Calculation Policy

A guide for teachers and parents/carers

January 2017

'Mathematics is a creative and highly inter-connected discipline essential to everyday life. A high-quality mathematics education provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject' **- National Curriculum, 2014**

Introduction

Our school has adopted the White Rose Hub's calculation document, who are leaders in the field of Mastery in Mathematics. We adapted the policy to match with our school's approach.

This policy is a statement of the aims, principles and strategies for teaching and learning of calculation strategies in Mathematics. It is designed to help teachers and staff at Maplewell Hall Scholl ensure that calculation is taught consistently across the school and to aid them in helping children who may need extra support or challenges.

This policy is also designed to help parents, carers and other family members support children's learning by providing an explanation of the methods used in our school.

The policy is set out in subjects, addition, subtraction, multiplication and division. Within each specific area there is a progression of skills, knowledge and layout for written methods. The calculation strategies which will be used will reflect this ideology – moving from concrete to pictorial and then abstract recording leading to more formal written methods. Mental methods and strategies will work in partnership with these methods.

Variety of mental calculation methods will be taught and that recall of facts will be taught in school and tested regularly. The progression of mental methods and expectations will comply with the New National Curriculum Statements from July 2014.

At Maplewell it is important that staff always use correct mathematical language and encourage this from every pupil. This will take place in class discussions as well as through oral and written feedback, next steps and target setting.

The basis of our maths calculation policy is that written methods are complementary to mental methods and should not be seen as separate from them. Children should use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence.

This document identifies progression in calculation strategies rather than specifying which method should be taught in a particular year group.

According to Mastery in Mathematics, children should not be made to go onto the next stage of their development if they are not ready and they are not confident. This will leads to misconceptions and poor mathematical foundations and eventually, in later years, pupils will not be able to make the required progress.

Eventually we aim to enable pupils to make informed choices about the methods they use both mental and written that are the most efficient and this includes recognised compact methods.

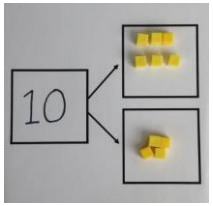
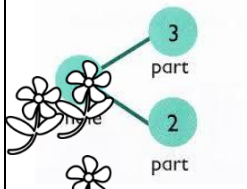
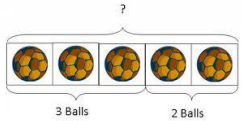
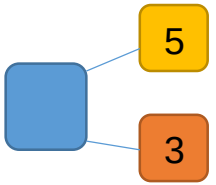
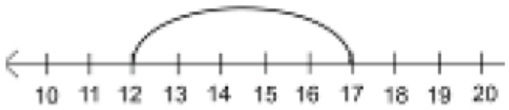
Developmental Aims:

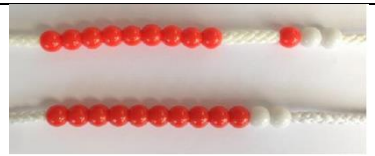
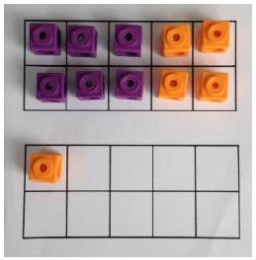
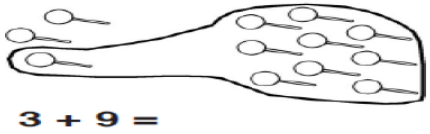
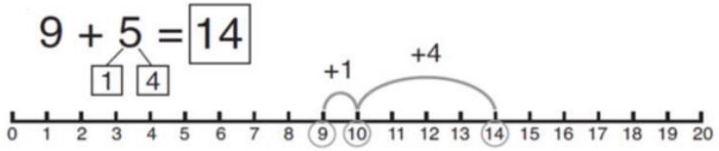
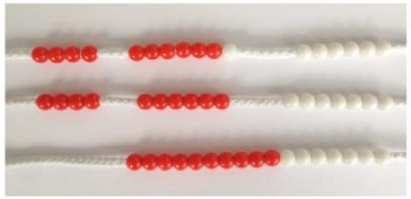
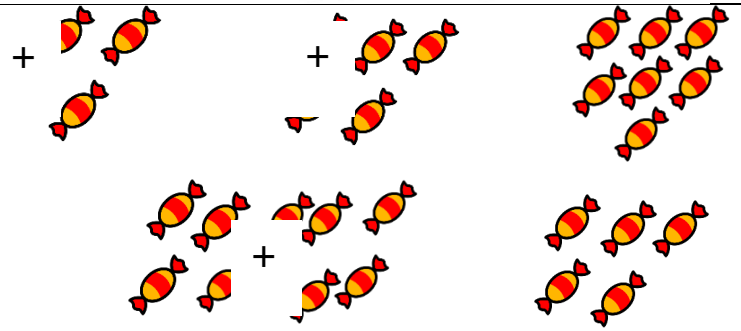
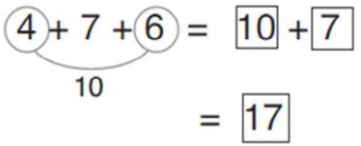
- To ensure consistency and progression in our approach to calculation and enable a smooth transition between year groups.
- As children begin to understand the underlying ideas they develop ways of recording to support their thinking and calculation methods, use particular methods that apply to special cases.
- To enable children to learn to interpret and use the signs and symbols.
- As children acquire secure mental methods of calculation and one efficient written method of calculation for addition, subtraction, multiplication and division which they know they can rely on when mental methods are not appropriate.
- To ensure that children can use these methods accurately with confidence and understanding.
- At whatever stage in their learning, and whatever method is being used, children's methods of calculating will be underpinned by a secure and appropriate knowledge of number facts, along with the mental skills that are needed to carry out the process and judge if it was successful.

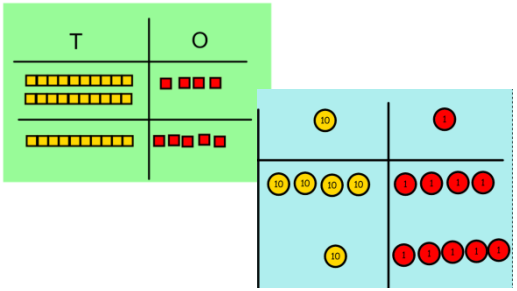
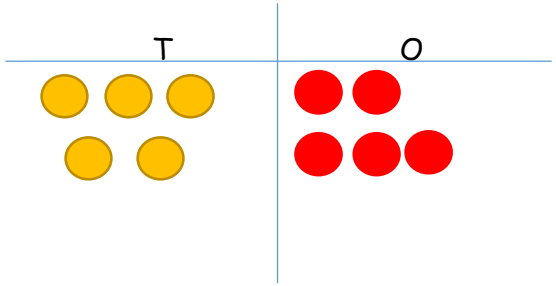
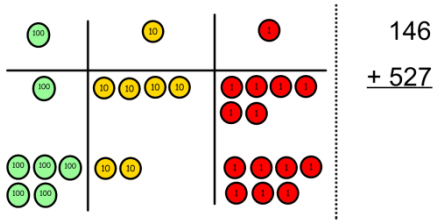
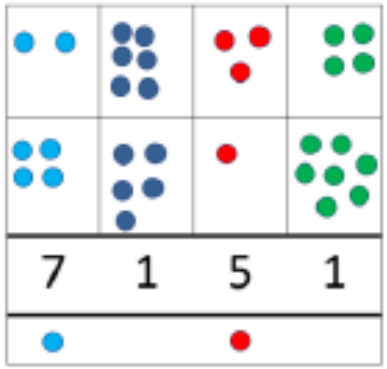
- To ensure that pupils are competent in fluency, reasoning and problem solving and can make informed and appropriate choices about the methods they wish to use (mental or written) to solve mathematical problems efficiently and effectively.

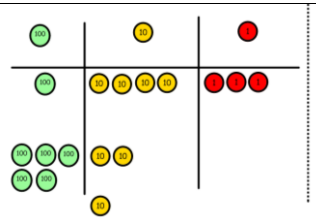
Progression in Calculations

Addition

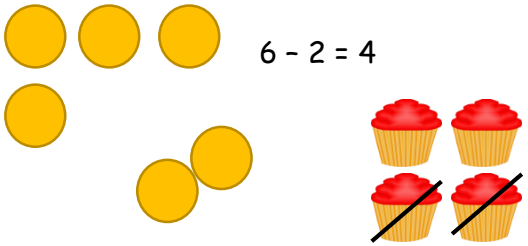
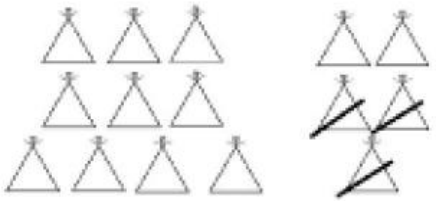
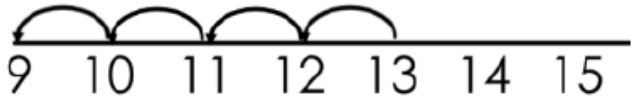
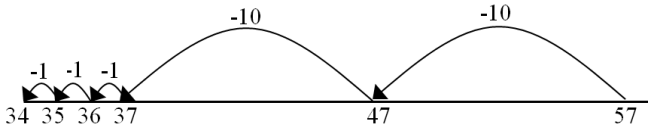
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part- whole model	   Use cubes to add two numbers together as a group or in a bar. 	  Use pictures to add two numbers together as a group or in a bar. 	4 + 3 = 7 10= 6 + 4  Use the part-part whole diagram as shown 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	12 + 5 = 17 	5 + 12 = 17

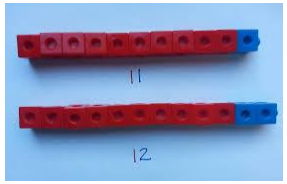
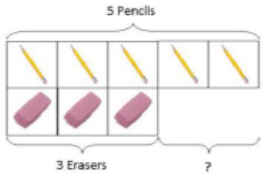
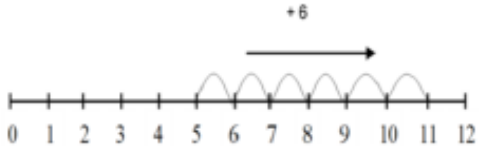
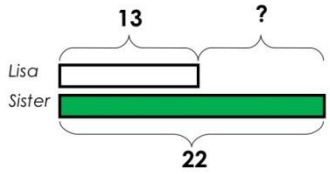
	smaller number 1 by 1 to find the answer.	Start at the larger number on the number line and count on in ones or in one jump to find the answer.	Place the larger number in your head and count on the smaller number to find your answer.
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10.	 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. 		 Combine the two numbers that make 10 and then add on the remainder.

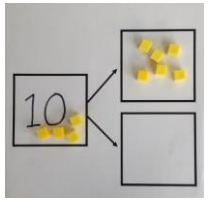
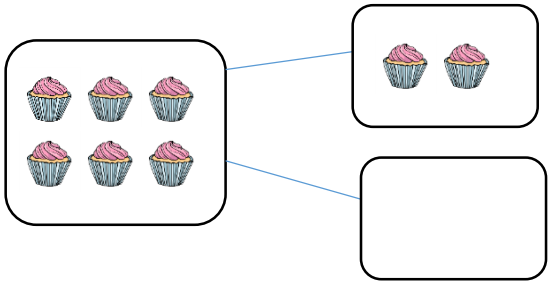
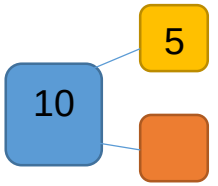
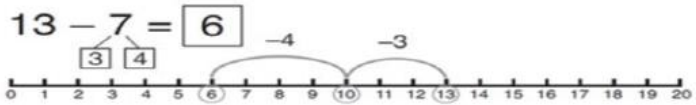
	Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	Add together three groups of objects. Draw a picture to recombine the groups to make 10.	
Column method- no regrouping	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first 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
Column method- regrouping	Make both numbers on a place value grid.  146 + 527 Add up the units and exchange 10 ones for one 10.	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. 20 + 5 40 + 8 60 + 13 = 73

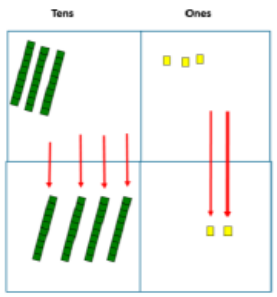
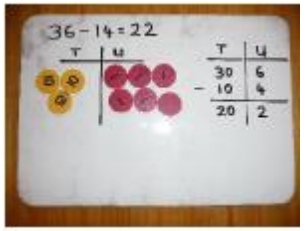
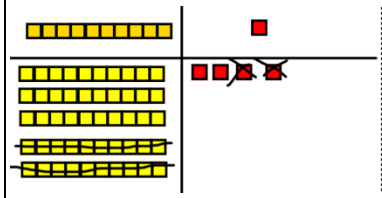
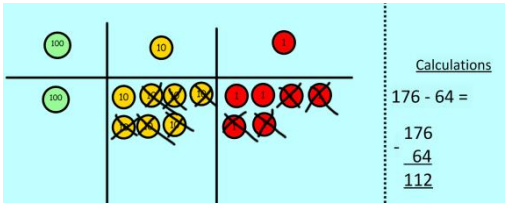
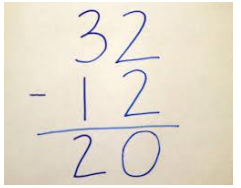
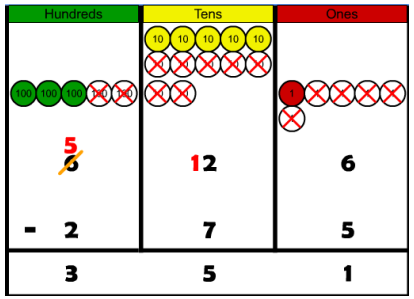
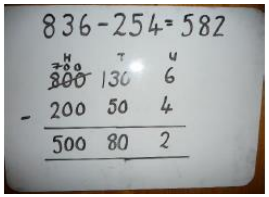
	 146 + 527 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.		536 + 85 621 1 1 As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 72.8 + 54.6 127.4 1 1 £ 2 3 . 5 9 + £ 7 . 5 5 £ 3 1 . 1 4 1 1 1 2 3 . 3 6 1 9 . 0 8 0 5 9 . 7 7 0 + 1 . 3 0 0 9 3 . 5 1 1 2 1 2

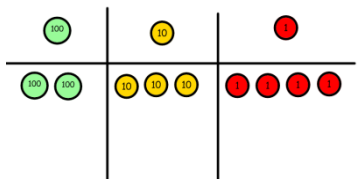
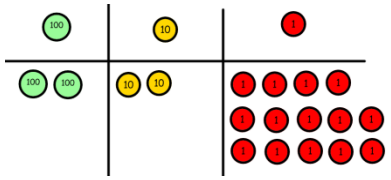
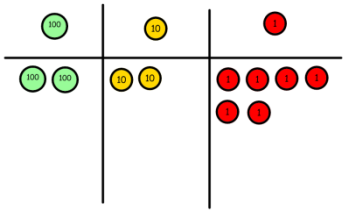
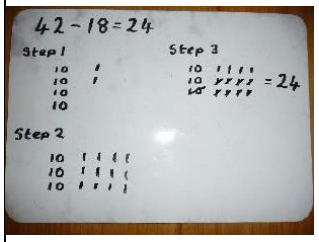
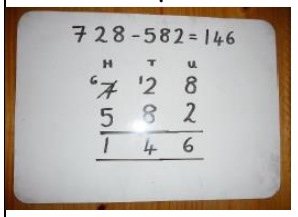
Subtraction

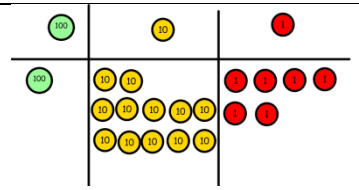
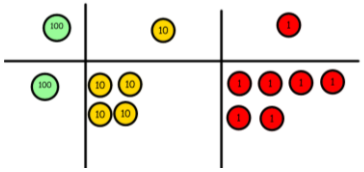
Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away.  6 – 2 = 4	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	18 -3= 15 8 – 2 = 6
Counting back	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones.  13 – 4	Count back on a number line or number track  9 10 11 12 13 14 15 Start at the bigger number and count back the smaller number showing the jumps on the number line.  -10 -10 -1 -1 -1 34 35 36 37 47 57	Put 13 in your head, count back 4. What number are you at? Use your fingers to help.

	Use counters and move them away from the group as you take them away counting backwards as you go. 	This can progress all the way to counting back using two 2 digit numbers.	
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.

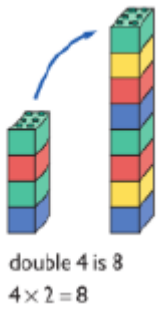
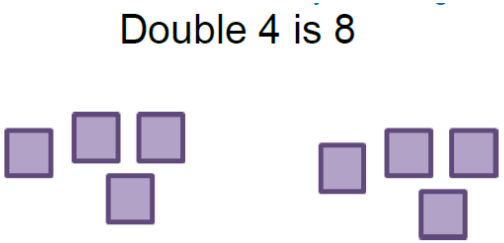
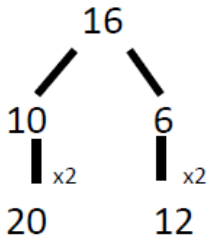
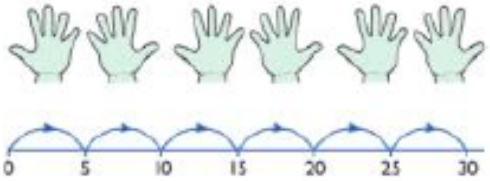
Part Part Whole Model	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =	Use a pictorial representation of objects to show the part part whole model. 	 Move to using numbers 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?

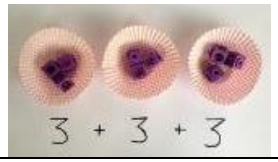
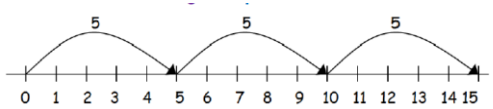
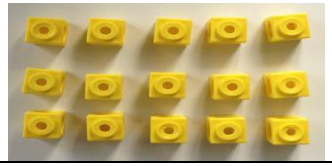
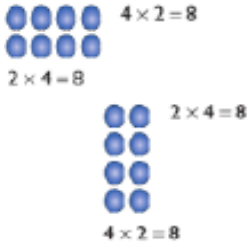
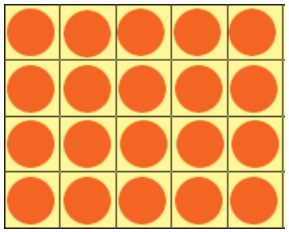
Column method without regrouping	 Use Base 10 to make the bigger number then take the smaller number away. Show how you partition numbers to subtract. Again make the larger number first. 	  Draw the Base 10 or place value counters alongside the written calculation to help to show working.	47-24=23 40+7 -20+4 20+3 This will lead to a clear  written column subtraction.
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		

	 Calculations 234 - 88 Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.  Calculations 234 - 88 Now I can subtract my ones.  Calculations 234 - 88 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.

	 Calculations 234 - 88 Now I can take away eight tens and complete my subtraction  Calculations 234 - 88 146 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.		5 12 1 2 ~~6~~ ~~3~~ . 0 - 2 6 . 5 2 3 6 . 5

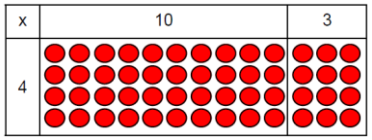
Multiplication

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.  2 + 2 + 2 + 2 + 2 = 10
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

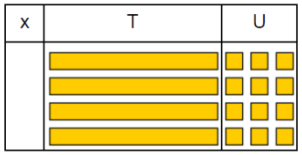
Grid Method

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



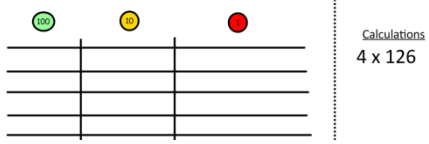
4 rows of 10
4 rows of 3

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

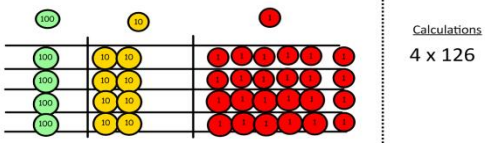


4 rows of 13

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.

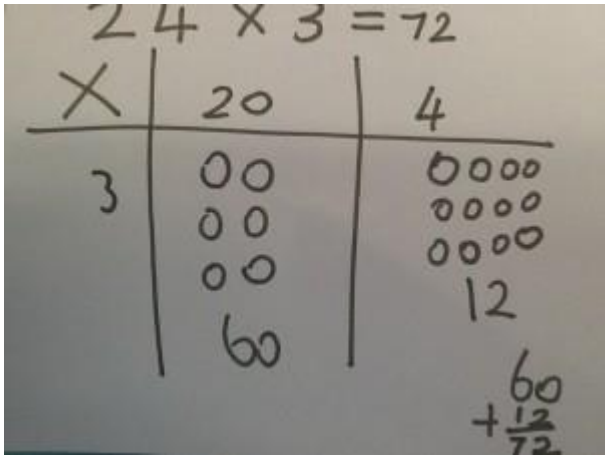


Fill each row with 126.



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.

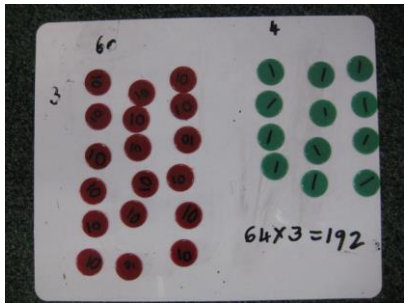
×	30	5
7	210	35

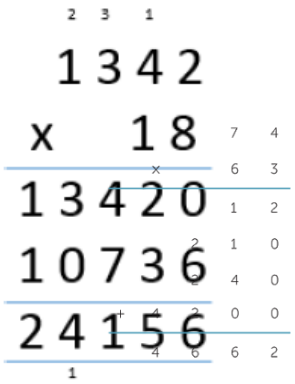
210 + 35 = 245

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

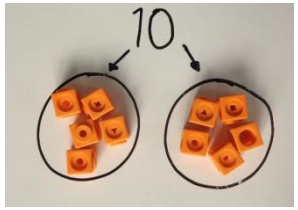
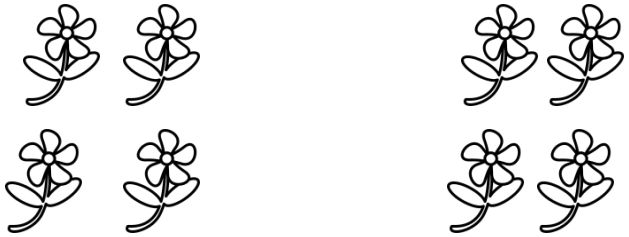
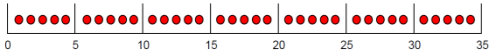
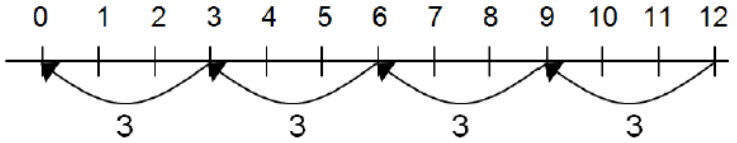
	10	8
10	100	80
3	30	24

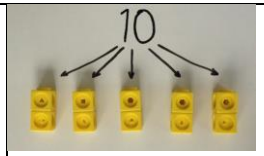
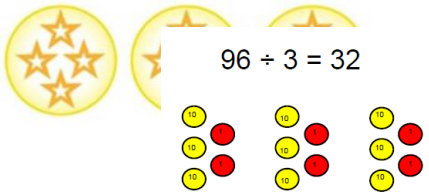
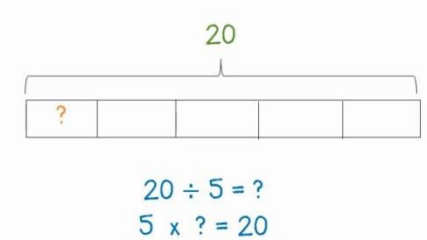
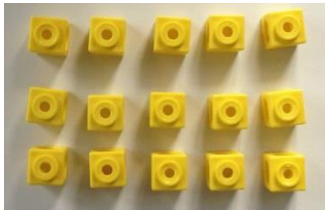
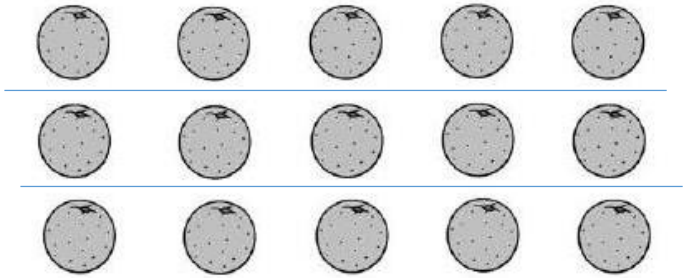
X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

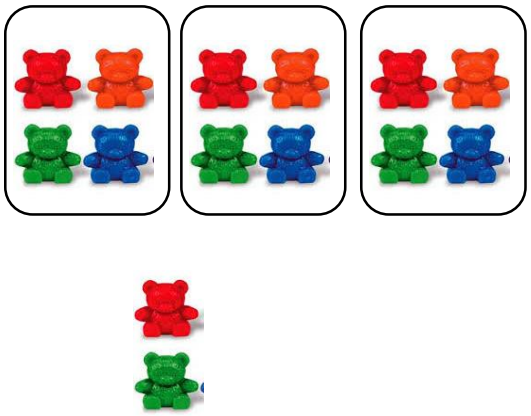
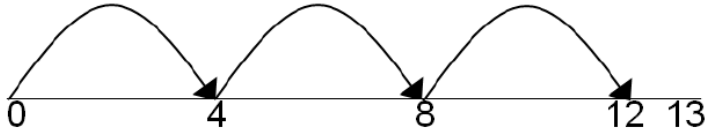
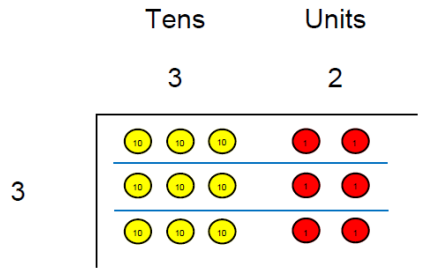
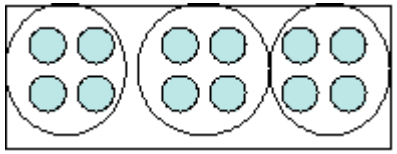
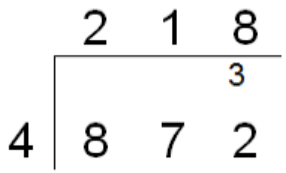
	Add up each column, starting with the ones making any exchanges needed.  Then you have your answer.		
Column multiplication	Children can continue to be supported by place value counters at the stage of multiplication.  It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.	Multiplication by partitioning. Example: 42x8= 40 x 8 = 320 2 x 8 = 16 320+16 = 336	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. 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768

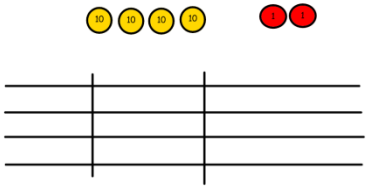
			This moves to the more compact method. 

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. 	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

	 	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. 	
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. Draw dots and group them to divide an amount and clearly show a remainder.  	Complete written divisions and show the remainder using r. 
Short division	 Use place value counters to divide using the bus stop method alongside	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. 

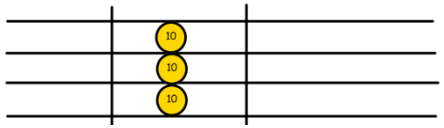


Calculations

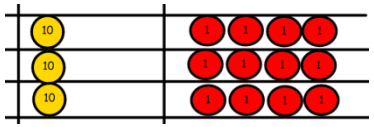
42 ÷ 3

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.

Move onto divisions with a remainder.

$$\begin{array}{r} 8\ 6\ r\ 2 \\ 3 \\ \hline 5\ |\ 4\ 3\ 2 \end{array}$$

Finally move into decimal places to divide the total accurately.

$$\begin{array}{r} 1\ 4\ .\ 6 \\ 16\quad 21 \\ \hline 3\ 5\ |\ 5\ 1\ 1\ .\ 0 \end{array}$$

References

1. Maths Progression in Calculation Policy
   https://drive.google.com/drive/folders/0B4zK1m7abbjEYzNDcG0weFM1aHc
2. National curriculum in England: mathematics programmes of study
   https://www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study/national-curriculum-in-england-mathematics-programmes-of-study
3. Calculation Guidance for primary schools – NCETM
   https://www.ncetm.org.uk/resources/48070