Westwood and Grove Primary School

Calculation Policy

Rationale:

This policy outlines a model progression which enables our children to reason mathematically, solve problems and become fluent in their understanding of number. Children should be enabled to progress stage by stage at a pace appropriate to them, building upon models and representations they recognise from previous teaching, allowing for deeper conceptual understanding and fluency.

Key concepts:

- Children need to understand the concept of equality before using the = sign. The equal sign is not just to be interpreted as 'the answer'
- The Bar Model is a pictorial representation; it is not a calculation.
- Number lines have been chosen as the calculation strategy to which we build on to more formal written methods. This choice offers continuity across the four methods and maths curriculum seeing number as a linear way. Children do however, need access to a wide range of resources and strategies to support them to understand maths and what they need to do to calculate, building fluency and depth.
- Every classroom should have a maths station full of developmentally appropriate resources for children to use. This needs to be tailored to the children.

The foundation of our Maths calculation policy:

Foundations of Maths

Song			Subitising						*Provision*	*Language*
Song	Move objects									
Song	Move objects	Match, sort and organise, pattern								
Song	Move objects	Match, sort and organise, pattern	Counting 1:1 correspondence							
Song	Move objects	Match, sort and organise, pattern	Counting 1:1 correspondence	Representing number						
Song	Move objects	Match, sort and organise, pattern	Counting 1:1 correspondence	Representing number	Combining number					
Song	Move objects	Match, sort and organise, pattern	Counting 1:1 correspondence	Representing number	Combining number	Combining numbers within 5				
Song	Move objects	Match, sort and organise, pattern	Counting 1:1 correspondence	Representing number	Combining number	Combining numbers within 5	Combing numbers within 10			
Song	Move objects	Match, sort and organise, pattern	Counting 1:1 correspondence	Representing number	Combining number	Combining numbers within 5	Combing numbers within 10	Combing numbers within 20		

<table>
<tr><th>Continuous teaching</th><th><u>Addition</u></th><th><u>Subtraction</u></th></tr>
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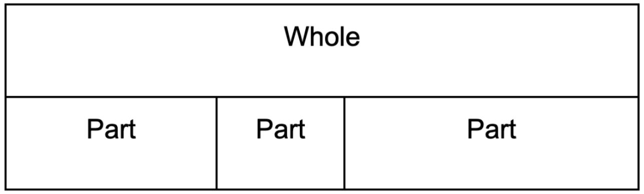
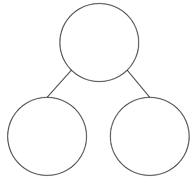
Addition and subtraction are connected.
Both express the relationship between 2 or more parts and the whole.





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Secure numbers facts to 10 and 20

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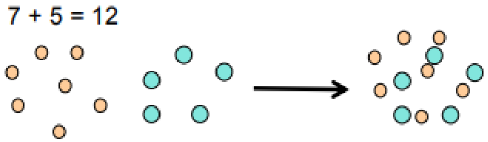
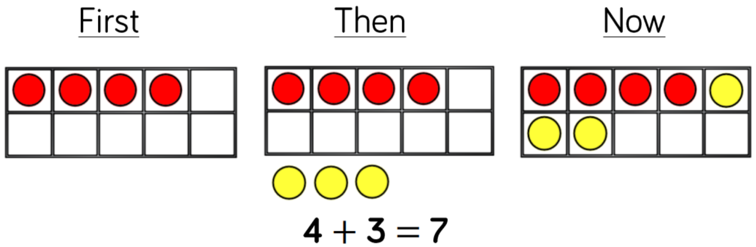
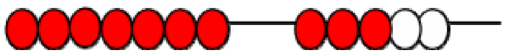
<u>Stage 1:</u>
Combining two sets (aggregation)
Putting together - two or more amounts or numbers are put together to make a total. Count one set, then the other set, Combine the sets and count again.





Counting along the bead string, count out the 2 sets, then draw them together. Count again, starting at 1.



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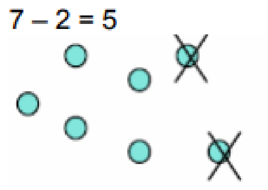
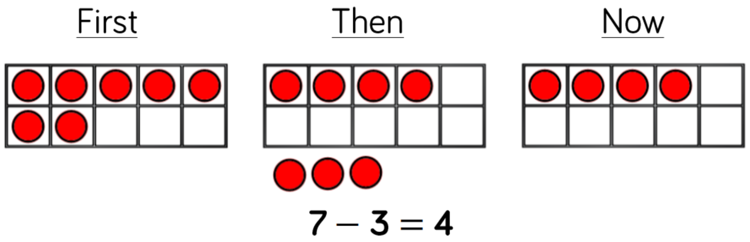
<u>Stage 1:</u>
There are two concepts linked to subtraction:
Subtract - where it is natural to count back to 'take away'
Find the difference – where the understanding of the vocabulary leads to using addition to count on [complementary addition]. Children should be taught to find the difference, using subtraction methods. This should be part of practitioners' vocabulary when teaching subtraction.

Taking away (subtraction method)
When one quantity is taken away from another to calculate what is left.





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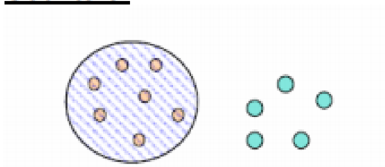
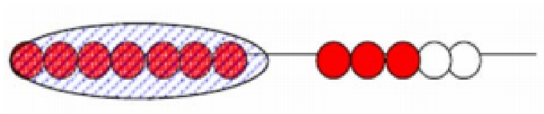
Combining two sets (augmentation)
This stage is essential in starting children to calculate rather than counting. When one quantity is increased by some amount. Count on from the total of the first set, e.g. put 3 in your head and count on 2. Always start with the largest number.

<u>Counters:</u>



Start with 7, then count on 8, 9, 10, 11, 12
<u>Bead strings:</u>

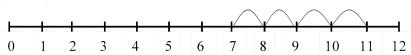


Make a set of 7 and a set of 5. Then count on from 7.

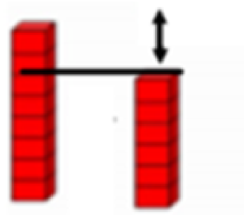
Children need to be secure with aggregation and augmentation before moving onto using a stage one number line

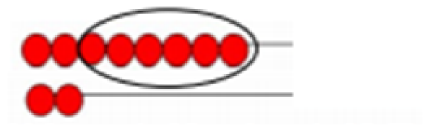
<u>The Number Line</u>
Number line Teaching Points:
- Always work with numbers reading from left to right (smallest to largest), whatever the operation of the calculation.
- Numbers ('landmarks') are written below the line.
- Size of the 'jumps' are written above the 'jumps'.

Children use a numbered line to count on in ones. Children use number lines and practical resources to support calculation and teachers *demonstrate* the use of the number line.
7+ 4



Finding the difference (comparison model)
Two quantities are compared to find the difference. *For example: 8 - 2 = 6*





<u>The Number Line</u>
Children use a numbered line to count on in ones. Children use number lines and practical resources to support calculation and teachers *demonstrate* the use of the number line.

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<td>Inverse needs to be taught throughout</td>
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It is crucial to know or be able to derive key number facts for totals of all numbers up to 10 (instant recall) before progressing further.

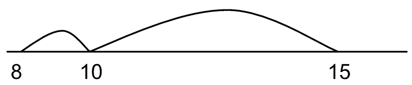
<u>**Stage 2:**</u>
Children must be secure in partitioning a single digit number.

Before moving on to a stage 2 number line where children jump on in 10s and 1s, children need to be completely secure in understanding of place value and use the appropriate vocabulary to recognise and explain 24 is ‘2 tens and 4 ones’.
e.g. 12 + 23 = 10 + 2 + 20 + 3
= 30 + 5
= 35

The steps in addition often bridge through a multiple of 10

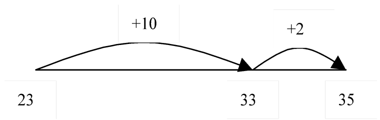
e.g. Children should be able to partition the 7 to relate adding the 2 and then the 5.

8 + 7 = 15



Jumping in 10s and 1s

23 + 12 = 23 + 10 + 2
= 33 + 2
= 35



Model this on a bead bar and practise on 100 bead strings, showing the ‘collection’ of 10s and then the ones. i.e “2 tens and 1 ten makes 3 tens, which is 30. Then 3 and 2 makes 5 ones. Altogether we can see 3 tens and 5 ones, which is 35.” Check by counting in tens and ones along the bead bar. Express this as: “20 add 10 equals 30”

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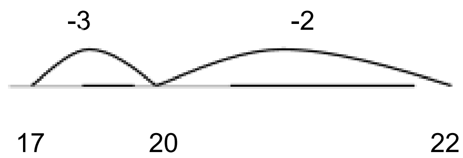
<u>**Stage 2:**</u>
Children must be secure in partitioning a single digit number.

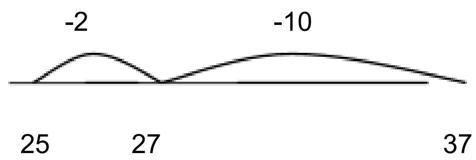
Use known number facts and place value to subtract (partition second number only)

Example: 22 – 5 = 22 – 2
= 20 - 3



Example: 80 – 30

37 – 12 = 37 – 10 – 2
= 27 – 2
= 25



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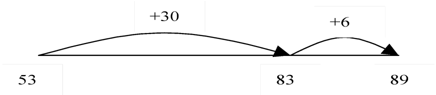
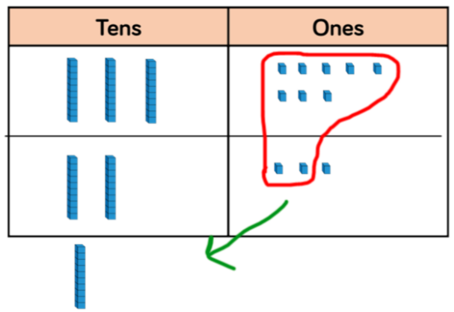
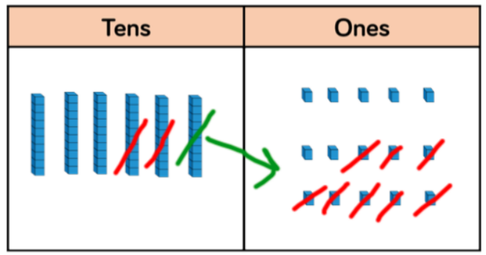
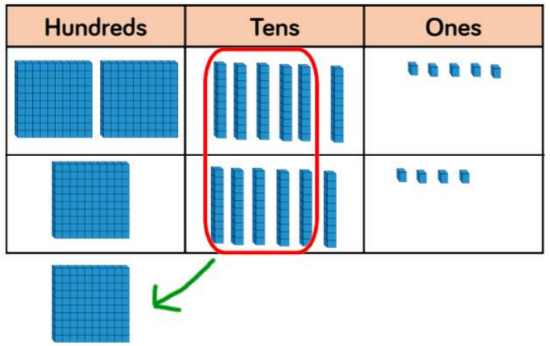
	AND as: “2 tens add 1 tens equals 3 tens or 30" **Partition into tens and ones** Partition both numbers and recombine. Count on by partitioning the second number only e.g. *36 + 53 = 53 + 30 + 6* *= 83 + 6* *= 89* 	
Ensure commas and decimal places are always used. *Ensure that columns are labelled and all digits are placed in the right column (digits of the same value line up).*	<u>**Stage 3:**</u> Children should become confident in adding first before exchanging whilst adding. Children should be confident in adding using base 10/place value counters in place value charts before recording pictorially. Children should become confident with recording column method alongside pictorial representations. When children are confident, children to solve calculations using column method. *For example: 38 + 23 = 61*  $\begin{array}{r} 38 \\ +\,23 \\ \hline 61 \\ \hline {\scriptstyle 1} \end{array}$	<u>**Stage 3:**</u> Children should become confident in subtracting first before exchanging whilst subtracting. Children should be confident in subtracting using base 10/place value counters in place value charts before recording pictorially. Children should become confident with recording column method alongside pictorial representations. When children are confident, children to solve calculations using column method. *For example: 65 - 28 = 37*  $\begin{array}{r} \overset{5}{\cancel{6}}\overset{1}{5} \\ -\,28 \\ \hline 37 \\ \hline \end{array}$

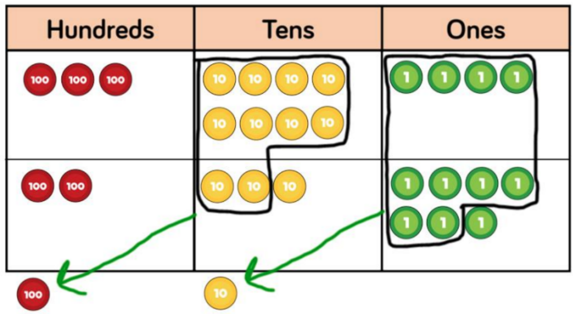
Ensure exchanging for addition is at the bottom

265 + 164 = 429



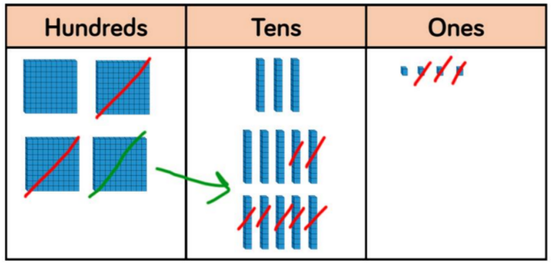
$$\begin{array}{r} 265 \\ +\,164 \\ \hline 429 \\ \hline {\scriptstyle 1} \end{array}$$

384 + 237 = 621



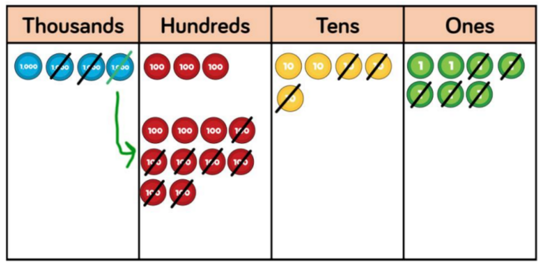
$$\begin{array}{r} 384 \\ +\,237 \\ \hline 621 \\ \hline {\scriptstyle 1}\,{\scriptstyle 1} \end{array}$$

435 - 273 = 262



$$\begin{array}{r} {}^{3}\cancel{4}{}^{1}35 \\ -\,273 \\ \hline 262 \\ \hline \end{array}$$

4357 - 2735 = 1622



$$\begin{array}{r} {}^{3}\cancel{4}{}^{1}357 \\ -\,2735 \\ \hline 1622 \\ \hline \end{array}$$

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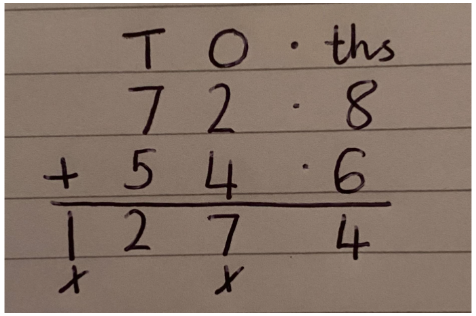
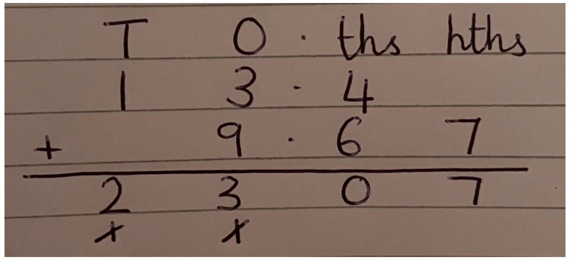
Extend to decimals (same number of decimals places) and adding several numbers (with different numbers of digits).



Extend to numbers with any number of digits and decimals with 1, 2 and/or 3 decimal places.



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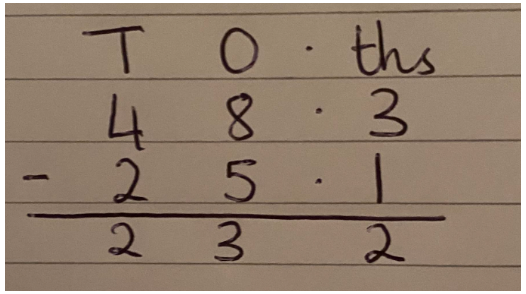
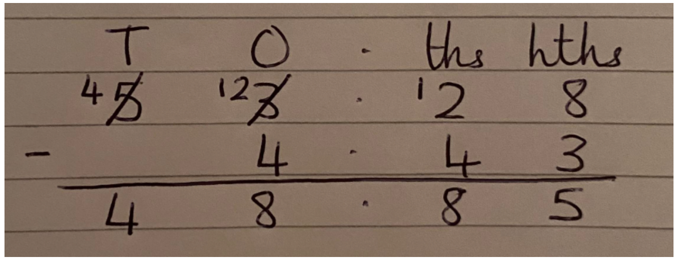
Extend to decimals (same number of decimals places) and subtracting several numbers (with different numbers of digits).



Extend to numbers with any number of digits and decimals with 1, 2 and/or 3 decimal places.



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	Multiplication	**Division**
	Multiplication and division are connected. *Both express the relationship between a number of equal parts and the whole.*	*Part* | *Part* | *Part* | *Part* / *Whole*

Part	*Part*	*Part*	*Part*
Whole			

The concept of inverse should be taught throughout multiplication and division.

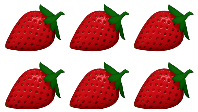
The environment and language used should represent this concretely, pictorially and visually.

Multiplication

Stage 1 - Arrays

Multiplication is related to doubling and counting groups of the same size. Children need to be fluid in doubling numbers as a foundation to their understanding of multiplication.

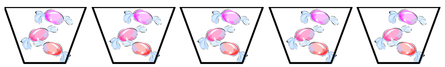
3 + 3 = 6



Counting using a variety of practical resources: Counting in 2s e.g. counting socks, shoes, animal's legs. Counting in 5s e.g. counting fingers, fingers in gloves, toes. Counting in 10s e.g. fingers, toes.

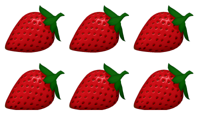
Pictures/marks – Teachers use pictures and marks to pictorially represent problems. Consolidation of one to one correspondence, aggregation and augmentation.

There are 3 sweets in one bag.
How many sweets are there in 5 bags?



Stage 2 - Arrays and repeated addition

Looking at rows
3 + 3
2 groups of 3



Division

Stage 1 - Sharing

Sharing requires secure counting skills and develops the importance of one-to-one correspondence.

8 sweets are shared between 2 people.
How many do they have each?

Children to become confident in sharing by participating in practical activities involving sharing, distributing cards when playing a game, putting objects onto plates, into cups, hoops etc.

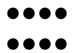
Grouping

Children working practically to group a total number of objects into smaller groups. Children to develop this skill pictorially. *Sorting objects into 2s / 3s/ 4s etc. How many pairs of socks are there?*

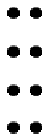
There are 12 bulbs. Plant 3 in each pot. How many pots are there?
Jo has 12 Lego wheels. How many cars can she make?

Stage 2 - Repeated subtraction

Children to use bead strings and number lines to recognise division calculations as repeated subtraction.



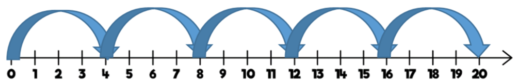
4 x 2 = 8 or 4 + 4 = 8   (4 times by 2 = 2 lots of 4)

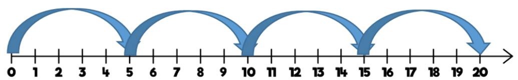


2 x 4 or   2 + 2 +2 + 2 (2 times by 4 = 4 lots of 2)

Children need to understand the inverse, supported by the use of arrays. If the calculation is 7 x 5 for example, children should understand that this means 7 + 7 + 7 + 7 + 7. However, children with secure knowledge of inverse and arrays can use the commutative to count 7 lots of 5.

Children use number lines to support understanding of repeated addition / jumping in equal groups:



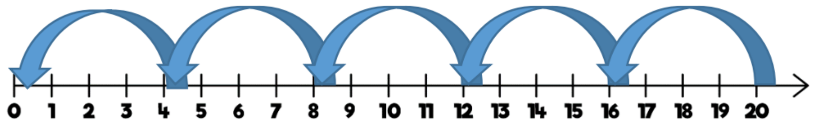


4 × 5 = 20
5 × 4 = 20

Bead strings can be used to demonstrate repeated addition: *5 x 3 = 15*
3 x 5 = 15

There are 3 groups of 5 in 15.
15 ÷ 3 = 3
5 + 5 + 5 = 15

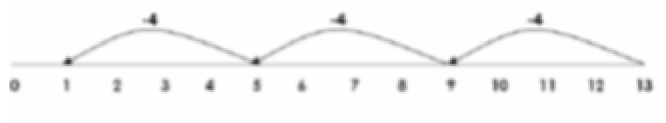
There are 5 groups of 4 in 20.
20 ÷4 = 5
4 + 4 + 4 + 4+ 4 = 20



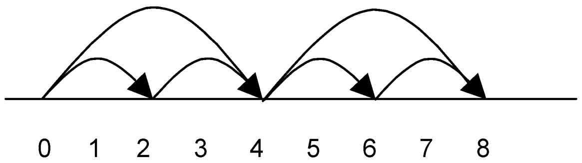
20 ÷ 4 = 5

Children to answer questions involving remainders using number lines and bead strings, recognising ‘left over’ beads as remainders.
For example: 13÷ 4 = 3 r1
Sharing - 13 shared between 4, how many left over?
Grouping – How many 4’s make 13, how many left over?

13 ÷ 4 = 3 r1

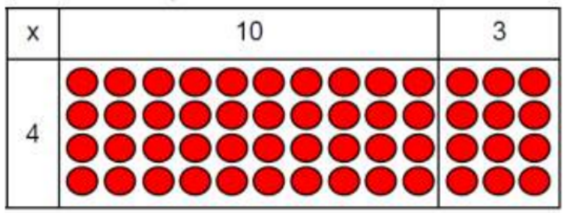


Number lines can also be used to support children's understanding of the relationship between different times tables e.g. 2 and 4:

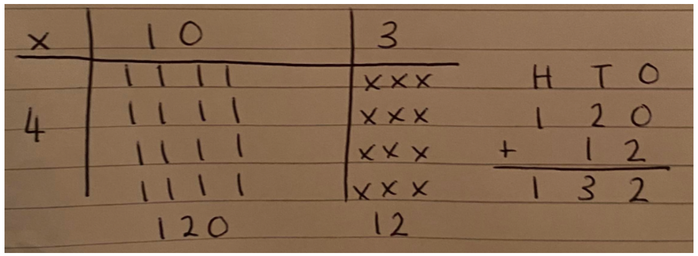


Stage 3 - Grid method

To introduce grid method, link children's knowledge of arrays and partitioning. Children to become confident in using the grid method with concrete resources and pictorially.



There are 4 rows of 10 and 4 rows of 3. 40 + 12 = 52

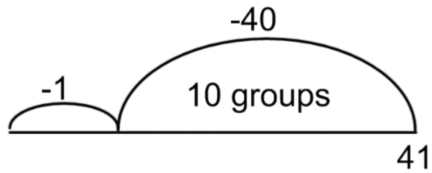


Stage 3 - Partitioning when dividing on number lines

Children can partition numbers and use mental number facts to calculate efficiently on number lines.

For example:

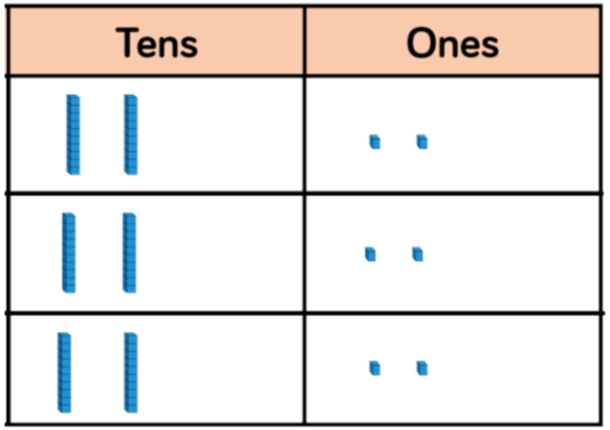
41 ÷ 4
40 ÷ 4 = 10
There is 1 left over
41 ÷ 4 = 40 r1



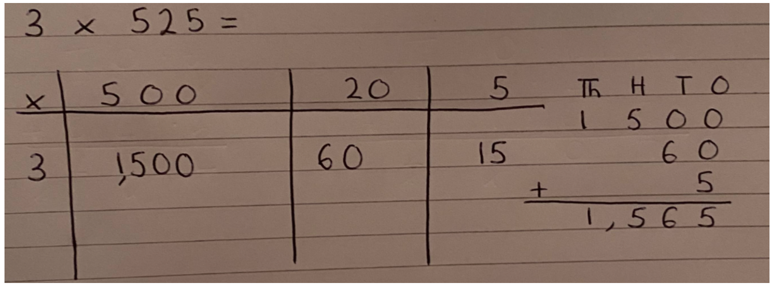
Stage 4 - Sharing Base 10/place value counters into groups (including remainders)

On place value charts, children divide the space into the amount of groups they are dividing by. Children to partition numbers and share equally into groups - e.g. 2 digit numbers will be partitioned into tens and ones. The tens will be shared evenly into X groups, then the ones will be shared evenly into X groups.

66 ÷ 3 = 22

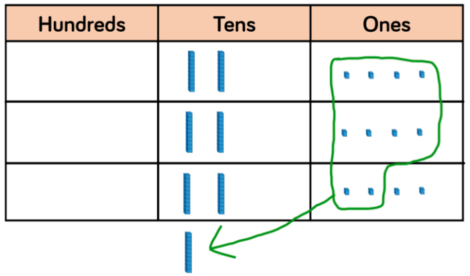


The next step would be to use the grid method (as above) but using abstract numbers rather than concrete resources or concrete representations.

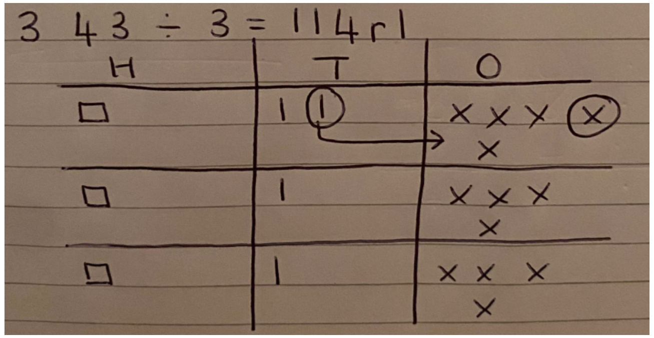


<u>Stage 4: Concrete/pictorial representations in place value charts</u>

Children to represent numbers using base 10/place value counters in place value charts. *For example: 3 groups of 24 or 3 x 24.* When counting the totals in each place value column, children exchange to the next place value column. *For example: exchanging 10 ones for 1 ten.* Once children are confident, children can represent base 10/counters pictorially.

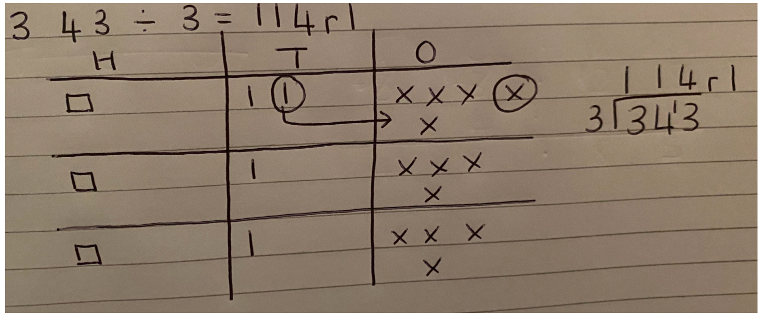


343 ÷ 4 = 114r1



<u>Stage 5: Short division</u>

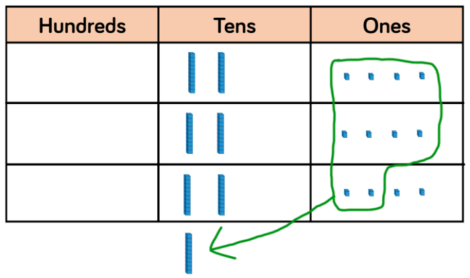
Children to be shown short division alongside pictorial representations in place value charts. Children to be confident in calculating with exchanges and with remainders.



Once children become confident in showing their working out with short division alongside pictorial representations, children can solve calculations using short division only. If needed, children to refer back to concrete/pictorial representations.

Stage 5: Short Column Multiplication

Children to be shown short column multiplication alongside pictorial calculations shown in place value charts. *(4 x 3 = 12 - exchange the 10. 2 tens x 3 = 6 tens + 1 ten = 7 tens. 24 x 3 = 72)*



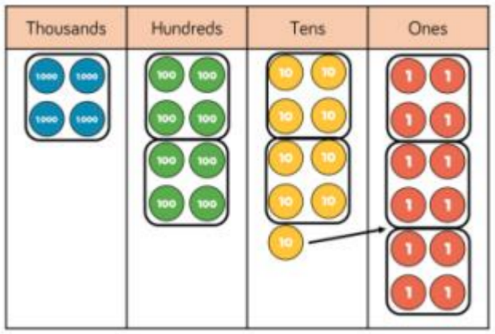
  1
 24
x 3
 72

The recording is reduced further, with exchanging digits recorded above the place value column. Exchanged digits should be crossed out once they have been added.

5
38
x 7
266

Children who are already secure with multiplication for TO × O and TO × TO should have little difficulty in using the same method for HTO × TO or applying decimals.

286
x 29
2574 *(9 x 286 = 2574)*
5720 *(20 x 286 = 5720)*
8294



  1223
4 | 48912

Children taught key vocabulary.

Stage 6: Long division

Alongside the pictorial representation children need to develop the written long division method.