Norwich Road Academy

Calculation Policy

Date of policy	March 2024
Member of staff responsible	E. HIlder
Review Date	March 2026

Intent

At Norwich Road Academy, we understand that Mathematics is an essential life skill. We feel that it is fundamental for children to be able to move from conceptual learning to abstract learning, in order to be able to successfully understand, use and apply their Mathematical skills. Therefore, we believe that Fluency, Reasoning and Problem solving go together and as such are taught together. The calculations we will use will reflect this intent, moving from Concrete to Pictorial to Abstract recording (CPA), leading to more formal written methods. Mental calculation strategies will be taught in partnership with written methods.

The calculation policy sets out the expectations of the strategies taught throughout Norwich Road Academy and is to be followed by all teachers and teaching assistants at our school. These strategies will be modelled by teachers and teaching assistants in lessons and supported by the use of the ‘Concrete, Pictorial, Abstract’ process. Examples of models and representations to support the calculation policy can be found in the White Rose guidance. The calculation policy will be shared with parents in order that they can support their children appropriately. This consistent approach to calculations following the use of the policy will enable pupils to make swift progress in mathematics.

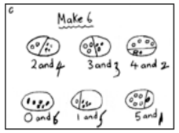
Addition

Stage 1

It is at this stage that children need to develop their understanding of = as 'the same as' and understand its movable position in calculations (i.e. 5=2+3; 2+3=5; 3+2=1+4).

Combing two groups

e.g. 3+2=
Count out 3, count out 2
Put together and count out 5.



Counting on

As above, but children are encouraged to hold one number in their head and count on the other number to be added.

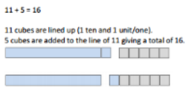
Marked number line

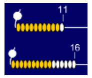
Count along in jumps (of one, progressing to greater jumps) on number line to add.

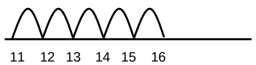
Stage 2

Empty number line

Children are counting on in jumps from the starting number to add on. They are encouraged to take bigger jumps and partition the number they are adding. **To be taught alongside various concrete representations and pictorial models.** *When adding 2-digit numbers, to support transition into next methods, always start by adding on the smallest place value digits.*







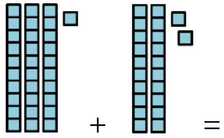
All children should be confident and competent in using the empty number line for addition at the end of Key Stage 1. Ideally, to ensure progression through Key Stage 2, children will have been introduced to partitioning with the expanded column method by the end of Year 2 also.

Stage 3

Partitioning

Children continue to use concrete representations to support calculations, particularly <u>Base 10 equipment</u>.

31 + 22 =



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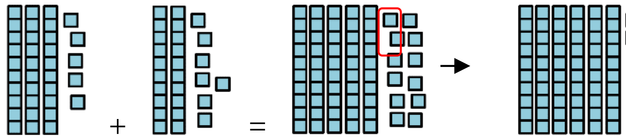
When the units total more than 10, children should be encouraged to **exchange**.

35 + 27 =



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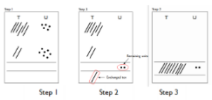
Where appropriate, children should be encouraged to record their addition of tens and ones vertically in preparation for the expanded column method. This can begin in Year 2 for those that have demonstrated sufficient conceptual understanding.

Stage 4

Please use your professional judgment – if children are not ready for this concept it should not be introduced; embed knowledge of addition and place value securely before introducing these methods.

Expanded Column Method

$$\begin{array}{r} 65 \\ +27 \\ \hline \end{array} \qquad \begin{array}{rr} 60 & 5 \\ +20 & 7 \\ \hline \end{array}$$



Stage 5

Formal Written Algorithms

Children should initially be taught the long column method to ensure the concept of 'exchanging' is clear and understood before conceptual methods are introduced.

$$\begin{array}{cccc} & H & T & O \\ & 2 & 6 & 3 \\ + & 2 & 4 & 5 \\ \hline & & & 8 \\ & 1 & 0 & 0 \\ + & 4 & 0 & 0 \\ \hline & 5 & 0 & 8 \\ \hline \end{array} \qquad \begin{array}{cccc} & H & T & O \\ & {}^{1}2 & 6 & 3 \\ + & 2 & 4 & 5 \\ \hline & 5 & 0 & 8 \\ \hline \end{array} \qquad \begin{array}{ccccc} & {}^{1}3 & . & {}^{1}5 & 6 \\ + & 2 & . & 4 & 7 \\ \hline & 6 & . & 0 & 3 \\ \hline \end{array} \qquad \begin{array}{ccccccc} & 4 & 0 & {}^{1}1 & . & 2 & 0 \\ & & 2 & 6 & . & 8 & 5 \\ + & & & 0 & . & 7 & 1 \\ \hline & 4 & 2 & 8 & . & 7 & 6 \\ \hline \end{array}$$

Though this is a quick and efficient method to use, it is a method that many pupils are not competent with until the later stages of primary school.

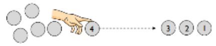
All children should be confident and competent in using formal written algorithms for addition at the end of Key Stage 2.

Subtraction

Stage 1

Take away
Use practical apparatus and pictorial representations to physically take away and count objects that remain.

Counting back
- Use practical apparatus (as above) but count back as the number to be subtracted is removed.



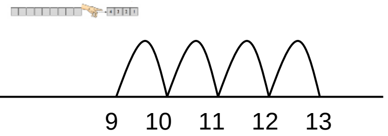
- Make the bigger number/hold it in their head and count back the smaller number

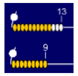
Marked Number Line
Count along in jumps (of one, progressing to greater jumps) on number line to add

Stage 2

Methods for subtraction mirror many of the addition methods. It is here that it becomes vital that is embedded in the children to <u>think and talk about</u> what the question/calculation/problem is asking to determine their use of the number and the 'direction' of the jumps they take.

Empty Number Line
Children are counting back from the number they are subtracting from to **find the difference** between the two numbers. They are encouraged to take bigger jumps and partition the number they are subtracting.



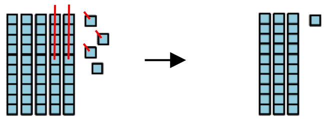


To be taught alongside various concrete representations and pictorial models.

All children should be confident and competent in using the empty number line for subtraction at the end of Key Stage 1.

Stage 3

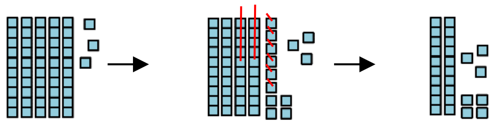
Partitioning
Chn continue to use concrete representations to support calculation. They continue to **find the difference** in their calculations.



54 - 23 = 31

When the amount of ones to be subtracted is greater than the ones subtracting from, an **exchange** is required.

e.g 53-26

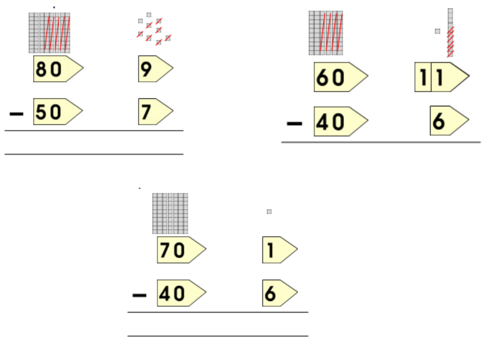


1 ten is exchanged for 10 ones

Stage 4

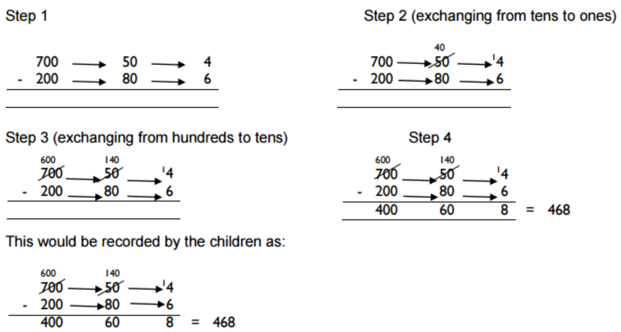
Pupils need to have a secure understanding of place value and subtraction before being introduced to this method.

Expanded Column Method
Chn continue to use concrete representations to support caluclaiton, particularly <u>place value arrow cards</u> and <u>base 10 equipment.</u>



Stage 5

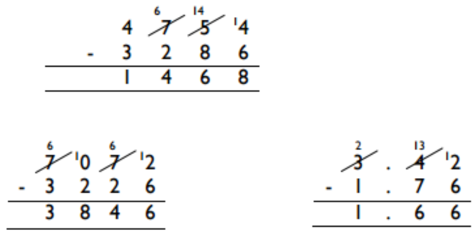
Expanded Column Method
Chn continue to use concrete representations to support calculation, particularly <u>place value arrow cards</u> and <u>base 10 equipment.</u>



When children are ready, this leads on to the compact method of decomposition:

Stage 6

Formal Written Algorithm – Decomposition
'The Column Method'
This is a method that many pupils tend to struggle with and should **only** be introduced when **fully competent** at stages 1-4. This method should only be introduced alongside concrete and pictorial representations of the concept (eg. Dienes and numicon) to ensure conceptual understanding and to highlight links with previous stages.

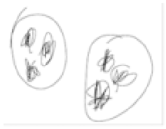


Multiplication

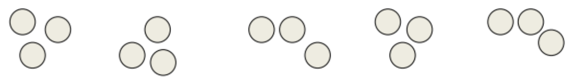
Stage 1

Repeated Addition
Children understand multiplication as repeated addition. Children understand multiplication as *lots of* (eg. 3x4=3 lots of 4)

Children should explore repeated addition using concrete and pictorial representations.



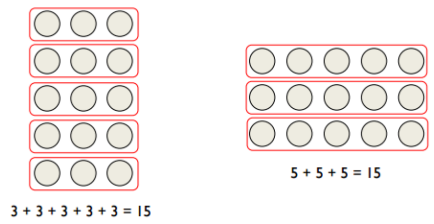
A child's jotting showing double three as three cookies on each plate.



Stage 2

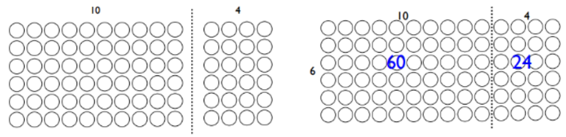
Arrays
Repeated addition is displayed as **arrays**. This should be related to arrays in real life (baking trays, egg boxes, ice cube trays etc). The introduction of arrays is key for allowing children to investigate the **commutative** property of multiplication.

<u>Example: 5x3</u>
5x3=5 lots of 3 - Pupils draw/create 5 rows of 3 dots.



Stage 3

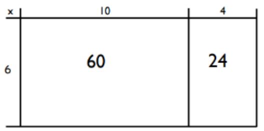
Partitioned arrays
The array can be partitioned into other, smaller arrays, highlighting that the number of counters is unchanged and allowing children to use their knowledge of times tables to support calculation (i.e. fluency)



This array has been split into 10 columns of 6 and 4 columns of 6. This helps pupils count up the dots but starts them thinking about 10 x 8 and 2 x 8.
To deepen understanding, children need to experience splitting this into different sizes (e.g. 5x6, 5x6, 4x6; 6x6, 6x6, 2x6; 10x3, 4x3, 10x3, 4x3).

Stage 4

Grid Method
Leading on from arrays. The two stages **must** be linked.
6 x 14 =



To deepen understanding, children need to split this into different sizes (e.g. 5x6, 5x6, 4x6; 6x6, 6x6, 2x6).

24 x 13

x	10	3
20	200	60
4	40	12

	$^{1}2$	0	0
		6	0
		4	0
+		1	2
	3	1	2

Stage 5

Expanded Short Multiplication
When ready, children are introduced to the expanded column method for multiplication which prepares them for the short column method and highlights links between methods.

23 x 8

```
  23
X  8
  24(3x8)
 160(20x8)
 184
```

346 x 9

```
  346
X   9
   54 (6x9)
  360 (40x9)
 2700 (300x9)
 31 14
 11
```

Stage 6

Short Multiplication
Once conceptually confident and competent with the expanded column method, children can be moved onto the compact formal method of short multiplication. Children use this method to multiply up to 4-digits but 1-digit.

2741 x 6 =

		$^{4}2$	$^{2}7$	4	1
x					6
	1	6	4	4	6

answer = 16,446

24 x 16 =

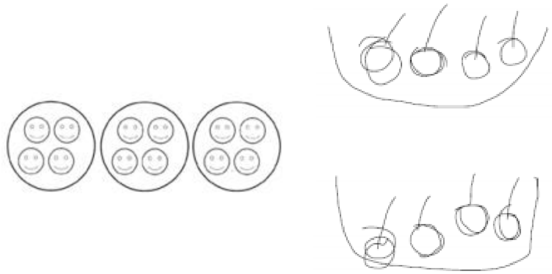
		$^{2}2$	4
x		1	6
	1	4	4
+	2	4	0
	3	8	4

answer = 384

Division

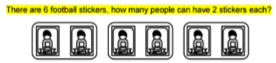
Stage 1

Sharing equally
Working at a practical level to gain experience of sharing and to become familiar with the appropriate language and mathematical symbols (÷)



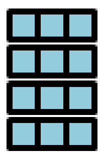
Stage 2

Grouping
Developing understanding of division as 'how many groups of x in y?'

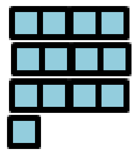


Chn continue to use concrete and pictorial representations to support their understanding. They see 12÷3, for example, as 'how many groups of 3 in 12?'.

12 ÷ 3 =

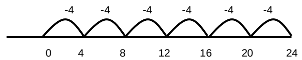


13 ÷ 4

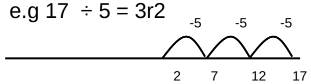


Stage 3

Repeated subtraction
Links should be highlighted between 'grouping' and repeatedly subtracting the same number.
e.g. 24 ÷ 4 = 6



Jumps should be recorded on an empty number line and the number of jumps shows how many *x* in *y*. Where children cannot get to 0, this is the remainder. Use of representation will support understanding of this.
e.g 17 ÷ 5 = 3r2

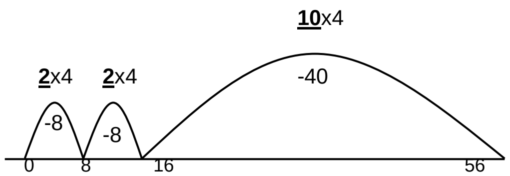


Here, children are introduced to division calculations that result in remainders. This should be used in context to ensure children are learnin whether remainders should be rounded up ro down.
EG: *I have 62p. Sweets are 8p each. How many can I buy? (7 – the remainining 6p is not enough for another sweet)*
Apples are packed into boxes of 8. There are 62 appples. How mnay boxes do I need? (8, the remaining 6 apples need to be placed in a box)

Stage 4

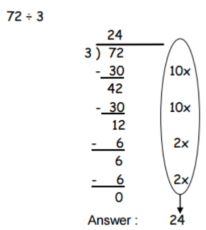
Chunking on Empty Number Line
Repeated subtraction is made more efficient by subtracting **chunks** of the **divisor**.
Chn should be prompted to write down key facts (e.g. 1x, 5x, 10x, 20x the divisor) that might help them to identify the largest group they can subtract in one chunk.

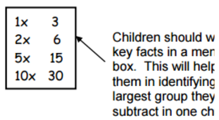
56 ÷ 4 =

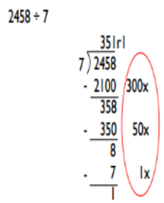


Stage 5

Formal algorithm – Chunking
This should not be introduced until children are confident and competent in understanding columnar methods for subtraction.
Here, children are chunking as with the empty number line, but it is set out formally to support accurate calculation when working with trickier numbers (larger numbers and decimals).







Stage 6

Formal Algorithm - Short Division
This should be taught as an efficient method for dividing by a single-digit number. When dividing by 2-digit numbers, children should use chunking. Children should be taught and encouraged to look at calculations to decide the most efficient method to use (in preparation for the arithmetic test at KS2)