

WESTGARTH PRIMARY SCHOOL

CALCULATION POLICY





Westgarth Calculation Policy Guidance

Reviewed September 2023

Purpose

The purpose of the Calculation Policy is to ensure continuity and progression across the school through use of models, methods and vocabulary used in the teaching of addition, subtraction, multiplication and division. Vitality, this supports pupils in developing fluency, confidence and competence as mathematicians in core arithmetic strategies.

This document, produced through utilisation of collective staff experiences of the teaching of maths across Westgarth school, is designed to support new and existing staff in producing lessons which aid pupils in becoming confident, competent mathematicians. It is a developing and changing document which is regularly reviewed and modified in line with new research and the needs of the pupils at Westgarth Primary School.

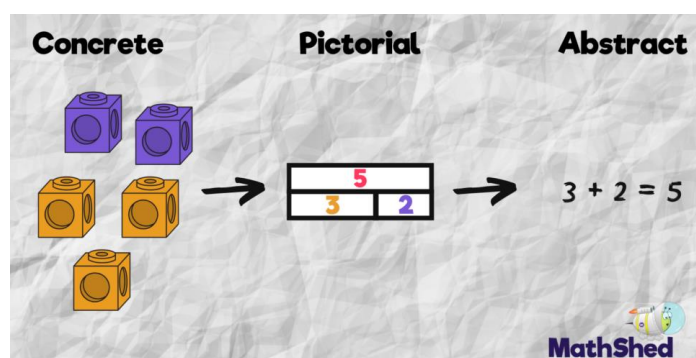
Principles of Practice:

I do, we do, you do

In order to support pupils in developing understanding and confidence across the maths curriculum, pupils will be provided with working examples as well as having opportunities to partake in activities as a group or pair before moving on to independent work.

Concrete, Pictorial, Abstract

Underpinning these calculation strategies, is a secure understanding of place value. Through the use of CPA (concrete, pictorial, abstract) activities and examples, we ensure all pupils have a depth of understanding in all areas of maths. This is developed through children manipulating concrete resources and using pictorial representations to support their developing understanding of abstract calculations. At Westgarth, a range of place value and counting resources are available for children to use in each classroom.



Modelling thinking processes

An integral part of teaching any calculation strategy is to ensure that children are encouraged to follow a thinking process rather than just carrying out calculations. At Westgarth, we use the EPC (estimate, procedure check). In this process, answers are first estimated either through verbal discussion or, as pupils develop into competent mathematicians, by using strategies such as rounding, the application of number bond skills or times tables facts. Pupils develop the ability to check their answer by considering if their answers are reasonable and if they make sense. This is achieved using techniques such as comparing the answer to the number they began with, comparing the size of the answer to the original number and operation – for example, in addition, is their answer greater than each of its parts. As their knowledge of inverse operations develops, pupils begin to use the inverse operation to check their answers.

Mistakes as learning opportunities

Mistakes are one of the most useful ways to learn in maths and develop as a mathematician. While support and intervention should be in place for pupils who lack understanding of a particular area, where mistakes are infrequent, pupils should be encouraged to embrace them as learning opportunities. Teachers encourage pupils to identify and articulate their mistakes through verbal and written feedback, peer or self-marking. Pupils should learn to use checking to identify their own errors and explain the consequence of these.

Mental Strategies

Mental strategies are a priority throughout school and are rehearsed regularly through retrieval work and within teaching.

Vocabulary

At all points accurate and varied mathematical vocabulary should be used as highlighted in this policy and through progression maps and the National Curriculum.

Application of mathematical skills

In order to consolidate and deepen their understanding of mathematical concepts, pupils apply their skills to problem solving, reasoning and investigative tasks. Opportunities to apply their knowledge to the wider curriculum are also embraced.

Glossary of General Terms

Calculation- working out the amount of something, usually by using one of the four operations. For example, calculate three multiplied by six.

Complement –in addition, a number and its complement make a total. For example, 300 is the complement to 700 to make 1,000.

Difference – the numerical difference between two numbers is found by comparing the quantity in each group. This should not be taught as a subtraction as difference is a unique mathematical concept not connected to subtraction. It represents how many numbers are between a set of two numbers.

Digit - a single part, it is used to make up a number.

Exchange –Change a number or expression for another of an equal value.

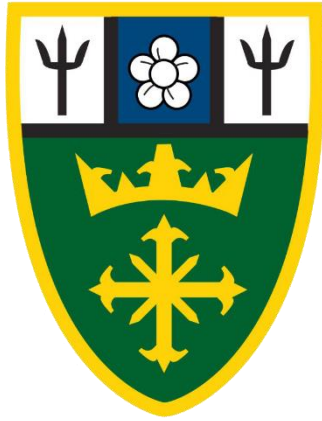
Number - a combination of digits, can also be a single value.

Partitioning –Splitting a number into its component parts.

Reduction –Subtraction as take away.

Subitise –Instantly recognise the number of objects in a small group without needing to count.

Sum -The result of an addition. **Total** –The aggregate or the sum found by addition. Note, the word sum applies only to calculations involving addition, for example, find the sum of these numbers.



multiplication

EYFS

multiplication

Galileo MAT Assessment Points	Linked Galileo MAT Assessment Points	Key Vocabulary
<p>Autumn:</p> <p>Spring:</p> <ul style="list-style-type: none"> Begins to identify when items haven't been distributed evenly i.e. when 2-3 groups don't contain the same amount of items. Can recall double facts to 3+3. <p>Summer:</p> <ul style="list-style-type: none"> Explores and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally. 	<ul style="list-style-type: none"> Begins to use pictures and writing to communicate mathematical ideas. Automatically recalls (without reference to rhymes, counting or other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts. Can create a more complex pattern ABB, AAB, ABC. Is able to identify errors in a repeating pattern. 	<ul style="list-style-type: none"> doubling number patterns pairs* sets of groups* equal sets* double
	<p>Linked Early Learning Goals</p> <ul style="list-style-type: none"> Explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally. Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity. 	

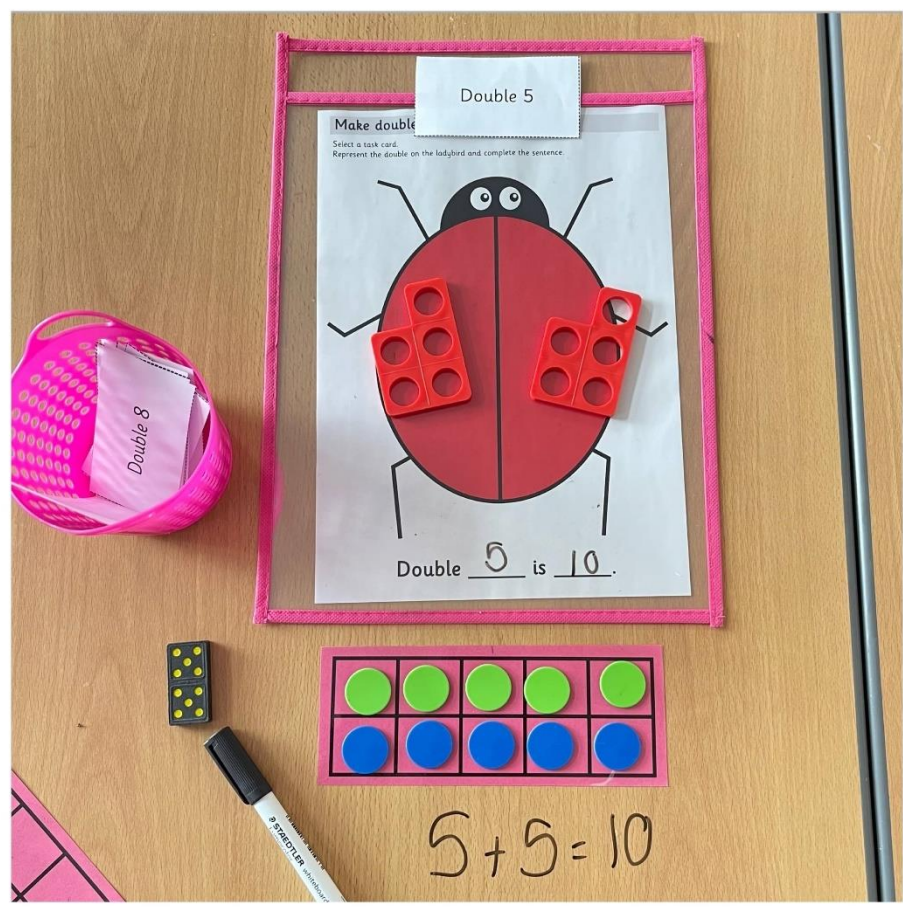
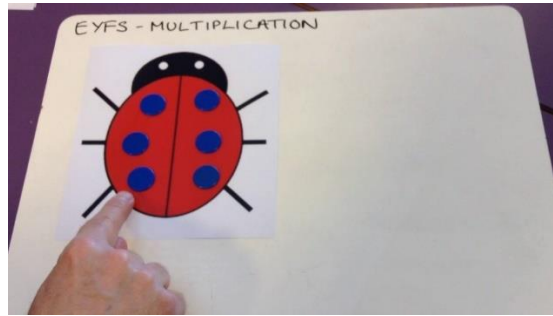
Concrete

Pupils use Rekenreks alongside other methods of addition to support them in building a rich mental picture of how numbers are made up and manipulated.

The use of Rekenreks for doubling numbers support pupils in gaining an understanding of what a 'double' is and how numbers can be combined to give a total.



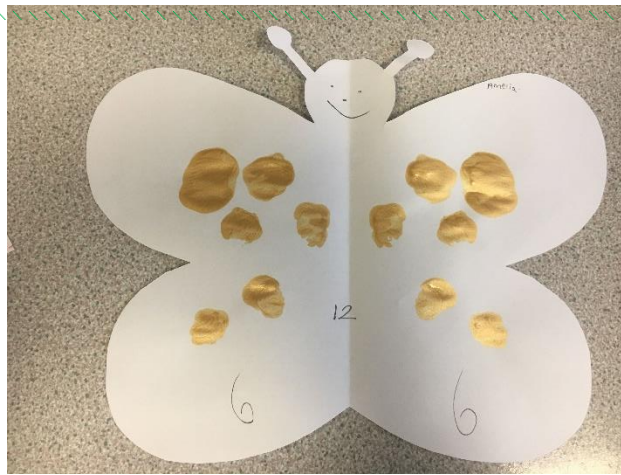
Further concrete and pictorial representations support pupils in gaining a mental picture of the concept of 'double'.



Pupils investigate doubling through a range of concrete and pictorial representations.

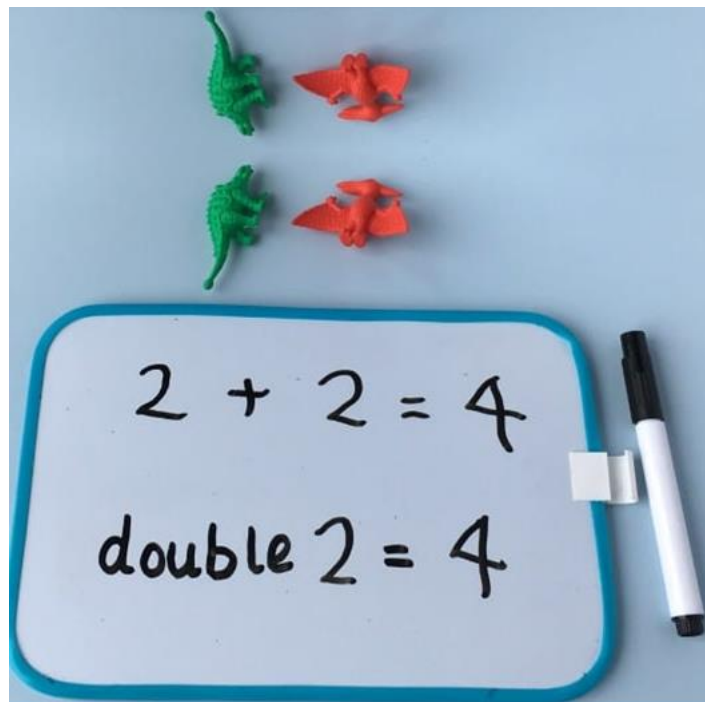
Pictorial

Pupils begin to use pictorial representations to combine two groups. Their developing knowledge of subitising supports them in finding totals to 10 and within 10.



Abstract

Pupils are introduced to the concept that a double is a combination of two groups of the same number. The representation of this information as a number sentence is introduced to pupils alongside concrete and pictorial representations.



Year 1

multiplication

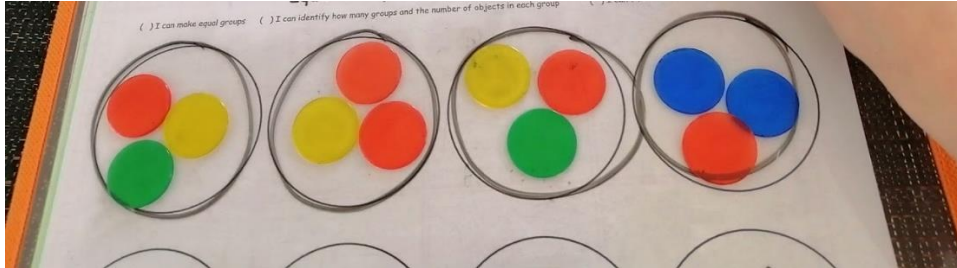
National Curriculum Objectives Multiplication Objectives from Westgarth Progress Map:	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">Solve one-step problems involving multiplication and division by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher	<ul style="list-style-type: none">Count in multiples of 2,5 and 10.	<p>Previous +</p> <ul style="list-style-type: none">multiplicationmultiplymultiplied bymultiplegrouping*array*near doublelots of*twice

Mental Methods:

- Counting in multiples of 2, 5, and 10s.
- Spotting number patterns when counting in 2, 5 and 10s.
- Repeated addition
- Links to doubling
- Use of arrays

Concrete

Pupils are introduced to the concept of multiple groups of objects containing the same number combining to create a total number of objects.



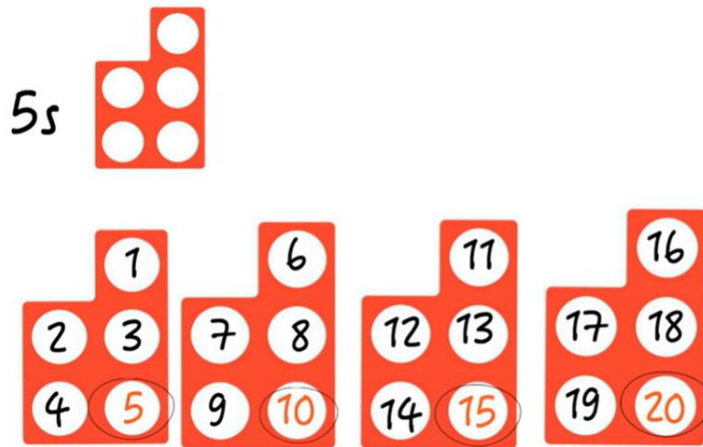
Rekenreks provide visual representations when counting in 10s and 5s but can also be used to count in 2s, pairing up beads to support pupils in making the connection that there are five sets of 2 in 10.



They relate these skills to aspects of every day life through investigating number in the real world. For example counting shoes in twos, counting fingers on gloves in 5s.



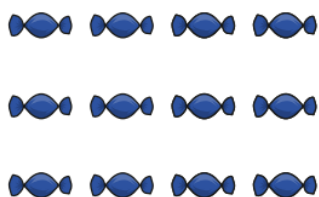
Numicon is used to support the idea of a repeated amounts, using counting on skills to reveal how groups build to create a total amount.



Pictorial

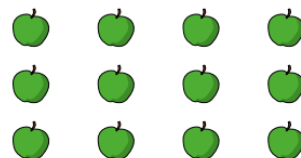
Pupils use and draw pictorial representations of familiar objects in groups of the same number. They give a total number. They are supported in calculation problems, such as by saying how many groups and how many in each group before giving a total number.

Circle each row of sweets.



How many rows are there?

Circle each column of apples.



How many columns are there?

Pupils begin to use pictorial representations of arrays, drawing groups of familiar objects. For example, counters.



Abstract

Pupils begin to identify and record the key elements of a multiplication calculation. They record how many groups (or rows), how many objects in each and the total number of objects.

Complete the sentences.

a) There are counters in each row.

There are rows.

There are counters altogether.

Year 2

multiplication

National Curriculum Objectives: Addition objectives from Addition and Subtraction Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">Recall and use multiplication and division facts for the 2,5 and 10 multiplication tables, including recognising odd and even numbersShow that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannotCalculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (\times), division (\div) and equals (=) signsSolve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.	<ul style="list-style-type: none">Recognise odd and even numbers.Count in steps of 2,3 and 5 from zero and in 10s from any number.	<p><i>Previous +</i></p> <ul style="list-style-type: none">groups oftimesonce, twice, three times ... ten timesrepeated additionone each, two each, three each...ten eachrowcolumnmultiplication tablemultiplication facttimes tablesfact family*odd*even*multiple of 10multiply

Mental Methods

- Counting in twos, fives and tens
- Repeated addition
- Use of arrays
- Children should recall multiplication facts for the 2, 5 and 10 times tables through practising counting and understanding of the operation and number patterns.
- Using doubling and understanding that this is the same as multiplying by 2.

- Reordering a calculation, knowing that multiplication can be done in any order.

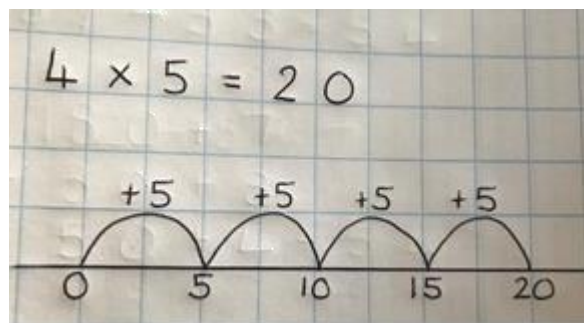
Concrete

Children work with familiar objects and coins to solidify the concept of equal groups.



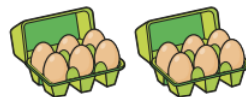
Pictorial

Pupils recognise multiplication as repeated addition and are able to recognise and represent this using a number line.



Abstract

Make links between pictorial, concrete and abstract by recognising the function of each number within a calculation. Explicit links made between pictures and concrete examples, leading to writing calculations.





$$\square \text{ lots of } 6 = \square$$

$$\square \text{ multiplied by } 6 = \square$$

$$\square \times 6 = \square$$

Link concrete and pictorial arrays to simple written calculations, understanding and demonstrating the role each number plays within the calculation.

Multiplication	Array 1	Array 2
3×8		

Year 3

multiplication

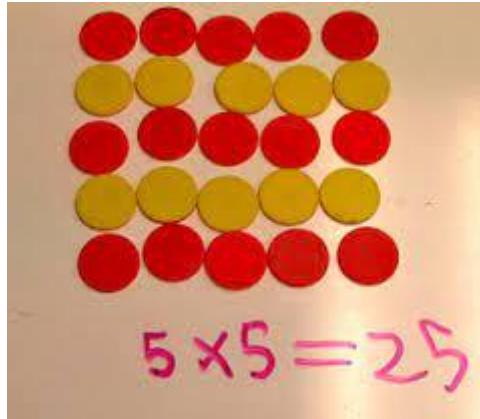
National Curriculum Objectives: Multiplication objectives from Multiplication and Division strand.	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">Recall and use multiplication and division facts for 3,4 and 8 multiplication tables.Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.Solve problems including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects and connected to m objects	<ul style="list-style-type: none">Count from 0 in multiples of 4 and 8.	Previous + <ul style="list-style-type: none">Factor*ProductScalingMissing number*Times larger

Mental Methods

- Counting in 2s, 5s, 10s, 3s, 4s and 8s.
- Repeated addition
- Recall multiplication facts for 2, 5 and 10 times tables (from Year 2)
- Recall multiplication facts for 3, 4 and 8 times tables
- Use known facts and place value to multiply by 2,3,4,5,8 and 10.
- Use doubles to link to x2, x4 and x8.
- Reorder a calculation, understanding that multiplication can be done in any order.

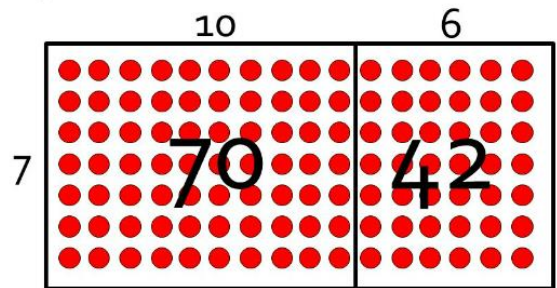
Concrete

Pupils continue to make arrays to show how groups or rows of numbers combine to make a total.



The grid method is introduced using arrays with the continued use of counters.

x	10	3
4	000000000000	000
	000000000000	000
	000000000000	000
	000000000000	000



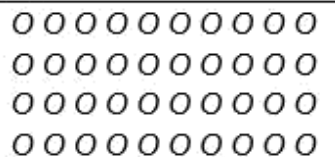

Pupils then use base ten equipment to deepen their understanding of the role of 'tens' in multiplication and when using the grid method.

$$5 \times 23$$

Tens	Ones

Pictorial

Pictorial representations of concrete tools allow pupils to begin to move towards an abstract approach to multiplication. Pupils draw and use arrays and base ten equipment to support them in solving calculations.

x	10	3
4		

Tens	Ones
	
	
	
	
	

The bar model is used to support pupils in gaining a deeper understanding of the concept of multiplication as repeated addition and begin to make connections between the relationship of multiplication and division. This is also utilised in supporting pupils when approaching some multiplication problem solving exercises.



$$5 + 5 + 5 + 5 = 20$$

$$5 \times 4 = 20$$

$$20 \div 4 = 5$$

$$20 \div 5 = 4$$

Abstract

Once pupils have secure understanding of the above steps, they are able to use the 'grid method'. Initially, this is used alongside concrete and pictorial representations.

x	30	5
7	210	35
	210 + 35 = 245	

Times Tables Rock Stars



To support in continued practise and consolidation of times tables facts, from Year 3 onwards, pupils have access to Time Tables Rock Stars which they are encouraged to access regularly in school and at home.

Year 4

multiplication

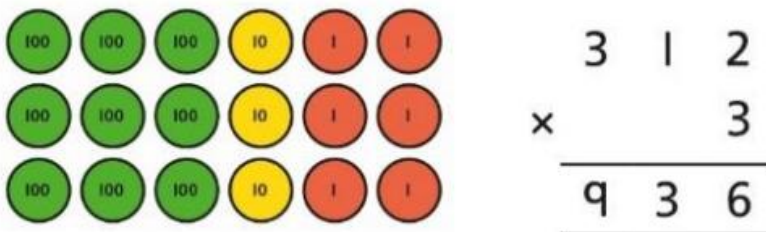
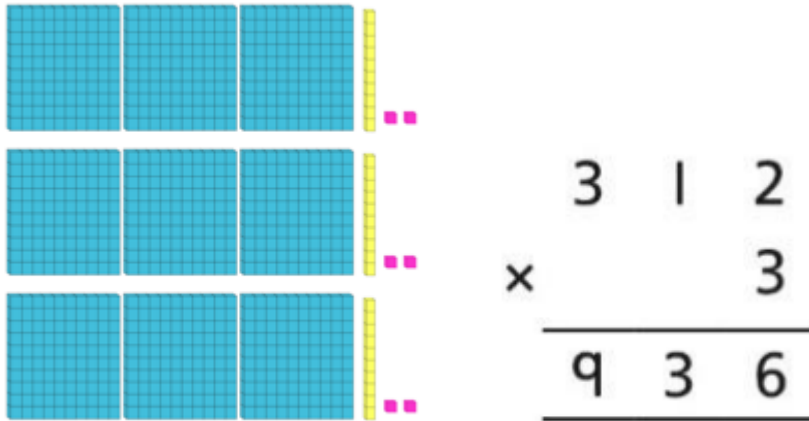
National Curriculum Objectives: Multiplication Objectives from Multiplication and Division strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">Recall multiplication and division facts for multiplication tables up to 12 x 12Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbersRecognise and use factor pairs and commutativity in mental calculationsMultiply two-digit and three-digit numbers by a one-digit number using formal written layoutSolve problems involving multiplying and adding, including using the distributive law to multiply two-digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects	<ul style="list-style-type: none">Count in multiples of 6, 7, and 9	<p>Previous +</p> <ul style="list-style-type: none">Inverse*Factor pair*Short multiplicationAssociative lawCommutativity

Mental Methods

- Counting in 6s, 7s, 9s, 25s and 100s
- Recall previously learnt multiplication facts with increasing confidence (2, 5, 10, 3, 4 and 8 times tables).
- Recall multiplication facts for the 6,7,9, 11 and 12 times tables.
- Partitioning: multiplying hundreds, tens and ones separately and then recombining.
- Using understanding of when a number is multiplied by 10, 100 or 1,000.
- Using knowledge of number facts and place value e.g. $7 \times 8 = 56$ to find 70×8 , 7×80 etc.

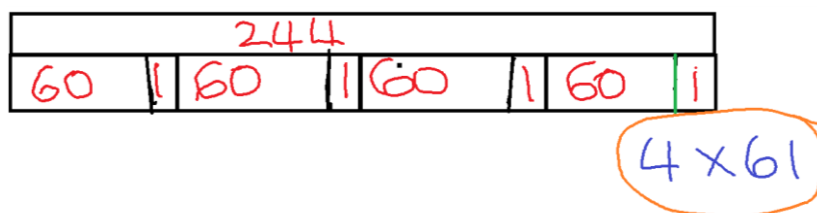
Concrete

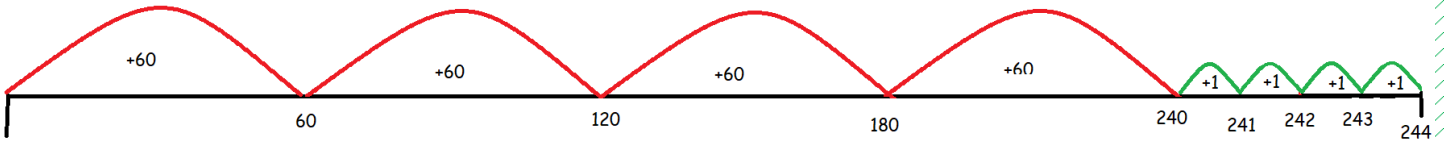
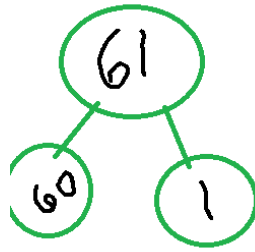
Place Value equipment is used alongside long division model to demonstrate how the method works to multiply numbers together.



Pictorial

Bar models, number lines and part-whole models are used to develop a deep and secure understanding of the process and concept of multiplication. The bar model is used to support pupils in accessing problem solving questions and developing their ability to find a starting point.





Abstract

The grid method supports pupils in developing their understanding of how and why the long multiplication method is used to find the product of two numbers.

x	10	9
10	100	90
4	40	36

Pupils are introduced to the long multiplication method through multiplying a single digit by a two or three-digit number.

$$\begin{array}{r}
 23 \\
 \times 5 \\
 \hline
 15 \\
 100 \\
 \hline
 115
 \end{array}$$

$$\begin{array}{r}
 312 \\
 \times 3 \\
 \hline
 936
 \end{array}$$

Year 5

multiplication

National Curriculum Objectives: Addition objectives from Addition and Subtraction Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">• Identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers• Know and use the vocabulary of prime factors and composite (non-prime) numbers• Establish whether a number up to 100 is prime and recall prime numbers up to 19• Recognise and use square numbers and cube numbers, and the notation for squared (2) and cubed (3)• Multiply numbers up to 4 digits by and one- or-two-digit number using a formal written method, including long multiplication for two-digit numbers• Multiply and divide numbers mentally drawing upon known facts• Multiply and divide whole numbers and those involving decimals by 10, 100 and 1000• Solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes• Solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates• Solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign	<ul style="list-style-type: none">• Count forwards in steps of powers of 10 for any given number up to 1,000,000.	<p><i>Previous vocabulary +</i></p> <ul style="list-style-type: none">• Square• Squared• Cube• Cubed• Square root*• Common factor*• Composite number*• Long multiplication• Non integer• Power of• Prime number*• Square number

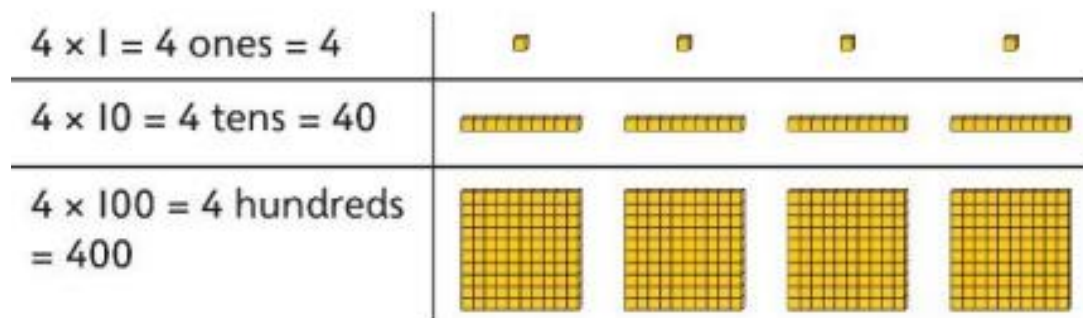
Mental Methods

- Counting in steps of powers of 10
- Use commutativity and tables to multiply
- Use known facts and place value to multiply

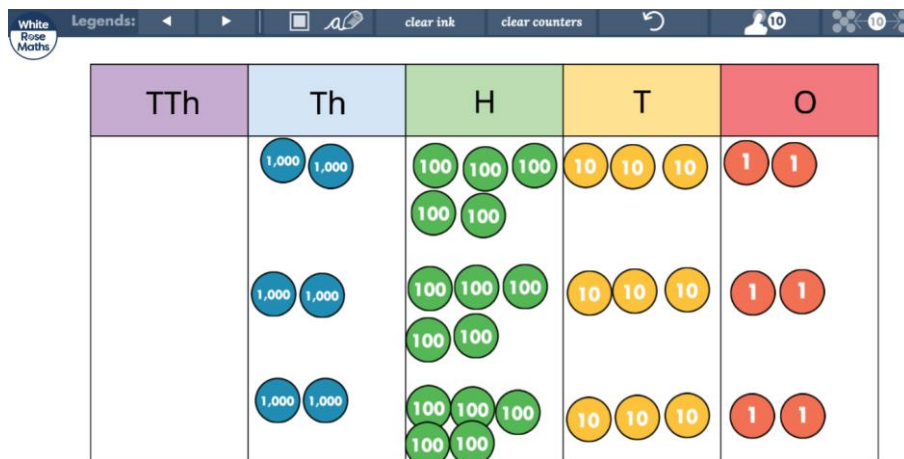
- Use related facts to multiply
- Scaling up using known facts to multiply
- Recall of all times tables up to 12 X 12
- Using times table facts to recognise and use square and cube numbers.
- Use understanding of multiplying by 10, 100 or 1,00 and how the digits change in their place value.
- Use the relationship between multiplication and division.

Concrete

Place value equipment is used to support pupils in recognising the effect of multiplying a number by ten.



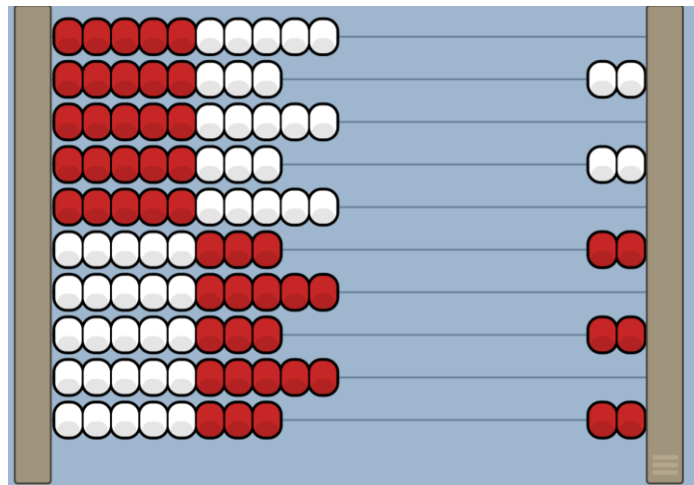
Where appropriate and necessary, pupils revisit multiplication as repeated addition and multiplication using partitioning using place value equipment and interactive manipulatives.



These are also used to support pupils in understanding the relationships between operations and developing mental maths strategies.

For example:

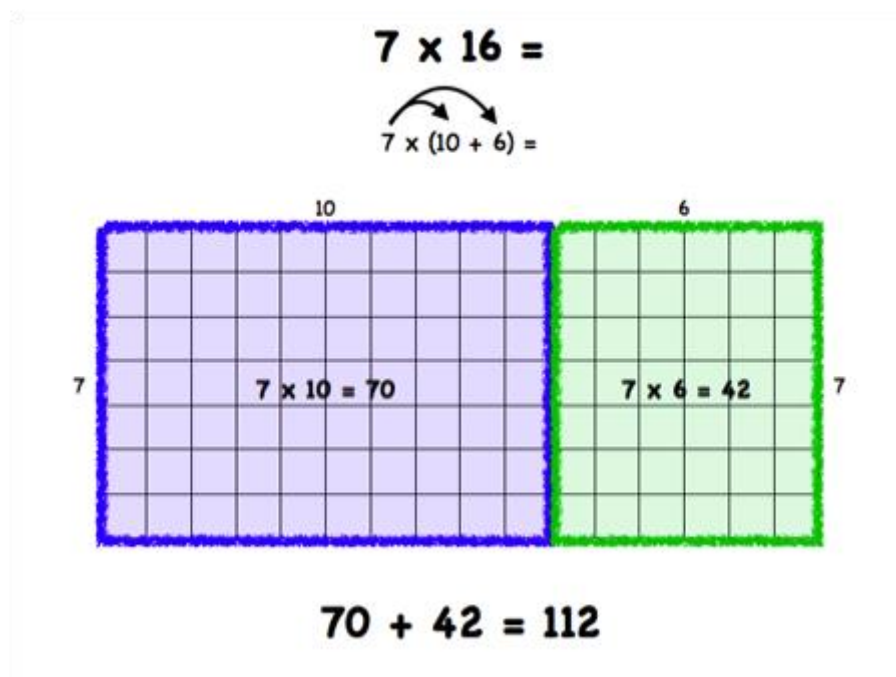
$$5 \times 18 = 5 \times 20 - 10$$



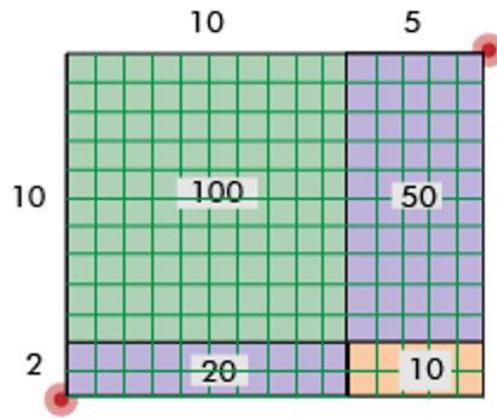
Pictorial

Pictorial representations build upon concrete methods and pupils are encouraged to identify and use relevant pictorial representations to support them in calculation and problem solving. These include, but are not limited to, bar models, place value charts, arrays.

The concept of area is also supported through arrays.

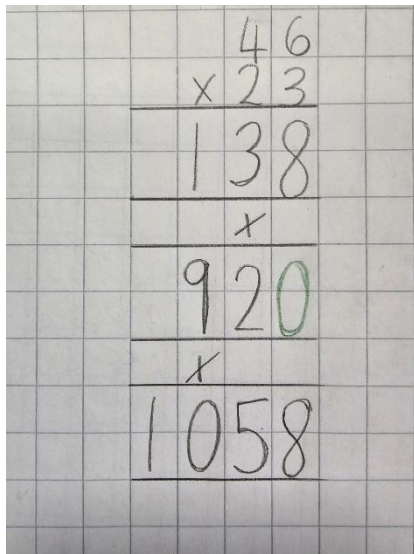


$$15 \times 12 = 180$$



Abstract

Pupils use the grid method alongside the long multiplication method to multiply two-digit numbers by numbers with up to four digits. Children use the 'big – small – big – small' layout to support them in exchanging numbers. Pupils write the 0 for their tens number in a different colour to remind them.



	100	40	3
10			
2			

Year 6

multiplication

National Curriculum Objectives: Multiplication objectives from Multiplication and Division Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">• Identify common factors, common multiples and prime numbers• Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy• Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication• Perform mental calculations, including with mixed operations and large numbers• Solve problems involving addition, subtraction, multiplication and division• Use their knowledge of the order of operations to carry out calculations involving the four operations	<ul style="list-style-type: none">• Understanding place value in large numbers	<p><i>Consolidate all previously taught vocabulary +</i></p> <p>Order of operation* Brackets *</p>

Mental Methods:

- Rapid recall of all times tables up to 12X12 - as in Year 4 and Year 5
- Recalling square and cubed numbers
- Use known facts and place value to multiply.
- Use related facts to multiply.
- Scaling up using known facts.
- Use the relationship between multiplication and division.

Concrete and Pictorial

In year 6, pupils should continue to have access to a wide range of concrete and pictorial resources in order to support and consolidate their understanding of place-value and formal multiplication methods. These are used by teachers, as appropriate, to support pupils in reinforcing connections between and within learning.

Abstract

Pupils will use formal written methods to multiply numbers with more than four digits by up to 2-digit numbers.

	4	.	2	6
x				8
3	4	.	0	8
	2		4	

			5	3	2	4		
		x			3	9		
<hr/>								
			4	7	9	1	6	
<hr/>								
			2	2	3			
<hr/>								
			1	5	9	7	2	0
<hr/>								
					x			
<hr/>								
			2	0	7	6	3	6
<hr/>								
			x	x	x			