Whitley and Eggborough Community Primary School

Calculations Policy

We feel that it is important that the same strategies are taught throughout school so that when entering a new class, with a new teacher, some things remain constant and the children are not re-learning by using a different technique. Although the more able children may not experience any difficulty, many will find this confusing and it may even have a detrimental effect upon their learning.

Learning is progressive throughout school, from Reception through to Year 6. The following calculation strategies are, therefore, also progressive throughout Key Stage 1 and Key Stage 2.

It is important that children work neatly and systematically, setting out their work so that it is clear and legible both to themselves and to the teacher.

ADDITION

Children need to be able to explain, illustrate and justify relationships, patterns and generalisations within addition and subtraction using models and images to support their reasoning. Equipment and manipulatives should be used throughout all stages to support children in developing their ability to explain their thinking.

<u>Stage 1</u>- Developing and recording mental pictures
Children should experience practical calculation opportunities using a wide variety of equipment, e.g. small world play, role play, counters, cubes etc. They develop ways of recording calculations using pictures, etc.

- Counting physical objects. If recording, representing the objects through pictures, e.g.

2 + 4 =

- Using fingers, counters, Numicon etc. to add together 2 or more numbers

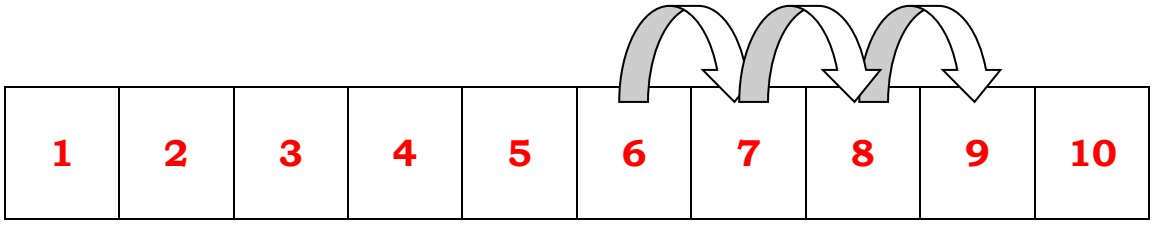
- Begin to count on from the highest number, using apparatus or fingers, e.g.

6 + 3 =

6, 7, 8, 9

- Develop the use of the number line for addition to reinforce the concept of beginning with the highest number and counting on, e.g.

6 + 3 =



<u>Stage 2</u>- developing additive number relationships
This stage focuses on children developing a secure understanding of the relationships between numbers through a variety of models and approaches

- Develop the use of the 100 square to show addition of larger numbers, e.g.

26 + 22 =

Begin at 26, add the 20 by moving down the 100 square to 46,
then add the 2 by moving to the right to number 48

26		
36		
46	47	48

<u>Stage 3</u>- Develop understanding of using the empty number line
The empty number line is intended to be a representation of a mental method, not a written algorithm. Therefore the order and size (physical and numerical) of the jumps should be expected to vary from one calculation to the next.
The empty number line helps to record the steps on the way to calculating the total.

<u>Stage 4</u>- Partitioning to support progression prior to introducing a formal written method
Children need to be able to partition numbers in ways other than into tens and ones to support mental calculations. Partitioning into tens and ones will support progression to the columnar method for addition.

- Children should use a range of practical apparatus (straws, Dienes apparatus, place value cards, place value counters) to support partitioning for addition progressing through gradually more abstract representations. Encourage jottings to show working out until the children are confident with the strategy, e.g.

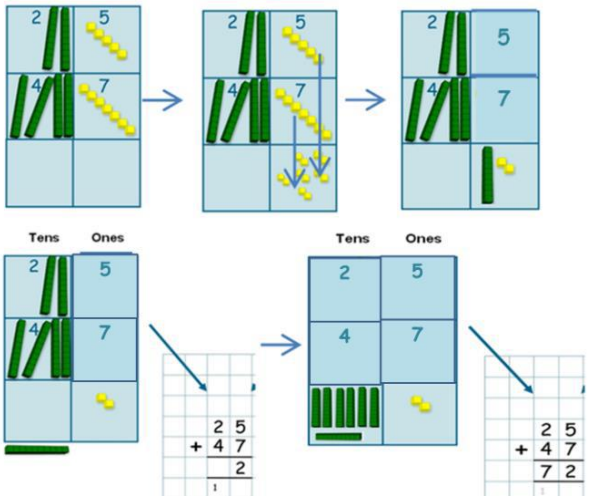
42 + 86 =

40 + 80 + 2 + 6 =

120 + 8 = 128

Straws, bundled into 10s and singularly allow children to see, create and count the '10' within the bundle. This then progresses to the use of Dienes (or similar) where 10s are clearly marked in ones but cannot be separated in the same way e.g. 25 + 47 =
Money should also be used (1ps, 10ps and £1) as place value equipment to help children develop their understanding of a range of representations.

Stage 5: Using Dienes alongside columnar written method
To ensure the statutory final written method is grounded in understanding, this stage connects the practical equipment to the formal written method using a similar and transferrable layout e.g.



Stage 6: Securing the compact column method
Extend to more complex combinations such as three two-digit numbers, two three-digit numbers, and problems involving several numbers of different sizes, including decimals. Challenge the children's understanding of column addition by using empty box problems. Exchanging of numbers should be completed underneath the numbers e.g.

$$\begin{array}{r} 258 \\ +\ 87 \\ \hline 345 \\ \hline 11 \end{array}$$

SUBTRACTION

Stage 1: Recording and developing mental pictures
Children are encouraged to develop a mental picture of the calculation in their heads. They experience practical activities using a variety of equipment and develop ways to record their findings including models and pictures.

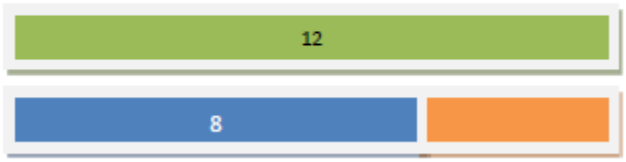
- Counting the correct number of objects and then physically removing/taking away the required number

- Use fingers to count the correct number of objects and then subtract the appropriate number by folding down that number of fingers.

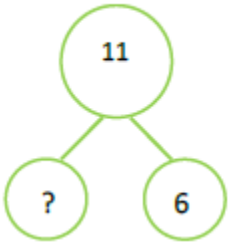
Stage 2: developing additive number relationships
This stage focuses on children developing a secure understanding of the relationships between numbers through a variety of models and approaches.

Part, part, whole models

12 – 8 =



11 – 6 =



- Develop the use of the 100 square to show subtraction of larger numbers, e.g.

64 – 22 =

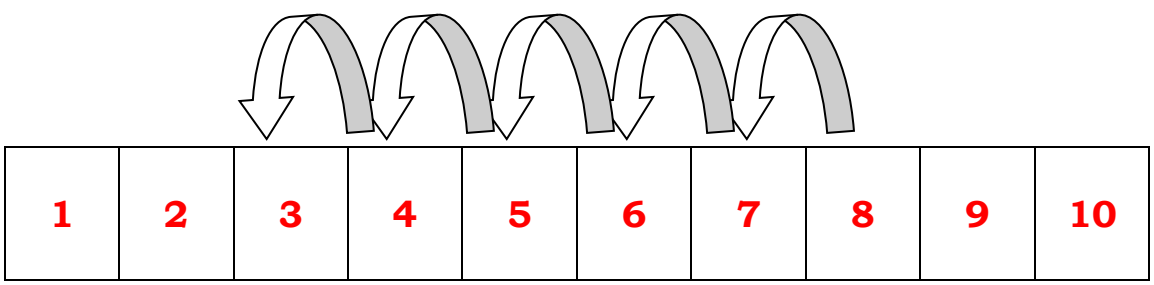
Begin at 64, subtract the 20 by moving upwards to 44, then subtract the 2 by moving to the left to number 42

42	**43**	**44**
		54
		64

Stage 3: Develop understanding of the number line
Children should develop a sound understanding of numbers to be able to use them confidently in calculation.

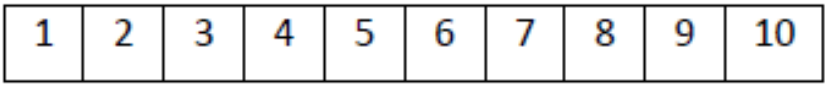
- Mental calculation is supported by using number lines to support calculations and develop mental images. Develop the use of the number line, e.g.

8 – 5 =

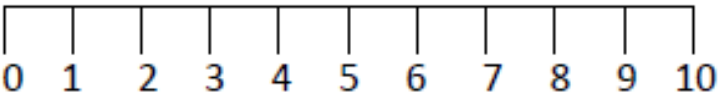


Children should experience a range of progressively more abstract representations of number lines e.g.

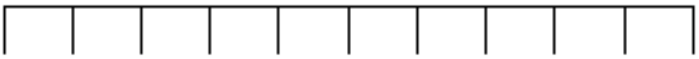
Number track



Number line, all numbers labelled



Number lines, marked but unlabelled



- Children should be taught to use jumps of different sizes, and completed in an order that is most helpful depending on the numbers they are calculating with.
- The same method can also be used to incorporate and demonstrate negative numbers. Children should never be told that a subtraction calculation, such as 5 – 8 =, cannot be completed simply because the answer is a negative number.

Subtraction as the inverse of addition

$14 - 11 = 3$

$11 + \square = 14$

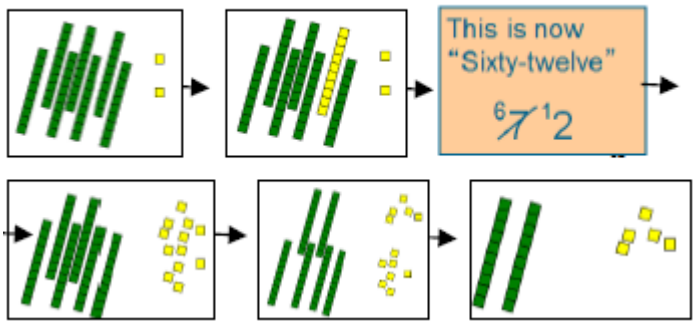
Subtraction as finding the difference

The difference between 11 and 14 is 3.

Stage 5: Partitioning to support progression to lead to a formal written method through take-away

- Children should use a range of practical apparatus (straws, Dienes apparatus, place value cards, place value counters) to support partitioning for subtraction progressing through gradually more abstract representations. Straws, bundled into 10s and singularly allow children to see create and count the '10' within the bundle. This then progresses to the use of Dienes (or similar) where 10s are clearly marked in ones but cannot be separated in the same way e.g.

e.g. 72 – 47 =

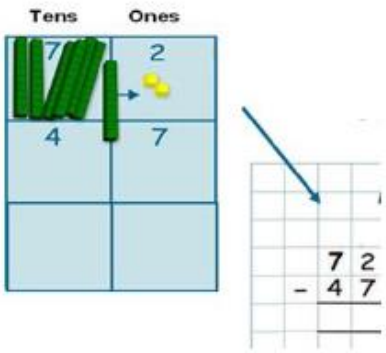


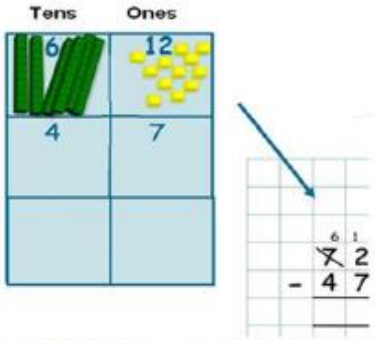
Once children are able to use these with understanding, they will be able to progress to the use of place value cards and place value counters which are a further abstraction as the '10' is labelled but not 'seen'. Money should also be used (1ps, 10ps and £1) as place value equipment to help children develop their understanding of a range of representations.

Stage 6: Using Dienes alongside columnar written method

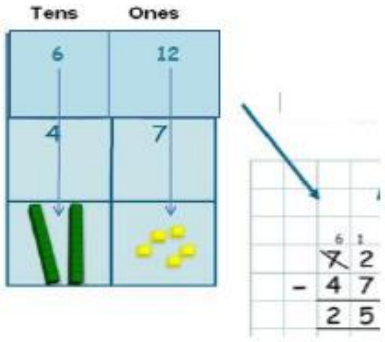
To ensure the statutory final written method is grounded in understanding, connect the practical equipment to the formal written method using a similar layout.

72 – 47

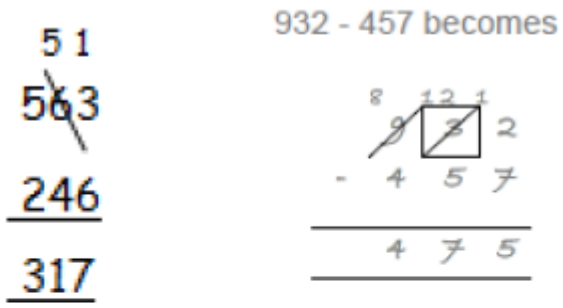




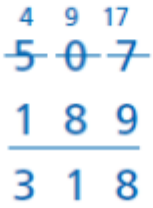
7 ones and then 4 tens are removed, leaving 25. The 25 can be dragged to the botton to model the recording used in the written algorithm



Stage 7: Compact column method
Extend to more complex combinations such as three two-digit numbers, two three-digit numbers, and problems involving several numbers of different sizes, including decimals.



Children may find it more helpful to present their exchanges like this to keep the numbers clear.



Exchanges should be completed above the number. Children should continue to use practical equipment to support conceptual understanding until they are confident without it.

MULTIPLICATION

Children need to be able explain, illustrate and justify relationships, patterns and generalisations within multiplication and division using models and images to support their reasoning. Equipment and manipulatives should be used throughout all stages to support children in developing their ability to explain their thinking.

Stage 1: Recording and developing mental images
Children should experience practical calculation opportunities involving equal sets or groups using a wide variety of equipment, e.g. small world play, role play, counters, cubes etc. Children will count equal groups of objects. They will count in 2s and 10s and begin to count in 5s (using fingers as an aid if necessary). Children will explore everyday versions of arrays such as egg boxes, baking trays, ice cube trays and wrapping paper Children will use repeated addition to carry out multiplication supported by the use of counters/cubes.

Stage 2: Developing understanding multiplication as repeated addition, counting on the bead string, number line and hundred square
Children continue to use repeated addition to carry out multiplication tasks and represent their counting on a bead string or a number line.

'Count out three groups of 5 then count the beads altogether'.

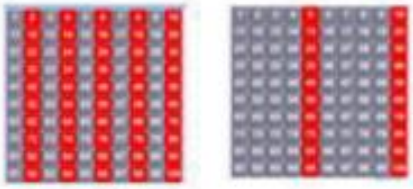
5 + 5 + 5 = 15

10p + 10p + 10p + 10p + 10 p = 30p

5 hops of 10

5 x 10p = 50 p

Children explore patterns on a 100 square to help them begin to recognise multiples and rules of divisibility.



Multiples of 2 Multiples of 5

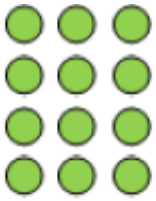
Stage 3: Developing understanding of multiplicative relationships

Children should to be able to visualise multiplication as a rectangular array. This helps develop understanding of the commutative law

i.e. 3 x 4 = 4 x 3

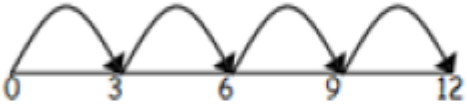
3 groups of 4

3 x 4



4 groups of 3

4 x 3



4 lots of 3 = 12

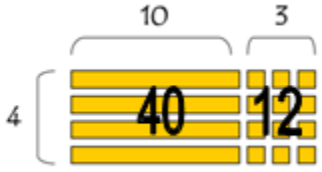
3 lots of 4 =12

A rectangular array allows the total to be found by repeated addition and the link can be made to the 'x' sign and associated vocabulary 'groups of' or 'lots of'.

Stage 4: Using the Grid Method to multiply by a single digit number.

The link between arrays and the grid method should be made clear to children by the use of place value apparatus such as place value counters and Dienes.

This then becomes



x	10	3
4	40	12

40 + 12 = 52

They begin to represent record in a column format alongside the grid method.

13
X 4
52

Some may need the expanded form to help support their understanding.

13
X 4
12 4 x 3
40 4 x 10
52

Stage 5: multiplying using the column method

Before carrying out calculations children should be encouraged to estimate their answer using rounding. They should compare their answer with the estimate to check for reasonableness.

Each digit continues to be multiplied by each digit, but the totals are recorded in a more compact form, using 'carrying'.

124 × 26 becomes

		1	2	
		1	**2**	**4**
×			**2**	**6**
		7	**4**	**4**
2	**4**	**8**	**0**	
3	**2**	**2**	**4**	
1	1			

Answer: 3224

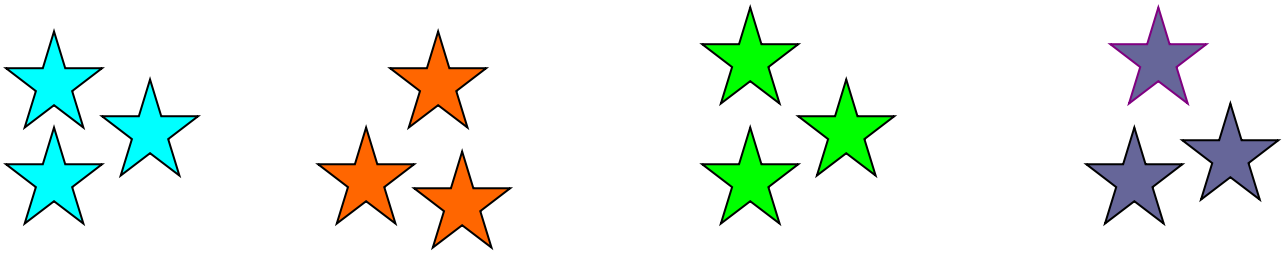
'Carrying' should be completed above the multiplication to avoid confusion when totalling the answer. This method should then be applied to decimal numbers and be used within the context of problems involving money.

DIVISION

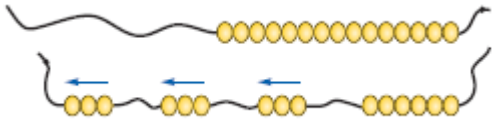
Stage 1: Recording and developing mental images

Children are encouraged through practical experience to develop physical and mental images. They make recordings of their work as they solve problems where they want to make equal groups of items or sharing objects out equally e.g.

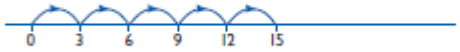
12 ÷ 4 =



Stage 2: children use equal step counting to support division
15 eggs are placed in baskets, with 3 in each basket. How many baskets are needed?

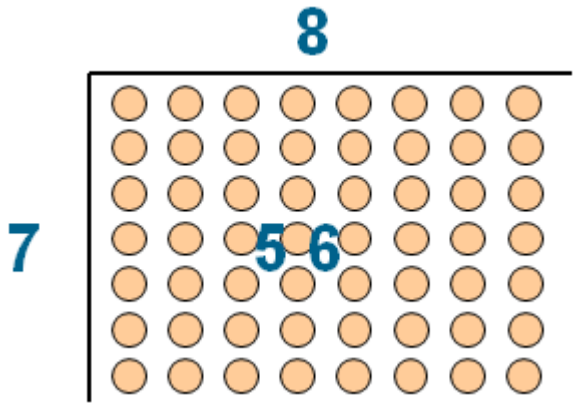


Counting on a labelled and then blank number lines. 15 ÷ 3 = 5

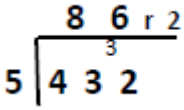


Stage 3: Developing understanding of multiplicative relationships
Arrays can be used to support children in seeing the links between grouping and sharing and between multiplication and division. Children continue to solve problems by grouping or by sharing developing an understanding of remainders in each context. They understand when a remainder can be expressed as a fraction.

Stage 4: Using arrays to support children in moving towards standard written methods for division
Children construct arrays by grouping the dividend into groups of the divisor. The number of groups made is recorded as the quotient. Children then begin to construct the arrays using place value equipment to represent the dividend. E.g.
Divided (56) ÷ divisor (7) = Quotient (8)



Stage 5: Short and Long division
Once children have developed a sound understanding of division, using the manipulatives 'formal written methods' of short and then long division can be introduced.



The children are to exchange the numbers above and to the left hand side.

Long Division

432 ÷ 15 becomes

```
      2  8
   ┌──────
15 │ 4  3  2
     3  0  0
   ──────────
      1  3  2
      1  2  0
   ──────────
         1  2
```

Answer 28 remainder 12

For calculations where numbers of up to 4 digits are divided by a two-digit number, children are expected to use long division.
Children may choose to record the 'chunks' alongside to help them calculate their final answer.

432 ÷ 15 becomes

```
      2  8
   ┌──────
15 │ 4  3  2
     3  0  0     15 x 20
   ──────────
      1  3  2
      1  2  0     15 x 8
   ──────────
         1  2
```

Answer 28 remainder 12

$$\frac{12}{15} = \frac{4}{5}$$

Children need to ensure that they interpret the remainder in the most appropriate way in the context of the question.

Reviewed by **S Ratliffe**

Date of Policy: **Nov 2016**

Review Date: **Nov 2019**