Berrybrook Primary School

Calculation Policy

The purpose of our Calculation Policy is to ensure consistency in the teaching of Mathematics throughout the school and to ensure that pupils develop efficient written and mental methods of calculation, underpinned by conceptual understanding.

Calculation Policy

This policy provides an overview of the strategies used in our school to teach Mathematics, specifically the four operations, as defined within the National Curriculum in England: Mathematics Programme of Study.

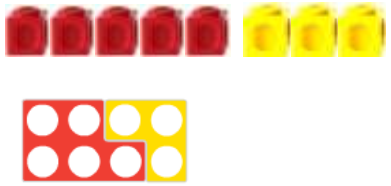
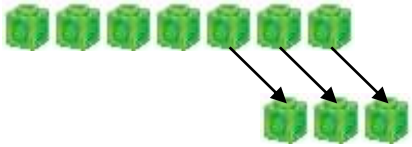
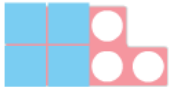
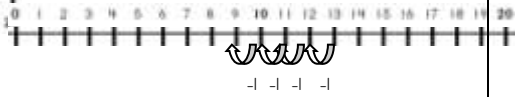
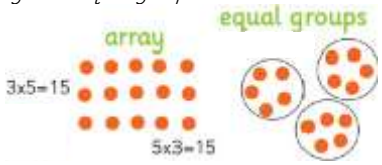
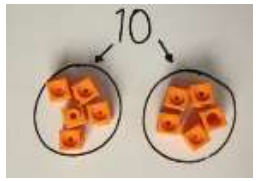
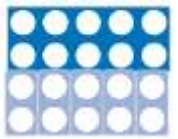
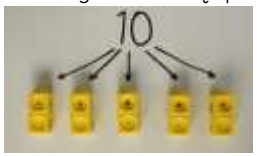
The progression of the four operations (+, –, x and ÷) are shown across each of the primary year groups 1 – 6. This is a guide since children progress at different rates. Teachers should model strategies appropriate to the ability of the children they teach, regardless of their year group, whilst striving to achieve age related expectations at the end of the academic year.

At Berrybrook Primary School, our children are introduced to calculation through practical activities, using **concrete** equipment. As children develop their understanding of the underlying concepts and mathematical models, they develop ways of recording to support their thinking. In the first instance, this recording takes the form of **pictorial** representations. Over time, children learn how to use models and images, such as empty number lines, to support their mental and informal written methods of calculation.

As children become more proficient in their use of mental methods, their informal written methods also become more efficient. Some recording takes the form of jottings, which are used to support children's thinking. More **abstract**, formal written methods are taught only when the child is able to use a wide range of mental calculation strategies and these are always underpinned by **concrete** and **pictorial** experiences.

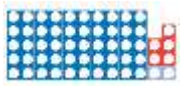
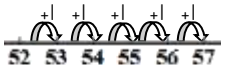
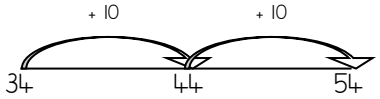
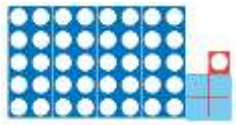
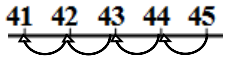
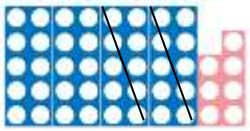
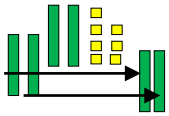
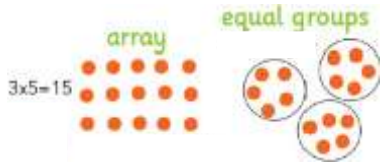
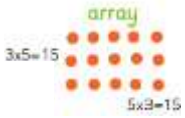
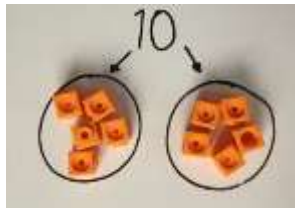
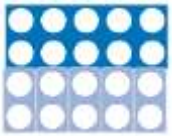
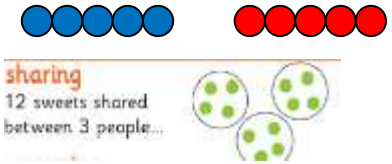
Our ultimate aim is for children to be able to select an efficient method to solve problems. Therefore children will be encouraged to look at a calculation or problem and to determine the most appropriate method to choose – pictures, mental calculation with or without jottings or a formal, written method.

The end of year expectations in the National Curriculum shows the progression in children's use of calculation within the following strands 'Addition and Subtraction' and 'Multiplication and Division'. These end of year expectations will be achieved through the use of the following written methods of calculation.

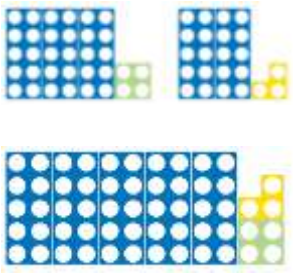
Year	Addition +	Subtraction –	Multiplication x	Division ÷
Year 1	• add **one-digit and two-digit numbers** to 20 including zero	• subtract **one-digit and two-digit numbers** to 20 including zero	• begin to understand **multiplication** through doubling numbers and quantities • use arrays and sets of 'equal groups' to look at other multiples, e.g. x5	• begin to understand **division** through grouping and sharing small quantities
	Addition of single digits 5 + 3 = 8 . . .using **concrete** equipment:  Addition of two digit numbers to 20 and a one digit number. 12 + 5 = 17 . . . using **concrete** equipment: *(Numicon)*  *(Bead Strings)*  . . .using **pictorial** representations: *(Number line)* 	Subtraction of single digits 7 – 4 = 3 . . .using **concrete** equipment:  *(Numicon)*  Subtraction of a one-digit number from a two-digit number to 20. 13 – 4 = 9 . . . using **concrete** equipment: *(Numicon)*  *(Bead Strings)*  . . .using **pictorial** representations: *(Number Line)* 	Doubling, linking to x 2 Double 4 is 8 or 4 + 4 = 8 or 4 x 2 = 8 . . . using **concrete** equipment:  . . . using **pictorial** representations:  Use an array or equal groups to solve multiplication problems for multiples other than 2 5, 3 times or 5 x 3 = 15 . . . using **concrete** equipment *(Numicon)*  1 then use my 10s checker  *(Bead Strings)*  . . .using **pictorial** representations: *(Arrays and equal groups)* 	Sharing equally Share 10 into 2 equal groups . . . using **concrete** equipment:  Count how many are in each set = 5 *(Numicon)*  Model putting the 2s on top. How many 2s have I used? . . . using **pictorial** representations:  . . . using **abstract** number sentences: 10 ÷ 2 = 5 Grouping How many 2s are in 10? What is 10 grouped into twos? . . . using **concrete** equipment:  Count how many groups = 5

	. . . using **abstract** mental strategies: *(Counting on)* "put 12 in your head and count on 5" 13, 14, 15, 16, 17 	. . . using **abstract** mental strategies: *(Counting on)* "put 13 in your head and count back 4" 12, 11, 10, 9 	. . . using **abstract** mental strategies: *(Counting in multiples)* 5 10 15 or 2, 4 ,6 	. . . using **pictorial** representations:  . . . using **abstract** number sentences: 10 ÷ 2 =5

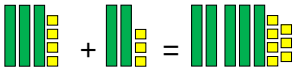
Year 2	• add numbers, including:
	  ◦ a **two-digit number and ones**
	  ◦ a **two-digit number and tens**
	  ◦ two **two-digit numbers**
	  ◦ adding **three one-digit numbers**
	• show that addition of two numbers can be done in any order (**commutative**)
		• subtract numbers, including:
		  ◦ a **two-digit number and ones**
		  ◦ a **two-digit number and tens**
		  ◦ two **two-digit numbers**
		• show that subtraction of two numbers cannot be done in any order
			• **calculate** multiplication statements within the **2, 5 and 10 multiplication tables** and write them using the multiplication (×) and equals (=) signs
			• show that multiplication of two numbers can be done in any order (**commutative**)
				• **calculate** division statements within the **2, 5 and 10 multiplication tables** and write them using the division (÷) and equals (=) signs
				• show that division of numbers cannot be done in any order

	Addition of a two-digit number and ones 52 + 5 = 57 . . .using **concrete** equipment: *(Numcion)* *(Bead Strings)*   . . .using **pictorial** representations: *(Number line)*  Addition of a two-digit number and tens 34 + 20 = 54 . . .using **concrete** equipment: *(Numicon)*  . . .using **pictorial** representations:  Addition of two two-digit numbers 34 + 23 = 57	Subtraction of a two=digit number and ones 45 – 4 = 41 . . . using **concrete** equipment: *(Numicon)*  . . . .using **pictorial** representations: *(Number line)*  Subtraction of a two-digit number and tens 47 – 20 = 27 . . .using **concrete** equipment: *(Numicon)*  *(Base 10 equipment)*  . . . using **pictorial** representations: *(Number line)* 	Multiplication of two numbers within the 2, **3**, 5, 10 multiplication tables. . . .using **concrete** equipment *(Numicon)* 5, 3 times or 5 x 3 = 15 . . . using **concrete** equipment *(Numicon)*  1 then use my 10s checker  . . .using **pictorial** representations *(Arrays and equal groups)*  Introduce x sign to mean 'how many times' and model recording calculations 5 x 3 = 15 or 5, 3 times = 15.  Understand multiplication can be done in any order 3 x 5 = 15 and 5 x 3 = 15.	Division of numbers within known multiplication tables *Consolidate understanding of 'sharing' and 'grouping' as outlined within Year 1.* Sharing equally Share 10 into 2 equal groups . . . using **concrete** equipment:  Count how many are in each set = 5 *(Numicon)*  Model putting the 2s on top. How many 2s have I used? . . . using **pictorial** representations: 

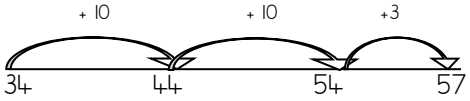
. . .using **concrete** equipment:



(Base 10 equipment)



. . .using **pictorial** representations:



Following the **concrete** equipment and **pictorial** representations, children will use **abstract** mental strategies:

52 + 5 = 57
34 + 20 = 54
34 + 23 = 57

Addition of three single digit numbers

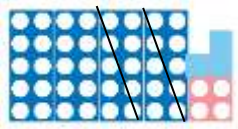
4 + 7 + 6 = 17

. . . using **concrete** equipment:
(Bead Strings)

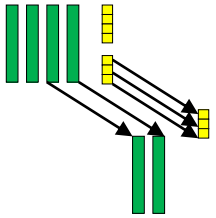
Subtraction two two-digit numbers (no regrouping)

47 – 23 = 24

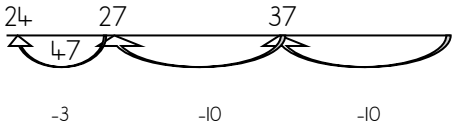
. . .using **concrete** equipment:
(Numicon)



(Base 10 equipment)



. . . using **pictorial** representations:
(Number line)



(Moving to subtracting 20 in one jump)

Following the **concrete** equipment and **pictorial** representations, children will use **abstract** mental strategies:

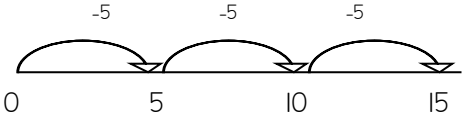
45 – 4 = 41
47 – 20 = 27
47 – 23 = 24

. . . using **abstract** mental strategies:
(Counting in multiples)

5 10 15 or 2, 4 ,6 or 10,20,30

. . .using **concrete** equipment
(Bead Strings)

. . .using **pictorial** representations
(Number line)



. . .using **abstract** mental strategies

Calculate mathematical statements within the **2, 5 and 10 multiplication tables** and write them using the multiplication (×) and equals (=) signs.

4 x 5 =
2
0
7 x 10 = 70
9 x 2 =18

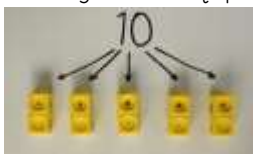
. . . using **abstract** number sentences:
10 ÷ 2 = 5
12 ÷ 3 = 4

This year, pupils to write number sentences to represent their workings out using the division (÷) and equals (=) signs.

Grouping

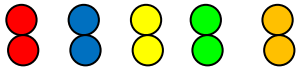
How many 2s are in 10? What is 10 grouped into twos?

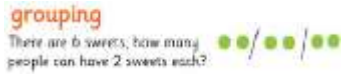
. . . using **concrete** equipment:

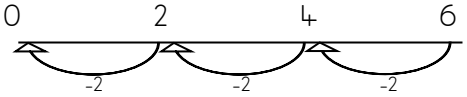


Count how many groups = 5

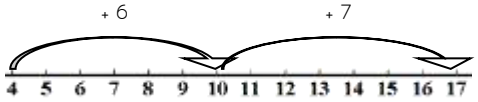
. . . using **pictorial** representations:

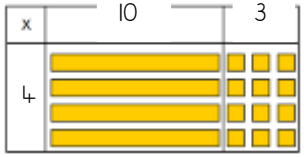
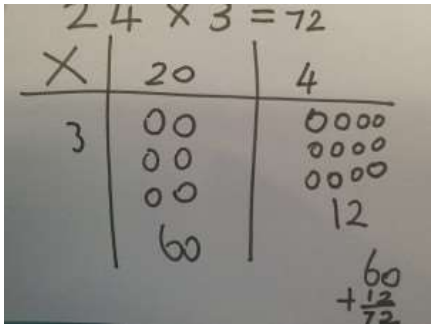
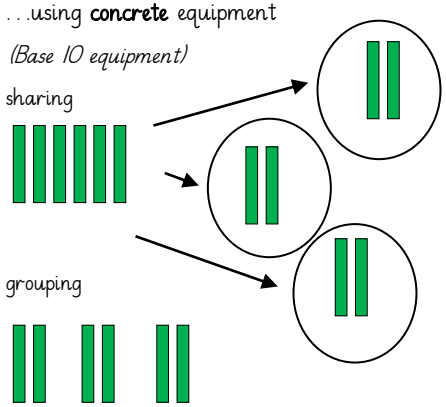




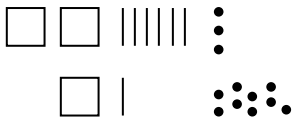


. . . using **abstract** number sentences:
10 ÷ 2 =5
6 ÷ 2 = 3

	(Identify number bonds if possible, e.g. 4 and 6 make 10 / 4 + 6 = 10. Then add on 7 (Numicon)  ... using **pictorial** representations: (Number line)  ... using **abstract**, mental strategies: (4) + 7 + (6) = 17 Identify the two numbers that make ten and then add on the remaining number mentally			

Year 3	• add numbers with **up to three digits**, using **formal written methods** of **columnar addition**	• subtract a **two-digit or 3-digit number from a two-digit or 3 digit number** using a **formal written method**	• multiply using multiplication tables that they know, including for **two-digit numbers times one-digit numbers**, using **efficient written methods- 'partitioning method'**	• divide using known multiplication tables, including for **two-digit numbers divided by one-digit numbers**, using mental methods, progressing to **efficient written methods**
	Addition of numbers with up to three digits 263 + 119 = 382 . . .using **concrete** equipment: *(Base 10 equipment)* 	Subtraction of numbers with up to three digits 263 – 119 = 144 . . .using **concrete** equipment: *(Base 10 equipment)* 	Multiplication of a two-digit number by a one-digit number. 13 x 4 = 52 24 x 3 = 72 . . .using **concrete** equipment *(Base 10 equipment)*  13 x 4 = (10 x 4) + (3 x 4) = 40 + 12 = 52 . . .using **pictorial** representations  24 x 3 = (20 x 3) + (4 x 3) = 60 + 12 = 72 . . .using **abstract** methods Use of partitioning method, independent of equipment and diagrams. 13 x 4 = (10 x 4) + (3 x 4) = 40 + 12 = 52	Division of a two-digit number by aa one-digit number, using known multiplication tables. 60 ÷ 3 = 20 . . .using **concrete** equipment *(Base 10 equipment)* sharing  *6 tens ÷ 3 = 2 tens = 20* A secure understanding of partitioning in different ways underpins this, 54 ÷ 3 =18 50 + 4 40 + 14 30 + 24 10 8 . . .using **pictorial** representations Representing the concrete equipment using jottings and diagrams to support mathematical understanding. . . .using **abstract** mental methods Completion of number sentences. 60 ÷ 3 = 20 54 ÷ 3 =18 50 + 4

. . .using **pictorial** representations



. . . using **abstract** mental strategies

(Partitioning)

	200	+	60	+	3
+	100	+	10	+	9
	300	+	70	+	12
	300	+	80	+	2

(Column method)

	2	6	3
+	1	1	9
	3	8	2
		1	

<u>Progression in columnar addition:</u>

Step 1 (to introduce)

2 digits – no carrying e.g. 45 + 32

Step 2

2 digits – carrying to the tens e.g. 43 + 18

Step 3

3 digits – carrying to the tens e.g 263 + 119

Step 4

3 digits – carrying to the hundreds e.g. 357 – 261

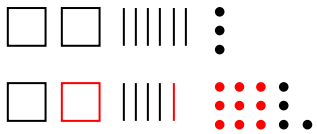
Step 5

3 digits – carrying to the thousands e.g. 847-931

Step 6

2 and 3 digit numbers – understand place value – place value of columns.

. . .using **pictorial** representations



. . .using **abstract** mental strategies

(Partitioning)

			50		13
	200	+	~~60~~	+	~~3~~
–	100	+	10	+	9
	100	+	40	+	4

(Column method)

		5	1
	2	~~6~~	3
–	1	1	9
	1	4	4

<u>Progression in columnar subtraction:</u>

Step 1 (to introduce)

2 digits – no exchanging e.g. 58 – 27

Step 2

2 digits – exchanging from tens e.g. 42 – 18

Step 3

3 digits – exchanging from tens e.g. 263 – 119

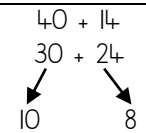
Step 4

3 digits – exchanging from hundreds e.g. 347 – 261

Step 5

2 from 3 digit numbers – understand place value – place value of columns.

$24 \times 3 = (20 \times 3) + (4 \times 3)$
$= 60 + 12$
$= 72$



Use the partitioning and rearranging strategy to support mental calculation.

Year 4	• add numbers with **up to 4 digits** using mental strategies and the **formal written methods (columnar addition)** • add numbers with **1 decimal place**, using **formal written methods (columnar addition)**	• subtract numbers with **up to 4 digits** using mental strategies and the **formal written methods (columnar subtraction)** • subtract numbers with **1 decimal place**, using **formal written methods (columnar subtraction)**	• multiply **two-digit and three-digit numbers by a one-digit number** using formal written layout *e.g. 84 x 6, 134 x 7* • multiply **three-digit numbers with 1 decimal place by a one-digit number** using formal written layout *e.g. 134.5 x 7*	• divide numbers up to **3 digits by a 1 digit number** using the formal written method (no remainders)

Addition of numbers with up to four digits

...using **concrete** equipment

(Base 10 equipment)

Use of place value mat and Base 10 equipment to support understanding (as used in Year 3).

...using **pictorial** representations

Use of place value pictorial prompts to support understanding (as used in Year 3).

...using **abstract** strategies

4 digit + 4 digit

	4	4	7	8
+	3	7	6	2
	8	2	4	0
	1	1	1	

4 digit + 3 digits

Understanding place value, columns

	1	4	5	6
+		7	6	5
	2	2	2	1
	1	1	1	

Subtraction of numbers with up to four digits

...using **concrete** equipment

(Base 10 equipment)

Use of place value mat and Base 10 equipment to support understanding (Year 3).

...using **pictorial** representations

Use of place value pictorial prompts to support understanding (as used in Year3).

...using **abstract** strategies

4 digit – 4 digit

	5	13	1	
	~~6~~	~~4~~	6	7
–	2	6	8	4
	3	7	8	3

4 digit – 3 digit

Understanding place value, columns

	1	14	13	1
	~~2~~	~~5~~	~~4~~	3
–		8	7	6
	1	6	6	7

Using 0 as a place holder

Multiplication of two and three digit numbers by a one-digit number

...using **concrete** equipment

(Base 10 equipment)

...using **abstract** methods

<u>Progression in column multiplication:</u>

Step 1 (to introduce)

2 digits x 1 digit – no carrying e.g. 32 x 3

	3	2	
x		3	
	9	6	

Step 2

2 digits x 1 digit – carry to tens e.g. 23 x 4

(Expand to model carrying)

Divide numbers with up to three-digit by a one-digit number

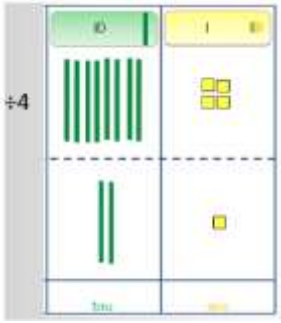
Step 1

2 and 3 digit numbers divided by a 1 digit number- no exchanging across place value columns

84 ÷ 4 = 21

...using **concrete** equipment

(Base 10 equipment)



...using **abstract** methods

	2	1
4	8	4

Use Base 10 alongside this method to ensure conceptual understanding

396 ÷ 3 = 132

	1	3	2
3	3	9	6

Using 0 as a place holder

$$\begin{array}{r} 2\ 6\ 0\ 5 \\ +\quad 8\ 0\ 9 \\ \hline 3\ 4\ 1\ 4 \\ \hline \end{array}$$

Numbers with 1 decimal place

$$\begin{array}{r} 3\ 7\ 9\ .1 \\ +\ 2\ 0\ 3\ .1 \\ \hline 5\ 8\ 2\ .2 \\ \hline \end{array}$$

*Use partitioning methods to support understanding of columnar addition where appropriate.

$$\begin{array}{r} 5\ 1\ 9\ 1 \\ 2\ \cancel{6}\ 0\ 5 \\ -\quad\ \ 8\ 9 \\ \hline 2\ 5\ 1\ 6 \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 1\ 9\ 1\ 9\ 1 \\ 2\ 0\ \cancel{0}\ \cancel{0} \\ -\quad\ \ 4\ 7\ 5 \\ \hline 1\ 5\ 2\ 5 \\ \hline \end{array}$$

Numbers with 1 decimal place

$$\begin{array}{r} 3\ 1 \\ 7\ \cancel{4}\ 3\ .7 \\ -\ 2\ 1\ 6\ .2 \\ \hline 5\ 2\ 7\ .5 \\ \hline \end{array}$$

*Use partitioning methods to support understanding of columnar subtraction where appropriate.

$$\begin{array}{r} 2\ 3 \\ \times\quad 4 \\ \hline 9\ 2 \\ \hline \end{array}$$

$$\begin{array}{r} 2\ 3 \\ \times\quad 4 \\ \hline 1\ 2 \\ +\ 8\ 0 \\ \hline 9\ 2 \\ \hline \end{array}$$

Step 3

2 digit x 1 digit – carry to tens and hundreds e.g. 84 x 6

$$\begin{array}{r} 8\ 4 \\ \times\quad 6 \\ \hline 5\ 0\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 8\ 4 \\ \times\quad 6 \\ \hline 2\ 4 \\ +\ 4\ 8\ 0 \\ \hline 5\ 0\ 4 \\ \hline \end{array}$$

Step 4

3 digits x 1 digit – carry to tens e.g. 219 x 4

$$\begin{array}{r} 2\ 1\ 9 \\ \times\quad 4 \\ \hline 8\ 7\ 6 \\ \hline \end{array}$$

Step 5

3 digits x 1 digit – carry to tens, hundreds and thousands e.g. 425 x 4

$$\begin{array}{r} 4\ 2\ 5 \\ \times\quad 4 \\ \hline 1\ 8\ 0\ 0 \\ \hline \end{array}$$

Step 2

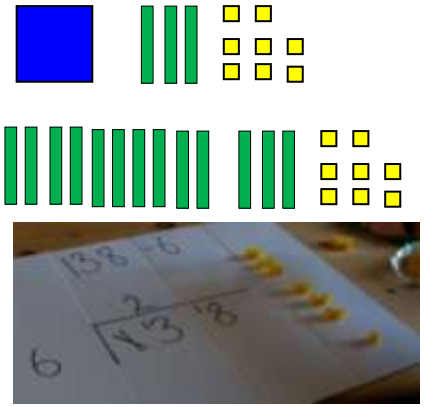
2 and 3 digit numbers divided by a 1 digit number – involving carrying across place value columns

138 ÷ 6 = 23

. . .using **concrete** equipment

(Base 10 equipment)

Alongside formal written method:



. . .using **abstract** methods

976 ÷ 8 = 122

$$\begin{array}{r|llll} & 1 & 2 & 2 \\ \hline 8 & 9 & {}^{1}7 & {}^{1}6 \end{array}$$

Introduce the concept of a remainder.

Year 5

- add **whole numbers** with **more than 4 digits** (and with **up to 3 decimal places**), including using formal written methods (columnar addition)
- subtract **whole numbers** with **more than 4 digits** (and with **up to 3 decimal places**), including using formal written methods (columnar subtraction)
- multiply numbers **up to 4 digits by a 1 digit number** using a formal written method *e.g. 3721 x 7*
- multiply **one-digit numbers with up to three decimal places by whole numbers**
- multiply numbers **up to 4 digits by 2-digit number** using a formal written method *e.g. 3721 x 37*
- divide numbers up **to 4 digits by a one-digit number** using the formal written method and **interpret remainders**
- divide numbers up **to 4 digits with up to 3 decimal places by a one-digit number** using the formal short written method

As for Year 4, but with larger numbers and with a greater number of decimals places - up to 3 decimal places.

Continue to ensure that the use of '0' as a place holder is used to ensure children are confident with this carrying and adding on process.

As for Year 4, but with larger numbers and with a greater number of decimals places - up to 3 decimal places.

Continue to ensure that the use of '0' as a place holder is used to ensure children are confident with this exchanging process.

Multiplication of a four-digit numbers by a one-digit numbers.

	3	7	2	1
x				7
2	6	0	4	7
2	5	1		

	4	7	2	5
x				9
4	2	5	2	5
4	6	2	4	

Multiplication of a one-digit number with up to three decimal places by a one-digit number.

	1.	4	3
x			6
	8.	5	8
	2	1	

Develop to up to 4 digits with up to 3 decimal places by a one-digit number.

Multiplication of a four-digit number by a two digit number.

		3	7	0	1
x				3	7
	2	5	9	0	7
+	1	1	1	0	3	0
	1	3	6	9	3	7

Division of numbers with up to four digits by a one-digit number.

Step 1

2 digit number divided by 1 digit number - with remainders

76 ÷ 6= 12 4/6 12.66

		1	2	r	4
6	7	1	6		

Step 2

3 digit number divided by 1 digit number - with remainders

852 ÷ 7= 121 5/7.

Round up or down given the context of the problem.

	1	2	1	r	5
7	8	1 5	1 2		

Step 3

Up to 4 digits with up to 3 decimal places by a one-digit number

		2	4	•	9	
7	1	7	3 4	•	6 3	

				2 3 • 2 9 8 | 1 8 ²6 • ²3 ⁷2 (Decimal point on the line) **Step 4** 4 digit number divided by 1 digit number – with remainders– interpreted as a decimal (to 3 decimal places) 6497 ÷ 8 = 812.125 0 8 1 2·1 2 5 8)6 4 9 7·⁷0 ²0 ⁴0

Year 6	• add **multi-digit numbers with more than 4 digits (with up to 3 decimal places)**, using formal written methods (columnar addition)	• subtract **multi-digit numbers with more than 4 digits (with up to 3 decimal places)**, using formal written methods (columnar subtraction)	• multiply **multi-digit numbers up to 4 digits by a two-digit whole number** using the formal written method of long multiplication	• divide numbers **up to 4 digits (with up to 3 decimal places) by a two-digit whole number** using the formal written method of division, and **interpret remainders as whole number remainders, fractions, or by rounding**, as appropriate for the context -short division -long division
	As for Year 4 and 5, but with multi-digit numbers with more than 4 digits (and with up to 3 decimal places).	As for Year 4 and 5, but with multi-digit numbers with more than 4 digits (and with up to 3 decimal places).	Multiplication of a four-digit number by a two-digit number. 3701 x 37 25907 + 11103 0 = 136937	Division of numbers with up to four digits and three decimal places, by a two-digit whole number. Short Division 2431 ÷ 17 = 243 remainder 7 or 243 r 7 or 243 7/17 or 243.41 or 243 (to the nearest whole number) or round up or down given the context of the problem. Long Division 243 17 4138 34 73 68 58 51 7

The Calculation Teaching Sequence

Fluency – Reasoning – Problem Solving

Main Teaching

Teach the skill - model, supported by concrete equipment, pictorial representations

Verbal talking frames:

- First
- Then
- Don't forget to...

$$\begin{array}{r} 28 \\ +\ 35 \\ \hline 63 \\ \hline {\scriptstyle 1} \end{array}$$

Fluency

1. Practise and consolidate the skill taught – using concrete equipment and pictorial representations, where appropriate to support abstract methods of calculation

Test children's understanding (application of skills):

2. Word problems- *If Jane is 35 years old and Sam is 28, what is their combined age?*

3. Test base questions

Reasoning

1. Spot the mistake- *for each calculation, can children identify what has been done wrong?*

$$\begin{array}{r} 36 \\ +\ 15 \\ \hline 411 \\ \hline {\scriptstyle 1} \end{array} \qquad \begin{array}{r} 36 \\ +\ 15 \\ \hline 41 \end{array} \qquad \begin{array}{r} 36 \\ +\ 15 \\ \hline 41 \end{array}$$

2. Missing number questions

$$\begin{array}{r} 2\square \\ +\ 35 \\ \hline 63 \\ \hline {\scriptstyle 1} \end{array}$$

Problem Solving

The sum of a two digit odd and an even number is odd. Is this always true, sometimes true or never true?
Prove it.