St John’s Calculation Policy

Parent’s Guide

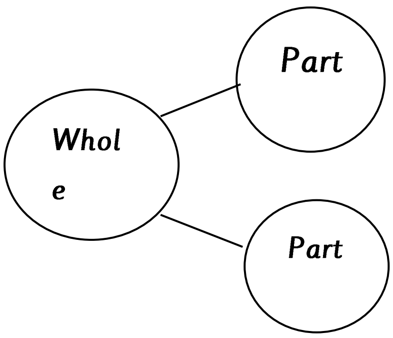
If what you remember as maths is pages of sums you may sometimes feel confused when your child’s maths book contains writing, pictures, diagrams, jottings or blank number lines and not many ‘formal calculations’. Certainly younger children, up to Year 3, will record calculations in a variety of ways that do not necessarily look like the kind of ‘sums’ you remember.

We know that school wide guidance, such as this, can ensure consistency of approach, enabling children to progress stage by stage through models and representations they recognise from previous teaching, allowing for deeper conceptual understanding and fluency. As children move between concrete and pictorial and abstract, teachers will be presenting strategies and equipment appropriate to children’s level of understanding.

Progression in addition and subtraction

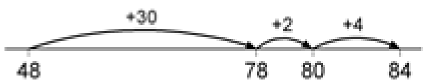
Addition and subtraction are connected.

Part	**Part**
Whole	



Addition names the whole in terms of the parts and **subtraction** names a missing part of the whole.

Year Three

Stage 1 – The empty number line	
• The mental methods that lead to column addition generally involve partitioning e.g. adding the tens and units separately. Children also need to be able to partition numbers in ways other than into tens and units to help them make multiples of ten by adding in steps. • The empty number line helps to record the steps on the way to calculating the total.	Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10. 8 + 7 = 15  48 + 36 = 84 

or:

Stage 2 – Partitioning

- The next stage is to record mental methods using partitioning. Add the tens and then the units to form partial sums and then add these partial sums.

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

Stage 3 – Expanded method in columns

- Move on to a layout showing the addition of the tens to the tens and the units to the units separately. To find the partial sums either the tens or the units can be added first, and the total of the partial sums can be found by adding them in any order. **As children gain confidence, ask them to start by adding the units digits first always.**
- The expanded method leads children to the more compact method so that they understand its structure and efficiency. The amount of time that should be spent teaching and practising the expanded method will depend on how secure the children are in their recall of number facts and in their understanding of place value.

Adding the tens first:

```
  47
 +76
 110
  13
 123
```

Discuss how adding the units first gives the same answer as adding the tens first. Refine over time to adding the units digits first consistently.

Adding the units first:

```
  47
 +76
  13
 110
 123
```

Stage 4 – Column method

- In this method, recording is reduced further. Exchange digits are recorded **below** the line, using the words 'exchange ten' or 'exchange one hundred', **not** 'exchange one'.
- Later, extend to adding three two-digit numbers, two three-digit numbers and numbers with different amounts of digits.

```
  25
 +47
   1   leave a line for exchanged tens
  72
```

Subtraction

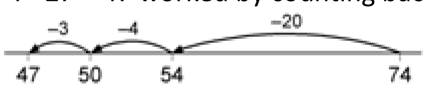
Stage 1 – The empty number line

- The empty number line helps to record or explain the steps in mental subtraction. A calculation like 74-27 can be recorded by counting back 27 from 74 to reach 47. The empty number line is also a useful way of modelling processes such as bridging through a multiple of ten.
- The steps can also be recorded by counting up from the smaller to the larger number to find the difference.
- With practice, children will need to record less information and decide whether to count back or forward. It is useful to ask children whether counting up or back is the more efficient for calculations such as 57-12, 86-77 or 43-28.

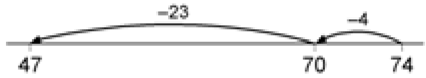
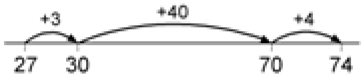
Steps in subtraction can be recorded on a number line. The steps often bridge through a multiple of 10.

15 - 7 = 8

74 - 27 = 47 worked by counting back:

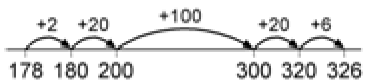


<table>
<tr><td></td><td>The steps may be recorded in a different order:


or combined:

</td></tr>
<tr><td colspan="2">Stage 2 The counting – up method</td></tr>
<tr><td>The mental method of counting up from the smaller to the larger number can be recorded using either number lines or vertically in columns. The number of rows (or steps) can be reduced by combining steps. With two-digit numbers, this requires children to be able to work out the answer to a calculation such as 30 + ? = 74 mentally.</td><td>

74
− 27
3 → 30
40 → 70
4 → 74
47

Or:


74
− 27
3 → 30
44 → 74
47</td></tr>
<tr><td>With three-digit numbers the number of steps can again be reduced, provided that children are able to work out answers to calculations such as 178 + ? = 200 and 200 + ? = 326 mentally.
The most compact form of recording remains reasonably efficient.</td><td>

326
−178
2 → 180
20 → 200
100 → 300
26 → 326
148

Or:


326
−178
22 → 200
126 → 326
148</td></tr>
<tr><td colspan="2">Stage 3 – Partitioning</td></tr>
<tr><td>Subtraction can be recorded using partitioning to write equivalent calculations that can be carried out mentally. For 74 - 27 this involves partitioning the 27 into 20 and 7, and then subtracting from 74 the 20 and the 4 in turn. Some children may need to partition the 74 into 70 + 4 or 60 + 14 to help them carry out the subtraction.</td><td>74 – 27 =
74 – (20 + 7)
74 – 20 = 54
54 – 7 = 47</td></tr>
<tr><td colspan="2">Stage 4 – Expanded method in columns</td></tr>
<tr><td>Partitioning the numbers into tens and ones and writing one under the other mirrors the column method, where ones are placed under ones and tens under tens.
This does not link directly to mental methods of counting back or up but parallels the partitioning</td><td>Partitioned numbers are then written under one another:

Example: 74 - 27

70 + 4
− 20 + 7

60 14
<s>70</s> + <s>4</s>
− 20 + 7
40 + 7

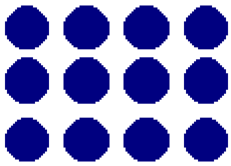
6 14
<s>7</s> <s>4</s>
− 2 7
4 7</td></tr>
</table>

method for addition. It also relies on secure mental skills.	
Stage 5 – Column method	
• This compact method follows from the expanded column method. When exchanging over make sure you refer to ‘exchanging ten’ or ‘exchanging hundred’ not exchanging one. The exchanged digit should be written above the original digit.	6 14 ~~7~~ ~~4~~ − 2 7 4 7 TU - TU 4 15 13 ~~5~~ ~~6~~ ~~3~~ − 2 7 8 2 8 5 HTU - HTU

Progression in Multiplication and Division

Multiplication and division are connected.
Both express the relationship between a number of equal parts and the whole.

Part	Part	Part	Part
Whole			

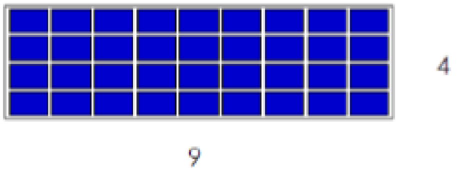


Multiplication

Partitioning for multiplication

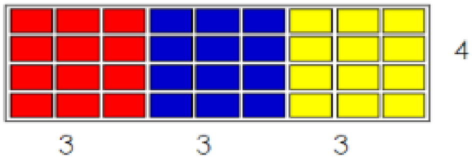
Arrays are also useful to help children visualise how to partition larger numbers into more useful representation.

9 x 4 = 36



Children are encouraged to be flexible with how they use number and can be encouraged to break the array into more manageable chunks.

9 x 4 =

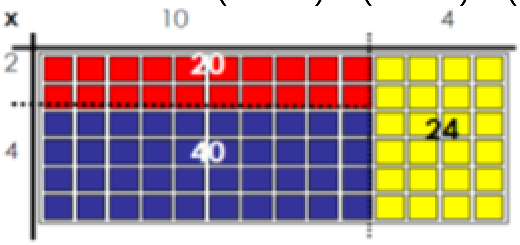


Which could also be seen as

9 x 4 = (3 x 4) + (3 x 4) + (3 x 4) = 12 + 12 + 12 = 36

Or 3 x (3 x 4) = 36

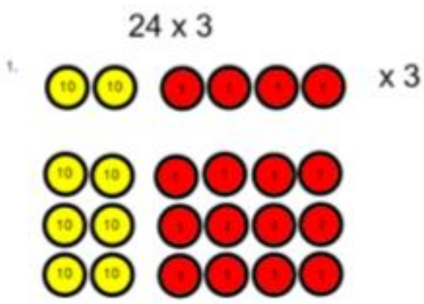
And so 6 x 14 = (2 x 10) + (4 x 10) + (4 x 6) = 20 + 40 + 24 = 84



Arrays leading into the grid method

Children continue to use arrays and partitioning, where appropriate, to prepare them for the grid method of multiplication.

Arrays can be represented as ‘grids’ in a shorthand version and by using place value counters to show multiples of ten, hundred etc.



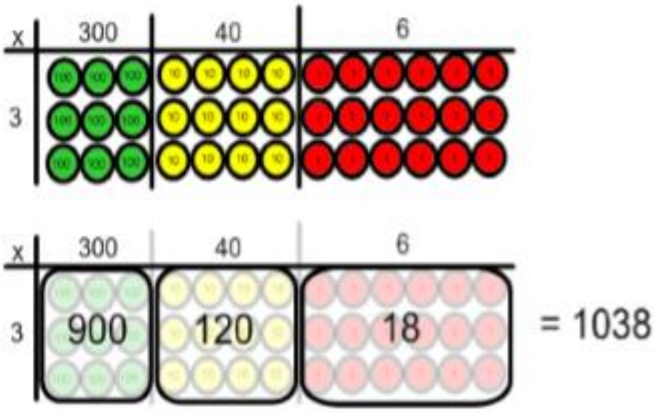
24

24

24

Grid method

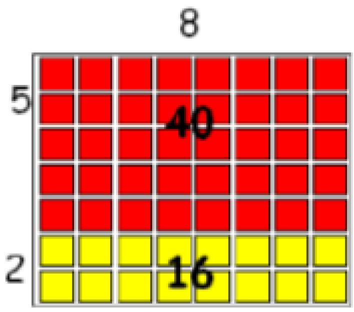
This written strategy is introduced for the multiplication of TO x O to begin with. It may require column addition methods to calculate the total.



Division

Partitioning for division

The array is also a flexible model for division of larger numbers
56 ÷ 8 = 7

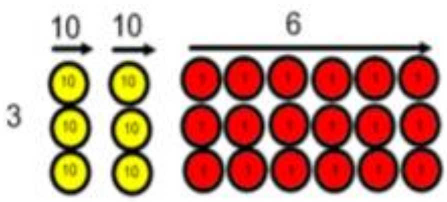


Children could break this down into more manageable arrays, as well as using their understanding of the inverse relationship between division and multiplication.

56 ÷ 8 = (40 ÷ 8) + (16 ÷ 8) = 5 + 2 = 7

Arrays leading into chunking and then long and short division

Children continue to use arrays and partitioning where appropriate, to prepare them for the ‘chunking’ and short method of division. Arrays are represented as ‘grids’ as a shorthand version.
e.g. 78 ÷ 3 =



78
\- 30 (10 x 3)
48
\- 30 (10 x 3)
18
\- 18 (6 x 3)
0

So 78 ÷ 3 = 10 + 10 + 6 =26

78 ÷ 3 = (30 ÷ 3) + (30 ÷ 3) + (18 ÷ 3) =

10 + 10 + 6 = 26

What you can do as parents:

- Have a look at the strategies we use in order to help with homework ina way the children are familiar with;
- Rehearse number facts often and thoroughly. These are the basis of most calculations and need to be learnt in order to be built on. It does take time, patience and practice at home but it leads to quicker calculating and the confidence of recognising something familiar;
- Practise couting forwards and backwards to 100 from any numberin steps of 2,3,4,5,8,10,50 and 100
- Learn number bonds to one hundred and one thousand (multiples of 10);
- Rehearse multiplication facts - by the end of Year 4 children are expected to know all multiplication facts up to 12 x 12.
- Play number based games like cards or board games. Access websites to encourage reasoning skills like http://nrich.maths.org/students or http://resources.woodlands.kent.sch.uk/maths/index.html