CALCULATION POLICY

MELLERS PRIMARY SCHOOL

April 2013

CALCULATION POLICY STATEMENT

Mathematics equips pupils with a uniquely powerful set of tools to understand and adapt to change the world. These tools include logical reasoning, problem-solving skills and the ability to think in abstract ways.

The ability to calculate is a fundamental skill not only for school but for the pupils to use throughout their adults lives. It is, therefore, essential that all pupils leave Key Stage Two being able to use the most efficient mental and written calculations strategies possible. This policy outlines the development of these skills through the use of concrete representations into the abstract representations needed to calculate with larger numbers.

At the heart of the policy, is the importance that the pupils have a deep understanding of number and calculations rather than the ability to follow a process.

AIMS

This calculation policy should be used with the following aims in mind. By the end of Key Stage Two, all pupils should:

- have a secure knowledge of number facts and a good understanding of the four operations;
- be able to use this knowledge and understanding to carry out calculations mentally and to apply general strategies when using one-digit and two-digit numbers and particular strategies to special cases involving bigger numbers;
- make use of diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads;
- have an efficient, reliable, compact written method of calculation for each operation that children can apply with confidence when undertaking calculations that they cannot carry out mentally;
- use a calculator effectively, using their mental skills to monitor the process, check the steps involved and decide if the numbers displayed make sense.

MENTAL STRATEGIES

It is important that pupils develop a secure understanding of how to solve problems involving all four operations mentally. The use of a mental strategy should always take precedent over that of a written method and pupils should be taught how to choose the correct strategy in their everyday lives. In order to achieve this there are a set of guidelines setting out the expectation at each year group.

Addition Stage One		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
- Manipulate a range of real objects. - Rearrange partition and recombine groups of real objects. - Notice and compare size of groups.	- Adults model representations of pupils' ideas on paper - Children's own jottings based on real objects 	- Adults model conventional number representations - Variety of maths symbols displayed in the environment.

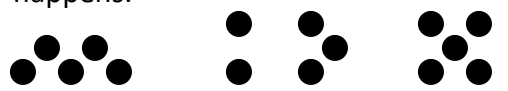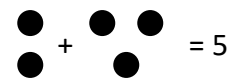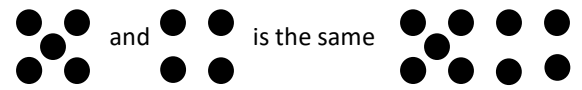| Addition Stage Two		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
- Manipulate apparatus that represent real objects e.g. cubes, Base 10, Cuisenaire, bead strings - Place objects in a line and on a number line. - Estimate and check size of groups - Rearrange, partition and recombine groups of objects and noticing what happens. - Use pennies to calculate money	- Children's jottings reflect abstract representations of objects e.g. tallies, spots - Adults model abstract representations $$2 + 3 = 5$$	- Adults model horizontal recording of calculation and vocabulary $$5 + 4 = 9$$ $$9 = 4 + 5$$ - Adults model = as 'the same as' - Represent Multilink, Base Ten, Cuisenaire on a number line

Addition Stage Three
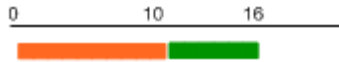
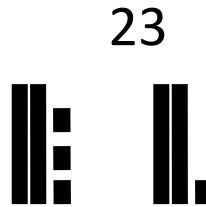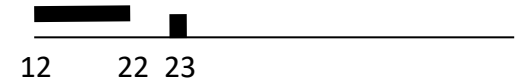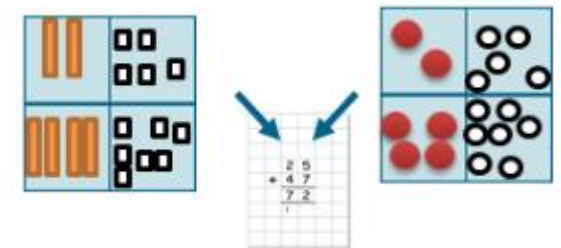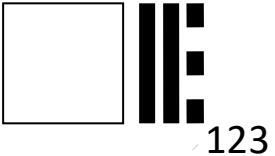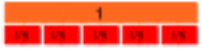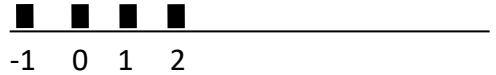| Concrete	Towards Written Calculation	Expected Written Method
o Use Cuisenaire and Base Ten on a number line o Use Cuisenaire and Base Ten to represent two digit numbers o Use £10 notes, £1, 10p and 1p coins to calculate money	o Use place value cards to partition two digit numbers. o Represent Base Ten and Cuisenaire on paper 23	o Represent Multilink, Base Ten, Cuisenaire on a number line 12 22 23 o Record calculations horizontally and 'read' using correct vocabulary $$5 + 4 = 9$$ $$12 + 11 = 23$$ O Children begin to add two digit numbers vertically with apparatus

Addition Stage Four		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
o Use Cuisenaire and Base Ten to represent two and three digit numbers o Begin to introduce decimals and fractions using real objects o Use coins and notes to calculate money to calculate money to the value of £1	o Use place value cards to represent two and three digit numbers o Represent Base Ten and Cuisenaire on paper 123	o Children begin to record by partitioning and recombining numbers $$52 + 43 = 95$$ $$50 + 40 = 90$$ $$2 + 3 = 5$$ $$90 + 5 = 95$$ o Adults begin to model vertical addition $$\begin{array}{r} 52 \\ +43 \\ \hline 95 \end{array}$$
Addition Stage Five		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
o Use Base Ten and Cuisenaire to exchange once 10 is reached o Use Cuisenaire and Base Ten to represent fractions and decimals to one decimal place o Use coins and notes when calculating money totals	o Use place value cards to represent decimal numbers and money o Use coins to represent money	o Children use vertical addition to bridge 10 $$\begin{array}{r} 69 \\ +23 \\ \small 1 \\ \hline 92 \end{array}$$ o Children begin to use number lines to calculate using negative numbers -1 0 1 2 o Children vertical addition to calculate

		amounts of money without bridging 10
Addition Stage Six		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u> o Children are proficient in using vertical addition for whole numbers and decimals $$\begin{array}{r} 12.53 \\ +19.28 \\ \hline 31.81 \end{array}$$

Subtraction Stage One		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
o Manipulate a range of real objects. o Rearrange partition and recombine groups of real objects. o Notice and compare size of groups.	o Adults model representing ideas on paper o Children's own jottings based on real objects	o Adults model conventional number representations o Variety of maths symbols displayed in the environment.

Subtraction Stage Two		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
o Manipulate apparatus that represent real objects e.g. cubes, Base 10, Cuisenaire, bead strings o Place objects in a line and on a number line. o Estimate and check size of groups o Rearrange partition and recombine groups of objects and noticing what happens. o Use pennies to calculate money	o Children's jottings to reflect abstract representations of objects e.g. tallies, spots o Adults model abstract representations 5 - 3 = 2	o Adults model horizontal recording of calculation and vocabulary $$9 - 4 = 5$$ $$5 = 9 - 4$$ o Adults model = as 'the same as' and is the same as

Subtraction Stage Three		
Concrete	Towards Written Calculation	Expected Written Method
- Use Cuisenaire and Base Ten on a number line - Use Cuisenaire and Base Ten to represent two digit numbers - Use £10 notes, £1, 10p and 1p coins to calculate money	- Use place value cards to partition two digit numbers. - Represent Base Ten and Cuisenaire on paper 23	- Represent Multilink, Base Ten, Cuisenaire on a number line 9 8 7 6 5 12 22 23 - Record calculations horizontally and 'read' using correct vocabulary $9 - 5 = 4$ $23 - 11 = 12$ - Children begin to subtract two digit numbers with apparatus $45 - 23 = 22$
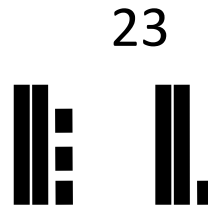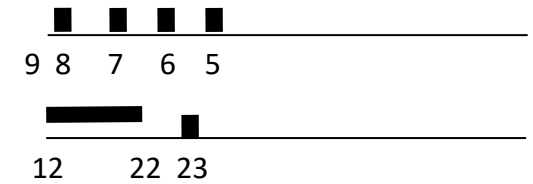
Subtraction Stage Four		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
- Use Cuisenaire and Base Ten to represent two and three digit numbers - Begin to introduce the subtraction of decimals and fractions using real objects - Use coins and notes to calculate money to calculate money to the value of £1	- Use place value cards to represent two and three digit numbers - Represent Base Ten and Cuisenaire on paper 123	- Children begin to record by partitioning the second number 93 - 47 = 52 93 - 7 = 86 86 - 40 = 46 - Adults model vertical subtraction

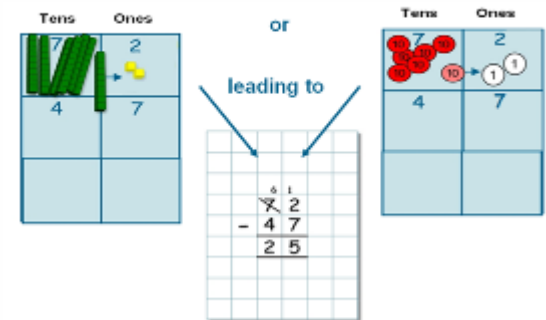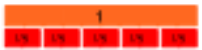| Subtraction Stage Five		
Concrete	Towards Written Calculation	Expected Written Method
o Use Base Ten and Cuisenaire to exchange once 10 is reached o Use Cuisenaire and Base Ten to represent fractions and decimals to one decimal place o Use coins and notes when calculating money totals	o Use place value cards to represent decimal numbers and money o Use coins to represent money	o Children use vertical addition to bridge 10 $\overset{5\ \ 1}{\cancel{6}3}$ $-\ 29$ $\overline{34}$ o Use number lines to calculate using negative numbers ■ ■ ■ ■ _____ -1 0 1 2
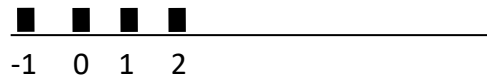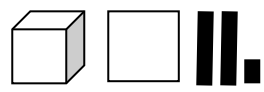
Subtraction Stage Six		
Concrete	Towards Written Calculation	Expected Written Method
	o Using place value cards to represent two and three digit numbers and money o Representing money as decimals o Representing Base Ten and Cuisenaire on paper 1121	o Children proficient in using vertical subtraction for whole numbers and decimals $\overset{1\ \ \ 1\ \ \ 4\ \ 1}{\cancel{2}\cancel{2}.\cancel{5}3}$ $-\ 19.28$ $\overline{03.25}$

Multiplication Stage One		
Concrete	**Towards Written Calculation**	**Expected Written Method**
o Manipulate a range of real objects. o Rearrange, partition and recombine groups of real objects. o Sort and group sets of objects	o Adults model representing ideas on paper o Children's own jottings based on real objects 🐻🐻🐻🐻 🐻🐻🐻🐻	o Adults model conventional number representations o Variety of maths symbols displayed in the environment.

Multiplication Stage Two		
Concrete	**Towards Written Calculation**	**Expected Written Method**
o Introduce language and concepts of multiplication in real life contexts e.g. counting pairs of shoes, sweets in a bag, grouping objects. o Place objects in groups of the same number and calculating how many altogether o Count sets of coins e.g. 10 pence pieces	o Children count in multiples of 2, 5 and 10 and recognising why these patterns occur using Cuisenaire, 100 squares, number lines o Children's jottings to reflect abstract representations of objects e.g. tallies, spots ● ● ● ● ● ● o Adults model abstract representations ● ● ● ● ● ● 2 + 2 + 2 = 6 or 3 x 2 = 6	o Adults model horizontal recording of calculation and vocabulary related to repeated addition $$3 + 3 + 3 + 3 + 3 = 15$$ o Adults model horizontal recording of calculation and vocabulary related to groups of and lots of $$3 \times 5 = 15$$ $$15 = 5 \times 3$$
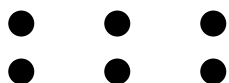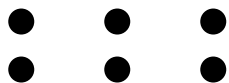
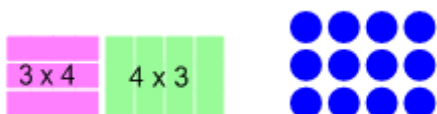| Multiplication Stage Three		
Concrete	**Towards Written Calculation**	**Expected Written Method**
o Make arrays with different pieces of equipment e.g. cubes, peg boards, Cuisenaire 3 x 4 4 x 3 o Use of number line to find multiplication facts	o Children count in multiples of all numbers to 10 and recognising why these patterns occur using Cuisenaire, 100 squares, number lines o Children begin to use abstract notation to answer problems e.g. drawing their own arrays. o Children begin to recall multiplication facts (2s, 3s, 5s, 10s)	o Children record calculations horizontally and 'read' using correct vocabulary. $$3 \times 4 = 12$$ $$4 \times 3 = 12$$ o Children understand that the operation is commutative o Children partition two digit numbers in order to multiply $$13 \times 4 =$$ $$10 \times 4 + 3 \times 4 =$$ $$40 + 12 = 52$$

Multiplication Stage Four		
Concrete	**Towards Written Calculation**	**Expected Written Method**
o Making arrays with different pieces of equipment in order to answer multiplication questions e.g. cubes, peg boards, Cuisenaire 3 x 4 4 x 3 o Use of number line to find multiplication fact	o Children proficient in recalling multiplication facts	o Use grid method for multiplying 1 digit by 2 digit numbers $$14 \times 4 = 56$$ <table><tr><td>x</td><td>10</td><td>4</td></tr><tr><td>4</td><td>40</td><td>16</td></tr></table> $$40 + 16 = 5$$

Multiplication Stage Five		
Concrete	Towards Written Calculation	Expected Written Method
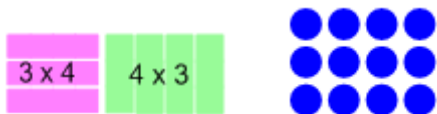
Towards Written Calculation

Children proficient in recalling multiplication facts to 12x12 200

$$+100$$
$$+\ 30$$
$$\underline{+\ \ 15}$$
$$345$$

Expected Written Method

o Use grid method for multiplying 2 digit by 2 digit numbers

23 x 15 =

x	10	5
20	200	100
3	30	15

$$+100$$
$$+\ 30$$
$$\underline{+\ \ 15}$$
$$345$$

o Use short multiplication

$$\begin{array}{r} 30+8 \\ \times\ \ \underline{\ \ 7} \\ 210 \\ \underline{\ \ 56} \\ 266 \end{array}$$

$$30\times7=210$$
$$8\times7=\ \ 56$$

$$\begin{array}{r} 38 \\ \times\ \underline{\ \ 7} \\ 210 \\ \underline{\ \ 56} \\ 266 \end{array}$$

Multiplication Stage Six		
Concrete	Towards Written Calculation	Expected Written Method
		o Children use and understand long multiplication $$\begin{array}{r} 56 \\ \times\ \underline{\ 27} \\ 1000 \\ 120 \\ 350 \\ \underline{\ 42} \\ \underline{1512} \\ 1 \end{array}$$ $\quad\begin{array}{l} 50 \times 20 = 1000 \\ 6 \times 20 = \ \ 120 \\ 50 \times 7 = \ \ 350 \\ 6 \times 7 = \ \ \ \ 42 \end{array}$

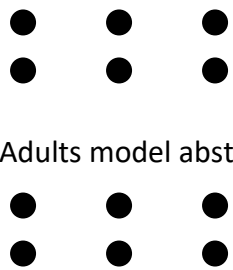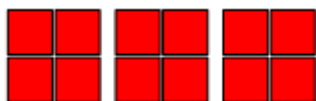| Division Stage One		
Concrete	Towards Written Calculation	Expected Written Method
o Manipulate a range of real objects. o Rearrange, partition and recombine groups of real objects. o Sort and group sets of objects	o Adults model representing ideas on paper o Children's own jottings based on real objects 	o Adults model conventional number representations o Variety of maths symbols displayed in the environment.
Division Stage Two		
Concrete	Towards Written Calculation	Expected Written Method
o Introduce language and concepts of division in real life contexts e.g. pairing up socks, sharing sweets, grouping objects	o Children count in multiples of 2, 3, 5 and 10 and recognise why these patterns in counting occur using Cuisenaire, 100 squares, number lines o Children's jottings to reflect abstract representations of objects e.g. tallies, spots o Adults model abstract representations 	o Adults model horizontal recording of calculation and vocabulary related to groups of and lots of $$15 \div 5 = 3$$ $$15 \div 3 = 5$$

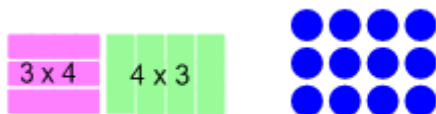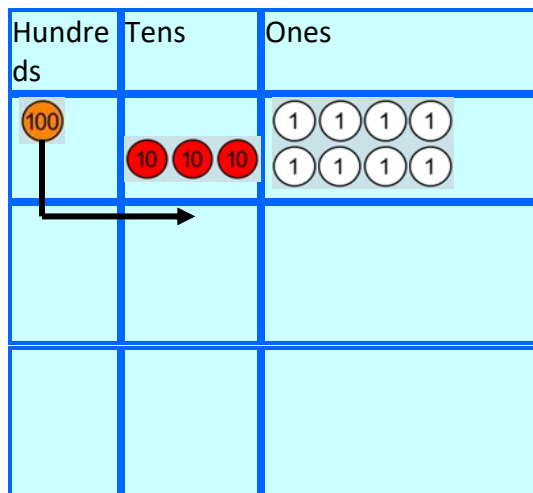| Division Stage Three		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u>
o Share and group using abstract apparatus e.g. cubes, Cuisenaire, bead strings e.g. how many 3's are in 9? How many equal groups can you put 12 cubes into? o Make arrays with different pieces of equipment to show relationship between multiplication and division e.g. cubes, peg boards, Cuisenaire 3 x 4 4 x 3 12 ÷ 4 = 3 12 ÷ 3 = 4	o Children count in multiples of all numbers to 10 and recognise why these patterns occur using Cuisenaire, 100 squares, number lines o Children begin to use abstract notation to answer problems e.g. spots, tallies II II II II o Children begin to use their knowledge of multiplication facts to recall division facts to 12x12	o Children record calculations horizontally and 'read' using correct vocabulary for numbers that can be divided exactly. $$15 \div 5 = 3$$ $$15 \div 3 = 5$$ o Children record calculations horizontally and 'read' using correct vocabulary for division questions involving a remainder $$16 \div 5 = 3 \ r1$$ $$16 \div 3 = 5 \ r1$$

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Division Stage Four		
Concrete	Towards Written Calculation	Expected Written Method
o Children explore exchange of counters for division	o Children proficient in using their knowledge of multiplication facts to recall division facts	o Adults model using the bus shelter method alongside the partitioning method

Concrete

o Children explore exchange of counters for division

Hundreds	Tens	Ones
100	10 10 10	1 1 1 1 / 1 1 1 1

Towards Written Calculation

o Children proficient in using their knowledge of multiplication facts to recall division facts

o Children partition numbers to divide

e.g. $84 \div 6 =$
$60 \div 6 + 24 \div 6 =$
$10 + 4 = 14$

Expected Written Method

o Adults model using the bus shelter method alongside the partitioning method

$81 \div 3$
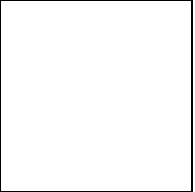
Partition 81 into 60 + 21
$60 \div 3 = 20$
$21 \div 3 = 7$

$20 + 7 = 27$ so $81 \div 3 = 27$

$$3 \overline{) 8\,^2 1}$$ 2 7

o Children should interpret remainders in different ways according to the context, as fractions, decimals or by rounding

e.g. $98 \div 4 = 24$ r $2 = 24\,\frac{1}{2} = 24.5$

Division Stage Five		

<u>Concrete</u>	<u>Towards Written Calculation</u>
	
	   o Children proficient in recalling division facts
		<u>Expected Written Method</u>
		
		   o Children proficient in using the bus shelter method to divide whole numbers and numbers with up to 2 decimal places by a single digit
		
		   o Children begin to divide whole numbers by a two-digit number

Division Stage Six		
<u>Concrete</u>	<u>Towards Written Calculation</u>	<u>Expected Written Method</u> o Children proficient in using long division to solve problems