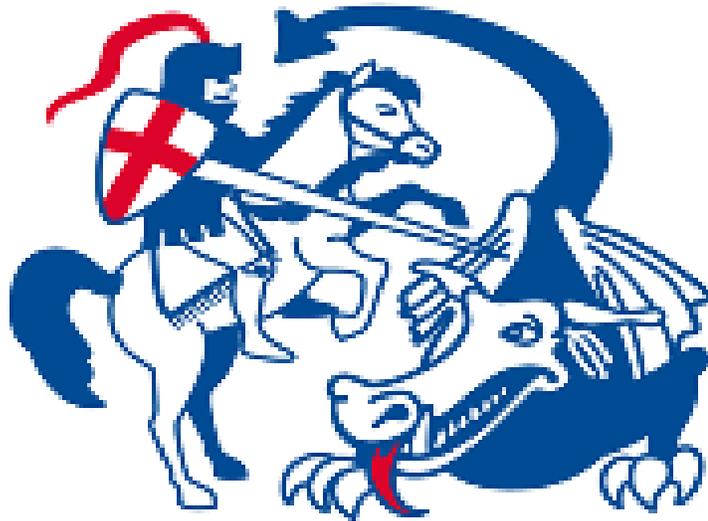


Calculation Policy

Reviewed on: September 2017
Next review: September 2018

St George's CEP School
Wrotham
Kent



This policy was reviewed by: Mrs K Baylis (Maths SL) September 2017

ST GEORGE'S CEP SCHOOL

Progression towards a standard method of calculation

Introduction:

The 2014 National Curriculum provides a structured and systematic approach to the teaching of calculation. The aim is for mental calculations and written procedures to be performed efficiently, fluently, accurately with understanding. Procedures and understanding are to be developed in tandem. End of key stage expectations are explicit in the programme of study.

At St George's School we have developed a consistent approach to the teaching of written calculation methods in order to establish continuity and progression through out the school.

Age related expectations:

This calculation policy is organised according to age appropriate expectations as set out in the National Curriculum 2014, however it is vital that pupils are taught according to the stage that they are currently working at, being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods. It is also important for children to be confident to use mental and written strategies to explain their thinking. This must be a priority within calculation lessons. Written methods need to be viewed as tools to enable children to solve problems and record their thinking in an organised way.

Aims :

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

To develop efficient written calculation strategies children need:

- Secure mental methods which are developed from early years
- A solid understanding of the number system
- Practical hands on experience including a range of manipulatives
- Visual models and images including number lines and arrays
- Experience of expanded methods to develop understanding and avoid rote learning
- Secure understanding of each stage before moving onto the next.

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 an expanded or compact written method?

When are children ready for formal written calculations?

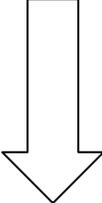
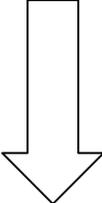
Addition and subtraction:

- Do they know addition and subtraction facts to 20?
- Do they understand place value and can they partition and re-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, 5 and 10 times tables and the 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 facts they know to derive mentally other multiplication facts that they do not know?
- Can they explain their mental strategies orally and record them using informal jottings?

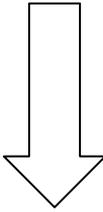
These lists are not exhaustive but are a guide for the teacher to judge when a child is ready to move from informal to formal methods of calculation. It is vitally important that children's mental methods of calculation continued to be practised and secured alongside their learning and use of an efficient written method for each operation.

Key Stage	Progression of Written Calculations
Foundation	<ul style="list-style-type: none"> • Begin to record in the context of play or practical activities and problems
	<ul style="list-style-type: none"> • Develop the use of pictures and mixture of words and symbols to represent numerical activities • Use of standard symbols and conventions (1 – 20, + , - , =) • Use of jottings to aid mental calculations, number tracks, empty number lines, partitioning <p style="text-align: center;">(All calculations will be presented horizontally)</p>
	<ul style="list-style-type: none"> • Continue use of jottings to aid mental calculations • Use of expanded methods for addition and subtraction • Develop use of compact method for addition and subtraction • Use of expanded methods for multiplication and division <p style="text-align: center;">(All calculations presented horizontally)</p> <ul style="list-style-type: none"> • Secure understanding of compact methods for addition and subtraction (develop use with decimals) • Develop use of compact methods for multiplication and division, expanded methods still acceptable

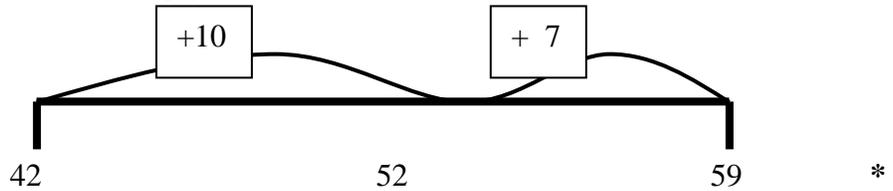
Progression in Addition

Foundation	<p>Begin to relate addition to combining two groups of objects</p> <ul style="list-style-type: none"> • Make a record in pictures, words or symbols of addition activities already carried out • Construct number systems to go with practical activities • Relate addition to counting on
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Understand the operation of addition and use the related vocabulary



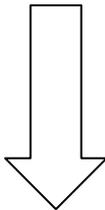
- Record simple mental additions in a number sentence using + and =
- Begin to partition and recombine (seeing $12+15$ as $10+10$ and $2+5$, then $20+7$ as 27)
- Using informal jottings with larger numbers (the empty number line) $42 + 17$



- **Develop pencil and paper methods for additions that cannot be done mentally**

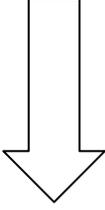
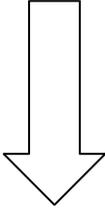
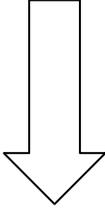
$$35 + 52 \quad 30 + 50 = 80$$
$$5 + 2 = 7 \quad 80 + 7 = 87$$

(no formal layout, informal jottings)



- Continue informal partitioning, reinforce use of empty number line. Expanded written method, vertical layout. (NO 'carrying')

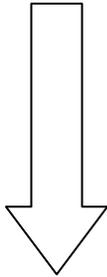
$67 + 24$
$60 + 7$
$\underline{20 + 4}$
$\underline{80 + 11} = 91$

 	<ul style="list-style-type: none"> • Expanded written methods, vertical layout <div style="display: flex; justify-content: space-around; margin: 10px 0;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> $\begin{array}{r} 67 \text{ add most} \\ +24 \text{ significant} \\ \hline 80 \text{ digit first} \\ \underline{11} \\ 91 \end{array}$ </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> $\begin{array}{r} 264 \\ + 48 \\ \hline 12 \\ 100 \\ \underline{200} \\ 312 \end{array}$ <p style="text-align: right; margin-right: 10px;"> <u>add least</u> <u>significant</u> <u>digit first</u> </p> </div> </div> <ul style="list-style-type: none"> • Compact written method <ul style="list-style-type: none"> ○ Carrying <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 150px;"> $\begin{array}{r} 783 \\ + 135 \\ \hline 918 \\ \hline 1 \end{array}$ </div>
	<p>Solve multi-step problems in contexts, deciding which operations/methods to use and why. Decimals up to 3dp (Context: Measures)</p>

Progression in Subtraction

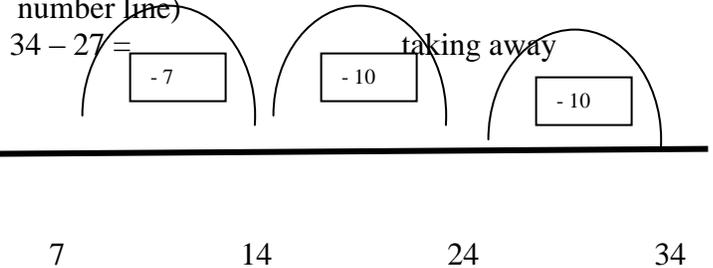
Foundation

- **Begin to relate subtraction to ‘taking away’**
 - Make a record in pictures, words or symbols of subtraction activities already carried out
 - Construct number sentences to go with practical activities
 - Relate subtraction to taking away and counting how many objects are left



- **Understand the operation of subtraction and use the related vocabulary**

- Record simple mental subtractions in a number sentence using – and =
- Use jottings to support mental subtractions (empty number line)

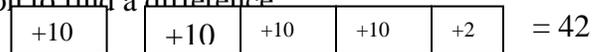


- **Develop pencil and paper methods for subtractions that cannot, at this stage, be done mentally (two digit numbers)**

67 - 25 = 42 With jottings and partitioning

$67 - 20 = 47, 47 - 5 = 42$

- Counting on to find a difference

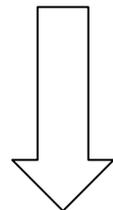


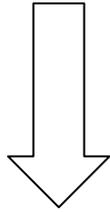
0 25 35 45 55 65 67

- Expanded written methods showing vertical

NO DECOMPOSITION

$$\begin{array}{r} 874 \\ - 523 \\ \hline 351 \end{array}$$



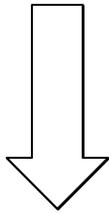


- Expanded decomposition

$$81 - 57 = 24$$

$$\begin{array}{r} 80 \quad 1 \quad \quad 70 \quad 11 \\ \underline{50 \quad 7} \quad \quad \underline{50 \quad 7} \\ \quad \quad \quad 20 \quad 4 \end{array}$$

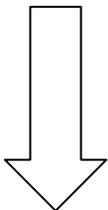
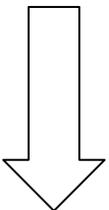
Extend to 3 digit numbers
and hundreds to tens
decomposition

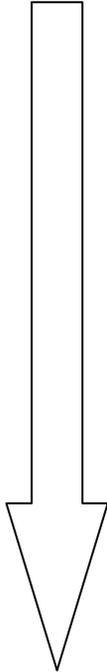


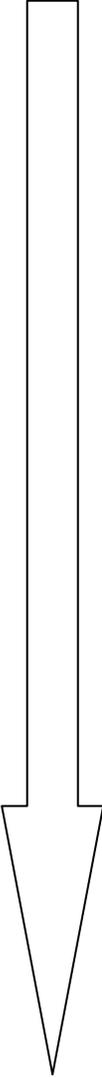
- Compact written methods involving decomposition

$$\begin{array}{r} 363 - 127 \\ \quad \quad \quad \overset{5}{5} \overset{13}{13} \\ \underline{363} \\ \underline{-127} \\ \underline{236} \end{array}$$

- Extend to larger numbers (up to 10,000) and decimal sums of money

<p>Foundation</p>	<p style="text-align: center;"><u>Progression in</u> <u>(concepts in multiplication closely linked and should</u></p> <ul style="list-style-type: none"> • Count in twos • Count in tens • Count in fives 	<p style="text-align: center;"><u>Multiplication and Division</u> <u>and division are very</u> <u>be developed together)</u></p>
	<ul style="list-style-type: none"> • Draw pictures to show equal sets • 3 sets of 3 make 9 xxx xxx xxx • 2 sets of 4 make 8 xxxx xxxx • Count in twos, fives and tens • Identify patterns of 2s, 5s, 10s on a hundred square 	<p>Draw pictures to show sharing and grouping</p> <ul style="list-style-type: none"> • 9 shared between 3 xxx xxx xxx • how many groups of 4 in 8 ? xxxx xxxx
	<p>Count in steps of 3, 4 and 5 to at least 30,40 and 50</p> <ul style="list-style-type: none"> • use numberline, 100 square as visual reminders when learning to count in steps of 3, 4 and 5 <p>Understand the operation of multiplication as repeated addition or as describing an array</p> <p>make arrays practically</p> <p>draw on squared paper</p> <p>Use x and = to record mental calculations</p> <p>3 lots of 2 2 lots of 3 'groups of' $3 \times 2 = 6$</p>	<p>Practical tasks:</p> <ul style="list-style-type: none"> • sharing equally $15 \div 3$ 15 shared between 3 • grouping $15 \div 3$ how many 3's in 15? <p>Relate grouping to arrays</p> <p>Use \div and = to record number calculations</p> <p>$6 \div 2 = 3$ $6 \div 3 = 2$</p>

Key Stage 2	Multiplication	Division
	<ul style="list-style-type: none"> • Learn additional multiplication facts and work on different ways to derive new facts from those that they already know • Know by heart multiplication facts for x2, x5 , x10 • Begin to know facts for x3, x4 • Understand effect of multiplying by 10 • Multiply a single digit by 1, 10, 100 <p>7 x 10 = 70</p> <p>4 x 100 = 400</p> <ul style="list-style-type: none"> • Double any multiple of 5 up to 50 <p>35 x 2 = 70</p> <p>25 x 2 = 50</p> <ul style="list-style-type: none"> • Derive related facts <p>7 x 5 = 35</p> <p>5 x 7 = 35</p> <p>35 ÷ 5 = 7</p> <p>35 ÷ 7 = 5</p>	<ul style="list-style-type: none"> • Derive quickly division facts corresponding to 2, 5, and 10 times table • Solve division calculations by using multiplication strategies • Understand effect of dividing by 10 • Divide a 3-digit multiple of 100 by 10 or 100 <p>800 ÷ 100 = 8</p> <p>300 ÷ 10 = 30</p> <ul style="list-style-type: none"> • Halve any multiple of 10 up to 100 <p>50 ÷ 2 = 25</p> <p>70 ÷ 2 = 35</p> <ul style="list-style-type: none"> • Given three numbers such as 4 , 5 , 20 say or write four different multiplication and division statements



Multiplication

- **Develop and refine written methods for multiplication**
- Begin to multiply a 2-digit number by a single digit number, multiplying the tens first
- Using multiples of 10 (mentally)

$$4 \times 30 = (4 \times 3) \times 10 \\ = 120$$

- Jottings to show stages of calculation (TU x U)

$$32 \times 3 = (30 \times 3) + (2 \times 3) \\ = 90 + 6 \\ = 96$$

- Leading to grid method
 37×4

x	30	7
4	120	28

= 148

Division

- **Develop and refine written methods for division**
- Divide a 2-digit number by a single-digit, using multiples of the divisor

$$27 \div 6 =$$

‘How many 6’s can I take from 27?’

$$\underline{27} \div 6 = 4 \text{ r.}3$$

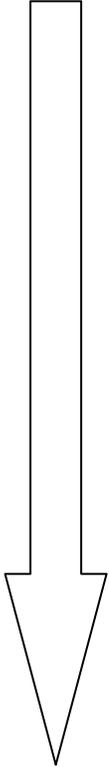
repeated

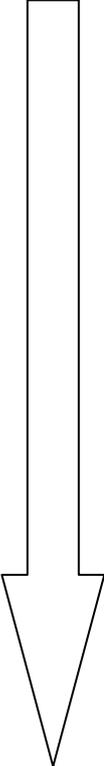
subtraction

- Leading to subtracting larger chunks (*multiples of 10*)

$$148 \div 4 = 37$$

$$= 148 - (4 \times 10) = 108 \\ - (4 \times 10) = 68 \\ - (4 \times 10) = 28 \\ - (4 \times \underline{7}) = 0 \\ 37$$

	Extend written methods Grid method (HTU x U) 246×7	Extend written methods Short division (HTU ÷ U) $196 \div 6$																			
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">x</td> <td style="text-align: center;">200</td> <td style="text-align: center;">40</td> <td style="text-align: center;">6</td> </tr> <tr> <td style="text-align: center;">7</td> <td style="text-align: center;">1400</td> <td style="text-align: center;">280</td> <td style="text-align: center;">42</td> </tr> </table> <p style="text-align: center;">$1400 + 280 + 49 = 1729$</p> <p>leading to expanded written method (for some children only)</p> $ \begin{array}{r} 246 \\ \times \quad 7 \\ \hline 1400 \\ 280 \\ \underline{42} \\ 1722 \end{array} $ <p>grid method (TU x TU)</p> 62×36 <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding-right: 10px;">x</td> <td style="padding-right: 10px;">60</td> <td style="padding-right: 10px;">2</td> <td></td> </tr> <tr> <td>30</td> <td>1800</td> <td>60</td> <td>1860</td> </tr> <tr> <td>6</td> <td>360</td> <td>12</td> <td>372</td> </tr> </table> <p style="text-align: center;">$1860 + 372 = 2232$</p>	x	200	40	6	7	1400	280	42	x	60	2		30	1800	60	1860	6	360	12	372
x	200	40	6																		
7	1400	280	42																		
x	60	2																			
30	1800	60	1860																		
6	360	12	372																		

	<p>Extend written methods for multiplication</p>	<p>Extend written methods for division</p>
	<p>- continue to use grid method and expanded written method</p> <p>- develop short multiplication</p> $\begin{array}{r} 625 \\ \times 6 \\ \hline 3750 \\ 13 \end{array}$ <p>leading to long multiplication</p> $\begin{array}{r} 352 \\ \times 27 \\ \hline 2464 \\ 7040 \\ \hline 9504 \\ 1 \end{array}$ <p>multiplication of numbers involving decimals</p> $\begin{array}{r} 4.62 \\ \times 3 \\ \hline 13.86 \\ 1 \end{array}$ <p>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.</p> <p><i>Pupils will be taught the more compact method of multiplication if the teacher feels they are ready for it.</i></p>	<p>- long division (HTU ÷ TU) continue using repeated subtraction</p> $972 \div 36 =$ $\begin{array}{r} 27 \\ \hline 36 \) 972 \\ \underline{- 720} \ (20 \times 36) \\ 252 \\ \underline{- 180} \ (5 \times 36) \\ 72 \\ \underline{- 72} \ (2 \times 36) \\ 0 \end{array}$ <p>short division giving quotient as fraction</p> $90 \div 7 = 12 \frac{6}{7}$ <p>giving quotient as decimal</p> $676 \div 8 =$ $\begin{array}{r} 84.5 \\ \hline 8 \) 676 \\ \underline{- 400} \ (50 \times 8) \\ 276 \\ \underline{- 240} \ (30 \times 8) \\ 36 \\ \underline{- 32} \ (4 \times 8) \\ 4 \\ \underline{- 4} \ (0.5 \times 8) \\ 0 \end{array}$ <p>short division of numbers involving decimals (87.5 ÷ 7)</p>

Review

This policy was reviewed by: Mrs K Baylis (Maths SL) September 2017.

This policy will be reviewed by: Maths Subject Leader September 2018.