Sandridge Primary School

Calculation Policy

Based upon the HfL Education
model Written Calculations Policy

The policy was reviewed and ratified by the Governing Body on 20th March 2025.

This policy will be reviewed every three years.

It is due for review in March 2028.

Rationale

This policy outlines a model progression through written strategies for addition, subtraction, multiplication and division in line with the new National Curriculum commencing September 2014. Through the policy, we aim to link key manipulatives and representations in order that the children can be vertically accelerated through each strand of calculation. We know that school wide policies, such as this, can ensure consistency of approach, enabling children to progress stage by stage through models and representations they recognise from previous teaching, allowing for deeper conceptual understanding and fluency. As children move at the pace appropriate to them, teachers will be presenting strategies and equipment appropriate to children's level of understanding. However, it is expected that the majority of children in each class will be working at age-appropriate levels as set out in the National Curriculum 2014 and in line with school policy. Appendix A in this policy, outlines the way in which Maths is delivered in Sandridge School.

The importance of mental mathematics

While this policy focuses on written calculations in mathematics, we recognise the importance of the mental strategies and known facts that form the basis of all calculations. The following checklists outline the key skills and number facts that children are expected to develop throughout the school.

To add and subtract successfully, children should be able to:

- recall all addition pairs to 9 + 9 and number bonds to 10
- recognise addition and subtraction as inverse operations
- add mentally a series of one digit numbers (e.g. 5 + 8 + 4)
- add and subtract multiples of 10 or 100 using the related addition fact and their knowledge of place value (e.g. 600 + 700, 160 — 70)
- partition 2 and 3 digit numbers into multiples of 100, 10 and 1 in different ways (e.g. partition 74 into 70 + 4 or 60 + 14)
- use estimation by rounding to check answers are reasonable

To multiply and divide successfully, children should be able to:

- add and subtract accurately and efficiently
- recall multiplication facts to 12 x 12 = 144 and division facts to 144 ÷ 12 = 12
- use multiplication and division facts to estimate how many times one number divides into another etc.
- know the outcome of multiplying by 0 and by 1 and of dividing by 1
- understand the effect of multiplying and dividing whole numbers by 10, 100 and later 1000
- recognise factor pairs of numbers (e.g. that 15 = 3 x 5, or that 40 = 10 x 4) and increasingly able to recognise common factors
- derive other results from multiplication and division facts and multiplication and division by 10 or 100 (and later 1000)
- notice and recall with increasing fluency inverse facts
- partition numbers into 100s, 10s and 1s or multiple groupings
- understand how the principles of commutative, associative and distributive laws apply or do not apply to multiplication and division
- understand the effects of scaling by whole numbers and decimal numbers or fractions
- understand correspondence where n objects are related to m objects
- investigate and learn rules for divisibility

Progression in addition and subtraction

Addition and subtraction are connected.

Part	Part
Whole	

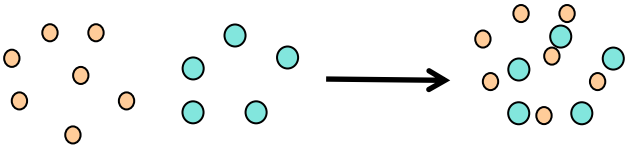
Addition names the whole in terms of the parts and **subtraction** names a missing part of the whole.

Addition

Combining two sets (aggregation)

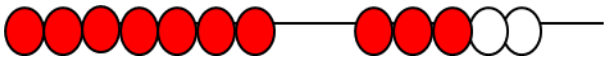
Putting together – two or more amounts or numbers are put together to make a total

7 + 5 = 12



Count one set, then the other set. Combine the sets and count again. Starting at 1.

Counting along the bead bar, count out the 2 sets, then draw them together, count again. Starting at 1.

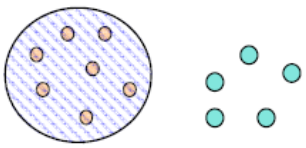


Combining two sets (augmentation)

This stage is essential in starting children to calculate rather than counting

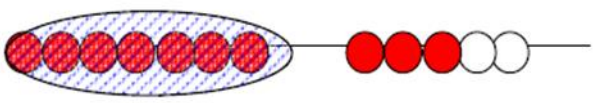
Where one quantity is increased by some amount. Count on from the total of the first set, e.g. put 3 in your head and count on 2. Always start with the largest number.

Counters:



Start with 7, then count on 8, 9, 10, 11, 12

Bead strings:



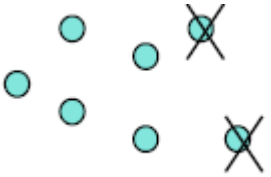
Make a set of 7 and a set of 5. Then count on from 7.

Subtraction

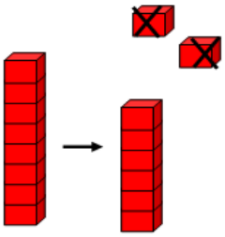
Taking away (separation model)

Where one quantity is taken away from another to calculate what is left.

7 – 2 = 5



Multilink towers - to physically take away objects.

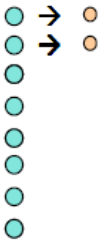


Finding the difference (comparison model)

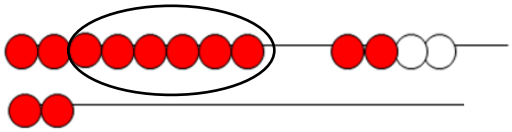
Two quantities are compared to find the difference.

8 – 2 = 6

Counters:



Bead strings:

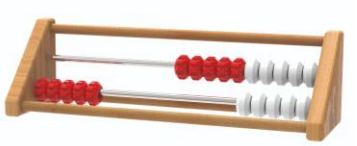


Make a set of 8 and a set of 2. Then count the gap.

Multilink Towers:



Rekenrek



Slide across one number and then count on how many more.

Number tracks:





Start on 5 then count on 3 more

Numicon:

Match the Numicon shapes up with the numbers to add together to find the total.

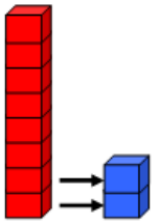
2 + 3 =



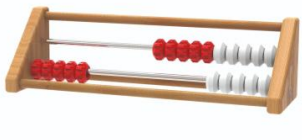


You can count the circles in the shapes to find the answer 5 or you can put the two shapes together to find the total.

Multilink Towers:



Rekenrek



Slide across the starting number (minuend) and then slide away the number that is being taken away (subtrahend).

Number tracks:

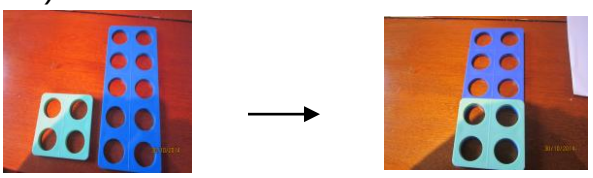




Start with the smaller number and count the gap to the larger number.

Numicon

Use the shapes to find the difference between the larger and smaller number. Place the smaller Numicon shape onto of the larger Numicon shape and count the difference (circles)

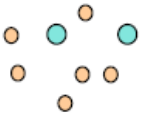


1 set within another (part-whole model)

The quantity in the whole set and one part are known, and may be used to find out how many are in the unknown part.

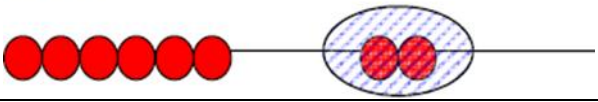
8 – 2 = 6

Counters:



Bead strings:

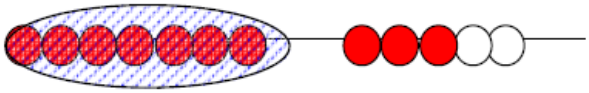
8 – 2 = 6



Bridging through 10s

This stage encourages children to become more efficient and begin to employ known facts.

Bead string:



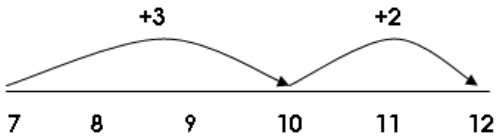
7 + 5 is decomposed / partitioned into 7 + 3 + 2. The bead string illustrates 'how many more to the next multiple of 10?' (children should identify how their number bonds are being applied) and then 'if we have used 3 of the 5 to get to 10, how many more do we need to add on? (ability to decompose/partition all numbers applied)

Number track:

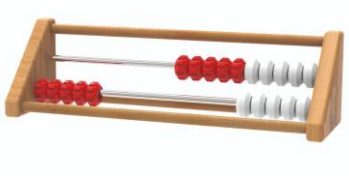


Steps can be recorded on a number track alongside the bead string, prior to transition to number line.

Number line

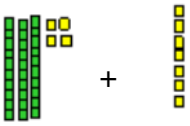


Rekenrek



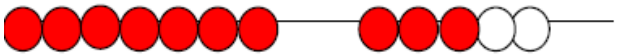
Slide across the starting number. Then pull across how many more (using both rails). How many altogether?

Base 10



Exchange 10 ones for 1 ten. There will then be 4 tens and 1 one.

Bead string:



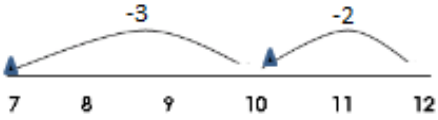
12 – 7 is decomposed / partitioned in 12 – 2 – 5. The bead string illustrates 'from 12 how many to the last/previous multiple of 10?' and then 'if we have used 2 of the 7 we need to subtract, how many more do we need to count back? (ability to decompose/partition all numbers applied)

Number Track:



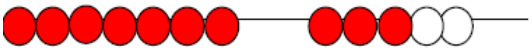
Steps can be recorded on a number track alongside the bead string, prior to transition to number line.

Number Line:



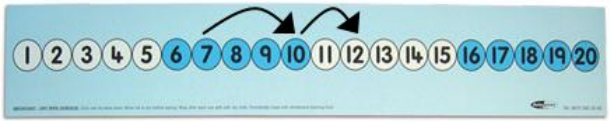
Counting up or 'Shop keepers' method

Bead string:

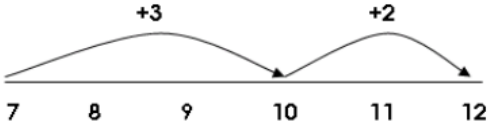


12 – 7 becomes 7 + 3 + 2.
Starting from 7 on the bead string 'how many more to the next multiple of 10?' (children should recognise how their number bonds are being applied), 'how many more to get to 12?'.

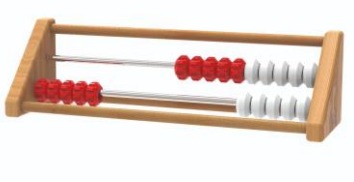
Number Track:



Number Line:



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Slide across the starting number. Then pull across how many more (using both rails). How many altogether?

Base 10



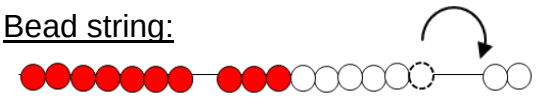
Exchange one of the tens for 10 ones. Then subtract the 7 ones. You will then be left with 2 tens and 7 ones.

Compensation model (adding 9 and 11) (optional)

This model of calculation encourages efficiency and application of known facts (how to add ten)

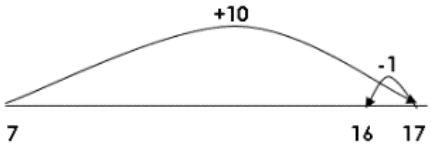
7 + 9

Bead string:



Children find 7, then add on 10 and then adjust by removing 1.

Number line:



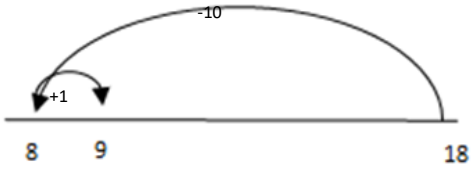
18 – 9

Bead string:



Children find 18, then subtract 10 and then adjust by adding 1.

Number line:



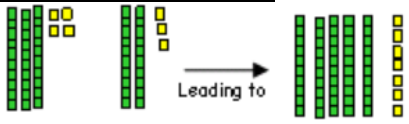
Working with larger numbers
Tens and ones + tens and ones

Ensure that the children have been transitioned onto Base 10 equipment and understand the abstract nature of the single 'tens' sticks and 'hundreds' blocks

Partitioning (Aggregation model) – (first taught in Y2)

34 + 23 = 57

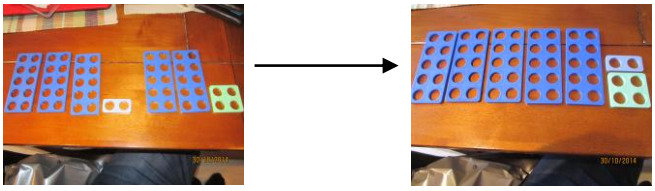
Base 10 equipment:



Children create the two sets with Base 10 equipment and then combine; ones with ones, tens with tens.

Numicon

32 + 24 = 56



Partitioning (Augmentation model)

Base 10 equipment:

Encourage the children to begin counting from

Take away (Separation model) - (first taught in Y2)

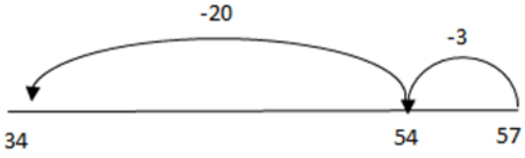
57 – 23 = 34

Base 10 equipment:

Children remove the lower quantity from the larger set, starting with the ones and then the tens. In preparation for formal decomposition.

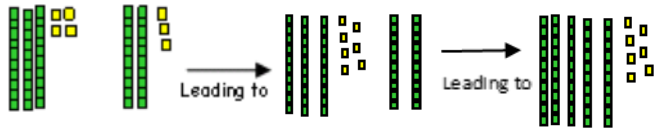


Number Line:



At this stage, children can began to use an

the first set of ones and tens, avoiding counting from 1. Beginning with the ones in preparation for formal columnar method.

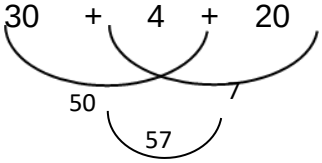


Number line:



At this stage, children can begin to use an informal method to support, record and explain their method. (optional)

30 + 4 + 20 + 3



informal method to support, record and explain their method (optional)

57 - 23

57 – 3 = 54

54 – 20 = 34

OR

57 – 23

57 – 20 = 37

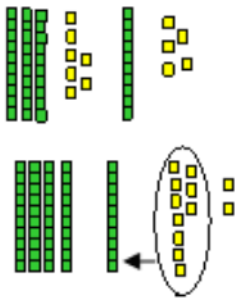
37 – 3 = 34

Bridging with larger numbers

Once secure in partitioning for addition, children begin to explore exchanging. What happens if the ones are greater than 10? Introduce the term 'exchange'. Using the Base 10 equipment, children exchange ten ones for a single tens rod, which is equivalent to crossing the tens boundary on the bead string or number line.

Base 10 equipment:

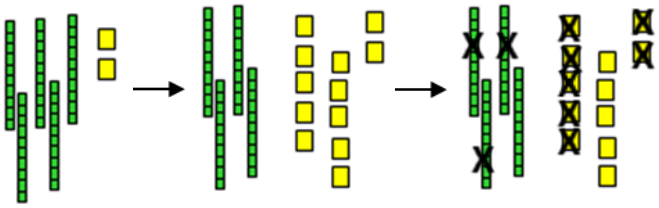
37 + 15 = 52



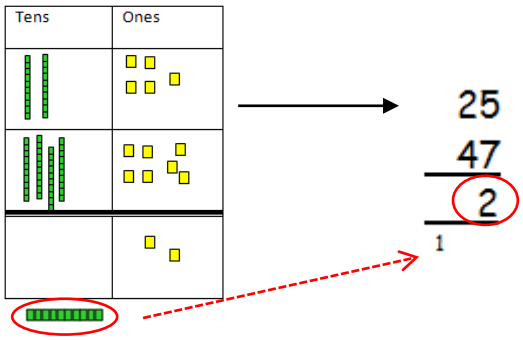
Discuss counting on from the larger number irrespective of the order of the calculation.

Base 10 equipment:

52 – 37 = 15

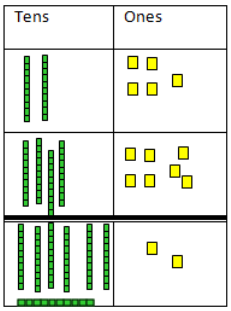


Compact method (first taught in Y3)

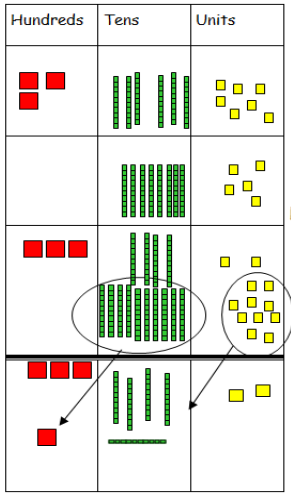


25
47
2
1

Leading to



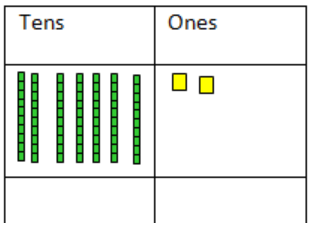
25
47
72
1



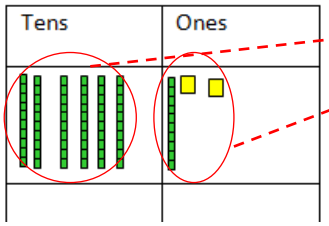
Leading to

3 6 7
+ 8 5
4 5 2
1 1

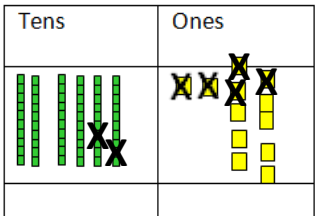
Compact decomposition (first taught in Y3)



72
-25
47



6 1
7 2
-25



6 1
7 2
-25
47

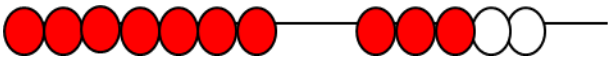
Vertical acceleration

By returning to earlier manipulative experiences children are supported to make links across mathematics, encouraging 'If I know this…then I also know…' thinking.

Decimals

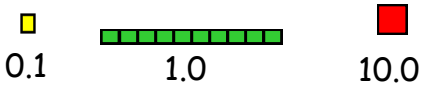
Ensure that children are confident in counting forwards and backwards in decimals – using bead strings to support.

Bead strings:



Each bead represents 0.1, each different block of colour equal to 1.0

Base 10 equipment:

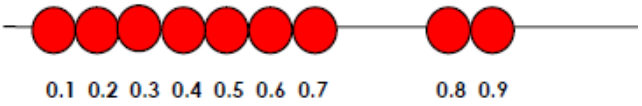


Addition of decimals (first taught in Y4)

Aggregation model of addition

Counting both sets – starting at zero.

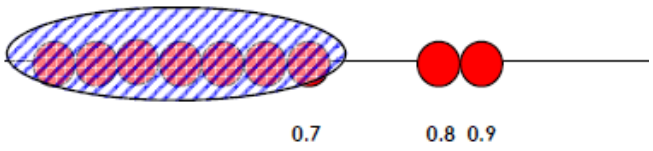
0.7 + 0.2 = 0.9



Augmentation model of addition

Starting from the first set total, count on to the end of the second set.

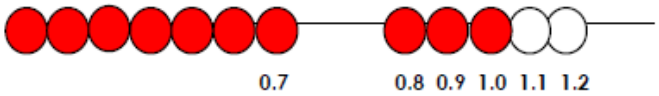
0.7 + 0.2 = 0.9



Bridging through 1.0

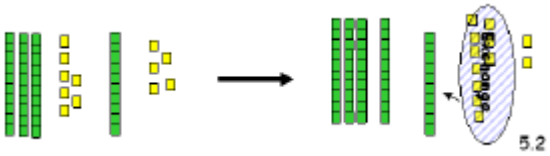
Encouraging connections with number bonds.

0.7 + 0.5 = 1.2



Partitioning

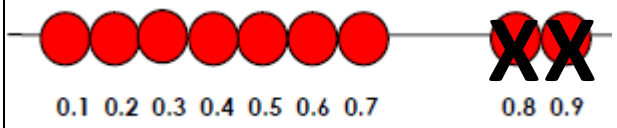
3.7 + 1.5 = 5.2



Subtraction of decimals (first taught in Y4)

Take away model

0.9 – 0.2 = 0.7



Finding the difference (or comparison model):

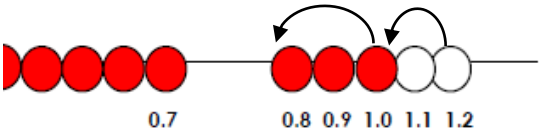
0.8 – 0.2 =



Bridging through 1.0

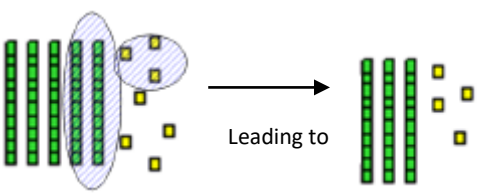
Encourage efficient partitioning.

1.2 – 0.5 = 1.2 – 0.2 – 0.3 = 0.7



Partitioning

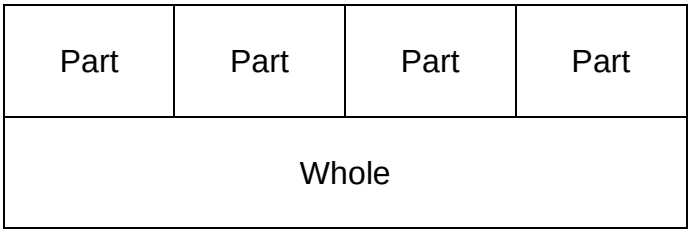
5.7 – 2.3 = 3.4



Gradation of difficulty- addition:	**Gradation of difficulty- subtraction:**
1) No exchange 2) One exchange 3) Multiple exchanges 4) Exchanging tens to hundreds 5) More than two numbers in calculation 6) Missing number calculations 7) Decimals up to 2 decimal places (same number of decimal places) 8) Add two or more decimals with a range of decimal places	1) No exchange 2) One exchange 3) Multiple exchanges 4) Multiples zeroes 5) Missing numbers in the calculation 6) Decimals up to 2 decimal places (same number of decimal places) 7) Add two or more decimals with a range of decimal places

Progression in Multiplication and Division

Multiplication and division are connected.
Both express the relationship between a number of equal parts and the whole.





The following array, consisting of four columns and three rows, could be used to represent the number sentences: -

3 x 4 = 12,

4 x 3 =12,

3 + 3 + 3 + 3 = 12,

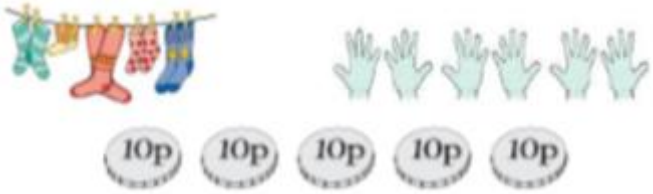
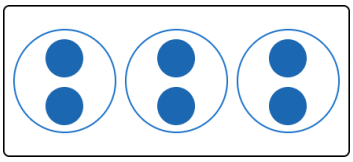
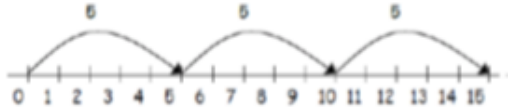
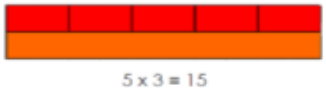
4 + 4 + 4 =12
And it is also a model for division

12 ÷ 4 = 3

12 ÷ 3 = 4

12 – 4 – 4 – 4 = 0

12 – 3 – 3 – 3 – 3 = 0

Multiplication	Division
Early experiences Children will have real, practical experiences of handling equal groups of objects and counting in 2s, 10s and 5s. Children work on practical problem solving activities involving equal sets or groups. 	Children will understand equal groups and share objects out in play and problem solving. They will count in 2s, 10s and 5s. 
Repeated addition (repeated aggregation) 3 times 5 is 5 + 5 + 5 = 15 or 5 lots of 3 or 5 x 3 Children learn that repeated addition can be shown on a number line.  Children learn that repeated addition can be shown on a bead string.  Children also learn to partition totals into equal trains using Cuisenaire Rods  **Numicon** Children use the Numicon shapes to recognise repeated addition and times tables (5 + 5 + 5 + 5 = 20 or 4 lots of 5 = 20 or 4 x 5 = 20) 	**Sharing equally** 6 sweets get shared between 2 people. How many sweets do they each get? A bottle of fizzy drink shared equally between 4 glasses.  **Grouping or repeated subtraction** There are 6 sweets. How many people can have 2 sweets each? 

Scaling

This is an extension of augmentation in addition, except, with multiplication, we increase the quantity by a scale factor. For example, if there was 1 marble in each pot and I got 3 pots, this can be written as:

1 + 1 + 1 = 3 □

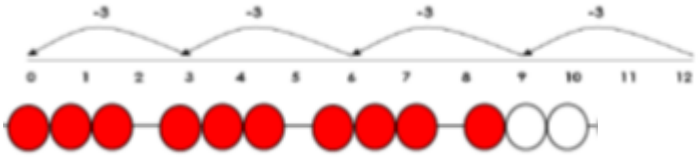
Another example might be: find a ribbon that is 4 times as long as the blue ribbon.

5 + 5 + 5 + 5



Repeated subtraction using a bead string or number line

12 ÷ 3 = 4

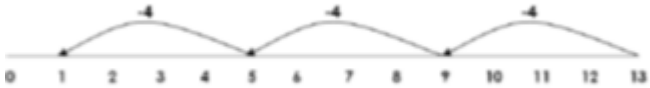


The bead string helps children with interpreting division calculations, recognising that 12 ÷ 3 can be seen as 'how many 3s make 12?'

Grouping involving remainders

Children move onto calculations involving remainders.

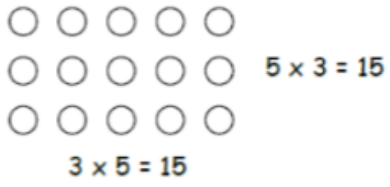
13 ÷ 4 = 3 r1



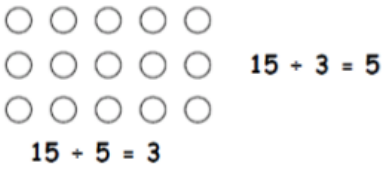
Or using a bead string see above.

Arrays

Children learn to model a multiplication calculation using an array. This model supports their understanding of **commutativity** and the development of the grid in a written method. It also supports the finding of factors of a number.



Children learn to model a division calculation using an array. This model supports their understanding of the development of partitioning and the 'bus stop method' in a written method. This model also connects division to **finding fractions** of discrete quantities.



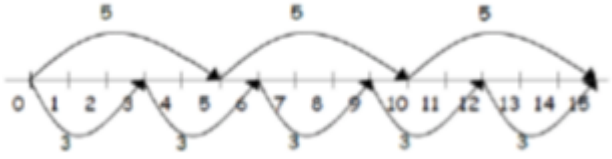
Commutativity

Children learn that 3 x 5 has the same total as 5 x 3.

This can also be shown on the number line.

3 x 5 = 15

5 x 3 = 15

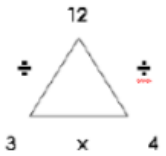


Children learn that division is **not** commutative and link this to subtraction.

Inverse operations

Trios can be used to model the 4 related multiplication and division facts. Children learn to state the 4 related facts.

3 x 4 = 12
4 x 3 = 12
12 ÷ 3 = 4
12 ÷ 4 = 3



Children use symbols to represent unknown numbers and complete equations using inverse operations. They use this strategy to calculate the missing numbers in calculations.

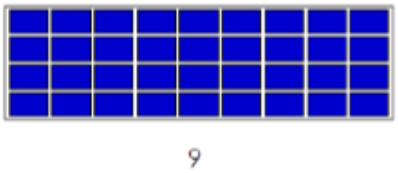
□ x 5 = 20 3 x Δ = 18 O x □ = 32
24 ÷ 2 = □ 15 ÷ O = 3 Δ ÷0 = 8

This can also be supported using arrays: e.g. 3 X ? = 12

Partitioning for multiplication

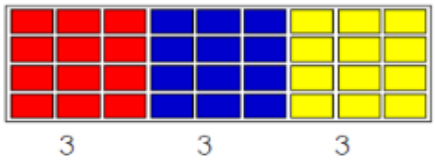
Arrays are also useful to help children visualise how to partition larger numbers into more useful representation.

9 x 4 = 36



Children should be encouraged to be flexible with how they use number and can be encouraged to break the array into more manageable chunks.

9 x 4 =

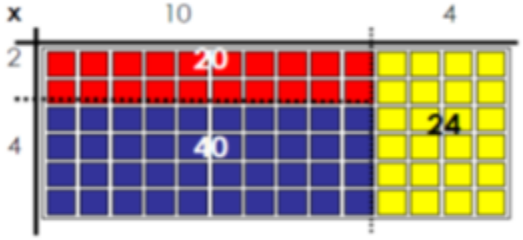


Which could also be seen as

9 x 4 = (3 x 4) + (3 x 4) + (3 x 4) = 12 + 12 + 12 = 36

Or 3 x (3 x 4) = 36

And so 6 x 14 = (2 x 10) + (4 x 10) + (4 x 6) = 20 + 40 + 24 = 84



Multiplication for division

Children can use their multiplication tables to work out division.

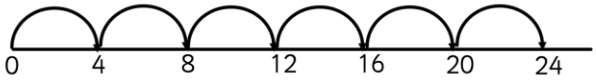
A calculation such as:

24 ÷ 4 =

How many fours make 24?

The children count up in their 4 times tables to see how many lots make 24.

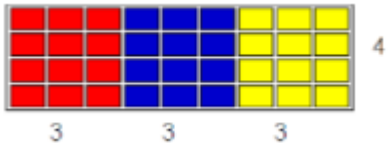
This can also be represented with jumps on a number line for visual representation.



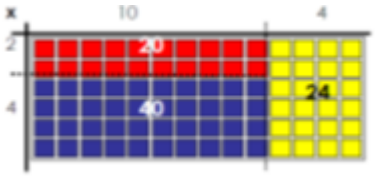
To be successful in calculation learners must have plenty of experiences of being flexible with partitioning, as this is the basis of distributive and associative law.

Associative law **(multiplication only)** :-

E.g. 3 x (3 x 4) = 36



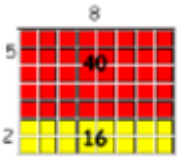
The principle that if there are three numbers to multiply these can be multiplied in any order.



Distributive law (multiplication):-

E.g. 6 x 14 = (2 x 10) + (4 x 10) + (4 x 6) = 20 + 40 + 24 = 84

This law allows you to distribute a multiplication across an addition or subtraction.



Distributive law (division):-

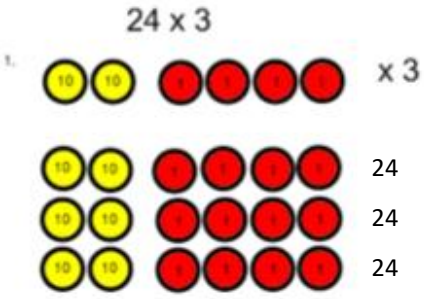
E.g. 56 ÷ 8 = (40 ÷ 8) + (16 ÷ 8) = 5 + 2 = 7

This law allows you to distribute a division across an addition or subtraction.

<u>Arrays leading into the grid method (first taught in Y3)</u>

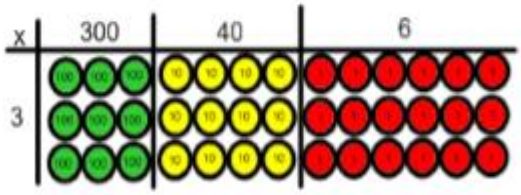
Children continue to use arrays and partitioning, where appropriate, to prepare them for the grid method of multiplication.

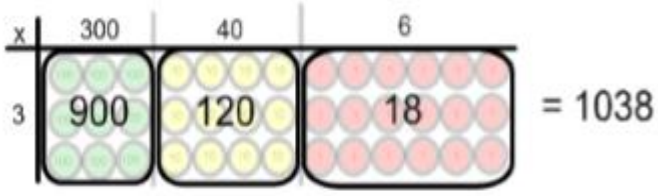
Arrays can be represented as ‘grids’ in a shorthand version and by using place value counters to show multiples of ten, hundred etc.



Grid method

This written strategy is introduced for the multiplication of TO x O to begin with. It may require column addition methods to calculate the total.

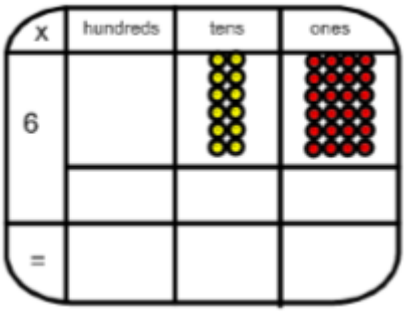




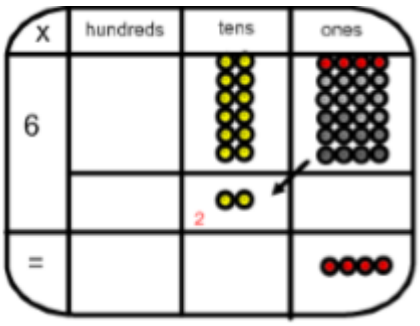
Short multiplication — multiplying by a single digit (first taught in Y5)

The array using place value counters becomes the basis for understanding short multiplication first without exchange before moving onto exchanging

24 x 6



$$\begin{array}{r} 24 \\ \times\ 6 \\ \hline \end{array}$$



$$\begin{array}{r} 24 \\ \times\ 6 \\ \hline 4 \\ \hline {\scriptstyle 2} \end{array}$$

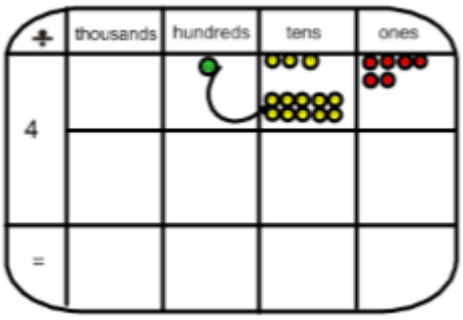
o x o

6 x 4 = 24

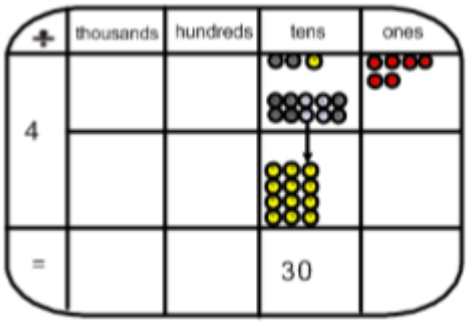
Short division — dividing by a single digit (first taught in Y5)

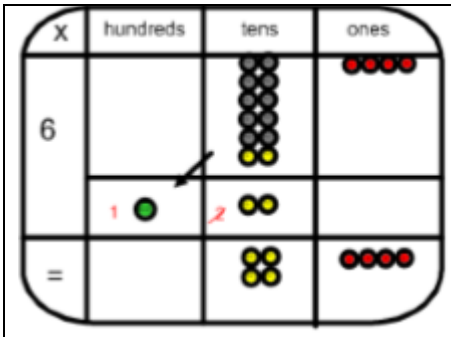
Whereas we can begin to group counters into an array to show short division working

136 ÷ 4



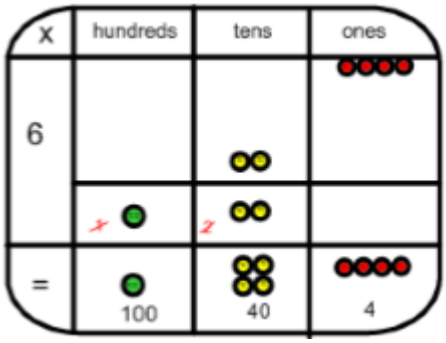
$$4\overline{)136}\quad 3$$





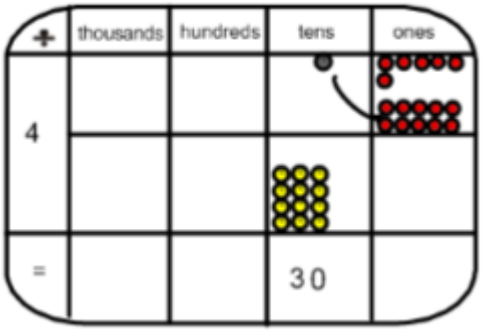
24
x 6
44
1 2

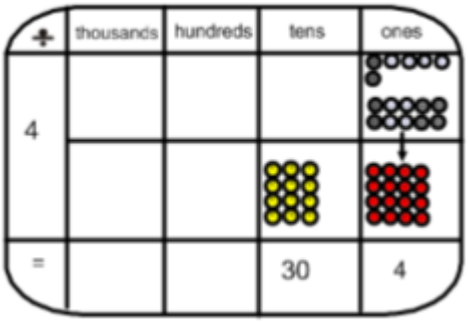
o x t
6 x 20 = 120
Add the 2 tens exchanged over = 140



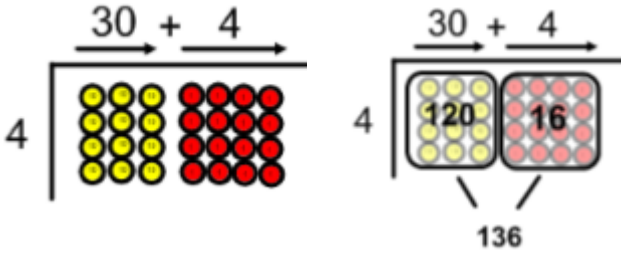
24
x 6
144
1 2

Nothing left to multiply.
Add the 1 to the hundreds column.





34
4 136
0 1 1



The vertical method- 'chunking' leading to long division

See above for example of how this can be modelled as an array using place value counters.

78 ÷ 3 =

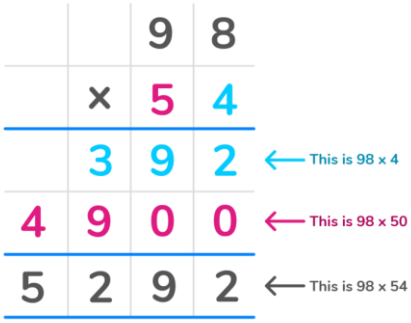
	78	
-	30	(10 x 3)
	48	
-	30	(10 x 3)
	18	
-	18	(6 x 3)
	0	

So 78 ÷ 3 = 10 + 10 + 6 =26

Long multiplication—multiplying by more than one digit

Children will refer back to grid method by using place value counters or Base 10 equipment with no exchange and using synchronised modelling of written recording as a long multiplication model before moving to TO x TO etc.

TO x TO example:



Dealing with remainders

Remainders should be given as integers, but children need to be able to decide what to do after division, such as rounding up or down accordingly.

e.g.:

- I have 62p. How many 8p sweets can I buy?
- Apples are packed in boxes of 8. There are 86 apples. How many boxes are needed?

Gradation of difficulty for expressing remainders

1. Whole number remainder
2. Remainder expressed as a fraction of the divisor
3. Remainder expressed as a simplified fraction
4. Remainder expressed as a decimal

Gradation of difficulty (column multiplication)

1) TO x O no exchange
2) TO x O with one exchange
3) HTO x O no exchange
4) HTO x O with one exchange
5) Any number x O with multiple exchanges
6) Decimal multiplication
7) Long multiplication

Gradation of difficulty (short division)

1) TO ÷ O no exchange no remainder
2) TO ÷ O no exchange with remainder
3) Any digits ÷ O with exchange no remainder
4) Any digits ÷ O with exchange, with remainder
5) Zero in the quotient e.g. 816 ÷ 4 = **204**
6) Decimal in the dividend e.g. **7.5** ÷ 5
7) Decimal in the quotient e.g. 88 ÷ 5 = **17.6**

Long division —dividing by more than one digit (first taught in Y5/6)

Children should be reminded about partitioning numbers into multiples of 10, 100 etc. before recording as either:-

1. Chunking model of long division using Base 10 equipment
2. Sharing model of long division using place value counters

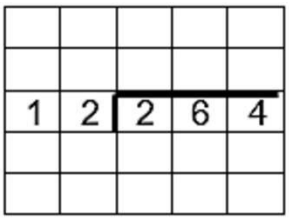
See the following pages for exemplification of these methods.

Chunking model of long division

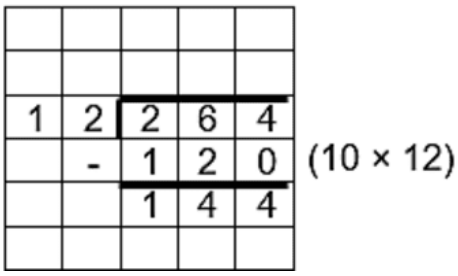
The expanded (chunking) method of long division involves subtracting groups (or chunks) of the divisor (the number that goes outside the bus-stop). It can help you to understand the relationship between multiplication and division. This method can be used when you first start to learn about long division. For example, look at the following calculation:

264 ÷ 12 =

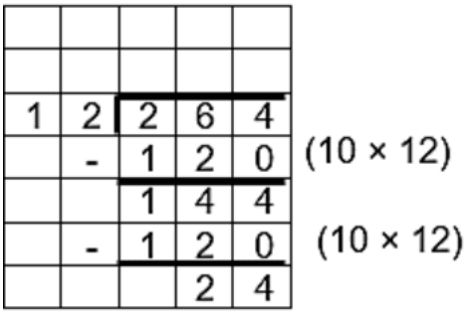
Lay out the calculation using the bus stop method:



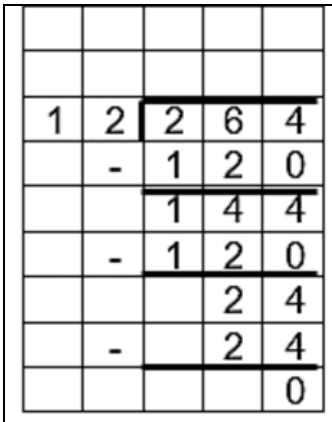
Next, we're going to subtract a multiple of the divisor (the number outside the bus stop). In this example, we have subtracted 120 (which is 10 × 12) from 264. We write 120 below 264 and complete the subtraction leaving an answer of 144. At the side of the calculation, we write the number of divisors we have subtracted (in this case 10 lots of 12 or 10 × 12).



We are still left with 144 so we can subtract another 'chunk' – or group – of 12. Let's subtract 120 again and write the multiplication by the side.



We are now left with 24. Let's think of another group ('chunk') of 12s that we can subtract. We can now subtract 24 (which is 2 × 12).



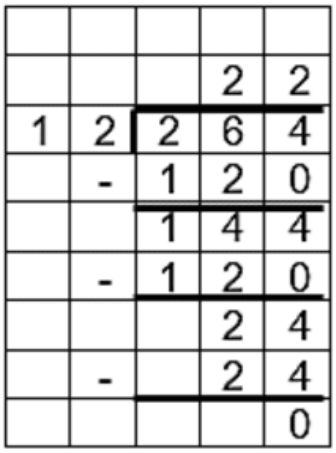
1	2	2	6	4
	-	1	2	0
		1	4	4
	-	1	2	0
			2	4
	-		2	4
				0

(10 × 12)

(10 × 12)

(2 × 12)

We cannot subtract any more 12s as the answer is 0. We now need to calculate the total amount of 12s we subtracted from 264. We used one group of 10 twelves, another group of 10 and a group of 2 twelves (10 + 10 + 2). Altogether, we subtracted 22 twelves from 264. Therefore, 264 ÷ 12 = 22. We can also say the inverse which is 22 × 12 = 264.



			2	2
1	2	2	6	4
	-	1	2	0
		1	4	4
	-	1	2	0
			2	4
	-		2	4
				0

(10 × 12)

(10 × 12)

(2 × 12)

The ‘chunking’ method can seem quite long but it can help you to complete larger division calculations by breaking it down into smaller calculations to get the final answer.

Above example from: https://www.twinkl.co.uk/homework-help/maths-homework-help/long-division/long-division-expanded-chunking-method

Maths in Sandridge School

Maths lessons in Sandridge School will follow a sequential plan, designed by the teachers using the Herts for Learning block planner. The lessons will include a differentiated 'Chilli Challenge'. This may be presented in a number of ways but will include at least the three main challenges below (Mild, Warm, Hot):

Chilli Challenge:

- **Extra Mild** – these are challenges which will be designed for the children working significantly below ARE (these may not be seen in every class / in every lesson)
- **Mild** – one of the three main challenges which will be designed for the children working below ARE (the level that they are 'below' will vary from class to class)
- **Warm** – one of the three main challenges which will be designed for the children working at ARE
- **Hot** – one of the three main challenges which will be designed for the children working above ARE
- **Spicy –** these are challenges which will designed to give greater depth to those children showing they have achieved 'Hot'. These challenges will take a different format, often more open-ended, investigative or explanatory problems.

Extra Mild → Hot challenges will include both fluency and reasoning questions. Children are expected to complete elements of fluency and reasoning in almost all lessons. Some lessons may be purely reasoning.

The children do not have to complete all of one challenge before moving on to another challenge. It is expected that the children show they are competent in the fluency element of the lesson and then they can be moved onto the reasoning. If a child is accurately working through a lesson at pace, the adult should assess and move the child onto the next part of the challenge or a more difficult challenge.

Maths lessons will be marked daily using the 'Marking and Presentation' policy. Marking will be adult, peer or self-marked. This ensures that: the accurate pitch of a lesson can continue into the following lesson; the children can understand how they have attained; and so that appropriate next steps or 'Rapid Reinforcement' can take place.