

Years 1 to 6

Calculation Policy



White
Rose
Maths



Horbury Bridge CE J&I Academy Calculation Policy (Adapted from White Rose Maths)



This policy has been adapted from White Rose Maths schemes used throughout our school. Progression within each area of calculation is in line with the programme of study in the 2014 National Curriculum. This calculation policy will support children to develop a deep understanding of number and calculation as they progress through school. It has been designed to teach children through the use of concrete, pictorial and abstract representations.

Concrete representation— a pupil is first introduced to an idea or skill by acting it out with real objects. This is a ‘hands on’ component using real objects and is a foundation for conceptual understanding.

Pictorial representation— a pupil has sufficiently understood the ‘hands on’ experiences performed and can now relate them to representations, such as a diagram or picture of the problem.

Abstract representation— a pupil is now capable of representing problems by using mathematical notation, for example $12 \times 2 = 24$.

It is important that conceptual understanding, supported by the use of representation, is secure for all procedures. Reinforcement is achieved by going back and forth between these representations.

Children will be able to select an efficient method (whether this be mental or written) that is appropriate for a given task. They will do this by always asking themselves:

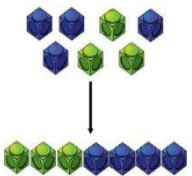
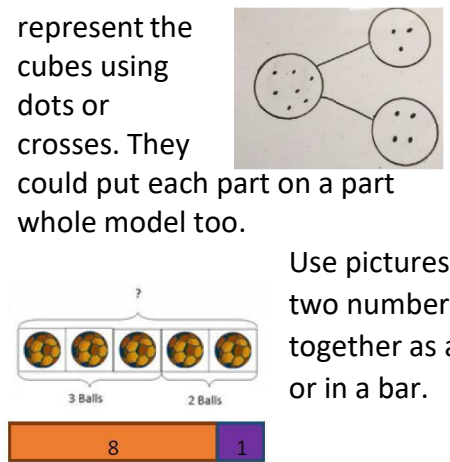
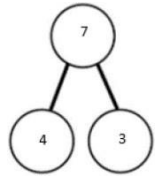
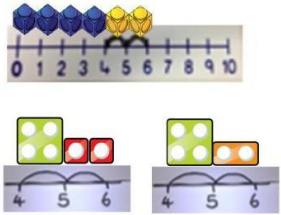
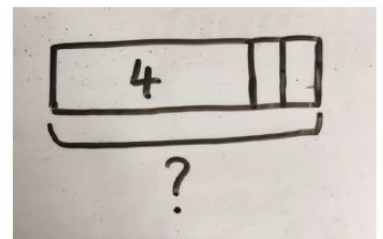

‘Can I do this in my head?’

‘Can I do this in my head using drawings or jottings?’

‘Do I need to use a written method?’

Addition

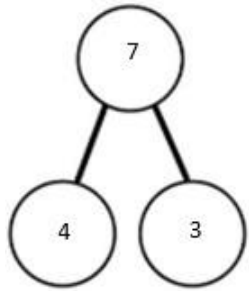
Key language: sum, total, parts and wholes, plus, add, altogether, more, 'is equal to' 'is the same as'.

Addition			
Key language: sum, total, parts and wholes, plus, add, altogether, more, 'is equal to' 'is the same as'.			
	Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole: Part Whole Model</p>	<p>use other resources too e.g. shells, teddy bears, cars</p> 	<p>Children to represent the cubes using dots or crosses. They could put each part on a part whole model too.</p>  <p>Use pictures to add two numbers together as a group or in a bar.</p>	<p>$4 + 3 = 7$</p> <p>Four is a part, 3 is a part and the whole is seven.</p>  <p>Ensure calculations are also done where the answer is in different places. E.g</p> <p><input style="width: 30px; height: 20px;" type="text"/> = $4 + 3$</p>
<p>Starting at the bigger number and counting on.</p> <p>Counting on using number lines</p>	<p>Use cubes or numicon.</p> 	<p>A bar model which encourages the children to count on, rather than count all.</p> 	<p>The abstract number line:</p> <p>What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2?</p> <p>$4 + 2$</p> 

<p>Regrouping to make 10 using ten frame. <i>This is an essential skill for column addition later.</i></p>	<p>Using ten frames and counters/cubes or using Numicon. $6 + 5$</p>	<p>Children to draw the ten frame and counters/cubes.</p>	<p>Children to develop an understanding of equality e.g.</p> $6 + \square = 11$ $6 + 5 = 5 + \square$ $6 + 5 = \square + 4$
<p>Adding three single digits.</p>	<p>Using ten frames and counters/cubes or using numicon. $7 + 3 + 2 =$ leads to $10 + 2 =$</p>	<p>Children to draw the ten frame and counters/cubes. $7 + 3 + 2 = 12$</p>	<p>Combine the two numbers that make or bridge 10 and then add on the third number.</p> $\begin{array}{c} \textcircled{4} + 7 + \textcircled{6} = \boxed{10} + \boxed{7} \\ 10 \\ = \boxed{17} \end{array}$
<p>Use of base 10 to combine two numbers. TO + O using base 10.</p>	<p>Continue to develop understanding of partitioning and place value. $41 + 8$</p>	<p>Children to represent the base 10 e.g. lines for tens and dot/crosses for ones.</p>	<p>$41 + 8$</p> <p>$1 + 8 = 9$ $40 + 9 = 49$</p>

<p>Column method-regrouping.</p> <p>e.g. TO + TO using base 10.</p>	<p>Continue to develop understanding of partitioning and place value using Dienes or Place Value counters.</p> <p>$36 + 25$</p>	<p>Children to represent the base 10 in a place value chart.</p>	<p>Partitioning</p> $36 + 25 = 30 + 6$ $= 20 + 5$ $50 + 11 = 61$ <p>Formal Method</p> $\begin{array}{r} 1 \\ 36 \\ + 25 \\ \hline 61 \end{array}$
<p>Column method-regrouping.</p> <p>e.g. Use of place value counters to add HTO + TO, HTO + HTO etc.</p> <p>Use of place value counters for adding decimals.</p>	<p>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.</p> <p>$243 + 368$</p>	<p>Children to represent the counters in a place value chart, circling when they make an exchange.</p>	<p>Partitioning if needed</p> $243 + 368 = 200 + 40 + 3$ $300 + 60 + 8$ $500 + 100 + 11 = 611$ <p>Formal Method</p> $\begin{array}{r} 11 \\ 243 \\ + 368 \\ \hline 611 \end{array}$

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



?	
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

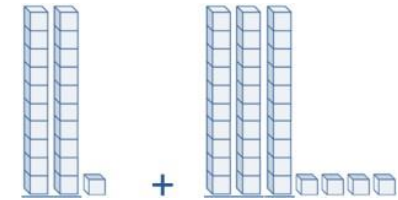
21

+34

—

$21 + 34 =$

 $= 21 + 34$

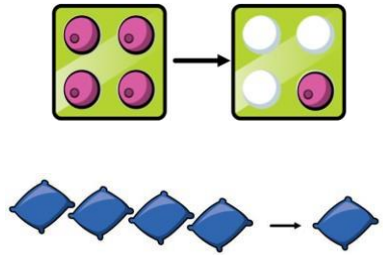
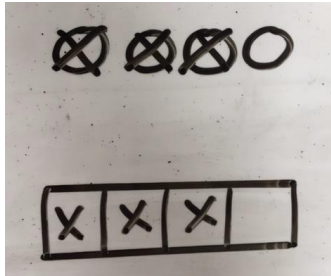
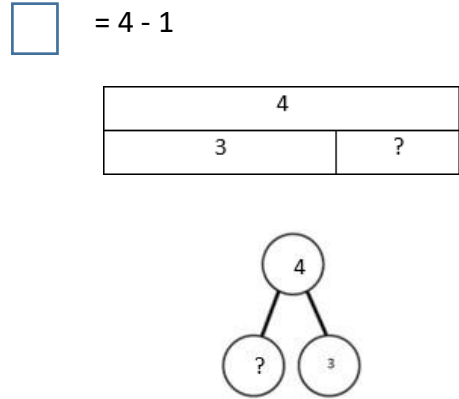
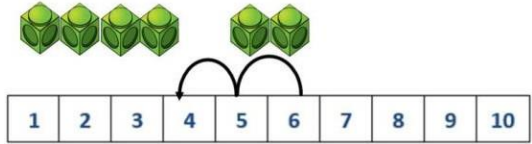
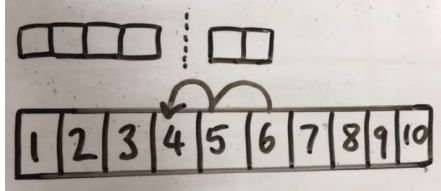
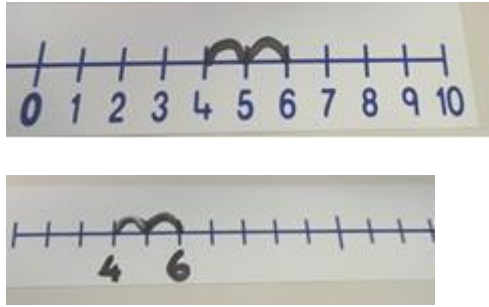


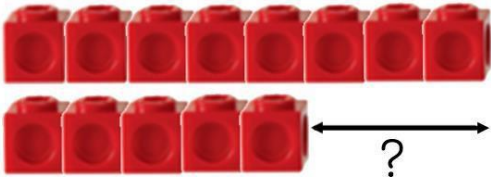
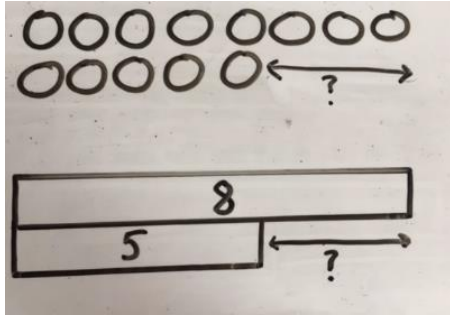
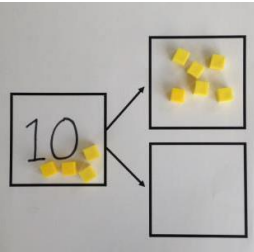
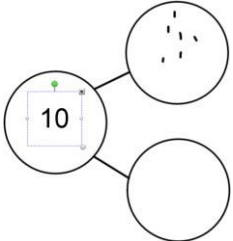
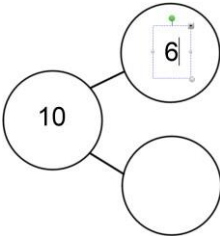
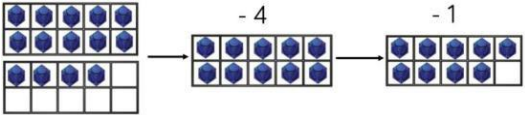
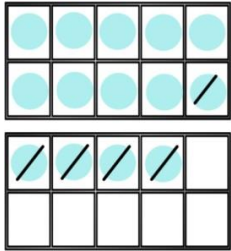
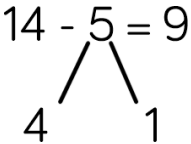
Missing digit problems:

10s	1s
	?
?	5

Subtraction

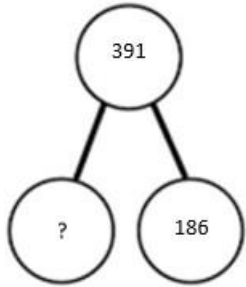
Key language: take away, less than, the difference, subtract, minus, fewer, decrease.

Subtraction			
	Concrete	Pictorial	Abstract
<p>Taking away ones</p> <p>Physically taking away and removing objects from a whole</p>	<p>Ten frames, Numicon, cubes and other items such as beanbags could be used.</p> <p>$4 - 3 = 1$</p> 	<p>Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used.</p> 	<p>$4 - 3 =$</p> <p><input style="width: 20px; height: 20px;" type="text"/> = $4 - 1$</p> 
<p>Counting back</p>	<p>Using number lines or number tracks Children start with 6 and count back 2.6</p> <p>$- 2 = 4$</p> 	<p>Children to represent what they see pictorially e.g.</p> 	<p>Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line</p> 

<p>Finding the difference</p>	<p>Using cubes, Numicon or other objects can also be used.</p> <p>Calculate the difference between 8 and 5.</p> 	<p>Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate.</p> 	<p>Find the difference between 8 and 5.</p> <p>$8 - 5$, the difference is <input type="text"/></p> <p>Children to explore why $9 - 6 = 8 - 5 = 7 - 4$ have the same difference.</p>
<p>Part Whole model</p>	<p>Link to addition. Use PPW model to model the inverse.</p> 	<p>Children to draw the PPW model to illustrate what they need to calculate.</p> 	<p>Move to using numbers within the PPW model.</p> 
<p>Making 10 using the 10 frame</p>	<p>Using ten frames.</p> <p>$14 - 5$</p> 	<p>Children to present the ten frame pictorially and discuss what they did to make 10.</p> <p>$14 - 5$</p> 	<p>Children to show how they can make 10 by partitioning the subtraction.</p> $14 - 5 = 9$  <p style="text-align: right;">$14 - 4 = 10$ $10 - 1 = 9$</p>

<p>Column method using base 10.</p>	<p>48 – 7</p>	<p>Children to represent the base 10 pictorially.</p>	<p>Column method or children could count back 7.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td></td><td>4</td><td>8</td></tr> <tr><td>-</td><td></td><td>7</td></tr> <tr><td></td><td>4</td><td>1</td></tr> </table>		4	8	-		7		4	1			
	4	8													
-		7													
	4	1													
<p>Column method with regrouping using base 10 and having to exchange.</p>	<p>41 – 26 =</p>	<p>Represent the base 10 pictorially, remembering to show the exchange.</p>	<p>Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because $41 = 30 + 11$.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td></td><td>34</td><td>1</td></tr> <tr><td>-</td><td>2</td><td>6</td></tr> <tr><td></td><td>1</td><td>5</td></tr> </table>		3 4	1	-	2	6		1	5			
	3 4	1													
-	2	6													
	1	5													
<p>Column method with regrouping using place value counters.</p>	<p>234 – 88</p>	<p>Represent the place value counters pictorially; remembering to show what has been exchanged.</p>	<p>Formal column method. Children must understand what has happened when they have crossed out digits.</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td></td><td>²2</td><td>¹3</td><td>4</td></tr> <tr><td>-</td><td></td><td>8</td><td>8</td></tr> <tr><td></td><td></td><td></td><td>6</td></tr> </table>		² 2	¹ 3	4	-		8	8				6
	² 2	¹ 3	4												
-		8	8												
			6												

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.

= 391 - 186

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

What is 186 less than 391?



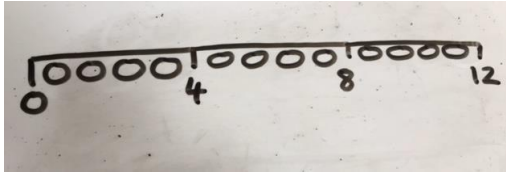
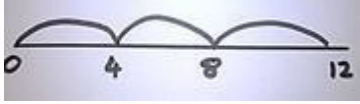

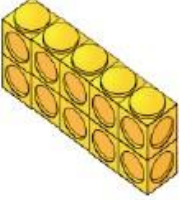
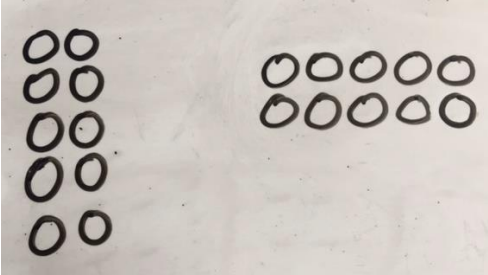
Missing digit calculations

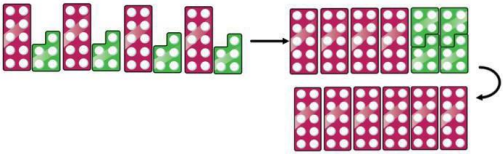
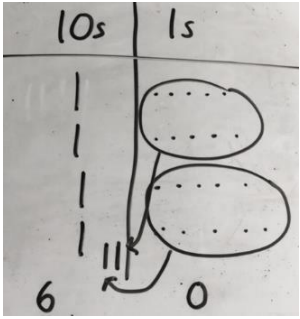
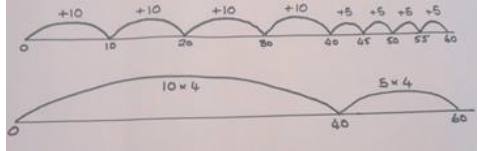
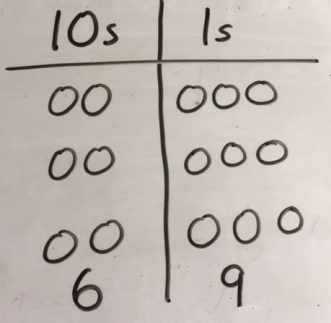
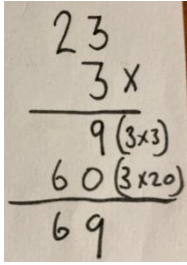
$$\begin{array}{r} 39\ \square \\ - \square\square 6 \\ \hline \square 0 5 \end{array}$$

Multiplication

Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups.

	Concrete	Pictorial	Abstract
<p>Recognising and making equal groups</p> <p>Repeated grouping/repeated addition</p>	<p>3×4 $4 + 4 + 4$</p> <p>There are 3 equal groups, with 4 in each group.</p>	<p>Children to represent the practical resources in a picture and use a bar model.</p>	<p>$3 \times 4 = 12$</p> <p>$4 + 4 + 4 = 12$</p>
<p>Doubling</p>	<p>Use practical activities using manipulatives including cubes and Numicon to demonstrate doubling</p>	<p>Children draw pictures to show how to double numbers</p> <p>Double 4 is 8</p>	<p>Partition a number and then double each part before recombining it back together.</p>

<p>Counting in multiples.</p> <p>Number lines to show repeated groups-</p>	<p>3×4</p>  	<p>Represent this pictorially alongside a number line e.g.:</p> 	<p>Abstract number line showing three jumps of four.</p> <p>$3 \times 4 = 12$</p> 
<p>Use arrays to illustrate commutativity</p>	<p>Counters and other objects can also be used.</p> <p>$2 \times 5 = 5 \times 2$</p>  <p>2 lots of 5</p>  <p>5 lots of 2</p>	<p>Children to represent the arrays pictorially.</p> 	<p>Children to be able to use an array to write a range of calculations e.g.</p> <p>$10 = 2 \times 5$ $5 \times 2 = 10$ $2 + 2 + 2 + 2 + 2 = 10$ $10 = 5 + 5$</p>

<p>2d × 1d using base 10</p> <p>Partition to multiply</p>	<p>Using Numicon, base 10</p> <p>4×15</p>  <table border="1" data-bbox="461 587 866 874"> <thead> <tr> <th>Tens</th> <th>Ones</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;">() () () () () ()</td> </tr> </tbody> </table>	Tens	Ones	 	() () () () () ()	<p>Children to represent the concrete manipulatives pictorially.</p> 	<p>Children to be encouraged to show the steps they have taken.</p> 4×15 $\begin{array}{r} 10 \\ 5 \end{array}$ $10 \times 4 = 40$ $5 \times 4 = 20$ $40 + 20 = 60$ <p>A number line can also be used</p> 		
Tens	Ones								
 	() () () () () ()								
<p>Formal column method</p>	<p>with place value counters (base 10 can also be used.)</p> <p>3×23</p> <table border="1" data-bbox="448 1085 873 1444"> <thead> <tr> <th>10s</th> <th>1s</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10 10 10 10 10 10</td> <td style="text-align: center;">1 1 1 1 1 1 1 1 1</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">9</td> </tr> </tbody> </table>	10s	1s	10 10 10 10 10 10	1 1 1 1 1 1 1 1 1	6	9	<p>Children to represent the counters pictorially.</p> 	<p>Children to record what it is they are doing to show understanding.</p> <p>Expanded method</p> $3 \times 23 = 3 \times 20 = 60$ $\underline{3 \times 3 = 9}$ $60 + 9 = 69$ <p>Formal written method</p> 
10s	1s								
10 10 10 10 10 10	1 1 1 1 1 1 1 1 1								
6	9								

<p>Formal column method</p>	<p>With place value counters. 6×23</p>	<p>Children to represent the counters/base 10, pictorially e.g. the image below.</p>	<p>Formal written method</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px;"> $\begin{array}{r} 23 \\ 6 \times \\ \hline 18 \text{ (} 6 \times 3 \text{)} \\ 120 \text{ (} 6 \times 20 \text{)} \\ \hline 138 \end{array}$ </div> <div style="text-align: right;"> $6 \times 23 =$ $\begin{array}{r} 23 \\ \times 6 \\ \hline 138 \\ 11 \end{array}$ </div> </div>
<p>Formal Column Method</p>	<p>When children start to multiply $3d \times 3d$ and $4d \times 2d$ etc., they should be confident with the abstract: To get 744 children have solved 6×124. To get 2480 they have solved 20×124.</p>	$\begin{array}{r} 124 \\ \times 26 \\ \hline 744 \\ 2480 \\ \hline 3224 \\ 11 \end{array}$ <p style="text-align: center;">Answer: 3224</p>	

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

23	23	23	23	23	23
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?

Mai had to swim 23 lengths, 6 times a week.

How many lengths did she swim in one week?

With the counters, prove that $6 \times 23 = 138$


Find the product of 6 and 236

$\times 23 =$

$= 6 \times 23$

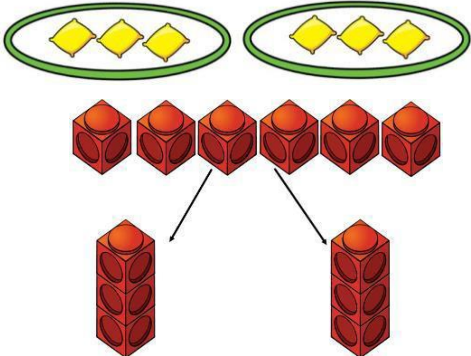
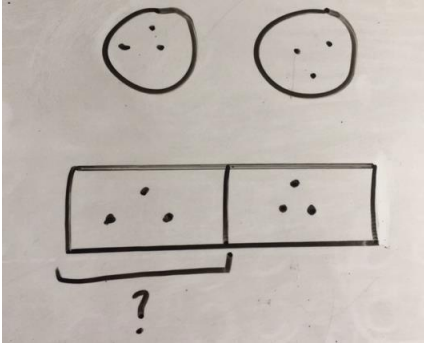
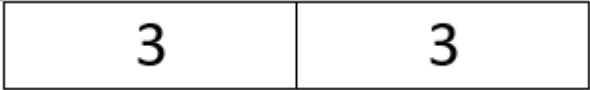
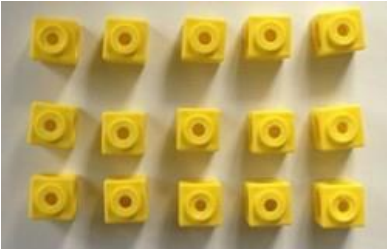
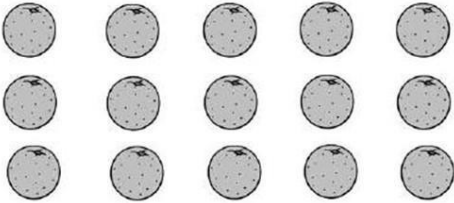
6	23
$\times \underline{23}$	$\times \underline{6}$
$\underline{\hspace{2em}}$	$\underline{\hspace{2em}}$

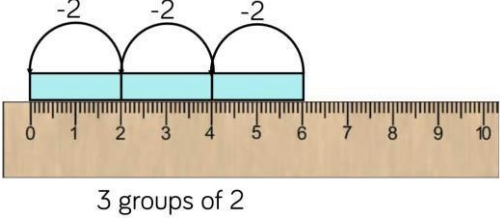
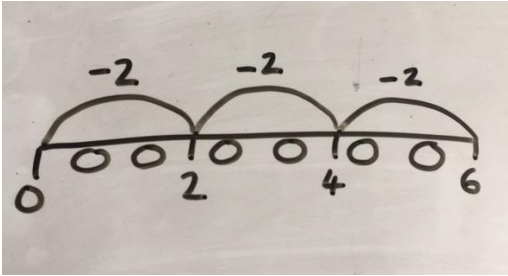
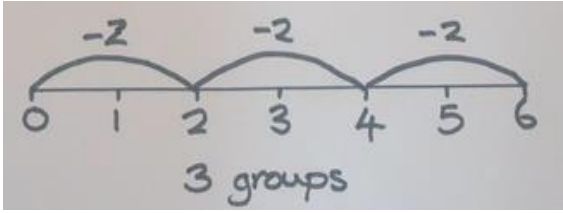
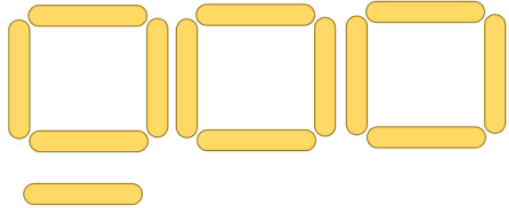
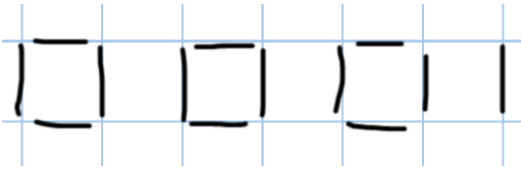
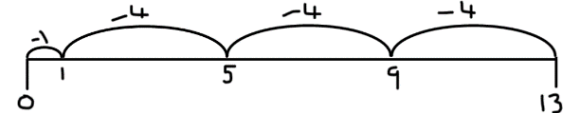
What is the calculation?
What is the product?

100s	10s	1s
		

Division

Key language: share, group, divide, divided by, half.

Division			
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	Concrete	Pictorial	Abstract
Sharing	Using a range of resources. $6 \div 2$ 	Represent the sharing pictorially. 	$6 \div 2 = 3$  Children should also be encouraged to use their 2 times-tables facts.
Division with Arrays	Link division to multiplication by creating an array and thinking about the number sentences that can be created. Eg $15 \div 3 = 5$ $5 \times 3 = 15$ $15 \div 5 = 3$ $3 \times 5 = 15$ 	Draw an array and use lines to split the array into groups to make multiplication and division sentences 	Find the inverse of multiplication and division sentences by creating eight linking number sentences. $7 \times 4 = 28$ $4 \times 7 = 28$ $28 \div 7 = 4$ $28 \div 4 = 7$ $28 = 7 \times 4$ $28 = 4 \times 7$ $4 = 28 \div 7$ $7 = 28 \div 4$

<p>Repeated subtraction</p>	<p>$6 \div 2$</p> 	<p>Children to represent repeated subtraction pictorially.</p> 	<p>Abstract number line to represent the equal groups that have been subtracted.</p> 
<p>$2d \div 1d$ with remainders</p>	<p>Using lollipop sticks. $13 \div 4$ Use of lollipop sticks to form wholes-squares are made because we are dividing by 4.</p>  <p>There are 3 whole squares, with 1 leftover.</p>	<p>Children to represent the lollipop sticks pictorially.</p>  <p>There are 3 whole squares, with 1 left over.</p>	<p>$13 \div 4 = 3$ 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'</p> 

Sharing using place value counters.

$42 \div 3 = 14$

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.

$42 \div 3$
 $42 = 30 + 12$
 $30 \div 3 = 10$
 $12 \div 3 = 4$
 $10 + 4 = 14$

Short division

Using place value counters to group.
 $615 \div 5$

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.

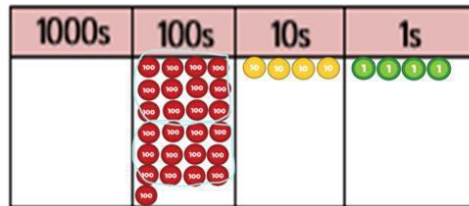
$$\begin{array}{r}
 123 \\
 5 \overline{) 615} \\
 \underline{5} \\
 11 \\
 \underline{10} \\
 15 \\
 \underline{15} \\
 0
 \end{array}$$

Long division

Using place value counters
 $2544 \div 12$

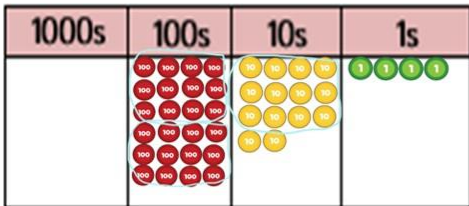


We can't group 2 thousands into groups of 12 so will exchange them.



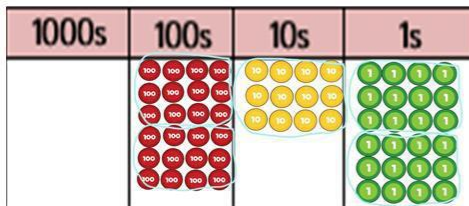
We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

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



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

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

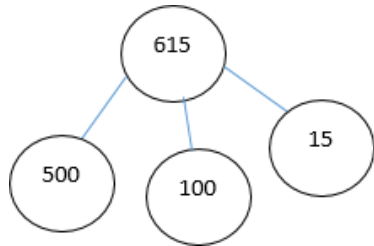


After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 groups of 12, which leaves no remainder.

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

Conceptual variation; different ways to ask children to solve $615 \div 5$

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?

$$5 \overline{)615}$$

$$615 \div 5 =$$

$$\square = 615 \div 5$$

What is the calculation?
 What is the answer?

