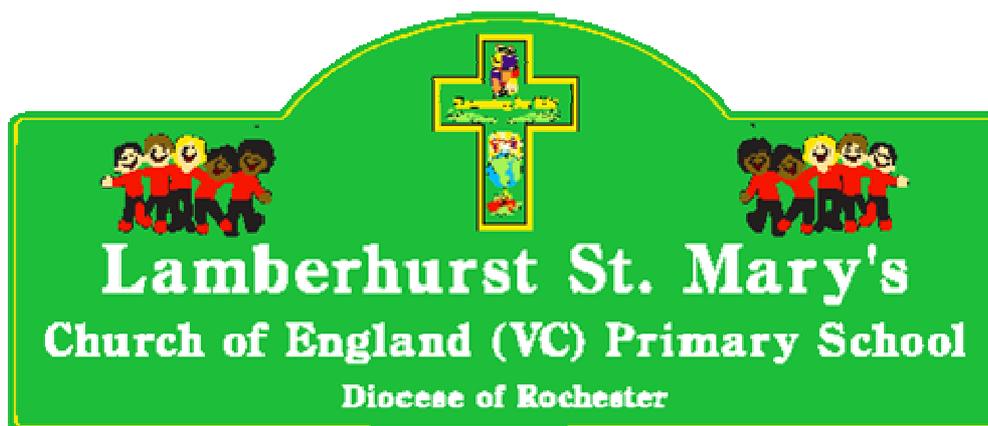


# Lamberhurst St Mary's Church of England Primary School



## **CALCULATION POLICY**

Policy Written/Reviewed	Nicola Mitchell January 2013
Agreed By Staff	January 2013

# **Lamberhurst St Mary's Church of England Primary School**

## **Progression towards a standard method of Calculation**

### **Introduction:**

The Primary Framework provides a structured and systematic approach to the teaching of calculation. There is considerable emphasis on teaching mental calculation methods. Up to the age of 9 (year 4) informal written recording is practised regularly and is an important part of learning and understanding. More formal written methods follow when the child is able to use a wide range of mental strategies. At Lamberhurst Primary School, we follow a consistent approach to the teaching of calculation methods in order to establish continuity and progression throughout the school.

### **Aims:**

Children should be able to use an efficient method, mental, written or calculator appropriate to the given task. By the end of year 6, children working at Level 4 and above will have been taught, and be secure with, a compact standard method for each operation.

### **General Progression:**

- Establish mental methods, based on a good understanding of place value
- Use of informal jottings to aid mental calculations
- Develop use of empty number line to help mental imagery and aid recording
- Use partitioning and recombining to aid informal methods
- Introduce expanded written methods
- Develop expanded methods into compact standard written form

### **Before carrying out a calculation, children will be encouraged to consider:**

- Can I do it in my head? (using rounding, adjustment)
- The size of an approximate answer (estimation)
- Could I use jottings to keep track of the calculation?
- Do I need to use a formal written method?

### **When are children ready for written calculations?**

#### **Addition and subtraction:**

- Do they know addition and subtraction facts to 20?
- Do they understand place value and can they partition numbers?
- Can they add three single digit numbers mentally?
- Can they add and subtract any pair of two digit numbers mentally?
- Can they explain their mental strategies orally and record them using informal jottings?

#### **Multiplication and Division:**

- Do they know the 2,3,4,5, 6 and 10 times tables and corresponding division facts?
- Do they know the result of multiplying by 1 and 0?
- Do they understand 0 as a place holder?
- Can they multiply two and three digit numbers by 10 and 100?
- Can they double and halve two digit numbers mentally?
- Can they use multiplication and division facts they know to derive mentally other multiplication and division facts that they do not know?
- Can they explain their mental strategies orally and record them using informal jottings?

It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for each operation. Additionally key number skills should be continually revisited to ensure that every child's understanding of concepts in number supports his/her development in calculation.

**Points to note:**

- Children should progress from one method to the next within each operation only when they have a secure understanding and are confident in the method they are using.
- To be successful in learning to calculate children must be able to; count reliably forwards and backwards, recognise individual digits, know what each digit represents, know that digits combine to make numbers and have some understanding of the concept of zero.
- The correct terminology should be used when referring to the value of digits to support the children's understanding of place value. E.g.  $68 + 47$  should be read 'sixty add forty' not 'six add four'
- Teachers should refer to the key vocab document and the vocabulary section of each block overview for key vocabulary to introduce to their children within each unit.

**Progression of Written Calculations**

Key Stage	Progression of Written Calculations
Foundation	Children begin to record in the context of play or practical activities and problems including number bond songs. Children are expected to write numbers up to 20, they need to understand the concept of 1, 2 etc. More praise and encouragement for children able to calculate in their head then say can you show me this, through a drawing/ picture, with objects, friends in the class. Children begin to understand problems telling a story using numbers, sharing, doubling.
Key Stage 1 (Years 1 & 2)	Children will: <ul style="list-style-type: none"> <li>• Develop the use of pictures and mixture of words and symbols to represent numerical activities</li> <li>• Use of standard symbols and conventions (0 – 9, +, -, x, ÷, =)</li> <li>• Use of jottings to aid mental calculations, number tracks, empty number lines, partitioning</li> </ul>
Lower Key Stage 2 (Years 3 & 4)	Children will: <ul style="list-style-type: none"> <li>• Continue use of jottings to aid mental calculations</li> <li>• Use of expanded methods for addition and subtraction</li> <li>• Develop use of compact method for addition and subtraction</li> <li>• Use of expanded methods for multiplication and division (by the end of year 4)</li> <li>• Begin to use a calculator as a calculating tool (by the end of year 4)</li> </ul>
Upper Key Stage 2 (Years 5 & 6)	<ul style="list-style-type: none"> <li>• Continue use of jottings to aid mental calculations</li> <li>• Secure understanding of compact methods for addition and subtraction (develop use with decimals)</li> <li>• Develop use of compact methods for multiplication and division, expanded methods still acceptable</li> <li>• Effective use of a calculator to support calculations</li> </ul>

## Progression in Addition

Stage	Progression of Written Calculations
Foundation	<p><b>Begin to relate addition to combining two groups of objects</b></p> <ul style="list-style-type: none"> <li>• Make a record in pictures, words or symbols of addition activities already carried out</li> <li>• Construct number sentences to go with practical activities</li> <li>• Relate addition to counting on</li> <li>• Use of games and songs to develop vocabulary</li> <li>• Use the language of addition e.g. 2 in one group and 1 in the other bring them together that makes 3</li> </ul>
Stage 1	<p><b>Understand the operation of addition and use the related vocabulary</b></p> <ul style="list-style-type: none"> <li>• Record simple mental additions in a number sentence using + and =</li> <li>• Know that addition can be done in any order</li> <li>• Introduction of empty number lines for most able</li> <li>• Count on from the most significant number</li> <li>• Continue to develop the use of vocabulary</li> </ul> <p>• Continue to use practical apparatus and visual aids to support the recording of calculations</p> <p>• Begin to partition and recombine (seeing <math>12+15</math> as <math>10+10</math> and <math>2+5</math>, then <math>20+7</math> as 27)</p> <p>• Using informal jottings with larger numbers (the empty numberline) <math>42 + 17</math></p>  <p><b>Develop pencil and paper methods for additions that cannot be done mentally</b></p> $35 + 52 \quad 30 + 50 = 80$ $5 + 2 = 7 \longrightarrow 87$ <p>(no formal layout, informal jottings)</p>
Stage 2	<ul style="list-style-type: none"> <li>• Continue informal partitioning, reinforce use of empty numberline. Expanded written method, horizontal layout.</li> </ul> $67 + 24$ $60 + 7$ $\underline{20 + 4}$ $\underline{80 + 11} \longrightarrow 91$

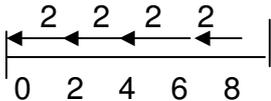
<p><b>Stage 3</b></p>	<ul style="list-style-type: none"> <li>Teachers will <b>model</b> the vertical layout, adding the least significant digit first, building on the previous stage and then progress to using the compact written method, involving carrying.</li> </ul> $  \begin{array}{r}  783 \\  + 135 \\  \hline  918 \\  \hline  1  \end{array}  $
<p><b>Stage 4</b></p>	<p><b>Extend written methods to column addition of two integers less than 10,000</b></p> <ul style="list-style-type: none"> <li>Add several numbers with different number of digits</li> <li>Extend column addition to decimal amounts of money, lengths, and weights.</li> </ul>
<p><b>Stage 5</b></p>	<p><b>Extend written methods for addition</b></p> <ul style="list-style-type: none"> <li>Any number of digits</li> <li>Several numbers with different numbers of digits</li> <li>Decimals with one or two decimal places</li> </ul>



<p><b>Stage 4</b></p>	<p>Leading onto:</p> <ul style="list-style-type: none"> <li>• <b>Expanded written methods showing vertical layout but with no decomposition</b></li> </ul> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <math display="block">  \begin{array}{r}  60 \text{ and } 7 \\  \underline{-20 \text{ and } 5} \\  40 \text{ and } 2 = 42  \end{array}  </math> </div>
<p><b>Stage 5</b></p>	<ul style="list-style-type: none"> <li>• Continue to use empty number lines to support mental calculation strategies</li> <li>• Compact written methods involving decomposition</li> </ul> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <math display="block">  \begin{array}{r}  4.363 - 127 \\  \phantom{4.} \overset{5}{3} \overset{13}{6} 3 \\  \underline{-127} \\  236  \end{array}  </math> </div> <ul style="list-style-type: none"> <li>• Extend to larger numbers (up to 10,000) and decimal sums of money</li> </ul>
<p><b>Stage 6</b></p>	<ul style="list-style-type: none"> <li>• Extend written methods for subtraction, to include decimal numbers with up to 2 decimal places</li> <li>• Choose the most efficient and appropriate method for each calculation.</li> </ul> <p><b>Some children will find the final compact method very difficult and will continue to use informal methods in years 5 and 6.</b></p>

**Progression in Multiplication and Division**

**(Concepts in multiplication and division are very closely linked and should be developed together)**

<p>Foundation</p>	<p><b>Real life contexts and use of practical equipment to count in repeated groups of the same size:</b></p> <ul style="list-style-type: none"> <li>Count in twos</li> <li>Count in fives</li> <li>Count in tens</li> </ul>	<p><b>Share objects into equal groups</b>          Use related vocabulary          Table songs          Make up own stories to illustrate these orally and with drawings</p>
<p>Stage 1</p>	<p><b>Draw pictures to show equal sets:</b>          3 sets of 3 make 9            xxx xxx xxx          2 sets of 4 make 8            xxxx xxxx</p> <p><b>Count in twos, fives and tens</b></p> <ul style="list-style-type: none"> <li>Identify patterns of 2s, 5s, 10s on a hundred square</li> <li>Solve practical problems that combine groups of 2s, 5s and 10s.</li> </ul>	<p><b>Draw pictures to show sharing and grouping:</b>          9 shared between 3                xxx xxx xxx          How many groups of 4 in 8?                xxxx xxxx</p> <p><b>Count in twos, fives and tens</b></p> <ul style="list-style-type: none"> <li>Solve practical problems sharing groups of 2,5 and 10.</li> </ul>
<p>Stage 2</p>	<p><b>Develop use of vocabulary for multiplication.</b></p> <ul style="list-style-type: none"> <li>Use x symbol.</li> </ul> <p><b>Count confidently in steps of 2,3,4,5 and 10.</b></p> <ul style="list-style-type: none"> <li>Recall multiplication facts for 2,3,4,5 and 10.</li> </ul> <p><b>Begin to count in steps of 3 and 4.</b></p> <ul style="list-style-type: none"> <li>Use of empty numberlines and 100 squares as visual reminders when learning to count in steps of 3, 4 and 5.</li> </ul> <p><b>Understand the operation of multiplication as repeated addition or as describing an array</b></p> <ul style="list-style-type: none"> <li>Make arrays practically</li> <li>Draw on squared paper</li> <li>Use x and = to record mental calculations:            3 lots of 2            2 lots of 3            'groups of'  <math>3 \times 2 = 6</math></li> </ul>	<p><b>Develop use of vocabulary for division.</b></p> <ul style="list-style-type: none"> <li>Use ÷ symbol.</li> </ul> <p><b>Count confidently in steps of 2,3,4,5 and 10.</b></p> <ul style="list-style-type: none"> <li>Recall division facts for 2,3,4,5 and 10.</li> </ul> <p><b>Practical tasks:</b></p> <ul style="list-style-type: none"> <li>Sharing equally:  <math>15 \div 3 =</math>            15 shared between 3</li> <li>Grouping:  <math>15 \div 3</math> how many 3s in 15?</li> </ul> <p><b>Relate grouping to arrays</b></p> <ul style="list-style-type: none"> <li>Use ÷ and = to record number calculations  <math>6 \div 2 = 3</math>  <math>6 \div 3 = 2</math></li> <li>Use a numberline to illustrate grouping e.g. <math>8 \div 2 = 4</math></li> </ul>  <ul style="list-style-type: none"> <li>Begin to solve practical problems involving remainders</li> </ul>

<p>Stage 3</p>	<p><b>Learn additional multiplication facts and work on different ways to derive new facts from those that they already know</b></p> <ul style="list-style-type: none"> <li>• Know by heart multiplication facts for x2, x3, x4, x5, x6, x7, x8, x9,x10, x11 x12.</li> <li>• Recognise multiples of 2, 5 and 10 up to 1000.</li> <li>• Understand effect of multiplying by 10</li> <li>• Multiply a single digit by 1, 10, 100           <math display="block">7 \times 10 = 70</math> <math display="block">4 \times 100 = 400</math> </li> <li>• Double any multiple of 5 up to 50           <math display="block">35 \times 2 = 70</math> <div style="display: inline-block; border: 1px solid black; width: 30px; height: 30px; vertical-align: middle;"></div> <math display="block">\times 2 = 50</math> </li> <li>• Derive related facts           <math display="block">7 \times 5 = 35</math> <math display="block">5 \times 7 = 35</math> <math display="block">35 \div 5 = 7</math> <math display="block">35 \div 7 = 5</math> </li> <li>• Use practical apparatus and informal methods to multiply two digit numbers by a single digit e.g. empty number line.</li> </ul>	<p><b>Derive quickly division facts corresponding to 2,3,4,5,6,7,8,9,10,11 and 12 times tables.</b></p> <ul style="list-style-type: none"> <li>• Continue to use empty number lines for division and introduce remainders.</li> <li>• Solve division calculations by using multiplication strategies</li> <li>• Understand effect of dividing by 10</li> <li>• Divide a 3-digit multiple of 100 by 10 or 100           <math display="block">800 \div 100 = 8</math> <math display="block">300 \div 10 = 30</math> </li> <li>• Halve any multiple of 10 up to 100           <math display="block">50 \div 2 = 25</math> <div style="display: inline-block; border: 1px solid black; width: 30px; height: 30px; vertical-align: middle;"></div> <math display="block">\div 2 = 35</math> </li> <li>• Given three numbers such as 4, 5, 20; say or write four different multiplication and division statements.</li> <li>• Use practical apparatus and informal methods to divide two digit numbers e.g. <math>39 \div 3</math>.</li> <li>• Round remainders up or down depending on the context.</li> </ul>
<p>Stage 4</p>	<p><b>Develop and refine written methods for multiplication</b></p> <ul style="list-style-type: none"> <li>• Multiply a 2-digit number by a single digit number, multiplying the tens first</li> <li>• Using multiples of 10 (mentally)           <math display="block">4 \times 30 = (4 \times 3) \times 10 = 120</math> </li> <li>• Use jottings to show stages of calculation e.g.</li> </ul> <p>(TU x U) Used for mental calculations</p> $32 \times 3 = (30 \times 3) + (2 \times 3)$ $= 90 + 6$ $= 96$	<p><b>Develop and refine written methods for division</b></p> <ul style="list-style-type: none"> <li>• Divide a 2-digit number by a single-digit, by using multiples of the divisor</li> <li>• Use informal jottings E.g.: <math>84 \div 7 =</math></li> </ul> $70 + 14$ $\downarrow \quad \downarrow \div 7$ $10 + 2 = 12$

Stage 5

**Develop the extended written method of the grid method TUxU**

e.g.  $37 \times 4$

<b>x</b>	<b>30</b>	<b>7</b>	
<b>4</b>	120	28	
			148

Stage 6

**Extend written methods, encouraging estimation first.**

Grid method (HTU x U)  
e.g.  $246 \times 7$

<b>X</b>	<b>200</b>	<b>40</b>	<b>6</b>
<b>7</b>	1400	280	42

$$1400 + 280 + 42 = 1722$$

Grid method (TU x TU)  
e.g.  $62 \times 36$

<b>x</b>	<b>60</b>	<b>2</b>	
<b>30</b>	1800	60	= 1860
<b>6</b>	360	12	= 372

$$1860 + 372 = 2232$$

**Extend written methods, encouraging estimation first.**

Children progress to the short division method with repeated subtraction (HTU  $\div$  U)

e.g.  $196 \div 6$

$$\begin{array}{r} \underline{32 \text{ r. } 4} \\ 4 \overline{) 196} \\ - 180 \quad (30 \times 6) \\ \hline 16 \\ - 12 \quad (2 \times 6) \\ \hline 4 \end{array}$$

This will then lead to a compact written method for multiplication;

Stage 7

$$\begin{array}{r} 246 \\ \times \quad 7 \\ \hline 42 \quad (6 \times 7) \\ 280 \quad (40 \times 7) \\ \hline 1400 \quad (200 \times 7) \\ \hline \underline{1722} \end{array}$$

<p>Stage 8</p>	<p><b>Extend written methods for multiplication, encouraging estimation first.</b></p> <ul style="list-style-type: none"> <li>continue to use grid method as an expanded written method</li> <li>develop short multiplication</li> </ul> $\begin{array}{r} 625 \\ \times 6 \\ \hline 3750 \\ 13 \end{array}$ <ul style="list-style-type: none"> <li>leading to multiplication of numbers involving decimals</li> </ul> $\begin{array}{r} 4.62 \\ \times 3 \\ \hline 13.86 \\ 1 \end{array}$ <p><b>Most children will be encouraged to continue to use the grid method, as analysis of test results show this to be a more reliable method for most children.</b></p> <p><i>Pupils will be taught the more compact method of multiplication if and when the teacher feels they are ready for it.</i></p>	<p><b>Extend written methods for division, encouraging estimation first.</b></p> <ul style="list-style-type: none"> <li>Continue to divide using repeated subtraction of the largest multiple of the divisor first (HTU ÷ TU)</li> </ul> <p>e.g. <math>972 \div 36 =</math></p> <ul style="list-style-type: none"> <li>short division of numbers involving decimals (<math>87.5 \div 7</math>)</li> </ul> <p>Short division method can be used when children are confident to divide two and three digit numbers by a single digit.</p> <p><b><i>Pupils will be taught the more compact method of long division if and when the teacher feels they are ready for it.</i></b></p>
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