

Calculations Policy



Updated Sept 2019

Whitehall Junior School Calculation Policy

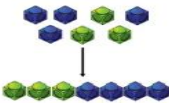

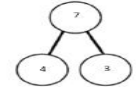


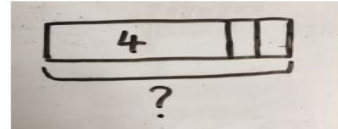

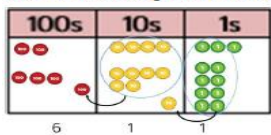
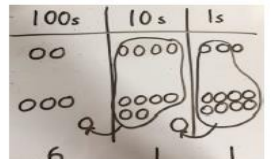
Practical apparatus are used throughout, including base 10 apparatus and place value counters.

Place value headings are used for all written calculations. We use the term 'ones' instead of 'units'. We always estimate before we calculate so children understand if the size of their answer is appropriate.

Missing number calculations are taught alongside mental and written methods.

We use a CPA approach throughout our maths curriculum: concrete – pictorial – abstract

For example:

Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars).</p> 	<p>Children to represent the cubes using dots or crosses. They could put each part on a part whole model too.</p> 	<p>$4 + 3 = 7$ Four is a part, 3 is a part and the whole is seven.</p> 
<p>Counting on using number lines using cubes or Numicon.</p>  	<p>A bar model which encourages the children to count on, rather than count all.</p> 	<p>The abstract number line: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? $4 + 2$</p> 
<p>Use of place value counters to add HTO + TO, HTO + HTO etc. When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred.</p> 	<p>Children to represent the counters in a place value chart, circling when they make an exchange.</p> 	<p style="text-align: center;"> $\begin{array}{r} 243 \\ +368 \\ \hline 611 \\ \hline 11 \end{array}$ </p>

The following policy (updated Sept 2017) outlines the methods used at Whitehall Junior and exactly how they are taught in a set order; each method building on previous learning experiences, understanding and knowledge.

Addition		
2	3	3 continued

Extend to

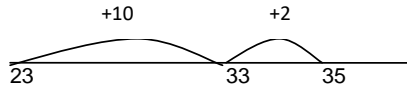
$$14 + 5 = 10 + \square$$

and

$$32 + \square + \square = 100 \quad 35 = 1 + \square + 5$$

Count on in tens and ones

$$23 + 12 =$$



*** Visualise 100 square**

11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

e.g. $26 + 23$. Jump 2 squares forwards and then 3 squares to the right = 49

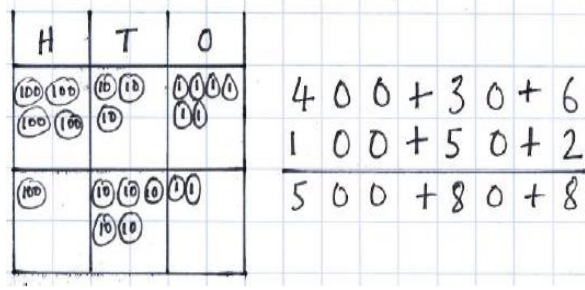
Pencil and paper procedures

e.g. $83 + 42 = 125$

Horizontal expansion using base 10 apparatus and place value counters.

$$\begin{array}{r} 80 + 3 \\ + 40 + 2 \\ \hline 120 + 5 = 125 \end{array}$$

$$436 + 152$$

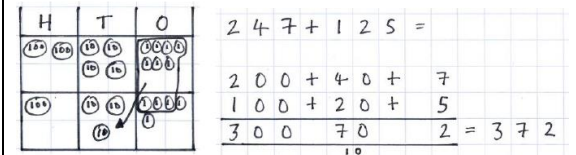


Pencil and paper procedures

$$367 + 185 = 552$$

1. Building from low 3 – using base 10 and place value counters.

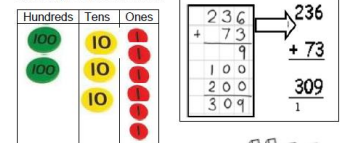
$$\begin{array}{r} \text{H} \quad \text{T} \quad \text{O} \\ 300 + 60 + 7 \\ + 100 + 80 + 5 \\ \hline 400 + 140 + 12 = 552 \end{array}$$



When children are confident lead to...

2. Vertical expansion:

$$\begin{array}{r} \text{HTO} \\ 367 \\ + 185 \\ \hline 12 \quad (7+5) \\ 140 \quad (60 + 80) \\ 400 \quad (300 + 100) \\ \hline 552 \end{array}$$



When children are confident lead to...

3. Compact column:

$$\begin{array}{r} \text{HTO} \\ 367 \\ + 185 \\ \hline 552 \\ 11 \end{array}$$

Addition

4

5

6

Pencil and paper procedures

Extend to numbers with at least four digits using **base 10 apparatus and place value counters**. Place value headings must be used.

$$3587 + 675 = 4262$$

$$\begin{array}{r} \text{ThHT O} \\ 3\ 5\ 8\ 7 \\ +\ 6\ 7\ 5 \\ \hline 4\ 2\ 6\ 2 \\ \text{1 1 1} \end{array}$$

Revert to expanded methods if the children experience any difficulty.

Extend to up to two places of decimals (same number of decimals places) and adding several numbers (with different numbers of digits). **Base 10 and place value counters must be used.**

$$\begin{array}{r} \text{TO } 1/10 \\ 72.8 \\ +54.6 \\ \hline 127.4 \\ \text{1} \end{array}$$

Add and subtract numbers with more than 4 digits – using **base 10 apparatus and place value counters**. Place value headings must be used.

$$\begin{array}{r} \text{TThThHTO} \\ 3\ 2\ 5\ 8\ 7 \\ +\ 1\ 6\ 1\ 9 \\ \hline 34\ 2\ 0\ 6 \\ \text{1 1 1} \end{array}$$

Pencil and paper procedures

Extend to numbers with any number of digits and decimals with 1, 2 and/or 3 decimal places using place value counters. Place value headings must be used.

$$13.86 + 9.481 = 23.341$$

$$\begin{array}{r} \text{TO } 1/10\ 1/100\ 1/1000 \\ 13.8\ 6 \\ +\ 9.4\ 8\ 1 \\ \hline 23.3\ 4\ 1 \\ \text{1 1 1} \end{array}$$

Revert to expanded methods if the children experience any difficulty.

Subtraction

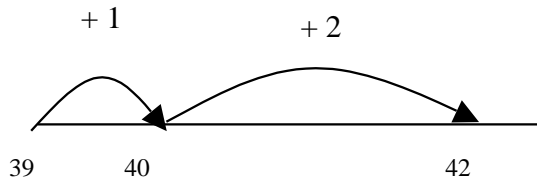
2

3

3 continued

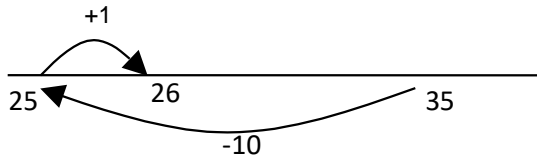
Find a small difference by counting up

$$42 - 39 = 3$$



Subtract 9 or 11. Begin to add/subtract 19 or 21

$$35 - 9 = 26$$



*Visualise 100 square

11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

e.g. $58 - 17$ is jump one square back and 7 to the right = 41

Use known number facts and place value to subtract
- = signs and missing numbers

Continue using a range of equations as in Year 1 but with appropriate numbers.

Extend to $14 + 5 = 20 - \square$

Add and subtract mentally:

Bridging to 10

$$\begin{aligned} 425 + 8 &= 425 + 5 + 3 \\ &= 430 + 3 \\ &= 433 \end{aligned}$$

Rounding and Adjusting

$$\begin{aligned} 425 + 90 &= 425 + 100 \\ &= 525 - 10 \\ &= 515 \end{aligned}$$

$$\begin{aligned} 146 - 9 &= 146 - 10 + 1 \\ &= 136 + 1 \\ &= 137 \end{aligned}$$

$$\begin{aligned} 146 - 50 &= 146 - 40 - 10 \\ &= 106 - 10 \\ &= 96 \end{aligned}$$

Counting forwards or backwards in 100s

$$636 - 500 = 136$$

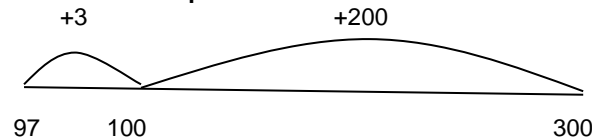
Find a small difference by counting on

e.g. $503 - 497 = 6$

This can be modelled on an empty number line. Children should be encouraged to use known number facts to reduce the number of steps. **Use base 10 and place value counters.**

Use 'counting on' to subtract $300 - 97 = 20$... use a number line as the appropriate method because using a columnar method would result in too much exchanging.

Use base 10 and place value counters.



When children become confident, use jottings e.g.

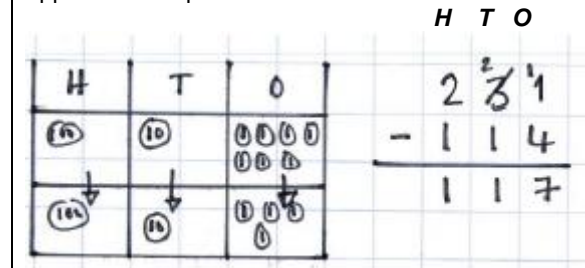
$$560 - 296$$

$$296 \longrightarrow 300 = 4$$

$$300 \longrightarrow 500 = 200$$

$$500 \longrightarrow 560 = 60 \qquad 200 + 60 + 4 = 264$$

Extend to a formal written method using Base 10 apparatus and place value counters.



In this example, the ones cannot be subtracted so regrouping takes place. Three tens are regrouped into two tens and ten ones.

Subtraction

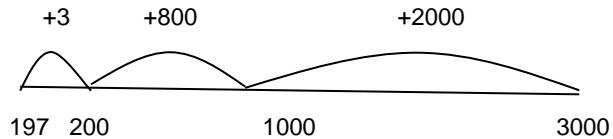
4

Find a small difference by counting one.g. $2503 - 2497 = 6$

This can be modelled on an empty number line. Children should be encouraged to use known number facts to reduce the number of steps. **Use base 10 and place value counters.**

Use known number facts and counting on to subtract

$3000 - 197 = 2803$ – to use a number line as the appropriate method because using a columnar method would result in too much exchanging. **Use base 10 and place value counters.**



When children become confident, use jottings e.g.

$$3000 - 197$$

$$197 \rightarrow 200 = 3$$

$$200 \rightarrow 1000 = 800$$

$$1000 \rightarrow 3000 = 2000 \quad 2000 + 800 + 3 = 2803$$

When children can do this confidently, **use base 10 and place value counters** to lead to column subtraction; including missing number calculations. Place value headings must be included.

Without exchanging first:

$$\begin{array}{r} 7329 - 215 = \\ \hline 7329 \\ - 215 \\ \hline 7114 \end{array}$$

Th H T O

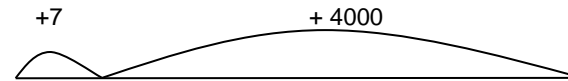
	Th	H	T	O
	7	3	2	9
-	2	1	5	
	7	1	1	4

	Th	H	T	O
	2	5	0	
-	1	4	2	
	1	8	5	8

5

Find a difference by counting one.g. $8006 - 2993 = 5013$

This can be modelled on an empty number line. Children should be encouraged to use known number facts to reduce the number of steps. **Use base 10 and place value counters.**

Use known number facts and counting on to subtract
 $12,000 - 7993 = 4007$


7993 8000 12,000

When children become confident, use jottings e.g.

$$12,000 - 7993$$

$$7993 \rightarrow 8000 = 7$$

$$8000 \rightarrow 12,000 = 4000$$

$$4000 + 7 = 4007$$

When children can do this confidently, **use base 10 and place value counters** to lead to column subtraction; including missing number calculations. Place value headings must be included.

T Th Th H T O

	T	Th	Th	H	T	O
	7	4	5	1	5	3
-	2	2	6	2	3	
	5	2	9	0	9	

6

Use known number facts and counting on to subtract

This can be modelled on an empty number line. Children should be encouraged to use known number facts to reduce the number of steps. **Use base 10 and place value counters.**



Use base 10 and place value counters to lead to column subtraction; including missing number calculations. Place value headings must be included.

	T	O	1/10
	2	5	3
-	1	7	5
	7	8	

Multiplication

2

x = signs and missing numbers

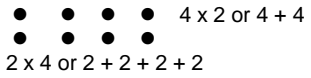
$$7 \times 2 = \square \quad \square = 2 \times 7$$

$$7 \times \square = 14 \quad 14 = \square \times 7$$

$$\square \times 2 = 14 \quad 14 = 2 \times \square$$

$$\square \times \nabla = 14 \quad 14 = \square \times \nabla$$

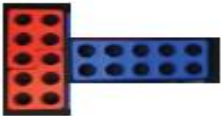
Arrays and repeated addition



5 frogs on each lily pad
 $5 \times 3 = 15$



$5 \times 2 = 2 \times 5$



Build tables on counting stick



Link to repeated addition



3

If I know $10 \times 8 = 80$ then ...



So $13 \times 4 = 10 \times 4 + 3 \times 4$



Build tables on counting stick



Develop written methods using arrays:

18×3

T O

X	1	0	8
3	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.
	.	.	.

30 + 16 = 46

3 continued

Leading to using **base 10 and place value counters:**

$18 \times 3 = 54$

X	1	0	8
3	(10)	(0)	(0)
	(10)	(0)	(0)
		(10)	(0)
			(10)
			(10)
			(10)
			(10)
			(10)
			(10)
			(10)
			(10)
			(10)
			(10)

Leading to...

18×3

$18 \times 3 = 54$

X	1	0	8
3	3	0	2
			4

$30 + 20 + 4 = 54$

When children are confident with the grid method, introduce short multiplication alongside it. Place value headings must be used.

T O

	1	8
X	3	
	5	4
	2	

4

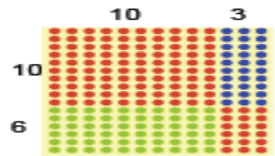
43 x 6 by partitioning

x	40	3
6	240	18

$$\begin{array}{l} 43 \times 6 \\ 40 \times 6 = 240 \\ 3 \times 6 = 18 \\ 43 \times 6 = 258 \end{array}$$

If I know $4 \times 6 = 24$
the 40×60 is ten times bigger.

13 x 16 by partitioning



$100 + 30 + 60 + 18 = 208$
Build tables on counting stick



Leading to the grid method using partitioning. **Base 10 and place value counters must be used.**
 135×5

H T O

x	100	30	5
5	500	150	25

Use column addition to add.

4 continued

When children are confident with the grid method, introduce short multiplication alongside it. Place value headings must be used.

$$\begin{array}{l} 24 \times 6 = \\ \begin{array}{r} x \quad 20 \quad 4 \\ 6 \quad 120 \quad 24 \end{array} \end{array} \rightarrow \begin{array}{l} 24 \times 6 = \\ \begin{array}{r} 24 \\ x \quad 6 \\ \hline 24 \quad (4 \times 6) \\ 120 \quad (20 \times 6) \\ \hline 144 \end{array} \end{array}$$

5

Long multiplication introduced alongside grid method. Place value headings, base 10 and place value counters must be used.

$$\begin{array}{l} 24 \times 16 = 384 \\ \begin{array}{r} x \quad 20 \quad 4 \\ 6 \quad 120 \quad 24 \end{array} \end{array} \rightarrow \begin{array}{l} 24 \\ x \quad 16 \\ \hline 24 \quad (4 \times 6) \\ 120 \quad (20 \times 6) \\ \hline 40 \quad (4 \times 10) \\ 200 \quad (20 \times 10) \\ \hline 384 \end{array} \rightarrow \begin{array}{l} 24 \\ x \quad 16 \\ \hline 144 \\ 240 \\ \hline 384 \end{array}$$

$$\begin{array}{l} 262 \times 19 = 4,978 \\ \begin{array}{r} x \quad 200 \quad 60 \quad 2 \\ 102,000 \quad 600 \quad 20 \quad 2620 \\ 91,800 \quad 540 \quad 18 \quad 2358 \\ \hline 4,978 \end{array} \end{array} \rightarrow \begin{array}{l} 262 \\ x \quad 19 \\ \hline 2358 \\ 2620 \\ \hline 4,978 \end{array}$$

6

When children are confident with the grid method, introduce short multiplication alongside it. Place value headings must be used.

6.42×7

	0	1/10	1/100
x	6	0.4	0.02
7	42	2.8	0.14

T O . 1/10 1/100

$$\begin{array}{r} 42.00 \\ \times 7 \\ \hline 280.00 \end{array}$$

$$\begin{array}{r} 2.80 \\ \times 7 \\ \hline 19.60 \end{array}$$

$$\begin{array}{r} 0.14 \\ \times 7 \\ \hline 0.98 \end{array}$$

$$\begin{array}{r} 44.94 \\ \times 7 \\ \hline 314.58 \end{array}$$

Division

2

÷ = signs and missing numbers

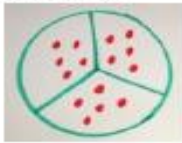
$$6 \div 2 = \square \quad \square = 6 \div 2$$

$$6 \div \square = 3 \quad 3 = 6 \div \square$$

$$\square \div 2 = 3 \quad 3 = \square \div 2$$

$$\square \div \nabla = 3 \quad 3 = \square \div \nabla$$

$15 \div 3 = 5$ in each group (sharing)



Link to fractions



$15 \div 3 = 5$ groups of 3 (grouping)



$10 \div 2 = 5$



Use language of division linked to tables



How many 2s?



3

Grouping using partitioning $43 \div 3$ If I know $10 \times 3 \dots$



$$\begin{array}{r} 43 \\ -3 \\ \hline 30 \\ -3 \\ \hline 13 \\ -3 \\ \hline 10 \\ -3 \\ \hline 7 \\ -3 \\ \hline 4 \end{array}$$

Use language of division linked to tables



How many 3s?



Record as:

$$30 \div 6 = 5$$



4

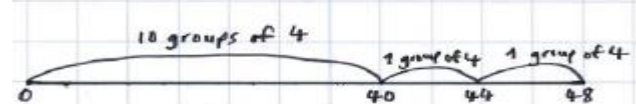
Two digit number divided by 1 digit number. **Base 10 and place value counters** to be used alongside.
Grouping with remainders:

$$34 \div 6 = 5 \text{ r } 4$$



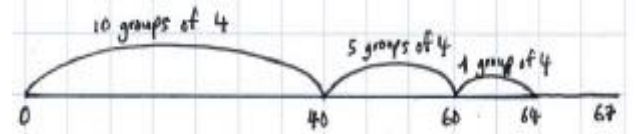
Extending to efficient grouping when confident.

$$48 \div 4 = 12$$



Extending to efficient grouping with remainders.

$$67 \div 4 = 16 \text{ r } 3$$



Division

4 continued

Extend to using number line grouping alongside formal method – using **base 10 and place value counters**.

$$96 \div 4$$

Toolbox: $4 \times 10 = 40$
 $4 \times 5 = 20$
 $4 \times 2 = 8$

T O

$$\begin{array}{r}
 4 \overline{) 96} \\
 - 40 \quad (4 \times 10) \\
 \hline
 56 \\
 - 40 \quad (4 \times 10) \\
 \hline
 16 \\
 - 16 \quad (4 \times 4) \\
 \hline
 00 \\
 \\
 = 24
 \end{array}$$

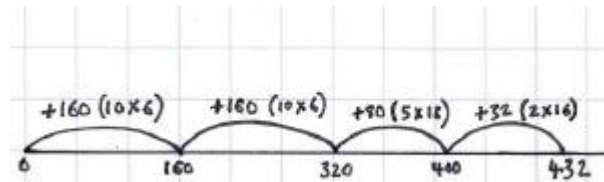
$$432 \div 16 = 27$$

$$\begin{array}{r}
 27 \\
 16 \overline{) 432} \\
 - 160 \quad (10 \times 16) \\
 \hline
 272 \\
 - 160 \quad (10 \times 16) \\
 \hline
 112 \\
 - 80 \quad (5 \times 16) \\
 \hline
 32 \\
 - 32 \quad (2 \times 16) \\
 \hline
 00
 \end{array}$$

5

3 and 4 digit divided by one digit number.
 3 digit number divided by a 2 digit number
 Using **base 10 and place value counters**.

Using efficient grouping:
 $432 \div 16 = 27$



Leading to... $432 \div 16$

Toolbox: $16 \times 10 = 160$ $16 \times 20 = 320$
 $16 \times 5 = 80$ $16 \times 4 = 64$

H T O

$$\begin{array}{r}
 16 \overline{) 432} \\
 - 320 \quad (16 \times 20) \\
 \hline
 112 \\
 - 80 \quad (16 \times 5) \\
 \hline
 32 \\
 - 32 \quad (16 \times 2) \\
 \hline
 00 \\
 \\
 = 27
 \end{array}$$

6

Quotients expressed as fractions or decimal fractions
 $676 \div 8 = 84.5$

4 digit divided by 2 digit number using **base 10 and place value counters**.

$$2145 \div 25$$

Toolbox: $25 \times 10 = 250$ $25 \times 20 = 500$
 $25 \times 40 = 1000$ $25 \times 80 = 2000$
 $25 \times 5 = 125$

Th H T O

$$25 \overline{) 2145}$$

$$\begin{array}{r}
 - 2000 \quad (25 \times 80) \\
 0145 \\
 - 125 \quad (25 \times 5) \\
 \hline
 020
 \end{array}$$

= 85 remainder 20

$$\begin{array}{r}
 20 \ 4 \\
 25 \overline{) 2145} = 85.8
 \end{array}$$

