



**Be the best we can be!**

**Maths Calculation Policy**  
**Model Village Primary School**

**April 2019**

The following calculation policy has been updated to match the White Rose Scheme of Work that our school will follow from April 2019.

The calculation policy focuses on the links between, and also the progression through, Concrete, Pictorial and Abstract.

Pupils need to be taught and encouraged to decide what approach they will take to a calculation, to ensure that they select the most appropriate method for the numbers involved:

Can I do it in my head using a mental strategy?

Could I use some jottings to help me?

Should I use a written method to work it out?

When working out trickier calculation, pupils should:

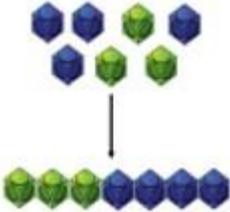
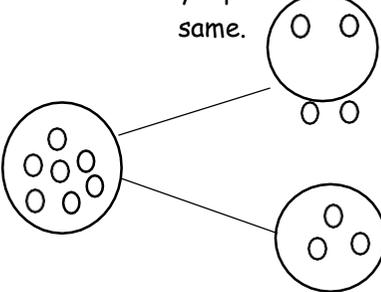
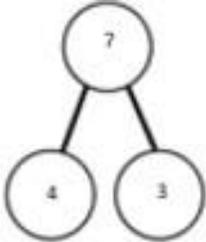
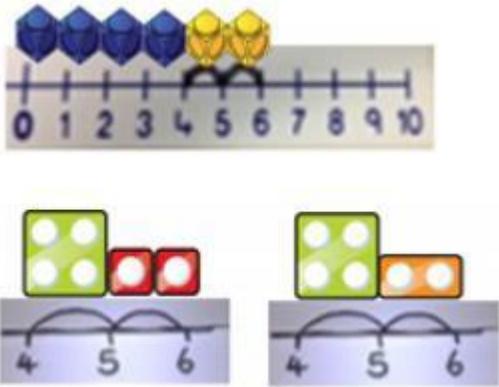
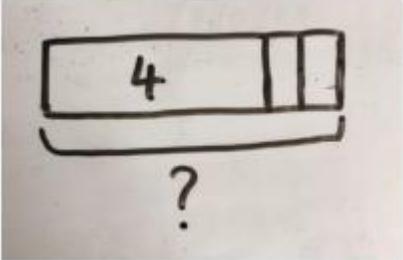
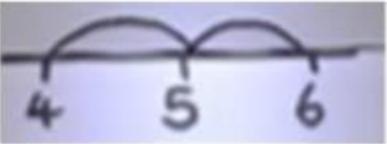
Approximate

Calculate

Check

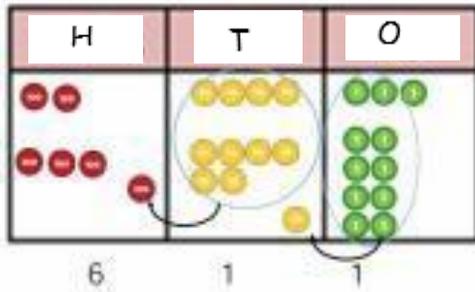
# Calculation Policy: Addition

Language; sum, total, parts, whole, plus, add, and, altogether, more, 'is equal', 'is the same as'

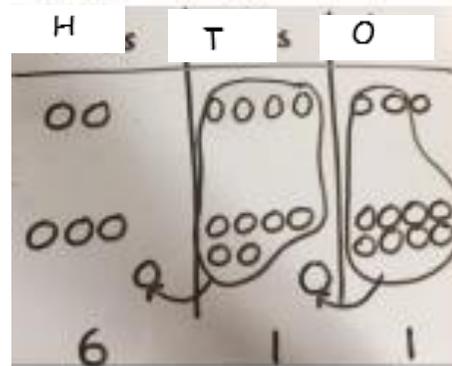
Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole.</p> 	<p>Children to represent the cubes using circles.</p> <p>Try not to use dots they become too small and accidental marks by a pencil could look the same.</p> 	<p><math>4 + 3 = 7</math></p> <p>Four is a part, 3 is a part and the whole is seven</p> 
<p>Counting on using number lines using 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?</p> <p>What is the sum of 2 and 4?</p> <p>What is the total of 4 and 2?</p> <p><math>4 + 2</math></p> 



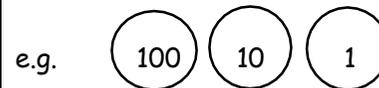
Use of place value counters to add HTO + TO, HTO + HTO etc. When there are 10 ones in the ones column we exchange for 1 ten, when there are 10 tens in the tens column we exchange for 100.



Children to represent the counters in a place value chart, circling when they make an exchange.



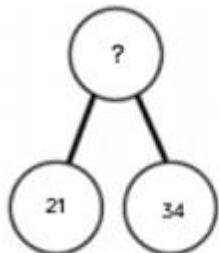
Record place value counters as circles with the value written inside



$$\begin{array}{r} 243 \\ +368 \\ \hline 611 \\ \hline 11 \end{array}$$

As the children move on, introduce decimals with the same number of decimal places and then different. Money can be used here.

## 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?

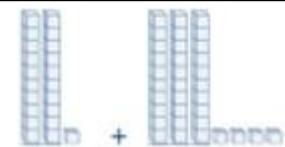
$21 + 34 = 55$ . Prove it.

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

$$21 + 34 =$$

$$\square = 21 + 34$$

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

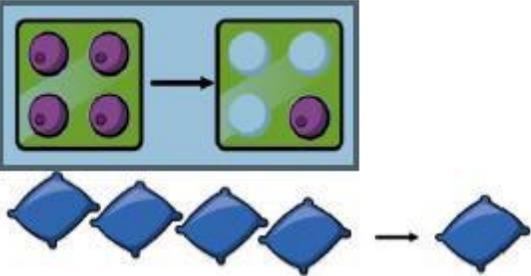
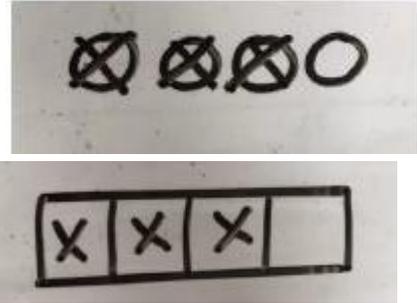
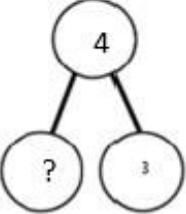
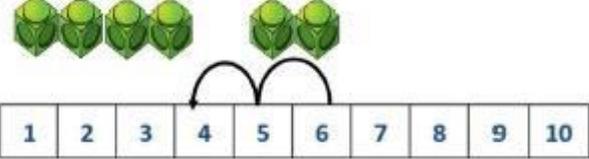
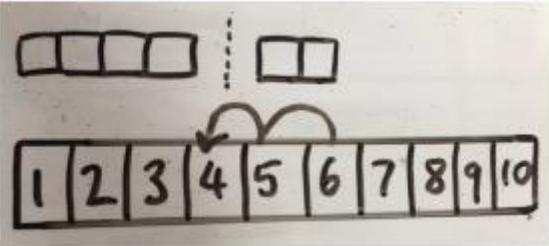
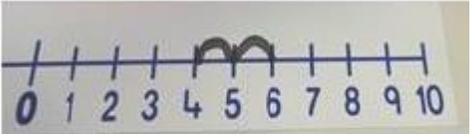
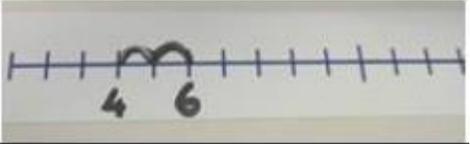


Missing digit problems:

10s	Ones
● ●	●
● ● ●	?
?	5

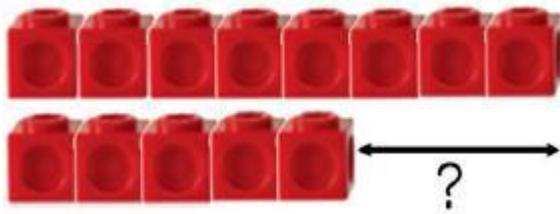
# Calculation Policy: Subtraction

Language; take away, less than, the difference, subtract, minus, fewer, decrease

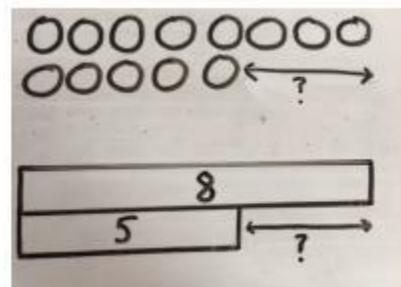
Concrete	Pictorial	Abstract				
<p>Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as bean bags could be used)</p> <p style="text-align: center;"><math>4 - 3 = 1</math></p> 	<p>Children draw the concrete resources they are using and cross out the correct amount. The bar model can also be used.</p> 	<p><math>4 - 3 =</math></p> <p> <math>= 4 - 3</math></p> <table border="1" data-bbox="1711 555 2024 635"> <tr> <td colspan="2" style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">?</td> </tr> </table> 	4		3	?
4						
3	?					
<p>Counting back (using number lines or number tracks) children start with 6 and count back 2.</p> <p><math>6 - 2 = 4</math></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>  				

**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.



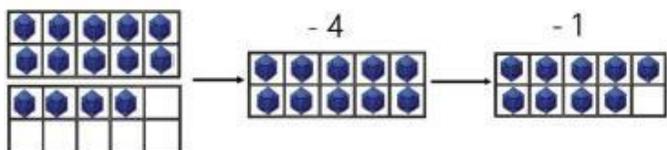
Find the difference between 8 and 5

8 - 5, the difference is

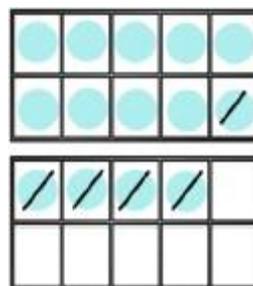
Children to explore why  $9 - 6 = 8 - 5 = 7 - 4$  (have the same difference).

**Making 10** using ten frames.

14-5



Children to present the ten frame pictorially and discuss what they did to make 10.



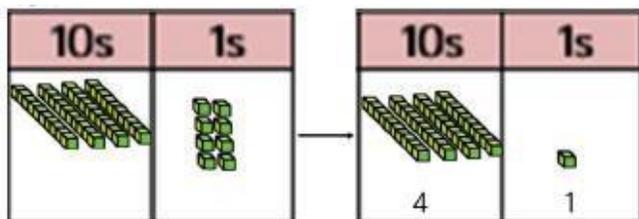
Children to show how they can make 10 by partitioning the subtrahend.

$$\begin{array}{r} 14 - 5 = 9 \\ \swarrow \quad \searrow \\ 4 \quad \quad 1 \end{array}$$

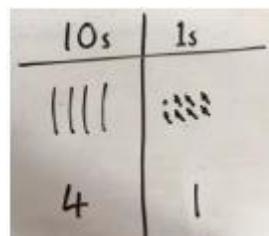
$$\begin{array}{l} 14 - 4 = 10 \\ 10 - 1 = 9 \end{array}$$

**Column method** using base 10/dienes.

48-7

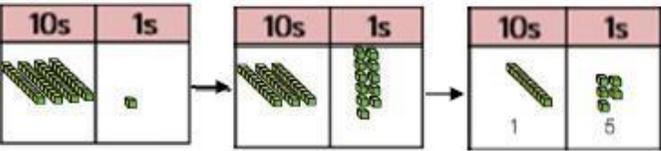
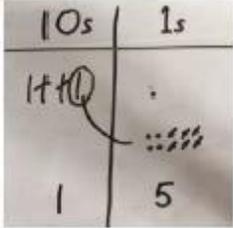
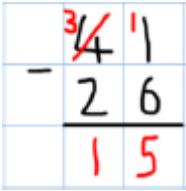
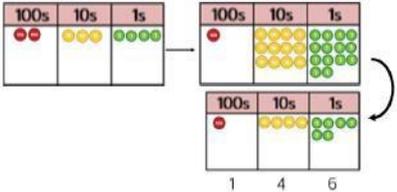
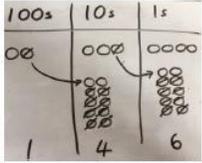
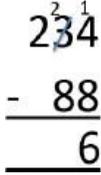


Children to represent the base 10/dienes pictorially.

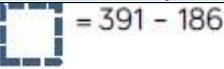
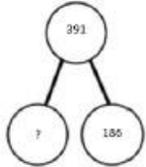
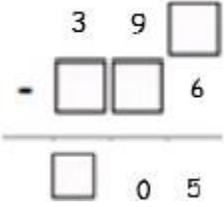


Column method or children could count back 7.

	4	8
-		7
	4	1

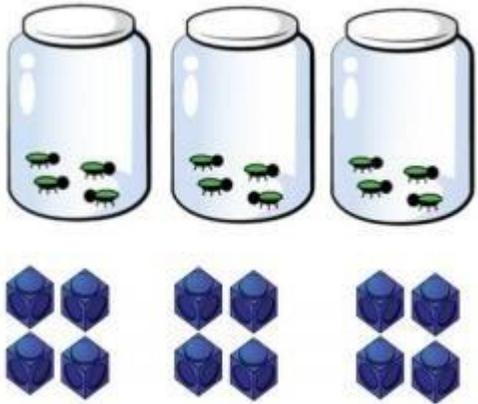
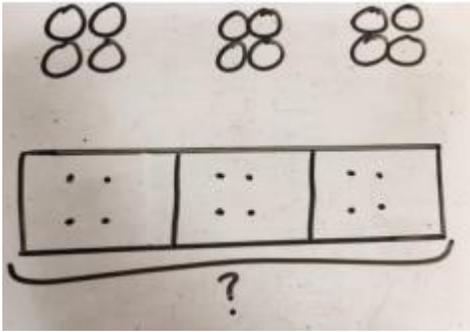
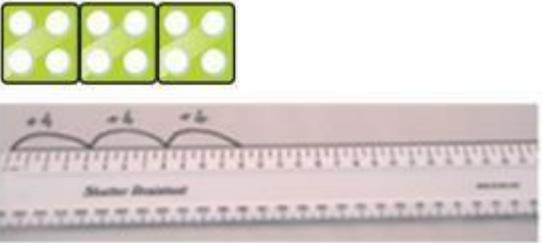
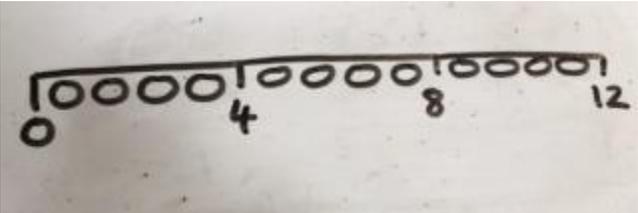
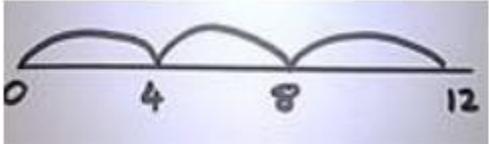
<p><b>Column method</b> using base 10 or dienes and having to exchange</p> <p>41-26</p> 	<p>Represent the base 10 or dienes pictorially, remembering</p>  <p>to show the exchange.</p>	<p>Formal column method.</p> <p>Children must understand that when they have exchanged the 10, they still have 41 because <math>41 = 30 + 11</math>.</p> 
<p><b>Column method</b> using place value counters. 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 the digits.</p> 
<p><b>Column method</b> including decimals (using money place value counters, and other manipulatives)</p>	<p>Represent the money/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 the digits.</p>

## Conceptual variations; different ways to ask children to solve 391-186

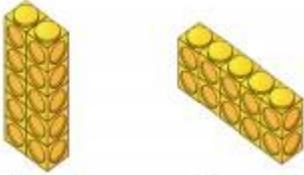
 <p>391 -186 ——</p> <p>What is 186 less than 391?</p>	 	<p>Missing digit calculations</p> 	<p>Raj spent £391, Timmy spent £186. How much more did Raj spend?</p> <p>Calculate the difference between 391 and 186.</p>
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# Calculation Policy: Multiplication

Language; double, times, multiplied by, the product of, groups of, lots of, equal groups.

Concrete	Pictorial	Abstract
<p><b>Repeated grouping/repeated addition</b>  <math>3 \times 4</math>  <math>4 + 4 + 4</math>                      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><math>3 \times 4 = 12</math>  <math>4 + 4 + 4 = 12</math></p>
<p><b>Number lines to show repeated groups -</b>  <math>3 \times 4</math></p>  <p>Cuisenaire rods can be used too.</p>	<p>Represent this pictorially alongside a number line                      e.g.</p> 	<p>Abstract number line showing three groups of four.</p> <p><math>3 \times 4 = 12</math></p> 

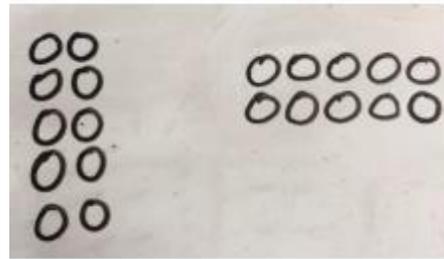
**Use arrays to illustrate commutativity** (counters and other objects can also be used to make these)  
 $2 \times 5 = 5 \times 2$



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.

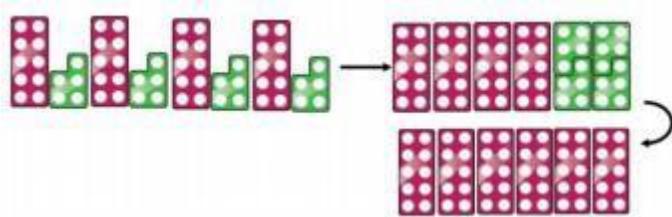
$$10 = 2 \times 5$$

$$5 \times 2 = 10$$

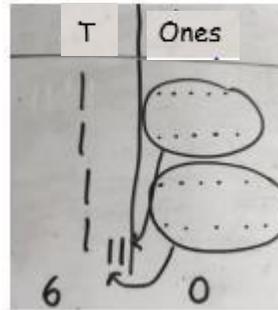
$$2 + 2 + 2 + 2 + 2 = 10$$

$$10 = 5 + 5$$

**Partition to multiply using Numicom or base 10.**  
 $4 \times 15$



Children to represent the concrete manipulatives pictorially.



Children to be encouraged to show the steps they have taken

$$4 \times 15$$

↙ ↘

10 5

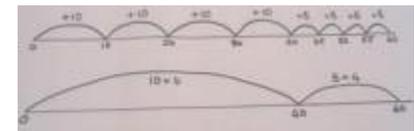
$$10 \times 4 = 40$$

$$5 \times 4 = 20$$

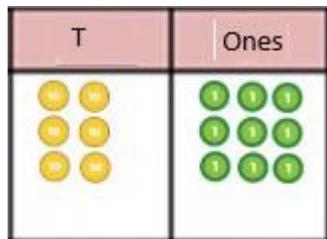
$$40 + 20 = 60$$

x	10	5
4	40	20

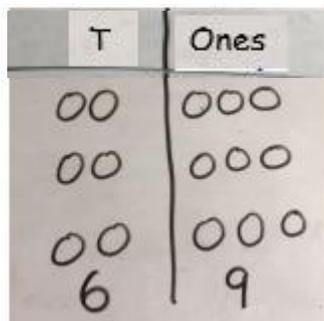
A number line can also be used



**Formal column method** with place value counters (base 10 can also be used.)  $3 \times 23$



Children to represent the counters pictorially



Children to record what it is they're doing to show understanding.

$$3 \times 23 \quad 3 \times 20 = 60$$

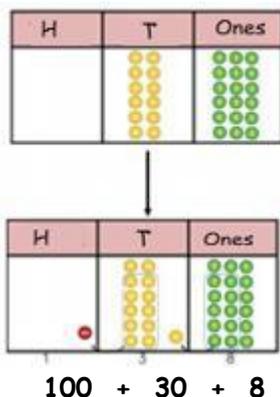
$$20 \quad 3 \quad 3 \times 3 = 9$$

$$60 + 9 = 69$$

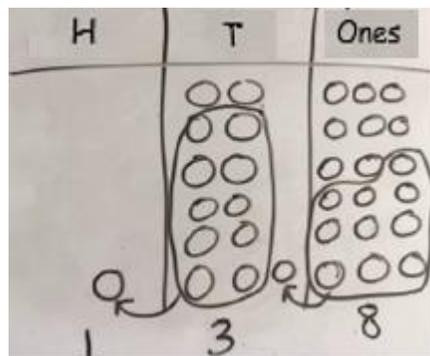
$$\begin{array}{r} 23 \\ \times 3 \\ \hline 69 \end{array}$$

$$\begin{array}{r} \times 20 \quad 3 \\ 3 \quad \boxed{60} \quad \boxed{9} \end{array}$$

**Formal column method** with place value counters  $6 \times 23$



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



Formal written method

$$6 \times 23 =$$

$$\begin{array}{r} 23 \\ \times 6 \\ \hline 138 \\ 11 \end{array}$$

OR grid method

$$\begin{array}{r} \times 20 \quad 3 \\ 6 \quad \boxed{120} \quad \boxed{18} \end{array}$$

$$120 + 18 = 138$$

When children start to multiply 3-digit by 3-digit and 4-digit by 2-digit etc., they should be confident with the abstract:

To get 744, children have solved  $6 \times 124$

To get 2480, they have solved  $20 \times 124$

Encourage children to record their steps if they struggle to add the zero for the tens. (See model opposite)

Once method is embedded then no recording is needed.

$$\begin{array}{r} 124 \\ \times 26 \\ \hline 744 \quad (124 \times 6) \\ 2480 \quad (124 \times 20) \\ \hline 3224 \end{array}$$

11

Answer: 3224

## Conceptual variation; different ways to ask children to solve $6 \times 23$

23	23	23	23	23	23
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?

Maj 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 23

$$6 \times 23$$

$$= 6 \times 23$$

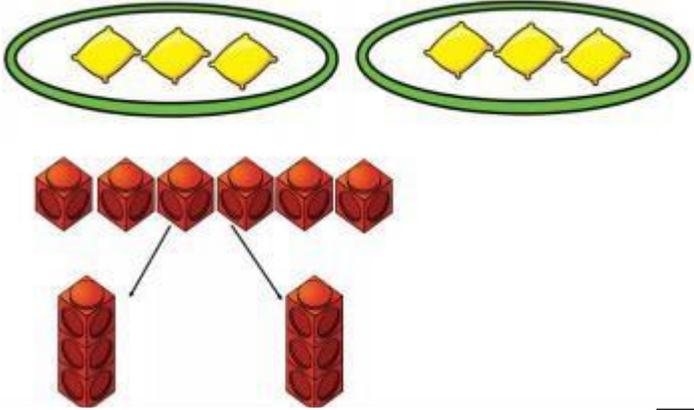
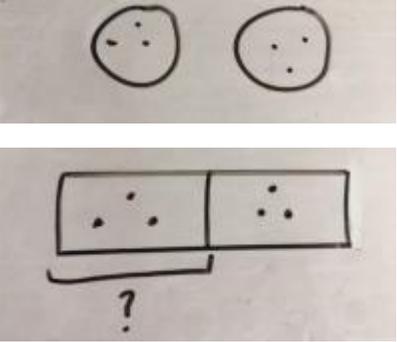
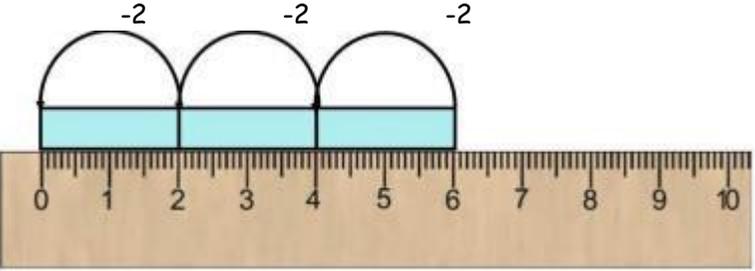
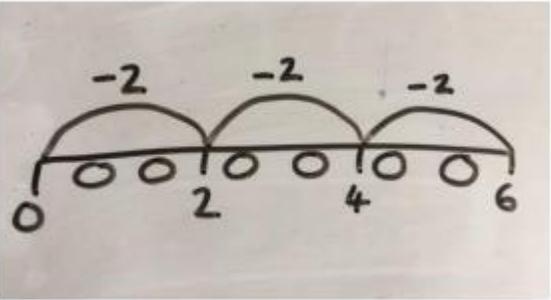
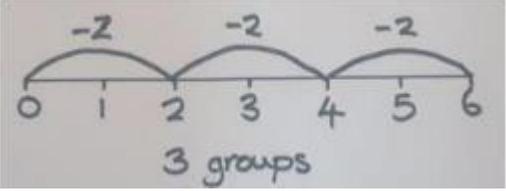
6	23
<u>x 23</u>	<u>x 6</u>
—	—

What is the calculation?  
What is the product?

100s	10s	1s
		

# Calculation Policy: Division

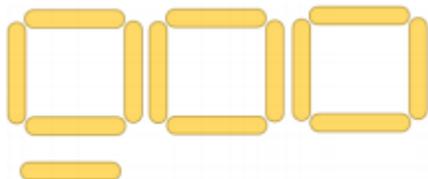
Language; share, group, divide, divided by, half

Concrete	Pictorial	Abstract
<p><b>Sharing</b> using a range of objects  <math>6 \div 2 = 3</math></p> 	<p>Represent the sharing pictorially</p> 	<p><math>6 \div 2 = 3</math></p>  <p>Children should also be encouraged to use their 2 times tables facts.</p>
<p><b>Repeated Subtraction</b> using displayed number line like a ruler. <math>6 \div 2 = 3</math></p> 	<p>Children to represent repeated subtraction pictorially.</p> 	<p>Abstract number line to represent the equal groups that have been subtracted.</p> 

**2d ÷ 1d with remainders** using lollipop sticks.

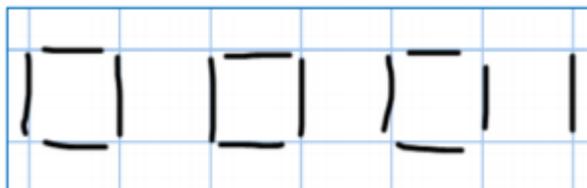
$13 \div 4$

Use of lollipop sticks to form wholes - squares are made because we are dividing by 4.



There are 3 whole squares with 1 left over.

Children to represent the lollipop sticks pictorially.

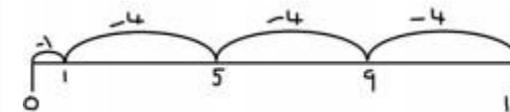


There are 3 whole squares with 1 left over.

$13 \div 4 = 3$  remainder 1

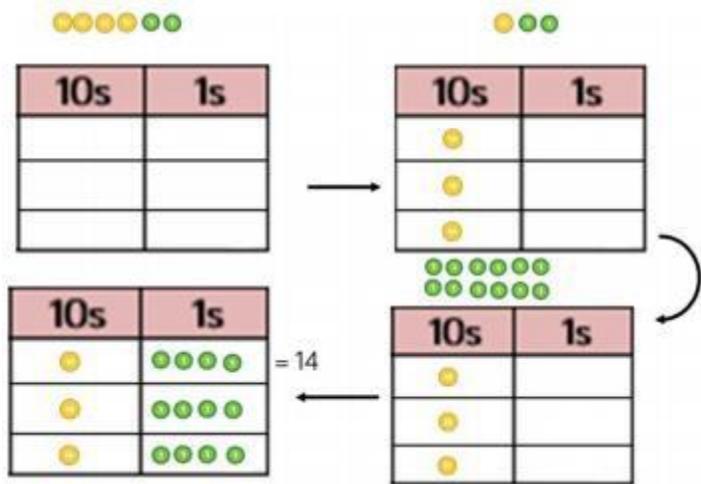
Children should be encouraged to use their times table facts; they could also represent repeated addition on a number lines.

'3 groups of 4, with 1 left over'

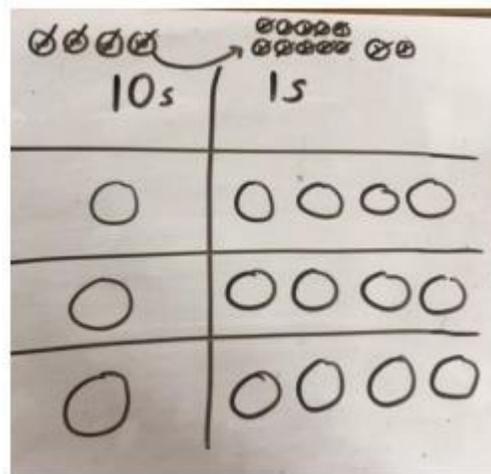


**Sharing using place value counters.**

$42 \div 3 = 14$



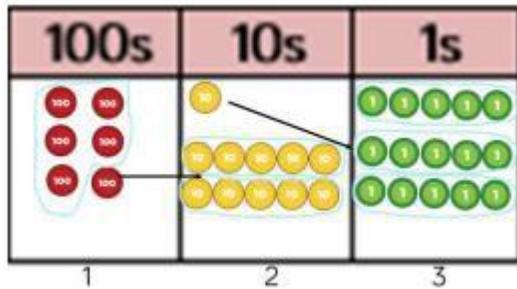
Children to represent the place value counters pictorially.



Children to be able to make sense of the place value counters and write calculations to show the process.

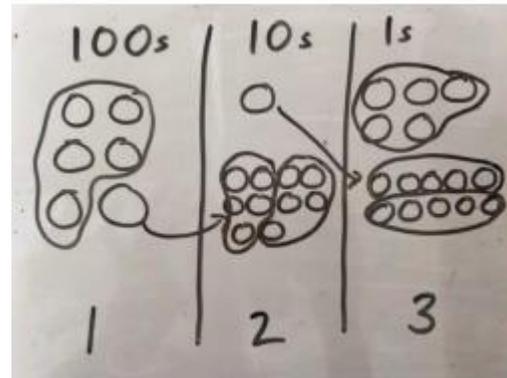
$42 \div 3$   
 $42 = 30 + 12$   
 $30 \div 3 = 10$   
 $12 \div 3 = 4$   
 $10 + 4 = 14$

**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.



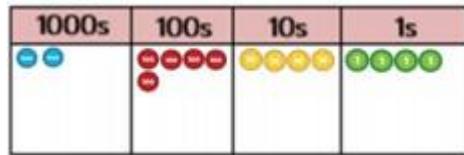
Children to record the calculation using the short division scaffold.

$$\begin{array}{r} 123 \\ 5 \overline{) 615} \end{array}$$

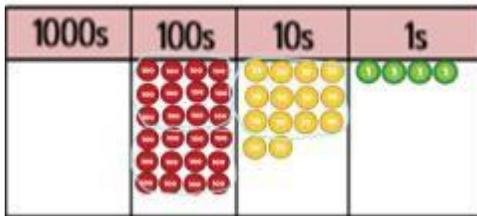
N.B. Children should also consider whether calculations can be done mentally/with jottings. i.e.  $615 \div 5 \rightarrow 615 \div 10 \times 2$

**Long division** using place value counters

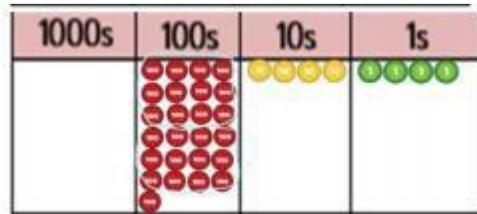
$$2544 \div 12$$



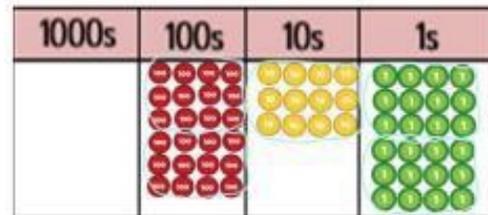
We can't group 2 thousands into groups of 12 so we'll exchange them.



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



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



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

Encourage children who struggle with bigger numbers (Eg  $\div$  by 37) to create short fact boxes to help them calculate.

$$\begin{array}{r} 02 \\ 12 \overline{) 22544} \\ \underline{24} \\ 1 \end{array}$$

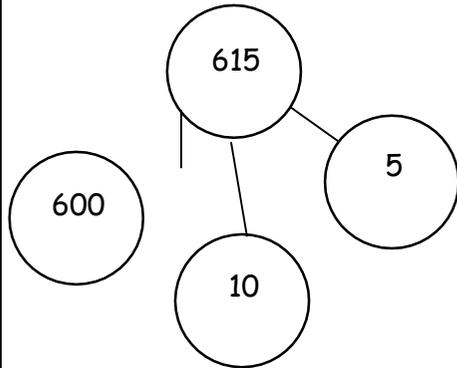
$$\begin{array}{r} 021 \\ 12 \overline{) 22544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$$

$$\begin{array}{r} 0212 \\ 12 \overline{) 22544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$$



## 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?

$$5 \overline{) 615}$$

$$615 \div 5 = \underline{\quad}$$

$$\underline{\quad} = 615 \div 5$$

What is the calculation?

What is the answer?

