The Ridings High School Numeracy Policy

The concept of "Numeracy" is changing constantly as technology advances.
The use of calculators has had a definite effect on pupils' number work.
Numeracy is not just arithmetic, it is not just "doing sums". The HMI definition of numeracy as:

"Pupils' ability to cope with the mathematical demands of everyday life and to

- handle number and measurement fluently, mentally, orally and in writing
- use calculators accurately and appropriately
- apply spatial concepts when necessary
- make sense of information presented numerically and graphically
- handle statistical information in everyday context."

Numerate pupils should therefore:

- tackle problems and not give up
- not go immediately to their teacher or friends for help
- use what they know to derive an answer
- know for themselves that answers are reasonable
- be able to explain their methods and reasoning
- have a mental facility with and for numbers
- use calculators sensibly

Some other relevant definitions include:

"Numeracy is an at-homeness with numbers and an ability to cope with the mathematical demands of everyday life… An ability to have some appreciation and understanding of information which is presented in mathematical terms, for instance, graphs, charts or tables or by reference to percentage increase or decrease"

(Cockcroft Report, 1982)

and…

"Numeracy is a proficiency which involves confidence and competence with numbers and measures. It requires an understanding of the number 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, 1999)

Pupils often display many different methods for solving problems numerically. The watchword in any policy of this sort is "If it works, don't try to mend it!"
However, pupils who are not confident numerically require consistency in approach when learning or practising such skills. Key areas in mathematical skills – which are frequently used across the curriculum need to be identified and simple methodologies for teaching/using them will be suggested in this policy over the next few pages.

Some possible identified key skills are:

- place value
- addition
- subtraction
- multiplication facts

- division
- inverse operations
- estimation
- accuracy
- decimals, fractions and percentages
- graphing
- measurement
- use of a calculator

Place Value

Use columns headed H,T,U,etc. Show that each column is 10 times the previous column. Exercises on what the "7" represents are helpful.

e.g. 672 the "7" stands for 10's i.e. 70

H	T	U
6	7	2

Addition

Adding in columns, not rows. Start with units and progress to the left. If numbers have to be "carried", ensure the number still looks like that number and not that number reversed e.g. 13 looks like 13 and not 31

e.g. 627 + 3981 is written as

```
  627
 3981
+4608
 9216
 211
```

Subtraction

The language of subtraction is varied e.g. 6 - 3 can mean "6 minus 3" or "take 3 from 6". We have had an agreement with our main feeder primary schools to use decomposition for several years now. So please use this method rather than "borrow and pay back" when discussing subtractions. It is more logical and easier to understand.

e.g. 627 - 359

```
  627
- 359
  268
```

The use of the empty number line is often useful

Multiplication/Division

A knowledge of multiplication tables is essential and is taught by the Maths. Faculty. We are lucky in that most of our feeder primary schools do teach tables. Division is the inverse operation of multiplication.

e.g. $6 \times 5 = 30$ so $30 \div 5 = 6$.

Long multiplication is taught from Year 7 and the majority of pupils cope with it but we also teach a grid method as follows:

	200	40	5
70	14000	2800	350
6	1200	240	30
	15200	3040	380

for 245×76

15200 + 3040 + 380 = 18620

Another alternative is to split the sum up into smaller more manageable parts.

e.g. 245 × 76. 76 can be split as 70 and 6. Multiply 245 by 70 (multiply by 7 and add a 0) and multiply 245 by 6 and add the two results.

Division requires the use of a multiplication table fact.

e.g. 448 ÷ 8 is written as $\begin{array}{r} 56 \\ 8\overline{)\,448} \end{array}$

Write down the multiplication table for 8 if necessary.

8's into 4 won't go. Carry the 4 to make 44. 8's into 44 go 5, remainder 4. Carry the 4 to make 48. 8's into 48 go 6 exactly. So 448 divided by 8 is 56.

Our pupils do find long division very difficult even though this is taught from Year 7 Term 1!

An alternative method is chunking – multiples of the divisor are taken from the number being divided until none is left. The answer is then the number of multiples taken away. Most of our Feeder Primary schools will have taught this method.

e.g. 323 ÷ 19

10 × 19 = 190 leaves 133
5 × 19 = 85 leaves 38
2 × 19 = 38 leaves 0

10 + 5 + 2 = 17 i.e. 323 ÷ 19 = 17

Inverse Operations

For every operation there is another which returns the problem to the original. Emphasise that the inverse of:

adding is subtracting and vice-versa
multiplying is dividing and vice-versa

Exercises with empty boxes to fill in are a useful way of consolidating this skill.

e.g. 16 × ☐ = 32 (divide by 16)

12 + ☐ = 20 (subtract 12)

Estimation

The ability to make sensible "educated" guesses about number, distance, area, money, weight and other measurable or calculated quantities

This process is useful for checking work. Always encourage pupils to estimate for sensible answers.

e.g. 63 is approximately 60, or even 50!

Make the numbers far more manageable and the calculations become easier.

e.g. 732 × 49 is approximately 700 × 50 = 35000
or 1000 × 50 = 50 000

(the actual answer is 35 868)

The size, or order of the answer is the important fact, giving rise to a sensible estimate.

Accuracy

Numbers are often written to a required degree of accuracy.

e.g. nearest whole number
nearest 10

nearest 100
nearest 1000

or even to a given number of "decimal places" or "significant figures"

Pupils often have problems in deciding whether to round up or down.

Consider the digit (single number) immediately after the required place value.

If it is 0, 1, 2, 3, 4 round down

if it is 5, 6, 7, 8, 9 round up (notice that 5 is not in the middle!)

e.g. 627 $\approx$ 630 (to nearest 10)

e.g. 743 $\approx$ 700 (to nearest 100)

Decimals, Fractions & Percentages

The connection between these three is essential to understanding. The key number is 100 and 10, 5 and 2 also have significance because they divide exactly into 100. Encourage pupils to consider the pattern involved.

e.g. 35% = $\frac{35}{100}$ = 0.35

e.g. 70% = $\frac{70}{100}$ = 0.7(0) (the 0 is not necessary but is sometimes used to aid pattern recognition)

Fractions in simplest form can be derived by considering 10, 5 and 2 as dividing numbers.

e.g. 60% = 60/100 (will each no. divide by 10? Yes)
= 6/10 (will each no. divide by 5? No. Will it divide by 2? Yes)
= 3/5.

A percentage of a quantity is best calculated by changing the percentage to a decimal and multiplying the amount by this decimal.

e.g. 17% of £80 = 0.17 $\times$ £80 = £13.60

On a calculator this is particularly easy:-

e.g. 17 $\times$ 80 % key (usually shift =)

The % key converts the 17 to a decimal.

Pupils should also be aware of the 10%, 5%, 1% method:

e.g. 17% of £80

17% = 10% + 5% + 2 $\times$ 1%

10% - divide amount by 10

5% - divide the 10% amount by 2

1% - divide the amount by 100.

You should note that the concept of adding and subtracting fractions is very difficult and this is reflected by the fact that it does not appear until level 8 in the Maths. National Curriculum. Pupils cannot cope with this conceptually until Year 9 or 10 and the least able will probably never cope with it!

Graphing

Emphasise the use of a sharp pencil and a good straight edge (ruler). Pupils should be encouraged to use appropriate scales, label axes and provide titles for their graphs.

Graphs - show information
- compare quantities
- create/show relationships.

It is important that the correct graph is used for the purpose in mind.

For information display, use Bar charts or Pictographs.
For comparing/relationships, use Line graphs, Scatter graphs or Conversion graphs.
Information may be continuous (measures like time, length or weight) or discrete (like number of cars or shoe size).
Discrete data should normally be represented on bar charts, Pie charts, etc., whilst continuous data is best represented by a Line graph. A Scatter graph may be used for either types of data.
An independent variable (e.g. time) is a variable which cannot be influenced and which controls other variables. Such variables should be placed on the horizontal axis.

Measurement
The use and application of length (distance), area (space), volume (capacity) and scale (the ability to read a scale, e.g. on a ruler). A knowledge of the relationship between metric and imperial units is required, especially as both systems are still in use in society, even though this country has gone metric!
Generally use metric units of measurement. Try to avoid complication by introducing conversions. Emphasise the different styles used by different curriculum areas
e.g. Design & Technology often use millimetres in measuring, not cm or m.

Use Of Calculators
1) Pupils should be encouraged to own a calculator as part of their basic school equipment.
2) Pupils should use calculators to check work done.
3) Calculators should be used as appropriate - when and only when mental calculation will not suffice or time does not allow
e.g. 9×8 or 20×7 or 3000×6 should be done mentally but 467×34 should be calculated using a calculator.
4) Calculators are a useful IT tool. Pupils should be encouraged to use them as such alongside other IT applications.
5) The Maths. Faculty buy calculators to sell to pupils and staff should encourage pupils to buy one - e.g. they make an excellent Christmas present!
6) Note that the new calculators use algebraic logic and this means that they type in sums as they see them written down
e.g. $\sqrt{58}$ requires the keys $\sqrt{}$ 58 = whereas with scientific and basic calculators you always put in the 58 first.

Ways of improving pupils' numeracy in the Mathematics classroom

1. 10 minute starter activities to develop and secure pupils' calculation strategies and rapid recall skills
2. using display work to jog the memory, both published material and pupils' own work
3. questioning pupils effectively, including as many of them as possible, giving them time to think before answering, targeting individuals to take account of their attainment and needs
4. using white boards so that all pupils have to give an answer. The teacher can quickly see if the class have understood the ideas

5. ask pupils to demonstrate and explain their methods and reasoning and exploring reasons for any wrong answers
6. encourage discussion of mental strategies within 'ordinary' classwork
7. puzzles and games which require development of strategies and logical thinking
8. identifying 'difficult' sums and targeting learning of these
9. rehearsal and development time built in for the 'basics'
10. setting short-term targets, such as timed or number of correct answers
11. opportunities to include contributions from all pupils such as 'show me what…' games
12. using a plenary to draw the whole class together to sort out misconceptions, identify progress and make links to other subjects, as well as to set homework

It is vital that all pupils experience all of the above ideas frequently in order to encourage the variety of skills and strategies we would wish them to acquire.

Links to other subjects

The Mathematics Faculty organised a whole school INSET day on Numeracy across the Curriculum on Friday 28th March 2002.

During the day each subject group filled in an audit of mathematical ideas each subject was likely to meet. The afternoon consisted of several workshops in which the Maths staff demonstrated various new techniques in numeracy. This was followed up by a Faculty meeting on Thursday 12th December 2002 in which representatives from the Maths Faculty visited all Faculties to discuss problems and the way forward.

The following list gives some of the topics mentioned by certain subjects:

Geography

Collect data
Display of data
Interpretation of data
Lines of best fit
Rates (e.g. per 1000, per 100 000)
Scale
Grid references
Area/distance
Application of the four rules of number

Science

%, decimals, fractions
Mass/weight
Collect, display and interpret data
Manipulate and substitute numbers into scientific formulae
Speed/distance/time
Standard form, large and small numbers
Measures

Area, Volume
Application of the four rules of number
Square and square roots
Proportional and inverse proportion
Lines of best fit (not necessarily straight lines)
Ratio

ICT/Business Studies

Use of spreadsheets
Formulae
Use of money
Profit and loss, break even
%, decimals and fractions
Display and interpretation of data
Application of the four rules of number

Technology

Length (particularly mm)
Area
Volume
Mass/weight
Collect, display and interpret data
%, decimals and fractions
Costings
Application of the four rules of number

History/RE

Islamic patterns
Subtraction by decomposition for dates (incl.BC and AD)
Large numbers – meaning of billion
Centuries (e.g. 845 is in the 9th Century)

Music

The use of < and > in dynamics
The four rules of number
Simple ratio and proportion
Add and subtract simple fractions (e.g. quavers +semi quavers)
Interpreting data (relating to the pop business)
Record results in simple lists, tables and block graphs
Interpret pie charts

Art

Recognise odd and even numbers
The four rules of number
Calculate fractions of quantities
Simple ratio and proportion
Estimating and checking answers

Names for 2-D and 3-D shapes/solids
Reflective symmetry
Metric units of length, capacity, mass and time
Drawing 2-D shapes in different orientations
Simple scale drawings
Recognise 2-D representations of 3-D solids
Circumference of a circle
Enlargement
Spatial awareness

P.E.

Estimating measures including reading tape measures (realising ft/in on one side & m/cm on the other)
Conversion between metric and Imperial units – particularly ft/in, m/cm and decilitres
Reading large numbers
Reading time from stop watches
Symmetry
Graphs
Consistency of terms across departments
The four rules of number including decimals to 2d.p.
Negative numbers in context
Understand angle as a measure of turn
Rotational symmetry
Interpret simple tables and lists
Understand and use the mode, median and the range of a set of data

SUMMARY

The Mathematics Faculty are charged with providing opportunities for learning numeracy skills. However, it is essential that the whole school is familiar with these skills and where opportunities exist within their own schemes to supplement numeracy skills. The Mathematics Faculty are prepared to support any other faculty in this respect. Mathematics should be seen as a subject for life rather than merely a subject for rote learning.

N A Quilter
Approved at Curriculum Committee July 2003