Primary Phase Calculation Policy

NLC Primary Phase Calculation Policy

Rationale

This policy is intended to prescribe the progression for the development of written calculations in Mathematics, throughout the primary phase at Netherhall Learning Campus.

The policy is divided into the four operations, and each operation is sub-divided into stages. This is to ensure that the teaching of mathematics meets the needs of individual learners needs and encourage the accelerated progress of learners, in accordance with the new curriculum.

★Please note that these stages do not directly correspond with a year group; Children may be expected to reach stage 5 by the end of year 3. This information is in **bold**.

Children should be exposed to these calculations and operations in a variety of formats and scenarios to ensure concepts are secure. For example; experience of an equals sign in different places within an algorithm.
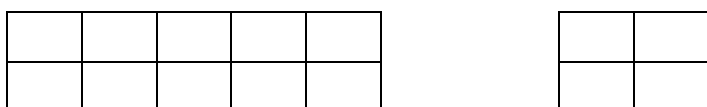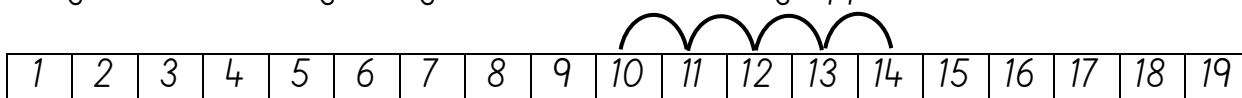
Addition

Stage 1:

Combining sets to make totals

★ Pupils working at Stage 1 need concrete use of practical objects and representations.

Example: 10 + 4 = 14

Progression: moving along a number track using apparatus.

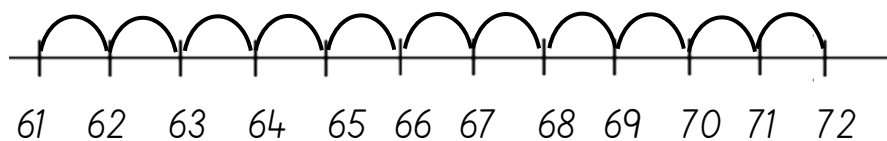| 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Numicon to be used to support throughout stage 1.

Stage 2:

Jumps along a number line (single digit jumps)

Example: 61 + 11 = 72

61   62   63   64   65   66   67   68   69   70 71   72
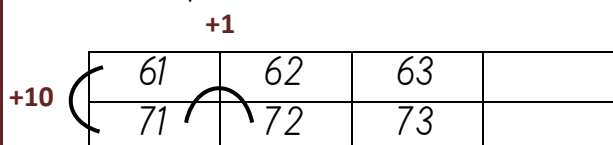
Progression: Using a hundred square.

★ Pupils working at stage 2 need lots of support with bridging 10.

Example: 61 + 11 = 72

+1

61	62	63	
71	72	73	

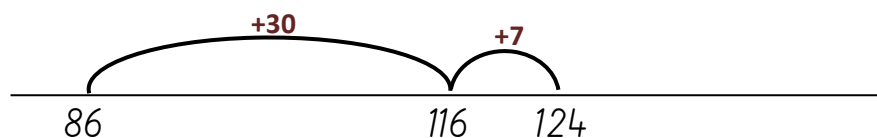**+10**

Stage 3:
Number line Tens and ones + tens and ones (partitioned jumps)

Example: 86 + 37 = 124

★ Pupils working at Stage 3 need explicit teaching and practice of partitioning tens and units.

Stage 4:
Written method by partitioning hundreds, tens and ones
All children must reach this stage before the end of Year 3.

Example: 825 + 48 = 863

100s	10s	1s
800	20	5
	40	8 $+$
800	60	13

★ Children working at stage 4 will still benefit from use of practical resources and equipment to aid understanding alongside columnar recording e.g. dienes blocks, numicon, place value arrow cards.

Stage 5:
Efficient written method (Columnar Addition)
All children should experience stage 5 with HTU by the end of Year 3. Most children will be fluent with using columnar addition by this time.

Example: 587 + 473 = 1062

	100s	10s	1s
	5	8	7
	4	7	3 $+$
1	0	6	0
	①	①	

4

- ★ All children must record place value above calculations
- ★ Introduce with examples without carrying.
- ★ When carrying is introduced, ensure children circle all carried digits, when they are added to the column total.
- ★ Explain that carries are a ten, hundred or thousand so they must be carried over to the appropriate column.
- ★ Place value should be constantly reinforced with apparatus.

Stage 6:
Efficient written method with decimals (Columnar Addition)

★ Children must have a secure understanding of decimal place value and notation before progressing to this stage.

Example: 9.56 + 6.72 = 16.28

10	1	.	$\frac{1}{10}$	$\frac{1}{100}$	
	9	.	5	6	
	6	.	7	2	+
1	6	.	2	8	

⑴

Models and Images

Stage 1 -4 supported by numicon,
Stage 2-3 supported by hundred square and number lines.
Stage 4-5 exchanges supported by place value counters

Subtraction

Stage 1:
Complementary Addition
Begin with counting on from objects of the smaller number and count up to the larger number. 'How many more make?'
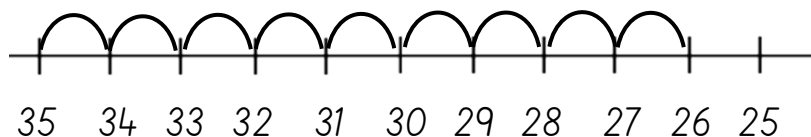
Example: 9 - 4 = 5

Progression: Count back using physical objects and representations. Begin with 9 objects, then 'take away' 4.
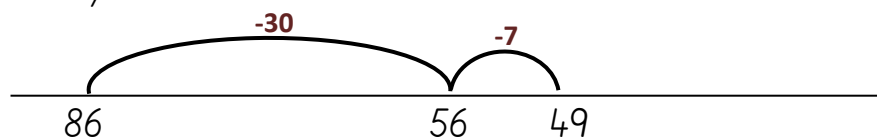
Stage 2:
Taking away (single digit jumps)

Example: 35 - 9 = 26

35 34 33 32 31 30 29 28 27 26 25

Progression: using jumps of multiples of 10.

Example 86 - 37 =

-30   -7

86   56   49

★ Pupils working at Stage 2 need explicit teaching and practice of partitioning tens and ones. Pupils may also need to continue subtracting ones in jumps of 1.
The biggest number must go first on the number line, to aid understanding in columnar method.

<u>Stage 3:</u>
<u>Decompostion using partitioning</u>

Example: 84 - 53 = 31

With Carrying...
Example: 84 - 56 = 28

10s	1s	
80	4	_
50	3	
30	1	

80	4	
50	6	—

70	14	
50	6	—
20	8	

★ Model exchanges using place value counters.

<u>Stage 4:</u>
<u>Decomposition by partitioning hundreds, tens and ones</u>
All children must reach this stage before the end of Year 3.

Example: 754 - 86 = 668

100s	10s	1s	
600 700 140 50	14		—
	80	6	
600	60	8	

★ Children working at stage 4 will still require modelling and use of place value counters.

<u>Stage 5:</u>
<u>Decomposition (hundreds, tens and ones)</u>
All children should experience stage 5 by the end of Year 3. Most children will be fluent with using efficient decomposition by this time.

Example: 754 - 286 = 468

100s	10s	1s	
⁶7	¹⁴5	4	_
2	8	6	
4	6	8	

★ All children must record 1000s 100s 10s 1s above calculations

- ★ Explain that exchanges are tens, hundreds or thousands as appropriate so they must be carried from that column to the next column along as their value stays the same. As a result, place value columns cannot be missed.
- ★ Place value should be constantly reinforced with apparatus.

Stage 6:
Decompostion (Involving thousands and decimals)
★ Children must have a secure understanding of decimal place value and notation before progressing to this stage.

Example: 6467 - 2684 = 3783

1000s	100s	10s	1s	
5̶6̶	¹³4̶	16	7	—
2	6	8	4	
3	7	8	3	

Models and Images
Stages 1-3 to be supported by numicon
Stages 2-4 to be supported by number lines
Stages 3-5 to be supported by place value counters

Multiplication

Times tables

Year 1: multiples of 2, 5, 10

Year 2: Continue securing Y1 multiplication tables with more able learners to move onto multiples of 3 and 4.

Year 3: Multiplication tables for 3's, 4's and 8's, and related division facts for these.
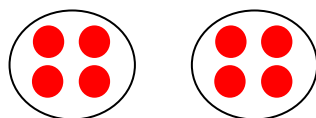
Year 4: All multiplication and related division facts up to 12 x 12.

Year 5 and 6: Continue with these facts 'on the boil' and introduce cube and square numbers.

Stage 1:
Doubles (Lots of 2)

Example: 4 + 4 = 8 (4 x 2 = 8)

★ Use practical resources to model this stage, to enforce notion of making 'lots of'.

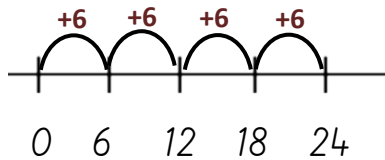## Stage 2:
Repeated addition

Example: 2 + 2 + 2 + 2 = 8

4 x 2 = 8
2 x 4 = 8

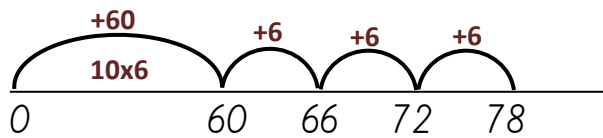★ Introduce using physical objects then progress to recording as an array.

Stage 3:
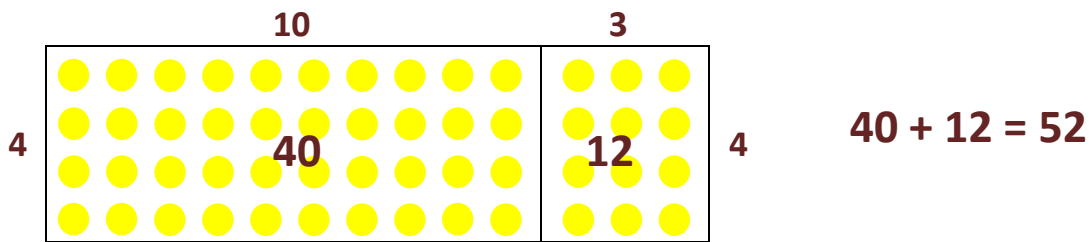### Repeated addition using a number line

Example 6 x 4 = 24

+6   +6   +6   +6

0   6   12   18   24

Example: (using known facts) 13 x 6 = 78

+60   +6   +6   +6

10x6

0   60   66   72   78

Stage 4:
Link arrays with grid method TU x U

Example: 13 x 4 = 52

40 + 12 = 52

⭐ Use grid method to apply when appropriate

x	10	3
4	40	12

40 + 12 = 52

Stage 5:
Grid method, used to introduce short multiplication (TU x U and HTU x U)
Children should be confident with this stage by the end of year 4.

Example: 136 x 5 = 680

x	100	30	6
5	500	150	30

500 + 150 + 30 = 680

Progression: Expanded short multiplication. (least significant digit first).

Example: 136 x 5 = 680

```
100s    10s    1s
1       3      6
               5  x
_____
        3      0  (5 x 6)
1       5      0  (5 x 30)
5       0      0  (5 x 100)
6       8      0
_____
```

★ Any carries should be circled as they are added to the column total.

<u>Stage 6:</u>
<u>Multiplication ThHTU x U and multiplying by TU using a formal written method.</u>
All Y5, and more able year 4 children should reach this stage by the end of Year 5.

Example: 1365 x 6 = 8190

```
1000s   100s   10s    1s
1       3      6      5
                      6  x
_____
               3      0
        3      6      0
1       8      0      0
6       0      0      0
8       1      9      0
ⓛ
```

Progression: Expanded written form for TU X TU

```
1000s   100s   10s    1s
               7      2
               3      8  x
_____
               1      6  (8 x 2)
        5      6      0  (8 x 70)
               6      0  (30 x 2)
2       1      0      0  (30 x 70)
2       7      3      6
               ⓛ
```

> Numbers should be multiplied from the bottom to the top.

<u>Stage 7:</u>
```

> Numbers should be multiplied from the bottom to the top.

_Long Multiplication (TH H T U x TU)_
_All Children must reach this stage by the end of year 6._

_Example: 38 x 72 = 2736_

|  1000s | 100s | 10s | 1s |
|---|---|---|---|
|  |  | 3 | 8 |
|  | (5) | 7 | 2 x |
|  |  | 7 | 6 |
| 2 | 6 | 6 | 0 |
| 2 | 7 | 3 | 6 |
|  |  | (1) |  |

★ Explain to children why the 0 has been added. On this row we are now multiplying by a ten, so we need all the digits to move one place to the left as when we multiply any number by 10.
Any carries when multiplying are put above the line, and circled only when added.

_Progression for Y5 and Y6: Multiplying by decimals._

## Models and Images
_Stages 1 and 2 - Practical counting and grouping resources. Teddies and Hoops etc. Use of numicon to support doubling and early multiplying._
_Stages 3 - 6 - Place value counters_

# Division

### Stage 1:
Halving (Sharing by 2)

Example: Half of 6 = 3

★ Use practical resources to model this stage, to enforce notion of sharing.

### Stage 2:
Grouping

Example: 6 ÷ 3 = 2

Sharing Equally 6 ÷ 3 = 2

★ Introduce division symbol at this stage. Use 'groups of' language

### Stage 3:
Counting Backwards using a number line

Example 12 ÷ 3 = 4

-3   -3   -3   -3

12   9   6   3   0

*Example: (with remainders) 17 ÷ 5 = 3 r 2*



## Stage 4:
### Number Line using known facts
Y4 children should move on to use short division as soon as they are secure with this stage.

*Example: 147 ÷ 7 = 21*



★ Children working at stage 4 will still benefit from use of practical resources and representations to reinforce the concept of division as sharing as well as **'How many groups of 7 are there in 147?'**. E.g. venn diagram hoops and counting bears.

## Stage 5:
### Short division (dividing by 1s)
All children should reach this stage by the end of Year 5. More able year 4 learners should also have experience of this stage.

*Example: 896 ÷ 7 = 128*



★ Possible script: **How many groups of 7 are in the hundreds?** 1, so we put a 1 in the hundreds column. There is 1 hundred left over, so we carry it over here to the tens to make 19 tens, like in subtraction. 'How many groups of 7 are there in 19 tens? ...'

*Example: (with remainders) 432 ÷ 5 = 86 r 2*

```
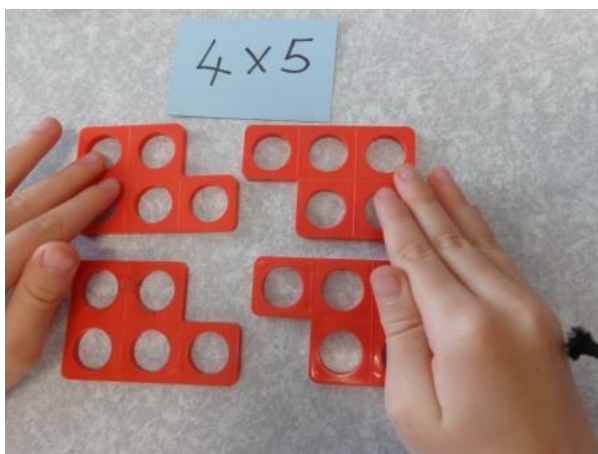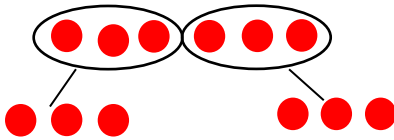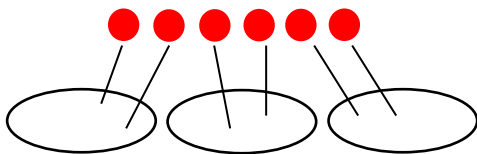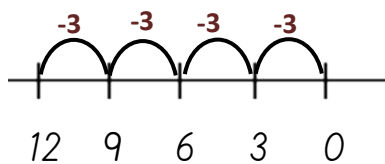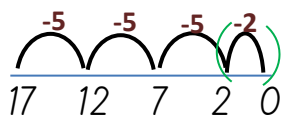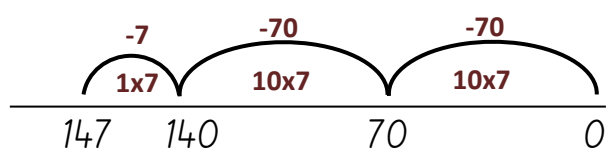      100s  10s  1s
             8   6   r 2
       5 | 4   3   ³2
```

Stage 6:
Long Division (dividing by 10s and 1s)
Children must reach this stage by the end of year 6. More able year 5 learners should also have experience of this stage.

Example: 432 ÷ 15 = 28.8

```
      100s 10s 1s  .  1/10
              2  8  .  8
        15 | 4  3  2  .  0
              3  0 ↓
              ‾‾‾‾
              1  3  2
              1  2  0
              ‾‾‾‾
                 1  2  .  0
                 1  2  .  0
                 ‾‾‾‾‾‾‾
                       0
```

Models and Images
Stages 1-3 to be supported by numicon and grouping hoops.
Stages 3-4 to use numberlines to support
Stages 3-5 to be supported by place value counters