Newbridge Primary School

Calculation Policy

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Newbridge Calculation Policy

Introduction

This calculation policy has been written in line with the programmes of study taken from the National Curriculum for Mathematics and with links to the White Rose model of teaching mathematics. On the first grid, the information written in black is taken from the National Curriculum, the red information is taken from the White Rose.

It provides guidance on calculation methods and progression using the Concrete, Pictorial and Abstract approach, as well as displaying how and when to introduce formal methods across the school. It provides progression for each operation to ensure smooth transition from one year group to the next. We understand that it is not about moving children onto the next method as soon as they can do the one before, but about providing rich and engaging activities, where children learn to apply and reason, using the methods they have learnt. The policy has been divided into the four sections of addition, subtraction, multiplication and division with examples of how to teach each rule, using the concrete, pictorial and abstract methodology across the school.

Rationale

Mathematical understanding is developed through use of representations that are first of all concrete (e.g. dienes, numicon), then pictorial (e.g. array, place value counters, tens frame) to then facilitate abstract working (e.g. columnar addition, long division). It is important that the conceptual understanding is supported by the use of representation. Children's conceptual understanding and fluency is strengthened if they experience concrete, visual and abstract representations of a concept during a lesson/ unit of work. Moving between the concrete and the abstract helps children to connect abstract symbols with familiar contexts, thus providing the opportunity to make sense of, and develop fluency in the use of abstract symbols.

Children must also make sense of maths through real life problem solving and therefore teachers will plan and deliver activities that provide children with such experiences.

Aims of the Policy

- To ensure that children at Newbridge leave being confident mathematicians.
- To ensure consistency and progression in our approach to calculation.
- To ensure that children develop an efficient, reliable, formal written method for all operations that they are secure with.
- To ensure that Staff are supported in their teaching of the formal methods.

	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition and Subtraction	Add and subtract one-digit and two-digit numbers to 20, including zero. Using quantities and objects, add and subtract 2 single digit numbers and count on or back to find the answer.	Add and subtract one-digit and two-digit numbers to 20, including zero. Combining two parts to make a whole: part whole model. Starting at the bigger number and counting on- using cubes. Regrouping to make 10 using ten frame/ Numicon. Using the part whole model. Make 10 using the ten frame.	Add and subtract numbers using concrete objects, pictorial representations including: * a two-digit number and ones * a two-digit number and tens * two two-digit numbers * Adding three single digits. Use of base 10 to add and subtract two numbers. Using the part whole model.	Add and subtract numbers with up to 3 digits, using formal written methods of columnar addition and subtraction (including regrouping). Using place value counters (up to 3 digits).	Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate (including regrouping).	Add and subtract numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction). Using place value counters for adding and subtracting decimals- with the same amount of decimal places.	Add and subtract numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction). Abstract methods. Using place value counters for adding decimals. Using place value counters when subtracting decimals- with different amounts of decimal places.

Multiplication and Division		Recognising and making equal groups. Sharing objects into groups. Division as grouping e.g. I have 12 sweets and put them in groups of 3, how many groups? Use cubes and draw around 3 cubes at a time.	Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs. Repeated addition and Arrays for multiplication. Sharing and repeated subtraction for division.	Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods. Division with a remainder- using lollipop sticks, times tables facts and repeated subtraction.	Multiply two-digit and three-digit numbers by a one-digit number using formal written layout. Division with a remainder.	Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers. Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context.	Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication. Divide numbers up to 4-digits by a two-digit whole number using the formal written method of short division. Where appropriate for the context divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context.

Calculation Policy: ADDITION

EYFS - Maths for young children should be meaningful. Where possible, concepts should be taught in the context of real life.

GUIDANCE/MODELS AND IMAGES	KEY VOCABULARLY
If available, NUMICON shapes are introduced straight away and can be used to: • Identify 1 more/1 less • Combine pieces to add • Find number bonds • Add without counting  Children can record this by printing or drawing around NUMICON pieces. Children being to combine groups of objects using concrete apparatus  Construct number sentences verbally or using cards to go with practical activities. Children are encouraged to read number sentences aloud in different ways. “Three add two equals 5” “5 is equal to three and two” Children make a record in pictures, words or symbols of addition activities already carried out. Solve simple problems using finders:  5 + 1 = 6 Number tracks can be introduced to count u on and to find one more: What is 1 more than 4? 1 more than 13? Number lines can then be used alongside number tracks and practical apparatus to solve addition calculations and word problems.  **Children will need opportunities to look at and talk about different models and images as they move between respresentations.**	**Games and songs can be a useful way to begin using vocabulary involved in addition eg:** Alice the Camel add plus is equal to equals more and make sum total altogether score double one more, two more, ten more … how many more to make …? how many more is … than … ?

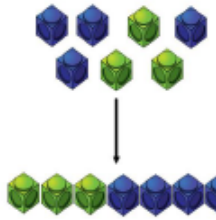
1	2	3	4	5	6

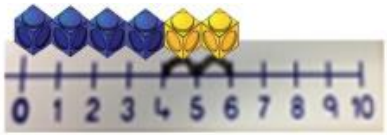
Calculation Policy : ADDITION

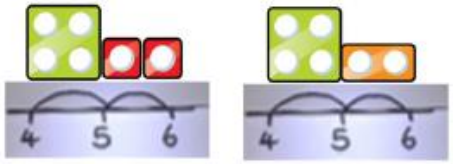
Key language: sum, total, parts and wholes, plus, add, altogether, more, 'is equal to', 'is the same as'

Year 1

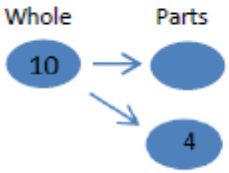
Using objects and number lines to count on.

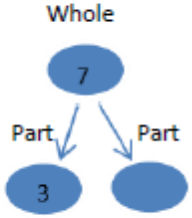






Understanding missing parts





Missing numbers need to be placed in all possible places.

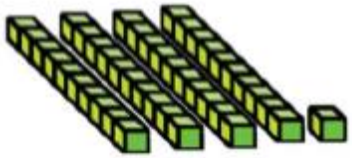
3 + 4 = □ □ = 3 + 4

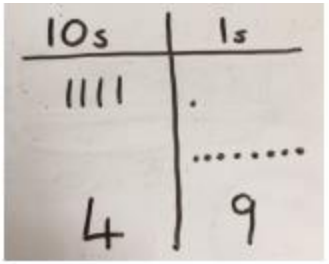
3 + □ = 7 7 = □ + 4

Year 2

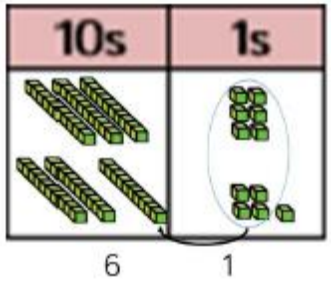
TO + O using base 10. Continue to develop understanding of partitioning and place value.

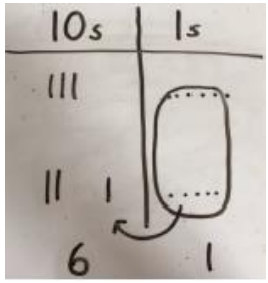
41 + 8 = 49





36 + 25 = 61



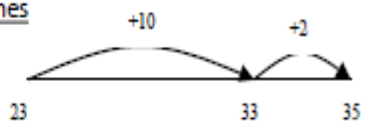


Counting on in tens and ones

23 + 12 = 23 + 10 + 2

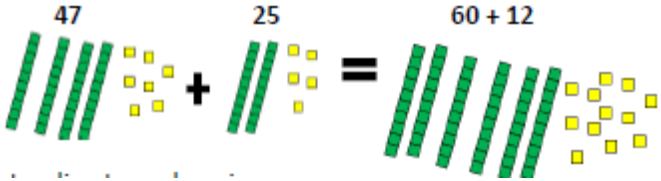
= 33 + 2

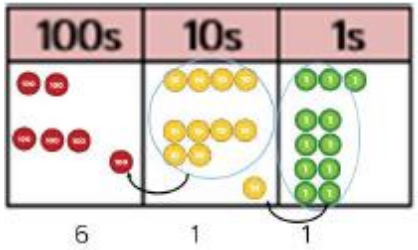
= 35

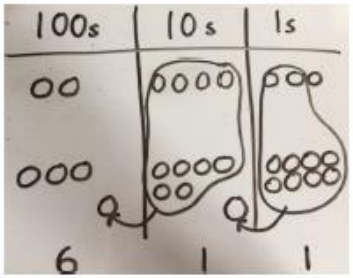


Year 3

Introduce expanded column addition modelled with place value counters (Dienes could be used for those who need a less abstract representation).

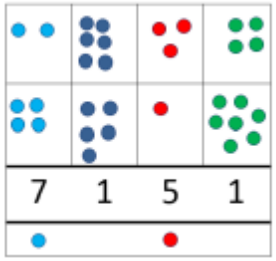






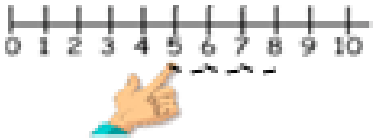
Moving to the final stage of formal method.

$$\begin{array}{r} 243 \\ +368 \\ \hline 611 \\ \hline 1\ 1 \end{array}$$

Year 4	Year 5	Year 6
Expanded column addition modelled with place value counters, progressing to calculations with 4 digit numbers.  200 + 40 + 7 100 + 20 + 5 300 + 60 +12 = 372 247 +125 12 60 300 372 Compact written method. Extend to numbers with at least 4 digits.  7 1 5 1 2634 +4517 7151	Progressing to calculations with more than 4 digits. As Year 4, progressing when understanding of expanded method is secure. Children will move on to the formal columnar method for whole numbers and decimal numbers. Start with place value counters or grids for adding decimal numbers with the same amount of decimal places.	As Year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with columnar method to be secured. Continue calculating with decimals, including those with different numbers of decimal places.

Calculation Policy : SUBTRACTION

EYFS - Maths for young children should be meaningful. Where possible, concepts should be taught in the context of real life.

GUIDANCE/MODELS AND IMAGES	KEY VOCABULARLY
Children begin with mostly pictorial representations  Concrete apparatus is used to relate subtraction to taking away and counting how many objects are left. Concrete apparatus models the subtraction of 2 objects from a set of 5.  5 – 1 = 4 Construct number sentences verbally or using cards to go with practical activities. Children are encouraged to read number sentences aloud in different ways – “five subtract one leaves four” “four is equal to five subtract one” Solve simple problems using fingers:  Number tracks can be introduced to count back and to find one less: | 1 | 2 | 3 | 4 | 5 | 6 | What is 1 less than 9? 1 less than 20? Number lines can be used alongside number tracks and practical apparatus to solve subtraction calculations and word problems. Children count back under the number line. 8 – 3 = 5  **Children will need opportunities to look at and talk about different models and images as they move between respresentations.**	**Games and songs can be a useful way to begin using vocabulary involved in addition eg:** Five little men in a flying saucer take (away) leave how many are left/left over? how many have gone? one less, two less … ten less .. how many fewer is … than …? difference between is the same as

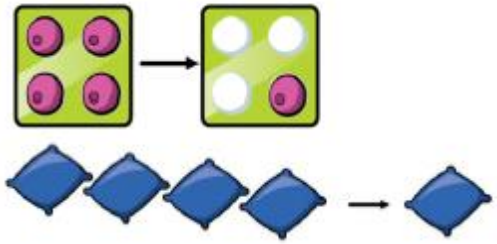
Calculation Policy : SUBTRACTION

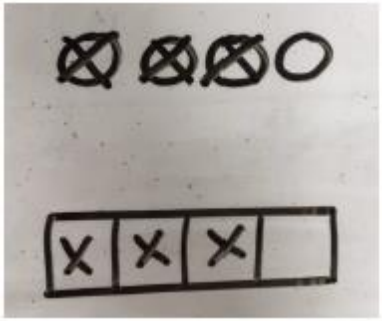
Key language: take away, less than, the difference, subtract, minus, fewer, decrease

Year 1

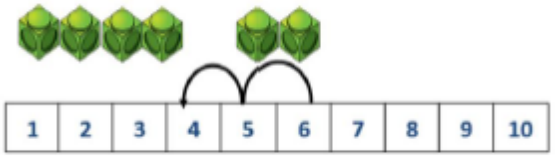
Understand subtraction as take away. Physically taking away and removing objects from a whole (tens frames, Numicon, cubes and other items)

4-3=1





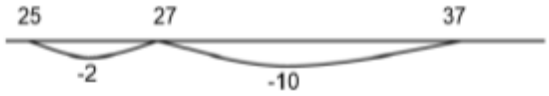
Counting back using number lines or number tracks.



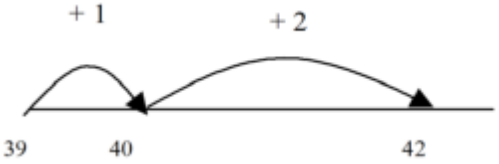
Year 2

Continue to use number lines to model take away and difference.

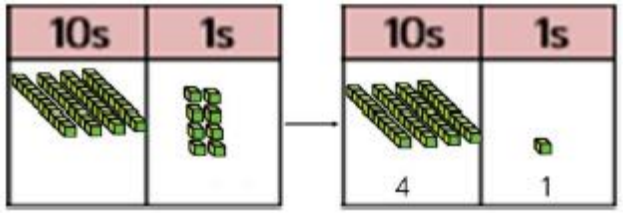
37- 12 = 25



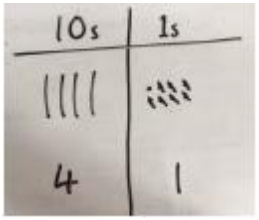
Finding the difference



48-7 = 41



Children cross through the ones to take away.

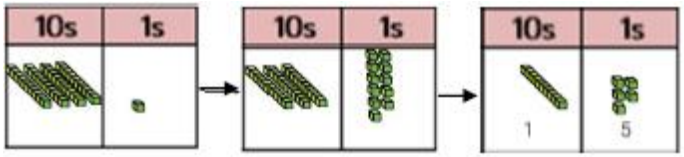


Year 3

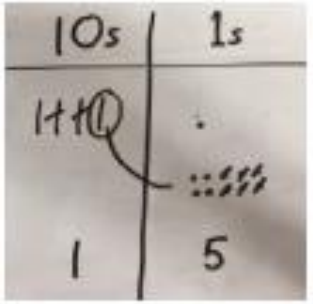
Subtracting numbers up to 3 digits.

Column method using base 10 and having to exchange

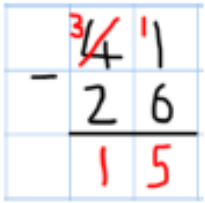
41-26.

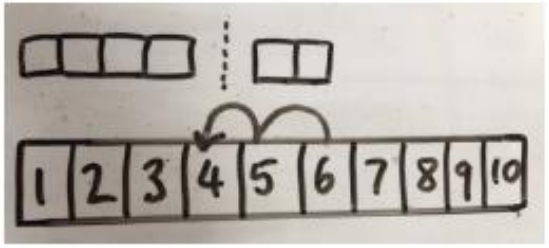


Move to pictorial representation showing the exchange.

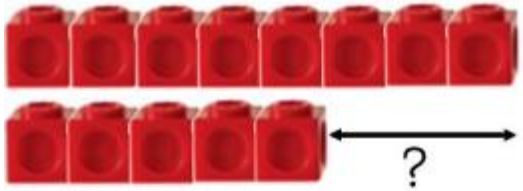


Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because 41 equals 30 + 11.

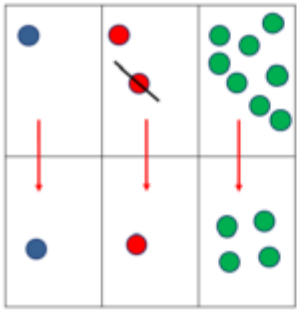
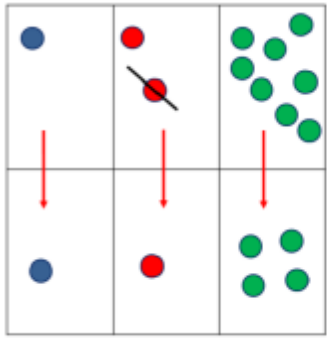
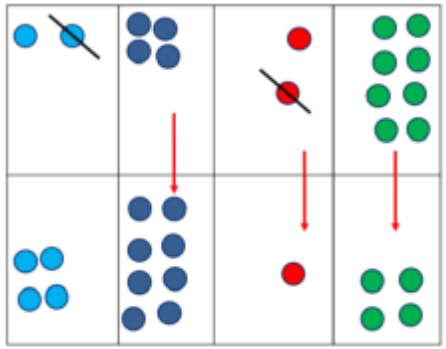




Calculate the difference between 8 and 5.



$$\begin{array}{r} {}^{2}\cancel{2}\,{}^{1}\cancel{3}4 \\ -\ 88 \\ \hline 6 \\ \hline \end{array}$$

Year 4	Year 5	Year 6
Written methods (progressing to 4 digits) Expanded column subtraction with decomposition, modelled with place value counters, progressing to calculations with 4 digit numbers.  200 ~~30~~ 20 ¹2 - 100 10 4 100 10 8 If understanding of the expanded method is secure, children will move on to the more formal method of decomposition.  2 ~~3~~ 1 2 - 1 1 4 1 1 8	Written methods (progressing to more than 4 digits). When understanding of the expanded method is secure, children will move on to the formal method of decomposition, which can be initially modelled with place value counters.  5 1 ~~2~~ 1 ~~3~~ 2 - 4 8 1 4 1 4 1 8 Progress to calculating with decimal, including those with different numbers of decimal places.	Written methods As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with decomposition to be secured. Continue calculating with decimals, including those with different numbers of decimal places.

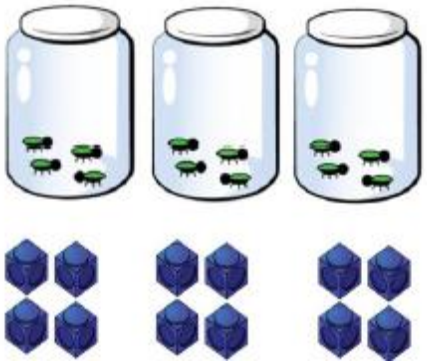
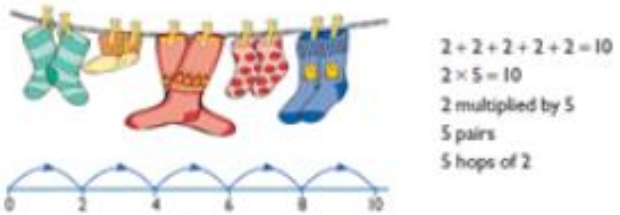
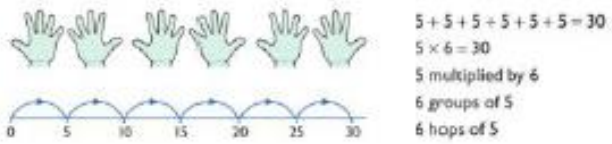
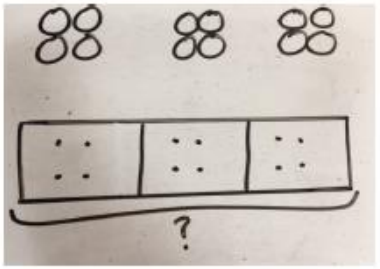
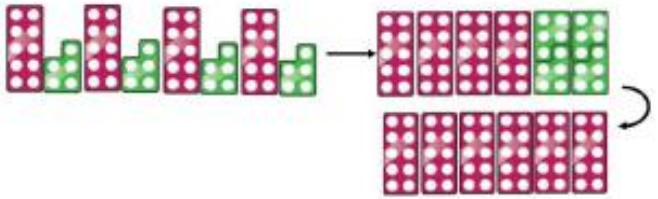
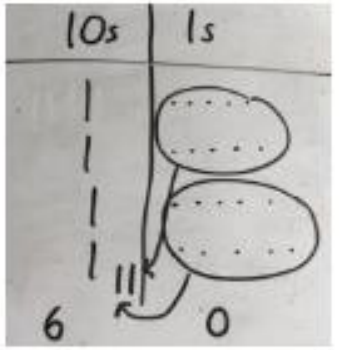
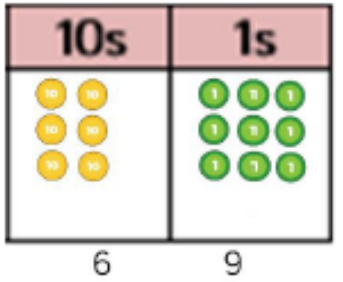
Calculation Policy : MULTIPLICATION

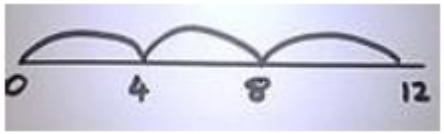
EYFS - Maths for young children should be meaningful. Where possible, concepts should be taught in the context of real life.

GUIDANCE/MODELS AND IMAGES	KEY VOCABULARLY
The link between addition and multiplication can be introduced through doubling. If available, NUMICON is used to visualise the repeated adding of the same number. These can then be drawn around or printed as a way of recording.  Children begin with mostly pictorial representations: X X X X X X X X X How many groups of 3 are there? Real life contexts and use of practical equipment to count in repeated groups of the same size:   How many wheels are there altogether? How much money do I have? Count in twos; fives, tens both aloud and with objects.  Children are given multiplication problems in a real life context. Children are encouraged to visualise the problem. How many fingers on two hands? How many sides of three triangles? How many legs of four ducks? **Children are encouraged to read number sentences aloud in different ways, "double 5 is …", "double 10 is equal to five multiplied by two".**	lots of groups of times multiply multiplied by multiple of once, twice, three times … ten times … times as (big, long, wide … and so on) repeated addition double

Calculation Policy : MULTIPLICATION

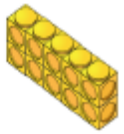
Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups

Year 1	Year 2	Year 3
Understand multiplication is doubling and combing groups of the same size. Using concrete objects to count e.g. Numicon, bundles of straws, pairs of socks, gloves with 5 fingers. There are 3 equal groups with 4 in each group.   2 + 2 + 2 + 2 + 2 = 10 2 × 5 = 10 2 multiplied by 5 5 pairs 5 hops of 2  5 + 5 + 5 + 5 + 5 + 5 = 30 5 × 6 = 30 5 multiplied by 6 6 groups of 5 6 hops of 5	Using concrete objects as in Year 1. Drawing arrays and writing repeated addition sentences as in Year 1. Children to use a pictorial representation using a bar model.  3 × 4 = 12 4 + 4 + 4 = 12 Number lines and Numicon to show repeated groups. 4 + 4 + 4   Abstract number line showing 3 jumps of 4.	Partition to multiply 15 x 4 = 60  Children to represent the concrete manipulatives pictorially.  Formal Column Method using place value counters or dienes. 23 x 3= 60 

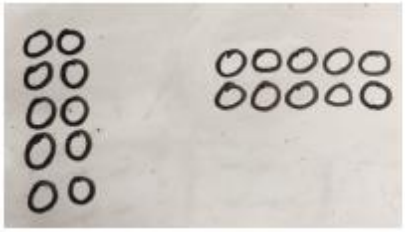


Using arrays

2 lots of 5



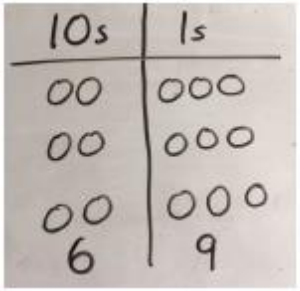
5 lots of 2



Using arrays to write a range of calculations.

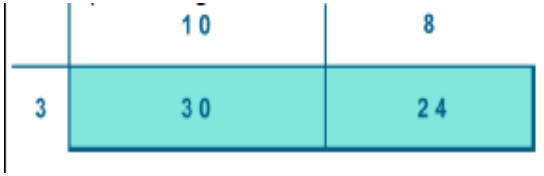
$10 = 2 \times 5$
$5 \times 2 = 10$
$2 + 2 + 2 + 2 + 2 = 10$
$10 = 5 + 5$

Progressing to a pictorial representation.
23 x 3



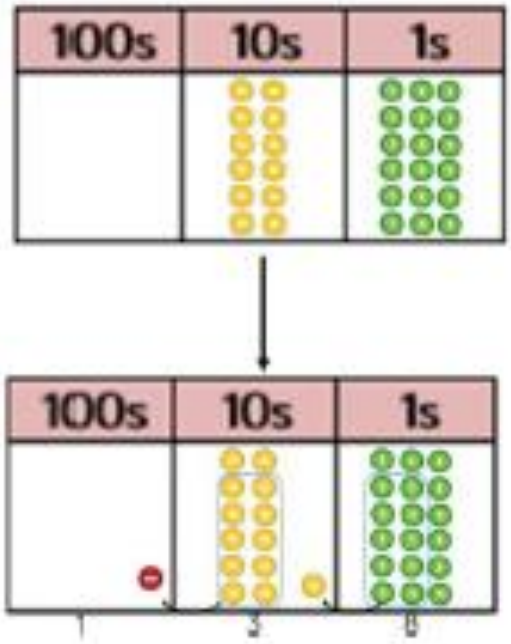
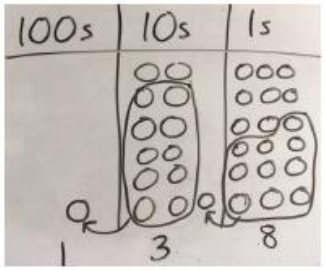
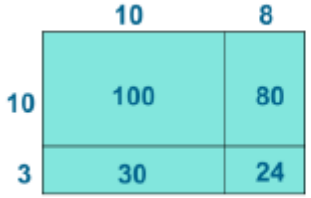
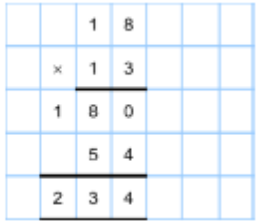
Children then record their work using the grid method.

18 x 3



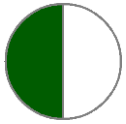
When the children are secure in this method they move onto formal written methods.

$$\begin{array}{r} 23 \\ \times\ 3 \\ \hline 69 \\ \hline \end{array}$$

Year 4	Year 5	Year 6
Written methods progressing to 3 digits by 2 digits. Children to embed and deepen their understanding of the grid method (see year 3). Use place value counters and pictorial representations before moving to the abstract. 6 x 23= 138   23 × 6 138 1 1	Written methods progressing to 4 digits by 2 digits. Use place value counters to support understanding of long multiplication. Continue to use the grid method to support an understanding of long multiplication.   	Written methods. Continue to refine and deepen understanding of written methods including fluency for using long multiplication. | X	1000	300	40	2
---	---	---	---	---
10	10000	3000	400	20
8	8000	2400	320	16	 2 3 1 1342 x 18 13420 10736 24156 1

Calculation Policy : DIVISION

EYFS - Maths for young children should be meaningful. Where possible, concepts should be taught in the context of real life.

GUIDANCE/MODELS AND IMAGES	KEY VOCABULARLY
The ELG states that children solve problems, including doubling, halving and sharing. Children need to see and hear representations of division as both grouping and sharing. Division can be introduced through halving.  Children begin with mostly pictorial representations linked to real life contexts: X X X X X X **Grouping model:** Mum had six socks. She grouped them into pairs – how many pairs did she make? **Sharing model:** I have 10 sweets. I want to share them with my friend. How many will we have each?  Children have a go at recording the calculation that has been carried out pictorially.	halve share, share equally one each, two each, three each … group in pairs, threes …, tens equal groups of divide divided by divided into left, left over

Calculation Policy : DIVISION

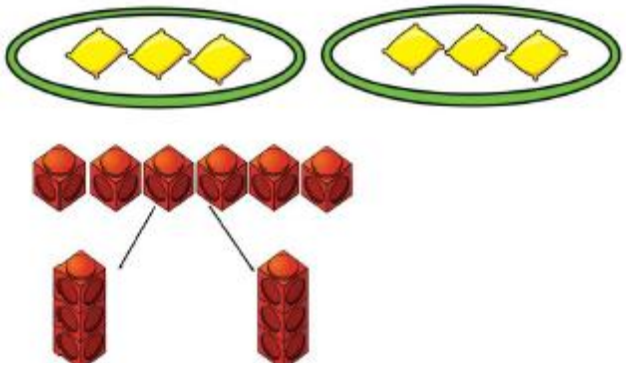
Key language: share, group, divide, divided by half

Year 1

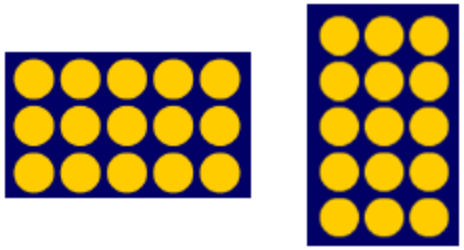
Children should be taught to share and group small quantities using concrete apparatus.

Sharing using a range of objects

6 ÷ 2 =



Grouping using arrays as a pictorial representation of division.



15 ÷ 3 = 5 There are 5 groups of 3.

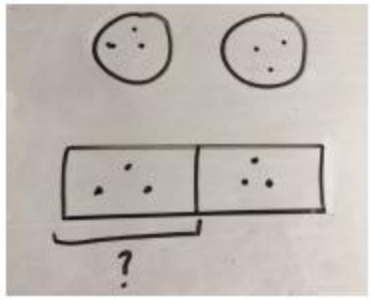
15 ÷ 5 = 3 There are 3 groups of 5.

Year 2

Continue to understand division by sharing using concrete apparatus.

Represent the sharing pictorially.

6 ÷ 2 = 3



8 ÷ 2 = 4

Abstract methods can be used when children have an understanding of pictorial representation.

6 ÷ 2 = 3

3	3

Children should also be encouraged to use their 2, 5 and 10 times table facts.

Year 3

Continue to use number lines and pictorial representations for grouping and sharing.

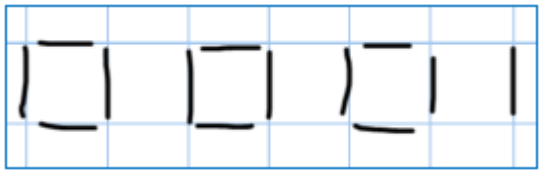
2 digits ÷ 1 digits using lollipop sticks.

13 ÷ 4

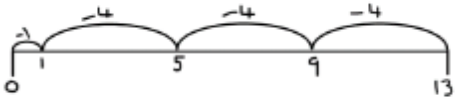
Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.

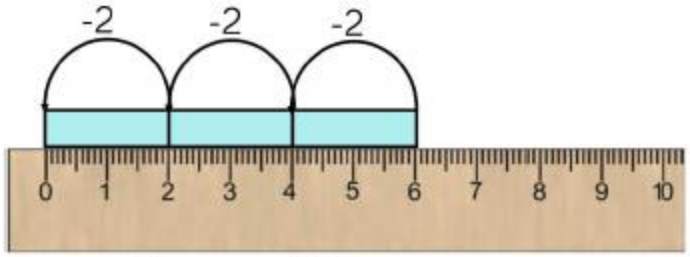
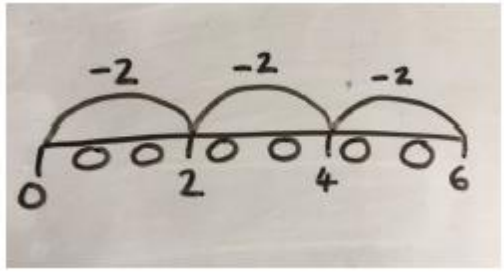
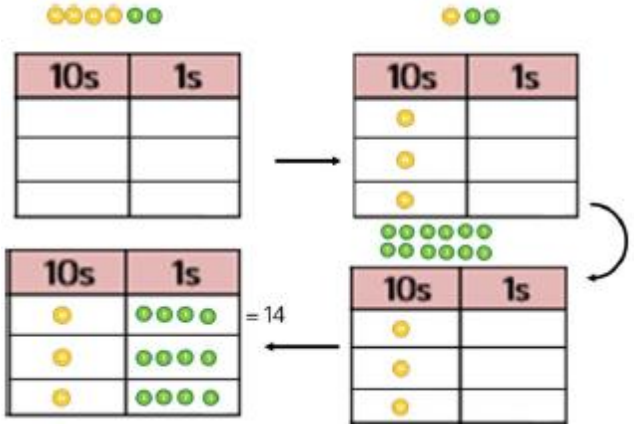
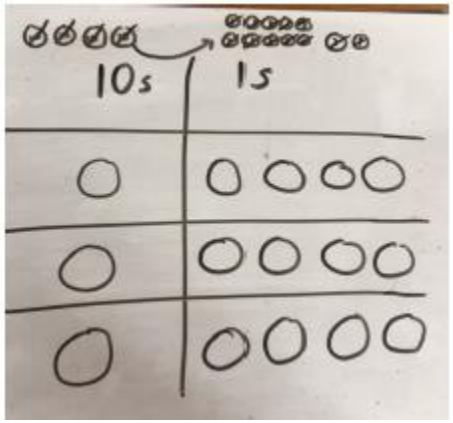
There are 3 wholes with 1 left over.

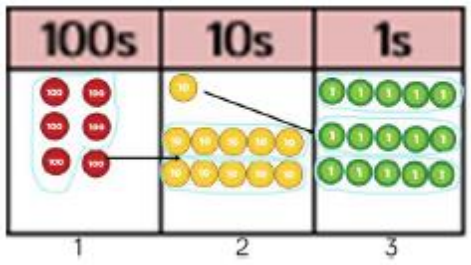
This can be represented pictorially.



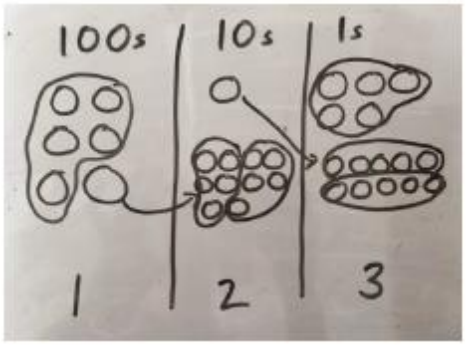
This could also be represented as repeated subtraction on a number line.



	Grouping using a number line. Repeated subtraction using a number line and Cuisenaire.  3 groups of 2 Pictorial representations 6 ÷ 3 = 2  Continue to use arrays to support understanding of how multiplication and division are inverse.	Sharing using place value counters 42 ÷ 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
Year 4	Year 5	
Short division using place value counters to group. 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 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?	Children will continue to explore division as sharing and grouping. Continue using formal methods for short division (see year 4). Children begin to practically develop their understanding of how to express the remainder as a decimal or a fraction.	

Represent the place value counters pictorially.



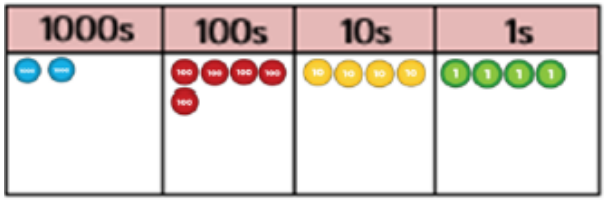
Children to do the calculation using the short division scaffold.

$$5\overline{)615}\quad 123$$

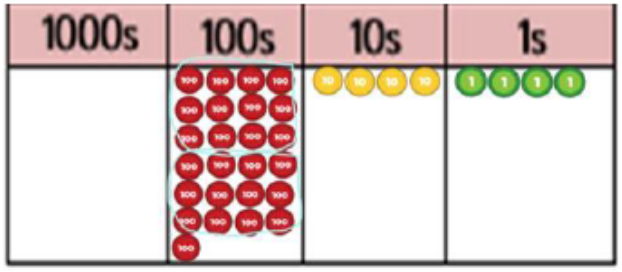
Year 6

Long division

2544 ÷ 12

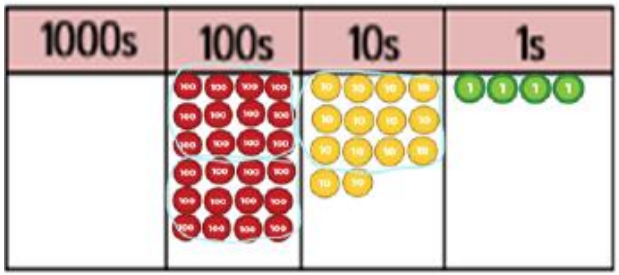


We can't group 2 thousands into groups of 12 so will exchange them.



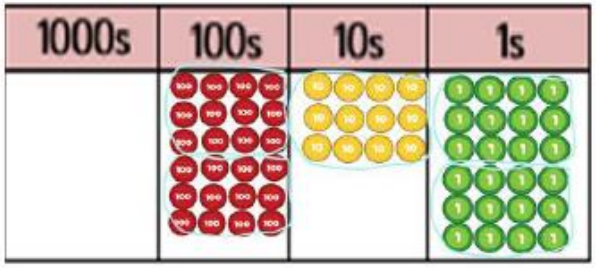
We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

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



After exchanging the hundred, we have 14 tens. We can group 12 tens into a group of 12, which leaves 2 tens.

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



After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

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

432 ÷ 15 becomes

$$\begin{array}{r} 28\ \text{r}\ 12 \\ 15\overline{)432} \\ 300 \\ \hline 132 \\ 120 \\ \hline 12 \end{array}$$

Answer: 28 remainder 12

432 ÷ 15 becomes

$$\begin{array}{rl} 28 & \\ 15\overline{)432} & \\ 300 & 15\times 20 \\ \hline 132 & \\ 120 & 15\times 8 \\ \hline 12 & \end{array}$$

$\frac{\cancel{12}}{\cancel{15}} = \frac{4}{5}$

Answer: $28\ \frac{4}{5}$

432 ÷ 15 becomes

$$\begin{array}{r} 28\cdot 8 \\ 15\overline{)432\cdot 0} \\ 30\downarrow \\ \hline 132\downarrow \\ 120\downarrow \\ \hline 120 \\ 120 \\ \hline 0 \end{array}$$

Answer: 28·8