Federation of Mowden Schools

MOWDEN

LEARNING IN PARTNERSHIP

Written Calculations Policy

This policy contains the key pencil and paper procedures that will be taught within our Federation. It has been written to ensure consistency and progression throughout the school and reflects a whole school agreement.

Although the focus of the policy is on pencil and paper procedures it is important to recognise that the ability to calculate mentally lies at the heart of mathematics. Mental methods will be taught systematically and pupils will be given regular opportunities to develop the necessary skills. However mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it. In every written method there is an element of mental processing. Sharing written methods with the teacher encourages children to think about the mental strategies that underpin them and to develop new ideas. Therefore written recording both helps children to clarify their thinking and supports and extends the development of more fluent and sophisticated mental strategies.

During their time at this Federation, children will be encouraged to see mathematics as both a written and spoken language. Teachers will support and guide children through the following important stages:

- use of jottings to aid a mental strategy
- use of pencil and paper procedures
- use of a calculator

This policy concentrates on the use of the empty number line as a jotting to aid mental calculation and on the introduction of pencil and paper procedures. It is important that children do not abandon jottings and mental methods once pencil and paper procedures are introduced. Therefore children will always be encouraged to look at a calculation/problem and then decide which is the best method to choose – mental calculation with or without jottings, structured recording or a calculator. Our long-term aim is for children to be able to select an efficient method of their choice (whether this be mental, written or using a calculator) that is appropriate for a given task. They will do this by always asking themselves:

'Can I do this in my head?'
'Can I do this in my head using jottings?'
'Do I need to use a pencil and paper procedure?'
'Do I need a calculator?'

All schools use a variety of concrete, pictorial and abstract representations for numbers and calculations. Pupils should have an opportunity to manipulate and experience a variety of models, images, and resources to enable them to choose the most suitable representation for each calculation.

The National Curriculum

Objectives for when to teach the 4 operations are taken from the National Curriculum. However, it is up to individual teachers to decide when it is appropriate to move an individual on to the next step. A child should be moved onto larger numbers or more formal written methods as soon as they are ready and not just when they reach a particular year group.

We feel that it is fundamental for children to be able to move from conceptual learning to abstract learning in order to be able to successfully understand, use and apply their mathematical skills. The calculation strategies which will be used will reflect this ideology – moving from concrete to pictorial and then abstract recording, leading to more formal written methods. Mental methods and strategies will work in partnership with these methods.

Developmental Aims:

- To introduce children to the processes of calculation through practical, oral and mental activities
- To support children in developing ways of recording to support their thinking and mental calculation methods
- Enable children to interpret and use the signs and symbols.
- To facilitate children's use of models and images, beginning with concrete images such as Numicon and moving to pictorial images such as the empty number-line
- To enable children to strengthen and refine their mental methods in order to develop informal written methods
- To support children in becoming more efficient and succinct in their recordings which will ultimately lead to efficient written methods that can be used more generally
- By the end of Key Stage 2 children should be equipped with mental, written and calculator methods that they understand and can use correctly
- By the end of Key Stage 2, when faced with a calculation, children will be able to decide which method is most appropriate and have strategies to check its accuracy
- At whatever stage in their learning, and whatever method is being used, children's methods of calculating will be underpinned by a secure and appropriate knowledge of number facts, along with the mental skills that are needed to carry out the process and judge if it was successful

Addition (+)

Definition

Addition is the process of calculating the total of two or more numbers or amounts. It is the inverse of subtraction.
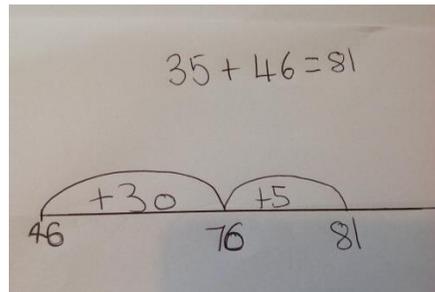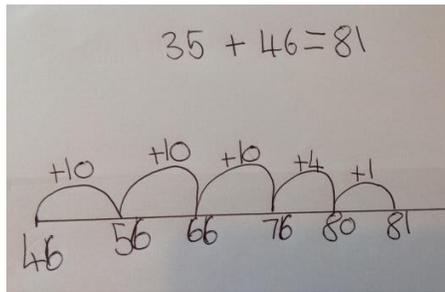
Early learning

Using a range of practical resources and real life contexts, pupils develop their understanding of the concept of addition through counting activities. They then use pictures/diagrams to represent the calculation.
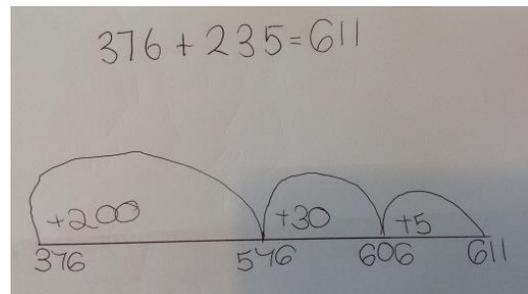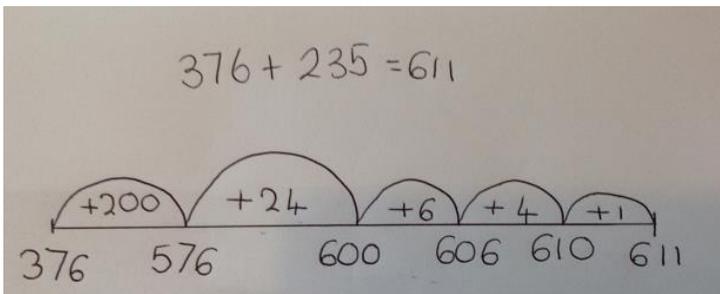
Written Methods

- *Using a number line to add*

E.g.

35 + 46

376 + 235

9.75 + 3.6

$$9.75 + 3.6 = 13.35$$

- *Partitioning: two digit numbers and then three digit numbers*

E.g.

46 + 23

$$46 + 23 = 69$$

357 + 268

$$357 + 268 = 625$$
$$300 + 200 = 500$$
$$60 + 50 = 110$$
$$7 + 8 = 15$$
$$500 + 110 + 15 = 625$$

- *Add a near multiple of 10 or 100 to a two-digit number, then adjust*

Secure mental methods by using a number line to model the method.

E.g. $35 + 19$ is the same as $35 + 20 - 1$

$458 + 79 =$ is the same as $458 + 80 - 1$

- *Formal written methods*

789 + 642 becomes

```
    7  8  9
 +  6  4  2
_____
 1  4  3  1
    1  1
```

Answer: 1431

Subtraction (-)

Definition

Subtraction is the process or skill of taking one number or amount away from another or finding the difference between two numbers.

Early Learning

Using a range of practical resources and real life contexts, pupils develop their understanding of the concept of subtraction through counting activities. They then use pictures/diagrams to represent the calculation.

Written Methods

- *Number lines to count back or take away*

Use an empty number line when subtracting one digit while counting backwards e.g. 9 – 3 or 35 – 6.

Progress to subtraction of two digit numbers from two digit numbers (e.g. 73 – 45), to two digit numbers from three digit numbers (e.g. 376- 93), to three digit numbers from three digit numbers (e.g. 426 – 375).
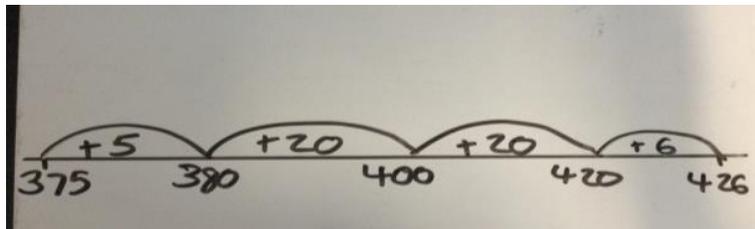
- *Subtract mentally a 'near multiple of 10' to or from a two-digit number*

Appropriate numbers e.g. 78 – 49 is the same as 78 – 50 + 1

- *Formal written methods*

874 – 523 becomes	932 – 457 becomes
	8 12 1
8 7 4	9̸ 3̸ 2
− 5 2 3	− 4 5 7
3 5 1	4 7 5
Answer: 351	Answer: 475

Multiplication (x)

Definition

Multiplication is the product of two numbers or repeatedly adding the same set of number as many times as the other number. Therefore 3 multiplied by 4 is 4 lots of 3, or 3 added repeatedly 4 times. It is an inverse operation of division.

Early learning

Pupils are given an opportunity to manipulate and experience a range of resources in real life contexts and through role play. They are encouraged to solve real life problems e.g. If one pair of welly boots = 2 then 3 pairs = 6

They are encouraged to draw pictures and represent their mathematical thinking through various representations e.g. bead strings, Numicon, cubes.

Written Methods

- *Number lines*

Use concrete representations such as bead strings, Numicon or cubes etc. to make sets or groups of various sizes. Use number lines alongside other mathematical equipment to represent repeated addition counting in regular steps of various sizes e.g. to calculate 3 x 6.
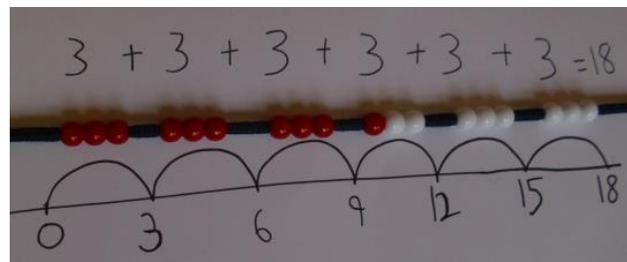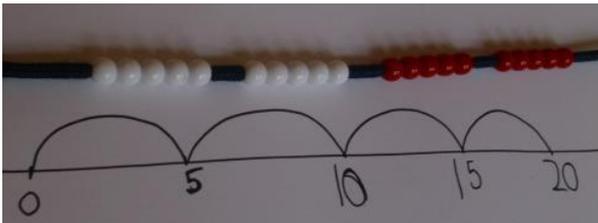
- *Arrays*

Arrays are an essential representation to solve multiplication problems. Pupils can count groups of objects in each row or column to find the product. They will be given a number of objects to arrange in an array of various dimensions and also be given an unknown number of objects to count by arranging in arrays.
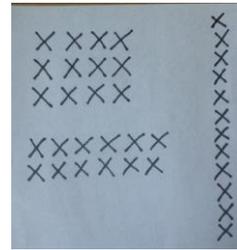
E.g. 3 lots of 4 = 4 groups of 3

4 x 3 = 3 x 4

4 + 4 + 4 = 3 + 3 + 3 + 3 = 12

Use of concrete representations should lead to drawing pictures and arrays.

- *Grid method*

When children are confident they should be encouraged to partition numbers using the grid method.

E.g. 23 x 7

x	20	3
7	140	21

$$140 + 21 = 161$$

E.g. 72 x 38

x	70	2
30	2100	60
8	560	16

$$2100 + 560 + 60 + 16 = 2736$$

- *Formal written methods*

Short multiplication

24 × 6 becomes

```
      2  4
  ×      6
  ─────────
  1   4  4
      2
```

Answer: 144

342 × 7 becomes

```
      3  4  2
  ×         7
  ──────────
  2   3  9  4
      2  1
```

Answer: 2394

2741 × 6 becomes

```
      2  7  4  1
  ×            6
  ─────────────
  1   6  4  4  6
      4  2
```

Answer: 16 446

Long multiplication

```
      4  3  2
  ×   ₁5  4
  ─────────
  1  7  2  8
2 1 6  0  0
─────────
2 3  3  2  8
  1
```

Division (÷)

Definition

Dividing is a quick way of subtracting several lots of the same number or quantity, or splitting it up into equal groups. Multiplying and dividing are the inverse or opposite of each other.

Division should not be taught in isolation it should be integrated into multiplication and seamlessly linked so that pupils feel confident to talk about division.

Early Learning

Pupils should have many practical experiences of sharing objects e.g. sharing between 2 people, or finding ½ of a group of objects. Pictures should be introduced as a next step to represent this.

Drawings and diagrams should be increasingly used to represent and demonstrate sharing.
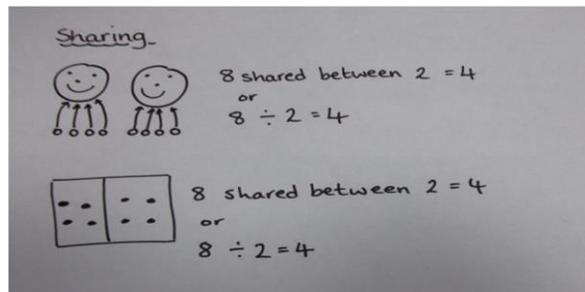

Sharing

Progressing from the drawings and diagrams pupils can share by partitioning or chunking. Here sharing can be recorded as jottings and numbers.
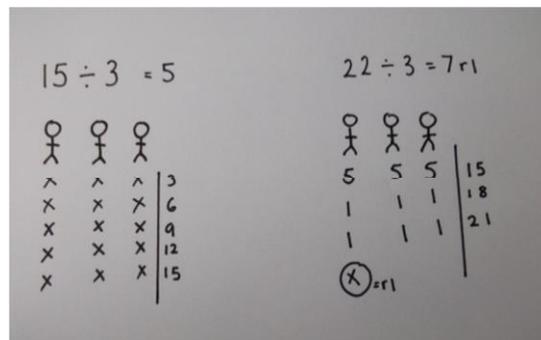
Written Methods

- *Number lines*

Number lines should be introduced to help record grouping strategies. This would involve the principle of repeated subtraction (and repeated addition as an alternative strategy).
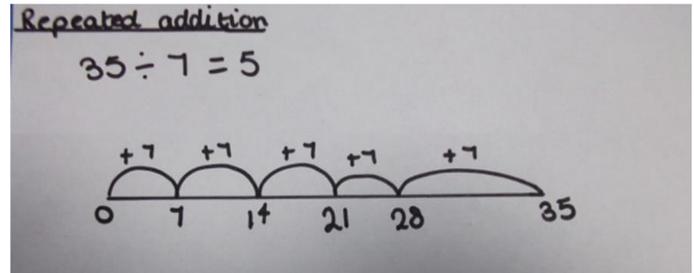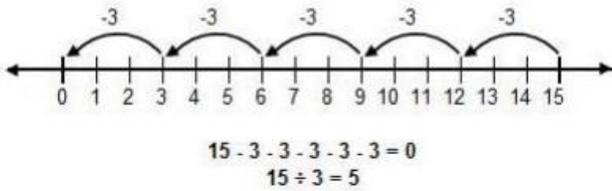
- *Formal Written Methods*

Short division

98 ÷ 7 becomes	432 ÷ 5 becomes	496 ÷ 11 becomes

```
     1   4
       2
  7  9   8
```
Answer: 14

```
         8   6  r 2
              3
   5   4  3   2
```
Answer: 86 remainder 2

```
         4   5  r 1
              5
  1  1   4  9   6
```
Answer: $45 \frac{1}{11}$

Long division

432 ÷ 15 becomes

```
              2   8
  1   5  |  4   3   2
            3   0   0      15×20
          _____
            1   3   2
            1   2   0      15×8
          _____
                1   2
```

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

Answer: $28 \frac{4}{5}$

432 ÷ 15 becomes

```
              2   8 · 8
  1   5  |  4   3   2 · 0
            3   0
          _____
            1   3   2
            1   2   0
          _____
                1   2   0
                1   2   0
              _____
                        0
```

Answer: 28·8