Kingsfield Primary School

A member of the Active Learning Trust

Statement / Policy Summary		**Equalities Impact Statement**	
This is our school's calculation policy.		Has this policy fully considered the school's equality objectives and statement?	Yes
Date ratified:	Is there any impact upon the school's equality objectives?	Is there any impact upon the school's equality objectives?	No
Date of review:	If 'yes', are these clearly described and their impact assessed?	If 'yes', are these clearly described and their impact assessed?	N/A

Introduction

This policy introduces key concepts using a concrete-pictorial-abstract approach.

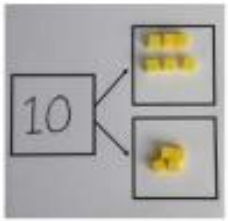
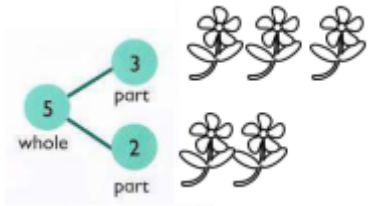
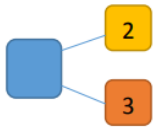
The use of concrete resources and visuals underpins this calculation policy and underpins Mathematic lessons at Kingsfield Primary School.

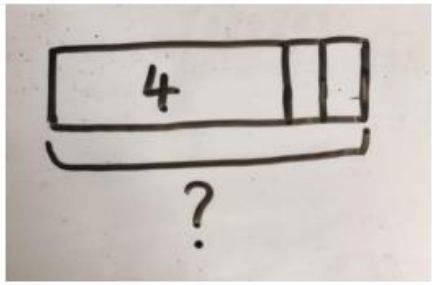
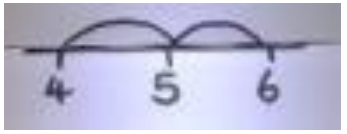
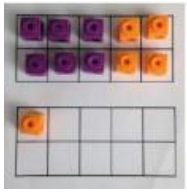
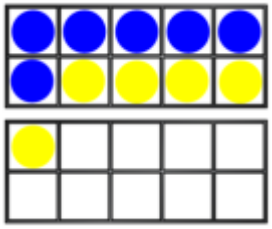
The policy details:

- Addition
- Subtraction
- Multiplication
- Division

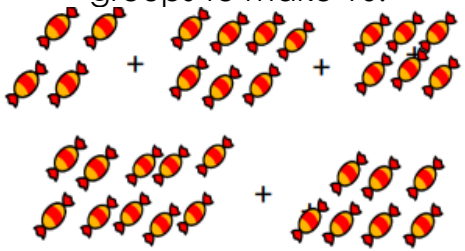
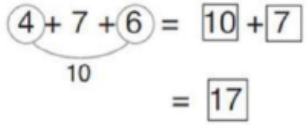
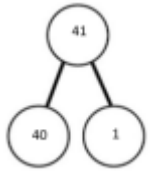
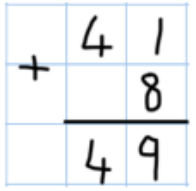
Each operation is broken down into skills for each year group and shows recommended models and visuals to support the teaching of the corresponding concepts alongside. Suggestions are also given for conceptual variation (Five Big Ideas of Mastery, NCETM).

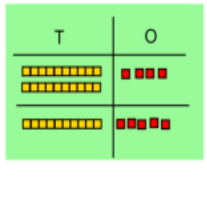
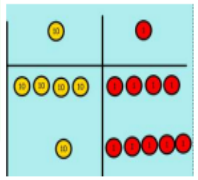
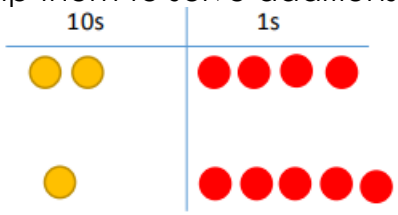
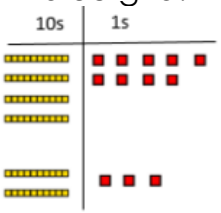
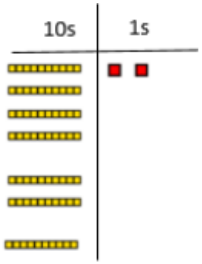
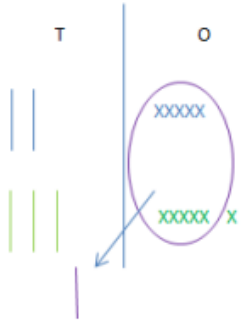
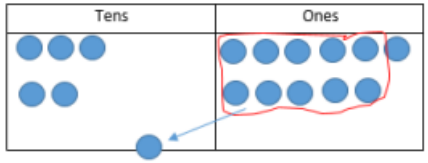
Calculation Policy: Addition

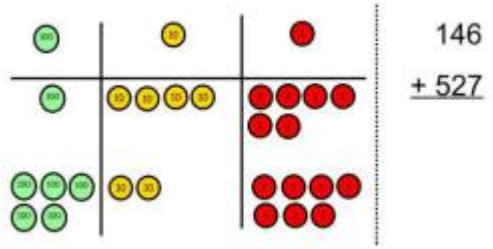
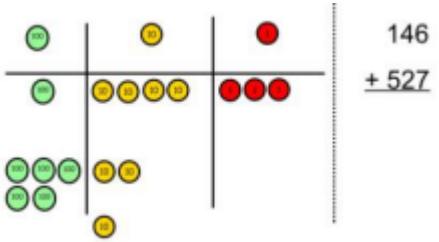
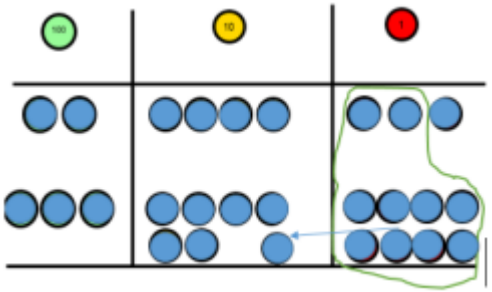
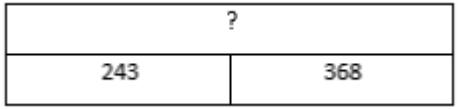
	Objective	Concrete	Pictorial	Abstract
Year 1	Combine two parts to make a whole	   Use cubes to add two numbers together as a group or in a bar. 	Use pictures to add two numbers together as a group or in a bar.  	2 + 3 = 5 3 + 2 = 5 5 = 3 + 2 5 = 2 + 3  Use the part-part-whole diagram as shown above to move into the abstract.

	Counting on	Count on using bead strings, cubes or Numicon:   	Use a number line to count on in ones:  Use 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 4 and 4? What's the total of 4 and 2? 4 + 2 
	Regrouping to make 10	  6 + 5 = 11 Start with the bigger number and use the smaller number to make 10.	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. 6 + □ = 11 6 + 5 = 5 + □ 6 + 5 = □ + 4

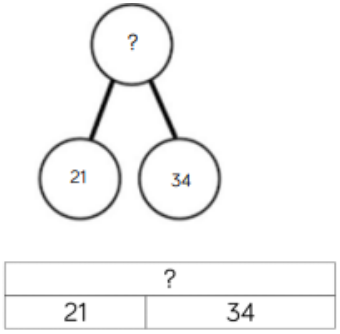
<table>
<tr><td rowspan="2">Year 2</td><td>Adding 3 single digit numbers</td><td>4 + 7 + 6= 17

Put 4 and 6 together to make 10.
Add on 7.
 
Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.</td><td>Add together three groups of objects.
Draw pictures to combine the groups to make 10.
  </td><td>Combine the two numbers that make 10 and then add on the remainder.
  </td></tr>
<tr><td>Add a two-digit number and ones</td><td>Continue to develop understanding of partitioning and place value.
  </td><td>Children to represent the concrete using a particular symbol e.g. lines for tens and dot/crosses for ones.
  </td><td>41 + 8
1 + 8 = 9
40 + 9 = 49
 
  </td></tr>
</table>

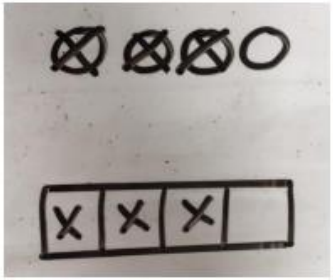
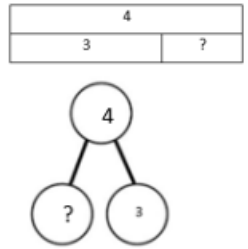
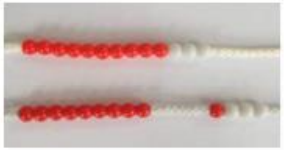
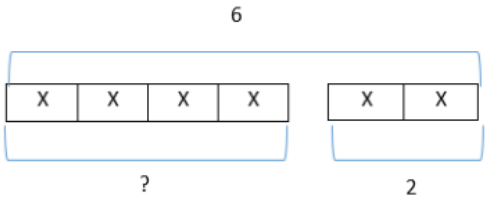
	Add two two-digit numbers (without regrouping)	Add together the ones first, then add the tens. Use the Base 10 blocks first before moving onto place value counters. 24 + 15 =  44 + 15 = 	Children can draw the counters to help them to solve additions.  	24 + 15 = 39 24 + 15 39
	Add two two-digit numbers (with regrouping)	Make both numbers on a place value grid.  Add up the units and exchange 10 ones for 1 ten.  	  	Look for ways to make 10: 36 + 25 = 30 + 20 = 50 5 + 5 = 10 50 + 10 + 1 = 61 Formal method: 36 +25 61 1

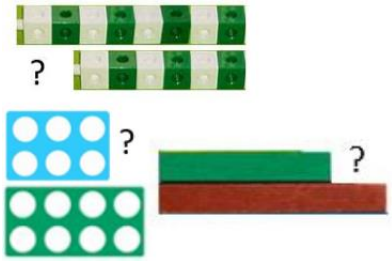
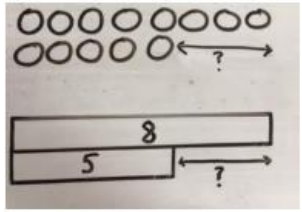
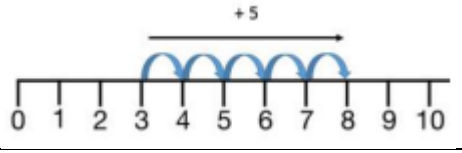
Year 3/4	Column method with regrouping	Make both numbers on a place value grid.  Add up the ones and exchange 10 ones for 1 ten.  As children move on to decimals, money and decimal place value counters can be used to support learning. Please note: By Year 4, children will progress to add four-digit numbers.	Children to represent the counters in a place value chart, circling when they make an exchange:  If the children are completing a word problem, encourage them to draw a bar model to represent what it's asking them to do.  	243 +368 611 1 1

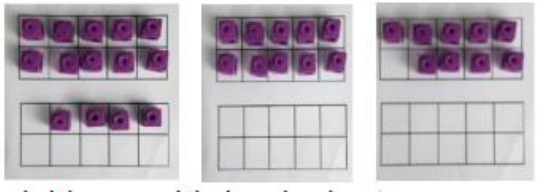
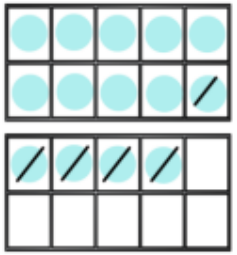
Year 5/6	Column method with regrouping	Consolidate understanding using numbers with more than 4 digits and extend by adding numbers with up to 3 decimal places.

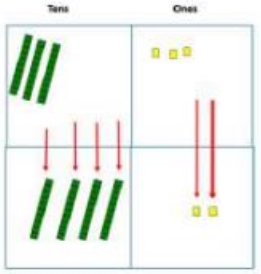
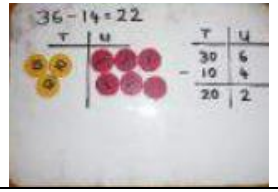
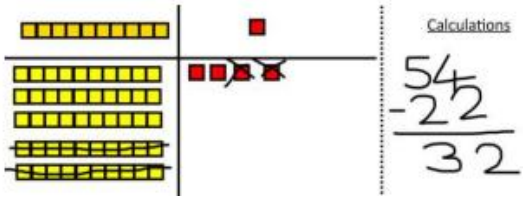
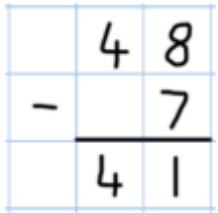
Conceptual variation; different ways to ask children to solve 21 + 34			
	Word problems: In year 3, there are 21 children and in year 4, there are 34 children. How many children in total? 21 + 34 = 55. Prove it	21 +34 —— 21 + 34 = □ = 21 + 34 Calculate the sum of twenty-one and thirty-four.	 Missing digit problems: 

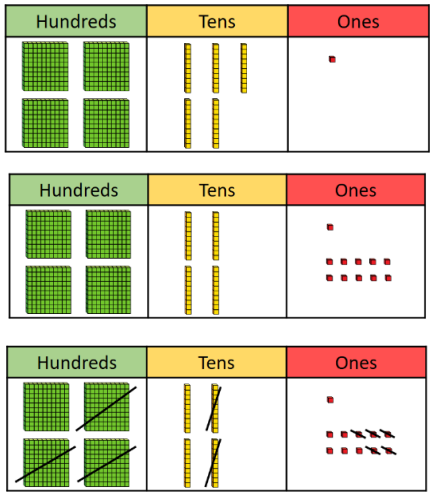
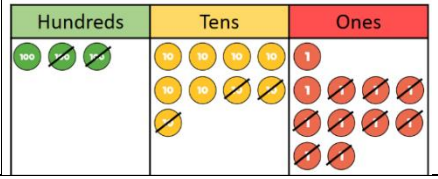
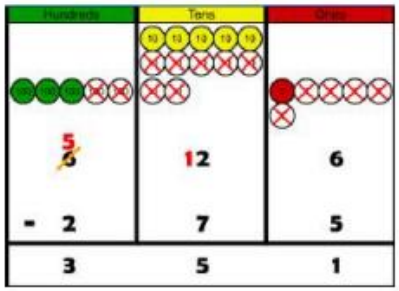
Calculation Policy: Subtraction

	Objective	Concrete	Pictorial	Abstract
Year 1	Take away ones	Use physical objects, counters, cubes etc. to show how objects can be taken away. 	Cross out drawn objects to show what has been taken away. 	4 - 3 = □ = 4 - 3 
	Count back	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones. 13 – 4 = 9  Use number lines or number tracks: 	Children to represent what they see pictorially e.g. 	

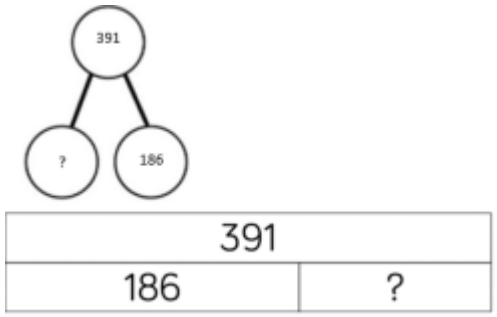
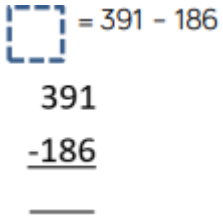
	Find the difference	Compare amounts and objects (cubes, Numicon or Cuisenaire rods) to find the difference.  	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate.  They use number lines to find the difference.  	Find the difference between 8 and 5. 8 – 5, the difference is… Children to explore why 9 - 6 = 8 – 5 (the difference of each digit has changed by 1 so the difference is the same – this will help when solving 10000 - 9987 etc.)

	Make 10	Children use Numicon or ten frames to make 10 when subtracting: 14 – 5  Children could also do this by subtracting a 5 from the 10. 	Children to present the ten frame pictorially and discuss what they did to make 10. 	Children to show how they can make 10 by partitioning the subtrahend. 14 – 5 = 14 – 4 = 10 10 – 1 = 9 14 – 5 = 9

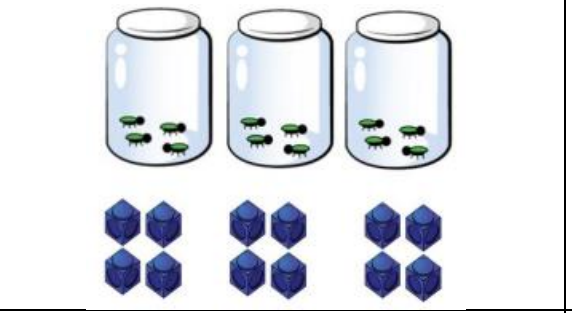
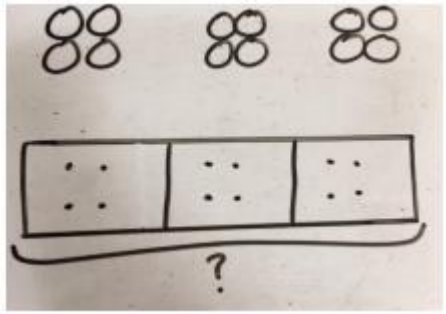
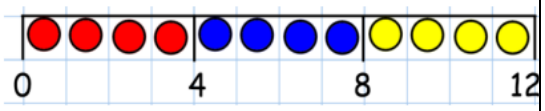
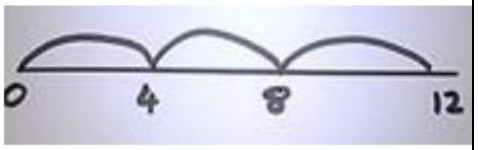
Year 2	Column method without regrouping	Use Base 10 to make the bigger number then take the smaller number away: 75 – 42 = 33  Partition numbers to subtract:  	Children draw the Base 10 or place value counters alongside the written calculation to help to show working.  	

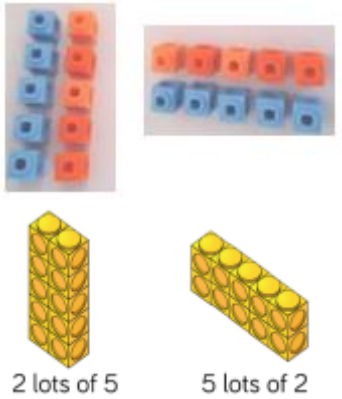
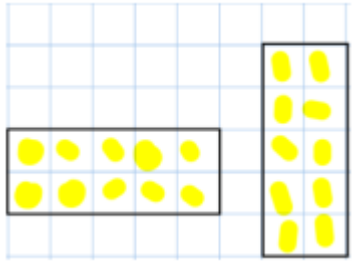
Year 3/4	Column method with regrouping	Children use Base 10 to solve subtraction problems before moving on to place value counters: 451 – 325 =  401 – 239 =  	Draw the counters onto a place value grid and show what has been taken away by crossing the counters out as well as clearly showing the exchanges made.  	Formal column method. Children must understand what has happened when they have crossed out digits. $\begin{array}{r} {}^{2}\not{2}{}^{1}\not{3}4 \\ -\ 88 \\ \hline 6 \end{array}$

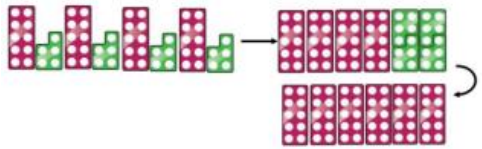
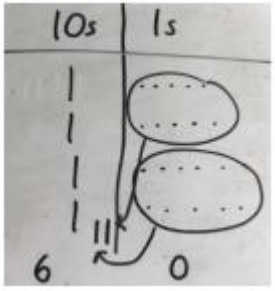
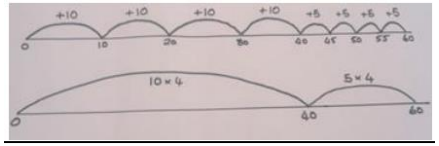
Year 5/6	Column method with regrouping	Consolidate understanding using numbers with more than 4 digits and extend by subtracting numbers with up to 3 decimal places.

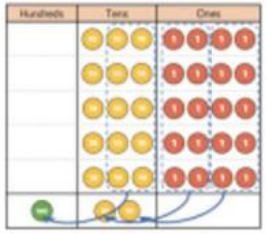
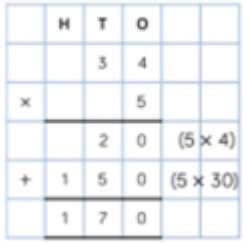
Conceptual variation; different ways to ask children to solve 391 - 186			
	Raj spent £391, Timmy spent £186. How much more did Raj spend? Calculate the difference between 391 and 186.	 What is 186 less than 391?	Missing digit calculations: 

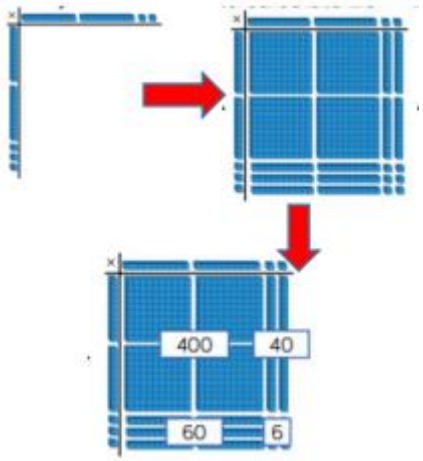
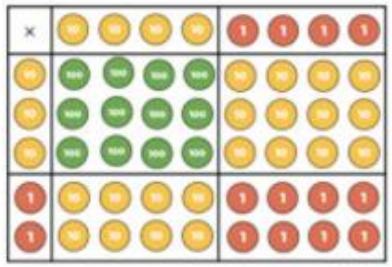
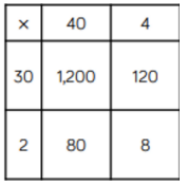
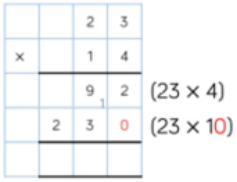
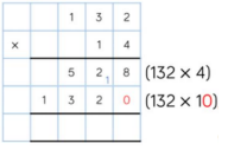
Calculation Policy: Multiplication

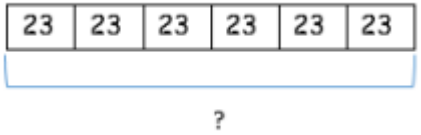
	Objective	Concrete	Pictorial	Abstract
Year 1/2	Repeated grouping/ repeated addition	 	Children to represent the practical resources in a picture and use a bar model. 	3 × 4 = 12 4 + 4 + 4 = 12
	Number lines to show repeated groups	 	Represent this pictorially alongside a number line: 	3 x 4 = 12 

	Arrays to illustrate commutativity	Create arrays using counters/cubes to show multiplication sentences.  	Children to draw the arrays: 	Children to be able to use an array to write a range of calculations e.g. 2 x 5 = 10 5 x 2 = 10 2 + 2 + 2 + 2 + 2 = 10 5 + 5 =10

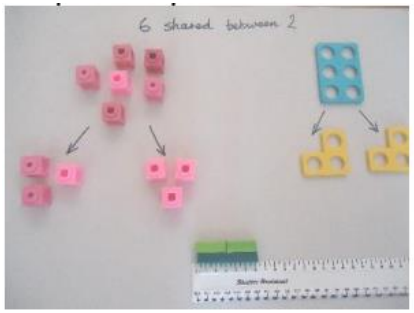
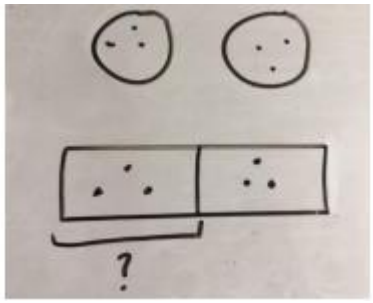
Year 3	Partition to multiply	Use Numicon, base 10 or Cuisenaire rods. 	Children to represent the concrete manipulatives pictorially. 	Children to be encouraged to show the steps they have taken: 4 x 15 10 x 4 = 40 5 x 4 = 20 40 + 20 = 60 A number line can also be used: 
Year 3/4	Multiplication by a single digit	3 x 23. Make 23, 3 times. See how many ones, then how many tens. 	Children to represent the Base 10/counters pictorially. 	3 x 23 = 3 x 20 = 60 3 x 3 = 9 60 + 9 = 69

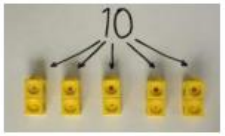
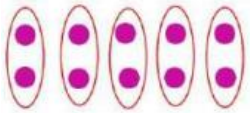
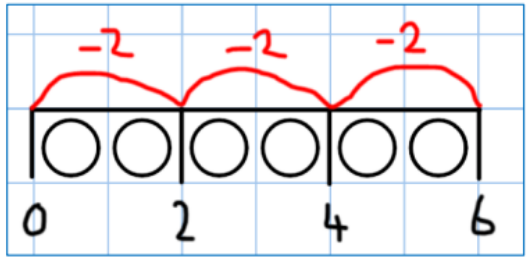
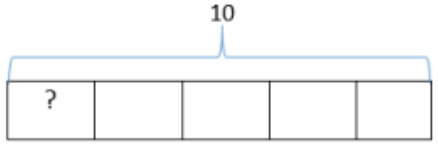
	Formal column method	245 x 4 =  	Children can represent their work with place value counters in a way that they understand. They use their knowledge of exchanging ten ones for one ten in addition and apply this to multiplication, including exchanging multiple groups of 10. 	 Move from expanded method to a compact method. 

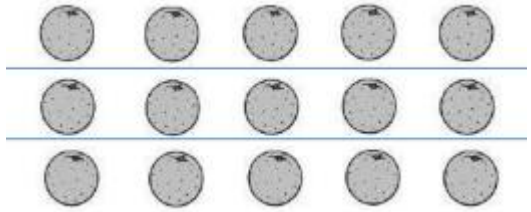
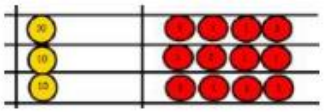
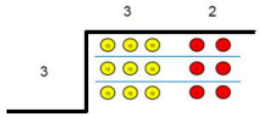
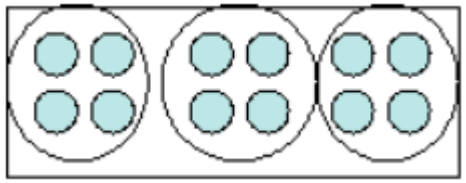
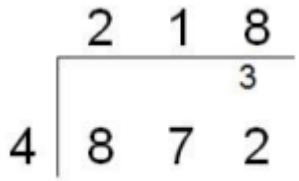
Year 5/6	Multiplication by 2-digits	Children use Base 10 to represent the area model of multiplication which will enable them to see the size and scale linked to multiplication. 23 x 22 =  	Children represent multiplication with place value counters which can also be drawn. 44 x 32 = 	44 x 32 =  Children will move on from the area model and work towards more formal methods. They will start by exploring the role of the zero in the column method and understanding its importance.  Children will extend their multiplication skills to multiplying 3 and 4-digit numbers by 2-digit numbers. 

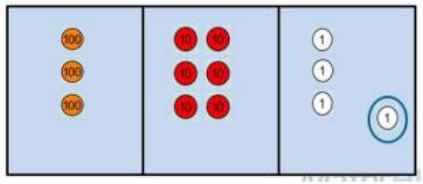
Conceptual variation; different ways to ask children to solve 6 × 23			
	Mai had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week? With place value counters, prove that 6 x 23 = 138.	Find the product of 6 and 23 6 × 23 = ___ = 6 x 23 6 × 23 = ___ 23 × 6 = ___	What is the calculation? What is the product? 

Calculation Policy: Division

	Objective	Concrete	Pictorial	Abstract
Year 1/2	Sharing using a range of objects.	6 shared between 2 	Represent the sharing pictorially: 	6 ÷ 2 = 3 3 | 3

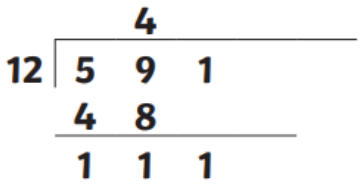
	Understand division as repeated grouping and subtracting	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.  	.Number line:  Bar model:  10 ÷ 5 = ? 5 x ? = 10	10 ÷ 5 = 2 Divide 10 into 5 groups. How many are in each group?

<table>
<tr><td rowspan="2">Year 3/4</td><td>Division with arrays</td><td>Link division to multiplication by creating an array and thinking about the number sentences that can be created.
E.g. 15 ÷ 3 = 5
5 x 3 = 15
15 ÷ 5 = 3
3 x 5 = 15
  </td><td> 
Draw an array and use lines to split the array into groups to make multiplication and division sentences.</td><td>Find the inverse of multiplication and division sentences by creating four linking number sentences.
5 x 3 = 15
3 x 5 = 15
15 ÷ 5 = 3
15 ÷ 3 = 5</td></tr>
<tr><td>Short division</td><td>Use place value counters to divide using the short division method alongside.
96 ÷ 3
 
  </td><td>Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.
 
Encourage them to move towards counting in multiples to divide more efficiently.</td><td>Begin with divisions that divide equally with no remainder:
  </td></tr>
</table>

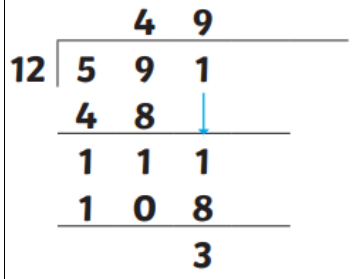
Year 5/6	Short division with remainders	364 ÷ 3 = 1 2 1 rem 1 3 | 3 6 4 	Children can draw place value counters to represent division.	Move onto divisions with a remainder. Once children understand remainders, begin to express as a fraction or decimal according to the context. 8 6 r 2 3 5 | 4 3 2 1 8 6 1/5 5 | 9 ⁴3 ³1 1 4 . 6 16 21 3 5 | 5 1 1 . 0

Year 6	Long division	

591 ÷ 12

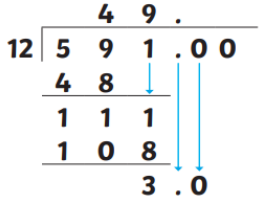


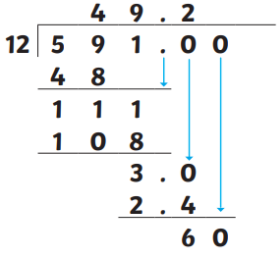
First, work out how many 12s there are in 59. The answer to this question is 4, which is written above the 9. We then write the product of 4 and 12 (48) under 59 and subtract, leaving 11. The 1 is then brought down and written next to 11 to make 111.

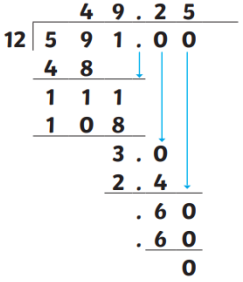


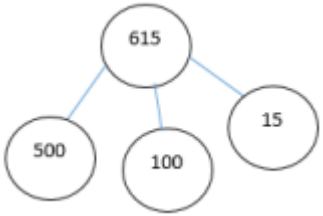
Next, work out how many 12s there are in 111. The answer to this question is 9, which is written above the 1. Then, write the product of 9 and 12 (108) under 111 and subtract it, leaving 3.

We can write 3 as a remainder or continue the long division method to calculate the remainder as a decimal:







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?