CALCULATION POLICY

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Our vision is for all children to be safe, happy and learning. We deliver this vision through clear aims that are underpinned by our school commitments.

Every child is safe, happy and learning because every adult is caring, happy in their work and skilled.

We value:

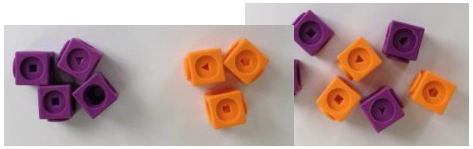
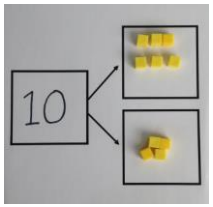
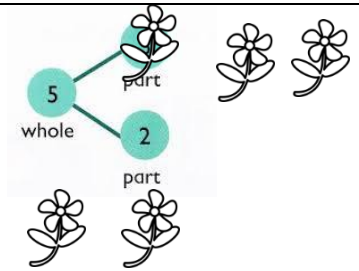
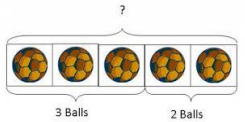
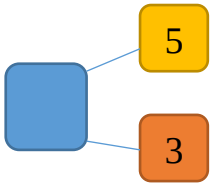
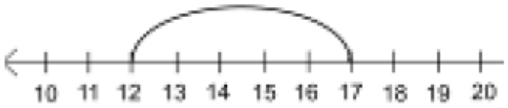
working **T**ogether
happiness

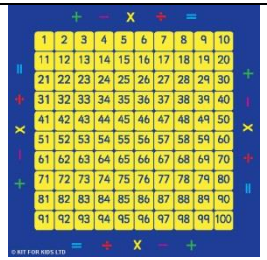
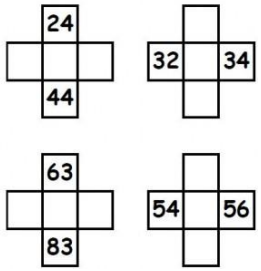
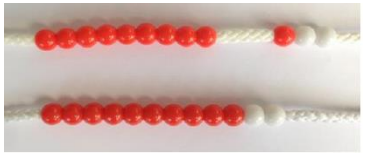
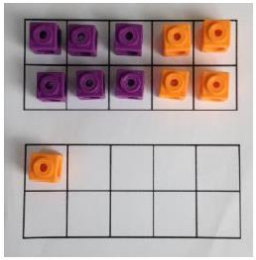
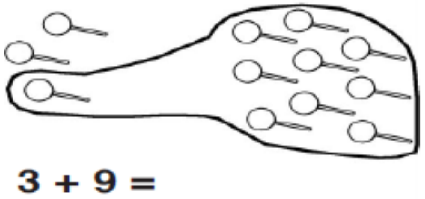
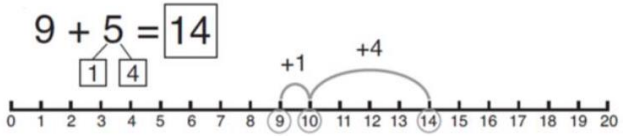
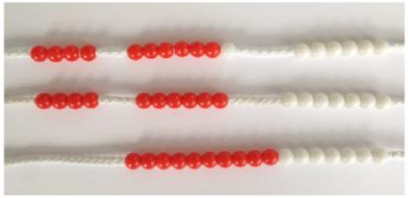
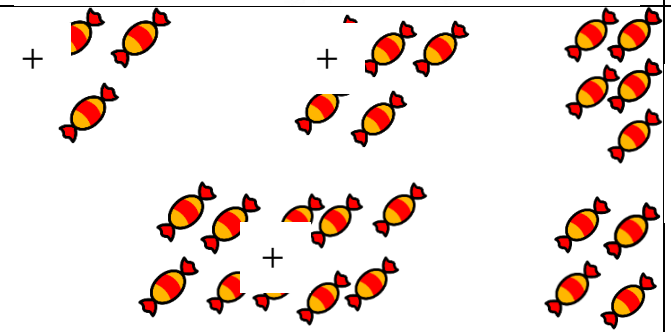
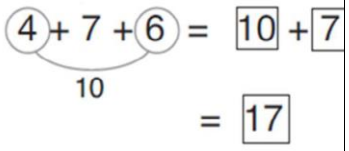
At Thorns, we use the White Rose Maths Scheme of Learning supported by iSee Reasoning, iSee Problem Solving and NCETM resources.

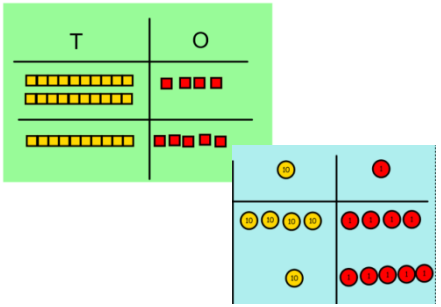
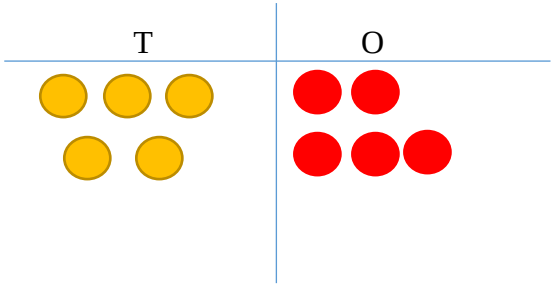
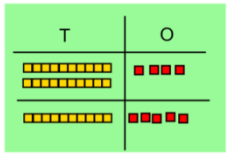
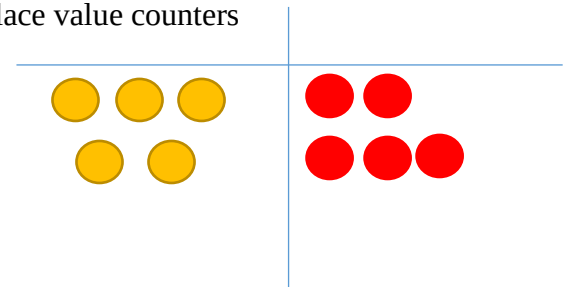
In order to assist teachers and learners, a clear pathway has been developed to support secure understanding of calculations. These use the concept of Concrete (manipulatives), Pictorial (representation) and Abstract (written methods – formal and informal). This calculation policy is designed to support the teaching of maths in Reception – Year 6.

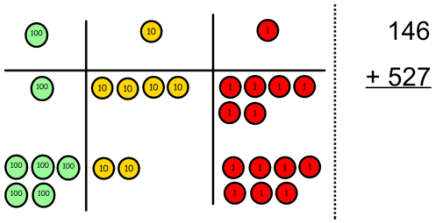
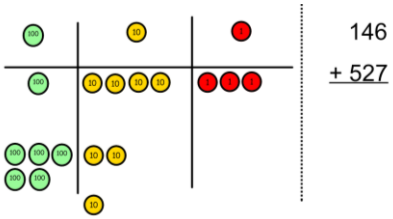
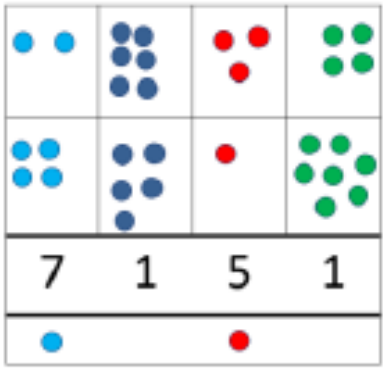
The exemplars shown in Appendix 2 are taken from The National Curriculum 2014 and are the end goal of this calculation policy.

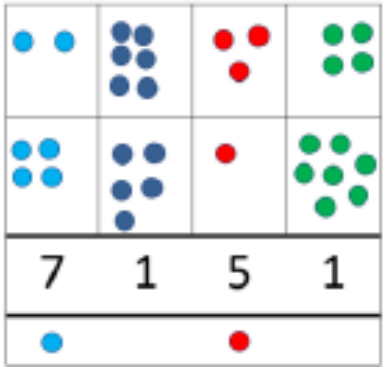
Addition

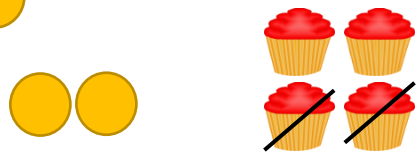
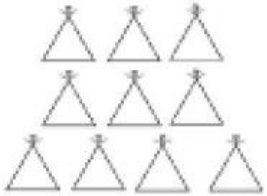
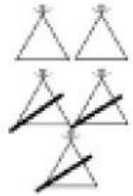
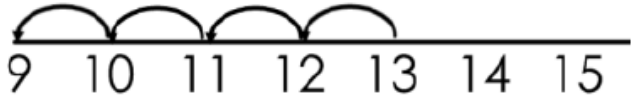
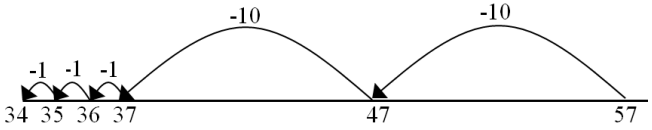
Calculation Stage	Objective and Strategies	Concrete	Pictorial	Abstract
Stage 1:Concrete objects and pictorial representations.	Combining two parts to make a whole: part- whole model	  Use cubes to add two numbers together as a group or in a bar. 	 Use pictures to add two numbers together as a group or in a bar.  	4 + 3 = 7 10= 6 + 4  Use the part-part whole diagram as shown above to move into the abstract.
Stage 2: Number lines and 100 squares	Starting at the bigger number and counting on	 Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.	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.

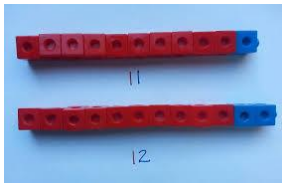
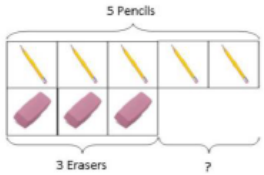
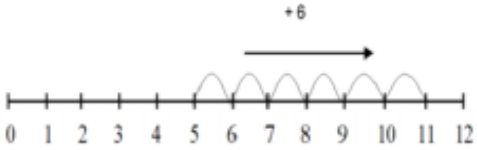
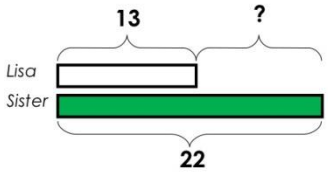
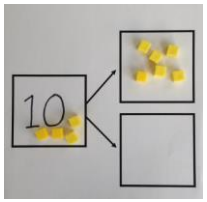
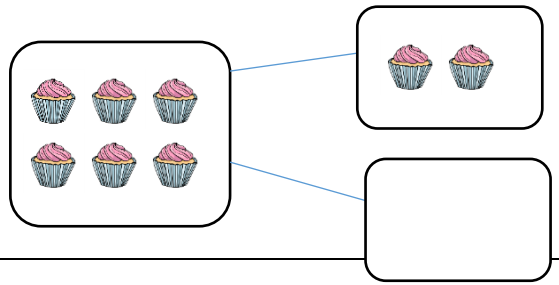
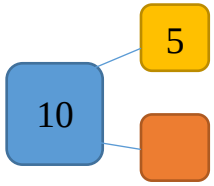
	Using a 100 square – adding 10s by dropping down	 Count on using a 100 square using counters. Drop down to add 10.	 Find missing numbers from a 100 square by using knowledge and pre-existing skills. Drop down, count on and use pictorial representations.	17+11 Drop down and count on in jumps.
Stage 3: Mental methods evolving into written methods	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?
	Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	 Combine the two numbers that make 10 and then add on the remainder.

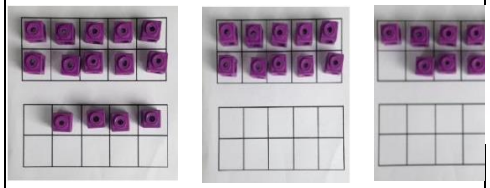
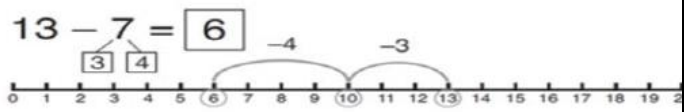
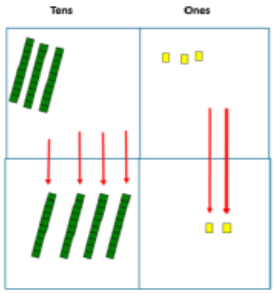
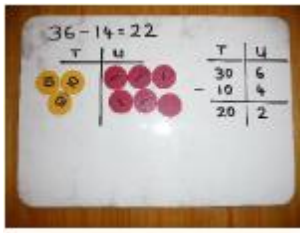
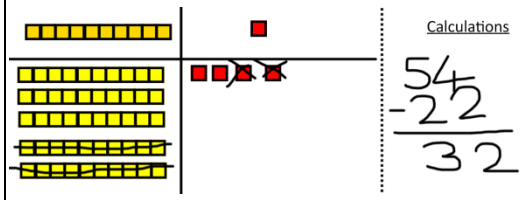
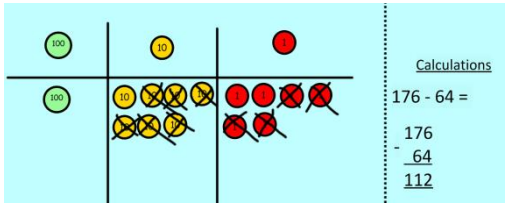
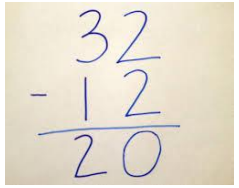
	Column method- no regrouping	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters. 	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. 	Calculations 21 + 42 = 21 + 42
	Partitioning to add numbers mentally	Use Base 10 to represent numbers in their partitioned stages  Then, add the tens together, then the ones.	Children move on to draw base 10 blocks and place value counters 	20 + 5 40 + 8 60 + 13 = 73

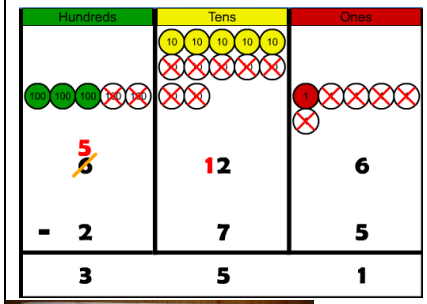
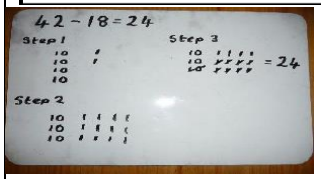
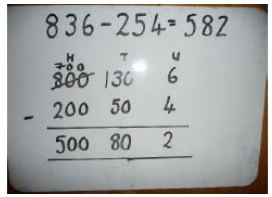
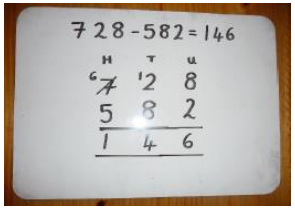
Stage 4: Column Method	Column method- regrouping	Make both numbers on a place value grid.  Add up the units and exchange 10 ones for one 10.  Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding.  	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 536 + 85 621 1 1

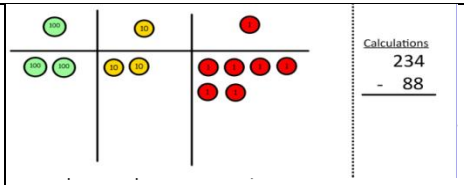
Stage 5: Column addition, moving to decimals and larger numbers.	Column method moving to decimals and larger numbers/multiple numbers.	As above, use physical representations such as large decimal points on a WB, using a line of children as numbers.		As with above, show another column with striking decimal points.	$\begin{array}{rcccc} & 2 & 3 & . & 3 & 6 & 1 \\ & & 9 & . & 0 & 8 & \mathbf{0} \\ & 5 & 9 & . & 7 & 7 & \mathbf{0} \\ + & 1 & & . & 3 & \mathbf{0} & \mathbf{0} \\ \hline & 9 & 3 & . & 5 & 1 & 1 \\ & {\scriptstyle 2} & {\scriptstyle 1} & & {\scriptstyle 2} & & \end{array}$ Use and represent 0 as a place holder in step one. Units of measurement come as final steps.

Subtraction				
Calculation Stage	Objective and Strategies	Concrete	Pictorial	Abstract
Stage 1: Concrete objects and pictorial representations	Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away.  6 – 2 = 4  	Cross out drawn objects to show what has been taken away.   15 – 3 = 12	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 take them away 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.

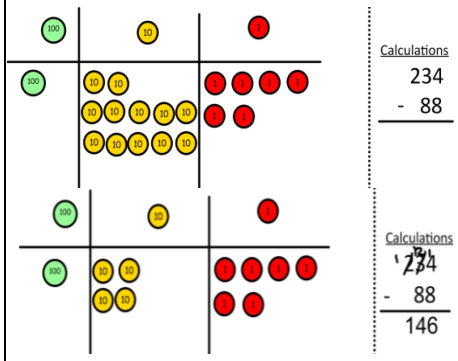
				
Stage 2: Number lines and 100 squares	Find the difference	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference	 Count on to find the difference. Draw bars to find the difference between 2 numbers. **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	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction.	Use a pictorial representation of objects to show the part part whole model. 	

		If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =		Move to using numbers within the part whole model.
Stage 3: Linking concrete to abstract to decompose	Make 10	14 – 9 =  Make 14 on the ten frame. Take away the four first to make 10 and then takeaway one more so you have taken away 5. You are left with the answer of 9.	 Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.	16 – 8= How many do we take off to reach the next 10? How many do we have left to take off?
	Column method without regrouping	 Use Base 10 to make the bigger number then take the smaller number away. Show how you partition numbers to subtract. Again make the larger number first. 	 Draw the Base 10 or place value counters alongside the written calculation to help to show working. 	47 – 24 = 23 40 + 7 – 20 + 4 20 + 3 This will lead to a clear  written column subtraction.

Stage 4: Compact decomposition, moving to larger numbers and decimals	Column method with regrouping	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones. Now I can subtract my ones. Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.	  Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make. When confident, children can find their own way to record the exchange/regrouping. Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.	 Children can start their formal written method by partitioning the number into clear place value columns.  Moving forward the children use a more compact method. This will lead to an understanding of subtracting any number including decimals.

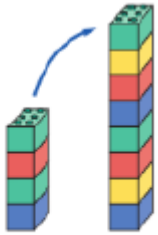
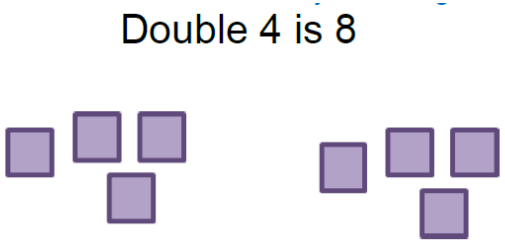
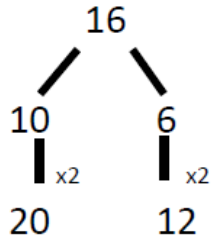


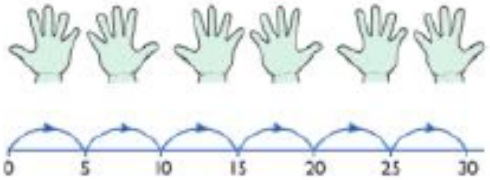
Now I can take away eight tens and complete my subtraction



Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.

$$\begin{array}{r} \ 5\ 12\ \ \ 1 \\ 2\ \cancel{6}\ \cancel{3}\ .\ \mathbf{0} \\ -\ \ \ 2\ 6\ .\ 5 \\ \hline 2\ 3\ 6\ .\ 5 \end{array}$$

<table>
<tr><th colspan="5">Multiplication</th></tr>
<tr><th>Calculation Stage</th><th>Objective and Strategies</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr><td rowspan="2">Stage 1: Concrete objects and pictorial representations</td><td>Doubling</td><td>Use practical activities to show how to double a number.
 
double 4 is 8
4 × 2 = 8</td><td>Draw pictures to show how to double a number.
 
</td><td> 

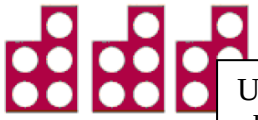
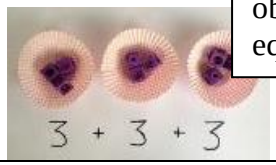
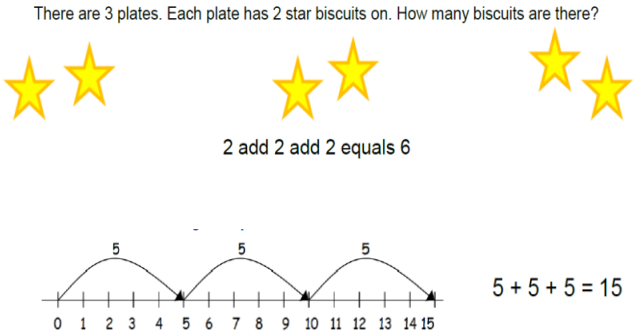
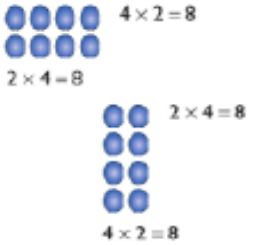
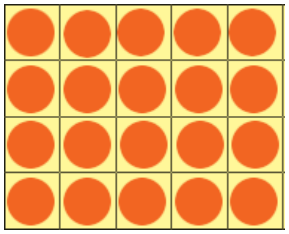
Partition a number and then double each part before recombining it back together.</td></tr>
<tr><td>Counting in multiples</td><td> 
 
Count in multiples supported by concrete objects in equal groups.</td><td> 

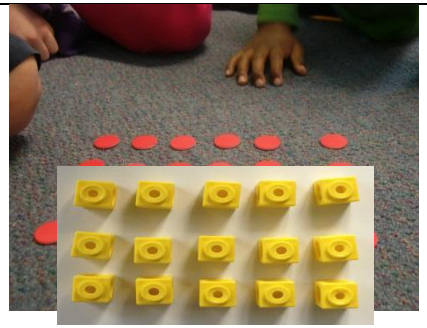
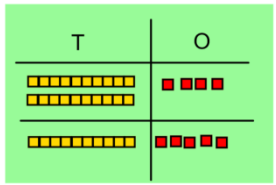
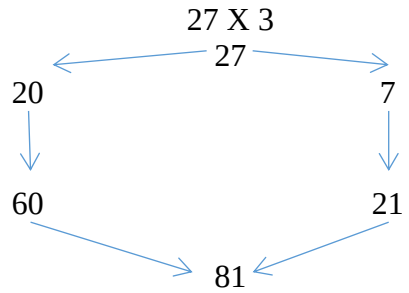
Use a number line or pictures to continue support in counting in multiples.</td><td>Count in multiples of a number aloud.

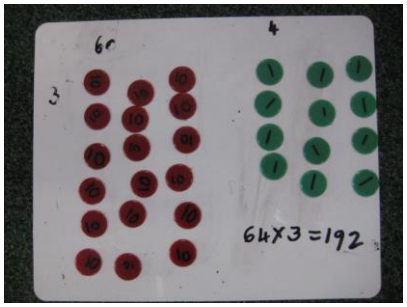
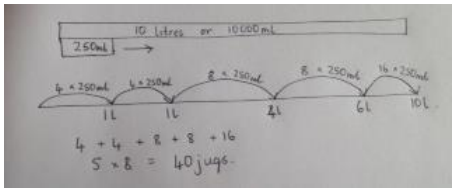
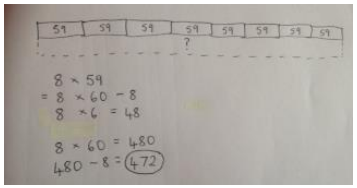
Write sequences with multiples of numbers.

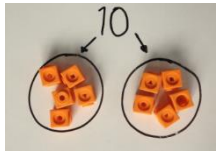
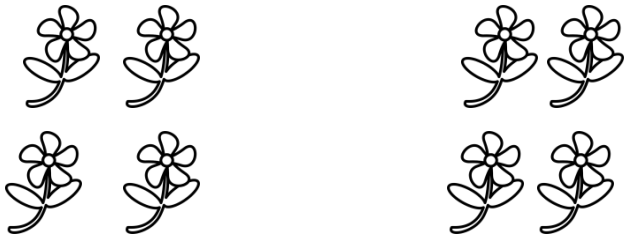
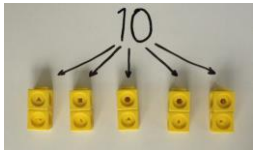
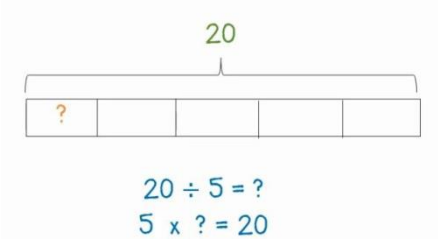
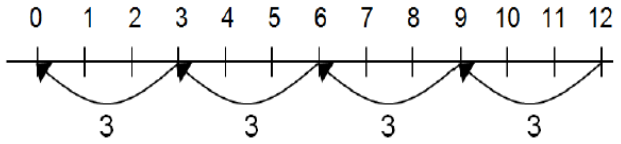
2, 4, 6, 8, 10

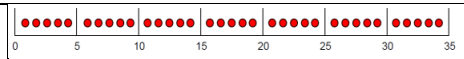
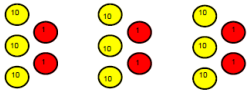
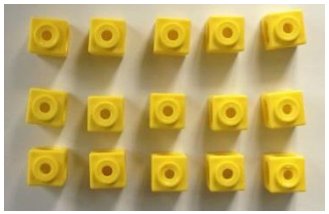
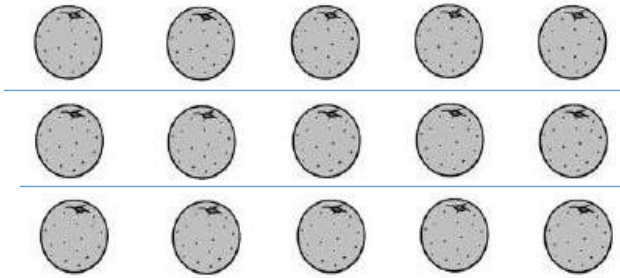
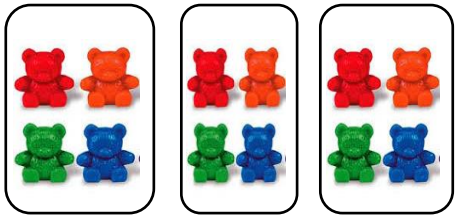
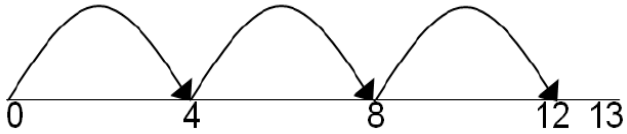
5, 10, 15, 20, 25 , 30</td></tr>
</table>

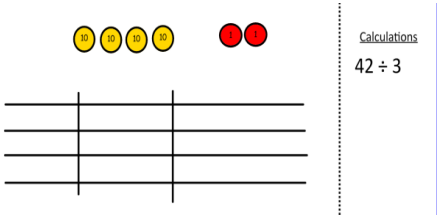
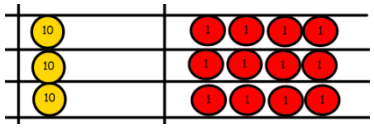
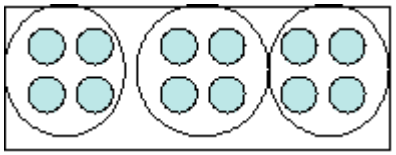
Stage 2: Arrays Stage 3: Repeated addition linking to practical apparatus	Repeated addition	  Use different objects to add equal groups. 		Write addition sentences to describe objects and pictures. 
	Arrays- showing commutative multiplication	Create arrays using counters/ cubes to show multiplication sentences.	Draw arrays in different rotations to find **commutative** multiplication sentences. Link arrays to area of rectangles.  	Use an array to write multiplication sentences and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15

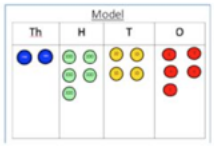
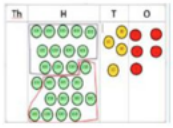
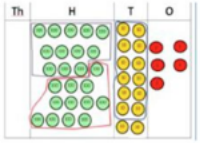
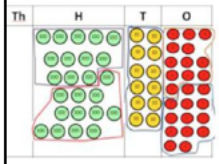
				
Stage 4: Number partitioning		Use Base 10 to show a number partitioned into tens and ones.  Multiple each piece using known tables.	Partition numbers into 10s and 1s and multiply each part before recombining.  	Use clear, well-formed number sentences and line up column values 27 X 3 20 X 3 = 60 7 X 3 = 21 60+21 = 81
Stage 5: Compact method 2x1 and 3x1	Column multiplication			H T O 4 7 6 X 4 1 9 0 4 3 2 Numbers are carried underneath. Label columns if needed.

Stage 6: Compact method 2x2 and 3x2 and beyond		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.   	With long multiplication, remind the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer. 2 3 1 1342 x 18 13420 10736 24156 1 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768

Division				
Calculation Stage	Objective and Strategies	Concrete	Pictorial	Abstract
Stage 1: Concrete objects and pictorial representations	Sharing objects into groups	 I have 10 cubes, can you share them equally in 2 groups? 	Children use pictures or shapes to share quantities.  $8 \div 2 = 4$	Share 9 buns between three people. $9 \div 3 = 3$
Stage 2: Grouping or repeated subtraction	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 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

		 96 ÷ 3 = 32 		
	Division within 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 four linking number sentences. 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. 	Complete written divisions and show the remainder using r. 

			Draw dots and group them to divide an amount and clearly show a remainder. 	
Stage 3: Short division (Bus stop)	Short division	Use place value counters to divide using the bus stop method alongside 42 ÷ 3=  Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over. We exchange this ten for ten ones and then share the ones equally among the groups.  We look how much in 1 group so the answer is 14.	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. Write down higher multiplication tables to help with trickier numbers: 16 32 48 64 80 96 112 128	Begin with divisions that divide equally with no remainder. 2 1 8 3 4 | 8 7 2 Move onto divisions with a remainder. 8 6 r 2 3 5 | 4 3 2
Stage 4: Long division	Long division			1 4 . 6 16 21 3 5 | 5 1 1 . 0 Finally move into decimal places to divide the total accurately.

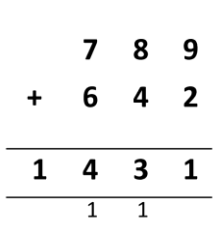
Concrete	Pictorial	Abstract
 0212 12 2544 24 14 12 24 24 0 2544 ÷ 12 How many groups of 12 thousands do we have? None	Children to represent the counters, pictorially and record the subtractions beneath.	0 12 2544 Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.
 Exchange 2 thousand for 20 hundreds.		02 12 2544 24 1 Step two- How many groups of 12 can I make with 25 hundreds? The 24 shows the hundreds we have grouped. The one is how many hundreds we have left.
 02 12 2544 24 1 How many groups of 12 are in 25 hundreds? 2 groups. Circle them. We have grouped 24 hundreds so can take them off and we are left with one.		021 12 2544 24 14 12 2 Exchange the one hundred for 10 tens. How many groups of 12 can I make with 14 tens? The 14 shows how many tens I have, the 12 is how many I grouped and the 2 is how many tens I have left.
 021 12 2544 24 14 12 2 Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2.		0212 12 2544 24 14 12 24 24 0 Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.
 Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2		

Appendix 1 - Vocabulary						
Strand	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition and Subtraction	Number bonds, number line, add, more, plus, make, sum, total, altogether, inverse, double, near double, equals, is the same as (including equals sign), difference between, subtract, take away, minus How many more to make ...?, How many more is ... than ... ?, How much more is ... ?, How many fewer is ... than ... ?, How much less is ... ?		Column addition and subtraction		Efficient written method	Order of operations
Multiplication and Division	Once, twice, three, five times, multiple of times Multiply, multiply by, repeated addition, array, row, column, double, halve, share, share equally, group in pairs, threes, etc., equal groups of, divide, divided by, left over		Product, multiples of four, eight, fifty and one hundred, scale up	Multiplication facts (up to 12x12), division facts, inverse, derive	Factor pairs, composite numbers, prime number, prime factors, square number, cubed number, formal written method	Order of operations Common factors and common multiples

Appendix 2 - Exemplars from The National Curriculum 2014

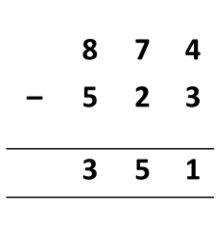
Addition and Subtraction

789 + 642 becomes



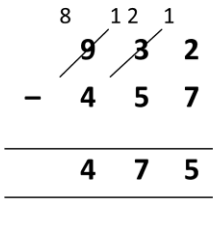
Answer: 1431

874 – 523 becomes



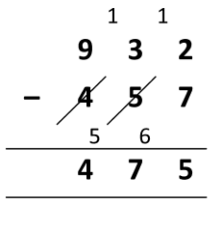
Answer: 351

932 – 457 becomes



Answer: 475

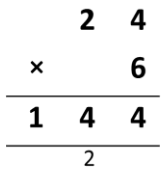
932 – 457 becomes



Answer: 475

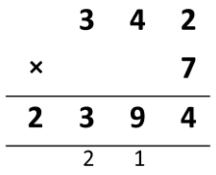
Short Multiplication

24 × 6 becomes



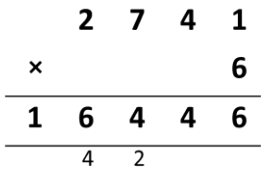
Answer: 144

342 × 7 becomes



Answer: 2394

2741 × 6 becomes



Answer: 16 446

Long Multiplication

24 × 16 becomes

$$\begin{array}{r} {\scriptstyle 2} \\ 24 \\ \times\ 16 \\ \hline 240 \\ 144 \\ \hline 384 \end{array}$$

Answer: 384

124 × 26 becomes

$$\begin{array}{r} {\scriptstyle 1\ 2} \\ 124 \\ \times\ 26 \\ \hline 2480 \\ 744 \\ \hline 3224 \\ {\scriptstyle 1\ 1} \end{array}$$

Answer: 3224

124 × 26 becomes

$$\begin{array}{r} {\scriptstyle 1\ 2} \\ 124 \\ \times\ 26 \\ \hline 744 \\ 2480 \\ \hline 3224 \\ {\scriptstyle 1\ 1} \end{array}$$

Answer: 3224

Long Division

432 ÷ 15 becomes

$$\begin{array}{r} 28\ \text{r}\ 12 \\ 15\overline{)\,432} \\ 300 \\ \hline 132 \\ 120 \\ \hline 12 \end{array}$$

Answer: 28 remainder 12

432 ÷ 15 becomes

$$\begin{array}{r} 28 \\ 15\overline{)\,432} \\ 300 \quad 15\times 20 \\ \hline 132 \\ 120 \quad 15\times 8 \\ \hline 12 \end{array}$$

$\frac{\cancel{12}}{\cancel{15}} = \frac{4}{5}$

Answer: $28\ \frac{4}{5}$

432 ÷ 15 becomes

$$\begin{array}{r} 28\cdot 8 \\ 15\overline{)\,432\cdot 0} \\ 30\downarrow \\ \hline 132\downarrow \\ 120\downarrow \\ \hline 120 \\ 120 \\ \hline 0 \end{array}$$

Answer: 28·8