Kirkby Stephen Primary School

Calculation Methods Policy

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INTRODUCTION

The following calculation policy has been devised to meet requirements of the 2014 National Curriculum for the teaching and learning of mathematics and to give the pupils a consistent and smooth progression of learning in calculations across the school.

As children move through the school, they will build up a bank of strategies that can be applied when appropriate. This booklet outlines the written calculation methods that children will use from the start to the end of their time at Kirkby Stephen Primary School. They are not presented by level or year group, but rather as a progression that children can work through choosing the most efficient method for the problem being solved. Although this booklet summarises the core methods that will be used when calculating these will be accompanied by a range of different teaching strategies and activities.

The calculation methods currently taught in schools gradually build on the children's understanding over time. They have been introduced after research programmes have shown them to be effective. The aim is to teach children methods which they understand and can use correctly and confidently to solve problems.

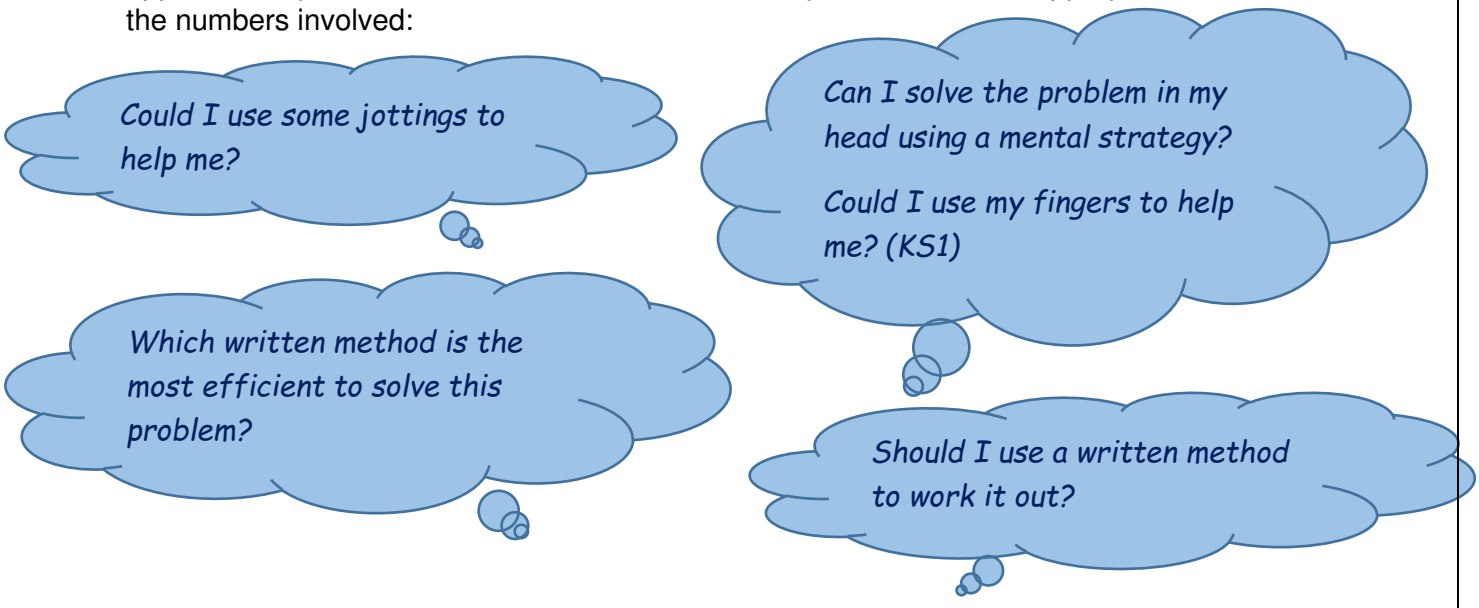
Parents and Carers

The methods used by children today are in many cases different from those used by adults when they were at school. This can cause anxiety with parents and carers who are unsure whether or not they should teach particular methods. If you are a parent or carer, as a general rule, if your child brings home some mathematics homework which involves calculations:

- Ask them to explain how they would solve this at school, and to explain to you the methods they have been taught (use this booklet to help.)
- If your child is unable to explain their method, or unsure what to do, the best advice is to contact your child's class teacher.

Choosing a calculation method

Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation to ensure they select the most appropriate method for the numbers involved:



ADDITION (+)

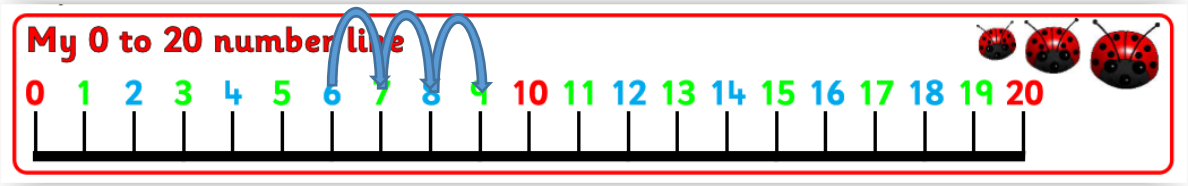
Addition Vocabulary

add, more, plus, and, make, sum, total, altogether, double, one more, two more, ten more……, how many more to make…?, how many more is…. than….?

Adding 2 single digit numbers together using a number line, ladder or track.

Children use number lines to add, by counting on in ones. Encourage children to start with the larger number and count on.

6 + 3 = 9 +1 +1 +1

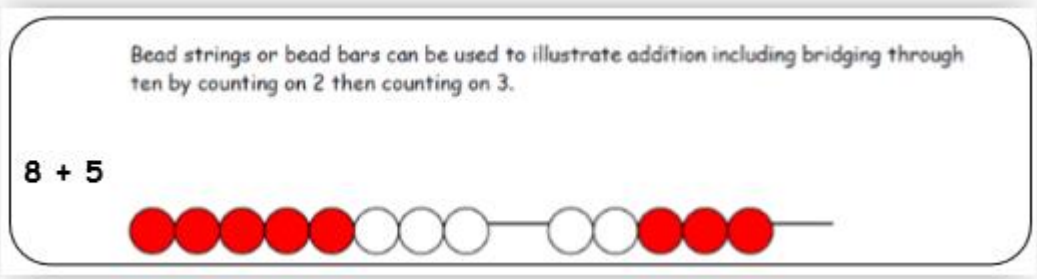


Children should:

- Have access to wide range of counting equipment, everyday objects, number tracks and number lines, and be shown numbers in different contexts.
- Read and write the additional (+) and equals (=) symbols within a number sentence.
- Interpret addition number sentences and solve missing box problems using concrete objects and number line addition to solve them:

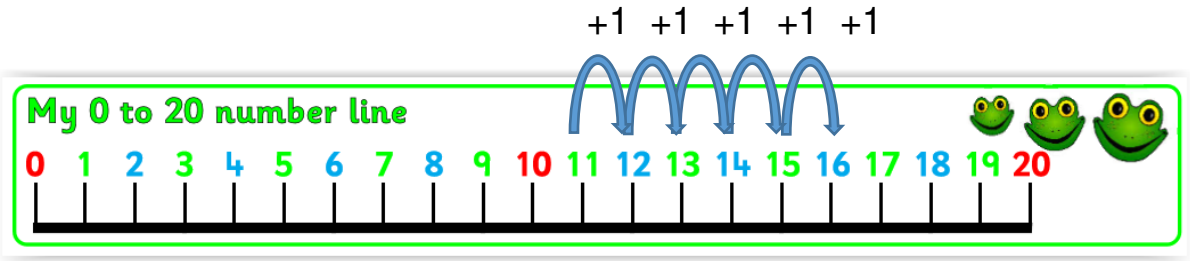
8 + 3 = ☐ 5 + 3 +1 = ☐ ☐ + ☐ = 6

This builds on from prior learning of adding by combining two sets of objects into one group (5 cubes and 3 cubes) in Early Years.

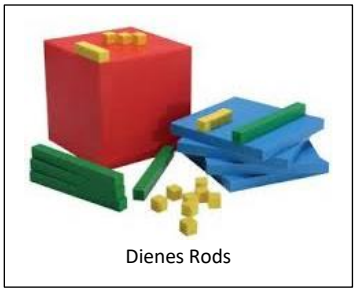


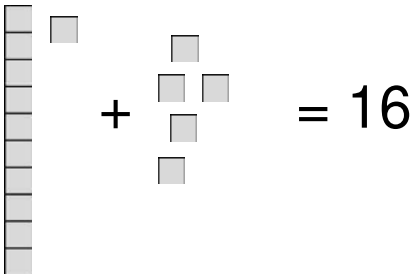
Adding a single digit number to a two-digit number.

Children use number lines to add, by counting on in ones. Encourage children to start with the larger number and count on.



Children will continue to use practical equipment, combining groups of objects to find the total by counting all or counting on. Using their developing understanding of place value, they will move on to be able to use 'Dienes Rods' to make teen numbers using separate tens and ones.

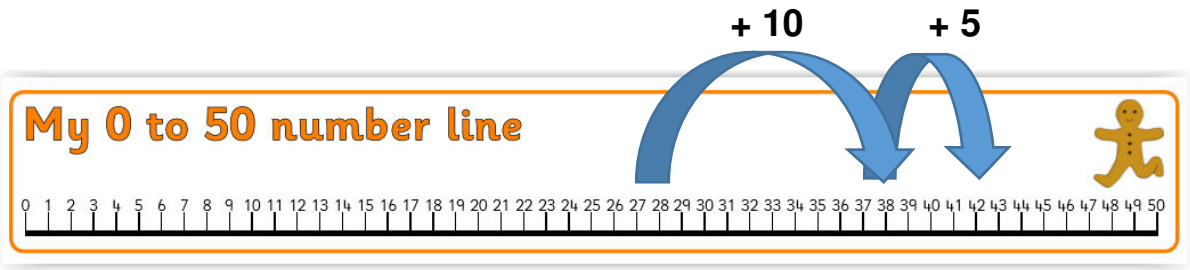

Dienes Rods



Adding two 2 digit numbers (TO + TO)

Children to use number lines to add, by counting on in tens first then counting on in ones. Encourage children to start with the larger number and count on.

27 + 15 =

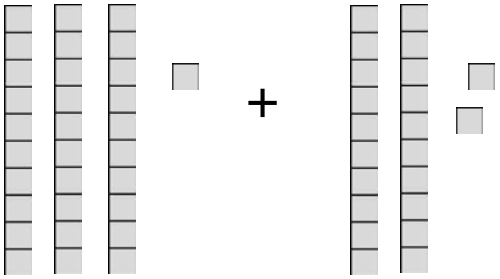


These calculations can also be carried out using a hundred square by finding the largest number, counting on the tens first then counting on in ones.

46 + 33 =

Children will continue to use 'Dienes Rods' to support their calculations by making the individual amounts, counting the tens first then counting the ones.

31 + 22 =



Children should now be using these calculation methods to begin to solve simple real life problems:

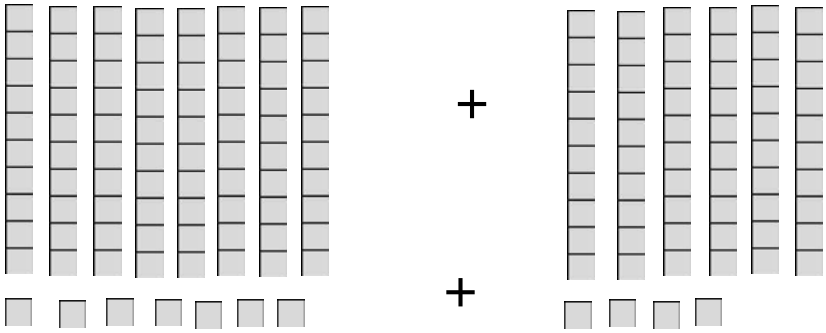
My sunflower is 47cm tall. My friend's is 25cm taller.
How tall is my friend's sunflower?

87 + 64 =

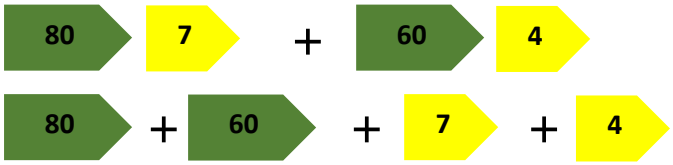
80 + 60 =

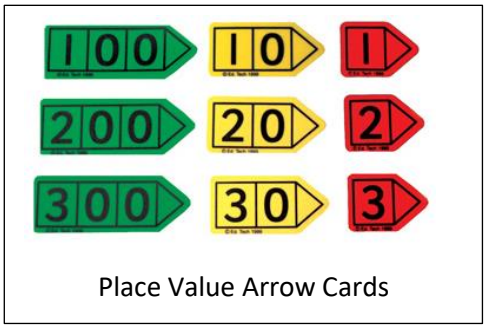
7 + 4 =

Children will continue to use 'Dienes Rods' to support their calculations by making the individual amounts, grouping the tens first then grouping the ones.



Place Value Arrow Cards should also be used to support children's learning.





Place Value Arrow Cards

Column Methods of Addition

Adding using partitioned column method.

Numbers are partitioned then set out in columns.

23 + 34 =

30 + 4

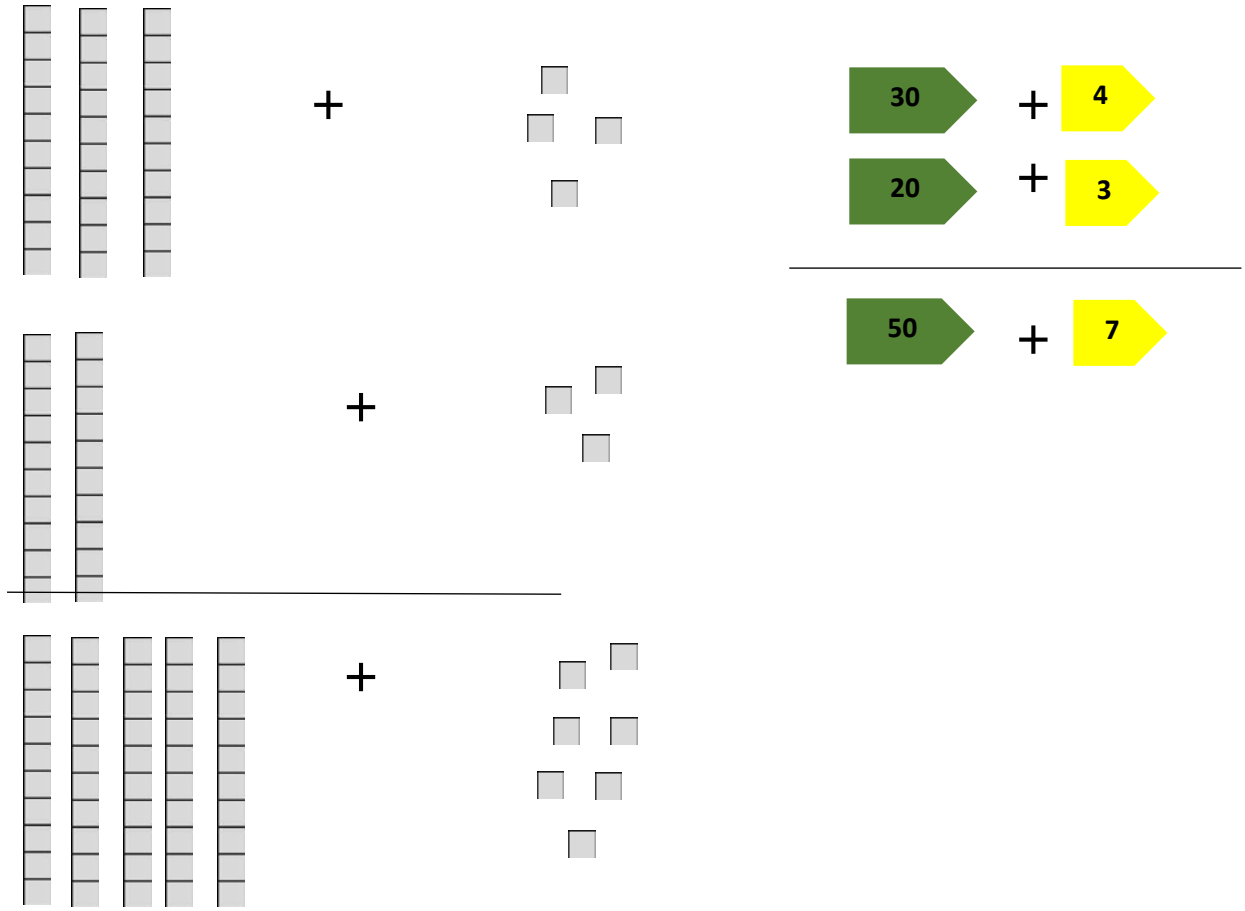
20 + 3

50 + 7

Initially children should only be given examples which do not cross the tens boundary. Only cross the boundary when they are secure with this method.

NOTE: Some children find it easier to put the largest number first/at the top as counting on from the largest number is more efficient. Higher ability children often don't need do this.

Children will continue to use ‘Dienes Rods’ and/or place value arrow cards to support their calculations by making the individual amounts and setting them out in columns.



Adding using expanded column method.

Children who are confident and accurate with the partitioned coloumn method (including crossing the tens boundary) should move on to the expanded column addition.

Dienes rods and place value arrow cards can still be used to support children’s learning but they should now be trying to move away from the use of concrete resources to more abstract thinking.

83 + 59 =

$$\begin{array}{r} 83 \\ +56 \\ \hline 9 \\ 130 \\ \hline 139 \end{array}$$

Add the ones first.

Then add the tens.

This is in preparation for the compact column addition method.

Adding using compact column method.

Once children are cofident and accurate with the partitioned column method they can move onto the compact column method, being introduced to 'carrying' for the first time.

236 + 73 =

```
  236
+  73
 309
   1
```

'Carry' numbers underneath the bottom line.

If children are consistently forgetting to add the 'carried' number encourage them to write it above:

```
  1
 236
+ 73
```

Add the ones first.

Then add the tens.
Ensure children use the actual values ***'3 tens and 7 tens equals 10 tens'***

This method is developed to use 4 or more digits and to add several numbers.

```
  3517
+  396
  3913
   1 1
```

```
   463
   257
+  345
  1065
  1 1 1
```

Pupils should be able to add more than two values carefully aligning place value columns.

```
  19·01
   3·65
+  0·70
 23·36
```

Ensure children are using the actual values ***'6 tenths add 7 tenths'*** and ***'1 hundredth at 5 hundredths'***

Empty decimal places can be filled with zero (place holder) to show the place value in each column.

```
    1 1
    23·3 6 1
      9·0 8 0
    59·7 7 0
+     1·3 0 0
    ---------
    93·5 1 1
    2 1  2
```

This method is developed to use when adding several numbers with different decimal places.

Problem Solving Using Column Methods

Children should be confident in solving problems using each column addition method before moving onto the next method. Problems should include money and measure problems.

When measuring a room, Mark found that the room was a strange size. One wall was 16.02m, one wall was 22.09m, one was 13.98m and one was 23.55m. What was the perimeter of the room?

SUBTRACTION (-)

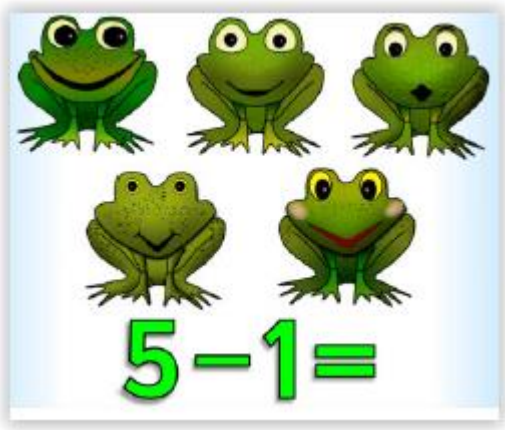
Subtraction Vocabulary

Take, take away, less, minus, subtract, leaves, distance between, difference between, how many more, how many fewer/less, count back, how many left, how much less is….?, exchange, decrease.

Subtracting one through use of songs

Songs are used to help children learn how to subtract one initially from 5 then from 10.

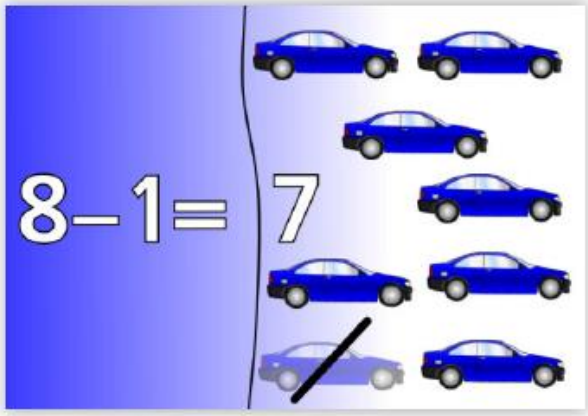
5 Little Speckled Frogs, 5 Little Ducks etc.



Using Objects to subtract a 1 digit number from a 1 digit number (U-U).

Children use practical objects to 'take away' a given number of objects. This is then developed to show the corresponding written calculation.

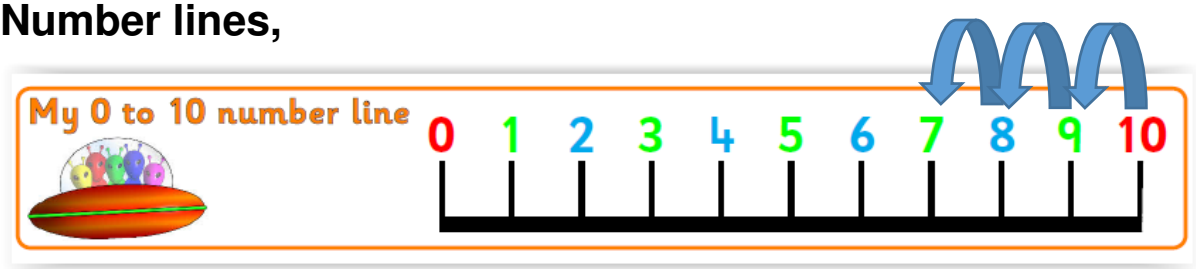
5 - 1 = 4



Counting back using number lines, bead bars, counting sticks and number squares.

Children develop their understanding of subtraction practically by counting back using number lines, bead bars/strings, counting sticks.

Number lines,



Bead bars & Bead Strings

Bead Bar

Children's Bead Strings

Counting sticks & Number Squares.

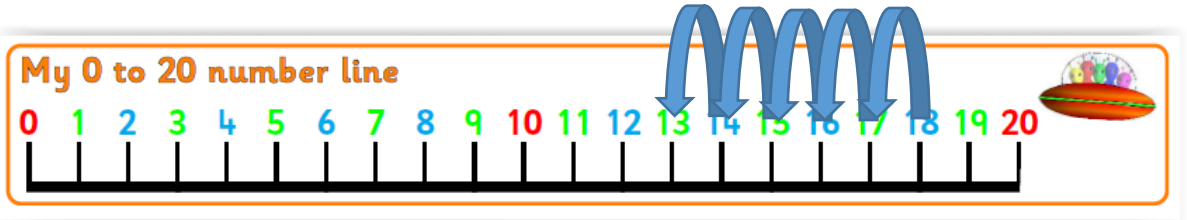
See NCETM Video on school server:
Staff (W):\MATHEMATICS\NCETM Videos\Subtraction\Counting on in Steps of one and ten.
This video can also be viewed online at: https://vimeo.com/70320279

Subtracting a 1 digit number from a 2 digit number (TU-U).

Children consolidate their understanding of subtraction practically using number lines, bead bars/strings and counting sticks and are introduced to more formal recording by counting back in ones on a number line.

Initially children should only be given examples which do not cross the tens boundary. Only cross the boundary when they are secure with this method.

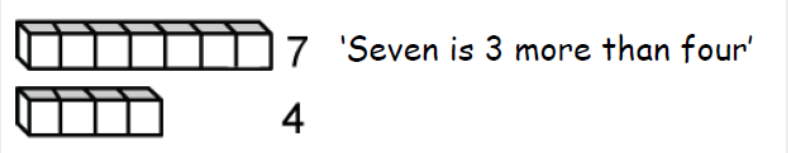
18 – 5 = 13



A 100 square can also be used for this but it is more difficult for younger/less able children to use these when crossing a tens boundary.

67 – 3 = 64

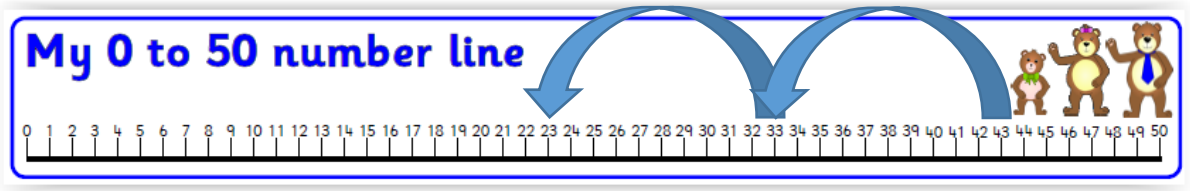
Blocks, multilink and Dienes rods (the unit cubes) can be used to introduce children to the subtraction language *'Find the distance'*, '*Find the difference'* and *'How many more?'*



Subtracting a 2 digit number from a 2 digit number (TU-TU).

Children subtract counting back in tens then ones. To develop their understanding of subtracting 2 digit numbers children move from subtracting ones to subtracting multiples of 10.

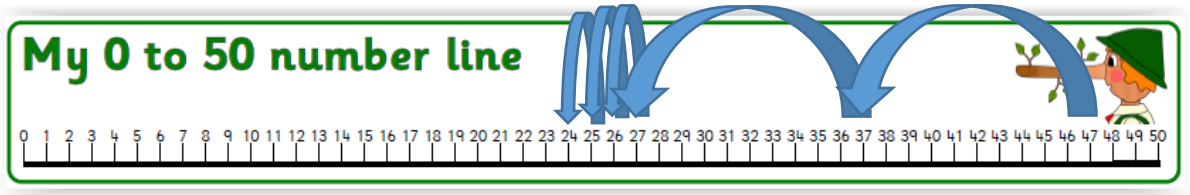
43 – 20 = 23



Children then move on to use partitioning (second number only) to subtract any 2 digit number. Place value arrow cards are useful to support this.

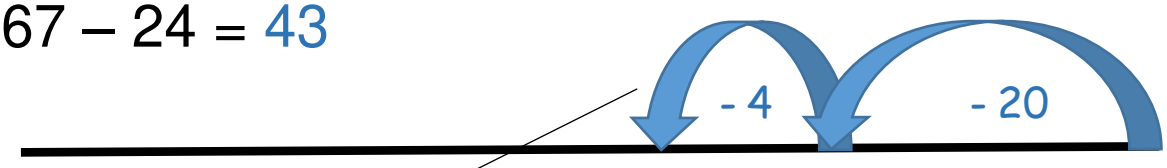
47 – 23 = 24

47 - 20 3 = 24



As children's confidence grows they should be encouraged to move away from using number lines to drawing their own number lines:

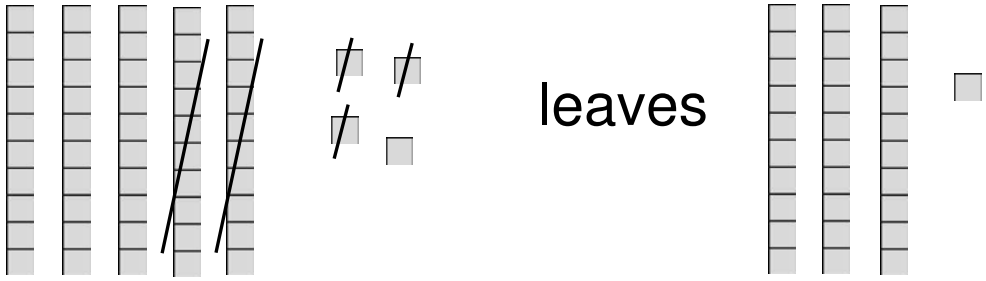
67 – 24 = 43



Some children may still need to count back in ones at this stage.

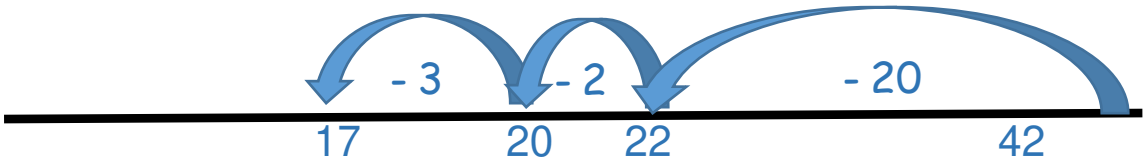
Throughout these stages children should use 'Dienes Rods', still using the take away or remove method, to support their understanding.

54 – 23 = 31



Children who are confident should then move on to bridging the tens boundary.

42 – 25 = 17



Children should be using these calculation methods to begin to solve simple real life problems:

I cut 27cm off a ribbon measuring 84cm.
How much ribbon is left?

Subtracting with 2 or 3 digit numbers by 'Counting On'.

Children who have a clear understanding of subtraction can be introduced to subtraction by counting on from the smallest number. This method is more efficient when carrying out:

- Calculations when the numbers are close together.
- Mental calculations

45 – 42 = 3

130 – 117 = 13

Column Methods of Subtraction

IMPORTANT: Children should be able to apply their knowledge of a range of mental strategies, mental recall skills, informal and formal written methods when selecting **the most appropriate method** to work out subtraction problems. In some instances the column method is not the most efficient method and children should be encouraged to continue to use 'counting on' as a strategy. These include:

- Close together numbers (121 – 118)
- Numbers that are multiples of, or near to multiples of 10, 100, 1000 (1001 – 873)
- Calculating change from £1, £5, £20 etc.
- Differences of time.

When carrying out column methods of subtraction children should be able to **check their answers** using the inverse operation (addition).

Subtracting using partitioned column method.

Numbers are partitioned before being set out in columns.

See NCETM Video on the school server:
Staff (W):\MATHEMATICS\NCETM Videos\Subtraction\Partitioning
This video can also be viewed online at: https://vimeo.com/70096846

Initially children should only be given examples which do not cross the tens boundary. Only cross the boundary when they are secure with this method.

89 – 35 = 54

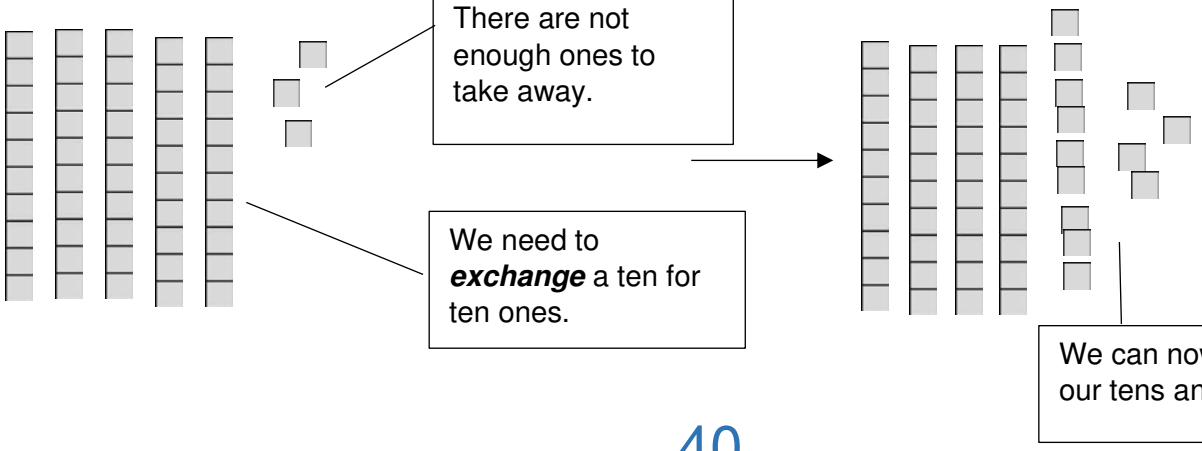
	80	+	9
-	30	+	5
	50	+	4

Children should subtract the ones column first.

Dienes Rods or Place Value Counters can be used at this stage. Children who are confident in the use of this method should move onto calculations which cross the tens boundary. 'Dienes Rods' and/or 'Place Value Counters' should continue to be used to introduce the language of **'exchange'** linking this to the column method.

See NCETM Video on the school server for use of Place Value Counters:
Staff (W):\MATHEMATICS\NCETM Videos\Subtraction/Developing Column Subtraction
This Video can also be seen online at: https://vimeo.com/70316060

53 – 26 = 27



$$\begin{array}{r} 50 + 3 \\ -\ 20 + 6 \\ \hline \end{array} \longrightarrow \begin{array}{r} \overset{40}{\cancel{50}} + 13 \\ -\ 20 + 6 \\ \hline 20 + 7 \end{array}$$

Children should subtract the ones column first.

Once pupils have a secure understanding of 'exchanging' they can use the partitioned method to subtract any 2 and 3 digit numbers.

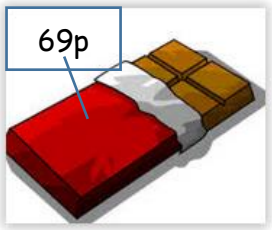
238 – 146 = 92

$$\begin{array}{r} 200 + 30 + 8 \\ -\ 100 + 40 + 6 \\ \hline \end{array} \longrightarrow \begin{array}{r} \overset{100}{\cancel{200}} + 130 + 8 \\ -\ 100 + 40 + 6 \\ \hline 0 + 90 + 2 \end{array}$$

Children can continue to use Dienes Rods or Place Value Counters to support their understanding if necessary.

Children should use these methods to solve one and two step problems, involving measures including money.

David has £1.85. He buys a chocolate bar for 69p.
How much money does David have left?



70

£1 + ~~80~~ + 15

− 60 + 9

£1 + 10 + 6

Subtracting using compact column method.

Once children are cofident and accurate with the partitioned column method they can move onto the compact column method. Children who are still not secure with number facts and place value will need to remain on the partitioned column method until ready for the compact method.

To introduce the compact method (decomposition):
Perform a subtraction calculation with the familiar partitioned column method then display the compact version of the same calculation. Ask children to consider how it relates to the method they know, what is similar and what is different, to develop an understanding of this.

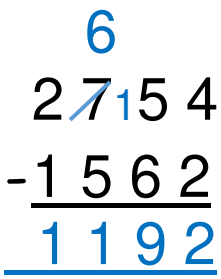
See NCETM Video on the school server
Staff (W):\MATHEMATICS\NCETM Videos\Subtraction\Column Subtraction.
This video can also be viewed online at: https://vimeo.com/70316466

3
3 ~~4~~ 16
-2 2 8
1 1 8

Subtract the ones first, then the tens.

Ensure children use the actual values ***'16 subtract 2 equals 3'*** and '***3 tens subtract 2 tens equals 1 ten'.***

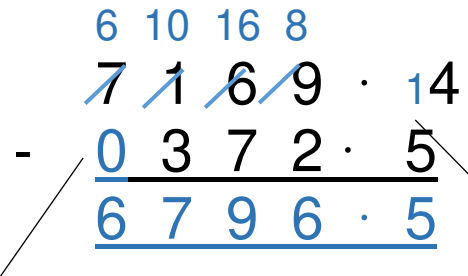
As children become more confident they are able to subtract with larger integers.



Subtract the ones first, then the tens.

Ensure children use the actual values:
'4 subtract 2 equals 2'
'15 tens subtract 6 tens equals 9 tens'
'6 hundreds subtract 5 hundreds equals 1 hundred'
'2 thousands subtract 1 thousand equals 1 thousand.

Subtracting numbers with decimals using the column method.



Empty decimal places can be filled with zero (place holder) to show the place value in each column.

Ensure children use the actual values:
'14 tenths subtract 5 tenths equals 5 tenths'
'8 subtract 2 equals 6'
'16 tens subtract 7 tens equals 9 tens'
'10 hundreds subtract 3 hundreds equals 7 hundreds'
'2 thousands subtract 1 thousand equals 1 thousand.

Children will practice using these methods to solve a variety of problems incluidng money and measures and decimals with different numbers of decimal places.

A shop sells three types of sunglasses.

What is the difference in price between the most expensive and least expensive sunglasses?

As pupils confidence grows they will progress to using the compact column method to subtract more complex integers.

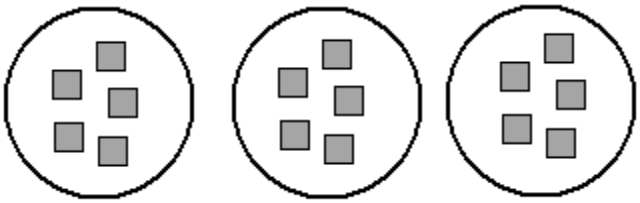
MULTIPLICATION (X)

Multiplication Vocabulary

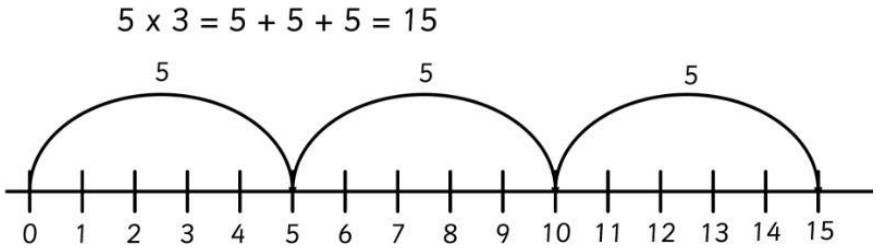
groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups of, …times as big as, twice, three times…., partition, grid method, multiple, product.

Counting in 2s, 5s and 10s

Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups. They develop their understanding of multiplication and use jottings to support calculation. They will understand multiplication as repeated addition: 3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 3 x 5.



Repeated addition should be shown on a number line, on a bead string and using Numicon:

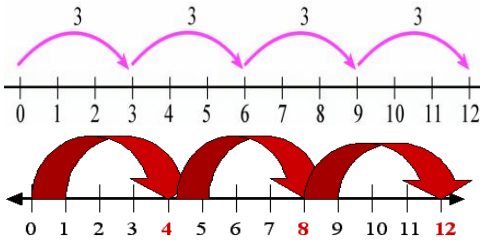


Children should be presented with practical problem-solving activities involving counting equal sets or groups: Children should have access to a wide range of counting equipment, everyday objects, number tracks and number lines, and be shown numbers in different contexts.

There are 5 crayons in a packet. How many crayons will 3 packets have?

Multiplying using repeated addition, arrays and commutativity

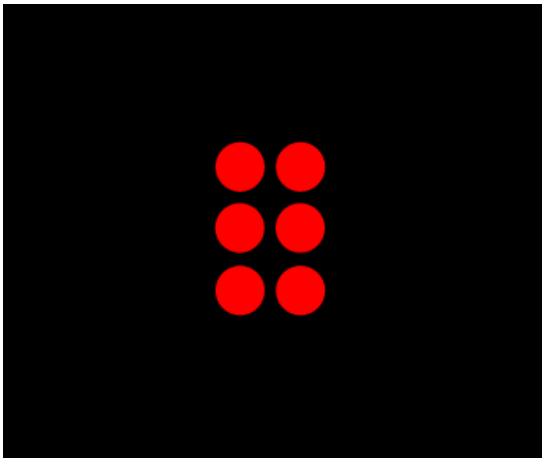
Children use repeated addition, commutativity and arrays to develop their understanding of multiplication. Repeated addition and commutativity can be modelled on an 'empty number line', e.g. 3 lots of 4 is the same as 4 lots of 3:



IS THE SAME AS

Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method:

3x2 = 6



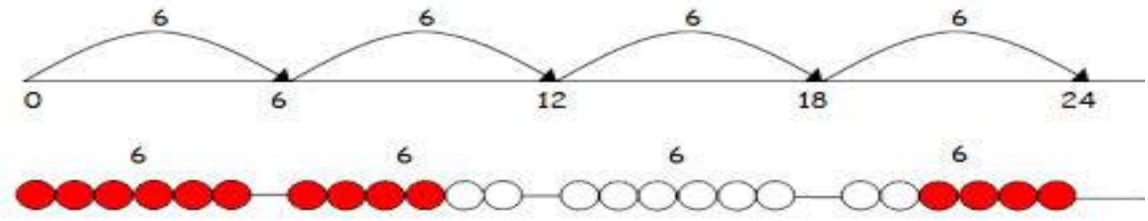
2x3 = 6

They should also use practical apparatus such as bead strings and Numicon:

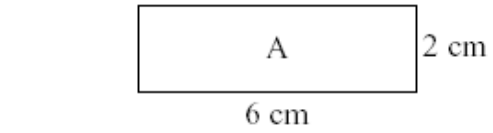
Children should also be encouraged to multiply on their hands i.e. 4 x 5, count in 5's 4 times.

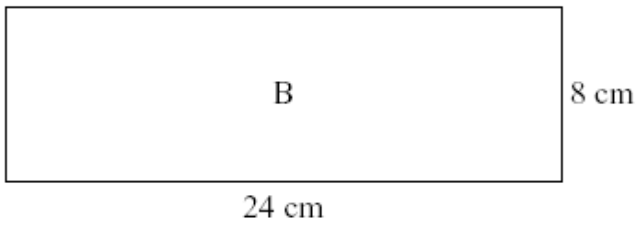
Mulitplying 2 digit numbers by 1 digit numbers

Moving into Year 3, children will continue to use informal models for multiplication, including the use of partitioning. They will be introduced to the grid method when appropriate. Children continue to use repeated addition, using empty number lines and bead strings to support their understanding:



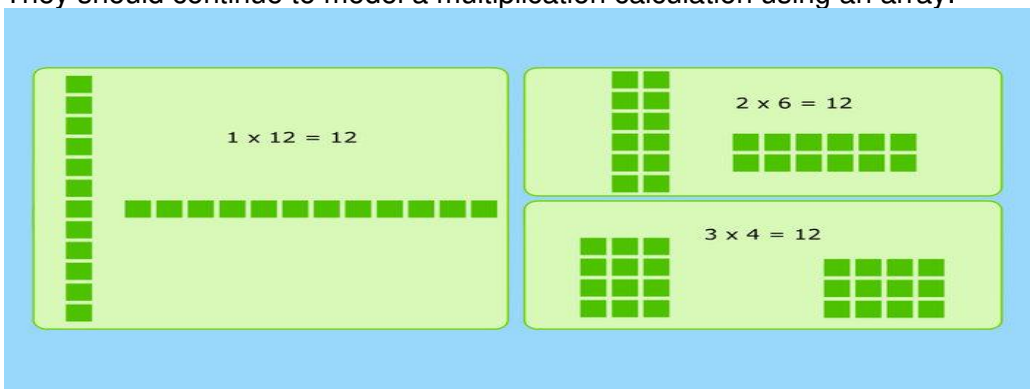
They will develop an understanding of scaling:





(All sides multiplied by 4)

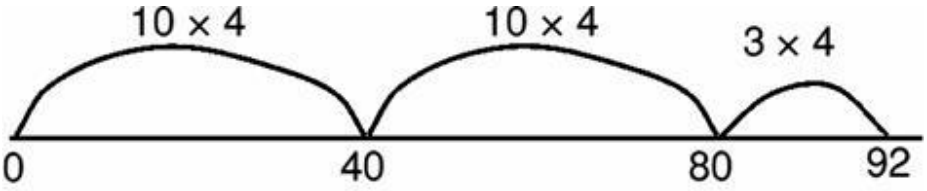
They should continue to model a multiplication calculation using an array:



They use an informal written method involving partitioning:

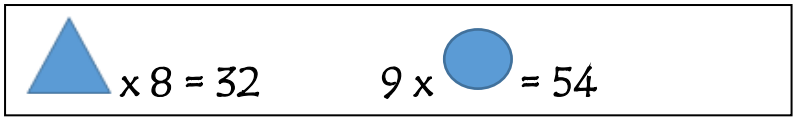
27 x 5 = (20x5) + (7x5)
= 100 + 35
= 135

Or on a number line by partitioning tens and ones. For example, 23 x 4 would look like:

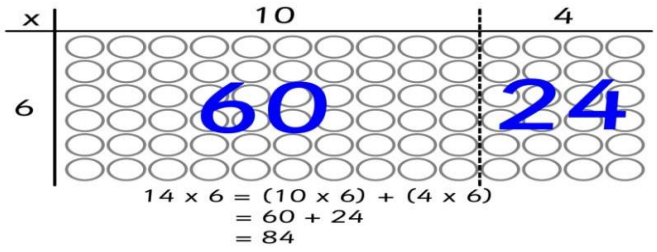


so 23 × 4 = (10 × 4) + (10 × 4) + (3 × 4) = 92
(using repeated addition in order to multiply)

They will use symbols to stand for unknown numbers to complete equations using inverse operations:

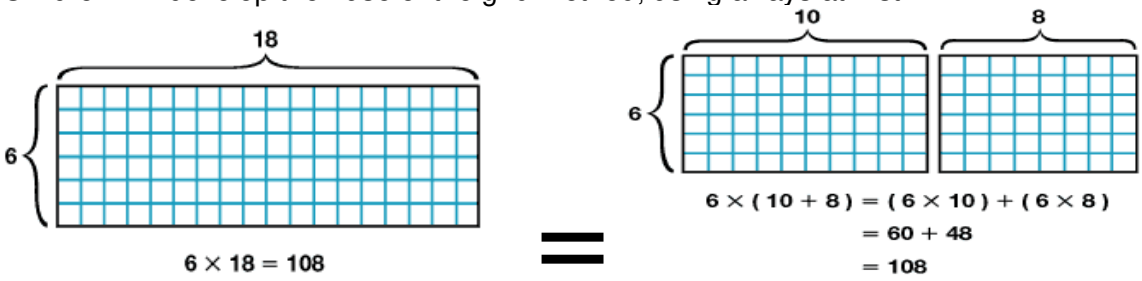


They will be introduced to the grid method if appropriate, linked to the use of an array:



Becoming more secure in using the grid method

Children will develop their use of the grid method, using arrays at first:



Then by partitioning 2 digit numbers into tens and ones:

23x5 = (20+3)x5

x	20	3
5	100	15

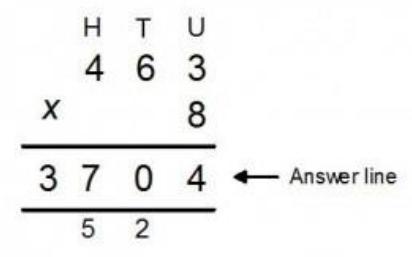
100+15=115

Children who are confident and accurate when multiplying 2 and 3-digit numbers by a single digit this way, and who are already confident in 'carrying' for written addition, can be introduced to short, or compact, multiplication:

23

X 5
115
1

This can be extended to multiplying 3 or 4 digit numbers by a single digit:



More formal methods of multiplication

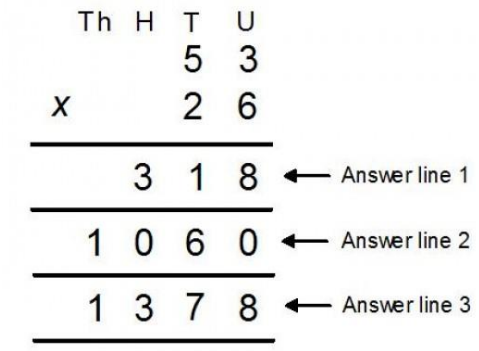
Before moving on to long multiplication (multiplying by 2 or 3 digit numbers), it is helpful for the children to see this represented in a grid:

53 x 26 = (50+3) x (20+6)

x	50	3
20	1000	60
6	300	18

1000+300=1300
60+18=78
1300+78=1378

They will be introduced to long multiplication if appropriate:
Answer line 1 shows 53 x 6, or 53 x the ones of the bottom number.
Answer line 2 shows 53 x 20, or 53 x the tens of the bottom number.
A place holder of 0 must be inserted in the ones column to reflect this and children should understand why.
Answer line 3 shows the two answer lines added together (final answer).



Multiplying decimals

Children will use the formal methods for short and long multiplication to answer questions involving more complex numbers including decimals. Children should take care to ensure that the place value columns are aligned:

```
   5.24
X  6
 31.44
   1 2
```

When multiplying pairs of decimals, they must continue to approximate first:

Round both factors down.			Round both factors up.		
44.8	→	40	44.8	→	50
x 15.4	→	x 10	x 15.4	→	x 20
		400			1000

The product of 44.8 and 15.4 ranges from 400 to 1000.

Children should be given the opportunity to apply the above methods in a range of real-life situations, especially involving money and measures.

DIVISION (÷)

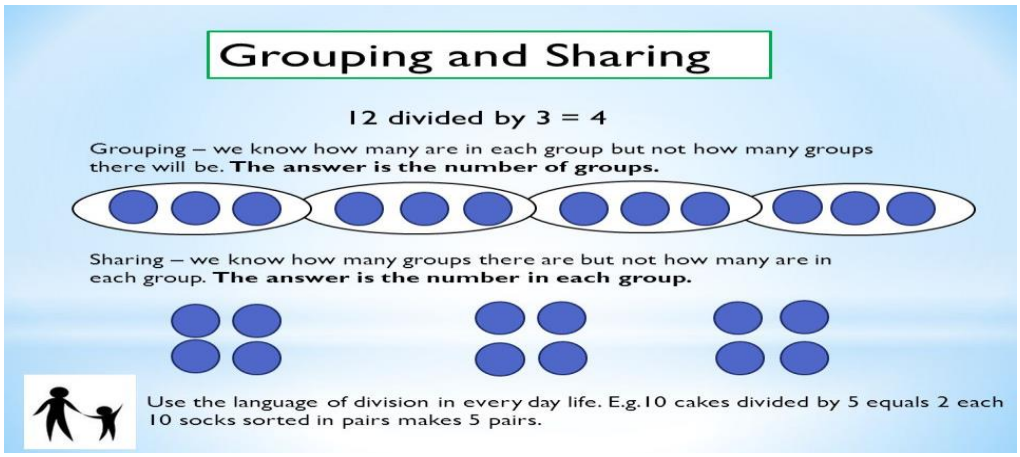
Division vocabulary

share, share equally, one each, two each…, group, groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over, inverse, chunking, carry, remainder, multiple, divisible by, factor, short division, quotient, prime number, prime factors, composite number (non-prime), common factor

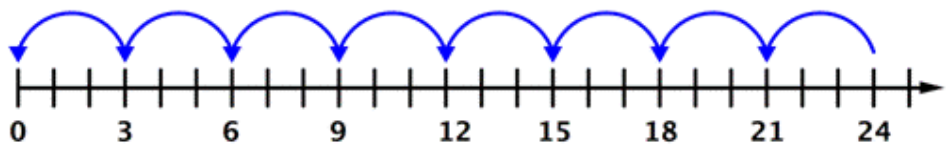
Grouping and sharing small quantities

Children will use objects, diagrams and pictorial representations to solve problems involving both grouping and sharing. They will understand equal groups and share items out in play and problem solving.

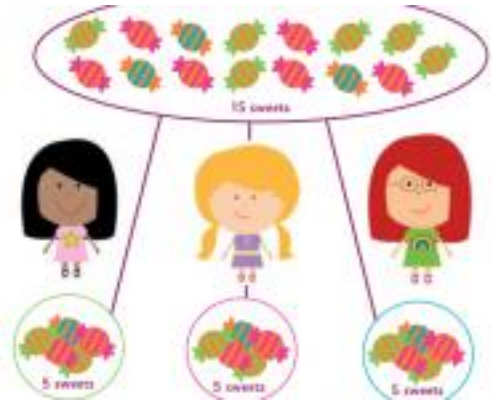
They put 12 sweets into groups of 3 and count the number of groups.
They will share a set of objects equally:
12 sweets shared between 3 people – how many will they each get?



They will understand division as repeated subtraction, which should be shown on a number line, on a bead string and using Numicon. For example, for 24 ÷ 3, count back in 3s from 24 and count how many 'hops' back to 0. 24 ÷ 3 = 8 'hops'.

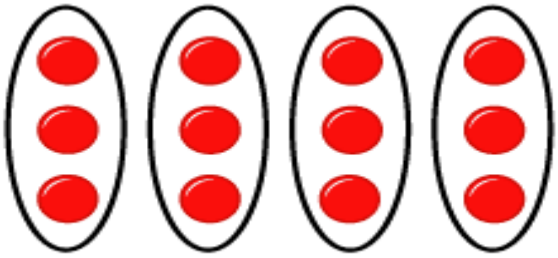


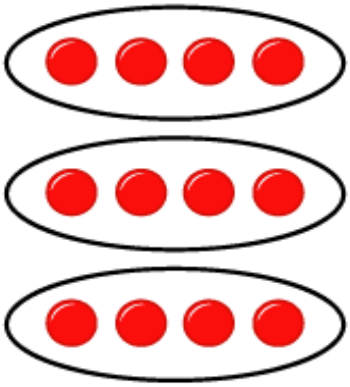
Children should have access to a wide range of counting equipment, everyday objects, number tracks and number lines, and be shown numbers in different contexts. Children should be presented with practical problem-solving activities involving counting equal sets or groups:



Dividing using arrays

Children should be able to model a division calculation using an array. This represents 12 ÷ 3, posed as how many groups of 3 are in 12? Pupils should also show that the same array can represent 12 ÷ 4 = 3 if grouped horizontally:





12 ÷ 4 = 3

12 ÷ 3 = 4

They should understand the difference, and the relationship, between grouping and sharing:

- *Six sweets are shared between two people. How many will they each get?*
- *There are six sweets. How many people can have two each?*

They will use symbols to stand for unknown numbers to complete equations using inverse operations:

□ ÷ 2 = 4

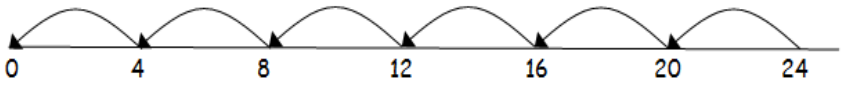
20 ÷ △ = 4

□ ÷ △ = 4

Moving on to remainders and ‘chunking’

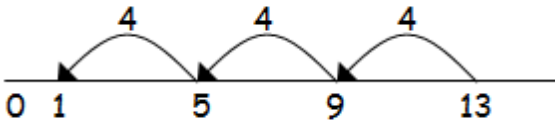
Children will continue to use repeated subtraction on an empty number line to divide. They will begin to use a more formal written method (‘chunking’) when dividing larger numbers where there is no remainder.

24÷4 = 6



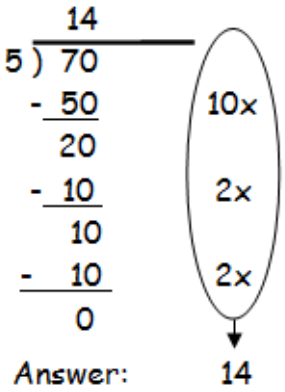
They will extend this method to calculations where there is a remainder:

13 ÷ 4 = 3 r 1



Once children are secure with division as grouping and can demonstrate this using number lines, arrays etc., a more formal written method (‘chunking’) should be introduced, initially with carefully selected examples which have no remainders:

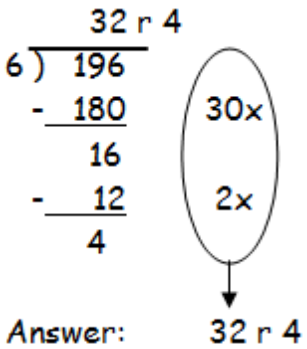
70 ÷ 5



Dividing up to 3 digit numbers by a single digit

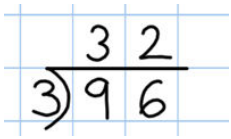
They will develop their understanding of chunking, including calculations which have a remainder:

196 ÷ 6

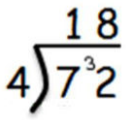


Short division

Children who are confident **and** accurate when dividing 2 and 3-digit numbers by a single digit this way can be introduced to short division:
They should start with numbers that do not involve carrying (each digit is a multiple of the divisor).



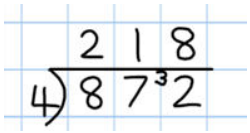
They will extend this method to calculations where there is no remainder in the final answer, but with remainders occurring within the calculation:



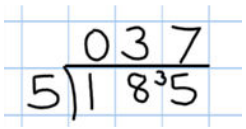
Children should be given the appropriate level of challenge, including questions that include money and measures contexts once they become increasingly confident.

Children will develop their understanding of short division and extend the method to more complex calculations. They will continue to use chunking for long division. They must be taught to approximate first in order to minimise errors.

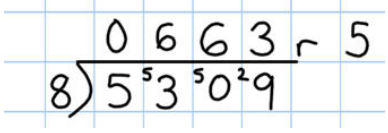
Children move onto dividing numbers with up to 3-digits by a single digit:



When the answer for the first column is zero, children should write a zero above to acknowledge its place, and must always carry the number over to the next digit as a remainder:



When confident, they can extend the method to calculations involving remainders. They should use the context of the question to interpret the remainder appropriately:

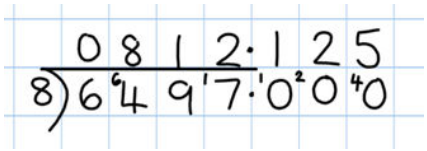


Children should continue to practise chunking as a formal written method for long division (when dividing by a 2-digit number).

Dividing at least 4-digit numbers by a 1 or 2-digit number

Children will use the formal methods for short and long division to answer questions involving more complex numbers. They must continue to approximate first.
When given examples that give rise to remainders, children should consider the meaning of the remainder within the context of the problem and decide how to express it, i.e. as a fraction, a decimal, or as a rounded number.

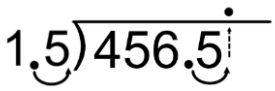
The dividend (number to be divided) can be written to 3 decimal places when children wish to express the answer as a decimal:



When dividing a decimal by a whole number the decimal points in the dividend and answer should always line up, as follows:

To divide a decimal by a decimal children need to make both the dividend and divisor whole numbers by moving the decimal points the same number of places. So 456.5 ÷ 1.5 becomes 4565 ÷ 15.

When there is a decimal in the divisor:



- Move the decimal in the divisor all the way to the right.
- Move the decimal in the dividend the same number of places.

This Policy was ratified by Governors on the

Signed: ----------

(Chair of Governors)

Policy to be reviewed in February 2025