

St Mary of the Angels Calculation Policy



Calculation policy

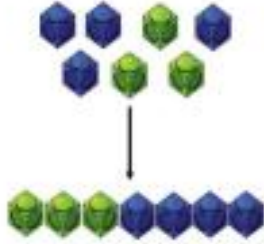
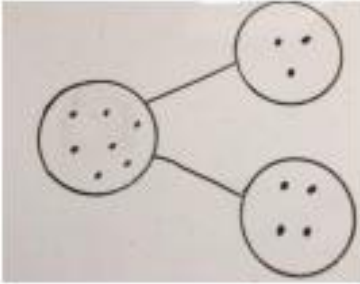
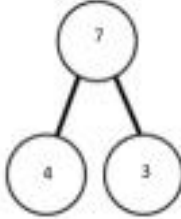
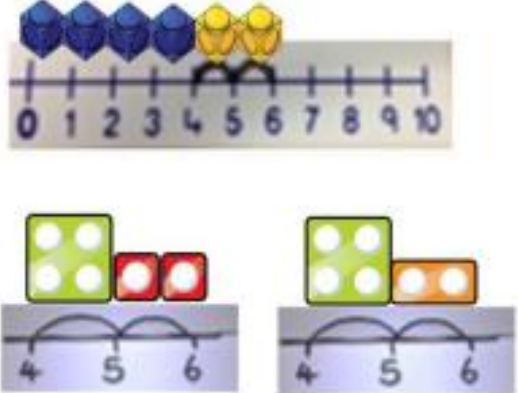
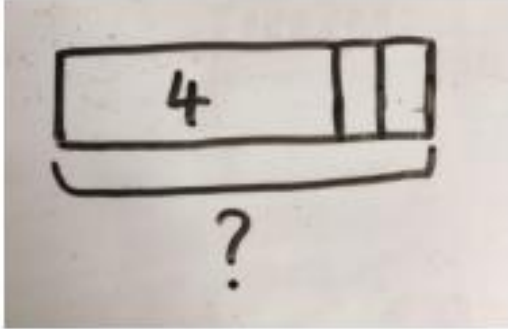

The following document outlines the strategies used when teaching the four operations at St Mary of the Angels. Teachers will use their knowledge of the pupils in their class to decide where children should start with each operation. We have purposely not prescribed year groups to each part of the policy - teachers deliver content at an appropriate level for the pupils in their class.

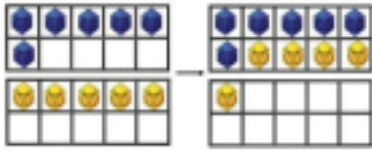
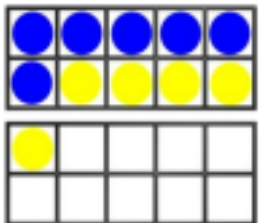
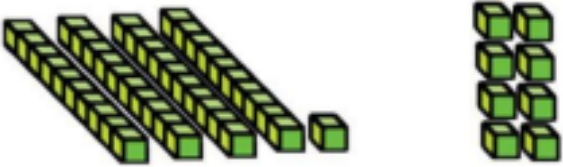
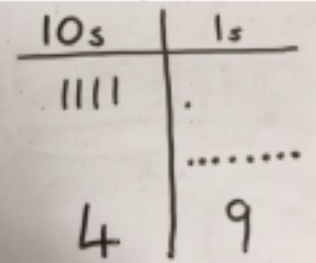
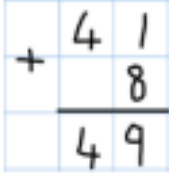
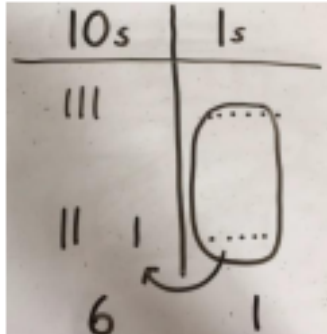
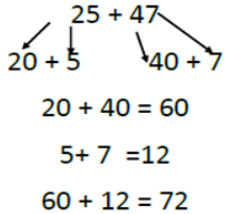
Teachers will adopt various additional strategies when teaching the four operations as needed. We expose children to multiple representations in all aspects of maths to ensure that children have a deep knowledge and understanding of maths topics.

We implement the CPA (Concrete, Pictorial, Abstract) approach when solving calculations.

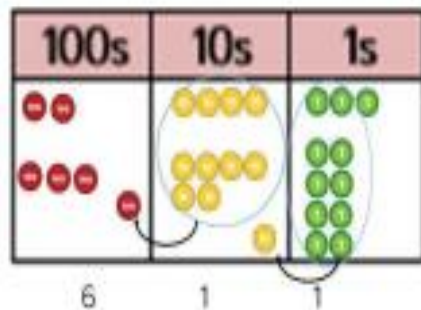
Concrete	Pictorial	Abstract
Children use equipment to represent and manipulate calculations physically. They do this in a range of different ways. Showing children multiple representations allows teachers to identify any misconceptions or gaps in their learning. This hands on approach starts in the early years and continues right the way up into Year 6 where children may be seen using equipment to help them solve complicated fractions questions! It is vital that children understand what is happening with numbers in a calculation, we do not want children to follow a set of rules without a deep understanding.	Once children have mastered manipulating equipment to represent calculations, they move on to drawing pictorial representation of equipment. This provides children with the understanding of what is happening without the need of equipment.	This is the 'end goal', the formal, written method for calculations. For example, column addition or subtraction. We only want children to use this approach when they are secure with the first two stages. This is to ensure that they fully understand what is happening with numbers.

Addition

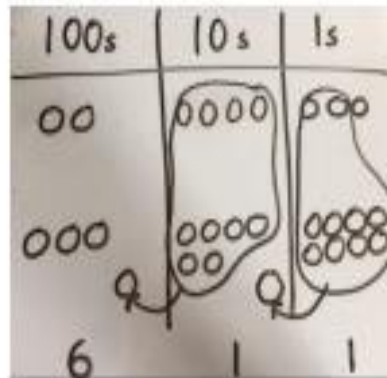
Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars).</p>  <p>The illustration shows two separate groups of cubes: one group of four blue cubes and one group of three green cubes. An arrow points down to a single row of seven cubes, where the four blue cubes are on the left and the three green cubes are on the right, 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 part-whole model consisting of three circles. One large circle on the left contains seven dots. Two smaller circles on the right are connected to the large circle by lines. The top-right circle contains three dots, and the bottom-right circle contains four dots, representing the two parts that make up the whole.</p>	<p>$4 + 3 = 7$ Four is a part, 3 is a part and the whole is seven.</p>  <p>An abstract part-whole model with three circles. A top circle contains the number 7. Two bottom circles are connected to it by lines. The left bottom circle contains the number 4, and the right bottom circle contains the number 3.</p>
<p>Counting on using number lines using cubes or Numicon.</p>  <p>The illustration shows a number line from 0 to 10. Blue cubes are placed on numbers 0, 1, 2, 3, 4, and yellow cubes on 5 and 6. A bracket spans from 4 to 6. Below the number line are two Numicon blocks: a green block with four dots and two red blocks with one dot each, placed on a number line with a bracket from 4 to 6. To the right, another Numicon block with four dots and two orange blocks with one dot each are placed on a number line with a bracket from 4 to 6.</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 horizontal rectangle divided into three sections. The first section on the left is the largest and contains the number 4. The second section is smaller, and the third section is the smallest. A bracket underneath the entire bar is followed by a 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? $4 + 2$</p>  <p>An abstract number line with numbers 4, 5, and 6. A curved line starts at 4 and ends at 5. Another curved line starts at 5 and ends at 6, illustrating the process of counting on from 4 to find the sum of 4 and 2.</p>

<p>Regrouping to make 10; using ten frames and counters/cubes or using Numicon.</p> <p>6 + 5</p> 	<p>Children to draw the ten frame and counters/cubes.</p> 	<p>Children to develop an understanding of equality e.g.</p> $6 + \square = 11$ $6 + 5 = 5 + \square$ $6 + 5 = \square + 4$
<p>TO + O using base 10. Continue to develop understanding of partitioning and place value.</p> <p>41 + 8</p> 	<p>Children to represent the base 10 e.g. lines for tens and dot/crosses for ones.</p> 	<p>41 + 8</p> $1 + 8 = 9$ $40 + 9 = 49$ 
<p>TO + TO using base 10. Continue to develop understanding of partitioning and place value. 36 + 25</p>	<p>Children to represent the base 10 in a place value chart.</p> 	<p>Looking for ways to make 10.</p> $30 + 20 = 50$ $5 + 5 = 10$ $50 + 10 + 1 = 61$ 

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.



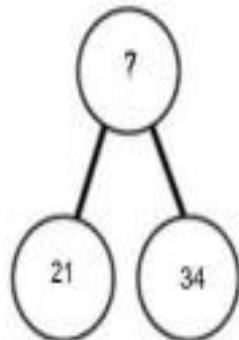
Children to represent the counters in a place value chart, circling when they make an exchange.



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

$$\begin{array}{r} 176 + 147 = 323 \\ 176 \\ +147 \\ \hline 13 \text{ (6 + 7)} \\ 110 \text{ (70 + 40)} \\ \hline 200 \text{ (100 + 100)} \\ \hline 323 \end{array}$$

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?

$$21 + 34 = 55. \text{ Prove it}$$

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

$$21 + 34 =$$

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

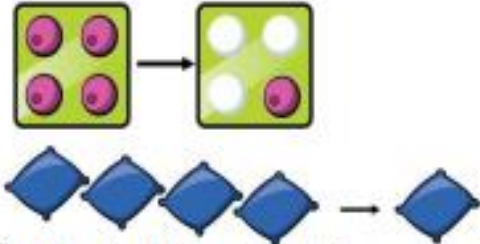
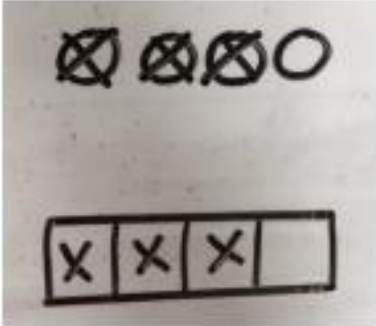
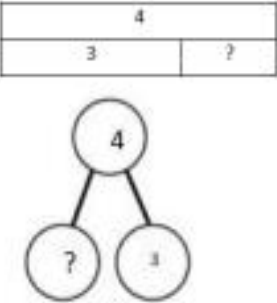
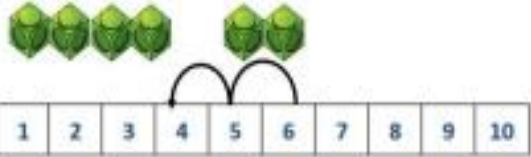
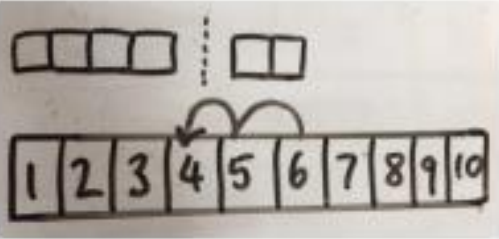
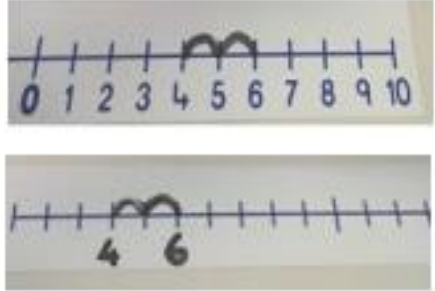
Calculate the sum of twenty-one and thirty-four.



Missing digit problems:

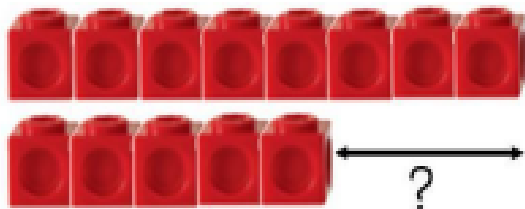
10s	1s
2	1
3	?
?	5

Subtraction

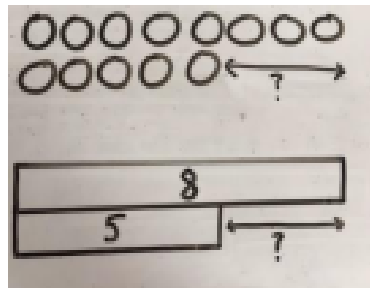
Concrete	Pictorial	Abstract
<p>Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used).</p> <p>$4 - 3 = 1$</p> 	<p>Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also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



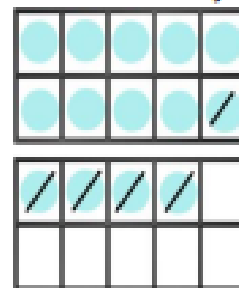
Find the difference between 8 and 5. $8 - 5$, the difference is ____

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.

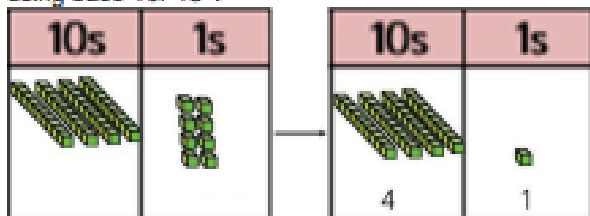
$$14 - 5 = 9$$

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

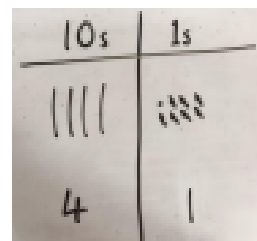
$$14 - 4 = 10$$

$$10 - 1 = 9$$

Column method using base 10. $48 - 7$

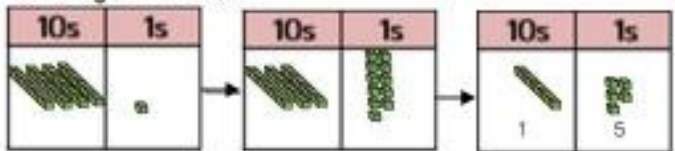


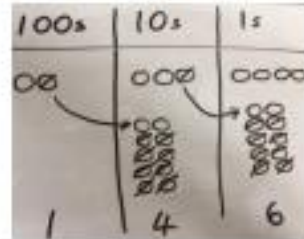
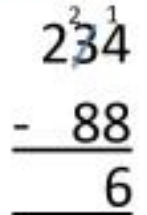


Children to represent the base 10 pictorially.

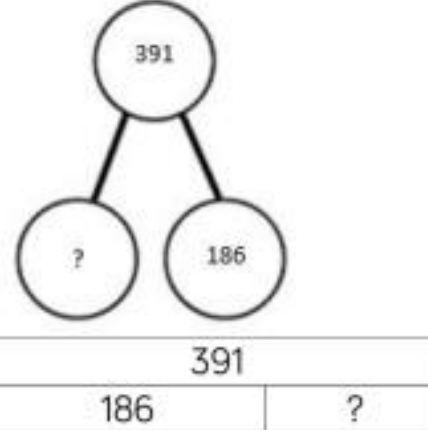


Column method or children could count back 7.

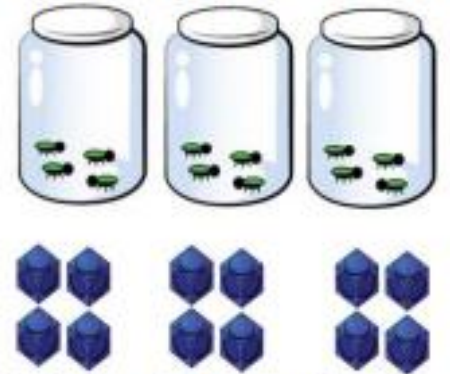
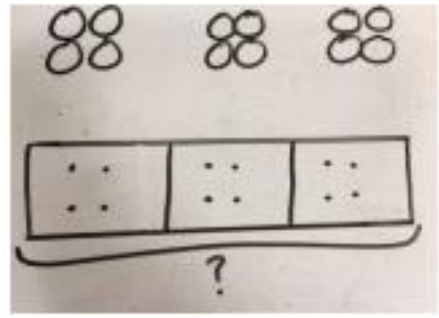
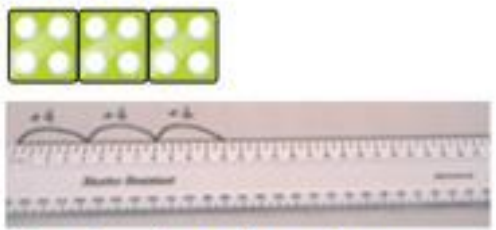
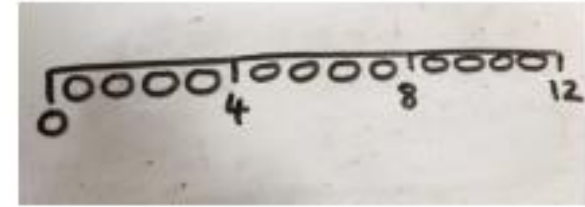
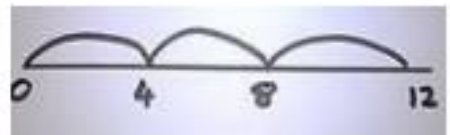
	4	8
-		7
	4	1

<p>Column method using base 10 and having to exchange. $41 - 26$</p> 	<p>Represent the base 10 pictorially, remembering to show the exchange.</p> 	<p>Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because $41 = 30 + 11$.</p> 
<p>Column method 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 digits.</p> 

Conceptual variation; different ways to ask children to solve $391 - 186$

	<p>Raj spent £391, Timmy spent £186. How much more did Raj spend?</p> <p>Calculate the difference between 391 and 186.</p>	<p>_____ = $391 - 186$</p> $\begin{array}{r} 391 \\ -186 \\ \hline \end{array}$ <p>What is 186 less than 391?</p>	<p>Missing digit calculations</p> $\begin{array}{r} 39\Box \\ -\Box\Box6 \\ \hline \Box05 \end{array}$
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Multiplication

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>The concrete representation shows three identical jars, each containing four green beads. Below the jars are three groups of four blue blocks, arranged in a 2x2 grid for each group.</p>	<p>Children to represent the practical resources in a picture and use a bar model.</p>  <p>The pictorial representation shows three groups of four circles arranged in a 2x2 grid. Below this is a bar model divided into three equal sections, each containing four dots. A bracket underneath the bar model is labeled with a question mark.</p>	<p>$3 \times 4 = 12$ $4 + 4 + 4 = 12$</p>
<p>Number lines to show repeated groups- 3×4</p>  <p>The number lines show three groups of four dots in green boxes above a number line. Below the number line, three jumps of size 4 are marked with arcs and the number 4 above each arc.</p>	<p>Represent this pictorially alongside a number line e.g.:</p>  <p>The number line shows a sequence of 12 circles. The first four circles are grouped together, and the next four are grouped together. The number 4 is written below the first group, 8 below the second group, and 12 below the end of the line.</p>	<p>Abstract number line showing three jumps of four.</p> <p>$3 \times 4 = 12$</p>  <p>The abstract number line shows three jumps of size 4, starting from 0 and ending at 12. The numbers 0, 4, 8, and 12 are marked on the line.</p>

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

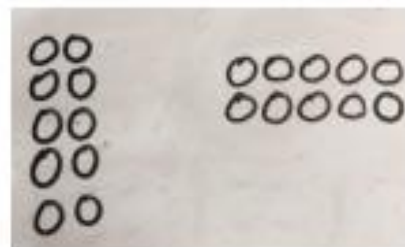
$$2 \times 5 = 5 \times 2$$



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.

$$10 = 2 \times 5$$

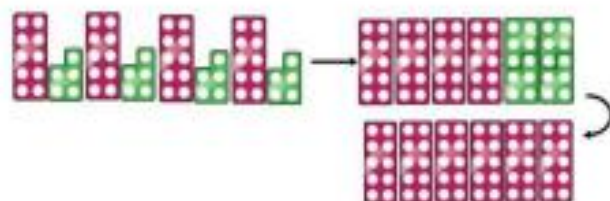
$$5 \times 2 = 10$$

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

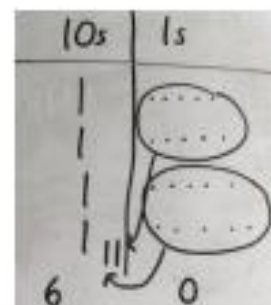
$$10 = 5 + 5$$

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.

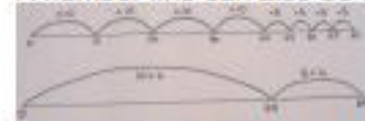
$$\begin{array}{r} 4 \times 15 \\ \swarrow \searrow \\ 10 \quad 5 \end{array}$$

$$10 \times 4 = 40$$

$$5 \times 4 = 20$$

$$40 + 20 = 60$$

A number line can also be used



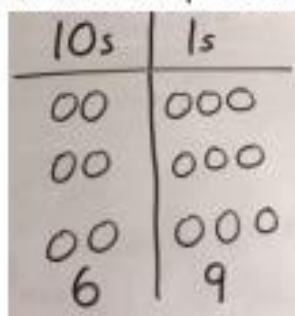
Formal column method with place value counters (base 10 can also be used.) 3×23

10s	1s

6

9

Children to represent the counters pictorially.



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

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

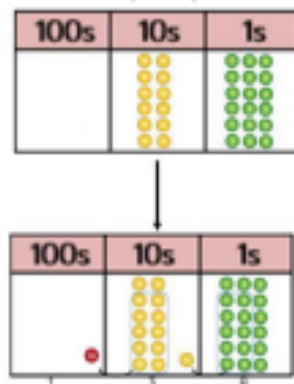
$$3 \times 3 = 9$$

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

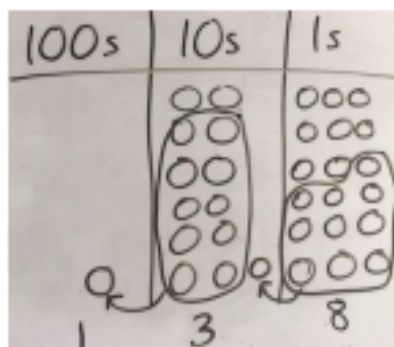
23

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

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

$$\begin{array}{r}
 6 \times 23 = \\
 23 \\
 \times 6 \\
 \hline
 138 \\
 \hline
 1 \quad 1
 \end{array}$$

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 .

$$\begin{array}{r}
 1 \quad 2 \quad 4 \\
 \times \quad 2 \quad 6 \\
 \hline
 7 \quad 4 \quad 4 \\
 \\
 2 \quad 4 \quad 8 \quad 0 \\
 \hline
 3 \quad 2 \quad 2 \quad 4 \\
 \\
 1 \quad 1
 \end{array}$$

Answer: 3224

Conceptual variation; different ways to ask children to solve 6×23



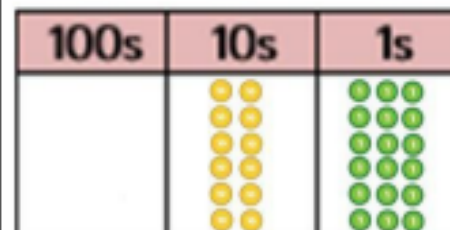
Mai had to swim 23 lengths, 6 times a week.
How many lengths did she swim in one week?

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

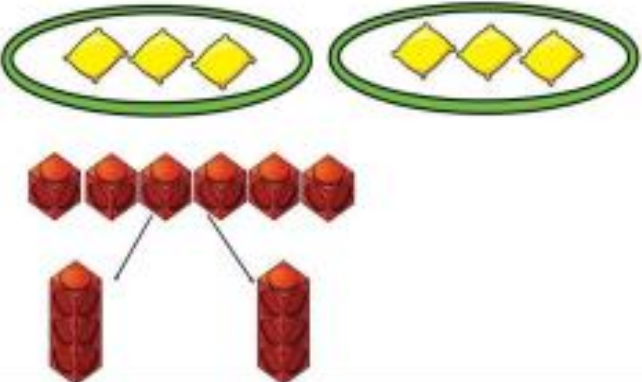
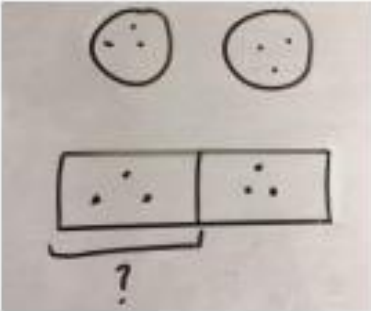
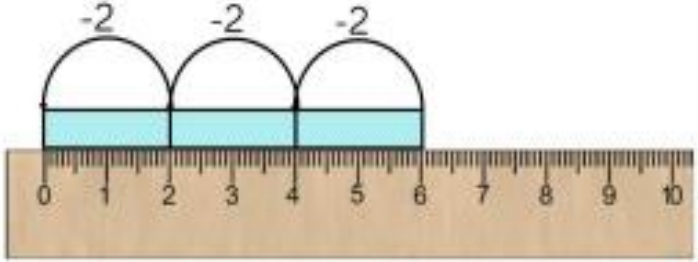
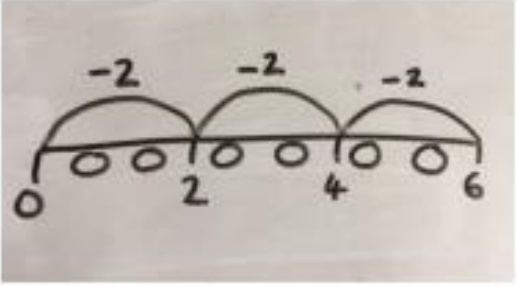
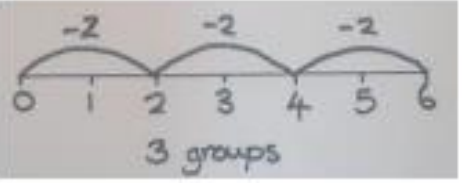
Find the product of 6 and 23 $6 \times$

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

What is the calculation? What is the product?



Division

Concrete	Pictorial	Abstract		
<p>Sharing using a range of objects. $6 \div 2$</p>  <p>The diagram shows two green ovals, each containing three yellow diamonds. Below them is a row of six red Cuisenaire rods. Two lines connect the first two rods to a single red rod below, and another two lines connect the next two rods to another single red rod below, illustrating that 6 rods can be grouped into 2 groups of 2 rods each.</p>	<p>Represent the sharing pictorially.</p>  <p>The diagram shows two circles, each containing three dots. Below them is a rectangle divided into two equal halves, each containing three dots. A bracket under the first half is labeled with a question mark, representing the problem of dividing 6 items into 2 equal groups.</p>	<p>$6 \div 2 = 3$</p> <table border="1" data-bbox="1585 467 2000 539"><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>Repeated subtraction using Cuisenaire rods above a ruler. $6 \div 2$</p>  <p>The diagram shows a ruler from 0 to 10. A light blue Cuisenaire rod is placed above the ruler, spanning from 0 to 6. Three arches are drawn above the rod, each labeled '-2', representing the repeated 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 number line from 0 to 6 with circles at each integer. Three arches are drawn above the line, each labeled '-2', representing the repeated subtraction of 2 from 6. The numbers 0, 2, 4, and 6 are written below the line.</p>	<p>Abstract number line to represent the equal groups that have been subtracted.</p>  <p>The diagram shows a number line from 0 to 6 with circles at each integer. Three arches are drawn above the line, each labeled '-2', representing the repeated subtraction of 2 from 6. The text '3 groups' is written below the line.</p>		

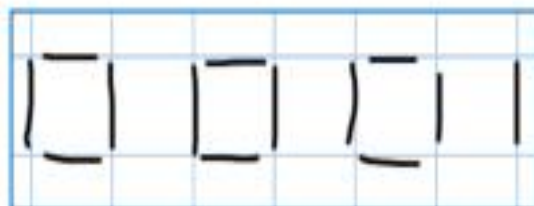
2d + 1d with remainders using lollipop sticks.
 Cuisenaire rods, above a ruler can also be used.
 $13 \div 4$

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.

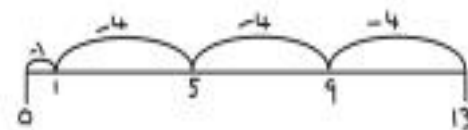


There are 3 whole squares, with 1 left over.

$13 \div 4 = 3$ remainder 1

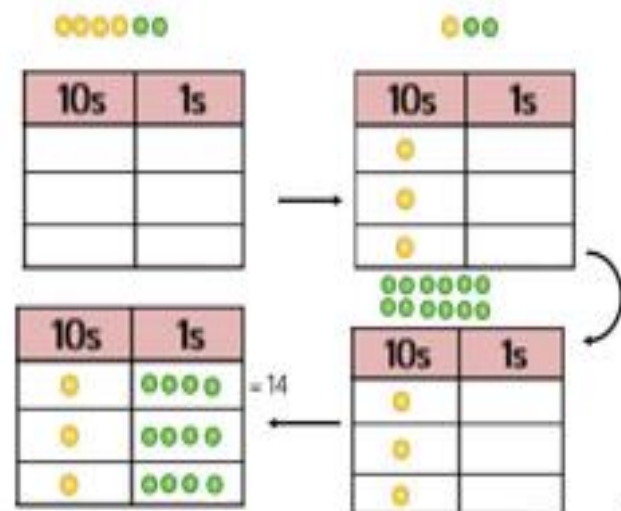
Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line.

'3 groups of 4, with 1 left over'

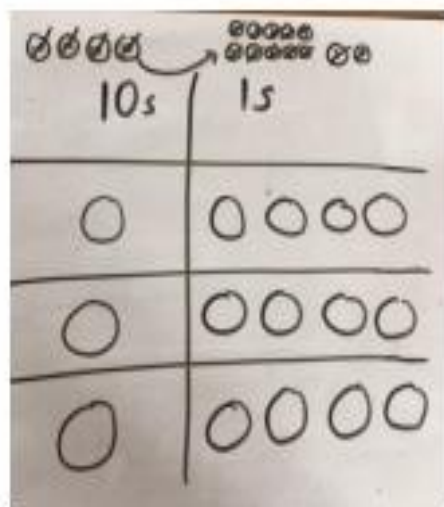


Sharing using place value counters.

$42 \div 3 = 14$



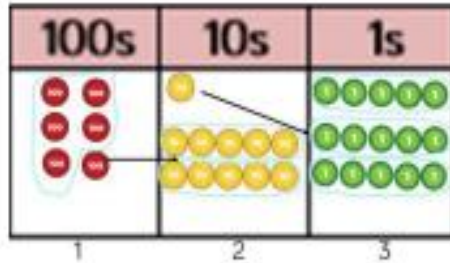
Children to represent the place value counters pictorially.



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

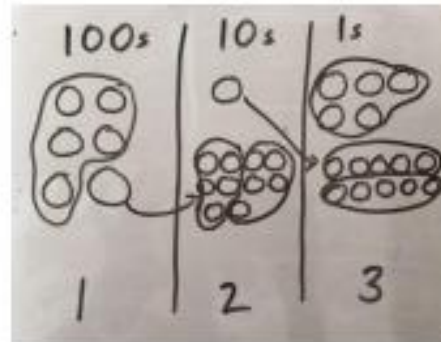
$42 \div 3$
 $42 = 30 + 12$
 $30 \div 3 = 10$
 $12 \div 3 = 4$
 $10 + 4 = 14$

Short division using place value counters to group. $615 \div 5$



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?

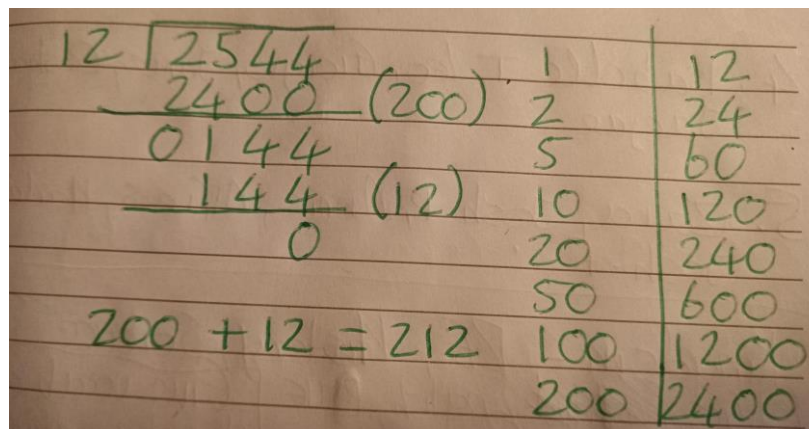
Represent the place value counters pictorially.



Children to the calculation using the short division scaffold.

$$5 \overline{) 615} \begin{matrix} 123 \\ \\ \end{matrix}$$

Long division

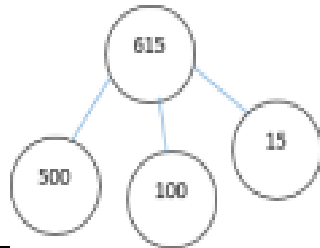


Using the Chunking method for long division.

Coin card is used to support finding multiples of a number.

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?

$$5 \overline{)615}$$

$$615 \div 5 =$$

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

What is the calculation? What is the answer?

100s	10s	1s