

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. 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.

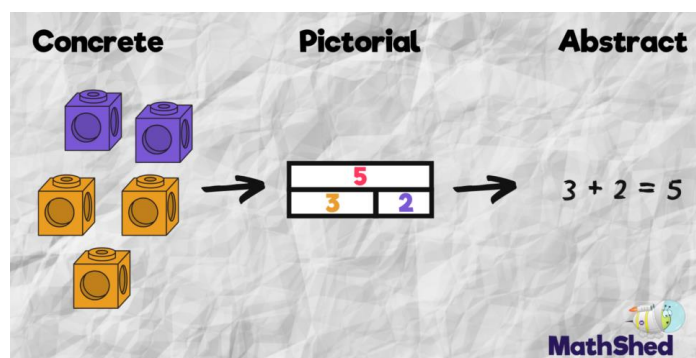
Principles of Practice:

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.

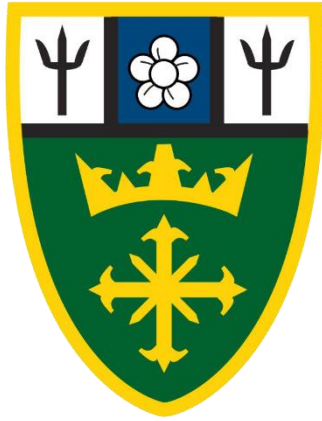
Number - a combination of digits, can also be a single value.

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.



- subtraction -

- subtraction -

EYFS

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

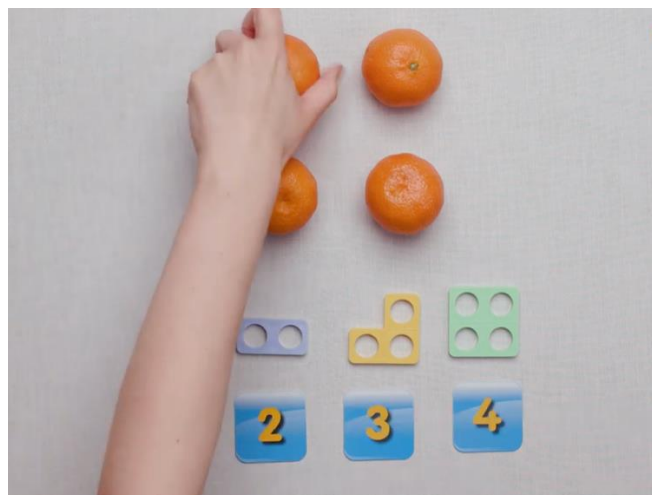
Pupils use Rekenreks alongside other methods of subtraction to support them in building a rich mental picture of how numbers are made up and manipulated. Pupils understand the concept of 'taking away' using the beads.



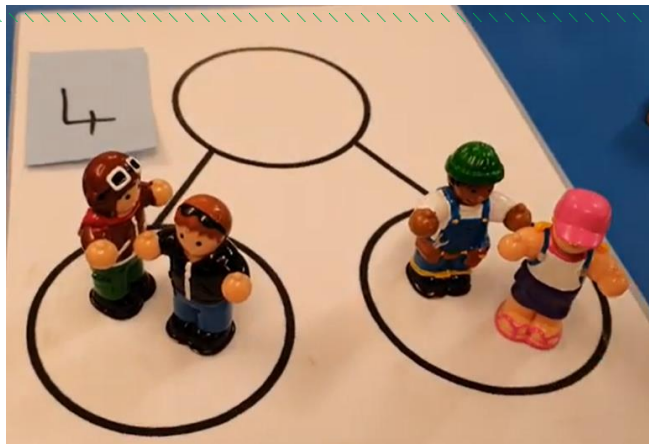
Children arrange objects and remove them to find how many are left, supporting them in understanding subtraction as 'take away'.



Links are made with Numicon by arranging objects in Numicon shapes to support pupils in establishing the relationship between 'taking away' and a reduction in size. Number digits are used and referred to throughout, to support pupils in building associations between digits and their values whilst developing their conceptual awareness of subtraction.



The part-whole model is explored with physical objects, supporting pupils in establishing the components of numbers up to 5 and the relationship between addition and subtraction facts.



Pictorial

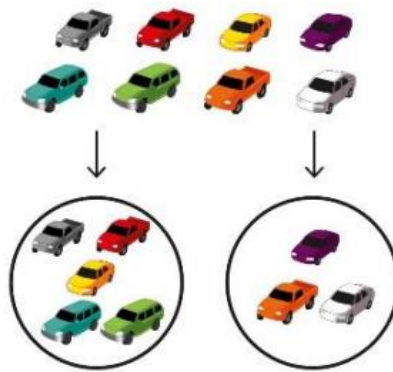
Pupils continue to develop their understanding of subtraction as 'take away' by crossing out pictures and counting how many are left.



Children use different representations of a number line to count forwards and backwards, supporting them in developing the concept of 'counting back' as a means of subtracting.



Pictorial representations of the part-whole model support pupils in developing number facts, including subtraction facts, by understanding the composition of numbers up to 5.



Abstract

Abstract calculations are modelled alongside pictorial and concrete representations in order to familiarise pupils with the format of a subtraction question.


$$\boxed{5} - \boxed{2} = \boxed{}$$

Year 1

- subtraction -

National Curriculum Objectives Subtraction Objectives from Addition and Subtraction Strand:	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">• Read, write and interpret mathematical statements involving addition (+) subtraction (-) and equals (=) signs• Represent and use number bonds and related subtraction facts within 20• Add and subtract one-digit and two-digit numbers to 20, including zero• Solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations and missing number problems such as $7 = \square - 9$	<ul style="list-style-type: none">• Count backwards from and across 100, beginning from any given number.• Count, read and write numbers to 100 in numerals.• Given a number, identify one less.• Identify and represent numbers using objects and pictorial representations including the number line.• Read and write numbers from 1-20 in numerals and words.	<p>Previous vocabulary +</p> <ul style="list-style-type: none">• subtract• equals• is the same as• missing number• minus• distance between• partition• problem• How much more?• How much more is?• How much less is?• How many fewer is...than...?

Mental Methods:

- Count back in ones
- Find one less than a number
- Find 10 less than a multiple of 10
- Take away a small number by counting back
- Find a small difference by counting on (using equipment)
- Begin to bridge through 10 when subtracting a one-digit number
- Start to recall subtraction facts up to and within 10 and 20 and understand subtracting 0.

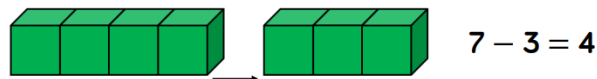
Concrete

Numicon is used to support pupils in their developing understanding of numbers being made up of parts. When subtracting numbers, children can start with the whole and then place one of the parts on top of the whole to see what part is missing. Again, children will start to be able to subitise the part that is missing due to their familiarity with the shapes.

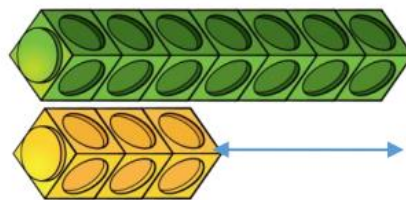


$$7 - 3 = 4$$

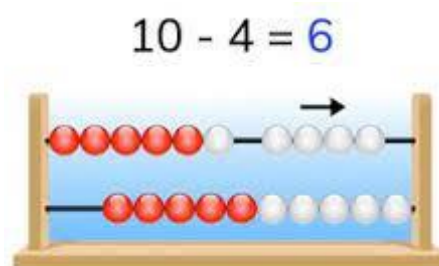
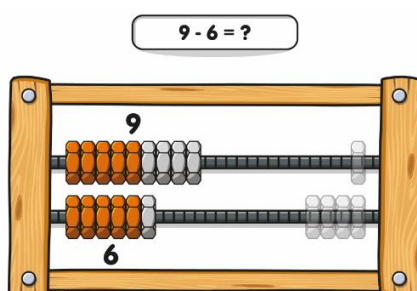
Cubes also support pupils in the concept of 'taking away'. When subtracting numbers, children start with the whole and then remove the number of cubes that they are subtracting in order to find the answer. This model of subtraction is reduction, or take away.



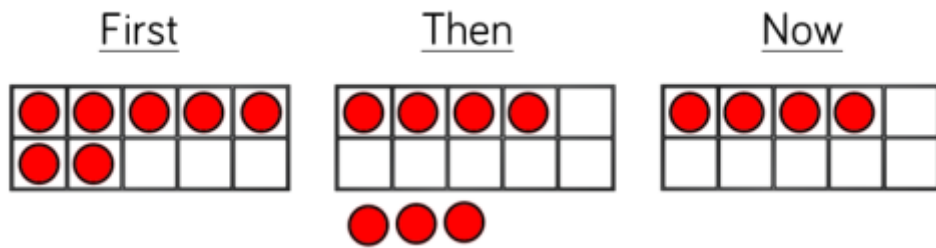
Cubes are also used to support pupils in the concept of subtraction as 'difference'.



Rekenreks provide visual representations of the relationships between addition and subtraction facts alongside. They support both the concept of reduction and the concept of difference.



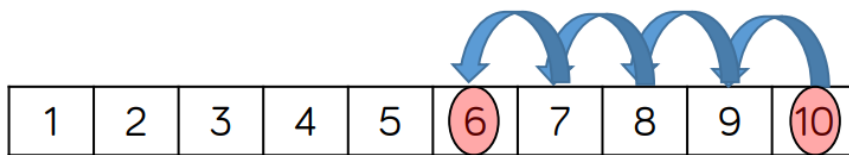
Tens frames are used to derive subtraction facts within ten. Counters are physically removed in order to



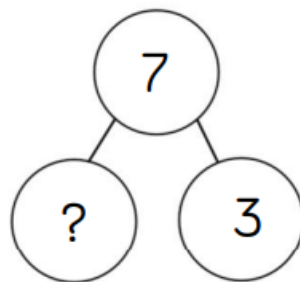
Pictorial

Children count back to find the answer to a subtraction question. They start at the minuend and then take away the subtrahend to find the difference between the numbers.

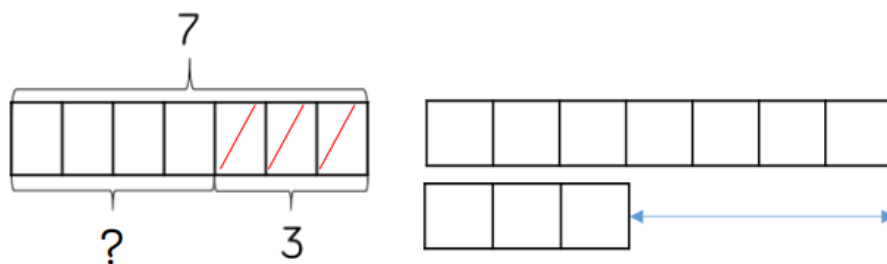
$$10 - 4 = 6$$



The part-whole model is used to develop pupils' understanding of the relationship between numbers within 10. Pupils learn that two parts combine to create a whole and that subtraction facts can be derived from the part-whole model.



The bar model is introduced to develop the concept of part-whole further and support pupils in identifying missing amounts. The model also supports the concept of subtraction as 'difference'.



Abstract

Abstract calculations are used alongside concrete and pictorial representations. Pupils begin to compose subtraction calculations of their own.

$$7 - 3 = 4$$

Year 2

- subtraction -

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 addition and subtraction facts to 20 fluently, and derive and use related facts up to 100Show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannotRecognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problemsAdd and subtract numbers using concrete objects, pictorial representations, and mentally, including:<ul style="list-style-type: none">A two-digit number and onesA two-digit number and tensTwo two-digit numbersSolve problems with addition and subtraction:<ul style="list-style-type: none">Using concrete objects and pictorial representations, including those involving numbers, quantities and measuresApplying their increasing knowledge of mental and written methods	<ul style="list-style-type: none">Count in steps of 2, 3 and 5 and count in tens from any numberUnderstand the place value of 2-digit numbers (tens, ones)Compare and order numbers to 100 and use $<$, $>$ and $=$ signs.Read and write numbers to at least 100 in numerals and words.Identify, represent and estimate numbers using different representations, including the number line.	<p>Previous vocabulary +</p> <ul style="list-style-type: none">one hundred lessnumber factstens boundaryCalculateCalculationMental methodWritten methodOne – step problemTwo – step problemRegroupingDifferenceExchanging

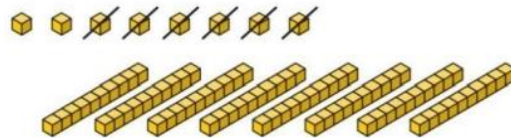
Mental Methods

- Reordering numbers when adding
- Count on in tens or ones
- Using knowledge of pairs making 10 and place value
- Compensating: add 9, 19, 11 or 21 by rounding and adjusting
- Compensating: doubling and adjusting

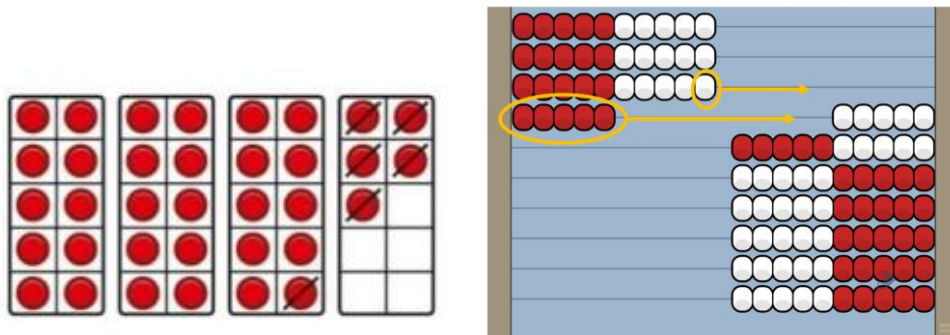
- Partitioning: Bridge through 10 when adding
- Partition and combine multiples of tens and ones
- Looking for number bonds/known facts when adding 3 one-digit numbers.

Concrete

Pupils make links between known subtraction facts within 10 and subtraction of tens. For example, $8 - 6 = 2$ so $80 - 60 = 20$.

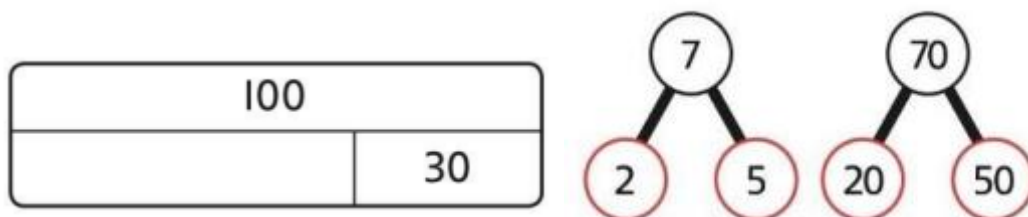


Tens frames and rekenreks, including interactive versions of these tools, are used to support pupils in bridging tens. In the example, to answer the question $35 - 6$, pupils first subtract 5 then subtract one.



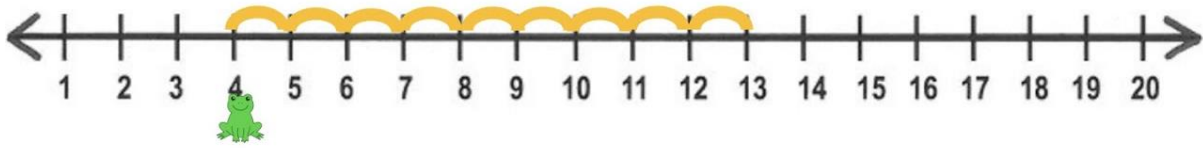
Pictorial

The bar and part-whole model are used to support pupils in building a strong concept of the relationships between number facts, including number bonds to 100, using their knowledge of number bonds to 10 to support them.

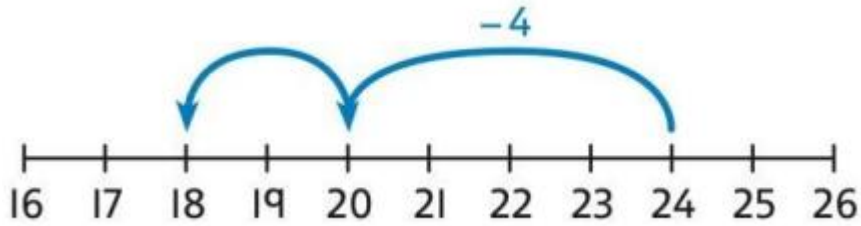


Number lines support pupils' deepening understanding of reduction. Pupils use number lines to count back in 1s.

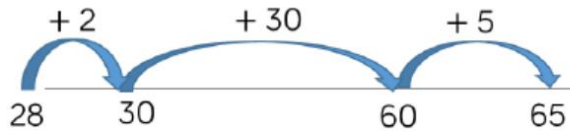
$$13 - 9 = 4$$



Number lines are also used to support pupils in the use of partitioning to support subtraction using known number facts.



Number lines are used to explore the concept of finding the difference as a way of solving subtraction calculations. Pupils use number facts and knowledge to bridge tens numbers.



Abstract

Through use of concrete and pictorial representations, children develop a deeper understanding of the roles of each number within a subtraction calculation.

Complete the subtraction.

$$\square - \square = \square$$

Year 3

- subtraction -



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

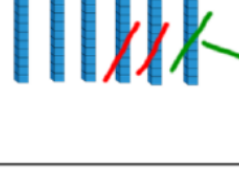

Mental Methods

- Counting back in hundreds, tens and ones.
- Counting on as a mental strategy for subtraction when the numbers are close together (e.g. 131-129), and for finding a small difference.
- Compensating: subtract mentally a near multiple of 10 then adjust.
- Bridging through a multiple of 10
- Use knowledge of number facts and place value to subtract pairs of numbers
- Subtract a two-digit number by partitioning it then subtracting tens and ones.
- Use patterns of similar calculations
- Use the relationship between addition and subtraction.

Concrete

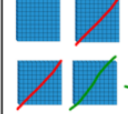


Base 10 equipment is used to support pupils in developing an understanding of exchanging when using formal subtraction methods (column subtraction) first without an exchange then beginning to introduce the concept of exchanging by exchanging a tens rod for ten ones.

T	O
	

Tens	Ones
	

$$\begin{array}{r} \overset{5}{\cancel{6}} \overset{1}{5} \\ - 28 \\ \hline 37 \end{array}$$

Pupils continue to use counters and base ten equipment to develop a deeper understanding of the process of column subtraction.

Hundreds	Tens	Ones
		

$$\begin{array}{r} \overset{3}{\cancel{4}} \overset{1}{3} 5 \\ - 273 \\ \hline 262 \end{array}$$

Pictorial

The bar model is used to deepen pupils' understanding of subtraction through both reduction and finding the difference. Bar models are used to support pupils in addressing subtraction-based problem-solving activities.

435	435				
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273	?				
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650		
38	53	

Pictorial representations of concrete methods are demonstrated, developed and used to support pupils in developing independence in solving subtraction questions.

$$\begin{array}{r} 45 \\ -29 \\ \hline 16 \end{array}$$

Tens | Ones

$$10 + 6 = 16$$

Abstract

Abstract concepts for subtraction are displayed alongside concrete and pictorial representations in order to allow pupils to make links between the two.

Tens	Ones	Calculation
		$\begin{array}{r} 57 \\ -23 \\ \hline 34 \end{array}$

Hundreds	Tens	Ones	Calculation
			$\begin{array}{r} 465 \\ -232 \\ \hline 233 \end{array}$

Pupils begin to use the column subtraction structure to subtract numbers without the need to exchange.

$$\begin{array}{r} 67 \\ -24 \\ \hline \end{array}$$

Pupils progress to using column subtraction with an exchange, subtracting two numbers with up to 3-digits.

$$\begin{array}{r} 54 \\ 682 \\ -365 \\ \hline 287 \end{array}$$

Year 4

- subtraction -

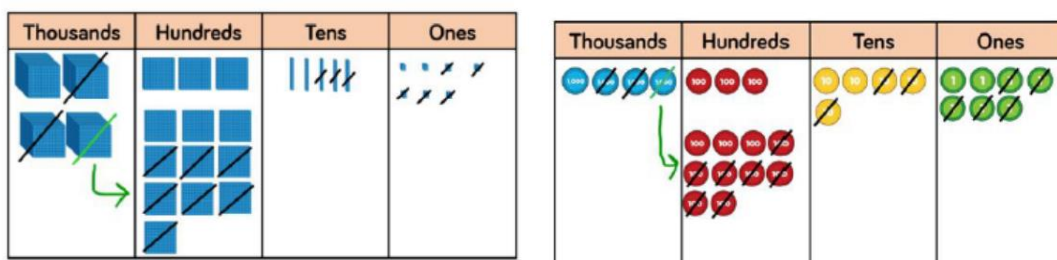
National Curriculum Objectives: Multiplication Objectives from Multiplication and Division strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none"> Estimate and use inverse operations to check answers to a calculation Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why 	<ul style="list-style-type: none"> Find 1,000 more than a given number. Recognise the place value of each digit in a four-digit number. Identify, represent and estimate numbers using different representations. 	<p>Previous vocabulary +</p> <ul style="list-style-type: none"> Inverse 4-digit number Operation Decimal Decimal point

Mental Methods

- Counting on and back in thousands, hundreds, tens, ones.
- Use known facts and place value to subtract
- Counting on to subtract when the numbers are close together.
- Find a difference by counting up through the next multiple of 10, 100 and 1,000
- Compensating: Subtracting the nearest multiple of 1, 10, 100 or 1,000 and adjust.

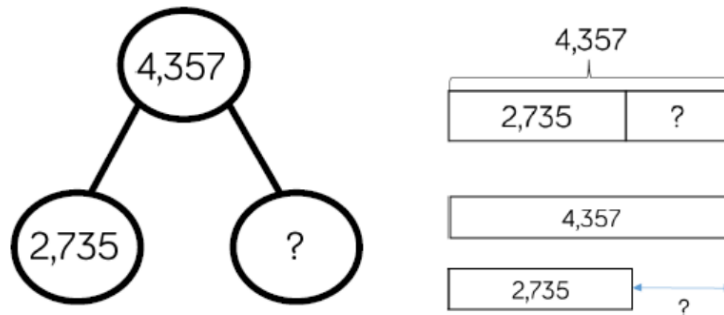
Concrete

A deep understanding of the concept of exchange in subtraction is established through use of base 10 equipment, place value counters and online tools that allow manipulation of these concrete resources.



Pictorial

Part-whole models and bar models are used to continue to deepen pupils understanding of reduction and difference as means of solving subtraction problems. Subtraction problem-solving is supported through use of both of these models, with pupils using the representations with increasing independence.



Abstract

Pupils use the column subtraction method with increasing precision and independence. Where pictorial and concrete representations are used, abstract methods are used alongside.

$$\begin{array}{r} \overset{3}{4} \overset{1}{3} 57 \\ - 2735 \\ \hline 1622 \end{array}$$

Year 5

- subtraction -

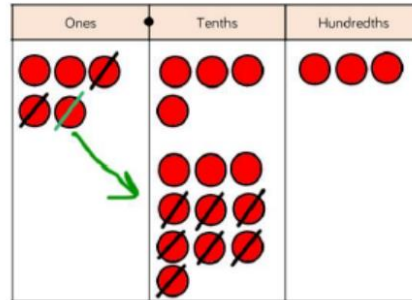
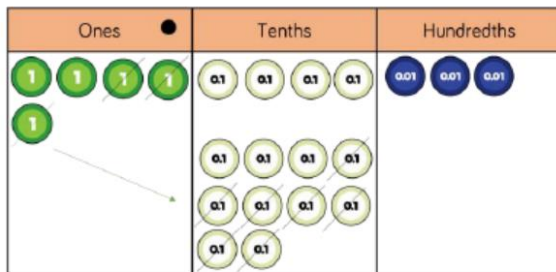
National Curriculum Objectives: Addition objectives from Addition and Subtraction Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">• Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy• Add and subtract whole numbers with more than 4 digits, including formal written methods (columnar addition and subtraction)• Add and subtract numbers mentally with increasingly large numbers• Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why• 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">• Read, write and compare numbers to at least 1,000,000 and determine the value of each digit.• Count backwards in steps of powers of ten for any given number up to 1,000,000.	<p><i>Previous vocabulary +</i></p> <ul style="list-style-type: none">• Ones boundary• Tenths boundary• Multistep problem• Level of accuracy• Rounding to estimate• Approximate

Mental Methods

- Counting back steps of 0.1, 1, 10, 100 or 1000
- Use known facts and place value to subtract
- Find a difference by counting on through the next multiple of 10, 100 or 1,000
- Subtract by counting up from the smaller to the larger number where this is the most efficient method
- Subtract the nearest multiple of 1, 10 or 100 then adjust
- Use knowledge of place value and related calculations e.g. $4.5 - 3.6$ using $45 - 36$
- Use the relationship between addition and subtraction

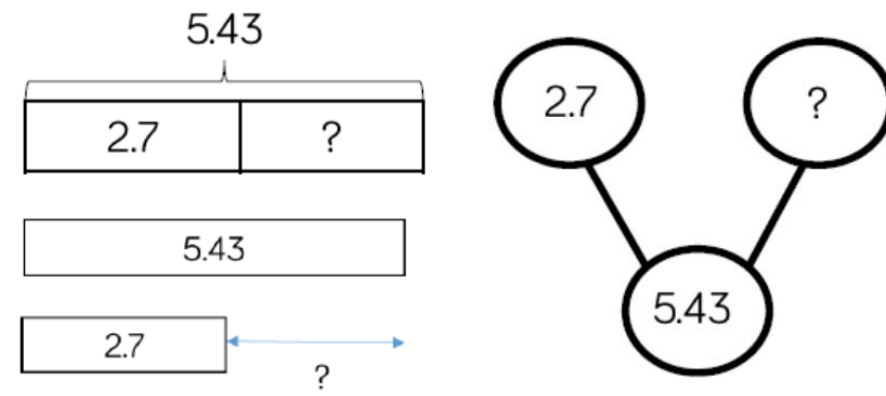
Concrete

Use of place value charts supports the children's development of understanding of the tenths boundary and ones boundary including the concept that 10 tenths can be exchanged for a one and 10 hundredths can be exchanged for a tenth.



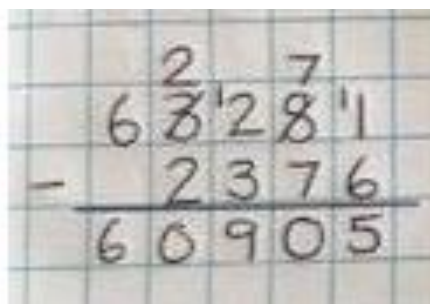
Pictorial

Bar models and part-whole models support pupils in understanding the concept of decimal subtraction and the construction of decimal numbers to two decimal places.



Abstract

Pupils use the column subtraction method to answer questions of increasing complexity, including those that involve making more than one exchange.



Pupils apply the column subtraction method to decimal subtraction calculations, learning to line the decimal points in order to ensure place value places are correctly aligned. This includes questions that involve whole numbers and decimal numbers. Pupils are taught to place a 0 in empty decimal places in order to support them in making accurate calculations.

A photograph of a student's handwritten work on grid paper. The student has performed a column subtraction of 451.5 from 8162.0. The numbers are aligned by their decimal points. A horizontal line is drawn under the second number. The result, 7711.5, is written below the line. There are small handwritten numbers '7' above the first column and '2' above the second column, likely indicating borrowing or carrying.

$$\begin{array}{r} 7 \\ 8162.0 \\ - 451.5 \\ \hline 7711.5 \end{array}$$

Year 6

- subtraction -

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">Perform mental calculations, including with mixed operations and large numbers.Use their knowledge of the order of operations to carry out calculations involving the four operations.Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.	<ul style="list-style-type: none">Read, write, order and compare numbers up to 10,000,000 and determine the value of each digit.	<p>Consolidate all previously taught vocabulary +</p> <ul style="list-style-type: none">Order of operationBrackets

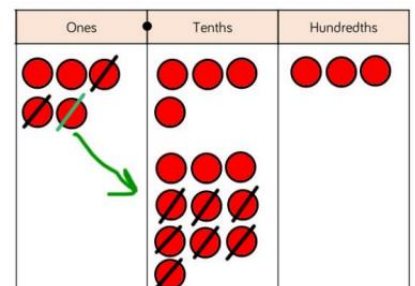
Mental Methods:

- Consolidate all mental strategies from previous year groups.
- Counting back in powers of tens, including tenths, hundredths and thousandths.
- Use knowledge of place value and related calculations
- Subtract a power of ten, or a whole number and adjust.
- Find the difference by counting up through the nearest multiple of 0,1, 10, 100 or 1,000 then adjust.
- Continue to use the relationship between addition and subtraction.

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

Place value grids and counters continue to be used to support the concept of exchange, particularly in decimal addition.



Abstract

Pupils continue to use formal column subtraction to complete calculations of increasing complexity, including those involving decimals to 3 decimal places. Pupils gain experience of subtracting from columns that use 0 as a placeholder. Pupils gain confidence in deciding whether finding the difference or reduction is the appropriate method for problems and calculations.

$$\begin{array}{r} ^0 ^9 ^3 \\ 105.419 \\ - 37.080 \\ \hline 68.339 \end{array}$$

$$\begin{array}{r} ^2 ^1 ^5 ^9 \\ 237800 \\ - 148532 \\ \hline 179068 \end{array}$$

$$\begin{array}{r} ^0 ^1 ^2 \\ 26821 \\ - 39151 \\ \hline 87170 \end{array}$$

$$12,003 - 11,865$$