Elmwood Infant & Nursery School

Calculation Policy

Article 29 'Education must develop every child's personality, talents and abilities to the full"

Article 28 'Every child has the right to an education'

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Date Policy agreed: March 2017

Date of next review: Spring 2020

Introduction

The 2014 National Curriculum for mathematics aims to ensure that all pupils:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

The aim of this policy is to ensure all children leave Elmwood Infants with a secure understanding of the four operations and can confidently use both written and mental calculation strategies in a range of contexts.

This policy states the required mental strategies and sets out the progression of written procedures that the children will use as they progress in their understanding of the four operations.

In order for children to develop a full understanding of the written procedures, they must first have a firm understanding of place value. It is expected that the majority of pupils will progress through the calculation stages as stated in this policy.

However, children **should not** be made to go onto the next stage if:

1. **They are not ready.**
2. **They are not confident.**

Children who do grasp concepts rapidly should be challenged through sophisticated and diverse problems, before being accelerated through new content.

Furthermore, it is essential that at each stage, children are making choices about whether to use a mental or written method.

Finally, it is essential that the strategies in this policy are being taught through mathematical problems and activities that are contextualised, relevant and rich in key mathematical vocabulary.

Mathematical Vocabulary

It is essential that the children are exposed to and supported in developing quality and varied mathematical vocabulary. This will support them in accessing mathematical problems, as well as presenting mathematical justification, argument or reasoning.

Therefore, it is staff's responsibility to facilitate mathematical discussion within lessons through modelling the use of this vocabulary and displaying it within their classrooms. Furthermore, visual and concrete resources should be used wherever possible to ensure the maths curriculum is accessible for all learners, especially EAL learners (see EAL policy).

Below is the list of vocabulary associated with each operation. Note that some pieces of vocabulary relate to various operations, so it is vital that the children become familiar with this vocabulary in appropriate contexts.

Addition and subtraction:	**Multiplication and division:**
add, addition, more, plus, increase, and, make, sum, total, altogether score, double, half, halve one more, two more, ten more etc… how many more to make… ? how many more is… than…? how much more is…?	lots of, groups of times, multiplication, multiply, multiplied by multiple of, product once, twice, three times etc… times as (big, long, wide, and so on) repeated addition array, row, column double, halve, share, share equally one each, two each, three each etc…
subtract, take (away), minus, decrease, leave how many are left/left over? how many have gone? one less, two less… ten less etc… how many fewer is… than…? difference between, leave is the same as, inverse	group in pairs, threes… tens equal groups of divide, division, divided by, divided into, divisible by, remainder, left, left over, factor, quotient, inverse

PROGRESSION THROUGH CALCULATIONS FOR ADDITION

MENTAL CALCULATIONS

Mental recall of number bonds

6 + 4 = 10 ☐ + 3 = 10
25 + 75 = 100 19 + ☐ = 20

Use near doubles

6 + 7 = double 6 + 1 = 13

Addition using partitioning and recombining

34 + 45 = (30 + 40) + (4 + 5) = 79

Counting on or back in repeated steps of 1, 10, 100, 1000

86 + 57 = 143 (by counting on in tens and then in ones)
460 - 300 = 160 (by counting back in hundreds)

Add the nearest multiple of 10, 100 and 1000 and adjust

24 + 19 = 24 + 20 – 1 = 43
458 + 71 = 458 + 70 + 1 = 529

Use the relationship between addition and subtraction

36 + 19 = 55 19 + 36 = 55
55 – 19 = 36 55 – 36 = 19

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

*CHILDREN SHOULD BE ENCOURAGED TO CONSIDER IF A MENTAL CALCULATION WOULD BE APPROPRIATE BEFORE USING WRITTEN METHODS.*THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

<u>Nursery</u>

Before addition can be introduced, children need to have a secure knowledge of number. In Nursery, children are introduced to the concept of counting, number order and number recognition through practical activities and games.

This is taught through child initiated games such as hide and seek and I spy. Children also learn how to count 1-1 (pointing to each object as they count) and that anything can be counted, for example, claps, steps and jumps.
This is reinforced by opportunities provided in the outdoor area for the children to count e.g. counting building blocks, twigs etc.

Introduction to addition:

Once children are secure in their number knowledge up to 10, children are introduced to the concept of more and less. Children learn how to distinguish the difference between sets of objects and when two groups are of the same size.

Adults model the initial addition vocabulary supported by age appropriate definition. An example of this is "this group has more, this group has less. Wow! These groups have the same. They are equal"

Children are taught all number objectives within the 30-50 month age band from the Development Matters curriculum. Children are then given opportunities to transfer adult taught skills during independent play. This is supported by the three characteristics of effective learning: playing and exploring, active learning, creating and thinking critically

Reception

Before addition can be introduced, children in Reception build on concepts taught in Nursery by working through the number objectives in the 40 – 60 month band of Development Matters. Children need to have a secure knowledge of number in order to begin addition.

Children are then introduced to the concept of addition through practical games and activities. Children act out addition sums to physically add two groups of objects together and use arm gestures to represent the signs + and =.
This is reinforced by opportunities provided in the outdoor area for the children to use addition e.g. adding together groups of building blocks, twigs etc.

Children build on their previous knowledge of 'more' by learning that adding two groups of objects together gives them a larger number (more objects).

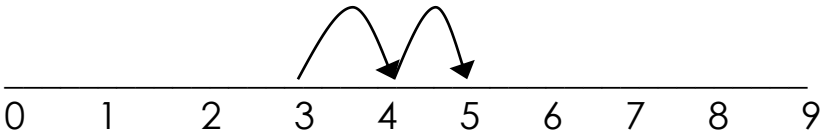
Adults model addition vocabulary supported by age appropriate definition. An example of this is "addition means we add two groups together / we put 2 lots of objects together. Equals means we find out how many we have got altogether. Wow! 3 add 2 equals 5! We have got 5 altogether".

Adults support children in recording their addition sums in the written form on whiteboards and in their maths books.

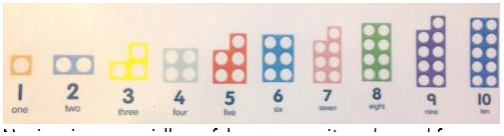
Number line:
When children are ready, they use a numberline and **practical resources** to support addition e.g. child orientated / chosen characters linked to topic (e.g. Superman, Ben 10, Cinderella, Minnie Mouse).

Teachers *demonstrate* the use of the numberline counting on in ones.

3 + 2 = 5 +1 +1



Numicon is an especially useful resource as it can be used for teaching all four operations as well as fractions, decimals, percentages and a range of other aspects of maths. Each piece represents an integer from 1 to 10. The children love using it as it is colourful and tactile

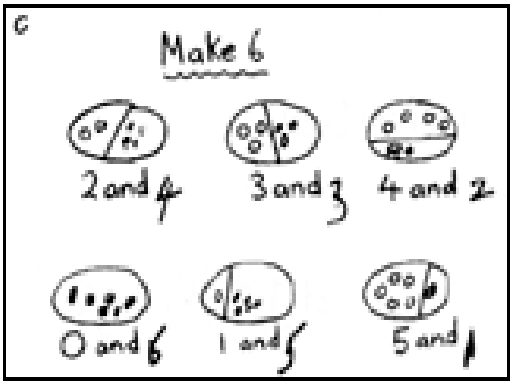


Children are taught all number objectives within the 40-60 month age band (including ELG) from the Development Matters curriculum. Children are then given opportunities to transfer adult taught skills during independent play. This is supported by the three characteristics of effective learning: playing and exploring, active learning, creating and thinking critically

Year 1

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.

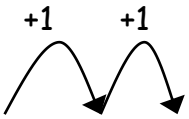
They should be encouraged to add through practical activities in meaningful contexts including using the outdoor area, as well as counting on using fingers.

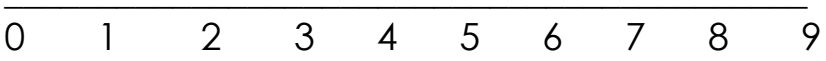


They use numberlines and **practical resources** to support calculation e.g. cubes, Numicon, Dienes, counters, beads etc.

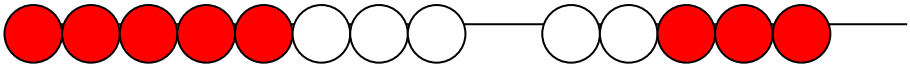
Teachers *demonstrate* the use of the numberline counting on in ones.

3 + 2 = 5





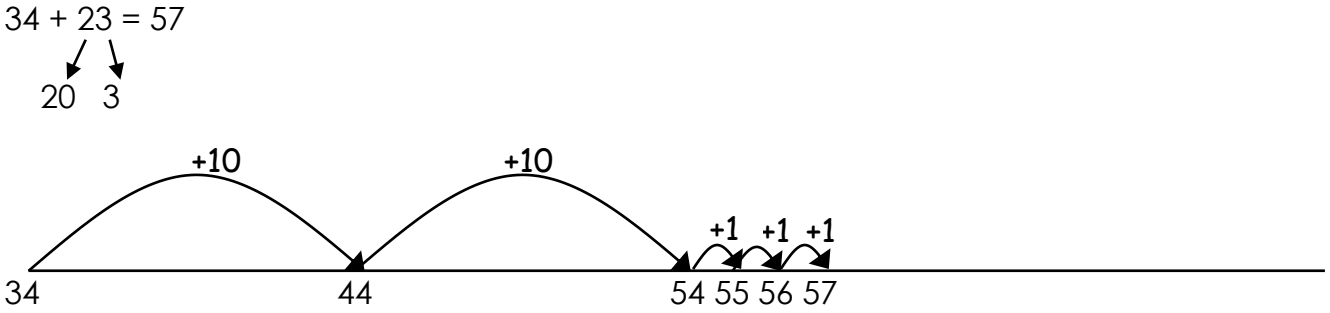
Bridging: Bead strings or Dienes can be used to illustrate addition including bridging through ten by counting on 2 then counting on 3.



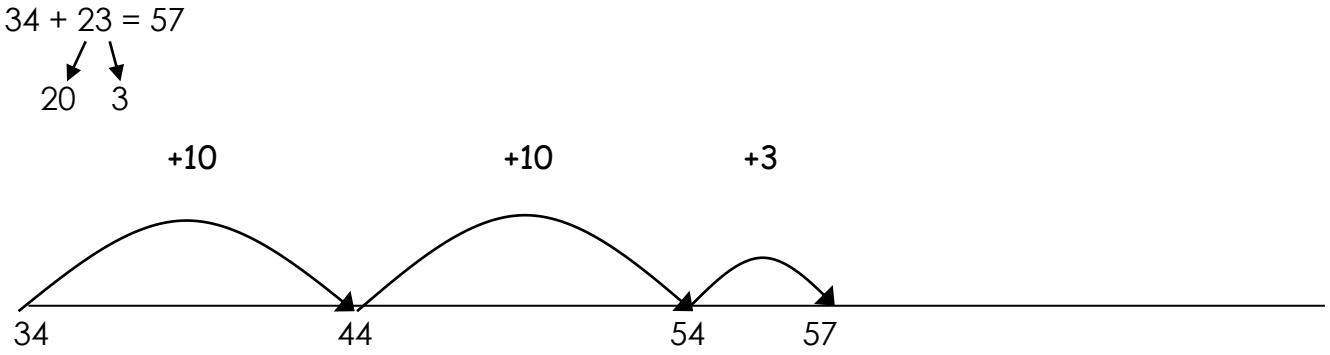
Year 2

Children will begin to use 'empty number lines' themselves. Firstly partitioning the smaller number and then counting on from the larger number.

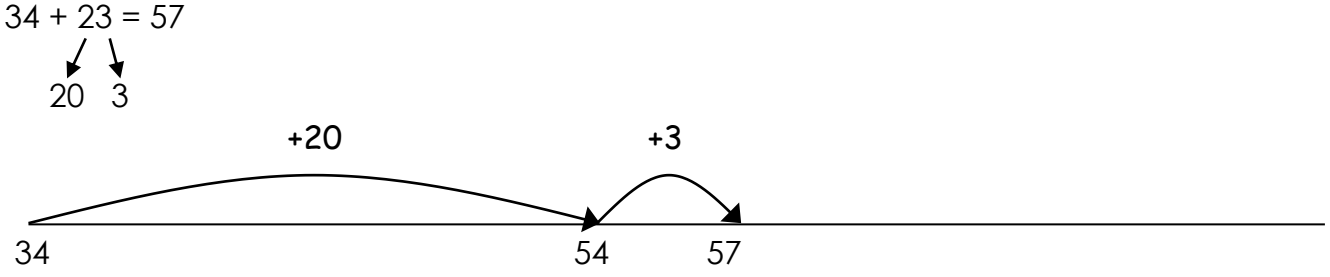
First counting on in tens and then ones.



Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

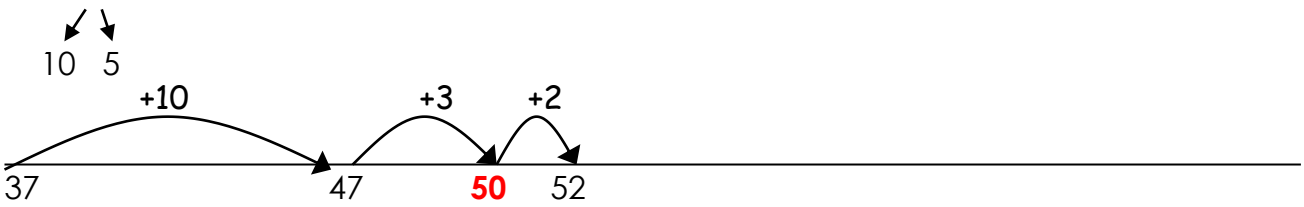


Followed by adding the tens in one jump and the units in one jump.



Bridging:
Bridging through the next ten can help children become more efficient.

37 + 15 = 52



Column Method
The column method is not statutory but it is taught alongside other strategies for addition in year 2

56
+45

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

MENTAL CALCULATIONS

Mental recall of addition and subtraction facts

10 – 6 = 4	17 - ☐ = 11
20 - 17 = 3	10 - ☐ = 2

Find a small difference by counting on
82 – 79 = 3

Counting on or back in repeated steps of 1, 10, 100,
86 - 52 = 34 (by counting on/back in tens and then in ones)
460 - 300 = 160 (by counting on/back in hundreds)

Subtract the nearest multiple of 10, 100 and adjust
24 - 19 = 24 - 20 + 1 = 5
458 - 71 = 458 - 70 - 1 = 387

Use the inverse relationship between addition and subtraction

36 + 19 = 55	19 + 36 = 55
55 – 19 = 36	55 – 36 = 19

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.
CHILDREN SHOULD BE ENCOURAGED TO CONSIDER IF A MENTAL CALCULATION WOULD BE APPROPRIATE BEFORE USING WRITTEN METHODS.

THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

Nursery

Before subtraction can be introduced, children need to have a secure knowledge of number.

In Nursery, children are introduced to the concept of counting backwards. This is taught through child initiated games indoors and outdoors such as acting out counting songs and running races (children shouting "5,4,3,2,1,0 - GO!").

Introduction to subtraction:

Once children are secure in their number knowledge up to 10, children are introduced to the concept of less and subtracting by counting backwards. Children learn how to take 1 object away through singing songs such as '5 little monkeys'. Children use their fingers to represent how many monkey's left with adults modelling how to 'subtract' one finger / monkey away each time.

Adults model the initial subtraction vocabulary supported by age appropriate definition. An example of this is "subtract / take away, we have one less monkey, OH NO! One monkey has gone away!"

Children are taught all number objectives within the 30-50 month age band from the Development Matters curriculum. Children are then given opportunities to transfer adult taught skills during independent play. This is supported by the three characteristics of effective learning: playing and exploring, active learning, creating and thinking critically

Reception

Before subtraction can be introduced, children in Reception build on concepts taught in Nursery by working through the number objectives in the 40 – 60 month band of Development Matters. Children need to have a secure knowledge of number in order to begin subtraction.

Children are then introduced to the concept of subtraction through practical games and activities. Children act out subtractions to physically subtract a number of objects from a group. Children use arm gestures to represent the signs - and =.
This is reinforced by opportunities provided in the outdoor area for the children to count e.g. counting building blocks, twigs etc.

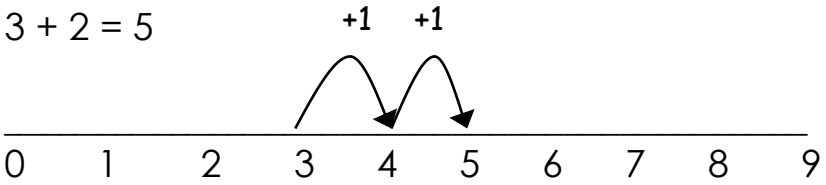
Children build on their previous knowledge of 'less' by learning that subtracting means taking away a certain number of objects from a group (leaving them with less objects).

Adults model subtraction vocabulary supported by age appropriate definition. An example of this is "subtraction means we take away objects from a group / we have

got less objects now. Equals means we find out how many we have got left. Wow! We have only got 3 left!"
Adults support children in recording their subtractions in the written form on whiteboards and in their maths books.

Number line:
When children are ready, they use a numberline and **practical resources** to support subtraction by counting back e.g. child orientated / chosen characters linked to topic (e.g. Superman, Ben 10, Cinderella, Minnie Mouse).

Teachers *demonstrate* the use of the numberline counting back in ones.



Children are taught all number objectives within the 40-60 month age band (including ELG) from the Development Matters curriculum. Children are then given opportunities to transfer adult taught skills during independent play. This is supported by the three characteristics of effective learning: playing and exploring, active learning, creating and thinking critically

Year 1

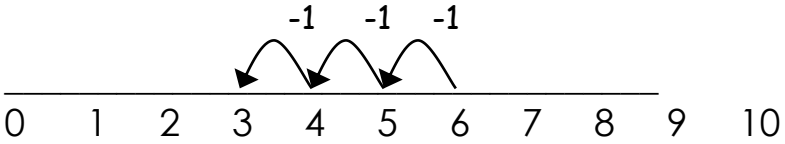
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.

They should be encouraged to subtract through practical activities in meaningful contexts including the outdoor area, as well as counting on using fingers.

Children use numberlines and **practical resources** to support calculation e.g. cubes, Numicon, Dienes, counters, beads etc.

Teachers *demonstrate* the use of the numberline counting back in ones.

6 – 3 = 3

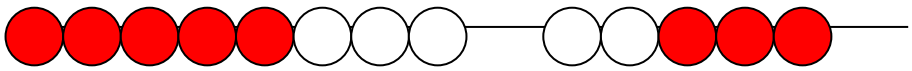


The numberline should also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.

Bridging:

Bead strings or Dienes can be used to illustrate subtraction, including bridging through ten by counting back 3 then counting back 2.

13 – 5 = 8



Year 2

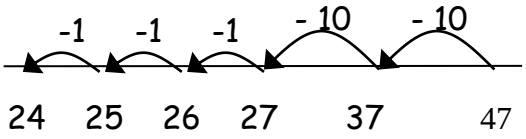
Children will begin to use empty number lines to support calculations.

Counting back - Firstly partitioning the smaller number and then counting back from the larger number.

First counting back in tens and ones.

47 - 23 = 24

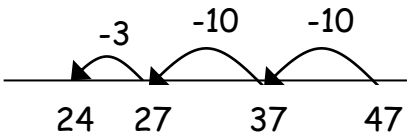
20 3



Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 - 23 = 24

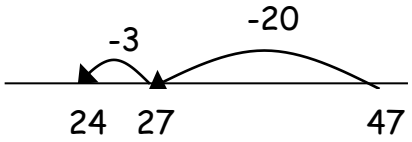
20 3



If ready, followed by subtracting the tens in one jump and the units in one jump.

47 - 23 = 24

20 3

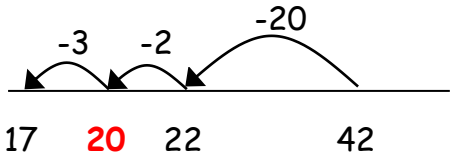


Bridging:

Bridging through ten can help children become more efficient.

42 - 25 = 17

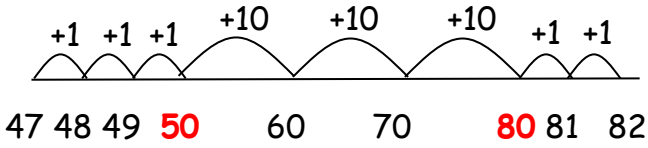
20 5



Counting on: Firstly in jumps of 10 and 1

If the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on.

82 – 47 = 35



Help children to become more efficient with counting on by:

- ✓ Subtracting the units in one jump;
- ✓ Subtracting the tens in one jump and the units in one jump;
- ✓ Bridging through ten.
- ✓ Practising finding change

Column Method

The column method is not statutory but it is taught alongside other subtraction strategies.

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION
MENTAL CALCULATIONS

Doubling and halving
Applying the knowledge of doubles and halves to known facts.
e.g. 8 x 4 is double 4 x 4

Using multiplication facts

Tables should be taught every day from Y1 onwards.

Year 1	1 times table 2 times table 10 times table	**Year 2**	3 times table 4 times table 5 times table

Using and applying division facts
Children should be able to utilise their tables knowledge to derive other facts.
e.g. If I know 3 x 7 = 21, what else do I know?
30 x 7 = 210,
□ x 7 = 21 300 x △ = 2100

Use closely related facts already known
13 x 11 = (13 x 10) + (13 x 1)
= 130 + 13
= 143

Multiplying by 10 or 100
Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.
Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

Partitioning
23 x 4 = (20 x 4) + (3 x 4)
= 80 + 12
= 102

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THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE

Nursery and Reception

By the end of Reception, children are expected to understand the concept of doubling and to be able to double a number up to 10. Before doubling can be introduced, children need to have a secure knowledge of counting, number facts and addition in order to double.

Children are then introduced to the concept of doubling through practical games and activities, including the use of the outdoor areas. Children act out 'doubling' by physically add two equal groups together to find out the 'doubles' answer.

What is double 2?

Double 2 equals 4

\+ =

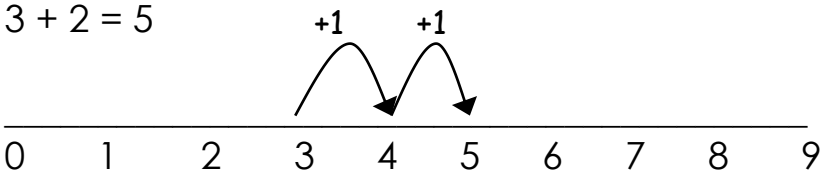
Children build on their previous knowledge of 'addition' by learning that doubling is when you add two equal amounts together.

Adults model doubling and initial multiplication vocabulary supported by age appropriate definition. An example of this is "double 2 is 4! Wow – that means that 2 add 2 equals 4, 2 times 2 equals 4".
Adults support children in recording their doubling sums in the written form on whiteboards and in their maths books.

Number line:
When children are ready, they use a numberline and **practical resources** to support doubling e.g. child orientated / chosen characters linked to topic (e.g. Superman, Ben 10, Cinderella, Minnie Mouse).

Teachers *demonstrate* the use of the numberline counting on in ones to find the answer to their doubles problem / question.

3 + 2 = 5



Children are then given opportunities to transfer adult taught skills during independent play. This is supported by the three characteristics of effective learning: playing and exploring, active learning, creating and thinking critically.

Years 1 and 2

As with Nursery and Reception, children will experience equal groups of objects and will count in 2s, 10s and 5s.

They will work on practical problem solving activities using practical resources, involving equal sets or groups.

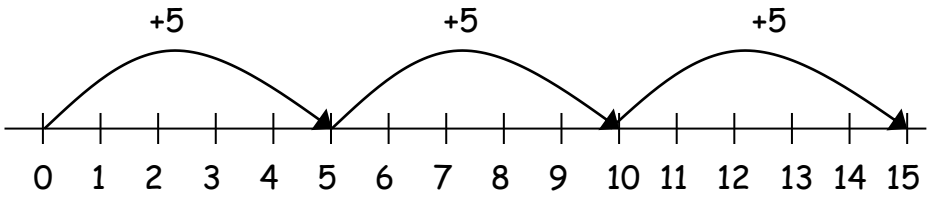
Following this, children will develop their understanding of multiplication and use jottings to support calculation:

Repeated addition:

3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 5 x 3

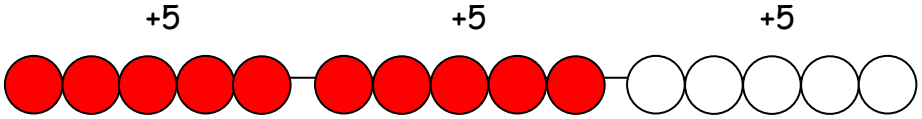
Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5



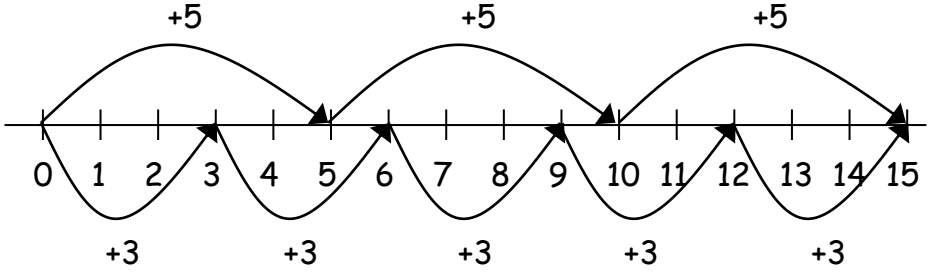
and on a bead bar:

5 x 3 = 5 + 5 + 5



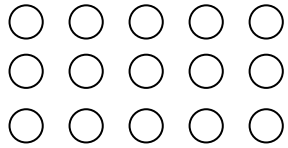
Commutativity:

Children should know that 3 x 5 has the same answer as 5 x 3. This can also be shown on the number line.



Arrays:

With support, children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



5 x 3 = 15

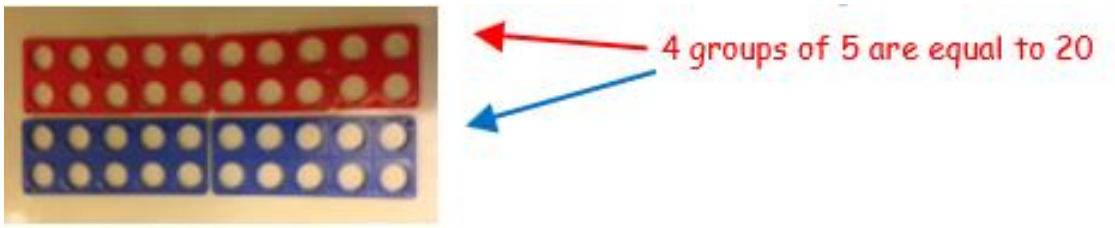
3 x 5 = 15

Doubling:

Children should begin to understand the term doubling and be able to double amounts of objects and up to 2 digit numbers by using number lines, objects and partitioning if ready.

12 x 2 = 24
↓ ↘
20 + 4

Numicon



PROGRESSION THROUGH CALCULATIONS FOR DIVISION

MENTAL CALCULATIONS

Doubling and halving
Knowing that halving is dividing by 2

Deriving and recalling division facts

Tables should be taught every day and used to derive division facts from Y1 onwards.

Year 1	1 times table 2 times table 10 times table	**Year 2**	3 times table 4 times table 5 times table

Using and applying division facts

Children should be able to utilise their tables knowledge to derive other facts.

E.g. If I know 3 x 7 = 21, what else do I know?

30 x 7 = 210, 300 x 7 = 2100,

□ ÷ 2 = 4 80 ÷ △ = 40 □ ÷ △ = 40

Dividing by 10 or 100

Knowing that the effect of dividing by 10 is a shift in the digits one place to the right.
Knowing that the effect of dividing by 100 is a shift in the digits two places to the right.

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

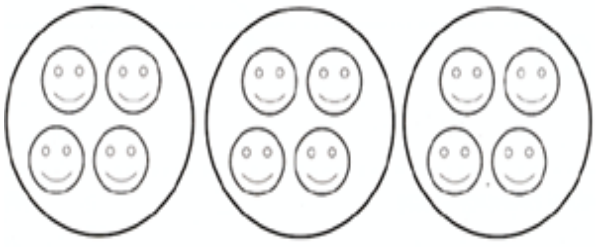
CHILDREN SHOULD BE ENCOURAGED TO CONSIDER IF A MENTAL CALCULATION WOULD BE APPROPRIATE BEFORE USING WRITTEN METHODS.

THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

Nursery and Reception

By the end of Reception, children are expected to understand the concept of halving and sharing. Before this can be introduced, children need to have a secure knowledge of counting backwards, number facts and subtraction in order to halve and share.

Children are then introduced to the concept of halving and sharing through practical games and activities. They act out 'halving and sharing' through activities such as sharing food for their Teddy Bear's Picnic, sharing resources equally to play a game. This is reinforced by opportunities provided in the outdoor area for the children to halve and share out objects such as building blocks, twigs etc.



Children build on their previous knowledge of 'subtraction' by learning that halving and sharing is when you divide an amount into equal groups.

Adults model halving, sharing and initial division vocabulary supported by age appropriate definition. An example of this is "one for you, one for me…! How many

have you got? (Adults to model counting to check) Yay! We have got the same. You have got 3 cakes and I have got 3 cakes".

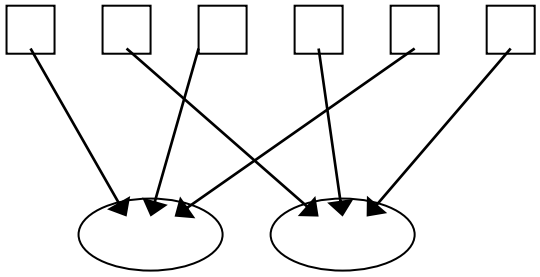
Adults support children in recording their halving and sharing activities in the written form on whiteboards and in their maths books.

Children are then given opportunities to transfer adult taught skills during independent play. This is supported by the three characteristics of effective learning: playing and exploring, active learning, creating and thinking critically.

Years 1 and 2

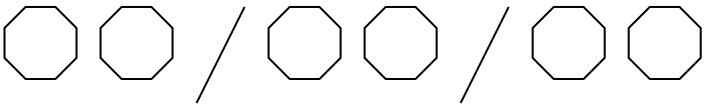
Children will continue to understand equal groups and share **practical items** out in play and problem solving. They will count in 2s, 10s and 5s.
Following this, children will develop their understanding of division and use jottings to support calculation.
Sharing equally:

6 sweets shared between 2 people, how many do they each get?



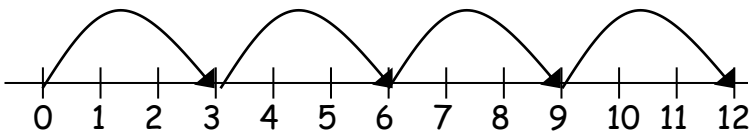
Grouping or repeated addition:

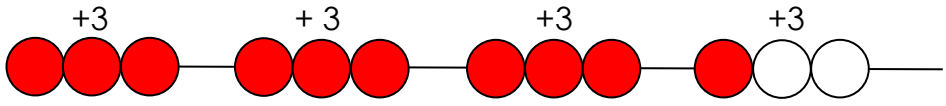
There are 6 sweets, how many people can have 2 sweets each?



Repeated addition using a number line or bead bar:

12 ÷ 3 = 4





The bead bar will help children with interpreting division calculations such as 10 ÷ 5 as 'how many 5s make 10? Remainders will be introduced in term 3 of year 2

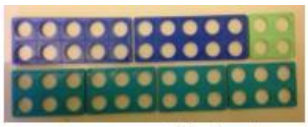
Halving:

Children should begin to understand the term halving and be able to halve amounts of objects and up to 2 digit numbers by using number lines, objects and partitioning if ready.

12 ÷ 2 = 6

↓ ↘

5 + 1



24 divided into groups (chunks) of 6
There are 4 groups of 6 in 24

3. Use dots/pictures and circles on paper *e.g. 24÷6 =4*