Northfield Primary School
Whole School Written Calculation Policy

Policy Aims:

- To ensure consistency in the teaching of written calculations across the school.

- To progressively secure pupils' understanding and confidence in using formal written methods in mathematics.

- To inform teaching staff and parents of the written mathematical methods taught at each stage of a pupils' education.

- To build on models and images which develop conceptual understanding.

Last Reviewed: January 2024
Approved: Strategic Development February 2024
Policy written by: S Clark
Next Review: January 2026

The **three main aims** of the 2014 National Curriculum for mathematics are **Fluency, Reasoning** and **Problem Solving**.

This policy has been designed to help develop these aims and ensures consistency and progression from the Foundation Stage to Year 6 in the written methods taught and applied when solving calculations.

Varied Fluency: Being able to recall facts and solve calculations with confidence, speed and accuracy when presented in a variety of forms.

Reasoning: The process of using systematic steps to arrive at a conclusion about a problem and explain this as a process. Pupils are taught and encouraged to to explain the steps, recognise the method through which a solution was reached and explain any mistakes or misconceptions that occur.

Problem Solving: Being able to solve mathematical problems, often involving multiple steps and operations. Problem solving requires pupils to recall key facts, have the ability to reason and be able to work systematically.

As a school, in Key Stage 1 and Key Stage 2, we follow the White Rose schemes of work and therefore use the White Rose calculation policies for addition, subtraction, addition and subtraction. The policies allow teaching staff (and parents) to refer to children's prior learning and the expectations for the following year group.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional calculations methods, and fraction calculation methods, which can be found in the appendix of this document, along with images and representations for use in the EYFS.

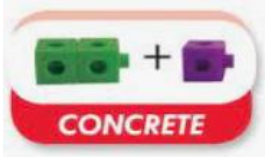
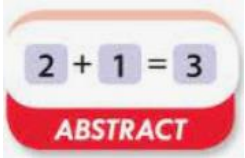
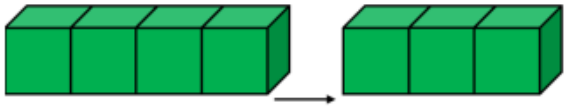
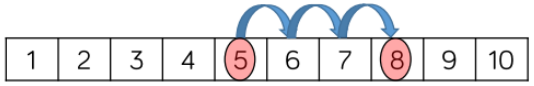
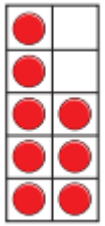
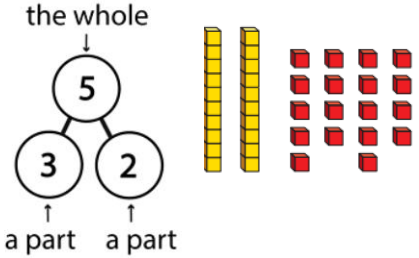
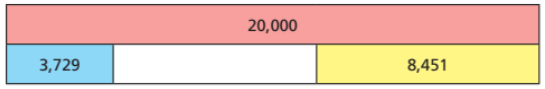
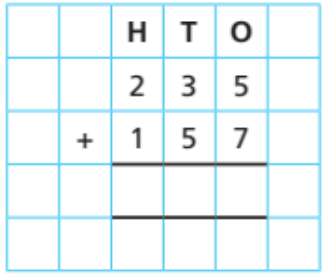
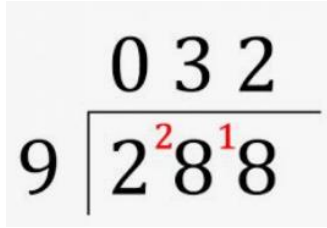
Pupils will be required to apply these written methods both when solving calculations and within the context of worded multi-step contextualised problems that progress in difficulty as they move up through school. This will develop their understanding of the purpose of the calculation and their problem-solving skills.

Visualisation in Maths

The key to children becoming successful Mathematicians is the consistent use of representations (models and images that support conceptual understanding of the mathematics) and this policy promotes a range of relevant representations, across the primary years. Mathematical understanding is developed through use of representations that are first of all concrete (e.g. Numicon, Dienes apparatus, Rekenrek), and then pictorial (e.g. Array, place value counters) to then facilitate abstract working (e.g. Columnar addition, long multiplication).

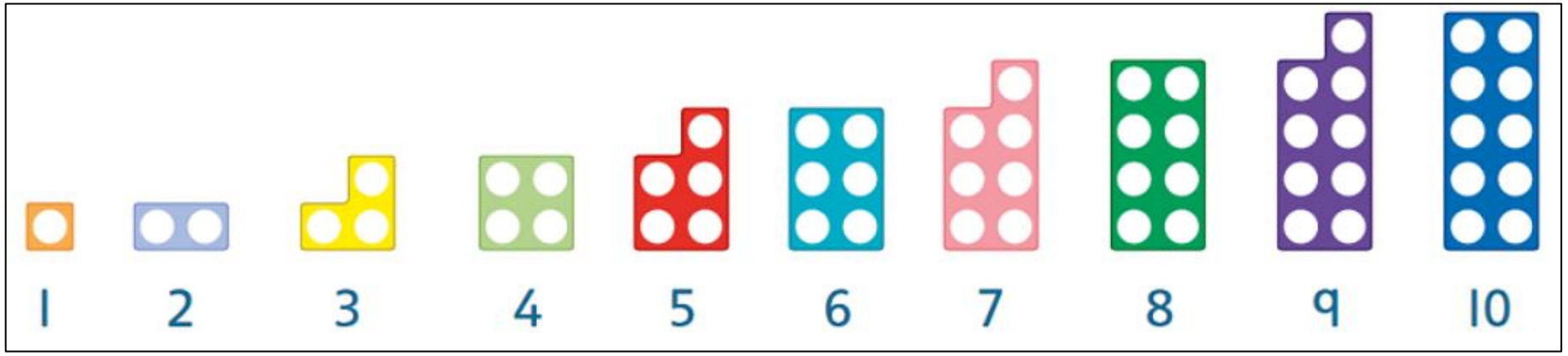
The expectation is that visualisation is used to support each written method being taught. Resources including Numicon, Dienes blocks and place value counters are recommended as well as the use of the bar model to unpick, understand and solve problems.

Concrete, Pictorial, Abstract (CPA)

Concrete	Pictorial	Abstract
		
Concrete is the 'doing' stage, using concrete objects or equipment to solve problems – this begins with objects found in real life before specific mathematical (yet still tangible) equipment is used to represent the objects. It brings the concept to life by allowing children to handle physical objects themselves. Every new abstract concept is learned first with a 'concrete' or physical experience.	**Pictorial** is the 'seeing/visualisation' stage, using representations of the objects involved in mathematical problems. Children learn to make mental connections between the physical object and abstract levels of understanding, by drawing or looking at pictures, circles, diagrams or bar models which represent the objects in the problem.	**Abstract** is the 'symbolic' stage where, once a solid understanding is demonstrated by pupils, abstract symbols are used to represent, model and solve mathematical problems. This is where formal written recordings of calculations are used. Teachers will ensure that pupils have the opportunity to apply their knowledge in a variety of contexts and problems to deepen their understanding.
Examples:   	**Examples:**    	**Examples:**  

Use of Numicon

Numicon is used across school as a concrete resource to support children's learning and development of conceptual understanding in Mathematics. This resource helps children to develop **fluency** by using a visual, practical base to develop conceptual understanding and fluent recall. It can help children to **reason** mathematically through the use of concrete objects and spoken language to explain and justify. It also helps children to develop into confident **problem-solvers** since it provides them with a visual stimulus to support their reasoning communication.



As a school we have decided on the use of the following colours for each Numicon piece, to ensure consistency across year groups:

1 plate: orange

2 plate: light blue

3 plate: yellow

4 plate: light green

5 plate: red

6 plate: turquoise

7 plate: pink

8 plate: dark green

9 plate: purple

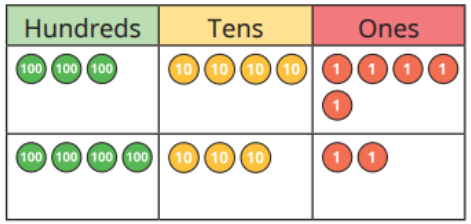
10 plate: dark blue

Use of Place Value Headers

Place value headers are used across school as a tool to develop children's understanding of the value of each digit within a number. Teaching staff model written calculations using place value headers and children are expected to use these in their independent maths work.

Examples of the use of headers:

345 + 432 = 777



	H	T	O
	3	4	5
+	4	3	2

6232 – 4814 = 1418

	T	H	T	O
	~~6~~	12	~~3~~	12
	~~5~~		~~2~~	
-	4	8	1	4
	1	4	1	8

12.7 – 1.953 = 10.747

	T	O	t	h	th
	1	~~12~~ 11	~~7~~ 16	~~0~~ 9	10
-	0	1	9	5	3
	1	0	7	4	7

Pupils are encouraged to place a 0 as a place value holder (as above).

24 x 3 = 72

X	20	4
3	60	12

H	T	O
	6	0
+	1	2
	7	2

389,949-150,699 = 239,250

	Hth	TTh	Th	H	T	O
	3	8	9	~~9~~ 8	14	9
-	1	5	0	6	9	9
	2	3	9	2	5	0

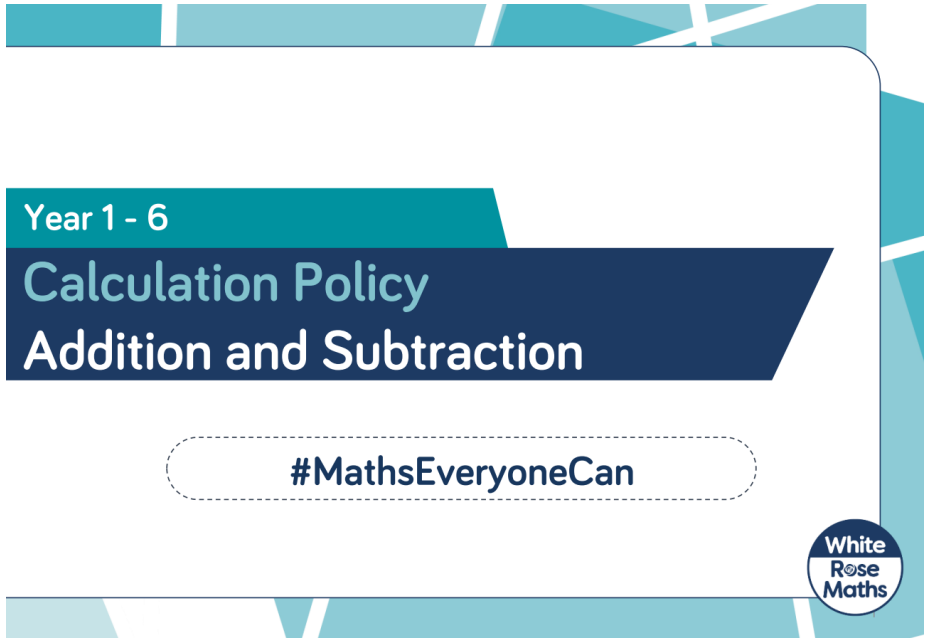
		Th	H	T	O
		7	5	2	3
	X			2	4
	3	0	0	9	2
1	5	0	4	6	0
1	8	0	5	5	2

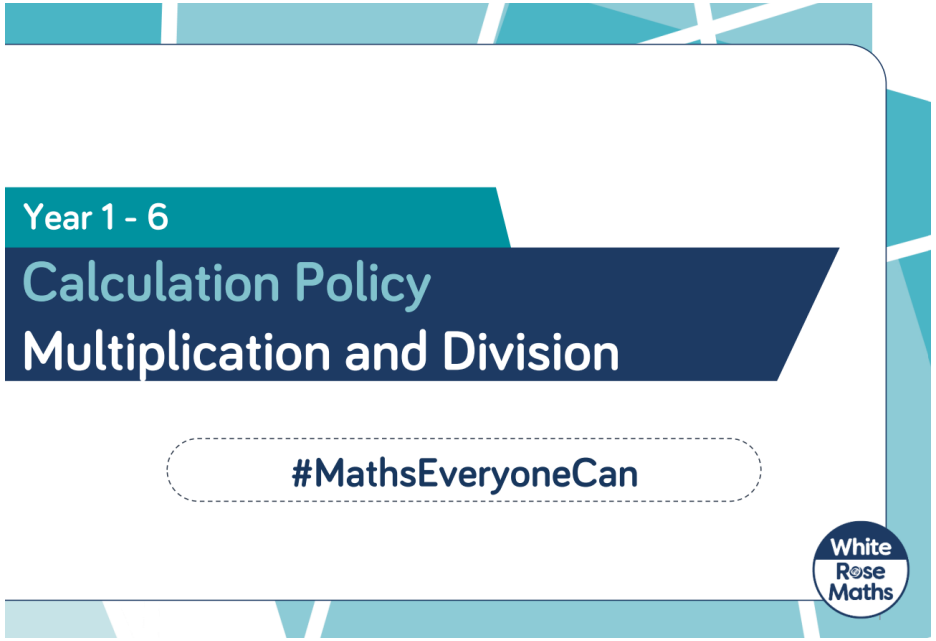
White Rose Calculation Policies

As a school, in Key Stage 1 and Key Stage 2, we follow the White Rose schemes of work and therefore use the White Rose calculation policies for addition, subtraction, addition and subtraction. The policies allow teaching staff (and parents) to refer to children's prior learning and the expectations for the following year group.

Please refer to the separate documents which detail the written methods we use for addition, subtraction, multiplication and division from Year 1 through to Year 6.

Methods for EYFS, and additional methods that we use as a school, are detailed on subsequent pages of this document.

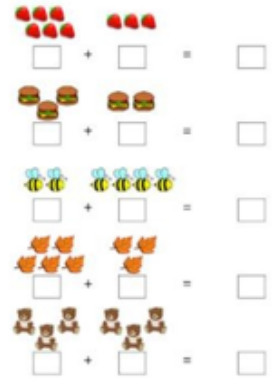
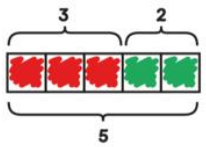
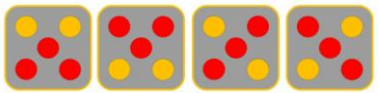
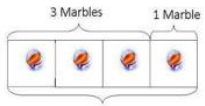
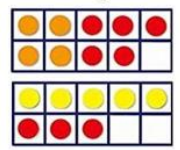
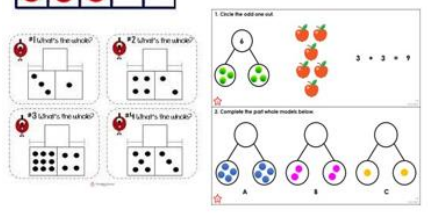
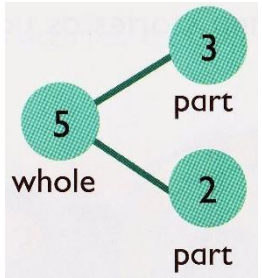
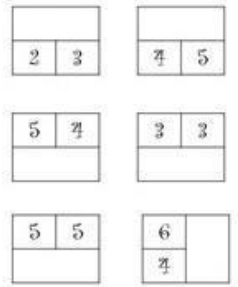




Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

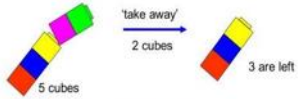
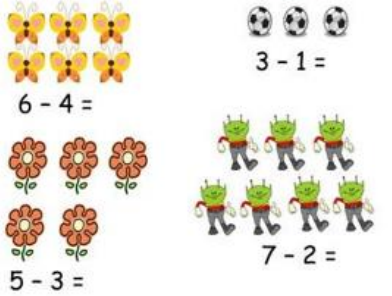
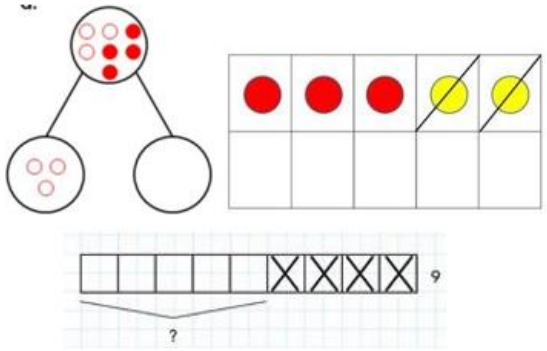
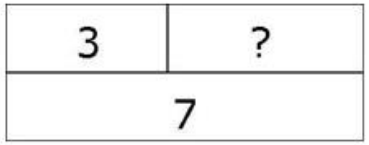
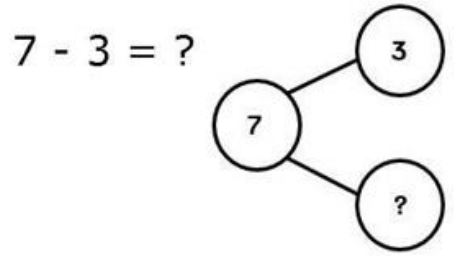
EYFS - Addition

Objectives:	Concrete	Pictorial	Abstract
Knows that a group of things change in quantity when something is added. Find the total number of items in two groups by counting all of them. Says the number that is one more than a given number. Finds one more from a group of up to five objects, then ten objects. In practical activities and discussion, beginning to use the vocabulary involved in adding. Using quantities and objects, they add two single digit numbers and count on to find the answer. Solve problems including doubling.	   Use of toys and general classroom resources for children to physically manipulate and regroup.  Use of specific maths resources including Numicon, double-sided counters, cubes, counting bears etc.    Use of visual supports such as tens frames, part-part whole models with the physical objects that can be manipulated.	  Two groups of pictures so children are able to count the total.   Bar model using visuals, pictures/icons or colours.   Use visual supports such as ten frames, part part whole and addition mats with pictures/icons. 	A focus on symbols and numbers to form a calculation. $5+2=7$   *(No expectation for children to be able to record a number sentence/addition calculation.)*

Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

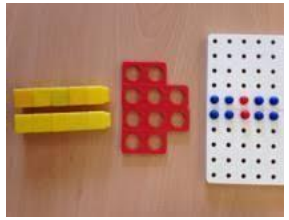
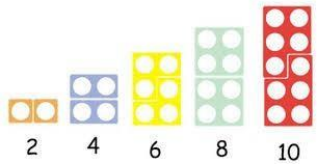
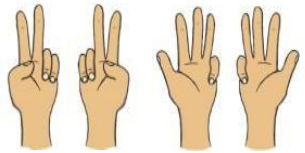
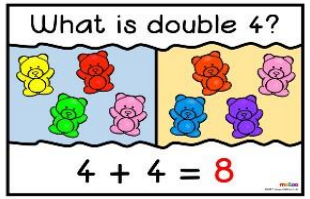
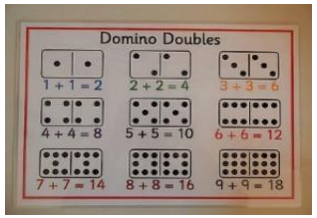
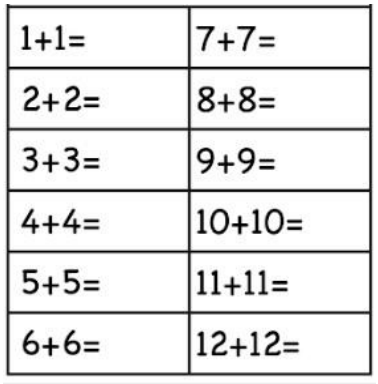
EYFS - Subtraction

Objectives:	Concrete	Pictorial	Abstract
Knows that a group of things change in quantity when something is taken away Find one less from a group of five objects, then ten objects. In practical activities and discussion, beginning to use the vocabulary involved in subtracting. Using quantities and objects, they subtract two single digit numbers and count back to find the answer.	   Use of toys and general classroom resources for children to physically manipulate and group/regroup.    Use of specific maths resources such as Numicon, cubes, bead strings etc.   Use of visual supports such as tens frames, part-part whole models with the physical objects that can be manipulated.	  A group of pictures for children to cross out or cover quantities to support subtraction.  Use visual supports such as ten frames, part-part whole and bar model with pictures/icons.	A focus on symbols and numbers to form a calculation.  10 - 6 = 4   *(No formal expectation for children to be able to record a number sentence/addition calculation.)*

Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

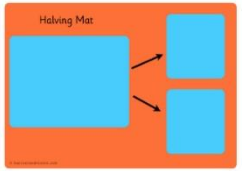
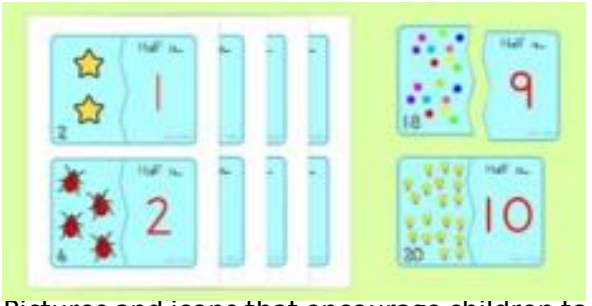
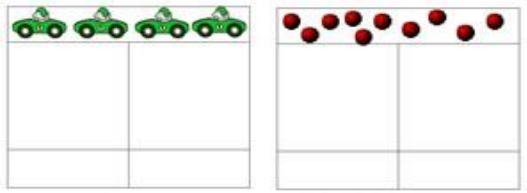
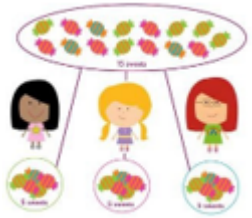
EYFS - Multiplication

Objectives:	Concrete	Pictorial	Abstract
Solve problems including doubling.	   Counting and other maths resources for children to make 2 equal groups.  Physical and real-life examples that encourage children to see concept of doubling as adding two equal groups.  	    Pictures and icons that encourage children to see concept of doubling as adding two equal groups.	A focus on symbols and numbers to form addition calculations to model adding two equal groups.  *(No formal expectation for children to be able to record a number sentence/addition calculation.)*

Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

EYFS - Division

Objectives:	Concrete	Pictorial	Abstract
Solve problems including halving and sharing. Halving a whole, halving a quantity of objects. Sharing a quantity of objects.	   Children have the opportunity to physically cut objects, food or shapes in half.    Use visual support such as halving mats and part-part whole models with physical objects and resources that can be manipulated.  Use of resources to share into two equal groups, and to explore sharing between 3 or more.	 Pictures and icons that encourage children to see concept of halving in relation to subitising, addition and subtraction knowledge. i.e. Knowing 4 is made of 2 groups of 2, so half of 4 is 2.  Bar model with pictures or icons to support understanding of finding 2 equal parts of a number, to further understand how two halves make a whole.  Pictures for children to create and visualise 3 or more equal groups.	*(No formal expectation for children to be able to record a number sentence/addition calculation.)*

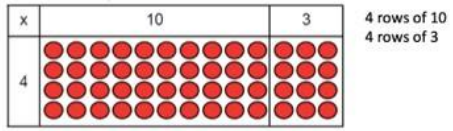
Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

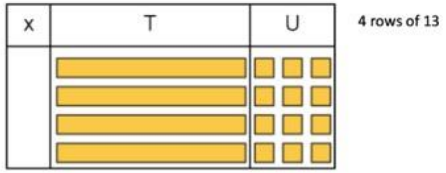
Year 3 – Multiplication – Multiply 2-digit numbers by 1-digit numbers

Concrete	Pictorial	Abstract
Children will develop their understanding of the grid method for multiplication to complete larger multiplication calculations (2 digit by 1 digit).		

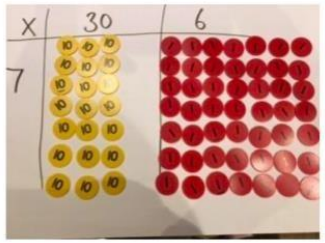
Show the link with arrays to first introduce the grid method.



Move on to using Base 10 to move towards a more compact method.

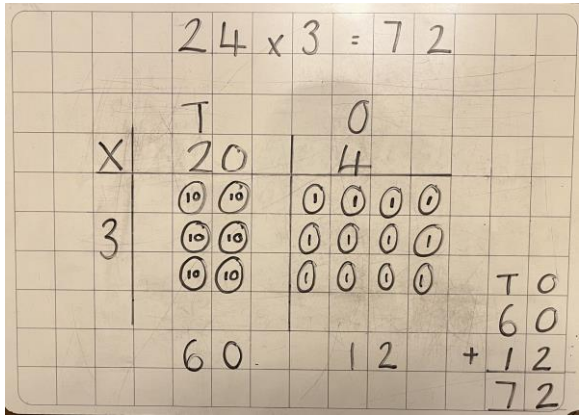


Move on to place value counters to show how we are finding groups of a number.



Add up each column, starting with the ones making any exchanges needed.
The calculation will be shown alongside the model chosen to see the connection.

Children can represent their calculations with place value counters, drawing the counters within the correct place value columns.



Start with multiplying by one-digit numbers and showing the clear addition alongside the grid. Use times tables facts to support multiplying by multiples of ten.

X	20	4
3	60	12

H	T	O
	6	0
+	1	2
	7	2

Once secure, pupils will be introduced to the expanded column method, as below.

	H	T	O	
		3	4	
×			5	
		2	0	(5 × 4)
+	1	5	0	(5 × 30)
	1	7	0	

Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

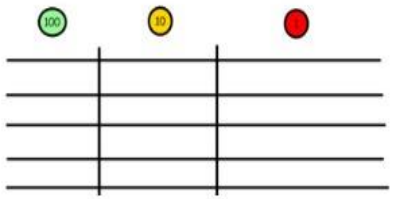
Year 4 – Multiplication – Multiply 3-digit numbers by 1-digit numbers

Children will develop their understanding of the grid method for multiplication to complete larger multiplication calculations (3 digit by 1 digit).

Concrete

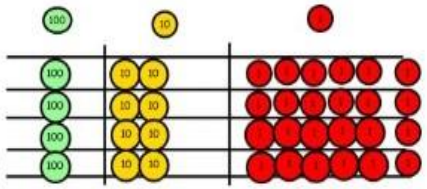
Use place value counters to show how we are finding groups of a number. We are multiplying by 4 so need 4 rows.

126 x 4 =



126 x 4

Fill each row with 126 made from place value counters.



126 x 4

Add up each column starting with the ones, making any exchanges needed.

	H	T	O
	4	0	0
		8	0
+		2	4
	4	2	4
	1		

The corresponding calculation should always be modelled alongside the concrete method.

Pictorial

The grid method will show how this relates to a formal written method.

126 x 4 =

	H	T	O
x	100	20	6
4	400	80	24

Add the product of each column to find the total product.

	H	T	O
	4	0	0
		8	0
+		2	4
	4	2	4
	1		

Bar modelling and number lines can support children when solving multiplication problems alongside formal methods.

126	126	126	126
?			

Abstract

Once secure in using the grid method to multiply 3-digit numbers by 1-digit numbers, the expanded method will be applied and mastered for the duration of the year using larger numbers (up to 3-digit by 1-digit).

Pupils should enter Year 5 using this method confidently to support their understanding of place value.

	H	T	O	
	4	2	8	
X			6	
		4	8	(6 x 8)
	1	2	0	(6 x 20)
2	4	0	0	(6 x 400)
2	5	6	8	

Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies.

To meet children's needs at Northfield, we also supplement the methods included in the White Rose calculation policies with additional methods in particular year groups, as detailed below:

Year 6 – Division – Divide up to 4 digit-numbers by a 2-digit number

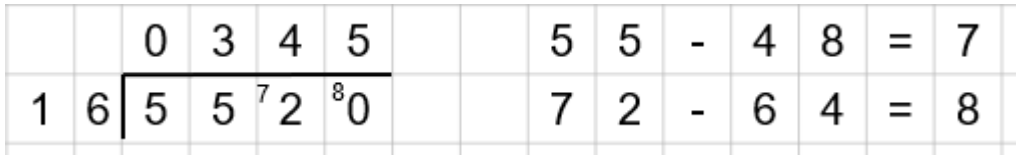
Children will be introduced to dividing 4-digit numbers by 2-digit numbers by using partitioning to find multiples of the divisor and then using the formal method of short division.	Once secure with using short division to divide by 2-digit numbers, children will be taught to apply the long division method, interpreting any remainders according to the context, with up to 3 decimal places.

5520 ÷ 16 =

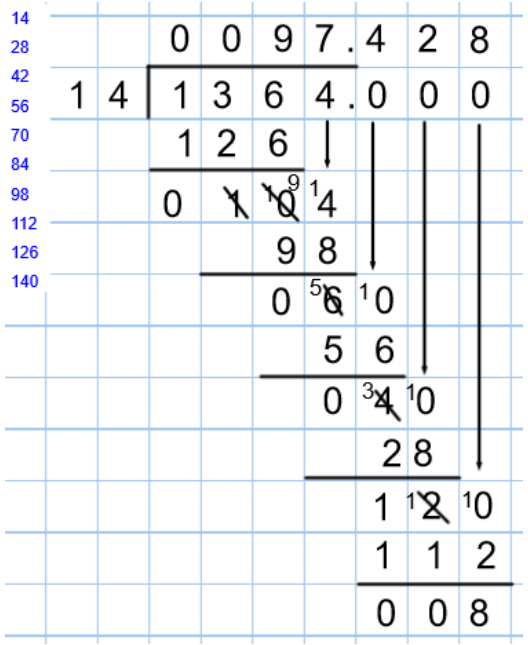
Children will partition the 2-digit number to find its multiples up to x9.

				1	6				
x1		1	0	+		6	=		1	6
x2		2	0	+	1	2	=		3	2
x3		3	0	+	1	8	=		4	8
x4		4	0	+	2	4	=		6	4
x5		5	0	+	3	0	=		8	0
x6		6	0	+	3	6	=		9	6
x7		7	0	+	4	2	=	1	1	2
x8		8	0	+	4	8	=	1	2	8
x9		9	0	+	5	4	=	1	4	4

They will use their list of multiples within the formal method for short division, interpreting any remainders appropriately according to the context of the calculation/problem. They will use jottings alongside the bus stop method to find the remainders.



Children are encouraged to write the multiples of the divisor before attempting the long division (using the partitioning method as a tool).

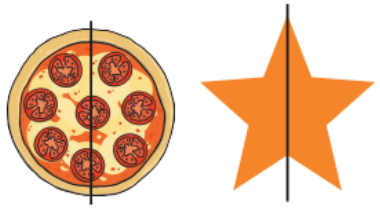
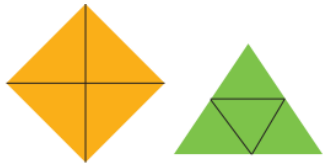
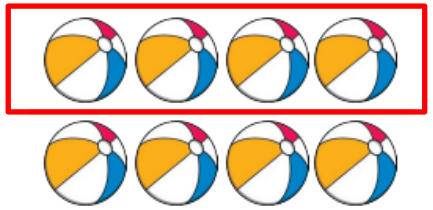
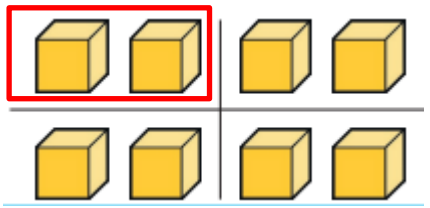
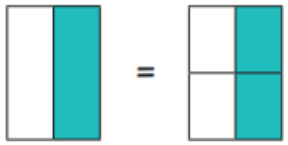
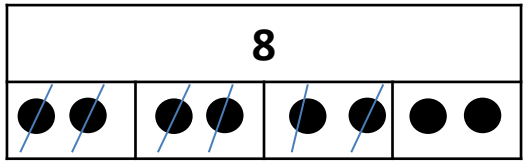
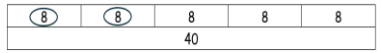
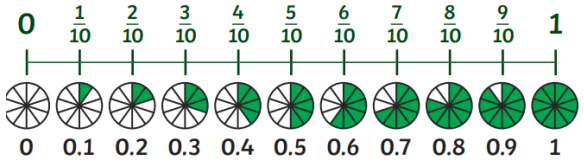


1364 ÷ 14 = 97.428 (3 decimal places)
= 97 r 6 (remainder)
$= 97\frac{6}{14}$ *or* $\frac{3}{7}$ (as a fraction)

Whole School Approach to Written Calculations

Fractions

Appendix – Written Methods of Calculation used in addition to the methods outlined in the White Rose policies

Year 1	Year 2	Year 3
Shape These objects and shapes are split in half. Each whole has 2 equal parts. $\frac{1}{2}$ = one half  These shapes are split into quarters. Each whole has 4 equal parts. $\frac{1}{4}$ = one quarter  **Object** There are 8 balls. They are grouped into 2 equal groups. Half of 8 is 4.  There are 8 blocks. 8 blocks are grouped into 4 equal groups. A quarter of 8 is 2. 	Pupils progress from recognising half and quarters, to recognising $\frac{1}{3}$, $\frac{2}{4}$ and $\frac{3}{4}$ of a length, shape, set of objects or quantity. Pupils begin to recognise the equivalence of $\frac{1}{2}$ and $\frac{2}{4}$. $\frac{1}{2} = \frac{2}{4}$  **Fraction of an amount** $\frac{3}{4}$ of 8 = 6 Pupils use (and draw) the Singapore bar, using the dominator to see how many to split the bar into e.g. 4 (quarters). The whole amount is shared equally between the parts. Finally, they look at the nominator to see how many parts they need to count e.g. 3 out of 4 parts. 	Pupils are taught to add and subtract fractions with the same denominator **within one whole**. $\frac{2}{5} + \frac{1}{5} = \frac{3}{5}$  $\frac{5}{6} - \frac{2}{6} = \frac{3}{6}$  **Fractions of an amount** Pupils are introduced to finding the fraction of an amount using the following method. 2/5 of 40 = 16 Divide the integer by the denominator: 40 ÷ 5 = 8 Then, multiply the answer by the numerator 8 x 2 = 16  **Counting in tenths** Pupils are taught to recognise that tenths arise from dividing an object into **10** equal parts and in dividing one-digit numbers of quantities by **10**. 

Year 4	Year 5

Once pupils are fluent in addition and subtraction of fractions with the same denominator. They begin to add and subtract fractions beyond a whole e.g.

$\frac{4}{5} + \frac{2}{5} = \frac{6}{5}$

Addition:

$\frac{8}{6} - \frac{5}{6} = \frac{3}{6}$

Subtraction:

Hundredths

Pupils count up and down in hundredths:

They recognise that hundredths arise when dividing an object by one hundred and dividing tenths by 10, using practical resources to support their understanding.

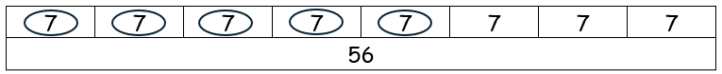
Fractions of an amount

Pupils continue to develop their understanding and fluency of working out fractions of amounts (unit and non-unit fractions).

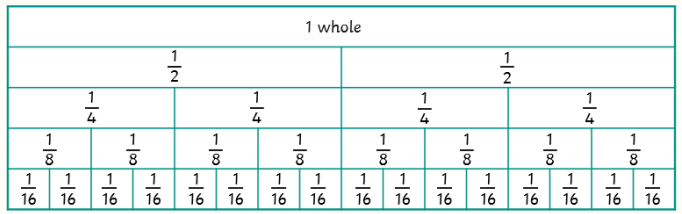
$\frac{5}{8}$ of 56 = 35

56 ÷ 8 = 7

7 x 5 = 35

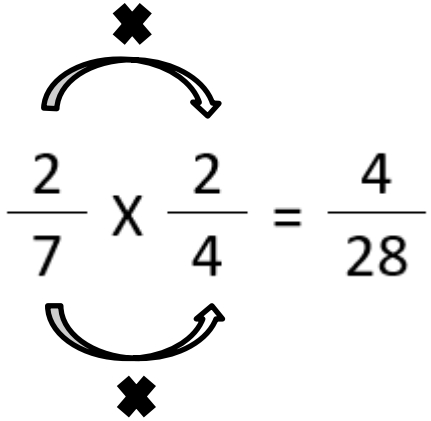


Recognise and show, using diagrams, families of common equivalent fractions



Multiplying fractions

Pupils are taught to multiply fractions by multiplying the numerators together and then multiplying the denominators together, to get their answer.



$$\frac{2}{7} \times \frac{2}{4} = \frac{4}{28}$$

Multiplying fractions by integers

Pupils' are taught to multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams.

$$\frac{3}{4} \times 3 = \frac{9}{4} = 2\frac{1}{4}$$

Step 1: $\frac{3}{4} \times \frac{3}{1}$

Step 2: $\frac{3}{4} \times \frac{3}{1} = \frac{9}{4}$

Year 6

Adding fractions

Adding fractions with different denominators, children write the common multiples under the denominators, until they find the lowest common denominator. Remembering to multiply the denominator and the numerator by the same amount.

$$\frac{1}{3}\ ^{x4}_{x4} + \frac{1}{4}\ ^{x3}_{x3} + \frac{1}{2}\ ^{x5}_{x5}$$

Step 1:

6	8	4
9	12	6
12		8
		12

Step 2: $\frac{4}{12} + \frac{3}{12} + \frac{6}{12} = \frac{13}{12} = 1\frac{1}{12}$

Subtracting

Children to use the same method with finding the lowest common dominator, so that they can subtract the numerator.

$$\frac{6}{7} - \frac{6}{14}$$

Step 1: $\frac{6}{7}\ ^{x2}_{x2}$

Step 2: $\frac{12}{14}$

Step 3: $\frac{12}{14} - \frac{6}{14} = \frac{6}{14}$

Adding fractions with mixed numbers

$$3\frac{9}{10} + \frac{1}{2} =$$

Step 1: $\frac{39}{10} + \frac{1}{2}$

Step 2: $\frac{39}{10} + \frac{5}{10} = \frac{44}{10} = 4\frac{4}{10}$

Dividing fractions by an integer

Use the 'Keep, Switch, Flip' method.

1. Write the whole number over 1.
2. **Keep** the original fraction as it is.
3. **Switch** the divide to a multiply.
4. **Flip** the whole number.
5. Multiply the pair of fractions (<u>numerator x numerator</u>)
   (denominator x denominator)

$$\frac{3}{5} \div \mathbf{4}$$

$$\frac{3}{5} \div \frac{4}{1}$$

K S F

$$\frac{3}{5} \times \frac{1}{4} = \frac{3}{20}$$