

Pensans CP School



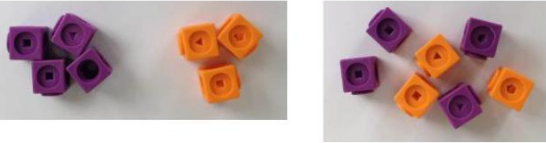
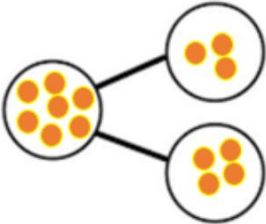
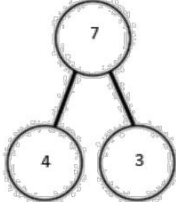
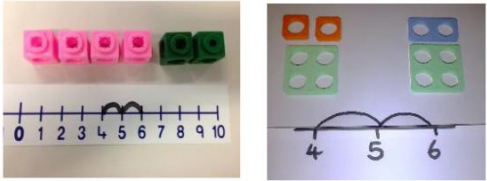
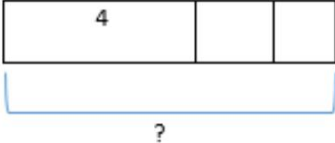

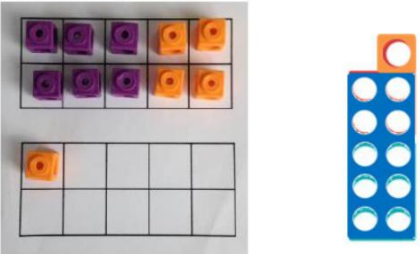
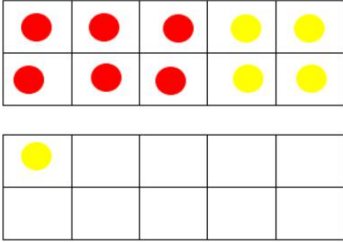
Maths Calculation Policy

Reviewed on February 2017

Next review date February 2019

Addition-

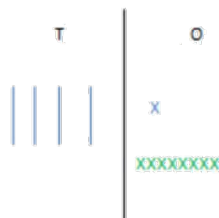
Key language which should be used: sum, total, parts and wholes, plus, add, altogether, more than, 'is equal to' 'is the same as'

Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears etc)</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 by using cubes or numicon</p> 	<p>A bar model which encourages the children to count on</p> 	<p>The abstract number line: What is 2 more than 4? What is the sum of 4 and 4? What's the total of 4 and 2? $4 + 2$</p> 
<p>Regrouping to make 10 by using ten frames and counters/cubes or using numicon: $6 + 5$</p> 	<p>Children to draw the ten frame and counters/cubes</p> 	<p>Children to develop an understanding of equality e.g $6 + \square = 11$ and</p> <p>$6 + 5 = 5 + \square$ $6 + 5 = \square + 4$</p>

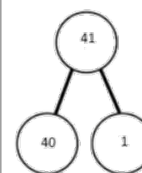
TO + O using base 10. Continue to develop understanding of partitioning and place value
 $41 + 8$



Children to represent the concrete using a particular symbol e.g. lines for tens and dot/crosses for ones.



$41 + 8$



$$1 + 8 = 9$$

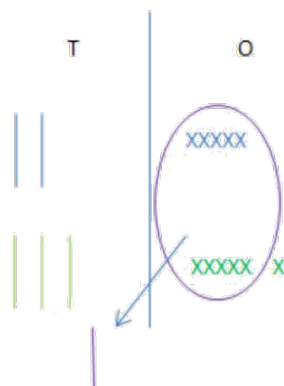
$$40 + 9 = 49$$

	4	1
+		8
	4	9

TO + TO using base 10. Continue to develop understanding of partitioning and place value and use this to support addition. Begin with no exchanging. $36 + 25$

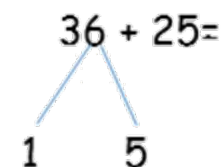
	Tens	Ones
+		
=		

This could be done one of two ways:



Tens	Ones

Looking for ways to make 10



$$30 + 20 = 50$$

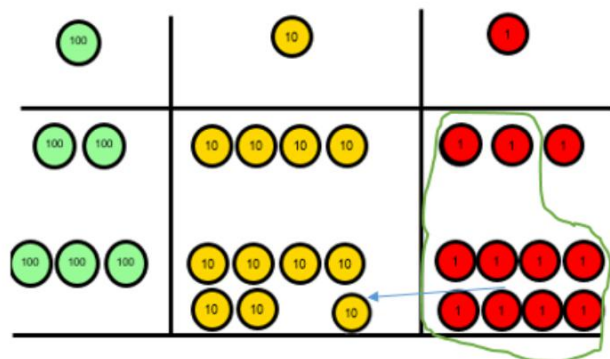
$$5 + 5 = 10$$

$$50 + 10 + 1 = 61$$

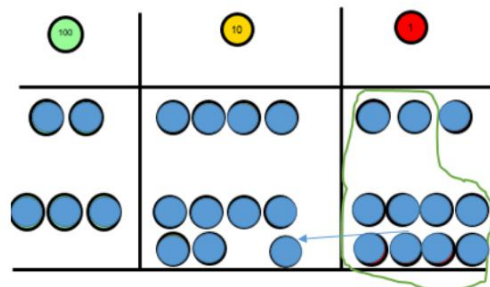
Formal method:

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

Use of place value counters to add HTO + TO, HTO + HTO etc. once the children have had practice with this, they should be able to apply it to larger numbers and the abstract



Children to represent the counters e.g. like the image below

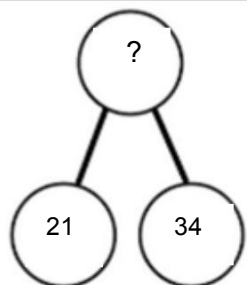


If the children are completing a word problem, draw a bar model to represent what it's asking them to do

?	
243	368

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

Fluency variation, different ways to ask children to solve 21+34:



Sam saved £21 one week and £34 another. How much did he save in total?

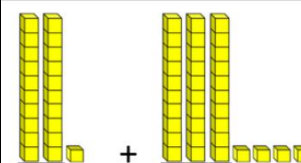
21+34=55. Prove it! (reasoning but the children need to be fluent in representing this)

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

$$21 + 34 =$$

$$\square = 21 + 34$$

What's the sum of twenty one and thirty four?

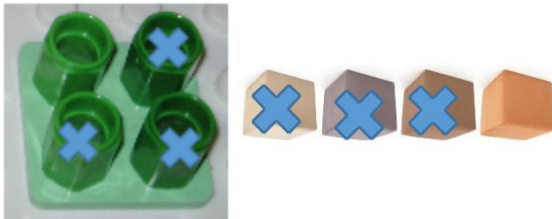
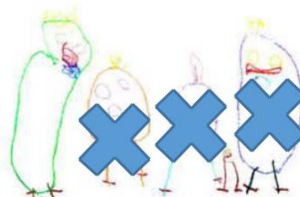

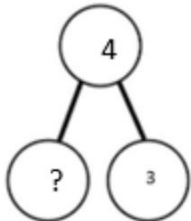
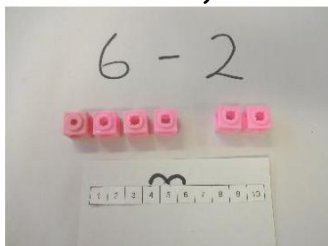
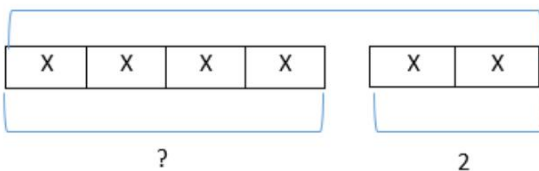
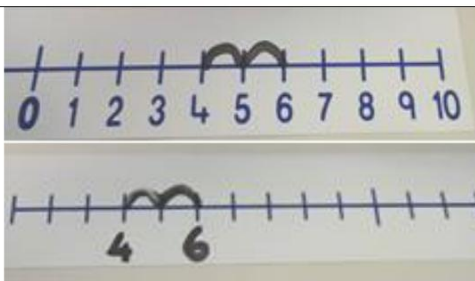


Always use missing digit problems too:

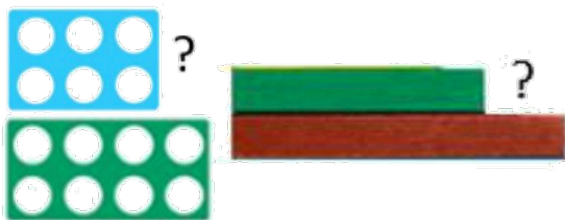
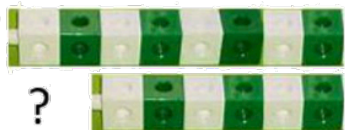
Tens	Ones
20	4
20	?
?	4

Subtraction-

Key language which should be used: take away, less than, the difference, subtract, minus, fewer, decrease, '7 take away 3, the difference is four'

Concrete	Pictorial	Abstract				
<p>Physically taking away and removing objects from a whole (use various objects too) rather than crossing out-children will physically remove the objects</p> <p>$4 - 3 = 1$</p> 	<p>Children to draw the concrete resources they are using and cross out.</p>  <p>Use of the bar model:</p> 	<p>$4 - 3 =$</p> <p><input type="text"/> = $4 - 3$</p> <table border="1" data-bbox="1411 587 1722 664"><tr><td colspan="2">4</td></tr><tr><td>3</td><td>?</td></tr></table> 	4		3	?
4						
3	?					
<p>Counting back (using number lines or number tracks)</p> 	<p>Children to represent what they see pictorially e.g.</p> <p>6</p> 					

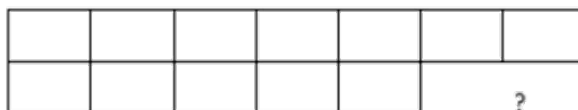
Finding the difference (using cubes, numicon or Cuisenaire rods, other objects can also be used)



Children to draw the cubes/other concrete objects which they have used

XXXXXXXX
XXXXXX

Use of the bar model



Find the difference between 8 and 6.

$8 - 6$, the difference is ?

Children to also explore why $9 - 7 = 8 - 6$ (the difference, of each digit, has changed by 1 so the difference is the same- this will help when solving $10000 - 9987$)

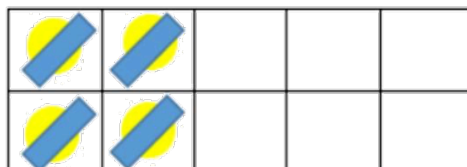
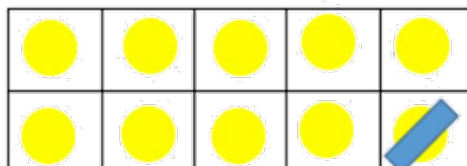
Making 10 (using numicon or ten frames)
 $14 - 5$



Children could also do this by subtracting a 5 from the 10.

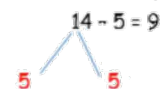


Children to present the ten frame pictorially

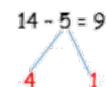


$14 - 5 = 9$ You also want children to see related facts e.g. $15 - 9 = 5$

Children to represent how they have solved it e.g.

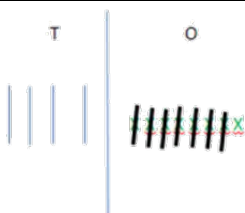
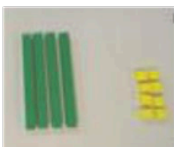


14 is made up of 5, 5 and 4 so I can subtract one 5 to be left with 4 and 5

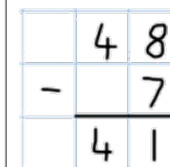



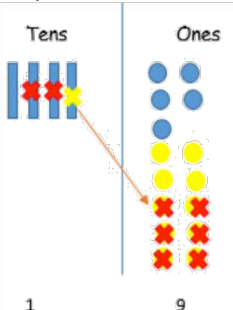
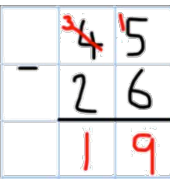
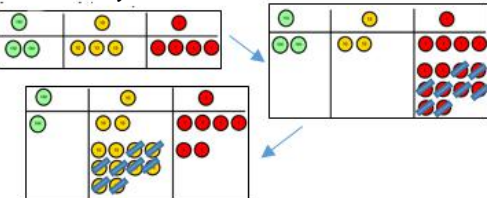
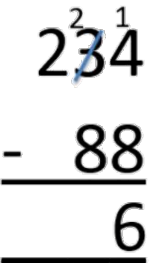
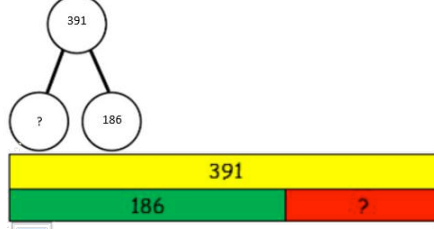
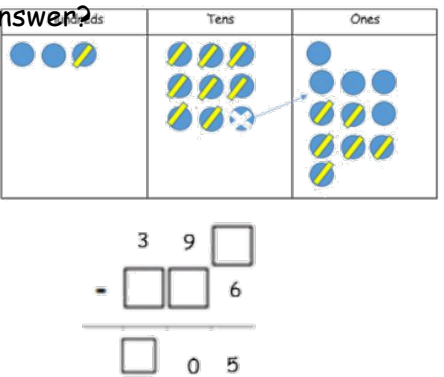
5 is made up of 4 and 1 so I can subtract 4 to make 10 and then 1 to get to 9

Column method (using base 10)
 $48 - 7$





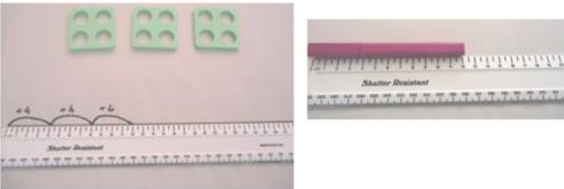
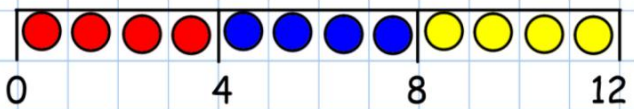
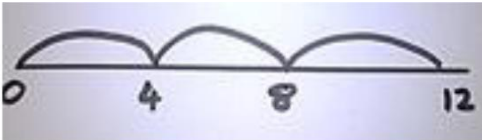
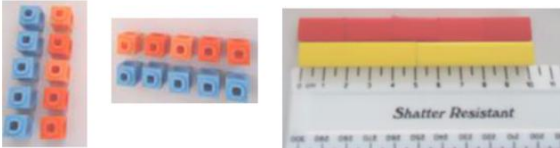
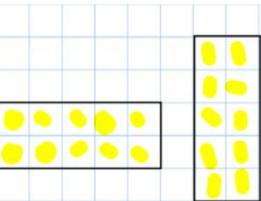
$48 - 7 =$



<p>Column method (using base 10 and having to exchange)</p> <p>45-26</p>  <ol style="list-style-type: none"> 1) Start by partitioning 45 2) Exchange one ten for ten more ones 3) Subtract the ones, then the tens. 	<p>Represent the base 10 pictorially</p> 	<p>It's crucial that the children understand that when they have exchanged the 10 they still have 45. $45 = 30 + 15$</p> 
<p>Column method (using place value counters) 234-88</p> 	<p>Once the children have had practice with the concrete, they should be able to apply it to any subtraction.</p> <p>Like the other pictorial representations, children to represent the counters.</p>	
<p>Fluency variation, different ways to ask children to solve 391-186:</p>		
	<p>Raj spent £391, Timmy spent £186. How much more did Raj spend?</p> <p>I had 391 metres to run. After 186 I stopped. How many metres do I have left to run?</p>	<p>$391 - 186$</p> <p><input type="text"/> = $391 - 186$</p> $\begin{array}{r} 391 \\ -186 \\ \hline \end{array}$ <p>Find the difference between 391 and 186</p> <p>Subtract 186 from 391.</p> <p>What is 186 less than 391?</p>
<p>What's the calculation? What's the answer?</p> 		

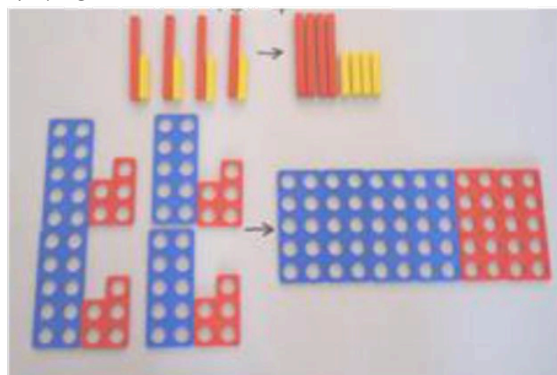
Multiplication-

Key language which should be used: double times, multiplied by, the product of, groups of, lots of, 'is equal to' 'is the same as'

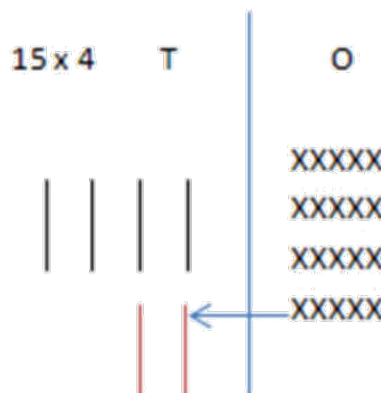
Concrete	Pictorial	Abstract
Repeated grouping/repeated addition (does not have to be restricted to cubes) 3×4 or 3 lots of 4 	Children to represent the practical resources in a picture e.g. $\text{XX} \quad \text{XX} \quad \text{XX}$ $\text{XX} \quad \text{XX} \quad \text{XX}$ Use of a bar model for a more structured method 	3×4 $4 + 4 + 4$
Use number lines to show repeated groups- 3×4 	Represent this pictorially alongside a number line e.g: 	Abstract number line $3 \times 4 = 12$ 
Use arrays to illustrate commutativity (counters and other objects can also be used) $2 \times 5 = 5 \times 2$ 	Children to draw the arrays 	Children to be able to use an array to write a range of calculations e.g. $2 \times 5 = 10$ $5 \times 2 = 10$ $2 + 2 + 2 + 2 + 2 = 10$ $5 + 5 = 10$

Partition to multiply (use numicon, base 10, Cuisenaire rods)

$$4 \times 15$$



Children to represent the concrete manipulatives in a picture e.g. base 10 can be represented like:



Children to be encouraged to show the steps they have taken

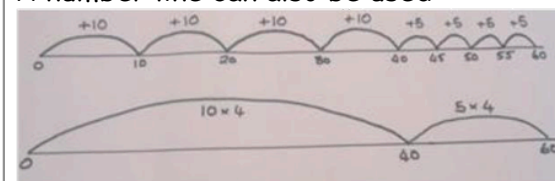
$$\begin{array}{r} 4 \times 15 \\ \swarrow \searrow \\ 10 \quad 5 \end{array}$$

$$10 \times 4 = 40$$

$$5 \times 4 = 20$$

$$40 + 20 = 60$$

A number line can also be used



Formal column method with place value counters or base 10 (at the first stage- no exchanging) 3×23

Make 23, 3 times. See how many ones, then how many tens



Children to represent the counters in a pictorial way



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

$$\begin{array}{r} 3 \times 23 \\ \swarrow \searrow \\ 20 \quad 3 \end{array} \quad \begin{array}{l} 3 \times 20 = 60 \\ 3 \times 3 = 9 \\ 60 + 9 = 69 \end{array}$$

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

Formal column method with place value counters (children need this stage, initially, to understand how the column method works)

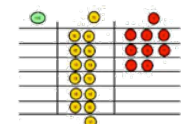
Children to represent the counters/base 10, pictorially e.g. the image below.

$$\begin{array}{r} 6 \times 23 \\ 6 \times 3 = 18 \\ 6 \times 20 = 120 \\ 120 + 18 = 138 \end{array}$$

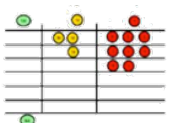
6×23



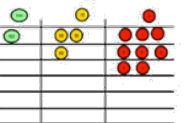
Step 1: get 6 lots of 23



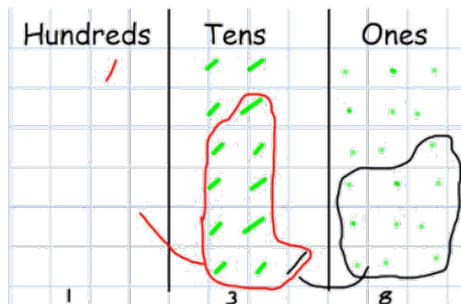
Step 2: 6×3 is 18. Can I make an exchange? Yes! Ten ones for one ten....



Step 3: 6×2 tens and my extra ten is 13 tens. Can I make an exchange? Yes! Ten tens for one hundred...



Step 4- what do I have in each column?



The aim is to get to the formal method but the children need to understand how it works.

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

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

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

Answer: 3224

Fluency variation, different ways to ask children to solve 6×23 :

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

?

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

Why is $6 \times 23 = 32 \times 6$?

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

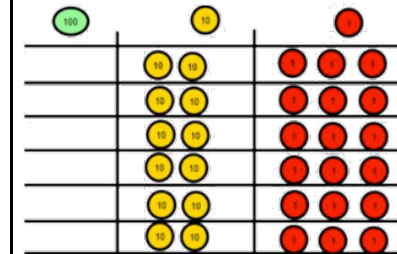
Tom saved 23p three days a week. How much did he save in 2 weeks?

Find the product of 6 and 23

$$6 \times 23 =$$

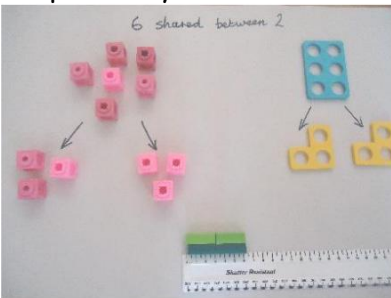
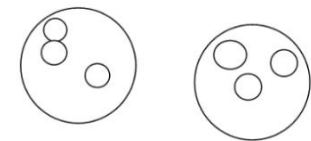
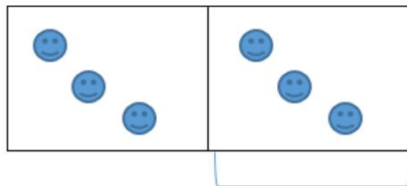
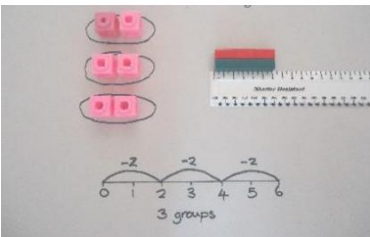
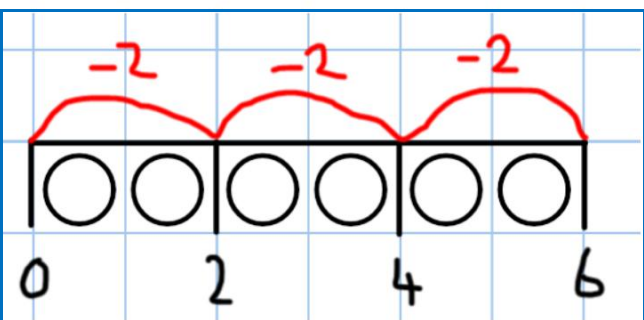
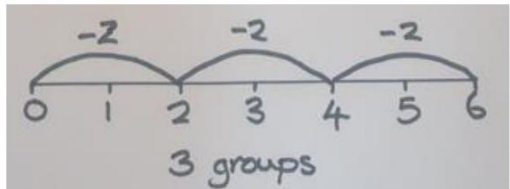
$$\begin{array}{r} \square = 6 \times 23 \\ 6 \quad 23 \\ \times \underline{23} \quad \times \underline{6} \\ \hline \hline \end{array}$$

What's the calculation? What's the answer?



Division-

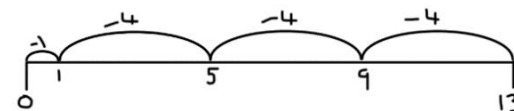
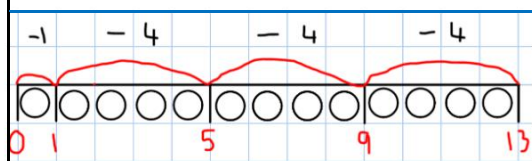
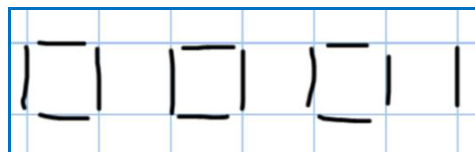
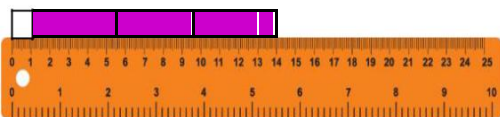
Key language which should be used: share, group, divide, divided by, half, 'is equal to' 'is the same as'

Concrete	Pictorial	Abstract		
<p>6 shared between 2 (other concrete objects can also be used e.g. children and hoops, teddy bears, cakes and plates)</p> 	 <p>This can also be done in a bar so all 4 operations have a similar structure:</p> 	<p>$6 \div 2 = 3$</p> <p>What's the calculation?</p> <table border="1"><tr><td>3</td><td>3</td></tr></table>	3	3
3	3			
<p>Understand division as repeated grouping and subtracting</p> <p>$6 \div 2$</p> 		<p>Abstract number line</p> 		
<p>2d ÷ 1d with remainders</p> <p>$13 \div 4 = 3$ remainder 1</p>	<p>Children to have chance to represent the resources they use in a pictorial way e.g. see below:</p>	<p>$13 \div 4 = 3$ remainder 1</p> <p>Children to count their times tables facts in their heads</p>		

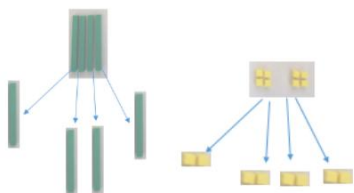
Use of lollipop sticks to form wholes



Use of Cuisenaire rods and rulers (using repeated subtraction)



2d divided by 1d using base 10 (no remainders) SHARING
 $48 \div 4 = 12$



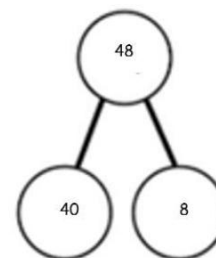
Start with the tens.

Children to represent the base 10 and sharing pictorially.

$$48 \div 4$$

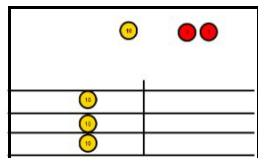
$$4 \text{ tens} \div 4 = 1 \text{ ten}$$

$$8 \text{ ones} \div 4 = 2 \text{ ones}$$

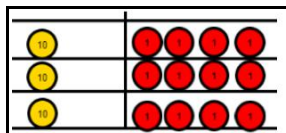


$$10 + 2 = 12$$

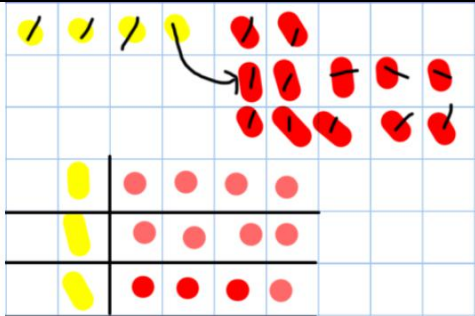
Sharing using place value counters.
 $42 \div 3 = 14$



1. Make 42. Share the 4 tens between 3. Can we make an exchange with the extra 10?



Exchange the ten for 10 ones and share out 12 ones



$$42 \div 3$$

$$42 = 30 + 12$$

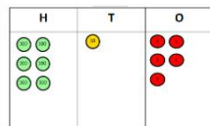
$$30 \div 3 = 10$$

$$12 \div 3 = 4$$

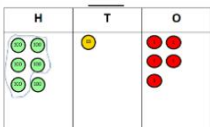
$$10 + 4 = 14$$

Use of the 'bus stop method' using grouping and counters. Key language for grouping- how many groups of X can we make with X hundreds'- *this can also be done using sharing!*

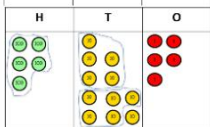
$$615 \div 5$$



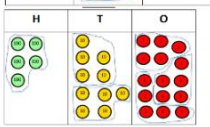
Step 1: make 615



Step 2: Circle your groups of 5



Step 3: Exchange 1H for 10T and circle groups of 5



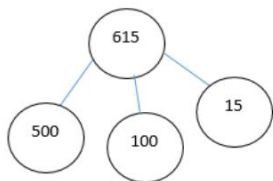
Step 4: exchange 1T for 10ones and circles groups of 5

This can easily be represented pictorially, till the children no longer to do it. It can also be done to decimal places if you have a remainder!

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

Fluency 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 the 'bus stop' method?



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?

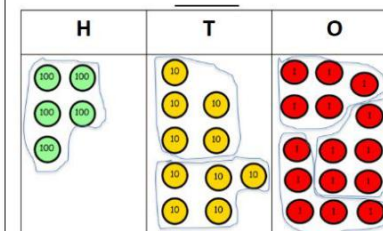
$$5 \overline{) 615}$$

$$615 \div 5 =$$

$$\square = 615 \div 5$$

How many 5's go into 615?

What's the calculation? What's the answer?



Long division

Concrete	Pictorial	Abstract
<div data-bbox="105 316 304 462"> </div> <div data-bbox="315 316 388 462"> $\begin{array}{r} 0212 \\ 12 \overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$ </div> <div data-bbox="409 300 672 462"> <p>$2544 \div 12$ How many groups of 12 thousands do we have? None</p> </div> <div data-bbox="105 479 304 641"> </div> <div data-bbox="315 479 388 641"> $\begin{array}{r} 02 \\ 12 \overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$ </div> <div data-bbox="409 479 672 641"> <p>Exchange 2 thousand for 20 hundreds.</p> </div> <div data-bbox="105 690 304 820"> </div> <div data-bbox="315 690 388 820"> $\begin{array}{r} 02 \\ 12 \overline{)2544} \\ \underline{24} \\ 1 \end{array}$ </div> <div data-bbox="409 690 672 820"> <p>How many groups of 12 are in 25 hundreds? 2 groups. Circle them.</p> </div> <div data-bbox="94 828 672 901"> <p>We have grouped 24 hundreds so can take them off and we are left with one.</p> </div> <div data-bbox="105 966 304 1112"> </div> <div data-bbox="315 966 388 1112"> $\begin{array}{r} 021 \\ 12 \overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$ </div> <div data-bbox="409 941 672 1128"> <p>Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2.</p> </div> <div data-bbox="105 1177 304 1339"> </div> <div data-bbox="315 1177 388 1339"> $\begin{array}{r} 0212 \\ 12 \overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$ </div> <div data-bbox="409 1201 672 1356"> <p>Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2</p> </div>	<p>Children to represent the counters, pictorially and record the subtractions beneath.</p>	<div data-bbox="1407 332 1564 422"> $\begin{array}{r} 0 \\ 12 \overline{)2544} \end{array}$ </div> <div data-bbox="1585 300 1953 454"> <p>Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.</p> </div> <div data-bbox="1407 511 1564 673"> $\begin{array}{r} 02 \\ 12 \overline{)2544} \\ \underline{24} \\ 1 \end{array}$ </div> <div data-bbox="1585 479 1953 706"> <p>Step two- How many groups of 12 can I make with 25 hundreds? The 24 shows the hundreds we have grouped. The one is how many hundreds we have left.</p> </div> <div data-bbox="1407 755 1564 933"> $\begin{array}{r} 021 \\ 12 \overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$ </div> <div data-bbox="1396 738 1953 1039"> <p>Exchange the one hundred for 10 tens. How many groups of 12 can I make with 14 tens? The 14 shows how many tens I have, the 12 is how many I grouped and the 2 is how many tens I have left.</p> </div> <div data-bbox="1407 1063 1564 1307"> $\begin{array}{r} 0212 \\ 12 \overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$ </div> <div data-bbox="1585 1071 1953 1226"> <p>Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.</p> </div>