The Federation of The Downs & Northbourne Church of England Primary Schools

Calculations Policy

Last Review Date:

May 2009	January 2015			

As a Church of England School this policy is read within the context of the Christian values and teachings of our school.

INTRODUCTION

The National Curriculum for Mathematics (2014) provides a structured and systematic approach to the teaching of calculation. It provides a step-by-step approach to the teaching and learning of the four operations.

Within The Federation of The Downs and Northbourne CEP Schools we have developed a consistent approach to the teaching of calculation methods, in order to establish continuity and progression throughout the school. The policy is based on national expectations from the National Curriculum for Mathematics (2014) but has additional steps inserted where we consider it to be useful.

Aims:
Children should be able to choose an efficient method, mental, written or calculator appropriate to the given task.

By the end of Year 6, children working at an age appropriate level, will have been taught, and be secure with, a compact standard method for each operation.

General Progression:
- Establish mental methods, based on a good understanding of place value.
- Develop use of number lines, hundred squares and other versatile manipulatives to aid mental calculations.
- Use of informal jottings to aid mental calculations.
- Develop use of empty number line to help mental imagery and aid recording.
- Use partitioning and recombining to aid informal methods.
- Introduce expanded written methods.
- Develop expanded methods into compact standard written form.

Before carrying out a calculation, children will be encouraged to consider:
- Can I do it in my head? (using rounding, adjustment)
- The size of an approximate answer (estimation)
- Could I use jottings to keep track of the calculation?
- Do I need to use an expanded or compact written method?

When are children ready for written calculations?

Addition and subtraction:
- Do they know addition and subtraction facts to 20?
- Do they understand place value and can they partition numbers?
- Can they add three single digit numbers mentally?
- Can they add and subtract any pair of two digit numbers mentally?
- Can they explain their mental strategies orally and record them using informal jottings?

Multiplication and division:

- Do they know the 2, 3, 4, 5 and 10 times tables?
- Do they know the result of multiplying by 1 and 0?
- Do they understand 0 as a place holder?
- Can they multiply two and three digit numbers by 10 and 100?
- Can they double and halve two digit numbers mentally?
- Can they use multiplication facts they know to derive mentally other multiplication facts that they do not know?
- Can they explain their mental strategies orally and record them using informal jottings?

These lists are not exhaustive but are a guide for the teacher to judge when a child is ready to move from informal to formal methods of calculation.

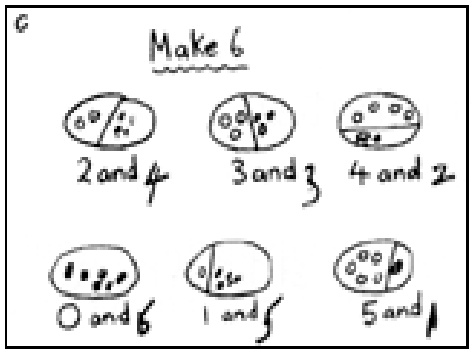
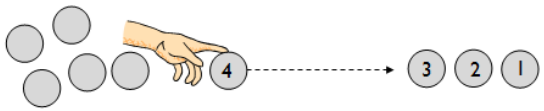
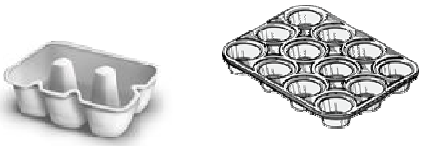
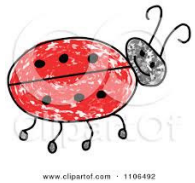
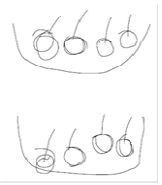
Vocabulary:

The correct terminology should be used when referring to the value of digits to support the children's understanding of place value.
E.g. 68 + 47 should be reading 'sixty add forty' and not 'six add four'.

	PROGRESSION OF WRITTEN CALCULATIONS
Lower School	• Begin to record in the context of play or practical activities and problems • Develop the use of pictures and mixture of words and symbols to represent numerical activities • Use of standard symbols and conventions (0-9, +, -, =) • Use of versatile manipulatives and jottings to aid mental calculations, number tracks, empty number lines, partitioning (**all calculations will be presented horizontally)**
Middle School	• Continue use of versatile manipulatives and jottings to aid mental calculations • Use of expanded methods for addition and subtraction • Develop use of compact method for addition and subtraction • Use of expanded methods for multiplication and division (**calculations presented horizontally and vertically)**
Upper School	• Continue use of jottings to aid mental calculations • Secure understanding of compact methods for addition and subtraction (develop use with decimals) • Develop use of compact methods for multiplication and division • Effective use of a calculator to support calculations where appropriate. (**calculations presented vertically)**

Children should be moved onto the next stage when they are confident and ready to progress.

CALCULATIONS POLICY
STAGE 1

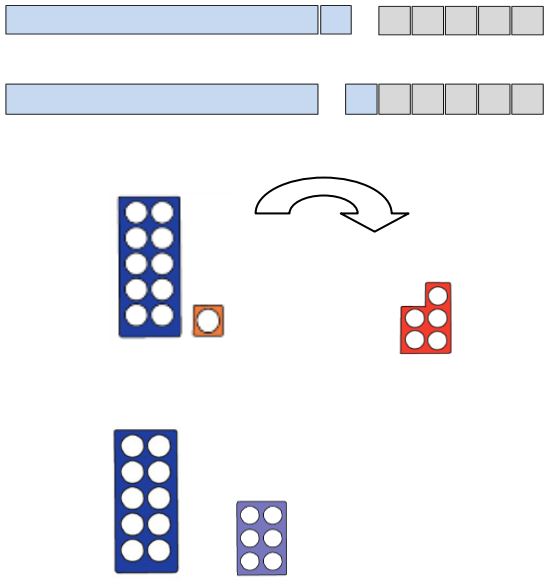
ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
 **Begin to relate addition to combining two groups of objects** • Children are encouraged to develop a mental image of the size of numbers. • Make a record in pictures, words or symbols of addition activities already carried out • Construct number sentences to go with practical activities • Begin by counting all of the items in the groups, then move on to counting on from the largest amount. • Relate addition to counting on **In practical activities and discussion begin to use the vocabulary involved in addition.**	 **Begin to relate subtraction to 'taking away'** • Children are encouraged to develop a mental image of the size of numbers. Make a record in pictures, words or symbols of subtraction activities already carried out • Construct number sentences to go with practical activities • Children will subtract two numbers by taking one away from the other and counting how many are left.  • They learn to think about subtraction as 'take away' in practical, real life situations. • They begin to record subtraction number sentences such as 8 – 5 = 3 **In practical activities and discussion begin to use the vocabulary involved in subtraction.**	**Count repeated groups of the same size** • Count in 2's • Count in 10's • Children are encouraged to develop a mental image of the size of numbers. • They learn to think about equal groups or sets of objects in practical, real life situations. • They begin to record these situations using pictures. A child's jotting showing fingers on each hand as a double. A child's jotting showing double three as three cookies on each plate.	**Share objects into equal groups and count how many in each group.** • Children are encouraged to develop a mental image of the number system in their heads to use for calculation. They should experience practical calculation opportunities involving **equal** groups and **equal** sharing.  • They may develop ways of recording calculations using pictures. • A child's jotting showing halving six spots between two sides of a ladybird.  • A child's jotting showing how they shared the apples at snack time between two groups. 

CALCULATIONS POLICY
STAGE 2

ADDITION

Understand the operation of addition and use the related vocabulary

- Record simple mental additions in a number sentence using + and =
- Know that addition can be done in any order
- Count on from the most significant number
- Move on to using Base 10 equipment to support their developing understanding of addition, e.g. 11 + 5 = 16



- Begin to partition and recombine

12 + 15 =
/ \
10 5
12 + 5 = 17
17 + 10 = 27

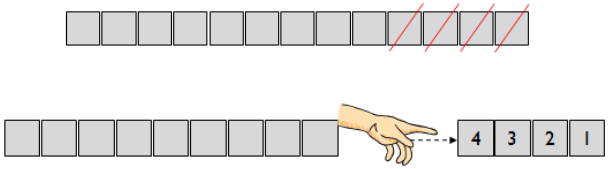
SUBTRACTION

Understand the operation of subtraction and use the related vocabulary

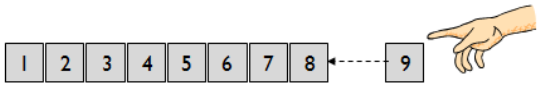
- Record simple mental subtractions in a number sentence using – and =
- Move on to using Base 10 equipment alongside a number track to support their developing understanding of subtraction.

13 - 4 = ?

13 cubes are lined up.
4 cubes are removed from the end of the line leaving 9.
It is important to keep track of how many have been removed.



Touch count and remove the number to be taken away.
Touch count to find the number that remains.



- Begin to partition and subtract by counting back.

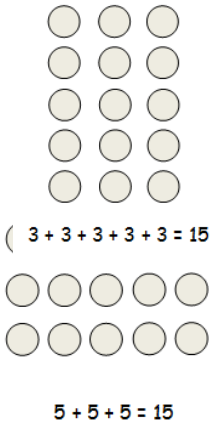
34 – 12 =
/ \
10 2
34 – 2 = 32
32 – 10 = 22

- Begin to use number lines when counting on to find a difference

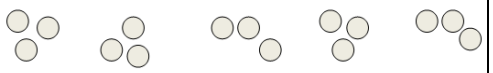
MULTIPLICATION

Draw pictures to show equal sets

- Children understand that multiplication is repeated addition and that can be done by counting in equal steps/groups.
- Children can then be introduced to the image of a rectangular array, initially through real items such as egg boxes, baking trays, ice cube trays, wrapping paper etc. and using these to show that counting up in equal groups can be a quicker way of finding a total.



- Children also understand that 3 x 5 is the same as 5 x 3



Count in twos, fives and tens

- Identify patterns of 2's, 5's, 10's on a hundred square
- Solve practical problems that involve combining groups of 2, 5 or 10.

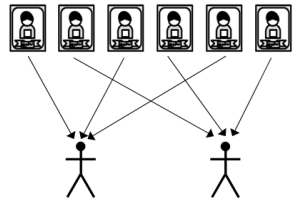
DIVISION

Draw pictures to show sharing and grouping

- 9 shared between 3
  xxx xxx xxx
- How many groups of 4 in 8?
  xxxx xxxx

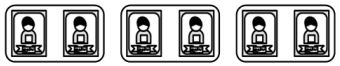
Solve practical problems that involve sharing into equal groups

6 ÷ 2 = ?
Equal sharing (6 shared equally between 2)

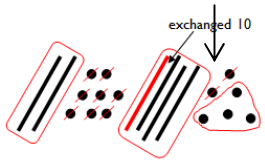
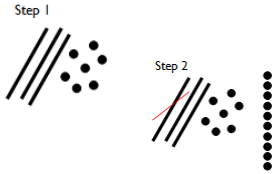
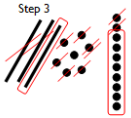
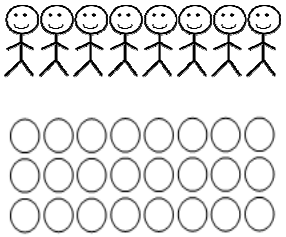
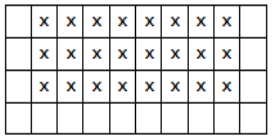
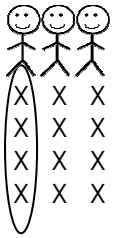


Equal grouping (How many groups of 2 are there in 6?)

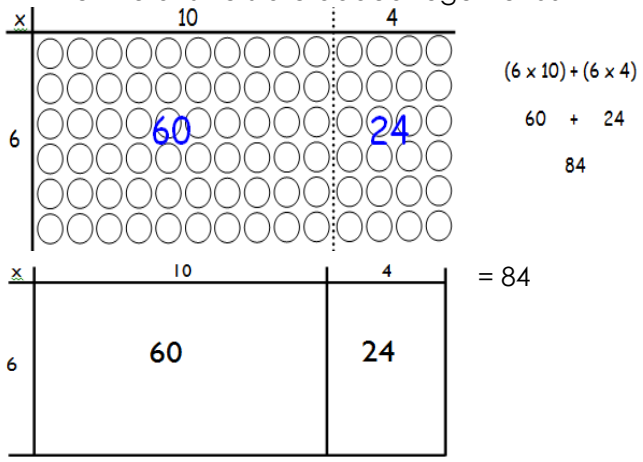
There are 6 football stickers, how many people can have 2 stickers each?



CALCULATIONS POLICY
STAGE 3

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
Understand that addition and subtraction are inverse operations. • Continue to use the Base 10 equipment to support calculations, and record drawings of the Base 10 equipment, using lines for 10 rods and dots for the unit blocks. 28 + 36 = ? The units are added first 8 + 6 = 14 with ten units exchanged for 1 ten.  The units not exchanged are the units part of the answer. The tens are then added, including the exchanged ten, to give answer. • Use partitioning and recombining with larger numbers. 35 + 26 = / \ / \ 30 5 20 6 5 + 6 = 11 30 + 20 = 50 50 + 11 = 61 **Begin to use an expanded written method using a vertical layout.** 67 + 24 11 (7+4) 80 (60+20) 91	**Understand that subtraction and addition are inverse operations.** • Continue to use the Base 10 equipment to support calculations and record drawings of the Base 10 equipment, using lines for 10 rods and dots for the unit blocks. 39 - 17 = ? 39 is drawn 17 is crossed out to give the answer giving 22. 37 – 19 = ?  37 is drawn 9 units cannot be crossed out, so a ten is crossed out and exchanged for 10 ones which are in a line.  19 is crossed out to give the answer 18 • Use partitioning with larger numbers. 34 – 27 = / \ 20 7 34 – 7 = 27 27 – 20 = 7	**Count confidently in steps of 2, 5 and 10** Begin to count in steps of 3 and 4. • Use number lines and 100 squares as visual reminders when learning to count in steps of 3, 4 and 5. **Understand the operation of multiplication as repeated addition or as describing an array.** • Children continue to use arrays and create their own to represent multiplication calculations  3 x 8 = 8 + 8 + 8 = 24 • Make arrays practically • Draw on squared paper  3 x 8 = 8 + 8 + 8 = 24 • Use x and = to record mental calculations 3 lots of 2 2 lots of 3 'groups of' 3 x 2 = 6 <u>Know facts for x 10 table</u>	• Children continue to use practical equipment to represent division calculations as grouping (repeated subtraction) and use jottings to support their calculation. 12 ÷ 3 = ? Children begin to read this calculation as '12 shared between 3' or 'How many groups of 3 are there in 12?' and will solve the calculation using an array  So, 12 ÷ 3 = 4 • At this stage, children will also be introduced to division calculations that result in remainders. 13 ÷ 4 = 3 remainder 1 • Use ÷ and = to record number calculations 6 ÷ 2 = 3 6 ÷ 3 = 2 <u>Derive division facts from known x 10 table facts</u>

CALCULATIONS POLICY
STAGE 4

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
Continue to use the expanded written methods with a vertical layout 264 + 48 12 (4+8) 100 (60+40) 200 (200+0) 312	**Develop pencil and paper methods for subtractions that cannot, at this stage, be done mentally (two digit numbers)** **67 – 25 = 42** • Counting on to find a difference 25 +10 +10 +10 +10 + 2 = 67 35 45 55 65 67 • With jottings and partitioning: 67 – 25 = / \ 20 5 67 – 5 = 62 62 – 20 = 42 Leading on to **Expanded written methods showing vertical layout (no decomposition)** 67 - 25 2 (7-5) 40 (60-20) 42 **Expanded written methods including stealing using the vertical layout** 62 - 27 5 (2 – 7) -> (12 – 7) 30 (60 – 20) -> (50 – 20) 35	**Learn additional multiplication facts and work on different ways to derive new facts from those that they already know** • Know by heart multiplication facts for x2, x5, x10 • Begin to learn and consolidate facts for x3, x4 and x8 • Understand the effect of multiplying by 10 and 100 • Multiply one-digit and two-digit numbers by 1, 10, 100 7 x 10 = 70 4 x 100 = 400 • Derive related facts 7 x 5 = 35 5 x 7 = 35 35 ÷ 5 = 7 35 ÷ 7 = 5 • Children will continue to use arrays to lead into the grid method of multiplication. 14 x 6 The 14 is partitioned (split) into 10 and 4. The answer to 6 x 10 is found = 60 The answer to 6 x 4 is found = 24 The two answers are added together 60 + 24  	**Derive quickly division facts corresponding to 2, 5 and 10 times table** • Continue to use empty number lines for division and introduce remainders • Understand that division is the inverse of multiplication and solve division calculations by using multiplication strategies • Understand the effect of dividing by 10 • Divide a 3-digit multiple of 100 by 10 or 100 800 ÷ 100 = 8 300 ÷ 10 = 30 • Halve any multiple of 10 up to 100 50 ÷ 2 = 25 □ ÷ 2 = 35 • Given three numbers such as 4, 5 and 20 say / write four different multiplication and division statements • At this stage, children also learn if the remainder should be rounded up or down e.g. 62 ÷ 8 = 7 remainder 6 I have 62p. Sweets are 8p each. How many can I buy? Answer: 7 (the remaining 6p is not enough for another sweet) Apples are packed into boxes of 8. There are 62 apples. How many boxes do I need? Answer: 8 (the remaining 6 apples still need to be placed into a box)

CALCULATIONS POLICY
STAGE 5

ADDITION

Compact written method

- Carrying
- Begin to refine written methods to include addition of money (£ and p)

Written method

Step 1

	T	U
	6	5
+	2	7

Step 2

	T	U
	6	5
+	2	7
		2
	1	

Step 3

	T	U
	6	5
+	2	7
	9	2
	1	

```
  783
+ 135
  918
  1
```

SUBTRACTION

Compact written methods involving decomposition

```
363 – 127
  5 13
  3 6 3
- 1 2 7
  2 3 6
```

- Extend to larger numbers (up to 10,000) and decimal sums of money

MULTIPLICATION

Develop and refine written methods for multiplication

- Begin to multiply a 2-digit number by a single digit number, multiplying the tens first
- Using multiples of 10 (mentally)
  4 x 30 = (4 x 3) x 10 = 120
- Leading to grid method. This is the final stage, the array is removed and children use the grid method.

23 x 8

×	20	3
8	160	24

160
+ 24
184

346 x 9

×	300	40	6
9	2700	360	54

2700
+ 360
+ 54
3114
1 1

DIVISION

Develop and refine written methods for division using chunking.
(This stage can be omitted at the discretion of the teacher)

72 ÷ 3

```
   24
3 ) 72
- 30      10x
  42
- 30      10x
  12
-  6      2x
   6
-  6      2x
   0
```

Answer : 24

1x	3
2x	6
5x	15
10x	30

Children should write key facts in a menu box. This will help them in identifying the largest group they can subtract in one chunk.

CALCULATIONS POLICY
STAGE 6

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
This is the final stage of the method, and should be continued to be used for all written addition calculations. HTU 625 + 48 673 1 The example above would be 'said' as follows: 5 + 8 = 13, put 3 down and carry the 10 20 + 40 + 10 that was carried over = 70 *(7 written in the tens column)* 600 + 0 = 600 *(6 written in the hundreds column)* 367 + 85 452 11 321 + 7 + 48 376 1	This final stage is the compact method of decomposition. 754 - 86 6141 754 - 86 668 This is the final stage of the process and will continue to be used with larger numbers and numbers involving decimals.	**Extend written methods, encouraging estimation first** • Grid method (HTU x U) 246 x 7 X | 200 | 40 | 6 7 | 1400 | 280 | 42 1400 + 280 + 42 = 1722 • Grid method (TU x TU) 62 x 36 X | 60 | 2 30 | 1800 | 60 6 | 360 | 12 1800 + 360 + 60 + 12 = 2232 • For the multiplication of numbers involving decimals children will be taught to multiply the decimal by 10 or 100 as appropriate to remove the decimal point. The calculation can then be undertaken using the grid method and the resulting answer divided by 10 or 100 to put the decimal point back in.	**Extend written methods, encouraging estimation first** • Continue to use chunking methods (where appropriate) 196 ÷ 6 32 r 4 6) 196 - 180 (30x) 16 - 12 (2x) 4 1x 6 2x 12 4x 24 5x 30 10x 60 20x 120 The key facts in the menu box should be extended to include 4x and 20x. Answer: 32 remainder 4 or 32 r 4 • Develop and refine written methods for short division (HTU ÷ U) using the bus stop method. 20 r 4 5) 104

CALCULATIONS POLICY
CONSOLIDATING STAGE 6

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
Extend written methods to column addition of two integers less than 10,000 (*explore larger numbers with expanded methods then apply compact method with least significant digit first*) • Add several numbers with different numbers of digits • Extend column addition to decimal amounts of money, lengths, weights (with up to two decimal places) £3.48 + £0.78 £4.26 1 1 **Extend written methods for addition** • Any number of digits • Several numbers with different numbers of digits • Decimals with one or two decimal places	**Extend written methods for subtraction, to include decimal numbers with up to 2 decimal places.** • Choose the most efficient and appropriate method for each calculation.	**Extend written methods for multiplication, encouraging estimation first** • Continue to use grid method and expanded written method • Develop short multiplication 625 x 6 3750 13 (Carryovers can be crossed through when added) • Simplifying the multiplication of numbers involving decimals 4.62 x 3 13.86 1 • Develop long multiplication 625 X 16 3750 6250 10000 Children need to be taught an accurate method of recording carryovers appropriately.	**Extend written methods for division, encouraging estimation first.** • As confidence grows menu box is not necessary 972 ÷ 36 27 36) 972 - 720 (20×) 252 - 252 (7×) 0 Answer : 27 • Short division (HTU ÷ TU) Using bus stop method as before • Long division (ThHTU ÷ TU) 27 36) 972 72 252 252 000 • Short division giving remainder as fraction 91 ÷ 4 = 22 ¾ • Short division giving remainder as decimal 676 ÷ 8 = 84.5 8) 676.0 • Short division of numbers involving decimals 87.5 ÷ 7 = 12.5