

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.

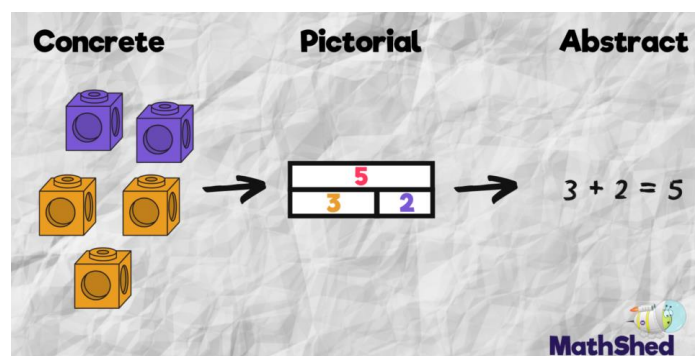
Principles of Practice:

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.

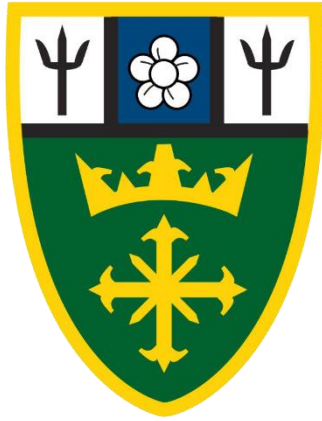
Number - a combination of digits, can also be a single value.

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.



DIVISION 

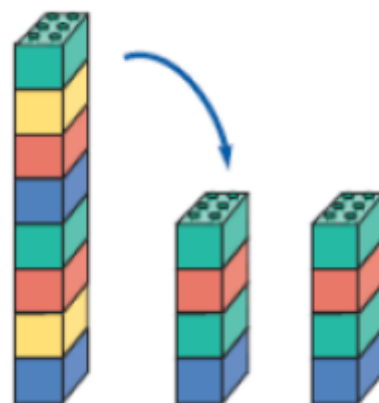
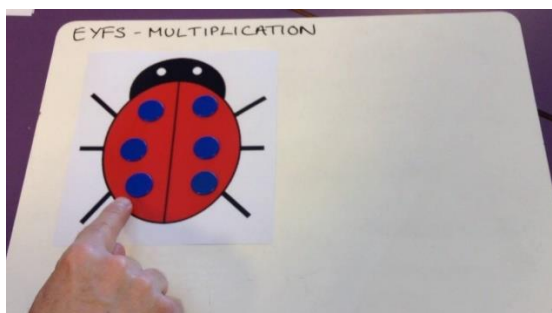
EYFS

DIVISION \div

Galileo MAT Assessment Points	Linked Galileo MAT Assessment Points	Key Vocabulary
<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. <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 recall double facts to 3+3. 	<ul style="list-style-type: none"> Sharing halving half Share between Number patterns* groups* Equal sets*
	<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. 	

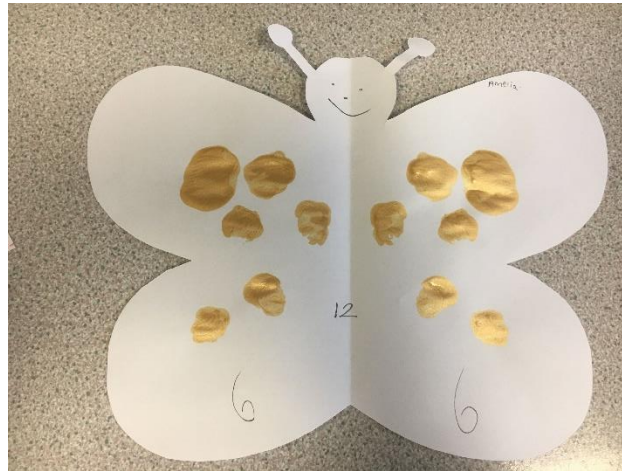
Concrete

Concrete and pictorial representations support pupils in gaining a mental picture of the concept of 'half'.



Pictorial

Pupils begin to use pictorial representations to investigate halves. Their developing knowledge of subitising supports halving numbers up to 10.



Abstract

Pupils are introduced to the concept of a half being a number partitioned into 2 equal parts. With support they begin to use the term “half” to describe a whole number divided equally into 2 parts.

Year 1

DIVISION ÷

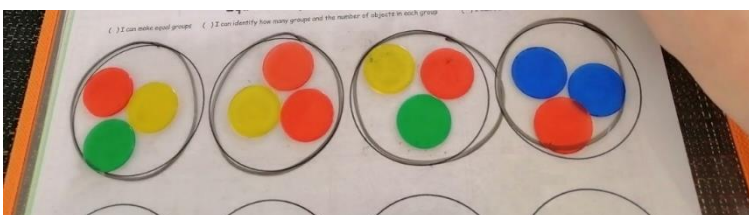
National Curriculum Objectives Division Objectives from Westgarth Progress Map:	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">Solve one-step problems involving multiplication and division by calculating the answer using concrete objects, pictorial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

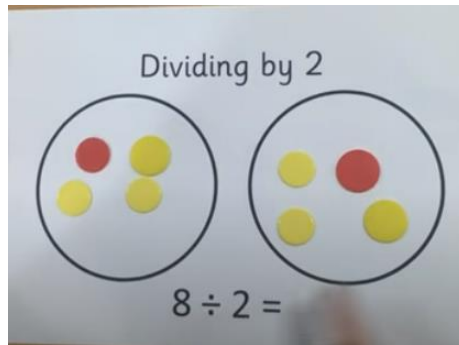
Mental Methods:

- Counting in twos, fives and tens
- Links to halving
- Use arrays

Concrete

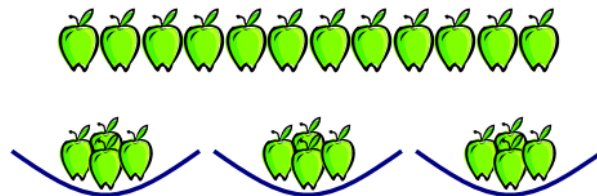
Pupils are introduced to the concept of sharing equally between given numbers of groups and creating equal groups of a given number. They explore sharing by experiencing equally sharing counters and other objects into groups.





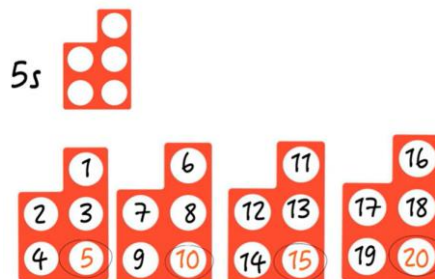
They relate these skills to aspects of real life by dividing everyday objects and problems.

How many apples in each bowl if I share 12 apples between 3 bowls?

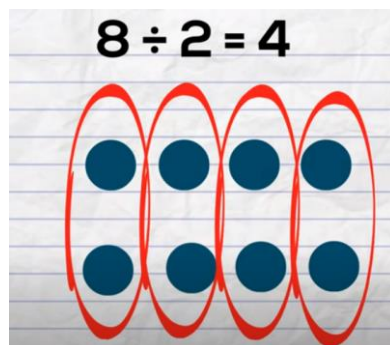


Numicon supports pupils in establishing how groupings of the same number create a total and equally, how a total can be made up of a number of groups of the same number.

$$4 \times 5 = 20 \quad / \quad 20 \div 5 = 4$$



The use of arrays supports pupils in developing an understanding of the link between multiplication and division facts. Objects and pictures are used to support pupils in creating 'groups' or 'rows' and use of questioning and vocabulary such as 'how many groups?' or 'how many rows?' supports pupils in establishing clear links between multiplication and division.

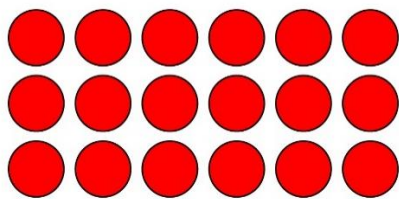


Pictorial

Pictorial representations of objects support pupils in the concept of division as 'sharing'.



Pictorial representations of arrays support pupils in establishing division facts and the link with multiplication facts. Pupils draw and use these to establish the answers to questions such as 'how many groups?', 'how many rows?', 'how many counters in each row?'



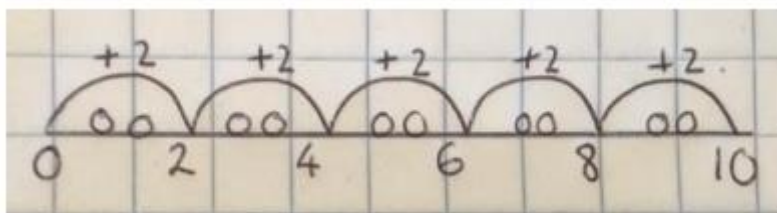
$$3 \times 6 = 18$$

$$6 \times 3 = 18$$

$$18 \div 3 = 6$$

$$18 \div 6 = 3$$

Pupils use number lines to divide objects into groups, using repeated addition to reach a given number. Pupils then use these representations to establish how many 'lots of' a given number can be divided into.



Abstract

Using a combination of pictorial and concrete methods, pupils begin to understand the concept of 'fact families', making links between multiplication and division.













Complete the sentences.

a) There are counters in each row.

There are rows.

There are counters altogether.

With support from concrete equipment, pupils answer simple division and multiplication calculations, pupils learn the connection between multiplication and division facts.

				$4 \times \square = 12$
				$3 \times \square = 12$
				$12 \div 4 = \square$
				$12 \div 3 = \square$

Year 2

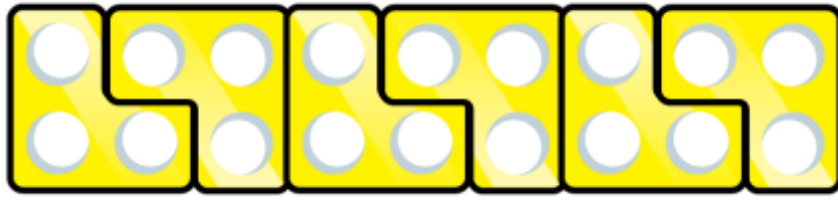
DIVISION

National Curriculum Objectives Division Objectives from Westgarth Progress Map:	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>Previous vocabulary +</p> <ul style="list-style-type: none">repeated subtractionodd*even*fact family*division factdividedivided bydivided intoshareshare equallyleftleft overgroup in pairsgroup in threes...tensequal groups ofrow*column*

Mental Methods

- Counting in 2s, 5s, 10s and 3s
- Links to arrays
- Recalling the division facts for the 2,5 and 10 times tables
- Using knowledge that halving is the inverse of doubling and the same as dividing by 2.
- Use known facts and place value to divide.

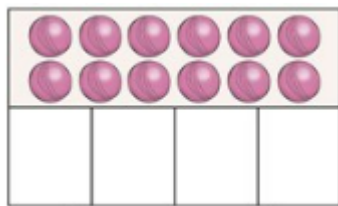
Concrete



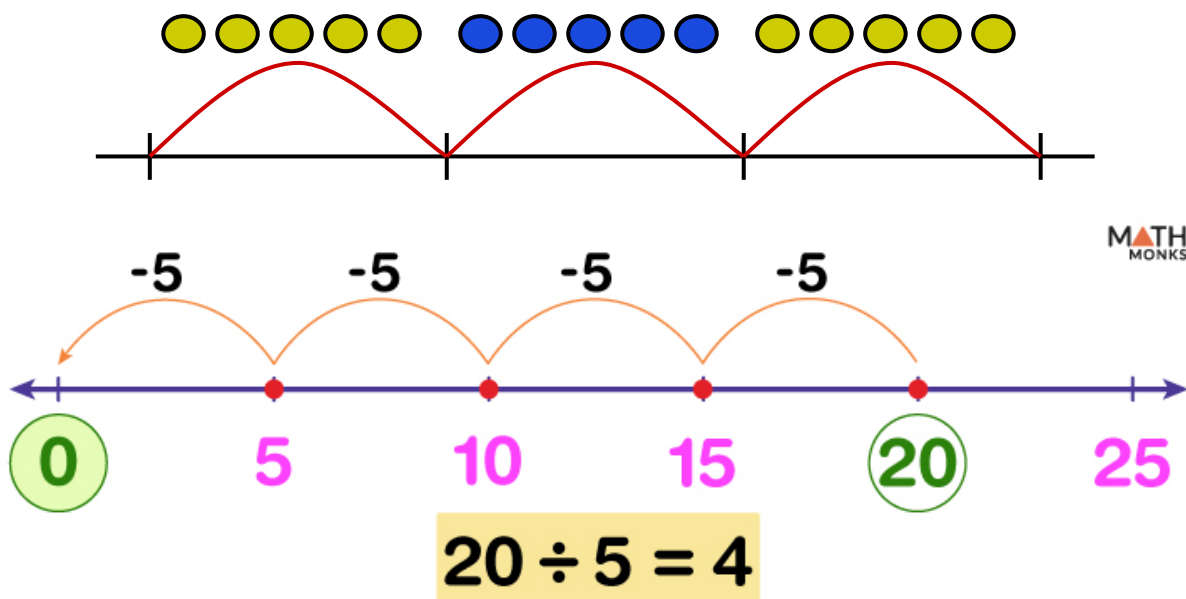
When dividing, Numicon is used to support children's understanding of division as grouping. Children make the number they are dividing and then place the number shape they are dividing by over the top of the number to find how many groups of the number there are altogether. For example, there are 6 groups of 3 in 18.

Pictorial

Bar models are used to support the concept of sharing into equal groups. Initially, this involves using counters or other manipulatives and moves to using pictorial representations.



Pupils use number lines to divide using repeated subtraction. They use pictorial representations of number to continue to develop their understanding of 'groups' of numbers.



Abstract

Pupils 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 written calculations.

Take 20 cubes.

- a) Share the cubes into 2 equal groups.

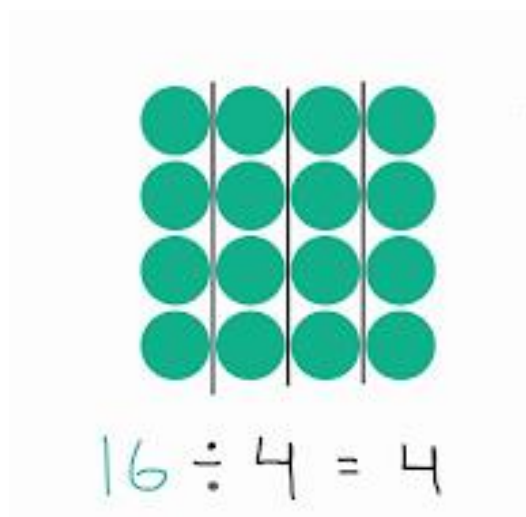
Complete the sentences.

There are 20 cubes.

There are groups.

There are cubes in each group.

$$20 \div 2 = 10$$



Year 3

DIVISION

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 in multiples of 4, 8, 50 and 100.	Previous vocabulary + <ul style="list-style-type: none">Factor*RemainderScaling*Missing number*Times smallerDivisible

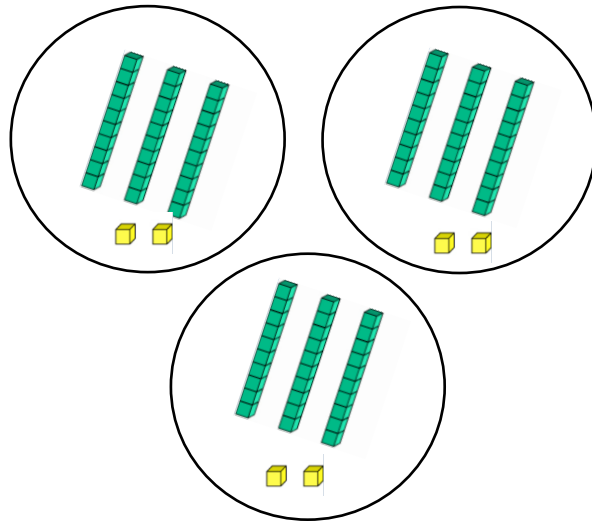
Mental Methods

- Counting in 2s, 5s, 10s, 3s, 4s and 8s
- Recalling the division facts for the 2,5 and 10 times tables- from Year 2
- Recalling the division facts for the 3, 4 and 8 times tables.
- Use known facts and place value to divide by 2, 3, 4, 5, 8 or 10
- Using knowledge that halving is the inverse of doubling and the same as dividing by 2. Use this to link to $\div 2$, $\div 4$ & $\div 8$.
- Using known facts/partition in different ways to become more efficient in mental calculations: e.g. $39 \div 3$ by taking 3 lots of 10 away mentally, then 3 lots of 3 to get 13 as the answer.
- Use the relationship between multiplication and division.
- Scaling down using known facts.

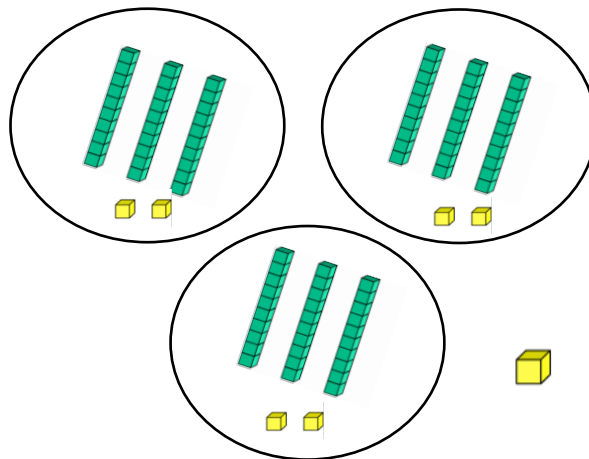
Concrete

Base ten equipment is used to support pupils in dividing larger 2-digit numbers by one digit numbers. The concept of remainders or 'left over' is also introduced through this method.

$$96 \div 3 =$$



$$97 \div 3 =$$



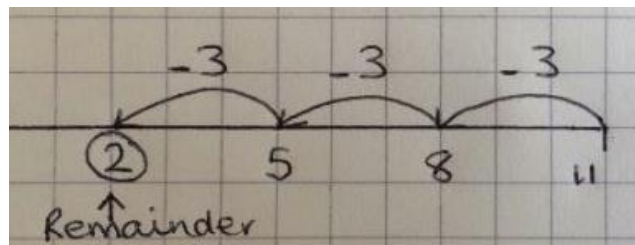
Pictorial

Pictorial representations of concrete tools allow pupils to begin to move towards an abstract approach to division, deepening the understanding of division as 'equal groups'.

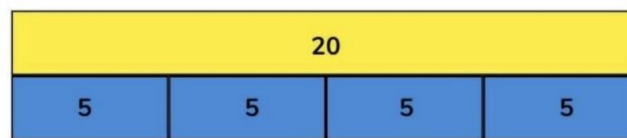
$46 \div 2 =$

Tens	Ones

Building upon their understanding of division as repeated subtraction, pupils begin to address problems involving remainders.



The bar model is used to support pupils in gaining a deeper understanding of the concept of division as the creation of equal groups. Through this, they further explore links between multiplication and division.

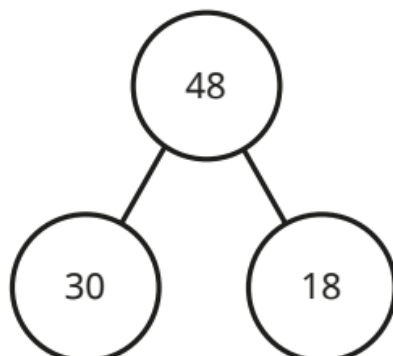


$5 + 5 + 5 + 5 = 20$
 $5 \times 4 = 20$

$20 \div 4 = 5$
 $20 \div 5 = 4$

Part-whole models are used to introduce the concept of 'chunking' to identify useful values within a total.

a) $48 \div 3 =$ 16



$30 \div 3 =$ 10
 $18 \div 3 =$ 6
 $48 \div 3 =$ 16

Abstract

Pupils read and write division calculations, solving them using a number of methods with increasing independence.

$$28 \div 3 = 9 \text{ r } 1$$

Times Tables Rock Stars



To support in continued practise and consolidation of times table and division 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

DIVISION

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 12×12• Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers• Recognise and use factor pairs and commutativity in mental calculations	<ul style="list-style-type: none">• Counting in 6s, 7s, 9s, 25s and 1000s	Previous vocabulary + <ul style="list-style-type: none">• Inverse*• Factor pair*• Quotient• Divisor• Dividend

Mental Methods

- Counting in 6s, 7s, 9s, 25s and 1000s.
- Recall division facts for all the times tables, up to 12×12
- Use understanding of place value and what happens to the value of each digit when it is divided by 10, 100 or 1,000.
- Use known facts and place value to solve calculations and to become more efficient in mental calculations e.g $92 \div 4$ by taking away 4 lots of 20, to be left with 12, then taking away 3×4 to get the answer of 23.
- Use related facts to divide
- Use factor pairs to divide
- Scaling down using known facts
- Use the relationship between multiplication and division

Concrete

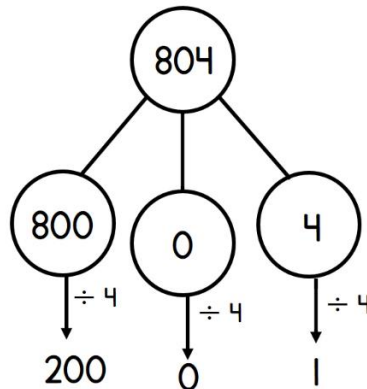
Place Value equipment is used to demonstrate how numbers with up to 3 digits can be divided.

$$484 \div 4 =$$

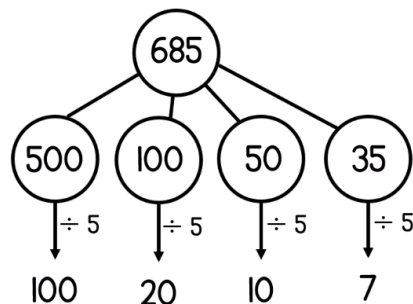
Hundreds	Tens	Ones
100	10 10	1
100	10 10	1
100	10 10	1
100	10 10	1

Pictorial

The concept of chunking is introduced using the part-whole model. Students begin by partitioning numbers using place value.



The part-whole model is used to further 'chunk' three-digit numbers. For example, in the number 685, students are taught to calculate $500 \div 5$ and then $100 \div 5$ rather than calculating $600 \div 5$ in one calculation.



Abstract

Pupils write and read division calculations with increasing confidence, applying known multiplication facts to division calculations by partitioning larger numbers into 'chunks'.

$$64 \div 4 = \square$$

$$40 \div 4 = 10$$

$$24 \div 4 = 6$$

$$\boxed{16}$$

$$10 \times 4 = 40$$

$$6 \times 4 = 24$$

Year 5

DIVISION

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">• 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• 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">• Identifying all factor pairs of a number and common factors of 2 numbers.• Know and use vocabulary of prime numbers, prime factors and composite (non-prime) numbers.• Establish whether a number up to 100 is prime and recall prime numbers up to 19.	<p>Previous +</p> <ul style="list-style-type: none">• Square root*• Common factor*• Composite number*• Non integer*• Prime number*

Mental Methods

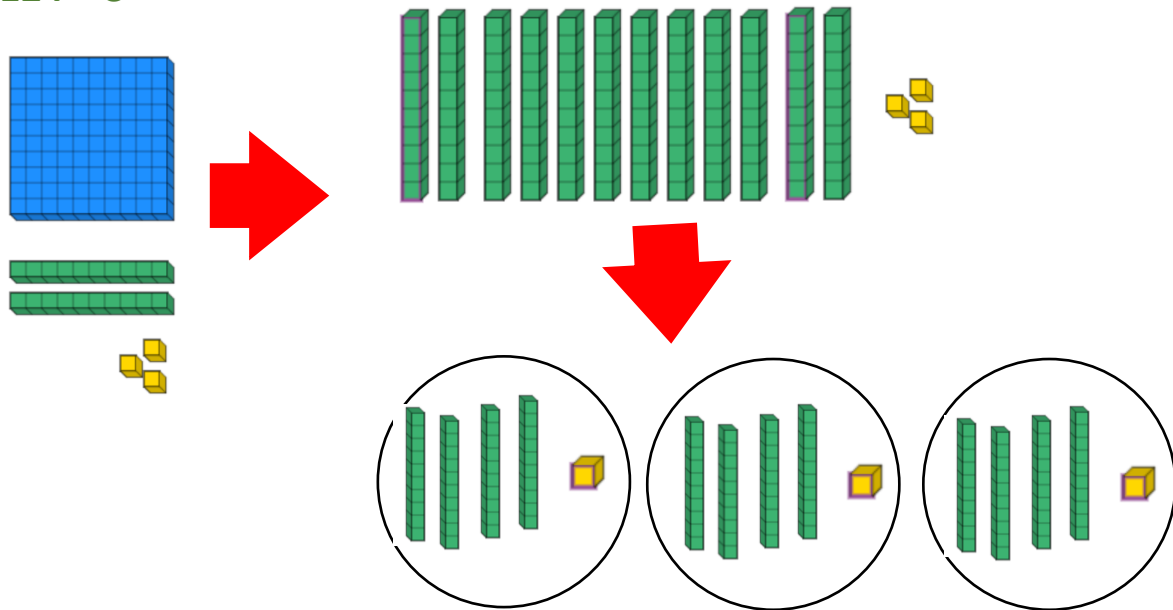
- Counting in steps of powers of 10.
- Recall division facts for all the times tables, up to 12X12
- Use understanding of place value and what happens to the value of each digit when it is divided by 10, 100 or 1,000.
- Use known facts and place value to solve calculations.
- Use related facts to divide
- Use factor pairs to divide
- Scaling down using known facts
- Use knowledge of division facts e.g. when carrying out a division to find a remainder.

- Use the relationship between multiplication and division.

Concrete

Base ten equipment is used to support the concept of division as sharing equally. Numbers with up to 3 digits are shared by single digit numbers using this approach. The concept of exchanging in division is also taught using base ten equipment.

$$124 \div 3$$



Pupils divide up to 4-digit numbers by single digit numbers using a place value grid.

TTh	Th	H	T	O
	1,000 1,000	100 100 100 100 100	10 10 10	1 1
	1,000 1,000	100 100 100 100 100	10 10 10	1 1
	1,000 1,000	100 100 100 100 100	10 10 10	1 1

Pictorial

Bar models continue to be used to support the concept of equal division of a number.

9,415							
a	a	a	a	a	a	a	a
b	b	b	b	b	b	b	b
5,328							
120	120	120	120				
c	c	c	c	c	c	c	c

Abstract

Pupils use 'chunking' to divide numbers with up to 3 digits. In this method, pupils break larger numbers into 'chunks' using their knowledge of multiplication.

$$\begin{array}{r}
 23 \text{ r } 4 \\
 24 \overline{) 556} \\
 \underline{-480} \quad 24 \times 20 \\
 76 \\
 \underline{-72} \quad 24 \times 3 \\
 4
 \end{array}$$

Pupils use the short division method to divide with and without remainders. Pupils are When completing the calculation, remainders are carried to the next place.

917 ÷ 6

$$\begin{array}{r}
 152 \text{ r } 5 \\
 6 \overline{) 917}
 \end{array}$$

Pupils are taught how to represent remainders as a fraction.

$0456 \text{ r } 3$
 $6 \overline{) 227339}$
 $= 456 \frac{3}{6} \text{ or } 456 \frac{1}{2}$

Year 6

DIVISION

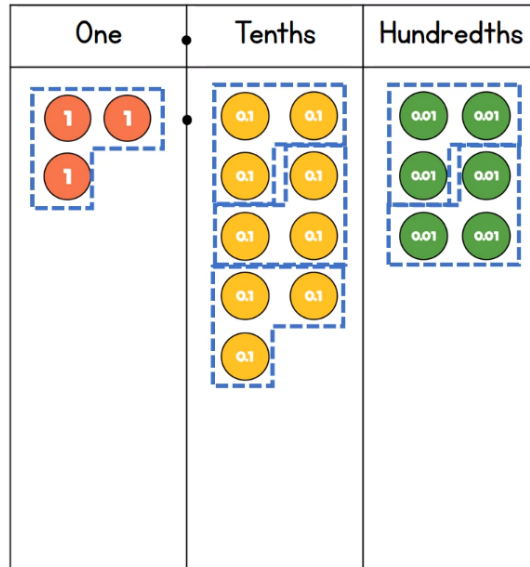
National Curriculum Objectives: Multiplication objectives from Multiplication and Division Strand	Key Skills/ other linked NC Objectives (Place Value)	Key Vocabulary
<ul style="list-style-type: none">• Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy• 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">• Identify common factors and prime numbers.• Use estimation to check answers to calculations.	<p><i>Consolidate all previously taught vocabulary +</i></p> <ul style="list-style-type: none">• Order of operations*• Brackets*

Mental Methods:

- Counting in steps of powers of 10.
- Recall division facts for all the times tables, up to 12X12
- Use understanding of place value and what happens to the value of each digit when it is divided by 10, 100 or 1,000.
- Use known facts and place value to solve calculations.
- Use knowledge of division facts e.g. when carrying out a division to find a remainder.
- Use factor pairs to divide
- Use the relationship between multiplication and division
- Consolidate all previously taught strategies.

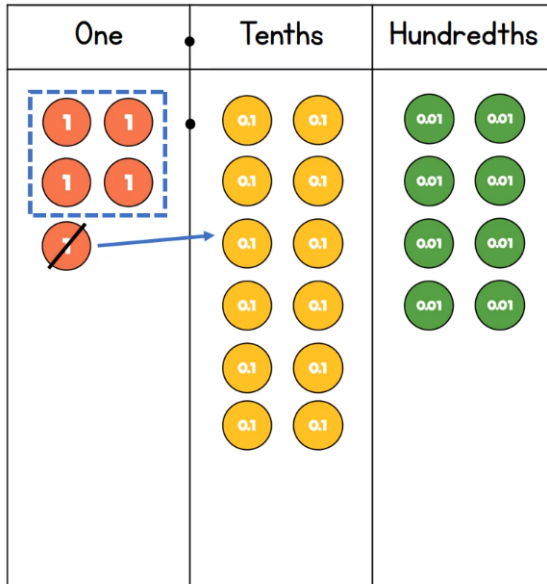
Concrete and Pictorial

Pupils are supported in the division of decimal numbers using place value charts and pictorial representations alongside the short division method.

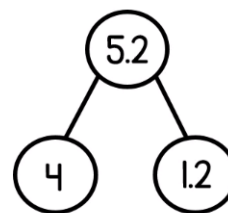


$$3 \overline{) 3.96} \begin{array}{r} 1.32 \\ \end{array}$$

The part-whole model is also used to support pupils in developing a deeper understanding of the process of and reasoning behind exchanging.



$$4 \overline{) 5.28} \begin{array}{r} 1. \\ \end{array}$$



Abstract

Short division is used to divide whole and decimal numbers.

$$\begin{array}{r} 14.36 \\ 3 \overline{) 43.08} \end{array}$$

$$\begin{array}{r} 0.25 \\ 8 \overline{) 2.00} \end{array}$$

Long division is used to divide numbers with more than 3-digits by numbers with 2-digits or more. Pupils record the first multiples of the number to support them in solving the calculation.

	543
1 - 24	24 $\overline{) 13032}$
2 - 48	$\begin{array}{r} -120 \\ \hline 103 \end{array}$ ↓
3 - 72	$\begin{array}{r} 103 \\ -96 \\ \hline 72 \end{array}$ ↓
4 - 96	$\begin{array}{r} 72 \\ -72 \\ \hline 00 \end{array}$
5 - 120	
6 - 144	
7 - 168	
8 - 192	
9 - 216	