St Matthew's Church of England Primary School

Calculation Policy

Teaching for Mastery

At the centre of the mastery approach for the teaching of mathematics is the belief that all children have the potential to succeed. All children should have access to the same curriculum content, 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 concepts 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). 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 mathematics policy is a guide for all staff at St Matthews's Primary School. It is purposely set out as a progression of mathematical skills and not into year group phases to encourage consistency across the school. It is expected that teachers will use their professional judgement as to when consolidation of existing skills is required or if to move onto the next concept. However, the focus must always remain on breadth and depth rather than accelerating through concepts. Children should not be extended with new learning before they are ready, they should deepen their conceptual understanding by tackling challenging and varied problems. All teachers have been given long term plans for lessons and arithmetic sessions and are required to base their planning around their year groups modules and not to move onto a higher year groups scheme work.

Teachers can use any teaching resources that they wish to use and the policy does not recommend one set of resources over another, rather that, a variety of resources are used. For each of the four calculations of number, different strategies are laid out, together with examples of what concrete materials can be used and how, along with suggested pictorial representations. The principle of the concrete-pictorial-abstract (CPA) approach [Make it, Draw it, Write it] is for children to have a true understanding of a mathematical concept, they need to master all three phases within a year group's scheme of work.

In order to succeed in the written calculations, it is imperative that children can do the metal skills, e.g. before using a number line, children must be able to count forwards and backwards in ones and tens.

Mental Maths Expectations

In order to access the curriculum, it is essential that all children can fluently recall these concepts at the end of each term. Time can be spent during Mini-Maths, Arithmetic and interventions as well as main class teaching and incidental learning to assist this.

Reception

Autumn	- Count reliably to 20. - Subitise numbers to 5
Spring	- Order numbers to 20 - Find 1 more or 1 less than numbers to 20 - Recall number bonds to 5
Summer	- Verbally count beyond 20 - Compare numbers within 10 - Recall doubles to 10 - Add and subtract two 1-digit numbers within 10

Year 1

Autumn	- Add and subtract 1 to a 2-digit number - Subtract within 10 - Add within 10 - Recall number bonds to 10
Spring	- Count forwards in 10's, 5's and 2's - Know halves of even numbers to 20 - Know doubles to 10 - Count reliably to 50 - Recall all number bonds within 10
Summer	- Recall number bonds to 20 - Subtract any 1-digit number from any 2-digit number within 20 - Add any 1-digit number to any 2-digit number within 20 - Recognise half and quarter of even numbers to 20

Year 2

Autumn	- Count forwards and backwards from and 2-digit number to 100 - Add ones to a 2-digit number - Add three single digit numbers - Say 10 more/less than any number to 100 - Add and subtract multiples of 10 to any given 2-digit number - Recall all number compliments of all numbers to 20 (e.g. know all the combination of numbers that can be used to make 13)
Spring	- Subtract 1s from a 2-digit number - Double and halve numbers to 20 - Find half, 1/3, 2/4, ¾ of a quantity - Count in 3's
Summer	- Recall 2's, 5's, and 10's times tables (including division facts) - Double and halve numbers up to 40

Year 3

Autumn	- Perform place value subtractions mentally e.g. 536-30=506 - Add and subtract any two digit numbers by counting on in 10s and 1s or by using partitioning - Count in 3's and 4's and 8s - Count in multiples of 10 beyond 100. - Begin to learn to count in 6's, 7's and 8's. Begin to know the 6x, 7x and 8x tables
Spring	- Recognise fractions that add to 1. (e.g. ¼ +3/4) - Halve even numbers up to 100 and add numbers to 20. - Double numbers up to 50 - Partition teen numbers to multiply by a single digit number (3 x 14 as 3 x10 and (3x4) Find 10 or 100 more/less than a given number. - Count on in 50's from 0
Summer	- Tell the time to the nearest minute using 12 and 24 hour clocks, know the number of days in a month. - Subtract, when appropriate, by counting back or taking away, using place value and number facts - Learn to count in 3s, 4s, and 8s - Add and subtract pairs 3 digit numbers that do not require regrouping/partitioning, e.g. 230 +450

Year 4

Autumn	- Find 10, 100 and 1000 more/less than a given number. - Add and subtract £1, 10p and 1p to amounts of money. - Know the 3x 4x and 8x table and associated division facts. - Quickly derive number bonds to 100 and £1 - Add and subtract any two 2 digit numbers by partitioning or counting on
Spring	- Read and compare and convert between analogue/digital 12/24 hr clocks. - Multiply mentally one digit by two digit numbers - Count in 6's and 12's. Know 6x and 12x tables and relevant division facts - Find change from £10, £20 and £50 - Count in multiples of 25
Summer	- Begin to double and halve amounts of money (£35.60 doubles = £71.20) - Read Roman numerals to 100. - Count up/down in hundredths - Know the 12x tables and relevant division facts - Partition 2-digit numbers to multiply by a single -digit number mentally (4 x 24 as 4 x 20 and 4 x 4) - Use understanding of place value and number facts in multiplication and division (36 x 5 is half of 36x10 and 50x60 = 3000 or 245÷20 is double 245 ÷ 10) - Divide multiples of 100 by 1-digit numbers using division facts (3200 ÷ 8= 400)

Year 5

Autumn	- Use place value and number facts to add two or more numbers including money and decimals (e.g. 3+4+8+6+7, 0.6+0.4+0.7) - Add and subtract decimal numbers which are near multiples of 1 or 10 including money (e.g £6.34-1.99 or £34.59-£19.95) - Add to the next 10 from a decimal number (e.g 13.6 + 6.4 =20). - Know number bonds to 1 and to the next whole number
Spring	- Use doubling and halving as mental division/multi strategies (58 x 5 = half of 58 x 10) - Use knowledge of factors and multiples in multiplication e.g (43 x 6 is double 43 x 3 and 28 x 50 is half of

	28 x 100 = 1400) - Identify all multiples and factors including finding all factor pairs. - Know square numbers and square roots up to 144. - Recall prime numbers up to 19
Summer	- Count up/down in thousands - Use knowledge of multiples and factors, test for divisibility (246 ÷ 6 = 123 ÷ 3) - Double and halve decimals by partitioning (Half of £75.40 = Half of £75 (37.50) plus half of 40p)

Year 6

Autumn	- Add two 1-place decimal numbers or two 2-place decimal numbers less than 1 (4.5 + 6.5 or 0.74 +0.33) - Count forward and backward with positive and negative numbers through zero. - Know all multiplication tables to 12x. Apply and extend - Derive quickly and without difficulty, number bonds to 1000
Spring	- Use divisibility tests to aid mental calculation - Use place value and number facts in mental multi (40,000 x 6 = 24,000) - Identify common factors, common numbers and prime numbers and use factors in mental division (438 ÷ 6 is 219 ÷ 3) - Identify common factors, common numbers and prime numbers and use factors in mental multiplication (e.g 326 x 6 is 652 x 3) - Know by heart all multiplication and division facts up to 12 x 12. Apply and extend - Add positive number to negative numbers (e.g calculate a rise in temp)
Summer	- Halve and double decimal numbers with up to 2 places using partitioning e.g 36.73 doubled is double 36 plus double 0 .73) - Know by heart all multiplication and division facts up to 12 x 12. Apply and extend - Use rounding in mental multiplication (34 x 19 as (20 x34) -34) - Use doubling and halving as a mental division and multiplication strategy. E.g to divide by 2,4,8,5,20 and 25 (628 ÷ 8 is halved three times) (28 x 25 is ¼ of 28 x 100 = 700)

Addition

Definition: Addition is the process of calculating the total of two or more numbers or amounts. It is the inverse of subtraction and is a commutative operation (can be done either way around, e.g. 2+3 is the same as 3+2)

Early Years

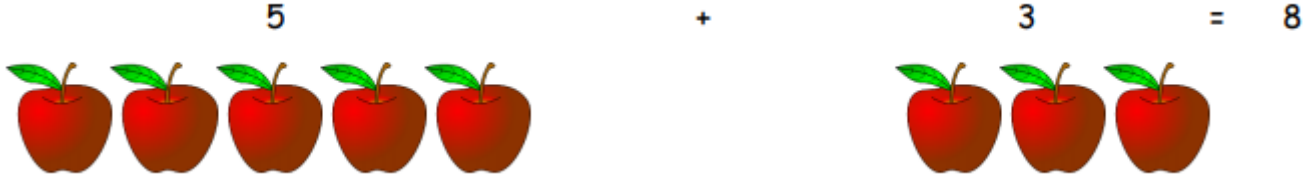
Using a range of practical resources and real life contexts, pupils develop their understanding of the concept of addition through counting activities. They then use pictures/diagrams to represent the calculation.

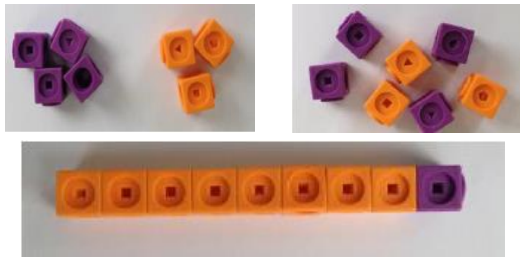
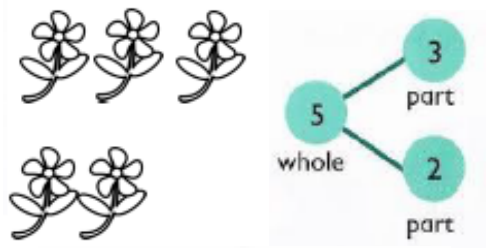
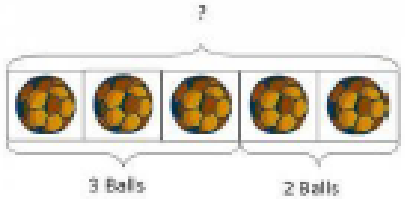
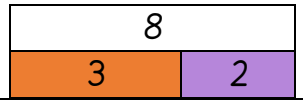
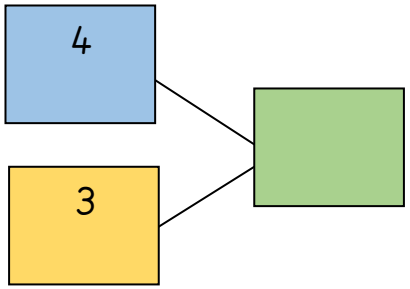
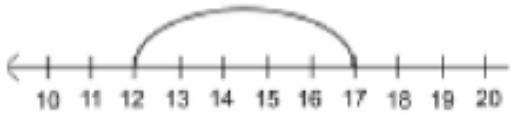
Children will engage in a wide variety of songs and rhymes, games and activities. They will begin to relate addition to combining two groups of objects, first by counting all and then by counting on from the largest number.

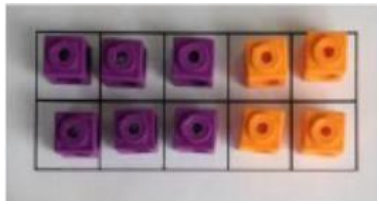
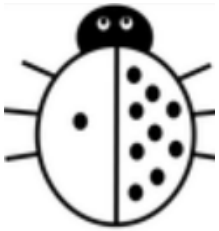
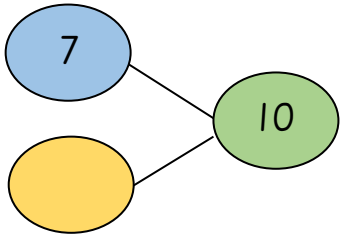
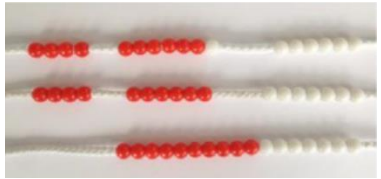
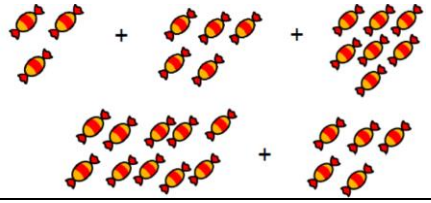
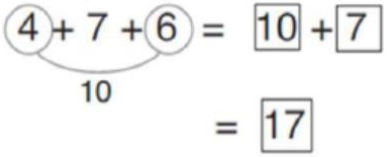
They will find one more than a given number.

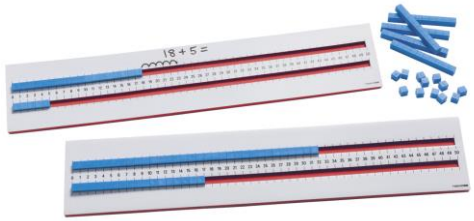
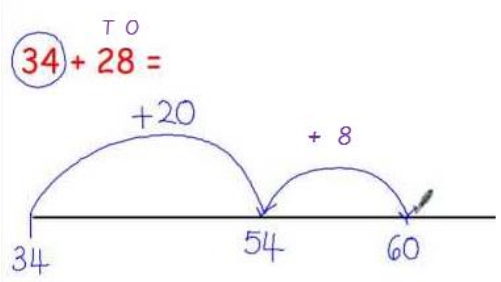
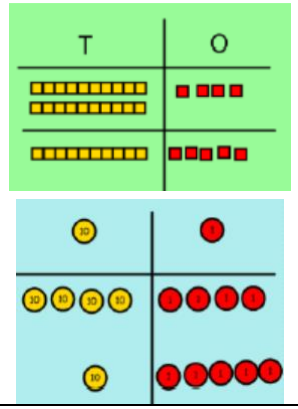
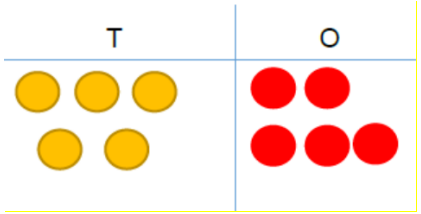
In practical activities and through discussion they will begin to use the vocabulary involved in addition.

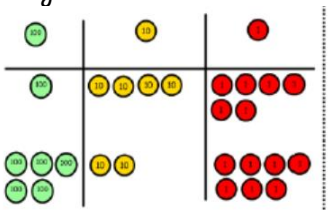
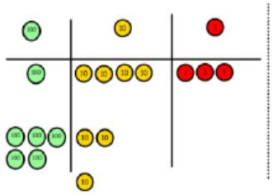
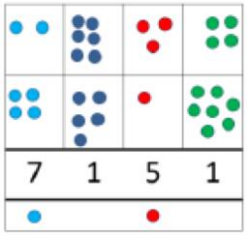
'You have five apples and I have three apples. How many apples altogether?'



Objective	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model Year 1	Use cubes to add two numbers together as a group or in a bar.  	Use pictures to add two numbers together as a group or in a bar.    	Use the part-part whole diagram as shown above to move into the abstract. 4 + 3 = 7 7 = 4 + 3 
Starting at the bigger number and counting on Year 1	Start with the larger number on the bead string and then count, 1 by 1, by the smaller number to find the answer 10+2=12 	Start at the larger number on the number line and count on in ones or in one jump to find the answer. 12+5=17  	Place the larger number in your head and count on the smaller number to find your answer. 5+12=17 Place 12 in head, and count on 5 more (using fingers if needed) to find the answer.

Number bonds to 10 Year 1	Start with the bigger number and use the smaller number to make 10.  	Use pictures or jottings to find the number bond to make 10.  	Use number bond knowledge to solve missing number problems. If I have 7, how many more do I need to make 10? 
Adding three single digits Year 2	Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit. 4+7+6=17 	Add together three groups of objects. Draw a picture to recombine the groups to make 10. 3+5+7 	Combine the two numbers that make 10 and then add on the remainder. 

Adding a 2-digt number to a 2-digit number Year 2	Using base ten and large number lines or tape measures, identify the largest number, then add on the tens and finally the ones. 	Children circle the larger number and identify tens and ones. Begin with the largest number on the left, complete the jump of 10s, record the answer below, then add ones and record answer below. 	Children can add two 2-digit numbers from a variety of contexts and create number lines independently.
Column method- no regrouping Year 2 G.D. Year 3	Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters. 24 + 15= 	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. 32+23= 	Move onto solving without counters or drawings, starting with the larger number. 23+32= 32 + 23 55

Column method- regrouping Year 3	Make both numbers on a place value grid.  146 + 527 Add up the ones and exchange 10 ones for one 10.  146 + 527 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.	Children can draw a pictorial representation of the columns and place value counters to further support their learning and understanding.  7 1 5 1	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 Move onto formal column addition where regrouping is representing below the answer. 536 + 85 621 1 1

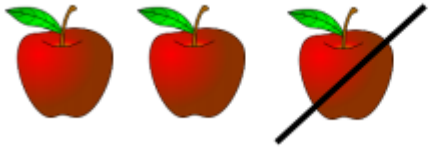
Subtraction

Definition: Subtraction is the process or skill of taking one number or amount away from another or finding the difference between two numbers.

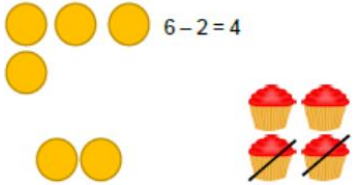
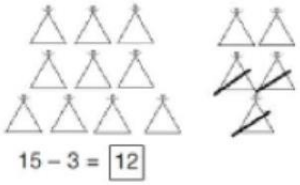
Early Years

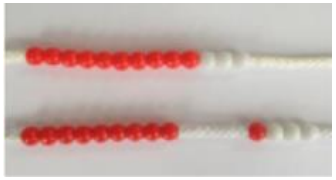
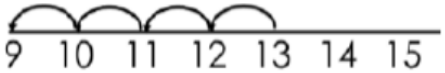
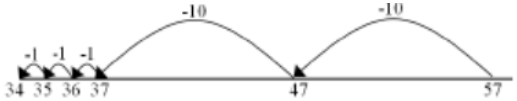
Using a range of practical resources and real life contexts, pupils develop their understanding of the concept of subtraction through counting activities. They then use pictures/diagrams to represent the calculation.

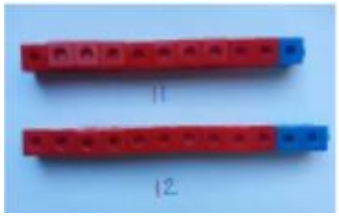
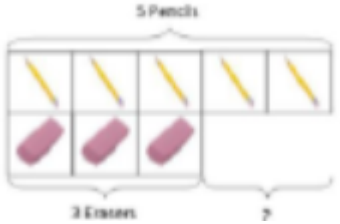
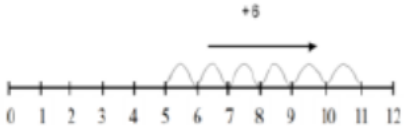
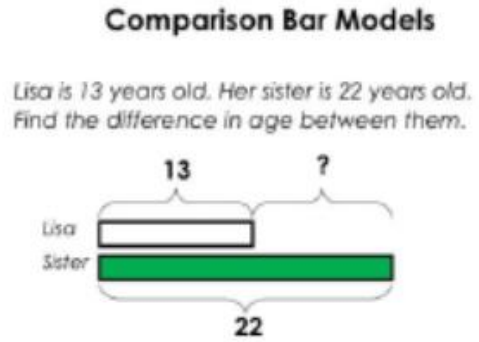
E.g. There are 3 apples and 1 is eaten. How many are left?

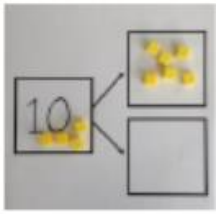
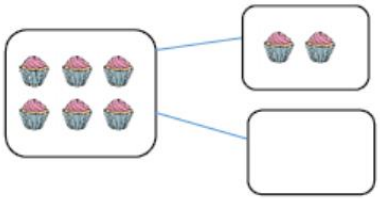
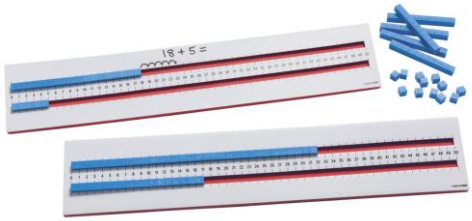
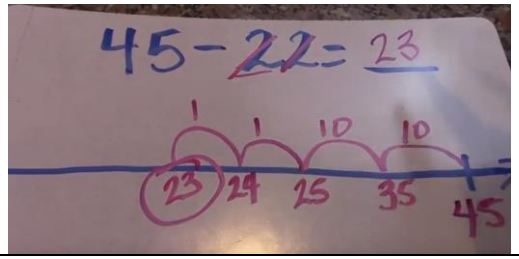


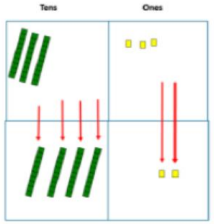
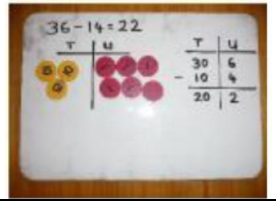
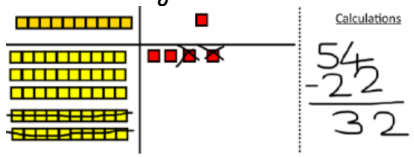
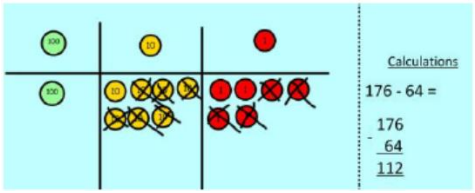
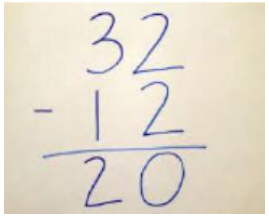
3 - 1 = 2

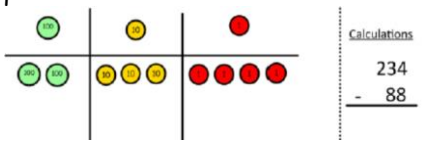
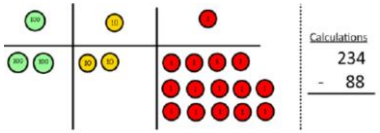
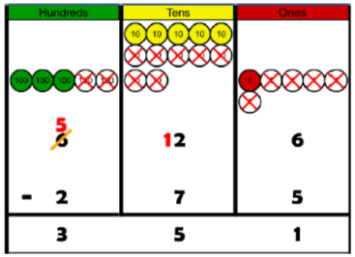
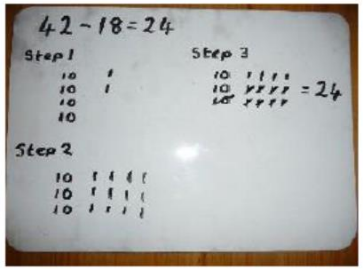
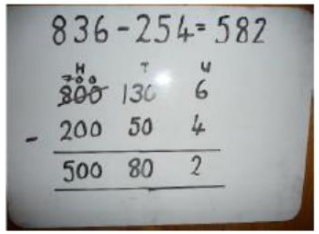
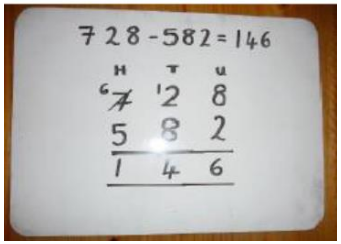
Objective	Concrete	Pictorial	Abstract
Taking away ones Reception	Use physical objects, counters, cubes etc to show how objects can be taken away. 	Use physical objects, counters, cubes etc to show how objects can be taken away.  15 – 3 = 12	Write the calculation starting with the larger number and taking away the ones. 8 – 2 = 6 18 -3= 15

Counting back Year 1 (Concrete)	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones. 13 – 4  Use counters and move them away from the group as you take them away counting backwards as you go. 	Count back on a number line or number track.  Start at the bigger number and count back the smaller number showing the jumps on the number line. This can progress all the way to counting back using two 2 digit numbers. 	Solve problems by writing the calculation and mentally counting back. Put 13 in your head, count back 4. What number are you at? Use your fingers to help.

Find the difference Year 1 (Concrete)	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference	Count on to find the difference.  Draw bars to find the difference between 2 numbers.  	Find the difference between two abstract amounts. Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.

Part-Part Whole Model Year 1	Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part?  10 - 6 =	Use a pictorial representation of objects to show the part-part whole model. 	Move to using numbers within the part whole model. 
Subtracting a 2-digit number on a number line Year 2	Using base ten and large number lines or tape measures, create the larger number using the tens and ones, 	Children circle the larger number and identify tens and ones in the smaller number. Begin with the largest number on the right, complete the backwards jump of 10s, record the answer below, then add ones and record answer below.  	Children can subtract a 2-digit number from a 2-digit number from a variety of contexts and create number lines independently. Questions may include finding the difference between 2 values as well as using the inverse of addition.

Column method without regrouping Year 2 G.D. Year 3	Use Base 10 to make the bigger number then take the smaller number away.  Show how you partition numbers to subtract. Again make the larger number first.  	Draw the Base 10 or place value counters alongside the written calculation to help to show working.   	This will lead to a clear written column subtraction. 47 − 24 = 23 40 + 7 − 20 + 4 20 + 3 

Column method with regrouping Year 3	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters  Calculations 234 - 88 Start with the ones, can I take away 8 from 4? I need to exchange one of my tens for ten ones.  Calculations 234 - 88	Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.  When confident, children can find their own way to record the exchange/regrouping. Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.  	Children can start their formal written method by partitioning the number into clear place value columns.  Moving forward the children use a more compact method. 

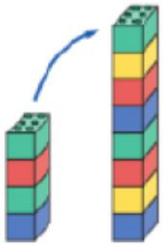
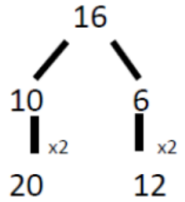
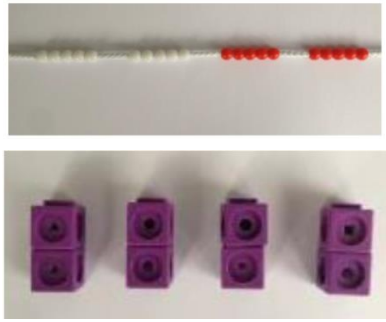
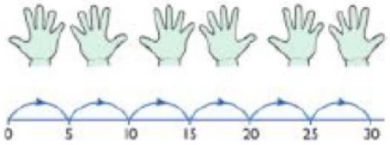
Multiplication

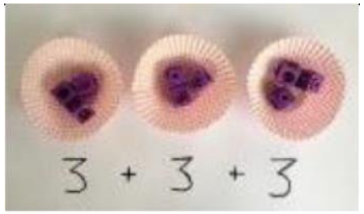
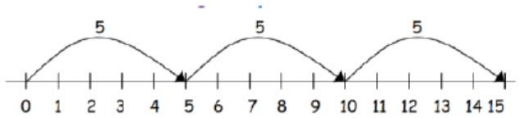
Definition: Multiplication is the product of two numbers or repeatedly adding the same set of number as many times as the other number. Therefore 3 multiplied by 4 is 4 lots of 3, or 3 added repeatedly 4 times. It is the inverse operation of division and is a commutative operation.

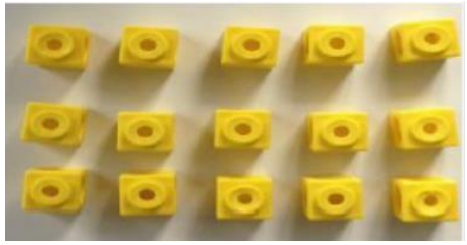
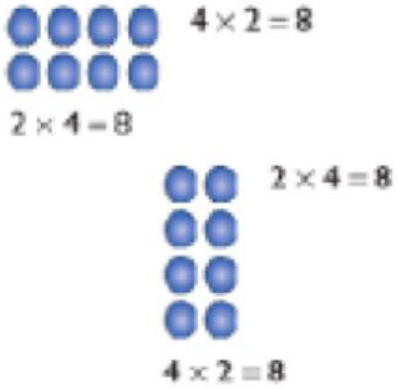
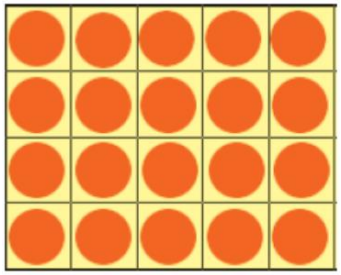
Early Years

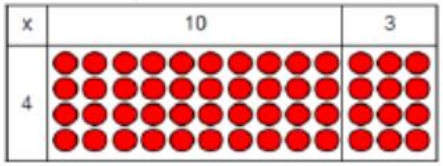
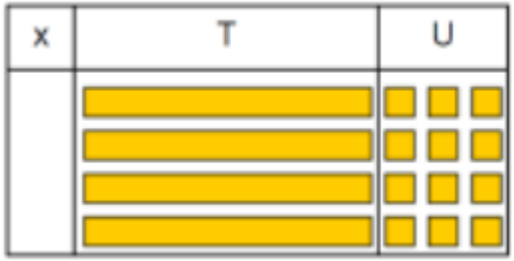
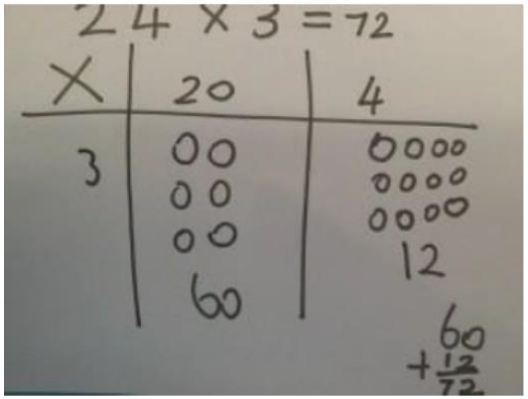
Pupils are given an opportunity to manipulate and experience a range of resources in real life contexts and through role play. They are encouraged to solve real life problems e.g. If one pair of welly boots = 2 then 3 pairs = 6 + + = 6

They are encouraged to draw pictures and represent their mathematical thinking through various representations e.g. bead strings, numi-con, cubes.
Finding doubles- Double 5 equals 10

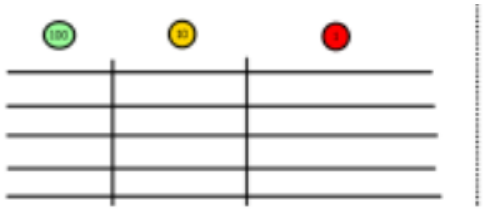
Objective	Concrete	Pictorial	Abstract
Doubling Reception (Concrete) Year 1	Use practical activities to show how to double a number.  double 4 is 8 4 × 2 = 8	Draw pictures to show how to double a number. Double 4 is 8 	Partition a number and then double each part before recombining it back together. 
Counting in multiples Year 1	Count in multiples supported by concrete objects in equal groups. 	Use a number line and pictures to continue support in counting in multiples. 	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25 , 30

Repeated addition Year 2	Use different objects to add equal groups.   	Draw shapes or symbols to represent adding equal groups.  Move onto equal jumps on a number line. 5+5+5=15  	Write addition sentences to describe objects and pictures 

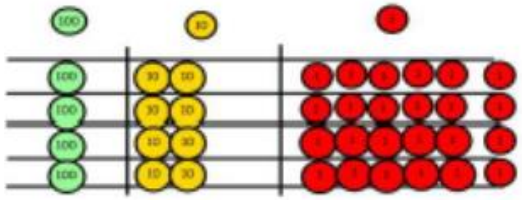
Arrays- showing commutative multiplication Year 1 (G.D.) Year 2	Create arrays using counters/ cubes to show multiplication sentences. 3 X 6 = 18  3 X 5 = 15 	Draw arrays in different rotations to find **commutative** multiplication sentences.  Link arrays to area of rectangles. (Year 3) 	Use an array to write multiplication sentences and reinforce repeated addition. 

Grid Method Year 3 (2-digit X 1 digit) Year 4 (1-digit X 2 / 3 digit)	Show the link with arrays to first introduce the grid method. 4 rows of 10 4 rows of 3  Move on to using Base 10 to move towards a more compact method. 4 rows of 13  Move on to place value counters to show how we are finding groups of a number. We are multiplying by 4 so we need 4 rows.	Children can represent the work they have done with place value counters in a way that they understand. They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below.  	Start with multiplying by one digit numbers and showing the clear addition alongside the grid. | × | 30 | 5 | | --- | --- | --- | | 7 | 210 | 35 | **210 + 35 = 245** Moving forward, multiply by a 2-digit number showing the different rows within the grid method. | | 10 | 8 | | --- | --- | --- | | 10 | 100 | 80 | | 3 | 30 | 24 | | X | 1000 | 300 | 40 | 2 | | --- | --- | --- | --- | --- | | 10 | 10000 | 3000 | 400 | 20 | | 8 | 8000 | 2400 | 320 | 16 |

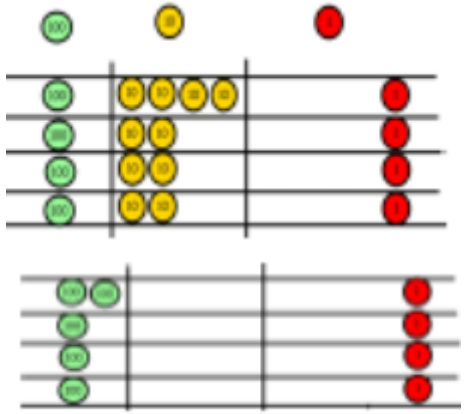
4 X126



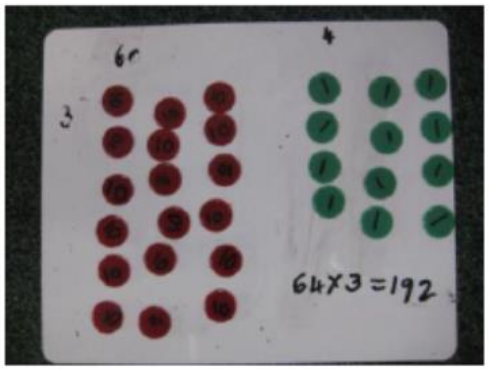
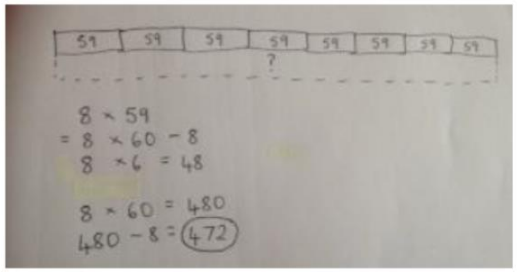
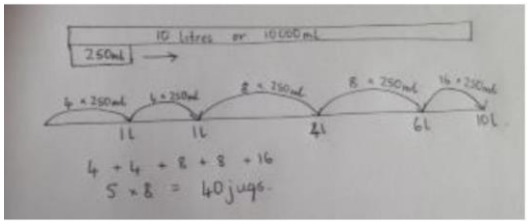
Fill each row with 126.



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



Then you have your answer.

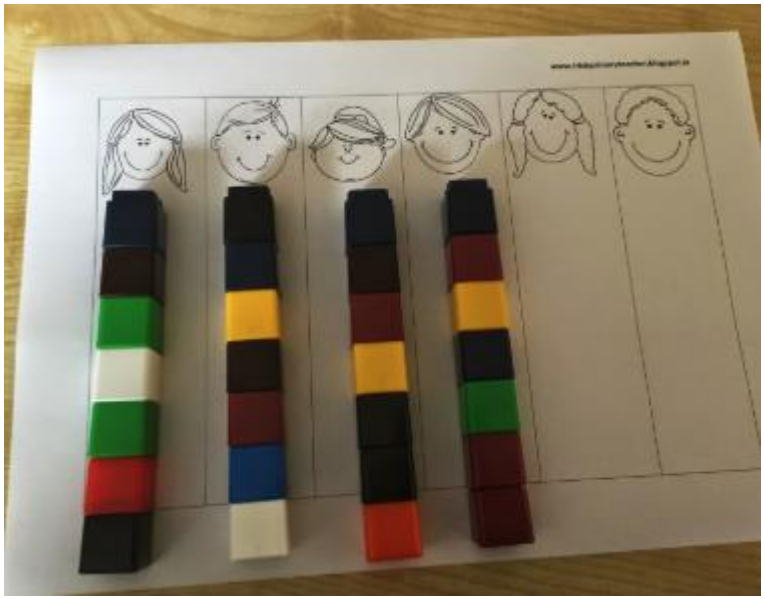
Column multiplication Year 4 (2 and 3 digit X 1 digit) Year 5 (up to 4 digit X 1 & 2 digit)	Children can continue to be supported by place value counters at the stage of multiplication. 64 X 3 = 192  It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.	Use bar model and number lines to support when solving problems with multiplication alongside the formal written methods.   	Start with long multiplication, reminding the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer. 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768 This moves to the more compact method. 74 x 63 12 210 240 + 420 4662

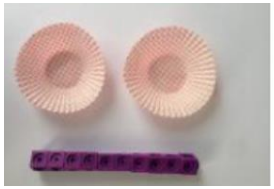
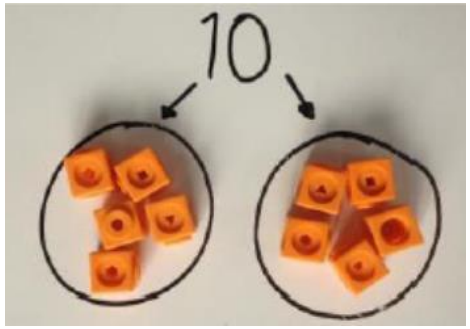
Division

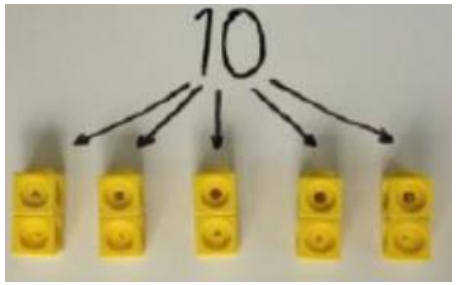
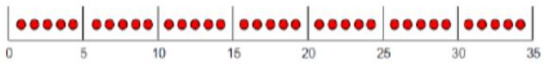
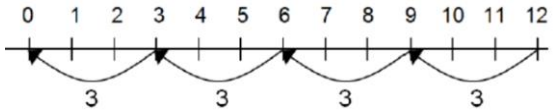
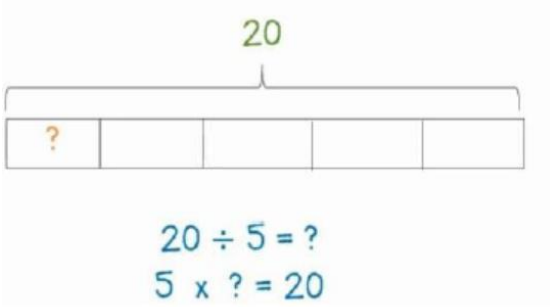
Definition: Dividing is a quick way of subtracting several lots of the same number or quantity, or splitting it up into equal groups. Multiplying and dividing are the inverse or opposite of each other.

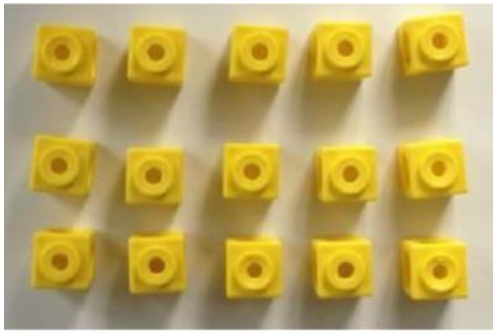
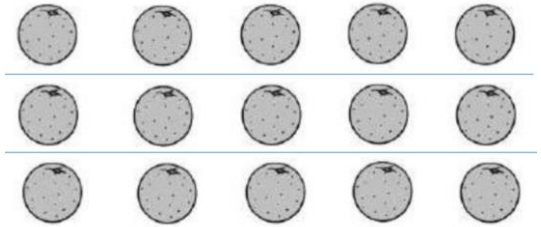
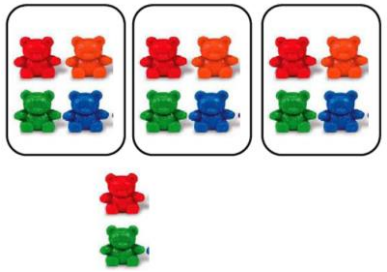
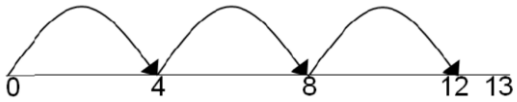
Early Years

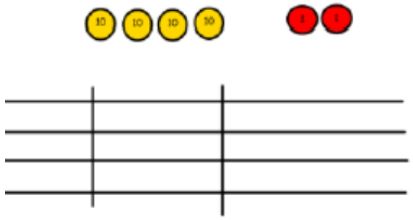
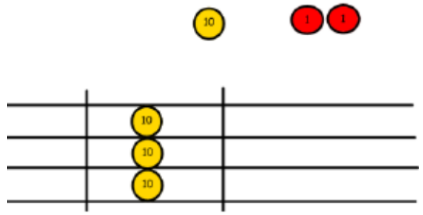
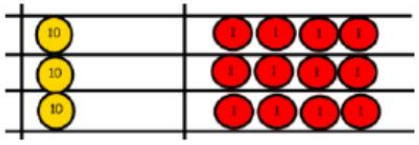
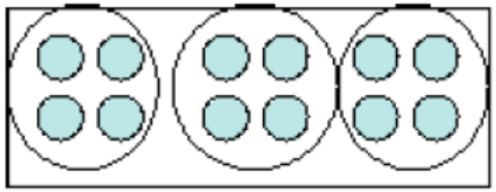
Pupils should have many practical experiences of sharing objects e.g. sharing between 2 people, or finding ½ of a group of objects. Pictures should be introduced as a next step to represent this.

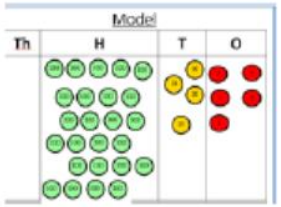
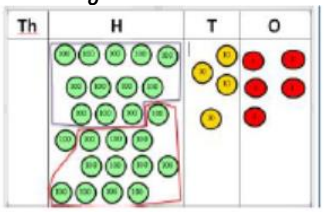
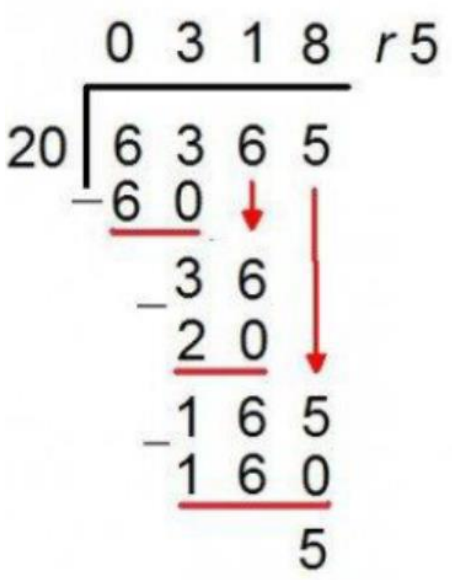


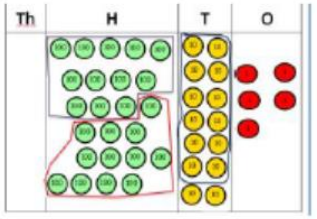
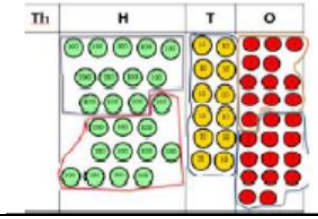
Objective	Concrete	Pictorial	Abstract
Sharing objects into groups Reception Year 1	Share items into equal groups, start with halves.   	$8 \div 2 = 4$ 	Share 9 buns between three people. $9 \div 3 = 3$

Division as grouping Year 1	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding. 10 ÷ 5 = 2   	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group.  	Divide 30 into 5 groups. How many are in each group? 30 ÷ 5 = 6

Division within arrays Year 3	Link division to multiplication by creating an array and thinking about the number sentences that can be created.  15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	Draw an array and use lines to split the array into groups to make multiplication and division sentences. 15 ÷ 3 = 5 	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
Division with a remainder Year 2 (G.D.) Year 3	Divide objects between groups and see how much is left over. 14 ÷ 3 = 4 r2 	Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder. 13 ÷ 4 = 3 r1  Draw dots and group them to divide an amount and clearly show a remainder.  	Complete written divisions and show the remainder. Use correct language for parts of the calculation from Year 3. 

Short division (bus stop method) **Year 3** (2-digit ÷ 1 digit, Concrete and pictorial) **Year 4** (3-digit ÷ 1 digit) **Year 5** (4-digit ÷ 1 digit with remainders)	Use place value counters to divide using the bus stop method alongside. 42 ÷ 3=  Start with the biggest place value column, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over.  We exchange this ten for ten ones and then share the ones equally among the groups.  Look how much in 1 group (row) so the answer is 14.	Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.  Encourage them to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainder. Represent remainders appropriately to the situation, this could be fractions, decimals or remainders. 872÷4=218 $$\begin{array}{r} 218 \\ 4\overline{)872} \\ \underline{3} \\ \end{array}$$ Move onto divisions with a remainder. 432÷5=86 r2 $$\begin{array}{r} 86\ r\ 2 \\ 5\overline{)432} \\ \underline{3} \\ \end{array}$$ Finally move into decimal places to divide the total accurately. (Year 6) $$\begin{array}{r} 14.6 \\ 35\overline{)511.0} \\ \underline{16}\ \ 21 \\ \end{array}$$

Long division Year 6	2544 ÷ 12 How many groups of 12 thousands do we have? None  Exchange 2 thousand for 20 hundreds.  $12\overline{)2544}$ 0 How many groups of 12 are in 25 hundreds? 2 groups. Circle them. We have grouped 24 hundreds so can take them off and we are left with one.  $12\overline{)2544}$ 02 24 1	Instead of using physical counters, students can draw the counters and circle the groups on a whiteboard or in their books. Use this method to explain what is happening and as soon as they have understood what move on to the abstract method as this can be a time consuming process.	Move onto formal written method with increasingly large numbers. 

	Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2  $\begin{array}{r} 021 \\ 12\overline{)2544} \\ 24 \\ \hline 14 \\ 12 \\ \hline 2 \end{array}$ Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2  $\begin{array}{r} 0212 \\ 12\overline{)2544} \\ 24 \\ \hline 14 \\ 12 \\ \hline 24 \\ 24 \\ \hline 0 \end{array}$		

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	Definition	Incorrect terminology
Ones	A cardinal number between 1 and 9, also the smallest whole number place value column e.g. there are 8 ones in 458.	units
Is equal to	The same quantity or amount e.g. four lots of 3 is equal to 12 is equal to 4 lots of 3.	Equals
Zero	The number between 1 and -1.	Oh (the letter), none, nothing.
Exchanging	The process of giving a partitioned number in column subtraction	Stealing, borrowing
Regrouping	The process of giving a number in column addition.	Giving
Calculation	a mathematical determination of the amount or number of something.	Sum (this is only correct for an addition calculation)

Addition (+)
augend + addend = sum

Subtraction (−)
minuend − subtrahend = difference

Multiplication (×)
multiplicand × multiplier = product

Division (÷)
dividend ÷ divisor = quotient