Progression in Calculation – St Mary's RC Primary School

At St Mary's RC Primary School we recognise that children's conceptual understanding and fluency is strengthened if they experience concrete, visual and abstract representations of a concept during a lesson. Moving between the concrete and the abstract helps children to connect abstract symbols with familiar contexts, thus providing the opportunity to make sense of, and develop fluency in the use of, abstract symbols.
Efficiency in calculation requires having a variety of mental strategies, in particular the importance of 10 and partitioning numbers to bridge through 10, and written methods are recognised as being complementary to mental methods and should not be seen as separate from them.
We believe that fluent computational skills are highly dependent on accurate and rapid recall of basic number bonds to 20 and times-tables facts and whole class chorus chanting is an important step to developing conceptual understanding through identifying patterns and relationships.
In all mathematics lessons, teachers' questioning encourages and develops their mathematical reasoning in order to develop conceptual understanding and fluency. This is done simply by asking children to explain how they worked out a calculation or solved a problem, and to compare and contrast different methods that are described.
The overall aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. It is important that by the end of year 6 children acquire secure mental methods of calculation and one efficient written method of calculation for addition, subtraction, multiplication and division which they know they can rely on when mental methods are not appropriate.
Throughout the school, mental and written methods are practised weekly within a specific calculation lesson, aimed at developing fluency and accuracy, and teachers meet termly to discuss progression in calculation.

This document identifies progression in calculation strategies that will be used throughout school.
Purpose of the Policy:

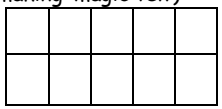
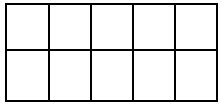
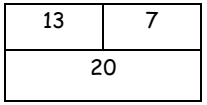
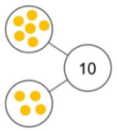
- To make teachers and parents aware of the strategies that pupils are formally taught within each year group that will support them to perform mental and written calculations. Pupils **should not** move on through the methods until they have secured and understood how to use the methods, including the concrete and pictorial representations.
- The policy supports teachers in identifying appropriate concrete apparatus and pictorial representations to help develop and secure understanding.

Aims of the policy:

- To ensure consistency and progression in our approach to calculation.
- To ensure that children develop an efficient, reliable, formal written method of calculation for all operations.
- To ensure that children can use these methods accurately with confidence and understanding.
- To enable children to apply their mathematical knowledge and understanding when solving a wide range of mathematical problems.

How to use this policy:

- Use the policy as the basis of your planning but ensure you use previous or following years' guidance to allow for personalised learning.
- Always use Assessment for Learning to identify suitable next steps in calculation for groups of children.
- If, at any time, children are making significant errors, return to the previous stage in calculation.
- Always introduce a new concept/calculation using suitable resources, models and images to support children's understanding of the calculation and place value, as appropriate.
- Encourage children to make sensible choices about the methods they use when solving problems.

Year	Addition	Subtraction	Multiplication	Division
Foundation Stage **Numbers 1-20**	Count reliably to 20 1 more – numbers to 20 Order numbers to 20 Combining two single digit numbers – practical – Tens frame (making 'magic ten')  Counting on	1 less – numbers to 20 Relate subtraction to taking away – practical Subtract 2 single digit numbers – practical - Counting back	Doubling numbers to 10 Count aloud in 1s, 2s, 5s and 10s.	Halving even numbers to 10 Share objects into equal groups and count how many in each group.
Y1 **2-digit numbers**	Count reliably to and across 100 from any given number. 1 more/10 more Number bonds with a total of 10. (making 'magic ten') Derive and recall all pairs of numbers with a total of 20. Addition facts for totals to 20. Doubles of all numbers to at least 10. Combine groups e.g. 5 +6 =11 - starting at the bigger number and counting on. **Bridging 10** – tens frame & 20 frame (making 'magic ten')  Record number sentences + - = **Number line** and number square used to support combining numbers but not recorded.  5 6 7 8 9 10 11 **Bar models**  13 7 20 **Part/Part/Whole Model**  10 **One-step problems** – concrete objects, pictorial representations and missing number problems	1 less/10 less Subtraction facts involving numbers up to 20. Understand subtraction as takeaway and calculate difference by counting up. Concrete objects initially. Number line and number square are used to support understanding (not recorded). Primarily taking away – counting back. e.g. 5 – 3 = 2 **One-step problems** – concrete objects, pictorial representations and missing number problems	Doubling numbers to at least 10. Counting in multiples of 2, 5, and 10. **One-step problems** – concrete objects, pictorial representations and arrays.	Practical sharing into equal groups. Halving even numbers to 20 **One-step problems** – concrete objects, pictorial representations and arrays.

Y2
2-digit numbers

Count forward in step of 2, 3, 5, and 10.
Read and write numbers to at least 100 in numbers and words.
Partition 2-digit numbers into tens and ones.

Derive fluently all pairs of numbers with a total of 20.
Derive and recall pairs of numbers with a total of 100.
Bar models

80	20
100	

Understand addition can be done in any order.
Add TU + U, TU + Tens, TU + TU and U + U + U.
Place value counters – add tens the units digit doesn't change.
Solve **problems** using concrete objects, pictorial representations and mentally. (Missing number problems)

- Tens frame/20 frame
- Bridging 10/making next ten – Dienes 'ten ones makes a ten'
- Use a hundred grid, number line and objects to support understanding.
- Record on a number line

e.g. 6 + 5 =

+4 +1

6 10 11

e.g. 27 + 5 =

+3 +2

27 30 32

- Add TU + TU – Partitioning

24 + 36
20 + 30 = 50
4 + 6 = 10
60

Count backward in steps of 2, 3, 5, and 10.
Use subtraction facts to 20 fluently.
Dienes - Take a ten and make 10 ones – 'take and make'

Understand that subtraction is the inverse of addition.
Understand that subtraction cannot be done in any order.
Bar models

80	20
100	

80 + 20 = 100
100 – 20 = 80

Solve **problems** using concrete objects, pictorial representations and mentally. (Missing number problems)

Use of number line and number square to support understanding – taking away **and** finding difference by counting on.

Taking away (bridging 10)
13 – 7 =

-4 -3

6 10 13

Subtracting (Partitioning)
24 – 13
24 – 10 = 14
14 – 3 = 11

Begin to record finding difference by counting on using a number line.

10 3

13 23 26

Know by heart 2, 5 and 10 times tables.

Recognise odd and even numbers.

Repeated addition e.g. 4 + 4 + 4 = 3 x 4

Bar Model

4	4	4	4	4
20				

Arrays

2 x 3 = 6

3 x 2 = 6

Understand that multiplication can be done in any order – commutative

Solve problems – concrete objects, pictorial representations, arrays and mental methods.

Repeated subtraction (grouping)

-3 -3 -3 -3 -3 -3

0 3 6 9 12 15 18

Relate to multiplication facts
e.g. 3 groups of
groups of 3

Practical sharing with and without remainders
Pictorial representation

Solve problems – concrete objects, pictorial representations, arrays and mental methods.

Y3
3-digit numbers

10 more/100 more than a given 3-digit number
Continue to work on bridging 10/100
e.g. 245 + 70 =

+ 55 +15

245 300 315

Addition up to HTU and HTU
Partitioning (see Y2) moves on to expanded column addition

HTU
564
235
9
90
700
799

Use concise formal written method of addition.

564
+235
799

Inverse operations to check answers

Solve **problems** – missing number problems, numbers facts, place value

Bar models

167	?
287	

Add fractions with the same denominator.

10 less/ 100 less
Use number lines to calculate difference.

Teach 'same value different appearance'
e.g. 34 = 20 + 14

Expanded column subtraction

23 20 + 3
- 12 10 + 2
10 + 1 = 11

Expanded column subtraction with decomposition.

148 ~~100~~ + ^{1}40 + 8
- 78 70 + 8
0 + 70 + 0 = 70

Inverse operations to check answers

Solve **problems** – missing number problems, numbers facts, place value

Bar models

34	?
87	

Subtract fractions with the same denominator.

Count in multiples of 4, 8, 50 and 100.
Multiplication facts x2, x3, x4, x5, x8, x10
Continued work on Arrays (see above)

Multiply TU and HTU by 10 and 100

Multiply a multiple of ten or 100 by U
e.g 20 x 4 =
300 x 2 = 600

Begin to work towards formal written method

35
x 4
20 (4 x 5)
120 (4 x 30)
140

Solve **problems** – including missing number problems.

Divide 2-digit numbers – with remainders

- Practical sharing
- Relate to multiplication facts

17 ÷ 6 = 2 ^{r5}
(2 x 6) = 12

38 ÷ 4 = 9 ^{r2}
(9 x 4) = 36

Solve **problems** – including missing number problems.

Y4

4-digit numbers & Negative Numbers & Roman Numerals

1000 more
Rounding numbers
Use written methods to add TU, HTU, ThHTU and £.p.

Condensed written method

$$\begin{array}{r} 3263 \\ +\ 1982 \\ \hline 5245 \\ {\scriptstyle 1\ 1} \end{array}$$

Inverse operations and estimation (rounding) to check answers

Varied pictorial representations of problems e.g. bar models, place value counters
Two-step problems – in contexts, deciding which operations to use and why.
Number line used when calc involves time and negative numbers.

Add fractions with the same denominator

1000 less
Rounding numbers
Use written methods to subtract TU, HTU, ThHTU and £.p.

Column subtraction

$$\begin{array}{r} {}^{2}\not{3}\,{}^{1}787 \\ -\ 1923 \\ \hline 1864 \end{array}$$

Inverse operations and estimation (rounding) to check answers

Varied pictorial representations of problems e.g. bar models, place value counters
Two-step problems – in contexts, deciding which operations to use and why.
Number line used when calc involves time and negative numbers.

Subtract fractions with the same denominator

Count in multiples of 6, 7, 9, 25 and 100.
Know all multiplication facts to 12 x 12
Multiply by 0 and 1
Multiply 3 numbers together.

Recognise and use factor pairs to find missing numbers
6 x ___ = 24
___ x ___ = 24

Develop mental calculation - associated facts
3 x 4 = 12
30 x 4 = 120
4 x 30 = 120

Multiply TU x U and HTU x U
Partitioning
24 x 5
20 x 5 = 100
4 x 5 = 20
120

Grid Method

x	20	4
5	100	20

= **120**

Move to **standard written method**

$$\begin{array}{r} 35 \\ \times\ 4 \\ \hline 20\ (4 \times 5) \\ 120\ (4 \times 30) \\ 140 \end{array}$$

Solve **problems** – including missing number problems.

Divide by 1

Relate division to fractions
Calculate fractions of quantities

Develop mental calculation - associated facts
3 x 4 = 12
12 ÷ 4 = 3
120 ÷ 40 = 3
One quarter of 12 = 3

Divide TU by U – expanded bus stop method

$$\begin{array}{r} 13 \\ 6\overline{)78} \\ 60\ (10 \times 6) \\ 18 \\ 18\ (3 \times 6) \\ 0 \end{array}$$

(Mam, Dad, Sister, Brother, Rufus the dog – this can be used to support our SEND pupils to remember the steps within formal division.)

Include simple remainders

Solve **problems** – including missing number problems.

Y5

Numbers to 1 million & Negative Numbers & Decimals

Count forwards and backwards in powers of 10.
Mental addition – bridging 10/100
4753 + 670
4753 + 600 = 5353
5353 + 70 = 5423

Rounding numbers to estimate answers.
Add large whole numbers and decimals to 3-decimal places.
Add several numbers.

123	6.32
+ 94	+ 4.10
217	10.42
1	

Varied pictorial representations of problems e.g. bar models, place value counters
Multi-step problems – in contexts, deciding which operations to use and why.

Add fractions with different denominators.

Count forwards and backwards in powers of 10.
Mental subtraction – bridging 10/100
635 – 67
635 – 60 = 575
575 – 7 = 568

Rounding numbers to estimate answers.
Subtract large whole numbers and decimals to 3-decimal places.
Column subtraction

$$\begin{array}{r} {}^{2}\not{3}{}^{1}78 \\ -\ 192 \\ \hline 186 \end{array}$$

Varied pictorial representations of problems e.g. bar models, place value counters
Two-step problems – in contexts, deciding which operations to use and why.

Subtract fractions with different denominators.

Factors and Multiples
Prime and composite numbers
Square numbers and cube numbers

Multiply whole numbers and decimals by 10, 100 and 100

Multiply numbers **mentally** drawing upon known facts
64 x 9
64 x 10 = 640
640 – 64 = 576

35 x 5 =
35 x 10 = 350
Halved = 175 = 5 x 35

68 x 11 =
68 x 10 = 680
680 + 68 = 748

Multiply ThHTU x U, HTU x TU, U.t x U
Partitioning – Grid Method

X	400	30	6
20	8000	600	120
4	1600	120	24

= **10464**

Short Multiplication

$$\begin{array}{r} 143 \\ \times\ 5 \\ \hline 715 \\ \hline \end{array}$$
2 1

Long Multiplication

$$\begin{array}{r} 253 \\ \times\ 14 \\ \hline (4 \times 253) \\ (10 \times 253) \\ \hline \end{array}$$

Two-step problems – in contexts, deciding which operations to use and why.

Multiply fractions by whole numbers – supported by materials and diagrams.
$2 \times \frac{1}{4} = \frac{1}{2}$

Divide whole numbers and decimals by 10, 100 and 100

Divide numbers mentally drawing upon known facts
738 ÷ 9
720 ÷ 9 = 80
18 ÷ 9 = 2
82

ThHTU divided by U – bus stop method

$$\begin{array}{r} 38\ r\ 3 \\ 6\overline{)231} \\ 18 \\ \hline 51 \\ 48 \\ \hline 3 \end{array}$$

Interpret remainders for the context

Write the remainder as a fractional part of the divisor.

Two-step problems – in contexts, deciding which operations to use and why.

Y6 **Numbers to 10 million** **&** **Fractions and decimals**	Consolidation **Multi-step problems** – in contexts, deciding which operations to use and why. Mental addition with increasingly large numbers Use knowledge of the order of operation BIDMAS Addition of fractions with different denominators and mixed numbers	Consolidation **Multi-step problems** – in contexts, deciding which operations to use and why. Mental subtraction with increasingly large numbers Use knowledge of the order of operation BIDMAS Subtraction of fractions with different denominators and mixed numbers	Consolidation Common factors, common multiples and prime numbers **Multi-step problems** – in contexts, deciding which operations to use and why. Mental multiplication with increasingly large numbers Use knowledge of the order of operation BIDMAS Multiplication of fractions & decimals 2 x 2/3 = 4/3 $\frac{1}{2} \times \frac{1}{4} = 1/8$ 2.24 x 12 =	ThHTU divided by U and TU U.t divided by U – long division 36 r 7 16 | 583 58 48 103 96 7 16 32 48 64 80 96 Write remainders as fractions and decimals **Multi-step problems** – in contexts, deciding which operations to use and why, interpreting remainders for the context Use knowledge of the order of operation BIDMAS Dividing fractions & decimals 2 ÷ 1/3 = 6 1/3 ÷ 2 = 1/6 $\frac{1}{2} \div 1/3 = 1\frac{1}{2}$ Pictorial or practically