CALCULATION POLICY

JANUARY 2015

INTRODUCTION

This calculation policy has been written in line with the programmes of study taken from the revised National Curriculum for Mathematics (2014). It provides guidance on appropriate calculation methods and progression. The content is set out in yearly blocks under the following headings: addition, subtraction, multiplication and division.
Statements taken directly from the programmes of study for 'addition and subtraction' and 'multiplication and division' are given in blue boxes.
Children will use mental methods as their first port of call when appropriate, but for calculations that they cannot do in their heads, they will need to use an efficient written method accurately and with confidence.

AIMS OF THE POLICY

• To ensure consistency and progression in our approach to calculation
• To ensure that children develop an efficient, reliable, formal written method of calculation for all operations
• To ensure that children can use these methods accurately with fluency, confidence and understanding

EYFS

ELG11 Numbers

> **Children count reliably with numbers from 1 to 20, place them in order and say which number is one more or one less than a given number. Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer. They solve problems, including doubling, halving and sharing.**

Information can be gathered to support EYFS Profile judgements using a range of evidence. There is no prescribed method of gathering evidence within the EYFS Profile. Examples of acceptable evidence are observations, samples of children's work, photographs and contributions from teachers, teaching assistants and parents. This is not an exhaustive list.

ADDITION

Year 1

Statutory requirements

Pupils should be taught to:

- read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20
- add and subtract one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = □ – 9.

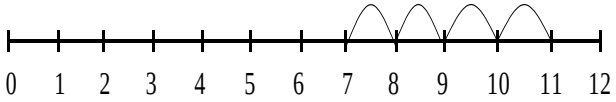
Children need to understanding the concept of equality before using the '=' sign. They should use practical equipment and resources wherever possible to support this. Calculations should be written either side of the equality sign so it does not purely demark the 'answer'.
2+2=3+1
6=3+3

Missing numbers need to be placed in all places to begin to understand the Commutative Law of addition (the answer is the same regardless of which way round the calculation is written).

4 + □ = 7 3 + 4 = □
3 + □ = 7 □ = 3 + 4

Children will combine two sets of objects:

Children will use a number line to count on:



7 + 4 = 11

Year 2

Statutory requirements

Pupils should be taught to:

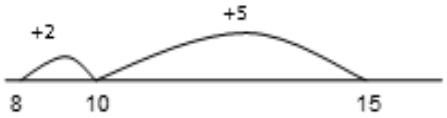
- solve problems with addition and subtraction:
  - using concrete objects and pictorial representations, including those involving numbers, quantities and measures
  - applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100
- add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
  - a two-digit number and ones
  - a two-digit number and tens
  - two two-digit numbers
  - adding three one-digit numbers
- show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

Continue using methods from Year 1.

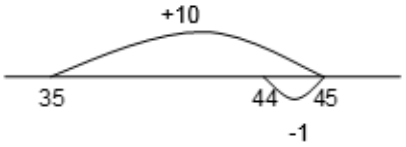
Count on in units and tens.

23 + 12 = 23 + 2 + 10
= 25 + 10
= 35

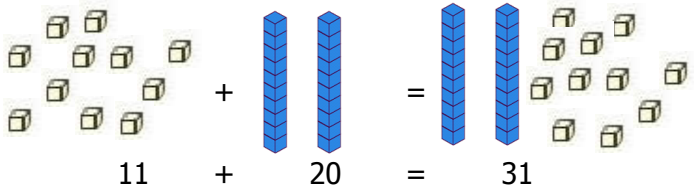
Bridging through 10:
e.g. Children should partition the 7 by adding the 2 and then the 5.
8 + 7 = 15



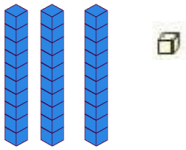
Adding 9 or 11 by adding 10 and adjusting by one:
e.g. Add 9 by adding 10 and adjusting by 1
35 + 9 = 44



Partitioning and recombining:
18 + 13 =
8 + 3 = 11
10 + 10 = 20
11 + 20 = 31



Leading to exchange:
31



Year 3

Statutory requirements

Pupils should be taught to:

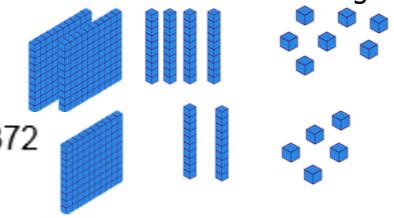
- add and subtract numbers mentally, including:
  - a three-digit number and ones
  - a three-digit number and tens
  - a three-digit number and hundreds
- add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction
- estimate the answer to a calculation and use inverse operations to check answers
- solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

Missing number problems using a range of equations as in Year 1 and 2 but with appropriate, larger numbers.

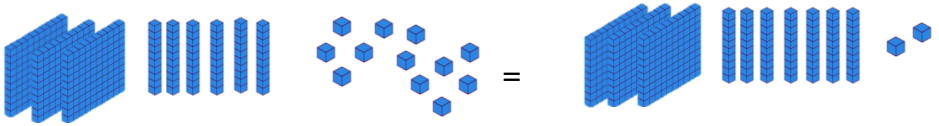
Children need to be secure adding multiples of 100 and 10 to any three-digit number including those that are not multiples of 10.

Introduce the column method modelled using base 10:

200 + 40 + 7
100 + 20 + 5
300 + 60 +12 = 372



Leading to children understanding exchange between tens and units:



Begin to use columns to support place value:

	247
	+125
7+5	12
40+20	60
200+100	300
	372

Some children may begin to use compact column method, initially introduced alongside the expanded method. The formal method should be seen as a more streamlined version of the expanded method, not a new method.

247
+125
372
1

Year 4

Statutory requirements

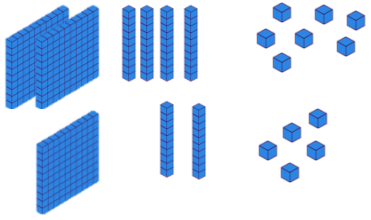
Pupils should be taught to:

- add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate
- estimate and use inverse operations to check answers to a calculation
- solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

Children will be encouraged to use the bar model to support problem solving. See attached.

Expanded column method modelled using base 10:

	247
	+125
7+5	12
40+20	60
200+100	300
	372



Compact column method. Extend to calculations with 4-digits:

789 + 642 becomes

$$\begin{array}{r} 7\ 8\ 9 \\ +\ 6\ 4\ 2 \\ \hline 1\ 4\ 3\ 1 \\ \hline \quad 1\ \ 1 \end{array}$$

Answer: 1431

Children should be able to choose to revert to the extended method should they see fit.

Extend to up to one decimal place and adding several numbers (with different numbers of digits).

$$\begin{array}{r} 72.8 \\ +\ 54.6 \\ \hline 127.4 \\ \hline 1\ 1 \end{array}$$

Year 5

Statutory requirements

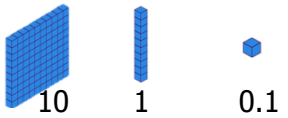
Pupils should be taught to:

- add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- add and subtract numbers mentally with increasingly large numbers
- use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

As year 4, when the expanded method is secure, children will move onto the compact column method for whole numbers and decimal numbers.

$$\begin{array}{r} 182.39 \\ +\ 64.73 \\ \hline 247.12 \\ \hline 1\ \ 1\ \ 1 \end{array}$$

Base 10 can be used alongside the column method to develop understanding of addition with decimal numbers, changing the value of each rod.



Year 6

Statutory requirements

Pupils should be taught to:

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context
- perform mental calculations, including with mixed operations and large numbers
- identify common factors, common multiples and prime numbers
- use their knowledge of the order of operations to carry out calculations involving the four operations
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why
- solve problems involving addition, subtraction, multiplication and division
- use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

As year 5, progressing to larger numbers, aiming for both understanding and fluency with compact column method to be secured.
Continue calculating with decimals, including those with different numbers of decimal places.

Apply to a variety of contexts and problems to extend understanding.

SUBTRACTION

Year 1

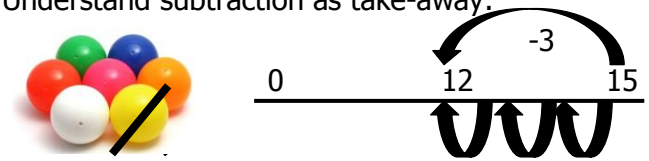
Missing number problems to encourage understanding of inverse relationship of addition and subtraction:

11 = ☐ - 9 20 - ☐ = 20

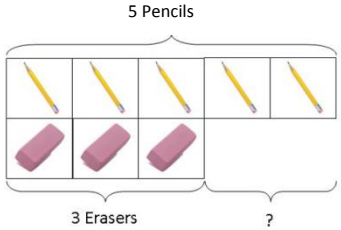
20 - ☐ = 9 ☐ - ☐ = 11

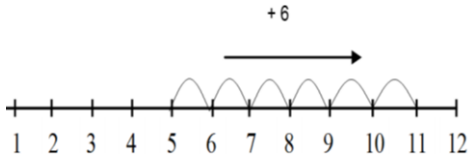
Use concrete objects and pictorial representations. If appropriate, progress from using number lines with every number shown to number lines with significant numbers shown.

Understand subtraction as take-away:



Understand subtraction as finding the difference:





Use a range of practical resources to model subtraction before using pictorial representations, such as Numicon, base 10, multi-link, cars/animals etc.

Year 2

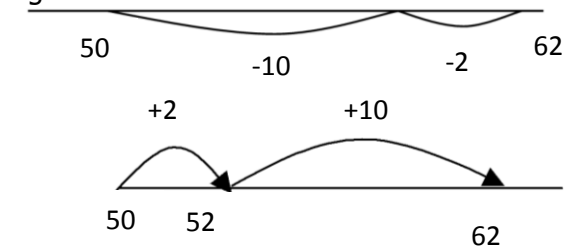
Missing number problems:

54 – 8 = ☐ ☐ - 10 = 35

15 = ☐ - 5 8 + ☐ + 3 = 19

Children should use a range of representations to support subtraction. Continue to use number lines to model take-away and difference:

e.g.

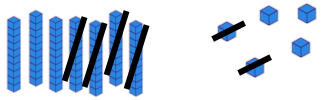


Towards written methods:

Using expanded column methods to subtract early on can support later understanding of decomposition and compact methods. This can also be modelled using base 10.

75 - 42=

70	5
- 40	2
30	3



Year 3

Missing number problems with larger numbers:

□ = 43 - 27 274 - 30 = □

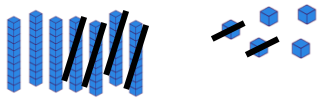
145 - □ = 138 245 - □ = 195

Count on to find the difference:

Written methods:

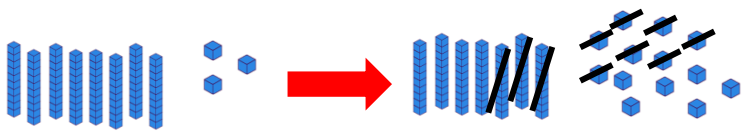
Introduce expanded column subtraction with no decomposition, modelled using base 10.

70 5
- 40 2
30 3



For some this will lead onto exchanging, modelled using base 10.

70 13
~~80~~ ~~3~~
- 30 7
40 6



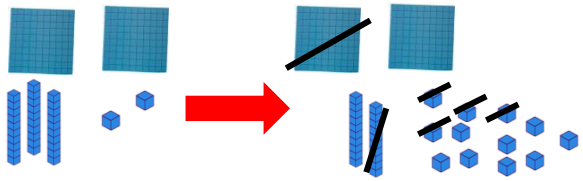
Year 4

Missing number problems.

Written methods:

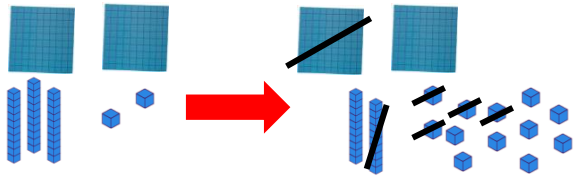
Expanded column subtraction with decomposition (exchanges). Modelled with base 10, progressing to calculations with 4-digit numbers.

20 12
200 ~~30~~ ~~2~~
- 100 10 4
100 10 8



If children are secure using the expanded method, they will move onto the compact method of decomposition, which again can be modelled using base 10.

2 1
2~~3~~2
- 114
118



Children should be able to revert to other methods, such as expanded decomposition or counting on as needed.

Year 5

Missing number problems:

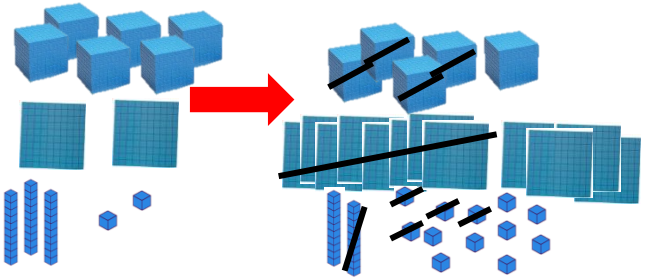
6.45 = 6 + 0.4 + □ 600,000 + □ + 1000 = 671, 000

119 - □ = 86 12, 462 – 2300 = □

Written methods:

When understanding of the expanded method is secure, children will move onto the compact method of decomposition. This can initially be modelled with base 10. Progress onto more than 4-digits.

5 1 2 1
~~6~~2~~3~~2
- 4814
1418



Year 6

Missing number/digit problems:

e.g. ☐ and # stand for two different numbers. # + # = ☐+☐+ #.

If #=12, what does ☐ equal?

Written methods:

As year 5, progressing to larger numbers. Aiming for fluency and understanding in a range of concepts. Decomposition to be secured.

MULTIPLICATION

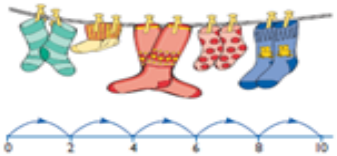
Year 1

Statutory requirements

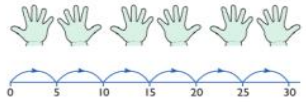
Pupils should be taught to:

- solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.

Begin to understand multiplication in regards to doubling and combining groups of the same size. Understand as repeated addition. Use a range of practical resources, pictures and concrete objects for counting.

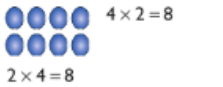


$2+2+2+2+2=10$
$2\times5=10$
2 multiplied by 5
5 pairs
5 hops of 2



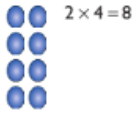
$5+5+5+5+5+5=30$
$5\times6=30$
5 multiplied by 6
6 groups of 5
6 hops of 5

Use arrays to begin to understand the Commutative Law of Multiplication (can be done in any order). Relate multiplying to the vocabulary of 'times' and 'lots of'.



$4\times2=8$

$2\times4=8$



$2\times4=8$

$4\times2=8$

2 lots of 4

4 lots of 2

Year 2

Statutory requirements

Pupils should be taught to:

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot
- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

Express multiplication as a number sentence using x. Use understanding of inverse to solve missing number problems.

7 x 2 = ☐

7 x ☐ = 14

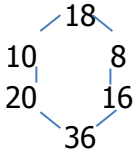
Develop understanding of concepts from year 1 using arrays and number lines. Include multiplications beyond those in the 2, 5 or 10 times tables. Begin to use language of scaling as multiplication.

e.g. '3 times as big.' 'Twice as many.'

Towards written methods:

Use jottings to develop an understanding of doubling two-digit numbers.

e.g.



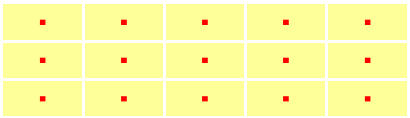
Year 3

Statutory requirements

Pupils should be taught to:

- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables
- write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods
- solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects.

Develop written methods using visual images and resources. Use number lines and arrays to extend understanding. Progress to 2-digit x 1-digit multiplication.



5 + 5 + 5 = 15

3 x 5 = 15

Use base 10 rods or cubes where needed to develop this understanding. When secure on understanding of partitioning to multiply, move onto more formal written methods.

```
  18
x  3
  24    3 x 8
  30    3 x 10
  54
```

Year 4

Statutory requirements

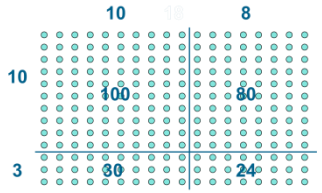
Pupils should be taught to:

- recall multiplication and division facts for multiplication tables up to 12 × 12
- use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers
- recognise and use factor pairs and commutativity in mental calculations
- multiply two-digit and three-digit numbers by a one-digit number using formal written layout
- solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

Continue to use arrays and column methods to embed and deepen understanding of multiplication. Progress towards 2-digit by 2-digit multiplication.

When secure record more formally using long multiplication.

```
  13
x 18
  24    8 x 3
  80    8 x 10
  30    10 x 3
 100    10 x 10
 234
```



N.B. Children who are having difficulty in partitioning in a column may be introduced to grids to support their partitioning.

Year 5

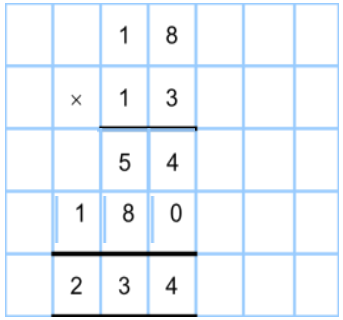
Statutory requirements

Pupils should be taught to:

- identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers
- know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers
- establish whether a number up to 100 is prime and recall prime numbers up to 19
- multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers
- multiply and divide numbers mentally drawing upon known facts
- divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000
- recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3})
- solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes
- solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign
- solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.

Children use long multiplication and begin to simplify by adding stages together.

Children explore how partitioning and arrays methods support their understanding of long multiplication.



Year 6

Continue to deepen and refine use of written methods, including fluency of 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

Use short multiplication:

24 × 6 becomes

```
     2 4
   ×   6
---------
   1 4 4
     2
```

Answer: 144

342 × 7 becomes

```
     3 4 2
   ×     7
-----------
   2 3 9 4
     2 1
```

Answer: 2394

2741 × 6 becomes

```
     2 7 4 1
   ×       6
-------------
   1 6 4 4 6
     4 2
```

Answer: 16 446

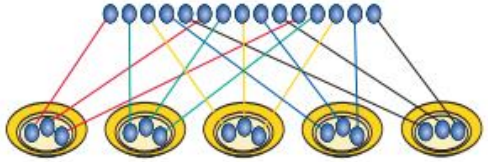
DIVISION

Year 1

Children should confidently count in 2s, 5s and 10s.

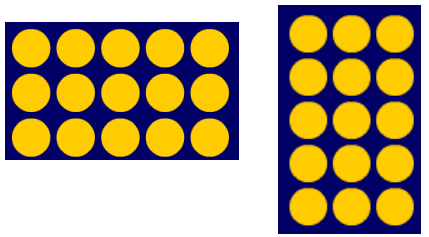
Use the terms 'group' and 'share', understanding the difference between the two.

Sharing:
Use concrete apparatus to share objects.
15 shared between 5
15 ÷ 5 = 3



Grouping:
How many 3s in 15?
15 ÷ 3 = 5

Use arrays to represent division.
15 ÷ 5 = 3 There are 5 groups of 3.
15 ÷ 3 = 5 There are 3 groups of 5.



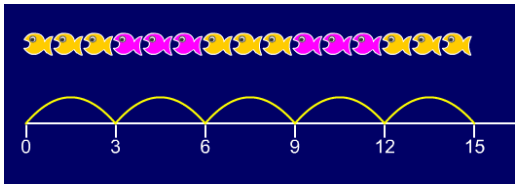
Year 2

Use the ÷ sign to represent division. Refer to division as sharing and grouping. Complete missing number calculations using knowledge of multiplication and inverse.

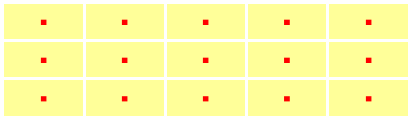
8 ÷ 2 = ☐ ☐ 8 ÷ = 4

☐ ÷ 2 = 3 2 = ☐ ÷ 4

Use grouping to find how many groups in a given number:
e.g. How many groups of 3 are there in 15?



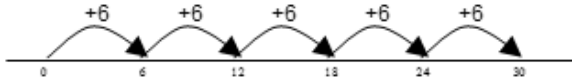
Continue to use arrays to understand the relationship between multiplication and division. Use these to begin to give the fact families for a given array.



3 x 5 = 15
5 x 3 = 15
15 ÷ 5 = 3
15 ÷ 3 = 5

Year 3

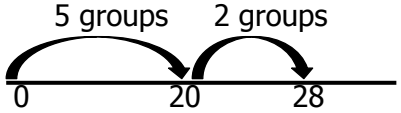
Use a number line to model grouping.



30 ÷ 6 = 5

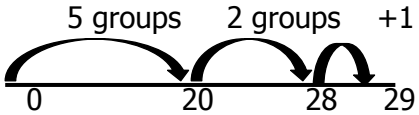
Derive related facts from known division facts:
6 ÷ 2 = 3
60 ÷ 2 = 30
60 ÷ 20 = 3

Use a number line to partition dividend (number being divided):
28 ÷ 4 = 7



= 7 groups of 4

Begin to use this to find remainders:
29 ÷ 4 = 7r1



= 7 groups of 4r1

Sharing: 29 shared between 4. How many left over?
Grouping: How many 4's make 29? How many are left over?

Year 4/Year 5

Children continue to explore division as sharing and grouping. Continue to represent calculations on a number line until they have a secure understanding. Begin to use written division calculations, logically progressing in the numbers they use:

- Dividend just over 10x the divisior e.g. 84 ÷ 7
- Dividend just over 10x the divisor when divisor is a teen number e.g. 187 ÷ 15
- Dividend over 100x the divsor e.g. 840 ÷ 7
- Dividend over 20x the divisor e.g. 168 ÷ 7

Children should use calculations including those with remainders.

Begin to use chunking to solve more complex divisions:
e.g. 840 ÷ 7 = **120**
7 x **100** = 700
7 x 2 = 14
7 x **20** = 140
700 + 140 = 840

Written methods:
Formal short division should only be introduced when children are secure with the use of chunking to find a target number, through number lines and links with multiplication.

Short division

98 ÷ 7 becomes

$$\begin{array}{r} 1\ 4 \\ 7\overline{)\,9^{2}\ 8} \end{array}$$

Answer: 14

432 ÷ 5 becomes

$$\begin{array}{r} 8\ 6\ r\,2 \\ 5\overline{)\,4\ 3^{3}\ 2} \end{array}$$

Answer: 86 remainder 2

496 ÷ 11 becomes

$$\begin{array}{r} 4\ 5\ r\,1 \\ 1\ 1\overline{)\,4\ 9^{5}\ 6} \end{array}$$

Answer: $45\frac{1}{11}$

Year 6

Children continue to use short division. Use long division to divide by a two-digit number.

Long division

432 ÷ 15 becomes

$$\begin{array}{r} 2\ 8\ r\,12 \\ 1\ 5\overline{)\,4\ 3\ 2} \\ 3\ 0\ 0 \\ \hline 1\ 3\ 2 \\ 1\ 2\ 0 \\ \hline 1\ 2 \end{array}$$

Answer: 28 remainder 12

432 ÷ 15 becomes

$$\begin{array}{r} 2\ 8 \\ 1\ 5\overline{)\,4\ 3\ 2} \\ 3\ 0\ 0 \quad 15\times 20 \\ \hline 1\ 3\ 2 \\ 1\ 2\ 0 \quad 15\times 8 \\ \hline 1\ 2 \end{array}$$

$\frac{12}{15} = \frac{4}{5}$

Answer: $28\frac{4}{5}$

432 ÷ 15 becomes

$$\begin{array}{r} 2\ 8\cdot 8 \\ 1\ 5\overline{)\,4\ 3\ 2\cdot 0} \\ 3\ 0 \\ \hline 1\ 3\ 2 \\ 1\ 2\ 0 \\ \hline 1\ 2\ 0 \\ 1\ 2\ 0 \\ \hline 0 \end{array}$$

Answer: 28·8

Monitoring and Review

This policy was created by the Maths Subject Coordinator in January 2015.

This policy will be reviewed as shown on the School Development Plant. Its implementation is seen as the responsibility of all staff. Its use and effectiveness will be supported and monitored by the Subject Coordinator working closely with the Headteacher.

The policy has been presented to the Full Governing Body and approved on 21/01/15.

Signed: Head teacher Date: 21/01/15

Signed: Chair of Governors Date: 21/01/15