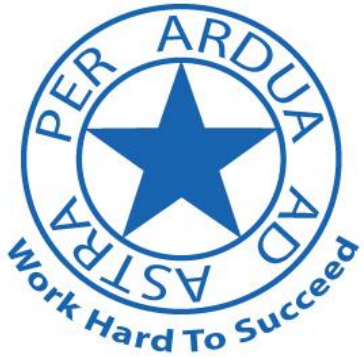
Garden Suburb Junior School



Mathematics

Calculations Policy

Rationale:

At Garden Suburb Junior School, we aim to inspire all children to achieve their full potential. In mathematics this means delivering a curriculum that is fully inclusive of all children and one that strives for the mastery of concepts by all learners. We aim to develop children's understanding of concepts using concrete and pictorial learning whilst enabling our children to also practise formal written methods. We encourage critical thought and communication between children in order to deepen understanding and foster collaboration. We provide opportunities to apply mathematical skills to different contexts with reasoning and problem solving at the heart of our curriculum.

Planning:

Planning begins with the high expectation that every child can achieve. A thorough understanding of the children's needs together with rigorous and effective assessments enable teachers to plan effective units. Medium planning is created through combining the Collins scheme and White Rose Maths. Our Collins units of work are grouped in line with the mastery approach of the White Rose Maths yearly overviews. This ensures a mastery approach and rigorous coverage of the National Curriculum. The yearly maths overviews for each year group can be found on our website. Within short term planning, clear small steps of progression between units build on children's learning, leading to a secure grasp of concepts. Activities and tasks are planned to meet the needs of all the children in the class. Lessons are differentiated – extending children by deepening their understanding rather than accelerating them through the curriculum. Class teachers also regularly plan for opportunities for children to apply their maths skills to different problems within maths lessons, in turn allowing children to revisit, practise and consolidate different areas of Mathematics.

Teaching:

Our maths learning builds from a concrete understanding of concepts where children are manipulating objects. When children are able to see concepts this way, they then move to understanding the same concepts represented pictorially. After this, children are then ready for abstract representation before being able to apply their knowledge to different situations. Throughout their learning, our children are encouraged to communicate their understanding of Maths so that it clarifies their thoughts. We build in an element of choice into our maths lessons to encourage independence and reflection and children choose the task which they think will suitably challenge them, with guidance from the teacher, where necessary. We believe that children's mental maths is of great importance and we place a particular focus on times tables fluency both at school and through homework activities.

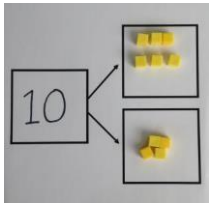
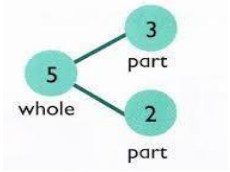
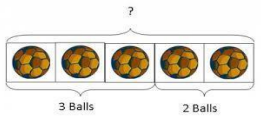
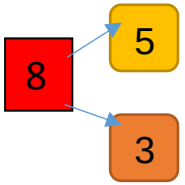
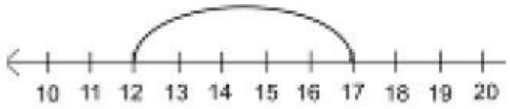
Assessment:

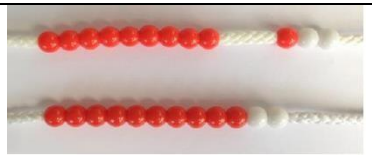
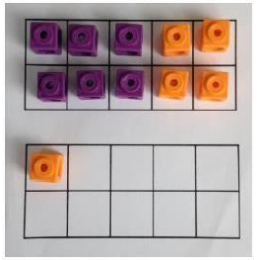
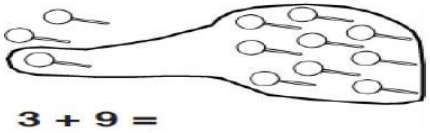
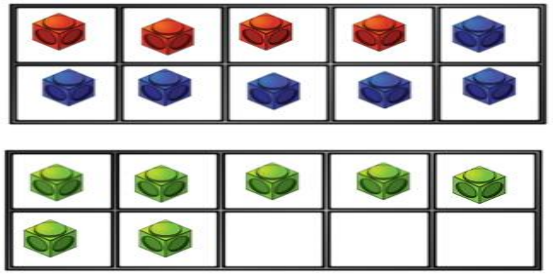
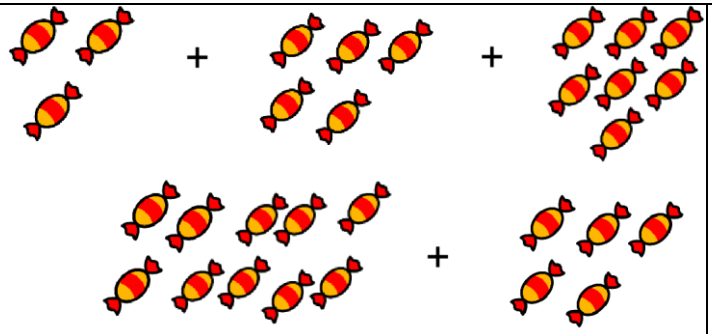
Assessment for learning occurs throughout our maths lessons, enabling teachers/learning support assistants to adapt their teaching/input to meet the children's needs. Pupils work is marked in line with our Marking Policy and models both how corrections should be made, giving children a chance to learn from their misconceptions as well as providing regular opportunities to stretch our children's understanding of concepts further. Assessment of attainment and progress is ongoing and is both formative and summative. Teachers use a tracking tool and this allows them to assess children's progress in Mathematics, gathering evidence over the course of the year. Teachers use this information to inform planning for groups and individual pupils.

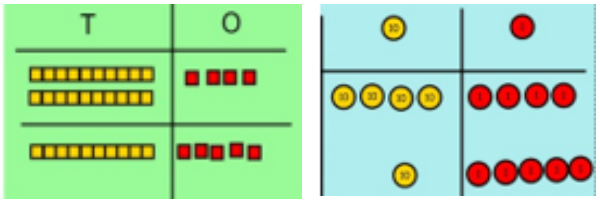
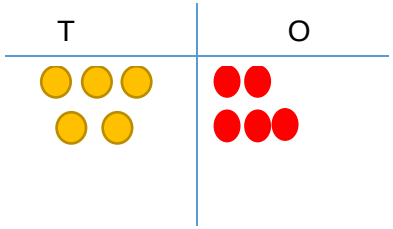
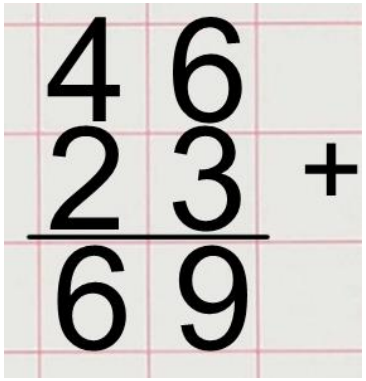
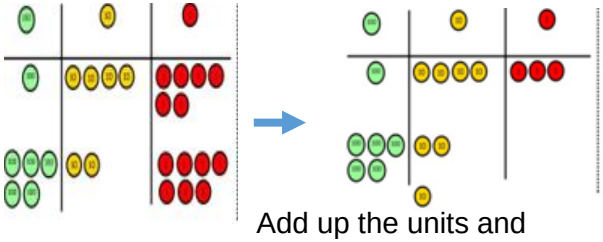
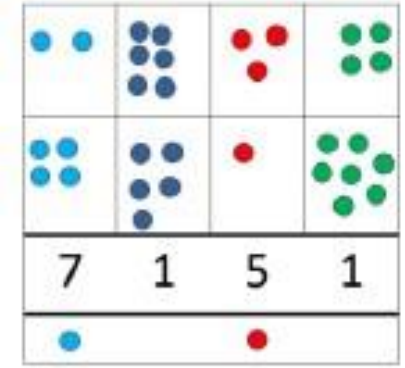
The structure of this document:

The document is divided into the four operations: addition, subtraction, multiplication and division. Within each section, the concrete, pictorial and abstract progressions of learning for each mathematical concept that we use at Garden Suburb Junior School are explained.

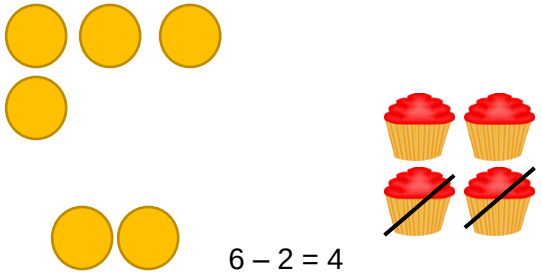
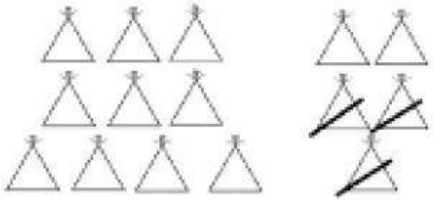
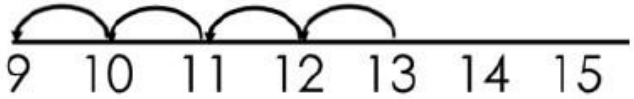
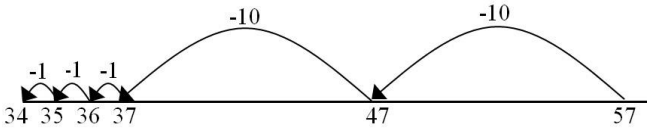
Progression in Calculations: Addition

Objective and Strategies	Concrete	Pictorial	Abstract
Using part-whole models to partition numbers.	   Use cubes to add two or more numbers together as a group, part – whole model or in a bar model. 	   3 Balls 2 Balls 8 1	4 + 3 = 7 10= 6 + 4 
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.

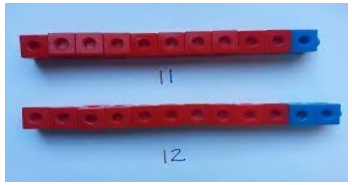
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10.	 3 + 9 = Use pictures or a number line. Regroup or partition the smaller number to make 10. 9 + 5 = 14 1 4 +1 +4 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	7 + 4= 11 If I am at seven, how 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.	4 + 7 + 6 = 10 + 7 10 = 17 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 dienes blocks first before moving onto place value counters.  	After practically using the dienes 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. 146 + 527  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 dienes blocks to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals and money place value counters can be used to support learning.	Children can draw a pictorial 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 1 1 536 + 85 621 As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 1 1 1 £23.59 + £7.55 £31.14 1 1 72.8 +54.6 127.4 2 1 2 2 3 . 3 6 1 9 . 0 8 0 5 9 . 7 7 0 + 1 . 3 0 0 9 3 . 5 1 1

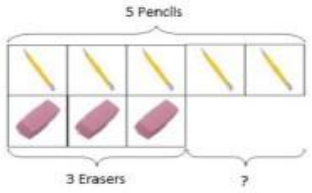
Progression in Calculations: Subtraction

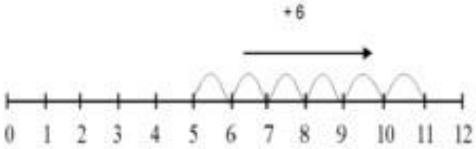
Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away.  6 – 2 = 4	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	18 – 3 = 15 8 – 2 = 6
Counting back	Make the larger number in your subtraction. 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.  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.  -1 -1 -1 -10 -10 34 35 36 37 47 57 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.

<table>
<tr>
<td>Find the difference</td>
<td>Compare amounts and objects to find the difference.

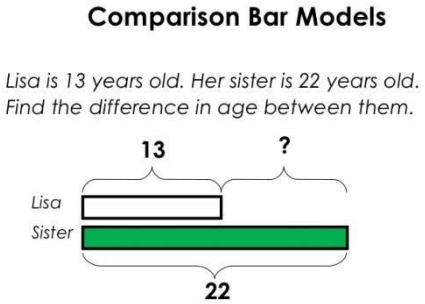
Use cubes to build towers or make bars to find the difference.

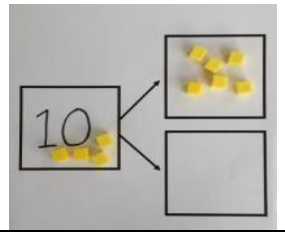
Use basic bar models with items to find the difference.</td>
<td> 

Count on to find the difference.

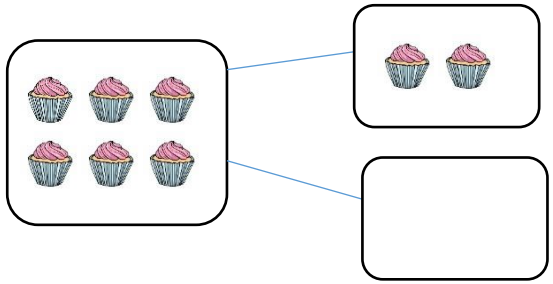
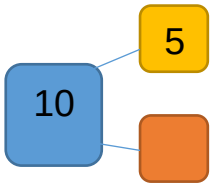
Draw bars to find the difference between 2 numbers.

 
</td>
<td>Hannah has 23 pencils; Helen has 15 pencils. Find the difference between the number of pencils.</td>
</tr>
<tr>
<td>Part Whole Model</td>
<td>Link to addition- use the part whole model to help explain the inverse between addition and subtraction.

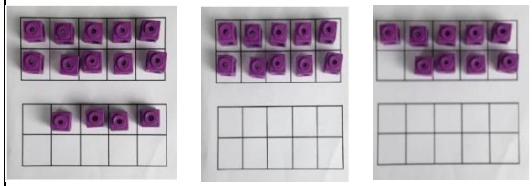
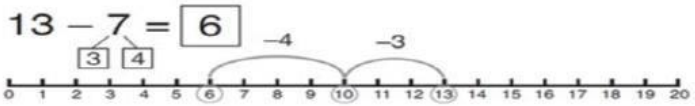
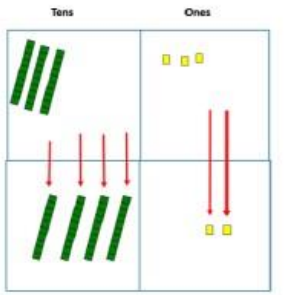
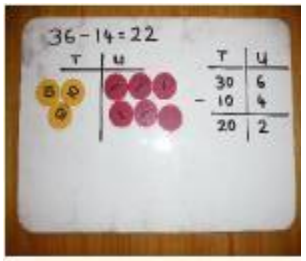
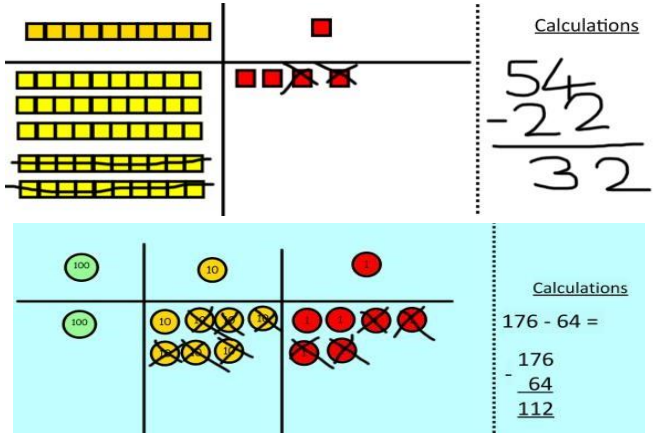
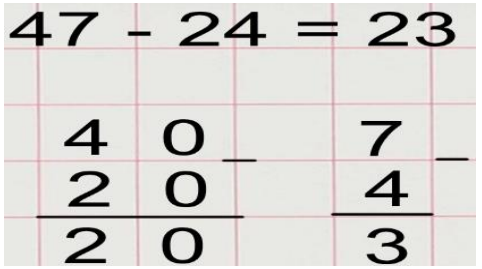
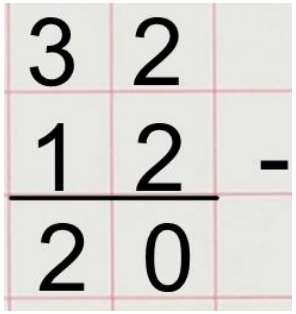
If 10 is the whole and 6 is one of the parts. What is the other part?

10 - 6 =</td>
<td>Use a pictorial representation of objects to show the part whole model.

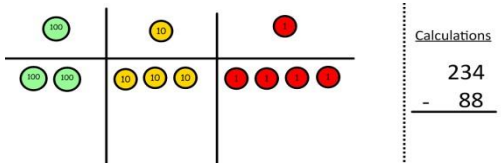
  </td>
<td> 

Move to using numbers within the part whole model.</td>
</tr>
</table>

Make 10	14 – 5 = 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.	36 – 8 = 28 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 dienes to make the bigger number then take the smaller number away.  Show how you partition numbers to subtract using place value counters. Again make the larger number first.	 Draw the dienes or place value counters alongside the written calculation to help to show working. Cross out the dienes and counters that are subtracted.	 Firstly, use partitioning to subtract the different place values. This will lead to a clear written column subtraction. 

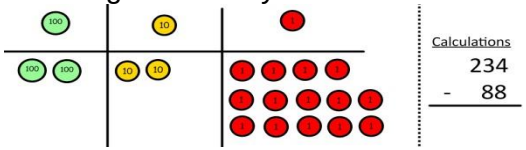
Column method with regrouping

Use dienes before moving on to place value counters. Start with one exchange only.
Make the larger number with the place value counters



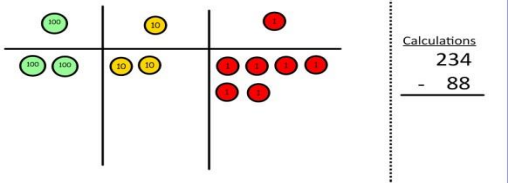
Calculations
234
- 88

Can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.



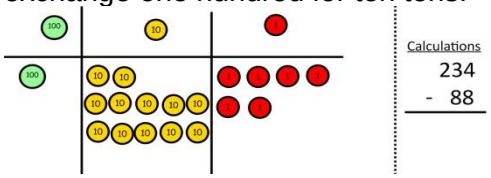
Calculations
234
- 88

Now I can subtract my ones.



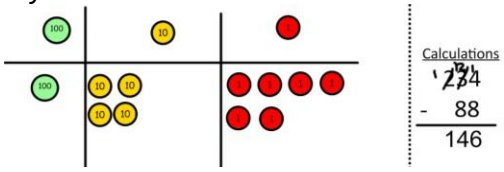
Calculations
234
- 88

Can I take away 8 tens easily? I need to exchange one hundred for ten tens.



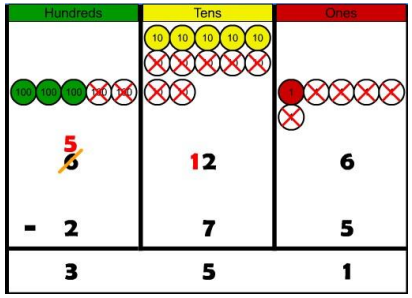
Calculations
234
- 88

Now I can take away eight tens and complete my subtraction

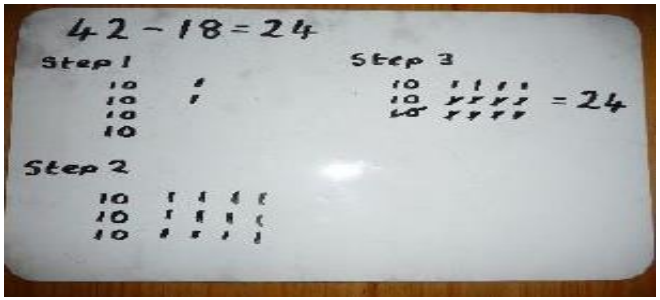


Calculations
~~234~~
- 88
146

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.

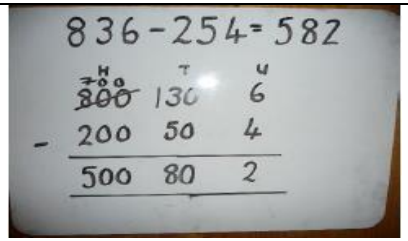


Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.

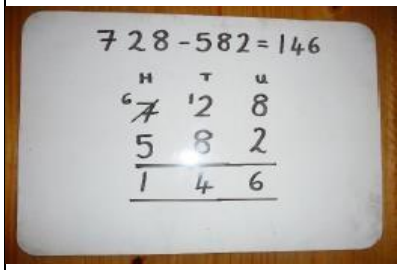


When confident, children can find their own way to record the exchange/regrouping.

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.

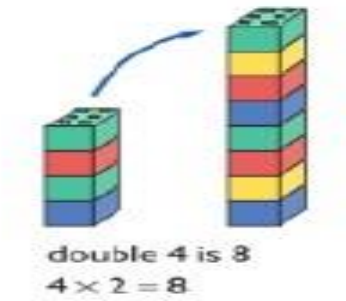
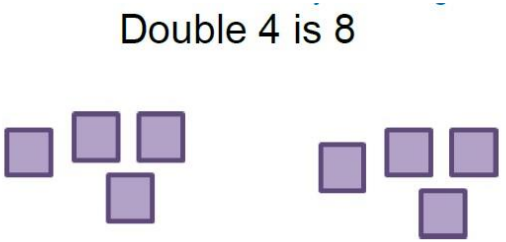
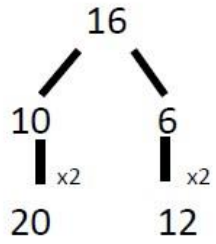
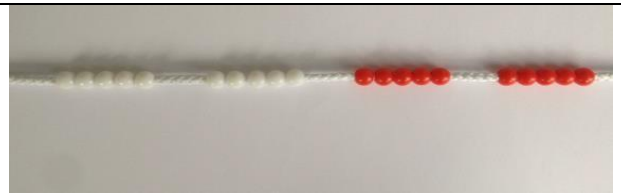
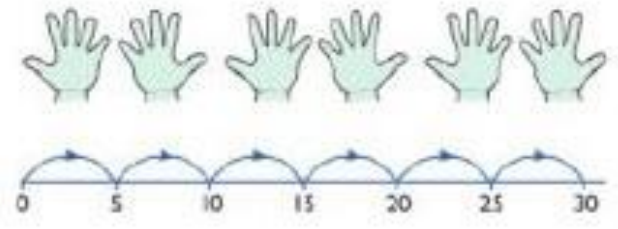


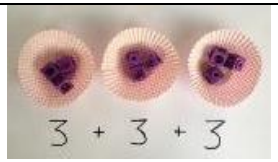
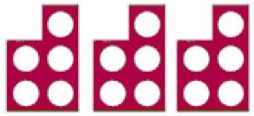
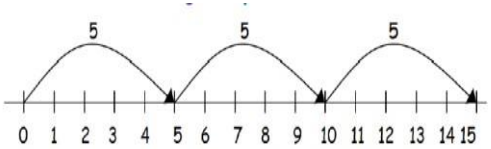
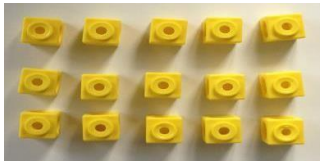
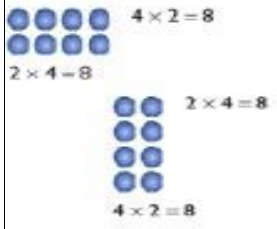
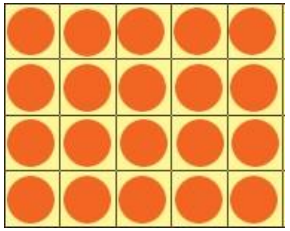
Moving forward the children use a more compact method.

This will lead to an understanding of subtracting any number including decimals.

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

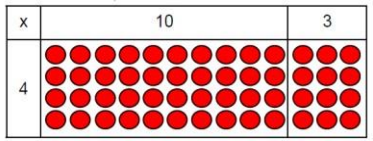
Progression in Calculations: Multiplication

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 when 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

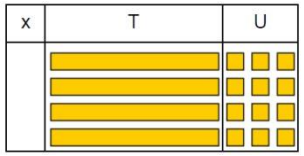
Repeated addition	   Use different objects to add equal groups.	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?  2 add 2 add 2 equals 6  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures.  2 + 2 + 2 + 2 + 2 = 10
Arrays- showing commutative multiplication	Create arrays using counters or cubes to show multiplication sentences.  	 Draw arrays in different rotations. to find **commutative** multiplication sentences.  Link arrays to the 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.

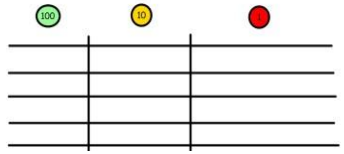


4 rows of 10 4 rows of 3



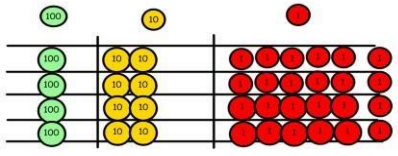
Move on to using dienes to move towards a more compact method.
4 rows of 13

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.



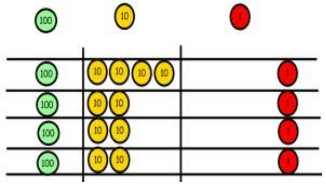
Calculations
4 x 126

Fill each row with 126.



Calculations
4 x 126

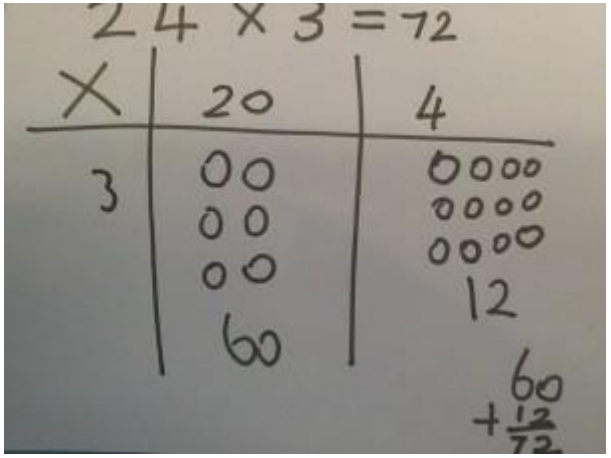
Add up each column, starting with the ones making any exchanges needed.



Then you have your answer.

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.

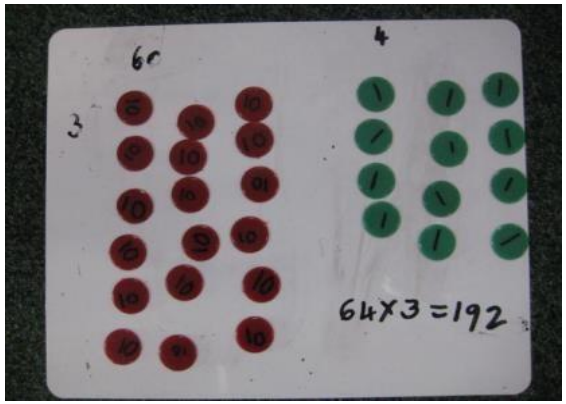
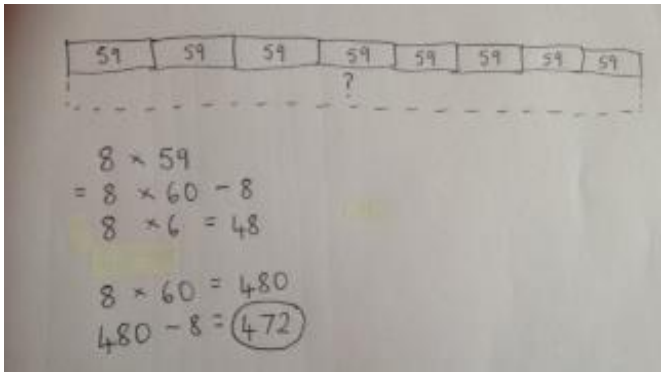
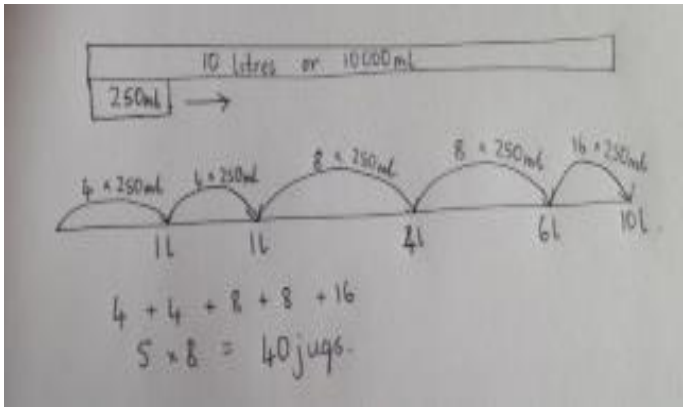
×	30	5
7	210	35

210 + 35 = 245

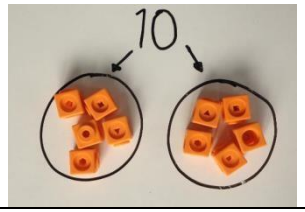
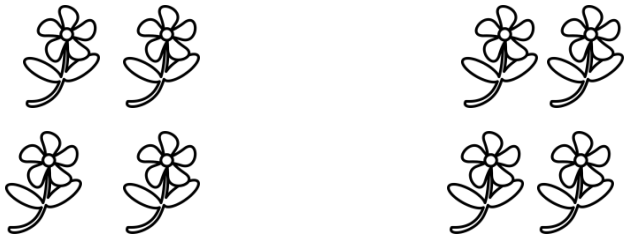
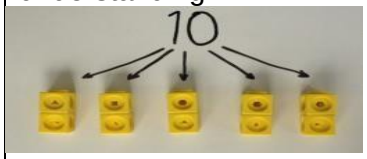
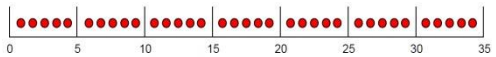
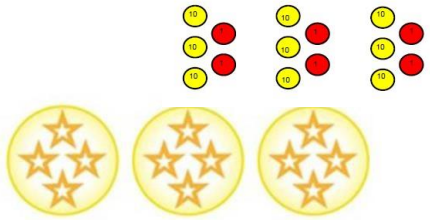
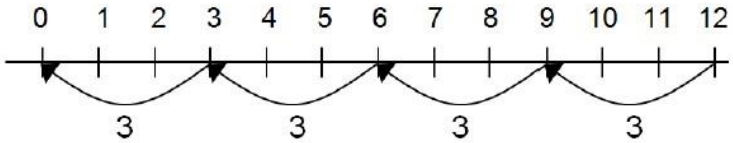
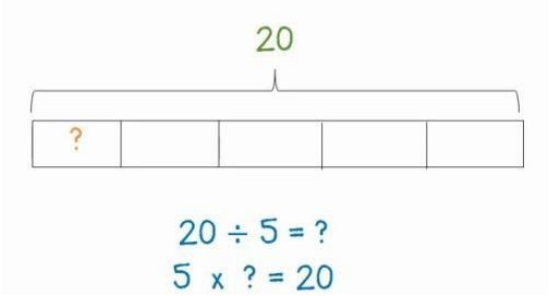
Moving forward, multiply by a 2-digit number showing the different rows within the grid method.

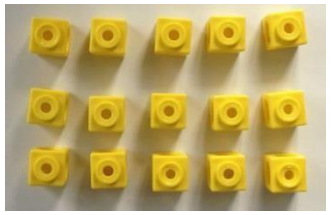
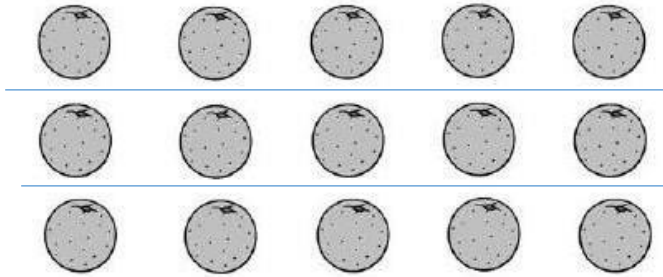
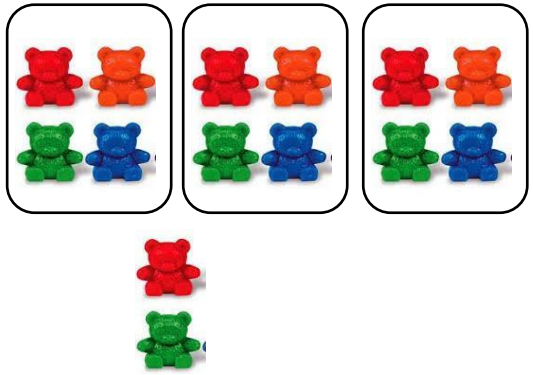
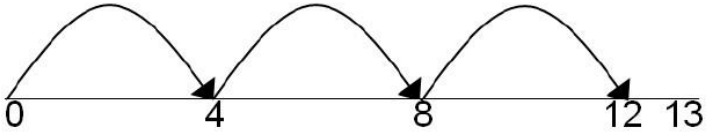
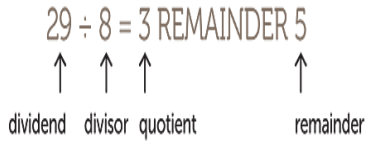
	10	8
10	100	80
3	30	24

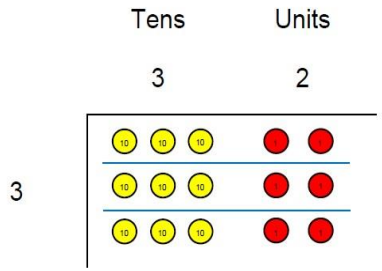
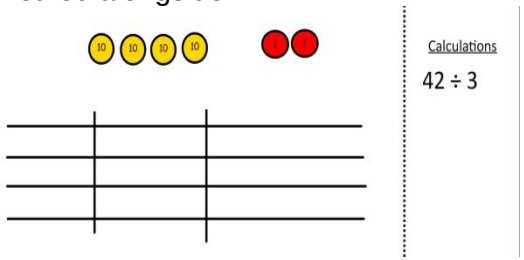
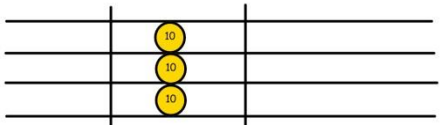
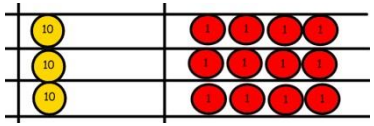
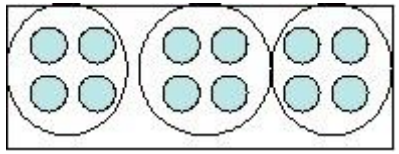
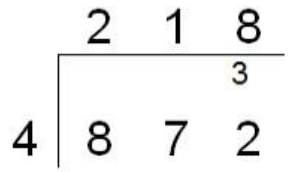
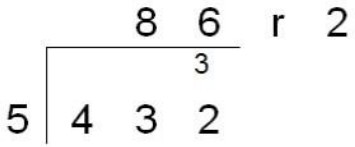
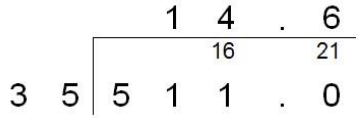
X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

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 (the expanded method). 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768 74 x 63 12 210 240 + 4200 4662 This moves to the more compact method. 2 3 1 1342 x 18 13420 10736 24156 1

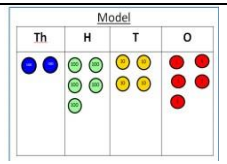
Progression in Calculations: Division

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.  $8 \div 2 = 4$	Share 9 buns between three people. $9 \div 3 = 3$
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.   $96 \div 3 = 32$ 	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Move onto bar modelling. 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. 	$28 \div 7 = 4$ 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 from it. 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. 

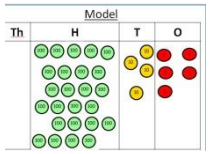
Short division	 Use place value counters to divide using the bus stop method alongside  42 ÷ 3= Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over.   We exchange this ten for ten ones and then share the ones equally among the groups.  We look how much in 1 group so the answer is 14.	Children 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.  Finally move into decimal places to divide the total accurately. Use their knowledge of fractions and decimals to help them convert the remainder as a decimal. 

Long division



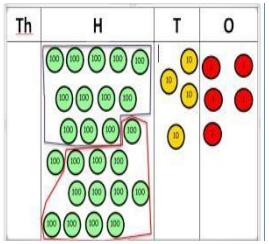
2544 ÷ 12

How many groups of 12 thousands do we have?
(How many times does 12 go into 2?)



Exchange 2 thousand for 20 hundreds.

$$\begin{array}{r} 0 \\ 12\overline{)\,2^{2}544} \end{array}$$

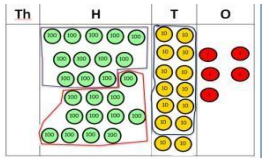


How many groups of 12 are in 25 hundreds?

(How many times does 12 go into 25?)

$$\begin{array}{r} 02 \\ 12\overline{)\,2^{2}544} \\ 24 \\ \hline 1 \end{array}$$

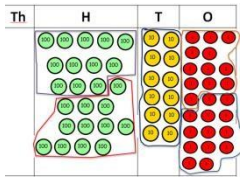
Circle those counters on the place value chart.
We have grouped 24 hundreds so can take them off and we are left with one remainder.



Exchange the one hundred for ten tens so now we have 14 tens.

$$\begin{array}{r} 021 \\ 12\overline{)\,2^{2}5^{1}4^{4}} \\ 24 \\ \hline 14 \\ 12 \\ \hline 2 \end{array}$$

Circle those counters on the place value chart.
How many groups of 12 are in 14?
(How many times does 12 go into 14?)



Exchange the two tens for twenty ones so now we have 24 ones.

How many groups of 12 are in 24?

$$\begin{array}{r} 0212 \\ 12\overline{)\,2^{2}5^{1}4^{4}} \\ 24 \\ \hline 14 \\ 12 \\ \hline 24 \\ 24 \\ \hline 0 \end{array}$$

Circle those counters on the place value chart.
(How many times does 12 go into 24?)

Instead of using physical counters, students can draw the counters and circle the groups on a whiteboard or in their books.

Use this method to explain what is happening and as soon as they have understood what move on to the abstract method as this can be a time consuming process.

$$\begin{array}{r} 0\,3\,1\,8\ r\,5 \\ 20\overline{)\,6\,3\,6\,5} \\ -\,6\,0\downarrow \\ \hline -\,3\,6 \\ \quad 2\,0 \\ \hline -\,1\,6\,5 \\ \quad 1\,6\,0 \\ \hline \qquad 5 \end{array}$$