

Newlands Primary School Calculations Policy



Headteacher: Mr C Markham

Date Adopted: July 2014

To be reviewed: July 2017

SIGNED BY CHAIR

DATE.....

NEWLANDS PRIMARY SCHOOL
Progression towards a standard method of Calculation

Introduction:

The 2014 National Curriculum provides a structured and systematic approach to the teaching of calculation. The aim is for mental calculations and written procedures to be performed efficiently, fluently, accurately with understanding. Procedures and understanding are to be developed in tandem. End of key stage expectations are explicit in the programme of study.

At Newlands Primary School, we have a consistent approach to the teaching of written calculation methods in order to ensure continuity and progression across the school.

Age related expectations:

This calculation policy is organised according to age appropriate expectations as set out in the National Curriculum 2014, **however it is vital that pupils are taught according to the stage that they are currently working at**, being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods. It is also important for children to be confident to use mental and written strategies to explain their thinking. This must be a priority within calculation lessons. Written methods need to be viewed as tools to enable children to solve problems and record their thinking in an organised way.

Aims:

Children should be able to use an efficient method, mental or written appropriate to the given task, with understanding. By the end of year 6, children will have been taught, and be secure with, a compact standard method for each operation.

To develop efficient written calculation strategies children need:

- Secure mental methods which are developed from early years
- A solid understanding of the number system
- Practical hands on experience including a range of manipulatives
- Visual models and images including number lines and arrays
- Experience of expanded methods to develop understanding and avoid rote learning
- Secure understanding of each stage before moving onto the next.

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?

Pre requisite skills for written calculations

Addition and subtraction:

- Do they know all the addition and subtraction facts for all numbers to 20?
- Do they understand place value and can they partition and then re-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, 5 and 10 times tables and corresponding division facts?
- 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 and division facts they know to derive mentally other multiplication and division 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 as they structure the move from informal to formal methods of calculation. It is vitally important that children's mental methods of calculation continued to be practised and secured alongside their learning and use of an efficient written method for each operation.

A pathway to teaching calculation methods:

Expanded methods should be viewed as steps towards a standard method and not as methods in themselves.

Before beginning to record in a more refined written format children must have had significant practical work reinforced with appropriate manipulative, models and images.

Teachers will guide pupils to refine their written methods of recording by modelling and asking questions such as "What is the same? What's different?"

Learning will be planned to ensure pupil are encouraged to use and apply what they have learnt to problem solving tasks.

As children move along the pathway it is vital that they practice, reinforce, consolidate, use and apply it to mathematical learning and NOT simply move onto the next step.

Point to note:

Teachers should refer to the programme of study for key vocabulary for each year group.

Reviewed: July 2014
Review Date: July 2015

Key Stage	Progression of Written Calculations
Foundation	<ul style="list-style-type: none"> • Begin to record in the context of play or practical activities and problems by providing children with opportunities to practise and improve their skills in counting numbers, calculating simple addition and subtraction problems • Using quantities and objects, pupils to add and subtract two single-digit numbers and count on or back to find the answer. Pupils to have opportunities to solve and record problems, including doubling, halving and sharing.
1	<ul style="list-style-type: none"> • 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 jottings to aid mental calculations, number tracks, empty number lines, partitioning <p>(calculations at KS1 will be presented horizontally, progressing in Year 2 to vertically)</p>
Lower Key Stage 2	<ul style="list-style-type: none"> • Continue use of 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 (end of year 4) <p>(calculations presented horizontally and vertically)</p>
Upper Key Stage 2	<ul style="list-style-type: none"> • 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, expanded methods still acceptable • Effective use of a calculator to support calculations <p>(calculations presented horizontally and vertically)</p>

Progression in Addition

Foundation	<p>Begin to relate addition to combining two groups of objects</p> <ul style="list-style-type: none"> • Make a record in pictures, words or symbols of addition activities already carried out • Construct number sentences to go with practical activities • Relate addition to counting on
Key Stage 1	<p>Understand the operation of addition and use the related vocabulary</p> <ul style="list-style-type: none"> • 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 • Begin to partition and recombine (seeing $12+15$ as $10+10$ and $2+5$, then $20+7$ as 27) • Using informal jottings with larger numbers (the empty numberline) $42 + 17$ <div style="text-align: center; margin: 10px 0;"> $42 \qquad \qquad \qquad 52 \qquad \qquad \qquad 59$  </div> <ul style="list-style-type: none"> • Develop pencil and paper methods for additions that cannot be done mentally <div style="text-align: center; margin: 10px 0;"> $35 + 52 \qquad 30 + 50 = 80$ $5 + 2 = 7 \qquad \qquad \qquad \longrightarrow \qquad 87$ </div> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 0 auto;"> $\begin{array}{r} 47 + 76 \\ \hline 40 + 70 = 110 \\ 7 + 6 = 13 \\ \hline 110 + 13 = 123 \end{array}$ </div> </div> <ul style="list-style-type: none"> • Introduce compact written method for addition end of Year 2, with and without carrying <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 0 auto;"> $\begin{array}{r} 48 \\ + 25 \\ \hline 73 \\ \hline 1 \end{array}$ </div> </div>

All children by the end of Year 2 and more-able in Year 1

Year 3	<ul style="list-style-type: none"> • Continue informal partitioning; reinforce use of empty number line. Expanded written method, vertical layout. (With and without 'carrying') <div data-bbox="685 856 997 1121" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> $\begin{array}{r} 67 + 24 \\ 60 + 7 \\ \underline{20 + 4} \\ \underline{80 + 11} \rightarrow 91 \end{array}$ </div> <ul style="list-style-type: none"> • Compact written method for addition, with and without carrying <div data-bbox="857 1314 1151 1575" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> $\begin{array}{r} 148 \\ +225 \\ \hline 373 \\ \hline 1 \end{array}$ </div>

Year 4

- **Expanded written methods, vertical layout**

$$\begin{array}{r} 67 \\ +24 \\ \hline 80 \\ \hline 11 \\ \hline 91 \end{array}$$

$$\begin{array}{r} 264 \\ + 48 \\ \hline 12 \\ 100 \\ \hline 200 \\ \hline 312 \end{array}$$

add least significant digit first

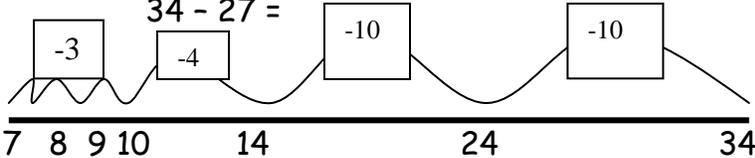
- **Compact written method, with and without carrying**

$$\begin{array}{r} 783 \\ + 135 \\ \hline 918 \\ 1 \end{array}$$

- **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 number of digits
- Extend column addition to decimal amounts of money, lengths, weights
- **Extend written methods for addition**
 - Any number of digits
 - Several numbers with different numbers of digits
 - Decimals with one or two decimal places

Years
5 & 6

Progression in Subtraction

Foundation	<ul style="list-style-type: none"> ○ Begin to relate subtraction to ‘taking away’ <ul style="list-style-type: none"> ○ Make a record in pictures, words or symbols of subtraction activities already carried out ○ Construct number sentences to go with practical activities ○ Relate subtraction to taking away and counting how many objects are left 										
Key Stage 1	<ul style="list-style-type: none"> ○ Understand the operation of subtraction and use the related vocabulary <ul style="list-style-type: none"> ○ Verbal methods of counting on to find the difference ○ Record simple mental subtractions in a number sentence using – and = ○ Use jottings to support mental subtractions (empty numberline) <div style="text-align: center;"> $34 - 27 =$  </div> <ul style="list-style-type: none"> ○ Introduce compact written methods in Year 2, extending to those involving decomposition <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr><td style="text-align: center;">78</td></tr> <tr><td style="text-align: center;">- 35</td></tr> <tr><td style="text-align: center;">———</td></tr> <tr><td style="text-align: center;">———</td></tr> </table> </div>	78	- 35	———	———						
78											
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Year 3	<ul style="list-style-type: none"> ○ Optional method: expanded decomposition <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr><td style="text-align: center;">$81 - 57 =$</td></tr> <tr><td style="text-align: center;">$80 + 1$</td></tr> <tr><td style="text-align: center;">$50 + 7$</td></tr> <tr><td style="text-align: center;">→ $20 + 4$</td></tr> </table> </div> <ul style="list-style-type: none"> ○ Compact written method; extend to 3-digit numbers with tens to ones and hundreds to tens decomposition <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr><td style="text-align: center;">$264 - 136 =$</td></tr> <tr><td style="text-align: center;">5 14</td></tr> <tr><td style="text-align: center;">264</td></tr> <tr><td style="text-align: center;">- 136</td></tr> <tr><td style="text-align: center;">———</td></tr> <tr><td style="text-align: center;">158</td></tr> </table> </div>	$81 - 57 =$	$80 + 1$	$50 + 7$	→ $20 + 4$	$264 - 136 =$	5 14	264	- 136	———	158
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<p>Year 4</p>	<ul style="list-style-type: none"> ○ Compact written methods involving decomposition <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> $\begin{array}{r} 363 - 127 \\ ^5 ^{13} \\ 363 \\ -127 \\ \hline 236 \end{array}$ </div> <ul style="list-style-type: none"> ○ Extend to larger numbers (up to 10,000) and decimal sums of money
<p>Years 5 & 6</p>	<ul style="list-style-type: none"> ○ 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.

Progression in Multiplication and Division

Concepts in multiplication and division are very closely linked and are to be developed together

Key Stage 1	Multiplication	Division
Foundation	<p>Begin to:</p> <ul style="list-style-type: none"> ○ Count in tens ○ Count in twos 	<p>Begin to start grouping and sharing in a practical way</p>
Year 1	<p>Draw pictures and arrays to show equal sets:</p> <ul style="list-style-type: none"> ○ 3 sets of 3 make 9 xxx xxx xxx ○ 2 sets of 4 make 8 xxxx xxxx ○ Count in twos, fives and tens ○ Identify patterns of 2s, 5s, 10s on a hundred square 	<p>Draw pictures and arrays to show sharing and grouping</p> <ul style="list-style-type: none"> ● 9 shared between 3 xxx xxx xxx ● how many groups of 4 in 8? xxxx xxxx
Year 2	<p>Count confidently in steps of 2,5 and 10.</p> <p>Begin to count in steps of 3 and 4.</p> <ul style="list-style-type: none"> ○ use number lines and 100 squares as visual reminders when learning to count in steps of 3, 4 and 5 <p>Understand the operation of multiplication as repeated addition or as describing an array</p> <ul style="list-style-type: none"> ○ make arrays practically draw on squared paper ○ Use x and = to record mental calculations <p style="margin-left: 40px;">3 lots of 2 2 lots of 3 'groups of' 3 x 2 = 6</p> <p>Know by heart multiplication facts for x2, x5 , 10 up to x12</p>	<p>Practical tasks, recorded pictorially:</p> <ul style="list-style-type: none"> ○ sharing equally: 15 ÷ 3 = 15 shared between 3 ○ grouping: 15 ÷ 3 how many 3's in 15? <p>Understand the operation of division as repeated subtraction and relate grouping to arrays</p> <p>Use ÷ and = to record number calculations</p> <p>6 ÷ 2 = 3 6 ÷ 3 = 2</p> <p>Use a number line to illustrate grouping: 8 ÷ 2 = 4</p> <div style="text-align: center;"> <p style="margin-left: 40px;"> ← 2 ← 2 ← 2 ← 2 0 2 4 6 8</p> </div> <p><u>Derive division facts</u></p>

Lower Key Stage 2	Multiplication	Division												
<p>Year 3</p> <p>By Year 3 Summer Term</p>	<ul style="list-style-type: none"> ○ Learn additional multiplication facts and work on different ways to derive new facts from those that they already know ○ Begin to learn facts to 12x12. ○ 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) $4 \times 30 = (4 \times 3) \times 10 = 120$ ○ Jottings to show stages of calculation (TU x U) $32 \times 3 = (30 \times 3) + (2 \times 3)$ $= 90 + 6$ $= 96$ ○ Leading to grid method 37×4 <table border="1" style="margin-left: 20px;"> <tr> <td style="padding: 2px 5px;">x</td> <td style="padding: 2px 5px;">30</td> <td style="padding: 2px 5px;">7</td> </tr> <tr> <td style="border-top: 1px solid black; padding: 2px 5px;">4</td> <td style="border-top: 1px solid black; padding: 2px 5px;">120</td> <td style="border-top: 1px solid black; padding: 2px 5px;">28</td> </tr> </table> $120 + 28 = 148$ 	x	30	7	4	120	28	<ul style="list-style-type: none"> ○ Derive quickly division facts corresponding to 2, 5, and 10 times table to x12 ○ Continue to use empty number lines for division and introduce remainders. ○ Solve division calculations by using multiplication strategies ○ Understand effect of dividing by 10 ○ Divide a 3-digit multiple of 100 by 10, 100 $800 \div 100 = 8$ $300 \div 10 = 30$ ○ Halve any multiple of 10 up to 100 $50 \div 2 = 25$ $\square \div 2 = 35$ ○ Divide a 2-digit number by a single-digit, using multiples of the divisor ○ Use informal jottings Eg: $84 \div 7 =$ $70 + 14$ $\downarrow \quad \downarrow \div 7$ $10 + 2 = 12$ <table border="1" style="margin-left: 20px;"> <tr> <td style="padding: 2px 5px;">x</td> <td style="padding: 2px 5px;">10</td> <td style="padding: 2px 5px;">2</td> </tr> <tr> <td style="padding: 2px 5px;">7</td> <td style="padding: 2px 5px;">70</td> <td style="padding: 2px 5px;">14</td> </tr> </table> ○ Introduce short method, with and without remainders $\frac{20 + 7}{3) \ 60 + 21} = 27$ Shortened to $\begin{array}{r} 27 \\ 3 \overline{) 8210} \end{array}$ 	x	10	2	7	70	14
x	30	7												
4	120	28												
x	10	2												
7	70	14												

	Multiplication	Division
Year 4	<ul style="list-style-type: none"> ○ Multiply a single digit by 1, 10, 100 $7 \times 10 = 70$ $4 \times 100 = 400$ ○ Double any multiple of 5 up to 50 $35 \times 2 = 70$ $\quad \times 2 = 50$ ○ 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) $4 \times 30 = (4 \times 3) \times 10 = 120$ ○ Jottings to show stages of calculation (TU x U) $32 \times 3 = (30 \times 3) + (2 \times 3)$ $= 90 + 6$ $= 96$ ○ Leading to method $ \begin{array}{r l} & 30 + 8 \\ \times & 7 \\ \hline & 210 \\ + & 56 \\ \hline & 266 \\ \hline \end{array} $	<ul style="list-style-type: none"> ○ Develop and refine written methods for division ○ Divide a 2-digit number by a single-digit, using multiples of the divisor <p>e.g. $81 \div 3$ $= (60+21) \div 3$ $= (60 \div 3) + (21 \div 3)$ $= 20 + 7$ $= 27$</p> <p>Recorded thus:-</p> $ \begin{array}{r} 20 + 7 \quad = 27 \\ 3 \overline{) 60 + 21} \end{array} $ <p>Shortened to</p> $ \begin{array}{r} 27 \\ 3 \overline{) 821} \end{array} $ <ul style="list-style-type: none"> ○ Include remainders
End of Year 4	<ul style="list-style-type: none"> ○ Where consolidated, introduce short method of multiplication $ \begin{array}{r} 625 \\ \times 6 \\ \hline 3750 \\ \hline 13 \end{array} $ <ul style="list-style-type: none"> ○ Know by heart multiplication facts up to 12×12 	

Upper Key Stage 2	Multiplication	Division																		
Year 5	<p>Extend written methods Encourage estimation first Grid method (HTU x U) 246×7</p> <table border="1" style="margin-left: 20px;"> <tr> <td style="padding: 2px 5px;">x</td> <td style="padding: 2px 5px;">200</td> <td style="padding: 2px 5px;">40</td> <td style="padding: 2px 5px;">7</td> </tr> <tr> <td style="padding: 2px 5px;">7</td> <td style="padding: 2px 5px;">1400</td> <td style="padding: 2px 5px;">280</td> <td style="padding: 2px 5px;">49</td> </tr> </table> <p>$1400+280+49=1729$</p> <p>Leading to compact written method</p> <table style="margin-left: 20px;"> <tr><td>246</td></tr> <tr><td><u> x 7</u></td></tr> <tr><td>1400 (200 X 7)</td></tr> <tr><td> 280 (40 X 7)</td></tr> <tr><td> 42 (6 X 7)</td></tr> <tr><td><u>1722</u></td></tr> </table>	x	200	40	7	7	1400	280	49	246	<u> x 7</u>	1400 (200 X 7)	280 (40 X 7)	42 (6 X 7)	<u>1722</u>	<p>Extend written methods Encourage estimation first Short division (HTU ÷ U) e.g. $291 \div 3$</p> <p>$= (270 + 21) \div 3$</p> <p>$= (270 \div 3) + (21 \div 3)$</p> <p>$= 90 + 7$</p> <p>$= 97$</p> <p>Recorded in short form:-</p> <p style="text-align: right;">$90 + 7 = 97$</p> <p>$3 \overline{) 290+1} = 3 \overline{) 270 + 21}$</p>				
x	200	40	7																	
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Year 5 Summer Term	<p>Grid method (TU x TU)</p> <p>62×36</p> <table border="1" style="margin-left: 20px;"> <tr> <td style="padding: 2px 5px;">x</td> <td style="padding: 2px 5px;">60</td> <td style="padding: 2px 5px;">2</td> </tr> <tr> <td style="padding: 2px 5px;">30</td> <td style="padding: 2px 5px;">1800</td> <td style="padding: 2px 5px;">60</td> </tr> <tr> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">360</td> <td style="padding: 2px 5px;">6</td> </tr> </table> <p>$2160+72 = 2232$</p> <ul style="list-style-type: none"> ○ Continue with short method of multiplication <table style="margin-left: 20px;"> <tr><td>625</td></tr> <tr><td><u> x 6</u></td></tr> <tr><td><u>3750</u></td></tr> </table>	x	60	2	30	1800	60	6	360	6	625	<u> x 6</u>	<u>3750</u>	<p>Extend written methods for division Encourage estimation first - long division (HTU ÷ TU)</p> <table style="margin-left: 20px;"> <tr><td>23</td></tr> <tr><td><u>24) 560</u></td></tr> <tr><td> 480</td></tr> <tr><td> 80</td></tr> <tr><td> 72</td></tr> <tr><td> 8</td></tr> </table> <p>Answer 23 r 8</p>	23	<u>24) 560</u>	480	80	72	8
x	60	2																		
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	Multiplication	Division																	
Year 6	<p>Extend written methods for multiplication Encourage estimation first</p> <ul style="list-style-type: none"> - continue to use grid method and expanded written method <p>grid method (TU x TU)</p> 62×36 <table border="1" style="border-collapse: collapse; margin-left: 20px;"> <tr> <td style="padding: 2px 5px;">x</td> <td style="padding: 2px 5px; border-right: 1px solid black;">60</td> <td style="padding: 2px 5px;">2</td> </tr> <tr> <td style="padding: 2px 5px; border-right: 1px solid black;">30</td> <td style="padding: 2px 5px;">1800</td> <td style="padding: 2px 5px;">60</td> </tr> <tr> <td style="padding: 2px 5px; border-right: 1px solid black;">6</td> <td style="padding: 2px 5px;">360</td> <td style="padding: 2px 5px;">6</td> </tr> <tr> <td colspan="3" style="padding: 2px 5px;">2160+72 = 2232</td> </tr> </table> <ul style="list-style-type: none"> - develop short multiplication $\begin{array}{r} 625 \\ \times 6 \\ \hline 3750 \\ 13 \end{array}$ <ul style="list-style-type: none"> - leading to multiplication of numbers involving decimals <p>Children will be taken back to the grid method as the digits increase</p> <p>Pupils will be taught the more compact method of multiplication when the teacher feels they are ready: TU x TU; multiplying the units first.</p> $23 \times 13 =$ <table style="margin-left: 20px;"> <tr><td style="padding: 2px 5px;">23</td></tr> <tr><td style="padding: 2px 5px;">x 13</td></tr> <tr><td style="padding: 2px 5px; border-top: 1px solid black;">69</td></tr> <tr><td style="padding: 2px 5px;">+ 230</td></tr> <tr><td style="padding: 2px 5px; border-top: 1px solid black; border-bottom: 1px solid black;">299</td></tr> </table>	x	60	2	30	1800	60	6	360	6	2160+72 = 2232			23	x 13	69	+ 230	299	<p>Continue with short division for HTU ÷ U</p> <p>Extend written methods for division Encourage estimation first for long division (HTU ÷ TU)</p> $\begin{array}{r} 23 \\ 24 \overline{) 560} \\ \underline{480} \\ 80 \\ \underline{72} \\ 8 \end{array}$ <p>Answer 23 r 8</p>
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+ 230																			
299																			

Progression in Calculating with Fractions

Key Stage 2	Addition and Subtraction	Multiplication and division
Year 3 and 4	<ul style="list-style-type: none"> ○ Add and subtract fractions with the same denominator within one whole $\frac{5}{7} + \frac{1}{7} = \frac{6}{7}$ 	
Year 5	<ul style="list-style-type: none"> ○ Add and subtract fractions with the same denominator and multiples of the same number ○ Recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number $\frac{2}{5} + \frac{4}{5} = \frac{6}{5} = 1\frac{1}{5}$ 	<ul style="list-style-type: none"> ○ Multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams
Year 6	<ul style="list-style-type: none"> ○ Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions 	<ul style="list-style-type: none"> ○ Multiply simple pairs of proper fractions, writing the answer in its simplest form $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$ ○ Divide proper fractions by whole numbers $\frac{1}{3} \div 2 = \frac{1}{6}$