Church Hill C of E Junior School

Calculation Policy – overview

This policy supports the White Rose maths scheme used throughout the school. Progression within each area of calculation is in line with the programme of study in the 2014 National Curriculum. This calculation policy should be used to support children to develop a deep understanding of number and calculation. This policy has been designed to teach children through the use of concrete, pictorial and abstract representations. It has been taken mainly from the White Rose Calculation Policy and adapted and mapped to meet the specific needs of the children in our school.

Concrete representation— a pupil is first introduced to an idea or skill by acting it out with real objects. This is the use of physical manipulatives that support the conceptual understanding of new learning.

Pictorial representation – the bridge between using the concrete to understanding the abstract maths. This is also a powerful tool to support explanations and proof in maths.

Abstract representation— the numerical representation or algorithm.

Concrete, pictorial and abstract teaching should not be taught in isolation but a mix of two at once to support children's move to a conceptual understanding thus reaching accuracy in using the abstract. When we teach using two of these methods we call this 'dual coding' and it is a way of teaching with more than one learning style.

Expectations by year group

Maths at Church Hill C of E Junior School is tailored to the individual needs of the pupil and adopts the mastery approach. Below map's the expectations of children who would be deemed to be working at the expected standard. Those working at mastery level would be expected to apply this at a deeper level.

Year 3

Addition – add numbers up to 3 digits

Subtraction – subtract numbers up to 3 digits using column subtraction (partitioning).

Multiplication – 2 digit numbers by 1 digit numbers using the grid method.

Division – 2 digit numbers by 1 digit numbers using number lines and repeated subtraction .

Year 4

Addition – add numbers up to 4 digits using full expanded column addition.

Subtraction – subtract numbers up to 4 digits using formal column subtraction.

Multiplication – multiply 2 and 3 digit numbers by a 1-digit number using long multiplication with the calculations written down the side.

Division – 2 digit numbers by 1 digit numbers.

Year 5

Addition – add numbers with more than 4 digits using compact column addition including decimals.

Subtraction – subtract numbers with more than 4 digits using formal column subtraction including decimals.

Multiplication – Multiply numbers up to 4 digits by a 1 or 2-digit number using short column multiplication.

Division – Divide numbers up to 4 digits by a 1-digit number using long division.

Year 6

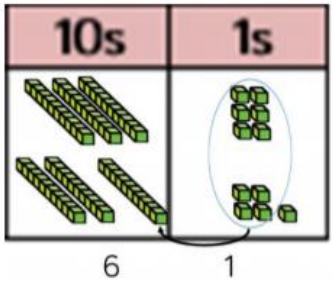
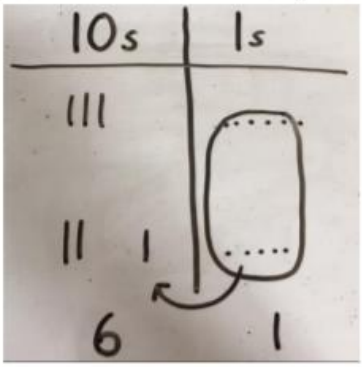
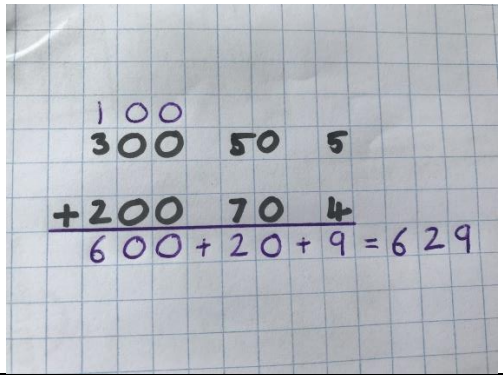
Addition – add numbers with more than 4 digits using compact column addition and including up to 3 decimal places.

Subtraction – subtract numbers with more than 4 digits using formal column subtraction and including up to 3 decimal places.

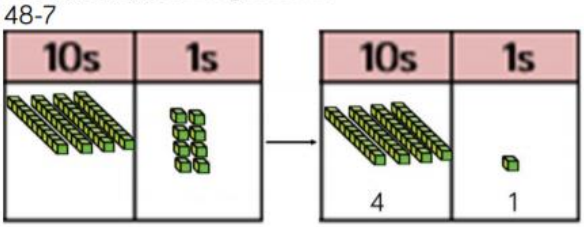
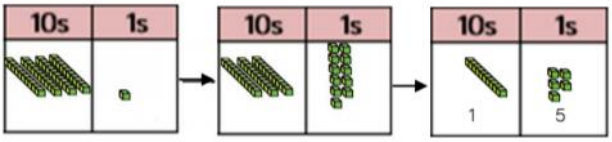
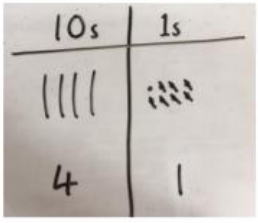
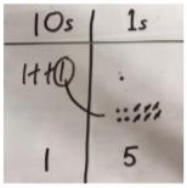
Multiplication – Multiply numbers up to 4 digits by a 2-digit number using short column multiplication including decimals.

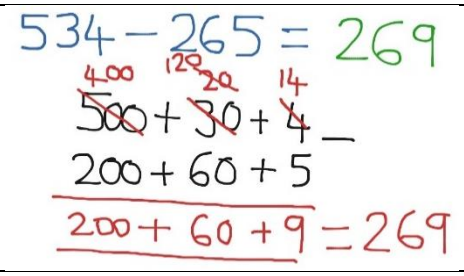
Division – Divide numbers up to 4 digits by a 2-digit number using short division including being able to record your answer as both a remainder or as a decimal.

Year 3 – addition

Add numbers up to 3 digits using expanded column addition with calculations written alongside.	Concrete: **TO + TO using base 10.** Continue to develop understanding of partitioning and place value. 36 + 25  Pictorial: Chidlren to represent the base 10 in a place value chart.  Abstract: 

Year 3 – Subtraction

Subtract numbers up to 3 digits using column subtraction (partitioning).	Concrete: **Column method** using base 10. 48-7  **Column method** using base 10 and having to exchange. 41 – 26  Pictorial: Children to represent the base 10 pictorially.  Represent the base 10 pictorially, remembering to show the exchange.  Abstract: 700 90 8 – 400 50 2 300 + 40 + 6 = 346

534 − 265 = 269
400 120 14
500 + 30 + 4 −
200 + 60 + 5
200 + 60 + 9 = 269

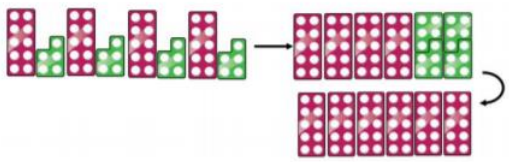
Year 3 – Multiplication

Multiply 2 digit numbers by 1 digit numbers

Children should be able to recall the 2, 5, 10, 3, 4 and 8 multiplication tables.

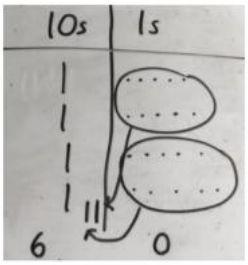
Concrete:

Partition to multiply using Numicon, base 10 or Cuisenaire rods.
4 × 15



Pictorial:

Children to represent the concrete manipulatives pictorially.



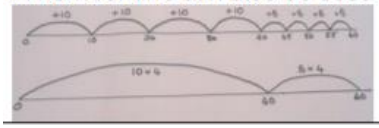
Abstract:

Children to be encouraged to show the steps they have taken.

4 × 15
10 5

10 × 4 = 40
5 × 4 = 20
40 + 20 = 60

A number line can also be used



and

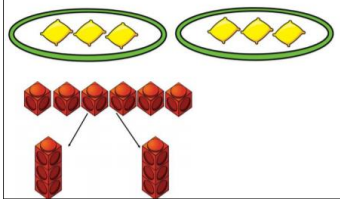
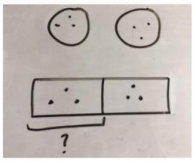
X	30	2
5	150	10

HTU
150
\+ 10
60
100
160

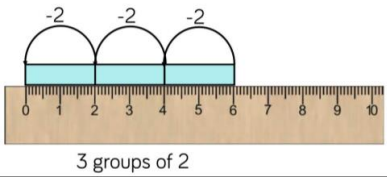
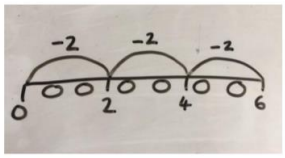
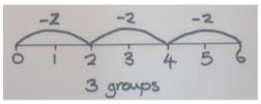
Year 3 Division

2 digit numbers by 1 digit numbers

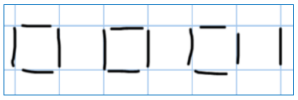
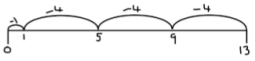
Children should all have the same starting point:

Concrete	Pictorial	Abstract
Sharing using a range of objects. 6 ÷ 2 	Represent the sharing pictorially. 	6 ÷ 2 = 3 3 | 3 Children should also be encouraged to use their 2 times tables facts.

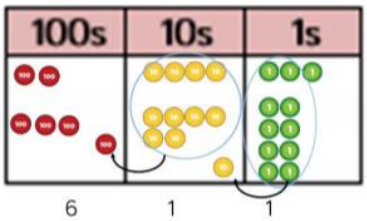
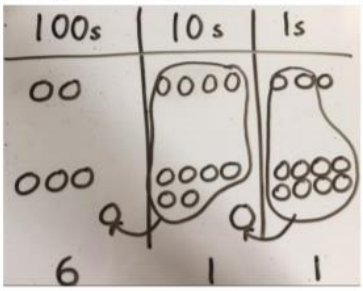
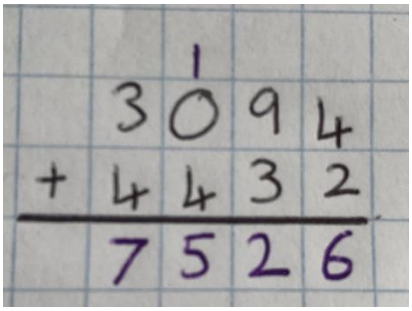
Before progressing to:

Repeated subtraction using Cuisenaire rods above a ruler. 6 ÷ 2  3 groups of 2	Children to represent repeated subtraction pictorially. 	Abstract number line to represent the equal groups that have been subtracted. 

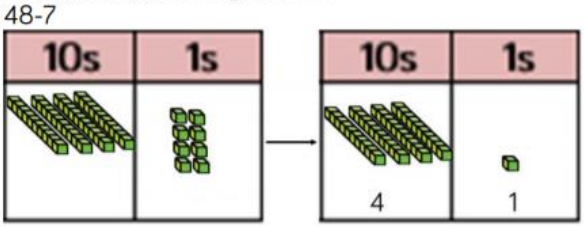
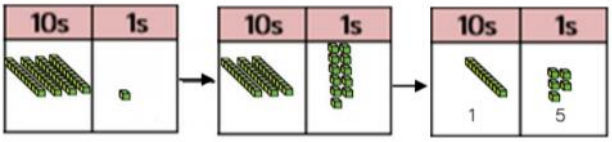
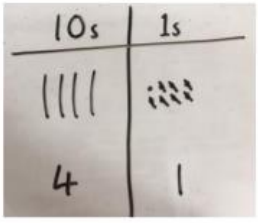
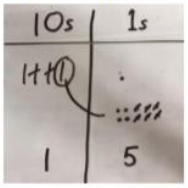
Then start to introduce remainders:

2d ÷ 1d with remainders using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.  There are 3 whole squares, with 1 left over.	13 ÷ 4 = 3 remainder 1 Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line. '3 groups of 4, with 1 left over' 

Year 4 – addition

Adding numbers with up to 4 digits.	**Concrete:** **Use of place value counters to add HTO + TO, HTO + HTO etc.** When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred.  **Pictorial:** Chidren to represent the counters in a place value chart, circling when they make an exchange.  **Abstract:**  Note: carry above

Year 4 – Subtraction

Subtract with numbers up to four digits, including exchanging.	Concrete: **Column method** using base 10. 48-7  **Column method** using base 10 and having to exchange. 41 – 26  Pictorial: Children to represent the base 10 pictorially.  Represent the base 10 pictorially, remembering to show the exchange.  Abstract: 534 – 265 = 269 400 120 20 14 500 + 30 + 4 – 200 + 60 + 5 200 + 60 + 9 = 269

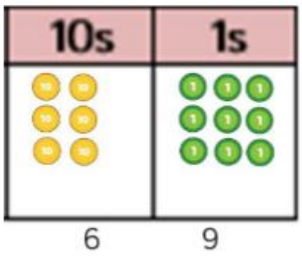
Year 4 – Multiplication

Multiply 2 and 3 digit numbers by 1 digit numbers

Children know all times tables up to 12 x 12

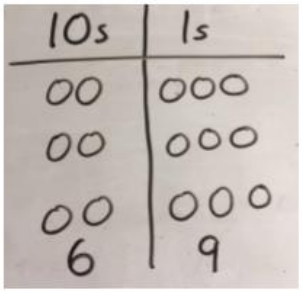
Concrete:

Formal column method with place value counters (base 10 can also be used.) 3 × 23



Pictorial:

Children to represent the counters pictorially.



Abstract:

Children to record what it is they are doing to show understanding.

3 × 23

20 3

3 × 20 = 60

3 × 3 = 9

60 + 9 = 69

$$\begin{array}{r} 23 \\ \times\ 3 \\ \hline 69 \end{array}$$

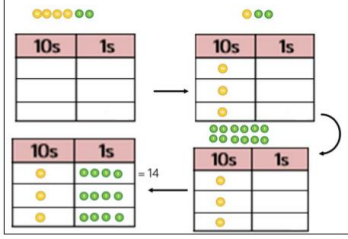
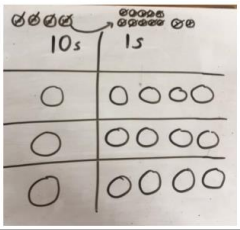
leading to

$$\begin{array}{rl} 314 & \\ \times\ 3 & \\ \hline 12 & (3 \times 4) \\ 30 & (3 \times 10) \\ +\ 900 & (3 \times 300) \\ \hline 942 & \end{array}$$

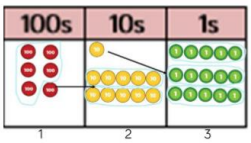
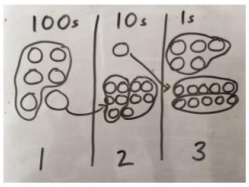
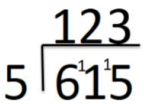
Year 4 Division

Dividing 3 digit numbers by 1 digit numbers

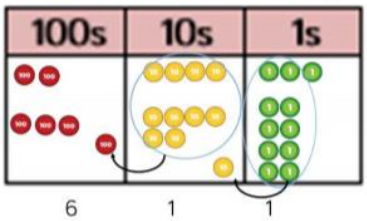
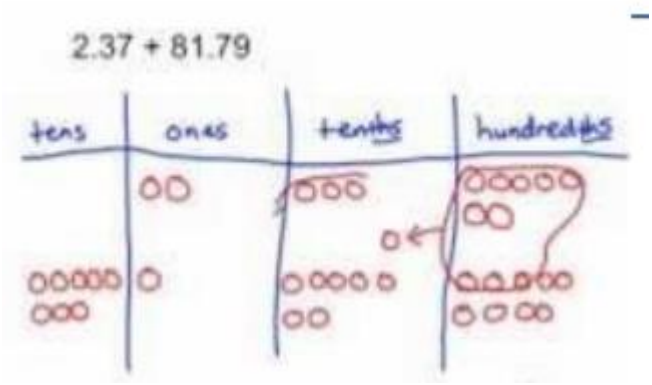
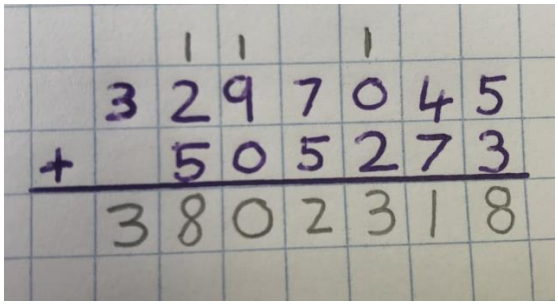
Children should all have the same starting point:

Sharing using place value counters. 42 ÷ 3 = 14	Children to represent the place value counters pictorially.	Children to be able to make sense of the place value counters and write calculations to show the process.
		42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14

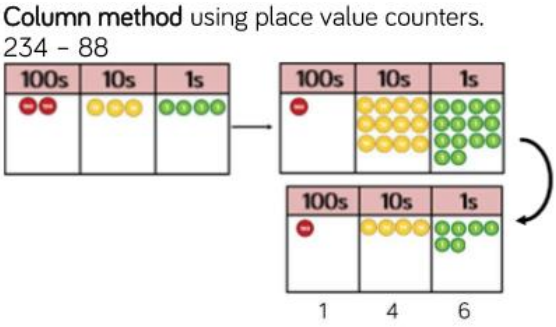
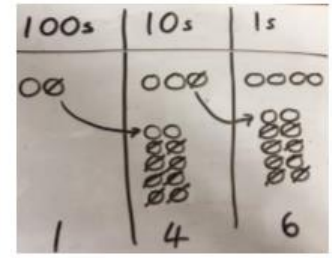
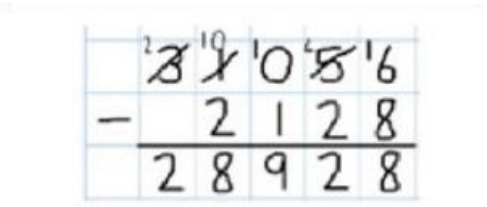
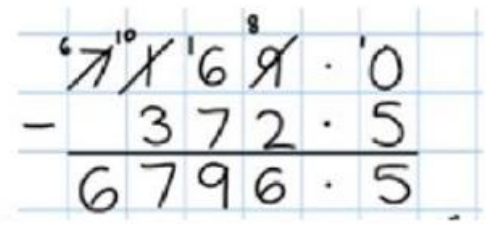
Before progressing to:

Short division using place value counters to group. 615 ÷ 5	Represent the place value counters pictorially.	Children to the calculation using the short division scaffold.
 1. Make 615 with place value counters. 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?		

Year 5 – addition

Adding numbers with more than 4 digits including decimals	Concrete: **Use of place value counters to add HTO + TO, HTO + HTO etc.** When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred.  Pictorial:  Abstract:  Note: carry above

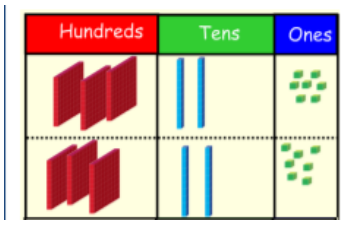
Year 5 – Subtraction

Subtract with at last 4 digits, including exchanging and 2 decimal places.	Concrete:  Pictorial:  Abstract:  

Year 5 – Multiplication

Multiply up to 4 digit numbers by up to 2 digit numbers using long division

Concrete:



It is important at this stage that they always multiply the ones first.

Children can continue to be supported by place value counters at the stage of multiplication. This initially done where there is no regrouping. 321 x 2 = 642

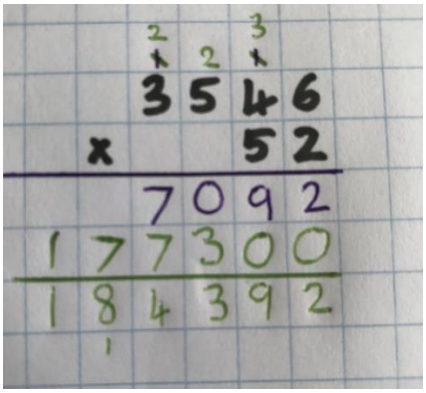
Pictorial:

x	300	20	7
4	1200	80	28

Abstract:

```
 3 1 4
   x 3
 ------
   1 2    (3 x 4)
   3 0    (3 x 10)
+ 9 0 0    (3 x 300)
 ------
   9 4 2
```

leading to

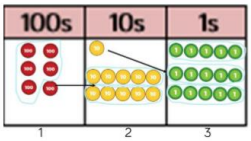


Year 5 Division

Divide up to 4 digit numbers using short division

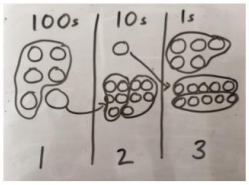
Short division:

Short division using place value counters to group.
615 ÷ 5



1. Make 615 with place value counters.
2. How many groups of 5 hundreds can you make with 6 hundred counters?
3. Exchange 1 hundred for 10 tens.
4. How many groups of 5 tens can you make with 11 ten counters?
5. Exchange 1 ten for 10 ones.
6. How many groups of 5 ones can you make with 15 ones?

Represent the place value counters pictorially.



Children to the calculation using the short division scaffold.

$$5\overline{)615} = 123$$

and then to 4 digit by 2 digit division :

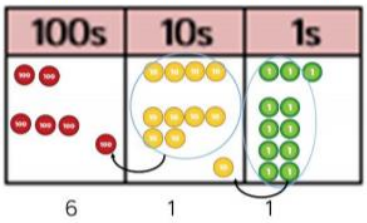
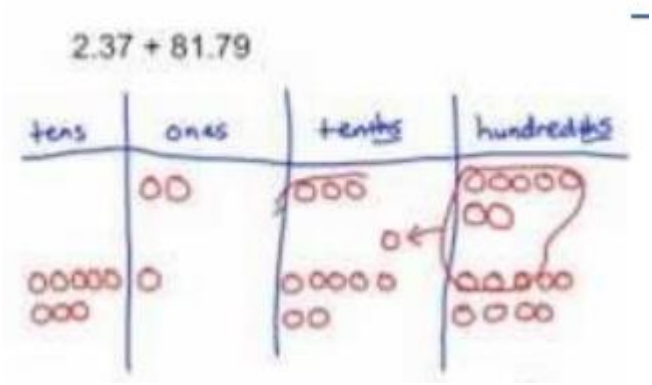
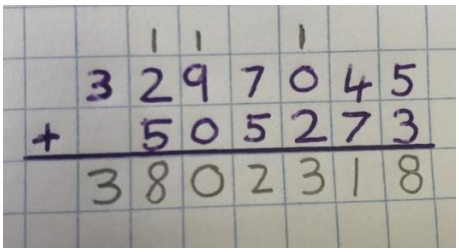
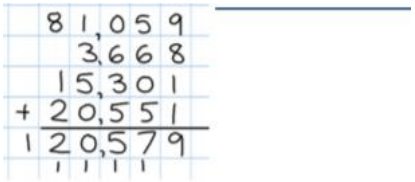
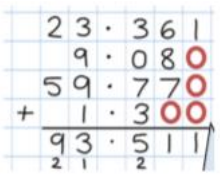
$$23\overline{)4945} = 0215$$

Check: $23 \times 10 = 230$

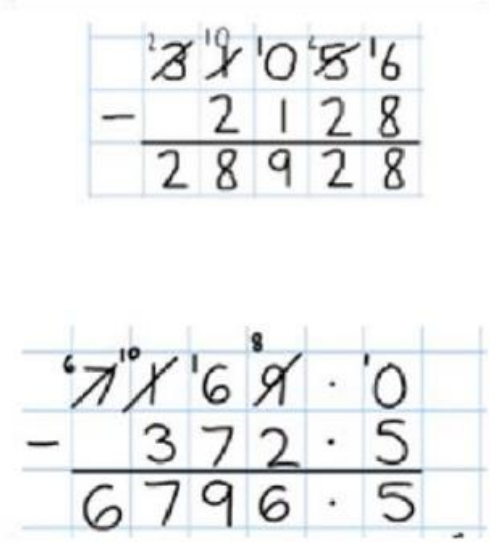
23	23
46	46
69	69
92	92
115	115
138	138
161	161
184	184
207	207
230	230

184 + 23 = 207
207 + 23 = 230

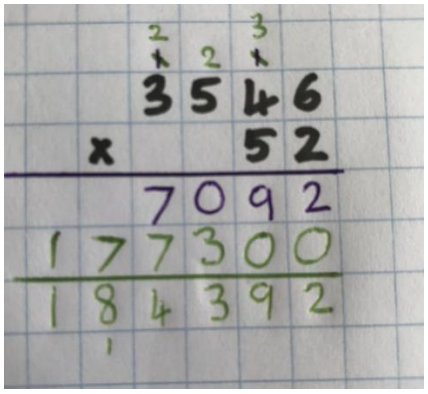
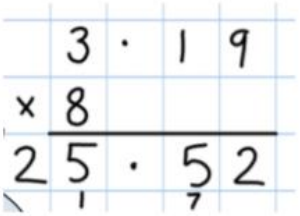
Year 6 – addition

Adding several numbers with up to 3 decimal places	Concrete: **Use of place value counters to add HTO + TO, HTO + HTO etc.** When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred.  Pictorial:  Abstract:  and  Insert zeros for place holders.  Note: carry above

Year 6 – Subtraction

Subtracting with increasingly more complex numbers including decimals	Abstract: 

Year 6 – Multiplication

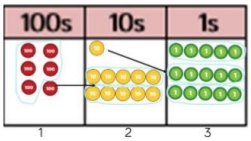
Short and long multiplication with up to 2 decimal places	Abstract:  and Remind children that the single digit belongs in the units column. Line up the decimal points in the question and the answer. 

Year 6 Division

Divide up to 4 digit numbers using short and long division

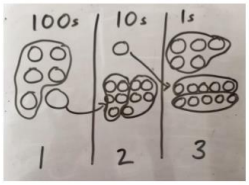
Short division:

Short division using place value counters to group.
615 ÷ 5



1. Make 615 with place value counters.
2. How many groups of 5 hundreds can you make with 6 hundred counters?
3. Exchange 1 hundred for 10 tens.
4. How many groups of 5 tens can you make with 11 ten counters?
5. Exchange 1 ten for 10 ones.
6. How many groups of 5 ones can you make with 15 ones?

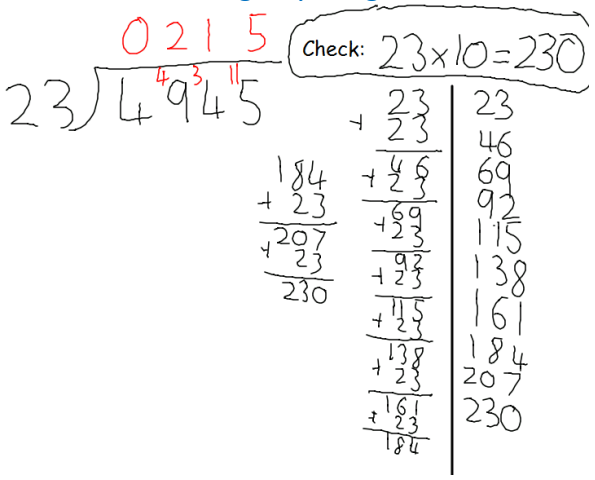
Represent the place value counters pictorially.



Children to the calculation using the short division scaffold.

$$5\overline{)615} = 123$$

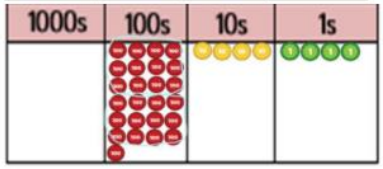
and then to 4 digit by 2 digit division:



Long division:

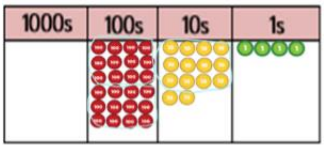
Long division using place value counters
2544 ÷ 12

We can't group 2 thousands into groups of 12 so will exchange them.



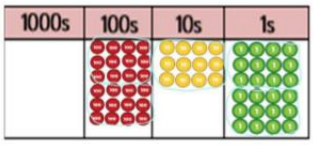
We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

$$12\overline{)2544} = 02\ \text{r}\ 1$$



After exchanging the hundred, we have 14 tens. We can group 12 tens into a group of 12, which leaves 2 tens.

$$\begin{array}{r} 021 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$$

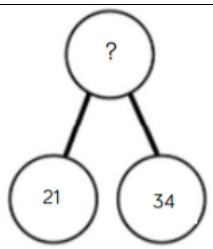
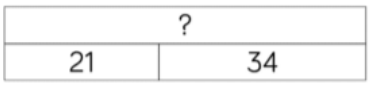
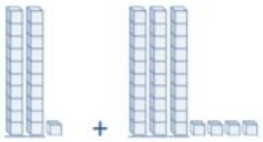
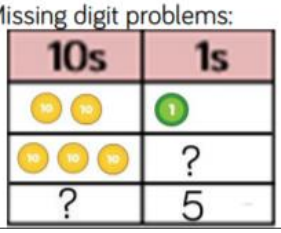


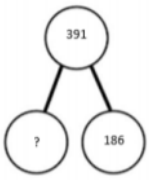
After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

$$\begin{array}{r} 0212 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$$

Bar modelling and conceptual variation

In addition to the methods taught above, it is also vital that the children and exposed to and taught a wide range of conceptual variations to apply the skills in order to achieve mastery and to understand the mathematics in a deeper context. Below shows some examples of conceptual variations for each operation which can be adapted to suit the required level of challenge:

Addition	  21 +34 21 + 34 = = 21 + 34 Calculate the sum of twenty-one and thirty-four. Word problems: In year 3, there are 21 children and in year 4, there are 34 children. How many children in total? 21 + 34 = 55. Prove it  Missing digit problems: 

Subtraction	 391 186 | ? □ = 391 − 186 391 -186 What is 186 less than 391?	Raj spent £391, Timmy spent £186. How much more did Raj spend? Calculate the difference between 391 and 186. Missing digit calculations 3 9 □ - □ □ 6 □ 0 5
Multiplication	23 | 23 | 23 | 23 | 23 | 23 ? Find the product of 6 and 23 6 × 23 = □ = 6 × 23 6 × 23 = 23 × 6	Mai had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week? With the counters, prove that 6 x 23 = 138 What is the calculation? What is the product? 

Division	Using the part whole model below, how can you divide 615 by 5 without using short division?  I have £615 and share it equally between 5 bank accounts. How much will be in each account? 615 pupils need to be put into 5 groups. How many will be in each group? $5\overline{)615}$ 615 ÷ 5 = ☐ = 615 ÷ 5 What is the calculation? What is the answer?  Four children bought a present for £28. They shared the costs equally. How much did each child pay?