CALCULATION POLICY

Broomwood Primary School

This policy supports the White Rose maths scheme used throughout the school. Progression within each area of calculation is in line with the programme of study in the 2014 National Curriculum. This calculation policy should be used to support children to develop a deep understanding of number and calculation. This policy has been designed to teach children through the use of concrete, pictorial and abstract representations.

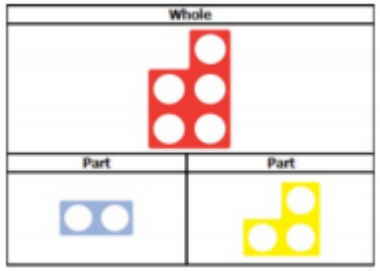
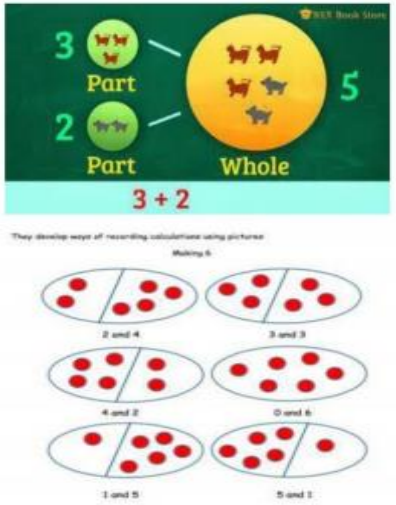
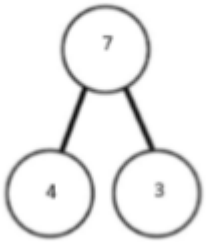
Concrete representation– a pupil is first introduced to an idea or skill by acting it out with real objects. This is a 'hands on' component using real objects and is a foundation for conceptual understanding.

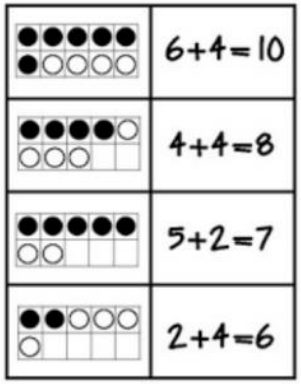
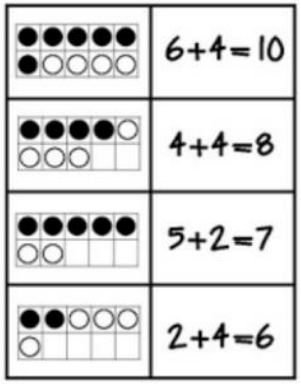
Pictorial representation – a pupil has sufficiently understood the 'hands on' experiences performed and can now relate them to representations, such as a diagram or picture of the problem.

Abstract representation–a pupil is now capable of representing problems by using mathematical notation, for example $12 \times 2 = 24$.

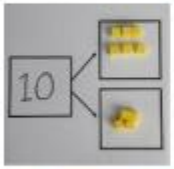
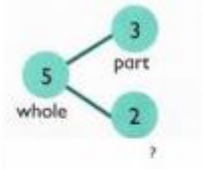
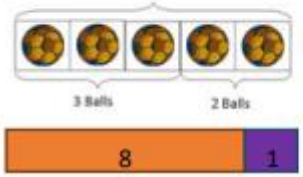
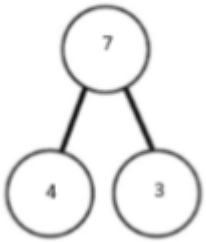
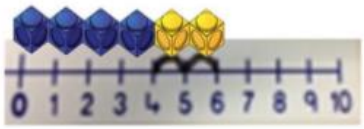
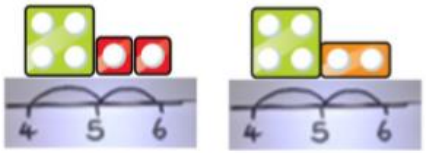
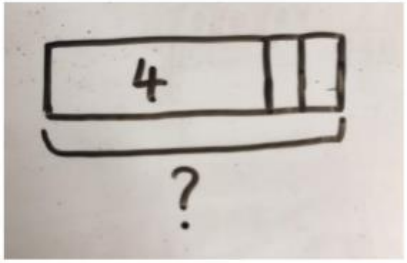
It is important that conceptual understanding, supported by the use of representation, is secure for all procedures. Reinforcement is achieved by going back and forth between these representations.

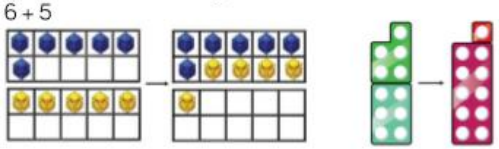
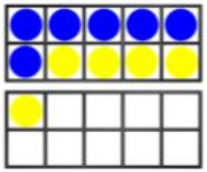
EYFS - Addition

	Concrete	Pictorial	Abstract
Explore part-part whole relationship combining two parts to make a whole	  		4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 

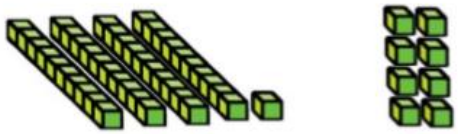
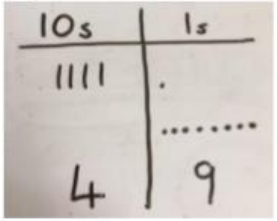
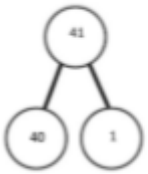
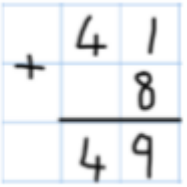
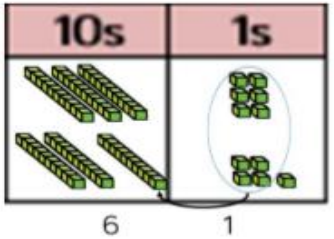
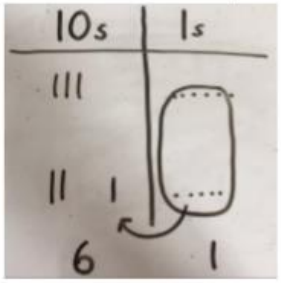
Using the ten frame/egg boxes to support addition of single digits– counting all/ combining two groups	 		
Solving problems using concrete, pictorial images.		 	5 + 2 = ___ Only where appropriate and supported by concrete/pictorial examples

Year One –

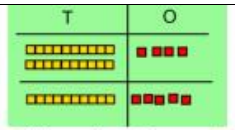
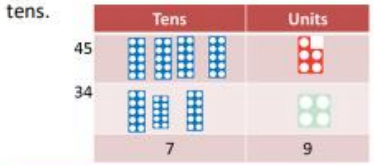
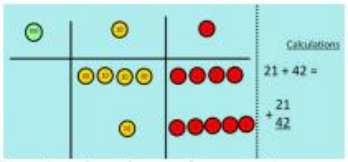
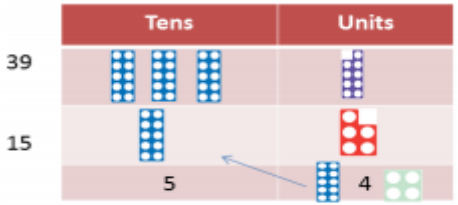
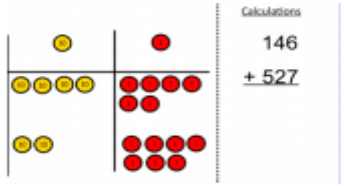
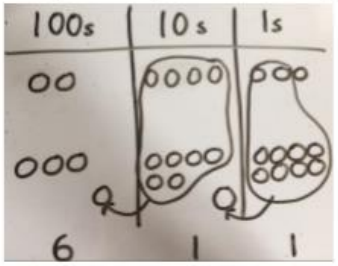
	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part whole model.	   Use part part whole model. Use cubes to add two numbers together as a group or in a bar. 	   Use pictures to add two numbers together as a group or in a bar.	4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 
Starting at the bigger number and counting on- using cubes.	**Counting on using number lines** using cubes or Numicon.  	A bar model which encourages the children to count on, rather than count all. 	The abstract number line: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? 4 + 2 

Regrouping to make 10 using ten-frame.	**Regrouping to make 10;** using ten frames and counters/cubes or using Numicon. 6 + 5 	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. $6 + \square = 11$ $6 + 5 = 5 + \square$ $6 + 5 = \square + 4$

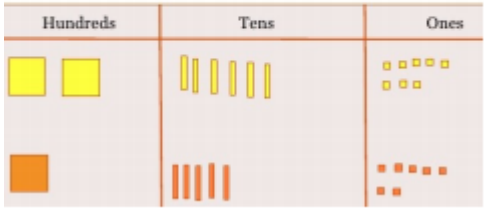
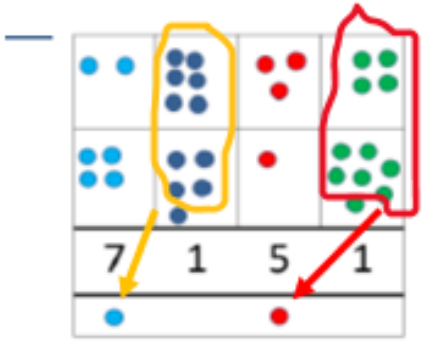
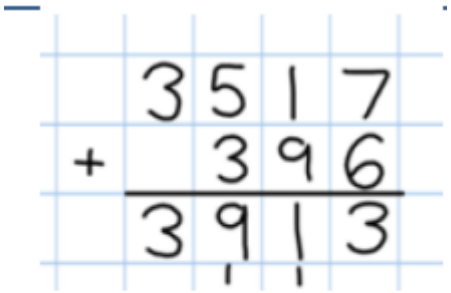
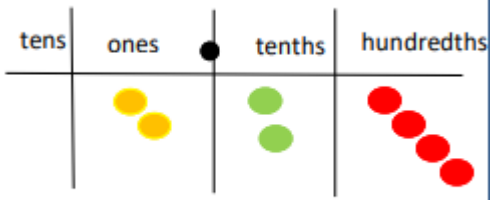
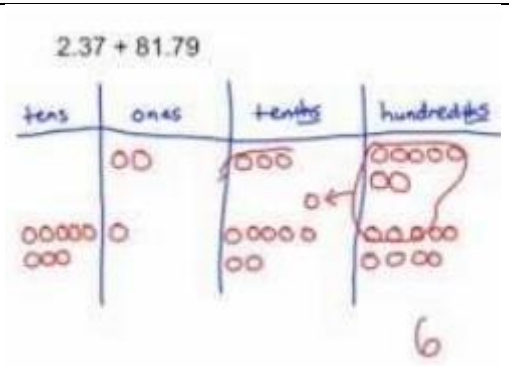
Year Two – Addition

	Concrete	Pictorial	Abstract
Adding three single digits.	 Combine to make 10 first if possible, or bridge 10 then add third digit	 Regroup and draw representation.  = 15	4 + 7 + 6 = 10 + 7 (10) = 17 Combine the two numbers that make/ bridge ten then add on the third.
Use base 10 to combine a single digit and 2-digit number	**TO + O using base 10.** Continue to develop understanding of partitioning and place value. 41 + 8 	Children to represent the base 10 e.g. lines for tens and dot/crosses for ones. 	41 + 8  1 + 8 = 9 40 + 9 = 49 
Use of base 10 to combine two 2-digit numbers	**TO + TO using base 10.** Continue to develop understanding of partitioning and place value. 36 + 25 	Chidlren to represent the base 10 in a place value chart. 	Looking for ways to make 10. 36 + 25= 1 5 30 + 20 = 50 5 + 5 = 10 50 + 10 + 1 = 61 Formal method: 36 +25 61 1

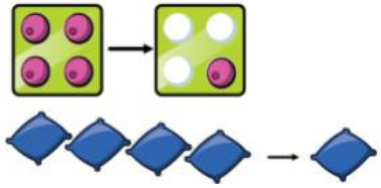
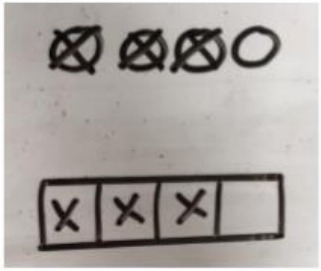
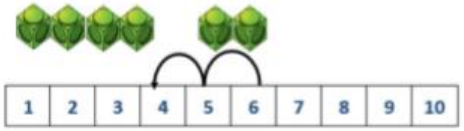
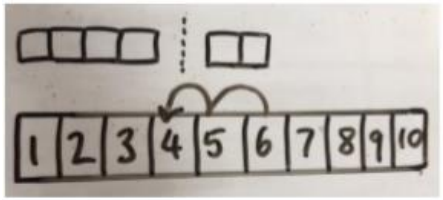
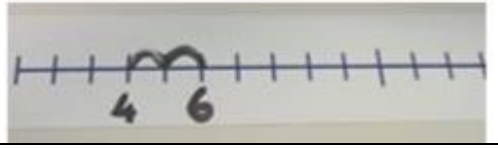
Year Three – Addition

	Concrete	Pictorial	Abstract
Column method no regrouping. 3-digit numbers	 Model using Dienes or numicon Add together the ones first, then the tens.   Move to using place value counters	Children move to drawing the counters using a tens and one frame.  	223 + 114 337 Add the ones first, then the tens, then the hundreds.
Column method regrouping 3-digit numbers	 Exchange ten ones for a ten. Model using numicon and pv counters.  	Chidren to represent the counters in a place value chart, circling when they make an exchange.  	243 +368 611 1 1

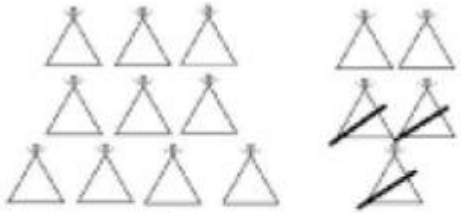
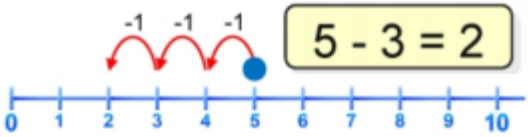
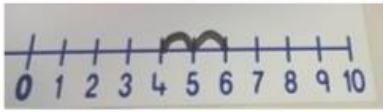
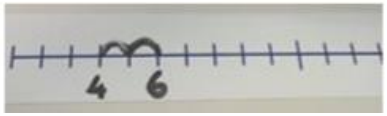
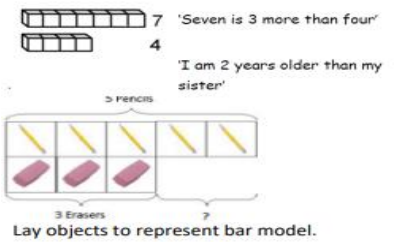
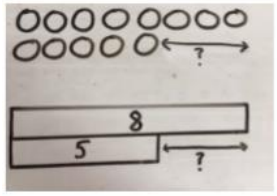
Year Four to Six – Addition

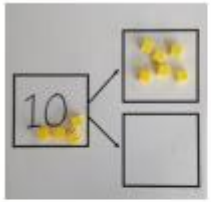
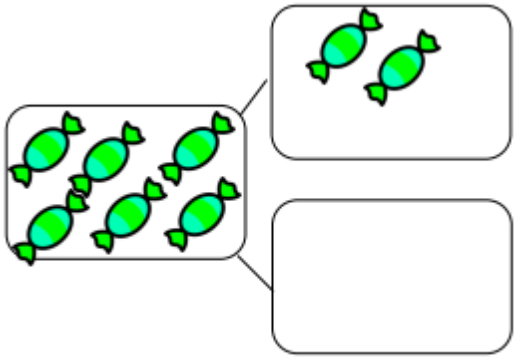
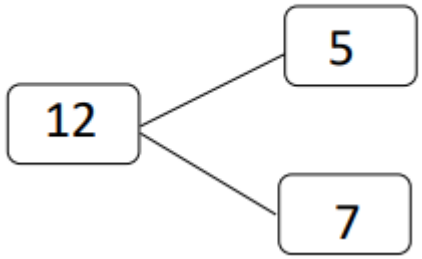
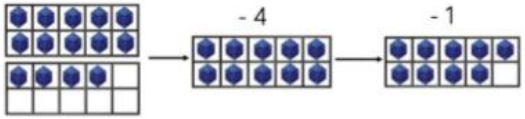
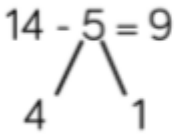
	Concrete	Pictorial	Abstract
Yr 4 Column method regrouping 4-digit numbers	~~Children continue to use dienes or pv~~ counters to add, exchanging ten ones for a ten and ten tens for a hundred and ten hundreds for a thousand.  	 Draw representations using pv grid.	 Continue from previous work to carry hundreds as well as tens. Relate to money and measures.
Yr 5 Column method regrouping Including decimals	As year 4  Introduce decimal place value counters and model exchange for addition.	 	72.8 + 54.6 127.4 1 1 £23.59 + £7.55 £31.14
Yr 6 Consolidate KS2 methods	Consolidate KS2 methods	Consolidate KS2 methods	Insert zeros for place holders. 23.361 9.080 59.770 + 1.300 93.511

EYFS - Subtraction

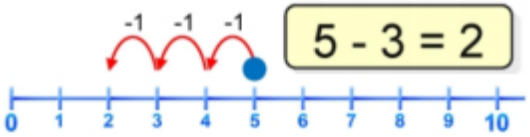
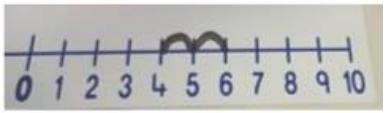
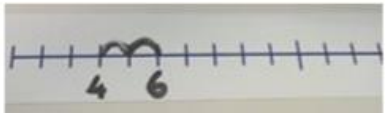
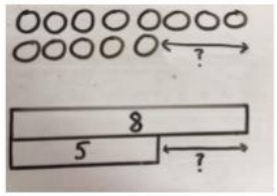
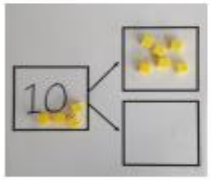
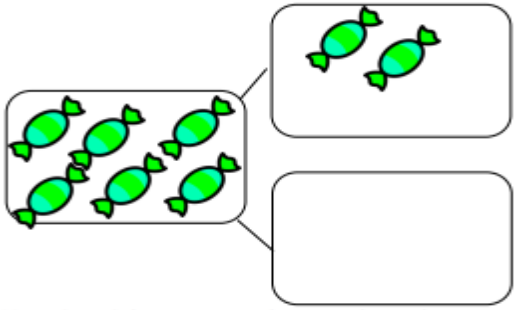
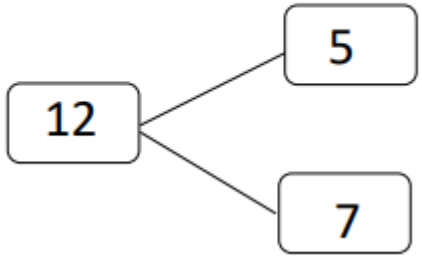
	Concrete	Pictorial	Abstract
Taking away ones	**Physically taking away and removing objects from a whole** (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 - 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	7—4 = 3 Only where appropriate and supported by concrete/pictorial examples
Counting back	**Counting back** (using number lines or number tracks) children start with 6 and count back 2. 6 - 2 = 4 	Children to represent what they see pictorially e.g. 	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  

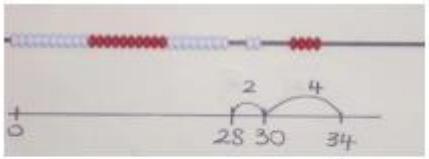
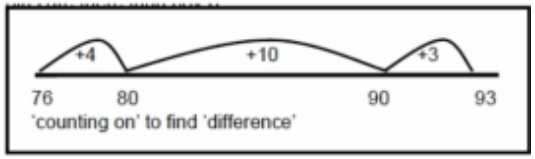
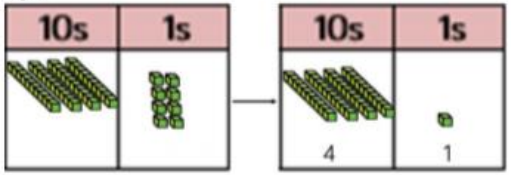
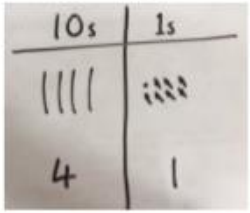
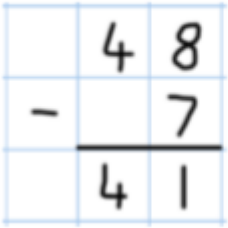
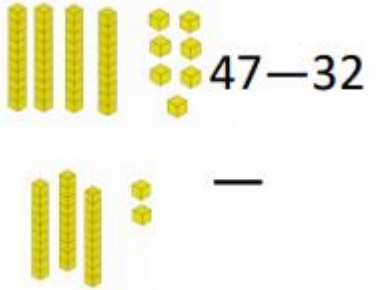
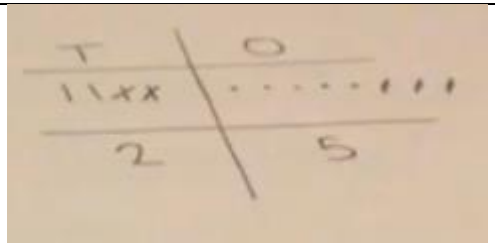
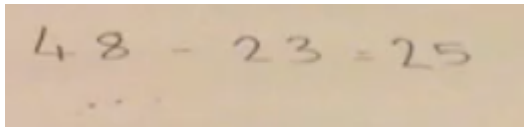
Year One – Subtraction

	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters , cubes etc to show how objects can be taken away.  6—4 = 2  4—2 = 2	 15 – 3 = 12 Cross out drawn objects to show what has been taken away.	7—4 = 3 16—9 = 7
Counting back	  Move objects away from the group, counting backwards.  Move the beads along the bead string as you count backwards.	 Count back in ones using a number line.	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  
Find the difference	Compare objects and amounts  Lay objects to represent bar model.	Children to draw the cubes/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.

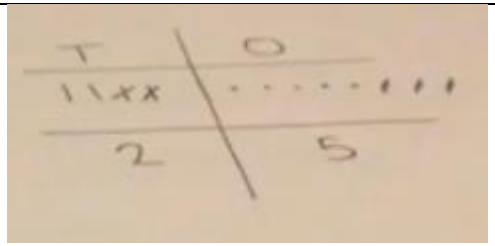
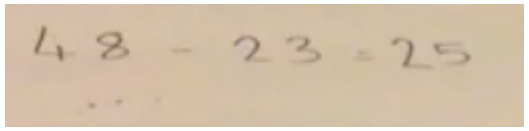
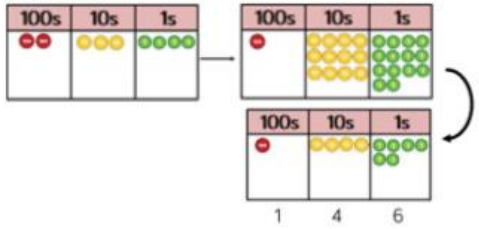
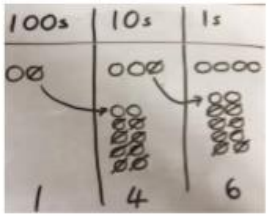
Part whole model	 Link to addition. Use PPW model to model the inverse. If 10 is the whole and 6 is one of the arts, what s the other part? 10—6 = 4	 Use pictorial representations to show the part.	Move to using numbers within the part whole model. 
Make 10 using the ten-frame	**Making 10** using ten frames. 14 - 5 	Children to present the ten frame pictorially and discuss what they did to make 10. 	Children to show how they can make 10 by partitioning the subtrahend.  14 - 4 = 10 10 - 1 = 9

Year Two – Subtraction

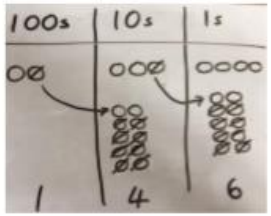
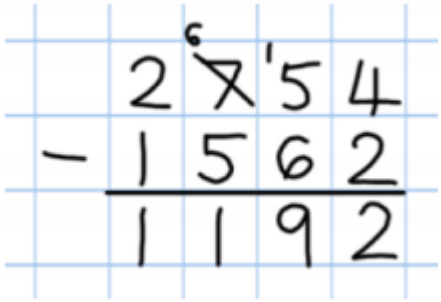
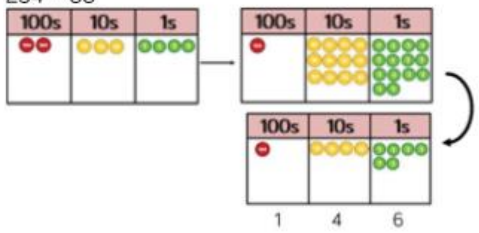
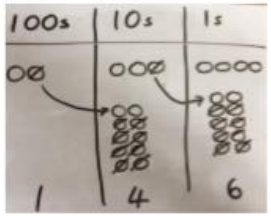
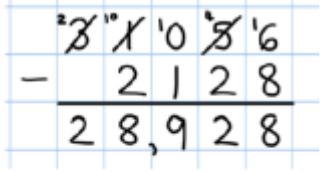
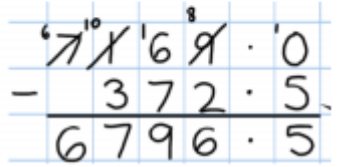
	Concrete	Pictorial	Abstract
Counting back	 Move objects away from the group, counting backwards.  Move the beads along the bead string as you count backwards.	 Count back in ones using a number line.	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  
Find the difference		Children to draw the cubes/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.
Part whole model	 Link to addition. Use PPW model to model the inverse. If 10 is the whole and 6 is one of the arts, what s the other part? 10—6 = 4	 Use pictorial representations to show the part.	Move to using numbers within the part whole model. 

Make 10 and find the difference	 34—28 Use a bead bar or bead strings to model counting to next ten and the rest.	 Use a number line to count on to next ten and then the rest.	93—76 = 17
Use base 10 to subtract a single digit number from a 2-digit number	Column method using base 10. 48-7 	Children to represent the base 10 pictorially. 	Column method or children could count back 7. 
Use base 10subtract two 2-digit number without exchanging	 Use base 10 or Numicon to model	 	47-24=23 40+7 -20+4 20+3 Intermediate step may be needed to lead to clear subtraction under-standing. 

Year Three – Subtraction

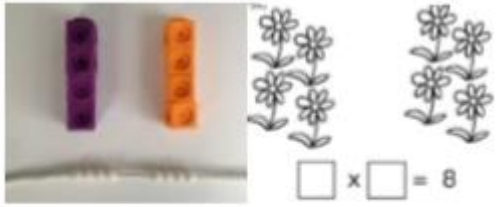
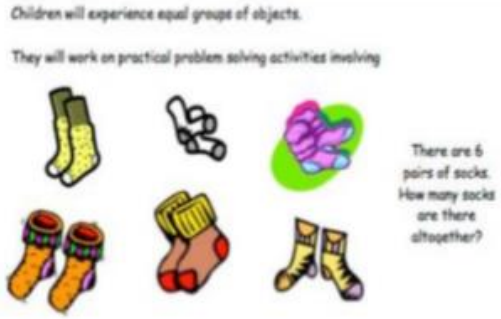
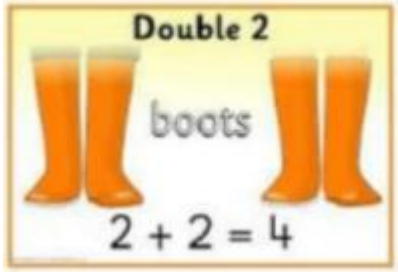
	Concrete	Pictorial	Abstract
Use base 10 to subtract two 2-digit numbers without exchanging	  Use base 10 or Numicon to model	 	47 – 24 = 23 40 + 7 – 20 + 4 20 + 3 Intermediate step may be needed to lead to clear subtraction understanding. 
Column method with regrouping (up to 3 digits using PV counters)	**Column method** using place value counters. 234 – 88 	Represent the place value counters pictorially, remembering to show what has been exchanged. 	Formal colum method. Children must understand what has happened when they have crossed out digits. 2 3 4 – 8 8 6

Year Four to Six -Subtraction

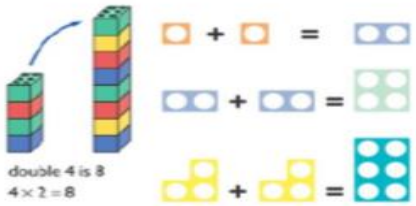
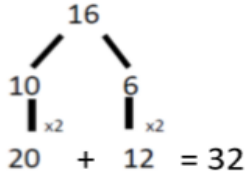
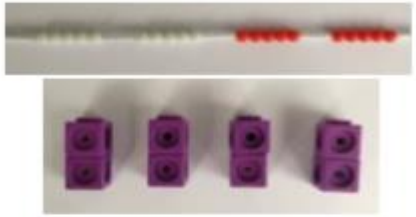
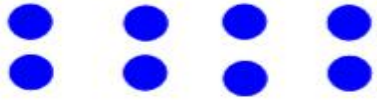
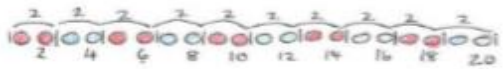
	Concrete	Pictorial	Abstract
Yr 4 Column method with regrouping Year 4 subtract with up to 4 digits.		Represent the place value counters pictorially; remembering to show what has been exchanged. 	
Yr 5 Column method with regrouping Year 5 subtract with	**Column method** using place value counters. 234 - 88 	Represent the place value counters pictorially; remembering to show what has been exchanged. 	 Use zeros for place-holders. 

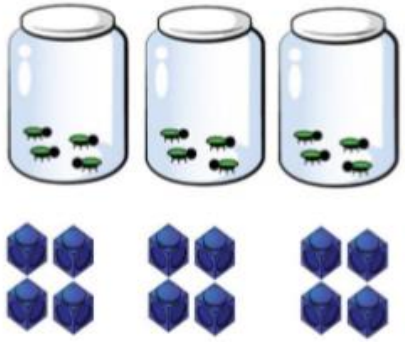
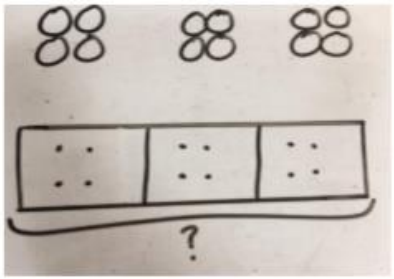
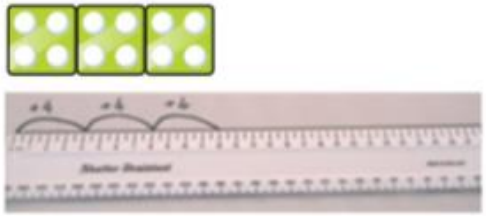
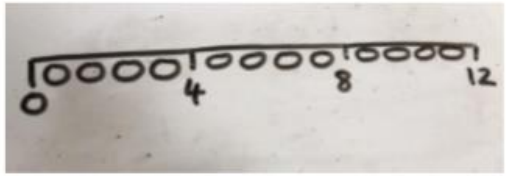
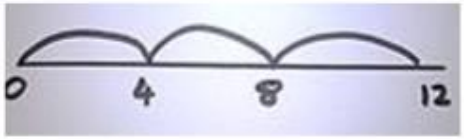
decimals linked to money			
Yr 6	Consolidate KS2 methods	Consolidate KS2 methods	Consolidate KS2 methods

EYFS – Multiplication

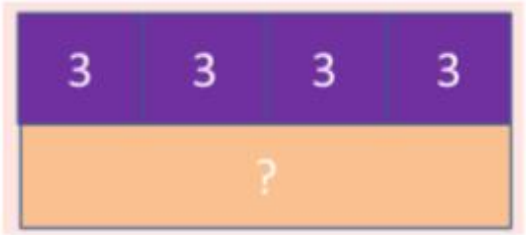
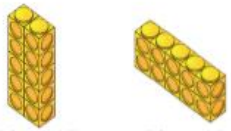
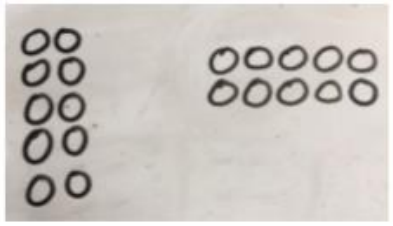
	Concrete	Pictorial	Abstract
Recognise and make equal groups of objects	 Use manipulatives to create equal groups.		 Only created by the teacher and for display purposes if required

Year One – Multiplication

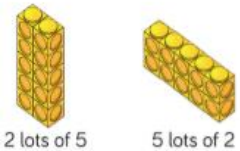
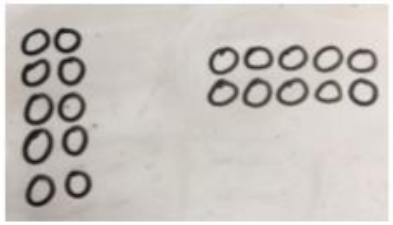
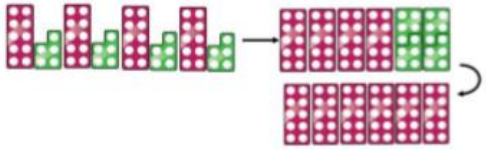
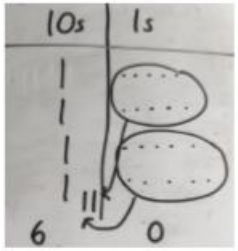
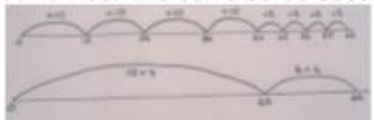
	Concrete	Pictorial	Abstract
Doubling	Use practical activities using manipulatives including cubes and Numicon to demonstrate doubling 	Draw pictures to show how to double numbers Double 4 is 8 	Partition a number and then double each part before recombining it back together. 
Counting in multiples	Count the groups as children are skip counting, children may use their fingers as they are skip counting. 	 Children make representations to show 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 grouping and repeated addition	**Repeated grouping/repeated addition** 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group. 	Children to represent the practical resources in a picture and use a bar model. 	$3 \times 4 = 12$ $4 + 4 + 4 = 12$
Using number lines to support repeated addition	**Number lines to show repeated groups-** 3 × 4  Cuisenaire rods can be used too.	Represent this pictorially alongside a number line e.g.: 	Abstract number line showing three jumps of four. 3 × 4 = 12 

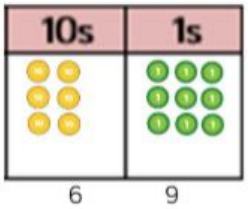
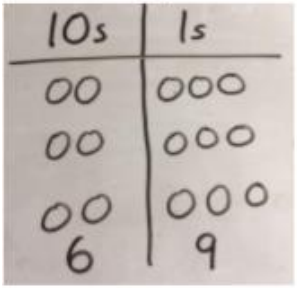
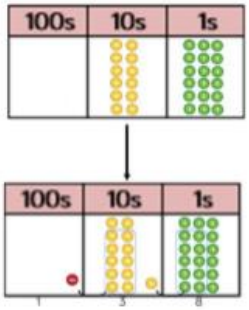
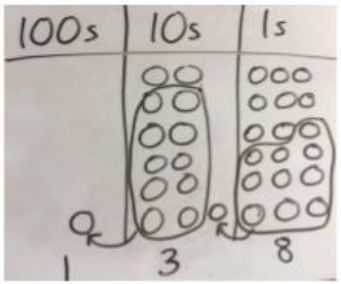
Year Two – Multiplication

	Concrete	Pictorial	Abstract
Counting in multiples of 2,3,5 and 10	Count the groups as children are skip counting, children may use their fingers as they are skip counting. Use bar models.  5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 = 40  	Number lines, counting sticks and bar models should be used to show representation of counting in multiples.    	Count in multiples of a number aloud. Write sequences with multiples of numbers. 0, 2, 4, 6, 8, 10 0, 3, 6, 9, 12, 15 0, 5, 10, 15, 20, 25 , 30 $4 \times 3 = \square$
Multiply using arrays	**Use arrays to illustrate commutativity** counters and other objects can also be used. $2 \times 5 = 5 \times 2$  2 lots of 5 5 lots of 2	Children to represent the arrays pictorially. 	Children to be able to use an array to write a range of calculations e.g. $10 = 2 \times 5$ $5 \times 2 = 10$ $2 + 2 + 2 + 2 + 2 = 10$ $10 = 5 + 5$

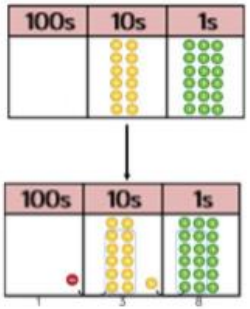
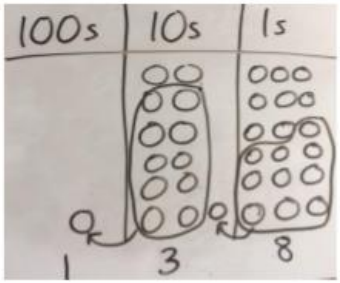
Year Three – Multiplication

	Concrete	Pictorial	Abstract
Multiply using arrays	**Use arrays to illustrate commutativity** counters and other objects can also be used. 2 × 5 = 5 × 2  2 lots of 5 5 lots of 2	Children to represent the arrays pictorially. 	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
Multiply 2-digit numbers by 1-digit numbers using base 10, Numicon or Cuisenaire rods	**Partition to multiply** using 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 

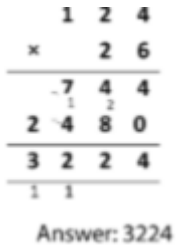
Year Four – Multiplication

	Concrete	Pictorial	Abstract
Multiply 2-digit numbers by 1-digit numbers using a formal column method	**Formal column method** with place value counters (base 10 can also be used.) 3 × 23 	Children to represent the counters pictorially. 	Children to record what it is they are doing to show understanding. 3 × 23 20 3 3 × 20 = 60 3 × 3 = 9 60 + 9 = 69 23 × 3 69
Multiply 3-digit numbers by 1-digit numbers using a formal column method	**Formal column method** with place value counters. 6 x 23 	Children to represent the counters/base 10, pictorially e.g. the image below. 	Formal written method 6 x 23 = 23 × 6 138 1 1

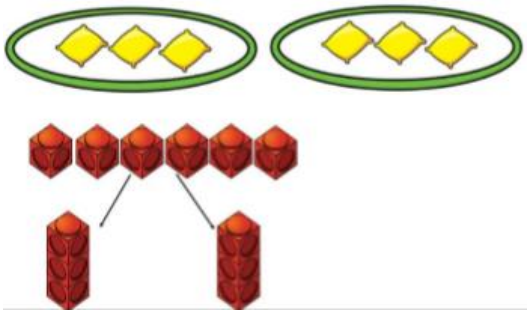
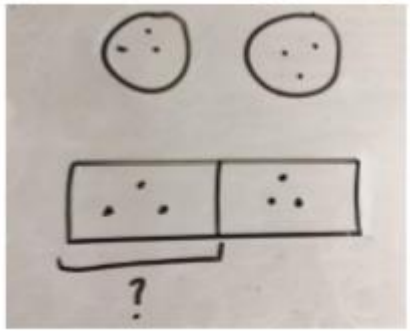
Year Five – Multiplication

	Concrete	Pictorial	Abstract
Multiply 3-digit numbers by 1-digit numbers using a formal column method	**Formal column method** with place value counters. 6 x 23 	Children to represent the counters/base 10, pictorially e.g. the image below. 	Formal written method 6 x 23 = 23 × 6 138 1 1
Multiply 4-digit numbers by 2-digit numbers using a formal column method	When children start to multiply 3d × 3d and 4d × 2d etc., they should be confident with the abstract: To get 744 children have solved 6 × 124. To get 2480 they have solved 20 × 124.		1 2 4 × 2 6 7 4 4 2 4 8 0 3 2 2 4 1 1 Answer: 3224

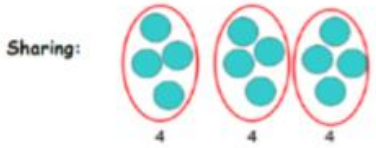
Year Six – Multiplication

	Concrete	Pictorial	Abstract
Multiply 4-digit numbers by 2-digit numbers using a formal column method	When children start to multiply 3d × 3d and 4d × 2d etc., they should be confident with the abstract: To get 744 children have solved 6 × 124. To get 2480 they have solved 20 × 124.		

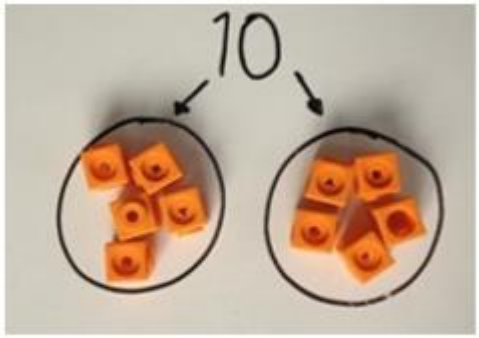
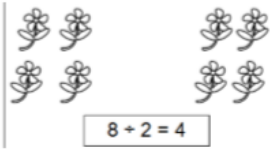
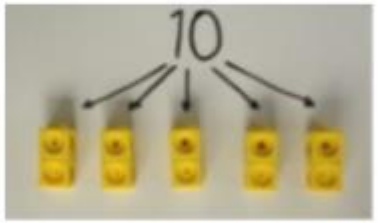
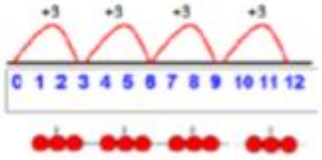
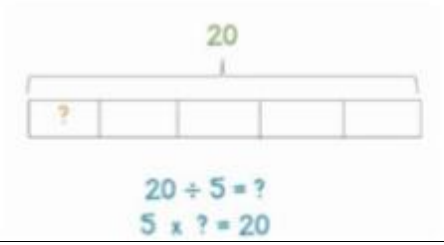
EYFS – Division

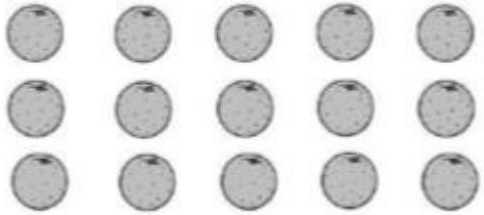
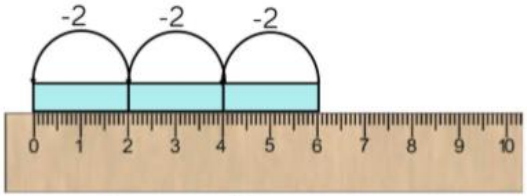
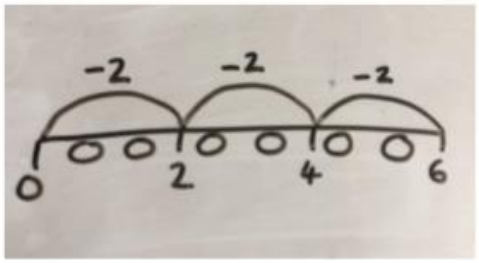
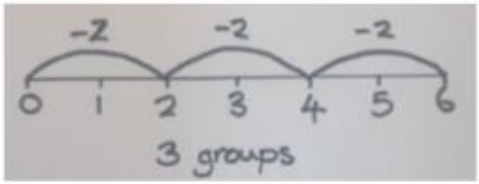
	Concrete	Pictorial	Abstract
Sharing with practical objects and hearing the language of sharing	**Sharing** using a range of objects. 6 ÷ 2 	Represent the sharing pictorially. 	This is not appropriate for this age groups

Year One – Division

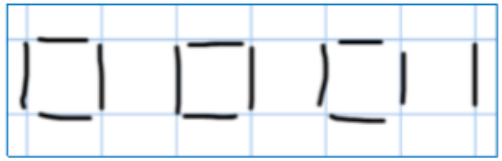
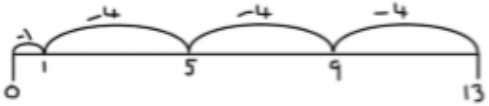
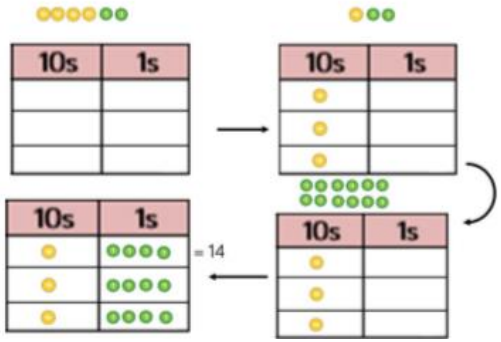
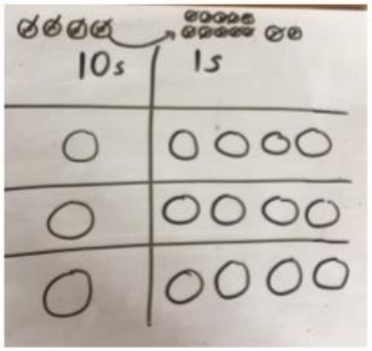
	Concrete	Pictorial	Abstract
Division as sharing	 	Children use pictures or shapes to share quantities.  8 shared between 2 is 4  12 shared between 3 is 4	12 shared between 3 is 4

Year Two – Division

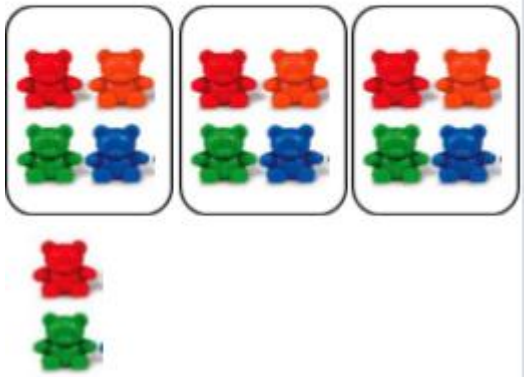
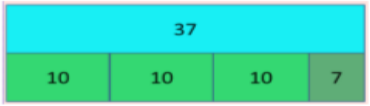
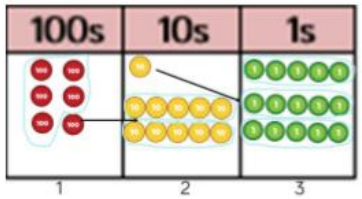
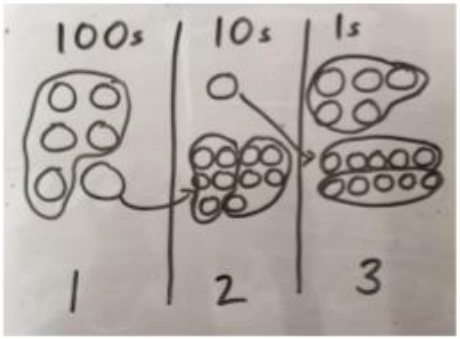
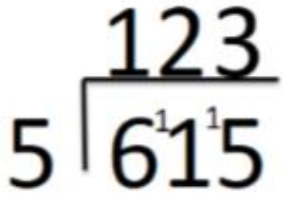
	Concrete	Pictorial	Abstract
Division as sharing	 I have 10 cubes, can you share them equally in 2 groups?	Children use pictures or shapes to share quantities.  8 ÷ 2 = 4 Children use bar modelling to show and support understanding.  12 ÷ 4 = 3	12 ÷ 3 = 4
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.  	Use number lines for grouping  12 ÷ 3 = 4 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 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

Division using our knowledge of arrays	 Link division to multiplication by creating an array and thinking about the number sentences that can be created. Eg 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	Draw an array and use lines to split the array into groups to make multiplication and division sentences 	Find the inverse of multiplication and division sentences by creating eight linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7 28 = 7 x 4 28 = 4 x 7 4 = 28 ÷ 7 7 = 28 ÷ 4
Division using repeated subtraction	**Repeated subtraction** using Cuisenaire rods above a ruler. 6 ÷ 2  3 groups of 2	Children to represent repeated subtraction pictorially. 	Abstract number line to represent the equal groups that have been subtracted. 

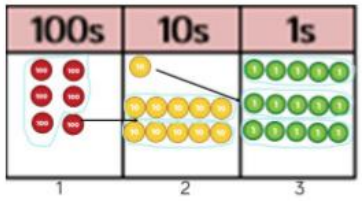
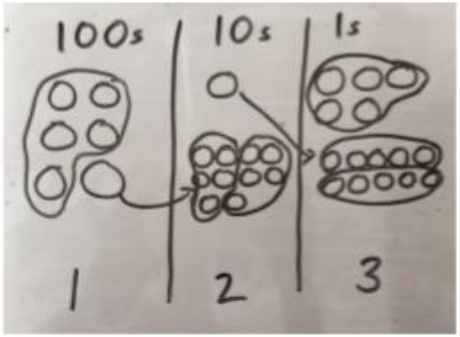
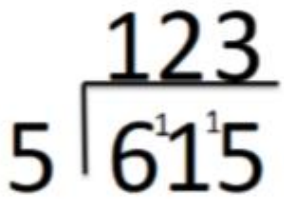
Year Three – Division

	Concrete	Pictorial	Abstract
2-digit and 1-digit division with remainders	**2d ÷ 1d with remainders** using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.  There are 3 whole squares, with 1 left over.	13 ÷ 4 = 3 remainder 1 Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line. '3 groups of 4, with 1 left over' 
2-digit and 1-digit division using PV counters and/or base ten	**Sharing using place value counters.** 42 ÷ 3 = 14 	Children to represent the place value counters pictorially. 	Children to be able to make sense of the place value counters and write calculations to show the process. 42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14

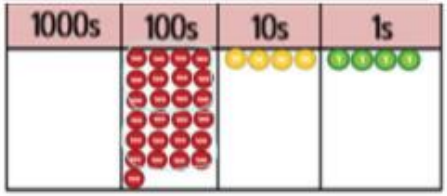
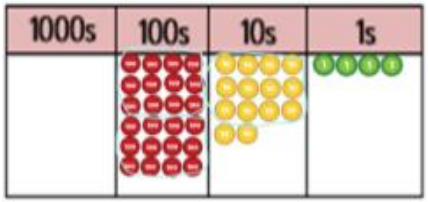
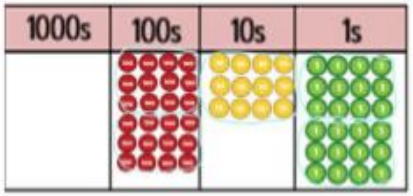
Year Four – Division

	Concrete	Pictorial	Abstract
Division with remainders	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.  Use bar models to show division with remainders. 	Complete written divisions and show the remainder using r. 
3-digit and 1-digit division using PV counters and/or base ten	**Short division** using place value counters to group. 615 ÷ 5  1. Make 615 with place value counters. 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?	Represent the place value counters pictorially. 	Children to the calculation using the short division scaffold. 

Year Five – Division

	Concrete	Pictorial	Abstract
4-digit and 1-digit division using PV counters including remainders	**Short division** using place value counters to group. 615 ÷ 5  1. Make 615 with place value counters. 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?	Represent the place value counters pictorially.  	Children to the calculation using the short division scaffold. 

Year Six – Division

	Long Division
4-digit by 2-digit long division	**Long division** using place value counters 2544 ÷ 12  We can't group 2 thousands into groups of 12 so will exchange them.  We can group 24 hundreds into groups of 12 which leaves with 1 hundred. 02 12 | 2544 24 1  After exchanging the hundred, we have 14 tens. We can group 12 tens into a group of 12, which leaves 2 tens. 021 12 | 2544 24 14 12 2  After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder. 0212 12 | 2544 24 14 12 24 24 0