Calculation Policy for Mathematics

January 2018

About our Calculation Policy

The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school. Please note that early learning in number and calculation in Reception follows the 'Development Matters' EYFS document, and this calculation policy is designed to build on progressively from the content and methods established in the Early Years Foundation Stage.
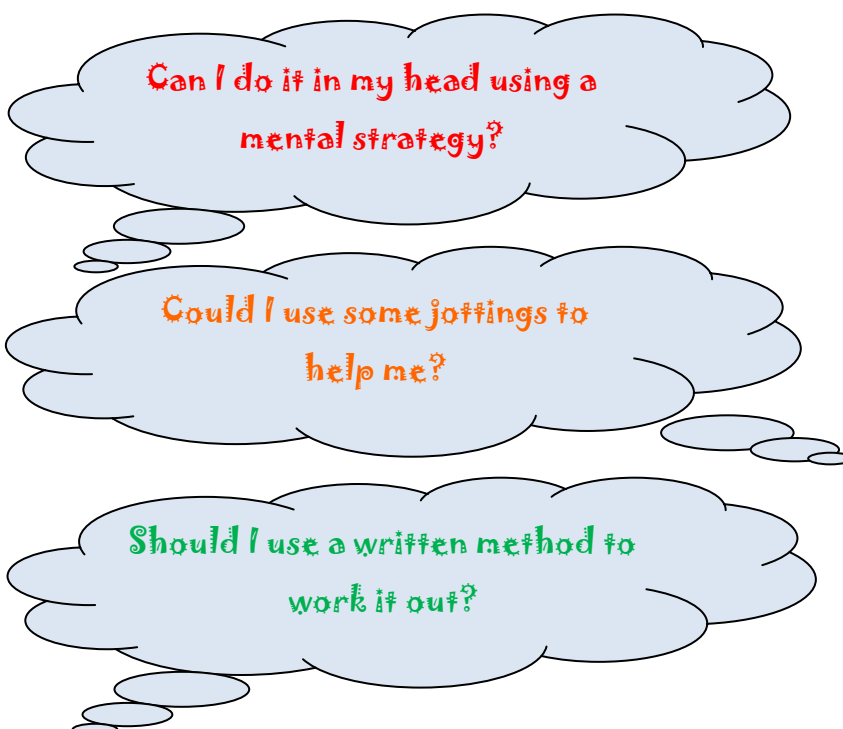
Age stage expectations

The calculation policy is organised according to age stage expectations as set out in the National Curriculum 2014. **However it is vital that pupils are taught according to their developmental stage; therefore a lower achieving set maybe working a year behind the age stage expectation and an upper achieving set a year above.**

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons.

Choosing a calculation method:

Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved:

Can I do it in my head using a mental strategy?

Could I use some jottings to help me?

Should I use a written method to work it out?

Remember, if using a written method:

Approximate,

Calculate,

Check it !

Addition

Year 1 Add with numbers up to 20

Use numbered number lines to add, by counting on in ones. Encourage children to start with the **larger** number and count on.

$6 + 3 = 9$

Children should:

- Have access to a wide range of counting equipment, everyday objects, number tracks and number lines, and be shown numbers in different contexts.

- Read and write the addition (+) and equals (=) signs within number sentences.

- Interpret addition number sentences and solve missing box problems, using concrete objects and number line addition to solve them: $8 + 3 = \square$
  $15 + 4 = \square$ 　　 $5 + 3 + 1 = \square$ 　　 $\square + \square = 6$

This builds on from prior learning of adding by combining two sets of objects into one group (5 cubes and 3 cubes) in Early Years.

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

8 + 5

Key vocabulary: *add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line*

Key skills for addition at Y1:

- Read and write numbers to 100 in numerals, incl. 1—20 in words

- Recall bonds to 10 and 20, and addition facts <u>within</u> 20

- Count to and across 100

Addition

Year 2 Add with 2-digit numbers

Developing mental fluency with addition and place value involving 2-digit numbers, then establish more formal methods.

Step 1: Partitioning in preparation for addition by partition:

```
    43
   /  \
  40   3
```

Use number lines, concrete equipment, hundred squares etc. to build confidence and fluency in mental addition skills.

43 + 20 = 63

40 3 20 0

60 + 3

Draw a loop and add the tens, then draw a loop and add the ones.

St

Step 3:

Adding a pair of 2-digit numbers using a condensed partition method :

43 + 25 = 68

60 + 8

Extend to crossing the ten boundary

Key vocabulary: *add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, addition, tens boundary*

Key skills for addition at Y2:

- Add a 2-digit number and ones (e.g. 27 + 6)
- Add a 2-digit number and tens (e.g. 23 + 40)
- Add pairs of 2-digit numbers (e.g. 35 + 47)
- Add three single-digit numbers (e.g. 5 + 9 + 7)
- Show that adding can be done in any order (the commutative law).
- Recall bonds to 20 and bonds of tens to 100 (30 + 70 etc.)

Addition

Year 3 Add numbers with up to 3-digits

Introduce informal column methods:

Step 1: **(Stepping stone for step 2)**

```
   587
+  475
   900
   150
    12
  1062
```

Add least significant digits first

Step 2:

```
   236
+   73
     9
   100
   200
   309
```

Add most significant digits first in preparation for the compact method.

Key vocabulary: *add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, plus, addition, column,*

Key skills for addition at Y3:

- Read and write numbers to 1000 in numerals and words.

- Add 2-digit numbers mentally, incl. those exceeding 100.

- **Add a three-digit number and ones mentally (175 + 8)**

- **Add a three-digit number and tens mentally (249 + 50)**

- **Add a three-digit number and hundreds mentally (381 + 400)**

- Estimate answers to calculations, using inverse to check answers.

- Solve problems, including missing number problems, using

- number facts, place value, and more complex addition.

Addition

Year 4 Add numbers with up to 4 digits

Move from informal column addition to the compact column method, **adding units first**, and 'carrying' numbers **underneath** the calculation. Also include money and measures contexts.

e.g. 3517 + 396 = 3913

```
  3 5 1 7
+   3 9 6
─────────
  3 9 1 3
    1 1
```

Introduce the **compact column addition** method by asking children to add the two given numbers together using the method that they are familiar with (informal column method—see Y3). Teacher models the compact method with carrying, asking children to discuss similarities and differences and establish how it is

Add **units** first.

'Carry' numbers **underneath** the bottom line.

Reinforce correct place value by reminding them the actual value is 5 hundreds add 3 hundreds, **not 5 add 3**, for example.

Use and apply this method to money and measurement values.

Key vocabulary: *add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, plus, addition, column, tens boundary, hundreds boundary, increase, vertical, 'carry', compact,* **thousands, hundreds, digits, inverse**

Key skills for addition at Y4:

- Select most appropriate method: mental, jottings or written and explain why.

- Recognise the place value of each digit in a four-digit number.

- Round any number to the nearest 10, 100 or 1000.

- Estimate and use inverse operations to check answers.

- Solve 2-step problems in context, deciding which operations and methods to use and why.

- Find 1000 more or less than a given number.

Addition

Year 5 Add numbers with more than 4 digits

including money, measures and decimals with different numbers of decimal places.

```
  £ 2 3 · 5 9
+ £  7 · 5 5
  £ 3 1 · 1 4
     1   1
```

The decimal point should be aligned in the same way as the other place value columns, and must remain in the same column in the answer row.

```
    2 3 4 8 1
+     1 3 6 2
    2 4 8 4 3
        1
```

Numbers should exceed 4 digits.

```
  1 9 · 0 1
    3 · 6 5
+ 0 · 7 0
  2 3 · 3 6
   1   1
```

Pupils should be able to add **more than two values**, carefully aligning place value columns.

Say '6 tenths add 7 tenths' to reinforce place value.

Empty decimal places can be filled with zero to show the place value in each column.

Children should:

- Understand the place value of **tenths and hundredths** and use this to align numbers with different numbers of decimal places.

Key vocabulary: *add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, plus, addition, column, tens boundary, hundreds boundary, increase, 'carry', expanded, compact, vertical, thousands, hundreds, digits, inverse* & **decimal places, decimal point, tenths, hundredths, thousandths**

Key skills for addition at Y5:

- Add numbers mentally with increasingly large numbers, using and practising a range of mental strategies ie. add the nearest multiple of 10, 100, 1000 and adjust; use near doubles, inverse, partitioning and re-combining; using number bonds.

- Use rounding to check answers and accuracy.

Addition

```
    2 3 · 3 6 1
        9 · 0 8 0
      5 9 · 7 7 0
    +   1 · 3 0 0
    ─────────────
      9 3 · 5 1 1
        2 1     2
```

Adding several numbers with different numbers of decimal places (including money and measures):

- Tenths, hundredths and thousandths should be correctly aligned, with the decimal point lined up vertically including in the answer row.

> Empty decimal places should be filled with zero to show the place value in each column.

```
      8 1 , 0 5 9
          3 , 6 6 8
        1 5 , 3 0 1
    +   2 0 , 5 5 1
    ───────────────
    1 2 0 , 5 7 9
        1   1 1 1
```

Adding several numbers with more than 4 digits.

Key vocabulary: *add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, plus, addition, column, tens boundary, hundreds boundary, increase, 'carry', expanded, compact, vertical, thousands, hundreds, digits, inverse, decimal places, decimal point, tenths, hundredths, thousandths*

Key skills for addition at Y6:

- Perform mental calculations, including with mixed operations and large numbers, using and practising a range of mental strategies.

- Solve multi-step problems in context, deciding which operations and methods to use and why.

- Use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy.
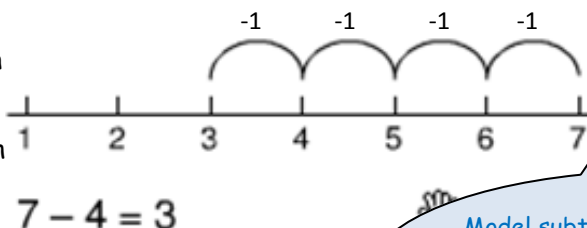
Subtraction

Children consolidate understanding of subtraction practically, showing subtraction on bead strings, using cubes etc. and in familiar contexts, and are introduced to more formal recording using number lines as below:

Read, write and interpret number sentences with - and = signs.

Subtract by taking away

Count back in ones on a numbered number line to take away, with numbers up to 20:

-1   -1   -1   -1

1   2   3   4   5   6   7

$7 - 4 = 3$

Model subtraction practically, using hundred squares, and numbered tracks/number lines.

Find the 'distance between'

This will be introduced practically with the language **'find the distance between'** and **'how many more?'** in a range of familiar contexts.

7

4
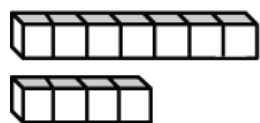
'Seven is 3 more than four'

'I am 3 years older than my sister'

Mental subtraction

Children should start recalling subtraction facts up to **and within** 10 and 20, and should be able to subtract zero.

Key vocabulary: *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_?*

Key skills for subtraction at Y1:

- Given a number, say **one more or one less.**

- Count to and over 100, **forward and back**, from any number.

- Represent and use **subtraction facts to 20 and within 20**.
- Subtract with **one-digit and two-digit** numbers to 20, including zero.

Subtraction

Year 2 Subtract with 2-digit numbers

Subtract on a number line and mentally by <u>counting back</u>, if subtracting a small number. (eg. 25 –3)

Extend to bridging:

When subtracting a bigger number ie a 2-digit number, use the counting on method:

Begin with subtracting from a multiple of ten (70– 36) then extend to crossing

.

Round to the nearest ten, then count in tens. Finally, jump to the target number.

Key vocabulary: *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_?*

difference, count on, strategy, partition, tens, units

Key skills for subtraction at Y2:

- Recognise the place value of each digit in a two-digit number.
- Recall and use subtraction facts to 20 fluently, and derive and use related facts up to 100.
- Subtract using concrete objects, pictorial representations, 100 squares and mentally, including: a two-digit number and ones, a two-digit number and tens, and two two-digit numbers.
- Show that subtraction of one number from another cannot be done in any order.
- Recognise and use inverse relationship between addition and subtraction, using this to check calculations and missing number problems.

Subtraction

Year 3 Subtracting with 2 and 3-digit numbers.

Introduce **partitioned column subtraction** method.

STEP 1: introduce this method with examples where **no exchanging** is required.

$$89 - 35 = \underline{54}$$

$$80 + 9$$
$$- 30 + 5$$

When learning to 'exchange', explore 'partitioning in different ways' so that pupils understand that when you exchange, the **VALUE** is the same ie **72** = 70+2 = 60+12 = 50+22 etc. Emphasise that the **value hasn't changed**, we have just partitioned it in a different way.

STEP 2: introduce 'exchanging' through practical subtraction. Make the larger number with Base 10, then subtract 47 from it.

72 - 47

$$^{60}7\!\!\!/0 + {}^{1}2$$
$$- 40 + 7$$

Before subtracting '7' from the 72 blocks, they will need to exchange a row of 10 for ten units. Then subtract 7, and subtract 4 tens.

STEP 3: Once pupils are secure with the understanding of 'exchanging', they can use the partitioned column method to subtract any 2 and 3-digit numbers.

$$238 - 146 = 92$$

$$\begin{array}{r} {}^{1}0\ 0 \\ 2\!\!\!/\ 0\!\!\!/\ 0 + {}^{1}30 + 8 \\ - 100 + 40 + 6 \\ \hline 0 + 90 + 2 \end{array}$$

Subtracting money: partition into e.g. £1 + 30p + 8p

Counting on as a mental strategy for subtraction:

Continue to reinforce counting **on** as a strategy for **close-together numbers** (e.g. 121—118), and also for numbers that are 'nearly' multiples of 10, 100, 1000 or £s, which make it easier to count on (e.g. 102-89, 131—79, or calculating change from £1 etc.).

Key vocabulary: *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_? difference, count on, strategy, partition, tens, units* **exchange, decrease, hundreds, value, digit**

Key skills for subtraction at Y3:

- Subtract mentally a: **3-digit number and ones, 3-digit number and tens, 3-digit number and hundreds** .
- Estimate answers and use inverse operations to check.
- Solve problems, including missing number problems.
- Find 10 or 100 more or less than a given number.
- Recognise the place value of each digit in a 3-digit number .
- Counting up differences as a mental strategy when numbers are close together or near multiples of 10 (see examples above)

- Read and write numbers up to 1000 in numerals and words.

Subtraction

Year 4 Subtract with up to 4-digit numbers

Partitioned column subtraction with 'exchanging' (decomposition):

$$2754 - 1562 = 1192$$

	2000	+	700 (600)	+ 50	+ 4
-	1000	+	500	+ 60	+ 2
	1000		100	+ 90	+ 2

Compact column subtraction

$$
\begin{array}{r}
2\,{}^6\!\!\not7\,{}^1\!5\,4 \\
-\ 1\,5\,6\,2 \\
\hline
1\,1\,9\,2
\end{array}
$$

> As introduced in Y3, but moving towards more complex numbers and values. Use **place value counters** to reinforce

> Subtracting money: partition into £1 + 30 + 5 for example.

To introduce the compact method, ask children to perform a subtraction calculation with the familiar partitioned column subtraction then display the compact version for the calculation they have done. Ask pupils to consider how it relates to the method they know, what is similar

> Give plenty of opportunities to apply this to money and measures.

Mental

> Always encourage children to consider the best method for the numbers involved—mental, counting on, counting back or written method.

strategies

A variety of mental strategies must be taught and practised, including counting on to find the difference where numbers are closer together, or where it is easier to count on.

Key vocabulary: *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_? difference, count on, strategy, partition, tens, units exchange, decrease, hundreds, value, digit, inverse*

Key skills for subtraction at Y4:

- Subtract by counting on where numbers are close together or they are near to multiples of 10, 100 etc.
- Children select the most appropriate and efficient methods for given subtraction calculations.
- Estimate and use inverse operations to check answers.
- Solve addition and subtraction 2-step problems, choosing which operations and methods to use and why.
- Solve simple measure and money problems involving fractions and decimals to two decimal places.
- Find 1000 more or less than a given number.
- Count backwards through zero, including negative numbers.
- Recognise place value of each digit in a 4-digit number Round any number to the nearest 10, 100 or 1000
- Solve number and practical problems that involve the above, with increasingly large positive numbers.

Videos: Progression in Subtraction - suite of videos (NCETM planning tool)

Subtraction

Year 5 Subtract with at least 4-digit numbers

including money, measures, decimals.

Compact column subtraction

(with 'exchanging').

$$
\begin{array}{r}
{}^{2}\cancel{3}\,{}^{10}\cancel{1}\,0\,{}^{4}\cancel{5}\,6 \\
-\ \ 2\ 1\ 2\ 8 \\
\hline
2\ 8{,}9\ 2\ 8
\end{array}
$$

Subtracting with larger integers.

> Children who are still not secure with number facts and place value will need to remain on the partitioned column method until ready for the compact method.

$$
\begin{array}{r}
{}^{6}\cancel{7}\,{}^{10}\cancel{1}\,{}^{8}\cancel{6}\,\cancel{9}\,\cdot\,0 \\
-\ \ 3\ 7\ 2\ \cdot\ 5 \\
\hline
6\ 7\ 9\ 6\ \cdot\ 5
\end{array}
$$

Subtract with decimal values, including mixtures of integers and decimals, aligning the decimal point.

> Show a 'zero' in any empty decimal places to aid understanding of what to

> Create lots of opportunities for subtracting and finding differences with money and measures.

Key vocabulary: *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_? difference, count on, strategy, partition, tens, units*   *exchange, decrease, hundreds, value, digit, inverse,* **tenths, hundredths, decimal point, decimal**

Key skills for subtraction at Y5:

- Subtract numbers mentally with increasingly large numbers .
- Use rounding and estimation to check answers to calculations and determine, in a range of contexts, levels of accuracy .
- Solve addition and subtraction multi-step problems in context, deciding which operations and methods to use and why.
- Read, write, order and compare numbers to at least 1 million and determine the value of each digit.
- Count forwards or backwards in steps of powers of 10 for any given number up to 1 million.
- Interpret negative numbers in context, counting forwards and backwards with positive and negative integers through zero.

Subtraction

$$\begin{array}{r} {}^{0}\cancel{7}\,{}^{14}\cancel{8}\,{}^{9}\cancel{0},\,6\;9\;9 \\ -\quad 8\;9,\;9\;4\;9 \\ \hline 6\;0,\;7\;5\;0 \end{array}$$

Using the compact column method to subtract more complex integers

$$\begin{array}{r} {}^{0}\cancel{7}\,\cancel{0}\,{}^{5}5\;\cdot\;{}^{3}\cancel{4}\,{}^{1}1\;9\;\text{kg} \\ -\quad 3\;6\;\cdot\;0\;8\;0\;\text{kg} \\ \hline 6\;9\;\cdot\;3\;3\;9\;\text{kg} \end{array}$$

Using the compact column method to subtract money and measures, including decimals with different numbers of decimal places.

> Empty decimal places can be filled with **zero** to show the place value in each column.

Pupils should be able to apply their knowledge of a range of mental strategies, mental recall skills, and informal and formal written methods when selecting **the most appropriate method** to work out subtraction problems.

Key vocabulary: *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_? difference, count on, strategy, partition, tens, units exchange, decrease, hundreds, value, digit, inverse, tenths, hundredths, decimal point, decimal*

Key skills for subtraction at Y6:

- Solve addition and subtraction multi-step problems in context, deciding which operations and methods to use and why.
- Read, write, order and compare numbers up to 10 million and determine the value of each digit
- Round any whole number to a required degree of accuracy
- Use negative numbers in context, and calculate intervals
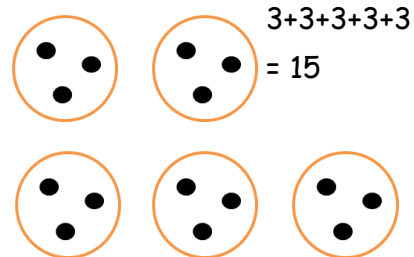- across zero.

Multiplication

Year 1 Multiply with concrete objects, arrays and pictorial representations.

How many legs will 3 teddies have?

2 + 2 + 2 = 6
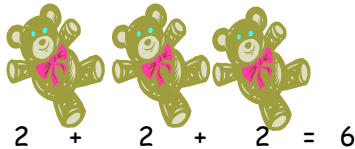
There are 3 sweets in one bag.
How many sweets are in 5 bags altogether?

3+3+3+3+3 = 15

- Give children experience of counting equal group of objects in 2s, 5s and 10s.

- Present practical problem solving activities involving counting equal sets or groups, as above.

Key vocabulary: *groups of, lots of, times, array, altogether, multiply, count*

Key skills for multiplication at Y1:

Count in multiples of 2, 5 and 10.

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

Multiplication

Use repeated addition on a number line:

- Starting from zero, make equal jumps up on a number line to work out multiplication facts and write multiplication statements using x and = signs.

4 X 5 =...

4 lots of 5

+5 +5 +5 +5

0   5   10   15   20

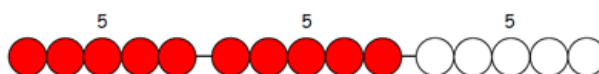**4 X 5 = 20**
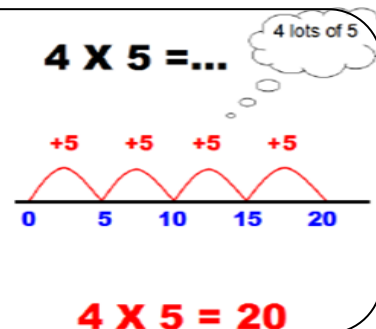
Use arrays:

$5 \times 3 = 15$

$3 \times 5 = 15$

5 x 3 = 3 + 3 + 3 + 3 = __15__

3 x 5 = 5 + 5 + 5 = __15__

Use arrays to help teach children to understand the commutative law of multiplication, and give examples such as **3 x __ = 6.**

Use practical apparatus:

$5 \times 3 = 5 + 5 + 5$

5   5   5

Use mental recall:

- Children should begin to **recall multiplication facts for 2, 5 and 10** times tables through practice in counting and understanding of the operation.

Key vocabulary: *groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times as big as, once, twice, three times…*

Key skills for multiplication at Y2:

- Count in steps of 2, 3 and 5 from zero, and in 10s from any number.

- Recall and use multiplication facts from the **2, 5 and 10** multiplication tables, including recognising odds and evens.

- Write and calculate number statements **using the x and = signs.**

- Show that multiplication can be done in any order (commutative).

- Solve a range of problems involving multiplication, using concrete objects, arrays, repeated addition, mental methods, and multiplication facts.

Multiplication
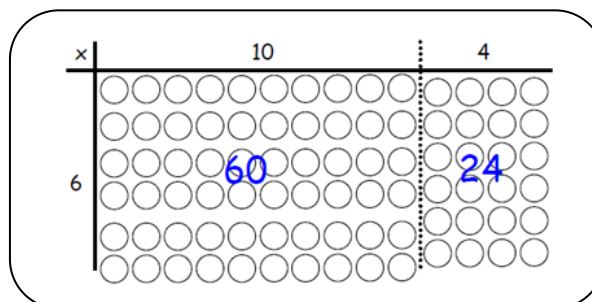
Year 3 Multiply 2-digits by a single digit number

Introduce the grid method for multiplying 2-digit by single-digits:

Eg.   23 x 8 = 184

| X	20	3
8	160	24

160 + 24 = 184

Link the layout of the grid to an array initially:

Introduce the grid method with children physically making an array to represent the calculation (e.g. make 8 lots of 23 with 10s and 1s place value counters), then translate this to grid method format (see video clip).

To do this, children must be able to:

- Partition numbers into tens and units
- Multiply multiples of ten by a single digit (e.g. 20 x 4) using their knowledge of multiplication facts and place value
- Recall and work out multiplication facts in the **2, 3, 4, 5, 8 and 10** times tables.
- Work out multiplication facts not known by repeated addition or other taught mental strategies (e.g. by commutative law, working out near multiples and adjusting, using doubling etc.) Strategies to support this are repeated addition using a number line, bead bars and arrays:
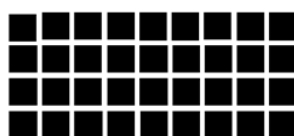
9 x 4 = 36
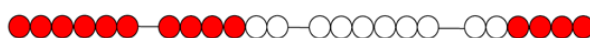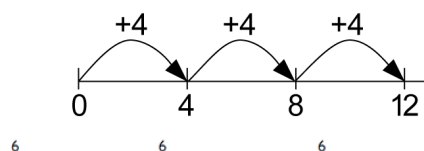
Key vocabulary: *groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times, _times as big as, once, twice, three times...,* **partition, grid method, multiple, product, tens, units, value**

Key skills for multiplication:

- Recall and use multiplication facts for the **2, 3, 4, 5, 8 and 10** multiplication tables, and multiply multiples of 10.
- Write and calculate number statements using the multiplication tables they know, including **2-digit x single digit**, drawing upon mental methods, and progressing to reliable written methods.
- Solve multiplication problems, including missing number problems.
- Develop mental strategies using commutativity (e.g. 4 x 12 x 5 = 4 x 5 x 12 = 20 x 12 = 240)

Multiplication

Developing the grid method:

Eg. 136 x 5 = 680

X	100	30	6
5	500	150	30

```
  500
  150
+  30
-----
  680
```

Encourage column addition to add accurately.

Children should be able to:

- **Approximate before they calculate**, and make this a regular part of their calculating, going back to the approximation to check the reasonableness of their answer. e.g:

   "346 x 9 is approximately 350 x 10 = **3500"**

   Record an approximation to check the final answer against.

- Multiply multiples of ten and one hundred by a single-digit, using their multiplication table knowledge.

- Recall all times tables **up to 12 x 12**

Approximate, Calculate, Check it mate!

Key vocabulary: *groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, array, column, row, commutative, groups of, sets of, lots of, equal groups, times, multiply, times as big as, once, twice, three times... partition, grid method, total, multiple, product, sets of, **inverse***

Key skills for multiplication at Y4:

- Count in multiples of 6, 7, 9, 25 and 1000

- Recall multiplication facts for **all multiplication tables up to 12 x 12.**

- Recognise place value of digits in up to 4-digit numbers

- Use place value, known facts and derived facts to multiply mentally, e.g. multiply by 1, 10, 100, by 0, or to multiply 3 numbers.

- Use commutativity and other strategies mentally 3 x 6 = 6 x 3 , 2 x 6 x 5 = 10 x 6 , 39x7 = 30 x 7 + 9 x 7.

Multiplication

Year 5 Multiply up to 4-digits by 1 or 2 digits.

Introducing column multiplication

- Introduce by comparing a grid method calculation to a short multiplication method, to see how the steps are related, but notice how there are less steps involved in the column method (see video).

- Children need to be taught to approximate first, e.g. for **72 x 38, they will use rounding: 72 x 38** is approximately 70 x 40 = **2800**, and use the approximation to check the reasonableness of their answer against.

x	300	20	7
4	1200	80	28

Short multiplication for multiplying by a single digit

$$3\,2\,7$$
$$\times\qquad 4$$
$$1\,3\,0\,8$$
$$_1_2$$

Pupils could be asked to work out a given calculation using the grid, and then compare it to 'your' column method. What are the similarities and differences? Unpick the steps and show how it reduces the steps.

	10	8
10	100	80
3	30	24

Introduce

$$1\,8$$
$$\times\ 1\,3$$
$$5\,4$$
$$_2$$
$$1\,8\,0$$
$$2\,3\,4$$

long multiplication for multiplying by 2 digits

The grid could be used to introduce long multiplication, as the relationship can be seen in the answers in each row.

Approximate,
Calculate,
Check it mate!

Key vocabulary *groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, _times as big as, once, twice, three times..., partition, grid method, total, multiple, product, inverse,* **square, factor, integer, decimal, short/long multiplication, 'carry'**

Key skills for multiplication at Y5:

Identify multiples and factors, using knowledge of **multiplication tables to 12x12.**

Solve problems where larger numbers are decomposed into their factors

Multiply and divide integers and decimals by 10, 100 and 1000

Recognise and use square and cube numbers and their notation

Multiplication

Year 6 Multiply 4 digits by 1 or 2 digits

4 digit numbers by a 1 digit number

$$
\begin{array}{r}
3\;6\;5\;2 \\
\times \qquad 8 \\
\hline
2\,9{,}2\;1\;6 \\
{\scriptstyle 5\;4\;1}
\end{array}
$$

4 digit numbers by a 2 digit number

$$
\begin{array}{r}
1\;2\;3\;4 \\
\times \quad 1\;6 \\
\hline
7\;4\;0\;4 \quad \text{(1234 x 6)}\\
1\;2\;3\;4\;0 \quad \text{(1234 x 10)}\\
\hline
1\;9{,}7\;4\;4
\end{array}
$$

Multiplying decimals with up to 2 decimal places

> Remind children that the single digit belongs in the units column.

$$
\begin{array}{r}
3\cdot1\;9 \\
\times \quad 8 \\
\hline
2\;5\cdot5\;2 \\
{\scriptstyle 1 \qquad 7}
\end{array}
$$

> Line up the decimal points in the question and the answer.

Children will be able to:

- Use rounding and place value to make approximations before calculating and use these to check answers against.

- Use **short multiplication** (see Y5) to multiply numbers with **more than 4-digits by a single digit**; to multiply money and measures, and to **multiply decimals with up to 2d.p. by a single digit**.

Key vocabulary: *groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, array, column, row, commutative, sets of, equal groups, times as big as, once, twice, three times... partition, grid method, total, multiple, product, inverse, square, factor, integer, decimal, short / long multiplication, 'carry',* **tenths, hundredths, decimal**

Key skills for multiplication at Y6:

- Recall multiplication facts for all times tables up to **12 x 12 (as Y4 and Y5).**

- Multiply multi-digit numbers, up to 4-digit x 2-digit using long multiplication.

- Perform mental calculations with mixed operations and large numbers.

- Solve multi-step problems in a range of contexts, choosing appropriate combinations of operations and methods.

- Estimate answers using round and approximation and determine levels of accuracy.

- Round any integer to a required degree of accuracy.

Division
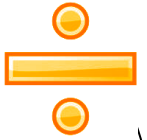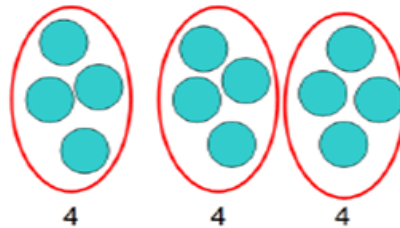
Year 1 Group and share small quantities

Using objects, diagrams and pictorial representations to solve problems involving **both** grouping **and** sharing.

How many groups of 4 can be made with 12 stars? = **3**

Grouping:

Sharing:

4   4   4

12 shared between 3 is 4

Example division problem in a familiar context:

There are 6 pupils on this table and there are 18 pieces of fruit to share between us. If we share them equally, how many will we each get?

Can they work it out and give a division statement… ?

"18 shared between 6 people gives you 3 each."

Pupils should :

- use lots of practical apparatus, arrays and picture representations

- Be taught to understand the difference between 'grouping' objects (How many groups of 2 can you make?) and 'sharing' (Share these sweets between 2 people)

- Be able to count in multiples of 2s, 5s and 10s.

- Find **half** of a group of objects by sharing into 2 equal groups.

Key Vocabulary: *share, share equally, one each, two each…, group, groups of, lots of, array*

Key number skills needed for division at Y1:

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

- Through grouping and sharing small quantities, pupils begin to understand, division, and finding
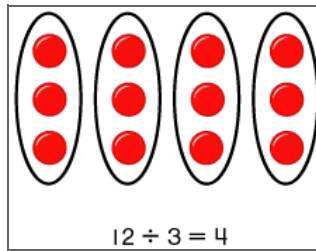
Division

Year 2 Group <u>and</u> share, using the ÷ and = sign

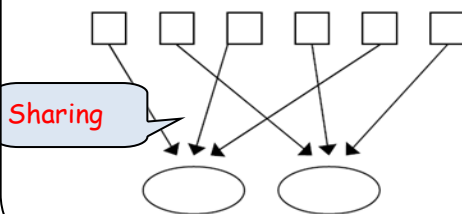Use objects, arrays, diagrams and pictorial representations, and grouping on a number line.

Arrays:

$12 \div 3 = 4$

This represents **12 ÷ 3, posed as** how many groups of 3 are in 12?

Pupils should also show that the

Know and understand sharing <u>and</u> grouping:

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

Sharing

Grouping

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

Children should be taught to recognise whether problems require sharing or grouping.

Grouping using a number line:

Group from zero in equal jumps of the divisor to find out 'how many groups of _ in _ ?'. Pupils could and using a bead string or practical apparatus to work out problems like 'A CD costs £3. How many CDs can I buy with £12?' **This is an important method to develop understanding of division as grouping.**

+3 +3 +3 +3

0 1 2 3 4 5 6 7 8 9 10 11 12
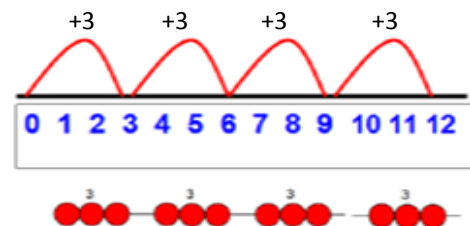
12 ÷ 3 = 4

Pose **12 ÷ 3** as '**How many groups of 3 are in 12?**'

Key Vocabulary: *share, share equally, one each, two each…, group, equal groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over*

Key number skills needed for division at Y2:

- Count in steps of 2, 3, and 5 from 0

- 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 x, ÷ and = signs.

- Show that multiplication of two numbers can be done in any order (commutative) and division of one

Division
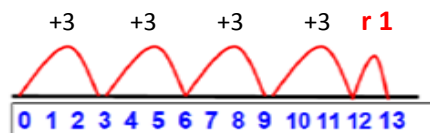
Year 3 Divide 2-digit numbers by a single digit (where there is no remainder in the final answer)

$$7 \div 2 = 3 \; R \; 1$$
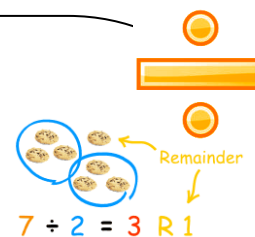
Remainder

Grouping on a number line:

$$13 \div 3 = 4 \; r \; 1$$

+3   +3   +3   +3   r 1

0 1 2 3 4 5 6 7 8 9 10 11 12 13

STEP 1: Children continue to work out unknown division facts by grouping on a number line from zero. They are also now taught the concept of **remainders,** as in the example. This should be introduced practically and with arrays, as well as being translated to a number line. Children should work towards calculating some basic division facts with remainders mentally for the 2s, 3s, 4s, 5s, 8s and 10's
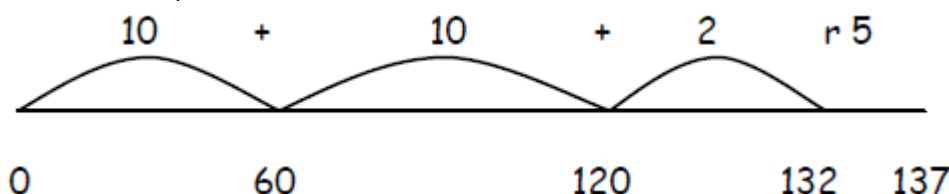
STEP 2: Children divide on a number line by chunking

$$41 \div 4 = 10 \; r1$$

$$41 = (10 \times 4) + 1$$
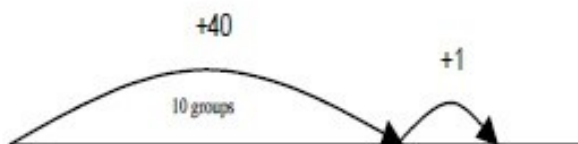
+40

10 groups

+1

Real life contexts need to be used routinely to help pupils gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

137 divided by 6   Extend beyond 10 groups.

10   +   10   +   2   r 5

0   60   120   132   137

Key Vocabulary: *share, share equally, one each, two each…, group, equal groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over,* **inverse, short division, 'carry', remainder, multiple**

Key number skills needed for division at Y3:

- Recall and use multiplication and division facts for the 2, 3, 4, 5, 8 and 10 multiplication tables (through doubling, connect the 2, 4 and 8s).

- 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, in contexts, and including missing number problems, involving multiplication and division.

Division

STEP 1: Dividing a 2-digit number

For 81 ÷ 3, the dividend of 81 is split into 60, the highest multiple of 3 that is also a multiple 10 and less than 81, to give 60 + 21. Each number is then divided by 3.

$$81 ÷ 3 = (60 + 21) ÷ 3$$
$$= (60 ÷ 3) + (21 ÷ 3)$$
$$= 20 + 7$$
$$= 27$$

This stage need only be discussed and modelled as a whole class input. There is no need for the children to record like this unless you find it beneficial for your group.

The short division method is recorded like this:

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

STEP 2: Pupils move onto dividing numbers with up to **3-digits** by a single digit.

$$
\begin{array}{r}
2\;1\;8 \\
4\overline{)8\;7\,{}^3 2}
\end{array}
$$

Real life contexts need to be used routinely to help pupils gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

Key Vocabulary: *share, share equally, one each, two each..., group, equal groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over, inverse, short division, 'carry', multiple,* **divisible by, factor**

Key number skills needed for division at Y4:

- **Recall multiplication and division facts for all numbers up to 12 x 12.**

- Use place value, known and derived facts to multiply and divide mentally, including: multiplying and dividing by 10 and 100 and 1.

- Pupils practise to become fluent in the formal written method of short division with exact answers when dividing by a one-digit number

- Pupils practise mental methods and extend this to three-digit numbers to derive facts, for example 200

Division

Year 5 Divide up to 4 digits by a single digit, including those with remainders.
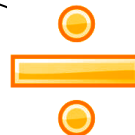
Short division, including remainder answers:

$$\begin{array}{r} 0\ 6\ 6\ 3\ r\ 5 \\ 8\overline{)5\ ^5 3\ ^50\ ^29} \end{array}$$

> The answer to 5309 ÷ 8 could be expressed as 663 and five eighths

> Include money and measure contexts.

Short division with remainders: Now that pupils are introduced to examples that give rise to remainder answers, division needs to have a real life problem solving context, where **pupils consider the meaning of the remainder and <u>how</u> to express it,** ie. as a fraction, a decimal, or as a rounded number or value , depending upon the context of the problem.

> Approximate,
>
> Calculate,
>
> Check it mate!

Key Vocabulary: *share, share equally, one each, two each…, group, equal groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over, inverse, short division, 'carry', remainder, multiple, divisible by, factor, inverse,* **quotient, prime number, prime factors, composite number (non-prime)**

Key number skills needed for division at Y5:

- Recall multiplication and division facts for all numbers up to 12 x 12 (as in Y4).

- Multiply and divide numbers mentally, drawing upon known facts.

- Identify multiples and factors, including finding all factor pairs of a number, and common factors of two number.

- Solve problems involving multiplication and division where larger numbers are decomposed into their factors.

- Multiply and divide whole numbers and those involving decimals by 10, 100 and 1000.

- Use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers.

- Work out whether a number up to 100 is prime, and recall prime numbers to 19.

Division
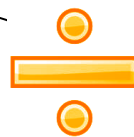
Year 6 Divide by 2-digit numbers including decimals by chunking.

Step 1:
Introduce long division by chunking for dividing by 2 digits.

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

Answer :    27
```

- Find out 'How many 36s are in 972?' by subtracting 'chunks' of 36, until zero is reached (or until there is a remainder).

- Teach pupils to write a **'useful list'** first at the side that will help them decide what chunks to use, e.g.:

  'Useful' list: 1x = 36

  10x = 360

  100x = 3600

  Introduce the method in a simple way by limiting the choice of chunks to 'Can we use 10 lots? Can use 100 lots? As children

> Where **remainders** occur, pupils should express them as fractions, decimals or use rounding, depending upon the problem.

Step 2:

Dividing a decimal number

```
            2   8 · 8
1   5 |  4  3   2 · 0
         3  0   ↓
         1  3   2
         1  2   0
            1   2   0
            1   2   0
                    0
```

Answer: 28·8

> Approximate,
>
> Calculate,
>
> Check it mate!

Key Vocabulary: *As previously, & common factor*

Key number skills needed for division at Y6:

- Recall and use multiplication and division facts for all numbers to 12 x 12 for more complex calculations

- 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. Use short division where appropriate.

- Perform mental calculations, including with mixed operations and large numbers.

- Identify common factors, common multiples and prime numbers.

- Solve problems involving all 4 operations.