Hawridge and Cholesbury Calculation Policy for Mathematics

Written by Angela Hughes

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Introduction

The following calculation policy has been devised to meet the requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school. Please note that early learning in number and calculation in Reception follows the 'Development Matters" EYFS document, and this calculation policy is designed to build on progressively from the content and methods established in the Early Years Foundation Stage.

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons reflecting the aims of the National Curriculum 2014 that pupils should make rich connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems.

Children will generally follow the programme of study at broadly the same pace, however it is vital that pupils are taught according to the stage that they are currently working at, being moved onto the next stage when they are ready, or working at a lower stage until they are secure enough to move on.

Hawridge and Cholesbury has adopted the mastery approach to teaching maths and so pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content. Those who are not sufficiently fluent with earlier material should consolidate their understanding, including through additional practice, before moving on. *(see Nrich Curriculum mapping docs and NCETM Teaching for Mastery assessment docs)*

The essential idea behind mastery is that all children need a deep understanding of the mathematics they are learning so that:

- future mathematical learning is built on solid foundations which do not need to be re-taught;
- there is little need for separate catch-up programmes due to some children falling behind;
- children who, under other teaching approaches, can often fall a long way behind, are better able to keep up with their peers, so that gaps in attainment are narrowed whilst the attainment of all is raised.

This policy sets out to ensure teachers are aware of the progression of skills and key concepts each child within our school will move through as part of each year's programme of study. Teachers must refer to the NCETM progression documents for each of the domains for further clarification.

Aims

* To introduce children to the processes of calculation progressing from concrete, pictorial to abstract means
* To ensure children have a large proportion of time spent reinforcing number to build competency
* To support children in developing ways of recording to support their thinking and calculation methods
* Enable children to learn and interpret calculation signs
* To provide consistent models and images across the school to promote secure understanding
* To facilitate the use of tools to help children construct their understanding without promoting the over reliance of such tools
* To enable children to strengthen and refine their mental methods in order to develop informal and formal written methods and judge the accuracy of their calculations
* To support children in becoming more efficient and succinct in their recordings which will ultimately lead to efficient formal written methods
* To understand mathematical vocabulary to allow children to carry out calculations correctly

* To promote the correct use of age appropriate mathematical vocabulary to enable children to explain their thinking and build reasoning both verbally and in written format
* By the end of KS1, pupils should develop confidence and mental fluency with whole numbers, counting and place value. Pupils should know the number bonds to 20 and be precise in using and understanding place value.
* By the end ofKS2, pupils should be fluent in written methods for all four operations, including long multiplication and division, and in working with fractions, decimals and percentages

Mental and Oral methods of calculation

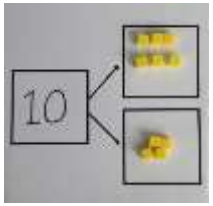
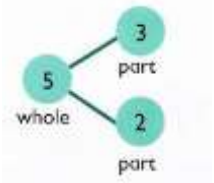
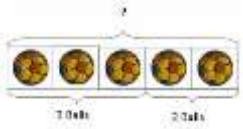
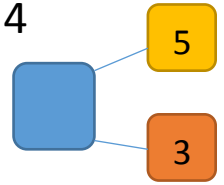
Early practical, oral and mental work lays the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts.

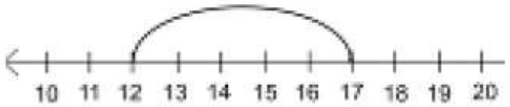
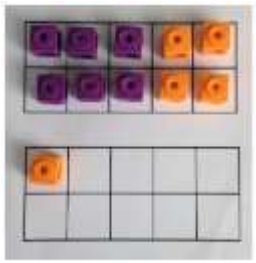
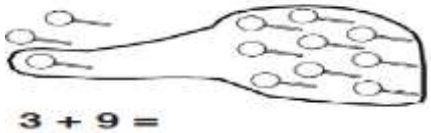
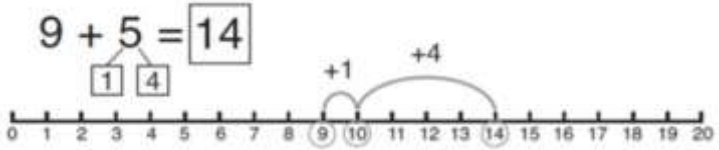
Reception	By the end of this stage children must be able to recognise patterns, begin counting sequences and recognise one more or one less than any given number 0-100.
Year 1	Counting in multiples of 2,10 and 5. By the end of the year 1, children can start learning the 2,10 and 5 times tables.
	Count and read, to and across 100 forwards and backwards beginning with any given number (0-100).
Year 2	Recall 2,10 and 5 times table. Learn 3 times tables.
Year 3	Recall 2,10,5 and 3 times table. Learn 4 and 8 times tables.
Year 4	Recall 2,10,5,3, 4 and 8 times table. Learn 6,7,9,11 and 12 times table
Year 5/6	Continue to practise of all times table up to 12 x 12.

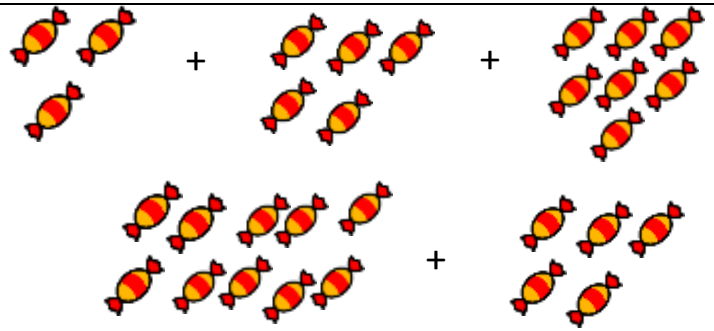
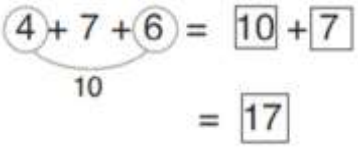
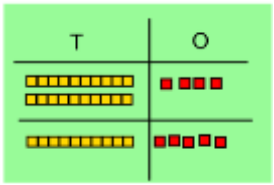
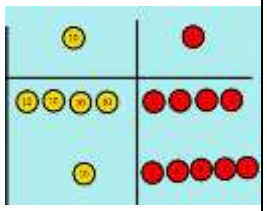
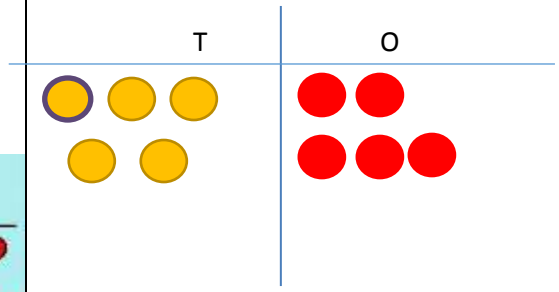
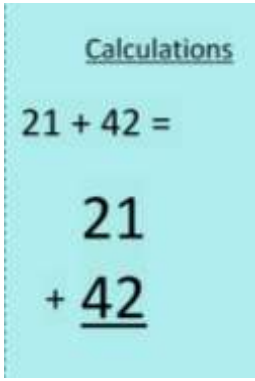
Each class will carry out a Terrific Times Table test weekly. This will be recorded and submitted to the maths co-ordinator each half term.

Progression in Calculations

Addition

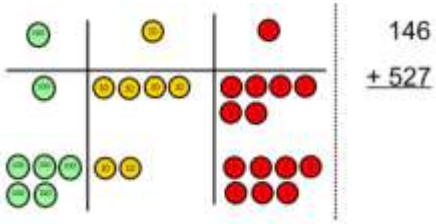
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	   Use cubes to add two numbers together as a group or in a bar. 	   Use pictures to add two numbers together as a group or in a bar. 	4 + 3 = 7 10= 6 + 4  Use the part-part whole diagram as shown above to move into the abstract.

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.
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10.	 Use pictures or a number line. Regroup or partition the smaller number to make 10.  	7 + 4= 11 If I am at seven, how many more do I need to make 10. How many more do I add on now?

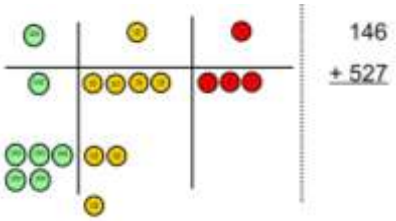
Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	 Combine the two numbers 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.  	

Column method- regrouping

Make both numbers on a place value grid.



Add up the units and exchange 10 ones for one 10.

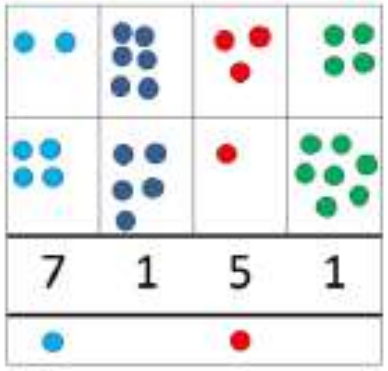


Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added.

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.

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

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

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

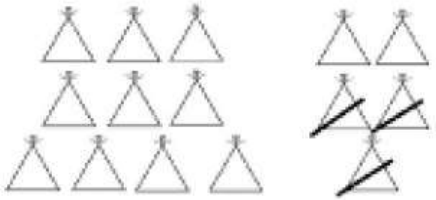
$$\begin{array}{r} 72.8 \\ +\ 54.6 \\ \hline 127.4 \\ 1\ 1 \end{array}$$

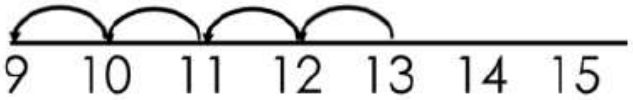
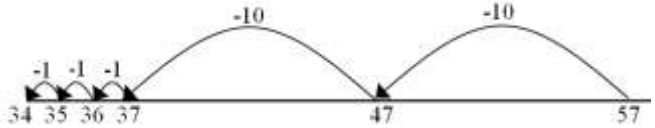
$$\begin{array}{rrrrr} £ & 2 & 3 & . & 5\ 9 \\ + \ £ & & 7 & . & 5\ 5 \\ \hline £ & 3 & 1 & . & 1\ 4 \\ & 1 & 1 & & 1 \end{array}$$

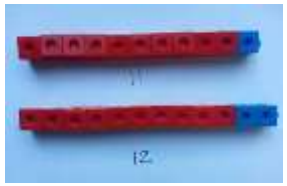
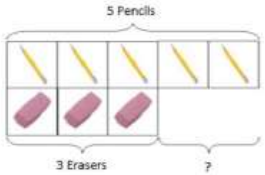
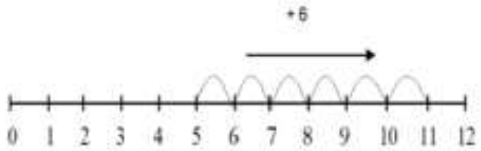
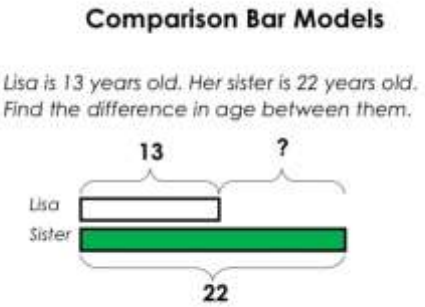
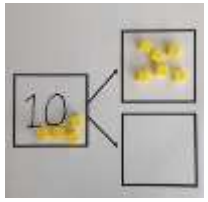
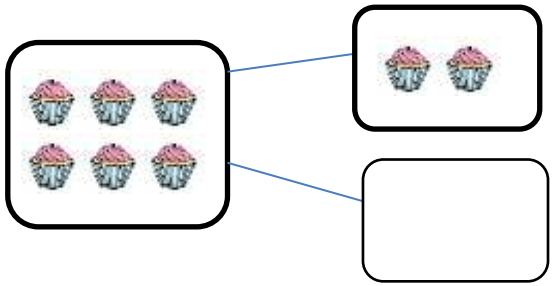
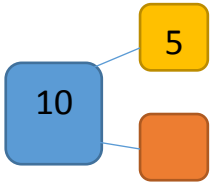
$$\begin{array}{rrrrr} 2 & 3 & . & 3 & 6\ 1 \\ & 9 & . & 0 & 8\ 0 \\ 5 & 9 & . & 7 & 7\ 0 \\ - & 1 & . & 3 & 0\ 0 \\ \hline 9 & 3 & . & 5 & 1\ 1 \\ 2 & 1 & & 2 & \end{array}$$

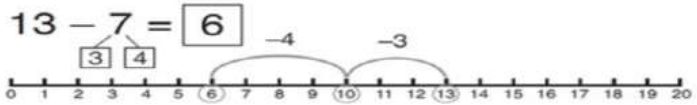
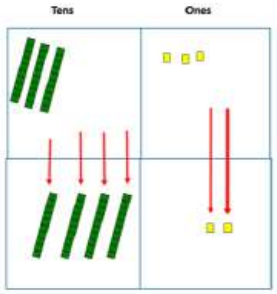
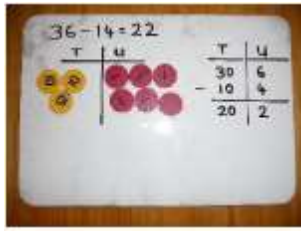
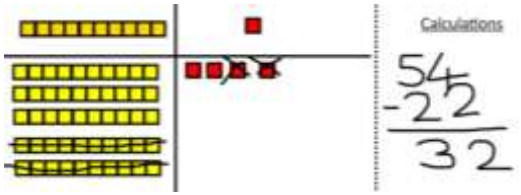
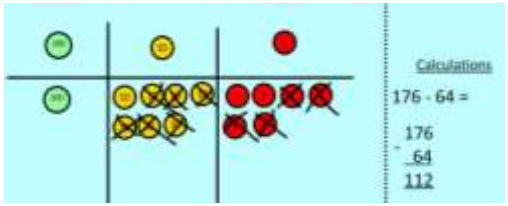
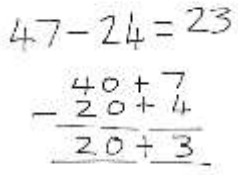
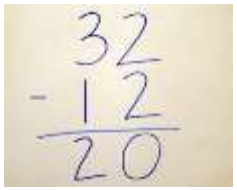
Key Vocabulary: **Add, and, count, on, addition, plus, more, sum, total, altogether, increase**

Subtraction

Objective and Strategies	Concrete	Pictorial	Abstract
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.

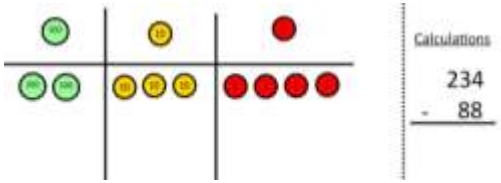
Find the difference	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference.	 Count on to find the difference. Draw bars to find the difference between 2 numbers. 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.
Part Part Whole Model	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =	Use a pictorial representation of objects to show the part part whole model. 	 Move to using numbers within the part whole model.

Make 10	14 – 9 =  Make 14 on the ten frame. 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.	 This will lead to a clear written colu mn subt racti on. 

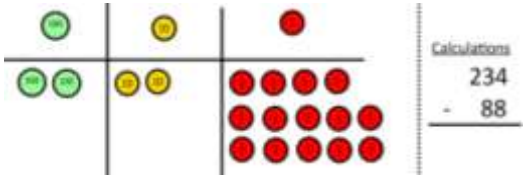
Column method with regrouping

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

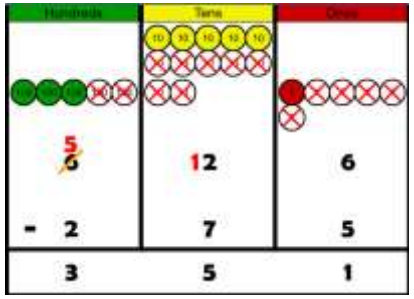


Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.



Now I can subtract my ones.

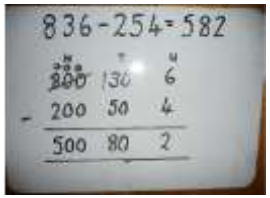
Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens



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.

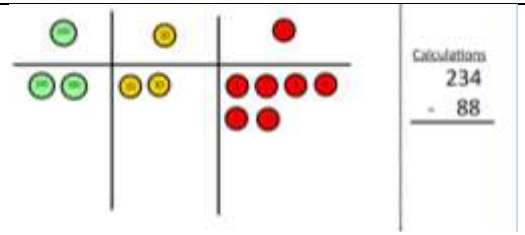
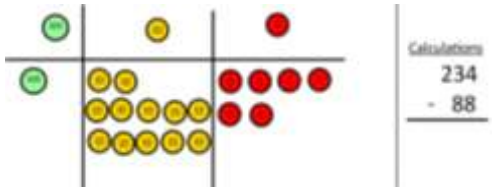
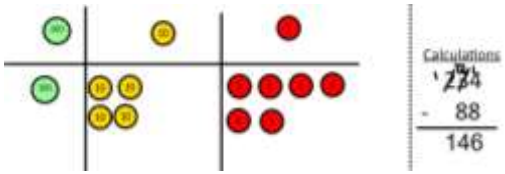
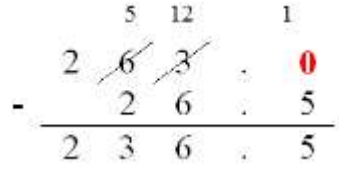
Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.



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.

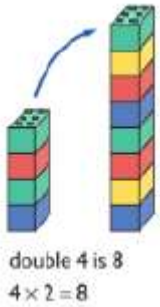
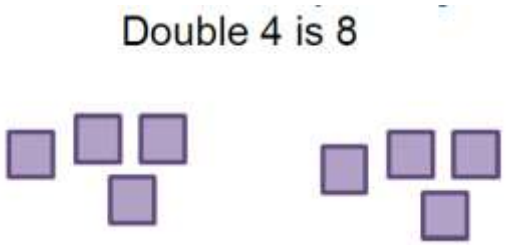
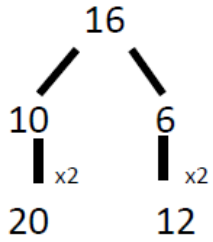
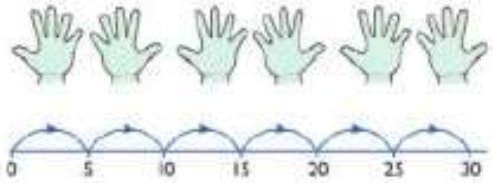
This will lead to an understanding of subtracting

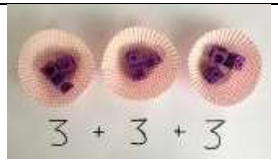
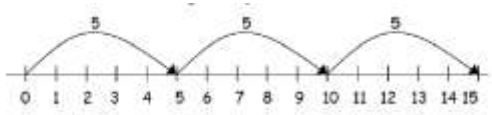
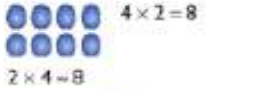
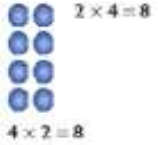
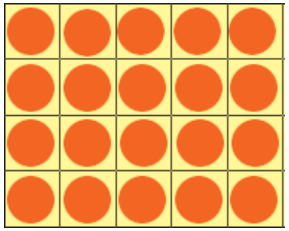
	  Now I can take away eight tens and complete my subtraction  Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.		any number including decimals. 

Key Vocabulary:

Count back, take away, fewer, subtract, less, minus, difference between

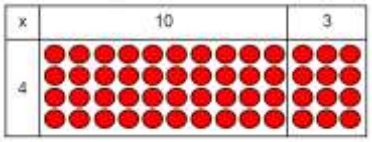
Multiplication

Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	Use practical activities to show how to double a number.  	Draw pictures to show how to double a number.  	 Partition a number and then double each part before recombining it back together.
Counting in multiples	  Count in multiples supported by concrete objects in equal groups.	 Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25 , 30

Repeated addition	   Use different objects to add equal groups.	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. 
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

Grid Method

Show the link with arrays to first introduce the grid method.

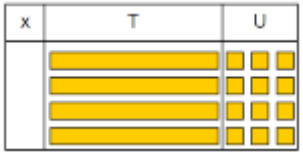


4 rows of 10

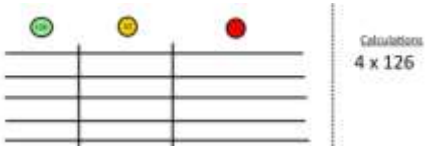
4 rows of 3

Move on to using Base 10 to move towards a more compact method.

4 rows of 13



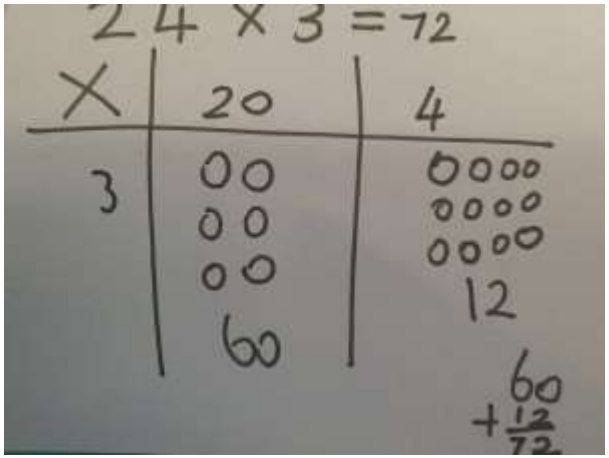
Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.



Fill each row with 126.

Children can represent the work they have done with place value counters in a way that they understand.

They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below.



Start with multiplying by one digit numbers and showing the clear addition alongside the grid.

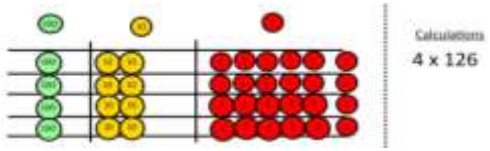
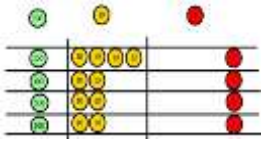
×	30	5
7	210	35

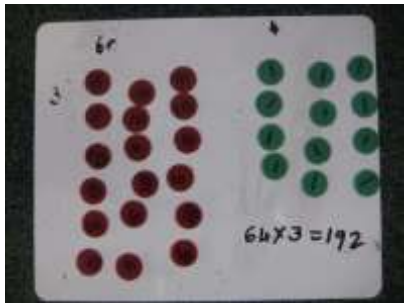
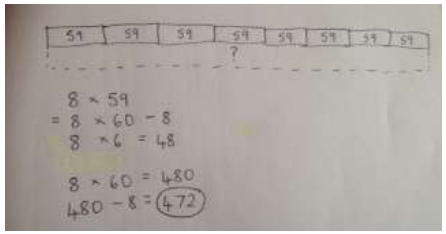
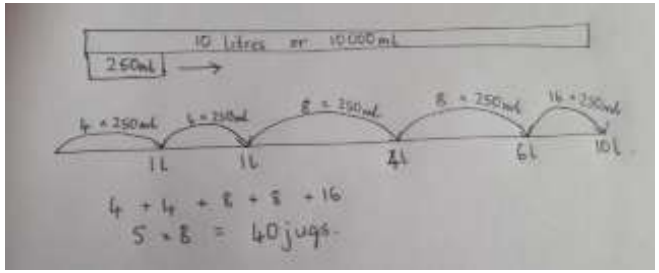
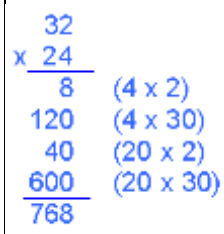
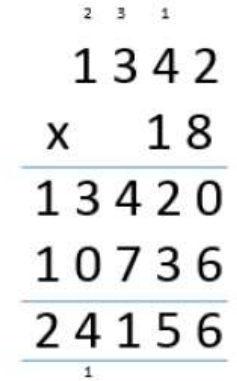
210 + 35 = 245

Moving forward, multiply by a 2 digit number showing the different rows within the grid method.

	10	8
10	100	80
3	30	24

X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

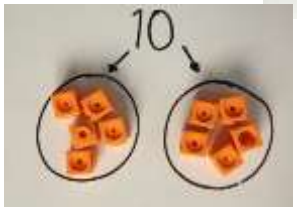
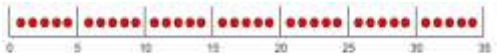
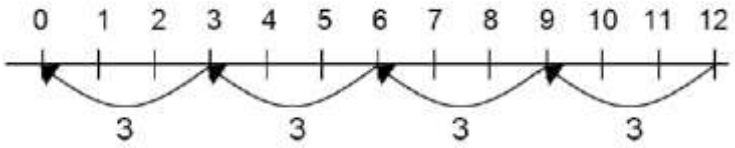
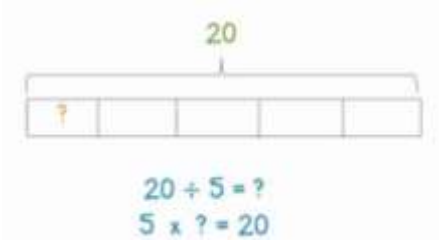
	 Add up each column, starting with the ones making any exchanges needed.   Then you have your answer.		

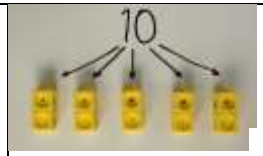
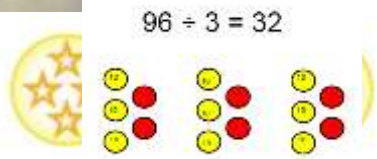
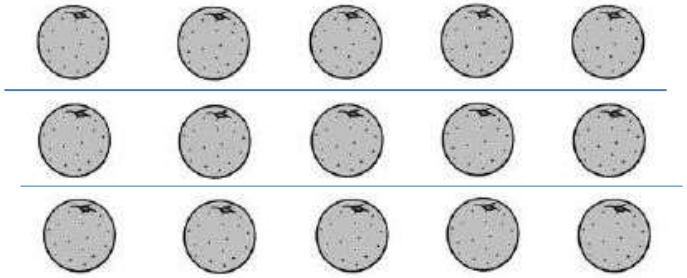
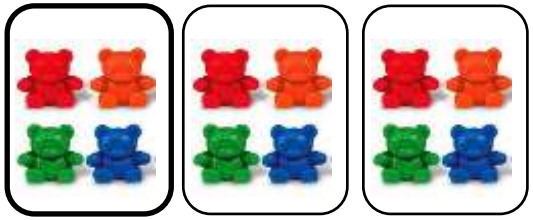
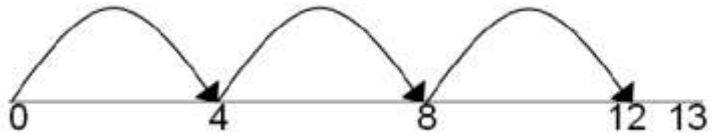
Column multiplication	Children can continue to be supported by place value counters at the stage of multiplication.  It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.	Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.   	Start with long multiplication, reminding 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.   

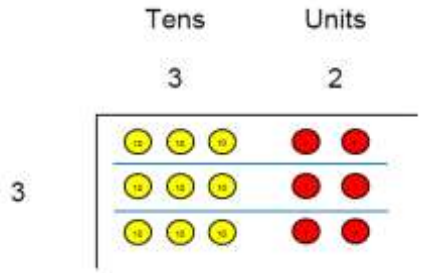
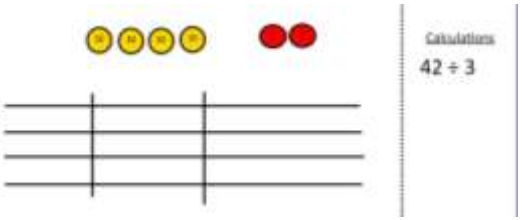
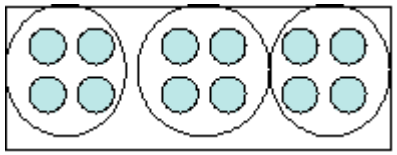
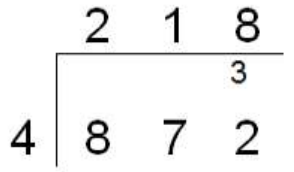
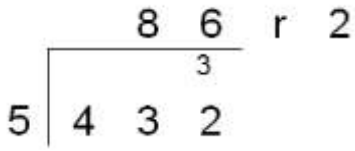
			This moves to the more compact method.

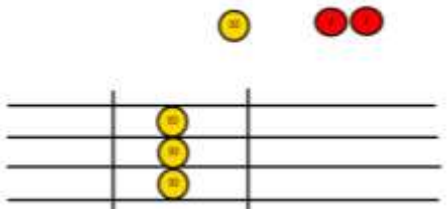
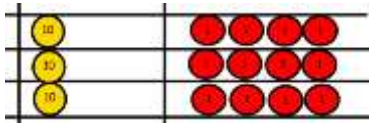
Key Vocabulary: **Groups off, product**

Division

Objective and Strategies	Concrete	Pictorial	Abstract
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 ÷ 2 = 4	Share 9 buns between three people. 9 ÷ 3 = 3
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding. 	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group. 	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

	 		
Division within arrays	 Link division to multiplication by creating an array and thinking about the 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. and  Draw dots group them to	Complete written divisions and show the remainder using r. 

		divide an amount and clearly show a remainder.	
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.	Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.  Encourage them to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainder.  Move onto divisions with a remainder. 

	 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.		Finally move into decimal places to divide the total accurately. 1 4 . 6 16 21 3 5 | 5 1 1 . 0

Written by Angela Hughes April 2016

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