St. Joseph's Catholic Primary School

Maths Calculation Policy

Love God,

Love learning,

Love life.

Date written	**September 2022**
Date agreed by governing body	**November 2022**
Date of next review	**September 2023**

Maths Mastery

Mastering maths means pupils of all ages acquiring a deep, long-term, secure and adaptable understanding of the subject. The phrase 'teaching for mastery' describes the elements of classroom practice and school organisation that combine to give pupils the best chances of mastering maths. Achieving mastery means acquiring a solid enough understanding of the maths that's been taught to enable pupils to move on to more advanced material. (NCETM) As a school, we use the White Rose Maths schemes of learning as a basis for Maths planning. Teachers use the year group modules for their particular year group and they will not move onto a higher year group's scheme of work. These modules support teaching for mastery and encourage the children to use concrete materials and pictorial representations, developing their fluency, reasoning and problem solving skills in mathematical concepts.

At the centre of the mastery approach to the teaching of mathematics is the belief that all children have the potential to succeed. They should have access to the same curriculum content and, rather than being extended with new learning, they should deepen their conceptual understanding by tackling challenging and varied problems. Similarly, with calculation strategies, children must not simply rote learn procedures but demonstrate their understanding of these procedures through the use of concrete materials and pictorial representations. This policy outlines the different calculation strategies that should be taught and used in Year 1 to Year 6 in line with the requirements of the 2014 Primary National Curriculum

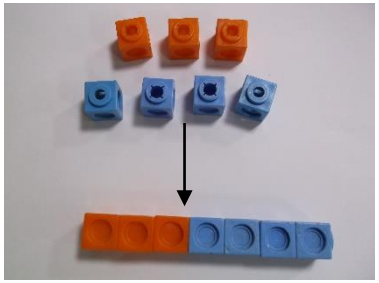
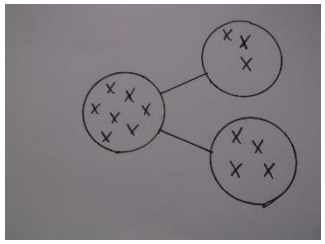
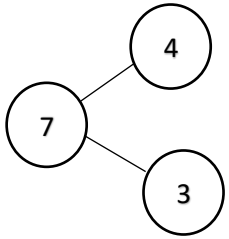
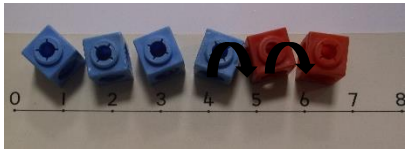
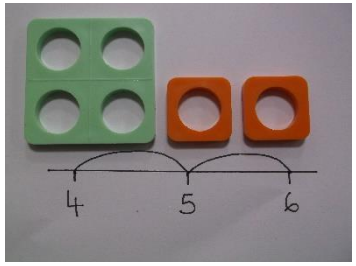
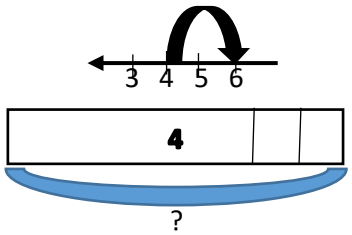
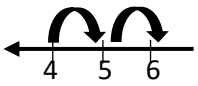
Mathematical Language

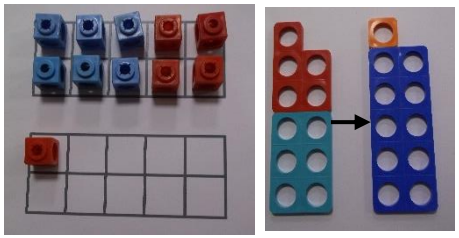
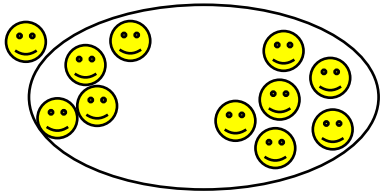
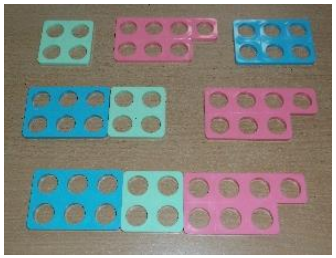
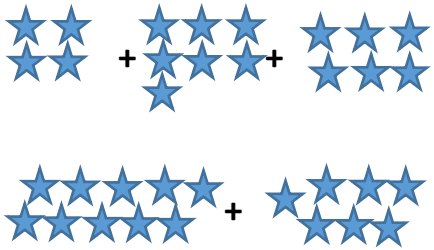
The 2014 National Curriculum is explicit in articulating the importance of children using the correct mathematical language as a central part of their learning (reasoning). Indeed, in certain year groups, the non-statutory guidance highlights the requirement for children to extend their language around certain concepts. It is therefore essential that teaching using the strategies outlined in this policy is accompanied by the use of appropriate and precise mathematical vocabulary. New vocabulary should be introduced in a suitable context (for example, with relevant real objects, apparatus, pictures or diagrams) and explained carefully. High expectations of the mathematical language used are essential, with teachers only accepting what is correct. The school agreed list of terminology is located at Appendix A to this document.

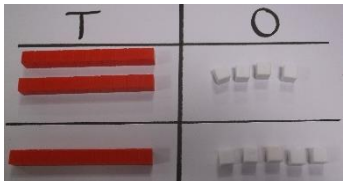
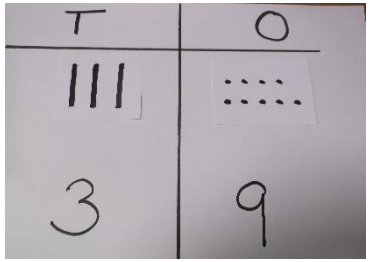
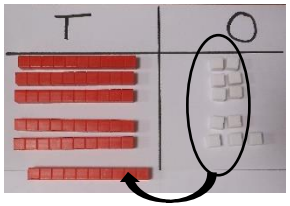
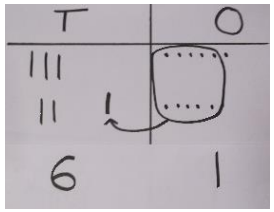
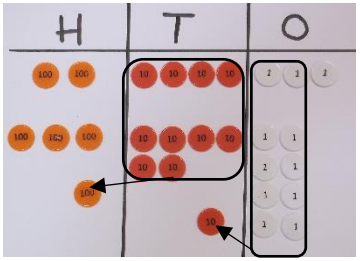
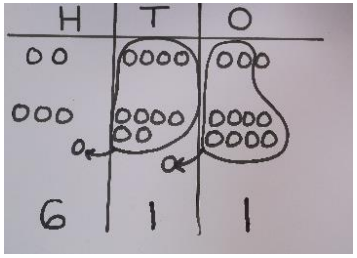
How to use the policy

This policy has been adapted from the White Rose Maths Calculation Policy. It has been set out as a progression of mathematical skills rather than into year group phases. Teachers will decide when consolidation of skills is required or when to move onto the next concept. It is vitally important however that **the emphasis for the children is to broaden and deepen their knowledge rather than to accelerate through the concepts**. In order to do this, children will tackle a variety of problems, developing their reasoning and problem solving skills with increasing challenges, within their year group scheme of work. Progression should be considered next to the 'Ready to Progress Criteria' provided by the Department for Education: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/897806/Maths_guidance_KS_1_and_2.pdf

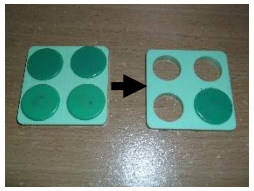
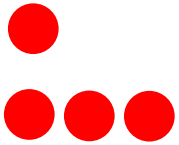
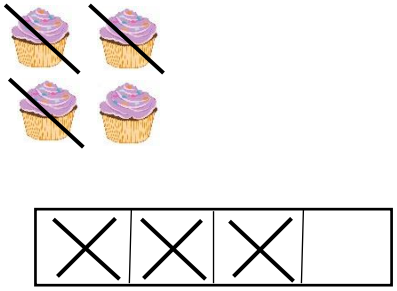
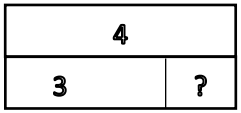
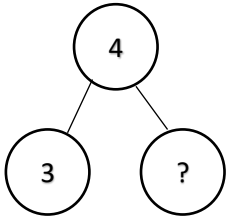
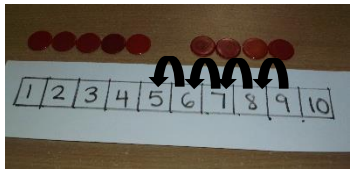
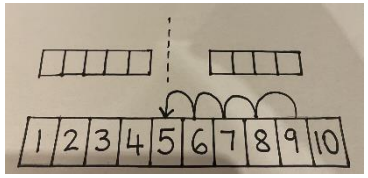
Addition

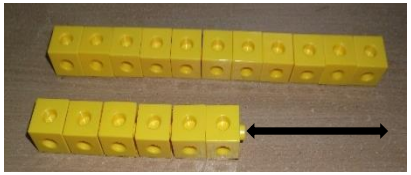
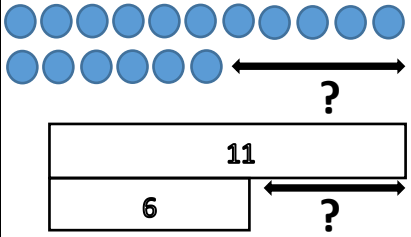
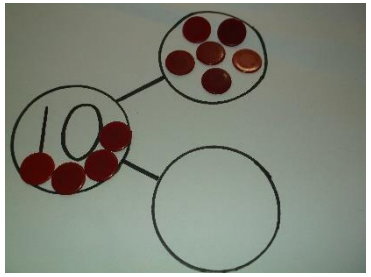
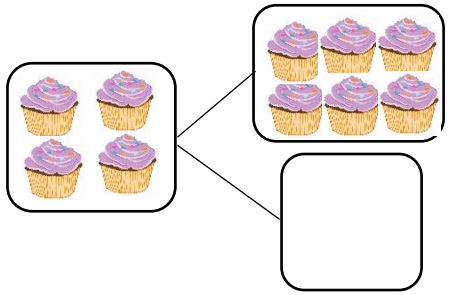
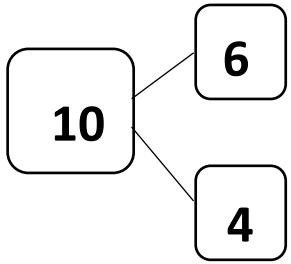
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	Use resources (e.g. cubes, cars, teddies, blocks) to add two numbers together as a group or in a bar. 	Represent the objects using pictures to add two numbers together as a group or in a bar. Dots or crosses could be used in a part-whole model. 	Use a part-part whole diagram to move onto the abstract. 4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 
Starting at the bigger number and counting on	Start with the larger number then count on 1 by 1 to find the answer.  	Start at the larger number on the number line or bar model and count on in ones or in one jump to find the answer. **4 + 2 = 6** 	The abstract number line: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? **4 + 2** 

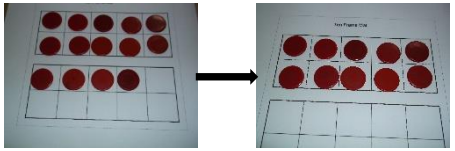
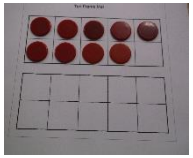
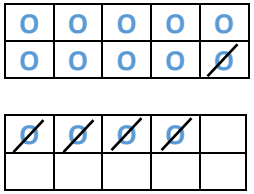
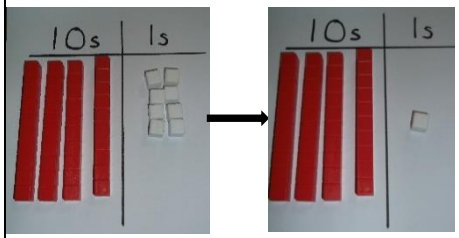
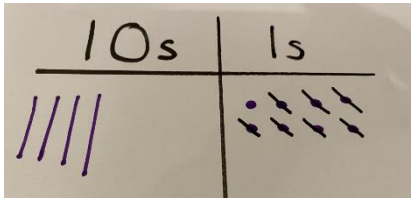
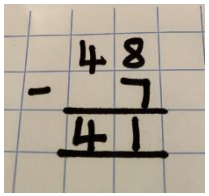
Objective and Strategies	Concrete	Pictorial	Abstract
Regrouping to make 10	Start with the larger number and use the smaller number to make 10 – e.g use ten frames and cubes or Numicon. 	Draw the ten frame, use pictures or a number line. Regroup or partition the smaller number to make 10.  **6 + 5 = 11** **4 1**	If I am at six, how many more do I need to make 10? How many more do I add now? **6 + 5 = 11 (6 + 4 = 10 + 1 = 11)** **6 + ☐ = 11** **6 + 5 = 5 + ☐** **☐ = 6 + 5**
Adding three single digits	Make 10 with two of the digits (if possible) then add the third digit. **4 + 7 + 6 = 17** Put 4 and 6 together to make 10. Add on 7. 	Add together three groups of objects. Draw a picture to recombine the groups to make 10. **4 + 7 + 6** **6 + 4 = 10 then + 7** 	Combine the two numbers that make 10 and add the remainder. **(4) + 7 + (6) = [10] + [7]** **10** **= [17]**

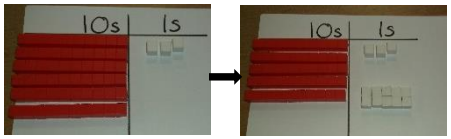
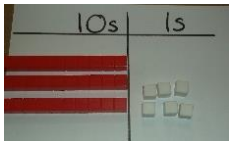
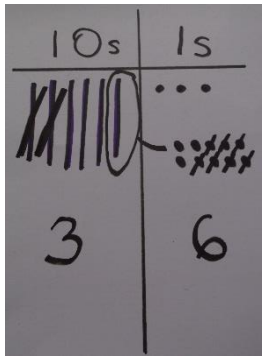
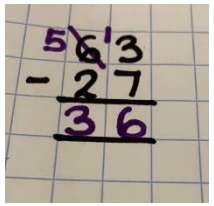
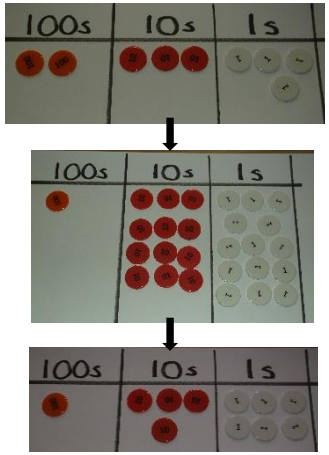
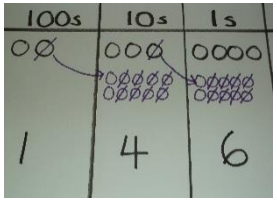
Objective and Strategies	Concrete	Pictorial	Abstract
Column method with base 10, no regrouping	Add together the ones first, then add the tens. Use Base 10 and then place value counters. **24 + 15** 	Represent Base 10 e.g. as lines for tens and dots/crosses for ones. 	**24 + 15** **4 + 5 = 9** **20 + 10 = 30** **30 + 9 = 39** **2 4** **+ 1 5** Formal method: **3 9**
Column method with base 10, with regrouping	Make both numbers with Base ten or place value counters. **36 + 25** 	Represent the Base 10 in a place value chart. 	Start by partitioning the numbers, before moving on to clearly show the exchange below the addition: **30 + 6** **20 + 5** **50 + 11 = 61** **36** **+ 25** **61** **1**
Column Method with place value counters	Use place value counters, showing exchange. **243 + 368** 	Represent the counters in a place value chart, circling when to make an exchange. 	Formal method: **2 4 3** **+ 3 6 8** **6 1 1** 1 1 This will lead to an understanding of adding any number, however large and including decimals.

Subtraction

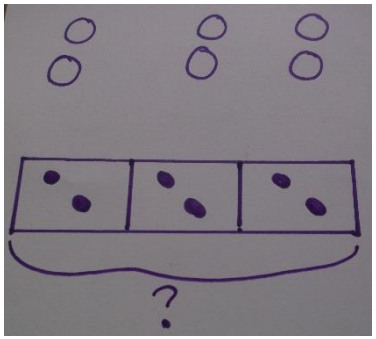
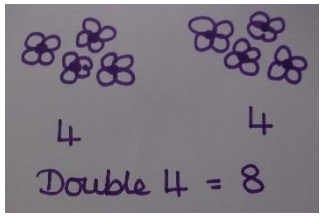
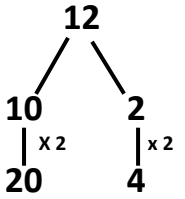
Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes, Numicon etc. to show how objects can be taken away. **4 – 3 = 1**  	Cross out drawn objects to show what has been taken away. 	**4 – 3 = 1** **= 4 - 3**  
Counting back	Start with the larger number and count back. **9 – 4 = 5**  	Count back on a number line or track. Make a pictorial representation. **9 – 4 = 5**  	"Put 9 in your head, count back 4. What number are you at? Use a number line to help – or your fingers!"

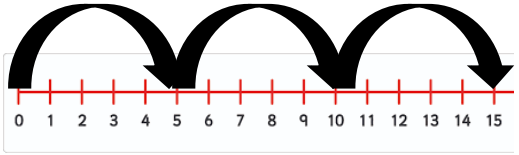
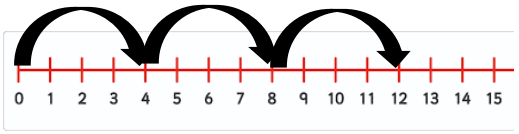
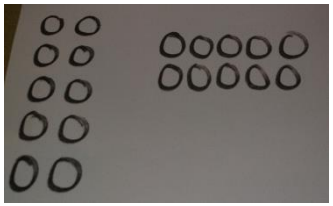
Objective and Strategies	Concrete	Pictorial	Abstract
Find the difference	Use cubes, Numicon or other objects to find the difference. Calculate the difference between 11 and 6  ?	Draw cubes or other objects used and/or use bars to find the difference. 	Find the difference between 11 and 6. 11 – 6, the difference is ☐ Rosie has 11 sandwiches, Sophie has 6 sandwiches. Find the difference between the number of sandwiches.
Part-whole model	Link to addition – use the part whole model to help explain the inverse between addition and subtraction. **10 – 6 =** 	Use a pictorial representation to show the part whole model 	Move to using numbers within the part whole model.  **10 – 6 = 4** **10 – 4 = 6**

Objective and Strategies	Concrete	Pictorial	Abstract
Make 10	Using a ten frame **14 – 5** **14** **- 4**  **- 1** 	Present the ten frame pictorially and discuss - start at 14, take away 4 to reach 10, then take away the remaining 1. They have taken away 5 altogether. 	Show how to make 10 by partitioning: **14 - 5 = 9** **4** **1** 14 – 4 = 10 10 – 1 = 9
Column method with base 10 without regrouping	Use base 10 **48 – 7** 	Represent the base 10 pictorially or with place value counters. 	This will lead to a clear, written, column subtraction. 

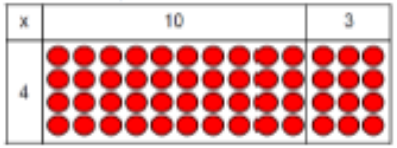
Objective and Strategies	Concrete	Pictorial	Abstract
Column method with regrouping	Use Base 10 and start with one exchange before moving onto subtractions with two or more exchanges. **63 - 27**  Make the larger number first, then exchange 1 ten for 10 ones. Now complete the subtraction.  	Represent the Base 10 pictorially, showing the exchange.  	Formal Column method. Children must understand that when they have exchanged the 10 they still have 63 because 63 = 50 + 13. 
Column method using place value counters	**234 – 88**  **146**	Represent the place value counters pictorially, remembering to show what has been exchanged.  	Formal column method. $^{1}2\not{}^{12}\not{3}\,^{1}4$ $-\quad 8\,8$ $1\,4\,6$ This will lead to an understanding of subtracting any number, however large and including decimals.

Multiplication

Objective and Strategies	Concrete	Pictorial	Abstract
Recognising and making equal groups	Use different objects to make equal groups. **3 x 2** 	Represent the practical resource as a picture. 	Write the equal groups as a number sentence **3 x 2 = 6** **2 x 3 = 6** **6 = 3 x 2**
Doubling	Use practical activities to show how to double a number.  **Double 4 = 8** **4 x 2 = 8**	Draw pictures to show how to double a number. 	Partition a number then double each part before recombining it back together.  **Double 12 is 20 + 4** **Double 12 = 24**

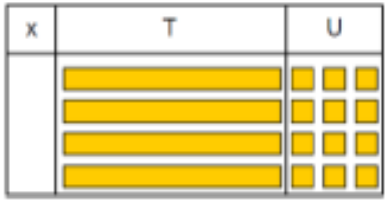
Objective and Strategies	Concrete	Pictorial	Abstract
Counting in multiples	Count in multiples with objects in equal groups **2 4 6 8 10** 	Use a number line or pictures to continue counting in multiples 	Count in multiples of a number aloud and write sequences with multiples of numbers. **2, 4, 6, 8, 10** **5, 10, 15, 20, 25, 30**
Repeated addition	Use different objects to add equal groups **4 + 4 + 4** 	Represent the practical resources as a picture and use a bar model.  **4 + 4 + 4** 	Write addition sentences to describe the objects and pictures. **4 + 4 + 4 = 12** **3 x 4 = 12** **4 x 3 = 12**
Arrays to show commutativity	Create arrays to show multiplication sentences **2 x 5 = 5 x 2** 	Represent the arrays pictorially 	Use an array to write a range of calculations **10 = 2 x 5** **2 x 5 = 10** **5 x 2 = 10** **2 + 2 + 2 + 2 + 2 = 10** **10 = 5 + 5**

<table>
<tr><th>Objective and Strategies</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Grid Method</td>
<td>Show the link first with arrays to introduce the grid method.

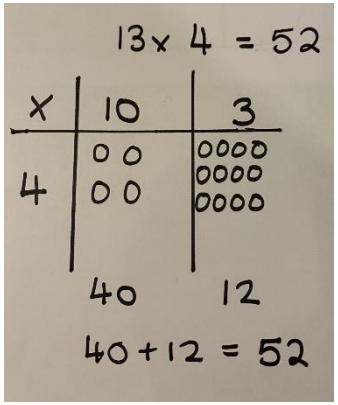
13 x 4
 

4 rows of 10 and 4 rows of 3

Move onto Base 10

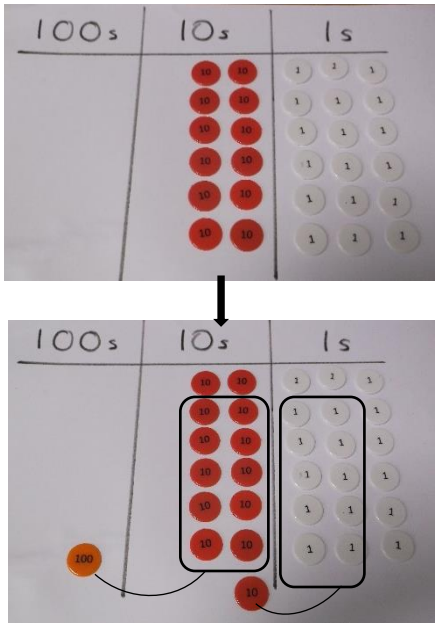
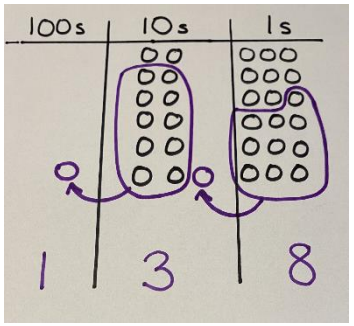
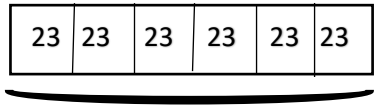
4 rows of 13</td>
<td>Represent the work pictorially, drawing the counters or just circles in different columns to show thinking.

 
</td>
<td>Start with multiplying one digit numbers and showing the clear addition alongside.
13 x 4

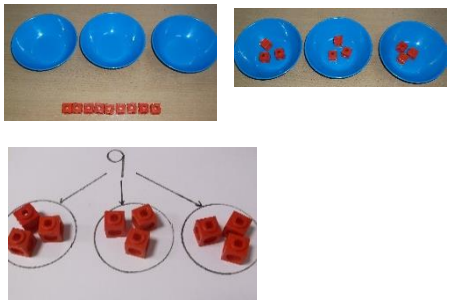
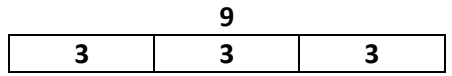
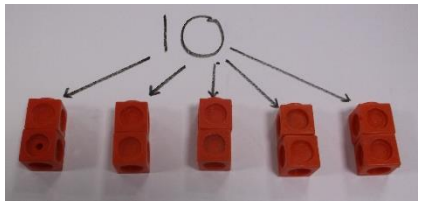
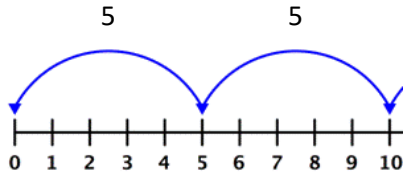
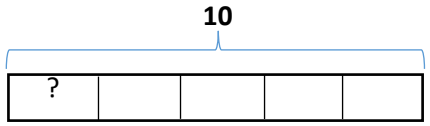
<table>
<tr><th>X</th><th>10</th><th>3</th></tr>
<tr><td>4</td><td>40</td><td>12</td></tr>
</table>
40 + 12 = 52

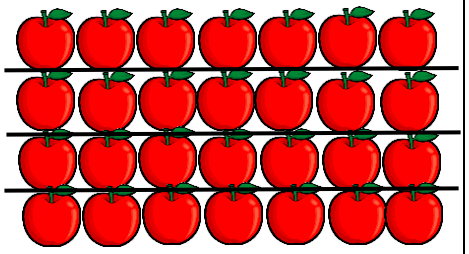
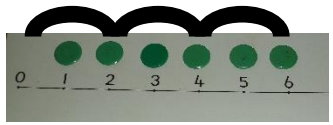
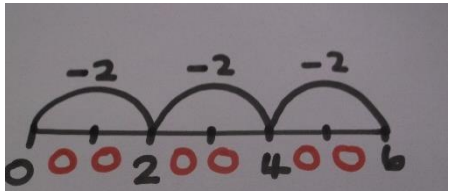
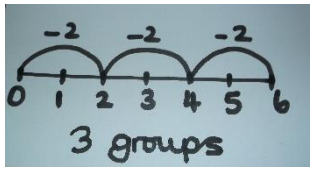
Moving forward, multiply 2 digits by 2 digits or more, showing the different rows in the grid.
18 x 13

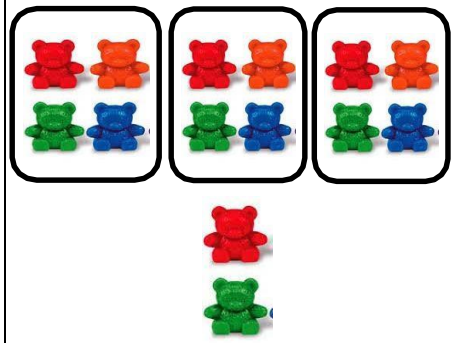
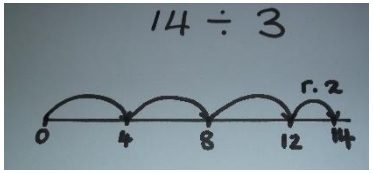
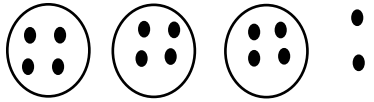
<table>
<tr><th>X</th><th>10</th><th>8</th></tr>
<tr><td>10</td><td>100</td><td>80</td></tr>
<tr><td>3</td><td>30</td><td>24</td></tr>
</table>
100 + 80 = 180
30 + 24 = 54
180 + 54 = 234</td>
</tr>
</table>

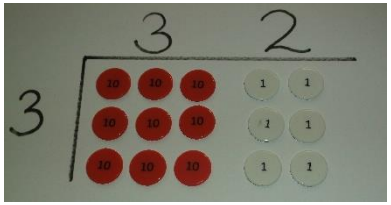
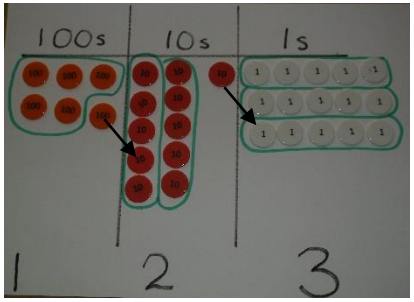
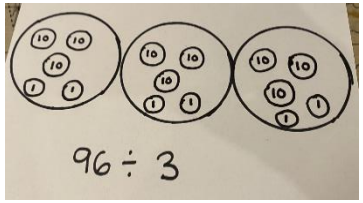
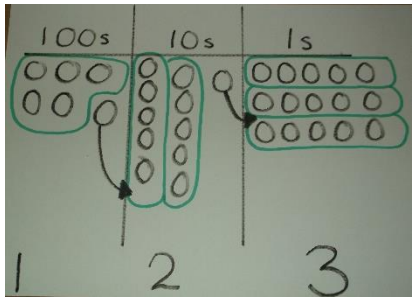
Objective and Strategies	Concrete	Pictorial	Abstract
Column multiplication	Use place value counters initially. Important to always multiply from the smallest place value column. **23 x 6**  1 3 8	Represent the counters pictorially and use a bar model **23 x 6**   **?**	Children record what they are doing to show understanding and move to the formal column method **3 x 23** **20 3** 3 x 20 = 60 3 x 3 = 9 60 + 9 = 69 **23** **X 3** **69** **6 x 23 =** **23** **X 6** **138** **1 1**
Long Multiplication	When children start to multiply 3 digits by 2 digits and 4 digits by 2 digits, they should be confident with the abstract. They should start with the grid method first (see above) and then move onto the formal method of long multiplication. To complete 124 x 26, children will: Get 744 by solving 124 x 6 Get 2480 by solving 124 x 20		**1 2 4** **X 2 6** **7 4 4** **2 4^{1}8^{2}0** **3 2 4** **1 1**

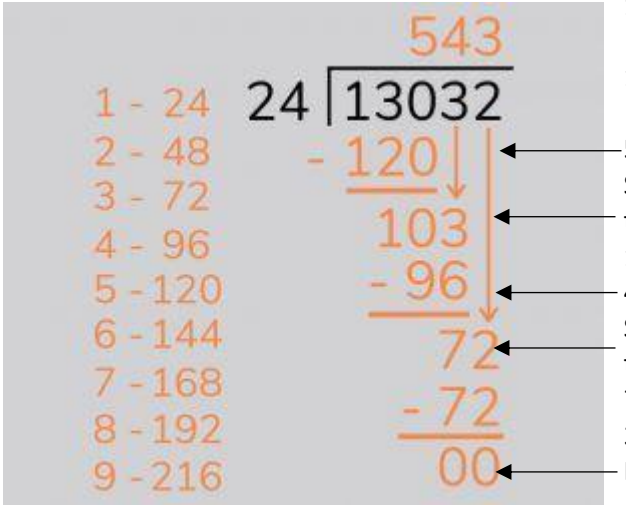
Division

Objective and Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups	Share into groups using a range of objects **9 ÷ 3** 	Represent the sharing pictorially 	**9 ÷ 3 = 3**  Share 9 biscuits between 3 people.
Division as grouping	Divide quantities into equal groups 10 ÷ 5 	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Use a bar model and split it into the number of groups you are dividing by to work out how many would be in each group.  10 ÷ 5 = ? 5 x ? = 10	**10 ÷ 5 = 2** Divide 10 into 5 equal groups. How many are in each group?

Objective and Strategies	Concrete	Pictorial	Abstract
Division within arrays	Link division to multiplication by creating arrays and thinking about the number sentences that can be created.  28 ÷ 4 = 7 7 x 4 = 28 28 ÷ 7 = 4 4 x 7 = 28	Draw an array and use lines to split the array into groups to make multiplication and division sentences. 	Find the inverse of multiplication and division sentences by creating four linking number sentences. **7 x 4 = 28** **4 x 7 = 28** **28 ÷ 7 = 4** **28 ÷ 4 = 7**
Repeated subtraction	Use counters above a ruler or number line **6 ÷ 2**  3 groups of 2	Represent repeated subtraction pictorially 	Use a number line to represent the equal groups that have been subtracted. **6 ÷ 2 = 3** 

Objective and Strategies	Concrete	Pictorial	Abstract
Division with a remainder	Divide objects between groups and see how many are left over. **14 ÷ 3** 	Use a number line to see how many groups you make and how many more you need to jump to find a remainder.  Draw dots and group them or a bar model to divide an amount and clearly show a remainder.  Remainder 2 14 4 | 4 | 4 | 2	Complete the written number sentence and show the remainder using r. **14 ÷ 3 = 4 r. 2** dividend divisor quotient remainder

Objective and Strategies	Concrete	Pictorial	Abstract
Short division	Use place value counters to divide using the short method alongside. **96 ÷ 3**  **615 ÷ 5** Make the number with place value counters. Start with the biggest place value, put 6 hundreds into groups of 5. Exchange the remaining hundred for 10 tens. Make groups of 5 out of the 11 tens. Exchange the remaining ten for 10 ones. Make groups of 5 with the 15 ones.  	Represent the division pictorially, encouraging them to move towards counting in multiples to divide more efficiently.  Represent the place value counters pictorially  	Complete the calculation using the short division scaffold. **3 2** **3 | 9 6** **1 2 3** **5 | 6 ¹1 ¹5**

Objective and Strategies	Concrete	Pictorial	Abstract
Short division with remainders and long division	By now, children should be confident with the abstract. They could still use place value counters if needed to provide support. 432 ÷ 5 = 86 r. 2 or 86 $\frac{2}{5}$ or 86.4 Long division should be taught as a step by step method: 1. Divide 2. Multiply 3. Subtract 4. And bring the next digit down	 13032 ÷ 24 = 130 ÷ 24 5 x 24 = 120 Subtract and bring the next digit down 103 ÷ 24 4 x 24 = 96 Subtract and bring the next digit down 72 ÷ 24 3 x 24 = 72 No remainder	8 6 r. 2 or $\frac{2}{5}$ 5 | 4 3 ³2 8 6 . 4 5 | 4 3 ³2 . 0 - 30 ↓ 2 0 2 8 .8 15 | 4 3 2 .0 3 0 ↓ 1 3 2 1 2 0 ↓ 1 2 0 1 2 0 0

Appendix A

Correct Mathematical Language

High expectations of the mathematical language used are essential, with staff only accepting what is correct. Consistency across the school is key:

Correct Terminology	Incorrect Terminology
ones	units
is equal to (is the same as)	equals
zero	oh (the letter o)
exchange exchanging regrouping	stealing borrowing
calculation equation	generic term of 'sum' or 'number sentence'
known unknown	
whole part	

Concept	Definition
Acute	Describes angles between 0 and 90 degrees.
Adjacent	Adjoining (as used to describe lines and angles).
Alternate	Every other one in a sequence.
Angle	The number of degrees rotated around a point.
Area	The amount of space within a perimeter (expressed in square units).
Ascending order	The arrangement of numbers from smallest to largest.
Average	A number representing a set of numbers (obtained by dividing the total of the numbers by the numbers itself).
Axis of symmetry	A line dividing a shape into two symmetrical parts.

Concept	Definition
Baker's dozen	The colloquial name given to the number 13.
Base	The line or face on which a shape is standing.
Base angles	Those angles adjacent to the base of a shape.
Bisect	To divide into two equal parts.
Breadth	Breadth is another name for width. It is the distance across from side to side.

Concept	Definition
Capacity	The amount of space in an object (the amount of liquid or air it contains).
Cardinal number	A number that shows quantity but not order.
Carroll Diagram	A number that shows quantity but not order.
Circumference	The distance around a circle (its perimeter).
Composite number	A number with more than two factors.
Congruent	Congruent shapes are the same shape and size (equal).
Consecutive	Consecutive numbers follow in order without interruption (e.g. 2,3,4,5).
Coordinates	Numbers used to locate a point on a grid.

Concept	Definition
Denominator	The number below the line in a fraction.
Descending order	The arrangement of numbers from the largest to smallest.
Diagonal	A straight line connecting two non- adjacent vertices (corners) of a polygon.
Difference	By how much a number is bigger or smaller than another.
Digit	Any number from 0 to 9 (inclusive).
Digital root	The digital root of 58 is 4 because 5 + 8 = 13 and 1 + 3 = 4
Dimensions	The measurements of a shape (i.e. length, width, height).
Dodecagon	A twelve sided polygon.

Concept	Definition
Edge	The intersection of two faces of a three-dimensional object.
Equation	A statement of equality between two expressions (e.g. 3 x 4 = 6 + 6).
Equilateral triangle	A triangle with congruent (equal) sides and angles.
Even number	A positive or negative number exactly divisible by 2.
Exterior	Outside.

Concept	Definition
Face	A plane surface of a three-dimensional object.
Face value	The numeral itself despite its position in a number (e.g. the face value of 8 in 38,250 is 8).
Factor	A number which will divide exactly into another number.

Concept	Definition
Greater than	An inequality between numbers. The symbol used to represent greater than is an arrow pointing towards the smallest number.
Gross	The name given to the number 144.

Glossary

Concept	Definition
Hendecagon	A two dimensional shape with eleven sides and eleven angles also called an undecagon.
Heptagon	A two dimensional shape with seven sides and seven angles also called a septagon.
Hexagon	A polygon with six sides.
Horizontal	Describes a line or plane parallel to the earth's surface.

Concept	Definition
Improper fraction	A fraction whose numerator is equal to or greater than it denominator.
Integer	A negative or positive whole number.
Interior	Inside.
Intersection	The point or line where two lines or two faces meet.
Irregular shapes	Shapes which do not have all congruent sides and all congruent angles.
Isosceles triangle	A triangle which has two equal sides of equal length.

Concept	Definition
Kite	A quadrilateral that has two adjacent pairs of sides that are equal in length, and at least one pair of opposite angles are equal.

Concept	Definition
Less than	An inequality between numbers. The symbol used to represent less than is an arrow pointing towards the smallest number.
Lozenge	Another name for a rhombus.

Glossary

Concept	Definition
Mean	The average of a set of numbers. The sum of the values in a set of data divided by the total number of items in that set.
Median	The middle value of a set of ordered data.
Mode	The value that occurs the most often in a set of data
Multiple	The product of a given number with another factor.

Concept	Definition
Numerator	The number above the line in a fraction.

Concept	Definition
Oblique	Oblique means sloping or slanting.
Oblong	A shape with two pairs of straight, unequal sides and four right angles. Also known as a rectangle.
Obtuse angle	An angle between 90 and 180 degrees.
Octagon	A polygon with eight sides and eight angles.
Odd number	A number that when divided by two leaves a remainder of one.
Ordinal number	Describes a position in a number sequence.

Glossary

Concept	Definition
Parallel lines	Lines with no common points and always the same distance apart.
Parallelogram	A four-sided polygon with opposite sides equal and parallel and the opposite angles are equal in size.
Perimeter	The length of the distance around the boundary of a shape.
Perpendicular line	A line at right angles to another line or plane.
Polyhedron	A three dimensional shape with plane faces.
Place value	Indicates the position of a numeral (e.g. the place value of the 3 in 738 is 30)
Prime number	A number with only two factors, 1 and itself (e.g. 2,3,5,7,11, 13, 17, 19, 23…)
Product	The result when two or more numbers are multiplied.

Concept	Definition
Quadrant	A quarter of the area of a circle which also contains a right angle.
Quotient	The result when one number is divided by another number.
Quindecagon	A polygon with fifteen sides and fifteen angles.

Concept	Definition
Rectangle	A quadrilateral with opposite sides equal and parallel and containing four right angles
Reflex angle	An angle greater than 180 degrees.
Rhombus	A parallelogram with congruent sides. Opposite sides are parallel and opposite sides are equal in size.
Roman numerals	Seven letters are used in combination to write numbers: I = 1 V = 5 X = 10 L = 50 C = 100 D = 500 M = 1000
Rotational symmetry	A shape is said to have rotational symmetry if it looks the same in different positions when rotated about its centre.
Rounding	An approximation used to express a number in a more convenient way.

Glossary

Concept	Definition
Scalene triangle	A triangle that has three sides of different length and no equal angles.
Score	The name given to the number 20.
Squared	A number squared is a number multiplied by itself.
Square number	A number whose units can be arranged into a square (e.g. 1,4,9,16,25,36,49,64…)
Sum	The result when two or more numbers are added together.
Symmetrical	A shape is symmetrical if it is identical on either side of a line dividing it into two parts.

Concept	Definition
Tally	A record of items using vertical and oblique lines to represent each item.
Tetragon	A four sided shape.
Tessellation	Shapes fitted together with a number of exact copies and with no overlaps or gaps.
Translation	This takes place when a shape is moved from one place to another just by sliding it (without rotating, reflecting or enlarging).
Trapezium	A quadrilateral with two parallel sides.
Triangular number	A number whose units can be arranged into a triangle (e.g. 1, 3, 6, 10, 15, 21…)
Trigon	A three sided shape.

Concept	Definition
Vertex	The point at which two or more line segments or two or more edges of a polyhedron meet.
Vertical line	A line which is at right angles to a horizontal line.