Introduction

Welcome to the Mawsley Primary School Calculation Policy. This is a working document meant to be used by teachers, teaching assistants, governors, parents and children. The purpose of this document is to outline the stages of progression for written calculation methods in the four number operations. Written methods of calculations are based on mental strategies. Each of the four operations builds on mental skills which provide the foundation for jottings and informal written methods of recording and so a summary of mental skills is included for each operation.

It is really important that the strategies for calculation are supported by lots of models, images and practical apparatus (manipulatives) to reinforce understanding and develop flexibility. Examples of these have been included for each operation. Each strategy goes through a concrete, pictorial and abstract phase and the children should experience all 3 stages in order to develop a sound conceptual understanding. Mathematical vocabulary is also vitally important and language that should be explored is included for each operation.

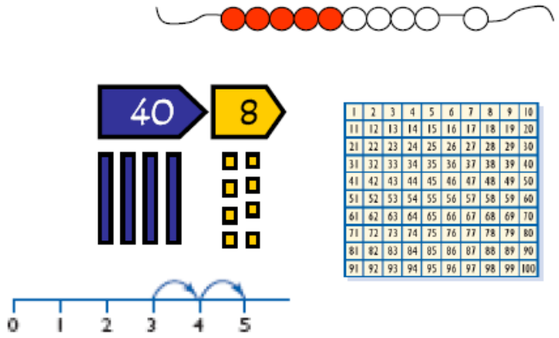
The strategies within this policy have been organised in the order in which the whole staff agreed they should be taught. It is really important that teachers (and parents) take into account current understanding and do not attempt to leap-frog stages so that children have a sound understanding of the mathematics and not just a procedural method for finding an answer. Therefore, calculation algorithms used in each year group will vary depending on the level of understanding the children have obtained. Previous stages may need to be revisited to consolidate understanding when introducing a new strategy.
All children should have, at their level, a reliable method for the four operations which they understand and *can explain.*

There are 2 appendices included within this document. The first is an outline of the stages of understanding that our children in foundation should progress through and the second is an overview of the strategies that most children will be taught in each year group.

Progression in Calculations

Addition

Models and Images

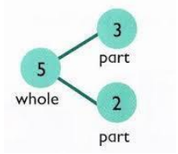
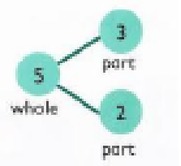
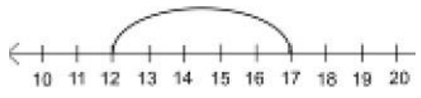
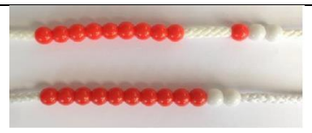
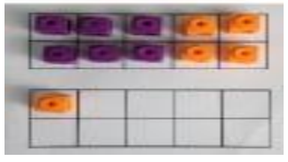
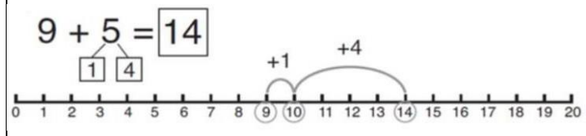


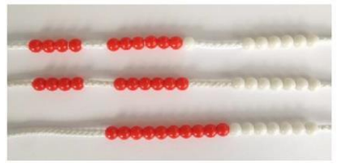
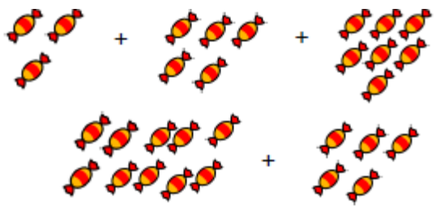
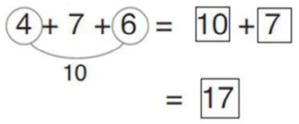
Counting apparatus
Place value apparatus
Place value cards
Number tracks
Numbered number lines
Marked but unnumbered number lines
Empty number lines
Hundred square
Counting stick
Bead string
Numicon
Models and Images charts
ITPs(Interactive Teaching Program) – Number Facts, Ordering Numbers, Number Grid, Counting on and back in ones and tens

Key vocabulary

Mental Skills

Recognise the size and position of numbers
Count on in ones and tens
Know number bonds to 10 and 20
Add multiples of 10 to any number
Partition and recombine numbers
Bridge through 10

Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model Year 1	  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. 	 5 = 2 + 3 3 + 2 = 5 Use the part-part whole diagram as shown above to move into the abstract.
Starting at the bigger number and counting on Year 1	 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. Year 1	 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 Year 2	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.

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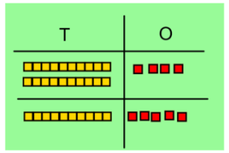
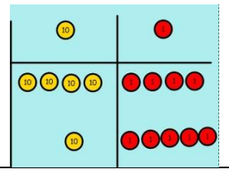
Column method- no regrouping

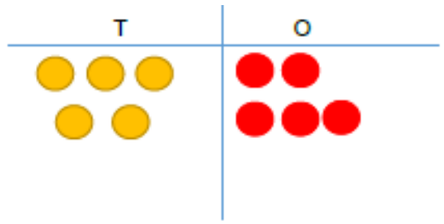
Year 2

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 =

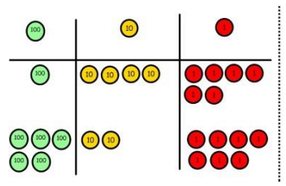
$$\begin{array}{r} 21 \\ +\ 42 \\ \hline \end{array}$$

Column method- regrouping

Year 3 to 6

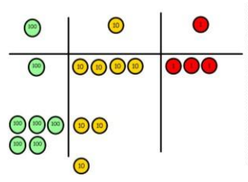
Year 3 up to 3 digits
Year 4 up to 4 digits
Year 5 more than 4 digits and with decimals with same amount of decimal places
Year 6, decimals with different numbers of decimal places

Make both numbers on a place value grid.



146
+ 527

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

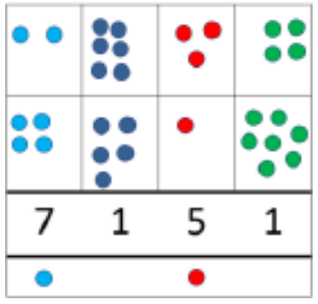


146
+ 527

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.

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.

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

$$\begin{array}{r} 536 \\ +\ 85 \\ \hline 621 \\ \scriptstyle 11 \end{array}$$

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

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

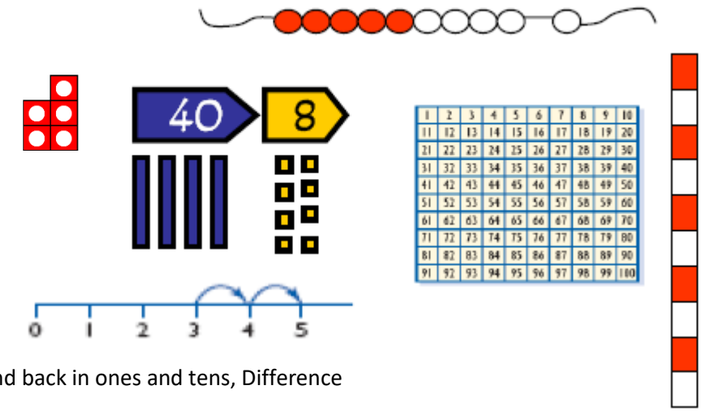
$$\begin{array}{rr} & £23.59 \\ + & £\ 7.55 \\ \hline & £31.14 \\ & \scriptstyle 1\ 1\quad 1 \end{array}$$

$$\begin{array}{rr} & 23.361 \\ & 9.080 \\ & 59.770 \\ + & 1.300 \\ \hline & 93.511 \\ & \scriptstyle 2\ 1\quad 2 \end{array}$$

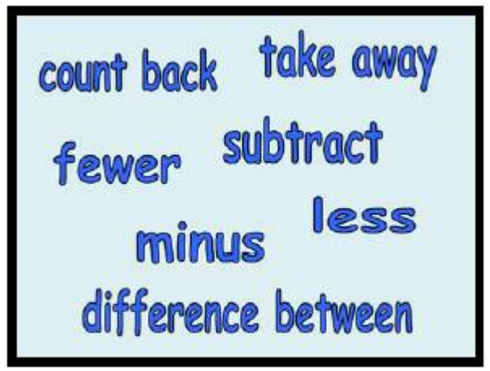
Subtraction

Models and Images

Counting apparatus
Place value apparatus
Place value cards
Number tracks
Numbered number lines
Marked but unnumbered lines
Hundred square
Empty number lines.
Counting stick
Bead strings
Numicon
Models and Images Charts
ITPs – Number Facts, Counting on and back in ones and tens, Difference

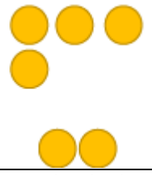
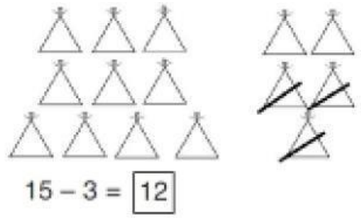
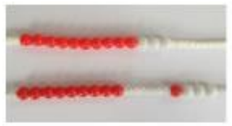
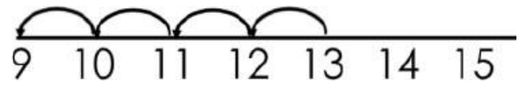
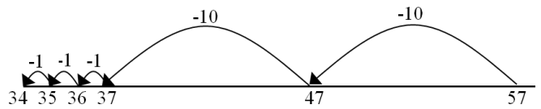


Key vocabulary



Mental Skills

Recognise the size and position of numbers
Count back in ones and tens
Know number facts for all numbers to 20
Subtract multiples of 10 from any number
Partition and recombine numbers (only partition the number to be subtracted)
Bridge through 10

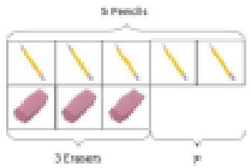
Taking away ones Year 1	Use physical objects, counters, cubes etc to show how objects can be taken away. 6 – 2 = 4 	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	18 -3= 15 8 – 2 = 6
Counting back Year 1 and 2	Make the larger number in your subtraction. Move the beads along your 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.  -10 -10 -1 -1 -1 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.

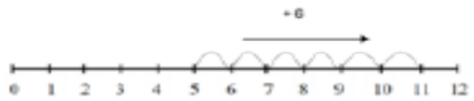
<table>
<tr>
<td>Find the difference

Year 1 and 2</td>
<td>Compare amounts and objects to find the difference.

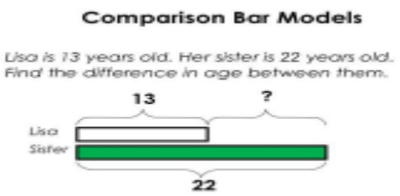
 

Use cubes to build towers or make bars to find the difference.

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

Count on to find the difference

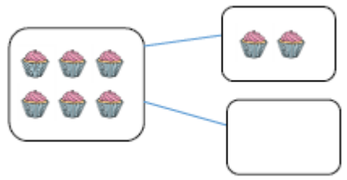
Draw bars to find the difference between 2 numbers</td>
<td>Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.</td>
</tr>
<tr>
<td>Part Whole Model

Year 1and 2</td>
<td> 

Link to addition- use the part whole model to help explain the inverse between ddition and subtraction.

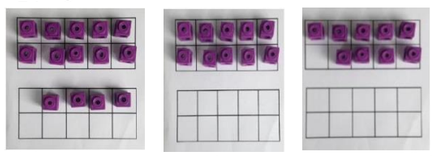
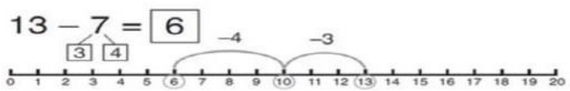
If 10 is the whole and 6 is one of the parts. What is the other part?

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

  </td>
<td> 

Move to using numbers within the part whole model.</td>
</tr>
<tr>
<td>Make 10

Year 1and 2</td>
<td>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</td>
<td> 

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.</td>
<td>16 – 8=

How many do we take off to reach the next 10?

How many do we have left to take off?</td>
</tr>
</table>

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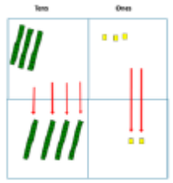
Column method without regrouping

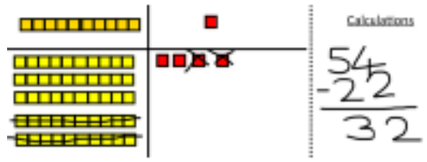
Year 2

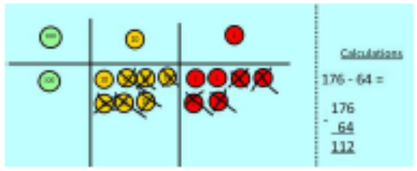
Use Base 10 to make the bigger number then take the smaller number away.

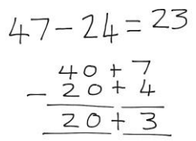


Show how to partition numbers to subtract. Again make the larger number first.

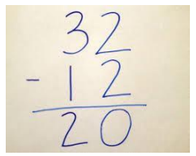
Draw the Base 10 or place value counters alongside the written calculation to help to show working.







This will lead to a clear written column subtraction.



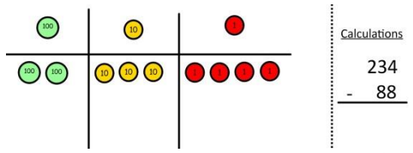
Column method with regrouping

Year 3 to 6

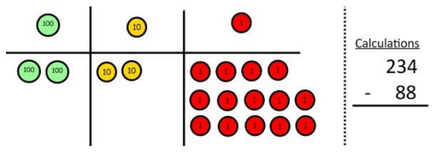
Year 3 up to 3 digits
Year 4 up to 4 digits
Year 5 more than 4 digits and with decimals with same amount of decimal places
Year 6, decimals with different numbers of decimal places

Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges.

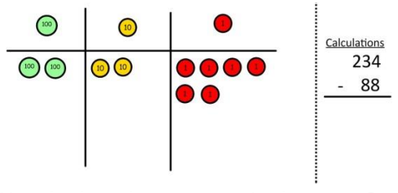
Make the larger number with the place value counters



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



Now I can subtract my ones.

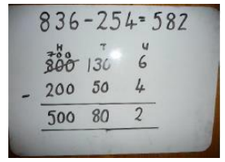


Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.

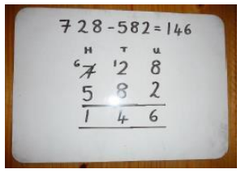
Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.

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

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

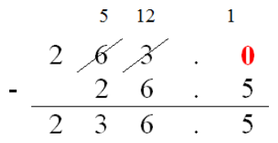


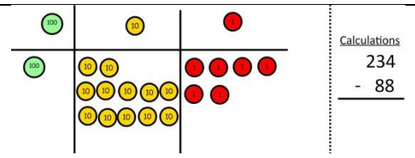
Children can start their formal written method by partitioning the number into clear place value columns.



Moving forward the children use a more compact method.

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

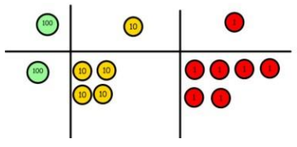




Calculations

234
- 88

Now I can take away eight tens and complete my subtraction



Calculations

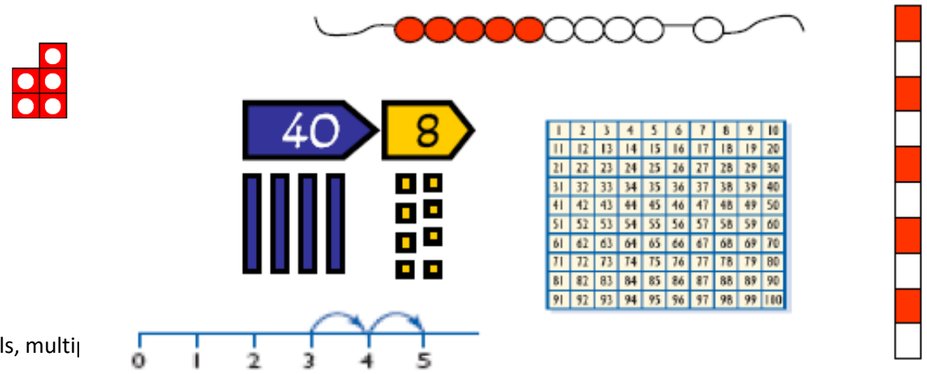
~~234~~
12
- 88
146

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.

Multiplication

Models and images

Counting apparatus
Place value apparatus
Place value cards
Number tracks
Numbered number lines
Marked but unnumbered lines
Hundred square
Empty number lines.
Counting stick
Bead strings
Numicon
Models and Images Charts
ITPs – multiplication grid, number dials, multi



Key vocabulary

Mental skills

Recognise the size and position of numbers

Count on in steps of 2, 5 and 10

Double numbers up to 10

Recognise multiplication as repeated addition

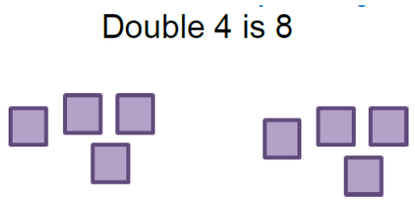
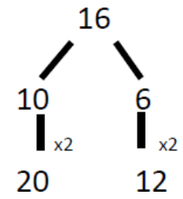
Quick recall of multiplication facts

Use known facts to derive associated facts

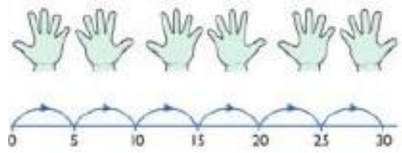
Multiply by 10, 100, 1000 and understand the effect and multiply by multiples of 10

<table>
<tr>
<td>Doubling

Year 1and 2</td>
<td> 

Use practical activities to show how to double a number.</td>
<td>Draw pictures to show how to double a number.
 
</td>
<td> 

Partition a number and then double each part before recombining it back together.</td>
</tr>
<tr>
<td>Counting in multiples

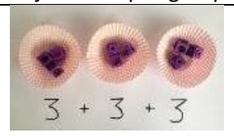
Year 1and 2 and 3</td>
<td> 
 
Count in multiples supported by concrete objects in equal groups.</td>
<td> 

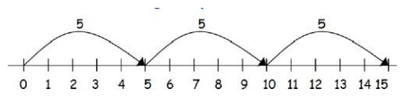
Use a number line or pictures to continue support in counting in multiples.</td>
<td>Count in multiples of a number aloud.

Write sequences with multiples of numbers.

2, 4, 6, 8, 10

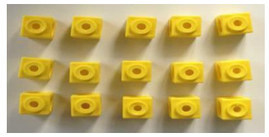
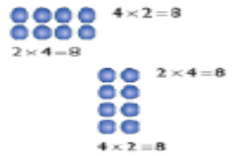
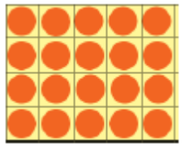
5, 10, 15, 20, 25 , 30</td>
</tr>
<tr>
<td>Repeated addition

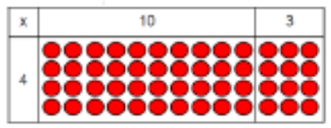
Year 2 and 3</td>
<td> 

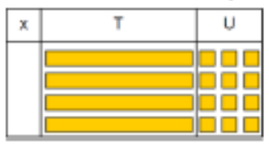
 
Use different objects to add equal groups
  </td>
<td>There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?
 
2 add 2 add 2 equals 6
 

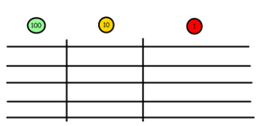
5 + 5 + 5 = 15</td>
<td>Write addition sentences to describe objects and pictures.
 
</td>
</tr>
</table>

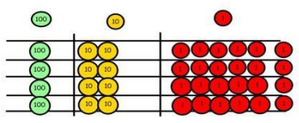
<table>
<tr>
<td>Arrays- showing commutative multiplication

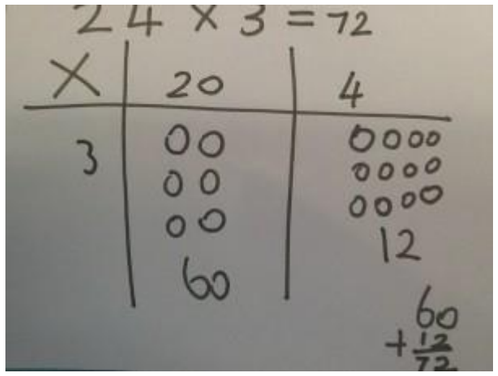
Year 2 and 3</td>
<td>Create arrays using counters/ cubes to show multiplication sentences.
 
  </td>
<td>Draw arrays in different rotations to find commutative multiplication sentences.
 
Link arrays to area of rectangles.
  </td>
<td>Use an array to write multiplication sentences and reinforce repeated addition.
 
5 + 5 + 5 = 15
3 + 3 + 3 + 3 + 3 = 15
5 x 3 = 15
3 x 5 = 15</td>
</tr>
<tr>
<td>Grid Method

Year 3</td>
<td>Show the link with arrays to first introduce the grid method.
 
4 rows of 10
4 rows of 3

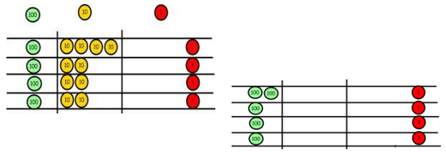
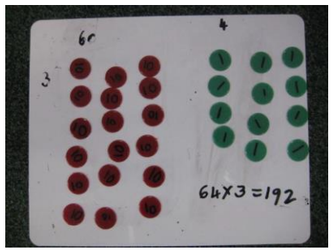
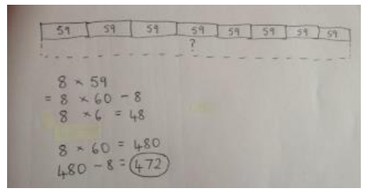
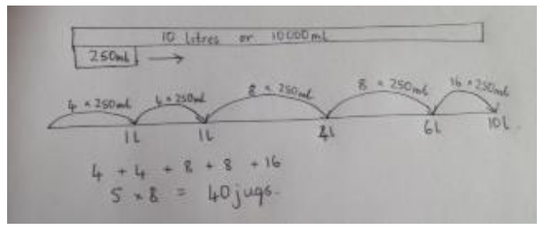
Move on to using Base 10 to move towards a more compact method.
 
4 rows of 13

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.
 
Calculations
4 x 126

Fill each row with 126.
 
Calculations
4 x 126</td>
<td>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.
 
</td>
<td>Start with multiplying by one digit numbers and showing the clear addition alongside the grid.
<table><tr><td>×</td><td>30</td><td>5</td></tr><tr><td>7</td><td>210</td><td>35</td></tr></table>
210 + 35 = 245

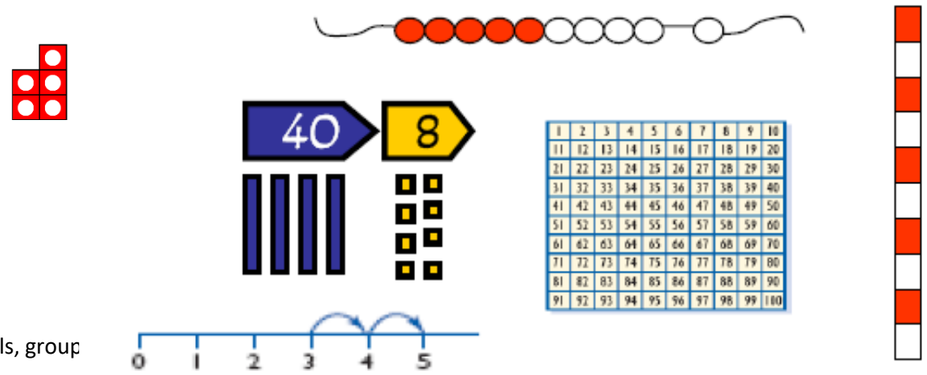
Moving forward, multiply by a 2 digit number showing the different rows within the grid method.
<table><tr><td></td><td>10</td><td>8</td></tr><tr><td>10</td><td>100</td><td>80</td></tr><tr><td>3</td><td>30</td><td>24</td></tr></table>
<table><tr><td>X</td><td>1000</td><td>300</td><td>40</td><td>2</td></tr><tr><td>10</td><td>10000</td><td>3000</td><td>400</td><td>20</td></tr><tr><td>8</td><td>8000</td><td>2400</td><td>320</td><td>16</td></tr></table></td>
</tr>
</table>

	Add up each column, starting with the ones making any exchanges needed.  Then you have your answer.		
Column multiplication Year 4 to 6 Year 4, 2 or 3 digit by 1 digit Year 5, up to 4 digits by 1 or 2 digits Year 6, 4 digits by 2 digits	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. 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768 74 × 63 12 210 240 + 4200 4662 This moves to the more compact method. 2 3 1 1342 x 18 13420 10736 24156 1

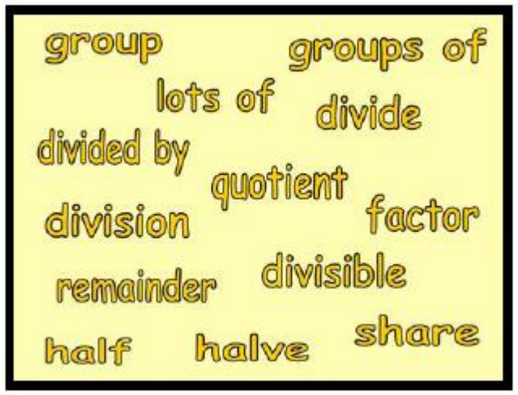
Division

Models and images

Counting apparatus
Place value apparatus
Place value cards
Number tracks
Numbered number lines
Marked but unnumbered lines
Hundred square
Empty number lines.
Counting stick
Bead strings
Numicon
Models and Images Charts
ITPs – multiplication grid, number dials, group



Key vocabulary



Mental skills

Recognise the size and position of numbers

Count back in steps of 2, 5 and 10

Halve numbers up to 20

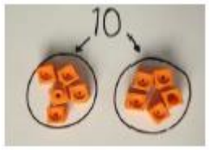
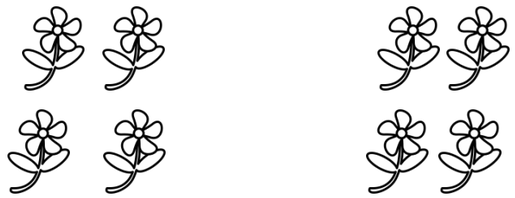
Recognise division as repeated subtraction

Quick recall of division facts

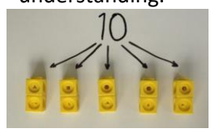
Use known facts to derive associated facts

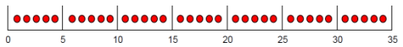
Divide by 10, 100, 1000 and understand the effect and divide by multiples of 10

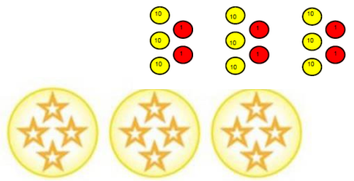
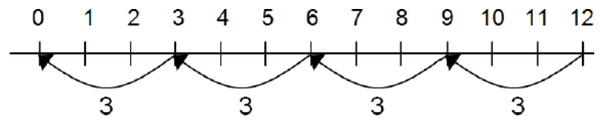
<table>
<tr>
<td>Sharing objects into groups

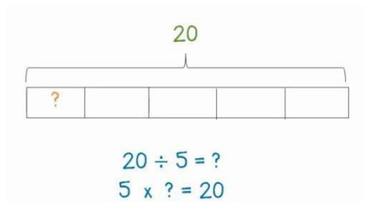
Year 1</td>
<td>  
I have 10 cubes, can you share them equally in 2 groups?
 
</td>
<td>Children use pictures or shapes to share quantities.
 
8 ÷ 2 = 4</td>
<td>Share 9 buns between three people.

9 ÷ 3 = 3</td>
</tr>
<tr>
<td>Division as grouping

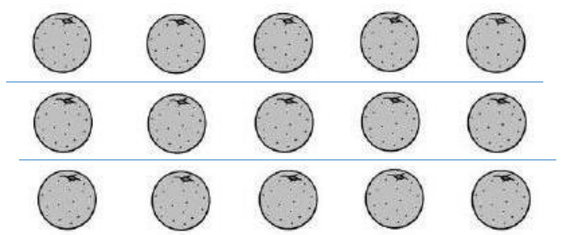
Year 1and 2</td>
<td>Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.
 



96 ÷ 3 = 32
  </td>
<td>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.
 
</td>
<td>28 ÷ 7 = 4

Divide 28 into 7 groups. How many are in each group?</td>
</tr>
<tr>
<td>Division within arrays

Year 2 to 4</td>
<td>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</td>
<td> 
Draw an array and use lines to split the array into groups to make multiplication and division sentences.</td>
<td>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</td>
</tr>
</table>

<table>
<tr>
<td>

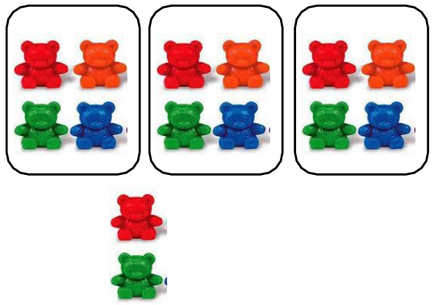
Division with a remainder

Year 3

</td>
<td>

14 ÷ 3 =

Divide objects between groups and see how much is left over



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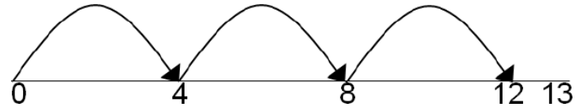
<td>

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.

</td>
<td>

Complete written divisions and show the remainder using r.

</td>
</tr>
<tr>
<td>

Short division

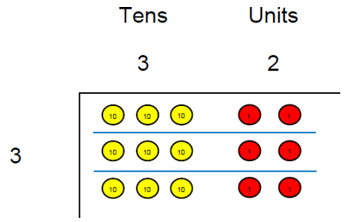
Year 3 to 6

Year 3- 2 digit by 1 digit (P and C)

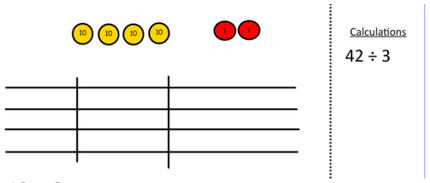
Year 4- 3 digit by 1 digit (P and C)

Year 5-4 digits by 1 digit and interpret remainders

</td>
<td>

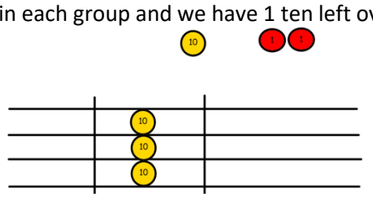


Use place value counters to divide using the bus stop method alongside

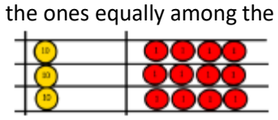


42 ÷ 3=

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.

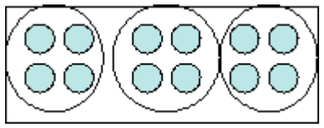


We exchange this ten for ten ones and then share the ones equally among the groups.



</td>
<td>

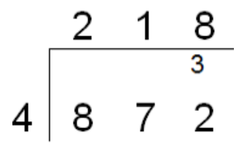
Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.



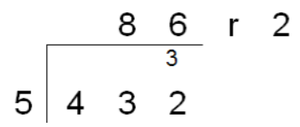
Encourage them to move towards counting in multiples to divide more efficiently.

</td>
<td>

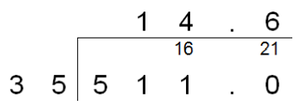
Begin with divisions that divide equally with no remainder.



Move onto divisions with a remainder.



Finally move into decimal places to divide the total accurately.



</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>We look how much in 1 group so the answer is 14.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>

Long division

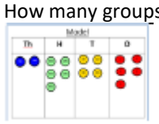
Year 6

4 digits by 2 digits and interpret remainder as whole numbers, fraction or round

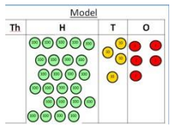
</td>
<td>

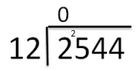
2544 ÷ 12

How many groups of 12 thousands do we have? None

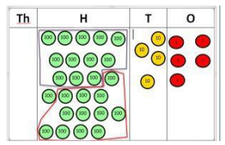


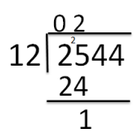
Exchange 2 thousand for 20 hundreds.



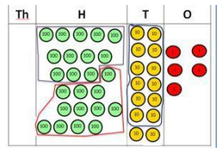


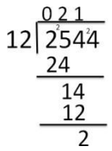
How many groups of 12 are in 25 hundreds?
2 groups. Circle them.
We have grouped 24 hundreds so can take them off and we are left with one.



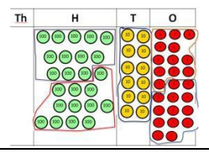


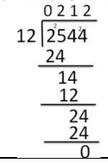
Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2





Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2



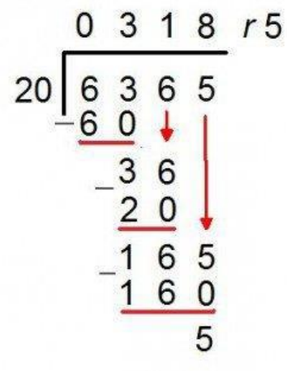


</td>
<td>

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.

</td>
<td>

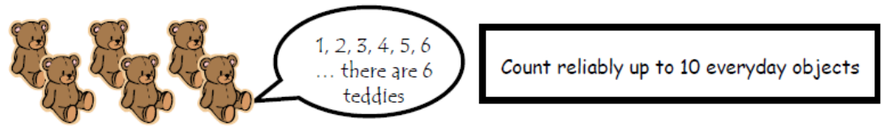
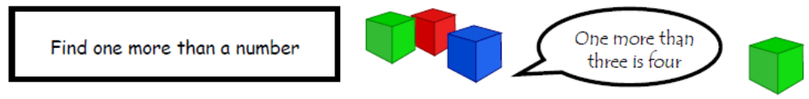
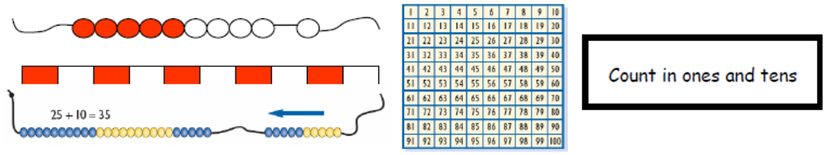
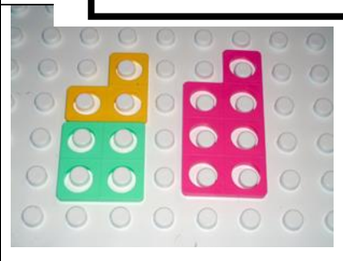
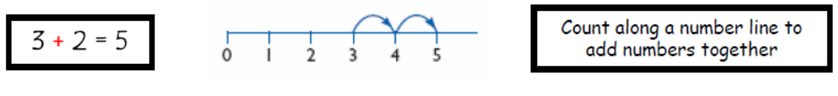


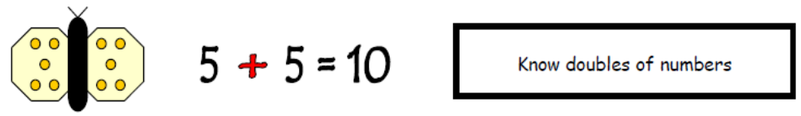
</td>
</tr>
</table>

Appendix 1

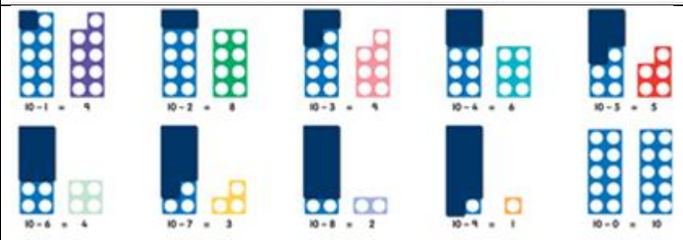
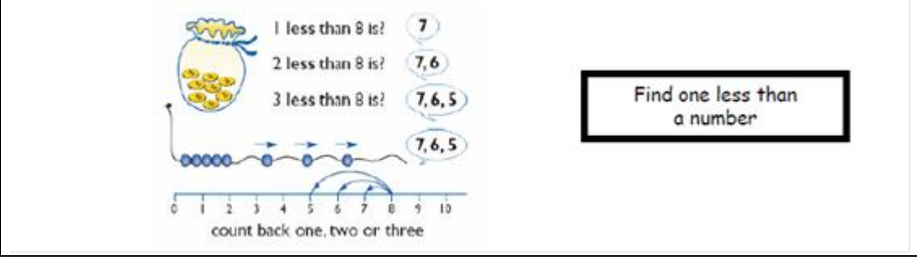
Foundation stage

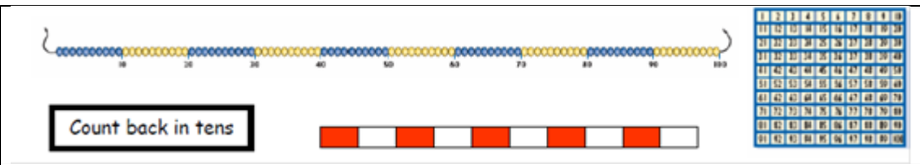
Addition

Recognise numbers 0 to 20 including numicon	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 
Count up to and beyond 10 everyday objects	
Find 1 more than a number	
Count in 1's and 10's	
Begin to relate addition to combining groups	
Use numicon to represent additions	
Count along a number line	

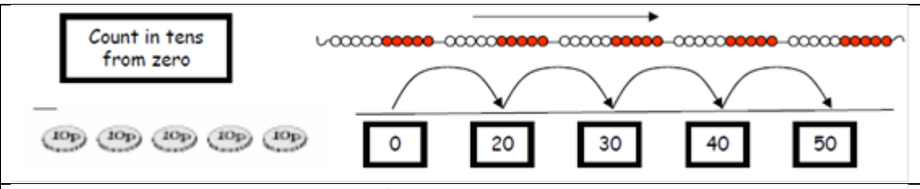
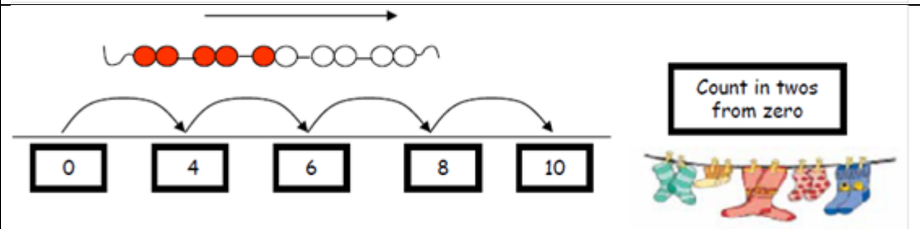
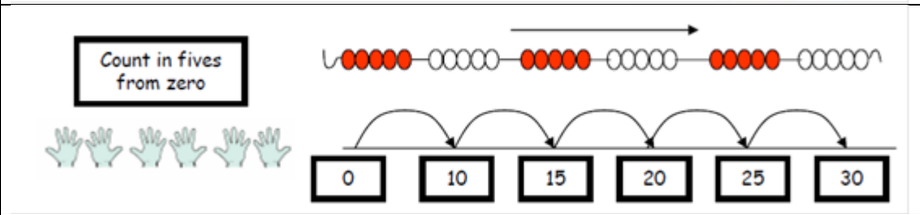
Begin to use + and = to record a number sentence	
Begin to calculate doubles	

Subtraction

Begin to count backwards in familiar contexts	
Continue to count backwards from a given number	
Begin to relate subtraction to taking away	
Use numicon to take away numbers less than 10	
Find 1 less than a number	

Count back in 10's	

Multiplication

Count in 10's from 0	
Count in 2's from 0	
Count in 5's from 0	

Appendix 2

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Combining two parts to make a whole: part whole model. Starting at the bigger number and counting on. Regrouping to make 10.	Adding three single digits. Column method – no regrouping.	Column method- regrouping. (up to 3 digits)	Column method- regrouping. (up to 4 digits)	Column method- regrouping. (with more than 4 digits) (Decimals- with the same amount of decimal places)	Column method- regrouping. (Decimals- with different amounts of decimal places)
Subtraction	Taking away ones Counting back Find the difference Part whole model Make 10	Counting back Find the difference Part whole model Make 10 Column method- no regrouping	Column method with regrouping. (up to 3 digits)	Column method with regrouping. (up to 4 digits)	Column method with regrouping. (with more than 4 digits) (Decimals- with the same amount of decimal places)	Column method with regrouping. (Decimals- with different amounts of decimal places)
Multiplication	Doubling Counting in multiples Arrays (with support)	Doubling Counting in multiples Repeated addition Arrays- showing commutative multiplication	Counting in multiples Repeated addition Arrays- showing commutative multiplication Grid method	Column multiplication (2 and 3 digit multiplied by 1 digit)	Column multiplication (up to 4 digit numbers multiplied by 1 or 2 digits)	Column multiplication (multi digit up to 4 digits by a 2 digit number)
Division	Sharing objects into groups Division as grouping	Division as grouping Division within arrays	Division within arrays Division with a remainder Short division (2 digits by 1 digit- concrete and pictorial)	Division within arrays Division with a remainder Short division (up to 3 digits by 1 digit- concrete and pictorial)	Short division (up to 4 digits by a 1 digit number interpret remainders appropriately for the context)	Short division Long division (up to 4 digits by a 2 digit number- interpret remainders as whole numbers, fractions or round)