

# Linacre Primary School Calculation Policy

*Reviewed - July 2020*



At Linacre Primary, we use the 'White Rose Hub' scheme as a basis for planning. This consists of the following principles:

- fluency - using Learning Objectives from the National Curriculum
- reasoning
- problem-solving

Throughout maths work, the children use the CPA approach within maths lessons (CPA – Concrete/ Pictorial/ Abstract)

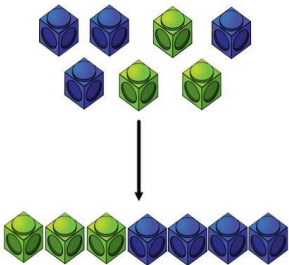
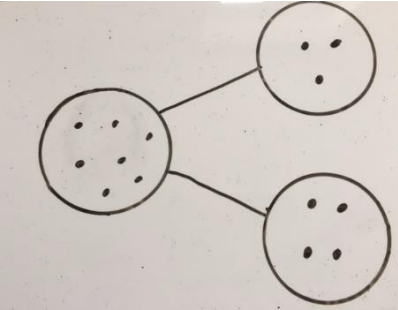
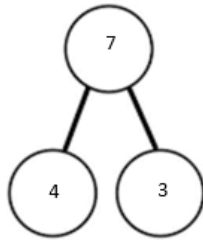
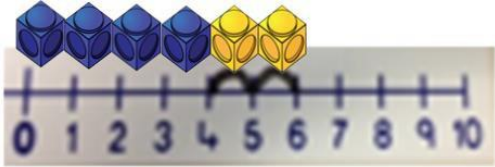
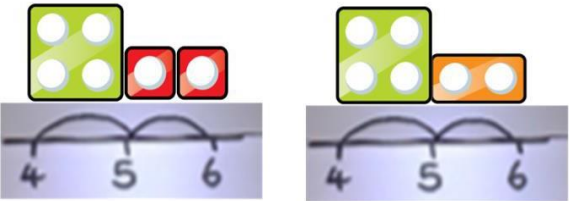
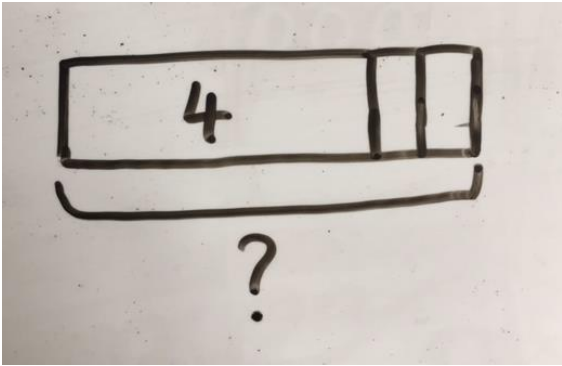

The children use resources such as - White Rose, White Rose Premium, NCETM Mastery documents & rich problems, Mastery Maths hubs.

The aim is that the children will:

- Have a secure knowledge of number facts and a good understanding of the four calculation operations (addition, subtraction, multiplication and division)
- Make use of jottings, diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads
- Have an efficient, reliable, written method of calculation for each operation that they are able to apply with confidence when they are unable to perform a calculation mentally

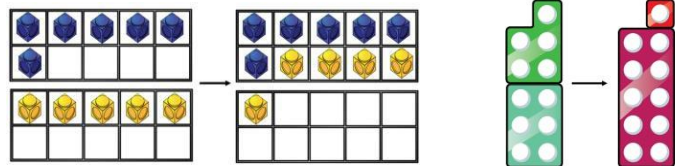
# Calculation policy: Addition

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

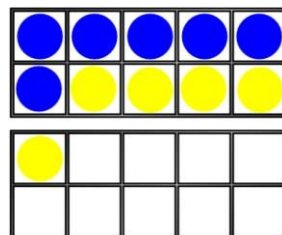
Concrete	Pictorial	Abstract
<p><b>Combining two parts to make a whole</b> (use other resources too e.g. eggs, shells, teddy bears, cars).</p> 	<p>Children to represent the cubes using dots or crosses. They could put each part on a part whole model too.</p> 	<p><math>4 + 3 = 7</math> Four is a part, 3 is a part and the whole is seven.</p> 
<p><b>Counting on using number lines</b> 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: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? <math>4 + 2</math></p> 

**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.

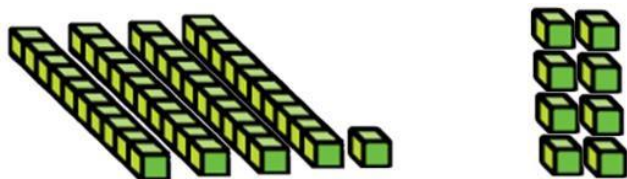
$$6 + \square = 11$$

$$6 + 5 = 5 + \square$$

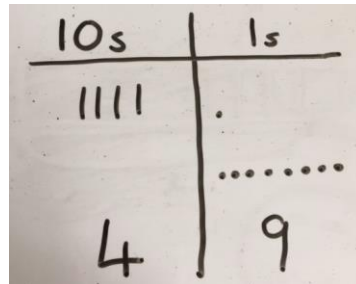
$$6 + 5 = \square + 4$$

**TO + O using base 10.** Continue to develop understanding of partitioning and place value.

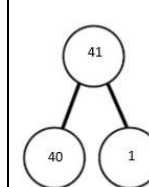
$$41 + 8$$



Children to represent the base 10 e.g. lines for tens and dot/crosses for ones.



$$41 + 8$$



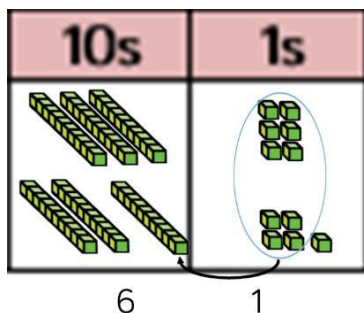
$$1 + 8 = 9$$

$$40 + 9 = 49$$

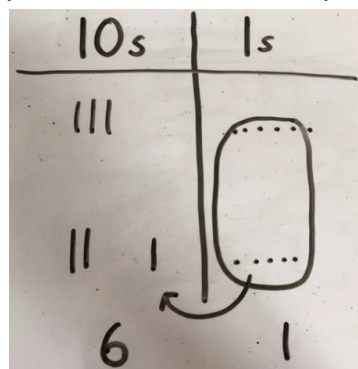
	4	1
+		8
	4	9

**TO + TO using base 10.** Continue to develop understanding of partitioning and place value.

$$36 + 25$$



Children to represent the base 10 in a place value chart.



Looking for ways to make 10.

$$36 + 25 =$$

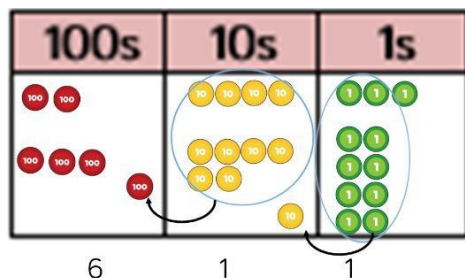
1      5

Formal method:

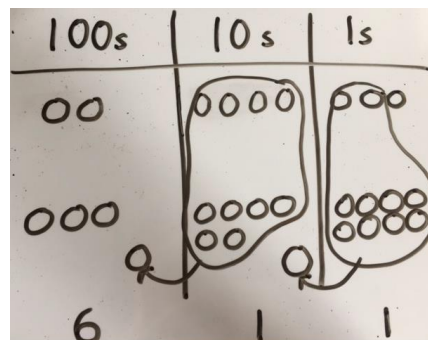
	25
+	36
	61
	1

30 + 20 = 50  
5 + 5 = 10  
50 + 10 + 1 = 61

**Use of place value counters to add HTO + TO, HTO + HTO etc.** 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.

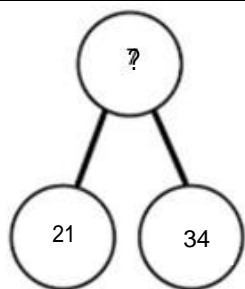


Children to represent the counters in a place value chart, circling when they make an exchange.



$$\begin{array}{r} 243 \\ +368 \\ \hline 611 \\ \hline 1 \quad 1 \end{array}$$

## 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?

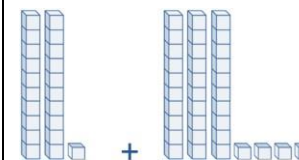
$21 + 34 = 55$ . Prove it

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

$21 + 34 =$

$$\boxed{\phantom{00}} = 21 + 34$$

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

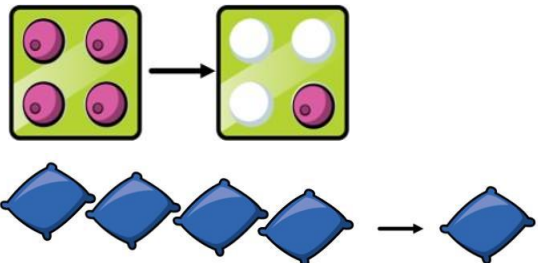
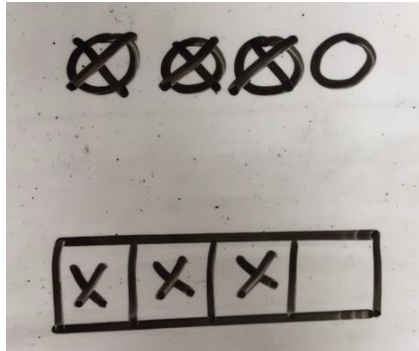

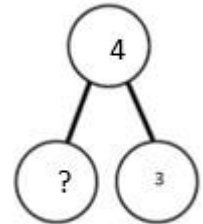
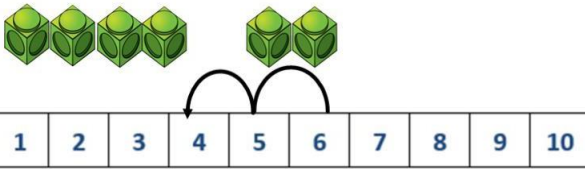
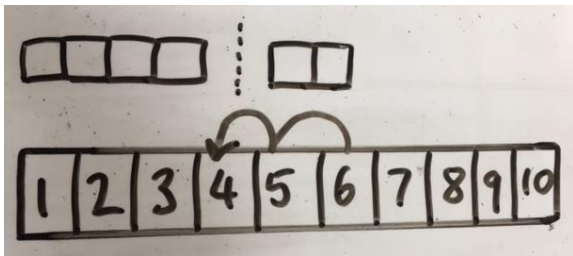
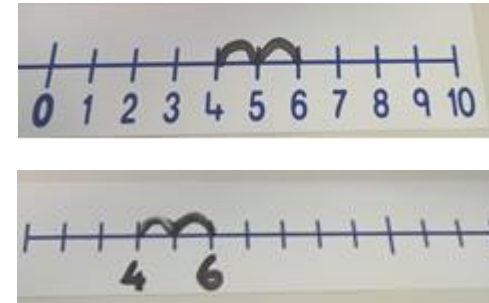


Missing digit problems:

10s	1s
10 10	1
10 10 10	?
?	5

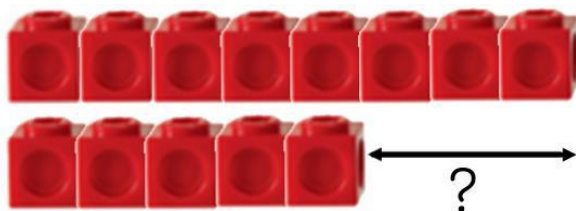
# Calculation policy: Subtraction

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

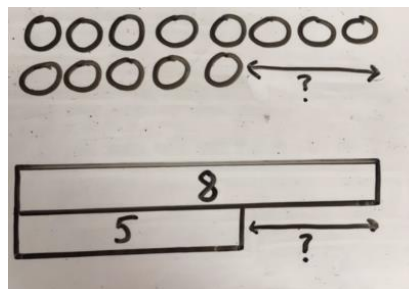
Concrete	Pictorial	Abstract				
<p><b>Physically taking away and removing objects from a whole</b> (ten frames, Numicon, cubes and other items such as beanbags could be used).</p> <p><math>4 - 3 = 1</math></p> 	<p>Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used.</p> 	<p><math>4 - 3 =</math></p> <p> <math>= 4 - 3</math></p> <table data-bbox="1644 549 1957 628"><tr><td colspan="2">4</td></tr><tr><td>3</td><td>?</td></tr></table> 	4		3	?
4						
3	?					
<p><b>Counting back</b> (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.



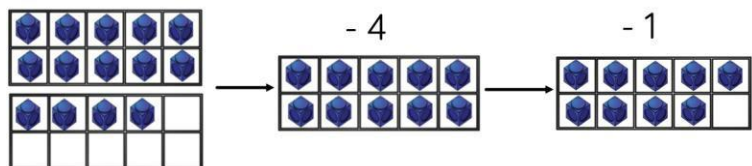
Find the difference between 8 and 5.

$8 - 5$ , the difference is

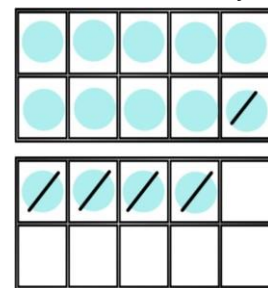
Children to explore why  
 $9 - 6 = 8 - 5 = 7 - 4$  have the same difference.

**Making 10** using ten frames.

$14 - 5$



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



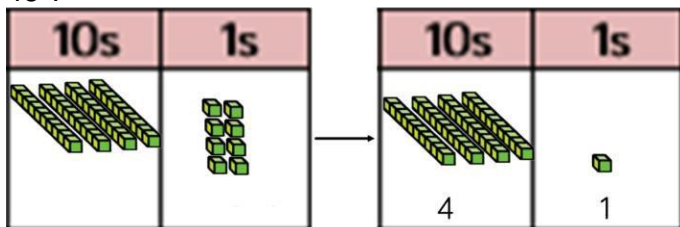
Children to show how they can make 10 by partitioning the subtrahend.

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

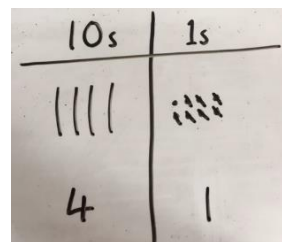
$$\begin{array}{l} 14 - 4 = 10 \\ 10 - 1 = 9 \end{array}$$

**Column method** using base 10.

$48 - 7$



Children to represent the base 10 pictorially.

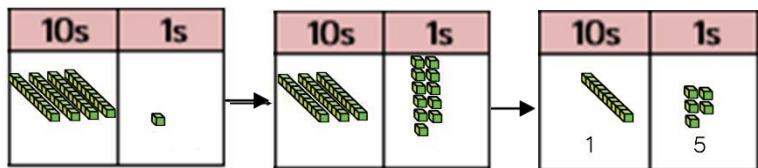


Column method or children could count back 7.

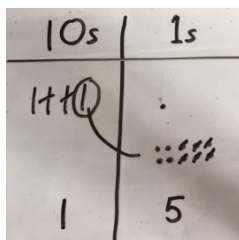
	4	8
-		7
	4	1



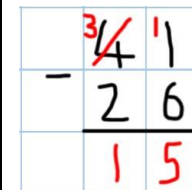
**Column method** using base 10 and having to exchange.  
41 – 26



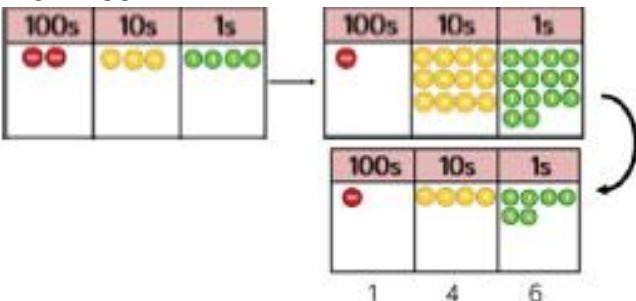
Represent the base 10 pictorially, remembering to show the exchange.



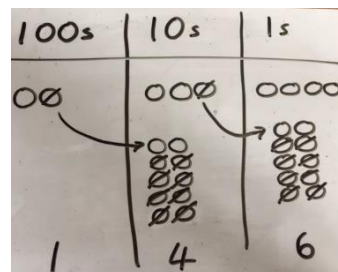
Formal column method. Children must understand that when they have exchanged the 10, they still have 41 because  $41 = 30 + 11$ .



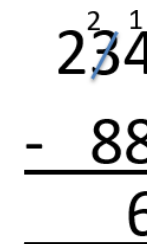
**Column method** using place value counters.  
234 – 88



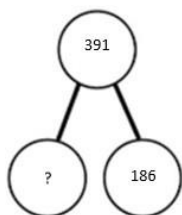
Represent the place value counters pictorially; remembering to show what has been exchanged.



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



391	
186	?

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

Calculate the difference between 391 and 186.

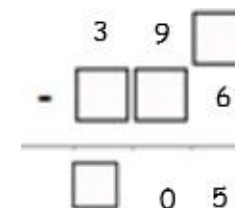
$$\boxed{\phantom{00}} = 391 - 186$$

391

-186

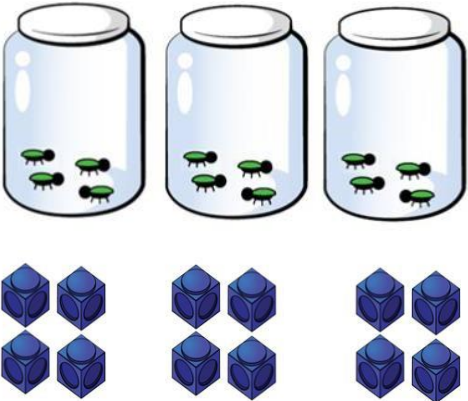
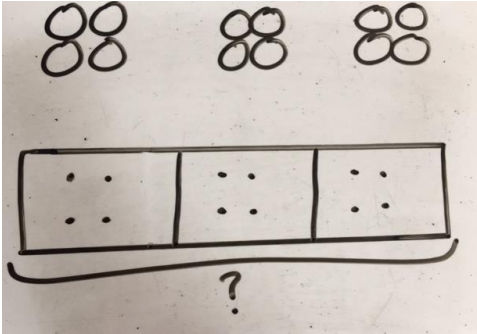
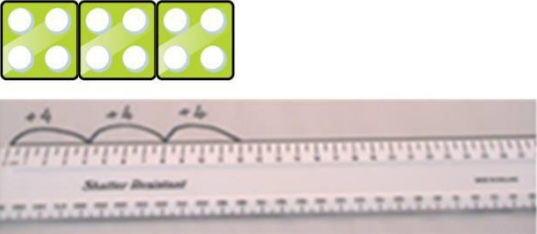
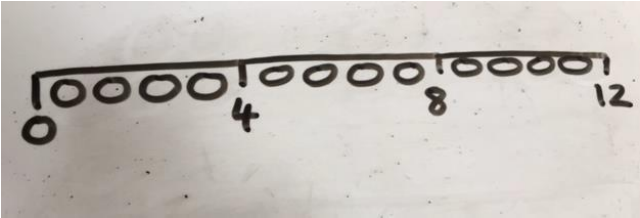
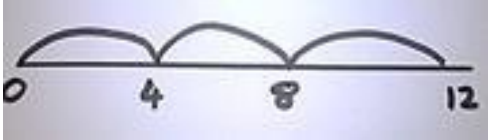
What is 186 less than 391?

Missing digit calculations



# Calculation policy: Multiplication

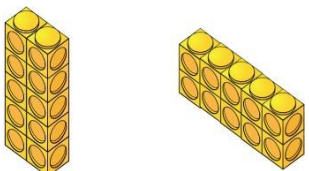
Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups.

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 jumps of four.</p> <p><math>3 \times 4 = 12</math></p> 



**Use arrays to illustrate commutativity** counters and other objects can also be used.

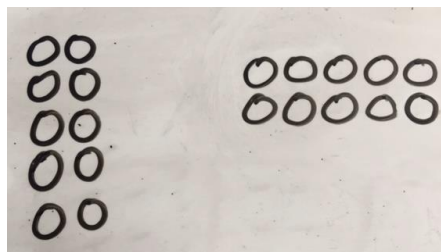
$$2 \times 5 = 5 \times 2$$



2 lots of 5

5 lots of 2

Children to represent the arrays pictorially.



Children to be able to use an array to write a range of calculations e.g.

$$10 = 2 \times 5$$

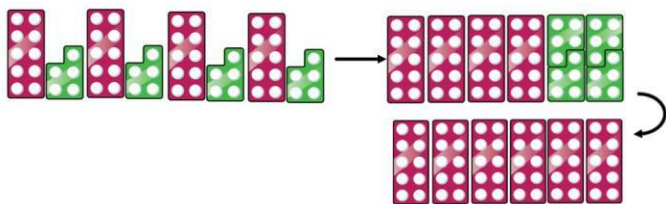
$$5 \times 2 = 10$$

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

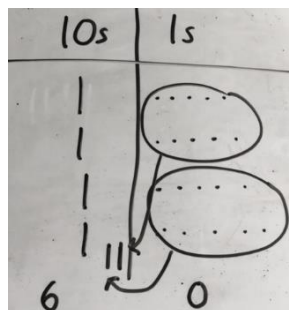
$$10 = 5 + 5$$

**Partition to multiply** using Numicon, base 10 or Cuisenaire rods.

$$4 \times 15$$



Children to represent the concrete manipulatives pictorially.



Children to be encouraged to show the steps they have taken.

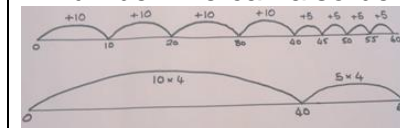
$$\begin{array}{r} 4 \times 15 \\ \swarrow \searrow \\ 10 \quad 5 \end{array}$$

$$10 \times 4 = 40$$

$$5 \times 4 = 20$$

$$40 + 20 = 60$$

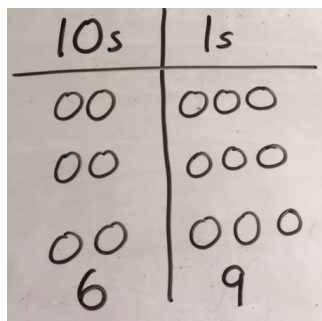
A number line can also be used



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

10s	1s
6	9

Children to represent the counters pictorially.



Children to record what it is they are doing to show understanding.

$$3 \times 23$$

$$3 \times 20 = 60$$



$$3 \times 3 = 9$$

$$60 + 9 = 69$$




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

**Formal column method** with place value counters.

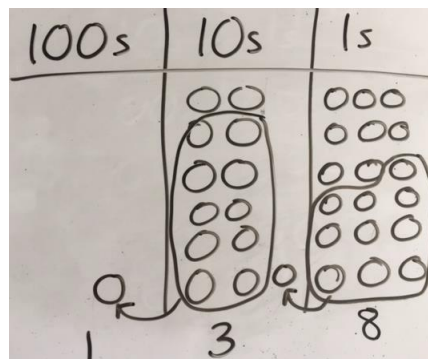
$$6 \times 23$$

100s	10s	1s
		



100s	10s	1s
		

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



Formal written method

$$6 \times 23 =$$

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

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  $6 \times 124$ .

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

$$\begin{array}{r} 124 \\ \times 26 \\ \hline 744 \\ 2480 \\ \hline 3224 \end{array}$$

Answer: 3224

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

23	23	23	23	23	23
----	----	----	----	----	----

?

Mai had to swim 23 lengths, 6 times a week.  
How many lengths did she swim in one week?



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

Find the product of 6 and 23

$$6 \times 23 =$$

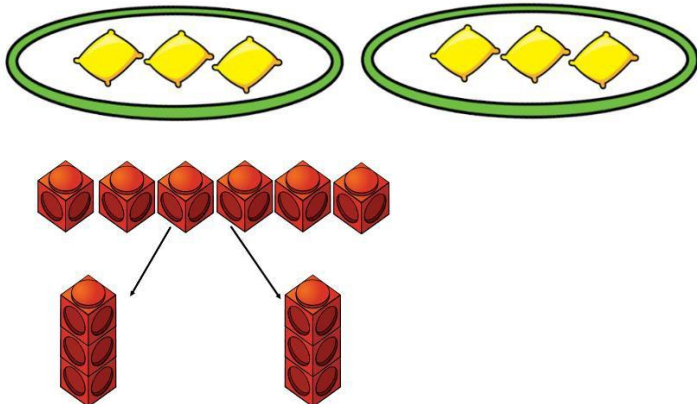
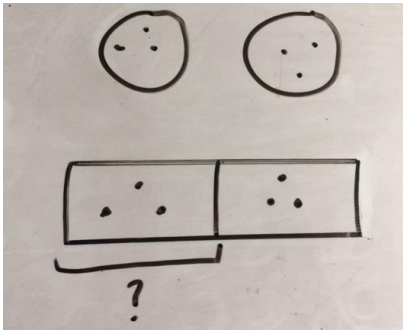
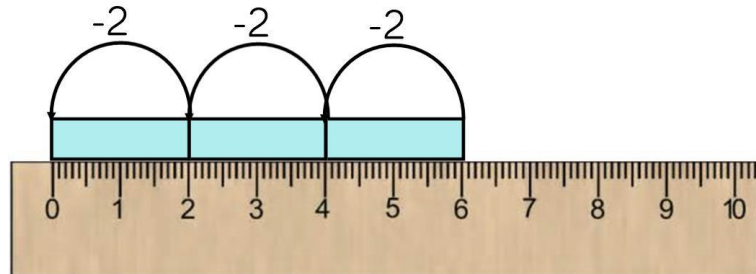
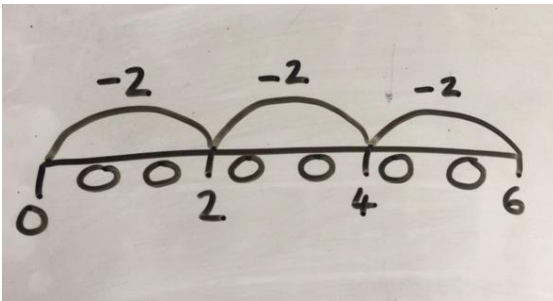
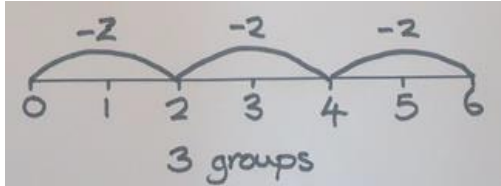
$$\begin{array}{r} 6 \times 23 \\ \times 23 \\ \hline \end{array} \quad \begin{array}{r} 6 \times 23 \\ \times 6 \\ \hline \end{array}$$

What is the calculation?  
What is the product?

100s	10s	1s
		

# Calculation policy: Division

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

Concrete	Pictorial	Abstract		
<p><b>Sharing</b> using a range of objects. <math>6 \div 2</math></p> 	<p>Represent the sharing pictorially.</p> 	<p><math>6 \div 2 = 3</math></p> <table border="1" data-bbox="1554 475 2002 544"><tr><td>3</td><td>3</td></tr></table> <p>Children should also be encouraged to use their 2 times tables facts.</p>	3	3
3	3			
<p><b>Repeated subtraction</b> using Cuisenaire rods above a ruler. <math>6 \div 2</math></p>  <p>3 groups of 2</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. Cuisenaire rods, above a ruler can also be used.

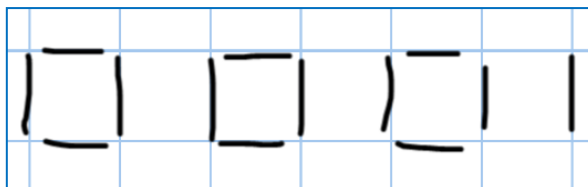
$$13 \div 4$$

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.

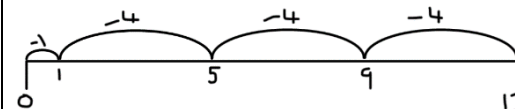


There are 3 whole squares, with 1 left over.

$$13 \div 4 = 3 \text{ remainder } 1$$

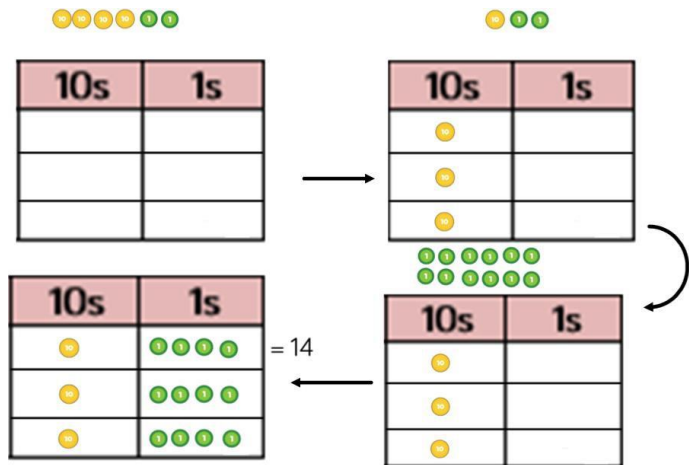
Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line.

'3 groups of 4, with 1 left over'

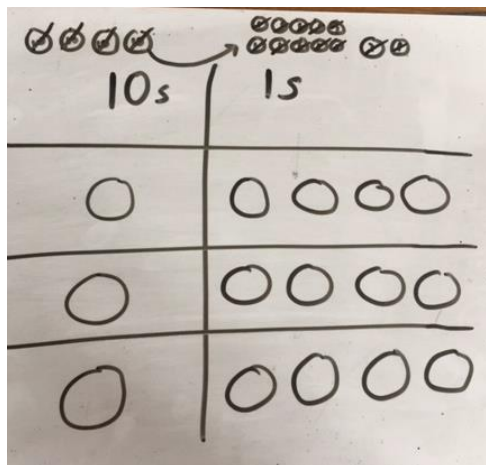


**Sharing using place value counters.**

$$42 \div 3 = 14$$



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.

$$42 \div 3$$

$$42 = 30 + 12$$

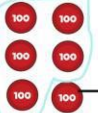


$$30 \div 3 = 10$$

$$12 \div 3 = 4$$

$$10 + 4 = 14$$

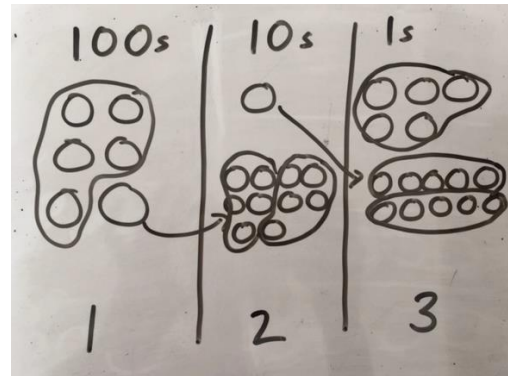
**Short division** using place value counters to group.

$$615 \div 5$$

100s	10s	1s
		
1	2	3

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.




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

**Long division** using place value counters

$$2544 \div 12$$

1000s	100s	10s	1s
			

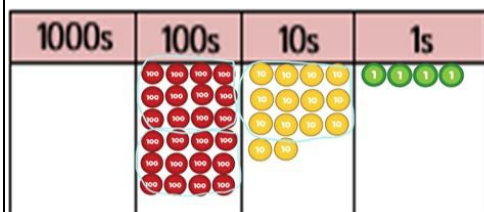
We can't group 2 thousands into groups of 12 so will exchange them.

1000s	100s	10s	1s
			

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

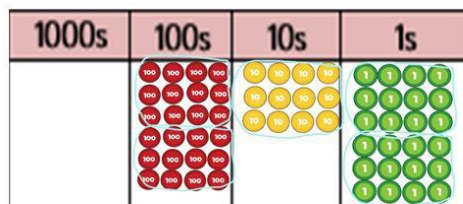
$$\begin{array}{r} 02 \\ 12 \overline{) 2544} \\ \underline{24} \\ 1 \end{array}$$





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

$$\begin{array}{r} 021 \\ 12 \overline{) 2544} \\ \underline{24} \phantom{0} \\ 14 \phantom{0} \\ \underline{12} \phantom{0} \\ 2 \phantom{0} \end{array}$$

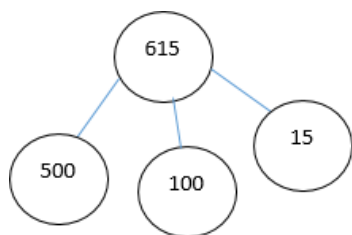


After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

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

## 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?

$$5 \overline{) 615}$$

$$615 \div 5 =$$

$$\boxed{\phantom{000}} = 615 \div 5$$

What is the calculation?  
What is the answer?

