St. David Haigh and Aspull CE Primary School

'A successful caring, Christian School, at the heart of the community.'

School Aim
St. David CE Primary School aims to provide a warm, caring and happy environment based on the Christian Faith, where each child is respected as an individual with personal, physical and emotional needs and talents.
Within this environment each child is given equal value and opportunities and is positively encouraged to reach their full potential, grow in confidence and develop high esteem so as to respond positively to opportunities, experiences and responsibilities of life in an ever-changing world.
We ensure that all children have access to the Mathematics curriculum regardless of race, ethnicity, gender or disability.

Calculation Policy

The ability to calculate mentally is central to good teaching and learning of mathematics. As children progress through the school they will need to develop ways of recording to support their thinking so that:

'By the end of Y6 children are equipped with mental, written and calculator methods that they can understand and use correctly'

(Primary Framework, Guidance Paper, Calculation)

This policy is intended to ensure consistency and progression from mental to written calculations throughout the school. This policy is now part of the school monitoring system.

Teachers should support and guide children through the following important stages:

- talk about mathematics using appropriate vocabulary
- develop the use of pictures, symbols and numerals to record
- use jottings to aid mental strategies.
- use an empty number line as a key model to support the teaching and learning of mental calculations.
- use an expanded method which leads to a standard method for each of the four operations.
- know when it is more efficient to use a mental or written method, or a calculator.

It is important that children do not abandon mental methods and jottings once written methods are introduced.

For mathematics to be meaningful children must see the links to real life situations. This means that using and applying newly acquired skills within problem solving and investigative work is essential and should be embedded in most mathematics lessons reflecting the importance of mathematics in everyday life.

St David Haigh and Aspull C.E. Primary School
September 2011
Due to be reviewed – September 2014

Progression towards a standard written method of calculation

REASONS FOR USING WRITTEN METHODS

- To aid mental calculation by writing down some of the numbers and answers involved
- To make clear a mental procedure for the pupil
- To help communicate methods and solutions
- To provide a record of work to be done
- To aid calculation when the problem is too difficult to be done mentally
- To develop and refine a set of rules for calculation

Whole School Approach

We have developed a consistent approach to the teaching of written calculation methods. This will establish continuity and progression throughout the school.

Mental methods will be established. These will be based on a solid understanding of place value in number and will include the following:

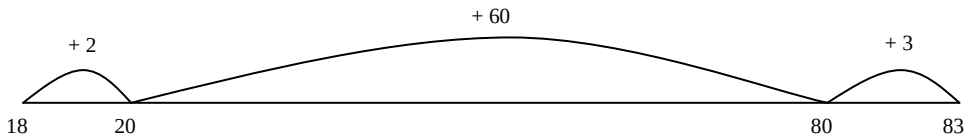
i. Remembering number facts and recalling them without hesitation
e.g. pairs of numbers which make 10
Doubles & halves to 20

ii. Using known facts to calculate unknown facts
e.g. 6 + 6 = 12 therefore 6 + 7 = 13
24 + 10 = 34 therefore 24 + 9 = 33

iii. Understanding and using relationships between addition & subtraction to find answers and check results
e.g. 14 + 6 = 20 therefore 20 –6 = 14

iv. Having a repertoire of mental strategies to solve calculations
e.g. doubles / near doubles
bridging 10 / bridging 20
adding 9 by +10 & -1

v. Making use of informal jottings such as blank number lines to assist in calculations with larger numbers *e.g.83 – 18 = 65*



vi. Solving one-step word problems (either mentally or with jottings) by identifying which operation to use, drawing upon their knowledge of number bonds and explaining their reasoning

vii. Beginning to present calculations in a horizontal format and explain mental steps using numbers, symbols or words

viii. Learn to estimate/approximate first e.g. 29 + 30 (round up to nearest 10, the answer will be near to 60).

Place value will be taught mentally first from Reception class where number tracks are used, progressing to number lines (to 10 or 20 as appropriate) in Years 1 and 2. The empty number line will then be introduced to aid calculations.

Subtraction will be taught by counting on and counting back depending on the numbers.

Numbers such as 10, 100, 1000 will be called Landmark Numbers.

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 time table
- Do they know the result of multiplying by 0 and 1?
- Do they understand 0 as a placeholder?
- 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?

The above 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.

Stages in Addition

1. Mental method, using partitioning:

   47 + 76 = (40 + 70) + (7 + 6)

   or

   47 + 76 = (47 + 70) + 6

2. Introduction to vertical layout, using partitioning

300	+ 70	+ 8	
400	+ 80	+ 7	
700	+ 150	+ 15	= 865

3. Vertical layout, expanded working, moving to adding the least significant digit first:

47	47	368	368
+ 76	+ 76	+ 493	+ 493
110	13	700	11
13	110	150	150
123	123	11	700
		861	861

4. Vertical layout, contracting the working to a compact efficient form:

47	47	368	368
+ 76	+ 76	+493	+493
13	123	11	861
110	11	150	11
123		700	
		861	

5. Bigger numbers and decimals

Stages in Subtraction by Decomposition

1. 563 - 241

	500	60	3	
-	200	40	1	
	300	20	2	= 322

leading to

	5	6	3
-	2	4	1
	3	2	2

2. 563 - 278

	500	60	3	→	400	150	13	
-	200	70	8	→	- 200	70	8	
					200	80	5	= 285

leading to

	$^{4}\cancel{5}$	$^{15}\cancel{6}$	$^{1}3$
-	2	7	8
	2	8	5

Stages in Multiplication

1. Mental method using partitioning multiplying tens first: 38 x 7

   38 x 7 = (30 x 7) + (8 x 7) = 210 + 56 = 266

2. Grid layout 38 x 7

x	30	8	
7	210	56	266

3. Grid layout - extend to bigger numbers i.e. 238 x 7

x	200	30	8	
7	1400	210	56	1666

Extend to ThHTU

4. Extend to bigger numbers: 56 x 27

   56 x 27 = (50 + 6) x (20 + 7)

x	50	6	
20	1000	120	1120
7	350	42	392
			1512

5. Vertical format, expanded working

```
    38
x    7
  ----
   210   (30x7)
    56   (8x7)
  ----
   266
```

Extend to HTU x U

Long multiplication

```
    56
x   27
  ----
  1000   (50 x 20)
   120   (6 x 20)
   350   (50 x 7)
```

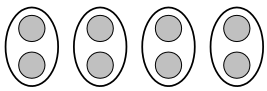
	42	(6 x 7)
	1512	

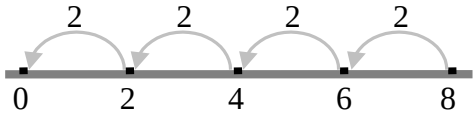
6. Vertical format, compact working

	56	
x	27	
	1120	(56 x 20)
	392	(56 x 7)
	1512	
	1	

Stages in Division

1. Number lines & grouping





2. Informal methods using multiples of the divisor or 'chunking' TU ÷ U

72 ÷ 5			72
	5 x 10	= 50	- 50
			22
	5 x 4	= 20	- 20
Answer: 14 r 2	14		2

3. 'Chunking' HTU ÷ U

256 ÷ 7			256
	7 x 10	= 70	- 70
Approximate answer			186
280 ÷ 7 = 40	7 x 20	= 140	- 140
			46
	7 x 6	= 42	- 42
Answer: 36 r 4	36		4

4. Efficient 'chunking'

HTU ÷ U

196 ÷ 6		196
	6 x 30 = 180	- 180
Approximate answer		16
180 ÷ 6 = 30	6 x 2 = 12	- 12
Answer: 32 r 4	32	4

5. Extend to decimals with up to 1 place

87.5 ÷ 7		87.5
	7 x 10 = 70.0	- 70.0
Approximate answer		17.5
84 ÷ 7 = 12	7 x 2 = 14.0	- 14.0
		3.5
	7 x 0.5 = 3.5	-3.5
Answer: 12.5	12.5	0

6. 'Chunking'

HTU ÷ TU

560 ÷ 24		560
	24 x 10 = 240	- 240
Approximate answer		320
550 ÷ 25 = 22	24 x 10 = 240	- 240
		80
	24 x 2 = 48	-48
		32
	24 x 1 = 24	-24
Answer: 23 r 8	23	8

7. Efficient chunking

HTU ÷ TU

560 ÷ 24		560
	24 x 20	- 480
Approximate answer		80

550 ÷ 25 = 22	24 x	3	-72
Answer: 23 r 8		23	8

8. Extending to an efficient standard method

560 ÷ 24

	24)	560
Approximate answer:	20	-480
550 ÷ 25 = 22		80
	3	-72
Answer 23 r 8	23	8

Extend to decimals with up to 2 decimal places

Informal to Standard Written Calculations

As a general rule the majority of the class should cover these stages, **in this order**, during Key Stage 2. If a child cannot grasp a method, **go back** & consolidate the previous method before trying again.

	Addition	**Subtraction**	**Multiplication**	**Division**
Y 3	**TU + TU developing to HTU + TU or HTU + HTU** 1. Use of number lines to count on 2. Horizontal expanded method, using partitioning 3. Vertical expanded method adding most (or least) significant digit first	**TU –TU, developing to HTU – TU or HTU – HTU** 1. Use of number line to count up 2. Use of number line to take too much & add back 3. Use of partitioned vertical form (expanded form) 4. Decomposition using expanded form	**No written methods** Repeated addition Describing an array Scaling	**No written methods** Grouping Sharing Remainders
Y 4	**HTU + TU then HTU + HTU** 1. Vertical expanded method adding most significant digit first 2. Vertical expanded method adding least significant digit first 3. Leading to 'carrying' below the line 4. Calculations	**HTU – TU then HTU – HTU** 1. Decomposition using expanded form 2. Decomposition using compact form 3. Calculations extended to include the difference between two 3-digit sums of money	**TU x U** 1. Grid method (TU x U) 2. Standard expanded short multiplication (TU x U) leading to 3. Compact short multiplication (TU x U)	**TU ÷ U** 1.TU ÷ U using chunking

	extended to include addition of two or more 3-digit sums of money			
Y 5	**HTU + HTU then ThHTU + ThHTU** 1. Vertical expanded method adding least significant digit first 2. Compact written method 'carrying' below the line 3. Calculations extended to include addition of two or more decimal fractions, with up to three digits & the same number of decimal places, in vertical format	**HTU – HTU, then ThHTU – ThHTU** 1. Decomposition using expanded form 2. Decomposition using compact form 3. Calculations extended to include subtraction of decimals, with up to 3 digits & the same number of decimal places, in expanded format leading to vertical format	**HTU x U, & TU X TU** 1. Grid method (HTU x U & TU x TU) 2. Standard expanded short multiplication (HTU x U) leading to 3. Compact short multiplication (HTU x U) 4. Long multiplication (TU x TU) 5. Calculations extended to include multiplying decimal fractions with one decimal place by a single digit	**HTU ÷ U** 1.HTU ÷ U using chunking 2. HTU ÷ U - efficient chunking
Y 6	**ThHTU + ThHTU & then any number of digits** 1. Compact written method 'carrying' below the line 2. Calculations extended to include addition of two or more decimal fractions with up to four digits & either one or two decimal places	**ThHTU – ThHTU & then any number of digits** 1. Decomposition using compact form 2. Calculations extended to include subtraction of two or more decimal fractions with up to 3 digits & either one or two decimal places in vertical format	**ThHTU x U & HTU x TU** 1. Grid method (ThHTU x U & HTU x TU) 2. Standard expanded short multiplication (ThHTU x U) leading to 3. Compact short multiplication (ThHTU x U) 4. Long multiplication (HTU x TU) 5. Calculations extended to include multiplying decimal fractions with two decimal places by a single digit	**HTU ÷ TU** 1.HTU ÷ TU using chunking 2.HTU ÷ TU – efficient chunking 3. HTU ÷ TU – efficient standard method 4. Extend to decimal fractions with up to two decimal places

Summary

- children should always estimate first
- always check the answer, preferably using a different method eg. the inverse operation
- always decide first whether a mental method is appropriate
- pay attention to language - refer to the actual value of digits
- children who make persistent mistakes should return to the method that they can use accurately until ready to move on
- children need to know number and multiplication facts by heart

- discuss errors and diagnose problem and then work through problem - do not simply re-teach the method

- when revising or extending to harder numbers, refer back to expanded methods. This helps reinforce understanding and reminds children that they have an alternative to fall back on if they are having difficulties.

Review date: September 2014