Claregate
Primary School

Calculation Policy

September 2018

Introduction

This policy is a guide for all staff at Claregate Primary School and has been adapted from the White Rose Hub's calculation document to match our school's approach.

It is set out as a progression of mathematical skills and not in year groups to encourage a flexible approach to teaching and learning. It is expected that teachers will use their professional judgement to establish where pupils are in their mathematical development to decide if consolidation of existing skills is needed or the pupils are ready to move onto the next concept.

The calculation policy is set out in the four areas of addition, subtraction, multiplication and division. Within each specific area there are different strategies laid out under the headings concrete, pictorial and abstract. These headings are explained below:

- **Concrete** is the "**doing**" stage. During this stage, pupils use concrete objects to model problems.
- **Pictorial** is the "**seeing**" stage. Here, visual representations of concrete objects are used to model problems. This stage encourages pupils to make a mental connection between the physical object they just handled and the abstract pictures, diagrams or models that represent the objects from the problem.
- **Abstract** is the "**symbolic**" stage, where pupils use abstract symbols to model problems. The abstract stage involves the teacher introducing abstract concepts (for example, mathematical symbols).

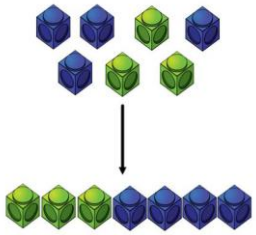
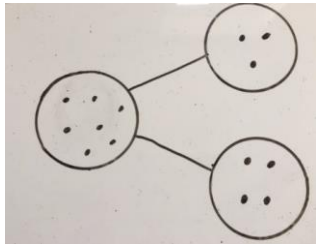
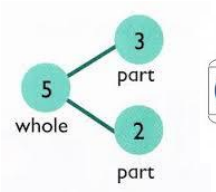
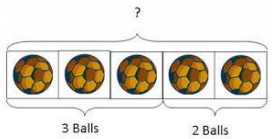
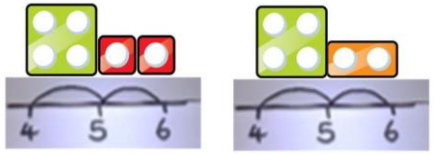
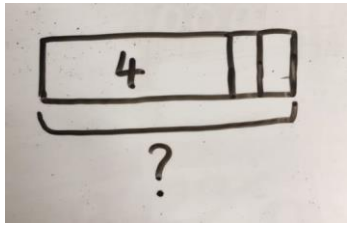
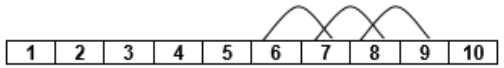
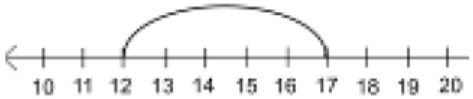
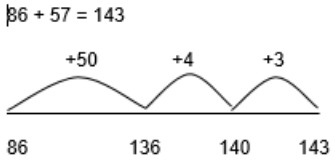
These stages are used so that the pupils have a true mathematical understanding of the concept before moving to more formal methods. Mental methods and strategies will work in partnership with these methods.

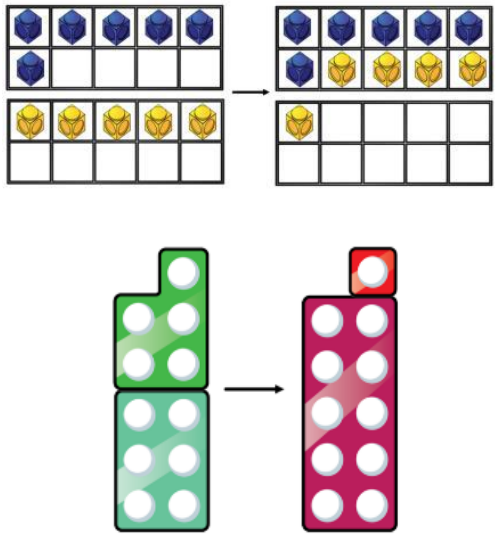
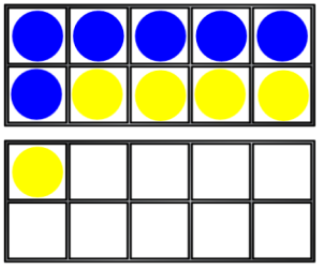
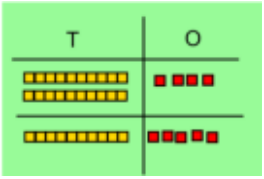
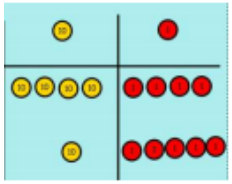
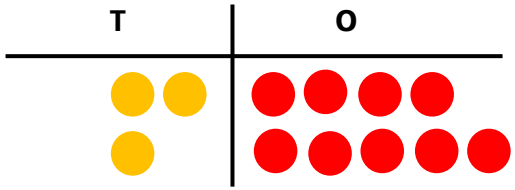
Mental calculation is not at the exclusion of written recordings and should be seen as complementary to and not separate from it. In every written method there is an element of mental processing. Pupils should use mental methods when appropriate to save time, but the basis of the calculation policy will give the pupils the understanding of an efficient written method they can use confidently when they cannot complete calculations in their heads.

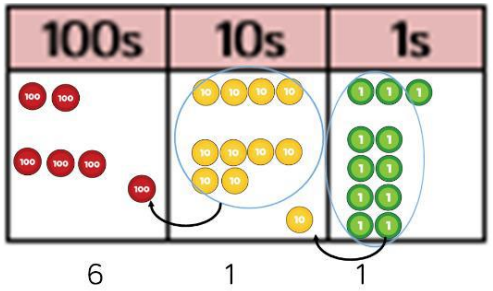
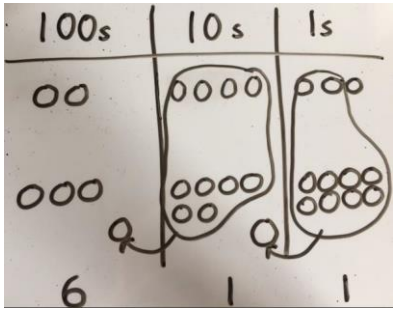
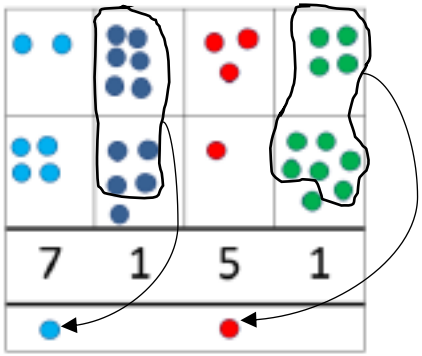
By using this policy appropriately we will ensure pupils are competent in fluency, reasoning and problem solving and are able to make informed choices about the methods they wish to use (mental or written) to solve mathematical problems efficiently and effectively.

This policy will ensure consistency and progression in the school's approach to calculation and enable a smooth transition between year groups.

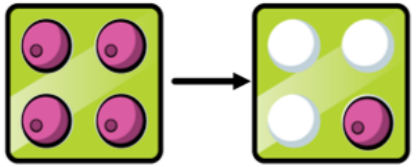
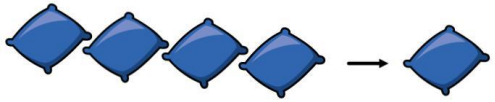
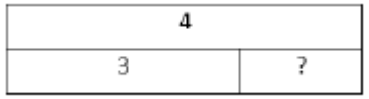
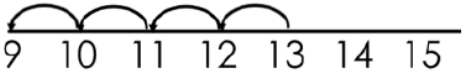
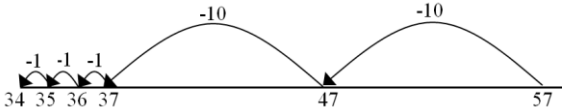
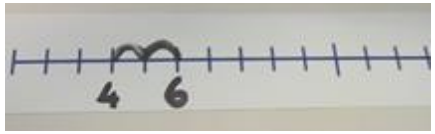
ADDITION

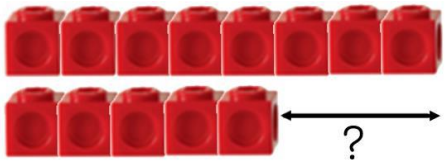
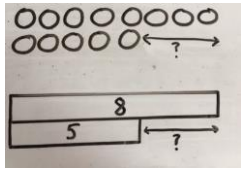
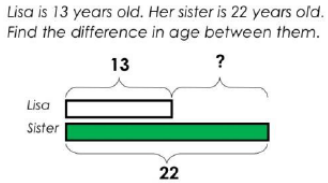
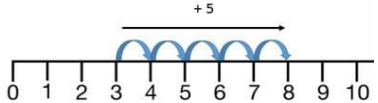
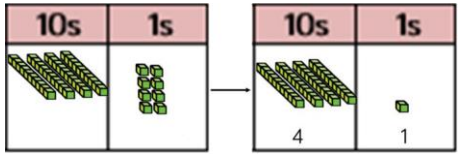
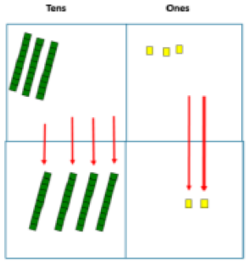
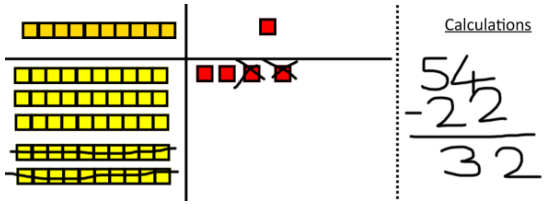
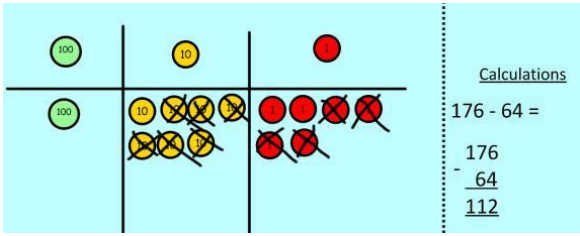
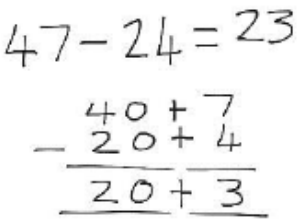
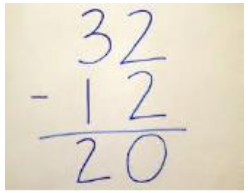
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	  	  	6 + 2 = 8 8 = 6 + 2
Counting on	  Start with the larger number on the bead string/Numicon/cubes etc and then count on to find the answer	 6 + 3  12 + 5 	8 + 4 = 12 6 + 13 = 19 Place the larger number in your head and count on the smaller number to find your answer Abstract number line 

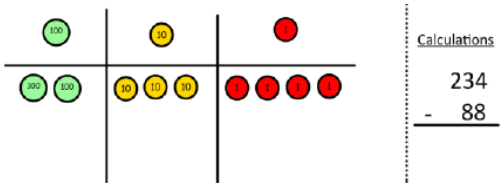
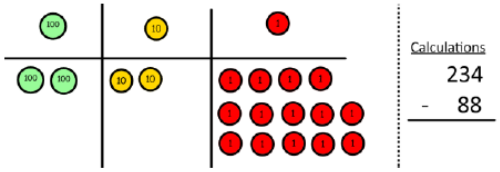
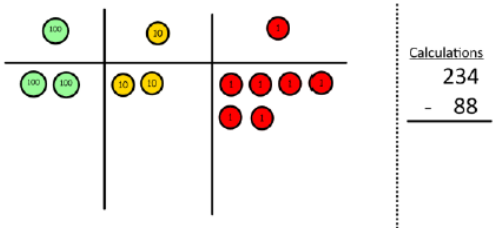
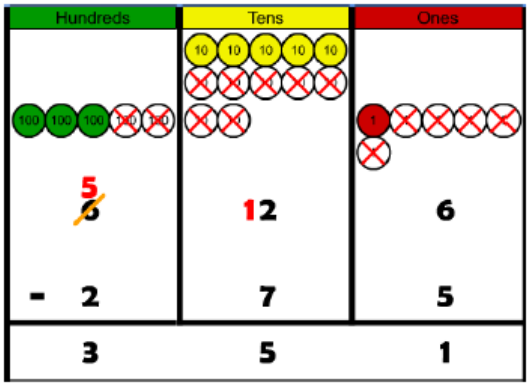
Objective and Strategies	Concrete	Pictorial	Abstract
Regrouping to make 10		Pupils to draw their own representation of the concrete methods  Use pictures or a number line	6 + ☐ = 11 If I am at six, how many more do I need to make 10? How many more do I add now? Develop an understanding of equality 6 + 5 = ☐ + 4
Column method – no regrouping	Add together the ones first, then add the tens. Use blocks or counters. 24 + 15 44 + 15  	After practically using the block or counters, pupils can draw the counters to help solve calculations. 24 + 15 	21 + 42 = 21 + 42

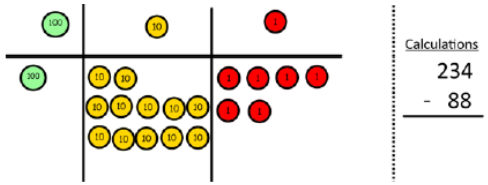
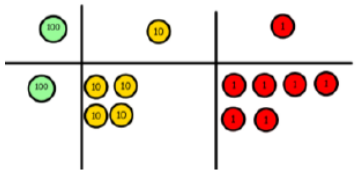
Column method – regrouping	Using counters or blocks, make both numbers on a place value grid. Add the ones and regroup 10 ones to make 1 ten. Add up the rest of the columns, regrouping 10 counters from one column for the 1 counter in the next place value column, until every column has been added. 243 + 368  	Children to represent the counters in a place value chart, circling when they regroup. 243 + 368  2634 + 4517  	Start with partitioning (expanded method) the numbers before moving on to show regrouping below the addition. $\begin{array}{r} 47 \\ +\ 76 \\ \hline 13 \\ 110 \\ \hline 123 \end{array}$ $\begin{array}{r} 367 \\ +\ 185 \\ \hline 552 \\ \hline {\scriptstyle 1\,1} \end{array}$ Develop this method to include decimals. $\begin{array}{r} 89.6 \\ +\ 28.9 \\ \hline 118.5 \\ \hline {\scriptstyle 1\,1} \end{array}$

SUBTRACTION

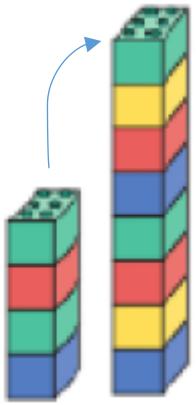
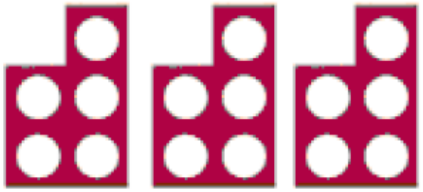
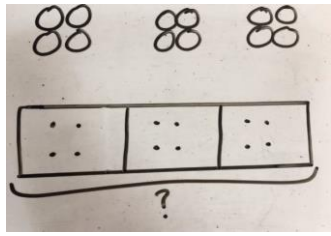
Objective and Strategies	Concrete	Pictorial	Abstract
Subtracting ones	Use physical objects, counters, cubes etc. to show how objects can be taken away. 4 - 3  	Cross out drawn objects to show what has been taken away. 4-2 	18 – 3 = 15 8 – 2 = 6 19 = 21 – 2 = 24 - 4 
Counting back	Make the larger number on a bead string or in cubes, counters etc then count backwards in ones. 13 - 4 	Count back on a number line or number track.  	Children to represent the calculation on a number line or number track. Encourage the children to use empty number lines.  Put 13 in your head, count back 4. What number are you on?

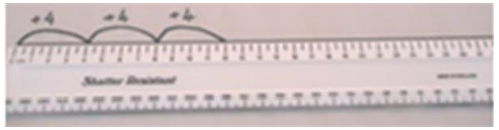
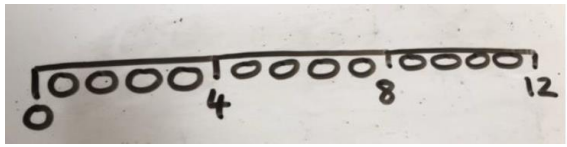
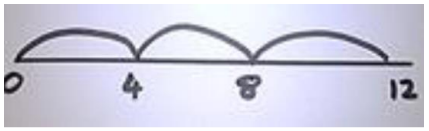
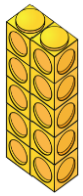
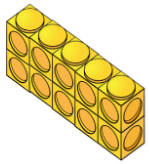
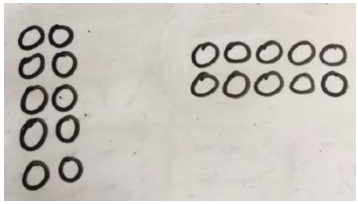
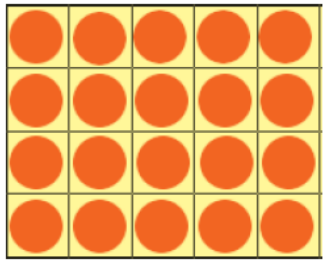
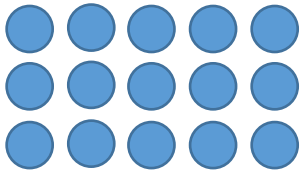
Objective and Strategies	Concrete	Pictorial	Abstract
Find the difference	Use cubes, Numicon, counters, Cuisenaire rods to calculate the difference.  	Children to draw the cubes/other concrete objects which they have used or use a bar model to illustrate what they need to calculate.   Count on to find the difference  	Find the difference between 8 and 5. The difference between 9 and 17 is ▭ Children to explore why 9 – 6 8 – 5 7 - 4 have the same difference.
Column method – no regrouping	Use base ten to make the larger number and then take the smaller number away.  75 – 42 = 33  	Draw the base 10 or counters alongside the written method to show workings.   	 This will lead to the formal written method of: 

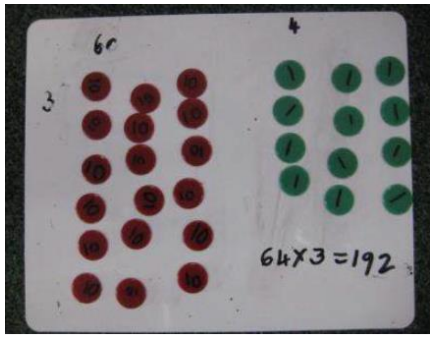
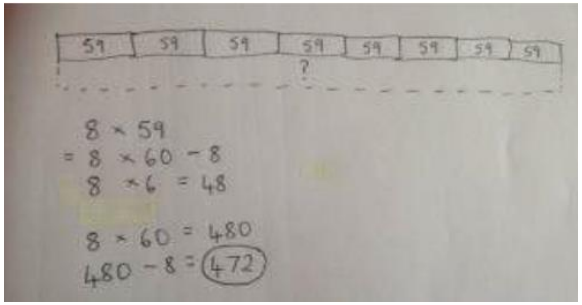
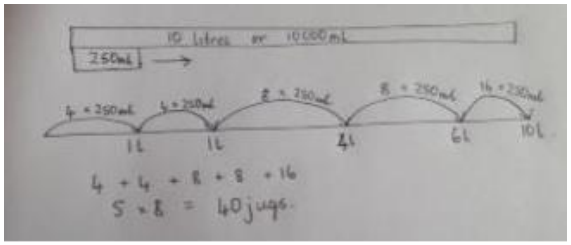
Column method – regrouping	Use base ten or counters. Start with subtractions which require one need to regroup, then move onto subtractions which require two or more needs to regroup.  Calculations 234 - 88 Start with the ones, can I subtract 8 from 4 easily? I need to regroup 1 of my tens to make 10 ones.  Calculations 234 - 88 Now I can subtract my ones  Calculations 234 - 88	 Draw the counters onto a place value grid and show what you have subtracted by crossing out the counters as well as clearly showing where the regrouping has taken place.	Children can start their foral written method by partitioning the number into clear place value columns. 81 = 70 ~~80~~ + 11 ~~1~~ - 57 - 50 + 7 20 + 4 = 24 754 = 600 ~~700~~ + 140 ~~50~~ + 14 ~~4~~ 286 - 200 + 80 + 6 = 400 + 60 + 8 =468 Moving forward the children use a more compact method. H T O 1 ~~2~~ 1 4 8 - 6 7 1 8 1

	Now look at the tens, can I subtract 8 tens easily? I need to regroup 1 hundred to make 10 tens.  Calculations 234 - 88 Now I can subtract 8 tens and complete my subtraction calculation.  Calculations ~~2~~~~3~~~~4~~ - 88 146 Show the children how the concrete method links to the written method alongside your workings. Cross out the numbers when regrouping and show where we write the new number.		This will lead to an understanding of subtracting any number including decimals H T O . t 5 ¹2 2 ~~6~~ ~~3~~ . ¹0 - 2 6 . 5 2 3 6 . 5

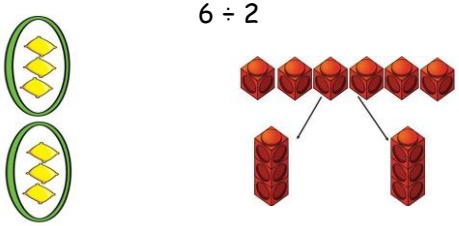
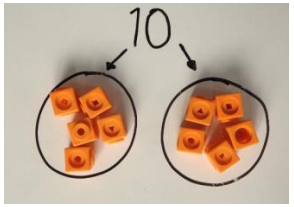
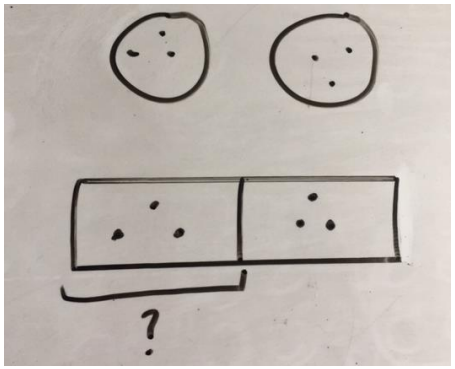
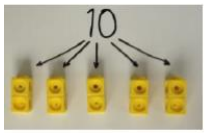
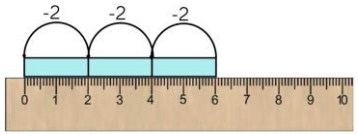
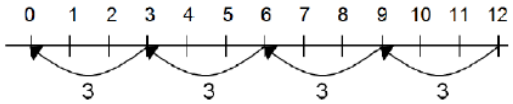
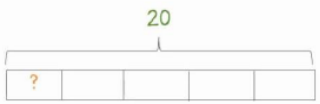
MULTIPLICATION

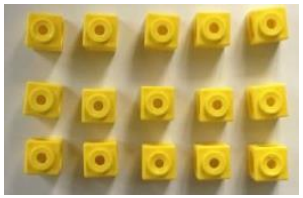
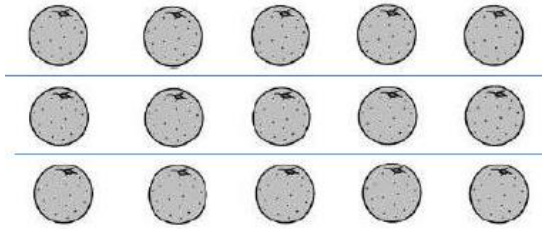
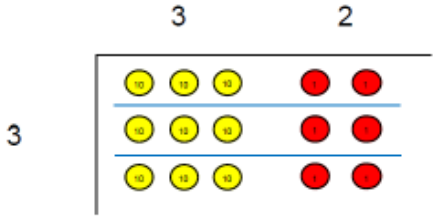
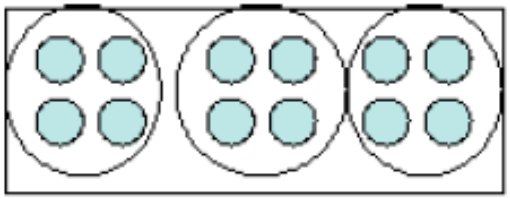
Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	 Use practical activities to show how to double a number. Double 4 is 8 4 x 2 = 8	Draw pictures to show how to double a number. Double 6 is 12 	Partition a number and then double each part before recombining it back together to get final answer. 18 10 ×2 → 20 8 ×2 → 16 20 + 16 = 36
Repeated Addition	Use different objects to add equal groups.  	Children to represent the repeated addition in picture form and use a bar model.  There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there? 	Write addition sentences to describe objects and pictures.  2 + 2 + 2 + 2 + 2 = 10

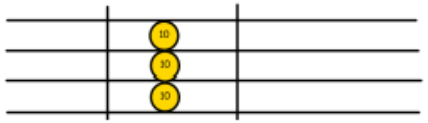
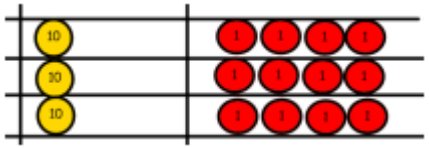
Objective and Strategies	Concrete	Pictorial	Abstract
Number lines to show repeated groups.	3 x 4  	Represent this pictorially alongside a number line e.g. 	Abstract number line showing three jumps of four. 3 x 4 
Arrays – showing commutative multiplication	Create arrays using counters/cubes to show multiplication sentences $2 \times 5 = 5 \times 2$  2 lots of 5  5 lots of 2	Children to represent the arrays pictorially. 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 5 x 3 = 15 3 x 5 = 15

Objective and Strategies	Concrete	Pictorial	Abstract
Column Multiplication	Children can continue to use counters or cubes to form arrays to help solve multiplication calculations.  It is important at this stage that the children always multiply the ones first and note down their answer, followed by the tens to calculate the final answer.	Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.   	<u>Short multiplication</u> 23 x 7 21 (7 x 3) 140 (7 x 20) 161 Leading to: 23 x 7 161 2 <u>Long Multiplication</u> 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768 7 4 x 6 3 1 2 2 1 0 2 4 0 + 4 2 0 0 4 6 6 2 Leading to the compact method of long multiplication: 352 x 27 2464 7040 9504 1

DIVISION

Objective and Strategies	Concrete	Pictorial	Abstract
Sharing	Use a range of objects 6 ÷ 2  I have 10 cubes, can you share them equally into 2 groups? 	Represent the sharing pictorially. 	Share 9 buns between three people. 9 ÷ 3 = 3
Division as grouping or repeated subtraction	Divide quantities into equal groups. Use cubes, counters etc. to aid understanding. 10 ÷ 2 = 5  96 ÷ 3 = 32  6 ÷ 2 = 3  3 groups of 2	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  20 ÷ 5 = ? 5 x ? = 20	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

Objective and Strategies	Concrete	Pictorial	Abstract
Division within arrays	Link division to multiplication by creating an array and thinking about the number sentences that can be created.  15 ÷ 3 = 5 15 ÷ 5 = 3 5 x 3 = 15 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 7 x 4 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7
Short Division	Use place value counters to divide using the short division method. 96 ÷ 3 = 32 	Children can continue to draw diagrams with dots or circles to help them divide numbers into equal groups.  Encourage the children to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainders. 2 1 8 4) 8 7 ³2 Move onto divisions with a remainder. 8 6 r2 5) 4 3 ³2

	42 ÷ 3   Start with the largest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left.   We can then regroup this ten to 10 ones and then share the ones equally among the three groups.  We now look how much in one group, therefore the answer is 14.		Move on to writing remainders as fractions and decimals. $\begin{array}{r} 86\frac{2}{5} \\ 5\overline{)43^{3}2} \end{array}$ $\begin{array}{r} 86.4 \\ 5\overline{)43^{3}2.^{2}0} \end{array}$

Objective and Strategies	Abstract
Long Division	Children will use long division to divide numbers with up to 4 digits by a 2 digit numbers. . 1) Start with long division where there are no remainders. 2) Move on to long division calculations with a remainder. 3) Then move on to giving remainders as fractions and decimals

		0	1	7	2
2	4	4	1	2	8
	−	0			
		4	1		
	−	2	4		
		1	7	2	
	−	1	6	8	
				4	8
			−	4	8
					0

		0	1	1	0	r 15
3	2	3	5	3	5	
	−	0				
		3	5			
	−	3	2			
			3	3		
		−	3	2		
				1	5	

		0	1	1	0	$\frac{15}{32}$
3	2	3	5	3	5	
	−	0				
		3	5			
	−	3	2			
			3	3		
		−	3	2		
				1	5	

		0	1	0	2.	2	5
2	4	2	4	5	4.	0	0
	−	0					
		2	4				
	−	2	4				
			0	5			
		−		0			
				5	4		
			−	4	8		
					6	0	
				−	4	8	
					1	2	0
				−	1	2	0
							0