## St.George's Primary School

# Developing calculation strategies

This policy provides a progression for the development of calculations

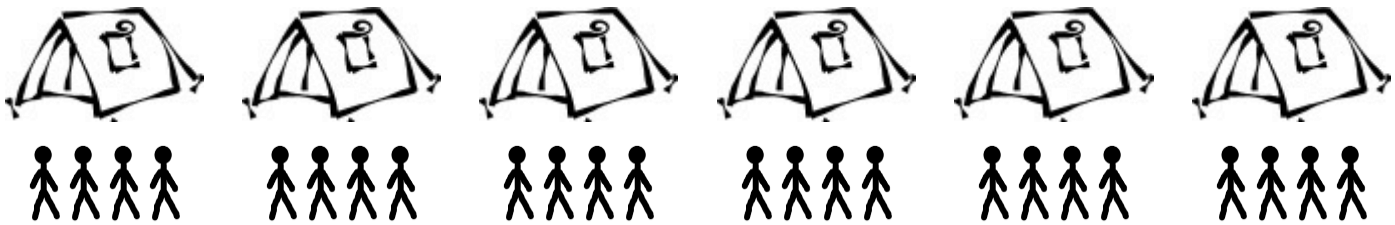
Within the school there will be a development of recording mental strategies which allows the children to make their thinking visible e.g. number lines, informal jottings and drawings. Recording in mathematics, and in calculation in particular, is an important tool both for furthering the understanding of ideas and for communicating those ideas to others. A useful written method is one that helps children carry out a calculation and can be understood by others. Written methods are complimentary to mental methods and should not be seen as separate from them. Children should be able to choose an efficient method; mental, written, calculator – that is appropriate to a given task.

**At every stage children will be provided with practical apparatus and visual images such as: Dienes, place value arrow cards, number lines, number squares, counters and other counting equipment.**

## INFORMAL RECORDINGS

**Using pictures to aid calculation**

*24 people went camping. 4 people went in each tent. How many tents did they use? 6*



## EARLY RECORDING

Initially children will be given opportunities to record using just the numerals without the use of signs for operations or the equals sign e.g. empty bucket / balances.

Children will then develop understanding of plus and minus signs by using appropriate contexts. This will be developed alongside the use of the equals sign which will be modelled through appropriate physical representations e.g. the number balance/ pictures.

**5-2=**

I had five balloons. Two burst. How many did I have left?

## EQUALS SIGN

Throughout school, the equals sign will be used accurately.

e.g. 3 + 4 = 7 + 8 = 15 **is not appropriate**

3 + 4 + 8 = 7 + 8 = 15 **is appropriate**

Balance beam and bucket balance will be used to demonstrate equality.

Children will have experience of a range of word sentences in a diversity of forms:

e.g. 3 + 4 + 5 = 12 7 = 4 + 3 3 + 4 = 5 + 2

## DEVELOPING RECORDING METHODS

Children will use different methods of recording mental strategies that include:

Arrow Diagrams

5 and 1 → 6 5 + 1 → 6

Number Sentences

3 + 4 = ☐ 3 + 8 = ☐ 9 = 5 + ☐

Number tracks, Numbered number lines and Partially numbered number lines

Should be used to aid calculation and recording in foundation and KS1

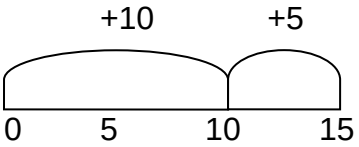
## ADDITION

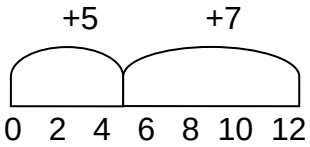
In Foundation stage addition is practical and topic based. Objects are physically moved and combined together to represent adding. Addition is represented visually by drawing pictures.

In Year 1 addition continues to be practical and is represented by pictures and simple number sentences. Number tracks, fully numbered number lines and hundred squares are used.

**Partially Numbered Number Lines** (Year 2)

***After moving from fully numbered number lines, children use partially numbered number lines before moving onto empty number lines.***



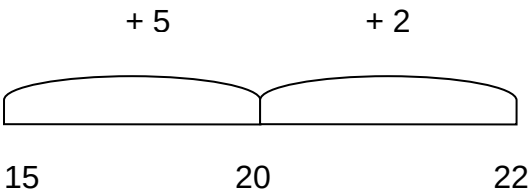




**Empty Number Lines** (from Y3)

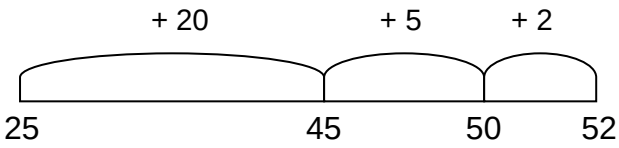
***Empty number lines should not be introduced until children have a lot of experience using numbered number lines to aid calculation.***

Addition recorded on the empty number line supports and improves pupils' **mental** strategies but does not progress into a standard written form.

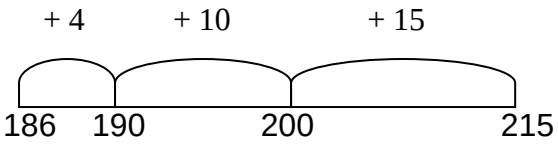
Bridging through 20 eg. 15 + 7 = 22

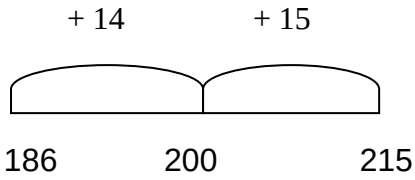



eg. 25 + 27 = 52



*Bridging through the nearest 10/100 eg. 186 + 29 = 215*




**Expanded Method**

The expanded written calculation for addition will only be developed when the child can:

- Add two single digit numbers mentally.
- Add multiples of ten mentally.
- Partition numbers into tens and units mentally.
- Add two digit numbers mentally and record the method informally e.g. empty number line

***Year 2/3 (Partition 2 digit numbers)***

eg. 47 + 76= ☐

40 + 70 = 110
7 + 6 = 13
123

***Year 3***

eg. 238+147= ☐ 200+30+ 8
100+40+ 7
300+70+15 (add mentally)

Children should only be working on numbers this large when they are able to add multiples of 10 and 100 with confidence.

***Year 4 to 6***

eg. 7588+346= ☐ 7588
346
14
120
800
7000
7934

**Standard Compact Method**

The standard compact method will only be introduced to more-able children (Y5/6) who are already confident using the expanded method and have a solid understanding of place value. **Some children will continue to calculate using a number line throughout the school**

```
  2 3 8        7 6 5 8
+ 1 4 7      +   3 4 6
    1          1 1 1
-------      ---------
  3 8 5      8 0 0 4
```

Encourage children to write the carried digit above the answer box. When the digit is written underneath, it is often forgotten.

**Explicit language must be used in standard compact method**

For example:

```
    5 4 7
+   2 7 6
  1 1
-------
  8 2 3
```

- Seven plus six equals thirteen. Write down three and carry the ten (child writes carry digit above).
- Forty plus seventy equals one hundred and ten, plus the extra ten, which equals one hundred and twenty. Write down the two tens and carry the one hundred (child writes carry digit above).
- Five hundred plus two hundred equals seven hundred, plus the extra one hundred, which equals eight hundred. Write down the eight hundreds.
- The total is eight hundred and twenty-three.

## SUBTRACTION

In Foundation stage subtraction is practical and taught alongside addition. Objects are physically moved and taken away. Subtraction is represented visually by drawing pictures.

In Year 1 subtraction continues to be practical and is represented by pictures and simple number sentences. Children record through drawing and crossing out. Number tracks, fully numbered number lines and hundred squares are used. Children find the difference and use counting on.

**Numbered number Lines** *(from Y1)*

Numbered number lines should be used to count back.

**Partially numbered number Lines** *(from Y2)*

**Partially n**umbered number lines should be used to count back.

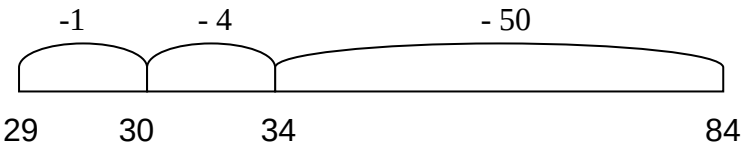
**Empty Number Lines** *(from Y3)*

***Empty number lines should not be introduced until children have a lot of experience using numbered number lines to aid calculation. Both counting on and counting back to be used where appropriate. E.g. Counting on to be used when calculating change or subtracting time.***

**Count Back Method**

Children should be encouraged to start with the larger number and subtract the smaller by partitioning

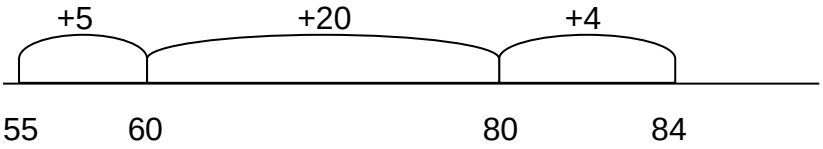
eg. 84 – 55 = 29




This demonstrates “taking away”, how much less than.

**Count on Method**

eg. 84 – 55 = 29



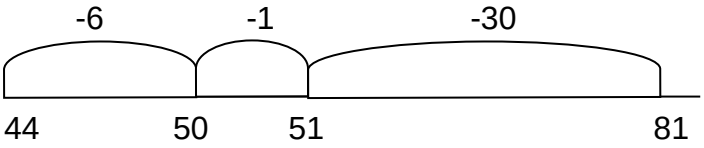

This demonstrates finding the difference, how much more than.

***Year 3***

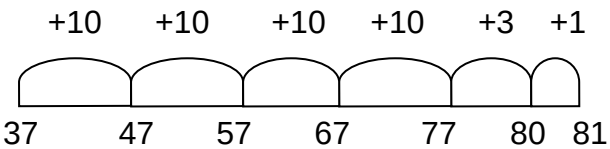
Empty number line should be used throughout using counting on and counting back.

eg. 81 – 37 = 44

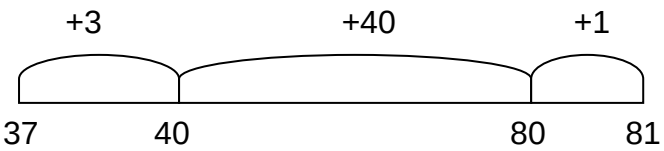
**Counting back**




**Counting on** can be done in several ways.




(counting on in tens) 81-37=44

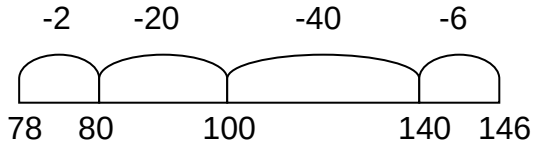



(counting to nearest 10) 81-37=44

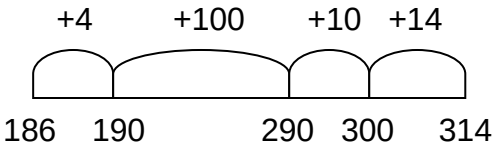
***Year 4***

Pupils continue to record on the number line by '**counting on'** and '**counting back'**. The calculations should be extended to bigger numbers.

eg **counting back** 146 – 78 =68




eg.**counting on** 314 – 186 =128




**More-able pupils** start to record in a column where numbers are partitioned. The calculations should be extended to bigger numbers.

**e.g.** 379 – 256

| | | | | | | |
|---|---|---|---|---|---|---|
| | **300** | **+** | **70** | **+** | **9** | |
| **-** | **200** | **+** | **50** | **+** | **6** | |
| | **100** | **+** | **20** | **+** | **3** | **= 123** |

**e.g.** 243 – 152

| | | | | | | |
|---|---|---|---|---|---|---|
| | **~~200~~ 100** | | **1** | | | |
| | **~~200~~** | **+** | **40** | **+** | **3** | |
| **-** | **100** | **+** | **50** | **+** | **2** | |
| | | | **90** | **+** | **1** | **= 91** |

***Year 5/6***

The expanded written calculation for subtraction will only be developed when the child can:

- Subtract two single digit numbers mentally
- Subtract multiples of ten mentally
- Partition numbers into tens and units mentally
- Subtract two digit numbers mentally and record the method informally e.g. empty number line.

More able pupils can be introduced to the following progression.

**Decomposition**

**e.g.** 379 – 256

| | | | |
|---|---|---|---|
| | 3 | 7 | 9 |
| - | 2 | 5 | 6 |
| | 1 | 2 | 3 |

**e.g.** 243 – 152

| | | | |
|---|---|---|---|
| | ~~2~~ | 4 | 3 |
| | 1 | 1 | |
| - | 1 | 5 | 2 |
| | | 9 | 1 |

# MULTIPLICATION

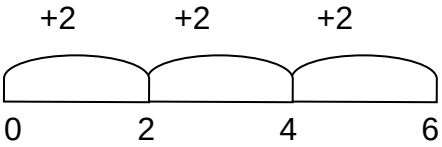
All multiplication sums given must link to times tables that children should know or are starting to learn within that year group.
Y2: x2, x5, x10
Y3: x2, x3, x4, x5, x6, x10
Y4 : All to x10

## Foundation Stage / Year 1

Counting in twos. Some children may move on to counting in tens and then fives.

Year 1 will move onto repeated addition using practical equipment.

**Number Lines**
Number lines will be used to demonstrate repeated addition




**Year 2**

**Arrays**
Arrays will be used to link mental strategies to written calculation and to demonstrate the distributitive and commutative law

Arrays 3 x 4 =
4 x 3 =

**4**
0000
**3** 0000
0000

**Year 3**

3 x 4 = 4 x 3 (commutative law)

Distributive law i.e. partitioning to aid mental calculation.

16 x 3 = (10 x 3) + (6 x 3)

= 30 + 18

= 48

**Year 4**

e.g. 13x7=91

70 +21 = 91

e.g. 137 x 3 = 411

300 + 90 + 21 = 411

**Grid Method**

When children are secure in their understanding of partitioning they will be gradually introduced to the grid method. (Check regularly that the children understand how many rows and columns in each box.)

Avoid using the Grid Method when multiplying by a one digit number. Children should be taught to partition the number without putting it into a grid (see above example).

**Year 4**

e.g. 17x19 = 323

| x | 10 | 7 |
|---|---|---|
| 10 | 100 | 70 |
| 9 | 90 | 63 |

170
+ 153
200
120
3
323

**Year 6**

| x | 700 | 20 | 4 | |
|---|---|---|---|---|
| 30 | 21000 | 600 | 120 | = 21,720 |
| 5 | 3500 | 100 | 20 | = 3,620 |
| | | | | 25,340 |

***Year 5/6* – Column Method multiplication**

The column method will only be introduced to more-able children (Y5/6) who are already confident using the grid method and have a solid understanding of place value. **Some children will continue to calculate using the grid method throughout the school.**

26 x 32 = 732

```
   2 6
 x 3 2
   5 2
   1
+ 6 8 0
 1
 7 3 2
```

4.6 x 7.8 = 35.88

```
     4 6
   x 7 8
     3 6 8
       4
+  3 2 2 0
     4
   3 5 8 8
```

When multiplying decimals, remove the decimal points (in the example each number has been made 10 times larger). After multiplying the digits replace the decimals point. As each number was made 10 times larger to become whole numbers, the answer needs to be 100 times smaller.

# DIVISION

Children will be introduced to both sharing and grouping using informal methods of recording division.

## Foundation Stage/ Year 1

### Sharing

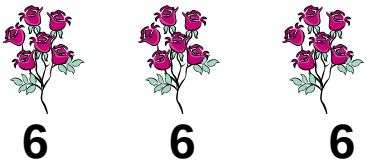
I have 6 sweets to share between 3 children. How many will they get each? **2**


## Year 2

### Grouping

18 flowers are bundled in bunches of 6

How many bunches can be made? **3**

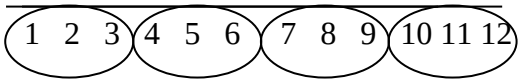



***Year 2*** - Division should be practical. Number lines will only be used by the most able. Grouping initially is repeated subtraction in the practical situation.

### Using Numbered number lines

How many 3s in 12?

There are 4 groups of 3 in 12




### Arrays

Also demonstrate using **arrays**

0000
0000
0000

How many 3's in 12

How many 4's in 12

0000
0000
0000

***Year 3/4***

Division should be taught through multiplication. All children should have access to times tables to help them with their calculations. They will use these calculations to add groups of numbers together to find the total they need.

E.g. 92 ÷ 4 = 23

40 (10 x 4)
40 (10 x 4)
12 (3 x 4)
92 (23 x 4)

| |
|---|
| 1 x 4 = 4 |
| 2 x 4 = 8 |
| 3 x 4 = 12 |
| 4 x 4 = 16 |
| 5 x 4 = 20 |
| 6 x 4 = 24 |
| 7 x 4 = 28 |
| 8 x 4 = 32 |
| 9 x 4 = 36 |
| 10 x 4 = 40 |

More able children will use their knowledge of place value to add together larger numbers.

E.g. 136 ÷ 4 = 37

If 3 x 4 = 12 then 30 x 4 = 120

120 (30 x 4)
16 (4 x 4)
136 (34 x 4)

| |
|---|
| 1 x 4 = 4 |
| 2 x 4 = 8 |
| 3 x 4 = 12 |
| 4 x 4 = 16 |
| 5 x 4 = 20 |
| 6 x 4 = 24 |
| 7 x 4 = 28 |
| 8 x 4 = 32 |
| 9 x 4 = 36 |
| 10 x 4 = 40 |

Year 5/6 – More able

*Short Division*

Short division of HTU ÷ U can be introduced as an alternative, more compact recording. Only children with a secure knowledge of place value and who are confident with multiplication and division facts should be taught this method of division. For most children this will be at the end of year 5 or the beginning of year 6.

```
    9  7
  ┌─────
3 │2  9  1
    2  2
```