Kimbolton Preparatory School

Calculation Policy

Written by Rebekah Bell Spring 2023

Resources and Strategies

The White Rose scheme was adopted in the autumn term of 2022, since then we have also adopted the majority of the calculation policy written by White Rose. This calculation policy is a snapshot of the two policies written by White Rose: Addition and Subtraction and Multiplication and Division. With permission, many of the diagrams and tables have been copied from these White Rose policies. If you would like more information about the White Rose calculation policy, then the links above (access online only) will take you directly to those documents.

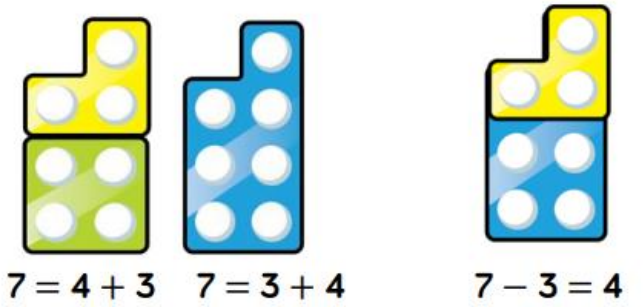
At Kimbolton Preparatory School, we value the use of practical resources to support the teaching and learning in maths lessons. The White Rose scheme promotes three teaching strands: concrete, pictorial and abstract. The concrete approach allows for children to have a hands-on experience in maths; allowing them to use real objects to solve calculations and problems. This could be by using cubes, place value counters or a number of other resources. Following on from this, the children begin to use the pictorial approach which presents children with mathematical diagrams or pictures. Finally, when the children are ready, they are presented with written calculations, known as the abstract approach.

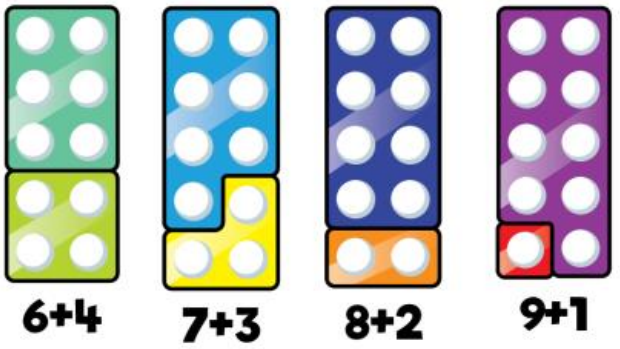
The children will be exposed to a range of mathematical language, some of which is explained in this document. In order to support the children's learning, a consistent approach is required across year groups and between home and school. Children may find some representations more helpful than others. As they grow as learners and mathematicians, children will be able to select the most efficient and accurate method using the 'toolbox' they have developed across their years at the preparatory school.

Learning times tables and division facts is a key part to developing a child's confidence when solving calculations. The expectations for each year group are outlined in this policy.

Number Shapes (some people may refer to this as numicon)

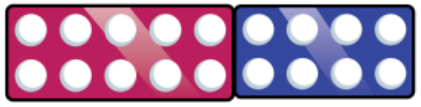
Number shapes can be really effective at helping children see the connection between numbers. They are a great starting resource when children are first introduced to number bonds. Number shapes also provide an introduction for children to recognise the parts that can be added together to create a total. As children become more familiar with the shapes, they will find the totals easier to identify as they will make a connection between the total and the shape that has been created when the parts are put together.



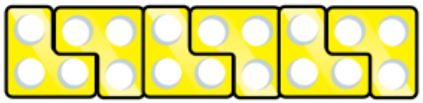


$5 \times 4 = 20$
$4 \times 5 = 20$

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



$18 \div 3 = 6$



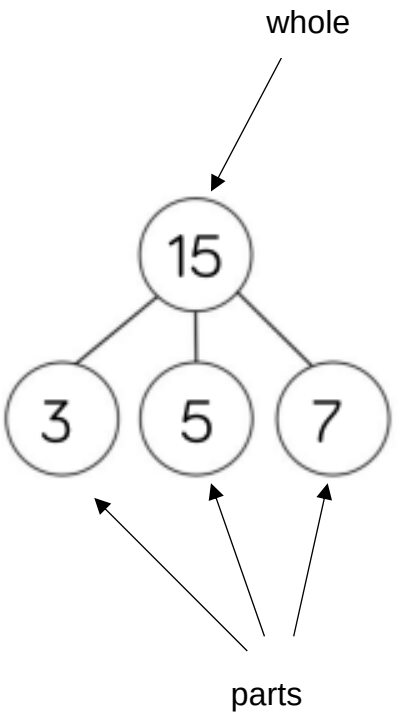
Number shapes can also be helpful when introducing the idea of multiplying to the children and understanding the concept of having 'lots of' a number.

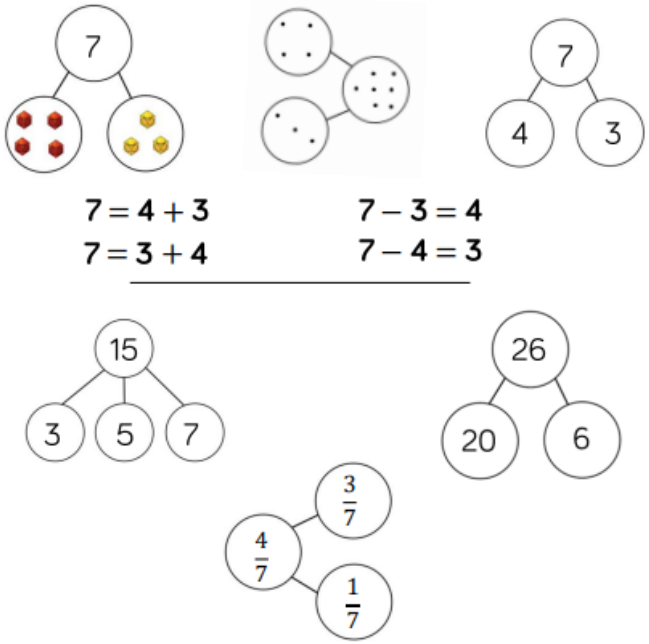
Using a number shape board, children can also make the total and then investigate how many different ways that total can be broken up e.g. 18 can be divided by 6 pieces of 3. This is a helpful way to introduce division to children.

Part-Whole Model

Part-Whole models can support children as they learn to partition numbers. As children move into the Upper Prep, they can be used to partition fractions, percentages and decimals.

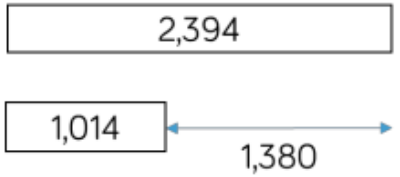
They are a useful diagram to help children solve missing number calculations (when a part is missing) or understand that the parts create the whole by adding.





Bar Model

Similar to a part-whole model, a bar model can help children identify missing numbers by subtracting or calculate the whole by adding.



$$2{,}394 - 1{,}014 = 1{,}380$$

They can help children turn a calculation into something visual e.g 432 + ? = 790

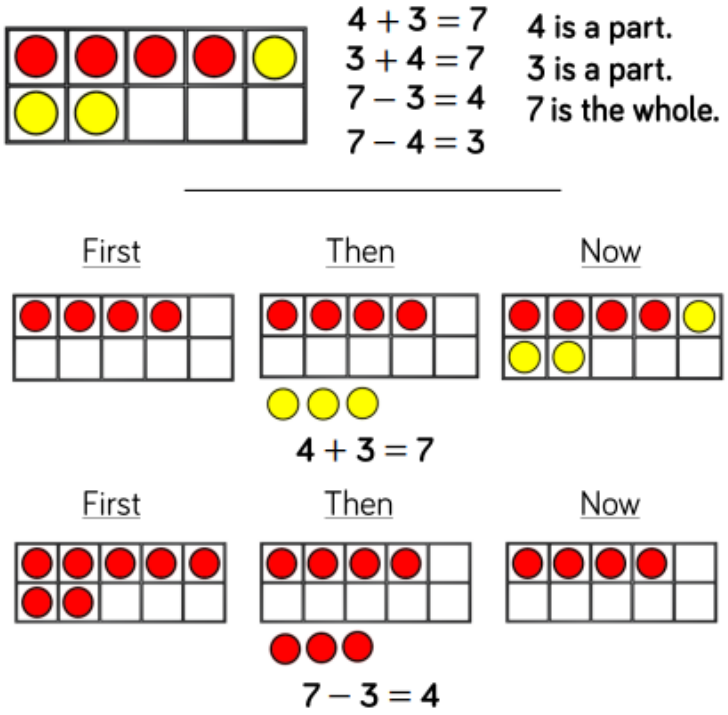
790	
432	?

40									
4	4	4	4	4	4	4	4	4	4

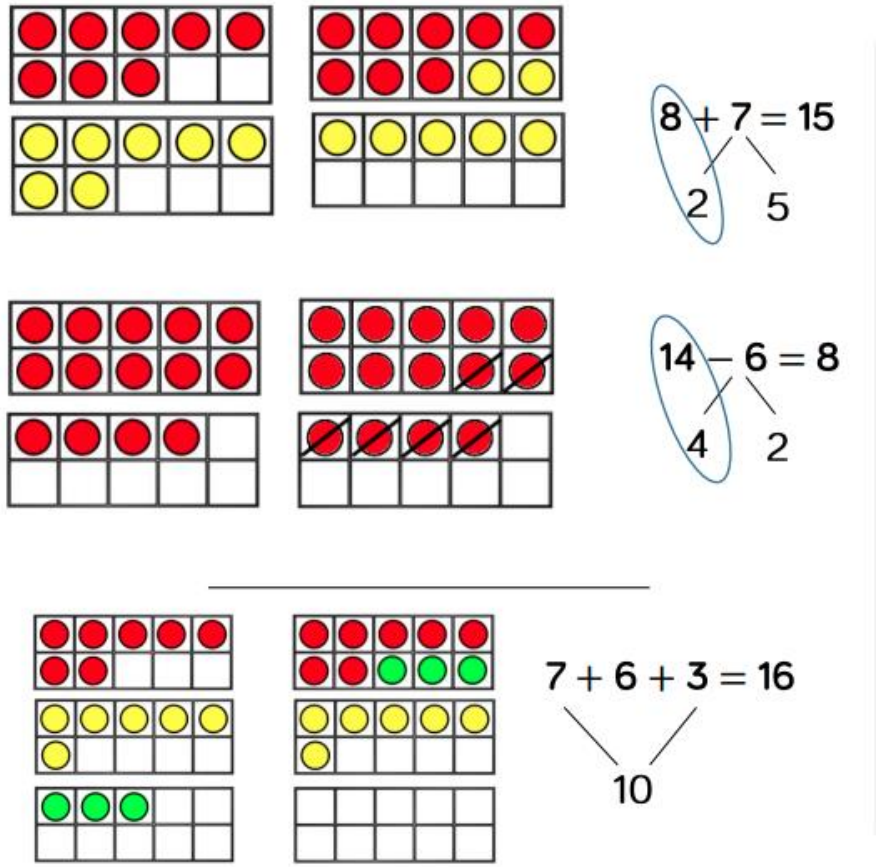
Bar models are a really useful way to explain division when the bar is split equally, or work out fraction of amounts e.g. 3/10 of 40

Ten Frames (and Five Frames)

Ten frames and five frames can be used to help children add and subtract, they can allow children a hands-on experience of increasing or decreasing the number of counters. This compliments the teaching of part-whole models where children understand that the whole can be split into parts and the parts can be totalled to create the whole. Counters do not always need to be used and children can draw different coloured circles to represent the counters.



As children become more number confident, they will be able to apply this knowledge to ten frames within 20. By identifying number bonds, children will be able to build on their mental calculations.



Bead Strings

$5 \times 3 = 15$
$3 \times 5 = 15$

$15 \div 3 = 5$

$5 \times 3 = 15$
$3 \times 5 = 15$

$15 \div 5 = 3$

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

$20 \div 4 = 5$

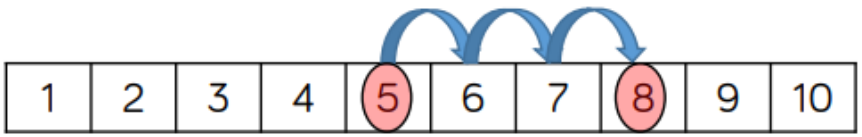
Bead strings can be useful to show children the relationship between multiplication and repeated addition. They can also be used to show related facts: understanding that a multiplication fact can help them solve a division fact.

Bead strings can also be used to support children with number bonds to 10 and 20.

Number Lines

To begin with, children may recognise these as 'number tracks'. Number tracks support the introduction or a number line and the concept of jumping along a line to solve calculations. They can be used to help children solve addition and subtraction calculations.

$5 + 3 = 8$

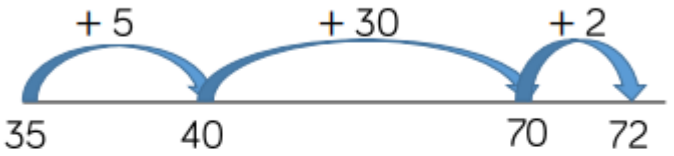


Number Lines support children with adding and subtracting, and can be used alongside a hundred square to mirror the jumps. Using a number line is a useful method to count on or back. As they grow in confidence, their jumps may be greater than ones. Children can use a physical number line, or they may draw one. It is really important that each jump touches the interval line which is labelled. Missing this out can cause mistakes and confusion.

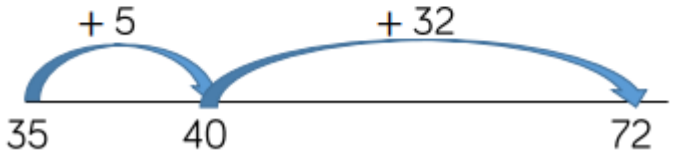
$5 + 3 = 8$

When children are confident enough, the set intervals on the number line can be removed and children will start to use a blank number line and complete the labels underneath for themselves. This allows them to make more efficient jumps and use their understanding of partitioning and bonds to 10. The number lines can continue to be used for addition and subtraction; either using it to count on or back.

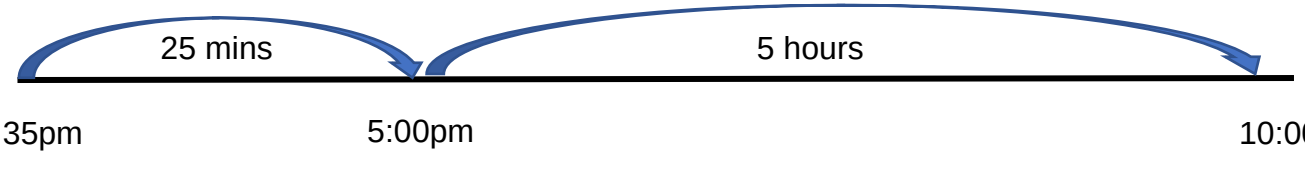
$35 + 37 = 72$



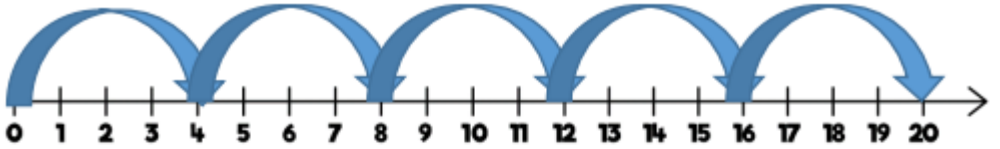
$35 + 37 = 72$

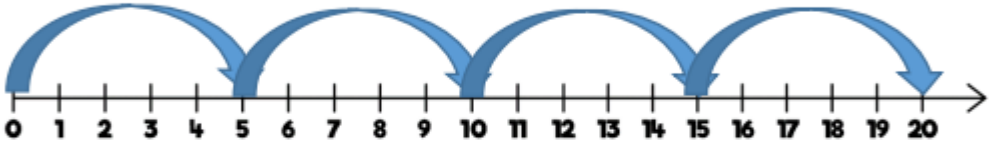


Number lines can also be used to help children calculate intervals of time.



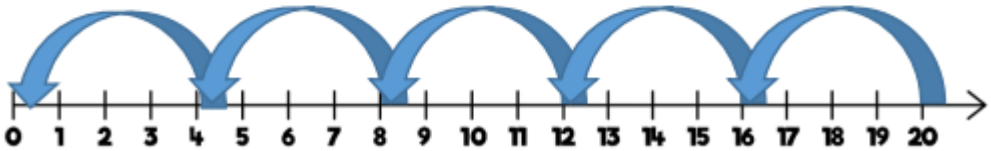
Number lines can also be very effective when teaching children to multiply and divide. Again, it is really important that the children recognise the need for accurate jumps which land on the interval line and it is labelled (if using a blank number line to start with). It is important that children understand that multiplication requires them to count on, whereas division will require them to count back. As children move through Upper Prep, they can use number lines for more challenging multiplication and division calculations.





$4 \times 5 = 20$

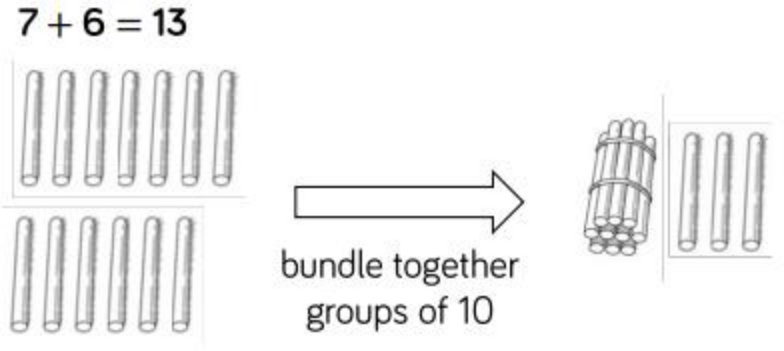
$5 \times 4 = 20$

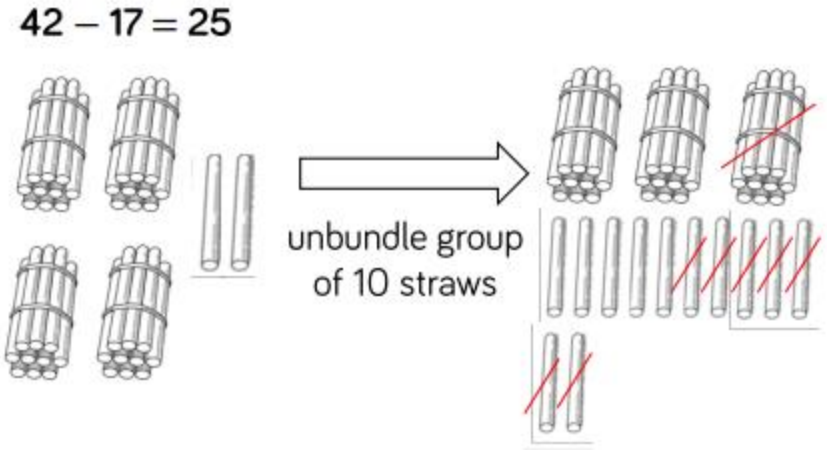


$20 \div 4 = 5$

Straws & Lollipops

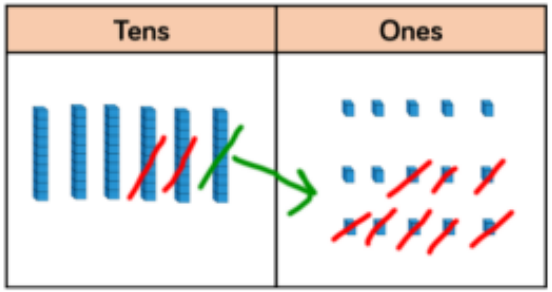
Using concrete resources such as bundles of straws or lollipops can be really effective to teach children about exchanging with adding or subtracting. When adding, children can tie together groups of ten to help them recognise the move from the ones column in a place value chart to the tens. When children are solving a subtraction calculation, they can unbundle a group of straws or lollipops and exchange them from a bundle of ten to ten ones (ten single straws). As children move through the school, strategies like this will be used alongside the teaching of the written method of addition and subtraction so that children can make the connection between the resources and the written calculations.



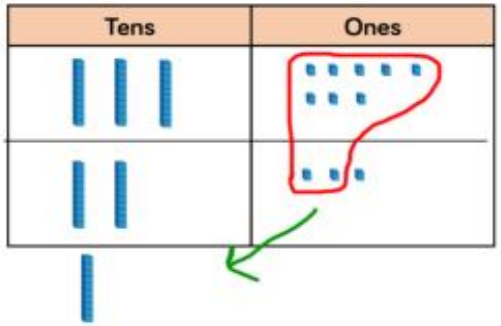


Base 10 or Dienes

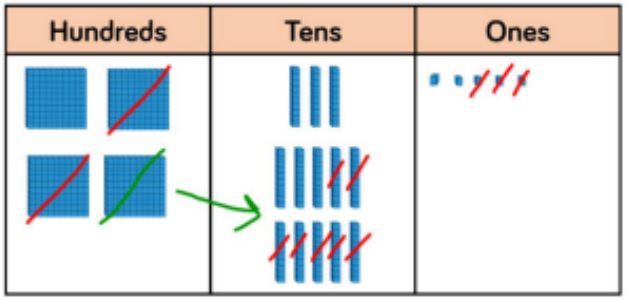
Base 10 or Dienes can be very useful to help children understand place value. Place value is essential to help children grasp the concept of numbers. The children come to recognise the value of each resource: ones, tens, hundreds and thousands. These resources can be used to support children with the learning of addition and subtraction.



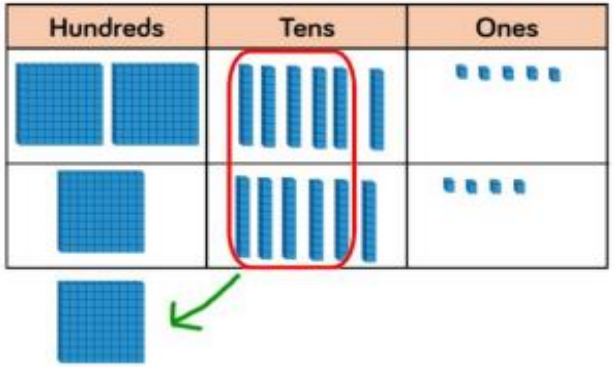
$$\begin{array}{r} {}^{5}\cancel{6}\,{}^{1}5 \\ -\ 2\,8 \\ \hline 3\,7 \end{array}$$



$$\begin{array}{r} 3\,8 \\ +\ 2\,3 \\ \hline 6\,1 \\ \hline 1 \end{array}$$



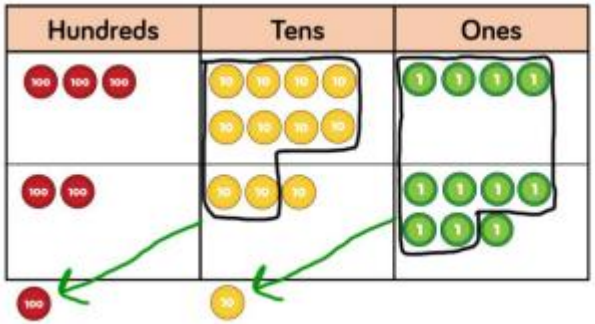
$$\begin{array}{r} {}^{3}\cancel{4}\,{}^{1}35 \\ -\ 2\,7\,3 \\ \hline 1\,6\,2 \end{array}$$



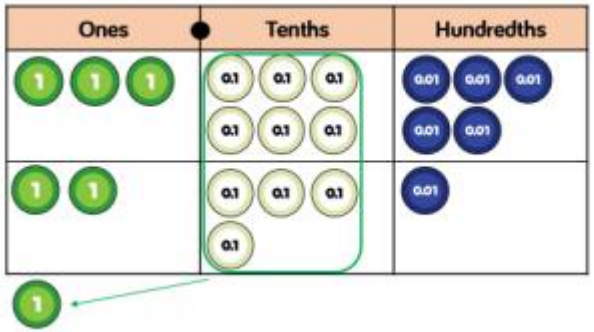
$$\begin{array}{r} 2\,6\,5 \\ +\ 1\,6\,4 \\ \hline 4\,2\,9 \\ \hline 1 \end{array}$$

Place Value Counters

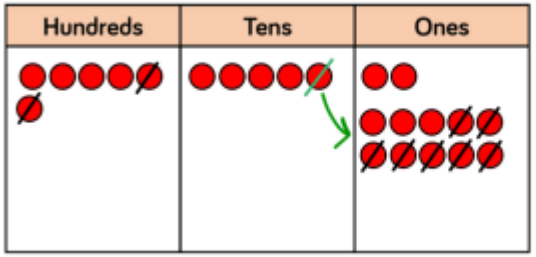
In a similar way, place value counters can also be used to support the children's understanding of place value, adding and subtracting.



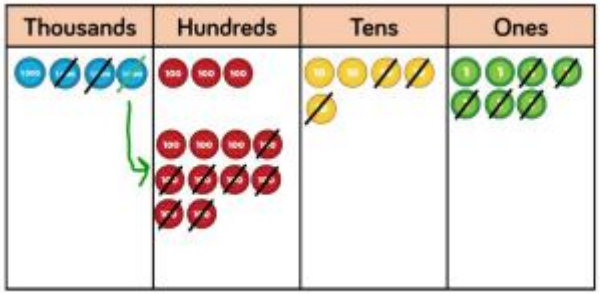
$$\begin{array}{r} 384 \\ +\ 237 \\ \hline 621 \\ \hline 1\ 1 \end{array}$$



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

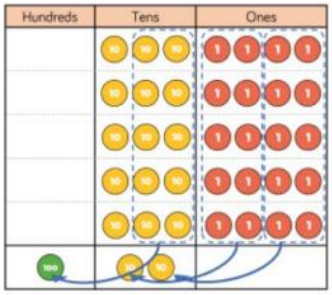


$$\begin{array}{r} {}^{4}6\not{5}^{1}2 \\ -\ 207 \\ \hline 445 \end{array}$$



$$\begin{array}{r} {}^{3}\not{4}^{1}357 \\ -\ 2735 \\ \hline 1622 \end{array}$$

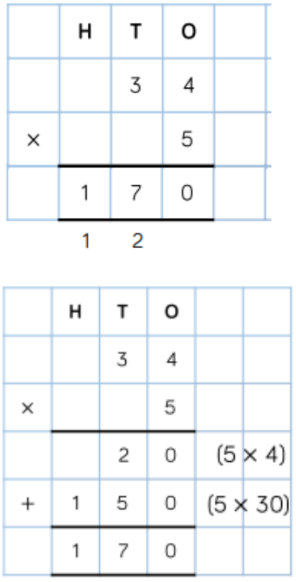
Children may also use place value counters when learning to multiply, displaying the concrete resources alongside the written method can be helpful for children to make the connection. Similarly, they could use the counters when dividing to share into equal groups.

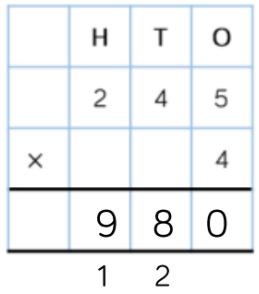
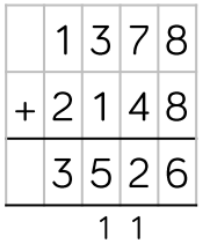
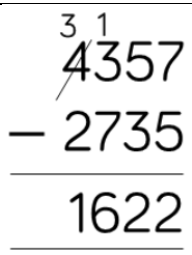


$$\begin{array}{r} 34 \\ \times\ 5 \\ \hline 170 \\ \hline 1\ 2 \end{array}$$

Written Methods

It is vital that children have a consistent approach when learning written methods. Altering language or placement of digits can cause children great difficulty. Where year groups do not introduce a new written method, children will be consolidating their learning and developing the method by applying it in different contexts. It should be noted, that in Lower Prep, Reception, Year 1 and Year 2 will use a range of methods such as part-whole models, number lines, bar models and practical resources to teach the four operations, as well as recording calculations appropriate to their ability. Number writing is also practised regularly in Reception and Year 1. There will also be a focus on practical maths.

Year group	Addition	Subtraction	Multiplication	Division
3	265 + 164 429 1	3 1 435 − 273 162		

			 H T O 2 4 5 × 4 9 8 0 1 2	
4	 1 3 7 8 + 2 1 4 8 3 5 2 6 1 1	 3 1 4357 − 2735 1622		 1 3 4 5 12

5

1	0	4	3	2	8
+	6	1	7	3	1
1	6	6	0	5	9

1

3.65
+ 2.41
6.06

1

	2	9	$^{3}\not{4}$	$^{1}3$	8	2
−	1	8	2	5	0	1
	1	1	1	8	8	1

$^{4}\not{5}\ ^{1}$.43
− 2.7
2.73

	Th	H	T	O
	1	8	2	6
×				3
	5	4	7	8

2 1

	H	T	O
		2	2
×		3	1
		2	2
	6	6	0
	6	8	2

		2	1	4
4	8	5	$^{1}6$	

	4	2	6	6
2	8	5	$^{1}3$	$^{1}2$

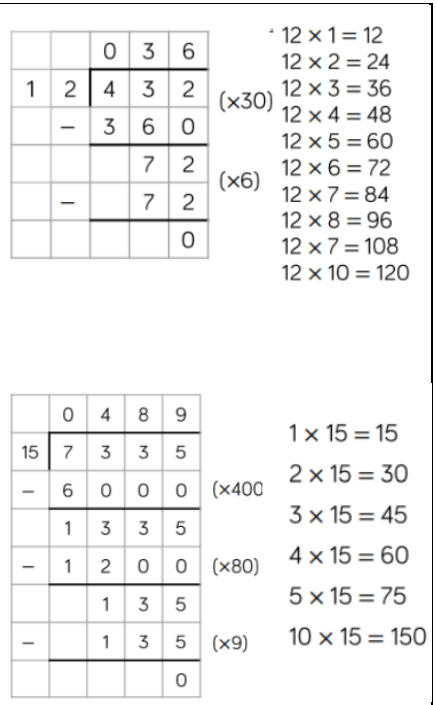
		0	3	6
12	4	$^{4}3$	$^{7}2$	

	0	4	8	9
15	7	$^{7}3$	$^{13}3$	$^{13}5$

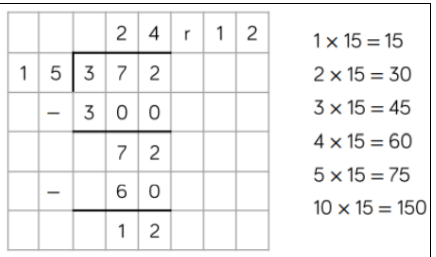
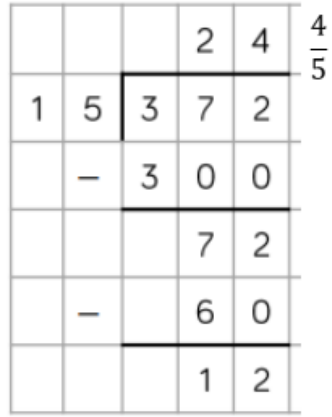
Th	H	T	O
	2	3	4
×		3	2
	4	6	8
$^{1}7$	$^{1}0$	2	0
7	4	8	8

TTh	Th	H	T	O
	2	7	3	9
×			2	8
$^{2}2$	$^{5}1$	$^{3}9$	$^{7}1$	2
$^{1}5$	4	$^{1}7$	8	0
7	6	6	9	2

1

6				

0 3 6
1 2 4 3 2 (×30)
– 3 6 0
7 2 (×6)
– 7 2
0
12 × 1 = 12
12 × 2 = 24
12 × 3 = 36
12 × 4 = 48
12 × 5 = 60
12 × 6 = 72
12 × 7 = 84
12 × 8 = 96
12 × 7 = 108
12 × 10 = 120
0 4 8 9
15 7 3 3 5
– 6 0 0 0 (×400
1 3 3 5
– 1 2 0 0 (×80)
1 3 5
– 1 3 5 (×9)
0
1 × 15 = 15
2 × 15 = 30
3 × 15 = 45
4 × 15 = 60
5 × 15 = 75
10 × 15 = 150

				 Children will begin by finding a remainder (represented with the letter 'r'), eventually they will build on this method and work the remainder out as a fraction or decimal. 

Progression of Skills

White Rose outlines when each skill should be taught from Year 1 through to Year 6 for the four operations: addition, subtraction, multiplication and division. It is important to note that children may not move on if they are not ready. Some methods require children to build on prior knowledge, if this is not secure then this could leave gaps in children's understanding which may lead to misconceptions as they progress. Using pre- and post- assessments, as discussed in the maths policy, is a really important tool, alongside teacher assessment. Those children receiving academic support may find that they are directed towards one method for each of the four operations. Some children can find multiple methods and representations overwhelming, however, for many children the different visuals and methods strengthens their understanding. Teacher assessment is crucial in deciding the best approach for individual children.

Reception also has a progression of skills which is specific to the year group (this is outlined below). The progression of skills also involves the four operations and is broken down across the three terms: Autumn, Spring and Summer.

Reception

Term	Skill	Representations and Models
Autumn	One more and less	Number cards, number lines, counters, cubes, five frames, tens frames, number shapes
Spring	Composition of 4 and 5	Five frames, tens frames, part-whole model, number lines
	Combining 2 amounts	Cubes, sorting objects, number lines, five frames, tens frames, part-whole model
	Making pairs	Number cards, sorting objects
	Bonds to 10	Tens frames, part-whole models
Summer	Building numbers	Cubes, number shapes, five frames, tens frames
	Adding more	Number lines, five frames, tens frames, counters, cubes
	Taking away	Number lines, five frames, tens frames, counters, cubes
	Doubling	Cubes, sorting objects, counters
	Sharing and grouping	Sorting objects

Addition

Skill	Year	Representations and models	
Add two 1-digit numbers to 10	1	Part-whole model Bar model Number shapes	Ten frames (within 10) Bead strings (10) Number tracks
Add 1 and 2-digit numbers to 20	1	Part-whole model Bar model Number shapes Ten frames (within 20)	Bead strings (20) Number tracks Number lines (labelled) Straws
Add three 1-digit numbers	2	Part-whole model Bar model	Ten frames (within 20) Number shapes
Add 1 and 2-digit numbers to 100	2	Part-whole model Bar model Number lines (labelled)	Number lines (blank) Straws Hundred square

Skill	Year	Representations and models	
Add two 2-digit numbers	2	Part-whole model Bar model Number lines (blank) Straws	Base 10 Place value counters
Add with up to 3-digits	3	Part-whole model Bar model	Base 10 Place value counters Column addition
Add with up to 4-digits	4	Part-whole model Bar model	Base 10 Place value counters Column addition
Add with more than 4 digits	5	Part-whole model Bar model	Place value counters Column addition
Add with up to 3 decimal places	5	Part-whole model Bar model	Place value counters Column addition

Subtraction

Skill	Year	Representations and models	
Subtract two 1-digit numbers to 10	1	Part-whole model Bar model Number shapes	Ten frames (within 10) Bead strings (10) Number tracks
Subtract 1 and 2-digit numbers to 20	1	Part-whole model Bar model Number shapes Ten frames (within 20)	Bead string (20) Number tracks Number lines (labelled) Straws
Subtract 1 and 2-digit numbers to 100	2	Part-whole model Bar model Number lines (labelled)	Number lines (blank) Straws Hundred square
Subtract two 2-digit numbers	2	Part-whole model Bar model Number lines (blank) Straws	Base 10 Place value counters

Skill	Year	Representations and models	
Subtract with up to 3-digits	3	Part-whole model Bar model	Base 10 Place value counters Column subtraction
Subtract with up to 4-digits	4	Part-whole model Bar model	Base 10 Place value counters Column subtraction
Subtract with more than 4 digits	5	Part-whole model Bar model	Place value counters Column subtraction
Subtract with up to 3 decimal places	5	Part-whole model Bar model	Place value counters Column subtraction

Multiplication

Skill	Year	Representations and models	
Solve one-step problems with multiplication	1/2	Bar model Number shapes Counters	Ten frames Bead strings Number lines
Multiply 2-digit by 1-digit numbers	3/4	Place value counters Base 10	Expanded written method Short written method
Multiply 3-digit by 1-digit numbers	4	Place value counters Base 10	Short written method
Multiply 4-digit by 1-digit numbers	5	Place value counters	Short written method

Skill	Year	Representations and models	
Multiply 2-digit by 2-digit numbers	5	Place value counters Base 10	Short written method Grid method
Multiply 2-digit by 3-digit numbers	5	Place value counters	Short written method Grid method
Multiply 2-digit by 4-digit numbers	5/6	Formal written method	

Division

Skill	Year	Representations and models	
Solve one-step problems with division (sharing)	1/2	Bar model Real life objects	Arrays Counters
Solve one-step problems with division (grouping)	1/2	Real life objects Number shapes Bead strings Ten frames	Number lines Arrays Counters
Divide 2-digits by 1-digit (no exchange sharing)	3	Straws Base 10 Bar model	Place value counters Part-whole model
Divide 2-digits by 1-digit (sharing with exchange)	3	Straws Base 10 Bar model	Place value counters Part-whole model

Skill	Year	Representations and models	
Divide 2-digits by 1-digit (sharing with remainders)	3/4	Straws Base 10 Bar model	Place value counters Part-whole model
Divide 2-digits by 1-digit (grouping)	4/5	Place value counters Counters	Place value grid Written short division
Divide 3-digits by 1-digit (sharing with exchange)	4	Base 10 Bar model	Place value counters Part-whole model
Divide 3-digits by 1-digit (grouping)	4/5	Place value counters Counters	Place value grid Written short division

Skill	Year	Representations and models	
Divide 4-digits by 1-digit (grouping)	5	Place value counters Counters	Place value grid Written short division
Divide multi-digits by 2-digits (short division)	6	Written short division	List of multiples
Divide multi-digits by 2-digits (long division)	6	Written long division	List of multiples

Times Tables

There are a number of ways to learn multiplication facts, however repetition is key; children need to be fluent in these facts in order to develop their knowledge with written methods for multiplication and division. Times table facts also support children in their learning of area, fractions, ratio and proportion and measurement, to name just a few. Ensuring that children understand the related facts is vital to develop their number confidence. Children can use Times Tables Rockstars (an online platform) to help them improve their times table fluency.

For example, knowing that 2 x 6 = 12 can lead to a number of other multiplication and division facts:

6 x 2 = 12
12 ÷ 6 = 2
12 ÷ 2 = 6
20 x 6 = 120
200 x 6 = 1200
1200 ÷ 6 = 200

Year Group	Times Table and division facts
2	2x 5x 10x
3	3x 4x 8x
4	6x 7x 9x 11x 12x

By Year 5 and 6, it is expected that the children will use this time to consolidate their knowledge of multiplication and division facts and be able to apply them to make them more efficient and accurate mathematicians.

Useful vocabulary:

Combine- bringing groups of objects or numbers together to find out the total

Common factor- factors which are the same for two or more numbers e.g. 4 and 2 are factors of 8 because 4 x 2 = 8 but they are also factors of 12 because 4 x 3 = 12 and 2 x 6 = 12

Common multiple- multiples which are the same for two or more numbers e.g. 15 is a multiple of 5 and 3 because 5 x 3 = 15 and 3 x 5 = 15 (15 appears in both the 5 times table and the 3 times table)

Commutative- numbers can be added in any order

Composite number- a whole number which can be created by multiplying other numbers (whole numbers). Any number which can't be made by multiplying whole numbers is called a prime number

Cubed number- a number which is used three times to multiply itself e.g. 4 x 4 x 4 = 64 Cubed numbers are represented by a small three above the number e.g. 4^3

Difference- numerical difference

Digit- a single numeral e.g. 3 345 is a number made up of the digits 3, 4, 5

Divide-sharing a number equally. If there is an amount which cannot be shared equally then we refer to this as the remainder. Year 6 may share this remainder and take it to a decimal.

Exchange-Change a number or expression for another of an equal value (e.g. exchanging a ten for ten ones when subtracting)

Factor- numbers which are multiplied together to get another number e.g. 4 and 2 are factors of 8 because 4 x 2 = 8

Integer- a number which does not include any decimals. It can mean positive or negative numbers.

Lots of- this is often referred to when multiplying

Multiple-the answer when multiplying a number by a whole number e.g. 14 is a multiple of 7 because 2 x 7 = 14

Multiply-this is also referred to as repeated addition. This is the process of increasing a number by a specific number of times.

Partitioning-splitting the number to make it easier to work with e.g. breaking the number into Tens and Ones.

Place holder- refers to a zero which is significant in the method

Prime factor – a factor of a number which is also a prime number

Prime number – a whole number, above one, that can only be divided by 1 and itself

Remainder-the remaining amount left over after division

Sharing-this is referred to when dividing as it is the process of splitting a number (or items) into equal groups

Squared number- a number which is multiplied by itself e.g. 4 x 4 = 16. A squared number is represented by a small 2 above the number e.g. 4^2

Subitise- recognising the amount of objects without the need to count them.

Sum-the result of addition

Times- another word used to mean multiply

Total-the answer when numbers have been added

There will be terminology which has not been covered in this section, there is a great website called 'Maths is Fun' which provides an illustrated dictionary for more mathematical terminology.
https://www.mathsisfun.com/definitions/letter-c.html