Carlton Miniott Mathematical Calculation Policy

PROGRESSION THROUGH CALCULATIONS FOR ADDITION

MENTAL CALCULATIONS

(ongoing)

These are a **selection** of mental calculation strategies:

See NNS Framework Section 5, pages 30-41 and Section 6, pages 40-47

Mental recall of number bonds

6 + 4 = 10 □ + 3 = 10

25 + 75 = 100 19 + □ = 20

Use near doubles

6 + 7 = double 6 + 1 = 13

Addition using partitioning and recombining

34 + 45 = (30 + 40) + (4 + 5) = 79

Counting on or back in repeated steps of 1, 10, 100, 1000

86 + 57 = 143 (by counting on in tens and then in ones)

460 - 300 = 160 (by counting back in hundreds)

Add the nearest multiple of 10, 100 and 1000 and adjust

24 + 19 = 24 + 20 – 1 = 43

458 + 71 = 458 + 70 + 1 = 529

Use the relationship between addition and subtraction

36 + 19 = 55 19 + 36 = 55

55 – 19 = 36 55 – 36 = 19

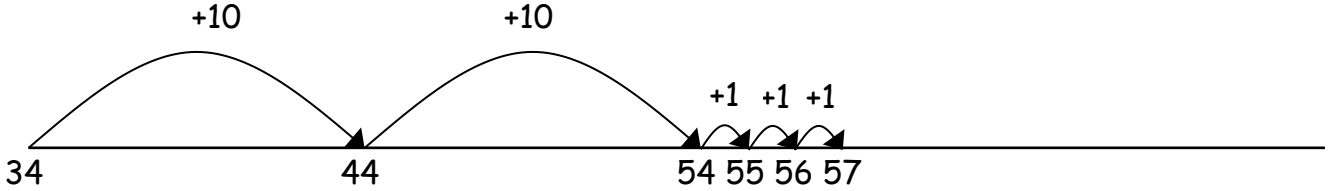
MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

Number lines will be used by children, using the following progression to support their mental strategies.

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

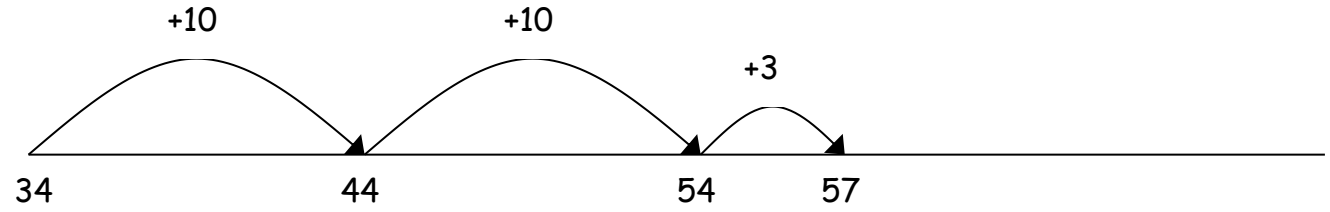
- ✓ First counting on in tens and ones.

34 + 23 = 57



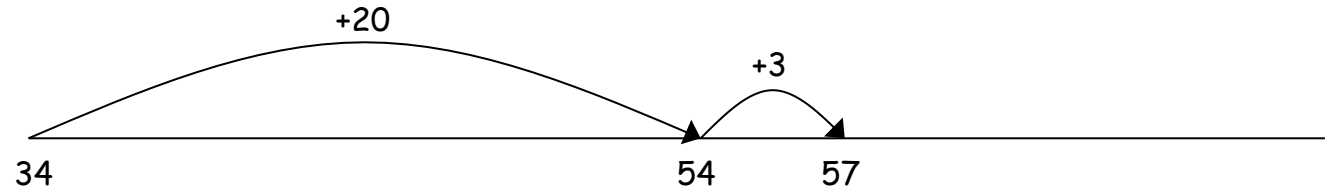
- ✓ Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57



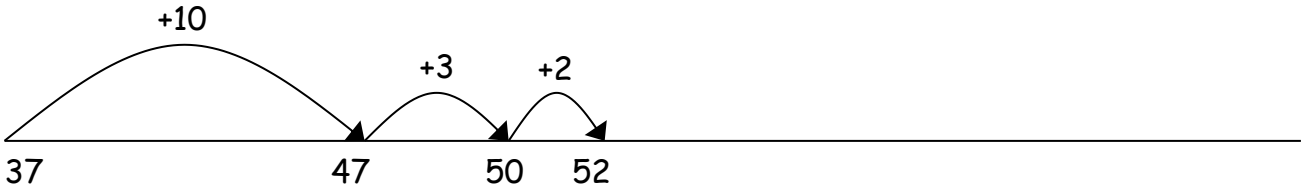
✓ Followed by adding the tens in one jump and the units in one jump.

34 + 23 = 57



✓ Bridging through ten can help children become more efficient.

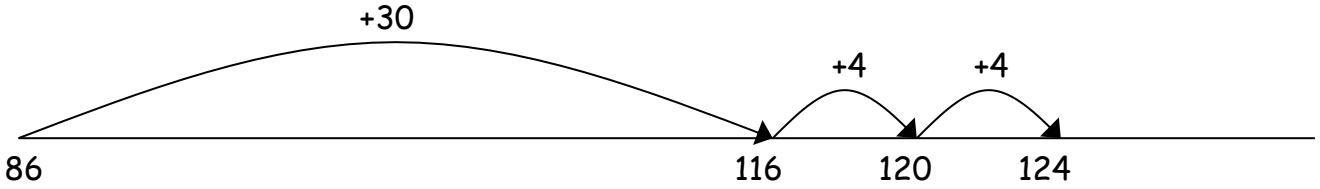
37 + 15 = 52



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

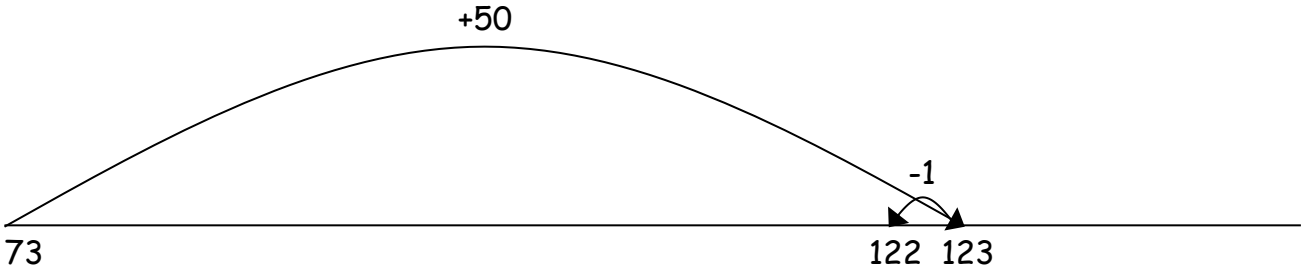
✓ Count on from the largest number irrespective of the order of the calculation.

38 + 86 = 124



✓ Compensation

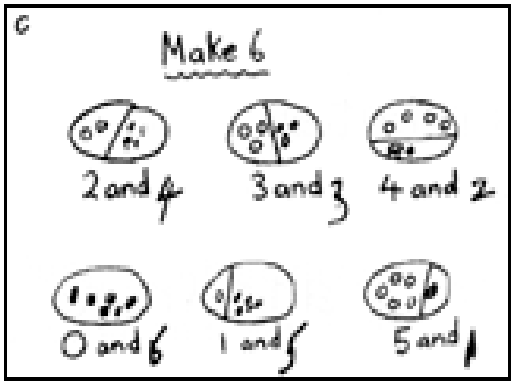
49 + 73 = 122



THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

YR and Y1

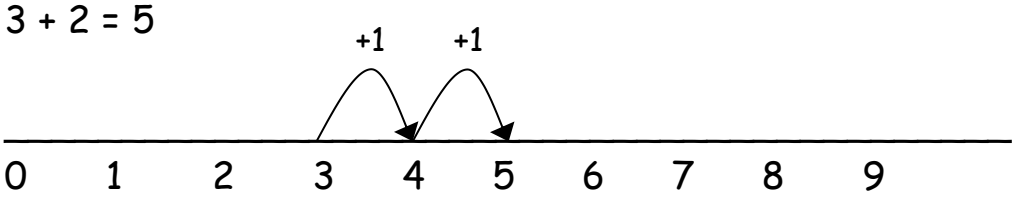
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.



They use practical resources such as Numicon and Deines (tens and ones) to support their calculation. This will help the children to recognise number bonds (using Numicon) and crossing the tens (using Deines).

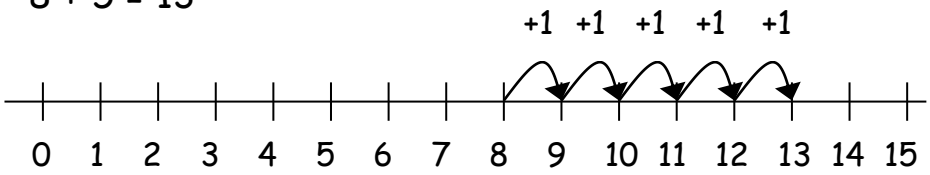
They use numberlines alongside practical resources to support calculation and teachers *demonstrate* the use of the numberline.

3 + 2 = 5

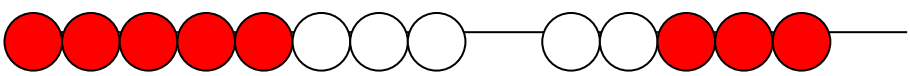


Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.

8 + 5 = 13



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



WRITTEN METHODS

Y2

The majority of children will continue to use Dienes and Numicon to practically solve addition calculations. As a prerequisite to the formal column method they will be taught to add the ones then the tens.

Y3

Children will begin to record using a formal column method although apparatus such as Deines will be used to support.
Children must write TO or HTO at the top with a line underneath.
Ensure the = sign is at the bottom for the answer to be written in.
Children are taught to add the ones first

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

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

Y4 Onwards

Children will begin to carry above the line. Teacher will use discretion as to whether children need to write HTO at the top of the column method.

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

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.
- ✓ 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.

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

MENTAL CALCULATIONS (ongoing)

These are a **selection** of mental calculation strategies:

See NNS Framework Section 5, pages 30-41 and Section 6, pages 40-47

Mental recall of addition and subtraction facts

10 – 6 = 4 17 - □ = 11

20 - 17 = 3 10 - □ = 2

Find a small difference by counting up

82 – 79 = 3

Counting on or back in repeated steps of 1, 10, 100, 1000

86 - 52 = 34 (by counting back in tens and then in ones)

460 - 300 = 160 (by counting back in hundreds)

Subtract the nearest multiple of 10, 100 and 1000 and adjust

24 - 19 = 24 - 20 + 1 = 5

458 - 71 = 458 - 70 - 1 = 387

Use the relationship between addition and subtraction

36 + 19 = 55 19 + 36 = 55

55 – 19 = 36 55 – 36 = 19

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

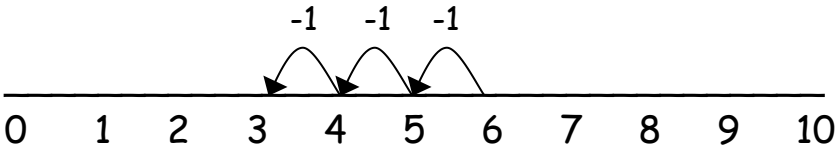
YR and Y1

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.

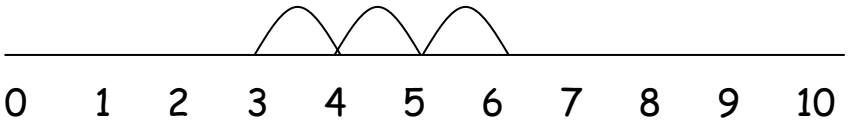
They use practical resources such as Numicon and Deines (tens and ones) to support their calculation. This will help the children to recognise number bonds (using Numicon) and crossing the tens (using Deines).

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

6 – 3 = 3

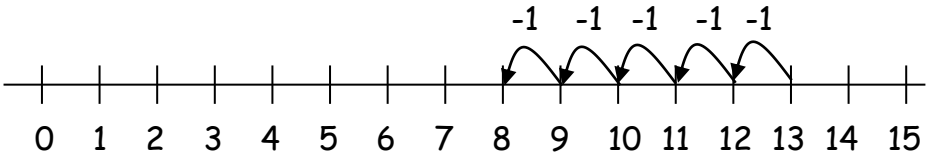


The number line should also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.



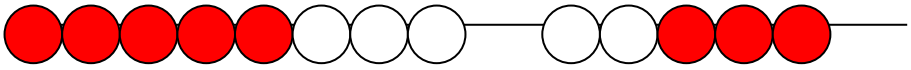
Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

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



Y2

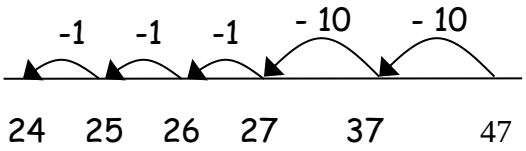
The majority of children will continue to use Dienes and Numicon to practically solve subtraction calculations. As a prerequisite to the formal column method they will be taught to subtract the ones then the tens.

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

Counting back

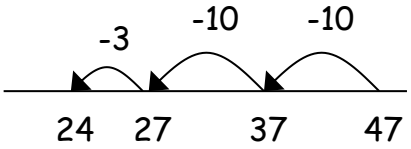
✓ First counting back in tens and ones.

47 – 23 = 24



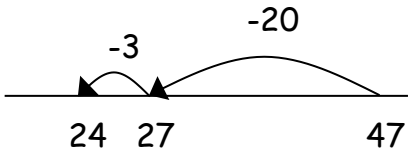
✓ Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



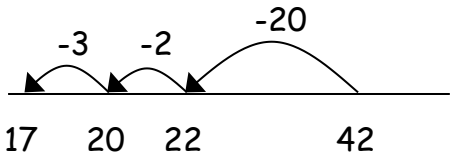
✓ Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



✓ Bridging through ten can help children become more efficient.

42 – 25 = 17

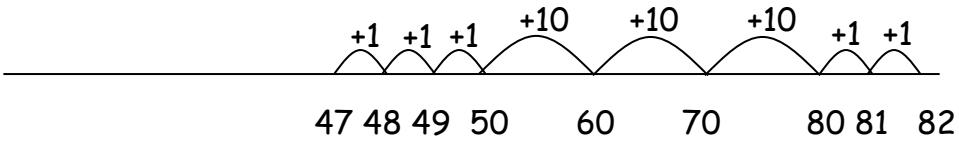


Counting on

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 1.

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.

Y3

Children will continue to use empty number lines, practical equipment such as Deines recording in a number sentence and begin to use a more formal column method.

Y4 Onwards

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

Once the children are secure with the number line they will move onto a column method. They can be taught the decomposition method using the following steps. Be aware however that many children find it easier not to do the partitioning stage and are ready to go straight to the decomposition technique. It is important to be sure that the children are fully aware of the method behind the technique. Teachers are encouraged to use Deines to ensure children understand the place value behind the method.

Partitioning and decomposition

754 – 86 =

Step 1
700 + 50 + 4
\- 80 + 6

Step 2
700 + 40 + 14 *(adjust from T to U)*
\- 80 + 6

Step 3
600 + 140 + 14 *(adjust from H to T)*
\- 80 + 6
600 + 60 + 8 = 668

For the first couple of weeks after the column method has been introduced this would be recorded by the children as:

600 140
~~7~~00 + ~~5~~0 + ^{1}4
\- 80 + 6
600 + 60 + 8 = 668

Decomposition

Children must write HTO at the top with a line underneath. Teachers will use their discretion to decide when children can stop writing this at the top.
Ensure the = sign is at the bottom for the answer to be written in.
Children are taught to add the ones first.
Numbers to be carried are to be written at the top.

HTO
614 1
~~7~~~~5~~4
\- 86
668

Children should:

- ✓ be able to subtract numbers with different numbers of digits;
- ✓ using this method, children should also 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.

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

MENTAL CALCULATIONS(ongoing)
These are a **selection** of mental calculation strategies:
See NNS Framework Section 5, pages 52-57 and Section 6, pages 58-65

Doubling and halving
Applying the knowledge of doubles and halves to known facts.
e.g. 8 x 4 is double 4 x 4

Using multiplication facts
Tables should be taught everyday from Y2 onwards, either as part of the mental oral starter or other times as appropriate within the day.

Year 2 x2, x5, x10
Year 3 as Y2 and x3, x4, x6
Year 4 Derive and recall all multiplication facts up to 10 x 10
Years 5 & 6 Derive and recall quickly all multiplication facts up to 10 x 10.

Using and applying division facts
Children should be able to utilise their tables knowledge to derive other facts.
e.g. If I know 3 x 7 = 21, what else do I know?
30 x 7 = 210, 300 x 7 = 2100, 3000 x 7 = 21 000, 0.3 x 7 = 2.1 etc

Use closely related facts already known
13 x 11 = (13 x 10) + (13 x 1)
= 130 + 13
= 143

Multiplying by 10 or 100
Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.
Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

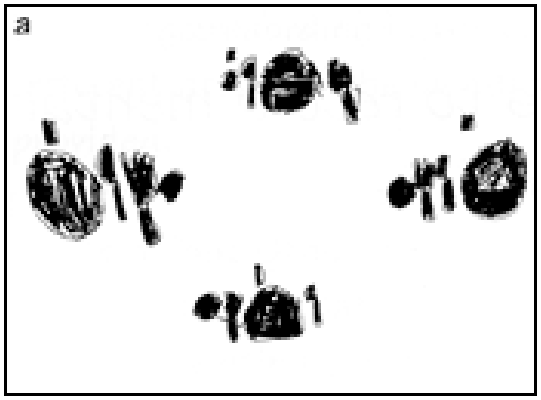
Partitioning
23 x 4 = (20 x 4) + (3 x 4)
= 80 + 12
= 102

Use of factors
8 x 12 = 8 x 4 x 3

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

YR and Y1
Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups.



Y2

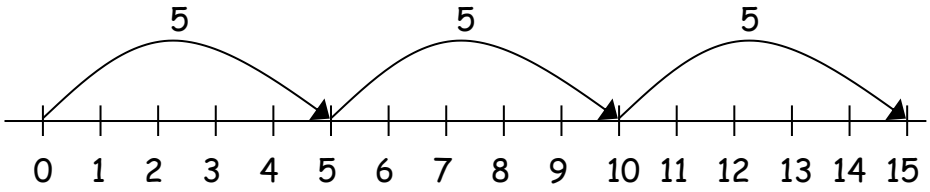
Children will develop their understanding of multiplication and use jottings to support calculation:

✓ **Repeated addition**

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

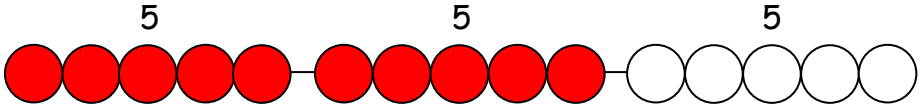
Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5



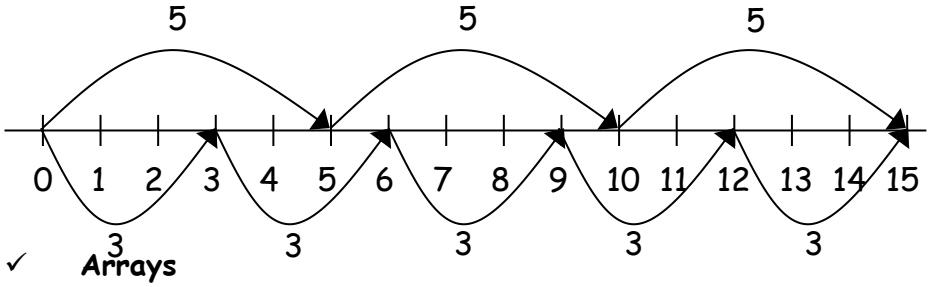
and on a bead bar:

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.

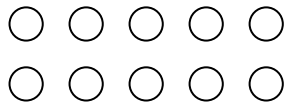


✓ **Arrays**

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

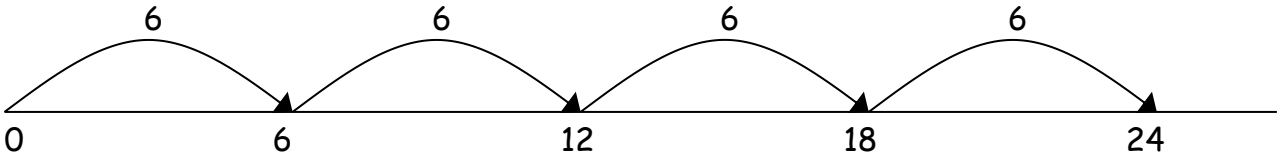
Lower KS2

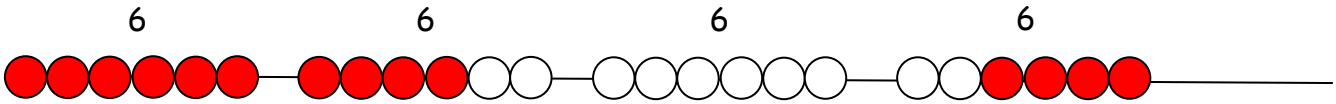
Children will continue to use:

✓ **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.





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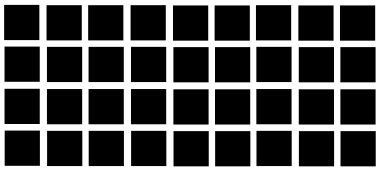

9 x 4 = 36

9 x 4 = 36

Children will also develop an understanding of

✓ **Scaling**

e.g. Find a ribbon that is 4 times as long as the blue ribbon

5 cm 20 cm

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

□ x 5 = 20 3 x △ = 18 □ x O = 32

✓ **Partitioning**

38 x 5 = (30 x 5) + (8 x 5)

= 150 + 40

= 190

NNS Section 5 page 47

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

Upper KS2

Grid method

HTU x U

(Short multiplication – multiplication by a single digit)

346 x 9

Children will approximate first

346 x 9 is approximately 350 x 10 = 3500

x	300	40	6
9	2700	360	54

2700
+ 360
+ 54
3114
1 1

TU x TU

(Long multiplication – multiplication by more than a single digit)

72 x 38

Children will approximate first

72 x 38 is approximately 70 x 40 = 2800

x	70	2
30	2100	60
8	560	16

2100
+ 560
+ 60
+ 16
2736
1

Using similar methods, they will be able to multiply decimals with one decimal place by a single digit number, approximating first. They should know that the decimal points line up under each other.

In the new curriculum most children should be

In the new curriculum most children should be moving onto formal short methods of multiplication such as;

15
x 9
90
+45
135

leading onto;

15
x 9
135
4

However, teachers are encouraged to ensure that understanding of place value is clear before this method is taught.

In Y6 children should be taught the long method of multiplication:

Long multiplication

24 × 16 becomes

```
    2
    2  4
  × 1  6
-------
  2  4  0
  1  4  4
-------
  3  8  4
-------
```

Answer: 384

124 × 26 becomes

```
      1  2
    1  2  4
  ×    2  6
-------
  2  4  8  0
     7  4  4
-------
  3  2  2  4
-------
  1  1
```

Answer: 3224

124 × 26 becomes

```
      1  2
    1  2  4
  ×    2  6
-------
     7  4  4
  2  4  8  0
-------
  3  2  2  4
-------
  1  1
```

Answer: 3224

PROGRESSION THROUGH CALCULATIONS FOR DIVISION

MENTAL CALCULATIONS(ongoing)

These are a **selection** of mental calculation strategies:

See NNS Framework Section 5, pages 52-57 and Section 6, pages 58-65

Doubling and halving

Knowing that halving is dividing by 2

Deriving and recalling division facts

See multiplication policy

Using and applying division facts

See multiplication policy

Dividing by 10 or 100

Knowing that the effect of dividing by 10 is a shift in the digits one place to the right.

Knowing that the effect of dividing by 100 is a shift in the digits two places to the right.

Use of factors

378 ÷ 21 378 ÷ 3 = 126 378 ÷ 21 = 18

126 ÷ 7 = 18

Use related facts

Given that 1.4 x 1.1 = 1.54

What is 1.54 ÷ 1.4, or 1.54 ÷ 1.1?

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THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

YR and Y1

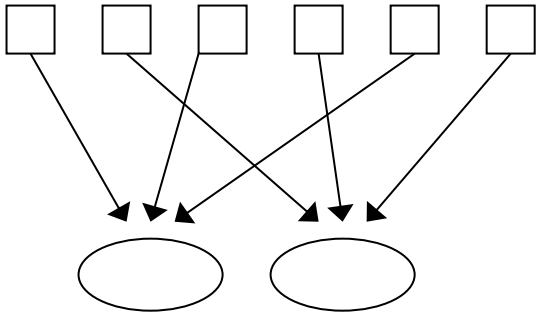
Children will understand equal groups and share items out in play and problem solving. They will count in 2s and 10s and later in 5s.

Y2

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

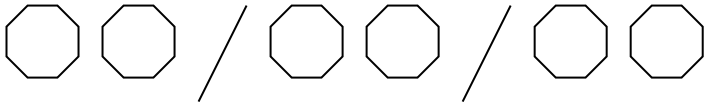
✓ **Sharing equally**

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



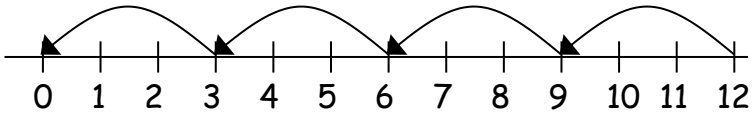
✓ **Grouping or repeated subtraction**

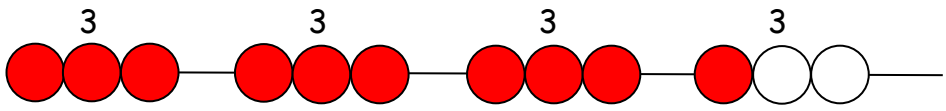
There are 6 sweets, how many people can have 2 sweets each?



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

12 ÷ 3 = 4



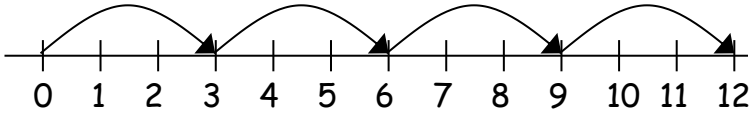


The bead bar will help children with interpreting division calculations such as 10 ÷ 5 as 'how many 5s make 10?'

As a staff we have said that we will use adding up on a number line in the majority of cases

✓ **Repeated addition using a number line**

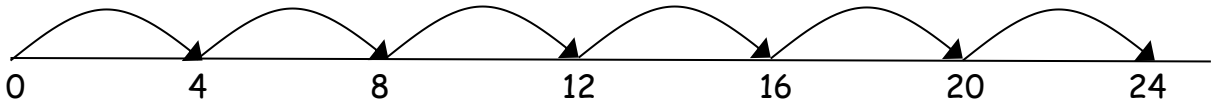
12 ÷ 3 = 4



Y3, 4 and 5

Ensure that the emphasis in Y3 is on grouping rather than sharing.
Children will continue to use grouping 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.

Short Division
Once pupils have fully understood the concept of division they can move quite quickly onto the final division strategy, for example:

282 ÷ 3

$$3\overline{)\,2^{2}8^{1}2}\quad 0\,9\,4$$

When teaching this method it is important that base ten resources are used to give children the understanding of place value and grouping.

Y6

Children will continue to use written methods to solve short division TU ÷ U and HTU ÷ U.

Long division HTU ÷ TU

972 ÷ 36

```
      27
36 ) 972
   - 720      20x
     252
   - 252       7x
       0
```

Answer : 27

Any remainders should be shown as fractions, i.e. if the children were dividing 32 by 10, the answer should be shown as $3\ ^{2}/_{10}$ which could then be written as $3\ ^{1}/_{5}$ in it's lowest terms.

Extend to decimals with up to two decimal places. Children should know that decimal points line up under each other.

87.5 ÷ 7

```
    12.5
7 ) 87.5
  - 70.0     10x
    17.5
  - 14.0      2x
     3.5
  -  3.5    0.5x
     0
```

Answer : 12.5

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By the end of year 6, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

1) **they are not ready.**
2) **they are not confident.**
3) **they do not understand the place value.**

Children should be encouraged to approximate their answers before calculating.
Children should be encouraged to check their answers after calculation using an appropriate strategy.
Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.