Roman Way Primary School

Maths Calculation Policy

2024

Issue Date 7/3/2024

Author Evangeline Cannell

Reviewed and Approved by Governors 14/3/2024

Tanya Hampton	Signed 

Review Date February 2027

This calculation policy should be used to support children to develop a deep understanding of number and calculation. This policy has been designed to teach children through the use of concrete, pictorial and abstract representations. The CPA approach builds knowledge and skills sequentially

• Concrete representation— a pupil is first introduced to an idea or skill by acting it out with real objects. This is a 'hands on' component using real objects and is a foundation for conceptual understanding.

• Pictorial representation – a pupil has sufficiently understood the 'hands on' experiences performed and can now relate them to representations, such as a diagram or picture of the problem.

• Abstract representation—a pupil is now capable of representing problems by using mathematical notation, for example 12 x 2 = 24. It is important that conceptual understanding, supported by the use of representation, is secure for all procedures.

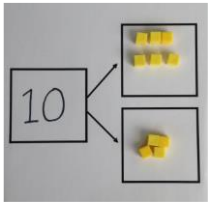
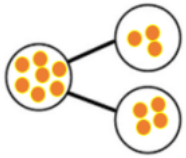
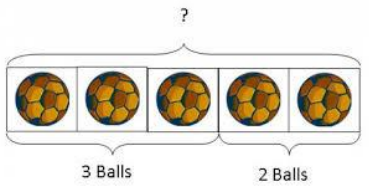
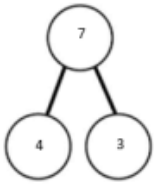
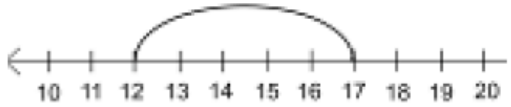
Reinforcement is achieved by going back and forth between these representations

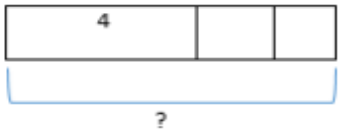
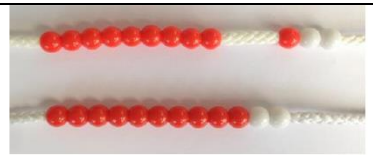
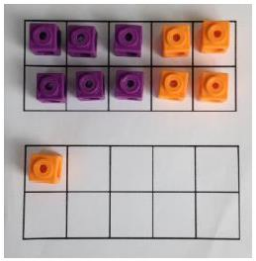
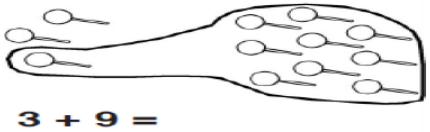
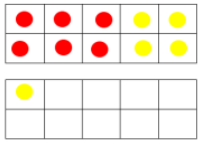
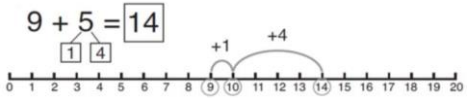
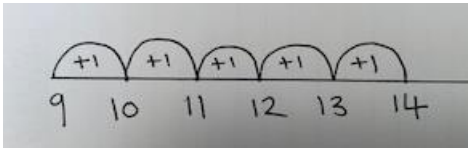
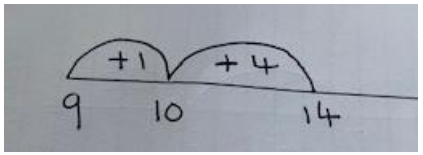
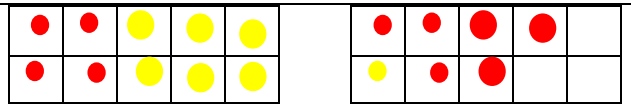
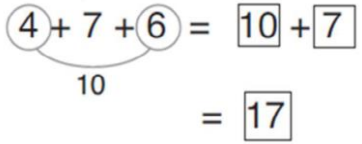
This mathematics policy is a guide for all staff at Roman Way Primary School and is used to support the Hampshire planning materials.

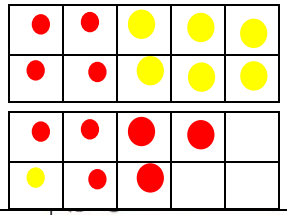
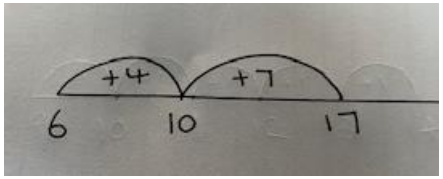
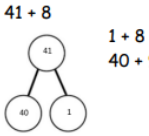
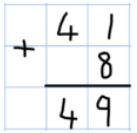
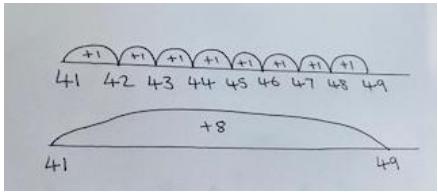
Teachers can use any teaching resources that they wish to use and the policy does not recommend one set of resources over another, rather that, a variety of resources are used. For each of the four rules of number, different strategies are laid out, together with examples of what concrete materials can be used and how, along with suggested pictorial representations. The principle of the concrete-pictorial-abstract (CPA) approach is for children to have a true understanding of a mathematical concept.

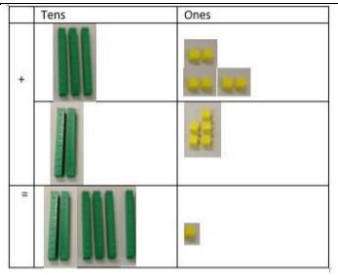
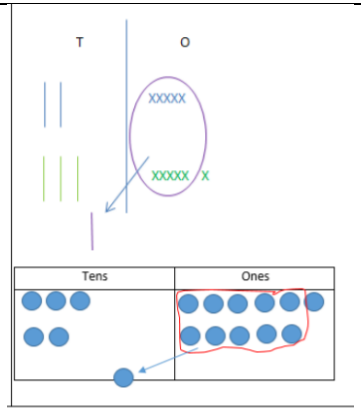
Progression in Calculation

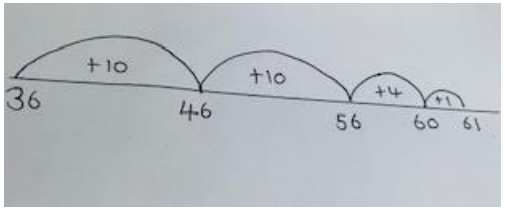
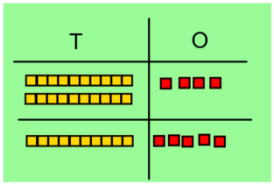
Addition

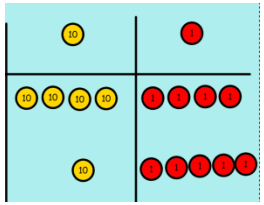
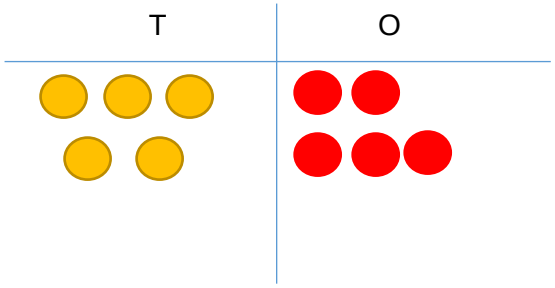
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	    Use cubes to add two numbers together as a group or in a bar.	Use pictures to add two numbers together as a group or in a bar.   	4 + 3 = 7 Use the part-part whole diagram as shown to move into the abstract. 
Counting on leading to use of a numberline	 Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.   Concrete resources to support use of the numberline	12 + 5 = 17  Start at the larger number on the number line and count on in ones or in one jump to find the answer. A bar model which encourages children to count on	Using an unstructured numberline to count on 4+2=6 

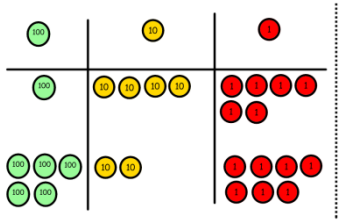
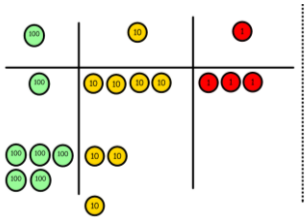
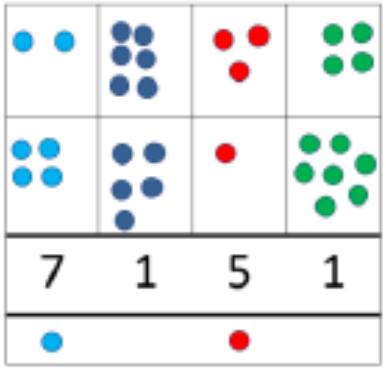
			
Regrouping to make 10.	 6 + 5 = 11 Use of tens frames.  Numicon Start with the bigger number and use the smaller number to make 10. 	Use pictures or a number line. Regroup or partition the smaller number to make 10.  Children to draw the ten frame. Support with counters/cubes  Use of a structured numberline 	9 + 5= 14 Use of an unstructured numberline   Children to develop an understanding of equality e.g 6+?=11 6+5=5+? 6+5=?=4
Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Recombine the groups to make 10 using tens frames	 Combine the two numbers that make 10 and then add on the remainder.

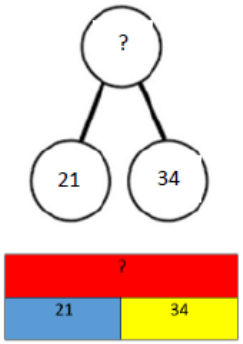
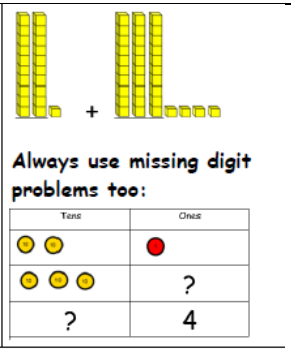
	Use objects in tens frames- counters, teddies etc 		Unstructured numberline 
T+O Using base 10	 Children continue to develop understanding of partitioning and plave value 41+8=	Children pictorially represent tens and ones using drawings 	41 + 8 1 + 8 = 9 40 + 9 = 49   

<table>
<tr>
<td>TO+TO using base 10</td>
<td> 
</td>
<td> 

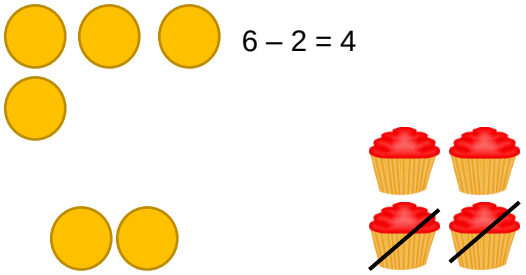
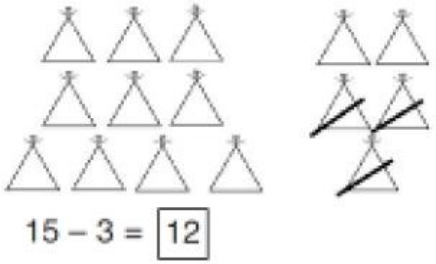
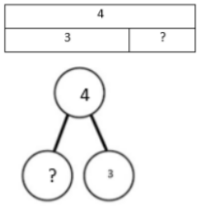
12+17=
 
</td>
<td>36 + 25= 30 + 20 = 50
5 + 5 = 10
50 + 10 + 1 = 61
1 5
Formal method:
36
+25
61
1
 
</td>
</tr>
<tr>
<td>Column method- no regrouping</td>
<td>24 + 15=
Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.
 

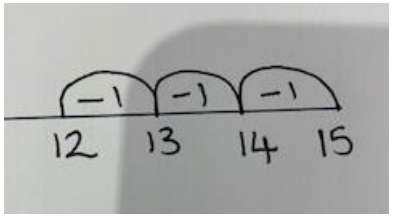
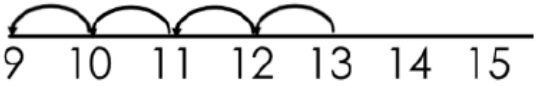
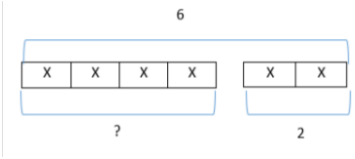
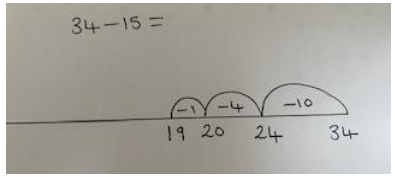
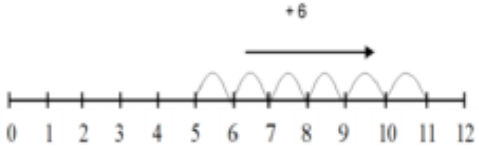
 </td>
<td>After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions.
 
</td>
<td>Calculations
21 + 42 =
21
+ 42</td>
</tr>
</table>

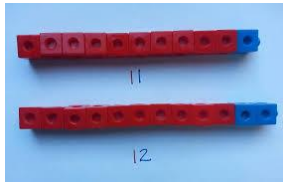
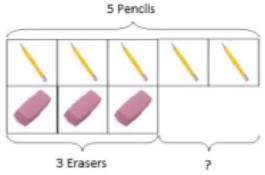
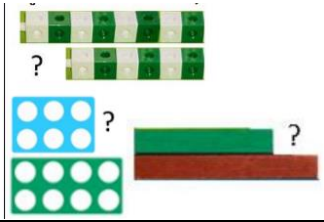
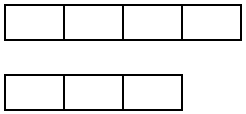
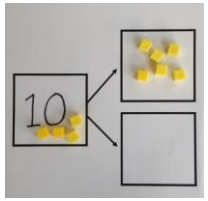
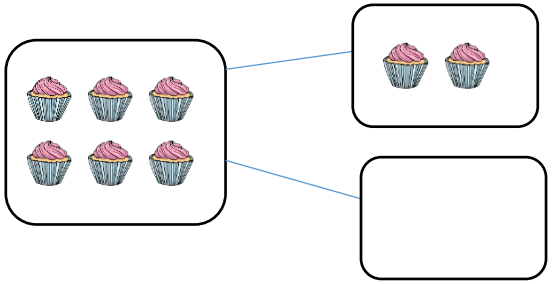
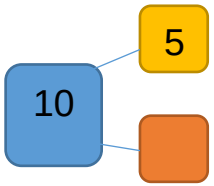
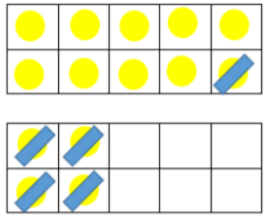
Column method- regrouping	Make both numbers on a place value grid.  146 + 527 Add up the units and exchange 10 ones for one 10.  146 + 527 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding.  	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 536 + 85 621 1 1 72.8 + 54.6 127.4 1 1 £ 2 3 . 5 9 + £ 7 . 5 5 £ 3 1 . 1 4 1 1 1 2 3 . 3 6 1 9 . 0 8 0 5 9 . 7 7 0 + 1 . 3 0 0 9 3 . 5 1 1 2 1 2
Fluency and variation **Different ways to ask children to solve 21+34**			

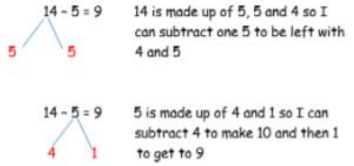
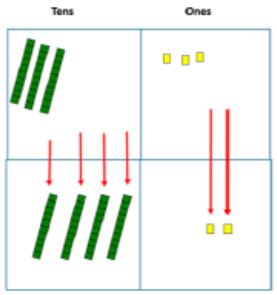
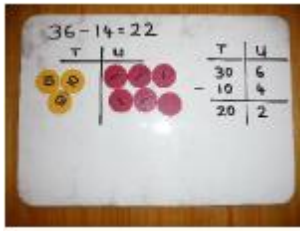
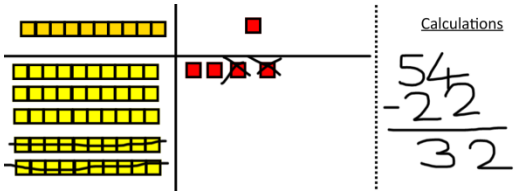
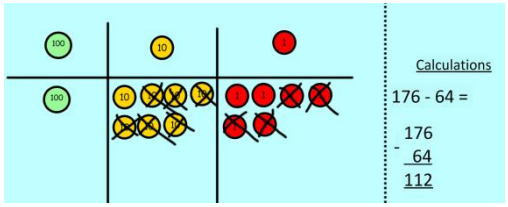
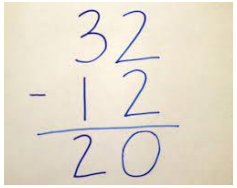
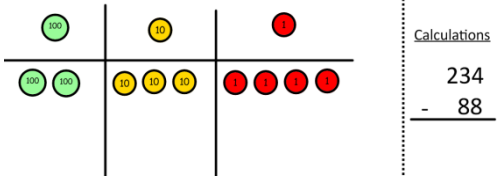
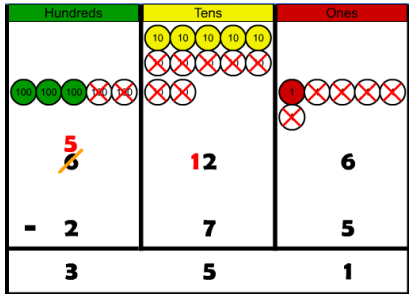
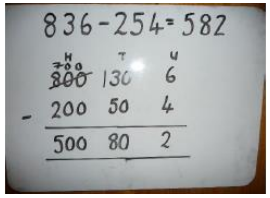
	Sam saved £21 one week and £34 another. How much did he save in total? 21+34=55. Prove it! (reasoning but the children need to be fluent in representing this)	21 +34 ___ 21 + 34 = ☐ = 21 + 34 What's the sum of twenty one and thirty four?	

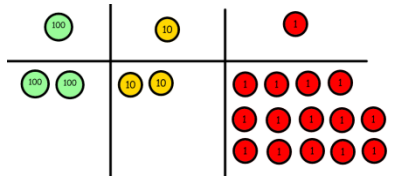
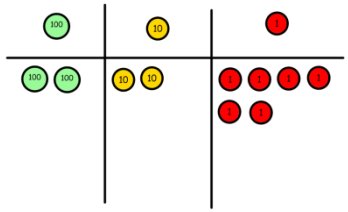
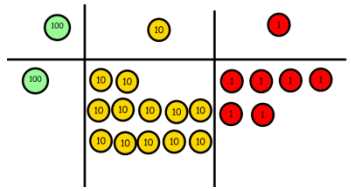
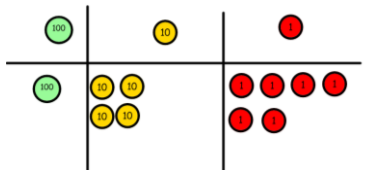
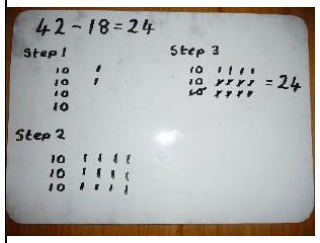
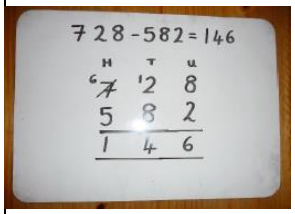
Subtraction

Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away. 	Cross out drawn objects to show what has been taken away. 	4-3= ? = 4-3 

			
Counting back	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones.  13 – 4 Use counters and move them away from the group as you take them away counting backwards as you go.  	Count back on a number line  Start at the bigger number and count back the smaller number showing the jumps on the number line. Bar model 	Unstructured numberline 
Find the difference	Compare amounts and objects to find the difference.	Count on to find the difference.  xxxxxxxx xxxxxx	Find the difference between 8 and 6. 8-6, the difference is? Children 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

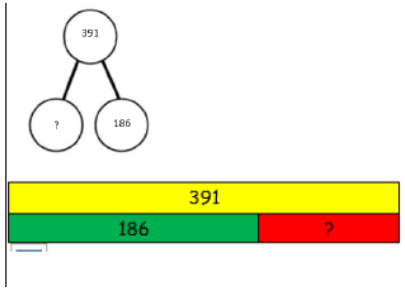
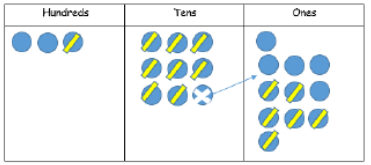
	 Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference 	Children draw cubes/ other concrete resources they have used Draw bars to find the difference between 2 numbers. 	
Part whole Model	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =	Use a pictorial representation of objects to show the part part whole model. 	 Move to using numbers within the part whole model.
Make 10	14 – 5 =  Make 14 on the ten frame. Take away the four first to make 10 and then	 Children to present the ten frame pictorially	14-5= 9 You also want children to see related facts e.g 14-9=5 Children to represent how they have solved it e.g

	takeaway one more so you have taken away 5. You are left with the answer of 9. Using numicon 	Start at 14. Take away 4 to reach 10. Then take away the remaining 1 so you have taken away 5 altogether. You have reached your answer. Numberline	
Column method without regrouping	 Use Base 10 to make the bigger number then take the smaller number away. Show how you partition numbers to subtract. Again make the larger number first. 	 Draw the Base 10 or place value counters alongside the written calculation to help to show working. 	47 - 24 = 23 40 + 7 - 20 + 4 20 + 3 This will lead to a clear written column subtraction. 
Column method with regrouping	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters  Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.		

	 Calculations 234 - 88 Now I can subtract my ones.  Calculations 234 - 88 Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.  Calculations 234 - 88 Now I can take away eight tens and complete my subtraction  Calculations 234 - 88 146 Show children how the concrete method links to the written method alongside your working. Cross out the	Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make. When confident, children can find their own way to record the exchange/regrouping.  Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.	Children can start their formal written method by partitioning the number into clear place value columns.  Moving forward the children use a more compact method. This will lead to an understanding of subtracting any number including decimals. 5 12 1 2 6 3 . 0 - 2 6 . 5 2 3 6 . 5

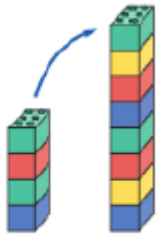
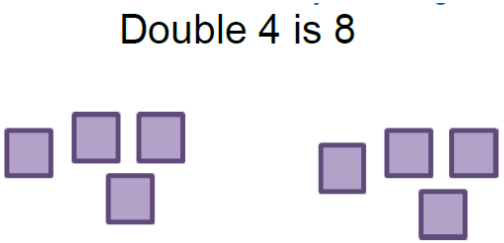
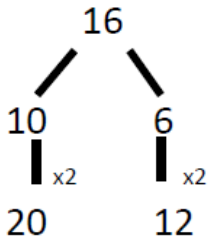
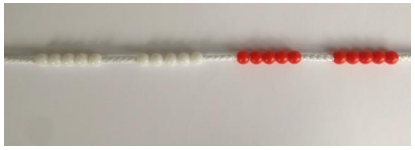
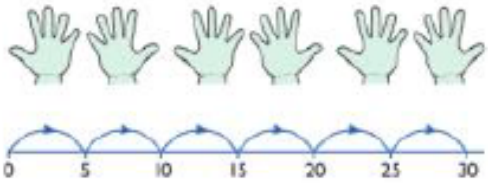
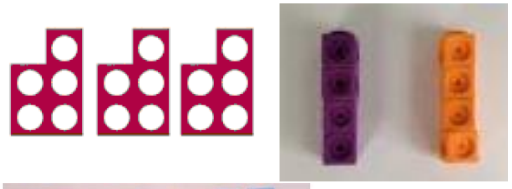
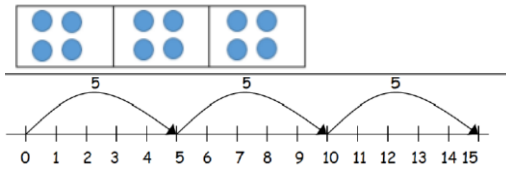
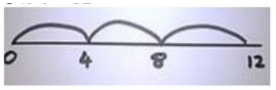
	numbers when exchanging and show where we write our new amount.		

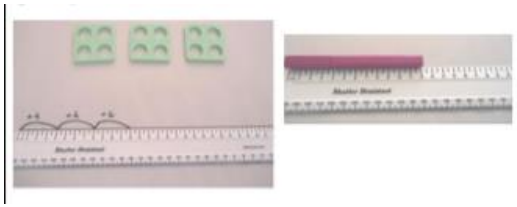
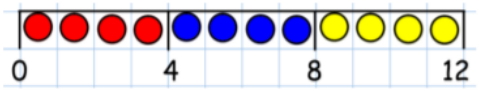
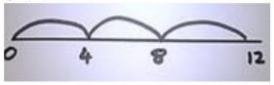
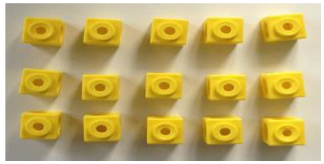
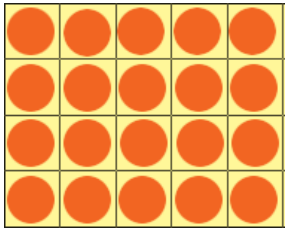
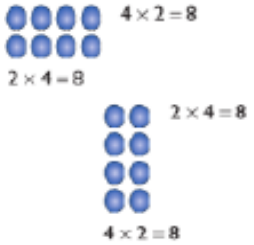
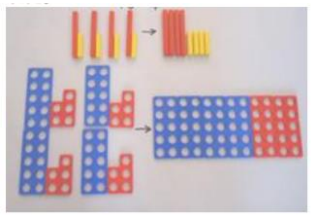
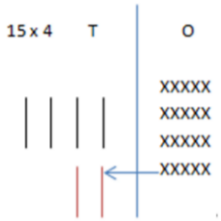
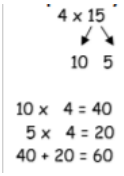
Fluency and variation
Different ways to ask children to solve 391-186

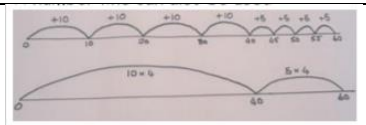
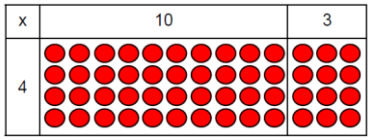
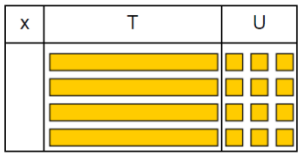
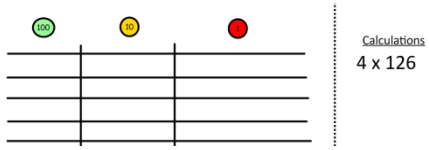
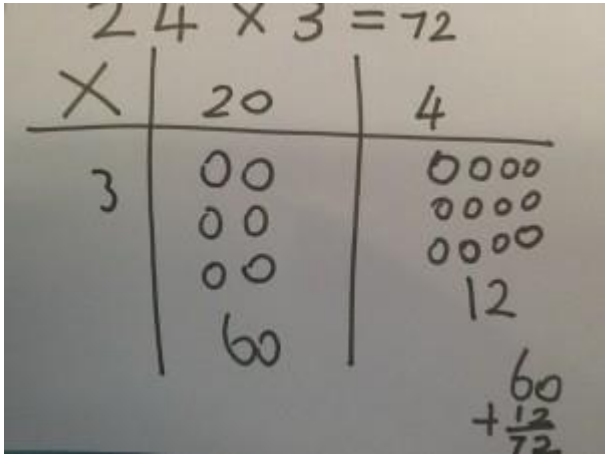
	Raj spent £391, Timmy spent £186. How much more did Raj spend? I had 391 metres to run. After 186 I stopped. How many metres do I have left to run?	What is 186 less than 391? Find the difference between 391 and 186 Subtract 186 from 391 391 - 186 ☐ = 391 - 186 391 -186 ___	What's the calculation? What's the answer?  

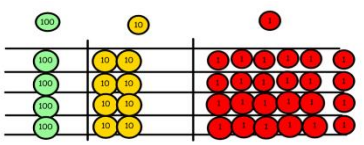
Multiplication

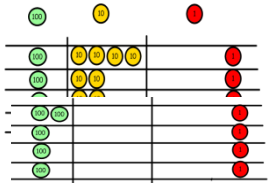
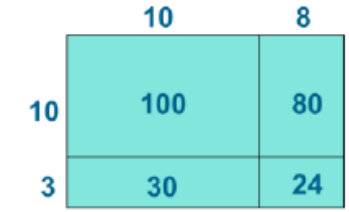
Objective and Strategies	Concrete	Pictorial	Abstract

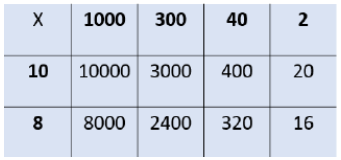
Doubling	Use practical activities to show how to double a number.  	Draw pictures to show how to double a number.  	 Partition a number and then double each part before recombining it back together.
Counting in multiples	  Count in multiples supported by concrete objects in equal groups.	 Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25 , 30
Repeated addition	Use different objects to add equal groups.  	Children represent practical resources in a picture XX XX XX XX XX XX Use of a bar model for a more structured method  5 + 5 + 5 = 15	3x4= 4+4+4= Solve on an unstructured numberline 

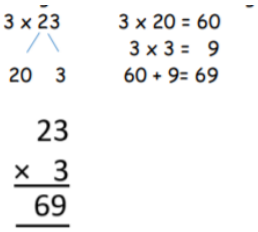
Using numberlines to show repeated groups	3x4 	Represent pictiorally alongside a number line 	Unstructured numberline 
Arrays- showing commutativity	Create arrays using counters/ cubes to show multiplication sentences.  	Draw arrays in different rotations to find **commutative** multiplication sentences.  Link arrays to area of rectangles. 	Use an array to write multiplication sentences and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 3 x 5 = 15 5 x 3 = 15
Partition to multiply	Numicon, base 10 , cuisenaire rods 4x15 	Children to represent the concrete manipulatives in a picture 	Children to be encouraged to show the steps they have taken  A numberline can also be used

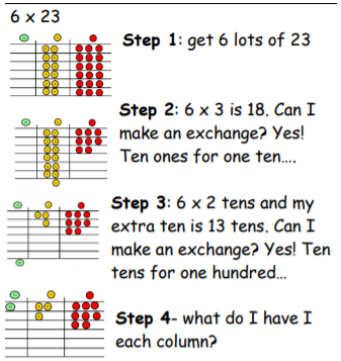
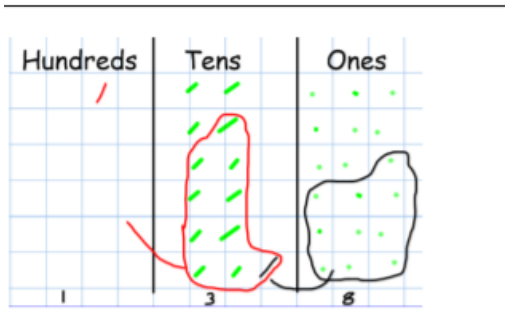
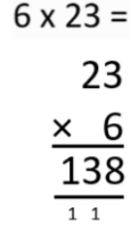
			
Grid Method	Show the link with arrays to first introduce the grid method.  4 rows of 10 4 rows of 3 Move on to using Base 10 to move towards a more compact method.  4 rows of 13 Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.  Fill each row with 126.	Children can represent the work they have done with place value counters in a way that they understand. They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below.  	Start with multiplying by one digit numbers and showing the clear addition alongside the grid.  210 + 35 = 245 Moving forward, multiply by a 2 digit number showing the different rows within the grid method.

<table>
<tr>
<td></td>
<td> 

Add up each column, starting with the ones making any exchanges needed.
 
Then you have your answer.</td>
<td></td>
<td> 


</td>
</tr>
<tr>
<td>Formal column method</td>
<td>Place value counters or base 10 (at the first stage no exchanging) 3x23

Make 23, 3 times. See how many ones, then how many tens
  </td>
<td>Children to represent the counters in a pictorial way
 
</td>
<td> 

</td>
</tr>
<tr>
<td></td>
<td>Children need this stage initially to understand how the column method works
 
</td>
<td>Children to represent the counters/base 10 pictorially
 
</td>
<td>6x23
6x3=18
6x20=120
120+18=138
The aim is to get to the formal method but the children need to understand how it works
 
</td>
</tr>
</table>

When children start to multiply 3 digit by 3 digit and 4 digit by 2 digit etc, they should be confident with the abstract:

To get 744 children have solved 6x124
To get to 2480 they have solved 20x124

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

Answer: 3224

Fluency and variation
Different ways to ask children to solve 6x23

23	23	23	23	23	23

?

With the counters, prove that 6 x 23 = 138

Why is 6x23 = 23x6=

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?

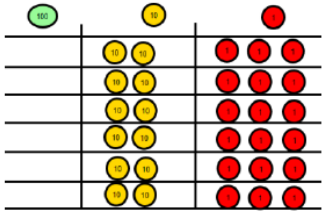
Find the product of 6 and 23

6 x 23 =

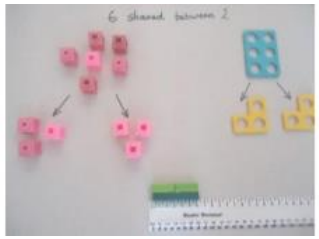
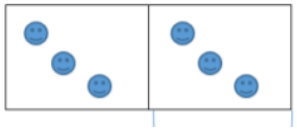
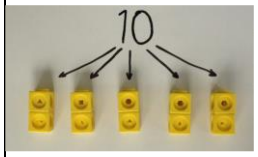
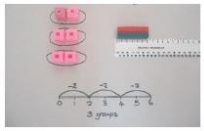
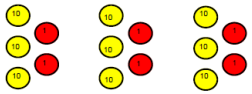
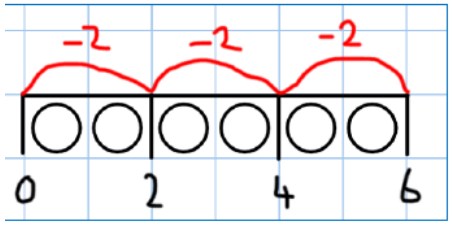
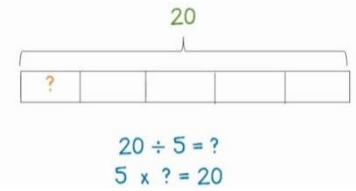
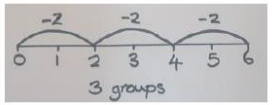
☐ = 6 x 23

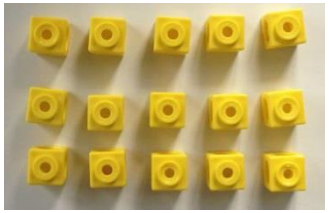
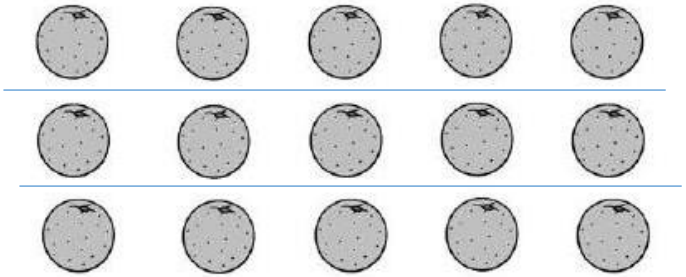
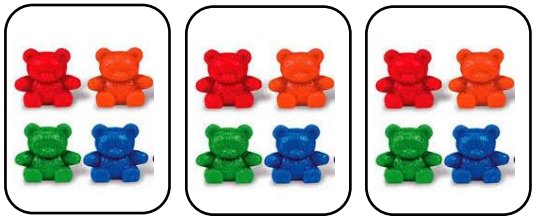
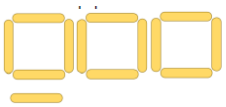
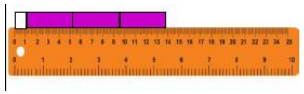
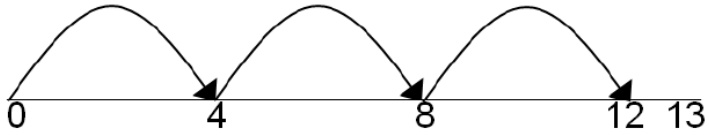
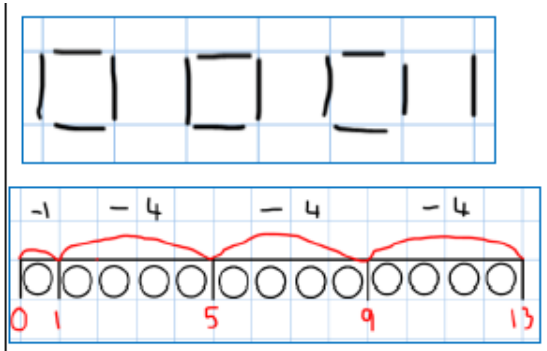
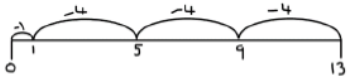
$$\begin{array}{r} 6 \\ \times\ 23 \\ \hline \end{array} \qquad \begin{array}{r} 23 \\ \times\ 6 \\ \hline \end{array}$$

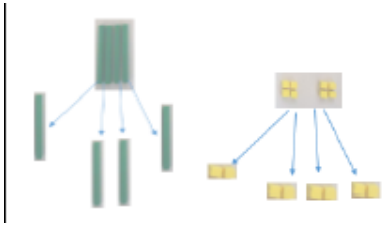
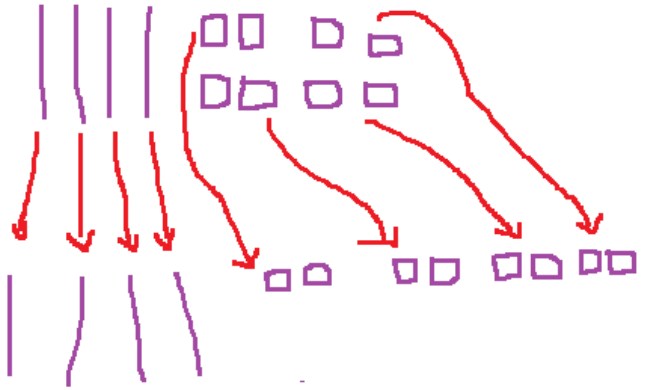
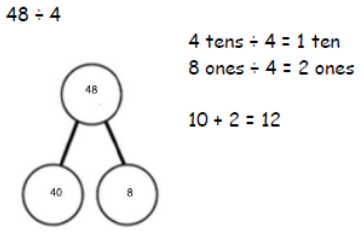
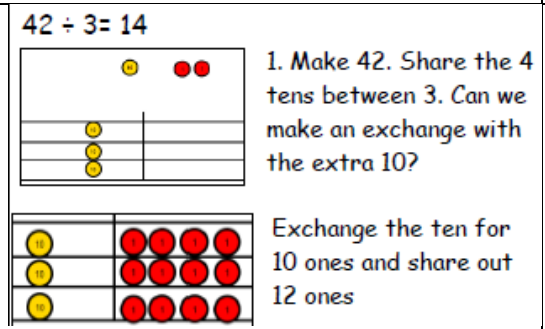
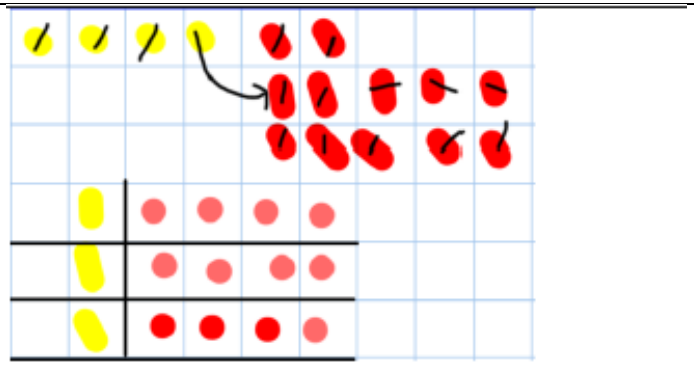
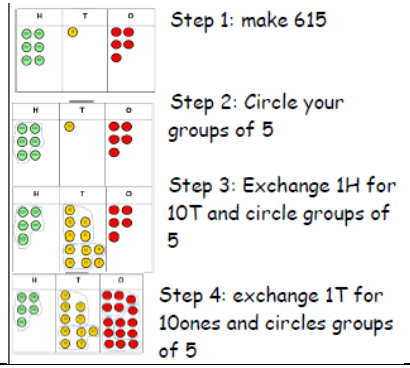
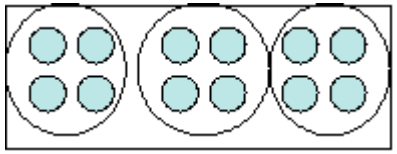
What's the calculation? What's the answer?

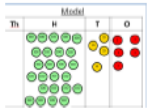
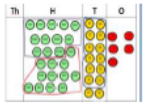
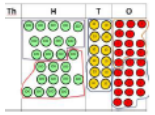


Division

Objective and Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups	6 Shared between 2 (Other concrete resources can be used e.g children and hoops, teddy bears, cakes and plates etc) 	 This can also be done in a bar 	6 ÷ 2= 3 What's the calculation? 
Division as repeated grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.     96 ÷ 3 = 32 	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group. 	Unstructured numberline 

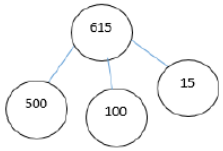
Division within arrays	 Link division to multiplication by creating an array and thinking about the number sentences that can be created. Eg 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	 Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the inverse of multiplication and division sentences by creating four linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7
Division with a remainder	14 ÷ 3 = Divide objects between groups and see how much is left over   Use of lollipop sticks to form wholes 14÷3  Use of cuisenaire rods and rulers (repeated subtraction) 	Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder.  Draw dots and group them to divide an amount and clearly show a remainder.   Represent concrete method pictorially	Complete written divisions and show the remainder using r.  Unstructured numberline 

2 digit divided by 1 digit using base 10 (no remainders)	48÷4 Start with the tens 	Children to represent the base 10 and sharing pictorially 	
Sharing using place value counters			42÷3 42= 30+12 30÷3=10 12÷3=4 10+4=14
Bus stop method	Using grouping and counters. 615÷5 	Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.  Encourage them to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainder. 123 5 ⟌ 615

			Move onto divisions with a remainder. $$\begin{array}{r} 8\ 6\ \text{r}\ 2 \\ 5\overline{)\,4\ 3\ 2} \\ \quad\ 3 \end{array}$$ Finally move into decimal places to divide the total accurately. $$\begin{array}{r} 1\ 4\ .\ 6 \\ 3\ 5\overline{)\,5\ 1\ 1\ .\ 0} \\ \quad\ 16\quad\ 21 \end{array}$$
Long division	 2544 ÷ 12 How many groups of 12 thousands do we have? None  Exchange 2 thousand for 20 hundreds.  How many groups of 12 are in 25 hundreds? 2 groups. Circle them. We have grouped 24 hundreds so can take them off and we are left with one.  Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2.  Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2	Children to represent the counters pictorially and record subtractions underneath	$$\begin{array}{r} 0 \\ 12\overline{)\,2544} \end{array}$$ Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds. $$\begin{array}{r} 0\,2 \\ 12\overline{)\,2544} \\ \quad 24 \\ \quad\ 1 \end{array}$$ 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. $$\begin{array}{r} 0\,2\,1 \\ 12\overline{)\,2544} \\ \quad 24 \\ \quad\ 14 \\ \quad\ 12 \\ \quad\ 2 \end{array}$$ 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. $$\begin{array}{r} 0\,2\,1\,2 \\ 12\overline{)\,2544} \\ \quad 24 \\ \quad\ 14 \\ \quad\ 12 \\ \quad\ 24 \\ \quad\ 24 \\ \quad\ 0 \end{array}$$ Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.

Fluency and variation
Different ways to ask children to solve 615÷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 ÷ 5 =

☐ = 615 ÷ 5

How many 5's go into 615?

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