

WOOLENWICK JUNIOR SCHOOL

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one **accurate** and **efficient** written method of calculation for multiplication, which they know they can rely on when mental methods are not appropriate.

MENTAL CALCULATIONS (ongoing)

To multiply successfully, children need to be able to:

Doubling and halving

Applying the knowledge of doubles and halves to known facts. e.g. 8×4 is double 4×4

Using multiplication facts

By the end of Year 4 children should be able to derive and recall all multiplication facts up to 10×10

Using and applying multiplication facts

Children should be able to utilise their tables knowledge to derive other facts.

e.g. If I know $3 \times 7 = 21$, what else do I know?

$30 \times 7 = 210$, $300 \times 7 = 2100$, $3000 \times 7 = 21\ 000$, $0.3 \times 7 = 2.1$ etc

Use closely related facts already known

$$\begin{aligned} 13 \times 11 &= (13 \times 10) + (13 \times 1) \\ &= 130 + 13 \\ &= 143 \end{aligned}$$

Multiplying by 10 or 100

Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.

Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

Partitioning

$$\begin{aligned} 23 \times 4 &= (20 \times 4) + (3 \times 4) \\ &= 80 + 12 \\ &= 102 \end{aligned}$$

Use of factors

$$8 \times 12 = 8 \times 4 \times 3$$

Note: It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for multiplication.

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

PHASE 1: Practical Resources and Pictures (NNF - YR/1, P Level/Level 1)

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using **pictures, cubes, counters** etc.

Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups.



Vocabulary
equal, sharing, groups, lots

PHASE 2: Repeated Addition, Commutatively and Arrays (NNF - Y2/3, Level 2/3)

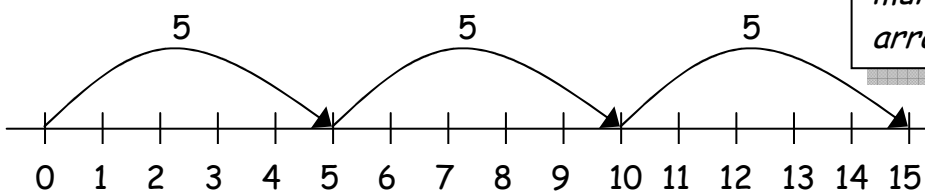
Children will develop their understanding of multiplication and use jottings to support calculation:

✓ **Repeated addition**

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

Repeated addition can be shown easily on a number line:

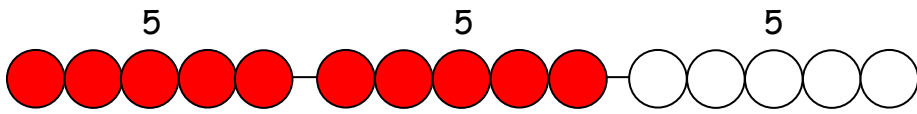
$$5 \times 3 = 5 + 5 + 5$$



Vocabulary
times, multiply, multiple of, multiplied, repeated addition, array, row, column,

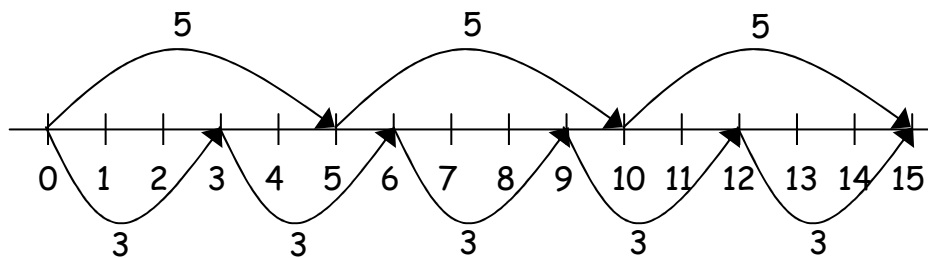
and on a bead bar:

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



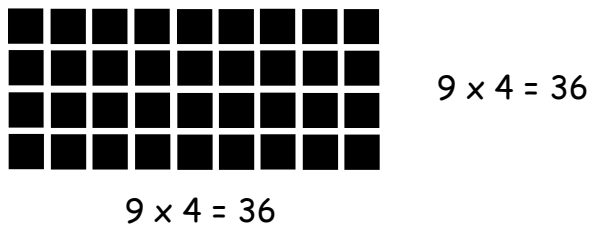
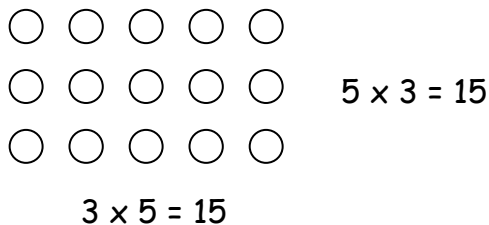
✓ **Commutativity**

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



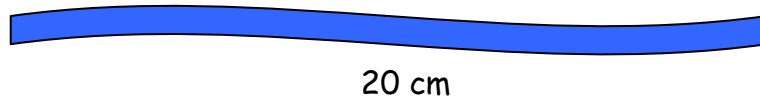
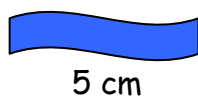
✓ **Arrays**

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



✓ **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

$$\square \times 5 = 20 \qquad 3 \times \triangle = 18 \qquad \square \times \circ = 32$$

PHASE 3: Mental multiplication using Partitioning (NNF - Y3/4, Level 3)

These methods are based on the distributive law. Children should be introduced to the principle of this law (not its name). This allows the tens and units to be multiplied separately to form partial products. These are then added to find the total product. Either the tens or the units can be multiplied first but it is more common to start with the tens.

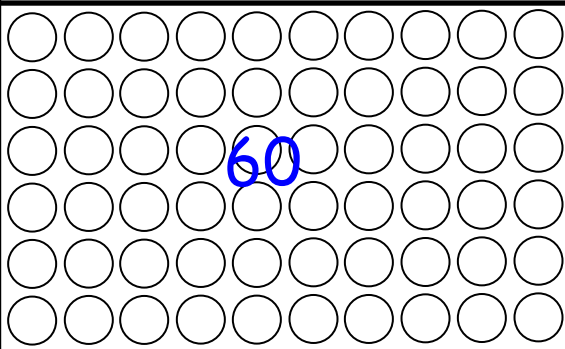

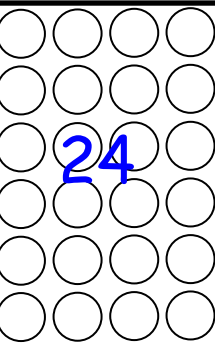
This should be laid out as:

$$\begin{aligned} 38 \times 5 &= (30 \times 5) + (8 \times 5) \\ &= 150 + 40 \\ &= 190 \end{aligned}$$

Vocabulary
partition, tens, units, product

PHASE 4: The Grid Method (NNF - Y4/5/6, Level 3/4)

Children will continue to use arrays where appropriate leading into the grid method of multiplication. This process should be demonstrated using **arrow cards** to show the partitioning and **base 10 materials** to show the decomposition of the number.

x	10	⋮	4	
6				$(6 \times 10) + (6 \times 4)$ $60 + 24$ 84

✓ HTU × U

(Short multiplication - multiplication by a single digit)

346×9

Children will approximate first.

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

x	300	40	6	
9	2700	360	54	2700
				+ 360
				+ 54
				<hr style="width: 50%; margin-left: 0;"/>
				3114
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✓ TU × TU

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

72×38

Children will approximate first

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

Vocabulary

partition, tens, units, product

x	70	2	
30	2100	60	
8	560	16	
			2100
			+ 560
			+ 60
			+ 16
			<hr style="width: 50%; margin-left: 0;"/>
			2736
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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

$$4.92 \times 3 \text{ is approximately } 5 \times 3 = 15$$

x	4	0.9	0.02	
3	12	2.7	0.06	
				12
				+ 0.7
				+ <u>0.06</u>
				<u>12.76</u>

PHASE 5: Expanded Short Multiplication (NNF - Y5/6, Level 4/5)

As children move onto phase 5, they will reduce recording showing links to the grid multiplication method. While this expanded method is cumbersome, it enables us to track back misconceptions. Begin by multiplying the most significant digit first. Children will approximate first.

286	
x 29	
4000	200 x 20 = 4000
1600	80 x 20 = 1600
120	6 x 20 = 120
1800	200 x 9 = 1800
720	80 x 9 = 720
<u>54</u>	6 x 9 = 54
<u>8294</u>	
1	

286 × 29 is approximately 300 × 30 = 9000

$$\begin{array}{r} 286 \\ \times 29 \\ \hline 5720 \\ 2574 \\ \hline 8294 \\ 1 \end{array} \quad \begin{array}{l} 286 \times 20 \\ 286 \times 9 \end{array}$$

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 check their answers after calculation using an appropriate strategy.
 - Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.