Brundall School Calculation Policy

If what you remember as mathematics is pages of calculations you may be surprised when your child's maths book contains writing, pictures, diagrams, jottings or blank number lines and not many traditional column calculations. Younger children, up to at least year 3, will record calculations in a variety of ways that do not necessarily look like the kind of 'sums' you may remember. This is because written calculations are not the ultimate aim: the aim is for children to do calculations in their heads and, if the numbers are too large, to use a way of writing them down that helps their thinking. This will, in years 4, 5 and 6, include vertical written methods.

As children develop their knowledge and understanding through years 3 - 6 teachers will be asking them to look at any calculation and ask "Can we do this in our heads?" Sometimes this is supported by a drawing, diagram or numerical jotting (notes). If they can't do it largely in their heads they should be looking for the most suitable written method or, during years 5 and 6, using a calculator for more complex calculations.

Here we try, as simply as possible, to help you to help your children. We take you through the ideas relating to children's number development from the earliest counting and mental skills to their recording of calculations to support thinking. If you've never felt very confident with numbers and calculations this might also help you! Read on and see.



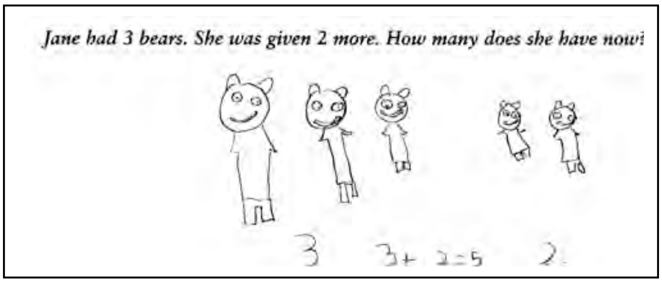
Looking at addition and subtraction

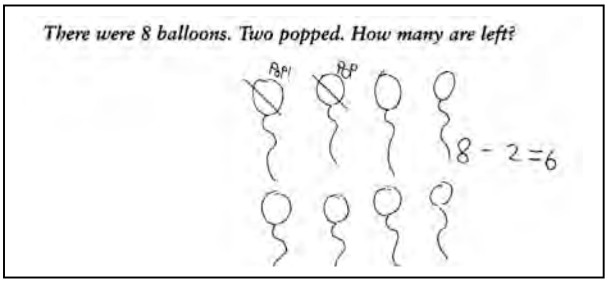
When children are in years 1 and 2 (or less able children in higher year groups) they are **not** expected to do vertical calculations like

$$\begin{array}{r} 6 \\ +4 \\ \hline 10 \\ \hline \end{array}$$

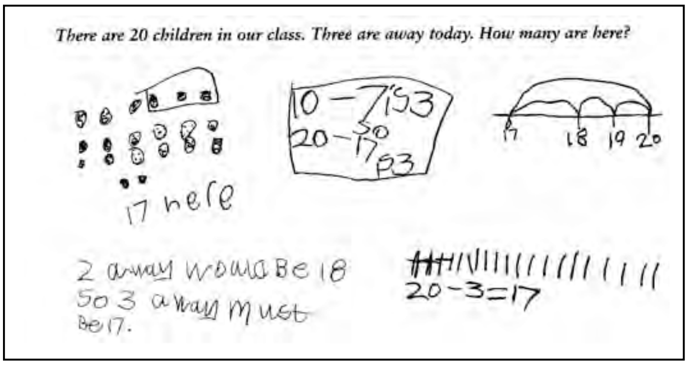
but that doesn't mean they won't learn that 6+4=10.

They will be doing a daily mixture of practical, mental and oral work including lots of counting, talking about numbers and using numbers in real life activities. They will begin to record what they've done with pictures and numbers. These recordings will help them to understand what is happening and to show how they've worked something out. Here are two examples of early recording.





This next example shows how different children have worked out and recorded the answer to the same problem about the children in the class.



These diagrams and jottings help the children to see what is happening to the numbers and to use facts they already know to help them work out others.

In years 3 and 4 children carry on using horizontal recording of addition and subtraction to support their mental calculations. The example below shows a common way of adding 76 and 93. It first splits (we refer to this as partitioning) the numbers into tens and ones (units) then adds the tens followed by the ones to give 169.

In a school there are 76 boys and 93 girls. How many children are there altogether?

93 + 76 = 90 + 70 + 3 + 6
= 90 + 70 + 9
= 160 + 9
= 169

The following example demonstrates how children might use facts that they already know, or things they can work out easily, to calculate.

There are 76 boys and 93 girls in the school. Find how many more girls there are than boys?
One strategy might be recorded as:

93 − 76
93 − 73 = 20
So 93 − 76 = 17

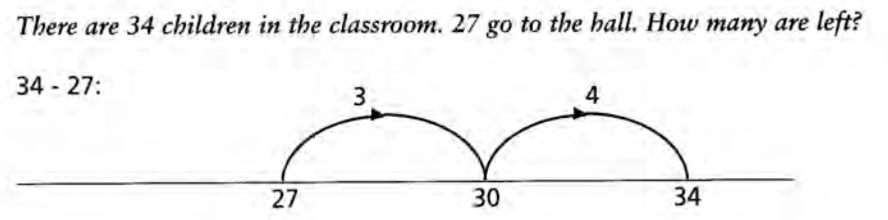
Children continue to use drawings, diagrams and blank number lines to support their thinking.

Towards the end of year 3 and into year 4 most children are taught written methods, including vertical addition and subtraction on a number line, for those calculations that they can't do 'in their heads'. At this stage these will be 'expanded methods' which are ways of recording that make the process of adding or finding the difference clear to children. These expanded methods build on the mental methods learnt and should help children to understand what is happening. Here is an example of adding using an expanded method.

The blue team's score of 287 points is increased by 145 points. What is the new score?	Explanation……
	The language used is very important to help children understand the size of numbers being added *(e.g. is it seven or seventy or seven hundred)*
2 8 7	
+ 1 4 5	
3 0 0 ↔	**two hundred** plus **one hundred** equals **three hundred**
1 2 0 ↔	**eighty** plus **forty** equals **one hundred and twenty**
1 2 ↔	**seven** plus **five** equals **twelve**
4 3 2 ↔	finally **three hundred** plus **one hundred and twenty** plus **twelve equals four hundred and thirty two**

Here is an example of finding the difference (subtraction) using a number line.

Put the lowest number at the start of the number line then jump to the next round number, writing the size of jump above the jump. Continue until you reach the larger number, add the jumps and you have the difference.



These methods mean that children may have to write a little more at this stage but, because it helps and supports their understanding, it enables them to become much more confident and quicker in the long run.

Once children really understand what they are doing they can be quickly taught how an 'expanded method' can be 'squashed' into the 'compact' method that you may recognise.

Try to decide how you would do the following calculations. Would you do them in your head, write them down or use a calculator? The notes may change your mind but don't read them until you've had a go at the calculation.

45+99	3006-2999	2.3 + 6.99	4532-3768	The sum of all the numbers from 1 to 10
This is easy to do if you think of 99 being one less than 100. So add 100 to make 145 and then take away 1 to give 144	These numbers are very close on the number line. We need 1 to get from 2999 to 3000 and 6 more to get to 3006 so the difference is 7. So much easier than doing a vertical sum!	This addition involving decimals may look hard but it's easier if you think of it as money. £2.30 add £6.99. So add £7 to get £9.30 and take away 1p to get £9.29 Easy!	This, for most people, needs a pencil and paper or calculator if speed is important.	This is easy if you think of pairs of numbers making 10 1 + 9 = 10 2 + 8 = 10 3 + 7 = 10 4 + 6 = 10 Finally 5 +10 =15 giving a total of 55

It is important that calculations are presented in problems or horizontally, as above, to encourage children to think about the numbers as a whole, what they mean, what a sensible answer might be and the best method of working them out. It's all about giving children confidence with and control over numbers.

Looking at multiplication and division

Did anyone ever tell you that you only needed to learn about half of the multiplication tables in order to know them all? If they didn't it was a bit mean because if you know 3x4=12 you also know 4x3=12, so why learn it twice?

Did anyone ever say that once you knew the 2 times table, which is only double the 1 times, then the 4 times was easy because you just double the 2 times? Then you can double the 4 times to get the 8 times. The 3 times doubles to the 6 times and 12 times, the ten times can be halved to give 5 times and so on. This uses the knowledge children are developing through addition and subtraction and makes important connections for them. This chart shows how this works for the 2x, 4x and 8x tables.

x	1	2	3	4	5	6	7	8	9	10
2times	2	4	6	8	10	12	14	16	18	20
4times	4	8	12	16	20	24	28	32	36	40
8times	8	16	24	32	40	48	56	64	72	80

double

It's also possible that you weren't told that you knew your division tables. If you were shown that division was the opposite of multiplication you will understand that knowing 3x4=12 or 4x3=12 also means you know 12÷4=3 and 12÷3=4. So knowing one number fact, like 3x4=12, immediately means we know at least four.

But did you also realise that knowing any one of these facts helps you to know a lot more than four without actually learning them? Read on.

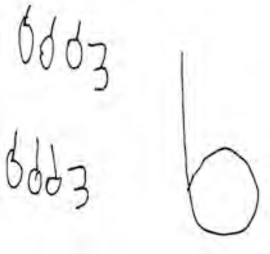
The early work children do introduces them to the ideas of multiplication and division. They count in different patterns, to see how multiplication is repeated addition and division is repeated subtraction and are shown how division is the opposite of multiplication and taught to understand place value (that in 234 the 2 is 200, the 3 is 30 and the 4 is 4 ones). This knowledge and understanding, with much of the work being done in their heads, opens up a whole world of facts for them and they don't all have to be memorised.

The following chart shows something of what this means.

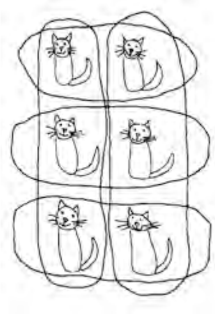
If you know 4x5= 20 what else do you know?
5x4=20
20÷4=5
20÷5=4
4+4+4+4+4=20
5+5+5+5=20
and using knowledge of place value
5x40=200
4x50=200
200÷50=4
200÷40=5
40x50= 2000 and so on
combined with knowing the multiples of ten, which are easy, we can work out that
5x44=220 (5x40=200 and 5x4=20…200+20=220)
therefore
220÷5=44
and so it goes on. Try it for yourself..in your head!

The ability to do what you've just seen, developed gradually through years 1,2,3 & 4 helps children in years 4,5 & 6 to move on with confidence to multiplication and division of bigger numbers including those involving decimals and as with addition and subtraction, the questions will usually be presented to children as word problems or, horizontally, as calculations. The children should then be encouraged to work them out mentally if they can (supported by drawings, diagrams, number jottings if necessary) or, if they can't, to use the most suitable written method they know.

In years 1 & 2 (or less able children in higher year groups) the children will be recording to demonstrate how they have done something and to show that they've understood what is happening, as below.



2 lots of 3apples makes 6
2 x3 apples =6



2x3 cats = 6cats
3x2 cats = 6 cats

In years 3 & 4 the children begin to use expanded methods to help them deal with calculations that they can't do in their heads. At this stage it mostly involves multiplying and dividing 2 digit numbers by a single digit (72x6 or 85÷4). When dividing they learn about and use remainders. The use of jottings to support children's calculations is encouraged.

> In this example, the 47 has been split (partitioned) into 40 and 7 before the calculation is carried out. This makes it simpler to calculate each part mentally.
>
> 47 x 8 =
> (40 x 8) + (7 x 8) =
> 320 + 56 = 376

A popular expanded method for multiplying is often called the grid method. It uses the mental skills and the knowledge children have learnt and helps most children to move, with understanding, to the 'compact' method you may know.

This chart shows 'the grid method'. You can see, as with addition and subtraction expanded methods, it uses knowledge of number facts and the idea of splitting a number into its parts (place value) to help understanding of the process.

How many sweets do I need for 24 party bags if each is to have 16 sweets?

x	20	4
10	200	40
6	120	24

Total:
200 + 120 +
40 + 24 = 384

The 24 and 16 have been split and then each part of the grid completed by calculating mentally and the four numbers added to give the final total. Many children develop the ability to do this kind of calculation totally in their heads.

The expanded method for division is often called 'chunking' and really involves taking away chunks of the same size until you run out. It uses the fact that division is repeated subtraction of the same size group. So 20÷4=5 involves subtracting 4s from 20 until it's been used up. You can do this 5 times.
Here is a more difficult example showing how larger chunks are taken away to speed up the process. Again this method uses and builds on the ideas explained earlier.

72 pears are sold in packets of 6. How many packets will that make?

72 (pears)
— 60 (this is **10** lots of 6)
12 (left over)
— 12 (this is **2** lots of 6)
0 (left over)
So **10+2** lots of 6 or 12 packets can be made.

As they move into years 5 & 6 children are encouraged to choose the most suitable method of calculation, mentally if possible. Where this is not possible they use expanded or compact methods and a calculator for more complex and involved work.

Most children are expected to multiply 3 digits x 1 digit and 3 digits x 2 digits using a written method. Here are some examples.

How many hours are there in the year 2009?
This means we do 365x24…a calculation you may find quite hard. Here it is expanded and using lots of mental skills…but none of them difficult.

x	300	60	5	
20	6000	1200	100	= 7300
4	1200	240	20	= 1460

So 20x365= 7300
4x365= 1460
giving a total of 8760 hours with no difficult calculation to do.

More complex division involves dividing 3 digit numbers by a 1 digit number and 3 digit numbers by a 2 digit number. With division, as with all calculation, it's important to think about what the actual problem is asking when you come to give an answer. This is shown up in the second example of expanded division or chunking involving buses for a school trip.

458 stickers are shared between 3 children. How many does each get?

	4 5 8	
−	3 0 0	that's **100** x3
	1 5 8	left
−	1 5 0	that's **50** x3
	8	left
−	6	that's **2** x3
	2	left over

So each gets **100+50+2** or 152 stickers with 2 left over.

458 ÷ 3 = 152 remainder 2

432 children and adults are going on a school trip. If each bus takes 30 people how many are needed?

	4 3 2	people going	
−	3 0 0	that's **10** x30	or**10** buses
	1 3 2	left	
−	1 2 0	that's **4** x30	or **4** buses
	1 2	left	**1** bus

So we see that the calculation would result in

432 ÷ 30 = 14 remainder 12

This is not a good answer for this question because the 12 people left over would need another bus or they couldn't go!

So we see that 15 buses are needed…or some cars.

When the children really understand these expanded methods they are shown how they are developed into a compact method. Remember that the expanded methods are perfectly good ways of working out an answer if the children feel more comfortable and therefore find it easier. They give the same answer and it can often be quicker if they are confident about what they are doing.

Hopefully reading this helps you understand how calculations are taught in our school. If you have any concerns or questions it's good to talk to your child's teacher for clarification. Children (and adults) need to feel confident with numbers and to enjoy playing with them and using them, that's really what it's all about.

Finally, have a go at these using expanded methods. Trying things out helps understanding. One of them at least could be done completely in your head…maybe! Remember we want children to decide on the best method, mentally if possible, or the most suitable, manageable written method if not. Can you check your answers? Asking children to check is another important strategy.

calculation	a) 27 x 7	b) 238 x 45
working		
calculation	c) 176 ÷ 6	d) 346 ÷16
working		

Several images in this document are used with kind permission of the Qualifications and Curriculum Authority. The policy was created with help from both Norfolk and Leicestershire Mathematics Teams and a special thank you must go to Micky Harcourt of the Norfolk Maths team for her support.