



Arreton St. George's C.E. Primary School

Calculation Policy

The following Calculation Policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school.

Age Stage Expectations

The Calculation Policy is organised according to age stage expectations as set out in the National Curriculum 2014, however it is vital that pupils are taught according to the stage that they are currently working at, being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

Providing a context for calculation

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons.

Choosing a calculation method

Children need to be taught and encouraged to use a range of processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved. Methods can include mental strategies, using jottings to support calculations or written methods.

Progression Towards a Written Method for Addition

Year 1

± signs and missing numbers

Children need to understand the concept of equality before using the '=' sign. Calculations should be written either side of the equality sign so that the sign is not just interpreted as 'the answer'.

$$2 = 1 + 1$$

$$2 + 3 = 4 + 1$$

Missing numbers need to be placed in all possible places.

$$3 + 4 = \quad = 3 + 4$$

$$3 + \quad = 7 \quad 7 = \quad + 4$$

Counting and Combining sets of Objects

Combining two sets of objects (aggregation) which will progress onto adding on to a set (augmentation)

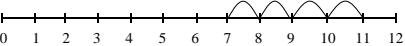


Understanding of counting on with a numbertrack.



Understanding of counting on with a numberline (supported by models and images).

$$7 + 4$$

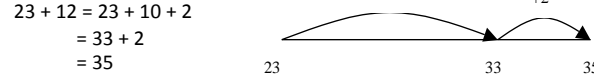


Year 2

Missing number problems e.g. $14 + 5 = 10 + \quad$ $32 + \quad = 100$
 $35 = 1 + \quad + 5$

It is valuable to use a range of representations (also see Y1). Continue to use numberlines to develop understanding of:

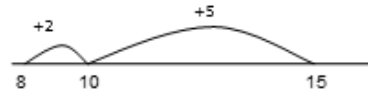
Counting on in tens and ones



Partitioning and bridging through 10.

The steps in addition often bridge through a multiple of 10 e.g. Children should be able to partition the 7 to relate adding the 2 and then the 5.

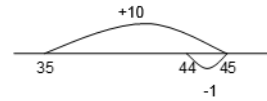
$$8 + 7 = 15$$



Adding 9 or 11 by adding 10 and adjusting by 1

e.g. Add 9 by adding 10 and adjusting by 1

$$35 + 9 = 44$$

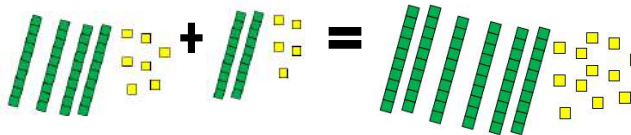


Towards a Written Method

Partitioning in different ways and recombine

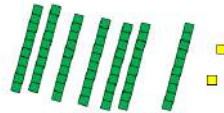
$$47 + 25$$

$$47 \quad 25 \quad 60 + 12$$



Leading to exchanging:

$$72$$



Expanded written method

$$40 + 7 + 20 + 5 =$$

$$40 + 20 + 7 + 5 =$$

$$60 + 12 = 72$$

$$\begin{array}{r} 40 + 7 \\ + 20 + 5 \\ \hline 60 + 12 = 72 \end{array}$$

Year 3

Missing number problems using a range of equations as in Year 1 and 2 but with appropriate, larger numbers.

Partition into tens and ones.

Partition both numbers and recombine.

Count on by partitioning the second number only e.g.

$$247 + 125 = 247 + 100 + 20 + 5$$

$$= 347 + 20 + 5$$

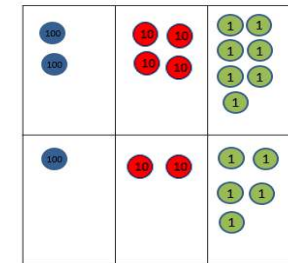
$$= 367 + 5$$

$$= 372$$

Children need to be secure adding multiples of 100 and 10 to any three-digit number including those that are not multiples of 10.

Towards a Written Method

Introduce expanded column addition modelled with place value counters (Dienes could be used for those who need a less abstract representation)



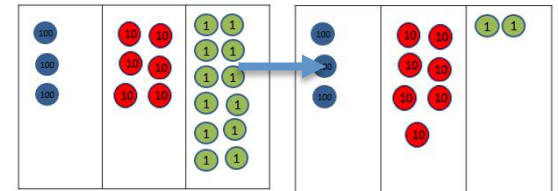
$$200 + 40 + 7$$

$$100 + 20 + 5$$

$$\hline 300 + 60 + 12 = 372$$

$$\begin{array}{r} 247 \\ + 125 \\ \hline 12 \\ 60 \\ \hline 300 \\ 372 \end{array}$$

Leading to children understanding the exchange between tens and ones.



Some children may begin to use a formal columnar algorithm, initially introduced alongside the expanded method. The formal method should be seen as a more streamlined version of the expanded method, not a new method.

$$\begin{array}{r} 247 \\ + 125 \\ \hline 372 \\ \hline 10 \end{array}$$

Progression Towards a Written Method for Addition

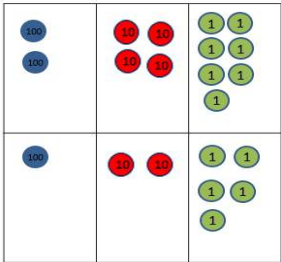
Year 4

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line.

Written methods (progressing to 4-digits)

Expanded column addition modelled with place value counters, progressing to calculations with 4-digit numbers.

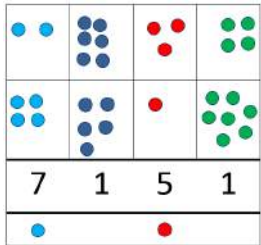


$$\begin{aligned} 200 + 40 + 7 \\ 100 + 20 + 5 \\ 300 + 60 + 12 = 372 \end{aligned}$$

$$\begin{array}{r} 247 \\ +125 \\ \hline 12 \\ 60 \\ 300 \\ \hline 372 \end{array}$$

Compact written method

Extend to numbers with at least four digits.



$$\begin{array}{r} 2634 \\ +4517 \\ \hline 7151 \\ \hline \end{array}$$

Children should be able to make the choice of reverting to expanded methods if experiencing any difficulty.

Extend to up to two places of decimals (same number of decimals places) and adding several numbers (with different numbers of digits).

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

Year 5

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line. Children should practise with increasingly large numbers to aid fluency e.g. $12462 + 2300 = 14762$

Written methods (progressing to more than 4-digits)

As year 4, progressing when understanding of the expanded method is secure, children will move on to the formal columnar method for whole numbers and decimal numbers as an efficient written algorithm.

$$\begin{array}{r} 172.83 \\ + 54.68 \\ \hline 227.51 \\ \hline 1 \quad 1 \quad 1 \end{array}$$

Place value counters can be used alongside the columnar method to develop understanding of addition with decimal numbers.

Year 6

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line.

Written methods

As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with columnar method to be secured.

Continue calculating with decimals, including those with different numbers of decimal places

Problem Solving

Teachers should ensure that pupils have the opportunity to apply their knowledge in a variety of contexts and problems (exploring cross curricular links) to deepen their understanding.

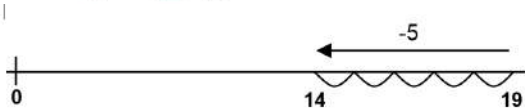
Progression Towards a Written Method for Subtraction

Year 1

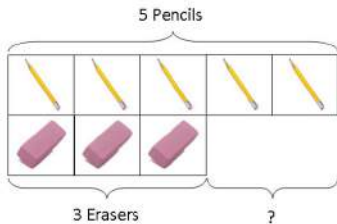
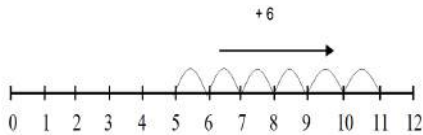
Missing number problems e.g. $7 = \square - 9$; $20 - \square = 9$; $15 - 9 = \square$;
 $\square - \square = 11$; $16 - 0 = \square$

Use concrete objects and pictorial representations. If appropriate, progress from using number lines with every number shown to number lines with significant numbers shown.

Understand subtraction as take-away:



Understand subtraction as finding the difference:

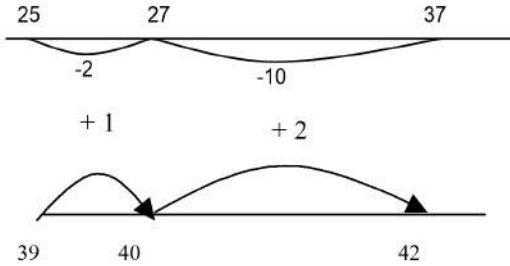


The above bar model would be introduced with concrete objects which children can move (including cards with pictures) before progressing to pictorial representation. The use of other images is also valuable for modelling subtraction e.g. Numicon, bundles of straws, Dienes apparatus, multi-link cubes, bead strings

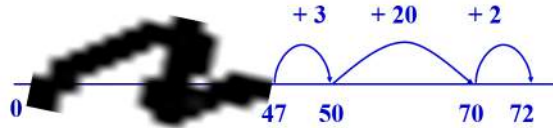
Year 2

Missing number problems e.g. $52 - 8 = \square$; $\square - 20 = 25$; $22 = \square - 21$; $6 + \square + 3 = 11$

It is valuable to use a range of representations (also see Y1). Continue to use number lines to model take-away and difference. E.g.



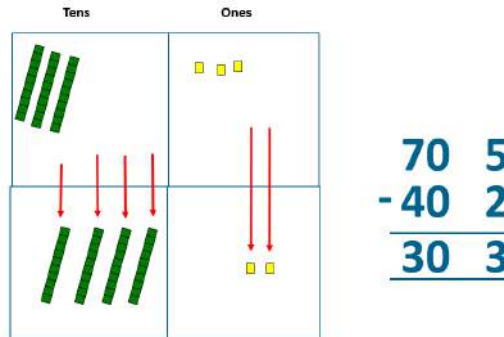
The link between the two may be supported by an image like this, with 47 being taken away from 72, leaving the difference, which is 25.



The bar model should continue to be used, as well as images in the context of **measures**.

Towards written methods

Recording addition and subtraction in expanded columns can support understanding of the quantity aspect of place value and prepare for efficient written methods with larger numbers. The numbers may be represented with Dienes apparatus. E.g. $75 - 42$



Year 3

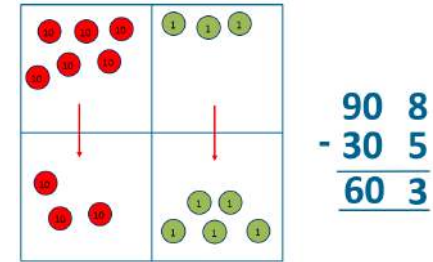
Missing number problems e.g. $\square = 43 - 27$; $145 - \square = 138$; $274 - 30 = \square$; $245 - \square = 195$; $532 - 200 = \square$; $364 - 153 = \square$

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving (see Y1 and Y2).

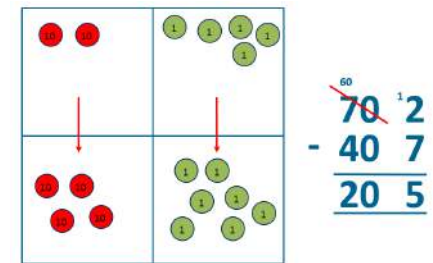
Children should make choices about whether to use complementary addition or counting back, depending on the numbers involved.

Written methods (progressing to 3-digits)

Introduce expanded column subtraction with no decomposition, modelled with place value counters (Dienes could be used for those who need a less abstract representation)



For some children this will lead to exchanging, modelled using place value counters (or Dienes).



A number line and expanded column method may be compared next to each other.

Some children may begin to use a formal columnar algorithm, initially introduced alongside the expanded method. The formal method should be seen as a more streamlined version of the expanded method, not a new method.

Progression Towards a Written Method for Subtraction

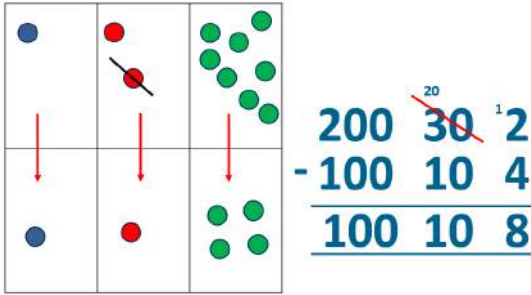
Year 4

Missing number/digit problems: $456 + \square = 710$;
 $1\square7 + 6\square = 200$; $60 + 99 + \square = 340$; $200 - 90 - 80 = \square$;
 $225 - \square = 150$; $\square - 25 = 67$; $3450 - 1000 = \square$; $\square - 2000 = 900$

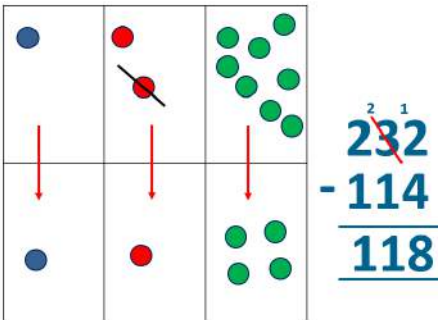
Mental methods should continue to develop, supported by a range of models and images, including the number line.

Written methods (progressing to 4-digits)

Expanded column subtraction with decomposition, modelled with place value counters, progressing to calculations with 4-digit numbers.



If understanding of the expanded method is secure, children will move on to the formal method of decomposition, which again can be initially modelled with place value counters.



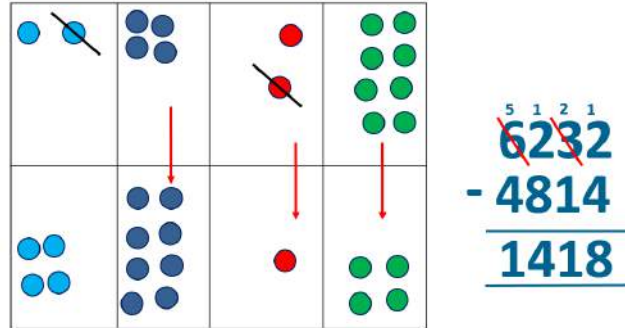
Year 5

Missing number/digit problems: $6.45 = 6 + 0.4 + \square$; $119 - \square = 86$;
 $1\ 000\ 000 - \square = 999\ 000$; $600\ 000 + \square + 1000 = 671\ 000$; $12\ 462 - 2\ 300 = \square$

Mental methods should continue to develop, supported by a range of models and images, including the number line.

Written methods (progressing to more than 4-digits)

When understanding of the expanded method is secure, children will move on to the formal method of decomposition, which can be initially modelled with place value counters.



Progress to calculating with decimals, including those with different numbers of decimal places.

Year 6

Missing number/digit problems: \square and $\#$ each stand for a different number. $\# = 34$. $\# + \# = \square + \square + \#$. What is the value of \square ? What if $\# = 28$? What if $\# = 21$;
 $10\ 000\ 000 = 9\ 000\ 100 + \square$
 $7 - 2 \times 3 = \square$; $(7 - 2) \times 3 = \square$; $(\square - 2) \times 3 = 15$

Mental methods should continue to develop, supported by a range of models and images, including the number line.

Written methods

As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with decomposition to be secured.

Teachers may also choose to introduce children to other efficient written layouts which help develop conceptual understanding. For example:

$$\begin{array}{r} 326 \\ -148 \\ -2 \\ -20 \\ \hline 200 \\ \hline 178 \end{array}$$

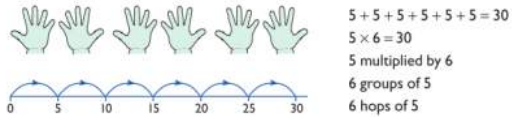
Continue calculating with decimals, including those with different numbers of decimal places.

Progression Towards a Written Method for Multiplication

Year 1

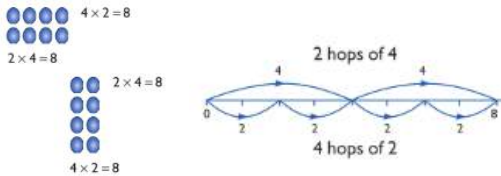
Understand multiplication is related to doubling and combining groups of the same size (repeated addition)

Washing line, and other practical resources for counting.
Concrete objects. Numicon; bundles of straws, bead strings



Use cuisenaire and bar method to develop the vocabulary relating to 'times' –
Pick up five, 4 times

Use arrays to understand multiplication can be done in any order (commutative)



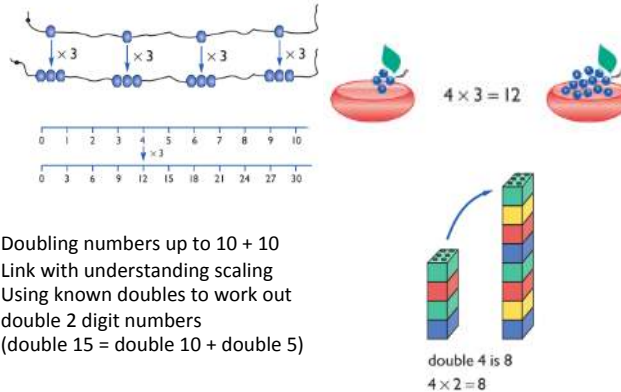
Year 2

Expressing multiplication as a number sentence using \times
Using understanding of the inverse and practical resources to solve missing number problems.

$7 \times 2 = \quad = 2 \times 7$
 $7 \times \quad = 14 \quad 14 = \quad \times 7$
 $\times 2 = 14 \quad 14 = 2 \times \quad$
 $\times \bigcirc = 14 \quad 14 = \quad \times \bigcirc$

Develop understanding of multiplication using array and number lines (see Year 1). Include multiplications not in the 2, 5 or 10 times tables.

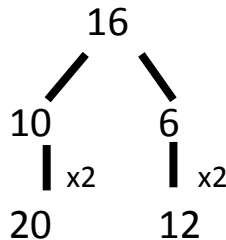
Begin to develop understanding of multiplication as scaling (3 times bigger/taller)



Doubling numbers up to $10 + 10$
Link with understanding scaling
Using known doubles to work out double 2 digit numbers
(double 15 = double 10 + double 5)

Towards written methods

Use jottings to develop an understanding of doubling two digit numbers.



Year 3

Missing number problems
Continue with a range of equations as in Year 2 but with appropriate numbers.

Mental methods

Doubling 2 digit numbers using partitioning

Demonstrating multiplication on a number line – jumping in larger groups of amounts

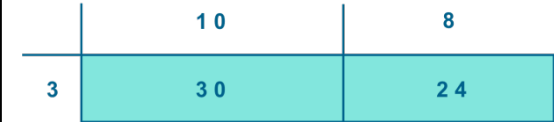
$13 \times 4 = 10 \text{ groups } 4 + 3 \text{ groups of } 4$

Written methods (progressing to 2d x 1d)

Developing written methods using understanding of visual images



Develop onto the grid method



Give children opportunities for children to explore this and deepen understanding using Dienes apparatus and place value counters

Progression Towards a Written Method for Multiplication

Year 4

Continue with a range of equations as in Year 2 but with appropriate numbers. Also include equations with missing digits

$$2 \times 5 = 160$$

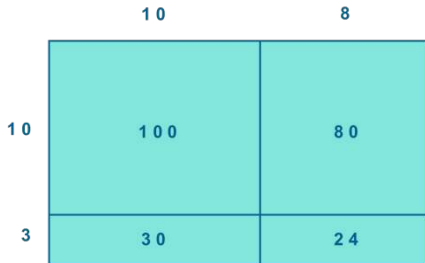
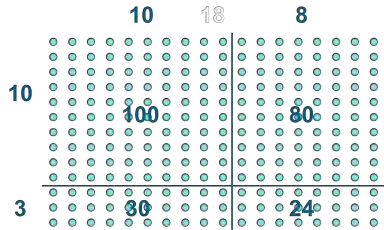
Mental methods

Counting in multiples of 6, 7, 9, 25 and 1000, and steps of 1/100.

Solving practical problems where children need to scale up. Relate to known number facts. (e.g. how tall would a 25cm sunflower be if it grew 6 times taller?)

Written methods (progressing to 3 digit x 2 digit)

Children to embed and deepen their understanding of the grid method to multiply up 2 digit x 2 digit. Ensure this is still linked back to their understanding of arrays and place value counters.



Year 5

Continue with a range of equations as in Year 2 but with appropriate numbers. Also include equations with missing digits

Mental methods

X by 10, 100, 1000 using moving digits ITP

Use practical resources and jottings to explore equivalent statements (e.g. $4 \times 35 = 2 \times 2 \times 35$)

Recall of prime numbers up to 19 and identify prime numbers up to 100 (with reasoning)

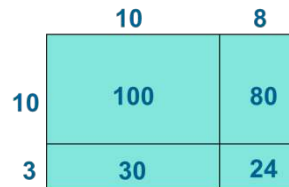
Solving practical problems where children need to scale up. Relate to known number facts.

Identify factor pairs for numbers

Written methods (progressing to 4 digit x 2 digit)

Long multiplication using place value counters

Children to explore how the grid method supports an understanding of long multiplication (for 2 digit x 2 digit)



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

Year 6

Continue with a range of equations as in Year 2 but with appropriate numbers. Also include equations with missing digits

Mental methods

Identifying common factors and multiples of given numbers

Solving practical problems where children need to scale up. Relate to known number facts.

Written methods

Continue to refine and deepen understanding of written methods including fluency for using long multiplication

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

$$\begin{array}{r}
 2 3 1 \\
 1342 \\
 \times 18 \\
 \hline
 13420 \\
 10736 \\
 \hline
 24156 \\
 1
 \end{array}$$

Progression Towards a Written Method for Division

Year 1

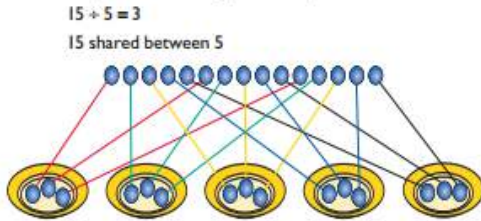
Children must have secure counting skills- being able to confidently count in 2s, 5s and 10s.

Children should be given opportunities to reason about what they notice in number patterns.

Group AND share small quantities- understanding the difference between the two concepts.

Sharing

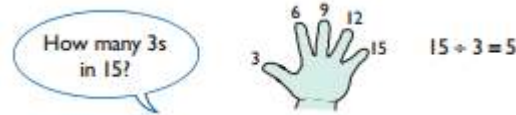
Develops importance of one-to-one correspondence.



Children should be taught to share using concrete apparatus.

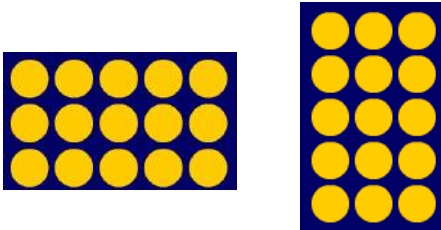
Grouping

Children should apply their counting skills to develop some understanding of grouping.



Use of arrays as a pictorial representation for division. $15 \div 3 = 5$ There are 5 groups of 3.

$15 \div 5 = 3$ There are 3 groups of 5.



Children should be able to find $\frac{1}{2}$ and $\frac{1}{4}$ and simple fractions of objects, numbers and quantities.

Year 2

\div = signs and missing numbers

$$6 \div 2 = \quad = 6 \div 2$$

$$6 \div \quad = 3 \quad 3 = 6 \div \quad$$

$$\div 2 = 3 \quad 3 = \div 2$$

$$\div \nabla = 3 \quad 3 = \div \nabla$$

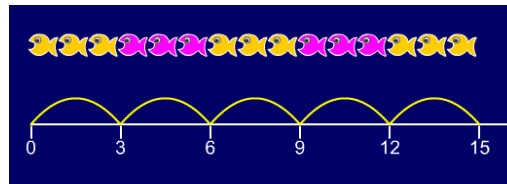
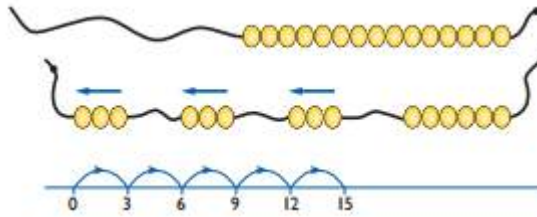
Know and understand sharing and grouping- introducing children to the \div sign.

Children should continue to use grouping and sharing for division using practical apparatus, arrays and pictorial representations.

Grouping using a numberline

Group from zero in jumps of the divisor to find our 'how many groups of 3 are there in 15?'

$$15 \div 3 = 5$$



Continue work on arrays. Support children to understand how multiplication and division are inverse. Look at an array – what do you see?

Year 3

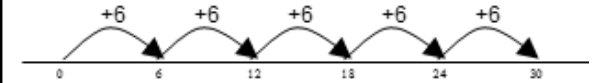
\div = signs and missing numbers

Continue using a range of equations as in year 2 but with appropriate numbers.

Grouping

How many 6's are in 30?

$30 \div 6$ can be modelled as:



Becoming more efficient using a numberline

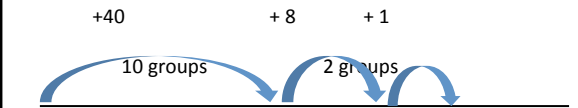
Children need to be able to partition the dividend in different ways.

$$48 \div 4 = 12$$



Remainders

$$49 \div 4 = 12 \text{ r}1$$



Sharing – 49 shared between 4. How many left over?

Grouping – How many 4s make 49. How many are left over?

Place value counters can be used to support children apply their knowledge of grouping.

For example:

$60 \div 10 =$ How many groups of 10 in 60?

$600 \div 100 =$ How many groups of 100 in 600?

Progression Towards a Written Method for Division

Year 4

÷ = signs and missing numbers

Continue using a range of equations as in year 3 but with appropriate numbers.

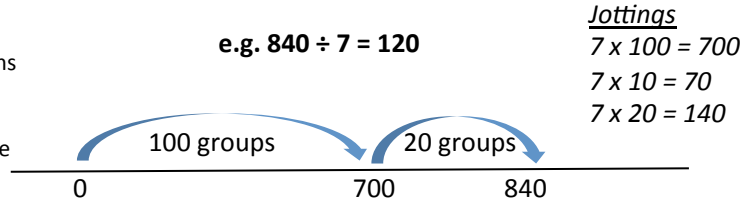
Sharing, Grouping and using a number line

Children will continue to explore division as sharing and grouping, and to represent calculations on a number line until they have a secure understanding. Children should progress in their use of written division calculations:

- Using tables facts with which they are fluent
- Experiencing a logical progression in the numbers they use, for example:
 1. Dividend just over 10x the divisor, e.g. $84 \div 7$
 2. Dividend just over 10x the divisor when the divisor is a teen number, e.g. $173 \div 15$ (learning sensible strategies for calculations such as $102 \div 17$)
 3. Dividend over 100x the divisor, e.g. $840 \div 7$
 4. Dividend over 20x the divisor, e.g. $168 \div 7$

All of the above stages should include calculations with remainders as well as without.

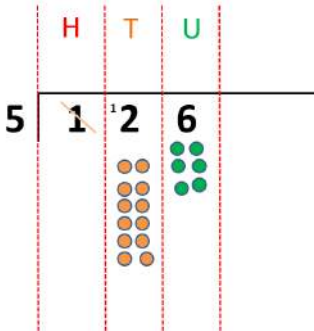
Remainders should be interpreted according to the context. (i.e. rounded up or down to relate to the answer to the problem)



Formal Written Methods

Formal short division should only be introduced once children have a good understanding of division, its links with multiplication and the idea of 'chunking up' to find a target number (see use of number lines above)

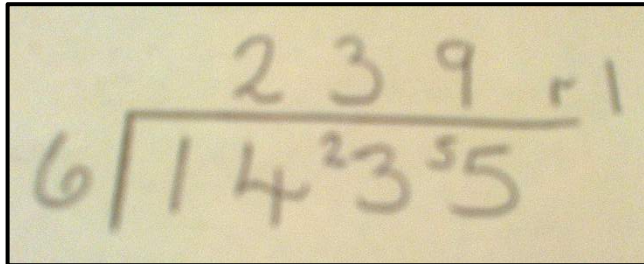
Short division to be modelled for understanding using place value counters as shown below. Calculations with 2 and 3-digit dividends. E.g. fig 1



Year 5

Formal Written Methods

Continued as shown in Year 4, leading to the efficient use of a formal method. The language of grouping to be used E.g. $1435 \div 6$



Children begin to practically develop their understanding of how express the remainder as a decimal or a fraction. Ensure practical understanding allows children to work through this (e.g. what could I do with this remaining 1? How could I share this between 6 as well?)

Year 6

÷ = signs and missing numbers

Continue using a range of equations but with appropriate numbers

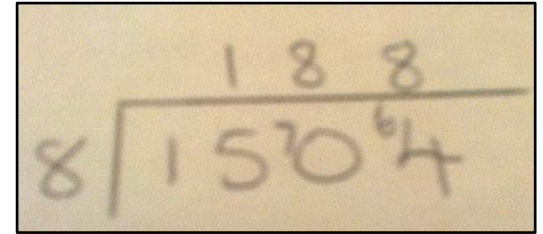
Sharing and Grouping and using a number line

Children will continue to explore division as sharing and grouping, and to represent calculations on a number line as appropriate.

Quotients should be expressed as decimals and fractions

Formal Written Methods – long and short division

E.g. $1504 \div 8$



E.g. $2364 \div 15$

