Friday Bridge Primary School

Calculation Policy 2017-18

Background to the Calculation Policy

Within the aims of the National Curriculum for Mathematics there is a clear emphasis placed on fluency in calculation in order to be able to reason mathematically and to solve problems.

This policy is written in the light of these aims. Consequently, wherever possible calculations will be taught and used within the context of problem solving, whether in real life scenarios or in puzzles.

Throughout the calculation policy, number lines and partitioning are used as support for mental calculation as the children develop and strengthen the skills required to calculate using written methods. Children should be encouraged to make jottings and use resources as necessary to aid their mental calculations.

As children become more confident using a range of mental strategies they should be encouraged to choose the most efficient method.

Mental calculation strategies should be taught and modelled through mental and oral starters or whole class teaching.

Class teachers should continue to build on strategies introduced in previous years and introduce new methods as appropriate to ensure progression.

Children should be encouraged to approximate their answers before calculating.

Children should be encouraged to check their answers after calculation using an appropriate strategy.

PROGRESSION THROUGH CALCULATIONS

ADDITION:-

YR and Y1

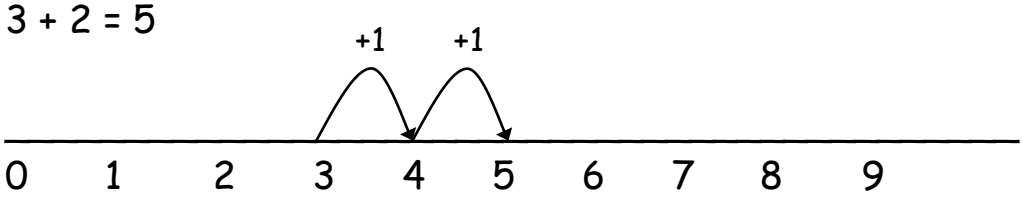
Children will use moveable objects and need to learn commutativity and know that changing the order of the 2 numbers being added does not change the answer.

4 + 2 = 6

2 + 4 = 6

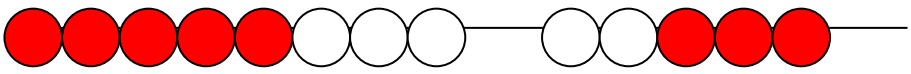
Children use printed number lines and practical resources to support calculation. Teachers demonstrate how number lines can be used solve simple sums. Teachers will also model how to solve calculations on empty number lines, ensuring they do not always start at zero. Children will begin to use number lines in small group activities and then independently.

3 + 2 = 5

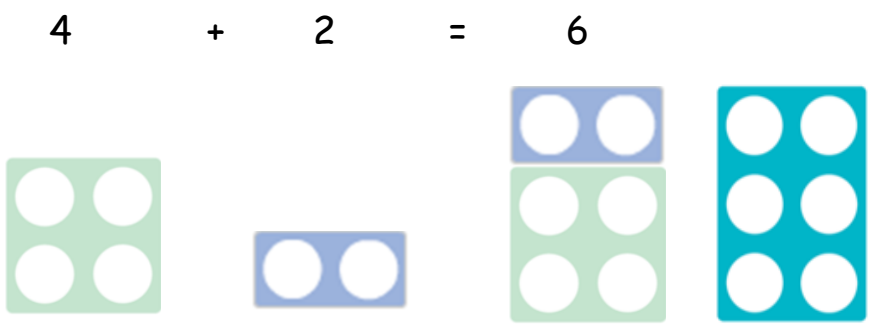


Bead strings can be used to illustrate addition including bridging through ten by counting on 2 then counting on 3.

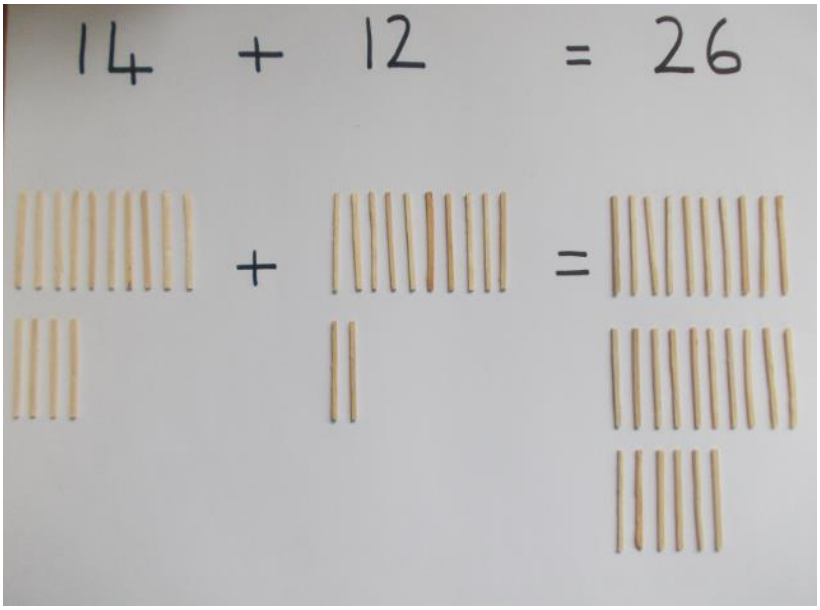
8 + 5 = 13



Numicon can also be used. Encourage children to lay the shape over the top of the combined Numicon to check their answer.



'Bundles of 10' (that children have made themselves yet are not permanently 'fixed') should be used to support their understanding of place value in calculations.



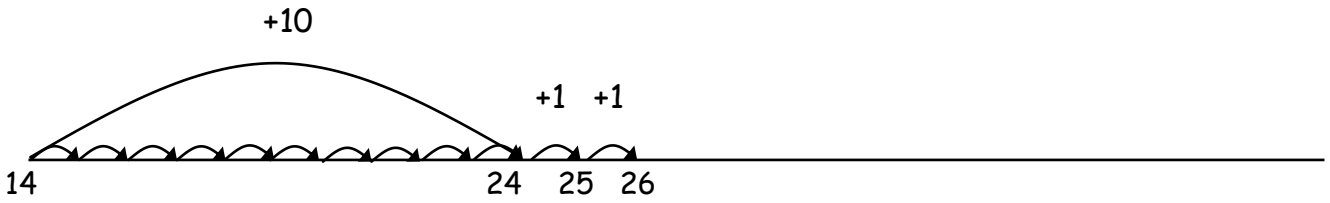
Y2

It is important that all work on addition, particularly when moving towards formal written methods, is supported by work on place value. This will be done using Dienes apparatus. In support of working towards the teaching of columnar methods for addition in KS2, Y2 will begin using Dienes apparatus to support their understanding of place value.

To record written addition, children will continue to use 'empty number lines' themselves, starting with the larger number and counting on.

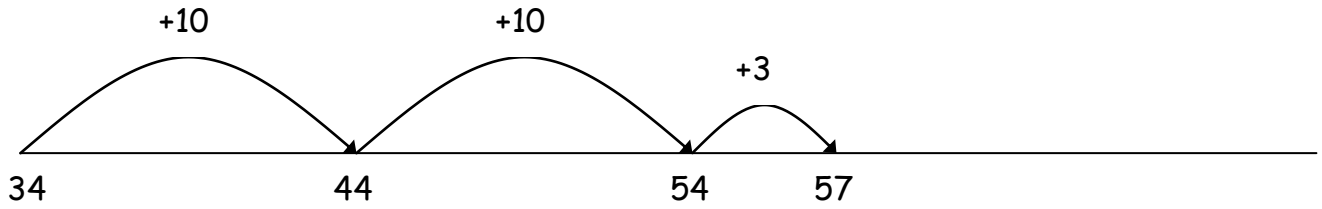
- First counting on in tens and ones.

14 + 12 = 26



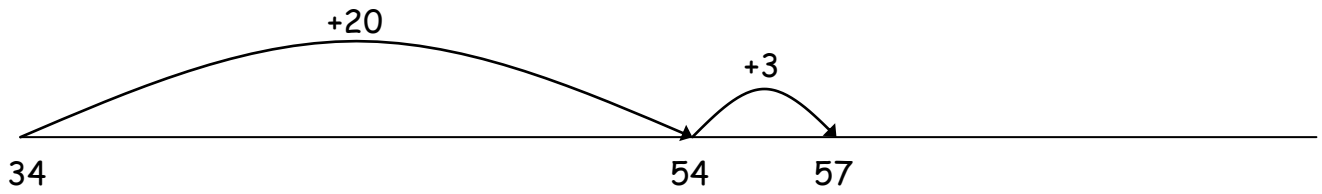
- Then helping children to become more efficient by adding the ones in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57

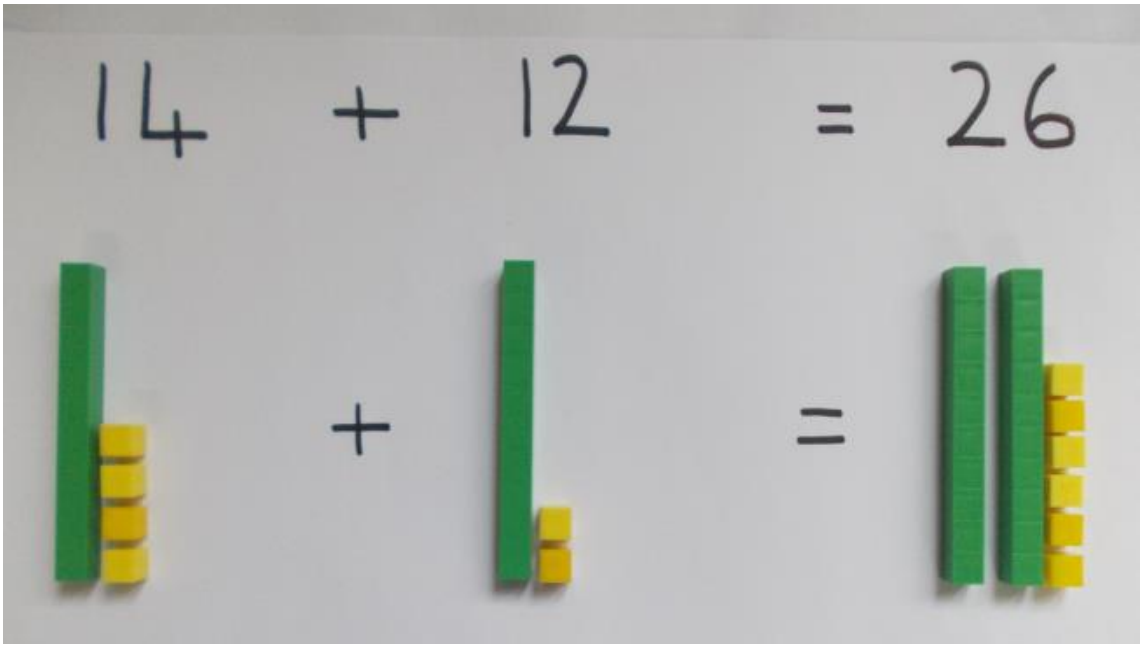


- Followed by adding the tens in one jump and the ones in one jump.

34 + 23 = 57



Dienes can be used to support calculations.



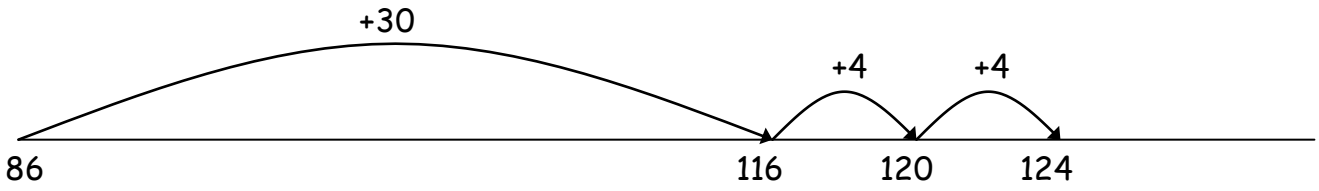
Continued use of Numicon and bead strings where appropriate.

Y3

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

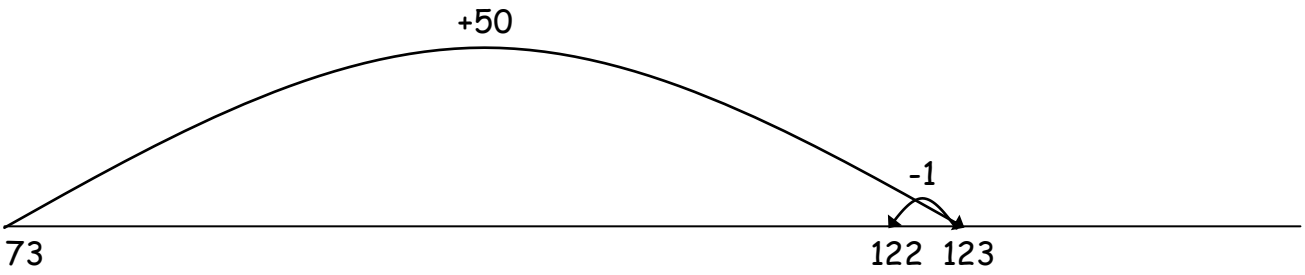
- Teach children to count on from the largest number in the calculation.

38 + 86 = 124

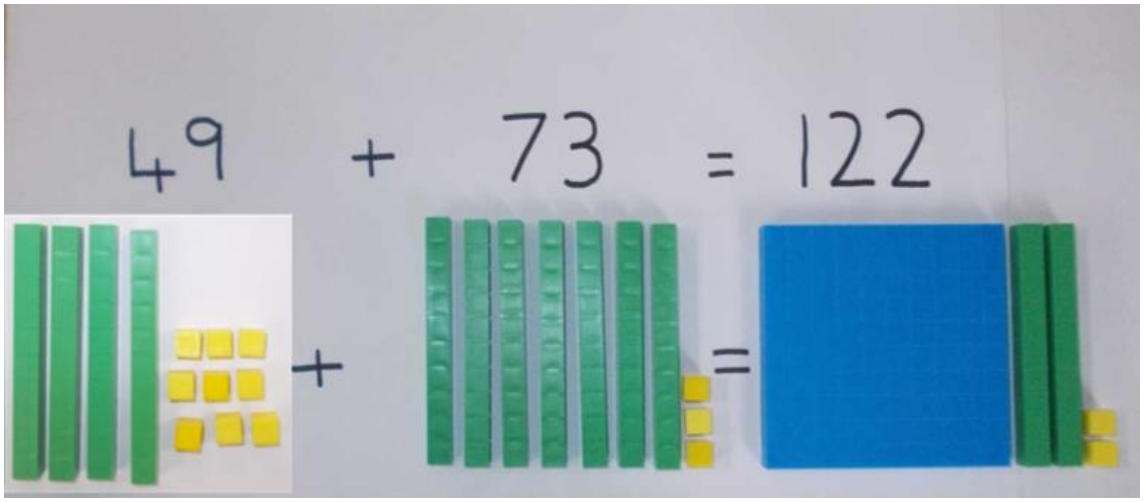


- Compensation

49 + 73 = 122



Dienes will be used to support place value and expanded methods, moving towards columnar addition.



Expanded methods

- Partition each number into tens and ones and then write one under the other. Add the tens and ones and then combine the answers.

	T	1s
	6	7
+	2	4
	80 + 11 = 91	

Expanded method in columns

- Adding the least significant digits first write the numbers in columns and add the ones first. Moving to adding the **ones** first in preparation for 'carrying'.

	T	1s	
	6	7	
+	2	4	
	1	1	(7 + 4)
+	8	0	(60 + 20)
	9	1	

	H	T	1s	
	2	6	7	
+		8	5	
		1	2	(7 + 5)
+	1	4	0	(60 + 80)
	2	0	0	
	3	5	2	

From this, children will begin to use the shorter formal columnar method, initially without carrying and then to carrying below the line.

T	1s
2	5
+ 4	8
7	3
1	

H	T	1s
7	8	3
+	4	2
8	2	5
1		

H	T	1s
3	6	7
+	8	5
4	5	2
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 converting 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*

1s	.	t	h
3	.	5	9
+ 0	.	7	8
4	.	3	7
1		1	

Y4

Children should begin to use the carrying method for calculations containing numbers with at least four digits, moving to 5 digits as the year progresses.

Th	H	T	1s
3	5	8	7
+	6	7	5
4	2	6	2
1	1	1	

T	1s	.	t	h
£ 4	8	.	7	3
£ 3	2	.	4	4
£ 8	1	.	1	7
	1		1	

Using similar methods, children will:

- *add several numbers with different numbers of digits;*
- *begin to add two or more decimal numbers 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*

	1s . t h
	3 . 2 0
+	2 . 8 0
	6 . 0 0 m
	1

Y5

Children should extend the carrying method to numbers with up to 7 digits.

	M	HTh	TTh	Th	H	T	1s
	6	4	3	6	5	8	4
+	2	1	5	5	8	4	8
	8	5	9	2	4	3	2
		1	1	1	1		

	TTh	Th	H	T	1s
			4	2	
	6	4	3	2	
+		7	8	6	
				3	
	4	6	8	1	
1	1	9	4	4	
	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 seven digits and either one or two decimal places;*
- *know that decimal points should line up under each other, particularly when adding mixed amounts, e.g. 401.2 + 26.85 + 0.71*

Y6

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

```
    H  T  1s . t  h  th
    3  4  6 . 5  0  0
       2  4 . 7  2  0
+         1 . 8  4  2
    3  7  3 . 0  6  2
       1  2
```

Using similar methods, children will

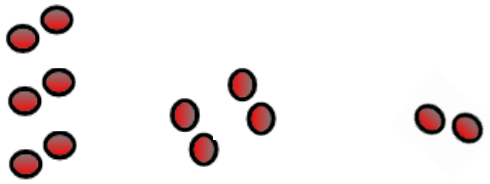
- *add two or more decimal fractions with up to four digits and up to three decimal places;*
- *know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 401.2 + 26.85 + 0.715*

Remember for some children progression across the stages will depend on their ability and confidence when applying taught strategies.
It is important that teachers look at strategies taught prior to and following those in their year group to ensure that the teaching is appropriate to the ability of the child, rather than just delivering what is prescribed for each year group.
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.

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

YR and Y1

Children will use moveable objects to solve simple calculations.

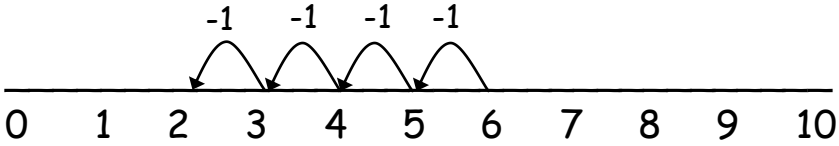


6 - 4 = 2

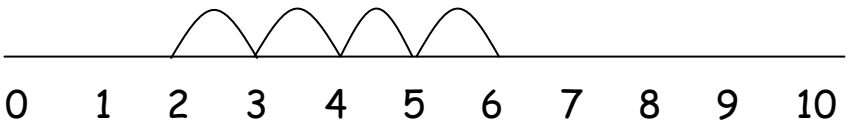
6 - 2 = 4

Children use printed number lines and practical resources to support calculation. Teachers demonstrate how number lines can be used solve simple calculations. Teachers will also model how to solve calculations on empty number lines, ensuring they do not always start at zero. Children will begin to use number lines in small group activities and then independently.

6 – 4 = 2

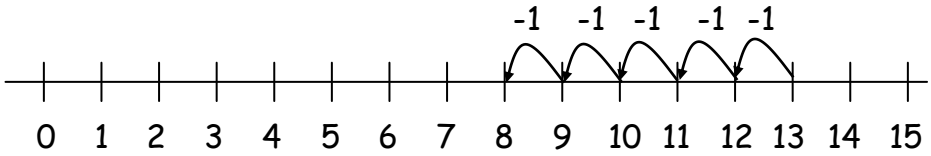


The number line should also be used to show that 6 - 4 means the 'difference between 6 and 4' or 'the difference between 4 and 6' and how many jumps they are apart.



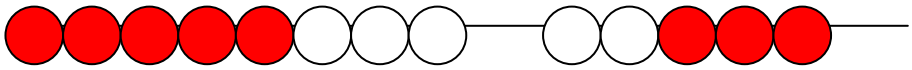
Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

13 – 5 = 8

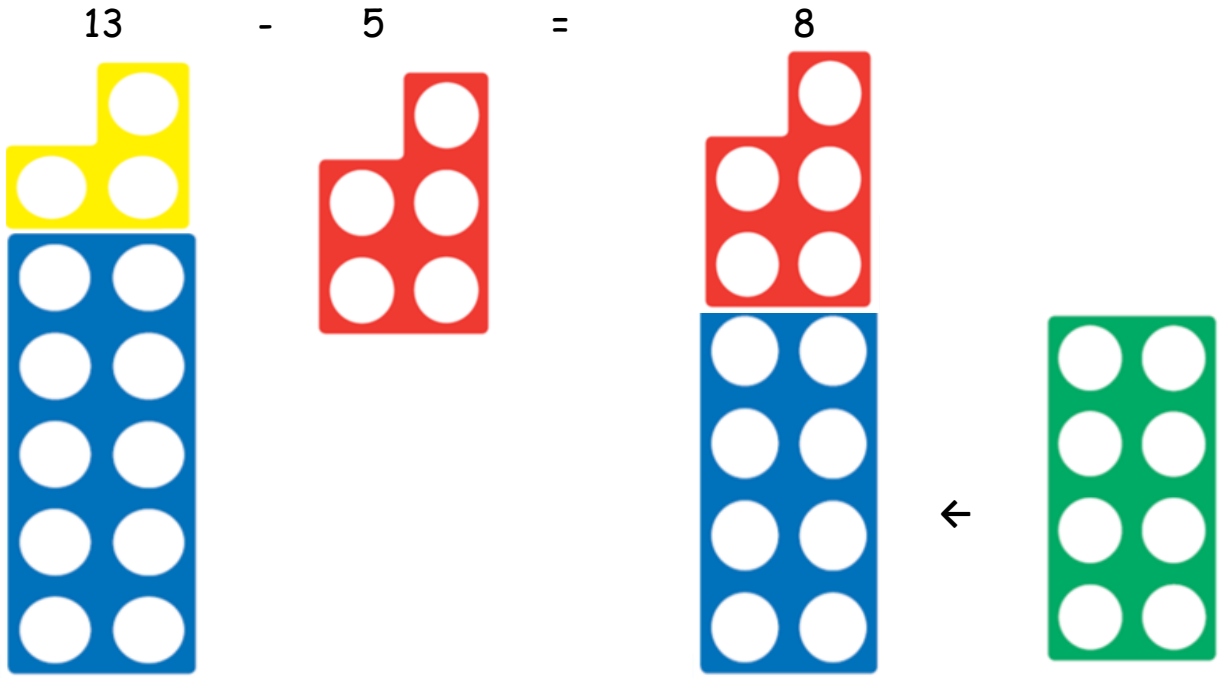


Bead strings can be used to illustrate subtraction including bridging through ten by counting back 3 then counting back 2.

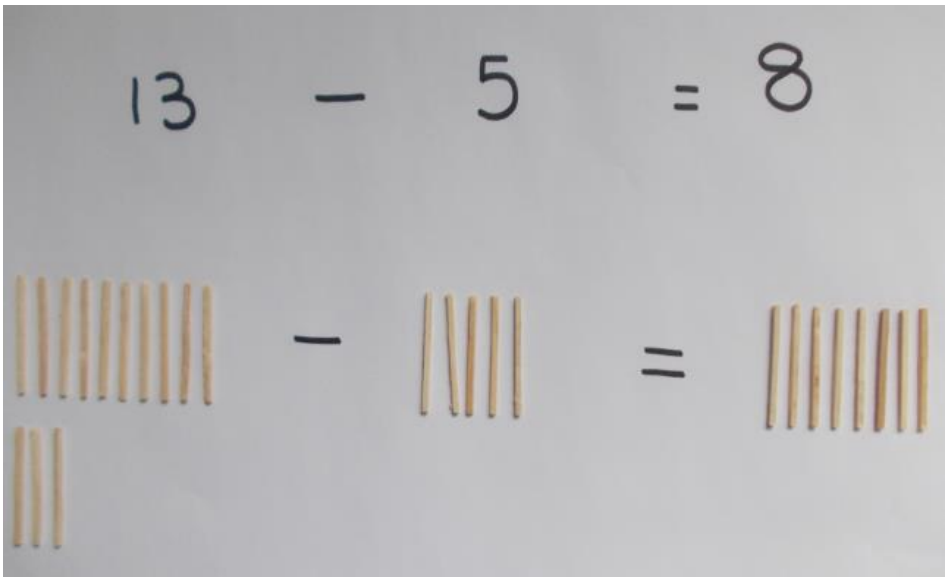
13 – 5 = 8



Numicon can also be used. Children cover up the amount they have to take away and look at the shape left uncovered. Children can check this by laying the correct Numicon shape over the top.



'Bundles of 10' (that children have made themselves yet are not permanently 'fixed') should be used to support their understanding of place value in calculations.



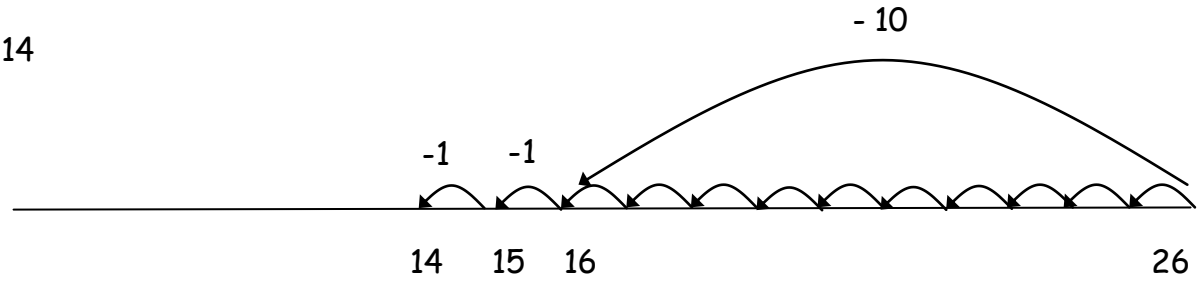
Y2

Children will continue to use empty number lines to support calculations, and use Dienes apparatus to develop their understanding of place value alongside their calculating.

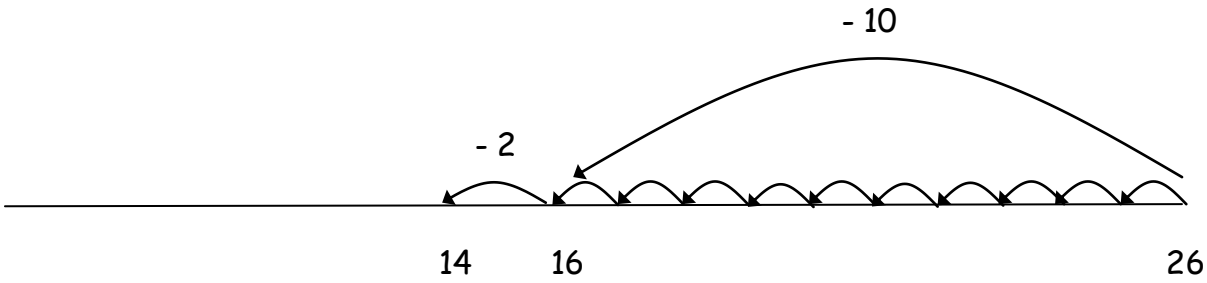
Counting back

First counting back in tens and ones.

26 – 12 = 14

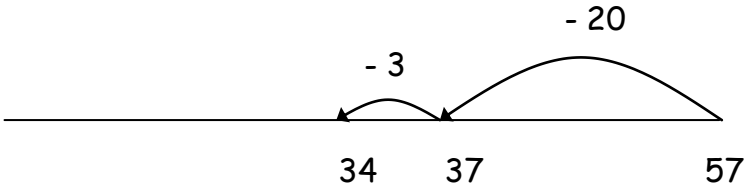


Then helping children to become more efficient by subtracting the ones in one jump (by using the known fact 6 – 2 = 4).

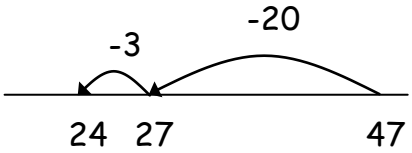


Subtracting the tens in one jump and the ones in one jump.

57 – 23 = 34

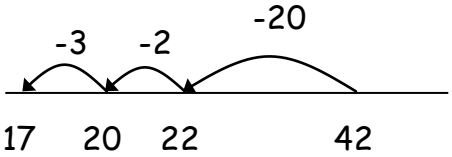


47 – 23 = 24



Bridging through ten can help children become more efficient.

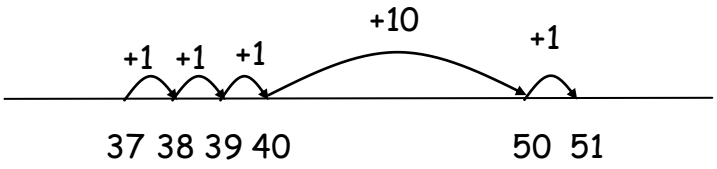
42 – 25 = 17



Counting on

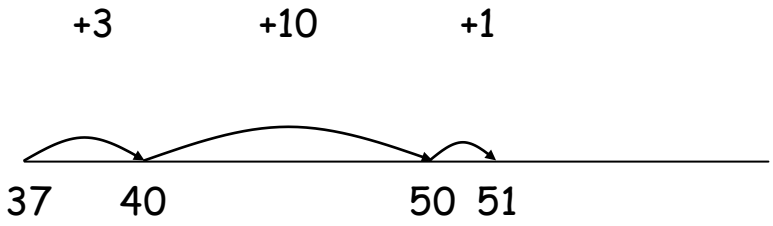
Children should be taught to recognise when counting on is more efficient than counting back.

51 - 37 = 14



Help children to become more efficient with counting on by:

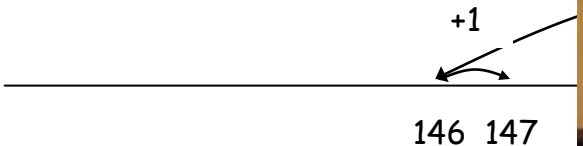
Jumping to the next multiple of 10 and then in jumps of ten or larger until they land on the larger number in the calculation.



Y3

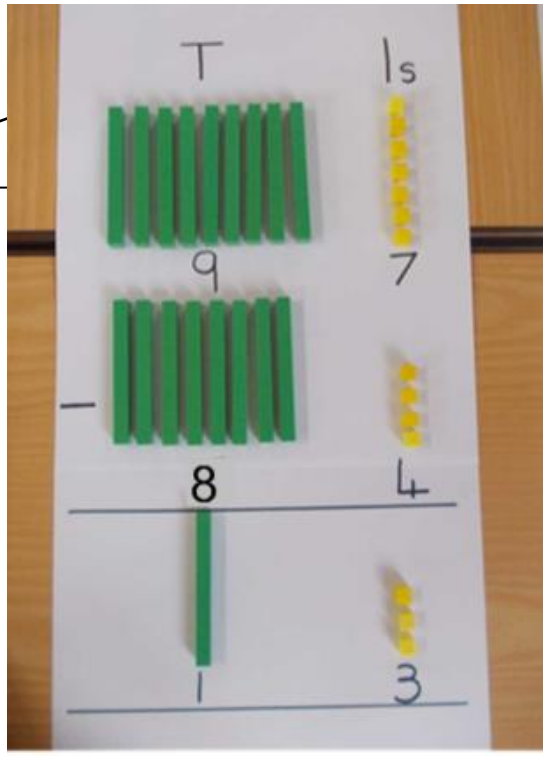
Where the numbers involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used.

176 – 29 = 147



176

As they are ready throughout the year, children will begin to use decomposition, completing the calculation with Dienes apparatus. Initially there will be no need for regrouping.



	T	1s
	9	7
-	8	4
	1	3

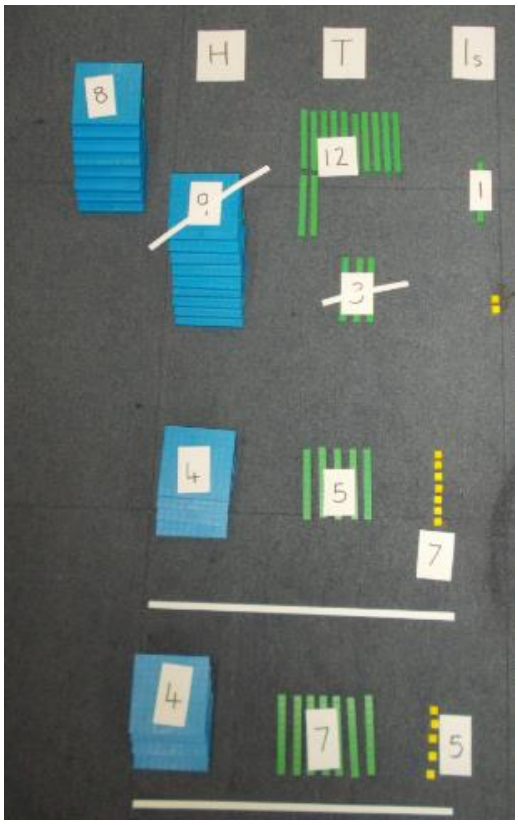
Y4

Children will also continue to use number lines, partitioning and move on to decomposition, where they will continue to use Dienes apparatus to support and illustrate the process.

Decomposition

Most children will use 3 digits and some use 4 digits including decimals in the context of money.

		H	T	1s
		8	12	1
		~~9~~	~~3~~	2
–		4	5	7
		4	7	5



	T	1s	.	t	h
		7		1	
£	4	~~8~~	.	~~8~~	3
£	3	2	.	4	4
£	1	6	.	3	9

Y5

Children will add and subtract numbers with more than 4 digits.

Decomposition

	TTh	Th	H	T	1s
	5	1	5	15	1
	~~6~~	4	~~6~~	~~6~~	4
-	4	6	4	8	5
	1	8	1	7	9

Children should:

- *be able to subtract numbers with different numbers of digits*
- *begin to find the difference between two decimals numbers, with up to three decimal places, including within the context of measures e.g. money, length, weight and volume.*
- *know that decimal points should line up under each other*

Y6

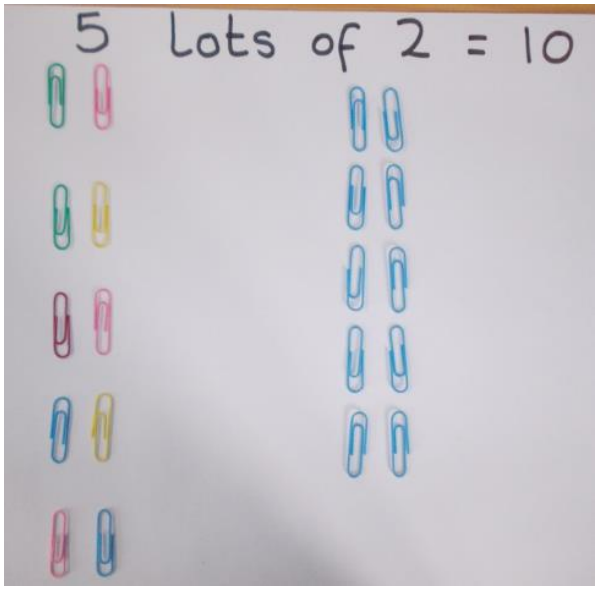
By the end of year 6, children will be able to use a range of written calculation methods. Selection will depend upon the numbers involved.

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

YR and Y1

Children will count forwards and backwards in 2s, 5s and 10s. The use of number squares will enable children to see the patterns when counting in these sequences.
Children will experience counting equal 'groups of'. They will work on practical problem solving activities involving equal sets or groups.

5 X 2 = 10



5 lots of 2 = 10

Y2

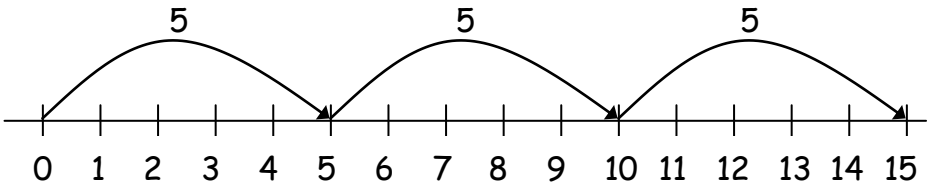
Children will count forwards and backwards in steps of 2, 3, and 5 from 0 and in tens from any given number. Children will develop their understanding of multiplication and use jottings to support calculation:

- **Repeated addition**

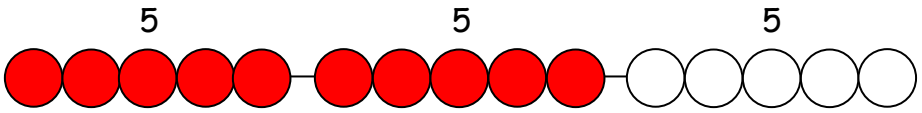
3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 3 x 5

Resources such as cubes, printed number lines and bead strings should be used to model repeated addition.

3 x 5 = 5 + 5 + 5

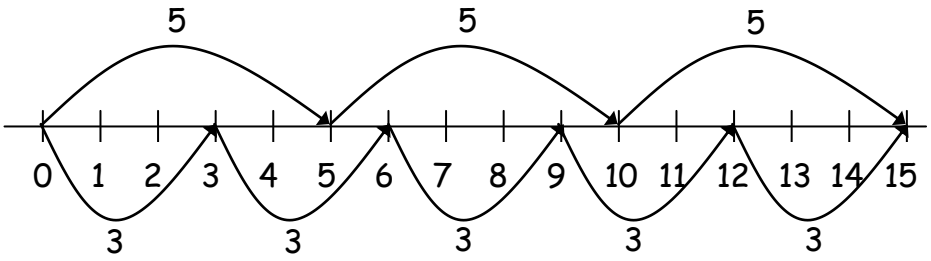


3 x 5 = 5 + 5 + 5



- **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.

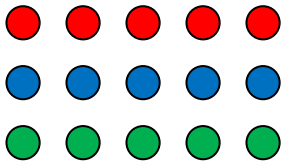


3 x 5

5 x 3

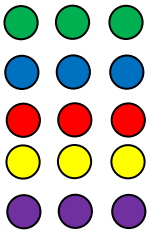
- **Arrays**

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

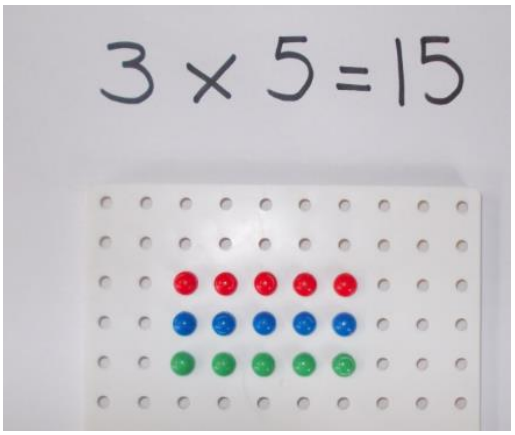


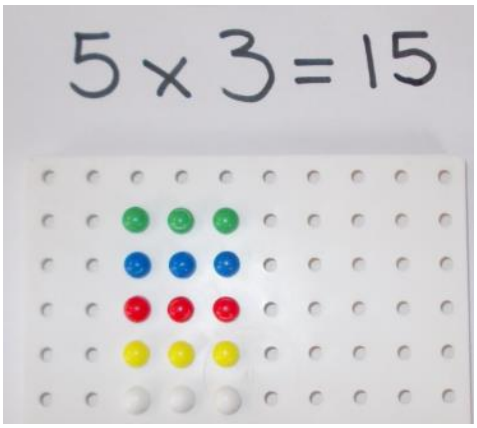
3 x 5 = 15

5 x 3 = 15



Children can make arrays practically using peg boards.





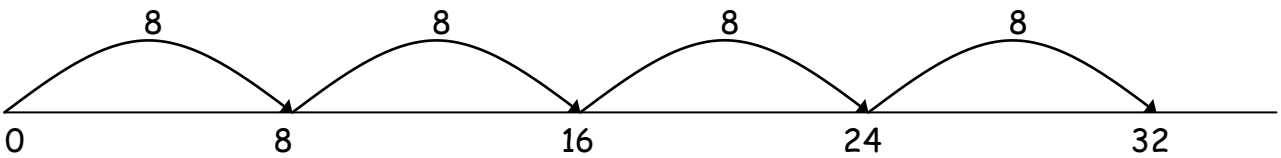
Y3

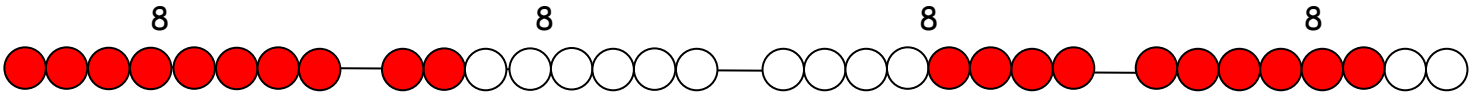
Children will continue to consolidate their existing knowledge of multiplication methods.

- **Repeated addition**

Children should have access to both printed and empty number lines and bead strings to support their understanding.

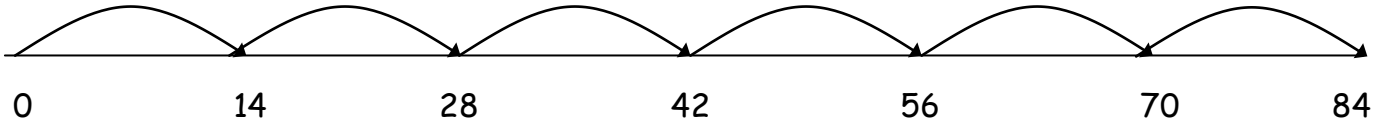
4 times 8 is 8 + 8 + 8 + 8 = 32 or 4 lots of 8 or 4 x 8





Children progress to solving 2-digit by 1 digit calculations.

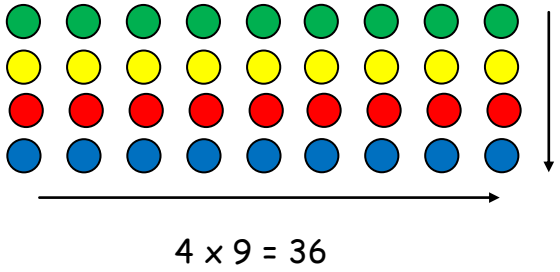
6 x 14 = 84



Arrays

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

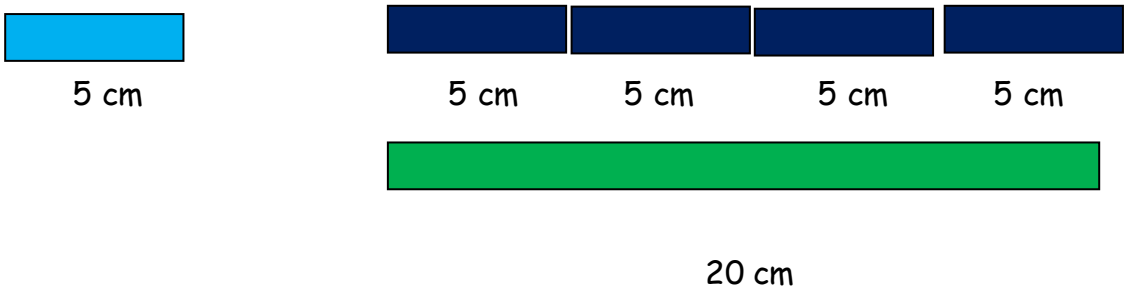
9 x 4 = 36



Children will also develop an understanding of

- **Scaling**

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



- **Partitioning**

Children will use their knowledge of partitioning to help multiply.

6 x 14 = (6 x 10) + (6 x 4)

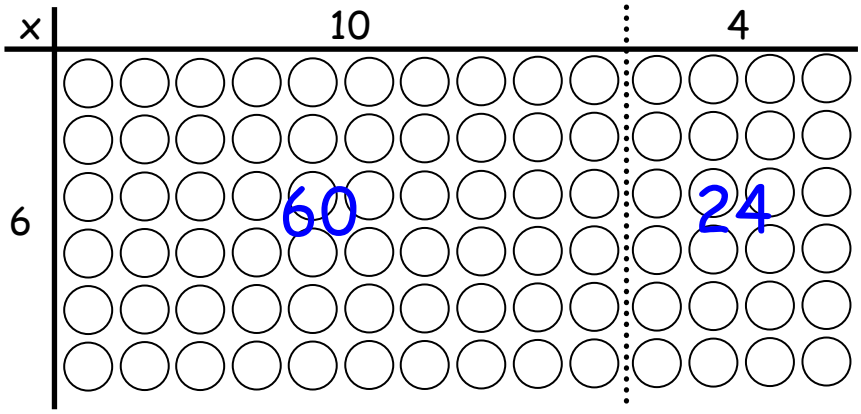
= 60 + 24

= 84

Y4

Children will continue to use arrays where appropriate leading into the grid method of multiplication, initially with a 2-digit multiplied by a 1-digit number and progressing to a 3-digit number multiplied by a 1-digit number.

6 x 14



(6 x 10) + (6 x 4)

60 + 24

84

Grid method

T 1s x 1s

(Short multiplication – 2-digit multiplication by a single digit)

6 x 14

X	**10**	**4**
6	60	24

T 1s

6 0
\+ 2 4
8 4

H T 1s x 1s

(Short multiplication – 3-digit multiplication by a single digit)

342 x 7

X	**300**	**40**	**2**
7	2100	280	14

Th H T 1s

2 1 0 0
\+ 2 8 0
1 4
2 3 9 4

By the end of year 4, children should progress to using a column method of multiplication.

3 4 2
× 7
2 3 9 4
2 1

Y5

ThHT1s x 1s / TTh ThHT1s x 1s

(Short multiplication – 4-digit multiplication by a single digit)

2741 x 6

X	**2000**	**700**	**40**	**1**
6	12000	4200	240	6

	TTh	Th	H	T	1s
	1	2	0	0	0
		4	2	0	0
+			2	4	0
					6
	1	6	4	4	6

2741 x 6 =

	2	**7**	**4**	**1**
×				**6**
1	**6**	**4**	**4**	**6**
	4	2		

T1s X T1s / HT1s X T1s / ThHT1s X T1s

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

Grid method - **T1s X T1s**

72 x 38

X	**30**	**8**
70	2100	560
2	60	16

	Th	H	T	1s
	2	1	0	0
		5	6	0
+			6	0
			1	6
	2	7	3	6

1

Column method - **T1s X T1s**

	Th	H	T	1s	
			7	2	
x			3	8	
			1	6	(8x2)
+		5	6	0	(8x70)
			6	0	(30x2)
	2	1	0	0	(30x70)
	2	7	3	6	
		1			

ThHT1s x T1s

(Long multiplication – 4-digit multiplication by a 2-digit number)

	TTh	Th	H	T	1s	
		1	2	9	7	
x				4	2	
				1	4	(2 x 7)
			1	8	0	(2 x 90)
			4	0	0	(2 x 200)
		2	1	0	0	(2 x 1000)
+				2	8	0	(40 x 7)
			3	6	0	0	(40 x 90)
			8	0	0	0	(40 x 200)
	4	0	0	0	0	(40 x 1000)
	5	4	4	7	4	
	1	1				

Using similar methods, they will be able to multiply decimals - a 1-digit number with 1 decimal place by a single digit number then two digit numbers.

For example:

4.9 x 3

X	**4**	**0.9**
3	12	2.7

	T	1s	.	t
	1	2	.	0
+		2	.	7
	1	4	.	7

	T	1s	.	t	
		4	.	9	
x		3			
		2	.	7	(3 x 0.9)
	1	2	.	0	(3 x 4)
	1	4	.	7	

During year 5, children will be taught to multiply **HT1s X T1s** using a standard shortened form of long multiplication. This will be related to grid method so that children can clearly see where each part of the recorded calculation comes from.

HT1s x T1s

372 x 24

X	**300**	**70**	**2**
20	6000	1400	40
4	1200	280	8

	Th	H	T	1s
	6	0	0	0
	1	2	0	0
+	1	4	0	0
		2	8	0
			4	0
				8
	8	9	2	8
		1		

More efficient column method:

HT 1s

372
X 24
1 4$_{2}$88 = (4 x 372)
+ 7$_{1}$4 40 = (20 x 372)
8 9 28
1

Y6

Children should build on the work in Y5 by using this more efficient method of writing long multiplication calculations across a range of number sizes and including decimals.

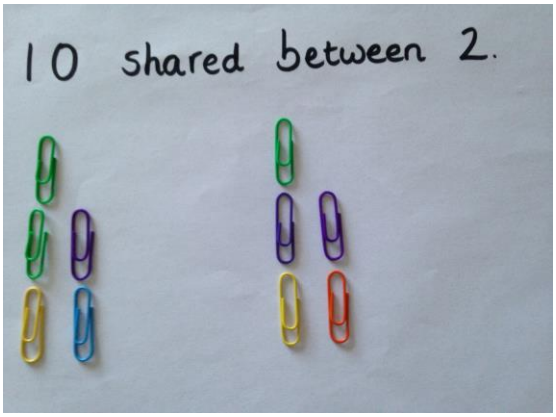
4.32
X 43
1 2.96 = (4.32 x 3)
17$_{1}$2.8 = (4.32 x 40)
185.76
1

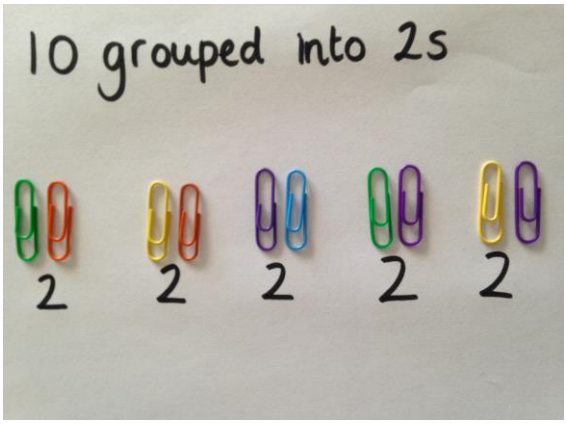
PROGRESSION THROUGH CALCULATIONS FOR DIVISION

YR and Y1

Children will understand sharing items and equal groups during role-play and initiated problem solving situations. They will count forwards and backwards in 2s, 10s and later in 5s.

Initially the focus will be on sharing with the children then beginning to group rather than share:

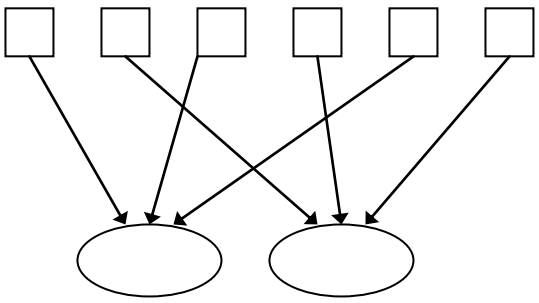




Children will continue to develop their understanding of division and use jottings to support calculation

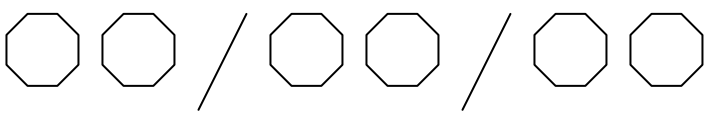
Sharing equally

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



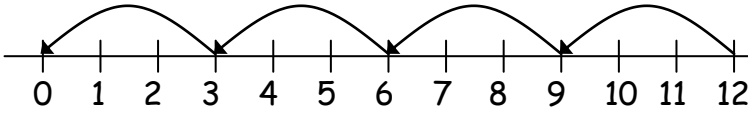
Grouping or repeated subtraction

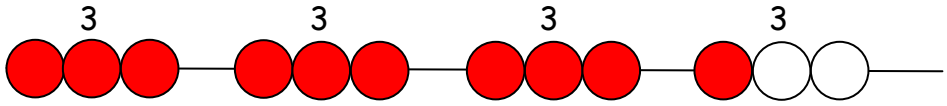
There are 6 sweets, how many people can have 2 sweets each?



Repeated subtraction using a number line or bead strings

12 ÷ 3 = 4





The bead string will help children with interpreting division calculations such as 12 ÷ 3 as 'How many 3s make 12?'

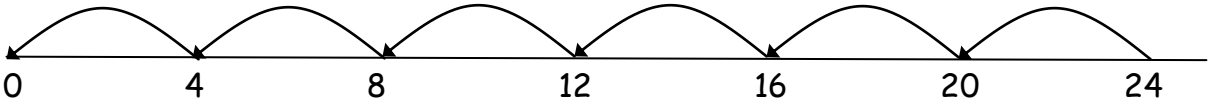
Y3

Children will continue to use:

Repeated subtraction using a number line

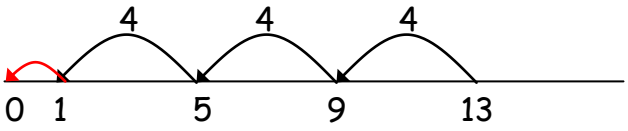
Children will use an empty number line to support their calculation.

24 ÷ 4 = 6



Children should also move onto calculations involving remainders.

13 ÷ 4 = 3 r 1



Y4

Children will use chunking to solve short division calculations up to H T 1s ÷ 1s

T1s ÷ 1s

72 ÷ 3

```
      24
   ------
3) 72
 - 30        (10x3)
   42
 - 30        (10x3)
   12
 -  6        (2x3)
    6
 -  6        (2x3)
    0
```

Answer : 24

HT1s ÷ 1s

Children can start to subtract larger multiples of the divisor, e.g. 30x, making clear links with multiplication tables knowledge.

196 ÷ 6

```
     32 r 4
   ---------
6 ) 196
  - 180      (30x6)   (instead of 3 lots of 10 x 6)
    16
  -  12      (2x6)
     4
```

Answer : 32 remainder 4 , 32 r 4

Y5

Children will use chunking to solve short division calculations up to Th H T 1s ÷ 1s

Any remainders should be shown as integers or fractions,
e.g. 44 ÷ 3 = 14 remainder 2, 14 r 2 or 14 2/3

1558 ÷ 9

```
        173 r 1
     9 ) 4 15
         1 5 5 8
     -   1 0 8 0      (120x9)
         0 4 7 8
     -     4 5 0      (50x9)
           2 8
     -     2 7        (3x9)
           0 1
```

Answer : 173 r 1 or 173 1/9

Short division

98 ÷ 7 becomes

```
      1  4
    ┌─────
  7 | 9  8
      2
```

Answer: 14

Y6

Children will continue to use chunking moving towards a formal method of recording long division – dividing up to 4-digit numbers by 2 digit numbers. This is really the same principle as chunking, ensuring that the maximum multiple of the divisor is removed each time, and that the recording of the answer is put at the top as the calculation is completed, without the need for each multiple to be recorded alongside.

HTU ÷ TU

972 ÷ 36

```
      27                                  27
36 ) 972                            36 ) 972
   - 720   (20x36)                      720
     252                                252
   - 252   (7x36)                      252
       0                                  0

Answer :    27
```

Both with short and long division children will extend calculations to include decimals with up to two decimal places. Children should know that decimal points line up under each other.

87.5 ÷ 7

```
      12.5                                12 . 5
7 ) 87.5                            7 ) 8[1]7 . [3]5
  - 70.0   (10x7)
    17.5
  - 14.0   (2x7)
     3.5
  -  3.5   (0.5x7)
       0
Answer :    12.5
```

By Y6 children will be expected to be able to select compact or long division recording methods as appropriate, depending on the numbers involved. Any remainders should be shown as fractions or decimals, 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 its lowest terms, or as 3.2.