

### Progression in Written Calculations

The aim of this agreement is to ensure consistency and progression throughout the school in written methods of calculation and reflects a whole school agreement. It contains the key pencil and paper procedures that will be taught throughout the school. Our aim is that most children follow this progression successfully and with understanding. Other methods may be introduced for more able pupils to investigate and explore.

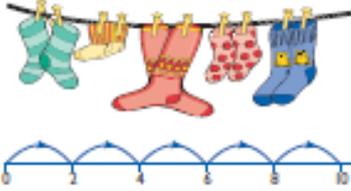
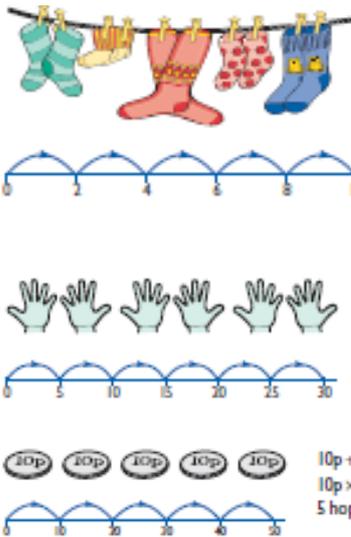
The aim for the school is that by the end of Y6, children will have been taught and be secure with a compact method for each operation. The children will have acquired their understanding through a wide range of models, representations, skills based developments and then embedded the knowledge through real life problems and contexts. Children will be encouraged to look at a calculation/problem/ investigation and then decide which calculation will best solve the problem. They will then select the most efficient method. The long-term aim is for children to be able to select the most efficient method of their choice (whether this be mental, written) that is appropriate for a given task.

Children should be guided towards increased efficiency and less dependence on informal jottings. Countries that are most successful at teaching number, avoid the premature teaching of standard written methods in order not to jeopardise the development of mental strategies.

#### Key points:

<u>Children should be encouraged to:</u>	<u>Points for teachers:</u>
Ask themselves, 'Can I do this calculation mentally?'	Refer to accompanying documents: Detailed Progression (Appendix 1) Progressive success criteria (Appendix 2 -5)
Approximate first	Continue to develop a range of mental strategies
Choose an efficient method appropriate for the numbers	Use appropriate numbers for child's ability
Apply knowledge of known facts	Present calculations in real life/problem solving contexts
Check results of calculations using the inverse	Make links between 4 operations
	Encourage children to share and discuss their methods
	Encourage a deeper conceptual understanding
	Use clear representations to support learning

## Multiplication

<p><b>Stage A</b></p>	<p>Children will experience equal groups of objects.</p> <p>They will count in 2s and 10s and begin to count in 5s.</p> <p>They will work on practical problem solving activities involving equal sets or groups.</p>  <p> <math>2 + 2 + 2 + 2 + 2 = 10</math>  <math>2 \times 5 = 10</math>            2 multiplied by 5            5 pairs            5 hops of 2         </p>
<p><b>Stage B</b></p>	<p>Children will experience equal groups of objects.</p> <p>They will count in 2's 5's and 10's.</p> <p>They will work on practical problem solving activities involving equal sets or groups.</p>  <p> <math>2 + 2 + 2 + 2 + 2 = 10</math>  <math>2 \times 5 = 10</math>            2 multiplied by 5            5 pairs            5 hops of 2         </p> <p> <math>5 + 5 + 5 + 5 + 5 = 30</math>  <math>5 \times 6 = 30</math>            5 multiplied by 6            6 groups of 5            6 hops of 5         </p> <p> <math>10p + 10p + 10p + 10p + 10p = 50p</math>  <math>10p \times 5 = 50p</math>            5 hops of 10         </p> <p>Children will use words alongside pictures and arrays (teacher modelled) to solve 1-step problems</p>

**Stage C**

In addition children will count in 3's and will know their 2, 5 and 10 times tables.

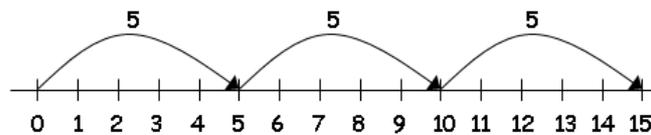
Children will develop their understanding of multiplication and use jottings to support calculation, including the  $\times$  and  $=$  symbols.

✓ **Repeated addition**

3 times 5 is  $5 + 5 + 5 = 15$  or 3 lots of 5 or  $5 \times 3$

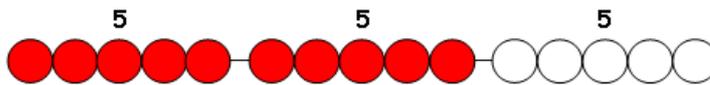
Repeated addition can be shown easily on a number line:

$$5 \times 3 = 5 + 5 + 5$$



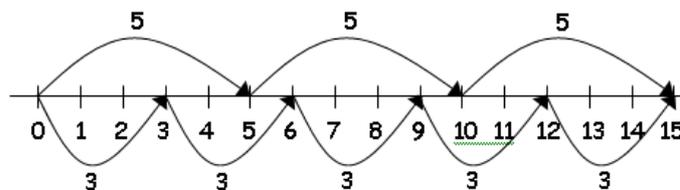
and on a bead bar:

$$5 \times 3 = 5 + 5 + 5$$



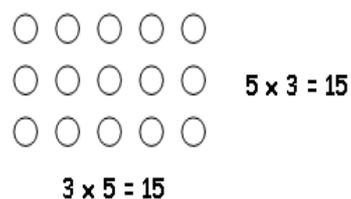
✓ **Commutativity**

Children should know that  $3 \times 5$  has the same answer as  $5 \times 3$ . This can also be shown on the number line.



✓ **Arrays**

Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



**Stage D**

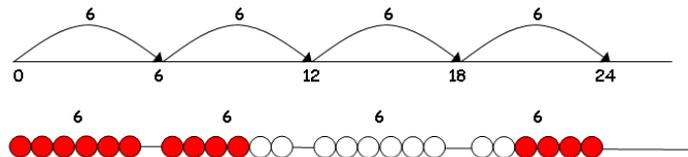
In addition children will count in 4's, 8's, 50's and 100's and will know their 3, 4 and 8 times tables.

Children will continue to use:

✓ **Repeated addition**

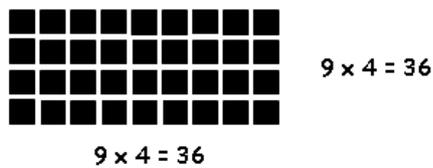
4 times 6 is  $6 + 6 + 6 + 6 = 24$  or 4 lots of 6 or  $6 \times 4$

Children should use number lines or bead bars to support their understanding.



✓ **Arrays**

Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



✓ **Scaling**

e.g. Find a ribbon that is 4 times as long as the blue ribbon



✓ **Using symbols to stand for unknown numbers to complete equations using inverse operations**

$$\square \times 5 = 20$$

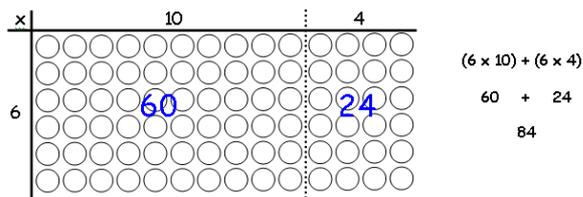
$$3 \times \triangle = 18$$

$$\square \times \circ = 32$$

✓ **Partitioning**

Teach using array or number line

$$\begin{aligned} 14 \times 6 &= (10 \times 6) + (4 \times 6) \\ &= 60 + 24 \\ &= 84 \end{aligned}$$



Then move onto the grid method

$18 \times 5$

x	10	8
5	50	40

**Stage E**

In addition children will count in 6's, 7's, 9's, 25's and 1000's and will know their times tables up to  $12 \times 12$ .

Children will continue to use arrays where appropriate leading into the grid method of multiplication.

✓ **Grid method**

**TU x U**

(Short multiplication - multiplication by a single digit)

$23 \times 8$

Children will approximate first

$23 \times 8$  is approximately  $25 \times 8 = 200$

x	20	3	
8	160	24	$160$ $+ 24$ <hr style="width: 50px; margin: 0;"/> $184$

**HTU x U**

(Short multiplication - multiplication by a single digit)

$346 \times 9$

Children will approximate first

$346 \times 9$  is approximately  $350 \times 10 = 3500$

$$\begin{array}{r}
 \times \quad 300 \quad 40 \quad 6 \\
 9 \quad \boxed{2700} \quad \boxed{360} \quad \boxed{54} \\
 \hline
 2700 \\
 + 360 \\
 + \quad 54 \\
 \hline
 3114 \\
 \hline
 \end{array}$$

Children will also multiply three single digit numbers together,  $5 \times 6 \times 7$ , by using multiplication facts and then TU x U grid method

### Multiplication rules

Children will learn that when any number is multiplied by 0 then the answer is 0.

Also when any number is multiplied by 1 then the answer is the same.

## Stage F Grid method

Children should be able to multiply up to 4 digit numbers by 1 or 2 digit numbers, including long multiplication

### TU x TU

(Long multiplication - multiplication by more than a single digit)

$$72 \times 38$$

Children will approximate first

$72 \times 38$  is approximately  $70 \times 40 = 2800$

$$\begin{array}{r}
 \times \quad 70 \quad 2 \\
 30 \quad \boxed{2100} \quad \boxed{60} \\
 8 \quad \boxed{560} \quad \boxed{16} \\
 \hline
 2100 \\
 + 560 \\
 + \quad 60 \\
 \hline
 2736 \\
 \hline
 \end{array}$$

### ThHTU x U

(Short multiplication - multiplication by a single digit)

$$4346 \times 8$$

Children will approximate first

$4346 \times 8$  is approximately  $4346 \times 10 = 43460$

x	4000	300	40	6	
8	32000	2400	320	48	

$$\begin{array}{r}
 32000 \\
 + 2400 \\
 + 320 \\
 + \underline{48} \\
 \hline
 34768
 \end{array}$$

### HTU x TU

(Long multiplication - multiplication by more than a single digit)

$$372 \times 24$$

Children will approximate first

$372 \times 24$  is approximately  $400 \times 25 = 10000$

x	300	70	2	
20	6000	1400	40	
4	1200	280	8	

$$\begin{array}{r}
 6000 \\
 + 1400 \\
 + 1200 \\
 + 280 \\
 + 40 \\
 + \underline{8} \\
 \hline
 8928
 \end{array}$$

Children should be able to multiply whole numbers and those involving decimals by 10, 100 and 1000.

**Stage G** Children should be able to use a written method to multiply multi-digit numbers, up to 4 digits, by a 2 digit whole number.

*Using similar methods, they will be able to multiply decimals with up to two decimal places by a single digit number and then two digit numbers, approximating first. They should know that the decimal points line up under each other.*

*For example:*

$$4.92 \times 3$$

Children will approximate first

$4.92 \times 3$  is approximately  $5 \times 3 = 15$

x	4	0.9	0.02	
3	12	2.7	0.06	

$$\begin{array}{r}
 12 \\
 + 0.7 \\
 + \underline{0.06} \\
 \hline
 12.76
 \end{array}$$

By the end of year 6, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

- 1) they are not ready.
- 2) they are not confident.

Children should be encouraged to approximate their answers before calculating.

Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.