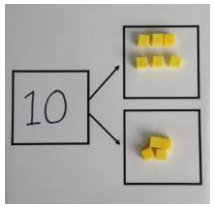
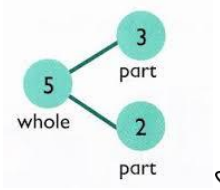
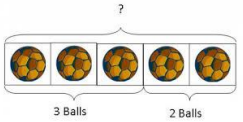
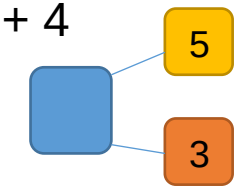
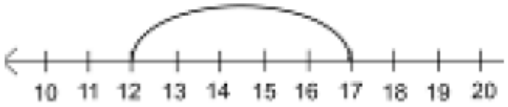
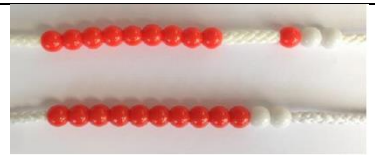
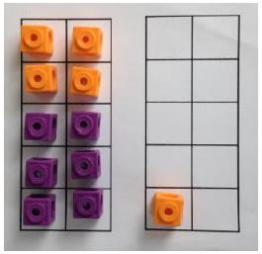
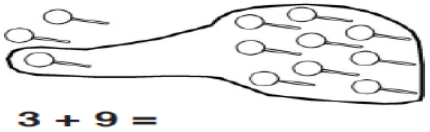
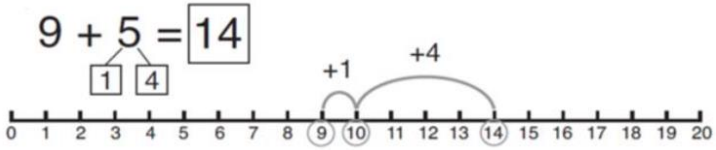
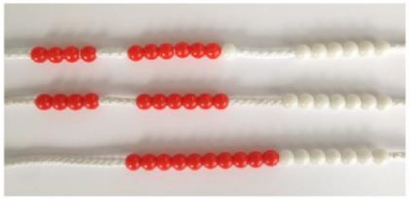
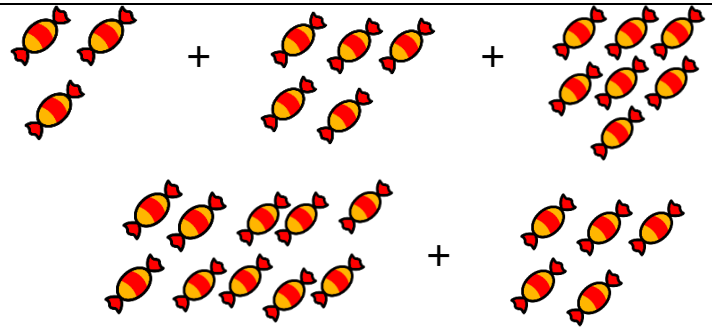
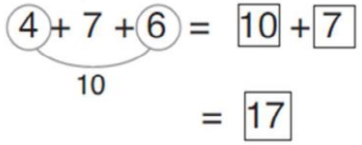
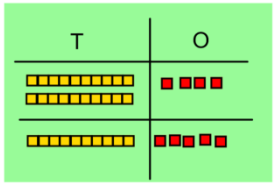
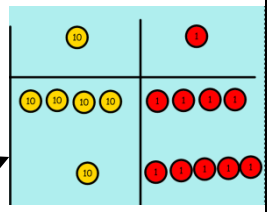
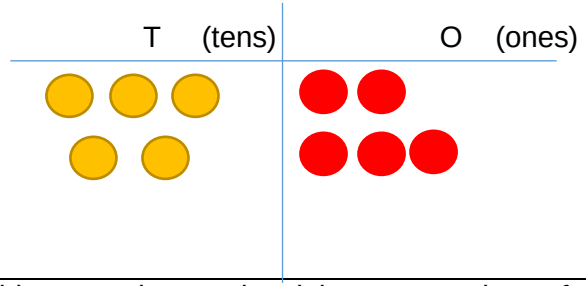
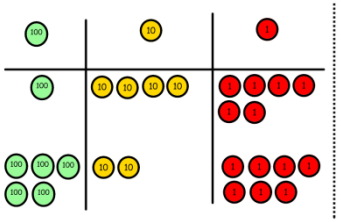
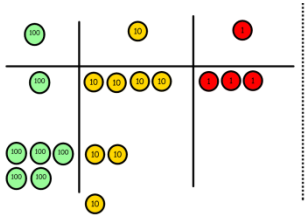
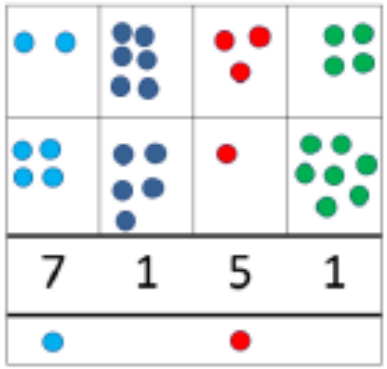
Progression in Calculations

Addition

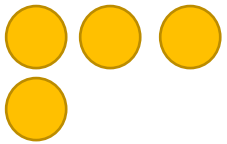
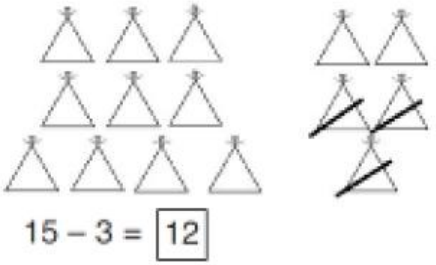
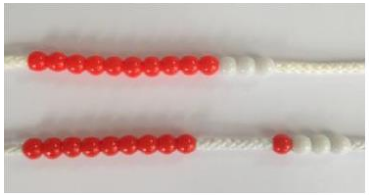
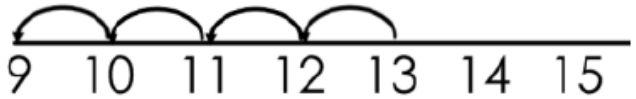
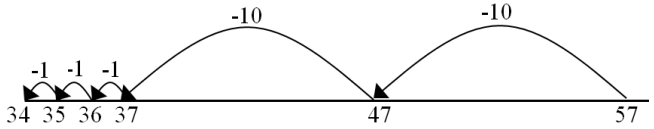
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-part-whole model	   Use cubes to add two numbers together as a group or in a bar. 	    3 Balls 2 Balls Use pictures to add two numbers together as a group or in a bar. Ensure that the 'whole' is a variety of numbers and that you explore the many different 'parts' of the whole. 	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. Explore the commutative nature of addition (adding can be done in any order – tell Maths stories to demonstrate this and ask them to represent this in journal entries).

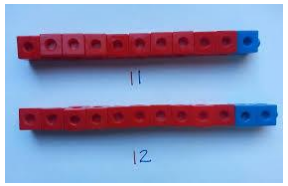
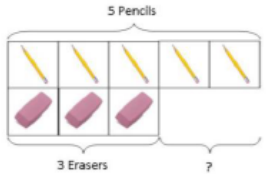
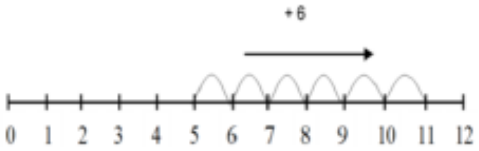
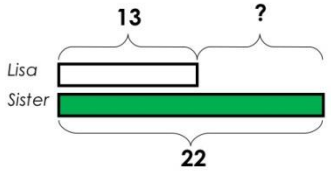
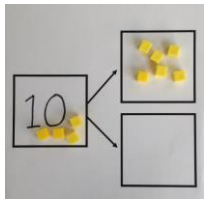
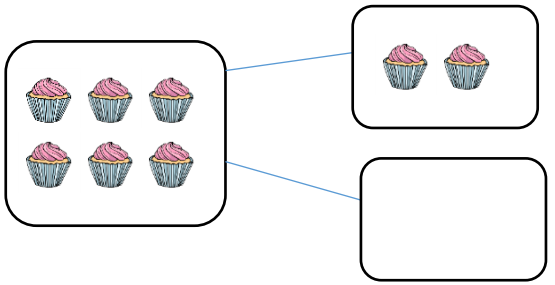
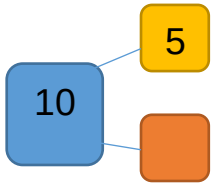
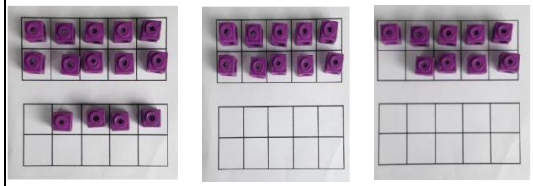
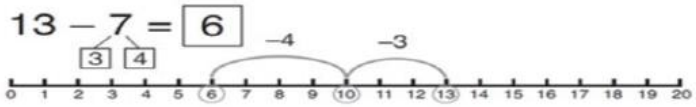
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10. (6 + 5 = 6 + 4 + 1 = 11)	 3 + 9 = Use pictures or a number line. Regroup or partition the smaller number to make 10.  	7 + 4= 11 If I am at seven, how many more do I need to make 10? How many more do I add on now? Use empty box problems e.g. 7 + ☐ = 10 6 + ☐ + 1 = 10 10 = 4 + 3 + ☐ This method should be used whenever mental strategies for larger numbers are appropriate e.g. 74 + 8 =
Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	 Combine the two numbers that make 10 and then add on the remainder.

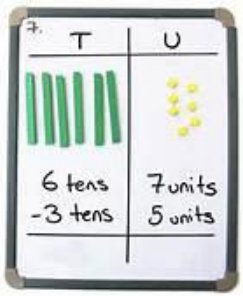
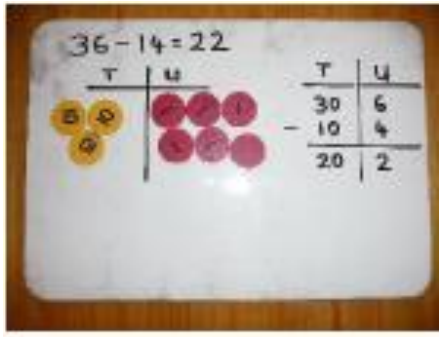
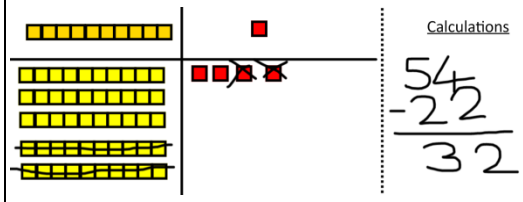
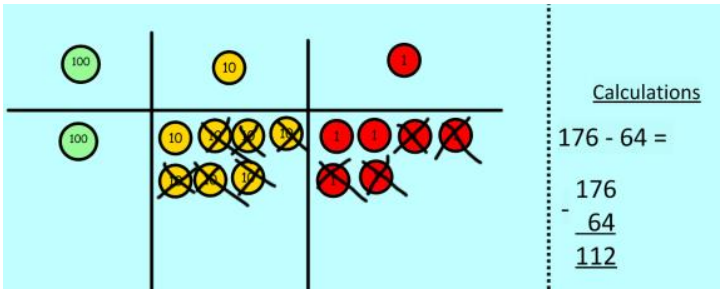
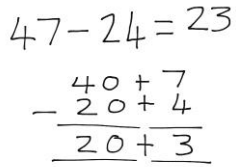
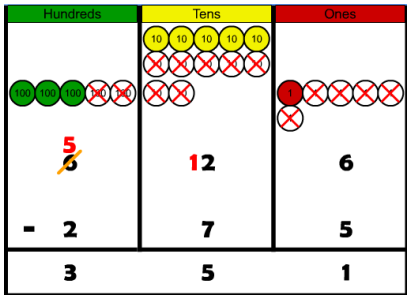
Column method- no regrouping	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.  44 + 15 =  Progress to 'unitising' (one yellow counter here represents 10 and one red counter represents 1)	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. Children could represent a 'number story' in a journal entry / or write a 'number story' about a calculation: 32 + 23 =  	Calculations 21 + 42 = 21 + 42
Column method- regrouping	Make both numbers on a place value grid.  146 + 527 Add up the units and exchange 10 ones for one 10.  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.	Children can draw a pictorial representations of the columns and place value counters to further support their learning and understanding. 2634 + 4517 =  	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 536 + 85 621 1 1 As the children move on, introduce decimals with the same number of decimal places first. Then progress to different number of

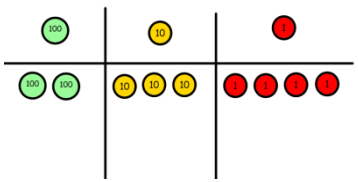
	This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.		decimal places. Money can be used. Encourage pupils to 'think of decimals, think of money'. £23.59 + £7.55 £31.14 1 1 1 23.361 9.080 59.770 + 1.300 93.511 2 1 2 72.8 +54.6 127.4 1 1

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  Ensure that pupils are told 'stories' about the subtraction and that they tell stories about what is represented.	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	18 - 3= 15 24 – 3 = 21
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 13 – 4 =  Start at the bigger number and count back the smaller number showing the jumps on the number line. 57 – 23 =  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? 14 - ☐ = 11

Find the difference	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference Show the bars in different orientations.	 Count on to find the difference. Use this method to find the difference between negative / positive numbers, time, money and other measures. Draw bars to find the difference between 2 numbers. **Comparison Bar Models** *Lisa is 13 years old. Her sister is 22 years old. Find the difference in age between them.*  	Find the difference between 28 and 47. Hannah has 23 sandwiches and Helen has 15 sandwiches. Find the difference between the number of sandwiches.
Part-Part-Whole Model	 Link to addition - use the part-whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10-6 =	Use a pictorial representation of objects to show the part-part-whole model. 	 Move to using numbers within the part whole model. Use knowledge of numbers to 10 to partition numbers to hundreds etc.
Make 10	14 – 9 =  Make 14 on the tens frame. Take away	 Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You	16 – 8= How many do we take off to reach the next 10? How many do we have left to take off?

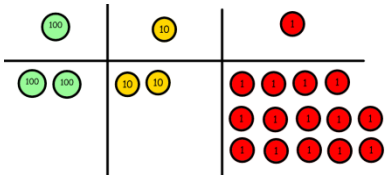
	the four first to make 10 and then take away one more so you have taken away 5. You are left with the answer of 9.	have reached your answer.	
Column method without regrouping	 Use Base 10 to make the bigger number then take the smaller number away.  Show how you partition numbers to subtract. Again make the larger number first.	 Draw the Base 10 or place value counters alongside the written calculation to help to show working. Progress to 'unitising' with place value counters: 	 This will lead to a clear written column subtraction. 7 8 - 3 4 4 4
Column method with regrouping	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters	 626 – 275 =	Children can start their formal written method by partitioning the number into clear place value columns.



Calculations

234
- 88

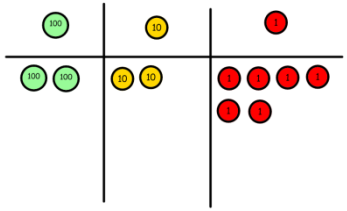
Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.



Calculations

234
- 88

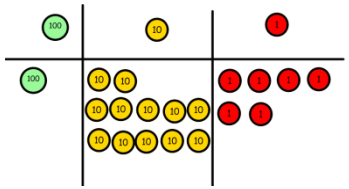
Now I can subtract my ones.



Calculations

234
- 88

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



Calculations

234
- 88

Now I can take away eight tens and complete my subtraction

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 (this example represents the stage where the exchange and crossing out have already taken place).

When confident, children can find their own way to record the exchange/regrouping. Ensure that they can explain WHY the stages are taking place.

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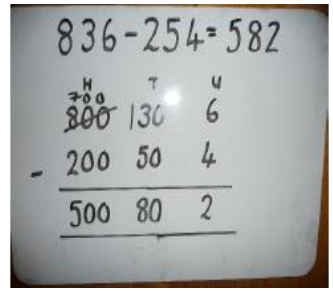
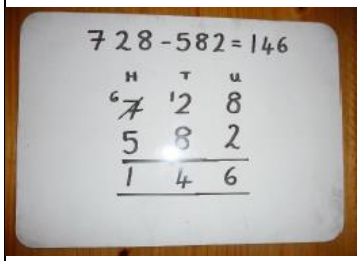
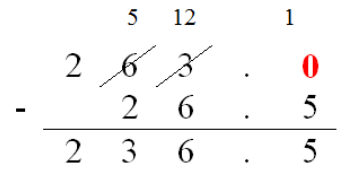
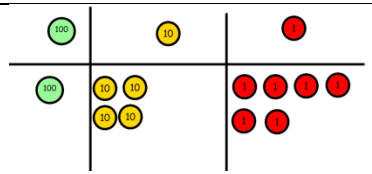
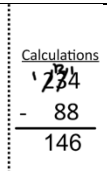


Moving forward the children use a more compact method.

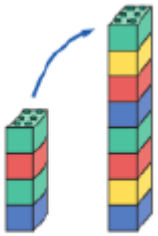
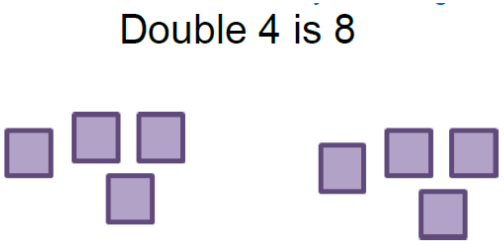
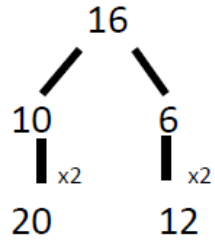
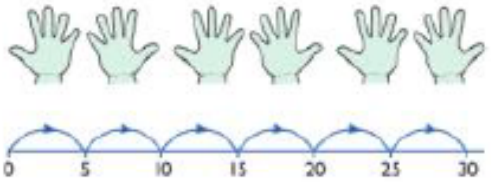


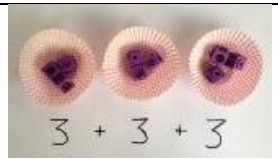
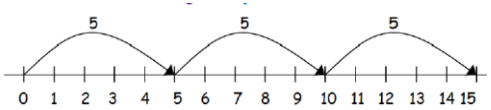
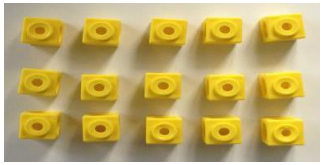
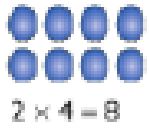
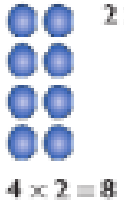
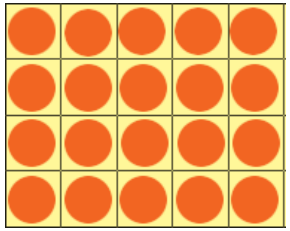
This will lead to an understanding of subtracting any number including decimals. Ensure that place value language is used during this process.



	  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.		

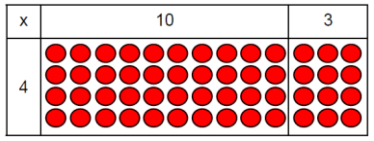
Multiplication

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

Repeated addition	   Use different objects to add equal groups.	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?  2 add 2 add 2 equals 6  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures.  Encourage children to represent various multiplications in journal entries.
Arrays- showing commutative multiplication	Create arrays using counters/ cubes to show multiplication sentences.  	Draw arrays in different rotations to find **commutative** multiplication sentences. Introduce the language of ‘groups of’.    Link arrays to area of rectangles.	Use an array to write multiplication sentences and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15 Progress to the distributive properties of multiplication i.e. 5 x 3 = (3 x 3) + (2 x 3) 3 2

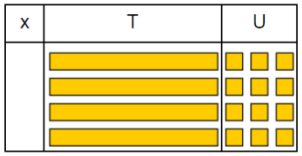
Grid Method

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



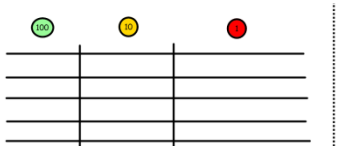
4 rows of 10
4 rows of 3

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

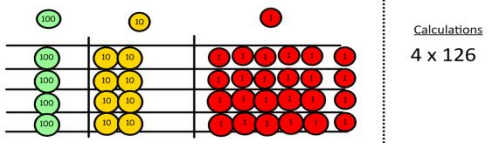


4 rows of 13

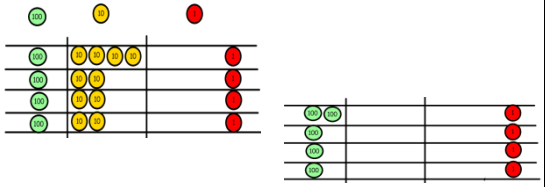
Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.



Fill each row with 126.



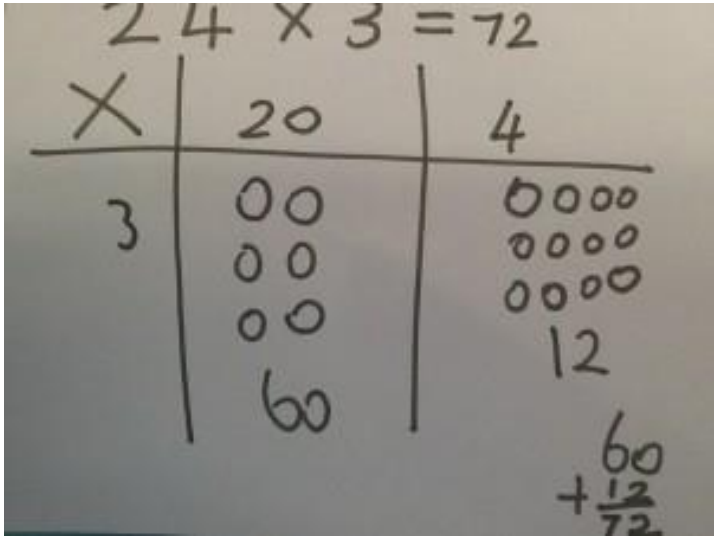
Add up each column, starting with the ones making any exchanges needed.



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.



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

×	30	5
7	210	35

210 + 35 = 245

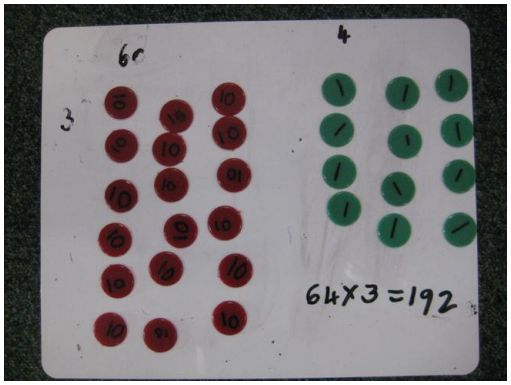
Moving forward, multiply by a 2 digit number showing the different rows within the grid method, then add the values. When adding, ensure that columns are correctly aligned to avoid miscalculation. Mental methods for addition should be used as far as possible (i.e. mentally add 10000, 8000 and 3000 before representing the column addition).

	10	8
10	100	80
3	30	24

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

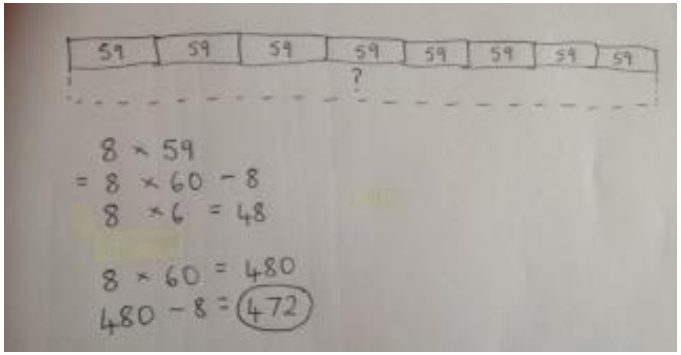
Column multiplication

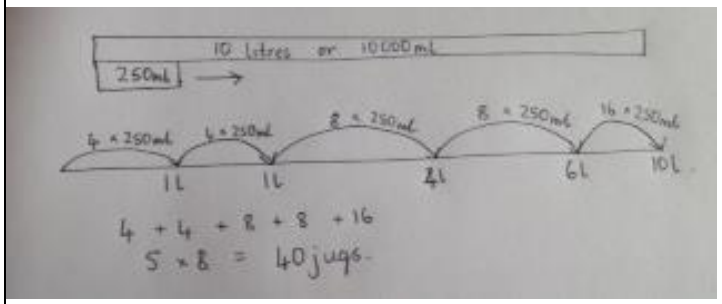
Children can continue to be supported by place value counters at the stage of multiplication.



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.

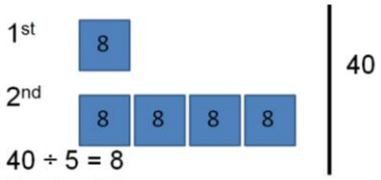
Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.





Introduce bars in the context of problem solving for multiplicative structures e.g.

- He posts four times as many second class letters as first.
- How many of each class of letter does he post?



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.

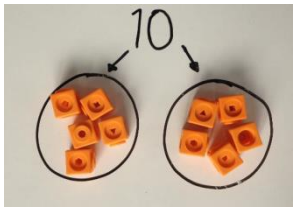
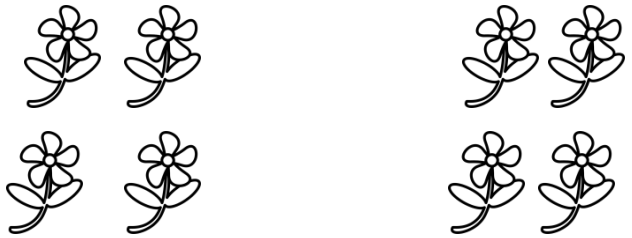
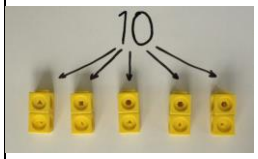
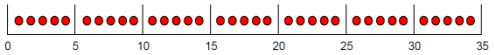
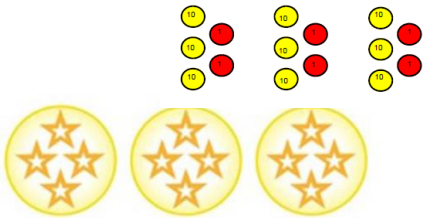
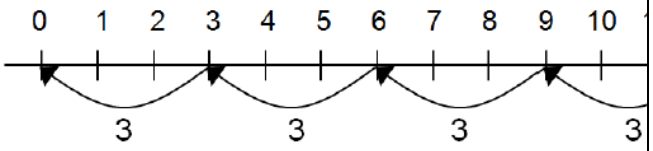
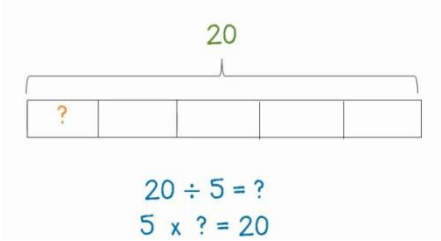
```
  32
x 24
  8    (4 x 2)
120    (4 x 30)
 40    (20 x 2)
600    (20 x 30)
768
```

```
      7  4
   x  6  3
   ---------
      1  2
   2  1  0
   2  4  0
+  4  2  0  0
   ---------
   4  6  6  2
```

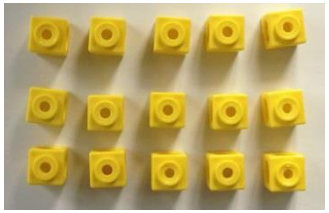
This moves to the more compact method.
Ensure that they clearly understand WHY the '0' is placed in the second row.

			1 3 4 2 X 1 8 ---------- 1 0 7 3 6 1 3 4 2 0 ---------- 2 4 1 5 6

Division

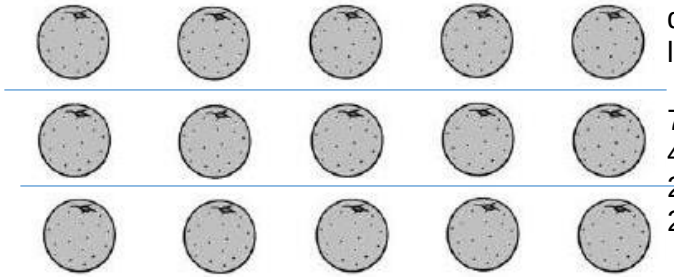
Objective and Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups	   I have 10 cubes, can you share them equally in 2 groups?	Children use pictures or shapes to share quantities.  8 ÷ 2 = 4	Share 9 buns between three people. 9 ÷ 3 = 3
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.   96 ÷ 3 = 32 	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group. 	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

Division within arrays



Link division to multiplication by creating an array and thinking about the number sentences that can be created.

Eg 15 ÷ 3 = 5 5 x 3 = 15
15 ÷ 5 = 3 3 x 5 = 15



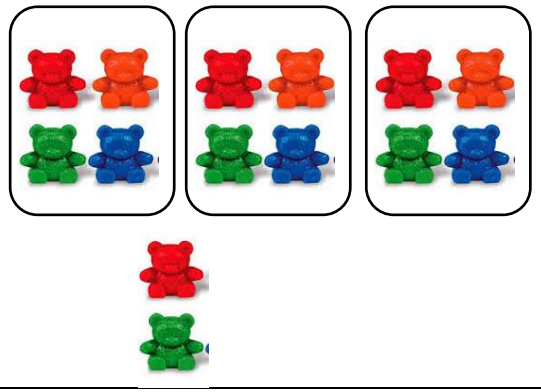
Draw an array and use lines to split the array into groups to make multiplication and division sentences.

Find the inverse of multiplication and division sentences by creating four linking number sentences.

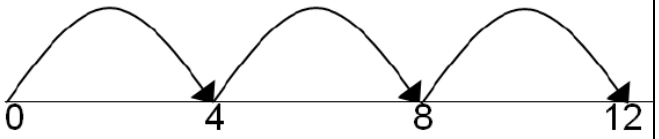
7 x 4 = 28
4 x 7 = 28
28 ÷ 7 = 4
28 ÷ 4 = 7

Division with a remainder

14 ÷ 3 =
Divide objects between groups and see how much is left over



Jump forward in equal jumps on a number line then see how many more you need to jump to

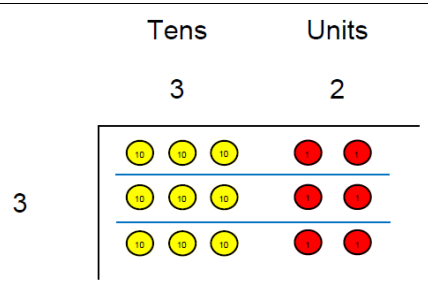


find a remainder.

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

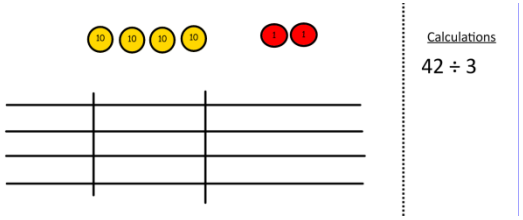
Complete written divisions and show the remainder using r.

Short division

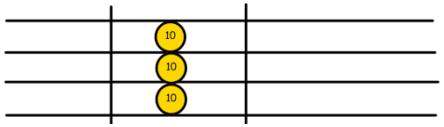


(96 divided by 3)

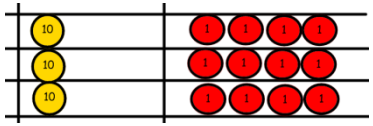
Use place value counters to divide using the bus stop method alongside



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.

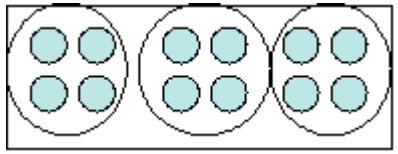


We exchange this ten for ten ones and then share the ones equally among the groups.



We look how much 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.

$$\begin{array}{r} 218 \\ 4\overline{)872} \\ \end{array}$$

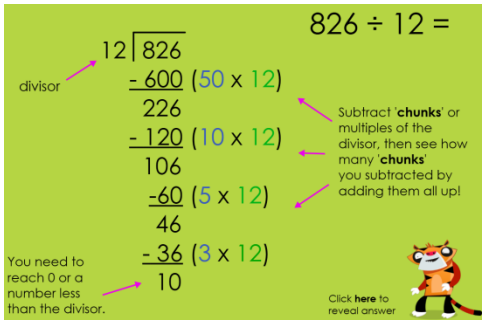
Move onto divisions with a remainder

$$\begin{array}{r} 86\ r\ 2 \\ 5\overline{)432} \\ \end{array}$$

Finally move into decimal places to divide the total accurately.

$$\begin{array}{r} 215.25 \\ 4\overline{)86\,^{2}1.\,^{1}0\,^{2}0} \\ \end{array}$$

When dividing by 2 digit divisors, children should use method of chunking e.g.

			 ***Remainders*** Quotients should eventually be expressed as fractions or decimal fractions e.g. 61 ÷ 4 = 15 ¼ or 15.25 Progress to the more formal compact bus stop method: 1 4 . 6 16 21 3 5 | 5 1 1 . 0