St Michael's Cof E Infant School - Progression in Calculation Policy

Introduction

Written methods of calculations are based on mental strategies. Each of the four operations builds on mental skills which provide the foundation for jottings and informal written methods of recording. Skills need to be taught, practised and reviewed constantly. These skills lead on to more formal written methods of calculation. Strategies for calculation need to be represented by models and images to support, develop and secure understanding. This, in turn, builds fluency. When teaching a new strategy it is important to start with numbers that the child can easily manipulate so that they can understand the methodology. The transition between stages should not be hurried as not all children will be ready to move on to the next stage at the same time, therefore the progression in this document is outlined in stages. Previous stages may need to be revisited to consolidate understanding when introducing a new strategy. A sound understanding of the number system is essential for children to carry out calculations efficiently and accurately.

Aims

The national curriculum for mathematics aims to ensure that all pupils:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately;
- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language;
- can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions;
- are taught a **range of strategies** and are encouraged to use the **most efficient method/strategy** depending on the calculation;
- are taught the **mathematical language.** Use maths vocabulary (see NNS list).

Magnitude of Calculations

Year R – U, TU, U + U, U - U, (numbers up to 20)

Year 1 – U + U, U + TU (numbers up to 20) including adding zero, U – U, TU – U (numbers up to 20) including subtracting zero, U x U, U ÷ U

Year 2 - TU + U, TU + multiples of 10, TU + TU, U + U + U, TU - U, TU – tens, TU – TU, TU x U, U ÷ U. Also knowledge of HTU numbers.

(Year 3 – add numbers with up to three-digits, HTU + multiples of 10, HTU + multiples of 100, subtract numbers up to three-digits, HTU – U, HTU – multiples of 10, HTU – multiples of 100, HTU – HTU, TU x U, TU ÷ U).

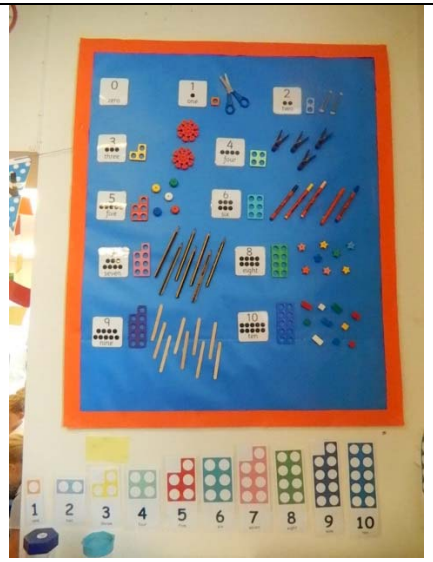
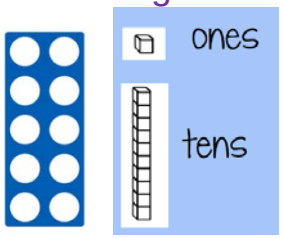
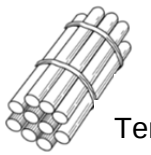
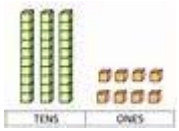
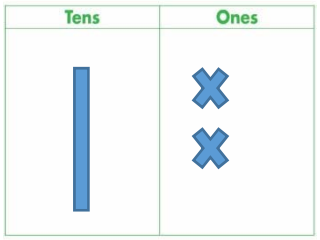
	End of Year R Expectation	Description of 'exceeding'
Number	ELG 11 Numbers: children count reliably with numbers from 1 to 20, place them in order and say which number is one more or one less than a given number.	Children estimate a number of objects and check quantities by counting up to 20. They solve practical problems that involve combining groups of 2, 5 or 10, or sharing into equal groups.
Addition	ELG 11 children use quantities and objects; they add 2 single-digit numbers and count on to find the answer.	
Subtraction	ELG 11 Children use quantities and objects, they subtract 2 single-digit numbers and count back to find the answer.	
Multiplication and Division	ELG 11 children solve problems, including doubling, halving and sharing.	

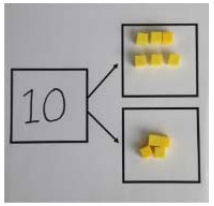
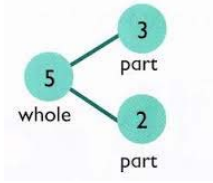
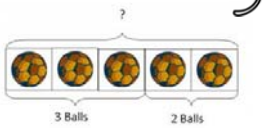
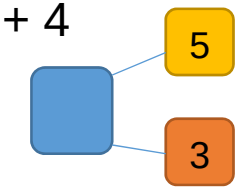
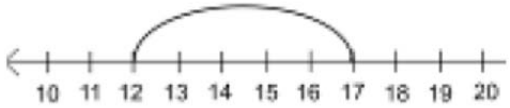
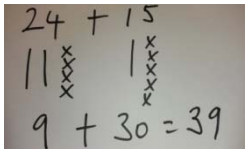
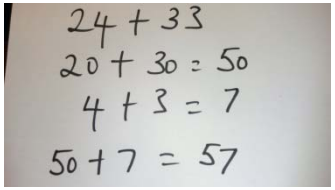
	End of Year 1 Expectation	Fluency
Addition	Children must experience combining two and then more than two groups of objects using counting on and the language of addition. Children must experience increasing numbers e.g: What is two more than 7? Compare quantities and say how many less/more.	Counting forwards, to and across 100, beginning with 0 or 1 or from any given number. Switch count between tens and ones e.g. 10, 20, 30, 31, 32, 33. Represent number bonds to 20 and related operations. Find 1 and 10 more than a number. Count in multiples of 2, 5 and 10 and highlight pattern.
Subtraction	Understand subtraction as taking away. What is ….. less than….? Compare quantities to say how many less/how many more.	Count backwards (including crossing 100). Switch count between ones and tens e.g. 33, 32, 31, 20, 10. Find one and ten less than a number. Count back in multiples of 2, 5 and 10 and highlight pattern.
Multiplication	Solve single step practical problems. Use concrete objects to explore grouping. Make connections between arrays, number patterns and counting in 2, 5 and 10. Double numbers and quantities.	Count in 2s, 5s and 10s from different multiples e.g. 6, 8, 10. Emphasise number patterns. Double quantities and numbers.
Division	Solve single step practical problems. Use concrete objects and pictorial representations. Understand division as grouping and sharing. Use the language of 'sharing equally between'.	Count in 2s, 5s and 10s from different multiples e.g. 6, 8, 10. Emphasise number patterns. Double quantities and numbers. Find simple fractions e.g. half and quarter of objects, numbers and quantities.

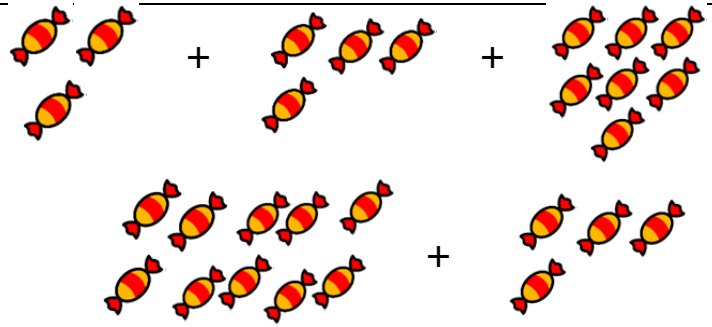
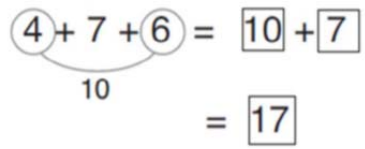
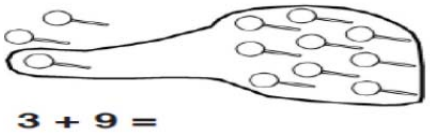
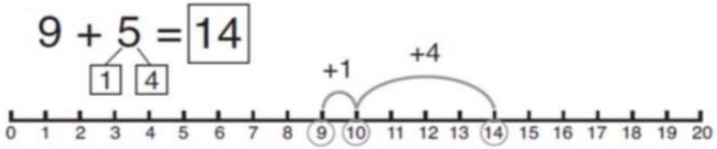
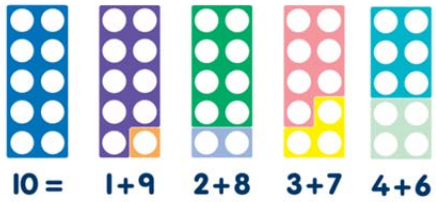
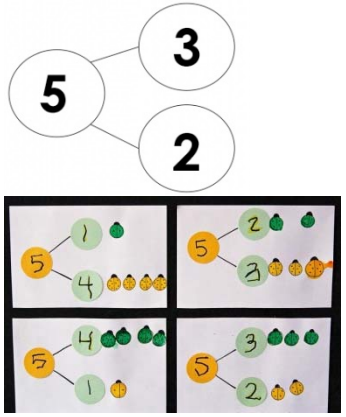
	End of Year 2 Expectation	Fluency
Addition	Children should be able to partition numbers in different ways e.g. 23 as 20 and 3, 10 and 13. Children should use concrete objects, pictorial representations and add numbers in different contexts e.g. money and measures. Ensure children have the opportunity to add more than two numbers. Children understand the language of sum. Ensure children understand that addition is commutative.	Show increasing fluency in deriving pairs of numbers up to 10 and 20. Use knowledge to derive and use numbers facts up to 100. Add numbers mentally including TU+U, TU + tens, TU +TU and U+U+U. Also knowledge of HTU numbers.
Subtraction	Understand subtraction as taking away and finding the difference. Ensure children understand that subtraction is not commutative. Children should be able to partition numbers in different ways.	Practise addition and subtraction facts to 20. Show increasing fluency in deriving subtraction facts for numbers up to 10 and then up to 20. Use known facts to 20 to derive new facts e.g. 3 + 6=9 30 +60=90. Use knowledge to derive and use subtraction number facts up to 100.
Multiplication	Understand multiplication as repeated addition. Calculate mathematical statements for multiplication with the tables and write them using symbols. Understand and solve problems involving arrays. Ensure children understand that multiplication is commutative (can be done in any order). Understand that multiplication and division are inverse operations.	Count in 2s, 5s and 10s from zero and tens from any number. Emphasise number patterns. Connect ten times tables to place value and five times tables to divisions on a clock face. Introduction to multiplication tables. Practise to become fluent in division facts for 2, 3, 5 and 0. Solve multiplication problems mentally.
Division	Solve single step practical problems. Use concrete objects and pictorial representations. Understand division as grouping. Find halves and quarters. Work with a range of materials and contexts in which multiplication and division relate to grouping and sharing discrete quantities and to arrays.	Count in 2s, 5s and 10s from zero and tens from any number. Emphasise number patterns. Connect ten times tables to place value and five times tables to divisions on a clock face. Introduction to multiplication tables. Practise to become fluent in division facts for 2, 3, 5 and 0. Solve division problems involving grouping and sharing.

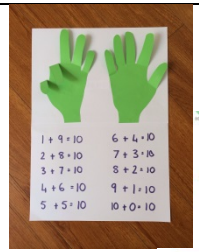
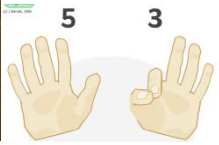
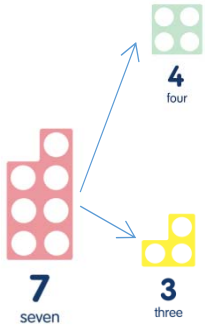
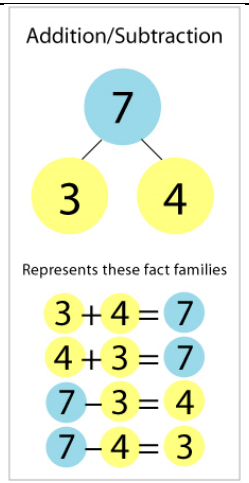
Progression in Calculations

Addition

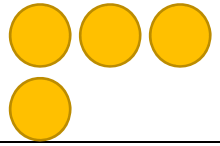
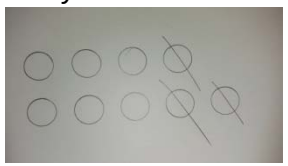
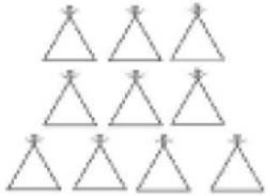
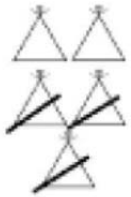
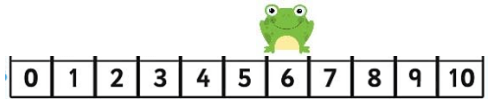
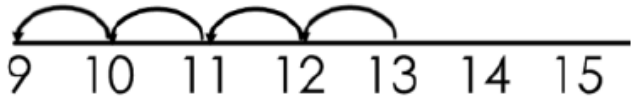
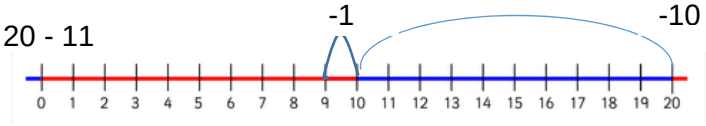
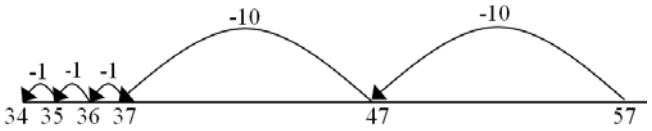
Objective and Strategies	Concrete	Pictorial	Abstract
What is a number?			1, 2, 3, One, two, three
Partitioning methods	Understanding tens and ones.   10p  Ten straws 		12 = one ten two units 34 = three tens and four units.

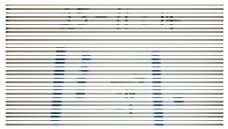
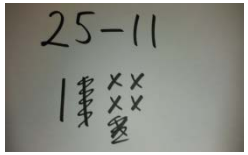
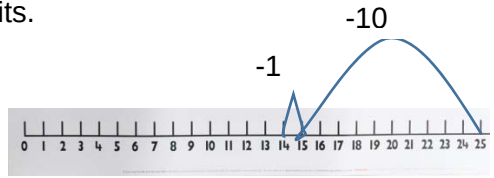
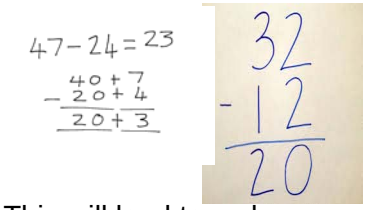
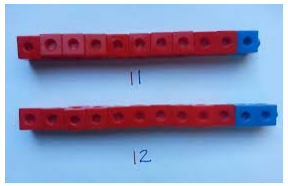
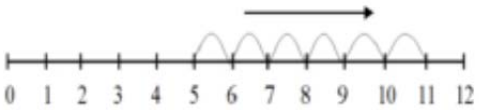
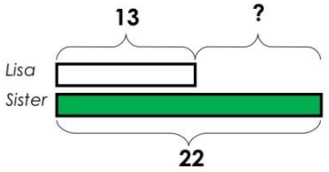
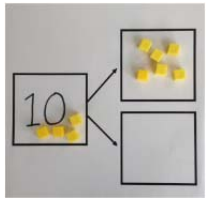
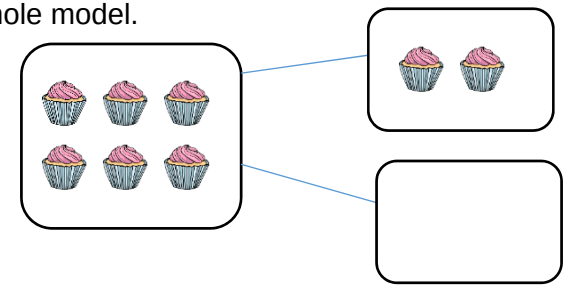
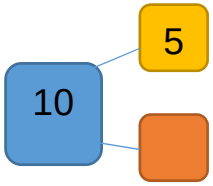
Combining two or more parts to make a whole: part-whole model	  4 + 3= 3 +9=  	   Use pictures to add two numbers together as a group or in a bar.  	4 + 3 = 7 10= 6 + 4 
Starting at the bigger number and counting on	5 + 12 =  Start with the larger number (from 12 not from 1) using the Dienes and then count on to the smaller number 1 by 1 to find the answer.	5 + 12 = 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.
Partition then re-combine	Numbers under 20  3 + 14=  24 + 15= Add together all the units first then add all the tens.	24 + 15=  Blank number line. Add units then tens	

Adding three single digits	3 + 4 + 7= 14 Put 3 and 7 together to make 10. Add on 4.  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.
Regrouping to make 10.	6 + 5 = 11 Start with the bigger number and use the smaller number to make 10. 	 3 + 9 = 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?
Knowledge of number bonds.	Learn facts by heart. Number bonds 0 – 20. 		7 = 3 + 4

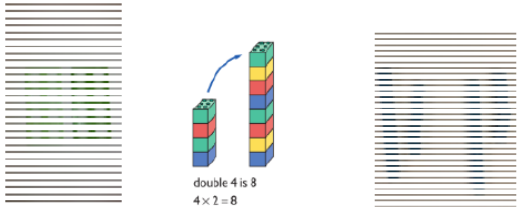
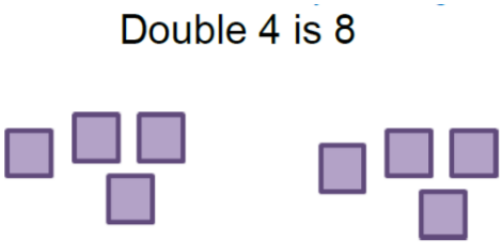
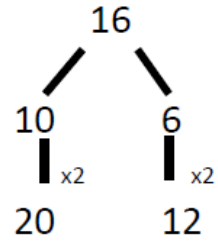
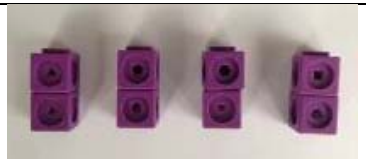
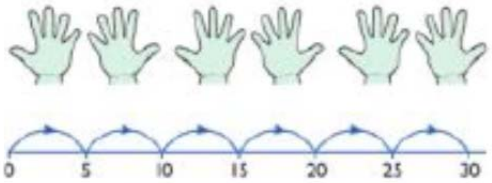
	   	 	

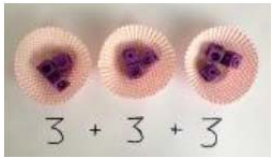
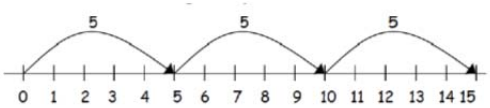
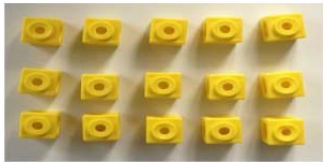
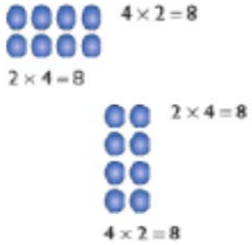
Subtraction

Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc. to show how objects can be taken away. 9 – 3 = 6   6 – 2 = 4 	Cross out drawn objects to show what has been taken away.  **9 – 3 = 6**   15 – 3 = 12	6 – 2 = 4 9 – 3 = 6 15 – 3 = 12
Counting back	Practically moving a child or toy back along a number line. Use fingers to count back.    	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. 20 - 11   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? 23 – 12 Put 23 in your head. Jump back 10, to get 13. Keep 13 in your head and count back 2.

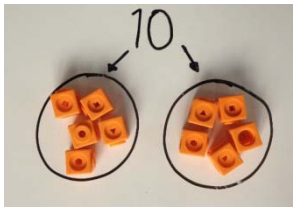
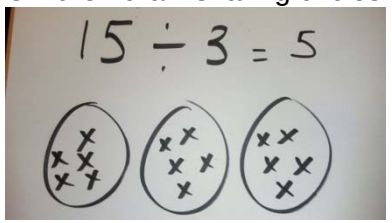
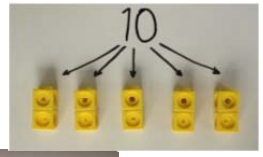
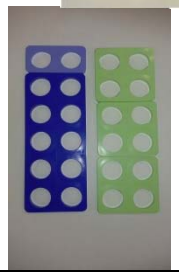
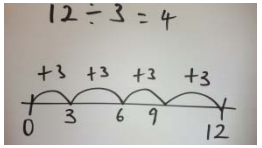
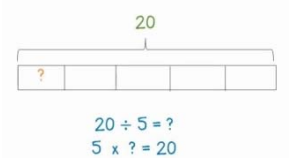
Column method without regrouping	Use Dienes to make the bigger number then take the tens and units away. Count what is left. 25-11= 	Draw Dienes and partition the smaller number. Cross out the tens and units.   Or show on a number line.	 This will lead to a clear written column subtraction.
Find the difference	Compare amounts and objects to find the difference. Numicon – difference between 8 and 3   Use cubes to build towers or make bars to find the difference Use basic bar models with items to find the difference	- 6 or +6  Count the gap to find the difference. Draw bars to find the difference between 2 numbers. **Comparison Bar Models** *Lisa is 13 years old. Her sister is 22 years old. Find the difference in age between them.* 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.
Part Part Whole Model (Knowing the related subtraction facts to 20).	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. 10 - 6 = If 10 is the whole and 6 is one of the parts. What is the other part? 	Use a pictorial representation of objects to show the part part whole model. 	 Move to using numbers within the part whole model.

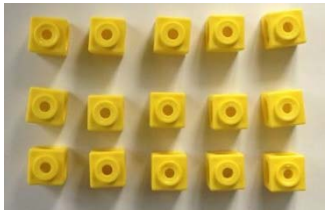
Multiplication

Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	Use Numicon, Dienes or cubes to show how to double a number. 	Draw pictures to show how to double a number. 2 x 4 = 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.  Linked to repeated addition. 5 + 5 + 5 + 5 = 20 5 x 4 = 20 Linking to real life e.g. coins in a can, pairs of socks on a washing line. 	 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 Encourage children to articulate patterns. Use maths vocabulary (see NNS list).

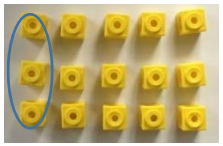
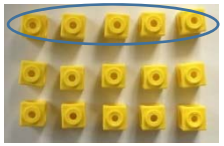
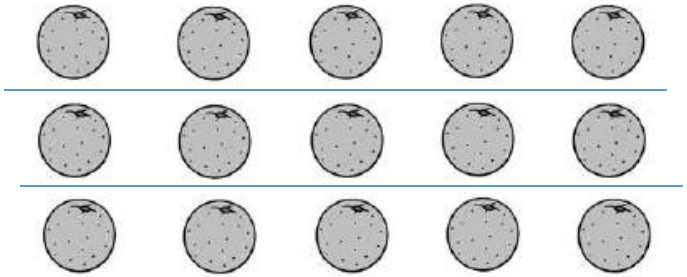
Repeated addition	3 x 3 = 3 x 5 = 5 + 5 + 5 =   Use different objects to add equal groups.	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?  2 add 2 add 2 equals 6  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures.  2 + 2 + 2 + 2 + 2 = 10
Arrays- showing commutative multiplication	Create arrays using counters/ cubes to show multiplication sentences.   Link to real life models E.g. Yorkshire pudding trays, chocolate boxes, muffin tins, sheets of stamps etc. 	Draw arrays in different rotations to find **commutative** multiplication sentences.  	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

Division

Objective and Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups	   10 ÷ 2 = 5 10 shared between 2.	Children draw sharing circles. 	10 ÷ 2 = 5 buns Share 10 buns between two people. How many do they get each? 20 ÷ 5 = 4 apples There are 20 apples. I put them in 5 boxes. How many apples are there in each box? 27 ÷ 3 = 9 children 27 children are split into 3 teams. How many children are there in each team?
Division as grouping	Divide quantities into equal groups. Use cubes and objects 10 ÷ 2 = 5 10 divided into groups of 2   12 ÷ 4 = 5 12 divided into groups of 4	12 ÷ 4 = 5 12 divided into groups of 4  Count up in multiples of the divisor.  Think of the bar as a whole 	20 ÷ 5 = 4 boxes There are 20 apples. I put them into boxes of 5. How many boxes will I need? 27 ÷ 3 = 9 teams Divide 27 children into teams of three. How many teams are there?

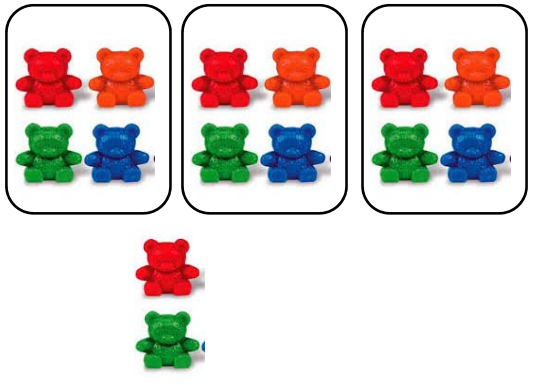
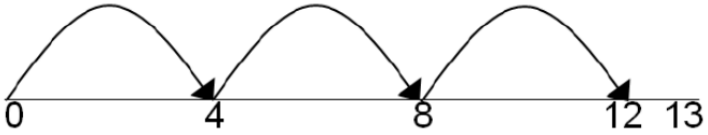
<table>
<tr>
<td>Division within arrays</td>
<td> 
Link division to multiplication by creating an array and thinking about the number sentences that can be created.

Eg 15 ÷ 3 = 5 5 x 3 = 15
15 ÷ 5 = 3 3 x 5 = 15

   </td>
<td> 
Draw an array and use lines to split the array into groups to make multiplication and division sentences.</td>
<td>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</td>
</tr>
<tr>
<td>Division with a remainder</td>
<td>14 ÷ 3 =
Divide objects between groups and see how much is left over
Q. How many groups of 3 are there and how many are left over?

Understand as sharing <u>and</u> grouping.

  </td>
<td>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.
 

Division can be explained as repeated subtraction.</td>
<td>Complete written divisions and show the remainder using r.

29 ÷ 8 = 3 <u>r5</u></td>
</tr>
</table>