Key Stage 2 Calculation Policy
Hazlewood Community Primary School

04/09/2018

Foreword

This policy is intended to demonstrate how we teach different forms of calculation at Hazlewood. It is organised by year groups. In the KS2 tests at the end of year 6, children are expected to use written formal methods for all four operations (addition, subtraction, multiplication and division). This policy is designed to help teachers and staff members ensure that calculation is taught consistently across the school and to aid them in helping children who may need extra support. This policy is also designed to help parents, carers and other family members support children's learning by letting them know the expectations for their child's year group and by providing an explanation of the methods used in our school.

Year 3

Objectives:

· Add and subtract numbers mentally, including: ; a three-digit number and ones; a three-digit number and tens; a three-digit number and hundreds

· Add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction

· Estimate the answer to a calculation and use inverse operations to check answers

· Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

· Pupils practise solving varied addition and subtraction questions. For mental calculations with two-digit numbers, the answers could exceed 100.

· Pupils use their understanding of place value and partitioning, and practise using columnar addition and subtraction with increasingly large numbers up to three digits to become fluent.

Addition	Subtraction

Addition

Continue to develop understanding of partitioning and place value and use this to support addition.

Use practical apparatus to support this, such as dienes/place value counters.

Where ones combine to make totals greater than 10, regroup using partitioning skills

$4 + 2 = 6$

$30 + 20 = 50$

$50 + 6 = 56$
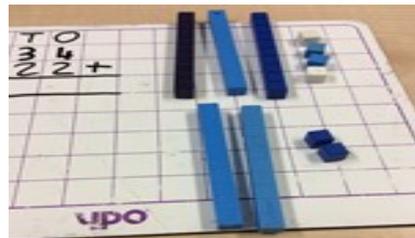
Pupils continue to determine when calculations are best carried out using mental strategies.

Record in columns with a focus on place value. Use expanded recording and apparatus to illustrate concept initially if required before moving towards the formal written method.

Expanded Column Addition

```
 T O
 2 3 +
 2 1
 ___
   4 +
 4 0
 ___
 4 4
```

Compact Column Addition

```
 T O
 2 3
 2 1  +
 ___
 4 4
```

```
 H T O
 1 2 8
 1 2 7 +
 _____
 2 5 6
     1
```

Subtraction

Continue to develop understanding of partitioning and place value and use this to support subtraction.

Use practical apparatus to support this, such as dienes/place value counters.

Use expanded recording and apparatus to illustrate concept initially if required before moving towards the formal written method.

No exchanging

$5 - 1 = 4$

$40 - 20 = 20$

$20 + 4 = 24$
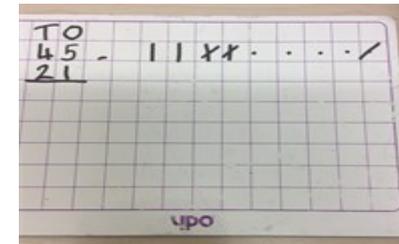
Pupils continue to determine when calculations are best carried out using mental strategies.

Record in columns with a focus on place value. Use expanded recording and apparatus to illustrate concept initially if required before moving towards the formal written method.

```
 T O
 5 3 -
 2 1
 ___
   2
 3 0 +
 ___
 3 2
```

```
 T O
 5 3
 2 1  -
 ___
 3 2
```

```
 H T O
      1
 2 2¹5
 1 1 7 -
 _____
 1 0 8
```

Year 3

Objectives:

· Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.

· Solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects.

· Pupils continue to practise their mental recall of multiplication tables when they are calculating mathematical statements in order to improve fluency.

· Pupils develop efficient mental methods, for example, using commutativity and associativity (for example, $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$) and multiplication and division facts (for example, using $3 \times 2 = 6$, $6 \div 3 = 2$ and $2 = 6 \div 3$) to derive related facts (for example, $30 \times 2 = 60$, $60 \div 3 = 20$ and $20 = 60 \div 3$).

· Pupils develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written methods of short multiplication and division.

· Pupils solve simple problems in contexts, deciding which of the four operations to use and why. These include measuring and scaling contexts, (for example, four times as high, eight times as long etc.) and correspondence problems in which m objects are connected to n objects (for example, 3 hats and 4 coats, how many different outfits?; 12 sweets shared equally between 4 children; 4 cakes shared equally between 8 children).

Multiplication	Division
Develop the use of x and = symbols to record calculations.	**Develop the use of ÷ and = symbols to record calculations.**

Develop the use of x and = symbols to record calculations.

Use arrays and other practical apparatus to illustrate commutativity (that multiplication calculations can be carried out in any order) e.g. 2 x 5 arrives at the same answer as 5 x 2. Begin to derive new facts from known facts e.g. 3 x 2 = 6 (known fact) 30 x 2 = 60 300 x 2 = 600 etc.

Begin to use understanding of place value and partitioning to carry out multiplication of two-digit by one -digit numbers using grid method.

3 x 3 = 9

20 x 3 = 60

60 + 9 = 69

<u>Short Multiplication</u>

HTO
13 x
  5
 15   3 x 5
 50 + 10 x 5
 65   Add them together

HTO
13 x
  5
 65
  1

Develop the use of ÷ and = symbols to record calculations.

Use arrays and other practical apparatus to illustrate making of repeated groups.

Begin to derive new facts from known facts e.g. 6 ÷ 2 = 3 (known fact) 60 ÷ 2 = 30, 600 ÷ 2 = 300

 Begin to carry out division of two- digit by one -digit numbers, first without remainders, then introducing remainders, illustrating this using informal methods first if required.

<u>Informal pictorial method</u>

Arrays (repeated groups)
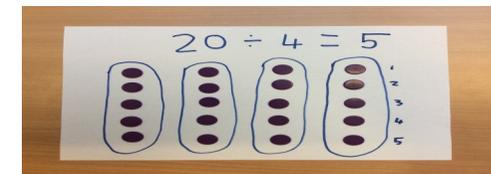
<u>Short Division</u>

81 ÷ 3 =

     2 7
3 | 8²1

If children are secure, introduce short division with remainders.

Year 4

Objectives:

· Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate

· Estimate and use inverse operations to check answers to a calculation

· Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

· Pupils continue to practise both mental methods and columnar addition and subtraction with increasingly large numbers to aid fluency

Addition	Subtraction
Column Addition should be revisited and extended to 4 digits. Use expanded recording and apparatus to illustrate concept initially if required before moving towards the formal written method.	Column Subtraction should be revisited and extended to 4 digits. Use expanded recording and apparatus to illustrate concept initially if required before moving towards the formal written method.

Addition

Expanded Column Addition   _Compact Column Addition_

```
Th H T O              Th H T O
 3 4 5 1 +             3 4 5 6 +
 2 5 3 7               2 8 3 7
_____               _____
       8 +             6 2 9 3
      8 0              _____
    9 0 0              1     1
  5 0 0 0
_____
  5 9 8 8
```

Ensure that in the tens column, children are taught to say '50 + 30' as opposed to '5 + 3' and for the hundreds column '400 + 500 'instead of '4 + 5'. Alternatively we can say 5 tens + 3 tens equals 8 tens.

Subtraction

Expanded Column Subtraction   _Compact Column Subtraction_

```
Th H T O                    Th H T O
 6 8 4 6 -                   5   3
 3 5 1 4                    ⁶ ³ ⁴¹5 -
_____                    ⁶ ³ ⁴ ¹5
       2 +                  3 8 1 7
      3 0                   _____
    3 0 0                   2 5 2 8
  3 0 0 0
_____
  3 3 3 2
```

Ensure that in the tens column, children are taught to say '40 - 10' as opposed to '4 - 1' and for the hundreds column '800 + 500 'instead of '8 - 5'. Alternatively we can say 4 tens - 1 ten equals 3 tens.

Year 4

Objectives:

· Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers

· Recognise and use factor pairs and commutativity in mental calculations

· Multiply two-digit and three-digit numbers by a one-digit number using formal written layout

· Solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

· Pupils continue to practise recalling and using multiplication tables and related division facts to aid fluency.

· Pupils practise mental methods and extend this to three-digit numbers to derive facts, (for example $600 \div 3 = 200$ can be derived from $2 \times 3 = 6$).

· Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers (see Mathematics Appendix 1).

· Pupils write statements about the equality of expressions (for example, use the distributive law $39 \times 7 = 30 \times 7 + 9 \times 7$ and associative law $(2 \times 3) \times 4 = 2 \times (3 \times 4)$).

· They combine their knowledge of number facts and rules of arithmetic to solve mental and written calculations for example, $2 \times 6 \times 5 = 10 \times 6 = 60$.

· Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as the numbers of choices of a meal on a menu, or three cakes shared equally between 10 children.

Multiplication	Division
Develop expanded recording in columns and then move to formal written method, using practical apparatus to support as required.	Move to develop the formal method of short division, first with no remainders, then with remainders.

Multiplication

H T O

1 2 5

___3 ×

  1 5   3 x 3

  6 0   3 x 20

3 0 0 + 3 x 100

3 7 5   Add them together

H T O

1 2 5

___3 ×

3 7 5

    1

Division

Short Division (No remainder)

$895 \div 5$

  1 7 9

5 | 8 9³ 5⁴

Short Division (with remainder)

$964 \div 7$

  1 3 7 r 5

7 | 9 6² 4⁵

Year 5 & 6

Objectives:

· Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)

· Add and subtract numbers mentally with increasingly large numbers

· Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy

· Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

· Pupils practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency

· They practise mental calculations with increasingly large numbers to aid fluency (for example, 12 462 – 2300 = 10 162). In the KS2 tests at the end of Year 6, children are expected to use the formal methods for addition and subtraction.

Addition	Subtraction
Extend knowledge of column addition to numbers with any number of digits and decimals with 1 and 2 decimal places. Revert back to using expanded method if any children are experiencing difficulty.	Extend knowledge of column subtraction to numbers with any number of digits and decimals with 1 and 2 decimal places. Revert back to using the expanded method if any children are experiencing difficulty.
Compact Column Addition	Compact Column Subtraction
Th H T O ● t th 6 8 8 7 ● 4 6 + 2 4 5 2 ● 3 9 _____ 9 3 3 9 ● 8 5 1 1 1	Th H T O ● t th 7 1 5 1 6 8 5 7 ● 6 6 - 2 4 8 2 ● 3 9 _____ 4 3 3 5 ● 2 7
Ensure that in the tens column, children are taught to say '50 + 40' as opposed to '5 + 4' and for the hundreds column '400 + 300 'instead of '4 + 3'. Alternatively we can say 5 tens + 4 tens equals 9 tens.	Ensure that in the tens column, children are taught to say '50 - 30' as opposed to '5 - 3' and for the hundreds column '700 + 400 'instead of '7 - 4'. Alternatively we can say 7 tens - 4 ten equals 3 tens.

Year 5

Objectives:

· Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers

· Pupils write statements about the equality of expressions (for example, use the distributive law 39 × 7 = 30 × 7 + 9 × 7 and associative law (2 × 3) × 4 = 2 × (3 × 4)).

· They combine their knowledge of number facts and rules of arithmetic to solve mental and written calculations for example, 2 x 6 x 5 = 10 x 6 = 60.

· Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as the numbers of choices of a meal on a menu, or three cakes shared equally between 10 children.

· Recognise and use square numbers and cube numbers, and the notation for squared (2) and cubed (3)

· Solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes

· Solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign

· Solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.

· Pupils practise and extend their use of the formal written methods of short multiplication and short division. They apply all the multiplication tables and related division facts frequently, commit them to memory and use them confidently to make larger calculations.

· Pupils use multiplication and division as inverses to support the introduction of ratio in year 6, for example, by multiplying and dividing by powers of 10 in scale drawings or by multiplying and dividing by powers of a 1000 in converting between units such as kilometres and metres.

· Pupils use and explain the equals sign to indicate equivalence, including in missing number problems (for example, 13 + 24 = 12 + 25; 33 = 5 x).

Multiplication	**Division**
Extend written approaches to ThHTO x O using short multiplication then introduce long multiplication when calculations are multiplying by a 2 digit number or larger.	Extend written approaches to ThHTO ÷ O using short division with and without remainders.

Short Multiplication

2741 x 6

Long Multiplication

3645 x 53

Short Division

Year 6

Objectives:

· Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication

· Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context

· Divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context

· Perform mental calculations, including with mixed operations and large numbers

· Identify common factors, common multiples and prime numbers use their knowledge of the order of operations to carry out calculations involving the four operations

· Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

· Solve problems involving addition, subtraction, multiplication and division

· Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

· Pupils practise addition, subtraction, multiplication and division for larger numbers, using the formal written methods of columnar addition and subtraction, short and long multiplication, and short and long division (see Mathematics Appendix 1 in the national Curriculum).

· They undertake mental calculations with increasingly large numbers and more complex calculations.

· Pupils continue to use all the multiplication tables to calculate mathematical statements in order to maintain their fluency.

· Pupils explore the order of operations using brackets; for example, 2 + 1 x 3 = 5 and (2 + 1) x 3 = 9.

In the KS2 tests at the end of Year 6, children are expected to use the formal methods for multiplication and division

Multiplication	Division
Extend written approaches to any number of digits using short multiplication then introduce long multiplication when calculations are multiplying by a 2 digit number or larger.	Extend written approaches to any number of digits using short division then introduce long division when calculations are dividing by a number greater than 12.

Multiplication

Short Multiplication

2741 x 6

Long Multiplication

3645 x 53

Division

Short Division

Long Division