Kingsdown Secondary School

Numeracy Policy

September 2015

Contents:

Definition

Numeracy is a life skill. It is a proficiency that is developed not just in Mathematics but also across the whole curriculum. Numeracy involves students having the confidence and competence to use numbers and measures. It requires an understanding of the number system, recalling Mathematical techniques and an ability to solve problems in a variety of contexts. A practical understanding of graphs, charts, tables and diagrams is an important part of numeracy.

We believe that every child can become a numerate adult – with skillful teaching in school and encouragement at home. (Mathematics made to measure, Ofsted 2012)

Aims

In adopting a whole school Numeracy Policy, the Governors of Kingsdown Secondary School are committed to developing the numeracy skills of our students, in the belief that it will support their learning, enabling them to access the whole curriculum and, in turn, raise standards for all. It is important to recognise that **all teachers** are teachers of **numeracy**. It is the key for academic success and the long-term sustainable improvement in attainment.

- To adopt a whole-school approach to Numeracy across the curriculum in order to raise standards of attainment for all students.
- To recognise the importance of Numeracy in all subjects across the curriculum.
- To identify similarities and differences in Mathematical teaching in different curriculum areas and develop a common approach.
- To encourage staff to take responsibility for the development of numeracy in each subject area.
- To raise staff and student awareness of key Numeracy strategies through whole school Inset time.
- To encourage students to transfer Mathematical skills and apply them in everyday and unknown contexts.

Strategies for ensuring progress against these aims

- All departments have a responsibility for identifying aspects of their schemes of work that contribute to raising standards of Numeracy and highlighting these aspects in their planning and making them explicit to students.
- All staff should encourage and promote the use of problem solving.
- Raise the profile of Mathematics throughout the school, promoting the use of numbers and measures whenever possible.
- Students identified as more able will be provided with opportunities to extend and develop their understanding.
- Students will be assessed in Year 7 or as they join Kingsdown to identify their levels in Numeracy. Students found to be at low levels will then take part in an intervention programme to raise standards where levels are found to be low..

Raising Standards

Raising standards in Numeracy across the school cannot be solely judged in increased test percentages. There is a need to evaluate the pupils' ability to transfer mathematical skills
Into other subject areas, applying techniques to problem solving. Their confidence in attempting this is initially as important as achieving the correct solution. The Senior Leadership
Team also has a commitment to the implementation and evaluation of this work. They are aware of the need to create time for liaison to sustain the cross curricular links forged between
subject areas. The effectiveness of these links will reduce the replication of work by teachers and pupils.

Consistency of Practice

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 mathematical lessons.

Teachers of Other Subjects 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.

Areas of Collaboration

Mental Arithmetic Techniques
There is an acceptance that pupils are able to tackle the same questions with a variety of methods. These approaches rely on mixing skills, ideas and facts: this is done by pupils drawing
On their personal preferences and the particular question. All departments should give every encouragement to pupils using mental techniques but must also ensure that they are guided
towards efficient methods and do not attempt complicated mental techniques when a written
or calculator method is required.

Written Calculations

Emphasis should be made of "non---standard" methods, particularly for grid multiplication and division by "bus stop". Whilst the desire for pupils to progress to formal algorithms and the most efficient methods is acknowledged, it must not be at the expense of having only a method and not a cohesive and full understanding of what is required.

Vocabulary

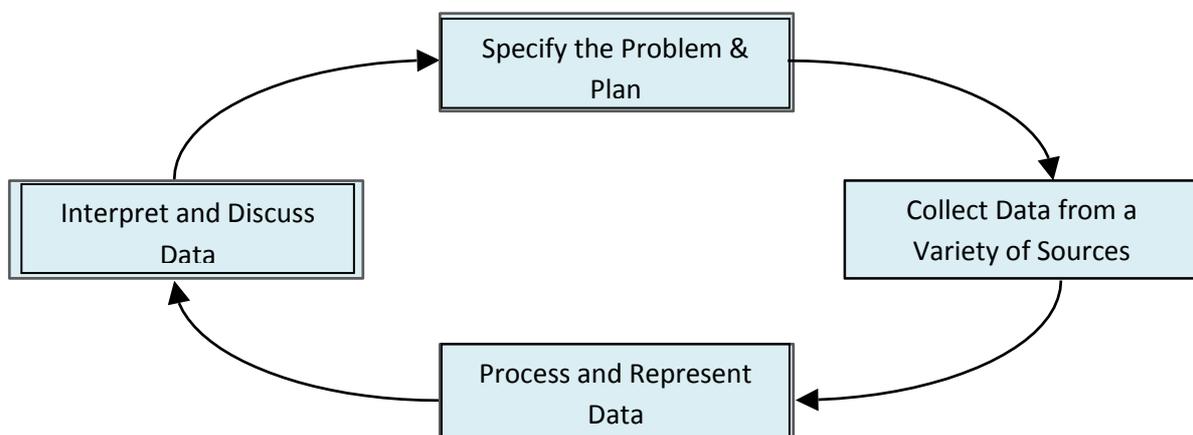The following are all important aspects of helping pupils with the technical vocabulary of Mathematics.

a) Use of display of key words.
b) Using a variety of words that have the same meaning e.g. add, plus, sum etc.
c) Encouraging pupils to be less dependent on simple words e.g. exposing them to
   the word multiply as a replacement for times
d) Discussions about words that have different meanings in Mathematics from everyday life e.g. take
   away, volume, product etc.
e) Highlighting word sources e.g. quad means four, lateral means side, so that pupils can use them to
   help remember meanings. This applies to both prefixes and suffixes to words.

Pupils should become confident that they know what a word means so that they can follow the instructions in a given question or interpret a mathematical problem. For example a pupil
reading a question including the word perimeter should immediately recall what that is and start to think about the concept rather than struggling with the word and then wondering what it means and losing confidence in their ability to answer the question. The instant recall of vocabulary and meanings can be improved through flash card activities in starters.
Try to do this twice a half term with each group – this may be key vocabulary at the start of a unit of work or recalling vocabulary from previous mathematics.

Measures

There is a potential for conflict between the Mathematics department and other departments with regard to units. For example in Design Technology they will use millimetres, whereas we will use centimetres and metres. We will need to ensure that we can help students to confidently convert between one set of units and another. This also applies to converting between metric and imperial measures.

Specify the Problem & Plan

Collect Data from a Variety of Sources

Process and Represent Data

Interpret and Discuss Data

Measures

Pupils can use this four---stage cycle throughout Key Stages 3 & 4 in many subject areas. Similarly many subjects use graphical representation and we, therefore, need to be consistent in our messages to Staff, Students & Parents.

Transfer of Skills

The Mathematics Department will deliver the National Curriculum knowledge, skills and understanding through the Numeracy Framework using direct interactive teaching, predominantly in lessons consisting of several "episodes". They will make references to the applications of Mathematics in other subject areas and give contexts to many topics. The transfer of skills is something that many pupils find difficult – especially if the approaches in other subjects differ significantly from those in the Mathematics Department.

Possible links with other departments could include:

Department	*Content*
ART	*symmetry; paint mixtures as a ratio*
FOOD	*recipes as a ratio; reading scales*
HUMANITIES (Geography, History, RE)	*representing data; use of spreadsheets ,timelines; sequencing events, interpretation/comparison of data from secondary sources*
ICT	*representing data, calculations using spreadsheet, programming using algorithms*
ENGLISH	*dates; counting in other languages*
MUSIC	*sequencing*
PE	*collection of real data*

SCIENCE	*calculating with formulae; three-way relationships*

Conclusion

The role of the Mathematics Department is to ensure that the explicit teaching of basic numeracy and mental arithmetic skills, including those of number, calculations, measures and handling data are securely embedded in the Key stage 3 and 4 schemes of work. These skills are consolidated at whole class and individual student level by having the opportunity to apply these skills when solving real-life problems.

Each member of staff is responsible for promoting numeracy skills when they arise naturally within their subject. A whole-school commitment to numeracy will enhance the teaching and learning process in all curriculum areas.

Date for Review   September 2017

Appendix: Mathematics across the curriculum

INTRODUCTION

Numeracy is a proficiency that involves confidence and competence with numbers and measures. It requires an understanding of the number system, a range of computational skills and an inclination and ability to solve number problems in a variety of contexts. Numeracy also demands practical
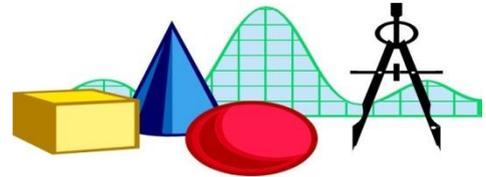
Understanding of the ways in which information is gathered by counting and measuring, and is presented in graphs, diagrams, charts and tables.

Mathematical skills can be consolidated and enhanced when pupils have opportunities to apply and develop them across the curriculum. Poor numeracy skills, in particular, hold back pupils' progress and can lower their self-esteem.

NEED FOR A WHOLE SCHOOL APPROACH

Improving numeracy skills is a whole-school matter. Each department should identify the contribution it can make towards the teaching of numeracy and other mathematical skills. So that pupils become confident in tackling mathematics in any context.

The teaching of numeracy is the responsibility of all staff and the school's approaches should be as consistent as possible across the curriculum.

All teachers should consider pupils' ability to cope with the numerical demands of everyday life and provide opportunities for students to:

- Handle number and measurement competently, mentally, orally and in writing;
- Use calculators accurately and appropriately;
- Interpret and use numerical and statistical data represented in a variety of forms.

Staff 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 and the opportunities to apply and use mathematics in real contexts. The key to making the most of all these opportunities is to identify the mathematical

possibilities in your subject at the planning stage.

CROSS·CURRICULAR GUIDANCE:

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

Approaches

- It is recognised that not all students in a teaching group will have the same numerical skills and where unsure of an appropriate 'numerical level' teachers should consult with the Mathematics Department.
- All teachers should discourage students from writing down answers only and encouraged students to show their numerical working out within the main body of their work.
- All teachers should encourage students to write mathematically correct statements.
- It is recognised that there is never only one correct method and students should be encouraged to develop their own correct methods, where appropriate, rather than be taught 'set' ways.
- All students should be helped to understand the methods they are using or being taught – students gain more and are likely to remember much more easily if they understand rather than are merely repeating by rote.

GENERAL ADVICE:

1.   Calculators

In order to improve numeracy skills, it is essential that students should be encouraged to use non-calculator methods whenever possible. However departments should ensure students 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.

2.   Methods and Presentation:

Where a student 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 students can manage this without confusion.

3.   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

4.   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, i.e. 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 size order.

Mode : Sample values which occur most frequently.

5.   Checking:

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

SPECIFIC ADVICE

NUMBER

1. Standard Form:

Students need to be aware of how their calculators express standard form and what it means. e.g. on some calculators

It should be noted that this should be recorded as 2.5×10^{-2} and that it is equivalent to 0.025

2. 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: 3.64   x   10

= 36.4

MEASURES

1. Rough Conversions between Metric and Imperial:

In the Math's 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
5 miles = 8km		

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

2. 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.]

DATA HANDLING

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.

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

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.)

Types of Data

- **Discrete Data**
  Data is described as discrete if specific values only can be used, e.g. 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.

Types of Data

- **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.

- **Pie Charts**
  Sectors should be labelled (e.g. 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.

ALGEBRA

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 the mathematics department staff 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)

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

$x = 4$

Flowchart Method:

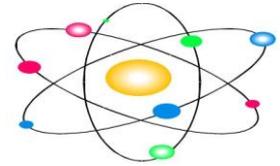**START:** $x \rightarrow \boxed{x3} \rightarrow \boxed{-7} \rightarrow 3x - 7$ (you now UNDO)

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

x = 4

SPECIFIC MATHEMATICAL LINKS WITH OTHER SUBJECTS

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 :-

- order numbers, including decimals

- calculate means and percentages

- use negative numbers when taking temperatures

- substitute values into formulae

- re-arrange equations

- decide which graph is the most appropriate to represent data and plot, interpret and make predictions from graphs.

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 scaling and ratio.

In Food Technology :

- a great deal of measurement occurs, including working out times

- there are opportunities to calculate the quantity of ingredients required when a recipe is adapted to feed different numbers of people

- costs may need to be calculated

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
- identify patterns and relationships.

Spreadsheet work can involve the use of formulae.

HUMANITIES

Geography:

In geography pupils have opportunities to collect, present and interpret data. It is important that there is consistency in the way that data handling is taught in mathematics and geography. In addition, map work involves the use of coordinates (6 figure grid references), map scales and compass bearings.

History:

Although there would appear to be fewer opportunities for developing numeracy in history lessons, historical data can be analysed and presented in graphical form. Timelines can also be used to calculate the passage of time between historical events.

Physical Education:

Athletic activities require measurement of height, distance, time and speed.

There is an opportunity to calculate averages and use graphs to, for example, chart improvements in performance.

Ideas of time, symmetry, movement. Position and direction are used extensively in dance, gymnastics and ball games.

## Religious Education, PSHE and Citizenship:

Belief and likelihood in religious education, or risk assessment in PSHE, relate well to work in mathematics. 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. Pupils should be encouraged to make reasoned and informed decisions, based on facts and to recognize 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.
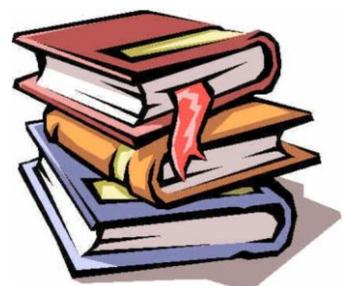
Music:

In music there are opportunities to explore

- time (time signatures and rhythm)
- the relationship between mathematics and the musical scale (using the idea of ratio)
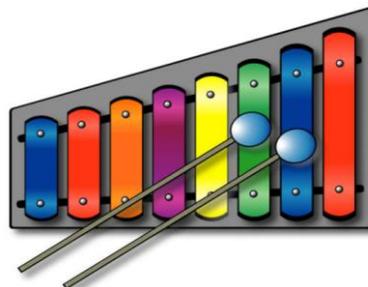
English:

Members of the English department can help pupils improve their achievement in mathematics by teaching them to identify important information from text. This will help them to better understand mathematical examination questions.

Actions	Impact	Measurement of Impact and time scales
Form tutor time numeracy boxes(sheets) to be used by all Keystage 3 forms once per week .	• *Improved problem solving, independent learning skills and repetition of basic numeracy skills*	• *Pupil voice annually* • *Staff voice annually*
Maths moments to be identified in all SOW	• *All staff to be aware of which topics in their subjects lend themselves to cross-curricular numeracy so that these opportunities are not missed.* • *Improved levels of numeracy for pupils and deeper understanding of the links between numeracy and subjects other than maths.*	• *SOW* • *Lesson Observations*
Numeracy signage to be on display on department corridors	• *Pupils to be aware of the cross curricular aspect of numeracy* • *Pupils to be aware of how useful numeracy is to all adults in the workplace and in their personal life* • *Consistent approaches across subjects when tackling numeracy related topics will lead to deeper understanding for pupils and less confusion.*	• *Pupil Voice annually* • *Staff Voice annually* • *Lesson Observations*
MyMaths for Year 10 and 11	• *Improved attainment for pupils*	• *Monitoring of maths levels of pupils involved half termly* • *Pupil voice half termly*