Ashford Park Primary School

Inspiring a love for lifelong learning

Calculation Policy

This policy has been largely adapted from the White Rose Maths Hub Calculation Policy with further material added. It is a working document and will be revised and amended as necessary.

At Ashford Park we are using the 'White Rose Scheme' as a basis for our planning.

We are using the White Rose Hub philosophy of:

- **fluency** - using Learning Objectives from the National Curriculum
- **reasoning**
- **problem-solving**

In all our maths learning we are using **a CPA approach** within our maths lessons (**CPA – Concrete/ Pictorial/ Abstract**)

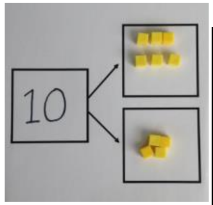
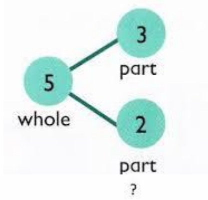
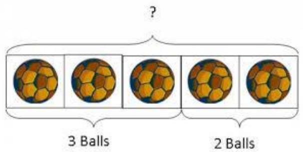
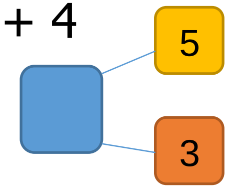
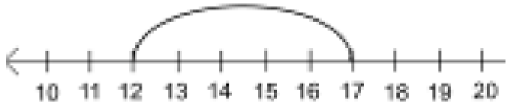
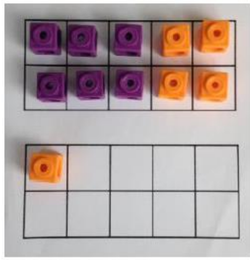
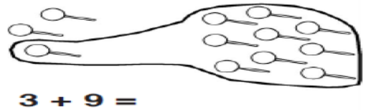
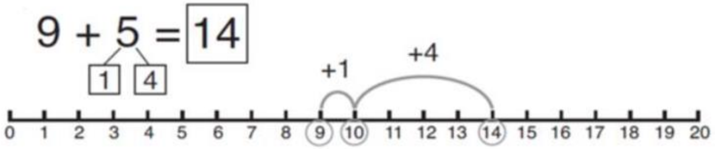
We are using resources such as - White Rose, Third Space Learning, NCETM Mastery documents & nrich problems.

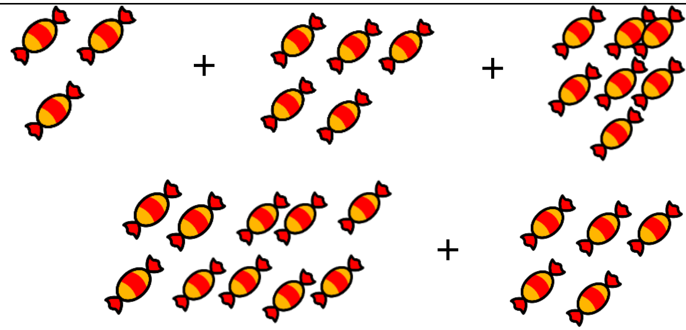
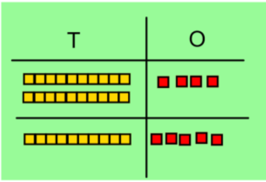
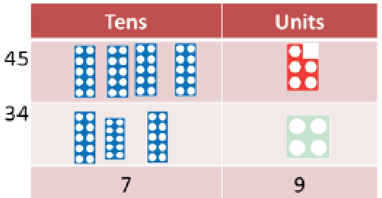
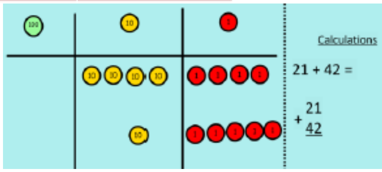
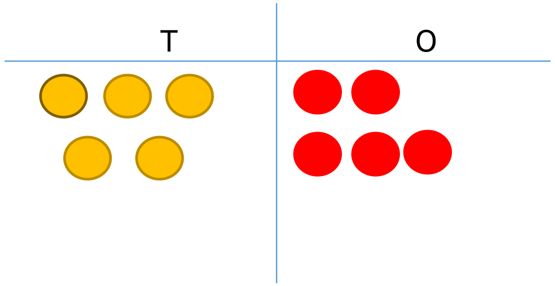
The aim is that when children leave Ashford Park they:

- Have a secure knowledge of number facts and a good understanding of the four calculation operations (addition, subtraction, multiplication and division)
- Make use of jottings, diagrams and informal notes to help record their thinking when using mental methods that generate more information than can be kept in their heads
- Have an efficient, reliable, written method of calculation for each operation that they are able to apply with confidence when they are unable to perform a calculation mentally

Progression in Calculations

Addition Key language that should be used: sum, total, parts and wholes, plus, add, altogether, more than, increase, 'is equal to' 'is the same as'

Objective & Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part- whole model	   Use part part whole model. Use cubes to add two numbers together as a group or in a bar. 	   Use pictures to add two numbers together as a group or in a bar. 	$4 + 3 = 7$ $10 = 6 + 4$  Use the part-part whole diagram as shown above to move into the abstract.
Starting at the bigger number and counting on	 Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.	$12 + 5 = 17$  Start at the larger number on the number line and count on in ones or in one jump to find the answer.	$5 + 12 = 17$ Place the larger number in your head and count on the smaller number to find your answer.
Regrouping to make 10.	 $6 + 5 = 11$  Start with the bigger number and use the smaller number to make 10. Use ten frames.	Use pictures or a number line. Regroup or partition the smaller number using the part, part whole model to make 10.  	$7 + 4 = 11$ If I am at seven, how many more do I need to make 10? How many more do I add on now?

Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	$\underbrace{4 + 7 + 6}_{10} = \boxed{10} + \boxed{7}$ $= \boxed{17}$ Combine the two numbers that make 10 and then add on the remainder.
Column addition with no regrouping Add two or three 2- or 3-digit numbers	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.  Add together the ones first then the tens.   Move to using 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. 	$\begin{array}{r} 2\;2\;3 \\ +\;1\;1\;4 \\ \hline 3\;3\;7 \end{array}$ Add the ones first, then the tens, then the hundreds.

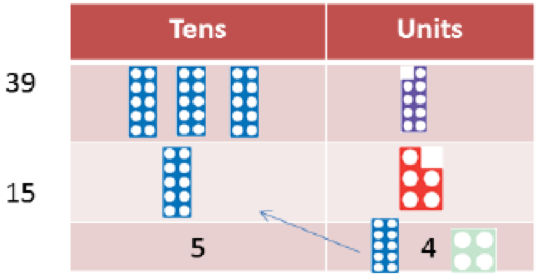
Column addition with regrouping

Y4
Add numbers with up to 4 digits.

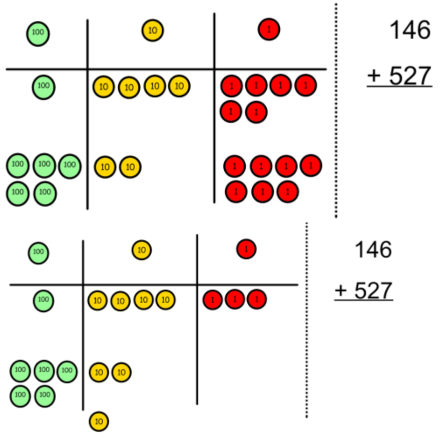
Y5
Add numbers with more than 4 digits.
Add decimals with 2 decimal places, including money.

Y6
Add several numbers of increasing complexity.

Including adding money, measures and decimals with different numbers of decimal points.

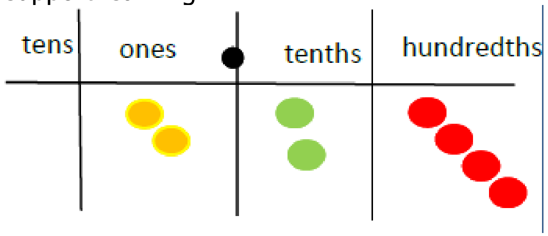


Exchange ten ones for a ten. Model using numicon and place value counters.

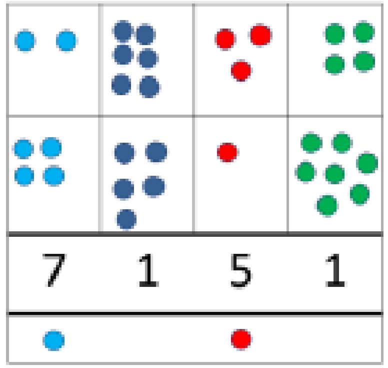


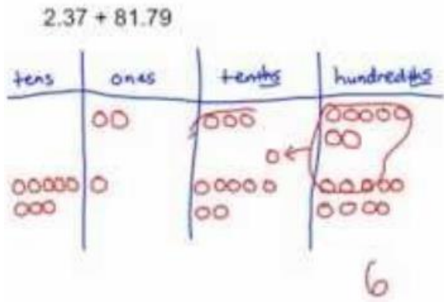
This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100.

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, carrying the ten, hundred or thousand **underneath** the line.

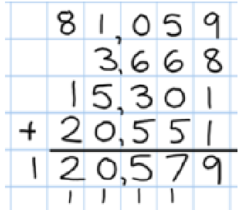




Start by partitioning the numbers before moving on to clearly show the exchange below the addition.

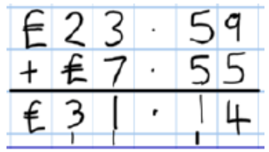
$$\begin{array}{ccccl} 20 & + & 5 & & \\ \underline{40} & \underline{+} & \underline{8} & & \\ 60 & + & 13 & = & 73 \end{array}$$

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

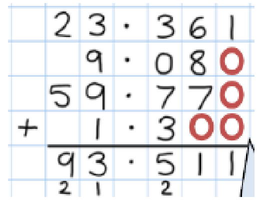


As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here.

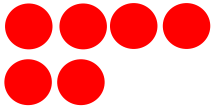
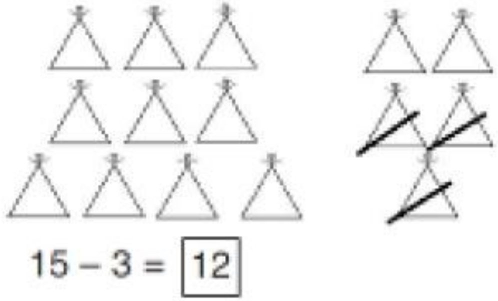
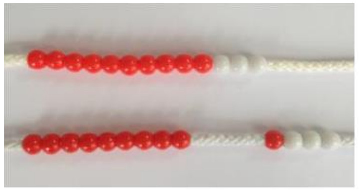
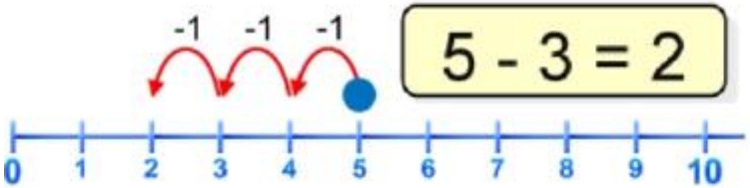
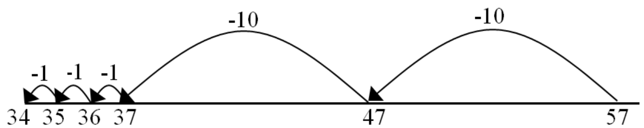
$$\begin{array}{r} 72.8 \\ \underline{+\ 54.6} \\ \underline{127.4} \\ 1\ \ 1\ \ \ \end{array}$$

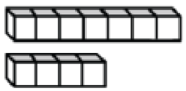
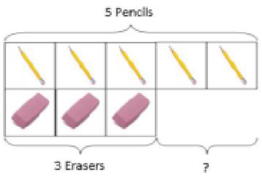
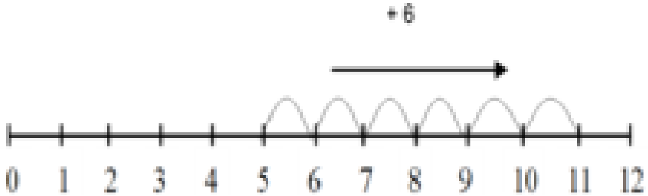
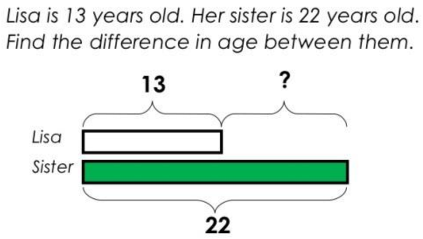
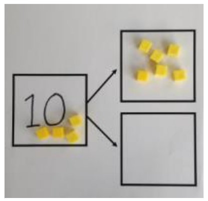
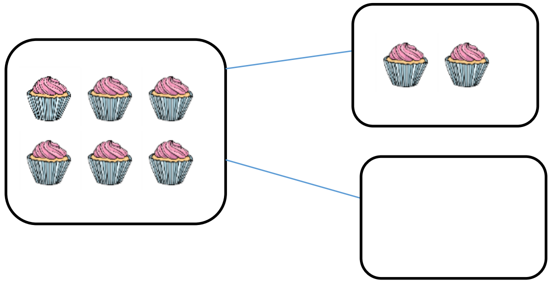
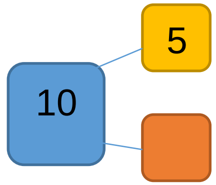


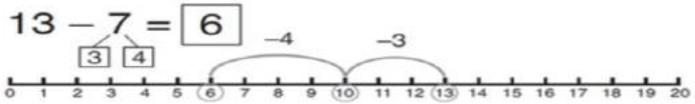
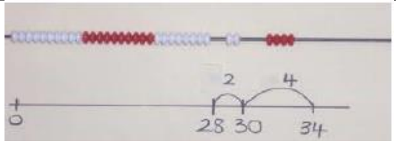
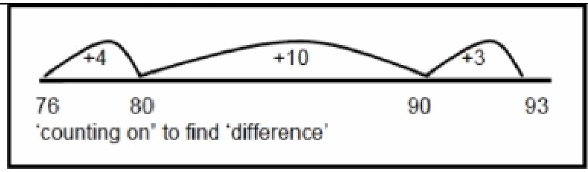
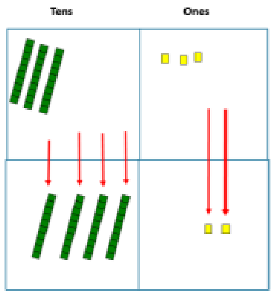
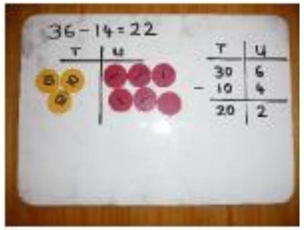
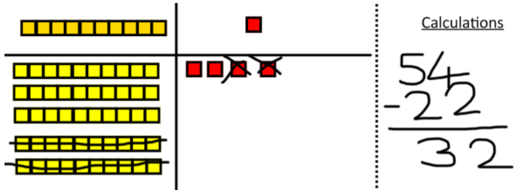
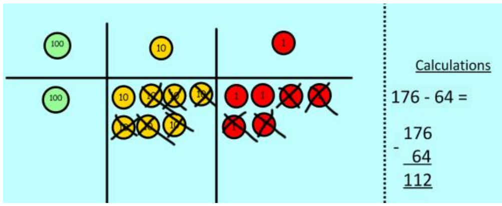
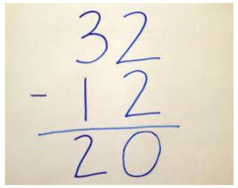
Insert zeros for place holders.



Subtraction Key language that should be used: take away, less than, the difference, subtract, minus, fewer, decrease, '7 take away 3, the difference is four'

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  4 – 2 = 2	 Cross out drawn objects to show what has been taken away.	7 – 4 = 3 16 – 9 = 7
Counting back	 Move objects away from the group, counting backwards. 13 – 4  Make the larger number in your subtraction. Move the beads along the bead string as you count backwards in ones.	Count back on a number line or number track.  Start at the bigger number and count back the smaller number showing the jumps on the number line. 57 – 23 = 34  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?

Find the difference	Compare amounts and objects to find the difference.  7 'Seven is 3 more than four' 4 Use cubes to build towers or make bars to find the difference.  Use basic bar models with objects to find the difference.	 Count on using a number line to find the difference. **Comparison Bar Models** Draw bars to find the difference between 2 numbers. 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches. Tom has 12 sweets and his sister has 5 sweets. How many more does Tom have than his sister?
Represent and use number bonds and related subtraction facts within 20. 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? $10 - 6 = 4$	 Use a pictorial representations of objects to show the part part whole model.	Move to using numbers within the part whole model. 

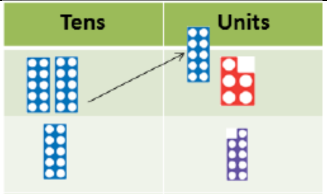
Make 10	14 – 9 =  Make 14 on the ten frame. Take 4 away to make 10, then take one more away so that you have taken away 5. You are left with the answer of 9.	 Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.	16 – 8= How many do we take off to reach 10? How many do we have left to take off?
Make ten strategy Progression should be crossing one ten, crossing more than one ten, crossing the hundreds.	 34 – 28 Use the bead bar or bead string to model counting to next ten and the rest.	 Use a number line to count on to the next 10 and then the rest.	93 – 76 = 17
Column subtraction 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 Intermediate step may be needed to lead to a clear understanding of the written column subtraction. 

Column method with regrouping

Y4
Subtract with up to 4 digits.
Introduce decimals subtraction through context of money.

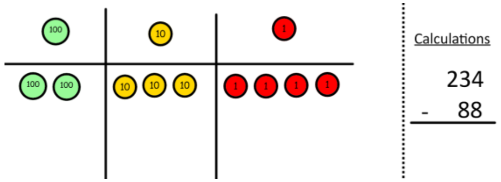
Y5
Subtract with at least four digits, including money and measures.
Subtract with decimal values, including mixtures of integers and decimals and aligning the decimal.

Y6
Subtract with increasingly large and more complex numbers and decimal values.

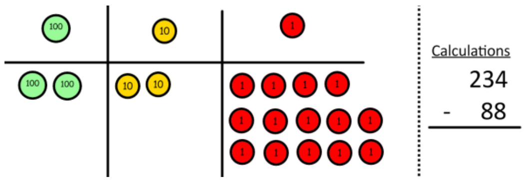


Use Base 10 or Numicon to start with before moving on to place value counters, modelling the exchange of a ten into ten ones. Start with one exchange before moving onto subtractions with two exchanges.

Make the larger number with the place value counters.

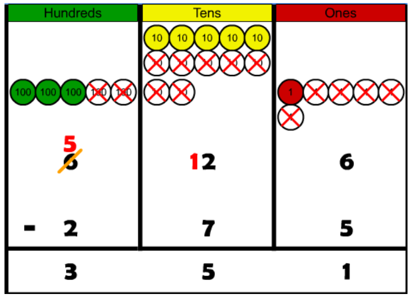


Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.

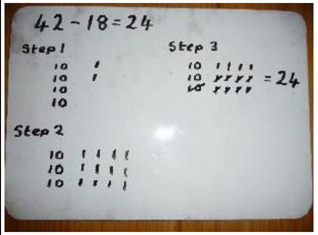


Now I can subtract my ones.

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

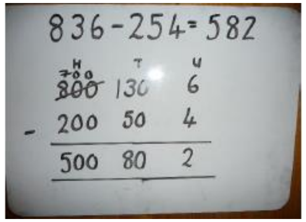


Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges made.

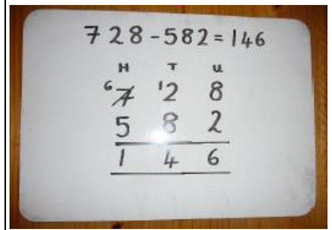


Children can, when confident, find their own way to record the exchange/regrouping.

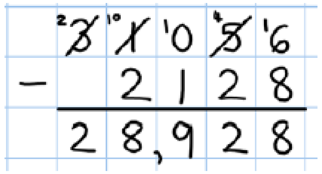
Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.

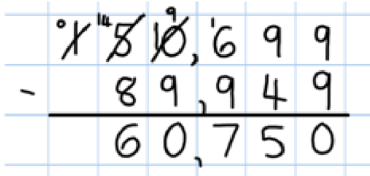


Begin the formal written method by partitioning the number into clear place value columns.



Then move to a more compact (formal) method.





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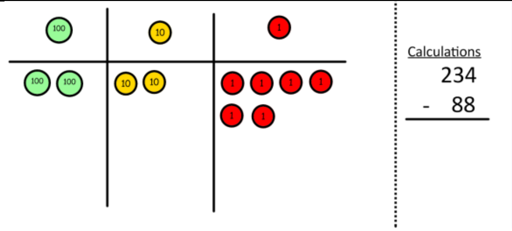
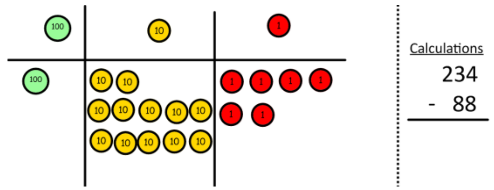
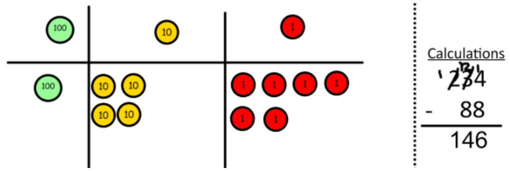




Now I can take away eight tens and complete my subtraction


Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.
</td>
<td></td>
<td>
This will lead to an understanding of subtracting any number including decimals.

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

$$\begin{array}{r} 1\ 0\ 5\ .\ 4\ 1\ 9\ \text{kg} \\ -\quad 3\ 6\ .\ 0\ 8\ 0\ \text{kg} \\ \hline 6\ 9\ .\ 3\ 3\ 9\ \text{kg} \end{array}$$

Use zeros for place holders.
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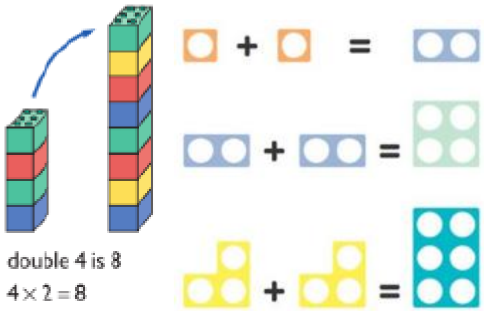
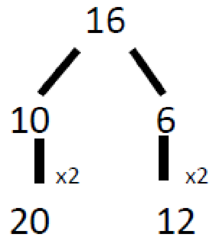
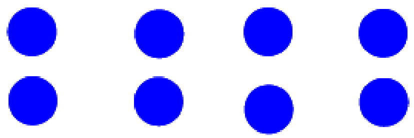
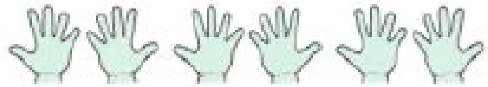
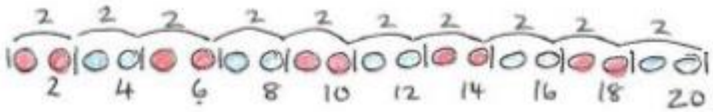
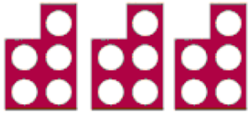
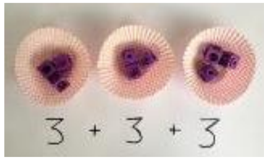
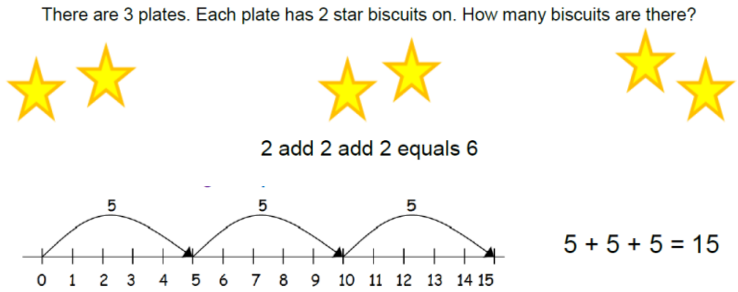
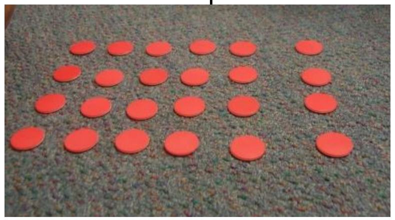
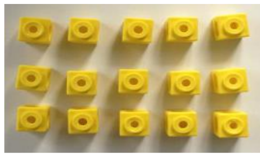
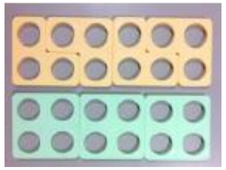
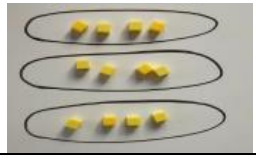
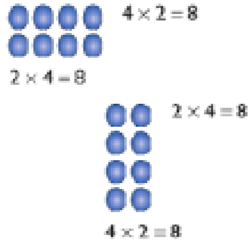
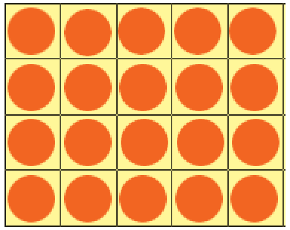
Multiplication Key language that should be used: double, times, multiplied by, the product of, groups of, lots of, 'is equal to' 'is the same as'

Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	Use practical activities using manipulatives including cubes and Numicon to demonstrate doubling.  	Draw pictures to show how to double a number. Double 4 is 8 	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.	    Children make representations to show 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

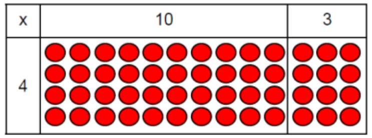
Repeated addition	 Use different objects to add equal groups.	Use pictorial representations including number lines to solve problems.  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures. 
Multiplication is commutative Arrays	Create arrays using counters, cubes and Numicon to show multiplication sentences.  Pupils should understand that an array can represent different equations and that, as multiplication is commutative, the order of multiplication does not affect the answer. 	Draw arrays in different rotations to find **commutative** multiplication sentences.   Link arrays to area of rectangles.	12 = 3 x 4 12 = 4 x 3 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

Y3
Multiplying a 2-digit number by a 1-digit number using the grid method.

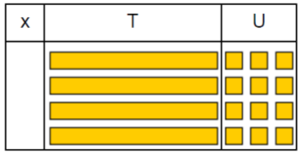
Y4
Multiplying a 3-digit number by a 1-digit number using the grid method.

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



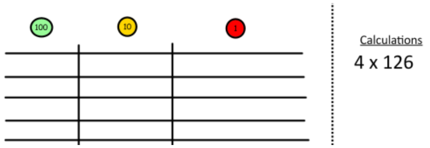
4 rows of 10
4 rows of 3

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

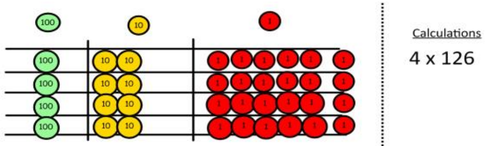


4 rows of 13

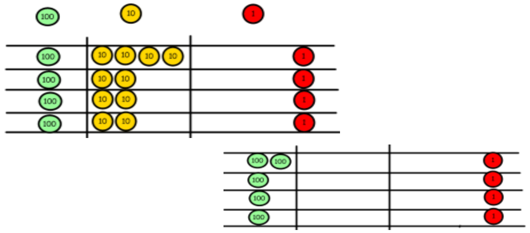
Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.



Fill each row with 126.



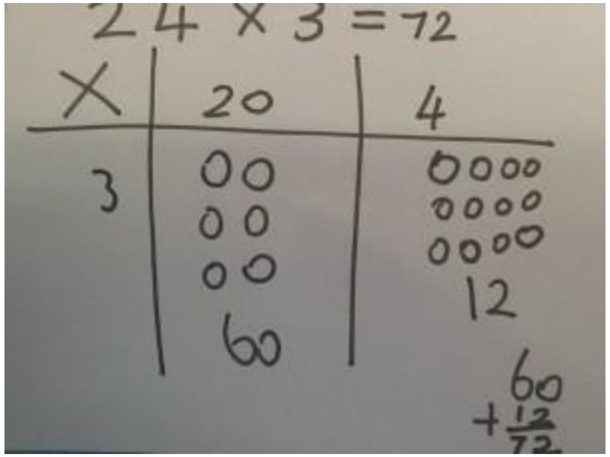
Add up each column, starting with the ones making any exchanges needed.



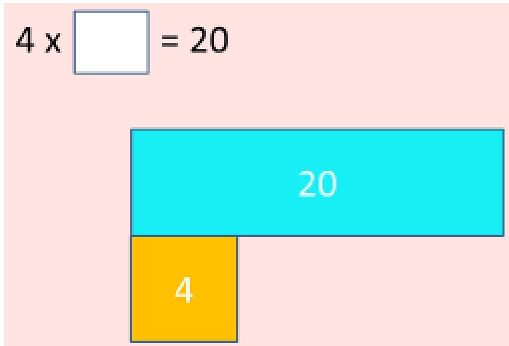
Then you have your answer.

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.



Bar models are used to explore missing numbers.



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

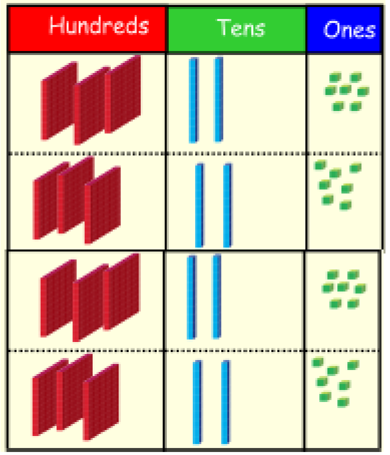
Column multiplication

Y4
Multiplying a 3-digit number by a 1-digit number.

Y5 and Y6
Multiplying a 3-digit and 4-digit number by a 1-digit number.

Y6
Multiplying decimals up to 2 decimal places by a single digit.

Children can continue to be supported by place value counters at this stage of multiplication. 327 x 4 = 1308



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.

Manipulatives may still be used with the corresponding long multiplication method modelled alongside.

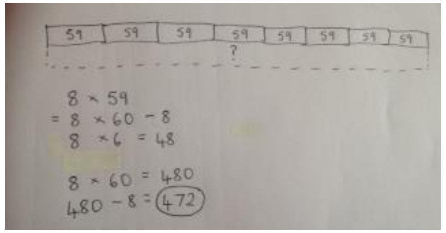
The grid method may be used to show how this relates to a formal written method.

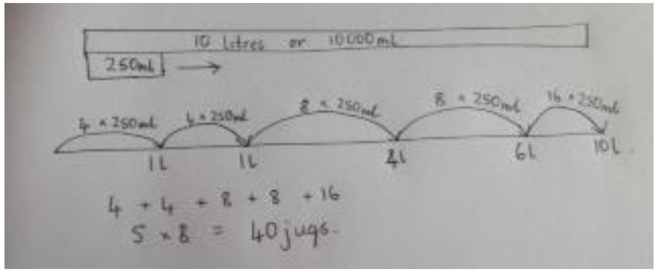
x	300	20	7
4	1200	80	28

```
  327
x   4
   28
   80
 1200
 1308
```

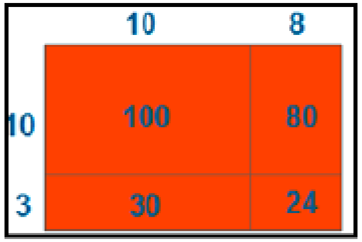
	3	2	7
x			4
1	3	0	8
	1	2	

This will lead to a compact method.





Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.



	1	8
x	1	3
	5	4
	2	
1	8	0
2	3	4

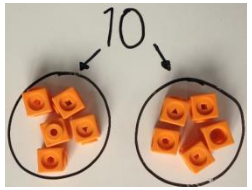
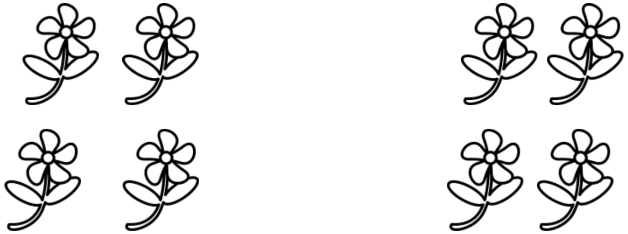
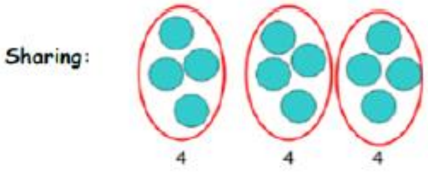
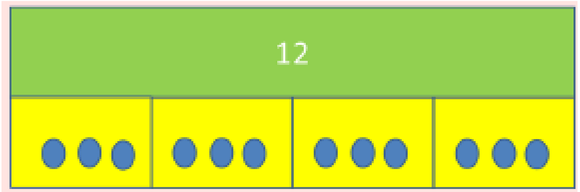
18 x 3 on the first row.
(8 x 3 is 24 – 2 from tens number is moved into the next column, then 1 x 3)

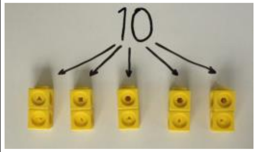
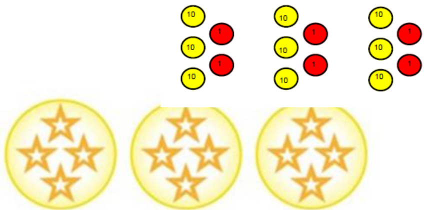
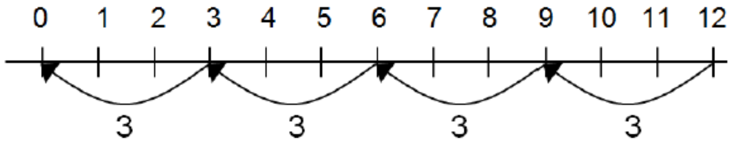
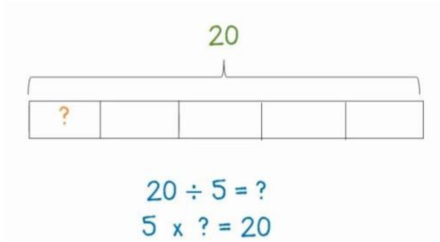
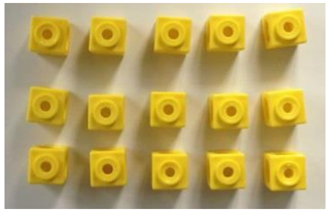
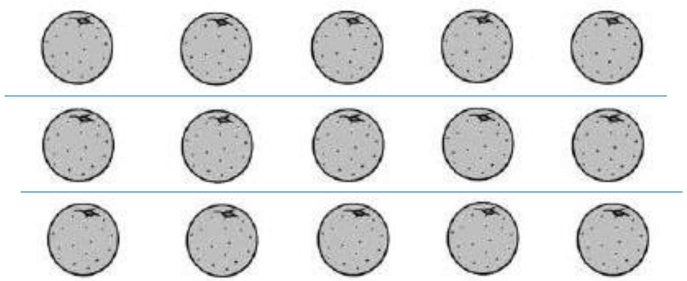
18 x 10 on the 2nd row. Show multiplying by 10 by placing zero in the ones column first.

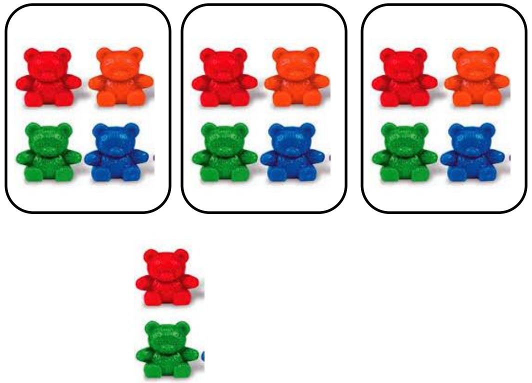
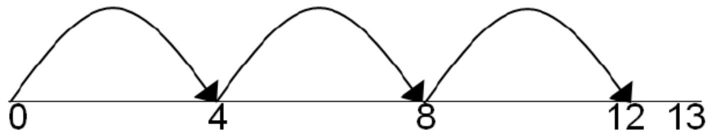
Continue to use bar modelling to support problem solving.

			2 3 1 1 3 4 2 x 1 8 1 3 4 2 0 1 0 7 3 6 2 4 1 5 6 1

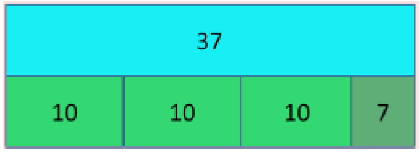
Division Key language that should be used: share, group, divide, divided by, half, 'is equal to' 'is the same as'

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 shared between 2 is 4. $\boxed{8 \div 2 = 4}$  12 shared between 3 is 4 Children use bar modelling to show and support understanding.  12 ÷ 4 = 3	Share 9 buns between three people. 9 ÷ 3 = 3 12 ÷ 4 = 3

Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.   96 ÷ 3 = 32 	Use a number lines for grouping. The number of jumps equals the number of groups.  12 ÷ 4 = 3 Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group. 	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?
Division within arrays	 Link division to multiplication by creating an array. Think about the number sentences that can be created. Eg 15 ÷ 3 = 55 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 eight linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7 28 = 7 x 4 28 = 4 x 7 4 = 28 ÷ 7 7 = 28 ÷ 4

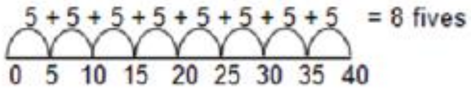
<table>
<tr>
<td>Division with remainders</td>
<td>14 ÷ 3 =
Divide objects between groups and see how much is left over.
</td>
<td>Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder.


Draw dots and group them to divide an amount and clearly show a remainder.

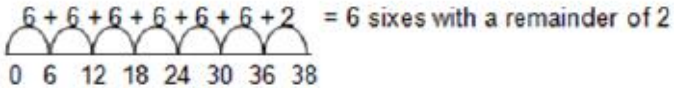

Use bar models to show division with remainders.

</td>
<td>Complete written divisions and show the remainder using r.

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

Example without remainder:
40 ÷ 5
Ask "How many 5s in 40?"



Example with remainder:
38 ÷ 6



For larger numbers, when it becomes inefficient to count in single multiples, bigger jumps can be recorded using known facts.

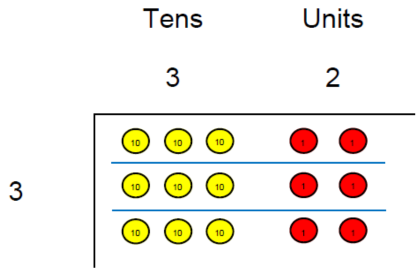
Short division

Y4
Divide a 2-digit or 3-digit number by a 1-digit number (Concrete and Pictorial).

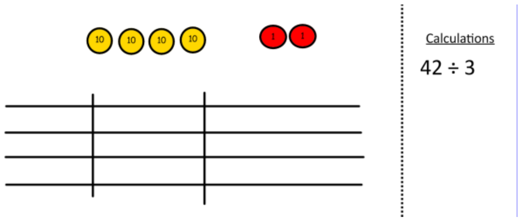
Y5
Divide numbers up to 4-digits by a 1-digit number using the formal written method of short division.

Y6
Divide numbers up to 4-digits by a 2-digit whole number using the formal written method of short division.

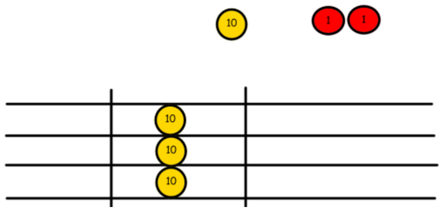
96 ÷ 3=



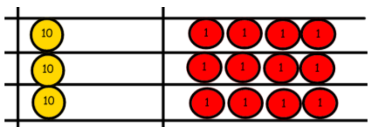
Use place value counters to divide using the bus stop method alongside.



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.

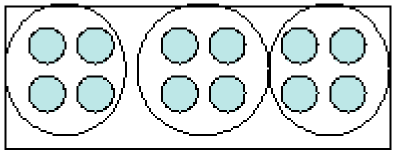


We exchange this ten for ten ones and then share the ones equally among the groups.



We look how much is in 1 group so the answer is 14.

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



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

Begin with divisions that divide equally with no remainder.

$$\begin{array}{r} 2\;\;1\;\;8 \\ 4\overline{)\,8\;\;^{3}7\;\;2} \end{array}$$

Move onto divisions with a remainder.

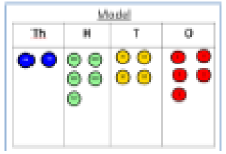
$$\begin{array}{r} 8\;\;6\;\;\text{r}\;2 \\ 5\overline{)\,4\;\;^{3}3\;\;2} \end{array}$$

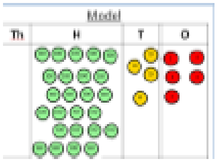
Finally move into decimal places to divide the total accurately.

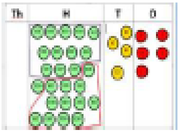
$$\begin{array}{r} 1\;\;4\;.\;6 \\ 35\overline{)\,5\;\;1\;\;^{16}1\;.\;^{21}0} \end{array}$$

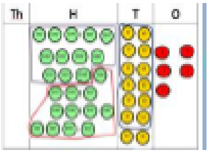
$$\begin{array}{r} 0\;\;6\;\;6\;\;3\;\text{r}\;5 \\ 8\overline{)\,5\;\;^{5}3\;\;^{5}0\;\;^{2}9} \end{array}$$

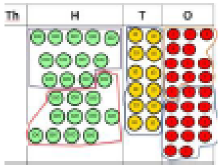
<table>
<tr>
<td>Long Division

Y6
Divide numbers up to 4-digits by a 2-digit whole number using the formal written method of long division.</td>
<td>
0212
12) 2544
24
14
12
24
24
0
2544 ÷ 12
How many groups of 12 thousands do we have? None


Exchange 2 thousand for 20 hundreds.


02
12) 2544
24
1
How many groups of 12 are in 25 hundreds? 2 groups. Circle them.
We have grouped 24 hundreds so can take them off and we are left with one.


021
12) 2544
24
14
12
2
Exchange the one hundred for 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>Children to represent the counters, pictorially and record the subtractions beneath.I</td>
<td>0
12) 2544
Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.

02
12) 2544
24
1
Step two- How many groups of 12 can I make with 25 hundreds? The 24 shows the hundreds we have grouped. The one is how many hundreds we have left.

021
12) 2544
24
14
12
2
Exchange the one hundred for 10 tens. How many groups of 12 can I make with 14 tens? The 14 shows how many tens I have, the 12 is how many I grouped and the 2 is how many tens I have left.

0212
12) 2544
24
14
12
24
24
0
Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.</td>
</tr>
</table>