Maths Calculation Policy

Moorlands Primary School Calculation Policy

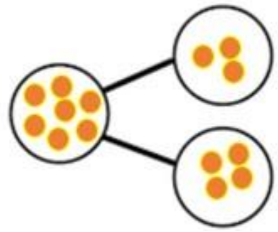
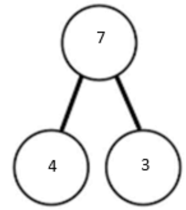
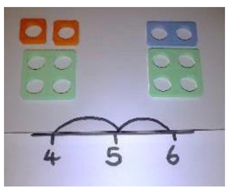
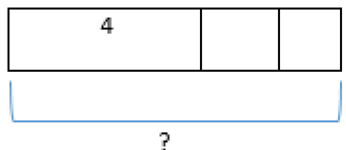
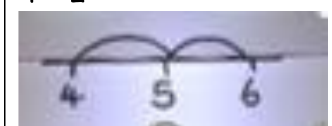
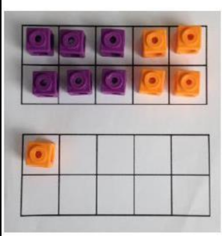
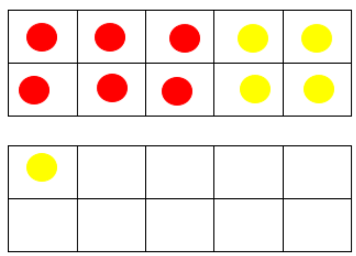
This policy shows the progression children need to move through in order to become efficient mathematicians.
It is not split into year groups or key stages, this policy shows the methods used to develop the required skills in order to, ultimately work abstractly with number. It is important that this guidance is used alongside Year Group Expectations to ensure correct content is taught. Do not move into higher year group expectations but if children are working below expected you can use the principles of previous years to help them gain a greater understanding, through the use of concrete resources and taking the concept back a step.
Children should move from concrete to pictorial to abstract. In KS2 if children are already competent with abstract (you are sure they fully understand and haven't just learnt a process) there is no need to make them go back to concrete, however it is important that they can use the concrete as these will often be needed in more complex problem solving activities. All examples of calculations should be moved onto children finding missing numbers within the calculation.
At Moorlands we recognise the importance of fluency variation, at the end of each section there are examples of varied ways you can ask the same question.

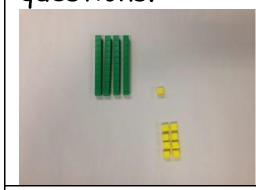
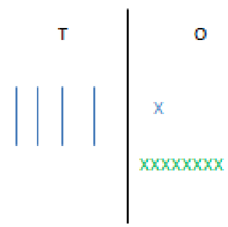
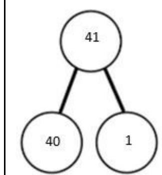
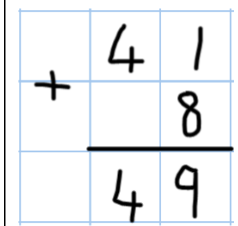
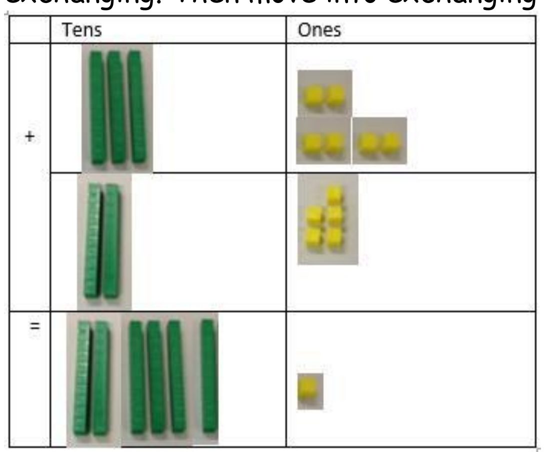
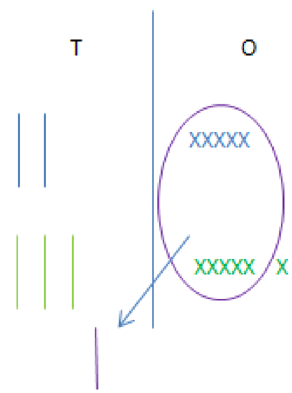
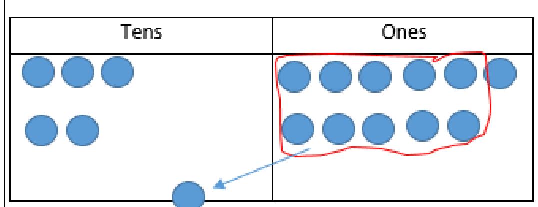
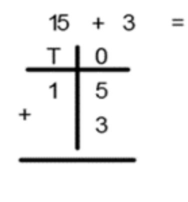
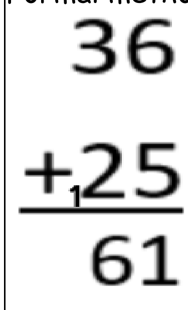
ANY NEW CONCEPT SHOULD ALWAYS BE INTRODUCED WITH CONCRETE RESOURCES.

The written steps on the calculation ALWAYS need to go alongside each step made with the concrete otherwise children will never be able to move away from concrete to abstract alone.

Addition-

Key language which should be used: sum, total, parts and wholes, plus, add, altogether, more than, 'is equal to' 'is the same as'

Concrete	Pictorial	Abstract
Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears etc) 		4 + 3 = 7 (four is a part, 3 is a part and the whole is seven) 
Counting on using number lines by using cubes or numicon 	A bar model which encourages the children to count on 	The abstract number line: What is 2 more than 4? What is the sum of 4 and 4? What's the total of 4 and 2? 4 + 2 
Regrouping to make 10 by using ten frames and counters/cubes or using numicon: 6 + 5 becomes 6 + 4 = 10 10 + 1 = 11 This then moves on to missing number questions worked out in the same way 5 + _ = 12 	Children to draw the ten frame and counters/cubes 	Children will add by bridging through 10 mentally. Children to develop an understanding of equality e.g 6 + □ = 11 and 6 + 5 = 5 + □ 6 + 5 = □ + 4

<table>
<tr>
<td>TO + O using base 10. Continue to develop understanding of partitioning and place value
41 + 8
This would move onto exchanging tens for a rod of 10. Show how to represent on calculation as each step is taken with the concrete. Develop this into missing number questions.
</td>
<td>Children to represent the concrete using a particular symbol e.g. lines for tens and dot/crosses for ones. When exchanging occurs children can group the ten ones or cross them out and exchange for a ten.
</td>
<td>41 + 8

1 + 8 = 9
40 + 9 = 49
</td>
</tr>
<tr>
<td>TO + TO using base 10. Continue to develop understanding of partitioning and place value and use this to support addition. Begin with no exchanging. Then move into exchanging 36 + 25

Here 10 ones have been exchanged for one ten.</td>
<td>This could be done one of two ways:

</td>
<td>
Formal method:
</td>
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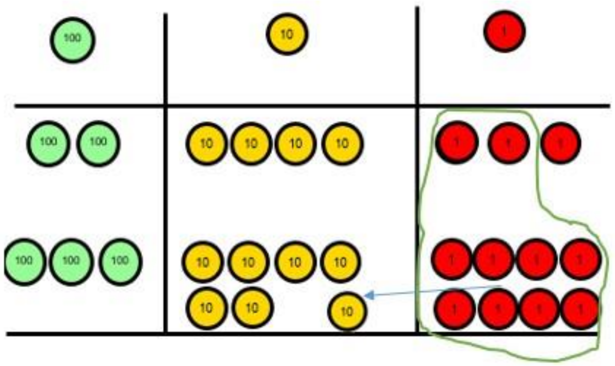
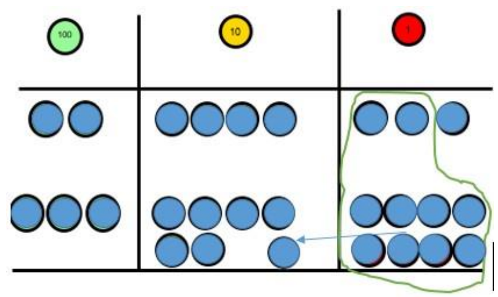
Use of place value counters to add HTO + TO, HTO + HTO etc. once the children have had practice with this, they should be able to apply it to larger numbers and the abstract



Chidren to represent the counters e.g. like the image below

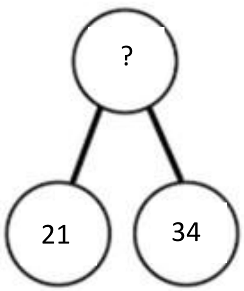


If the children are completing a word problem, draw a bar model to represent what it's asking them to do

?	
243	368

243
+368
(carried: 1 1)
611

Fluency variation, different ways to ask children to solve 21+34:



Sam saved £21 one week and £34 another. How much did he save in total?

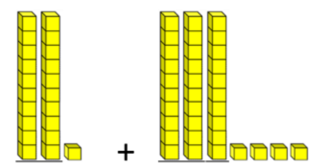
21+34=55. Prove it! (reasoning but the children need to be fluent in representing this)

21
+34
———

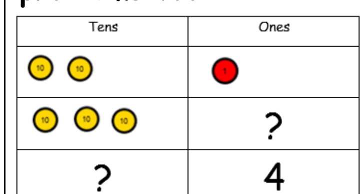
21 + 34 =

☐ = 21 + 34

What's the sum of twenty one and thirty four?

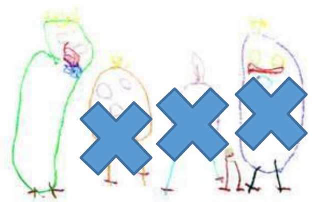
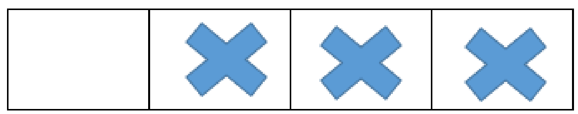
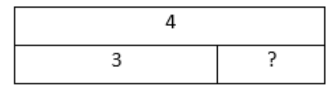
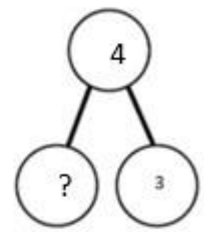
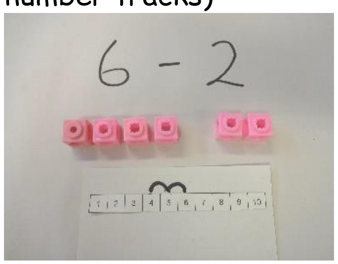
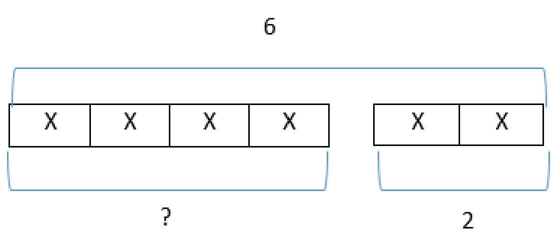
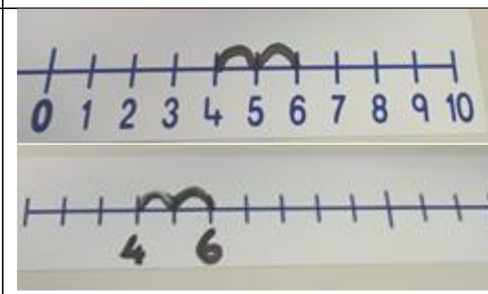


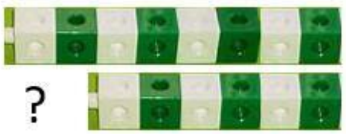
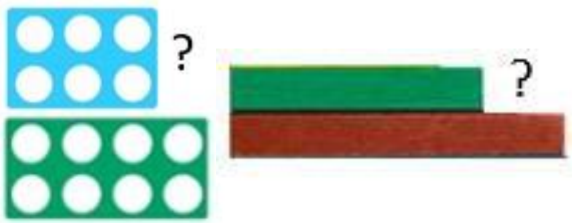
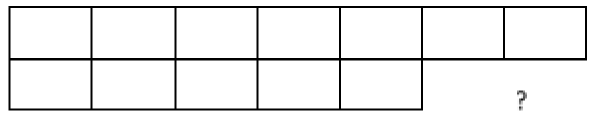
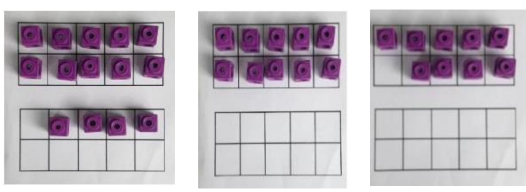
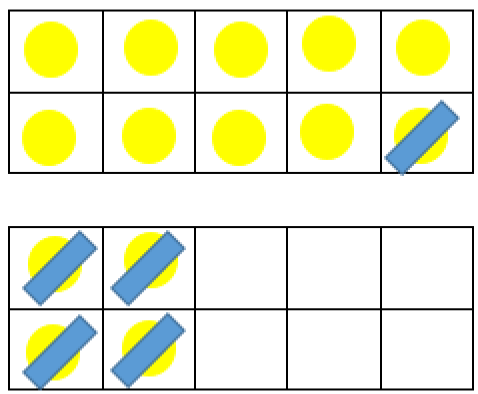
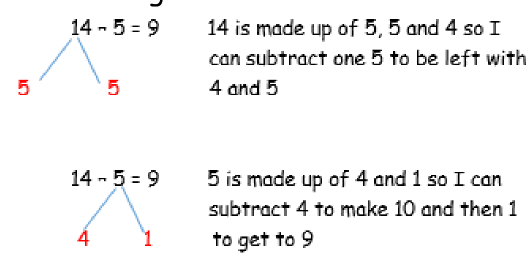
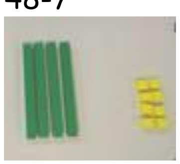
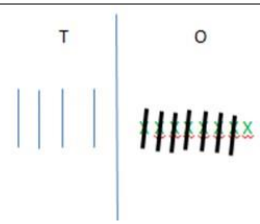
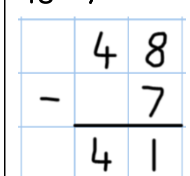
Always use missing digit problems too:



Subtraction-

Key language which should be used: take away, less than, the difference, subtract, minus, fewer, decrease, '7 take away 3, the difference is four'

Concrete	Pictorial	Abstract
Physically taking away and removing objects from a whole rather than crossing out- children will physically remove the objects. Move this onto missing numbers 4 − 3 = 1 	Children to draw the concrete resources they are using and cross out.  Use of the bar model: 	**4- 3 =** **□ = 4 - 3**  
Counting back (using number lines or number tracks) 	Children to represent what they see pictorially e.g. 	

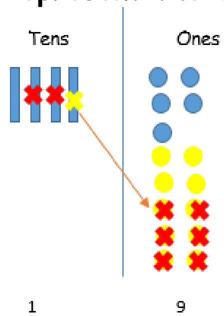
Finding the difference (using cubes, numicon or Cuisenaire rods, other objects can also be used)  	Children to draw the cubes/other concrete objects which they have used XXXXXXXX XXXXXX Use of the bar model 	Find the difference between 8 and 6. 8 – 6, the difference is ? Children to also explore why 9 - 7 = 8 – 6 (the difference, of each digit, has changed by 1 so the difference is the same)
Making 10 (using numicon or ten frames) 14 – 5 becomes 14 – 4 = 10 then take one more away to gain answer of 9.  Carry this out with missing number questions e.g. 16 - _= 7	Children to present the ten frame pictorially 	14 – 5 = 9 You also want children to see related facts e.g. 15 – 9 = 5 Children to represent how they have solved it e.g. 
Column method (using base 10) 48-7  Develop this into missing number questions.	 Develop this into missing number questions.	48 – 7 =  Develop this into missing number questions.

Column method (using base 10 and having to exchange)

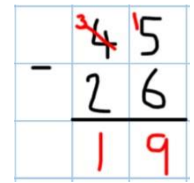
45-26

1) Start by partitioning 45
2) Exchange one ten for ten more ones
3) Subtract the ones, then the tens.

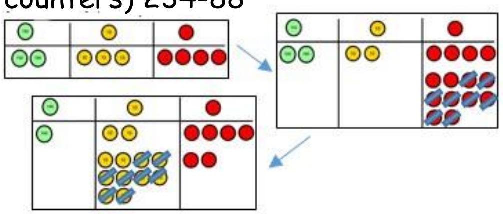
Represent the base 10 pictorially



It's crucial that the children understand that when they have exchanged the 10 they still have 45. 45 = 30 + 15

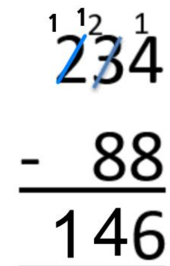


Column method (using place value counters) 234-88

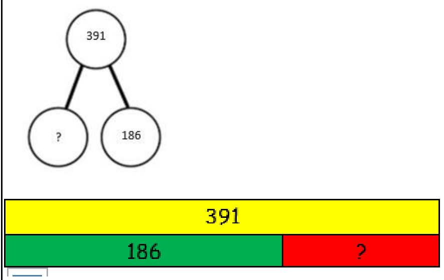


Once the children have had practice with the concrete, they should be able to apply it to any subtraction.

Like the other pictorial representations, children to represent the counters.



Fluency variation, different ways to ask children to solve 391-186:



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

I had 391 metres to run. After 186 I stopped. How many metres do I have left to run?

391 - 186

= 391 - 186

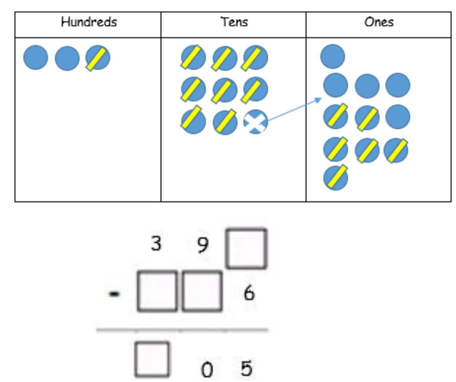
391
-186
____

Find the difference ebtween 391 and 186

Subtract 186 from 391.

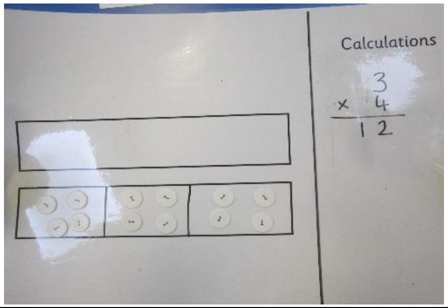
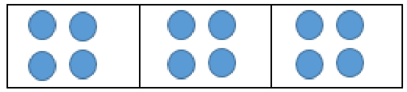
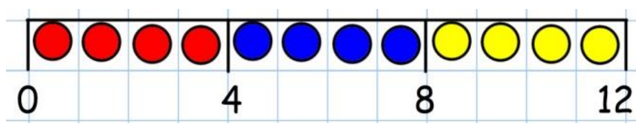
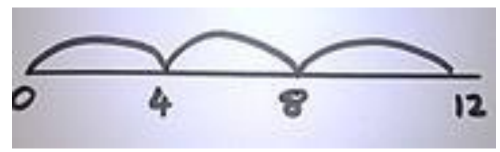
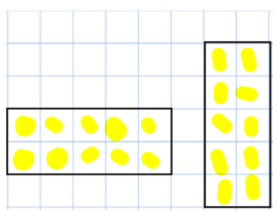
What is 186 less than 391?

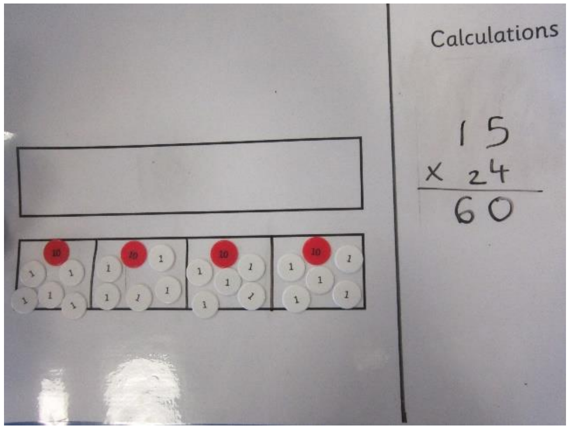
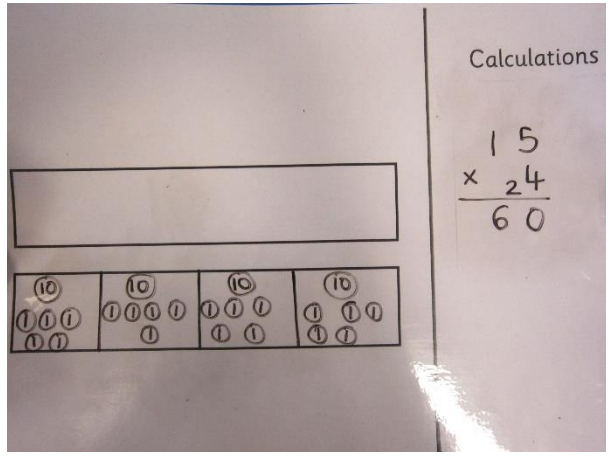
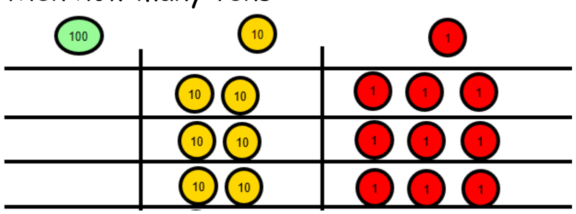
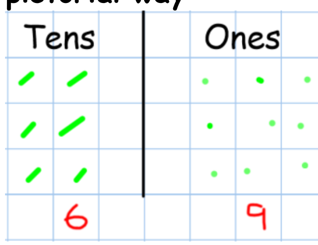
What's the calculation? What's the answer?



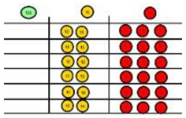
Multiplication-

Key language which should be used: double times, multiplied by, the product of, groups of, lots of, 'is equal to' 'is the same as'

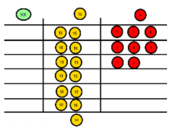
Concrete	Pictorial	Abstract
Repeated grouping/repeated addition 3 x 4 or 3 lots of 4 	Use of a bar model to draw dots 	3 x 4 4 + 4 + 4
Use number lines to show repeated groups- 3 x 4  	Represent this pictorially alongside a number line e.g: 	Abstract number line **3 x 4 = 12** 
Use arrays to illustrate commutativity (counters and other objects can also be used) **2 x 5 = 5 x 2**   	Children to draw the arrays 	Children to be able to use an array to write a range of calculations e.g. 2 x 5 = 10 5 x 2 = 10 2 + 2 + 2 + 2 + 2 = 10 5 + 5 =10

Partition to multiply 4 x 15 using place value counters on a bar model.  	Draw place value counters on the bar model.  	Children to be encouraged to show the steps they have taken 4 x 15 10 5 **4 x 5 – 20** **4 x 10 = 40** **40 + 20 = 60** **This is a step before formal written method.**
Formal column method with place value counters or base 10 (at the first stage- no exchanging) 3 x 23 Make 23, 3 times. See how many ones, then how many tens 	**Children to represent the counters in a pictorial way**  	Children to record what it is they are doing to show understanding 3 x 23 3 x 3 = 9 3 x 20 = 60 20 3 60 + 9= 69 23 x 3 69
Formal column method with place value counters (children need this stage, initially, to understand how the column method works)	Children to represent the counters/base 10, pictorially e.g. the image below.	**6 x 23** 6 x 3 = 18 6 x 20 = 120 120 + 18 = 138

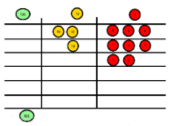
6 x 23



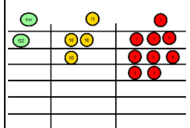
Step 1: get 6 lots of 23



Step 2: 6 x 3 is 18. Can I make an exchange? Yes! Ten ones for one ten….

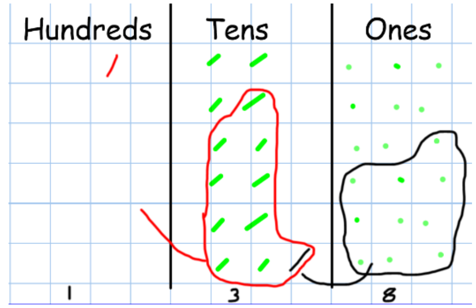


Step 3: 6 x 2 tens and my extra ten is 13 tens. Can I make an exchange? Yes! Ten tens for one hundred…

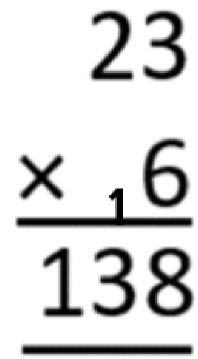


Step 4- what do I have I each column?

Here each step that is taken with the concrete needs showing on the written calculation alongside. E.g. as an exchange is made show how that would look on the calculation.



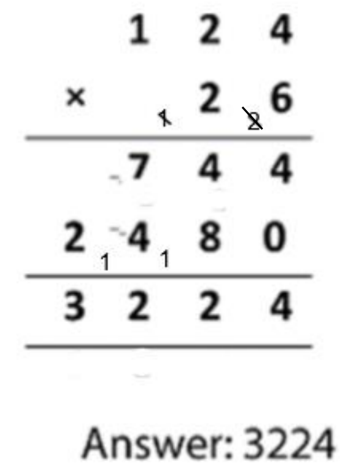
The aim is to get to the formal method but the children need to understand how it works.



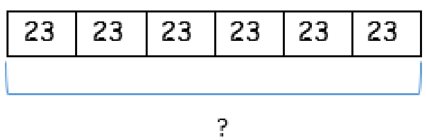
When children start to multiply 3d x 3d and 4d x 2d etc, they should be confident with the abstract:

To get 744 children have solved 6 x 124
To get 2480 they have solved 20 x 124

When exchanging in the first calculation, the exchanged number goes above the line.
When children start to multiply the tens or hundreds, they must cross out the exchanging from the previous calculation and write in the new exchanging.



Fluency variation, different ways to ask children to solve 6 x 23:



With the counters, prove that 6 x 23 = 138

Why is 6 x 23 = 32 x 6?

Mai had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week?

Tom saved 23p three days a week. How much did he save in 2 weeks?

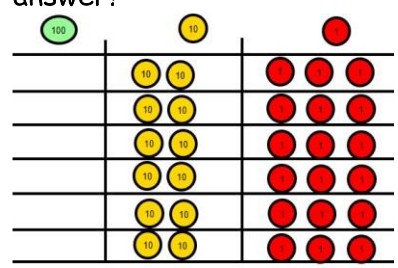
Find the product of 6 and 23

6 x 23 =

= 6 x 23

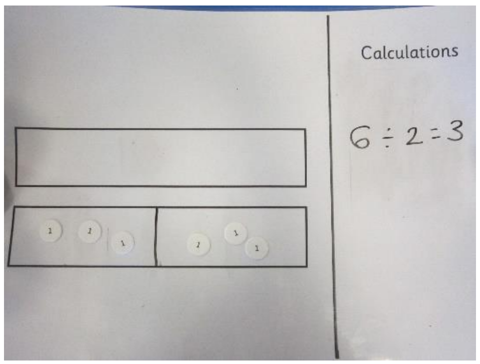
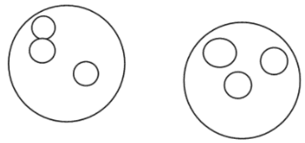
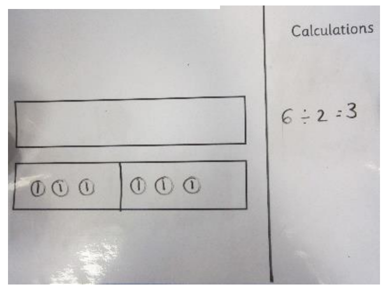
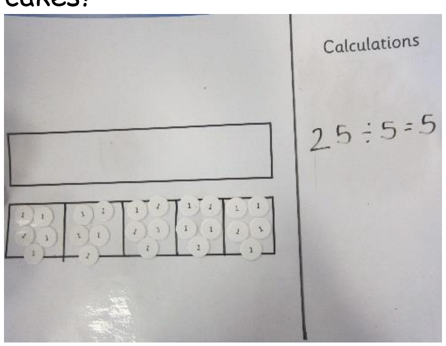
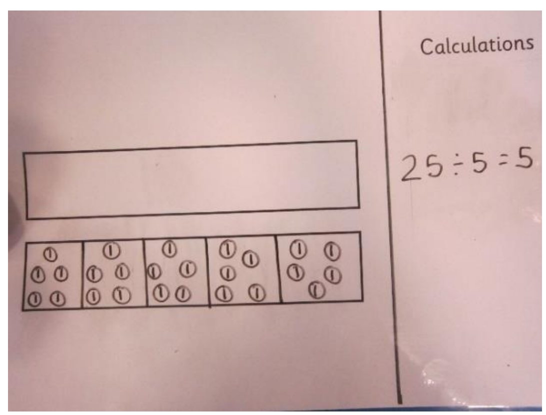
```
  6        23
x 23     x  6
----     ----
```

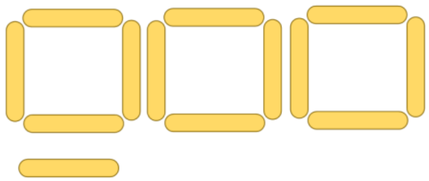
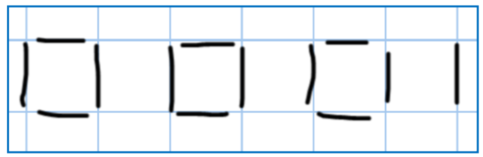
What's the calculation? What's the answer?

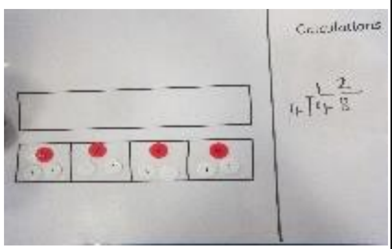
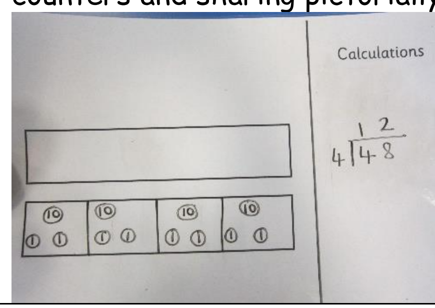


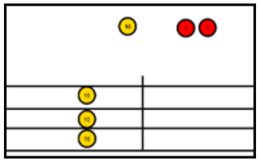
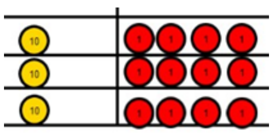
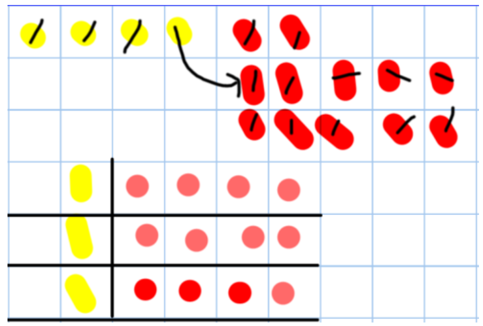
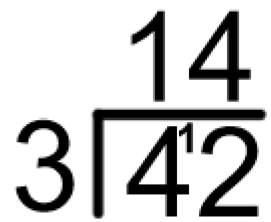
Division-

Key language which should be used: share, group, divide, divided by, half, 'is equal to' 'is the same as'

Concrete	Pictorial	Abstract
6 shared between 2 show on bar model using concrete resources 	 Children will begin draw circles on bar model 	6 ÷ 2 = 3 What's the calculation? | 3 | 3 |
Understand division as repeated grouping "Sam wants to pack cakes into boxes of 5. How many boxes will he need for 25 cakes?"  Here we are counting in 5s up to 25 to see how many lots of 5.	Children will draw counters on the bar. 	Children move towards putting numbers on the bar model and using times table knowledge. | 25 | | 5 | 5 | 5 | 5 | 5 | When children have a secure knowledge of their times tables they will be able to answer these style of questions mentally without the need to show on a bar.

2d ÷ 1d with remainders 13 ÷ 4 – 3 remainder 1 Show on bar model as above with concrete but remainder will be left. Remainders can also be shown through the use of lollipop sticks to form wholes 	Children to have chance to represent the resources they use in a pictorial way on bar model as above. Children can then draw the wholes that can be made. 	13 ÷ 4 = 3 remainder 1 As above with children showing written numbers on the bar, then children to count their times tables facts in their heads to work out the remainder.

2d divided by 1d using place value counters (no remainders) SHARING done on a bar model. 48 ÷ **4 = 12** Start with the tens and show calc alongside using bus stop method. 	Children to represent the place value counters and sharing pictorially on bar model. 	Children will use their times table knowledge where appropriate or will show on bus stop method through abstract calculation. $3\overline{)96}$ = 32

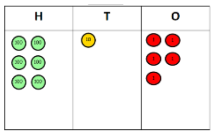
Sharing using place value counters on a HTO grid **42 ÷ 3= 14**  **1. Make 42. Share the 4 tens between 3. Can we make an exchange with the extra 10?** Exchange the ten for 10 ones and share out 12 ones  **As these steps are taken show how this looks on the written calculation of bus stop method.**	Children begin to find ways to record their counters pictorially. 	After lots of experience of using concrete and pictorial children can use bus stop method using abstract numbers and times table knowledge. 

Use of the 'bus stop method' using grouping and counters.

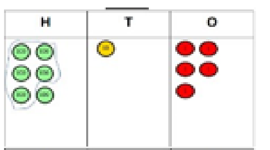
Key language for grouping- how many groups of X can we make with X hundreds'

615 ÷ 5

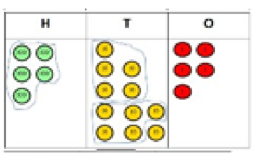
Step 1 make 615



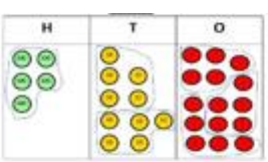
Step 2 Circle your groups of 5 in hundreds.



Step 3: Exchange left over hundred for 10 tens and circle groups of 5 in the tens.



Step 4: Exchange left over ten for 10 ones and circle groups of 5.



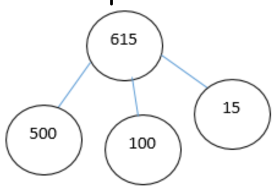
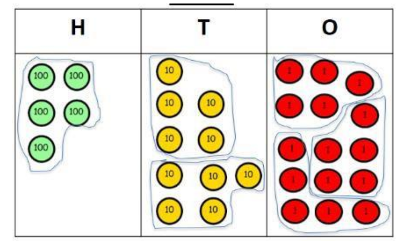
ALWAYS show how this would look on written bus stop alongside every step that is taken with the counters.

This can easily be represented pictorially, until the children no longer need to do it.

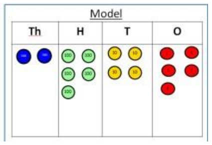
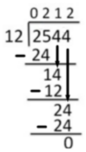
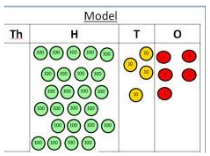
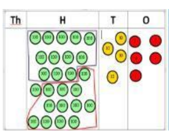
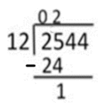
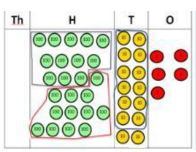
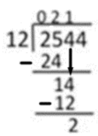
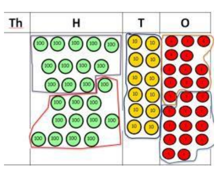
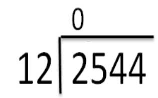
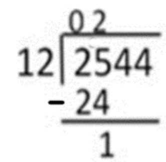
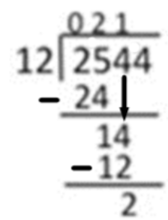
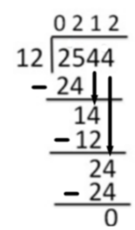
It can also be done to decimal places if you have a remainder!

$$\begin{array}{r} 123 \\ 5\overline{)6\,{}^{1}1\,{}^{1}5} \end{array}$$

Fluency variation, different ways to ask children to solve 615 ÷ 5:

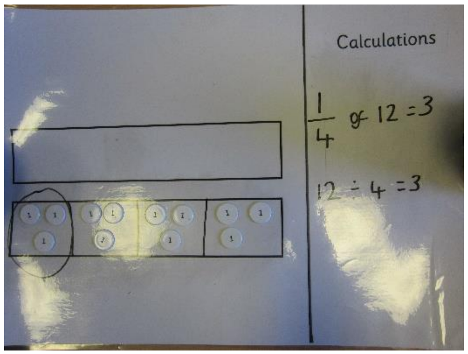
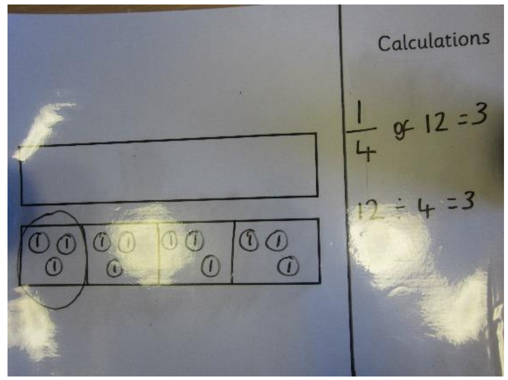
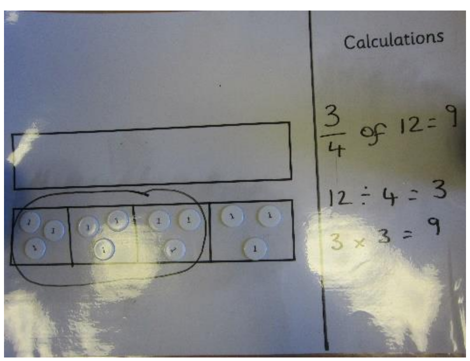
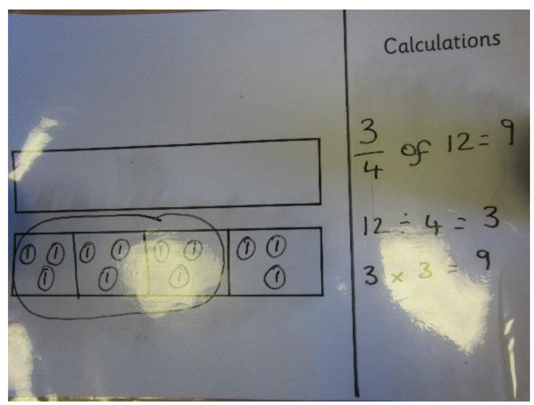
Using the part whole model below, how can you divide 615 by 5 without using the 'bus stop' method?  	I have £615 and share it equally between 5 bank accounts. How much will be in each account? 615 pupils need to be put into 5 groups. How many will be in each group?	5 | 615 615 ÷ 5 = = 615 ÷ 5 How many 5's go into 615?	What's the calculation? What's the answer? ____ 

Long Division

Concrete	Pictorial	Abstract
  2544 ÷ 12 How many groups of 12 thousands do we have? None  Exchange 2 thousand for 20 hundreds.   How many groups of 12 are in 25 hundreds? 2 groups. Circle them. We have grouped 24 hundreds so can take them off and we are left with one.   Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2.  Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2	Children to represent the counters, pictorially and record the subtractions beneath.	 Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.  Step two- How many groups of 12 can I make with 25 hundreds? The 24 shows the hundreds we have grouped. The one is how many hundreds we have left.  Exchange the one hundred for 10 tens. How many groups of 12 can I make with 14 tens? The 14 shows how many tens I have, the 12 is how many I grouped and the 2 is how many tens I have left.  Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.

Fractions

It is a non-negotiable at Moorlands that bar modelling be used as an introduction to fractions and carried on being used until children are fully secure with the abstract method.

Concrete	Pictorial	Abstract
Finding a fraction of an amount e.g. $\frac{1}{4}$ of 12. 	Children will draw counters on the bar. 	Eventually children will recognise that $\frac{1}{4}$ is dividing by 4 and use their x table knowledge. $\frac{1}{4}$ of 12 = 12 ÷ 4 = 3
Children will move onto finding more than one part. The bar model will help to focus them on how many parts to look at. 	Children will draw counters on the bar. 	Children will divide by the fraction amount then x by how many parts. (This is quite a complex abstract method so should be used only when full understanding is evident).
For further fraction work in KS2, if children are finding the abstract difficult refer to these stages of showing fractions concrete and pictorial using a bar model.		