THE FEDERATION OF NETTLESTONE & NEWCHURCH PRIMARY SCHOOLS

CALCULATION APPENDICES

Date Agreed: March 2014

Review Date: March 2015

Signed: _____

Chairman Board of Governors

The Federation of Nettlestone & Newchurch Primary Schools

APPENDIX 1 - PROGRESSION OF WRITTEN CALCULATIONS (Method Examples)

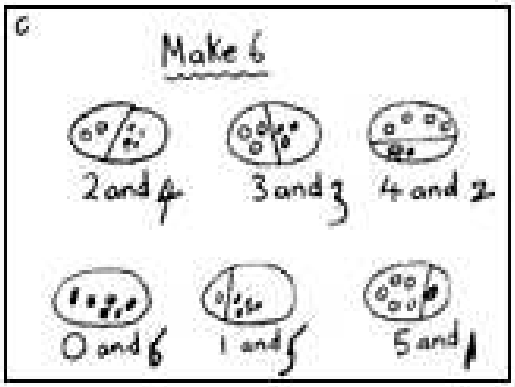
ADDITION

KEY STAGE ONE

The emphasis in Key Stage One will be on practical experiences and activities, which are important to develop the children's mathematical concepts.

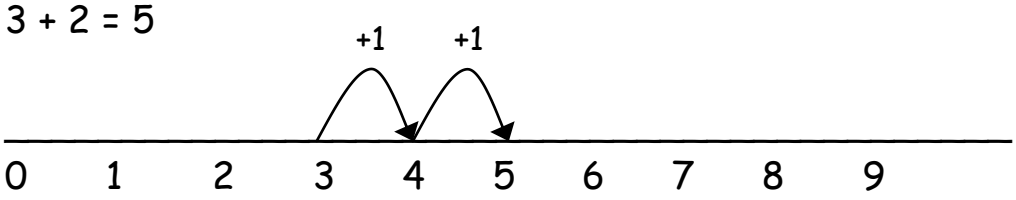
Reception and Year 1

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.



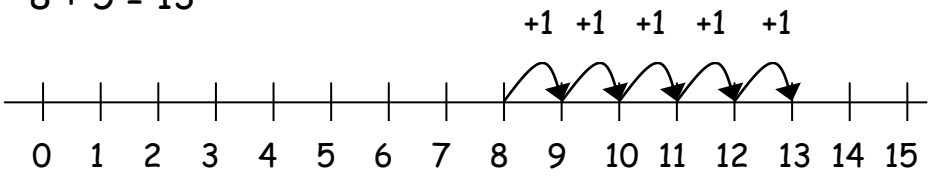
They use numberlines and practical resources to support calculation and teachers *demonstrate* the use of the numberline.

3 + 2 = 5

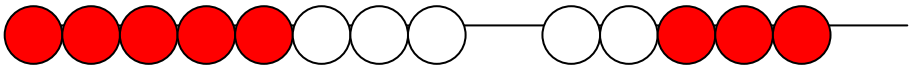


Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.

8 + 5 = 13



Bead strings or bead bars can be used to illustrate addition including bridging through ten by counting on 2 then counting on 3.

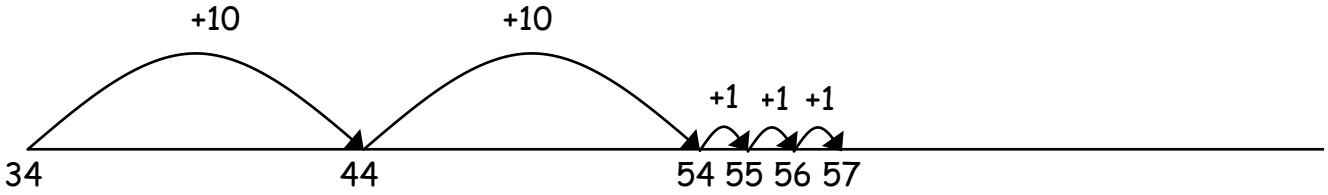


Year 2

Children will begin to use 'empty number lines' themselves starting with the larger number and counting on.

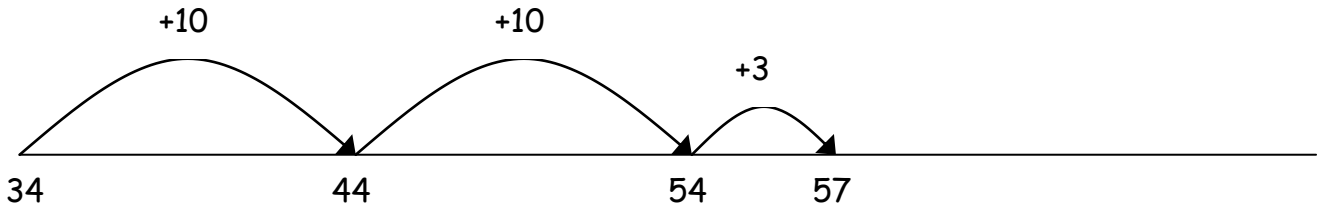
✓ First counting on in tens and ones.

34 + 23 = 57



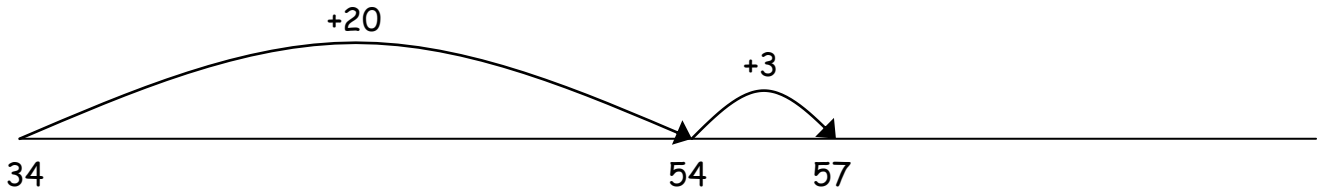
✓ Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57



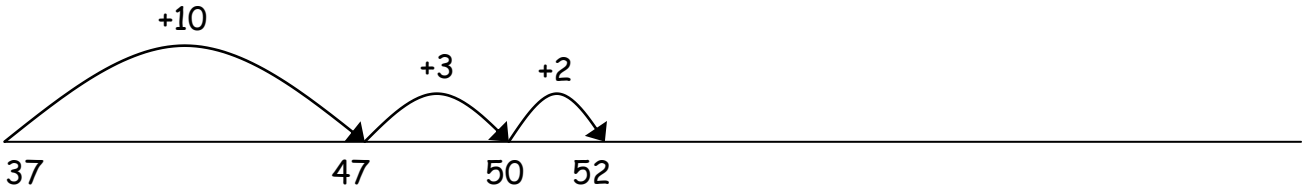
✓ Followed by adding the tens in one jump and the units in one jump.

34 + 23 = 57



- ✓ Bridging through ten can help children become more efficient.

37 + 15 = 52



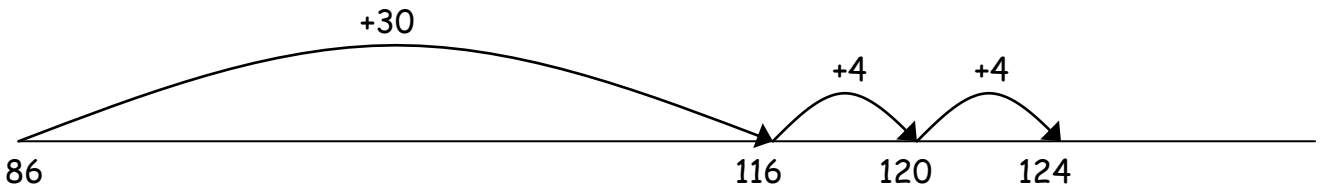
KEY STAGE TWO

Year 3

Children will continue to use empty number lines with increasingly large numbers, including compensation where appropriate.

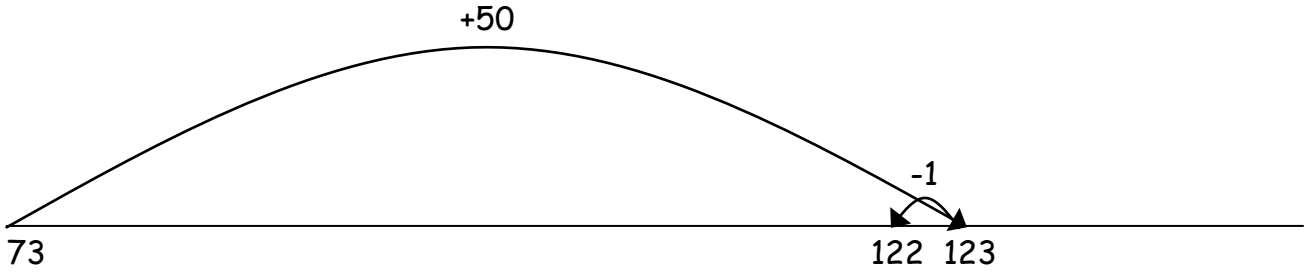
- ✓ Count on from the largest number irrespective of the order of the calculation.

38 + 86 = 124



- ✓ Compensation

49 + 73 = 122



Children will begin to use informal pencil and paper methods (jottings) to support, record and explain partial mental methods building on existing mental strategies.

Children will learn to partition numbers, for example, into tens and units and add the most significant digits first.
E.g.

57 + 22 = (50 + 20) + (7 + 2)
= 70 + 9
= 79

Children will then move onto the vertical method for addition adding the most significant digits first.

```
  67
+ 24
  80  (60 + 20)
  11  ( 7 +  4)
  91
```

```
  267
+  85
  200
   140  (60 + 80)
    12  ( 7 +  5)
  352
```

Year 4

Children will move to adding the least significant digits first in preparation for 'carrying'.

```
   67
+  24
   11    Add mentally
   80
   91
```

The above would be used as an explanation to the children but they **would not** be expected to set it out like this in their books.

The children will begin to carry below the line and their work should look like this:

625	783	367
+48	+42	+85
673	825	452
1	1	1 1

Using similar methods, children will:

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more three-digit sums of money, with or without adjustment from the pence to the pounds;*
- ✓ *know that the decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. £3.59 + 78p.*

Year 5

Adding the least significant digits first.

```
    587                    7587
+   475                +   675
    12  )                  12  )
   150  ) add mentally    150  ) add mentally
   900  )                 1100  )
  1062                    7000  )
                          8262
```

The above would be used as an explanation to the children but they **would not** be expected to set it out like this in their books.

The children should extend the carrying method to numbers with at least four digits.

```
  587          3587
+ 475        +  675
 1062         4262
  1 1         1 1 1
```

Using similar methods, children will:

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more decimal fractions with up to three digits and the same number of decimal places;*
- ✓ *know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 3.2 m – 280 cm.*

Year 6

Children should extend the carrying method to number with any number of digits.

```
  7648          6584            42
+ 1486        + 5848          6432
  9134         12432           786
  1 1 1        1 1 1             3
                             + 4681
                               11944
                               1 2 1
```

Using similar methods, children will

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more decimal fractions with up to four digits and either one or two decimal places;*
- ✓ *know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 401.2 + 26.85 + 0.71.*

SUBTRACTION

KEY STAGE ONE

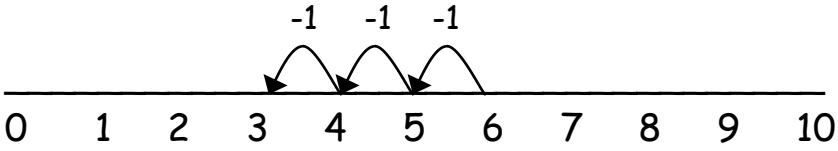
The emphasis in Key Stage One will be on practical experiences and activities, which are important to develop the children's mathematical concepts.

Reception and Year 1

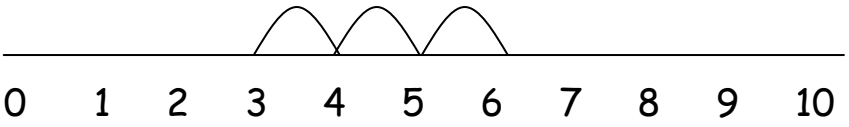
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.

They use numberlines and practical resources to support calculation. Teachers *demonstrate* the use of the numberline.

6 – 3 = 3

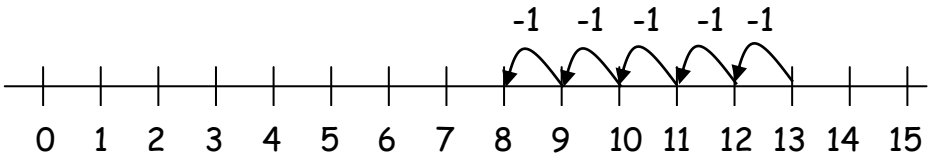


The numberline should also be used to show that 6 - 3 means the 'difference between
6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.



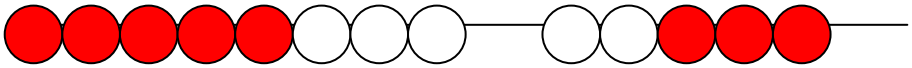
Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

13 – 5 = 8



Bead strings or bead bars can be used to illustrate subtraction including bridging through ten by counting back 3 then counting back 2.

13 – 5 = 8



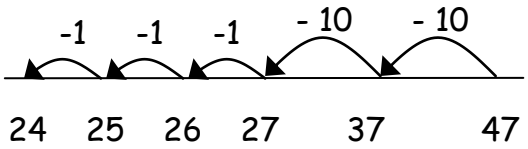
Year 2

Children will begin to use empty number lines to support calculations.

Counting back

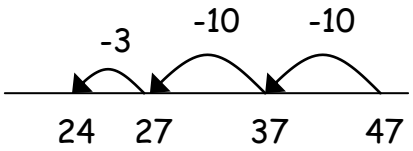
✓ First counting back in tens and ones.

47 – 23 = 24



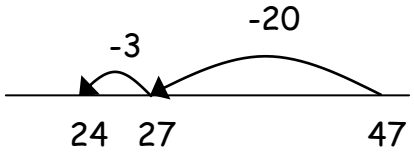
✓ Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



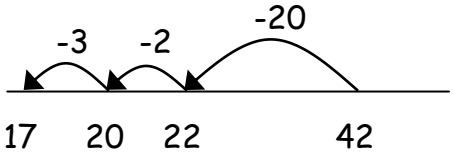
✓ Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



✓ Bridging through ten can help children become more efficient.

42 – 25 = 17



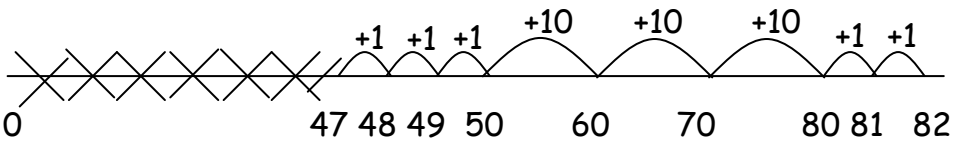
Counting on

If the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on.

Count up from 47 to 82 in jumps of 10 and jumps of 1.

The number line should still show 0 so children can cross out the section from 0 to the smallest number. They then associate this method with 'taking away'.

82 - 47



Help children to become more efficient with counting on by:

- ✓ Subtracting the units in one jump;
- ✓ Subtracting the tens in one jump and the units in one jump;
- ✓ Bridging through ten.

KEY STAGE TWO

Year 3

Children will continue to use empty number lines with increasingly large numbers.

Children will begin to use informal pencil and paper methods (jottings) to support, record and explain partial mental methods building on existing mental strategies.

Partitioning and decomposition
This process should be demonstrated using arrow cards to show the partitioning and base 10 materials to show the decomposition of the number.

NOTE When solving the calculation 89 – 57, children should know that 57 **does NOT EXIST AS AN AMOUNT** it is what you are subtracting from the other number. Therefore, when using base 10 materials, children would need to count out only the 89.

89	=	80	→	9	
- 57		50	→	7	
		30	→	2	= 32

Initially, the children will be taught using examples that do not need the children to exchange.

From this the children will begin to exchange.

71	=		=		
- 46					

Step 1 70 → 1

- 40 → 6

Step 2 60 → 11

- 40 → 6

20 + 5 = 25

The calculation should be read as e.g. take 6 from 1.

This would be recorded by the children as

60

~~7~~0 ^{1}1

- 40 → 6

20 → 5 = 25

Children should know that units line up under units, tens under tens, and so on.

Year 4

Decomposition

755			700	50	5	
- 86	=			80	6	
	=		700	40	15	
		-		80	6	
	=		600	140	15	
		-		80	6	
			600	60	9	= 669

The above would be used as an explanation to the children but they **would not** be expected to set it out like this in their books.

Children should set it out like this:

614 1

~~7~~~~5~~4

- 86

668

Extend to decimals.
Begin to find the difference between two three-digit sums of money, with or without "adjustment" from the pence to the pounds. Know that decimal points should line up under each other.

£8.95 - £4.38

Year 5

Decomposition

	1755		1000	700	50	5
-	286	=		200	80	6
			1000	700	40	15
		=		200	80	6
			1000	600	140	15
		=		200	80	6
			1000	400	60	8

The above would be used as an explanation to the children but they **would not** be expected to set it out like this in their books.

They should set it out like this:

```
  614 1
  1754
- 286
------
  1468
```

Extend to decimals.
Find the difference between two decimal fractions with up to three digits and the same number of decimal places. Know that decimal points should line up under each other.

19.42
-6.78

Year 6

Decomposition

```
  5 13 1
  6 4 6 7
- 2 6 8 4
  3 7 8 3
```

Extend to decimals.
Subtract two or more decimal fractions with up to three digits and either one or two decimal places. Know that decimal points should line up under each other.

```
324.90
-  7.25
```

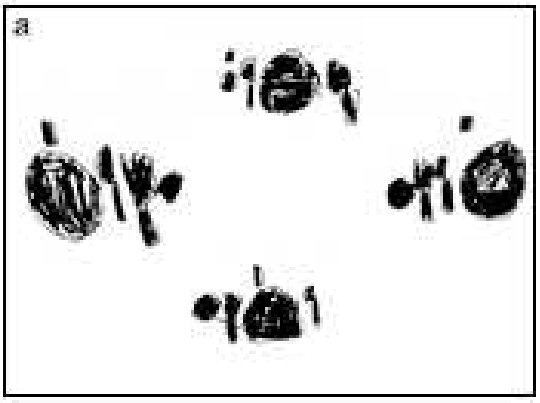
MULTIPLICATION

KEY STAGE ONE

The emphasis in Key Stage One will be on practical experiences and activities, which are important to develop the children's mathematical concepts.

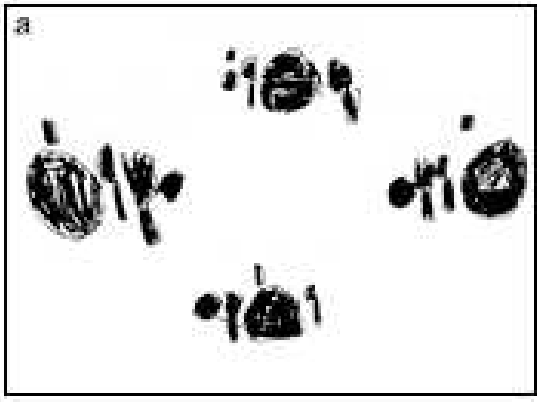
Reception

Children will understand equal groups and share items out in play and problem solving.



Year 1

Children will understand equal groups and share items out in play and problem solving.
They will count in 2s and 10s and later in 5s.



Year 2

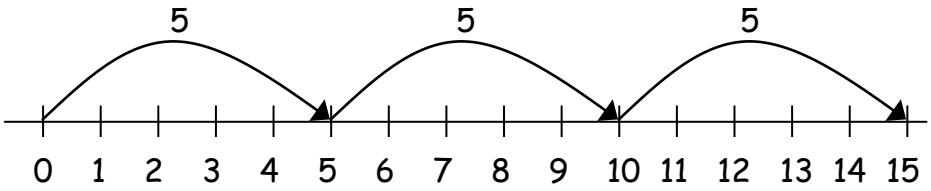
Children will develop their understanding of multiplication and use jottings to support calculation:

- ✓ **Repeated addition**

3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 5 x 3

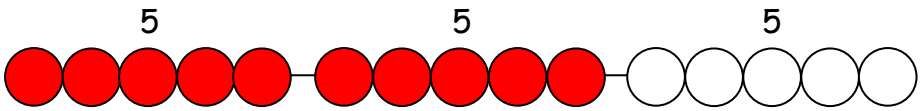
Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5



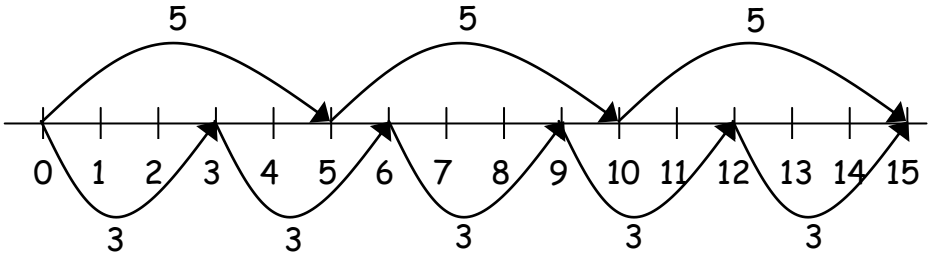
and on a bead bar:

5 x 3 = 5 + 5 + 5



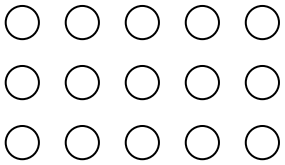
- ✓ **Commutativity**

Children should know that 3 x 5 has the same answer as 5 x 3. This can also be shown on the number line.



✓ **Arrays**

Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



5 x 3 = 15

3 x 5 = 15

KEY STAGE TWO

Year 3

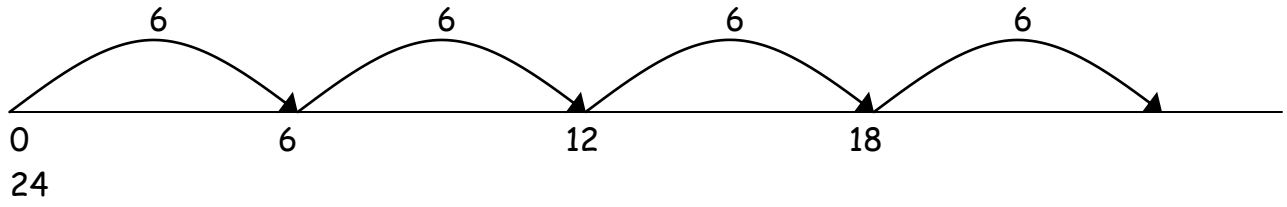
Children in Year 3 continue to work mentally and informally on multiplication.

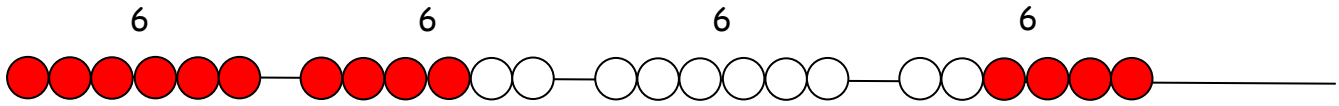
Children will continue to use:

✓ **Repeated addition**

4 times 6 is 6 + 6 + 6 + 6 = 24 or 4 lots of 6 or 6 x 4

Children should use number lines or bead bars to support their understanding.





Arrays

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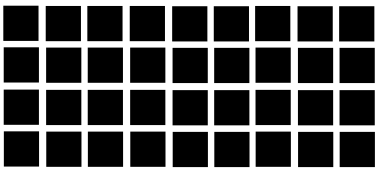


9 x 4 = 36

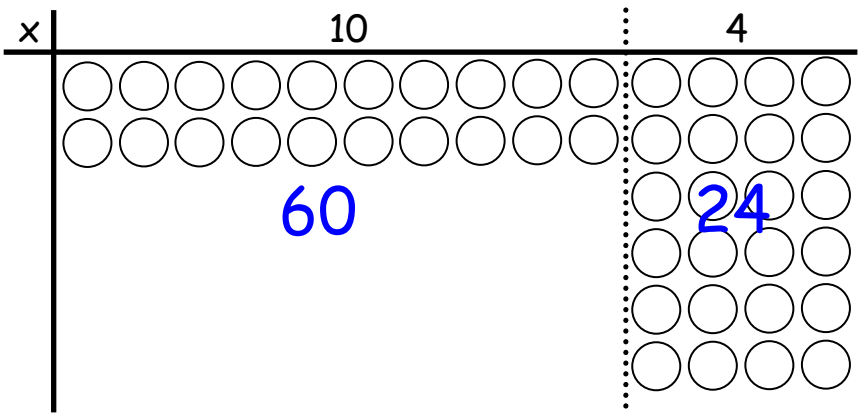
9 x 4 = 36

Partitioning

38 x 5 = (30 x 5) + (8 x 5)
= 150 + 40
= 190

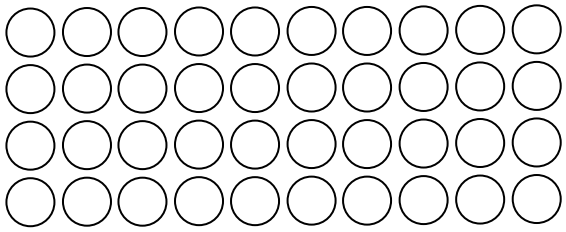
Year 4

Children will continue to use arrays where appropriate leading into the grid method of multiplication.



(6 x 10) + (6 x 4)

60 + 24

6 

Grid method

TU x U
(Short multiplication – multiplication by a single digit)

23 x 8

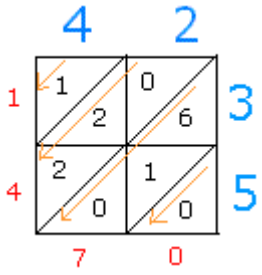
Children will approximate first
23 x 8 is approximately 25 x 8 = 200

x	20	3
8	160	24

160
+ 24
184

Lattice method
(Short multiplication – multiplication by a single digit)

42 x 35 = 1470



Year 5

In Year 5 the compact method for multiplication will be introduced to the children, which builds on their knowledge of the grid and lattice method.

Short Multiplication (HTU × U)

$$
\begin{array}{rl}
 & 346 \\
\times & \underline{\quad 9} \\
 & 54 \quad (6 \times 9) \\
 & 360 \quad (40 \times 9) \\
 & \underline{2700} \quad (300 \times 9) \\
 & 3114
\end{array}
$$

The above would be used as an explanation to the children.
The children would be expected to set it out as below:

$$
\begin{array}{rl}
 & 346 \\
\times & \underline{\quad 9} \\
 & \underline{3114} \\
 & {\scriptstyle 4\ 5}
\end{array}
$$

Long Multiplication (TU × TU)

The children would be expected to set it out as follows:

$$
\begin{array}{r}
46 \\
\times 28 \\
\hline
368 \\
\ {\scriptstyle 4} \\
920 \\
{\scriptstyle 1}\ \ \ \\
\hline
1288 \\
\ \ \ {\scriptstyle 1}\ \ \
\end{array}
$$

Extend to decimals.
Multiply by a single digit, approximating first. Know that decimal points should line up under each other.

4.9 × 3

$$
\begin{array}{r}
4.9 \\
\times \quad 3 \\
\hline
14.7 \\
\ {\scriptstyle 2}\ \ \
\end{array}
$$

Year 6

Long multiplication (HTU × TU)

$$
\begin{array}{r}
336 \\
\times \quad 29 \\
\hline
3024
\end{array}
$$

```
   3 5
 6 7 2 0
   1
 _______
 9 7 4 4
```

Extend to decimals.
Multiply by a single digit, approximating first. Know that decimal points should line up under each other.

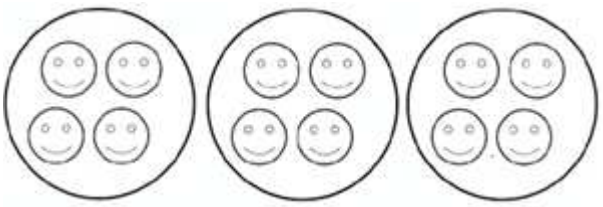
```
   3.6 2
 ×     3
 _______
 1 0.8 6
   1
```

DIVISION

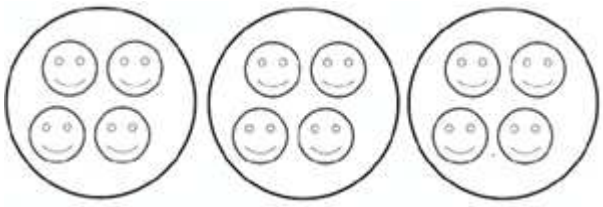
KEY STAGE ONE

The emphasis in Key Stage One will be on practical experiences and activities, which are important to develop the children's mathematical concepts.

Reception
Children will understand equal groups and share items out in play and problem solving.



Year 1
Children will understand equal groups and share items out in play and problem solving.
They will count in 2s and 10s and later in 5s.

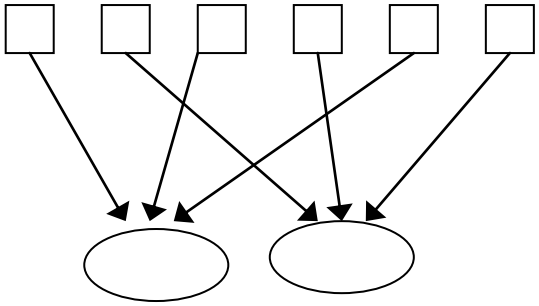


Year 2

Children will develop their understanding of division and use jottings to support calculation

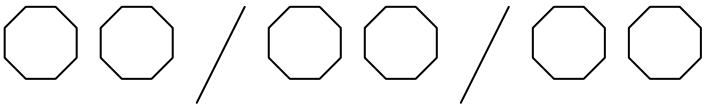
✓ **Sharing equally**

6 sweets shared between 2 people, how many do they each get?



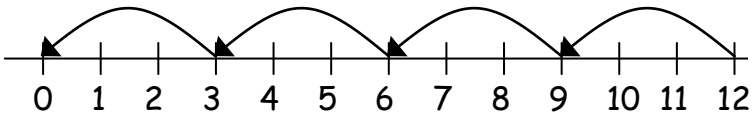
✓ **Grouping or repeated subtraction**

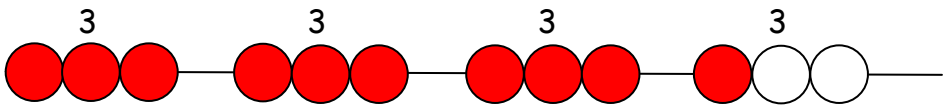
There are 6 sweets, how many people can have 2 sweets each?



✓ **Repeated subtraction using a number line or bead bar**

12 ÷ 3 = 4





The bead bar will help children with interpreting division calculations such as 10 ÷ 5 as 'how many 5s make 10?'

- ✓ **Using symbols to stand for unknown numbers to complete equations using inverse operations**

□ ÷ 2 = 4 20 ÷ △ = 4 □ ÷ △ = 4

KEY STAGE TWO

Children must be secure in both their tables and in multiplication methods before they can cope with division.

Year 3

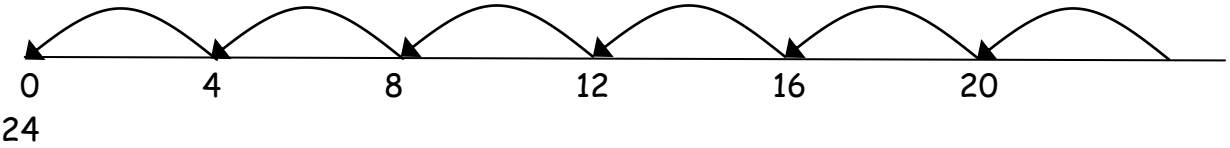
Ensure that the emphasis in Y3 is on grouping rather than sharing.

Children will continue to use:

- ✓ **Repeated subtraction using a number line**

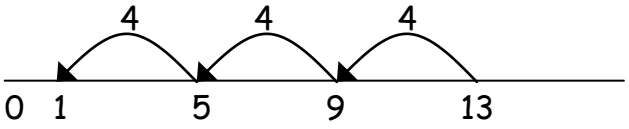
Children will use an empty number line to support their calculation.

24 ÷ 4 = 6



Children should also move onto calculations involving remainders.

13 ÷ 4 = 3 r 1



Understand that division is the inverse of multiplication and that division facts can be derived from multiplication sums.

Using symbols to stand for unknown numbers to complete equations using inverse operations

$26 \div 2 = \square$ $24 \div \triangle = 12$ $\square \div 10 = 8$

Year 4

Short division (TU ÷ U)

96 ÷ 6

```
   16
6 | 96
  - 60   (10 × 6)
    36
  - 36   (6 × 6)
     0
```

Year 5

Short division (HTU ÷ U)

196 ÷ 6

```
   32 r 4
6 |
    196
  - 180   (30 × 6)
     16
  -  12   ( 2 × 6)
      4
```

Year 6

Continue to work on short division – see Year 5.

Long division (HTU ÷ TU)

972 ÷ 36

```
   27
36 | 972
   - 720   (20 × 36)
     252
   - 252   (7 × 36)
       0
```

Extend to decimals with up to two decimal places.
Children need only be able to do simple division with decimals and they should work most out mentally, only using repeated subtraction when necessary.

87.5 ÷ 7

```
    12.5
7 ) 87.5
  - 70      (10 × 7)
    17.5
  - 14      (2 × 7)
     3.5
     3.5    (0.5 × 7)
     0.0
```