Nook Lane Junior School

Calculation Policy

September 2022

Maths Calculation Policy 2021

INTRODUCTION

This Maths Calculation Policy has been produced in line with the 2014 National Curriculum for Mathematics to ensure consistency and progression in teaching throughout the school that is age appropriate. It aims to introduce children to the processes of calculation through practical, oral and mental activities. As children begin to understand the underlying ideas, they develop ways of recording to support their thinking and calculation methods, use particular methods that apply to special cases and learn to interpret and use signs and symbols involved. This policy shows the natural progression that a child should make in their mathematical education. Children should not progress onto the advanced stages of formal written methods until they have a secure conceptual understanding. By the end of Year 6, children should be able to choose the most appropriate approach to solve a problem: making a choice between using jottings (an extended written method), an efficient written method or a mental method.

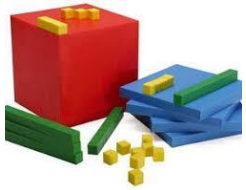
As a school, we use the White Rose Maths Scheme as a foundation for our planning and teaching. However, through continuous evaluation, we have adapted some methods of calculation to better suit the needs of our learners and build progressively on what we have taught in previous years.

Concrete, pictorial and Abstract (CPA) approach
Concrete, pictorial and Abstract (CPA) approach At Nook Lane Junior School, we recognise that the **Concrete Pictorial Abstract (CPA)** approach is highly effective in the teaching of Maths to develop conceptual understanding. This approach will vary between year groups and the individual abilities of children within each class. Objects, pictures, words, numbers and symbols are everywhere. The mastery approach incorporates all of these to help children explore and demonstrate mathematical ideas, enrich their learning experience and deepen understanding. Together, these elements help cement knowledge so pupils truly understand what they've learnt. All pupils, when introduced to a key new concept, should have the opportunity to build competency in this topic by taking this approach. Pupils are encouraged to physically represent mathematical concepts. Objects and pictures are used to demonstrate and visualise abstract ideas, alongside numbers and symbols. Concrete – The doing stage

There is a clear focus on the use of manipulatives and visual images to support understanding in every year group. Each new concept or calculation strategy will be introduced using appropriate manipulatives, giving the children a clear picture of the theoretical mathematics they are learning. It is important that children have access to a wide range of manipulatives in every year group and, consequently, we encourage children to be independent in their use of manipulatives throughout the school and access resources as they see fit. This is the foundation for conceptual understanding.

Concrete resources that may be found in classrooms will include:




These resources will vary depending on year group and individual needs.

Pictorial – The seeing stage

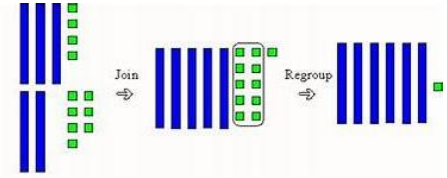
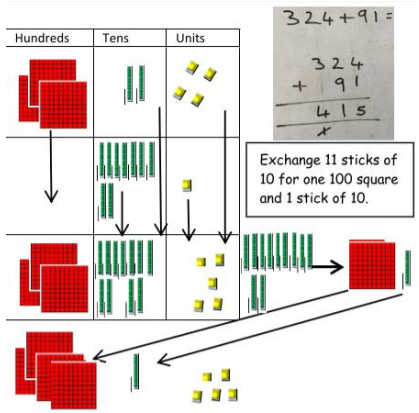
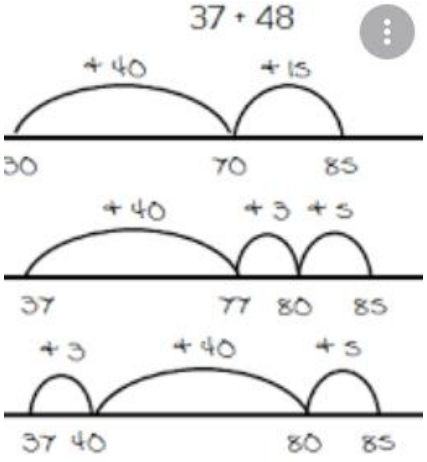
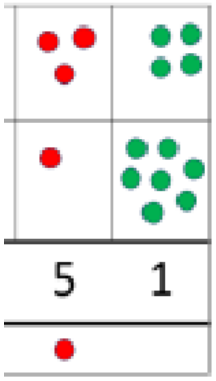
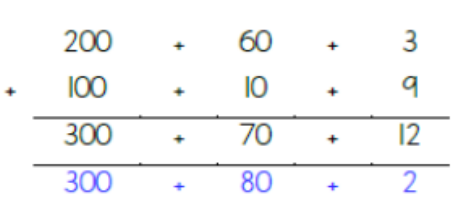
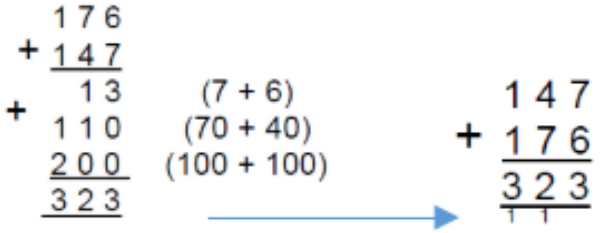
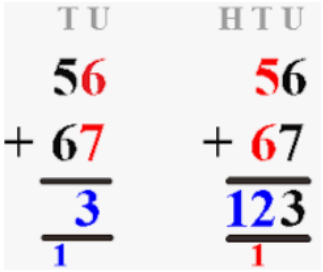
A child has sufficiently understood the hands-on experiences performed and can now relate them to representations, such as a diagram or a picture of the problem.

Abstract- The symbolic stage

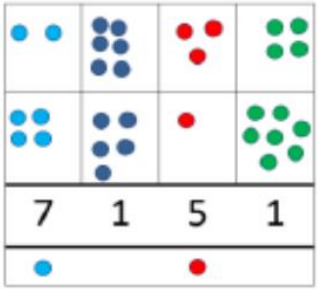
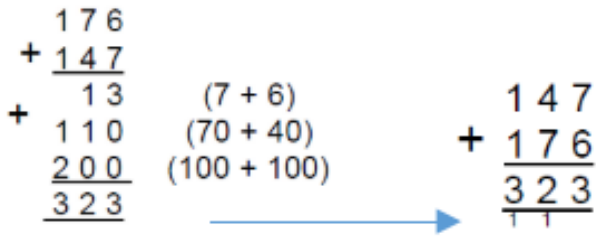
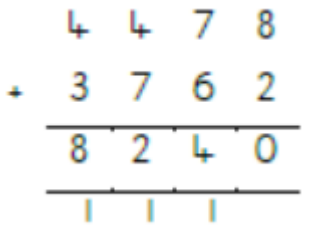
At this stage children can solve more abstract calculations without the need for concrete resources or pictures to facilitate understanding.

E.g. 236 + 176 = or 734 x 5 =

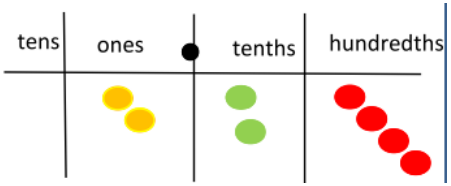
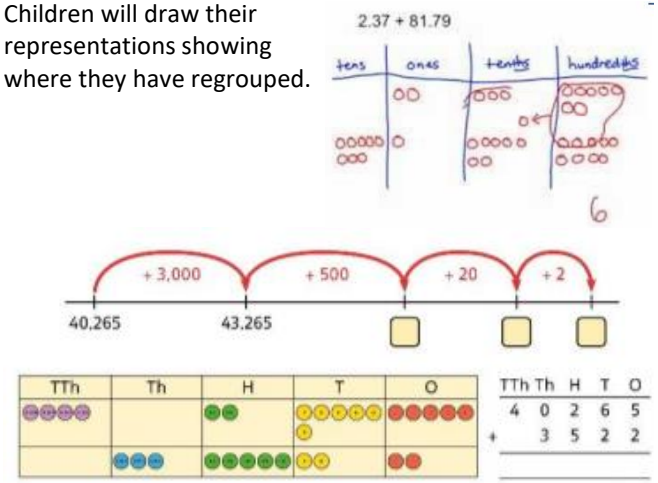
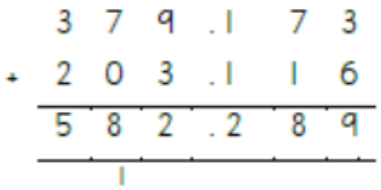
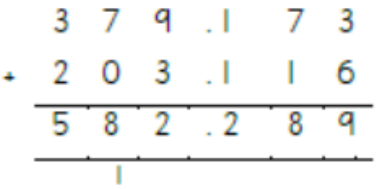
Y3 Addition

Concrete	Pictorial	Abstract	Method by the end of the year
Use dienes cubes to consolidate learning from KS1. Ensure children are confident at using these to join, regroup and count. This will support them moving onto the next stage of column addition.  Introduce children to place value counters and dienes cubes. Use the column method layout to support their learning onto the abstract method 	**Number line** Consolidate their learning from KS1 by using an empty number line to count larger numbers.  Children can draw a representation of the grid to further support their understanding, carrying the ten underneath the line. 	**Partitioning** Children will consolidate using the partitioning method. The layout will begin to form a written method to support further progress onto the column method. Hundreds, Tens and ones will be added to form partial sums and then these partial sums will be added together to find the total. **Expanded column method - Formal method**  Children to use the Expanded Column Method. Start by partitioning the numbers before the formal column to show the exchange. Once confident, they can move onto the column method in stage 3. 	**Column method - Formal method** Column Method for addition to be used. 

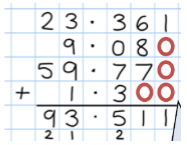
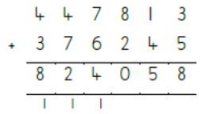
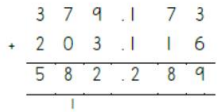
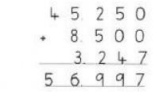
Y4 Addition

Concrete	Pictorial	Abstract	Method by the end of the year
Children will add larger numbers where they will need to exchange place value counters or dienes cubes. 	Children can draw a representation of the grid using larger numbers.  	**Expanded column method - Formal method** Children to use the Expanded Column Method. Start by partitioning the numbers before the formal column to show the exchange. Once confident, they can move onto the column method in stage 3.  	**Column method - Formal method** Column Method for addition to be used with larger numbers. 

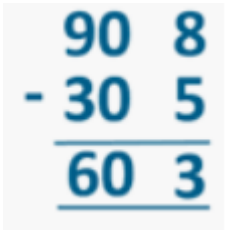
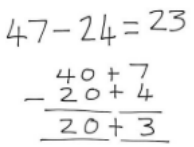
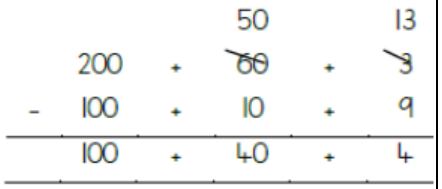
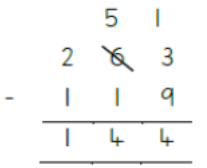
Y5 Addition

Concrete	Pictorial	Abstract	Method by the end of the year
Introduce decimal place value counters and model regrouping for addition.  	Children will draw their representations showing where they have regrouped.  	 **Column method** Children will continue to develop their understanding of column method addition. Calculations will become larger and include decimal places.	

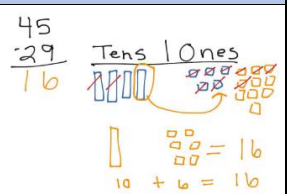
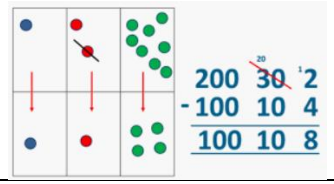
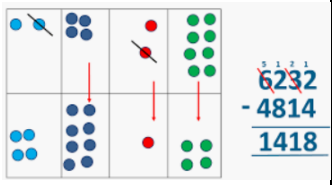
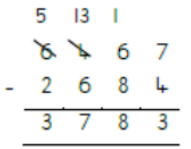
Y6 Addition

Concrete	Pictorial	Abstract	Method by the end of the year
Please note: Concrete apparatus and pictorial representations should still be used to support children who may be struggling with abstract concepts. Concrete apparatus should be readily available for lower achieving children and those with SEND.		Children to further develop their confidence using the column method. Larger numbers, decimal places and inserting zero for place holders when decimals are different. Insert zeros for place holders. 	6 digit + 6 digit  Numbers with 3 decimal place  Numbers with a different number of decimal places 45.25 + 8.5 + 3.247 

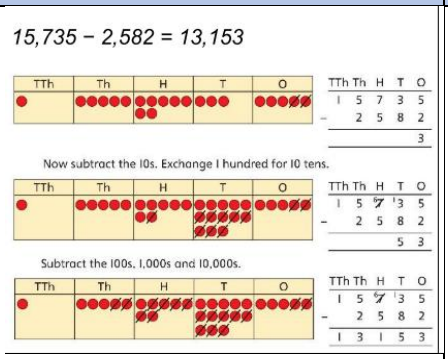
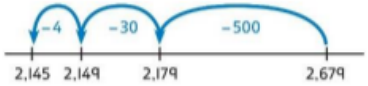
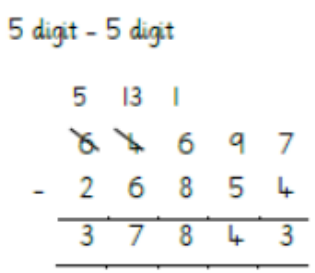
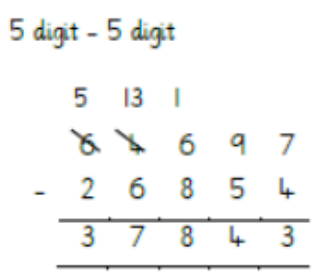
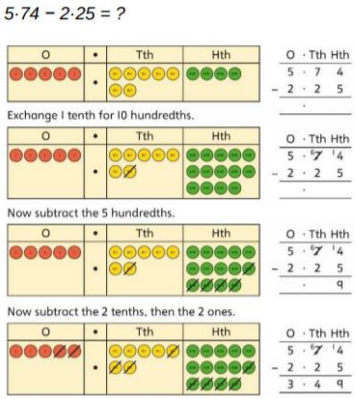
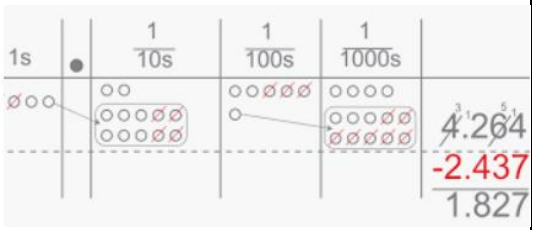
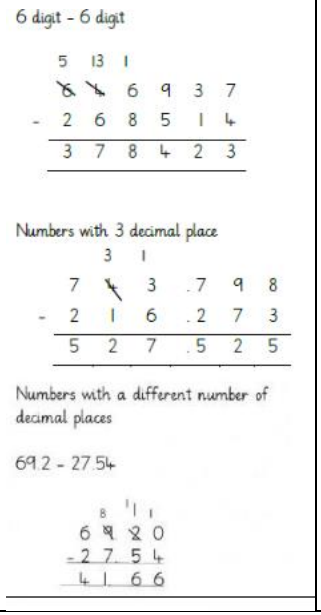
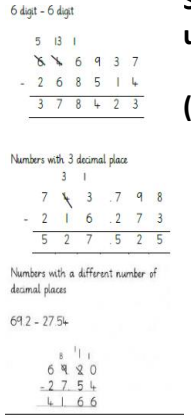
Y3 subtraction

Concrete	Pictorial	Abstract	Method by the end of the year
Children begin to set out HTU - HTU using dienes cubes and place value counters (that cross the tens boundary) in columns and record as column subtraction with decomposition. Teach children how to exchange units of numbers Children begin to set out HTU - HTU using dienes cubes and place value counters (that cross the tens boundary) in columns and record as column subtraction with decomposition. Teach children how to exchange units of numbers. 	Children will also be able to draw representations of dienes cubes and place value counters by crossing out the number being taken away. 	Children to further secure their knowledge using the **partitioning method** but will start to lay their work out using the column method approach. Tens and ones will be subtracted to form partial calculations and then these partial calculations will be added together to find the total.  	**Partitioning method - with exchanging** Children will use the partitioning method to show exchanging.  Once confident, children can start to use the column method. 

Y4 subtraction

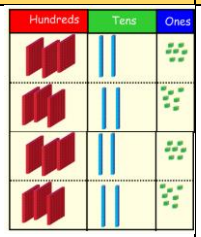
Concrete	Pictorial	Abstract	Method by the end of the year
Children continue to set out HTU - HTU using dienes cubes and place value counters (that cross the tens boundary) in columns and record as column subtraction with decomposition. Teach children how to exchange units of numbers. 	Children may draw dienes cubes or place value counters and cross off showing their understanding of taking away. They will need to represent any exchanging that takes place.  	Children draw  representations from concrete activities using dienes cubes and place value counters.	**Column Method** Children continue to use column method to subtract larger numbers. 

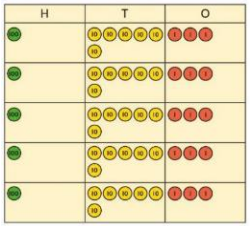
Y5 and Y6 subtraction (whole numbers and decimals)

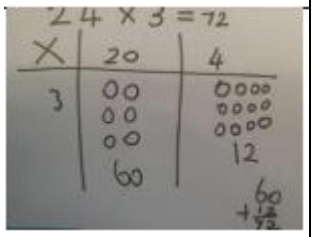
Concrete	Pictorial	Abstract	Method by the end of the year
Please note: Concrete apparatus and pictorial representations should still be used to support children who may be struggling with abstract concepts. Concrete apparatus should be readily available for lower achieving children and these with SEND.	Children can draw using place value counters showing how  exchanging takes place between the units of numbers. Children also show subtraction on an empty number line using larger numbers. 	**Column Method** Children will continue to develop their understanding of column method subtraction. Calculations will become larger. 	**Formal column method with larger numbers** 
Introduce decimal place value counters and model exchange for subtracting between units of numbers. 	Children will draw their representations showing where they have exchanged. 	Children will continue to develop their understanding of column method subtraction. Calculations will become larger, include decimal places and require 0 to be added as a placeholder. 	 **Subtract numbers with up to 3 dp.** **(check this)**

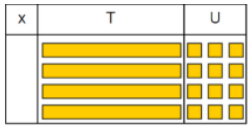
Y3 multiplication

Concrete	Pictorial	Abstract	Method by the end of the year
Grid Method Show the links with arrays to first introduce the grid method. Move onto Dienes cubes to move towards a more compact method. Move on to place value counters to show how we are finding groups of a number. We are multiplying by 5 so we need 5 rows of that number.	Pictorial representations can be made using their concrete manipulatives as visuals. They can draw the counters using colours to show different amounts or just use the circles in the different columns to show their thinking as shown. 13 x 4 = (10 x 4) + (3 x 4) = 40 + 12 = 52	Children should be able to draw the grid method for each multiplication. The grid method will be used to show how this relates to a formal written method.	Children should be able to draw the grid method for each multiplication. The grid method will be used to show how this relates to a formal written method. A formal addition is to be written at the side e.g.









Grid method

X	30	6
4	120	24

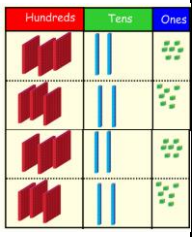
Grid method

X	30	6
4	120	24

+120
24
144

Y4 multiplication

Concrete	Pictorial	Abstract	Method by the end of the year
The multiplication unit should start with a re-cap on concrete methods from Y3. Some children may need more time using the resources than others. **Grid Method** Show the links with arrays to first introduce the grid method. Move onto Dienes cubes to move towards a more compact method.	The **grid method** may be used to show how this relates to a formal written method. Grid method will lead onto **expanded method** and then onto the **compact short multiplication.**	Leading to expanded method 36 x 4 24 (6 x 4) 120 (30 x 4) 144	Leading to expanded method 36 x 4 24 (6 x 4) 120 (30 x 4) 144



Grid method

X	30	6
4	120	24

Leading to expanded method
36
x 4
24 (6 x 4)
120 (30 x 4)
144

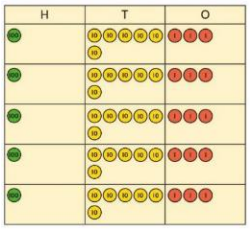
36
x 4
144
2

Leading to expanded method
36
x 4
24 (6 x 4)
120 (30 x 4)
144

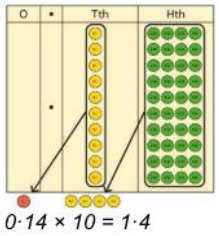
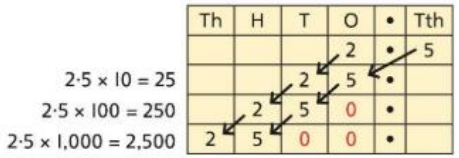
36
x 4
144
2

Leading to expanded method
36
x 4
24 (6 x 4)
120 (30 x 4)
144

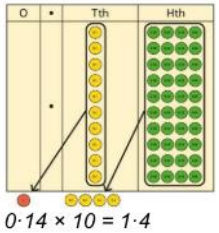
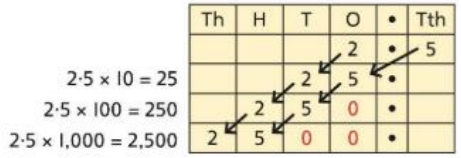
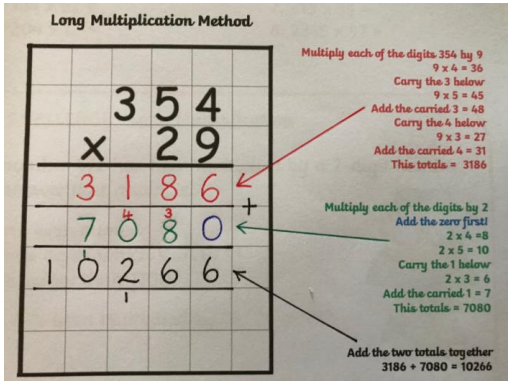
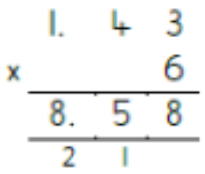
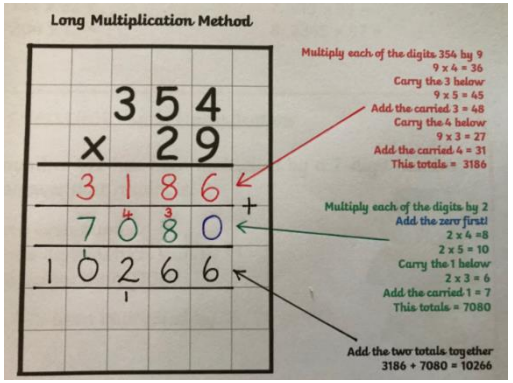
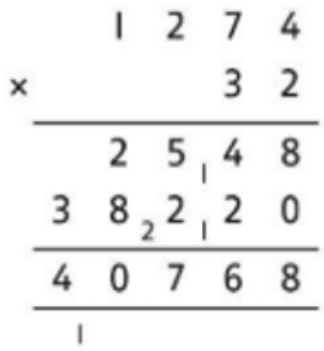
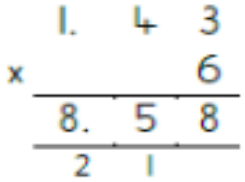
36
x 4
144
2

Place value counters to show how we are finding groups of a number. We are multiplying by 5 so we need 5 rows of that number. 	Use known facts and unitising to multiply. 5 × 4 = 20 5 × 40 = 200 5 × 400 = 2,000 5 × 4,000 − 20,000 5,000 × 4 = 20,000		

Y5 multiplication

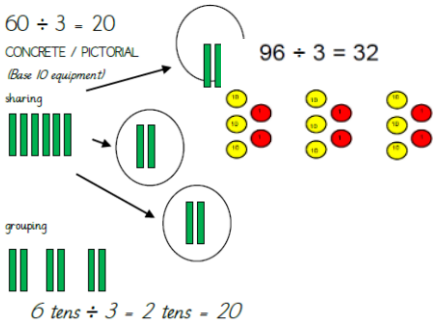
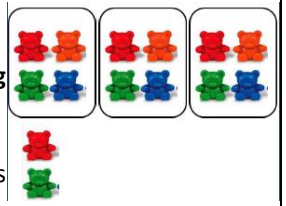
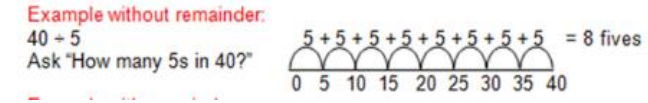
Concrete	Pictorial	Abstract	Method by the end of the year
When multiplying decimals by 10,100,1000 initial concrete resources will be used to support understanding to show how exchanging can take place. 	This pictorial grid method will support children's understanding of multiplying by 10, 100, 1000. 	**Long multiplication** Children may wish to use 2 separate calculations to support their understanding. Reinforce language of place value when multiplying by multiples of 10. Extend to 3 or 4-digit numbers multiplied by a 2-digit number. 23 X 13 + 69 (3 x 23) 230 (10 x 23) 299	23 X 13 + 69 (3 x 23) 230 (10 x 23) 299

Y6 multiplication

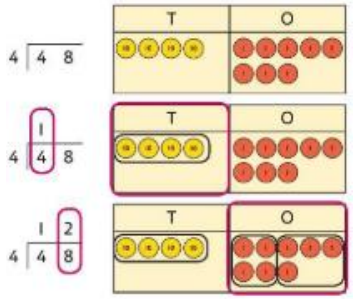
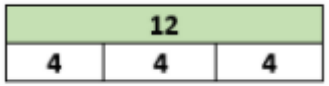
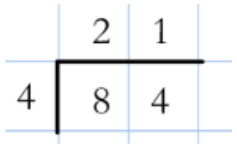
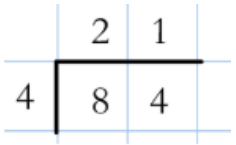
Concrete	Pictorial	Abstract	Method by the end of the year
When multiplying decimals by 10,100,1000 initial concrete resources will be used to support understanding to show how exchanging can take place.  *0·14 × 10 = 1·4*	This pictorial grid method will support children's understanding of multiplying by 10, 100, 1000.  	**Long multiplication** Children short be taught long multiplication without an expanded method. Children should be able to calculate TU x TU, HTU x TU and ThHTU x TU.  <u>Short multiplication with decimals</u> Children should also be taught to solve short multiplication problems with decimals. These should be linked, where possible to context e.g. money and measures. 	  

Please note: Concrete apparatus and pictorial representations should still be used to support children who may be struggling with abstract concepts. Concrete apparatus should be readily available for lower achieving children and these with SEND.

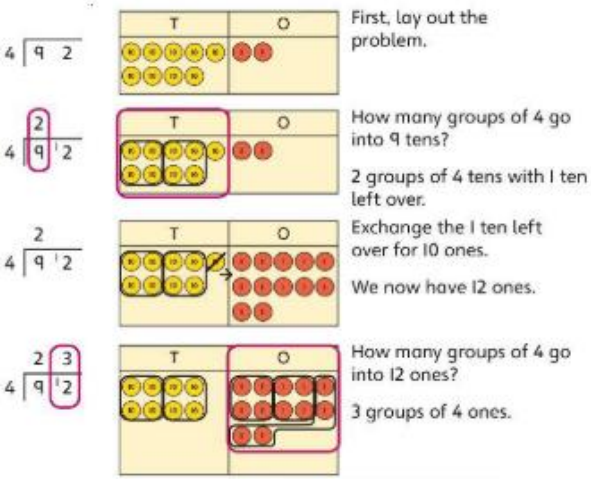
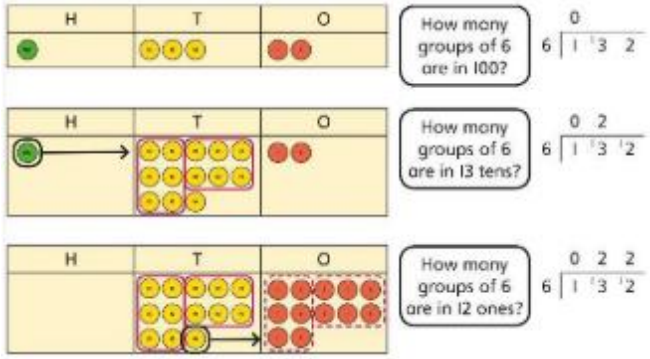
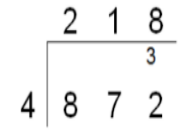
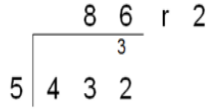
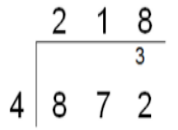
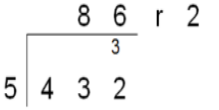
Y3 Division

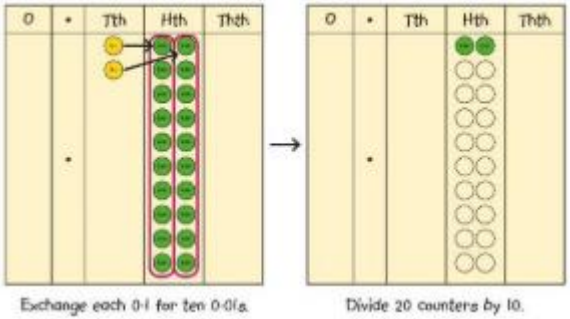
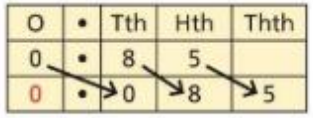
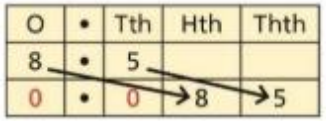
Concrete	Pictorial	Abstract	Method by the end of the year
Traditionally our pupils need more revision of sharing and grouping from KS1. For this reason we start with concrete sharing of materials with and without remainders. **Division through sharing**  **Division with remainder through sharing** 14 ÷ 3 = Divide objects between groups and see how much is left over. 	Division using number lines Consolidate learning from KS1 using diagrams of sharing and repeated subtraction and addition on a number line to make jumps  Concrete methods could be represented pictorially within books to show understanding.	How many groups of 6 in 24? $24 \div 6 = 4$ Abstract methods may be supported with pictorial methods within the children's books. Children will begin to move onto division with remainders. A number sentence will support any abstract written calculation by using pictorial method to support.  	

Y4 Division

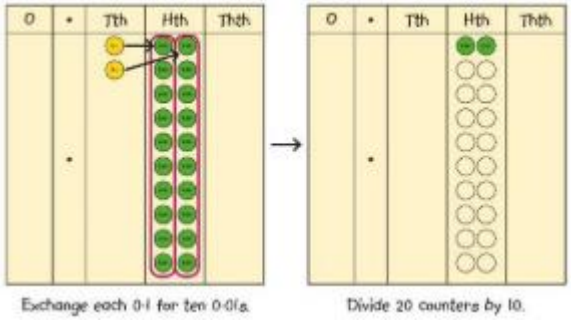
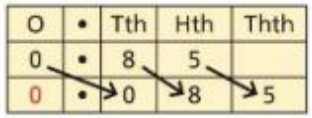
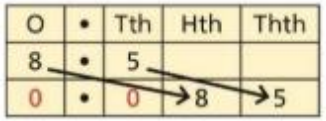
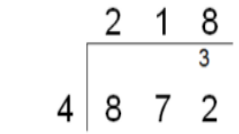
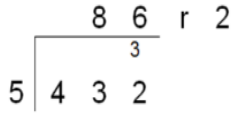
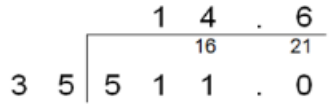
Concrete	Pictorial	Abstract	Method by the end of the year
Use place value equipment on a place value grid alongside short division. The model uses grouping. 	Children can use bar models for sharing. These can be used with concrete resources such as dots, Dienes, place value counters or numbers to show sharing in division. This also links with fraction work. 	**Short division** Children will begin to use the formal written method of division without remainders. This will only come after a clear concept is understood using manipulatives.  Dividing by 2,3,4, and 5	 Dividing by 2,3,4, and 5

Y5 Division

Concrete	Pictorial	Abstract	Method by the end of the year
Division with remainders - Bus stop 	Pictorial representations can be used to support any concrete manipulatives. 	**Bus Stop Method for division** Begin with divisions that divide equally with no remainder.  Move onto divisions with a remainder. 	**Bus Stop Method for division** Begin with divisions that divide equally with no remainder.  Move onto divisions with a remainder. 

Dividing decimals by 10, 100 and 1,000 Use place value counters to represent dividing by 10, 100, 1000. Represent division using exchange on a place value grid up to 2 decimal places, while still introducing the language for 3 decimal places.  0·2 is 2 tenths. 2 tenths is equivalent to 20 hundredths. 20 hundredths divided by 10 is 2 hundredths.	Represent division to show the relationship with multiplication. Understand the effect of dividing by 10, 100 and 1,000 on the digits on a place value grid up to 2 decimal places, while still introducing the language for 3 decimal places.  $0{\cdot}85 \div 10 = 0{\cdot}085$  $8{\cdot}5 \div 100 = 0{\cdot}085$		

Y6 Division

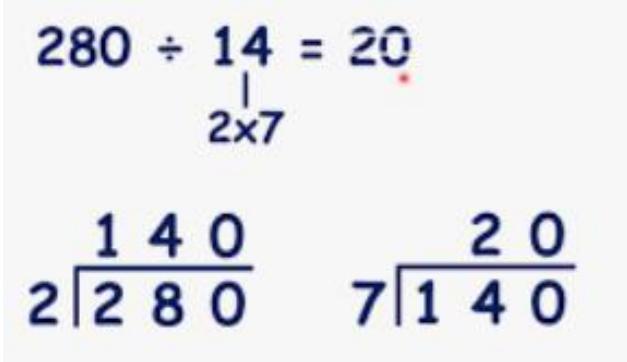
Concrete	Pictorial	Abstract	Method by the end of the year
Dividing decimals by 10, 100 and 1,000 Use place value counters to represent dividing by 10, 100, 1000. Represent division using exchange on a place value grid up to three decimal places.  0·2 is 2 tenths. 2 tenths is equivalent to 20 hundredths. 20 hundredths divided by 10 is 2 hundredths.	Represent division to show the relationship with multiplication. Understand the effect of dividing by 10, 100 and 1,000 on the digits on a place value grid up to 3 decimal places.  *0·85 ÷ 10 = 0·085*  *8·5 ÷ 100 = 0·085*	Short division to be routinely in place (see Y5). Begin with divisions that divide equally with no remainder.  Move onto divisions with a remainder.  Finally move into decimal places to divide the total accurately using a formal method for division (Bus stop)  	

Long division – using factor pairs.

When a number is being divided by a number which is not prime, it is possible to solve the problem using factor pairs.

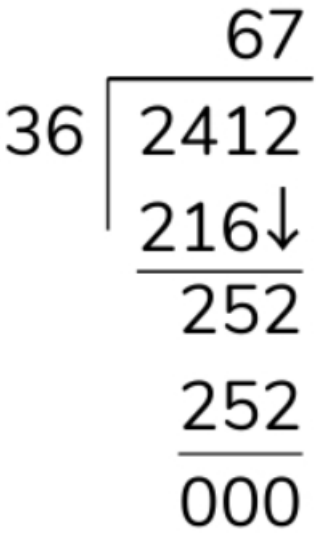
In this case the divisor is 14. Rather than dividing the dividend by 14, it is possible to use factor pairs instead. A factor Pair of 14 is 2 and 7.

In the example below, the dividend is divided by 2 and then the answer is divided by 7. This then gives the answer to The calculation.



Long Division - Abstract Method

1. How many 36 fit in 2. Zero.
2. How many 36 fit in 24. Zero.
3. How many 36 fit in 241. Six. Six is placed on the top line.
4. Write the answer to 6 x 36 (216) underneath.
5. 241 – 216 = 25. 25 is written below.
6. As 36 does not fit into 25, drop the next digit down from the original number. In this case a 2.
7. How many 36 fit in 252? Seven. Write seven on the top line.
8. Now put the answer to 252 below and subtract from 252. The answer is zero and the calculation is complete.
9. At Nook Lane we encourage the children to continue to work through the calculation until they have reached a bottom answer of zero (unless a remainder is involved).



In order to help children with the 36 times table. At Nook Lane we teach the following method:

30 + 6 = 36

60 + 12 = 72

90 + 18 = 108

120 + 24 = 144

150 + 30 = 180

180 + 36 = 216

210 + 42 = 252

By teaching the children to partition in this method, enables them to answer complex questions, particularly when the dividend is a prime number and can not be solved using factor pairs.