• Use dates, sequences and counting in other languages. • Use basic graphs and surveys to practise foreign language vocabulary and reinforce interpretation of data. • Use of, and calculation with, money. • Conversion/exchange rates. • Directions.	Music	• Use addition of fractions in bar music. • Use counting for beats. • Use sound waves, frequency and oscillations. • Use graph sketching to demonstrate change over time e.g. in dynamics over a piece.

PE	• Use time, height and distance in measurements. • Telling the time, timekeeping. • Reading from scales using measuring equipment • Calculation of speed, acceleration, deceleration and graphing of these over time during an action/event. • Design data collection sheets. • Collect and record real data, find the averages, compare and draw conclusions. • Sequencing results (decimals, lengths etc.) • Scoring. • Athletic activities use measurement of height, distance and time, and data-logging devices to quantify, explore, and improve performance. • Ideas of counting, time, symmetry, movement, position and direction are used extensively in music, dance, gymnastics, athletics and competitive games. E.g. angles, rotation, planes, axes.	Science	• Use formulae to calculate work, power, mass, density. • Rearrange formulae. • Use graphs to represent data, interpretation of graphs. • Estimating quantities or results of calculations. • Use standard measures to find length, mass, time, force, temperature, area or capacity; • Hypothesise before an experiment, consider limitations to findings afterwards. • Manipulate numerical data from their experiments and do calculations including averages. • Record results in tables – choose appropriate form and design data collection sheets. • Use mathematical symbols and notation, construct and interpret graphs and charts. • Constructing graphs, extrapolating, recognising patterns. • Take readings from scales.

Minimum expected numeracy skills

Low Y7	Year 7	Year 8
Telling time from clock face	Covert between metric units of length	Solve problems involving conversions of units metric
+9,19,21 etc.		
Compliments to 100	Compliments to 100 including decimals	Compliments to 90, 180, 360
X and ÷ integers by 10, 100	X and ÷ decimals by 10, 100	X and ÷decimals by 10, 100, 1000
Double/Halve		
Tables up to 10 x 10	Tables up to 12 x 12	Associated division facts up to 12 x 12
Add/subtract integers	Add/Subtract integers and decimals	All four operations with integers
Multiplication 2 by 2 digits	Multiplication 3 by 2	
Finding 10%	Finding 10% and using it to find 5%, 20%	Finding any % mentally
Simple equivalences fractions decimals and percentages (fdp) i.e.) 0.25, 0.5, 0.75	Equivalences between fdp for all multiples of 0.1	Equivalences between fdp for all multiples of 0.05
	Short division	Short division including dealing with remainders
Square numbers up to 10	Square numbers up to 12	Square numbers to 15 and associated square roots
	Identifying fractions of pictures/amount	
	Simple equivalent fractions	Any equivalent fraction
	Round to 10, 100…	Rounding to decimal places
	Bodmas in simple cases	Bodmas
	Order decimals 1 decimal place	Ordering including decimals to 2dp
	Convert mixed to improper simple	Convert mixed to improper (denominators up to 12)
	Order integer negative numbers	Order negative numbers including decimals
		Add and sub negative numbers (integer)
	Factors of numbers less than 30	Factors of any number
		Add/sub fractions one denominator needs changing
		Calculating averages from lists

Year 9	Year 10	Year 11
Solve problems with conversions of units metric and imperial		
Compliments any multiple of 10.		
X and ÷decimals by any power of 10	Understand effects of multiply or divide by power of 10	
Use known facts to find others		
All four operations with integers and add/sub/multiply decimals	All four operations with integers and decimals	
Increase any percentage mentally	Increase and decrease percentages mentally	Calculate simple percentage changes mentally
Equivalences between fdp multiples of 0.01		Recur decimals to fractions
Short division writing remainders as fractions		
Cubes and roots to 5	Write numbers in standard form	Calculate using numbers in standard form
Simplifying fractional answers without prompt		
Rounding numbers bigger than 1 to 1sf	Rounding to 1sf and use to estimate	Round to any number of sig figs
Ordering any decimal or fractions	Order mixture of decimals and fractions	Order mixture of decimals, fractions and %
Convert mixed to improper (any)		
All four operations with negatives (integer)	All four operations with negatives	
Factors, multiplies and primes		
Add/Sub fractions both denominators to change	Multiply and divide integers by fraction	All four operations with fractions