St Richard's Catholic College

Numeracy Policy

The Policy was approved by the Governing Body: **November 2016**

Chair of Governors:_____

The Governing Body will review the policy in November 2018

Numeracy is a life skill. Having confidence in numeracy gives us the ability to make informed choices and decisions in a variety of everyday life. Being numerate is more than completing calculations, it involves an awareness of number relationships and interpreting answers.

> *"Numeracy is a Proficiency which involves confidence and competence with numbers and measures. It requires an understanding of the numbers system, a repertoire of computational skills and an inclination and ability to solve number problems in a variety of contexts. Numeracy also demands practical understanding of the ways in which information is gathered by counting and measuring, and is presented in graphs, diagrams, charts and tables."*
>
> *National Framework for teaching Mathematics*

> *"A Numerate pupil is one who has the ability to cope confidently with the mathematical needs of adult life. There should be an emphasis on the wider aspects of numeracy and not purely the skills of computation."*
>
> *The Cockcroft report 1982*

Mission Statement

At St Richard's Catholic College we are committed to raising the numeracy standards of our pupils across all year groups. We want all our pupils to use transferable numeracy skills across the curriculum.

Furthermore, we want to empower our pupils beyond school; we want them to have the confidence to apply and develop numeracy skills in further education, their career path and everyday life.

Numeracy at St Richard's will go beyond mathematic knowledge and computational skills; it will develop the pupil's ability to be systematic through problems involving numbers, shapes, space and measures, interpret information and make informed choices.

All staff at St Richard's will:

i. Support the pupils' understanding of the size of a number and where it fits into a number system.
ii. Develop shared language and methods in areas where it is necessary to use established mathematical conventions.
iii. Encourage pupils, when calculating, to use the most appropriate and efficient methods to solve problems; using a calculator only when appropriate.
iv. Encourage pupils who are trying to solve a problem in a particular context to be logical and systematic, ready to persevere with their method but also flexible when required.
v. Develop awareness of possible difficulties and common misconceptions pupils experience when solving problems.
vi. Develop the pupils' skills in estimation and approximation and have strategies for checking the reasonableness of their answers.
vii. Empower pupils to explain their methods and reasoning using consistent language.
viii. Communicate regularly with the mathematics department and other departments regarding difficulties and successes in developing pupils' numeracy skills.
ix. Support the development of interpretation skills among pupils encouraging them to explain how and why certain predictions are made from information given in graphs, charts and tables.
x. Identify and share key numeracy skills and applications that occur in different curriculum areas within the school.

xi. Have a positive attitude to solving numerical problems. Unfortunately for millions of adults and children in the UK, "I can't do maths" has become a self-fulfilling prophecy.
xii. With the support of the mathematics department, develop and build on a range of strategies to support the development of numeracy across the curriculum, and to determine intervention strategies for pupils encountering problems.
xiii. Use the numeracy box resources and vocabulary whenever possible to support the numeracy content in their lessons.

"The Acquisition of at least basic mathematical skills is vital to the life opportunities and achievements of individual citizens. Research shows that problems with basic skills have a continuing adverse effect on people's lives and that problems with numeracy lead to the greatest disadvantage for the individual in the labour market."

Smith, 2004 Making Mathematics Count

Pupils at St Richard's will be expected to:

i. Cooperate with the requests of staff at all times
ii. Use their rough book whenever necessary to support their strategies when solving a problem, or to make notes of a problem that they need further assistance with.
iii. Attempt to use key words learnt in mathematics lessons to support their learning in other subjects.
iv. Encourage parental involvement by sharing the work done daily in school and emphasising where numerical skills have been used.
v. Use the middle pages of their mathematics books to maintain a list of important vocabulary that they can use to explain their work and methods in subjects across the curriculum.

Vocabulary and Literacy

Pupils will have a list of vocabulary in the middle section of their mathematics books that they will update regularly. Pupils will be made aware of the use of the words in a mathematical context but will also be reminded that the same words might be used differently outside that context. A list of vocabulary with ambiguous meanings is detailed below and will be made available to other departments to allow for better cross-curricular coherency.

Word	**Possible interpretation**	**Mathematical interpretation**
Average	Estimate a general standard	Used synonymously with arithmetic mean; for a set of discreet data this is the sum of quantities divided by the number of quantities
Difference	Being dissimilar, non-identical	The result of subtraction
Even	Level or smooth	A positive integer that is divisible by two
Expression	Intonation of voice or aspect of face indicating emotion	A mathematical form expressed symbolically
Face	Front of head from forehead to chin	One of the flat surfaces of a solid shape
Mean	Small minded, malicious, ill-tempered	The arithmetic mean of a set of discrete data is the sum of quantities divided by the number of quantities
Negative	Image on developed film	A number less than zero

Word	Possible interpretation	Mathematical interpretation
Odd	Extraordinary, strange, remarkable	A positive integer that has a remainder of 1 when divided by 2
Power	Mechanical or electrical energy as opposed to manual labour	This is a way of indicating how a number (symbol) must be operated on by using another number written as a subscript to the first
Prime	Chief or most important	A whole number greater than one has exactly two factors, itself and 1
Product	A thing or substance produced by a natural process or manufacture	The result of multiplying one number by another
Root	Part of a plant below the earth's surface, which attaches it to the earth and carries nourishment from the soil to the plant	A value, which satisfies the equation which has been formed by putting an expression, containing one variable, equal to zero
Sign	Write one's name, a signature, important information displayed on a board	A quantity added or subtracted from others in an arithmetic or algebraic expression

Secondary Maths ITE, 2003 Literacy in Mathematics

Language of operations

Some pupils may experience difficulty in associating terms with symbols.

+	-	x	÷
Add	Decrease	Multiply	Divide
Increase	Difference	Of	Share
More	Less	Product	
Plus	Minus	Times	
Sum	Reduce		
total	Subtract		
	Take		

Monitoring and Evaluating

To ensure that the policy is being successful the mathematics department will:

i. Monitor the scores that pupils achieve from Year 7 through to Year 11.
ii. Maintain and regularly update the numeracy box, which will form a central resource bank for all teachers to share good numeracy across the curriculum.
iii. Carry out pupil interviews to ensure that pupils are making links between different curriculum areas.
iv. Ensure that selected pupils are asked to keep a diary for a week documenting when they have used mathematics in other subjects
v. At the end of each academic year, the numeracy policy will be discussed within the maths department and other departments, to action areas of development.

Numeracy Box

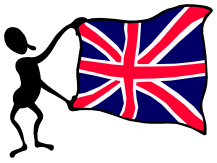
The numeracy box will be a source for inter-curricular resources to be shared. Staff may wish to add resources to their respective section and also browse other sections to find relevant materials. The resources will be reviewed regularly.

It is the responsibility of each teacher to explicitly demonstrate connections to numeracy through their subject **where appropriate**. The mathematics department will maintain the numeracy box to ensure that all resources are organised and up to date.

Making links between mathematics and other subjects

You need to look for opportunities for drawing mathematical experience out of a wide range of children's activities. Mathematics contributes to many subjects of the curriculum, often in practical ways. Activities such as recording the growth of a plant or an animal, measuring temperature and rainfall, or investigating the cog wheels in a bicycle can provide data or starting points for discussion in your mathematics lessons as well as opportunities to apply and use mathematics in real contexts.

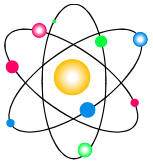
English:



Mathematics lessons can help to develop and support pupils' literacy skills: for example, by teaching mathematical vocabulary and technical terms, by asking children to read and interpret problems to identify the mathematical content, and by encouraging them to explain, argue and present their conclusions to others. Equally, English lessons can support your mathematics lesson. For example non-fiction texts can be chosen in which mathematical vocabulary, graphs, charts and tables have to be interpreted.

An identified opportunity exists in Year 9
Advertising Unit – Pie Charts/Graphs representing sales/demand for products and cost of campaigns

Science:



Almost every scientific investigation or experiment is likely to require one or more of the mathematical skills of classifying, counting, measuring, calculating, estimating, and recording in tables and graphs. In science pupils will, for example, order numbers, including decimals, calculate means and percentages, use negative numbers when taking temperatures, substitute into formulae, re-arrange equations, decide which graph is the most appropriate to represent data, and plot, interpret and predict from graphs.

An identified opportunity exists in Year 8:
Distance time graphs, representing speed – See PE
Discuss range of formulae used – re-arranging and substitution a possibility

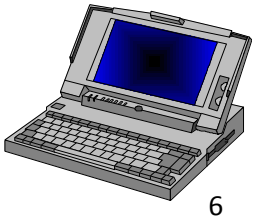
An identified opportunity exists in Year 7
Line - Temperature against time graph demonstrating a cooling liquid
Bar – Cancer against cigarettes smoked

Art, Design and Technology:

Measurements are often needed in art and design and technology. Many patterns and constructions are based on spatial ideas and properties of shapes, including symmetry. Designs may need enlarging or reducing, introducing ideas of multiplication and ratio. When food is prepared a great deal of measurement occurs, including working out times, adapting recipes, and calculating cost; this may not be straightforward if only part of a packet of ingredients has been used.

An identified opportunity exists in Year 8 Design and Technology:
2D representations of 3D objects – Isometric drawings, plan and elevation drawings to scale.
Graphs from questionnaires

Information and Communications Technology:



Children will apply and use mathematics in a variety of ways when they solve problems using ICT. For example, they will collect and classify data, enter it into data handling software, produce graphs and tables, and

interpret and explain their results. Their work in control includes the measurement of distance and angle, using uniform non- standard then standard measures. When they use computer models and simulations they will draw on their abilities to manipulate numbers and identify patterns and relationships.

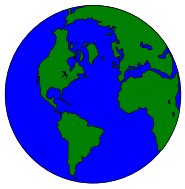
An identified opportunity exists in Year 7

Use of formulas in spreadsheets – predicting outcomes

An identified opportunity exists in Year 8

Representing weather data – interpretation of the various graphs and discussion as to which ones are valid and why.

History, Geography and Religious Education:



In history and geography children will collect data by counting and measuring and make use of measurements of many kinds. The study of maps includes the use of co-ordinates and ideas of angle, direction, position, scale and ratio. Historical ideas require understanding of the passage of time. which can be illustrated on a time line. similar to the number line that they already know.

An identified opportunity exists in Year 7 Geography

Use of scale in reading maps and drawings of bedroom
Pie Charts or divided bar charts

An identified opportunity exists in Year 8 Geography

Climate graphs

An identified opportunity exists in Year 9 Geography

Development indicator graphs (Scatter graphs)

An identified opportunity exists in Year 7 RE

Possible to survey how widely available are fair trade goods in shops.

An identified opportunity exists in Year 9 RE

Possible to make use of surveys and results regarding the environment.

An identified opportunity exists in Year 9 History

Graphs of weapons and ships available during the 1st and 2nd world war – interpretation of the graphs.

Physical Education and Music:

Athletic activities require measurement of height, distance, time and speed, while ideas of time, symmetry, movement. position and direction are used extensively in music. dance, gymnastics and ball games.

The key to making the most of all these opportunities is to identify the mathematical possibilities across the curriculum at the planning stage. You should also draw children's attention to the links between subjects by talking frequently about them, both in Mathematics and in other lessons.

Identified opportunities exist in Years 7,8 and 9 PE

Angle of elevation of shot putt, discuss, javelin, hitting softball – link with substituting into formulas and drawing graphs.

Timing of distances in athletics - link with distance time graphs (take split times)
Compare different events, average speed, real life graphs, compare with world records.

Scale drawing of the sports hall and of different courts. Problem solving exercise such as we need a sports hall that allows us to play 5 games of badmington etc… what are the possible sizes of the sports hall?

Scale drawing of an athletics field.

Modern Foreign Languages

An identified opportunity exists in Year 7

Drawing and interpretation of 'happiness' graphs using correct vocabulary

An identified opportunity exists in Years 8 and 9

Drawing and interpretation of conversion graphs using correct vocabulary

Cross-curricular guidance:

This document should provide information and guidelines to help produce consistency across the curriculum - it is not intended to be a prescription for teaching although some advice is given.

Approaches

- It is recognised that not all pupils in a teaching group will have the same numerical skills and where unsure of an appropriate 'numerical level' teachers will consult with the Mathematics Department.

- All teachers will discourage pupils from writing down answers only and encourage pupils to show their numerical working out within the main body of their work.

- All teachers will encourage the use of estimation particularly for checking work.

- All teachers will encourage pupils to write mathematically correct statements.

- It is recognised that there is never only one correct method and pupils will be encouraged to develop their own correct methods where appropriate rather than be taught 'set' ways.

- Wherever possible pupils will be allowed and encouraged to 'vocalise' their maths - a necessary step towards full understanding for many pupils.

- All pupils should be helped to understand the methods they are using or being taught - pupils gain more and are likely to remember much more easily if they understand rather than are merely repeating by rote.

Calculators:

In order to improve numeracy skills, it is essential that pupils should be encouraged to use non-calculator methods whenever possible. However departments should ensure pupils have access to calculators when they are necessary.

It is recognised that where calculators are to be used their correct use may have to be taught.

Methods and Presentation:

Where a pupil is gaining success with a particular method it is important that s/he is not confused by being given another method. This does not disallow the possibility of introducing alternatives in order to improve understanding or as part of a lesson deliberately designed to investigate alternative methods, provided pupils can manage this without confusion.

Working out:

In all arithmetic, the importance of place value and neat column keeping should be stressed. In a line of workings an "equals" sign should only appear once.

This is poor practice: £3.50 x 0.85 = 2.975 + 3.50 = 6.475 = £6.48

This is good practice: £3.50 x 0.85 = 2.975
2.98 + 3.50 = £6.48

Language:
When referring to decimals say "three point one four" rather than "three point fourteen".
Read numbers out in full, so say three thousand four hundred rather than three, four, zero, zero.
It is important to use the correct mathematical term for the type of average being used, ie. mean, median or mode.

Mean	Total of values of sample ÷ sample size.
	[The term average is commonly used when referring to the mean]
Median	Middle value of sample when sample values are arranged in order size.
Mode	Sample values which occur most frequently.

Checking:
Encourage students to check divisions by multiplication and subtractions by adding.

Rough Conversions between Metric and Imperial:
In the Maths Department we teach the following conversions:

1 inch ≈ 2.5 cm	1 yard ≈ 1 m	1 kg ≈ 2.2 lbs
2 pints ≈ 1 litre	1 mile ≈ 1.6 km	1 oz ≈ 25 g

Pupils should be expected to record the units they are using when answering a question.

Standard Form:
Students need to be aware of how their calculators express standard form and what it means. E.g. on some calculators $5 \div 200 = 2.5^{-2}$
It should be noted that this should be recorded as 2.5 x 10^{-2} and that it is equivalent to 0.025

Multiples of ten:
When multiplying by ten do not teach the 'rule' add a nought or move the decimal point along one but rather explain that the numbers move one place to the left relative to the decimal place. So 3 . 6 4 x 10

= 3 6 . 4

Time:
Pupils should never record 3hrs and 30 mins as 3.30hrs but as 3.5hrs.
[When working with time it is possible to use the degrees/mins/secs key on many calculators.]

Equations:

The terms "cross-multiply" and “swap sides – swap signs” can lead to misunderstandings, as part of any explanation of how to solve equations and so should be avoided.

To teach solution of linear equations we use the 'balancing method' or a flow diagram
To solve: $3x - 7 = 5$

Balance Method: $3x - 7 = 5$ (add 7 to both sides)

$3x - 7 + 7 = 5 + 7$

$3x = 12$ (divide both sides by 3)

$3x \div 3 = 12 \div 3$

$x = 4$

Flow Chart Method:

START: $x \rightarrow \boxed{x3} \rightarrow \boxed{-7} \rightarrow 3x - 7$ (you now UNDO)

END: $4 \leftarrow \boxed{\div 3} \leftarrow \boxed{+7} \leftarrow 5$

$X = 4$

Guidelines for Constructing/Using Graphs and Charts

Students should be encouraged to:

- use a sharp pencil.
- label both axes and give a title
- use independent variable on *x*-axis, and dependant variable on the *y*-axis, eg: if graphing temperature of a cooling liquid, time should go on the *x*-axis and temperature on the *y*-axis. [The temperature of the liquid is dependant on the time of the reading.]
- label lines not spaces, unless a bar-chart with discrete data
- use equally spaced intervals
- use convenient scales
- mark points by a small cross not a dot
- draw graphs on squared or graph paper
- to draw graphs of a sensible size (they tend to make them too small)

Pupils should be exposed to Bar Charts, Pie Charts, Pictograms, Line graphs and Cumulative frequency curves. Histograms are only tackled by higher level students.

Students need to be taught when each type of graph is appropriate. (This is very important as students will generally produce the type of graph they last met without much thought to appropriateness.)

Bar-charts
the bars should be of equal width and equally spaced
the bars do not have to touch for discrete data
frequency should be on the y (vertical) axis.

Discrete data

Data is described as discrete if specific values only can be used, eg. shoe size is discrete as sizes such as 4.8 and 5.77 cannot exist.

Continuous data

Data is described as continuous if all values can exist, eg. height and weight are continuous data as potentially any value could be measured.

Pie Charts

Sectors should be labelled (eg. Car, Blue….) or there should be a key.
Do not be surprised if the total of all the angles is 360° plus or minus one or two degrees. This will almost certainly be due to the rounding that may be necessary. In these cases either add or take the one or two degrees from the largest angle.

Histograms

Do not use the term Histogram unless the bar widths are unequal and relative frequency is plotted along the y axis. This is only taught to those in the top set in Years 10 and 11. Students need to appreciate the connection between the area and the frequency.

Scaling

If axes do not start from zero, a break represented by a zig-zag line should be shown on the axis.