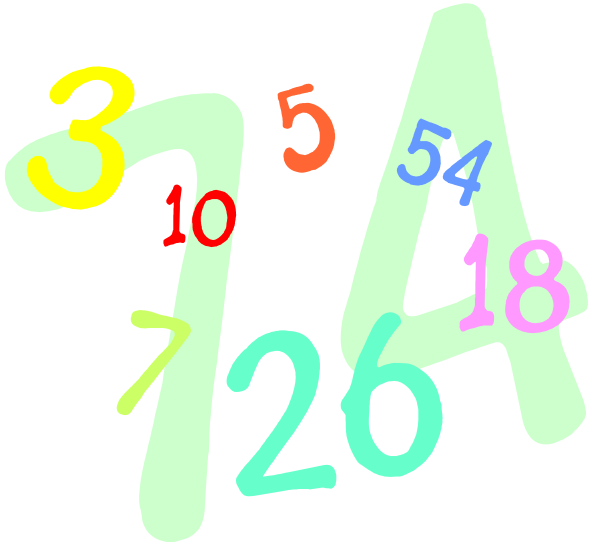
Calculation Policy

July 2019 Update



Introduction

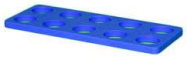
At Langford Village we are using the 'White Rose Hub' format as a basis for our planning. We are not following it completely but use it as a tool, to ensure effective progression through the curriculum.

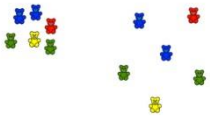
We are using the White Rose Hub philosophy of:

- **Fluency** - the ability to recall the answers to basic mathematical facts automatically and without hesitation.
- **Reasoning** – this involves thinking through mathematical problems logically in order to arrive at solutions. It also involves being able to identify what is important and unimportant in solving a problem and to explain or justify a solution.
- **Problem-solving** – the ability (and resilience) to tackle 'real life' problems, where their maths is placed in a context and/or is presented in a different way to what they are used to. Children can apply their fluent methods and reasoning skills to tackle the problem independently or collaboratively.

Throughout the calculation policy, and during each lesson at Langford Village, you will see elements of **concrete, pictorial** and **abstract models** (C-P-A) The **C-P-A** method involves using actual objects for children to add, subtract, multiply or divide. They then progress to using pictorial representations of the object, and ultimately, abstract symbols. Through this process, we are able to ensure children have a clearer understanding and conceptual awareness for the maths they are learning.

In early mathematics, there are fundamental skills that it is important for children to develop as building blocks to future learning in maths, including that linked to calculation. A selection of the skills include:

- Ordinality – 'the ordering of numbers in relation to one another' – e.g. (1, 2, 3, 4, 5…)
- Cardinality – 'understanding the value of different numbers'– e.g. (7 =  17 =   14 = 
- Equality – 'seven is the same total as four add three' – e.g.  
- Subitising – 'instantly recognizing the number of objects in a small group, without counting them' – e.g.  → five

- Conservation of number– ‘recognising that a value of objects are the same, even if they are laid out differently’ – e.g. 
- One-to-one correspondence – e.g. 

- Counting on and back from any number – e.g. ‘five add three more totals eight’  ‘ten take away three totals seven’
- Using apparatus and objects to represent and communicate thinking – e.g.  

- Maths language – using mathematical words verbally in every-day situations – e.g. ‘climb up to the top’ / ‘climb down to the bottom’

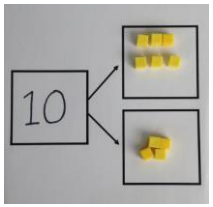
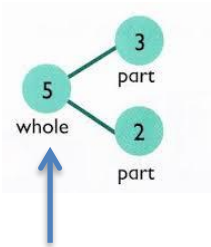
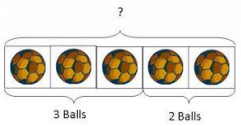
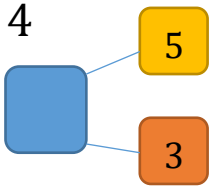
By the end of Year 6, children will be equipped with efficient mental and written calculation methods, which they use with fluency. Decisions about when to progress should always be based on the security of pupils’ understanding and their readiness to progress to the next stage. At whatever stage in their learning, and whatever method is being used, a secure understanding and knowledge of number facts that can be recalled fluently must still underpin children’s strategies.

The aim is that when children leave Langford Village they:

- Have a secure knowledge of number facts and a clear conceptual understanding of the four calculation operations (addition, subtraction, multiplication and division)
- Have resilience and appropriate methods to tackle mathematical problems - for example through the use of jottings, diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads
- Have an efficient, reliable, written method of calculation for each operation that they are able to apply with confidence when they are unable to perform a calculation mentally
- Have a **Growth Mindset** in Mathematics, where they have a confidence to try and see opportunities to learn from mistakes.

Progression in Calculations

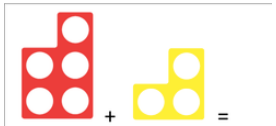
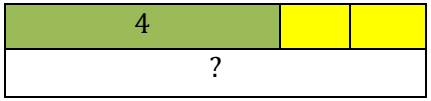
Addition

Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model EYFS/Year 1	   Use concrete equipment to add two numbers together as a group or in a bar (number track).  In EYFS/Year 1, children will also use songs, role-play, stories and practical play/activities to develop concept of addition.	  'Cherry tree models' to demonstrate the idea of the 'whole' and 'parts' e.g. 5 is the 'whole' and 3 + 2 are the 'parts'.  Use pictures to add two numbers together as a group or in a bar. 	4 + 3 = 7 10= 6 + 4  Use the part-part whole diagram as shown above to move into the abstract, where children can use the addition and equals symbols to write sentences that represent a calculation.

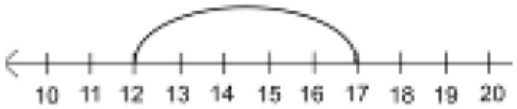
<table>
<tr>
<td>Starting at the bigger number and counting on

EYFS/Year 1</td>
<td> 

Start with the larger number on the bead (or with other equipment) string and then count on to the smaller number 1 by 1 to find the answer.

 
”I have 5, now count on 3 more…”</td>
<td> 

Use of bar models can help to encourage children to count on, rather than count all.</td>
<td>12 + 5 = 17

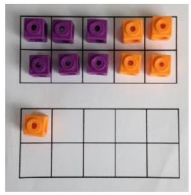
 

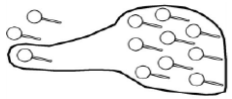
Start at the larger number on the number line and count on in ones or in one jump to find the answer.

5 + 12 = 17

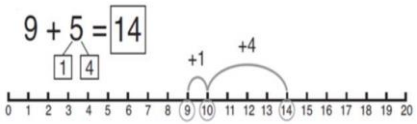
Children recognise it is more efficient to place the larger number in your head and count on the smaller number to find your answer. Use of equipment and number lines can be used to support.</td>
</tr>
<tr>
<td>Regrouping to make 10.

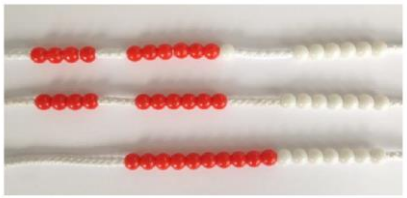
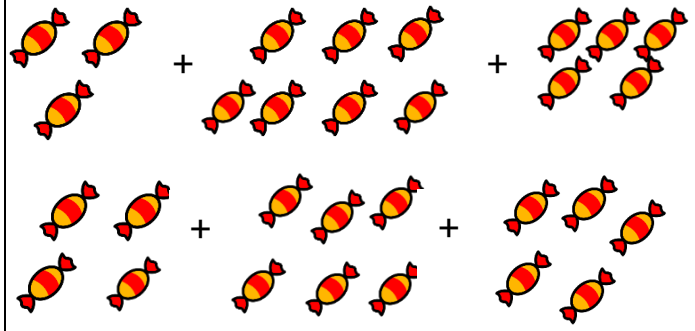
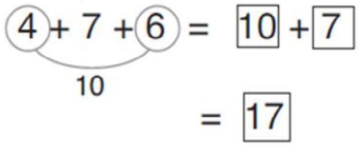
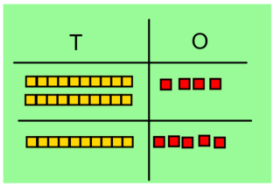
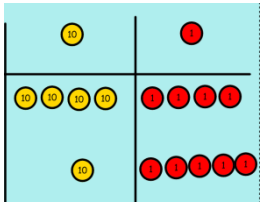
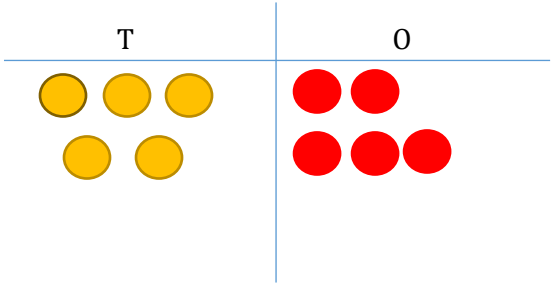
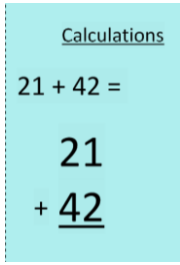
EYFS/Year 1</td>
<td>6 + 5 = 11

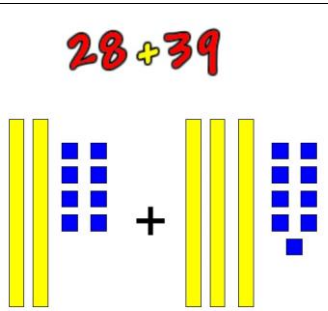
 

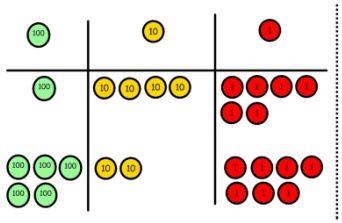
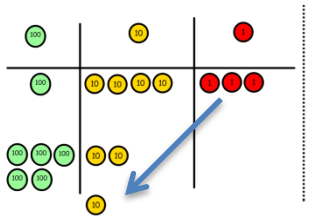
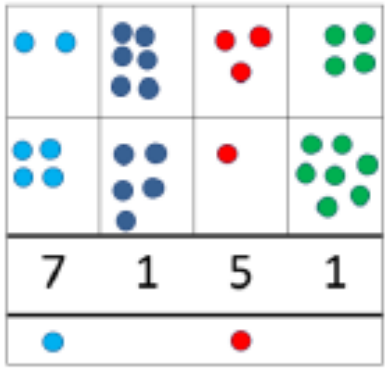
Start with the bigger number and use the smaller number to make 10.</td>
<td> 

Use pictures or a number line. Regroup or partition the smaller number to make 10.

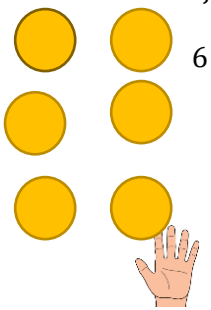
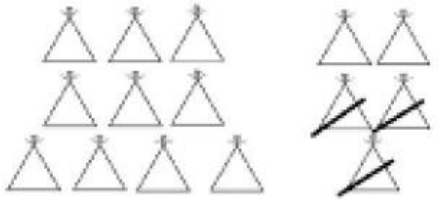
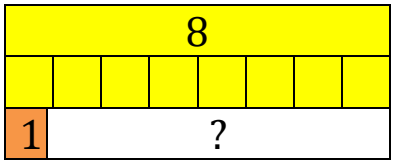
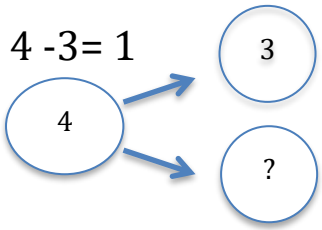
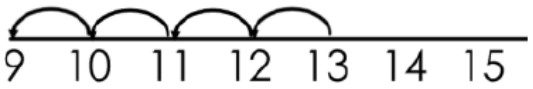
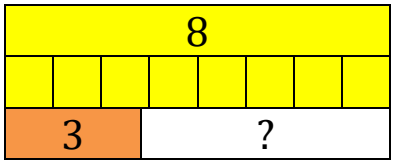
 
</td>
<td>7 + 4= 11 “If I am at seven, how many more make 10. How many more do I add on now?”
Develop understand of equality:
6 + __ = 11
6 + 5 = 5 + __
6 + 5 = __+ 4</td>
</tr>
</table>

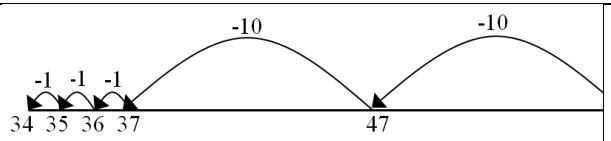
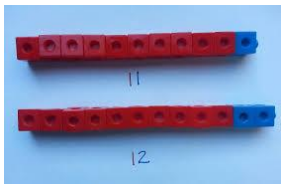
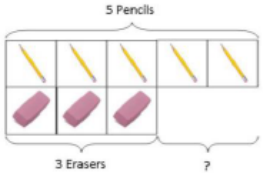
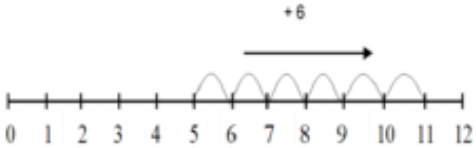
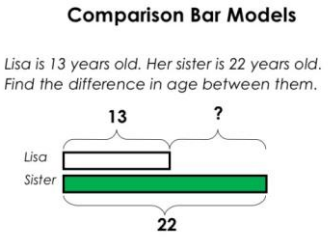
Adding three single digits Year 2	4 + 7 + 6= 1 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	 Combine the two numbers that make 10 and then add on the remainder.
Using base 10 to combine two numbers TO + O/TO + TO Year 2	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks or place value counters.  	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. Eg 32 + 23 =  	 Children to solve addition with abstract column method, first without crossing boundaries. Children then start to add two numbers thar require bridging of ten.

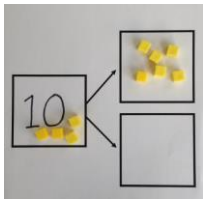
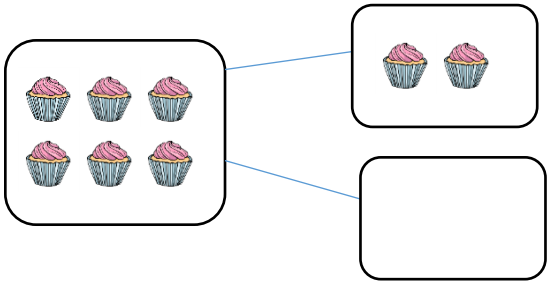
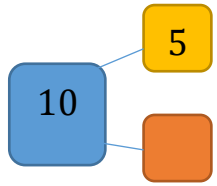
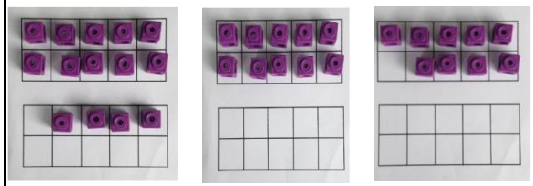
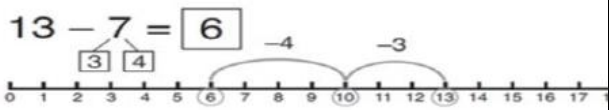
		 "Can you exchange any ones for a ten?"	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 Develop expanded method. Adding up the ones first, followed by the tens, before totalling. 25 + 48 13 60 73

Column method- regrouping Year 3 – Up to 3 digits Year 4 – Up to 4 digits Year 5 – Using decimals Year 6 – Using decimals up to 3 dp.	Make both numbers on a place value grid.  146 + 527 Add up the units and exchange 10 ones for one 10.  146 + 527 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding.  7 1 5 1	536 + 85 621 1 1 Children are using a formal written method for column addition – expanded if required, but ideally compact. As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 72.8 + 54.6 127.4 1 1 £ 2 3 . 5 9 + £ 7 . 5 5 £ 3 1 . 1 4 1 1 1 2 3 . 3 6 1 9 . 0 8 0 5 9 . 7 7 0 + 1 . 3 0 0 9 3 . 5 1 1 2 1 2 Introduction of **worded problems** to help children apply to problem solving and use of reasoning to justify.

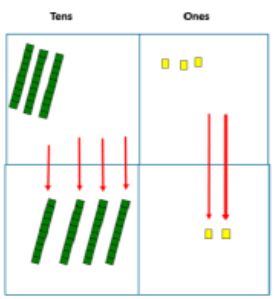
Subtraction

Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones EYFS/Year 1	Use physical objects, counters, cubes etc to show how objects can be taken away.  6 – 2 = 4  4 cakes, take 2 away...	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	8 – 1 = 6  4 -3= 1 
Counting back EYFS/Year 1/2	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones. 13 – 4  Use counters and move them away from the group as you take them away counting backwards as you go.	Count back on a number line or number track  Start at the bigger number and count back the smaller number showing the jumps on the number line.	Put 8 in your head, count back 3. What number are you at? Use your fingers to help.  Children to represent the calculation on a number line or track and show their jumps.

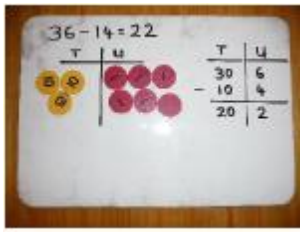
		 This can progress all the way to counting back using two 2 digit numbers.	
Find the difference EYFS/Year 1/2	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference	 Count on to find the difference. Draw bars to find the difference between 2 numbers. 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.

Part - Part - Whole Model Year 1/2	 Link to addition- use the part-part-whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =	Use a pictorial representation of objects to show the part-part-whole model. 	 Move to using numbers within the part whole model.
Make 10 using the ten frame Year 1/2	14 – 9 =  Make 14 on the ten frame. Take away the four first to make 10 and then takeaway five more so you have taken away 9. You are left with the answer of 5.	 Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.	16 – 8= How many do we take off to reach the next 10? How many do we have left to take off?

<table>
<tr>
<td>Column method without regrouping

Year 2/ Year 3</td>
<td> 

Use Base 10 to make the bigger number then take the smaller number away.

Show how you partition numbers to subtract. Again make the larger number first.
 
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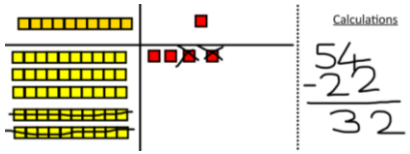
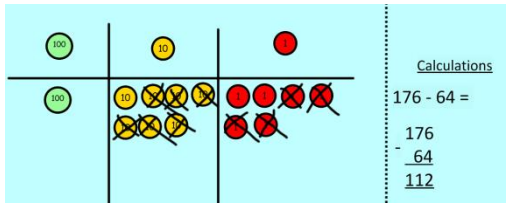
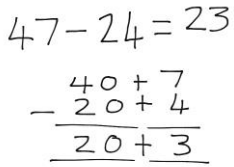
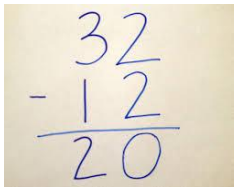
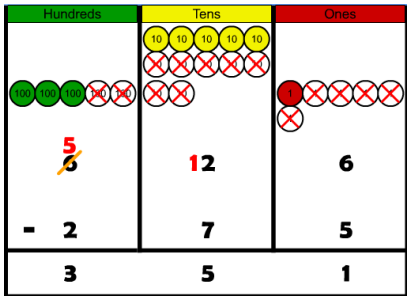
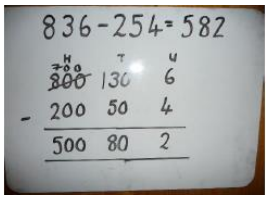
<td> 

Draw the Base 10 or place value counters alongside the written calculation to help to show working.
 
</td>
<td> 

This will lead to a clear written column subtraction.
 
</td>
</tr>
<tr>
<td>Column method with regrouping

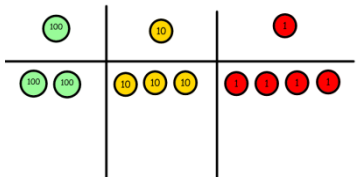
Year 3 – Up to 3 digits
Year 4 – Up to 4 digits</td>
<td>Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges.

Make the larger number with the place value counters</td>
<td> 

Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.</td>
<td> 

Children can start their formal written method by partitioning the number into clear place value columns (expanded coloumn subtraction)</td>
</tr>
</table>

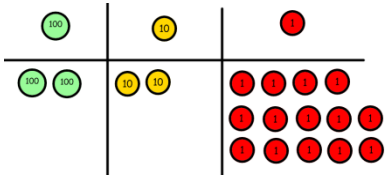
Year 5 – Using decimals
Year 6 – Using decimals up to 3 dp.



Calculations

234
- 88

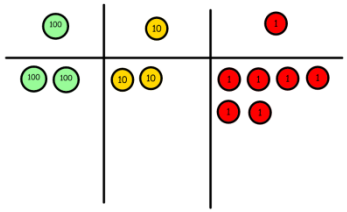
Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.



Calculations

234
- 88

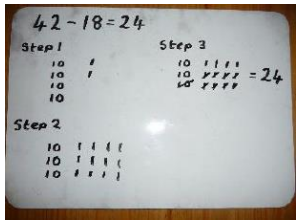
Now I can subtract my ones.



Calculations

234
- 88

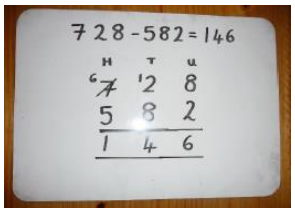
Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.



When confident, children can find their own way to record the exchange/regrouping.

Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.

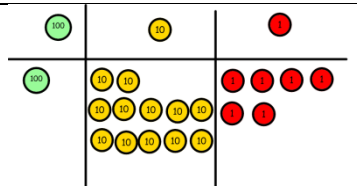
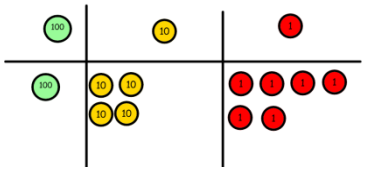
These methods can be applied to decimals, using place value counters that represent tenths, hundredths etc. Children to see the process is the same with decimals, as it is with integers.



Moving forward the children use a more compact method.

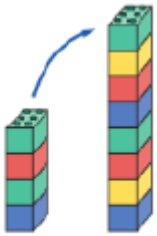
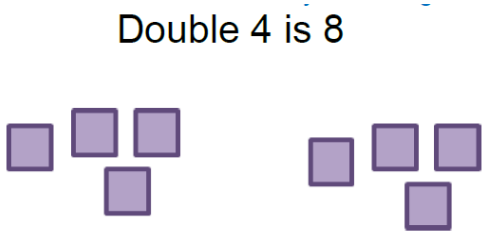
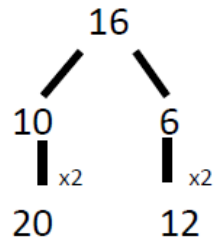
This will lead to an understanding of subtracting any number including decimals.

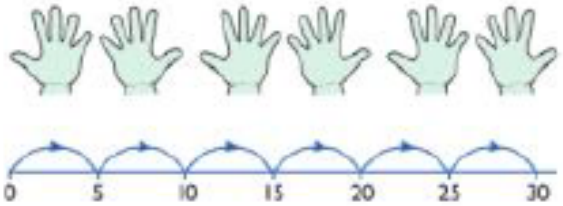
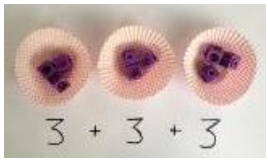
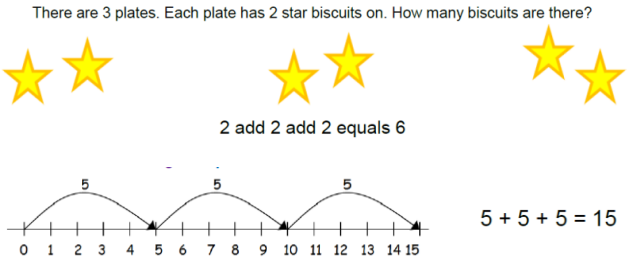
$$\begin{array}{r} \ 5\ \ 12\ \ \ \ 1 \\ 2\ \cancel{6}\ \cancel{3}\ .\ \mathbf{0} \\ -\ \ \ 2\ \ 6\ .\ \ 5 \\ \hline 2\ \ 3\ \ 6\ .\ \ 5 \end{array}$$

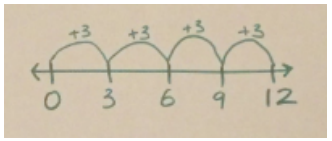
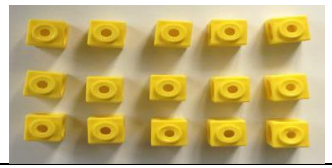
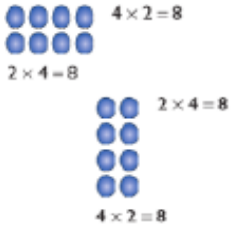
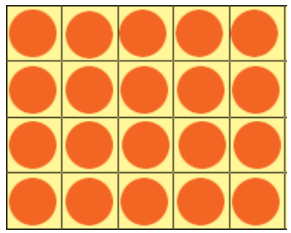
	 Calculations 234 - 88 Now I can take away eight tens and complete my subtraction  Calculations ~~2~~ 234 - 88 146 Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.		

Multiplication

N.B – please note that it is imperative for children to develop their fluency of recall with the times tables. Children now complete a national statutory times table test in Year 4. If a child has fluency with the tables, the use of each method is greatly improved and accurate.

Objective and Strategies	Concrete	Pictorial	Abstract
Doubling EYFS/Year 1	Use practical activities to show how to double a number.  double 4 is 8 4 × 2 = 8	Draw pictures to show how to double a number. 	 Partition a number and then double each part before recombining it back together.

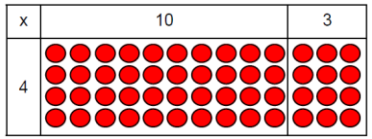
Counting in multiples EYFS/Year 1	 Count in multiples supported by concrete objects in equal groups. 	 Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25, 30
Repeated addition EYFS/Year 1	   Use different objects to add equal groups.	Use of many images to help establish that repeated counting of equal groups.  	Write addition sentences to describe objects and pictures. 

			Children also begin to use and draw their own number lines Eg. 3 x 4 / 4 x 3 
Arrays- showing commutative multiplication Year 2/Year 3	Create arrays using counters/cubes to show multiplication sentences.  	Draw arrays in different rotations to find **commutative** multiplication sentences.   Link arrays to area of rectangles.	Use an array to write multiplication sentences and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15

Grid Method/ Partition to multiply

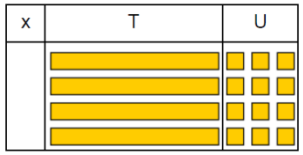
Year 3

Show the link with arrays to first introduce the grid method.



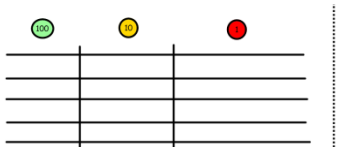
4 rows of 10
4 rows of 3

Move on to using Base 10 to move towards a more compact method.



4 rows of 13

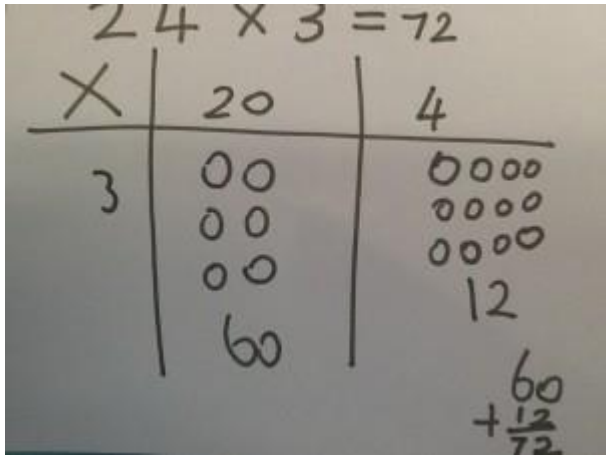
Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.



Fill each row with 126.

Children can represent the work they have done with place value counters in a way that they understand.

They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below.



Start with multiplying by one digit numbers and showing the clear addition alongside the grid.

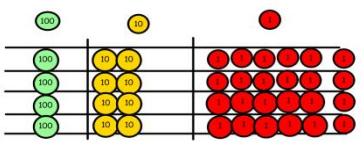
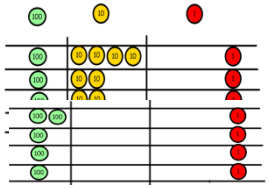
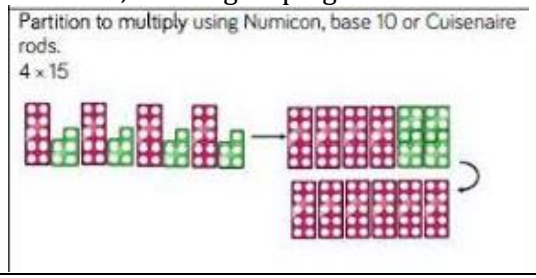
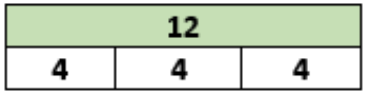
×	30	5
7	210	35

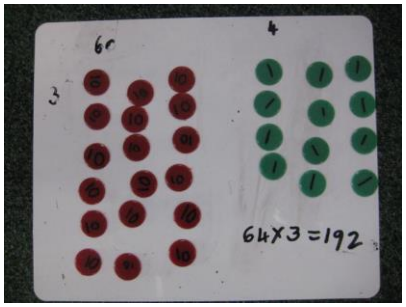
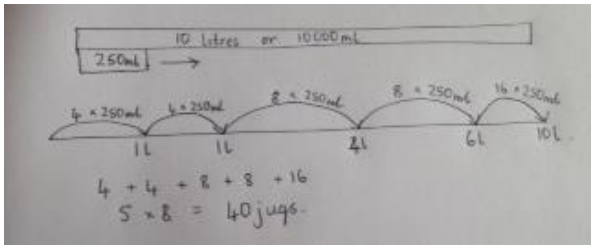
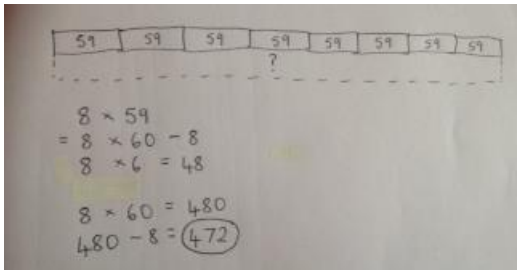
210 + 35 = 245

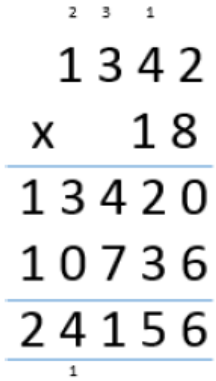
Moving forward, multiply by a 2 digit number showing the different rows within the grid method.

	10	8
10	100	80
3	30	24

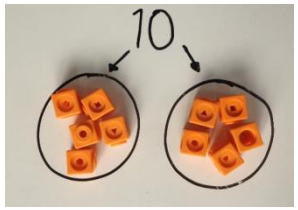
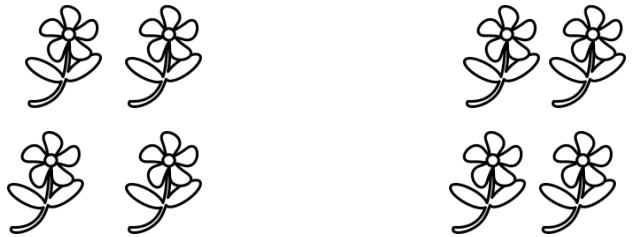
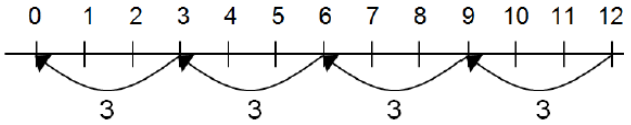
X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

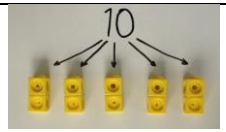
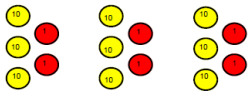
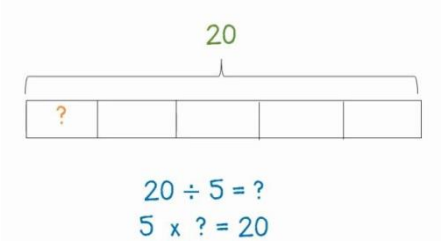
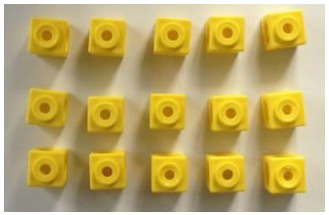
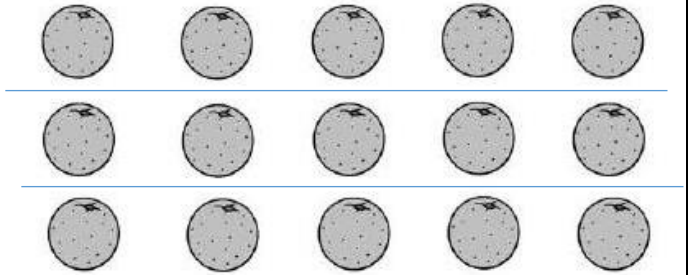
	 Calculations 4 x 126 Add up each column, starting with the ones making any exchanges needed.  Then you have your answer. Use of numicon can also be used to show the repeated addition, after partitioning numbers, then regrouping after.  Partition to multiply using Numicon, base 10 or Cuisenaire rods. 4 × 15	Bar models can be used to further solidify their concept of multiplication – not used to work out the problem, but used to represent them  12 4 4 4 This image is important! If established early, then children can use this bar model to solve problems in older years.	

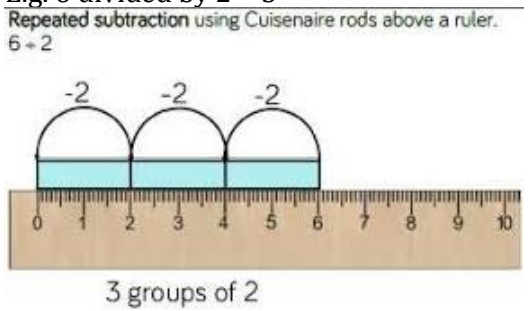
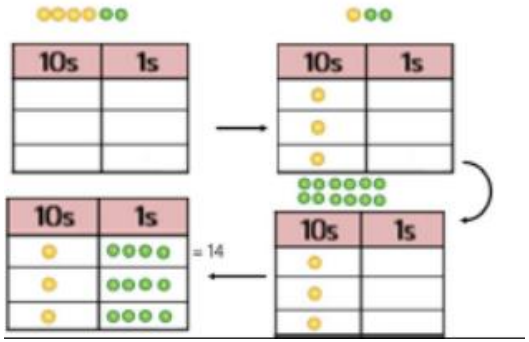
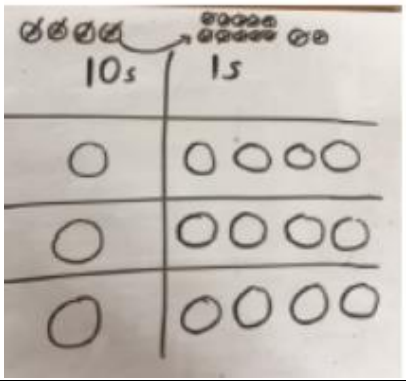
Column multiplication Year 4 – Up to 3 digits by 1 digit Year 5 – Up to 4 digits by 1 or 2 digits Year 6 – Up to 4 digits by 2 digits, including decimals	Children can continue to be supported by place value counters at the stage of multiplication.  It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.	Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.   	Start with long multiplication, reminding the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer. 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768

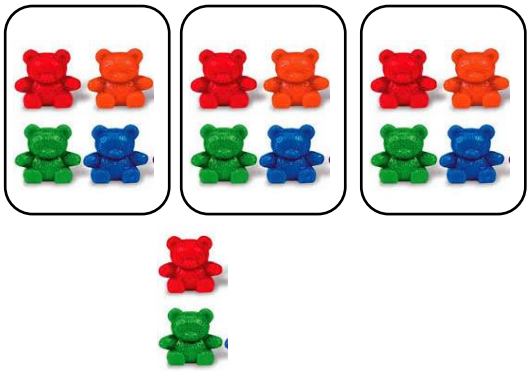
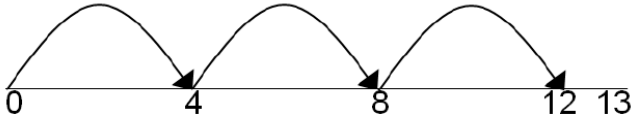
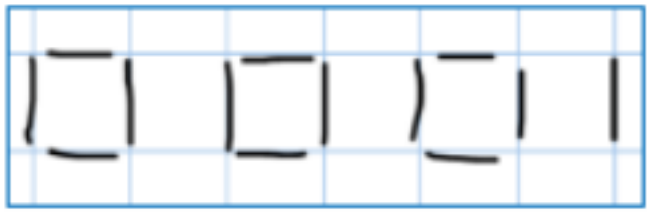
			 This moves to the more compact method. 

Division

Objective and Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups EYFS/Year 1	 I have 10 cubes, can you share them equally in 2 groups? 	Children use pictures or shapes to share quantities.  8 ÷ 2 = 4	Share 9 buns between three people. 9 ÷ 3 = 3
Division as grouping Year 1/Year 2	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding. 12 flowers dividing into groups of 3 	Use a number line to show jumps in groups. The number of jumps equals the number of groups. 	12 ÷ 4 = 3 Divide 12 into 4 groups. How many are in each group? Counting in 4's in their mind, with fingers recording now many lots of 4 go into 3.

	  More advanced for older years is acceptable for conceptual development like 96 divided by 3. 96 ÷ 3 = 32 	Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group. 	
Division within arrays Year 2/ Year 3	 Link division to multiplication by creating an array and thinking about the number sentences that can be created. E.g. 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	 Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the inverse of multiplication and division sentences by creating four linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7

Repeated subtraction Year 2/Year 3	Use of equipment like cuisinere rods above a ruler to show repeated subtraction of an equal amount. E.g. 6 divided by 2 = 3  	Children then represent the repeated subtraction pictorially 12 divided by 4 = 3 (groups) Discussions around division fact families to develop reasoning of the maths.  	
Sharing with Place value counters Year 3	Sharing using place value counters 42 divided by 3 = 14  	Children to represent the place value counters pictorially  	Children to be able to make sense of the place value counters and write calculations to show the process 42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14

Division with a remainder Year 3/ Year 4	14 ÷ 3 = Divide objects between groups and see how much is left over   Use of lollipop sticks or cuisineres rods to model division of 13 by 3	Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder.   Draw dots and group them to divide an amount and clearly show a remainder.  Draw sticks to show 3 wholes and 1 remainder when dividing 13 by 3.	Complete written divisions and show the remainder using r. 

Short division

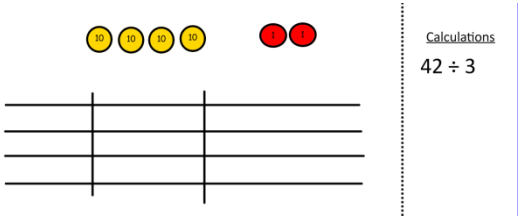
Year 4 – Up to 3 digits by 1 digit

N.B. there is no requirement for Year 4 to use standard written methods to divide and should be used as an aspirational target for Year 4.

Year 5 – Up to 4 digits by 1 digit

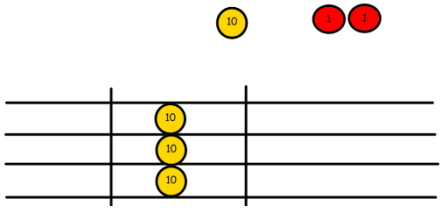
Year 6 – Up to 4 digits by 1 or 2 digits, including decimals

Use place value counters to divide using the bus stop method alongside

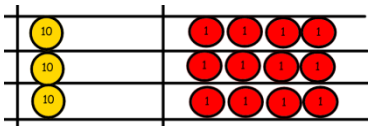


42 ÷ 3=

Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over.

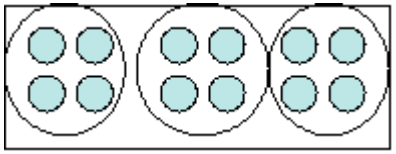


We exchange this ten for ten ones and then share the ones equally among the groups.



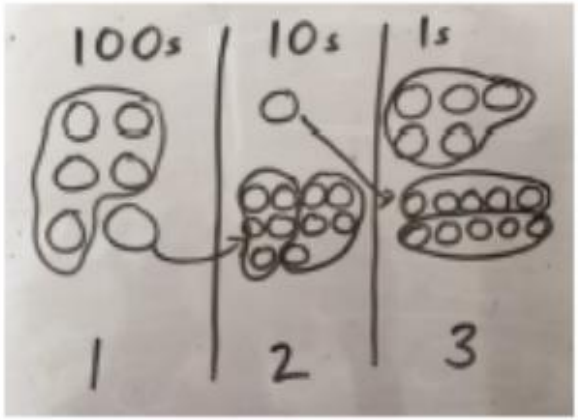
We look how much in 1 group so the answer is 14.

Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.



Encourage them to move towards counting in multiples to divide more efficiently.

Representing the place value counters pictorially



Begin with divisions that divide equally with no remainder.

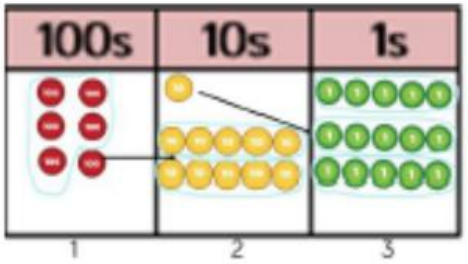
$$\begin{array}{r} 218 \\ 4\overline{)872} \\ 3 \end{array}$$

Move onto divisions with a remainder.

$$\begin{array}{r} 86\ r\ 2 \\ 5\overline{)432} \\ 3 \end{array}$$

Finally move into decimal places to divide the total accurately.

$$\begin{array}{r} 14.6 \\ 35\overline{)511.0} \\ 16\ \ 21 \end{array}$$

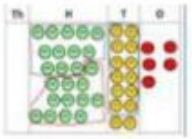
	Bigger numbers can also be completed. 615 ÷ 5  1. Make 615 with place value counters 2. How many groups of 5 hundreds can you make with 6, hundred counters? 3. Exchange the 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11, ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups fo 5 ones can you make with 15 ones?		
Long division Year 6 – Up to 4 digits by a 2 digit	 2544 ÷ 12 How many groups of 12 thousands do we have? None		$\begin{array}{r} 0 \\ 12\overline{)2544} \end{array}$ Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds. $\begin{array}{r} 02 \\ 12\overline{)2544} \\ \underline{24} \\ 1 \end{array}$ 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 2 thousand for 20 hundreds.

$$\begin{array}{r} 02 \\ 12\overline{)2544} \\ \underline{24} \\ 1 \end{array}$$

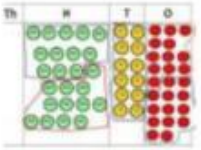
How many groups of 12 are in 25 hundreds? 2 groups. Circle them.

We have grouped 24 hundreds so can take them off and we are left with one.



$$\begin{array}{r} 021 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$$

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

$$\begin{array}{r} 021 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$$

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.

$$\begin{array}{r} 0212 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$$

Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.