Bell Baxter High School

Numeracy Across the Curriculum

A guide for Parents as to how topics involving numbers are taught within the school

December 2017

Introduction

Bell Baxter High School is fully 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.

(Equations and using formulae have also been included as they are often used in other subjects.)

Contents

Back to Basics

When pupils come to Secondary school they start a lot of different subjects and have a lot of new interests but it is still important that they practise their basic number work which may not be reinforced as often as it was in Primary school.

Every pupil should know their tables, particularly as they go up the school. The multiplication tables should be remembered in sentences, for example:

$3 \times 1 = 3$
$3 \times 2 = 6$
$3 \times 3 = 9$ etc.

and not just as a list of multiples, for example

3, 6, 9, etc.

Their six, seven, eight and nine times tables are very important and can be practised at home.

Primary school learning about place value is often forgotten and can be reinforced at home.

Remember

Hundreds	Tens	Units	Decimal Point	Tenths	hundredths
3	5	6	.	7	5

Reading and writing large numbers is a common difficulty you can help with, for example:
3 600 004 reads three million six hundred thousand and four

Pupils can be made aware of metric and imperial weights and measures as well as their own height and weight in both they can practise estimating sensibly and getting an understanding or large and small weights, heights and distances and using money in a practical way.

The better your child knows the basics, the easier it will be for him or her to make progress.

Estimating

We expect pupils to

- estimate height and length in cm, m, $\frac{1}{2}$ m, $\frac{1}{10}$ m, mm, etc.

  e.g. length of pencil = 10 cm

  width of desk = $\frac{1}{2}$ m or 50 cm

- estimate small weights, small areas, small volumes.

  e.g. bag of sugar = 1 kg or 1000 g etc.

  e.g. know what 1 cm^2 looks like

- estimate areas in square metres, lengths in mm and m

  e.g. area of a blackboard = 4 m^2

  diameter of 1p coin = 2 cm

Rounding

We expect pupils to

- round any number to the nearest whole number, 10 or 100.
- round to any number of decimal places or significant figures.

Note: We always round up for 5 or above.

Worked Examples:

74 → 70 (to the nearest 10)
386 → to 390 (to the nearest 10)

347.5 → 348 (to nearest whole number);
347.5 → 350 (to the nearest ten)
347.5 → 300 (to the nearest hundred)

7.51 → 7.5 (to 1 decimal place)
8.06 → 8.1 (to 1 decimal place)

3.14159 → 3.142 (to 3 decimal places)
3.14159 → 3.14 (to 2 decimal places)
3.14159 → 3.14 (to 3 significant figures)

Addition & Subtraction

- Subtraction using decomposition (as a written method).
- Check by addition.
- Promote alternative mental methods where appropriate
  e.g. To subtract 19, subtract 20 then add 1 back on.
- For 10 – 6 say "ten subtract six".

Worked Examples

- Decomposition

$$\begin{array}{r} 2\,\cancel{7}^{6}\,1^{1} \\ -\,3\,8 \\ \hline 2\,3\,3 \end{array} \qquad \begin{array}{r} \cancel{4}^{3}\,\cancel{0}^{9}\,0^{1} \\ -\,7\,4 \\ \hline 3\,2\,6 \end{array}$$

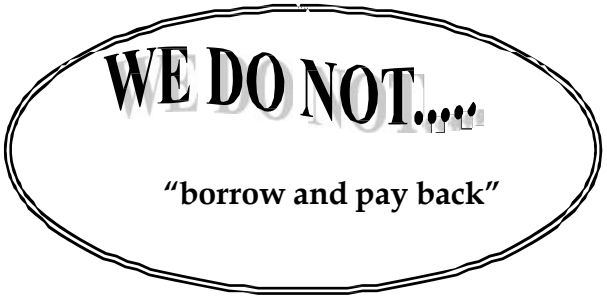
- Counting on:

  To solve 41 – 27, count on from 27 until you reach 41

- Breaking up the number being subtracted:

  e.g. to solve 41 – 27, subtract 20 then subtract 7

- Sum is the result of adding.
  Difference is the result of subtracting.



Multiplication & Division

- The decimal point stays fixed and the digits "move" when multiplying and dividing.

- We do not say "add on a zero" when multiplying by 10.
  This can lead to the wrong answer, e.g. $3.6 \times 10 = 3.60$
  Say "the digits move one place to the left".
  Put in a zero to keep place value when appropriate.

- Product is the result of multiplying.
  Quotient is the result of dividing.

- When using multiplication tables, remember in sentences, e.g. $3 \times 1 = 3$, $3 \times 2 = 6$, etc. and not just a list of multiples, e.g. 3, 6, 9, 12, etc.

Fractions

We expect pupils to

- talk about decimal fractions (decimals), and common or vulgar fractions (fractions) to help pupils make the connection between the two.
- do simple fractions of 1 or 2 digit numbers, e.g.
  $\frac{1}{3}$ of 9 = 3 (9 ÷ 3); $\frac{1}{5}$ of 70 = 14 (70 ÷ 5)
- do simple fractions of up to 4 digit numbers, e.g.
  $\frac{3}{4}$ of 176 = 132 (176 ÷ 4 × 3)
- use equivalence of widely used factions and decimals, e.g.
  $\frac{3}{10}$ = 0.3 = 30%
- find fractions of a quantity with a calculator,
- find widely used fractions mentally,
- use equivalence of all fractions, decimals and percentages add, subtract, multiply and divide fractions with and without a calculator,

Worked Examples

Add and Subtract	**Multiply**	**Divide**
Make the denominators equal	Multiply top and multiply bottom	Invert the second fraction and multiply
$\frac{1}{2}+\frac{1}{3}$ $=\frac{3}{6}+\frac{2}{6}$ $=\frac{5}{6}$	$1\frac{2}{3}\times\frac{3}{4}$ $=\frac{5}{3}\times\frac{3}{4}$ $=\frac{15}{12}$ $=1\frac{3}{12}=1\frac{1}{4}$	$\frac{3}{4}\div\frac{2}{5}$ $=\frac{3}{4}\times\frac{5}{2}$ $=\frac{15}{8}=1\frac{7}{8}$

Mixed numbers become improper fractions at start and then revert back at the end.

Equivalence

"What is the highest number that you can divide the numerator and denominator by?". Check by asking "Can you simplify again?".

Negative Numbers

We expect pupils to

- know that the number line extends down beyond zero to negative numbers.
- add and subtract both positive and negative numbers.

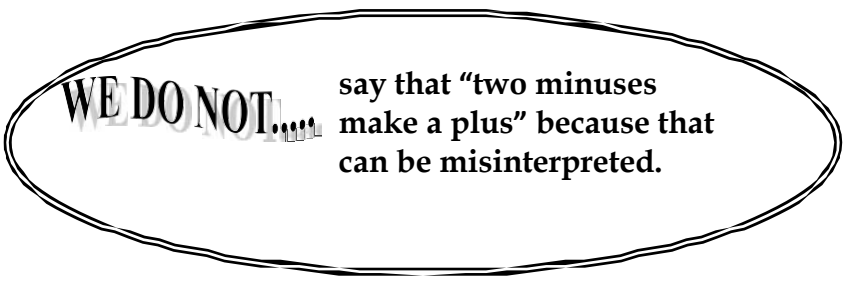
We talk about a vertical number line being like a thermometer and calculations as moving "up" or "down" the number line. Pupils are encouraged to draw or use a number line.

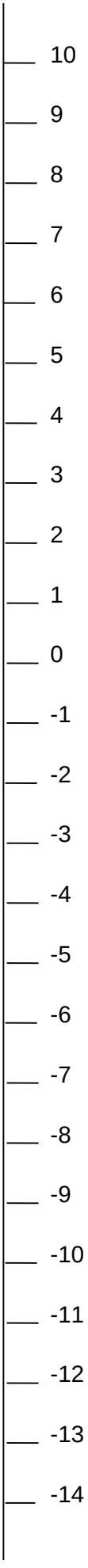
The number -7 is said "negative seven", not "minus seven".

Worked Examples:

- $2 - 5 = -3$
  Start at two, go down five
- $(-10) + 3 = -7$
  Start at -10, go up three
- $7 + (-12) = -5$
  Start at seven, go down twelve
  (because the negative means go the other way)
- $3 - (-4) = 7$
  Start at three, go up four
  (because the negative means go the other way)

  Note that we write negative numbers in brackets to distinguish a negative number from a subtraction symbol.





Co-ordinates

- *x* co-ordinate across (horizontal)
- *y* co-ordinate up/down (vertical)

We expect pupils to

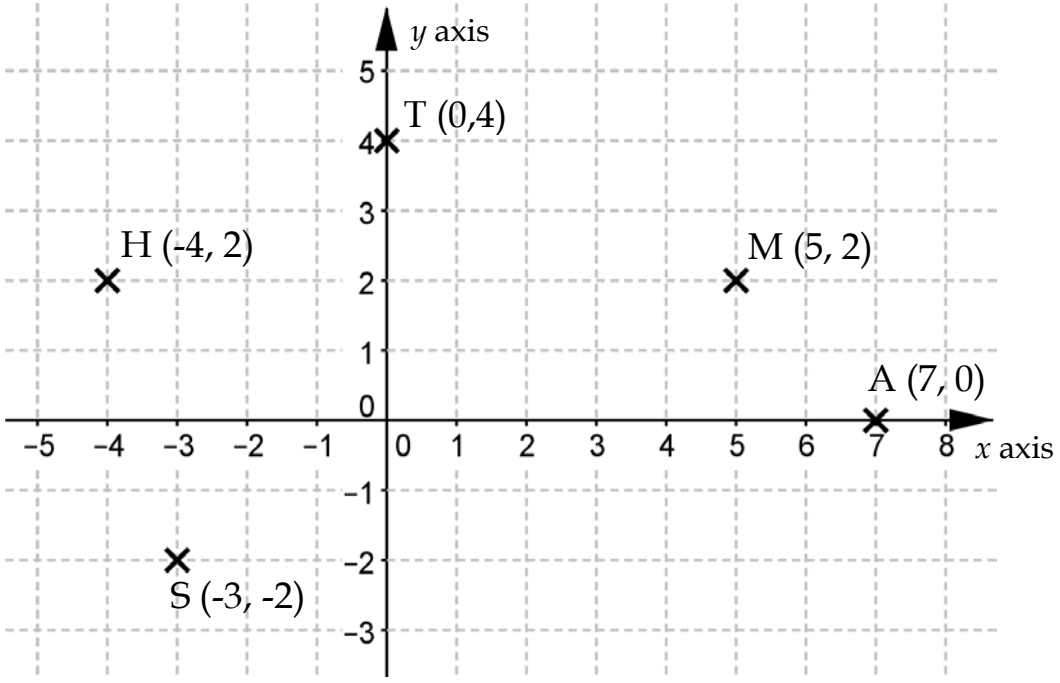
- use a co-ordinate system to locate a point on a grid.
- number the grid lines rather than the spaces.
- use the terms across/back and up/down for the different directions. (horizontal & vertical)
- use a comma to separate as follows: 3 across 4 up = (3, 4)

We expect pupils to

- use co-ordinates in all four quadrants to plot positions.

Worked Example:

Plot the following points:
M (5, 2), A (7, 0), T (0, 4), H (-4, 2), S (-3, -2)



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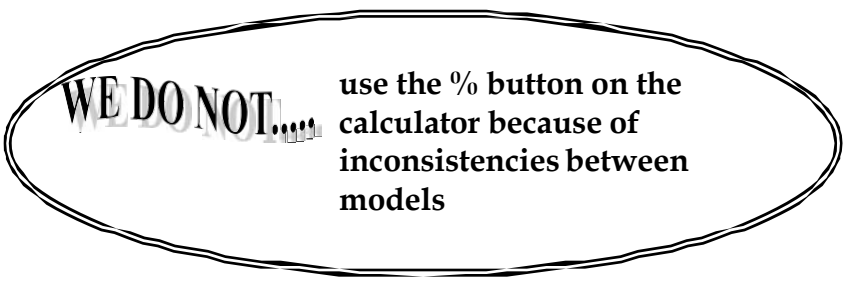
Percentages

We expect pupils to

- find 50%, 25%, 10% and 1% without a calculator and use addition to find other amounts $\left(\frac{1}{2}, \frac{1}{4}, \frac{1}{10}, \frac{1}{100}\right)$.
- switch between percentages and decimals e.g. 23% = 0.23
- use decimal equivalents to find percentages using a calculator: 23% of £300 = 0.23 × 300 = £69
- express some fractions as percentages without a calculator.
- express a fraction as a percentage via the decimal equivalent.

Worked Examples

- Find 36% of £250 without a calculator
  10% is £25
  30% is £75 (× 3)
  5% is £12.50 (10% ÷ 2)
  1% is £2.50 (10% ÷ 10)
  36% is £90 (30% + 5% + 1%)
- Express two fifths as a percentage
  $\frac{2}{5} = \frac{4}{10} = \frac{40}{100} = 40\%$ or $\frac{2}{5}$ of 1 40%
- Express three eighths as a decimal $\frac{3}{8} = 0.125 = 12.5\%$
- You buy a car for £5000 and sell it for £3500 what is the percentage loss?
  Loss = £5000 − £3500 = £1500
  $\frac{1500}{5000} = \frac{15}{50} = \frac{30}{100} = 30\%$
- Increase £350 by 15%
  15% of 350 = 0.15 × 350 = £52.50 (….to find the increase)
  (…then add on for the new total) £350 + £52.50 = £402.50



Proportion

We expect pupils to

- identify direct proportion.
- use the unitary method (i.e. find the value of 'one' first then multiply by the required value).
- if rounding is required we do not round until the last stage.

Worked Example

If five bananas cost 80 pence, then what do three bananas cost?

Bananas		Cost (pence)
5	→	80
1	→	80 ÷ 5 = 16
3	→	16 x 3 = 48

So three bananas cost 48 pence.

Equations

We expect pupils to solve simple equations by

- "balancing"
- performing the same operation to each side of the equation
- doing "undo" operations e.g.
  undo + with – , undo – with +
  undo × with ÷, undo ÷ with ×
- encouraging statements like:
  "add something to both sides"
  "multiply both sides by something"
- We prefer the letter x to be written differently from a multiplication sign
  one equals sign per line
  equals signs beneath each other
  we discourage bad form such as $3 \times 4 = 12 \div 2 = 6 \times 3 = 18$

Worked Examples:

$$\begin{aligned} 2x + 3 &= 9 \\ 2x &= 6 \\ x &= 3 \end{aligned}$$

take away 3 from both sides
divide by 2 both sides

$$\begin{aligned} 3x + 6 &= 2(x - 9) \\ 3x + 6 &= 2x - 18 \\ 3x &= 2x - 24 \\ x &= -24 \end{aligned}$$

expand the bracket
subtract 6 from both sides
subtract $2x$ from both sides

Line Graphs

We expect pupils to

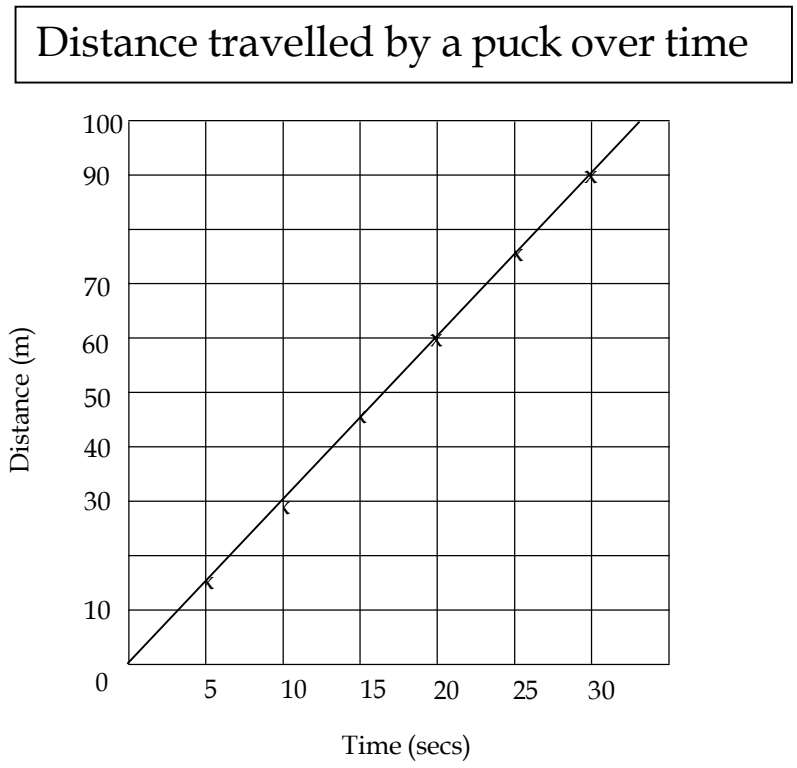
- use a sharpened pencil and a ruler.
- choose an appropriate scale for the axes to fit the paper.
- label the axes.
- give the graph a title.
- number the lines not the spaces.
- plot the points neatly (using a cross or dot).
- fit a suitable line.

- If necessary, make use of a jagged line to show that the lower part of a graph has been missed out.
- If there is more than one line graph on the same axes, the graph needs a key.

Worked Examples:

The distance an ice puck travels over time has been recorded in the table below:

Time(s)	0	5	10	15	20	25	30
Distance (m)	0	15	30	45	60	75	90



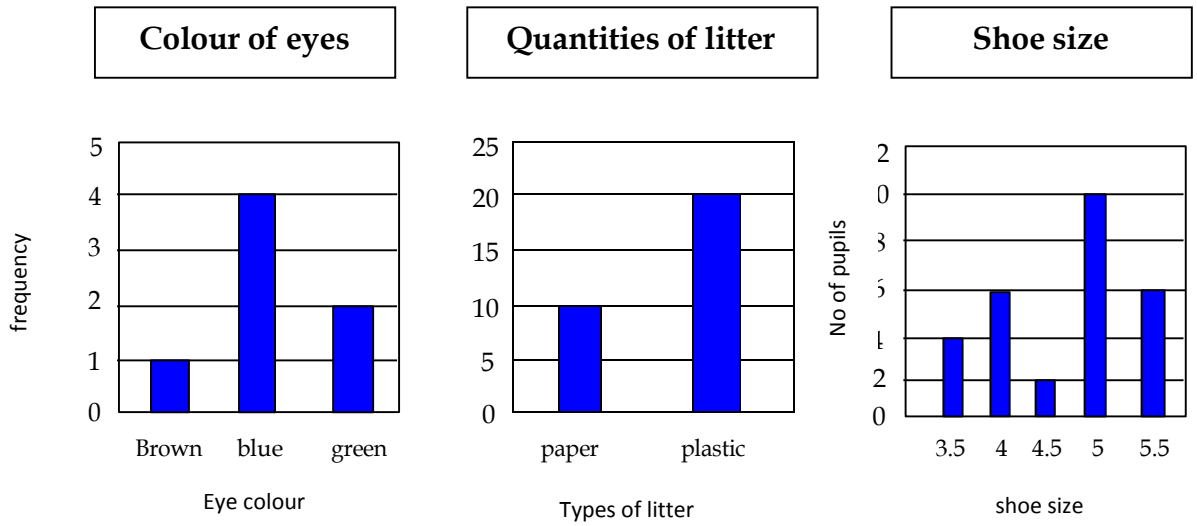
Bar Graphs

We expect pupils to

- use a pencil.
- give the graph a title.
- label the axes.
- label the bars in the centre of the bar (each bar has an equal width).
- label the frequency (up the side) on the lines not on the spaces.
- make sure there are spaces between the bars.
- leave a space between the y-axis and the first bar.

- Construct bar graphs with frequency graduated in single units.
- Construct bar graphs with frequency graduated in multiple units.
- Construct bar graphs involving simple fractions or decimals.

Worked Examples:



Pie Charts

We expect pupils to

- use a pencil.
- label all the slices or insert a key as required.
- give the pie chart a title.

- construct pie charts involving simple fractions or decimals.

- construct pie charts of data expressed in percentages.

- construct pie charts of raw data.

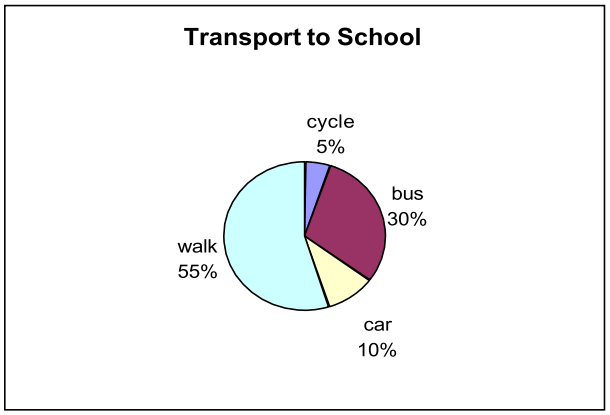
Worked Examples:

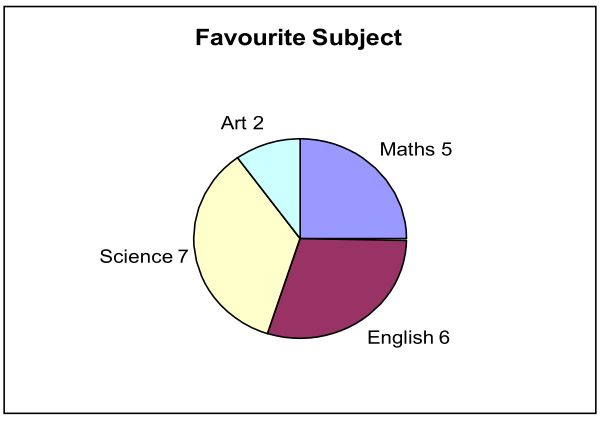
30% of pupils travel to school by bus, 10% by car, 55% walk and 5% cycle.
Draw a pie chart of the data.
10% of 360° = 360 ÷ 10 = 36°
30% of 360° = 36 × 3 = 108°

Bus 30% = 3 × 10% = 108°
Car 10% = 36°
Walk 55% = 5.5 × 10% = 198°
Cycle 5% = ½ of 36° = 18°

20 pupils were asked "What is your favourite subject?"
Replies were Maths 5, English 6, Science 7, Art 2.
Draw a pie chart of the data.
360 ÷ 20 (the total) = 18°

Maths 5 5 × 18 = 90°
English 6 6 × 18 = 108°
Science 7 7 × 18 = 126°
Art 2 2 × 18 = 36°





Time Calculations

We expect pupils to

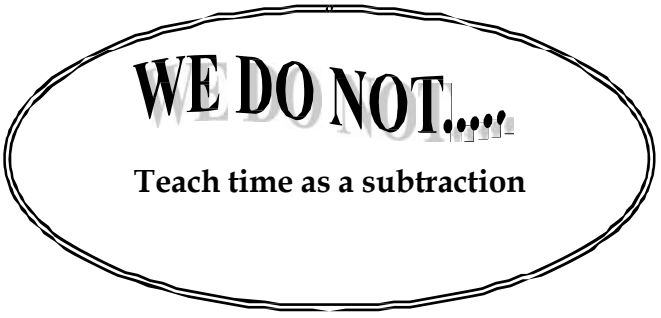
- convert between the 12 and 24 hour clock (23:27 ↔ 11.27pm).
- calculate duration in hours and minutes by counting up to the next hour then on to the required time.
- convert between hours and minutes (multiply by 60 for hours into minutes).
- know and use the relationships between distance, speed and time.
- Time zones.

Worked Examples:
How long is it from 07:55 to 09:48?

07:55 → 08:00 → 09:00 → 09:48
(5 mins) + (1 hr) + (48 mins)

Total time: 1 hr 53 minutes

Change 27 minutes into hours equivalent
27 min = 27 ÷ 60 = 0.45 hours
(without a calculator)



Notes
- For 02:00 say "zero two hundred hours".
- We write 24-hour times with a colon e.g. 18:51
- We write 12-hour times with a dot and am or pm e.g. 6.51pm
- There is no agreement about what 12.00am or 12.00pm mean. Use "12 noon" or "12 midnight" instead.

Using Formulae

We expect pupils to construct and use simple formulae by

- writing down the formula first.
- rewriting the formula replacing the letters by the appropriate numbers (substitution).
- evaluate.
- interpreting the answer and putting the appropriate units back into context.

Worked Examples:

The length of a spring S millimetres changes depending on the weight W grams attached to it. The formula is:

$$S = 16 + 3W$$

(a) Find S when W = 3 grams

$S = 16 + 3W$	(write formula)
$S = 16 + 3 \times (3)$	(replace letters by numbers)
$S = 16 + 9$	(evaluate)
$S = 25$	
Length of spring is 25 mm	(interpret result in context)

(b) Find W when S = 20.5 mm

$S = 16 + 3W$	(write formula)
$20.5 = 16 + 3W$	(replace letters by numbers)
$4.5 = 3W$	(solve the equation – by doing and undoing)
$1.5 = W$	
The weight is 1.5 g	(interpret result in context)

WE DO NOT.....

- **Rearrange the formula before substitution (too difficult)**
- **State the answer only. Working must be shown.**

Data Analysis

We expect pupils to

- analyse ungrouped data using a tally table and frequency column or an ordered list.
- calculate range of a data set. In Maths this is taught as the difference between the highest and lowest values of the data set. (Range is expressed differently in Biology)
- calculate the mean of a set of data.
- use a stem and leaf diagram.
- median (central value of an ordered list).
- mode (most common value) of a data set.
- obtain these values from an ungrouped frequency table.

Correlation in scatter graphs is described in qualitative terms.
For example:
"The warmer the weather, the less you spend on heating" is negative correlation.
"The more people in your family, the more you spend on food" is positive correlation.

Probability is always expressed as a fraction

$$\text{P (event)} = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$$

Worked Example:
The results of a survey of the number of pets pupils owned were 3, 3, 4, 4, 4, 5, 6, 6, 7, 8

Mean	=	(3 + 3 + 4 + 4 + 4 +5 + 6 + 6 + 7 + 8) ÷ 10 = 5		
Median	=	the middle = (4 + 5) ÷ 2	=	4.5
Mode	=	most common	=	4
Range	=	highest – lowest = 8 – 3	=	5

Order of Operations or BODMAS

BODMAS is the mnemonic which we teach in Maths to enable pupils to know exactly the right sequence for carrying out mathematical operations.

Scientific calculators use this rule to know which answer to calculate when given a string of numbers to add, subtract, multiply, divide, etc.

For example:
What do you think the answer to $2 + 3 \times 5$ is?
Is it $(2 + 3) \times 5 = 5 \times 5 = 25$? or $2 + (3 \times 5) = 2 + 15 = 17$?

We use BODMAS, multiplication should always be done before addition, therefore 17 is the correct answer according to BODMAS and should also be the answer which your scientific calculator will give if you type in $2 + 3 \times 5$ <enter>.

Order means a number raised to a power such as 2^2 or $(-3)^3$.
The power is also called the exponent or index leading to alternative mnemonics BEDMAS or BIDMAS but both mean the same thing.

Worked Examples:

Calculate $6 + 4 \times 2$

$= 6 + 8$

$= 14$

because multiply before add

Calculate $70 \div (4 + 3)$

$= 70 \div 7$

$= 10$

because brackets first

Possible Activities to Promote Numeracy Skills

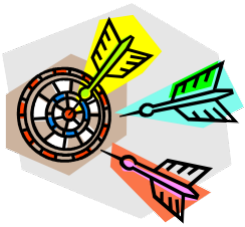
- Look for sale prices in shops, magazines and newspapers. Work out the prices for 50%, 25%, 12½% off.

- Measure the family's heights in centimetres and change to decimals, eg 152 cm = 1.52 m.

- Using shopping catalogues "buy" four household items for under £60 and work out how much change should be given and list the coins and notes to be given in change.

- Look at a take-away food menu, plan a meal for the family, working out the total cost and think of different combinations of notes to pay the bill and receive change.

- Play darts and ask your child to mentally keep the score.



- Play mental maths games

- Use mathsworkout. Username: *bellbaxterhs* Password: *equation91*

- Look at weights on food boxes and round to the nearest 10, 100, 1000.

- Look at the sports pages in newspapers for crowd attendance figures at football matches and round them to nearest 10 or 100.

- 
Look at the supermarket receipt with individual item prices and round each item to given an approximate total bill.

- Use a numbers board from a snakes and ladders game and identify patterns such as 3, 6, 9, etc and then progress on to more challenging examples such as 1, 1, 2, 3, 5, 8, 13.

- Encourage your child to think of patterns and sequences for you to work out.

- Ask your child to estimate, then check by measuring, the length of a variety of objects and encourage him/her to choose a suitable measuring device, e.g. ruler or tape measure.

- Involve your child in the preparation of foods – encourage the use of measuring jug and scales.

- Check the temperature in the house, outside and maybe in the car. Talk about "negative" temperatures rather than "minus".

- Look at bus or train timetables with your child and ask them to work out the length of different journeys.

- Set the alarm on a digit alarm clock.

- Work out the length of film and different programmes on TV.

- Measure, then calculate the perimeter of a room, patio or pieces of grass in the garden.

- Identify 3D objects within the house, e.g. a fridge is a cuboid.

- Open up packets to find shape nets.

- Use a compass to find the direction of friends' houses from your own house.

- Use newspaper and TV articles to identify and interpret graphs. Be aware of misleading graphs.

- Board games including Snakes and Ladders, dominoes, playing cards, Bingo, Connect 4, Yahtzee and Battleships.

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