Progression in Methods of Calculation Policy

Introduction

The following policy outlines the significant stages in the teaching and learning of calculation strategies for addition, subtraction, multiplication and division at Oak Grove College.

Our aim is to help support students' learning by providing a common reference tool for children, staff and parents that details how calculations are taught at Oak Grove College.

These methods are to be taught after the student has a clear understanding of the concept being taught. This understanding is developed through the use of a variety of concrete resources and models and images (Models and Images progression charts). Putting these concepts into context is also an essential element of a students' understanding.

In addition to the steps of progression in the methods of calculations, it is important to show progression through the range of numbers the pupils are being asked to calculate. We must teach/familiarise a student with parts of the number system before they can calculate with numbers from that part.

Calculations should be accurate, reliable, and efficient. Hence using the acronym C.A.R.E helps remind children to think about the method they choose to calculate with.

Please feedback any comments you have on the policy to the Lead Maths Teacher (Gemma Kelly) as we will review this policy annually and wish it to be as useful as possible.

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Calculation for students working within the P levels

The teaching of calculation can take place at many levels, including the sensory curriculum. For students working within the P levels calculation is about identifying how quantities change (increase and decrease) and communicating about these changes. This can be broken down into specific areas:

- Appreciating that quantities can change
- Recognising changes in quantities
- Communicating about changes
- Realising the consequences of changing quantities
- Counting
- Manipulating quantities
- Recording changes in quantity

Experiences which contribute to the development of understanding about changing quantities include:

- Handling
- Anticipating
- Giving and taking
- Collecting
- Experiencing increase
- Separating
- Sorting
- Distributing
- Appreciating pattern and progressions
- Estimating
- Predicting

Work should be practically based using concrete objects and relate to real life experience. Opportunities for generalisation should be planned across the school day.

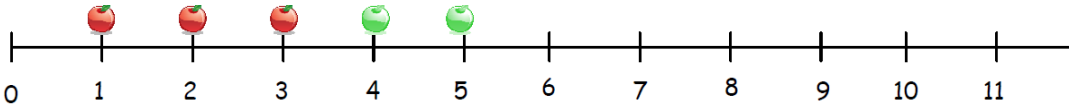
Calculation for students with ASC.

When considering the use of this policy it is important to remember that student with ASC do not learn in the same way as typically developing children and may require a more personalised approach.

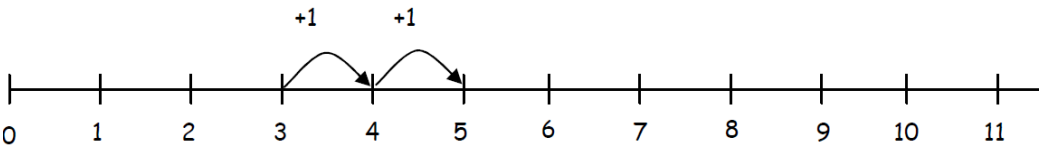
ADDITION

Stage 1 — using structured number lines to count on in ones, tens and hundreds.

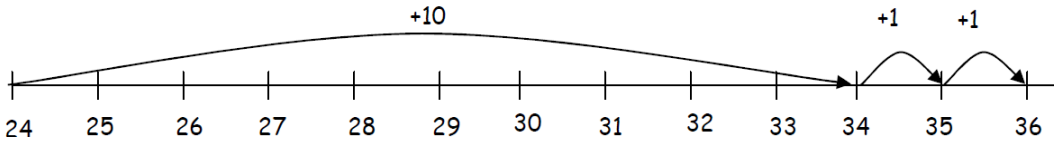
3 + 2 = 5



This is initially done using pictures of the objects being counted e.g. apples. In time this pictorial representation is replaced with arrows, (as shown below). The formal recording of the calculation, 3+2=5, is gradually introduced alongside this.

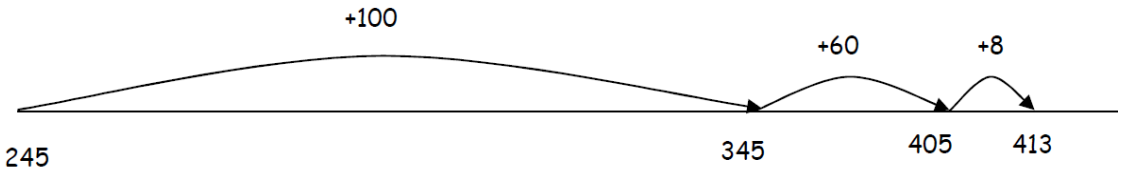


As the students become more confident in working with larger numbers, they are taught to partition the number (separate into hundreds, tens and units) count on in this way in steps of 10 and 100. So 24 + 12 = 36 would look like this.



Stage 2 — using unstructured number lines to represent addition

Students are shown how to draw their own number lines and the steps, always partitioning the smaller number and adding first hundreds, then tens then units. So 245 + 168 becomes
245 + 100 + 60 + 8



Stage 3 — developing a formal method.

83+ 42=125

80+3
40+2
120+5=125

Progresses quickly to ➡

83
+ 42
125

Stage 4 — formal method showing numbers carried underneath

This is the final written method. It is eventually used for adding two or more numbers with any number of digits and decimals with one or two decimal places.
NB. Note position of "carried" numbers.

267
+ 78
345
1 1

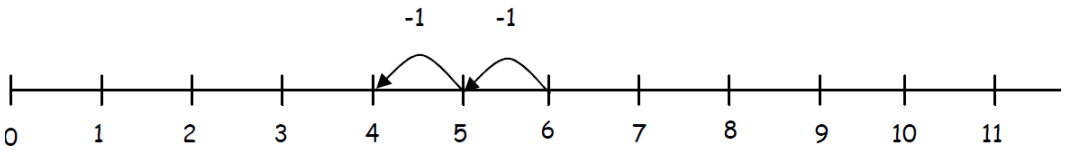
£ 2.36
+£ 7.68
10.04
1 1

5687
+ 7839
13526
1 1 1

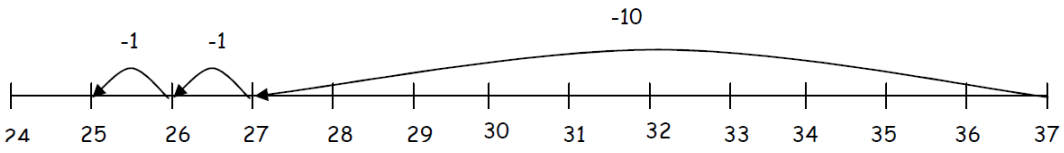
SUBTRACTION

Stage 1 — using structured number lines to count back in ones, tens and hundreds.

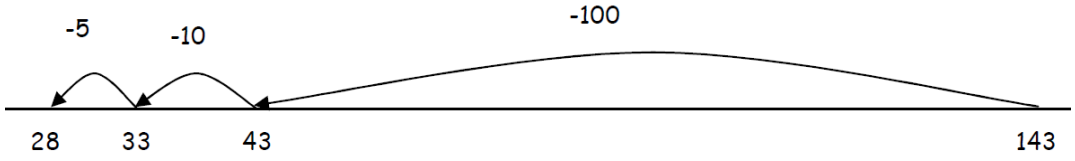
This is initially done using pictures of the objects being counted e.g. If I have 6 apples and I eat 2, I have 4 apples left. In time this pictorial representation is replaced with arrows, (as shown below).
The formal recording of the calculation, 6-2=4, is gradually introduced alongside this.



As the children become more confident in working with larger numbers, they are taught to partition the number (separate into hundreds, tens and units) count back in this way in steps of 10 and 100.
So 37 – 12 = 25 would look like this.



Stage 2 — using unstructured number lines to represent addition



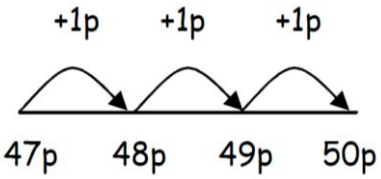
Students are shown how to draw their own number lines and the steps, always partitioning the number to be subtracted and counting back first hundreds, then tens then units. So 143 - 115 becomes 143 – 100 – 10 – 5 = 28.

Stage 3 — using unstructured number lines to perform complementary addition (counting up from the smaller number to the larger number)

NB. For some students the concept of counting on to subtract or find a difference is confusing—therefore this stage should only be taught when children are extremely secure in the idea of subtraction by counting back.

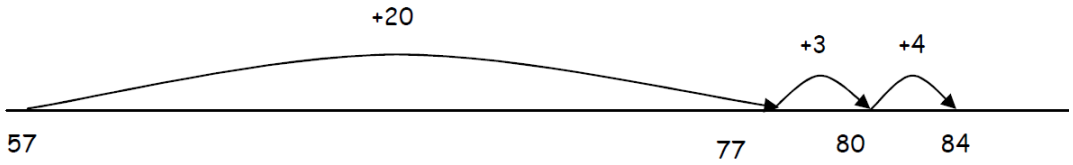
Students will begin by using mental and practical methods to find a small difference.

(E.g. shopkeeper's change—"Stickers cost 47p. John pays with a 50p piece. How much change will he get?" 47p + 3p = 50p rather than 50p - 47p = 3p



This skill is then extended to finding larger differences.

84 – 57 = 27 becomes 57 + ? = 84



Stage 4— moving toward formal vertically arranged subtraction with decomposition.

84-57= rewritten as:

80+4

-50+7

_____

_____

As 7 cannot be subtracted from 4 a Ten is taken and given to the units:

70+14

-50+ 7

20+ 7

This is shortened to:

$^{7}\not{8}^{1}4$

- 5 7

2 7

This is then extended to any number of digits and up to two decimal places.

NB. The first two steps of Stage 4 are used to exemplify to students what is happening in decomposition, they are not recordings the children should use themselves for any length of time.

MULTIPLICATION

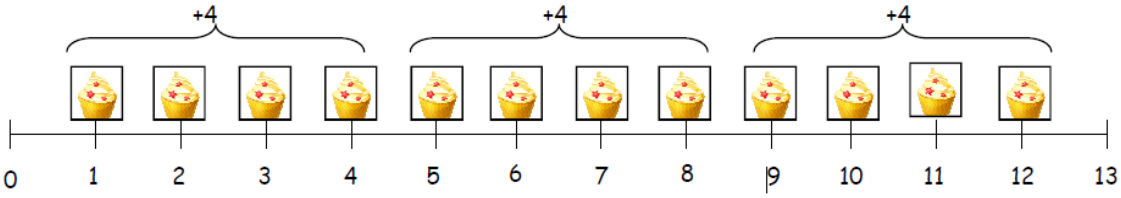
Stage 1 — pictures

students create their own pictures to record practical examples of multiplication.

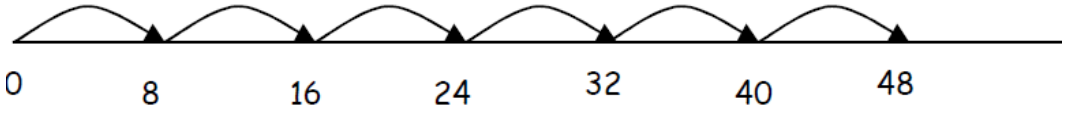
There are 4 cupcakes in each box.
How many cupcakes are there in 3 boxes?

Stage 2 — recording repeated addition

Students use structured number lines to record repeated addition.



This progresses to unstructured number lines so 8 x 6 = 48



Stage 3—first formal written method, known as "The Grid Method"

Once students have a useful recall of multiplication facts up to 10x10, they can begin to record multiplication of larger numbers using this method based on partitioning the numbers to be multiplied. Children should already be aware of this through their understanding of arrays and as a mental strategy.
37x3= (30x3)+(7x3)

x	3
30	90
7	21

90+21=111

This idea is then extended to the multiplications of larger numbers and decimals.
126 x 13 =

x	10	3
100	1000	300
20	200	60
6	60	18

Stage 4— Grid Method (continued).

Mr Brown buys 18 bags of sweets. Each bag costs £1.23. How much does he spend?

x	10	8
1	10	8
0.2	2	1.6
0.03	0.3	0.24

10+8+2+1.6+0.3+0.24= £22.14

Stage 5—second formal written method for multiplication.

Those students who are confident and accurate in their use of the "Grid Method", will be taught formal short multiplication.

The first step is to represent the recording in column format, but showing the working (a). Attention should be drawn to the links to the Grid Method. The recording is then reduced further with carry digits recorded below the line (b).

(a)
$$\begin{array}{r} 30+7 \\ \times\ 3 \\ \hline 90 \quad (30\times3=90) \\ 21 \quad (7\times3=21) \\ \hline 111 \end{array}$$

(b)
$$\begin{array}{r} 37 \\ \times\ 3 \\ \hline 111 \\ \hline {\scriptstyle 2} \end{array}$$

DIVISION

Stage 1—Pictures

Students are shown how to use pictures to represent practical examples of sharing and grouping.

12 children are grouped in teams of four. How many teams are there?



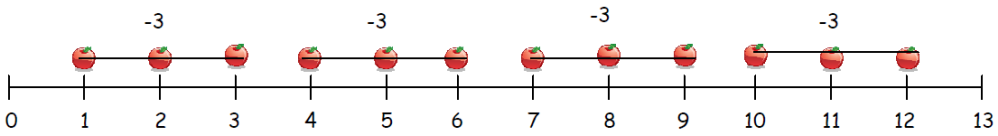
Mrs Brown has made 15 cakes. She shares them equally between her three children. How many cakes do they each get?



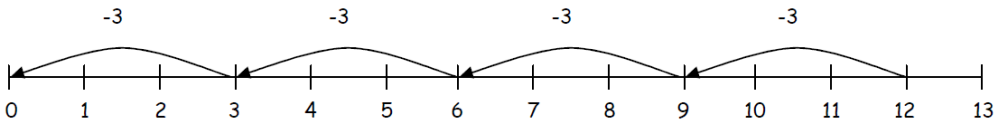
Stage 2—Using structured and eventually unstructured number lines.

Number lines should be used to model division (sharing or grouping) as repeated subtraction.

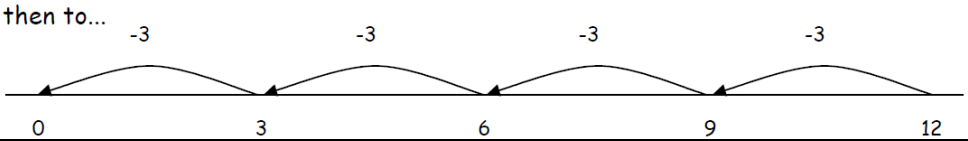
12 apples shared equally between 4 children. 12÷4=



The above leads to...



and then to...



Stage 3—beginning to record mental division using partitioning.

Students are taught to apply their mental recall of multiplication facts and their understanding of partitioning numbers into hundreds, tens and units (or ones), to develop informal recording strategies for division.

For example 91 ÷ 7 = ?

91 is first partitioned into 70 (the highest multiple of 7 and 10 that is less than 91) and 21. Then applying their knowledge of multiplication facts students record that 70 ÷ 7 = 10 and 21 ÷ 7 = 3 10 + 3 = 13 so 91 ÷ 7 = 13.

Further examples:

64÷4 =(40+24)÷4
= (40÷4)+(24÷4)
= 10+6=16

Remainders after division can also be recorded this way

96 ÷ 7 = (70 + 26) ÷ 7
= (70 ÷ 7) + (26 ÷ 7)
= 10 + 3R3 = 13R3

Stage 4—Division by subtracting multiples of the divisor.

This method of recording introduces what is often regarded as the "formal" written method for division. It is closely linked to Stage 3 and mental division strategies.

Initially it would be used for dividing TU÷U, but here is shown for HTU÷TU

How many packs of 24 biscuits can we make from 560 biscuits?

24)560
- 480 (24x20)
80
- 72 (24x3)
8
Answer: 23 R8

At early stages it is appropriate that students would subtract smaller multiples of the divisor e.g. 240 (24x10) and take more "steps".

Stage 5—short division of TU÷U

When students can confidently explain their use of the previous stages they will be taught short division, initially as indicated in example (a) to make the link to the Stage 3 strategy clear, then quickly moving on to using the shortened form (b).

91÷7=

(a)
```
  10+  3
7) 70+21
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QUICKLY MOVE TO

(b)
```
   1  3
7) 9 21
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This is then extended to HTU÷U. For HTU÷TU use Stage 4.

Key Vocabulary

Addition	add, plus, more than, count on, increase, total, altogether, sum, more
Subtraction	subtract, decrease, take away, difference between, minus, count back, less than
Multiplication	multiple, groups of, lots of, product, times, double, repeated addition, arrays
Division	Equal groups of, lots of, divide, share, group, repeated subtraction, factor