The Stoke Poges School Calculation Policy

Rationale

This policy outlines a model progression through written strategies for addition, subtraction, multiplication and division in line with the National Curriculum. Through the policy, we aim to link key manipulatives and representations in order that the children can be vertically accelerated through each strand of calculation. We know that school wide policies, such as this, can ensure consistency of approach, enabling children to progress stage by stage through models and representations they recognise from previous teaching, allowing for deeper conceptual understanding and fluency. As children move at the pace appropriate to them, teachers will be presenting strategies and equipment appropriate to children's level of understanding. However, it is expected that the majority of children in each class will be working at age-appropriate levels as set out in the National Curriculum 2014 and in line with school policy. More able learners will be challenged through greater depth - rather than accelerated content, (moving onto next year's concepts). Teachers will set tasks to deepen knowledge and improve reasoning skills within the objectives of their year group

As we plan and sequence our Maths learning with the support of White Rose resources, the strategies are closely aligned with those suggested within White Rose. Whilst the most common strategies have been presented within this document, this list is not exhaustive and teachers should use the White Rose schemes of learning and NCETM guidance to further support their planning.

The importance of mental mathematics

While this policy focuses on written calculations in mathematics, we recognise the importance of the mental strategies and known facts that form the basis of all calculations. The following checklists outline the key skills and number facts that children are expected to develop throughout the school.

To add and subtract successfully, children should be able to:

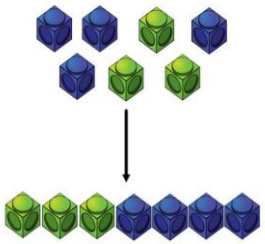
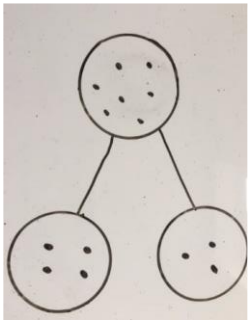
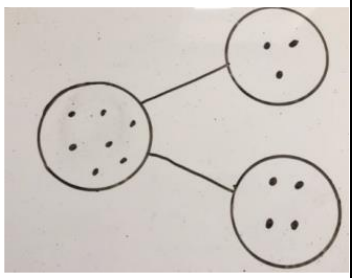
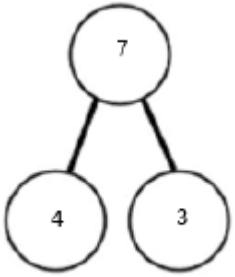
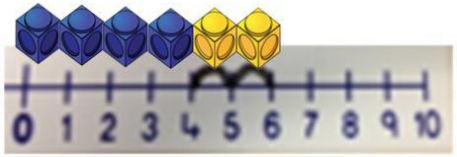
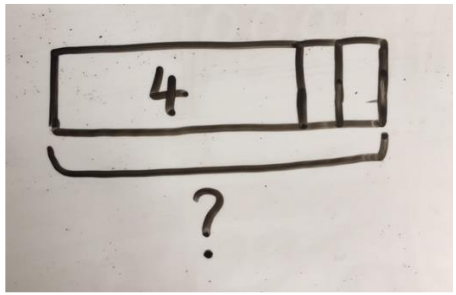
- recall all addition pairs to 9 + 9 and number bonds to 10
- recognise addition and subtraction as inverse operations
- add mentally a series of one digit numbers (e.g. 5 + 8 + 4)
- add and subtract multiples of 10 or 100 using the related addition fact and their knowledge of place value (e.g. 600 + 700, 160 — 70)
- partition 2 and 3 digit numbers into multiples of 100, 10 and 1 in different ways (e.g. partition 74 into 70 + 4 or 60 + 14)
- use estimation by rounding to check answers are reasonable

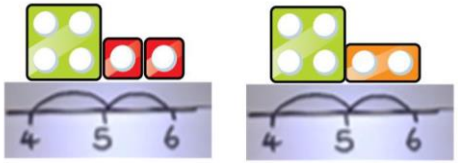
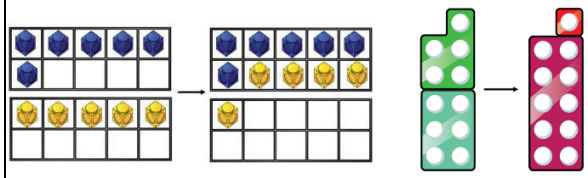
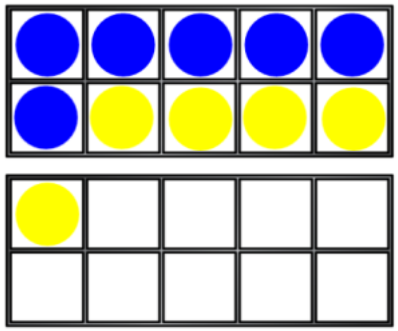
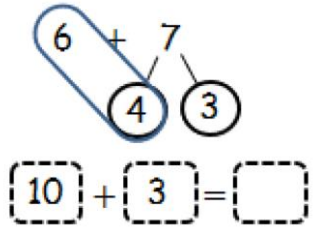
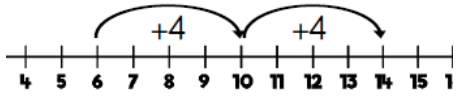
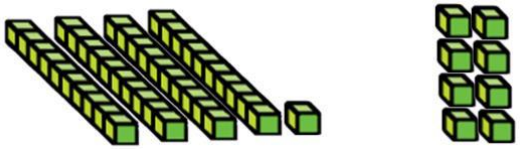
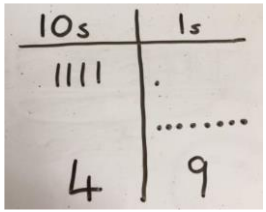
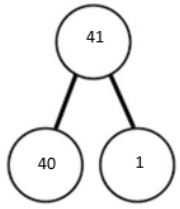
To multiply and divide successfully, children should be able to:

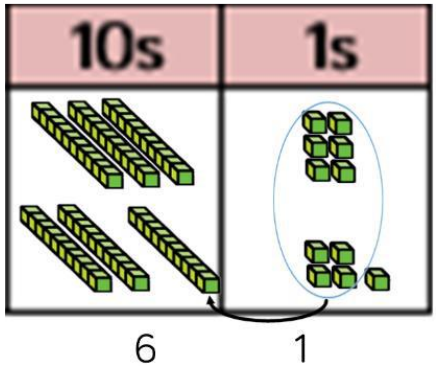
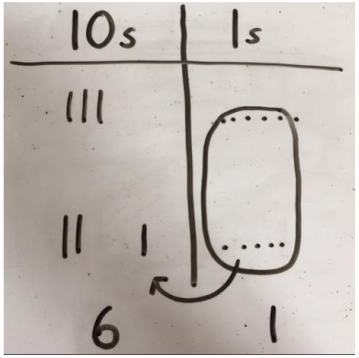
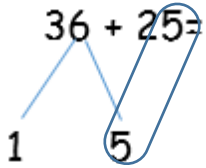
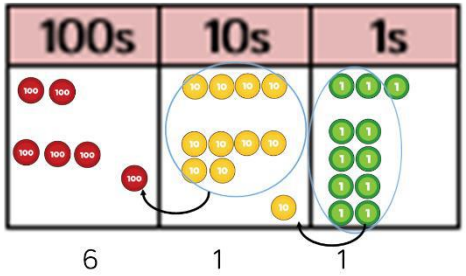
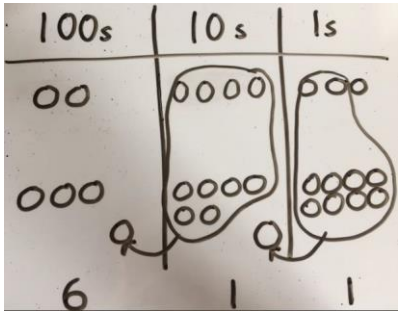
- add and subtract accurately and efficiently
- recall multiplication facts to 12 x 12 = 144 and division facts to 144 ÷ 12 = 12
- use multiplication and division facts to estimate how many times one number divides into another etc.
- know the outcome of multiplying by 0 and by 1 and of dividing by 1
- understand the effect of multiplying and dividing whole numbers by 10, 100 and later 1000
- recognise factor pairs of numbers (e.g. that 15 = 3 x 5, or that 40 = 10 x 4) and increasingly able to recognise common factors
- derive other results from multiplication and division facts and multiplication and division by 10 or 100 (and later 1000)
- notice and recall with increasing fluency inverse facts
- partition numbers into 100s, 10s and 1s or multiple groupings
- understand how the principles of commutative, associative and distributive laws apply or do not apply to multiplication and division
- understand the effects of scaling by whole numbers and decimal numbers or fractions
- understand correspondence where n objects are related to m objects
- investigate and learn rules for divisibility

Addition

Key Vocabulary
sum, total, parts and wholes, plus, add, altogether, more, 'is equal to' 'is the same as'

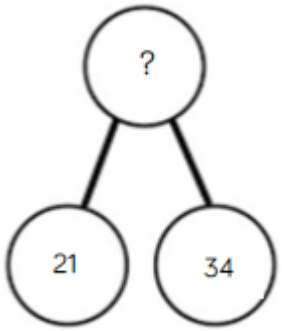
	Concrete	Pictorial	Abstract
Year 1 **Adding numbers within 10**	**Combining two parts to make a whole:** part-whole model (use other resources too e.g. eggs, shells, teddy bears, cars) 	Children to represent the cubes using dots or crosses. They could put each part on a part whole model too. Expose the children to **variations** of this model e.g. when the whole is at the top.  	4+3=7 Four is a part, 3 is a part and the whole is seven. 
Year 1 **Adding numbers within 10**	**Counting on using number lines**, using cubes or Numicon. 	A bar model which encourages the children to count on, rather than count all. 	The abstract number line: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? 4+2 

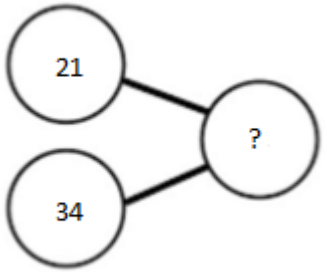
			
Year 1 **Adding numbers within 20**	**Regrouping to make 10**; using ten frames and counters/ cubes or using Numicon. 6+5 	Children to draw the ten frame and counters/cubes. 	Children to show how they regrouped to make 10. Working out could include the following methods: *Example: 6 + 7 = 13*  *Example: 6 + 8 = 14* 
Year 2 **Adding a 2-digit number and a 1-digit number**	**TO + O using base 10 (or other appropriate resources)**. Continue to develop understanding of partitioning and place value. 41 + 8. This could be completed using dienes, counters or other appropriate resources. 	Children to represent the base 10 e.g. lines for ten and dot/crosses for ones. Reinforce the understanding of place value with this method by encouraging the children to express how many tens they have and how any ones. 	Children to use regrouping, or a written method to add.  41 + 8 1 + 8 = 9 40 + 9 = 49

Year 2 **Adding two 2-digit numbers**	**TO + TO using base 10 (or other appropriate resources)**. Continue to develop understanding of partitioning and place value. 36 + 25  	Children to continue to represent the base 10 in a place value chart.  	Pupils to continue to use the column method. Pupils may also be encouraged to use strategies from previous year groups where we regrouped to make 10. *Column Method* 36 +25 61 1  *Formal method:* 30 + 20 = 50 5 + 5 = 10 50 + 10 + 1 = 61
Years 3 – 6 **Addition of larger numbers** N.B. This same method can be used. However, the number of digits will increase as pupils progress through the year groups. It can also be replicated for adding 3 or more numbers, decimal numbers or money.	**HTO + TO, HTO + HTO, etc. using place value counters (or other appropriate resources)** When there are more than 10 in one column regrouping must take place (e.g. 10 ones in the 1s column – we exchange for 1 ten).  	Children to represent the counters in a place value chart, circling when they make an exchange.  	Pupils to continue to use the column method. 243 +368 611 1 1

Conceptual variation; different ways to ask children to solve 21 + 34

Missing number questions presented through different working frames.





?	
21	34

Word problems:

In Year 3, there are 21 children and in Year 4, there are 34 children. How many children in total?

21 ants are building an ant nest. 34 other ants join them. How many ants are there in total?

In the river there are white ducks and black ducks. Altogether there are 55 ducks. 34 are white, how many are black?

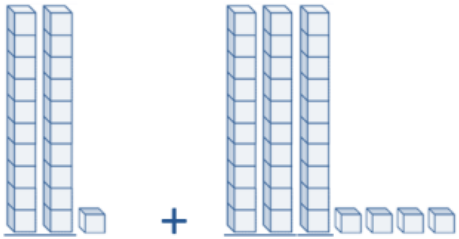
In the drain there are 21 frogs and 34 worms. How many more worms are there than frogs? How many fewer frogs are there than worms?

$$\begin{array}{r} 21 \\ +34 \\ \hline \\ \end{array}$$

$$21 + 34 =$$

$$= 21 + 34$$

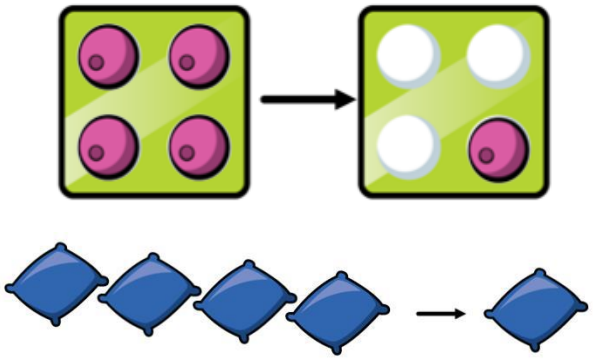
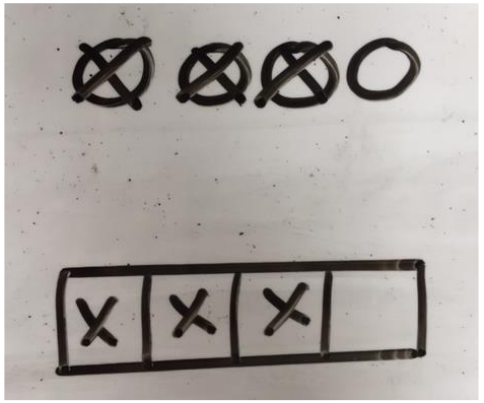
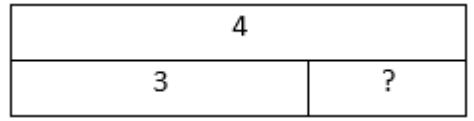
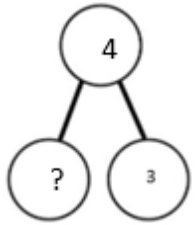
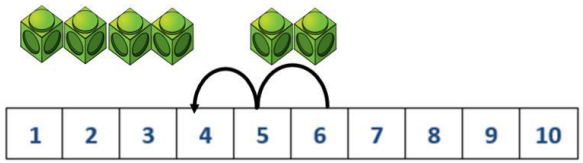
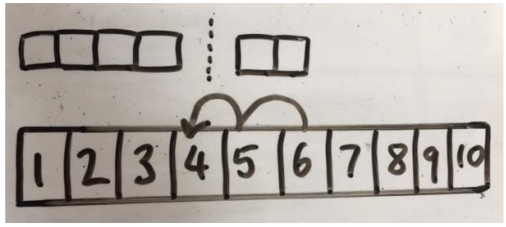
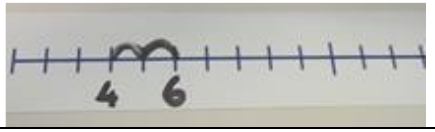
Calculate the sum of twenty-one and thirty-four.

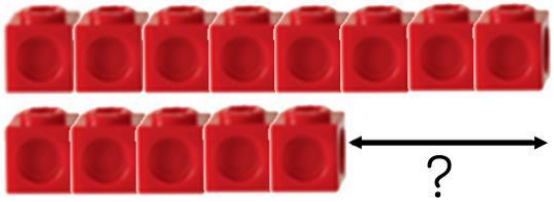
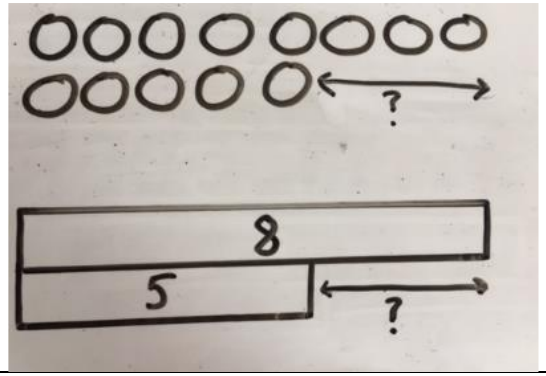
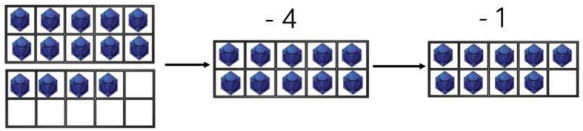
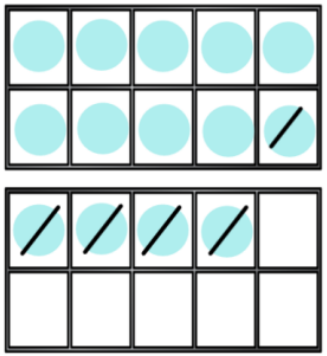
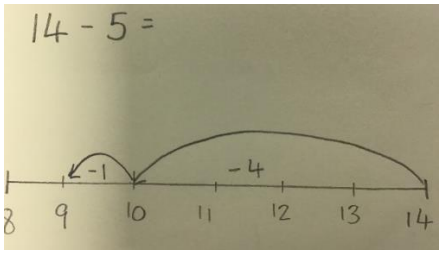
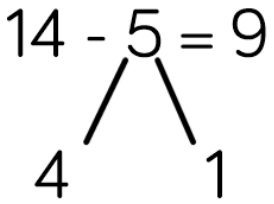


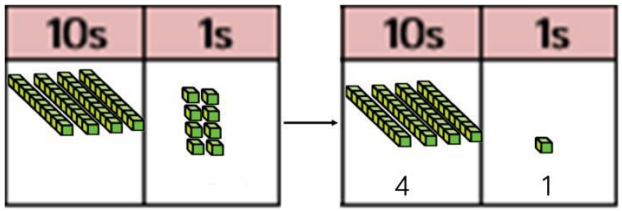
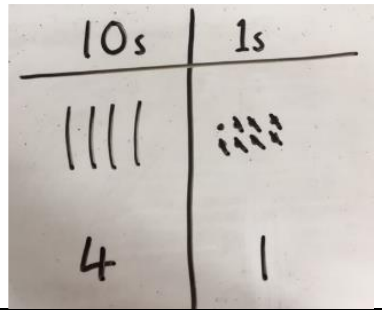
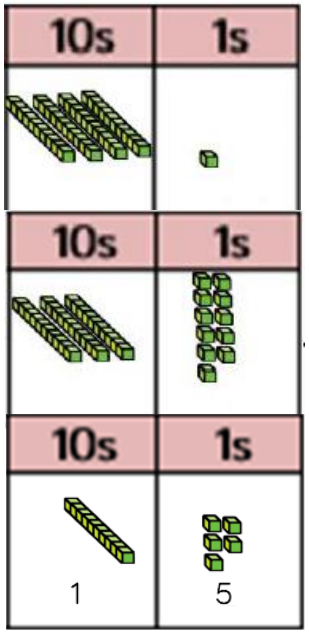
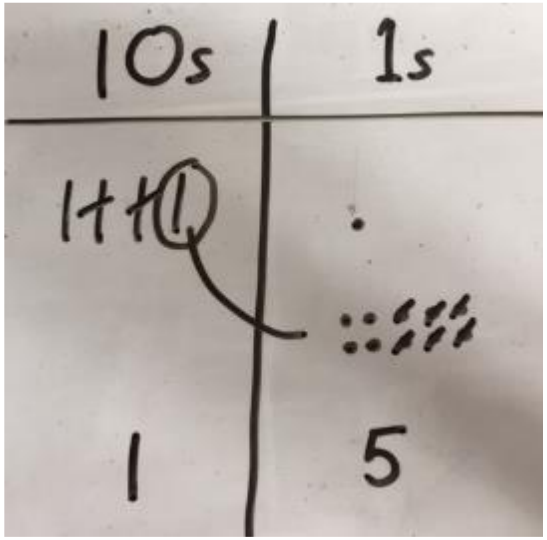
Missing digit problems:

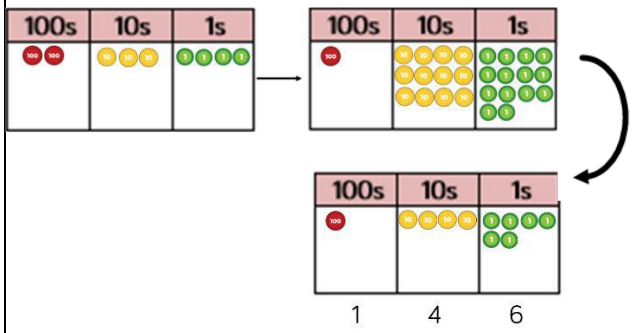
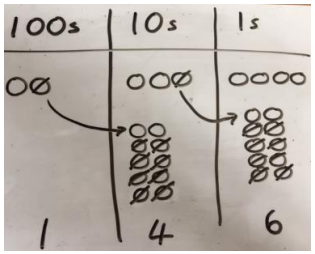
Subtraction

Key Vocabulary
Take away, less than, the difference, subtract, minus, fewer, decrease

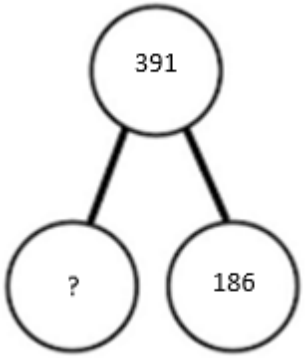
	Concrete	Pictorial	Abstract
Year 1 **Subtracting numbers within 10 (can be extended to numbers up to 20)**	**Physically taking away and removing objects from a whole** (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 – 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	4 - 3 = 1 1 = 4 – 3  
Year 1 **Subtracting numbers within 10 (can be extended to numbers up to 20)**	**Counting back** (using number lines or number tracks) children start with 6 and count back 2. 6 – 2 = 4  	Children to represent what they see pictorially e.g.  	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  

Year 1 **Finding the difference between numbers (up to 20)**	**Finding the difference** (using cubes, Numicon or Cuisenaire rods, other objects can also be used). Calculate the difference between 8 and 5**.** 	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to **calculate.** 	Find the difference between 8 and 5. 8 – 5, the difference is ____ Children to explore why 9 - 6 = 8 – 5 = 7 – 4 have the same difference.
Year 1 **Subtracting numbers within 20 (crossing 10)**	**Making 10** using ten frames (or other appropriate resources) 14 – 5 	Children to present the ten frame pictorially and discuss what they did to make 10 . 	Children to encouraged to show how they can make 10 by partitioning the subtrahend.   14 – 4 = 10 10 – 1 = 9
Year 2 **Subtracting numbers**	**Column method** using base 10 (or other appropriate resources) 48-7	Children to represent the base 10 pictorially.	Subtracting by counting back.

within 100 (no regrouping)			
Year 2 **Subtracting numbers within 100 (with regrouping)**	**Column method** using base 10 (or other appropriate resources) and having to exchange. 41 – 26  Display 41 using dienes. Exchange one of the tens for ones and move to the ones column Subtract the six ones from the ones column and then the two tens from the tens column.	Represent the base 10 pictorially, remembering to show the exchange. 	Written method.
Years 3 – 6 **Subtraction of larger numbers** N.B. This same method can be used. However, the	**Column method** using place value counters (or other appropriate resources). 234 – 88	Represent the place value counters pictorially; remembering to show what has been exchanged.	Pupils to use formal column method. Children must understand what has happened when they have crossed out digits (exchanged).

number of digits will increase as pupils progress through the year groups.			$\begin{array}{r} {}^{2}\not{3}\,{}^{1}4 \\ -\ 88 \\ \hline 6 \end{array}$

Conceptual variation; different ways to ask children to solve 391 - 186



391	
186	?

Raj spent £391, Timmy spent £186. How much more did Raj spend?

Calculate the difference between 391 and 186.

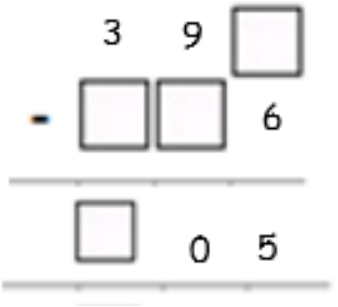
There is a total of 391 ducks. 186 of them flew away, how many remain?

= 391 – 186

$$\begin{array}{r} 391 \\ -186 \\ \hline \\ \hline \end{array}$$

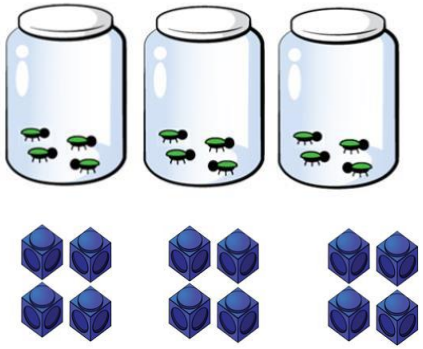
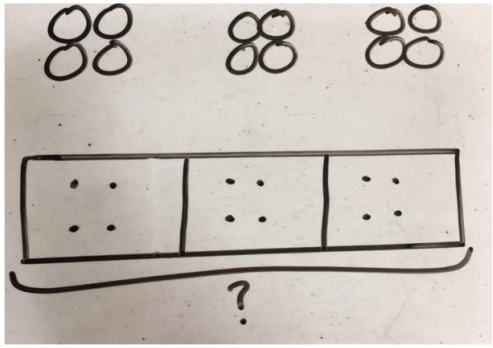
What is 186 less than 391?

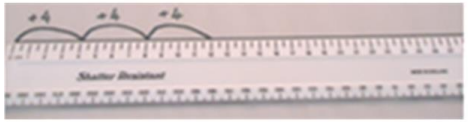
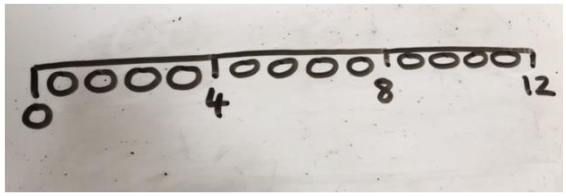
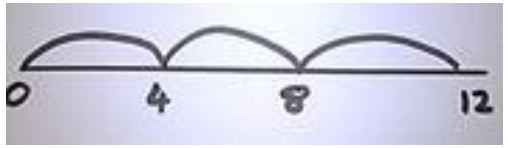
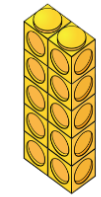
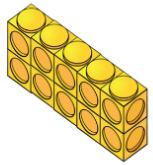
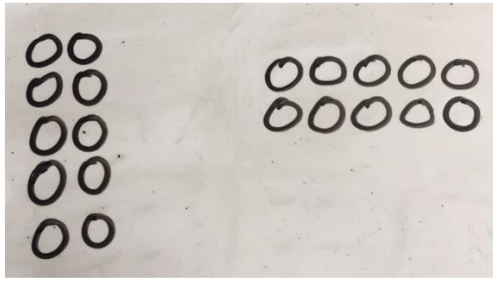
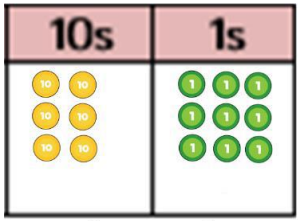
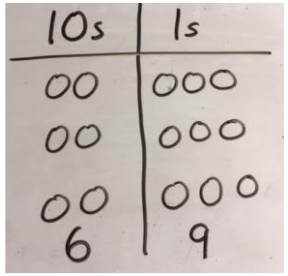
Missing digit calculations



Multiplication

Key Vocabulary
Double, times, multiplied by, the product of, groups of, lots of equal groups

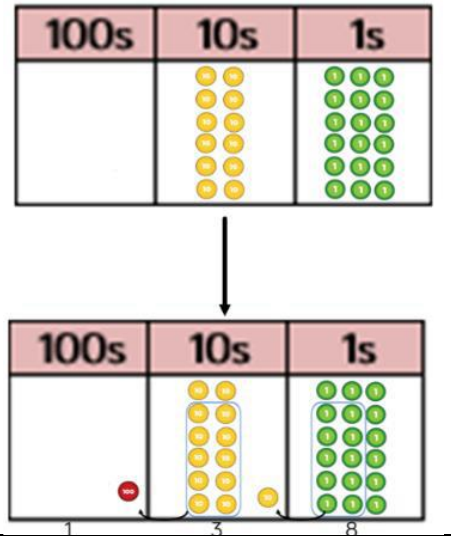
	Concrete	Pictorial	Abstract
Years 1 - 3 **Multiplication through repeated addition**	**Repeated grouping/repeated addition** 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group. 	Children to represent the practical resources in a picture and use a bar model.  As pupils progress and develop their understanding, they may start to represent in other forms of bar models. For example: 12 4 | 4 | 4	Pupils should be able to show their working out as both a multiplication calculation and repeated addition (the link between the 2 calculations should be reinforced). 3 × 4 = 12 4 + 4 + 4 = 12

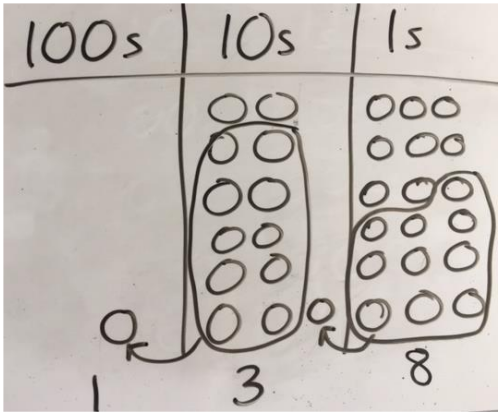
Years 1 – 3 **Multiplication through repeated addition (number line method)**	**Number lines to show repeated groups**- 3 × 4   Cuisenaire rods can be used too.	Represent this pictorially alongside a number line e.g.: 	Abstract number line showing three jumps of four. 3 × 4 = 12 
Years 1 – 4 **Multiplication through arrays**	**Use arrays to illustrate commutativity counters.** Other objects can also be used. 2 × 5 = 5 × 2  2 lots of 5  5 lots of 2	Children to represent the arrays pictorially. 	Children to be able to use an array to write a range of calculations e.g. 10 = 2 × 5 5 × 2 = 10 2 + 2 + 2 + 2 + 2 = 10 10 = 5 + 5
Year 3 – 6 **Multiplying a 2/3/4-digit number by a 1-digit number (no regrouping)**	**Formal column method with place value counters** (or other appropriate resources). 3 × 23  6 9	Children to represent the counters pictorially. 	Children to record using a formal written method. 23 × 3 69 They may also be encouraged to show their working out in a variety of ways (e.g. using the distributive law) 23 x 3 → 20 x 3 = 60, 3 x 3 = 9 → 69

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr>
<td>Years 3 – 6

Multiplying a 2/3/4-digit number by a 1-digit number (with regrouping)</td>
<td>Formal column method with place value counters (or other appropriate resources).

6 x 23

 
</td>
<td>Children to represent the counters/base 10, pictorially e.g. the image below.

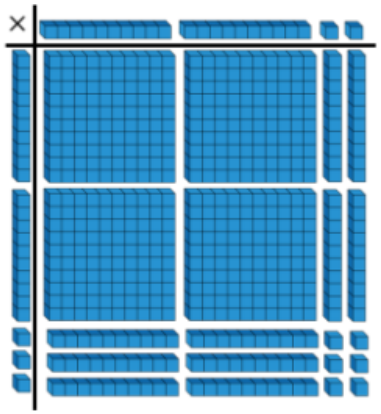
 
</td>
<td>Formal written method

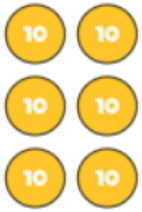
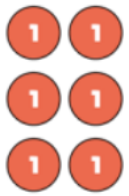
6 x 23 =

23
× 6
138
1 1</td>
</tr>
<tr>
<td>Years 5 – 6

Multiplying two 2-digit numbers</td>
<td>Area model with base ten (or other appropriate resources)

22 x 23 =

 
</td>
<td>Pupils represent pictorially using counters (or similar)

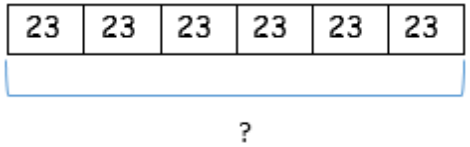
<table>
<tr><td>x</td><td>20</td><td>2</td></tr>
<tr><td>20</td><td>  </td><td>  </td></tr>
<tr><td>3</td><td>  </td><td>  </td></tr>
</table></td>
<td>Area model filled out with numbers

<table>
<tr><td>x</td><td>20</td><td>2</td></tr>
<tr><td>20</td><td>400</td><td>40</td></tr>
<tr><td>3</td><td>60</td><td>6</td></tr>
</table>

400 + 60 + 40 + 6 = 506</td>
</tr>
</table>

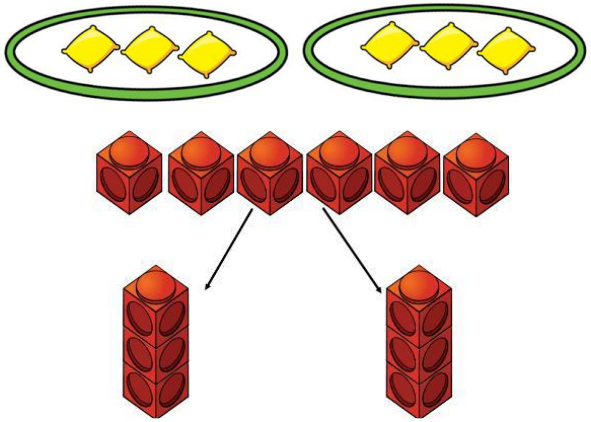
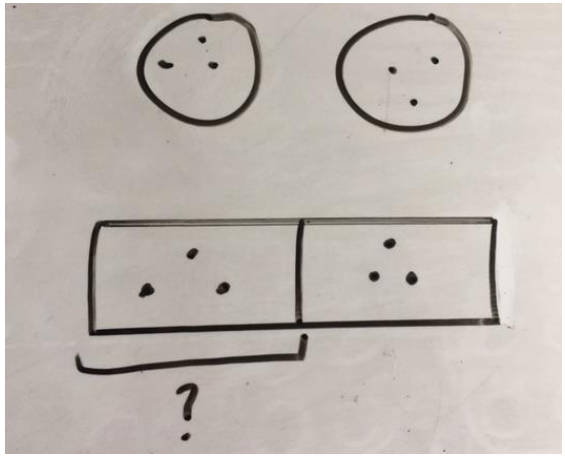
Years 5 – 6	When children start to multiply 3d × 3d and 4d × 2d etc., they should be confident with the abstract: To get 744 children have solved 6 × 124. To get 2480 they have solved 20 × 124.	1 2 4 × 2 6 7 4 4 1 2 2 4 8 0 3 2 2 4 1 1 Answer: 3224

Conceptual variation; different ways to ask children to solve 6 x 23

	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 Eddy says that 6 x 23 is 140. Is he correct? How do you know?	Find the product of 6 and 23 6 × 23 = = 6 × 23 6 × 23 = ____ 23 × 6 = ____	What is the calculation? What is the product 

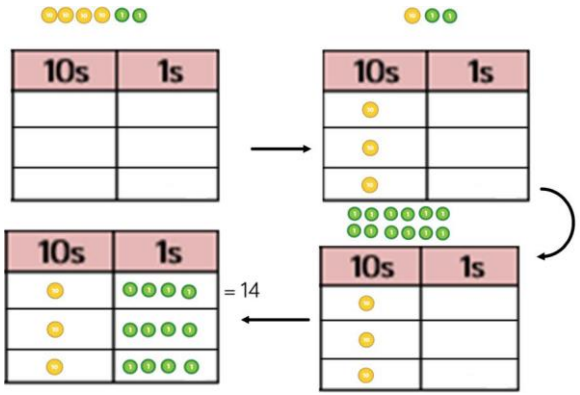
Division

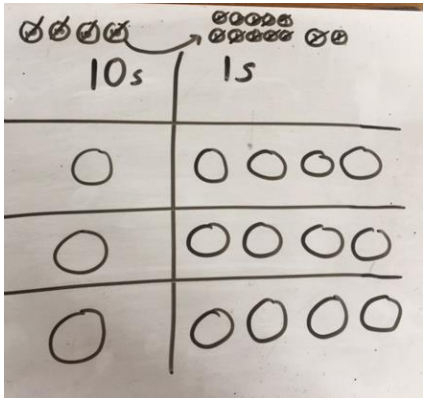
Key Vocabulary
Share, group, divide, divided by, half, quotient

	Concrete	Pictorial	Abstract
Years 1 – 4 Making equal groups (sharing)	**Sharing using a range of objects**. 6 ÷ 2 	Represent the sharing pictorially. 	Write the calculation and encourage pupils to show it in a variety of ways. 6 ÷ 2 = 3 3 | 3 6 3 | 3 Children should also be encouraged to use their 2 times tables facts.
Years 1 – 4 Making equal groups (grouping)	**Grouping** using a range of objects How many groups of 2 can you make using 8 mittens? 	Represent grouping pictorially. X X X X X X X X	Write the calculation and encourage pupils to show it in a variety of ways. 8 ÷ 2 = 4 8 mittens split into groups 2 makes 4 equal groups. 8 2 | 2 | 2 | 2

<table>
<tr>
<td>Years 3 – 4

Dividing larger numbers by sharing into groups</td>
<td>Sharing using place value counters.
42 ÷ 3 = 14

 
</td>
<td>Children to represent the place value counters pictorially.

 
</td>
<td>Pupils write the calculation and may show their working out in a variety of ways.

42 ÷ 3 = 14

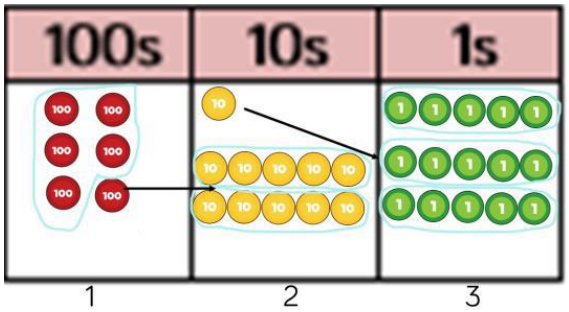
<table>
<tr><td colspan="3">42</td></tr>
<tr><td>14</td><td>14</td><td>14</td></tr>
</table>

42 split into 3 equal groups is 14 in each group.</td>
</tr>
<tr>
<td>Years 5 – 6

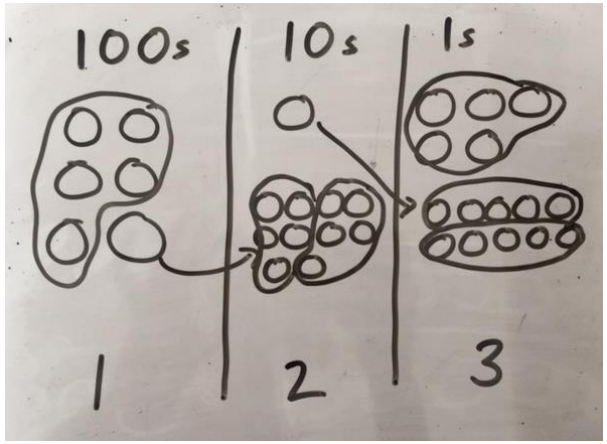
Short Division

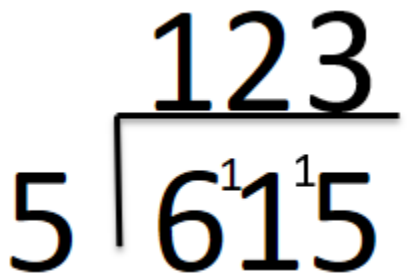
(This may also be taught as an efficient method in Years 3 and 4 after pupils have secured a deep understanding of previous methods)</td>
<td>Short division using place value counters to group.

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?</td>
<td>Represent the place value counters pictorially.

 
</td>
<td>Children to write the calculation using the short division scaffold.

 
</td>
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<tr><td></td><td></td><td></td><td></td></tr>
</table>

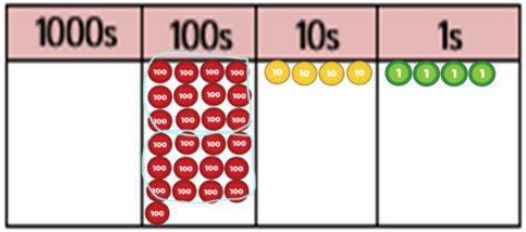
Year 6

Long Division

Long division using place value counters

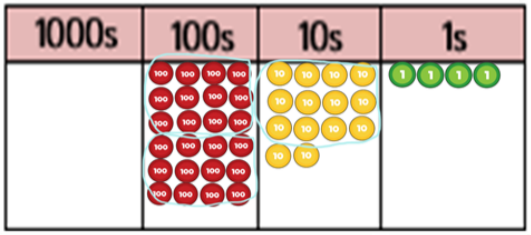
2544 ÷ 12

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



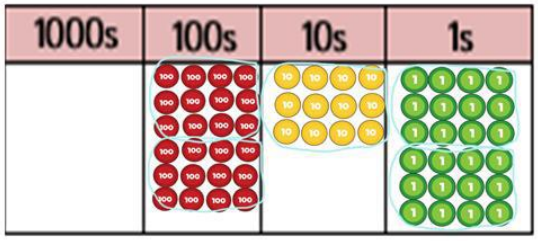
We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

$$\begin{array}{r} 02 \\ 12\overline{)2544} \\ 24 \\ \hline 1 \end{array}$$



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

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

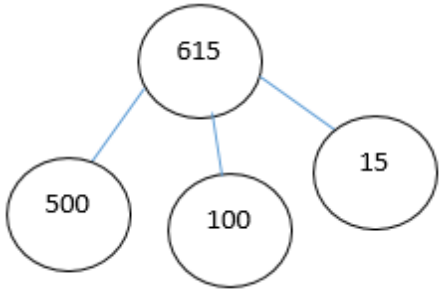


After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

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

Conceptual variation; different ways to ask children to solve 615 ÷ 5

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?