

# WESTGARTH PRIMARY SCHOOL

## CALCULATION POLICY





## Westgarth Calculation Policy Guidance

### 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. Vivaly, 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.

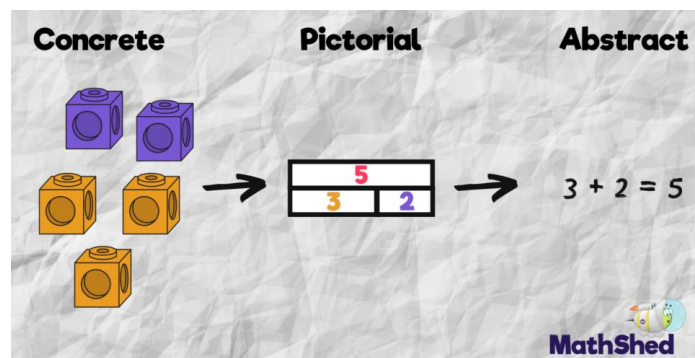
### Principles of Practice:

#### 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.

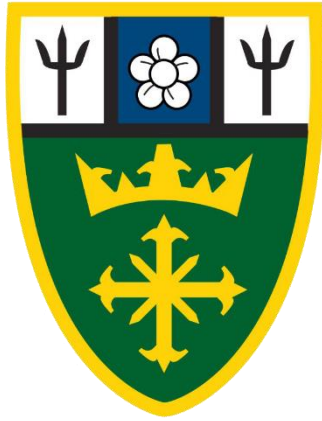
**Number** - a combination of digits, can also be a single value.

**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.



+ADDITION+

# Reception

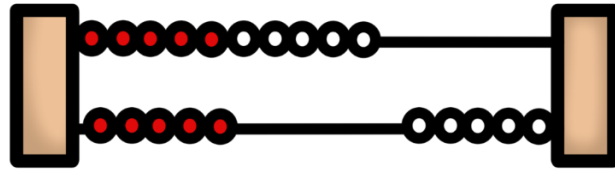
## +ADDITION+

Galileo MAT Assessment Points	Linked Galileo MAT Assessment Points	Key Vocabulary
<p><b>Autumn:</b></p> <ul style="list-style-type: none"> <li>Can say which numbers they can see inside a number up to 5.</li> <li>Recalls some number bonds to 5.</li> <li>Begins to recall one more and one less to 5.</li> </ul> <p><b>Spring:</b></p> <ul style="list-style-type: none"> <li>Subitise (recognise quantities without counting) up to 5.</li> <li>Can recognise numbers to 10.</li> <li>Has an understanding of numbers to 10 and can say which numbers make up the number using objects</li> <li>Recall number bonds to 0-5 using objects to help them.</li> <li>Says one more and one less than numbers to 5</li> <li>Can recall double facts to 3+3.</li> </ul> <p><b>Summer:</b></p> <ul style="list-style-type: none"> <li>Has a deep understanding of numbers to 10, including the composition of each number.</li> <li>Can subitise (recognise quantities without counting) up to 5.</li> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>Can count up to 5 objects accurately from a larger group.</li> <li>Has an understanding of numbers up to 5 and knows their position in the counting order.</li> <li>Begins to use pictures and writing to communicate mathematical ideas.</li> <li>Can count up to 10 objects accurately.</li> <li>Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity.</li> </ul>	<ul style="list-style-type: none"> <li>add,</li> <li>more</li> <li>make</li> <li>sum</li> <li>and</li> <li>total</li> <li>altogether</li> <li>one more, two more</li> <li>...</li> <li>ten more</li> <li>how many more to make ...?</li> <li>How much more is?</li> <li>number bond</li> </ul>
	<p><b>Linked Early Learning Goals</b></p>	
	<ul style="list-style-type: none"> <li>Have a deep understanding of numbers to 10, including the composition of each number.</li> <li>Subitise (recognise quantities without counting) up to 5.</li> <li>Automatically recall (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.</li> <li>Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity.</li> </ul>	



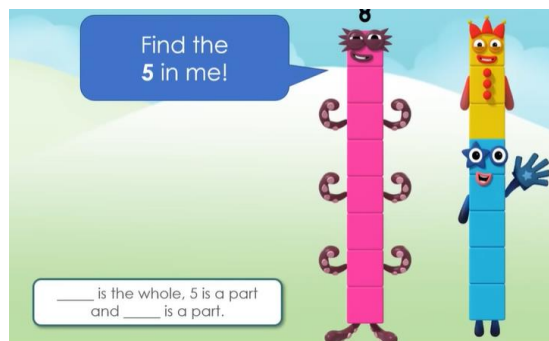
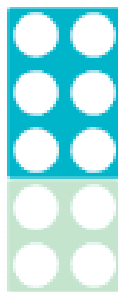
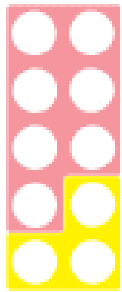
# Concrete

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. Pupils use Rekenreks to build the ability to subitise (recognise the number of objects without counting). This supports pupils to make statements such as “five and two more makes seven”. Rekenreks also help pupils explore number bonds to 10 and 20.

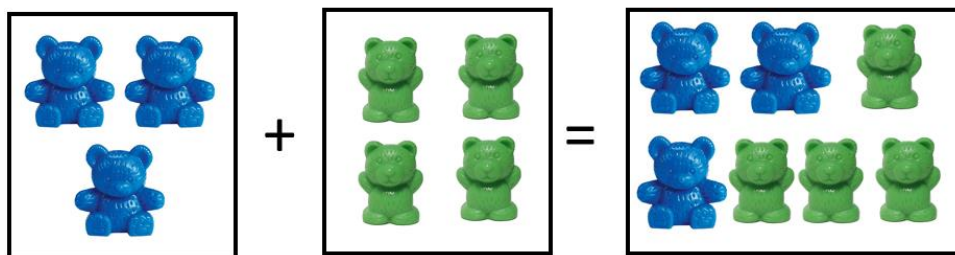


## Understanding the part-whole relationship

At Westgarth, in reception, pupils will make numbers using equipment and see how 2 different things can be combined to create a whole. For example, by making fruit kebabs using 2 different types of fruit. Pupils will also sort people or items into groups and understand how these form part of a whole.



Pupils use concrete objects and sorting to support the development of the concept that combining two numbers creates a total.

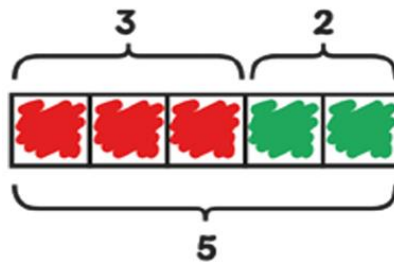


# Pictorial

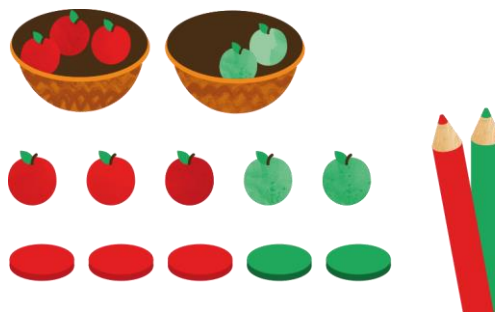
Pupils begin to use pictorial representations to combine two groups. Their developing knowledge of subitising supports them in finding totals to 10 and within 10.



Children are introduced to the bar model using pictures, icons or colours. This supports their ability to subitise and continued development of the knowledge that a whole is made up of parts.



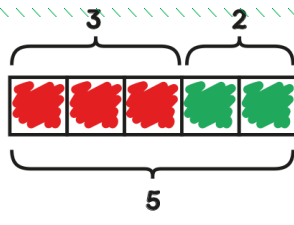
Familiar objects are pictorially represented in order to support pupils with the concept of combining two groups to obtain a total number.



## Abstract

Concrete and pictorial representations are used alongside abstract representations in order to build pupils' understanding of addition calculations.





$$3 + 2 = \boxed{5}$$

# Year 1

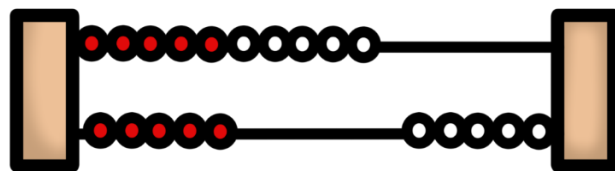
## +ADDITION+

<b>National Curriculum Objectives: Addition objectives from Addition and Subtraction Strand</b>	<b>Key Skills/ other linked NC Objectives (Place Value)</b>	<b>Key Vocabulary</b>
<ul style="list-style-type: none"><li>• Read. Write and interpret mathematical symbols involving addition (+) and equals (=) signs.</li><li>• Represent and use number bonds within 20.</li><li>• Add one-digit and two-digit numbers to 20, including 0.</li><li>• Solve one step problems that involve addition, using concrete objects and pictorial representations and missing number problems.</li></ul>	<ul style="list-style-type: none"><li>• Count forwards to and across 100, beginning with 0 or 1, or from any given number.</li><li>• Count, read and write numbers to 100 in numerals.</li><li>• Given a number, identify one more.</li><li>• Identify and represent numbers using objects and pictorial representations including the number line.</li><li>• Read and write numbers from 1-20 in numerals and words.</li></ul>	<p><i>Previous +</i></p> <p>addition near double equals is the same as missing number partition problem more than</p>

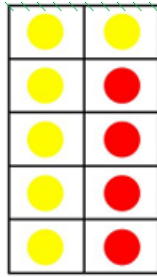
## Concrete

Children have access to a wide range of equipment to support with addition, subitising and counting.

Continued consolidation using rekenreks supports all pupils in the development of fluency in number bonds, subitising and addition to 20.



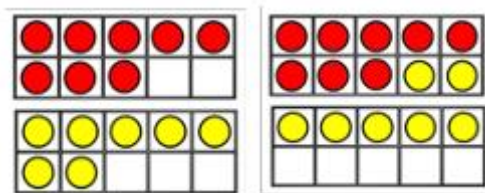
Pupils use tens frames to continue to build understanding of number bonds. Different coloured counters support in seeing the different parts of the number.



Number bonds to ten may also be used as an early representation of a bar model, allowing pupils to see further examples of how numbers are made up of parts.



Pupils then begin to develop their understanding of tens place value by using multiple tens frames to create numbers over 10 by adding two numbers.

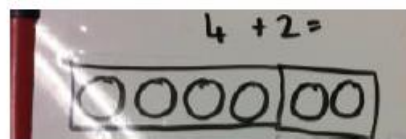
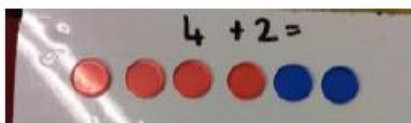


Numicon is used to support pupils in recognising and building number bonds to 10 and numbers within 10.

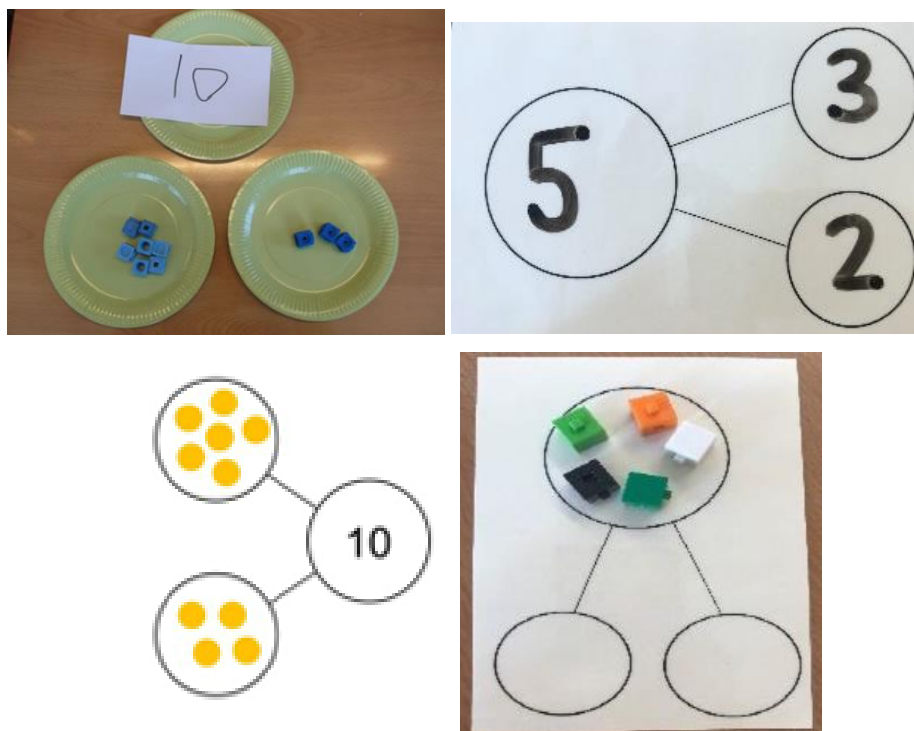


# Pictorial

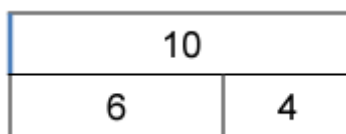
Pictorial representations of concrete models begin to allow children to develop independence in choosing a method that allows them to access simple addition questions.



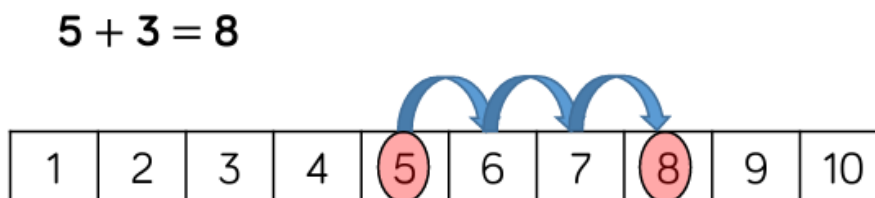
Part-whole models continue to be used in order to ensure pupils recognise that numbers are made up of parts and that these come together to create a whole. Representations of the part-whole move from being largely concrete to pictorial representations which the pupils create to support them in addition.



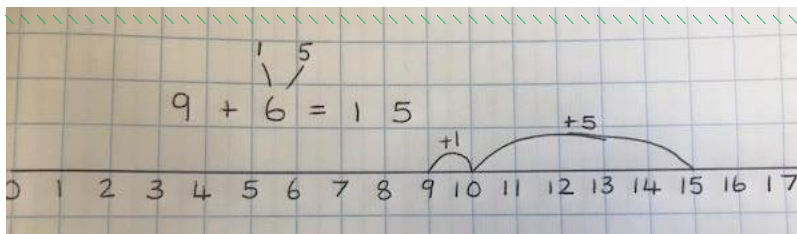
Bar models continue to reinforce the idea that a whole is made up of different parts, while beginning to introduce number representations and the concept of calculation.



Number tracks are used to support the concept of counting on or back. This may be done in ones, but children are encouraged to use their knowledge of subitising and number bonds to support them.



Labelled number lines are used to begin to make larger 'jumps' when using number bonds to bridge tens.

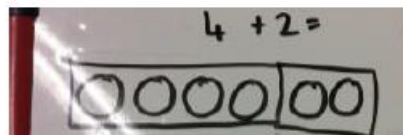


Pictorial contextualisation of the abstract concept of addition to support pupils in deepening understanding in order to access early problem-solving activities.

<p>Before      then      now</p> <p>Write the number sentence that matches this story</p>	<p>Before      then      now</p> <p>Draw the middle picture and Write the number sentence that matches this story</p>
Slide 1	Slide 2
<p>Before      then      now</p> <p>4 - 0 = 4</p>	<p>Before      then      now</p> <p>Finish the story and write the number sentence</p>

# Abstract

Pupils use pictorial and concrete representations to support them in creating a calculation including the use of + and = symbols.



Building on their understanding of number bonds and the composition of numbers, pupils bridge tens by using number bonds to partitioning numbers in order to first add to the next ten before adding the remaining amount.

8 + 7 = 15

Number bond: 8 is split into 2 and 6. 6 + 7 = 13, then 13 + 2 = 15.

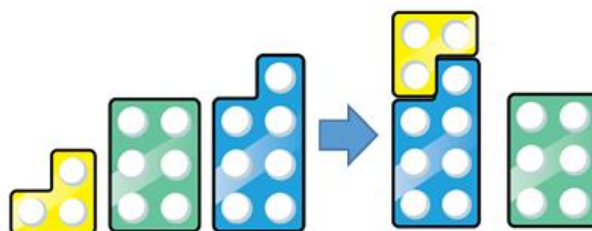
# Year 2

## +ADDITION+

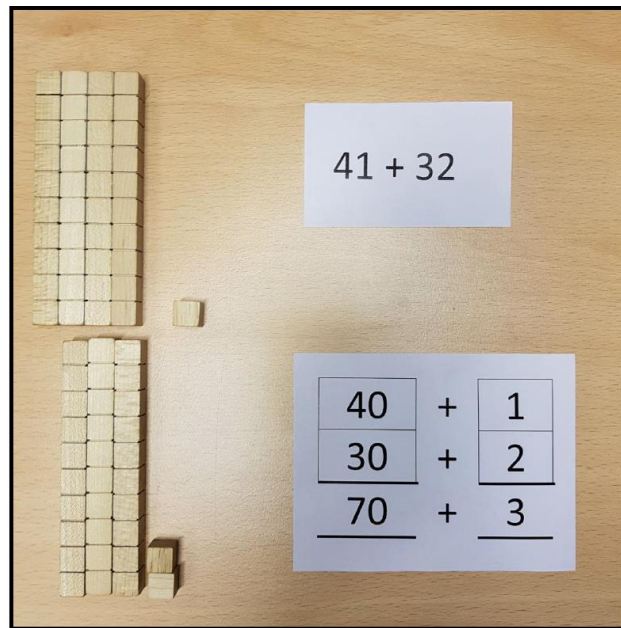
National Curriculum Objectives: Addition objectives from Addition and Subtraction Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<p>Solve problems with addition</p> <ul style="list-style-type: none"><li>Using concrete objects and pictorial representations, including those involving numbers, quantities and measures.</li><li>Apply their increasing knowledge of mental and written methods.</li></ul> <p>Add numbers using concrete objects, pictorial representations and mentally:</p> <ul style="list-style-type: none"><li>Add two-digit numbers and ones.</li><li>Add two-digit numbers and tens.</li><li>Add two, two-digit numbers.</li><li>Add three one-digit numbers.</li></ul> <ul style="list-style-type: none"><li>Recall and use addition facts up to 20 fluently and derive and use related facts up to 100.</li><li>Show that addition can be done in any order.</li><li>Recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing box number problems.</li></ul>	<ul style="list-style-type: none"><li>Count in steps of 2, 3 and 5 and count in tens from any number</li><li>Understand the place value of 2-digit numbers (tens, ones)</li><li>Compare and order numbers to 100 and use <math>&lt;</math>, <math>&gt;</math> and <math>=</math> signs.</li><li>Read and write numbers to at least 100 in numerals and words.</li><li>Identify, represent and estimate numbers using different representations, including the number line.</li></ul>	<p><b>Previous +</b></p> <p>One hundred more number facts tens boundary Calculate Calculation Mental method Written method Column addition One – step problem Two – step problem Regrouping Exchanging</p>

## Concrete

Children look for number bonds to 10 to support them in adding numbers that total over 10.

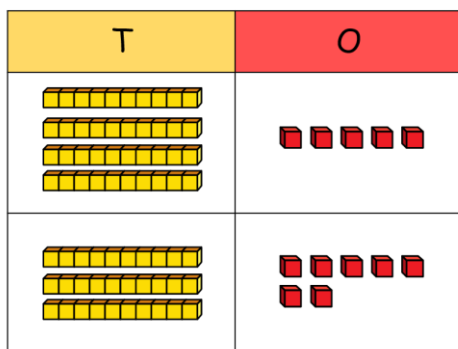


Addition of two 2-digit numbers without exchanging is explored through use of base ten equipment.

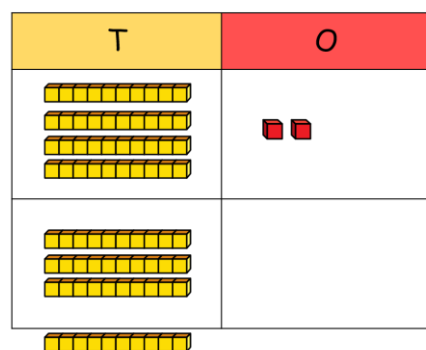


Pupils are introduced to the concept of exchanging and carrying through the use of base ten equipment.

Use base 10 to calculate  $45 + 37$

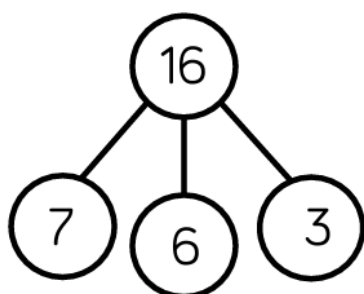


Use base 10 to calculate  $45 + 37$



## Pictorial

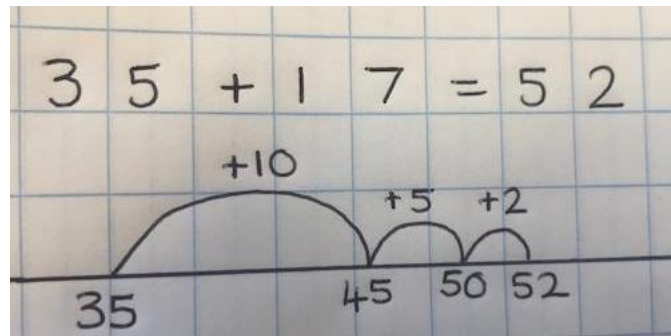
Bar models and part-whole models are used to support pupils in understanding that numbers are made up of parts. Pupils develop their understanding of this concept through use of bar models and part-whole models that break numbers into more than 2 parts.



16		
7	6	3



Children use unlabelled number lines to calculate addition questions.



## Abstract

Numbers are partitioned and added as parts to ensure pupils understand the value of each digit within a calculation.

32 + 27

30 + 2

20 + 7

50 + 9 = 59

Column addition is introduced beginning with calculations which do not require carrying.

32

+ 27

59

Pupils move on to column addition where carrying is necessary.

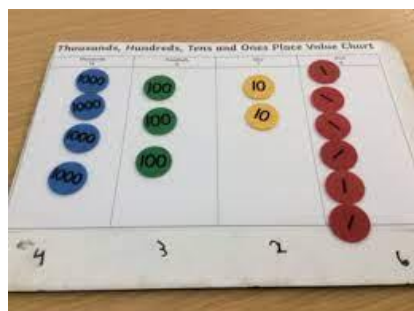
# Year 3

## +ADDITION+

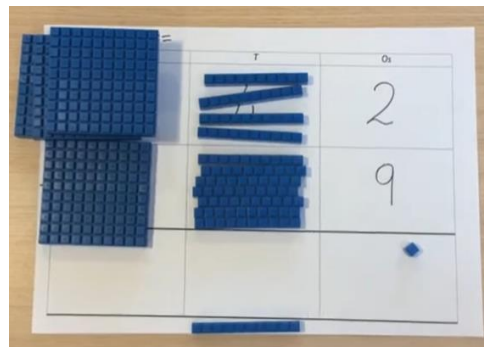
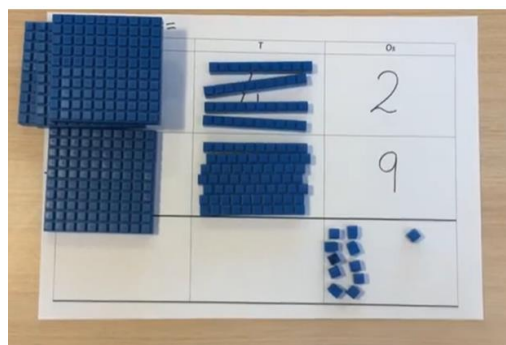
National Curriculum Objectives: Addition objectives from Addition and Subtraction Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none"><li>• Add numbers mentally, including three-digit numbers and ones.</li><li>• Add numbers mentally, including three-digit numbers and tens.</li><li>• Add numbers mentally, including three-digit numbers and hundreds.</li><li>• Add numbers with up to 3 digits, using formal written method of columnar addition.</li><li>• Estimate the answer to a calculation and use inverse operations to check answers.</li><li>• Solve problems including missing number problems, using number facts, place value, and more complex addition.</li></ul>	<ul style="list-style-type: none"><li>• Find 10 or 100 more than a given number.</li><li>• Recognise the place value of each digit in a three-digit number.</li><li>• Identify, represent and estimate numbers using different representations.</li><li>• Read and write numbers up to 1000 in numerals in words.</li><li>• Compare and order numbers up to 1000.</li></ul>	<b>Previous +</b> Hundreds boundary 100 more Combine Rounding Column digit Bridging Carry Expanded Compact Increase

## Concrete

Using place value charts and counters, pupils develop their understanding of addition. This then evolves to include exchanging. When adding money, place value charts are used with coins to support pupils understanding of the monetary system and how this links with the numerical system.



Links are made between concrete examples and abstract calculations. Using dienes of base ten equipment, pupils continue to solidify their understanding of exchanging and carrying.



Hundreds	Tens	Ones

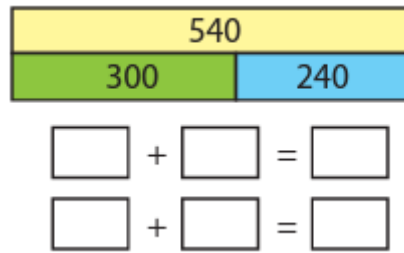
$$\begin{array}{r} 265 \\ + 164 \\ \hline 429 \\ \hline 1 \end{array}$$

## Pictorial

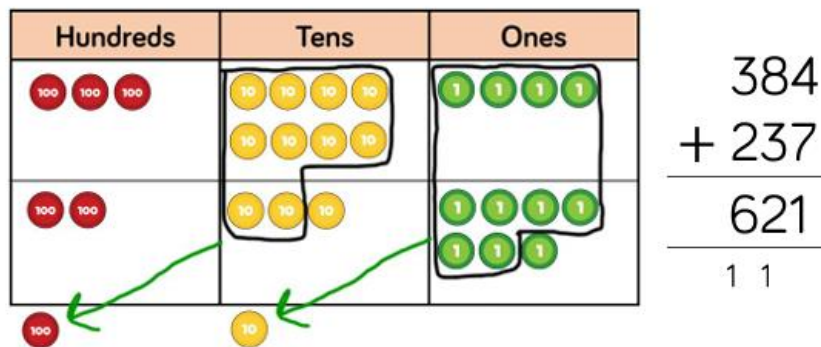
Pictorial representations of concrete tools allow pupils to begin to move towards an abstract approach to addition with counters being drawn to represent exchanging and carrying.

Hundreds	Tens	Ones

The bar model continues to be used to provide pictorial representation of the part-whole model. Through use of the bar model, pupils can formulate abstract calculations.



Links are made between pictorial and abstract concepts in order to support pupils in developing an understanding of the concept of addition. Initially pupils use dienes or base ten equipment to deepen their understanding of exchanging and carrying.



## Abstract

Children apply their place value knowledge to addition questions by adding hundreds, tens and ones to formulate an answer.

### Step 1

$$225 = 200 + 20 + 5$$

$$63 = 60 + 3$$

### Step 2

Hundreds:  $200 = 200$

Tens:  $20 + 60 = 80$

Units:  $5 + 3 = 8$

## Step 3

$$\begin{array}{r} \text{Hundreds: } 200 = 200 \\ \text{Tens: } 20 + 60 = + 80 \\ \text{Units: } 5 + 3 = + 8 \\ \hline \hline 288 \end{array}$$

The expanded addition format, enables pupils to build a solid foundation on which they can build an understanding of the concept of column addition.

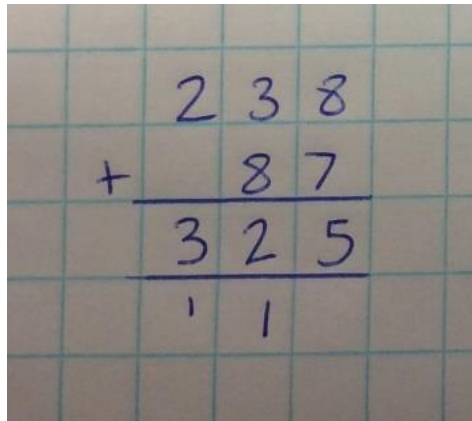
$$\begin{array}{r} 238 \\ + 87 \\ \hline \end{array} = \begin{array}{r} 200 + 30 + 8 \\ \quad \quad 80 + 7 \\ \hline 200 + 110 + 15 = 325 \end{array}$$

$$\begin{array}{r} 238 \\ + 87 \\ \hline 15 \quad (8+7) \\ 110 \quad (30+80) \\ + 200 \quad (200+0) \\ \hline 325 \end{array}$$

Pupils then move on to compact column addition without carrying learning to begin by adding the ones.

$$\begin{array}{r} 82 \\ + 14 \\ \hline 96 \end{array}$$

Pupils move to questions that involve carrying, ensuring that numbers are carried underneath the bottom line.



A photograph of a handwritten addition problem on a grid background. The problem is:

$$\begin{array}{r} 238 \\ + 87 \\ \hline 325 \\ \hline \phantom{0}1\phantom{0} \end{array}$$

The calculation shows the sum of 238 and 87. The result is 325, with a carry of 1 written below the bottom line.



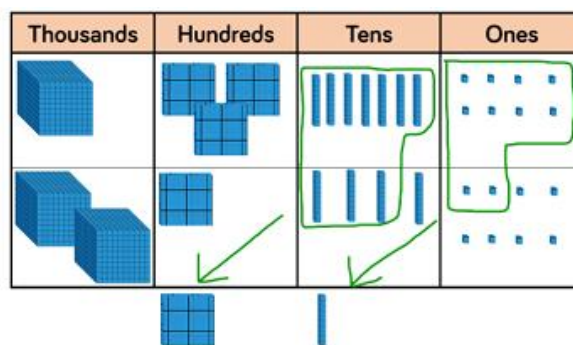
# Year 4

## +ADDITION+

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"><li>• Add numbers with up to 4 digits using the formal methods of columnar addition where appropriate.</li><li>• Estimate and use the inverse operations to check answers to a calculation.</li><li>• Solve two-step addition problems in contexts, deciding which operations to use and why.</li></ul>	<ul style="list-style-type: none"><li>• Find 1,000 more than a given number.</li><li>• Recognise the place value of each digit in a four-digit number.</li><li>• Identify, represent and estimate numbers using different representations.</li><li>• Compare and order numbers beyond 1000.</li></ul>	<b>Previous +</b> Inverse Operation 4-digit number Decimal Decimal point Commutative Associative Law

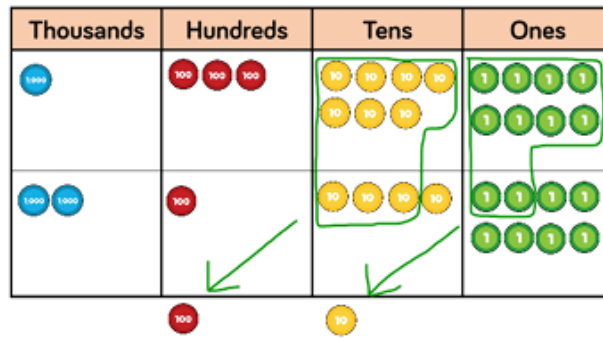
## Concrete

Dienes or base ten equipment supports pupils' developing understanding of exchanging and carrying.



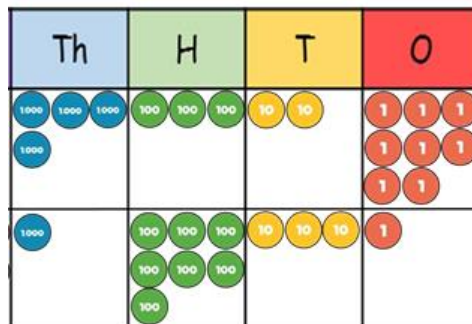


This is then reinforced with place value counters, supporting pupils with progression to the abstract approach and the carrying of numbers.

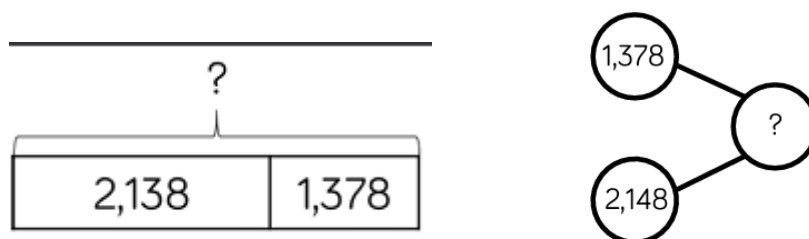


# Pictorial

Pictorial representations of concrete resources support pupils in developing a deeper understanding of the concept of addition and the necessity to exchange and carry. Pupils build independence by producing and utilising pictorial representations to support their learning.



The bar and part-whole models continues to support pupils in developing the concept that numbers of any size are made up of parts which combine to produce a total. In addition, the bar model supports pupils in Year 4 with their understanding of inverse operations by allowing them to visualise the components of a number and the relationships between them.



# Abstract

Use of the compact formal method of addition is consolidated using numbers of increasing size. Pupils add numbers of varying length (for example a 3-digit number added to a 4-digit number) remembering to line the ones places up and begin by adding the ones.

A photograph of a student's handwritten addition on grid paper. The problem is  $3721 + 498$ . The numbers are aligned by their rightmost digits. A horizontal line is drawn under the second number. The sum,  $4219$ , is written below the line. Small '1' marks are written below the '2' and '7' in the sum, indicating carry-over from the previous column.

$$\begin{array}{r} + 3721 \\ \quad 498 \\ \hline 4219 \\ \quad 1 \quad 1 \end{array}$$

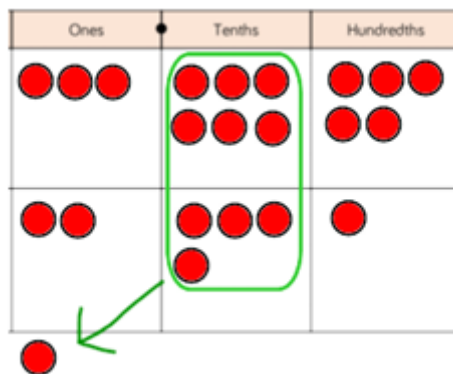
# Year 5

## +ADDITION+

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"><li>• Add whole numbers with more than 4 digits, including using formal written methods (columnar addition).</li><li>• Add increasingly large numbers mentally.</li><li>• Solve addition multi-step problems in contexts, deciding which operations and methods to use and why.</li></ul>	<ul style="list-style-type: none"><li>• Read, write and compare numbers to at least 1,000,000 and determine the value of each digit.</li><li>• Count forwards in steps of powers of ten for any given number up to 1,000,000.</li></ul>	<b>Previous +</b> Ones boundary tenths boundary Multistep problem Level of accuracy Rounding to estimate Approximate

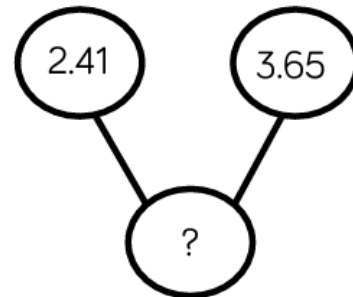
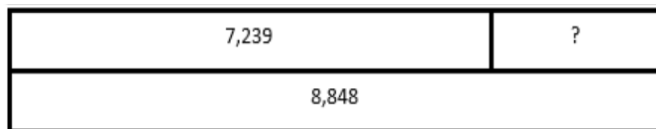
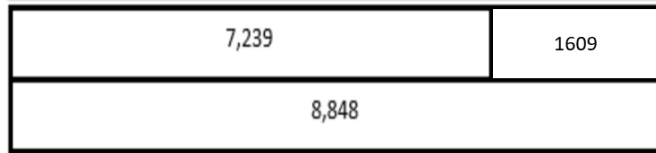
## Concrete

Pupils use counters on a place value chart which includes tenths and hundredths, supporting them in understanding the necessity to exchange and carry in decimal addition.



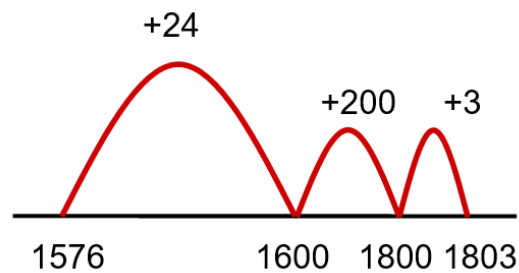
# Pictorial

Use of the part-whole model and bar model when working with decimals allows pupils to link the idea that whole numbers are made up of parts with the understanding that this is also applicable for decimal numbers. This also continues to support pupils developing understanding of inverse operations and the relationship between addition and subtraction.



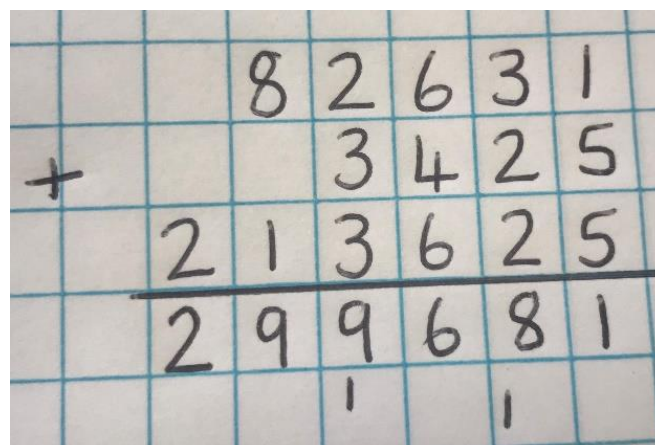
Number lines continue to provide pictorial representations of addition calculations, supporting pupils in the development of mental methods for addition. For example, how to utilise number bonds and facts to add numbers mentally.

$$1576 + 227 =$$



# Abstract

Pupils continue to use the compact column method to complete addition calculations, including those that involve adding three or more numbers.



Children learn that when adding decimal numbers, including in the context of money, they need to line up the decimal points.

$$\begin{array}{r} 3.65 \\ + 2.41 \\ \hline 6.06 \\ \hline 1 \end{array}$$

£	2	4	.	3	2
£	1	2	.	8	4
£	3	7	.	1	6
		1			

# Year 6

## +ADDITION+

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"><li>• Add whole numbers with more than 4 digits, including using formal written methods (columnar addition).</li><li>• Add increasingly large numbers mentally.</li><li>• Solve addition multi-step problems in contexts, deciding which operations and methods to use and why.</li></ul>	<ul style="list-style-type: none"><li>• Read, write, order and compare numbers up to 10,000,000 and determine the value of each digit.</li></ul>	<b>Consolidate all previously taught vocabulary +</b> Order of operations Brackets

## 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 addition methods. These are used by teachers, as appropriate, to support pupils in reinforcing connections between and within learning.

## Abstract

Pupils continue to use the compact column method to add decimal numbers of differing length (for example a number with 2 decimal places and a number with 3 decimal places). Pupils line up the decimal point and place the decimal point within their answer box at the beginning of the calculation.

A photograph of a student's handwritten work on a grid background. The student has added two decimal numbers: 23.361 and 9.080. The numbers are aligned by their decimal points. The sum, 32.441, is written below a horizontal line. The decimal point in the answer is placed at the beginning of the calculation. The numbers 080 and 000 in the second and third rows are written in red ink.

$$\begin{array}{r} 23.361 \\ + 9.080 \\ \hline 32.441 \end{array}$$

Pupils use compact column addition to add several numbers larger than 4-digits and of differing lengths.

A photograph of a handwritten compact column addition problem on blue grid paper. The numbers are aligned to the right. A horizontal line is drawn under the second row. The result is written below the line, with carry digits '1' written below the tens and hundreds columns.

			8	2	6	3	1
+			3	4	2	5	
	2	1	3	6	2	5	
	2	9	9	6	8	1	
			1		1		