Mathematics Calculation Policy

May 2016

Reviewed September 2017

Reviewed December 2018

Reviewed September 2019

St Mawes Primary School

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Introduction

The purpose of this document is to create a personalised, updated policy reflecting the requirements of the National Curriculum 2014 and more importantly, the needs of our pupils.

This policy aims to develop, model and explain core understandings and mathematical principles and progression to ensure consistency in the teaching and learning of mathematics in our school.

The focus of this policy is the calculation of the four mathematical operations with an emphasis on written strategies to clarify processes and understanding and to make direct links to mental calculating. It is crucial that these mental strategies are discretely taught and linked to written strategies and not confined to starter activities in lessons.

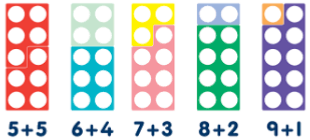
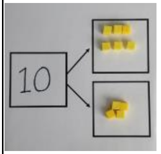
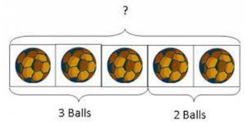
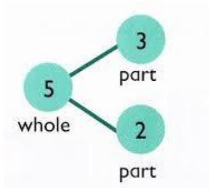
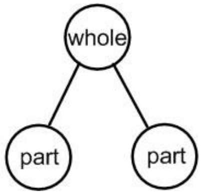
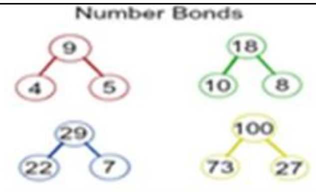
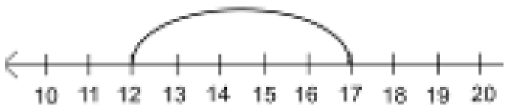
The overall aims of this policy are that, when children leave primary school they:

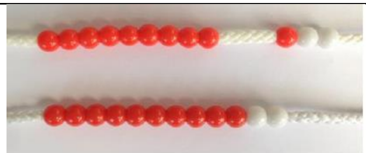
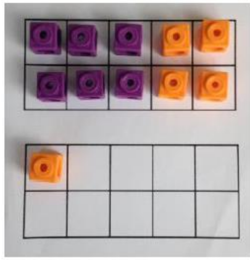
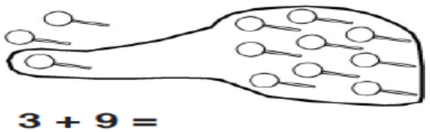
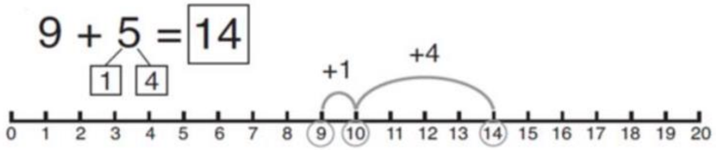
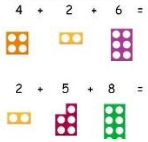
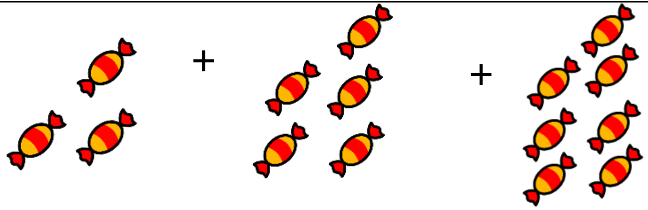
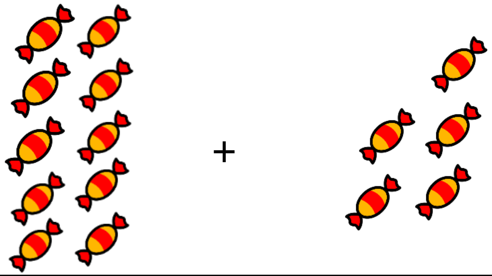
- have a secure knowledge of number facts and a good understanding of the four operations supported by a fluency and understanding of the fundamentals of mathematics
- know the best strategy to use, estimate before calculating, systematically break problems down into a series of simpler steps with perseverance and use estimation and rounding to check that an answer is reasonable
- are able to use this knowledge and understanding to carry out calculations mentally, solve problems of increasing complexity and develop an ability to recall and apply knowledge rapidly
- make use of diagrams and informal notes and jottings to help record steps and partial answers when using mental methods
- have an efficient, reliable, compact written method of calculation for each operation, which they can apply with confidence when undertaking calculations
- be able to identify when a calculator is the best tool for the task and use this primarily as a way of checking rather than simply a way of calculating
- be able to explain their strategies to calculate and, using spoken language, give mathematical justification, argument or proof

The new bits	
Reception	Children will count numbers to 20. Children will double, halve and share numbers up to 20.
Year 1	Children count to and across 100, forwards and backwards beginning from any given number. Children begin to use ½ and ¼.
Year 2	Children recognise, name and write the fractions 1/3, ¼, 2/4 and ¾ of length, shapes and quantities.
Year 3	Compare, order and calculate number totals up to 1000. Begin to use columnar methods for addition and subtraction. Count on and back in tenths. Tell and write the time from an analogue clock and 12 and 24 hour clocks. Recognise Roman numerals from I to XII. (1 to 12) Recall multiplications for 4s and 8s
Year 4	Compare, order and calculate number totals up to 10,000. Multiply two and three-digit numbers by a one-digit number using formal written method. Recognise Roman numerals from I to C (1 to 100) Tell and write the time with accuracy using 24h notation. Recognise and write decimal equivalents to ¼, ½ and ¾. Recall all multiplication tables
Year 5	Compare, order, round and calculate number totals up to 1,000,000 and determine the value of each digit. Recognise and use square and cubed numbers and use the notation for these: ^{2} ^{3} Recognise and write Roman numerals from I to M (1 to 1000)
Year 6	Compare, order, round and calculate number totals up to 10,000,000 and determine the value of each digit. Use long multiplication to multiply multi-digit numbers by a two-digit number. Use formal short division and interpret remainders according to context.

Progression in Calculations

Addition

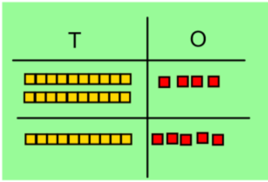
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	     	   Use pictures to add two numbers together as a group or in a bar.   	 Use the part-part whole diagram as shown to move into the abstract. 4 + 3 = 7 10= 6 + 4
Starting at the bigger number and counting on	 Start with the larger number on the bead string or number line and then count on to the smaller number 1 by 1 to find the answer.	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.	5 + 12 = 17 Place the larger number in your head and count on the smaller number to find your answer.

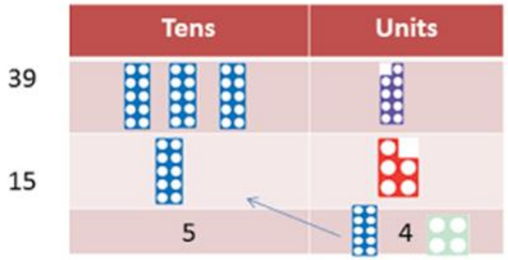
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10.	 Use pictures or a number line. Regroup or partition the smaller number to make 10. 	7 + 4= 11 If I am at seven, how many more do I need to make 10. How many more do I add on now?
Adding three single digits	 Use Numicon or objects. 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.	$\underbrace{4 + 7 + 6}_{10} = \boxed{10} + \boxed{7}$ $= \boxed{17}$ Combine the two numbers that make 10 and then add on the remainder.

Formal method- grouping and exchanging of tens

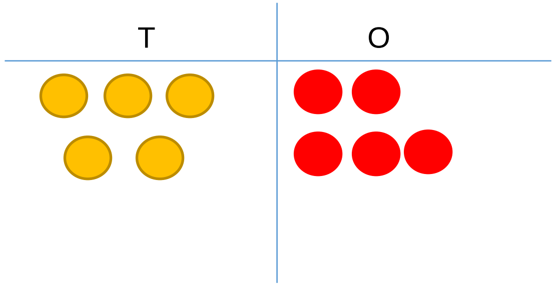
24 + 15=

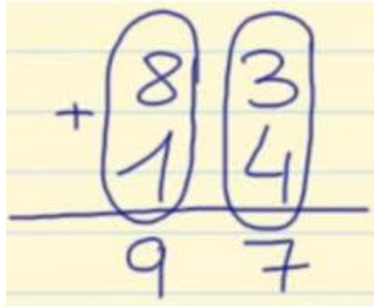
Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.





After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions.





Start by partitioning the numbers before moving on to clearly show the exchange below the addition.

$$\begin{array}{rcrl} 20 & + & 5 & \\ \underline{40} & \underline{+} & \underline{8} & \\ 60 & + & 13 & = 73 \end{array}$$

$$\begin{array}{r} 536 \\ \underline{+\ 85} \\ \underline{621} \\ 1\ 1 \end{array}$$

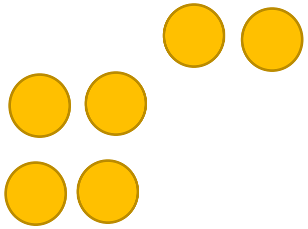
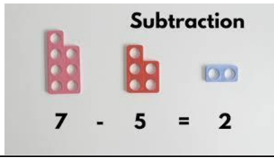
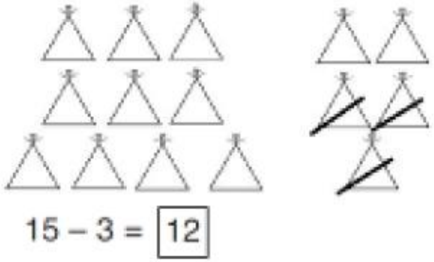
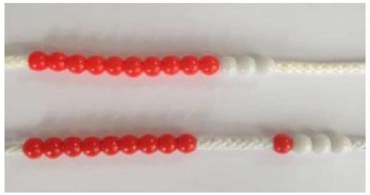
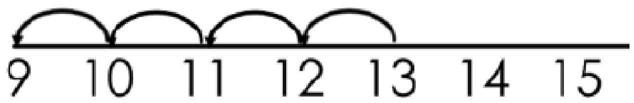
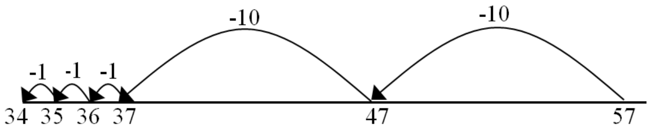
As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here.

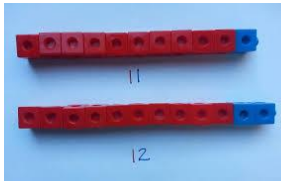
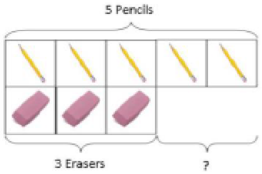
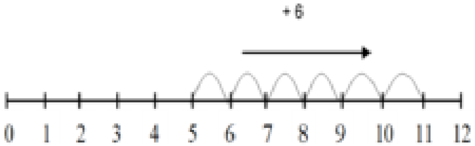
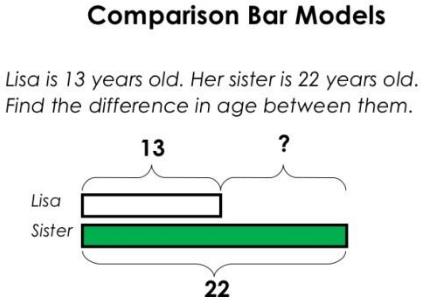
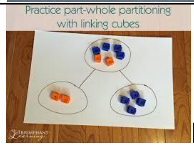
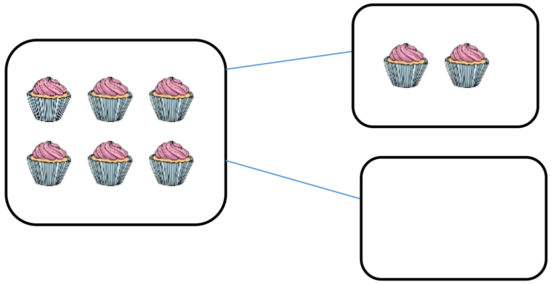
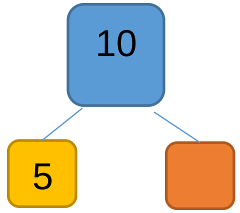
$$\begin{array}{cccccc} 2 & 3 & . & 3 & 6 & 1 \\ & 9 & . & 0 & 8 & \color{red}{0} \\ 5 & 9 & . & 7 & 7 & \color{red}{0} \\ + & 1 & . & 3 & \color{red}{0} & \color{red}{0} \\ \hline 9 & 3 & . & 5 & 1 & 1 \\ \hline {\scriptstyle 2} & {\scriptstyle 1} & & {\scriptstyle 2} & & \end{array}$$

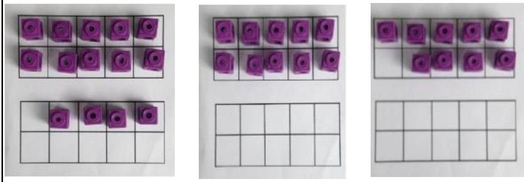
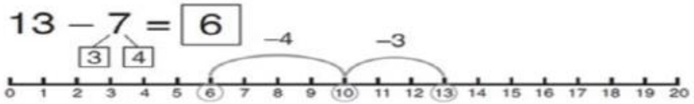
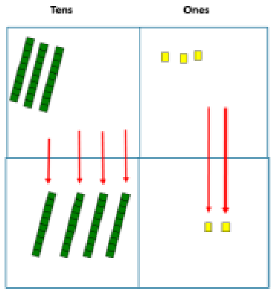
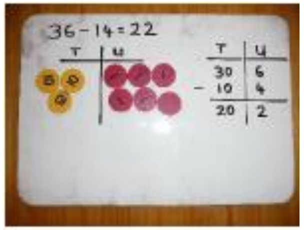
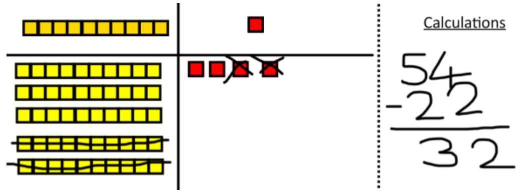
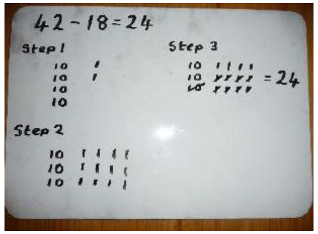
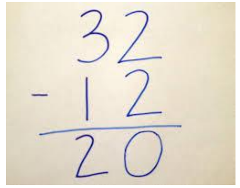
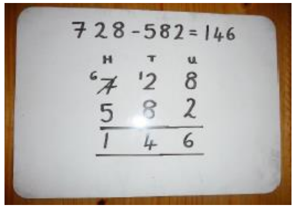
$$\begin{array}{r} 72.8 \\ \underline{+\ 54.6} \\ \underline{127.4} \\ 1\ 1 \end{array}$$

$$\begin{array}{cccccccc} & £ & 2 & 3 & . & 5 & 9 \\ + & £ & & 7 & . & 5 & 5 \\ \hline & £ & 3 & 1 & . & 1 & 4 \\ \hline & & {\scriptstyle 1} & {\scriptstyle 1} & & {\scriptstyle 1} & \end{array}$$

Subtraction

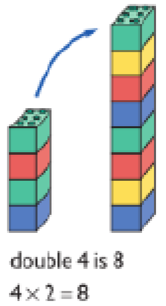
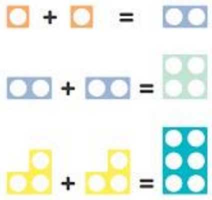
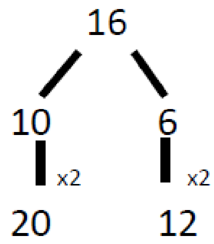
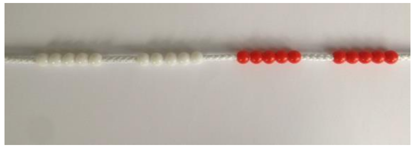
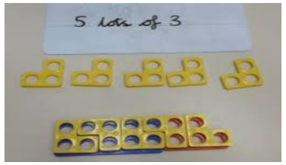
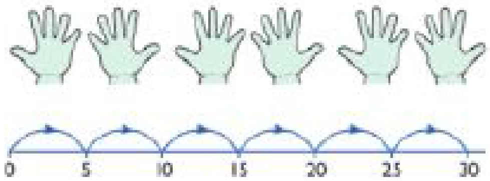
Objective and Strategies	Concrete	Pictorial	Abstract
Subtracting ones	Use physical objects, counters, cubes etc to show how objects can be subtracted.   6 – 2 = 4  	Cross out drawn objects to show what has been subtracted.  	18 -3= 15 8 – 2 = 6
Counting back	Make the larger number in your subtraction. 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 subtract, counting backwards as you go. 	Count back on a number line or number track  Start at the bigger number and count back the smaller number 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.

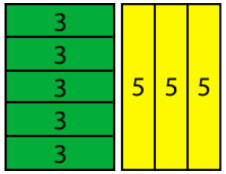
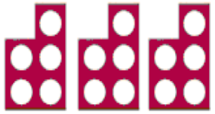
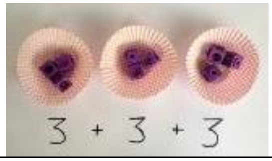
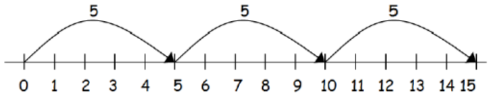
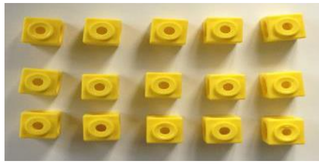
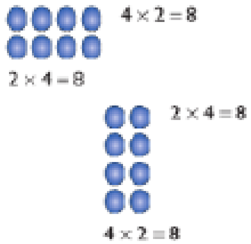
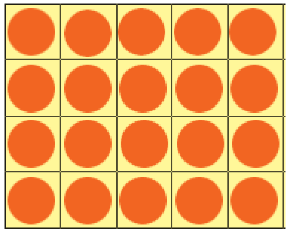
Find the difference	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference 	 Count on to find the difference. Draw bars to find the difference between 2 numbers. 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.
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. 	 Move to using numbers within the part whole model.

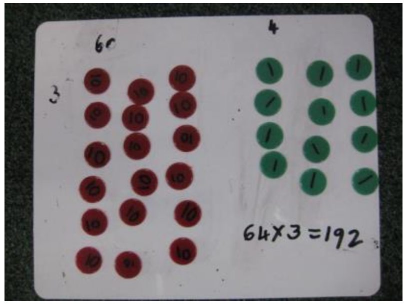
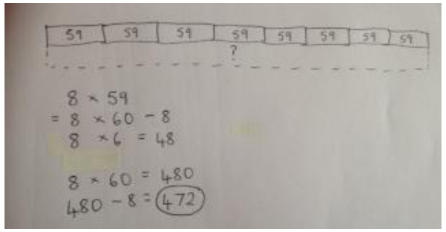
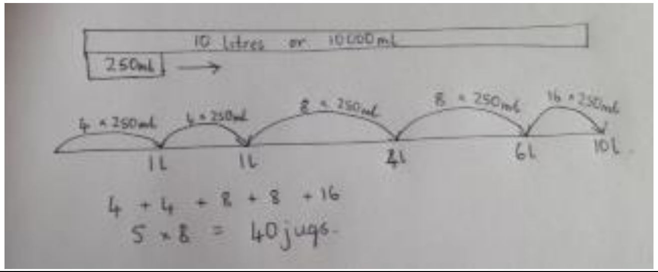
Make 10	14 – 9 =  Make 14 on the ten frame. Subtract the 4 first to make 10 and then subtract one more so you have subtracted 5. You are left with the answer of 9.	 Start at 13. Subtract 3 to reach 10. Then subtract the remaining 4 so you have subtracted 7 altogether. You have reached your answer.	16 – 8= How many do we subtract to reach the next 10? How many do we have left to subtract?
Formal method with and without exchanging	 Use Base 10 to make the bigger number then subtract the smaller number. Show how you partition numbers to subtract. Again make the larger number first. 	Draw the Base 10 or place value counters alongside the written 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.calculation to help to show working. 	$47-24=23$ $40+7$ $-\ 20+4$ $20+3$ This will lead to a clear written column subtraction.   Moving forward the children use a more compact method. This will lead to an understanding of

			subtracting any number including decimals. $\begin{array}{cccccc} & & ^{5} & ^{12} & & ^{1} \\ & 2 & \cancel{6} & \cancel{3} & . & \color{red}{0} \\ - & & 2 & 6 & . & 5 \\ \hline & 2 & 3 & 6 & . & 5 \end{array}$

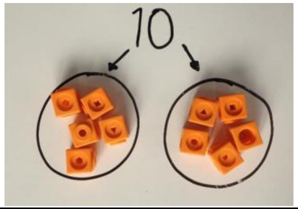
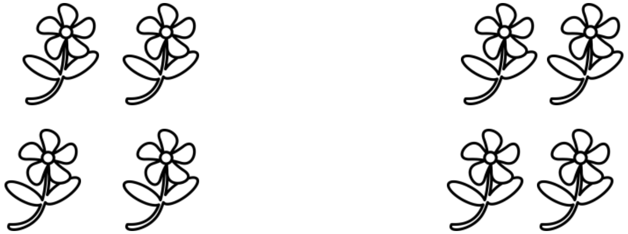
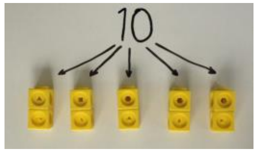
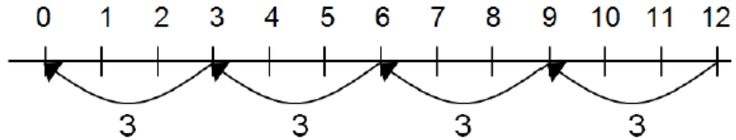
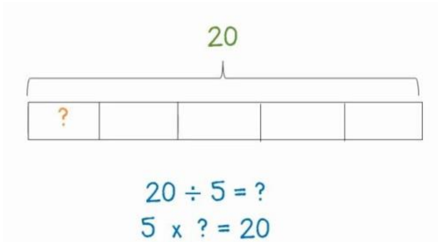
<u>Multiplication</u>

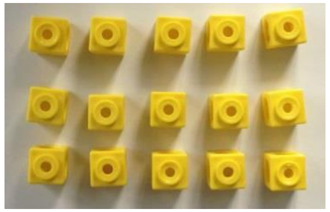
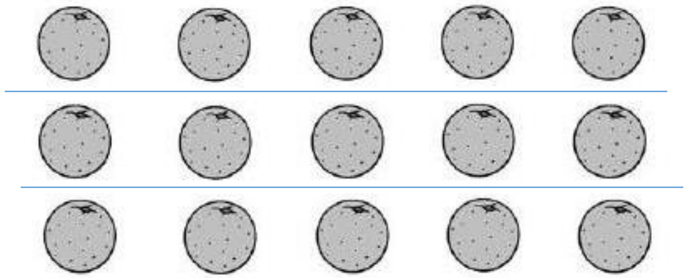
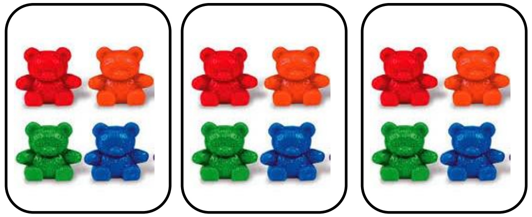
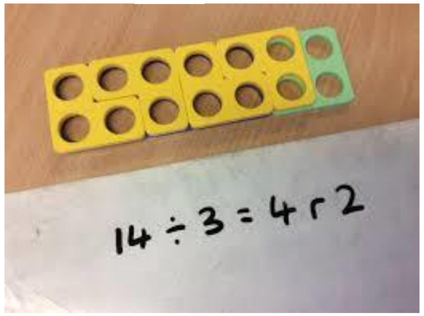
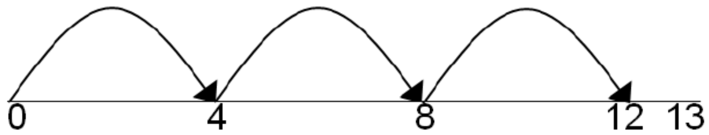
Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	Use practical activities to show how to double a number.  	Draw pictures to show how to double a number. Double 4 is 8 	 Partition a number and then double each part before recombining it back together.
Counting in multiples	   Count in multiples 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

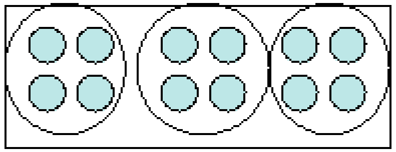
Repeated addition	 Use different objects to add equal groups.   	  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures. 
Arrays- showing commutative multiplication	Create arrays using counters/ cubes to show multiplication calculations.  	Draw arrays in different rotations to find **commutative** multiplication calculations.   Link arrays to area of rectangles.	Use an array to write multiplication calculations and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15

Formal 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.   	1342 x 18 ------- 10736 (8x1342) 13420 (10x 1342) -------- 24156 --------

<u>Division</u>

Objective and Strategies	Concrete	Pictorial	Abstract
Dividing objects into groups	 I have 10 cubes, can you share them equally in 2 groups? 	Children use pictures or shapes to share quantities.  $\boxed{8 \div 2 = 4}$	Share 9 buns between three people. $9 \div 3 = 3$
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.   	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. 	$28 \div 7 = 4$ Divide 28 into 7 groups. How many are in each group?

Division within arrays	 Link division to multiplication by creating an array and thinking about the calculatons 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 calculations.	Find the inverse of multiplication and division sentences by creating four linking calculations. 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   	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. 	Complete written divisions and show the remainder using r. 29 ÷ 8 = 3 REMAINDER 5 dividend divisor quotient remainder

## Short division		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. $\begin{array}{r\|l} & 2\ \ 1\ \ 8 \\ \hline 4 & 8\ \ 7\ \ {}^{3}2 \end{array}$ Move onto divisions with a remainder. $\begin{array}{r\|l} & \ \ \ 8\ \ 6\ \ \text{r}\ 2 \\ \hline 5 & 4\ \ 3\ \ {}^{3}2 \end{array}$ Finally move into decimal places to divide the total accurately. $\begin{array}{r\|l} & \ \ \ 1\ \ 4\ .\ 6 \\ \hline 3\ 5 & 5\ \ 1\ \ {}^{16}1\ .\ {}^{21}0 \end{array}$

Long division			First, set the calculation out as shown: $51\overline{)748}$ We work out 74 divided by 51, and write the answer (1) above the 4. 1 × 51 = 51, so we write this underneath 74. Subtract 51 from 74 to get the remainder (23). $\begin{array}{r} 1 \\ 51\overline{)748} \\ -51 \\ \hline 23 \end{array}$ We now bring down the next digit (8) and write it on the end of the 23. $\begin{array}{r} 1 \\ 51\overline{)748} \\ -51 \\ \hline 238 \end{array}$ We now work out 238 divided by 51, and write the answer (4) above the 8. You use estimation skills here: 51 is roughly 50 and 4 × 50 = 200. You can work out 51 × 4 = 204 separately.

			We write 204 underneath the 238 and subtract to find the remainder. There are no more digits to bring down, so we have our answer: $$\begin{array}{r} 14 \\ 51\overline{)748} \\ -51 \\ \hline 238 \\ -204 \\ \hline 34 \end{array}$$ So the answer is **14 remainder 34.** **Move onto remainder being shown as a decimal and then as a fraction.**