Northbourne CE (A) Primary School

Calculation policy:
Addition and subtraction

Aims and background

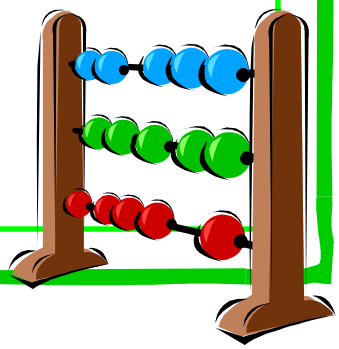
The National Curriculum for maths is based on **3 key aims**:

- Pupils' developing fluency in the fundamentals of mathematics so that they develop conceptual understanding and the ability to recall and use maths rapidly and accurately
- Being able to use reasoning and generalisation to develop an argument or proof
- Developing pupils' ability to solve problems by applying maths to a range of increasingly complex problems

Being able to calculate effectively underpins all of these aims. At Northbourne, pupils are introduced to calculating through practical, oral and mental activities. As pupils become more able to record their thinking, their mental methods are strengthened and informal written methods are introduced. These methods become increasingly efficient and refined, leading to the use of traditional compact written methods.

The aim of this policy is to ensure all members of our school community – children, parents and children - understand the progression through the stages of developing fluency with written methods. This will ensure it is taught, explained and understood in a way which is systematic and consistent.
Teaching of each calculation method includes:

- Effective use of a range of structured apparatus, as shown in the rest of this policy
- Use of visual images and models
- Parallel teaching of the inverse operation to strengthen pupils' understanding of links between different areas of maths
- Wider context – in the form of, for example, word problems – to ensure pupils understand when the strategy might be applied



Subtraction

Stage One: Taking away from a group

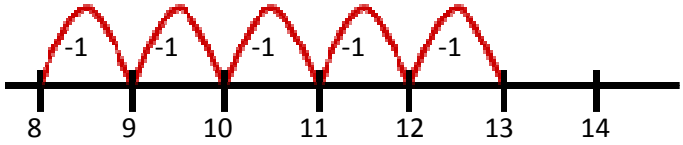
Children develop a mental picture of the number system to support their calculation. This is supported using a range of models and images, including using number tracks to demonstrate counting back. Children learn that they can subtract by removing objects, counters etc from the number track, set or group as a precursor to using a fully numbered number-line.

1	2	3	4	5	6	7	8	9	10	11	12

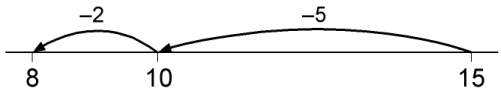
Stage Two: Subtracting by counting back and on

Children start with labelled number lines to support counting back, initially doing so in ones before moving to work more efficiently by, for example, 'bridging' to the nearest ten.

13—5 = 8

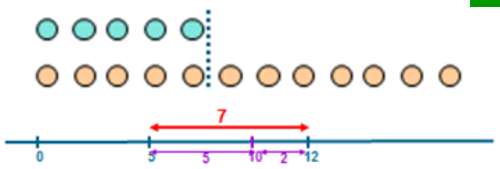


15 - 7 = 8



Stage Three: Finding the difference

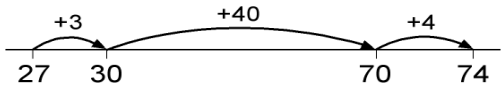
Children are shown how to find the difference when 2 numbers are close together. This can take the form of counting on or counting back, depending on how close the numbers are and which way around is most efficient.

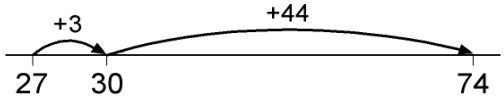


Stage Four: Empty number lines

Children are shown how to use an empty number line to count on from the smaller number, bridging through multiples of 10...

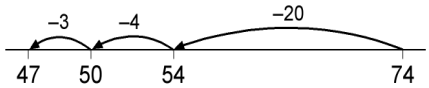
74 - 27 = 47

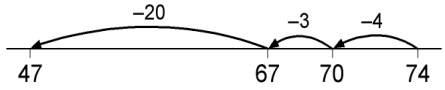




...or, starting from the larger number (which is kept whole) and partitioning the second number to help with counting back.

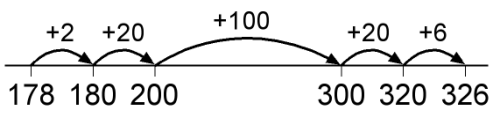
74 - 27 = 47

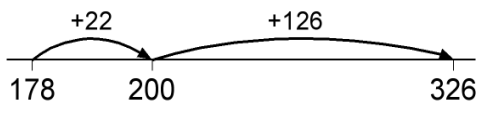




Empty number lines can continue to be used for three-digit numbers. Children start making small steps and, in time, the number of steps can be further reduced.

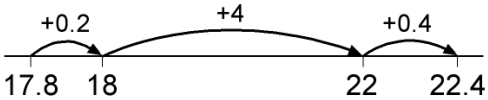
The steps for this calculation can be recorded in different orders. **326 - 178 =**

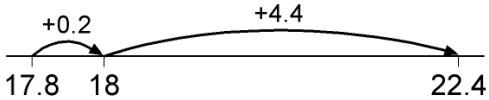




This method can then be used to calculate with decimals, including money.

22.4 - 17.8 =





Stage Five: Expanded column layout

This is a bridging step, between informal and formal methods. The numbers are partitioned into tens and ones and written underneath each other, mirroring the column approach. This relies on secure mental skills, and leads children into the column method by ensuring they understand its structure and efficiency. Language used is around 'exchanging', **not** borrowing. The various outcomes of this approach are shown below.

563—241—no 'exchanging' needed

$$\begin{array}{r} 500 + 60 + 3 \\ -\ 200 + 40 + 1 \\ \hline 300 + 20 + 2 \end{array}$$

Partition the numbers and then subtract the ones, then tens, then hundreds.
Refer to the tens by saying, for example, 'sixty subtract forty', not 'six subtract four'.

563—246—exchanging one ten for ten ones

		50		13	
	500	+ ~~60~~	+	~~3~~	
-	200	+ 40	+	6	
	300	+ 10	+	7	= 317

Discuss that there is a problem with trying to subtract the ones and explain we need to exchange a ten. To do this, we exchange a 10 from 60 into 10 ones making the subtraction 13—6.

563—271—adjustment from hundreds to tens

		400		160		
	~~500~~	+	~~60~~	+	3	
-	200	+	70	+	1	
	200		90		2	= 292

Discuss that there is a problem with trying to subtract the tens and explain we need to exchange a hundred. To do this, we exchange a hundred into 10 tens making the subtraction 160—70.

563—278—adjustment from hundreds to tens and tens to ones

		400		150			
				~~50~~		13	
-	~~500~~	+	~~60~~	+		~~3~~	
	200	+	70	+		8	
	200	+	80	+		5	= 285

Here, both the tens and ones digits to be subtracted are larger than the tens and ones they are being subtracted from. A ten is exchanged into 10 ones, and then a 100 is exchanged for 10 tens .

Stage Six: Compact column method

When a child is secure with the expanded written methods, the formal column method will be introduced. The vocabulary of 'tens' and 'ones', as well as that related to 'exchanging', is retained to ensure children develop a deep conceptual understanding of how this method works.

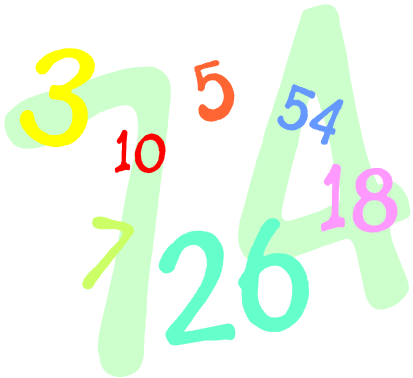
	5	1		4	1
	~~5~~	~~6~~3		~~5~~	~~6~~3
-	2	4 6	-	2	7 1
	3	1 7		2	9 2

Even when a child reaches Stage Six...

...they are still taught that, for some calculations and in some contexts, one of the earlier methods remains the most efficient. For example, 2007-1992 is easier to solve by counting on using a number line than to try to solve using the column method. We expect children to make informed decisions about which strategies to use, based on their secure understanding of these different methods.

Mathematical Vocabulary

45 **subtract** 21 **equals** 24
45 **minus** 21 **equals** 24
45 **take away** 21 equals 24
The **difference between** 45 and 21 is 24
21 is 24 **less than** 45
45 is 21 **more than** 24



Addition

Stage One: Number tracks

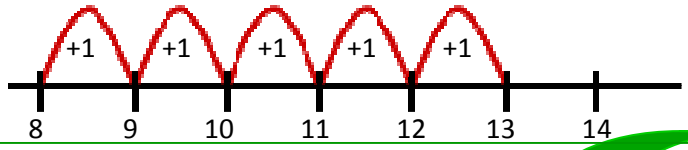
Children develop a mental picture of the number system to support their calculation. This is supported using a range of models and images, including using number tracks to demonstrate counting on. Children learn that, as addition is about combining two groups, they can line up these groups on the number track to support their addition.

1	2	3	4	5	6	7	8	9	10	11	12

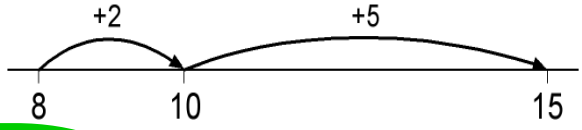
Stage Two: Number lines

Starting with labelled number lines, children begin to count on in ones to add two numbers. Through doing this, they learn that it is often easiest to re-order a calculation to start with the largest number and count on from this.

8 + 5 = 13

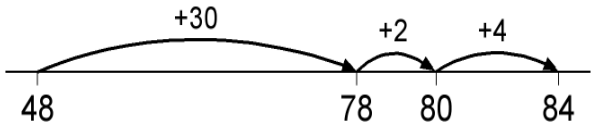


8 + 7 = 15



Stages Three and Four: Expanded horizontal addition

Using structured apparatus and their knowledge of place value, pupils learn to start from the larger number, partition the smaller number and count on. As pupils become confident, they are encouraged to think about the order in which they add, for example, the tens and the ones to ensure the method used is the most efficient one Possible, but continue to use empty number lines.



Stage Five: Expanded vertical methods

Children move onto learning an expanded column method which retains the understanding they have developed through the other stages. Pupils' understanding of place value is preserved through both the layout of the column in the early stages and the language used when explaining this—"40 plus 70 equals 110...7 plus 6 equals 13", for example.

47 + 76
40 + 70 = 110
7 + 6 = 13
110+ 13 = 123

47 = 40 + 7
+ 76 = 70 + 6
110 + 13 = 123

Stage Six: Column addition (formal written method)

The concept of exchange (not carrying!) is introduced through the use of practical equipment. For the 2-digit example below, teachers explain "I have 5 ones to add to 7 ones, which gives me 12 ones...I exchange 10 of my 12 ones for a ten counter...I then add 2 tens, 4 tens and 1 ten to make 7 tens in total". This method is similarly used to model adding 3-digit numbers and decimals.

25	**366**
+ 47	**+458**
72	**824**
1	11

47 *adding tens first*
+76
110
13
123

47 *adding ones first*
+76
13
110
123

The fact that either of these methods results in the same answer is stressed to pupils whilst they develop confidence.

End-of-year expectations

The National Curriculum specifies what most children can be expected to achieve at the end of each year group. It is expected that the vast majority of pupils progress at the following pace…

Y1: Add and subtract one– and two-digit numbers to 20
Y2: Add and subtract TU+U, TU + multiples of ten, TU + TU, U+U+U
Y3: Add and subtract 3-digit numbers to ones, tens and hundreds
Y4: Add and subtract up to 4 digit numbers using column methods where appropriate
Y5 and Y6: Add and subtract numbers with up to 4 digits, including using formal written methods