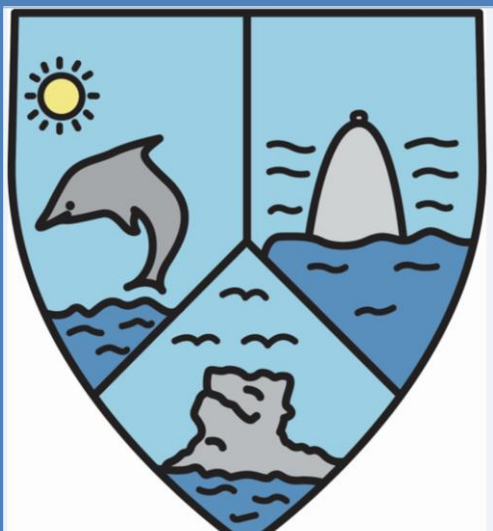


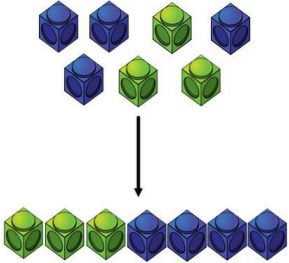
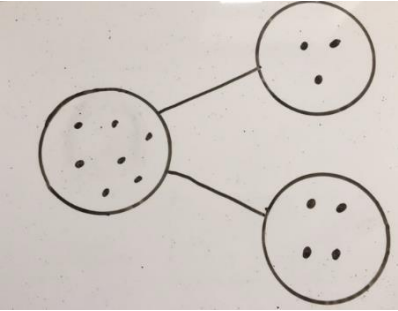
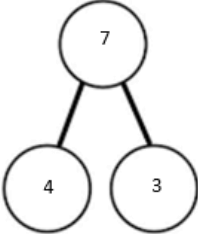
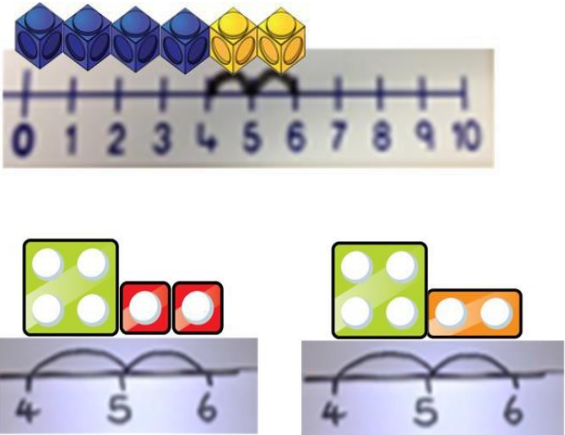
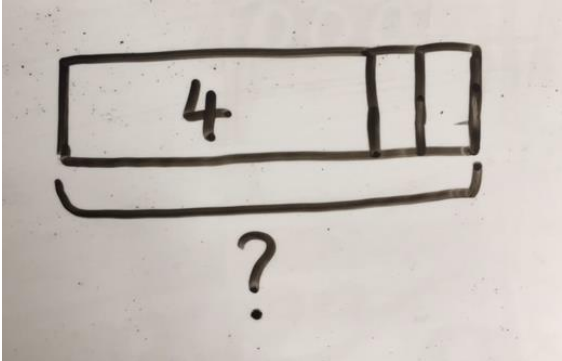

# **CALCULATION POLICY PORTREATH SCHOOL**



**September 2018**

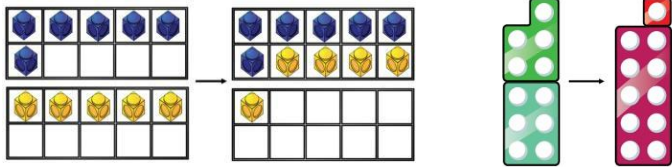
# Calculation policy: Addition

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

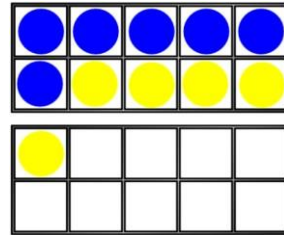
Concrete	Pictorial	Abstract
<p><b>Combining two parts to make a whole</b> (use other resources too e.g. eggs, shells, teddy bears, cars).</p>  <p>The illustration shows two separate groups of cubes: one group of four blue cubes and one group of three green cubes. An arrow points down to a single row of seven cubes, where the first four are green and the last three are blue, representing the sum of the two groups.</p>	<p>Children to represent the cubes using dots or crosses. They could put each part on a part whole model too.</p>  <p>A hand-drawn diagram showing a large circle on the left containing seven dots. Two lines connect it to two smaller circles on the right. The top-right circle contains four dots, and the bottom-right circle contains three dots, illustrating the decomposition of the whole into two parts.</p>	<p><math>4 + 3 = 7</math> Four is a part, 3 is a part and the whole is seven.</p>  <p>An abstract diagram of a part-whole model. A large circle at the top contains the number 7. Two lines connect it to two smaller circles below. The left circle contains the number 4, and the right circle contains the number 3.</p>
<p><b>Counting on using number lines</b> using cubes or Numicon.</p>  <p>The illustration shows a number line from 0 to 10. Blue cubes are placed on the numbers 0 through 4, and yellow cubes on 5 and 6. A curved arrow starts at 4 and points to 6. Below the number line are two Numicon blocks: a green block with four dots and two red blocks with one dot each, and another set with a green block (4 dots) and an orange block (2 dots). Both sets have a curved arrow starting at 4 and ending at 6 on a number line.</p>	<p>A bar model which encourages the children to count on, rather than count all.</p>  <p>A hand-drawn bar model consisting of a long rectangle divided into three sections. The first section is labeled with the number 4. The other two sections are empty. Below the bar is a large question mark.</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>  <p>An abstract number line from 4 to 6. A curved arrow starts at 4 and ends at 5. A second curved arrow starts at 5 and ends at 6, showing the process of counting on from 4 by 2 to reach 6.</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.

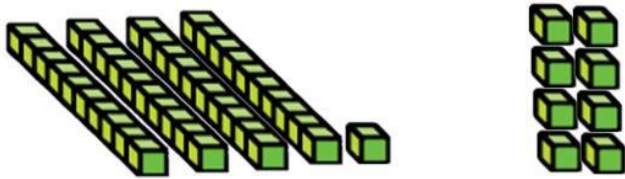
$6 + \square = 11$

$6 + 5 = 5 + \square$

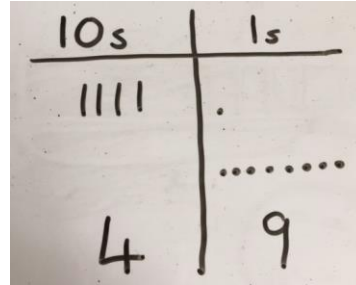
$6 + 5 = \square + 4$

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

41 + 8

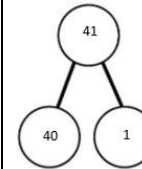


Children to represent the base 10 e.g. lines for tens and dot/crosses for ones.



41 + 8

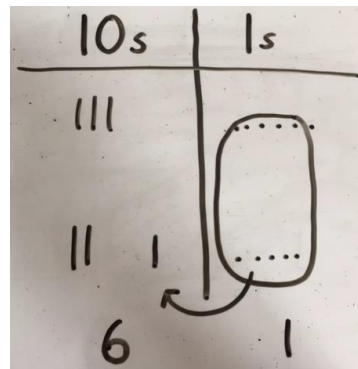
$1 + 8 = 9$   
 $40 + 9 = 49$



	4	1
+		8
<hr/>		
	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.

$36 + 25 =$

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

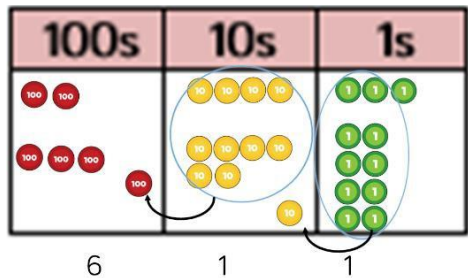
36

Formal method:

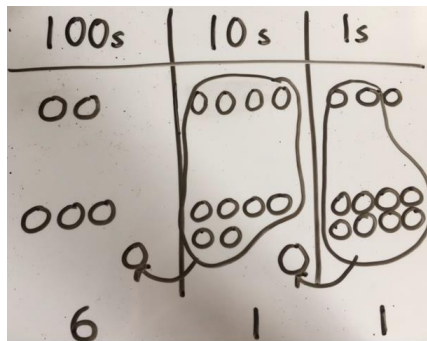
36

$+25$
<hr/>
61
<hr/>
1

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.

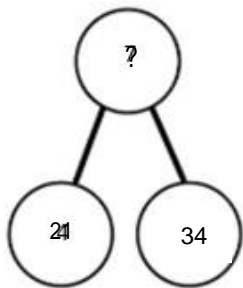


Children to represent the counters in a place value chart, circling when they make an exchange.



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

## 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?

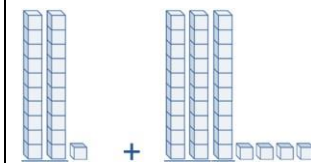
$21 + 34 = 55$ . Prove it

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

$21 + 34 =$

$\square = 21 + 34$

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

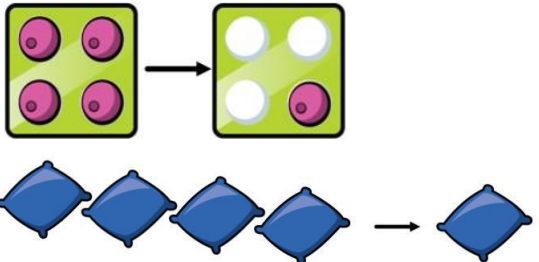
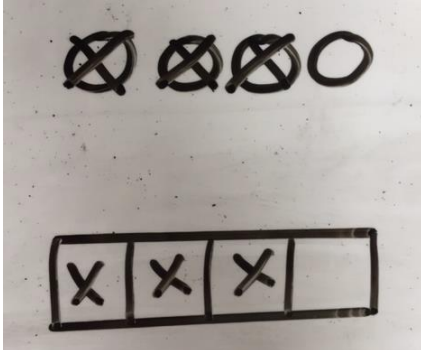

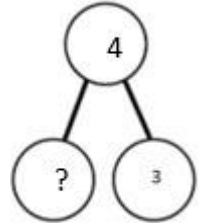
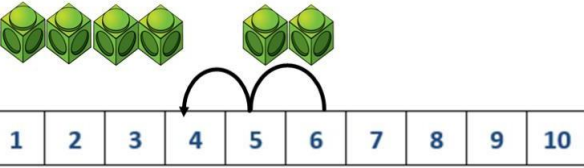
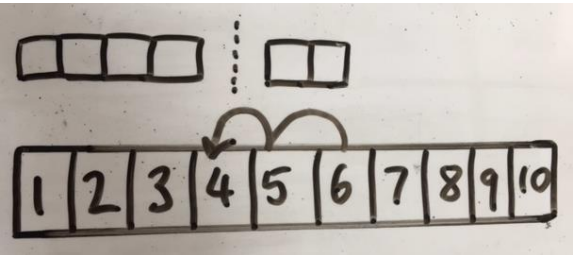
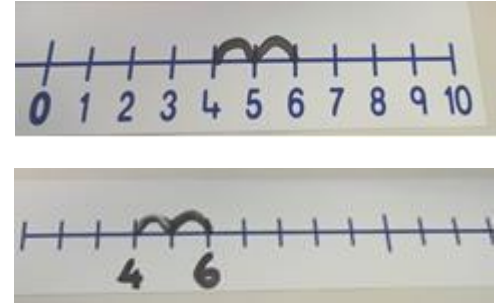


Missing digit problems:

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

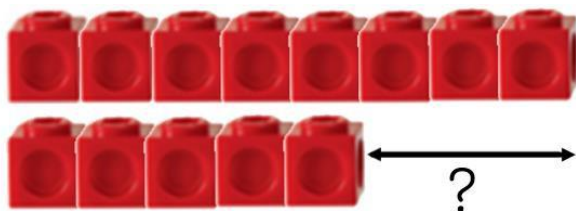
# Subtraction

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

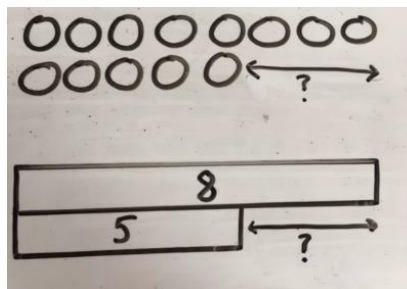
Concrete	Pictorial	Abstract				
<p><b>Physically taking away and removing objects from a whole</b> (ten frames, Numicon, cubes and other items such as beanbags could be used).</p> <p><math>4 - 3 = 1</math></p> 	<p>Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used.</p> 	<p><math>4 - 3 =</math></p> <p> <math>= 4 - 3</math></p> <table border="1" data-bbox="1646 550 1960 630"> <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.



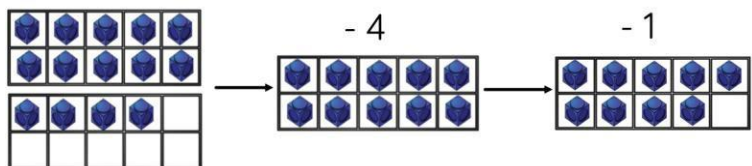
Find the difference between 8 and 5.

8 - 5, the difference is

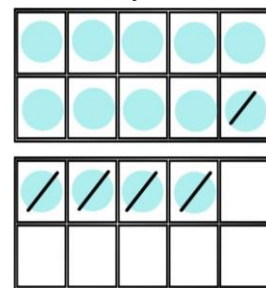
Children to explore why  $9 - 6 = 8 - 5 = 7 - 4$  have the same difference.

**Making 10** using ten frames.

$14 - 5$



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



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

$$14 - 5 = 9$$

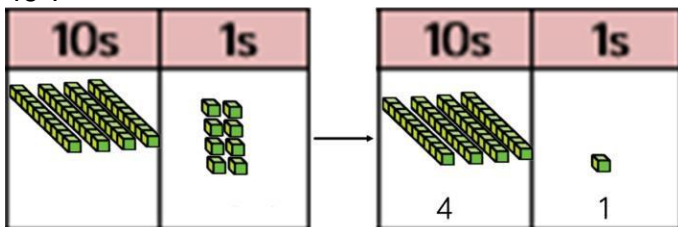
$$\begin{array}{c} 4 \quad 1 \end{array}$$

$$14 - 4 = 10$$

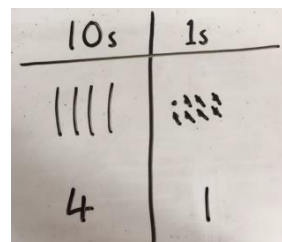
$$10 - 1 = 9$$

**Column method** using base 10.

$48 - 7$



Children to represent the base 10 pictorially.

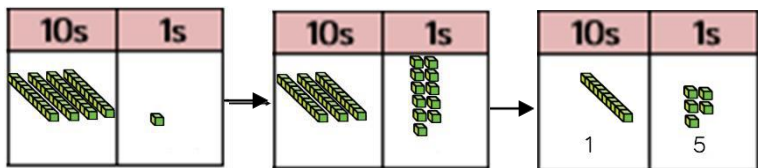


Column method or children could count back 7.

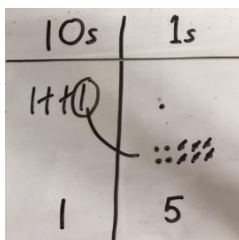
	4	8
-		7
	4	1



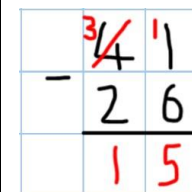
**Column method** using base 10 and having to exchange.  
41 – 26



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

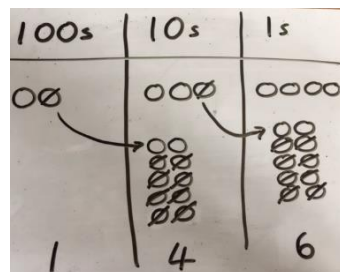


Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because  $41 = 30 + 11$ .

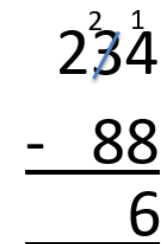


**Column method** using place value counters.  
234 – 88

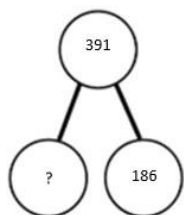
Represent the place value counters pictorially; remembering to show what has been exchanged.



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.

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

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

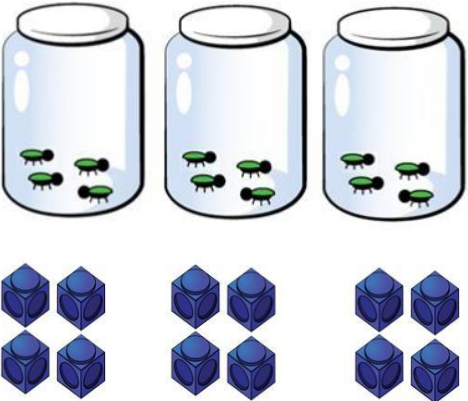
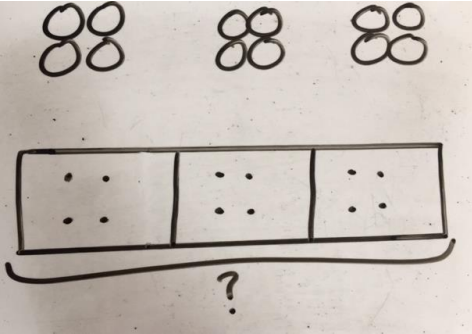
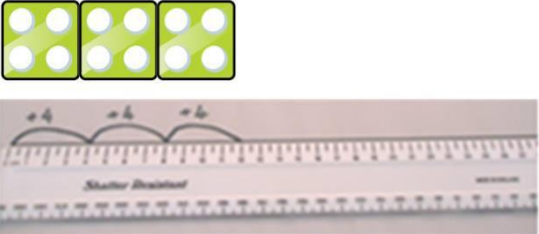
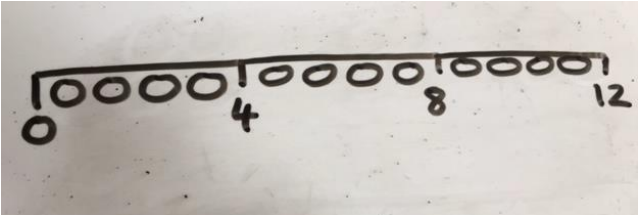
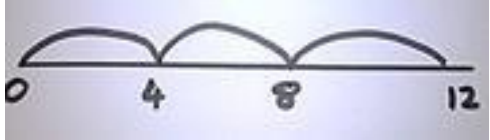
What is 186 less than 391?

Missing digit calculations

$$\begin{array}{r} 39\boxed{\phantom{0}} \\ - \boxed{\phantom{0}}\boxed{\phantom{0}}6 \\ \hline \boxed{\phantom{0}}05 \end{array}$$

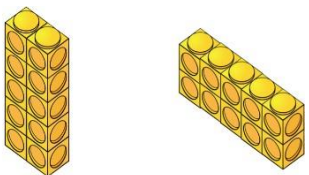
# Calculation policy: Multiplication

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>The image shows three identical jars, each containing four small green beetles. Below the jars are three groups of four blue cubes, arranged in two rows of two cubes each.</p>	<p>Children to represent the practical resources in a picture and use a bar model.</p>  <p>The image shows a hand-drawn pictorial representation. At the top, there are three groups of four small circles arranged in a 2x2 grid. Below this is a hand-drawn bar model consisting of a long rectangle divided into three equal sections. Each section contains four dots arranged in a 2x2 grid. A bracket underneath the entire bar model has a question mark below it.</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>The image shows three green Cuisenaire rods, each with four white dots. Below them is a ruler with three curved arrows indicating jumps of 4 units each, starting from 0 and ending at 12.</p> <p>Cuisenaire rods can be used too.</p>	<p>Represent this pictorially alongside a number line e.g.:</p>  <p>The image shows a hand-drawn number line from 0 to 12. There are three curved arrows indicating jumps of 4 units each, starting from 0 and ending at 12. The numbers 4, 8, and 12 are marked on the line.</p>	<p>Abstract number line showing three jumps of four.</p> <p><math>3 \times 4 = 12</math></p>  <p>The image shows an abstract number line from 0 to 12. There are three curved arrows indicating jumps of 4 units each, starting from 0 and ending at 12. The numbers 4, 8, and 12 are marked on the line.</p>

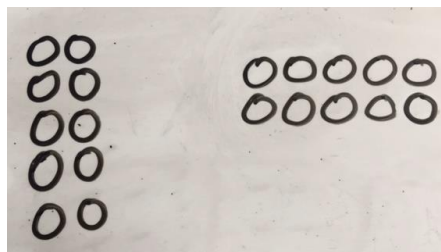


**Use arrays to illustrate commutativity** counters and other objects can also be used.  
 $2 \times 5 = 5 \times 2$



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.

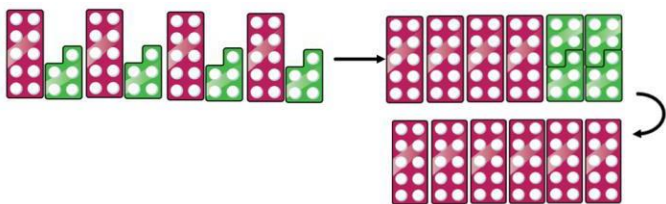
$$10 = 2 \times 5$$

$$5 \times 2 = 10$$

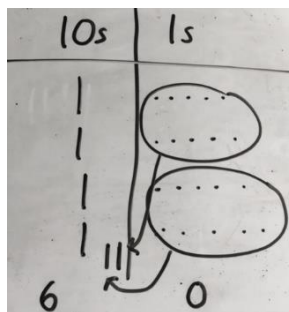
$$2 + 2 + 2 + 2 + 2 = 10$$

$$10 = 5 + 5$$

**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.

$$4 \times 15$$

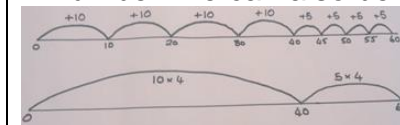
$$\begin{array}{r} 10 \\ 5 \end{array}$$

$$10 \times 4 = 40$$

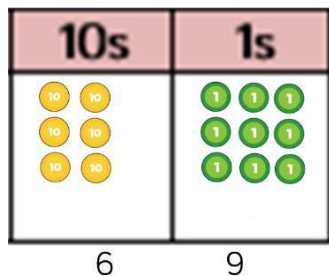
$$5 \times 4 = 20$$

$$40 + 20 = 60$$

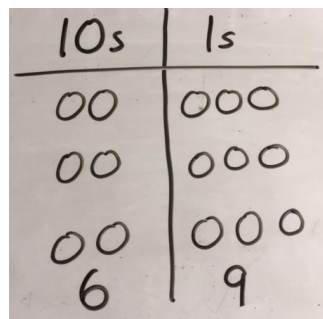
A number line can also be used



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



Children to represent the counters pictorially.



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

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

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

$$20 \quad 3 \quad 60 + 9 = 69$$

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

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

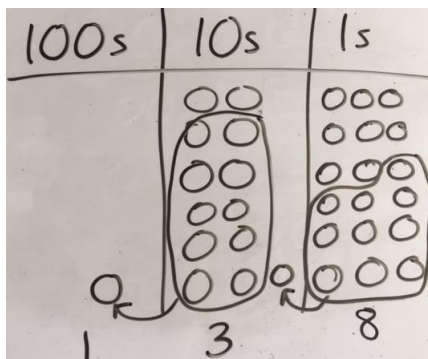
$6 \times 23$

100s	10s	1s
	60	18



100s	10s	1s
1	38	8

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



Formal written method

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

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  $6 \times 124$ .

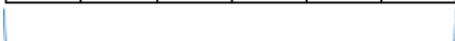
To get 2480 they have solved  $20 \times 124$ .

$$\begin{array}{r}
 124 \\
 \times 26 \\
 \hline
 744 \\
 2480 \\
 \hline
 3224 \\
 11
 \end{array}$$

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

$6 \times 23 =$

$\square = 6 \times 23$

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

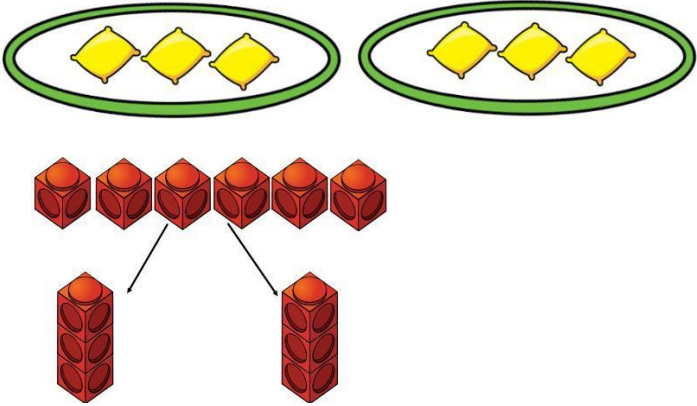
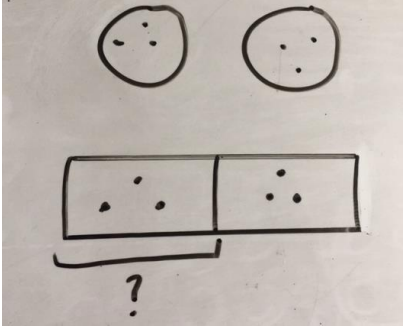
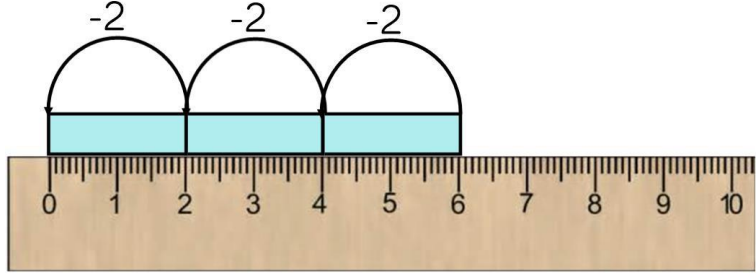
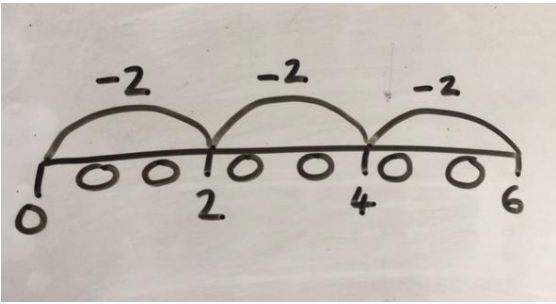
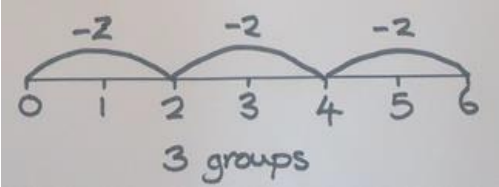
What is the calculation?

What is the product?

100s	10s	1s
	60	18

# 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>The diagram shows two green ovals, each containing three yellow diamonds. Below them is a row of six red cubes. Two arrows point from the first and fourth cubes to two separate vertical stacks of three cubes each, illustrating the sharing process.</p>	<p>Represent the sharing pictorially.</p>  <p>The diagram shows two hand-drawn circles, each containing three dots. Below them is a hand-drawn rectangle divided into two equal halves, each containing three dots. A bracket under the first half is labeled with a question mark, indicating the unknown number of groups.</p>	<p><math>6 \div 2 = 3</math></p> <table border="1" data-bbox="1554 478 2004 547"><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>The diagram shows a ruler from 0 to 10. Three light blue Cuisenaire rods, each representing 2 units, are placed above the ruler. Arched lines above each rod are labeled '-2', showing the subtraction of 2 from 6. Below the ruler, the text '3 groups of 2' is written.</p>	<p>Children to represent repeated subtraction pictorially.</p>  <p>The diagram shows a hand-drawn number line from 0 to 6. Three arcs are drawn above the line, each labeled '-2'. The arcs start at 0, 2, and 4, and end at 2, 4, and 6 respectively. Below the line, the numbers 0, 2, 4, and 6 are marked, and the text '3 groups' is written below the line.</p>	<p>Abstract number line to represent the equal groups that have been subtracted.</p>  <p>The diagram shows a hand-drawn number line from 0 to 6. Three arcs are drawn above the line, each labeled '-2'. The arcs start at 0, 2, and 4, and end at 2, 4, and 6 respectively. Below the line, the numbers 0, 1, 2, 3, 4, 5, and 6 are marked, and the text '3 groups' is written below the line.</p>		

**2d ÷ 1d with remainders** using lollipop sticks. Cuisenaire rods, above a ruler can also be used.

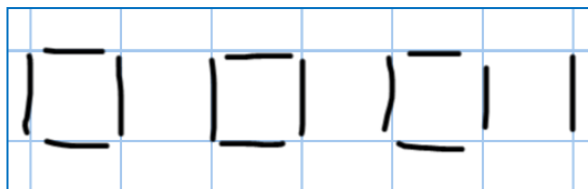
$13 \div 4$

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.

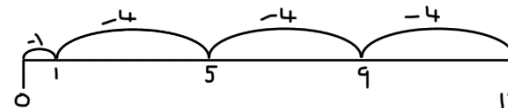


There are 3 whole squares, with 1 left over.

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

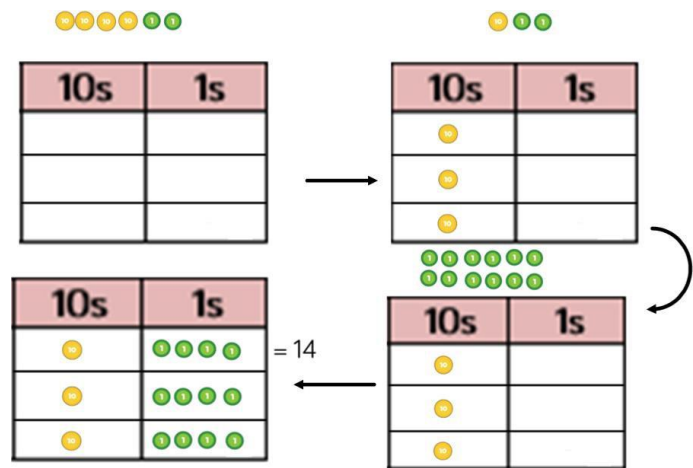
Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line.

'3 groups of 4, with 1 left over'

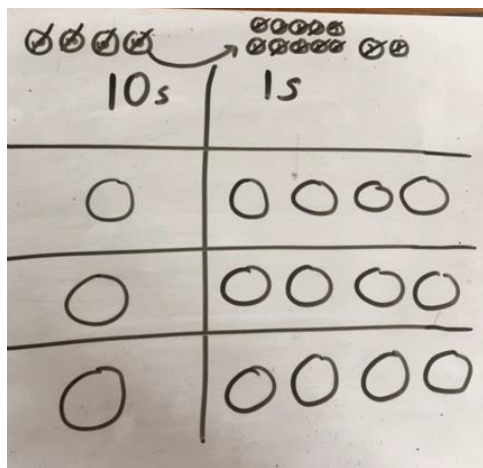


**Sharing using place value counters.**

$42 \div 3 = 14$



Children to represent the place value counters pictorially.

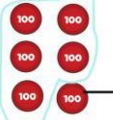
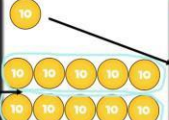



Children to be able to make sense of the place value counters and write calculations to show the process.

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

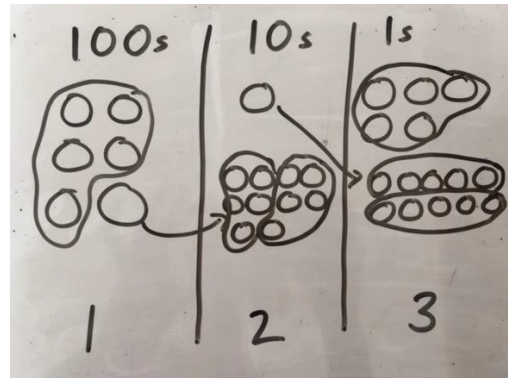
**Short division** using place value counters to group.

$$615 \div 5$$

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.




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

**Long division** using place value counters

$$2544 \div 12$$

1000s	100s	10s	1s
			

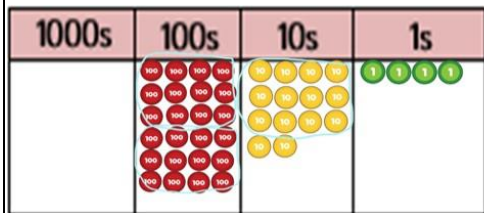
We can't group 2 thousands into groups of 12 so will exchange them.

1000s	100s	10s	1s
			

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

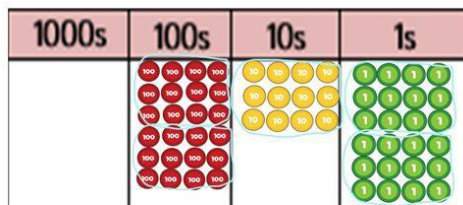
$$\begin{array}{r}
 02 \\
 12 \overline{) 2544} \\
 \underline{24} \phantom{0} \\
 1 \phantom{0}
 \end{array}$$





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

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

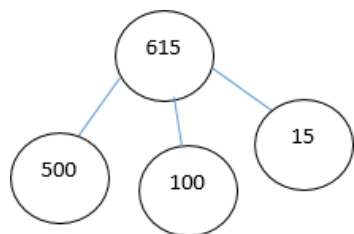


After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

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

## 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?

