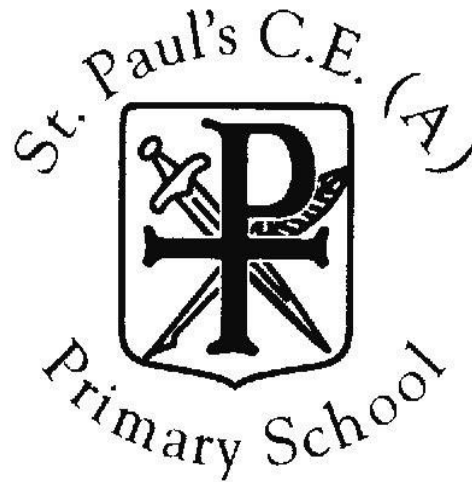


St Paul's Church of England (A) Primary School

Calculations Policy



Policy Adopted: October 2016

Policy published: October 2016

Policy Review: October 2017





St. Paul's C of E Primary School

Calculation Policy

Addition - Years 1-6

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.

$$3 + 4 = \square$$

$$\square = 3 + 4$$

$$3 + \square = 7$$

$$7 = \square + 4$$

Counting and Combining sets of Objects

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



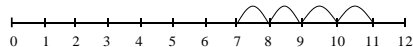
Understanding of counting on with a numbertrack.



Understanding of counting on with a numberline

(supported by models and images).

$$7 + 4$$



$$\text{Numcion } 7+3=10$$



Year 2

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

It is valuable to use a range of representations (also see Y1).

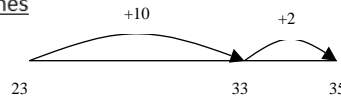
Continue to use numberlines to develop understanding of:

Counting on in tens and ones

$$23 + 12 = 23 + 10 + 2$$

$$= 33 + 2$$

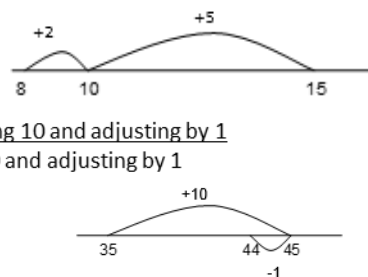
$$= 35$$



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.

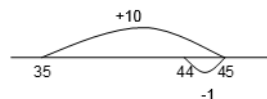
$$8 + 7 = 15$$



Adding 9 or 11 by adding 10 and adjusting by 1

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

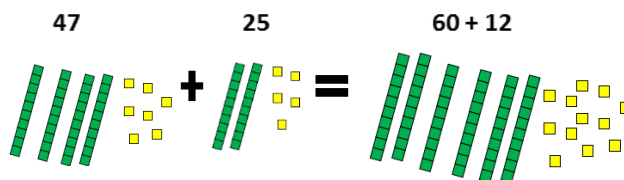
$$35 + 9 = 44$$



Towards a Written Method

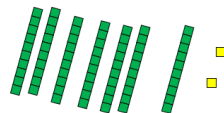
Partitioning in different ways and recombine

$$47 + 25$$



Leading to exchanging:

$$72$$



Expanded written method

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

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

$$60 + 12 = 72$$

$$\begin{array}{r} 40 + 7 = 47 \\ + 20 + 5 = 25 \\ 60 + 12 = 72 \end{array}$$

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.

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

$$= 347 + 20 + 5$$

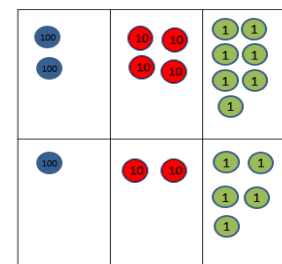
$$= 367 + 5$$

$$= 372$$

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

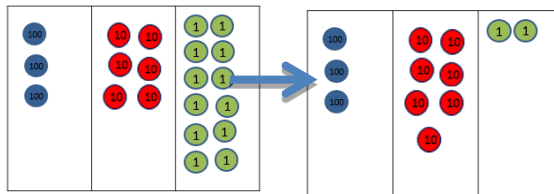
Towards a Written Method

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



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

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.

$$\begin{array}{r} 247 \\ + 125 \\ \hline 372 \\ 11 \end{array}$$

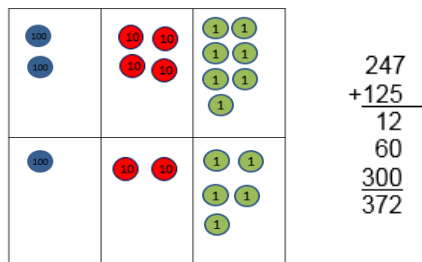
Year 4

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line. The number line should continue to be used to help with problem solving.

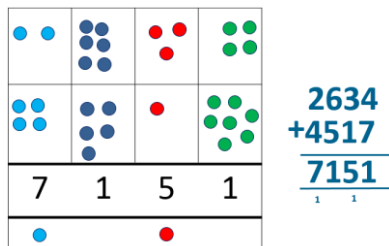
Written methods (progressing to 4-digits)

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



Compact written method

Extend to numbers with at least four digits.



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 decimal places) and adding several numbers (with different numbers of digits).

$$\begin{array}{r} 72.8 \\ +54.6 \\ \hline 127.4 \\ 11 \end{array}$$

Year 5

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line. The number line should continue to be used to help with problem solving. 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.

$$\begin{array}{r} 172.83 \\ +54.68 \\ \hline 227.51 \\ 111 \end{array}$$

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. The number line should continue to be used to help with problem solving.

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.

$$\frac{2}{5} + \frac{4}{5} = \frac{9}{5} = 1\frac{4}{5}$$



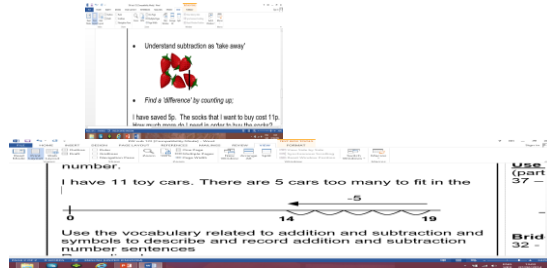
St. Paul's C of E Primary School

Calculation Policy Subtraction - Years 1-6

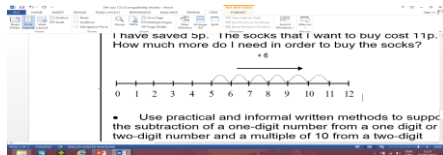
Year 1

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:



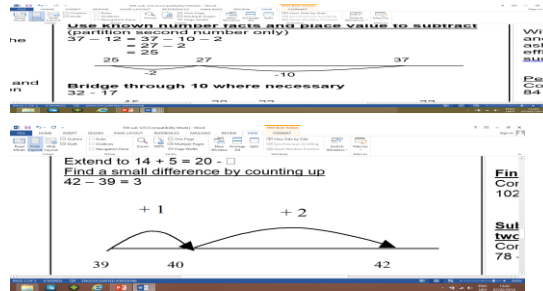
The above model would be introduced with concrete objects which children can move (including cards with pictures) before progressing to pictorial representation.
The use of other images is also valuable for modelling subtraction e.g. Numicon, bundles of straws, Dienes apparatus, multi-link cubes, bead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

$$18 - 15 = 3$$

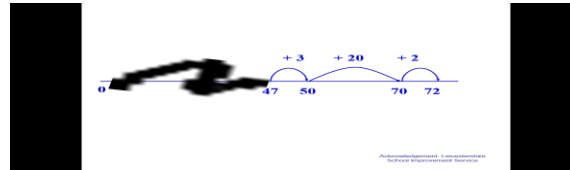


Year 2

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.



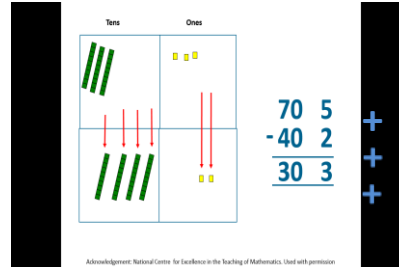
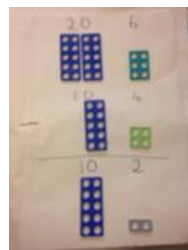
The link between the two may be supported by an image like this, with 47 being taken away from 72, leaving the difference, which is 25.



The number line 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 or Numicon apparatus. E.g. 26-14 75-42



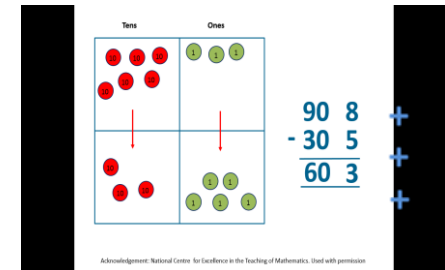
Year 3

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

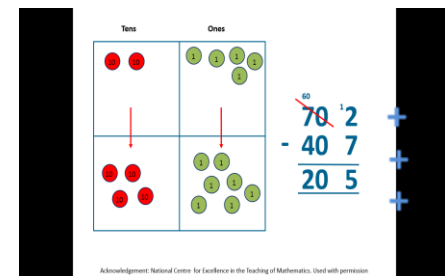
Mental methods should continue to develop, supported by a range of models and images, including the number line. The number line should continue to be used to help with problem solving (see Y1 and Y2). Children should make choices about whether to use complementary addition or counting back, depending 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.

Year 4

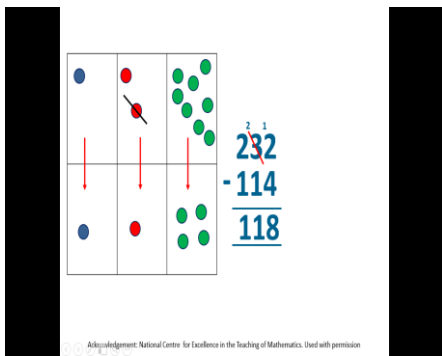
Missing number/digit problems: $456 + \square = 710$; $1\square7 + 6\square = 200$; $60 + 99 + \square = 340$; $200 - 90 - 80 = \square$; $225 - \square = 150$; $\square - 25 = 67$; $3450 - 1000 = \square$; $\square - 2000 = 900$

Mental methods should continue to develop, supported by a range of models and images, including the number line. The number line should continue to be used to help with problem solving.

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.



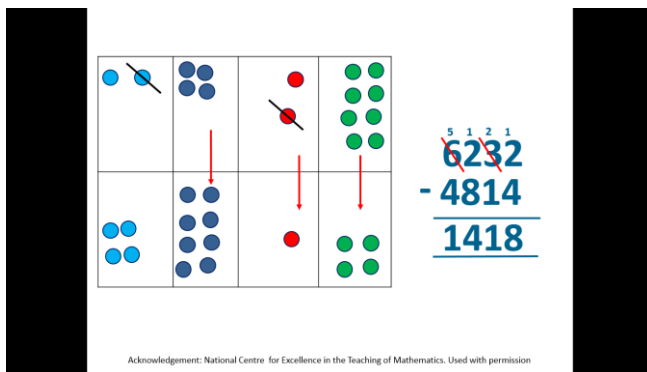
Year 5

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. The number line should continue to be used to help with problem solving.

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 Δ each stand for a different number $\Delta = 34$. $\Delta + \Delta = \square + \square + \square$. What is the value of \square ? What if $\# = 28$? What if $\Delta = 21$

$10\,000\,000 = 9\,000\,100 + \square$

$7 - 2 \times 3 = \square$; $(7 - 2) \times 3 = \square$; $(\square - 2) \times 3 = 15$

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

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:

$$\begin{array}{r} 1\ 1\ 8\ 1 \\ 3\ 2\ 4\ .\ 9\ 0 \\ -\ 7\ .\ 2\ 5 \\ \hline 3\ 1\ 7\ .\ 6\ 5 \end{array}$$

Decimal points to be aligned under each other.

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



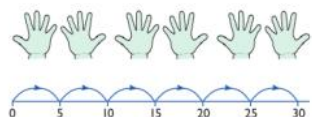
St. Paul's C of E Primary School

Calculation Policy
Multiplication - Years 1-6

Year 1

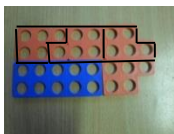
Understand multiplication is related to doubling and combining groups of the same size (repeated addition)

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



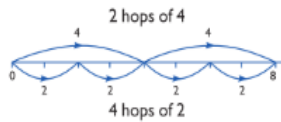
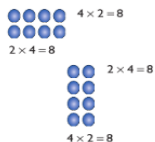
Problem solving with concrete objects (including money and measures. Use cuisenaire, numicon and bar method to develop the vocabulary relating to 'times' –

5 lots of 3
 $5 \times 3 = 15$



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 x
 Using understanding of the inverse and practical resources to solve missing number problems.

$$7 \times 2 = \square \quad \square = 2 \times 7$$

$$7 \times \square = 14 \quad 14 = \square \times 7$$

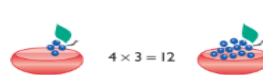
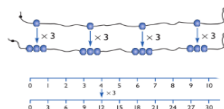
$$\square \times 2 = 14 \quad 14 = 2 \times \square$$

$$\square \times \bigcirc = 14 \quad 14 = \square \times \bigcirc$$

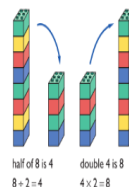
Develop understanding of multiplication using array and number lines (see Year 1). Include multiplications not in the 2, 5 or 10 times tables.

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

Repeated addition



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)

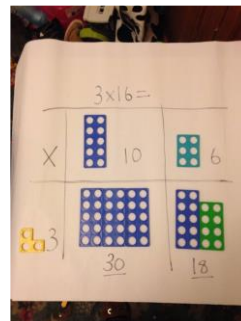


Towards written methods

Use jottings to develop an understanding of doubling two digit numbers. Concrete objects, Numicon, cuisenaire rods to multiply 1 digit x 2 digit.

Partitioning tens and units

$$\begin{array}{r} 16 \\ \swarrow \searrow \\ 10 \quad 6 \\ \downarrow \quad \downarrow \\ 20 \quad + \quad 12 \\ \hline 32 \end{array}$$



Year 3

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

Mental methods

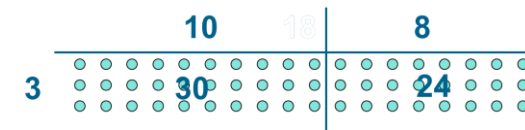
Doubling 2 digit numbers using partitioning

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

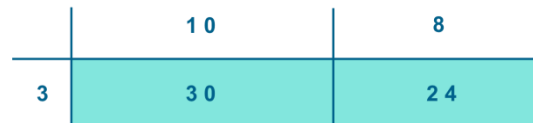
$$13 \times 4 = 10 \text{ groups } 4 (10 \times 4) + 3 \text{ groups of } 4 (3 \times 4)$$

Written methods (progressing to 2 digit x 1 digit)

Developing written methods using understanding of visual images



Develop onto the grid method



$$30 + 24 = 54$$

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

Expanded method 2 digit x 1 digit/ 3 digit x 1 digit

$$\begin{array}{r} 36 \\ \times 5 \\ \hline 30 \text{ (} 5 \times 6 \text{)} \\ 150 \text{ (} 5 \times 30 \text{)} \\ \hline 180 \end{array}$$

$$\begin{array}{r} 327 \\ \times 3 \\ \hline 21 \text{ (} 3 \times 7 \text{)} \\ 60 \text{ (} 3 \times 20 \text{)} \\ 900 \text{ (} 3 \times 300 \text{)} \\ \hline 981 \end{array}$$

Year 4

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

$$\blacksquare 2 \times 5 = 160$$

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 1 digit)

Children to embed and deepen their understanding of the grid method to multiply up 3 digit x 1 digit. Ensure this is still linked back to their understanding of arrays and place value counters.

100 30 2

$$\begin{array}{r} 700 \\ 210 \\ + 14 \\ \hline 924 \end{array}$$

$$132 \times 7 = 924$$

Expanded method (2 digit x 2 digit)

$$\begin{array}{r} 132 \\ \times 7 \\ \hline 14 \text{ (7 x 2)} \\ 210 \text{ (7 x 30)} \\ 700 \text{ (7 x 100)} \\ \hline 924 \end{array}$$

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
Identify square numbers up to 144

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)

| | | | | |
|----|-----|----|--|--|
| | 10 | 8 | | |
| 10 | 100 | 80 | | |
| 3 | 30 | 24 | | |

| | | | | | |
|--|---|---|---|--|--|
| | | 1 | 8 | | |
| | × | 1 | 3 | | |
| | 1 | 8 | 0 | | |
| | | 5 | 4 | | |
| | 2 | 3 | 4 | | |

Short expanded method (3 digit x 1 digit)

$$\begin{array}{r} 324 \\ \times 3 \\ \hline 972 \\ \hline \end{array}$$

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

$$\begin{array}{r} 231 \\ 1342 \\ \times 18 \\ \hline 10736 \\ 13420 \\ \hline 24156 \\ \hline 1 \end{array}$$



St. Paul's C of E Primary School

Calculation Policy
Division - Years 1-6

Year 1

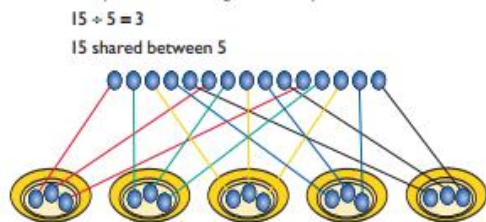
Children must have secure counting skills- being able to confidently count in 2s, 5s and 10s.

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.

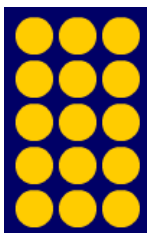
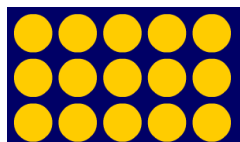
Grouping

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

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

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

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

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

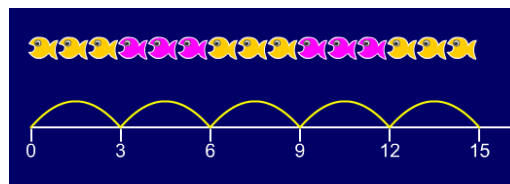
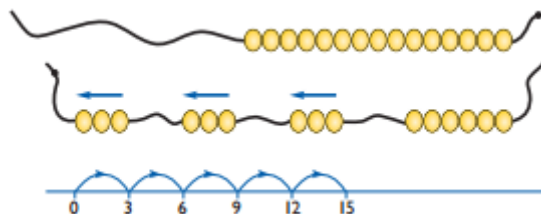
Know and understand sharing and grouping- introducing children to the \div sign.

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

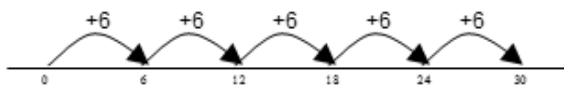
\div = signs and missing numbers

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

Grouping

How many 6's are in 30?

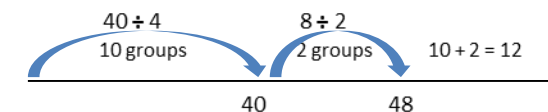
$30 \div 6$ can be modelled as:



Becoming more efficient using a numberline

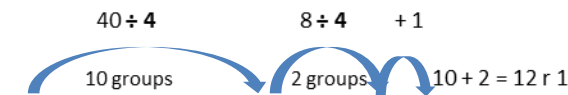
Children need to be able to partition the dividend in different ways.

$$48 \div 4 = 12$$



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?

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

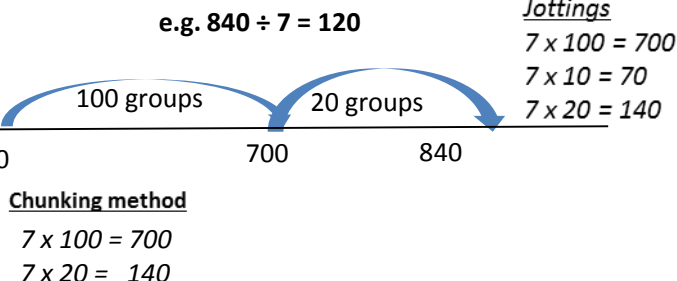
Children will continue to explore division as sharing and grouping, and to represent calculations on a number line until they have a secure understanding. Children should progress in their use of written division calculations:

- 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)

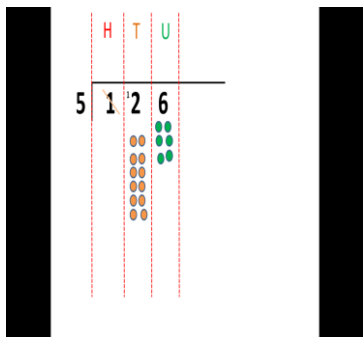
$$840 \div 7 = 120$$



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

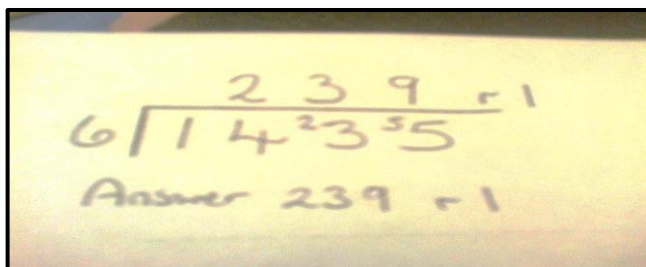


Year 5

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 (see link from fig. 1 in Year 4)

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

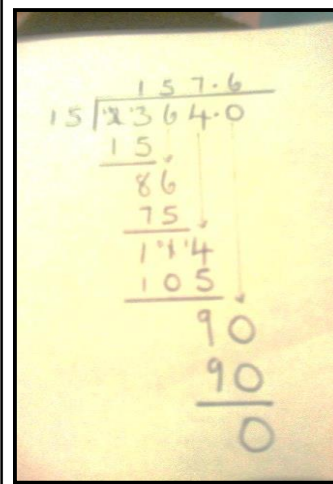
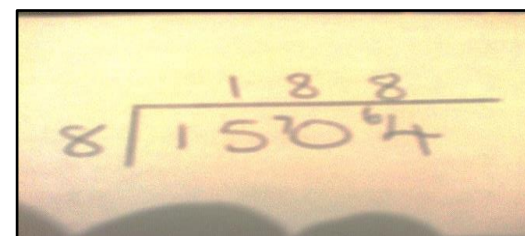
Sharing and Grouping and using a number line

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 for divisor 12 or less

E.g. $1504 \div 8$



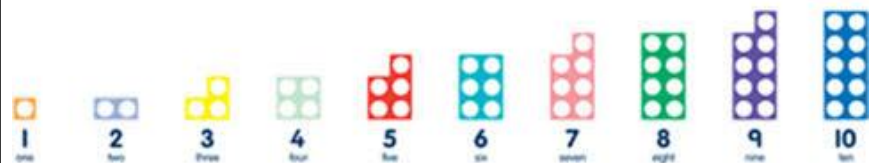


St. Paul's C of E Primary School

Calculation in the Early Years
Foundation Stage

Calculation Guidelines for Foundation Stage

Children begin to record in the context of play or practical activities and problems.
Numicon shapes are introduced straight away and can be used to:



- Identify 1 more/less
- Combine pieces to add
- Find number bonds
- Add without counting
- Children can record this by printing or drawing around Numicon pieces

Estimating e.g. guess how many cubes are in a group and does the number get bigger or smaller when we add more/less objects

ADDITION

Begin to relate addition to combining two groups of objects

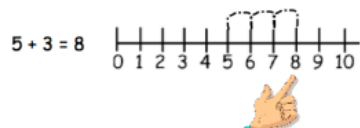
- Make a record in pictures, Numicon and words or symbols of addition activities already carried out.
- Construct number sentences to go with practical activities
- Use of games, songs and practical activities to begin using vocabulary

Solve simple word problems using their fingers



Can find one more to ten.

Higher Ability/ Gifted and Talented children progress to using a number line. They jump forwards along the number line using finger and use Numicon and different models and images as they move between representations.



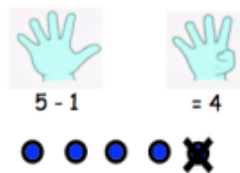
$$7 + 3 = 10$$



SUBTRACTION

Begin to relate subtraction to 'taking away'

- Use of games, songs and practical activities to begin using vocabulary
- Construct number sentences to go with practical activities
- Relate subtraction to taking away and counting how many objects are left.



$$5 - 1 = 4$$

Can find one less to ten.

Higher Ability/ Gifted and Talented Progression:



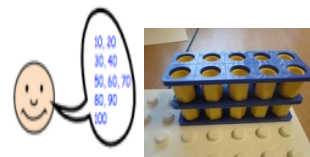
Counting backwards along a number line using finger.

MULTIPLICATION

Real life contexts and use of practical equipment to count in repeated groups of the same size:

- Count in twos; fives; tens

Also chanting in 2s, 5s and 10s.



Reinforcing repeated addition with stacking Numicon 2, 5 and 10s

Finding double to 10



DIVISION

Share objects into equal groups
Use related vocabulary

Activities might include:

- Sharing of milk at break time
- Sharing sweets on a child's birthday
- Sharing activities in the home corner
- Count in tens/twos
- Separate a given number of objects into two groups (addition and subtraction objective in reception being preliminary to multiplication and division)

Count in twos, tens
How many times?
How many are left/left over?
Group
Answer
Right, wrong
What could we try next?
How did you work it out?
Share out
Half, halve