

Naseby C of E Primary Academy

Policy Name	Calculation Policy
Owner	Naseby CE Primary Academy
Statutory	No

Date published	Review Date
September 2019	September 2020

Naseby C of E Primary Academy Aims

Our aim is to teach calculation with understanding, and not just as a process that is to be remembered. This Calculation Policy clarifies progression in calculation with examples that are ‘mathematically transparent’, in other words the way the calculation works is clear and supports the development of mathematical concepts within a school that fosters and encourages Christian values.

The Aims of 2014 curriculum:

The national curriculum for mathematics aims to ensure that all pupils:

- become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Recording

Recording is developed in a range of ways, including the following. Although initially they will be developed in this order, once a way of recording, such as ‘by showing real objects’, is in place, that will continue to be used throughout the Primary years. In EYFS most recording will be by showing real objects, whereas in Y6 real objects may be used to show an understanding of calculation.

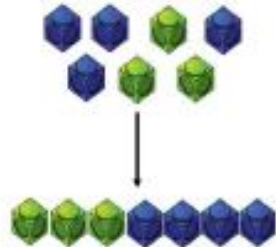
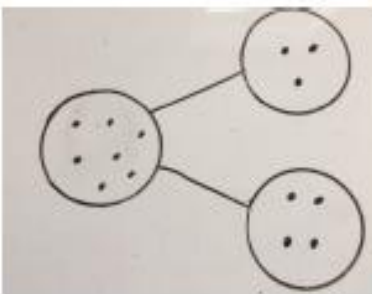
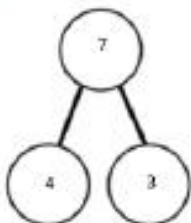
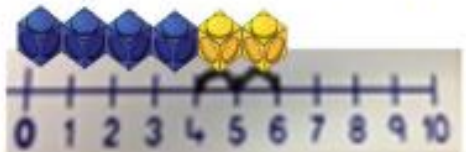
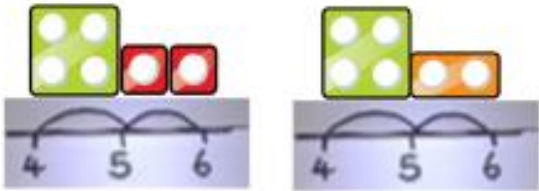
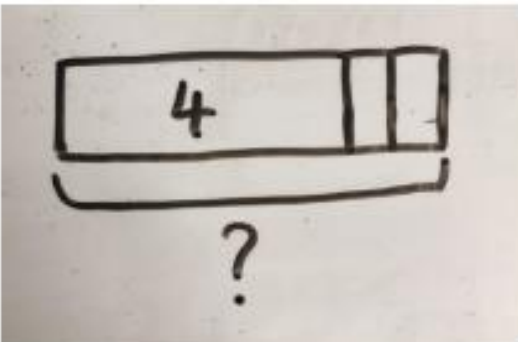

Development of recording:

- by showing real objects
- by photographing or drawing the calculation activity
- counting on a number line
- a practical calculation activity on a number line
- a number bond on a number line
- a mental calculation on a number line
- a practical activity as a number sentence
- a number bond as a number sentence
- a mental calculation as a number sentence
- a written calculation

	EYFS/Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	<p>Combining two parts to make a whole: part whole model.</p> <p>Starting at the bigger number and counting on- using cubes.</p> <p>Regrouping to make 10 using ten frame.</p>	<p>Adding three single digits.</p> <p>Use of base 10 to combine two numbers.</p>	<p>Column method- regrouping.</p> <p>Using place value counters (up to 3 digits).</p>	<p>Column method- regrouping.</p> <p>(up to 4 digits)</p>	<p>Column method- regrouping.</p> <p>Use of place value counters for adding decimals.</p>	<p>Column method- regrouping.</p> <p>Abstract methods.</p> <p>Place value counters to be used for adding decimal numbers.</p>
Subtraction	<p>Taking away ones</p> <p>Counting back</p> <p>Find the difference</p> <p>Part whole model</p> <p>Make 10 using the ten frame</p>	<p>Counting back</p> <p>Find the difference</p> <p>Part whole model</p> <p>Make 10</p> <p>Use of base 10</p>	<p>Column method with regrouping.</p> <p>(up to 3 digits using place value counters)</p>	<p>Column method with regrouping.</p> <p>(up to 4 digits)</p>	<p>Column method with regrouping.</p> <p>Abstract for whole numbers.</p> <p>Start with place value counters for decimals- with the same amount of decimal places.</p>	<p>Column method with regrouping.</p> <p>Abstract methods.</p> <p>Place value counters for decimals- with different amounts of decimal places.</p>

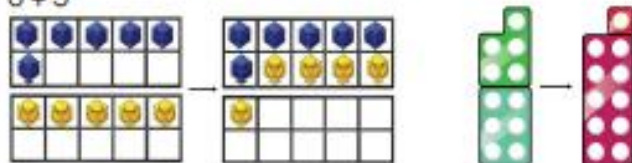
Calculation policy: Addition

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

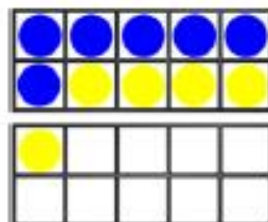
Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars).</p> 	<p>Children to represent the cubes using dots or crosses. They could put each part on a part whole model too.</p> 	<p>$4 + 3 = 7$ Four is a part, 3 is a part and the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

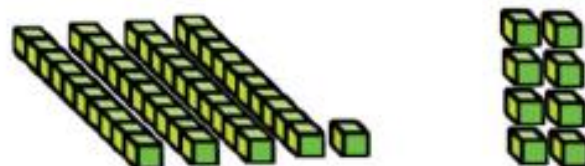
$$6 + \square = 11$$

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

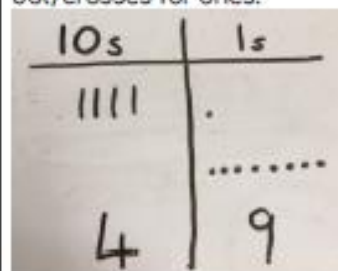
$$6 + 5 = \square + 4$$

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

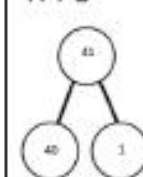
$$41 + 8$$



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

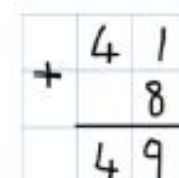


$$41 + 8$$



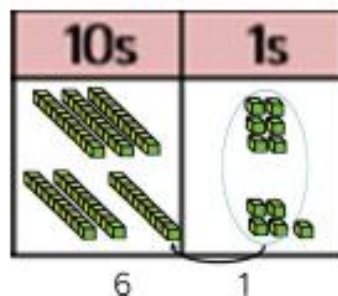
$$1 + 8 = 9$$

$$40 + 9 = 49$$

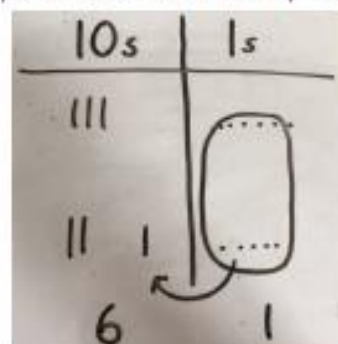


TO + TO using base 10. Continue to develop understanding of partitioning and place value.

$$36 + 25$$



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



Looking for ways to make 10.

$$36 + 25 =$$

$$30 + 20 = 50$$

$$5 + 5 = 10$$

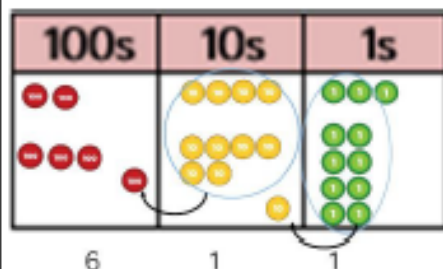
$$50 + 10 + 1 = 61$$

$$36$$

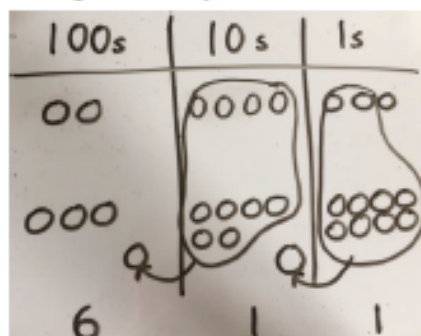
Formal method:

$$\begin{array}{r} +25 \\ 36 \\ \hline 61 \\ 1 \end{array}$$

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.



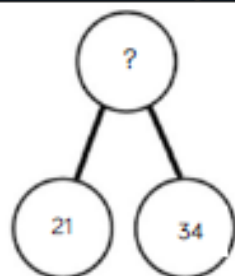
243

+368

611

1 1

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



?	
21	34

Word problems:

In year 3, there are 21 children and in year 4, there are 34 children. How many children in total?

$21 + 34 = 55$. Prove it

21

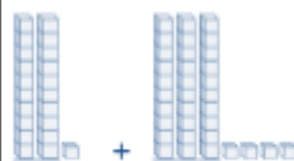
+34

—

$21 + 34 =$

= $21 + 34$

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

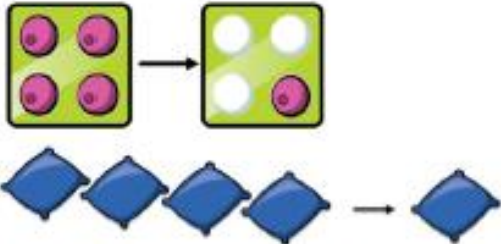
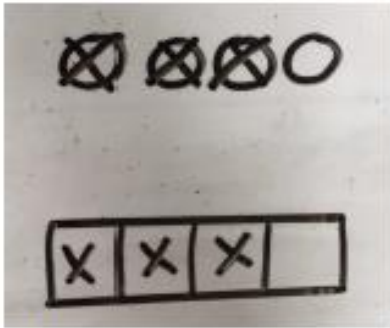
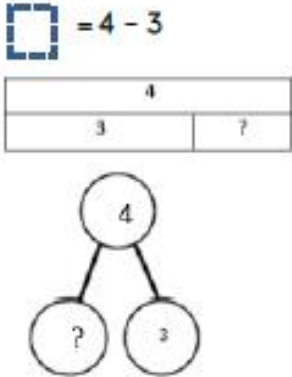

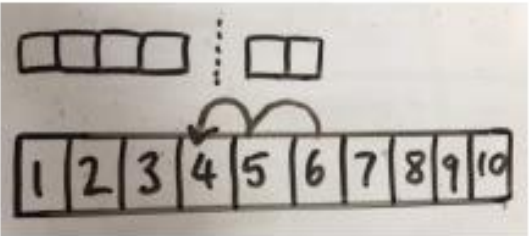
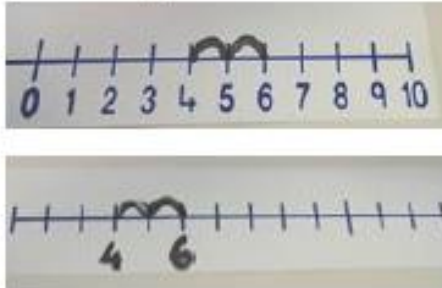


Missing digit problems:

10s	1s
20	1
30	?
?	5

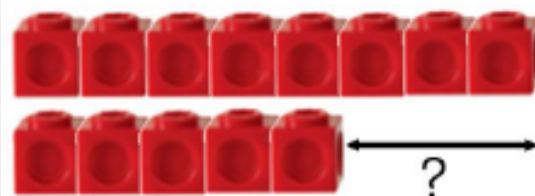
Calculation policy: Subtraction

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

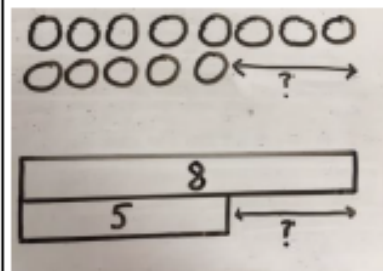
Concrete	Pictorial	Abstract
<p>Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used).</p> <p>$4 - 3 = 1$</p> 	<p>Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also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

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.



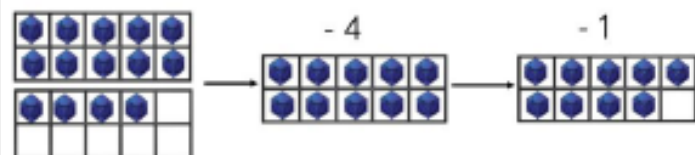
Find the difference between 8 and 5.

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.

$$14 - 5 = 9$$

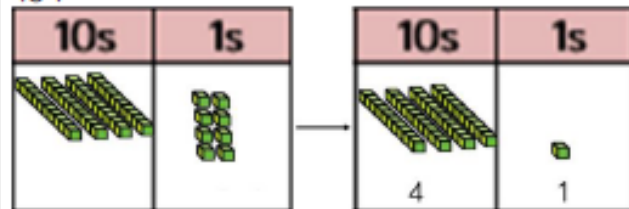
$\swarrow \quad \searrow$
 4 1

$$14 - 4 = 10$$

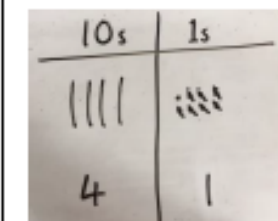
$$10 - 1 = 9$$

Column method using base 10.

48 - 7



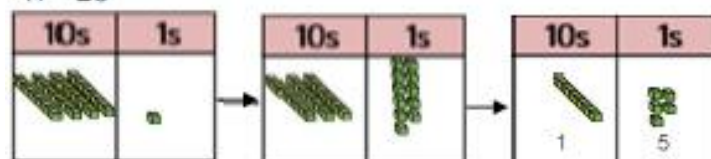
Children to represent the base 10 pictorially.



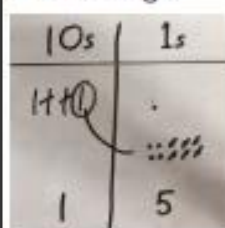
Column method or children could count back 7.

	4	8
-		7
	4	1

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



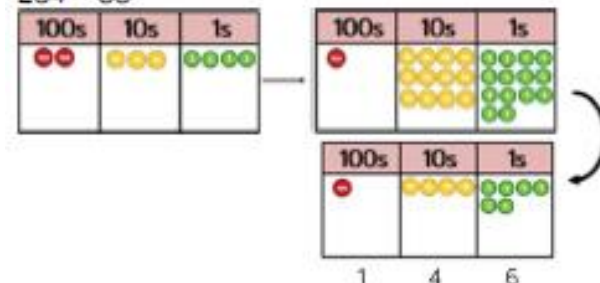
Represent the base 10 pictorially, remembering to show the exchange.



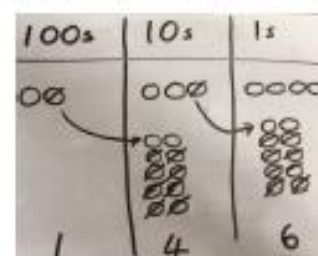
Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because $41 = 30 + 11$.

$$\begin{array}{r} \overset{3}{4} \overset{1}{1} \\ - 26 \\ \hline 15 \end{array}$$

Column method using place value counters.
234 - 88



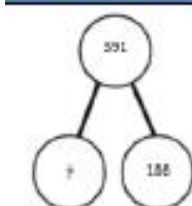
Represent the place value counters pictorially; remembering to show what has been exchanged.



Formal column method. Children must understand what has happened when they have crossed out digits.

$$\begin{array}{r} \overset{2}{2} \overset{3}{3} \overset{4}{4} \\ - 88 \\ \hline 146 \end{array}$$

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.

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

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

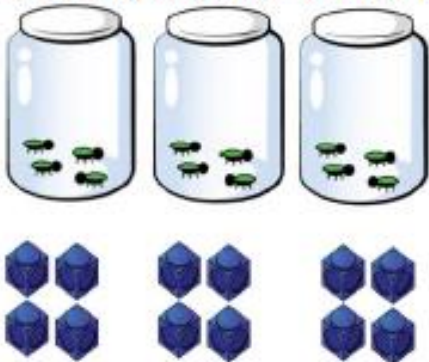
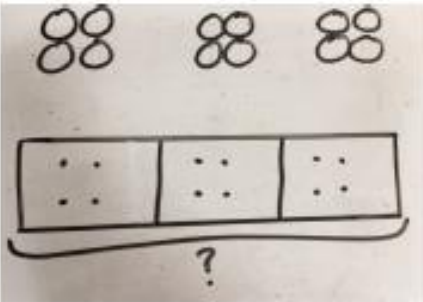

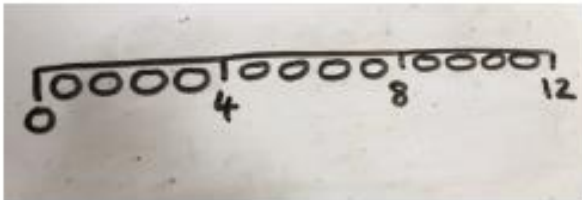
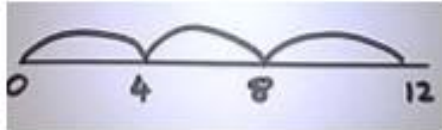
What is 186 less than 391?

Missing digit calculations

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

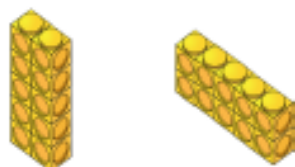
Calculation policy: Multiplication

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

Concrete	Pictorial	Abstract
<p>Repeated grouping/repeated addition 3×4 $4 + 4 + 4$ There are 3 equal groups, with 4 in each group.</p> 	<p>Children to represent the practical resources in a picture and use a bar model.</p> 	<p>$3 \times 4 = 12$ $4 + 4 + 4 = 12$</p>
<p>Number lines to show repeated groups- 3×4</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>$3 \times 4 = 12$</p> 

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

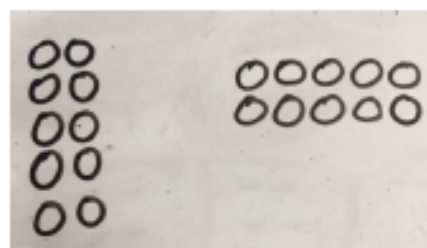
$$2 \times 5 = 5 \times 2$$



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.

$$10 = 2 \times 5$$

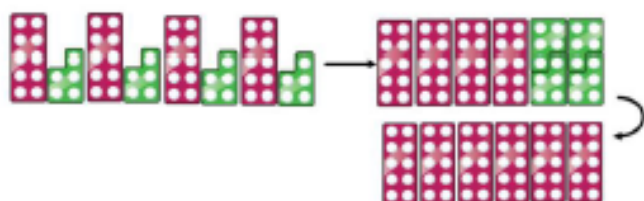
$$5 \times 2 = 10$$

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

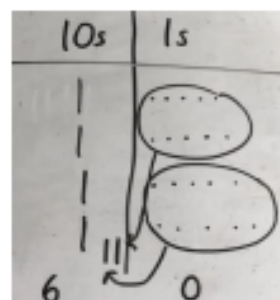
$$10 = 5 + 5$$

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.

$$4 \times 15$$

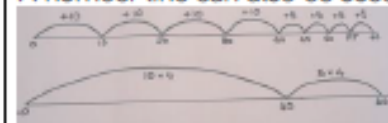
$$10 \quad 5$$

$$10 \times 4 = 40$$

$$5 \times 4 = 20$$

$$40 + 20 = 60$$

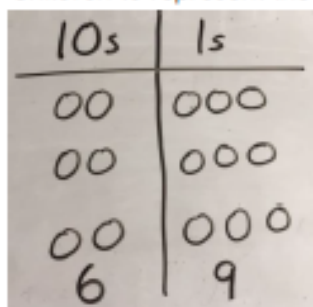
A number line can also be used



Formal column method with place value counters (base 10 can also be used.) 3×23

10s	1s
6	9

Children to represent the counters pictorially.



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

$$3 \times 23$$

$$3 \times 20 = 60$$

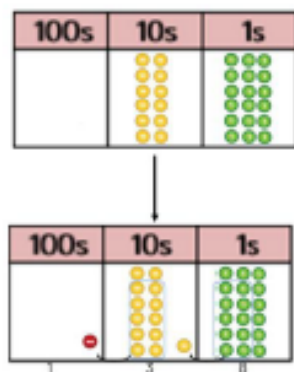
$$20 \quad 3$$

$$3 \times 3 = 9$$

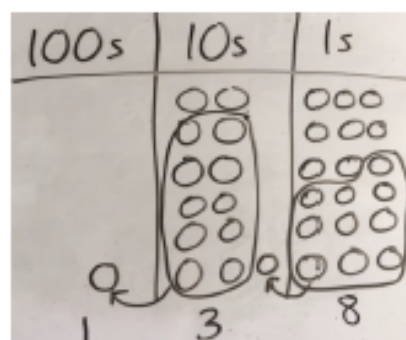
$$60 + 9 = 69$$

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

Formal column method with place value counters.
 6×23



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



Formal written method

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

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 6×124 .
 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 6×23

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 6×23
 $= 138$

Find the product of 6 and 23

$$6 \times 23 =$$

$$\square = 6 \times 23$$

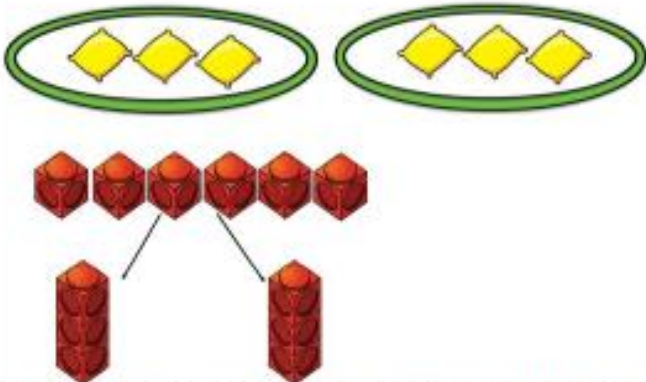
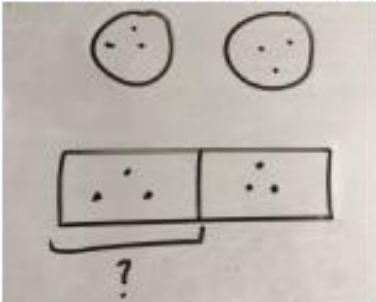

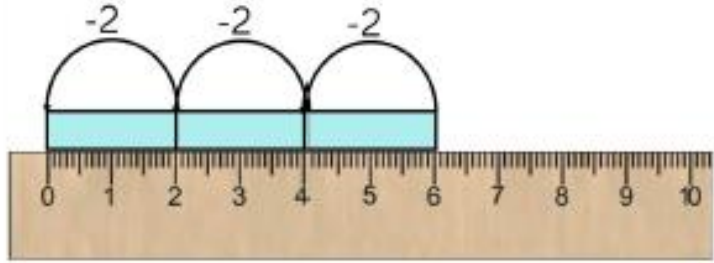
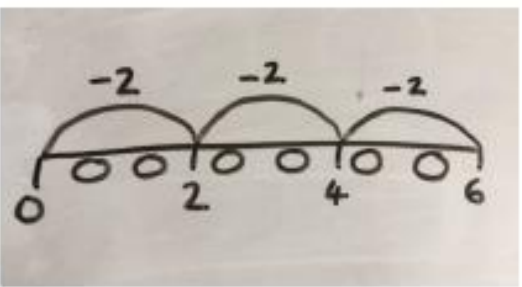
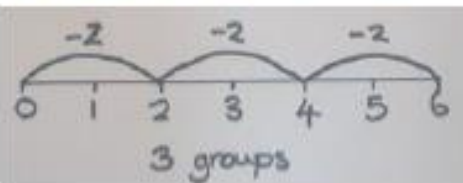
$$\begin{array}{r}
 6 \quad 23 \\
 \times 23 \quad \times 6 \\
 \hline
 \end{array}$$

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>Sharing using a range of objects. $6 \div 2$</p>  <p>The image shows two green ovals, each containing three yellow diamonds. Below these, there are six red cubes arranged in a single row. Two lines branch out from the middle of this row, pointing down to two separate vertical stacks of three red cubes each.</p>	<p>Represent the sharing pictorially.</p>  <p>The image shows two hand-drawn circles, each containing three dots. Below them is a hand-drawn rectangle divided into two equal halves, with three dots in each half. A bracket is drawn under the left half, with a question mark below it.</p>	<p>$6 \div 2 = 3$</p>  <p>The image shows a horizontal number line with two boxes. The first box contains the number 3, and the second box contains the number 3.</p> <p>Children should also be encouraged to use their 2 times tables facts.</p>
<p>Repeated subtraction using Cuisenaire rods above a ruler. $6 \div 2$</p>  <p>The image shows a wooden ruler with markings from 0 to 10. Three blue Cuisenaire rods, each labeled with a '-2' above it, are placed end-to-end along the ruler, starting from the 0 mark and ending at the 6 mark.</p> <p>3 groups of 2</p>	<p>Children to represent repeated subtraction pictorially.</p>  <p>The image shows a hand-drawn number line from 0 to 6. There are small circles at each integer mark. Three curved arrows are drawn above the line, each labeled '-2'. The first arrow starts at 0 and ends at 2, the second starts at 2 and ends at 4, and the third starts at 4 and ends at 6.</p>	<p>Abstract number line to represent the equal groups that have been subtracted.</p>  <p>The image shows a hand-drawn number line from 0 to 6. There are small circles at each integer mark. Three curved arrows are drawn above the line, each labeled '-2'. The first arrow starts at 0 and ends at 2, the second starts at 2 and ends at 4, and the third starts at 4 and ends at 6. Below the number line, the text '3 groups' is written.</p>

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

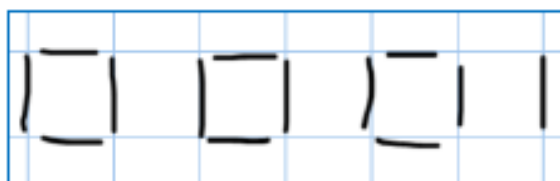
$$13 \div 4$$

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.

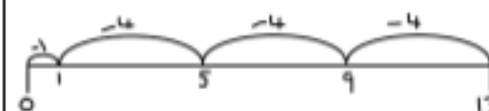


There are 3 whole squares, with 1 left over.

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

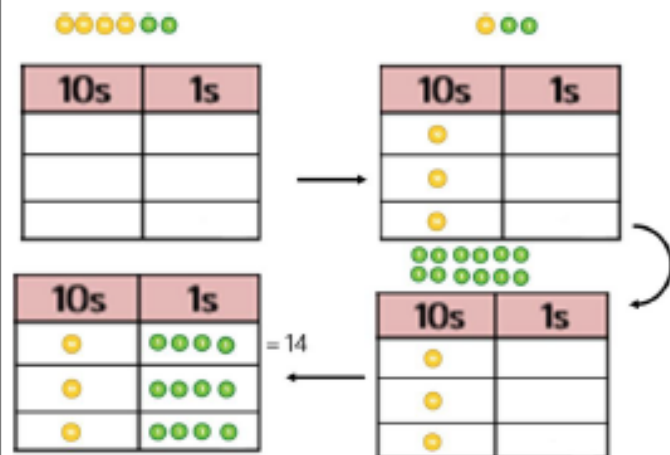
Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line.

'3 groups of 4, with 1 left over'

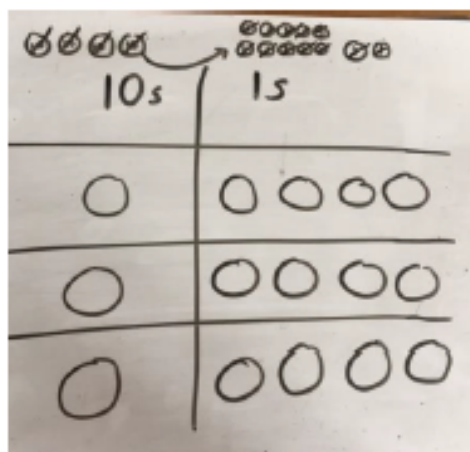


Sharing using place value counters.

$$42 \div 3 = 14$$



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.

$$42 \div 3$$

$$42 = 30 + 12$$

$$30 \div 3 = 10$$

$$12 \div 3 = 4$$

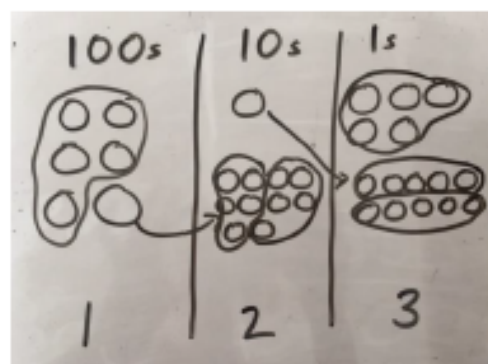
$$10 + 4 = 14$$

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.

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

1000s	100s	10s	1s
			

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

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

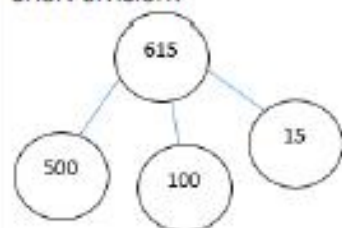
1000s	100s	10s	1s
			

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?

100s	10s	1s
		