Dundry Primary School Progression in Calculations Year R – 6 (2022/23)

"*Mathematics is a creative and highly interconnected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject."*

The National Curriculum in England 2014 Department for Education

This calculation policy is a guide for all staff at Dundry Primary School and forms part of the mathematics policy.

It is designed to be used alongside any teaching resources that teachers use.

All staff have access to White Rose Maths schemes of work and resources which provides guidance on lessons as well as ideas and activities to develop mastery in Mathematics. These resources support the learning of mathematics and should be tailored to support the needs of the pupils. Staff are also encouraged to access the NCETM website and Third Space Learning for further ideas and guidance. Where appropriate, staff are encouraged to base their planning around the recommended White Rose Maths blocks. However, it should be emphasised that all planning should take account of the requirements of the pupils in terms of where they are in their learning and how they can achieve successful outcomes. Teachers are responsible for making these judgments.

The White Rose Maths schemes of work provide sequential programmes of study that are underpinned by promoting fluency in number. They emphasise that all pupils must have a thorough grounding in the four basic rules of number before progressing on to the next level. This complete understanding gives pupils more confidence in dealing with number activities and in turn, leads to mastery of the four operations.

Whilst the calculation policy guidance document is separated into year group phases, these are intended to be used only as a guide and it is the teachers' professional judgement as to when the pupils move on to the next phase.

As our understanding of mathematical mastery within the primary years develops at Dundry School, this policy may be subject to change

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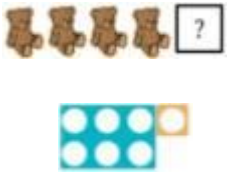
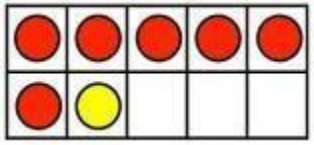
	EYFS ELG	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Saying which number is one more than a given number. Finding the total number of items in two groups by counting all of them. Finding the total by starting at the bigger number and counting on.	Combining two parts to make a whole: part whole model. Starting at the bigger number and counting on. Regrouping to make 10.	Adding three single digits. Use of base 10 to combine two numbers	Column method- regrouping Using place value counters (up to 3 digits)and/or base 10	Column method - regrouping. (Up to 4 digits)	Column method – regrouping (with more than 4 digits)	Column method- regrouping. Abstract methods.
	Taking away using objects or drawings. Saying which number is one less than a given number. Subtracting two single digit numbers by counting back.	Taking away ones Counting back Find the difference Part whole model Make 10 using a tens frame	Counting back Finding the difference Part whole model Make 10 Use of base 10	Column method with regrouping (up to 3 digits using place value counters) Using place value counters (up to 3 digits)and/or base 10	Column method – regrouping. (Up to 4 digits)	Column method – regrouping (with more than 4 digits) Abstract for whole numbers.	Column method - regrouping. Abstract methods.
Multiplication	Problem solving – doubling Start to count in 2's up to 10	Recognise and make equal groups. Doubling Counting in multiples - use cubes, Numicon and other objects in the classroom	Doubling Counting in multiples Repeated addition Arrays – showing commutative multiplication	Counting in multiples Repeated addition Arrays 2 digit × 1 digit using base 10 or place value counters	Column multiplication- introduced with place value counters (2 and 3 digit multiplied by 1 digit	Column multiplication (up to 4 digit numbers multiplied by 1 or 2 digits) Abstract only but might need a repeat of year 4 first	Column multiplication Abstract methods (multi-digit up to 4 digits by a 2 digit number)

	Problem solving – halving and sharing up to 10	Sharing objects into groups Division as grouping e.g. I have 12 sweets and put them in groups of 3, how many groups?	Division as grouping Division within arrays Repeated subtraction	Division with a remainder Short Division (2 digits by 1 digit- using base 10 or place value counters)	Division with a remainder Short division (up to 3 digits by 1 digit- concrete and pictorial)	Short Division (up to 4 digits by a 1 digit number interpret remainders)	Short Division (up to 4 digits by a 1 and 2 digit number interpret remainders)

Addition

Key language: addend, sum, total, parts and wholes, plus, add, altogether, more, 'is equal to' 'is the same as', commutative

Objective & Strategy	Concrete	Pictorial	Abstract
Finding one more	Counting on using familiar resources and objects   Adding machine	Using ten frames with counters or drawing on ten frames. 	Introduction to + and = symbols to create equations (number sentences) 4 + 1 = 5

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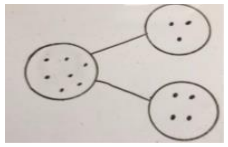
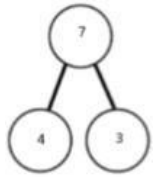
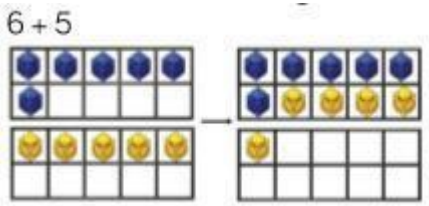
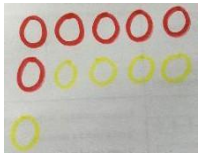
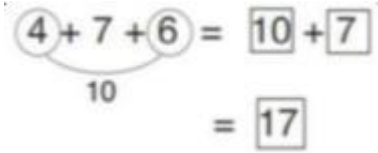
Combining two parts to make a whole (aggregation)	Combining two parts to make a whole (use a range of resources from the classroom)   Adding machine	Objects initially used on a part-whole model and then represented using dots or circles. The part-whole model is presented in different orientations. 	Four is a part Three is a part The whole is seven 4 + 3 = 7 
Counting on (augmentation)	Concrete resources may not change, but children begin to count on from the largest number   Adding machine	Children draw circles for the amount to be added on and count on using the circles: 8 + ◯◯◯◯ =	Recording as equations (number sentences) 8 + 4 = 12
Re-grouping to make 10	Using ten frames and counters 	Children draw their own representation of ten frames and counters. Start with the larger number and use the smaller number to make 10. 	Children record as equations and begin to understand equality and commutativity 6 + 5 = 11 6 + 5 = 5 + 6 6 + 5 = 7 + 4
Adding 3 single digits	Children look for known number bonds, using their knowledge of commutativity. Ten frames may also be used for this step. 	This stage is not represented pictorially, as the focus is on recall of known number facts. Concrete objects are used initially to demonstrate commutativity.	Look for known number bonds and combine these numbers first before adding on the remaining number 

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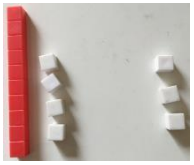
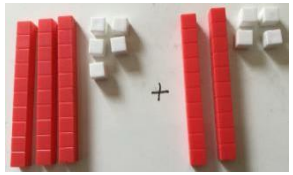
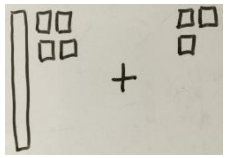
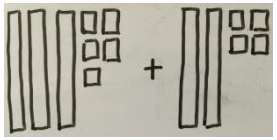
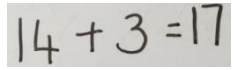
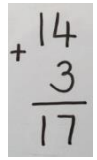
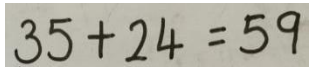
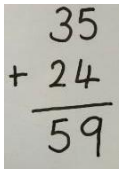
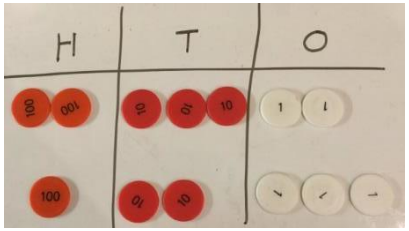
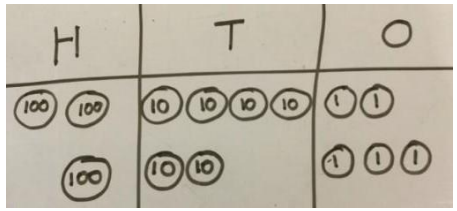
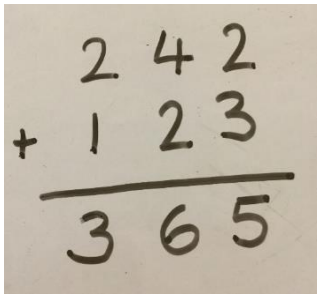
Combining 2 numbers – no exchanging	Children represent the numbers to be added using Base 10 and then add together first the ones then the tens. TO + O using Base 10 (Diennes)  TO + TO using Base 10 	After using Base 10 practically, children draw it out, remembering to solve the addition by adding ones and then tens. TO + O drawing Base 10 (Diennes)  TO + TO drawing Base 10  Or 	Record horizontally initially, moving onto column addition, adding ones and then tens.  When ready, moving onto:   When ready, moving onto: 
	Move onto using place value counters. HTO + HTO using place value counters 	And representing by drawing in a place value frame. HTO + HTO drawing place value counters 	Add the ones first, then the tens and hundreds. 

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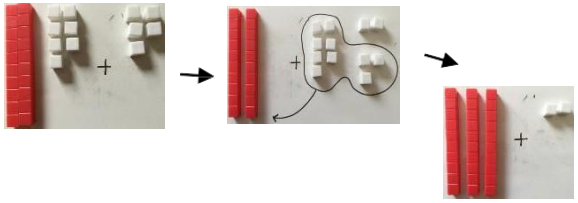
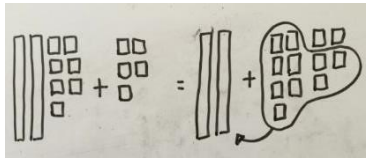
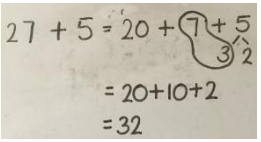
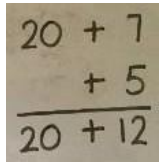
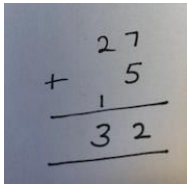
Combining 2 numbers – with exchanging	As before, children represent the numbers to be added using Base 10 and then add together first the ones then the tens, carrying and exchanging ones for tens (enabling children to clearly see that one ten equals ten ones and one hundred equals ten tens). TO + O using Base 10 (Diennes) 	As before, after using Base 10 practically, children draw it out, remembering to solve the addition by adding ones and then tens, and circling when an exchange is made. TO + O drawing Base 10 (Diennes) 	Record horizontally initially, moving onto column addition, adding ones and then tens.  When ready, moving onto column method:  and/or  (expanded)

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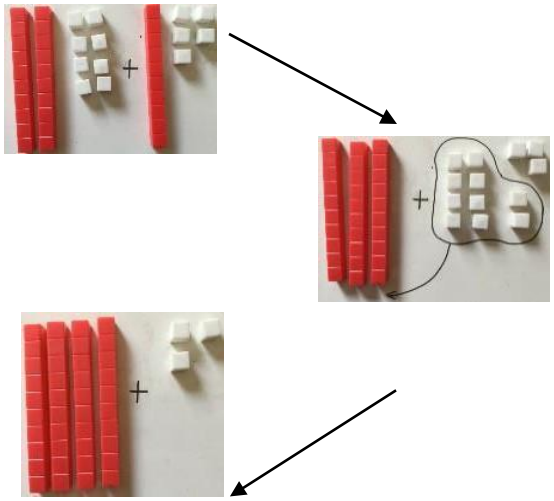
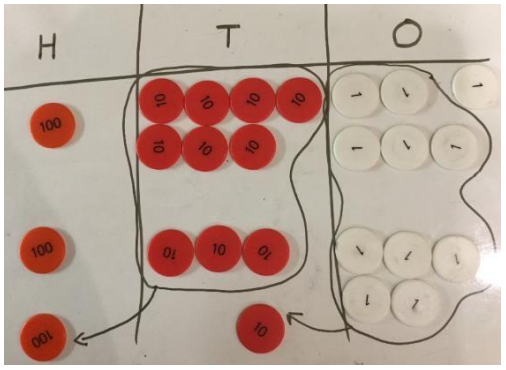
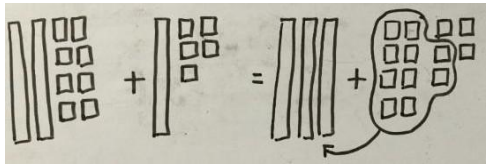
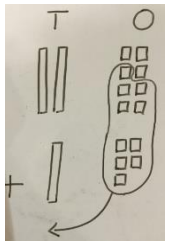
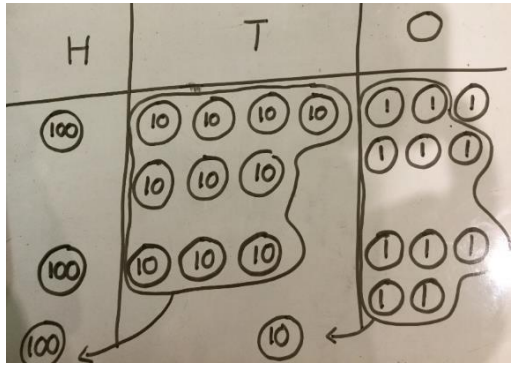
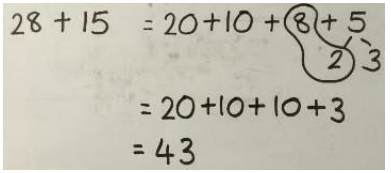
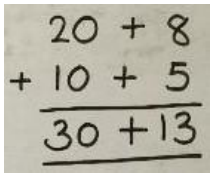
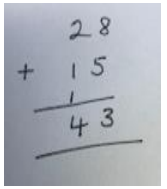
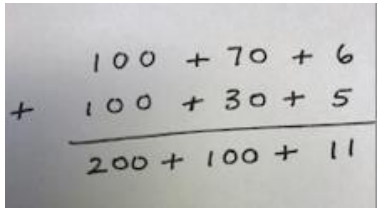
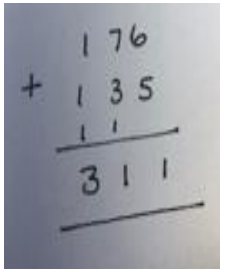
	TO + TO using Base 10  Move onto using place value counters. HTO + HTO using place value counters 	TO + TO drawing Base 10  Or  And representing by drawing in a place value frame. HTO + HTO drawing place value counters 	 When ready, moving onto:  and/or  (expanded) Add ones, then tens and hundreds  (expanded) and/or 

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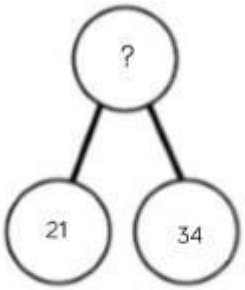
Conceptual Variation: different ways to ask children to solve 21 + 34

Suggestions for other models of addition children should use to develop conceptual fluency once they are fluent with methods and procedures.



?	
21	34

Word problems:

In year 3, there are 21 children and in year 4, there are 34 children. How many children in total?

21 + 34 = 55. Prove it

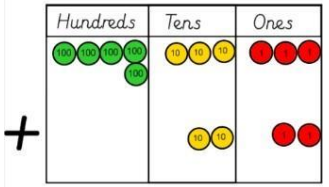
21
+ 34
___

21 + 34 =

□ = 21 + 34

Calculate the sum of twenty-one and thirty-four.

Addition represented using place value counters:

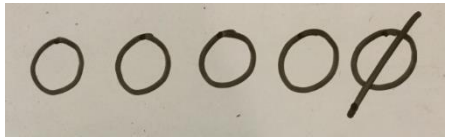
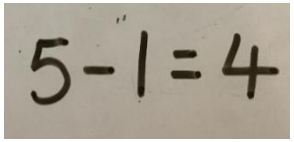
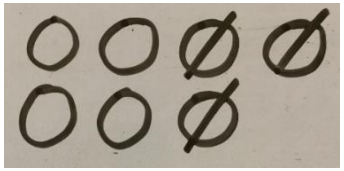
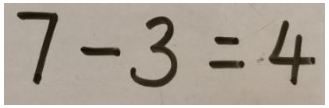


Missing digit problems:

10s	1s
	?
?	5

Subtraction

Key language: subtrahend, minuend, take away, less than, the difference, difference between, subtract, minus, fewer, decrease, how many have you got left?

	Concrete	Pictorial	Abstract
Finding one less	Taking away or removing an object from the whole – represented using Numicon and pegs, cubes, counters or other familiar objects and resources. Subtraction is introduced through real life situations (e.g. losing something or eating something), through songs (e.g. Five Little Speckled Frogs, Ten Green Bottles) and through stories (e.g. The Three Little Pigs).   	Children draw circles to represent the apparatus they are using, crossing one off and counting the remaining circles (or counting backwards, depending on familiarity with numbers and counting). 	When ready, children begin to record as an abstract equation (number sentence). 
Taking away and removing objects from a whole	Children move onto removing more than one object from the whole, again introduced initially through familiar contexts, stories and songs, but moving onto representing using Numicon and pegs or counters. Children count the number that remain.  	Represented as circles, with the number that are being subtracted crossed off. 	Recorded as an equation (number sentence). 

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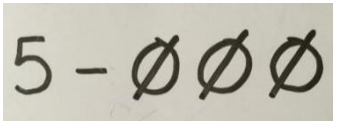
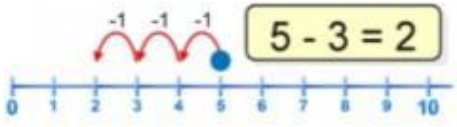
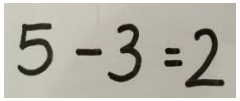
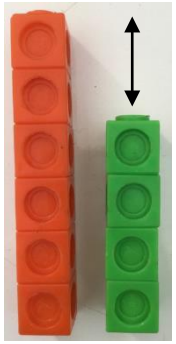
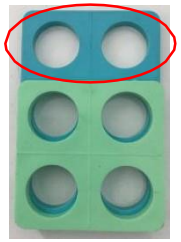
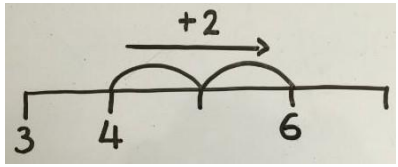
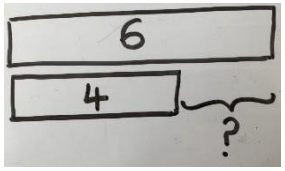
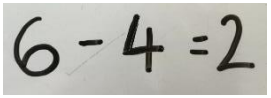
Counting back in ones	Counting backwards as objects are removed from a group, moving onto counting back along a numbertrack or numberline.  Starting from 5 and counting backwards, 5…4,3,2	The initial amount is recorded as a digit and the amount being taken away is recorded as circles. Each circle is crossed off as children count backwards in ones.  Children will also be shown how to count back in ones along a number line. 	Recorded as an equation (number sentence). 
Finding the difference	Comparing amounts and objects to find the difference using cubes or Numicon.  What is the difference between 6 and 4? Six is 2 more than four. 	Counting on using a number line to find the difference between two numbers. Children are encouraged to begin to draw their own number lines and to realise that they do not need to start from 0 each time.  or drawing a comparison bar model. 	Recorded as an equation (number sentence). 

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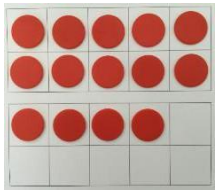
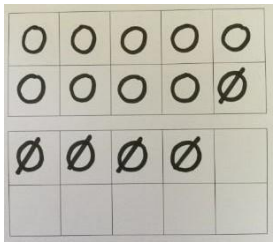
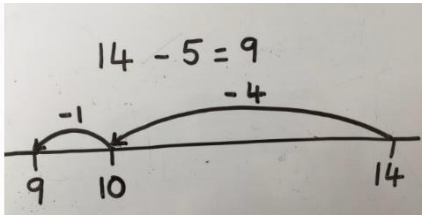
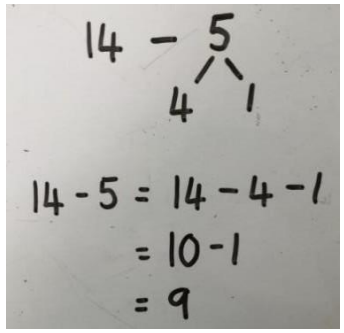
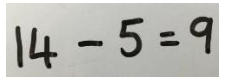
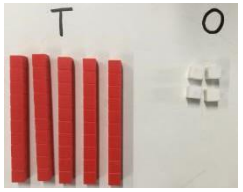
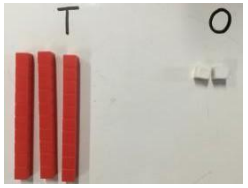
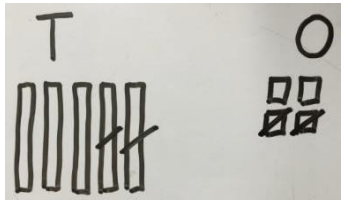
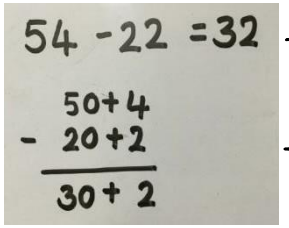
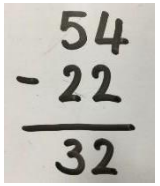
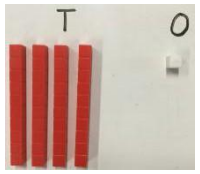
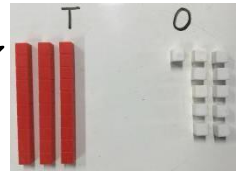
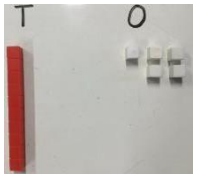
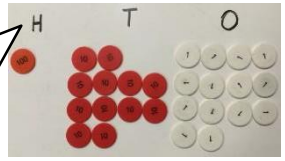
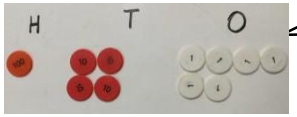
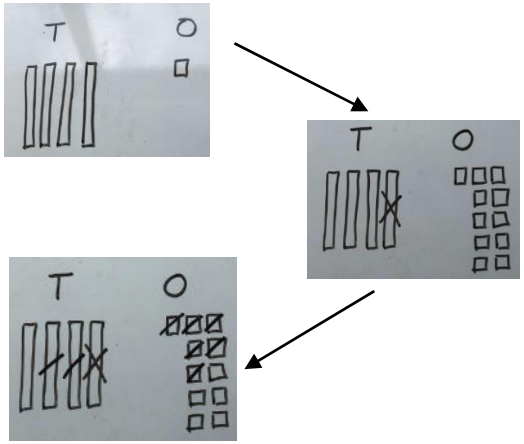
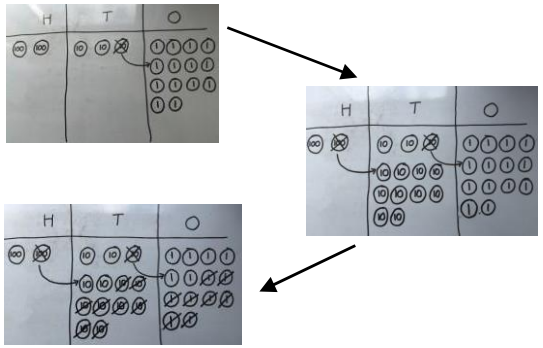
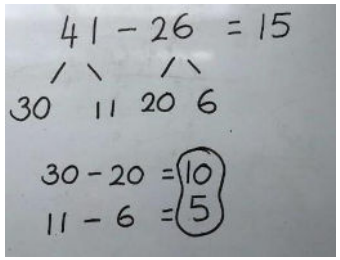
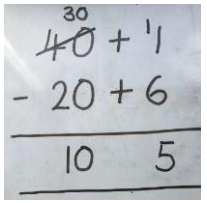
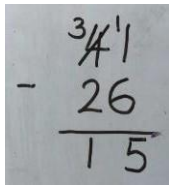
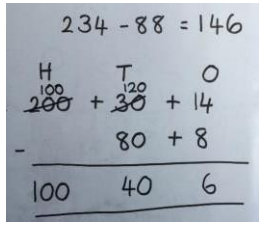
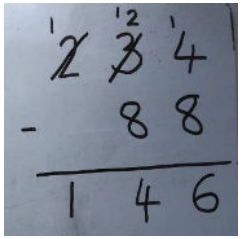
Making ten	Using 10 frames to calculate 14 – 5.  Partition five into 4 and 1. First take away 4 to leave 10   Then take away 1 to leave 9.	Children represent the ten frame pictorially and discuss their method.  They can then move onto representing on a number line. 	Initially, children show partitioning in their abstract recording to reinforce their understanding from concrete and pictorial work.  When ready, they move onto recording only the equation. 
Column method (no regrouping/ and exchanging)	Using Base 10 to calculate 54-22  Represent 54 using Base 10, separating tens and ones. Take away ones and then tens. 	Children draw representations of Base 10 and cross out the amount being subtracted, first ones and then tens. 	Initially record horizontally before moving onto column subtraction – reinforcing that ones need to be subtracted before tens.  Horizontal Expanded column Column 

Dundry Primary School Progression in Calculations Year R – 6 (2022/23)

Column method (with regrouping/and exchanging)	Using Base 10 to calculate 41 - 26  Represent 41 using Base 10.  Carry one ten to the ones column and exchange for ten ones.  Take away ones and then tens. Using Place Value counters to calculate 234 - 88  ~~Represent 234~~ using Place Value counters Carry a ten to the ones column and exchange. Carry a hundred to the tens and exchange.  Subtract ones and then tens.  	Children draw representations of Base 10, showing carrying and exchanging by crossing out one ten and drawing as ten ones in the ones column. The subtracted ones and tens are then crossed off.  Children draw representations of Place Value counters, showing carrying and exchanging by: ● crossing out one ten and drawing as ten ones in the ones column ● crossing out one hundred and drawing as ten tens in the tens column The subtracted ones and tens are then crossed off.  	Initially record horizontally, partitioning numbers and relating back to part-whole model. Recombining as the final step to find the answer.  Move onto expanded method of column subtraction (if needed), and then formal written/compact method.   Use expanded method initially, moving onto formal written/compact method.  

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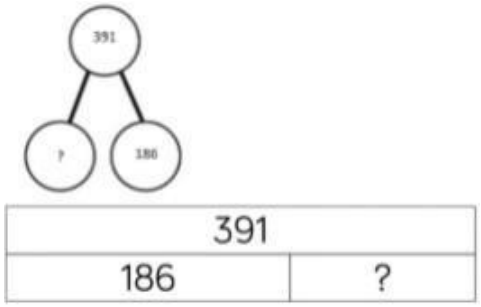
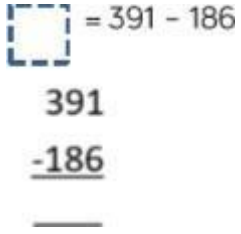
Conceptual Variation: different ways to ask children to solve 391-186

Suggestions for other models of subtraction children should use to develop conceptual fluency once they are fluent with methods and procedures.

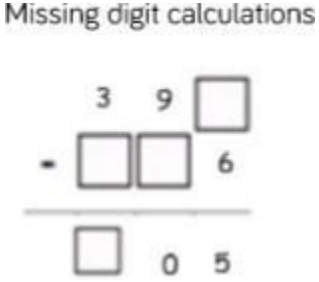


Raj spent £391, Timmy spent £186.
How much more did Raj spend?

Calculate the difference between 391 and 186.

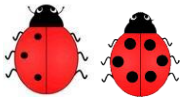
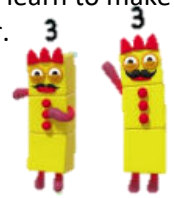
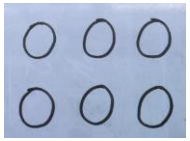
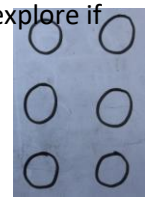
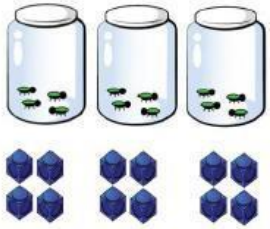
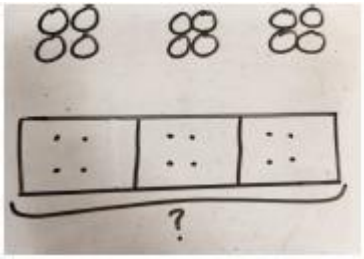
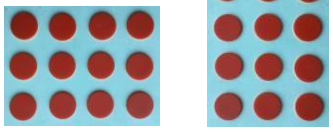
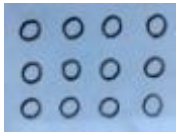
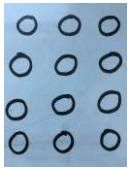


What is 186 less than 391?



Multiplication

Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups

	Concrete	Pictorial	Abstract
Doubling	In practical activities, children learn to make and show double of a number.  3 Double 3  Double 3	Children record pictorially and are encouraged to set out as an array and to explore if orientation affects the final amount.  	At appropriate stages, children learn to represent doubling as addition or multiplication: 3 + 3 = 6 3 x 2 = 6
Recognising and making equal groups & Repeated addition	Children recognise and can make equal groups of objects. They use stem sentences to describe the groupings: There are 3 equal groups with 4 in each group 	Children represent pictorially through drawing resources and bar models.  Or by drawing repeated jumps along a number line. 	The total amount is represented by repeated addition and the use of a multiplication sign is introduced. 4 + 4 + 4 = 12 3 x 4 = 12
Using arrays to demonstrate commutativity	Children use arrays to illustrate and explore commutativity. 3 x 4 = 4 x 3 	They represent arrays pictorially.  	Arrays can be used by children to derive and write a range of calculations e.g. 3 + 3 + 3 + 3 = 12 12 = 4 + 4 + 4 12 = 4 x 3 3 x 4 = 12

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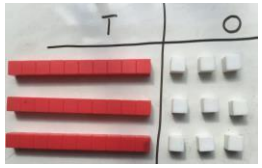
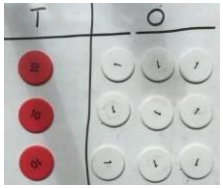
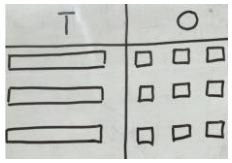
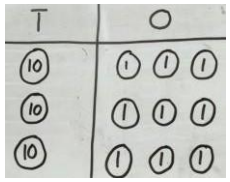
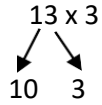
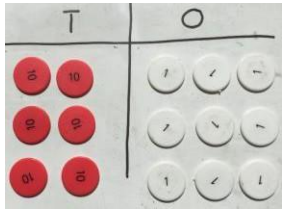
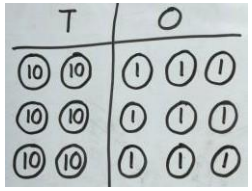
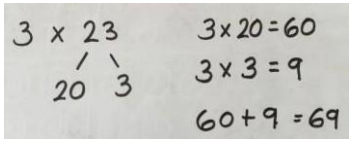
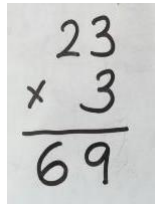
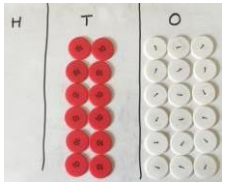
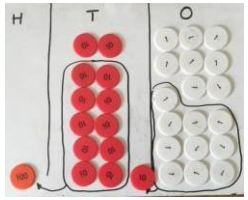
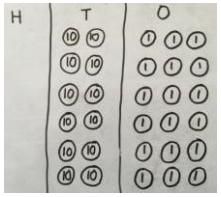
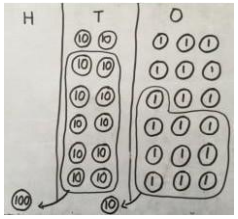
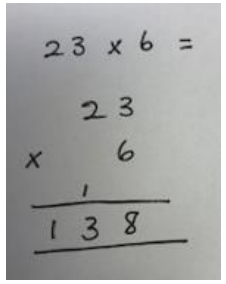
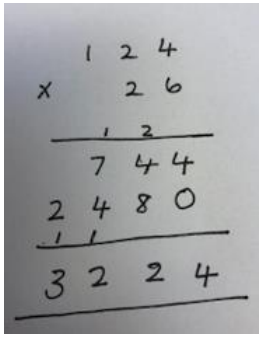
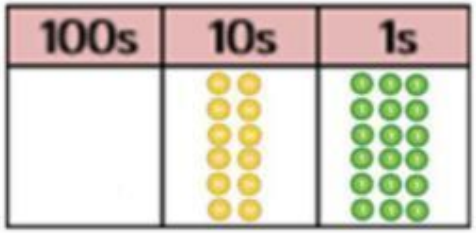
Partitioning to multiply	Initially, children use Base 10 to explore multiplying a two digit number by a single digit number.  3 x 13 = When secure with this, they move onto using place value counters.  3 x 13 =	They represent their work pictorially drawing Base 10 representations to begin with…  … moving onto representing place value counters  	Children use partitioning and known number facts and are encouraged to record the steps they have taken to calculate the answer.  10 x 3 = 30 3 x 3 = 9 30 + 9 = 39
Column multiplication	Children use place value counters to represent the calculation.  4 x 23 =	Place value counters are represented pictorially .  	Children record, using an expanded method, to demonstrate their understanding.  
Formal column method	Children use place value counters to represent the calculation.  6 x 23 =  	Place value counters are represented pictorially.   	Formal written method. 

Dundry Primary School Progression in Calculations Year R – 6 (2022/23)

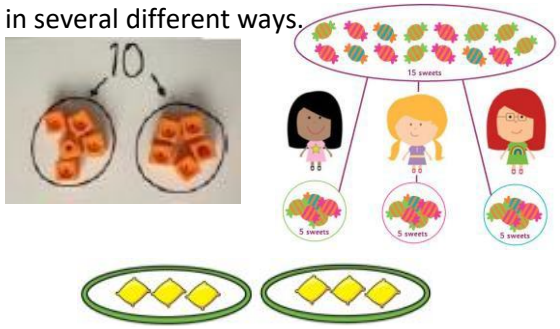
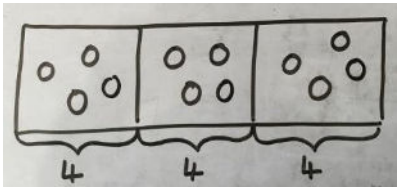
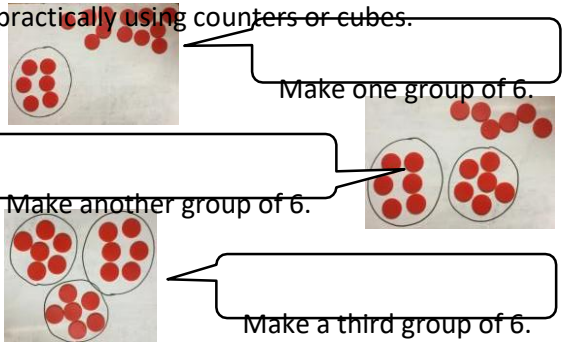
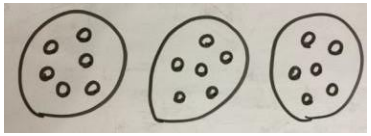
<table>
<tr><td></td><td>Once children start to multiply 4 digit numbers by 2 digit numbers etc., they should be confident with the abstract.</td><td colspan="2"> 
</td></tr>
<tr><td colspan="4"><u>Conceptual Variation: different ways to ask children to solve 6 x 23</u>
Suggestions for other models of multiplication children should use to develop conceptual fluency once they are fluent with methods and procedures.</td></tr>
<tr><td> 
</td><td>Mai had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week?

With the counters, prove that 6 x 23 = 138</td><td>Find the product of 6 and 23.

$6 \times 23 =$
$\square = 6 \times 23$
6×23 $\quad$ 23×6</td><td>What is the calculation?
What is the product?
 
</td></tr>
</table>

Division

Key language: dividend, divisor, quotient, divide, divided by, share, group, equal groups, half, part, fraction of

	Concrete	Pictorial	Abstract
Sharing	Children are introduced to sharing through practical applications such as sharing biscuits, sweets or fruit. They investigate sharing between different amounts of groups and explore how numbers such as 12 can be shared in several different ways. 	Children draw pictorial representations, either in groups or as a bar model.   Stem sentence: _____divided between_____is _____each.	Children move onto recording the abstract division equation when they are ready. Regular use of stem sentences has helped to prepare them for this. 6 ÷ 2 = 3 10 ÷ 2 = 5 15 ÷ 3 = 5
Grouping	Grouping is introduced through practical applications e.g. there are 18 children who need to get into teams of 6. How many teams will there be? Children can work this out practically using counters or cubes. 	Children represent grouping through drawing the individual groups (and the remainder if there is one).  Stem sentence: ___divided into groups of ____ is ____groups.	Children record the abstract equation when they are ready. Use of the stem sentence has helped to prepare them for this. 18 ÷ 6 = 3

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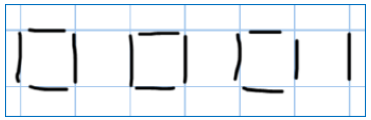
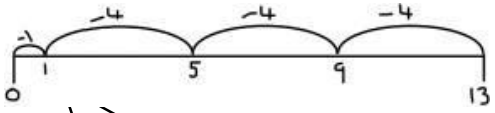
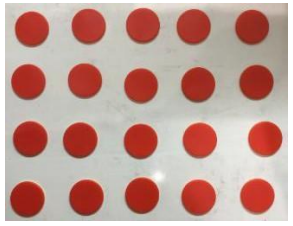
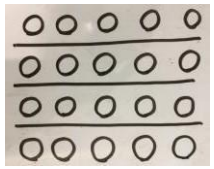
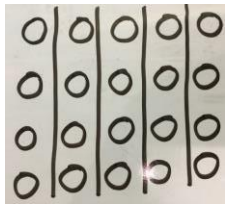
Repeated subtraction	Children are shown how grouping can also be seen as repeated subtraction (the inverse operation of repeated addition in multiplication). e.g. 13 ÷ 4 Lollipop sticks, matches or straws could be used as apparatus, with the groups making squares because we are dividing by 4.  There are 3 whole squares, with one left over.	The lollipop sticks can be represented pictorially,  and on a number line.  13 divided into groups of 4 is 3 groups and a remainder of 1.	The abstract equation is recorded. 13 ÷ 4 = 3 remainder 1
Division with arrays	Division can be linked to multiplication by creating an array and thinking about the equations that can be created.  20 ÷ 4 = 5 20 ÷ 5 = 4 4 x 5 = 20 5 x 4 = 20	Children draw arrays and use vertical and horizontal lines to split the array into different groups to make multiplication and division equations.  4 groups of 5 or 20 divided into groups of 5 5 groups of 4 or 20 shared between 5 groups 	Multiplication and division fact families can be derived and recorded. 4 x 5 = 20 20 = 4 x 5 5 x 4 = 20 20 = 5 x 4 20 ÷ 4 = 5 5 = 20 ÷ 4 20 ÷ 5 = 4 4 = 20 ÷ 5

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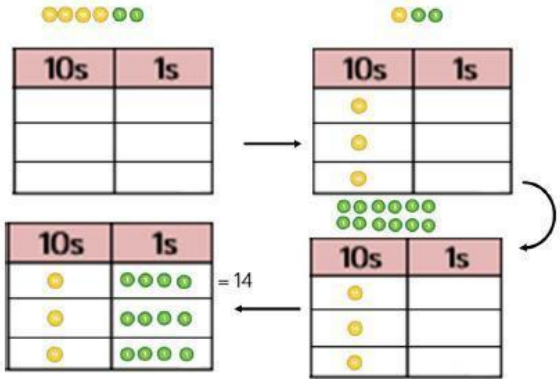
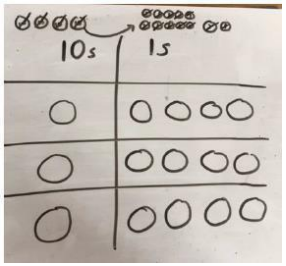
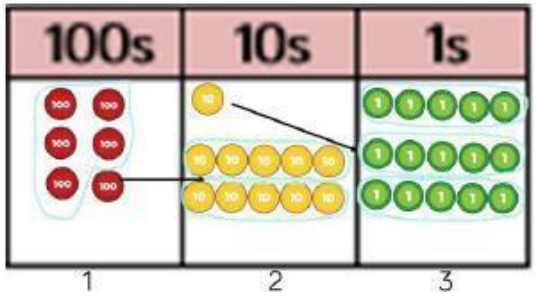
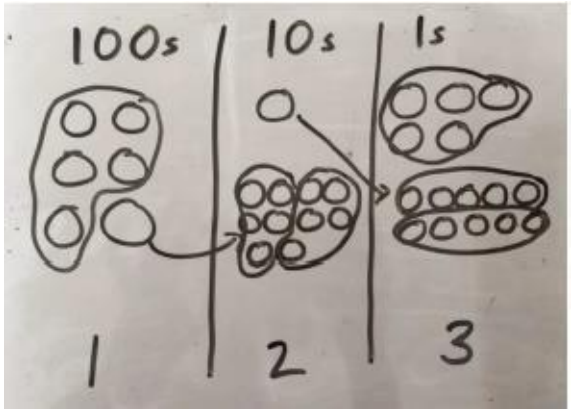
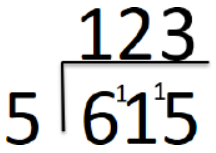
Sharing using place value counters	Using place value counters to share. 42 ÷ 3 	Children represent the place value counters pictorially. 	Children are able to write calculations to show the process: 42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14
Short division	Using place value counters to group. 615 ÷ 5  1. Make 615 with the place value counters 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?	The place value counters can be represented pictorially. 	The calculation is recorded as a short division. 

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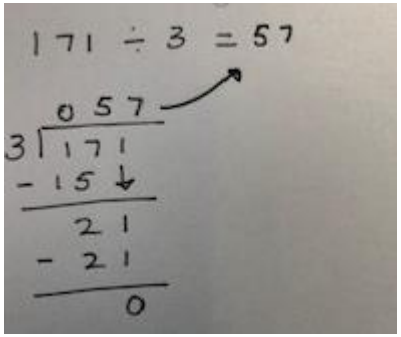
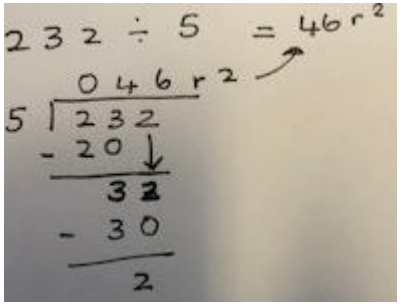
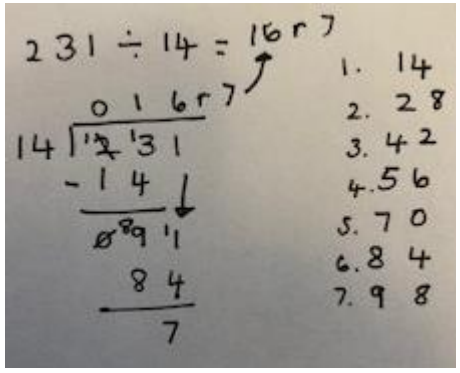
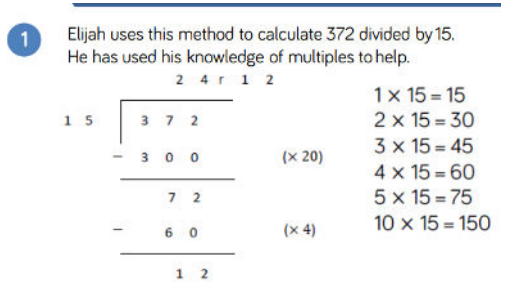
Long Division	Children should be confident with abstract short division before beginning long division. Dividing with a single digit number with no remainder  Dividing with a 2 digit number with remainder   

Conceptual Variation: different ways to ask children to solve 415 ÷ 5

Suggestions for other models of division children should use to develop conceptual fluency once they are fluent with methods and procedures.

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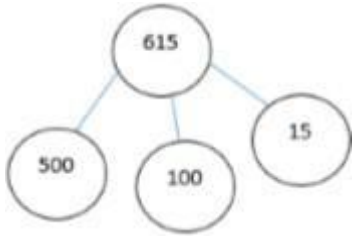
Using the part whole model below, how can you divide 615 by 5 without using short division?  	I have £615 and share it equally between 5 bank accounts. How much will be in each account? 615 pupils need to be put into 5 groups. How many will be in each group?	$5 \overline{)615}$ $615 \div 5 =$ $\square = 615 \div 5$	What is the calculation? What is the answer?