

Progression of Calculations through Reigate St Mary's



REIGATE ST MARY'S
PREPARATORY AND CHOIR SCHOOL

CALCULATIONS POLICY

UPDATED	REVIEW DATE
6 September 2016	30 January 2017
Name of staff member responsible for document Mrs Andrea Gower	

Progression of Calculations through Reigate St Mary's

Rationale

At St Mary's, we believe a clear progression in calculation will support the learning and teaching of Maths throughout the school, allow clarity and provide a secure foundation upon which to build and develop mathematical skills. The aim is to have a steady progression of understanding in Maths as your child moves through the school. Different methods are taught, but they have been chosen to build on one another, according to the level your child is working at, rather than which year group they are in.

This policy contains the key pencil and paper procedures that will be taught within St Mary's and should be read alongside the Maths Policy. Although the focus of the policy is on pencil and paper procedures it is important to recognise that the ability to calculate mentally lies at the heart of the maths framework. In every written method there is an element of mental processing. Sharing written methods with the teacher encourages children to think about the mental strategies that underpin them and develop new ideas. Therefore, written recording both helps children to extend and clarify their thinking. Children should be encouraged to see mathematics as both a written and a spoken language.

Teachers should support and guide children through the following stages:

1. Develop the use of pictures and use of words and symbols to represent numerical activities.
2. Use standard symbols and conventions.
3. Use of jottings to aid a mental strategy.
4. Use of pencil and paper procedures.
5. It is important that children do not abandon jottings and mental methods once other pencil and paper procedures are introduced. Children will always be encouraged to look at a calculation/problem and then decide on the best method.

Progression in calculation should include:


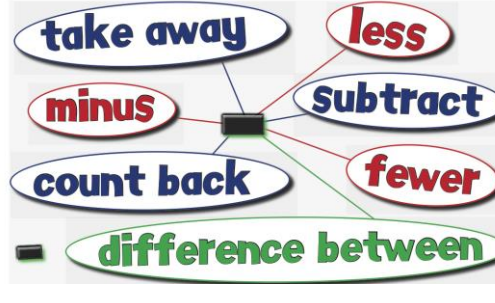

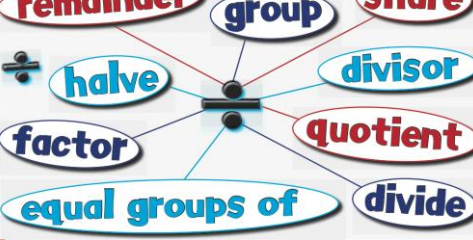
A range of mental strategies to be used as a first resort, even once written methods have been introduced and embedded.

1. An ability to understand and use the relationships between the four operations of number.
2. An ability to explain, describe and record their methods.
3. An ability to estimate and check whether the answer is correct.
4. An ability to solve a wide range of problems involving calculation in a wide variety of contexts.
5. An ability to choose and use the most appropriate method of calculation; mental, jottings, written or using a calculator.
6. An ability to take the initiative to return to an earlier method that children are more confident with.

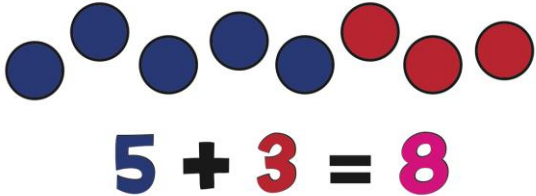

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To work out a tricky calculation:
Can I do it in my head? Approximate
Could I use some jottings to help me? Calculate
Should I use a written method to work it out? Check it

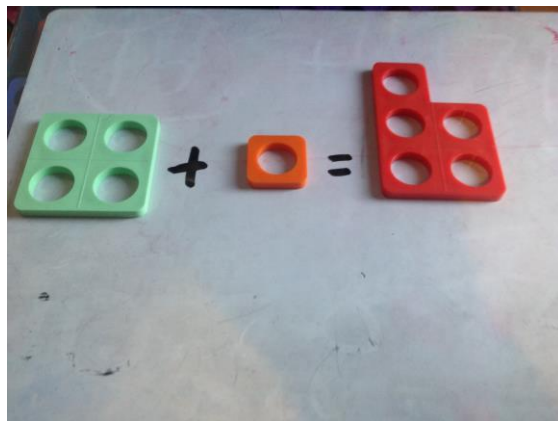
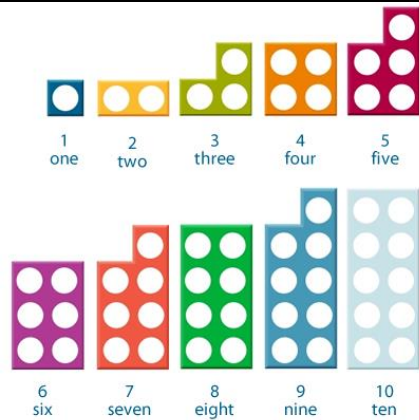
This policy shows the progression in each operation (addition, subtraction, multiplication and division.) All methods should be taught with understanding rather than by rote and put into real life contexts. Differentiated outcomes throughout the progression will be the size of the numbers the children are using.

S T A G E	<p>Addition</p> <p>Addition Vocabulary</p>  <p>A central plus sign (+) is connected to the following terms: increase, add, total, plus, addition, more, count on, sum, and altogether.</p> <p>Reigate St. Mary's</p>	<p>Subtraction</p> <p>Subtraction Vocabulary</p>  <p>A central minus sign (-) is connected to the following terms: take away, less, subtract, minus, fewer, count back, and difference between.</p>	<p>Multiplication</p> <p>Multiplication Vocabulary</p>  <p>A central multiplication sign (X) is connected to the following terms: groups of, times, product, multiple, double, lots of, multiply, and repeated addition.</p>	<p>Division</p> <p>Division Vocabulary</p>  <p>A central division sign (÷) is connected to the following terms: remainder, group, share, divisor, quotient, divide, equal groups of, factor, and halve.</p> <p>Reigate St. Mary's</p>
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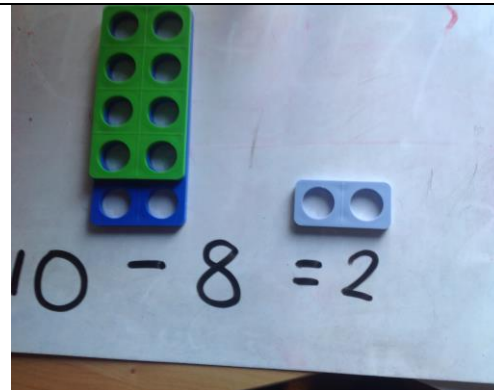
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S T A G E	Addition	Subtraction	Multiplication	Division
1	<p>Children are encouraged to develop a mental picture of the number system in their head for calculation. They develop ways of recording calculations using pictures, numicon etc They handle objects for early addition work</p> <p>A1a: Largest Number 1st</p> 	<p>Before children can move onto the methods for subtraction they need to be able to count reliably including one to one</p> <p>The children will be supported with these concepts through singing Nursery Rhymes and develop ways of recording calculations using pictures or using apparatus, such as Numicon.correspondence</p>	<p>Children will experience equal groups of objects</p> <p>They will count in 2s and 10s and begin to count in 5s.</p> <p>They will work on practical problem solving activities involving equal sets or groups.</p> <p>Numicon will be used to help the children to visualise the grouping of numbers and to support counting on as repeated addition.</p> <p>How many legs will 3 teddies have?</p> 	<p>Children will understand equal groups and share items out in play and problem solving. They will count in 2s and 10s and later in 5s.</p> <p>They will experience the language of sharing early on; sharing of toys, fruit etc, and will have experienced the idea of groups - by working in a practical way practical way group with an adult or sorting toys or objects into groups of the same colour for instance.</p> <p>They will draw pictures in groups or sets.</p> <p>Division will be explored using grouping (with numicon, then number line)</p>

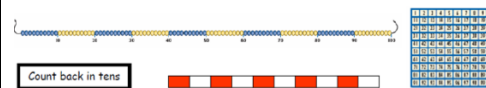
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They use numberlines (slide c1a) and practical resources to support calculation and teacher's demonstrate the use of a numberline.



Children will be able to count up or back from any number



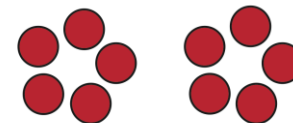
Children will understand subtraction as taking away

Children will begin to know the inverse relationship of number facts to 20



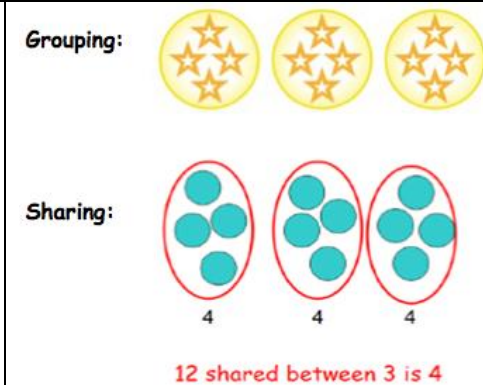
Numicon tiles are essential for making lots of and aiding the counting in fives and other numbers.

(M1: Groups)



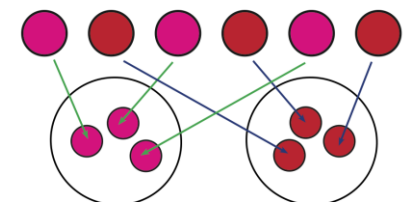
"2 groups of 5 counters makes 10 counters altogether"

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child groups the objects by sorting

D1: Sharing (Concept)



"If I share 6 into 2 equal amounts, how many in each group?" Answer: 3

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C1a: Number Order



The Numbers must be said once and always in the conventional order.

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Children need to be able to **count on** from any number, combining two groups (slide c6)

C6: Counting On

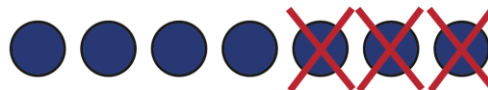


Children will recognise that addition can be done in any order.

Children will begin to know addition facts to

Children will subtract numbers using equipment and Numicon (start by subtracting the units first in preparation for later work).

S1: Objects



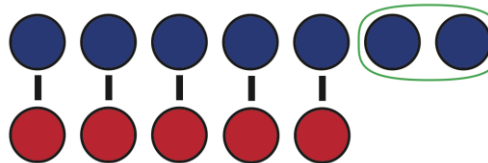
$$7 - 3 = 4$$

"What do I get if I take 3 away from 7? Answer: 4"

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S2: What's the Difference?

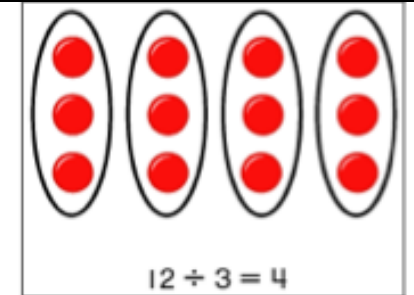


$$7 - 5 = 2$$

"How many more is 7 than 5? What is the difference?"

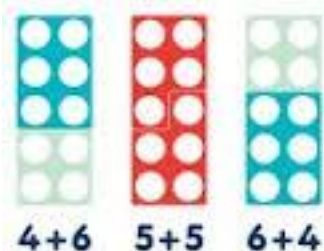
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Children will halve numbers and work out simple fractions of numbers

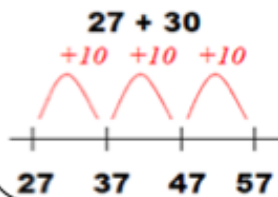
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	<p>ten.</p> <p>Children will be able to count on in ones on a numbered line.</p> <p>Children will be able to use more efficient jumps, starting with the larger number and counting on in ones.</p>  <p>$4+6$ $5+5$ $6+4$</p>			
2	<p>Children are encouraged to develop a mental picture of the number system in their head for calculation. They develop ways of recording calculations using pictures, numicon etc (slide A1a)</p> <p>Pupils to recognize the effect of adding and subtracting zero</p> <p>Children then begin to use numbered lines to support their own calculations using a numbered line to count on in Children are able to count on using a marked unlabelled</p>	<p>Children are encouraged to develop a mental picture of the number system in their head for calculation. They develop ways of recording calculations using pictures, numicon etc</p> <p>The numberline should be used to show that 6-3 means the difference between 3 and 6 and how many jumps they are apart.</p>	<p>Children will experience equal groups of objects</p> <p>They will count in 2s and 10s and begin to count in 5s.</p> <p>They will work on practical problem solving activities involving equal sets or groups.</p> <p>Numicon will be used to help the children to visualise the grouping of numbers and to support</p>	<p>The children will be able to divide objects into equal groups</p> <p>They use counters, bears, Numicon or other objects to group with to solve problems. They will begin to recognise how times- table facts can help them and see the inverse relationship between division and multiplication.</p> <p>Groupings using a number line</p>

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number line, then by drawing their own number lines

Add 2-digit numbers and tens:



Bead strings can be used to illustrate addition including bridging through ten.

Bead strings or bead bars can be used to illustrate addition including bridging through ten by counting on 2 then counting on 3.

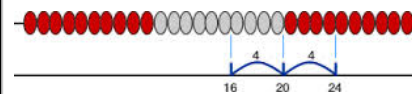
$$8 + 5$$



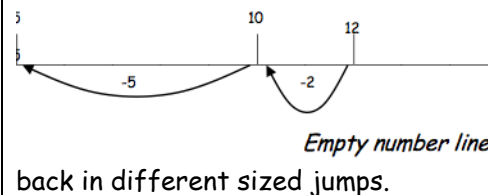
They begin to use jumps of various sizes, applying number bond knowledge to help them 'bridge' to the next 5 or 10. (slide A2a)

Bead strings can be used to illustrate subtraction using bridging through ten by counting back 4 then counting back 4.

$$24 - 8 = 16$$



Children are able to count back using a marked unlabelled number line, then by drawing their own. They use their knowledge of number patterns to count



back in different sized jumps.

counting on as repeated addition

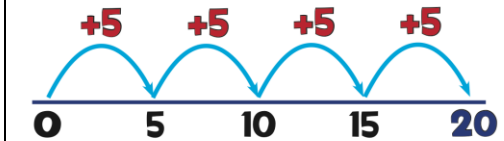


The children will understand double as two equal groups of objects or numbers.

They will be able to draw arrays.

The children will be able to represent jumps of 2, 5 and 10 on a numbered number line and relate it to the concept of repeated addition.

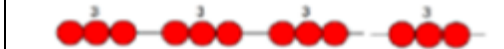
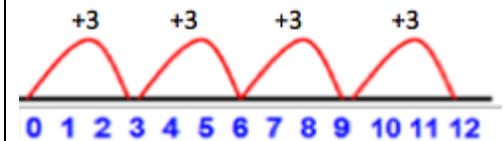
D5: Grouping on a Number Line



20 ÷ 5 = 4

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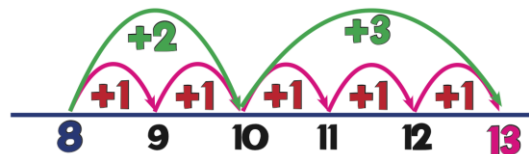


12 ÷ 3 = 4

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A2a: Counting On

Bridging 10

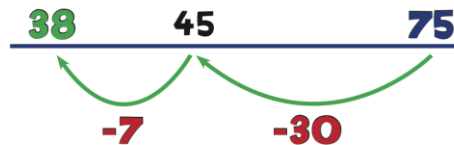


$$8 + 5 = 13$$

Pupils will understand the words sum and total

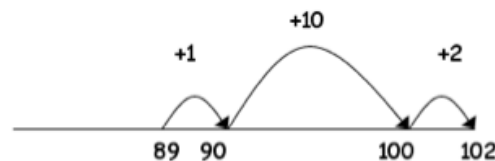
Pupils count in fractions up to 10

S7: Backwards Jump

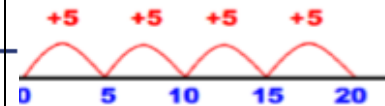


$$75 - 37 = 38$$

Where the numbers are involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used. $102 - 89 = 13$



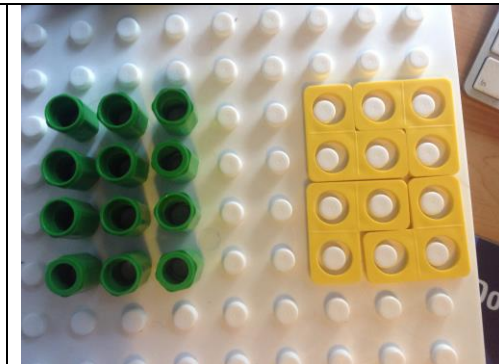
$$4 \times 5 = \dots$$



$$4 \times 5 = 20$$



They will see the relationship between addition and multiplication: $2+2+2+2+2=10$ being the same as $5 \times 2 = 10$. Numicon tracks and Cuisenaire Rods will help the children to visualise the grouping and repeated addition concept.



or $12 \text{ divided by } 3 = 4$

Or repeated subtraction

e.g. 12 take away 3, take away 3 more, take away 3 more and take away 3

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3 Children will begin to use empty number lines themselves starting with the larger number and counting on

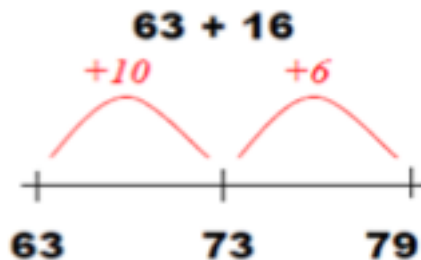
First counting on in tens and ones

Then helping children to become more efficient by adding the units in one jump

(by using known facts e.g. $3+4 = 7$)

Followed by adding the tens in one jump and the units in one jump.

Bridging through ten can help the children to become more efficient.



Children will use partitioning to see how numbers are broken down into their different values. Children will be introduced to the partitioned column

(S10: Expanded Subtraction)
Additional

$$87 - 23 = 64$$

$$\begin{array}{r} 80 \quad 7 \\ 20 \quad 3 \\ \hline 60 \quad 4 \end{array}$$

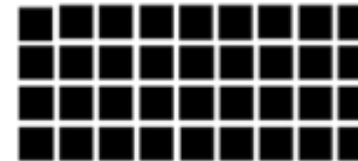
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Repeated addition



4 times 9 is $9+9+9+9$ or 9 lots of 4 or 4×9



$$9 \times 4 = 36$$

Children will be comfortable with the concept of multiplying and dividing by powers of ten

Children will develop their understanding of division and use jottings to support calculation

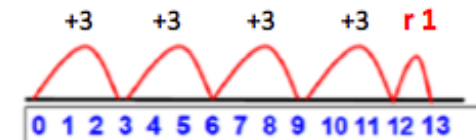
Sharing equally

6 sweets shared between 2 people, how many do they each get?

Repeated addition using a number line or beads

Grouping on a number line:

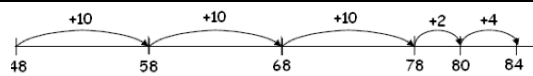
$$13 \div 3 = 4 \text{ r } 1$$



Using symbols to stand for unknown numbers to complete equations using inverse operations

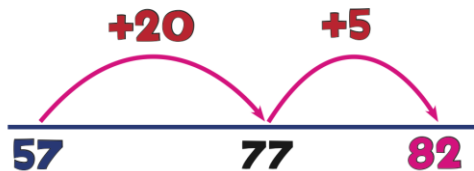
Short division for larger 2 digit numbers
shelter method
The number being divided (the dividend) in the middle (under the shelter).
2. Start by looking at the most significant number and work out how many

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A3a: Forwards Jump

$$57 + 25 = 82$$

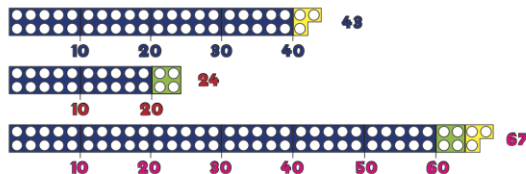


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D: Numicon

$$43 + 24 = 67$$



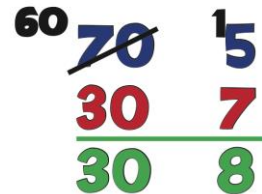
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(S10: Expanded Subtraction)

Additional:

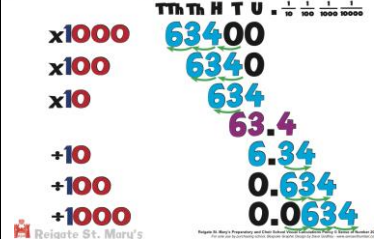
$$75 - 37 = 38$$



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MM1a: Jump!



M5: Grid Method

Short Multiplication

$$15 \times 5 = 75$$

x	10	5
5	50	25

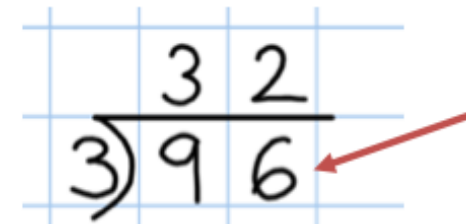
$$50 + 25 = 75$$

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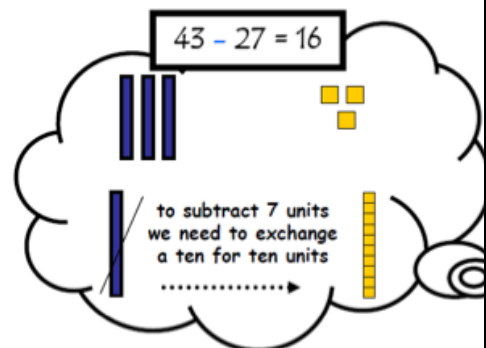
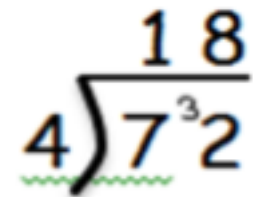
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times it can go into the number.
Carry over the remainders.

Short division: Limit numbers to
NO remainders in the answer OR carried
(each digit must be a multiple of the divisor).



moving to remainders



Arrays

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Moving onto the expanded addition method

(slide
A4b))

A4b: Partitioning

$$86 + 48 = 134$$

$$80 + 40 = 120$$

$$6 + 8 = 14$$

$$134$$

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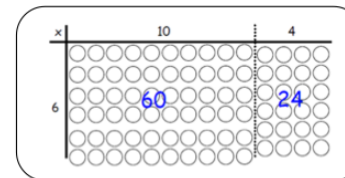
A4f: Partitioning

$$4.8 + 3.8 = 8.6$$

$$4 + 3 = 7$$

$$0.8 + 0.8 = 1.6$$

Link the layout of the grid to an array initially:



Children should be able to model a multiplication calculation using an array. This later supports the grid method.

M5a: Grid Method

$$43 \times 6 = 258$$

x	40	3
6	240	18

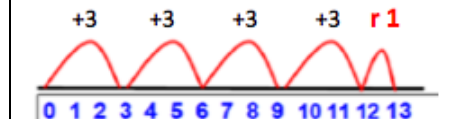
$$240 + 18 = 258$$

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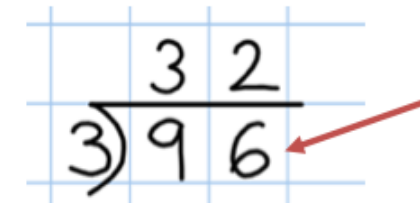
They will be able to use times table knowledge to be able to multiply larger numbers by partitioning. They will use arrays to help them visualise this.

Grouping on a number line:

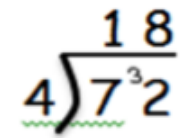
$$13 \div 3 = 4 \text{ r } 1$$



Short division: Limit numbers to **NO** remainders in the answer **OR** carried (each digit must be a multiple of the divisor).



Short division: Limit numbers to **NO** remainders in the final answer, but with remainders occurring within the



sum.

(D10: Short Division)
Additional

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4 Children will continue to use empty number lines with increasingly large numbers, including compensation where appropriate

Count on from the largest number irrespective of the order of the calculation

Children will use partitioning to see how numbers are broken down into their different values. Children will be introduced to the expanded column method for larger numbers before moving quickly onto the formal column method as they will then have developed an understanding of the process

Children will continue to use empty number lines with increasingly large numbers

They will use the expanded column method (known as decomposition) to partition the number and subtract each place value separately always starting with the least significant digits (e.g. the units). It is very important they understand the importance of keeping the digits lined up.

$$\begin{array}{r}
 2754 - 1562 = 1192 \\
 \begin{array}{r}
 2000 + \cancel{700} + 50 + 4 \\
 - 1000 + 500 + 60 + 2 \\
 \hline
 1000 + 100 + 90 + 2
 \end{array}
 \end{array}$$

First they will work with numbers that have no exchanging (e.g. the units or tens of the number being subtracted is smaller than the starting number).

Children will become confident with the grid method

Developing the grid method:

Eg. $136 \times 5 = 680$

X	100	30	6
5	500	150	30

500

150

+ 30

680

The children will understand how to deal with **remainders in a real life context**

$$\begin{array}{r}
 18 \\
 4 \overline{) 732}
 \end{array}$$

$$\begin{array}{r}
 037 \\
 5 \overline{) 185}
 \end{array}$$

When the answer for the first column is zero (1 ÷ 5, as in example), children could initially write a zero above to acknowledge its place, and must always 'carry' the number (1) over to the next digit as a remainder.

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A6: Expanded Column Addition

$$\begin{array}{r}
 \text{H} \quad \text{T} \quad \text{U} \\
 687 \\
 + 248 \\
 \hline
 15 \\
 120 \\
 800 \\
 \hline
 935
 \end{array}$$

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Adding the least significant digits first in preparation for 'carrying.' Formally moving to the column method of addition(Slide A7)

(A7: Column Addition)

$$\begin{array}{r}
 \text{T} \quad \text{U} \\
 57 \\
 + 25 \\
 \hline
 1 \\
 82
 \end{array}$$

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Next they will learn how to exchange from the tens to the units. They need to recognise when the starting number's units have less than the

number being subtracted. When this is the case they need to 'exchange' 10 from the tens into the units, in order to be able to subtract the numbers. It is important the children understand the tens have to come over to the units as a whole 10. The Base 10 (Dienes) apparatus helps the children to visualise what happens and how the exchange takes place. We also use place value counters.

$$\begin{array}{r}
 2754 \\
 - 1562 \\
 \hline
 1192
 \end{array}$$

Once the children understand this process of exchanging, they will often

M5: Grid Method Short Multiplication

$$15 \times 5 = 75$$

x	10	5
5	50	25

$$50 + 25 = 75$$

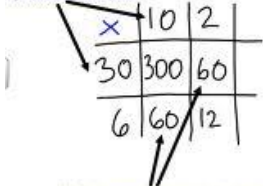
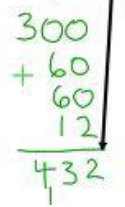

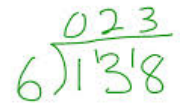
Reigate St. Mary's

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Progression of Calculations through Reigate St Mary's

		do it in one go to save time.										
5	<p>Move from expanded addition to the compact column method, adding units first, and carrying numbers above the calculation. Also include money and measures contexts.</p> <p>A7e: Column Addition</p> <p>M HTTh TTh Th H T U</p> <p>787567 + 446278</p> <p>1 1 1 1 1 1233845</p>	<p>Children will be able to subtract using the Compact Decomposition Method and understand the importance of lining up each digit.</p> <p>S11: Column Subtraction</p> <p>6 H T U 723 - 356 367</p>	<p>Children will continue to use arrays where appropriate using the grid method of multiplication</p> <p>Grid method as stage 4 HTU x U</p> <p>M5b: Grid Method Short Multiplication</p> <p>147 x 4 = 588</p> <table border="1"><tr><td>x</td><td>100</td><td>40</td><td>7</td></tr><tr><td>4</td><td>400</td><td>160</td><td>28</td></tr></table> <p>400 + 160 + 28 = 588</p> <p>Reigate St. Mary's</p> <p>Then TU x TU</p>	x	100	40	7	4	400	160	28	<p>Continue to develop short division/ bus stop method This method relies heavily on times tables knowledge</p> <p>- 2 digit numbers divided by single digit <u>Then</u> 3 digits divided by a single digit</p> <p>18 4 7³2</p> <p>218 4 87³2</p>
x	100	40	7									
4	400	160	28									

Progression of Calculations through Reigate St Mary's

			<p>$12 \times 36 = 432$</p> <p>1) Partition each number</p>  <p>2) Calculate each multiplication</p> <p>3) Then find the sum of all the products.</p>  <p>Column multiplication is introduced</p> <p>M7: Column Multiplication</p>  <p>Reigate St Mary's</p>	
6	<p>Add numbers with more than 4 digits including money, measures and decimals with different numbers of decimal places.</p>	<p>The children will be using the Compact Decomposition Subtraction method to solve subtractions of decimal numbers and more complex numbers.</p>	<p>Column multiplication linked to grid multiplication</p>	<p>$138 \div 6 = 23$</p> 

Progression of Calculations through Reigate St Mary's

The decimal point should be aligned in the same way as the other place value columns, and must be in the same column in the answer.

A7j: Column Addition With Decimals

$$73.4 + 5.67 = 79.07$$

	T	U	.	$\frac{1}{10}$	$\frac{1}{100}$
	7	3	.	4	
+		5	.	6	7
				1	
	7	9	.	0	7

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S11d: Column Subtraction

	Th	H	T	U
	5	0	4	2
-	1	7	7	6
	3	2	6	6

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	100	10	1	
	8	9	9	4
-				
	6	0	7	5

	10	8
10	100	80
3	30	24

M7: Column Multiplication

	H	T	U
	1	4	7
x			4
	1	2	
	5	8	8

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Working towards more complex numbers

Short division involving remainders

(D10: Short Division) Additional:

$$65 \div 4 = 16r1$$

$$4 \overline{) 65} \begin{matrix} 16 \\ r1 \end{matrix}$$

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Short division with remainders: Now that pupils are introduced to examples that give rise to remainder answers, division needs to have a real life problem solving context, The pupils consider the meaning of the remainder and how to express it, i.e. as a fraction, a decimal, or as a rounded number or value, depending upon the context of the word problem.

Progression of Calculations through Reigate St Mary's

<p>A7i: Column Addition With Money</p> $\begin{array}{r} \text{£}38.25 \\ + \text{£}27.46 \\ \hline \text{£}65.71 \end{array}$ <p>Reigate St. Mary's</p>		<p>M9a: Long Multiplication</p> $\begin{array}{r} \text{Th H T U} \\ 243 \\ \times 68 \\ \hline 1944 \quad (8 \times 243) \\ + 14580 \quad (60 \times 243) \\ \hline 16524 \end{array}$ <p>Reigate St. Mary's</p>									
<p>7 To be able to use their knowledge of place value to know how to add 1.234 to 4.1</p> <p>To know how to add numbers of increasing complexity e.g. 81,059,3,668,15,301 and 20,551.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Line up the decimal points</p> $\begin{array}{r} 22.3 \\ + 34.1 \\ \hline 56.4 \end{array}$ </div> <div style="text-align: center;"> <p>Line up the decimal points</p> $\begin{array}{r} 1.234 \\ + 4.1 \\ \hline 5.334 \end{array}$ </div> </div>	<p>Decimal subtractions</p> <p>S11f: Column Subtraction</p> $\begin{array}{r} \text{T U } \frac{1}{10} \frac{1}{100} \\ 72.43 \\ - 47.85 \\ \hline 24.58 \end{array}$	<p>Multiplying decimals with one decimal place either by grid or long multiplication column</p> <p>M8e: Grid Method Long Multiplication</p> $7.38 \times 6 = 44.28$ <table border="1" style="margin: 10px auto;"> <tr> <td>x</td><td>7</td><td>0.3</td><td>0.08</td></tr> <tr> <td>6</td><td>42</td><td>1.8</td><td>0.48</td></tr> </table> $42 + 1.8 + 0.48 = 44.28$ <p>Being comfortable to do decimal adjustments</p>	x	7	0.3	0.08	6	42	1.8	0.48	<p>This method relies heavily on times tables knowledge.</p> <p>It can be used to supply an answer with decimal places and it can be used to convert fractions to decimals.</p> <p>D10f: Short Division Different Remainders</p> $\begin{array}{r} 169.2 \\ 5 \overline{) 846.0} \end{array}$ $846 \div 5$ $\begin{array}{r} 169r1 \\ 5 \overline{) 846} \end{array}$ $\begin{array}{r} 169\frac{1}{5} \\ 5 \overline{) 846} \end{array}$ <p>Reigate St. Mary's</p>
x	7	0.3	0.08								
6	42	1.8	0.48								

Progression of Calculations through Reigate St Mary's

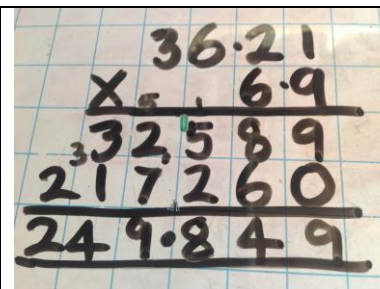
MA3: Number Bonds

Year 6

$$24.25 + 31.63 + 21.75 = 77.63$$

46

31.63


$$\begin{array}{r} 36.21 \\ \times 6.9 \\ \hline 32589 \\ 217260 \\ \hline 249.849 \end{array}$$

D10i: Short Division

$$87.5 \div 7 = 12.5$$


$$\begin{array}{r} 12.5 \\ 7 \overline{) 87.5} \end{array}$$

Progression of Calculations through Reigate St Mary's