

Newton Primary School Calculation Policy

This policy contains the key procedures that are to be taught throughout the school. It has been written to ensure consistency and progression throughout the school. We are aiming to get each child to show fluency, reasoning and problem solving skills from EYFS – Year 6.

- Although the main focus of this policy is showing the core **Concrete, Pictorial and Abstract** ways of solving Maths problems, it is important to recognise that the ability to calculate mentally lies at the heart of numeracy.
- Mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it. In every written method there is an element of mental processing.
- Written recording both helps children to clarify their thinking and supports and extends the development of more *fluent* and sophisticated mental strategies.
- Children are encouraged to use the most efficient method for them, making sure they use ones they have a clear understanding of.
- The long-term aim is for children to be able to select an efficient method of their choice that is appropriate for a given task. They should do this by always asking themselves:
 - 'Do I need to use manipulatives to help me?'
 - 'Can I do this using drawings or jottings?'
 - 'Do I need to use a written method?'
 - 'Can I do this in my head?'

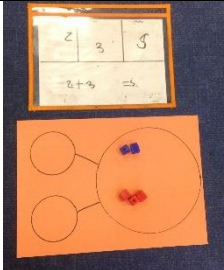
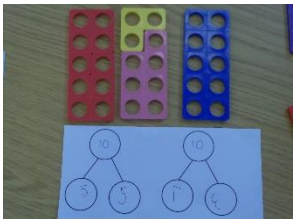
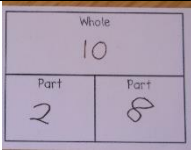
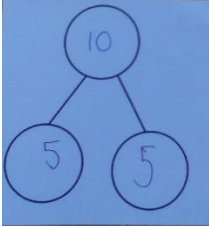
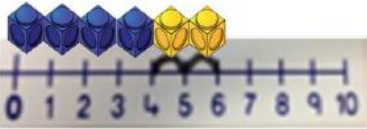
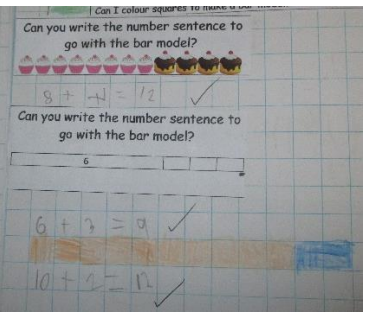
Stem sentences are in red, these are to help children embed their learning.

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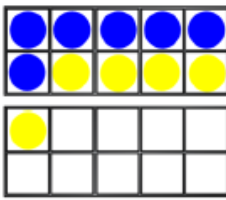
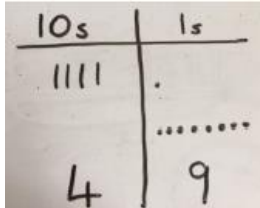
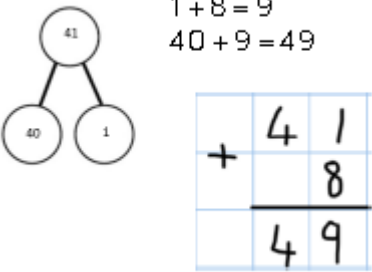
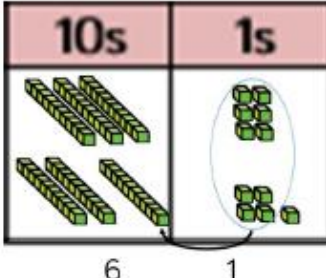
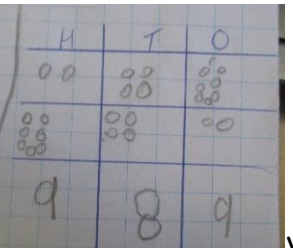
Addition

Vocab: add, plus, more than, total, sum of,

Bar model, part-part-whole, number line, tens frame, base 10, place value counters, missing numbers,

STEM sentences	Concrete (can we MAKE it?)	Pictorial (can we draw it?)	Abstract (can we write the calculation?)
_____ is a whole, _____ is a part, _____ is a part. There are _____ in total.	 Use cubes, numicon and others to add two numbers together.  Use numicon and cubes to show number bonds.	  Use pictures to add two numbers together as a group or a bar.  Introduce the bar model and the part-whole model to secure number bonds.	$5 + 5 = 10$ 5 is a part, 5 is a part, the whole is ten. 
First... Then... Now... E.g. First there were 4 children on the bus, then 3 children got on, Now there are 7 children on the bus. (this will help with the inverse relationship and missing number)	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? $4 + 2$ 

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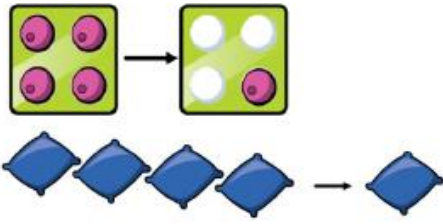
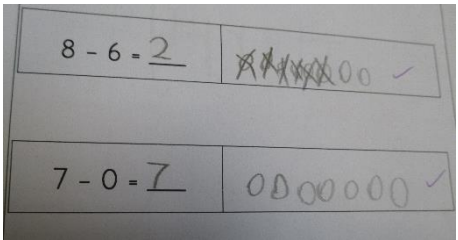
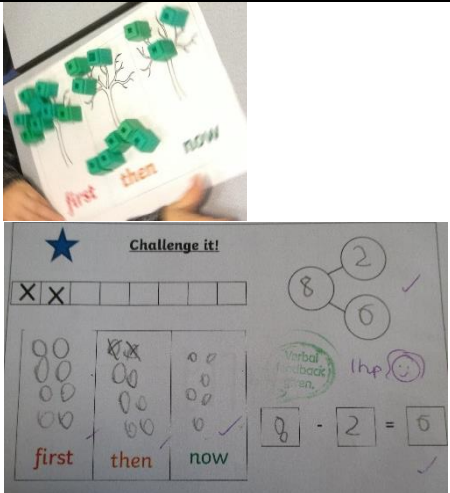
I need ____ to make ten. I have ____ left over. $10 + \underline{\hspace{1cm}}$ is ____.	Regrouping to make 10: using ten frames and counters/cubes or using Numicon. $6 + 5$ 	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. $6 + \square = 11$ $6 + 5 = 5 + \square$ $6 + 5 = \square + 4$
	TO + O using base 10. Continue to develop understanding of partitioning and place value. $41 + 8$ 	Children to represent base 10 e.g. lines for tens and dots for ones. 	$41 + 8$ $1 + 8 = 9$ $40 + 9 = 49$ 
	TO + O using base 10. Continue to develop understanding of partitioning and place value. $36 + 25$  $\begin{array}{r} 36 \\ +25 \\ \hline \end{array}$	Children to represent the base 10 or place value counters, in a place value chart 	Looking for ways to make 10. $36 + 25 =$ $30 + 20 = 50$ $5 + 5 = 10$ $50 + 10 + 1 = 61$ 36 Formal method: $\begin{array}{r} 36 \\ +25 \\ \hline 61 \\ \hline 1 \end{array}$
Conceptual variation; different ways to ask children to solve $21 + 34$			

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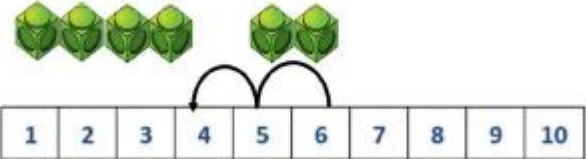
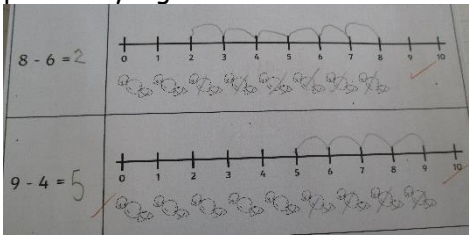
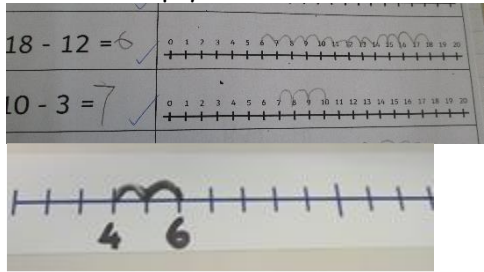
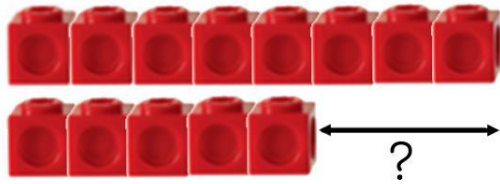
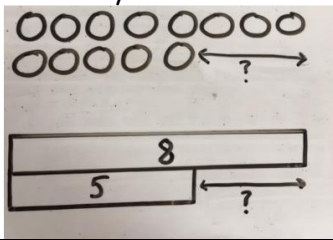
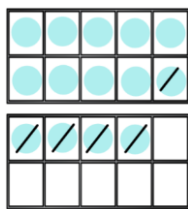
problems. 370 326 44 53 775 828 621 543 78	Word problems: In year 3, there are 21 children and in year 4, there are 34 children. How many children in total? $21 + 34 = 55$. Prove it	21 <u>+34</u> $21 + 34 =$ $= 21 + 34$ Calculate the sum of twenty-one and thirty-four.	+ Missing digit problems: <table><tr><th>10s</th><th>1s</th></tr><tr><td> 10 10 </td><td> 1 </td></tr><tr><td> 10 10 10 </td><td> ? </td></tr><tr><td> ? </td><td> 5 </td></tr></table>	10s	1s	10 10	1	10 10 10	?	?	5
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Subtraction

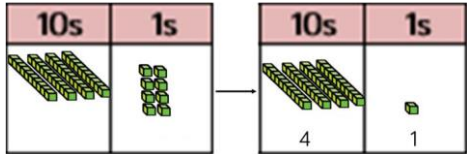
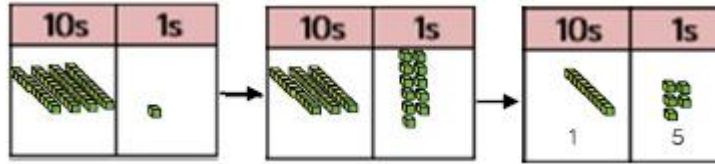
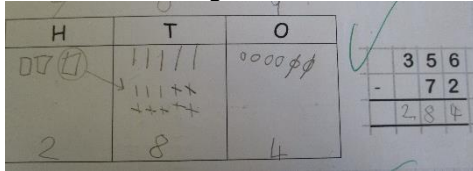
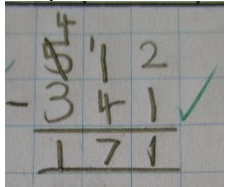
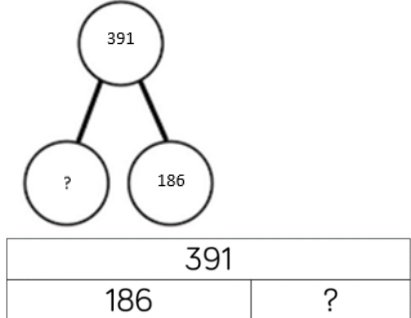
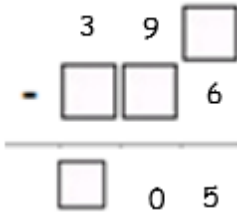
Vocab: take away, less than, the difference, subtract, minus, fewer, decrease, exchange

STEM sentences	Concrete	Pictorial	Abstract
First... Then... Now... e.g. First there were 4 children in the car, then 1 child got out, Now there are 3 children in the car.	Physically taking away objects from a whole (tens frame, numicon, cubes etc...) $4 - 3 = 1$ 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	

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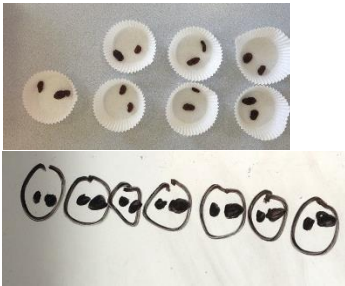
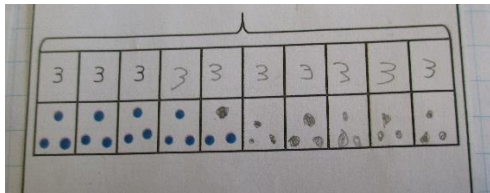
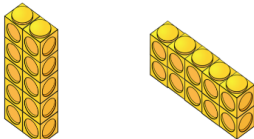
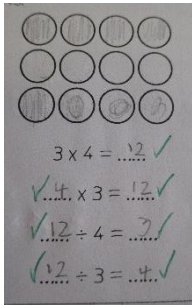
The whole is _____. The part we are taking away is _____. Start on _____ and count back _____.	Counting back (using number lines or tracks) 6-2= Children start at 6 and count back 2 	Children to represent what they see pictorially e.g. 	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line 
	Finding the difference (using cubes, Numicon or 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.
		Children to present the ten frame pictorially and discuss what they did to make 10. 	When children are confident they can draw this themselves. Remind them to show order and uniform to help them.

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	Column method using base 10 or place value counters. 48-7 	Children to represent the base 10 pictorially. 35 - 23 =  draw the 3 tens and 5 ones cross out the ones cross out the tens look how much remains	Encourage children to use mental strategies
	Column method using base 10 or place value counters and having to exchange. 41 - 26  41 Here 1 ten has been exchanged for 10 ones Answer	Represent the place value counters pictorially; remembering to show what has been exchanged. 	Formal column method. Children must understand what has happened when they have crossed out digits. 
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.	= 391 - 186 391 -186 — What is 186 less than 391?	Missing digit calculations 

Multiplication

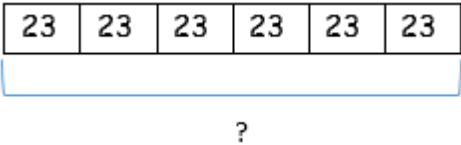
Vocab: double, times, multiplied by, the product of, groups of, lots of, equal groups, exchange

STEM sentences	Concrete	Pictorial	Abstract
We are counting in multiples of ____ so we count every ____. There are ____ in each group. There are ____ groups. We have to add ____ times.	Repeated grouping/repeated addition 7×2 $2 + 2 + 2 + 2 + 2 + 2 + 2 =$ There are 7 equal groups, with 2 in each group. 	Children to represent the practical resources in a picture and use a bar model. 	$3 \times 4 = 12$ $4 + 4 + 4 = 12$
____ lots of ____ is the same as ____ lots of ____.	Use arrays to illustrate commutativity counters and other objects can also be used. $2 \times 5 = 5 \times 2$  2 lots of 5 5 lots of 2	Children to represent the arrays pictorially.  $3 \times 4 = 12$ ✓ $4 \times 3 = 12$ ✓ $12 \div 4 = 3$ ✓ $12 \div 3 = 4$ ✓	Children to be able to use an array to write a range of calculations e.g. • $10 = 2 \times 5$ • $5 \times 2 = 10$ • $2 + 2 + 2 + 2 + 2 = 10$ • $10 = 5 + 5$

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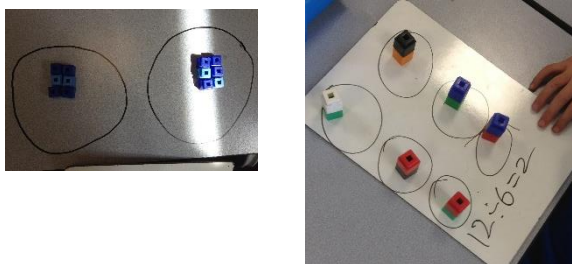
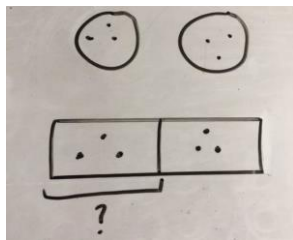
_____ can be partitioned into _____ and _____. _____ lots of _____ ones is _____. _____ lots of _____ tens is _____. _____ ones add _____ tens is _____. _____.	To first introduce the grid method, use Base 10 before moving towards a more compact method. $36 \times 3 = 108$ <table border="1"><tr><th>T</th><th>O</th></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td>10</td><td>08</td></tr></table> $36 \times 3 =$ Make 36 on each row, there are 3 rows. Add up each column, starting with the ones and exchange if needed. Move on to Place Value Counters to show how we are finding groups of a number. We are multiplying by 3 so need 3 rows. <table border="1"><tr><th>T</th><th>O</th></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr></table>	T	O							10	08	T	O							Children can represent the work they have done with place value counters in a way that they understand. They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below. $24 \times 3 = 72$ <table border="1"><tr><th>T</th><th>O</th></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td>60</td><td>12</td></tr><tr><td></td><td>72</td></tr></table>	T	O							60	12		72	Start with multiplying by one digit numbers and showing the clear addition alongside the grid. <table border="1"><tr><td>X</td><td>30</td><td>5</td></tr><tr><td>7</td><td>210</td><td>35</td></tr></table> $210 + 35 = 245$ Moving forward, multiply by a 2 digit number showing the different rows within the grid method. <table border="1"><tr><td>X</td><td>1000</td><td>300</td><td>40</td><td>2</td></tr><tr><td>10</td><td>10000</td><td>3000</td><td>400</td><td>20</td></tr><tr><td>8</td><td>8000</td><td>2400</td><td>320</td><td>16</td></tr></table>	X	30	5	7	210	35	X	1000	300	40	2	10	10000	3000	400	20	8	8000	2400	320	16
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_____ ones times _____ ones is _____ ones. _____ ones times _____ tens is _____ tens. Because we are multiplying by ten, we need to add in a zero as a place value holder. We cannot have more than one digit in any place value column, so we need to exchange _____ ones as _____ ten	Formal column method with place value counters (base 10 can also be used.) 32×3 <table border="1"><tr><th>T</th><th>O</th></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td>90</td><td>6</td></tr></table>	T	O							90	6	Children to represent the base 10 or place value counters pictorially. $84 \times 4 =$ <table border="1"><tr><th>T</th><th>O</th></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td> </td><td> </td></tr><tr><td>320</td><td>6</td></tr><tr><td>326</td><td></td></tr></table>	T	O									320	6	326		Formal Written Method <table border="1"><tr><td>57</td><td>73</td></tr><tr><td>X 3</td><td>X 5</td></tr><tr><td>171</td><td>365</td></tr></table>	57	73	X 3	X 5	171	365																					
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	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.	$ \begin{array}{r} 124 \\ \times 26 \\ \hline 744 \\ 2480 \\ \hline 3224 \end{array} $ Answer: 3224						
Conceptual variation; different ways to ask children to solve 23×6								
	Mae had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week? With the counters prove that $23 \times 6 = 138$	Find the product of 6 and 23 $6 \times 23 = \underline{\quad}$ $ \begin{array}{r} 23 \\ \times 6 \\ \hline \end{array} $ What is the calculation? What is the product? <table border="1" style="border-collapse: collapse; text-align: center;"> <thead> <tr style="background-color: #f8d7da;"> <th>100s</th> <th>10s</th> <th>1s</th> </tr> </thead> <tbody> <tr> <td style="height: 40px;"></td> <td style="height: 40px;">  </td> <td style="height: 40px;">  </td> </tr> </tbody> </table>	100s	10s	1s			
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Division

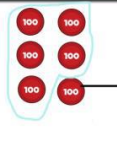
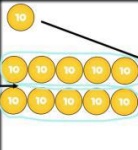
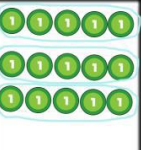
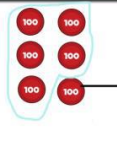
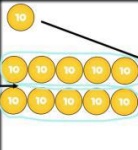
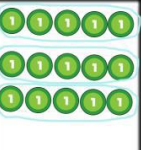
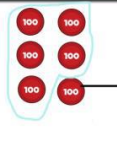
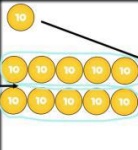
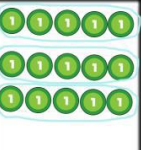
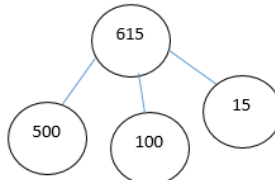
Vocab: share, group, divide, divided by, half, divisor, dividend, quotient, remainder, exchange

STEM sentences	Concrete	Pictorial	Abstract				
_____ shared equally between _____ is _____	Sharing a range of objects 12 ÷ 2 = 	Represent the sharing pictorially 	6 ÷ 2 = 3 <table border="1"><tr><td colspan="2">6</td></tr><tr><td>3</td><td>3</td></tr></table> Children should also be encouraged to use their 2 times tables facts.	6		3	3
6							
3	3						

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	Sharing - using concrete methods	1. Use counters to represent the problem. Sam has 8 packs of socks. He has 16 socks in total. How many socks are in a pack? Draw your representation using the boxes and write the calculation. There are 2 packs with 2 socks in each. 2. We move on to use formal jottings to help us solve the division. These can be in the form of sharing circles (squares!) There are 2 packs with 2 socks in each.	Children can use a bar model to help represent the division. They should order 4 packs of books.
In division, we start from the largest place value column. We start from the right. ___ is ___ tens and ___ ones. ___ tens divided by ___ is ____. ones divided by ___ is ____. ___ add ___ is ____.	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. $84 \div 6 =$ 84 can be partitioned into 60 and 24. $60 \div 6 = 10$ $24 \div 6 = 4$ $10 + 4 = 14$ So, $84 \div 6 = 14$
	Short division using place value counters to group. $615 \div 5$	Represent the Place Value counters pictorially	Children to do the calculation using short division scaffold $\begin{array}{r} 123 \\ 5 \overline{) 615} \\ \underline{5} \\ 11 \\ \underline{10} \\ 15 \\ \underline{15} \\ 0 \end{array}$

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	<table><tr><th>100s</th><th>10s</th><th>1s</th></tr><tr><td></td><td></td><td></td></tr><tr><td>1</td><td>2</td><td>3</td></tr></table> 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?	100s	10s	1s				1	2	3	<table><tr><th>100s</th><th>10s</th><th>1s</th></tr><tr><td></td><td></td><td></td></tr><tr><td>1</td><td>2</td><td>3</td></tr></table>	100s	10s	1s				1	2	3	
100s	10s	1s																			
																					
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100s	10s	1s																			
																					
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	Long division using place value counters $2544 \div 12$ <table><tr><th>1000s</th><th>100s</th><th>10s</th><th>1s</th></tr><tr><td></td><td></td><td></td><td></td></tr></table> We can't group 2 thousands into groups of 12 so will exchange them. <table><tr><th>1000s</th><th>100s</th><th>10s</th><th>1s</th></tr><tr><td></td><td></td><td></td><td></td></tr></table> We can group 24 hundreds into groups of 12 which leaves with 1 hundred. $\begin{array}{r} 0.2 \\ 12 \overline{) 2544} \\ \underline{24} \\ 1 \end{array}$			1000s	100s	10s	1s					1000s	100s	10s	1s						
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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 bank account? 615 pupils need to be put into 5 groups. How many will be in each group?	$5 \overline{) 615}$ $615 \div 5 = \underline{\quad}$ $\underline{\quad} = 615 \div 5$	What is the calculation? What is the answer? <table><tr><th>100s</th><th>10s</th><th>1s</th></tr><tr><td></td><td></td><td></td></tr></table>	100s	10s	1s															
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