Ardleigh Green Junior School

Calculation Policy

National Curriculum 2014

In September 2014 the Government updated the National Curriculum. This adaptation raised the expectations for each year group and has put a high focus on times table knowledge and formal written methods. This policy will outline the different methods that will be used throughout the school. Even though these are the recommended strategies for each year group, a range of options will still be taught. Therefore, this will mean that during lessons, it would be expected to see the students use a range of strategies.

Addition Strategies:

By the end of year three, it is now expected that all children should be able to use the formal method of the columnar strategy to solve addition and subtraction. In order for the place value knowledge to become secure, year three will use an expanded version of columnar addition. It is of great importance that the children understand the value of each digit in a number, which is why this method will be taught first.

Stage 1: The expanded partitioning method:

354
123+
7 (4 + 3)
70 (50 + 20)
400 (300 + 100)
477

Step 1: Start by adding the ones together.
Step 2: Then add the tens together.
Step 3: Finally, add the hundreds together.
Step 4: Then add together each column.
E.g. ones: 7 + 0 + 0 =7
tens: 70 + 0 + 0 = 70
hundreds: 400 + 0 + 0 = 400

It is important to use the brackets to show which numbers the child are adding together. This ensures that they understand the place value of each digit and that they do not see all the digits as ones.

Once the children are comfortable with the method above, the method can be condensed. However, they must be solid on their place value understanding before moving onto this stage.

Stage 2: The formal written method:

354
123+
477

Step 1: 4 (ones) + 3 (ones) = 7 ones
Step 2: 5 (tens) + 2 (tens) = 7 tens
Step 3: 3 (hundreds) + 1 (hundred) = 4 hundreds

This is very straightforward until the children must carry. This method is demonstrated below.

Stage 3: The formal written method (with carrying):

251
293 +
544
1

Step 1: Add the ones together (1 + 3 = 4 ones)
Step 2: Add the tens (5 tens + 9 tens = 14 tens). Due to the answer being a two digit number, it has to be carried under the hundreds column)
Step 3: Add the hundred (2 hundreds + 2 hundreds + the 1 hundred that is carried = 5 hundreds)

This strategy can then be applied to larger numbers and decimal numbers.

What are the possible struggles?

1. The digits must be lined up in the correct columns

Despite this sounding quite simple, it can be tricky at the beginning for children to line the digits up in the correct column.

Why?
One common reason is that the children line up from the first digit. E.g. 134

$$\begin{array}{r} 23 \quad + \\ 364 \end{array}$$

What can be done to help?
Remind the child that they should line up the ones first.

2. Presentation

The children can something not write the digits clearly in their working out. This can cause problems.

Why?
If digits are different sizes, children can become confuse when deciding which digits to add together. Alternatively, the child may even read the digit incorrectly. It is common for 1s to look like 2s and 7s and 3s to look like 8s if not written clearly.

What can be done to help?
The child could re-write the numbers clearly in their books or on paper. If formation is an issue, children can use a number square to help with formation. In addition, the children can use larger squared paper if the child's handwriting is too large for the small boxes. However, emphasising each digit should have its own box is essential.

3. Not remembering to carry

Why?

This can be due to forgetting to write the number that is being carried down. Alternatively, it could be that the one has been written in the wrong column. Another common issue is that children can write the digits the incorrect way. They put the one that should be carried within the line and carry the other digit. E.g.

345
293 +
818
3

Here, you can see that 40 + 90 = 130 so the 1 should be carried but the child has carried the 3 instead. This can sometimes be very hard to notice.

What can be done to help?

It should be reinforced that the carried one must be placed in the next column along from the column the child is working on.

Subtraction Strategies:

The expanded partitioning (without exchange)

Similarly to the addition strategy, this is an important stage to ensure that the children have a solid place value understanding.

92
41 –
1 (2 – 1 = 1)
50 (90 – 40 = 50)
51

Step 1: Start by taking away the ones.
Step 2: Then take away the tens.
Step 3: Finally, take away the hundreds.
Step 4: Then, join the steps together.
E.g. 50 + 1 = 51

It is important to use the brackets to show which numbers the child are taking away, to ensure that they understand the place value of each digit and that they do not see all the digits as ones.

Once the children are comfortable with the method above, the method can be condensed. However, they must be solid on their place value understanding before moving onto this stage.

Stage 2: The formal written method:

354
123 -
231

Step 1: 4 (ones) - 3 (ones) = 1 ones
Step 2: 5 (tens) - 2 (tens) = 3 tens
Step 3: 3 (hundreds) - 1 (hundred) = 2 hundreds

Stage 3: The formal written method (with exchanging):

11
2 5 7
193 -
064

Step 1: Subtract the ones (7 - 3 = 4)
Step 2: Subtract the tens (5 tens - 9 tens = which cannot be done). Therefore, you need to borrow from the next column along. So, the 5 tens turns to 15 tens (15 tens – 9 tens = 6 tens) But, the hundred turns from 2 hundreds to 1 hundred as I have exchanged 100 into 10 tens which is shown with the little one above the 5.
Step 3: Subtract the hundreds column (1 hundred – 1 hundred = 0 hundreds).

This strategy can then be applied to larger numbers and decimal numbers.

What are the possible struggles?

1. The digits must be lined up in the correct columns

Despite this sounding quite simple, it can be tricky at the beginning for children to line the digits up in the correct column.

Why?
One common reason is for the children to line up from the first digit. Therefore, when they are subtracting numbers that have different amounts of digits this can cause issues. E.g.

534
23 -
304

What can be done to help?
Remind the child that they should line up the units first.

2. Children may swap the digits around in their head particularly when an exchange might be needed.

Why?
Sometimes, children just read the calculation the wrong way round. Or they automatically read the bigger number first whether it's the top or bottom number.

What can be done to help?
To remind the children to read from top to bottom and ask the question … can I take away the bottom number from the top? This will ensure they think carefully about the order they are using the numbers.

3. Children may forget to cross out and change the numbers properly when exchanging.

Why?

The children forget to change the digit in the next column along after borrowing. Alternatively, some children do not replace the number correctly from the borrowed column. For example, it is common for children to change any digit that is borrowed from to a one. It doesn't matter whether it is a 5 that should become a 4 some children will put a one anyway.

What can be done to help?

The only advice that can be given is to ask the child questions so that think about what they have done. Often it is just a slight confusion and they can see the problem themselves when pointed out by an adult. Questions might include: If I had 5 and I borrowed one from it, how many would I have? Now check your work, is that what you have done?

Other Methods:

Despite children being expected to use the formal methods by the end of year three, there are some other methods that could be used if a child struggles with these methods.

Partitioning:

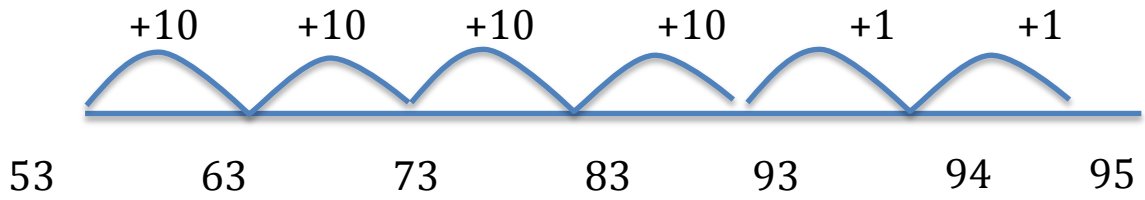
	53 + 42 = 95
Step 1: add the tens	50 + 40 = 90
Step 2: add the ones	3 + 2 = 5
Step 3: add the answers	90 + 5 = 95

The same can be used for subtracting without exchanging.

	95 - 24 =
Step 1: subtract the tens	90 - 20 = 70
Step 2: subtract the ones	5 - 4 = 1
Step 3: add the answers	70 + 1 = 71

Number line:

53 + 42 =



Step 1: Put the largest number at the bottom of the number line.
Step 2: Add the tens first (4 tens in the example)
Step 3: Add the ones (2 units in the example)

The jumps can be any jumps as long as they add the correct total number of tens and units. Exactly the same process can be applied to subtraction.

Multiplication Methods:

The first point that must be noted is that by the end of year 4 children must know all of their tables up to 12 by 12. Also, by the end of year 3, children must know the 2, 3, 4, 5, 8 and 10 times tables. This is essential if children want to be successful with multiplication and division.

From the outset, children will use a formal method to work multiplication

Partitioned Vertical Multiplication:

57
8 x
56 (7 x 8)
400 (50 x 8)
456

Step 1: Multiply the ones by the bottom line.
Step 2: Multiply the ten by the bottom line.
Step 3: Add each column together.

This can be extended for 2 digit number multiplication.

57
18 x
56 (7 x 8)
70 (7 x 10)
400 (50 x 8)
500 (50 x 10)
1026

The Formal Multiplication Method:

$$\begin{array}{r} 57 \\ \times\ 8 \\ \hline 456 \\ {\scriptstyle 4\ 5} \end{array}$$

Step 1: Multiply the ones by the bottom line. As there is a ten in the answer, this must be carried to the next column. In this case the ten is 50 so a 5 (5 lots of 10) is placed underneath the tens column.
Step 2: Multiply the ten by the bottom line. Once again, any hundred must be carried to the next column (50 x 8 = 400). However, here you must add the 5 (50 as it is 5 tens) to the answer so it becomes 450. So the 5 tens go in the tens column and the 4 (400) is carried to the next column.
Step 3: As there are no hundreds to multiply, the 4 (4 hundreds) underneath is moved into the answer box.

This can be extended for 2 digit number multiplication.

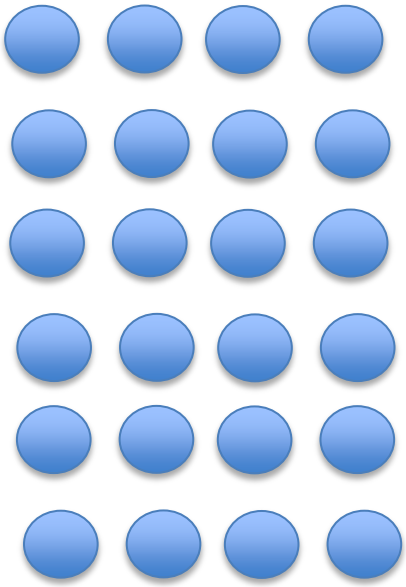
$$\begin{array}{r} 57 \\ \times\ 18 \\ \hline 456 \\ {\scriptstyle 4\ 5} \\ 570 \\ \hline 1026 \end{array}$$

Other Multiplication Methods:

Some children may find the vertical method difficult, particularly if they do not know their tables. Here are some other methods that can be used.

Arrays:

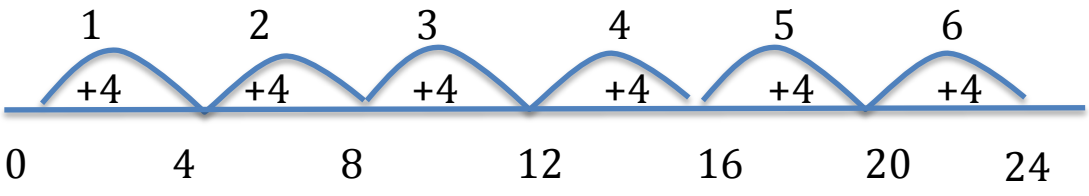
6 x 4 = 6 lots of 4 so draw 6 lots of 4 dots



Step 1: There are 6 lots of 4. So, the child draws 6 lots of 4 dots.
Step 2: Count them all up and this gives the answer.

Number line:

This can then be extended to using a number line to count on rather than using dots.



Grid Method:

This method is used when multiplying two digit numbers and the children find carrying difficult.

25 x 3=

x	20	5
3	60	15

Step 1: Multiply the tens by the bottom number (20 x 3 = 60).
Step 2: Multiply the ones by the bottom number (5 x 3 = 15).
Step 3: Add the answers together.

This can be extended to multiplying two digits by two digits.

25 x 31=

x	20	5
30	600	150
1	20	5

Step 1: Multiply the tens by the tens bottom number (20 x 30 = 600).
Step 2: Multiply the ones by the tens bottom number (5 x 30 = 150).
Step 3: Multiply the tens by the ones bottom number (20 x 1 = 60).
Step 4: Multiply the ones by the ones bottom number (5 x 1 = 15).
Step 5: Add all the answers together

What are the possible struggles?

1. Children don't multiply tens properly

When children move onto two digit multiplication and they multiply 30 x 20 for example. If they use their 3 x 2 knowledge, sometimes they can only multiply by 10 instead of 100.

Why?
This is often because both numbers are tens they think they only have to multiply by ten once.

What can be done to help?
Remind the children that as they have used 3 x 2 to help them they have divided both numbers by 10 to reduce them. Therefore, each in turn will need to be multiplied by 10 again. As there were two numbers, the answer needs to be multiplied my ten twice.

2. Not remembering to carry

Why?
This can just be forgetting to write the carry number down. Alternatively, it could be that the carry has been written in the wrong column. Another common issue is that children can write the digits the incorrect way round.

What can be done to help?
It should be reinforced that the carried number (the ten) must be placed in the next column along from the column the child is working on.

3. Adding the carry number twice

Why?

During the multiplication, the children should add any carried numbers as they go. But sometimes at the end, when children are adding all the numbers together, the children can add the carried numbers once again.

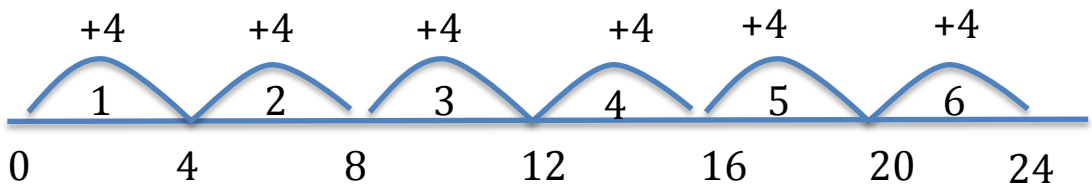
What can be done to help?

Once they have used the carried number, cross it out so that the children know they have added it into the answer already.

Division Methods:

Number line:

24 ÷ 4 =



Step 1: Draw a number line and put 0 at the beginning.
Step 2: Count up in the amounts you are dividing by (in this case 4) until you reach the larger number (in this case 24).
Step 3: Count the jumps and this is your answer.

This can be used for remainders too. The child jumps until they can get as close as they can to the number. The remainder is then any left over.

Bus Stop Method (not carrying)

Knowing the tables is essential for this method.

$$2\overline{)86}\quad 43$$

Step 1: How many 2s go into the first digit (8) and put that number above it.
Step 2: How many 2s go into the second digit (6) and put that number above it.
Step 3: The number on top is the answer.

Bus Stop Method (with carrying):

Knowing the tables is essential for this method.

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   4  8
2 ⟌9¹6
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Step 1: How many 2s go into the first digit (9)? If it cannot be divided exactly, any leftover must be carried to the next number in this case it is a one.
Step 2: How many 2s go into the second digit (16)? Put that number above it.
Step 3: The number on top is the answer

Bus Stop Method (chunking):

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   113
7 ⟌791
  700 – (100 x 7)
   91
   70 – (10 x 7)
   21
   21 – (3 x 7)
    0
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Step 1: Think of the easiest but highest jump that can be done. In this case that is 100 lots of 7. This can then be taken away.
Step 2: What is the next easiest but highest jump that can be done? In this case, it is 10 lots of 7. Then, take that away.
Step 3: There are 3 lots of 7 left so this is taken away and leaves 0.
Step 4: The jumps of 7, in the brackets, are counted and that is the answer.
Step 5: If on other occasions there are any left over this becomes a remainder.

Formal Bus Stop Method (long division):

Knowing the tables is essential for this method.

$$16 \overline{)1^{1}1^{11}5^{3}2} \quad 7\ 2$$

16
32
48
64
80
96
112
144
160

Step 1: Write out the 16 x tables to the side of your work.
Step 2: Divide the first digit by 16 (1 ÷ 16). This cannot be done so the 1 is carried to the next column.
Step 3: Divide the second digit by 16 (11 ÷ 16). This cannot be done so the 11 is carried to the next column.
Step 4: Divide the third digit by 16 (115 ÷ 16). This can be done. Look at the tables and see which number gets you closest. In this case, it is 112 and there are 3 left over. The 6 is written on top of the bus stop and the 3 is carried.
Step 5: The final digit is divided by 16 (32 ÷ 16) which is 2.

What are the possible struggles?

1. Children don't know the tables

What can be done to help?
Practise regularly even if it is just a few questions on your way to school. However, remember to practise all the tables not just the one they are currently working on otherwise the others are forgotten.

2. Not remembering to carry

Why?
This can just be forgotten or the children carry the wrong amount.

What can be done to help?
It should be reinforced that the carried number (the ten) must be placed in the next column along from the column the child is working on.