Chapel End Primary School Calculation Policy

This calculation policy has been written in line with the programmes of study taken from the revised National Curriculum for Mathematics (2014) and developed from Whiterose Maths Hub. It provides guidance on appropriate calculation methods and progression. The content is set out in blocks (guidance only) under the following headings: addition, subtraction, multiplication and division.

Aims of the Policy:

- To ensure consistency and progression in our approach to calculation
- To ensure that children develop an efficient, reliable, formal written method of calculation for all operations
- To ensure that children can use these methods accurately with confidence and understanding

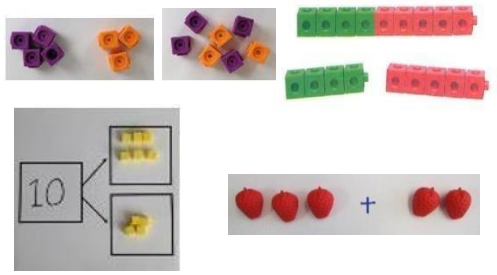
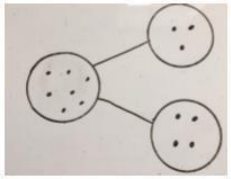
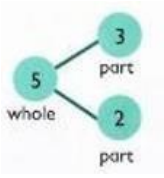
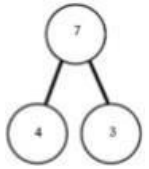
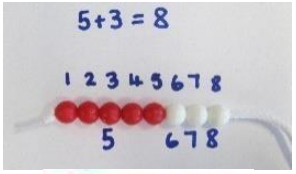
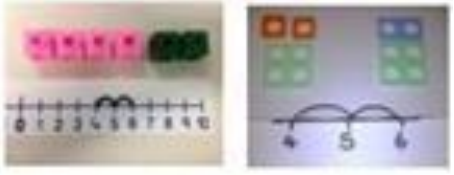
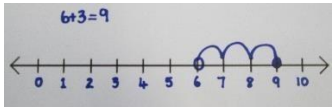
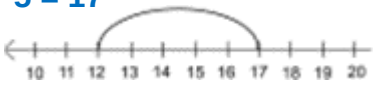
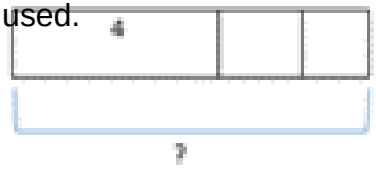
How to Use This Policy:

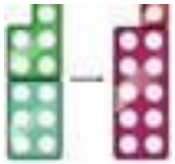
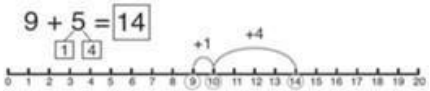
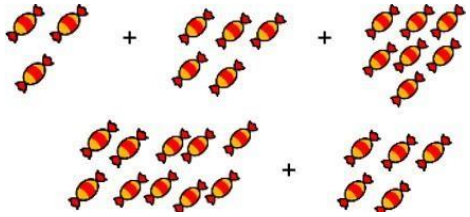
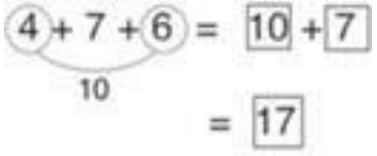
- Use the policy as the basis of your planning but ensure you use previous or following stages' guidance to allow for personalised learning
- Always use Assessment for Learning to identify suitable next steps in calculation for groups of children
- If, at any time, children are making significant errors, return to the previous stage in calculation
- Always use suitable resources, models and images to support children's understanding of calculation and place value, as appropriate
- Encourage children to make sensible choices about the methods they use when solving problems

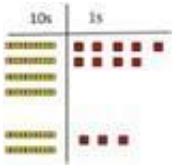
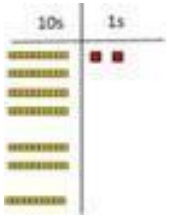
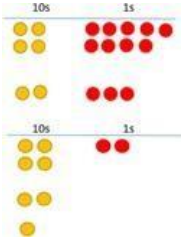
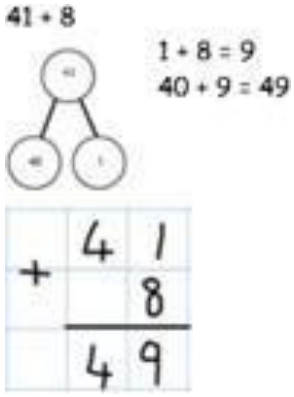
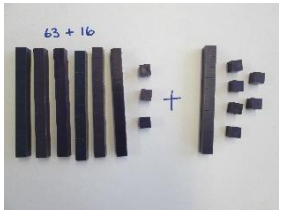
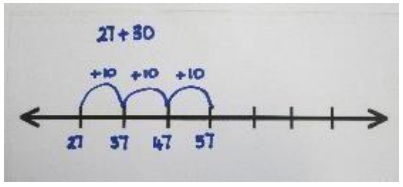
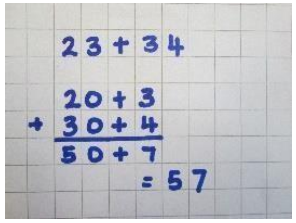
Representations:

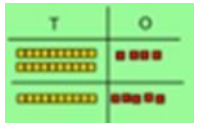
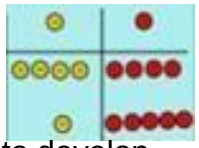
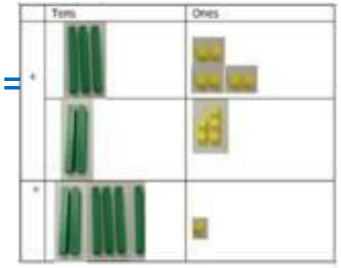
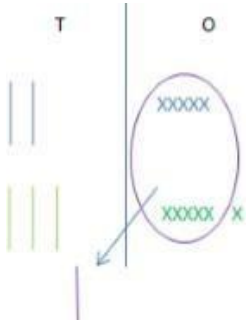
The key to successful implementation of a school calculation policy is the consistent use of representations (models and images that support conceptual understanding of the mathematics) and this policy promotes a range of relevant representations, across the primary years.
Mathematical understanding is developed through use of representations that are first of all concrete (e.g. Dienes apparatus, cubes), and then pictorial (e.g. array, place value counters) to then facilitate abstract working (e.g. column addition, long multiplication).
This policy guides teachers through an appropriate progression of representations, and if at any point a pupil is struggling they should revert to familiar pictorial and/or concrete materials/ representations as appropriate.
Whilst a mathematically fluent child will be able to choose the most appropriate representation and procedure to carry out a calculation, whether written or mental, teachers should support pupils with carefully selected representations that underpin calculation methods (as detailed in this policy), and ensure there is consistency across year groups.

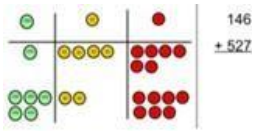
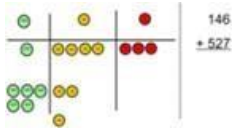
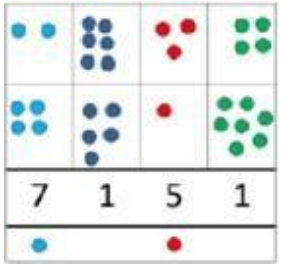
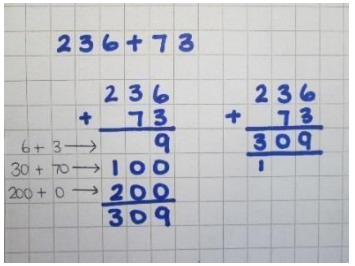
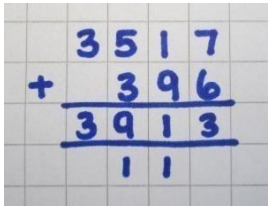
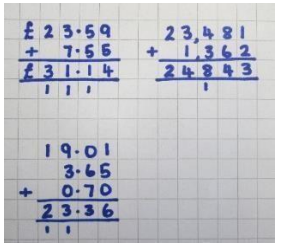
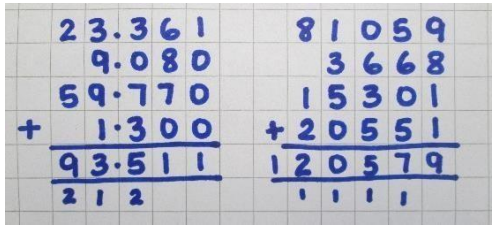
ADDITION

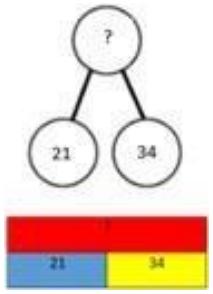
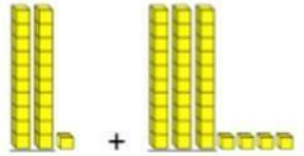
	OBJECTIVE	CONCRETE	PICTORIAL	ABSTRACT
Stage A	Combining two parts to make a whole. Number bonds of 5, 6, 7, 8, 9 and 10	Use cubes or any other resources (teddy bear, shells, beads) to add two numbers together as a group or in a bar. 	Use pictures to add two numbers together as a group or in a bar.   	Use the part-part-whole diagram to move into the abstract. **4 + 3 = 7** (4 is a part, 3 is a part, 7 is a whole)  **2 + 3 = 5** **5 = 3 + 2** **2 + ☐ = 5** **2 + 3 = ☐** **3 + 2 = 5** **5 = 2 + 3** **☐ + 3 = 5**
Stage B	Counting on using number lines. Starting at the bigger number and counting on.	Start with the larger number on the bead string and then count on to the smaller number, 1 by 1, to find the answer.  	Use a number line to count on in ones or in one jump to find the answer.  **12 + 5 = 17**  A bar model which encourages the children to count on could be used. 	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?  **5 + 3 = 8** **5 + 12 = 17** Place the larger number in your head and count on with the smaller number to find your answer.

Stage C	Regrouping to make 10.	Regrouping to make 10; using ten frames and counters/cubes or using Numicon. **6 + 5 = 11**   **9 + 3 = 12**	Children to draw the ten frame and counters/cubes.  Use pictures or a number line. Regroup or partition the smaller number to make 10. **3 + 9 = 12**  	**7 + 4= 11** **If I am at seven, how many more do I need to make 10?** **How many more do I add on now?** Children to develop an understanding of equality: **6 + ☐ = 11** **6 + 5 = 5 + ☐** **6 + 5 = ☐ + 4**
Stage D	Adding 3 single digit numbers.	**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. Draw a picture to recombine the groups to make 10. 	Combine the two numbers that make 10 and then add on the remainder. 

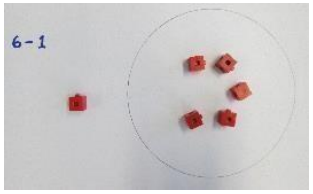
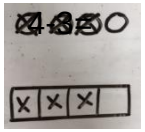
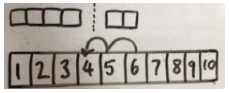
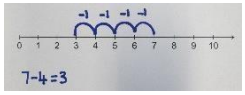
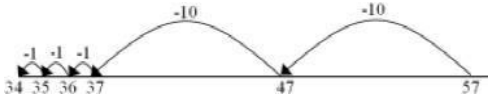
Stage D	Column method – no regrouping. TO + O using base 10.	Continue to develop understanding of partitioning and place value. **41 + 8**  Make both numbers on a place value grid.  Add up the ones and exchange 10 ones for 1 ten. 	Using place value counters, children can draw the counters to help them to solve additions. 	**40 + 9** **20 + 3** **60 + 12 = 72** 
Stage E	Column method – no regrouping. TO + TO	Add together the ones first, then add the tens. Use the Base 10 blocks first before moving onto place value counters. Continue to develop understanding of partitioning and place value and use this to support addition. **Begin with no exchanging.** 	This could be done a number of ways:  34 + 23 = 	

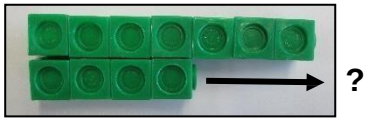
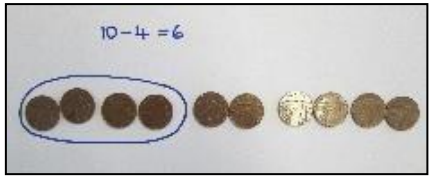
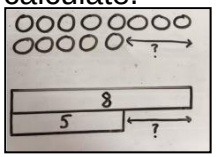
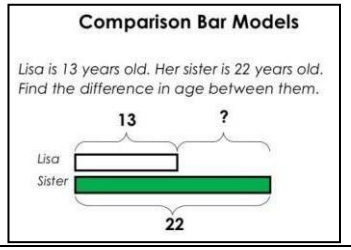
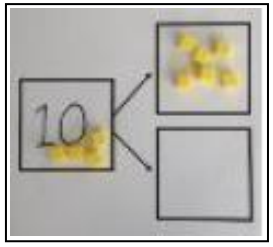
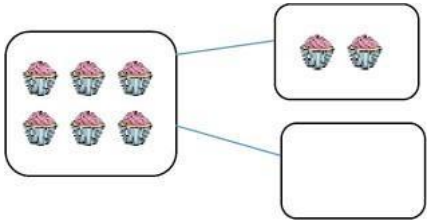
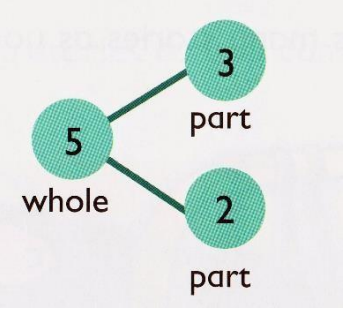
Stage F	Column method with regrouping. TO + TO	With exchanging: **24 + 15 =**  **44 + 15 =**  Continue to develop understanding of partitioning and place value and use this to support addition. Begin with no exchanging. **36 + 25 =**  	**25 +36 =**  **36 + 25=**	**36 + 25 =** **30 + 20 = 50** **6 + 5 = 11** **50 +11 = 61** 36 +25 61 1

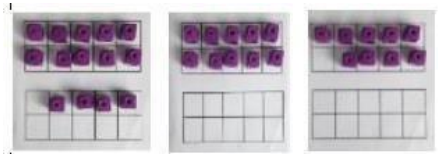
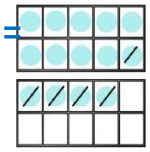
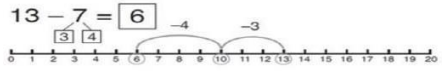
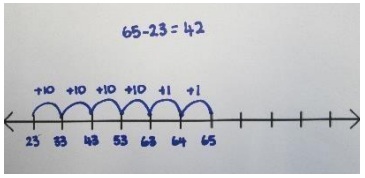
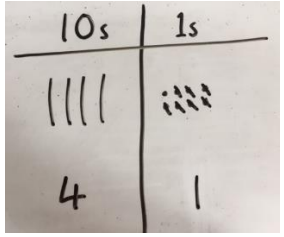
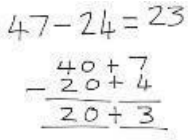
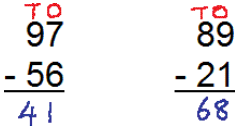
Stage G	Column method with regrouping. HTO + HTO Moving to Th H T O as demonstrated	Make both numbers on a place value grid.  Add up the units and exchange 10 ones for 1 ten.  Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column 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 pictorial representation of the columns and place value counters to further support their learning and understanding.  	  As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 
Stage H	Add with several numbers of increasing complexity	-	-	Add ‘zeros’ where needed to show the place value of decimals. 

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)	21 +34 —— 21 + 34 = □ = 21 + 34 What's the sum of twenty one and thirty four?	 Always use missing digit problems too: 

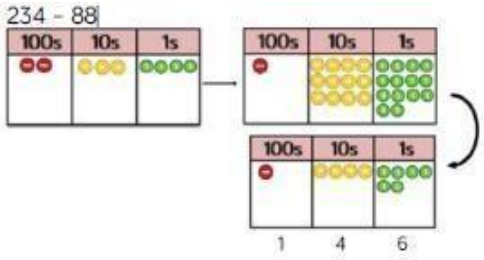
SUBTRACTION

	OBJECTIVE	CONCTRETE	PICTORIAL	ABSTRACT
Stage A	Taking away ones	Physically taking away and removing objects from a whole. Ten frames, Numicon, cubes and other items such as beanbags could be used. 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used.  	**4 - 3 =** **? – 3 = 1**
Stage B	Counting back	Counting back in ones on a number line or number track. **13 – 4 =**  Again numicon, counters, blocks or other equipment could be used for this.	Start at the bigger number and count back in ones showing the jumps on the number line.   This can progress all the way to counting back using two 2 digit numbers. 	Put 13 in your head, count back 4. What number are you at? Use your fingers to help.

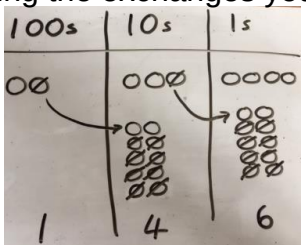
Stage C	Find the difference	Using cubes, Cuisenaire rods or Numicon. Other objects can also be used. **Calculate the difference between 7 and 4.**   	Children to draw the cubes or other concrete objects which they have used or use the bar model to illustrate what they need to calculate.   	**Find the difference between 8 and 5.** **8 – 5, the difference is** ☐ **Children to explore why 9 - 6 = 8 – 5 = 7 – 4 have the same difference.** **Hannah has 23 sandwiches; Helen has 15 sandwiches. Find the difference between the number of sandwiches.**
Stage D	Part – 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. Any objects can be used for this. 	Move to using numbers within the part-part-whole model. 

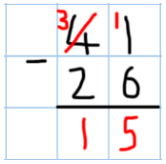
Stage E	Make 10	**14 – 9 =** ☐ Make 14 on the ten frame. Take away the four first to make 10 and then takeaway one more so you have taken away 5. You are left with the answer of 9. 	Children to present the ten frame pictorially and discuss what they did to make 10. **14 – 5 =**  Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer. 	**17 – 9=** ☐ **How many do we take off to reach the next 10?** **How many do we have left to take off?** Subtract by counting back gradually using more effective numbers. 
Stage F	Column method without regrouping (Incorporating Base 10)	Use Base 10 to make the bigger number then take the smaller number away. 	Draw the Base 10 or place value counters alongside the written calculation to help to show working. Children to represent pictorially. **48 - 7 = ?** 	Column method or children could count back 7.  This should lead to clear written column subtraction. 

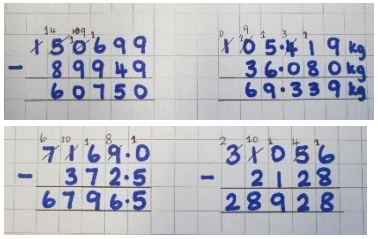
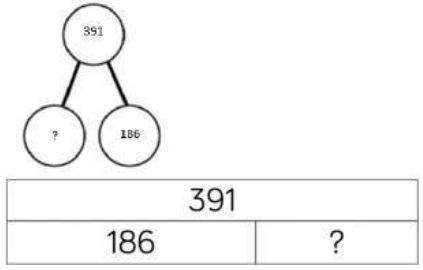
<table>
<tr>
<td>Stage G</td>
<td>Column method with regrouping (Incorporating base 10)</td>
<td>Column method using base 10 and having to exchange.
Using place value counters.

234 – 88 =
 

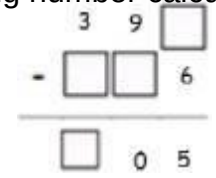
Make the larger number with the place value counters
Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.</td>
<td>Represent the Base 10 pictorially, remembering to show the exchange.

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.
 

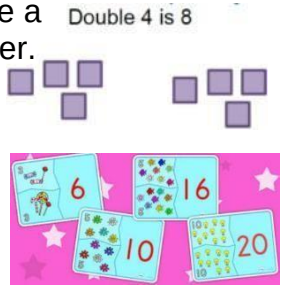
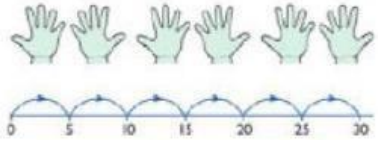
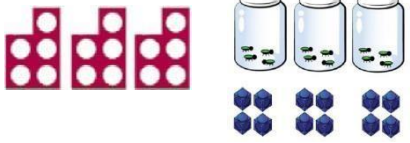
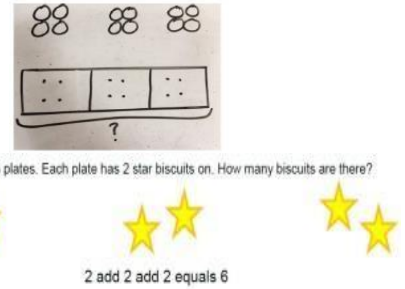
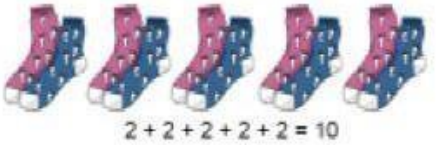
When confident, children can find their own way to record the exchange/regrouping.</td>
<td>Children must understand that when they have exchanged the 10 they still have 41 because 41 = 30 + 11.
 

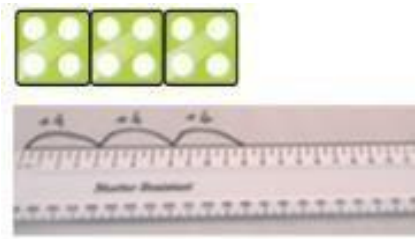
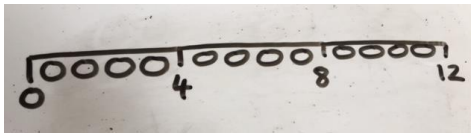
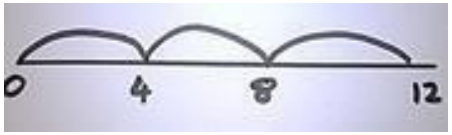
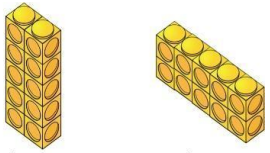
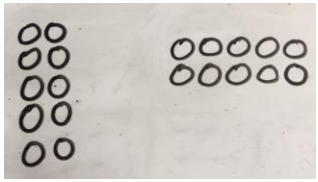
Children must understand what has happened when they have crossed out digits.
2 1
2 3 4
- 8 8
6</td>
</tr>
<tr>
<td>Stage H</td>
<td>Subtract with increasingly large and more complex numbers and decimal values.</td>
<td>-</td>
<td>-</td>
<td> 
</td>
</tr>
<tr>
<td colspan="5">Fluency variation, different ways to ask children to solve 391 - 186</td>
</tr>
<tr>
<td> 
</td>
<td>Raj spent £391, Timmy spent £186. How much more did Raj spend?

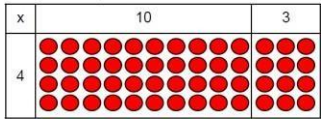
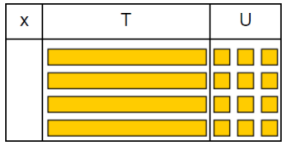
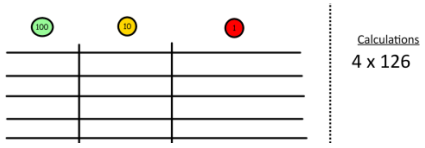
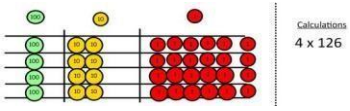
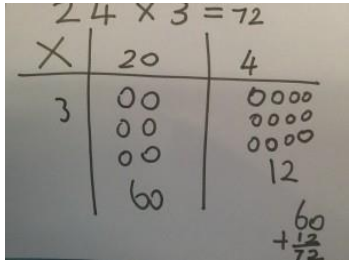
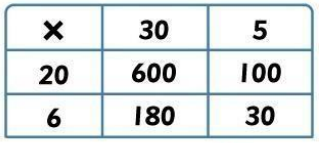
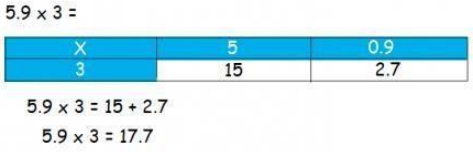
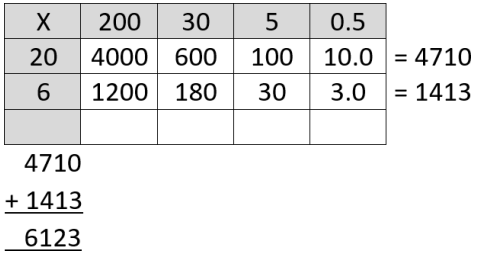
Calculate the difference between 391 and 186.</td>
<td>□ = 391 – 186
391
-186
___

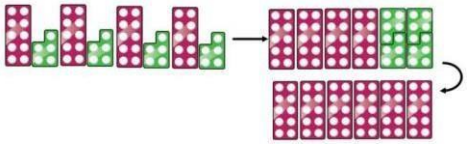
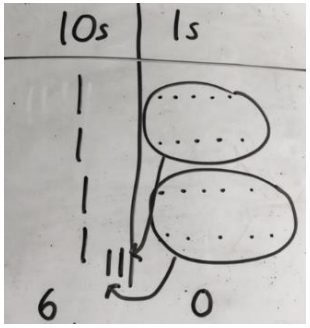
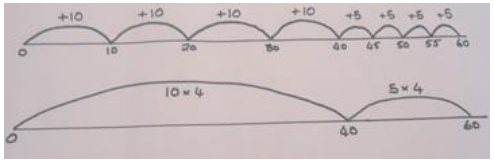
What is 186 less than 391?</td>
<td colspan="2">Missing number calculations
 
</td>
</tr>
</table>

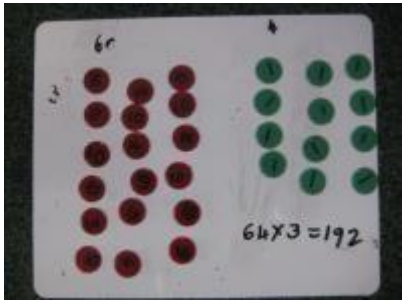
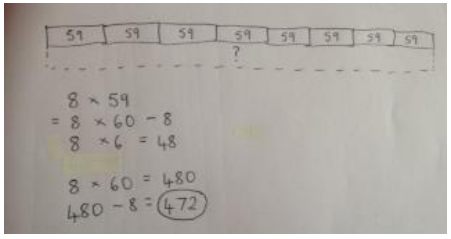
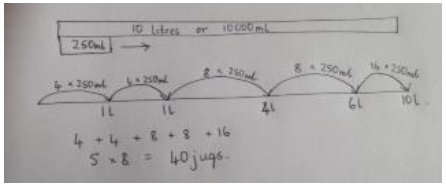
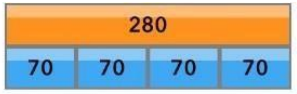
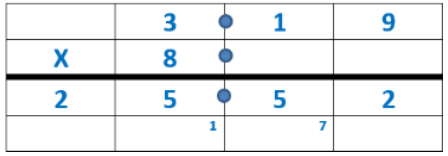
MULTIPLICATION

	OBJECTIVE	CONCRETE	PICTORIAL	ABSTRACT
Stage A	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. **2x16 = (2 x 10) + (2 x 6)** **= 20 + 12** **= 32**
Stage B	Counting in multiples	Count in multiples supported by concrete objects in equal parts.  	Use a number line or pictures to continue support in counting in multiples. 	Count in multiples of a number aloud. (Use a counting rod to support this). **Write sequences with multiples of numbers.** **2, 4, 6, 8, 10** **5, 10, 15, 20, 25 , 30**
Stage C	Repeated addition	Repeated grouping/repeated addition. **3 × 4** **4 + 4 + 4** **There are 3 equal groups, with 4 in each group.** 	Children to represent in picture and/or use a bar model. 	Write addition sentences to describe objects and pictures. **4 + 4 + 4 = 12** 

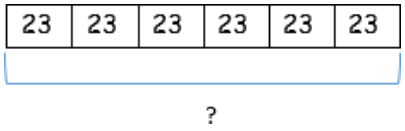
Stage D	Number lines showing repeated groups.	**3 x 4 =** ☐  Cuisenaire rods can also be used.	Represent this pictorially.  	Abstract number lines showing 32 jumps of 4: 
Stage E	Arrays- showing commutative multiplication	Create arrays using counters/ cubes to show multiplication sentences. **3 lots of 4** **4 lots of 3**   Any other equipment could be used e.g. cake/muffin tins to hold equipment.	Children to represent the arrays pictorially.  Make sure the arrays are drawn in different orientations to find the commutativity. (Link arrays to areas of rectangles)	Children to be able to use an array to write a range of calculations e.g. **10 = 2 × 5** **5 × 2 = 10** **2 + 2 + 2 + 2 + 2 = 10** **10 = 5 + 5** Use an array to write multiplication sentences and reinforce repeated addition.

Stage F	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 compacy method  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.  Add up each column starting with the ones making any exchanges needed.  Then you have your answer.	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.  	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.  **600 + 100 = 700** **180 + 30 = 210** **700 + 210 = 910**  **235.5 x 26 = ?** 

Stage G	Partition to multiply	You can use Numicon, base 10 or Cuisenaire rods. **4 × 15 =** ☐ 	Children to represent the concrete manipulatives pictorially. 	Children to be encouraged to show the steps they have taken. 4 x 15 10 5 10 x 4 = 40 5 x 4 = 20 40 + 20 = 60 A number line can also be used. 

Stage H	Column multiplication	Children can continue to be supported by place value counters at the stage of multiplication. It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below. 	Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.    	Start with long multiplication, reminding the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer. 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768  This moves to the more compact method.
Stage I	Multiply decimals.	-	-	

Fluency variation, different ways to ask children to solve 6 x 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 x 23 = 138

Find the product of 6 and 23

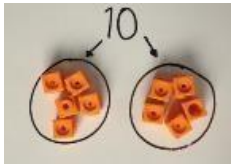
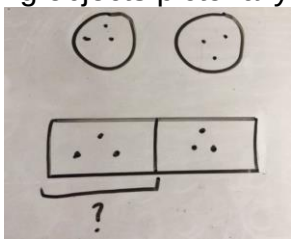
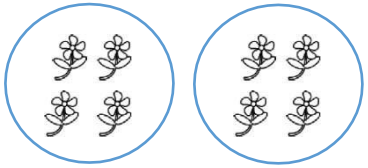
6 × 23 = ☐

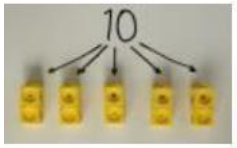
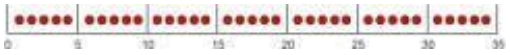
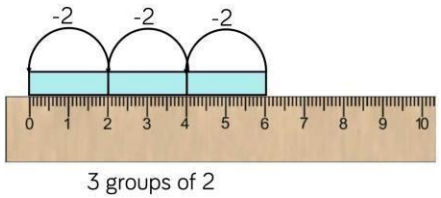
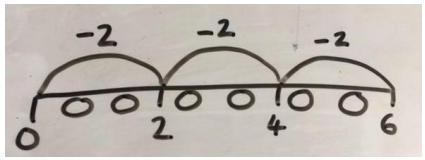
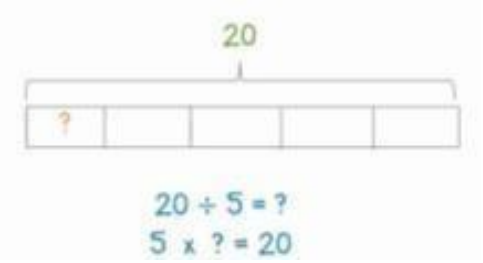
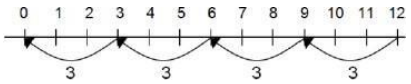
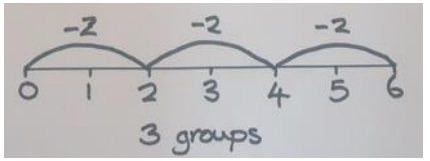
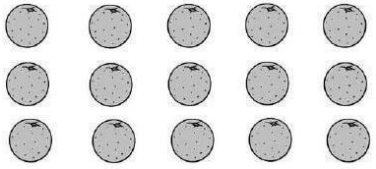
☐ = 6 × 23

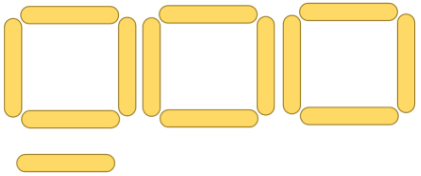
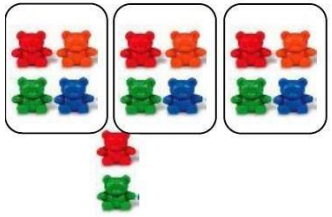
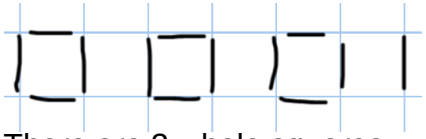
6	23
× 23	× 6
___	___

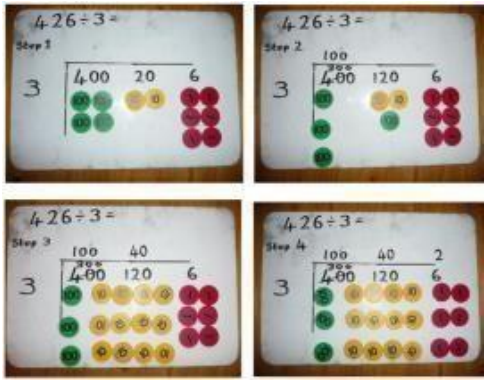
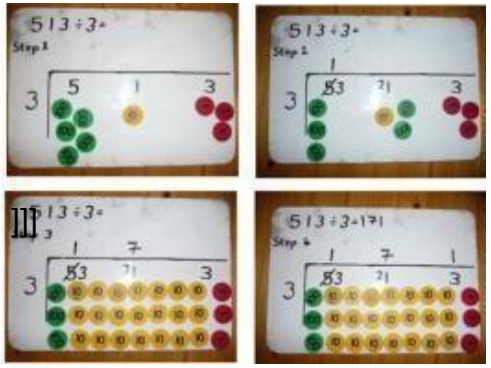
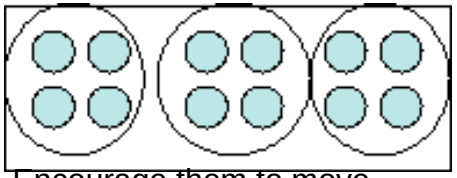
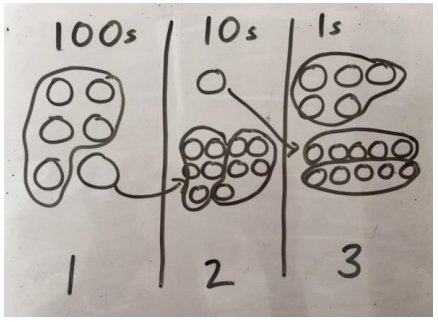
What is the calculation? What is the product?

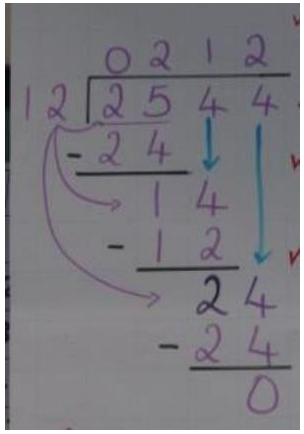
DIVISION

	OBJECTIVE	CONCRETE	PICTORIAL	ABSTRACT
Stage A	Sharing objects into groups	 I have 10 cubes; can you share them equally in 2 groups? 	Sharing objects pictorially.  **8 ÷ 2 =** ☐ 	**Share 9 buns between three people.** **9 ÷ 3 = 3** **6 ÷ 2 = 3** Children should also be encouraged to use their 2 times table facts. 

Stage B	Division as grouping / Repeated subtraction	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.   Repeated subtraction using Cuisenaire rods above a ruler. **6 ÷ 2 =** ☐  3 groups of 2	Children can represent this pictorially.  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.  	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  
Stage C	Division within arrays	Link division to multiplication by creating an array and thinking about the number sentences that can be created. E.g. **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**

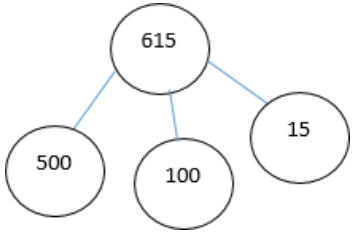
Stage D	Division with a remainder	Use lollipop sticks. Cuisenaire rods, above a ruler can also be used. **13 ÷ 4 =** ☐ Use of lollipop sticks to form whole squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over. **14 ÷ 3 =** ☐ Divide objects between groups and see how much is left over 	Children to represent the lollipop sticks pictorially.  There are 3 whole squares, with 1 left over. Draw dots and group them to divide an amount and clearly show a remainder. 	Complete written divisions and show the remainder using r. 

Stage E	Short division	Divide a three digit number, then moving to a four digit number, by a one digit number by using partitioning and place value counters.  Divide a three digit number, then moving to a four digit number, by a one digit number without partitioning but using place value counters. 	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. Represent the place value counters pictorially. 	Begin with divisions that divide equally with no remainder. $\begin{array}{r} 218 \\ 4\overline{)872} \\ \end{array}$ Move onto divisions with a remainder. $\begin{array}{r} 86\ r\ 2 \\ 5\overline{)432} \\ \end{array}$ Finally move into decimal places to divide the total accurately. $\begin{array}{r} 14.6 \\ 35\overline{)511.0} \\ \end{array}$

Stage F	Long division	-	-	

Conceptual 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 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 ÷ 5 = ☐

☐ **= 615 ÷ 5**

What is the calculation? What is the answer?